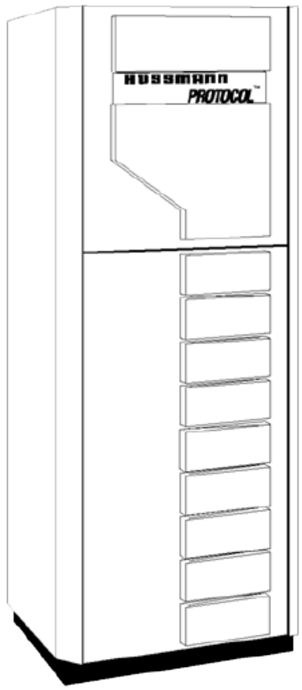
HUSSMANN®

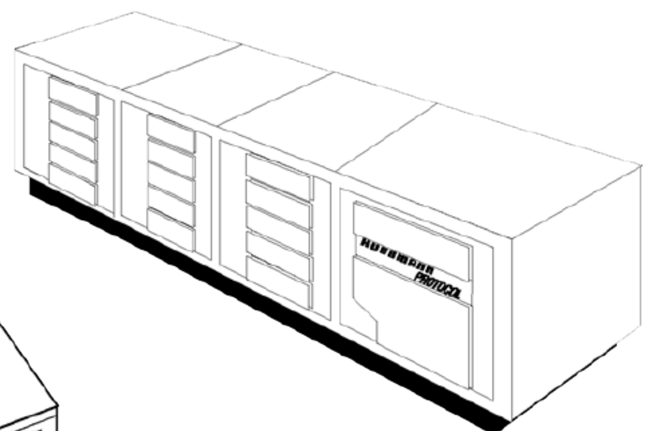
PROTOCOL™

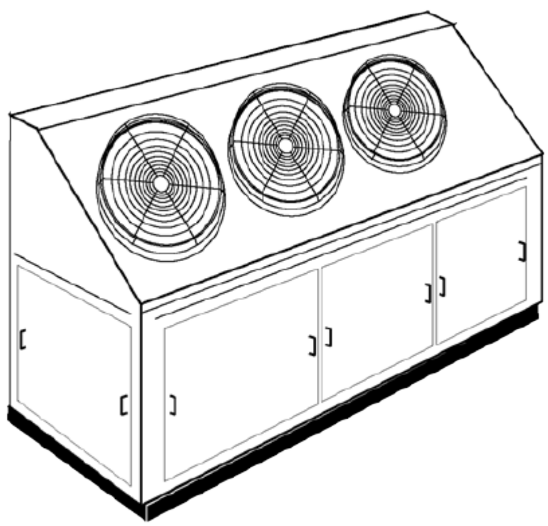
and

PROTO-AIRE

Installation and Operation Manual







P/N 0385841_G
August 2018

MANUAL- I/O PROTOCOL AND PROTOAIRE

Table Of Contents

Installation

Overview

This section is limited to the information needed to set the Protocol™ Unit. Auxiliary equipment information is found in the sections devoted to them or in the manuals accompanying them.

Related information is contained in Protocol™ Planning Data and the Pumping Station Planning Data.

Shipping Damage

All equipment should be thoroughly examined for shipping damage before and while unloading.

This equipment has been carefully inspected at our factory, and the carrier has assumed responsibility for safe arrival. If damaged, either apparent or concealed, the claim must be made to the carrier.

Apparent Loss or Damage

If there is an obvious loss or damage, it must be noted on the freight bill or express receipt and signed by the carrier's agent; otherwise, carrier may refuse claim. The carrier will supply the necessary claim forms.

Concealed Loss or Damage

When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

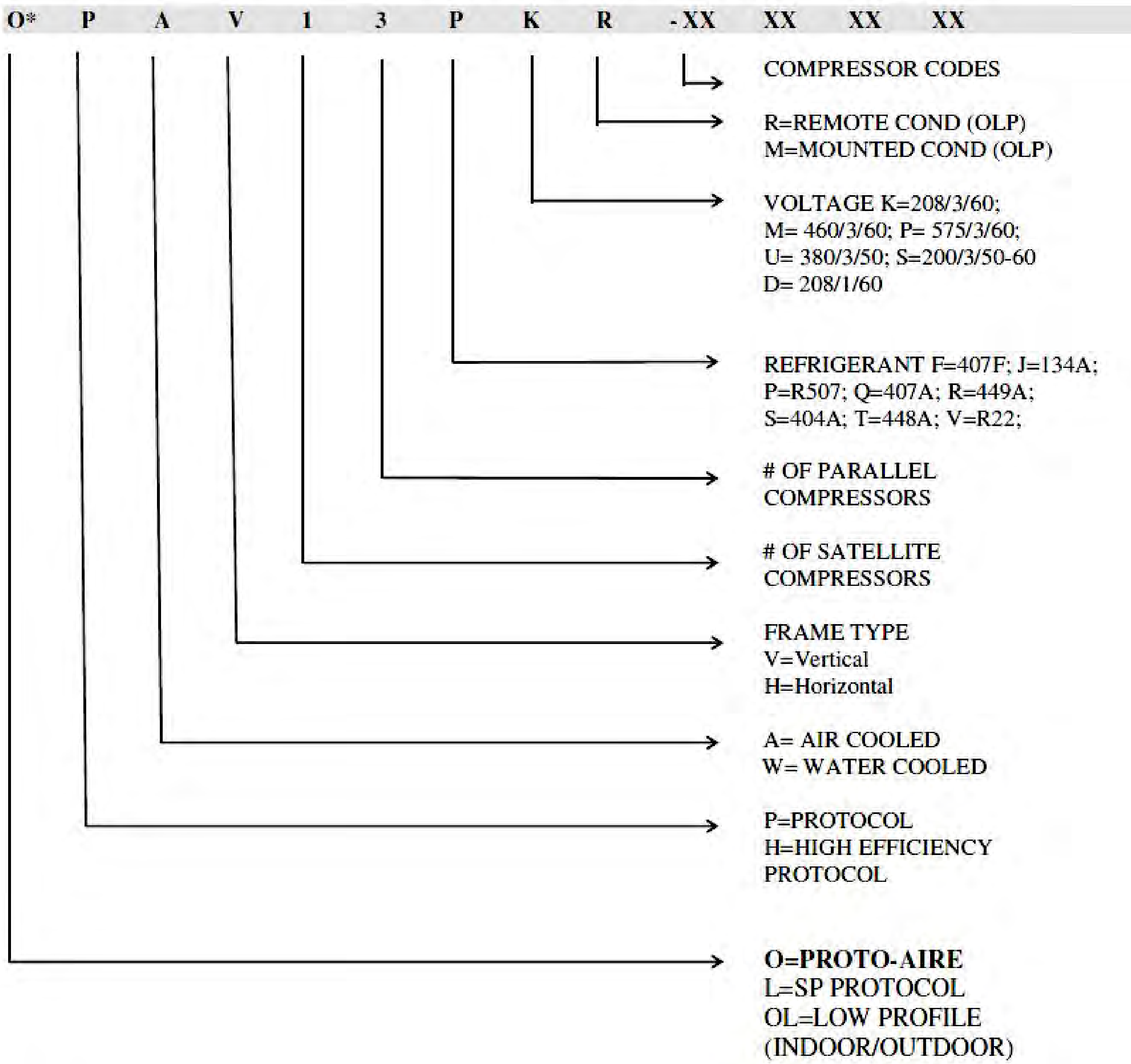
On Site Damage Control

The Protocol™ is shipped on skids with panels installed. Remove panels to access lifting points on frame. Do not attempt to move the unit from the skids without first removing the panels.

This warning does not mean that Hussmann products will cause cancer or reproductive harm, or is in violation of any product-safety standards or requirements. As clarified by the California State government, Proposition 65 can be considered more of a 'right to know' law than a pure product safety law. When used as designed, Hussmann believes that our products are not harmful. We provide the Proposition 65 warning to stay in compliance with California State law. It is your responsibility to provide accurate Proposition 65 warning labels to your customers when necessary. For more information on Proposition 65, please visit the California State government website.

PROTOCOL UNIT NOMENCLATURE

The model numbers of PROTOCOL units are shown on the legend in modular form. The nomenclature is interpreted as follows:



The unit nomenclature is part of the UL code requirements and must be included on the legend as well as the data plate for each unit.

Receiver Capacities are based on 80% liquid fill at 105 °F.

Vertical – 55 lb		
Horizontal– 72 lb (Standard)	200# option	300# option

*Refer to Proto-Aire Submittal Documents

Field Supplied and Installed Water Components

The Protocol™ comes equipped with a flow control/shutoff valve for servicing the plate heat exchanger. All other water loop components must be field supplied and installed. A 16-20 mesh strainer (1 mm) is required immediately upstream of each Protocol™.

Accessibility

All stardard control panel doors require 40 inches accesssibility clearance. Oversized control panel doors require 48 inches accessibility clearance. Access to either side is also recommended. horizontal protocol units must be serviceable from three sides, the front and right side as well as the top or back as viewed facing the removable panels. A minimum of 40 inches clearance is recommended.

It is the responsibility of the installer to ensure that the final equipment installation meets all applicable code requirements.

For electrical clearances, N.E.C. and local electrical code restrictions must be followed.

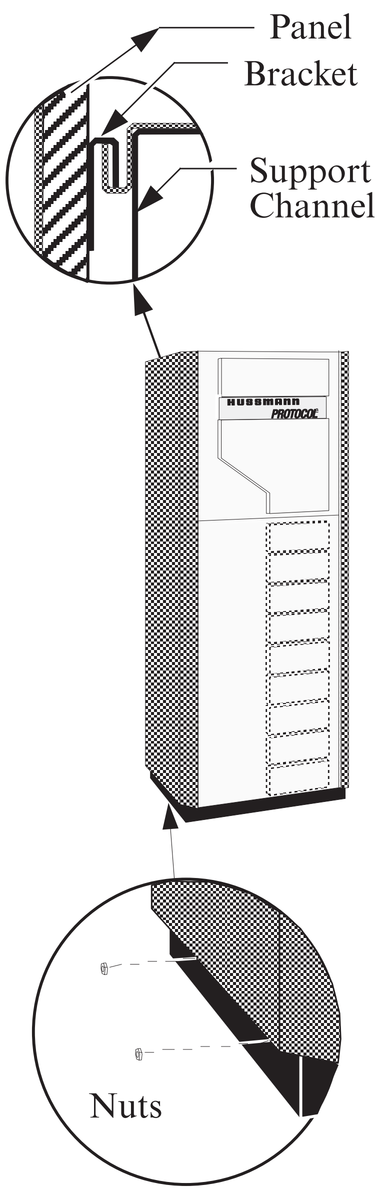
Panel Removal

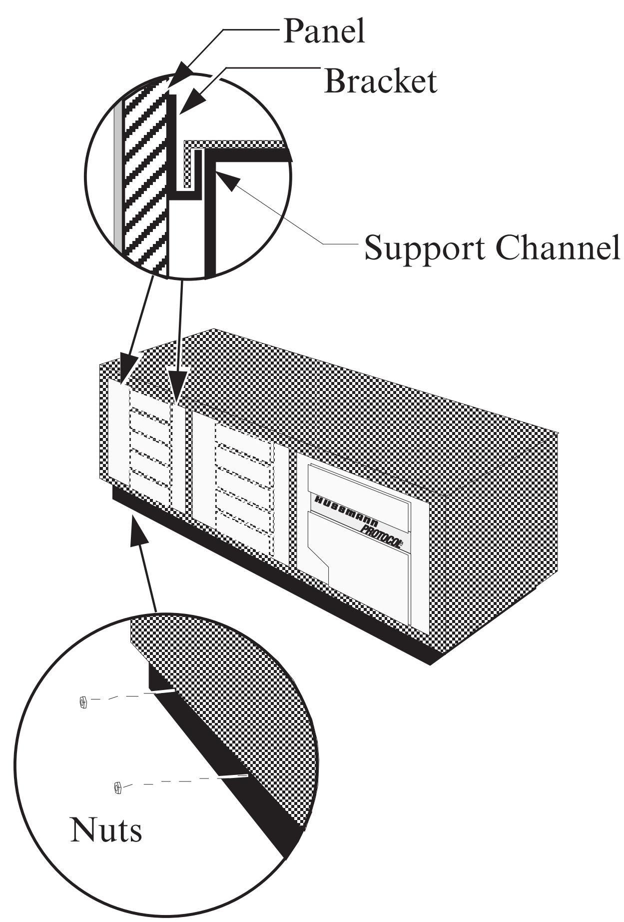
Vertical Units

At the top, a bracket in a channel supports each panel. At the bottom, each panel is held in place by two nuts. Remove the nuts at the bottom of the panel, then lift up and out.

Horizontal Units

At the top, a bracket in a channel supports each panel. At the bottom, each panel rests on two studs and is held in place by nuts. Remove the nuts at the bottom of the panel, then slide the panel out at the bottom and down.

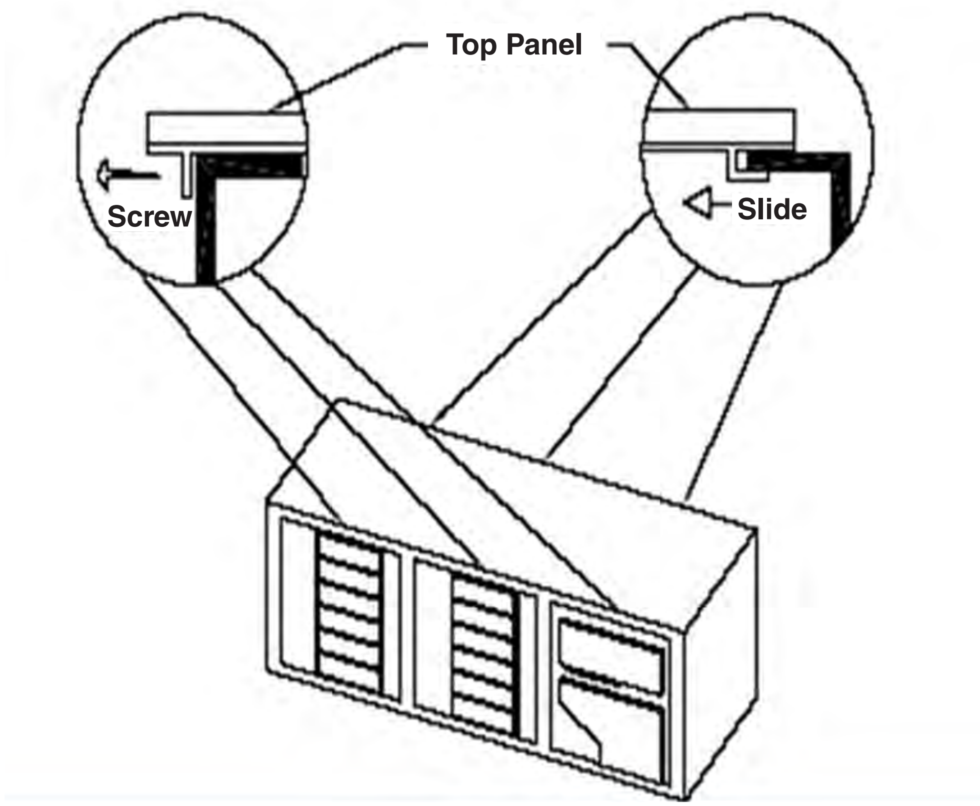




Horizontal Units – Top Removal

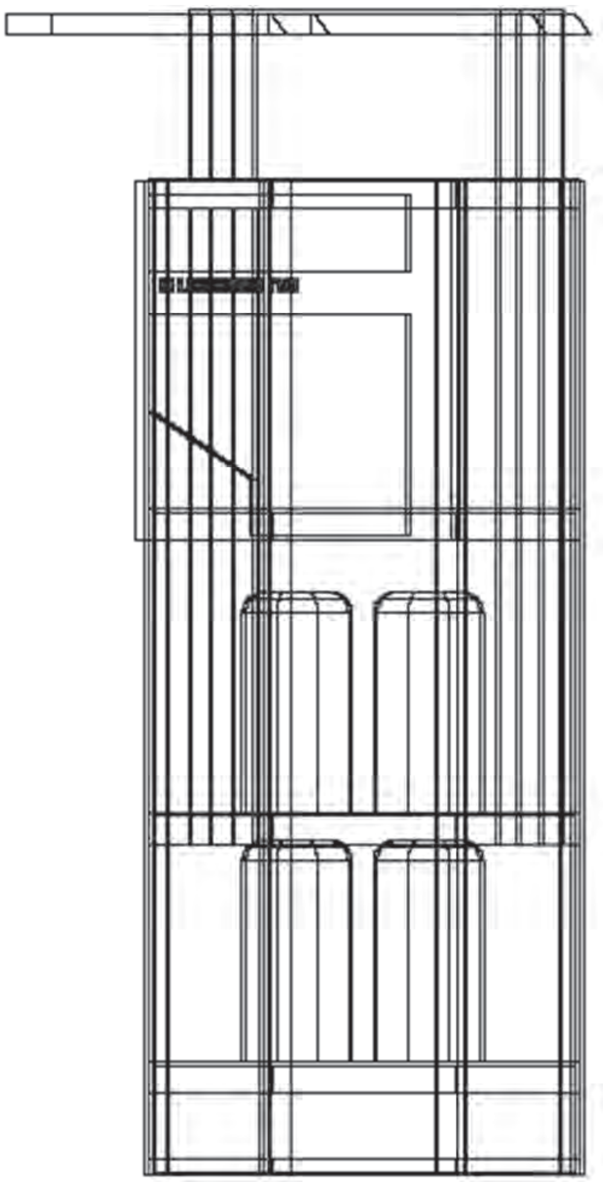
To remove the top assembly, first remove the front panels. Then remove the bracket screw at top center of each panel opening and above the control panel. Slide the top assembly forward until the back clips disengage. Lift the top off. Reverse procedure to install.

For some under-table applications, it may be desirable to remove the finished top panel to reduce the Protocol™ unit's height by two inches. To separate the top panel assembly, remove it and take out the screws holding the finished top panel to the sub-panel. The sub-panel **MUST** be installed, even when the finished top is not used.



Rigging and Hoisting

The installer is responsible for ensuring that the equipment used to move the Protocol™ is operated within its limits. Under no circumstances should the top of the unit or the outer panels be used for lifting or moving the unit. For strap rigging, run the straps under the top level of compressor mounting channel.

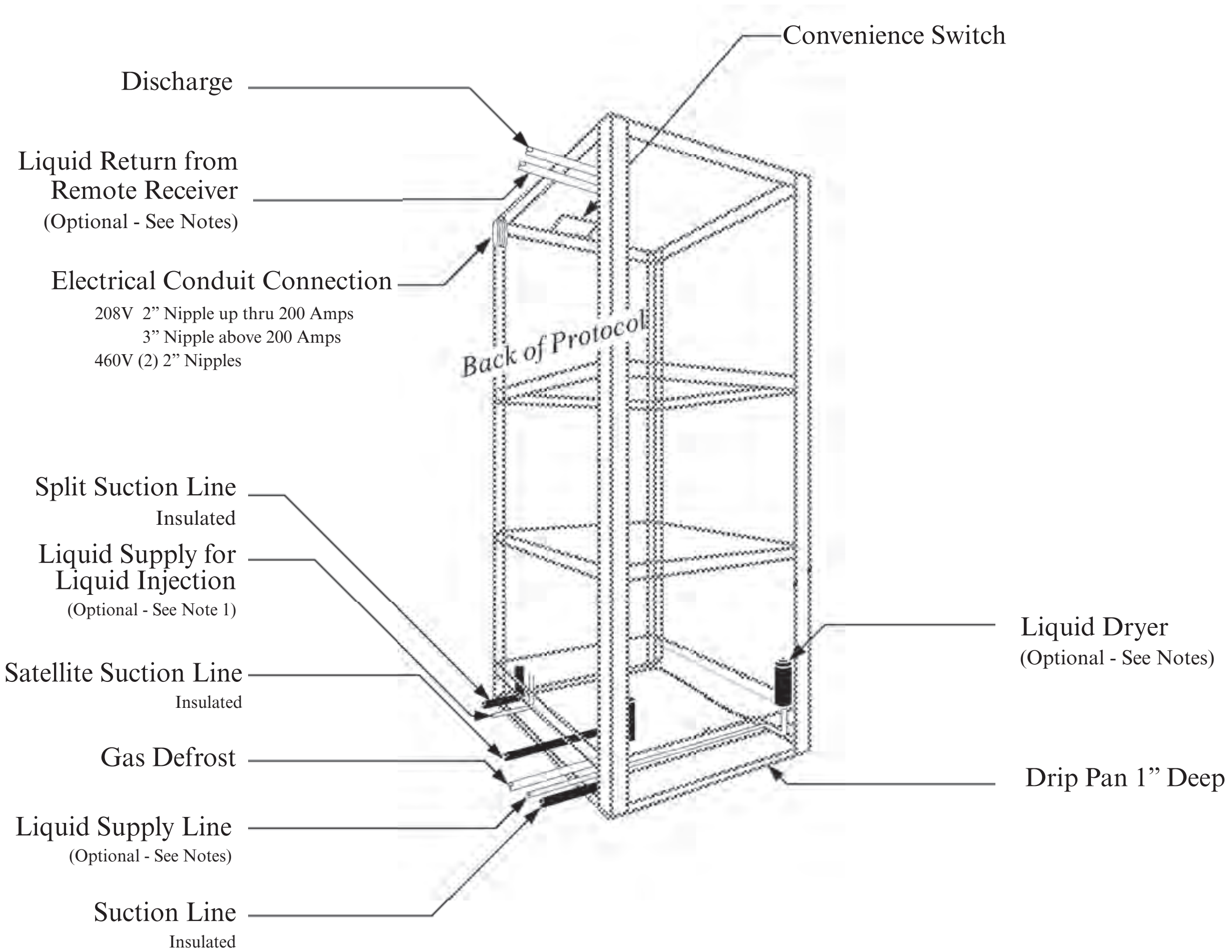


Vibration Pads

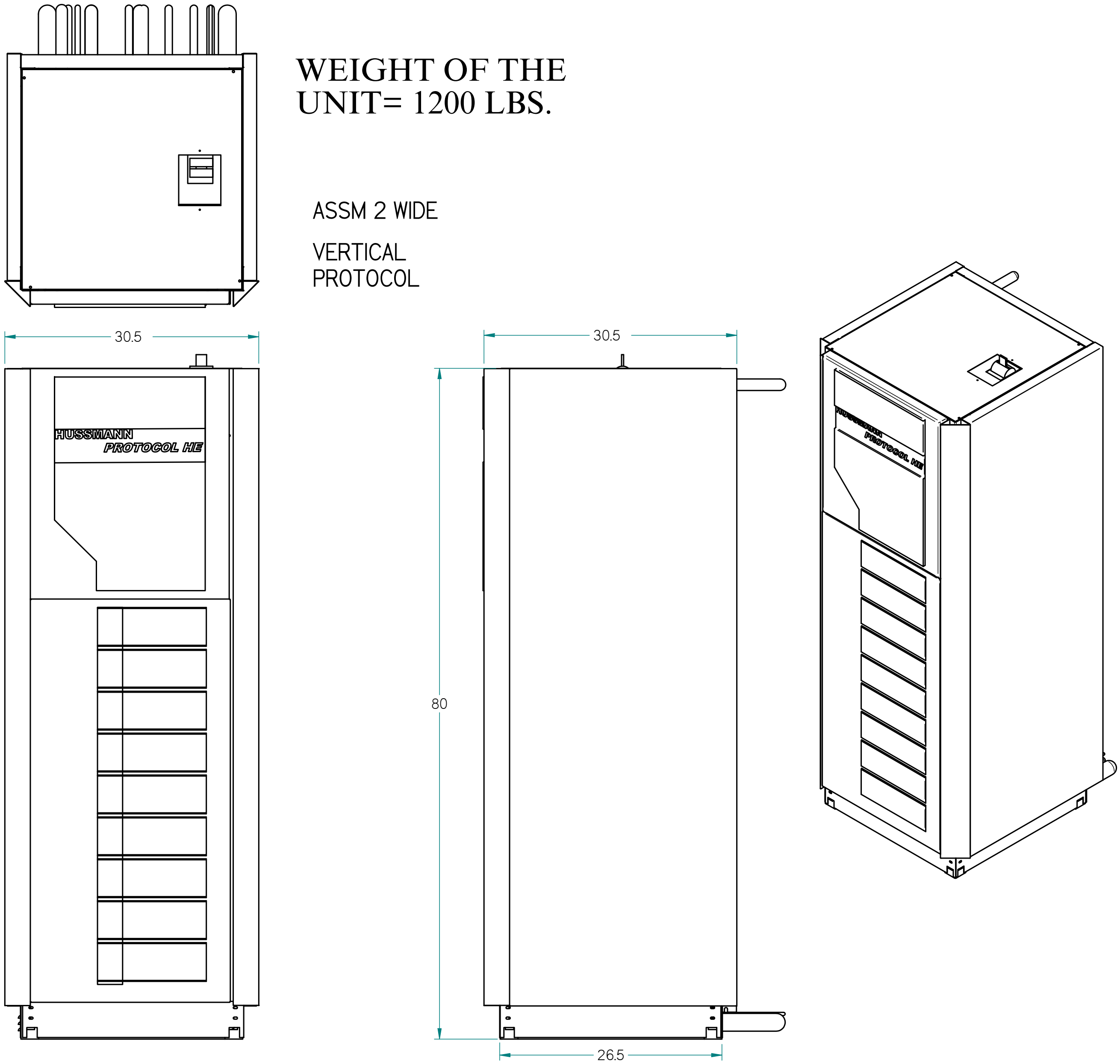
Vibration Isolation Pads are supplied with each Protocol™ unit. To adjust for slightly uneven floors, place 16 gauge galvanized steel shims between the vibration pads and the floor (shims must be field supplied). One vibration pad is installed under each upright channel. Vertical units use four pads. Horizontal units use 8 to 10 pads.

TYPICAL PIPING & ELECTRICAL HOOKUP

Vertical Units



WEIGHT OF THE UNIT= 1200 LBS.



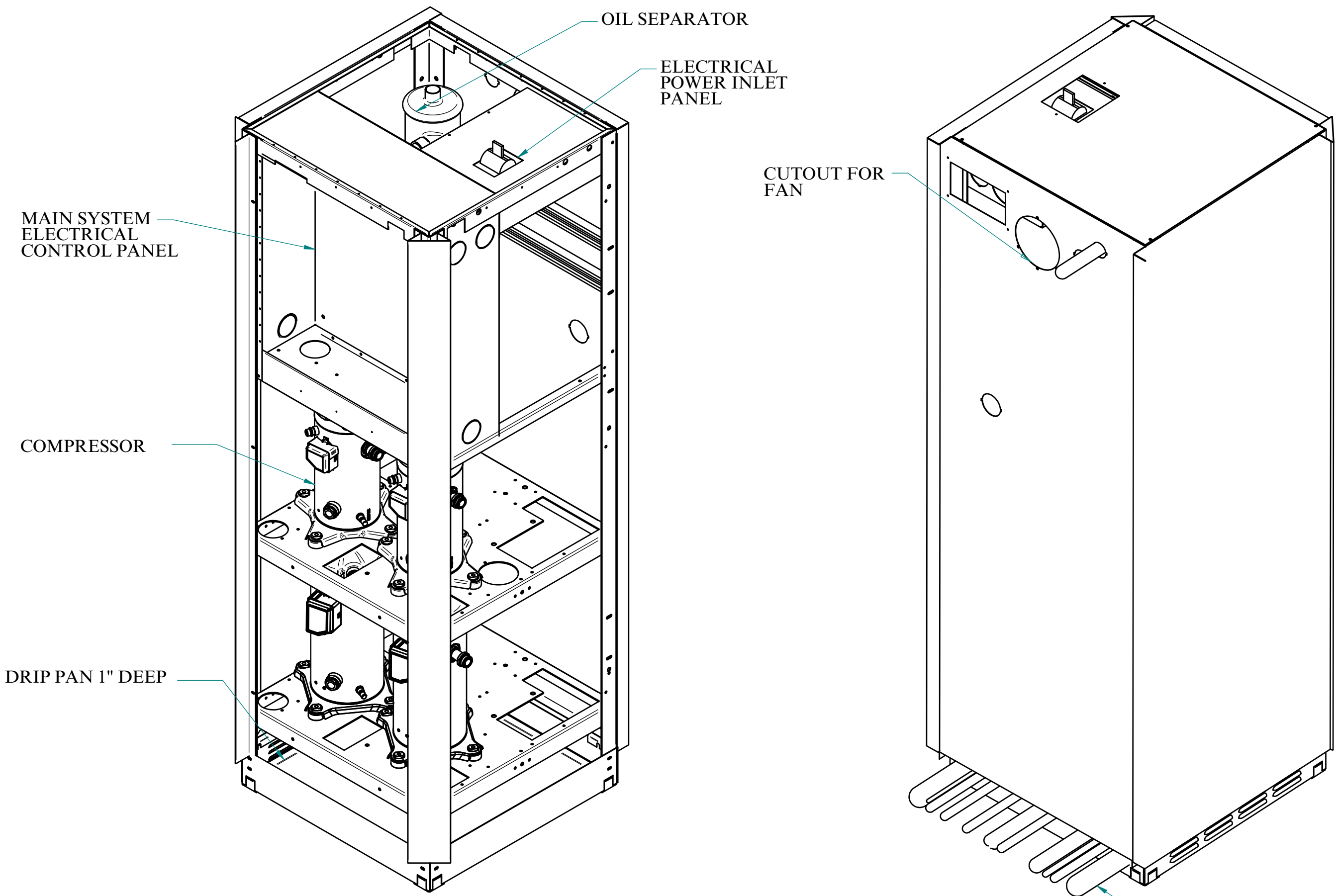


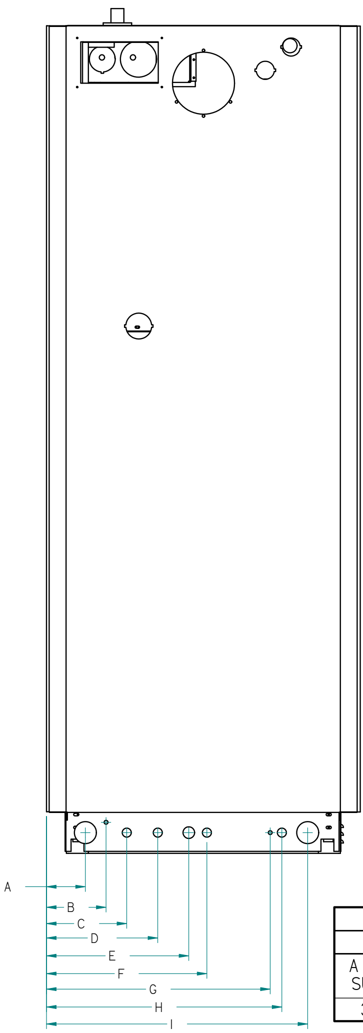
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION

ACCESSIBILITY

ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.

IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.

FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.



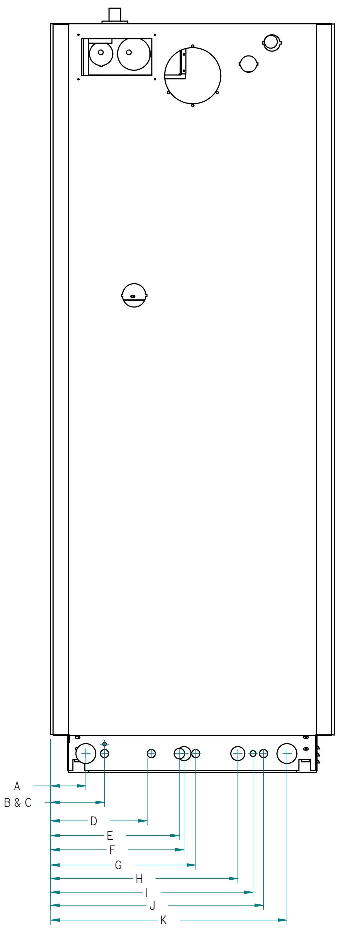
AIRCOOLED 2WIDE VERTICAL PROTOCOL

STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	SPLIT SUCTION	1 5/8" TO 2 1/8"
B	LIQUID INJECTION	3/8"
C	LT LIQUID TO CASES	7/8"
D	MT LIQUID TO CASES	7/8"
E	LIQUID FROM CONDENSER / RECEIVER	7/8" TO 1 1/8"
F	SATELLITE SUCTION	7/8"
G	GAS DEFROST	5/8"
H	LIQUID LINE	7/8"
I	SUCTION LINE	2 1/8"

Actual Line Sizing may be adjusted to match system capacities.

ASSM 2 WIDE VERTICAL PROTOCOL

MEASURMENT OF STUB OUT LINES								
A - SPLIT SUCTION	B - LIQUID INJECTION	C - LT LIQUID TO CASES	D - MT LIQUID TO CASES	E - MT LIQUID FROM RECEIVER	F -SATELLITE SUCTION	G - GAS DEFROST	H - LIQUID LINE	I - SUCTION
3 1/2"	5 1/2"	7 1/2"	10 1/2"	13 1/2"	15 1/4"	21 3/8"	22 1/2"	25"



ASSM 2 WIDE VERTICAL PROTOCOL

WATER COOLED 2WIDE VERTICAL PROTOCOL

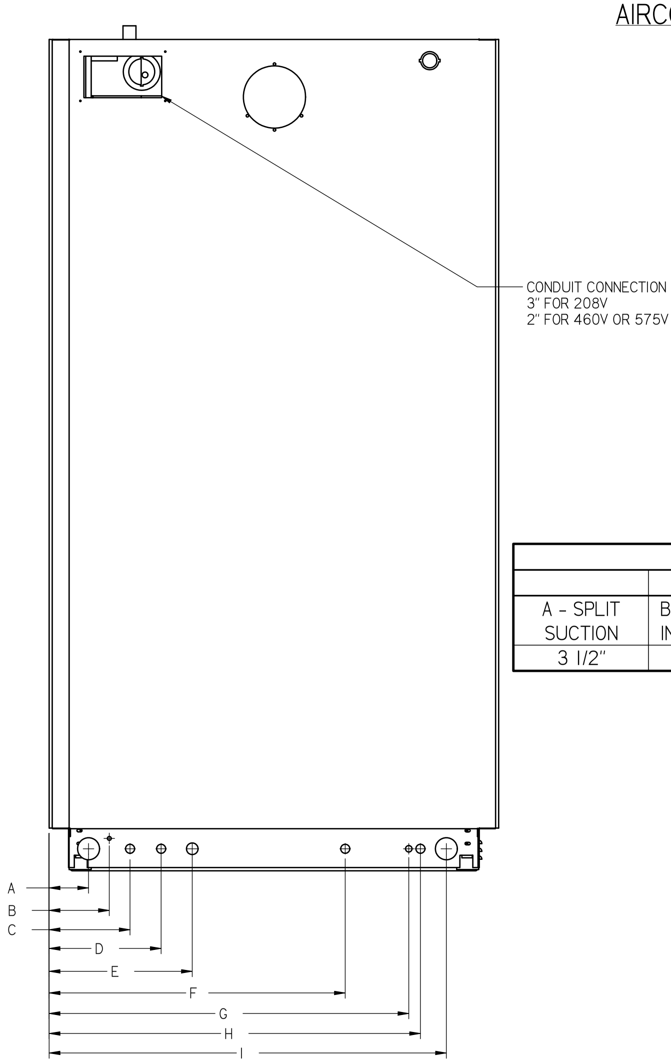
STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	SPLIT SUCTION	1 5/8" TO 2 1/8"
B	LIQUID INJECTION	3/8"
C	LT LIQUID TO CASES	7/8"
D	MT LIQUID TO CASES	7/8"
E	LIQUID FROM CONDENSER / RECEIVER	7/8" TO 1 1/8"
F & H	WATER INLET	1 1/2"
G	SATELLITE SUCTION	7/8"
H	GAS DEFROST	5/8"
I	LIQUID TO RECEIVER	7/8"
J	SUCTION	2 1/8"

Conduit Connection
3" for 208V
2" for 460V or 575V

Actual Line Sizing may be adjusted to match system capacities.

MEASURMENT OF STUB OUT LINES										
A - SPLIT SUCTION	B - LIQUID INJECTION	C - LT LIQUID TO CASES	D - MT LIQUID TO CASES	E - MT LIQUID FROM RECEIVER	F - WATER INLET	G -SATELLITE SUCTION	H - WATER OUTLET	I - GAS DEFROST	J - LIQUID TO RECEIVER	K - SUCTION
3 1/2"	5 1/2"	5 1/2"	10 1/2"	13 1/2"	14"	15 1/4"	19 3/4"	22 3/8"	22 1/2"	25"

AIRCOOLED 3WIDE VERTICAL PROTOCOL

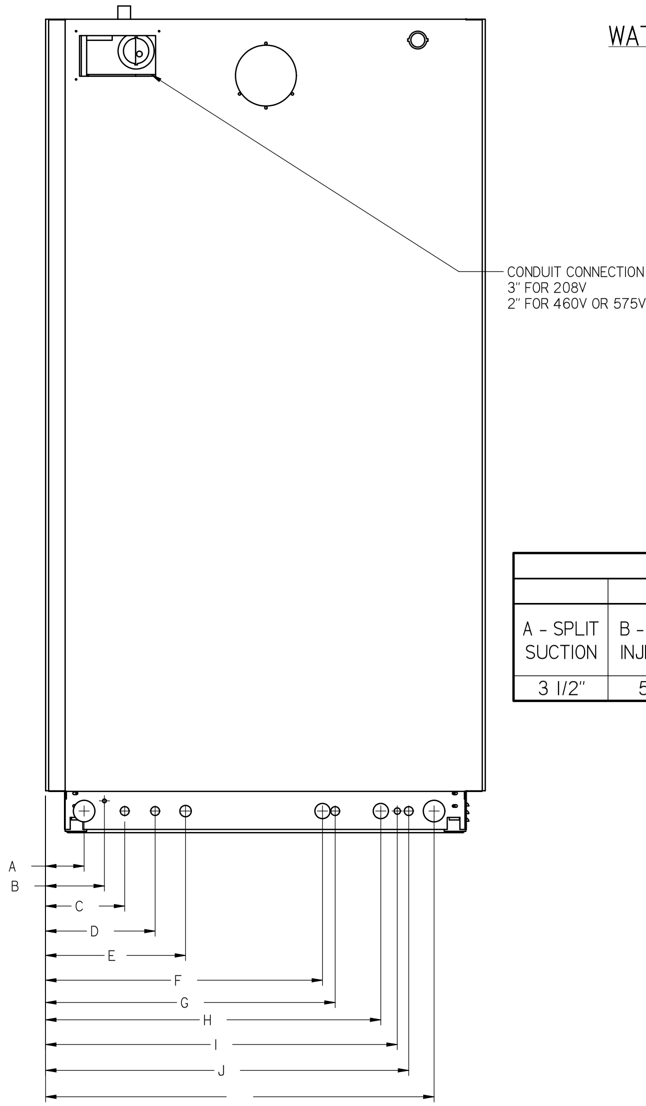


3W VERTICAL
PROTOCOL
SUBMITTAL

STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	SPLIT SUCTION	2 1/8"
B	LIQUID INJECTION	3/8"
C	LT LIQUID TO CASES	7/8"
D	MT LIQUID TO CASES	7/8"
E	MT LIQUID FROM CONDENSER / RECEIVER	7/8" TO 1 1/8"
F	SATELLITE SUCTION	7/8"
G	GAS DEFROST	5/8"
H	LIQUID LINE	7/8"
I	SUCTION LINE	2 1/8"

ACTUAL LINE SIZE CAN
BE ADJUSTED TO MATCH
SYSTEM CAPACITIES

MEASURMENT OF STUB OUT LINES								
A - SPLIT SUCTION	B - LIQUID INJECTION	C - LT LIQUID TO CASES	D - MT LIQUID TO CASES	E - MT LIQUID FROM RECEIVER / CONDENSER	F - SATELLITE SUCTION	G -GAS DEFROST	H - LIQUID LINE	I - SUCTION
3 1/2"	5 1/2"	7 1/2"	10 1/2"	13 1/2"	28 1/4"	34 3/8"	35 1/2"	38"



WATERCOOLED 3WIDE VERTICAL PROTOCOL

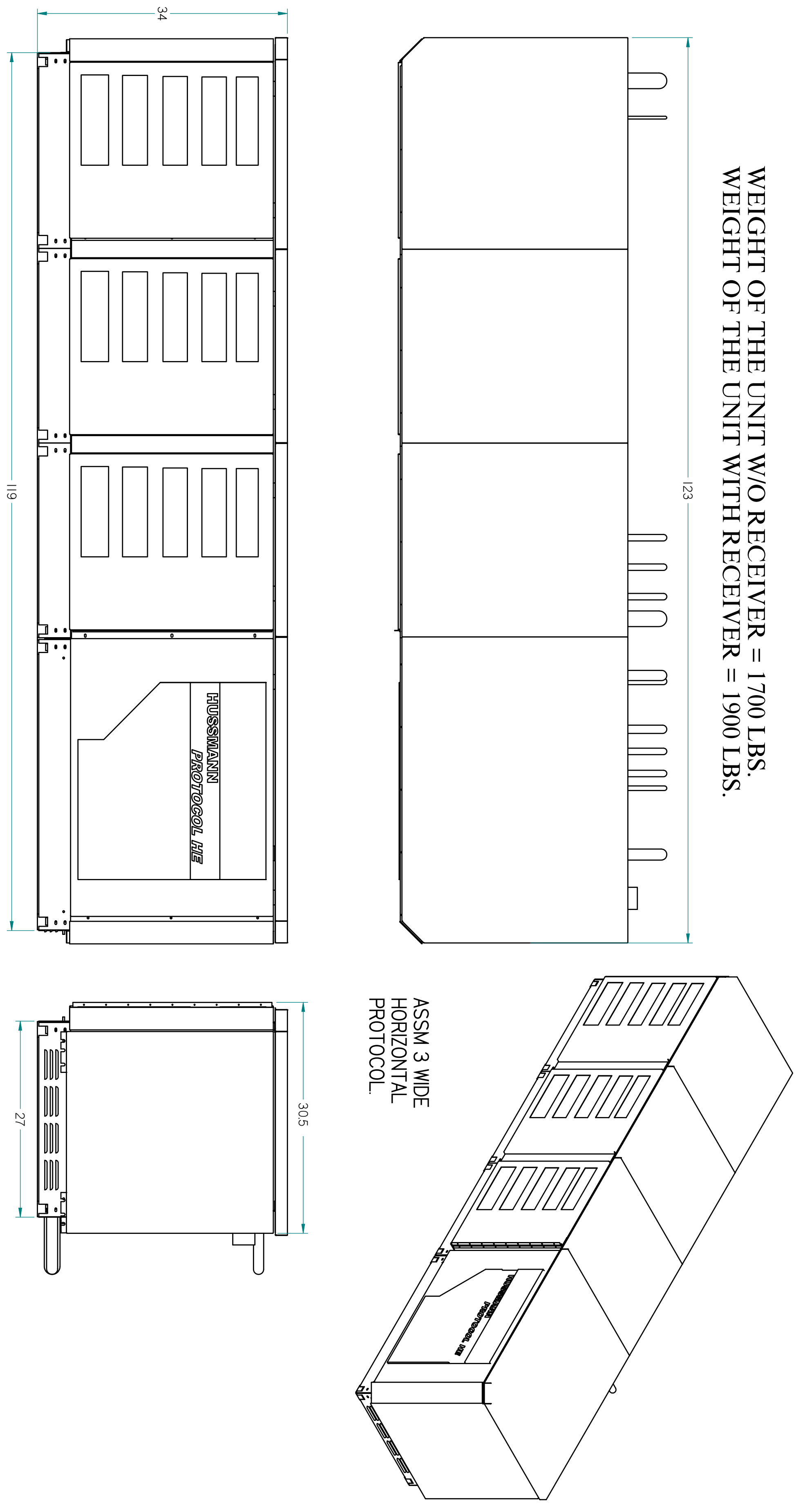
3W VERTICAL
PROTOCOL
SUBMITTAL

STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	SPLIT SUCTION	2 1/8"
B	LIQUID INJECTION	3/8"
C	LT LIQUID TO CASES	7/8"
D	MT LIQUID TO CASES	7/8"
E	LIQUID FROM CONDENSER / RECEIVER	7/8" TO 1 1/8"
F & H	WATER LINE	1 1/2"
G	SATELLITE SUCTION	7/8"
I	GAS DEFROST	5/8"
J	LIQUID TO RECEIVER	7/8" TO 1 1/8"
K	SUCTION LINE	2 1/8"

ACTUAL LINE SIZE CAN BE ADJUSTED TO MATCH SYSTEM CAPACITIES

MEASURMENT OF STUB OUT LINES

A - SPLIT SUCTION	B - LIQUID INJECTION	C - LT LIQUID TO CASES	D - MT LIQUID TO CASES	E - MT LIQUID FROM RECEIVER / CONDENSER	F - WATER INLET	G - SATELLITE SUCTION	H - WATER OUTLET	I - GAS DEFROST	J - LIQUID TO RECEIVER	K - SUCTION
3 1/2"	5 1/2"	7 1/2"	10 1/2"	13 1/2"	27"	28 1/4"	32 3/4"	34 3/8"	35 1/2"	38"


34
119
123
27
30.5
HUSSMANN
PROTOCOL HE
WEIGHT OF THE UNIT W/O RECEIVER = 1700 LBS.
WEIGHT OF THE UNIT WITH RECEIVER = 1900 LBS.
ASSM 3 WIDE
HORIZONTAL
PROTOCOL.

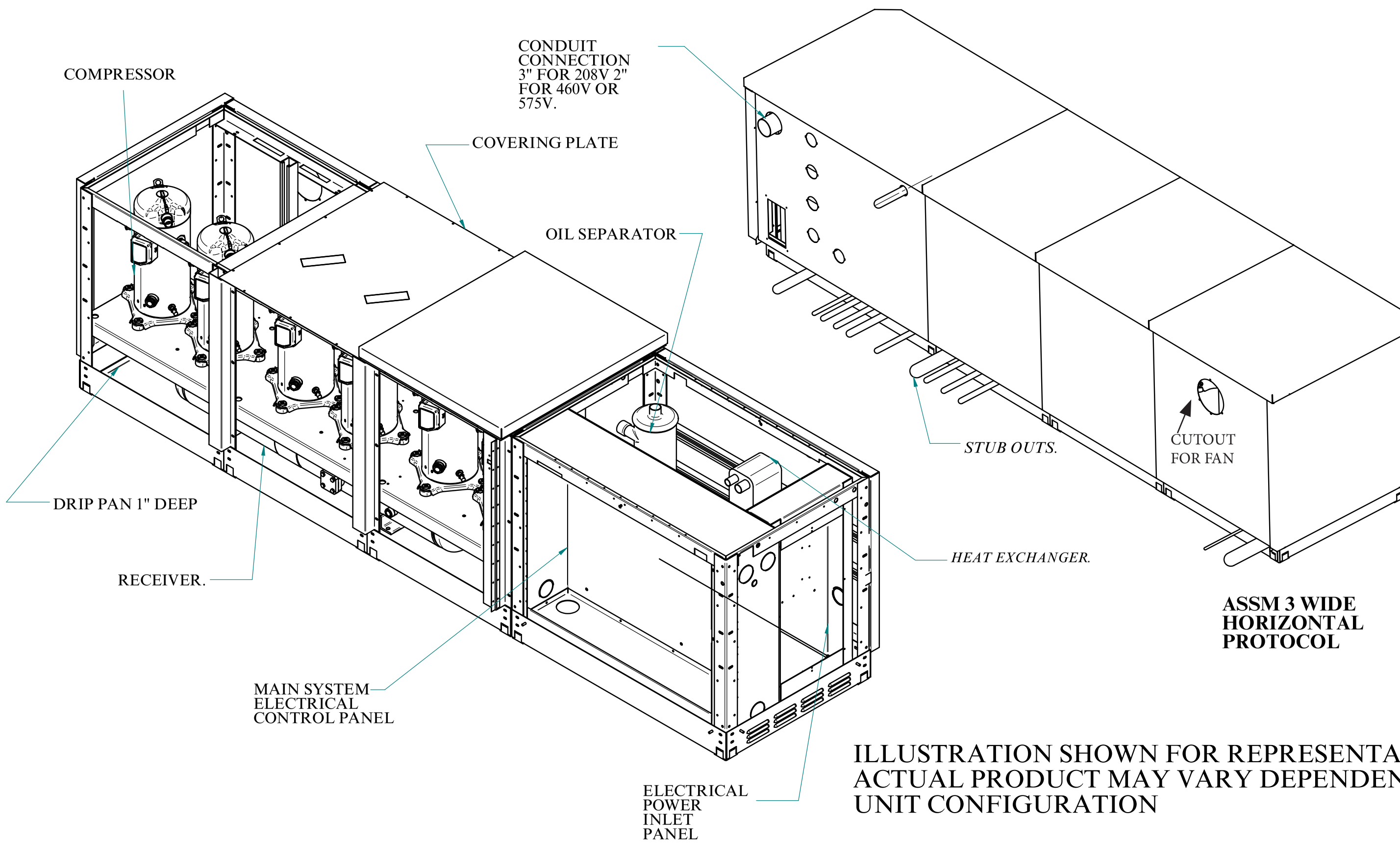


ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON
UNIT CONFIGURATION

ACCESSIBILITY

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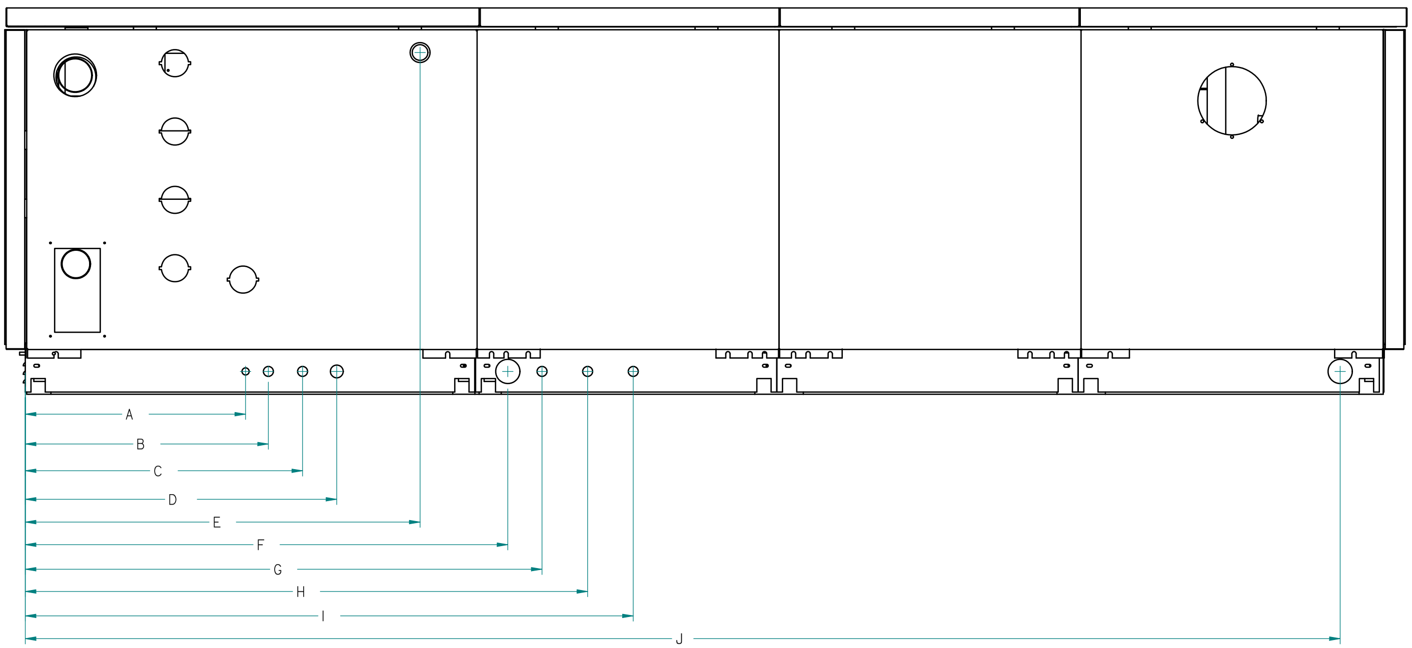
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.

AIRCOOLED 3WIDE HORIZONTALPROTOCOL



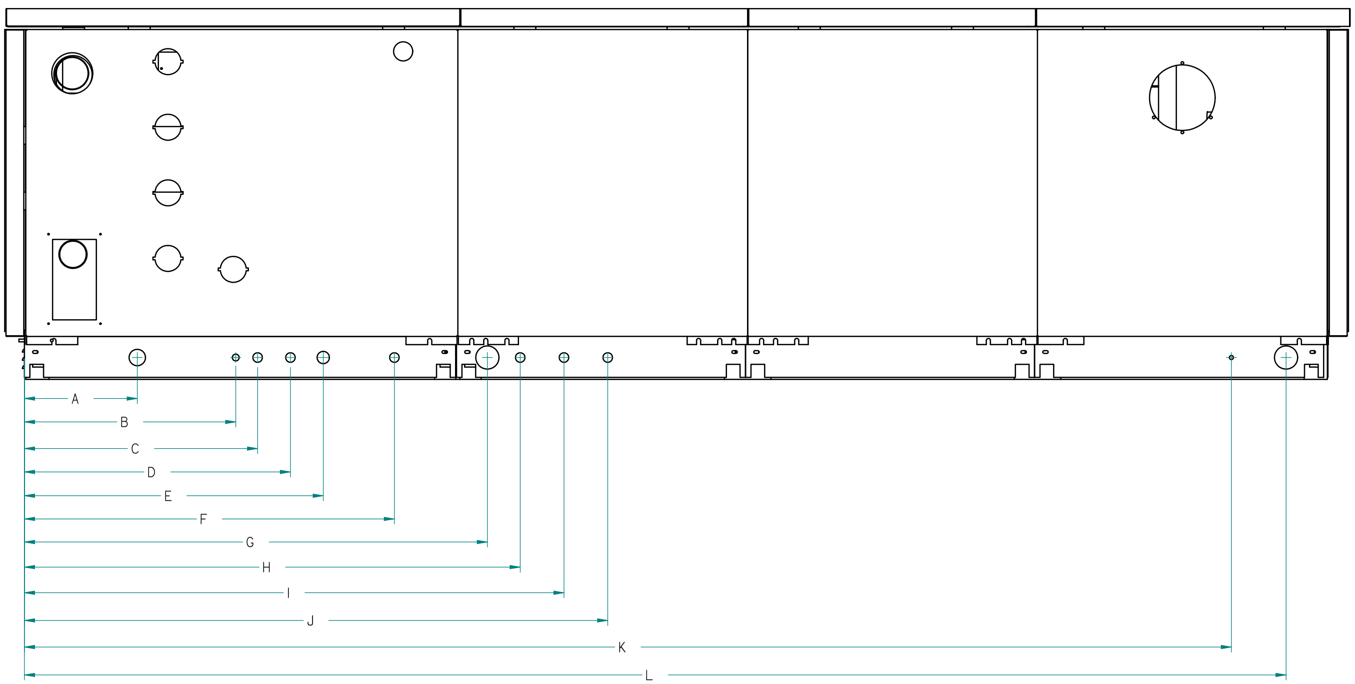
STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	GAS DEFROST	5/8"
B	LT LIQUID TO CASES	7/8"
C	MT LIQUID TO CASES	7/8"
D	LIQUID FROM CONDENSER / RECEIVER	7/8" TO 1 1/8"
E	DISCHARGE	1 3/8"
F	SUCTION LINE	2 1/8"
G	SATELLITE SUCTION	7/8"
H	LIQUID LINE	7/8"
I	RECEIVER REGULATOR LINE	7/8"
J	SPLIT SUCTION	2 1/8"

Actual Line Sizing may be adjusted to match system capacities.

MEASURMENT OF STUB OUT LINES									
A - GAS DEFROST	B - LT LIQUID TO CASES	C - MT LIQUID TO CASES	D - LIQUID FROM RECEIVER / CONDENSER	E - DISCHARGE	F -SUCTION LINE	G - SATELLITE SUCTION	H - LIQUID LINE	I - RECEIVER REGULATOR LINE	J - SPLIT SUCTION
19"	21"	24"	27"	35"	42"	45"	49"	53"	115"

ASSM 3 WIDE HORIZONTAL PROTOCOL.

WATER COOLED 3WIDE HORIZONTAL PROTOCOL

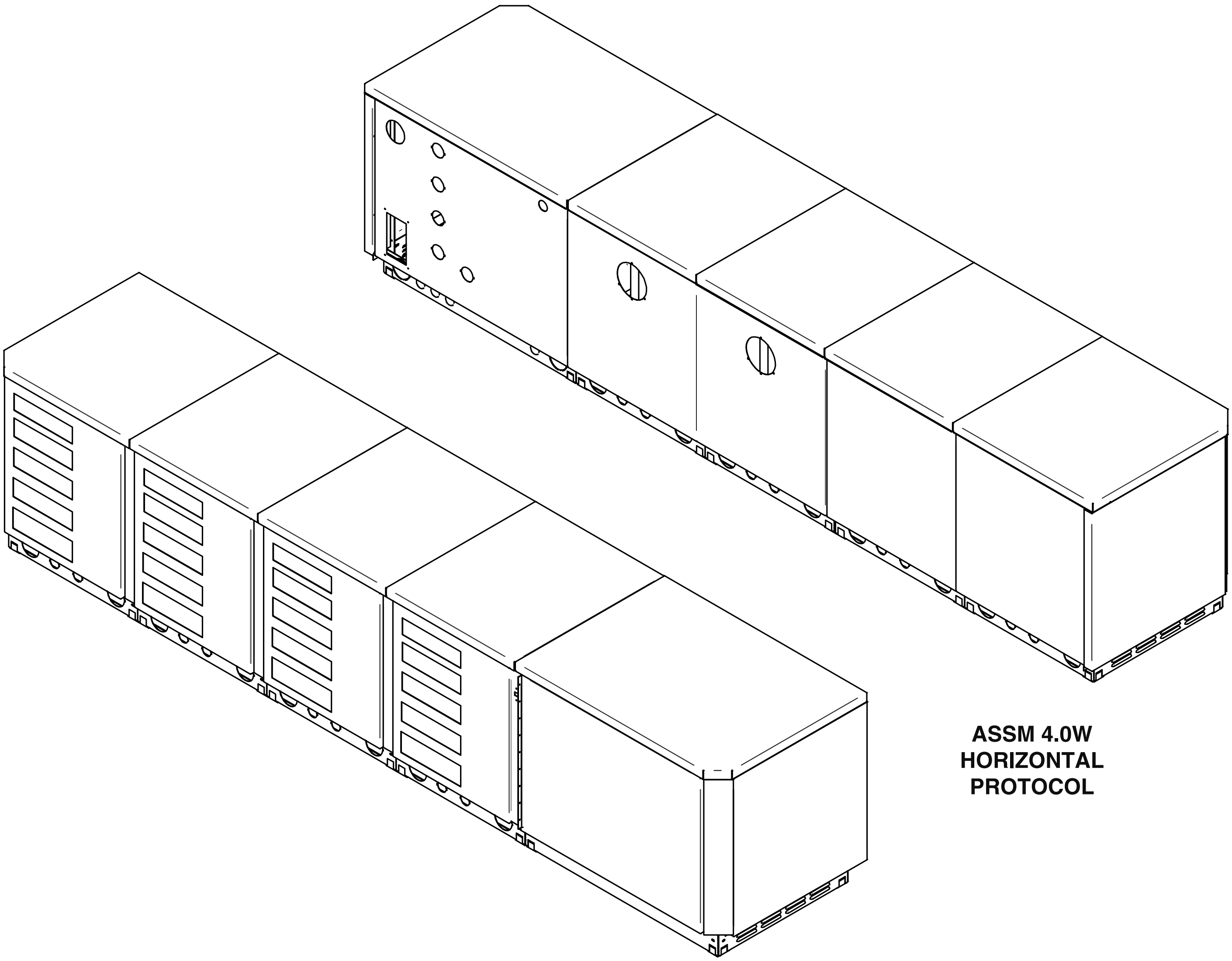


STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A & I	WATER LINE	1 1/2"
B	GAS DEFROST	5/8"
C	LT LIQUID TO CASES	7/8"
D	MT LIQUID TO CASES	7/8"
E	MT LIQUID FROM RECEIVER	7/8" TO 1 1/8"
F	LIQUID TO RECEIVER	7/8"
G	SUCTION	2 1/8"
H	SATELLITE SUCTION	7/8"
J	SPLIT SUCTION	2 1/8"
K	LIQUID INJECTION	3/8"
L	LIQUID LINE	7/8"

Actual Line Sizing may be adjusted to match system capacities.

MEASURMENT OF STUB OUT LINES											
A - WATER OUTLET	B - GAS DEFROST	C - LT LIQUID TO CASES	D - MT LIQUID TO CASES	E - MT LIQUID FROM RECEIVER	F -LIQUID TO RECEIVER	G - SUCTION	H - SATELLITE SUCTION	I - WATER INLET	J - SPLIT SUCTION	K - LIQUID INJECTION	L- LIQUID LINE
10"	19"	21"	24"	27"	33.5"	42"	45"	53"	115"	112"	49"

ASSM 3 WIDE HORIZONTAL PROTOCOL.



WEIGHT OF THE UNIT WITHOUT RECEIVER= 1900 LBS.
WEIGHT OF THE UNIT WITH RECEIVER= 2200 LBS

ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
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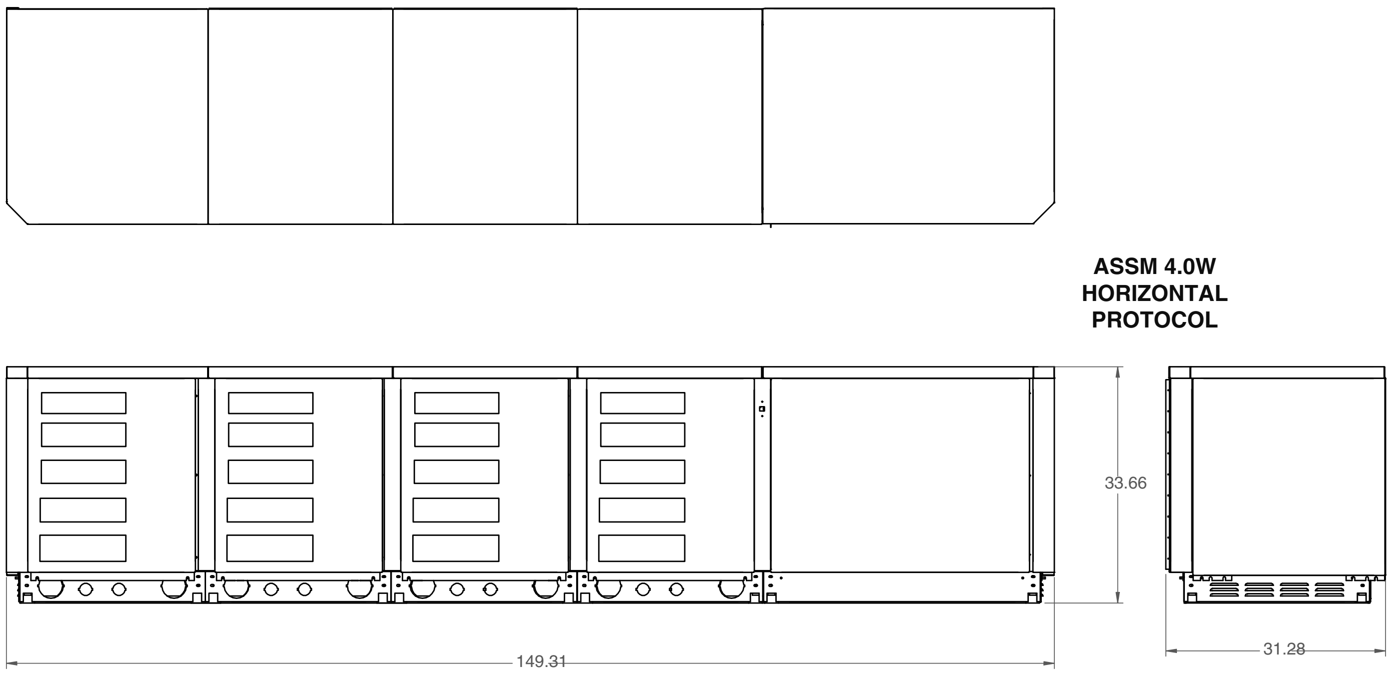

ACCESSIBILITY

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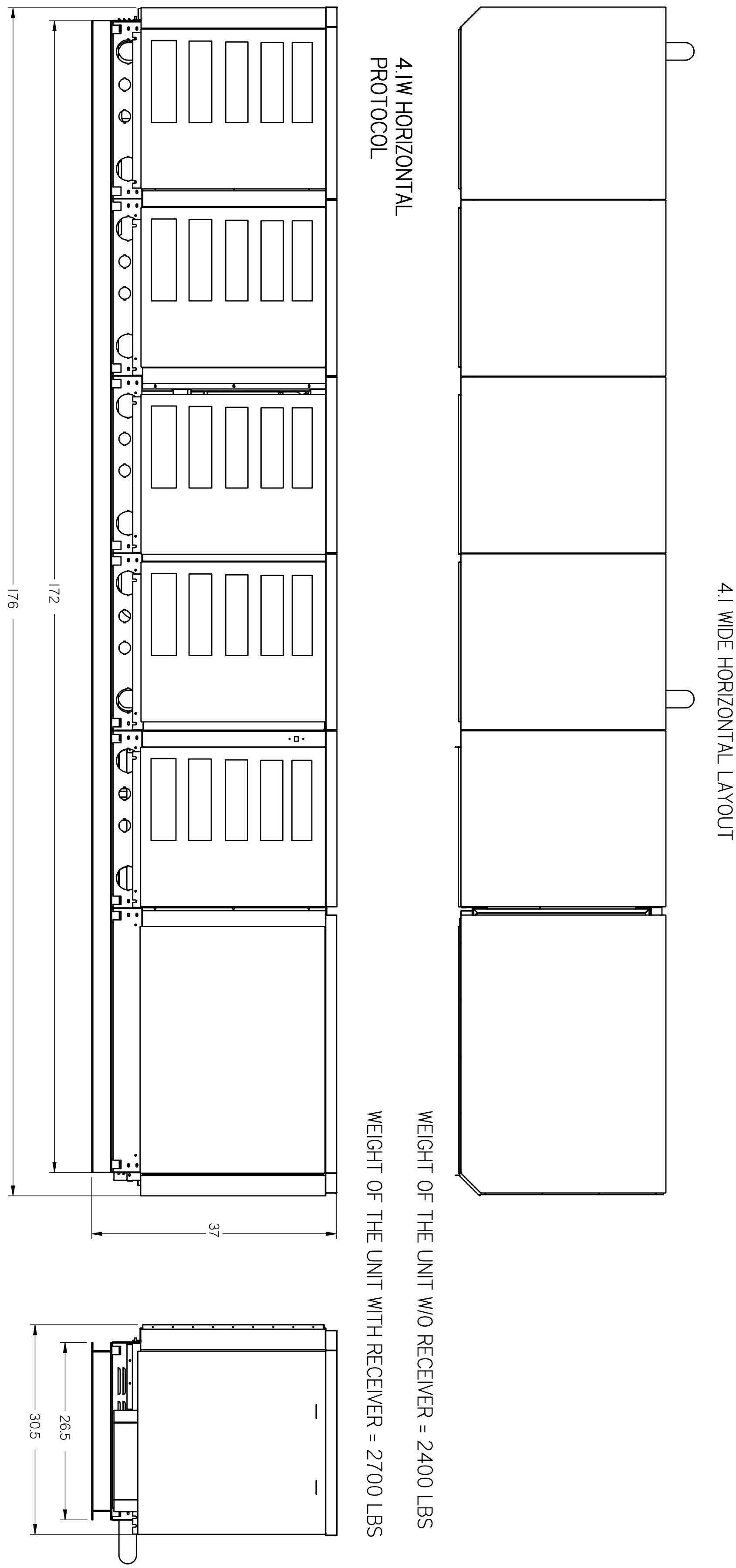
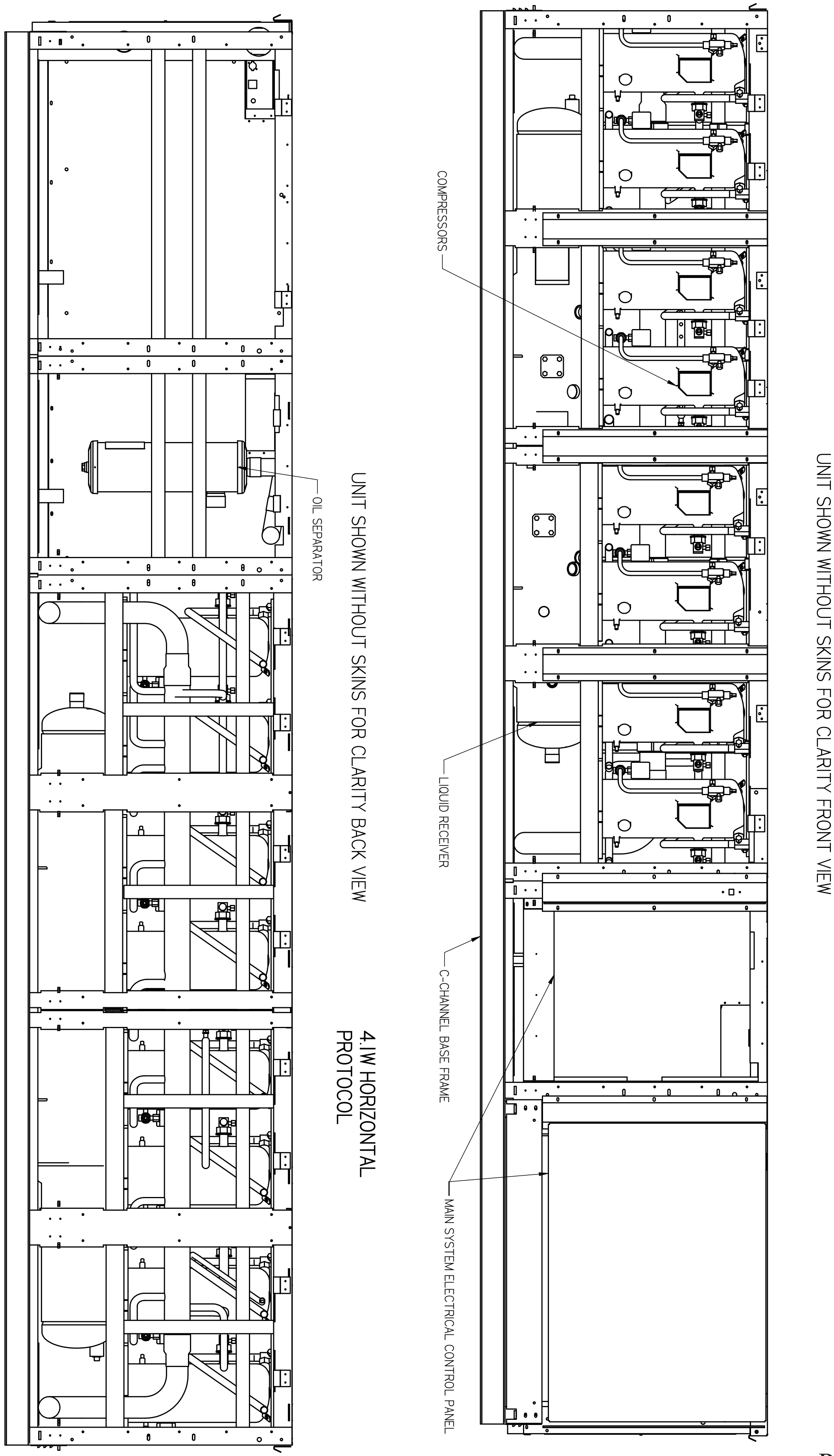
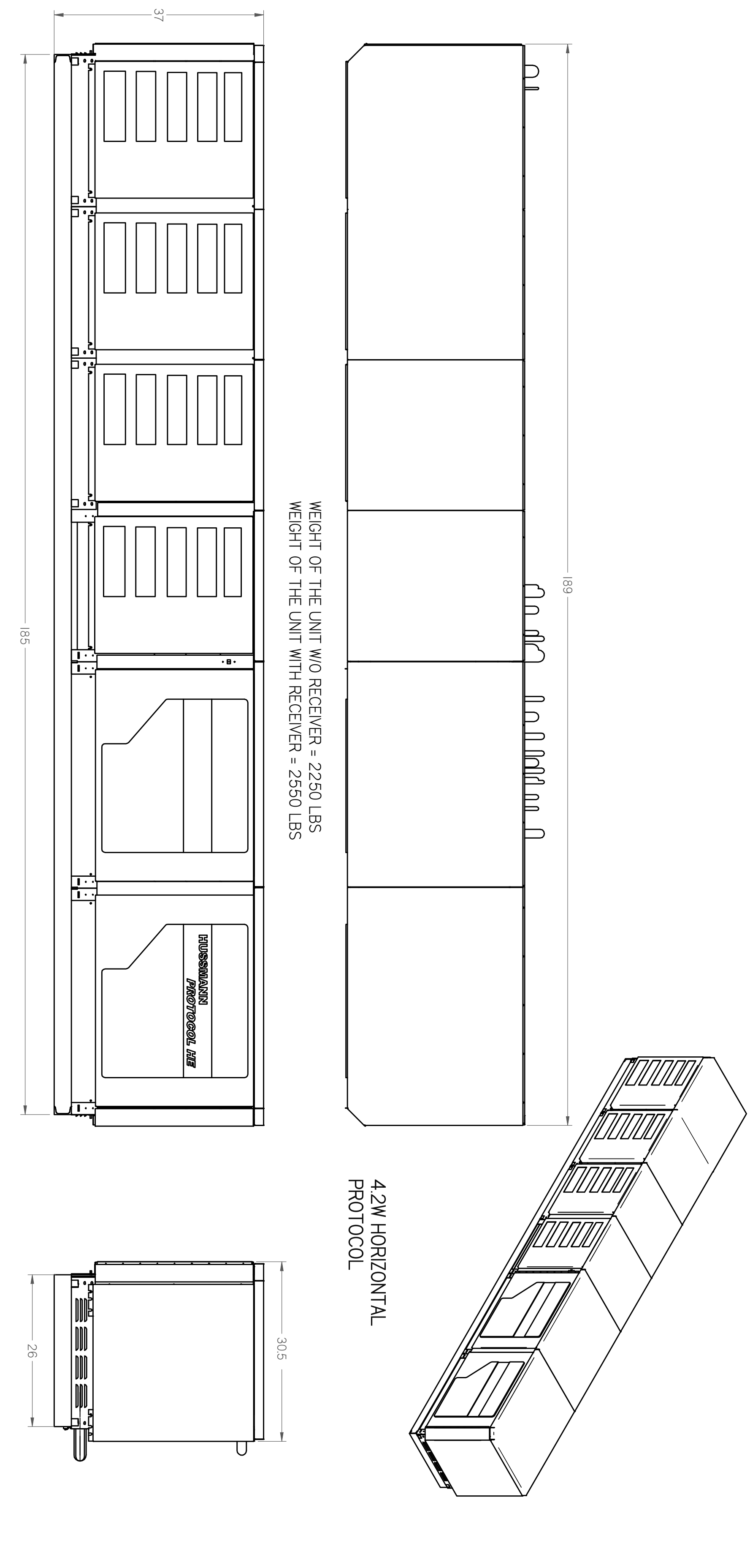
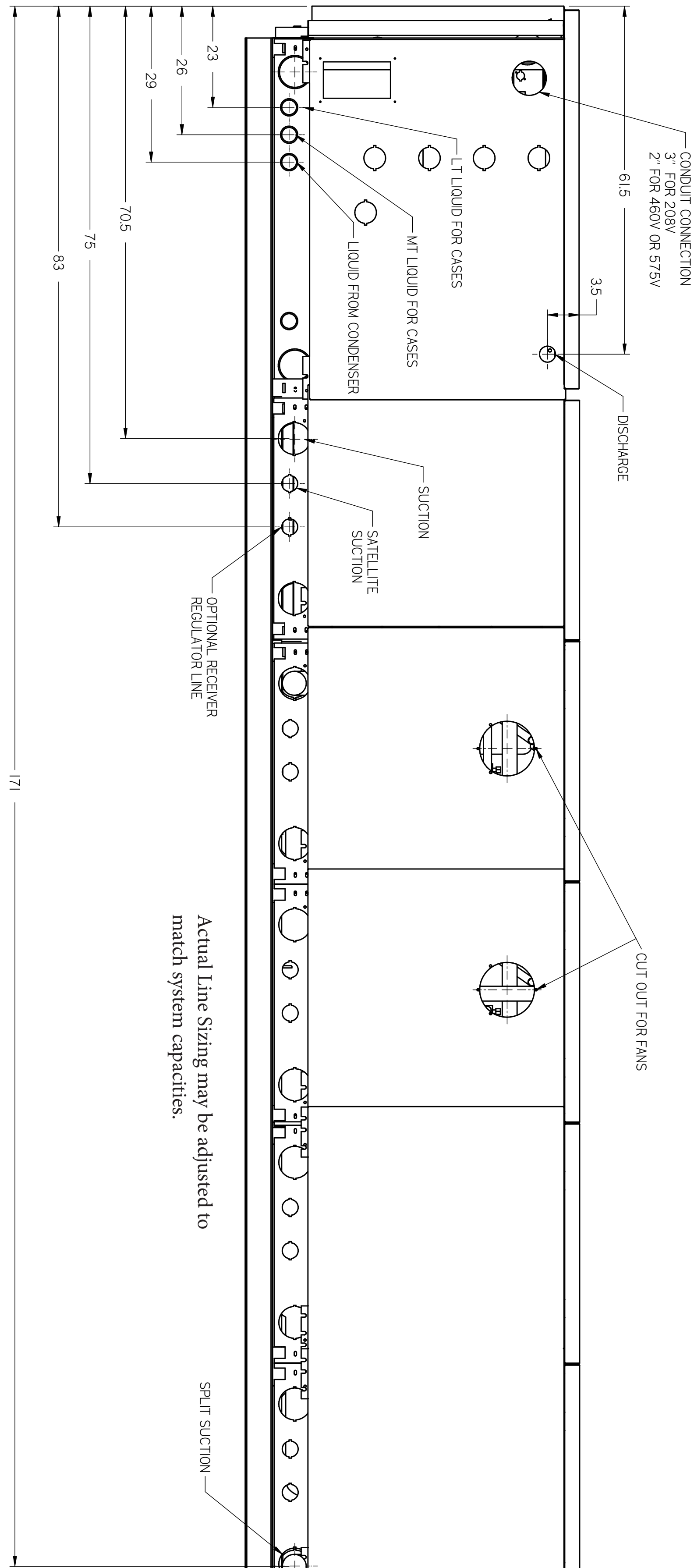
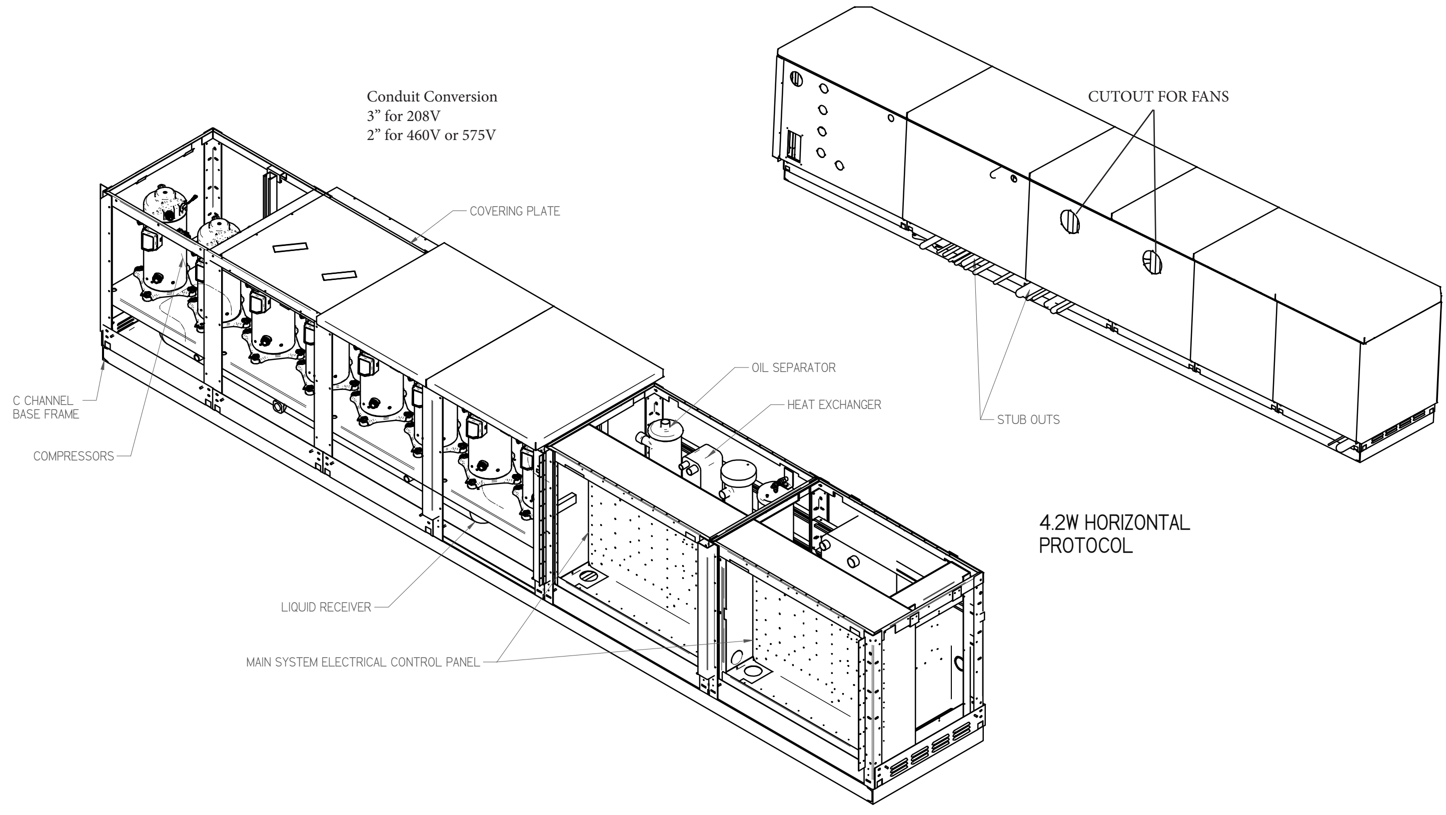

4.1W HORIZONTAL
PROTOCOL
4.1 WIDE HORIZONTAL LAYOUT
176
172
37
30.5
26.5
WEIGHT OF THE UNIT W/O RECEIVER = 2400 LBS
WEIGHT OF THE UNIT WITH RECEIVER = 2700 LBS


OIL SEPARATOR
UNIT SHOWN WITHOUT SKINS FOR CLARITY BACK VIEW
4.1W HORIZONTAL
PROTOCOL
COMPRESSORS
LIQUID RECEIVER
C-CHANNEL BASE FRAME
MAIN SYSTEM ELECTRICAL CONTROL PANEL
UNIT SHOWN WITHOUT SKINS FOR CLARITY FRONT VIEW


37
185
189
26
30.5
WEIGHT OF THE UNIT W/O RECEIVER = 2250 LBS
WEIGHT OF THE UNIT WITH RECEIVER = 2550 LBS
HUSSMANN
PROTOCOL HE
4.2W HORIZONTAL
PROTOCOL



PIPE STUBS - DESIGNATIONS & LOCATIONS BACK OF PROTOCOL



ACCESSIBILITY

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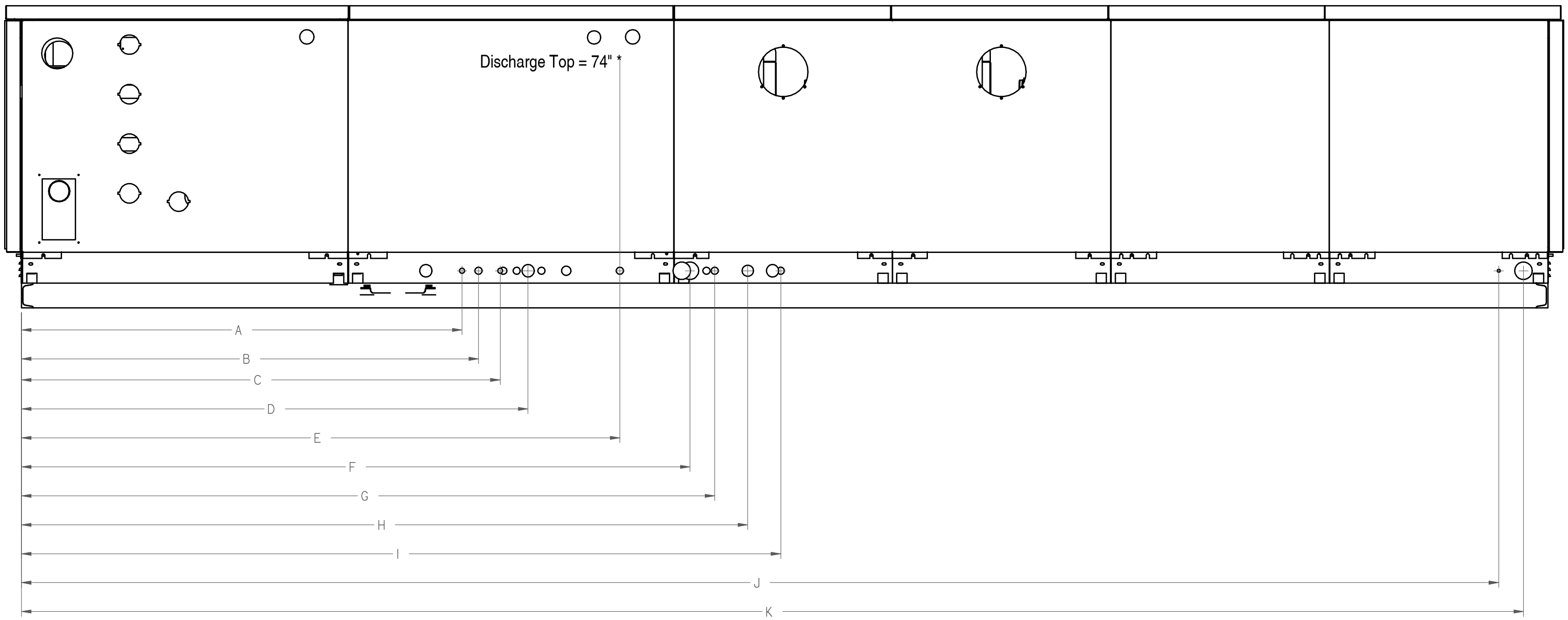
AIRCOOLED 4.2WIDE HORIZONTAL PROTOCOL

Actual Line Sizing may be adjusted to match system capacities.

STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	GAS DEFROST	5/8 "
B	LT LIQUID TO CASES	7/8" OR 1 1/8"
C	MT LIQUID TO CASES	7/8" OR 1 1/8"
D	LIQUID FROM CONDENSERS	7/8" OR 1 1/8"
E	DISCHARGE	1 5/8"
F	SUCTION LINE	2 5/8"
G	SAT. SUCTION	7/8 " OR 2 5/8"
H	LIQUID SUPPLY LINE	1 3/8"
I	OPTIONAL RECEIVER REGULATOR LINE	7/8"
J	FOR INJECTION	3/8"
K	SPLIT SUCTION	2 5/8"

4.2W HORIZONTAL PROTOCOL



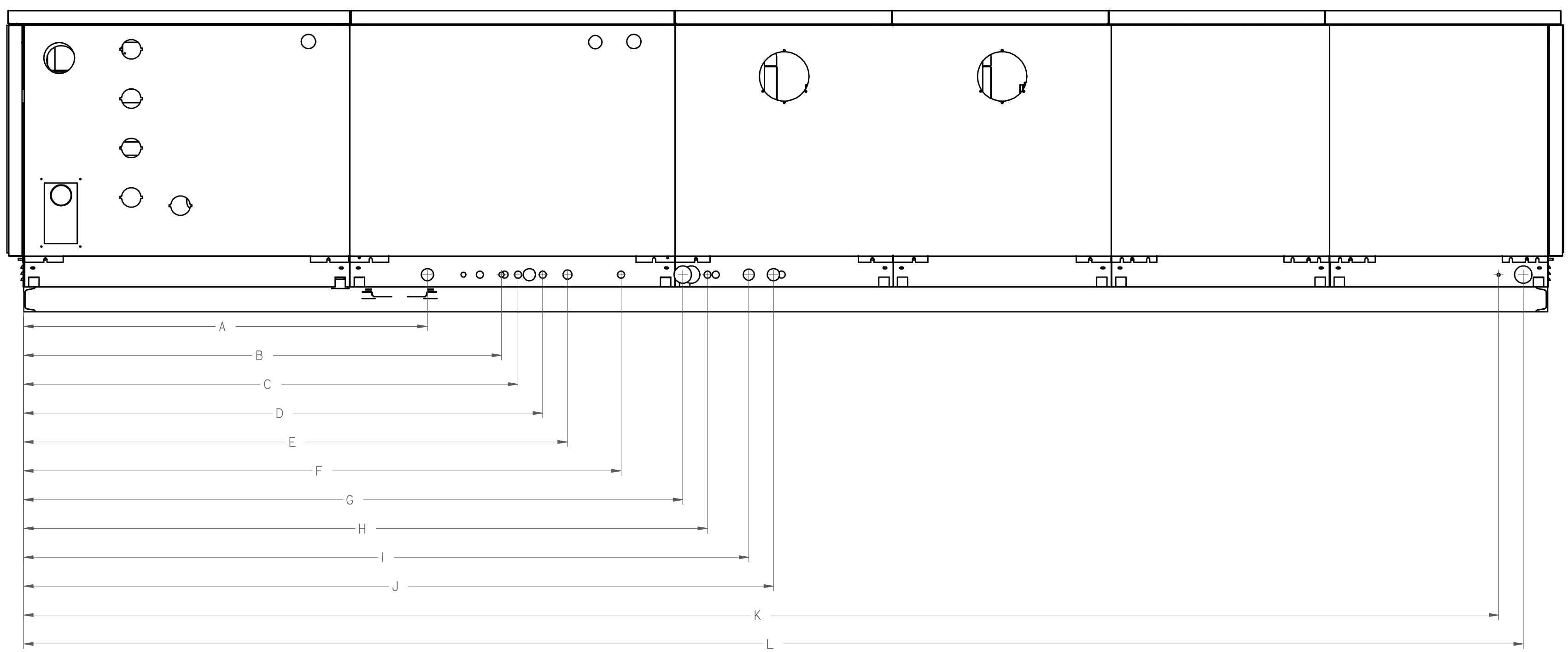
MEASURMENT OF STUB OUT LINES										
A-GAS DEFROST	B-LT LIQUID FOR CASES	C-MT LIQUID TO CASES	D-LIQUID FROM RECEIVER / CONDENSER	E-DISCHARGE	F-SUCTION	G-SAT SUCTION	H-LIQUID SUPPLY LINE	I-OPTIONAL RECEIVER REGULATOR LINE	J-FOR INJECTION	K-SPLIT SECTION
71"	55 3/8" OR 27"	54"	61 3/8" OR 66"	69" 3/8" OR 74"	81" OR 82"	84" OR 85"	88" OR 89"	96"	179"	182"

WATERCOOLED 4.2 WIDE HORIZONTAL PROTOCOL

Actual Line Sizing may be adjusted to match system capacities.

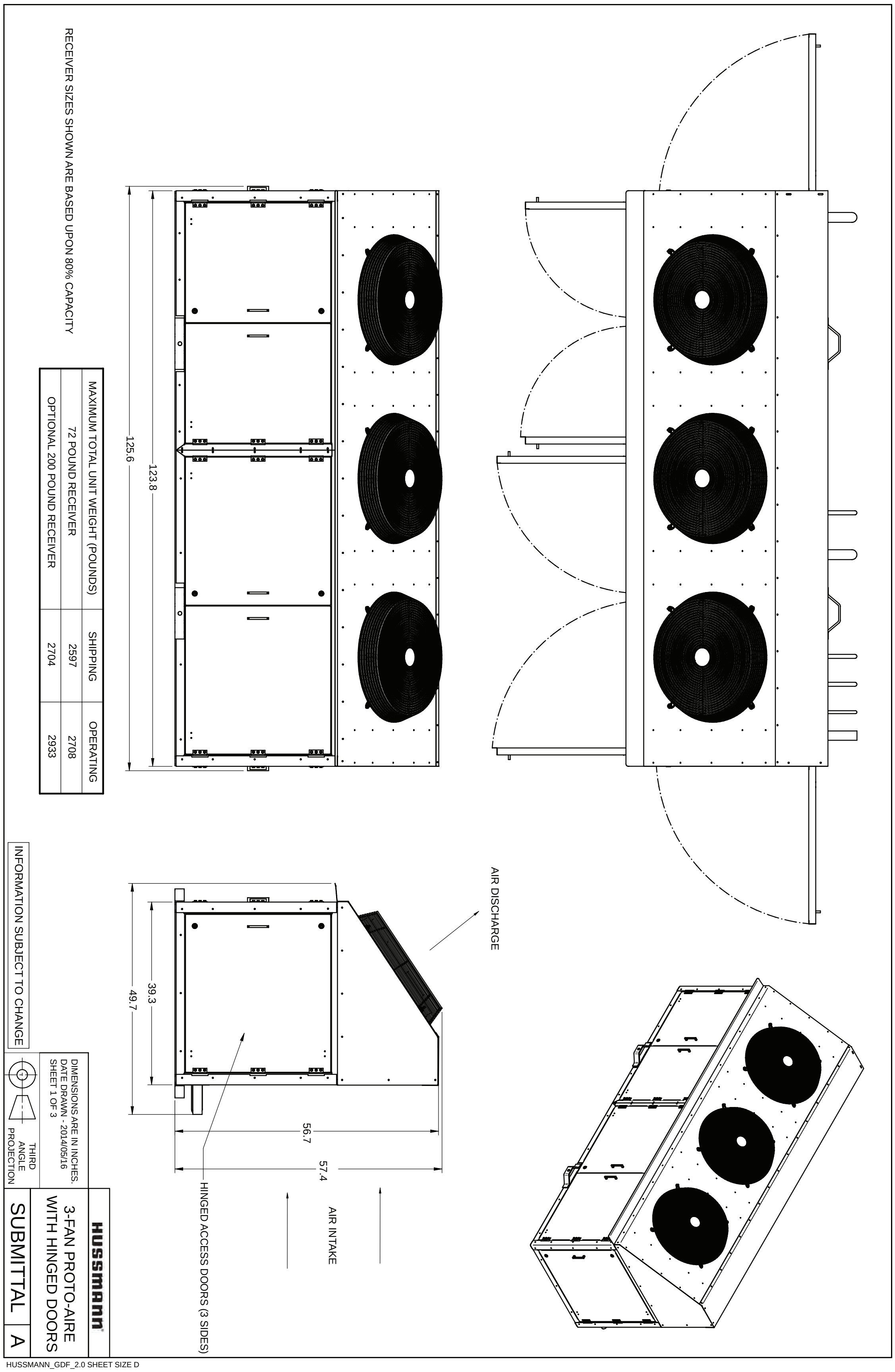
STUB OUT LINE DETAILS.		
	LINE TYPE	SIZE O.D
A	WATER OUTLET	1 1/2"
B	GAS DEFROST	5/8"
C	LT LIQUID FOR CASES	7/8"
D	MT LIQUID FOR CASES	7/8"
E	MT LIQUID FROM RECEIVER	7/8" OR 1 1/8"
F	LIQUID TO RECEIVER	7/8" OR 1 1/2"
G	SUCTION	2 5/8"
H	SAT. SUCTION	7/8"
I	LIQUID LINE	1 3/8"
J	WATER INLET	2 1/8"
K	FOR INJECTION	3/8"
L	SPLIT SUCTION	2 5/8"

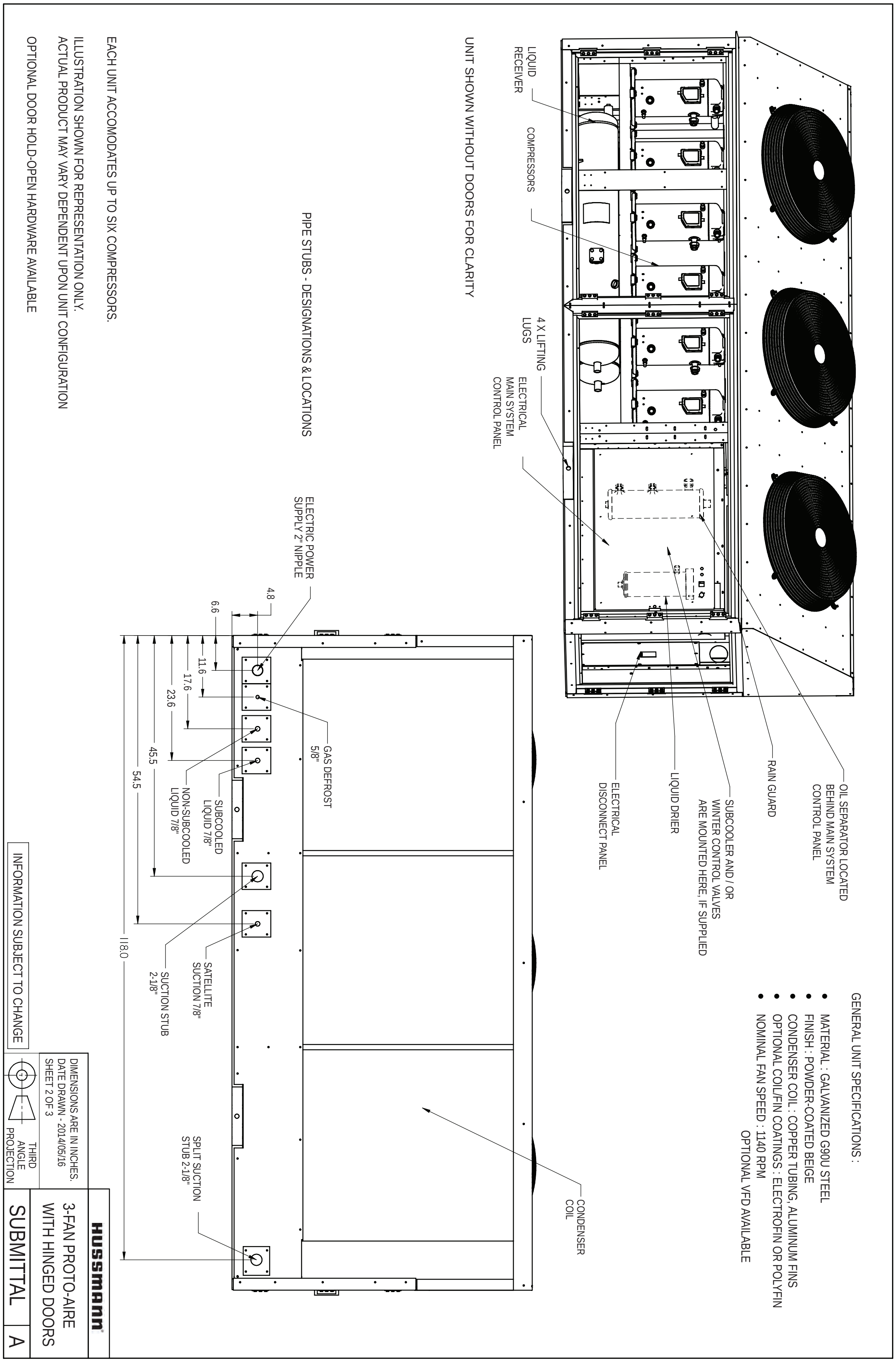
4.2W HORIZONTAL PROTOCOL



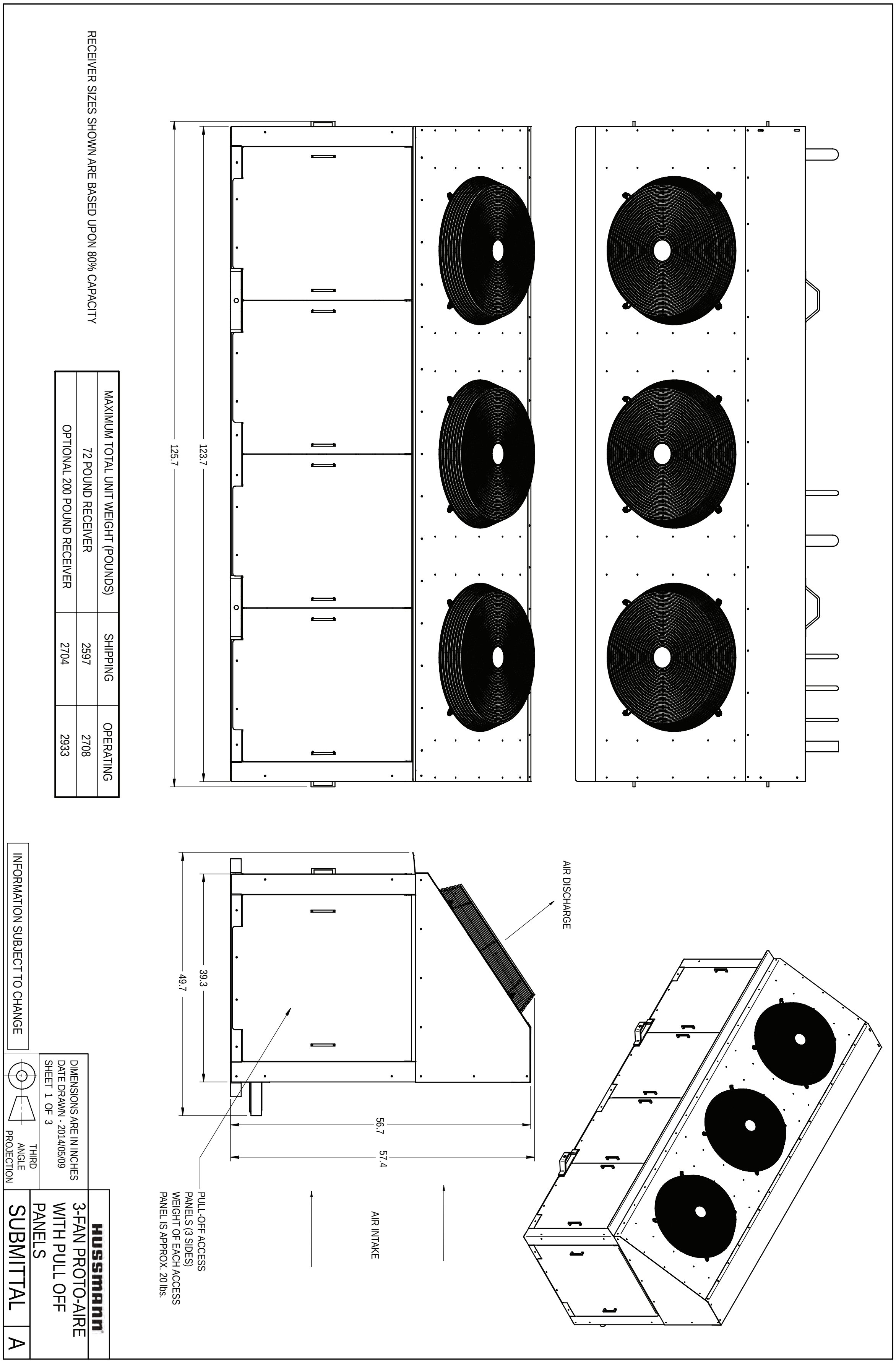
MEASURMENT OF STUB OUT LINES											
A - WATER OUTLET	B-GAS DEFROST	C-LT LIQUID FOR CASES	D-MT LIQUID FOR CASES	E - MT LIQUID FROM RECEIVER	F-LIQUID TO RECEIVER	G-SUCTION	H-SAT. SUCTION	I-LIQUID LINE	WATER INLET	FOR INJECTION	SPLIT SECTION
49"	58"	60"	63"	66"	72 1/2"	80" OR 81"- 82"	83" OR 85"	88" OR 89"	91" OR 93"	179"	182"

Proto Aire Units

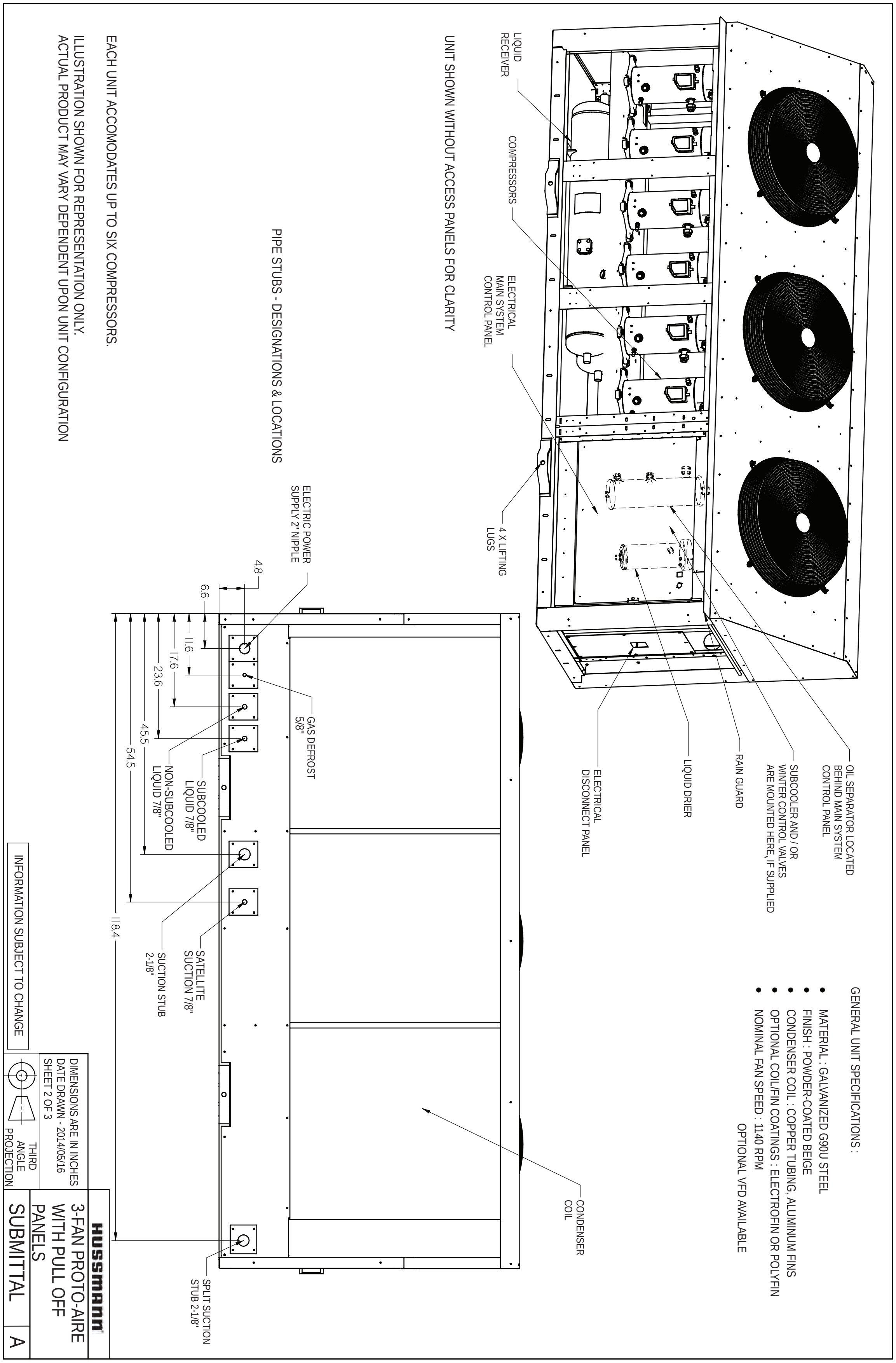


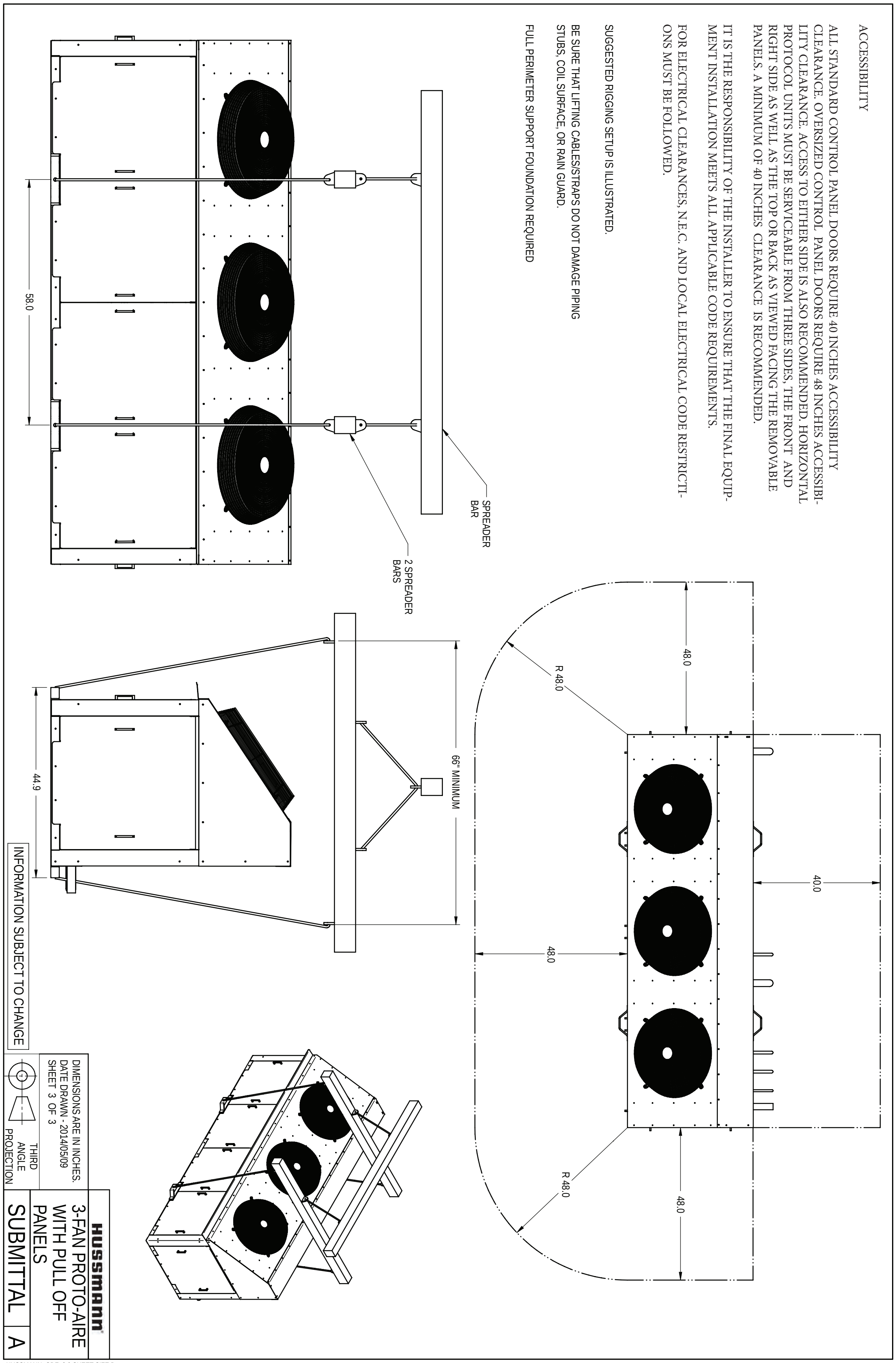


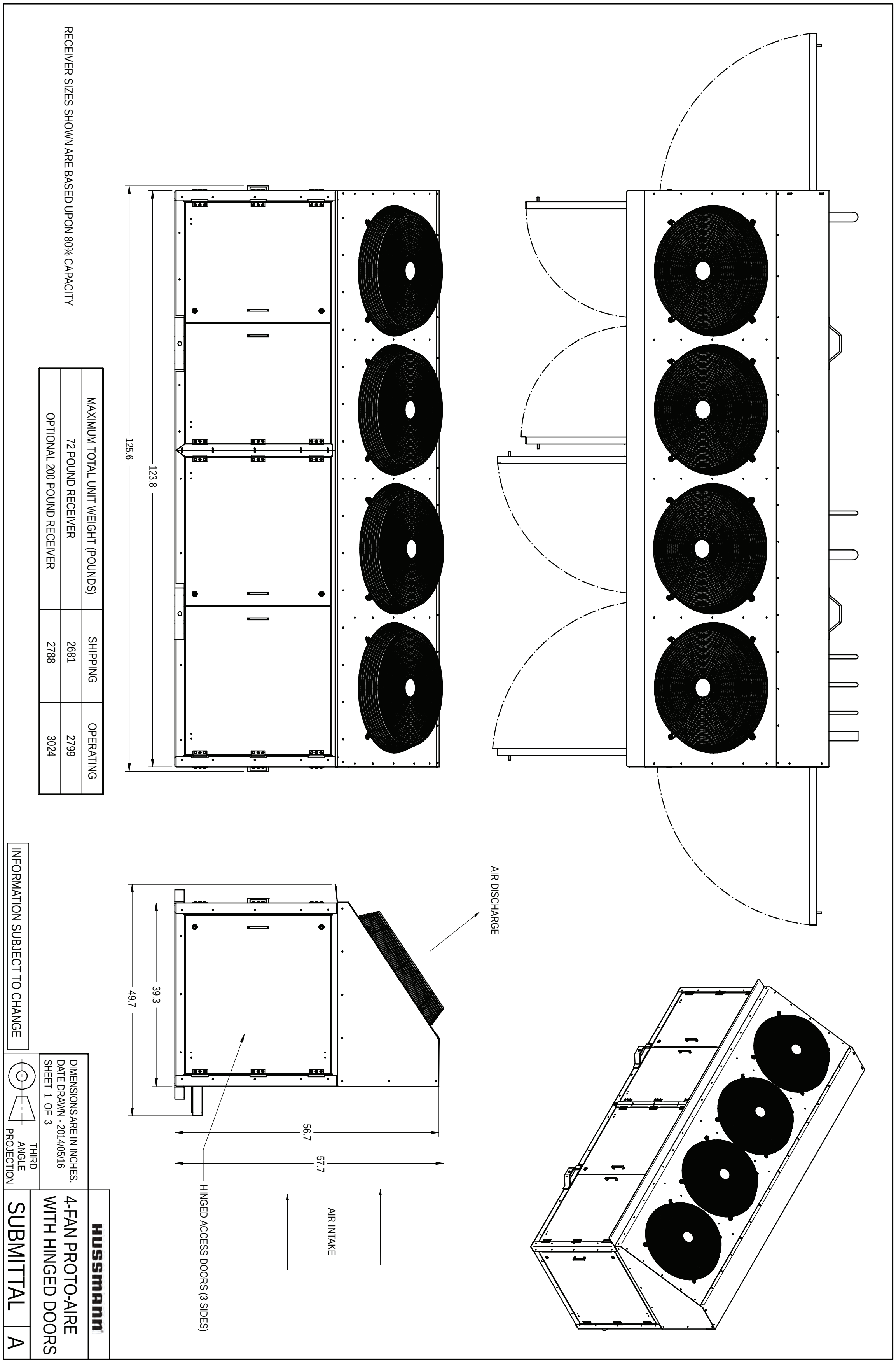
UNIT SHOWN WITHOUT DOORS FOR CLARITY
LIQUID RECEIVER
COMPRESSORS
4 X LIFTING LUGS
ELECTRICAL MAIN SYSTEM CONTROL PANEL
OIL SEPARATOR LOCATED BEHIND MAIN SYSTEM CONTROL PANEL
RAIN GUARD
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
LIQUID DRIER
ELECTRICAL DISCONNECT PANEL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
PIPE STUBS - DESIGNATIONS & LOCATIONS
ELECTRIC POWER SUPPLY 2" NIPPLE
4.8
6.6
11.6
17.6
23.6
45.5
54.5
118.0
GAS DEFROST 5/8"
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
SATELLITE SUCTION 7/8"
SUCTION STUB 2-1/8"
SPLIT SUCTION STUB 2-1/8"
CONDENSER COIL
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
OPTIONAL DOOR HOLD-OPEN HARDWARE AVAILABLE
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
3-FAN PROTO-AIRE WITH HINGED DOORS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D



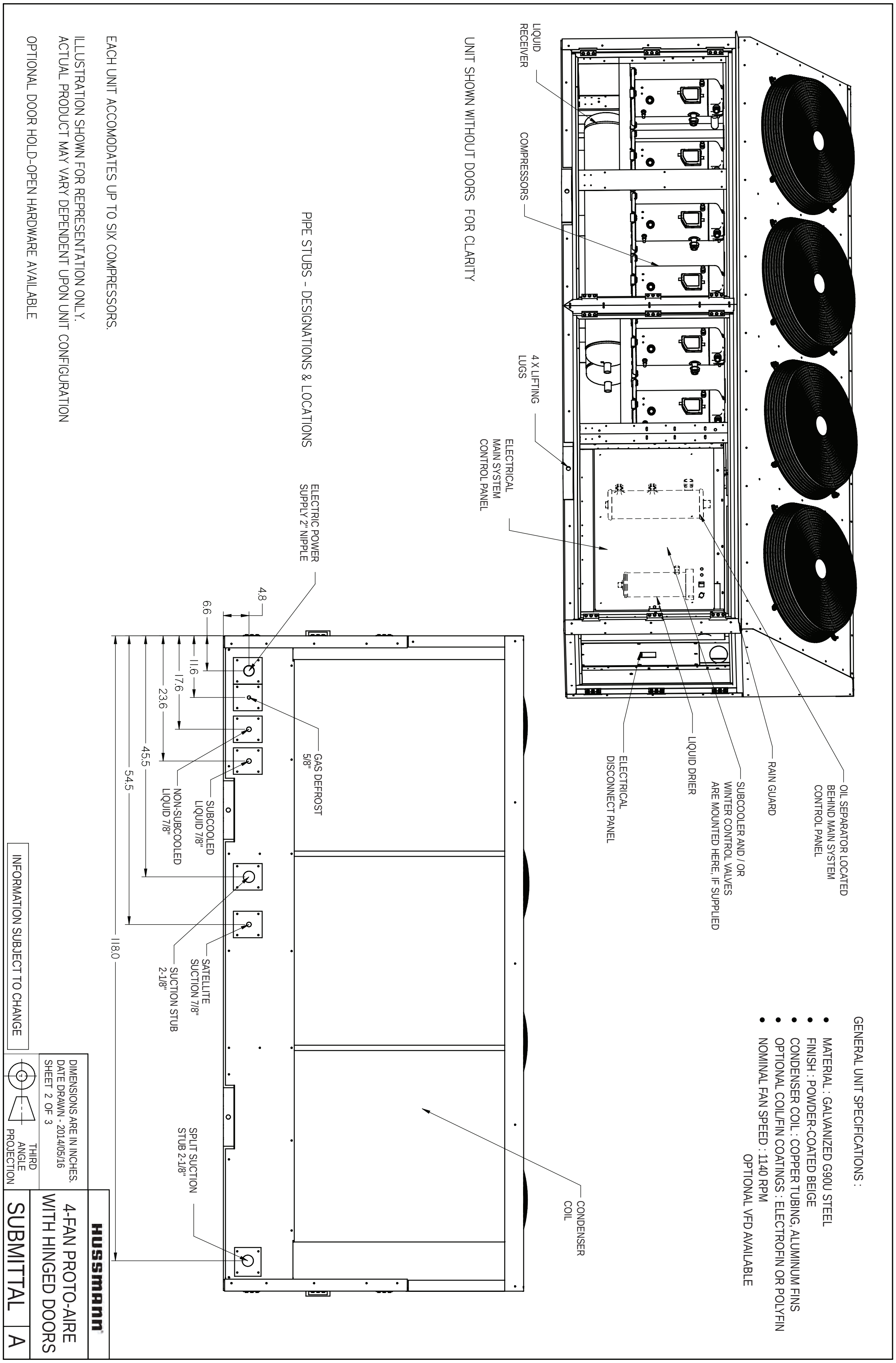
MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
72 POUND RECEIVER	2597	2708
OPTIONAL 200 POUND RECEIVER	2704	2933

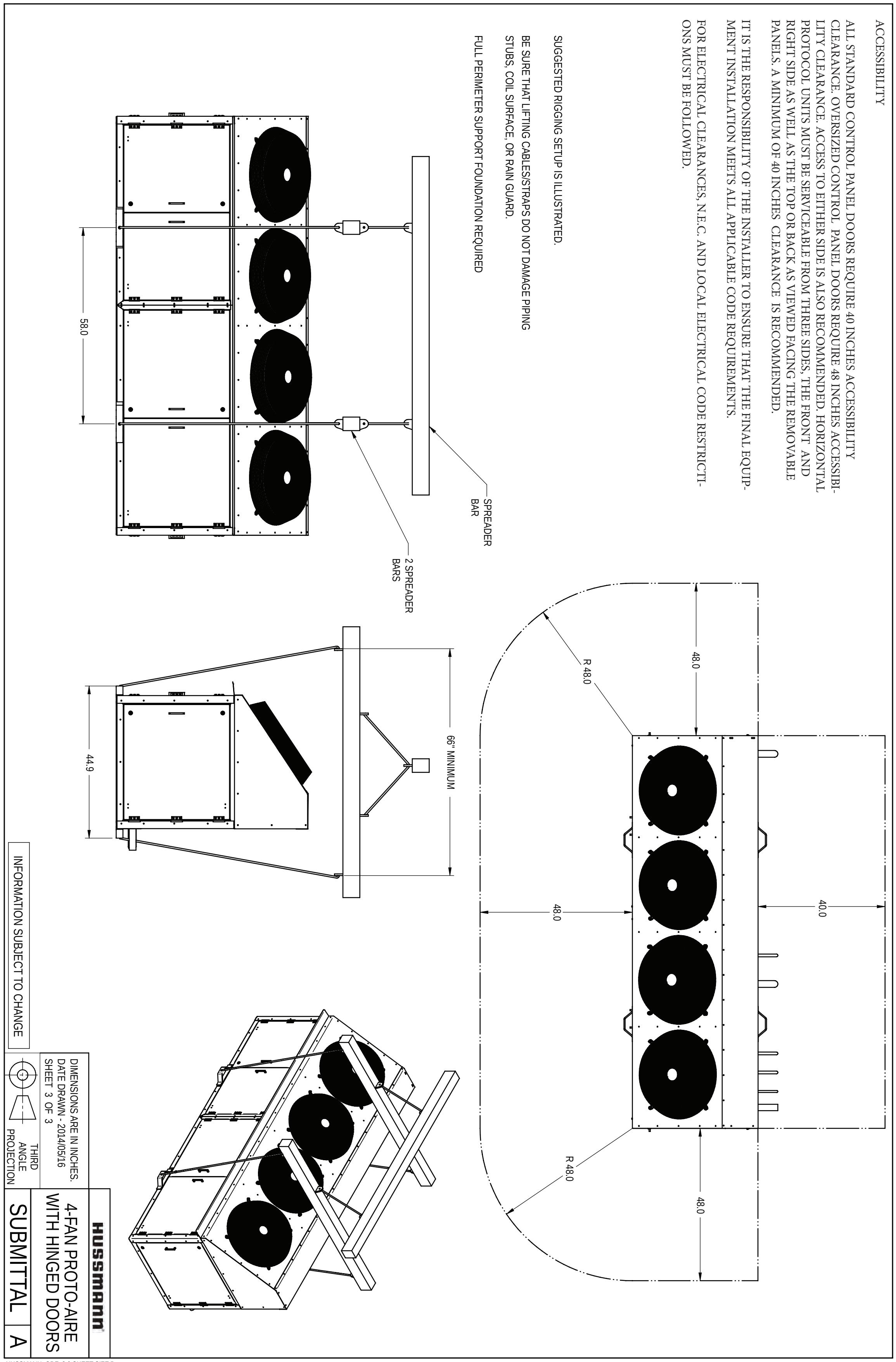

UNIT SHOWN WITHOUT ACCESS PANELS FOR CLARITY
LIQUID RECEIVER
COMPRESSORS
ELECTRICAL MAIN SYSTEM CONTROL PANEL
4 X LIFTING LUGS
OIL SEPARATOR LOCATED BEHIND MAIN SYSTEM CONTROL PANEL
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
RAIN GUARD
LIQUID DRIER
ELECTRICAL DISCONNECT PANEL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
PIPE STUBS - DESIGNATIONS & LOCATIONS
ELECTRIC POWER SUPPLY 2" NIPPLE
4.8
6.6
11.6
17.6
23.6
45.5
54.5
118.4
GAS DEFROST 5/8"
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
SATELLITE SUCTION 7/8"
SUCTION STUB 2-1/8"
SPLIT SUCTION STUB 2-1/8"
CONDENSER COIL
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES
DATE DRAWN - 2014/05/16
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
3-FAN PROTO-AIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D

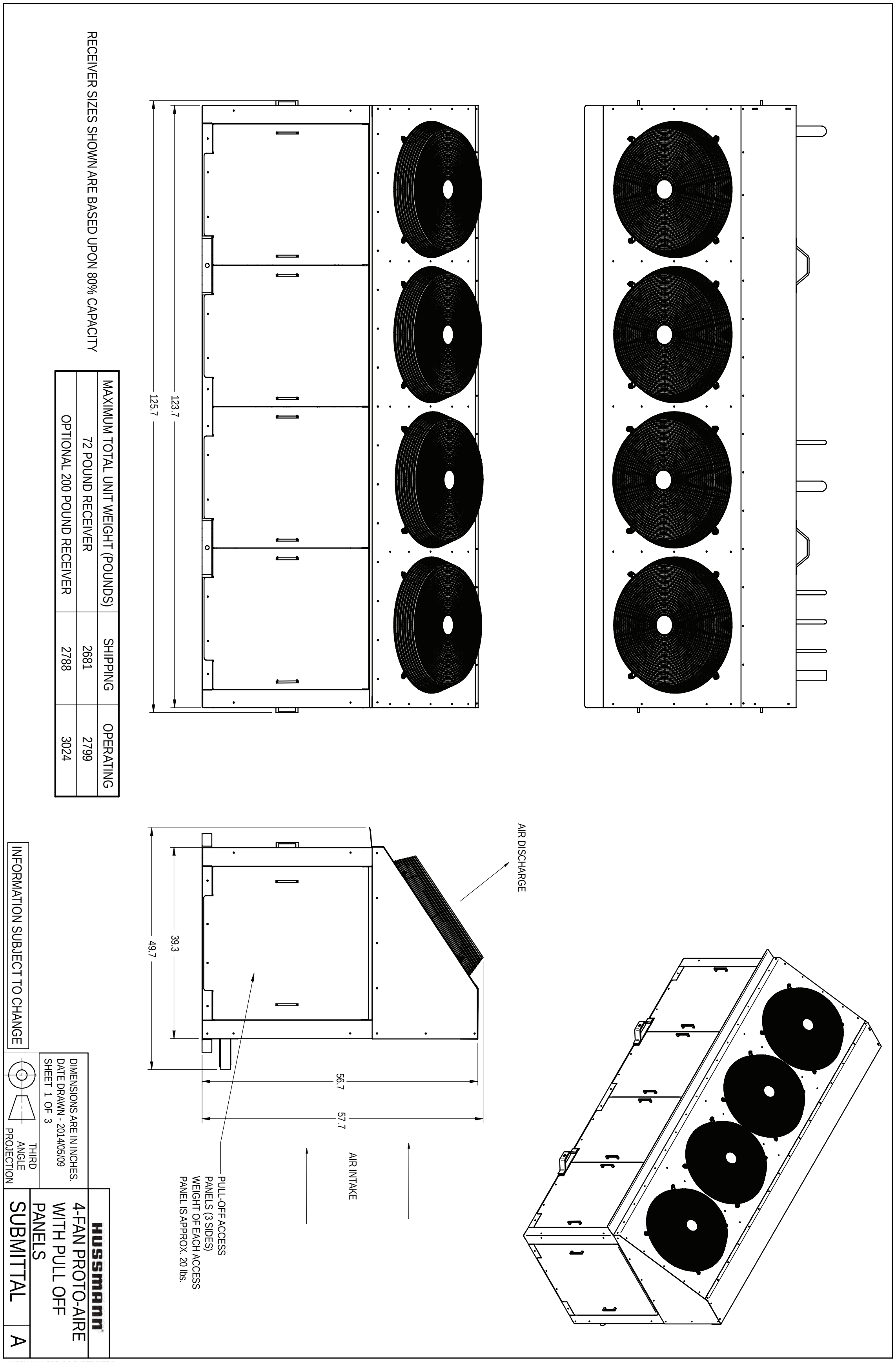

ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
SPREADER BAR
2 SPREADER BARS
58.0
44.9
66" MINIMUM
48.0
R 48.0
40.0
48.0
R 48.0
48.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/09
SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
3-FAN PROTO-AIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D



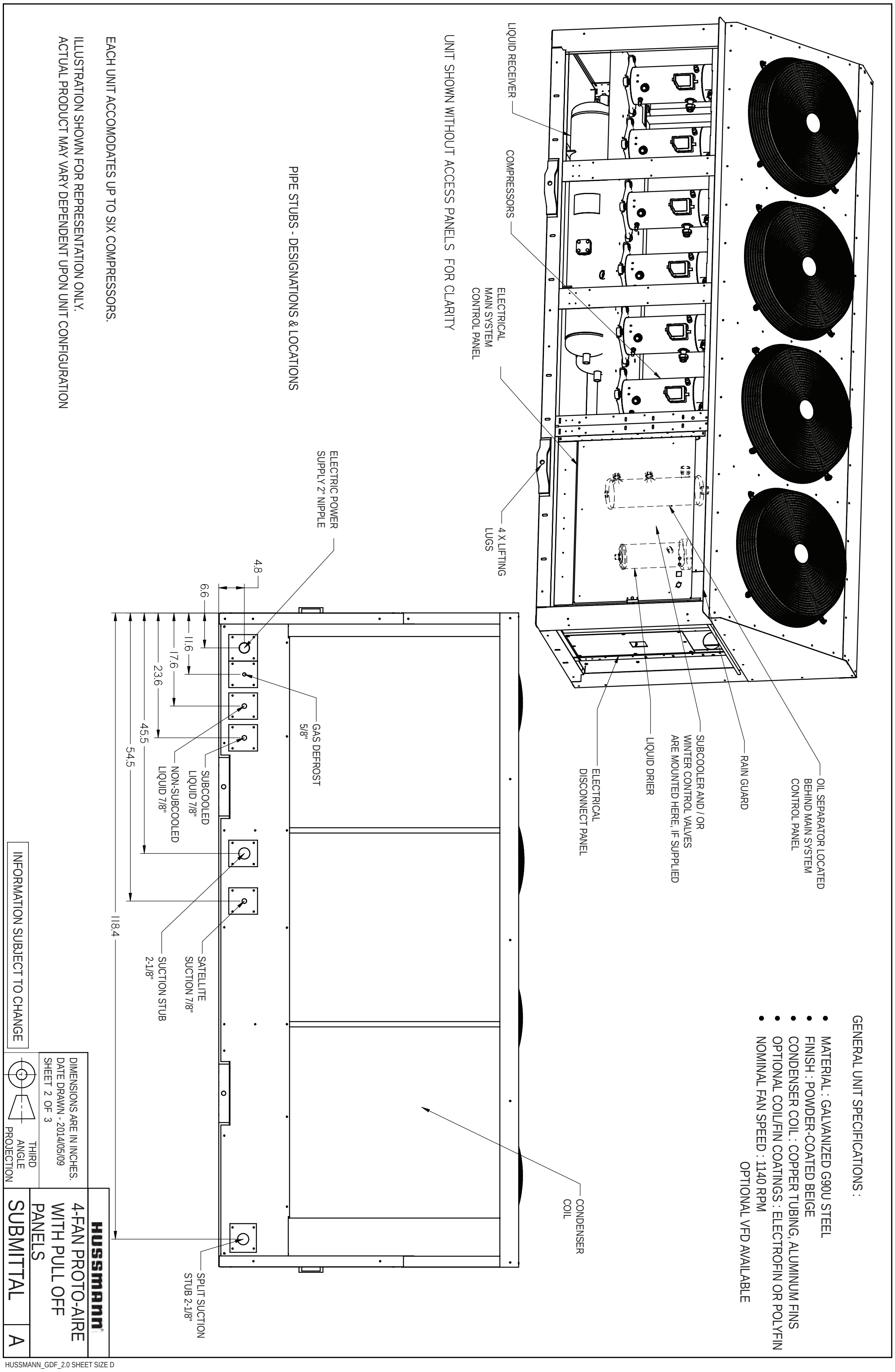
MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
72 POUND RECEIVER	2681	2799
OPTIONAL 200 POUND RECEIVER	2788	3024

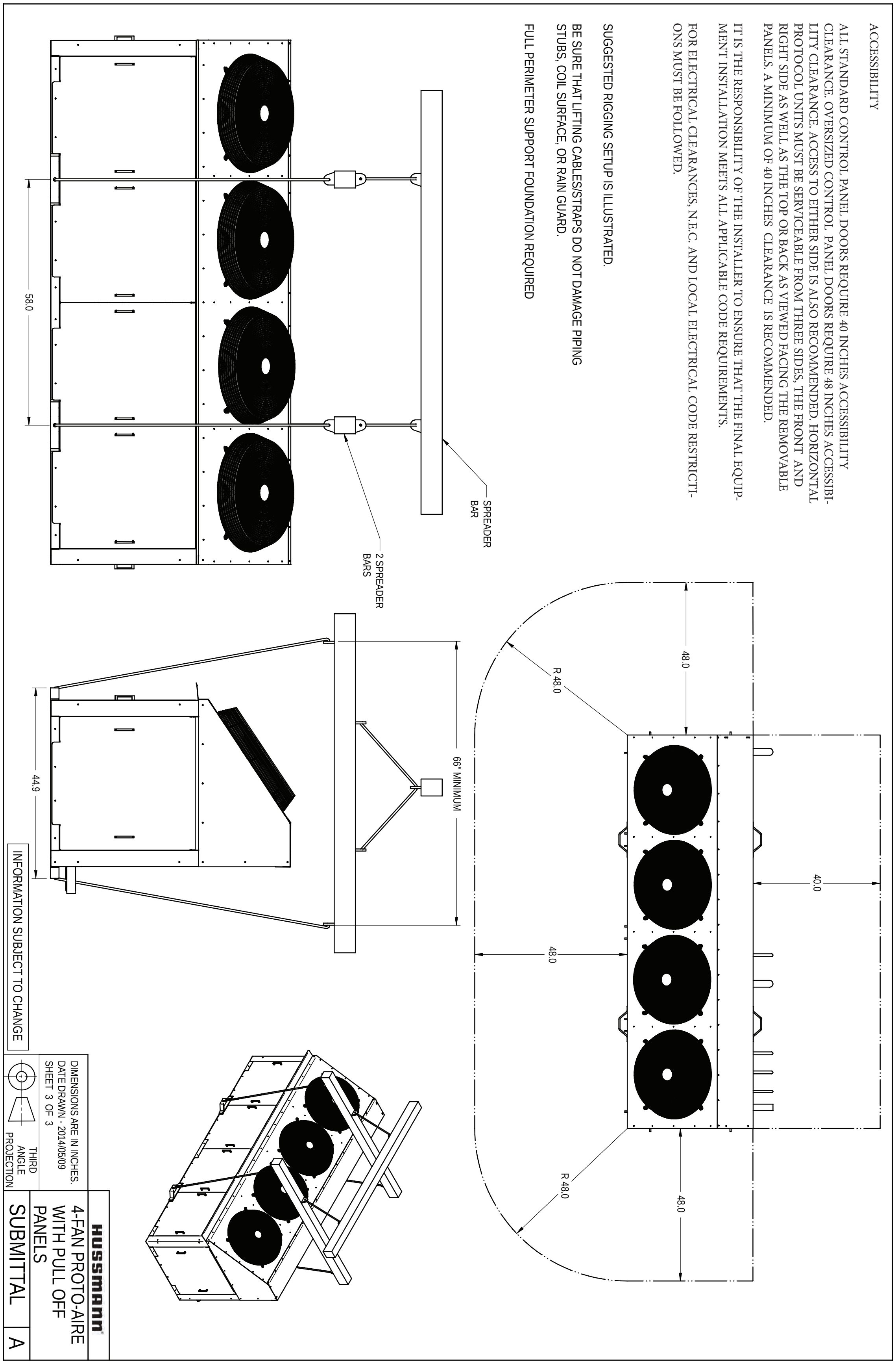

LIQUID RECEIVER
COMPRESSORS
4 X LIFTING LUGS
ELECTRICAL MAIN SYSTEM CONTROL PANEL
OIL SEPARATOR LOCATED BEHIND MAIN SYSTEM CONTROL PANEL
RAIN GUARD
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
LIQUID DRIER
ELECTRICAL DISCONNECT PANEL
UNIT SHOWN WITHOUT DOORS FOR CLARITY
PIPE STUBS - DESIGNATIONS & LOCATIONS
ELECTRIC POWER SUPPLY 2" NIPPLE
4.8
6.6
11.6
17.6
23.6
45.5
54.5
118.0
GAS DEFROST 5/8"
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
SATELLITE SUCTION 7/8"
SUCTION STUB 2-1/8"
SPLIT SUCTION STUB 2-1/8"
CONDENSER COIL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
OPTIONAL DOOR HOLD-OPEN HARDWARE AVAILABLE
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
4-FAN PROTO-AIRE WITH HINGED DOORS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D


ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
58.0
SPREADER BAR
2 SPREADER BARS
44.9
66" MINIMUM
48.0
R 48.0
40.0
48.0
R 48.0
48.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
4-FAN PROTO-AIRE WITH HINGED DOORS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D



MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
72 POUND RECEIVER	2681	2799
OPTIONAL 200 POUND RECEIVER	2788	3024


LIQUID RECEIVER
COMPRESSORS
UNIT SHOWN WITHOUT ACCESS PANELS FOR CLARITY
ELECTRICAL MAIN SYSTEM CONTROL PANEL
4 X LIFTING LUGS
OIL SEPARATOR LOCATED BEHIND MAIN SYSTEM CONTROL PANEL
RAIN GUARD
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
LIQUID DRIER
ELECTRICAL DISCONNECT PANEL
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
PIPE STUBS - DESIGNATIONS & LOCATIONS
ELECTRIC POWER SUPPLY 2" NIPPLE
4.8
6.6
11.6
17.6
23.6
45.5
54.5
118.4
GAS DEFROST 5/8"
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
SATELLITE SUCTION 7/8"
SUCTION STUB 2-1/8"
SPLIT SUCTION STUB 2-1/8"
CONDENSER COIL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/09
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
4-FAN PROTO-AIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D


ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
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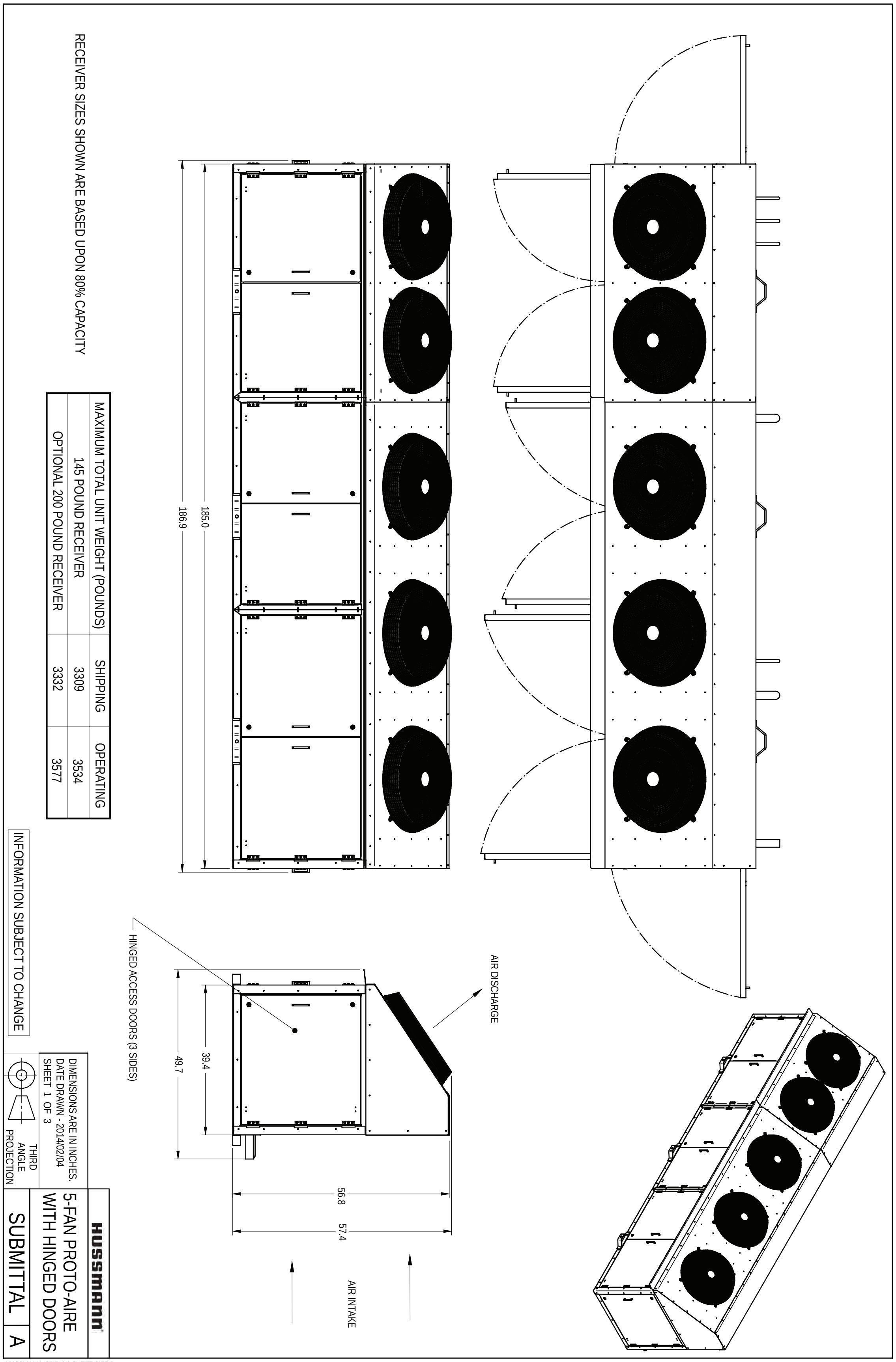
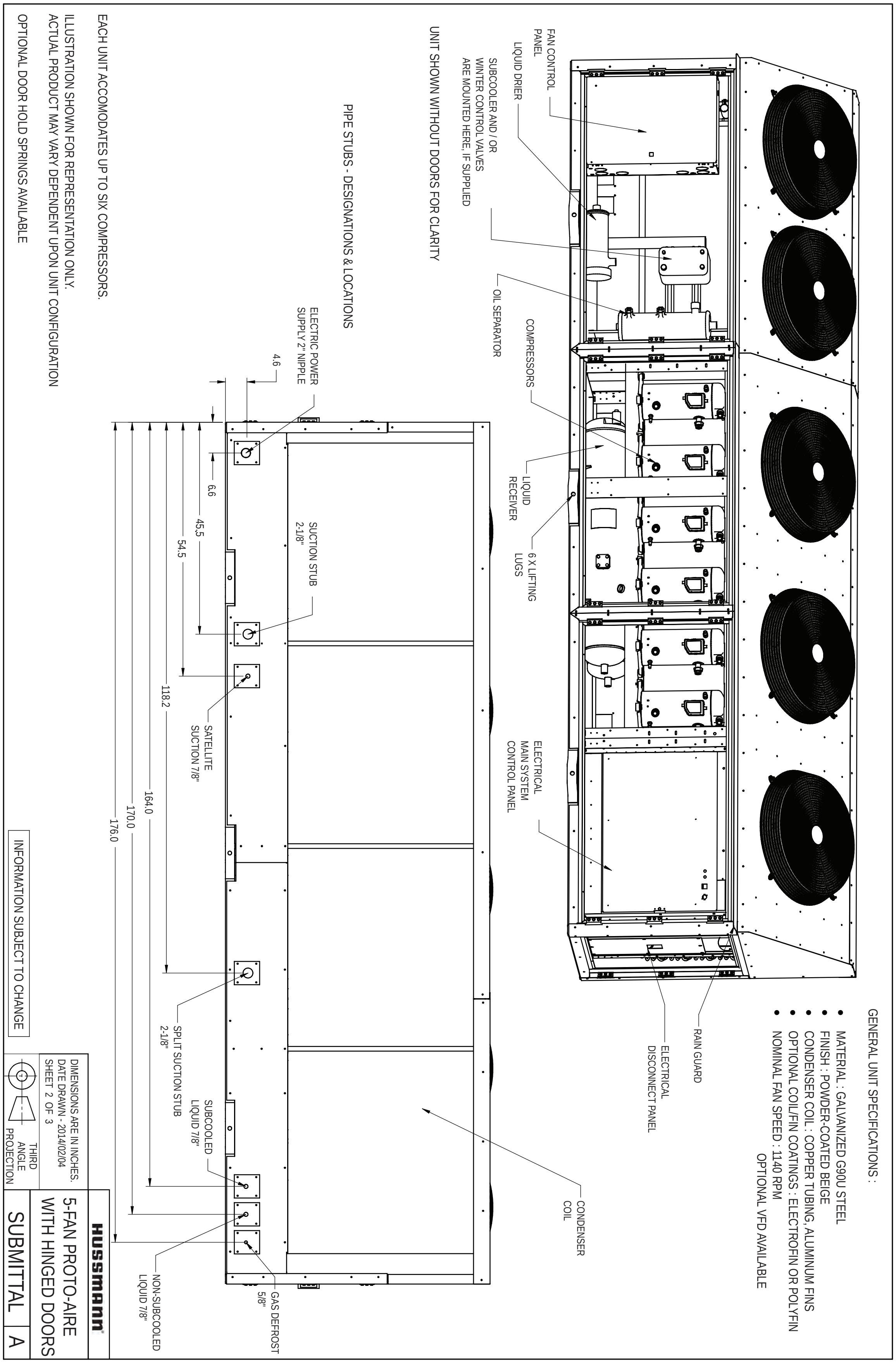
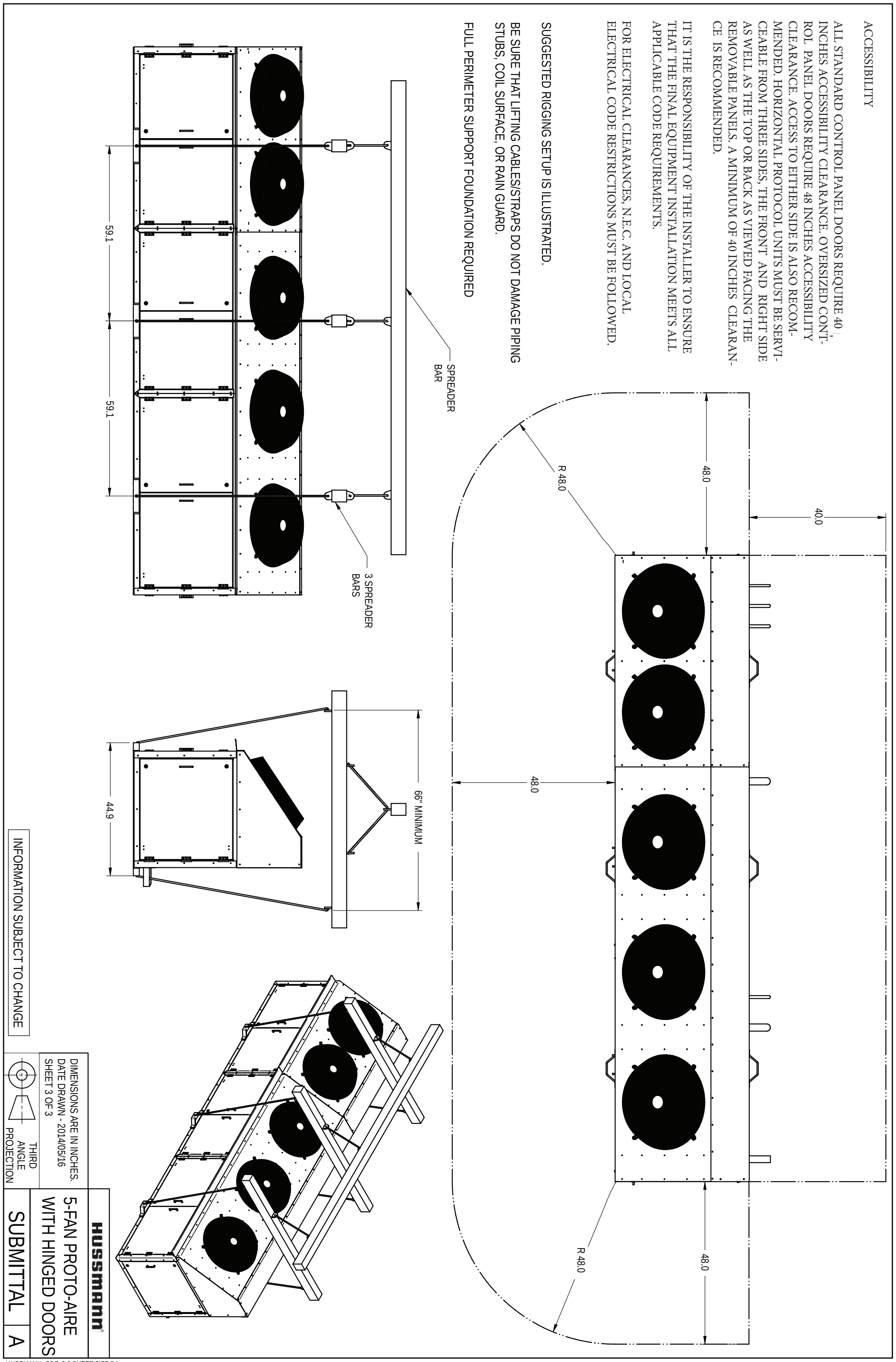
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
SPREADER BAR
2 SPREADER BARS
58.0
44.9
66" MINIMUM
48.0
R 48.0
40.0
48.0
R 48.0
48.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/09
SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
4-FAN PROTO-AIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D

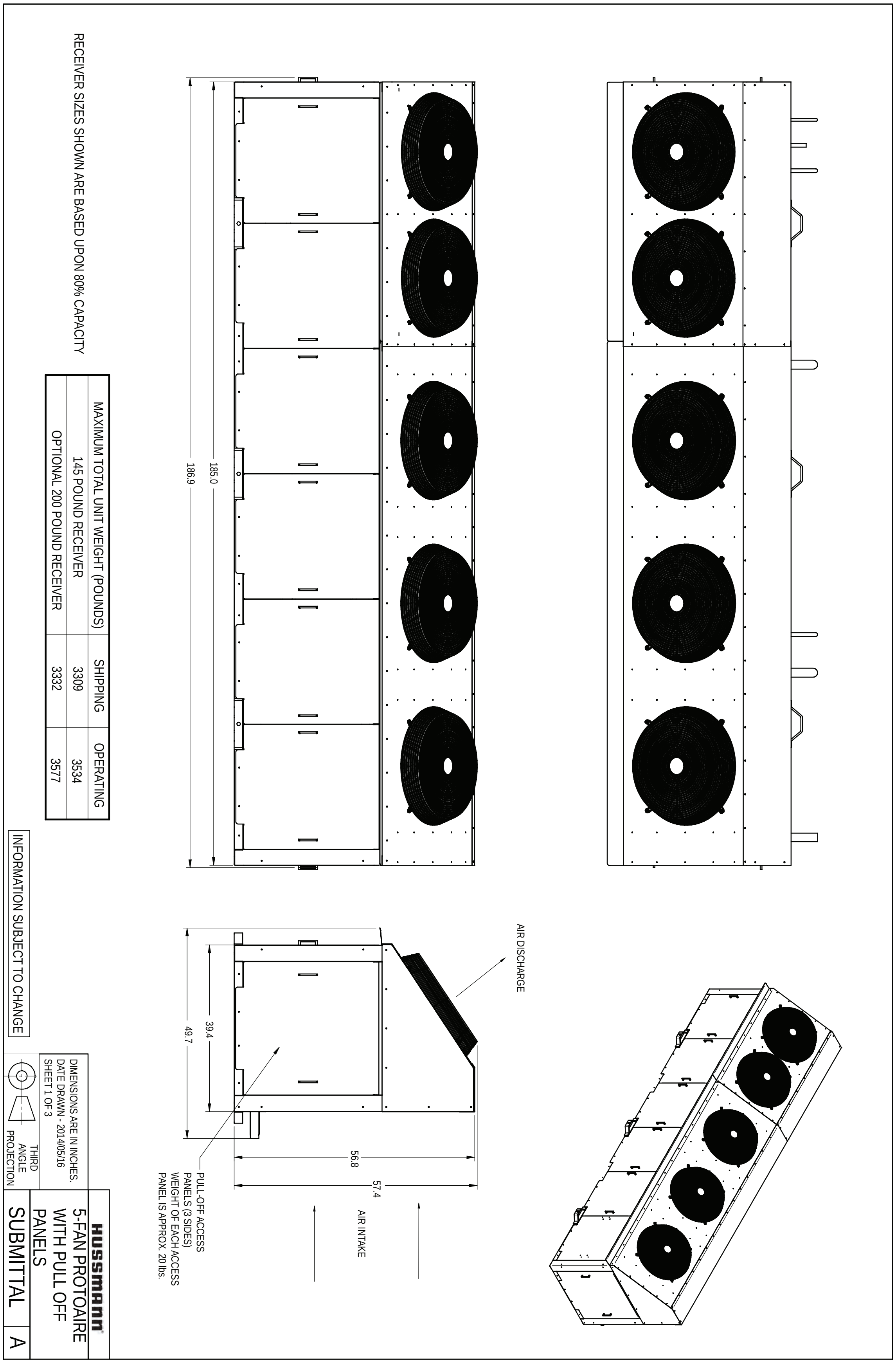


MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
145 POUND RECEIVER	3309	3534
OPTIONAL 200 POUND RECEIVER	3332	3577

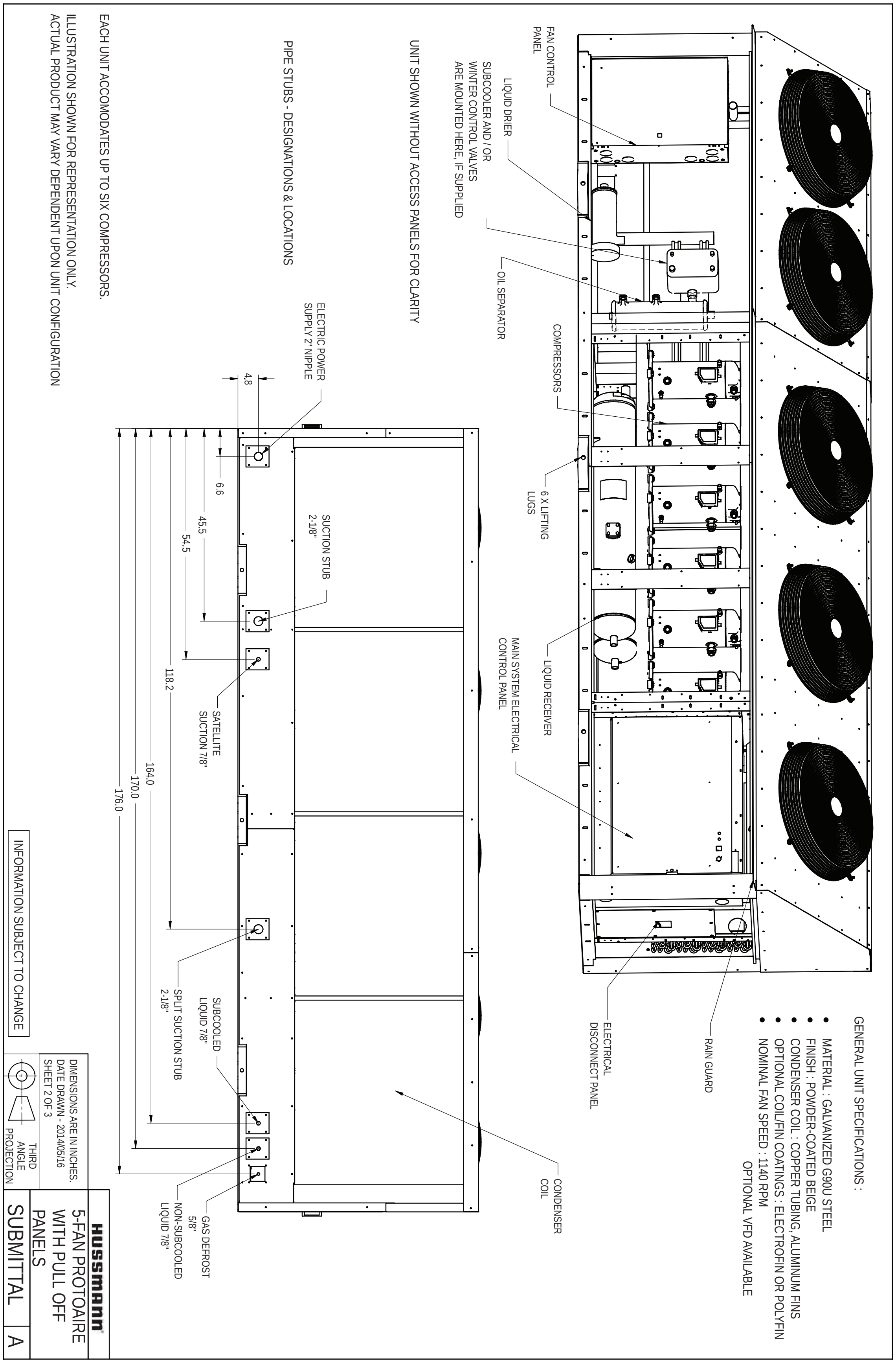
HUSSMANN_GDF_2.0 SHEET SIZE D

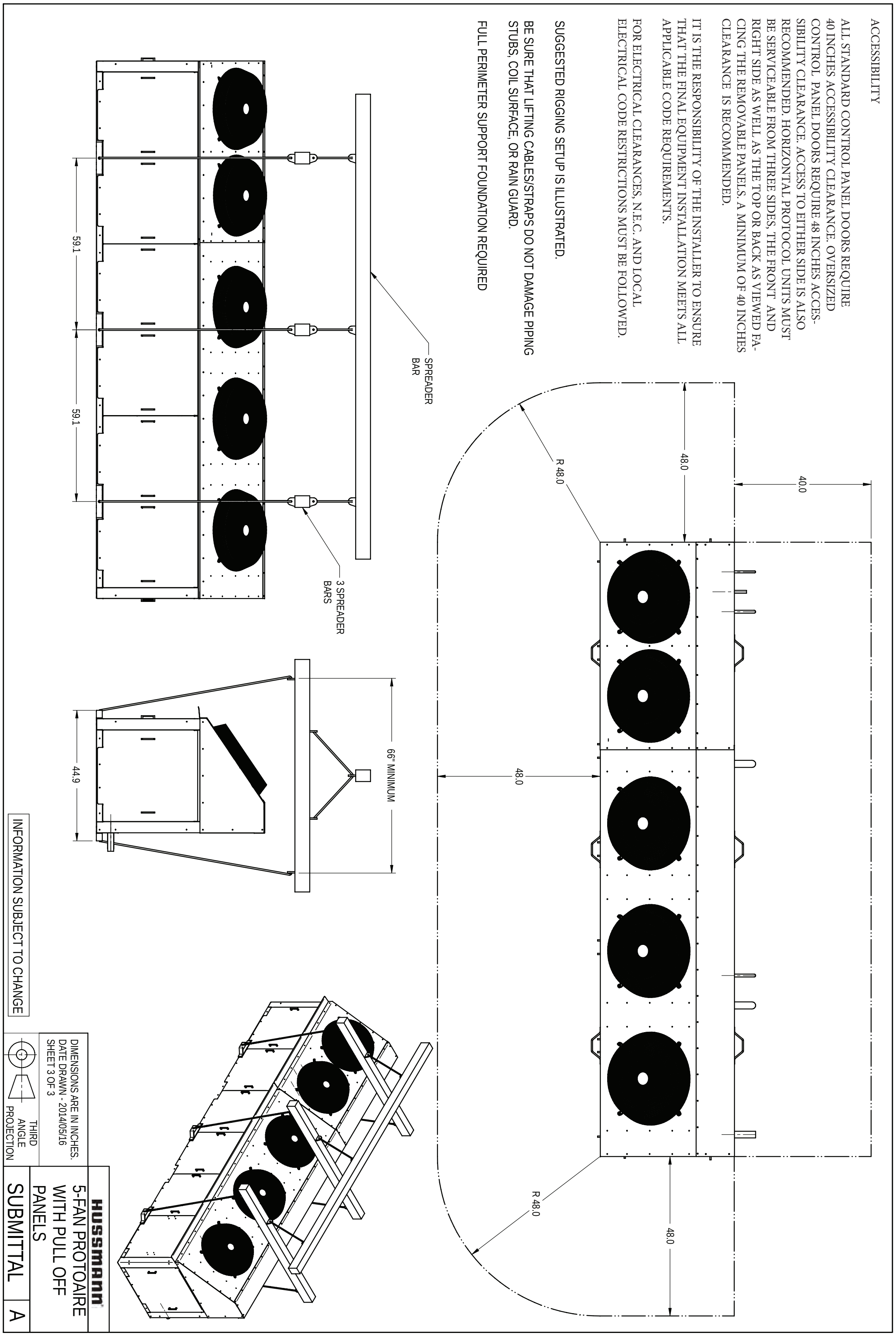

FAN CONTROL PANEL
LIQUID DRIER
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
OIL SEPARATOR
COMPRESSORS
LIQUID RECEIVER
6 X LIFTING LUGS
ELECTRICAL MAIN SYSTEM CONTROL PANEL
RAIN GUARD
ELECTRICAL DISCONNECT PANEL
CONDENSER COIL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
UNIT SHOWN WITHOUT DOORS FOR CLARITY
PIPE STUBS - DESIGNATIONS & LOCATIONS
ELECTRIC POWER SUPPLY 2" NIPPLE
4.6
6.6
45.5
54.5
118.2
164.0
170.0
176.0
SUCTION STUB 2-1/8"
SATELLITE SUCTION 7/8"
SPLIT SUCTION STUB 2-1/8"
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
GAS DEFROST 5/8"
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
OPTIONAL DOOR HOLD SPRINGS AVAILABLE
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/02/04
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
5-FAN PROTO-AIRE
WITH HINGED DOORS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D

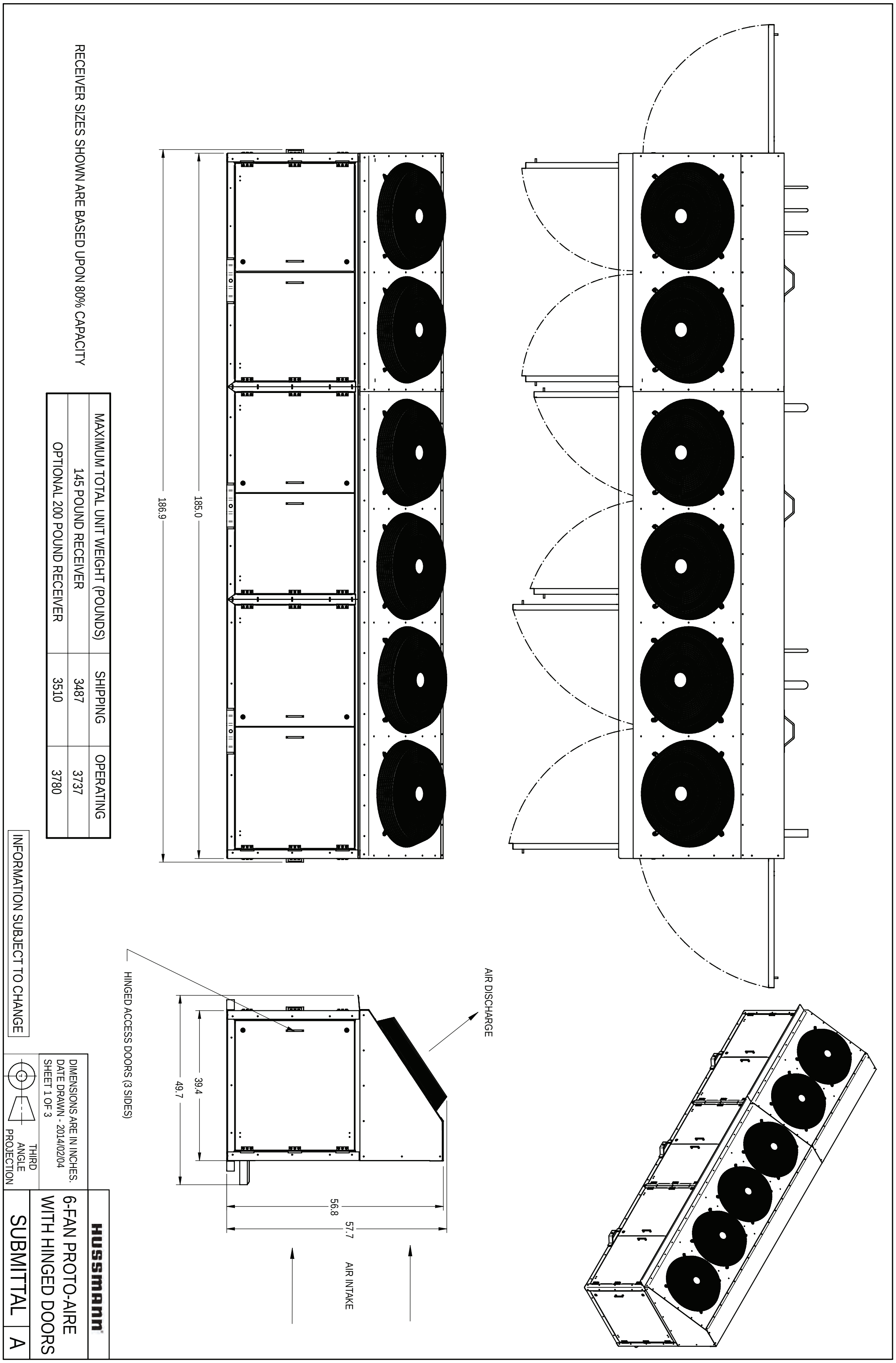

ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
40.0
48.0
48.0
R 48.0
R 48.0
48.0
SPREADER BAR
3 SPREADER BARS
66" MINIMUM
59.1
59.1
44.9
HUSSMANN
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 3 OF 3
THIRD ANGLE PROJECTION
5-FAN PROTO-AIRE WITH HINGED DOORS
SUBMITTAL
A
INFORMATION SUBJECT TO CHANGE
HUSSMANN_GDF_2.0 SHEET SIZE DA



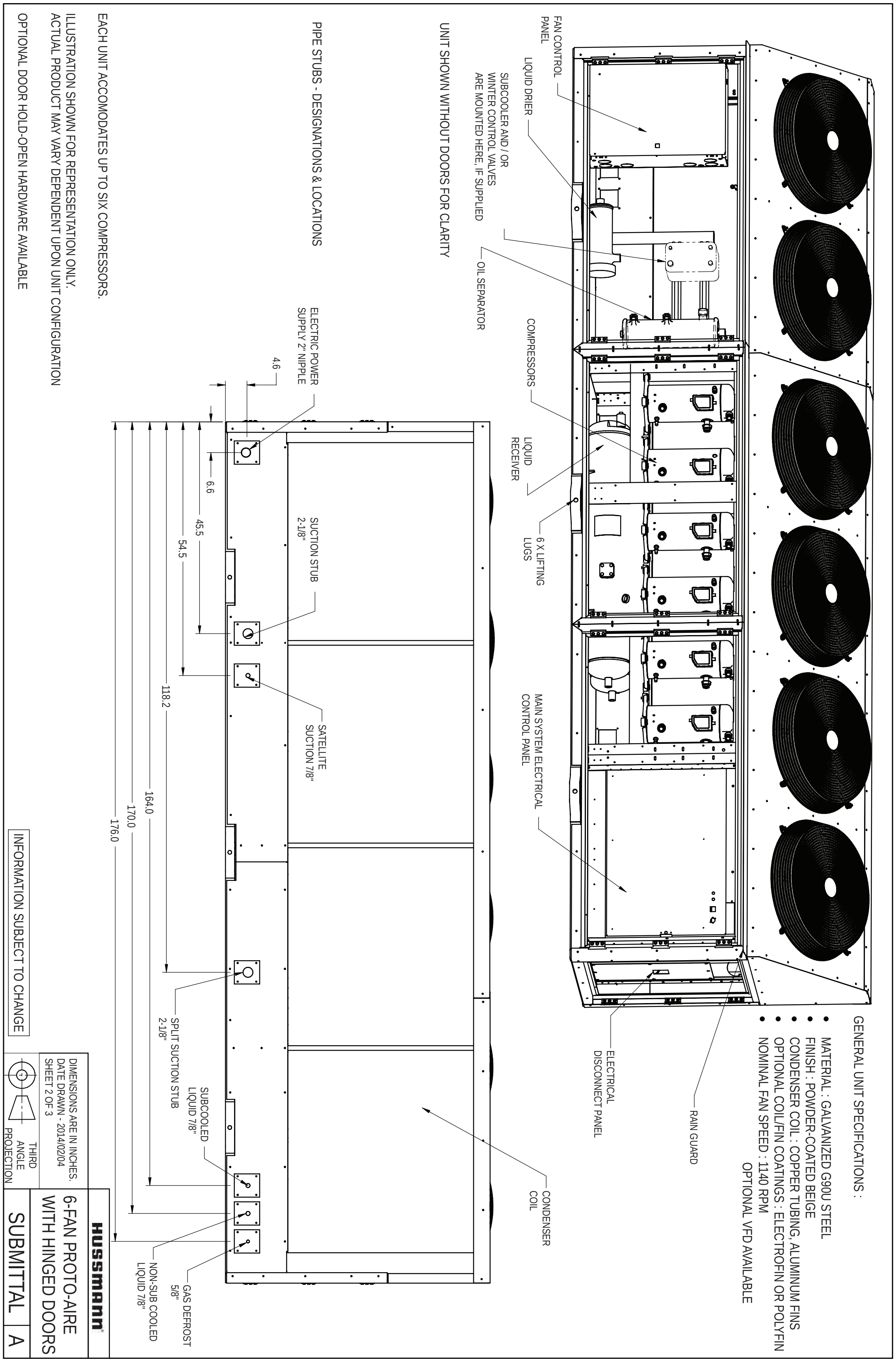
MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
145 POUND RECEIVER	3309	3534
OPTIONAL 200 POUND RECEIVER	3332	3577

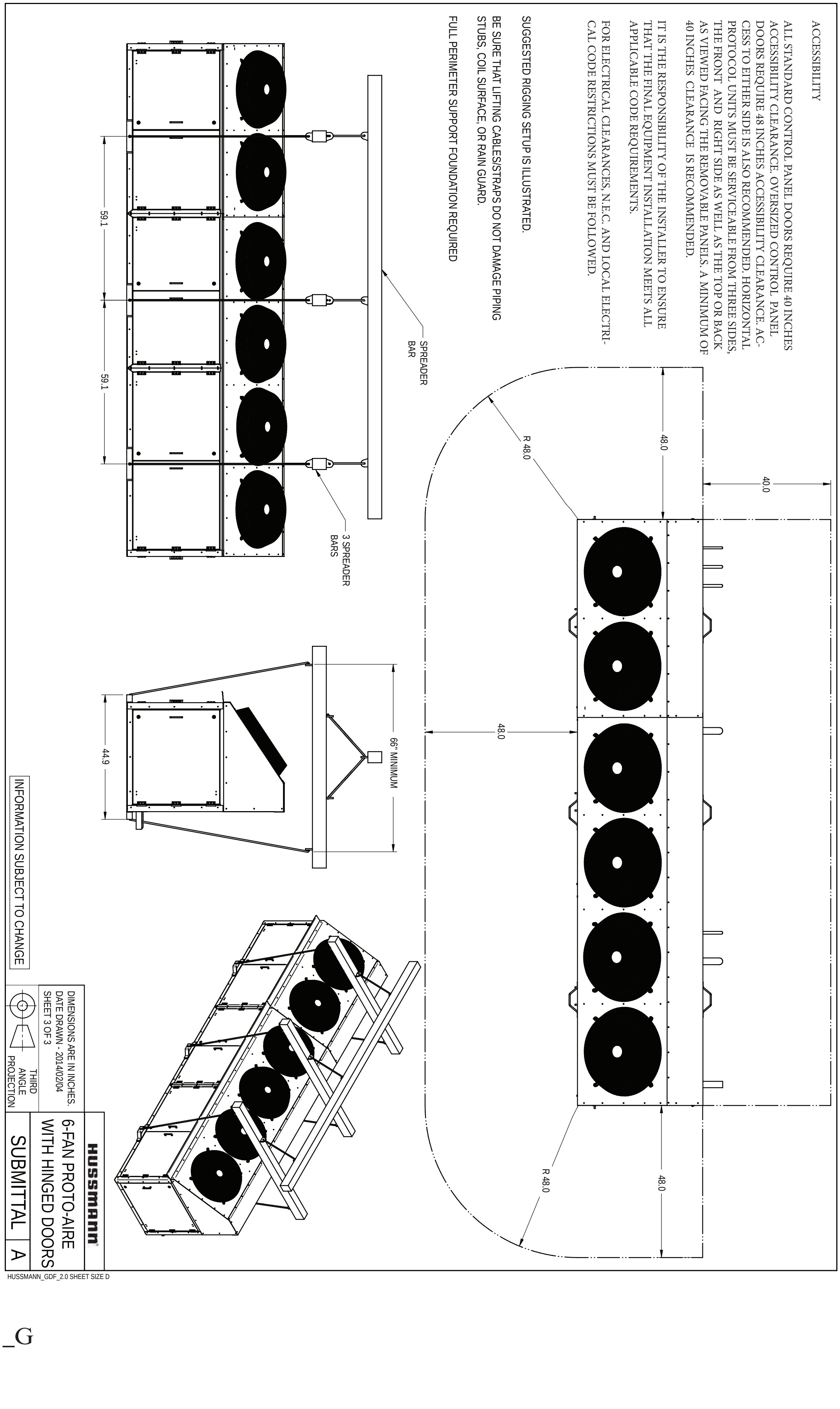

FAN CONTROL PANEL
LIQUID DRIER
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
OIL SEPARATOR
COMPRESSORS
6 X LIFTING LUGS
LIQUID RECEIVER
MAIN SYSTEM ELECTRICAL CONTROL PANEL
ELECTRICAL DISCONNECT PANEL
RAIN GUARD
CONDENSER COIL
GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
UNIT SHOWN WITHOUT ACCESS PANELS FOR CLARITY
PIPE STUBS - DESIGNATIONS & LOCATIONS
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
ELECTRIC POWER SUPPLY 2" NIPPLE
SUCTION STUB 2-1/8"
SATELLITE SUCTION 7/8"
SPLIT SUCTION STUB 2-1/8"
SUBCOOLED LIQUID 7/8"
GAS DEFROST 5/8"
NON-SUBCOOLED LIQUID 7/8"
4.8
6.6
45.5
54.5
118.2
164.0
170.0
176.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
5-FAN PROTOAIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D


ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
SPREADER BAR
3 SPREADER BARS
59.1
59.1
44.9
66" MINIMUM
48.0
40.0
R 48.0
48.0
R 48.0
48.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
5-FAN PROTOAIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D



MAXIMUM TOTAL UNIT WEIGHT (POUNDS)	SHIPPING	OPERATING
145 POUND RECEIVER	3487	3737
OPTIONAL 200 POUND RECEIVER	3510	3780


GENERAL UNIT SPECIFICATIONS :
• MATERIAL : GALVANIZED G90U STEEL
• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
FAN CONTROL PANEL
LIQUID DRIER
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
OIL SEPARATOR
COMPRESSORS
LIQUID RECEIVER
6 X LIFTING LUGS
MAIN SYSTEM ELECTRICAL CONTROL PANEL
RAIN GUARD
ELECTRICAL DISCONNECT PANEL
CONDENSER COIL
UNIT SHOWN WITHOUT DOORS FOR CLARITY
PIPE STUBS - DESIGNATIONS & LOCATIONS
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
ACTUAL PRODUCT MAY VARY DEPENDENT UPON UNIT CONFIGURATION
OPTIONAL DOOR HOLD-OPEN HARDWARE AVAILABLE
ELECTRIC POWER SUPPLY 2" NIPPLE
4.6
6.6
45.5
54.5
118.2
164.0
170.0
176.0
SUCTION STUB 2-1/8"
SATELLITE SUCTION 7/8"
SPLIT SUCTION STUB 2-1/8"
SUBCOOLED LIQUID 7/8"
NON-SUB COOLED LIQUID 7/8"
GAS DEFROST 5/8"
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/02/04
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
6-FAN PROTO-AIRE WITH HINGED DOORS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D


ACCESSIBILITY
ALL STANDARD CONTROL PANEL DOORS REQUIRE 40 INCHES ACCESSIBILITY CLEARANCE. OVERSIZED CONTROL PANEL DOORS REQUIRE 48 INCHES ACCESSIBILITY CLEARANCE. ACCESS TO EITHER SIDE IS ALSO RECOMMENDED. HORIZONTAL PROTOCOL UNITS MUST BE SERVICEABLE FROM THREE SIDES, THE FRONT AND RIGHT SIDE AS WELL AS THE TOP OR BACK AS VIEWED FACING THE REMOVABLE PANELS. A MINIMUM OF 40 INCHES CLEARANCE IS RECOMMENDED.
IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE FINAL EQUIPMENT INSTALLATION MEETS ALL APPLICABLE CODE REQUIREMENTS.
FOR ELECTRICAL CLEARANCES, N.E.C. AND LOCAL ELECTRICAL CODE RESTRICTIONS MUST BE FOLLOWED.
SUGGESTED RIGGING SETUP IS ILLUSTRATED.
BE SURE THAT LIFTING CABLES/STRAPS DO NOT DAMAGE PIPING STUBS, COIL SURFACE, OR RAIN GUARD.
FULL PERIMETER SUPPORT FOUNDATION REQUIRED
SPREADER BAR
3 SPREADER BARS
59.1
59.1
44.9
66" MINIMUM
48.0
R 48.0
40.0
48.0
48.0
R 48.0
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/02/04
SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
6-FAN PROTO-AIRE WITH HINGED DOORS
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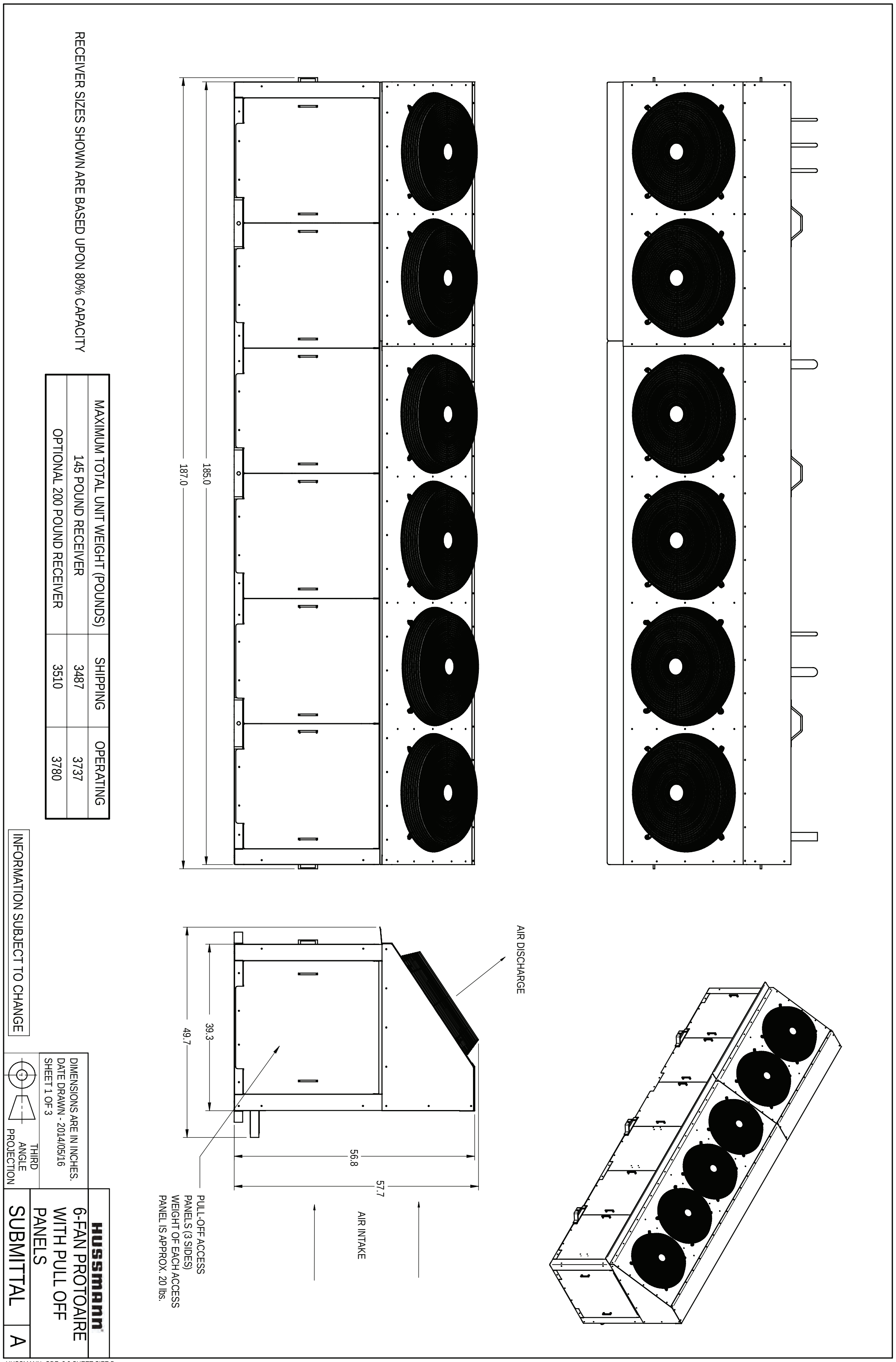
HUSSMANN_GDF_2.0 SHEET SIZE D



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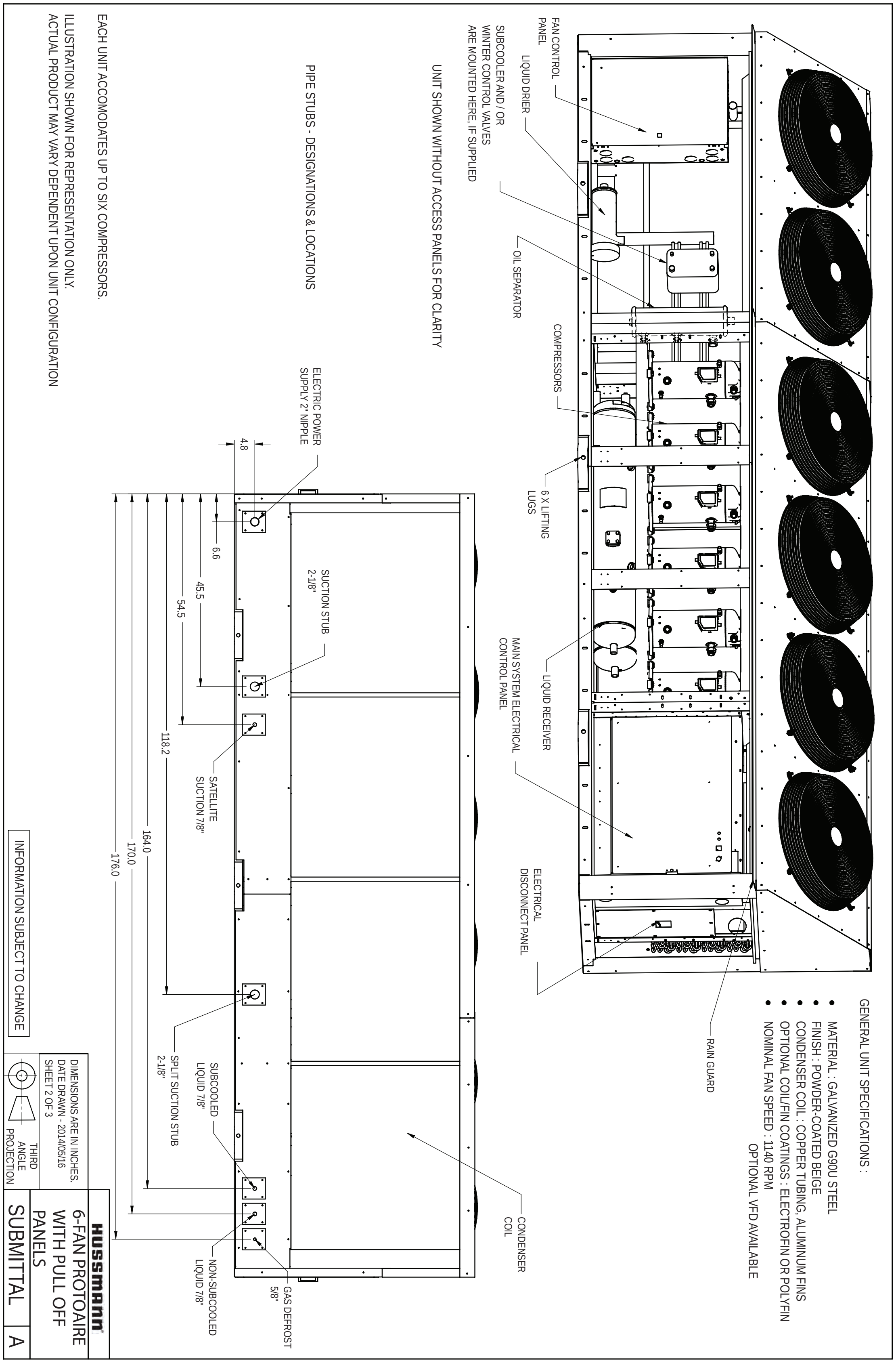
GENERAL UNIT SPECIFICATIONS :
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• FINISH : POWDER-COATED BEIGE
• CONDENSER COIL : COPPER TUBING, ALUMINUM FINS
• OPTIONAL COIL/FIN COATINGS : ELECTROFIN OR POLYFIN
• NOMINAL FAN SPEED : 1140 RPM
OPTIONAL VFD AVAILABLE
RAIN GUARD
FAN CONTROL PANEL
LIQUID DRIER
SUBCOOLER AND / OR WINTER CONTROL VALVES ARE MOUNTED HERE, IF SUPPLIED
OIL SEPARATOR
COMPRESSORS
6 X LIFTING LUGS
LIQUID RECEIVER
MAIN SYSTEM ELECTRICAL CONTROL PANEL
ELECTRICAL DISCONNECT PANEL
CONDENSER COIL
UNIT SHOWN WITHOUT ACCESS PANELS FOR CLARITY
PIPE STUBS - DESIGNATIONS & LOCATIONS
EACH UNIT ACCOMODATES UP TO SIX COMPRESSORS.
ILLUSTRATION SHOWN FOR REPRESENTATION ONLY.
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SUCTION STUB 2-1/8"
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SATELLITE SUCTION 7/8"
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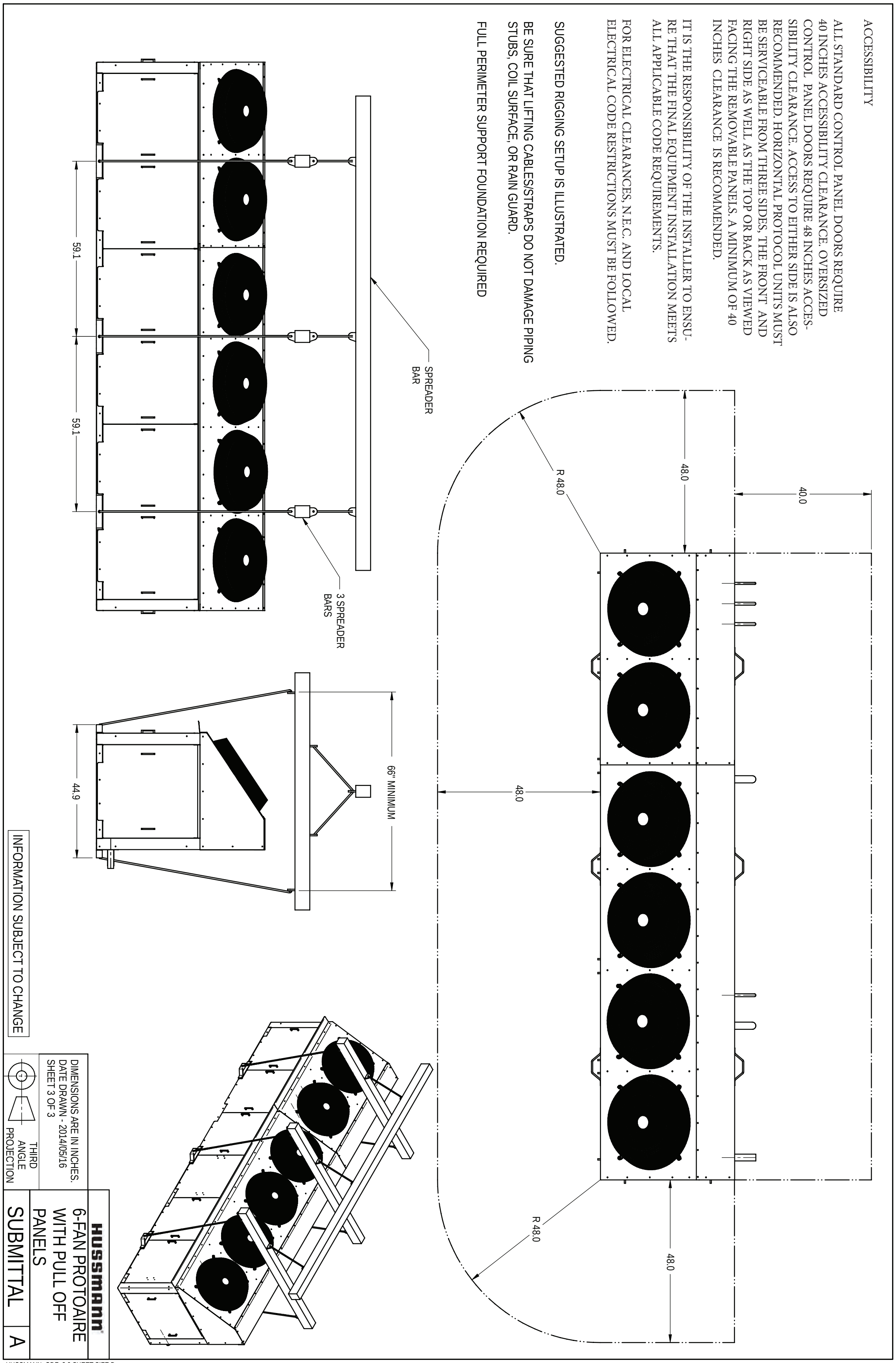
SUBCOOLED LIQUID 7/8"
NON-SUBCOOLED LIQUID 7/8"
GAS DEFROST 5/8"
INFORMATION SUBJECT TO CHANGE
DIMENSIONS ARE IN INCHES.
DATE DRAWN - 2014/05/16
SHEET 2 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
6-FAN PROTOAIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D


ACCESSIBILITY
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FULL PERIMETER SUPPORT FOUNDATION REQUIRED
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SHEET 3 OF 3
THIRD ANGLE PROJECTION
HUSSMANN
6-FAN PROTOAIRE WITH PULL OFF PANELS
SUBMITTAL
A
HUSSMANN_GDF_2.0 SHEET SIZE D

REFRIGERATION PIPING

Important: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor.
Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.
The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig at the lowest point in the piping.

Overview

This section details the major refrigeration components and their locations in each piping system.

Refrigeration Line Piping

Use only clean, dehydrated, sealed refrigeration grade copper tubing. Use dry nitrogen in the tubing during brazing to prevent the formation of copper oxide. All joints should be made with silver alloy brazing material, and use 35% silver solder for dissimilar metals.

Liquid and suction lines must be free to expand and contract independently of each other. Do not clamp or solder them together. Run supports must allow tubing to expand and contract freely. Do not exceed 100 feet without a change of direction or an offset. Plan proper pitching, expansion allowance, and P-traps at the base of all suction risers. Use long radius elbows to reduce flow resistance and breakage. Avoid completely the use of 45° elbows. Install service valves at several locations for ease of maintenance and reduction of service costs. These must be UL approved for 450 psig minimum working pressure.

All Protocol™ units have one-inch drip pan at the bottom of the unit. DO NOT run piping through the bottom of this pan.

Return Gas Superheat

Return gas superheat should be 10 to 30 °F on all units.

Suction Line

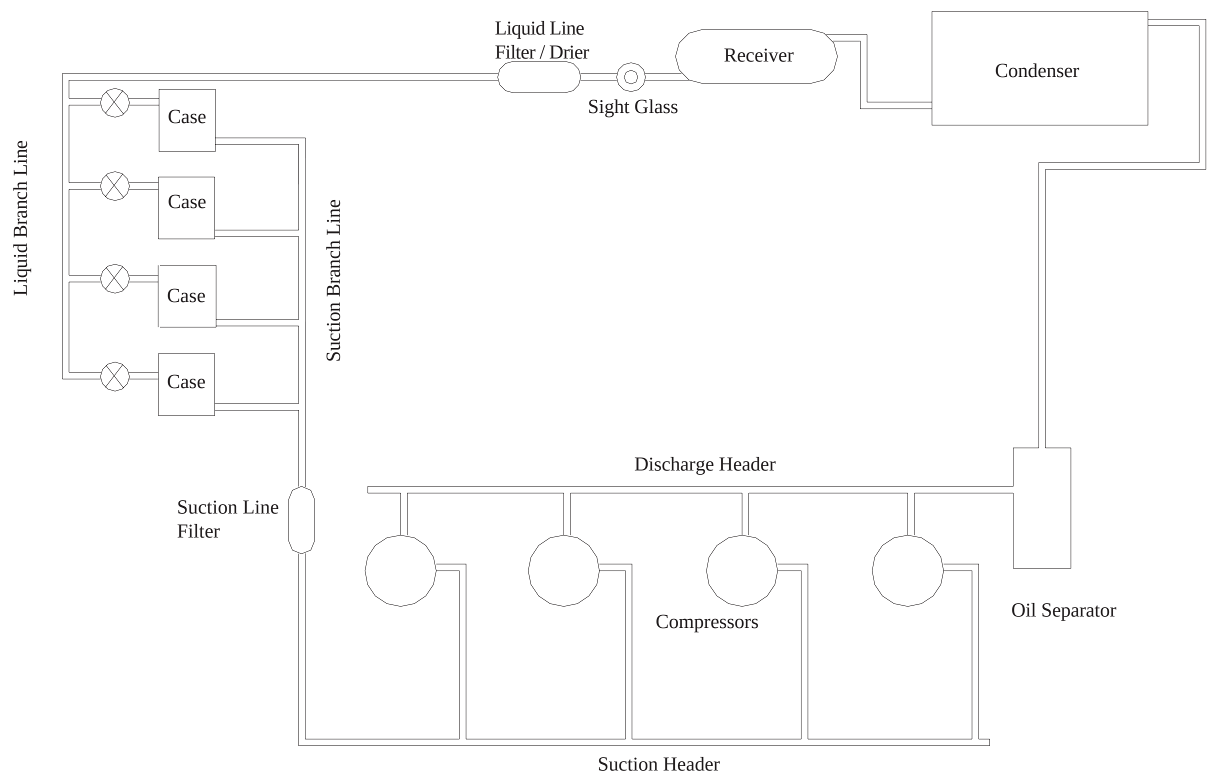
1. Install a downward slope in direction of flow. A P-trap is required for all vertical risers.
2. Line may be reduced by one size after first third of case load and again after the second third. Do not reduce below evaporator connection size.
3. Suction returns from evaporators must enter at the top of the line.

Liquid Line

1. Take-offs to evaporators must exit the bottom of the liquid line. Provide an expansion loop for each evaporator take-off (minimum 3-inch diameter).
2. Offtime and Electric Defrost may be reduced by one size after one half the case load. Do not reduce below evaporator connection size.

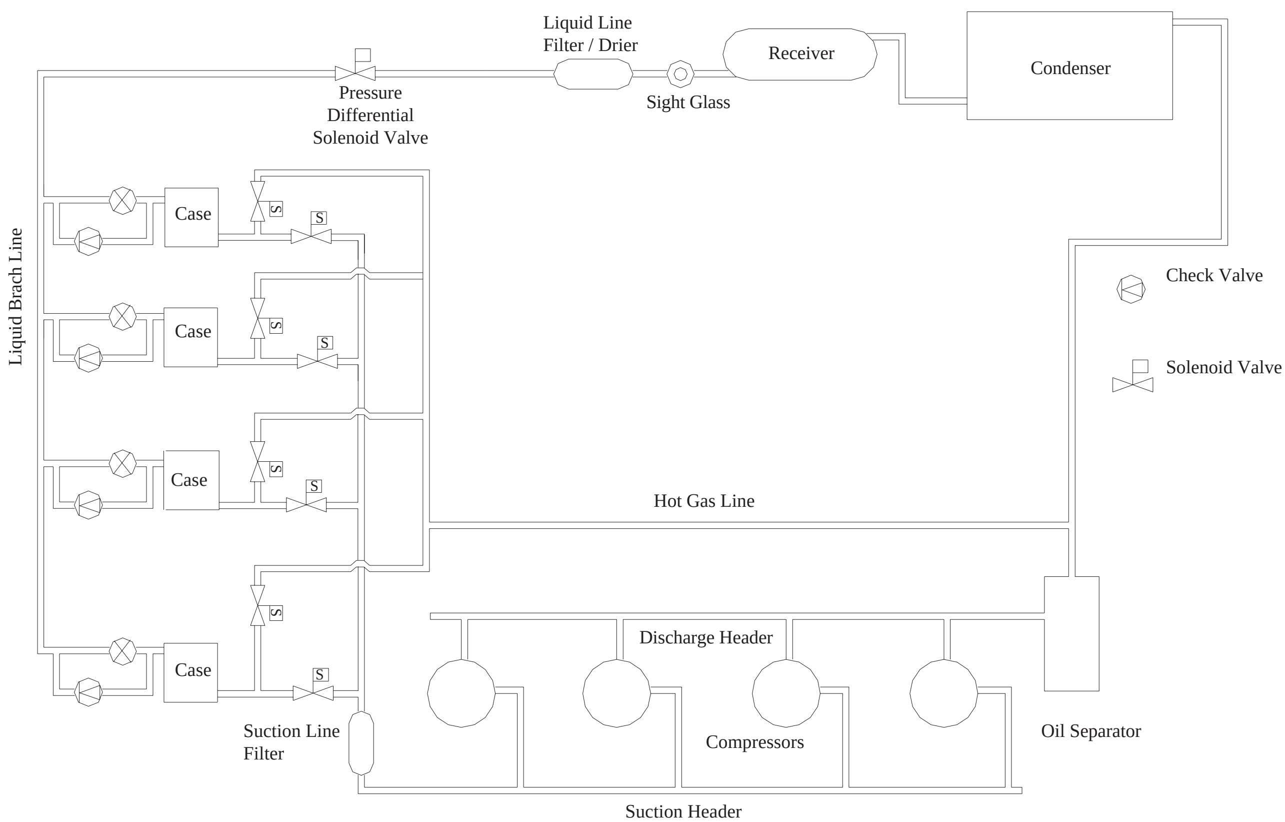
Refrigeration Cycle
Oil Return System Not shown

Beginning with Compressors, refrigerant vapor is compressed into the Discharge Header.
The oil separator effectively divides the refrigerant from the lubricant in the system. The lubricant is then returned to the compressors. The Condenser dissipates the unwanted heat from the refrigerant into either a water/ glycol, or, air condenser depending on the type used.
The receiver acts as a vapor trap and supplies the Liquid Line with quality liquid refrigerant.
A Liquid Line Filter/Drier removes water and other contaminants from the refrigerant.
The liquid branch line supplies liquid refrigerant to the Thermostatic Expansion Valve (TXV), which in turn feed refrigerant to the cases (evaporator coils). These coils pick up heat from the product stored in the cases. A Suction Filter removes system contaminants from return vapor, which is factory supplied but field installed. It is also a good idea to install isolation valves for ease of service. The oil return system is not shown in the following illustration.



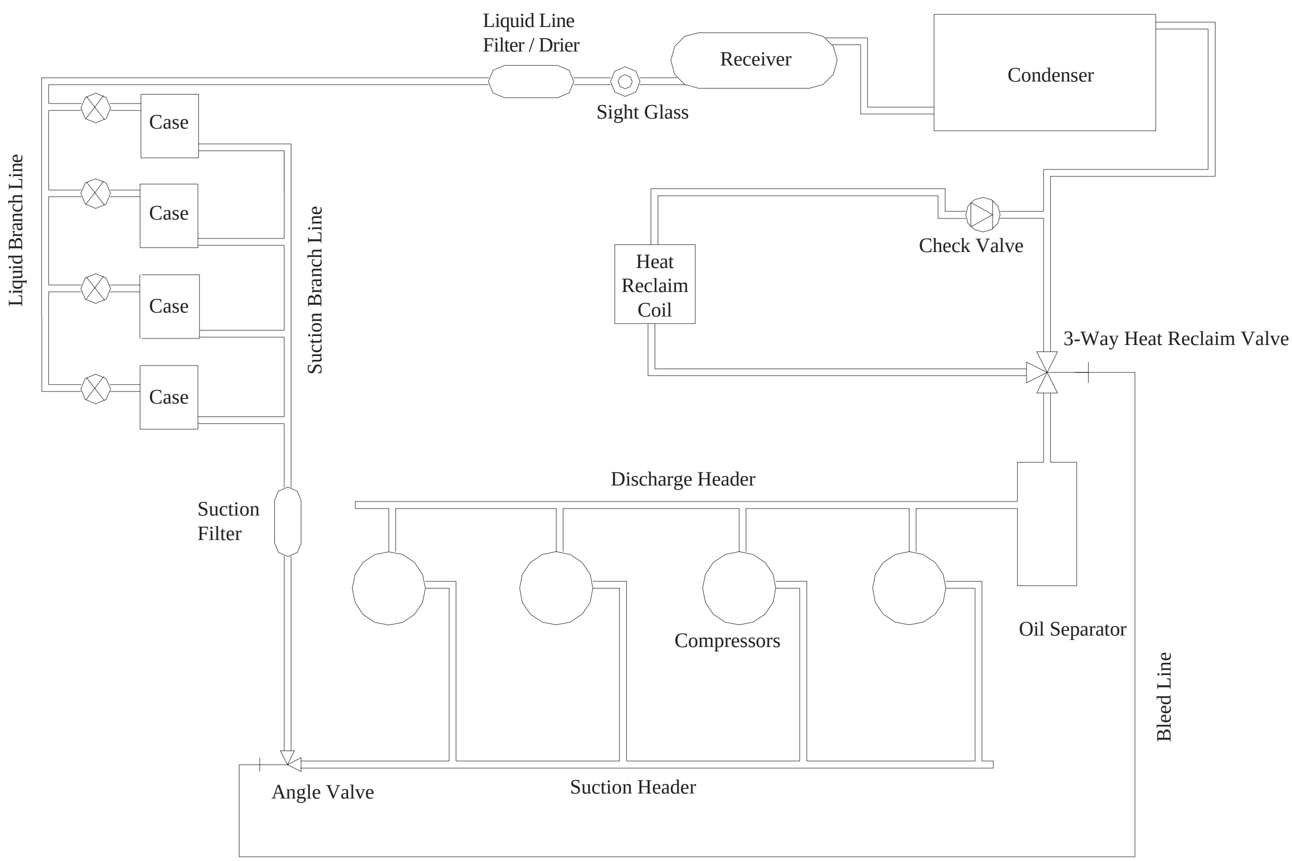
Protocol™ with 3-Pipe Gas Defrost
Oil Return System Not shown

When 3-pipe gas defrost is used, hot gas is piped from the discharge line, after the oil separator, to the cases. Solenoid valves are placed in both the suction and hot gas line so that each system can be turned on or off by the controller. Place a bypass line, with a check valve ensuring that flow during defrost can bypass the TXV. A pressure differential solenoid valve needs to be installed in the main liquid line to insure proper flow during defrost. The pressure differential solenoid valve is factory installed in a vertical or horizontal Protocol™. Ensure that during defrost no more than 45 lbs or 20% of the total load is in defrost at any given time.



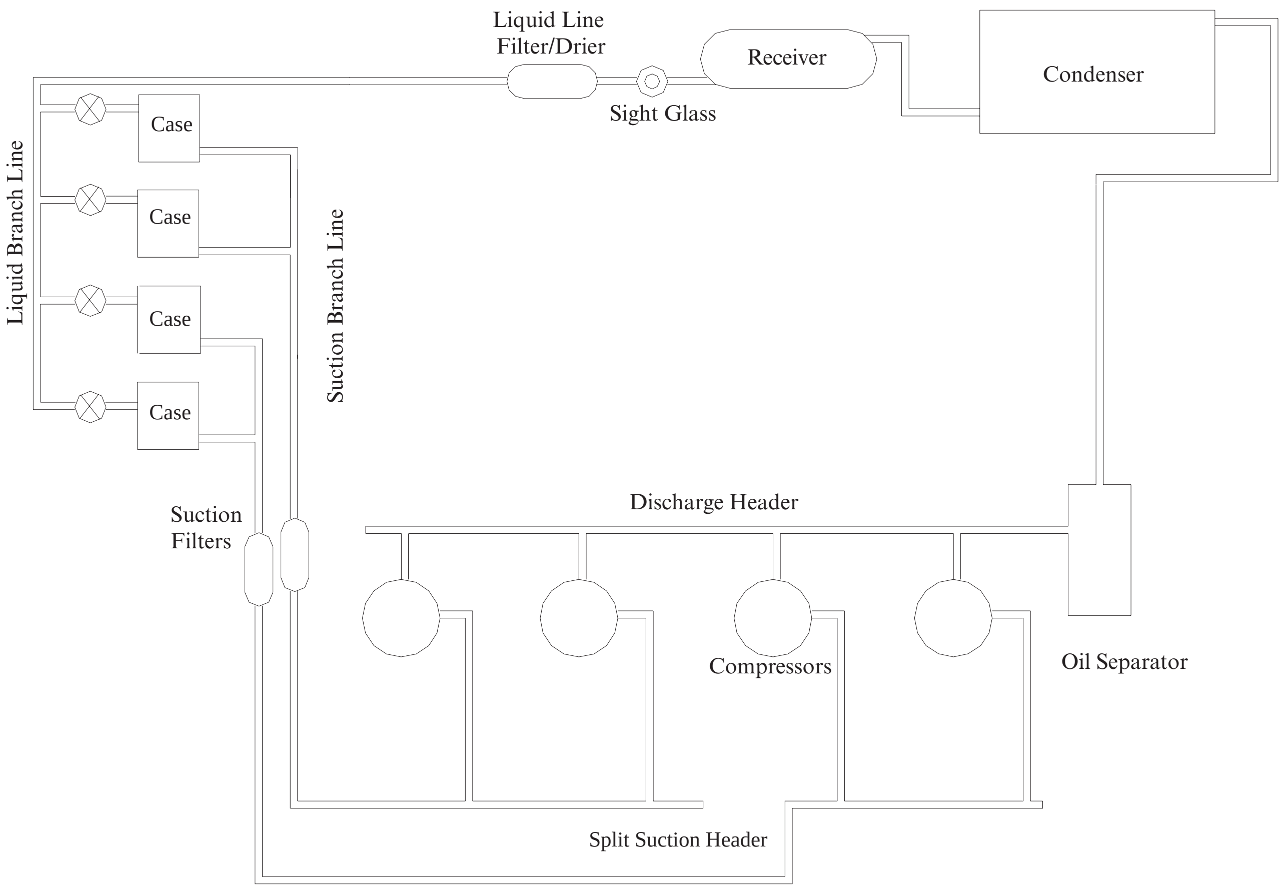
Protocol™ with Heat Reclaim
Oil Return System Not shown

When heat reclaim (for water or air) is used with the Protocol™ a 3-Way Heat Reclaim Valve should be installed after the oil separator. A bleed line should be installed from the heat reclaim valve to the angle valve found in the suction header. A check valve is installed in the heat reclaim return loop. This check valve ensures that back flow through the heat reclaim coil is eliminated when heat reclaim is not used. Refer to specific manufacturers guidelines for sizing reclaim coils. In the case of water heat reclaim, a 10# check valve should be used to bypass the water tank in the case that the pressure drop across the tank become excessive.



Protocol™ with Split Suction
Oil Return System Not shown

Split suction is used when two temperatures are required from the same Protocol™ unit. The use of split suction allows for greater efficiency due to the fact that the compressors are operating closer to the desired suction temperature.

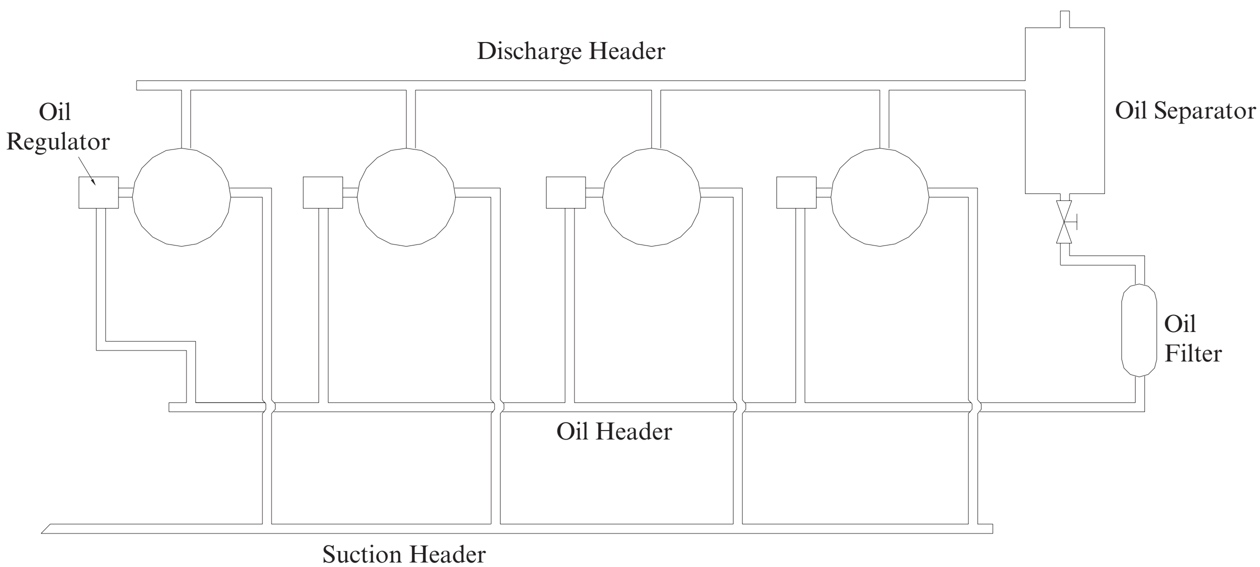


Oil Cycle

Discharge refrigerant carries droplets of oil from the compressor's outlet. The Oil Separator separates the oil from the refrigerant. The oil is stored in the Oil Separator until needed. The oil returns to the system through the high-pressure line and oil filter.

The oil filter removes impurities from the oil. The high-pressure oil is distributed to the electronic oil level control, which feeds oil into the compressor through a solenoid valve.

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply.
When the oil level in the compressor drops below ½ sightglass, the fill light comes on, and the oil solenoid is energized. If after 90 seconds the oil level does not rise above ½ sightglass, the unit opens the compressor control circuit. If oil becomes available, the electronic oil level control will automatically re-set and the compressor will resume operation.



Compressors with Pre-Charged Oil as Standard	Systems Shipped Dry
Protocol OLP Protocol SP Protocol Proto-aire	*OLP Protocol with Bitzer compressors

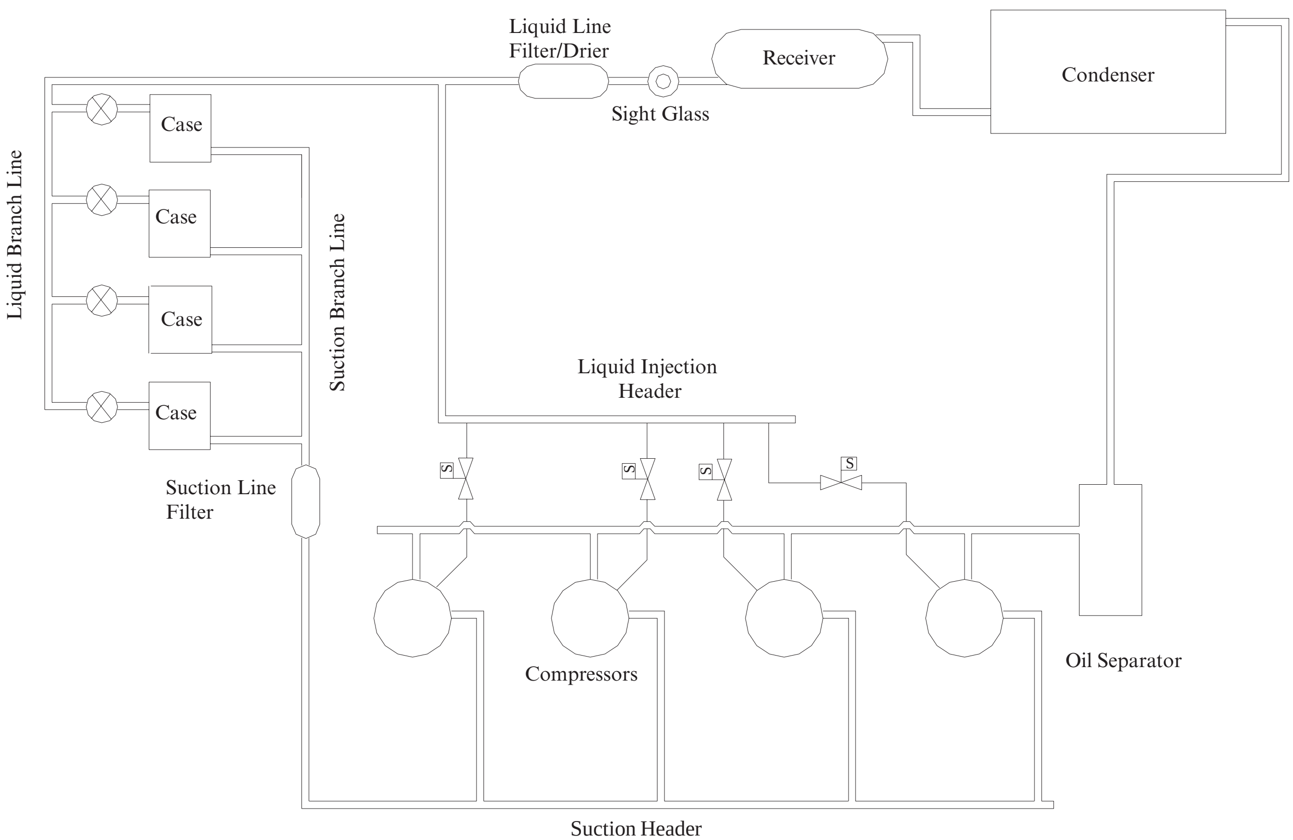
*ANY OLP PROTOCOLS SELECTED WITH BITZER COMPRESSORS WILL NOT HAVE OIL PRE-CHARGED OR INLCUDED AS STANDARD, BUT CAN BE ORDERED AS AN OPTION (SHIP LOOSE).

To resolve the exception with Bitzer compressors, ship loose oil which is available as an option should be included. One gallon per compressor would be required on OLP

Liquid Injection

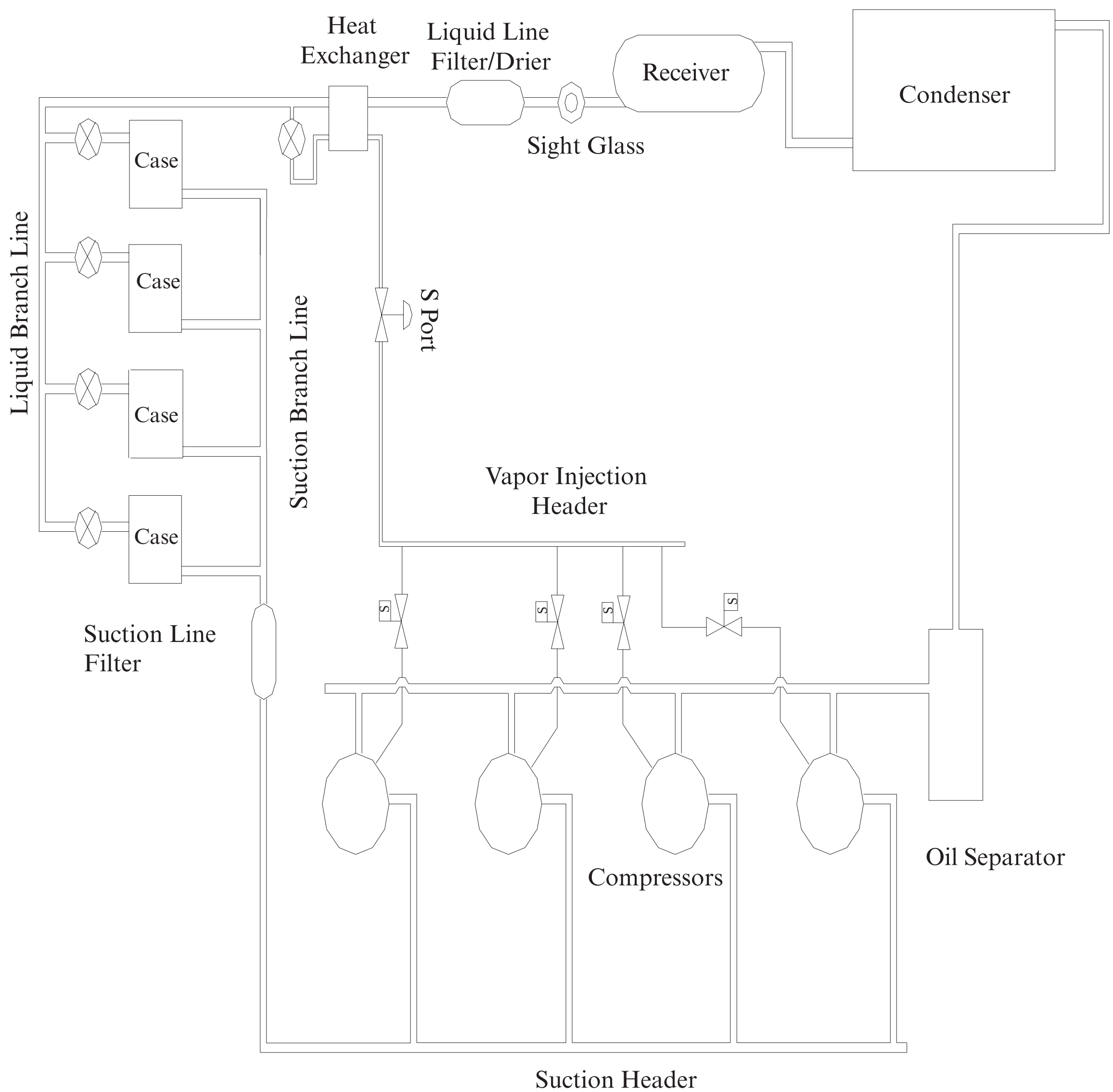
When operating at high compression ratios, injecting liquid partway through the compression process is a method of cooling the scroll compressor. A discharge temperature control (DTC) valve or an EXV (Electronic Expansion Valve) must be applied for liquid injection. The EXV valve requires an injection solenoid valve. Each compressor liquid injection line has its own shutoff valve, injection solenoid valve with EXV or DTC valve, and supply hose. When the compressor is off, the solenoid valve is de-energized via a current sensing relay mounted at the compressor contactor. If the DTC valve is used, the DTC valve will close when the compressor is off.

Note: On units with remote receivers, liquid refrigerant must be piped to the liquid injection stub-out at the back of the Protocol™ unit.



Vapor Injection

Another method of cooling the scroll compressor is to use vapor injection. Vapor Injection takes a small portion of liquid refrigerant from the main liquid line and runs it through a thermostatic expansion valve and a heat exchanger, which helps to ensure vapor is sent to the compressor as well as sub-cooling the main refrigerant before it goes to the TXV and evaporator in the case.



Water Loop Piping

Important: Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor. **It is mandatory that glycol be added to the water loop before startup to prevent freezing. Use only non-ferrous metal or PVC for water loop piping.**

The Water Loop should be tested for leaks using pressurized water.

DO NOT exceed 75 psig

Overview

This section details major water loop components, and their locations in the piping system.

Water Loop Guidelines

Pipe Connections
PVC Plastic pipe should be solvent welded (glued) together as described on the glue can.

Pipe Fittings must be clean and dry.

Cut Pipe with a guillotine type cutter to get a clean, square cut; remove any burrs.

Use Purple Primer on both pipe and fitting before gluing.

Apply glue to both pipe and fitting and join with a twisting motion.

Hold joint together for approximately 30 seconds to allow glue to set.

Allow to dry for 24 hours before putting in to service.

Where it is necessary to connect plastic and metal pipe. **DO NOT USE A THREADED CONNECTION.** A compression type fitting should be used. For larger pipe sizes, a flanged connection may be used.

Isolation Valves
Install isolation valves at inlet and outlet of each Protocol™ unit.

It is good practice to include isolation valves at several locations throughout the piping. For example valves should be used where branches tie into main supply and return lines.

PVC plastic ball valves may be used.

Strainers
Use a 16-mesh strainer at inlet of each Protocol™ unit. Position isolation valves so that this strainer can be opened for cleaning.

Air Vent Valves
Manual air vent valves are recommended. Air vent valves should be located at piping high points where air will tend to collect. Momentarily open these vents and release trapped air a few times during startup.

Tie-Ins to Supply Headers
Branch supply pipes **SHOULD NOT** tie into the bottom of main supply pipes. Always tie into top of a main supply pipe; that is, the "T" fitting should point **UP, NOT DOWN.**

Pipe Supports
Pipe support should be provided as follows:

Nominal Pipe Size, inches	Distance Between Supports, feet Schedule 40 Pipe @ 100 °F	Distance Between Supports, feet Schedule 80 Pipe @ 120 °F
1.0	4.5	3.5
1.5	5.0	3.5
2.0	5.0	4.0
3.0	6.0	4.5
4.0	6.5	5.0
6.0	7.5	6.0

Do not clamp supports tightly – this restricts axial movement of the pipe. Supports should provide a smooth bearing surface that conforms to the bottom of the pipe, and should be a minimum of 2 inches wide.

Exposure to Direct Sunlight
Piping that will be exposed to direct sunlight should be shaded or covered. A thin layer of insulation is adequate for this.

Leak Check
Check for leaks in the piping before startup by filling with pressurized water at 50 psig.

Cleaning and Flushing
The pipe loop should be cleaned before the system is put into service. Fill the closed loop with a solution of 1% trisodium phosphate and (99%) water, by weight.

Circulate the detergent/water solution for 24 hours.

Drain the loop and refill with fresh water. Circulate for at least 3 hours.

Drain and refill again. Repeat until all phosphate is gone.

Filling
The water loop MUST have adequate corrosion protection. In most situations, using fully inhibited, industrial grade ethylene glycol or propylene glycol 30% by volume with water can

provide corrosion protection. For most installations, 30% glycol by volume will also provide **BURST** protection to –20 °F.

If the store location has particularly hard water, with a total hardness greater than 100 ppm, the water used to fill the loop should be softened or distilled. Local water treatment vendors can provide information on local water quality.

Use only industrial grade, fully inhibited ethylene or propylene glycol such as Dow Chemical's Dowtherm SR-1 or Dowfrost. Consult local regulations as to which type – ethylene or propylene – to use. Propylene glycol is generally considered non-toxic, while ethylene glycol is somewhat toxic. **DO NOT USE AUTOMOTIVE GRADE GLYCOL**.

Use a refractometer to check the glycol concentration at least once a year.

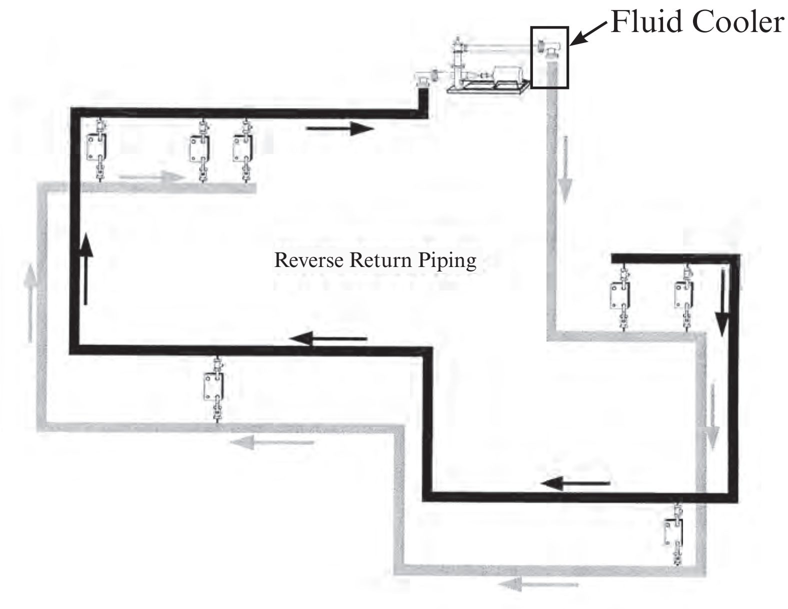
The pumping station has a low fluid pressure switch set at roughly 10 to 20 psig, which should be tied into an alarm. It is good practice to test the operation of this switch at least once a year.

Balance Valve Adjustment

A flow balancing valve is located inside each Protocol™. These valves should be set at startup using the following procedure.

Presetting The Flow Control (Balancing) Valve
(Bell & Grossett 1½ inch Circuit Setter)

Balancing the Water Loop

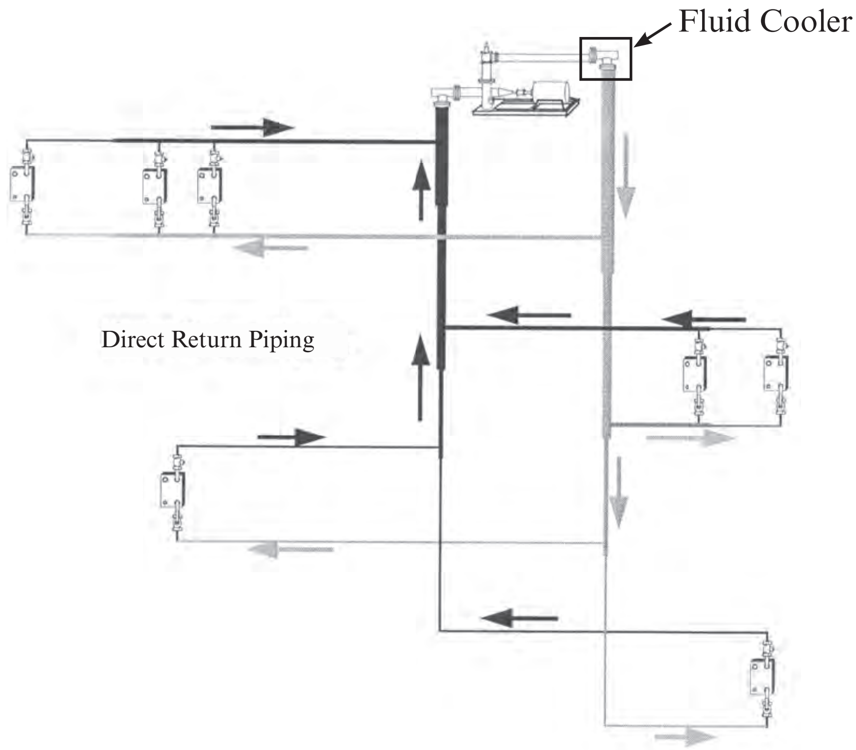


Balancing the Water Loop for Direct Return Piping
Several factors must be accounted for when balancing the water loop of a Protocol™ installation using direct return piping. Two major factors stand out:

1 – Balancing to attain the correct water flow for each Protocol™; and
2 – Balancing the system for Piping Head Loss.

Since these factors have nearly unlimited combinations, finding the appropriate setting for each combination is unrealistic. However, if these factors are separated, their effect on the system can easily be defined.

Balancing the Water Flow



Balancing the Water Flow for Each Protocol™

If the store were designed so that each Protocol™ condenser was supplied from and returned to a Very Large Box, and the piping to each condenser was identical; then flow rate (GPM) would be proportional to the Degrees of Closure on each Circuit Setter.

Balancing the System for Piping Head Loss

If the store were designed so that each Protocol™ condenser was identical; the flow rate (GPM) for each condenser could be set from a simple table. Balancing Head Loss for Length of Piping Run could be equated to Degrees of Closure on each Circuit Setter.

By accounting for Head Loss and Flow Rate (GPM) for each Protocol™ in a system, a Preset Value for each Protocol™ unit's Circuit Setter may be established.

Since each installation is unique, all Protocol™ units must be carefully monitored during store startup. Once all Protocol™ units are running, the water loop must be checked, and final balancing performed.

Table 1 shows a proportional Closure for the Circuit Setter based on Protocol™ GPM requirements.

Table 1					
GPM	° Closure	GPM	° Closure	GPM	° Closure
58	0	42	8	26	16
57	0	41	8	25	16
56	1	40	9	24	17
55	1	39	9	23	17
54	2	38	10	22	18
53	2	37	10	21	18
52	3	36	11	20	19
51	3	35	11	19	19
50	4	34	12	18	20
49	4	33	12	17	20
48	5	32	13	16	21
47	5	31	13	15	21
46	6	30	14	14	22
45	6	29	14	13	22
44	7	28	15	12	23
43	7	27	15		

Table 2 shows a proportional Closure for the Circuit Setter based on Length of Piping Run.

Table 2	
Length of Run	° Closure
1000	0
950	1
900	2
850	3
800	4
750	5
700	6
650	7
600	8
550	9
500	10
450	11
400	12
350	13
300	14
250	15
200	16
150	17
100	18
50 and below	19

Presetting the Degree of Closure

Look up flow rate (GPM) for each Protocol™. Find the closest GPM in **Table 1**. Log the listed °Closure Value for each Protocol™ in the ***Table 1 Value* row**.

Establish Length of Run for each Protocol™. Find the closest Length of Run in **Table 2**. Log the listed °Closure Value for each Protocol™ in the ***Table 2 value* row**.

Add the two values logged for each Protocol™.

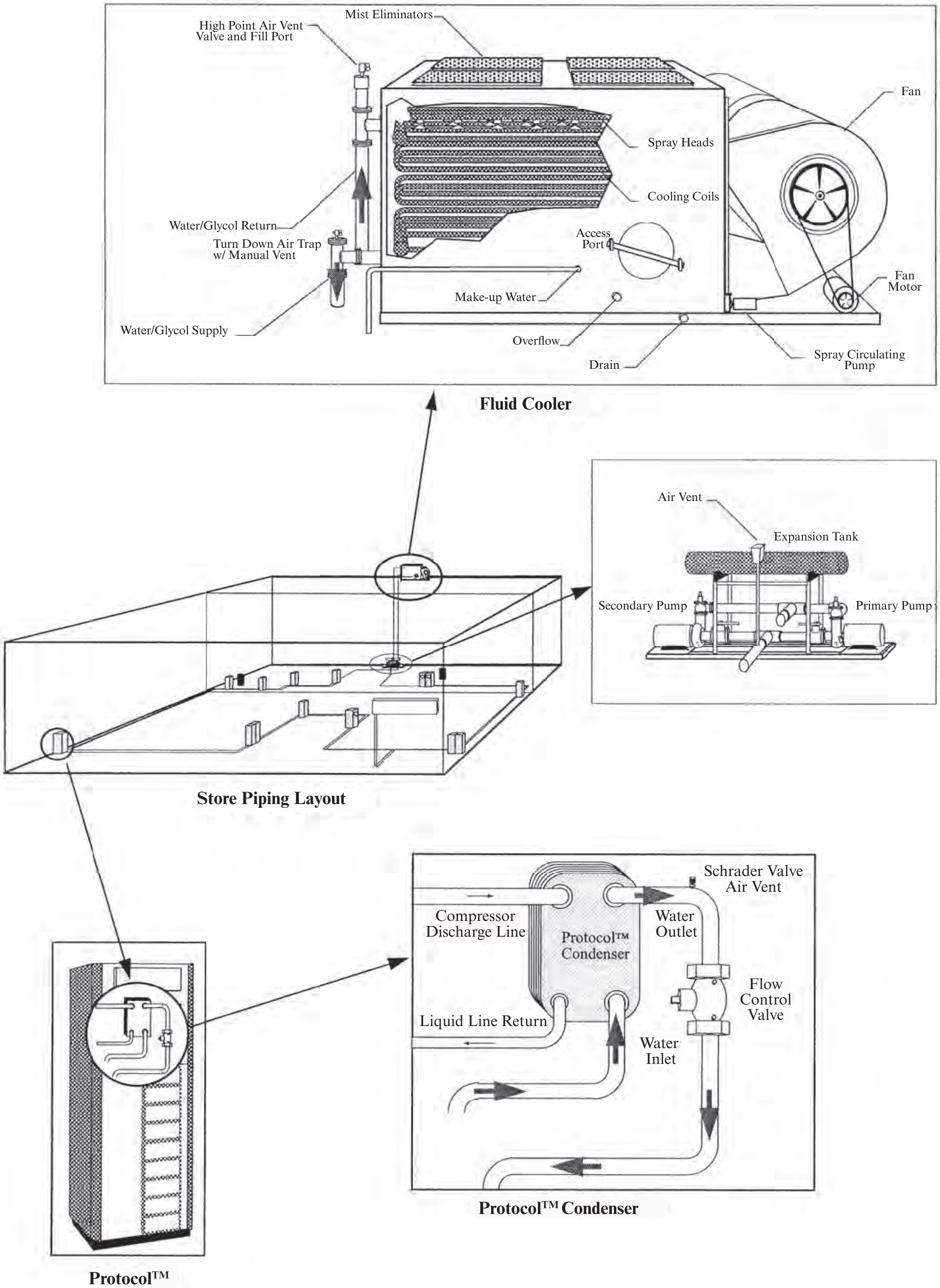
Locate the lowest **Total**. Subtract it from each Protocol™ Unit's **Total**, to get Presetting °Closure.

Important Note: Length of Run includes both the supply and return piping.

Example

Protocol™	A	B	C	D	E	F	G	H	I		
Table 1 Value (+) Table 2 Value	11 9	9 14	14 5	12 8	15 11	7 9	15 10	11 12	8 18		
Total (-) Lowest Total	20 **16**	23 **16**	19 **16**	20 **16**	26 **16**	16 **16**	25 **16**	23 **16**	26 **16**		
Presetting °Closure	4	7	3	4	10	0	9	7	10		

Protocol™											
Table 1 Value (+) Table 2 Value											
Total (-) Lowest Total											
Presetting °Closure											


Mist Eliminators
High Point Air Vent
Valve and Fill Port
Fan
Spray Heads
Cooling Coils
Water/Glycol Return
Turn Down Air Trap
w/ Manual Vent
Access
Port
Fan
Motor
Make-up Water
Water/Glycol Supply
Overflow
Spray Circulating
Pump
Drain
Fluid Cooler
Air Vent
Expansion Tank
Secondary Pump
Primary Pump
Store Piping Layout
Schrader Valve
Air Vent
Compressor
Discharge Line
Protocol™
Condenser
Water
Outlet
Flow
Control
Valve
Liquid Line Return
Water
Inlet
Protocol™ Condenser
Protocol™

Electrical

Field Wiring

Maximum Field Wire Size
Based on the total load amperes, the largest connectable wire sizes for the terminals on the convenience switch are listed below. (Wire size is based on the serial plate minimum circuit ampacity.)

Total Connected RLA	Largest Connectable Wire
200 A (max)	3 /0 per Ø
400 A (max)	2 x (3 /0) per Ø

Refer to National Electric Code for temperature derating factors.

Sizing Wire and Overcurrent Protectors
Check the legend for Minimum Circuit Ampacity (MCA), Maximum Overcurrent Protective Devices (MOPD), and total RLAs. Follow NEC guidelines.

> Note: A convenience switch is provided as part of the unit. A Branch Circuit must be built to the unit using information supplied on the unit data plate for Minimum Current Ampacity (MCA) and Maximum Over Current Protective Device (MOPD).

Protocol™ components are wired as completely as possible at the factory with all work completed in accordance with the National Electrical Code. All deviations required by governing electrical codes will be the responsibility of the installer.

The lugs on the convenience switch in the convenience switch box are sized for copper wire only, with 75 °C THW insulation. All wiring must be in compliance with governing codes.

For 208-230/3/60 Compressor Units:
To each Protocol™ provide:
- One 208-230/3/60 branch circuit
- One 120/1/60 neutral
- One ground wire to earth ground

For 380-460/3/60-50 Compressor Units with Remote Mounted Transformer:
To each Protocol™ provide
- One 380-460/3/60-50 branch circuit
- One ground wire to earth ground

To remote mounted transformer
- One 380-460/1 or 3/60-50 branch circuit from Protocol™ Fuse Block
- One ground wire to ground wire connection

From remote mounted transformer

One 240/1 or 3/60-50 connection to 240V convenience switch in panel
- One derived neutral from transformer

For 380-460/3/60-50 Compressor Units without Remote Mounted Transformer:
To each Protocol™ provide
- One 380-460/3/60-50 branch circuit
- One ground wire to earth ground
- One 208-240/1 or 3/60-50 branch circuit
- One 120/1/60-50 neutral

For 575/3/60 Compressor units without Remote Mounted Transformer:
To each Protocol™ provide:
- One 575/3/60 branch circuit
- One ground wire to earth ground
- One 220/1/60 branch circuit

Consult factory for other voltages.

Alarm Wiring

Protocol™ provides one NO/NC pilot duty relay for remote alarm. The field connection pins are located in the convenience switch panel.

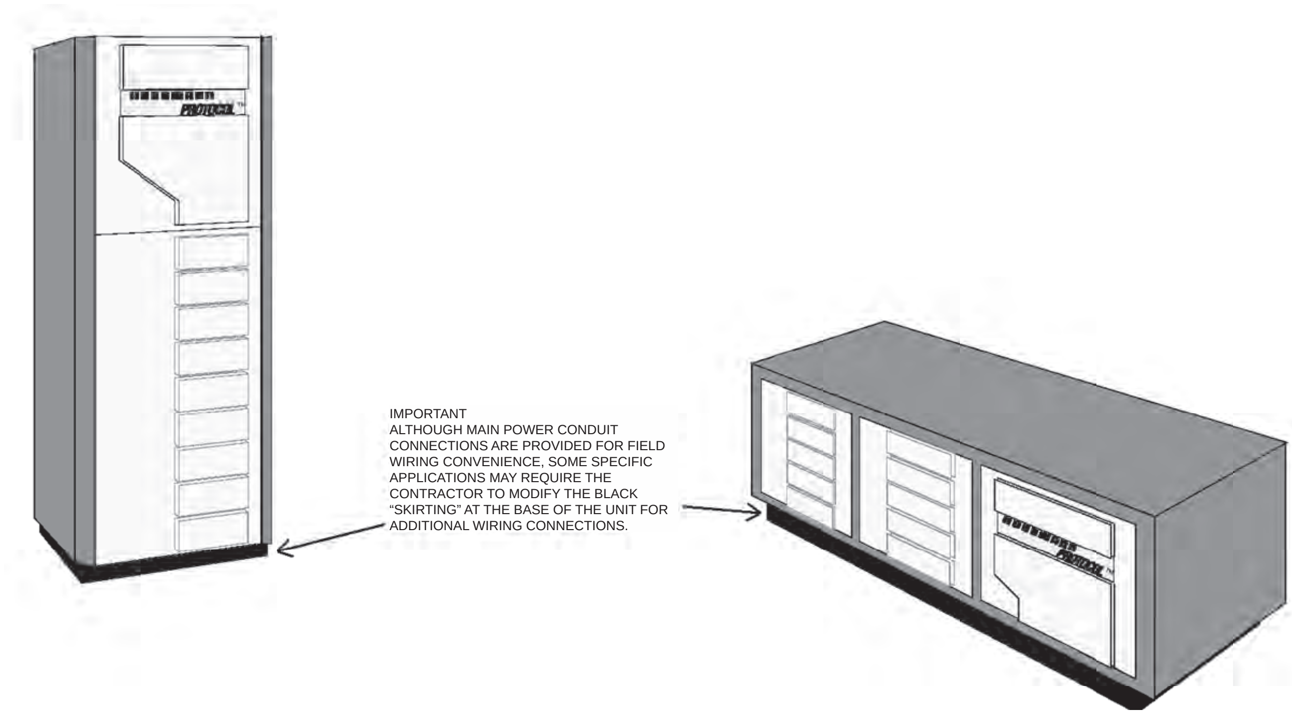
Temperature Sensors and Defrost Termination Thermostats

Use shielded and grounded Belden Cable #8762, or equivalent, between control panel and case sensors or thermostats.

Important
Shielded cable must be used. The shield wire must be attached to the panel liner on the control panel door.

Additional Circuits

Check the store legend for components requiring electrical circuits to the Control Panel and Case Power Distribution Box. The Protocol™ can provide power for all case electrical needs including:
- Fan and Anti-sweat Heater Circuits
- Satellite Control
- Electrical Defrost Heaters
- Case mounted refrigeration solenoid
- Case Lighting
- Unit Cooler Fan Power (electric defrost only)



Evaporator Mounted Refrigeration Solenoid

Power for refrigeration solenoids at the evaporator comes from the Protocol™ case electrical terminal pins located in the main control panel.

Cooler Door Switch Wiring

Check the store legend for door switch kits (M115 or M116). The switch is mounted to the cooler doorframe, and controls the field installed liquid line solenoid and evaporator fans. For Gas Defrost applications, M116 includes a check valve to bypass the liquid line solenoid valve.

Panel Voltages

The Protocol™ Control Panels contain voltages:

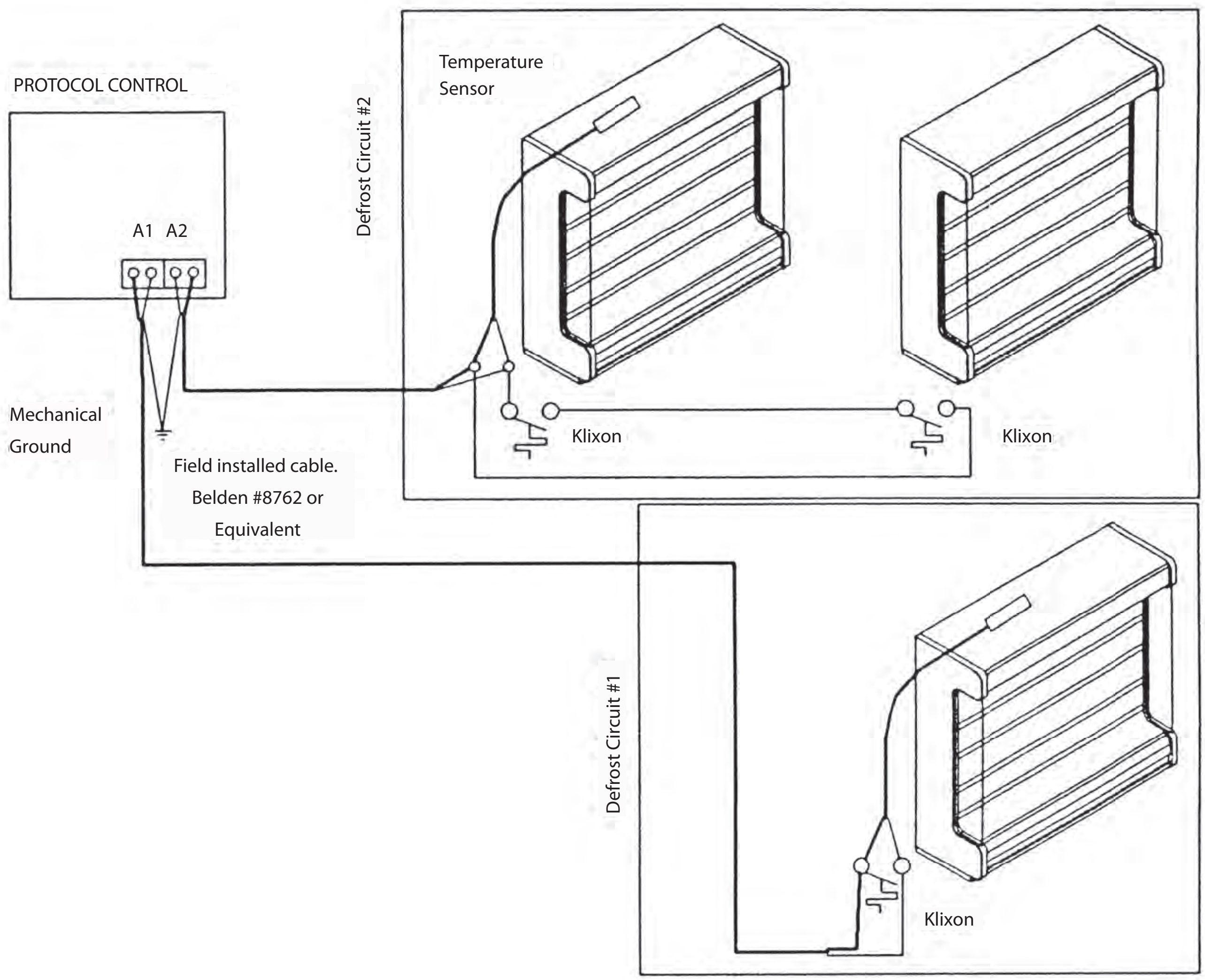
24V	PC Board, POWERLINK™ Control Circuits Electronic oil level control
120V and 208/230V 380V	Control Circuits
460V or 575V	Power Supply Circuits

NOTE: The current draw required by an analog meter (Volt-Ohm Meters or VOMs) **can permanently damage electronic equipment.** Never use a VOM to check computer components or computer controlled systems. Use a Digital Multimeter (DMM) to measure voltage, amperage, milliamperes, or ohms. If a range is exceeded the display will show OL (overload).

Alarm LEDs
One exterior and one interior Alarm LED assist in preliminary troubleshooting.

Alarm Light on Control Board	Alarm Relay Light	Exterior Alarm Light	Condition
ON	**ON**	**OFF**	**Okay**
OFF	ON	OFF	Monitoring Alarm
OFF	**OFF**	**ON**	**Switchback**
ON	ON	ON	Compressor Safeties Failed

Typical wiring diagram for Temperature Sensor and Klixon wiring.
Individual wiring may vary.
See page 102 for details on control types.



Electrical Legend

RELAY CONTACTS NORMALLY OPEN

RELAY CONTACTS NORMALLY CLOSED

JUMPER

SPLICE

CLOSE ON RISE
FAN CONTROL

CLOSE ON RISE PRESSURE CONTROL
LOW PRESSURE

OPEN ON RISE PRESSURE CONTROL
HIGH PRESSURE

OIL CONTROL

LIGHT

COOLING FAN

TERMINAL BLOCK

THERMOSTAT OPEN ON RISE
DISCHARGE TEMPERATURE OR DEFROST TERMINATION THERMOSTAT

THERMOSTAT CLOSE ON RISE
REFRIGERATION THERMOSTAT

COMPRESSOR OR CIRCUIT NUMBER

FACTORY WIRING

FIELD WIRING

GROUND

120V RECEPTACLE

CURRENT SENSING RELAY

CONTACTOR

COMPRESSOR

SOLENOID (SUCTION SOLENOID,
HOT GAS SOLENOID, LIQUID SOLENOID,
INJECTION SOLENOID, HEAT RECLAIM
SOLENOID, LIQUID DIFFERENTIAL SOLENOID,
MAIN LIQUID LINE SOLENOID)

RELAY OR COIL (ALARM RELAY,
MOTOR CONTACTOR COIL, FAN RELAY,
FAN CONTACTOR, ALARM RELAY, ETC.)

SINGLE POLE CIRCUIT BREAKER

TWO POLE CIRCUIT BREAKER

THREE POLE CIRCUIT BREAKER

PHASE MONITOR

TRANSFORMER

THREE PHASE
BUSSBAR

SINGLE PHASE
BUSSBAR

POWERLINK MOTOR

POWERLINK POWER SUPPLY

SINGLE POLE POWERLINK

TWO POLE POWERLINK

THREE POLE POWERLINK

THREE POLE MOTORSTARTER
460V OR 575V COMPRESSORS

MISC. NOMENCLATURE

PL - POWERLINK CIRCUIT BREAKER
PS - POWERLINK POWER SUPPLY
AR1 - ALARM RELAY #1
GAR - GENERAL ALARM RELAY
HPC - HIGH PRESS. CONTROL
LPC - LOW PRESS. CONTROL
OLA - OIL LEVEL ALARM
PLA - PHASE LOSS ALARM
SBA - SWITCHBACK ALARM RELAY
LS - LIQUID SOLENOID VALVE
RT - REFRIGERATION T'STAT
SS - SUCTION STOP SOLENOID VALVE
HGV - HOT GAS SOLENOID VALVE
* - DISCONNECT TERMINAL PIN

WIRE COLOR CODE

B = BLACK
BL = BLUE
BR = BROWN
O = ORANGE
P = PURPLE
R = RED
Y = YELLOW
W = WHITE
G = GREEN

Terminal Connections

Protocol™ units carrying 5 and 6 compressors, or an oversized Control Panel, do not use a single-phase bussbar. Wire number assignments and corresponding terminal number assignments in the Power Distribution Box differ from the smaller panel arrangement.

120V Circuit Logic

The Protocol™ includes as standard the following 120V components:

Service Receptacle (5 Amp Max)
Cabinet Exhaust Fan
120V by 24V Transformer
Compressor Contactor Coils
Valve Solenoids
External Alarm Light

24V Circuits

The printed circuit control boards with attached relay coils are 24V. The POWERLINKS™ are powered by a 24V DC supply (used to control electric defrost heaters). Each POWERLINK™ power supply will drive up to 5 POWERLINKS™ at once, and require 2 seconds to recharge an internal DC capacitor between operations. If the POWERLINK™ power supply fails, **a transformer will NOT replace it.**

Electronic Oil Level Control

A 24V transformer powers the electronic oil level control. All circuit logic including oil solenoid control is 24 volt. Only the alarm contact is 120V. See next two pages for typical wiring diagrams.

Satellite Short Cycle Control Relay

The Satellite short cycle control relay is intended to prevent rapid cycling when the compressor goes into pumpdown mode. It is a single-shot time-delay relay. When the low pressure control opens on a decrease in pressure, the short cycle control relay becomes energized and starts timing. After 3 minutes (regardless of the action of the low pressure control) this relay will close, thereby re-engaging the control circuit and allowing the compressor to run again.

Liquid Injection

When operating at high compression ratios, injecting liquid partway through the compression process is a method of cooling the scroll compressor. Hussmann applies liquid injection on all units below 0 °F evaporating temperature. Each compressor has its own Direct Thermal Control (DTC) valve, which is an all-in-one injection solenoid that allows for a more energy efficient use of liquid.

Note: On units with remote air-cooled condensers, liquid refrigerant must be piped to the liquid injection header inside the Protocol™ unit.

Vapor Injection

Another method of cooling compressors is to use vapor injection. The Protocol High Efficiency (HE) series incorporates vapor injected (ZFKV) scroll compressors for low temperature applications, and the ZBKCE series of scroll compressors for medium temperature. When compared to the standard Protocol low temperature unit at typical design conditions, the HE series has 40 % more capacity and has a 20% improvement in EER. This is accomplished by the economizer cycle, which sub cools liquid refrigerant through a heat exchanger and injects vapor via a port on the compressor at a „mid-pocket" interstage pressure. The HE series is available in horizontal units and 3 wide vertical frame units with air or water cooled options. However when selecting horizontal models, they MUST BE accessible from the Top. When sizing EVI Low Temp compressors, DO NOT EXCEED 90% of capacity rating. Also Liquid Lines MUST BE INSULATED.

Protocol HE horizontal units must be accessible from the top. The economizer system is pre-installed on every Protocol HE unit. Factory settings for the EPR between the heat exchanger and compressor injection ports in the system should be set with a 10°F TD using midpoint properties:

However field adjustments of the EPR may be required at a later date, therefore horizontal units must be accessible from the top.

The expansion valve in the economizer loop may also need to be adjusted once the system is operating. Settings need to maintain approximately a 10 °F superheat after the heat exchanger.

The subcooled liquid to the cases is designed to be approximately 50 °F leaving the heat exchanger when vapor injection is activated. When liquid temperatures entering the subcooler fall to 55 °F, the T-STAT control in the unit will open and will de-energize the vapor injection solenoid, thus disabling vapor injection. The T-STAT control will re-energize the solenoid when the condensing temperature reaches 65 °F. Consult Engineering representative if adjustment of the T-STAT control is required.

FIELD PIPING & TXV SIZING

Besides standard discharge lines, the liquid return line from the condenser must also be piped back to the unit when remote air-cooled units are used with low temp cases.

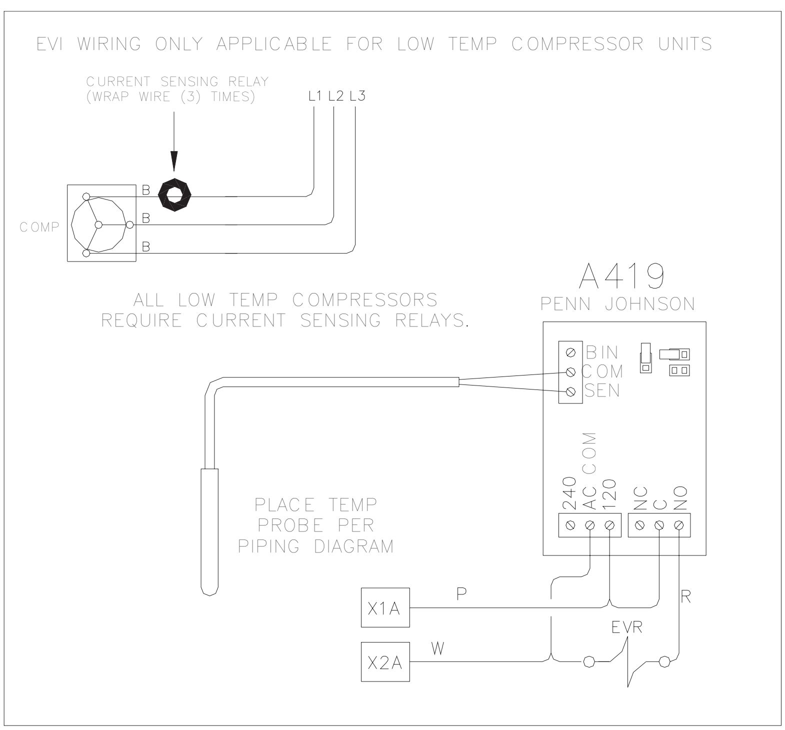
If the unit has low and medium temp suction groups, the protocol unit will have TWO liquid lines leaving the unit- one for medium temp cases and one for low temp cases. Only the liquid to the low temp cases will be subcooled to 50 °F. The liquid to the medium temp cases will be at the condensing temperature.

Units with low temp ZFKV compressors **must insulate** the liquid line to the low temp cases/ walk-ins coolers since the refrigerant is at a subcooled temperature. Also, suction line sizing should take into account the lower liquid temperature.

When expansion valves are selected for the cases, they should be sized for a liquid temperature of 50 °F due to subcooling.

SERVICE

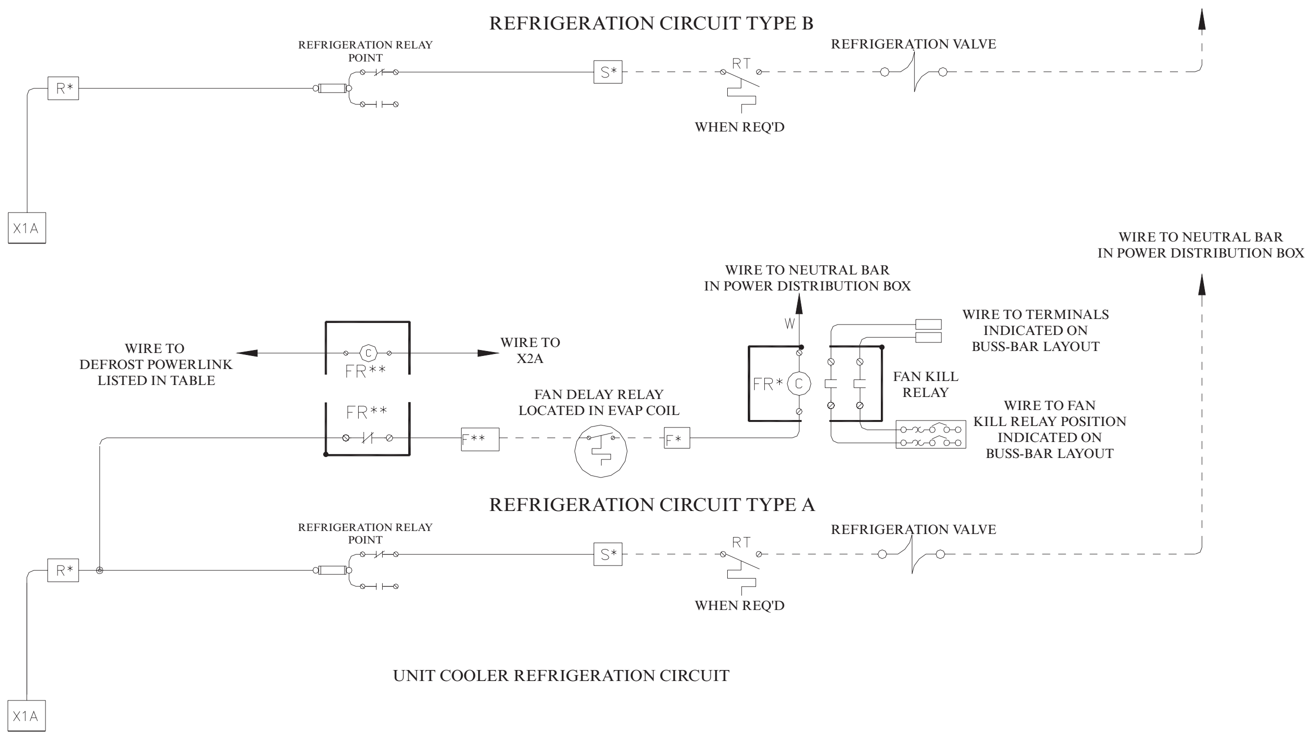
There is a shut off valve before the TXV for service of solenoids, the TXV, or the EPR in the Low Temp economizer loop. Shut off valves are also present at each compressor injection port.



Defrost Schedule

Refrigeration Circuit Control

The following circuits show the electrical connections during the refrigeration cycle. Power comes into the control board from X1A. The refrigeration solenoid valve and thermostat (if needed) are wired to the terminal pin. The unit cooler circuit is the same as a simple refrigeration circuit but it has an additional fan control circuit. The fan control circuit ensures that the fans will not turn on during the defrost cycle. It should be noted that off time defrost is achieved by turning the refrigeration valve off. For unit cooler fan wiring.



Defrost Circuit Control

Off time Sequence of Operation

Control Board energizes the Defrost Board Relay Coil, which open the Main Liquid Line Solenoid circuit.

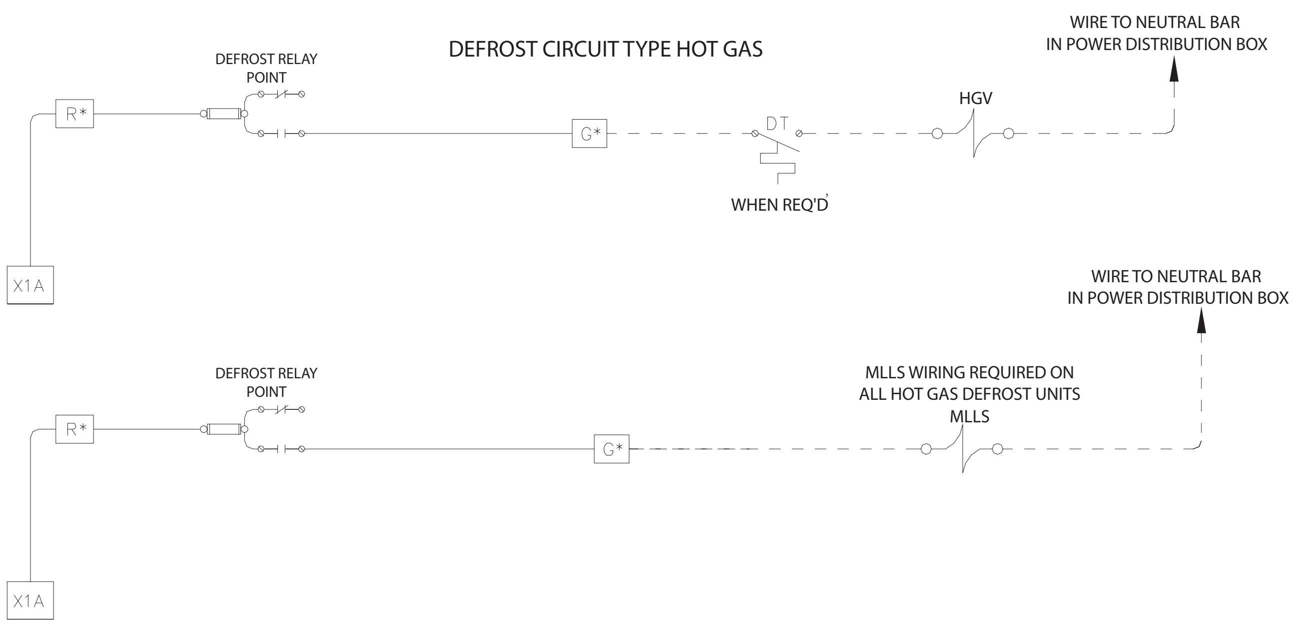
Main Liquid Line Valve closes. As evaporators empty, the compressors cycle off on Low Pressure.

Defrost may be time or temperature terminated.

Hot Gas

Control Board energizes the Aux Relay Coil, which de-energizes the Main Liquid Line Pressure Differential Solenoid. The valve reduces liquid supply line pressure. The Control Board also energizes the Defrost Relay coil, which open Hot Gas Solenoid valves and closes the Suction Solenoid valves. Each case terminates defrost through individual defrost termination thermostats, and goes into drip cycle until branch is timed off by the Control Board.

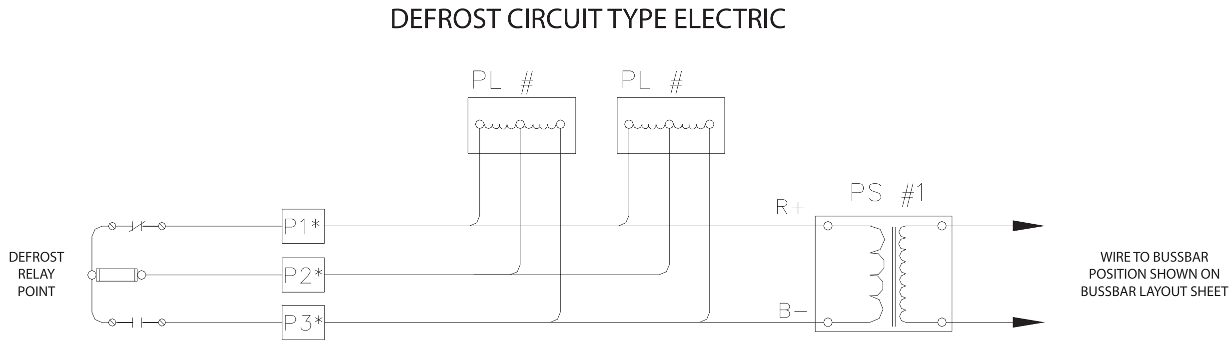
Note: Only 20% of the cases may be defrosted at once because of the requirement to keep a refrigeration load on the compressors to provide gas for defrost.



Electric Defrost

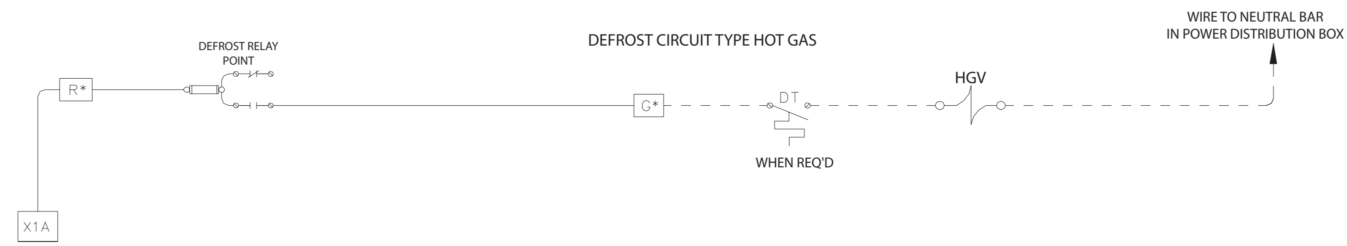
Control Board energizes two Defrost Board Relay Coils for each Defrost Circuit:

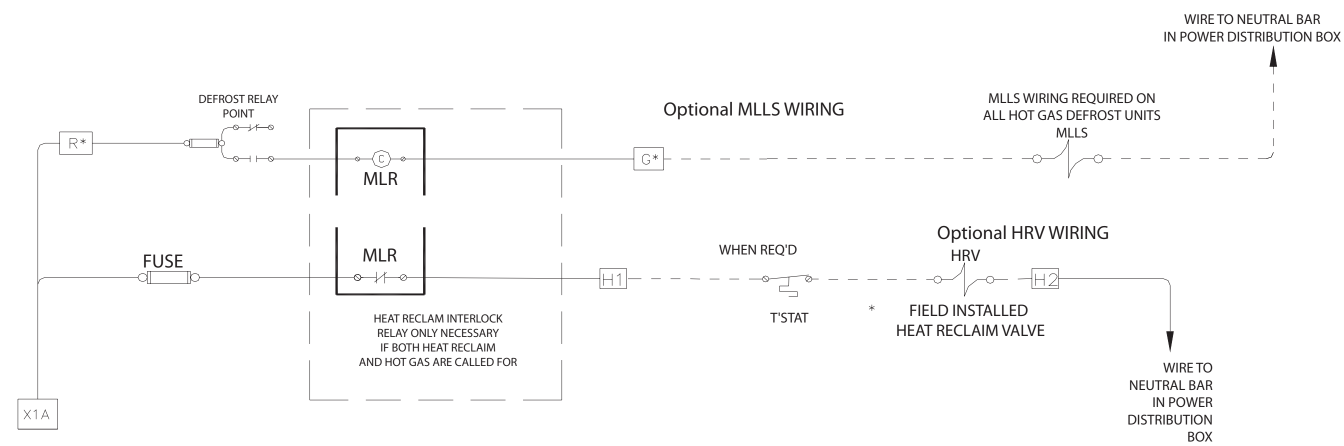
1) When the relay output is de-energized, the POWERLINK™ and heaters are also de-energized. Liquid line solenoids are open and refrigeration is active.
2) When the relay output is energized, the POWERLINK™ and heaters are energized while the liquid line solenoids are closed.
3) See POWERLINK™ operation diagram on Page 112. See Page 105 for further information on defrost operation.



Special Case of Heat Reclaim with Hot Gas Defrost

When you have the special case of heat reclaim with hot gas it is necessary to interlock the Main Liquid Line solenoid wiring with the heat reclaim valve wiring. This wiring will ensure that heat reclaim does not take place while defrost is occurring.

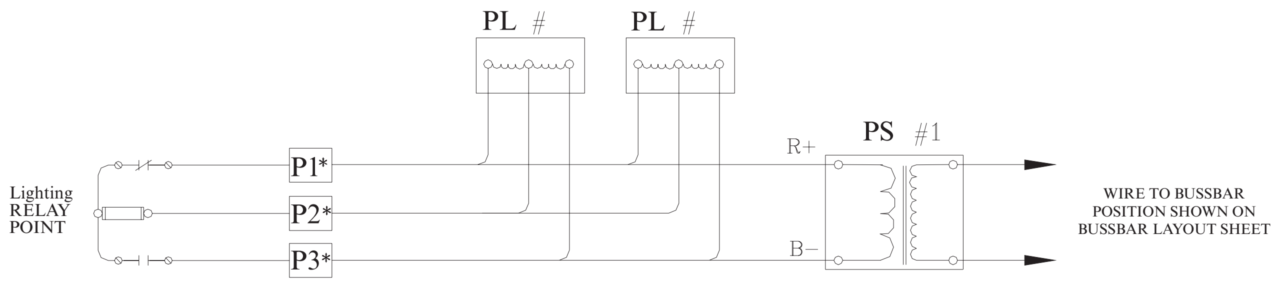




Lighting Control

Control Board energizes one output relay for each lighting circuit. Each lighting circuit has a schedule which determines when the output is turned on and when the output turns off.

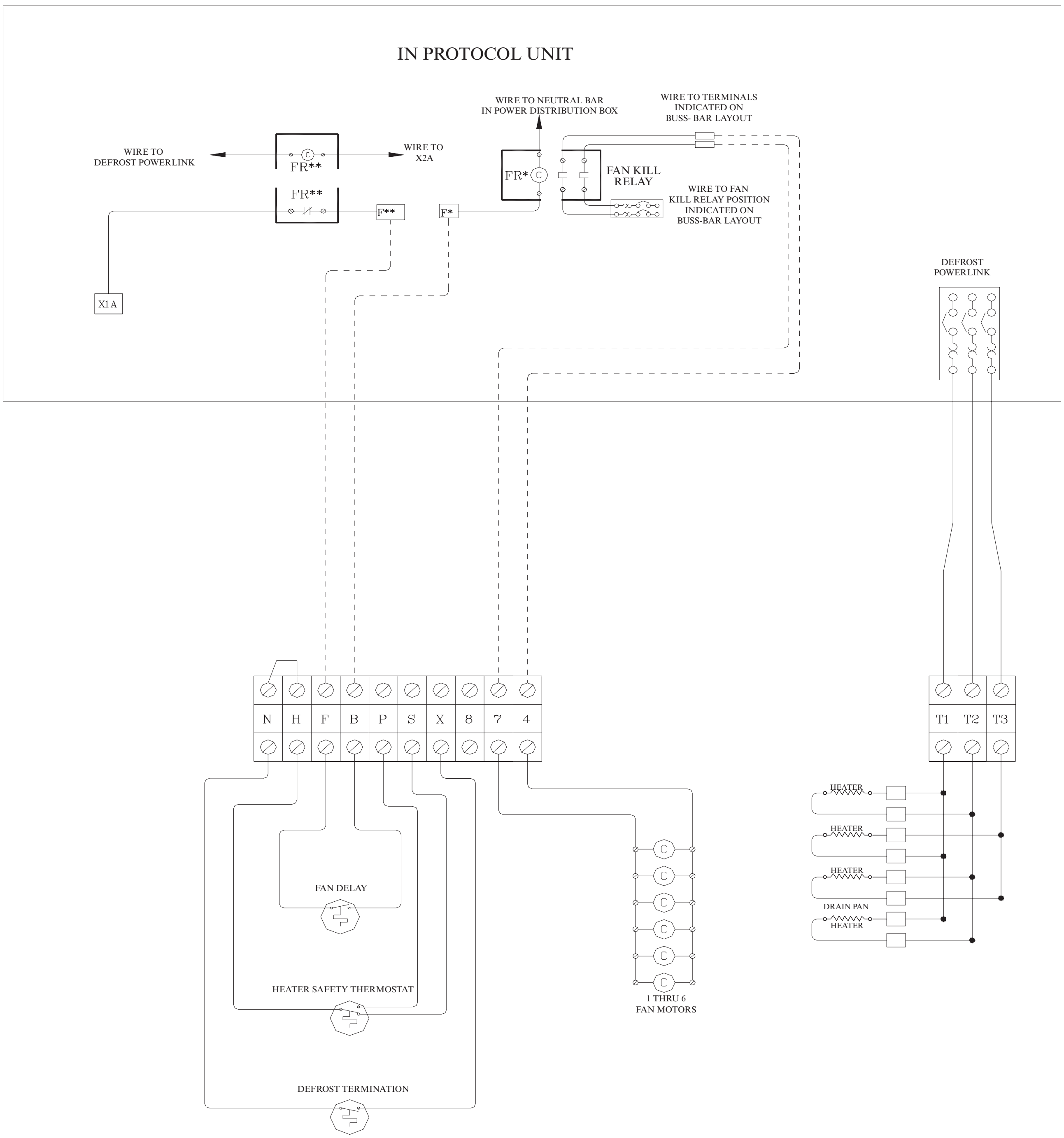
Lighting Relay Point



Unit Cooler Fan Wiring

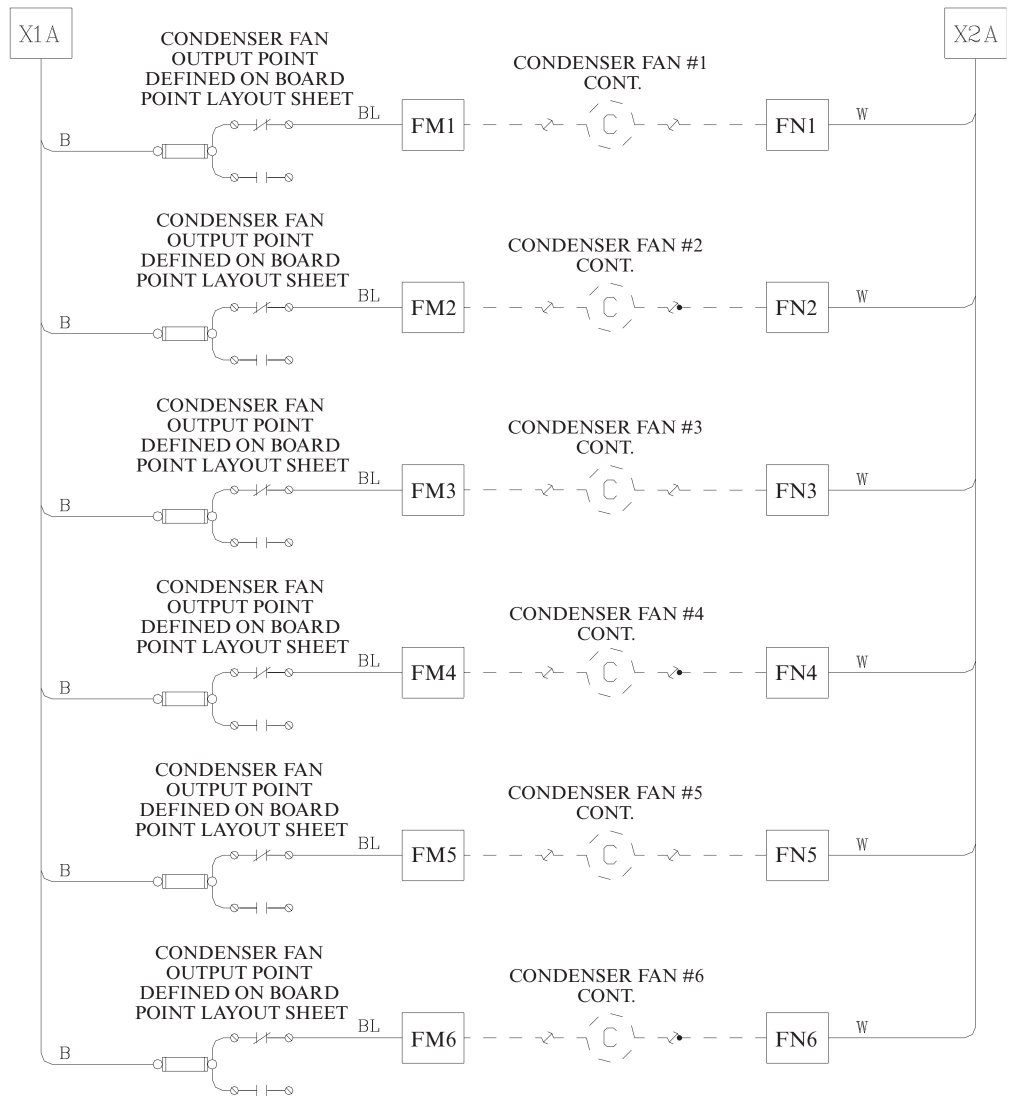
The following drawing shows the wiring to control the fans in a unit cooler. Defrost termination by Klixon may connect back to the controller relay board based on individual customer specs. See job specific board layout sheets and wiring diagrams for your individual installation.

Unit Cooler Fan Wiring



Protocol™ Remote Condenser Fan Wiring

The installer must wire the condenser fan to the terminal pin that corresponds to the correct board point in order to ensure proper control of the condenser fans. The following diagram shows the wiring for a typical Protocol™ with a remote condenser.



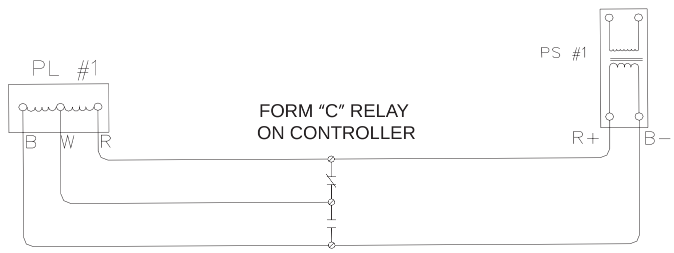
In the event that the condenser is ordered with control boards attached, these boards must be connected back to the controller with communication cable in a manner appropriate for the individual controller. The board addressing and the controller program should be checked to verify that the boards are addressed correctly and the controller is programmed to recognize the boards and control the condenser through them.

Proto-Aire™ Fan Wiring

The following diagram shows the fan electrical wiring present in a Proto-Aire™. At the bottom of the diagram the receiver and crankcase heaters are shown, which are common to each type of Proto-Aire™.

POWERLINK™ Operation

POWERLINK OPERATION



IN THE OPEN POSITION
NEGATIVE POTENTIAL IS
APPLIED TO THE WHITE
WIRE AND THE POWER
LINK TURNS ON.

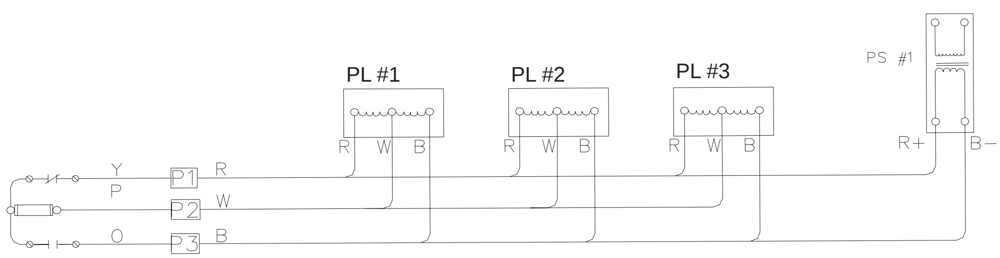
IN THE CLOSED POSITION
POSITIVE POTENTIAL IS
APPLIED TO THE WHITE
WIRE AND THE POWER
LINK SHUTS OFF.

WIRED IN THIS MANNER
THE ELECTRONIC CONTROLLER
CLOSES THE FORM "C" RELAY
WHICH TURNS THE POWER LINK(S)
ON, BEGINNING DEFROST.

AFTER DEFROST, THE CONTROL
POINT RETURNS TO THE OPEN
POSITION, DE-ENERGIZING THE
POWER LINK(S).

THE POWER LINK ACTS
LIKE A BREAKER IN THAT
ONCE IT TRIPS, IT HAS TO
BE MANUALLY RESET.

THEORY OF OPERATION



RO8 BOARD #2
OUTPUT #2

TYPICAL WIRING DIAGRAM FOR ELECTRIC DEFROST

RULES:

1.) MAXIMUM OF 5 POWER LINKS PER POWER SUPPLY.

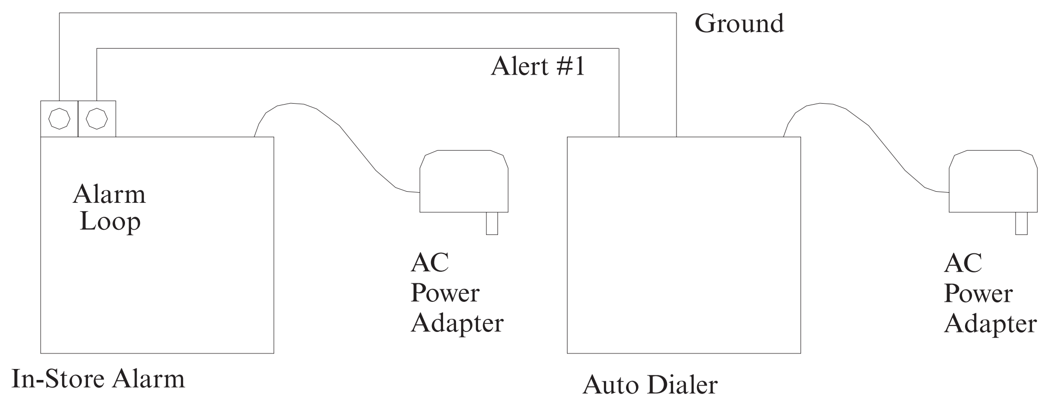
2.) ALL POWER LINKS FOR A CIRCUIT MUST BE ON THE SAME POWER SUPPLY.

Wiring Optional Auto Dialer and In-Store Alarm

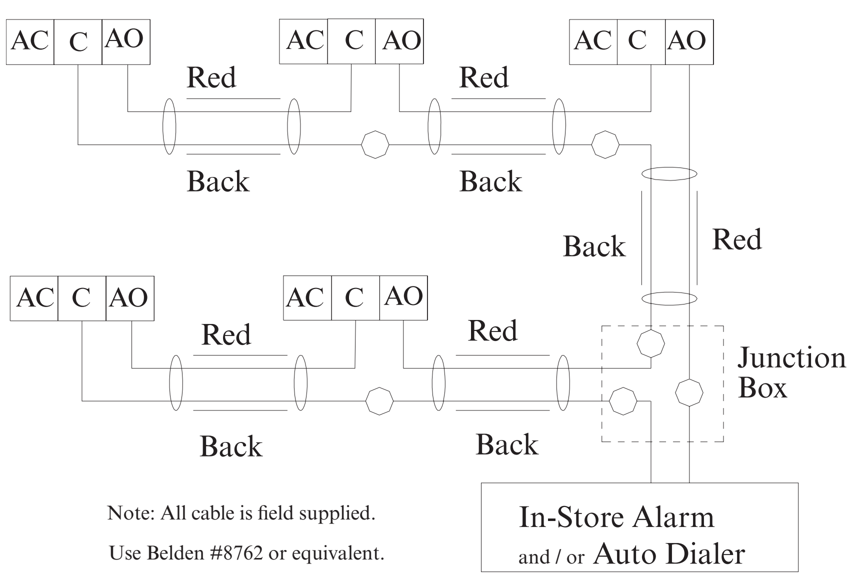
When the In-Store Alarm box and Auto dialer are used together, the correct method for wiring the alarm signals from each Protocol™ is a continuous current loop fed around the store. You will need to connect to the "COMMON" and "NORMALLY OPEN" alarm terminals located in the convenience switch box of each Protocol™ unit. See wiring diagram for proper connection methods.

IMPORTANT: The Paralleled connection between the In-Store Alarm box and the Auto Dialer is polarity sensitive. Follow the wiring connections shown.

Wiring Method
Auto Dialer and In-Store Alarm



Wiring Method
to Connect Alarm Loop



Startup

Important:	Since Hussmann has no direct control over the installation, providing freeze-burst protection is the responsibility of the installing contractor.

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. Note: SOME EQUIPMENT HAS MORE THAN ONE POWER SUPPLY.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent line when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.
The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig

Startup

The closed loop system and evaporative fluid cooler must be running before starting up any Protocol™ units.

Charging the Closed Loop

The closed loop may be filled through a large ball valve at the highest point in the system. Use a funnel when pouring or pumping the glycol into the loop. Water may be added with a hose. The funnel provides an air break, and ensures no glycol contamination of the water supply. Where the high point is not accessible, glycol must be pumped into the system. Water charging from a utility supply line will require anti-backflow equipment. (A simple check valve in the supply line is not sufficient.)

Vent trapped air. Place a towel around the vent valve to catch any liquid. Any valve and hose assembly used in venting should not be used for anything else. If the loop employs reverse return piping, open each circuit setter completely. For direct return piping, adjust the circuit setter proportionally for piping head loss and GPM requirements.

Start pumps individually just long enough to check for proper rotation. If pumps are running backwards, have the field connections corrected.

Periodically vent trapped air during startup.

Charging the Refrigeration Side

Leak Testing
Visually inspect all lines and joints for proper piping practices.

Open Power Supply
Compressors – Open circuit breakers to all compressors.

Isolate
Compressors – Front seat service valves on suction and discharge.

Pressure Transducers – Close angle valves.

Open
Valves – to condenser, heat reclaim, receiver.

Liquid Line Solenoid Valve(s) – Solenoid should be energized.

Verify
Refrigerant requirements for system, compressors, and TXV's in merchandisers and coolers.

Electrical supply and component requirements.

Test Charge
Using properly regulated dry nitrogen and refrigerant mixture, pressurize the system with vapor only. Bring the system pressure up to 150 psig. Use an electronic leak detector to inspect all connections. If a leak is found, isolate, repair, and retest. Be sure system is a 150 psig and all valves closed to repair the leak are re-opened. After the last leak is repaired and retested, the system must stand unaltered for at least 12 hours with no pressure drop from 150 psig.

Evacuation
Nitrogen and moisture will remain in the system unless proper evacuation procedures are followed. Nitrogen left in the system may cause excessive head pressure. Moisture causes TXV ice blockage, wax build up, acid, oil, and sludge formation.

Do not simply purge the system because this procedure is illegal, expensive, harmful to the environment, and may leave moisture and nitrogen.

Do not run the compressor to evacuate because this procedure introduces moisture into the compressors crankcase oil and does not produce adequate vacuum to remove moisture from the rest of the system at normal temperatures.

Setup
Using an 8 CFM or larger vacuum pump, connect to the access port on both the suction and discharge header of the Protocol™ unit. Connect one micron vacuum gauge at the pump, and one at the furthest point in the system from the compressor. Plan procedures so breaking the vacuum with refrigerant will not introduce contaminates into the system. The vacuum pump must be in good condition and filled with fresh oil to achieve desire results.

Procedure – Triple Evacuation

Pull a vacuum to 1500 microns. If the vacuum fails to hold, determine the cause and correct. Begin again and pull a vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig. Do not exceed the micron gauge transducer's maximum pressure surge to the transducer of the micron gauge.

Pull a second vacuum to 1500 microns.

Break the vacuum with refrigerant vapor to a pressure of about 2 psig.

Pull a third vacuum to 500 microns. Close vacuum header valves and allow system to stand for a minimum of 12 hours. If the 500 micron vacuum holds, charging may begin. If not, the cause must be determined and corrected. Repeat the entire evacuation procedure from the first step.

Pre-charge Check List
During any of the pull downs, check:

Merchandisers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting

Walk-in Coolers and Freezers
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper fan operation
- Thermostat setting

Water Loop
- Electrical requirements and power supply
- Electrical connections tight and clean
- Proper pump operation
- Proper fan operation
- Thermostat or pressure settings
- Damper operation, if equipped
- Protocol™ Water valves set properly

Heat Reclaim and Other Systems
- Electrical requirements and power supply
- Electrical connections tight and clean
- Component Operation

Refrigerant Charge
Remember the condenser in the Protocol™ holds only a small amount of refrigerant. It is therefore very easy to overcharge the Protocol™ unless care is taken during the charging process.

Charging until the liquid sight glass is clear of bubbles will often overcharge the system causing head pressure alarms.

Because the HFC refrigerants are less dense than the refrigerants they replace, they will tend to "flash" or bubble more easily, even when the correct charge is in the system. Therefore, charge only until the sight glass on the receiver is covered with refrigerant when the system is operating in a balanced refrigeration mode. Protocol™ units with gas defrost should also be monitored during defrost to ensure that the receiver does not completely empty. Add enough refrigerant, if necessary, to maintain a liquid seal on the receiver outlet if the receiver empties during defrost.

Oil Charge

Charge the Oil Separator with oil.

Use only Mobil EAL Arctic 22 CC, ICI Emkarate RL 32 CF, or Copeland Ultra 22 CC
Oil Separator is shipped without oil charge.

Oil Levels
Compressor top half of the sight glass
Oil Separator between the two sight glasses

Important Notice to the Installer
The compressors and the Turba-Shed must be closely monitored during startup because the POE oil does not return from the evaporators as quickly as mineral oil

Compressor Motor Rotation
To check compressor rotation, use the following procedure:

1. Install gauges on suction and discharge headers. Be aware of Satellite and Split-Suction Protocol™ units when making hookup. A momentary compressor run should cause a drop in suction pressure and a rise in discharge pressure.

2. With convenience switch ***OFF***, switch ***OFF*** all breakers in the control panel EXCEPT the control circuit breaker.

3. Turn ON convenience switch.

4. Look for the green light on the single-phase protector. If the light is red, turn ***OFF*** the convenience switch. All Protocol™ 3-phase wiring is connected L1 to T1, L2 to T2, and L3 to T3. Have the field connections corrected so the phase protector indicates phase alignment. (The light is green.)

5. Turn ***ON*** convenience switch.

6. Turn all compressors ON using the electronic controller.

7. Momentarily turn ***ON*** compressor breaker #1 and verify correct pumping direction. Check all compressors before switching any wires. If all compressors are rotating backwards, change two legs at the field side of the convenience switch. For individual compressor, change the Legs on the load side of the compressor contactor.

8. **Remove Forced Conditions**

Final Checks

Return Gas Superheat

Return gas superheat should be 10 to 30 °F on all units

Once system is up and running, it is the responsibility of the installer to see that all the final adjustments are made so the Protocol™ delivers maximum temperature performance and efficiency for the customer. These include:

Thermostatic Expansion Valve superheat adjustment
Electronic Pressure Regulator settings
Defrost scheduling and timing
Condenser flow balance
High and low pressure controls
Thermostat settings
Adjustments to electronic controls
Electronic oil level controls

Thoroughly inspect all field piping while the equipment is running and add supports where line vibration occurs. Be sure additional supports do not conflict with pipe expansion and contraction.

When merchandisers are completely stocked, check the operation of the system again.

At 90 days recheck the entire system, including all field wiring.

Caution

Never run the compressors in a vacuum as this may quickly damage the compressors.

Control Settings

High Pressure Safety – 395 psig
Vacuum Pressure Safety – 0 psig
Discharge Temperature Sensor – 240 °F

<u>It is mandatory that the mechanical low-pressure controls be set in the field</u>

Electronic Oil Level Control

Electronic oil regulators monitor oil levels. The units are powered by a 24V power supply. When the oil level in the compressor drops below ½ sightglass, the fill light comes on and the oil solenoid is energized. If after 90 seconds the oil level does not rise above ½ sightglass, the unit opens the compressor control circuit. If oil becomes available, the control will re-set and the compressor will resume operation.

Auxiliary Systems

This form of sensor inputs can be programmed for analog operation (case temperature sensor) or digital operation (such as Klixon). The auxiliary sensors are typically used to provide information to control regarding a particular defrost circuit. The auxiliary sensors can also be used to provide monitoring inputs from some external device; i.e. glycol temperature, computer room thermostat, or pump station alarm relay closure.

It is important to remember that the auxiliary sensors, when used to provide information regarding a particular defrost circuit, must be located in the correct defrost circuit lineup of cases. Sensor A1 can only be used on Defrost Circuit #1. Sensor A2 can only be used on Defrost Circuit #2. The same attachment of sensors to defrost circuits can be repeated for A3 through A6.

NOTE: In the following examples, the #( ) refers to a defrost circuit and/or Aux sensor # between 1 and 6. The same screens apply for all circuit and sensor attachments.

Temperature Termination (Digital Mode)

When an Auxiliary Sensor is used to connect a defrost termination thermostat (Klixon*) device to the control in order to terminate defrost on high temperature, the following information is required for proper operation.
(*No case temperature sensor present.)

Note: When temperature termination is Enabled, the control will automatically alarm on a non-defrost mode contact closure from the defrost termination thermostat device. It is assumed that while in refrigeration, the defrost termination thermostat (which is a close on rise device) should be open.

Temperature Termination (Analog Mode)

In some applications of the Protocol™, there are not enough inputs to provide all the information to the control for terminating defrost, alarming and monitoring purposes. When this is the case, a temperature sensor and a defrost termination thermostat can be wired in parallel at the case and then one cable run back to the Protocol™ control and connected Auxiliary input. Under this application, the temperature sensor is used to provide alarming and monitoring of discharge air while the defrost termination thermostat provides the termination input.

3-Pipe Gas Defrost

Application

3-pipe gas defrost is designed to operate with different defrost schedules and durations.

Only one lineup or no more than 20 percent of the load should go into defrost at one time. As a lineup goes into defrost, the other cases will be fed liquid from the Protocol™ and from the lineup in defrost. For longer lineups, or cases with large evaporator coils, partitions may be required to split these lineups into smaller sections. All the valves, gas solenoid and suction solenoid, are located in the cases and are controlled by the Protocol™. The main liquid differential valve is located in the Protocol™ on vertical units, and field installed on horizontal units. Isolation ball valves for each lineup branch are recommended for ease of servicing.

Defrost Operation

1. When a system goes into defrost, the liquid differential valve, located in the Protocol™ on vertical units and outside the Protocol™ for horizontal units, is de-energized allowing the valve to modulate at the desired setting of 15-20 lbs. (Note: higher settings may be required if the Protocol™ unit is located above the evaporators).
2. The control board will simultaneously switch the appropriate output relay for the defrosting circuit which will de-energize the suction solenoid and energize the hot gas solenoid allowing discharge gas to flow through the coil and return through the liquid line.
3. The defrost cycle can be either temperature terminated using a thermostat or time terminated. No drip cycle has been built in.

Electric Defrost

Application

Electric defrost is the same with Protocol™ as with any other system. The only exception is that POWERLINK™ type circuit breaker is used for the defrost loads. This breaker will provide overload protection, and also be the contactor that switches the defrost heaters on and off. Liquid solenoids should be used to control temperature and defrost for each circuit. This prevents a possible pump down problem. The defrost solenoid and POWERLINK™ breakers are controlled by independent output relays on the defrost board, but will be assigned (programmed) so the same defrost circuit so that they will be energized simultaneously. The amp draw for each circuit must be entered into the controller so that a defrost shedding of compressors can occur reducing the overall amp draw of the unit. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. The control board will de-energize the solenoid (suction or liquid) when a defrost occurs while simultaneously energizing the relay controlling the defrost breakers.

2. When the defrost relay is energized the POWERLINK™ breakers will receive a momentary charge or pulse from a capacitor in its POWERLINK™ Power Supply (PPS). The energized motor moves a push/pull rod similar to what might be found in a manual switch. A slight delay between the control circuit demand and the POWERLINK™ response will be noticed. This pulse switches the POWERLINK™ such that the heaters are now energized. At the termination of defrost, the PPS will receive another pulse, causing the POWERLINK™ to switch off.

Offtime Defrost

Application

Offtime defrost is the simplest defrost type. A relay is used to de-energize a solenoid valve at specific times. Suction stop solenoid valves should be used to control temperature on long lineups due to the limited receiver capacity. Isolation ball valves for each case lineup are recommended for ease of servicing.

Defrost Operation

1. To initiate a defrost, the control board will de-energize the specific circuit solenoid.

2. After the preset time for defrost has elapsed, the unit will energize the solenoid allowing normal refrigeration.

Sensor Applications

Suction Pressure Sensor
This suction pressure input provides the electronic controller the necessary information to cycle the compressors on and off to maintain an overall setpoint. You will need to program the following: Setpoint, High Alarm, Low Alarm, Range.

The high and low alarm settings provide a window of safe operation that the Protocol™ should operate within. If the suction pressure moves outside this margin of operation for more than 30 minutes, the control will default to switchback operation and control of the compressors will be passed to a low pressure mechanical switch mounted inside the Protocol™ cabinet.

Suction Pressure Input
This suction pressure input has a dual function. It can provide the electronic controller the necessary information to cycle the compressors on and off under a split suction configuration, or it can be used to monitor the discharge pressure. If the input is used to monitor discharge pressure, you will need to program the following: High Alarm, Low Alarm, and Range (typically 500 psi).

Under split suction configuration, this input provides the electronic controller pressure signal used to cycle compressors on and off. The split suction configuration may contain multiple compressors (2 or more) or a single compressor (low or high end satellite). When two or more compressors are attached to the second suction header, you will need to program the following: Split Suction Operation (Enabled/Disabled), Number of Compressors, Split Suction Setpoint, High Alarm, Low Alarm, Range.

If only a single compressor is used (Satellite configuration), you will need to program the following: Satellite Operation (Enabled/Disabled), Satellite Setpoint, Satellite Differential, High Alarm, Low Alarm, Range.

Temperature Input

This temperature input has a dual function operation: 1) temperature input for Suction Pressure Reset feature or 2) alarming and monitoring of temperature for a display case. The Suction Pressure Reset function allows the suction pressure setpoint to float upward to reduce compressor energy consumption. The temperature sensor used with the Suction Pressure Reset function alls a setpoint to be entered for a specific display case, normally the case containing the evaporator with the lowest suction temperature. When the temperature in this case is satisfied, the suction pressure setpoint will increase by 1 psi. The following information should be programmed into the control: Suction Pressure Reset (Enable/Disable), Suction Pressure Reset Setpoint, High Alarm, Low Alarm.

When this temperature input is used to monitor and alarm on temperature of a given display case, the following information should be used: High Alarm, Low Alarm, Alarm Activation (Enabled/Disabled), Alarm Delay, Circuit Attachment.

All Additional Pressure/Temperature Inputs

This temperature input has a dual function operation: 1) pressure input for monitoring discharge pressure or 2) alarming and monitoring of temperature for a display case. Since this input can operate as a temperature or pressure, you will need to configure both the hardware (input circuitry) and software (memory settings) for proper operation. When operating as a pressure input, the following should be programmed: Input mode (Set to pressure), High Alarm, Low Alarm, Alarm Activation (Enable/Disabled).

When operating as a temperature input, the following should be programmed: Input mode (Set to temperature), High Alarm, Low Alarm, Alarm Activation (Enable/Disabled), Circuit Attachment.

Programming the Optional In-store Alarm and Auto Dialer

All alarm wiring (refer to Electronic section) must be complete before beginning the programming of the alarm dialer. The Protocol™ units and any other equipment connected on the alarm connection must not be in alarm. This normal operation state is used to allow the auto dialer to preset the non-alarm condition present on the alert inputs.

IMPORTANT: Make sure that the auxiliary batteries if required for the auto dialer are inserted before beginning programming information within the auto dialer's memory.

1. Program the ID# for the Auto Dialer. This ID# will be used to indicate which store is in alarm. If the customer wishes the auto dialer to be muted during the verbal alarm message, the MUTE key must be pressed first and then the store ID# will follow (see page 21 and 22 in Owners Manual).

2. Next, program one or all of the available phone numbers that will be dialed during an alarm condition. You will need to know if the store telephone system uses “Tone” or “Pulse” dialing (see page 15 and 16 in the Owners Manual). You will also need to include any prefix number when required, for gaining access externally through the telephone system (i.e. 9, 555, 1212).

3. Preview the above programming information by pressing the “What is” key and then the item you wish to preview.

Recommended Phone Number Programming

In many cases, it is advantageous to program the store as the first phone number dialed. This helps to avoid nuisance alarms and allows the store manager to take appropriate action during normal store hours. The second and subsequent phone numbers should be programmed to dial a phone answering service, personnel home number or answering machine, or pager. The choice and decision of phone numbers is at the customer’s discretion.

Troubleshooting Guide

This section is to aid in the troubleshooting of electrical and electronic considerations of the Protocol™ Refrigeration System. The manual assumes that the reader has a working knowledge of the electronic controller communications platform used in networking the Protocol™ Electronic controls. It will be necessary to have a copy of the control manuals on hand to facilitate the troubleshooting process.

The structure of this troubleshooting guide is based on a Question/Answer format. In most cases, the electronic controller will be used to determine whether the problem lies within the electronic control, or external to the control – most likely contained in the control panel. You will need to follow the instructions carefully to ensure a quick method of solving the problem or question.

IMPORTANT

The current draw required by analog meters (Volt-Ohm Meters or VOMs) **can permanently damage electronic equipment.**

Never use a VOM to check computer components or computer controlled systems. Use a Digital Multimeter (DMM) to measure voltage, amperage, milliamperes, or ohms. If a range is exceeded, the display will show OL (overload).

Electrical Questions

Problem A: The compressor will not turn **ON** or will not run.

Step A1 Visually observe if the Alarm on the control board is **ON**. If it **ON**, go to step A2. If it is **OFF**, go to Step A9.

Step A2 Access the protocol and enter the Force Comp On submenu. Enter the compressor number you wish to turn ON. Visually observe if the correct compressor relay output LED on the control board is turned ON. If turned ON, go to Step A3. If it does not turn ON, go to step A7.

Step A3 If the compressor contactor is energized, verify that the compressor turned ON by cycling the compressor circuit breaker (the compressor should turn ON and OFF with the circuit breaker) or use an amp probe and measure all three phase wires between the contactor and the compressor. If the compressor contactor did not energize, go to Step A6.

Step A4 If the compressor contactor energized, but the compressor cannot be cycled with the circuit breaker, you will need to open up the compressor terminal box located on the side of the compressor, and ensure that the power wires are tightened down. **Important: you should turn the compressor circuit breaker off before implementing this check.**

Step A5 If the compressor wires are tight with the terminal box, the compressor may be damaged internally and may need to be replaced.

Step A6 Problem appears to be located in the control circuit wiring, most likely in one of the safeties. Referring to the supplied customized wiring diagram, use a digital voltmeter and determine where the circuit is being broken. The control circuit originates from the phase monitor, passes through the control board safety switch, the discharge line thermostat, and finally through the electronic oil level control safety.

Step A7 If you cannot force the compressor ON through the controller parameters:

1. No electric defrost is currently engaged. Electric defrosts implement a compressor shedding routine, which may be keeping the particular compressor you want to energize off-line.
2. The correct number of compressors is installed.
3. Check that the suction pressure is not below 2 psi activate the vacuum prevention routine which will not allow the compressors to turn ON.

Step A8 If the preceding parameters check out, you may need to replace the electronic control board.

Step A9 At this point, it is assumed that the electronic control board is in switchback (see page 6-6 for details describing switchback). If the compressor you are trying to turn ON is not wired to the switchback control circuit (refer to the supplied customized wiring diagram), you will need to investigate the cause of this switchback condition and correct the existing problem.

Step A10 If the compressor you are trying to turn ON is wired into the switchback control circuit, use a digital voltmeter and determine where the circuit is being broken. The switchback control circuit originates from the phase monitor, passes through the switchback relay on the control board, through the low pressure mechanical backup switch, then back through the control board relay and fuse, through the high pressure safety switch, the discharge line thermostat and finally through the electronic oil level control safety.

Problem B: Evaporator is not defrosting.

Step B1 Visually observe if the Alarm Relay LED on the control board is ON. If LED is ON, got to step B2. If LED is OFF, refer to the Troubleshooting Alarms section of this document.

Step B2 Verify that the Clock contained in the Protocol is keeping time. Access and select the Set the Clock submenu. If the clock is running, go to step B3. If the clock is not running, try changing the time to the correct setting. You may want to consult the section on Electrical Noise contained within this manual.

Step B3 Enter the defrost circuit number you wish to turn ON and activate it. Now exit and go to the Defrost Menu. Observe the circuit you forced into defrost. If the status indicates defrost proceed to Step B4. If the status does not indicate defrost, go to Step B7.

Step B4 Visually observe which defrost relay located on the defrost board is energized. The corresponding indicator light on the defrost board should be ON. If the indicator light is ON, proceed to Step B5. If the indicator light is OFF, proceed to Step B10.

Step B5 At this point, we have assumed that the control is responding correctly and the problem lies within the control panel. Use a digital voltmeter to check that voltage is present at the correct terminal blocks in the power distribution box. You will need to refer to the supplied customized wiring diagram to determine which terminal blocks are providing power for the particular case load you are defrosting. If voltage is present at the terminal blocks, verify that the case is in defrost by visual inspection and then return to Step B6. If voltage is not present at the terminal blocks, go to Step B11.

Step B6 If the status of this defrost circuit indicates it is deactivated, reactivate the circuit and verify the programming of this circuit as outlined in controller manual. If the status of this defrost circuit indicates that it is not installed, N/A, go to the Protocol™ configuration menu and access the Protocol Setup submenu. Enter the DEFR Setup program the control with the correct number of defrost circuits. Repeat this step to verify that the circuit is activated.

Step B7 Verifying the defrost circuit configuration. Check the number of defrosts per day, the defrost length and defrost start times to ensure proper configuration. Go to Step B9.

Step B8 Verifying the Defrost Output Assignments. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. Now that all programming information has been verified, return to Step B3 to force the defrost on.

Step B9 Verifying the Defrost Output Assignments. Verify that the correct output(s) have been assigned to the appropriate defrost circuit. If the correct outputs have been assigned, and the status reveals the circuit is in defrost, and check the ribbon cable between the control board and defrost board. Try replacing the ribbon cable with one from another Protocol™ to verify they cable is good or bad. If the cable is good, replace the control board. The defrost output drive chip has possibly been damaged. If the correct outputs have not been assigned, enter the correct programming and repeat this step.

Step B10 Electrical Wiring Check. Use a digital voltmeter to verify where the circuit is being broken. Power for defrost solenoids originates from the 'X1' terminal block, passes through the fuse relay located on the defrost board, and ends at the terminal block located in the power distribution block. If the fuse on the defrost board has blown, try replacing it with another fuse and repeat the voltage checks.

For electric defrosts, a minimum of two defrost outputs will be used for defrost: one for the solenoid and one for the defrost heaters. The power for the solenoid can be checked as described previously in this step. To verify the defrost heater wiring go to Step B12.

Step B11 POWERLINK™ wiring. You may want to first familiarize yourself with information on POWERLINK™ Operation as detailed in this manual. Visually inspect that the circuit breaker handles of the POWERLINK™(S), located on the bus bars within the control panel, are in the ON position. If the handle is in the ON position, use a digital meter and check for voltage at the terminals of the POWERLINK™ device and again at the terminal blocks in the power distribution panel. If voltage is not present at these two points, got to Step B13.

Step B12 POWERLINK™ Power Supply Check. Using a digital meter, inspect the POWERLINK™ Power Supply, which provides power for the POWERLINK™ device. Set your digital meter for DC voltage. There should be 24 VDC across the terminals of the POWERLINK™ Power Supply. If 24 VDC is not present, replace the POWERLINK™ Power Supply. If 24 VDC is present, go to Step B14.

Step B13 Check fuse on defrost relay board. Replace fuse if it is blown. If fuse is good, measure the voltage present at the white connector on the defrost relay board. Place the positive test lead of you meter (typically the red wire) on the normally open (N.O.) contact of the defrost relay board connector. Place the negative test lead of your meter (typically the black wire) on the common (COM) contact of the defrost relay board connector. Your digital meter should read +24 volts DC. If +24 volts DC is present, the POWERLINK™ Device must be replaced. If +24 volts DC is not present, verify that wiring is correct as compared with the supplied customized wiring diagram.

Problem C: Pressure transducer is not reading properly.

The transducer cable is shielded and should not have the bare drain wire attached to door panel liner. The mechanical ground connection is achieved through the threaded fitting on the suction and/or discharge header.

Step C1 Use a service gauge to verify the actual pressure reading. If the pressure reading of the gauge and the reading of the Hand-Held controller is more than 2 psi, check the pressure transducer offset, which is available on the electronic control.

Step C2 Verify that the transducer range is set properly. Select the pressure input you are currently having problems with and observe the transducer range. Suction transducers should be selected for a 200 psi range while discharge transducers require a 500 psi range. If the range is not set properly, make the programming change and reevaluate the transducer. If the range is set properly, go to Step C3.

Step C3 Use a digital volt meter with the scale set for DC volts to measure the excitation voltage and signal voltage of the transducer.

Step C4 If the excitation voltage is not within the limits set by the controller manufacturer.

Step C5 If the pressure reading, as indicated by the above formula matches the reading of the Hand-Held Device replace the transducer. If the pressure reading, as indicated by the above formula does not match the reading of the Hand-Held Device, replace the control board.

Step C6 Use a digital voltmeter to measure the control transformer secondary voltage. With the scale of your meter set for AC volts, remove the power plug connected to the Protocol™ control and place your test leads of the meter to the two outside pins. The voltage present at these two pins should be between 20 and 27 VAC. If the secondary voltage is within limits replace the control board. If the secondary voltage is out of limits, investigate supply voltage to the control transformer.

Problem D: Temperature Sensor is not reading properly.

The temperature sensor used on Protocol™ is typically used to sense discharge air temperatures at the evaporator load. The sensor contains a NTC (Negative Temperature Coefficient) thermistor, which will increase resistance as temperature falls and decrease resistance as temperature rises.

Trouble Shooting Alarms

The following section gives information on diagnosing specific alarms. The first step in analyzing alarms is to determine when the alarm occurred. The alarms will appear in the controller. The cause, time and date of the alarm will be shown.

There are two types of alarms: switchback and non-switchback. A switchback alarm is normally the result of some external failure as seen or interpreted by the electronic control. When a switchback alarm occurs, the electronic control removes itself from control of the compressors. Operation and cycling of the compressors will be controlled by a low pressure mechanical switch located inside the Protocol™ system, which will cycle one half of the compressors. The indication of alarm will be dependent upon which alarm device has been installed: auto dialer, in store alarm or computer system. Note that under a switchback alarm no defrosts will occur. There are three types of switchback alarms: (1) High Suction Pressure, (2) Low Suction Pressure or (3) All compressors off for more than 60 minutes.

All other types of alarms fall under the “non-switchback” category, such as high discharge temperatures. The control will continue to cycle compressors and manage defrosts under this category of alarms.

Alarm: **High Suction Pressure**

This alarm is one of the three “switchback” alarms. The time delay for this condition is 30 minutes. High suction pressures are ignore during defrosts.

Possible Causes
One or more compressors are operational.
High alarm limit is not set properly.

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm.

Step 2 Proceed to the Status Menu for this Protocol™. Observe the operation of compressors turning ON, and watch for suction pressure to come down. If the suction pressure does not come down when a compressor comes on, it is an indication that some external device is keeping the compressors off line (high pressure safety, oil safety, phase monitor, etc.) You will need to go to this Protocol™ and investigate whether or not compressors are running.

Alarm: Low Suction Pressure

This alarm is one of the three "switchback" alarms (See the paragraph describing switchback). The time delay for this condition is 30 minutes. Low suction pressures are ignored during defrost.

Possible Causes:
Low Refrigerant Charge
Low Alarm Limit is Not Set Properly

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm. Press the DEL key to remove the current alarm condition.

Step 2 Proceed to the Protocol™. Observe the operation of compressor turning ON, as indicated by X's. The Protocol™ should begin to operate the compressors and suction pressure should be maintained. If this does not occur you will need to further investigate the Protocol™ operation.

Alarm: All Compressors Off

This alarm is one of the three "switchback" alarms (See the paragraph describing switchback). The time delay for this condition is 60 minutes. When the electronic control has not turned on a compressor for one hour, this alarm will be triggered. This condition exists when the suction pressure, as read by the electronic control is above the low alarm limit and below the suction pressure setpoint.

Possible Causes:
An external influence has turned ON one or more compressors
Faulty reading from the pressure transducer

Step 1 Enter the Alarm Menu. Observe the time and date of the alarm. You will be prompted as to whether or not you want to clear the current alarm.

Step 2 Proceed to the Protocol™. Observe the operation of compressors turning ON, as indicated by X's. The Protocol™ should begin to operate the compressors and suction pressure should be maintained. If this does not occur you will need to further investigate the Protocol™ operation.

Service and Maintenance

IMPORTANT: Since Hussmann has no direct control over the installation, providing the freeze-burst protection is the responsibility of the installing contractor.

Know whether or not a circuit is open at the power supply. Remove all power before opening control panels. Note: Some equipment has more than one power supply.

Always use a pressure regulator with a nitrogen tank. Do not exceed 2 psig and vent lines when brazing. Do not exceed 350 psig for leak testing high side. Do not exceed 150 psig for leak testing low side.

Always recapture test charge in approved recovery vessel for recycling.

The Water Loop should be tested for leaks using pressurized water.
DO NOT exceed 75 psig.

Service

Compressor Replacement

Before beginning removal of old compressor prepare replacement compressor as follows:

Verify

- Replacement compressor
  - Electrical requirements
  - Refrigerant application
  - Capacity
  - Piping hookup location and design
  - Suction and discharge gaskets
  - Mounting requirements

Have compressor in an easily accessible position, uncrated and unbolted from shipping pallet.

Disconnect Electrical Supply

Turn off motor and control panel power supplies to the Unit.

Turn off control circuit and open all compressor circuit breakers.

Tag and remove electrical wires from the compressor.

Isolate Compressor

Frontseat Suction and Discharge Service Valves.
Bleed compressor pressure through both discharge and suction access ports into an **approved recovery vessel.**

Remove externally mounted components that will be re-used on the replacement compressor.

Remove suction and discharge rotolocks.

Remove mounting bolts.

Plug holes per compressor manufacturer's specifications.

Install the new compressor in reverse order of removal. Do not open the new compressor to the system until the system has been leak tested and triple evacuated.

Replacing Drier

Shut down the system. Isolate the Drier to be replaced and bleed off pressure into an **approved recovery vessel**. Replace. Pressurize, leak test and bring back on line.

Recommended Maintenance

Hussmann recommends the following maintenance for Protocol™ systems:

Twice a Month

1. Review store operating data.
   a. Graph the various temperatures and pressures for each unit; look for unusual trends.
   b. Look through the alarm menu of each unit.

Every Six Months

1. Check water strainers at each unit. Clean as necessary.
2. Go through Protocol™ Checklist. See sample on next page. You should duplicate the blank checklist for your use. File the completed checklists for future reference.
3. Check and keep a record of pumping station inlet and outlet pressures.
4. Review maintenance logs. ALL service must be logged.

Every Year

1. Check freezing point of glycol in closed loop; add water or glycol as required.

2. Replace Liquid, Oil, and Suction Filters.

3. Check the Alarm functions on the pumping station. The low fluid pressure, high fluid temperature, and automatic pump switching functions should be checked.

4. If equipped with air-cooled condenser, inspect and clean as necessary.

Every Two Years

Sample the closed loop fluid and have it analyzed. If this fluid contains a Dow product (Dowtherm or Dowfrost), Dow can perform the analysis. Call Dow at 1-800-447-4369 and ask for a fluid sampling kit.

Use only Mobil EAL Arctic 22 CC, ICI Emkarate RL 32CF, OR Copeland Ultra 22 CC. Oil Separator is shipped without oil charge. **Oil Levels** Compressor – top half of the sight glass. Oil Separator – between two sight glasses.

Sample Protocol™ Checklist

Store: Joe's Market	Location: Anytown, USA
Date: 6/7/2004	Time:
Unit	K
Model Number	PH06PK-MEMEMEMEMEMF
Serial Number	
Factory Order Number	06542
Manufacture Date	08/31/98
Defrost	

Circuit NO.	1	2	3	4	5	6	7	8
Type	Off	Off	Off	Off	Off	Off		
No./Day	4	3	3	2	1	3		
Length	40m	45m	45m	45m	60m	45m		

Superheat	42°
Suction Set Point	52 psig
Suction Pressure	52.0 psig / 17°F Saturated
Suction Temperature	59 °
Split/Satellite Superheat	
Suction Set Point	
Suction Pressure	
Suction Temperature	
Oil	POE
Oil Separator	Between Glasses
Pressure Differential	
Condenser	
Head Pressure	214.9 psig
Water Temperature In	OK
Water Temperature Out	OK
Refrigerant	404a
Receiver Level	
Liquid Sight Glass	Foamy

Compressor No.	1	2	3	4	5	6
Model No.	ZF13K4	ZH13K2	ZH13K2	ZH13K2	ZF13K4	ZF15K4
Discharge Temperature	173	166	166	165	162	165
Amp Draw	10.2	10.7	10.8	11.2	10.2	12.5
Shell Temp at Oil Connect	hot	hot	warm	warm	warm	warm
Float or Oil Connect	¾	full	7/8	3/4	1/2	full

Oil Control Magnet Cond.	
Controller	
Alarms	
Time & Date Displayed	

Notes: L.L. Filter changed
All valves adjusted. 4 PEXH4s, 2 C-store Reach Ins, 1 ND5 would not adjust
Removed T-stats from PEXH4s, ND5s, and DM.
Raised suction S.P. from 48 psig to 52 psig. All PEXH4s cleaned. 1-2 inches of slime grew there

Protocol™ Checklist								
Store:	Location:							
Date:	Time:							
Unit								
Model Number								
Serial Number								
Factory Order Number								
Manufacture Date								
Defrost								
Circuit NO.	1	2	3	4	5	6	7	8
Type								
No./Day								
Length								
Superheat								
Suction Set Point								
Suction Pressure								
Suction Temperature								
Oil								
Oil Separator								
Pressure Differential								
Condenser								
Head Pressure								
Water Temperature In								
Water Temperature Out								
Refrigerant								
Receiver Level								
Liquid Sight Glass								

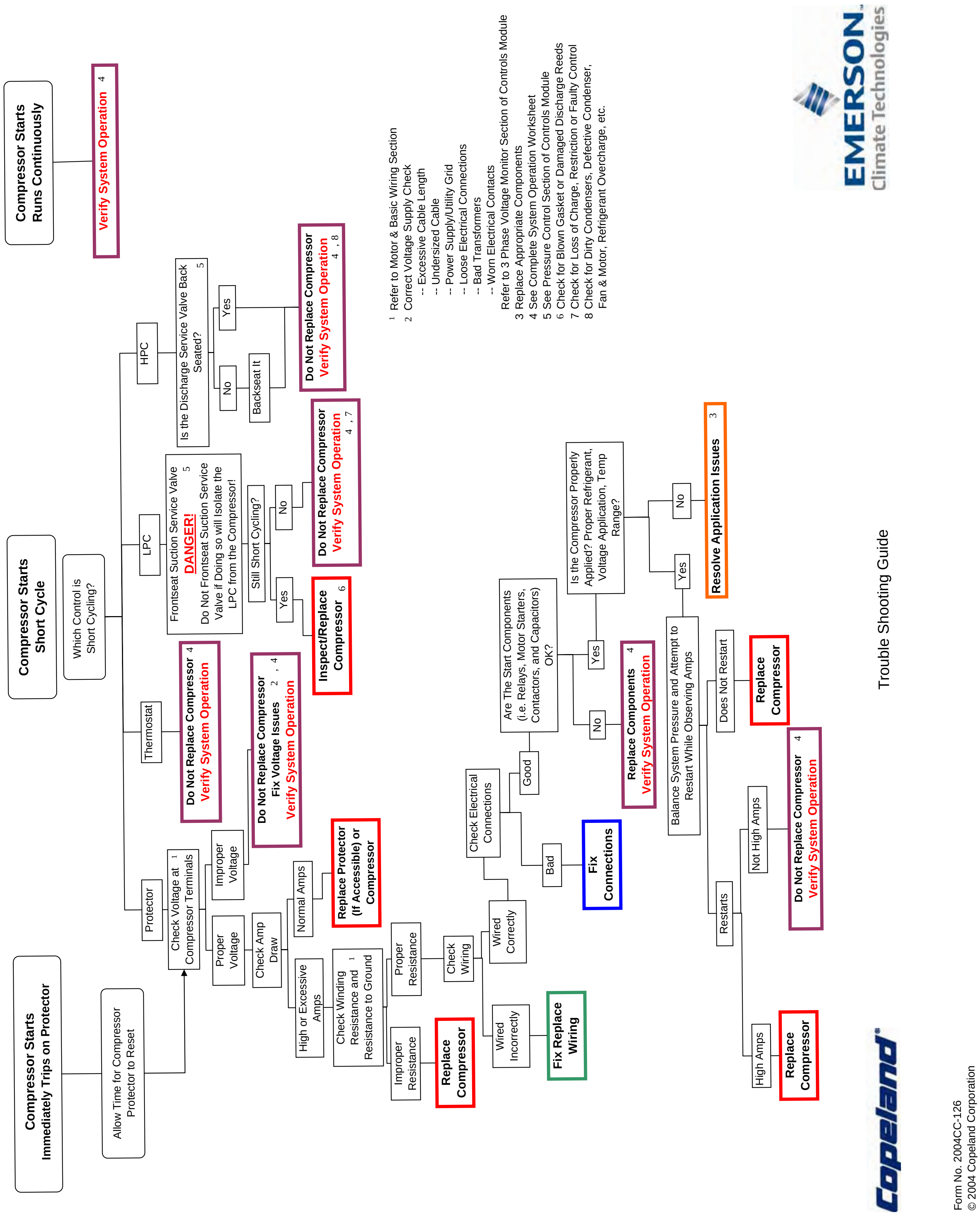
Compressor No.	1	2	3	4	5	6
Model No.						
Discharge Temperature						
Amp Draw						
Shell Temp at Oil Connect						
Float or Oil Connect						
Oil Control Magnet Cond.						
Controller						
Alarms						
Time & Date Displayed						
Notes:						

TROUBLE SHOOTING GUIDE

SPORLAN
http://www.sporlanonline.com

EMERSON
Fault Finder app
http://www.emersonclimate.com/en-us/Resources/Mobile_Apps/Pages/mobileapps.aspx

SQUARE D HOTLINE
888-SQUARED (888-778-2733)
Tech Support Line. Level One provides product initial Tech Support and can connect the Caller to Level 2, if required.


Compressor Starts Immediately Trips on Protector
Allow Time for Compressor Protector to Reset
Check Voltage at Compressor Terminals 1
Proper Voltage
Improper Voltage
Check Amp Draw
High or Excessive Amps
Normal Amps
Check Winding Resistance and Resistance to Ground 1
Improper Resistance
Proper Resistance
Replace Compressor
Replace Protector (If Accessible) or Compressor
Check Wiring
Wired Incorrectly
Wired Correctly
Fix Replace Wiring
Check Electrical Connections
Bad
Good
Fix Connections
Are The Start Components (i.e. Relays, Motor Starters, Contactors, and Capacitors) OK?
No
Yes
Replace Components Verify System Operation 4
Is the Compressor Properly Applied? Proper Refrigerant, Voltage Application, Temp Range?
Yes
No
Resolve Application Issues 3
Balance System Pressure and Attempt to Restart While Observing Amps
Restarts
Does Not Restart
High Amps
Not High Amps
Replace Compressor
Do Not Replace Compressor Verify System Operation 4
Compressor Starts Short Cycle
Which Control is Short Cycling?
Protector
Thermostat
LPC
HPC
Do Not Replace Compressor Verify System Operation 4
Do Not Replace Compressor Fix Voltage Issues 2, 4 Verify System Operation
Frontseat Suction Service Valve 5
DANGER!
Do Not Frontseat Suction Service Valve if Doing so will Isolate the LPC from the Compressor!
Still Short Cycling?
Yes
No
Inspect/Replace Compressor 6
Do Not Replace Compressor Verify System Operation 4, 7
Is the Discharge Service Valve Back Seated? 5
No
Yes
Backseat It
Do Not Replace Compressor Verify System Operation 4, 8
Compressor Starts Runs Continuously
Verify System Operation 4
1 Refer to Motor & Basic Wiring Section
2 Correct Voltage Supply Check
-- Excessive Cable Length
-- Undersized Cable
-- Power Supply/Utility Grid
-- Loose Electrical Connections
-- Bad Transformers
-- Worn Electrical Contacts
Refer to 3 Phase Voltage Monitor Section of Controls Module
3 Replace Appropriate Components
4 See Complete System Operation Worksheet
5 See Pressure Control Section of Controls Module
6 Check for Blown Gasket or Damaged Discharge Reeds
7 Check for Loss of Charge, Restriction or Faulty Control
8 Check for Dirty Condensers, Defective Condenser, Fan & Motor, Refrigerant Overcharge, etc.
Trouble Shooting Guide
Copeland
EMERSON Climate Technologies
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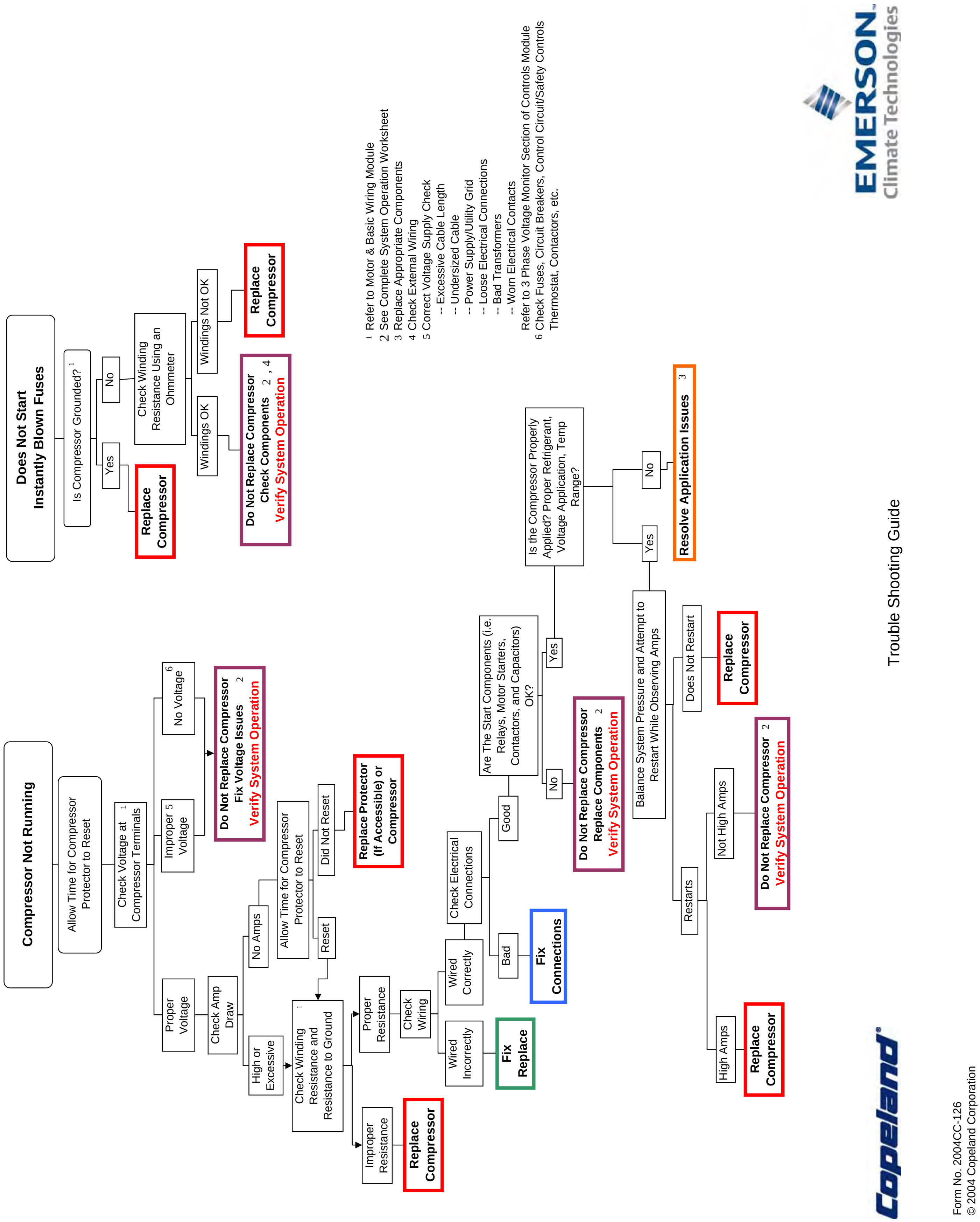
Compressor Not Running
Allow Time for Compressor Protector to Reset
Check Voltage at Compressor Terminals 1
Proper Voltage
Improper Voltage 5
No Voltage 6
Do Not Replace Compressor Fix Voltage Issues 2 Verify System Operation
Check Amp Draw
High or Excessive
No Amps
Allow Time for Compressor Protector to Reset
Reset
Did Not Reset
Replace Protector (If Accessible) or Compressor
Check Winding Resistance and Resistance to Ground 1
Improper Resistance
Replace Compressor
Proper Resistance
Check Wiring
Wired Incorrectly
Fix Replace
Wired Correctly
Check Electrical Connections
Bad
Fix Connections
Good
Are The Start Components (i.e. Relays, Motor Starters, Contactors, and Capacitors) OK?
No
Do Not Replace Compressor Replace Components 2 Verify System Operation
Yes
Balance System Pressure and Attempt to Restart While Observing Amps
Restarts
High Amps
Replace Compressor
Not High Amps
Do Not Replace Compressor 2 Verify System Operation
Does Not Restart
Replace Compressor
Is the Compressor Properly Applied? Proper Refrigerant, Voltage Application, Temp Range?
Yes
No
Resolve Application Issues 3
Does Not Start Instantly Blown Fuses
Is Compressor Grounded? 1
Yes
Replace Compressor
No
Check Winding Resistance Using an Ohmmeter
Windings OK
Do Not Replace Compressor Check Components 2, 4 Verify System Operation
Windings Not OK
Replace Compressor
1 Refer to Motor & Basic Wiring Module
2 See Complete System Operation Worksheet
3 Replace Appropriate Components
4 Check External Wiring
5 Correct Voltage Supply Check
-- Excessive Cable Length
-- Undersized Cable
-- Power Supply/Utility Grid
-- Loose Electrical Connections
-- Bad Transformers
-- Worn Electrical Contacts
Refer to 3 Phase Voltage Monitor Section of Controls Module
6 Check Fuses, Circuit Breakers, Control Circuit/Safety Controls Thermostat, Contactors, etc.
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To obtain warranty information or other support, contact your Hussmann representative. Please include the model and serial number of the product.

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