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Integrity Testing / Discharge Testing of Suppression systems

Fire suppression systems extinguish fires and prevent re-ignition by flooding the enclosure rapidly with an agent that prevents combustion thus extinguishing any source of a fire condition.

The extinguishing features can be engineered into a system however the enclosures ability to retain the suppressing agent is governed by the ability of the enclosure in which it is utilized to contain the extinguishing agent; this is defined as the enclosures "integrity" or its rate of leakage. This does fluctuate and will need to be kept regularly in check, this is one of the reasons why regular testing is required, usually this is once a year (Integrity Test) however if any known modifications are taking place and if these could affect the structural integrity then it is advisable (time permitting) to conduct a leakage check once modifications are complete.

If an enclosure has a high rate of leakage the extinguishing agent is able to leak out reducing the concentration and the ability to suppress a fire condition.

Any form of leakage is detrimental to an enclosure, it reduces the efficiency of the air conditioning equipment, it can increase running costs, and it permits the ingress of contaminants such as dust into the sensitive environment. In the worst-case scenario it can allow the ingress of smoke / fire into the compartment.

The Integrity Test helps overcome this particular problem by making it practical to identify if an enclosure is leaking, and if it is, possible sources.

This is conducted annually as part of the maintenance to ensure that the enclosure has retained an acceptable level of Integrity (on the basis that this has been obtained at the time of installation / commissioning). In most cases it is conducted after an outage or similar period when the enclosure housing may have been dismantled in whole or in part and subsequently re-assembled and the test is utilized to confirm that the housing is still adequately sealed. It should be noted that all areas protected by suppression systems should be checked as an annual requirement as this is always the one element likely to fluctuate.

In order to simulate the occurrences obtained during a discharge as accurately as possible there are certain parameters that need to be known as these can, and will affect the retention time, the test procedure and ultimately the suppressions systems capability at extinguishing a fire condition both at the initial stages and in the long term preventing re-ignition.

Please be aware that adverse weather conditions and the failure to operate correctly of dampers can affect the occurrences in a discharge condition and these will affect the results. The other important point to note is that when a damper is operated, is, it is only effective if it shuts correctly, therefore the method of damper operation needs effective verification as well as correct closure, this ideally should be checked regularly.

The other common causes of reduced system performance are the effectiveness of door seals and closure of the doors them selves. Door seals often deteriorate with constant use and these need to be checked on a regular basis

In order to provide an effective extinguishing concentration the design is based on a flooding factor to suit the risk in accordance with the standards available.

In order to conduct a test as accurately as possible we need to be aware of

1 Gross Volume of the enclosure (m^3) (each unit being tested) as incorporated in the system design

2 Net Volume (m^3) (each unit being tested) as incorporated in the system design

These are utilised to determine the actual extinguishant concentrations, which are often designed around the Gross Volume and therefore should easily satisfy the requirements of the net volume.

3 Normal operating temperature

4 Required design concentration of the Extinguishant during the initial discharge, this is the design concentration required to extinguish any initial fire source and is generally governed by any appropriate material conversion factors (obtained from the standards) and temperature (altitude sometimes plays a part in this but only if it is excessive).

Usually only on **Carbon Dioxide** Installations

The Initial shot usually consists of a fewer number of cylinders (in a central bank system) or a designated quantity of Carbon Dioxide controlled via a timed discharge (in a low-pressure system) discharged through larger bore pipework. This should be generally designed to give the desired (initial) concentration throughout the risk area in at most 2 minutes generally within 60 seconds.

Ideally as part of our procedure we need to know how many cylinders or how much extinguishant is utilised in this initial discharge, the total weight of Extinguishant this incorporates and the time which it takes for this to discharge (as designed)

If an extended discharge is incorporated

5 The required design concentration for the extended discharge.

This extended discharge usually consists of a larger number of cylinders or a set quantity of CO_2 discharged through smaller bore pipework over a time duration and is generally utilised to compensate for any leaks or unclosable openings. Generally this tops up the CO_2 on a continuous basis usually for the full duration of the required retention period (normally a minimum of 20 minutes). This is used to compensate for anticipated equipment run down periods and to a degree leakage / losses of CO_2.

For this we ideally need to know the number of cylinders or quantity of CO_2 utilised along with the weight incorporated, the length of time this extended discharge will continue for, this will allow us to establish the kg/min required for the discharge. Along with the required / design concentration that is expected after the 20 or so minute period.

6 The enclosure height from the base to the top perimeter boundary (ceiling / roof).

The general standards for Carbon Dioxide systems cover two distinctive aspects; there is what is known as a surface fire risk and a deep seated fire risk and this will govern the way in which the CO_2 should be applied, the concentration (this will also be influenced by the materials present) and the overall retention time.

CO_2 is a very adaptable extinguishant and is often used when there are un-closable openings present as it can be designed in such a manner to compensate for this. The other main advantage of Carbon Dioxide is that when prolonged protection is required it can easily be designed to cater for this and can also be adjusted to cater for higher temperatures.
This is one of the main reasons why it is utilised to protect Turbines which not only have a high value (cost wise) also have specific run down periods and generally operate at higher than average temperatures.

Carbon Dioxide is an asphyxiate and as a result must be treated with caution, the enclosures into which this agent is to be discharged should be well sealed to enhance the suppression systems extinguishing ability, not only will this enhance the systems extinguishing facility it will also provide better protection against the ingress of fire / smoke.

Hence an adequately sealed enclosure greatly enhances its fire protection capabilities and will improve site safety with regard to personnel being affected by CO_2; this can also have an impact on the safety of personnel working in close proximity to the hazard.

Sealing for effective containment

It is very important to note that when an enclosure has to be sealed, the use of the correct sealing materials is essential. Materials must be used which are not only suitable to the original construction but also which have an appropriate fire rating. The correct operation of dampers is also essential and it is important that all services operate correctly (door closers, door seals etc). Failure for these to operate will result in an increase in the leakage area and this will result in a decreased retention time.

It is advisable that the integrity of every enclosure that is protected by a suppression system be regularly checked, Turbines tend to vary more radically but even a standard enclosure can vary.