INSTRUCTION MANUAL

FOR

LECTRODRYER BAC-50

HYDROGEN DRYING SYSTEM

Manufactured for: General Electric
End User: _____
Plant Name: _____
Unit Number: _____

Lectrodryer Serial Number:

_____

P.O. Box 2500
Richmond, Kentucky 40476-2602
Phone: (859) 624-2091 Fax: (859) 623-2436
www.lectrodryer.com

CE2003.02

TABLE OF CONTENTS

Appendix Material

LECTRODRYER, LLC
135 QUALITY DRIVE
RICHMOND, KENTUCKY 40475
PHONE: (859) 624-2091

TYPE: BAC SIZE: 50

CE Ex II3G

EEx nP II T4
EPSILON 03ATEX1245

Minimum Purge Flow Rate:	66L/Min.
Minimum Purge Flow Time:	17 Min.
Leakage Rate	100%
Minimum Over Pressure:	0.5mBar
Maximum Over Pressure:	14mBar
Internal Volume	0.094 m^3

DO NOT OPEN ENCLOSURE WHILE ENERGIZED OR, WHEN A FLAMMABLE ATMOSPHERE IS PRESENT.

LECTRODRYER PAST & PRESENT

Lectrodryer, L.L.C., originally was founded in May of 1932 by the W. E. Moore Company located in Pittsburgh, Pennsylvania, and was named the "Pittsburgh Lectrodryer Corporation." The W. E. Moore Company was a major manufacturer of electric arc furnaces for the steel industry. Pittsburgh Lectrodryer was formed for the purpose of drying gases used in these metal-treating furnaces. At that time, there were no companies manufacturing adsorption dryers. Most steel companies or furnace manufacturers built their own dryers on an as needed basis with very little adsorption technology. Pittsburgh Lectrodryer Corporation with cooperation from Aluminum Company of America, the leader in adsorbents, then developed desiccant dryers. Based on this research and data, Pittsburgh Lectrodryer Corporation introduced to industry the first fully engineered line of adsorption dryers. Its first order was for drying high-pressure natural gas for the Thomas Steel Company (now U.S. Steel) in Youngstown, Ohio.

In 1955, the W.E. Moore Company was purchased by McGraw Electric Company, which merged with Thomas A. Edison Industries in 1956 (now known as McGraw Edison Company). Then, in 1972 McGraw Edison sold the Lectrodryer Division to Ajax Magnethermic of Warren, Ohio. At that time the name was changed to Lectrodryer, Division of Ajax Magnethermic. The plant and office personnel were moved from Pittsburgh to a facility in Richmond, Kentucky. In 2001 the Lectrodryer Division was purchased by the current owners who maintain a 12,000 square foot facility at 135 Quality Drive in Richmond, Kentucky.

Today, Lectrodryer plays a vitally important role in solving the drying and purification problems of industry with heavy emphasis on the power industry. It has designed and manufactured units for every major generator manufacturer and is a leader in providing new control technology.

CUSTOMER ASSISTANCE AND FIELD SERVICE

Lectrodryer has a complete staff of engineers and technicians to help assist you in your dryer problems or needs. If problems arise from any aspect of your dryer that can't be solved with the aid of this manual request our **Customer Service or Engineering Department** at:

Lectrodryer, LLC
P.O. Box 2500
Richmond, KY 40476-2602
(859)-624-2091 (phone)
(859)-623-2436 (fax)

For prompt and accurate answers to written or verbal inquires please provide the following information:

1. Dryer Type and Size
2. Dryer Serial Number
3. Dryer Operating Conditions (temperatures, pressures, flowrates etc.).
4. Approximate time in service.
5. Nature of the problem

For spare parts needs, request our **Spare Parts Department**.

For your Local Area Representative, request our **Marketing Department.**

For information on other dryer applications request our **Marketing Department.**

Shipping Damage

If visible external or suspected internal damage has occurred during shipping, immediately enter a claim with the shipping carrier and contact our **Customer Services Department.**

Note:

Equipment shipped F.O.B. our Richmond, KY plant has the ownership transferred to the purchaser upon departure from our plant. All shipping claims of this nature must be processed by the owner with the shipping carrier and are not handled through Lectrodryer. Lectrodryer as a manufacturer will assist in any way possible, however, the responsibility for the claim rests with the owner.

Any mishandling or carelessness by the carrier should be noted on the delivery receipt. Obtaining a signed agreement with the delivery person will facilitate any insurance claims. Any damage should be reported to Lectrodryer prior to installing the equipment.

Dryer Specification Sheet

Gas Being Dried	Hydrogen
Operating Pressure	10-75 psig (7.04-5.28 kg/cm2)
Inlet Dry Bulb Temperature	120°F (49°C)
Inlet Dewpoint	+50°F (+10°C)
Outlet Dewpoint	-40°F (-40°C)
Heaters	1064 watts (each)
Blower Motors	1/2 HP (each)
Desiccant	Activated Alumina 50 lbs (23 kg) per tower
Enclosure Type	NEMA 4 with Type Z Purge Class 1, Group B, Division 2

UTILITIES

Power Supply (2.0 KVA)	__ volts, __3__ phase, __50/60__ hertz
Cooling Water Requirements	1.0 gpm at 85°F (3.81 lpm at 29°C)

OPTIONS

Inlet Hygrometer	__X__ Yes ____ No
Outlet Hygrometer	____ Yes __X__ No
Diagnostics Package	__X__ Yes ____ No

Dryer Serial Number: ____0824

Normal Readings and Instrument Setpoints

BED TEMPERATURE SWITCHES

TIS-1 and TIS-2

Setpoint	400°F (204°C)
Normal Reading	325°F ± 50°F (163°C ± 28°C) (At end of heating cycle)

BED OUTLET TEMPERATURE

TI-1	180°F ± 20°F (82°C ± 11°C) (2-3 hrs into heating cycle)

COOLER OUTLET TEMPERATURE

TI-2	less than 100°F (38°C)

CONTROL PANEL PURGE

Regulator	6 inches (15.2 mm) of water column
Differential Pressure Switch	0.75 inches (19 mm) of water column
Purge Outlet Pressure Gage	1-6 inches (25 – 152 mm) of water column

General Description of Desiccant Dryers

Adsorption

Adsorption is the process by which a dryer removes water from a fluid (gas or liquid). The fluid is passed through a column of desiccant, which is a material that has an attraction for "polar" molecules, such as water molecules. The material is manufactured to have a porous structure. The size of these "pores" is controlled to optimize the collection capacity and minimize the retention of larger molecules. The porous structure of the desiccant greatly increases its effective surface area. As a "wet" fluid is passed over desiccant particles, the adsorbed molecule is attracted to, and captured by the desiccant. The fluid comes out dry.

Reactivation

As the desiccant eventually will become saturated, it must either be replaced, or else reactivated. To replace the desiccant every 8 hours is not practical from a labor, or material cost perspective. Hence, the process of reactivation.

Reactivation is the process of driving the trapped water molecules from the desiccant and restoring the desiccant's ability to adsorb.

LECTRODRYER BAC-50

The Lectrodryer BAC-50 is designed for the specific purpose of removing moisture from hydrogen-cooled generators.

The BAC-50 is a dual tower dryer, having one tower in service, continuously drying the hydrogen gas in the generator (Adsorbing), while the other tower is being renewed by reactivation. After 8 hours of Adsorbing, the online tower is ready to be taken offline and reactivated. The freshly reactivated tower is ready to go back into Adsorption service.

Reactivation on a Lectrodryer BAC-50 is a closed loop process with hydrogen gas at line pressure, with no purge loss. Each reactivation consists of 4 hours of heating and 4 hours of cooling. A blower, internal to each vessel, produces the reactivation flow.

Heating - The desiccant is heated using internal, low watt density heaters, specifically designed for this application. The moisture is liberated from the warm desiccant and is carried out of the vessel by the reactivation flow, and on to the cooler, where the gas is cooled and the moisture begins to condense. The water is removed from the system by a centrifugal-type separator and a float-type trap. The reactivation flow continues back to the vessel where it begins this heating process all over again. The heating step is 4 hours.

Cooling - The same reactivation flow continues with the heater turned off, cooling the desiccant down in preparation for its next adsorption cycle. The cooling step is 4 hours.

Installation

Recommendations for Installation

1. 1" piping from the generator to the dryer and back is recommended, although a number of dryers operate adequately using 1/2" piping.

2. Isolation valves in these lines should be adequately sized so as to not cause excessive pressure drop in the system. Pay special attention to the C_v of the isolation valves.

3. This dryer should remove between a few ounces and several quarts of water every day, depending on specific conditions. It may be desirable to run this condensate to a drain.

   It can be a helpful troubleshooting or diagnostic tool to collect, measure, and record this condensate. This is an easy, effective, low cost way of verifying that the dryer is still functioning correctly, as well as a way to track the amount of water leakage into the generator.

Reference Drawing: Dimension (See Appendix)

When the Lectrodryer BAC-50 is first received, it should be closely inspected for any damage that may have occurred during shipment. If any signs of damage are present the unit should not be installed and Lectrodryer should be contacted immediately. When the unit is determined to be in good condition, the following installation procedures should be followed:

Mechanical Connections

1. Place unit on a flat, level concrete platform and bolt firmly in place. The unit is provided with four 11/16 inch (17mm) holes at the corners of the skid for this purpose.

   NOTE:
   Insure there is enough clearance around the dryer to access all valves. Also, there must be a 30" (762 mm) clearance directly above vessel heads for heater removal.

2. Ground the unit using the grounding lug located on the front right of the skid.

3. Connect the 1" 150 lbs. process inlet flange of the dryer to the high pressure tap on the generator. This line should be 1" (25 mm) minimum and should have full line size isolation valves.

4. Connect the 1" 150 lbs. process outlet flange of the dryer to the low pressure tap on the generator. This line should be 1" (25 mm) minimum and should be provided with full line size isolation valves.

5. Pipe the cooling water to the reactivation cooler. Water flow should be from right to left if you face the dryer from in front of the control panel. The water connections are 1/2", 150 lb., raised face flanges. Required water flow rate is 1 GPM at 85°F inlet temperature (3.81 lpm at 29°C). If cooling water temperatures are higher, flow rates may have to be increased to compensate.

6. Place relief valves on top of each tower, if desired. A 1/2" fnpt connection is provided directly behind the pressure gages on the top of each tower. Once the relief valves are in place the discharge should be piped away to a safe location.

7. A 1/4" fnpt connection is located on the left side of the dryer for control air and control panel purging. This connection should be hooked to an instrument air quality air line, with a minimum of 60 psig (4.23 kg/cm2) and a maximum of 120 psig (8.45 kg/cm2) of air pressure.

8. The dryer CO_2 purge inlet connection is located on the bottom right side of the dryer, (V-5). It should be piped to a location where carbon dioxide and hydrogen gas can both be supplied. Another option is to use portable tanks for purging when necessary.

9. The dryer CO_2 purge outlet connection is located on the front of the dryer directly below the control box, (V-6). This connection should be piped to a safe vent or header. Another option is to use a temporary line run to a vent when purging is necessary.

10. The condensate drain connection is located on the trap. This 1/2" fnpt connection has been connected to a street elbow that is pointing vertically upward. If this connection is to be piped away, the street elbow should be removed and piping hooked up that does not rise above the elevation of the trap outlet.

    This piping system should be designed such that the water discharged from the trap can be measured. It is recommended that a container of some sort (beaker, bucket, coffee cup, etc.) be placed below this drain to collect the condensate. It should be checked and recorded at regular intervals, preferably daily. The container should collect very nearly the same amount of water every day. Depending on conditions and parameters of a given system, any where from a few ounces to several quarts of water should be removed from the system every day. If the dryer is located outdoors or where the temperature could drop below 32°F (0°C), the trap and discharge piping must be heat traced.

11. Hygrometer Probes / Moisture Sensors

Inlet and / or Outlet Dewpoint Monitors are optional equipment on the Lectrodryer BAC-50. (see the Unit Specification Sheet, page iii, to determine if a particular dryer has these options.)

If either of these is included, the hygrometer probes will need to be installed. These probes are shipped pre-packed in a small black box inside the control panel. Note that the probes are unit specific and must be matched up with the correct hygrometer.(inlet probe with inlet hygrometer and outlet probe with outlet hygrometer.)

A blue cable will be hanging loose near the probe installation point. Connect this blue cable to the correct probe after installation.

Electrical Connections

The only required electrical connection for the BAC-50 is the main power supply. This 3-phase power should be connected to the terminal blocks located in the top left corner of the control box. A 1" NPT hub is provided on the left hand side, near the top of the control box.

The actual voltage to be applied depends on the particular dryer. The voltage should be specified at the time of ordering and can be determined by looking at the specification sheet in the front of this manual or on the dryer nameplate on the front of the control panel.

There are six (6) options available for the main power supply. One of three different transformers is used to step down the supplied voltage to the 110 volts needed for the controls and the heater.

		TRANSFORMER FUSE SIZES
1.	208 volts, 3 phase, 50/60 hertz	FNQ-10
2.	230 volts, 3 phase, 50/60 hertz	FNQ-9
3.	460 volts, 3 phase, 50/60 hertz	FNQ-5
4.	575 volts, 3 phase, 50/60 hertz	FNQ-4
5.	380 volts, 3 phase, 50/60 hertz	FNQ-6
6.	415 volts, 3 phase, 50/60 hertz	FNQ-5

Electrical power should not be applied until after the "Prestartup checks" have been completed (see Page 8).

NOTE:
To prolong the life of dryer electrical components, the dryer should be operated as closely as possible to the rated voltage. The dryer should never be operated at voltage in excess of 10% above the rated voltage.

NOTE:
The configuration of the internal blowers is such that the direction of rotation is not critical to the performance of the unit. Therefore, the three (3) legs of the power supply can be connected in any orientation and the dryer will function properly.

Optional Electrical Connections

1. Common Alarm Relay

   Normally Open (N.O.) auxiliary contact is provided for remote indication of alarms. See wiring diagram for actual terminal numbers.

   Relay is energized during normal operation.
   (N.O. contact is closed)
   de-energized for alarm or loss of power.
   (N.O. contact is open)

   Note: Normally Closed (N.C.) contacts can be used by switching the wire at the relay, from the N.O. contact to the N.C. contact.

2. Inlet Dewpoint Monitor

   Normally Open (N.O.) auxiliary contact is provided for remote indication of High Inlet Dewpoint Alarm. See wiring diagram for actual terminal numbers.

   Relay is energized during normal operation.
   (N.O. contact is closed)
   de-energized for alarm or loss of power.
   (N.O. contact is open)

   Note: Normally Closed (N.C.) contacts can be used by switching the wire at the back of the hygrometer from the N.O. contact to the N.C. contact.

   A 4-20 milli-amp signal is provided for remote monitoring of the dewpoint. This connection is located on the back of the hygrometer.

3. Outlet Dewpoint Monitor

   Normally Open (N.O.) auxiliary contact is provided for remote indication of High Outlet Dewpoint Alarm. See wiring diagram for actual terminal numbers.

   Relay is energized during normal operation.
   (N.O. contact is closed)
   de-energized for alarm or loss of power.
   (N.O. contact is open)

Note: Normally Closed (N.C.) contacts can be used by switching the wire at the back of the hygrometer from the N.O. contact to the N.C. contact.

A 4-20 milli-amp signal is provided for remote monitoring of the dewpoint. This connection is located on the back of the Hygrometer.

See Wiring Diagram for contact configuration and wire/terminal block numbers for the auxiliary alarm contacts.

Once all of these connections have been completed, the unit is ready to be tested and started up. See the "Prestartup Procedures" section of this manual, page 7, for proper testing requirements.

Startup & Shutdown Procedures

Prestartup Procedures

After the dryer has been properly installed, but before pressurizing with hydrogen, the following checks should be made: (The results should be recorded in the "Dryer Performance History Chart" of this manual, for future reference and trouble shooting.)

A. Power Off

1. Verify that all conduits entering the control box are sealed using a conduit seal fitting, or by using putty. Verify that all conduit seals have been poured.

2. Measure the resistance values for both motors and both heaters. Record in the "Dryer Performance History Chart".

   Motor resistance phase to phase
   Motor resistance phase to ground
   Heater resistance phase to phase
   Heater resistance phase to ground

B. Power On

1. Apply power.

2. Verify that the Allen Bradley Panelview 300 Micro operator interface begins reading.

3. Turn "Off / Run" switch to the "Run" position.

4. Using the Push-to-Step feature, cycle the dryer thru the 4 steps of its sequence of operation.

   Step 1, Adsorbing 1, Heating 2
   Step 2, Adsorbing 1, Cooling 2
   Step 3, Adsorbing 2, Heating 1
   Step 4, Adsorbing 2, Cooling 1

5. Verify that the 4 way valves, V-7 & V-8, switch properly.

6. Measure and record the amps draw for both motors and both heaters.

Optional

7. Test the Alarms

a. Switch Failure Alarm - Shut off the instrument air supply to the solenoid valve. Then, using the "Push-to-Step" feature, advance the dryer until it tries to switch towers. The valves should not switch. After a 10 second time delay, a Switch Failure Alarm will be indicated. The Common Alarm Relay (CR1) will de-energize for alarm conditions.

b. Heater Failure Alarm - Trip the heater circuit breaker, CB-1, 15 amps. Advance the dryer to step 1 or 3, a heating step. After 10 seconds a Heater Failure Alarm will be indicated. The Common Alarm Relay (CR1) will de-energize for alarm conditions.

c. Motor Failure Alarm - Trip the Motor Starter Protector, MSP. After 10 second a Motor Failure Alarm will be indicated. The Common Alarm Relay (CR1) will de-energize for alarm conditions.

d. Control Box Purge Failure Alarm - Shut off the purge gas supply to the control panel, or just open the door. A Control Box Purge Failure Alarm will be indicated. The Common Alarm Relay (CR1) will de-energize for alarm conditions.

8. Once all of the electrical checks have been completed, be sure to put the dryer in step 1, then back to automatic mode.

C. Power Off

1. Prime the Trap
   Insure proper trap drainage by removing the vent tubing on the top of the trap and pouring water into the trap until it discharges. This will also provide a water seal on the trap discharge to insure no hydrogen leakage.
   a. Record in “Dryer Performance History Chart”.

2. Purge the Control Panel
   Verify control panels have been purged properly and maintain an internal purge pressure of at least 0.1" W.C. See “Control Box Purging” section of this manual.
   a. Record the purge pressure in the “Dryer Performance History Chart”.

3. Purge the dryer with CO_2 to remove all air from the system. See “Process Purging” section of this manual.

4. Purge/Pressurize With Hydrogen
   Once all of the above checks and measurements have been verified and recorded, the dryer is ready to be purged and pressurized with hydrogen.

   a. Follow the same steps found in “Process Purging”, except using hydrogen instead of CO_2.

b. Once brought to line pressure with hydrogen, the dryer should be thoroughly checked for hydrogen leaks.

c. Special attention should be paid to all process connections that are connected via electrical conduit to the control panels. Especially:
Two (2) heater terminal studs in the top of each vessel.

One (1) motor electrical feed-thru in the bottom of each vessel.

5. Position all manual valves in their normal operating position.

V-1, Flow Control Valve - partially open; see setting reactivation flow section of this manual.

V-2, Trap isolation valve - Open.

V-3, Trap vent valve - Open.

V-5, Purge Inlet - Closed.

V-6, Purge Outlet - Closed

Start-Up Procedures

Before attempting to start-up the BAC-50, the installation procedures, pre-start-up procedures, CO_2 purging, control box purging, and hydrogen leak check must be properly completed. The unit should be under pressure and electrically ready to go on-line. When all of this is complete the following procedures should be followed to place the unit on-line.

POWER OFF

1. Insure that both vessels are at line pressure.

2. Valves V-2 & V-3, should be fully open.

3. Valves V-5 & V-6, should be fully closed.

4. Valve V-1 (Flow Control Valve) should be open about 1-1/2 turns.

6. Insure that all owner supplied in-line block valves are open.

7. Verify the circuit breaker on each of the motor starter protectors (MSP-1, 2) are in the ON position.

8. Verify the control boxes have been properly purged and maintain an internal pressure of at least 0.1" W.C. (25 Pa).

POWER ON

9. Close the disconnect switch on the side of the control box to apply power to the dryer.

10. Place the OFF/RUN switch in the RUN position.

The unit should begin its continuous cycle as soon as the switch is placed in the RUN position. During the first several cycles the unit requires adjustments to achieve maximum performance. It also requires monitoring to assure that all aspects of operation are working properly. As soon as operation begins, the following should be completed:

11. Check the dryer operation against the "Sequence of Operation" section of this manual to assure proper operation.

12. Once the reactivating tower has reached temperature (about 2 hours into heating), V-1 should be closed in 1/8-turn intervals until the optimum temperatures are reached. The bed outlet temperature (TI-1) should show 180°F ± 20°F (82°C ± 11°C) and the beds should be at 325°F ± 50°F (163°C ± 28°C) (See “Setting Reactivation Flow" section of this manual.)

    NOTE:
    Once adjustments have been made, 15-20 minutes are required for the unit to reach steady state conditions.

13. Monitor the water removal per cycle for the first several cycles. Water should begin to discharge from the trap just after the bed temperature reaches 180°F ± 20°F (82°C ± 11°C). Total water removal is dependent upon moisture load in the generator as well as several other factors. The water taken out during the first several cycles should be between 1 pint and 1 quart. The very first reactivation cycle will have significantly less water removal if the desiccant is dry when installed.

14. Monitor the outlet dewpoint of the dryer.

LECTRODRYER BAC-50
PERFORMANCE HISTORY

		SHOP TEST		STARTUP													
	DATE																
		TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2	TOWER 1	TOWER 2
1	MOTOR RESISTANCE (PHASE 1 TO PHASE 2)																
2	MOTOR RESISTANCE (PHASE 1 TO PHASE 3)																
3	MOTOR RESISTANCE (PHASE 2 TO PHASE 3)																
4	HEATER RES. TO GND. (50 KOHMS MIN.)																
5	MOTOR RES. TO GND. (800 KOHMS MIN.)																
6	HEATER RES. (10.8 - 12.8 OHMS)																
7	TRANSFORMER VOLTAGE PRIMARY SIDE																
8	TRANSFORMER VOLTAGE SECONDARY SIDE																
9	MOTOR AMP DRAW - PHASE 1 WIRES 13 & 15																
10	MOTOR AMP DRAW - PHASE 2 WIRES 23 & 25																
11	MOTOR AMP DRAW - PHASE 3 WIRES 33 & 35																
12	HEATER AMP DRAW (APPROX. 8 AMPS)																
13	BED TEMP. SWITCH SETPOINT (°F)																
14	ACTUAL BED TEMP (°F) (3 HRS INTO HEATING)																
15	BED OUTLET TEMP (°F) (3 HRS INTO HEATING)																
16	TOWER PRESSURE (PSIG)																
17	CONTROL PANEL PURGE PRES (INCHES OF W.C.)																
18	INLET DEWPOINT																
19	OUTLET DEWPOINT																
20	CONDENSATE TRAP FUNCTIONAL																

Control Box Purging Instructions

General Description

Lectrodryer Type "Z" purge system is designed to meet or exceed the requirements of the National Fire Protection Association (NFPA), particularly NFPA 496 "Purged and Pressurized Enclosures" and NFPA 70 "National Electric Code" (NEC). Lectrodryers provided with a Type "Z" purged electrical enclosure are permitted by the NEC to be used in a Class I, Division 2 location. The purging/pressurizing of a general-purpose enclosure protects it by reducing the concentration of hazardous gases and vapors initially present to a safe level, and keeps the safe level by maintaining a positive pressure in the enclosure. Instrument quality air or suitable inert gases are normally considered acceptable purge supplies. The purge system includes a regulator, pressure gage, outlet valve, warning nameplate, differential pressure switch, relief valve, and loss of purge alarm light with SPDT "dry" contacts.

Purge Requirements

Before applying power, the control panel must be purged with four (4) enclosure volumes of protective purge gas while maintaining a minimum pressure of 0.1 inches of water (25 Pa). In order to accomplish this, the purge flow regulator must be set to maintain a minimum pressure of 0.7 inches of water (175 Pa) with the purge outlet valve wide open. This will produce a purge flow of approximately 1.8 scfm.

The initial purge time (number of minutes) is stamped on the purge warning nameplate on the front of the enclosure. After this initial purge time the purge outlet valve must be left open for continuous purge, unless one of the following exceptions apply.

EXCEPTION #1 - The protective purge gas supply is an inert gas such as nitrogen or carbon dioxide (CO_2).

EXCEPTION #2 - There are no conduit connections to any flammable / hazardous gas or fluid that, by way of a single failure such as a diaphragm on a pressure switch, could allow the flammable/hazardous gas or fluid into the conduit system, and ultimately into the control panel. This includes any means of introducing a flammable / hazardous gas or fluid into the control panel by way of a single failure.

If one of the above exceptions does apply, then after the initial purge time, the purge outlet valve may be closed in order to minimize purge gas usage.

Note: On the Lectrodryer BAC-50, the purge gas connection is tubed up to the Instrument Air Connection for the dryer switching valves. In this configuration, instrument air is necessary at the one connection point to serve both functions.

Operation

It is very important to note that Power **must not** be applied to the enclosure until it has been purged and pressurized per these instructions. If the enclosure has not been fully purged or if the purge has failed, do not operate any disconnects, buttons, or switches at the enclosure. Only turn the power off from a "safe" (remote) location to prevent arcing in an unprotected enclosure.

1. Apply pressure to the purge supply regulator inlet. Maximum supply pressure 100 psig.
2. Open the purge outlet valve located by the enclosure pressure indicator. Ensure a minimum of 0.7 inches of water (175 Pa) is maintained in the enclosure during the purge period.
3. Purge the enclosure for the time period stamped on the warning nameplate. The enclosure must be purged for 4 volume changes.
4. At the end of the initial purge period the purge outlet valve may be closed if one of the exceptions, previously listed, does apply. A minimum of 0.1 inches of water column pressure must be maintained.
5. Turn power on to the enclosure.

IMPORTANT: ALWAYS REMOVE POWER FROM THE ENCLOSURE BEFORE THE PURGE SYSTEM IS SHUT OFF.

Purge Failure Alarm

A differential pressure switch monitors the purge pressure. Under normal conditions the purge pressure is above the setpoint and the purge alarm relay is energized signaling a normal condition. If the purge pressure drops below the setpoint the relay will be de-energized. A "Purge Failure" alarm will be signaled locally with a light and remotely with the customer's dry contacts. Power to the enclosure must be shut off immediately from a "safe" (remote) location. **Push buttons and switches on the enclosure should not be operated.** The enclosure must be purged again before power can be re-applied to the enclosure.

Process Purging

Specific instructions for purging the dryer with CO_2 or other inert gas should be established by the appropriate operating and/or safety personnel for each plant. However, as a minimum, it is recommended the unit be purged prior to initial start-up or any time the dryer is being brought on-line after having been depressurized. Also, the dryer should be purged immediately following depressurization in order to remove all hydrogen from the system.

One method of purging the dryer is as follows:

A. Close all isolation valves between the dryer and the generator.

B. Connect CO_2 supply to purge inlet valve V-5, minimum 30 psig (2.1 kg/cm^2), maximum 100 psig (7.0 kg/cm^2).

C. Connect tubing to purge outlet valve V-6 and pipe away to safe location.

D. Open valves V-2 & V-3.

C. Depressurize dryer by opening purge outlet valve V-6, if not already depressurized. Close purge outlet valve V-6.

D. Open purge inlet valve V-5. Pressurize the dryer with CO_2 to a <u>minimum</u> of 30 psig (2.1 kg/cm^2).

E. Close purge inlet valve V-5.

F. Open purge outlet valve V-6. Depressurize the dryer to 5 psig (0.35 kg/cm^2).

CAUTION: Do not allow pressure to reach atmospheric pressure, because this could allow oxygen to re-enter the dryer.

G. Close purge outlet valve V-6.

Repeat Steps D, E, F, and G four (4) times to reduce the percent of oxygen to less than 0.65%.
Always use a "sniffer" analyzer to confirm purging complete.

<u>Alternate Purge Method:</u>

Open purge inlet valve V-5 and purge outlet valve V-6. Purge the reactivating tower by sweep method until "sniffer" analyzer indicates that purging is complete. It is recommended to swap the dryer towers several times during purging if using a sweep method. An easy way to swap towers is to reverse the pushloc tubing coming out of the solenoid valve, going to the actuator. Make certain to re-install the tubing to the proper ports when complete.

Solenoid Valve port 2	Actuator port facing the back of the control box.
Solenoid Valve port 4	Actuator port facing tower #1.

Operation

Explanation of Adsorption and Reactivation Flowpaths

Assume that tower #1 is on Adsorption and tower #2 is on Reactivation.

ADSORPTION

The adsorption consists of hydrogen exiting the high-pressure tap on the generator, passing through the bottom 4-way valve, V-8. At this point, the adsorption flow is diverted into the bottom of tower #1 where the internal blower assists in forcing the hydrogen up through the desiccant bed where the water is removed. The dry hydrogen exits the dryer through the top 4-way valve, V-7, and then returns to the low-pressure tap on the generator.

While Tower 1 is in adsorption service providing dry hydrogen to the generator, Tower 2 is being reactivated, the process of drying out the desiccant, restoring its ability to adsorb moisture. Once Tower 2 is fully reactivated, it is ready to go back into adsorption service. The 2 towers alternate back and forth in this manner.

REACTIVATION

Starting at the blower motor, the hydrogen is forced up through the bed that is being warmed by the heater, driving off the water collected by the desiccant. The wet flow then travels through the flow control valve (V-1) and on to the cooler. Flow of warm moist hydrogen continues through the cooler where the temperature is lowered to less than 100°F (38°C), and water begins to condense. A centrifugal type separator separates the water from the hydrogen. The water is taken out of the system via the float-type trap. The cooled hydrogen flow continues through the bottom 4-way valve, V-8, then back into the bottom of the vessel where this heating process starts all over again.

During normal operation, valves V-2 & V-3 should be open. Valves V-5 & V-6 should be closed, and V-1 should be partially closed.

Valves V-7 & V-8 are 4-way switching valves and are controlled automatically by the dryer.

Sequence of Operation

The Lectrodryer BAC-50 is a fully automatic, dual tower, continuous operation hydrogen drying system. The BAC-50 adsorption flow uses blowers that are internal to the adsorption vessels, to assist the generator fan differential in producing adsorption flow.

The BAC-50 timing cycle consists of 8 hours adsorbing and 8 hours of reactivation for each tower. The reactivation consists of 4 hours heating and 4 hours cooling.

The BAC-50 is designed to operate according to the following 4 steps:

Step 1	Adsorbing 1, Heating 2	4 hours
Step 2	Adsorbing 1, Cooling 2	4 hours
Step 3	Adsorbing 2, Heating 1	4 hours
Step 4	Adsorbing 2, Cooling 1	4 hours

Assume the dryer is in Step 1, adsorbing tower #1 and heating tower #2. Outputs 0 and 3 are energized. Output 0 energizes solenoid coil S-1 to position the 4-way valves for adsorbing tower #1. Output 3 energizes heater contactor CON-2. The motors run continuously unless power is removed from the dryer, or if the ON/OFF circuit breaker on the motor starter protector is OFF.

The heating process liberates the moisture trapped by the desiccant during the adsorption period. The movement of the gas through the bed, the cooler, and the separator removes the liberated and condensed water vapor from the reactivation system via the drain trap.

After 4 hours the dryer will advance to Step 2, Adsorbing tower #1, Cooling tower #2. In this step the heater de-energizes. Flow continues through tower #2 to cool the desiccant.

After 4 hours of cooling the towers reverse and the dryer will adsorb on tower #2 and reactivate tower #1.

This cycle will continue until power is removed from the dryer.

A pressure make-up line is provided across the lower 4-way valve. The make-up line insures that both vessels are at line pressure before switching.

Push-to-Step Feature

The Lectrodryer BAC-50 is controlled by a Programmable Logic Controller (PLC) and is equipped with a "**Push to Step**" feature.

"**Push to Step**" is a troubleshooting tool that is used to manually sequence the dryer, and to verify the Sequence of Operation.

Under normal operating conditions the PLC is programmed to control the dryer according to a predetermined set of conditions. When in the normal automatic operating mode, the only thing that can advance the dryer to the next step is these conditions becoming satisfied. For the BAC-50, the conditions are the heating and cooling timer that last 4 hours each. In order to save an operator or trouble shooting personnel from waiting on these timers, the "**Push to Step**" feature was added. **It will allow the predetermined set of conditions to be overridden and advance the dryer to the next step in the sequence.**

This is a very important feature and can be very helpful when troubleshooting. **WARNING: It is also a very powerful tool and should be used with extreme caution. Always make sure that you understand the dryer and sequence, and that you know exactly what is going to happen when the dryer enters the next step.** All safety interlocks are overridden by the Push to Step feature. Make sure that it is safe to advance to the next step before doing so. **Always know what is going to happen, before it happens.**

A time delay of 5 seconds must expire between each step when using the "**Push to Step**" feature. This delay is sometimes the only interlock preventing a cycle advance. It is left up to the operator's judgment as to whether it is safe to advance.

When in "Test" mode, the dryer cannot cycle automatically. Always change the controller back to "Auto" when trouble-shooting is complete.

SUMMARY:

1. Be sure to understand the dryer and the dryer sequence.
2. Place the dryer in "**Test**" mode Refer to the Operator Interface – Panelview 300 Micro.
3. Verify conditions are safe to advance to next step.
4. Wait for the 5-second time delay.
5. Advance step – Function key F4 on the Dryer Status screen.
6. Repeat steps 3-5 until troubleshooting is complete.
7. Change the controller back to "**Auto**" mode.

Operator Interface Display – Panelview 300 Micro

The Allen Bradley Panelview 300 Micro operator interface is designed to provide status, timing, and alarm indication to operators and maintenance personnel.

Six normal operating pages are currently configured for the PanelView operator interface. Use the left and right arrow keys to scroll through these pages.

Page 1 Dryer Status
Page 2 List of Alarms
Page 3 PLC Input Status
Page 4 PLC Output Status
Page 5 Active Alarms
Page 6 Alarm History

There is also a Screen Selector Page.

Password Protected Pages

There are six other pages configured that are password protected. They do not show up as you scroll through the normal pages listed above. They do show up on the Screen Selector page.

Select Automatic or Test Modes of Operation Page
Counter Setup Page
Reset Heating Page
Reset Cooling Page
Screen Configure Page
Change Password Page

When prompted to do so, enter the password from left to right. Use the up and down arrow keys to change the first digit, then press the right arrow to move to the next digit. When all digits are correct, press the enter button.

Page1 "Dryer Status" will display the following:

Lectrodryer "Run / Stop" Status
Dryer sequence step name, number and elapsed time
Dryer mode of operation (Automatic / Test)
Alarm Status

Three function key push buttons are enabled on this page:

F2 Go to "Screen Selector" Page
F3 Go to "Select Automatic or Test Modes of Operation" Page
F4 Push to Step - If dryer is in "Test Mode" this button will advance the dryer to the next sequence step.

Page 2 "Alarm Status" will display the following:

4 Way Valve Failure	Alarm / No Alarm
Heater #1 Failure	Alarm / No Alarm
Heater #2 Failure	Alarm / No Alarm
Motor #1 Failure	Alarm / No Alarm
Motor #2 Failure	Alarm / No Alarm
C-box Purge Failure	Alarm / No Alarm

Two function key push buttons are active on this page:

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" page

Page 3 "PLC Input Status"

This page will display all of the PLC digital inputs that are used in the program, and their status (on / off). This is useful when troubleshooting. The control panel is purged and normally requires a permit to open. This page allows an operator to view all inputs without having to open the box.

The only push buttons that are active on this page are:

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page

Page 4 PLC Out put Status

This page will display all of the PLC digital outputs that are used in the program, and their status (on / off). This is useful when troubleshooting. The control panel is purged and normally requires a permit to open. This page allows an operator to view all outputs without having to open the box.

The only push buttons that are active on this page are:

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page

Page 5 Active Alarms"

This will display any alarms that have not yet been acknowledged.
To acknowledge an alarm from this page, use the up and down arrow keys to scroll to the alarm to be acknowledged. Press the "enter" button.

The only push buttons that are active on this page are:

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page

Page 6 "Alarm History"

This page will display the 100 most recent alarms. After 100, the oldest alarms get pushed out as new ones come in.

The only push buttons that are active on this page are:

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page

"Screen Selector Page"

This page displays a list of all pages in the Panelview 300 Micro program. Use the up and down arrow keys to scroll to the desired page, then press the "enter" button, and the display will go directly to that page.

Select Automatic or Test Modes of Operation Page

This page allows the operator to switch the dryer between Automatic and Test Modes of operation.

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page
F3 Automatic Mode
F4 Test Mode

Counter Setup Page

This page displays and allows for changes, to the preset and accumulated values, for Minutes and Hours, for both the heating and cooling steps.

Use the left and right arrow keys to scroll to the value to change. Use the up and down arrows to change the value, then press the enter button.

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page

Reset Heating Page

This page allows the operator to reset the sequence to the beginning of the Heating Step. If the sequence is currently in the Heating Step, then the counter will just reset to zero. If the sequence has already advanced to the Cooling Step, then the sequence will back up and restart the previous Heating Step.

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page
F3 Reset sequence to the beginning of the Heating Step

Reset Cooling Page

This page allows the operator to reset the sequence to the beginning of the Cooling Step. If the sequence is currently in the Cooling Step, then the counter will just reset to zero. If the sequence is still in the Heating Step, then the sequence will skip the Heating Step and jump into the Cooling Step.

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page
F3 Reset sequence to the beginning of the Cooling Step.

Screen Configure Page

This page allows the operator to adjust screen parameters such as contrast, time and date, etc.

F1 Go to "Dryer Status" Page
F2 Go to "Screen Selector" Page
F3 Enters the Screen Configuration Menu

Change Password Page

This panel is programmed to accept up to 3 different passwords. They are all 3 factory set at "2450". A supervisor may wish to assign different passwords to different operators or departments.

F1 Go to "Dryer Status" Page
F2 Select password to change
F3 New Password
F4 Verify Password

Setting Reactivation Flow

The reactivation flow control valve, V-1, is factory set at approximately 1-1/2 turns open. During start-up, it may be necessary to adjust V-1 to achieve the proper reactivation temperatures.

Normal Operating Temperatures:

A. 325°F ± 50°F (163°C ± 28°C) at TIS-1 or TIS-2,bed temperature

B. 180°F ± 20°F (82°C ± 11°C) at TI-1, bed outlet gas temperature

C. 100°F (38°C) or less at TI-2, cooler outlet gas temperature

NOTE:

If V-1 is set properly, the bed outlet gas temperature of 180°F ± 20°F (82°C ± 11°C) will be reached approximately two hours into the heating step.

1. If the reactivation flow is too low:

A. The bed temperature will be too high.
B. The bed outlet gas temperature will be too low.
C. The cooler outlet gas temperature will be normal.

V-1 should be opened in 1/8 turn increments to increase the reactivation flow. Once adjustments have been made, allow 15 - 20 minutes for the temperature to stabilize before re-adjusting. Refer to "*Normal Operating Temperatures*".

2. If the reactivation flow is too high:

A. The bed temperature will be too low.
B. The bed outlet gas temperature could be too low, too high, or normal, depending on how much too high the reactivation flow is.
C. The cooler outlet gas temperature will be too high.

V-1 should be closed in 1/8 turn decrements to decrease the reactivation flow. Once adjustments have been made, allow 15 - 20 minutes for the temperature to stabilize before re-adjusting. Refer to "*Normal Operating Temperatures*".

In order to maximize the efficiency of the dryer, all three of these temperatures must be balanced as best as possible.

Maintenance

Blower Removal

1. Verify the tower to be serviced is off-line and has been purged.

2. Remove the three (3) motor leads and conduit from the terminal blocks in the junction box "3" on the outside of the bottom head.

3. Remove the interconnecting piping "4" between the vessel and bottom 4-way valve, V-8.

4. Carefully remove vessel bottom head bolts "1". When all of these bolts have been removed, the bottom head "2" can be lowered. The entire blower assembly is attached to the bottom head and will be lowered along with the head.

   NOTE:
   Use caution when lowering the head as the weight of the assembly is 125 lbs. (56 kg)

5. To remove the blower wheel "6", loosen set screw "7" and lift upward.

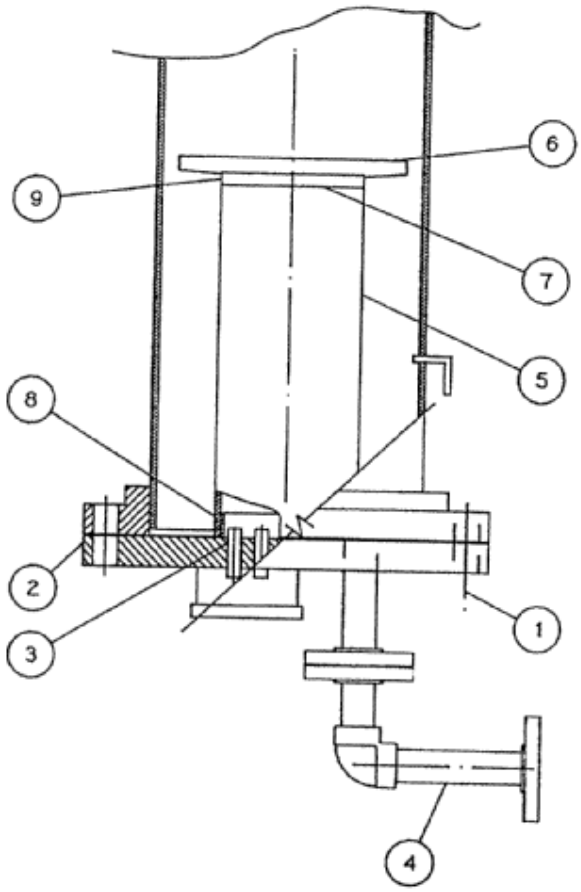
6. To remove the blower housing end plate, remove four (4) screws "9" and lift upward.

7. To remove the blower housing "5", remove the four (4) bolts "8" and lift upward.

8. Remove motor leads from electrical feed through wires on the inside of the bottom head. The wires should be clipped near the splice connectors.

   CAUTION:
   Use caution when working with split bolts and electrical "feed through". High heat tape and heat shink must be used (500 °F/260 °C) Damage to these can be a source of hydrogen leakage and electrical short. Do not over tighten. Always check this area after servicing.

9. To remove the motor, remove the four (4) remaining bolts from the inside of the housing.



Be sure to transfer the auxiliary stop collar (not shown) on the old motor shaft to the new motor shaft.

Blower Installation

1. Verify the motor is mounted securely inside blower housing "**5**" and the stop collar has been transferred from the old motor shaft to the new shaft.

2. Connect motor leads to the feed through wires located on the inside of the bottom head "**2**".

3. Mount the blower housing "**5**" inside the ring on the inside of the bottom head. Secure with the four (4) bolts "**8**".

4. Place the blower housing end plate in place and secure with four (4) screws "9".

5. Place the blower wheel "**6**" on the motor shaft and tighten set screw "7". There should be a 1/64" to 1/16" (0.5 - 1.5 mm) clearance between the blower wheel and the top of the blower motor housing.

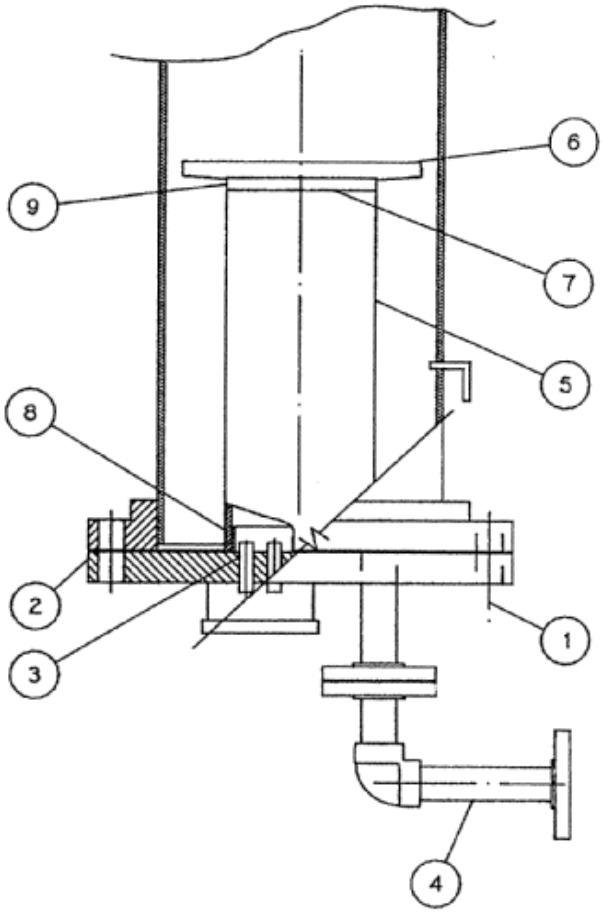
6. Replace the 10" 150 lb flange gasket (must be good for hydrogen at 150 psig {10.56 kg/cm^2} and 500°F {260°C}).

7. Bolt vessel bottom head back into place (bolt torque 80-100 ft.-lbs {10.88 - 13.61 M-kg}).

8. Bolt the interconnecting piping "**4**" back into place (replace 1", 150 lb gasket).

9. Connect the three (3) motor leads to the terminal block in the junction box on the outside of the bottom head.

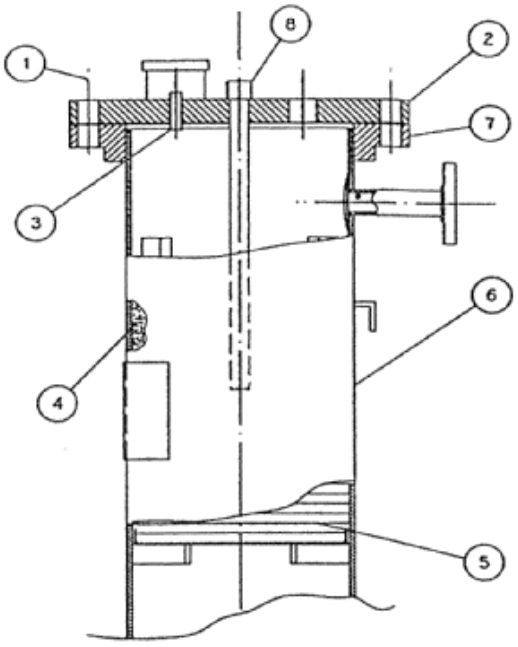
   CAUTION:
   Use caution when working with split bolts and electrical "feed through". High heat tape and heat shink must be used (500 °F/260 °C) Damage to these can be a source of hydrogen leakage and electrical short. Do not over tighten. Always check this area after servicing.



10. Leak test.

11. Purge the dryer of air to ready it to be placed back on-line. See "Process Purging Instructions."

Heater Removal



1. Verify the tower to be serviced is off-line and has been purged.

2. Remove the temperature switch element "**8**" from the top head. Remove leads and conduit from the terminal studs "**3**" on the outside of the top head.

3. Remove vessel top head bolts "**1**".

4. Lift top head "**2**" and disconnect heater from terminal studs "**3**" on inside of head.

   CAUTION:
   Use caution when working with split bolts and electrical "feed through". High heat tape and heat shink must be used (500 °F/260 °C) Damage to these can be a source of hydrogen leakage and electrical short. Do not over tighten. Always check this area after servicing.

5. Remove head "**2**".

6. The desiccant "**4**" must then be removed per the "Changing the Desiccant Procedure" section of this manual.

7. Once the desiccant has been removed from the vessel "**6**", the heater "**5**" can easily be removed.

Heater Installation

1. Place the heater "**5**" back inside the vessel "**6**".

2. Refill vessel with desiccant "**4**".

3. Replace the 10" 150 lb flange gasket (must be good for hydrogen at 150 psig {10.56 kg/cm^2} and 500°F {260°C}).

4. Connect heater to terminal studs "**3**".

   CAUTION:
   Use caution when working with these terminal stud "feed-throughs". Damage to these can be a source of hydrogen leakage. Do not over tighten. Always check these for leaks after servicing.

5. Check heater resistance at terminal studs to verify no short-to-ground exists.

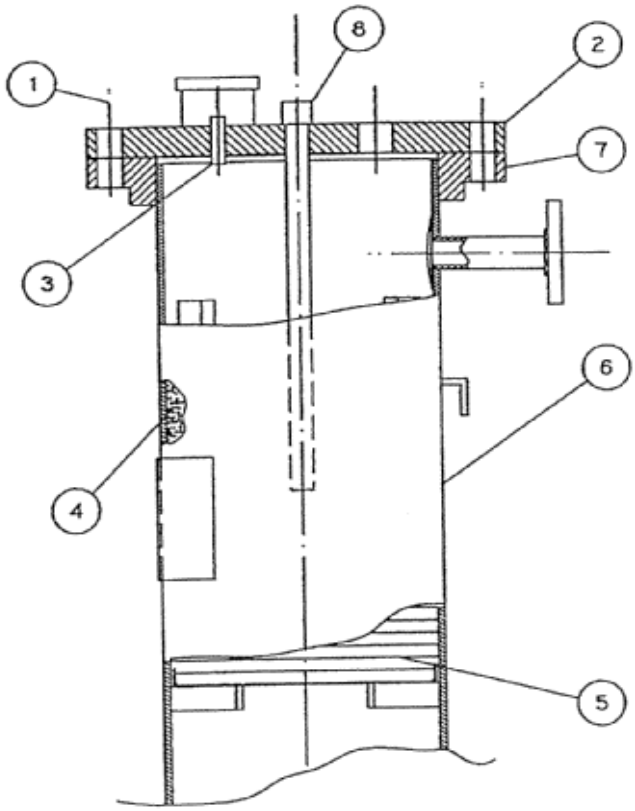
6. Bolt vessel head back into place (bolt torque 80-100 ft.-lbs {10.88 - 13.61 M-kg}).

7. Reinstall temperature switch element and heater wires on the outside of the top head.
8. Dryer should be leak checked and purged prior to being placed back into service.

Changing the Desiccant

The BAC-50 holds 50 lbs. (23 kg) of activated alumina desiccant per tower. Under normal operation the desiccant will be good for approximately 3 to 5 years. If the hydrogen has oil present or is dirty, desiccant life may be shorter. When the desiccant performance has fallen off to an unacceptable level, the following procedure should be followed to replace it with new desiccant.

1. Take the unit off-line and purge the dryer using the process purging instructions.



2. Remove the temperature switch element "8" from the top head. Remove heater leads and conduit from the terminal studs "**3**" on the outside of the top head.

3. Remove bolts "**1**", lift the top head "**2**" slightly and disconnect the heater wires from the terminal studs "**3**".
4. Remove old desiccant "**4**" with a vacuum.

5. Remove the heater "**5**". Vacuum remaining desiccant and clean the bottom screen.

6. Replace the heater assembly.

7. Refill vessel with new desiccant. Take care not to pour desiccant dust into the vessel.

8. Replace the 10" 150 lb flange gasket (must be good for hydrogen at 150 psig {10.56 kg/cm^2} and 500°F {260°C}).

9. Reconnect heater wires to terminals "**3**" and replace the top head "**2**". Replace bolts "**1**".

   CAUTION:
   Use caution when working with split bolts and electrical "feed through". High heat tape and heat shink must be used (500 °F/260 °C) Damage to these can be a source of hydrogen leakage and electrical short. Do not over tighten. Always check this area after servicing.

10. Check heater resistance at terminals to verify no short-to-ground exists.

11. Bolt vessel head back into place (bolt torque 80-100 ft.-lbs) {10.88 - 13.61 M-kg}).

12. Leak test.

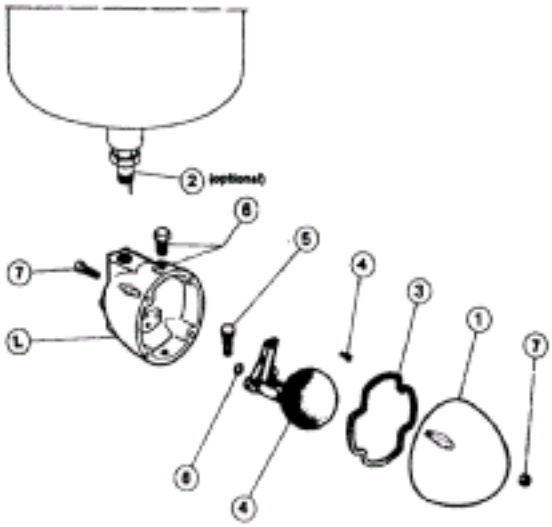
13. Purge the dryer of air to ready it to be placed back on-line.

Cleaning the Trap

The trap should be cleaned weekly for the first two weeks of operation, once ever three months thereafter.

To clean the trap:

1. Close valves V-2 & V-3. Be sure these valves are closed before servicing the trap.
2. Disconnect drain line from trap outlet.
3. Remove the four bolts around the circumference of the trap and remove float assembly.
4. Clean trap thoroughly with detergent solution. Check to be sure drain orifice is clear.
5. Reassemble trap.
6. Reconnect drain line.
7. Remove plug in top of trap and fill with water until drainage occurs. Place plug back in trap.
8. Open valves V-2 & V-3.
9. Leak test.
10. Verify that trap is operational by observing drainage at end of heating cycle.



PART	DESCRIPTION
1	Drainer Casing
2	½" NPT Union
3	Body Seal
4	Valve Float and Lever
5	Manual Drain Valve
6	Plug
7	Screw
8	O-Ring

WARNING:
Valves V-2 and V-3 must be CLOSED while servicing trap. Failure to close these valves will allow pressurized hydrogen to leak into the atmosphere, which could result in an explosion causing personal injury.

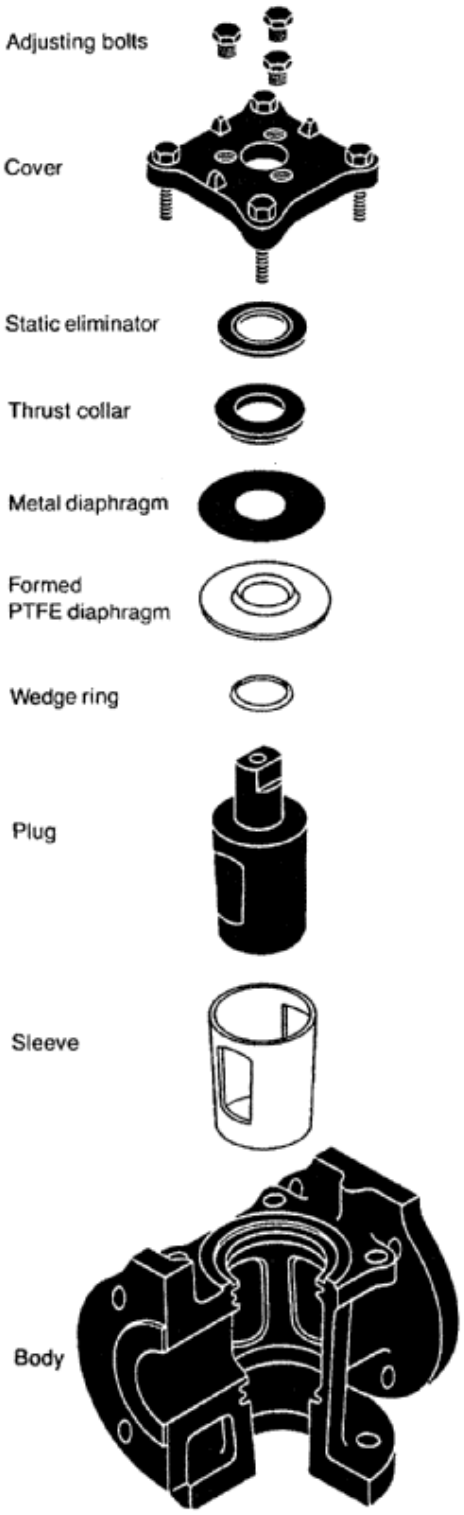
CAUTION:
During normal operation valve V-2 and V-3 must be OPEN. Failure to open these valves after servicing trap or closing them for extended periods of time will result in damage to the dryer.

Proper Maintenance of Non-Lubricated Sleeved Plug Valves

The non-lubricated plug valves used on BAC-50 dryer are designed and built to give long, trouble-free service. Properly applied, adjusted and operated, these valves should require minimum attention.

Field repair of valves may be performed carefully following the instructions in this book, but should be weighed against the advantage of returning the valves to Lectrodryer, because of the availability of specialized service equipment. Consult Lectrodryer for any questions or additional information.

The following procedures have been prepared to assist you in the maintenance and repair of these valves:



ADJUSTMENTS

Loss of seal

All valves are factory adjusted and normally further adjustment is not required. However, if seepage does occur at the plug shank or downstream, the following adjustments can be made:

Tighten each of the three adjustment bolts (or screw) 1/4 turn. Operate valve and check for leakage. Repeat as necessary to stop the seepage. The need for frequent adjustment of the bolts, and/or many adjustment turns indicates the seals are worn to the point of needing replacement. Excessive tightening of the adjustment bolts will cause an increase in the valve stem torque.

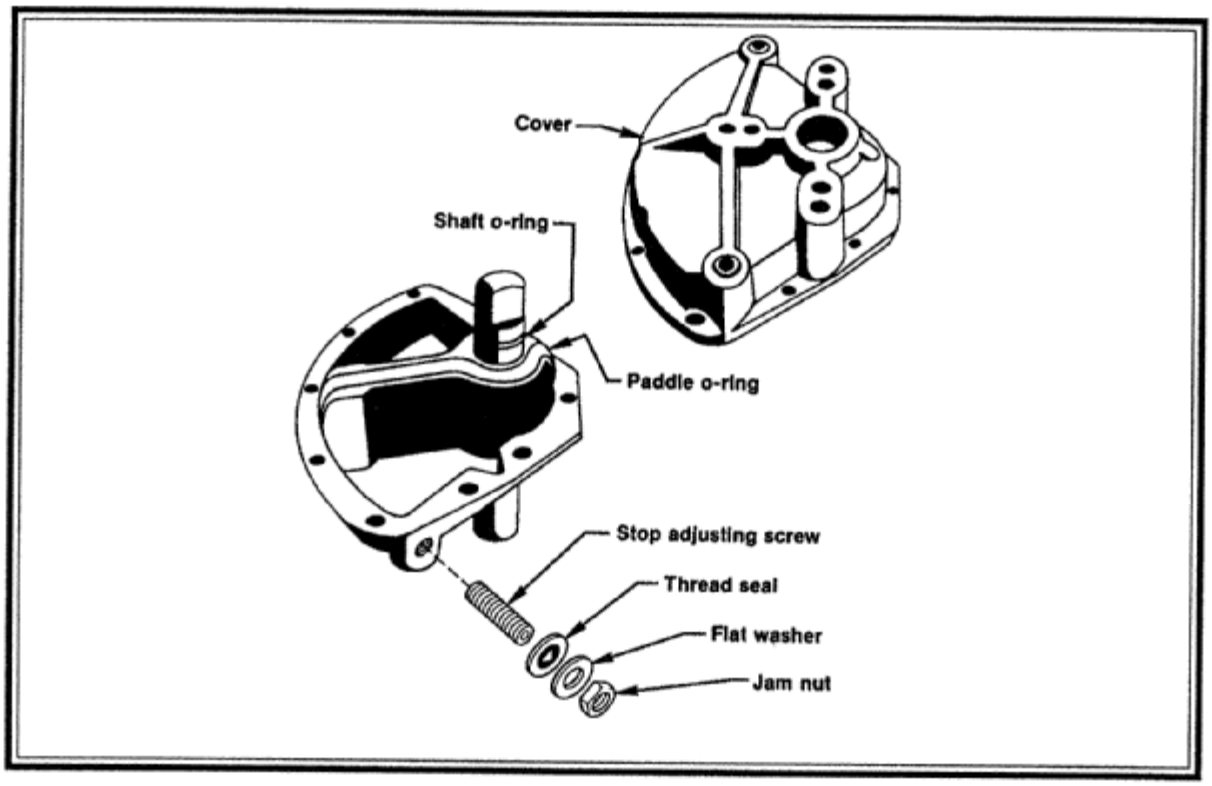
Valve torque

Valves should be operated under service conditions for at least twelve hours before any torque adjustments are made, since the initial breakaway torque normally reduces with usage and temperature.

If necessary to “loosen” the valves to obtain proper shifting each of the three adjustment bolts must be loosened uniformly 1/4 turn. Check the operation of the valves. Repeat this procedure as necessary but no more than three times, or leakage may occur.

After the initial break-in period, the following adjustments can be made if the valve torque is higher than the recommended 15 foot - pounds (2.04 M-kg) at the stem.

Instructions for Servicing Matryx Vane Actuators



1. Remove all screws. Lift off cover and remove paddle.
2. Clean inside surface with solvent.
3. Remove sealant on joint surface with lacquer thinner.
4. Lubricate internal surfaces with Parker O-Lube.
5. Replace O-rings and paddle seal rings. Lubricate with Parker O-Lube.
6. Place paddle in body half.
7. Coat housing joint surface with General Electric or Dow Corning silicone sealant. This is available as silicone bathtub caulk.
8. Replace top half of body. With paddle turned to right side, snug down screws on left side shoulder bolt first. Rotate paddle to left side of actuator and snug down screws on right side, shoulder bolt first.
9. Tighten all screws securely.
10. Rotate shaft several times.
11. Actuator should not be placed in service for at least 4 hours so sealant will be completely set up.

Preventive Maintenance Schedule

Daily

1. Check dryer control panel and remote alarms for any alarm conditions.
2. Collect, measure, and record the amount of water removed through the condensate trap.

Weekly

1. Verify the heater outlet temperature near the end of the four (4) hour heating period is 180°F ± 20°F (82°C ± 11°C), and bed temperature is reading approximately 325°F ± 50°F (163°C ± 28°C).
2. Check dewpoint.
3. Verify trap drainage at the end of four (4) hour heating period. Disassemble and clean if necessary.

Quarterly

1. Check entire dryer for hydrogen leakage including all electrical feed-through connections.
2. Measure differential pressure across the dryer to verify flow through dryer.

Every Six Months

1. Take dryer readings and record on Performance Chart.
2. Verify proper operation of 4-way valves, V-7 & V-8.
3. Verify proper operation of Switch Failure, Heater Failure, Motor Failure, and Control Panel Purge Failure Alarms.

Yearly

1. Clean and inspect Hygrometer probe as described in the Panametrics Manual, if applicable.
2. Verify and/or calibrate relief valves if applicable.
3. Clean solenoid valves. Rebuild as necessary.
4. Clean/flush cooler fin/tube bundle.

Every Three Years

1. Replace desiccant if performance hasn't necessitated prior replacement.
2. Return Panametrics Series 5 Hygrometer to Panametrics for recalibration, if applicable.

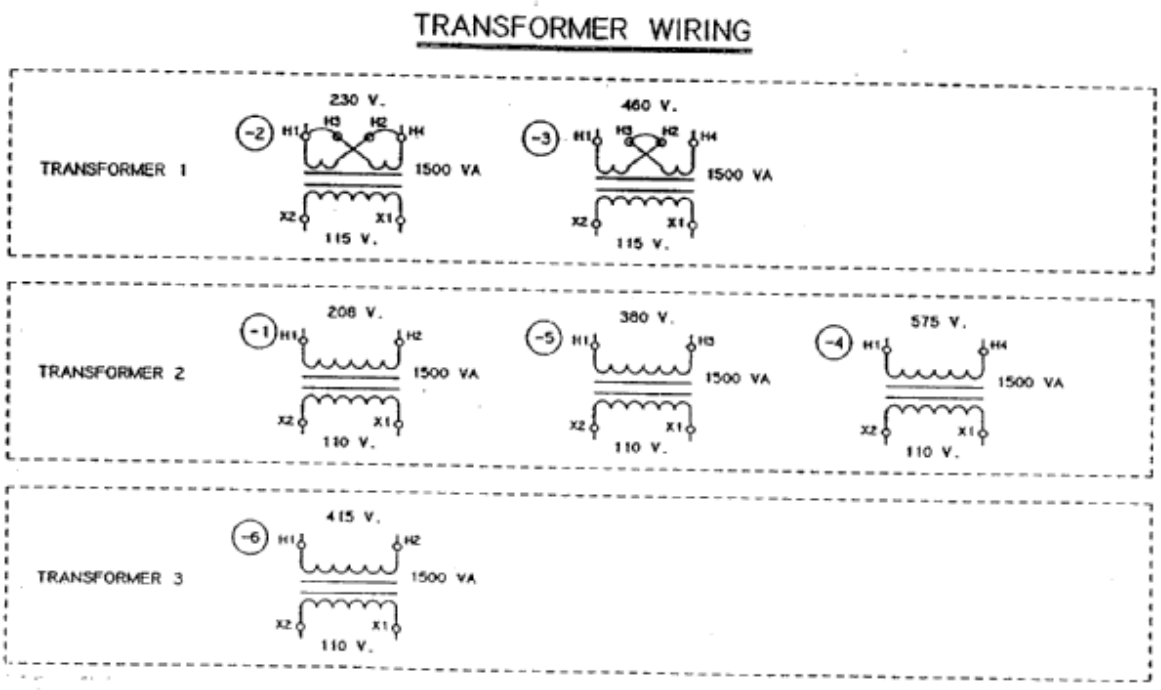
Every Outage

1. Perform Daily, Weekly, Quarterly, and Six Month preventive maintenance items above.

Optional Electrical Features

Optional Voltages

Several different voltages are offered as standard on the BAC-50. To accomplish this and still keep all components identical, special transformers are installed. These transformers can be wired differently for different primary voltages to achieve the same secondary voltages (110 volt). The different wirings for the transformer are shown below.



Diagnostics Package (Alarms)

A diagnostics package consisting of Switch Failure, Motor Failure, Heater Failure Alarms is provided as optional equipment on the Commercial Model BAC-50. Each of these is explained below. Refer to Wiring Diagram and the PLC Ladder Logic for exact details.

Switch Failure

During normal operation limit switch contact ZS-3 will close when Tower 1 is adsorbing and ZS-4 will close when Tower 2 is adsorbing. If the main adsorbing valves fail to operate properly, timer T4:2 will begin counting. After 10 seconds the Switch Failure Alarm will be indicated and the Common Alarm Relay (CR1) will de-energize.

Heater Failure

During normal operation of a heating step, one of the heater contactor auxiliary contacts CON1-1B or CON2-1B will be closed indicating that the heater contactor is energized. If the contactor is in fact energized, then the heater should be drawing current (approximately 9.5 Amps). The current relay (IR-1) will be energized The normally open contact wired to input #5 will close and energize the input, indicating normal operation.

If the heater burns out, shorts out, or a fuse or circuit breaker trips, the current relay will detect no current and de-energize, the normally open contact (IR-1) will open and turn off input #5 and the PLC timer T4:3 for heater 1, or T4:4 for heater 2 will begin counting. After 10 seconds the Heater Failure Alarm will be indicated and the Common Alarm Relay (CR1) will de-energize.

Motor Failure

During normal operation both blower motors run continuously. The motor starter auxiliary interlocks should both be closed and inputs #3 and #4 should be energized, indicating normal operation. If either motor burns up, overloads, shorts out, or a phase unbalance or phase loss is detected by the Motor Starter Protector (MSP), the MSP will trip and de-energize that motor starter contactor. Input #3 or #4 will be de-energized and the PLC timer T4:5 for motor 1, or T4:6 for motor 2 will begin counting. After 10 seconds the Motor Failure Alarm will be indicated and the Common Alarm Relay (CR1) will de-energize.

Inlet and Outlet Hygrometers

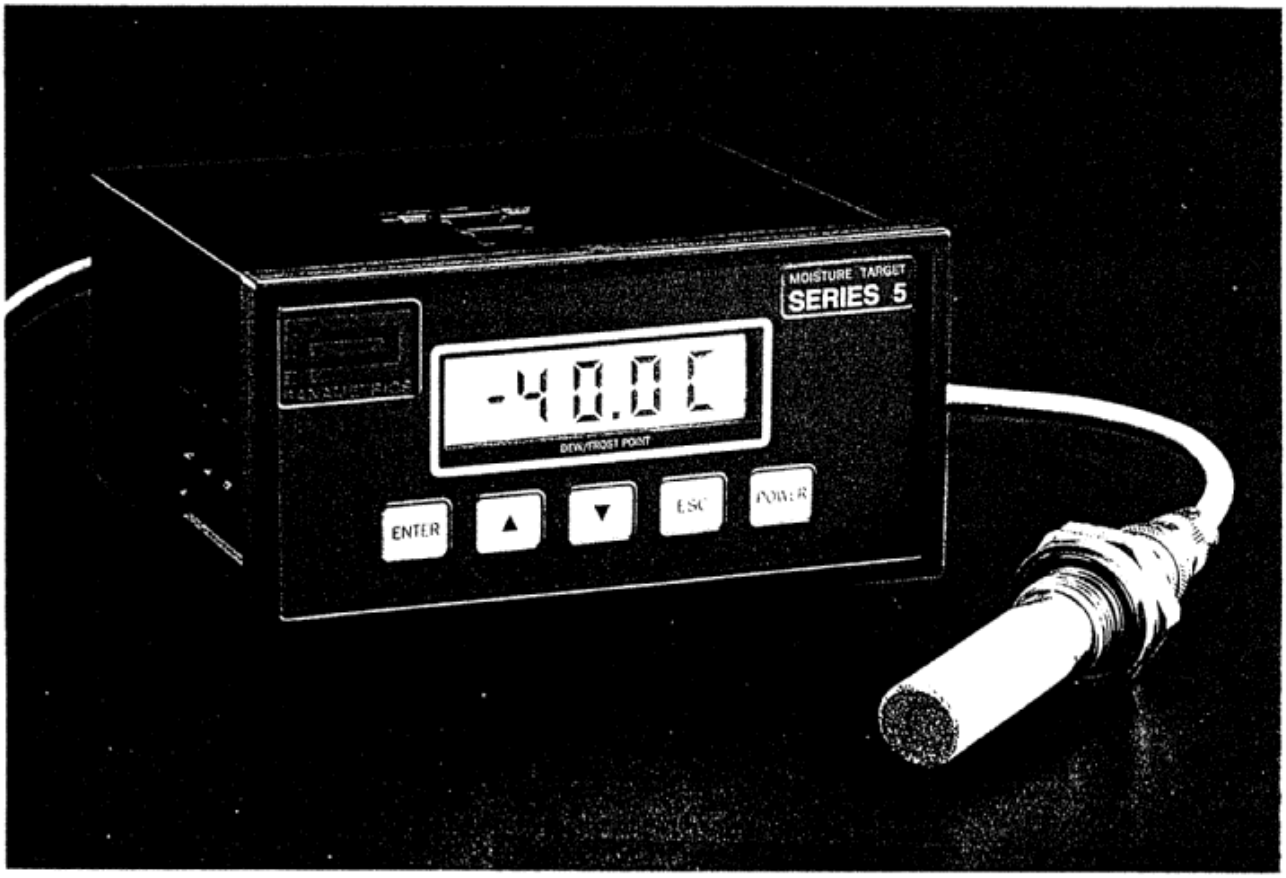
Optional Inlet and outlet hygrometers are provided for monitoring the moisture content entering and exiting the dryer.

Each hygrometer is provided with an aluminum oxide probe and is calibrated over a range of -166°F to +68°F (-110°C to +20°C). Each is provided with a normally open and normally closed alarm contact and a 4-20 milliamp output. The alarm contacts are prewired to a terminal strip. The alarm points are adjustable by opening the window kit on the front panel. The alarms are preset at the factory at:

AI-1 (inlet)	+20°F (-7 °F)
AI-2 (outlet)	-20°F (-29°C)

NOTE:
A complete hygrometer instruction manual is shipped with every dryer.

Moisture Target™ Series 5



Parts Description and Functions

ADSORBER VESSELS - The absorber vessels are of carbon steel construction with stainless steel desiccant support screens. The vessels contain a low watt density removable embedded heater for efficient heating of the desiccant.

BLOWER ASSEMBLY - An internal blower is provided in each absorber vessel. The blower is used for reactivation flow, and to assist adsorption blow.

TOWER PRESSURE GAGE - Tower mounted pressure gages have a scale of 0-200 psig are provided.

PROGRAMMABLE CONTROLLER - An Allen Bradley MicroLogix 1000 Programmable Controller is provided to control the sequencing of the dryer.

MAIN VALVES - Four-way non-lubricated plug valves are used to direct the normal flow of air through the adsorption and reactivation circuits.

MAIN POWER DISCONNECT - A three (3) pole disconnect switch is provided for the dryer package.

THERMOCOUPLES – Two (2) thermocouples are included to monitor both tower temperatures.

MOTOR STARTER PROTECTOR - Provides motor protection for current overload, phase unbalance, single phase or short circuit. Also used as ON/OFF circuit breaker on motors.

TYPE Z PURGE STYSTEM - Includes purge pressure regulator, differential pressure switch, local pressure gage (0-15" W.C.) and local purge failure alarm light.

OPERATOR INTERFACE DISPLAY –Allen Bradley Panelview 300 Micro message display provides status, timing and alarm indication to operators and maintenance personnel.

Parts List

DESCRIPTION		PART NUMBER
Desiccant, 50 lbs/tower (23 kg/tower)		D40107
Heater (1 KW at 115 volts)		D53251
1/2 H. P. Blower Motors,	(208, 230, 380, 460 volts)	D35508
	(575 volts)	D35510
All other voltages – contact factory		
1/2" Diaphragm Valves		D57013
1" Diaphragm Valves		D57014
1" 4-Way Switching Valves (V-7 & V-8)		D57418
Condensate Trap		D52347
Tower Pressure Gages (PI-1 & PI-2)	(psi-kg/cm^2)	D53714
	(psi-Barg)	D53714-001
	(psi-kPa)	D53714-002
Control Air Filter		D52309
Solenoid Valve (S-1 and S-2)		D37518
Operator Interface Display		D36946
Programmable Controller (PLC)		D36945
24 VDC Power Supply		D39608
Heater Contactors (CON-1, CON-2)		D36630
Motor Starter Contactors (MS-1, MS-2)		D36630
Motor Starter Protectors, 460 volts (MSP-1, MSP-2)		
208, 230 volts		T-3504-22
380, 415, 460, 575 volts		D36629
Current Relay (IR-1)		D36621

DPDT Relay (CR1)	D36617
Heater Circuit Breaker - 15 Amps (CB-1)	D38234
Controls Circuit Breaker - 2.5 Amps (CB-2)	D38233
Main Disconnect Switch (30 Amps)	D38235
Transformer Primary Side Fuses - FNQ-5	D33368
PLC Output Fuses 2.0 Amps AGC-2	D33369
Hygrometers (AI-1 & AI-2)	D36632
Probes (sensing elements) for Hygrometers (AE-1, AE-2)	D36634
Limit Switches (ZS-3, ZS-4)	D35157
OFF/RUN Selector Switch	32557A01
Purge System Regulator	D58821
Purge System Pressure Gage	D52764
Purge System Differential Pressure Switch	D55808
Red Pilot Light	D32515