OWNER'S MANUAL

HEATLESS REGENERATIVE DRYERS

PHL SERIES

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RECEIVING & INSPECTION

1. Carefully inspect the packaging and dryer for external and/or internal damage. If you suspect damage has occurred during shipment, notify the transportation agency at once. This is the customer's responsibility.
2. Check the nameplate for correct power supply requirements.
3. Inspect all piping and tubing. Vibration during shipment may have loosened the connections.
4. Standard Pioneer compressed air dryers are tested and operated before leaving the factory. They are ready to operate after connecting to the proper services.

NOTE: To avoid erosion or powdering of desiccant in shipment, models PHL 1400 and larger are shipped without desiccant in vessels. The desiccant is shipped separately. Fill the dryer vessels with desiccant prior to operation.

INTRODUCTION

Congratulations on your purchase of a PHL Series Regenerative Dryer from Pioneer Air Systems. Your dryer has been designed, engineered, manufactured, and factory- tested to ensure many years of reliable operation. We at Pioneer take pride in a job well done, which is why we offer the longest standard warranties in the industry.

This owner's manual provides you with information typical to standard Pioneer heatless regenerative dryers. Options and custom equipment may not be included in this manual.

Pioneer Air Systems, Inc. was founded in the spring of 1980 amidst a deep recession in American industry. As pioneers in the compressed air industry, Pioneer engineers and designers boldly faced manufacturing challenges, which their competitors ignored. Pioneer had thrived because of the company's willingness to solve problems, the daring to be innovative and the foresight to do everything well.

Originally located in Canton, Michigan, Pioneer's initial product offering was a refrigerant-type compressed air and gas dryer, today known as Mr. Goodaire. Pioneer rapidly expanded its product line and its manufacturing facilities, which are presently located in the foothills of the Cumberland Mountains in East Tennessee.

Today, in addition to refrigerant dryers, Pioneer's product line includes desiccant dryers, air and water filtration systems, several types of process water cooling equipment, breathing air purifiers, compressed natural gas dryers, and a host of related equipment and accessories. In just a few short years, Pioneer boasts one of the largest, most comprehensive product lines in the compressed air industry, and each product is designed and manufactured with the same attention to quality and functionality that brought Pioneer where it is today.

A worldwide network of Pioneer distributors and factory representatives actively seek new problems, new challenges, and new business. Like Pioneer products, they represent the very best in the industry.

STANDARD FEATURES

1. NEMA 4 electrical
2. Electronic Timing Sequence Module
3. Sequence Lights
    a. Left tower drying
    b. Right tower drying
    c. Left tower regenerating
    d. Right tower regenerating
    e. Left tower repressurizing
    f. Right tower repressurizing
    g. Fail to shift alarm
4. Tower safety relief valves
5. ASME coded vessels (PHL 100 and larger)
6. Tower pressure gauges
7. Purge pressure gauge
8. Tower exhaust mufflers
9. Non-lube valves
10. Stainless steel inlet/outlet diffusers

INSTALLATION

Location

Locate your Pioneer PHL series dryer on a level floor free from vibrations and in clean surroundings. Although the dryer is a freestanding package, it may be secured by bolting the dryer base to the floor. Allow approximately three feet on each side of the dryer for ease of connecting and maintaining the dryer.

The ambient temperature in the dryer's location should range from 35^{o}F to 120^{o}F. The dryer will function in warmer ambient, but as a result, the degrees of dew point suppression will decrease. Operation of the dryer in ambient approaching freezing could cause freezing of separated liquids in the pre-filter sump or in the dryer itself. For dryer operation at temperatures below freezing, Pioneer recommends heat tracing the pre-filter sump, drain trap, and inlet manifold. For more information on heat tracing, contact your Pioneer distributor or contact the factory.

Protective barriers are recommended for the prevention of accidental damage that may occur due to vehicular or personnel traffic, particularly for dryers located in open areas.

Connecting Services

1. Connect inlet piping, including a shut off valve.
2. Connect outlet piping, including a shut off valve.
3. Install pre-filter(s) and after filter(s) if not factory installed.
4. If desired, install bypass piping using bubble tight valves. Bypass piping is recommended for ease of maintenance, troubleshooting, and service.
5. Connect electrical supply to the control box. This should be performed by a qualified electrician according to local and national codes.
6. Install access ports upstream and downstream of the dryer for dew point and temperature measurements.

Filtration

All regenerative desiccant dryers are designed to remove water in the vapor phase. The possibility of liquid carry over to the desiccant dryer must be avoided. A coalescing pre-filter will eliminate the carry over of droplets and aerosol-sized mists of both liquid water and compressor lubricant. The use of a Pioneer coalescing filter (CS Series) will enhance the dew point depression capability of the dryer. It will also extend the life of the desiccant by preventing compressor lubricant fouling of the desiccant bed. In installations with excessive oil carry over, use a Pioneer Oil-Alert filter (OA Series) before the coalescer for better performance and longer desiccant life.

Although the pre-filter sump can be manually drained of separated liquids, it is highly recommended that an additional automatic drain, such as a Pioneer Sensor Drain or Timer Drain, be installed to eliminate the possibility of failure to drain the pre-filter sump.

After filtration is also a very important step. All regenerative desiccant dryers gradually produce hard and abrasive desiccant fines. These contaminants should be removed with a Pioneer particulate filter (PS Series). The elimination of desiccant fine carry over will protect your plant air systems and reduce future system malfunctions.

When installing filters, make connections according to the arrow directions marked on the filter head. For example, CS filters flow from 1 to 2. PS filters flow from 2 to 1.

Back Pressure Regulator

In dryer applications where sudden downstream demand for dry air frequently occurs, a rapid pressure loss in the compressed air system is possible. To prevent this, it is recommended that a back pressure regulator be installed downstream from the dryer.

The back pressure regulator will maintain a constant pressure within the dryer. This will eliminate any chance of saturating the desiccant bed by sudden flow surges, which accompany rapid pressure loss. By eliminating saturation and desiccant bed “bumping”, the life of the desiccant charge will increase, and the after filter will not become prematurely clogged with desiccant fines.

Purge Exhaust Piping

To eliminate noise created by frequent tower release of purge exhaust, the dryer’s exhaust may be piped to an outside or more remote location. This will also eliminate any possible problems caused by indoor accumulation of condensed moisture from the purge exhaust. If extending the exhaust pipe, install it horizontal or downward to avoid accumulation of condensate at low points. If the purge exhaust is required to run upward, install a valve at the low point. Keep this valve partially (50-75%) open to continually drain any liquid water. If extending the exhaust pipe farther than 15 feet, consult the factory for recommendations.

DIP Switches

There are two DIP switches on the PHL electronic board located inside the electrical enclosure. One is a 4-pin switch; the other is a 6-pin switch. When the switch is on the same side of the pin and the number, it is ON.

Explanation of 4-pin switch:

	ON	OFF
1	50 Hertz	60 Hertz
2	5 minute cycle	10 minute cycle
3	Factory use only – always OFF	
4	Demand cycle	Demand cycle off

PIN 1- Used for selecting different electrical power frequencies. U.S.A. uses 60 Hertz.
PIN 2- Standard cycle time is 10 minutes. For a PDP of -80^{o}F to -100^{o}F use a 5-minute cycle time.
PIN 3- For factory use only. This should always be OFF.
PIN 4- This should always be ON.

Explanation of 6-pin switch:

	ON	OFF
1	Add 1 second	Does nothing
2	Add 2 seconds	Does nothing
3	Add 4 seconds	Does nothing
4	Add 8 seconds	Does nothing
5	Add 16 seconds	Does nothing
6	Add 32 seconds	Does nothing

The 6-pin DIP switch controls repressurization time. The factory setting is for a 60-second repressurization- switches 1 and 2 are OFF; switches 3, 4, 5, and 6 are ON. This gives a total of 4 + 8 + 16 + 32 = 60 seconds of repressurization time.

START UP

WARNING- Do not operate the dryer with no purge flow. It may damage the dryer and will void the warranty.

After all installation procedures are performed, drain water from the system prior to dryer start up. This will prevent saturation of the desiccant bed and improve performance of the dryer.

1. The block valves upstream and downstream of the dryer should be closed; the bypass valve should be open.
2. Prior to turning the dryer control panel switch ON, pressurize the dryer by SLOWLY opening the block valve upstream of the dryer. **CAUTION**: Sudden pressurization of the dryer will cause a rush of high velocity air into the desiccant bed. This will hasten the need for after filter element and desiccant replacement and may cause premature failure of valves due to desiccant fines.
3. When both tower pressure gauges indicate line pressure, open the outlet block valve and close the bypass valve.

4. Switch the control panel power switch ON. Five seconds after activating the dryer control circuit, one tower will depressurize to atmospheric pressure. Regenerating purge air will then flow through the regenerating tower.
5. Set the purge adjustment valve to 45 psig (45 psig is standard. Actual setting may vary depending on load.). The purge pressure can be properly set only when the purge exhaust valve is open and the regenerating tower is at atmospheric pressure.

"Deadheading" the Dryer

After start up has been completed and the dryer has been checked for proper operation, "deadheading" the dryer is recommended. To "deadhead" the dryer is to operate it without a load to remove any moisture absorbed by the desiccant prior to installation.

The airflow through the dryer is used for regeneration only. This is accomplished by closing the outlet block valve and operating the unit for a minimum of three to five days prior to placing the dryer on-line.

OPERATION

The Pioneer PHL Series dryer is specifically designed to remove moisture in vapor form. The dryer's Electronic Sequence Module is fully automatic, alternately cycling gas flow through the dryer's twin desiccant towers. Cycling between the two towers accomplishes the adsorption and regeneration processes and provides a continuous flow of air.

The compressed air/gas laden with moisture vapor enters a tower and flows upward through the desiccant bed. The desiccant has great affinity for moisture vapor; therefore it adsorbs or removes moisture from the air and holds it on its surfaces. The adsorption process is an exothermic process meaning heat is produced as moisture is adsorbed on the desiccant surface. At the end of the drying cycle, the desiccant in the tower is regenerated- or the moisture that the desiccant adsorbed is removed by dry, warm air. A small portion of the dry gas is expanded to near atmospheric pressure by passing through an orifice specifically designed for the regeneration (purge) stream to strip the previously adsorbed moisture vapor. The exothermic reaction from the previous drying cycle contributes to the regeneration of the desiccant bed. The heat is picked up by the regeneration stream, which in turn increases the moisture adsorption capacity of the regeneration stream.

-40^{o}F PDP operating sequence (standard) - Assume the dryer has completed repressurization and the left tower has begun drying. The inlet-compressed air/gas enters the dryer and is diverted to the left tower to begin the five-minute drying cycle. Approximately five seconds later the right tower purge (regeneration) exhaust valve will open, depressurizing the off-line tower. The purge flow will continue for a period of three minutes and fifty-five seconds. When regeneration of the off-line tower is complete, the purge exhaust valve will close, initiating the sixty-second repressurizing phase. After repressurization is complete, the inlet selector valve will switch inlet valves and the inlet air/gas stream will divert from the left tower to the right tower. After five seconds the left tower purge exhaust valve will open and depressurizing the off-line tower to begin the regeneration cycle. The dryer will continuously cycle through the sequence described above until power is removed from the dryer. The complete standard operating (NEMA) cycle is ten minutes, see page 11. Under normal conditions and during normal operation, the dryer should provide an outlet pressure dew point (PDP) of -40^{o}F or below.

-100°F PDP operating sequence (optional)- In systems rated for -100°F PDP the time cycle is reduced to five minutes. Actual drying time per tower will be two and a half minutes. The actual purge time will be one minute and fifty-five seconds. The repressurization time will be thirty seconds. The operating sequence is similar to the standard -40° PDP operating sequence.

Demand Cycle operating sequence (optional) - The Demand Cycle operational sequence is similar to the standard -40° PDP sequence, except when in Demand Cycle mode, dryer sequencing is determined by the dew point analyzer. If, at the end of the five-minute drying cycle, the dew point analyzer indicates that the on-line tower has remaining adsorptive capacity, tower switch-over is delayed. The drying tower will remain on-line and the off-line tower will remain in a pressurized standby state until the moisture content in the drying tower reaches the analyzer set point (normally factory set at -40°F). A Demand Cycle Override switch is located on the control panel to allow the operator to select between a fixed operating cycle and Demand Cycle.

MAINTENANCE

WARNING- Before servicing any component, be certain the component is depressurized and valves are closed. Otherwise, equipment damage, severe injury, or death could result.

Pre-filter

Under normal operating conditions, the pressure drop across the filter- visible on the pressure differential indicator- indicates when the element needs changing (typically 6 PSI △P or greater). However, inspect the filter element at least every three months for proper seating and condition of the element. If the element has collapsed or cannot be properly seated, replace the element.

The automatic drain trap is often overlooked. Inspect it frequently and clean as necessary. A plugged drain may damage the desiccant in the dryer and void the warranty.

After filter

Under normal operating conditions, the pressure drop across the filter- visible on the pressure differential indicator- indicates when the element needs changing (typically 6 PSI △P or greater). However, inspect the filter element at least every three months for proper seating and condition of the element. If the element has collapsed or cannot be properly seated, replace the element. Replacement of the element will enhance system operation and prevent desiccant fine migration down stream.

Control air filter

The control air filter should be inspected periodically and replaced when dirty. Periodic replacement of the element will ensure clean control air for operation of the valves.

> **NOTE:** The useful life of a filter element depends upon the quality of the air. To ensure optimum performance, enact time-scheduled maintenance, for example, every three months.

Purge flow rate adjustment

The purge flow rate should be checked periodically for proper adjustment. The purge pressure for full load operation should be set at 45 PSIG. The purge calibration graph, page 11, may be used for purge adjustment when the load is less than capacity.

Solenoid valves

Inspect solenoid valves periodically for proper operation. The inspection should include monitoring the tower pressure gauge on each tower during the cycle. The back pressure on a regenerating tower should not be greater than 5 PSIG. Higher pressure indicates either a malfunctioning valve and/or a clogged muffler.

Frequent monitoring of the tower pressure gauges in conjunction with the control panel will give a good indication of proper operation and can assist with troubleshooting should a problem occur.

Failure of a solenoid valve may result from:

1. Faulty control circuit. Check the electrical system to verify that the solenoid coil is receiving electrical input.
2. A burned out coil. Replace the coil.
3. Clogged solenoid valve. Disassemble and clean.
4. Damaged valve seat. Replace valve.

Desiccant replacement and installation

Use only Pioneer Activated Alumina -100^{o}F in your PHL Series.

Remove contaminated desiccant from each vessel through the desiccant "drain port" located near the bottom of each vessel. Pour new desiccant into the indicated "fill port" located near the top of each vessel. Allow adequate space above the desiccant bed to permit bed motion and expansion during drying. Change the desiccant periodically for optimum dryer performance. Store any unused desiccant in an airtight container.

MAINTENANCE SCHEDULE/CHECKLIST

Maintenance Contracts- Pioneer and its network of distributors offer yearly maintenance contracts for worry-free operation. Contact Pioneer Air Systems at 423-346-6693 for details.

Frequency*	Action	Method
2-3 days after start-up and prior to placing dryer on-line	Inspect filters	Inspect pre-filter and after filter for dirt, oil, and other contaminants. Replace if contaminated.
Every 3-4 months	Inspect filters	Inspect pre-filter and after filter for dirt, oil, and other contaminants. Replace if contaminated.
Every 6 months	Calibrate optional dew point meter	Refer to Dew Point Meter Owner's Manual
Every 6 months	Inspect and clean purge exhaust mufflers	Replace muffler if desiccant deposits are found.
Every 6 months	Inspect purge exhaust valves	While dryer is operating, inspect for air leaking from the muffler on the drying tower. If leak exists, depressurize dryer and clean valve. If leak persists, replace valves.
Yearly	Replace filter elements	Replace pre-filter, after filter, control air filter, and optional dew point filter elements for uninterrupted operation.
Yearly	Inspect/replace inlet valves	Inspect valve seating and valve internals. Replacement recommended.
Yearly	Inspect inlet selector valve	Inspect valve (located on the back of the electrical enclosure) and valve piping for leaks. Repair or replace if leaks are present.
Yearly	Inspect pressure gauges	Replace if readings are incorrect.
Every 2-7 years	Replace desiccant	Replace if contaminated. Oil, moisture, and other contaminants inhibit the performance of the desiccant.

***** Maintenance frequency under normal conditions. In harsher conditions, perform maintenance twice as often.

TROUBLESHOOTING GUIDE

Problem	Cause	Remedy
Poor dew point	1. Excessive inlet flow	1. Reduce flow to rated capacity
	2. Excessive inlet temperature	2. Inspect, repair, or replace upstream aftercooler
	3. Excessive water	3. Check upstream separator, pre-filter, and their drain traps; repair or replace
	4. Desiccant contamination	4. Replace desiccant and pre-filter element
	5. Pre-filter drain failure	5. Check if clogged; clean, repair, or replace
	6. Low purge flow	6. Check purge calibration curve; see purge failure below
	7. Low inlet pressure	7. Check for pressure loss over pre-filter
	8. Liquids entering dryer inlet	8. Inspect pre-filtration system and drains
Excessive pressure drop	1. Excessive inlet flow	1. Reduce flow to rated capacity or install larger dryer
	2. Low inlet pressure	2. Check for pressure loss over pre-filter
	3. Excessive pressure drop over pre-filter and/or after filter	3. Change element(s)
Purge failure	1. Purge flow control valve or orifice clogged	1. Remove and clean
	2. Purge exhaust valve fails to close	2. Check solenoid actuator, purge exhaust valve, and sequence module
	3. Purge muffler clogged	3. Check muffler; replace if necessary
Pressurization failure	1. Repressurization failure	1. Check regulator, orifice, and check valve
	2. Purge exhaust valve fails to close	2. Check solenoid actuator, purge exhaust valve, and sequence module
Switch over failure	1. No control air	1. Check control air filter and control air lines
	2. Electric power loss	2. Check control fuse and incoming power
	3. Switching valve fails	3. Check inlet valve, actuator, and solenoid
High back pressure in off stream tower	1. Purge muffler clogged	1. Clean or replace
	2. Restrictive purge exhaust piping	2. Replace with larger size pipe
	3. Check valve leakage	3. Repair or replace

PURGE AIR CALIBRATION CHART

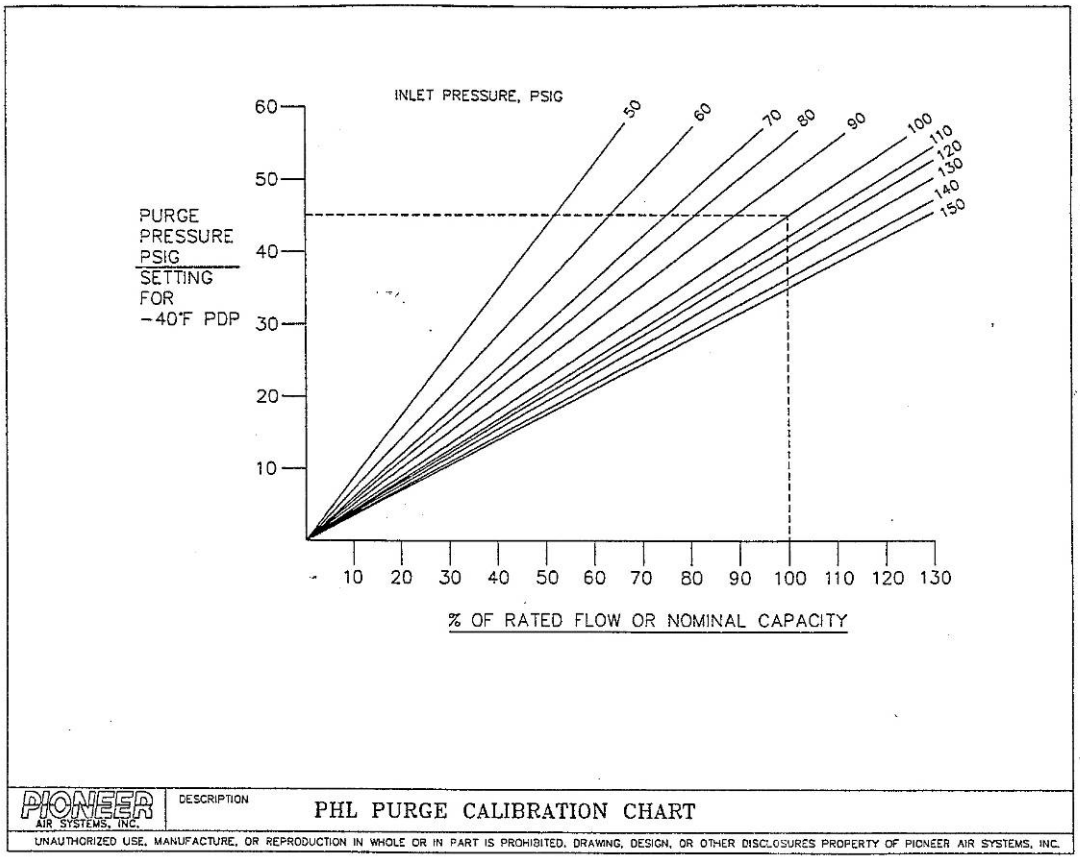

Figure 10. Purge air calibration chart

TIMING SEQUENCE

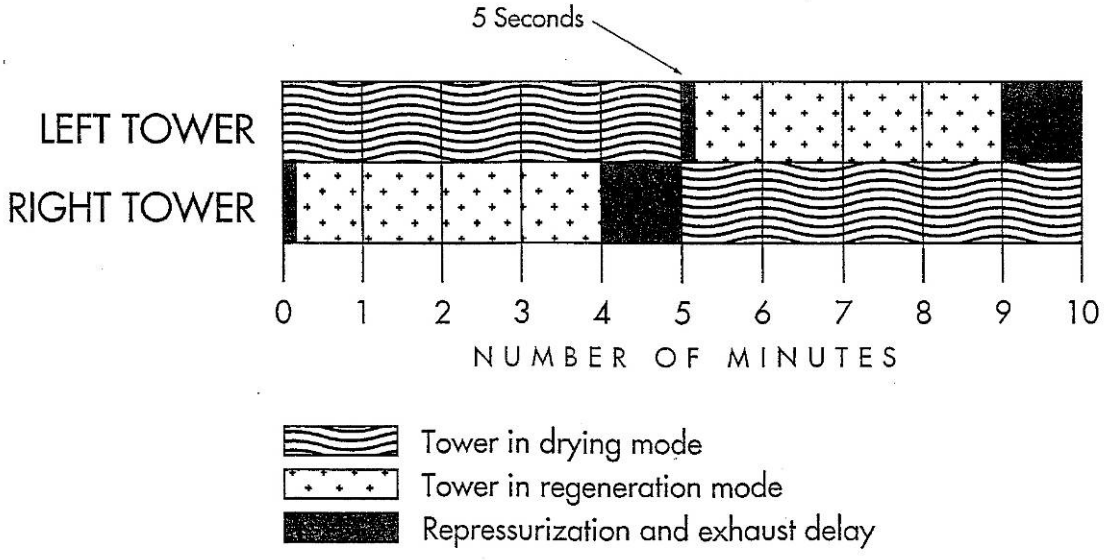

Figure 11. PHL25 and larger timing sequence diagram