Enclosure Integrity Test Training Program

Handouts

Covering the

FST Digital Enclosure Integrity Test Kit

With the Model 3 Blower and DG-700 Digital Gauge

And

EIT Quick Test Intl.

Prepared for

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The blower door testing equipment, software and instruction manuals have been designed, built, calibrated, and written in accordance to the NFPA 2001, 2004, 2012 and 2015 editions Appendix C Enclosure Integrity Procedure by the The Energy Conservatory and by Fire Safety Technology a division of Worldwide Trade & Services, Inc. The accuracy of the calculations and the predicted hold time is the responsibility of the publisher of the standard the National Fire Prevention Association (NFPA). However it is the responsibility of the company (individual) conducting the enclosure integrity test and the authority having jurisdiction supervising the test to assure all tests are conducted in full compliance with the NFPA procedure. Neither The Energy Conservatory nor Fire Safety Technology, assume any responsibility or liability for any errors or omissions nor assume any responsibility or liability for the passage of a discharge test and/or for maintaining the specified concentration for the predicted time in case of an actual emergency.

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(Training manual title page Mod 3 DG-700 EIT Intl V17 10 27 2016.pub)

TAB 1

Enclosure Integrity Test Procedure

Background:

Many high value zones are protected by fire suppression gases such as Halon and the more recent Clean Agents such as FM-200, Sapphire, Ecaro 25, Inergen, Argonite etc. Upon detection of a fire, these agents are released into the protected zone.

In order to provide the proper protection, the fire suppression gas must be retained in the zone for a significant period of time to assure extinguishment of the fire, prevent re-ignition of the fire and to allow time for the arrival of the fire and security personnel.

The first fire suppression gas used in occupied spaces was Halon. In order to assure that the Halon concentration would be retained in the zone a discharge test was performed and using a concentration meter the "hold" time was determined. If the zone was not properly sealed, the Halon concentration would escape and the required hold time would not be obtained.

Due to environmental reasons beginning in 1990 Halon was replaced by the current "Clean Agents". Though a discharge test could be conducted with the clean agents, it has become cost prohibitive. The Enclosure Integrity Test Procedure was developed to measure the actual leakage areas and to predict the "hold" time.

Standards:

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems, Section 7.7.2.3 Review Enclosure Integrity (acceptance testing).

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems, Annex C Enclosure Integrity Procedure.

Principle:

Enclosure Integrity Test Procedure is based on the "door fan" test procedure which was developed to determine the leakage area in buildings for energy conservation. Using a similar procedure and calculations the leakage area and therefore the "hold" time for the suppression gas concentration can be predicted.

Equipment:

A calibrated (CFM), variable speed fan; door frame and cover to hold the fan; digital micro-manometer pressure gauges; computer with appropriate software plus various test accessories such the TEC-2003-DK FST Digital Enclosure Integrity Test Kit by Fire Safety Technology or equivalent.

Enclosure Integrity Test Procedure

Test Procedure:

Upon arrival the technician will survey and measure the protected zone to accurately establish the as built dimensions and the height of the protected equipment. He will also determine a suitable doorway for locating the test equipment and will survey the area surrounding the protected zone to assure a free return air path back to the fan.

The zone data, gas type and concentration will be entered into the test program.

After the equipment is set up in the selected doorway, the zone must be placed in discharge status: dampers on incoming duct work closed. In an actual fire emergency it is recommended that self contained air handlers be shut down as well as all UPS units and all electrically operated equipment. For the Enclosure Integrity Test this equipment may remain operating. During the actual test, all doors must remain closed. Personnel may remain in the zone.

Per the test procedure the zone will be pressurized and de-pressurized to the column pressure created by the suppression / air gas mixture usually in the range of 10 to 20 pa (.0015 to .0030 psi)and the required air flow recorded. The average leakage area and "hold" time will be calculated.

If the "hold" time is less than is required the technician may assist in locating possible leakage areas. These indicated areas may or may not be all the leakage areas. This is service is provided as a courtesy with no responsibility to determine all leakage areas. For further guidance on typical leakage areas please refer to our publication "Sealing of Rooms for Containment of Fire Suppression Agents."

Following the test a full written test report will be distributed within one week.

For more information on the test procedure and requirements please refer to NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems, Annex C: Enclosure Integrity Procedure.

Annual Inspection, Testing:

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems, Section 7.4 Enclosure Inspection (annual inspection and retesting of zone).

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Conducting a Enclosure Integrity Test

A Photo Summary

1. Arriving at test site, equipment easily fits in suv or work van.

2. Equipment loaded on hand truck

3. Rolling into test zone

4. First thing—disconnect tank!

5. Unpack door frame

6. Assemble door frame

Conducting a Enclosure Integrity Test

A Photo Summary

7. Place frame in door for trial fit.

8. If door closer blocks door frame it will have to be removed

9. Drop in cross bars

11. Unpack door panel

12. Install panel on door frame

13. Install green tubing through patch on door

Conducting a Enclosure Integrity Test

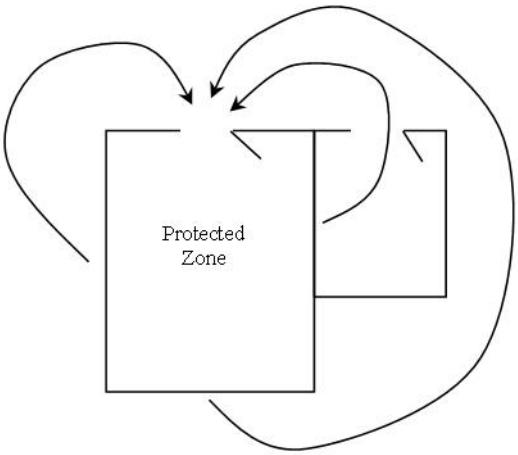
A Photo Summary

14. Measure the zone, here the maximum protected height

15. Measure height of equipment (hazard), the minimum protected height—also measure length and width of zone

16. Make sketch of zone and record measurements on the test data form

17. Enter zone data and measurements into EIT Quick Test 2001



18. Survey the area surrounding the test zone to assure a free return air path to fan.

Conducting a Enclosure Integrity Test

A Photo Summary

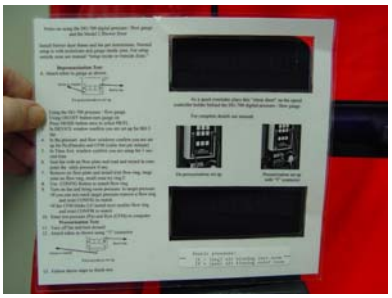
19. Install door frame with panel into the test door

20. Using toggle cams lock frame into the test door

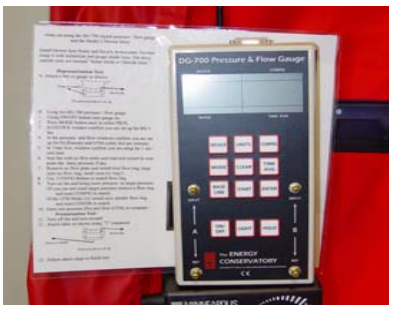
21. Extend green outside air pressure tube away from fan

22. Install fan into frame with white flow rings facing you

23. Clamp speed control board to cross bar



24. Place check list (“cheat sheet”) in front of board and hold in place with the DG-700 digital gauge

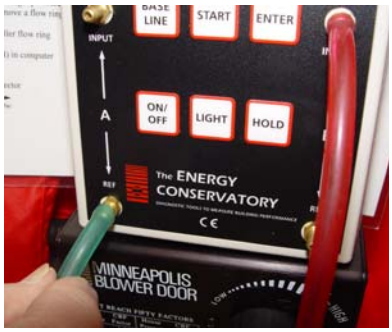


Conducting a Enclosure Integrity Test

A Photo Summary

25. Attach red fan pressure tube to top right nipple on gauge

26. Attach other end of the red fan pressure to nipple on fan



27. Attach green outside pressure tube to lower left nipple

28. Again make sure all tanks are disconnected

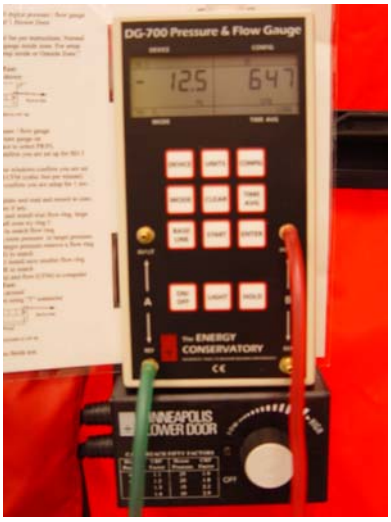
29. Have experience alarm technician, call out alarm system, silence building alarm, and cycle panel to activated any HVAC dampers connected to panel

Conducting a Enclosure Integrity Test

A Photo Summary

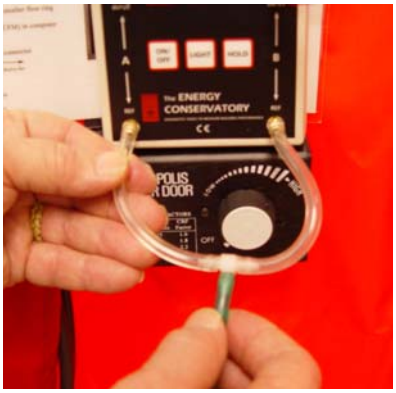
30. Turn on gauge -see cheat sheet- With fan completely closed and all HVAC dampers closed measure the static (bias) pressure

31. Remove blocking plate and flow rings “C”, “B”, “A” as necessary



32. Turn on fan and bring up to pressure within the “target pressure range”—record pressure and flow

33. Turn fan around



34. Connect “T” tube to lower nipples and to green outside pressure tube

35. Turn on fan and bring up to target pressure range—record

36. Enter all test data into EIT Quick Test which will calculate the predicted hold time

TAB 2

Conducting a NFPA 2001 Enclosure Integrity Test
Part 1 Preliminary Survey and Review

A. Upon arrival at the room to be tested:

Make sure the suppression gas tanks are disarmed.

Then take time to familiarize yourself with the room. Check and note the following:

1. Obvious sources of leaks in room but particularly above ceiling and under a raised floor: cable trays, conduits and raised floor panels if the lead out of room.

2. Duct work through walls, are dampers present?

3. Air conditioners and air handling systems in room?

4. Location of room in relation to the building (outside wall?) and surrounding rooms.

5. Determine free air passage to and from door that will be used for the test. Do outside doors or stair well doors need to be kept open?

6. Construction of room:

   Sheet rock, is it sealed at floor?
   Block, is it painted?
   Walls, do they go deck to deck or deck to roof?
   are they sealed at overhead deck or roof?
   Doors, do the have wiper or drop seals at floor and are they sealed around jam?
   are the always closed or are they self closing at alarm?
   Widows, are the sealed (silicone caulk recommended)?

7. Review drawings and room specifications, verify with tape floor heights, ceiling height, roof height and room dimensions. Calculate cubic feet of protected volume.

8. Inspect suppression system, determine piping corresponds to the zone to be tested, note and verify total fill weights of cylinders. Are the cylinders disarmed?

9. Review calculations.

B. After the initial inspection, review with the alarm installer and building engineer:

1. Sealing work that has taken place and who is responsible for sealing.

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2. HVAC status at discharge: Self-contained and/or building air handlers shut down?

   Dampers closed?

3. Door status at discharge: Are closers activated?

C. Review with AHJ the minimum required protected height (for a concentration test this would be the height of the highest probe)?

D. At this time install door frame, fan and control module and prepare for test. *Be sure outside air pressure sampling tube is attached to door frame.* While this is taking place the outside doors and/or stairwell doors should be blocked opened. Doors on neighboring rooms should also be opened. The system installer should place the alarm system in discharge mode (make sure system tanks are disarmed) with all dampers closed and air handlers shut down.

E. Now start the door fan test.

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Conducting a NFPA 2001 Enclosure Integrity Test
Part 2 Using the Model 3 Blower Door and the DG 700 Digital Gauge

Make sure the fire suppression gas tanks are disarmed .

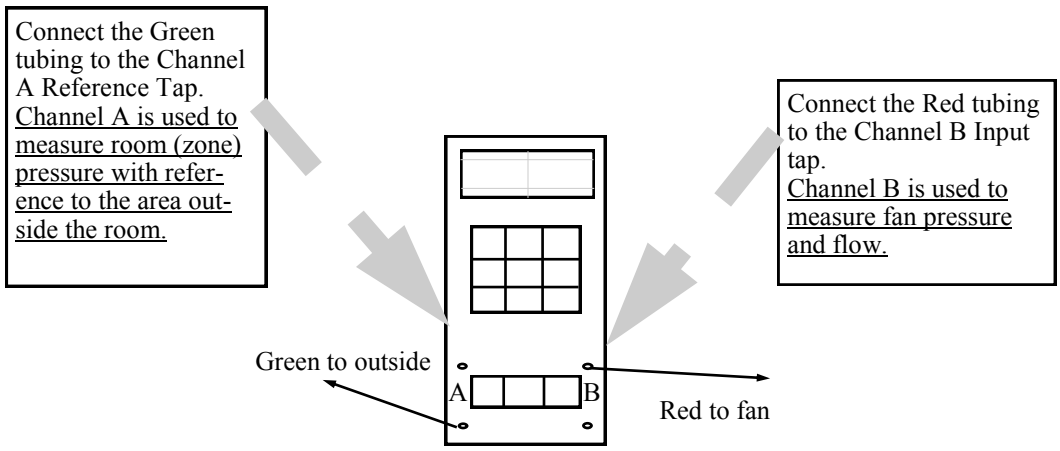
1. Install the Blower Door system (see chapters 2 and 3, pages 7 to 19 in the Minneapolis Blower Door Operation Manual, and *Conducting a Enclosure Integrity Test, A Photo Summary).*

a. Install the aluminum frame and nylon panel in the selected door.

b. Attach the gauge mounting board and fan speed controller to a door or to the aluminum frame gauge hanger bar using the C-clamp on the back of the mounting board.

c. Place the DG-700 pressure gauge onto the mounting board (using the Velcro strips) in front of the "Cheat Sheet" and connect tubing to the DG-700 for the de-pressurization test as shown below.

Note: Normal setup is with the technician inside the protected zone. If you setup outside the protected zone see *Setup Inside or Outside Zone?*



De-pressurization Set Up

d. Run approximately 3 – 5 feet of the remaining end of the Green tubing outside through one of the patches in the bottom corners of the nylon panel. Be sure the outside end of the tubing is well away from the exhaust flow of the Blower Door fan.

Hint: Keep the green tube installed in the nylon panel. It will save time setting up and will remind you to have green tube properly installed.

e. Install the Blower Door fan, with the flow rings and no-flow plate installed, into the large hole in the nylon panel. The exhaust side of the fan should be outside (the side with the chrome grill), and the inlet side of the fan (the side with the flow rings) should be inside facing the operator.

f. Insert the female plug from the fan speed controller into the receptacle located on the fan electrical box. The remaining cord (power cord) should be plugged into a power outlet that is compatible with the voltage and wattage of the fan motor.

g. If the fan is equipped with a fan direction switch be sure it is set to exhaust air out of the zone.

h. The remaining end of the Red tubing should now be connected to the pressure tap on the Blower Door fan electrical box.

2. Prepare for test:

a. Cycle fire suppression control panel through to discharge mode to activate any dampers, HVAC controls, etc. which are controlled by the panel.

b. Be sure to have a free return air path from the outside of all the protected zone walls back to the fan. (Open all doors to connecting closets, offices, etc.)
(Important See *Free Return Air Flow Path)*

c. Turn on computer, start EIT Quick Test 2001 and type in the room and location data. (See *EIT Quick Test Intl. Manual*)

3. Bias (Static) Pressure

a. Using the ON /OFF button, turn on the DG-700. (For more detailed instructions see *Operating Instructions for the DG-700 Pressure and Flow Gauge*)

1. Press the MODE button once to select PR/ FL. Indicating operating in the Pressure / Flow Mode.
2. In the DEVICE window confirm that you are set up for the BD 3 fan. (Later we will use the CONFIG button to change to our selected flow ring.)
3. In the pressure and flow windows confirm you are set up for Pa (Pascals) for pressure and CFM (cubic feet per minute) for flow. If not use the UNITS button to change or to select your preferred test units.
4. In the Time Ave. window confirm you are set up for 1 second time averaging. You may wish to change that later if the readings fluctuate excessively.

c. With all flow rings attached to fan add the blank off plate to completely seal the zone.

d. Measure the bias (static) pressure, the difference between inside and outside the zone.

1. Measure the bias (static) pressure at Discharge Conditions, that is with the doors of any adjacent rooms in their normal conditions.
2. Measure the bias (static) pressure at Test Conditions, that is with any adjacent rooms doors open to give a free return air path. (see *EIT Quick Test Manual, page 18, Special Notes, Bias (Static) Pressure.*)
3. If subfloor is pressurized at discharge (HVAC system on) then measure bias (static) pressure between subfloor and outside the protected zone.

4. Conduct the Enclosure Integrity Test —DE-PRESSURIZATION

a. Remove the No-flow plate and install a trial flow ring. For a large zone try using the open fan (no flow ring), for a very small zone try ring C.

b. Use the CONFIG button to match the flow ring you are using

OPEN Indicates the fan is in the open (no flow plate) configuration.
A1 Indicates the A Ring is installed
B2 Indicates the B Ring is installed
C3 Indicates the C Ring is installed

c. Turn on the Blower Door Fan by slowly turning the fan controller clockwise. As the fan speed increases, room pressure indicated on Channel A should also increase. Increase fan speed until you reach the target pressure as shown in the EIT Quick Test software. The flow gauge will now display the current cfm. Enter the pressure and cfm in the EIT software. To make reading the gauges easier, use the HOLD button to freeze the display.

If the readings are fluctuating excessively, use the TIME AVG button to select a longer averaging period. TIME AVG cycles through 1, 5, 10 seconds averaging blocks of data. LONG starts averaging data immediately and continues indefinitely. Use LONG and watch until readings stop fluctuating.

If you can not reach the target pressure, you must remove a flow ring and using the CONFIG button match the new flow ring.

If the CFM display blinks LO, install the next smaller flow Ring and select the correct setting for the new flow ring.

After entering the test pressure (Pa) and flow (CFM) in the computer, turn off the fan.

*For NFPA 2001/2004 Enclosure Integrity Test Procedure one set of measurements, flow and pressure is take for both De-Pressurization and Pressurization.

*For NFPA 2001/2012 and 2015 Enclosure Integrity Test Procedures two sets of measurements, flow and pressure are taken for both De-Pressurization and Pressurization.

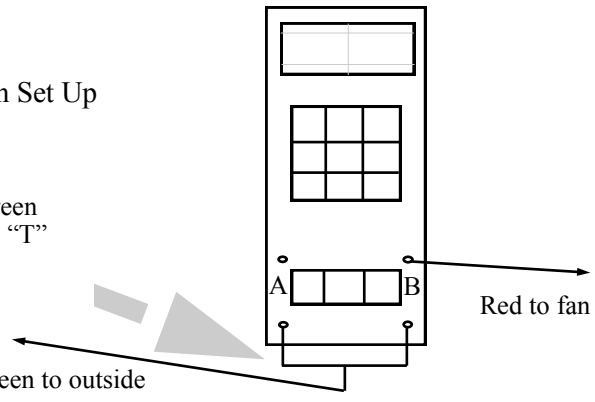
5. Enclosure Integrity Test—PRESSURIZATION.

a. Turn fan around so that the chrome grill is facing you and the fan is blowing into the zone. (Never conduct a pressurization test by reversing the fan using the fan direction switch if so equipped. Any readings displayed with the fan reversed are invalid.)

b. Using the “T” connector and the short tubing connect the green tube to the DG 700 as shown:

Pressurization Set Up

Change the green tube using the “T” connector



c. As in 4c., Turn on the Blower Door Fan by slowly turning the fan controller clockwise. As the fan speed increases, room pressure indicated on Channel A should also increase. Increase fan speed until you reach the target pressure as shown in the EIT Quick Test software. The flow gauge will now display the current cfm. Enter the pressure and cfm in the EIT software.

If you can not reach the target pressure, you must remove a flow ring and using the CONFIG button match the new flow ring.

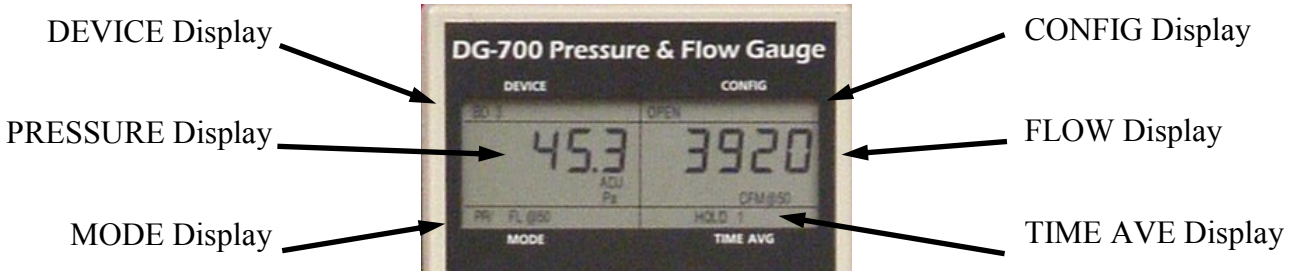
If the CFM display blinks LO, install the next smaller flow Ring and select the correct setting for the new flow ring.

After entering the test pressure (Pa) and flow (CFM) in the computer, turn off the fan.

The EIT Quick Test 2001 software will now indicated the leakage area and the predicted hold time for the zone.

Again, For NFPA 2001/2004 Enclosure Integrity Test Procedure one set of measurements, flow and pressure is take for both De-Pressurization and Pressurization.

For NFPA 2001/2012 and 2015 Enclosure Integrity Test Procedures two sets of measurements, flow and pressure are taken for both De-Pressurization and Pressurization.



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TAB 3

Test Kit Check List

Review list and equipment before leaving office!

Standard Items included with test kit:

1. Fan in case with:
    a. Extension cord
    b. “A”, “B”, “C” Rings and Closed Plate
2. Door Frame in case with:
    a. Frame cover (red nylon)

3. Accessory case with:
    a. Digital pressure gauge in case with red and green tubes
    b. Speed controller
    c. Instruction manual with back up CD software disk
    d. Smoke tube kit

Additional must have items:

1. Computer with software loaded and 110v power supply
2. Tape measure

Strongly recommended items:

1. Calculator
2. Flashlight with spare batteries
3. Masking tape, duct tape
4. Current copy of NFPA 2001
5. Tool kit including: Screwdrivers, large enough to remove door closers and large channel lock wrench
6. Door stops
7. Signs, “Do Not Close”,”Do Not Open”
8. Clip board
9. Extra test report forms
10. Extra hand outs of “ How to Seal” and ‘Technical Judgment”
11. Power strip or multi plug adaptor with ground
12. Safety glasses, hard hat, safety shoes, ear plugs if needed at site

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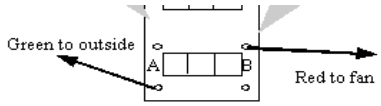
Install blower door frame and fan per instructions. Normal setup is with technician and gauge inside zone. For setup outside zone see manual “Setup inside or Outside Zone.”

Depressurization Test:

A. Attach tubes to gauge as shown:



De-pressurization set up

B. Using the DG-700 pressure / flow gauge

1. Using ON/OFF button turn gauge on
2. Press MODE button once to select PR/FL
3. In DEVICE window confirm you are set up for BD 3 fan
4. In the pressure and flow windows confirm you are set up for Pa (Pascals) and CFM (cubic feet per minute)
5. In Time Ave. window confirm you are setup for 1 second time
6. Seal fan with no flow plate and read and record in computer the bias (static) pressure if any.

See Bias (Static) Pressure notes on back.

When set up as shown and inside zone:

—(neg) static pressure = air blowing into zone

+ (pos) static pressure = air blowing out of zone

7. Remove no flow plate and install trial flow ring, large zone no flow ring, small zone try ring C
8. Use CONFIG Button to match flow ring
9. Turn on fan and bring room pressure to target pressure.

•If you can not reach target pressure remove a flow ring and reset CONFIG to match

•If the CFM blinks LO install next smaller flow ring and reset CONFIG to match

For NFPA 2001/2004 Test at Target Pressure both depressurization and pressurization.

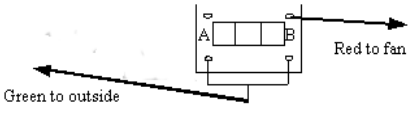
For NFPA 2001/2012,2015 Test at 10 & 50pa both depressurization and pressurization.

See Test Procedure notes on back.

10. Use TIME AVE Button to select LONG, wait till readings stabilize and record—return to 1 second
11. Enter test pressure (Pa) and flow (CFM) in computer

Pressurization Test:

12. Turn off fan and turn around
13. Attach tubes as shown using “T” tube



Pressurization set up

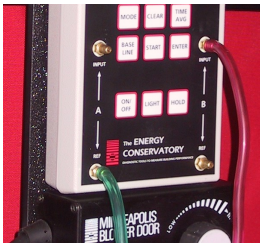
14. Follow above steps to finish test.

Notes on using the DG-700 Digital Pressure/Flow Gauge
and the Model 3 Blower door
NFPA 2001/2004, 2012, 2015

FYI: 1 Pascal (PA) = .004 in wc = .00015 psi

As a quick reminder place this “cheat sheet” on the speed controller holder behind the DG-700 digital pressure / flow gauge.

For complete details see manual.



De-pressurization set up

Pressurization set up with “T” connector

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Bias (Static) Pressure;

Measure the bias (static) pressure, the difference between inside and outside the zone.

1. Measure the bias (static) pressure at Discharge Conditions, that is with the doors of any adjacent rooms in their normal conditions.
2. Measure the bias (static) pressure at Test Conditions, that is with any adjacent rooms doors open to give a free return air path. (see *EIT Quick Test Manual, page 18, Special Notes, Bias (Static) Pressure.*)
3. If subfloor is pressurized at discharge (HVAC system on) then measure bias (static) pressure between subfloor and outside the protected zone. (see *EIT Quick Test Manual, page 18, Special Notes, Bias (Static) Pressure.*)

Test Procedure:

Turn on the Blower Door Fan by slowly turning the fan controller clockwise. As the fan speed increases, room pressure indicated on Channel A should also increase. Increase fan speed until you reach the target pressure as shown in the EIT Quick Test software. The flow gauge will now display the current cfm. Enter the pressure and cfm in the EIT software. To make reading the gauges easier, use the HOLD button to freeze the display. If the readings are fluctuating excessively, use the TIME AVG button to select a longer averaging period.

If you can not reach the target pressure, you must remove a flow ring and using the CONFIG button match the new flow ring.

If the CFM display blinks LO, install the next smaller flow Ring and select the correct setting for the new flow ring.

After entering the test pressure (Pa) and flow (CFM) in the computer, turn off the fan.

*For NFPA 2001/2004 Enclosure Integrity Test Procedure one set of measurements, flow and pressure is take for both De-Pressurization and Pressurization.

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TAB 4

EIT Quick Test Intl

V 1.0.0.xx

September 2016 Installation Notes

You have or will receive(d) a copy of our new enclosure integrity test program EIT Quick Test Intl either on a cd or by downloading from a cloud forwarding service Hightail. Following are instructions for installing the program:

If your have the CD then copy the folder to your computer. You may set up a new folder or just use the folder from the CD.

If your have received an e-mail from Hightail, open e-mail and click on download, that will take you to a second screen, click on down load again. That will open a pop up screen with the option open with Windows Explore or Save file. I recommend "Save File" which will save the .zip file to your Download Folder. Create a new folder such as "NFPA Enclosure Integrity Test". Copy and paste this .zip file to your new folder. Click on the .zip file and you should see the option to "extract" .zip file. Click extract and the full program should be extracted to your new folder. If you get a warning about an unknown publisher click OK or proceed.

To run the program, double click on "Integrity Test.exe ". You may also wish to send it to your desktop for easy access.

**This program will run with Windows XP, 7, 8.1 and 10. If you have a problem running the program you may need to download the Microsoft .NET Framework 4.0 plugin. Go to:

http://www.microsoft.com/en-us/download/confirmation.aspx?id=17851

Once running go to Tools>Preferences and select the folder where you want to save your test files, often the same as the program folder. You may also set your default Standard or Metric test units. If you wish you may change individual measurements. Once selected click on "Lock Units of Measurements" then "Apply and Save".

Now run the program and explore it. There is a "Demo Test.fst" file, use File>Open to load the file.

**Printing, as with most Windows programs click on File>Print your should see a print screen that will allow you to print a "hard" copy or a .pdf (button at bottom). If this does not appear you need to install the Microsoft Report Viewer:

For Windows XP Service Pack 3, Vista Service Pack 2, & Windows 7: Windows Report Viewer 2010
http://www.microsoft.com/en-us/download/details.aspx?id=6442

For Windows Vista Service Pack 2, Windows 7, Windows 8, Windows 8.1: Windows Report Viewer 2012
http://www.microsoft.com/en-us/download/details.aspx?id=35747

Or Goggle: Microsoft Report Viewer and pick either 2010 or 2012 version as needed

If you have used our previous program you will find this new EIT Quick Test Intl to have the same look and feel and be easy for you to use. However there have been some changes in the test procedure in NFPA 2001/2204, 2012 & 2015 enclosure integrity test procedure. Be sure to read carefully the EIT Quick Test Manual and the full FST Digital Enclosure Integrity Tester and EIT Quick Test Intl Manual both are located in the reference folder. Pay attention to the Bias (Static) pressure notes and the two test points for NFPA 2001/2012 & 2015.

Thank you for your patience. Please notify us of any problems or suggestions for the program.

Fire Safety Technology
P.O. Box 1063
Severna Park, MD 21146 U.S.A.
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FAX 410-647-7066
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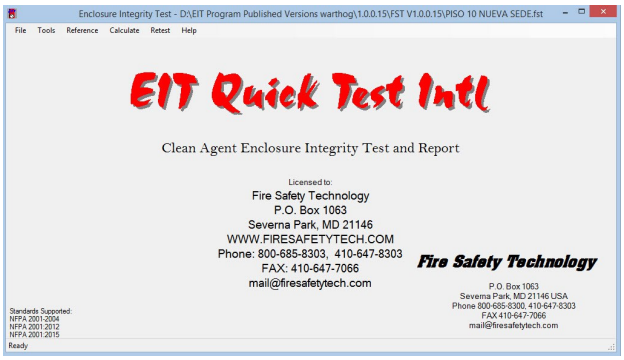
www.firesafetytech.com

EIT Quick Test Intl.

Manual

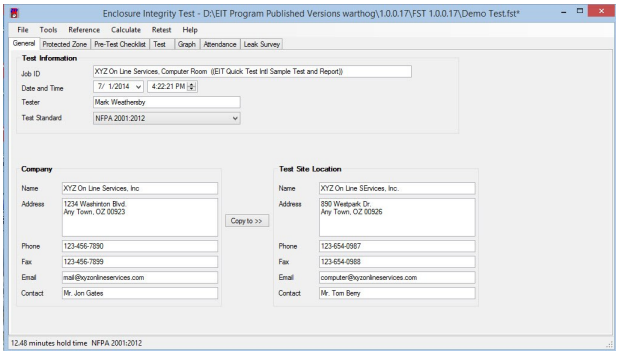
Index Screen By Screen



Opening Screen

EIT Quick Test Intl. our program for enclosure integrity testing per NFPA 2001/ 2004, 2012 and 2015. Standard Windows format, easy to understand, easy to use, designed for quick one step inputting of test data, producing on the spot complete, professional quality test reports.

EIT Quick Test Intl. Leads you through the test procedure step by step, screen by screen

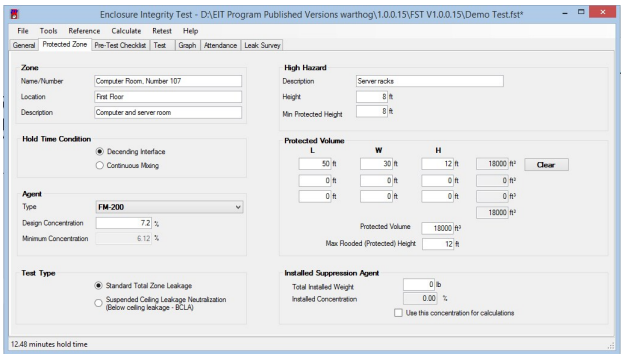


Test file identification
Date, time, technician
Choice of NFPA standard

Customer name and details

Test Site location and contact

Screen 2 General
Test Information
Customer and Test Site



Protected zone details

Hold time conditions

Gas type and concentration

Test type

Screen 3 Protected Zone
Zone Description
Hold time Condition
Clean Agent Selection

Fire Safety Technology
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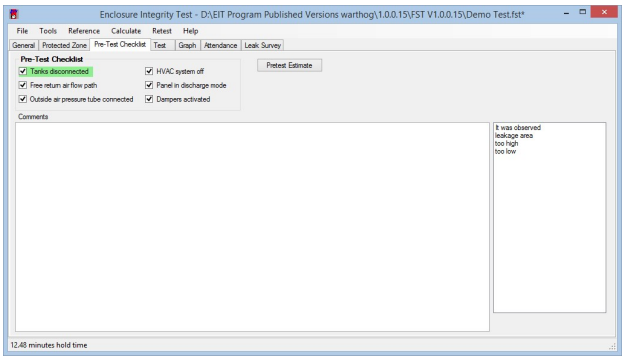
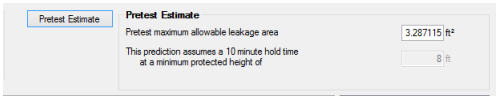
e-mail: mail@firesafetytech.com
www.firesafetytech.com

EIT Quick Test Intl.

Index Screen By Screen



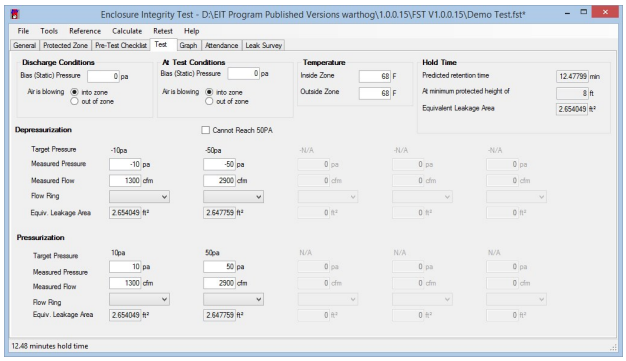
Pre-Test Checklist
Important do not forget items



Pre-Test Estimate
Calculates maximum leakage area

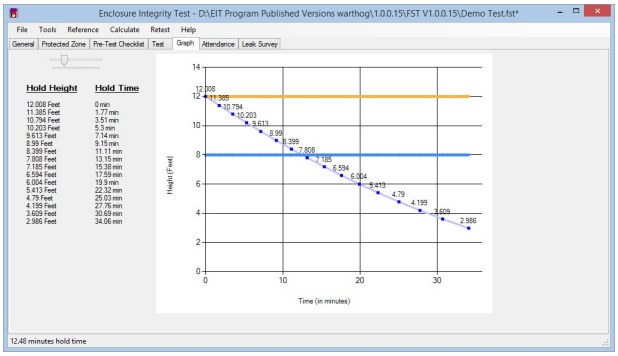
Screen 4, Pre-Test Checklist
Pre-Test Estimate
Comments

Easy to follow "fill in the blanks" leads the technician through the test procedure

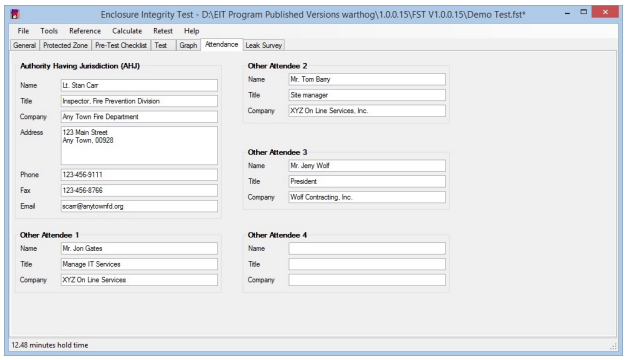


Screen 5, Test
Test Data and Results

Hold time vs. height graph
Easy to understand how the level of the suppression gas decreases over time.



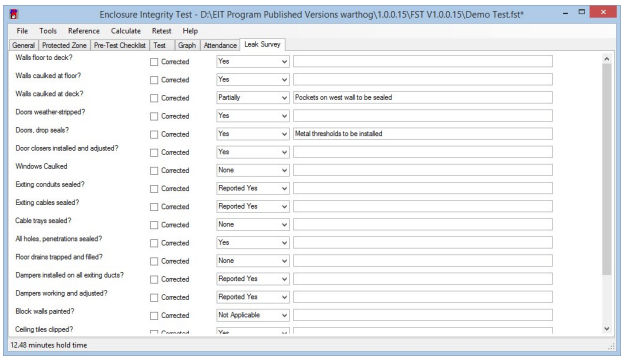
Screen 6, Graph
Graph
Hold Height vs. Time Table



Attendance
Capture, for the record, the names and companies of witnesses to the test including the AHJ if present.

Screen 7, Attendance
Authority Having Jurisdiction
Attendees

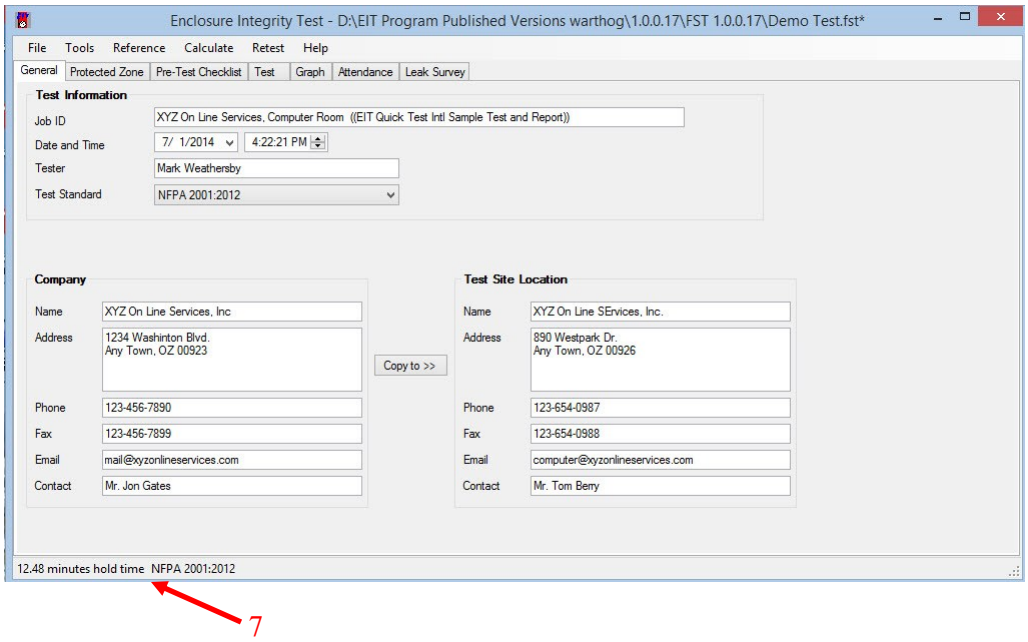
Leak Survey
Should the test fail, the optional leak survey lists the common leakage areas to help guide the customer in sealing the zone. This may or may not be included in the final test report depending on the tester's requirements.



Screen 8, Leak Survey
Optional Leak Survey

EIT Quick Test Intl.

Screen 2, General Test Information



1. **Job ID**: You may use your company filing system name here or other identifying name. This will appear at the top of each page of the report.
2. **Date and Time**: This is taken from your computer however it may be manually changed should the test be delayed after you have logged in to EIT Quick Test Intl.
3. **Tester**: The name of the technician actually conduction the enclosure integrity test.
4. **Test standard**: Here you select the NFPA Test Standard, depending on your local code requirements you have a choice of:

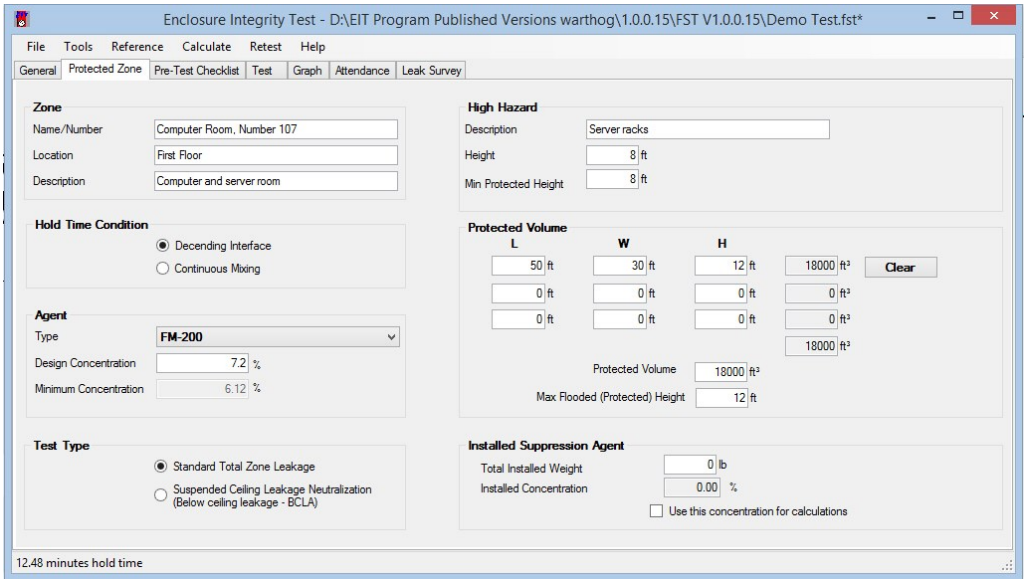
   NFPA 2001/2004
   NFPA 2001/2012
   NFPA 2001/2015

5. **Company**: this is the name, address etc. for your customer.
6. **Job Site Location**: In many cases the company name is the company office but the test site is at a different location: for example your contract may be with Verizon at their local office but the test site is a cell tower at a different location.

If the test site is the same as the company then simply click the "Copy To" button to transfer the data

7. Lower left corner: When the test is completed the hold time will show here on all screens as well as the test standard.

Screen 3, Protected Zone



1. **Zone**:

Name/Number: If known use the name and/or used by your customer or as noted on your drawings.

Location: This may be simply “first floor” or “ground floor” but in cases like a large hospital or college campus it may be “3rd Floor West Hall” or “Schaefer Hall Lower Level”

Description: Is the “computer room”, “server room”, “telcon room”, “MRI room” or ?

2. **Hold Time Condition:**

Descending Interface or Continuous Mixing

If all HVAC systems are shut down prior to discharge and there is no moving air in the zone the gas/air mixture will leak out the lower leakage areas and fresh air will enter through the high leakage areas. A layer or interface will form between the gas/air mixture and the fresh air. This interface will drop over time.

If the HVAC systems continue to operate after discharge, the heavy gas/air mixture will leak out of the lower leakage areas and fresh air will enter through the high leakage area. But since the HVAC system continues to operate mixing the room air the concentration of the suppression gas will drop.

See Special Notes, Page 19 Continuous Mixing

3. **Agent**

Type: This is a drop down listing all the NFPA 2001 clean agents (will all trade names), Halon, and CO_2

Concentration: When a gas is selected the nominal concentration is shown here. However it is important to check the drawings or contact the system designer to verify the actual design concentration.

Minimum Concentration: In case of “Continuous Mixing” the NFPA 2001 codes allow a minimum concentration of 85% of the design concentration. This is calculated from the above design concentration and is only active when “Continuous Mixing” is selected.

5. **Test Type**:

Standard Total Zone Leakage / Suspended Ceiling Leakage Neutralization
(Below Ceiling Leakage Area –BCLA)

Standard Total Zone Leakage: The zone during test is in it's normal state with no special covering of the ceiling.

Suspended Ceiling Leakage Neutralization: The ceiling has been covered with sheet plastic to block of leakage through the drop ceiling. A technique which can be used when there is excessive un-sealable leakage area above the drop ceiling or a totally open plenum.

See Special Notes, Page 17

6. **High Hazard**:

Description: What is the hazard or what is being protected with the suppression gas, i.e. server racks, UPS, UPS Batteries, computer, art storage, rare books, or ?

Height: What is the height of the protected item? Height is measured from the lowest point if on the regular floor or slab then from the floor, if on a raised floor then from the slab or floor under the raised floor.

Minimum Protected Height: Normally this is the same as the Height and is automatically filled in. However is some cases the AHJ or owner may want the protected height to be higher than the height of the hazard. This can be changed by typing over. Note: the calculated hold time is based on this Minimum Protected Height.

Important Note:
Minimum Protected Height is the height of the hazard or the protected property.
Maximum Flooded (Protected) Height is the height of the zone.
The minimum height must always be less than the maximum height

6. **Protected Volume**:

For a normal cube shaped zone you may enter the length, width, height of up to three connected areas (all in one zone) and the program will calculate the total volume or you may simply type the total Protected Volume. This will be necessary when the protected volume is a unusual shape and not a cube. It is useful to sketch the zone and divide into squares, triangle or even is some case parts of a circle to calculate total volume. It is strongly recommended to do your own measurements on site and not rely on the submitted drawings as often there can be changes in the zone during or after construction.

7. **Max (Maximum) Flooded (Protected) Height**:

In case of a cube shaped zone this is the over all height of the zone. Note: This Maximum height is always greater than the Minimum Protected Height. If you mistakenly enter a height grater than the minimum protected height you will get an error message.

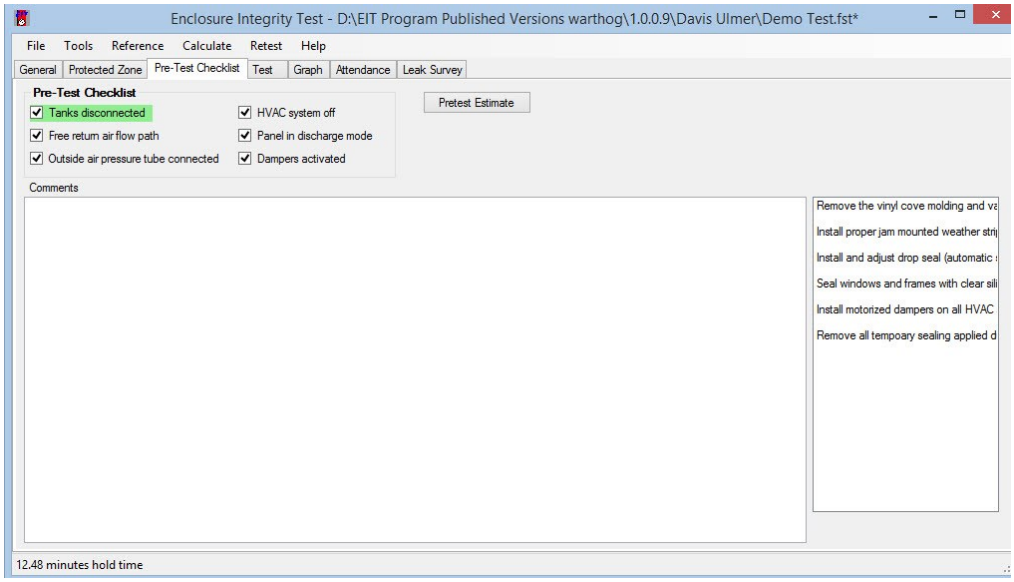
In case of more than one connected rooms (one zone) of different heights the program will calculate an weighted average height of the zone based on the area of each protected room.

8. **Installed Suppression Agent**:

Total Installed Weight: The total weight of the gas in the tank(s) taken off the label of the tank. Only used with the gases such as FM-200 which are measured by weight not the high pressure gasses like nitrogen or Inergen which are measured by volume.

The program calculates the Installed Concentration. You may use this concentration for calculating hold time by checking the box: Use this concentration for calculations.

Screen 4, Pre-Test Checklist, Comments

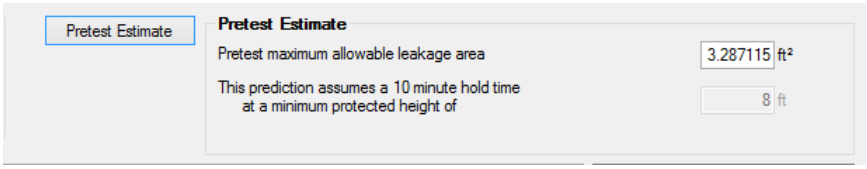


1. Pre-Test Checklist:

This is a reminder list for the testing technician cover a few important items that might be overlooked. This does print in the test report.

2. **Pretest Estimate:**

Clicking on the button will bring up the pretest Estimate showing the maximum allowable leakage area for the zone.



Useful comparing the found leakage area or as guide to the owner or contractor prior to a test.

3. **Comments**:

An open field to type in any special comments on the test which will print in the test report.

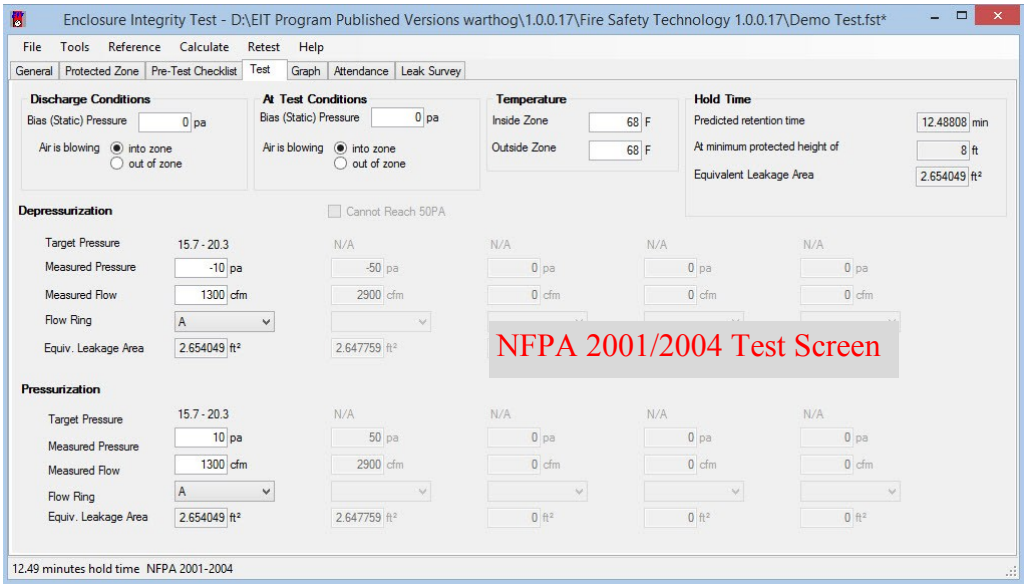
For example: "All areas temporary sealed (such as with duct tape or plastic sheeting) must be permanently sealed prior to final acceptance."

Or "Satisfactory quality weather stripping must be installed on test door prior to final acceptance."

4. **Comment right field:**

We have included a few often used comments. These may be double clicked and added to the comment field and modified as necessary. If your company has standard clauses or disclaimers to be included in each report these may be added to the selection. They are entered in the Tools tab.

Screen 5, Test



1. Bias (Static) Pressure (See "Static (Bias) Pressure Notes" page 18 and "Conducting an Enclosure Integrity Test, A photo Summary Photo 30", and "Conducting a NFPA 2001 Enclosure Integrity Test Part 2")

Discharge Conditions; This is the static (bias) pressure at discharge conditions. If the gauge is properly connected enter the pressure from the gauge including the sign (+/-) the program will set the proper air blowing state which may be difficult to determine visually.

At Test Conditions: This is the static (bias) pressure at test conditions.

2. **Temperature:**

Inside zone: This is the temperature of the protected zone. If this is a computer/server room with special HVAC systems the temperature may be taken off the HVAC control system.

Outside Zone: This is the temperature of the area surrounding the protected zone, often the office area. Not "outside" the building unless the protected zone is something like a cell site control building (box).

3. **Hold Time:**

Will be calculated by the program when the test is completed.

4. **Test Data:**

NFPA 2001/2004 Enclosure Integrity Test

(see "Conducting a Enclosure Integrity Fan Test, a Photo Summary, "The Cheat Sheet" and ?)

The 2004 code requires both a depressurization and pressurization test at one pressure within the Target Pressure range.

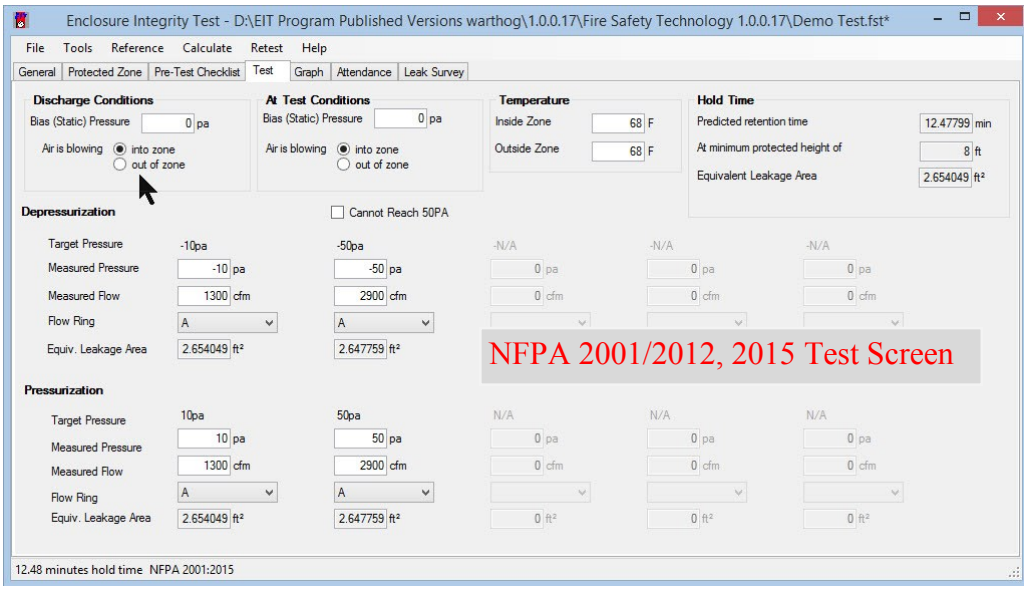
With the fan in the door panel and the gauge properly connected and tester inside the zone

Start by depressurizing the zone, that is with the white flow rings facing you and the fan blowing out. For a small zone that is well sealed start with the C ring, with large zone start with the A ring. Turn fan on and bring up to target pressure range. If you can not reach the target pressure turn fan off and remove one flow ring. If the flow reading flashes LO LO LO, turn fan off and add a flow ring.

When pressure and flow stabilize record **Measured Pressure** and **Measured Flow** readings along with **Flow Ring** which is a drop down selection.

Turn fan around a repeat above steps. Most often the fan flow ring configuration will be the same but sometimes you make have change the flow rings.

Screen 5, Test



NFPA 2001/ 2012, 2015 Enclosure Integrity Test

(see “Conducting a Enclosure Integrity Fan Test, a Photo Summary, “The Cheat Sheet” and “Conducting a NFPA 2001 Enclosure Integrity Test Part 2)

The 2012 and 2015 code requires two depressurization tests and two pressurization tests at 10pa and 50pa.

With the fan in the door panel and the gauge properly connected and tester inside the zone

Start by depressurizing the zone, that is with the white flow rings facing you and the fan blowing out. For a small zone that is well sealed start with the C ring, with large zone start with the A ring. Turn fan on and bring up to 10pa. If you can not reach 10pa turn fan off and remove one flow ring. If the flow reading flashes LO LO LO, turn fan off and add a flow ring.

When pressure and flow stabilize record readings along with flow ring.

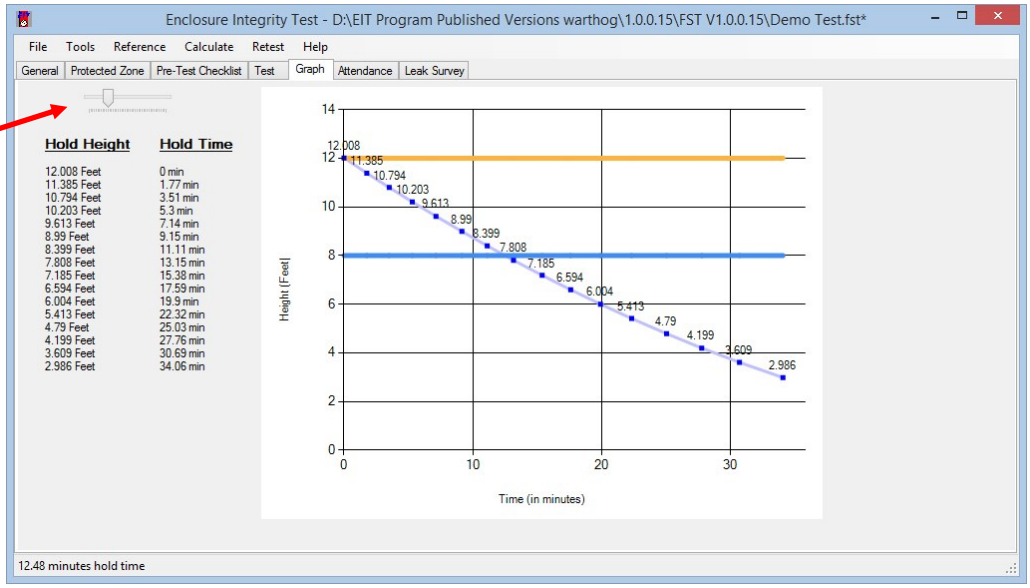
Repeat above step and depressurize to 50pa. Often you may have to change flow rings to reach 50pa.

Turn fan around a repeat above steps. Again you may have to change flow rings to meet the required test pressures.

When both depressurization and pressurization data are entered the calculated hold time will show in the upper right hand corner and the lower left hand corner on all screens.

The NFPA code requires a 10 minute hold time but a lesser time may be approved by the local AHJ depending on several factors.

Screen 6, Graph



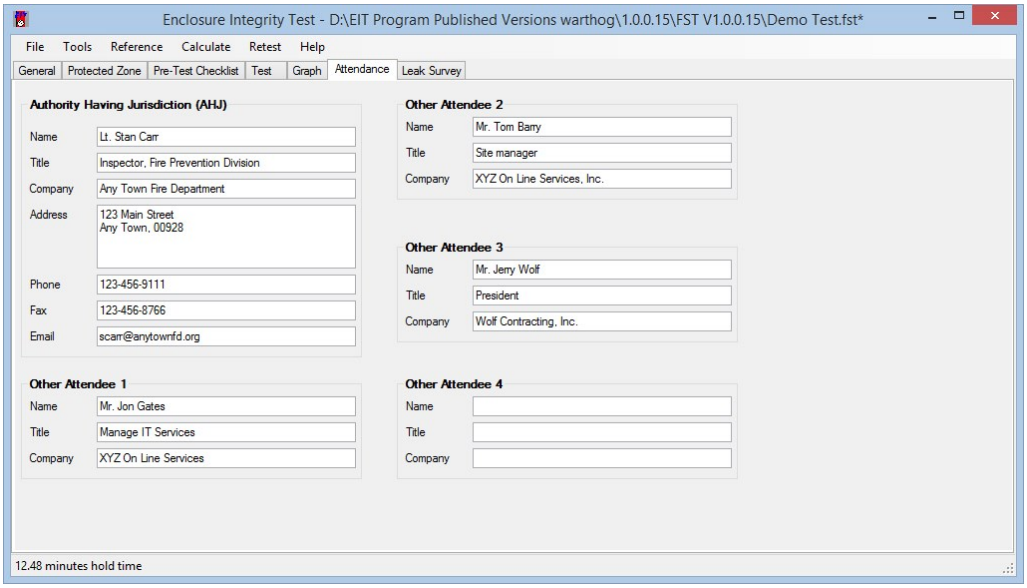
Graph and Hold Height vs. Hold Time Table

When the test is complete the program produces the above graph and table. The graph is very useful to show the rate that the interface is falling in the zone.

By moving the slider 1 the graph may be adjusted to the best presentation of the data.

Note: The graph function only is available for the heavy gases i.e. FM-200.

Screen 7, Attendance



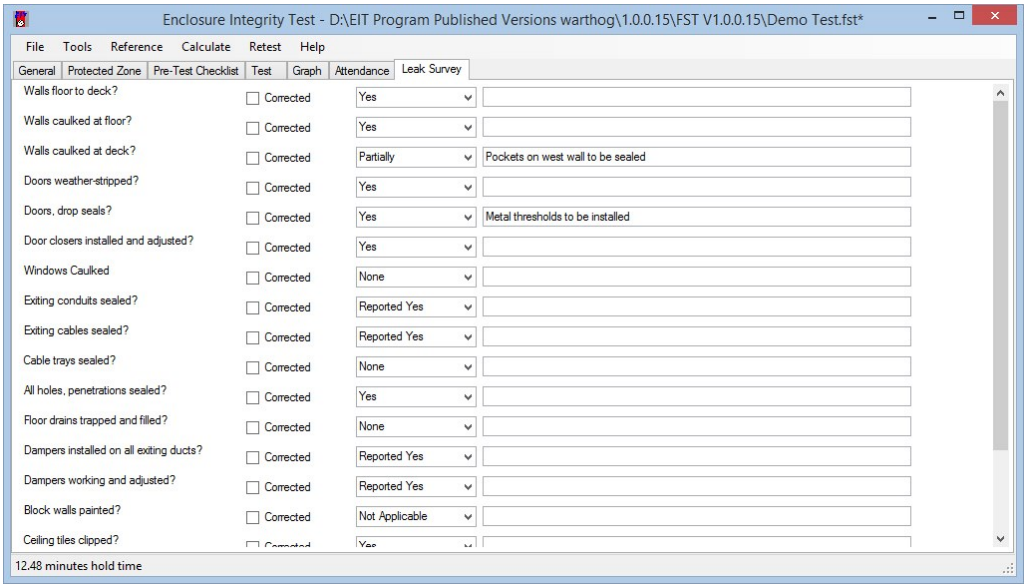
Attendance

Add the names of individuals who are present at the test, including any company employees that may be assisting the testing technician. These names will be printed in the test report.

Note: It is recommended that the Enclosure Integrity Test Data Form is used to make a hard copy of the test data in case there is a computer problem and loss of the test data.

It is easy to pass around the last page of the Data Form and have the individuals fill in their names and company.

Screen 8, Leak Survey



Leak Survey

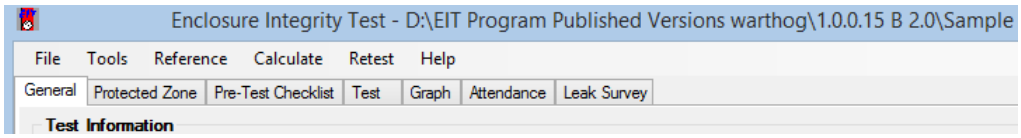
If the zone does not meet the required hold time it is due to too much leakage. The tester can by both observation based on his experience and by using the door fan and smoke help identify the leakage areas.

The survey form list the most common leakage areas with room for comments.

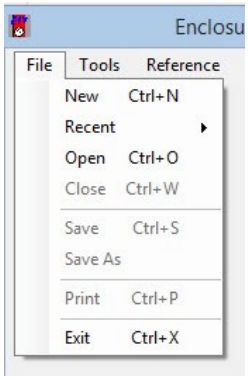
The completed form can be very helpful for the owner and/or contractor.

If the owner and/or contractor has not already received a copy of “Sealing of Rooms for Containment of Fire Suppression Agents” a copy should be included with the test report.

Again it is recommended that the above survey is completed manually on the Test Data Form and copied into the computer form later.

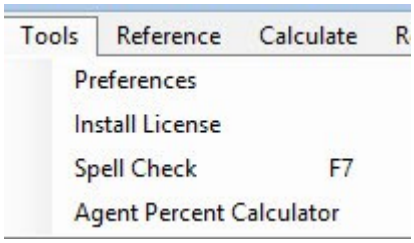


EIT Quick Test Intl. is formatted in the very familiar standard Windows format including a toolbar making it easy to learn and use.



File
The standard Windows functions New, Open, Close, Save, Save As, Print, Exit.

Also included is Recent, useful in quickly finding



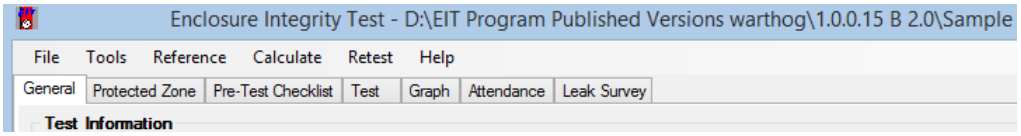
Tools
Preference for setting and locking your desired units and adding standard comments to the comment field.

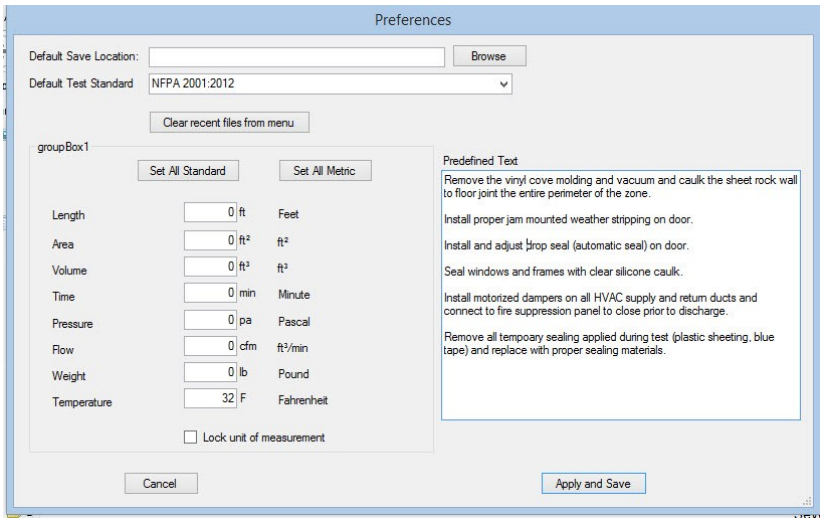
Install License
Only used is moving program from one folder to another or changing computers.

Spell Check
Useful especially when making comments in the comment field.

Agent Percent Calculator
No longer being used

Toolbar Tools>Preferences





Tools>Preferences

Default Save Location: Normally the program will save your test files in the same folder as the program. If you wish to same the test files in a different folder you may select it here.

Default Test Standard: You may set your preferred test standard here. You may always change it for a specific test requirement in the **General** screen.

Clear recent files from the menu: Click this button to clear the files that come up when **Recent** is selected in **File.**

Group Box 1: The program may be run in many different units, metric, standard (also known as Imperial or SAE) or a mix of units depending on your preference. You may Set all Standard or Set all Metric by clicking on the button or you may select or change an individual unit.

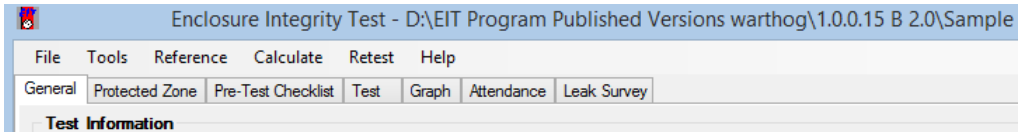
Lock unit of measurement [Important]: Once you have selected your preferred units check this box (or uncheck if you need to change the units). If this is not checked you may inadvertently change the units while working in the program and not realize it.

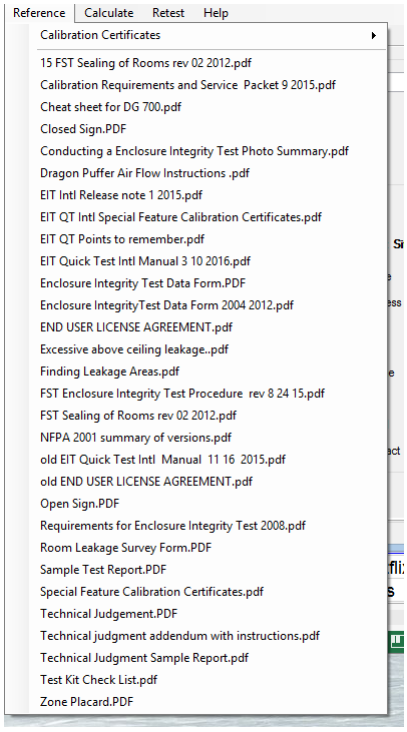
Predefined Text: We have included standard comments which we have often needed to include in the test report. You may add any of these to your report by double clicking on the comment. You may also add your own standard comments (boiler plate) which will appear in Screen 4 and may be double clicked to add them to the comment field.

Apply and Save: Click this button after any changes of units or Predefined Text.

EIT Quick Test Intl.

Toolbar: Reference, Calculate



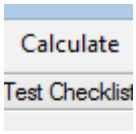


Reference: A collection of our handouts and helpful documents in .pdf format which you are welcome to read, print and give to your customers.

Especially useful for your customers and contractors is our document on sealing a zone "Sealing of Zones"

Useful and recommended for the testing technician is "Enclosure Integrity Test Data Form" for collecting a hard copy of the test data should your have a computer problem and lose the test data.

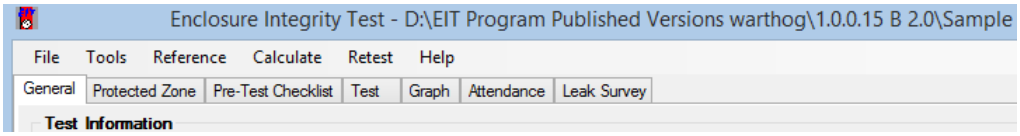
Calibration Certificates: V 1.0.015+ Contains the calibration certificates for your fan and gauge. They will pop up in **Help** should you need to show them to an AHJ. When a gauge is recalibrated, scan the new certificate as a .pdf and add it to this folder.

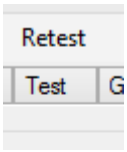


Calculate: Forces a recalculation of the hold time. Whenever there is new data or a change of data entered the program recalculates. However sometimes it may seem that there was no recalculation. Clicking on Calculate forces a recalculation

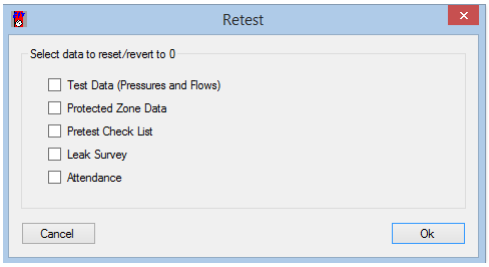
EIT Quick Test Intl.

Toolbar: Retest, Help





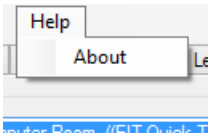
Retest: One of our most useful features. Often you will be retesting a zone, either the same day or later after there is additional sealing. Retest allow you to delete portions of the earlier test so that you do not have start from scratch or manually delete certain data fields and you can select just which fields to delete.

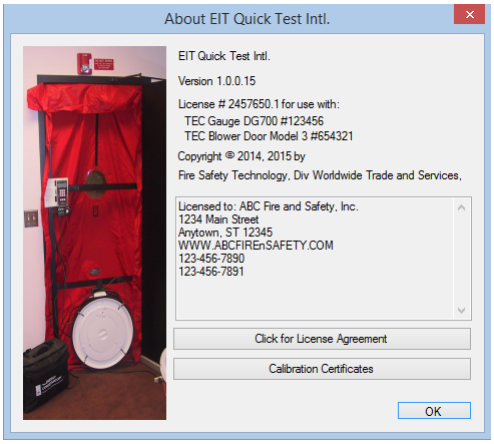


Test Data: Only erases the last test data.

Protected Zone Data: If you are going to test another zone in the same facility at the same date you would check both Test Data and Protected Zone Data and add the Zone Data for the new zone and do a test.

Pretest Check List:
Leak Survey:
Attendance: All function as above.



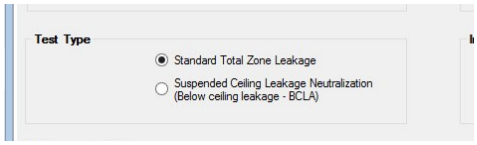


Help>About: Basic data about your copy of EIT Quick Test Intl. including Version, License Number, Gauge and Fan Serial Numbers, and your company details.

Click for License Agreement: Brings up a copy of the license agreement.

Calibration Certificates: Brings up copies of your calibration certificates, and information sheets on calibration requirements and recalibration order forms.

Suspended Ceiling Leakage Neutralization (Below Ceiling Leakage Area-BCLA)



Test Type: In screen 3, Protected Zone , Test Type you have the choice between Standard Total Zone Leakage and Suspended Ceiling Leakage Neutralization (Below Ceiling Leakage Area– BCLA)

Almost all tests are "Standard Total Zone Leakage", that is we test the entire zone high and low for leakage.

The Suspended Ceiling Leakage Neutralization (Below Ceiling Leakage Area– BCLA) test is a special test used in cases where there is excessive above ceiling leakage areas, for example in a case where the side wall do not go to the over head deck and there is an open plenum covering the entire building area or where the walls do go to the overhead deck but are not sealed at the deck and/or there are above ceiling holes in the side walls.

We know that the gases are heavy and leak out of the lower leakage areas. In calculating hold time the standard procedure assumes that half of the found leakage area is high and half is low. The size of the low leakage area and the weight of the gas/air mixture determines the rate of leakage.

However when we test a zone with a drop ceiling and an open plenum the found leakage area is not half high and half low but normally the high leakage area is much greater than the low leakage area.

In order to correct for this difference there is a special test procedure.

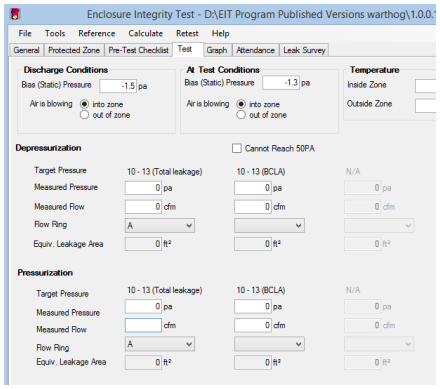
First we test the zone in the normal way with all ceiling tiles in place.

Second we cover the ceiling with plastic sheeting and retest the zone (the BCLA test)

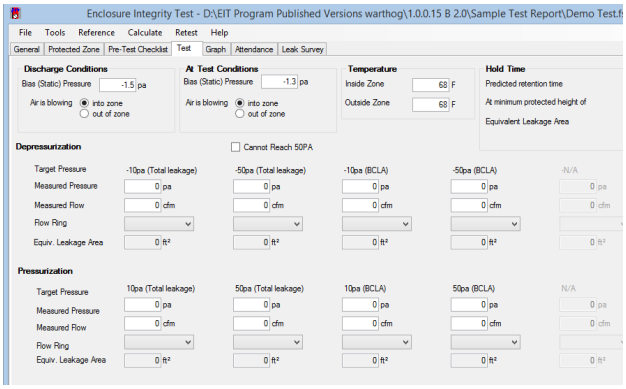
The program then calculates the hold time.

After selecting the Suspended Ceiling Leakage Neutralization (Below Ceiling Leakage Area– BCLA) option when you select the **Test** tab you will see data fields for both tests.

For more information NFPA 2001/ 2004 C.2.6.2 or NFPA 2001/2012, 2015 C.2.7.2



NFPA 2001/2004 BCLA Test



NFPA 2001/2012,2015 BCLA TEST

Bias (Static) Pressure:

The bias or also known as static pressure is the pressure acting on the zone, that is pressure or de-pressure out side the zone. This may be due to building HVAC systems, possibly due to an unbalanced system creating a negative or positive pressure in the area outside the zone, or wind effect on the building, a special lab or kitchen exhaust located near the protected zone or even fluctuations of air pressure due to the elevators.

Excessive bias pressure could shorten the predicted hold time by sucking or forcing out the gas/air mixture at an accelerated rate. By code the bias pressure must not exceed 25% of the pressure created in the zone by the gas/air mixture, the target pressure in NFPA 2001/2004 (and is calculated with warnings in EIT Quick Test Intl for NFPA 2001/2012, 2015).

The NFPA 2001 Enclosure Integrity Test Procedure has always required measurement of the bias pressure. See "Conducting an Enclosure Integrity Test, Photo Summary" photo 30, and "Conducting a NFPA 2001 Enclosure Integrity Test, Part 2"

The test procedure always required the zone and the area to be in the expected discharge condition when the test is conducted. The test is conducted with dampers, HVAC, doors, etc. in the discharge state, but beyond these items it is of course impossible for the tester to accurately predict the state of the zone or surrounding area at the time of an emergency.

The exception to this is in the case where we have opened a normally closed door to an adjoining room in order to obtain a free return air path during the test. Therefore in such case measure the bias pressure with the door closed, then open it for the test.

If the underfloor is pressurized at discharge (HVAC system on) then measure bias (static) pressure between the underfloor and the area outside the protected zone with HVAC on.

NFPA 2001/ 2012 and 2015 require the entry of both the bias pressure at discharge condition and at test condition. Unless there is a situation with an adjoining zone enter the normally measured bias pressure for both the discharge and at test condition.

See below C.2.6.2 from NFPA 2001/2012,2015

C.2.6.2 Bias Pressure Measurement.

C.2.6.2.1 Bias pressures are the background pressures that exist in the enclosure when the fan is stopped and sealed. Bias pressure must be measured or estimated for two different conditions. The first condition (which can always be measured) is the bias pressure present during the actual enclosure integrity test (P_{bt}). The second condition (which may need to be estimated) is the bias pressure expected after discharge, during the hold time (P_{bh}). To measure bias pressure, seal the fan opening with the door fan properly installed but without the fan operating. Observe the room pressure gauge for at least 30 seconds. Look for minor fluctuations in pressure. Determine the flow direction with smoke or other indicating method.

C.2.6.2.2 With the room set up as it would be under hold time conditions, measure the bias pressure P_{bh} across a section of envelope containing the largest quantity of leaks expected to leak clean agent. If the subfloor is pressurized during the hold time, measure the differential between the subfloor and outside the envelope. If the room cannot be set up as would be under discharge conditions, P_{bh} will need to be estimated.

C.2.6.2.3 With the room set up for the room integrity test, measure the bias pressure P_{bt}. If P_{bt} has an absolute value greater than 25 percent of the column pressure calculated in C.2.7.1.4, it must be permanently reduced. Large bias pressures decrease the level of certainty inherent in this procedure. The most common causes of excessive bias pressure are leaky dampers, ducts, and failure to shut down air-handling equipment serving the enclosure.

C.2.6.2.4 Record the position of all doorways, whether open or shut, when the bias pressure P_{bh} is measured.

Continuous Mixing:

It is normally recommended that all HVAC systems, computers, UPS equipment, switch gear etc. in the protected zone be shut down (de-powered) prior to discharge of the fire suppression gas. It is easy to understand that in case of a fire emergency shutting down this equipment this would minimize the risk of damage to the equipment and minimize the risk of re-ignition. There have been cases in which the HVAC / air handlers have been the source of smoke setting off the fire suppression system.

However some owners demand that the equipment and in particular the HVAC system is not shut down. In such cases because the air handlers are operating and moving air in the zone one has a situation referred to as "continuous mixing" of the suppression gas / air mixture. This is different from the standard discharge condition where the interface of the gas / air mixture is falling in the zone at a predictable rate. Briefly with "continuous mixing" there is a loss of the gas / air mixture out of the lower leakage areas but due to the mixing action of the air handlers the percentage of the suppression gas in the whole zone decreases. For this condition the calculation of the "hold time" is different from the standard Enclosure Integrity Test Procedure. We actually need to calculate the time lapse, "hold time" until the falling concentration reaches the minimum acceptable concentration.

NFPA 2001 /2012, 2015 5.6 and C.2.8.1.5 requires a minimum of 85% of the design concentration be held in the zone for 10 minutes.

If you have a zone with a continuous mixing then In the Protected Zone Screen, Hold Time Condition click Continuous Mixing. EIT Quick Test Intl. will then calculate the hold time using the Minimum (Allowable) Concentration.

TAB 5

EIT Quick Test Intl. ©

Enclosure Integrity Test
Test Data Form

Enclosure Integrity Test					
Date:		Contract:		Job #:	
Customer:					
Address:					
City:		State:		Zip:	
Contact:		Phone:		FAX:	

Site:					
Building:					
Address:					
City:		St:		Zip	
Contact:		Phone:		FAX:	

Zone:							
Test Standard:	NFPA 2001/2004 NFPA 2001/2012						
Room, Location:							
Description:							
Other fire protection:	Sprinklers y / n Type pre-action or ?						
Security:	Zone y / n Type: Cameras? or Building y / n 24/7 y / n Type:						

Suppression gas:							
Trade name:		Concentration:		Weight, volume:		Manufacture:	
Control Panel mfg:				Model:		Installer:	

Heights:					
Raised floor ht.:		Floor to drop ceiling:		Drop ceiling to upper deck:	
Total protected height:					
High hazzard, description:			Height of high hazzard:		
Minimum protected height:			Per (AHJ or ?):		

Volume:			
Overall protected volume:		Volume of solid objects:	
Net Protected volume:		Floor area:	

Temperature:	*Outside temperature is the temperature surounding the zone, not necessairly outside the building*		
Temperature inside zone:		Temperature outside zone:	

Free return air flow path	*Must have open air path from outside zone walls back to fan*
Confirmed:	

Test Set Up Door:	*Weather stripped?*	*Drop seal / door sweep?*	*Door Closer?*

Pretest, Maximum Leakage:	*Based on the zone's specfications, the calculated maximum allowable leakage for a 10 minute hold time (0.00 static pressure)*
Maximum leakage:	

Static air pressure	*Must be less than 25% of target test pressure* *+ Positive if blowing out of zone, - Negative if blowing into zone* **BE SURE OUTSIDE SAMPLING TUBE IS THROUGH DOOR PANEL**	
Static air pressure:	Discharge Condition	Test Condition

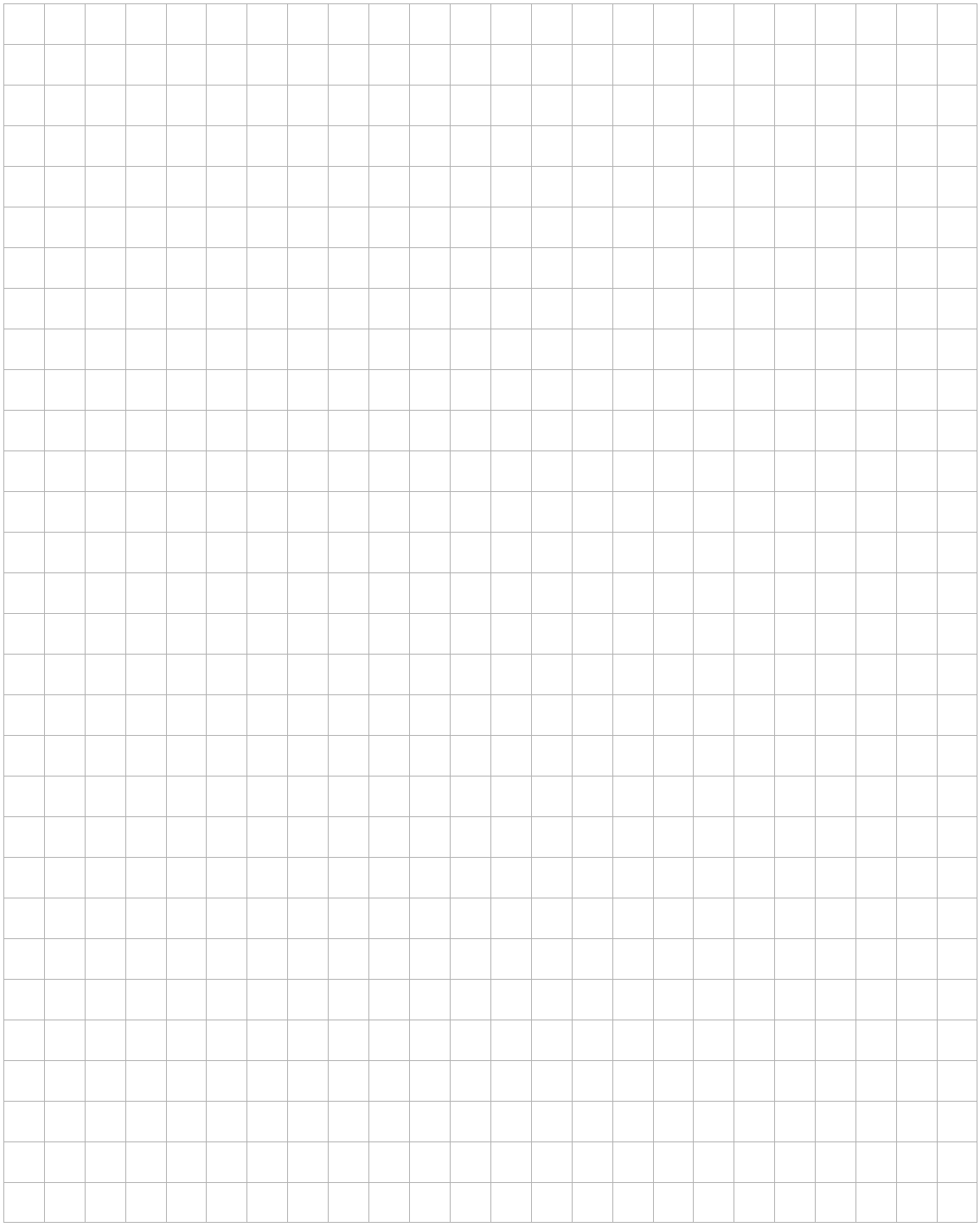
Hold Time Condition:		Test Type	
Descending Interface ☐	Continuous Mixing ☐	Standard Total Zone Leakage ☐	Suspended Ceiling Leakage Neutralization (Below ceiling Leakage BCLA) ☐

Test Data:	NFPA 2001/2004: Use indicated target pressure NFPA 2001/2012: Use 10pa & 50pa, if can not reach 50 pa check box and test at 10 pa						
Depres	Target pressure:			Press:	Target pressure:		
	Test pressure:				Test pressure:		
	Flow:				Flow:		
	Low Flow Plate:				Low Flow Plate:		

Test Results:				
Total leakage	Sq Inches:		Sq Feet:	
Hold time	Height (ft):		Minutes:	
	Height (ft):		Minutes:	
	Height (ft):		Minutes:	
	Height (ft):		Minutes:	

DRAWING:

1” =.083 2” =.166 3” =.25 4” =.333 5” =.416 6” =.50 7” =.583 8” =.666 9” =.75 10” = .833 11” = .9166



Possible leakage areas

Problem area	Y/N (1)	Corrected	Comments
Walls floor to deck			
Walls caulked at floor			
Walls caulked at deck			
Doors weather-stripped			
Doors, drop seals			
Door closers installed, adjusted			
Windows caulked			
Exiting conduits sealed			
Exiting cables sealed			
Cable trays sealed			
All holes, penetrations sealed			
Floor drains trapped and filled			
Dampers installed on all exiting ducts			
Dampers working and adjusted			
Block walls painted			
Ceiling tiles clipped			
HVAC shut down			
Halon exhaust dampered			
Halon exhaust damper closed			

1. Y—yes
N— No
R—-Reported
?—-Unknown
N/A—Not Applicable
I/A—-Inaccessible

Attendance at test:	
Name	Company / Department

Fire Safety Technology
P.O. Box 1063
Severna Park, MD 21146 U.S.A.
Phone 800-685-8303, 410-647-8303
Cell 443-928-8567
FAX 410-647-7066
e-mail: mail@firesafetytech.com
www.firesafetytech.com

TAB 6

NFPA 2001:2012
Clean Agent Enclosure Integrity Test

Conducted by:

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

123-456-7890

123-456-7891

WWW.ABCFIREnSAFETY.COM

Tuesday, July 1, 2014 4:22 PM

XYZ On Line Services, Computer Room ((EIT Quick Test Intl Sample Test and Report))

Enclosure Integrity Test Report

XYZ On Line Services, Computer Room ((EIT Quick Test Intl Sample Test and Report))

General

Test Date	**7/1/2014 4:22:21 PM**
Tested by	**Mark Weathersby**
Job ID	**XYZ On Line Services, Computer Room ((EIT Quick Test Intl Sample Test and Report))**

Company

Name	**XYZ On Line Services, Inc**
Address	**1234 Washinton Blvd. Any Town, OZ 00923**
Contact	**Mr. Jon Gates**
Phone	**123-456-7890**
Fax	**123-456-7899**
E-mail	**mail@xyzonlineservices.com**

Location

Name	**XYZ On Line SErvices, Inc.**
Address	**890 Westpark Dr. Any Town, OZ 00926**
Contact	**Mr. Tom Berry**
Phone	**123-654-0987**
Fax	**123-654-0988**
E-mail	**computer@xyzonlineservices.com**

Protected Zone

Name/Number	**Computer Room, Number 107**
Location	**First Floor**
Description	**Computer and server room**

High Hazard

Description	**Server racks**
Height	**8 Feet**

Enclosure Integrity Test Report

XYZ On Line Services, Computer Room ((EIT Quick Test Intl Sample Test and Report))

General

Protected Volume	**18000.000**	**ft³**
Maximum Protected Height	**12.000**	**Feet**
Minimum Protected Height	**8.000**	**Feet**
Temperature Inside Zone	**68.0**	**Fahrenheit**
Temperature Outside Zone	**68.0**	**Fahrenheit**
Static Pressure (test)	**0.000**	**Pascal**
Static Pressure (discharge)	**0.000**	**Pascal**

Test Standard

Name	**NFPA 2001:2012**
Hold Time Condition	**Descending Interface**
Test Type	**Total Zone Leakage**

Suppression Agent

Name	**FM-200 (HFC-227ea)**
Gas Design Concentration	**7.2 %**

Hold time calculations based on the design concentration of the supression agent.

Maximum Allowable Leakage: **3.287 ft²**

Depressurization

Target	-10pa	-50pa
Pressure	-10.0 Pascal	-50.0 Pascal
Flow	1300.00 ft³/min	2900.00 ft³/min
Leakage Area	2.654 ft²	2.648 ft²

Pressurization

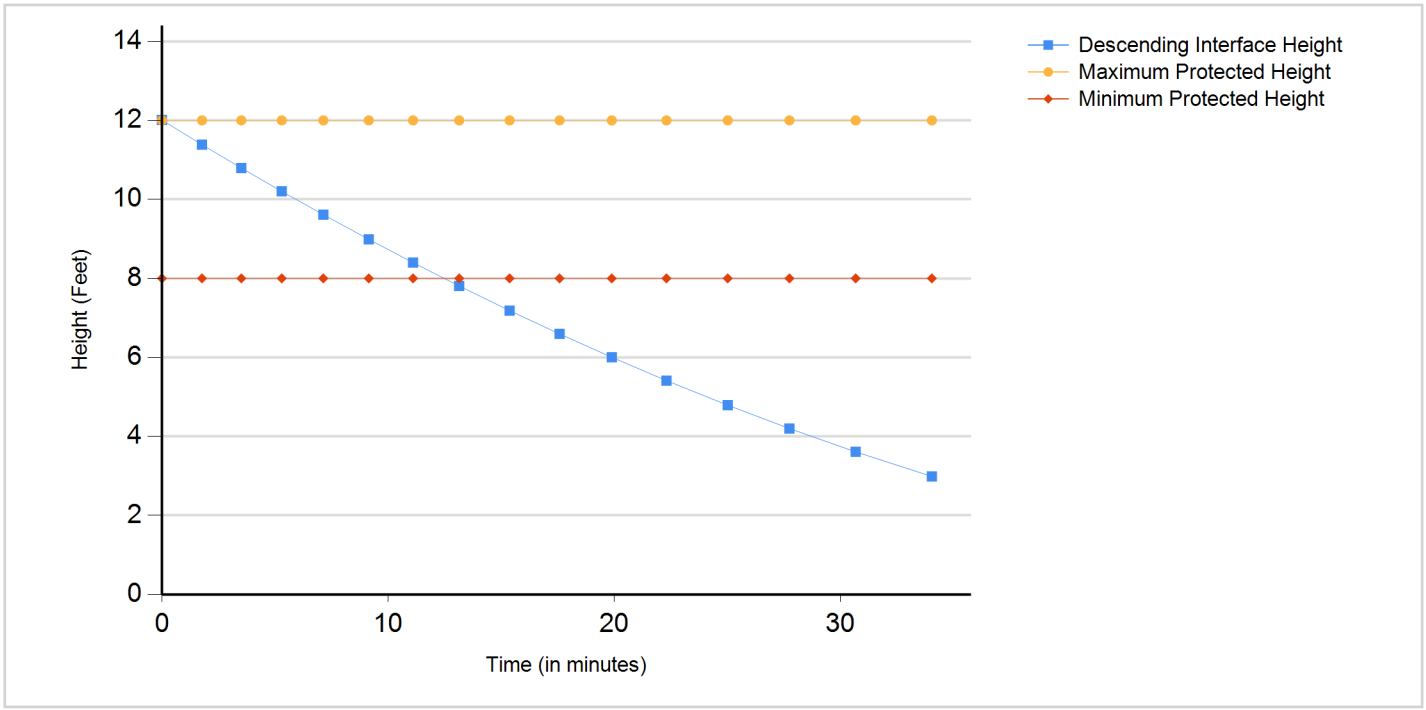
Target	10pa	50pa
Pressure	10.0 Pascal	50.0 Pascal
Flow	1300.00 ft³/min	2900.00 ft³/min
Leakage Area	2.654 ft²	2.648 ft²

NFPA 2001, 2012 edition, Annex C, Enclosure Integrity Procedure

Predicted Hold Time at 8 Feet	12.48 Minutes
Equivalent Leakage Area:	1.875 ft²

Enclosure Integrity Test Report

XYZ On Line Services, Computer Room ((EIT Quick Test Intl Sample Test and Report))



Height (Feet)	Time (minutes)
12.008	0
11.385	1.77
10.794	3.51
10.203	5.3
9.613	7.14
8.99	9.15
8.399	11.11
7.808	13.15
7.185	15.38
6.594	17.59
6.004	19.9
5.413	22.32
4.79	25.03
4.199	27.76
3.609	30.69
2.986	34.06

Authority Having Jurisdiction

Name	Lt. Stan Carr
Contact	Inspector, Fire Prevention Division
Address	123 Main Street Any Town, 00928
Phone	123-456-9111
Fax	123-456-8766
E-mail	scarr@anytownfd.org

Other Attendees

Name	Mr. Jon Gates
Title	Manage IT Services
Company	XYZ On Line Services
Name	Mr. Tom Barry
Title	Site manager
Company	XYZ On Line Services, Inc.
Name	Mr. Jerry Wolf
Title	President
Company	Wolf Contracting, Inc.
Name	
Title	
Company	

Pretest Checklist

Tanks disconnected:	Yes	HVAC system off:	Yes
Free return of air flow path:	Yes	Panel in discharge mode:	Yes
Outside air pressure tube connected:	Yes	Dampers activated:	Yes

Comments

Conditions

This test is a calculated prediction of the hold time and is based on the NFPA 2001:2012 Edition, Annex C, Enclosure Integrity Procedure and on the condition of the zone at the time of the test. This test was conducted in accordance with the NFPA procedure.

The software was produced by the Fire Safety Technology division of Worldwide Trade & Services, Inc. and is based on the equations and calculations as published in the above cited NFPA standard. The accuracy of the predicted hold time is totally the responsibility of the publisher of the standards, NFPA.

The Fire Safety Technology division nor Worldwide Trade & Services, Inc., assumes no responsibility or liability for the passage of a subsequent discharge test or from maintaining the concentration of the suppression gas for the predicted time in case of an actual fire emergency.

The sealing integrity of this zone must be maintained to assure the effectiveness of the fire suppression agent in case of an actual fire emergency. NFPA 2001:2012 Edition, Section 7.4 requires an annual inspection and possible retesting of this zone. Next inspection is due one year from the date of the test.

Test conducted by:

Mark Weathersby

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

Leakage Survey

Description	Response	Corrected	Comments
Walls floor to deck?	Yes		
Walls caulked at floor?	Yes		
Walls caulked at deck?	Partially		Pockets on west wall to be sealed
Doors weather-stripped?	Yes		
Doors, drop seals?	Yes		Metal thresholds to be installed
Door closers installed and adjusted?	Yes		
Windows Caulked	None		
Exiting conduits sealed?	Reported Yes		
Exiting cables sealed?	Reported Yes		
Cable trays sealed?	None		
All holes, penetrations sealed?	Yes		
Floor drains trapped and filled?	None		
Dampers installed on all exiting ducts?	Reported Yes		
Dampers working and adjusted?	Reported Yes		
Block walls painted?	Not Applicable		
Ceiling tiles clipped?	Yes		
HVAC shut down?	Yes		
Gas exhaust dampered?	None		
Gas exhaust damper closed?			

Note:

The above listed leakage areas were observed at the time of the enclosure integrity test and may or may not be all the leakage areas. Sealing of the listed leakage areas does not assure the passage of a subsequent enclosure integrity test. The above problem areas have been listed as an aid. It is the responsibility of the owner and/or his sealing contractor to thoroughly inspect and seal the zone. Please review the attached "Sealing of Rooms for Containment of Fire Suppression Agents" for additional guidance.

ATTENTION

This room is protected with a clean agent gaseous fire extinguishing system.

To be effective in a fire emergency, the fire suppression agent must be retained in the room.

Upon installation of this system, all doors were equipped with automatic closers, weather stripping and floor seals; all cables and conduits leading in or out of the room were sealed (including those above the ceiling or under the raised floor); and all leaks or cracks were seals. As required per NFPA 2001, 2012 edition, Annex C, Enclosure Integrity Procedure to assure it was properly sealed to retain the fire suppression agent.

For the safety of the occupants and equipment in this room:

1. Doors must not be blocked open.
2. All weather stripping and seals must be maintained in good operating condition
3. Any new cables or conduits leading in or out of the room must be caulked and sealed.
4. Any holes or penetrations through the walls must be repaired and sealed.

To assure the sealing integrity of this room, NFPA 2001, 2012 edition, Section 7.4 requires an annual inspection and possible retesting of this room. Next inspection due one year from Test Date.

Test Results:

Test Date	**7/1/2014 4:22:21 PM**
Minimum Protected Height	**8.000 Feet**
Hold Time:	**12.48 Minutes**

For more information or to schedule an inspection contact:

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

Phone	**123-456-7890**
Fax	**123-456-7891**
E-mail	
Website	**WWW.ABCFIREnSAFETY.COM**

TAB 7

Fire Safety Technology
Division of
Worldwide Trade and Services, Inc.

P. O. Box 1063
Severna Park, MD 21146
U.S.A.
PHONE 410-647-8303
FAX 410-647-7066
e-mail:
mail@firesafetytech.com

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems Enclosure Integrity Testing Procedure 2004, 2008, 2012 Editions A Summary

NFPA 2001 2004 Enclosure Integrity Testing Procedure

The procedure and calculations as presented in NFPA 2001 2004 edition were virtually unchanged from the previous editions and were the same calculations as were published in the NFPA 12A Halon 1301 Fire Extinguishing Systems 1989, 1993 editions. The NFPA 2001 procedure added the constants for the new clean agents which were used in place of the Halon 1301 constant. This was a single point test for both pressurizing and depressurizing the protected zone.

NFPA 2001 2008 Enclosure Integrity Testing Procedure

The revised procedure as presented in the NFPA 2001 2008 edition incorporated a multipoint test procedure. This test would have required 5 test points for both pressurization and depressurization of the protected zone. This is similar to the ISO 14520 and the EN 15004 test procedure. The purpose of the change was to make the procedure less conservative, in other words to increase the predicted hold time for a given zone. Unfortunately, the calculations as published were erroneous and did not calculate and there were no published revisions of the calculations.(1) Therefore the NFPA 2001 2008 procedure was not and could not be adopted by local authorities.

NFPA 2001 2012 Enclosure Integrity Testing Procedure

The NFPA 2001 2012 procedure incorporates a 2 point test procedure for both the pressurization and depressurization tests of the zone. Again the purpose of the change is to make the procedure less conservative. This procedure was finally published in late 2012. I know of no local authorities in this country that have at this time adopted the 2012 standard.

NFPA 2001 2004 vs. NFPA 2001 2012 Enclosure Integrity Testing Procedure

When a zone is tested using both the NFPA 2001 2004 and the NFPA 2001 2012 procedure the NFPA 2001 2004 predicted hold time will be shorter than the predicted hold time calculated by the NFPA 2001 2012 procedure. In other words the NFPA 2001 2004 is the most conservative procedure and offers the greatest margin of protection for the zone and the protected equipment.

(1).Colin Genge, President of Retrotec has for many years been a contributor to the NFPA 2001 committee and has helped develop the calculations and procedures including the ones published in NFPA 2001/2008 version. He recently (2/25/2013) wrote “The 2012 test procedure was required by the 2008 version but it had so many typos that it was unusable.”

The problems with the 2008 version were earlier confirmed in a direct conversation with Jeffery L. Harrington Chairman of the NFPA 2001 committee and Barry D. Chase the NFPA Staff Liaison.

TAB 8

SEALING OF ROOMS

FOR CONTAINMENT OF FIRE SUPPRESSION AGENTS

This bulletin has been prepared to assist anyone who must seal a room for a fire suppression gas system. Suppression gas systems are designed to suppress all flame and fire spread, but cannot in every instance extinguish the initial source of ignition (for instance, severe electrical short circuit). Therefore it is critical that the suppression gas remain in the protected area until emergency personnel have a chance to deal with a possible continuing source of ignition.

1. **ALL DOORS** leading from the protected areas or into another protected zone shall have drop seals (1) on the bottoms, weather-stripping(2) around the jams, latching mechanisms and door closer hardware. In addition, double doors shall have a weather-stripped astragal(2) to prevent leakage between doors and a coordinator to assure proper sequence of closure. In general, doors shall be treated as though they are being weatherproofed for outside use with no light possible passing around all sides. Doors, which for any reason cannot be kept normally closed, shall be equipped with electromagnets designed to release on alarm.

2. **ALL WINDOWS** in the zone shall be caulked with silicone around the frame and at the glass-rubber gasket. Particular attention shall be given to the area under the window sill which often has large leakage areas.

3. **ALL DUCTWORK** not in service, leading from or into a protected area shall be permanently sealed off, air tight, with metal plates caulked and screwed in place. Ductwork left in service from the building air handling unit shall have blade type dampers installed with elastomer blade tip and side seals. Dampers shall be spring loaded or motor operated to provide 100% air shut-off.(5) Dampers shall be located at the wall line where the ducts enter and exit the zone. The ducts shall be fitted with inspection ports to allow inspection of the damper blades. It is further recommended that the building air handling units be shut down prior to discharge to prevent the spread of smoke and fire byproducts into other areas of the building and excessive static pressure on the protected zone.

4. **ALL CONDUITS** leading from or into a protected zone shall be sealed with a rated duct seal. All electrical switch boxes and receptacles, including computer LAN connections shall be sealed to prevent leakage from the zone.

5. **SELF-CONTAINED AIR HANDLING UNITS** within the protected zone may be left in service. However subfloor pressurization may accelerate leakage through the subfloor and one must consider the possibility that the air handling unit could be the source of the fire. It is strongly recommended that the air handlers be shut down prior to

discharge and in particular, systems not manned 24 hours a day should be shutdown.

6. **PROTECTED AREAS** shall be enclosed with wall partitions which extend slab-to-slab. All walls shall be caulked around the inside perimeter of the room where the walls rest on the floor slab and where the walls intersect with the ceiling slab above. Sealing shall take place on the inside surface of the zone to avoid leakage into the partition wall void. Particular attention shall be given to a wall which meets a corrugated overhead pan. The pockets shall be sealed with a properly rated material(3), fiberglass covered with sheet rock mud is an economical method. Unrated, canned foam is not acceptable. Drop ceiling tiles shall be clipped in place within 4 feet of any discharge nozzle.

7. **ALL HOLES, CRACKS OR PENETRATIONS** leading into or out of the protected area shall be sealed. This includes pipe chases, wire troughs and expansion joints. It is recommended that ***wire troughs*** **and** ***cable trays*** be sealed with reusable, intumescent, rated sealbags ***not canned foam***.(4).

8. **IF A RAISED FLOOR** continues out of the protected area into adjoining rooms, bulkheads shall be installed under the floor directly under above-floor border partitions. These bulkheads must be caulked top and bottom. If the bottom of the floor tiles are "waffled" or perforated allowing leakage through the tile, caulked sheet metal may be attached to provide a seal between the bulkhead and the bottom of the tile. If the adjoining rooms share the same underfloor air handlers, then the bulkheads shall have dampers installed the same as required for ductwork. See Item #2.

9. **ALL FLOOR DRAINS** shall have traps and the traps should be designed to have water in them at all times or shall be filled with a non evaporating, approved liquid.

10. **POROUS BLOCK WALLS** must be sealed slab-to-slab to prevent gas from passing through the block. Two or three coats of paint are normally required. Unpainted block walls are totally unacceptable. If an unpainted block wall is covered by sheetrock which stops just above a dropped ceiling, the exposed block wall above the ceiling must be painted and the joint between the sheetrock and wall sealed.

11. **QUALITY OF MATERIALS,** all materials used to seal the zone shall have proper fire rating and must be of a lasting quality. Canned foam generally does not have proper fire rating and is subject to special AHJ approval per NFPA 2001.

12. **IN GENERAL,** the basic intent is to make the protected areas as air tight as possible during and after discharge. The suppression gases are heavier than air and therefore, openings below floors are usually more critical than those above a ceiling. Small zones with high protected equipment are much harder to seal than large zones with low protected equipment. See attached chart.

13. **ONCE THE GAS IS DISCHARGE,** in most jurisdictions, it must remain in the room at its designed concentration and height for ten minutes. The length of time that the gas will remain is directly proportional to the "air tightness," "integrity" of the room.

14. If INERGEN is used as the suppression gas, please contact the supplier of INERGEN for pressure relief recommendations.

The above points are based on our testing, observations and experience. However, sealing of these leakage areas does not guarantee "passing" of an enclosure integrity test. A subsequent enclosure integrity test may determine that there are additional leakage areas which prevent "passing" of the test. In some cases it may be impossible to determine the actual location of leakage.

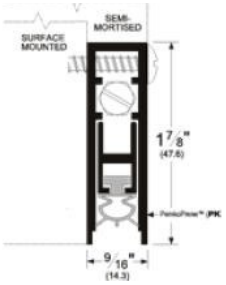
In all cases, Fire Safety Technology a division of Worldwide Trade & Services, Inc. assumes no responsibility for "passing" of an enclosure integrity test, retention of the suppression gas during an emergency or approval of the zone by the authority having jurisdiction.

Code references:
From NFPA 2001, 2004 Edition Annex C, Enclosure Integrity Procedure:

C.2.8.2 Leakage Alteration.
C.2.8.2.1 Procedure.
C.2.8.2.1.1 Protected areas should be enclosed with wall partitions that extend from the floor slab to ceiling slab or floor slab to roof.
C.2.8.2.1.2 If a raised floor continues out of the protected area into adjoining rooms, partitions should be installed under the floor directly under above-floor border partitions. These partitions should be caulked top and bottom. If the adjoining rooms share the same under-floor air handlers, then the partitions should have dampers installed the same as required for ductwork.
C.2.8.2.1.3 Any holes, cracks, or penetrations leading into or out of the protected area should be sealed. This includes pipe chases and wire troughs. All walls should be caulked around the inside perimeter of the room where the walls rest on the floor slab and where the walls intersect with the ceiling slab or roof above.
C.2.8.2.1.4 Porous block walls should be sealed slab-to-slab to prevent gas from passing through the block. Multiple coats of paint could be required.
C.2.8.2.1.5 All doors should have door sweeps or drop seals on the bottoms, and weather stripping around the jambs, latching mechanisms, and door closer hardware. In addition, double doors should have a weather-stripped astragal to prevent leakage between doors and a coordinator to ensure proper sequence of closure.
C.2.8.2.1.6 Windows should have solid weather stripping around all joints.
C.2.8.2.1.7 All unused and out-of-service ductwork leading into or from a protected area should be permanently sealed off (airtight) with metal plates caulked and screwed in place. Ductwork still in service with the building air-handling unit should have butterfly blade-type dampers installed with neoprene seals. Dampers should be spring-loaded or motor operated to provide 100-percent air shutoff. Alterations to air conditioning, heating, ventilating ductwork, and related equipment should be in accordance with NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, or NFPA90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, as applicable.
C.2.8.2.1.8 All floor drains should have traps, and the traps should be designed to have water or other compatible liquid in them at all times.
C.2.8.2.2 Materials.
C.2.8.2.2.1 All materials used in altering leaks on enclosure envelope boundaries, including walls, floors, partitions, finish, acoustical treatment, raised floors, suspended ceilings, and other construction, should have a flame spread rating that is compatible with the flame spread requirements of the enclosure.
C.2.8.2.2.2 Exposed cellular plastics should not be used for altering leakage unless considered acceptable by the authority having jurisdiction.

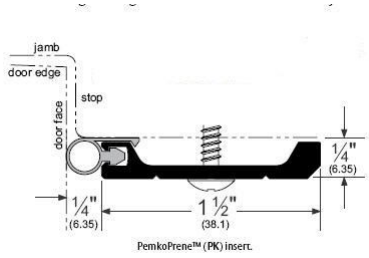
Additional References:
1.Drop seals or automatic door bottoms such as PEMCO 4301CPKL with UBC 7.2 rating or equal, from PEMCO, P.O. Box 18966, Memphis, TN 38181 Phone 901-3656-2160, 800-824-3018, FAX 901-365-1354 Available from your local commercial door hardware supplier; they are also stocked by McMaster-Carr, phone 404-346-7000 or www.mcmaster.com listed as "Automatic-Sealing Door Bottoms" see stock number 8403A56 or "google" Pemco 4301CPKL for internet supplier.

Functioning of an automatic door bottom

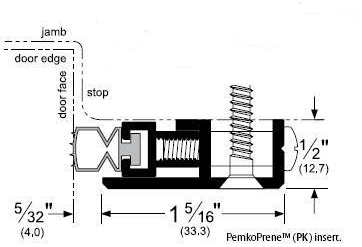


Cross section

2. Rigid jamb mounted weatherstripping such as PEMCO 290APK or even better the adjustable rigid jamb mounted weatherstripping PEMCO 379CPK is recommended for durability and adjustability. Special sealing products for double door astragals also available from PEMCO or others.



Rigid jamb mounted weatherstrip-



Adjustable, rigid jamb mounted weather-

3. Fiberglass or mineral wool backing can be sprayed or painted with a fire rated product such as 3M Fire Dam Spray from 3M Fire Protection Products, 800-328-1687 or equal[www.3m.com/firestop].

See also McMaster-Carr item numbers 93455K46, 9340K11 and Grainger item 4MM44. www.grainger.com

4. Fire rated, intumesce Sealbags from International Protective Coatings phone 800-334-8796, 215-362-9020, FAX 888-531-5192 or equal. Also 3M Fire Barrier Pillows and McMaster-Carr stock number 9359K51

5. Fire & smoke dampers with appropriate UL 555S fire rating and AMCA Standard 500-89 Class I leakage rating or better such as Ruskin fire and smoke dampers, Ruskin, 39000 Dr. Graves Rd., Kansas City, MO 64030, 816-761-7476 FAX 816-761-0521 www.ruskin.com or Johnson Controls VD-1330 Class 1 Control Dampers, www.johnsoncontrols.com

Zone Size, Height of Protected Equipment VS. Allowable Leakage Area
Small zones with high protected equipment are more difficult to meet sealing requirements

Example	Square Footage of Zone	Height of Zone	Height of Protected Equipment	Allowable Leakage Area
A(1)	300 sq. ft.	10 ft	6 ft.	108 sq. inches .75 sq feet
A(2)	300 sq. ft.	10 ft.	8 ft.	50 sq. inches .35 sq. feet
B(1)	1210 sq. ft.	10 ft.	6 ft.	436 sq. inches 3 sq. feet
B(2)	1210 sq. ft.	10 ft.	8 ft.	204 sq. inches 1.42 sq. feet
C(1)	6000 sq. ft.	10 ft.	6 ft.	1083 sq. inches 7.52 sq. feet
C (2)	6000 sq. ft.	10 ft.	8 ft.	507 sq. inches 3.52 sq. feet

FM-200, 7% concentration, 68° inside and outside zone

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Finding Typical Leakage Areas

More times than not the zones we test will fail the initial enclosure integrity test. This happens in spite of our best efforts to inform the owner and/or general contractor the necessity of proper sealing of the zone including furnishing them with copies of our hand out *Sealing of Rooms of Containment of Fire Suppression Agents.* (Still a good idea in spite of the poor success record). This handout covers the typical leakage areas as does the punch list on page 4 of the *Test Data Form.*

The page 4 punch list in *Test Data Form* is design to be used by the technician conducting the test to help locate leakage areas and to assist the owner and/or general contractor in proper preparation of the zone.

Use of the ***Dragon Puffer***, air flow indicator is a reliable and safe way of locating the leakage areas. It also makes a very vivid and un arguable image of the leakage. Review the instructions on use of the ***Dragon Puffer***. Note that the nozzle must be brought very close to the suspected leakage area. You can not hold the ***Dragon Puffer*** in the middle of the zone hoping to follow the smoke to the leakage.

The last phase of the normal test procedure is with the zone pressurized. This makes it easy to turn the fan back on and pressurize the zone which will accelerate the smoke out any leakage areas.

To review the possible leakage areas as listed in the *Test Data Form* punch list:

Walls floor to deck
Walls caulked at floor
Walls caulked at (overhead) deck

In order to retain the suppression gas the entire “envelop” of the zone must be sealed. This means the wall need to go from the lower slab to the upper deck and be sealed and caulked at both joints even in cases where there is a dropped ceiling and the protected zone is only below the dropped ceiling.

The wall floor joint is particularly important as the suppression gasses are heavy and will leak out the lower leakage areas. It is also an area that is often overlooked and not sealed. Use the ***Dragon Puffer*** with the fan pressurizing the zone and apply smoke to the wall floor joint and look for any leakage areas. to properly seal the joint the vinyl cove molding or carpet

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Finding Typical Leakage Areas

Similarly the wall to over head deck must be examined for leakage.

Doors weather-stripped
Doors, drop seals
Door closers installed, adjusted

Again using the ***Dragon Puffer*** apply smoke to the edge of the door and especially the bottom of the door. If weather-stripping and a bottom seal has not been installed or properly adjusted you will see the smoke streaming out of the zone. We strongly recommend quality jam mounted weather-stripping (not foam tape) and drop seals (not brush or plastic sweeps) than can be adjusted and will last.

The door where the fan is installed should be examined visually for leakage areas before or after the test. Light coming through the door to jam joint is a sure sign of leakage.

Widows caulked

Use the ***Dragon Puffer*** to apply smoke to the glass-frame joint and around the perimeter of the window frame. Often there is leakage at the corners and the glass-rubber gasket joint leaks.

Exiting conduits sealed
Exiting cables sealed
Cable trays sealed

Use the ***Dragon Puffer*** to apply smoke to these areas. Cable bundles are difficult to seal and may need additional caulk in the core of the bundle.

All holes, penetrations sealed

Obviously—do not need the ***Dragon Puffer*** for this.

Floor drains trapped and filled

Use the *Dragon Puffer* to apply smoke to any floor drains. If the trap has not been filled you will see the smoke pouring down the drain. Fill the trap with vegetable oil which will not evaporate. A floor drain that is used to drain condensation from the HVAC equipment will most likely have enough continuous water to keep the trap filled.

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Finding Typical Leakage Areas

Dampers installed on exiting ducts
Dampers working and adjusted

Use the ***Dragon Puffer*** to apply smoke to diffusers or inspection ports to determine if the dampers are working and adjusted. One must be careful however as even small leakage around a closed damper may be enough to create a stream of smoke from the ***Dragon Puffer*** but not enough leakage area to be significant. This can be confirmed by visual inspection of the closed dampers through an inspection port.

Block wall painted

Even though unpainted block walls are a leakage area, there is not enough flow though any singled area to be visually detected by using smoke. However visually one can confirm that block walls, both below and above grade blocks, are porous.

Your software **EIT Quick Test 2001** has an optional punch list in the same style as the punch list in the Test Data Form. The testing technician has the option to include the punch list with the test report.

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Dragon Puffer™
Air Flow Indicator

Introduction

We have been searching for a replacement for the toxic chemical smoke tubes we have been using for leak detection. The Dragon Puffer though originally marketed as a toy has proven to be a useful, safe and economical tool. It provides an instant, harmless, non toxic, non corrosive controlled smoke plume, exactly what is needed in detecting air leakage from the zones we are testing.

The Dragon Puffer uses the same type smoke fluid as used in theatrical smoke generators, primarily distilled water with propylene glycol and glycerin. The fluid is forced through a tiny heated tube creating the instant, harmless smoke plume. (See the MSDS)

In our kits we have included the Dragon Puffer, fluid and batteries. Additional supplies are available as needed.

Instructions

1. Install 6 AA batteries per instructions in battery compartment and 1 AA battery in the Fan body
2. Fill fluid tank about 3/4 full with Super Zero Fluid
3. Turn on blower door fan to pressurize zone
4. Install and turn on blue power nozzle (trim back nozzle if needed to create thicker smoke plume)
4. Press POWER LEVER down gently until blue LED light glows.
5. Hold POWER LEVER down for 6 to 9 seconds to allow smoke generator to heat, then gently squeeze SMOKE LEVER to create a plume of smoke.
6. If the EXCESS FLUID TANK is full, suck out the fluid with the Super Zero Fuel bottle and put it back into the FILL TANK.

Hints

1. Be patient, hold POWER LEVER down longer than shorter.
2. Practice squeezing the SMOKE LEVER slowly to create a plume of smoke, not just one puff.
3. If the quantity of smoke produced seems to decrease, empty the EMPTY TANK and fill the FILL TANK, replace batteries.

Order the ZTS-800 Dragon Puffer Kit with one Dragon Puffer with one fan body, 2 pencil stream cones, 3oz. Bottle Super Zero fluid, seven AA batteries, instructions, MSDS Sheet all in hard case…… $ 59.95

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TAB 9

Excessive Above Ceiling Leakage

As detailed in our handout *Technical Judgment, Testing Zones with Excessive High Leakage* zones with excessive high leakage will hold the gas concentration longer than the Enclosure Integrity Test Procedure will indicate. The test "sees" all leakage in the zone and assumes that half is high and half is low. If the majority of the leakage is high the Enclosure Test Procedure will predict a shorter than actual hold time and the zone may "fail"; not meet the required hold time.

This is often the case in a retrofit zone in an office situation where the side walls do not extend all the way to the overhead deck and there is an open plenum through out the building. Typically these zones will be fitted with a lay-in drop ceiling.

There is also a similar situation where the side walls do go to the overhead deck but are not sealed or have many open pockets where they meet the corrugated decking.

In testing these zones we have several options:

1. Technical Judgment: If the zone is properly constructed and well sealed with minimum penetrations below the drop ceiling, the zone can be surveyed and examined while pressurized with a smoke wand to determine minimal low leakage from the zone. Please refer to our handout *Technical Judgment, Testing Zones with Excessive High Leakage.*

2. Covering the ceiling with plastic sheeting: If the zone is small, the ceiling may be covered from below with plastic sheeting. The sheeting can be held to the "T" bars with large binder clips and sealed around the edges with blue masking tape so as not to damage painted walls. All cables going through the ceiling need to be sealed to the plastic sheeting. Generally you will only be able to do a pressurization test. Enter the pressurization test data for both the pressurization and de-pressurization tests. In evaluating the test results remember: This method is detailed in NFPA 2001/2008 C.2.6.2.8

3. Above ceiling neutralization with 2 fans: This method is detailed in NFPA 2001/2008 C.2.6.2.1. It has a number of limitations: It can not be used with large over head leakage areas such as an open plenum situation; or when there is air movement in the zone making it difficult to determine "neutralization" of pressures; or if there are obstructions in the overhead area interfere with flow of the air or limited height above ceiling again making determination of 'Neutralization" difficult. This test procedure also has the disadvantage of requiring additional equipment and specialized operator training.

Important Note: For options 2 and 3

A. The allowable leakage area is 1/2 the allowable leakage area for a standard test—you will be measuring only the lower leakage in the zone.

B. The hold time must be twice the normal hold time. If you require 10 minute hold time the test must have a minimum of 20 minutes.

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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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TAB 10

Job ID

ENCLOSURE INTEGRITY TEST REPORT

Predicted Hold Time

Minimum hold height

Technical Judgment Addendum

The NFPA 2001 Appendix C Enclosure Integrity Test predicted hold time for this zone is minutes at the minimum protected height of feet. However by examination and use of a smoke generator no significant low leakage was found in the zone. In accordance with the 2004 edition of NFPA 2001 Standard on Clean Agent Extinguishing Systems, Appendix C, Enclosure Integrity Procedure Section C-1.2.2(5) Technical Judgment it is the opinion of the tester that this zone would retain the concentration of the suppression gas at the minimum protected height for a significant time greater than the calculated predicted hold time. See attachment *Technical Judgment, Testing Zones with Excessive High Leakage.*

Tester Signature

Test conducted by:

x_____

Tester

Company:

Company

Date:

Date

NOTE:
1. In comment field in Zone Screen, type in "See Technical Judgment Addendum".
2. Be sure to attach to report a copy of the .pdf "Technical Judgment, Testing Zones with Excessive High Leakage"

Job ID

ENCLOSURE INTEGRITY TEST REPORT

Predicted Hold Time

Minimum hold height

Technical Judgment Addendum

The NFPA 2001 Appendix C Enclosure Integrity Test predicted hold time for this zone is minutes at the minimum protected height of feet. However by examination and use of a smoke generator no significant low leakage was found in the zone. In accordance with the 2004 edition of NFPA 2001 Standard on Clean Agent Extinguishing Systems, Appendix C, Enclosure Integrity Procedure Section C-1.2.2(5) Technical Judgment it is the opinion of the tester that this zone would retain the concentration of the suppression gas at the minimum protected height for a significant time greater than the calculated predicted hold time. See attachment *Technical Judgment, Testing Zones with Excessive High Leakage.*

Tester Signature

Test conducted by:

x_____

Tester

Company:

Company

Date:

Date

NOTE:
1. In comment field in Zone Screen, type in "See Technical Judgment Addendum".
2. Be sure to attach to report a copy of the .pdf "Technical Judgment, Testing Zones with Excessive High Leakage"

TAB 11

NFPA 2001:2012
Clean Agent Enclosure Integrity Test

Conducted by:

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

123-456-7890

123-456-7891

WWW.ABCFIREnSAFETY.COM

Wednesday, October 26, 2016 5:18 PM

Lightning On Line Services (File L207)

Enclosure Integrity Test Report

Lightning On Line Services (File L207)

General

Test Date	**10/26/2016 5:18:34 PM**
Tested by	**Tom Jones**
Job ID	**Lightning On Line Services (File L207)**

Company

Name	**Lightning On Line Services**
Address	**102 New York Ave.NE** **Washington, DC 20003**
Contact	**Mike Smith**
Phone	**123-456-7890**
Fax	**123-456-7891**
E-mail	**msmith@jabcservices.com**

Location

Name	**Lightning On Line Services**
Address	**902 First St NE** **Washington, DC 20003**
Contact	**Mike Smith**
Phone	**123-456-8970**
Fax	**123-456-8971**
E-mail	**msmith@jabcservices.com**

Protected Zone

Name/Number	**Server Room**
Location	
Description	**Server / Telcom Room**

High Hazard

Description	**Server Racks**
Height	**6.5 Feet**

Enclosure Integrity Test Report

Lightning On Line Services (File L207)

General

Protected Volume	**2629.100**	**ft³**
Maximum Protected Height	**8.340**	**Feet**
Minimum Protected Height	**6.500**	**Feet**
Temperature Inside Zone	**68.0**	**Fahrenheit**
Temperature Outside Zone	**72.0**	**Fahrenheit**
Static Pressure (test)	**0.600**	**Pascal**
Static Pressure (discharge)	**0.600**	**Pascal**

Test Standard

Name	**NFPA 2001:2012**
Hold Time Condition	**Descending Interface**
Test Type	**Total Zone Leakage**

Suppression Agent

Name	**FM-200 (HFC-227ea)**
Gas Design Concentration	**7 %**

Hold time calculations based on the design concentration of the supression agent.

Maximum Allowable Leakage: **53.639 in²**

Depressurization

Target	-10pa	-50pa
Pressure	-9.8 Pascal	-50.5 Pascal
Flow	770.00 ft³/min	1772.00 ft³/min
Leakage Area	184.004 in²	209.824 in²

Pressurization

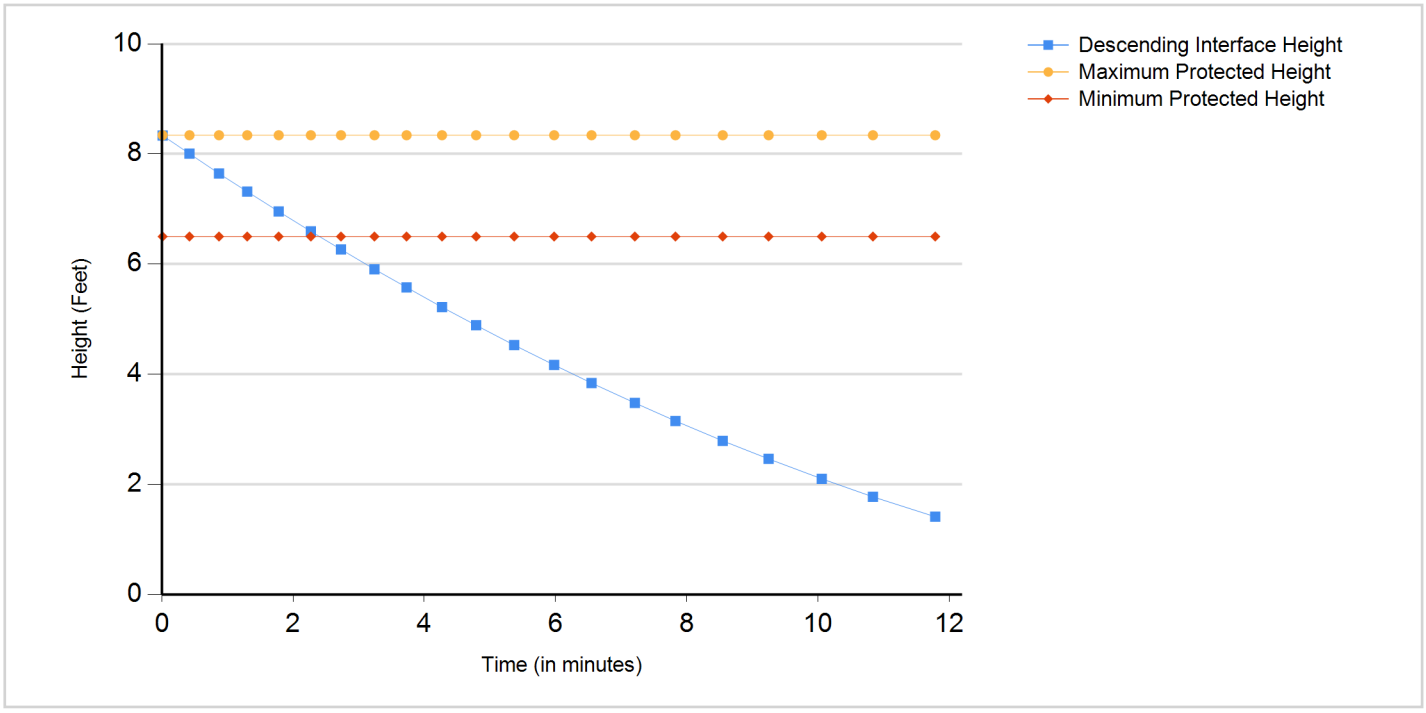
Target	10pa	50pa
Pressure	10.8 Pascal	50.1 Pascal
Flow	760.00 ft³/min	1700.00 ft³/min
Leakage Area	280.238 in²	249.777 in²

NFPA 2001, 2012 edition, Annex C, Enclosure Integrity Procedure

Predicted Hold Time at 6.5 Feet	2.4 Minutes
Equivalent Leakage Area:	221.491 in²

Enclosure Integrity Test Report

Lightning On Line Services (File L207)



Height (Feet)	Time (minutes)
8.333	0.01
8.005	0.42
7.644	0.87
7.316	1.3
6.955	1.78
6.594	2.27
6.266	2.73
5.906	3.24
5.577	3.73
5.217	4.27
4.888	4.79
4.528	5.37
4.167	5.98
3.839	6.55
3.478	7.21
3.15	7.83
2.789	8.55
2.461	9.25
2.1	10.06
1.772	10.84
1.411	11.79

Authority Having Jurisdiction

Name	
Contact	
Address	
Phone	
Fax	
E-mail	

Other Attendees

Name	Justin Flagg
Title	IT Facilities Manager
Company	Lightning On Line Services
Name	Dan Jones
Title	Technician Assistant
Company	ABC Fire and Safety, Inc.
Name	
Title	
Company	
Name	
Title	
Company	

Enclosure Integrity Test Report

Lightning On Line Services (File L207)

Pretest Checklist

Tanks disconnected:	Yes	HVAC system off:	Yes
Free return of air flow path:	Yes	Panel in discharge mode:	Yes
Outside air pressure tube connected:	Yes	Dampers activated:	Yes

Comments

Except for minor leakage areas in zone (see Leakage Survey) all detected leakage is out of the zone above the drop ceiling.

With corrections as listed in Leakage Survey, the actual hold time of the heavy gas/air mixture would be significantly longer than the calculated hold time.

See attached "Technical Judgment Amendment" and Technical Judgment, Testing Zones with Excessive High Leakage."

Conditions

This test is a calculated prediction of the hold time and is based on the NFPA 2001:2012 Edition, Annex C, Enclosure Integrity Procedure and on the condition of the zone at the time of the test. This test was conducted in accordance with the NFPA procedure.

The software was produced by the Fire Safety Technology division of Worldwide Trade & Services, Inc. and is based on the equations and calculations as published in the above cited NFPA standard. The accuracy of the predicted hold time is totally the responsibility of the publisher of the standards, NFPA.

The Fire Safety Technology division nor Worldwide Trade & Services, Inc., assumes no responsibility or liability for the passage of a subsequent discharge test or from maintaining the concentration of the suppression gas for the predicted time in case of an actual fire emergency.

The sealing integrity of this zone must be maintained to assure the effectiveness of the fire suppression agent in case of an actual fire emergency. NFPA 2001:2012 Edition, Section 7.4 requires an annual inspection and possible retesting of this zone. Next inspection is due one year from the date of the test.

Test conducted by:

Tom Jones

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

Leakage Survey

Description	Response	Corrected	Comments
Walls floor to deck?	Yes		
Walls caulked at floor?	Partially		Remove vinyl cove molding and vacuum and caulk wall to floor joint.
Walls caulked at deck?	No		
Doors weather-stripped?	Partially		Replace foam tape with proper jam mounted weather stripping
Doors, drop seals?	Yes		
Door closers installed and adjusted?	Yes		
Windows Caulked	None		
Exiting conduits sealed?	Yes		
Exiting cables sealed?	Yes		
Cable trays sealed?	Not Applicable		
All holes, penetrations sealed?	Yes		
Floor drains trapped and filled?	None		
Dampers installed on all exiting ducts?	Yes		
Dampers working and adjusted?	Yes		
Block walls painted?	None		
Ceiling tiles clipped?	Partially		
HVAC shut down?	Yes		
Gas exhaust dampered?	Not Applicable		
Gas exhaust damper closed?	Not Applicable		

Note:

The above listed leakage areas were observed at the time of the enclosure integrity test and may or may not be all the leakage areas. Sealing of the listed leakage areas does not assure the passage of a subsequent enclosure integrity test. The above problem areas have been listed as an aid. It is the responsibility of the owner and/or his sealing contractor to thoroughly inspect and seal the zone. Please review the attached "Sealing of Rooms for Containment of Fire Suppression Agents" for additional guidance.

ATTENTION

This room is protected with a clean agent gaseous fire extinguishing system.

To be effective in a fire emergency, the fire suppression agent must be retained in the room.

Upon installation of this system, all doors were equipped with automatic closers, weather stripping and floor seals; all cables and conduits leading in or out of the room were sealed (including those above the ceiling or under the raised floor); and all leaks or cracks were seals. As required per NFPA 2001, 2012 edition, Annex C, Enclosure Integrity Procedure to assure it was properly sealed to retain the fire suppression agent.

For the safety of the occupants and equipment in this room:

1. Doors must not be blocked open.
2. All weather stripping and seals must be maintained in good operating condition
3. Any new cables or conduits leading in or out of the room must be caulked and sealed.
4. Any holes or penetrations through the walls must be repaired and sealed.

To assure the sealing integrity of this room, NFPA 2001, 2012 edition, Section 7.4 requires an annual inspection and possible retesting of this room. Next inspection due one year from Test Date.

Test Results:

Test Date	**10/26/2016 5:18:34 PM**
Minimum Protected Height	**6.500 Feet**
Hold Time:	**2.40 Minutes**

For more information or to schedule an inspection contact:

ABC Fire and Safety, Inc.

1234 Main Street
Anytown, ST 12345

Phone	**123-456-7890**
Fax	**123-456-7891**
E-mail	
Website	**WWW.ABCFIREnSAFETY.COM**

ENCLOSURE INTEGRITY TEST REPORT

Lightning On Line Services (File L207)

Technical Judgment Addendum

The NFPA 2001 Appendix C Enclosure Integrity Test predicted hold time for this zone is 2.4 minutes at the minimum protected height of 6.5 feet. However by examination and use of a smoke generator no significant low leakage was found in the zone. In accordance with the 2004 edition of NFPA 2001 Standard on Clean Agent Extinguishing Systems, Appendix C, Enclosure Integrity Procedure Section C-1.2.2(5) Technical Judgment it is the opinion of the tester that this zone would retain the concentration of the suppression gas at the minimum protected height for a significant time greater than the calculated predicted hold time. See attachment *Technical Judgment, Testing Zones with Excessive High Leakage.*

Test conducted by:

x_____

Tom Jones

Company:

ABC Fire and Safety, Inc

Date:

October 26, 2016

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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TAB 12

This section saved for your copy of the

NFPA 2001/ 2015 Annex C Enclosure Integrity Procedure

Name:_____

Company:_____

Fire Safety Technology

NFPA 2001 Enclosure Integrity Procedure

Training Seminar Outline

1. Background and development of the door fan hold time/leakage analysis procedure.

2. Principles of the procedure

3. Equipment: use and maintenance.

4. FST door fan test procedure
   "Enclosure Integrity Test Procedure"

5. Using EIT Quick Test 2001
   "Points to Remember"
   "Enclosure Integrity Test, Test Data Form"
   "NFPA 201 Clean Agent Enclosure Integrity Test"- Sample Test Report"

6. Typical Leakage areas
   "Sealing of Rooms for Containment of Fire Suppression Agents"

7. Using the door fan to find problems

8. Testing problem areas
   "Excessive Above Ceiling Leakage"
   "Technical Judgement, Testing Zones with Excessive High Leakage"

9. NFPA 2001 Standard on clean Agent Fire Extinguishing Systems and the Enclosure Integrity Procedure

10. The testing technician, responsibilities and obligations

11. Review, questions and test

Sign_____

Date_____

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