BMIL Technologies, LLC.

DEHUMIDIFICATION SUBMITTAL

BMIL®

(3) Dry Zone DZ-2000

Desiccant Dehumidifier

ADVANTAGES

- **Simple Installation**
  - **Hang the unit**
  - **Connect power**
  - **Connect a drain line**
  - **No ducting required!**
- **Reduce humidity in the space without adding significant heat**
- **Eliminate frost formation and condensation**

The DZ-2000 is a desiccant dehumidifier that is used to reduce humidity in spaces maintained from 20°F to 55°F. Maintaining a lower humidity level prevents mold and mildew growth, frost formation, condensation drips, and increases shelf-life of the product. The DZ-2000 operates on a patent pending desiccant dehumidification technology. This innovative new design can be installed directly in the space, eliminating the need for duct work. Other cold room dehumidifiers require two large holes in the cold room walls, which result in wasted energy and increased humidity levels due to air leakage.

The regeneration air stream is a completely closed loop cycle. The only byproducts are water vapor from the space that is condensed on the cooling coil and drained away; and

an insignificant amount of heat that can easily be removed by the existing cooling equipment. Other cold room dehumidifiers add excessive heat to the cold room requiring post cooling, resulting in an increase in refrigeration horsepower of 25% to 100%. The DZ-2000 cold room dehumidifier does not require post cooling refrigeration and minimizes energy consumption through the use of EC motors, a digital scroll compressor and air-to-air energy recovery. This patent pending design has 50% more dehumidification capacity with 50% less energy consumption than other similar cold room dehumidification equipment.

Dry Zone DZ-2000 Desiccant Dehumidifier

In cold room applications from 20°F to 55°F the DZ-2000 can eliminate the need for defrost cycles which saves energy, reduces temperature fluctuations, protects product integrity, and increases perishable product shelf life.

Construction Features:

- 2" foam-injected double wall panels
- Aluminum interior and exterior walls
- Removable panels for easy component access and minimal clearance requirements

Process Air Components

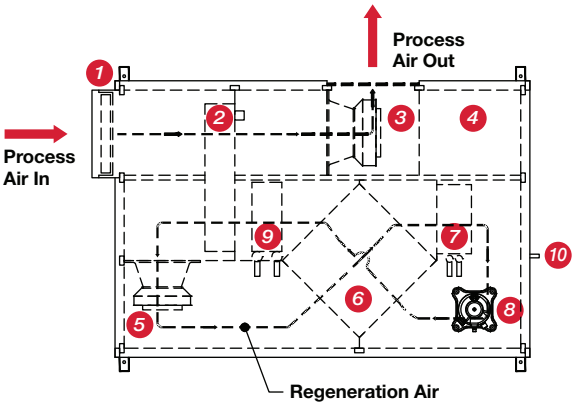
- 2" MERV 8 front access filter rack
- Desiccant wheel
- High efficiency EC motor impeller process air fan

Regeneration Air Components

- Desiccant wheel
- High efficiency EC motor impeller regeneration air fan
- Aluminum air-to-air flat plate heat exchanger
- Fully intertwined DX coil with stainless steel drain pan
- Full capacity condenser coil
- Digital scroll compressor to match dehumidification load

Controls

- DDC controller with remote user terminal
- RA temperature and humidity sensors included (used to calculate space dew point)
- BMS connectivity
- ETL listed



1 Process Air Filter
2 Desiccant Wheel
3 Process Air Fan
4 Controls Section
5 Regeneration Fan
6 Air-to-Air Heat Exchanger
7 DX Coil
8 Compressor
9 Condenser Coil
10 Condensate Drain

DZ-2000 Sizing Chart

APPLICATION	Cold Room									Cold Room & Ice Rink			
Cold Room Space Temperature	20 F			30 F			40 F			50 F			
Cold Room Space Humidity	90% RH	70% RH	50% RH	90% RH	70% RH	50% RH	90% RH	70% RH	50% RH	90% RH	65% RH	56% RH	50% RH
Maximum Capacity (lbs/hr)	8.9	6.6	4.2	12.5	9.5	6.4	15.0	11.6	8.0	15.0	9.3	8.6	7.2
Process Leaving Air Temp/Dew Point (F)	27 / 2.5	25.7 / -1.4	24.3 / -6.1	38.8 / 14.6	37.2 / 9.6	35.4 / 3.7	50.2 / 26.4	48.2 / 21.1	46.2 / 14.4	59.8 / 40	57.2 / 32.8	56.2 / 28.4	55.5 / 26.3
Unit Voltage / Phase / FLA / MCA	208V / 3P / 25.5 / 28.4					230V / 3P / 24.1 / 27.0				460V / 3P / 9.2 / 10.8			
Unit Dimensions and Weight	90" long x 60" wide x 34" high									970 pounds			

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(Manufactured by Innovent, LLC)

Issue 1
Job #: 7676593

Contents

Section 1 / Engineering Data

Section 2 / Components Provided By Others

DZ-2000-DT-460 Units Only
- Process air inlet duct work and process air outlet duct work
- Process air filter

CASING PERFORMANCE:
- Leakage class rating of 5.0 at 8" total static pressure
- Maximum panel deflection shall not exceed L/250 at 8" total static pressure
- Minimum R-value of 6 per inch for the walls, roof and floor
- The panel insertion loss, per octave band, shall not be less than the following:

Frequency:	100	125	250	500	1000	2000	4000	8000
Insertion loss, dB:	24	16	30	32	33	34	63	60

CASING MATERIALS:

- Standard & Ducted Units
  - Indoor construction
  - 0.080” aluminum frame
  - 2” double wall casing panels (minimum R-value = 12)
  - 0.040” aluminum outer wall
  - 0.040” aluminum inner wall
  - 2” double wall floor panels
  - 0.063” aluminum inner floor
  - 0.040” aluminum outer floor
  - Aluminum bird screen for process air outlet

Specification

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CASING ACCESS:

- Double wall casing access panels insulated with 2 pcf polyurethane foam as noted on unit drawing.

Process Air Components:

FILTERS:

- Standard Unit
  - 2" pleated MERV 8 filter
  - Front access
  - Aluminum rack
- Ducted Unit
  - Process air filter rack and filters must be provided by others and installed by others for ducted DZ-2000 arrangement. Recommend a minimum MERV 8, 2" pleated filter at a maximum 500FPM face velocity located upstream of the DZ-2000 process air inlet.

DESICCANT DEHUMIDIFICATION WHEEL:

- Corrugated fiberglass with a formed silica gel desiccant
- Heavy gage 304 stainless steel casing
- Twin contact Viton seals
- Drive system with continuous perimeter sprocket and drive motor

PROCESS FAN & MOTOR:

- Backward curved plenum fan
- 6 blade profiled composite wheel
- Galvanized sheet steel frame
- Fan statically and dynamically balanced within 0.11 in/sec peak velocity
- Direct drive
- Electronically commutated (EC) motor
- Premium efficient
- Integrated variable speed motor controller

Regeneration Air Components:

AIR TO AIR HEAT EXCHANGER:

- Cross flow flat plate type.
  - 8 mil smooth aluminum plates separated by formed ribs
  - Aluminum framing & end plates
  - 201 stainless steel drain pan under heat exchanger (drains into cooling coil pan)

REGENERATION AIR FAN & MOTOR:

- Backward curved plenum fan
- 6 blade profiled composite wheel
- Galvanized sheet steel frame
- Fan statically and dynamically balanced within 0.11 in/sec peak velocity
- Direct drive
- Electronically commutated (EC) motor
- Premium efficient
- Integrated variable speed motor controller

Specification

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DEHUMIDIFICATION/COOLING:

- Integral air cooled refrigeration system
- DX coil rated in accordance with AHRI 410-2001
  - 201 Stainless steel drain pan
  - .016" thick copper tubes
  - .006" thick aluminum fins
  - 16 ga. galvanized frame
- Single digital scroll compressor
- Condenser coil with copper tubes and aluminum fins
- Refrigerant circuit tested, dehydrated and charged with refrigerant
- Refrigeration high and low pressure tap fittings on exterior of casing

ELECTRICAL:

- Single point 3-phase power connection with unit mounted disconnect
- All wires terminated at the unit mounted NEMA 3R panel
- Unit is ETL listed per UL standard 1995 and CSA standard C22.2 #236
- **Electrical Accessories:**
- Standard & Ducted Units
  - Phase loss protection
  - Unit On/Off Switch, green “on” lamp, and red “alarm” lamp mounted on the front of the control panel.

CONTROLS:

- Stand alone DDC controller with Remote User Terminal provided by the manufacturer.
  - DDC controller shall be factory programmed per the sequence of operation.
  - Remote User Terminal shall be factory mounted in the control panel and pre-wired to a prefabricated 50 foot cord on standard units.
    - Note: Remote user terminal can be field mounted (by others) up to 50 feet away from unit using the factory supplied prefabricated 50 foot cord.
  - Room temperature and humidity sensor shall be factory mounted in the process air inlet section.
    - Note: Room temperature and humidity sensor can be field mounted (by others) in the space.

WARRANTIES:

- 1 year parts only warranty for the entire unit. The warranty period will start on the date of original equipment installation or 6 months from the date of shipment from the factory, whichever occurs first.

MISCELLANEOUS:

- Unit shall be packaged with shrink wrap over top and sides (open to bottom) and installed into a stackable wooden crate.
- Units shall be secured to the wooden crate using lag bolts to ensure there is no shifting of the unit inside the crate during shipping.
- Each crate shall be labeled with the following
  - Ship date
  - Model #
  - Voltage

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SEQUENCE OF OPERATION

The sequence of operation displayed below is Innovent's interpretation of what is required for this project. This is subject to review by controls contractor. Innovent will not be responsible for any costs associated with modification of this sequence after the equipment has shipped.

STAND ALONE DDC CONTROLLER.

- Provided with required sensors.
- Factory programmed, mounted, and tested.
- Remote User Terminal with LCD readout for changing set points and monitoring unit operation.

UNIT CONTROL AND MONITOR POINTS.

Set Points
Process air inlet dew point temperature (room dew point temperature)

Analog Inputs
Process air inlet temperature (room temperature)
Process air inlet relative humidity (room relative humidity)
Process air inlet dew point temperature (calculated from process air inlet temperature and relative humidity)
Cooling coil discharge air temperature
Condenser coil discharge air temperature (calculated set point range 95F – 125F)
Refrigeration system suction pressure
Refrigeration system liquid pressure

Digital Inputs
Unit "On/Off" switch (located on the front of the control panel)

Analog Outputs
Digital scroll compressor (auto control through DDC controller)
Process air fan speed (manual factory set point)
Regeneration air fan speed (auto control through DDC controller)

Digital Outputs
Green "On" lamp (located on the front of the control panel)
Red "Alarm" lamp (located on the front of the control panel)

SEQUENCE OF OPERATION. The Stand-alone DDC controller shall perform the following control sequence.

UNIT START COMMAND – Disconnect switch in "On" position, On/Off switch in "On" position.

- Dehumidification operation per below.
- Process fan is energized at factory preset speed – 84%.

UNIT STOP COMMAND – Disconnect switch in "Off" position or On/Off switch in "Off" position.

- Fans, desiccant wheel, and compressors are de-energized

DEHUMIDIFICATION SET POINT.

- The DDC controller shall energize the dehumidifier when the process air inlet dew point (room dew point) increases above the set point plus a dead band (factory set point = 20F dew point temperature + 2F dead band; adjustable at the Remote User Terminal).

Sequence of Operation

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DEHUMIDIFICATION MODE:

- On a call for dehumidification, the DDC controller shall energize the dehumidification mode:

    - **Regeneration warm up**; Regeneration fan on at a constant factory preset speed of 62% and compressor comes on at minimum and begins to modulate per below:
        - Compressor capacity shall be modulated up to maximum capacity per **Compressor Modulation** below.
        - Regeneration fan speed shall be modulated per **SUCTION LINE PRESSURE HIGH AND LOW LIMIT FUNTION** below.
        - Once the condenser coil discharge air temperature reaches 95F, the desiccant wheel shall be energized.

    - **Compressor Modulation**. The compressor modulation shall be controlled based on the regeneration condenser coil discharge air temperature (regeneration air inlet temperature to the desiccant wheel). This condenser temperature set point will be reset based on the process air inlet dew point temperature (room dew point).
        - The condenser coil discharge air temperature set point shall be reset downwards (minimum 95F) in response to a decrease in process air inlet dew point temperature (room dew point) from set point and upwards (maximum 125F) in response to an increase in process air inlet dew point temperature (room dew point).
        - Compressor capacity shall be modulated, and cycled, to maintain the condenser leaving temperature set point. In this way, the compressor capacity modulates to match the dehumidification load in the space.
        - There shall be a minimum on/off time to prevent short cycling of the dehumidification mode (240sec, adjustable).

SUCTION LINE PRESSURE / LOW LIMIT FUNCTION. When the suction pressure drops below 95psi the compressor capacity command will be reduced and the regeneration fan air flow will be increased. The compressor capacity command is reduced from its current command down to a minimum of 15% output, as the suction pressure drops from 95 psi (29F) to 85psi (24F). The regeneration fan speed command is increased from its current command up to a maximum of 100% in step increments, until the suction pressure is above the low limit of 95psi. Function: Prevent low refrigeration pressure trips and prevent operation outside the operating envelope of the compressor.

NOTE: Unit fans and desiccant wheel keep running regardless of low suction pressure conditions. When suction drops below 25psi, the low pressure switch alarms and lights the red lamp and cycles the compressor off. When the suction pressure rises above 50psi, the low pressure alarm will be auto-reset after a 600 second delay. After the delay, the compressor will be allowed to restart, per the above dehumidification sequence.

COLD ROOM START-UP: If the room temperature is 30F (adj) or below, the low pressure switch, detailed above, is ignored for 600 seconds. This time delay keeps the red light off and allows the compressor to remain running until condenser heat is built-up.

SUCTION LINE PRESSURE / HIGH LIMIT FUNCTION. When the suction pressure increases above 170psi the compressor capacity command will be reduced and the regeneration air flow will be reduced. The compressor capacity command is reduced from its current command down to a minimum of 25% as the suction pressure increases from 170 (60F) to 180psi (63F). The regeneration fan air flow command is decreased from its current command down to a minimum of 45% in step increments until the suction pressure is below the limit of 170psi. Function: Prevent compressor operation outside the compressor operating limit.

NOTE: Unit keeps running regardless of suction high pressure conditions.

Sequence of Operation

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LIQUID LINE PRESSURE / HIGH LIMIT FUNCTION. When the liquid line pressure rises above 475psi the compressor capacity command will be reduced. The capacity command is reduced from its current command down to a minimum of 25% as the liquid line pressure rises from 475 (130F) to 550psi (145F).

> **NOTE:** Unit fans and desiccant wheel keep running regardless of high discharge pressure conditions. When the liquid line pressure rises above 575psi, the high pressure switch alarms and lights the red lamp and cycles the compressor off. When the liquid line pressure drops below 550psi, the high pressure alarm will be auto-reset after a 600 second delay. After the delay, the compressor will be allowed to restart, per the above dehumidification sequence.

REFRIGERATION PRESSURE HIGH AND LOW LIMITS ALARMS. Per the above, if the refrigeration system high and low pressure limits are exceeded, the DDC controller shall signal an alarm condition, turn on the red “alarm” lamp and cycle the compressor off. The unit fans and desiccant wheel continue to run.

PHASE LOSS ALARM. If the phase loss protector indicates loss of phase the entire unit shall be de-energized and the DDC controller shall signal an alarm condition and turn on the red “alarm” lamp. The unit shall automatically restart when phase loss alarm has reset.

ALARM INDICATION. Alarm indications are indicated by the red “alarm” lamp on the front of the control panel. All alarms shall be viewable from the Remote User Terminal.
rminal.

BMIL PERFORMANCE DATA SUMMARY

TAG: **Spot Dehumidifier: DZ-2000** **ELEVATION:** **0 FT**

DEHUMIDIFICATION CAPACITY							
PROCESS CFM	EAT (°F)	MOISTURE (%RH)	Process LAT (°F)	Process LAT Dew Point F	REACTIVATION CFM	Compressor Capacity (%)	Dehumidification Capacity (lbs/hr)
20F Cold Room Capacity							
2,000	20.0	90%	27.0	2.5	1,000	90.0	8.9
2,000	20.0	70%	25.7	-1.4	1,000	90.0	6.6
2,000	20.0	50%	24.3	-6.1	1,000	90.0	4.1
30F Cold Room Capacity							
2,000	30.0	90%	38.8	14.6	1,000	75.0	12.5
2,000	30.0	70%	37.2	9.6	1,000	75.0	9.6
2,000	30.0	50%	35.4	3.7	1,000	75.0	6.5
40F Cold Room Capacity							
2,000	40.0	90%	50.2	26.4	1,000	65.0	15
2,000	40.0	70%	48.2	21.1	1,000	65.0	11.6
2,000	40.0	50%	46.2	14.4	1,000	65.0	8.0
50F Cold Room and Ice Rink* Capacity							
2,000	50.0	90%	61.2	40.0	1,000	50.0	15.8
		70%	60.2		1,000	50.0	12.1
2,000	50.0	65%*	58.2	32.8	1,000	50.0	11.1
		56%*	57.7	28.4	1,000	50.0	9.1
2,000	50.0	50%	56.6	26.3	1,000	50.0	7.8
Terminal Unit Capacity							
2,000	20.0	100%	27.7	5.2	1,000	90.0	10.1
2,000	25.0	100%	33.7	10.2	1,000	82.0	12.1
2,000	30.0	100%	39.7	17.4	1,000	75.0	14.0
2,000	35.0	100%	45.4	22.9	1,000	70.0	15.3
2,000	40.0	100%	51.1	29.2	1,000	65.0	16.7
2,000	45.0	100%	56.2	35.9	1,000	58.0	17.0
2,000	50.0	100%	61.2	42.1	1,000	50.0	17.5
2,000	55.0	100%	65.0	49.2	1,000	47.0	15.7

BMIL PERFORMANCE DATA SUMMARY

TAG: **Spot Dehumidifier: DZ-2000 (460 V/3P)** **ELEVATION:** **0 FT**

FAN/MOTOR ASSEMBLY:									**PROCESS AIR**
CFM		SIZE		TSP ("WC)		RPM	BHP		MOTOR HP
2,000		**12.5"**		**1.70**		**2,638**	**1.14**		**1.5**
ESP *	**0.00**	HX (D. WHEEL)	**1.10**			FILTER	**0.45**	PLENUM	**0.15**
								TSP:	**1.70** **"WC**

* ESP = 0 reflects unducted process air inlet and discharge. For ducted arrangements contact the factory.

ELEVATION: **0 FT**

FAN/MOTOR ASSEMBLY:									**REACTIVATION AIR**
CFM		SIZE		TSP ("WC)		RPM	BHP		MOTOR HP
1,000		**12.5"**		**2.03**		**2,190**	**0.67**		**1.5**
ESP *	**0.00**	HX (PLATE-PC)	**0.25**			COND COIL	**0.27**	PLENUM	**0.22**
HX (D. WHEEL)	**0.48**	HX (PLATE-RH)	**0.24**			DX COIL	**0.57**		
								TSP:	**2.03** **"WC**

* ESP = 0 reflects closed loop reactivation fan system.

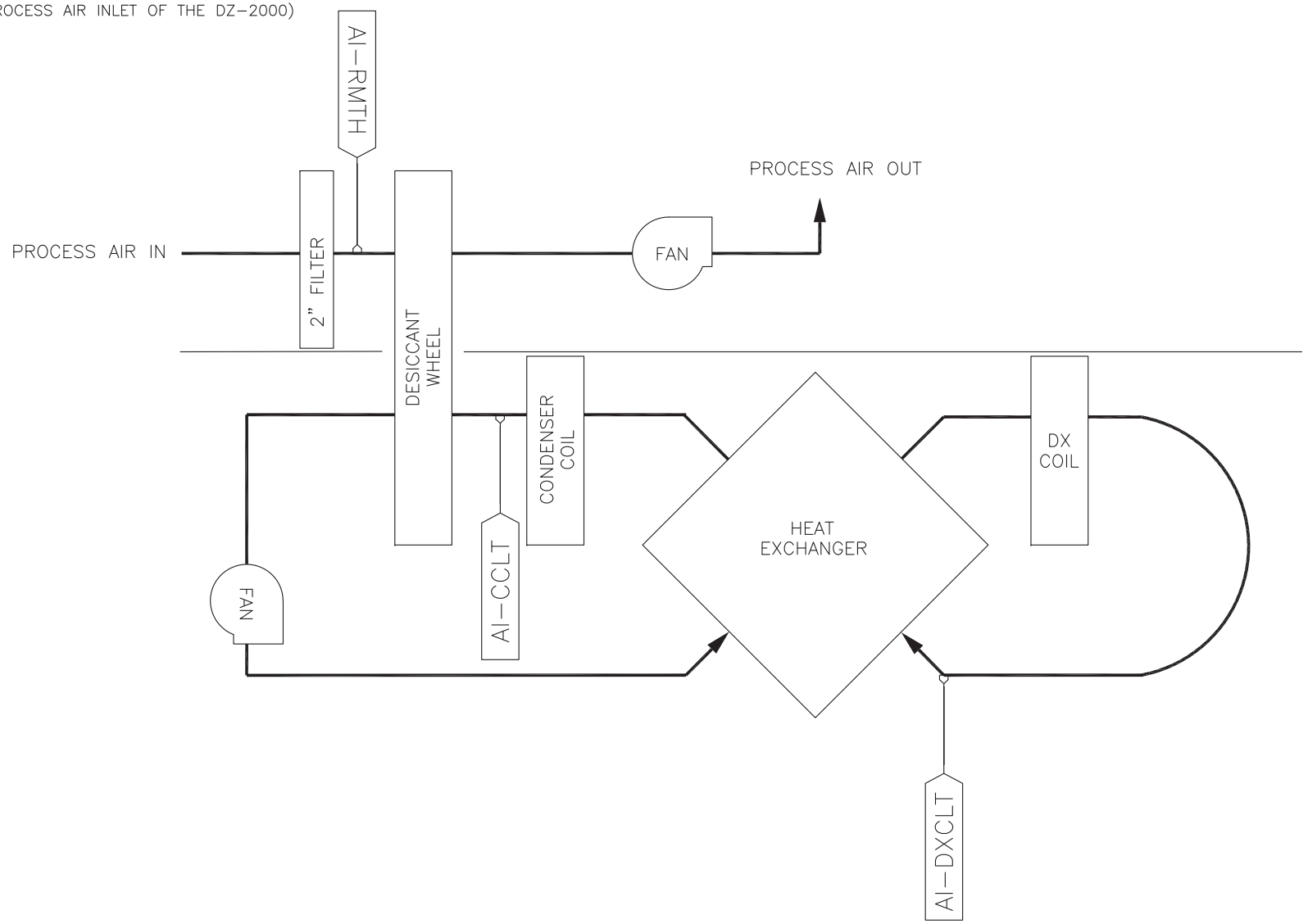
CLOSED LOOP REFRIGERATION CIRCUIT:								**REACTIVATION AIR**
DX COIL		CONDENSER COIL		A-A HEAT EXCHANGER	REFRIGERATION SYSTEM			
CFM	FPM	CFM	FPM	Efficiency	Circuits	Nominal Tons	Refrigerant	EER
1,000	**462**	**1,000**	**462**	**64%**	**1 (Modulating)**	**2.83**	**R410A**	**13.8**

ELECTRICAL INFORMATION:								**SINGLE POINT POWER**
COMPONENT	VOLTS	PHASE	FREQ.	DISCONNECT	FUSING	MOP	MCA	ETL
UNIT	**460**	**3**	**60**	**30**	**N/A**	**30**	**12.6**	**LISTED**

LEGEND

CCLT – CONDENSER COIL LEAVING AIR TEMPERATURE
DXCLT – DX COIL LEAVING AIR TEMPERATURE
RMTH – ROOM TEMPERATURE AND HUMIDITY (FACTORY MOUNTED IN THE PROCESS AIR INLET OF THE DZ–2000)

AI – ANALOG INPUT
DI – DIGITAL INPUT



(MANUFACTURED BY INNOVENT, LLC)

ENGINEER: D. OHS		DESCRIPTION: SENSOR SCHEMATIC
DRAWN BY: MMS		PROJECT: BMIL
JOB #		TAG # DRY ZONE SPOT DEHUMIDIFIER / REV #: 1
FILE NAME:	DATE: 11/07/17	MODEL # DZ–2000–AL–460

COMPONENTS:

1.) PROCESS AIR FILTER (18"X25"X2")
2.) DESICCANT WHEEL
3.) PROCESS AIR FAN
4.) CONTROL PANEL/MAIN DISCONNECT
5.) REGENERATION FAN
6.) AIR TO AIR HEAT EXCHANGER
7.) DX COIL
8.) COMPRESSOR
9.) CONDENSATE DRAIN (3/4" MPT)
10.) CONDENSER COIL
11.) REFRIGERATION ACCESS PORTS
12.) REFRIGERATION ACCESS SECTION

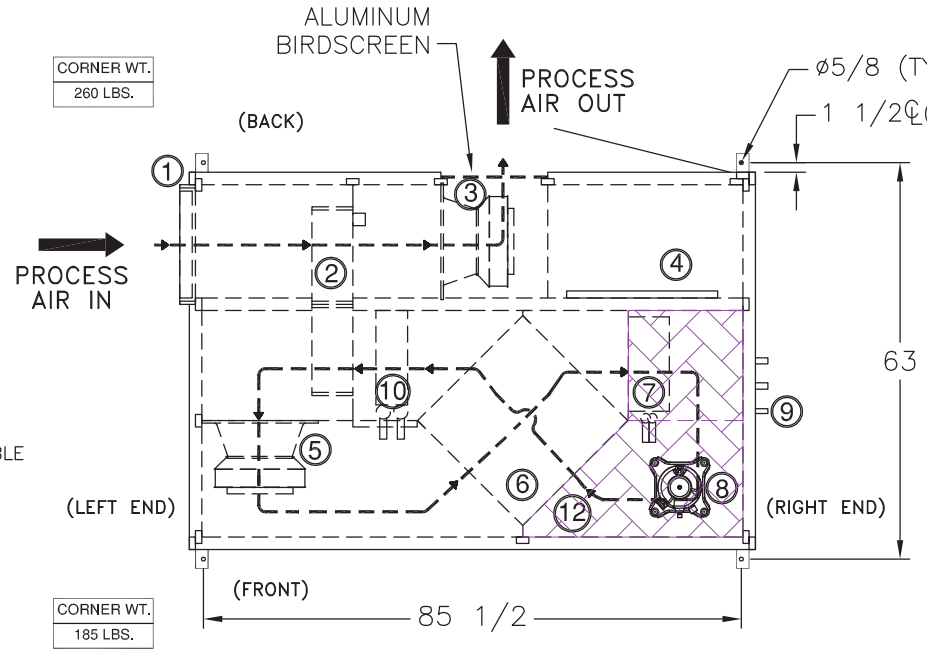
WEIGHT:

915 LBS.

NOTE:

ALL SIDE & TOP PANELS ARE REMOVABLE FOR ACCESS

ALL REFRIGERATION COMPONENTS AS NOTED ON REFRIGERATION SCHEMATIC SHALL BE LOCATED IN REFRIGERATION ACCESS SECTION.



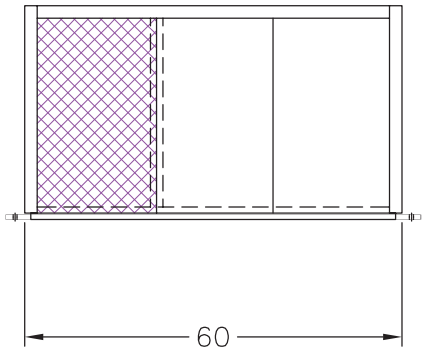
PLAN VIEW

CLEARANCES:

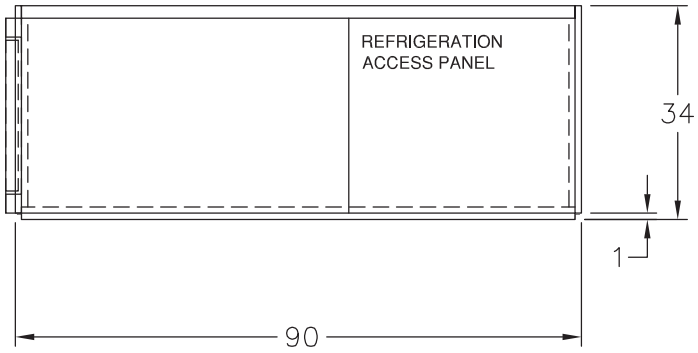
FRONT: 30"
BACK (UNDUCTED): 72"
BACK (DUCTED): 36"
LEFT END (UNDUCTED): 30"
LEFT END (DUCTED): 30"
RIGHT END: 6"
TOP: 2"
BOTTOM: 0"

DUCT SIZES (IF DUCTED):

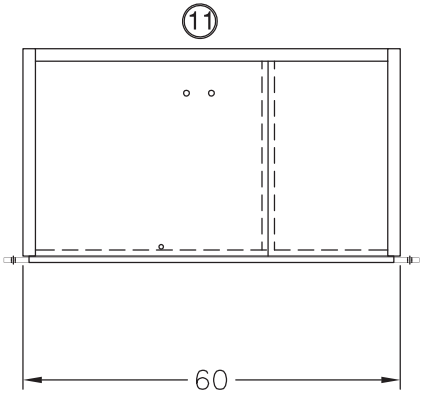
PROCESS INLET 19"W X 31"H
PROCESS OUTLET 17"W X 31"H



LEFT END VIEW



FRONT VIEW



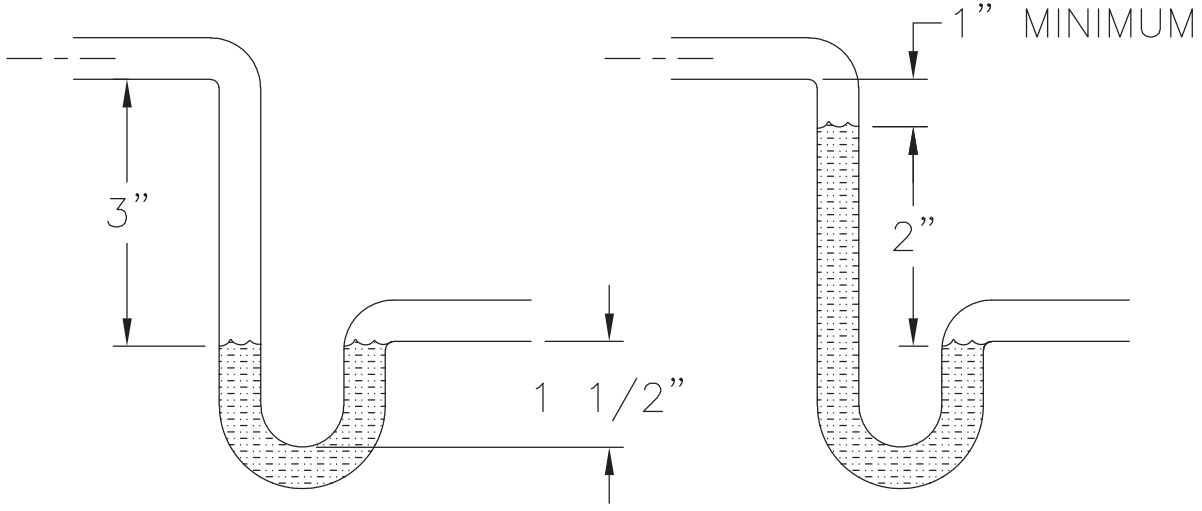
RIGHT END VIEW

(MANUFACTURED BY INNOVENT, LLC)

ENGINEER: L. VANDERHOFF		DESCRIPTION: UNIT DRAWING: SPOT DEHUMIDIFIER	
DRAWN BY: MMS		PROJECT: DZ2000 (STANDARD)	
JOB #		TAG # SPOT DEHUMIDIFIER	REV #: 1
FILE NAME:	DATE: 11/15/17	MODEL # DZ-2000-AL-460	

RECOMMENDED DRAIN TRAP DESIGN

(TRAP BY OTHERS)

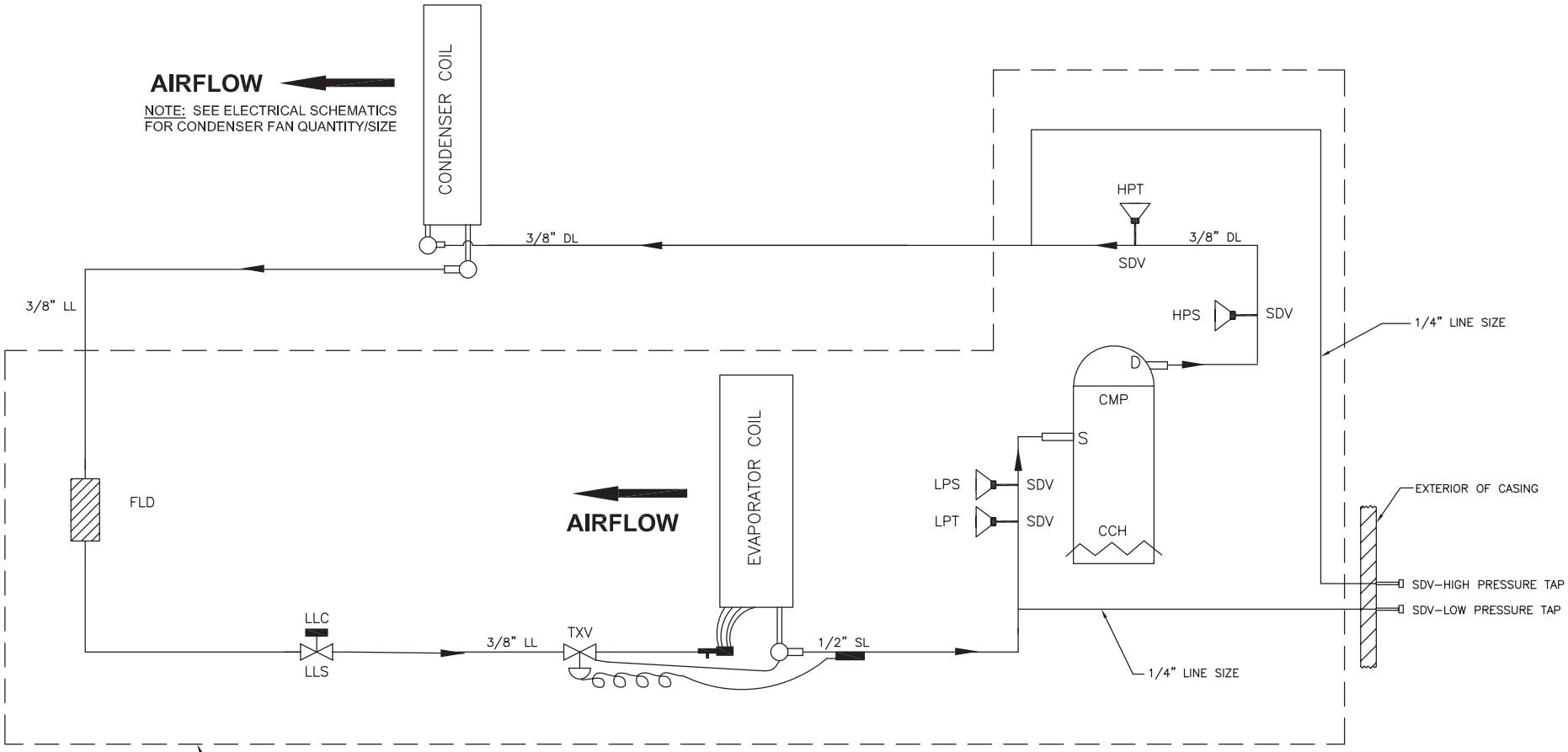


(MANUFACTURED BY INNOVENT, LLC)

ENGINEER: L. VANDERHOFF		DESCRIPTION: DRAIN CONNECTION/TRAP DETAIL
DRAWN BY: MMS		PROJECT: BMIL
JOB #		TAG # SEE UNIT DRAWING / REV #: 1
FILE NAME:	DATE: 11/7/17	MODEL # SEE UNIT DRAWING FOR MODEL # REFERENCE

Ckt A

VERSION
2/4/2015



SDV	SCHRADER VALVE W/.25" PIPE	LLC	120V/1PH SOLENOID COIL
FLD	FILTER DRIER (REPLACEABLE)	LLS	SOLENOID VALVE
HPS	HIGH PRESSURE SWITCH (AUTO RESET)	CMP	COMPRESSOR
TXV	THERMAL EXPANSION VALVE	CCH	CRANK CASE HEATER
LPT	LOW PRESSURE TRANSMITTER	HPT	HIGH PRESSURE TRANSMITTER
		LPS	LOW PRESSURE SWITCH

NOTE: CHARGE SYSTEM TO 4 LBS–9OZ R410A REFRIGERANT

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(MANUFACTURED BY INNOVENT, LLC)

ENGINEER: D. OHS		DESCRIPTION: REFRIGERATION SCHEMATIC	
DRAWN BY: MMS		PROJECT: BMIL	
JOB #		TAG #: DRY ZONE SPOT DEHUMIDIFIER	REV #: 1
FILE NAME:	DATE: 11/07/17	MODEL #: SEE UNIT DRAWING FOR MODEL # REFERENCE	