CHEMETRON Fire Systems™

CARDOX

CO_2

Application Bulletin

CARBON DIOXIDE FIRE SUPPRESSION –

Automated Information Storage Systems for Computer Operations

Intro duction

The introduction of computer tape storage in cartridges and the automated handling of same has substantially changed the method of storing data off line and the time required to access it. Such systems include the StorageTek L5500, PowderHorn® 9310 and 4410 Tape Libraries manufactured by Storage Technology Corporation, illustrated in the accompanying drawing. Other systems such as the Memorex Telex 5400 Automatic Tape Library perform similar functions.

The key to the ready customer acceptance of such systems is the tremendous amount of data that can be stored for quick access at low cost. The StorageTek L5500, for example, can store up to 5500 cartridges in each library storage module (LSM). With 100 GB (native) of data on each cartridge, each LSM can store 550 TB of vital information. Several LSMs can be coupled together for larger operations.

It is suggested that the non-computer professional, who is interested in fire protection planning for such a system, familiarize him/herself with the system by obtaining copies of the manufacturer's brochures, which are very well done.

With the very large amount of data located in one concentrated enclosure, the potential for substantial monetary loss in case of a fire is very high, even though the likelihood of fire is very small. Some units require as much as 19 KVA of power (Memorex Telex Large Unit) and are not built for easy access in the event of a fire. Manual fire fighting would be difficult. Therefore, the manufacturers have recommended internal fire protection systems.

It is preferable to locate the tape storage units, which represent a significant fire loading, outside of the computer room. The units are designed to allow for remote storage and can even operate in the dark.

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However, since cable access is through a raised floor and some units (e.g., L5500) require installation in a computer type environment (controlled temperature and humidity), locating this equipment in the computer room is common.

Fire Protection Choices

Because it was common practice to protect computer rooms with Halon 1301 total flooding systems, together with the usual proximity of computer and ACS equipment, and the similarity of the internal fire hazard, it was only natural that Halon 1301 internal flooding systems be chosen when this equipment was first offered.

That was before the Montreal Protocol and subsequent events. Protection now requires the use of halon alternatives. As of this writing (1994) CO_2 or FM-200 are logical alternatives to consider. The CO_2 approach is more cost effective.

Storage Technology Corporation has indicated that, as far as the equipment is concerned, use of carbon dioxide (CO_2) for fire protection should present no problems.

Since the units contain some semi-enclosed equipment and many nooks and crannies, the use of a 3-dimensional agent has a big advantage over water, which is 2-dimensional.

Reducing the risk of releasing water in a computer environment is another reason for using a gaseous extinguishant.

However, if the area in which this equipment is installed is sprinklered, sound fire protection practice would be to extend coverage inside the storage modules to back up any gaseous agent protection. Remember that a gaseous agent's primary function is to protect continuity of operation of the facility, while sprinklers are to protect the equipment and facility from a catastrophic loss. Therefore, they are not mutually exclusive of one another.

CO_2 As A Fire Extinguishant

The type of combustible protected in this application is solid surface burning, which tests have shown does not become deep-seated burning. In true deep-seated burning, the fire burrows into the combustible, covering itself with the ash of the burned material. For such a fire to be extinguished with a gaseous agent, the agent has to penetrate the burning material mass to reduce the oxygen level at the combustion to a point where the generation of new heat from ongoing burning is less than the heat loss from the burning mass to surrounding materials. At this point cooling occurs, with eventual extinguishment. If the open burning (flaming) is just suppressed, not totally extinguished, then some form of overhaul must be a part of the fire system planning. Most systems are best designed to allow for extinguishment by the system. However, tests have shown that the higher the extinguishing concentration, the faster solid burning materials, deep-seated or not, will be extinguished. While it is impractical to design FM-200 protection with higher concentrations than those needed for flame extinguishment, it is not so with CO_2. Higher CO_2 concentration levels will accelerate extinguishment.

This is not new technology. For years many other CO_2 applications used higher CO_2 levels (thus reducing O_2 levels) to effect quicker extinguishment. For example, the standard CO_2 design method for internal protection of metal clad switchgear calls for a 3 minute discharge with high CO_2 levels. The combustibles in these cabinets are cables, arc guides, molded plastics, etc., not dissimilar to the combustibles we are discussing here.

CO_2 Calculation Method Recommended For The Library Storage Modules

For a typical unit, we have a gross volume of approximately 688 cubic feet for the LSM. There are some ventilation openings on the side, small cable openings in floor, and openings to adjacent LSM's if two or more are coupled together.

Based on tests and considerable experience designing CO_2 extinguishing systems, we have determined the CO_2 discharge required to flood the module to a satisfactory level for suppressing surface fires involving solid materials when this level is held for 3 minutes or more.

The 3 minute discharge approach is consistent with the IRI Interpretive Guide P-6.2 Para. 2-3.5.5.

Reasons For An Extended Discharge

If it is necessary to maintain an extinguishing concentration for some time, i.e. if the power cannot be cut off, and the enclosure being flooded cannot be sealed well enough to hold the initial discharge, the answer is an extended discharge. This normally involves two separate gas supplies (initial and extended) and separate discharge piping and nozzles, an extra expense. But is an extended gas concentration holding time necessary?

The reasons for needing an extended holding time are:

- A continuing source of ignition. Often, if a fire is of an electrical nature, malfunctioning electrical protective devices are involved. If they do not clear an electrical fault, protection must be continued until some other method of power disconnect is used. During this time total extinguishment is not possible and the gaseous agent serves as a fire stop to prevent fire from spreading from the source of the electrical fault to other equipment.

- There is a tight bundling of cables or similar material, requiring some time for the agent to penetrate the bundle; or time is needed for the fire supporting oxygen in the air spaces between the cable components to be consumed by the fire.

- There is a desire to ensure a full level of protection until operating personnel have time to respond to the system actuation.

Our analysis of the equipment protected here is that deep-seated fires are unlikely. Power cut-off can be accomplished through the fire system control panel and/or a pressure operated switch. And there is little bundling of combustibles to be concerned about.

Therefore, our approach here is to extend the initial discharge for a time period longer than normal, rather than use a separate extended discharge. Therefore, rather than discharging CO_2 for 1 minute, it is continued for 3 minutes.

All that this arrangement necessitates is adding CO_2 in storage, while eliminating the need for additional equipment and added piping.

For those wanting an extended discharge this can, of course, be provided and Chemetron would provide such in an appropriate design.

Safety Considerations

The big concern with CO_2 is that the non-toxic but inert gas will reduce the oxygen level in occupied spaces to the point where it would be hazardous to personnel.

The safety aspects of the protection must be fully considered. NFPA Standard No. 12 "Carbon Dioxide Extinguishing Systems" is an excellent reference source for this.

In this case, we consider that the worst case condition is that the CO_2 discharged inside the module will totally leak from same, be picked up by the room air conditioning and then circulated and mixed in the air that serves the room in which the module is installed.

There is really no difference here than if the space under the raised floor were to be protected by CO_2, which has been done for many years. (For this application refer to Chemetron Bulletin #0600, Protection of Spaces Beneath Raised Floors.)

The NFPA Electric Generating Stations Committee voted to accept CO_2 for underfloor protection in control rooms when calculations showed that CO_2 discharged underfloor could not contaminate the control room due to the relative volumes involved.

A CO_2 safety level calculation is as follows (per Figure A-2-1(B) of NFPA Standard No. 12):

19% O_2 is 9% CO_2, obtained by a flooding factor of .012 lb. per cu.ft.

Therefore, 100 lbs. of CO_2 could develop a 5% CO_2 level if totally and completely mixed in a room and module totaling 8,333 cubic feet (32.3' x 32.3' x 8').

An O_2 monitor could be provided to monitor room conditions.

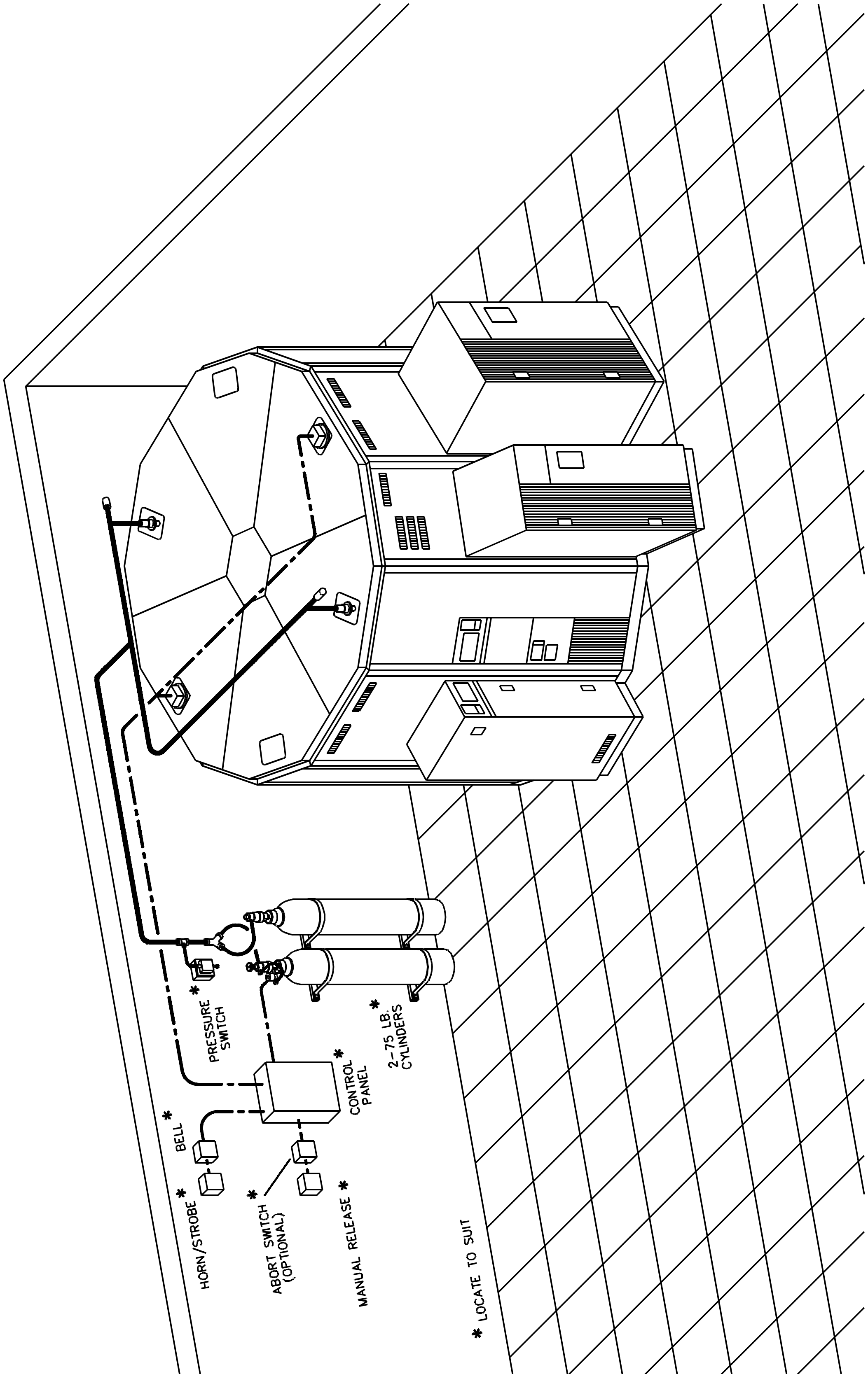
It is recommended that the CO_2 discharge be odorized. It is also recommended that the system be arranged to prevent automatic discharge without warning when someone is inside a module.

System Arrangement

A CO_2 flooding system is illustrated on the accompanying drawing.

The recommended practice of protecting each module with a separate system would be unaffected. However, a group of interconnected modules could be protected as a common hazard to save costs of duplicate controls. (We would calculate the safe CO_2 level accordingly.)

Chemetron Fire Systems will be pleased to discuss details of controls, provide a description on how a CO_2 discharge can be odorized with a wintergreen smell, help make the CO_2 calculations required above, or assist in evaluating this type protection.



High Pressure CO_2 Fire Protection for an Automated Information Storage System