Fike CORPORATION

CO_2 DESIGN GUIDE

DUST COLLECTION SYSTEM

The ***Dust Collection Application Profile*** (AP 004) provides guidance on fire protection requirements for Dust Collector applications. In the event of a fire, the Fike Carbon Dioxide Extinguishing System will protect costly hardware, and provide a safe working environment.

This Design Guide provides a step by step design process of a Fike Carbon Dioxide Extinguishing System protecting a Baghouse type Dust Collection System. There are numerous unique Dust Collection systems filtering numerous different products. This Design Guide is intended to be a sample and is not applicable to all Dust Collection Systems. Fike's Carbon Dioxide Design, Installation, and Maintenance Manual and NFPA 12 should be referenced when designing systems.

This carbon dioxide design guide will be a deep seated fire hazard protecting a Baghouse type Dust Collector with no leakage or ventilation compensation. The following design parameters have been taken into consideration to determine the amount of agent, flow rate, quantity of nozzles, and ultimately a Fike CO_2 parts list.

Example:
1) Dust Collector with combustible filter bags
2) Ventilation system to shutdown upon discharge
3) All leakage areas sealed
4) Hazard Size: 14 ft. (4.3 m) long x 6 ft. (1.8 m) wide x 18 ft. (5.5 m) high

STEP #1 - DETERMINE THE HAZARD VOLUME

The first step is to calculate the total volume of the hazard being protected.

- The volume is determined by multiplying: length x width x height.
- Volume = 14 ft. x 6 ft. x 18 ft. = 1,512 ft^3 (4.3 m x 1.8 m x 5.5 m = 42.6 m^3)

STEP #2 – DETERMINE THE FLOODING FACTOR

The flooding factor used for a system design is based on the specific hazard being protected. To determine the base quantity of Carbon Dioxide agent required, multiply the hazard volume by a flooding factor selected from the following table:

FLOODING FACTORS FOR SPECIFIC HAZARDS					
Design Conc.	**ft^3 / lb. CO_2**	**lb. CO_2 / ft^3**	**m^3 / kg. CO_2**	**kg. CO_2 / m^3**	**Specific Hazard**
50%	10	0.100	0.62	1.60	Dry electrical hazards in general. (Spaces 0 - 2,000 ft^3./ 56.6 m^3)
50%	12	0.083 (200 lb/min)	0.75	1.33 (91 kg/min)	Dry electrical hazards (Spaces over 2,000 ft^3 / 56.6 m^3)
65%	8	0.125	0.50	2.00	Record or bulk paper storage, ducts & covered trenches
75%	**6**	**0.166**	**0.38**	**2.66**	Fur storage vaults, **dust collectors**, etc.

Minimum Carbon Dioxide Concentration and Flooding Factor

Both the minimum Carbon Dioxide concentration and flooding factor are based on the specific hazard being protected. For this example, a dust collector (bag house) requires:

- Minimum Carbon Dioxide concentration = 75%.
- Flooding factor = 0.166 lb. CO_2/ft^3 (2.66 kg CO_2/m^3)

STEP #3 – CALCULATE THE MINIMUM EXTINGUISHING QUANTITY REQUIRED

The minimum quantity of Carbon Dioxide required is based on the volume of the hazard being protected and the Flooding Factor. Multiply the volume of the hazard times the correct flooding factor.

MINIMUM QUANTITY OF CARBON DIOXIDE – UNADJUSTED SYSTEM	
English Units	**Metric Units**
1,512 ft^3 x .166 = 251 lbs. Carbon Dioxide	42.6 m^3 x 2.66 = 113.3 kg. Carbon Dioxide

STEP #4 – DETERMINE THE DISCHARGE DURATION AND FLOW RATE

Deep-Seated hazard systems are discharged at a slower flow rate and for a longer duration to counter-act the characteristics of a smoldering fire. <u>For Deep-Seated fires, the design concentration shall be achieved within **seven (7) minutes,** but at a flow rate that will provide a concentration of 30% within **two (2) minutes**</u>.

To calculate the minimum flow rate for a 30% concentration, multiply the hazard volume by **0.043 (0.688** for metric calculations). This will determine the amount of Carbon Dioxide to be discharged within **two (2) minutes**. Dividing the resultant quantity of Carbon Dioxide by **two (2)** provides the required flow rate in pounds (kg) of Carbon Dioxide per minute. (Reference: NFPA 12, Section 2-5.2.3)

NOTE: For Deep-Seated hazards requiring a 75% concentration, the flow rate required to discharge within seven (7) minutes is greater than the 30% requirement stated above, and must be used.

MINIMUM FLOW RATE REQUIREMENTS	
English Units	**Metric Units**
251 lbs. ÷ 7 minutes = 36 lbs./min. (flow rate)	113.3 kg. ÷ 7 minutes = 16.2 kg/min. (flow rate)

STEP #5 - DETERMINE THE NOZZLE TYPE AND QUANTITY

For most applications, a surface-mounted nozzle arrangement that allows the discharge piping to be run outside of the bag house is preferred. Therefore, the nozzle selected should either be a flange-mount Vent or "S" Type nozzle. For applications where stirring up dust may present an explosion hazard, the "S" Type nozzle would be preferred because it will create a "softer" discharge application of the carbon dioxide within the bag house.

A single nozzle of either type will deliver the flow rate required for this example, but multiple nozzles should be provided to ensure complete coverage around the bag filters. For this example, a minimum of two nozzles should be used.

STEP #6 – DESIGN CONSIDERATIONS

Carbon Dioxide extinguishes fire primarily by displacing oxygen in the flame zone by creating an inert atmosphere. Dust Collectors are subject to an enormous amount of air movement. To allow the Carbon Dioxide system to achieve its primary extinguishing mechanism of oxygen displacement, proper shutdown of fresh air supply and the loss of carbon dioxide concentration should be implemented. Installing dampers in the "air intake" and "air exhaust" as well as shutting down the fans shall be implemented. Shutting down the fans should be done prior to the carbon dioxide discharge. Dampers are activated pneumatically with pressure trip assemblies, which are part of the CO_2 distribution piping. By implementing these design parameters, and isolating the collection system, the fire is starved of oxygen.

If total air shutdown is not possible and dampers are installed, air pressure from the fans will allow leakage through the ductwork, assuming the dampers will not be entirely effective. Additional carbon dioxide gas will be required to compensate for a non-static flooding condition. When this particular condition appears with your application, Fike Protection Systems should be consulted to provide assistance in designing the Carbon Dioxide system.

STEP #7 – DEVELOP A FIKE CO_2 PARTS LIST

Fike CO_2 *Sample* Parts List – Dust Collection Application		
Quantity	Description	Part Number
3	100 lb. (45.4 kg) Cylinder w/Brass Valve	C70-100
3	Flexible Discharge Bend w/Check Valve	C70-226
2	12V DC Master Cylinder Package	C85-113
1	Connecting Link Assembly	C70-228
3	"S" Type Nozzle	C80-010
3	Flange & Seal Kit for "S" type Nozzle	C80-1018
3	Pressure Trip Assembly	C02-1229
1	½" Stop Maintenance Valve	C02-1210
1	3 Cylinder Rack Assembly w/weigh track	C70-040-30
1	SHP Control System, 110 VAC	10-051-R-1
1	SRM4, Relay Module	10-2176
1	Battery Assembly, 7AH	10-2190-1
5	194° Thermal Detector /Rate Anticipated	60-008
1	Manual Release Station	10-1638
2	Horn/Strobe Device, 15/75 Candela	20-098
1	Warning Sign / Do Not Enter	C70-1081
1	Warning Sign / Manual Actuation	C70-1032

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