

PHD Series

Heated Purge
Desiccant Compressed
Air Dryer

Models	Rated Flow	Refer as models
PHD300-CD	300 SCFM	300
PHD400-CD	400 SCFM	400
PHD500-CD	500 SCFM	500
PHD600-CD	600 SCFM	600
PHD750-CD	750 SCFM	750
PHD900-CD	900 SCFM	900
PHD1050-CD	1050 SCFM	1050
PHD1300-CD	1300 SCFM	1300
PHD1500-CD	1500 SCFM	1500
PHD1800-CD	1800 SCFM	1800
PHD2200-CD	2200 SCFM	2200
PHD2600-CD	2600 SCFM	2600
PHD3200-CD	3200 SCFM	3200



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1.0 General Safety Information

This equipment is designed and built with safety as a prime consideration; industry-accepted safety factors have been used in the design. Each dryer is checked at the factory for safety and operation. All pressure vessels which fall under the scope of ASME Section VIII, are hydrostatically tested in accordance with the latest addenda. A factory-installed safety relief valve is standard on each dryer.

WARNING – *The following safety rules must be observed to ensure safe dryer operation. Failure to follow these rules may void the warranty or result in dryer damage or personal injury.*

1. Never install or try to repair any dryer that has been damaged in shipment. See the Receiving and Inspection instructions in this manual for appropriate action.
2. This equipment is a pressure-containing device. Never operate the dryer at pressures or temperatures above the maximum conditions shown on the data plate.

Never dismantle or work on any component of the dryer or compressed air system under pressure. Vent internal air pressure to the atmosphere before servicing.
3. This equipment requires electricity to operate. Install equipment in compliance with national and local electrical codes. Standard equipment is supplied with NEMA 4, 4X electrical enclosures and is not intended for installation in hazardous environments.

Never perform electrical service on the dryer unless the main power supply has been disconnected. Parts of the control circuit may remain energized when the power switch is turned off.
4. Air treated by this equipment may not be suitable for breathing without further purification. Refer to OSHA standard 1910.134 for the requirements for breathing quality air.
5. Certain parts of the dryer are not insulated and may become hot during normal operation of the dryer. Do not touch any of these areas without first determining the surface temperature.
6. Use only genuine replacement parts from the manufacturer. The manufacturer bears no responsibility for hazards caused by the use of unauthorized parts.

Safety instructions in this manual are boldfaced for emphasis. The signal words **DANGER**, **WARNING** and **CAUTION** are used to indicate hazard seriousness levels as follows:

DANGER – Immediate hazard which will result in severe injury or death.

WARNING – Hazard or unsafe practice which could result in severe injury or death.

CAUTION – Hazard or unsafe practice which could result in minor injury or in product or property damage.

The dryer data plate, attached to the electrical control box, contains critical safety and identification information. If the data plate is missing or defaced, immediately contact your local distributor for a replacement.

2.0 Receiving, Storing, and Moving

2.1 Receiving and Inspection

This shipment has been thoroughly checked, packed and inspected before leaving our plant. It was received in good condition by the carrier and was so acknowledged.

Immediately upon receipt, thoroughly inspect for visible loss or damage that may have occurred during shipping. If this shipment shows evidence of loss or damage at time of delivery to you, insist that a notation of this loss or damage be made on the delivery receipt by the carrier's agent. Otherwise no claim can be enforced against the carrier.

Also check for concealed loss or damage. When a shipment has been delivered to you in apparent good order, but concealed damage is found upon unpacking, notify the carrier immediately and insist on his agent inspecting the shipment. The carrier will not consider any claim for loss or damage unless an inspection has been made. If you give the carrier a clear receipt for goods that have been damaged or lost in transit, you do so at your own risk and expense. Concealed damage claims are not our responsibility as our terms are F.O.B. point of shipment. Shipping damage is not covered by the dryer warranty.

2.2 Storing

Store the dryer indoors to prevent damage to any electrical or mechanical components. All packaging material should be left in place until the dryer is in position.

2.3 Handling

The dryer is designed to be moved by means of the shipping skid or the base channels. The dryer may also have lifting lugs for use with an overhead crane. Be sure to attach all of the lift points and use appropriate spreader bars to prevent damage to the dryer.

CAUTION – *Never lift the dryer by attaching hooks or slings to the piping, or to any part other than the lifting lugs. Severe structural damage could occur.*

3.0 Description

3.1 Function

Externally heated purge air dryers are an economical and reliable way to dry compressed air to dew points below the freezing point of water. Desiccant dryers lower the dew point of compressed air by adsorbing the water vapor present in the compressed air onto the surface of the desiccant. Adsorption continues until equilibrium is reached between the partial pressure of the water vapor in the air and that on the surface of the desiccant.

These dryers continuously dry compressed air by using two identical towers, each containing a desiccant bed. While one tower is on-stream drying, the other tower is off-stream being regenerated (reactivated, i.e. dried out). The towers are alternated on- and off-stream so that dry desiccant is always in contact with the wet compressed air. In this way a continuous supply of dry air downstream of the dryer is possible. The switching from one tower to the other is controlled by a solid-state controller on either a fixed time basis (standard) or a demand basis (optional).

1. Fixed Cycle Regeneration (Standard)

When a tower is placed off-line, it is slowly depressurized and the desiccant is regenerated by driving off (desorbing) the water collected on its surface. Regeneration is accomplished by expanding a portion of the dried air to atmospheric pressure. This extremely dry air (purge air) is then passed through a heater. This heated air flows through the desiccant bed, desorbs the moisture from the desiccant, and carries the desorbed water out of the dryer. The heater is turned off when the Heat Saver temperature sensor detects bed heating is complete. The purge air continues to flow through the off-stream tower, cooling the desiccant bed and reducing the dew point spike after tower change over. The tower is then repressurized to full line pressure. This prevents desiccant bed movement and downstream pressure loss when the tower goes back on-line.

2. Optional Demand Cycle Regeneration (With Venturi Blower)

When a tower is placed off-line, it is slowly depressurized and the desiccant is regenerated by driving off (desorbing) the water collected on its surface. Regeneration is accomplished by expanding a portion of the dried air to atmospheric pressure through a venturi blower. The venturi blower also draws ambient air into the purge line. This combination of purge and ambient air is then passed through a heater. This heated air flows through the desiccant bed, desorbs the moisture from the desiccant, and carries the desorbed water out of

the dryer. The heater and venturi suction valve are turned off when the Heat Saver temperature sensor detects bed heating is complete. Dry purge air continues to flow through the off-stream tower, cooling the desiccant bed and reducing the dew point spike after tower change over. The tower is then repressurized to full line pressure. This prevents desiccant bed movement and downstream pressure loss when the tower goes back on-line.

4.0 Installation

4.1 System Arrangement

Install the dryer downstream of an aftercooler, separator, receiver, and high-efficiency oil-removing filter(s) so that the dryer inlet air is between 40°F (4.4°C) and 120°F (49°C) and contains no liquid water or oil. Liquid water and/or inlet air temperatures above 100°F (37.8°C) can reduce drying capacity. Contact your local distributor for information on proper dryer sizing at elevated inlet air temperatures.

Adequate filtration is required upstream of the dryer in order to protect the desiccant bed from liquid and solid contamination. Use an Air Line Filter in systems supplied by a non-lubricated (oil-free) air compressor. In systems supplied by a lubricated air compressor, use a High Efficiency Oil Removal Filter. A coarser filter will be required upstream of the Oil Removal Filter if heavy liquid or solid loads are present.

To ensure downstream air purity (prevent desiccant dust from traveling downstream) adequate filtration downstream of the dryer is required. A High Temperature Afterfilter, typically rated at 450°F (232°C) operating temperature and capable of removing all desiccant fines 1 micron and larger should be installed at the dryer outlet.

DANGER – This dryer must be fitted with a high efficiency coalescing filter and liquid drainer that is maintained properly. Failure to do so could result in an in-line fire.

WARNING – The afterfilter, if installed, must be rated for 450°F (232°C).

4.2 Minimum & Maximum Operating Conditions

The compressed air supply to the dryer inlet should be checked periodically to ensure that dryer design specifications are not exceeded. Normally the compressor installation includes intercoolers, aftercoolers, separators, receivers, or similar equipment, which adequately pretreat the compressed air supply in order to avoid excessively high air temperatures and liquid slugging of downstream equipment.

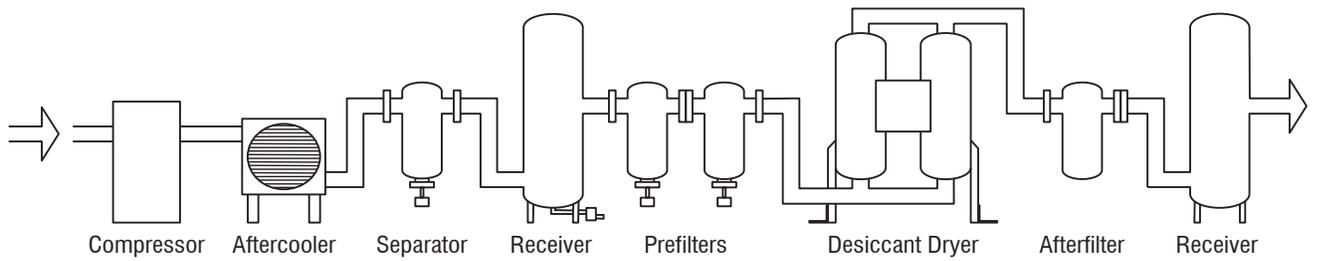


Figure 1
Typical System Configuration

4.2.1 Maximum Operating Pressure (MOP)

- 150 psig (10.3 barg)

Refer to Dryer Serial Number Tag.

WARNING – Do not operate the dryer at pressures above the maximum operating pressure shown on the serial number tag.

NOTE: Consult factory for applications requiring higher maximum operating pressures.

4.2.2 Minimum Operating Pressure

- 60 psig (4.1 barg)

Refer to Dryer Serial Number Tag.

WARNING – Do not operate the dryer at pressures below the minimum operating pressure shown on the serial number tag.

NOTE: Consult factory for applications requiring lower minimum operating pressures.

4.2.3 Maximum Compressed Air Temperature at Dryer Inlet

- 120°F (49°C) for all models

4.2.3 Minimum Compressed Air Temperature at Dryer Inlet

- 40°F (4°C) for all models

4.3 Ambient Air Temperature

Locate the dryer under cover in an area where the ambient air temperature will remain between 35°F (2°C) and 120°F (49°C).

NOTE: If dryer is installed in ambients below 35°F (2°C), low ambient protection requiring heat tracing and insulation of the prefilter bowls, auto drains and/or sumps, and lower piping with inlet switching and purge/repressurization valves is necessary to prevent condensate from freezing. If installing heat tracing, observe electrical class code requirements for type of duty specified. Purge mufflers and their relief mechanisms must be kept clear from snow and ice buildup that could prevent proper discharge of compressed air.

4.4 Location and Clearance

Install the dryer on a level pad. Ensure the dryer is level by grouting or shimming as necessary. Holes are provided in the dryer base members for floor anchors. Securely anchor the dryer frame to the floor. Allow 24 inches clearance on all sides of the dryer for servicing. Provide adequate clearance for prefilter element, afterfilter element and heater element replacement. Provide protection for the dryer if it is installed where heavy vehicles or similar portable equipment is likely to cause damage.

4.5 Piping and Connections

All external piping must be supplied by the user unless otherwise specified. Refer to Figure 2 for connection sizes. Inlet and outlet isolation valves and a vent valve are recommended so the dryer can be isolated and depressurized for servicing. The connections and pipe fittings must be rated for or exceed the maximum operating pressure given on the dryer nameplate and must be in accordance with industry-wide codes. Be sure all piping is supported. Do not allow the weight of any piping to bear on the dryer or filters. Piping should be the same size as or larger than the dryer connection. Piping smaller than the dryer connections will cause high pressure drop and reduce drying capacity.

If the purge exhaust piping must be extended outside the dryer area, choose a combination of diameters, lengths, and turns that limits the additional pressure drop to 1/4 psid or less. **BACK PRESSURE WILL CAUSE DRYER MALFUNCTION.** Consult the factory for piping details if required.

WARNING – Do not operate dryer without installed mufflers. Exhausting compressed air directly to atmosphere will result in noise levels above OSHA permissible levels and rapidly expanding gas could potentially cause harm to persons or property.

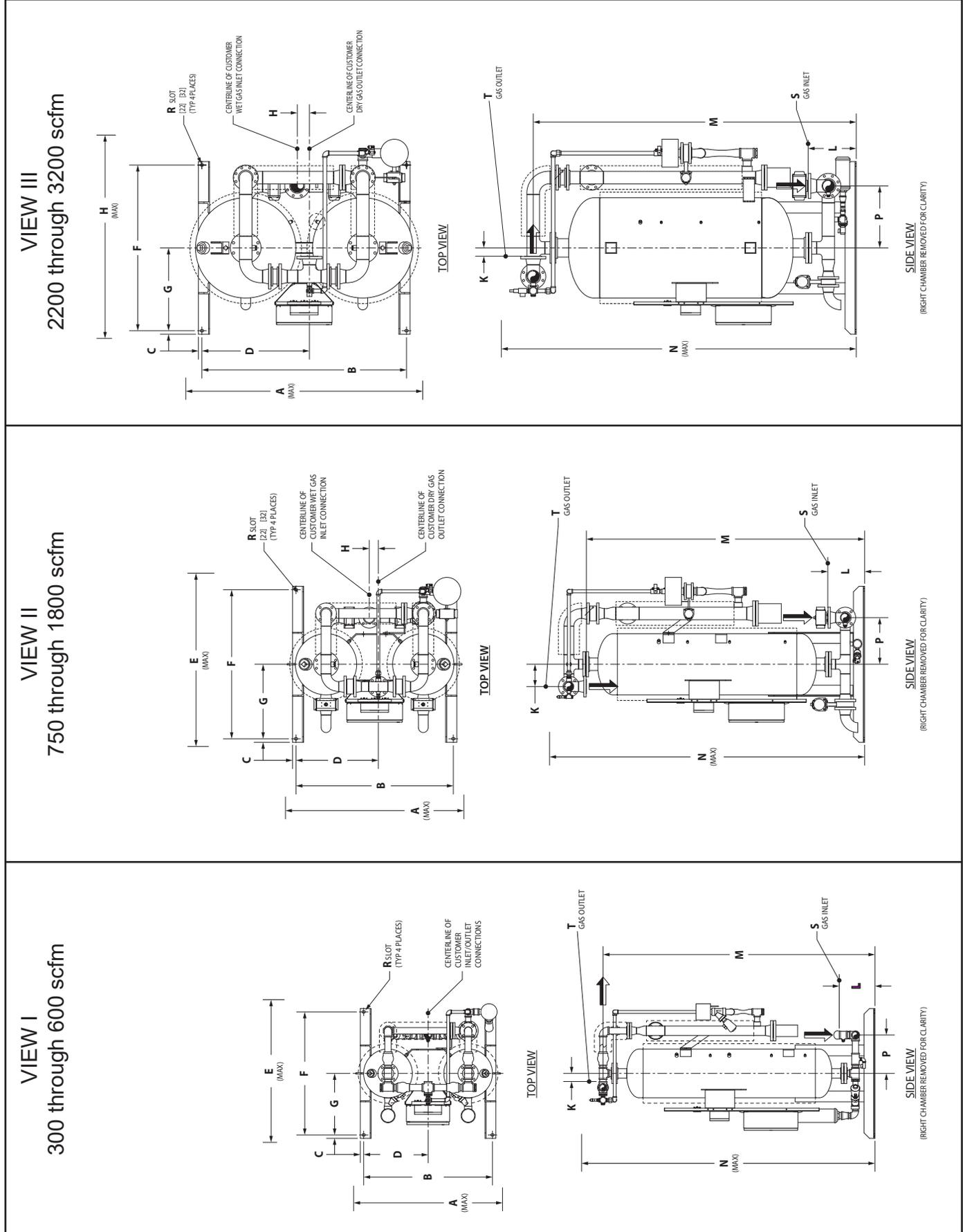
Dryer bypass piping may be installed to allow uninterrupted airflow during servicing. If the downstream application cannot tolerate unprocessed air for short periods, install a second dryer in the bypass line.

CAUTION – Do not hydrostatically test the piping with the dryer in the system. The desiccant will be damaged if saturated with water.

Dimensions and Connections – Dryer Only

Figure 2 (continued on next page)

(For construction purposes, contact factory to request certified drawings when mounted filters are included with order)



Dimensions and Connections
Figure 2 (continued from previous page)

DIMENSIONS IN INCHES													
MODEL	300	400	500	600	750	900	1050	1300	1500	1800	2200	2600	3200
VIEW REF.	I	I	1	1	II	II	II	II	II	II	III	III	III
A	48	53	53	55	60	60	64	66	80	80	85	85	97
B	39.11/16	46.3/4	46.3/4	47.9/16	52.11/16	52.11/16	56.7/16	57.5/16	69.13/16	69.13/16	73.3/8	73.7/8	82.7/8
C	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4	1.1/4
D	19.7/8	23.3/8	23.3/8	23.13/16	26.5/8	26.5/8	29.9/16	30	34.7/8	34.7/8	38.9/16	38.9/16	46.5/16
E	46	52	52	53	59	59	62	63	66	66	73	73	82
F	39.1/2	45.1/2	45.1/2	45.1/2	53.1/2	53.1/2	53.1/2	53.1/2	53.1/2	53.1/2	59.1/2	59.1/2	59.1/2
G	192.3/4	22.3/4	22.3/4	22.3/4	26.3/4	26.3/4	26.3/4	26.3/4	26.3/4	26.3/4	29.3/4	29.3/4	29.3/4
H	—	—	—	—	1.1/4	1.1/4	3.1/4	3.1/4	5.15/16	5.15/16	4.3/8	4.3/8	10.1/2
K	2.7/16	2.7/16	3	3	8	8	8	8	8	8	3	3	3
L	10.13/16	12	12.11/16	13.3/16	13.7/16	13.7/16	13.3/16	13.3/16	15.5/8	15.5/8	17.1/4	17.1/4	17
M	90.1/4	96.15/16	96.15/16	100.7/16	100.11/16	100.11/16	99.13/16	104.13/16	101.7/8	101.7/8	115.7/8	115.7/8	113.3/8
N	98	104	105	108	114	114	113	118	119	119	127	127	125
P	11.3/8	13.3/16	13.3/16	14.3/16	15.3/4	15.3/4	16.3/4	17.3/4	20.3/4	20.3/4	22.1/4	22.1/4	26.1/2
R	7/8 X 1.1/4												
S	1.1/2 NPT	1.1/2 NPT	2 NPT	2 NPT	3 FLANGE	4 FLANGE	4 FLANGE	4 FLANGE					
T	1.1/2 NPT	1.1/2 NPT	2 NPT	2 NPT	3 FLANGE	4 FLANGE	4 FLANGE	4 FLANGE					
WT/LBS	1,360	1,776	1,776	1,978	2,323	2,339	2,816	3,326	5,094	5,094	7,753	7,753	8,963

DIMENSIONS IN MILLIMETERS													
MODEL	300	400	500	600	750	900	1050	1300	1500	1800	2200	2600	3200
VIEW REF.	I	I	1	1	II	II	II	II	II	II	III	III	III
A	1207	1346	1346	1397	1524	1524	1626	1676	2032	2032	2169	2169	2464
B	1008	1187	1187	1208	1338	1338	1434	1456	1773	1773	1864	1864	2106
C	32	32	32	32	32	32	32	32	32	32	32	32	32
D	504	594	594	604	677	677	750	761	886	886	980	980	1177
E	1164	1315	1315	1340	1503	1503	1580	1605	1682	1682	1855	1855	2090
F	1003	1156	1156	1156	1359	1359	1359	1359	1359	1359	1511	1511	1511
G	502	578	578	578	679	679	679	679	679	679	756	756	756
H	—	—	—	—	32	32	83	83	151	151	111	111	267
K	62	62	76	76	203	203	203	203	203	203	76	76	76
L	274	305	322	335	341	341	335	335	397	397	438	438	432
M	2293	2462	2462	2551	2557	2557	2535	2662	2588	2588	2943	2943	2880
N	2480	2649	2664	2753	2903	2903	2870	2997	3013	3021	3234	3234	3170
P	289	335	335	360	400	400	425	451	527	527	565	565	673
R	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32	22 X 32
S	1.1/2 NPT	1.1/2 NPT	2 NPT	2 NPT	3 FLANGE	4 FLANGE	4 FLANGE	4 FLANGE					
T	1.1/2 NPT	1.1/2 NPT	2 NPT	2 NPT	3 FLANGE	4 FLANGE	4 FLANGE	4 FLANGE					
WT/KGS	617	806	806	897	1,054	1,061	1,277	1,509	2,311	2,311	3,517	3,517	4,066

4.5 Electrical Connections

WARNING – These procedures require entering gaining access to the dryer’s electrical enclosure(s). All electrical work must be performed by a qualified electrical technician.

Connect the proper power supply to the dryer according to the electrical drawings in the back of this manual. Be sure to follow all applicable electrical codes.

NOTE: A disconnect switch is not provided as standard equipment and therefore, must be supplied by the customer.

NOTE: Before turning high voltage on to the dryer, an ohmic test should be performed on the heater elements to insure they are dry before proceeding with start-up. This should be done after extended shut downs and long delays between delivery and start-up. Connect one lead of a megger to an unpainted surface of the control panel or dryer frame. Connect the other lead to each phase on the load side of the contactor. Adjust the megger to the 1500 volt setting. Perform the ohmic test on each zone of the heaters. A minimum value of 500k ohms must be obtained.

CAUTION – Failure to ohmic test heaters after extended periods may cause heater failure.

4.6 Initial Desiccant Charge

Externally heated purge air dryers use activated alumina as the desiccant in the dryer towers.

Models 300 through 1050 are shipped with activated alumina (1/8" bead) in the dryer towers. Desiccant is shipped loose with all other standard models.

All desiccant shipped loose must be added to the dryer towers before the dryer is put into service.

Refer to TABLE 1, DESICCANT REQUIREMENTS for desiccant type and quantity per tower.

TO ADD DESICCANT

WARNING – The following procedure provides instructions for adding the initial desiccant to the towers. If replacing desiccant, refer to the "Procedure for Desiccant Charge Replacement" in Section 7.0.

1. Verify pressure gauges of both towers indicate 0 psig. If not, depressurize the towers according to the shutdown instructions in Section 6.
2. Remove the pipe plug or fill port flange cover (where applicable) from the desiccant fill port at the top of each tower. Refer to Figure 3 for the fill port location.

CAUTION – Pouring desiccant creates a fine dust; safety goggles, gloves and a dust mask should be worn by personnel installing desiccant. Refer to the Material Safety Data Sheet that accompanies desiccant shipped loose for more complete information.

CAUTION – Do not tamp the desiccant in the towers. Tamping damages desiccant and causes dusting.

3. Refer to Table 1 for desiccant **quantity per tower**.
When using Table 1 you will find the desiccant quantities listed in layers. Each layer will vary in depth due to the type, quantity and purpose of the desiccant. Layer 1 must be installed first at the bottom of the vessel followed by layer number 2 etc., until the complete charge of desiccant has been installed.
4. Utilizing an appropriate sized funnel, fill each desiccant tower as follows:
 - a. Install the required quantity of activated alumina in layer 1 of each tower.
 - b. Level layer 1 and each subsequent layer of desiccant as added to each tower.
 - c. Finish filling each tower with desiccant until all desiccant has been installed. LIGHT tapping on the tower sides with a soft-face mallet should yield additional free space to allow installation of all desiccant required. **DO NOT TAMP OR RAM DESICCANT.**
5. Clean the fill port closure. Replace the fill plug using Teflon tape or another pipe thread sealant suitable for compressed air service. Reinstall fill port flange cover (where applicable) in each desiccant tower.

Table 1 Desiccant Requirements (Quantity per Tower)

Model	Layer 1	2
300	210# 1/8" bead AA*	—
400	354# 1/8" bead AA*	—
500	354# 1/8" bead AA*	—
600	453# 1/8" bead AA*	—
750	590# 1/8" bead AA*	—
900	590# 1/8" bead AA*	—
1050	710# 1/8" bead AA*	—
1300	48# 1/4" bead AA*	876# 1/8" bead AA*
1500	92# 1/4" bead AA*	1167# 1/8" bead AA*
1800	92# 1/4" bead AA*	1167# 1/8" bead AA*
2200	161# 1/4" bead AA*	1706# 1/8" bead AA*
2600	161# 1/4" bead AA*	1706# 1/8" bead AA*
3200	258# 1/4" bead AA*	2119# 1/8" bead AA*

* AA = Activated Alumina

5.0 Instrumentation

The following instrumentation helps in monitoring dryer operation and performance. Instruments which are available as options are so noted.

Externally Heated Purge Air dryers are rated NEMA 4 and include the following:

- Solid State Controls
- Tower Pressure Gauges
- Purge Flow Pressure Gauge
- Energy Management (Option A)
- Energy Management System & Dew Point Transmitter (Option B)

5.1 Controls

The solid-state dryer controls are located in a polycarbonate, NEMA Class 4X, IP66 rated electrical enclosure mounted to a center panel located between the two desiccant towers. Control features include:

- Multiple screens to indicate operating status and fault conditions.
- Upon power loss, dryer "fails safe" (inlet valve remains in position). On power recovery, controller resumes where power was lost.

5.2 Tower Pressure Gauges

A gauge mounted on the gauge panel indicates which tower is on-stream and which is regenerating. The gauge for the onstream tower indicates operating pressure; the gauge for the regenerating tower indicates 0 psig.

5.3 Purge Flow Pressure Gauge

A gauge mounted on the gauge panel of the dryer indicates purge air pressure.

5.4 Energy Management System

The optional Energy Management System (EMS) automatically adjusts dryer operation to compensate for changes in operating conditions. Air samples are continuously taken from the on-stream tower and passed over a moisture probe which senses both temperature and relative humidity. The moisture content of the air within the desiccant bed is then precisely determined. The on-stream tower will not depressurize and regenerate until a predetermined set point has been reached. This elimination of unnecessary regeneration reduces energy consumption and extends dryer desiccant and component life.

5.5 Dew Point Transmitter

This option monitors and displays outlet pressure dew points and provides an alarm signal if the dew point exceeds user-specified set point. Recommended calibration interval is 12 months. Contact the service department for details.

Operation – The dew point is measured at the dryer operating pressure and is displayed in the operator interface. If the dew point is outside of the temperature range, the display will indicate an over-range (high dew point) or under-range (low dew point) condition. A defective sensor assembly or an electronics malfunction could also cause the transmitter to indicate under-range.

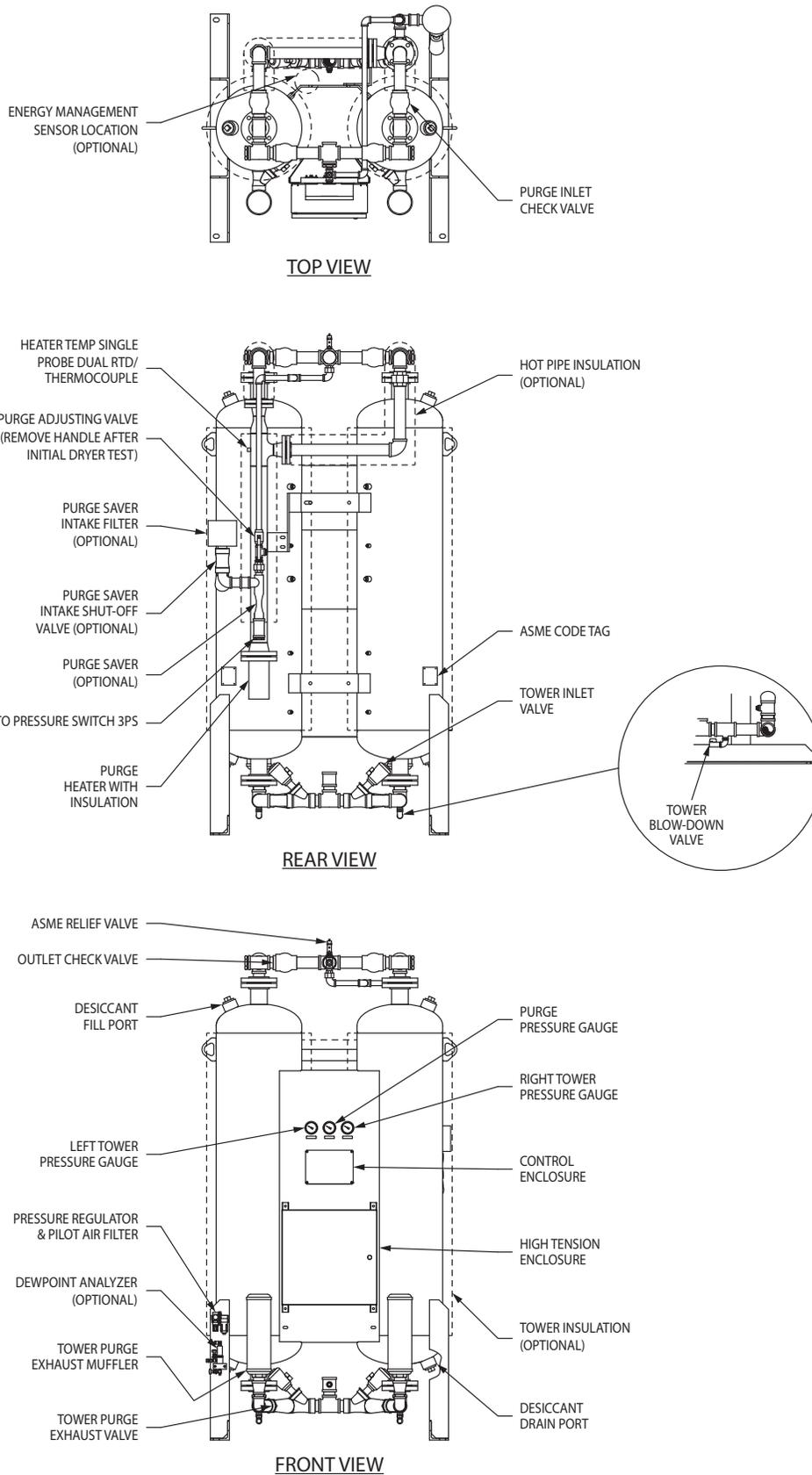


Figure 3a
General Layout Drawing
(Models 300 through 600)

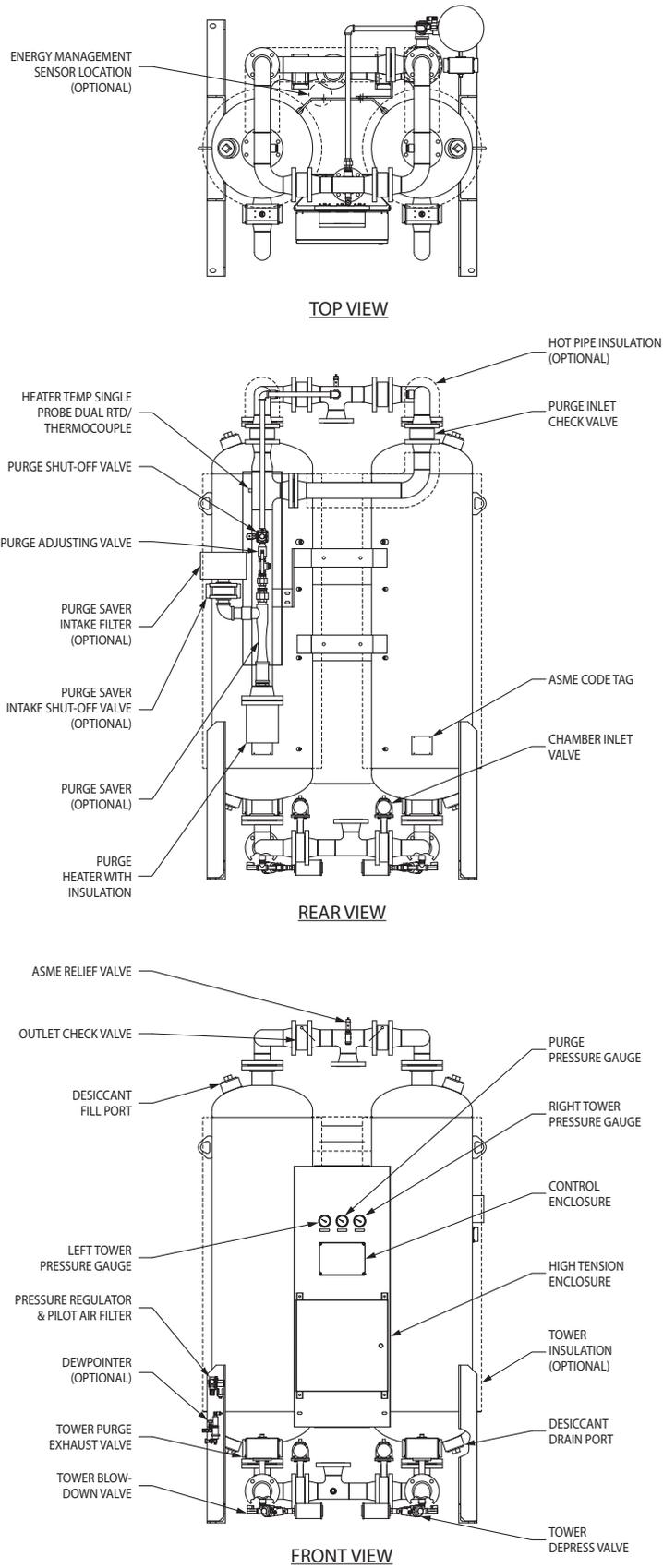


Figure 3b
General Layout Drawing
(Models 750 through 1800)

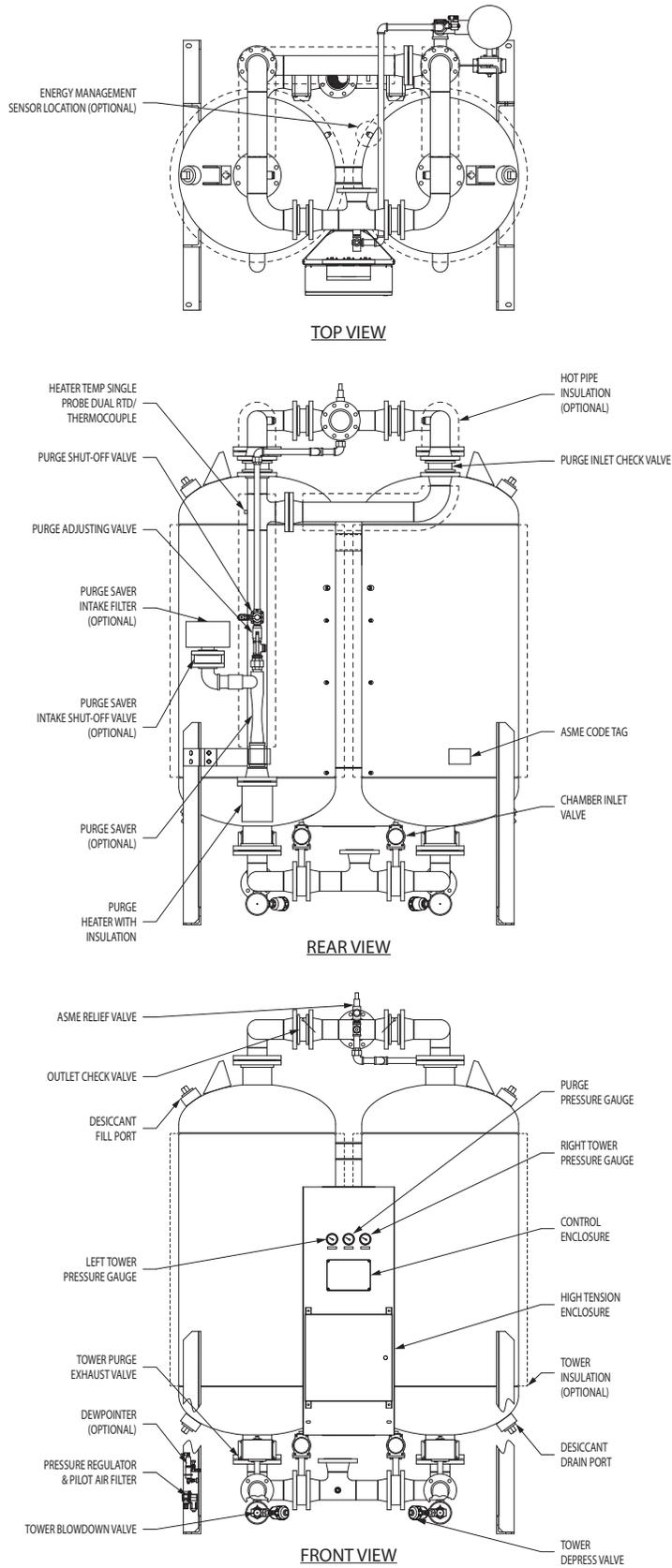


Figure 3c
General Layout Drawing
(Models 2200 through 3200)

6.0 Operation

6.1 Controls

A solid-state controller controls valve and heater operation, monitors all critical operating conditions, and indicates operating status. The controller receives input data from pressure switches, temperature sensors and the operator interface. The operator interface displays information about the dryer operating status and is used to change the dryer operating mode.

6.2 Operating Modes

6.2.1 Automatic and Manual Advance

The drying and regeneration cycles are divided into discrete steps. The operator selects either one of the automatic advance modes (Energy Management, Dew Point Control, or Fixed Cycle) or manual advance mode through the operator interfaces Setup screen.

Selecting any of the automatic advance modes enables a timer in the controller to advance the program step-by-step according to the programmed schedule.

Setting up the controller for manual advance disables the timer and the operator can advance the program one step at a time. This mode is used for diagnostic purposes.

6.2.2 Fixed, Energy Management or Dew Point Control Operation

The operator interface is used to select either Fixed, Energy Management or Dew Point Control operation. In Fixed Cycle operation, each tower is on-line (drying) for a fixed time period regardless of the operating conditions. In Energy Management or Dew Point Control operation, a tower remains on-line until the desiccant bed has been fully utilized. For lower than designed moisture loads, this results in longer drying cycles, longer time between regenerations and, therefore lower energy consumption. Energy Management or Dew Point Control operation are optional features.

6.3 Operating Sequence Description

1. Left Tower Drying – Right Tower Regenerating (See Figure 2A)

At the start of the left tower drying cycle, left inlet valve **V1A** opens, right inlet valve **V1B** closes to isolate the two towers. Wet, compressed air flows up through the left tower where it is dried. The dry air exits the dryer through the left outlet check valve **V2A**.

Next, the purge supply valve (Solenoid E) is closed and the right tower depressurization valve **V11** is opened. The right tower is slowly depressurized through an exhaust muffler.

After the right tower has depressurized, purge supply valve (Solenoid E) and right tower purge exhaust valve **V4** are opened, and the heater is energized.

The heated purge air flows through the right purge check valve **V6**, down through the right tower, and exits through the right purge valve **V4**. The heater is de-energized when the temperature at the bottom of the right tower, as sensed by the right tower temperature sensor **RTD2**, reaches the heat termination set point. This indicates that the bed has been fully heated.

NOTE: Purge flow will continue to cool the right tower desiccant bed while "recovered" bed heat strips additional moisture from the desiccant.

The cooling Sweep Step continues until:

- a) the right tower bed temperature falls to 150°F or,
- b) it is time to repressurize the right tower, whichever occurs first.

At the end of the cooling Sweep Step, the right tower depressurization valve **V11** and the right tower purge exhaust valve **V4** are closed. The right tower slowly repressurizes to full line pressure and is ready to go back on-line.

NOTE: In Fixed Cycle, the bed will normally be partially cooled because the repressurization step will occur before the bed temperature can fall to 150°F.

NOTE: In Energy Management or Dew Point Control, as the drying time extends beyond 4 hours, additional cooling time becomes available thus the cooling step will frequently terminate based on temperature providing complete bed cooling.

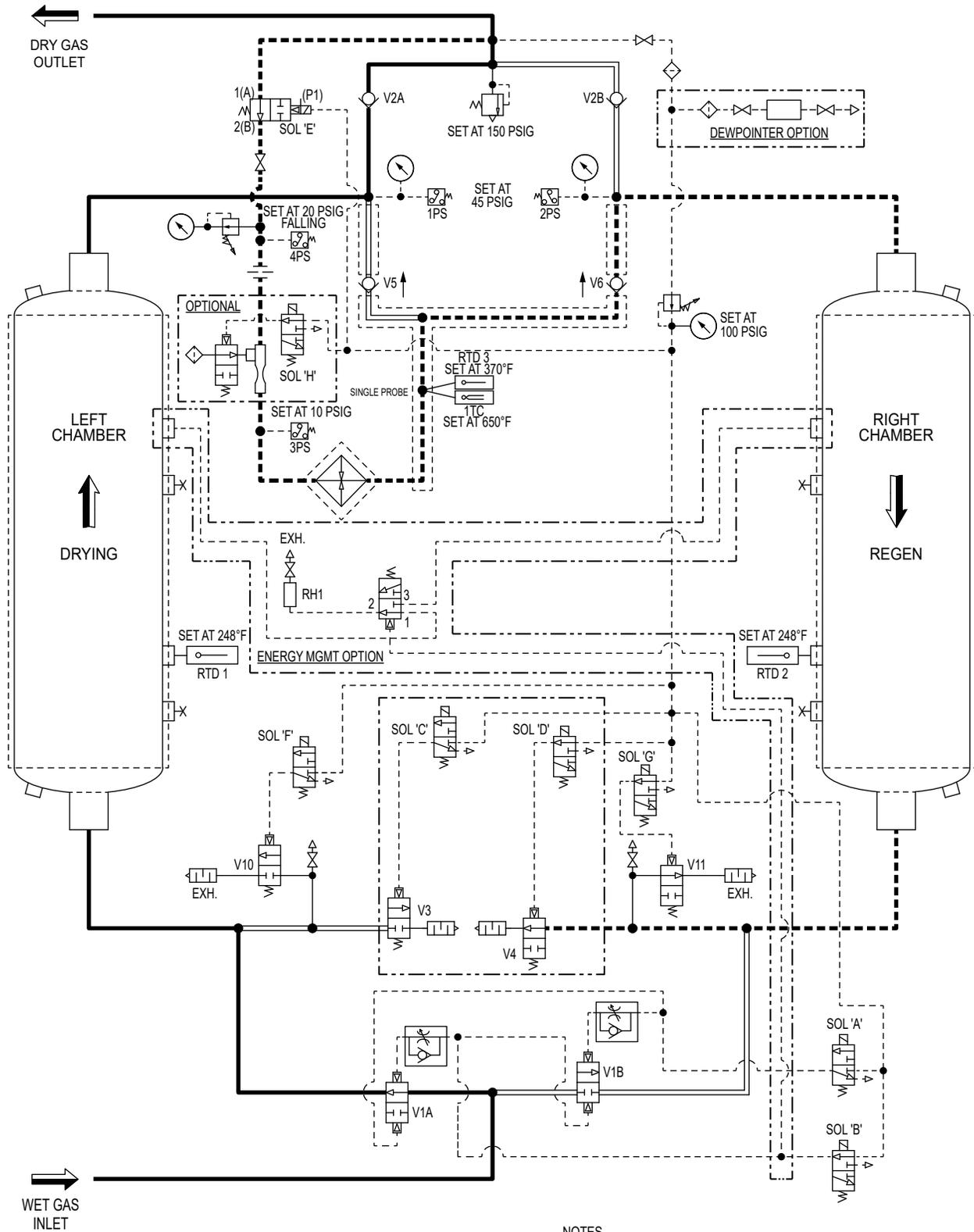
2. Right Tower Drying – Left Tower Regenerating

At the start of the right tower drying cycle, right inlet valve **V1B** opens, left inlet valve **V1A** closes to isolate the two towers. Wet, compressed air flows up through the right tower where it is dried. The dry air exits the dryer through the right outlet check valve **V2B**.

Next, the purge supply valve (Solenoid E) is closed and the left tower depressurization valve **V10** is opened. The left tower is slowly depressurized through an exhaust muffler.

After the left tower has depressurized, purge supply valve (Solenoid E) and right tower purge exhaust valve **V4** are opened, and the heater is energized. The heated air flows through the left purge check valve **V5**, down through the left tower, and exits through the left purge valve **V3**. The heater is de-energized when the temperature at the bottom of the left tower, as sensed by the left tower temperature sensor **RTD1**, reaches the heat termination set point. This indicates that the bed has been fully heated.

NOTE: Purge flow will continue to cool the right tower desiccant bed while "recovered" bed heat strips additional moisture from the desiccant.



- NOTES
1. SYMBOLS ARE PER ANSI Y32.10 "GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS."
 2. AS SHOWN FLOW DIRECTION IS:
 - LEFT CHAMBER DRYING
 - - - RIGHT CHAMBER REGEN
 - · · PILOT GAS LINE
 3. SOLENOID VALVES 'B', 'D', 'G', & 'H' ARE SHOWN ENERGIZED. SOLENOID VALVES 'A', 'C', 'E', & 'F' ARE SHOWN DE-ENERGIZED.
 4. [---] INDICATES OPTION

Figure 4
Sequence of Operation — Fixed Cycle Operation
Left Tower Drying – Right Tower Regenerating (shown)
 (continued on next page)

The cooling Sweep Step continues until:

- a) the right tower bed temperature falls to 150°F
- or,
- b) it is time to repressurize the right tower,

whichever occurs first.

At the end of the cooling Sweep Step, the left tower depressurization valve **V10** and the left tower purge exhaust valve **V3** are closed. The left tower slowly repressurizes to full line pressure and is ready to go back on-line.

NOTE: In Fixed Cycle, the bed will normally be partially cooled because the repressurization step will occur before the bed temperature can fall to 150°F.

NOTE: In Energy Management or Dew Point Control, as the drying time extends beyond 4 hours, additional cooling time becomes available thus the cooling step will frequently terminate based on temperature providing complete bed cooling.

6.3.1 Energy Management Control (optional)

Operation of the Energy Management Control cycle is identical to the fixed cycle except the cycle is extended until the desiccant bed in the on-line tower has been fully utilized. The off-line tower is regenerated and remains in a stand-by mode after being repressurized.

Figure 5 shows the air sampling system for the Energy Management System – EMS option. A 3-way pilot valve directs an air sample from the drying tower to the EMS sensor. The EMS sensor detects the relative humidity and temperature of the air sample. The air sample then exhausts to atmosphere. The drying tower remains on-line until the moisture front arrives at the sensor.

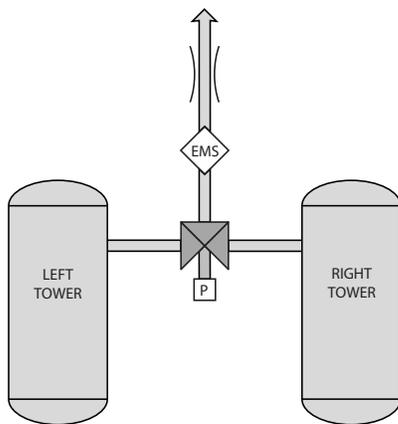


Figure 5
*Optional Moisture Sensing
Energy Management System (EMS)*

6.4 PHD-CD Series Controller

This section provides connection, adjustment and operational information for the PHD-CD series controller.

6.4.1 Reference Figures

- Figure 6 Start-up Screen
- Figure 7 PHD-CD Home Screen (Models 300-750)
- Figure 8 PHD-CD Home Screen (Models 900-3200)
- Figure 9 Alarm Banner and Alarm Tag Home Screen Features
- Figure 10 Alarm Flashing Frame and Alarm & Warning Tag Home Screen Feature
- Figure 11 Legend Screen
- Figure 12 Status Overlay
- Figure 13 Login Screen
- Figure 14 Passcode Screen (Passcode Entering Process)
- Figure 15 Technician Home Screen View
- Figure 16 Menu Overlay
- Figure 17 Utilities Screen
- Figure 18 Local User Firmware Update Screen
- Figure 19 Local User Firmware Update: Selection Options & Information
- Figure 20 Local User Firmware Update: Installation Progress Bar
- Figure 21 Local User Firmware Update: System Reboot
- Figure 22 Spare Parts Screen
- Figure 23 Alarms & Events Screen
- Figure 24 Alarms and Events Filter Drop Down Menu
- Figure 25 Settings Screen
- Figure 26 Selection Adjustment Screen
- Figure 27 Numeric Adjustment Screen
- Figure 28 Date Adjustment Screen
- Figure 29 Time Adjustment Screen if Time Format is 24 HR
- Figure 30 Time Adjustment Screen if Time Format is 12 HR
- Figure 31 Network Settings Screen
- Figure 32 IP Address Screen
- Figure 33 Time Zone Selection Screen
- Figure 34 Time Zone Selection Validation Screen
- Figure 35 Trends Screen
- Figure 36 Axis Configuration Overlay (before selecting data to plot)
- Figure 37 Axis Configuration Overlay (after selecting data)
- Figure 38 No Data Selected
- Figure 39 Data Selected for the left axis, but not the right axis
- Figure 40 Modbus Screen
- Figure 41 Inputs/Outputs Screen
- Figure 42 Setup Screen

- Figure 43 Offline Screen
- Figure 44 Standby Screen
- Figure 45 Standby Screen (with Alarms & Warnings Indicators)
- Figure 46 Drop Down Company Specific Information
- Figure 47 Confirmation Screen

6.4.2 Connections

Refer to the electrical schematic at the back of this manual and the gland plate assembly illustration for the location and function of the various cable and cord connectors that are provided on the bottom of the PHD-CD series controller enclosure.

WARNING – Do not overtighten polycarbonate screws on controller cover. Torque to 12 in-lb.

6.4.2.1 Connections – Alarm and Warning Contacts

6.4.2.1.1 Connections – Alarm Contacts (optional)

Connections to voltage-free common alarm contact with a maximum 1-amp rating can be made at pins 65 through 67.

- Pin 67 is the common contact connection.
- Pin 65 is the N.O. (normally open) contact connection.
- Pin 66 is the N.C. (normally closed) contact connection.
- The common alarm is designed to activate on a dryer fault alarm condition.

6.4.2.1.2 Connections – Warning Contacts (optional)

Connections to voltage-free common warning contact with a minimum 5-amp rating can be made at pins 58 through 60 and pins.

- Pin 60 is the common contact connection.
- Pin 58 is the N.O. (normally open) contact connection.
- Pin 59 is the N.C. (normally closed) contact connection.
- The common warning is designed to activate on either a dryer fault warning condition or a service reminder.

6.4.3 Control Board DIP Switches

Switch SW1 is located next to the HDMI connector on the right side of the main board and consists of 6 individual DIP switches. No DIP switches are used on the PHD-CD controller.

6.4.4 Front Panel Operation (User Interface)

The user interface for the PHD-CD series controller is provided by a 7" LCD, capacitive touchscreen. The user interface is composed of multiple screens that guide the user control of the dryer and provides visual status indications of dryer operation.

NOTE: Under the most adverse and highly unlikely conditions of fast-transient electromagnetic disturbances, the front panel screen may go blank with a faint light flashing before the controller immediately returns to a fully functional condition.

Refer to Table 2 for a list of Primary Screens and Overlays of the PHD-CD series controller User Interface.

Refer to Figure 6 for information regarding the PHD-CD series controller User Interface.

#	Primary Screens	Secondary Screens or Overlays
1	Start-Up Screen	-
2	Home Screen	Menu Overlay (all screens)
		Log In Screen
		Status Screen
		Legend Screen
3	Trends Screen	Select Data Overlays
4	I/O (Inputs/Outputs) Screen	-
5	Utilities Screen	User Manual Overlay
		Firmware Update Screen
6	Modbus Screen	-
7	Spare Parts Screen	Contact Sales and Service
8	Settings Screen	Selection Screen
		Numeric Screen
		Date Screen
		Time Screen
		Network Settings Screen
		IP Address Screen
		Time Zone Screen
Validation Screen		
9	Alarms & Events Screen	Filter Option Screen
10	Setup (password protected)	-
11	Offline/Standby Screen	-
12	Other Screens	Brand Screen
		Confirmation Screen
		Alarm Border
		Screen Saver

Table 2
List of Primary Screens and Overlays

6.4.4.1 Splash Screen

Shows Pneumatic Products logo. Transitions to Start-Up screen once application starts.

6.4.4.2 Start-Up Screen

The Start-Up screen is displayed when the application has started. The Start-Up screen shows dryer model and serial number and the Sales and Service contact information.



Figure 6
Start-Up Screen

6.4.4.3 Home Screen

The Home screen will depend upon the current product configuration and will show the Piping and Instrumentation Diagram (P&ID) for the dryer. It will allow the operator to quickly evaluate the state of the drying operation by having all inputs available at a quick glance.

6.4.4.3.1 Common Graphical Elements

The following symbols will be used throughout each P&ID:

Symbol	Description
	Valve
	Check Valve (Indicates direction)
	Exhaust Muffler
	Gauge with the outer circle referencing the percentage of full value.

When a valve is open or allowing flow through (in the case of check valves), it will be highlighted in orange or blue.

6.4.4.3.2 PHD-CD Home Screen (Models 300-750)

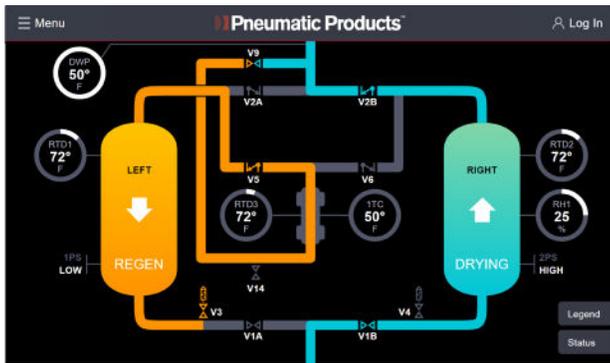


Figure 7

PHD-CD Home Screen (Models 300-750)

Label	Description
V1A	Left Inlet Valve (SOL A)
V1B	Right Inlet Valve (SOL B)
V2A	Left Outlet Check Valve
V2B	Right Outlet Check Valve
V3	Left Purge Exhaust Valve (SOL C)
V4	Right Purge Exhaust Valve (SOL D)
V5	Left Purge Check Valve
V6	Right Purge Check Valve
V9	Purge Adjusting Valve
V14	Purge Saver Intake Shut-Off Valve (SOL H)
1PS	Left Pressure Switch
2PS	Right Pressure Switch
RTD1	Left Tower Temperature
RTD2	Right Tower Temperature
RTD3	Heater Temperature Control
DWP	Dew Point Monitor
RH1	Relative Humidity (this sensor shows on the tower that is heating)
1TC	Heater Over-Temperature Sensor

6.4.4.3.3 PHD-CD Home Screen (Models 900-3200)

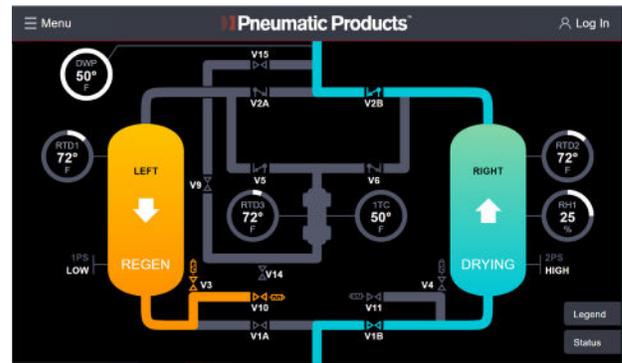


Figure 8

PHD-CD Home Screen (Models 900-3200)

Label	Description
V1A	Left Inlet Valve (SOL A & SOL B)
V1B	Right Inlet Valve (SOL A & SOL B)
V2A	Left Outlet Check Valve
V2B	Right Outlet Check Valve
V3	Left Purge Exhaust Valve (SOL C)
V4	Right Purge Exhaust Valve (SOL D)
V5	Left Purge Check Valve
V6	Right Purge Check Valve
V9	Purge Adjusting Valve
V10	Left Depress Valve (SOL F)
V11	Right Depress Valve (SOL G)
V14	Purge Saver Intake Shut-Off Valve (SOL H)
V15	Purge Shut-Off Valve (SOL E)
1PS	Left Pressure Switch
2PS	Right Pressure Switch
RTD1	Left Tower Temperature
RTD2	Right Tower Temperature
RTD3	Heater Temperature Control
DWP	Dew Point Monitor
RH1	Relative Humidity (this sensor shows on the tower that is heating)
1TS	Heater High Inlet Temperature Switch
1TC	Heater Over-Temperature Sensor

6.4.4.3.4 Common Actions

6.4.4.3.4.1 Alarms and Warning Home Screen Appearance and Banner

When an alarm or warning is active, a banner is shown at the top of the Home screen to indicate the alarm/warning to the user until the alarm is reset/cleared, as shown in Figure 9. The banner will show text with a description of the alarm. The banner can be dismissed by pressing the X. The banner will reappear whenever the user re-enters the home screen.

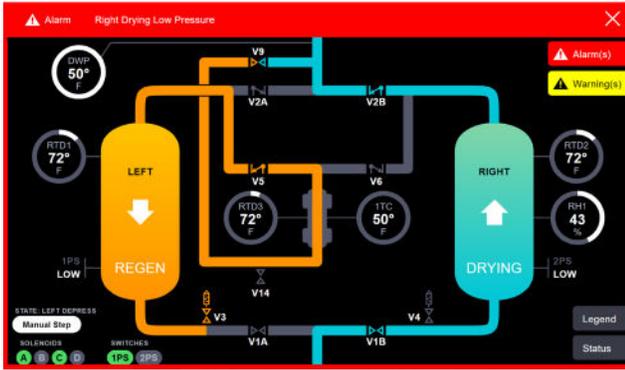


Figure 9
Alarm Banner and Alarm Tag
Home Screen Features

When an alarm or warning is triggered, a color-coded tag will be displayed on the upper right corner. An example screen is shown below. The user will be directed to the Events and Alarms screen by clicking on them. The list of items on the Events and Alarms screen will be filtered depending on the type of event (only alarms or only warnings, whatever applies).

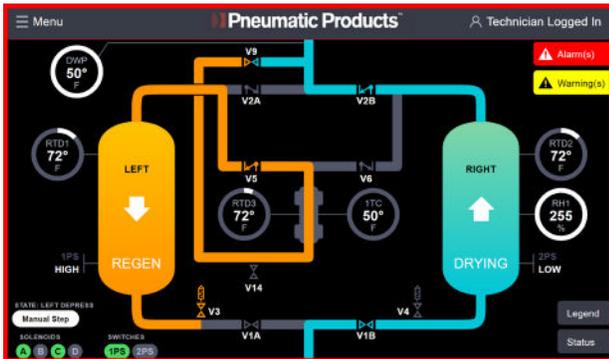


Figure 10
Alarm Flashing Frame and Alarm & Warning Tag
Home Screen Feature

An alarm banner will also be presented on the Home screen to provide a bold indication that an alarm is present.

- The alarm banner will show the most recent active alarm/warning on the Home screen of the local or web interface.
- The alarm banner can be cleared on an interface by pressing the X. This will not clear the alarm banner on any other interface.

- If a user using either the local or web interface resets all active alarm/warnings, the alarm banner on all interfaces is cleared.
- Clearing the alarm banner is only a way to give access to the user to the buttons that remain underneath. Clicking the X on the banner, will not reset the alarm/warning. The alarm/warning can only be reset on the Alarms & Events screen.

6.4.4.3.4.2 Dew Point Analyzer Gauge

The dew point Analyzer gauge will only be visible if the device is installed on the unit and it is enabled on the SetUp screen.

6.4.4.3.4.3 Pressure Switches

Pressure switches will be displayed only if one of the following conditions is true:

- Manual mode is active (for troubleshooting purposes).
- Alarm/warning related to the switch is active.
- Switch is disabled. In this case it will show with the word "disabled", instead of low/high.

6.4.4.3.4.4 Legend Screen

When Legend is pressed, the legend screen opens. The legend screen contains tables of diagram elements grouped by type (valves, switches, gauges, etc.) The elements to be listed are defined in the tables under Figures 7 and 8, and are different for each home screen. The legend screen contains a header with the text LEGEND, and a subheader with the dryer model number. Press X to exit.

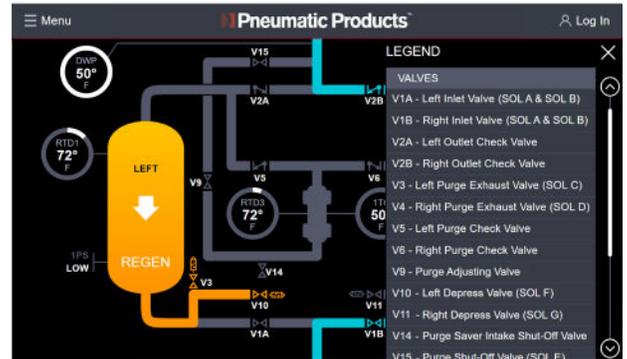


Figure 11
Legend Screen

6.4.4.3.4.5 Status Overlay

The Status Overlay is presented to the user or technician to provide drying and state status. It also contains the power/standby/on-off button. Touching the left side of the screen or the X closes the overlay.

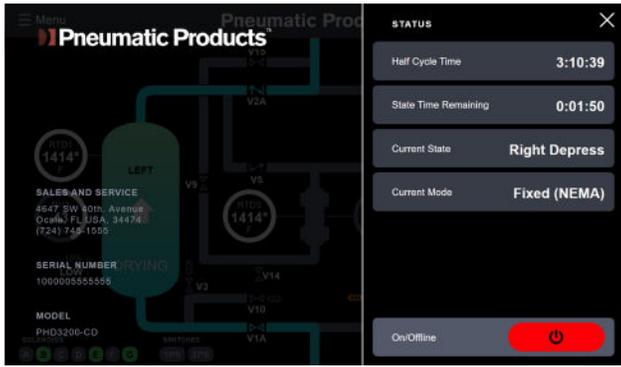


Figure 12
Status Overlay

The fields in the Status Overlay are described in the following table.

Label	Description
Half Cycle Time	The amount of time remaining before the next switchover.
State Time Remaining	The amount of time remaining for the current step.
Current State	The name of the current step.
Current Mode	The current operational mode.
On/Offline	Once clicked, the On/Offline Selection Screen will be shown.
Sales and Service	The contact information for sales and service (same as parts list).
Serial Number	The serial number of the dryer.
Model	Model

Table 3
Status Overlay Fields Description

6.4.4.3.4.6 Login Screen

When the LogIn button in the header is pressed, a Login Screen is presented. Enter the default passcode (provided with your unit) using the numeric keypad, or press X to exit.

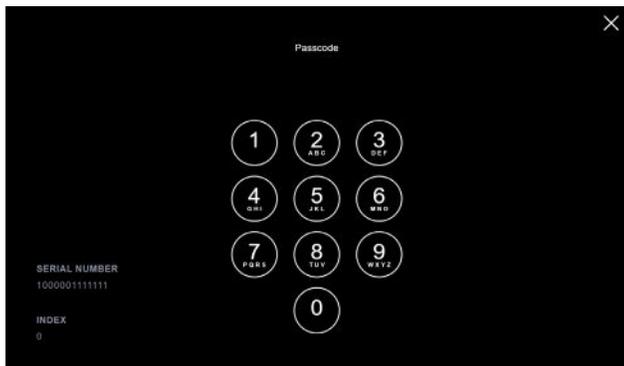


Figure 13
Login Screen

After entering the passcode, press the green check icon to enter. Use the backspace icon to delete entries. In the event of an incorrect passcode, the user interface will notify the user that the passcode is incorrect.

NOTE: As digits are entered, white dots appear above the keypad to indicate the number of digits entered so far. A backspace key appears when one or more digits are entered and a submit key appears when four or more digits are entered.

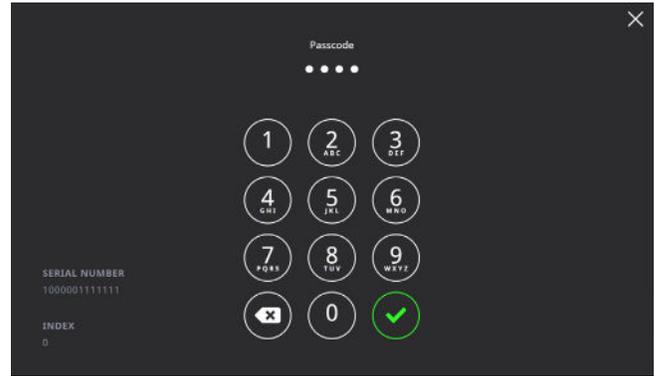


Figure 14
Passcode Entering Process (Login Screen)

After logging in, the Login button will change to Technician Logged In. Pressing the Technician Logged In button will create a dropdown menu with Change Passcode and Log Out options.

- Change Passcode: Allows the user to change the static passcode. When the submit key is pressed, the user is asked to enter the passcode again for verification. If the two entered passcodes match, the dots momentarily flash green and the passcode is changed. If the two entered passcodes do not match, the dots momentarily flash red.
- Log Out: Logs the user out.

In the event a user forgets their passcode, they will need to contact the Pneumatic Products service center for assistance.

6.4.4.3.4.7 Technician Mode Home Screen

When a technician is logged in, the Home screen will show additional information to aid the technician. An example screen is shown below:

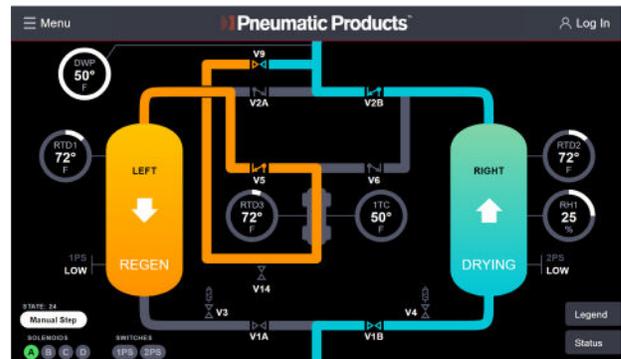


Figure 15
Technician Home Screen View

Additional Elements:

- Manual Step button (only present when the dryer is in Manual mode): allows the technician to manually step through cycle states when in manual mode.
- State: shows the current dryer cycle step.
- Solenoids virtual LED indicator: shows the current logical state of the corresponding valve controlled by each solenoid (green = energized, gray = de-energized).
- Switches lighted-bubble indicator: show the current switch inputs (digital input logical value active = green, inactive = gray).

NOTE: Automatic Technician Timeout will occur after 30 minutes of inactivity on the user interface. Technician login information will need to be resubmitted to recover technician access. If the dryer is in manual mode it will remain in manual mode even if the technical mode times out.

6.4.4.3.4.8 Menu Overlay

The Menu button is present on all screens.

When Menu is pressed, a navigation overlay is presented to allow the user to move to different screens. The SETUP navigation button is only visible if a technician is logged in. The other eight buttons are always visible. Tapping a navigation button goes to that screen, tapping X exits the menu without changing screens.

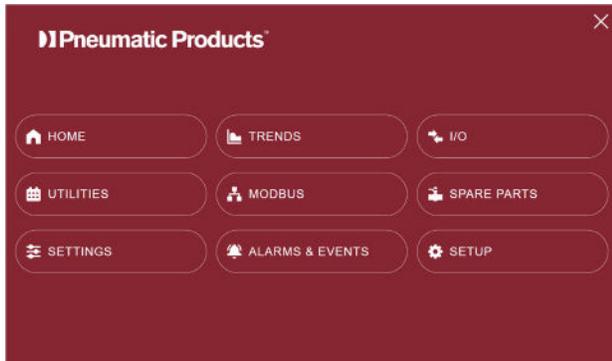


Figure 16
Menu Overlay

6.4.4.4 Utilities Screen

The Utilities screen displays the three service timers and intervals: Filters, Desiccant, and Valves. The right panel displays specific dryer information, including the model number, material number, serial number, total cycle count, and partial cycle count. A button in the header allows a user to view the instruction manual.

The Total Cycle Count is the number of drying cycles performed by the unit. The Partial Cycle Count is a resettable counter that allows the user to reset as needed.

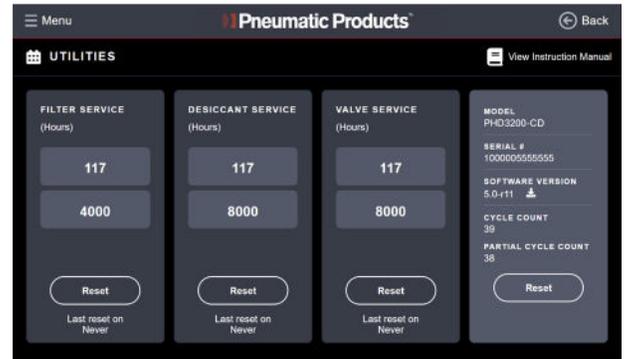


Figure 17
Utilities Screen

When a service timer is within 30 days of the service interval, a flashing yellow border appears around the box for that service interval. In addition to the yellow border, a "Spare Parts" button appears, which, when pressed, takes the user to the Spare Parts screen to assist in ordering parts.

6.4.4.4.1 Service Reset Buttons

A reset button exists for each service timer. Pressing the reset button for a service timer resets it to zero and sets the "Last reset on" date to the current date.

6.4.4.4.2 Spare Parts Buttons

A spare parts button exists for each service timer but is only shown when service is required within 30 days. The spare parts buttons appear in yellow and, when pressed, takes the user to the Spare Parts screen.

6.4.4.4.3 Partial Cycle Count Reset Button

The final reset button, located in the right panel below the cycle count, resets the partial cycle count. The total cycle count cannot be reset.

6.4.4.4.4 View Instruction Manual Button

In the header, a button labeled "View Instruction Manual" displays the PDF of the dryer's instruction manual. The PDF can be closed with the X in the upper right corner.

6.4.4.4.5 Firmware Update Button

The controller is capable of being upgraded in the field by downloading an upgrade file using the USB drive or Web Interface by a user. In each case, the firmware upgrade is started by the interface on the Utilities page. Firmware update packages will be signed to prevent installation from an unverified source.

6.4.4.4.5.1 Local User Firmware Update

User inserts a USB drive containing a firmware update, then taps the software version on the utilities screen. A Firmware Update Screen appears listing the firmware update files on the USB drive and prompts the user to select one.



Figure 18
Local User Firmware Update Screen

Tapping an update filename on the left selects it. If the update file contains information about what components it applies to (application, spare parts, service info, password), this will be shown on the right.



Figure 19
Local User Firmware Update: Selection Options & Information

Tap the update button to verify and begin installing update. A progress bar is shown indicating the progress of the update. An update cannot be cancelled once started.

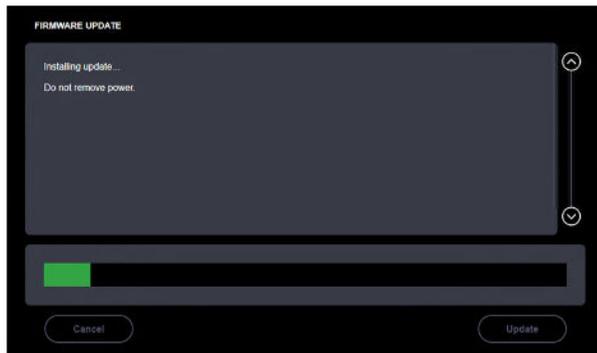


Figure 20
Local User Firmware Update: Installation Progress Bar

Once the update finishes installing, tapping the reboot button reboots the system, finishing the update. This is the only option.



Figure 21
Local User Firmware Update: System Reboot

6.4.4.5 Spare Parts Screen

The Spare Parts screen displays a list of the serviceable parts in the system. Touching the button in the header that reads "Contact Sales and Service" brings up an overlay containing the service provider address and phone number.

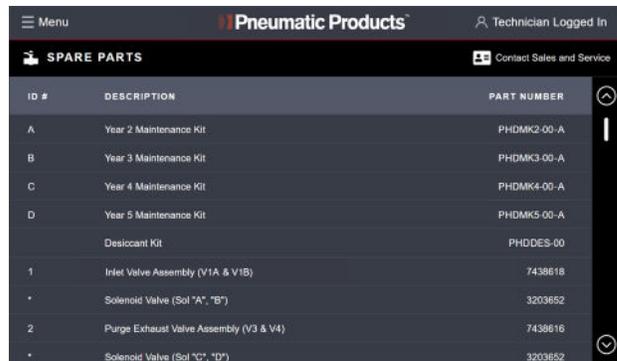


Figure 22
Spare Parts Screen

6.4.4.6 Alarms & Events Screen

The Alarms & Events screen displays a filterable log of events. It also provides a way for the user to reset alarms and warnings.

Events are displayed in a table in chronological order with the most recent events on top. The table can be scrolled to browse events from the last 30 days.

The table contains three columns: Event, Time, and Reset. The Event column displays the type of event (event, warning, or alarm) as well as a short description. The Time column displays the date and time the event occurred. The Reset column displays a reset button for alarms and warnings that have not been reset. The reset column is only used for alarms and warnings, as events cannot be reset.

A full list of alarms and warnings can be found in Section 6.4.8, including index and description. Events are generated whenever the dryer state changes.

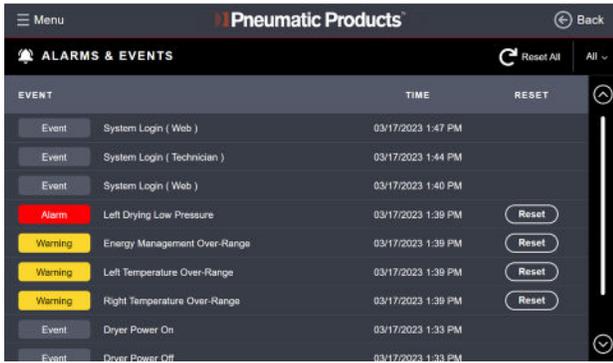


Figure 23
Alarms & Events Screen (Example)

6.4.4.6.1 Filter Dropdown

The Events list can be filtered using the dropdown in the header. In Figure 20a, the filter is set to "All" to show all alarms, warnings, and events. There are four filter options.

Filter	Description
All	Shows all alarms, warnings, and events.
Only Alarms	Shows only alarms, including alarms that are "active" (have not been reset) and alarms that have been reset.
Only Warnings	Shows only warnings, including warnings that are "active" (have not been reset) and warnings that have been reset.
Active Alarms & Warnings	Shows both alarms and warnings, but only those that are "active" (have not been reset).

Table 4
Alarms & Events
Filter Drop Down Feature Options

The filter can be changed by tapping on the dropdown, which brings up a list of options. Tapping a filter option selects it and updates the table.

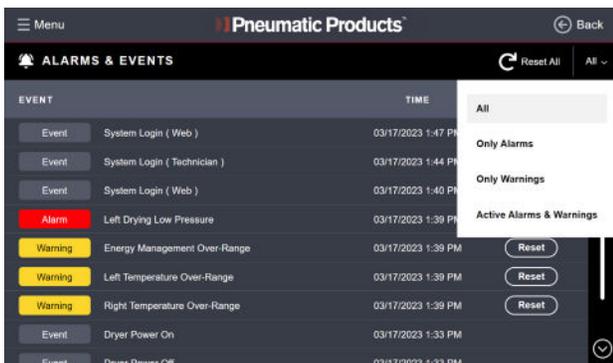


Figure 24
Alarms & Events Filter Drop Down Menu Example

6.4.4.6.2 Reset All Button

In the header, next to the filter dropdown, is a button that resets all filtered events.

- If the selected filter is "All" or "Active Alarms & Warnings", this button will reset both alarms and warnings.
- If the selected filter is "Only Alarms", this button will change to say "Reset Alarms" and will only reset active alarms (ignoring warnings).
- If the selected filter is "Only Warnings", this button will change to say "Reset Warnings" and will only reset active warnings (ignoring alarms).

6.4.4.6.3 Reset Alarm or Warning

Alarms and warnings can be individually reset by pressing the associated reset button in the reset column. Once an alarm or event is reset, the reset column will display the date and time the reset occurred.

6.4.4.6.4 Reset Action

Alarms and warnings can only be reset if the alarm or warning conditions are not present. If the alarm or warning condition is still present, the Reset button for the alarm or warning will remain visible.

6.4.4.7 Settings Screen

The Settings screen provides access to dryer settings that can be changed without logging in as a technician. All settings that require technician login are on the Setup screen. Together, the Settings and Setup screens contain all dryer settings.

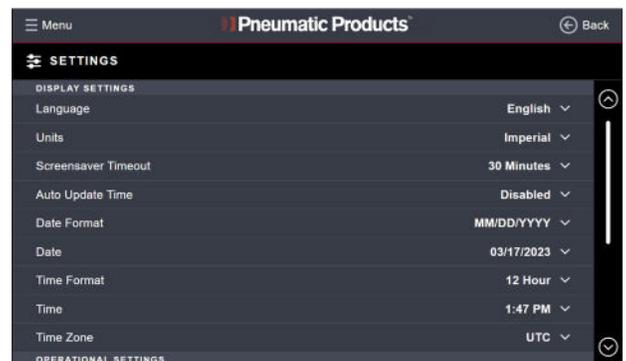


Figure 25
Settings Screen

6.4.4.7.1 Settings on the Settings Screen

Refer to Table 5 for a list of the settings that are available on the Settings screen.

6.4.4.7.2 Adjustment Screens

When a user selects a setting to change, an adjustment screen is shown. Different settings have different adjustment screens.

Parameter	Display Settings	Range/Step	Default	Overlay
Language	Display Language	English French German Spanish Portuguese Italian Polish Danish Dutch Norwegian Finnish Swedish Czech Chinese Japanese Russian Icelandic Slovene Croatian Bulgarian Rumanian Greek Hungarian Slovakian Latvian Lithuanian Stonian Korean	English	Selection
Units	Unit type used for all measurements	Metric Imperial	Imperial	Selection
Screensaver Timeout	Automatically display screen saver after a period of inactivity	2 Minutes 5 Minutes 15 Minutes 30 Minutes Never	30 min	Selection
Auto Update Time	Enable/Disable NTP	Enabled Disabled	Disabled	Selection
Date Format	Format for Date	MM/DD/YYYY DD/MM/YYYY	MM/DD/YYYY	Selection
Date (visible if Auto Update Time is Disabled)	Date value	1/1/2000 to 12/31/2099	Factory	Date
Time Format	Format for Time	24 Hour 12 Hour	12 Hour	Selection
Time (visible if Auto Update Time is Disabled)	Time value	00:00:00 to 23:59:59 00:00:00 AM to 11:59:59 PM	Factory	Time
Time Zone	Region / Universal Time Coordinates (UTC)	Region / Universal Time Coordinates (UTC)	—	Time Zone

Parameter	Operational Settings	Options	Default	Overlay
Mode	Dryer Mode	Fixed (NEMA) Dewpoint EMS	Fixed (NEMA)	Selection
Auto-Restart	On Off state on startup	Off = dryer off on startup On = dryer resumes	On	Selection

Parameter	Network Settings	Options	Default	Overlay
Modbus address	Modbus address	1 to 247 in 1 increments	6	Numeric
IP Configuration	Automatic or manual IP	Dynamic Static	Static	Selection
Configure Static IP	IP Address	nnn.nnn.nnn.nnn	192.168.1.10	IP Address
Subnet Mask	Subnet Mask	nnn.nnn.nnn.nnn	255.255.255.0	IP Address
Gateway Address	Gateway Address	nnn.nnn.nnn.nnn	192.168.1.1	IP Address
DNS Address	DNS Address	nnn.nnn.nnn.nnn	—	Numeric

Parameter	Warning Settings	Min	Max	Step	Units	De- fault	Overlay
Dew Point Warning	Outlet Dewpoint Temperature Warning	dpSP+5°C	10 50	1 1.8	°C °F	-20 -4	Numeric

Table 5
Settings

6.4.4.7.2.1 Selection Screen

The Selection screen is shown for the user to select one of several options.

- When over 5 options are offered, the items will arrange in two columns.
- When over 10 options are presented, items will also arrange in two columns, and the option list will become scrollable.

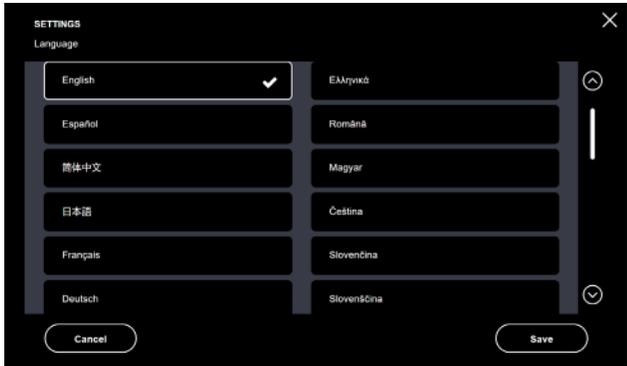


Figure 26
Selection Adjustment Screen

6.4.4.7.2.2 Numeric Screen

The Numeric screen is shown for the user to enter a numerical value. The number on the draggable circle moves above the circle while the user is dragging it to allow for the current value to be more easily seen.



Figure 27
Numeric Adjustment Screen

6.4.4.7.2.3 Date Screen

The Date screen is shown for the user to enter a date. The order of the day and month depend on the selection of "Date Format".

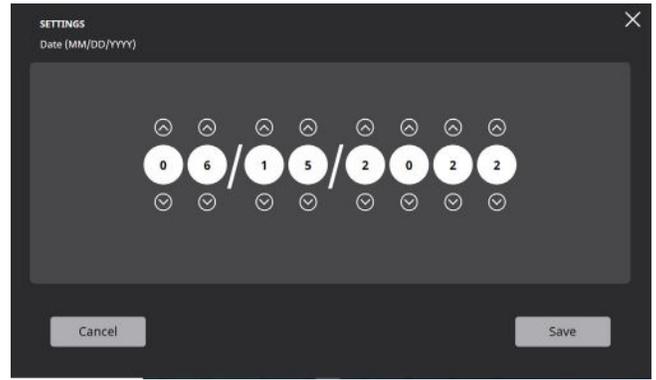


Figure 28
Date Adjustment Screen

6.4.4.7.2.4 Time Screen

The Time screen is shown for the user to enter a time. The format will depend on the selection of "Time Format".

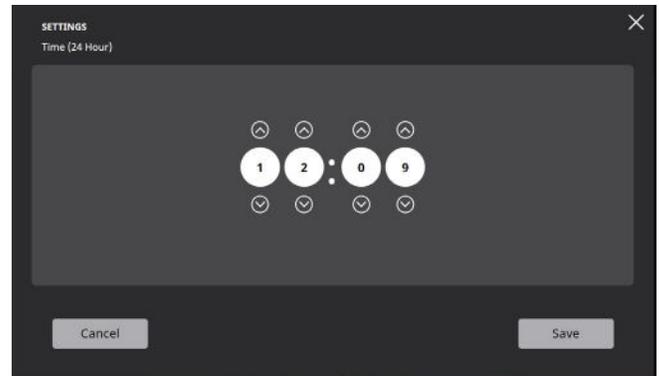


Figure 29
Time Adjustment Screen if time format is 24 HR

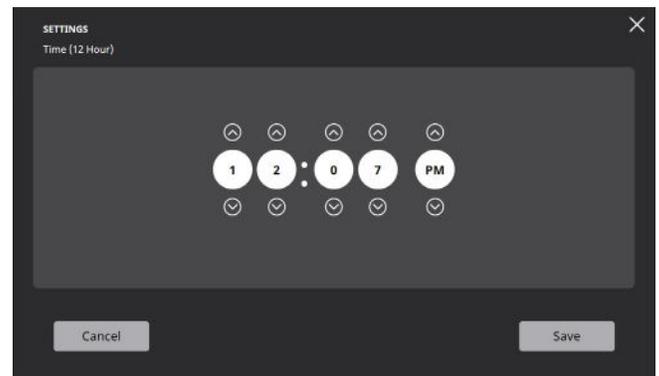


Figure 30
Time Adjustment Screen if time format is 12 HR

6.4.4.7.2.5 Network Settings Screen

The Network Settings screen is shown when the user taps the dryer's IP address on the settings screen. If the IP configuration is set to dynamic, the network settings overlay displays the network settings. If the IP configuration is static, the network settings screen allows the user to set the network settings. The MAC address is read-only and cannot be modified in either configuration.

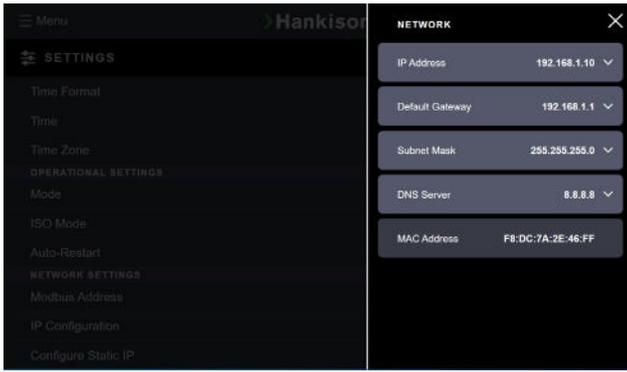


Figure 31
Network Settings Screen

6.4.4.7.2.6 IP Address Screen

The IP address screen is shown for the user to enter an IP address. It is used for entering the IP address, default gateway, subnet mask, and DNS server.

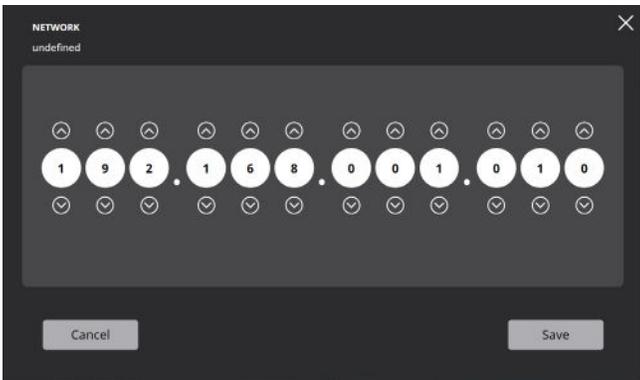


Figure 32
IP Address Screen

6.4.4.7.2.7 Time Zone Screen

The Time Zone screen is shown for the user to select a time zone. It consists of two scrolling lists of options. The user first must select a region from the list on the left and then a city from the list on the right. If the user selects the special option "UTC" (Universal Time Coordinated) on the left, no region selection is required.

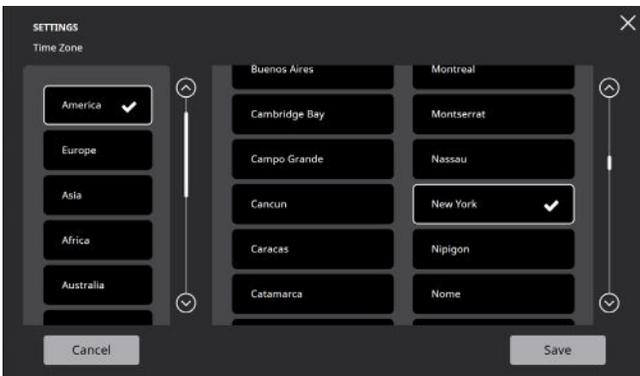


Figure 33
Time Zone Selection Screen

6.4.4.7.2.8 Validation Screen

The date, time, and IP entries require validation because some values which can be entered are impossible. For example, the date cannot be February 30th and the time cannot be 25:40. When the adjustment is set to an invalid value, an error text is shown in red and the save button is grayed out. The user cannot save the setting in this case and must change it to a valid value or cancel.

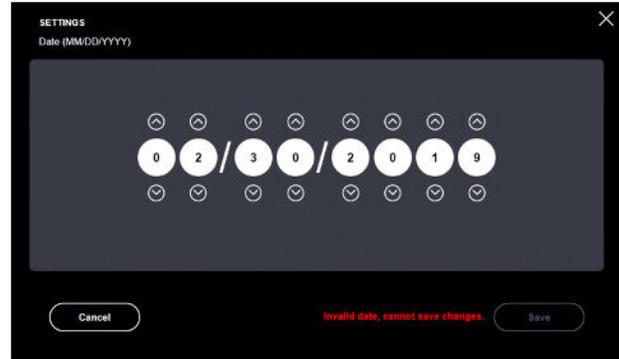


Figure 34
Validation Screen Example

6.4.4.8 Trends Screen

The Trends screen allows the user to view Temperature, Pressure, and Pressure Dew Point plotted over time. The values available for plotting on the Trends screen are the same values from the gauges on the P&ID diagram. The previous 30 days of data will be accessible via the Trends screen.

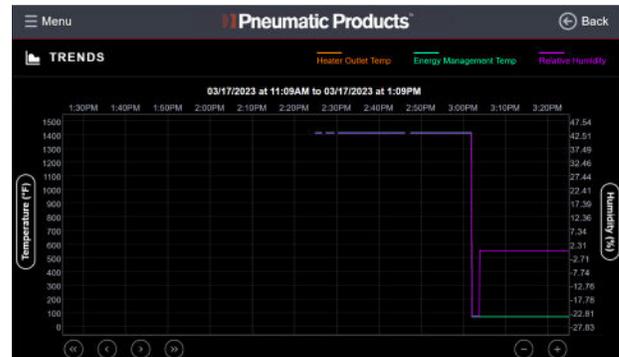


Figure 35
Trends Screen Example

6.4.4.8.1 Axis

Tapping on the left axis label brings up the axis configuration overlay, which allows the user to select data to appear on the left axis, as well as set the axis range. Before selecting data to plot, the right panel will be blank.



Figure 36
Axis Configuration Screen
(before selecting data to plot)

Once data is selected, the right panel will allow for range customization.

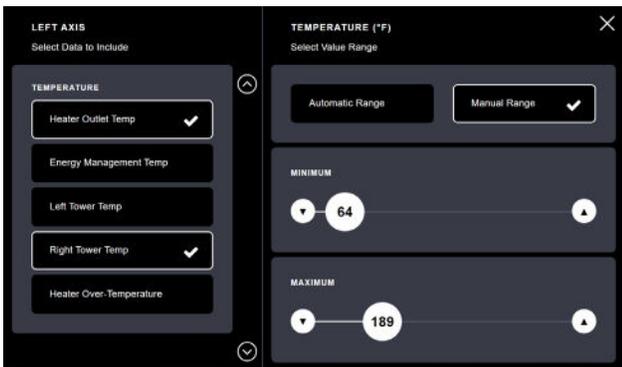


Figure 37
Axis Configuration Screen
(after selecting data)

The axis label buttons appear differently when no data is selected, as shown below.

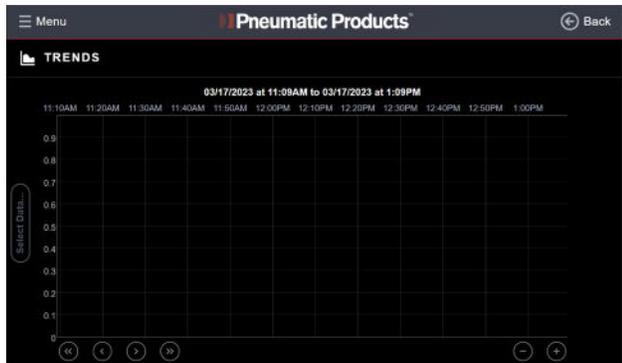


Figure 38
No Data Selected



Figure 39
Data selected for the left axis, but not the right axis.

NOTE: Right axis is only available after a left axis is selected.

6.4.4.8.2 Pan and Zoom

The buttons below the plot allow the user to pan and zoom the graph.



The buttons on the left pan the graph. The single arrow buttons move the graph slightly left or right, for fine adjustment, and the double arrow buttons move the graph an entire page to the left or right, for coarse adjustment.

The buttons on the right zoom the graph. The minus button zooms out for a wider view, allowing the user to see more data. The plus button zooms in for a closer view, allowing the user to see less data, but in more detail. The user can select to view as little as 2 hours of data at once, or as much as 7 days.

6.4.4.9 Modbus Screen

This screen allows the user to view Modbus register values.

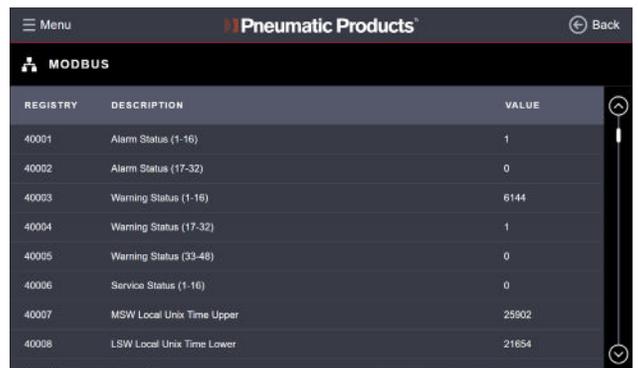


Figure 40
Modbus Screen

See Table 6 for details on the Modbus register assignments.

Ref	Addr	Name/Source	Units	Description	Access
40001	0x000	event.modbus_bitmasks[0]	Bitmask	Alarm Status (1-16)	RO
40002	0x001	event.modbus_bitmasks[1]	Bitmask	Alarm Status (17-32)	RO
40003	0x002	event.modbus_bitmasks[2]	Bitmask	Warning Status (1-16)	RO
40004	0x003	event.modbus_bitmasks[3]	Bitmask	Warning Status (17-32)	RO
40005	0x004	event.modbus_bitmasks[4]	Bitmask	Warning Status (33-48)	RO
40006	0x005	event.modbus_bitmasks[5]	Bitmask	Service Status (1-16)	RO
40007	0x006	system.timestamp	Seconds	MSW Local Unix Time Upper	RW
40008	0x007	system.timestamp	Seconds	LSW Local Unix Time Lower	RW
40020	0x013	event.state	Bitmask	Dryer State	RO
40021	0x014	settings.mode	enum	Dryer mode	RO
40023	0x016	settings.nema_mode	enum	NEMA Mode	RO
40025	0x018	event.dryer_timer	Seconds	Drying Timer Upper	RO
40026	0x019	event.dryer_timer	Seconds	Drying Timer Lower	RO
40027	0x01A	event.state_timer	Seconds	Remaining State Timer Upper	RO
40028	0x01B	event.state_timer	Seconds	Remaining State Timer Lower	RO
40029	0x01C	System.operating_state	Int	System Operating State	RO or R/W
40050	0x031	settings.modbus_address	int	Modbus Address	RW
40051	0x032	??-fixed(1)	Integer	Controller Identifier	RO
40052	0x033	??-fixed(100)	Integer	Manufacturer Identifier	RO
40060	0x03B	modbus.dryer_id[0]	int	Dryer ID 0	RW
40061	0x03C	modbus.dryer_id[1]	int	Dryer ID 1	RW
40062	0x03D	modbus.dryer_id[2]	int	Dryer ID 2	RW
40063	0x03E	modbus.dryer_id[3]	int	Dryer ID 3	RW
40064	0x03F	modbus.dryer_id[4]	int	Dryer ID 4	RW

Table 6
Modbus Registers (RO=read only, RW=read & write)

Ref	Addr	Name/Source	Units	Description	Access
40080	0x04F	event.service_times[0]	Hours	Filter Usage	RO
40081	0x050	event.service_times[1]	Hours	Valve Usage	RO
40082	0x051	event.service_times[2]	Hours	Desiccant Usage	RO
40083	0x052	event.energy_savings		Percent Energy Savings	RO
40084	0x053	event.history[0][0]	Minutes	Current Drying Time	RO
40085	0x054	event.history[0][1]	Minutes	Current Heating Time	RO
40086	0x055	event.history[0][2]	Minutes	Current Sweep Time	RO
40087	0x056	event.history[0][3]	Minutes	Current Hold Time	RO
40088	0x057	event.history[1][0]	Minutes	Left Drying Time	RO
40089	0x058	event.history[1][1]	Minutes	Left Heating Time	RO
40090	0x059	event.history[1][2]	Minutes	Left Sweep Time	RO
40091	0x05A	event.history[1][3]	Minutes	Left Hold Time	RO
40092	0x05B	event.history[2][0]	Minutes	Right Drying Time	RO
40093	0x05C	event.history[2][1]	Minutes	Right Heating Time	RO
40094	0x05D	event.history[2][2]	Minutes	Right Sweep Time	RO
40095	0x05E	event.history[2][3]	Minutes	Right Hold Time	RO
40096	0x05F	event.total_cycle_count	units	Total Cycle Count Upper	RO
40097	0x060	event.total_cycle_count	units	Total Cycle Count Lower	RO
40127	0x07E	io.HeaterOT	bool	Heater Overtemperature	RO
40129	0x080	io.ShutDn	bool	Shut Down	RO
40130	0x081	io.RtPressLo	bool	Right Pressure Low Switch	RO
40131	0x082	io.LtPressLo	bool	Left Pressure Low Switch	RO
40137	0x088	io.LtPressHi	bool	Left Pressure High Switch	RO
40138	0x089	io.RtPressHi	bool	Right Pressure High Switch	RO
40152	0x097	io.DewPointSen	0.1°C	Outlet Dew Point Temperature	RO
40154	0x099	io.HtrOverTempSen	0.1 BAR	Heater Over Temperature	RO
40159	0x09E	io.RelHumidSen	%	Relative Humidity	RO
40160	0x09F	io.EnergyMgtVaporPress	0.1 BAR	Energy Management Vapor Pressure	RO
40175	0x0AE	io.LtTemp	0.1°C	Left Tank Temperature	RO
40176	0x0AF	io.RtTemp	0.1°C	Right Tank Temperature	RO
40177	0x0B0	io.HeaterTemp	0.1°C	Heater Temperature	RO
40178	0x0B1	io.EnergyMgtTemp	0.1°C	Energy Management Temp	RO

Table 6 (continued)
Modbus Registers (RO=read only, RW=read & write)

Ref	Addr	Name/Source	Units	Description	Access
40192	0x0BF	io.LtInletV	bool	Left Inlet Valve	RO
40193	0x0C0	io.RtInletV	bool	Right Inlet Valve	RO
40194	0x0C1	io.LtExhAV or LtExhBV	bool	Left Exhaust Valve	RO
40195	0x0C2	io. RtExhAV or RtExhBV	bool	Right Exhaust Valve	RO
40199	0x0C6	io. PurgeSOV	bool	Purge Shut Off Valve	RO
40200	0x0C7	io. PurgeSavV	bool	Purge Saver Valve	RO
40201	0x0C8	io.LtDepressV	bool	Left Depressurization Valve	RO
40202	0x0C9	io.RtDepressV	bool	Right Depressurization Valve	RO
40210	0x0D1	io.AlarmOn	bool	Alarm Relay	RO
40230	0x0E5	settings.language	enum	Language	RO
40231	0x0E6	settings.units	enum	System Units	RO
40232	0x0E7	settings.auto_restart	bool	Auto Restart	RO
40233	0x0E8	settings.filter_service_interval	Hours	Filter Interval	RO
40234	0x0E9	settings.valve_service_interval	Hours	Valve Interval	RO
40235	0x0EA	settings.desiccant_service_interval	Hours	Desiccant Interval	RO
40238	0x0ED	settings.dew_point_control_setpoint	0.1°C	Dewpoint Control Setpoint	RO
40239	0x0EE	settings.alarm_outlet_dew_point	0.1°C	Dewpoint Alarm Setpoint	RO
40240	0x0EF	settings.alarm_outlet_dew_point_delay	seconds	DWP Hi-Humid Alarm Delay	RO
40243	0x0F2	settings.heat_complete_setpoint	0.1°C	Heat Termination Setpoint	RO
40244	0x0F3	settings.heater_temperature_control_setpoint	0.1°C	Heater Temp Control Setpoint	RO
40245	0x0F4	settings.sweep_complete_setpoint	0.1°C	Sweep Termination Setpoint	RO
40246	0x0F5	settings.relative_humidity_control_setpoint	%	EMS RH Setpoint	RO
40247	0x0F6	settings.relative_humidity_alarm_setpoint	%	High RH Alarm Setpoint	RO
40248	0x0F7	settings.vapor_pressure_control_setpoint	mBar	EMS VP Control Setpoint	RO
40249	0x0F8	settings.vapor_pressure_alarm_setpoint	mBar	High VP Ctrl Alarm Setpoint	RO
40250	0x0F9	settings.ems_high_humidity_alarm_delay	seconds	EMS Hi-Humidity Alarm Delay	RO
40251	0x0FA	settings.heater_low_temperature_alarm_setpoint	0.1°C	Heater Low Temp Alarm	RO
40252	0x0FB	settings.heater_low_temperature_alarm_delay	seconds	Htr Low Temp Alarm Delay	RO
40253	0x0FC	settings.heater_high_temperature_alarm_setpoint	0.1°C	Heater High Temp Alarm	RO

Table 6 (continued)
Modbus Registers (RO=read only, RW=read & write)

Ref	Addr	Name/Source	Units	Description	Access
40270	0x10D	settings.dip_auto_manual_mode	bool	Manual/Auto Mode	RO
40271	0x10E	settings.internal_operating_pressure	bool	Operating Pressure	RO
40274	0x111	settings.dip_pressure_switches	bool	Pressure Switches	RO
40276	0x113	settings.dip_outlet_dewpoint_sensor	bool	Outlet Dewpoint Sensor	RO
40278	0x115	settings.internal_heater_type	bool	Blower Purge/External Heater	RO
40279	0x116	settings.dip_energy_management_system	bool	Energy Management System	RO
40280	0x117	settings.dip_sweep	bool	Sweep	RO
40286	0x11D	settings.standby_mode	bool	Standby Mode	RO
40287	0x11E	settings.offline_mode	bool	Offline Mode	RO
40306	0x131	settings.inlet_close_time	Seconds	Inlet Close Time Upper	RO
40307	0x132	settings.inlet_close_time	Seconds	Inlet Close Time Lower	RO
40308	0x133	settings.depress_time	Seconds	Depressurization Time Upper	RO
40309	0x134	settings.depress_time	Seconds	Depressurization Time Lower	RO
40310	0x135	settings.repress_time	Seconds	Repressurization Time Upper	RO
40311	0x136	settings.repress_time	Seconds	Repressurization Time Lower	RO
40312	0x137	settings.max_drying_time	Seconds	Max Drying Time Upper	RO
40313	0x138	settings.max_drying_time	Seconds	Max Drying Time Lower	RO
40314	0x139	settings.estimated_drying_time	Seconds	Estimated Drying Time Upper	RO
40315	0x13A	settings.estimated_drying_time	Seconds	Estimated Drying Time Lower	RO
40316	0x13B	settings.exhaust_open_time	Seconds	Inlet Close Time Upper	RO
40317	0x13C	settings.exhaust_open_time	Seconds	Inlet Close Time Lower	RO
40322	0x141	settings.max_heat_time	Seconds	Max Drying Time Upper	RO
40323	0x142	settings.max_heat_time	Seconds	Max Drying Time Lower	RO
40326	0x145	settings.heater_cool_down_time	Seconds	Max Drying Time Upper	RO
40327	0x146	settings.heater_cool_down_time	Seconds	Max Drying Time Lower	RO
40330	0x149	settings.min_sweep_time	Seconds	Max Drying Time Upper	RO
40331	0x14A	settings.min_sweep_time	Seconds	Max Drying Time Lower	RO
40332	0x14B	settings.max_sweep_time	Seconds	Estimated Drying Time Upper	RO
40333	0x14C	settings.max_sweep_time	Seconds	Estimated Drying Time Lower	RO
40334	0x14D	settings.min_drying_time	Seconds	Max Drying Time Upper	RO
40335	0x14E	settings.min_drying_time	Seconds	Max Drying Time Lower	RO

Table 6 (continued)
Modbus Registers (RO=read only, RW=read & write)

6.4.4.10 I/O Screen

The I/O Screen provides the state of the Inputs and Outputs. This screen facilitates communication with the customer when troubleshooting.

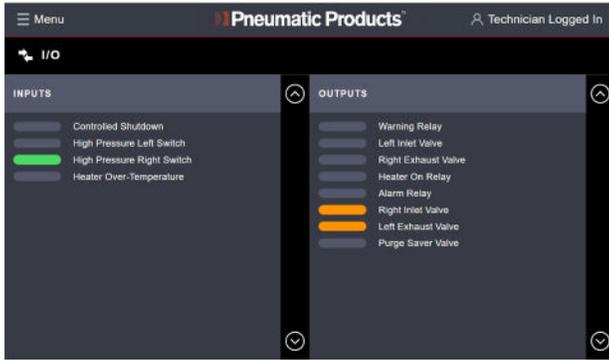


Figure 41
Inputs/Outputs Screen

The values (green=active input, orange=active output, gray=inactive) reflect the pin state.

6.4.4.11 Setup Screen

The Setup screen is password protected. Different levels of protection are put in place, to grant different access levels. Ability to adjust all setup parameters will not be available for all level access. See section 6.4.4.3.5.6 for more information.

The screen is divided into two different spaces: virtual DIP switches in the top part and setup parameters in the lower section.

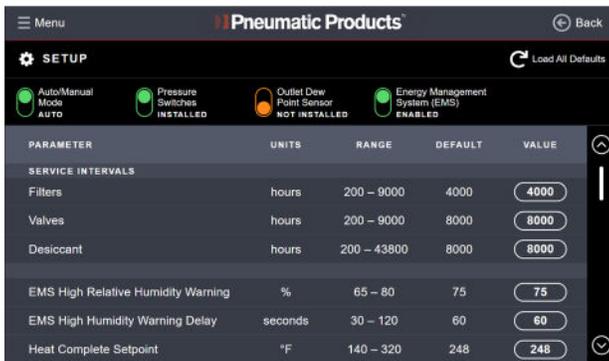


Figure 42
Setup Screen

6.4.4.11.1 Setup Parameters

This section presents all numerical parameters that are relevant to the control logic (i.e. termination set points) and alarm/warning limits (i.e. maximum temperatures, or relative humidity ranges). Each parameter can be adjusted using min, max, default, and step parameters.

General Settings						
Parameter	Access	Units	Min	Max	Step	Default
Filter Service Interval	Technician	hrs	200	9000	200	4000
Valves Service Interval	Technician	hrs	200	9000	200	4000
Desiccant Service Interval	Technician	hrs	200	43800	200	8000
Dew Point Control Setpoint	Technician	°C	-80	10	1	-40
		°F	-112	50	1.8	-40
Dew Point Warning Delay	Technician	sec	1800	7200	10	3600
EMS High Relative Humidity Warning	Technician	%	65	80	5	75
EMS High Humidity Warning Delay	Technician	sec	30	120	10	60
Heat Complete Setpoint	Technician	°C	60	160	1	120
		°F	140	320	1.8	248
Heater High Temperature Alarm	Technician	°C	288	344	1	316
		°F	550	650	1.8	600.8
Heater Low Temperature Warning	Technician	°C	60	121	1	121
		°F	140	250	1.8	250
Heater Low Temperature Warning Delay	Technician	sec	300	1200	10	900
Heater Temperature Control Setpoint	Technician	°C	150	188	1	188
		°F	302	370	1.8	370.4
Sweep Complete Setpoint	Technician	°C	40	66	1	49
		°F	104	150.8	1.8	120.2
Inlet Close Time	Technician	sec	5	20	1	15
Depress Time	Technician	sec	50	450	10	120
Repress Time	Technician	sec	100	500	10	180
Max Drying Time	Technician	sec	100020	300000	180	144000
Estimated Drying Time	Technician	sec	14400	28800	180	28800
Exhaust Open Time	Technician	sec	2	20	1	10
Min Heat Time	Technician	min	4	120	1	10
Max Heat Time	Technician	min	167	417	1	230
Heater Cool Down Time	Technician	sec	40	300	1	240
Min Sweep Time	Technician	sec	3300	7500	60	3300
Max Sweep Time	Technician	sec	5400	12000	60	10500
Min Drying Time	Technician	min	133	267	1	240

Table 7
Setup Adjustable Parameters - General Settings

6.4.4.11.1.1 Virtual DIP Switches

Virtual DIP Switches allow the user to enable certain features or to tell the system whether a specific piece of hardware is connected to the controller (i.e. optional dew point). They also offer the option to switch the operation to Manual mode, for troubleshooting.

Each switch is presented as a colored toggle button (green=enabled/installed, orange=disabled/not installed). Please, see below the list of options.

Hardware Options (Virtual DIP Switch)			
Parameter	Access	Selection	Default
Manual Mode	Technician	Manual Auto	Auto
Pressure Switches	Technician	Not Installed Installed	Installed
Outlet Dew Point Sensor	Technician	Not Installed Installed	Not Installed
Energy Management System (EMS)	Technician	Disabled Enabled	Enabled

Table 8
Setup Adjustable Parameters Hardware Options

6.4.4.12 Offline Screen

When the system is in the Offline operational state, the valves are in the idle state and air can flow through the system. The user interface should indicate the Offline operational state by showing the following screen:

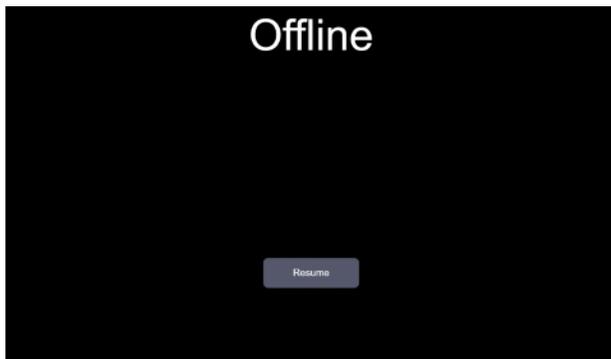


Figure 43
Offline Screen

The user can return to the Online state by pressing the RESUME button or via Modbus (see 6.4.4.12.1).

6.4.4.12.1 Remote Offline Operation via Modbus

The System Operating State Modbus register (Ref. 40029, address 0x01C) that is accessible via the Modbus TCP or Serial interfaces allows the user to enter or exit Offline operational state remotely through Modbus access. As a result, Offline can be controlled via user interface (locally) and via Modbus (remotely). Both methods to enter and exit Offline should be compatible and should be clearly reported in real time in both, the user interface and Modbus.

6.4.4.13 Standby Screen

When the system is in the Standby operational state, both tanks are pressurized and air can flow through the system even though the unit will not cycle, hence the air is not actively being dried. This mode is used by some customers to save energy when air is not needed (e.g. overnight). The user interface should indicate the Standby operational state by showing the following screen:



Figure 44
Standby Screen

If alarms or warnings are active, they will be displayed with the following screen:



Figure 45
*Standby Screen
(with Alarms & Warnings Indicators)*

To transition back to the On state, the user will press the RESUME button or via Modbus (see Section 6.4.4.9).

6.4.4.13.1 Remote Standby Operation via Modbus

The System Operating State Modbus register (Ref. 40029, address 0x01C) that is accessible via the Modbus TCP or Serial interfaces allows the user to enter or exit Standby operational state remotely through Modbus access. As a result, Standby can be controlled via user interface (locally) and via Modbus (remotely) in all models. Both methods to enter and exit Standby should be compatible and should be clearly reported in real time in both, the user interface and Modbus.

NOTE: The standby_mode setting (used to determine UI access) does not have to be enabled to allow Modbus control.

6.4.4.14 Auto-Restart

The Auto-Restart feature would restart the dryer if On when power was removed and power returned.

- If Auto-Restart is Off – when power returns the User Interface will start in the Off screen with the Resume button showing. If Resume is pressed, the Right Tower would start at state/step 0.
- If Auto-Restart is On – when power returns the User Interface should start in the normal P&ID Home screen and the Right Tower will start drying.

6.4.4.15 Drop Down Company Specific Information

This screen provides brand specific information, as well as sales and service contact information.

This overlay screen can be accessed from any other screen (not from the overlays), by pressing the brand logo as long as the header logo is accessible.

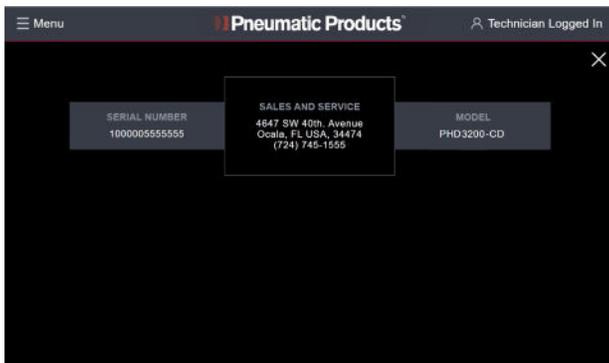


Figure 46

Drop Down Company Specific Information

6.4.4.16 Confirmation Screen

The Confirmation screen appears when the user is about to perform an action. The screen asks the user to confirm the action. Selecting Confirm causes the action to occur, and selecting Cancel cancels the action.

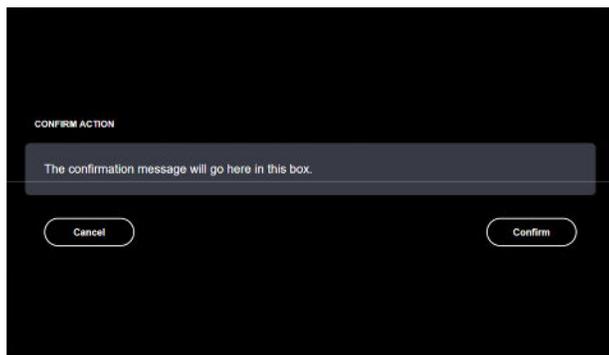


Figure 47

Confirmation Screen

6.4.4.16 Screen Saver

The Screen Saver display screen will appear after a time of inactivity. Inactivity will be considered when no user interaction of any kind takes place with the user interface.

The user can choose how long inactivity needs to occur before the screen saver is displayed. A limited number of options will be presented in the settings screen.

When exiting the screen saver, the user will always return to the Home screen, no matter what the previous screen was, except if the system was Offline/Standby, in which case the returning screen will be one of those.

The user will be able to exit the screen saver by simply touching anywhere on the screen. The screen saver will also be exited if an alarm or warning occurs.

6.4.5 Web Interface

The web interface can be accessed via the ethernet port using a web browser. Initial access to the web interface will require the user enter a fixed remote password. After the password is successfully entered, the interface will present the same interface as the local user interface to the web browser.

There is a web server connection automatic timeout after 10 minutes of inactivity. Resubmission of login information will be required to regain access.

The Web Interface URL will be in the form:

`http://ip_address`

where:

`ip_address` is the dynamic or static assigned IP address

Software updates can be uploaded to the controller via the web interface. See section 6.4.4.4.5 for additional information.

NOTE: The UI is not currently updated between the web server and local UI when switching between Manual and Auto modes.

6.4.6 Data Logging

The dryer will log dryer state, I/O, all sensor data (temperature, pressure, pressure dew point, etc.), alarms, warnings, and events. Data is collected every 10 seconds.

6.4.6.1 USB Storage

The dryer can transfer the log data to a USB drive while the USB drive is inserted. The USB drive must be present when the dryer is powered on. The dryer will log information to the USB driver for up to the limit of the USB drive storage and then will replace the oldest data with new data files. To reduce the chance for data corruption and limit the size of data files, files will be written to the USB drive containing a one-day period of data.

6.4.6.1.1 Operation

USB data logging will begin when a USB drive is detected on power-up. The application will:

- Write a series of log files corresponding to the log history currently contained in the unit.
- Data logs are uploaded to USB at a slow rate to avoid interference with dryer operation. A complete data log may take up to 45 minutes to write to a USB drive.
- After storing the current data, the application will add log data as it occurs.

NOTE: USB drives that do not properly report a S/N or Manufactures address are unlikely to be correctly read by the PHD-CD series controller due to DMR software in the USB subroutines.

6.4.6.1.2 File Format

The Comma Separated Value (CSV) file format for each daily file will be:

- Information Header
- Data Header
- Comma separated list of timestamped data.

NOTE: All text in log files translated to the current language selected.

6.4.7 Dryer Operation

6.4.7.1 Manual Mode

Manual mode is activated when the technician login has been entered and the user toggles the manual mode in the setup screen. When in manual mode, the P&ID diagram adds additional technician features described in section 6.4.4.3.4.7.

Manual mode can be used as a troubleshooting tool to determine if the solenoids and temperature probes are operating properly and to advance through dryer steps. Pressing the manual step button located on the P&ID screen will advance the dryer immediately to the next step (if allowed by the dryer state). See Tables 9, 10, 11 and 12.

The manual mode can only be entered or exited when in technician mode and the manual mode state will be retained over a power failure or a technician mode timed out.

6.4.7.2 Fixed Mode

Fixed Mode is activated by selecting the dryer mode in the Settings screen.

When in Fixed Mode, the dryer will use the timing selected by the Fixed NEMA mode.

6.4.7.3 Demand Modes

Demand modes are activated by selecting the dryer mode in the Settings screen. The selection of Demand mode may offer the following options: Energy Management (EMS) or Dewpoint.

Demand modes allow the use of sensors to guide adjust the timing of specific stages in the cycle based on the indirect measure of the moisture content of the desiccant.

When in the Energy Management (EMS) or Dewpoint demand modes, the Hold state can only be exited if Remote Stop is not active.

6.4.7.3.1 Dew Point Mode

In Dew Point Mode, a tower remains on-line until the desiccant bed has been fully utilized. The cycle pattern has fixed timing except for the Hold state. The Hold state allows the off-line tower to be put on hold after re-pressurization until the dew point of the exiting air gets higher than the set point.

For lower than designed moisture loads, this results in longer drying cycles, longer time between regenerations and, therefore, lower energy consumption.

6.4.7.3.2 Energy Management Mode

The optional Energy Management System (EMS) automatically adjusts dryer operation to compensate for changes in operating conditions.

Air samples are continuously taken from the on-stream tower and passed over a moisture probe which senses both temperature and relative humidity. The moisture content of the air within the desiccant bed is then precisely determined. The on-stream tower will not depressurize and regenerate until a predetermined set point has been reached. This elimination of unnecessary regeneration reduces energy consumption and extends dryer desiccant and component life.

Step #	State Description	Left Inlet Valve (V1A)	Right Inlet Valve (V1B)	Left Purge Valve (V3)	Right Purge Valve (V4)
0	Right Offline	Open	Closed	Closed	Open
1	Right De-pressurize	Open	Closed	Closed	Open
2	Right Heating	Open	Closed	Closed	Open
3	Right Cooling	Open	Closed	Closed	Open
4	Right Sweep	Open	Closed	Closed	Open
5	Right Re-pressurize	Open	Closed	Closed	Closed
6	Right Standby	Open	Closed	Closed	Closed
7	Left Offline	Closed	Open	Open	Closed
8	Left De-pressurize	Closed	Open	Open	Closed
9	Left Heating	Closed	Open	Open	Closed
10	Left Cooling	Closed	Open	Open	Closed
11	Left Sweep	Closed	Open	Open	Closed
12	Left Re-pressurize	Closed	Open	Closed	Closed
13	Left Standby	Closed	Open	Closed	Closed

Table 9
Cycle Sequence Steps (300-750)

Step #	State Description	Left Drying Solenoid (B)	Right Drying Solenoid (A)	Left Purge Solenoid (C)	Right Purge Solenoid (D)
0	Right Offline	On	Off	Off	On
1	Right De-pressurize	On	Off	Off	On
2	Right Heating	On	Off	Off	On
3	Right Cooling	On	Off	Off	On
4	Right Sweep	On	Off	Off	On
5	Right Re-pressurize	On	Off	Off	Off
6	Right Standby	On	Off	Off	Off
7	Left Offline	Off	On	On	Off
8	Left De-pressurize	Off	On	On	Off
9	Left Heating	Off	On	On	Off
10	Left Cooling	Off	On	On	Off
11	Left Sweep	Off	On	On	Off
12	Left Re-pressurize	Off	On	Off	Off
13	Left Standby	Off	On	Off	Off

Table 10
Cycle Solenoid Position (300-750)

Step #	State Description	Left Inlet Valve (V1A)	Right Inlet Valve (V1B)	Left Purge Valve (V3)	Right Purge Valve (V4)	Left Depress Valve (V10)	Right Depress Valve (V11)	Purge Shut-Off Valve
0	Right Offline	Open	Closed	Closed	Closed	Closed	Open	Closed
1	Right De-pressurize	Open	Closed	Closed	Closed	Closed	Open	Closed
2	Right Purge Exhaust	Open	Closed	Closed	Closed	Closed	Open	Closed
3	Right Heating	Open	Closed	Closed	Open	Closed	Open	Open
4	Right Cooling	Open	Closed	Closed	Open	Closed	Open	Open
5	Right Sweep	Open	Closed	Closed	Open	Closed	Open	Open
6	Right Re-pressurize	Open	Closed	Closed	Closed	Closed	Closed	Open
7	Right Standby	Open	Closed	Closed	Closed	Closed	Closed	Open
8	Left Offline	Closed	Open	Closed	Closed	Open	Closed	Closed
9	Left De-pressurize	Closed	Open	Closed	Closed	Open	Closed	Closed
10	Left Purge Exhaust	Closed	Open	Closed	Closed	Open	Closed	Closed
11	Left Heating	Closed	Open	Open	Closed	Open	Closed	Open
12	Left Cooling	Closed	Open	Open	Closed	Open	Closed	Open
13	Left Sweep	Closed	Open	Open	Closed	Open	Closed	Open
14	Left Re-pressurize	Closed	Open	Closed	Closed	Closed	Closed	Open
15	Left Standby	Closed	Open	Closed	Closed	Closed	Closed	Open

Table 11
Cycle Sequence Steps (900-3200)

Step #	State Description	Left Drying Solenoid (B)	Right Drying Solenoid (A)	Left Purge Solenoid (C)	Right Purge Solenoid (D)	Left Depress Solenoid (F)	Right Depress Solenoid (G)	Purge Shut-Off Solenoid (E)
0	Right Offline	On	Off	Off	Off	Off	Off	On
1	Right De-pressurize	On	Off	Off	Off	Off	On	On
2	Right Purge Exhaust	On	Off	Off	Off	Off	On	On
3	Right Heating	On	Off	Off	On	Off	On	Off
4	Right Cooling	On	Off	Off	On	Off	On	Off
5	Right Sweep	On	Off	Off	On	Off	On	Off
6	Right Re-pressurize	On	Off	Off	Off	Off	Off	Off
7	Right Standby	On	Off	Off	Off	Off	Off	Off
8	Left Offline	Off	On	Off	Off	Off	Off	On
9	Left De-pressurize	Off	On	Off	Off	On	Off	On
10	Left Purge Exhaust	Off	On	Off	Off	On	Off	On
11	Left Heating	Off	On	On	Off	On	Off	Off
12	Left Cooling	Off	On	On	Off	On	Off	Off
13	Left Sweep	Off	On	On	Off	On	Off	Off
14	Left Re-pressurize	Off	On	Off	Off	Off	Off	Off
15	Left Standby	Off	On	Off	Off	Off	Off	Off

Table 12
Cycle Solenoid Position (900-3200)

6.4.8 Alarms, Warnings, and Events

This section describes the alarms, warnings, and events for the controller.

Alarms, Warnings, and Events will be stored in non-volatile memory for up to 30 days and then overwrite old data with new.

NOTE: Alarms will halt the cycling of the dryer. Warnings will not halt the cycling of the dryer.

6.4.8.1 Alarms

ID	DESCRIPTION	ALARM TRIGGER	DELAY	ALARM ACTION	HALT CYCLE	EXIT CONDITION
0	Left Drying Low Pressure	Pressure Switches Enabled AND left tower pressure low AND Left Drying	3 sec	Heater Off Alarm relay On	X	Left tower pressure High (left tower repressurized)
1	Right Drying Low Pressure	Pressure Switches Enabled AND right tower pressure low AND Right Drying	3 sec	Heater Off Alarm relay On	X	Right tower pressure High (right tower repressurized)
2	Left Depress High Pressure	Pressure Switches Enabled AND left tower pressure High AND (step = LT_DEPRESS AND step timer ≥ depress time) OR [step ≥ LT_EXHAUST AND step ≤ LT_REPRESS]	3 sec	Heater Off Alarm relay On	X	Left tower pressure Low (left tower depressurized)
3	Right Depress High Pressure	Pressure Switches Enabled AND right tower pressure High AND (step = RT_DEPRESS AND step timer ≥ depress time) OR [step ≥ RT_EXHAUST AND step ≤ RT_REPRESS]	3 sec	Heater Off Alarm relay On	X	Right tower pressure Low (right tower depressurized)
4	Left Repress Low Pressure	Pressure Switches Enabled AND left tower pressure Low AND (step = LT_REPRESS OR [step = FIRST_START]) AND (step timer ≥ repress time OR [step ≥ LT_STANDBY AND step ≤ LT_ONLINE])	3 sec	Heater Off Alarm relay On	X	Left tower pressure High (left tower repressurized)
5	Right Repress Low Pressure	Pressure Switches Enabled AND right tower pressure Low AND (step = RT_REPRESS [OR [step = FIRST_START]) AND (step timer ≥ repress time) OR [step ≥ RT_STANDBY AND step ≤ RT_ONLINE])	3 sec	Heater Off Alarm relay On	X	Right tower pressure High (right tower repressurized)
7	Heater Over-Temperature	Heater Over-Temperature Switch Open (1TC)	3 sec	Heater Off Alarm relay On	X	Manually cleared
8	Heater High Temperature	step = RT_HEATING OR LT_HEATING AND HeaterTemp > High Temp Alarm Setpoint	15 sec	Heater Off Alarm relay On	X	Manually cleared

6.4.8.2 Warnings

ID	DESCRIPTION	WARNING TRIGGER	DELAY	WARNING ACTION	HALT CYCLE	EXIT CONDITION
40	Outlet DewPoint Over-Range	Dew Point sensor installed AND Outlet dew point > 43C	3 sec	Warning relay On [Dewpoint wet]		Outlet dew point <43C
41	Left Temperature Under-Range	Left Tower Temp < -28C	3 sec	Warning relay On		Left Tower Temp ≥ -28C
42	Right Temperature Under-Range	Right Tower Temp < -28C	3 sec	Warning relay On		Right Tower Temp ≥ -28C
43	Left Temperature Over-Range	Left Tower Temp > 454C	3 sec	Warning relay On		Left Tower Temp ≤ 454C
44	Right Temperature Over-Range	Right Tower Temp > 454C	3 sec	Warning relay On		Right Tower Temp ≤ 454C
45	Left Tower High Humidity	EMS installed/mode/OK AND Left Drying AND RelHumid > RelHumid Alarm Setpoint OR VaporPress > Vapor Pressure Alarm Setpoint AND DryTimer > EMS alarm delay AND PowerupTimer > EMS alarm delay	EMS Alarm delay	Warning relay On [EMS wet]		RelHumid ≤ RelHumid Alarm Setpoint AND VaporPress ≤ Vapor Pressure Alarm Setpoint
46	Right Tower High Humidity	EMS installed/mode/OK AND Right Drying AND RelHumid > RelHumid Alarm Setpoint OR VaporPress > Vapor Pressure Alarm Setpoint AND DryTimer > EMS alarm delay AND PowerupTimer > EMS alarm delay	EMS Alarm delay	Warning relay On [EMS wet]		RelHumid ≤ RelHumid Alarm Setpoint AND VaporPress ≤ Vapor Pressure Alarm Setpoint
47	Energy Management Under-Range	EMS RH% < -15% OR EMS RTD < -28 C	3 sec	Warning relay On [EMS wet]		EMS RH% > -15% AND EMS RTD > -28C
48	Energy Management Over-Range	EMS RH% > 115% OR EMS RTD > 204C	3 sec	Warning relay On [EMS wet]		EMS RH% < 115% AND EMS RTD < 204C
49	Inlet Temperature Under-Range	InletTemp < -28C	3 sec	Warning relay On		InletTemp > -28C
54	Left Tower Outlet Dew Point	Dew point installed AND Outlet dew point > Dew point alarm set point AND Left Drying	3 sec	Warning relay On [Dewpoint wet]		Outlet dew point < Dew point alarm set point OR !Left Drying
55	Right Tower Outlet Dew Point	Dew point installed AND Outlet dew point > Dew point alarm set point AND Right Drying	3 sec	Warning relay On [Dewpoint wet]		Outlet dew point < Dew point alarm set point OR !Right Drying
57	Outlet Dew Point Under-Range	Dew point installed AND Outlet dew point <-100C	3 sec	Warning relay On ¹ Bypass Demand Mode ²		Outlet dew point > -100C
58	Inlet Air High Temperature	Inlet air temperature > High inlet air temperature alarm set point	3 sec	Warning relay On ¹		Inlet air temperature < High inlet air temperature set point
62	Heater Low Temperature	step = RT_HEATING OR LT_HEATING AND step timer > Low Temp Alarm Delay AND Powerup timer > Low Temp Alarm Delay AND HeaterTemp < Low Temp Alarm Setpoint	5-15 min Low Temp Alarm Delay	Heater Off Alarm relay On	X	HeaterTemp ≥ Low Temp Alarm Setpoint
80	Time to Service the Filters	Filter service timer > filter service interval	3 sec	Warning relay On ¹		Manually cleared
81	Time to Service the Valves	Valve service timer > valve service interval	3 sec	Warning relay On ¹		Manually cleared
82	Time to Service the Desiccant	Desiccant service timer > desiccant service interval	3 sec	Warning relay On ¹		Manually cleared

6.5 Start-up

6.6.1 Controller Settings

Set or verify settings on Controller. Detailed operational points are presented in section 6.4.

WARNING – Enclosure may have live electric parts. De-energize dryer before opening enclosure.

6.6.2 Initial Pressurization

SLOWLY pressurize dryer to full line pressure. (If the dryer was installed with inlet and outlet isolation valves, the inlet isolation valve should be slowly opened while the outlet isolation valve remains closed.)

During initial start-up, check the entire system for leaks. If necessary, de-pressurize the dryer and correct any leaks.

6.6.2.1 Energy Management Sensor (if installed)

Open and adjust the sample exhaust valve until a very slight, continuous gas bleed is felt exhausting out of the sample cell.

6.6.2.2 Dew Point Sensor (if installed)

Ensure that the supply air valve is open (one turn). Open and adjust the sample exhaust valve until a very slight, continuous gas bleed is felt exhausting out of the sample cell.

6.6.3 Energizing the Dryer

Energize the dryer controls.

NOTE: The switching failure alarm may be activated if the unit is energized before it is pressurized. To deactivate alarm, allow dryer to cycle to next step and press the reset button.

6.6.4 Bringing the Dryer On-line

Establish a normal flow through the dryer. Slowly open the outlet isolation valve if present. Close any dryer bypass valves.

6.7 Operational Check Points

6.7.1 Power to unit

Check periodically that there is power to the unit.

6.7.2 Alarms

Periodically check for flashing red alarm or yellow warning frames.

A flashing alarm frame will appear if either tower fails to pressurize or de-pressurize to the required levels at the proper time. Refer to Section 6.4.4.3.4.1 and Section 6.4.8.1.

NOTE: Alarm will activate if dryer is energized without being pressurized. If this occurs, allow dryer to cycle to next step and press reset button. The alarm frame light will continue to flash even if fault clears. To clear alarm, press reset button.

If the tower being regenerated fails to re-pressurize, the dryer will not switch towers. The switching failure alarm will be activated and the dryer will remain in this mode until the tower re-pressurizes.

6.7.3 Tower Pressure Gauges

Periodically check tower pressure gauges to verify that the pressure gauge of the on-line tower reads line pressure and the pressure gauge of the off-line tower reads below 2 psig (0.14 kgf/cm²).

NOTE: Read the off-line tower pressure gauge when the tower is purging (air exhausting from muffler).

6.7.4 Check Mufflers For Back Pressure

Excessive back pressure may result due to the accumulation of desiccant fines (dust) in the muffler cartridges. This sometimes occurs after start-up due to dusting of the desiccant during tower filling and dryer transport. If the tower pressure gauge of the off-stream tower rises above 1 psig, the muffler elements should be replaced.

6.7.5 Process Valves

Determine if air control valves are operating and sequencing correctly.

6.7.5.1 Valves – Models 300 through 600

Inlet switching valves are normally open, pneumatically piston-actuated, Y-angle poppet valves. A yellow indicator can be seen through a clear window at the top of the actuator housing when the valve is in the open position.

Purge exhaust valves are normally closed, pneumatically piston-actuated, Y-angle poppet valves. A yellow indicator can be seen through a clear window at the top of the actuator housing when the valve is in the open position.

12 volt DC, normally-closed, 3-way pilot solenoid valves are wired to the controller and are used to direct pilot air to the actuators of the inlet switching and purge/repressurization valves.

Dryers are equipped with a safety relief valve that has been sized to provide overpressure protection due to a fire for both desiccant towers.

6.7.5.2 Valves – Models 750 through 3200

Inlet switching valves are resilient seated butterfly valves with double acting pneumatic rack and pinion actuators. A yellow arrow indicator located on the top of the actuator output shaft points to valve position indicator icons.

(Model 750 only) Purge exhaust valves are normally closed, pneumatically piston-actuated, Y-angle poppet valves. A yellow indicator can be seen through a clear window at the top of the actuator housing when the valve is in the open position.

(Models 900 through 3200) Purge exhaust valves are resilient seated butterfly valves with spring return, fail closed, pneumatic rack and pinion actuators. A yellow arrow indicator located on the top of the actuator output shaft points to valve position indicator icons. Pilot air is directed to actuator ports to close both purge/repressurization valves upon loss of power.

(Models 750 through 3200) 12 volt DC, normally-closed, 3-way pilot solenoid valves are wired to the controller and are used to direct pilot air to the actuators of the inlet switching valves.

(Models 750) 12 volt DC, normally-closed, 3-way pilot solenoid valves are wired to the controller and are used to direct pilot air to the actuators of the purge/repressurization valves.

(Models 900 through 3200) 12 volt DC, normally-closed, 3-way pilot solenoid valves are wired to the controller and are used to direct pilot air to the actuators of the depressurization valves.

(Models 1050 through 3200) 12 volt DC, single solenoid, 4-way pilot valves are wired to the controller and are used to direct pilot air to the actuators of the purge/repressurization valves.

Two mainline outlet and two purge line check valves are installed in the upper piping to control the flow of outlet and purge air. Check valve sticking will result in excessive air discharge through a muffler. Excessive air discharge through the muffler can be associated with a leaking outlet check valve on the same side or a purge check valve of the opposite side tower.

Dryers are equipped with a safety relief valve that has been sized to provide overpressure protection due to a fire for both desiccant towers.

The tower pressure gauge of the on-line tower should read line pressure. Air should not be leaking from the purge-repressurization valve of the on-line tower.

The tower pressure gauge of the off-line tower should read below 2 psig (0.14 kgf/cm²) while that tower is purging. If excessive air is exhausting during the purge cycle, the inlet-switching valve on the same side may have failed to close or a check valve may be sticking.

6.8 Dryer Shut Down

1. Shutdown the PHD-CD series controller.

NOTE: In order to avoid "nuisance alarms", the PHD-CD series controller needs to be shut down properly to avoid issues.

- a. On the home screen, press the status button in the bottom right corner. This opens the status overlay.
- b. Press the red power button in the bottom right of the status overlay. This brings up a "select mode" screen which has the options "Standby" and "Offline".

- c. If you wish to shut down the dryer along with the compressors immediately press the "Offline" button. This will stop the dryer in the cycle exactly where it is at.

- d. If you will continue to run the compressor and are concerned with dew point, press the "Standby" button, this will allow the dryer to complete the cycle and shut down at the end of the cycle.

NOTE: In the event the dryer air supply is removed during non-work hours, place the dryer in the "Offline" mode prior to removing the air supply.

- e. To return to normal operation after putting the dryer in "Standby" or "Offline" mode, press the "Resume" button then press "Confirm" when asked to confirm action. The dryer will now resume operation.

2. To depressurize the dryer.

- a. Place the PHD-CD series controller in the "Offline" mode.

- b. If the dryer installation is equipped with dryer bypass and inlet and outlet isolation valves, the bypass valve should be opened and the inlet and outlet isolation valves closed.

- c. Remove power from dryer.

- d. SLOWLY open the tower blow down valves (refer to Figures 3, 3A, or 3B for general location) to vent the dryer internal pressure.

- e. When all dryer pressure gauges indicate zero pressure, close the tower blow down valves. Depressurization is complete.

6.9 Loss of Power

Control valves are designed so that upon loss of power the air dryer is capable of drying air until the desiccant exposed to the airflow is saturated.

6.9.1 Power Recovery:

6.9.1.1 On loss of electrical power –

All controller outputs turn off causing the dryer operating valves to react as follows:

- 1a. For models with poppet style inlet valves (models 300 - 600): both inlet valves will open. Both towers will repressurize.

- 1b. For models with butterfly inlet valves (models 750 - 3200): inlet valves will remain in position. Any minor leakage through the inlet valve or check valve will slowly repressurize the off-line tower.

2. Purge exhaust valves close.

3. Purge supply valve fails open. (Models 900 - 3200)

4. Purge saver intake shut-off valve fails closed.

5. Depressurization valves (where used) close.

6. The off-line tower repressurizes to line pressure.

6.9.1.2 On restoration of power –

1. If power is lost when the off-line tower is in either the Heating or Sweep step, the off-line tower will be either partially or fully repressurized. On power recovery the sequence:
 - a. Resumes at the Depressurization step to let down the pressure in the off-line tower then,
 - b. Advances directly to the beginning of whichever stage of Heating or Sweep it had been at when power was interrupted.
2. If the off-line tower was at any other step (Switchover, Depressurization, Repressurization or Hold) when power was lost, then the sequence simply resumes at that step.

- c. Replace the drain plug using Teflon tape or another pipe thread sealant suitable for compressed air service. Reinstall drain port flange cover (where applicable) in each desiccant tower.
- d. Refer to Table 1 (on page 5) for desiccant **quantity per tower**.

When using Table 1 you will find the desiccant quantities listed in layers. Each layer will vary in depth due to the type, quantity and purpose of the desiccant. Layer 1 must be installed first at the bottom of the vessel followed by layer number 2 etc., until the complete charge of desiccant has been installed.

- e. Utilizing an appropriate sized funnel, fill each desiccant tower as follows:
 - 1) Install the required quantity of activated alumina in layer 1 of each tower.
 - 2) Level layer 1 and each subsequent layer of desiccant as added to each tower.
 - 3) Finish filling each tower with desiccant until all desiccant has been installed. LIGHT tapping on the tower sides with a soft-face mallet should yield additional free space to allow installation of all desiccant required. **DO NOT TAMP OR RAM DESICCANT.**
- f. Clean the fill port closure. Replace the fill plug using Teflon tape or another pipe thread sealant suitable for compressed air service. Reinstall fill port flange cover (where applicable) in desiccant tower.

3. Insuring Desiccant Dryness

Replacement desiccant is shipped in airtight containers. Keep the covers on these containers tightly closed until use to avoid moisture contamination. If desiccant is exposed to air it can be heated in an oven at 400°F (204°C) for four hours before use. Alternatively, if the dryer is not refilled with dry desiccant, it may be necessary to operate the unit with an inlet flow rate of less than 50% of maximum rated inlet capacity until the desiccant has regenerated fully.

7.2 Purge Mufflers

Purge mufflers should be checked regularly, changed annually. Muffler disseminator elements become clogged with desiccant dust over time, creating back pressure and restricted purge flow.

7.3 Valves

1. Process and pilot valves should be checked frequently for leaks and proper operation.
2. Purge pressure adjustment valve should be checked frequently for proper adjustment.

7.0 Maintenance

WARNING – This equipment is a pressure-containing device. Depressurize before servicing.

NOTE: The Dryer Controller is equipped with Service Reminder functions for filters, desiccant and valves.

7.1 Desiccant Replacement

NOTE: The use of the correct replacement desiccant is necessary for proper dryer operation. Never use hygroscopic salts of the type commonly used in "deliquescent" type dryers.

1. Frequency Of Desiccant Replacement

Desiccant should be replaced whenever the required dew point cannot be maintained while the dryer is being operated within its design conditions and there are no mechanical malfunctions.

NOTE: Desiccant life is determined by the quality of the inlet air. Proper filtering of the inlet air will extend the life of the desiccant. Typically desiccant life is 2 years.

2. Procedure for Desiccant Charge Replacement

- a. Depressurize and de-energize the dryer.
- b. Remove the fill and drain plugs or flanges (where applicable) from the desiccant tower and drain the spent desiccant. Place a container at the base of the vessel to collect the desiccant. If necessary tap the sides of the vessels with a rubber mallet to loosen desiccant.

NOTE: Use extreme care when inserting rods or other tools through the desiccant fill or drain ports to loosen packed desiccant. Internal flow diffusers at the ends of the desiccant beds can be damaged or punctured by sharp instruments. These diffusers are necessary to distribute the airflow and keep the desiccant beads within the tower. Desiccant beads in exhaust mufflers, afterfilters, or the piping connected to the desiccant towers may indicate a perforation of a diffuser.

7.4 Pilot Air Filter Element Replacement

1. Frequency of replacement

The pilot air filter contains a filter element that should be changed yearly. Replacement may be required sooner if pressure drop across cartridge prevents valves from actuating properly.

WARNING – The pilot air filter housing is a pressure-containing device, depressurize before servicing. Slowly open manual drain valve on bottom of filter bowl by turning clockwise to verify that the housing is depressurized before removing bowl.

2. Procedure for element replacement

- a. Isolate dryer from air supply
- b. Depressurize dryer by running dryer and allowing system pressure to purge to atmosphere. Loss of pilot pressure will eventually prevent purge/repressurization valves from opening. Remaining pressure can be vented to atmosphere through the manual drain on the pilot air filter. The system must be fully depressurized before removing the bowl.
- c. Remove the filter bowl by pushing up, turning counterclockwise and then pulling straight down.
- d. Clean the filter bowl.
- e. Replace the element.
- f. Clean and lubricate o-ring at top of bowl and reassemble in reverse order.

- c. Remove the filter bowl by pushing up, turning counterclockwise and then pulling straight down.
- d. Clean the filter bowl.
- e. Replace the element.
- f. Clean and lubricate o-ring at top of bowl and reassemble in reverse order.

7.5 Dew Point Analyzer Filter (optional) Element Replacement

1. Frequency of replacement

The Dew Point Analyzer filter contains a filter element that should be changed yearly. Replacement may be required sooner if pressure drop across cartridge prevents the Dew Point Analyzer from operating properly.

WARNING – The Dew Point Analyzer filter housing is a pressure-containing device, depressurize before servicing. Slowly open manual drain valve on bottom of filter bowl by turning clockwise to verify that the housing is depressurized before removing bowl.

2. Procedure for element replacement

- a. Isolate dryer from air supply
- b. Depressurize dryer by running dryer and allowing system pressure to purge to atmosphere. Loss of pilot pressure will eventually prevent purge/repressurization valves from opening. Remaining pressure can be vented to atmosphere through the manual drain on the pilot air filter. The system must be fully depressurized before removing the bowl.

8.0 Troubleshooting

WARNING – A POTENTIAL ELECTRICAL SHOCK HAZARD EXISTS. Some of the troubleshooting checks may require gaining access to the dryer’s electrical enclosure(s) while the power supply is energized and should be performed by a qualified electrical technician.

WARNING – Before performing any electrical or mechanical repairs or maintenance, or removing or disassembling any component, be sure to de-energize and depressurize the dryer.

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Indicator lights not illuminated	<ol style="list-style-type: none"> 1. No power to unit. 2. Loss of power supply to (or at) dryer’s electrical disconnect switch or breaker. (customer supplied) 3. Blown fuse. 4. Board malfunction. 	<ol style="list-style-type: none"> 1. Check voltage at terminal board. 2. Check disconnect switch or breaker closed. If tripped breaker or blown fuse is noted, investigate and remedy cause. 3. Replace fuse. 4. Replace controller.
Excessive pressure drop in dryer	<ol style="list-style-type: none"> 1. Inlet/Outlet screens on desiccant towers are dirty. 2. Excessive flow rate. 	<ol style="list-style-type: none"> 1. Clean screens; follow desiccant removal instructions in the Maintenance section. 2. Check flow rate of inlet air. Reduce to design flow rate.
Left Drying Low Pressure Alarm or Right Drying Low Pressure Alarm	<ol style="list-style-type: none"> 1. Loss of dryer air supply. 2. Excessive air demand. 3. Faulty drying tower pressure switch. 4. Drying tower inlet valve failed to open. 5. Drying tower purge exhaust valve failed to close. 6. Drying tower depressurization valve failed to close. 7. Regenerating tower outlet check valve failed to close. 	<ol style="list-style-type: none"> 1. Check compressor supplying dryer. 2. Check equipment downstream of dryer. 3. Check pressure switch operation using tower pressure gauge for comparison. Replace switch if defective. 4a. Check for loss of pilot air - ensure manual drain valve on bottom of pilot air filter is fully closed, ensure pilot air filter cartridge is not clogged, ensure pilot air shut-off valve is open 4b. Check for inlet pilot air solenoid valve failure. Check valve operation. Repair or replace as necessary. 4c. Check for drying tower Inlet Valve failure - examine valve and actuator for damage. Repair or replace as necessary. 5a. Check for air flow out of drying tower purge valve or exhaust piping indicating valve is not completely closed. 5b. Check for loss of pilot air - ensure manual drain valve on bottom of pilot air filter is fully closed, ensure pilot air filter cartridge is not clogged, ensure pilot air shut-off valve is open 5c. Check for purge pilot air solenoid valve failure. Check valve operation. Repair or replace as necessary. 5d. Check for drying tower purge exhaust valve failure - examine valve and actuator for damage. Repair or replace as necessary. 6. Check for air flow out of drying tower depressurization muffler indicating valve is not completely closed. Repair or replace as necessary. 7. Indicated by excessive flow out of regenerating tower purge valve. Examine valve internals. Repair or replace as necessary.

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Left Depress High Pressure Alarm or Right Depress High Pressure Alarm	<ol style="list-style-type: none"> 1. Faulty regenerating tower pressure switch 2. Regenerating tower depressurization muffler clogged. 3. Regenerating tower depressurization valve failed to open. 4. Regenerating tower purge exhaust piping obstructed. 5. Regenerating tower purge exhaust valve failed to open. 	<ol style="list-style-type: none"> 1. Check pressure switch operation using tower pressure gauge for comparison. Replace switch if defective. 2. Examine inner core and clean or replace as necessary. 3. Check valve operation. Repair or replace as possible. 4. Ensure piping is free of obstructions. 5a. Check for loss of pilot air - ensure manual drain valve on bottom of pilot air filter is fully closed, ensure pilot air filter cartridge is not clogged, ensure pilot air shut-off valve is open. 5b. Check for purge pilot air solenoid valve failure. Check valve operation. Repair or replace as necessary. 5c. Check for regenerating tower purge exhaust valve failure - examine valve and actuator for damage. Repair or replace as necessary.
Left Repress Low Pressure Alarm or Right Repress Low Pressure Alarm	<ol style="list-style-type: none"> 1. Faulty left tower pressure switch. 2. Regenerating tower purge exhaust valve failed to close. 3. Regenerating tower depressurization valve failed to close. 	<ol style="list-style-type: none"> 1. Check pressure switch operation using tower pressure gauge for comparison. Replace switch if defective. 2a. Check for air flow out of regenerating tower purge valve or exhaust piping indicating valve is not completely closed. 2b. Check for loss of pilot air - ensure manual drain valve on bottom of pilot air filter is fully closed, ensure pilot air filter cartridge is not clogged, ensure pilot air shut-off valve is open 2c. Check for purge pilot air solenoid valve failure. Check valve operation. Repair or replace as necessary. 2d. Check for regenerating tower purge exhaust valve failure - examine valve and actuator for damage. Repair or replace as necessary. 3. Check for air flow out of regenerating tower depressurization Muffler indicating valve is not completely closed. Repair or replace as necessary.
Heater Low Temperature Alarm	<ol style="list-style-type: none"> 1. Heating malfunction due to heater failure or heater contactor failure. 2. Temperature sensor failure. 	<ol style="list-style-type: none"> 1. Replace heater or heater contactor. 2. Repair and replace as required.
Heater Over-Temperature Alarm	<ol style="list-style-type: none"> 1. Insufficient purge gas flow. 2. Temperature sensor failure. 	<ol style="list-style-type: none"> 1. Check for purge blockage, temperature sensor failure, etc. 2. Repair and replace as required.
Heater High Temperature Alarm	<ol style="list-style-type: none"> 1. Heating malfunction due to heater failure or heater contactor failure. 2. Temperature sensor failure. 	<ol style="list-style-type: none"> 1. Replace heater or heater contactor. 2. Repair and replace as required.
Outlet DewPoint Over-Range Warning	<ol style="list-style-type: none"> 1. Inlet air flow higher than the sizing condition. 2. Liquids entering the dryer inlet. 3. Inlet air temperature higher than the sizing condition. 4. Desiccant dusting. 5. Contaminated desiccant (e.g. with oil). 6. Heater temperature set too low. 7. Heating malfunction due to heater failure or heater contactor failure. 	<ol style="list-style-type: none"> 1. Reduce inlet flow to sizing condition. 2. Check the inlet air line for liquids. Inspect prefilter and drain valve. Clean, repair or replace automatic drain valve. 3. Check the compressor aftercooler and cooling system. Reduce inlet air temperature to sizing condition. 4. Check air pressure, airflow and airflow surges and correct as necessary. Replace desiccant. 5. Check prefilter and automatic drain valve. Replace prefilter element. Clean, repair or replace drain valve as necessary. Consult factory concerning need for desiccant replacement. 6. Adjust controller set point. 7. Replace heater or heater contactor.

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Left Tower Temperature Under-Range Warning or Right Tower Temperature Under-Range Warning	1. Tower temperature sensor failure. Under-Range → Short circuit on sensor	1. Check temperature circuit for continuity. Repair or replace as necessary.
Left Tower Temperature Over-Range Warning or Right Tower Temperature Over-Range Warning	1. Tower temperature sensor failure. Over-Range → Open circuit on sensor	1. Check temperature circuit for continuity. Repair or replace as necessary.
Left Tower High Humidity Warning or Right Tower High Humidity Warning	1. Desiccant bed overloaded. 2. Dew point sensor or monitor damaged or defective. 3. Loss of desiccant drying capacity	1. Check inlet air flow rate, temperature and pressure. Higher than design flow, and temperature, and lower than design pressure will result in overloading of the dryer. 2. Examine sensor for physical damage and check monitor/sensor operation. Replace sensor or monitor as necessary. 3. Inlet air improperly filtered causing desiccant contamination - examine filter elements and drains. Repair or replace as necessary. Useful life of desiccant has been exceeded.
Energy Management Under-Range Warning or Energy Management Over-Range Warning	1. Energy management sensor failure.	1. Check circuit for continuity. Repair or replace as necessary.

9.0 Electrical Data – Fusing Guide

Fusing Guide

MODEL	HEATER KW	F.L.A. @480VAC	SUGGESTED FUSING
300	5.0	6.01	10 AMPS
400	7.0	8.80	15 AMPS
550	7.0	8.80	15 AMPS
600	8.0	9.62	15 AMPS
750	10.0	12.02	20 AMPS
900	12.0	14.43	20 AMPS
1050	14.0	16.85	25 AMPS
1300	17.0	21.34	30 AMPS
1500	19.0	22.85	30 AMPS
1800	23.0	27.66	35 AMPS
2200	27.5	33.07	45 AMPS
2600	32.0	38.49	50 AMPS
3200	39.0	46.91	60 AMPS

NOTE: This is just a suggested fusing guide. Full load amperage (F.L.A.) values are based on 430.250 table in NEC 2011. Actual F.L.A. may slightly vary depending on individual heater nameplates.

Component Connection	Pin	Description
Purge Valve (Right)	1	Solenoid D HIGH (+12V)
	2	Solenoid D LOW
Purge Saver Intake Shutoff Valve	3	Solenoid H HIGH (+12V)
	4	Solenoid H LOW
Heater Thermocouple Output	13	4-20 mA Current Loop #2 OUT
	14	4-20 mA Current Loop #2 RET
Right Pressure Switch	33	Pressure Sensor #2
	34	Pressure Sensor #2 (GND)
Left Pressure Switch	35	Pressure Sensor #1
	36	Pressure Sensor #1 (GND)
Inlet Valve (Left)	37	Solenoid A HIGH (+12V)
	38	Solenoid A LOW
Inlet Valve (Right)	39	Solenoid B HIGH (+12V)
	40	Solenoid B LOW
Purge Valve (Left)	47	Solenoid C HIGH (+12V)
	48	Solenoid C LOW
Heater Over Temp Alarm	53	Digital Input #2 +
	54	Digital Input #2 - (GND)
Warning On	58	Relay #5 NO
	59	Relay #5 NC
	60	Relay #5 Common
+5VDC	62	+5VDC (to power analog sensor)
Relative Humidity Analog Output	63	Analog Input #1 +
	64	Analog Input #1 - (GND)
Alarm On	65	Relay #1 NO
	66	Relay #1 NC
	67	Relay #1 Common
Heater	71	Relay 1CR NO
	72	Relay 1CR Common
Heater Temperature RTD3	73	RTD #3 +
	74	RTD #3 -
Right Tower RTD2	77	RTD #2 +
	78	RTD #2 -
Left Tower RTD1	79	RTD #1 +
	80	RTD #1 -
Relative Humidity RTD4	81	RTD #4 +
	82	RTD #4 -
Dew Point Sensor	83	4-20 mA Current Loop #1 OUT
	84	4-20 mA Current Loop #1 RET

Table 14
PHD-CD Series Controller Connections
Models PHD300-CD through PHD750-CD

NOTES:

1. TO INSURE SAFE AND RELIABLE OPERATION, CUSTOMER MUST CONNECT GROUND TERMINAL INDEPENDENTLY TO A QUALITY ELECTRICAL GROUND. GROUND CONDUCTOR MUST BE SIZED ACCORDING TO NEC 250-122. GROUND MUST BE CONNECTED BEFORE MAIN POWER (L & N) CAN BE CONNECTED.
2. GROUND TO BE TERMINATED AT BUSSBAR ONLY. DO NOT JUMPER FROM TERMINAL BLOCKS.
3. CUSTOMER IS RESPONSIBLE FOR PROVIDING A DISCONNECTING MEANS AND ALL FUSING AS REQUIRED BY THE NEC.
4. ALL RTD'S MUST BE PT100 ONLY.
5. EMS GREEN AND BROWN RTD WIRES ARE NOT USED.
6. TEMPERATURE CONTROLLER (1TC) SHOULD BE SET TO 650 °F (343°C)..
7. RELAYS HAVE A MAXIMUM LOAD OF 5 VDC @ 1 AMP AND PROVIDE NO VOLTAGE.
8. REFER TO P&ID DRAWING TO VERIFY ACTUAL SETTINGS.

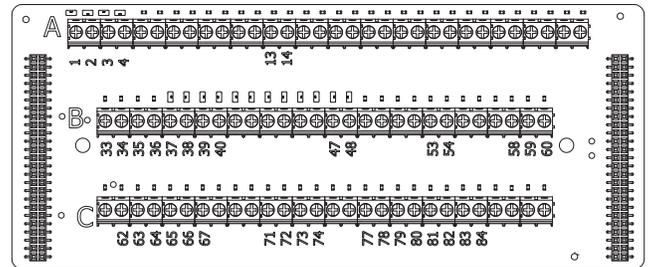


Figure 48
PHD-CD Series Controller Connector Board
Models PHD300-CD through PHD750-CD

USB	Main Board	Display
Cable 1	USB_HOST	J2
Cable 2	+V_PWR	J3

Table 15
PHD-CD Series Controller to Display Connections

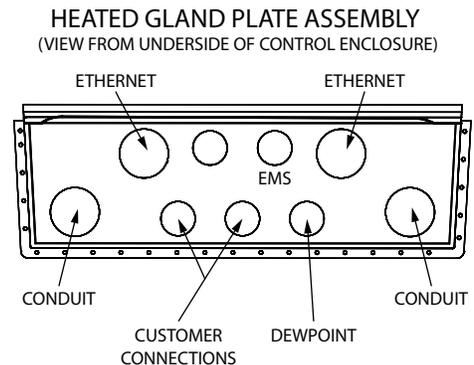
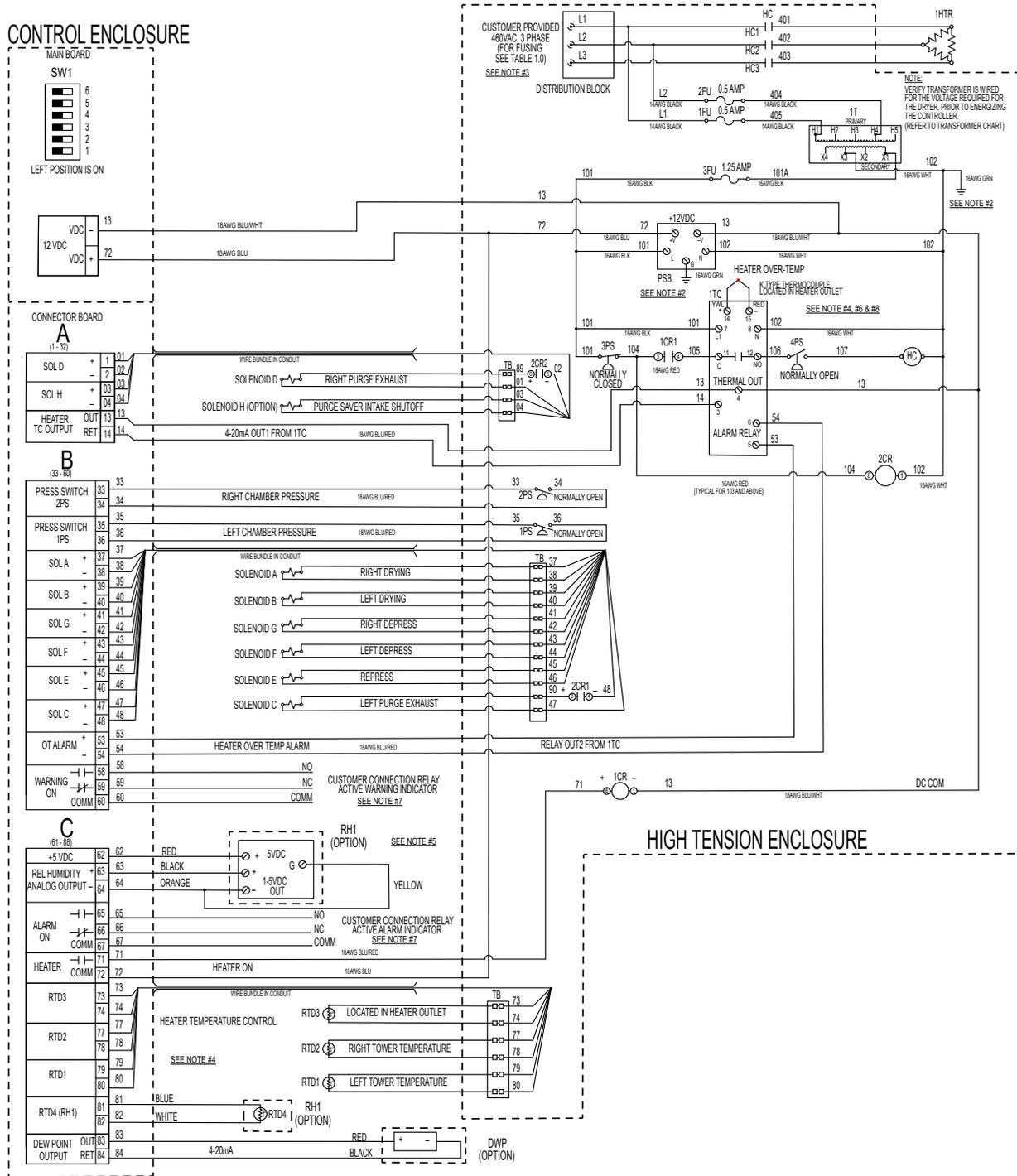


Figure 49
PHD-CD Series Controller Gland Plate Assembly

Electrical Schematic – Models 900 through 3200

(Contact factory to request certified drawings)



TRANSFORMER VOLTAGES						
CONNECT TO LINE FOR RESPECTIVE VOLTAGE				OUTPUT VOLTS		
H1 - H2	H1 - H3	H1 - H4	H1 - H5	X1 - X2	X1 - X3	X1 - X4
208	-	-	500	85	100	110
220	380	440	550	91	110	120
230	400	460	575	95	115	125
240	416	480	600	99	120	130

Table 16
Transformer Chart

Component Connection	Pin	Description
Purge Valve (Right)	1	Solenoid D HIGH (+12V)
	2	Solenoid D LOW
Purge Saver Intake Shutoff Valve	3	Solenoid H HIGH (+12V)
	4	Solenoid H LOW
Heater Thermocouple Output	13	4-20 mA Current Loop #2 OUT
	14	4-20 mA Current Loop #2 RET
Right Pressure Switch	33	Pressure Sensor #2
	34	Pressure Sensor #2 (GND)
Left Pressure Switch	35	Pressure Sensor #1
	36	Pressure Sensor #1 (GND)
Inlet Valve (Left)	37	Solenoid A HIGH (+12V)
	38	Solenoid A LOW
Inlet Valve (Right)	39	Solenoid B HIGH (+12V)
	40	Solenoid B LOW
Depress Valve (Right)	41	Solenoid G HIGH (+12V)
	42	Solenoid G LOW
Depress Valve (Left)	43	Solenoid F HIGH (+12V)
	44	Solenoid F LOW
Repress Valve	45	Solenoid E HIGH (+12V)
	46	Solenoid E LOW
Purge Valve (Left)	47	Solenoid C HIGH (+12V)
	48	Solenoid C LOW
Heater Over Temp Alarm	53	Digital Input #2 +
	54	Digital Input #2 - (GND)
Warning On	58	Relay #5 NO
	59	Relay #5 NC
	60	Relay #5 Common
+5VDC	62	+5VDC (to power analog sensor)
Relative Humidity Analog Output	63	Analog Input #1 +
	64	Analog Input #1 - (GND)
Alarm On	65	Relay #1 NO
	66	Relay #1 NC
	67	Relay #1 Common
Heater	71	Relay 1CR NO
	72	Relay 1CR Common
Heater Temperature RTD3	73	RTD #3 +
	74	RTD #3 -
Right Tower RTD2	77	RTD #2 +
	78	RTD #2 -
Left Tower RTD1	79	RTD #1 +
	80	RTD #1 -
Relative Humidity RTD4	81	RTD #4 +
	82	RTD #4 -
Dew Point Sensor	83	4-20 mA Current Loop #1 OUT
	84	4-20 mA Current Loop #1 RET

Table 17

*PHD-CD Series Controller Connections
Models PHD900-CD through PHD3200-CD*

USB	Main Board	Display
Cable 1	USB_HOST	J2
Cable 2	+V_PWR	J3

Table 18

PHD-CD Series Controller to Display Connections

NOTES:

1. TO INSURE SAFE AND RELIABLE OPERATION, CUSTOMER MUST CONNECT GROUND TERMINAL INDEPENDENTLY TO A QUALITY ELECTRICAL GROUND. GROUND CONDUCTOR MUST BE SIZED ACCORDING TO NEC 250-122. GROUND MUST BE CONNECTED BEFORE MAIN POWER (L & N) CAN BE CONNECTED.
2. GROUND TO BE TERMINATED AT BUSSBAR ONLY. DO NOT JUMPER FROM TERMINAL BLOCKS.
3. CUSTOMER IS RESPONSIBLE FOR PROVIDING A DISCONNECTING MEANS AND ALL FUSING AS REQUIRED BY THE NEC.
4. ALL RTD'S MUST BE PT100 ONLY.
5. EMS GREEN AND BROWN RTD WIRES ARE NOT USED.
6. TEMPERATURE CONTROLLER (1TC) SHOULD BE SET TO 650 °F (343°C)..
7. RELAYS HAVE A MAXIMUM LOAD OF 5 VDC @ 1 AMP AND PROVIDE NO VOLTAGE.
8. REFER TO P&ID DRAWING TO VERIFY ACTUAL SETTINGS.

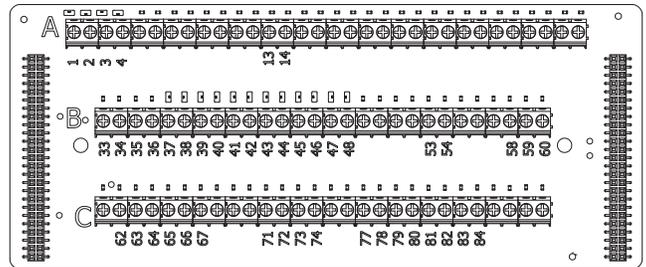


Figure 50

*PHD-CD Series Controller Connector Board
Models PHD900-CD through PHD3200-CD*

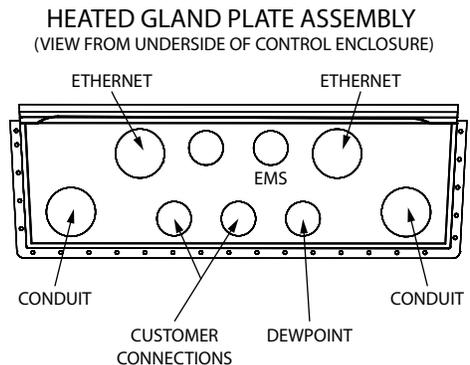
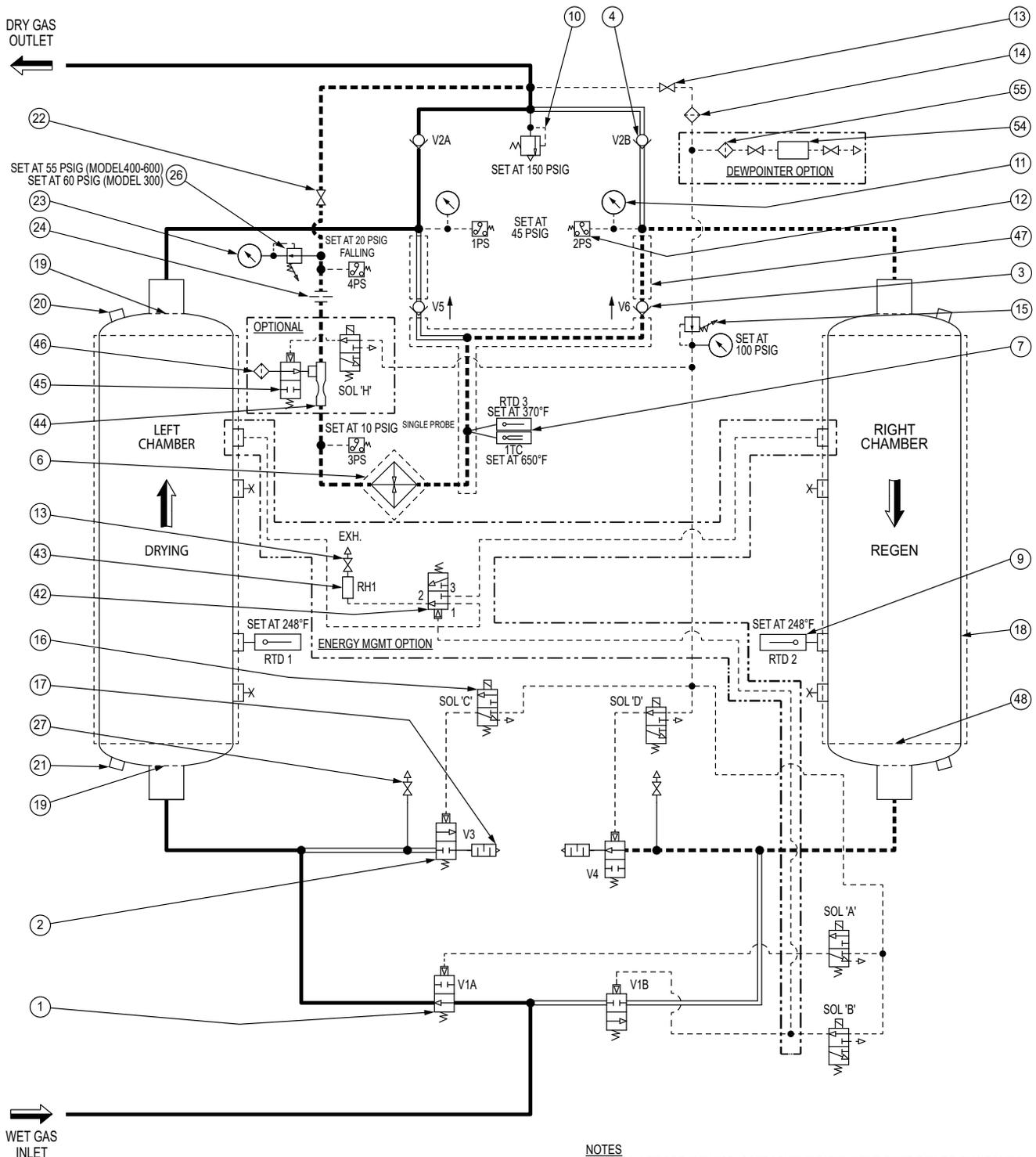


Figure 51

PHD-CD Series Controller Gland Plate Assembly

P&ID Schematic - Models 300 through 600

(Contact factory to request certified drawings)



- NOTES**
1. SYMBOLS ARE PER ANSI Y32.10 "GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS."
 2. AS SHOWN FLOW DIRECTION IS:
 - LEFT CHAMBER DRYING
 - - - RIGHT CHAMBER REGEN
 - · · PILOT GAS LINE
 3. SOLENOID VALVES 'B', 'D', 'G', & 'H' ARE SHOWN ENERGIZED. SOLENOID VALVES 'A', 'C', 'E', & 'F' ARE SHOWN DE-ENERGIZED.
 4. [- - -] INDICATES OPTION

LEGEND

1. INLET VALVE (V1A LEFT, V1B RIGHT)
2. PURGE EXHAUST VALVE (V3 LEFT, V4 RIGHT)
3. PURGE CHECK VALVE (V5 LEFT, V6 RIGHT)
4. OUTLET CHECK VALVE (V2A LEFT, V2B RIGHT)
6. PURGE HEATER WITH INSULATION
7. HEATER TEMPERATURE SINGLE PROBE-DUAL THERMOCOUPLE/OVERTEMPERATURE RTD
9. TOWER RTD (LEFT & RIGHT)
10. RELIEF VALVE
11. TOWER PRESSURE GAUGES (LEFT & RIGHT)
12. TOWER PRESSURE SWITCH (LEFT & RIGHT)
13. SERVICE VALVE
14. PILOT AIR FILTER
15. PRESSURE REGULATOR & GAUGE
16. SOLENOID VALVE
17. MUFFLER
18. DESICCANT TOWER
19. DESICCANT RETAINING SCREEN (TOP & BOTTOM)
20. DESICCANT FILL PORT
21. DESICCANT DRAIN PORT
22. PURGE ADJUSTING VALVE (V9)
23. PURGE PRESSURE GAUGE
24. PURGE FLOW ORIFICE
(NOT PROVIDED WITH PURGE SAVER)
26. PRESSURE REGULATOR
27. TOWER BLOW-DOWN VALVE

ENERGY MANAGEMENT OPTION

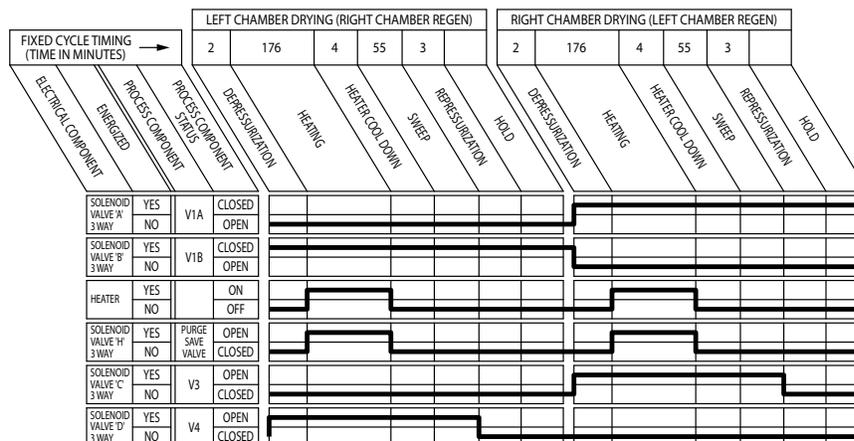
42. ENERGY MANAGEMENT PILOT OPERATED VALVE
43. ENERGY MANAGEMENT SENSOR (RTD4/HS1)
44. PURGE SAVER
45. PURGE SAVER INTAKE SHUT-OFF VALVE
46. PURGE SAVER INTAKE FILTER/SILENCER

INSULATION OPTION

47. HOT PIPE INSULATION
48. TOWER INSULATION

DEWPOINTER OPTION

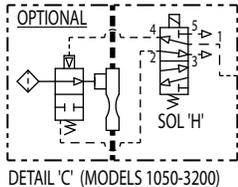
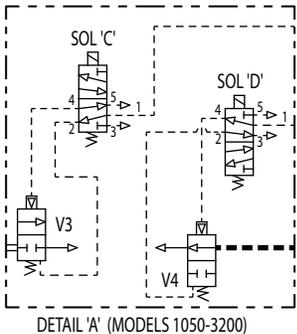
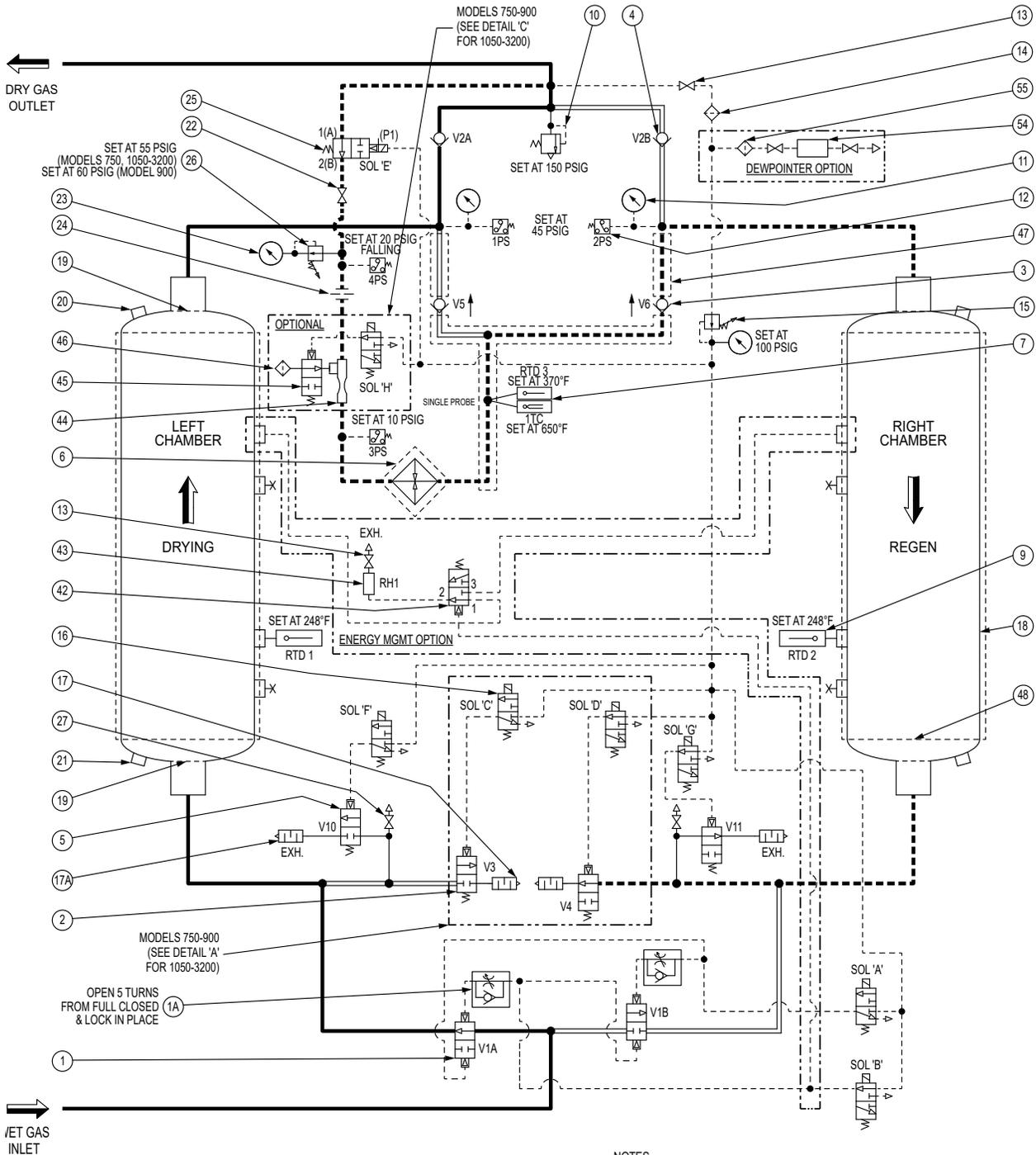
54. DEWPOINT ANALYZER
55. DEWPOINT ANALYZER FILTER



Sequence of Operation
(Models 300 through 600)

P&ID Schematic - Models 750 through 3200

(Contact factory to request certified drawings)



- NOTES
1. SYMBOLS ARE PER ANSI Y32.10 "GRAPHIC SYMBOLS FOR FLUID POWER DIAGRAMS."
 2. AS SHOWN FLOW DIRECTION IS:
 - LEFT CHAMBER DRYING
 - - - RIGHT CHAMBER REGEN
 - · · PILOT GAS LINE
 3. SOLENOID VALVES 'B', 'D', 'G', & 'H' ARE SHOWN ENERGIZED. SOLENOID VALVES 'A', 'C', 'E', & 'F' ARE SHOWN DE-ENERGIZED.
 4. [---] INDICATES OPTION

LEGEND

1. INLET VALVE (V1A LEFT, V1B RIGHT)
- 1A. FLOW CONTROL VALVE
2. PURGE EXHAUST VALVE (V3 LEFT, V4 RIGHT)
3. PURGE CHECK VALVE (V5 LEFT, V6 RIGHT) (NO SPRING)
4. OUTLET CHECK VALVE (V2A LEFT, V2B RIGHT)
5. DEPRESS SOLENOID VALVE (V10 LEFT, V11 RIGHT) (MODELS 900 THROUGH 3200)
6. PURGE HEATER WITH INSULATION
7. HEATER TEMPERATURE SINGLE PROBE-DUAL THERMOCOUPLE/OVERTEMPERATURE RTD
9. TOWER RTD (LEFT & RIGHT)
10. RELIEF VALVE
11. TOWER PRESSURE GAUGES (LEFT & RIGHT)
12. TOWER PRESSURE SWITCH (LEFT & RIGHT)
13. SERVICE VALVE
14. PILOT AIR FILTER
15. PRESSURE REGULATOR & GAUGE
16. SOLENOID VALVE
17. MUFFLER (750 ONLY)
- 17A. MUFFLER (900 THRU 3200)
18. DESICCANT TOWER
19. DESICCANT RETAINING SCREEN (TOP & BOTTOM)
20. DESICCANT FILL PORT

21. DESICCANT DRAIN PORT
22. PURGE ADJUSTING VALVE
23. PURGE PRESSURE GAUGE
24. PURGE FLOW ORIFICE (NOT PROVIDED WITH PURGE SAVER)
25. PURGE SHUTOFF VALVE (MODELS 900 THROUGH 3200)
26. PRESSURE REGULATOR
27. TOWER BLOW-DOWN VALVE

ENERGY MANAGEMENT OPTION

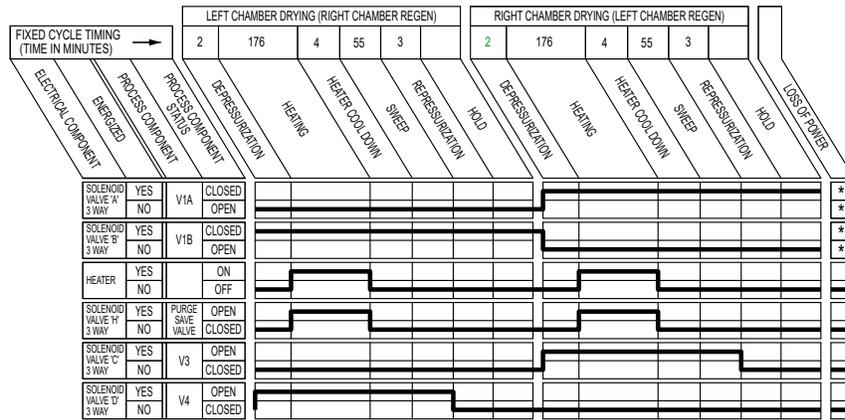
42. ENERGY MANAGEMENT PILOT OPERATED VALVE
43. ENERGY MANAGEMENT SENSOR (RH1)
44. PURGE SAVER
45. PURGE SAVER INTAKE SHUT-OFF VALVE
46. PURGE SAVER INTAKE FILTER/SILENCER

INSULATION OPTION

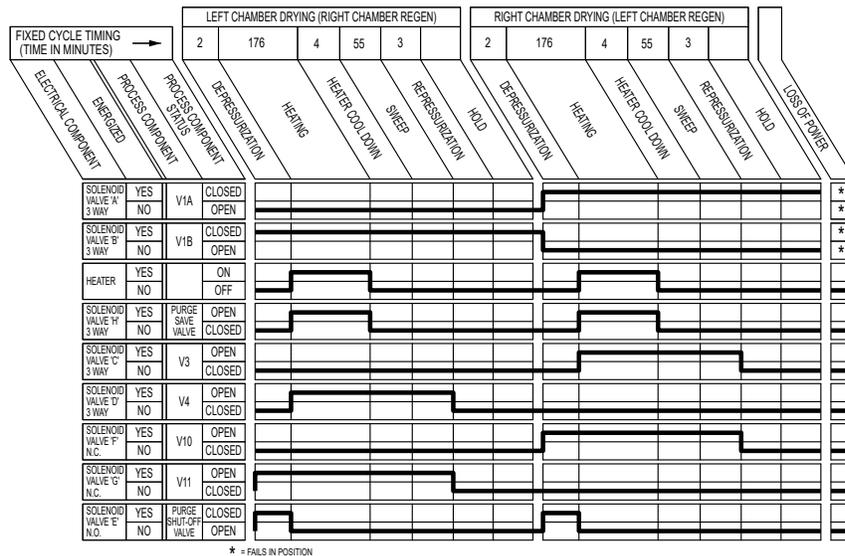
47. HOT PIPE INSULATION
48. TOWER INSULATION

DEWPOINT OPTION

54. DEWPOINT ANALYZER
55. DEWPOINT ANALYZER FILTER

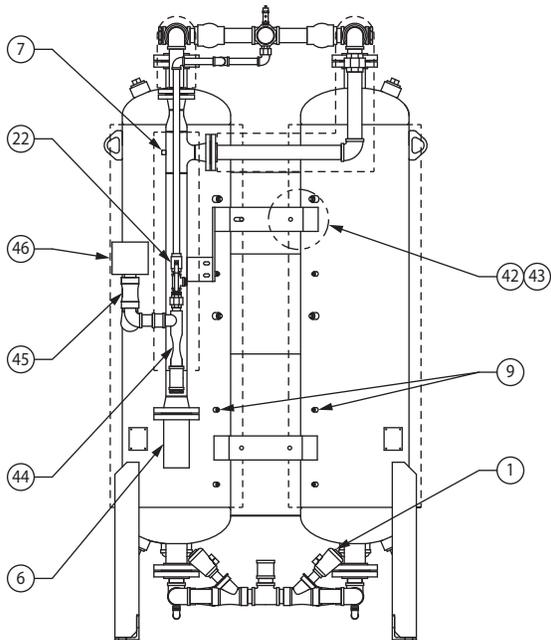


Sequence of Operation (Model 750)

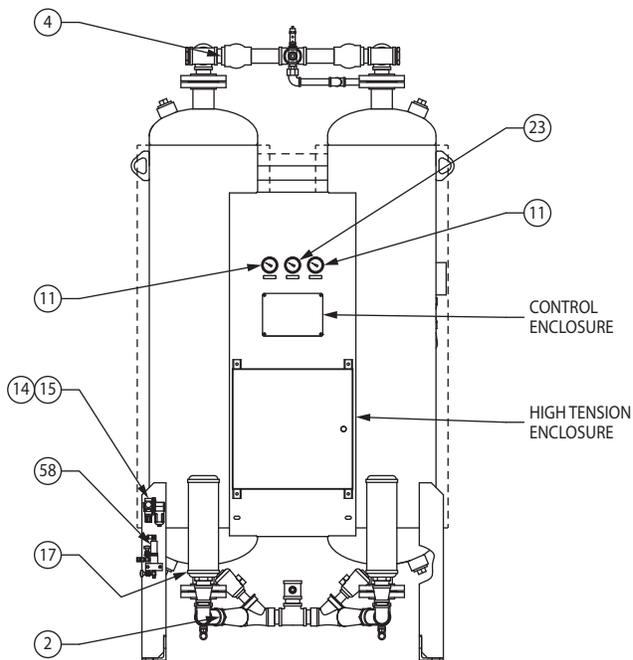


Sequence of Operation (Model 900 through 3200)

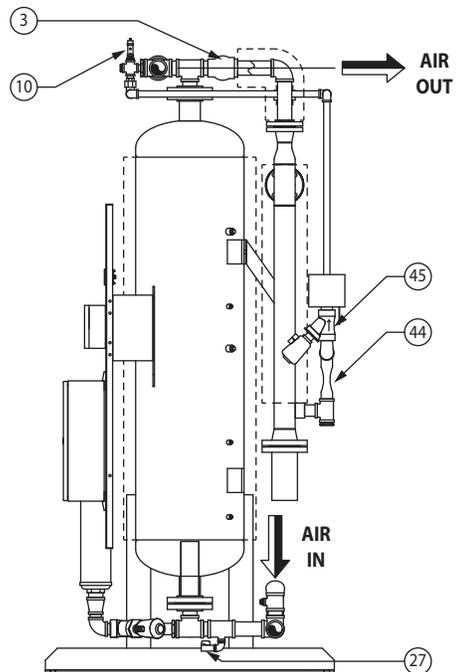
Replacement Parts – Models 300 through 600



REAR VIEW



FRONT VIEW



SIDE VIEW

(RIGHT CHAMBER REMOVED FOR CLARITY)

MODEL			
300	400	500	600

MAINTENANCE KITS

Year 2 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK2-00-A	PHDMK2-02-A	PHDMK2-04-A	PHDMK2-06-A
Year 3 Maintenance Kit	All the contents of the 2 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK3-00-A	PHDMK3-02-A	PHDMK3-04-A	PHDMK3-06-A
Year 4 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK4-00-A	PHDMK4-02-A	PHDMK4-04-A	PHDMK4-06-A
Year 5 Maintenance Kit	All the contents of the 4 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK5-00-A	PHDMK5-02-A	PHDMK5-04-A	PHDMK5-06-A
Desiccant Kit		PHDDES-00	PHDDES-02	PHDDES-04	PHDDES-06

*NOTE: Replacement Prefilter and Afterfilter elements are included in Standard Kits.

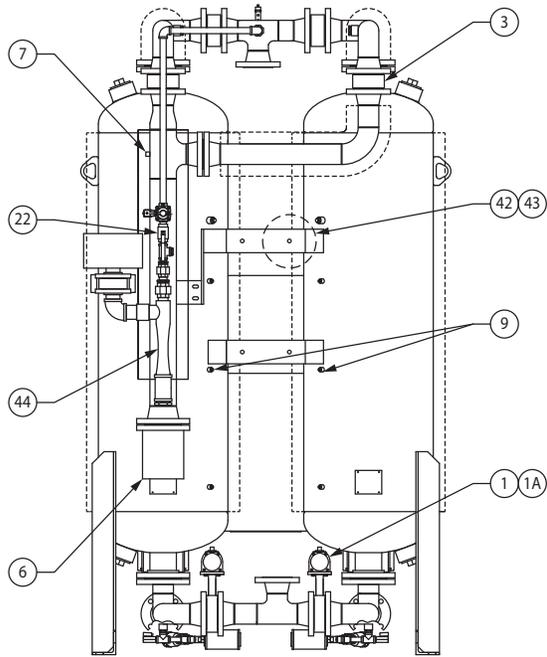
REPLACEMENT PARTS

ID#	DESCRIPTION					SAFETY STOCK	DRYER QTY.
1	Inlet Valve Assembly (V1A & V1B)	7438618	7438618	3151877	3151877	1	2
*	Solenoid Valve (Sol "A", "B")	3203652	3203652	3203652	3203652	1	2
2	Purge Exhaust Valve Assembly (V3 & V4)	7438616	7438616	7438616	7438616	1	2
*	Solenoid Valve (Sol "C", "D")	3203652	3203652	3203652	3203652	1	2
3	Purge Check Valve (V5 & V6)	3160400	3160400	3160401	3160401	1	2
4	Outlet Check Valve (V2A & V2B)	3160400	3160400	3160401	3160401	1	2
6	Purge Heater (460V)	3152744	3152739	3152739	3152740		1
7	Thermocouple (Dual RTD/TC) Heater Temperature Thermocouple (1TC) / Heater Overtemperature RTD (RTD3)	7452909	7452909	7452909	7452909		1
9	Chamber RTD (RTD1, RTD2)	7452907	7452907	7452907	7452907	1	2
10	Pressure Relief Valve	7473402	7473402	7473402	7473402		1
11	Chamber Pressure Gauge	7450553	7450553	7450553	7450553	1	2
12	Chamber Pressure Switch (1PS, 2PS)	3149016	3149016	3149016	3149016	1	2
*	Chamber Depressurization Pressure Switch (3PS)	3249688	3249688	3249688	3249688	1	1
*	Purge Pressure Switch (4PS)	7418860	7418860	7418860	7418860	1	1
14	Pilot Air Filter Element	3158592	3158592	3158592	3158592		1
15	Pilot Air Pressure Regulator	3154237	3154237	3154237	3154237		1
17	Exhaust Muffler	7490554	7490555	7490555	7490556		2
*	Exhaust Muffler Replacement Core	7473674	7473675	7473675	7473676	1	2
22	Purge Adjusting Valve (V9)	1196180	1196180	1170583	1170583		1
23	Purge Pressure Gauge	7450555	7450554	7450554	7450554		1
26	Purge Pressure Regulator	3204278	3204277	3204277	3204277		1
27	Chamber Blowdown Valve	4009894	4009894	4009894	4009894		2
42	Energy Management Pilot Operated Valve	1274209	1274209	1274209	1274209		1
43	Energy Management Sensor (RTD4/HS1)	7465603	7465603	7465603	7465603		1
*	Energy Management Vent Needle Valve	7483836	7483836	7483836	7483836		1
44	Purge Saver	3152713	3152714	3152714	3152715		1
45	Purge Saver Inlet Valve Assembly (V14)	7438614	7438615	7438615	7438616	1	1
*	Purge Saver Solenoid (Sol "H")	3203652	3203652	3203652	3203652	1	1
46	Purge Saver Intake/Filter Silencer	3152725	3152726	3152726	3152727		1
*	Inlet Silencer Element	3153682	3051062	3051062	3051062	1	1
58	Dew-point Sensor - Ceramic	3154859	3154859	3154859	3154859		1
*	Dryer Controller	7456214	7456214	7456214	7456214		1
*	Heater Contactor	3157896	3157896	3157896	3157896		1
*	Fuse 1.25A 600V (3FU)	1240671	1240671	1240671	1240671	1	1
*	Fuse .5A 600V (1FU, 2FU)	1241118	1241118	1241118	1241118	1	2
*	Relay, DPDT 12VDC Coil, 120VAC, 5A (1CR)	3154361	3154361	3154361	3154361	1	1
*	Temperature Controller	7473274	7473274	7473274	7473274		1
	Desiccant Evaluation Kit	7452585	7452585	7452585	7452585		
	Pre-Filter Assembly	PCS13401G24	PCS15001G24	PCS15001G24	PCS16001G32		
	Auto-Drain	7462875	7462875	7462877	7462877		
	Afterfilter Assembly	PCS13401G24	PCS15001G24	PCS15001G24	PCS16001G32		

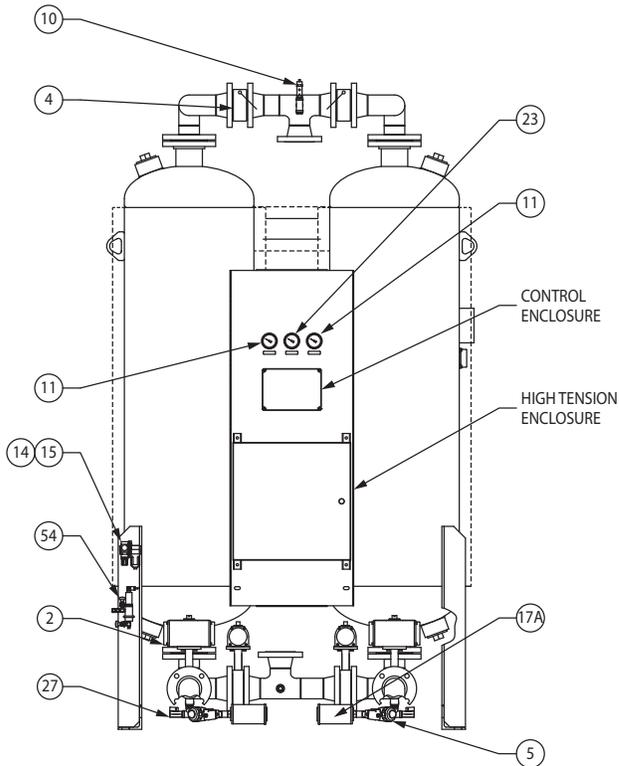
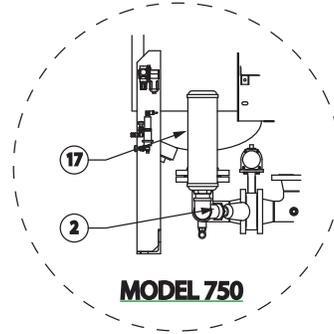
NOTES:

- Parts and Maintenance Kits are for standard builds only. Please contact the factory with your dryer serial number for assistance on identifying spare parts and maintenance kits for your specific unit.
- All quantities for one dryer.
- ID# correspond to P&ID legend (* Not pictured in diagrams.)

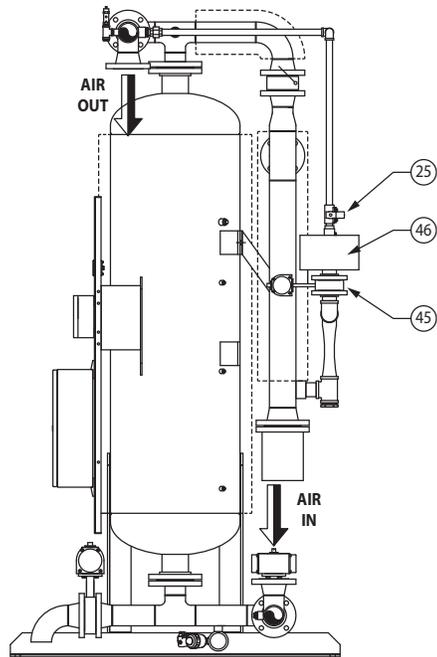
Replacement Parts – Models 750 through 1800



REAR VIEW



FRONT VIEW



SIDE VIEW

(RIGHT CHAMBER REMOVED FOR CLARITY)

MODEL					
750	900	1050	1300	1500	1800

MAINTENANCE KITS

Year 2 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK2-08-A	PHDMK2-10-A	PHDMK2-12-A	PHDMK2-14-A	PHDMK2-16-A	PHDMK2-18-A
Year 3 Maintenance Kit	All the contents of the 2 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK3-08-A	PHDMK3-10-A	PHDMK3-12-A	PHDMK3-14-A	PHDMK3-16-A	PHDMK3-18-A
Year 4 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK4-08-A	PHDMK4-10-A	PHDMK4-12-A	PHDMK4-14-A	PHDMK4-16-A	PHDMK4-18-A
Year 5 Maintenance Kit	All the contents of the 4 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK5-08-A	PHDMK5-10-A	PHDMK5-12-A	PHDMK5-14-A	PHDMK5-16-A	PHDMK5-18-A
Desiccant Kit		PHDDES-08-A	PHDDES-10-A	PHDDES-12-A	PHDDES-14-A	PHDDES-16-A	PHDDES-18-A

*NOTE: Replacement Prefilter and Afterfilter elements are included in Standard Kits.

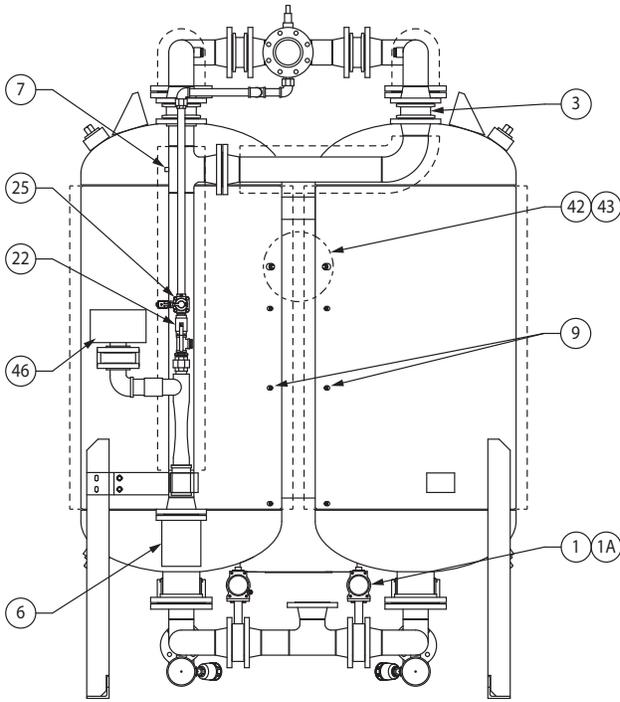
REPLACEMENT PARTS

ID#	DESCRIPTION	750	900	1050	1300	1500	1800	SAFETY STOCK	DRYER QTY.
1	Inlet Valve Assembly (V1A & V1B)	7473345	7473345	7473345	7473345	7473345	7473345	1	2
*	Solenoid Valve (Sol "A", "B")	3203652	3203652	3203652	3203652	3203652	3203652	1	2
1a	Inlet Pilot Operated Valve	3155189	3155189	3155189	3155189	3155189	3155189	1	2
2	Purge Exhaust Valve Assembly (V3 & V4)	3152701	3152701	7473350	7473350	7473350	7473350	1	2
*	Solenoid Valve (Sol "C", "D")	3203652	3203652	4009878	4009878	4009878	4009878	1	2
*	Solenoid Valve (Sol "C", "D") (coil only - used with 4009878)	NA	NA	4009810	4009810	4009810	4009810	1	2
3	Purge Check Valve (V5 & V6)	7473451	7473451	7473447	7473447	7473447	7473447	1	2
4	Outlet Check Valve (V2A & V2B)	7473435	7473435	7473435	7473435	7473435	7473435	1	2
5	Depressurization Valve (V10 & V11)	N/A	7438612	7438612	7438613	7438613	7438613	1	2
*	Depress Solenoid Valve (Sol "F", "G")	N/A	3203652	3203652	3203652	3203652	3203652	1	2
6	Purge Heater	3152742	3152741	1200773	3152734	3152735	1171782		1
7	Thermocouple (Dual RTD/TC) Heater Temperature Thermocouple (1TC) / Heater Overtemperature RTD (RTD3)	7452909	7452909	7452909	7452909	7452909	7452909		1
9	Chamber RTD (RTD1, RTD2)	7452907	7452907	7452907	7452907	7452907	7452907	1	2
10	Pressure Relief Valve	7473402	7473402	7473409	7473409	7473409	7473409		1
11	Chamber Pressure Gauge	7450553	7450553	7450553	7450553	7450553	7450553	1	2
12	Chamber Pressure Switch (1PS, 2PS)	3149016	3149016	3149016	3149016	3149016	3149016	1	2
*	Chamber Depressurization Pressure Switch (3PS)	3249688	3249688	3249688	3249688	3249688	3249688	1	1
*	Purge Pressure Switch (4PS)	7418860	7418860	7418860	7418860	7418860	7418860	1	1
14	Pilot Air Filter Element	3158592	3158592	3158592	3158592	3158592	3158592		1
15	Pilot Air Pressure Regulator	3154237	3154237	3154237	3154237	3154237	3154237		1
17	Exhaust Muffler	7490556	N/A	N/A	N/A	N/A	N/A		2
*	Exhaust Muffler Replacement Core	7473676	N/A	N/A	N/A	N/A	N/A	2	2
17a	Depress Muffler	N/A	7490553	7490553	7490553	7490560	7490560		2
*	Depress Muffler Replacement Core	N/A	7473672	7473672	7473672	7473673	7473673	2	2
22	Purge Adjusting Valve (V9)	1170583	1170583	1170583	1170583	1170583	7401510		1
23	Purge Pressure Gauge	7450554	7450555	7450554	7450554	7450554	7450554		1
25	Purge Shut-Off Valve (V15) (Sol "E")	N/A	7452865	7452865	7452865	7452865	7452865	1	1
26	Purge Pressure Regulator	3204277	3204278	3204277	3204277	3204277	3204277		1
27	Chamber Blowdown Valve	4009894	4009894	4009894	4009900	4009900	4009900		2
42	Energy Management Pilot Operated Valve	1274209	1274209	1274209	1274209	1274209	1274209		1
43	Energy Management Sensor (RTD4/HS1)	7465603	7465603	7465603	7465603	7465603	7465603		1
*	Energy Management Vent Needle Valve	7483836	7483836	7483836	7483836	7483836	7483836		1
44	Purge Saver	3152715	3152715	3152462	3152462	3152462	3152716		1
45	Purge Saver Inlet Valve Assembly (V14)	7438616	7438616	7473348	7473348	7473348	7473349	1	1
*	Purge Saver Solenoid (Sol "H")	3203652	3203652	4009878	4009878	4009878	4009878	1	1
*	Purge Saver Solenoid (Sol "H") (coil only - used with 4009878)	NA	NA	4009810	4009810	4009810	4009810	1	1
46	Purge Saver Intake/Filter Silencer	3152727	3152727	3152461	3152461	3152461	3152728		1
*	Inlet Silencer Element	3051062	3051062	1270769	1270769	1270769	1270769	1	1
54	Dew-point Sensor - Ceramic	3154859	3154859	3154859	3154859	3154859	3154859		1
*	Controller	7456214	7456214	7456214	7456214	7456214	7456214		1
*	Heater Contactor	3157896	3157896	3157896	3157896	3158650	3158650		1
*	Fuse 1.25A 600V	1240671	1240671	1240671	1240671	1240671	1240671	1	1
*	Fuse .5A 600V	1241118	1241118	1241118	1241118	1241118	1241118	1	2
*	Relay, DPDT 12VDC Coil, 120VAC, 5A (1CR)	3154361	3154361	3154361	3154361	3154361	3154361	1	1
*	Relay, DPDT 120VAC Coil, 120VAC, 10A (2CR)	N/A	3158359	3158359	3158359	3158359	3158359	1	1
*	Temperature Controller	7473274	7473274	7473274	7473274	7473274	7473274		1
Desiccant Evaluation Kit		7452585	7452585	7452585	7452585	7452585	7452585		
Pre-Filter Assembly		PCS18001G32	PCS19501G49	PCS112001G49C	PCC114003G49	PCC118003G65	PCC118003G65		
Auto-Drain		7462877	7462877	7462877	7462877	7462877	7462877		
Afterfilter Assembly		PCS18001G32	PCS19501G49	PCS112001G49C	PCC114003G49	PCC118003G65	PCC118003G65		

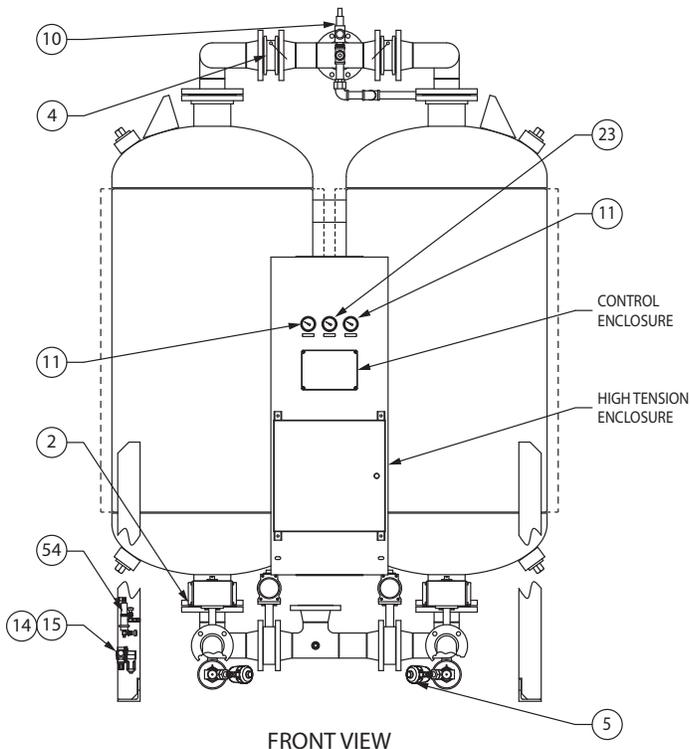
NOTES:

- Parts and Maintenance Kits are for standard builds only. Please contact the factory with your dryer serial number for assistance on identifying spare parts and maintenance kits for your specific unit.
- All quantities for one dryer.
- ID# correspond to P&ID legend (* Not pictured in diagrams.)
- N/A - Not Applicable to this Model Size

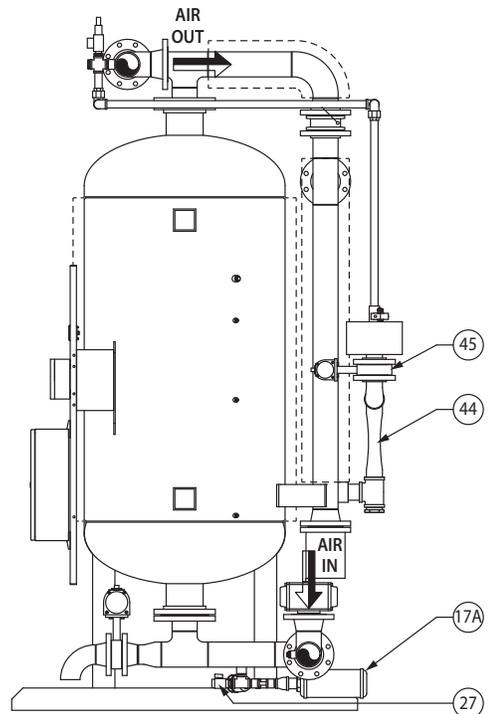
Replacement Parts – Models 2200 through 3200



REAR VIEW



FRONT VIEW



SIDE VIEW
(RIGHT CHAMBER REMOVED FOR CLARITY)

MODEL		
2200	2600	3200

MAINTENANCE KITS

Year 2 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK2-20-A	PHDMK2-22-A	PHDMK2-24-A
Year 3 Maintenance Kit	All the contents of the 2 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK3-20-A	PHDMK3-22-A	PHDMK3-24-A
Year 4 Maintenance Kit	Elements*, Muffler, Drain, Desiccant Evaluation Kit	PHDMK4-20-A	PHDMK4-22-A	PHDMK4-24-A
Year 5 Maintenance Kit	All the contents of the 4 Year Kit, Pressure Switches, Valve Repair Kits	PHDMK5-20-A	PHDMK5-22-A	PHDMK5-24-A
Desiccant Kit		PHDDES-20	PHDDES-22	PHDDES-24

*NOTE: Replacement Prefilter and Afterfilter elements are included in Standard Kits.

REPLACEMENT PARTS

ID#	DESCRIPTION				SAFETY STOCK	DRYER QTY.
1	Inlet Valve Assembly (V1A & V1B)	7473346	7473346	7473346	1	2
*	Solenoid Valve (Sol "A", "B")	3203652	3203652	3203652	1	2
1a	Inlet Pilot Operated Valve	3155189	3155189	3155189	1	2
2	Purge Exhaust Valve Assembly (V3 & V4)	7473350	7473350	7473351	1	2
*	Solenoid Valve (Sol "C", "D")	4009878	4009878	4009878	1	2
*	Solenoid Valve (Sol "C", "D") (coil only - used with 4009878)	4009810	4009810	4009810	1	2
3	Purge Check Valve (V5 & V6)	7473448	7473448	7473448	1	2
4	Outlet Check Valve (V2A & V2B)	7473436	7473436	7473436	1	2
5	Depressurization Valve (V10 & V11)	7438614	7438614	7438614	1	2
*	Depress Solenoid Valve (Sol "F", "G")	3203652	3203652	3203652	1	2
6	Purge Heater	3152736	3152738	1217919		1
7	Thermocouple (Dual RTD/TC) Heater Temperature Thermocouple (1TC) / Heater Overtemperature RTD (RTD3)	7452909	7452909	7452909		1
9	Chamber RTD (RTD1, RTD2)	7452907	7452907	7452907	1	2
10	Pressure Relief Valve	7473409	7473409	7473409		1
11	Chamber Pressure Gauge	7450553	7450553	7450553	1	2
12	Chamber Pressure Switch (1PS, 2PS)	3149016	3149016	3149016	1	2
*	Chamber Depressurization Pressure Switch (3PS)	3249688	3249688	3249688	1	1
*	Purge Pressure Switch (4PS)	7418860	7418860	7418860	1	1
14	Pilot Air Filter Element	3158592	3158592	3158592		1
15	Pilot Air Pressure Regulator	3154237	3154237	3154237		1
17a	Depress Muffler	7490555	7490555	7490555		2
*	Depress Muffler Replacement Core	7473675	7473675	7473675	2	2
22	Purge Adjusting Valve (V9)	7401510	7401510	7401510		1
23	Purge Pressure Gauge	7450555	7450555	7450555		1
25	Purge Shut-Off Valve (V15) (Sol "E")	7452866	7452866	7452866	1	1
26	Purge Pressure Regulator	3204278	3204278	3204278		1
27	Chamber Blowdown Valve	4009900	4009900	4009900		2
42	Energy Management Pilot Operated Valve	1274209	1274209	1274209		1
43	Energy Management Sensor (RTD4/HS1)	7465603	7465603	7465603		1
*	Energy Management Vent Needle Valve	7483836	7483836	7483836		1
44	Purge Saver	3152716	3152716	3152717		1
45	Purge Saver Inlet Valve Assembly (V14)	7473349	7473349	7473350	1	1
*	Purge Saver Solenoid (Sol "H")	4009878	4009878	4009878	1	1
*	Purge Saver Solenoid (Sol "H") (coil only - used with 4009878)	4009810	4009810	4009810	1	1
46	Purge Saver Intake/Filter Silencer	3152728	3152728	3152729		1
*	Inlet Silencer Element	1270769	1270769	3153683	1	1
54	Dew-point Sensor - Ceramic	3154859	3154859	3154859		1
*	Controller	7456214	7456214	7456214		1
*	Heater Contactor	3158650	3158650	3158650		1
*	Fuse 1.25A 600V (3FU)	1240671	1240671	1240671	1	1
*	Fuse .5A 600V (1FU, 2FU)	1241118	1241118	1241118	1	2
*	Relay, DPDT 12VDC Coil, 120VAC, 5A (1CR)	3154361	3154361	3154361	1	1
*	Relay, DPDT 120VAC Coil, 120VAC, 10A (2CR)	3158359	3158359	3158359	1	1
*	Temperature Controller	7473274	7473274	7473274		1
Desiccant Evaluation Kit		7452585	7452585	7452585		
Pre-Filter Assembly		PCC124004G65	PCC136003G97	PCC136003G97		
Auto-Drain		7462877	7462877	7462877		
Afterfilter Assembly		PCC124004G65	PCC136003G97	PCC136003G97		

NOTES:

- Parts and Maintenance Kits are for standard builds only. Please contact the factory with your dryer serial number for assistance on identifying spare parts and maintenance kits for your specific unit.
- All quantities for one dryer.
- ID# correspond to P&ID legend (* Not pictured in diagrams.)

WARRANTY

The manufacturer warrants the product it manufactures, when properly installed, operated, applied, and maintained in accordance with procedures and recommendations outlined in manufacturer's instruction manuals, will be free from defects in material or workmanship for a period as specified below, provided such defect is discovered and brought to the manufacturer's attention within the aforesaid warranty period.

The manufacturer will repair or replace any product or part determined to be defective by the manufacturer within the warranty period, provided such defect occurred in normal service and not as a result of misuse, abuse, neglect or accident. Normal maintenance items requiring routine replacement are not warranted. The warranty covers parts and labor for the warranty period unless otherwise specified. Repair or replacement shall be made at the factory or the installation site, at the sole discretion of the manufacturer. Although not required for warranty consideration, it is recommended that the manufacture be contacted prior to doing any warranty related service work. This action will provide guidance and instruction on the repair often times authorization to perform the work. **NOTE:** The manufacture reserves the right to repair, replace in the case of warranty approval or reject the warranty claim once submitted.

Unauthorized service and use of unauthorized or pirated parts voids the warranty and any resulting charges or subsequent claim will not be paid. Products repaired or replaced under warranty shall be warranted for the unexpired portion of the warranty applying to the original product.

The foregoing is the exclusive remedy of any buyer of the manufacturer's product. The maximum damages liability of the manufacturer is the original purchase price of the product or part.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR STATUTORY, AND IS EXPRESSLY IN LIEU OF THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. THE MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OR DAMAGE BY REASON OF STRICT LIABILITY IN TORT OR ITS NEGLIGENCE IN WHATEVER MANNER INCLUDING DESIGN, MANUFACTURE OR INSPECTION OF THE EQUIPMENT OR ITS FAILURE TO DISCOVER, REPORT, REPAIR, OR MODIFY LATENT DEFECTS INHERENT THEREIN. THE MANUFACTURER, HIS REPRESENTATIVE OR DISTRIBUTOR SHALL NOT BE LIABLE FOR LOSS OF USE OF THE PRODUCT OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE BUYER, WHETHER ARISING FROM BREACH OF WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

Please note that the manufacturer's warranty for this product is intended to cover manufacturing defects and therefore does not cover consumable components (desiccants, filter elements, soft goods, standard maintenance kit wear items, etc.) or components that require periodic user adjustment (expansion valve, hot gas bypass valve or cooling water regulating valve) or calibration (dew point elements/sensors, gauge calibration, etc.)

Warranty Period

One (1) year parts and labor from the date of shipment from the manufacturer or the manufacturer's authorized distributor (not to exceed eighteen (18) months from the date of shipment from the factory, whichever occurs first).

An extended warranty of up to 5 years from the date of purchase may be available for your dryer. Please contact your local distributor for more details of the requirements for activation of warranty extension.

AUTHORIZATION FROM THE SERVICE DEPARTMENT IS NECESSARY BEFORE MATERIAL IS RETURNED TO THE FACTORY OR IN-WARRANTY REPAIRS ARE MADE.

SERVICE DEPARTMENT: (724) 746-1100



PHD SERIES

Heated Purge Desiccant
Compressed Air Dryer

4647 S.W. 40th Avenue
Ocala, Florida 34474-5788
U.S.A.

P: (352) 873-5793
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continuous at Pneumatic Products.
Specifications may change
without notice.

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