CHEMETRON Fire Systems™

CARDOX

CO_2

Application Bulletin

CARBON DIOXIDE FIRE SUPPRESSION —

Under the Sidewalk Transformer Vaults

Sample excerpts of typical newspaper reports:

April, 1985: "About 230 workers were evacuated from their offices ...after a transformer caught fire, possibly because of an electrical overload caused by air conditioners."

July, 1986: "An explosion and fire in an underground electrical vault ...injured 121 people, forced evacuation of at least one high rise office building and spread power outages and confusion over a wide area."

June, 1987: "When a transformer at a downtown...athletic club exploded and erupted in fire last week, the major concern was PCB's."

The power requirements of the modern high rise building are significant, necessitating the provision of underground vaults to house equipment connecting local utility lines to the building. These contain transformers that convert incoming power from, say, a 12 KV feeder to 120 volts for local use. Cables and other electrical equipment are also present. Many of these transformers were insulated by polychlorinated biphenyls (PCB's). While these should have been replaced, when fighting fires on this equipment, it is prudent to consider the materials involved as hazardous. New insulating materials can help reduce the fire risk as compared to oil filled units. But while the fire hazard may be reduced, fires still occur. No matter what is used, or to be used, the need for fire protection has been ably demonstrated.

In some cases vaults have been provided with fixed fire protection, but this has been rare because there are so many. Another approach is the provision of specialized fire fighting equipment to be placed in service in central business districts where high rise buildings are common.

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A World of Protection

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During analysis of the proper fire extinguishant to be used in these special units, the following factors were considered:

- The agent should be three-dimensional as it may not be possible to direct the fire extinguishant directly at the fire.
- It should not need drainage.
- Since the fault causing the fire is almost always related to the failure of circuit protective devices from disconnecting power, the extinguishant should be a nonconductor; one that will not break down under the continuous electrical arcing.

Carbon dioxide meets all the above criteria.

A solution to the protection need identified above was to establish a mobile supply of low pressure liquid CO_2 that could be quickly moved to the building involved in fire. Low pressure storage, because of its lower weight and size requirement, was the obvious choice.

Two different methods of applying the CO_2 discharge to the fire have been used.

In one case, each vault was piped with nozzles placed to cover the protected equipment. The pipe and nozzles were sized to give the appropriate discharge rate and distribution of the CO_2. High temperature pipe and nozzles were used to stand up to the fire during the time needed to start a discharge. Piping is extended to street access.

The mobile supply, which can be either trailer or truck mounted, has hose that can be quickly coupled to the piping connection for the vault. Valves allow the fire fighters to control the CO_2 discharge.

In another case, as illustrated here, a truck mounted unit was used. It was equipped with hydraulically operated boom equipment to remove the cover from the vault, and then to place over the opening a special steel plate to which can be affixed a projection type CO_2 nozzle. This is the type nozzle, with its high discharge rate and projection ability, that proved so effective in aircraft crash fire/rescue operations performed by the military during World War II and the Korean War. A squeeze valve on the hose line playpipe affords flow control. Of course, the playpipe with the projection nozzle can be used in many ways for local application or indirect total flooding wherever appropriate.

Since the described low pressure CO_2 units travel on the public streets, the pressure vessels, while still meeting all other applicable codes, are built to the requirements of the Department of Transportation (DOT).

It should be noted that for confined fires in an inaccessible space anywhere — the type on which you might use high expansion foam, this CO_2 unit could provide more rapid suppression since it can deliver very rapid application of agent. The CO_2 does not build up from the bottom of the space, but rather mixes and immediately starts to reduce the fire supporting oxygen. Thus, it will be effective quickly in confined spaces that do not exceed a size for which the unit is effective (estimated to be 1 pound of CO_2 for each 25 cubic feet). Mobile CO_2 supplies are covered by Chapter 5 of NFPA Standard No. 12, Carbon Dioxide Extinguishing Systems.

Another use of this type equipment was discussed in the NFPA Fire Journal in an article that described the extinguishment of a stubborn fire in a cargo hold of a docked ship. The fire department used a CO_2 liquid transport unit and a $LPCO_2$ hand hose line. Fortunately, a transport unit was available (they are normally always tied up making deliveries.) This was a slow burning — albeit active — fire, allowing time to arrange for this use.

Other Indirect Total Flooding Applications for $LPCO_2$ Hand Hose Lines

As previously pointed out, the relatively high discharge flow of the $LPCO_2$ hand hose lines can make these units valuable fire fighting tools for confined spaces of all kinds.

Tests have shown that a CO_2 concentration of 25% will extinguish open burning; this is an oxygen concentration of about 15.5%. Considering that a fire in a confined space is already consuming oxygen, adding CO_2 can often quickly suppress the active open burning and significantly help fire fighting efforts.

For example: If an $LPCO_2$ hose line (1") is discharging at a rate of 300 lbs/minute, then that discharge will reduce the oxygen from 21% to 15.5% in a space of 18,000 cubic feet in 2 minutes time if it is reasonably enclosed. This would be a space about 50' x 45' x 8'.

Of course, distribution of the gas is all important. Fortunately, the $LPCO_2$ hand hose line projection nozzle has an extended projection range — up to 50' — and, therefore, would be expected to effect flooding rather quickly in appropriately sized enclosures with no significant openings. Openings could delay suppression, and large openings could prevent same. Therefore, we only recommend you consider this use in confined spaces by discharging into same from outside.

As the CO_2 discharge continues, it keeps adding inert gas to the volume, further reducing the fire supporting oxygen level to help control deep-seated burning.

For a big complex with a number of critical electrical switchgear rooms or unmanned control rooms, providing a fixed total flooding gas system for each might not be affordable. An alternative is to provide each with a good fire detection system — smoke/flame/ heat or a combination — and then plan to extinguish the fire with $LPCO_2$ hand hose lines from a fixed or mobile supply.

Swinging cover plates in the room doors are often used to give access for the nozzle to discharge inside. When a fire is detected, the line is charged, the swing plate pushed aside, and the nozzle shoved into the opening. Instructions indicate the discharge time recommended for flooding each space. These systems can be tested for performance in the same way any total flooding CO_2 system is tested.

Often, more than one hand hose line are made available to provide the required CO_2 if the protected space is large.

In-Plant Mobile Units

We previously discussed $LPCO_2$ units designed for transport on the streets and highways and for use by the fire service. Units designed for in-plant use by plant fire brigades have also been widely used. The CO_2 unit design is similar, but the vehicle would be an in-plant type.

Safety Concerns: The use of large capacity (high flow) $LPCO_2$ hand hose lines in large open spaces (power plant bays, mill floors, etc.) does not normally give any cause for concern that CO_2 will build up enough to affect the operator. It is expected that the products of combustion from the material burning will create more potential hazard for the operator than will the CO_2 being applied. However, it is always an excellent idea to have air breathing apparatus available in the vicinity of hosereel locations to be used in case of a fire. When CO_2 starts to build up from hose line operation in a large open area, it must build up essentially from the floor; you can feel the cool on your legs. When inhaled in very small amounts, CO_2 acts as a stimulant to breathing. This is an involuntary reaction and very apparent to the operator.

Use of CO_2 hand hose lines in a confined space without air breathing appartus is very dangerous and should be avoided.

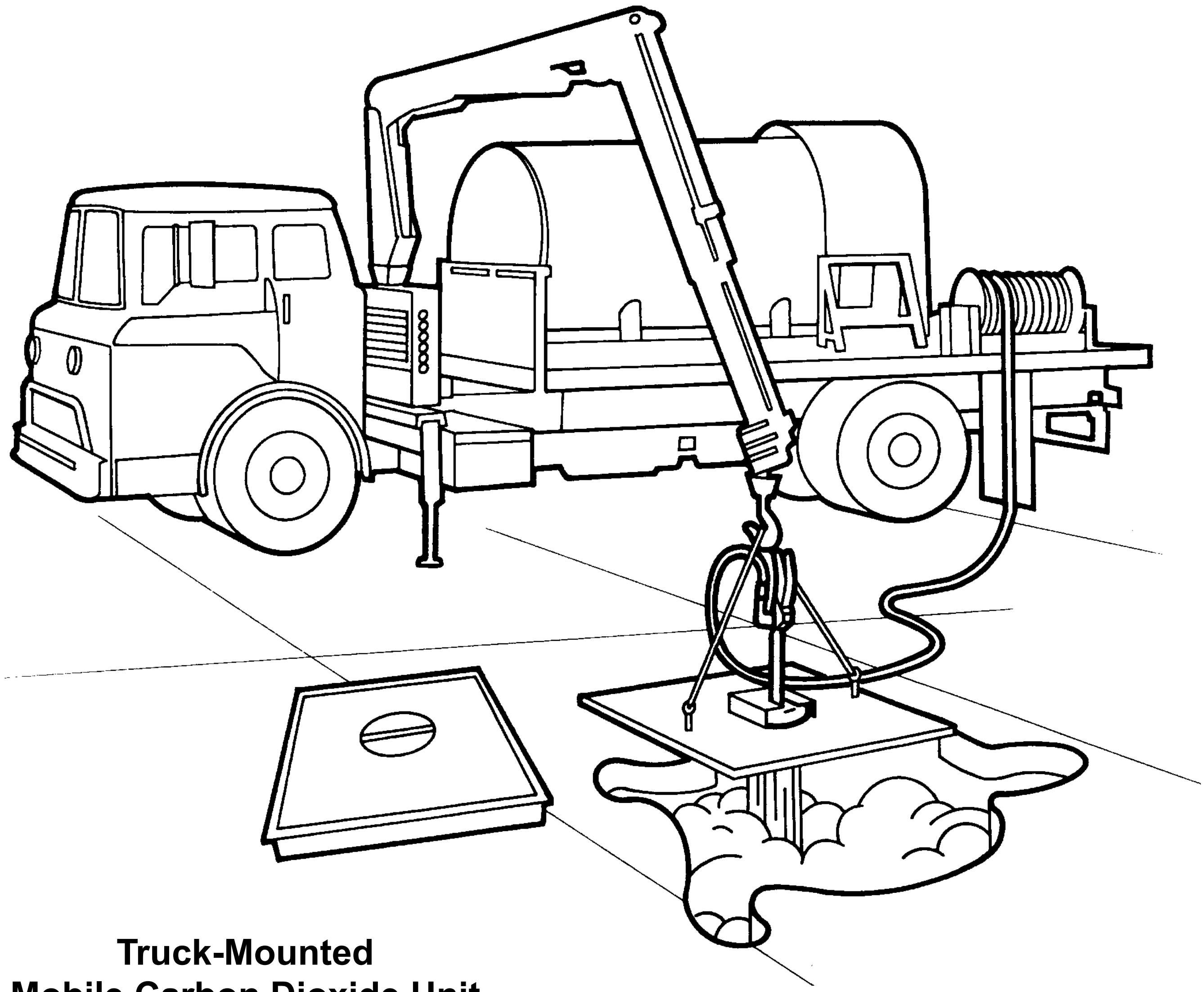
IMPORTANT

IF HOSE LINES ARE LOCATED SO THAT THEY CAN BE USED EVEN IN LARGE AREAS WHERE FIXED PROTECTION IS ALSO PRESENT, YOU MUST ENSURE THAT THE FIXED PROTECTION DOES NOT OPERATE WHEN HOSE LINES ARE BEING USED. A FIXED PROTECTION SYSTEM DISCHARGE COULD ENVELOP THE HOSE LINE OPERATOR; AND IF NOT EQUIPPED WITH AIR-BREATHING APPARATUS, THE OPERATOR COULD BE OVERCOME. IT SHOULD BE NOTED THAT IF HE IS FIGHTING A FIRE, HIS ATTENTION WILL BE DIRECTED AWAY FROM ANY WARNING SYSTEM THAT MAY BE PRESENT AS PART OF THE FIXED SYSTEM.

Hand hose lines are generally intended for protection where there is no automatic fixed protection.

NFPA Standard No. 12 should be consulted for a discussion of safe uses of CO_2.

For more detailed information regarding CO_2 hand hose line fire protection, see Industrial Facilities Bulletin #0760, High Capacity Portable Protection with CO_2 Hand Hose Lines.



**Truck-Mounted
Mobile Carbon Dioxide Unit**