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CLASS A EQUIPMENT FOR SOLVENT PROCESSING

OSHA requires ovens processing flammable solvents or vapors to conform to the National Fire Protection Association Standard 86. NFPA 86 defines ovens for these applications as Class A ovens. In order to keep flammable vapor concentration at safe levels, Class A ovens include additional equipment to provide safety ventilation. This additional equipment is sized based on the volume of solvent being evaporated and the maximum operating temperature. Feel free to reach out to Grieve directly for any specific questions related to Class A ovens or questions regarding required exhauster size and heat loss at (847) 546-8225 or sales@grievecorp.com.

Safety ventilation also depends on the processing method. In **batch processes**, all parts heat up at the same time and the flammable vapor concentration is not constant. As the work temperature rises, the vapor concentration also rises to a peak value and then tapers off. This requires greater safety ventilation than in **continuous processing** where parts are heated sequentially and the vapor concentration remains constant.

Direct-fired gas ovens include Class A equipment to remove products of combustion. Combustion venting is sized at 183 standard cubic feet per minute of exhaust per 1,000,000 BTU/HR of burner rating. Depending on the amount of flammable solvent processed, a larger powered forced exhauster may be required to handle both combustion venting and safety ventilation.

Electrically-heated ovens require that the following be added:

- Powered forced exhauster
- Purge timer

Powered forced exhauster

The following table contains the standard available exhaust sizes and part numbers. Carbon steel exhausters are only rated to run up to 850°F. 80 CFM exhausters are only available up to 550°F. 80 and 130 CFM exhausters are not available on walk-in ovens. Larger capacity exhausters are also available.

Capacity (CFM)	Carbon Steel Part Number			Stainless Steel Part Number			Power (HP)	Outlet Diameter	Height
	208V	230V	460V	208V	230V	460V			
80	X808	X802	X804	N/A	N/A	N/A	1/8	4”	16”
130	X1308	X1302	X1304	SX1308	SX1302	SX1304	1/3	4”	20”
325	X3258	X3252	X3254	SX3258	SX3252	SX3254	1/3	6”	23”
650	X6508	X6502	X6504	SX6508	SX6502	SX6504	½	6”	23
975	X9758	X9752	X9754	SX9758	SX9752	SX9754	1	8”	23”

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All exhausters have a damper which can be adjusted to reduce exhaust rate to the required volume. Electric ovens equipped with an exhauster may require additional heat input to offset exhaust heat loss, especially at higher temperatures and for larger exhaust rates.

Purge timer

The purge timer is provided with a specific time period to ensure that four oven volumes of fresh air are exhausted prior to turning on the heat.

SIZING SAFETY VENTILATION AND HEAT LOSS

*This information is based on NFPA Standard 86 and is subject to changes in this standard. All flammable solvent processing applications should be reviewed by Grieve.

Safety ventilation exhaust provides a supply of fresh air to ensure that the flammable vapor concentration in the oven remains below the Lower Flammable Limit (LFL) at all times. When more than one flammable solvent is present, safety ventilation is based on the solvent requiring the greatest amount of ventilation.

Direct-fired gas heated ovens require combustion venting which must be added to the safety ventilation exhaust rate.

Combustible solids or substrates do not require safety ventilation unless flammable constituents are released when these materials are heated. Powder-coat curing ovens require safety ventilation to be calculated as though 9% of the powder weight is being evaporated as the flammable solvent Xylene.

Exhaust rates must be corrected for maximum operating temperature. As oven operating temperature increases, greater exhaust is required to compensate for the decrease in air density. Similarly, at altitudes over 1000 feet, the exhaust rate must be increased to compensate for lower air density. Examples of actual calculations can be found in NFPA 86. Estimated safety ventilation exhaust rate and heat loss can be scaled from charts shown below.

Batch Processing

For batch oven applications below 250° F, the safety ventilation exhaust rate must be sized at a rate of 440 standard cubic feet per minute for each gallon of solvent introduced into the oven in a batch. Between 250° F and 500° F, this exhaust rate must be increased by a multiplier of 1.4. Above 500° F, the 1.4 multiplier is not appropriate and a correction factor must be determined by tests run by the solvent manufacturer.

In addition, for solvents where the volume of air necessary to render 1 gallon of solvent barely explosive exceeds 2640 standard cubic feet, the exhaust rate must be increased. The increase is made by multiplying by a factor created by taking the volume of air necessary to render 1 gallon of solvent barley explosive and dividing it by 2640 standard cubic feet.

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Safety ventilation and heat loss for a batch process can be estimated using the chart below. This chart shows the exhaust rate and heat loss for 0.1 gallon of solvent. The data is based on a solvent with LFL of 2640 standard cubic feet and on an installation located below 1000 feet in altitude.

Exhaust rate and heat loss for 0.1 gallons of solvent at various temperatures

Oven Temperature (°F)	Batch Exhaust Rate (CFM)	Heat Loss (kW)	Heat Loss (Btu/hr)
100	46	0.4	1,435
150	51	1.1	3,827
200	55	1.8	6,219
250	83	3.5	12,056
300	88	4.5	15,405
350	94	5.5	18,754
400	100	6.5	22,103
450	106	7.5	25,452
500	112	8.4	28,800

Continuous Processing

For continuous processing ovens, the safety ventilation exhaust rate must be sized to keep the concentration of solvent in the oven atmosphere below 25% of the Lower Flammable Limit (LFL) after the LFL has been corrected for operating temperature.

The specific gravity and vapor density of the solvent are used to determine the gallons of vapor created by 1 gallon of evaporated solvent. Combining this information with the Lower Flammable Limit determines the air volume rendered barely explosive when 1 gallon of solvent is evaporated. This is multiplied by a factor of 4 to limit the vapor concentration to 25% of the Lower Flammable Limit.

The safety ventilation exhaust rate is obtained by multiplying this volume by the number of gallons of solvent evaporated per minute.

Safety ventilation and heat loss for a continuous process can be estimated using the chart below. This chart shows the exhaust rate and heat loss for 0.1 gallon of Xylene. Xylene has specific gravity of 0.88 (Water = 1) and vapor density of 3.7 (Air = 1). The Lower Flammable Limit by volume is 0.9%. The amount of air rendered barely explosive per gallon evaporated is 2899 standard cubic feet. The

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calculated exhaust required per gallon of Xylene evaporated in continuous processing is 193 standard cubic feet per minute.

Exhaust rate and heat loss for 0.1 gallons of Xylene for continuous process at various temperatures

Oven Temperature (°F)	Continuous Exhaust Rate (CFM)	Heat Loss (kW)	Heat Loss (Btu/hr)
100	21	0.2	638
150	23	0.5	1,742
200	26	0.8	2,897
250	28	1.2	4,107
300	31	1.6	5,375
350	34	2.0	6,707
400	37	2.4	8,107
450	40	2.8	9,580
500	43	3.3	11,132