AFE
ANGUS FIRE ENGINEERING

CARBON DIOXIDE CO_2

Industrial fire suppression systems

Kidde engineers developed carbon dioxide fire extinguishing over 60 years ago and Kidde have been responsible for every major improvement that has been made in this branch of fire protection. Kidde benefits from the accumulated experience of thousands of installations in power plants, industrial plants, oil refineries, electronic processes, on ships and in a wide variety of hazardous areas.

CO_2 is versatile

The co_2 is stored as liquid, under pressure. When a system is activated, the liquid co_2 flows through discharge pipework to specially designed nozzles. The agent's low boiling point means that the liquid vaporises rapidly during the discharge, providing a penetrative three-dimensional action. The rapid expansion of the gaseous agent allows fires to be targeted even in the most inaccessible areas of the risk.

Fire is extinguished by reducing the oxygen level in the risk area to the point where combustion cannot be sustained. Cooling is a secondary action of the agent; this feature is used in local applications where the liquid phase of the discharge is applied directly to the fire and risk materials.

CO_2 is fast and efficient

The Kidde High Pressure co_2 system uses a large bore discharge valve, enabling high mass flow rates to be achieved. The fast action of the control system and valve enables the system to react within the first few seconds of a fire that can make the difference between a nuisance and a disaster.

CO_2 is clean

Co_2 is a colourless, odourless, dry, inert gas and is one of the most familiar of all chemicals. After extinguishing a fire it vapourises fully leaving no residue. There is no mess, nothing to clear up, no water damage. It is non-corrosive and will not contaminate foodstuffs. It is non-conductive and so can be used on energised electrical equipment. It is safely used to protect delicate electrical equipment, antiquities or archive materials.

CO_2 is low cost

Carbon dioxide is a standard commercial product with many other uses and it is readily available throughout the world. Because of its universal use it can be obtained cheaply and this is an important consideration when frequent recharging of storage containers is

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Control head with pilot cylinder

Solenoid for control head

Klem valve with metron actuator

Klem valve with solenoid actuation

Discharge nozzles

Manual pull box

Pressure Switch

Pressure Trip

Cylinder contents monitoring option

necessary as in local application systems, where fires may be more frequent.

Benefits

- High flow 'Klem' valve
- Manual or Automatic operation
- Pilot cylinder or Direct Acting Solenoid options
- Continuous weight monitoring option
- Design compliance with BS5306-4
- Fully compatible with Kidde Extinguishing Control Panels

Typical applications

- Flammable liquid storage areas
- Printing presses, flow solder machines
- Quench tanks/exhaust fume ducts
- Paint spray booths
- Fryers/ovens
- EDP/computer rooms and floor voids*
- Commercial kitchens
- Industrial fryers/ovens
- Transformers
- Generators

* co_2 is not the agent of choice for manned areas, please contact AFE applications for more information.

System design

Both total flooding and local application systems can be supplied.

Flexible design

The wide range of components manufactured by Kidde enables systems to be engineered to suit individual customer requirements. Systems can be either automatically or manually operated and arranged to protect single or multi-zone hazards and with any number of reserve discharges. Automatic control can be achieved mechanically, pneumatically or electronically or by any combination of these to suit site conditions.

Facilities are available for providing a pre-alarm and delayed discharge as well as various methods of preventing automatic release while protected rooms are occupied by personnel.

Audible and visual indications of system control can be provided together with facilities to automatically shut fuel valves, fire doors, dampers and shutters by either mechanical or electrical devices.

co_2 is stored in solid drawn steel cylinders manufactured to British Standards. The storage pressure varies with ambient temperature but is 58.6 bar at 21°C.

Any number of cylinders can be manifolded together and simultaneously released to provide the total design requirement of co_2.

Approvals

Major approvals for the Kidde co_2 system include:

- Factory Mutual (FM)
- Lloyds
- American Bureau of Shipping
- Det Norske Veritas
- Maritime and Coastguard Agency (UK DETR)
- Germanischer Lloyd

Extinguishing Control Panel

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Total Flooding Systems

Total flooding systems extinguish fires by rapidly discharging co_2 into an enclosed volume to create an atmosphere that is incapable of supporting combustion.

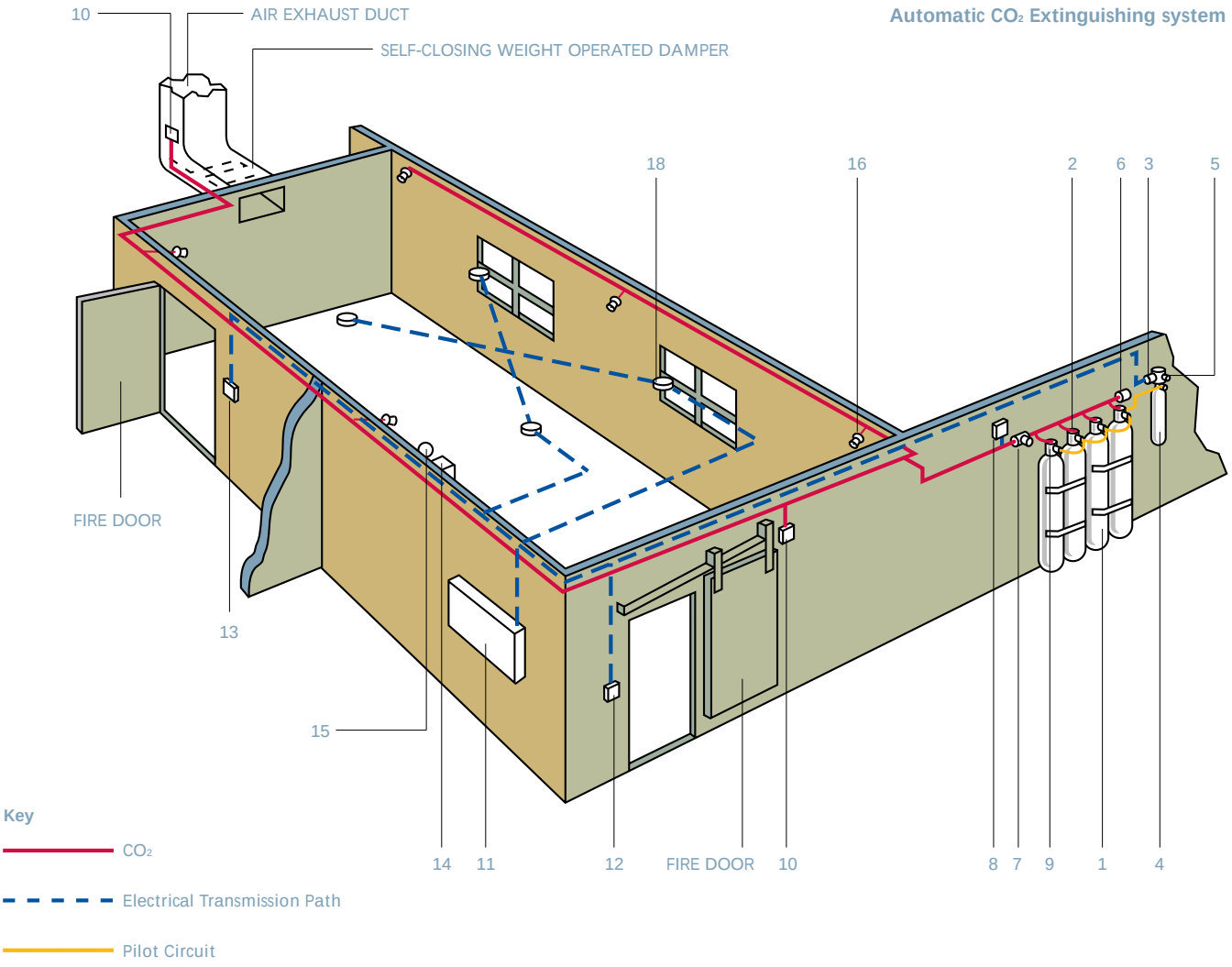
The agent mixes homogeneously within the risk area to generate a co_2 concentration by volume of at least 34%. This concentration of co_2 presents a serious hazard to personnel and under no circumstances should co_2 be released into areas that may be manned at the time of discharge.

Total flood co_2 systems are ideal for unmanned applications such as transformer rooms, remote switch rooms, generators and archives. All systems should be installed with safety systems in place to prevent the inadvertent release of agent into occupied spaces. Kidde offer time delays, isolating valves including distribution valves and control head lockout pins to facilitate the safe use of co_2.

Legend

1 co_2 cylinder assembly
2 Cylinder valve and actuator
3 Solenoid
4 Nitrogen pilot cylinder and control head
5 Manual push button
6 Pressure relief device
7 Isolating ball valve
8 Discharge pressure switch
9 Pilot bleed
10 Pressure trip
11 Extinguishing control panel
12 Status indicator unit
13 Status indicator with release control
14 1st stage alarm sounder
15 2nd stage alarm sounder
16 Discharge nozzle
17 Fire door
18 Smoke detector

Automatic CO_2 Extinguishing system



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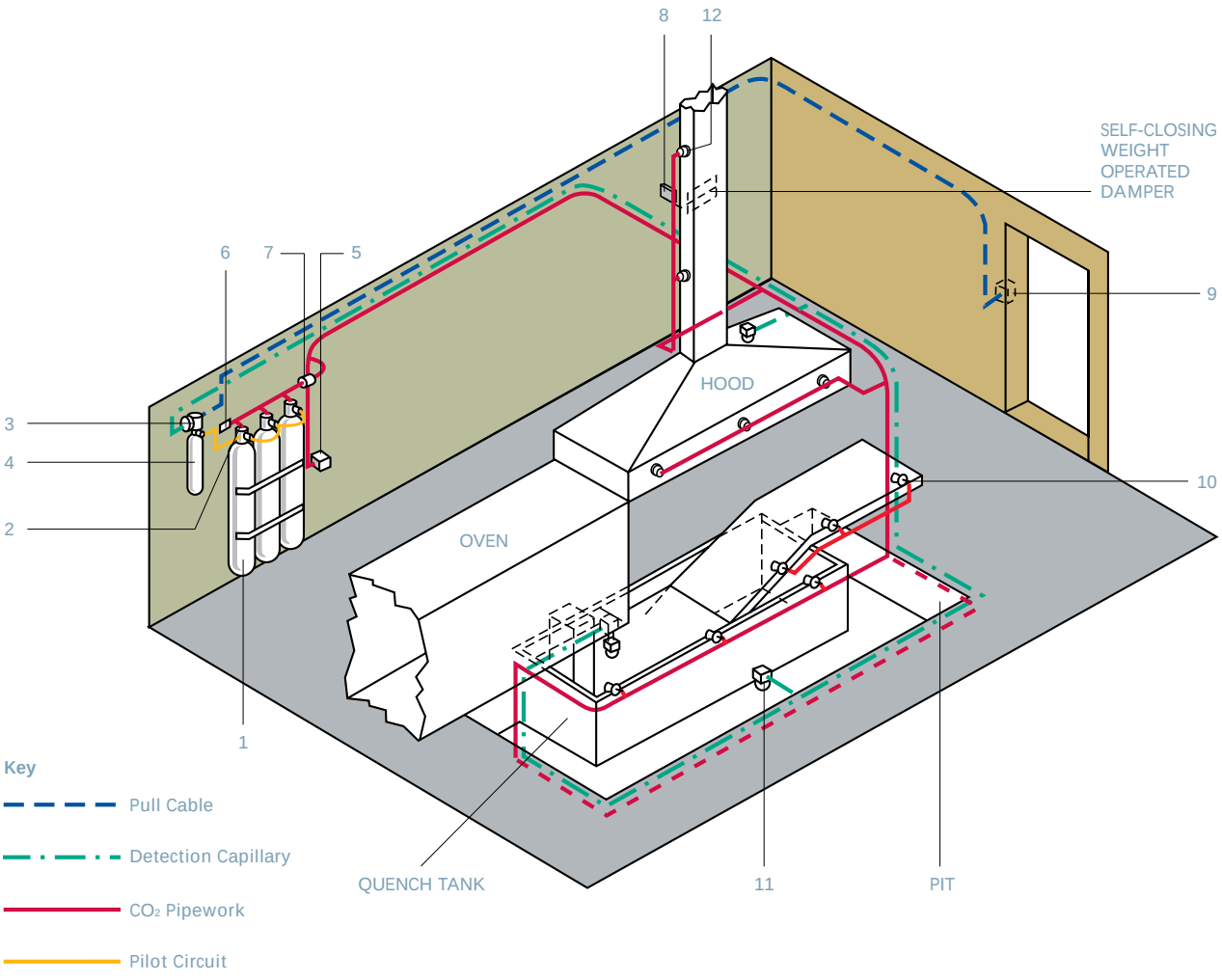
Local Application

This method of system design is used to protect hazards that are open or have only partial enclosure, situated within a larger area that would be unsafe or uneconomic to protect using a total flood system. Discharge nozzles are placed so as to provide direct agent flow at the points and areas prone to fire. The direct contact of the rapidly expanding co_2 provides efficient cooling and the gas dramatically reduces the oxygen concentration in the hazard zone.

Local application systems are designed to provide extremely fast discharges to 'knock-down' the fire in a matter of seconds. These systems are very effective and are often installed with connected reserve banks so that the system can be reinstated during the same shift as a fire event, while the empty cylinders are recharged.

Legend
1 co_2 cylinder assembly
2 Cylinder valve and actuator
3 Pneumatic actuator
4 Nitrogen pilot cylinder and control head
5 Discharge pressure switch
6 Pressure relief device
7 Isolating ball valve
8 Pressure trip
9 Break glass pull box
10 Discharge nozzle, multi-jet horn
11 Pneumatic, rate of rise detector
12 Flanged, multi-jet nozzle

Mechanical Automatic, Local Application CO_2 Extinguishing system



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System Information
Total Flooding Systems

Surface Fires
Fires involving flammable liquids, gases or solid materials not subject to smouldering are known as surface type fires.

The design concentration of co_2 provided must be maintained for 10 minutes.

Basic quantities of carbon dioxide for various space volumes may be calculated from Table 1.

The basic quantity of co_2 is factored according to the risk material. Some typical values are shown in Table 2.

Deep Seated Fires
A fire involving a solid material that is subject to smouldering is called a deep seated fire.

Rooms containing these materials should have no openings that cannot be automatically closed, other than small openings or pressure vents near the top of the enclosure.

Additional quantities of co_2 are needed and held within the space for not less than 20 minutes.

Recommended design concentrations for various hazards are shown in Table 3.

Integrity and venting requirement
Total flood suppression systems rely on the enclosure retaining the required gas concentration for a period of time known as the hold time. The ability of the hazard enclosure to retain the gas for the required hold is usually determined by door fan integrity testing. If the test shows that the leakage would reduce the hold time below that specified for the fire type, additional co_2 must be provided.

The release of co_2 into a tightly sealed enclosure could result in damage caused by pressure variations during discharge. Normally the natural leakage of an enclosure is adequate to prevent damage but in some cases pressure relief venting may be required.

System Information
Local Application Systems

Volume Method
The volume method of system design is used where the fire hazard consists of three dimensional irregular objects that cannot easily be reduced to equivalent surface area.

The total discharge rate of the system is based on the volume of an assumed enclosure surrounding the hazard. The basic design rate is 16 kg min m^{-3} but this can be reduced according to the degree of existing enclosure on site.

Area Method
The quantity of carbon dioxide required is based upon the total discharge rate from a carefully sited nozzle arrangement, a sufficient number of nozzles being used to adequately cover the entire area on the basis of the unit area protected by each nozzle.

For this method of design, where a horizontal or vertical flat surface is protected, nozzles are to be positioned in accordance with the guidance of the Kidde co_2 design manual. The position and distance from the hazard has a critical effect on the quantity of co_2 required. This protection methodology is well suited to painting, dipping and drying type applications.

Table 1
– to determine basic CO_2 quantity

Volume - m^3		Factor - $kg.m^3$
	>4	1.15
>4	>14	1.07
>14	>45	1.01
>45	>126	0.90
>126	>1400	0.80
>1400		0.74

Table 2
– to determine higher concentrations for specific hazards

Capitalise factor	
Acetylene	2.5
Benzol	1.1
Butadiene	1.3
Ethyl Ether	1.5
Ethylene	1.6
Hexane	1.1
Hydrogen	3.2
Kerosene	1.0
Petrol	1.0

Note: MCF of 1.0 is equal to a concentration of 34%

Table 3
– concentrations for deep seated hazards (BS5306: 4)

Hazard	Flooding Factor
Dry electrical wiring and insulation	1.35kg m^{-3}
Computer equipment	1.50kg m^{-3}
Data processing and tape storage	2.25kg m^{-3}
Record stores/archives	2.00kg m^{-3}
Dust collectors	2.70kg m^{-3}

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6 ELECTRICALLY ACTUATED CO_2 SYSTEM

Direct-acting CO_2 Solenoid
Designed for use with standard Kidde 45kg co_2 cylinders, the direct-acting solenoid allows co_2 systems to be actuated electrically without the need for a separate pilot nitrogen supply.

The solenoid actuation system utilises a modified version of the existing cylinder valve, replacing the nitrogen pilot cylinder with a solenoid directly coupled to the co_2 cylinder valve. The system also retains the facility for local manual release or via a mechanical pull cable.

Operation
The pressure/manual actuator (K62341) is fitted to the cylinder (Klem) valve, with the solenoid assembly (D8522-001) attached to the poppet orifice connection by means of a swivel nut and O-ring seal. The solenoid assembly has a flexible hose connection to the pressure/manual actuator.

In the unactivated state, the pneumatic actuator is subject only to atmospheric pressure and the Klem valve remains closed. On receipt of an electrical signal from an extinguishant release control panel, the solenoid coil is activated, releasing high pressure co_2 from the cylinder. The co_2 passes through a short flexible hose to the pressure/manual actuator, which then operates the Klem valve, allowing co_2 to exit via the discharge port. Further co_2 cylinders may be discharged by interconnecting the pressure/manual actuators using flexible pilot hoses (K93433).

Also available, Metron actuator c/w manual lever (D8521-002), ideal for single cylinder electrical operation.

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