CO_2 DESIGN GUIDE

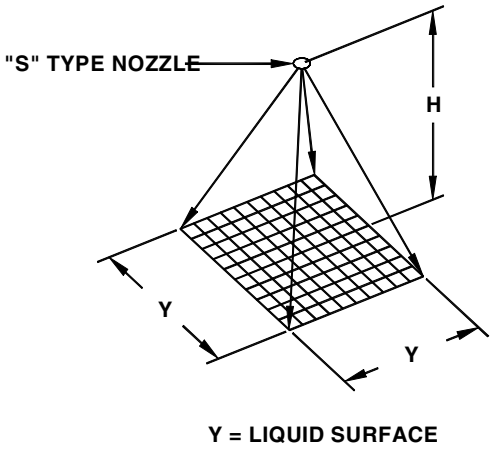
ELECTRIC DISCHARGE MACHINING (EDM)

The ***Electric Discharge Machining Application Profile*** (AP 003) provides guidance on fire protection requirements of the EDM process. In the event of a fire, the Fike Carbon Dioxide Extinguishing System will protect costly hardware, and provide a safe working environment.

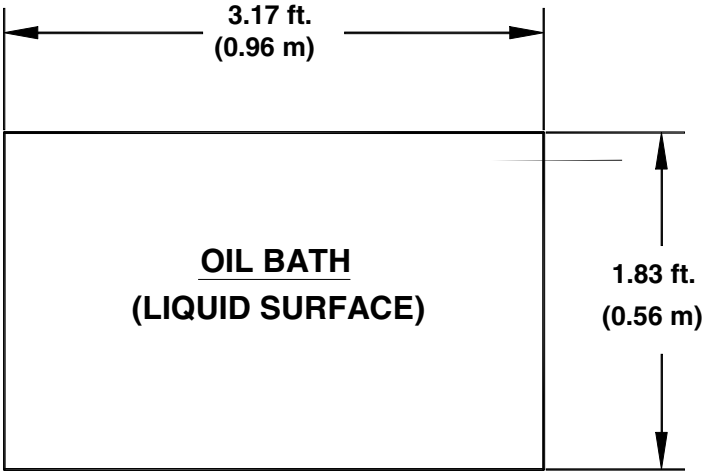
This Design Guide provides a step by step design process of a Fike Carbon Dioxide Extinguishing System protecting an EDM application. It is intended to be a sample and is not applicable to all EDM Applications. Fike's Carbon Dioxide Design, Installation, and Maintenance Manual should be referenced when designing systems.

STEP #1 - DETERMINE THE NUMBER OF NOZZLE ROWS

The first step is to determine the number of nozzle rows required to cover the width of the protected surface. Divide the width of the protected space by the surface dimension ("Y") from the Rate-by-Area Nozzle Coverage Chart **located on the last page of this guide**. The appropriate dimension ("Y") is dependent upon the nozzle height (H) above the protected surface. The result identifies the number of nozzle **ROWS** that are required.



Y = LIQUID SURFACE



NOZZLE HEIGHT = 4'-0" (1.22 m)

DETERMINE NOZZLE ROWS	
English Units	**Metric Units**
Liquid Surface:	**Liquid Surface**:
Width of Surface = 1.83 ft. / Nozzle Height = 4.0 ft.	Width of Surface = 0.56 m / Nozzle Height = 1.22 m
Dim. "Y" = 3.27 ft.	Dim. "Y" = 1.0 m
(Taken from Rate-by-Area Chart)	(Taken from Rate-by-Area Chart)
Nozzles Rows required = 1.83' ÷ 3.27' = 0.6 = 1 Row	Nozzles Rows required = 0.56 ÷ 1.0 = 0.6 = 1 Row

STEP #2 – DETERMINE THE NOZZLES REQUIRED IN EACH ROW

Next, divide the length of the protected space by the surface dimension ("Y") from the Rate-by-Area Nozzle Coverage Chart. The appropriate dimension ("Y") is dependent upon the nozzle height (H) above the protected surface. The result identifies the number of nozzles required **IN EACH ROW**.

DETERMINE NUMBER OF NOZZLES IN EACH ROW	
English Units	**Metric Units**
Liquid Surface: Length of Surface = 3.17 ft. / Nozzle Height = 4.0 ft. Dim. "Y" = 3.27 ft. (Taken from Rate-by-Area Chart) Nozzles Per Row = 3.17' ÷ 3.27' = .97 = 1 Nozzle/Row	**Liquid Surface**: Length of Surface = 0.96 m / Nozzle Height = 1.22 m Dim. "Y" = 1.0 m (Taken from Rate-by-Area Chart) Nozzles Per Row = 0.96 ÷ 1.0 = .96 = 1 Nozzle/Row

STEP #3 – CALCULATE THE TOTAL NOZZLES REQUIRED

The total number of nozzles is now calculated by multiplying the number of rows by the number of nozzles required for each row. Therefore, this hazard can be protected with a single row with one nozzle based on the nozzle distance of 4'-0" (1.22 m) above the protected hazard.

NOTE: Moving the nozzle location height affects the area coverage and the flow rate requirements for the system. For example, if the nozzle height is 3'-0" (.91 m), two nozzles would be required to cover the hazard – and they would require a flow rate of 64 lbs./min. (29 kg/min.).

STEP #4 – WHERE DO I INSTALL THE NOZZLES?

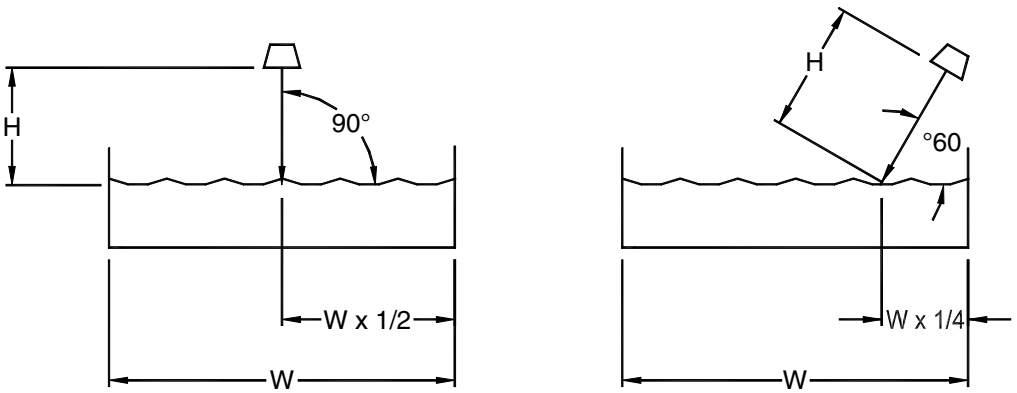
Nozzles should be installed in a location that will enable an extinguishing "Envelope" to be developed around the entire protected area. Any obstructions that could interfere with the flow of Carbon Dioxide from the nozzle to the protected surface must be avoided to ensure proper system performance. If obstructions **cannot** be avoided, the nozzle(s) must be repositioned or relocated. ***If additional nozzles are required, the agent quantity will have to be revised accordingly***. Whenever possible, nozzles should be installed perpendicular to the hazard and centered over the protected area. They may also be installed at an angle between 45 degrees and 90 degrees from the plane of the hazard surface.

NOTE: For nozzles mounted at an angle, the height used in determining the flow rate and area coverage shall be the distance from the aiming point on the protected surface to the face of the nozzle; as measured along the axis of the nozzle. (Refer to NFPA 12, Section 3-4.4.3)

STEP #5 – CAN I AIM THE NOZZLE AT THE HAZARD?

Nozzles can be aimed at the hazard and shall be aimed at a point that is a specific distance in from the edge of the protected surface. This distance, from the near side of the protected surface to the aiming point, is calculated by multiplying the coverage dimension ("Y") of the nozzle's protected area by the Aiming Factor found in the table below. The concept is illustrated below the table.

Aiming Factors for Angular Placement of Nozzles		
Discharge Angle (Degrees from plane of hazard surface)	**Aiming Factor** (Fractional amount of coverage area)	
45 - 60°	1/4	(0.25)
60 - 75°	1/4 - 3/8	(0.25 - 0.375)
75 - 90°	3/8 - 1/2	(0.375 - 0.50)
90° (Perpendicular)	1/2	(Centered)



STEP #6 - DETERMINE THE FLOW RATE AND REQUIRED AMOUNT OF CO_2 AGENT

The quantity of agent required for the system is determined by multiplying the number of nozzles required to cover the projected surface area times the flow rate per nozzle as determined by the Rate-by-Area Coverage Chart. This gives you the total system flow rate that will be utilized to determine pipe sizes.

Multiply the system flow rate times 1.4 to compensate for the liquid portion of the discharge and times 0.5 (the minimum effective discharge time) to determine the total agent quantity required to protect the area.

DETERMINE AGENT QUANTITY TO SUPPLY	
English Units	**Metric Units**
Agent Quantity: Total Flow Rate = 1 Nozzle @ 41 lbs./min. (Taken from Rate-by-Area Chart) Flow Rate = 41 lbs./min. 41 x 1.4 (liquid comp.) x 0.5 (discharge time) = 28.7 lbs. required (50 lbs. supplied)	**Agent Quantity**: Total Flow Rate = 1 Nozzle @ 18.6 kg/min. (Taken from Rate-by-Area Chart) Flow Rate = 19 kg/min. 19 x 1.4 (liquid comp.) x 0.5 (discharge time) = 13.3 kg required (22.7 kg supplied)

STEP #7 – DEVELOP A FIKE CO_2 PARTS LIST

Fike CO_2 *Sample* Parts List – EDM Application		
Quantity	Description	Part Number
1	50 lb. (22.7 kg) Cylinder w/Brass Valve	C70-050
1	Flexible Discharge Bend w/Check Valve	C70-226
1	24V DC Master Cylinder Package	C85-114
1	"S" Type Nozzle	C80-010
1	50 lb. Cylinder Strap	C70-211
1	Pressure Switch Assembly	C70-202
1	SHP Control System, 110 VAC	10-051-R-1
1	SRM4, Relay Module	10-2176
1	Battery Assembly, 7AH	10-2190-1
1	U.V. Flame Detector	64-010
1	Manual Release Station	10-1638
1	Horn/Strobe Device, 15/75 Candela	20-098
1	Warning Sign/Manual Actuation	C70-1032

RATE-BY-AREA NOZZLE COVERAGE CHART							
English Units				Metric Units			
Nozzle Height (feet)	**Flow Rate (lb/min)**	**Coated Surface Dim. "X" (feet)**	**Liquid Surface Dim. "Y" (feet)**	**Nozzle Height (meters)**	**Flow Rate (kg/min)**	**Coated Surface Dim. "X" (meters)**	**Liquid Surface Dim. "Y" (meters)**
1.00	16.0	2.65	2.24	0.31	7.3	0.81	0.68
1.25	17.5	2.78	2.34	0.38	7.9	0.85	0.71
1.50	20.0	2.90	2.45	0.46	9.1	0.88	0.75
1.75	22.0	3.00	2.53	0.53	10.0	0.92	0.77
2.00	24.0	3.13	2.65	0.61	10.9	0.95	0.81
2.25	26.0	3.22	2.72	0.69	11.8	0.98	0.83
2.50	28.0	3.30	2.79	0.76	12.7	1.00	0.85
2.75	30.0	3.41	2.88	0.84	13.6	1.04	0.89
3.00	32.0	3.49	2.95	0.91	14.5	1.06	0.90
3.25	34.5	3.59	3.03	0.99	15.7	1.09	0.92
3.50	36.5	3.69	3.11	1.07	16.6	1.12	0.95
3.75	38.5	3.78	3.19	1.14	17.5	1.15	0.97
4.00	***41.0***	3.87	***3.27***	***1.22***	***18.6***	1.18	***1.00***
4.25	43.0	3.94	3.33	1.30	19.5	1.20	1.02
4.50	45.0	4.01	3.39	1.37	20.4	1.22	1.04
4.75	47.0	4.10	3.48	1.45	21.3	1.25	1.06

NOTE: If Higher Nozzle Heights are required, please refer to the Design Section of Fike's CO_2 Design, Installation, and Maintenance Manual.