THERMAL AND CATALYTIC OXIDIZERS

GAS AND ELECTRIC FIRED SYSTEMS
ENCLOSED FLARES
PROCESS FURNACES

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THE HITEMP ADVANTAGE

HTT systems options can include preheat exchangers, induced draft or secondary combustion blower, modulating dilution air TEE's, stack extensions, and catalyst modules. The Catalytic Oxidizers function exactly the same as a Thermal Oxidizer. The major difference is the operating temperature necessary for destruction of the VOCs. The HTT Lo-Temp Catalyst can operate effectively at temperatures as low as 400 F in some applications. The fuel savings at these low temperatures can be significant in reducing operating costs. Catalysts cannot be used in applications where chemical poisons or particulates are present such as SOX and silicone compounds.

300 SCFM Thermal Oxidizer

Systems will be of the two basic types of waste gas streams. The first is the most common. The application will have a waste gas stream that will be mostly ambient air with a small quantity of VOC. For these applications, you can select the size based on the flow rate in SCFM. The second type is more complicated. In these applications, the gas stream that will contain little or no oxygen and high concentrations of VOC. In these applications, we calculate the amount of combustion air necessary to burn all of the hydrocarbons in the stream and then must add sufficient additional combustion air so that the final exhaust gas will contain a minimum of 8-10 percent oxygen.

Exhaust gas from a chemical process that contains almost 100 percent VOC, can sometimes be injected directly through the burner nozzle. With this type the system the Oxidizer is started with natural gas and brought up to temperature. Once temperature is reached the waste stream is slowly added to the natural gas passing through the burner. When this occurs the temperature rises, the natural gas is throttled back, and the system uses the waste gas and thus displaces the natural gas. Should the temperature in the chamber rises above set point, and the burner output throttles back to low fire, the second temperature controller opens the damper on secondary air blower. During this condition, the secondary air is used to maintain temperature.

4000 SCFM Thermal Oxidizer and Low Profile Burner

In some applications the waste stream is diluted with secondary air before injection into the firing chamber. The same auxiliary temperature controller can be used to operate a bleed air tee valve thus controlling the amount of dilution air necessary during operation.

For these special applications, we select a medium velocity premix type burner with an integral high-pressure combustion air blower sized for the waste gas volume plus the required combustion air.

Also furnished on our standard units, will be the natural gas valve train including, solenoid shutoff valves, flamerod detection, and gas butterfly valve with modulating control motor keeping the system in compliance with FM requirements. Components may be furnished pre-piped and wired or supplied loose for installation by others.

SYSTEM DESIGN CONSIDERATIONS

1. When is a dangerous situation created by mixing of waste gases with combustion air?

A fuel/air mixture of a small quantity of fuel and a lot of air is a lean mixture. As the amount of fuel in the ratio increases, the mixture approaches the Lower Explosive Limit (100% LEL). 100% LEL is the minimum amount of fuel needed to support combustion. As the ratio increases, the flame will be able to achieve higher temperatures; the ratio will eventually reach the stoiciometric ratio. This is the theoretical ratio that means that all of the fuel will burn with all of the air. As the ratio increases, all of the air is used, but the exhaust will contain unburned fuel.

12 MM Btu/hr Landfill Enclosed Flare for Landfill Methane Gases

More fuel and the ratio will eventually reach the point where there is so much fuel, and so little air, that the flame will be extinguished. This is the Upper Explosive Limit (UEL). Under these conditions, gas stream will contain virtually no oxygen and so this ratio is above the UEL. To burn this gas stream, we must mix in air, in a controlled environment at high temperature, such as in our combustion chamber so that combustion takes place continuously and not all at once. Whether the gas

stream is injected through the orifice/venturi in the burner or through an orifice/venturi in the chamber will not effect the destruction efficiency or the margin of safety of the equipment.

The burners that are typically used by HTT are medium velocity packaged burners that fire down a stainless steel tube assembly. We can introduce the customers waste gas stream directly into the combustion air blower or can add a second stainless tube around this firing tube for injection of your gas stream directly into the chamber. Under these conditions the gases are both heated and mixed with the products of combustion and the excess air. As the mixing takes place continuously in the chamber, there is no possibility of an explosion or rough light-off. As a further safety feature the package could include the optional spark arrester in the waste gas duct to the oxidizer.

Burner - 12 MM Btu/hr Enclosed Flare for Landfill Methane Gases

2. What is the source of primary and secondary air to the premix burner?

The main burner combustion blower, if properly sized, will supply both the primary and secondary air. The oxidizer must control the flow of combustion air and auxiliary fuel regardless of the amount of the makeup of the waste gas being feed to the chamber. We have designed the HTT Systems with an oversized burner, which has

a very high turndown ratio. For the system to operate properly, the combustion air must be adjusted until the exhaust has a minimum O2 content of 8-10% (100% excess air). Below 8%, the system may not properly destroy the waste gases and may even smoke. The burner is sized larger to provide all of the combustion air necessary for the auxiliary fuel and for the waste gas stream combined, with a good safety margin. Two temperature controllers will adjust the fuel and air separately.

3. How does the HTT system control the secondary air in high VOC concentrations streams?

We have designed a system that will control the secondary air and fuel separately. By adding only as much air as the process requires, the system will lower overall operating costs and keep the chamber at temperature in standby condition. The systems will startup with minimal secondary air. The burners will bring the unit up to operating temperature. Once temperature is reached, the waste gas dampers will open to direct the flow to the unit. The waste gases will enter the chamber, mix with the secondary air and will pass through the burner flame.

3 MM Btu/hr Enclosed Flare for Landfill Methane Gases

During startup, the blower butterfly valve will be set at minimum airflow as required for output and the fuel butterfly will be set at maximum output. This is adjusted to bring the oxidizer up to the set point as required. Once the unit approaches set point, the air will remain constant and the fuel input will decrease until the temperature set point is maintained.

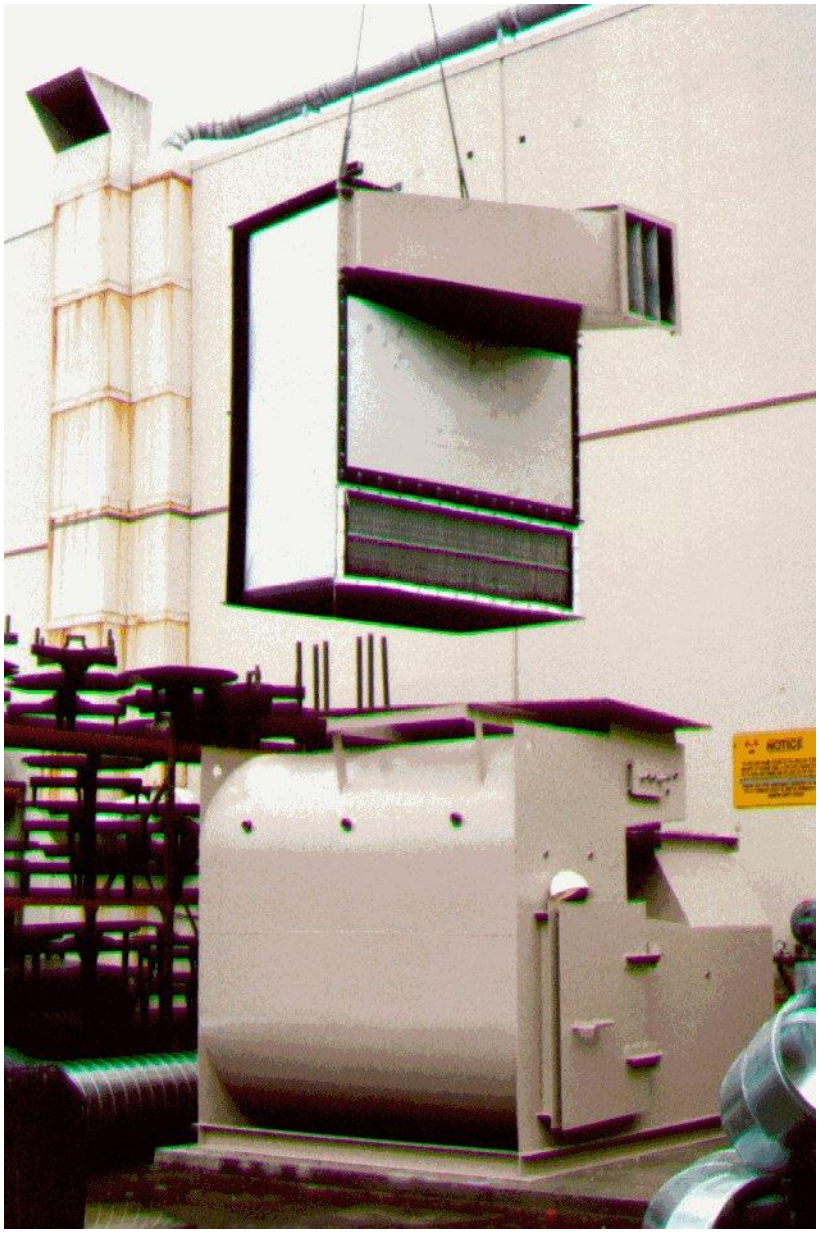
Upon reaching this set point, the duct valve will open and the injection of the waste gases into the oxidizer will begin. Since the gases will contain a heat value, the temperature will begin to rise. When this happens, the fuel output will drop to a preset minimum low-fire. If the heat value does not maintain temperature, the burner will control the auxiliary fuel to maintain the set temperature. If the burner drops to low fire and the temperature begins to rise above the first set point, a second set point on the combustion air controller will increase the secondary air until the second set point is maintained.

12,000 **SCFM Recuperative Catalytic Oxidizer and Low Profile Burner**

Because the gases will contain heat value, the temperature will rise in the chamber. This will cause the burner controls to decrease burner output. If the heat content is high enough, the burners will drop to low fire and the temperature will continue to rise. The secondary air dampers will be operated from the second controller. Once this set-point is reached, the damper opens and the secondary air is increased. The secondary air volume controls the temperature. Typically, this set point is 50 F above the burner set-point. As the heat value of the gas changes the secondary air damper will adjust.

The system shall include a 6” ceramic fiber refractory lined horizontal/vertical chamber. The waste gas connection will be on the side of the unit or at the blower inlet and the exhaust stack connection will be on the top. The installation will require setting unit, utility connections, and bolting on the stack and customer provided supply duct.

We have also designed the systems using Nema 4 components and can include an optional air/N2 pressure regulator for implementation of a Class X or Z purge. This will satisfy your requirements for XP area classification.



HITEMP TECHNOLOGY

TYPICAL HTT THERMAL OXIDIZER SYSTEM

HTT shall supply one Fume Incineration System. The system shall raise the temperature of the exhaust gases to the required operating temperature. This will assure maximum destruction of the VOC in the exhaust gas. The system shall be packaged complete with natural gas burner, refractory lined chamber, and the required optional components as described below:

REFRACTORY CHAMBER

The chamber shall be constructed of carbon steel and lined with a combination of Ceramic Fiber and high temperature insulating materials. The refractory shall be installed with SS anchors to maintain integrity. Chamber shall be coated with an acid resistant epoxy coating.

The chamber shall be mounted on a channel steel skid with suitable cross bracing. Chamber shall include sight ports, thermal wells, and access door. Surfaces shall be solvent washed brushed and painted with one coat of a high temperature gray primer. Extra paint will be supplied for customers future touchup.

EZ-Bolt in type 3000 SCFM Catalyst Module

CATALYST BED (CAT Option)

Catalyst shall be supplied in modular sections in separate frames. The frames will be complete with mounting flanges and gaskets. The frames will bolt directly to a SS support grid inside the chamber of the retention zone. The EZ-Bole Catalyst modules may be installed externally for ease of removal and maintenance.

PREHEAT EXCHANGER (HR Option)

The system shall include an integral preheat exchanger for raising the temperature of the exhaust gases prior to entering the firing chamber. The exchanger shall be a plate type unit as manufactured by DES CHAMPS LABORATORIES, INC. Exchanger shall be complete with Computer runs shall be supplied.

NATURAL GAS BURNER (G Option)

The system shall include one (1) packaged gas fired burner, with secondary air combustion blower as described below, for raising the temperature of the gases to operating temperature as required. System shall be complete with flame safety, controls and safeties. A motorized modulating gas valve will regulate the burner output using digital controllers. Burner train components are supplied loose for field installation. Customer shall supply natural gas regulator.

SYSTEM BLOWER (BL Option)

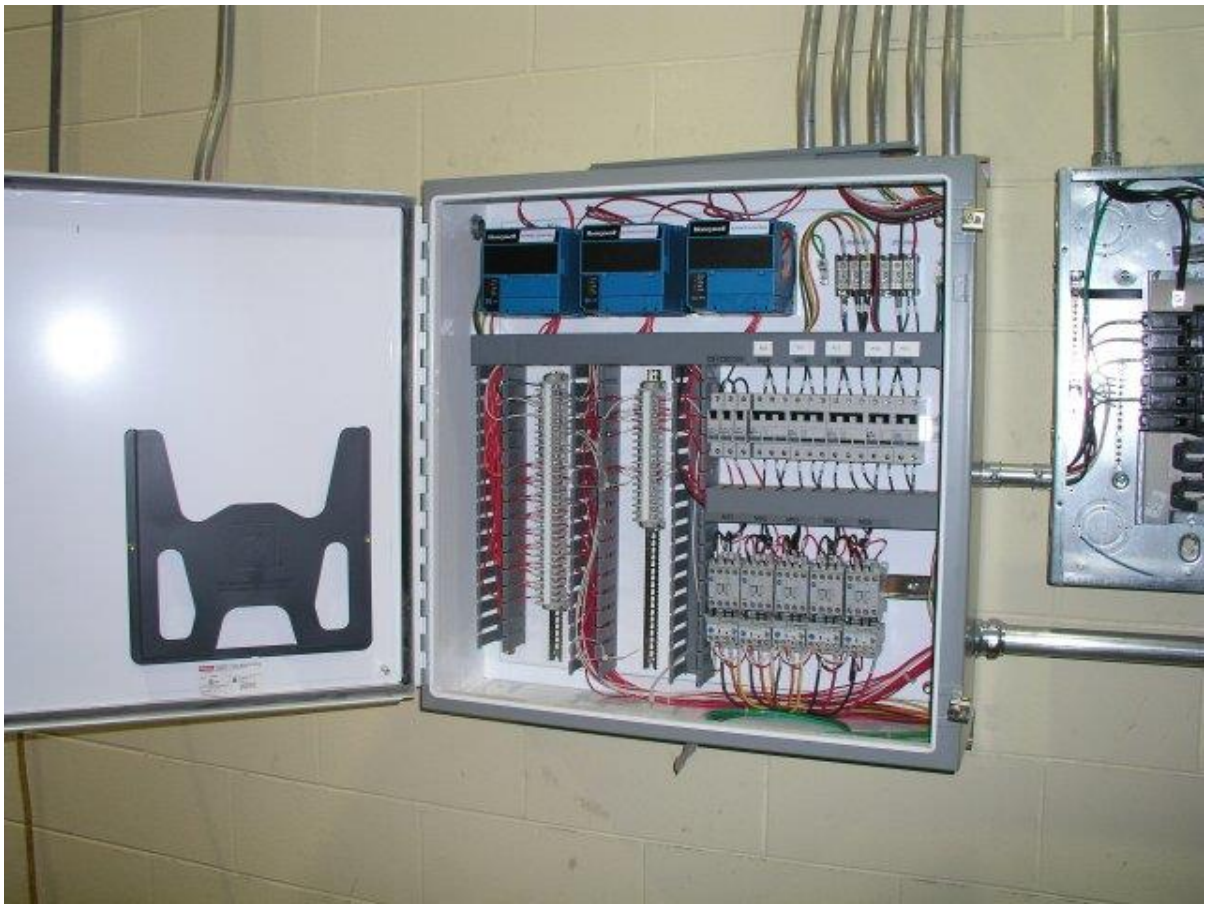
The system shall include one (1) dilution air blower for maintaining minimal air ratio and for controlling chamber temperature. The blower shall include a control damper and modulating actuator.

FLAME ARRESTER (FA Option)

The system shall include one (1) flame arrester to prevent the gases and flame from backing up the supply duct.

AIR CONTROL TEE (T Option)

The system shall include one (1) waste gas diverting tee for closing off the stack during operation or for closing off the waste gas to the oxidizer when the system is not operational. Package shall include a spring return actuator that will divert up the stack during a power failure.

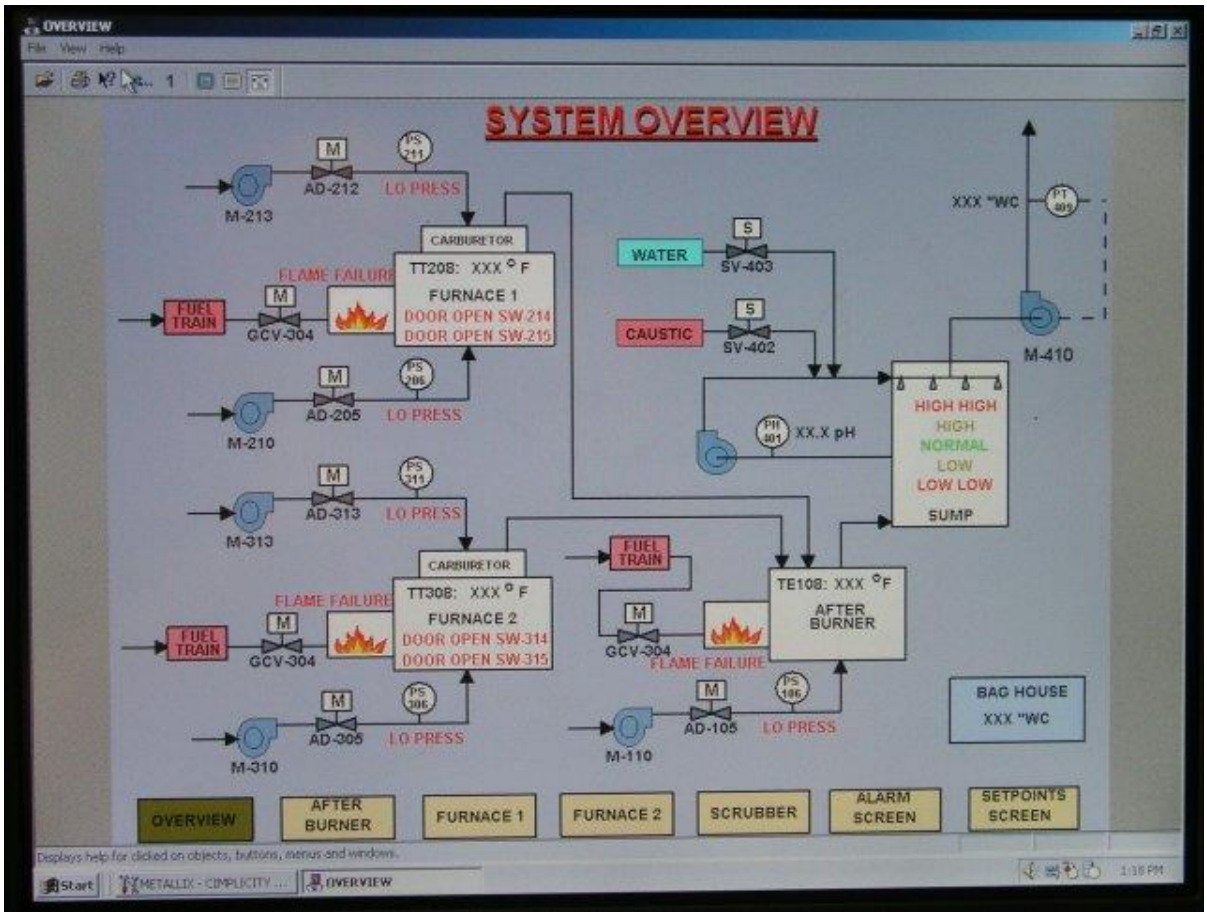


CONTROL OPERATION

The operator shall start and stop the system from the main panel or from remote inputs. Startup shall prove the blower, start burner, prove set temperature, and signal to start fume injection. Blower pressure and the customer safety limits must

be proven prior to burner ignition. Component failures will shut down system and alert the operator. Indicator lights will display fault.

The system shall be designed to operate with a variable waste gas input. Natural gas will be controlled to maintain a preset temperature. The system will be able to self regulate the fuel input to both maintain temperature and adjust conditions to match the flow of the waste gas stream.



CONTROLS

The package shall include one (1) Hoffman Nema 4 control panel, for remote control and monitoring. The system shall maintain a preset temperature utilizing a type K T/C and 4-20 ma digital controllers. The system shall be monitored with Honeywell DC-3000 temperature controllers for system operation located in the main panel. All controls and safeties are operated from this panel. The controller will modulate the gas to maintain temperature. Contacts will be provided for remote start and stop, pressure limit switch, and for motor starter coil.

HTT personnel provide off site technical assistance for control changes at no charge during the life of the equipment. Travel and living expenses not included.

Optional - Package may include an optional multi-point strip chart recorder. Recorder shall accept T/C, MA, or DC inputs for required sensors. These will accept the inputs from the optional monitors. The panel shall be provided with Nema 4 control switches, indication lights, and terminal strip contactors.

1000 SCFM THERMAL OXIDIZER – TRAILER MOUNTED

GAS FIRED FM-G THERMAL OXIDIZER SYSTEM DESIGN DATA

Flow Rate:	100	300	500	1000	1500	2000	3000	4000	SCFM
Inlet Temp:	70	70	70	70	70	70	70	70	F
Outlet Temp:	1400	1400	1400	1400	1400	1400	1400	1400	F
Max Burner Input:	1.0	1.0	1.0	2.0	3.0	4.0	6.0	8.0	MM Btu
Gas Press:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	PSI
Refractory Lining:	6	6	6	6	6	6	6	6	In
Chamber Size:	6	20	30	60	90	120	180	240	Cu Ft
Residence Time:	1	1	1	1	1	1	1	1	Second
Destruction Eff.:	99	99	99	99	99	99	99	99	%
SHELL DIM. (OD)									
(Add 18” for panel)	36	36	36	48	48	48	60	60	Width
	42	42	42	54	54	66	72	72	Height
(Add 24” for burner)	48	60	120	96	120	120	120	144	Length
WEIGHT:	600	1000	1500	2000	2800	3400	5,000	8,000	LBS.

15,000 SCFM @ 2200F Thermal Oxidizer

ENCLOSED FLARES AND THERMAL OXIDIZER SYSTEMS

GAS FIRED FM-G THERMAL OXIDIZER SYSTEM DESIGN DATA

Flow Rate:	5,000	10,000	15,000	20,000	SCFM
Inlet Temp:	70	70	70	70	F
Outlet Temp:	1400	1400	1400	1400	F
Max Burner Input:	10.0	20.0	30.0	40.0	MM Btu
Gas Press:	0.5	0.5	0.5	0.5	PSI
Refractory Lining:	6	6	6	6	In
Chamber Size:	300	600	900	1,200	Cu Ft
Residence Time:	1	1	1	1	Second
Destruction Eff.:	99	99	99	99	%
SHELL DIM. (OD)	72	84	96	96	DIA.
	180	264	300	420	Length

3000 SCFM EZ-Bolt CATALYTIC OXIDIZER SYSTEM

FM-CAT-G CATALYTIC OXYDIZER SYSTEM DESIGN DATA

Flow Rate :	1000	1500	2000	3000	4000	5000	SCFM
Inlet Temp:	70	70	70	70	70	70	F
Stack Outlet Temp:	550+	550+	550+	550+	550+	550+	F
Catalyst Inlet Temp:	550	550	550	550	550	550	F
Catalyst (95%):	1	1.5	2	3	4	5	Cu. ft.
Catalyst (98%):	2	3	4	6	8	10	Cu. ft.
Destruction Eff.:	95	95	95	95	95	95	% Catalytic
Destruction Eff.:	98	98	98	98	98	98	% Catalytic
Burner Input:							
@0.0 PPM	0.6	0.9	1.08	1.65	2.16	3.3	MM Btu/Hr
@1000 PPM	0.6	0.9	1.08	1.65	2.16	3.3	MM Btu/Hr
Gas Press:	0.5	0.5	0.5	0.5	0.5	0.5	PSI
Refractory Lining:	6	6	6	6	6	6	In
SHELL DIM. (OD)							
(Add 18” for panel)	24	24	36	36	60	72	Width
	48	60	60	72	72	72	Height
	60	72	84	96	96	96	Length
WEIGHT:	600	1000	1500	2500	4000	5,000	LBS.

2000 SCFM System

FM-CAT-HR-G CATALYTIC SYSTEM DESIGN DATA

Flow Rate :	1000	1500	2000	3000	4000	5000	SCFM
Inlet Temp:	70	70	70	70	70	70	F
Stack Outlet Temp:	270	270	270	270	270	270	F
Catalyst Inlet Temp:	550	550	550	550	550	550	F
Catalyst (95%):	1	1.5	2	3	4	5	Cu. ft.
Catalyst (98%):	2	3	4	6	8	10	Cu. ft.
Destruction Eff.:	95	95	95	95	95	95	% Catalytic
Destruction Eff.:	98	98	98	98	98	98	% Catalytic
Burner Input:							
@0.0 PPM	0.6	0.9	1.08	1.65	2.16	3.3	MM Btu/Hr
@1000 PPM	0.0	0.0	0.0	0.0	0.0	0.0	MM Btu/Hr
Gas Press:	0.5	0.5	0.5	0.5	0.5	0.5	PSI
Refractory Lining:	6	6	6	6	6	6	In
SHELL DIM. (OD)							
(Add 18” for panel)	36	36	48	48	60	72	Width
	48	60	60	72	72	72	Height
	96	96	120	120	120	120	Length
WEIGHT:	1000	1200	1800	2500	5000	7000	LBS.

HTT GAS and ELECTRIC CATALYTIC OXIDIZERS

TYPICAL HTT SYSTEM

HTT shall supply one Fume Incineration System. The system shall include an integral preheat exchanger to raise the temperature of the process gases to the required operating temperature. This will assure maximum destruction of the VOC in the exhaust gas. The system shall be packaged complete with an integral preheat exchanger, Inconel sheath low watt density heating elements, precious metal ceramic type catalyst module, refractory lined processing chamber, and the field installed stack.

CATOX SYSTEM CHAMBER

The Catox System shall be constructed of 304 stainless steel (Note: We use 316 L for HCl solvent applications) and insulated with a combination of Ceramic Fiber and high temperature insulating materials. The refractory shall be installed with SS anchors to maintain integrity. The lower chamber shall be constructed of carbon steel and coated with an acid resistant epoxy coating.

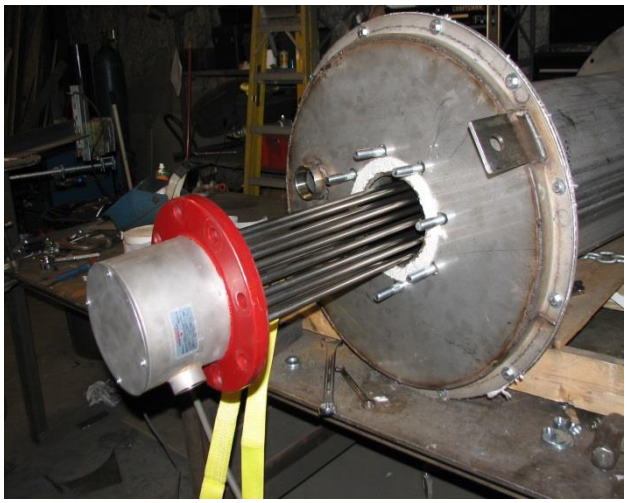
150 SCFM Catox Shell with EZ-Bolt on Catalyst Module

CATALYST BED

Catalyst shall be supplied in modular sections in separate frames. The frames will be complete with mounting flanges and gaskets. The frames will bolt directly to a SS support grid inside the chamber of the retention zone. The EZ-Bolt-On Catalyst modules may be installed internally for ease of removal and maintenance.

PREHEAT EXCHANGER

The system shall include an integral preheat exchanger for raising the temperature of the exhaust gases prior to entering the firing chamber. The exchanger shall be a shell and tube type unit manufactured using easy clean 1 in alloy tubes.



ELECTRIC HEATING SYSTEM (E)

The system shall include a process air electric heater for raising the temperature of the gases to operating temp as required. System shall be complete with an Incalloy sheathed tubular heater rated at 20 watts/sq. in, mounted on a stainless flange with a weather-proof terminal housing, and screw type terminals.

300 SCFM ELECTRIC CATOX SYSTEMS

500 SCFM ELECTRIC CATOX SYSTEMS

SYSTEM OPTIONS

ID BLOWER (IDB Option)

The system shall include one (1) dilution air blower for maintaining minimal air ratio and for controlling chamber temperature. The blower shall include a control damper and modulating actuator.

FLAME ARRESTER (FA Option)

The system shall include one (1) flame arrester to prevent the gases and flame from backing up the supply duct.

AIR CONTROL TEE (T Option)

The system shall include one (1) waste gas diverting tee for closing off the stack during operation or for closing off the waste gas to the oxidizer when the system is not operational. Package shall include a spring return actuator that will divert up the stack during a power failure.

DATA LOGGING (DL Option)

Package may include an optional Data Logging system as manufactured by HOBO and may be model H12-002 for a single channel type K TC. Other recorders shall are available that will accept T/C, MA, or DC inputs for required sensors.

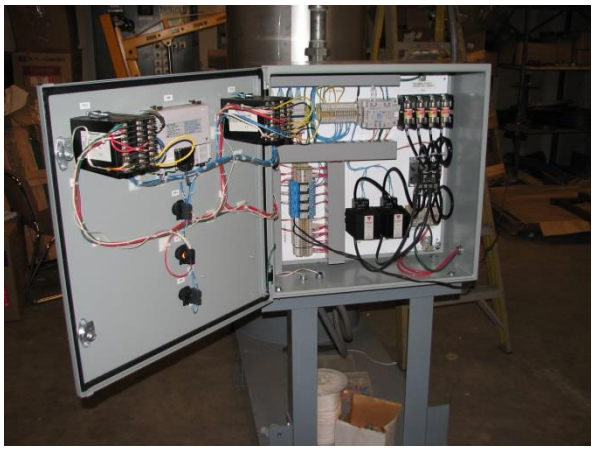
NATURAL GAS BURNER (G Option)

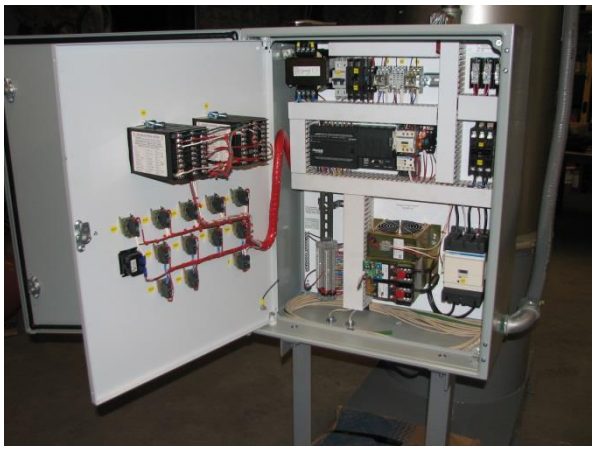
The system is available with a packaged gas fired burner, for raising the temperature of the gases to operating temperature as required. System shall be complete with flame safety, controls and safeties. A motorized modulating gas valve will regulate the burner output using digital controllers. Burner train components are supplied loose for field installation. Customer shall supply natural gas regulator.

CONTROL OPERATION

The operator shall start and stop the system from the main panel or from remote inputs. Startup shall prove the blower, start burner, prove set temperature, and signal to start fume injection. Blower pressure and the customer safety limits must be proven prior to burner ignition. Component failures will shut down system and alert the operator. Indicator lights will display fault.

The system shall be designed to operate with a variable waste gas input. Natural gas will be controlled to maintain a preset temperature. The system will be able to self regulate the fuel input to both maintain temperature and adjust conditions to match the flow of the waste gas stream.





CONTROLS

The package shall include one (1) Hoffman Nema 4 control panel, for remote control and monitoring. The system shall maintain a preset temperature utilizing a type K T/C and 4-20 ma digital controllers. The system shall be monitored with Honeywell DC-3000 temperature controllers for system operation located in the main panel. All controls and safeties are operated from this panel. The controller will modulate the heat input to maintain temperature. Contacts will be provided for remote start and stop, pressure limit switch, and for motor starter coil. PLC operation is optional.

ELECTRIC CATALYTIC SYSTEM DESIGN DATA

Flow Rate:	100	200	300	500	1000	1500	SCFM
Waste Gas Temp:	100	100	100	100	100	100	F
Preheat Temp:	415	415	415	415	415	415	F
Catalyst inlet Temp:	550	550	550	550	550	550	F
Temp rise from Elec:	135	135	135	135	135	135	F
Temp rise from VOC:	200	200	200	200	200	200	F @ 8% LEL
Catalyst outlet Temp:	700	700	700	700	700	700	F
Est. Stack Temp:	250	250	250	250	250	250	F
Calc. Heat Input:							
0% LEL	7.5	15	24	37,5	75	112	KW
3% LEL	4	8	16	20	40	60	KW
6% LEL	0	0	0	0	0	0	KW
Heating Element Rating	12	24	36	60	120	180	KW
Destruction Eff:	99	99	99	99	99	99	%
Preheat Eff:	70	70	70	70	70	70	%
Catalyst Volume:	0.5	0.5	1.0	1.5	2	3	Cu. Ft.

DELIVERY: Shall be 4-8 weeks after the receipt of a valid purchase order, progress payments, and all required approvals.

TERMS: 33.3% with order, 33.3% when fabrication period is half way, 33.3% when fabrication is completed prior to shipment.

Note: Costs of any and all emissions testing are extra. Any additional equipment or controls required above those stated herein shall be provided at extra charge.

INSTALLATION: Installation will require running gas and utilities to unit from source. We suggest the gas train, supply duct, and main panel are located indoors, we will provide these components loose prior to shipment of the main unit to be installed prior to delivery of main units.

Typical Sources of Supply

1. Refractory Materials
   - AP GREEN
   - CARBORUNDUM

2. System Controls

SWITCHES	- Square D, Allen-Bradley
RELAYS	- 3PDT W\Neon indication
PANELS	- Hoffman, NEMA 4
CONTROLLERS	- Honeywell, UDC-3000
VALVE TRAIN	- Asco, Honeywell

3. Burners - Midco, Haulk, Maxon

4. Catalyst materials -Air Flow Corporation

Warrantee: HTT shall warrant that the system described shall meet all pertinent emissions codes per the submitted documentation. HTT shall warrant that the equipment furnished shall be free of defects in materials and workmanship. This warrantee shall cover parts manufactured by HTT for a period of FIVE YEARS. HTT shall extend warrantees for parts not manufactured by HTT. Defective components shall be repaired or replaced per the manufacturers warrantee to be installed by customers personnel.

Documentation: HTT shall provide operating and maintenance manuals that include operating instructions, component data, and drawings.

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