



Enclosure Integrity Test Report

In compliance with NFPA 2001 (2022 Edition) Annex C Enclosure Integrity Procedure

First Floor Comms Room

Kingspan

Kingscourt

Co Cavan


Ref: 12-10-678

Issue Date: 30th January 2025

Prepared for: Martin Hickey

Tested building:	First Floor
Tested enclosure:	Comms Room
Building Address:	Kingspan Kingscourt Cavan
Performed for:	Martin Hickey
Test date:	14/01/2025
Associated Test file:	

Summary – Comms Room

 FanTestic Integrity		version: 5.16.81	licensed to: Atbec Ltd
Test date: 14/01/2025		By:	Certification:
Location: Kingspan Kingscourt Cavan			Building: First Floor
Witness:			
Enclosure conditions prior to discharge		Extinguishing agent details	
Net protected volume, V [m ³]	48	Agent	FM200 (NFPA) [HFC-227ea]
Max flooded height, H _o [m]	2.8	Quantity [kg]	25
Required protected height, H _p [m]	2.2	Type	Halocarbon
Design temp, T [C]	20.0	Discharge time, [s]	10
Enclosure pressure limit, [Pa]	500	Mixing during hold time	Yes
Specified Hold Time, [min]	10	Initial concentration, c _i	6.7298%
Elevation, [m]	100	Design concentration, c	6.7%
Minimum design humidity	30%	Minimum concentration, C _{min}	5.695%
Maximum design humidity	60%	Bias during Hold, P _{bh} [Pa]	0
Test equipment		Hold time results	
Fan make/model	Retrotec 1000	Leakage exponent, n	0.9807
Fan serial #	H01799	Leakage constant, k ₁ [m ³ /h/Pa ⁿ]	22.25
Fan calibration date	07/28/2025	Total Leakage Area, [cm ²]	238
Gauge make/model	DM32	Predicted Hold Time, t [min]	10
Gauge serial #	203519		
Gauge calibration date	18/12/2025		

Hold Time compliance based on Annex C of NFPA 2001 (2022 Edition)

Calculations predict that the extinguishing agent concentration will fall from the initial concentration of 6.7298% to the minimum concentration of 5.695% in **10.0 minutes**. The enclosure **PASSES** this acceptance procedure because this hold time is greater than the specified minimum of 10 minutes.

Assumptions and warnings

While FanTestic Integrity software may identify clean agent peak pressure and hold time risks, use of this software does not in any way guarantee the elimination of those risks.

Enclosure Integrity (hold time)

The enclosure was tested in compliance with NFPA 2001 (2022 Edition) Annex C Enclosure Integrity Procedure. These tests only address potential failures in maintaining extinguishing agent concentration due to excessive enclosure leakage. The following assumptions were made:

- The initial extinguishing agent concentration as indicated in the test report will be achieved.

- Ductwork connected to air-handling systems that are outside this enclosure will be either isolated with dampers or will be shut down during the hold time.
- If air handlers are used to provide continuous mixing, they will be dedicated to this enclosure and will not create significant flows across the enclosure boundaries.
- An adequate return path for the air flow was provided during the enclosure integrity door fan tests.
- All intentional openings will be sealed during the enclosure leakage for hold time tests.
- Design temperature inside the tested enclosure during discharge is 20.0 C.
- The conditions in the enclosure are such that the air will be moving enough during the hold time to force the extinguishing agent and air to mix continuously and NOT form an agent/air interface.
- All other non-integrity tests, as outlined in the NFPA standard, will be satisfactorily completed.

Background

Hold time prediction, Continuous Mixing Model

This procedure predicts the hold time for the extinguishing agent concentration to drop from the initial concentration to the minimum concentration, based on the variables shown in this report. It is assumed that the conditions in the enclosure are such that the air will be moving enough during the hold time to force the extinguishing agent and air to mix continuously and NOT form an extinguishing agent/air interface. Due to the conservative assumptions regarding leakage distribution, this prediction model usually predicts a shorter retention time as compared to an actual discharge, but not always.

A calculation for continuous mixing will yield the same results at all levels in the enclosure and is recommended for enclosures where protection must be held at high levels in the enclosure. This prediction only applies to conditions as found at the time of the test. Additional penetrations, weather, open doorways, HVAC modifications, malfunctions and the inherent assumptions in the enclosure integrity procedure could all combine to give very different results in a real discharge.

Leakage area defined for hold time

The Total Enclosure Leakage test measures all unintentional holes in the enclosure, the sub-floor and the above-ceiling space, whether or not extinguishing agent will leak out of these holes. All intentional openings (such as installed pressure relief vents) must be held in their closed position but not sealed. The measurement is performed over a range of pressures so that the exact leakage rate at lower pressures for agent loss will be known. The predicted hold time is worst case since it is assumed that half of the measured leakage is located in the ceiling and the other half is located in the floor.

Discussion of Results – Comms Room

Hold Time

Compliance with Annex C of NFPA 2001 (2022 Edition)

It is predicted that the leakage area **measurement** in this enclosure of 238 cm² would allow the extinguishing agent concentration to fall from the initial concentration of 6.7298% to the minimum concentration of 5.695% in

10.0 minutes. This hold time is greater than the specified minimum of 10 minutes, therefore the enclosure **PASSES** this acceptance procedure. The hold time is calculated based on a 'continuous mixing' model where NO interface is formed between extinguishing agent and air. Under mixing, all locations throughout the enclosure fall to the same percent concentrations at the same time.

The maximum leakage allowed in the enclosure that will still maintain a hold time of 10 minutes is 237 cm² (calculated at a reference pressure of 10Pa).

Test Data Appendix- Comms Room

Enclosure Construction Data

The maximum flooded height used in the calculations is 2.8 m. The equipment was installed in the room, and the top of the rack was measured to be 2.2 m, so 2.2 m was taken as the minimum height for protection. Net protected volume used is 48 m³. Building elevation used is 100 m, and the elevation correction factor used in the calculations is 0.988.

Total Enclosure Leakage test data

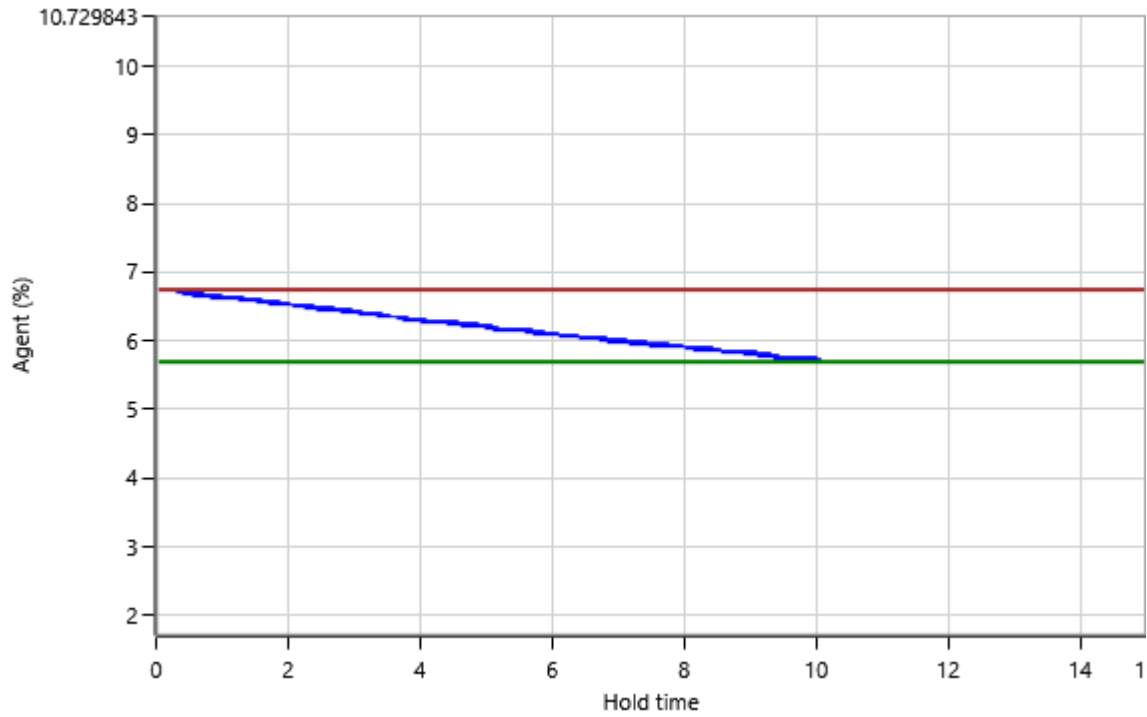
Based on **measured** values, the enclosure alone has an equivalent leakage area of **238 cm²** at a reference pressure of 10 Pa.

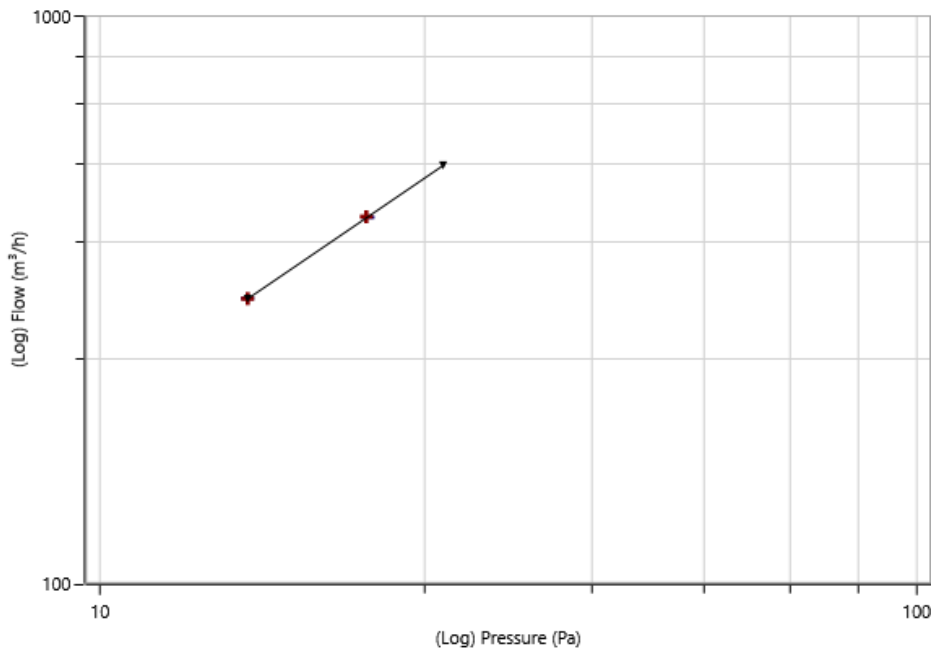
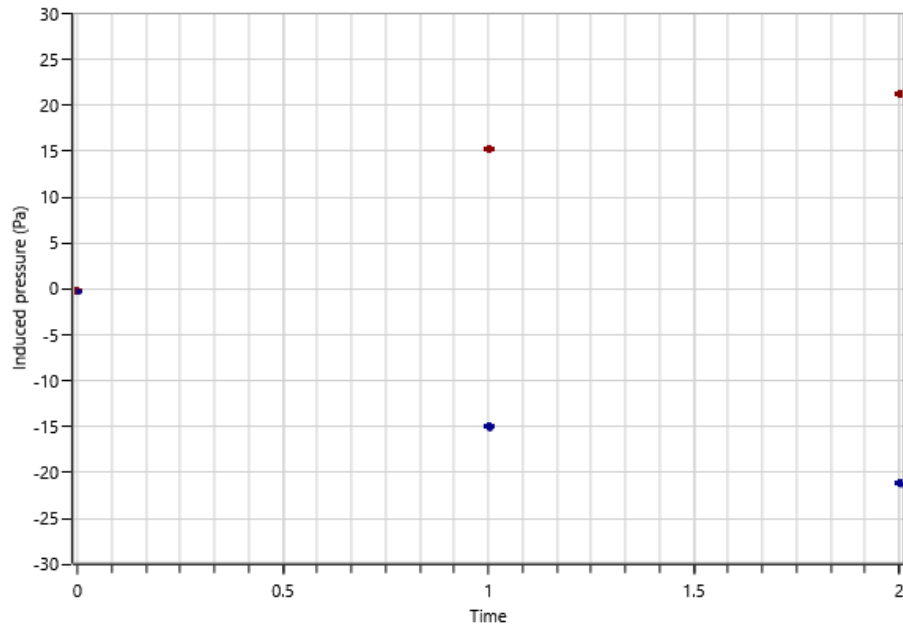
The following table represents the results from the enclosure integrity procedure carried out on the whole enclosure, with all intentional openings sealed.

Test conditions			
Test date	14/01/2025	Inside temperature, T _e [C]	20 C
Test time	11:46:47	Outside temperature, T _o [C]	20 C
Operator location	Inside	Bias pressure, P _{bt} [Pa]	-0.20

		Pressurize Data		Depressurize Data	
Measured pressure [Pa]		15.1	21.1	-15.1	-21.2
Induced pressure [Pa]		15.1	21.1	-15.1	-21.2
Fan #1	Fan Pressure [Pa]				
	Flow [m ³ /hr]	319.3	445.2	318.6	442.5
Total Flow rate [m ³ /h]		319.3	445.2	318.6	442.5
Leakage exponent, n		0.994		0.968	
Leakage characteristic, k ₁ [m ³ /h/Pa ⁿ]		21.518		22.999	

Leakage area at 10 Pa [cm ²]	236.71	238.67
Correlation, r	1.0000	1.0000





Test Equipment

The following test equipment was used in the performance of the enclosure integrity tests.

	Fan	Fan serial	Fan location	Gauge	Gauge serial	Gauge Calibration
#1	Retrotec 1000	H01799	Enclosure Door	DM32	203159	18/12/2025

Certificate of Compliance NFPA 2001 Enclosure Integrity Certificate

This is to confirm that the
First Floor Comms Room
Kingspan, Kingscourt, Co Cavan

Passed

An integrity test to verify that the gaseous fire extinguishing system will work as designed. On 14th January 2025, the total leakage was 800.5 cm². Protection will be maintained for at least 10 minutes throughout the enclosure, in accordance with NFPA 2001.

Test Engineer: James Taggart

Certificate No: 12-10-678 m3/hr C1

This integrity test only verifies the ability of the protected enclosure to retain extinguishing agent following a discharge. It does not address the design, equipment or installation of the fire suppression system and its detection and control devices. It is assumed that these have been designed and installed in accordance with the requirements of the relevant standards, and that these are fully operational and in conformance.

This test assumes that:

- Continual mixing will occur in the enclosure after a discharge.
- The extinguishing gas will be correctly delivered into the enclosure.

This test certificate should be read in conjunction with the report Ref 12-10-678 T9 and associated test method statement.

Signed:



Name: James Taggart

Date Issued: 30/01/2025

Recommended repeat room integrity test date:

January 2026