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SEAL, INC.**

Engineered Products and Services
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DHS-XXX SAMPLING SYSTEM

BASIC OPERATION

*rev 1.1

The DHS-XXX SERIES Emissions Sampling System is designed and manufactured by Atmo-Seal Engineering, Inc., for use with the MKS Multi-Gas Analyzer. This system is designed to deliver heated, filtered emissions samples, Nitrogen and various calibration gasses to the Multi-Gas for analysis and operation. The DHS-XXX SERIES also provides a regulated system to deliver Nitrogen - as a purge gas - to the Multi-Gas.

The DHS-XXX SERIES consists of a primary module containing temperature controllers, filtration, cal/purge gas delivery and monitoring. Additional modules provide pump flow control, additional calibration gas ports, regulated N₂ for purge, and additional control zones for system expansion. The system also contains a high-flow pump, spaces for the blade computer and Multi-Gas, and all heated components needed to deliver a sample to the Multi-Gas.

The emissions sample is pulled through the gas cell via a high velocity pump. Controls for the pump are integrated into the DHS-XXX SERIES emissions sampling package. The emissions sample is precisely temperature controlled from the source to the Multi-Gas. This precision heating ensures the highest sample integrity and reduces problems associated with cold spots and sample degradation. Three independent temperature control zones within the package regulate temperature. Junction heaters, slaved heaters and insulated sleeves also work in concert within the DHS-XXX SERIES system to minimize temperature variances in the sample train. An Atmo-Seal, Inc., heated sample line is used convey the sample to the DHS-XXX SERIES sampling package. Control for this heated line is provided by the DHS-XXX SERIES. The sample is then delivered, after filtration, to the Multi-Gas through the System Line.

After analysis, the heated sample is drawn into the vacuum pump. Pump flow regulation is adjustable via the needle valve located on the front panel of the DHS-XXX SERIES. This valve is fed by, and feeds into, a self-regulating heated sample lines. Keeping the sample warm minimizes maintenance issues associated with pulling a wet gas through a pump. The sampled gas then exits the pump through a compression fitting located inside the cabinet. The end-user is responsible for connecting suitable drain and exhaust tube to this port.

Calibration and purge/zero gasses are introduced to the Multi-Gas through two solenoid valves located inside the DHS-XXX SERIES. The internal solenoid valves are switched on and off by the two toggle switches located on the DHS-XXX SERIES front panel. Calibration/zero gas pressures are manually adjusted via two regulators located on the front panel of the primary module of the DHS-XXX SERIES. A flow meter and valve allows for fine flow adjustment from the front panel. In addition, the DHS-XXX SERIES sampling package incorporates four additional solenoid valves – manifolded to a common output – which will also deliver calibration gases to the Multi-Gas. Control for these valves emanates from a remote I/O connector located on the interior, rear panel of the DHS-XXX SERIES.

Fine sample filtration occurs inside the heated filter located in the DHS-XXX SERIES primary module. This filter may be changed easily at the DHS-XXX SERIES front panel.

It should be noted that providing a filtered, hot sample is the primary purpose of the DHS-XXX SERIES sampling system. Pulling a wet or cold sample into the Multi-Gas may damage internal components to the Multi-Gas optics, resulting in downtime and costly maintenance. To prevent a cold, wet sample from being introduced into the Multi-Gas, and to cut down on wasted calibration gases, a Safety Interlock feature is incorporated into the DHS-XXX SERIES.

The sampling pump will not operate if the temperature of the heated line, which feeds the Multi-Gas, has not stabilized above dew point. The actual temperature in which the pump is allowed to run will vary in a range between 150-190 C. Furthermore, if the sample temperature drops below dew point, the pump will shut off and will not re-start until the sample line reaches a temperature of 150 – 190 c and soaks.

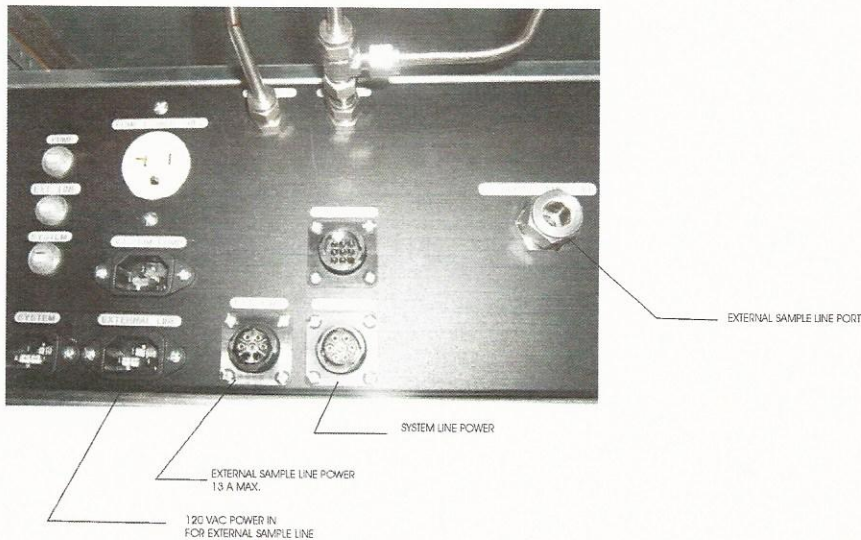
The sampling pump will not operate if either the calibration gas or zero/nitrogen solenoid valves are energized. Two toggle switches are located on the front panel of the DHS-XXX SERIES's primary module; energize the solenoids, allowing gas to flow. Placing either or both of these switches the energized or "on" position will prevent the pump from operating.

The system is contained in a wheeled cabinet for easy transport. A manual foot brake is incorporated into the system and should be used when the system is in place.

ATTACHING THE HEATED SAMPLE LINES

The internal heated sample line connects to the rear of the DHS-XXX SERIES primary module. Control for the line comes from a connector on the rear of the module marked "Ext. Line" and the line is coupled to a swage port marked "External Sample In." Use proper techniques and tools when installing this line. **ALWAYS USE A BACKUP WRENCH WHEN COUPLING OR UNCOUPLING A SWAGE CONNECTION.** Failure to use a backup wrench may result in damage or leaks in the DHS-XXX SERIES system. **Lines with a current load exceeding 13 amps should not be electrically driven by this circuit of the DHS-XXX SERIES.** This circuit has its own breaker and

power cord/module and may be powered by a separate 120 VAC power source if needed. Temperature adjustments may be made via the controller marked “External Sample Line” on the front of the DHS-XXX SERIES primary module.



The System Line delivers the sample to the Multi-Gas. Control is via the connector marked “System Line” and it is controlled from the front panel of the DHS-XXX SERIES primary module. The line comes pre-swaged to the DHS-XXX SERIES system but must be attached by the end-user to the Multi-Gas via a swage fitting. A junction heater to heat the sample in elbow is provided and must be in place when using the Multi-Gas. A K-type temperature probe is also provided to verify the temperature of the incoming sample. Adjustments to the system line temperature – to ensure proper incoming sample temperatures – are acceptable providing the system has been running with flow for at least 30 minutes to allow the elbow to heat soak. Do not exceed 230 C when adjusting the system line temperature.

The system line should be installed with a loop, as shown in the illustration below.



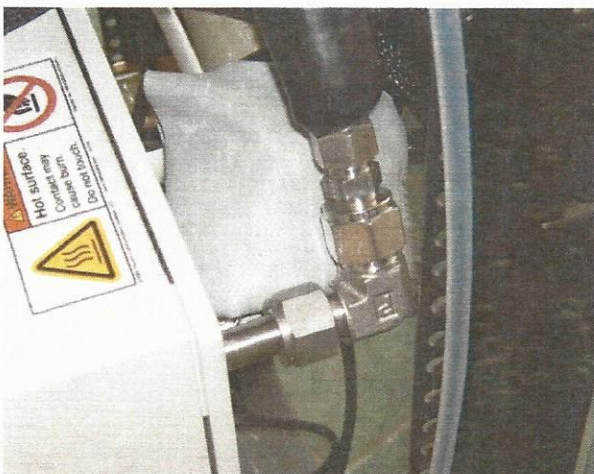
Above: Junction slave heater and temperature probe installed



Above: System line looped and installed

PUMP LINE

A self-regulating line provided the vacuum source to pull the sample through the Multi-Gas sample cell. Flow is adjusted via a manual valve located in the front of the DHS-XXX SERIES. The line is swaged to the exit port of the Multi-Gas as shown below. The adjacent Teflon line seen below is used to supply Nitrogen as a purge gas to the rear of the Multi-Gas (see GAS CONNECTIONS).



Note: Be sure to use the insulated wraps provided for junctions. Read the labels on the packages to determine placement. Insulation and retaining straps must be installed on the sample input into the Multi-Gas and on the input port to the system line

GAS CONNECTIONS

Nitrogen and Span Gas are delivered to the system via a panel located on the rear of the DHS-XXX SERIES. Nitrogen for both purge and zero enter through a common rear port. The supply line is teed to feed both the Multi-Gas purge input and the DHS-XXX SERIES "NITROGEN" input. A 1/4" OD Teflon tube transports the Nitrogen to the quick disconnect located on the rear of the Multi-Gas for purge. This line is labeled "Nitrogen Drip."

Pressure to the Multi-Gas for Nitrogen purge is controlled via a manual regulator located on the rear of the DHS-XXX SERIES. The adjacent gage represents the pressure in the line supplying purge gas to the rear of the Multi-Gas. Please follow MKS' instructions when connection the tube to the disconnect. MKS supplies the disconnect as part of the Multi-Gas package, it is not supplied by ASE, Inc.



Rear panel showing the Nitrogen regulator & gage, Nitrogen input and primary calibration gas input. Secondary calibration gas inputs are located on the Lower right of the panel

Calibration Gas and Nitrogen/Zero gas inputs are located on the rear panel and labeled.. Each of these inputs' flow is controlled by solenoid valves. Incoming calibration gas pressure should not exceed 25 psig. Exceeding this pressure may open the valves in the opposite direction of their intended flow, resulting in mixing of cal gases. It is always good practice to cap and seal any gas input ports when they are not in use. ASE provides caps for these ports.

INSTALLING THE MULTI-GAS AND POWER HOOK-UPS

The power strip marked "Clean Conditioned Power" should be connected to a 120 VAC outlet, 15A, cleaned and conditioned. The second power strip is "dirty" power and a standard wall power is acceptable. Note: When using long sample lines or additional control zones, it may be necessary to unplug the "Ext. Line" power cord from the power strip and run to a separate power source depending on the available power at your facility.

The Multi-Gas is installed on the pullout shelf. This shelf slides in and out for Liquid Nitrogen filling. **BE SURE THE BRAKE IS ON AND LOCKED BEFORE POURING LIQUID NITROGEN INTO** is recommended that the Multi-Gas be secured to the rack rails between fillings. Power for the Multi-Gas should also be provided via the clean power strip located in the rear of the cabinet.



Pump and power strips for incoming 120 VAC power

FRONT PANEL CONTROLS



TEMPERATURE

Three front panel controllers regulate the temperature of the three primary zones in the DHS-XXX SERIES. The individual control zones are labeled. All of the controllers are set to read in degrees C and are programmed for K-type thermocouples. In addition, the DHS-XXX SERIES has four additional control zones for future expansion. Each controller is set for degrees C and K-type. Maximum output for all four channels should not exceed 15 combined amps or 13 amps per channel. This controller should be powered by clean, conditioned 120 VAC to ensure there is no damage to the electronics from spikes or surges. A manual and supplemental sheet are provided with the DHS-XXX SERIES documentation showing pin-out configurations for controller modules made by ASE, Inc.

GAS FLOW

The regulators on the front panel primary module control calibration and zero gas pressure. Both calibration and zero gas pass through the flow meter on the front panel. Use the needle at the base of the flow meter to make fine adjustments in flow. Two toggle

switches energize the solenoid valves that allow zero/cal gas to flow. Putting the switches in the up/on position energize the valve and also turn off the pump. The pump will not operate if either of these valves is in the on position.

Flow through the pump may be adjusted via a control valve located on a panel below the DHS-XXX SERIES primary module. Heated lines connect this valve to the rear sample out port on the Multi-Gas, through the valve, then into the vacuum port of the sample pump. Sample is pulled through the Multi-Gas sample cell under vacuum. Manual adjustments to pressure may need to be performed if back pressure varies during gas analysis.

When calibrating the Multi-Gas, the end of the sample line needs to be capped to prevent excessive cal gas from dumping back into the emissions source.

Note: Sample gas does not pass through the flow meter on the front of the DHS-XXX SERIES primary module. Sample Cell pressure inside the MKS is displayed on the Multi-Gas computer monitor.

FILTRATION

CHANGING THE FILTER ELEMENT

The DHS-XXX SERIES incorporates a fine filter into the front panel. To install or change the filter, please perform the following:

- 1) Carefully unscrew the filter handle on the front of the DHS-XXX SERIES primary module.
- 2) Extract the handle from the module. The filter element should be removed with the handle. If needed, pull the filter from the module by hand.
- 3) Perform a visual inspection of the handle gasket; change if needed (see below).
- 4) Pull the old filter from off of the handle if applicable.
- 5) Slide a new filter on the handle being sure to press the silicone seal on the filter element over the sealing ring on the handle. A pilot rod should be visible protruding from the opposite end of the filter element.
- 6) Use the pilot rod to center the filter by inserting the rod into the female threads of the flow tube inside the filter.
- 7) Press gently.
- 8) Carefully screw the filter handle and element into the body of the filter housing. Tighten to seal.

If the filter is hot, wear gloves and use caution when changing the filter.

Note: If the pilot rod had bent it may catch slightly as the filter is being inserted. A slight jiggle of the filter handle when installing will typically aid in installation if the bend is not severe. If there is an issue, straighten the rod and/or contact Atmo-Seal for a repair or replacement.

CHANGING THE GASKET

If the gasket sealing the filter body to the handle appears damaged, please change it. Do not change the gasket when the handle is hot.

Carefully peel the gasket from the handle. Remove any silicone sealer left on the handle and discard the gasket. Replacement gaskets are available by contacting Atmo-Seal, Inc.

Run a thin (1/8") line of silicone of silicone sealer inside the groove in the filter handle.

Submerge the gasket into the silicone, wiping away excess

Gently thread the filter handle into the filter body (see above). Heat the filter to 191 C. This will cure and seal the silicone.

Note: Atmo-Seal, Inc., recommends the use of Krytox or similar non-out gassing lubricants on both the seals of the filter element and the face of the filter body where contact with the sealing gasket is made.

REMOTE I/O (Optional)

The DHS-XXX SERIES features a remote I/O control circuit for internal/external calibration and zero gas solenoid valves and pump operation. A nine pin connector is located on the back of the DHS-XXX SERIES, labeled "REMOTE I/O." Pin 9 is the common/hot pin. Completing the circuit from pin 9 to any of the other pins will actuate the appropriate valve or operate the pump.

Pins	Action
9 to 1	Actuates SV-1 for calibration gas on the front of the DHS-XXX SERIES
9 to 2	Actuates SV-2 for calibration gas on the rear of the DHS-XXX SERIES
9 to 3	Actuates SV-3 for calibration gas on the rear of the DHS-XXX SERIES
9 to 4	Actuates SV-4 for calibration gas on the rear of the DHS-XXX SERIES
9 to 5	Operates the pump
9 to 6	Actuates the internal SV for calibration gas flow
9 to 7	Actuates the internal SV for nitrogen/zero gas flow

When using the remote I/O, all safety interlock functions are negated. The pump may operate regardless of the temperature of the sampling system. Energizing the zero/cal SVs will not negate pump operation when using the Remote I/O.

TROUBLESHOOTING

Symptom	Probable Cause	Remedy
No Sample Flow	Pump is not on	Check pump switch

		System line not up to temp, wait until the line reached temp and heat soaks Zero/Nitrogen or Calibration switch is in the "on" position, toggle switch(es) Replace plug into socket marked PUMP
	Pump is unplugged From the rear of the DHS-XXX SERIES Circuit breaker on the rear of the DHS-XXX SERIES has tripped	Reset circuit breaker
	System Line is electrically unplugged, reattach Pump Valve is closes Filter is clogged External line clogged Upstream filter is clogged Line is capped	Reconnect system line connector Open Valve Replace filter element Blow out line, inspect for kinks R & R filter element Remove sample line/filter cap
Cannot Calibrate w/gas Filter is not sealed	Line is not capped Cal/zero gas not connected SVs not operating Regulators turned down Flow meter valve dialed down	Cap sample line to prevent cal gas from leaking during calibration Carefully tighten filter head Change filter gasket Verify calibration gas connections Check toggle switches, remote I/O Dial up regulator pressure as needed Dial up flow meter valve
No heat on Components	Temp Controllers off Temp controllers set down settings – see manual Circuit breaker blown Product disconnected	Check panel switch, turn on Check temperature controller Re-set breaker. Check to ensure maximum current capabilities not exceeded with longer sample line or other components Check connectors on DHS-XXX SERIES rear. Switch to the backup Thermocouple included with the heated line, Install Thermocouples based on the supplied pin-out.

For other technical support issues, please contact Atmo-Seal Engineering, Inc. at (248) 528-9640 or e-mail [engineering @atmoseal-eng.com](mailto:engineering@atmoseal-eng.com)

POWER CONSUMPTION

PUMP – 5.7 A @ 120 VAC

MAIN SYSTEM POWER – 8.8 A @ 120 VAC

IGH-144 X ½" SAMPLE LINE - 8.4 AMPS @ 120 VAC (12 FT)

IGH-300 X ½" SAMPLE LINE – 10.5 AMPS @ 120 VAC (25 FT)



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ADDENDUM:

Note: A heated manual valve has been added to this system to be used during calibration. This valve is attached to the sample line supplied with this system,. The valve should be in the open position during normal operation. Close the valve when running Zero or Span to avoid back-feeding calibration gases into the sample train.

The additional heated valve is located inside the main DHS Rack-Mounted Module. The valve is controlled by pulling or pushing the lever on the front panel marked "Pull to Calibrate." When the lever is pulled out, the valve is closed and calibration gas will not back flow into the heated filter body. Sample will not flow through the valve in this position.

When the lever is pushed inward, sample may flow through the filter for normal operation.

Note: This generation DHS Sample Filtration, Conditioning and Distribution System features a tilt-monitor mechanism. Installation is accomplished by attaching the standard Dell Monitor included with the MKS Multi Gas to the bracket mounted to the rack panel. A slot is provided for cable/power hookups.

Note: This generation DHS Sample Filtration, Conditioning and Distribution System includes an upgraded keyboard and mouse

drawer. The mouse pad is located under the keyboard drawer and may be pulled out as needed by the operator.

Note: This generation DHS Sample Filtration, Conditioning and Distribution System includes a Velcro & Nylon strap to hang the heated hose as the system is being moved from location to location.