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It is important to note that due to the overall characteristics of FM-200 the sealing requirements for effective retention are much more stringent than those for any of the Inert agents. In general an enclosure protected with FM-200 needs to be sealed to reduce the leakage by at least half that allowed for the Inert Agents, this can and does have an impact on the structural sealing costs. If an enclosure has satisfied an Integrity Test utilising Halon as the medium it will definitely satisfy the requirements for any of the inert agents resulting in no additional structural costs. Unless the result with Halon is in excess of 12.5 minutes it will not satisfy the requirements for containing FM-200 resulting in the need for structural improvements inevitably leading to an increase in building costs.

Fire Stopping / Enclosure Sealing.

The Integrity of an enclosure is defined as the ability of the structure to adequately retain an extinguishing agent at a suitable level of concentration to suppress a fire condition. For any Gaseous Fire Suppression Installation to be effective, the design concentration must first be achieved, and then maintained at suitable levels within the risk, to achieve this the enclosure must be adequately sealed. This is verified by performing an enclosure integrity test upon completion of the installation, by carrying out the Integrity Test at the same time as the sealing works it is possible to obtain a positive result.

Design : Enclosure

It is the responsibility of the user and system suppliers to ensure that the enclosure and extinguishing system meet the design requirements. At contract stage it is essential that responsibility for each of the enclosure requirements is made clear to all concerned.

Design Factors

The term enclosure refers to the solid boundaries (walls, floor and ceiling) forming the room or compartment that contains the asset(s) to be protected by the extinguishing system. In a normal room the floor void and ceiling space are generally considered as part of the same enclosure, with the boundaries formed at the floor slabs and partitioning in the suspended floor and ceiling.

There are four critical design factors to consider for each protected enclosure:

- Enclosure strength (to withstand pressure during discharge)
- Enclosure fire resistance/Precautions (to withstand fire external to the enclosure);
- Enclosure pressure relief (to constrain the pressure differential across the enclosure structure to an acceptable level, by venting off excess enclosure gases during agent discharge);
- Enclosure integrity (to aid retention of the agent after agent discharge);

Enclosure Strength

Each enclosure will need to be assessed and protected against under and over pressurisation caused by the injection of agent into the space. In addition, the fire itself will exert pressure. The strength of an enclosure will be dependent on the materials of construction, the strength of fixings and attachments and the area they present to the load applied by the pressurised agent.

Enclosure Fire Resistance/Precautions

It has been shown that once a fire, which has commenced externally to the protected area, breaks into the protected enclosure the agent will have little or no impact on asset protection. It is important therefore to maintain a minimum fire resisting enclosure of 60 min.

Enclosure Pressure Relief Venting

There will always be a pressure pulse that will be experienced in an enclosure on discharge of all extinguishing systems. This should be taken into consideration when designing the enclosure, with pressure relief measures taken to prevent pressure-related damage to the enclosure.

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Enclosure Integrity

The primary purpose in defining the boundaries of an enclosure is to define the volume that is to hold the agent. Unexpected or excessive loss of agent from an enclosure will result in a reduced agent concentration and decreased period of protection.

The design and installation of a facility should include an examination of the enclosure to locate potential leaks. These may then be dealt with appropriately, usually by being effectively sealed. Codes [10, 11. 12] specify an enclosure integrity test to investigate the presence and magnitude of leaks. Enclosure integrity tests check that the enclosure can hold the agent for a minimum period of time.

Experience has shown that enclosure integrity will reduce over the normal lifetime of an enclosure unless it is properly maintained. For example, it will suffer if cable penetrations are disturbed or new openings are made to run additional cables. Since the design of extinguishing systems depends critically upon enclosure Integrity; it is essential that enclosure integrity is maintained for the lifetime of the enclosure. Regular checks and a 'permit to work' scheme will help maintain its integrity.

The Integrity Test is based upon a descending interface being formed; in this case the extinguishant is discharged into the enclosure and gradually escapes through leakage paths around the perimeter being replaced by the ingress of fresh air forming a descending interface. The retention period is the time it takes for this descending interface to reach the tallest item of equipment requiring protection. Obviously the greater the leakage area, the quicker the loss of agent, if this exceeds the allowable leakage rate, protection will not be fully effective for the tallest items of equipment over the recommended retention period.

If a ten-minute retention time cannot be obtained, the enclosure should be structurally sealed to reduce the leakage rate, restricting the loss of agent and enabling the retention time to be achieved. The enclosure should then be re-tested to confirm an acceptable level of Integrity has been achieved

Enclosure Evaluation: - General Sealing Requirements

If an enclosure is to satisfy the structural sealing requirements to retain an extinguishing agent the following sealing works need to be completed as an absolute minimum.

Slab walls abutting a fixed / solid ceiling are an essential requirement when considering the overall protection provided by a gaseous protection system and the prevention of fire / smoke ingress into an enclosure. It is assumed that all ceiling void sections are included within the scope of protection and are covered by the suppression agent, unprotected ceiling voids tend to result in an enclosure failing to satisfy the retention criteria and lack of protection in the ceiling void should be treated as false economy.

Due to the nature of an enclosure to reduce the detrimental affect of the overall leakage it is essential that ALL low level leakage areas are sealed before proceeding with any Integrity tests.

The perimeter walls of the protected enclosure should extend from the structural floor to the underside of the fixed ceiling. All joints should be taped and sealed and any services passing through the ceiling (vents / grills / conduits etc) should be adequately sealed to the underside of the ceiling. If any cable trays / trunking passes through the structure these should be sealed around the edges and internally.

Where an under floor space continues out of the Clean Agent protected area into adjoining rooms, airtight fire rated partitions should be installed under the floor directly under above-floor boundary partitions. The partitions should all be caulked top and bottom internally around the entire perimeter. If a removable floor tile extends under a doorway over such a partition, it shall either be: permanently sealed in place; installed with a flexible seal between it and the wall below; or the tile shall be discontinued at the doorway with a permanent airtight ledge created up to which the floor tiles abut.

All holes, cracks, or penetrations leading into or out of the protected area should be sealed. Pipe chases and cable trays should be sealed around both the outside and inside at a point where they pass through the envelope of the protected zone. All walls should be caulked around the inside perimeter of the room where the walls

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rest on the floor slab and where the walls intersect the ceiling slab or roof above. Porous block walls should be sealed slab-to-slab to prevent agent from passing through the blockwork. Multiple coats of paint may be required to provide an effective seal. We often identify leakage passing through block walls around pointing and especially through coarse walls..

All doors should be adequately sealed to the structure itself especially from within the enclosure, they should have adequate door sweeps or drop seals on the bottoms, weather stripping around the jambs, latching mechanisms and door closer hardware. In addition, double doors should have a weather-stripped astral to prevent leakage between doors and a coordinator to assure proper sequence of closure.

The use of foam fillers and the like should be avoided where possible, they often have no acceptable fire rating, provide a poor seal and look extremely messy.

Windows should have solid weather-stripping around all joints. Glass to frame and frame to wall joins should all be sealed. 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 at the point where they breach the envelope of the protected zone. All materials used should be fire rated and approved to BS 476 standards.

Dampers & Ducts

Means of prompt ventilation of a protected enclosure after discharge are recommended so that the decomposition products, combustion products and the agent can be safely removed to atmosphere. The principle objective of this being to afford safety margins to operatives when entering the enclosure and a safe un-contaminated environment for equipment located within.

Extract units should be fitted with approved fire dampers which close in the event of a fire condition / discharge to maintain the enclosure integrity.

If any fresh air supply duct or extract duct is utilised or installed then this would need to be fitted with a fire damper, installed at the enclosure boundary and linked to the control panel. This should be configured so that all dampers close prior to a discharge to prevent the ingress of air and any loss of extinguishant. Note: this applies to any duct that is utilised to feed air to and from an enclosure.

It is essential that the method of operation of any ancillary devices / dampers linked to the suppression system are checked on a regular basis as part of the routine maintenance. This is to ensure that they operate as intended and continue to provide a good effective seal against air ingress and agent loss.

Pressure Relief/Venting Requirements

High pressures occur in the event of a discharge and these need to be fully controlled or compensated for if the extinguishing ability is not to be impaired. It is important that consideration be given to provide pressure relief in areas where structural damage may occur if there is not sufficient venting to allow the dispersal of localised spike pressures in the event of a discharge.

As the natural leakage area from an enclosure may vary it is recommended that this is not utilised as the pressure relief facility as it will not remain constant. It is therefore recommended that the enclosure is structurally sealed to a very high degree and that the pressure relief is then catered for by installing PRD (Pressure Relief Damper) units with an equivalent surface area.

Any leakage areas into adjacent protected enclosures should be sealed with a permanent fire rated seal. Failure to seal leakage paths into adjacent areas protected by automatic fire suppression systems could lead to a cascade discharge situation, resulting in the activation of adjacent systems simultaneously.
Good cable management is an essential element in retaining an acceptable level of Integrity within an enclosure. Failure to do so could result in a drop in the performance of the extinguishing systems should they ever be required.

Note: This is particularly important when it comes to the installation of any new equipment. This will involve the running of cables and will mean that the cable routes, which have been

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presently sealed off, will be opened up. It is important that all of these are sealed once the cables are in place. If there is any doubt or the modifications are excessive then the enclosure should be re-tested to ensure that the level of Integrity is still within the required Tolerances.

Access.

In order to resolve these leakage paths it may be necessary to move some of the equipment. Please note for insurance purposes we are not allowed to move or relocate any equipment and it may be necessary to have personnel available to move some equipment racks as the sealing works progress. This would only be a temporary arrangement whilst the sealing works are conducted.

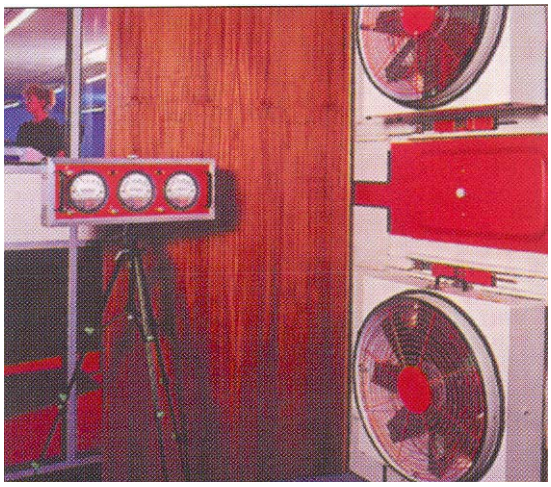
Structural Sealing

In both cases the ceiling void and floor void will need to be sealed around the entire perimeter as detailed above, this is important to obtain Compartmentation to aid agent retention and to prevent fire ingress. The sealing works are also required for the prevention of smoke / air / contaminated particle ingress into the enclosure resulting in the possibility of a false discharge.

It is important to note sealing works may also be required on external wall sections especially if there is a gap between cladding / external linings between floor levels, around window frames and through heating / ventilation systems. Note the comments on porous block walls.
It is strongly recommended that all sealing works are conducted from within an enclosure.

Air Conditioning

With regard to the air conditioning requirements, please refer to the sections detailed above for general information. If any ducted air supply / extract system crosses the boundary of a protected enclosure this should be fitted with a shut off damper. If an A/C unit has a fresh air makeup supply this would need to be dampered or connected to the fire system control panel to ensure that it is closed prior to a discharge occurring. Cassette type units tend to be of a re-circulating mode of operation, the cooling being affected via pipework to external units, these do not need to be dampered as long as all services are adequately sealed where they pass through the walls.



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