



Submittal

WMT-SEC-CO2- 1/10-208

July 11, 2024

RAE Corporation
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RAE CORPORATIONN
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WMT-SEC-CO2 -1/10 Submittal

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Please contact our customer service department at service@rae-corp.com or 918-825-7222 if you have any questions, comments or issues with this equipment. Provide the serial and model number when contacting us.



4492 Hunt St • Pryor, Oklahoma 74361

www.RAECorp.com

Call (918) 825-7222 • Fax (918) 825-6366

Submittal Revision Summary

Project Number: WMT-SEC-CO2 208V

Project Name: Walmart Secondary CO2

Original Submittal Date: 10/19/2023

Date:	Drawings Affected:	Revision Description:
11/16/23	EEV Selections	Added selection for EEV at 70F Cond and 50F Liquid
12/5/23	All	- Revised unit model to 1-10 gpm range - Added Pressure setting to Electrical drawings
12/7/23	P&ID	PRV setpoint changed to 45 bar
12/19/23	RLS & EEV Selections	- Revised Refrigerant Line Sizing and EEV selections for -26F Dew point Evap Temp - Relocated CO2 Supply and Return - Removed 2nd Pressure Switch
3/19/24	Electrical Drawings	Revised ECU schematic and controller power source
4/2/24	Electrical Drawings	- Removed Optional RAE.Connect - Added RJ-45 and Convenience Outlet.
5/8/24	Unit Drawing	- Revised Unit Service Clearance - Added Electrical Power Entry Location - Added Lifting Diagram
	Electrical Drawings	Clarified ECU Wiring Diagram
	Spec Sheets	Revised Liquid Filter Drier
5/30/24	E1	- Added heat trace for control enclosure - Revised ECU Circuit Grounding
6/6/24	E1E	Disconnect for convenience outlet and between Inverter and Skid Fuse Shown



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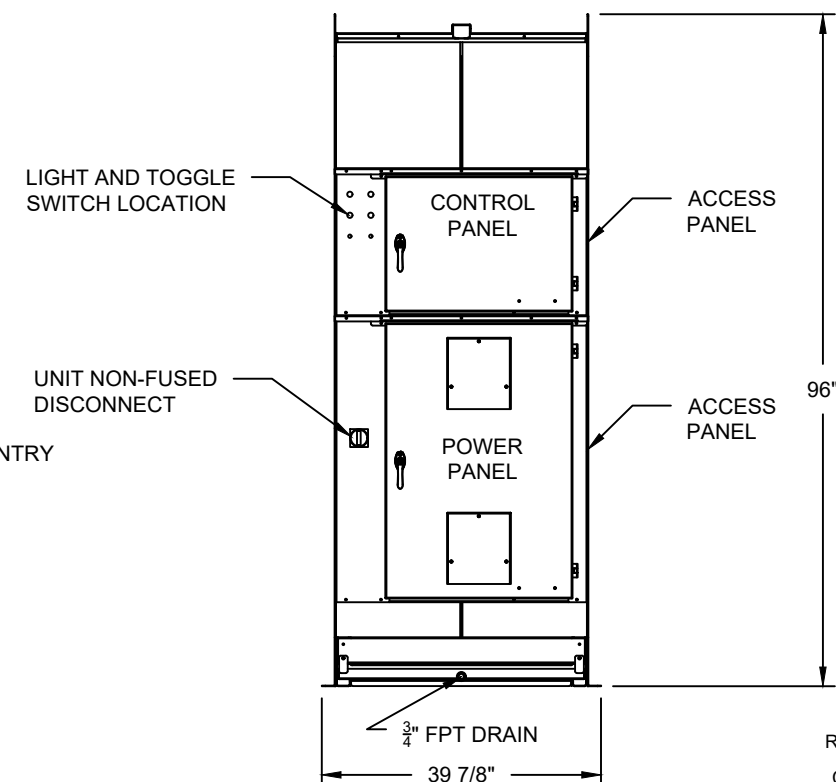
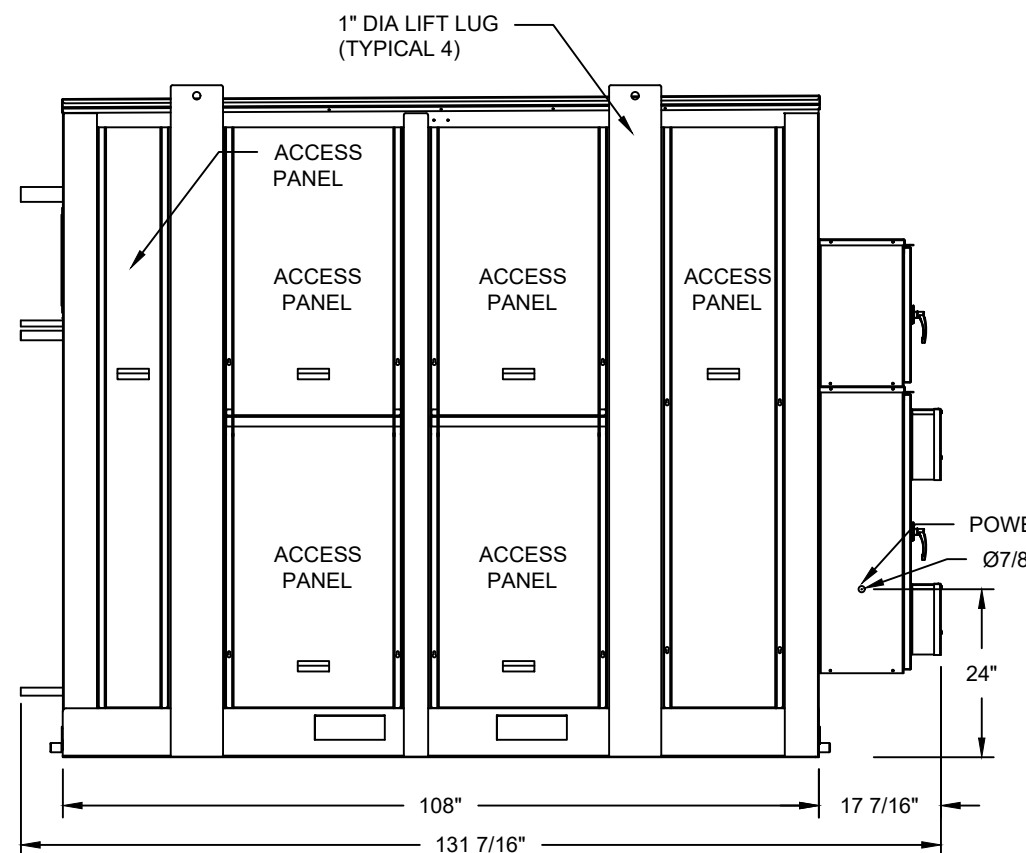
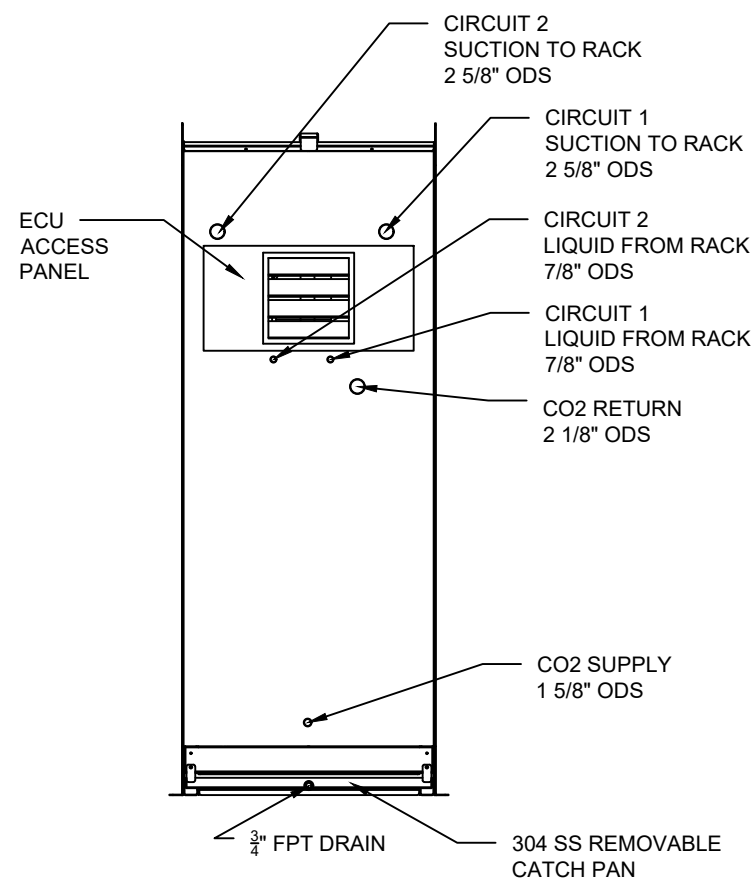
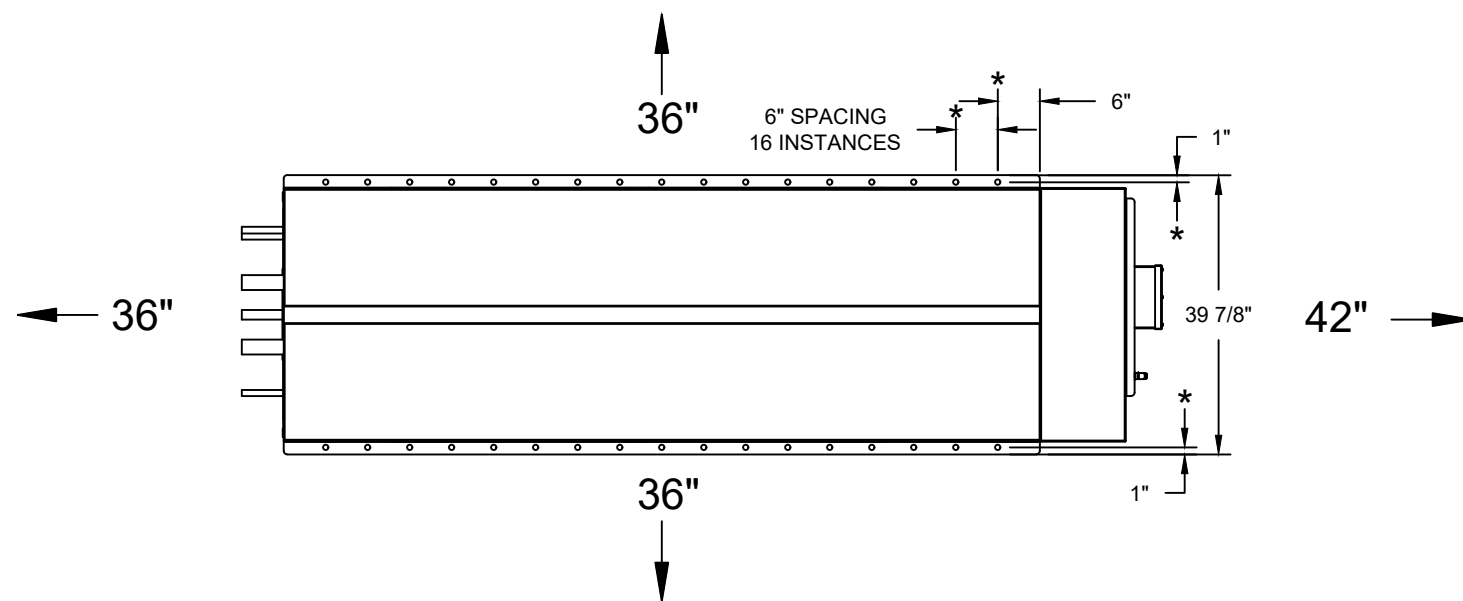
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<i>Date:</i>	<i>Drawings Affected:</i>	<i>Revision Description:</i>
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07/09/24	Unit Drawing	• Updated circuit callouts
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07/11/24	Electrical Drawings	• Changed the Max fuse size from 70 to 40 on ECU page
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MINIMUM RECOMMENDED SERVICE CLEARANCES



- Revised Circuit Callouts, CM 070824 5
- REVISED SERVICE CLEARANCES 4
- Changed Line Size Suction to Rack 3
- Rev Model # to 1-10 2
- Raised height 6" for ease of access to valves, 60 Bar design 1

⊕ 2-1/2" Rigging Holes
 * 5/8" Mounting Holes
 Est. Shipping Weight: 4,648#
 Est. Operating Weight: 5,648#



TITLE:

Unit Drawing
 WMT-SEC-CO2-1/10

SCALE: 7/16" = 1' 0"

DATE: 10/30/23

SUB-TITLE:

ENGINEERING
 APPROVED BY:

QUALITY CONTROL
 APPROVED BY:

DRAWN BY:

FILE LOC:

DRAWING NUMBER:
 WMT-CO2-1/10-208

REVISED BY:

DATE:

REV. NO:

CM

11-8-23

1

CM

12-1-23

2

CM

12-21-23

3

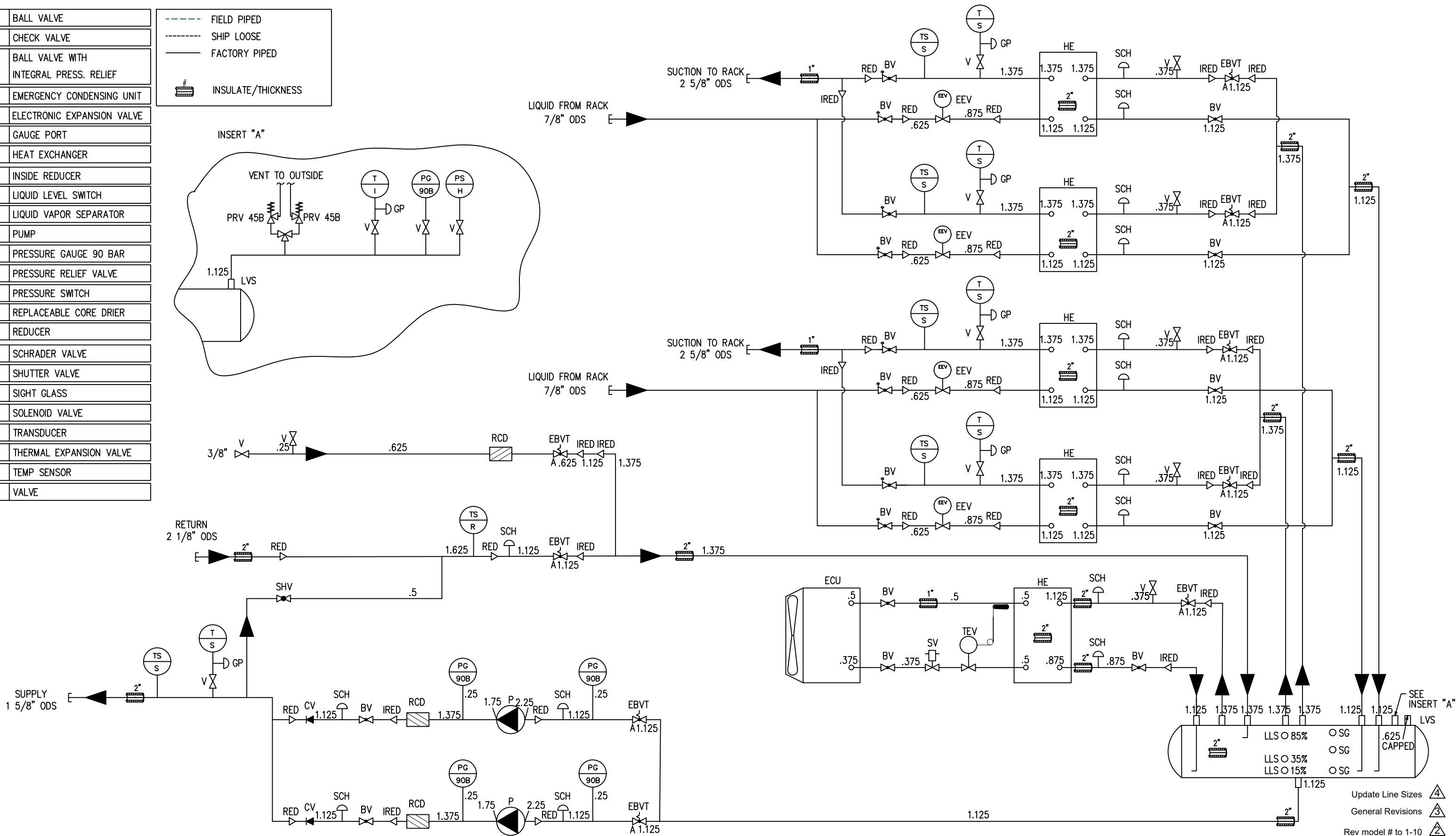
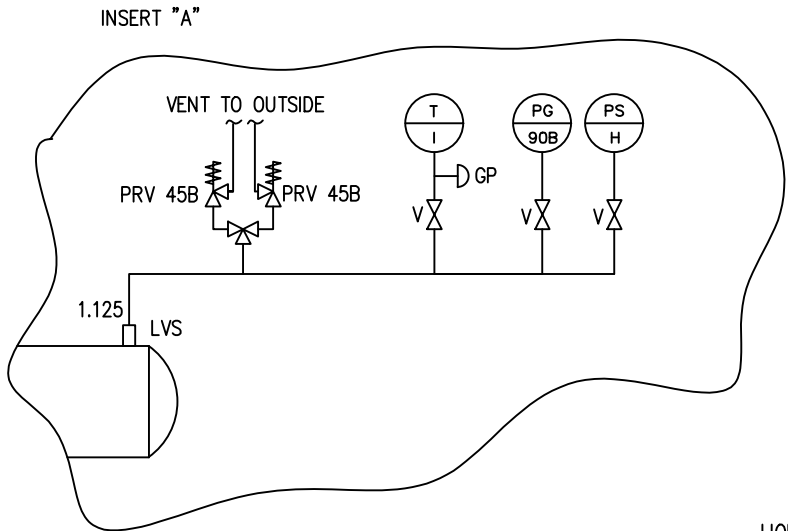
M.L.

04-29-24

4

BV	BALL VALVE
CV	CHECK VALVE
EBVT	BALL VALVE WITH INTEGRAL PRESS. RELIEF
ECU	EMERGENCY CONDENSING UNIT
EEV	ELECTRONIC EXPANSION VALVE
GP	GAUGE PORT
HE	HEAT EXCHANGER
IRED	INSIDE REDUCER
LLS	LIQUID LEVEL SWITCH
LVS	LIQUID VAPOR SEPARATOR
P	PUMP
PG	PRESSURE GAUGE 90 BAR
PRV	PRESSURE RELIEF VALVE
PS	PRESSURE SWITCH
RCD	REPLACEABLE CORE DRIER
RED	REDUCER
SCH	SCHRADER VALVE
SHV	SHUTTER VALVE
SG	SIGHT GLASS
SV	SOLENOID VALVE
T	TRANSDUCER
TEV	THERMAL EXPANSION VALVE
TS	TEMP SENSOR
V	VALVE

	FIELD PIPED
	SHIP LOOSE
	FACTORY PIPED
	INSULATE/THICKNESS



- Update Line Sizes
- General Revisions
- Rev model # to 1-10
- 60 Bar design
- Added SHV and Removed 1 EBVT AND CV (M.L 4-29-24) Removed 1 FA8 and FA57 (CM 1-4-23-4)



TITLE:
Refrigerant Piping
WMT-SEC-CO2-1/10

SCALE: N/A
DATE: 10/30/23
SUB-TITLE:

ENGINEERING
APPROVED BY:

QUALITY CONTROL
APPROVED BY:

DRAWN BY:
FILE LOC: ACAD148000
DRAWING NUMBER:
WMT-SEC-CO2-1/10-208

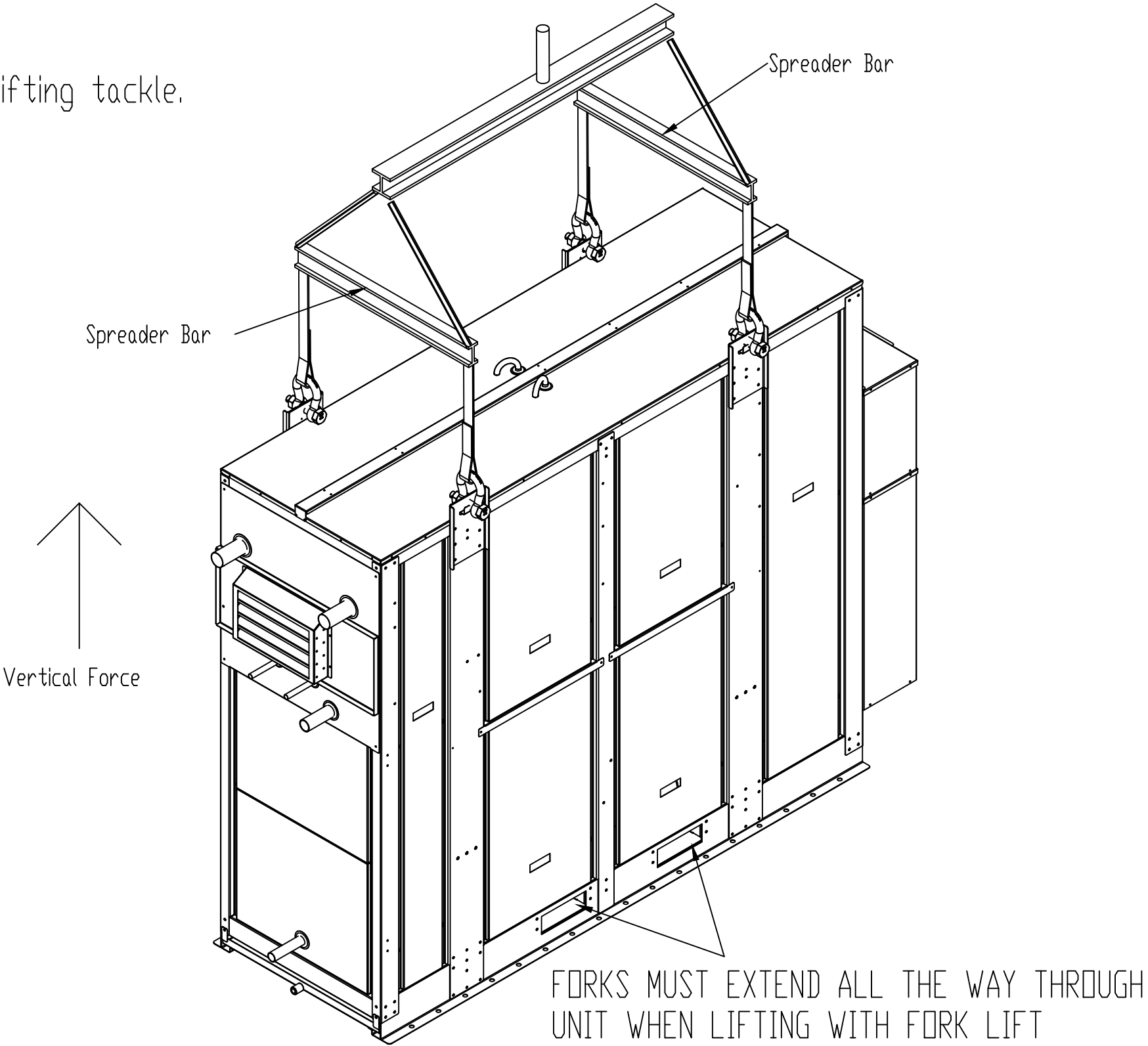
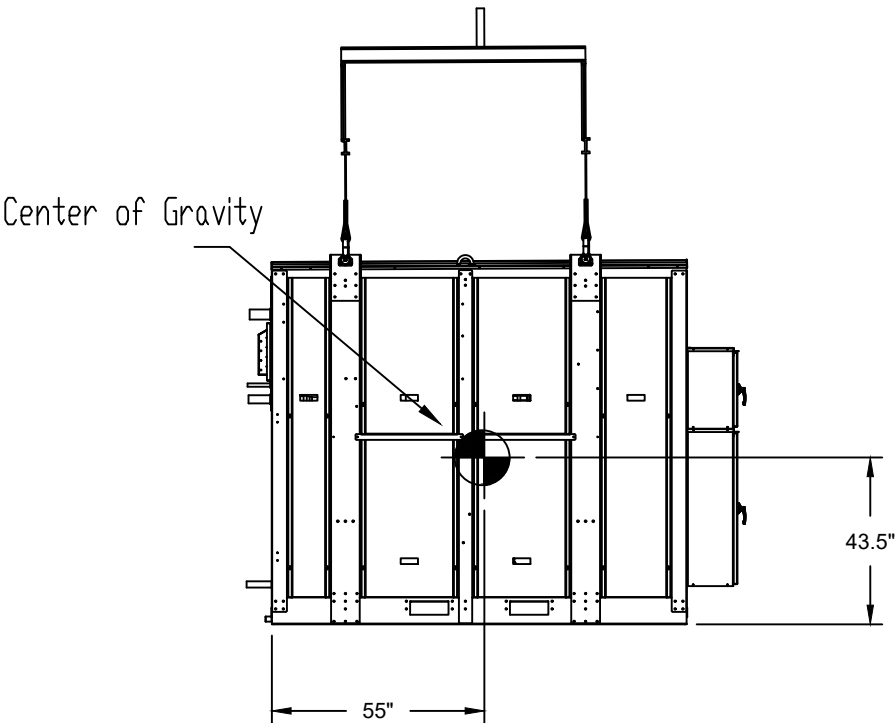
REVISED BY:	DATE:	REV. NO:
CM	11-15-23	
CM	12-1-23	
CM	12-7-23	
CM	12-21-23	

Lifting Requirements:

- 1. Use all lifting points.
- 2. A spreader bar must be used to keep vertical force on lifting tackle.

Failure to use each lifting point, along with spreader bars and/or neglecting proper lifting procedures may lead to property damage, injury, or death.

UNIT WEIGHT LISTED ON U1 UNIT DRAWING



	SCALE:	NONE	ENGINEERING APPROVED BY:	QUALITY CONTROL APPROVED BY:	DRAWN BY:
	DATE:	05/02/2024			M.L
	SUB-TITLE:	WMT-C02-LIFTING			DRAWING NUMBER:

NOTES:

PRESSURE LINE COLOR CODE	
FREEZE	BLUE
LOW	BLUE
HIGH	RED
FAN CYCLE	RED
OIL HIGH	BLACK
OIL LOW	BLUE

LEGEND

AA-Audible Alarm
ADC-Alarm Dry Contact
AFI-Air Flow Interlock
BBH-Belly Band Heater
BLM-Blower Motor
C-Contactor
CCH-Crankcase Heater
CF-Condenser Fan
COMP-Compressor
CPR-Crankcase Press. Reg.
CST-Cooling Stage T'stat
CT-Current Transformers
DDPR-Diff. Disch. Press. Reg.
DEF-Evap. Defrost Load
DPH-Drain Pan Heaters
DS-Door Interlock Sol.
DSHS-Desuperheat hot gas sol.
DTS-Discharge Line Temp. Stat
ECU-Emergency Cond. Unit
EF-Evap. Fan Load
EPR-Evap. Press. Reg.
FCS-Fan Cycle Control
FS-Flow Switch
FZ-Freeze Safety
GR/G-Ground
HCC-Heater Cable, Chiller
HCR-Heater Cable, Receiver
HGBS-Hot Gas Bypass Sol.
HGD-Hot Gas Defrost Sol.
HP-High Pressure Safety
HTR-Unit Heater
LALT-Low Amb. Lock Out T'stat
LIS-Liquid Injection Sol.
LLL-Low Liquid Level
LLPS-Load Limit Press. Switch
LLS-Liquid Line Sol.
LO-Lo Press. Control
LO-UPS-Close On Rise UPS
MET-Meter Elapsed Time
MSD-Man.Sw. Door
MSHS-Man. Sw. Horn Silence
MSHOA - Man. Sw. Hand-Off-Auto
MSLL-Man. Sw. Lead Lag
MSPD-Man. Sw. Pumpdown
MSPDDR-Man. Sw. Pumpdown Off Run
MSPHM-Man.Sw. Phase Monitor
OF- Oil Failure Safety
OS-Oil Separator Sol.
OVL-Overload
PHM-Phase Monitor
PM-Power Module, Compressor Box
R-Relay
RH-Evap. Reheat Load
RHC-Reheat Control
RHS-Reheat 3 Way Valve Solenoid
SPR-Spray Pump
SUMP-Sump Heater
TD-Time Delay
TM/TD-Time Delay
TPWS-Timer Part Wind Start
UC DISC-Unit Cooler Disconnect
ULS-Unloader Sol.
UPS-Unloading Press. Sw.

FILE# ACADWMT-24

No.	By	Date
1		
2		
3		
4		
5		
6		

SUB-TITLE:
ELECTRICAL SCHEMATIC
PAGE 1 of 5

SCALE:
N/A
DATE: 01/04/24
ENGINEERING
APPROVED BY:
QUALITY CONTROL
APPROVED BY:
DRAWN BY: RJP
DRAWING NUMBER:
WMT-C02-1/10-208

DENOTES COMPONENTS LOCATED EXTERNAL OF U.L. ENCLOSURE
() INDICATES WIRE NUMBER IDENTIFICATION
FIELD WIRING - - - (BY OTHERS)
FAN MOTORS ARE INHERENTLY PROTECTED.
3 PHASE MOTORS ARE PROTECTED AGAINST
PRIMARY SINGLE PHASING.

POWER ENCLOSURE

CONTROL CIRCUIT POWER: ☐ BY OTHERS
☒ (115/60/1) TO SEPARATE SOURCE
☒ (24/60/1) BY FACTORY
☐ OTHER
MIN. VA_1118_

**HACR* BKR. OR TIME DELAY FUSE MUST BE USED IF COMPRESSOR PROTECTION IS NOT PROVIDED.
**FOR MCA VALUE OF 100 OR LESS, USE TYPE 60°C, IF GREATER THAN 100 USE TYPE 75°C COPPER CONDUCTORS ONLY

208/60/3 POWER
MAX. FU./*BKR._20_
MCA_19_
RLA_16_
SCCR_5KA

☐ DISCONNECTING MEANS BY OTHERS
☐ UNIT CIRCUIT BREAKER
☒ UNIT NON-FUSED DISCONNECT (EXTERNAL)
☐ UNIT FUSED DISCONNECT

GR GROUND LUG

PUMP-1 MOTOR
P1 (P1)
P2 # (P2)
P3 (P3)
P4 HP_3.0_ FLA_10.6
P5
P6
P7
P8
P9
P10
P11
P12
P13

PUMP-1 20A C/B
(P1A) (P1B)
(P2A) (P2B)
(P3A) (P3B)

PUMP-1 VFD
G T3 T2 T1
L1 L2 L3 G
SHIELDED CABLES GROUND AT CONTROLLER END ONLY NOT AT VFD END
2A11 3A3ND 11 12 13 10
RED BLK
FROM LINE 150 0 TO 10 VDC
(1) NO. (1A)
R109-1
(110) (268A)
OPEN ON FAIL VFD FAIL CONTACTS TO LINE 110

GROUND

CONTACTS SHOWN IN FAULTED STATE
NO NC
16 27 25 26

PUMP-2 20A C/B
(P1C) (P1D)
(P2C) (P2D)
(P3C) (P3D)

PUMP-2 VFD
G L3 L2 L1
T1 T2 T3 G
SHIELDED CABLES GROUND AT CONTROLLER END ONLY NOT AT VFD END
26 25 27 16
10 13 12 11 3 2
RED BLK
FROM LINE 151 0 TO 10 VDC
(1B) NO. (1C)
R110-1
(111) (268A)
OPEN ON FAIL VFD FAIL CONTACTS TO LINE 111

GROUND

CONTACTS SHOWN IN FAULTED STATE
NC NO
26 25 27 16
10 13 12 11 3 2
RED BLK
FROM LINE 151 0 TO 10 VDC
(1B) NO. (1C)
R110-1
(111) (268A)
OPEN ON FAIL VFD FAIL CONTACTS TO LINE 111

208V
TF-1 12A FUSE
(P12) (P12A)
(P13) (P13A)
OPEN ON FAIL VFD FAIL CONTACTS TO LINE 111

TRANSFORMER 1 #
MIN VA: 1118
115V
WHT

20A FUSE
(6A) RED
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TO LINE 154
TO GROUND TERMINAL BLOCK
HOFFMAN
L N G
PANEL HEATER 800 WATTS SET AT 50°F (ADJUSTABLE)
VENT FAN RLA .24 VA 20
INT 275-1
INT 275-2
INT 275-3
LVL LOW SWITCH CONTACTS ON LINE 106
LVL HIGH SWITCH CONTACTS ON LINE 107
LVL INTER SWITCH CONTACTS ON LINE 108
THERMODISC R BR BK (13)
THERMODISC R BR BK (22)
CONTROL ENCLOSURE HEAT 65 WATTS

NOTES:

LEGEND									
AA-Audible Alarm									
ADC-Alarm Dry Contact									
AFI-Air Flow Interlock									
BBH-Belly Band Heater									
BLM-Blower Motor									
C-Contactor									
CCH-Crankcase Heater									
CF-Condenser Fan									
COMP-Compressor									
CPR-Crankcase Press. Reg.									
CST-Cooling Stage T'stat									
CT-Current Transformers									
DDPR-Diff. Disch. Press. Reg.									
DEF-Evap. Defrost Load									
DPH-Drain Pan Heaters									
DS-Door Interlock Sol.									
DSHS-Desuperheat hot gas sol.									
DTS-Discharge Line Temp. Stat									
ECU-Emergency Cond. Unit									
EF-Evap. Fan Load									
EPR-Evap. Press. Reg.									
FCS-Fan Cycle Control									
FS-Flow Switch									
FZ-Freeze Safety									
GR/G-Ground									
HCC-Heater Cable, Chiller									
HCR-Heater Cable, Receiver									
HGBS-Hot Gas Bypass Sol.									
HGD-Hot Gas Defrost Sol.									
HP-High Pressure Safety									
HTR-Unit Heater									
LALT-Low Amb. Lock Out T'stat									
LIS-Liquid Injection Sol.									
LLL-Low Liquid Level									
LLPS-Load Limit Press. Switch									
LLS-Liquid Line Sol.									
LO-Lo Press. Control									
LO-UPS-Close On Rise UPS									
MET-Meter Elapsed Time									
MSD-Man.Sw. Door									
MSHS-Man. Sw. Horn Silence									
MSHOA - Man. Sw. Hand-Off-Auto									
MSLL-Man. Sw. Lead Lag									
MSPD-Man. Sw. Pumpdown									
MSPDDR-Man. Sw. Pumpdown Off Run									
MSPHM-Man.Sw. Phase Monitor									
OF- Oil Failure Safety									
OS-Oil Separator Sol.									
OVL-Overload									
PHM-Phase Monitor									
PM-Power Module, Compressor Box									
R-Relay									
RH-Evap. Reheat Load									
RHC-Reheat Control									
RHS-Reheat 3 Way Valve Solenoid									
SPR-Spray Pump									
SUMP-Sump Heater									
TD-Time Delay									
TM/TD-Time Delay									
TPWS-Timer Part Wind Start									
UC DISC-Unit Cooler Disconnect									
ULS-Unloader Sol.									
UPS-Unloading Press. Sw.									

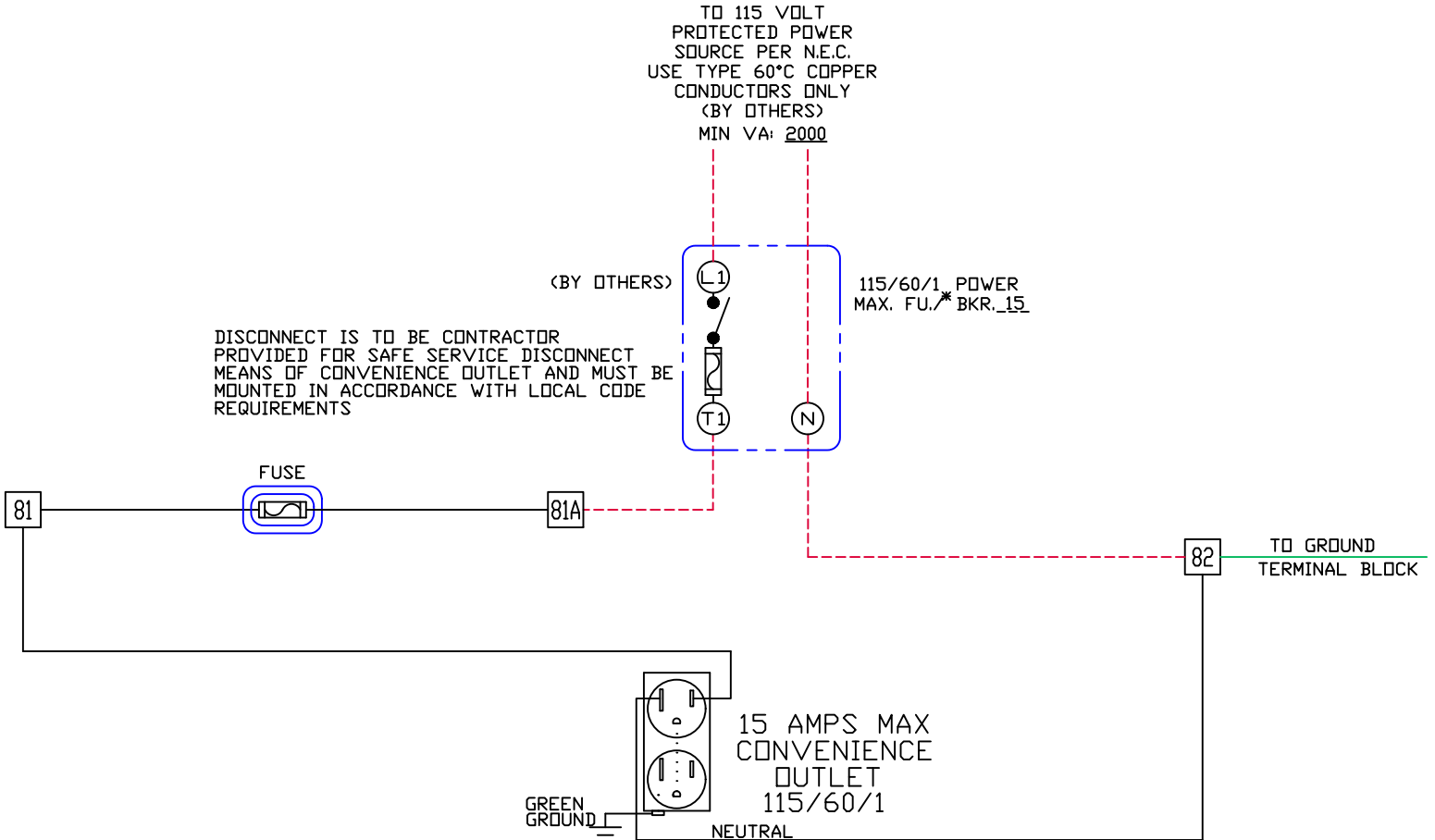
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REVISIONS									
No. By Date									
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SUB-TITLE: ELECTRICAL SCHEMATIC									
DATE: 01/04/24									
SCALE: N/A									
ENGINEERING APPROVED BY:									
QUALITY CONTROL APPROVED BY:									
DRAWN BY: RJP									
DRAWING NUMBER: WMT-C02-1/10-208									

WMT-SEC-C02-1/10

WMT-C02-1/10-208

DENOTES COMPONENTS LOCATED EXTERNAL OF U.L. ENCLOSURE
□ INDICATES TERMINAL BLOCK
< > INDICATES WIRE NUMBER IDENTIFICATION
FIELD WIRING -----<BY OTHERS>

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95



REVISITONS		No.
By	Date	
		1
		2
		3
		4
		5
		6
		7

		
SCALE: N/A	ENGINEERING APPROVED BY:	
DATE: 01/04/24		
SUB-TITLE:	ELECTRICAL SCH	
	PAGE 3 of 3	

TITLE: WMT-SEC-C02-1/10	QUALITY CONTROL APPROVED BY:
	DRAWN BY: RJP
DRAWING NUMBER: WMT-C02-1/10-200	EMATIC

LEGEND

AA-Audible Alarm
ADC-Alarm Dry Contact
AFI-Air Flow Interlock
BBH-Belly Band Heater
BLM-Blower Motor
C-Contactor
CCH-Crankcase Heater
CF-Condenser Fan
COMP-Compressor
CPR-Crankcase Press. Reg.
CST-Cooling Stage T'stat
CT-Current Transformers
DDPR-Diff. Disch. Press. Reg.
DEF-Evap. Defrost Load
DPH-Drain Pan Heaters
DS-Door Interlock Sol.
DSHS-Desuperheat hot gas sol.
DTS-Discharge Line Temp. Stat
ECU-Emergency Cond. Unit
EF-Evap. Fan Load
EPR-Evap. Press. Reg.
FCS-Fan Cycle Control
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HCR-Heater Cable, Receiver
HGBS-Hot Gas Bypass Sol.
HGD-Hot Gas Defrost Sol.
HP-High Pressure Safety
HTR-Unit Heater
LALT-Low Amb. Lock Out T'stat
LIS-Liquid Injection Sol.
LLL-Low Liquid Level
LLPS-Load Limit Press. Switch
LLS-Liquid Line Sol.
LO-Lo Press. Control
LO-UPS-Close On Rise UPS
MET-Meter Elapsed Time
MSD-Man. Sw. Door
MSHS-Man. Sw. Horn Silence
MSHOA - Man. Sw. Hard-Off-Auto
MSLL-Man. Sw. Lead Lag
MSPD-Man. Sw. Pumpdown
MSPPDR-Man. Sw. Pumpdown Off Run
MSPHM-Man. Sw. Phase Monitor
OF- Oil Failure Safety
OS-Oil Separator Sol.
OVL-Overload
PHM-Phase Monitor
PM-Power Module, Compressor Box
R-Relay
RH-Evap. Reheat Load
RHC-Reheat Control
RHS-Reheat 3 Way Valve Solenoid
SPR-Spray Pump
SUMP-Sump Heater
TD-Time Delay
TM/TD-Time Delay
TPWS-Timer Part Wind Start
UC DISC-Unit Cooler Disconnect
ULS-Unloader Sol.
UPS-Unloading Press. Sw.

REVISITONS		No.
By	Date	
		1
		2
		3
		4
		5
		6
		7

		
SCALE: N/A	ENGINEERING APPROVED BY:	
DATE: 01/04/24		
SUB-TITLE:	ELECTRICAL SCH	
	PAGE 3 of 3	

TITLE: WMT-SEC-C02-1/10	QUALITY CONTROL APPROVED BY:
	DRAWN BY: RJP
DRAWING NUMBER: WMT-C02-1/10-200	EMATIC

DENOTES COMPONENTS LOCATED EXTERNAL OF U.L. ENCLOSURE
□ INDICATES TERMINAL BLOCK
() INDICATES WIRE NUMBER IDENTIFICATION
FIELD WIRING ----- (BY OTHERS)

The diagram illustrates the electrical wiring for a vehicle control system, organized into several functional blocks:

- Power Supply (J1):** Connected to FROM LINE 268 (268A) and FROM LINE 270 (270). It includes a GND terminal.
- Digital Inputs (J5, J7, J8):**
 - J5 DIG. IN:** Includes terminals ID1 through ID8. ID1 is connected to a SKID DISABLE JUMPER (105, 105A) and a C02 SKID OFF/ON # switch. ID2, ID3, and ID4 are connected to LVL LOW, LVL HIGH, and LVL INTER SEPARATOR signals respectively, each through a 10K resistor and a 275-1, 275-2, or 275-3 switch. ID6 and ID7 are connected to PUMP VFD-1 and PUMP VFD-2 OPEN ON FAIL signals through 110 and 111 relays. ID8 is connected to FROM LINE 270 (270) and labeled IDC1.
 - J7 DIG. IN:** Includes terminals ID9 through ID12 and IDC9 through IDC13H.
 - J8 DIG. IN:** Includes terminals ID13 through ID14 and IDC13 through IDC14H.
- Analog Outputs (J4):** Includes terminals VG, VG0, Y1, Y2, Y3, and Y4. Y1 and Y2 are connected to PUMP-1 VFD and PUMP-2 VFD SPEED SIGNALS through 150 and 151 relays. Y3 and Y4 are connected to TO GROUND TERMINAL BLOCK.
- Relays and Switches:**
 - C02 SKID OFF/ON #:** A switch connected to ID1.
 - 105, 105A:** A jumper switch connected to ID1.
 - 110, 111:** Relays connected to PUMP VFD-1 and PUMP VFD-2 OPEN ON FAIL signals.
 - 150, 151:** Relays connected to PUMP-1 VFD and PUMP-2 VFD SPEED SIGNALS.
- Control Unit (BI):** A central unit with multiple connectors:
 - J12 DIG. OUT:** Includes terminals C1, ND1, ND2, ND3, C4, ND4, ND5, ND6, C7, ND7, C7, ND8, C8, and NC8. ND1, ND2, and ND3 are connected to PUMP 1 VFD RUN, FAIL, and RUN LIGHTS through 103, 104, and 105B relays. ND4, ND5, and ND6 are connected to PUMP 2 VFD FAIL LIGHT, R109, and R110 relays. ND7 and ND8 are connected to EEV-1A and EEV-1B ENABLE signals through 184 and 186 relays. ND9 and ND10 are connected to EEV-2A and EEV-2B ENABLE signals through 210 and 212 relays. ND11 and ND12 are connected to EEV-2A and EEV-2B ENABLE signals through 210 and 212 relays. ND13 and NC13 are connected to EEV-2A and EEV-2B ENABLE signals through 210 and 212 relays.
 - J13:** Includes terminals ND5 and ND6.
 - J14:** Includes terminals ND7 and ND8.
 - J15:** Includes terminals C8 and NC8.
 - J16:** Includes terminals ND9, ND10, and ND11.
 - J17:** Includes terminals ND12 and NC12.
 - J18:** Includes terminals ND13 and NC13.
- Sensors and Transducers:**
 - SEPARATOR TRANSDUCER:** 4-20mA 0 TO 60 BAR, connected to U1 and U2.
 - PUMP DISCHARGE TRANSDUCER:** 4-20mA 0 TO 60 BAR, connected to U3 and U4.
 - SUPPLY C02 TEMP:** NTC 10K, connected to U5 and U6.
 - RETURN C02 TEMP:** NTC 10K, connected to U7 and U8.
- Other Components:**
 - 185, 186, 210, 212:** Relays connected to EEV-1A, EEV-1B, EEV-2A, and EEV-2B ENABLE signals.
 - 211, 212:** Relays connected to EEV-2A and EEV-2B ENABLE signals.
 - 214:** A relay connected to R124, 266 ECU ENABLE.

1 ADD RJ-45

** TO PROTECTED POWER
 SOURCE PER N.E.C.

CONTROL CIRCUIT POWER: ☐ BY OTHERS
☐ (115/60/1) TO SEPARATE
☒ (230/60/1) SOURCE
☐ OTHER ☒ BY FACTORY

MIN. VA_403_

* "HACR" BKR. OR TIME DELAY
FUSE MUST BE USED IF
COMPRESSOR PROTECTION
IS NOT PROVIDED.

RS **FOR MCA VALUE OF
100 OR LESS, USE
TYPE 60°C, IF GREATER
THAN 100 USE TYPE 75°C
COPPER CONDUCTORS ONLY

***NOT REQUIRED IF USING
FUSED DISCONNECT

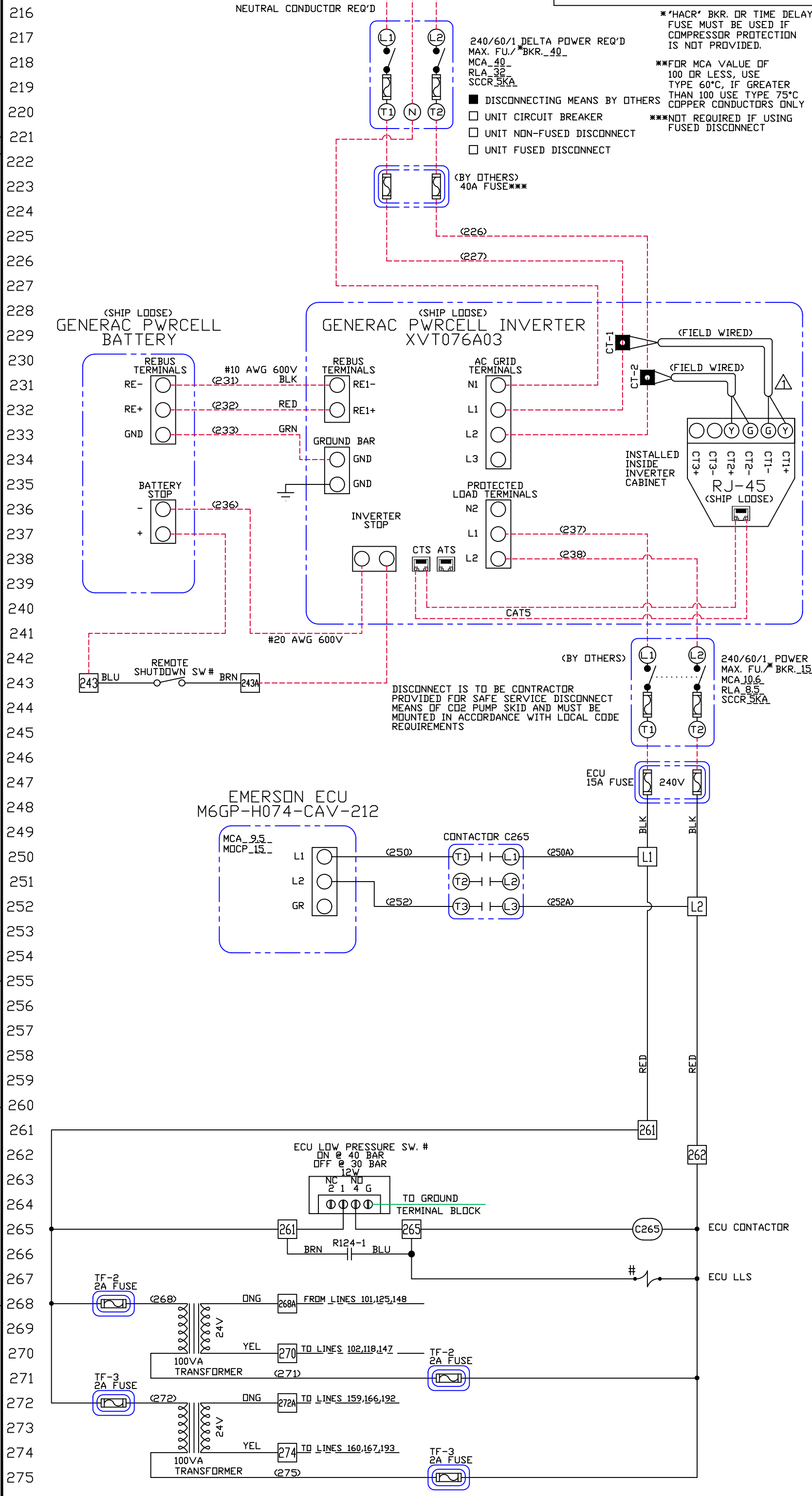
LEGEND

AA—Audible Alarm
ADC—Alarm Dry Contact
AFI—Air Flow Interlock
BBH—Belly Band Heater
BLM—Blower Motor
C—Connector
CCH—Crankcase Heater
CF—Condenser Fan
COMP—Compressor
CPR—Crankcase Press. Reg.
CST—Cooling Stage T'st
CT—Current Transformers
DDPR—Diff. Disch. Press. Reg.
DEF—Evap. Defrost Load
DPH—Drain Pan Heaters
DS—Door Interlock Sol.
DSHS—Desuperheat hot gas sol.
DTS—Discharge Line Temp. Stat
ECU—Emergency Cond. Unit
EF—Evap. Fan Load
EPR—Evap. Press. Reg.
FCS—Fan Cycle Control
FS—Flow Switch
FZ—Freeze Safety
GR/G—Ground
HCC—Heater Cable, Chiller
HCR—Heater Cable, Receiver
HGBS—Hot Gas Bypass Sol.
HGD—Hot Gas Defrost Sol.
HP—High Pressure Safety
HTR—Unit Heater
LAL—Low Amb. Lock Out T'st
LIS—Liquid Injection Sol.
LLL—Low Liquid Level
LLPS—Load Limit Press. Switch
LLS—Liquid Line Sol.
LO—Lo Press. Control
LO—UPS—Close On Rise UPS
MET—Meter Elapsed Time
MSD—Man.Sw. Door
MSHS—Man. Sw. Horn Silence
MSHOA — Man. Sw. Hand-Off—Auto
MSLL—Man. Sw. Lead Lag
MSPD—Man. Sw. Pumpdown
MSPDDR—Man. Sw. Pumpdown Off Run
MSPH—Man.Sw. Phase Monitor
OF— Oil Failure Safety
OS—Oil Separator Sol.
OVL—Overload
PHM—Phase Monitor
PM—Power Module, Compressor Box
R—Relay
RH—Evap. Reheat Load
RHC—Reheat Control
RHS—Reheat 3 Way Valve Solenoid
SPR—Spray Pump
SUMP—Sump Heater
TD—Time Delay
TM/TD—Time Delay
TPWS—Timer Part Wind Start
UC DISC—Unit Cooler Disconnect
ULS—Unloader Sol.
UPS—Unloading Press. Sw.

FILE# ACADWMT-24

		SCALE:	N/A	ENGINEERING APPROVED BY:
		DATE:	01/04/24	
SUB-TITLE:		ELECTRICAL SCHEM		
		PAGE 5 of 5		

TITLE: WMT-SEC-C02-1/10	QUALITY CONTROL APPROVED BY:	DRAWN BY: RJP
	DRAWING NUMBER: WMT-C02-1/10-200	



WMT-SEC-CO2 1-10 Max Suction

SUCTION LINE PRESSURE DROP DATA

Refrigerant R- 448A
 Evaporator Temperature (°F): -26 (Dew) Equivalent Length (ft): 50
 Liquid Temperature (°F): 100 Line Capacity (tons): 14.5

Vapor Volume (ft³/lbm): 2.458 Vapor Flow Rate (lbm/min): 51.9
 Abs Viscosity (lbf-s/ft²): 2.268e-007

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
2-5/8	2.4650	7.347e+005	3849	0.56	1.1

=====

WMT-SEC-CO2 1-10 Min Suction

SUCTION LINE PRESSURE DROP DATA

Refrigerant R- 448A
 Evaporator Temperature (°F): -26 (Dew) Equivalent Length (ft): 50
 Liquid Temperature (°F): 50 Line Capacity (tons): 7.25

Vapor Volume (ft³/lbm): 2.458 Vapor Flow Rate (lbm/min): 19.5
 Abs Viscosity (lbf-s/ft²): 2.268e-007

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
2-5/8	2.4650	2.760e+005	1446	0.092	0.18

=====

WMT-SEC-CO2 1-10 Max Liquid

LIQUID LINE PRESSURE DROP DATA

Refrigerant R- 448A Vertical Height (ft): 5.0
 Evaporator Temperature (°F): -26 (Dew) Equivalent Length (ft): 50
 Liquid Temperature (°F): 100 Line Capacity (tons): 14.5

Liquid Density (lbm/ft³): 67.25 Liquid Flow Rate (lbm/min): 51.9
 Abs Viscosity (lbf-s/ft²): 2.796e-006

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
7/8	0.7850	1.871e+005	230	3.7	1.1

=====

WMT-SEC-CO2 1-10 Min Liquid

LIQUID LINE PRESSURE DROP DATA

Refrigerant R- 448A Vertical Height (ft): 5.0
 Evaporator Temperature (°F): -26 (Dew) Equivalent Length (ft): 50
 Liquid Temperature (°F): 50 Line Capacity (tons): 7.25

Liquid Density (lbm/ft³): 75.39 Liquid Flow Rate (lbm/min): 19.5
 Abs Viscosity (lbf-s/ft²): 3.973e-006

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
7/8	0.7850	4.948e+004	76.9	2.8	1.4

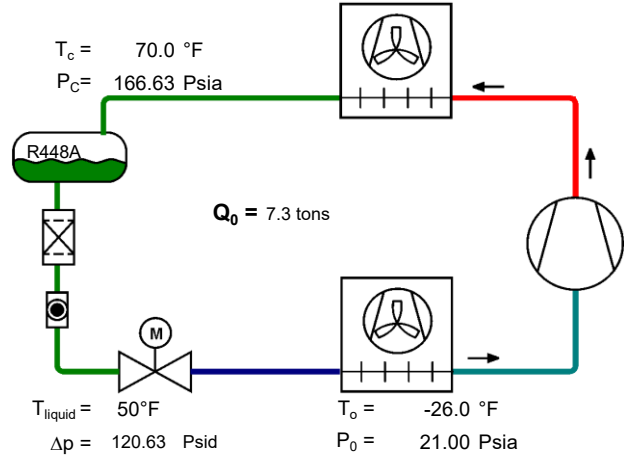
Project: [REDACTED]

Electrical control valves

Expansion valve



Refrigerant: R448A	
Evaporating temperature (Dew Point)	-26.0 °F
Condensing temperature	70.0 °F
Subcooling	20.0 °F
System cooling capacity	7.3 tons
Pressure drop *	25.00 Psid
*) Liquid line, filter drier, solenoid valve, sight glass, liquid distributor and evaporator	



High performance stepper motor ECV



Type	Part No.	MWP	Ratio
EX5-U21	800 618	870 Psid	
EX5-U31	800 619	870 Psid	50% OK

Maximum valve capacity at selected conditions (tons)	
Type	R448A
EX8-M21	257
EX7-M21	96
EX6-M21	35
EX5-U21	15
EX4-M21	4.8

Standard stepper motor EXV (To > -35°C)



Type	Part No.	MWP	Ratio
#N/A	#N/A	#N/A Psid	
#N/A	#N/A	#N/A Psid	#N/A

Type	R448A
FX9-U17	-
FX8-M42	-
FX7.5-U11	-
FX7-U11	-
FX6.5-M28	-
FX6-M28	-
FX5-U07	-

Standard stepper motor EXV (To > -35°C)



Type	Part No.	MWP	Ratio
#N/A	#N/A	#N/A Psid	#N/A

Type	R448A
EXL-B1G	-
EXL-B1F	-
EXM-B0E	-
EXM-B0D	-
EXM-B0B	-
EXM-B0A	-

PWM driven EXV



Orifice

Type	Part No.	MWP	Ratio *
EX2-M00	801 091	40 Psid	
EX2-I00	801 090	40 Psid	
CX2-I00	801 095	90 Psid	

#N/A	#N/A		#N/A
------	------	--	------

R448A		
Type	100%	80% *
EX2/CX2-I00/M00	5.03	4.02
EXO-004	3.19	2.55
EXO-003	2.10	1.68
EXO-002	1.26	1.01
EXO-001	0.94	0.75
EXO-000	0.47	0.37
EXO-00X	0.26	0.21

* 20% oversized valve for PWM function at highest load

ASC3 Coil

Type	Part No.
ASC3-24V 50Hz	801 079
ASC3-230V 50Hz	801 077

#VALUE!

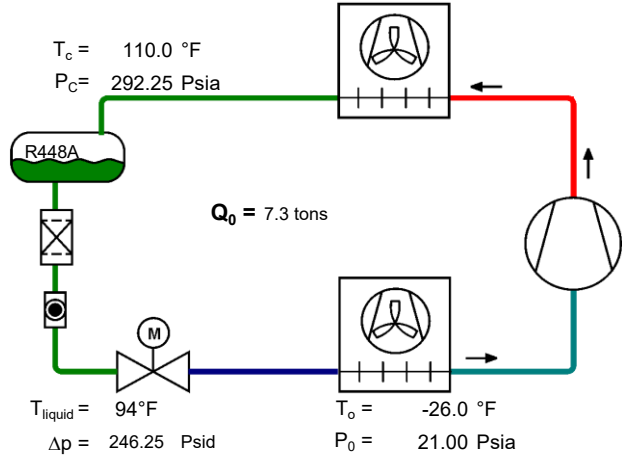
Project: [REDACTED]

Electrical control valves

Expansion valve



Refrigerant: R448A	
Evaporating temperature (Dew Point)	-26.0 °F
Condensing temperature	110.0 °F
Subcooling	16.0 °F
System cooling capacity	7.3 tons
Pressure drop *	25.00 Psid
*) Liquid line, filter drier, solenoid valve, sight glass, liquid distributor and evaporator	



High performance stepper motor ECV



Type	Part No.	MWP	Ratio
EX5-U21	800 618	870 Psid	
EX5-U31	800 619	870 Psid	47% OK

Maximum valve capacity at selected conditions (tons)	
Type	R448A
EX8-M21	273
EX7-M21	103
EX6-M21	37
EX5-U21	16
EX4-M21	5.1

Standard stepper motor EXV (To > -35°C)



Type	Part No.	MWP	Ratio
#N/A	#N/A	#N/A Psid	
#N/A	#N/A	#N/A Psid	#N/A

Type	R448A
FX9-U17	-
FX8-M42	-
FX7.5-U11	-
FX7-U11	-
FX6.5-M28	-
FX6-M28	-
FX5-U07	-

Standard stepper motor EXV (To > -35°C)



Type	Part No.	MWP	Ratio
#N/A	#N/A	#N/A Psid	#N/A

Type	R448A
EXL-B1G	-
EXL-B1F	-
EXM-B0E	-
EXM-B0D	-
EXM-B0B	-
EXM-B0A	-

PWM driven EXV



Orifice

Type	Part No.	MWP	Ratio *
EX2-M00	801 091	40 Psid	
EX2-I00	801 090	40 Psid	
CX2-I00	801 095	90 Psid	

#N/A	#N/A		#N/A
------	------	--	------

R448A		
Type	100%	80% *
EX2/CX2-I00/M00	5.34	4.27
EXO-004	3.39	2.71
EXO-003	2.24	1.79
EXO-002	1.34	1.07
EXO-001	0.99	0.80
EXO-000	0.50	0.40
EXO-00X	0.28	0.22

* 20% oversized valve for PWM function at highest load

ASC3 Coil

Type	Part No.
ASC3-24V 50Hz	801 079
ASC3-230V 50Hz	801 077

#VALUE!

Walmart Secondary CO2 ECU TXV Selection

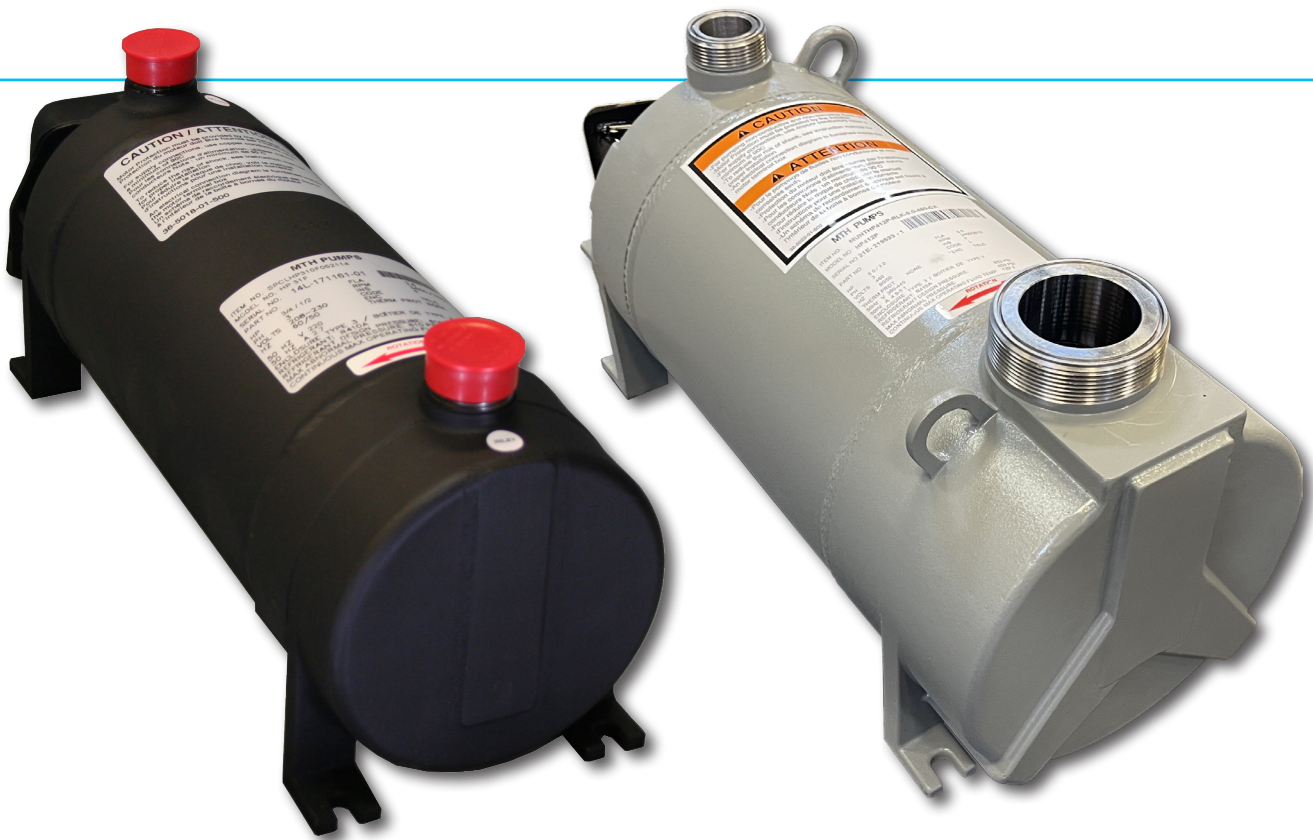
THERMOSTATIC EXPANSION VALVE SELECTION DATA

Refrigerant R- 448A	Liquid Temperature (°F): 100
Evaporator Temperature (°F): 4	Dist & High Side Loss (psi): 17
Condenser Temperature (°F): 114	Evaporator Capacity (tons): 0.350

Subcooling at TEV inlet (°F): 10	ΔP Across TEV (psi): 248
Suggested Thermostatic Charge: VC	

Valve Description	Percentage of Rated Capacity
EGVE-1/2	62

HP Series Hermetic Regenerative Turbine Pump for Freon, CO₂, & other Refrigerants



- Capacities to 45 GPM
- Heads to 450 Feet
- Temperatures to 150°F (66°C)*
- Sealless
- For Non-conductive Fluids
- For Non-corrosive Fluids
- Inverter Duty Motor

* Consult factory for higher temperatures.



MTH PUMPS

www.MTHPumps.com

Hermetic Regenerative Turbine Pumps



MTH HP Series

The HP31, HP41, and HP412 Series line of hermetically sealed regenerative turbine pumps (also known as hermetic or zero emission pumps) is designed to seal, non-conductive, non-corrosive fluids such as freons, CO₂'s, and others, where absolutely leak free performance is required, and mechanical seals simply cannot provide the needed reliability, protection, and performance. All of this is accomplished at a price point previously unseen in the industry, and is often comparable with other mechanically sealed solutions, but without the leaks and inevitable seal maintenance. Exotic non-conductive fluids present no difficulty for these units at fluid temperatures from -58°F (-50°C) up to 150°F (66°C). The hermetic design is far preferable to magnetic drive couplings as it does not add excessive length to the unit in tight OEM enclosures, or suffer from the magnetic de-coupling problems often associated with mag-drive solutions. Two bearings, high strength cast steel components, and CNC welded sealless design assure extended maintenance free life.

Steep Operating Characteristics

Near-constant fluid delivery is maintained over wide variations

in discharge pressure. High shut-off pressures can often overcome temporary line resistances to maintain flow. Superior to Centrifugal pumps when dual speed 50-60 Hertz operation is desired.

Several Sizes Currently Available

Our current models include the HP31F, HP41E, HP41J, HP41P, and HP412P. Horsepowers range from 1 1/2 up to 7 1/2. Contact factory if greater pressures and flows are needed.

Self-Adjusting Impeller

A hydrodynamic film on each side of the impeller centers it in the casing and minimizes friction, which lengthens

pump life. The impeller also exerts no axial thrust load on the bearings.

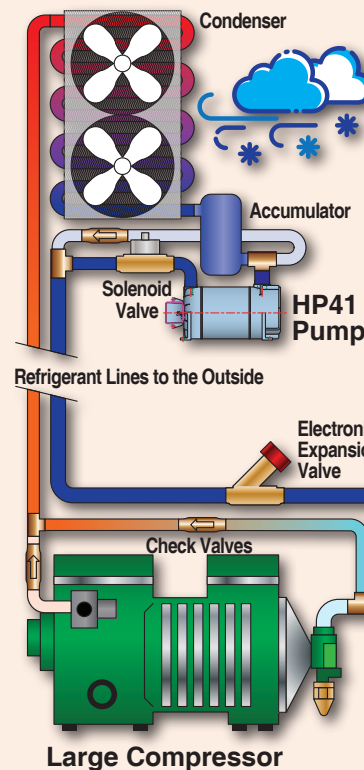
Leak Free Sealless Design

The hermetically sealed pump/motor combination uses the process fluid itself for cooling. Ends down time and maintenance problems associated with mechanical seals. Environmentally safe leak-free design. Each and every pump is tested for barrier and containment integrity before shipment.

Non-Cavitating

Sealless Turbine pumps may be operated under adverse inlet conditions without audible or measurable cavitation if fluid begins to vaporize.

HP Series in Practice



When the outside temperatures become low enough to maintain the desired cooling temperature, there is no need to compress the refrigerant to a higher pressure/temperature.

During colder outdoor temperatures, the system can be switched from running the high electricity consuming compressor to running the much lower horsepower pump and power consumption can be saved.

STANDARD MATERIALS

PART	STANDARD MATERIALS OF CONSTRUCTION*
Inlet	Steel
Discharge	Steel
Impeller	Bismuth Brass (C89836)
Drive Key	316 Stainless Steel
Channel Rings	Ductile Iron
Motor	Steel, Copper, & Aluminum
Thrust Bearings	304 Stainless Steel
Bearings	Carbon

* Other materials may be available for custom OEM consideration. Contact factory for more information

LIMITATIONS

Case Working Pressure	870 PSI
Differential Pressure (Min.)	5 PSI
Speed (Max.)	3450 RPM
Temperature	
Max Ambient	104°F (40°C)
Standard Construction	-58°F (-50°C)* to 150°F (66°C)
Horsepower	
HP31	3/4
HP41	1 1/2, 3
HP412	5, 7 1/2

*Contact Factory for operation below -58°F (-50°C)

Best Efficiency

Designs optimize best efficiency for each size.

Low NPSH Requirements

Like its T31 and T41 Series mechanically sealed counterparts, the HP Series hydraulic passageways are designed to minimize thrust on the self-adjusting impeller to avoid upsetting its hydraulic balance, and to handle low NPSH conditions which can occur in some applications. New to the HP Series is the location of the inlet on the centerline of the impeller

to further eliminate the potential of axial imbalance that sometimes occurs during periods of marginal NPSH availability. With these design features, MTH has eliminated almost all of the bearing thrust loads in these units, and the motor thrust bearings exist only to provide axial rotor positioning. Proper vapor or air purging at startup will help assure that the bearings are properly lubricated and minimize startup wear and priming problems. Rotolock fittings are used for both of these openings to assure a reliable leak-free fit, and to minimize the potential of galling that

can be troublesome if over-tightening should occur.

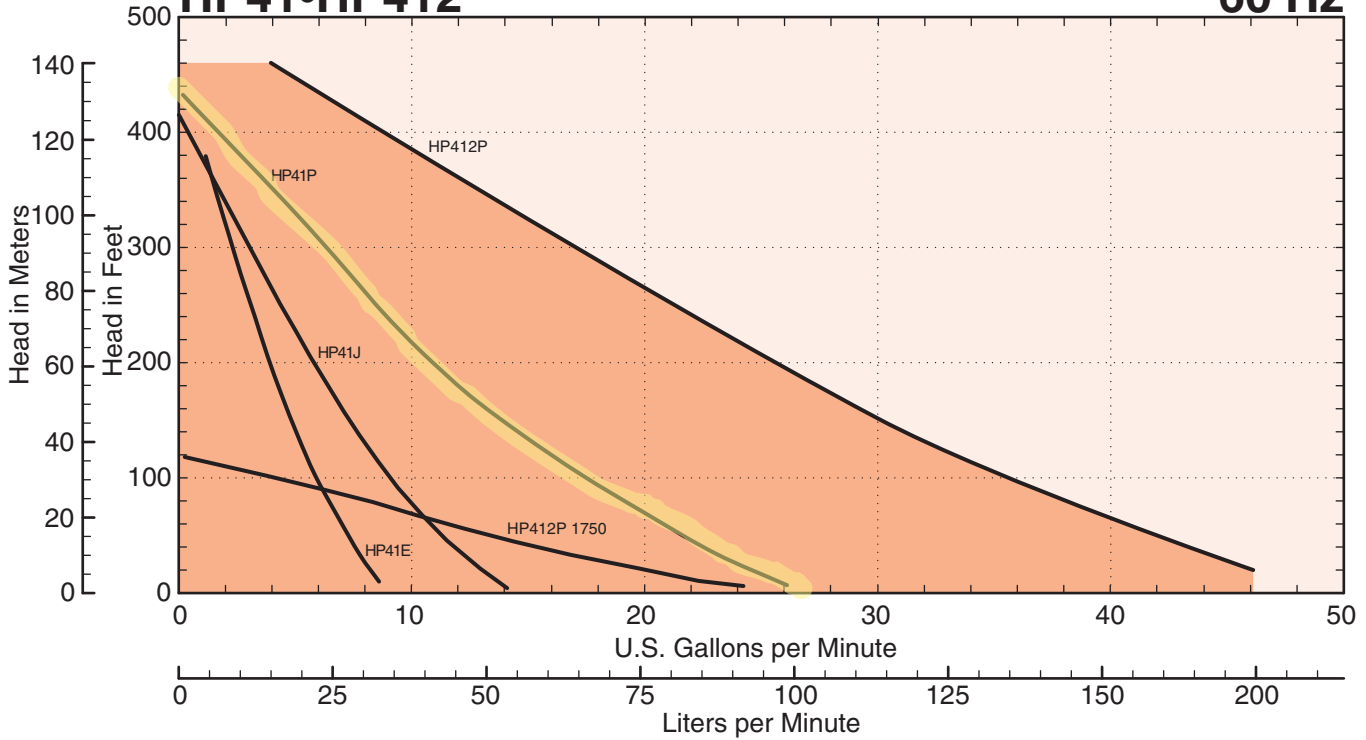
Compact Integrated design

The pump/motor units use two carbon bearings, with the motor rotor positioned between two thrust bearings and the impeller overhung to provide long running life. As with all plain bearing pumps, keeping pumping systems free of solids to prevent bearing failure is important.

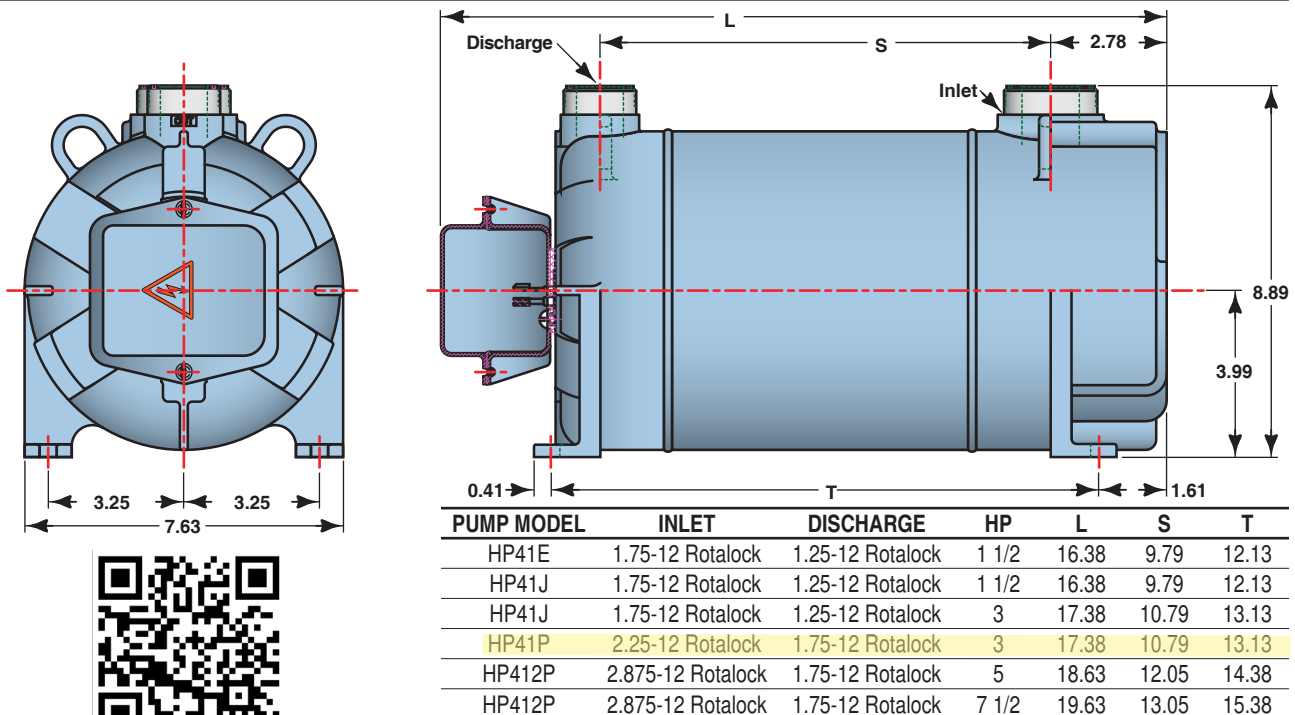
Performance Curves

HP41•HP412

60 Hz



Dimensions



See more HP Series Information



WARNING:
CANCER AND REPRODUCTIVE HARM
WWW.P65WARNINGS.CA.GOV

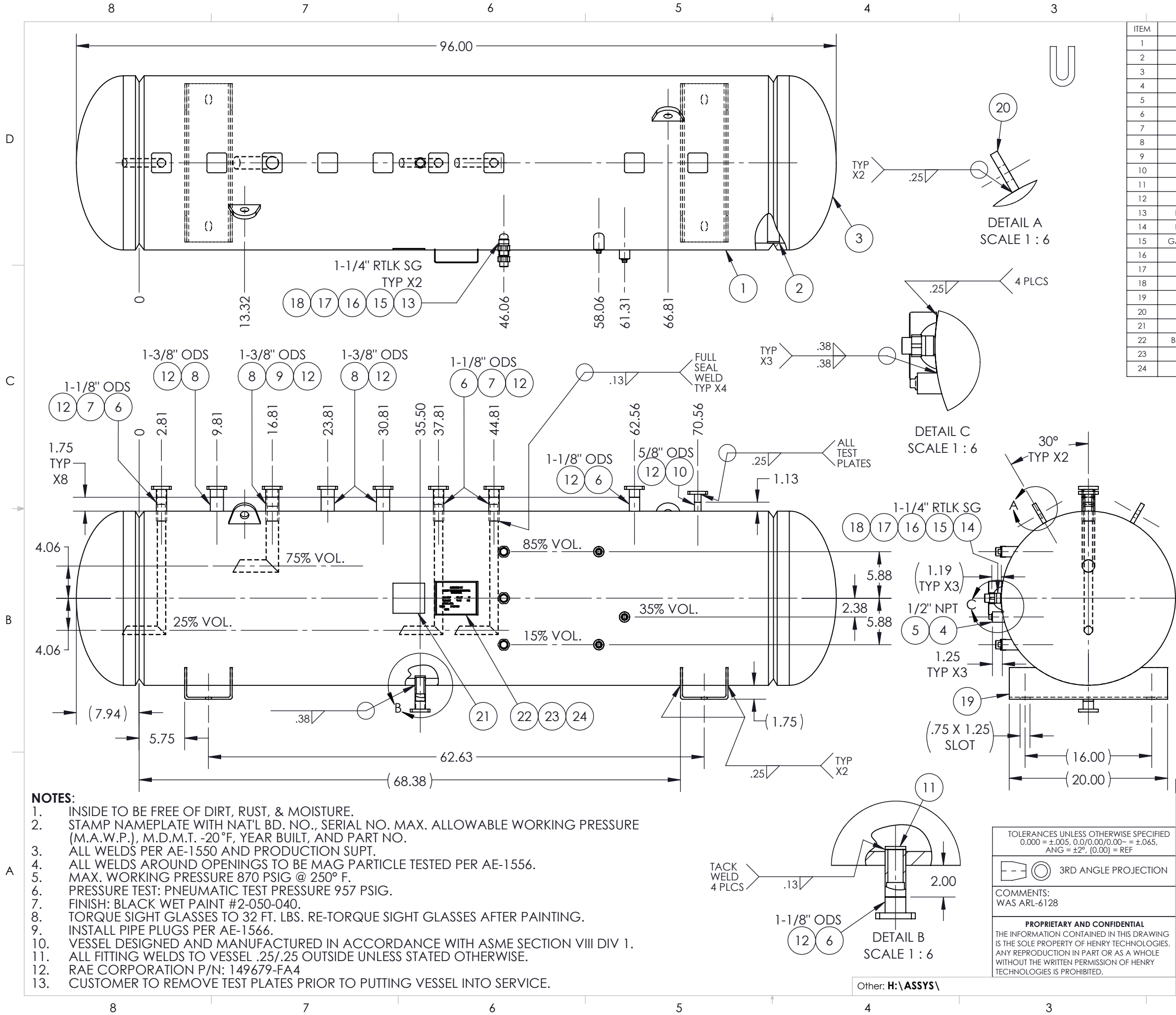


*Manufacturing MTH Pumps
in the USA since 1965*
ISO Registered Company



MTH PUMPS

401 West Main Street • Plano, IL 60545-1436
Phone: 630-552-4115 • Fax: 630-552-3688
Email: Applications@MTHPumps.com
https://www.MTHPumps.com



ITEM	DESCRIPTION	PART NO.	QTY.	MATERIAL
1	SHELL, 22" OD X .875W	3-002-3943	1	SA-106 GR.B
2	ASME BACKING RING, 24" NPS	2-038-812	2	SA-36/SA-1008
3	HEAD - 22"OD X 0.875"THK	2-003-679	2	
4	FITTING - 1/2" NPT	3-009-879	3	SA-106 GR.B
5	PIPE PLUG -1/2" NPT	2-009-004	3	1215 CRS.
6	FITTING 1-1/8 IDS X 4.0 " L	3-009-640W	5	SA-106 GR. B
7	DIPTUBE, 1-1/8" OD	3-012-1190	3	SAE J-525 C.D. GR. 1010
8	FITTING, 1-3/8" ODS, BW	3-009-1692W	4	SA 106 GR.B
9	DIPTUBE, 1-5/8" OD	3-012-1189	1	A513 TYPE 5 GR 1020
10	FTG, 5/8" ODS X 5/8" OD, BW	3-009-1136W	1	SA-106 GR.B
11	VORTEX BREAKER, 1" NPS	3-047-788	1	A/SA-36, -1011, -1008
12	TEST PLATE, 2.5" X 2.5" X 3/8"	3-047-739	10	A/SA-36,-1008,-1011
13	RTALK SPUD 1-1/4"-12 X 3.50"LG	2-009-695	2	SA-106 GR.B
14	RTALK SPUD 1-1/4"-12 X 3.04"LG	2-009-688	1	SA-106 GR.B
15	GASKET 1 1/4"-12 ROTOLOCK SPUD	2-023-015	3	Teflon PTFE
16	ROTOLOCK GLASS W/BALL	3-020-067A	3	A108 GR. 1215 & GLASS
17	SLIP NUT 1-1/4"-12 ROTALOCK	2-015-018	3	A108 GR. 1215
18	PROTECTOR-MASKING DISK	2-024-105	3	POLYESTER
19	SADDLE BRACKET 22" OD	3-019-863	2	A/SA-36, A/SA-1011
20	LIFT BKT, 4" X 2.75" X 1/2"	3-019-694	2	A/SA-36, S/SA-1011
21	PRODUCT LABEL	1-026-002	1	MATTE CHROME POLYESTER
22	BRACKET, NAMEPLATE STANDOFF	2-019-749	1	Carbon Steel (P-No.1)
23	ASME NAMEPLATE	2-026-612	1	AISI 304
24	NAMEPLATE MASKING	2-024-116	1	Tape Masking

Customer Approval

☐ A – Approved with no comments or changes.

☐ B – Approved with editorial changes/comments only.

☐ C – Not approved until changes are made.

X _____ Date _____

- NOTES:**
1. INSIDE TO BE FREE OF DIRT, RUST, & MOISTURE.
 2. STAMP NAMEPLATE WITH NAT'L BD. NO., SERIAL NO. MAX. ALLOWABLE WORKING PRESSURE (M.A.W.P.), M.D.M.T. -20°F, YEAR BUILT, AND PART NO.
 3. ALL WELDS PER AE-1550 AND PRODUCTION SUPT.
 4. ALL WELDS AROUND OPENINGS TO BE MAG PARTICLE TESTED PER AE-1556.
 5. MAX. WORKING PRESSURE 870 PSIG @ 250° F.
 6. PRESSURE TEST: PNEUMATIC TEST PRESSURE 957 PSIG.
 7. FINISH: BLACK WET PAINT #2-050-040.
 8. TORQUE SIGHT GLASSES TO 32 FT. LBS. RE-TORQUE SIGHT GLASSES AFTER PAINTING.
 9. INSTALL PIPE PLUGS PER AE-1566.
 10. VESSEL DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ASME SECTION VIII DIV 1.
 11. ALL FITTING WELDS TO VESSEL .25/.25 OUTSIDE UNLESS STATED OTHERWISE.
 12. RAE CORPORATION P/N: 149679-FA4
 13. CUSTOMER TO REMOVE TEST PLATES PRIOR TO PUTTING VESSEL INTO SERVICE.

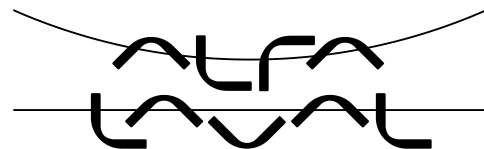
TOLERANCES UNLESS OTHERWISE SPECIFIED
0.000 = ±.005, 0.0/0.00/0.00 = ±.065,
ANG = ±2°, (0.00) = REF

3RD ANGLE PROJECTION

COMMENTS:
WAS ARL-6128

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REV.	ECO	DESCRIPTION	DATE	BY
NEXT ASSY.:			SIM. TO:	
STOCK SIZE:			MATERIAL: CARBON STEEL	
SIZE:			WEIGHT: 1660.476 LBS	
DESCRIPTION:				
SURGE TANK, HORZ, 22" X 96" LG				
SHEET: 1 OF 1			HENRY INCORPORATED	
SCALE: 1:12				
DRAWN: DAP				
DATE: 11/20/2023		DRAWING NO./PART NO.:		REV:
APPROVED:		S-8890A-HP		-



Brazed Plate Heat Exchanger

Technical Specification

Model : CBXP52-150HDS-F(30751 3040 5)
Item name : Walmart Cascade 180mbh Dual 444A Date: 1/10/2024
Units : 2

		Hot Side	Cold side
		Secondary side	Primary side(S4)
Fluid		Carbon dioxide	R448A
Mass flow rate	lb/h	691.4	1472
Fluid Condensed/Vapourized	lb/h	691.4	837.9
Inlet temperature	°F	-20.0	-26.8
Dew p.	°F	-20.0	-26.0
Outlet temperature(vapor/liquid)	°F	-20.0/-21.3	-21.0
Operating pressure(in/out)	psia	215/215	52.3/20.0
Pressure drop	psi	0.0319	32.4
Velocity connection(in/out)	ft/s	10.5/0.477	100/135
Heat exchanged	kBtu/h	90.00	
Heat transfer area	ft²	81.25	
OHTC clean conditions	Btu/(ft²·h·°F)	300.0	
OHTC service	Btu/(ft²·h·°F)	259.8	
Fouling resistance*10000	ft²·h·°F/Btu	0.0	
Margin	%	15.5	
Mean Temperature Difference	°F	4.3	
Relative directions of fluids		Countercurrent	
Number of passes		1	1
Materialplate/ brazing		Alloy 316 / Cu	
ConnectionS1 (Hot-in)		Soldering/ 1 3/8" (L24XP) Alloy 304	
ConnectionS2 (Hot-out)		Soldering/ 1 1/8" (H21XP) Alloy 304	
ConnectionS3 (Cold-in)		Sold for Distributor/ 1 1/8" (Q21XP) Alloy 304	
ConnectionS4 (Cold-out)		Soldering/ 1 3/8" (L24XP) Alloy 304	
Pressure vessel code		UL	
Design pressure at -321.000000 Fahrenheit	Psig	1190	1190
Design pressure at 400.000000 Fahrenheit	Psig	1190	1190
Design temperature	°F	-320.8/400.0	
Overall length x width x height	in	16 x 4 x 21	
Net weight, empty / operating	lb	80.2 / 111	

Performance is conditioned on the accuracy of customers data and customers ability to supply equipment and products in conformity therewith.

Physical Properties

(inlet/outlet)	Hot Side Liquid	Vapour	Cold side Liquid	Vapour
Dens	66.86/66.85	2.405/2.410	82.04/81.95	0.4271/0.3847
Sp.heat	0.4973/0.4971	0.2758/0.2765	0.3100/0.3047	0.1990/0.1959
Visc	0.161/0.161	0.0124/0.0124	0.307/0.316	0.0102/0.0102
Th.Cond	0.0829/0.0829	0.0081/0.0081	0.0617/0.0577	0.0055/0.0056
Bub. p.		-20.0/-20.0		/-36.9
Dew p.		-20.0/-20.0		/-26.0
Mol.W.		44.01/44.01		86.28/86.28
Cr.pr.		1069.99/1069.99		675.59/675.59
Cr.Temp.		87.8/87.8		182.7/182.7
Lat.heat		129.5/129.5		102.3/97.3



Brazed Plate Heat Exchanger

Technical Specification

Model : CBXP52-150HDS-F(30751 3040 5)
Item name : Walmart Cascade Dual R448A: -10F Date: 5/2/2024
Units : 2

		Hot Side Secondary side	Cold side Primary side(S4)
Fluid		Carbon dioxide	R448A
Mass flow rate	lb/h	718.0	1487
Fluid Condensed/Vapourized	lb/h	718.0	848.9
Inlet temperature	°F	-10.0	-18.2
Dew p.	°F	-10.0	-16.0
Outlet temperature(vapor/liquid)	°F	-10.0/-11.6	-11.0
Operating pressure(in/out)	psia	257/257	53.7/25.5
Pressure drop	psi	0.0261	28.1
Velocity connection(in/out)	ft/s	9.06/0.507	82.9/109
Heat exchanged	kBtu/h	90.00	
Heat transfer area	ft ²	81.25	
OHTC clean conditions	Btu/(ft ² ·h·°F)	292.4	
OHTC service	Btu/(ft ² ·h·°F)	227.9	
Fouling resistance*10000	ft ² ·h·°F/Btu	0.0	
Margin	%	28.3	
Mean Temperature Difference	°F	4.9	
Relative directions of fluids		Countercurrent	
Number of passes		1	1
Materialplate/ brazing		Alloy 316 / Cu	
ConnectionS1 (Hot-in)		Soldering/ 1 3/8" (L24XP) Alloy 304	
ConnectionS2 (Hot-out)		Soldering/ 1 1/8" (H21XP) Alloy 304	
ConnectionS3 (Cold-in)		Sold for Distributor/ 1 1/8" (Q21XP) Alloy 304	
ConnectionS4 (Cold-out)		Soldering/ 1 3/8" (L24XP) Alloy 304	
Pressure vessel code		UL	
Design pressure at -321.000000 Fahrenheit	Psig	1190	1190
Design pressure at 400.000000 Fahrenheit	Psig	1190	1190
Design temperature	°F	-320.8/400.0	
Overall length x width x height	in	16 x 4 x 21	
Net weight, empty / operating	lb	80.2 / 111	

Performance is conditioned on the accuracy of customers data and customers ability to supply equipment and products in conformity therewith.

Physical Properties

(inlet/outlet)	Hot Side Liquid	Vapour	Cold side Liquid	Vapour
Dens	65.35/65.34	2.894/2.900	81.10/80.85	0.5171/0.4852
Sp.heat	0.5089/0.5088	0.2947/0.2953	0.3126/0.3082	0.2039/0.2009
Visc	0.147/0.147	0.0127/0.0127	0.287/0.292	0.0104/0.0104
Th.Cond	0.0791/0.0790	0.0086/0.0086	0.0602/0.0564	0.0057/0.0058
Bub. p.		-10.0/-10.0		/-26.9
Dew p.		-10.0/-10.0		/-16.0
Mol.W.		44.01/44.01		86.28/86.28
Cr.pr.		1069.99/1069.99		675.59/675.59
Cr.Temp.		87.8/87.8		182.7/182.7
Lat.heat		124.6/95.5		100.6/95.6

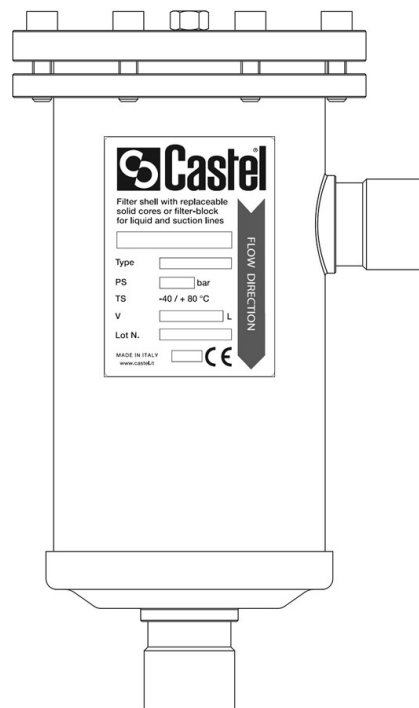
Product Code

4411E/9AF

Solid Core Drier Shell CO2

1.1/8"ODS

PS = 62 bar - ND PSI



Product use

Dryers for the liquid line that allow the replacement of the dryer elements, so-called cartridges. Accessories for use with refrigerant R744.

Product details

Connections ODS Ø [in.] 1.1/8"

Connections ODS Ø [mm] -

W Ø [mm] 33,7

Cores type 4490/B4490/AB4490/BB4490/E

N° of cores 1

Nominal volume [cm³] 800

PS [bar] 62

MWP [psi] (1) ND

TS [°C] min. -40

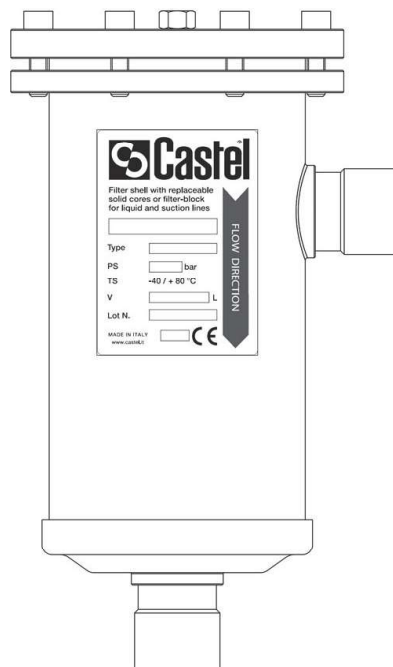
TS [°C] max. +80

Package pcs 1

Product Code

4411E/5AF

Solid Core Drier Shell CO2
5/8"- 16 mm ODS



Product use

Dryers for the liquid line that allow the replacement of the dryer elements, so-called cartridges.
Accessories for use with refrigerant R744.

Product details

Connections ODS Ø [in.] 5/8"

Connections ODS Ø [mm] 16

W Ø [mm] 21,3

Cores type 4490/B4490/AB4490/BB4490/E

N° of cores 1

Nominal volume [cm³] 800

PS [bar] 62

MWP [psi] (1) ND

TS [°C] min. -40

TS [°C] max. +80

Package pcs 1



SPORLAN

Ball Valve with Integral Pressure Relief

Type EBV(T)-PR



ENGINEERING YOUR SUCCESS.



BALL VALVE WITH INTEGRAL PRESSURE RELIEF EBV(T)-PR Series

For greater system design flexibility and increased productivity, specify the **EBV(T)-PR Ball Valve with Integrated Pressure Relief**. This compact solution eliminates the check valve and associated brazing involved when piping a ball valve and check valve in parallel to protect a system from over pressurization.

- Compact design **simplifies installation**
- Eliminates the check valve and associated piping, resulting in significant **material cost savings**
- Decreases braze joints resulting in **labor savings and increased productivity**
- Minimizes the potential for leaks and decreases nuisance call-backs

FEATURES

- Allows for positive shut-off in one direction and flow in the other direction whenever pressure differential is present. (The integrated pressure relief feature is one direction only.)
- Protects system from pressure spikes when servicing equipment.
- Welded body joint. Factory tested to ensure positive, leak-free performance. Forged brass body construction with extended copper fittings. Optional access fitting versions available.
- Full size ports for unrestricted flow on most sizes, 3/8" (10 mm) through 1-1/8" (28 mm).
- Dual Teflon seals surround the polished, brass ball to prevent leakage. Stem seal and stem washer provide the primary stem seal. Bottom load stem for safety.

- Stainless steel stop plate ensures fully open to fully closed with a 1/4 turn.
- All EBV(T)-PR ball valves may be installed in any position.
- All EBV(T)-PR ball valves use C19400 (K65) copper fitting material.

SPECIFICATIONS

- Continuous temperature range: -40 deg F to 248 deg F (-40 deg C to 120 deg C)
- Installation temperature (15 minutes max.) limit: 300 deg F (149 deg C)
- Design working pressure: 1,305 psig (90 barg)
- Integral Pressure Relief
 - Crack open pressure: <5 psid
 - Full open pressure: 50 psid
 - Wide open flow: 1.93 gpm H₂O @ 50 psid
- For refrigeration or air conditioning systems
- Suitable for use with Class A1 refrigerants: HFC, HCFC, HFO (nontoxic and nonflammable), and CO₂.
- U.S. Patent 10,107,406; EP3295067; and other International Patents Pending
- U.L. Recognized, File No SA5460 (SFJQ2)
- CE and RoHS Compliant
- Date code is YYMMDD

The EBV(T)-PR valve will close in one direction and relieve pressure in the other direction. This single valve would replace a current ball valve plus a check valve plumbed around the ball valve. Allows evaporator coil to be isolated without over pressurizing due to warm up. May also have needs in loop piping and at the rack.

The symbol 'A' indicates the pressure relief side of the valve. Any pressure build up on the 'A' side with the ball valve in the closed position can relieve to the other side of the ball valve. When used on an evaporator coil, the 'A' side of the valve should always be on the coil side of the valve. (See Figure 1.)

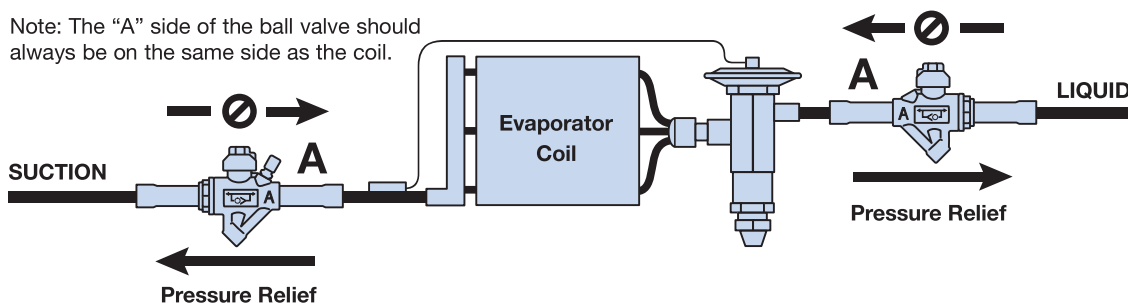


This symbol indicates the direction of pressure relief and direction of check valve feature. Flow from left to right is check direction. Flow from right to left is pressure relief direction.

IMPORTANT: This valve has a pressure relief feature in one direction only. If installed incorrectly, pressures may drastically increase causing rupture of valve, piping and/or other components exposed to such pressure. This could cause damage to equipment and cause injury or possible death to anyone in the area.

Figure 1 - Valve Closed for Evaporator Service

Note: The "A" side of the ball valve should always be on the same side as the coil.



DIMENSIONS

EBV(T)-PR Series - Inches

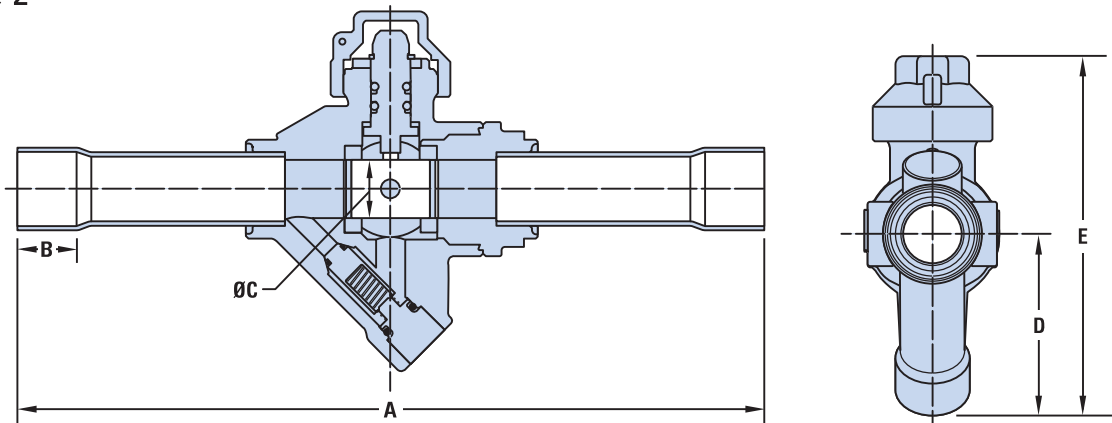
Part Number	Model Number	Connection (ODF)	Overall Length A	Socket Depth B	Port Size C	D	Overall Height E	Cv
502199	EBV-PR1030	3/8	6.50	0.31	0.50	1.56	3.08	4.3
502200	EBV-PR1040	1/2	6.50	0.38	0.50	1.56	3.08	7.0
502201	EBV-PR1050	5/8	6.50	0.50	0.50	1.56	3.08	13.9
502202	EBV-PR1060	3/4	7.25	0.61	0.75	1.79	3.59	21.0
502203	EBV-PR1070	7/8	7.25	0.75	0.75	1.79	3.59	30.3
502204	EBV-PR1090	1-1/8	8.50	0.91	1.00	2.13	4.11	61.3
502205	EBVT-PR1030*	3/8	6.50	0.31	0.50	1.56	3.08	4.3
502206	EBVT-PR1040*	1/2	6.50	0.38	0.50	1.56	3.08	7.0
502207	EBVT-PR1050*	5/8	6.50	0.50	0.50	1.56	3.08	13.9
502208	EBVT-PR1060*	3/4	7.25	0.61	0.75	1.79	3.59	21.0
502209	EBVT-PR1070*	7/8	7.25	0.75	0.75	1.79	3.59	30.3
502210	EBVT-PR1090*	1-1/8	8.50	0.91	1.00	2.13	4.11	61.3

EBV(T)-PR Series - Millimeters

Part Number	Model Number	Connection (ODF)	Overall Length A	Socket Depth B	Port Size C	D	Overall Height E	Kv
502399	EBV-PR 10MM	10 mm	165.1	8	12.7	39.6	78.2	3.7
502400	EBV-PR 12MM	12 mm	165.1	10	12.7	39.6	78.2	6.0
502401	EBV-PR 16MM	16 mm	165.1	13	12.7	39.6	78.2	12.0
502402	EBV-PR 18MM	18 mm	184.1	17	19.1	45.5	91.3	18.1
502403	EBV-PR 22MM	22 mm	184.1	20	19.1	45.5	91.3	26.2
502405	EBV-PR 28MM	28 mm	216.0	24	25.4	54.2	104.3	53.0
502406	EBVT-PR 10MM*	10 mm	165.1	8	12.7	39.6	78.2	3.7
502407	EBVT-PR 12MM*	12 mm	165.1	10	12.7	39.6	78.2	6.0
502408	EBVT-PR 16MM*	16 mm	165.1	13	12.7	39.6	78.2	12.0
502409	EBVT-PR 18MM*	18 mm	184.1	17	19.1	45.5	91.3	18.1
502410	EBVT-PR 22MM*	22 mm	184.1	20	19.1	45.5	91.3	26.2
502411	EBVT-PR 28MM*	28 mm	216.0	24	25.4	54.2	104.3	53.0

* With access fitting.

Figure 2



NOMENCLATURE

Inches - Example: EBVT-PR1030

EBV	T	-	PR	1	03	0
Valve Type	Access Fitting	Pressure Relief	Series: 1 = Full Port 2 = Reduced Port	Fitting Size: (In eighths of an inch): 03 = 3/8"	Fitting Configuration: 0 = ODF x ODF	

Millimeters - Example: EBVT-PR 12MM

EBV	T	-	PR	12mm
Valve Type	Access Fitting	Pressure Relief	Metric Fitting Size	Fitting Configuration: ODF x ODF

INSTALLATION

Brazing Instructions

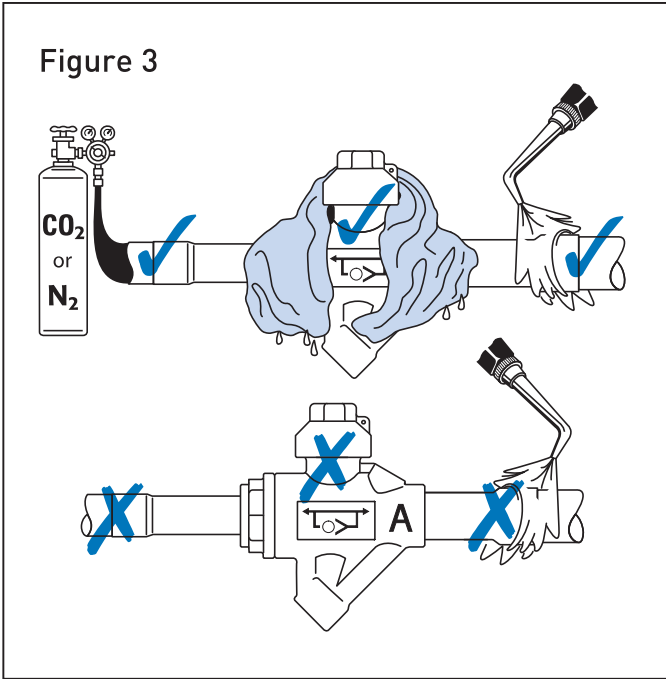
- DO NOT DISASSEMBLE.**
- WRAP THE BODY OF THE VALVE WITH A WET RAG** (to dissipate heat-overheating causes damage).
- Bleed dry nitrogen or CO₂ through the valve while brazing.
- Use flux with silver brazing alloys.
- Flux not required with phoscopper alloys, on copper to copper joints, but flux is recommended for deeper penetration and more uniform results with all alloys.
- Use large enough torch to rapidly heat joint to brazing temperature. Direct flame away from existing copper to brass joints.
- Quench to reduce heat spread after brazing.

OPERATION NOTES

- Remove seal cap. **CAUTION:** Pressure may be under seal cap, remove slowly.
- Rotate stem using adjustable wrench. Turn 90° against the mechanical stops. Align open arrow with refrigerant line for non-directional flow. Turn clock-wise to close; counter-clockwise to open.
- This valve contains mechanical stops. **DO NOT USE EXCESSIVE FORCE AGAINST STOPS OR PERMANENT DAMAGE MAY OCCUR.**
- Install seal cap.
- Valves are designed for use with Class A1 refrigerants: HFC, HCFC, HFO (nontoxic and nonflammable), and CO₂.

REPLACEMENT STEM CAPS

Connection	Part Number
3/8 - 5/8	183390
3/4 - 1-1/8	183391



NOTICE:
DO NOT DISASSEMBLE VALVE FOR ANY REASON.
IF THE STOP PLATE IS DAMAGED OR MISSING,
REMOVE THE VALVE FROM SERVICE.

NOTE:
WARRANTY IS VOID IF THESE INSTRUCTIONS ARE NOT FOLLOWED.

⚠ WARNING – USER RESPONSIBILITY

Failure or improper selection or improper use of the products described herein or related items can cause death, personal injury and property damage.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

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INT275 L[®] Level monitor

INT275 L[®]



INT275 L

Application

The optical level monitoring INT275 L is employed for contactless single point measurement of fluid levels, e.g. on compressors, pumps, tanks, etc. The solution consists of a screw-in part and an evaluation unit. The screw-in part for optical level monitoring is permanently built-in at the measuring point. The electronic evaluation unit can be mounted or replaced without opening the circuit of the medium to be monitored.

Functional description

Light pulses of the device are refracted in fluids and reflected in gaseous environments. This allows the INT275 L to detect the fluid level reliably.

Level monitoring begins 3 seconds after supply voltage has been connected.

Time-delayed reaction prevents switching errors that can be caused by temporary fluctuations of the fluid.

If the level is too low or if there is an error, the relay drops out.

Once the correct level has been reached again or the error has been rectified, the relay energises again.

The potential-free, normally open contact can be looped into a safety circuit without an auxiliary relay.

An integrated own monitoring system ensures high reliability; an installation check monitors the proper assembly.

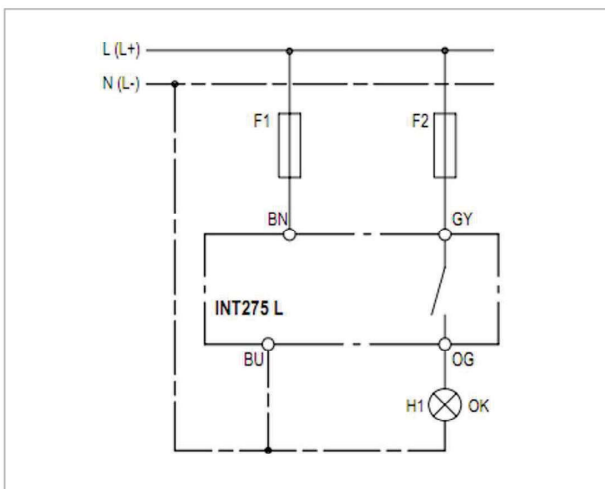
Installation instructions

1. Ensure cleanliness of thread and glass of the screw-in part.
2. Mount evaluation unit into the screw-in part. The cable outlet has to point downwards here.
3. Tighten the coupling ring hand tight.

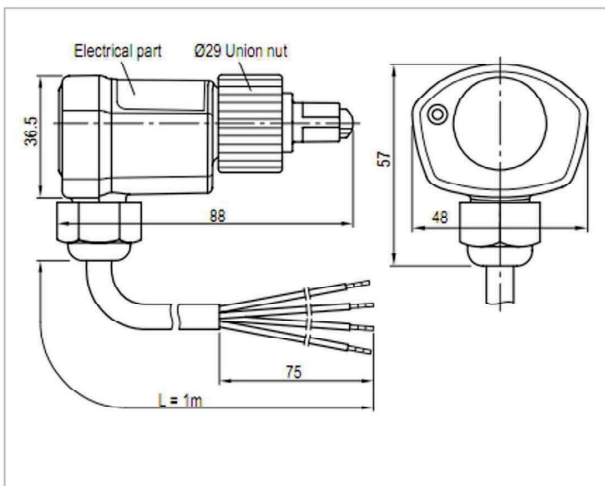


The mounting, maintenance and operation are to be carried out by an electrician. The valid European and national standards for connecting electrical equipment have to be observed.

See back side for further specifications



Wiring diagram



Dimensions in mm

Technical changes reserved

INT275 L[®] Level monitor



INT275 L[®]

Technical specifications

Supply voltage	
- 52 S 475 ...	AC 50/60Hz 230V $\pm 10\%$ 3VA
- 41 S 475 ...	AC 50/60Hz 115V $\pm 10\%$ 3VA
- 20 S 475 ...	AC/DC 50/60Hz 24V $\pm 10\%$ 3VA
Permitted ambient temperature	-30...+60°C
Medium temperature	Max. +80°C
Permitted rel. humidity	10-95% r. h. no condensation
Switch delay	
- After applying the supply voltage	3s ± 1 s
- Level missing or fault	5s ± 2 s
- Level good and no fault	5s ± 2 s
Relay	
- Contact	AC 240V 2.5A C300 at least AC/DC 24V 20mA
- Mechanical service life	Approx. 1 million switching cycles
Protection class acc. to EN 60529	IP54 in mounted condition
Connection type	Cable 4 x AWG 18/7
Housing material	PA glass-fibre-reinforced
Mounting	Union nut (torque max. 10Nm)
Dimensions	Refer to dimensions in mm
Weight	Approx. 160g
Check base	EN 61000-6-2, EN 61000-6-3 EN 61010-1 Overvoltage category II Pollution level 2
Approval	UL File No. E222056 eUR _{us}

Order data

INT275 L Level monitor (AC 230V)	52 S 475 S60
INT275 L Level monitor (AC 115V)	41 S 475 S60
INT275 L Level monitor (AC/DC 24V)	20 S 475 S60
Accessories and application information	see www.kriwan.com

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Technical Bulletin

EXD-SH1/2 are stand-alone universal superheat and or temperature controllers for air conditioning units or refrigeration systems.

Features

- EXD-SH1: Control of one valve
- **EXD-SH2: Control of two valves in two independent circuits**
- Main function

	Circuit 1	Circuit 2
EXD-SH1	Superheat or temperature control	
EXD-SH2	Superheat or temperature control	Superheat Control

- Other functions: Limitation of evaporating pressure (MOP), Low pressure switch, freeze protection and manual positioning of valve(s)
- Self-adapting superheat control function in conjunction with EMERSON EX4-8 (EX4-7-FLR) and CV4-7 series
- For multiple refrigerants, including ultralow temperature refrigerant R23
- Modbus (RTU) communication
- Integrated keyboard with two lines display
- Monitoring of sensors and detection of sensor (ECN.../TP1.../PT5N...(FLR)) /stepper motor wiring failures
- Optional upload/download key (accessory) for transmission of parameter settings among controllers with the same setting
- Low/high superheat alarm as well as other function alarms
- Electrical connection via plug-in type screw terminals included with controller and Micro Molex EXD-M03 (must be ordered separately)
- DIN rail mounting housing



EXD-SH2



EXD-M03

Selection table

Type	Description	Part No.	
		Multipack (pcs)	Single pack
Controllers			
EXD-SH1	Controller for single refrigeration circuit	-	807855
EXD-SH2	Controller for two independent refrigeration circuits	-	807856
EXD-M03	Molex terminal with 3 m wires	-	807865
Temperature sensors			
TP1-NP3	Temperature sensor with 3 m cable	804489M (20)	804489
TP1-NP6	Temperature sensor with 6 m cable	804490M (20)	804490
ECN-Z60	Ultralow Temperature sensor with 6 m cable	-	807826
Pressure transmitters: PT5N (7/16-20UNF connection)			
PT5N-07M	Sensing pressure range -0.8...7 bar	805350M (25)	805350
PT5N-18M	Sensing pressure range 0...18 bar	805351M (25)	805351
PT5N-30M	Sensing pressure range 0...30 bar	805352M (25)	805352
PT5N-50M	Sensing pressure range 0...50 bar	805353M (25)	805353
PT5N-150D	Sensing pressure range 0...150 bar (1/4- 18 NPT)	805379M (25)	805379
Pressure transmitters: PT5N (Brazing connection)			
PT5N-07T / PT5N-07P-FLR	Sensing pressure range -0.8...7 bar	805380M / 805390M (25)	805380 / 805390
PT5N-010P-FLR	Sensing pressure range -0.8...10 bar	805391M (25)	805391
PT5N-18T	Sensing pressure range 0...18 bar	805381M (25)	805381
PT5N-30T / PT5N-30P-FLR	Sensing pressure range 0...30 bar	805382M / 805389M (25)	805382 / 805389
PT5N-50T	Sensing pressure range 0...50 bar	805383M (25)	805383

Note: Pressure range 18 bar for system with R410A, 30 bar for R410A economizer, 50/150 bar for CO₂

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Accessories

Type	Description	Part No.	
		Multipack (20 pieces)	Single pack
M12 Plug and cable for pressure transmitters PT5N(FLR)			
PT4-M15	1.5 m	804803M	804803
PT4-M30	3.0 m	804804M	804804
PT4-M60	6.0 m	804805M	804805
PT4-M60 FLR	6.0 m	-	804806
Uninterruptible Power supply			
ECP-024	Backup battery with two outputs for two controllers	-	804558
K09-P00	Electrical Terminal Kit for ECP-024	-	804560
EXD-PM	Super cap for only EXD-SH1 (two pieces of EXD-PM required for one EXD-SH2)	-	807854

Note: ⚠ Warning -Flammable refrigerants: EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

Description of functions

Controllers are featured with a main function as superheat controller or temperature controller. The main function is selectable.

Superheat control of evaporators or economizers

This function requires the connection of temperature sensor(s) as well as pressure transmitters(s). The other functions are:

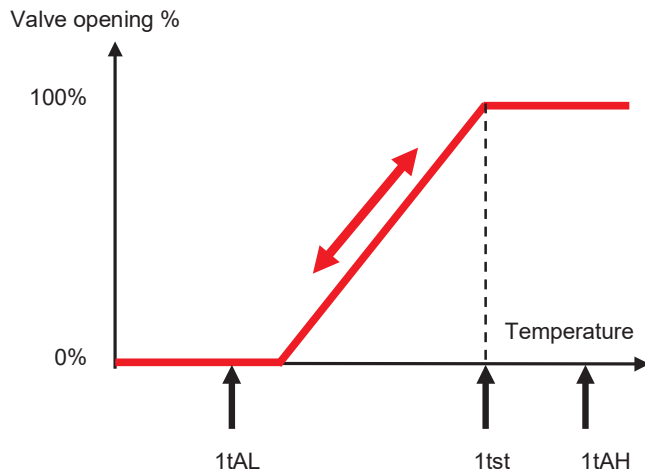
- MOP control: enables the limitation of saturated temperature of suction line (outlet of evaporator/economizer)
- Low pressure behaves similar to low pressure switch including alarm conditions
- Freeze protection is based on saturated temperature from converting measuring suction pressure. It provides alarm condition below certain adjusted temperature.

Temperature controller

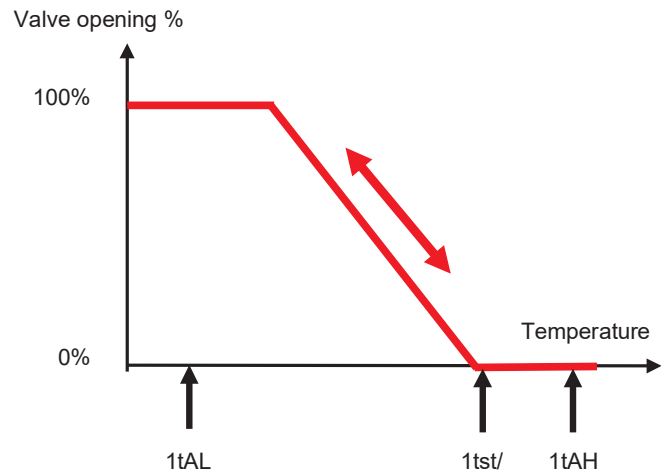
The function is to maintain desired temperature by modulating refrigerant mass flow. If controller is operated as temperature controller, the connection of pressure transmitter is not required.

In order to fulfill varieties of the applications, the refrigerant mass flow variation can be set according temperature increase or decrease.

**Temperature control in normal sense
(A: Mass flow increases if temperature rises)**



**Temperature control in reverse sense
(B: Mass flow decreases if temperature rises)**

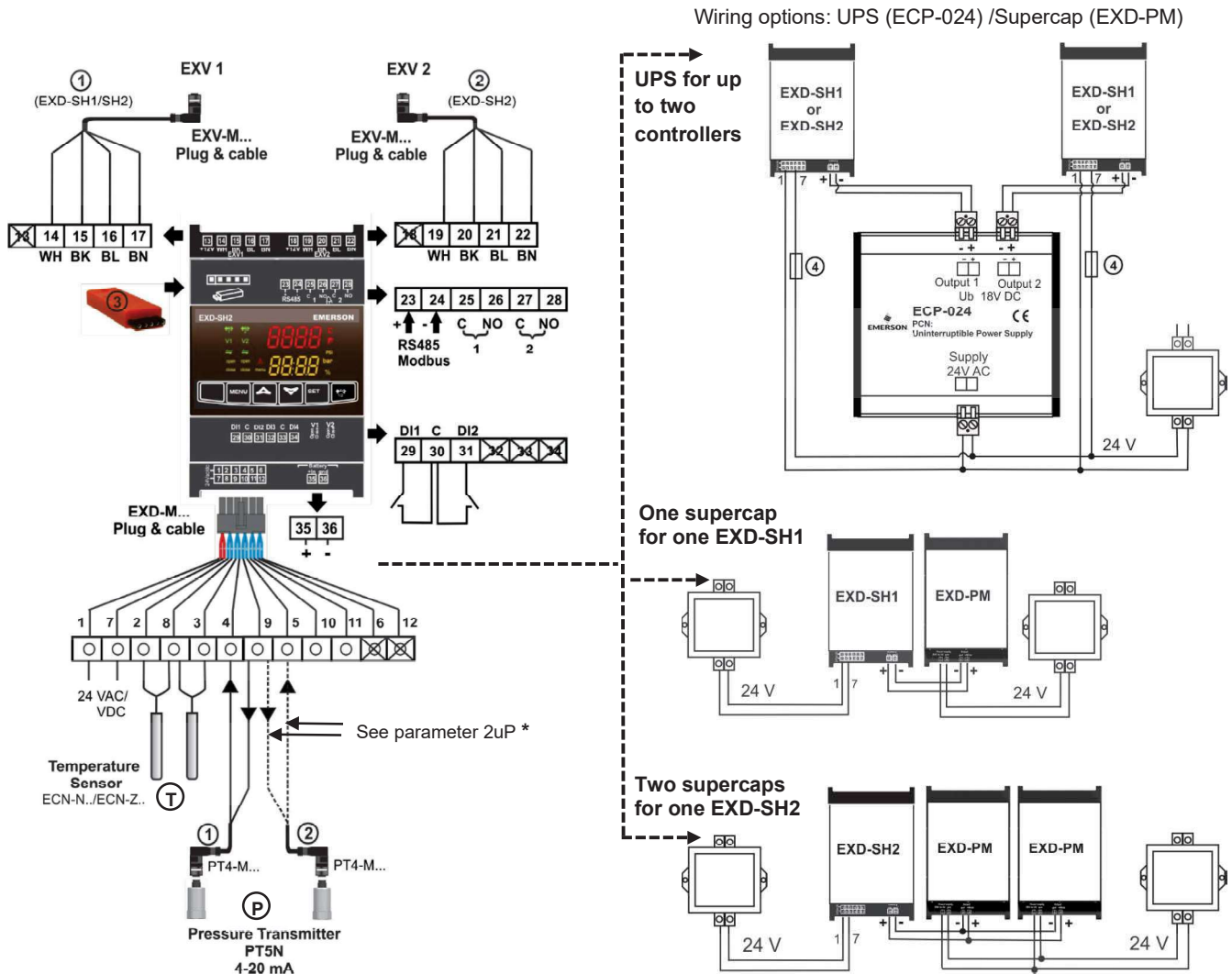


Examples of applications:

- Temperature control by throttling suction mass flow (normal sense, A)
- Temperature control by modulating hot gas into inlet or outlet of evaporators (reverse sense, B)
- Discharge temperature control by injecting liquid (normal sense, A)
- Head pressure control by means of temperature control (normal sense, A)

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

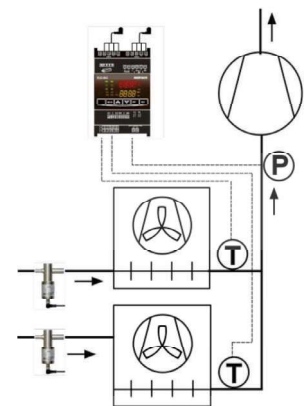
Wiring



①	Circuit 1 (EXD-SH1/SH2)	14-17	Electronic expansion valve circuit 1 (EXV1) EXV-M... Electrical plug: wire colors WH-white BK-black BL-blue BN-brown
②	Circuit 2 (EXD-SH2)	19-22	Electronic expansion valve circuit 2 (EXV2) EXV-M... Electrical plug: wire colors WH-white BK-black BL-blue BN-brown
③	Download/upload key	23 & 24	RS485 (+/-terminal)
1 & 7	Supply voltage 24 VAC/DC	25 & 26	Alarm relay circuit 1 (C, NO) – Suitable for 24 VAC/DC
2 & 8	Temperature sensor circuit 1	27 & 28	Alarm relay circuit 2 (C, NO) – Suitable for 24 VAC/DC
3 & 8	Temperature sensor circuit 2	29 & 30	Digital input circuit1 (DI1) – Dry contact, potential free
4 & 5	PT5N... circuit 1 & circuit 2 (white wire: 4...20 mA signal)	31 & 30	Digital input circuit 2 (DI2) – Dry contact, potential free
9	+ 12 VDC Voltage input for PT5N... (brown wire)	35 & 36	Battery/Super capacitor connection terminal
Alternative ratiometric third Party Pressure Transmitter:		④	Fuse EXD-SH1 (1A), EXD-SH2 (2A)
4 & 5	Pressure transmitter circuit 1 & circuit 2 (0.5...4.5 V signal)	6,12,13, 18,32-34	Not used (Terminals on EXD-SH12)
11	+ 5 VDC voltage input		
10	GND Ground		

Note: No hard failure detection if ground wire of transmitter to be interrupted.

*) Parameter 2uP with No 9 = only Pressure sensor circuit 1 is used



EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Available configuration options

	Selectable Valves	
	EX	CV
Refrigerants	R22, R134a, R507, R404A, R407C, R410A, R124, R744 (subcritical), R407A, R407F, R23, R32, R1234ze, R448A, R449A, R450A, R513A, R290, R1270, R454C, R452B, R454B, R454A, R452A, R444B, R455A, R133zde, R1234yf	R744 (CO ₂)
Main function	Superheat or and temperature control	Superheat control
Pressure transmitters	PT5N... or 3 rd party ratio metric	PT5N....

Note:

EXD-SH1/2 IS NOT ATEX APPROVED!

Technical Data: EXD-SH1/2

Supply voltage	24 VAC/DC ±10%, 50/60 Hz	Mounting	DIN rail mounted
Power consumption	EXD-SH1: Max. 25 VA EXD-SH2: Max. 50 VA	Temperatures storage operating/ surrounding	-25...+60°C 0...+55°C
Terminals 1 to 12	Suitable for 12 poles molex plug	Relative humidity	20...85% non-condensing
Terminals 13 to 36	Suitable for removable screw version: wire size 0.14...1.5 mm ² Included in controller delivery	Accessory (12 poles molex plug with 3 m cable)	Type: EXD-M03 (to be ordered separately)
Protection class	IP 00	Housing	Self-extinguishing ABS
Compliance	EMC, RoHS,	Weight	320 g
Marking			

Input, Output EXD-SH1/2

Description	Specification
Analogue input(s): NTC Temperature sensor Analogue input: PT1000 Temperature sensor	TP1-N... (-45...+150°C operating range) ECN-Z60 (-80...-40°C sensing range)
Analogue input(s): 4...20 mA pressure transmitters Analogue input(s): 0.5...4.5 V pressure transmitters	PT5N... Third party ratio metric pressure transmitters (total error: ≤ 1%)
Digital input(s)	Dry contact, potential free
Digital output(s): Alarm relay(s) Contact is closed: During alarm condition Contact is open: During normal operation and supply power OFF	Resistive Load 24 VAC/DC, max. 1 A Inductive Load 24 V AC, max. 0.5 A
Communication	RS485 RTU Modbus, two wires
Stepper motor output	Valves: EX4-8 (EX4-7-FLR), CV4-7

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Optional EXD-PM Supercap

Supply voltage	24 VAC/DC $\pm 10\%$, 50/60 Hz
Output voltage	12 VDC
Max. output current	- 1.2 A - 350 mA during charging
Power consumption	12 VA
Terminals	Suitable for removable screw version: wire size 0.14...1.5 mm ²
Output: to driver/controller	Suitable for one EXD-SH1 Two EXD-PM for one EXD-SH2
Charging time	60 seconds
Max. cable length between EXD-PM and EXD-SH1/2	50 cm AWG18 wire size

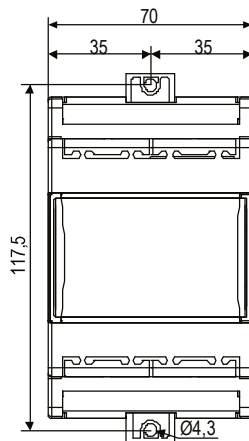
Protection class	IP 20
Mounting	DIN rail mounted
Temperatures	Storage -20...+70°C operating/ surrounding -10...+60°C
Housing	Self-extinguishing ABS
Relative humidity	20...85% non-condensing
Weight	125 g
Marking	CE, EAC

Optional Uninterruptible Power Supply ECP-024

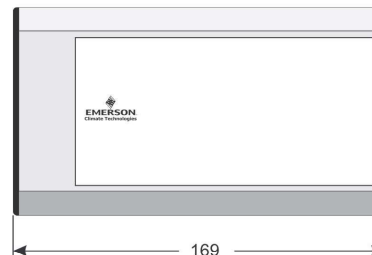
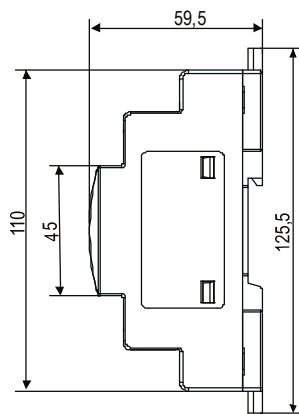
Backup battery type	Lead acid gel rechargeable battery
Number of backup batteries	2, each 12 VDC, 0.8 Ah
Supply voltage	24 VAC $\pm 10\%$, 50-60 Hz
Output voltage, UB	18 VDC
Number of outputs to drivers	2
Battery recharge time	approximately 2 hours
Temperatures	Storage -20...+65°C operating/ surrounding -10...+60°C

Protection class	IP 20
Mounting	DIN rail mounted
Housing	Aluminum
Connection	Screw terminals for wire size 0.5...2.5 mm ²
Relative humidity	< 90% non-condensing
Accessories: Terminals	K09-U00 Part No: 804559
Weight	1200 g
Marking	CE, EAC

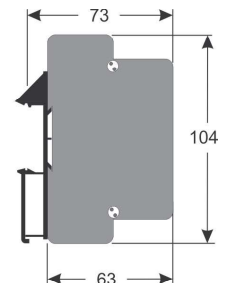
Dimensions (mm)



EXD-SH1/2 or EXD-PM



ECP-024

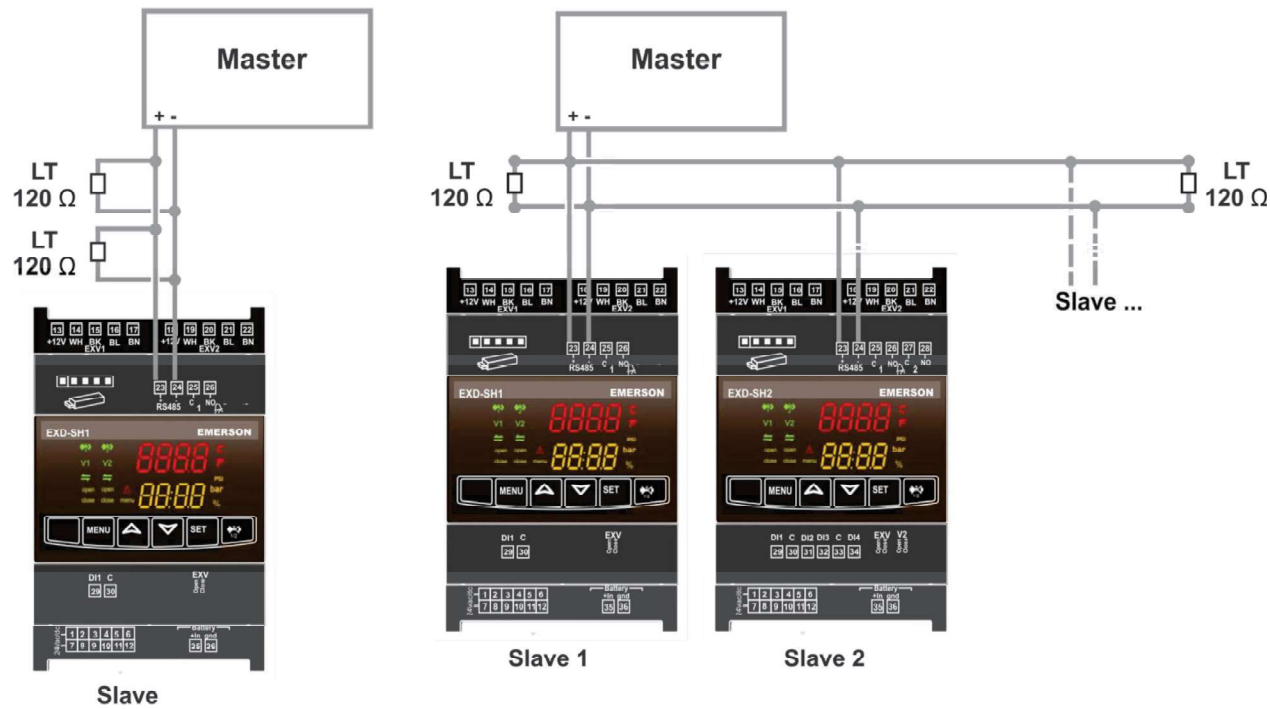


EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Communication

The use of communication is not necessary/mandatory; however, the communication is available for connection to upper level of system controller (third party controller) in order to perform data and commands transfer as well as data logging. EXD-SH1/2 act as slave and third party controller is master. In case of several EXD-SH1/2 connections to master, each driver needs to be addressed for proper communication.

Bus topology



ModBus protocol details

- Mode: RTU
- Modbus slave address range: 1 to 127 (parameter **Adr**)
- Baud rate: 9600 bps, 19200 bps (default, parameter **Br**)
- Start bit: 1
- Data bits: 8
- Parity: even (default), no parity (parameter **Par**)
- Stop bits: 1
- Master response timeout: 500ms

Transmission Details

ModBus register address ranges

- Read-only data: Starting address: 0x0100 (256)
- Writable data: Starting address: 0x0200 (512)
- Configuration data: Starting address: 0x0300 (768)

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Read Data transmission

Available through Modbus Function code 03 (0x03) Read Holding Registers

Request

Function code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	1 to 125 (0x7D)

Response

Function code	1 Byte	0x03
Byte count	1 Byte	2 x N*
Holding Registers	N* x 2 Bytes	

*N = Quantity of Input Registers

Error

Error code	1 Byte	0x83
Exception code	1 Byte	01 or 02 or 03

01 = Function code not supported

02 = Starting Address or register count out of range

03 = Register count out of range

Write Data transmission (single register)

Available through Modbus Function code 06 (0x06) Write Holding Register

Request

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Value	2 Bytes	0x0000 to 0xFFFF

Response

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Value	2 Bytes	0x0000 to 0xFFFF

Error

Error code	1 Byte	0x86
Exception code	1 Byte	01 or 02 or 03

01 = Function code not supported

02 = Starting Address out of range

Write Data transmission (multiple registers)

Available through Modbus Function code 16 (0x10) Write Holding Registers

Request

Function code	1 Byte	0x10
Start Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	0x0001 to 0x0078
Byte count	1 Byte	2 x N
Registers values	2 x N Bytes	Value

N = register count.

Response

Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	0x0001 to 0x0078

Error

Error code	1 Byte	0x90
Exception code	1 Byte	01 or 02 or 03

01 = Function code not supported

02 = Register Address invalid

03 = Register Value out of range

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Read-only variables

Modbus address dec. / hex.	Description	Unit	Remarks
256 / 0x100	Software version		
Circuit 1			
257 / 0x101	Main function, circuit 1		0 = superheat control 1 = temperature control 2 = reverse temperature control
258 / 0x102	Valve opening circuit 1	1/100%	
259 / 0x103	Digital input circuit 1		0x0000: No demand 0x0001: Demand
260 / 0x104	Digital output circuit 1		0x0001: alarm relay
261 / 0x105	P1 suction pressure circuit 1	1/100 barg	
262 / 0x106	T1 suction temperature circuit 1	1/100°C	
263 / 0x107	Sat. Temp circuit 1	1/100°C	
264 / 0x108	Pressure 1 sensor failure circuit 1		0 = No failure 1 = Failure
265 / 0x109	Temp. 1 sensor failure circuit 1		0 = No failure 1 = Failure
266 / 0x10A	Functional Alarm set circuit 1		0x0001 = N/A 0x0004 = High superheat 0x0010 = Freeze 0x0040 = Min. Temp (Temp. control) 0x0002 = Low pressure 0x0008 = Low superheat 0x0020 = Max. Temp (Temp. control)
267 / 0x10B	Hardware alarm set		0x0001 = Temp sensor 1 0x0004 = Pressure sensor 0x0010 = Stepper 1 0x0040 = Modbus timeout (3 sec.) 0x0100 = Config inconsistency 2 0x0002 = Temp sensor 2 (SH2) 0x0008 = Pressure sensor 2 (SH2) 0x0020 = Stepper 2 (SH2) 0x0080 = Config inconsistency 1 0x0200 = Power Failure
268 / 0x10C	Application state circuit 1		0 = OFF 1 = Waiting startup (valve ref pending) 2 = Startup 3 = Control 4 = Closing 5 = Alarm 6 = Manual mode 7 = Power fail 8 = MOP
269 / 0x10D	Superheat set point circuit 1	1/100 K	
270 / 0x10E	Superheat circuit 1	1/100 K	
Circuit 2			
271 / 0x10F	Valve opening circuit 2	1/100%	
272 / 0x110	Digital input circuit 2		0 = no demand 1 = demand
273 / 0x111	Digital output circuit 2		0x0001: alarm relay
274 / 0x112	P2 suction pressure circuit 2	1/100 bar	
275 / 0x113	T2 suction temperature circuit 2	1/100°C	
276 / 0x114	Sat. Temp. circuit 2	1/100°C	
277 / 0x115	Pressure 2 sensor failure circuit 2		0 = No failure 1 = Failure
278 / 0x116	Temp 2 sensor failure circuit 2		0 = No failure 1 = Failure
279 / 0x117	Functional alarm circuit 2		0x0001 = N/A 0x0004 = High superheat 0x0010 = Freeze 0x0002 = Low pressure 0x0008 = Low superheat
280 / 0x118	Application state circuit 2		0 = OFF 1 = Waiting startup (valve ref pending) 2 = Startup 3 = Control 4 = Closing 5 = Alarm 6 = Manual mode 7 = Power fail 8 = MOP
281 / 0x119	Superheat setpoint circuit 2	1/100 K	
282 / 0x11A	Superheat circuit 2	1/100 K	

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Writable variables

Modbus address dec. / hex.	Display code	Description	Units	Remarks
512 / 0x200		Factory default		1 = do a factory default
513 / 0x201		Future use		
514 / 0x202		Alarm reset		1 = Resets alarms (only the alarms which are set as manual reset)
515 / 0x203	1Ho	Manual mode Circuit 1		0 = off 1 = on
516 / 0x204	1HP	Manual valve opening Circuit 1	%	only active while manual mode is "on"
517 / 0x205		Alternative to digital input, circuit 1 via Modbus		Demand circuit 1 0 = disabled 1 = enabled
518 / 0x206		Pressure circuit 1 via Modbus	1/100 barg	Pressure if 1uP selection is Modbus Range: -0.1 to 150 barg Minimum update rate: 1s Alarm timeout: 3 sec.
519 / 0x207		Digital output circuit 1		To set the relay 1 manually, only active when manual mode circuit1 is "on" 0 = off 1 = on
520 / 0x208	2Ho	Manual mode Circuit 2		0 = off 1 = on
521 / 0x209	2HP	Manual valve opening Circuit 2	%	only active while manual mode 2 = on
522 / 0x20A		Alternative to digital input, circuit 2 via Modbus		Demand circuit 2 0 = disabled 1 = enabled
523 / 0x20B		Pressure circuit 2 via Modbus	1/100 barg	Pressure if 2uP selection is Modbus Range: -0.1 to 150 barg Minimum update rate: 1s Alarm timeout: 3 sec.
524 / 0x20C		Digital output circuit 2		To set the relay 2 manually, only active when manual mode circuit 2 is "on" 0 = off 1 = on

Note: References to control circuit 2 of EXD-SH2 are invisible in configuration/write list if disabled.

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability



Basically 2 variants are possible to set the parameters:

- Configuration parameters in flash memory - Max. 1000 overwrite cycle limitation!**
- Configuration parameters in RAM memory - unlimited overwrite cycles possible**

Note: In case of power failure, the stored data from the RAM memory will be lost and controller switches to the configuration data. (Factory setting)

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
768 / 0x300	H5	Password		12	1 - 1999	
769 / 0x301	Adr	Modbus address		1	1 - 127	
770 / 0x302	br	Modbus baudrate		0	0 - 1	0 = 9600 baud 1 = 19200 baud
771 / 0x303	PAr	Modbus parity		0	0 - 1	0 = parity even 1 = no parity
773 / 0x305	-C2	Circuit 2 Enabled ²		1	0 - 1	0 = circuit 2 disabled 1 = circuit 2 enabled Only EXD-SH2
774 / 0x306	-uC	Units conversion		0	0 - 1	0 = °C, K, barg 1 = °F, psig This parameter only affects the display. Internally (as well as for MODBUS communication) the units are always SI-based.
775 / 0x307		Future use				
776 / 0x308		Future use				

Note: ²) References to control circuit 2 if EXD-SH2 are invisible in configuration/write list if disabled

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 1						
777 / 0x309	1Fct	Function circuit 1		0	0 - 2	Changes only allowed if circuit 1 is in "OFF" state 0 = superheat control 1 = Temperature control Normal sense 2 = Temperature control Reverse sense
778 / 0x30A	1u4	Control mode circuit 1		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
779 / 0x30B	1u0	Refrigerant circuit 1		1	0 - 27	Changes only allowed if circuit 1 is in "OFF" state 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 22 = R454A* 23 = R452A 24 = R444B* 25 = R455A* 26 = R1233zde* 27 = R1234yf*
780 / 0x30C	1uP	Pressure sensor type 1		1	0 - 8	Changes only allowed if circuit 1 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus
781 / 0x30D	1Prr	Ratio metric range 1	1/10 bar	30	3 - 60	If ratio metric is used
782 / 0x30E	1ut	Valve type 1		0	0 - 12	Changes only allowed if circuit 1 is in "OFF" state 0 = EX4-6 1 = EX7 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5+6 12 = CV7

Note: *) EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
783 / 0x30F	1uF	Valve scaling 1	%	100	5 - 100	
784 / 0x310	1uu	Start opening valve1	%	10	0 - 100	
785 / 0x311	1u9	Start opening duration valve 1	s	5	0 - 120	
786 / 0x312	1uL	Low superheat alarm mode circuit 1		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
787 / 0x313	1u5	Superheat setpoint circuit 1	1/10 K	6	0.5 - 30	Range = 3 – 30K with 1uL = 1 or 2
788 / 0x314	1u2	MOP mode circuit 1		1	0 - 1	0 = disabled 1 = enabled
789 / 0x315	1u3	MOP sat. temp. limit circuit1	1/10°C			see MOP table (page 16)
790 / 0x316	1P9	Low pressure alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
791 / 0x317	1PA	Low pressure alarm cut-out circuit1	1/10 bar	0	-0.8 - 17.7	
792 / 0x318	1Pb	Low pressure alarm delay circuit1	s	5	5 - 199	
793 / 0x319	1Pd	Low pressure alarm cut-in circuit1	1/10 bar	0.3	-0.5 - 18	
794 / 0x31A	1P4	Freeze alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
795 / 0x31B	1P2	Freeze alarm cut-out circuit1	1/10°C	0	-5 - 5	
796 / 0x31C	1P5	Freeze alarm delay circuit1	s	30	5 - 199	
797 / 0x31D	1uH	High superheat alarm mode circuit 1		0	0 - 1	0 = disabled 1 = enabled auto-reset
798 / 0x31E	1uA	High superheat alarm setpoint circuit 1	1/10 K	30	16 - 40	
799 / 0x31F	1ud	High superheat alarm delay circuit 1	min	3	1-15	
800 / 0x320	1tSt	Temperature set point	1/10°C	4	-80 - 50	
801 / 0x321	1tbd	Temperature band	1/10 K	2	1 - 10	
802 / 0x322	1tAF	Temperature Alarm Enable		0	0 - 1	0 = disabled 1 = enabled
803 / 0x323	1tAL	Min. temperature alarm set-point	1/10°C	0	-50 - 50	
804 / 0x324	1tdL	Min. temperature alarm delay	min	3	1 - 10	
805 / 0x325	1tAH	Max. temperature alarm set-point	1/10°C	15	-50 - 50	
806 / 0x326	1tdH	Max. temperature alarm delay	min	3	1 - 10	
807 / 0x327		Future use				
808 / 0x328		Future use				
809 / 0x329	1tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
852 / 0x354	1P-	Superheat control circuit1 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
853 / 0x355	1i-	Superheat control circuit1 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
854 / 0x356	1d-	Superheat control circuit1 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 2						
810 / 0x32A	2u4	Control mode circuit 2		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
811 / 0x32B	2u0	Refrigerant circuit 2		1	0 - 27	Changes only allowed if circuit 2 is in OFF state 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 22 = R454A* 23 = R452A 24 = R444B* 25 = R455A* 26 = R1233zde* 27 = R1234yf*
812 / 0x32C	2uP	Pressure sensor type circuit 2		1	0 - 9	Changes only allowed if circuit 2 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus 9 = Pressure sensor type and refrigerant settings from circuit1
813 / 0x32D	2Prr	Ratio metric range circuit 2	1/10 bar	30	3 - 60	If ratio metric is used
814 / 0x32E	2ut	Valve type circuit 2		0	0 - 12	Changes only allowed if circuit 2 is in "OFF" state 0 = EX4-6 1 = EX7 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5+6 12 = CV7
815 / 0x32F	2uF	Valve scaling circuit 2	%	100	5 - 100	
816 / 0x330	2uu	Start opening valve circuit 2	%	10	0 - 100	
817 / 0x331	2u9	Start opening duration valve circuit 2	s	5	0 - 120	
818 / 0x332	2uL	Low superheat alarm mode circuit 2		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
819 / 0x333	2u5	Superheat setpoint circuit 2	1/10 K	6	0.5 - 30	Range = 3 – 30K with 2uL = 1 or 2
820 / 0x334	2u2	MOP mode circuit 2		1	0 - 1	0 = disabled 1 = enabled
821 / 0x335	2u3	MOP sat. temp. limit circuit 2	1/10°C			see MOP table (page 16)
822 / 0x336	2P9	Low pressure alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
823 / 0x337	2PA	Low pressure alarm cut-out circuit 2	1/10 bar	0	-0.8 - 17.7	
824 / 0x338	2Pb	Low pressure alarm delay circuit 2	s	5	5 - 199	
825 / 0x339	2Pd	Low pressure alarm cut-in circuit 2	1/10 bar	0.3	-0.5 - 18	
826 / 0x33A	2P4	Freeze alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
827 / 0x33B	2P2	Freeze alarm cut-out circuit 2	1/10°C	0	-5 - 5	
828 / 0x33C	2P5	Freeze alarm delay circuit 2	s	30	5 - 199	
829 / 0x33D	2uH	High superheat alarm mode circuit 2		0	0 - 1	0 = disabled 1 = enabled auto-reset
830 / 0x33E	2uA	High superheat alarm setpoint circuit 2	1/10 K	30	16 - 40	

Note: *) EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
831 / 0x33F	2ud	High superheat alarm delay circuit 2	min	3	1-15	
832 / 0x340	2tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
833 / 0x341	2P-	Superheat control circuit 2 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
834 / 0x342	2i-	Superheat control circuit 2 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
835 / 0x343	2d-	Superheat control circuit 2 fixed PID Td factor	1/10s	3.0	0.1 - 30	Display 1/10K, Kd = Kp*Td

2. Configuration parameters in RAM memory - unlimited overwrite cycles

Note: In case of power failure, the stored data from the RAM memory will be lost and switch to the configuration data. (Factory setting)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1792 / 0x700		NA				
1793 / 0x701		NA				
1794 / 0x702		NA				
1795 / 0x703		NA				
1797 / 0x705	-C2	Circuit 2 Enabled ³		1	0 - 1	0 = circuit 2 disabled 1 = circuit 2 enabled Only EXD-SH2
1798 / 0x706	-uC	Units conversion		0	0 - 1	0 = °C, K, barg 1 = °F, psig This parameter only affects the display. Internally (as well as for MODBUS communication) the units are always SI-based.
1799 / 0x707		Future use				
1800 / 0x708		Future use				

Note: ³) References to control circuit 2 of EXD-SH2 are invisible in configuration/write list if disabled

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 1						
1801 / 0x709	1Fct	Function circuit 1		0	0 - 2	Changes only allowed if circuit 1 is in "OFF" state 0 = superheat control 1 = Temperature control Normal sense 2 = Temperature control Reverse sense
1802 / 0x70A	1u4	Control mode circuit 1		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
1803 / 0x70B	1u0	Refrigerant circuit 1		1	0 - 27	Changes only allowed if circuit 1 is in "OFF" state 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 22 = R454A* 23 = R452A 24 = R444B* 25 = R455A* 26 = R1233zde* 27 = R1234yf*
1804 / 0x70C	1uP	Pressure sensor type 1		1	0 - 8	Changes only allowed if circuit 1 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus

Note: *) EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles possible (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1805 / 0x70D	1Prr	Ratio metric range 1	1/10 bar	30	3 - 60	If ratio metric is used
1806 / 0x70E	1ut	Valve type 1		0	0 - 12	Changes only allowed if circuit 1 is in "OFF" state 0 = EX4-6 1 = EX7 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5+6 12 = CV7
1807 / 0x70F	1uF	Valve scaling 1	%	100	5 - 100	
1808 / 0x710	1uu	Start opening valve1	%	10	0 - 100	
1809 / 0x711	1u9	Start opening duration valve 1	s	5	0 - 120	
1810 / 0x712	1uL	Low superheat alarm mode circuit 1		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1811 / 0x713	1u5	Superheat setpoint circuit 1	1/10 K	6	0.5 - 30	Range = 3 – 30K with 1uL = 1 or 2
1812 / 0x714	1u2	MOP mode circuit 1		1	0 - 1	0 = disabled 1 = enabled
1813 / 0x715	1u3	MOP sat. temp. limit circuit1	1/10°C			see MOP table (page 16)
1814 / 0x716	1P9	Low pressure alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1815 / 0x717	1PA	Low pressure alarm cut-out circuit1	1/10 bar	0	-0.8 - 17.7	
1816 / 0x718	1Pb	Low pressure alarm delay circuit1	s	5	5 - 199	
1817 / 0x719	1Pd	Low pressure alarm cut-in circuit1	1/10 bar	0.3	-0.5 - 18	
1818 / 0x71A	1P4	Freeze alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1819 / 0x71B	1P2	Freeze alarm cut-out circuit1	1/10°C	0	-5 - 5	
1820 / 0x71C	1P5	Freeze alarm delay circuit1	s	30	5 - 199	
1821 / 0x71D	1uH	High superheat alarm mode circuit 1		0	0 - 1	0 = disabled 1 = enabled auto-reset
1822 / 0x71E	1uA	High superheat alarm setpoint circuit 1	1/10 K	30	16 - 40	
1823 / 0x71F	1ud	High superheat alarm delay circuit 1	min	3	1-15	
1824 / 0x720	1tSt	Temperature set point	1/10°C	4	-80 - 50	
1825 / 0x721	1tbd	Temperature band	1/10 K	2	1 - 10	
1826 / 0x722	1tAF	Temperature Alarm Enable		0	0 - 1	0 = disabled 1 = enabled
1827 / 0x723	1tAL	Min. temperature alarm set-point	1/10 °C	0	-50 - 50	
1828 / 0x724	1tdL	Min. temperature alarm delay	min	3	1 - 10	
1829 / 0x725	1tAH	Max. temperature alarm set-point	1/10°C	15	-50 - 50	
1830 / 0x726	1tdH	Max. temperature alarm delay	min	3	1 - 10	
1831 / 0x727		Future use				
1832 / 0x728		Future use				
1833 / 0x729	1tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
1876 / 0x754	1P-	Superheat control circuit1 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
1877 / 0x755	1i-	Superheat control circuit1 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
1878 / 0x756	1d-	Superheat control circuit1 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 2						
1834 / 0x72A	2u4	Control mode circuit 2		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
1835 / 0x72B	2u0	Refrigerant circuit 2		1	0 - 27	Changes only allowed if circuit 2 is in "OFF" state 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 22 = R454A* 23 = R452A 24 = R444B* 25 = R455A* 26 = R1233zde* 27 = R1234yf*
1836 / 0x72C	2uP	Pressure sensor type circuit 2		1	0 - 9	Changes only allowed if circuit 2 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus 9 = Pressure sensor type and refrigerant settings from circuit1
1837 / 0x72D	2Prr	Ratio metric range circuit 2	1/10 bar	30	3 - 60	If ratio metric is used
1838 / 0x72E	2ut	Valve type circuit 2		0	0 - 12	Changes only allowed if circuit 2 is in "OFF" state 0 = EX4-6 1 = EX7 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5+6 12 = CV7
1839 / 0x72F	2uF	Valve scaling circuit 2	%	100	5 - 100	
1840 / 0x730	2uu	Start opening valve circuit 2	%	10	0 - 100	
1841 / 0x731	2u9	Start opening duration valve circuit 2	s	5	0 - 120	
1842 / 0x732	2uL	Low superheat alarm mode circuit 2		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1843 / 0x733	2u5	Superheat setpoint circuit 2	1/10 K	6	0.5 - 30	Range = 3 – 30K with 2uL = 1 or 2
1844 / 0x734	2u2	MOP mode circuit 2		1	0 - 1	0 = disabled 1 = enabled
1845 / 0x735	2u3	MOP sat. temp. limit circuit 2	1/10°C			see MOP table (page 16)
1846 / 0x736	2P9	Low pressure alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1847 / 0x737	2PA	Low pressure alarm cut-out circuit 2	1/10 bar	0	-0.8 - 17.7	
1848 / 0x738	2Pb	Low pressure alarm delay circuit 2	s	5	5 - 199	
1849 / 0x739	2Pd	Low pressure alarm cut-in circuit 2	1/10 bar	0.3	-0.5 - 18	
1850 / 0x73A	2P4	Freeze alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1851 / 0x73B	2P2	Freeze alarm cut-out circuit 2	1/10°C	0	-5 - 5	
1852 / 0x73C	2P5	Freeze alarm delay circuit 2	s	30	5 - 199	

Note: *) EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1853 / 0x73D	2uH	High superheat alarm mode circuit 2		0	0 - 1	0 = disabled 1 = enabled auto-reset
1854 / 0x73E	2uA	High superheat alarm setpoint circuit 2	1/10 K	30	16 - 40	
1855 / 0x73F	2ud	High superheat alarm delay circuit 2	min	3	1-15	
1856 / 0x740	2tt-	Temperature sensor type		0	- 1	0 = TP1-N... 1 = ECN-Z60
1857 / 0x741	2P-	Superheat control circuit 2 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
1858 / 0x742	2i-	Superheat control circuit 2 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
1859 / 0x743	2d-	Superheat control circuit 2 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

MOP saturation temperature limit table

Refrigerant	°C			Refrigerant	°C			Refrigerant	°C		
	Min.	Max.	Default		Min.	Max.	Default		Min.	Max.	Default
R22	-70	50	+13	R23	-70	-18	-40	R452B	-45	66	+25
R134a	-57	66	+15	R32	-52	30	+15	R454B	-40	45	+18
R507	-75	42	+7	R1234ze	-57	66	+24	R454A	-57	66	+10
R404A	-76	42	+7	R448A	-57	66	+12	R452A	-45	66	+15
R407C	-66	48	+15	R449A	-57	66	+12	R444B	-45	66	+15
R410A	-52	30	+15	R450A	-57	66	+19	R455A	-57	66	+14
R124	-45	91	+50	R513A	-57	66	+13	R1233zde	-45	90	+15
R744	-40	-4	-5	R290	-66	48	+15	R1234yf	-52	66	+15
R407A	-66	48	+10	R1270	-66	48	+15				
R407F	-66	48	+10	R454C	-66	48	+17				

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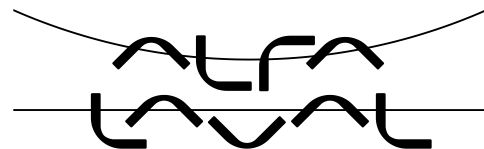
EMERSON. CONSIDER IT SOLVED.

Mechanical		Electrical	
Unit Height (in):	11.8	Max Fuse Size:	15
Unit Length (in):	18.1	Min Circuit Ampacity:	9.5
Unit Width (in):	14.3	Compressor:	RST55C1E-CAV-104
Ship Weight (lbs):	59.0	Compressor LRA - Low:	
Condenser Type:	Air	Compressor LRA - High:	33.70
CopeVap Water Storage:	NA	Compressor LRA - Half winding:	
Liquid Connection Size (in)/Type:	0.375 SWEAT	Compressor RLA	6.8
Suction Connection Size (in)/Type:	0.5 SWEAT	UL:	Recognized
Discharge Line Size(in):	0.25	UL File #:	SA633
Water Inlet (in):		UL Guide Card:	LZFE2
Water Outlet (in):			
Oil Type:	POE	Amps Per Motor:	
Oil Recharge Amount (oz):	15	Fan Motor Quantity:	1

Performance			
Release Date:	11-Jan-2017	Return Gas Temp. (°F):	40
Compressor:	RST55C1E-CAV-104 x 1	Subcooling (°F):	5
Performance No:	10143	Air Flow Rate (CFM):	450

90 °F Ambient Air Temperature				
Evap Temp(°F)	Unit Capacity (BTU/hr)	Cond. Temp.(°F)	Temp. Diff.(°F)	EER(BTU/wh)
Evap Temp(°F)	Unit Capacity (BTU/hr)	Cond. Temp.(°F)	Temp. Diff.(°F)	EER(BTU/wh)
-10	2,680	107.4	17.4	3.8
-5	3,020	108.6	18.6	4.0
0	3,440	110.0	20.0	4.3

5	3,910	111.7	21.7	4.6
10	4,440	113.5	23.5	4.9
15	5,030	115.4	25.4	5.3
20	5,660	117.5	27.5	5.7
25	6,340	119.7	29.7	6.1
30	7,060	122.0	32.0	6.6



Brazed Plate Heat Exchanger

Technical Specification

Model : CBXP27-6H-F(30751 3040 2)
Item name : Cascade - 4.4mbh Date : 1/11/2024
Units : 1

		Hot Side	Cold side
		Secondary side	Primary side(S4)
Fluid		Carbon dioxide	R448A
Mass flow rate	lb/h	40.85	66.10
Fluid Condensed/Vapourized	lb/h	40.85	43.40
Inlet temperature	°F	23.0	4.4
Dew p.	°F	23.0	10.0
Outlet temperature(vapor/liquid)	°F	23.0/19.1	14.0
Operating pressure(in/out)	psia	442/442	47.2/45.7
Pressure drop	psi	0.0166	1.54
Velocity connection(in/out)	ft/s	0.362/0.0546	7.73/22.0
Heat exchanged	kBtu/h	4.400	
Heat transfer area	ft ²	1.08	
OHTC clean conditions	Btu/(ft ² ·h·°F)	370.7	
OHTC service	Btu/(ft ² ·h·°F)	304.3	
Fouling resistance*10000	ft ² ·h·°F/Btu	0.0	
Margin	%	21.8	
Mean Temperature Difference	°F	13.4	
Relative directions of fluids		Countercurrent	
Number of passes		1	1
Materialplate/ brazing		Alloy 316 / Cu	
ConnectionS1 (Hot-in)		Weld + soldering/ 33.7 mm (1 1/8") Welding /	
Soldering (J39XP) Alloy 304			
ConnectionS2 (Hot-out)		Soldering/ 7/8" (22.3 mm) (H23XP) Alloy 304	
ConnectionS3 (Cold-in)		Soldering/ 1/2" (H24XP) Alloy 304	
ConnectionS4 (Cold-out)		Soldering/ 1/2" (H24XP) Alloy 304	
Pressure vessel code		UL	
Design pressure at -321.000000 Fahrenheit	Psig	1190	1190
Design pressure at 400.000000 Fahrenheit	Psig	1190	1190
Design temperature	°F	-320.8/400.0	
Overall length x width x height	in	3 x 4 x 12	
Net weight, empty / operating	lb	7.02 / 7.58	

Performance is conditioned on the accuracy of customers data and customers ability to supply equipment and products in conformity therewith.

Physical Properties

(inlet/outlet)	Hot Side Liquid	Vapour	Cold side Liquid	Vapour
Dens	59.69/59.69	5.204/5.210	78.45/77.98	0.8442/0.8477
Sp.heat	0.5753/0.5753	0.3972/0.3977	0.3218/0.3179	0.2191/0.2155
Visc	0.109/0.109	0.0141/0.0141	0.240/0.241	0.0110/0.0110
Th.Cond	0.0665/0.0665	0.0109/0.0109	0.0571/0.0530	0.0062/0.0064
Bub. p.		23.0/23.0		/-0.7
Dew p.		23.0/23.0		/10.0
Mol.W.		44.01/44.01		86.28/86.28
Cr.pr.		1069.99/1069.99		675.59/675.59
Cr.Temp.		87.8/87.8		182.7/182.7
Lat.heat		105.5/100.2		96.5/91.0

GENERAC®

PWRCELL

OUTDOOR RATED BATTERY CABINET

PWRcell Outdoor Rated Battery Cabinet

Model #: APKE00028 (includes foot mounting brackets)

Model #: APKE00042 (Battery enclosure only)

3.0kWh PWRcell DCB Battery Module

Model #: G0080040 (BJ-DCB05ZKBG)

3.0kWh PWRcell EX Battery Module

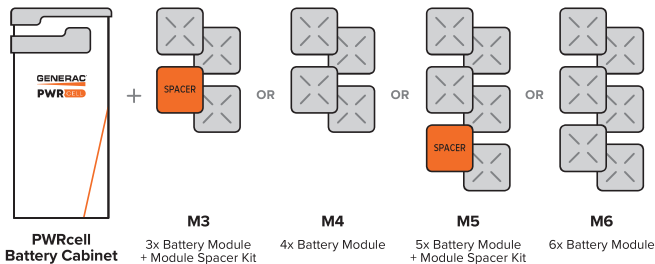
Model #: G0080001, G0080003

The PWRcell™ Outdoor Rated (OR) Battery Cabinet is a Type 3R smart battery enclosure that allows for a range of storage configurations to suit any need. DC-couple to Generac PWRzone solar, PWRgenerator, or AC-couple to a third party PV array. No other smart battery offers the power and flexibility of PWRcell.

PWRcell BATTERY CABINET DESIGN

The PWRcell Battery Cabinet allows system owners the flexibility to scale from an economical 9kWh to a massive 18kWh by installing additional battery modules to the PWRcell Battery Cabinet. An existing PWRcell Battery Cabinet can be upgraded with additional modules. Use the graphic below and the chart on the back of this sheet to understand what components you need for your chosen PWRcell configuration.

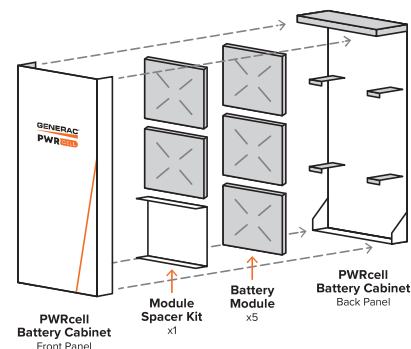
BATTERY CONFIGURATION GUIDE



FEATURES & BENEFITS

- Best-in-class battery backup power
- AC-couple to third party solar array
- Connect 2 PWRcell Battery Cabinets to a single PWRcell Inverter for up to 36kWh of usable storage
- Plug-and-play with all PWRcell products
- Time-of-use (TOU) and zero-export ready
- 3R cabinet for outdoor and indoor installations
- Floor standing or wall-mounted design

BATTERY CABINET ASSEMBLY



Specifications

PWRcell™ BATTERY CONFIGURATIONS	M3	M4	M5	M6
BATTERY MODULES:	3	4	5	6
USABLE ENERGY ¹ :	9 kWh	12 kWh	15 kWh	18 kWh
NOMINAL CONT. AC POWER ^{1,2} :	3.4 kW	4.5 kW	5.6 kW	6.7 kW
MAX. AC POWER ^{1,3} :	4.5 kW	6 kW	7.5 kW	9 kW
NOMINAL CONT. DC (CHARGE/DISCHARGE) - A:	11.6	15.5	19.4	23.3
PEAK MOTOR STARTING CURRENT (2 SEC) - A, RMS:	25	33	42	50
COMPATIBLE BATTERY MODULES ⁴ :	Generac PWRcell EX 3.0 kWh, Generac PWRcell DCB 3.0 kWh, Generac PWRcell DCB 2.85 kWh			
REbus™ VOLTAGE - INPUT/OUTPUT:	360-420 VDC			
NOMINAL VOLTAGE:	380 VDC			
DC-DC ROUND-TRIP EFFICIENCY:	96.5%			
MAXIMUM AMBIENT OPERATING TEMPERATURE:	14 TO 122 °F (-10 TO 50 °C)			
OPTIMAL AMBIENT OPERATING TEMPERATURE:	41 to 104 °F (5 to 40 °C)			
MAXIMUM INSTALLATION ALTITUDE - FT (M):	6560 (2000)			
DIMENSIONS, L x W x H - IN (MM):	22" x 10" x 68" (559 x 254 x 1727)			
WEIGHT, ENCLOSURE - LB (KG):	115 (52)			
WEIGHT, INSTALLED W/ DCB MODULES - LB (KG):	280 (127)	335 (152)	390 (177)	445 (202)
WEIGHT, INSTALLED W/ EX MODULES - LB (KG):	287 (130)	344 (156)	401 (182)	459 (208)
WEIGHT, ACCESSORY MOUNTING HARDWARE - LB (KG):	21 (10)			
ENCLOSURE TYPE:	Type 3R			
WARRANTY - LI-ION MODULES:	10 Years, (7.56MWh)			
WARRANTY - ELECTRONICS AND ENCLOSURE:	10 Years			
COMMUNICATION PROTOCOL:	REbus™ DC Nanogrid™			
SEISMIC RATING:	IEEE 693-2018 (HIGH)			
COMPLIANCE:	UL 9540, UL 9540A ⁵ , UL 1973, UL 1642, CSA 22.2 #107.1			

¹Assumes use of 3.0kWh battery module. ²Average AC power over a complete discharge cycle. ³Values provided for 40°C (104°F). ⁴All PWRcell battery models used in a PWRcell Battery Cabinet must be the same model. Do NOT combine module SKUs in a single battery cabinet. ⁵4th ed. tested at unit-level when installed with DCB battery modules and OR enclosure. Note: Charge/discharge rate may be reduced at temperature extremes

Generac offers a Foot Bracket Accessory Kit (Model #APKE00043) for the PWRcell Battery Cabinet that is available for installations where a foot bracket mount is required.

PWRcell ACCESSORIES

Inside of the PWRcell Battery Cabinet, battery modules are stacked two deep on three levels, allowing for up to six modules to be connected in series. You can upgrade an existing PWRcell Battery Cabinet by adding Battery Modules and a Module Spacer (APKE00008). A Module Spacer is only required for battery configurations with an odd number of modules (i.e. 3 or 5).

Generac offers a convenient PWRcell Battery Upgrade Kit (APKE00009) to help replace lost or misplaced hardware.

Note: When adding modules, be sure all modules within a cabinet are the same model (i.e., EX or DCB). Instructions are provided in product manual.

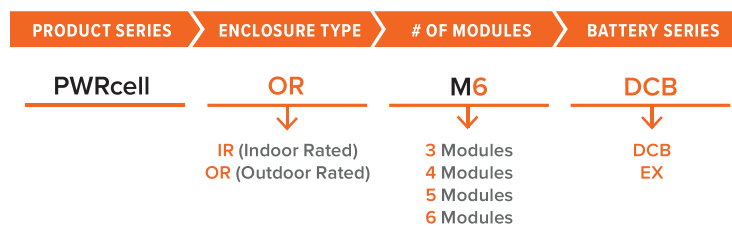
Generac Power Systems, Inc.
S45 W29290 Hwy. 59, Waukesha, WI 53189

www.Generac.com | 888-GENERAC (436-3722)

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PWRcell MODEL BUILDER



Sample Model Name: PWRcell OR M6 DCB

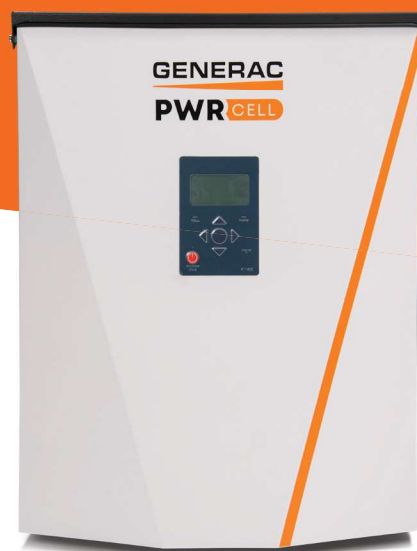
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GENERAC®

PWRCELL

7.6kW 1Ø PWRcell Inverter with CTs
Model #: XVT076A03

11.4 kW 3Ø PWRcell Inverter with CTs
Model #: X11402 (Ordering SKU: APKE00013)



Solar + storage is simple with the Generac PWRcell™ Inverter. This bi-directional, REbus™-powered inverter offers a simple, efficient design for integrating smart batteries with solar. Ideal for self-supply, backup power, zero-export and energy cost management, the PWRcell Inverter is the industry's most feature-rich line of inverters, available in single-phase and three-phase models.

FEATURES & BENEFITS

- Single inverter for grid-tied solar with smart battery integration
- Simplified system design: No autotransformer or battery inverter needed
- User-selectable modes for backup power, self-supply, time-of-use, zero-import and export limiting
- Free system monitoring included via PWRview™ Web Portal and Mobile App

AC OUTPUT/GRID-TIE	MODEL XVT076A03	MODEL X11402
CONT. GRID-TIED AC POWER @ 50°C (122°F):	7600 W	11400 W
AC OUTPUT VOLTAGE:	120/240, 1Ø VAC	120/208, 3Ø VAC
AC FREQUENCY:	60 Hz	
MAXIMUM CONTINUOUS OUTPUT CURRENT:	32 A, RMS	
GROUND-FAULT ISOLATION DETECTION:	Included	
CHARGE BATTERY FROM AC:	Yes	
THD (CURRENT):	< 2%	
TYPICAL NIGHTTIME POWER CONSUMPTION ¹ :	< 7 W	

AC OUTPUT/ISLAND MODE	MODEL XVT076A03	MODEL X11402
MAX. CONT. AC POWER WHILE IN ISLAND MODE WITHOUT AN EXTERNAL TRANSFER SWITCH ² :	7600 W	
MAX. CONT. AC POWER WHILE IN ISLAND MODE W/ EXTERNAL TRANSFER SWITCH AND SINGLE 6 MODULE BATTERY CABINET ³ :	9000 W	
MAX. CONT. AC POWER WHILE IN ISLAND MODE W/ EXTERNAL TRANSFER SWITCH AND 2 BATTERY CABINETS (8 MODULES MINIMUM) ³ :	11000 W	9600 W-11000 W*
PEAK MOTOR STARTING CURRENT (2 SEC):	50 A, RMS	
AC BACKUP OUTPUT VOLTAGE:	120/240, 1Ø VAC	120/208, 1Ø VAC
AC FREQUENCY:	60 Hz	
THD (VOLTAGE):	< 2%	
ALLOWABLE SPLIT PHASE IMBALANCE:	Up to 30%	

DC INPUT	MODEL XVT076A03	MODEL X11402
DC INPUT VOLTAGE RANGE:	360-420 VDC	
NOMINAL DC BUS VOLTAGE:	380 VDC	
DC DISTRIBUTION INPUT BREAKERS:	4 x 2P30 A	
MAX INPUT CURRENT PER DC INPUT:	30 A	
REVERSE-POLARITY PROTECTION:	Yes	
TRANSFORMERLESS, UNGROUNDED:	Yes	
DC BUS EXPORT FUSES (+/-):	40 A	
2-POLE DISCONNECTION:	Yes	

EFFICIENCY	MODEL XVT076A03	MODEL X11402
PEAK EFFICIENCY:	97.3%	97.7%
CEC WEIGHTED EFFICIENCY:	96.5%	97.5%

¹Nighttime power consumption depends on the system mode

²In Island Mode, continuous power output is restricted to 7.6kW unless backup power is routed through an external transfer switch in a whole home backup application.

³Peak performance, values provided for 40°C (104°F).

*In Island mode X11402 protected loads only supply 2 phases 120 VAC L-N, 208 L-L which results in lower power than in a grid tied 3 phase state. The low value of the range is for full L-L loading while high value of the range is full L-N loading

Specifications

FEATURES AND MODES

ISLAND MODE ⁴ :	Yes
GRID SELL:	Yes
SELF CONSUMPTION:	Yes
PRIORITIZED CHARGING FROM RENEWABLES:	Yes
GRID SUPPORT - ZERO EXPORT:	Yes
ESS PCS OPERATION MODES (IMPORT ONLY, EXPORT ONLY):	Yes

ADDITIONAL FEATURES

SUPPORTED COMMUNICATION INTERFACES:	REbus™, CANbus, Ethernet
SYSTEM MONITORING:	PWRview™ Web Portal and Mobile App
BACKUP LOADS DISCONNECT ⁴ :	Yes, 50 A Circuit Breaker
INVERTER BYPASS SWITCH:	Automatic
WARRANTY:	10 Years

STANDARDS COMPLIANCE

SAFETY:	UL 1741 SA, CSA 22.2 #107.1, UL 1998
GRID CONNECTION STANDARDS:	IEEE 1547, Rule 21, Rule 14H (HECO V1.1), CSIP, UL 1741 PCS CRD (Import Only, Export Only)
EMISSIONS:	FCC Part 15 Class B

DIMENSIONS AND INSTALLATION SPECIFICATIONS

ENCLOSURE KNOCKOUTS - QTY, SIZE - IN (MM):	6 x Combo 3/4" x 1" (19 x 25.4) 7 x Combo 1/2" x 3/4" (12.7 x 19)	1 x 0.575" exclusively for optional LTE antenna mounting
DIMENSIONS L x W x H - IN (MM):	24.5" x 19.25" x 8" (622.3 x 488.9 x 203.2)	
WEIGHT - LB (KG):	62.7 (28.4)	
COOLING:	Forced convection	
AUDIBLE NOISE:	< 40 dBA	
OPERATING TEMPERATURE:	-4 to 122 °F (-20 to 50 °C) ⁵	
ENCLOSURE TYPE:	Type 3R	

INSTALLATION GUIDELINES

BATTERY TYPES SUPPORTED:	PWRcell™ Battery
MODULE SUBSTRING SIZE PER PV LINK OPTIMIZER:	Varies, refer to PV Link Installation Manual
MAXIMUM RECOMMENDED DC POWER FROM PV ⁶ :	10 kW (1Ø), 15 kW (3Ø)

⁴3Ø inverters offer backup for [single phase] 208 V loads.

⁵Includes ambient temperature rising from inverter operation. Reduced power at extreme temperatures.

⁶Values provided for PV-only or small storage systems. Additional PV power is permissible if sufficient battery storage capacity is installed.