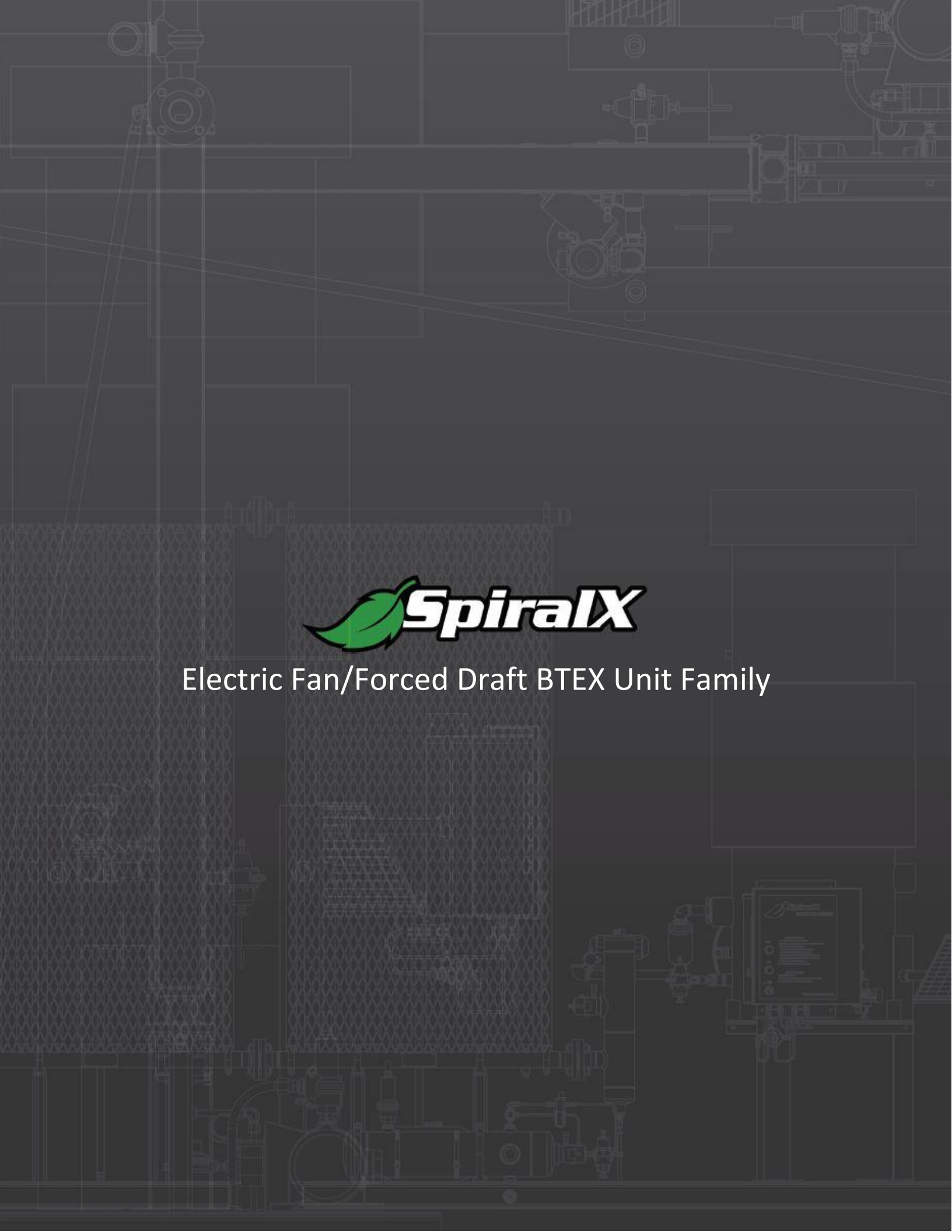


Electric Fan/Forced Draft BTEX Unit Family

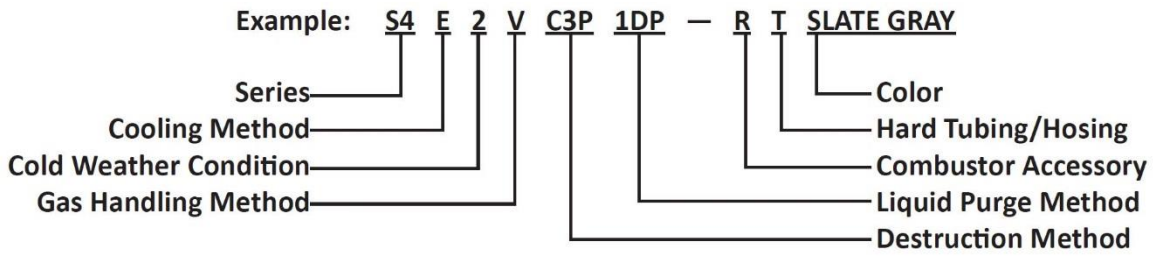
Table of Contents

1 | INTRODUCTION

Congratulations on beginning the process of selecting a SpiralX BTEX system! Please read this entire manual to make sure you learn about all the features our units have to offer. This document is meant to showcase the SpiralX standard Forced Draft BTEX system and its various optional upgrades, but it can also be used as a general reference for system start-up and other beneficial information.

The SpiralX Forced Draft BTEX units use electric fans to force air across finned tubes and promote condensation independent of the surround ambient temperature, designed for use with triethylene glycol dehydration units. They use all the steps necessary to prepare BTEX for elimination safely and efficiently. Standard components for these units are a carbon steel atmospheric accumulator tank complete with a bypass system, as well as a diaphragm pump to remove collected condensate. Available upgrade options are a stainless-steel accumulator tank for greater corrosion resistance, an electric pump for ZERO emissions compliance, and a dual pump setup with automatic switching to adequately collect condensate during upset conditions and reduce downtime in the field.

1.1 | Part Number Sheet for Ordering



SERIES	
S1	Series 1
S2	Series 2
S3	Series 3
S4	Series 4
S5	Series 5
S6	Series 6
S8	Series 8
S10	Series 10
S12	Series 12
COOLING METHOD	
A	Ambient, natural draft
E	Forced Draft (fan)
G	Shell & Tube heat exchange
COLD WEATHER CONDITION	
0	No enclosure / No heat trace
1	Enclosure / No heat trace
2	Enclosure w/ heat trace
GAS HANDLING METHOD	
V	Vented
C	Captured/No Vent

DESTRUCTION METHOD	
C3P	30” Combustor Profire BMS
C4P	48” Combustor Profire BMS
SC	On Board Compressor
F2	2” Fuel Ring
F4	4” Fuel Ring
F6	6” Fuel Ring
000	N/A
LIQUID PURGE METHOD	
1EP	Single Electric Pump
2EP	Double Electric Pump
1DP	Single Diaphragm Pump
2DP	Double Diaphragm Pump
COMBUSTOR ACCESSORY	
0	NONE
R	Rain Cap
X	Extension
S	Stainless Steel Burner Grid
RX	Rain Cap and Extension
RS	Rain Cap and Stainless Steel Burner Grid
XS	Extension and Stainless Steel Burner Grid
RXS	Rain Cap, Extension, and SSBG
HARD TUBE/HOSING	
H	JIC Hosing
T	Stainless Hard Tubing
COLOR	
_____	Select approved BLM color

Notes:

1. This sheet is for educational purposes only regarding SpiralX LLC part numbering method. Official orders to be made through quotes.

2. Some configurations prohibit others. i.e. Combustor accessory cannot be chosen without choosing combustor as destruction method.

3. BLM (Bureau of Land Management) color chart @blm.gov

4. Notation “C” for gas handling method is captured venting or NO venting for Zero Emission Setup.

1.2 | Paint Coating & Material Standards

Spiral X LLC uses the following paint materials:

- Process Skids

  [PPG] AMERCOAT 370 PRIMER

  [PPG] PITTHANE ULTRA URETHANE 95-812 TOPCOAT

  **Alternatives include the Sherwin Williams Macropoxy 646 Epoxy Primer B58(A) & hardener B58(B), and HI-SOLID Polyurethane gloss top coat B56(S) & hardener B60(T).

- Combustor (high temperature) components

  HEATCOTE HC335 - FLAT BLACK. 1000°F resistant.

  **Alternatives include the Tufcote™ 3.5 Hi-Heat paint 982. 1200°F resistant. Silicone Alkyd COLOR – BLACK

Spiral X LLC adheres to the following paint spec from the Society for Protective Coatings (SSPC):

- SSPC-SP1

  SOLVENT CLEANING – Using various solvents with approved/verifiable safety data sheets to remove all visible oil, grease, soil, drawing and cutting compounds, and all other soluble contaminants from steel surfaces.

- SSPC-SP2

  HAND TOOL CLEANING – Using various non-powered hand tools to remove loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter from surfaces to be painted.

- SSPC-SP3

  POWER TOOL CLEANING – Using various power-assisted tools (rotary, impact, or power brushing tools and power abrading tools) to remove loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter from surfaces to be painted. Power tools must not be used in a manner that can create burrs, sharp ridges, and sharp cuts.

  **Sand blasting (SSPC 6) can be performed as an upgrade option if specified by customer.

Spiral X LLC Standard Colors

Spiral X LLC standard colors are listed below.

- Carlsbad Canyon Tan*
- Shale Green*
- Ansi Gray
- Flat Black (Combustors)

*Taken from the Bureau of Land Management (BLM) approved colors.

To request a new color, please provide Spiral X LLC with the corresponding color code, preferably RAL code, but Sherwin Williams color code is also acceptable.

Spiral X LLC Standard Quality Control Testing Procedure

Thickness tested per SSPC-PA 2. Brief description of process shown in Paint Spec Checklist.

Material Specifications

GENERAL NOTES
NDE not required
Pneumatic connections: Teflon line JIC hose - or - 304 Stainless tubing.

PIPING			
SIZE	MATERIAL	SCHEDULE (STD)	NOTES
≤1"	*A/SA312 TP304/304L	sch.40	
	ASTM A500 GR-B	sch. 80	
2" NPS	ASTM A500 GR-B	sch. 80	EXHAUST PIPING
HEX HEADER (3")	A/SA312 TP304/304L	sch. 10	per ASME Sect. VIII UM vessels
HEX FINNED TUBE	A/SA249 TP304/304L	16 GA	per ASME Sect. VIII UM vessels

*1" stainless tubing, 0.065" t w/ yorlok fittings also used. Upgrade: Swagelok fittings

FITTINGS			
SIZE	MATERIAL	SCHEDULE/CLASS	NOTES
≤1"	A/SA312 TP316/316L	CL3000	Per ASME B36.19
	A/SA-105	CL3000	
2"	A/SA312 TP316/316L	CL150	
	A/SA-105	CL150	
3"	N/A		

FLANGES			
SIZE	MATERIAL	SCHEDULE/CLASS	NOTES
≤1"	A/SA182 TP304/304L	CL150 RF	
	A/SA-105	CL150 RF	
2"	A/SA182 TP304/304L	CL150 RF	
	A/SA-105	CL150 RF	
3"	A/SA182 TP304/304L	CL150 RF	

GASKETS			
SPIRAL WOUND	CG AISI 316 W/ GRAPHITE	CL150	

1.3| Models in 99 Hi C Series family

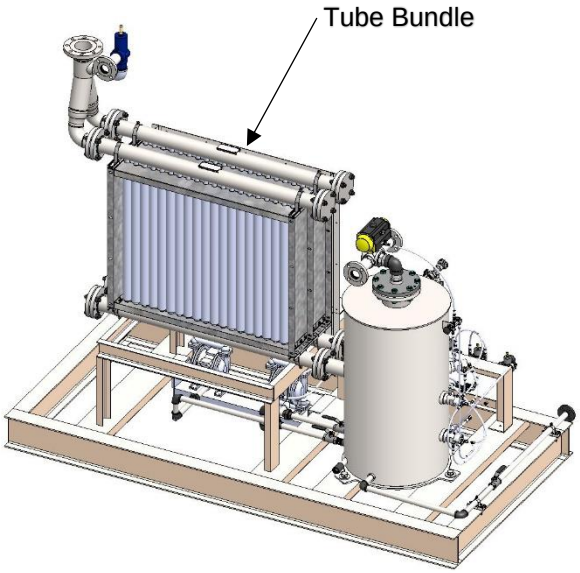
WARM WEATHER

- Series S3E-S5E

  S3: 1 Tube Bundle

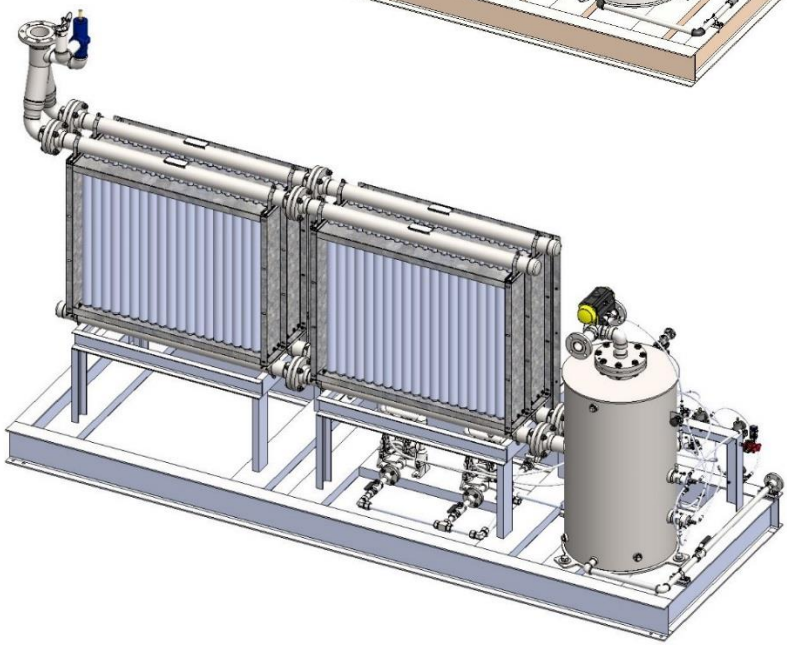
  S4: 2 Tube Bundles

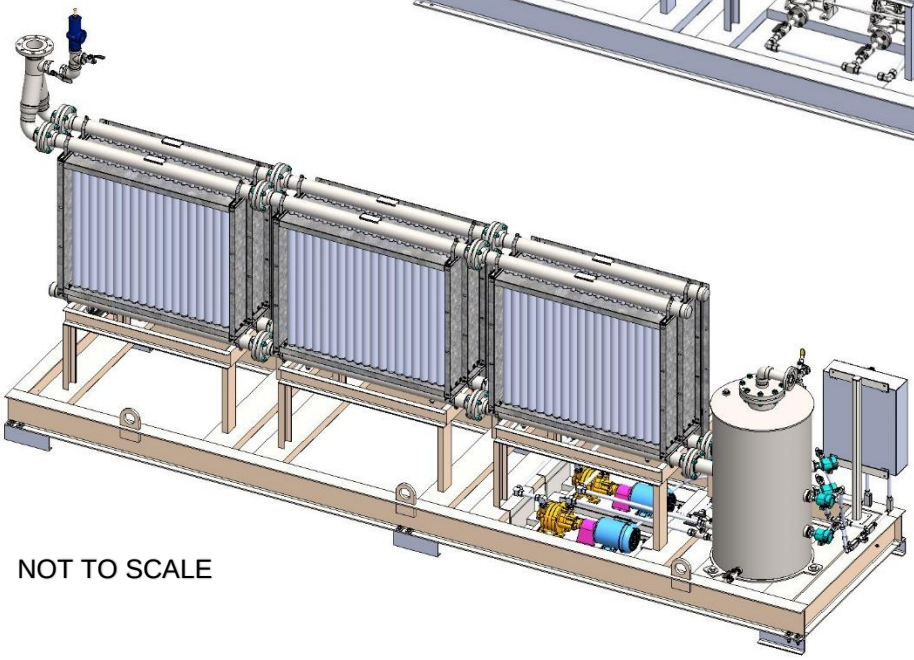
  S5: 3 Tube Bundles



- Series S6E

  S6: 4 Tube Bundles

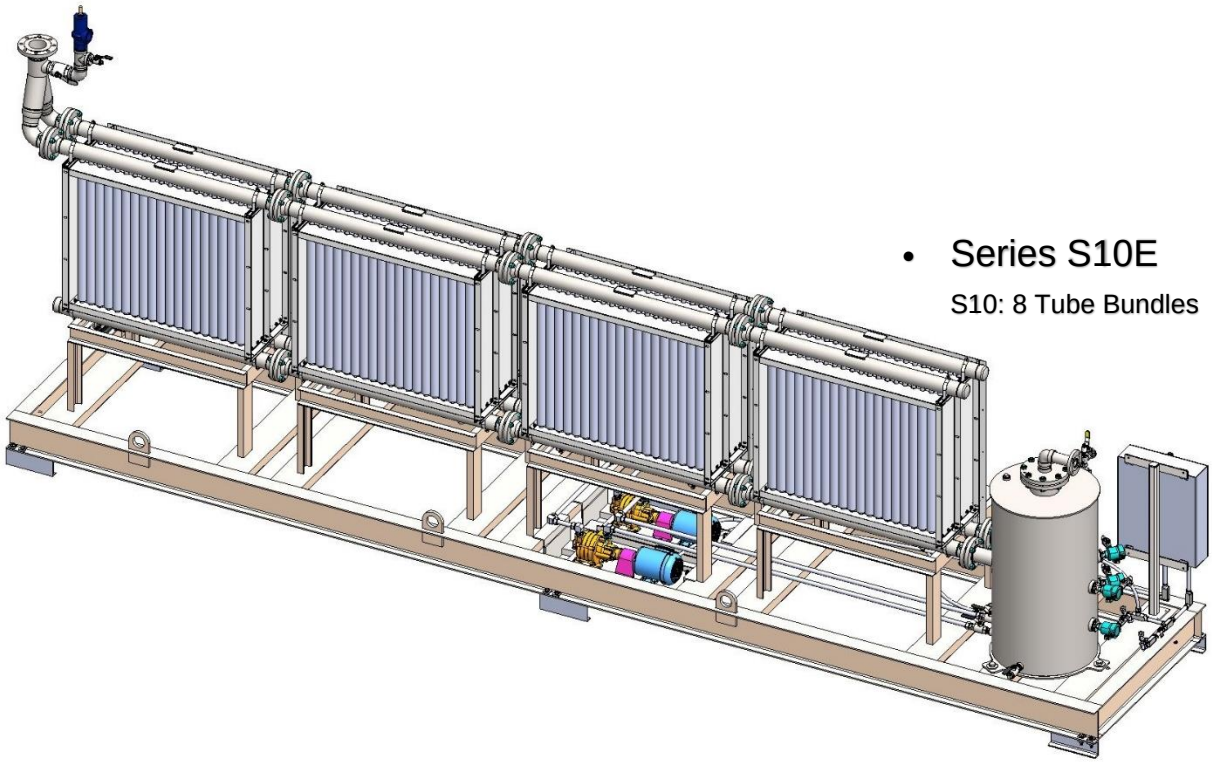




- Series S8E

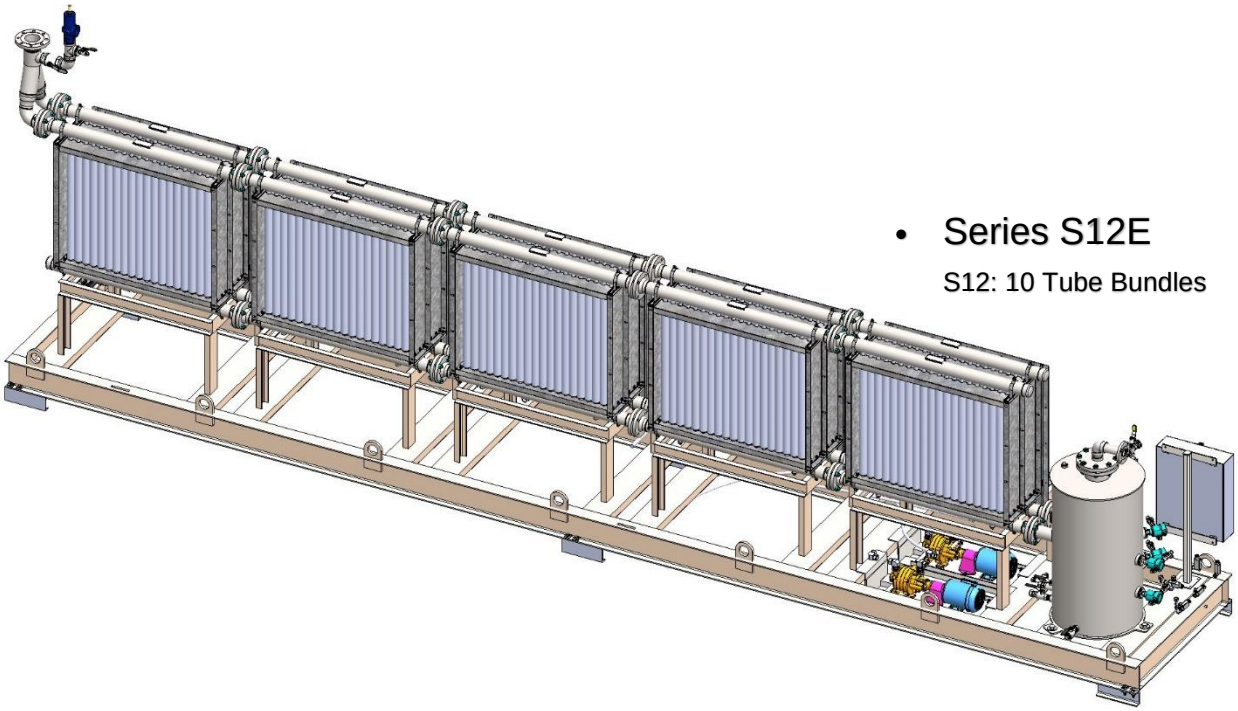
  S8: 6 Tube Bundles

NOT TO SCALE



- Series S10E

S10: 8 Tube Bundles



- Series S12E

S12: 10 Tube Bundles

NOT TO SCALE

1.4 | Important Safety Information

Installation and use must not deviate from the directions in this manual. Positions of components shown within this manual may differ slightly from your actual unit.

Because the entire system is gravity dependent, the skid must sit on a level surface for correct operation.

All pneumatic vents must be sent to a safe location. Instrument gas collection in unsafe areas can be an explosion hazard.

Condensate fluid is extremely flammable; all safety precautions must be used when operating this system. All outlet piping of BTEX exhaust must slope upward towards method of destruction/collection to allow condensate to fall back into accumulator tank.

EXPLOSION HAZARD 

Do not attempt to service or open ignition panel when energized unless area is known to be non-hazardous.

FOR QUESTIONS PLEASE CALL US.
469-480-8802

1.5 | Included Components

ITEM	*DESCRIPTION*	*QTY.*
1	Primary condenser skid with accumulator tank	1
2	Double diaphragm pump / electric pumps	1-2
3	Electric heat trace connection kit (optional)	0-1
4	Inlet pressure safety valve spool or manifold (PSV)	1

A sight glass is mounted on the side of the accumulator tank to allow visual confirmation that the system is functioning.

2 | INSTALLATION

Installing the SpiralX BTEX System is very simple. Follow the directions carefully. If you need assistance, you can call tech support at 469-480-8802.

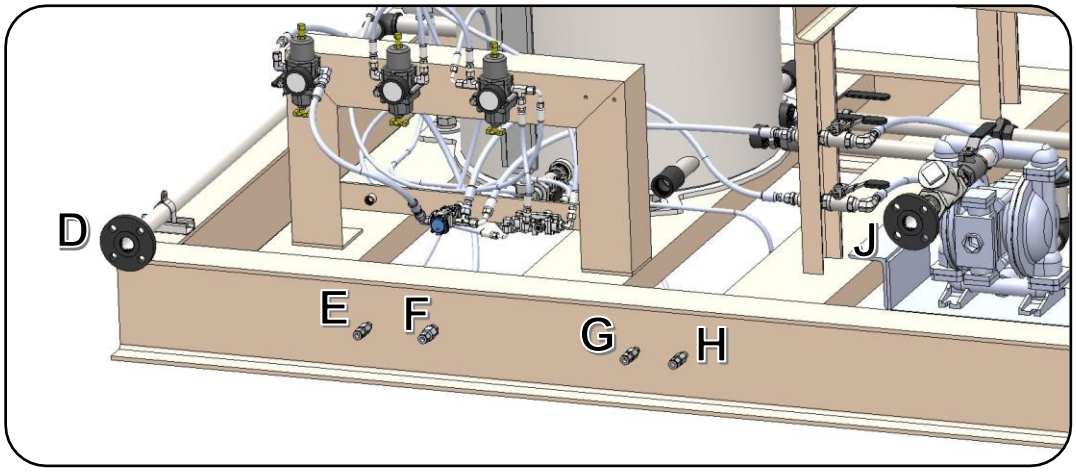
2.1 | Input & Output Connections

Below are the connections necessary to operate the system. They are labeled to match with the system's general arrangement document.

ITEM	*DESCRIPTION*	*PRESSURE*	*SIZE*
D	TANK DRAIN	N/A	1" CL150RF
E	INSTRUMENT AIR FOR SWITCHES	55-100 PSI	3/8" TUBING
F	INSTRUMENT GAS FOR PUMPS	80-100 PSI	3/8" TUBING
G	HLSD SIGNAL TO COMBUSTOR (IF INCLUDED)	0-55 PSI	3/8" TUBING
H	PILOT SIGNAL FROM COMBUSTOR (IF INCLUDED)	0-55 PSI	3/8" TUBING
J	PUMP OUT	N/A	1" CL150RF

2.2 | Instrument Supply

Instrument air/gas is supplied to the system through tubing bulkheads located along the skid. These bulkhead fittings need to be supplied with instrument air/gas as shown in the figures. A coupling is also in place for transporting condensate from system.



Bulkheads E is the instrument air supply for the pneumatic level switches and the bypass system. It pressurizes the system to allow the components to actuate based on liquid level within the tank. Bulkhead F is the instrument air/gas supply for the diaphragm pump(s). This is the air that will pass through either pump to dispel the tank liquid. Port J is a 1" condensate outlet and Port D is a flanged condensate outlet used to drain the tank. Both sources of condensate are to be collected by the user.

2.3 | Post Assembly

Due to some shipping constraints, these units may arrive with the PSV assembly detached from the unit fixed to the skid. This must be threaded into the inlet manifold to match the General Arrangement. Once this is completed, the unit can be connected to the inlet and outlet connections on site. The PSV, “BTEX OUT”, and bypass connections require 2-inch gaskets and stud kits, and the tank drain requires a 1-inch gasket and stud kit. The system inlets and other connections may vary based on series model.

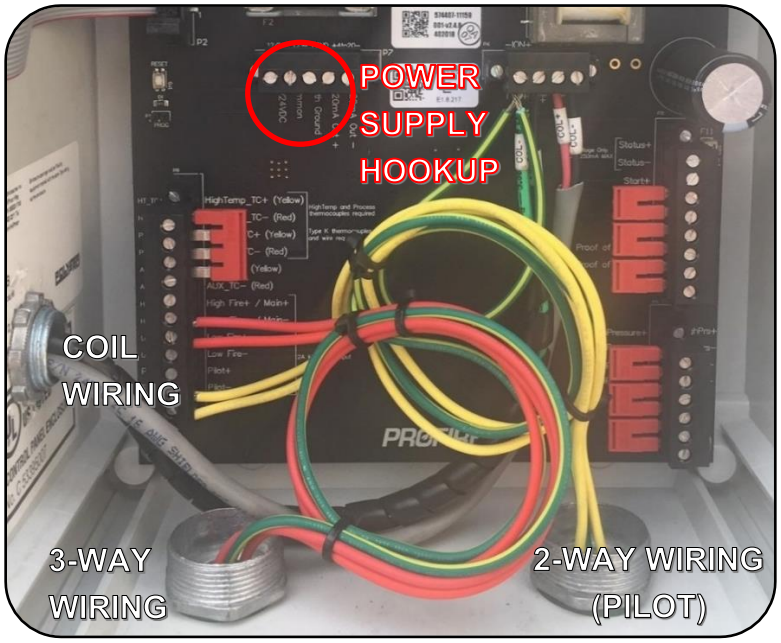
The flanged connections will have tape or plastic covers like the one shown to protect against debris during transport. Remove these and line up the connections with the correct on-site connection points. A common practice is to unscrew the nuts on one side of the stud kit, insert the studs into the flange holes, and rest the gasket on the two lower studs. This can facilitate stud and gasket placement when lining up the BTEX unit. Once the flanges have been lined up and the studs pass through the two flanges, screw the nuts back on and tighten to the necessary torque for the respective flange sizes. Make sure that the flanges remain concentric as you tighten each stud. An offset flange interface can increase the chance of blowing a gasket.

3 | ELECTRICAL CIRCUITS/ENVIRONMENT

This system uses a combination of electric and pneumatic circuits to function with minimal operator supervision. The Profire ignition uses solenoid valves to operate pneumatic lines via electric signals and pressure switches are available to monitor the tank supply line in case of failure. Each electrical component has its own unique tag-id. Use these tags and the corresponding pictures to reference the P&ID and follow the circuit.

3.1 | Profire™ Ignition & Solenoids

The main electrical component on the unit is the Profire™ ignition system, rated for CLASS I DIV. II. It is responsible for directing supply gas, igniting the burner pilot, and monitoring the combustor to stay at an optimal temperature via connecting solenoid valves. 12 or 24 VDC Power supply must be hooked up to the unit by the user to power the ignition system (shown below). The Profire™ ignition has an upgradeable option for emergency shutdown for high temperatures defined by the user (194°F default) that relays shutdown procedures to the rest of the system. It also has an optional Modbus upgrade that connects to the ignition box to monitor and control the unit remotely from a control room. These options require an upgraded Profire 2100 and additional parts (thermocouple/Modbus card). Refer to the Profire 2100 owner's manual for more information on installation and setup.



3.2 | Governance Module

Key Features:

- OPC UA Server Integration
- Plug-and-Play Compatibility
- Data Integrity and Reliability
- EPA History
- Manual, Time-Based, & Auto Features

The Spiral X Governance Module, a standard feature of all units, is an interactive BTEX Unit monitoring system that stores and distributes Modbus information and all I/O data. The Module interface is accessed via an HMI screen, where users can control and monitor real time data from SpiralX emissions control BTEX systems.

You can collect Profire™ data from your Dehy and combustors, both of which are equipped with Modbus RS-485, and input their signals into the governance module. Additionally, the module supports inlets and outlets such as temperature transmitters used for fan control. Data can be stored and transcribed from Modbus RS-485 to either TCP/IP or OPC UA, facilitating various distribution methods.

The Governance Module is designed to leverage OPC UA server communication, as it is compatible with customer SCADA systems. This system prioritizes security and optimizes the user experience, ensuring that the connection between the OPC UA client and SpiralX PLCs is both reliable and precise to maintain governance.

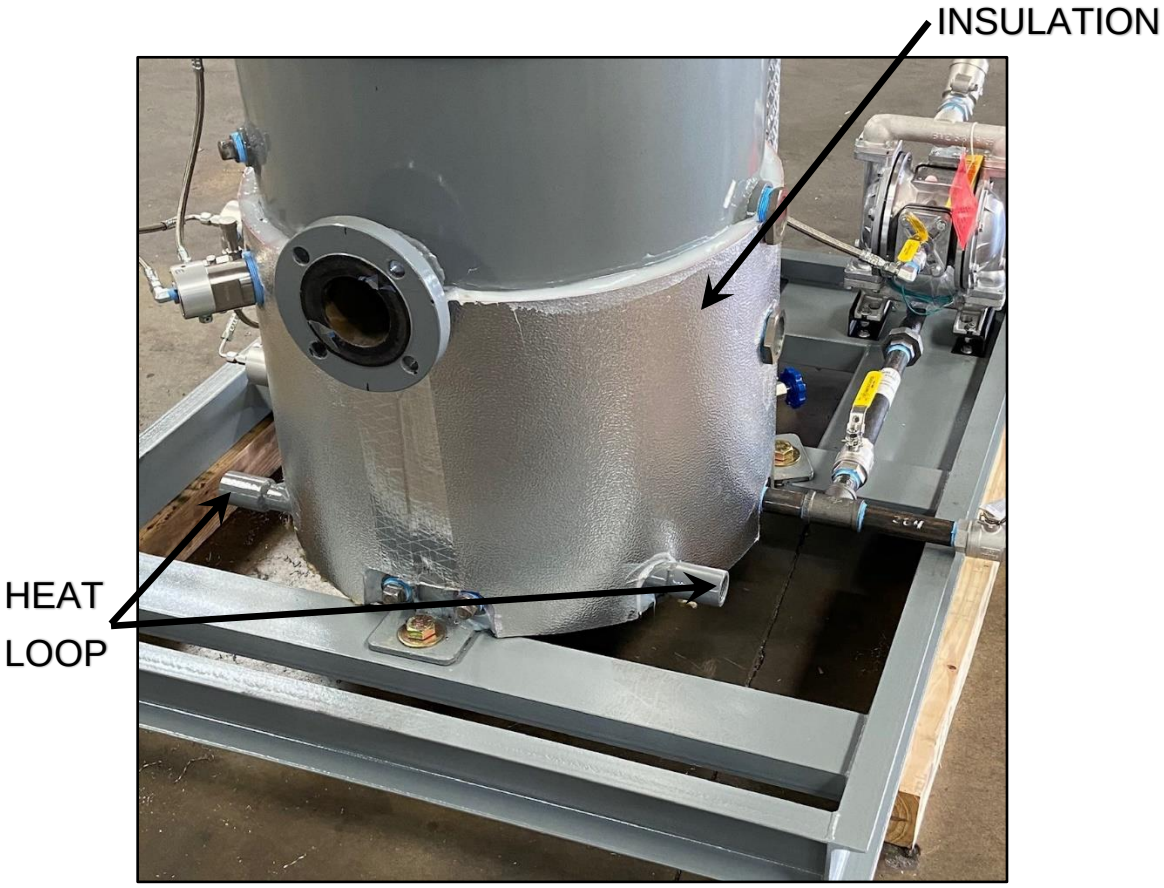
For detailed steps and guidelines, refer to our Control Panel manual's dedicated second on OPC UA client configuration and server interface interaction.

3.3 | System Environment

All of the SpiralX systems offer self-regulating electric heat trace to combat freezing temperatures in the field. A heat trace electrical connection kit is optional and must terminate 240 VAC power. It is made of Tinned/Copper braid and TPE Overjacket. Instructions for using the connection kit are included in the box. Must be 10 WATT. All components rated for Class 1, Div. II environments. Cable is wrapped around tank and traces liquid lines with an extra 5 feet to travel off skid for connection.

Cold Weather Upgrade

All SpiralX units have a cold weather upgrade available to further prevent freezing in cold areas.



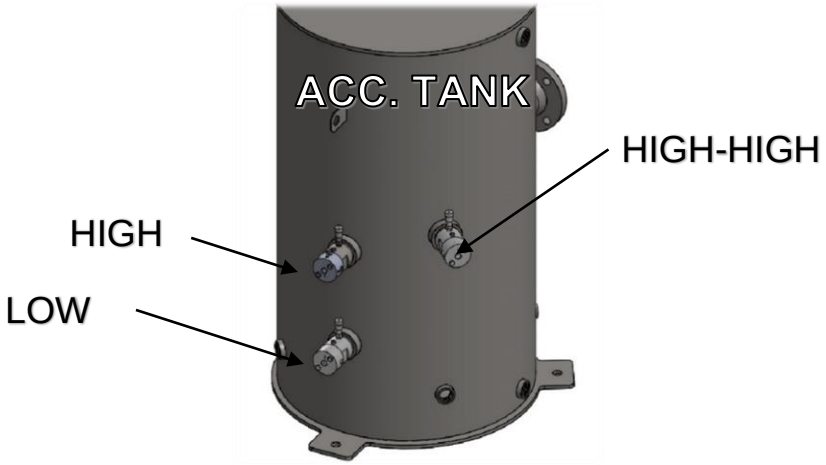
1-inch-thick Lamella insulation (rated to 1200°F) with an Aluminum jacket insulates the liquid retaining portion of the tank. Complies with ASTM C447, C1393, C585, C1335, C1338, & E84.

A heat loop also runs through the bottom portion of the tank. Warm media from location (heated air, warm glycol, etc.) can be cycled through these connections to keep liquid from freezing in colder seasons.

4 | OPERATING PNEUMATIC CIRCUITS

In the next section, the pneumatic circuit will be explained with detailed pictures. Both the condenser and combustor system play an important role in the operation of the pneumatic circuit. Knowing these components and how they work will help greatly to aid in troubleshooting during a malfunction. This section will cover the atmospheric accumulator tank, bypass, and combustion system, as well as the pneumatic failsafes. Each valve has its own unique tag-id. Use these tags and the corresponding pictures to reference the P&ID and follow the circuit.

4.1 | Tank & Level Switches



Accumulator Tank

The function of the accumulator tank (ABOVE) is to collect the condensate produced by the condenser circuit and further separate the liquid from the inlet gas via a demister pad located at the top outlet of the tank. From there, the drier gas is transferred to the BTEX or bypass outlet as its condensate collects until the pump setup is signaled to remove it. As liquid collects within the tank, there are six scenarios that can occur.

1.) Liquid is underneath low-level switch:
    The diaphragm pump will turn off if previously activated from scenario 4. LOW is normally open, so its supply remains on the “off” signal of the bistable pilot until the liquid level reaches it.
2.) Liquid is at low level switch:
    LOW cuts off supply to the “off” signal of the bistable pilot, allowing it to be turned on by the high-level switch. When the system is first activated, no physical change should occur because the pump is still de-activated from scenario 1.
3.) Liquid is in between the low- and high-level switches:
    System function will continue based on which scenario has just occurred. For instance, if liquid is coming from low-level, the pump is to remain deactivated. If liquid is coming from high-level, the pump is to remain on.

4.) Liquid is at high-level switch:
The bistable pilot is signaled to turn on the pump by opening its air supply. This activates the in-line pneumatic components and dispels liquid out of condensate outlet.

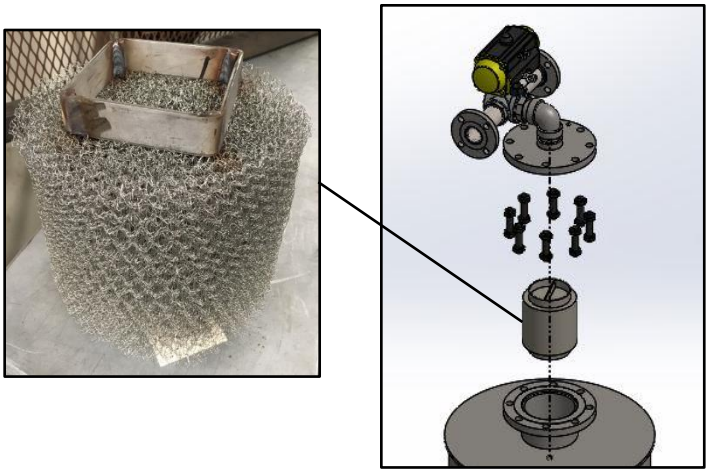
5.) Liquid is in between the high- and high high-level switches:
The pump remains on. Air supply will be sent back to the manual reset if previously cut off from scenario 6. Note that the manual reset knob must be pulled to allow pressure back to the bypass valve and divert exhaust back to the combustor. Secondary pump (if included) can assume the role of the primary pump via opening/closing the appropriate in-line ball valves.

6.) Liquid is at or above high high-level switch:
Supply to the pilot valve is cut off, effectively diverting tank exhaust to bypass. It is assumed that the pump has malfunctioned at this point. If both pumps are running simultaneously, check if ball valves to both pumps are open. This scenario is known as the High Level Shut Down (HLSD), put in place to prevent condensate from entering the combustor during failure. Liquid reaching this level is indicative of pump/primary level switch failure.

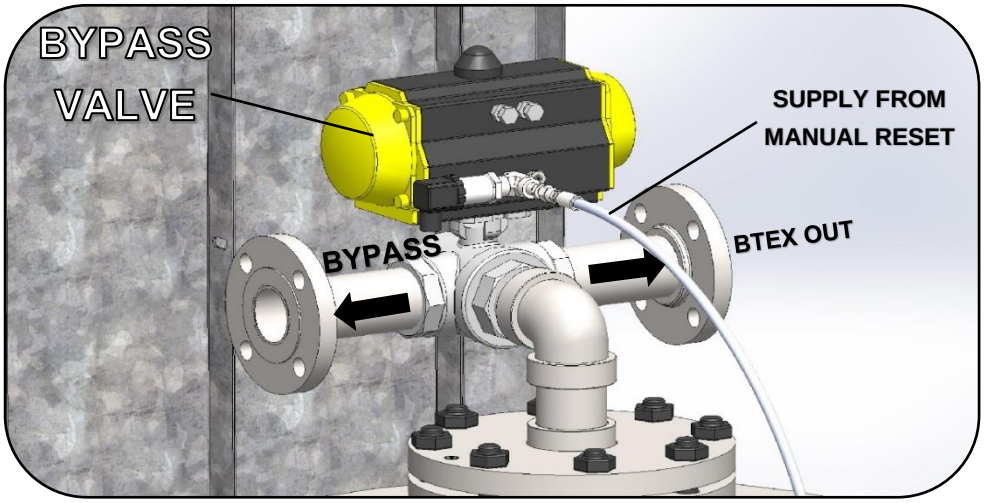
Once the system has been running for some time, the liquid should stay between scenarios 2 and 4. Liquid staying in the other scenarios for too long are indicative of pump or drain malfunction, or too high of a condensate flowrate into the tank.

Demister Pad

All SpiralX accumulator tanks are fitted with a removeable, stainless demister pad. This is a final pass for the exhaust entering the method of destruction, capturing the remaining possible vapor from the exhaust to make it as dry as possible for destruction. The pad is very easy to remove. Remove the connecting piping and 6” flange. Pull out demister pad, spray off to clean, then replace.



4.2 | Bypass System



The bypass system is located on top on the accumulator tank and is dictated by the rack and pinion actuator bypass valve. This actuator diverts the tank exhaust either to the BTEX outlet to be destroyed, or to a secondary bypass location. As a safety precaution, this bypass connection, as well as the PSV connection MUST be captured by the user to an atmospheric collection tank away from an open flame at a downward slope. The tank must be fitted with a level switch and diaphragm pump to dispel liquid as well as a high-level safety switch that turns off the combustor (if applicable) when signaled.

FAILURE TO ADHERE TO THESE SAFETY PRECAUTIONS IS A FIRE HAZARD AND WILL VOID ANY AND ALL WARRANTY FROM SPIRALX LLC.

The system is sent into bypass either by the high high-level switch cutting off instrument supply to the manual reset due to high liquid level within the accumulator tank or the combustor pilot flame not being detected, dictated by the Profire BMS. The system will open air supply back to the manual reset once the liquid level drops below the HIGH-HIGH switch and the combustor pilot flame is detected, but the actuator will not divert exhaust back to the combustor until the manual reset knob has been activated. An indicating knob is located on top of the bypass valve to show which direction the exhaust is currently flowing via yellow arrows.

The manual reset knob is present to prevent the system from automatically diverting BTEX back into “BTEX OUT” after a detected failure has been corrected. This can be hazardous if the BTEX is being sent to a component that can become oversaturated. If at any time the system has indicated a cut off supply to the manual reset and the system is back to functioning normally, an operator must manually pull the reset knob to redirect the exhaust back to “BTEX OUT”.

4.3 | Pump Options

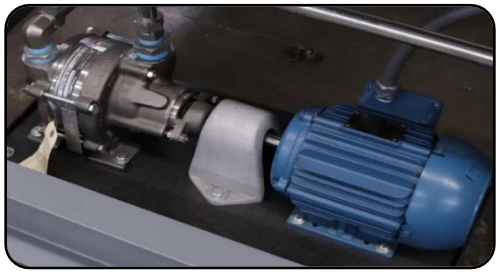
Pneumatic

The pneumatic pump is supplied with 80-100 PSI of instrument gas to dispel condensate at approximately 35 GPM. It is recommended by pump vendor to use instrument gas instead of air to avoid air/gas mixture if the pump’s diaphragm were to rupture, but if instrument gas is used, it is recommended to capture pump’s exhaust port.

Please note that using vent gas will produce some emissions and must be captured and sent to an atmospheric line. It cannot be captured by feeding it back into any outlet of the pneumatic pump. The back pressure created within the liquid line by the check valves will overcome the supply pressure within the pneumatic pump, prohibiting pump function.

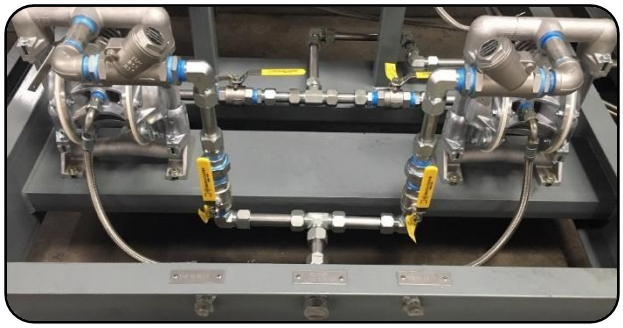
Electric

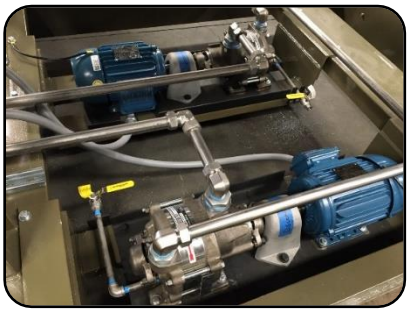
An electric pump option is available that does not require any air or gas to be vented, allowing for 100% zero emissions. Pneumatic level switches are replaced with electric switches and controlled by an on-skid control box that can be connected to the PLC, all rated for Class I, Div. II environments. Electric pumps keep liquid from sitting stagnant and allows for quicker startup as compared to pneumatic. To request this unit with an electric pump setup, please refer to Section 1.1.



Dual Pump Configurations

SpiralX units can be configured to have dual pump setups that allow the primary pump to be repaired / replaced in the event of malfunction while the backup pump takes over. When repairs have been made, the primary pump can be switched back to continue its function without ever having to stop production.





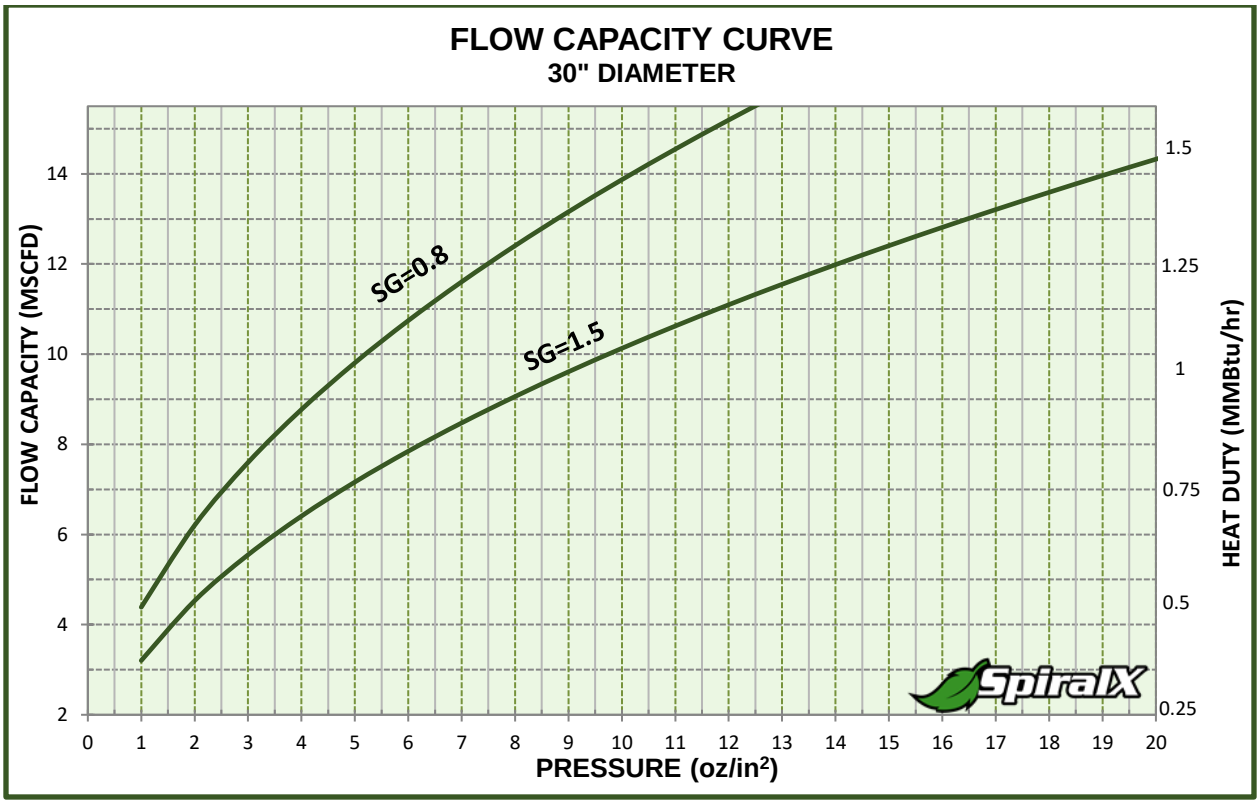
4.4 | Destruction Options

Combustor

VOC DESTRUCTION EFFICIENCY OF SPIRALX ENCLOSED COMBUSTORS

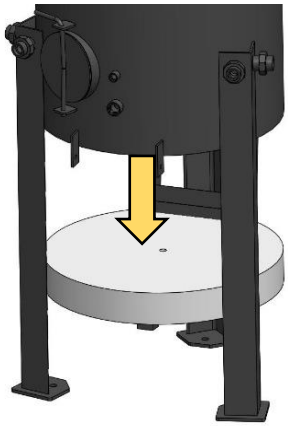
SpiralX LLC combustors are designed for the destruction of volatile organic compounds (VOCs) in compliance with regulations governing upstream oil and gas facilities (40 CFR 60, Subpart OOOOa) and gas dehydration facilities (40 CFR 63, Subparts HH and HHH). Expect 0000a certified combustors by 2025. The reduction in the mass content of volatile organic compounds is a minimum of 99% as prescribed in 40 CFR 60.5412a(d)(iv).

The capacity curve of standard BTEX for the 30”, 48”, and 60” combustor bodies are shown.



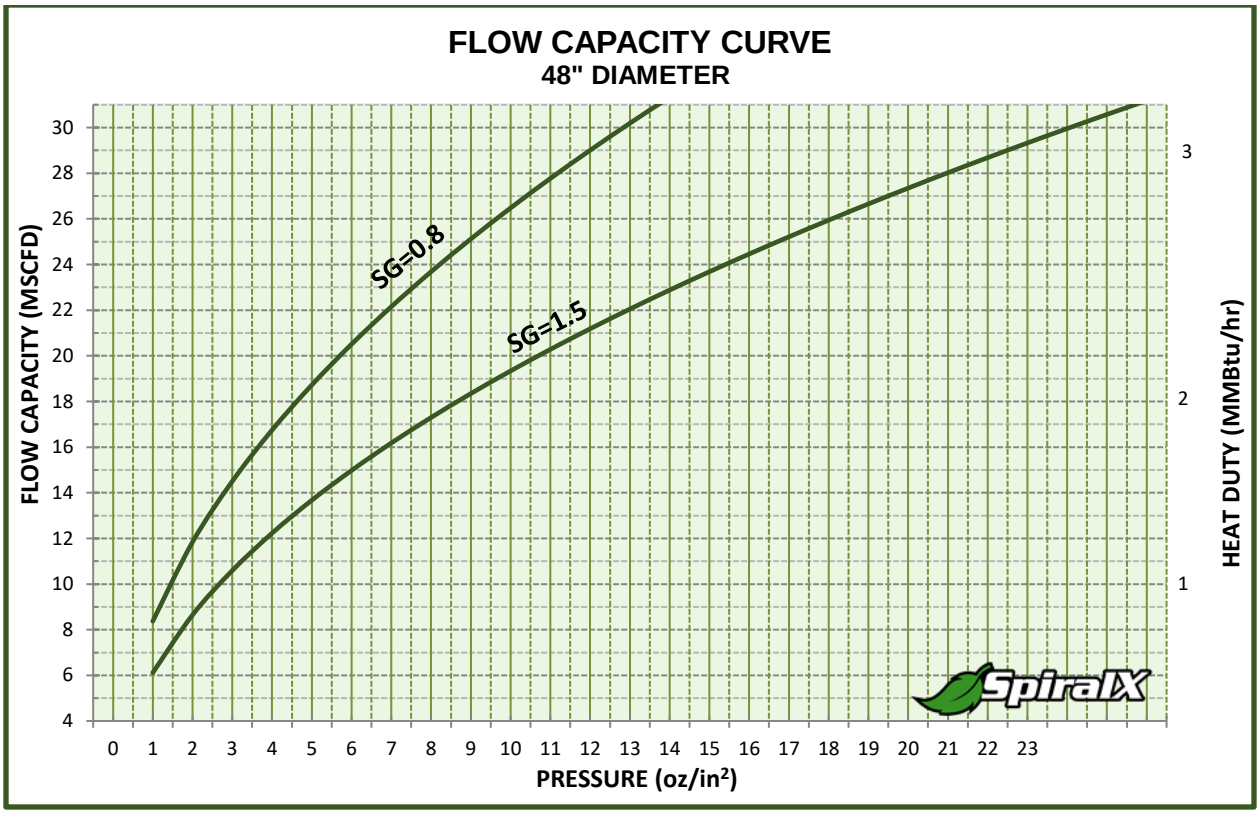
Flow capacity of standard BTEX within a 30” combustor body based on pilot pressure.

SpiralX combustors utilize Profire 2100 systems to monitor the pilot flame and divert BTEX exhaust away from the combustor if a pilot flame is ever not detected. This prevents the combustor from filling up with exhaust and becoming oversaturated. An oversaturated combustor is a fire and explosion hazard. If flames coming out the top of the combustor are higher than approx. three feet, it is recommended to inspect the purity of the glycol within the dehy.

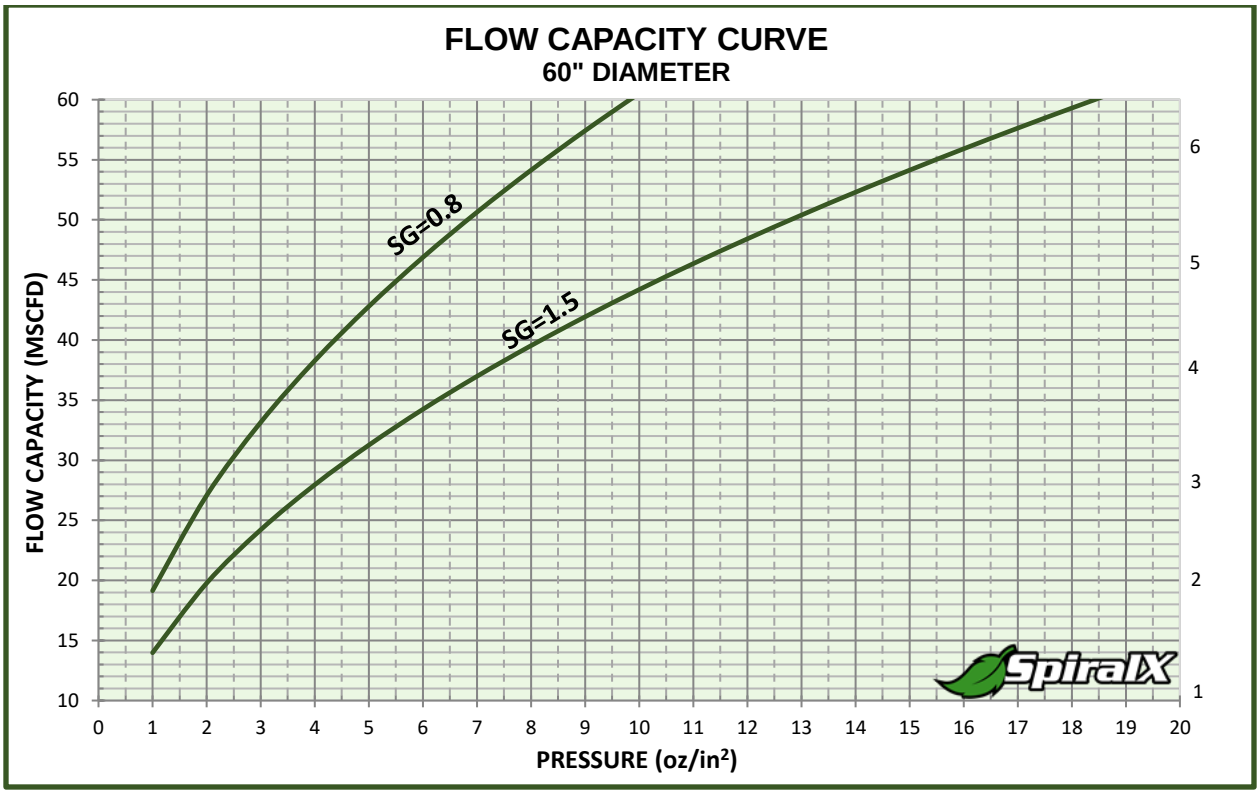


It is highly recommended to not construct any piping, tubing, or similar structures underneath the combustor bottom since this area needs to be clear for flame arrestor removal.

A 48” combustor is available for increased combustion needs. SpiralX also has stand-alone combustor skids that can be attached to existing units if site standards require combustors to be positioned away from flammable areas.



Flow capacity curve of BTEX for 48” diameter combustor as a function of pressure.



Flow capacity of standard BTEX within a 60” combustor body based on pilot pressure.

Fuel Ring

With the SpiralX compound injector burner set, you can send the dry gases from the BTEX system back to the reboiler to be used as burner fuel. The burner set includes a mixer ring which adapts onto the burner inside the fire tube. This allows BTEX gases to be sent to the burner and mixed in with the main burner fuel gas. When the reboiler has reached its operating temperature, the burner will cycle off. When the burner is off, the 3-way ball valve redirects the flow of BTEX gases into the burner stack on the reboiler where it hits the nickel chromium glow plug. The glow plug is manufactured in house at SpiralX, and is installed in the field by the customer into the reboiler’s burner stack. With the glow plug welded into the burner stack wall, the nickel chromium heating element is constantly heated. This allows the BTEX to burn as it passes by the glow plug.

5 | MAINTENANCE

Proper maintenance techniques are the best way to ensure your BTEX system continues to function as efficiently as possible. All of our components are chosen with wear and corrosion resistance in mind, and many of our vendors offer replacement/repair kits whenever a component breaks down or runs out.

5.1 | Scheduled Maintenance

Always remember to shut off all pressure supplies before opening any pneumatic lines during testing. When testing electronic components, all power supply must be completely shut off. Test electrical connections with an ammeter.
Here is a list of maintenance intervals for the system's main components.

ITEM	*DESCRIPTION*	*TEST METHOD*	*INTERVAL*
1	Pneumatic Level Switches	Push manual override switch to activate.	Every 6 months
2	High Level Shutdown/ drain valve	Observe during system testing	Every 6 months
3	Flame Arrestor (ONLY WITH COMBUSTOR)	Shut down system, remove, and inspect. Clean out debris.	Once a year
4	Condenser Fin Tubes	Disconnect system from dehy, flush tubes with compressed air or water.	Every 6 months
5	Versa Manual Reset Valve	Push reset knob in. Check that actuator knob changes direction.	Every 6 months
6	Pressure Safety Valve	Compressed air test to over 12 oz. If in-line connection available.	Once a year