P&H Mine Air Systems

JOYGLOBAL

MAS-1500
OPERATIONS MANUAL

Applicable 480V/60Hz unit part numbers:
NPMNM150-SXH-04

Applicable 380V/50Hz unit part numbers:
NPMNM150-SYH-05

OPM150_V1, Rev9

TABLE OF CONTENTS

TABLE OF FIGURES

1.0 NORMAL OPERATIONS

1.1 Overview

The MAS-1500 is an environmental conditioner based upon a closed loop, heating, cooling and filtering model. In this model the air from the operators cab is circulated past heating and cooling elements to achieve the desired temperature prior to supplying the air to the operators cab.

The unit is divided into 4 modules as follows:

- Compressor/Condenser module
- Evaporator/Heater module
- Electrical Box Module
- Pressurizer Module

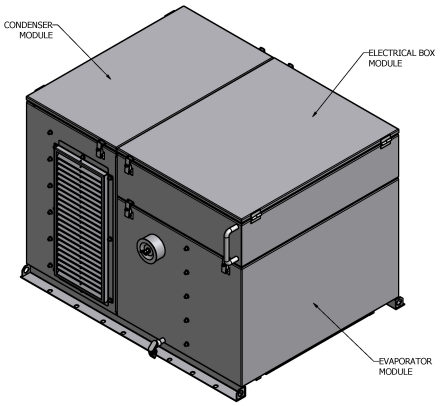


Figure 1 Major Components

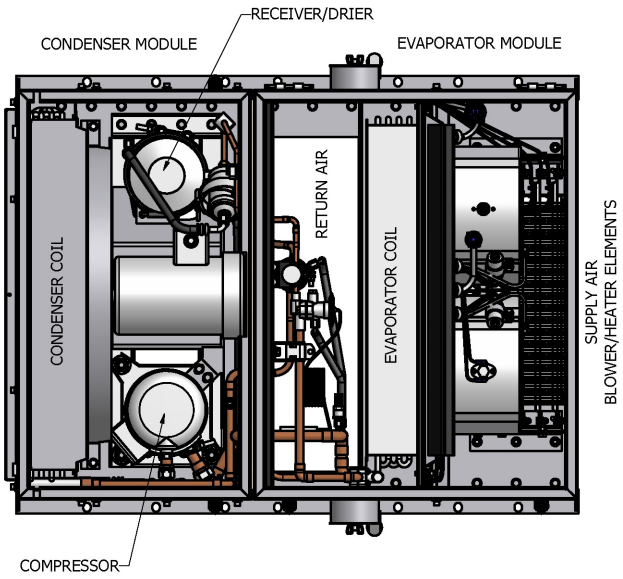


Figure 2 Major Internal Components

Filtration is provided by the circulation of air. A plenum filter is installed inline on the return air side of the MAS-1500 and a cartridge filter/cyclonic separator combination is installed on the suction side of the Pressurizer unit (a 2 stage filtration system).

The process air flow of the MAS-1500 is shown below. Typically this unit is installed in pairs, with one unit supplying conditioned air to the operators cab while the second provides air for the electrical room. The units provide filtered and conditioned air through a series of ducts. The return air venting allows air to be returned to the conditioner and re-circulated. New filtered air is added to the system via the pressurizer, allowing the cab/electrical room to maintain positive pressure in relation to the outside environment.

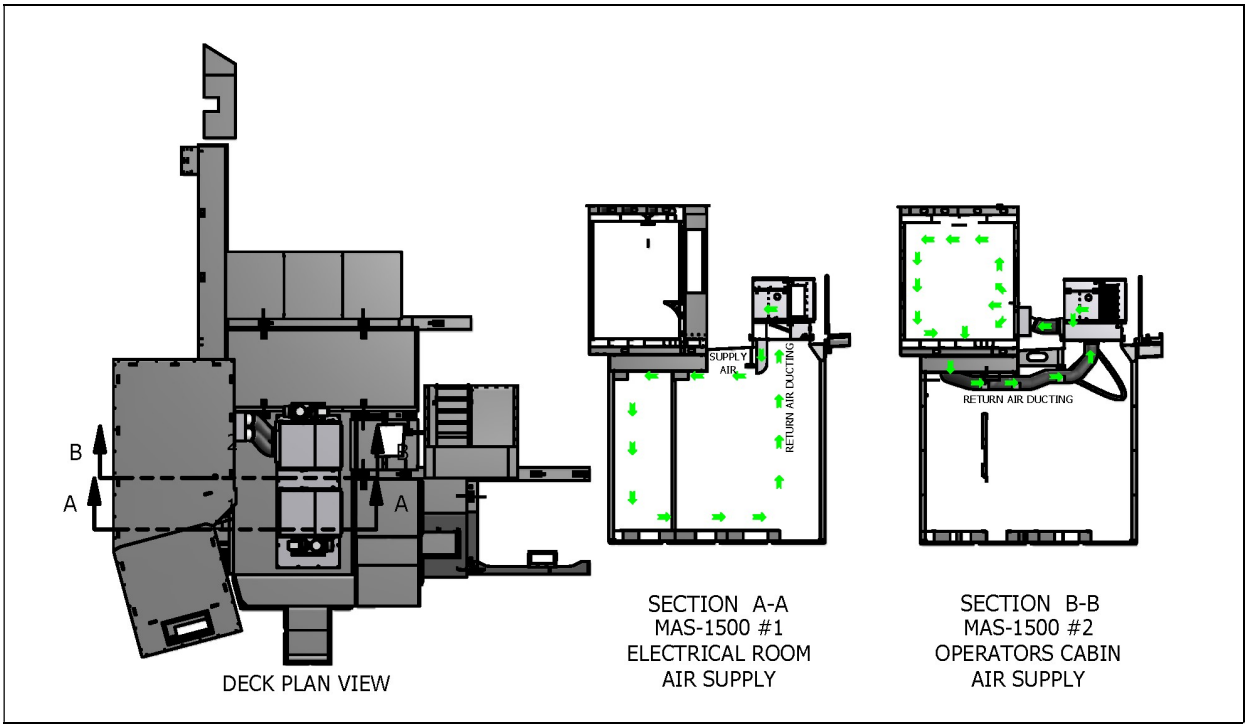


Figure 3 Air Flow Diagram

The standard control system provided with the MAS-1500 is either a Standard Electronic Control (SEC) analog package or a Mine Logic Controller (MLC) digital package. The SEC is an analog system powered by the primary unit. The MLC is a digital system that operates as both the interface and operator controls.

The SEC can be mounted near the operator based on where the mine has placed the GPS/radio etc.

For detailed specifications refer to Section 8.0 of the operations manual.

1.2 Electrical

1.2.0 Overview

The MAS-1500 is a 480 VAC, 3 phase, 60 Hz system, or a 380 VAC, 3 phase, 50 Hz system. The system is organized into 3 primary sections; the electrical box, the internal wiring system and the SEC/MLC controller. These schematics for these sections can be found in sections 4.1 to 4.6.

1.2.1 Electrical Protection Features, 480V/60Hz

The MAS-1500 is protected by:

- 60 or 30 amp main power disconnect switch (optional)
- 35 amp time delay circuit breaker for main power
- 15 amp time delay circuit breaker for compressors and motors
- 3 amp circuit breaker for control transformer
- 5 amp circuit breaker for fan transformer
- 30 amp time delay time circuit breaker for the 18 KW electric heating
- Contactors and over load relays (manual reset) for compressors and motors

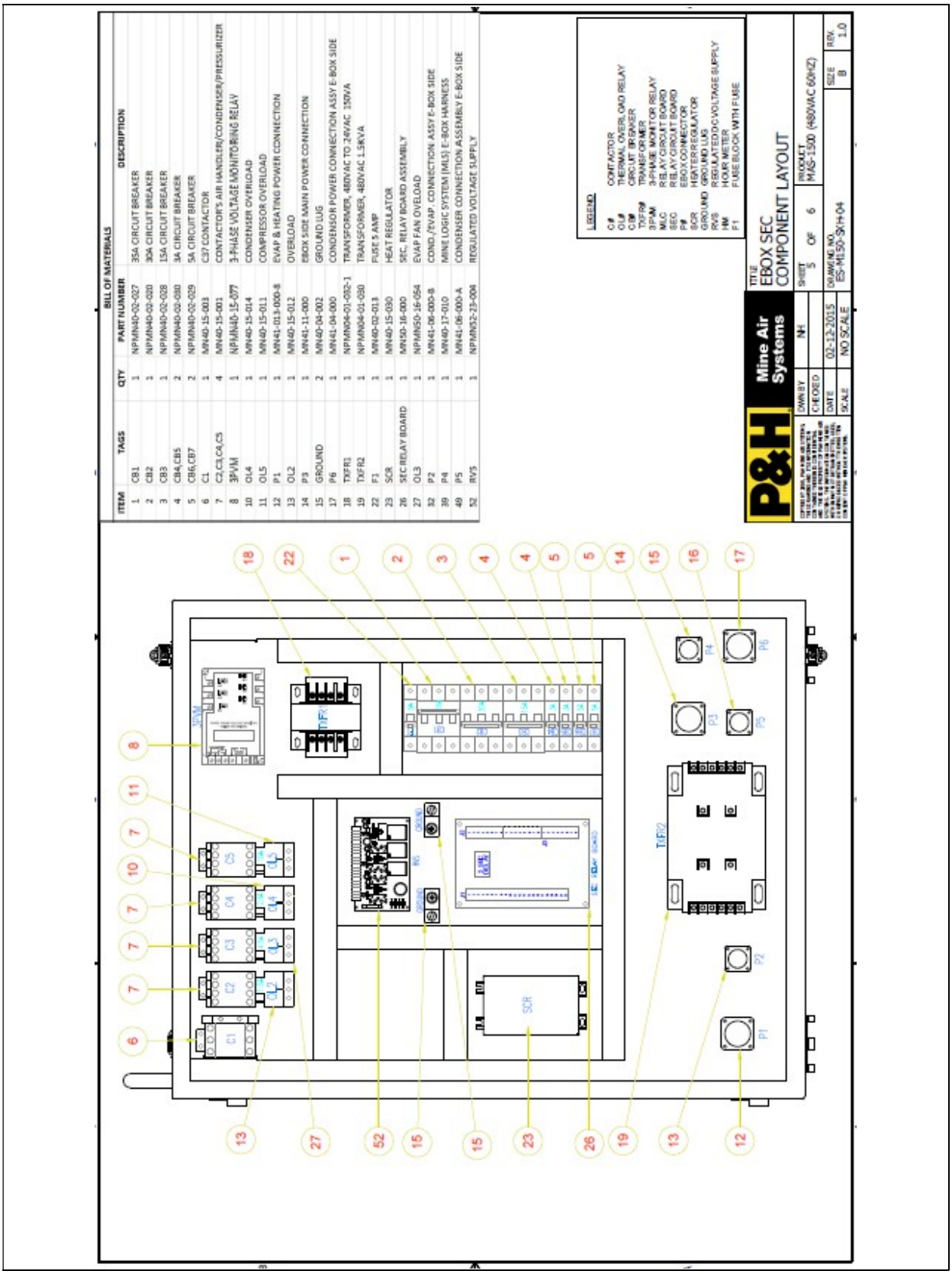


Figure 4 Electrical Box Panel Layout

1.2.2 Electrical Protection Features, 380V/50Hz Units

The MAS-1500 is protected by:

- 60 amp main power disconnect switch (optional)
- 40 amp time delay circuit breaker for main power
- 15 amp time delay circuit breaker for compressors and motors
- 3 amp circuit breakers for control transformer
- 5 amp circuit breakers for blower transformer
- 35 amp time delay circuit breaker for the 18 KW electric heating
- Contactors and overload relays (manual reset) for compressors and motors

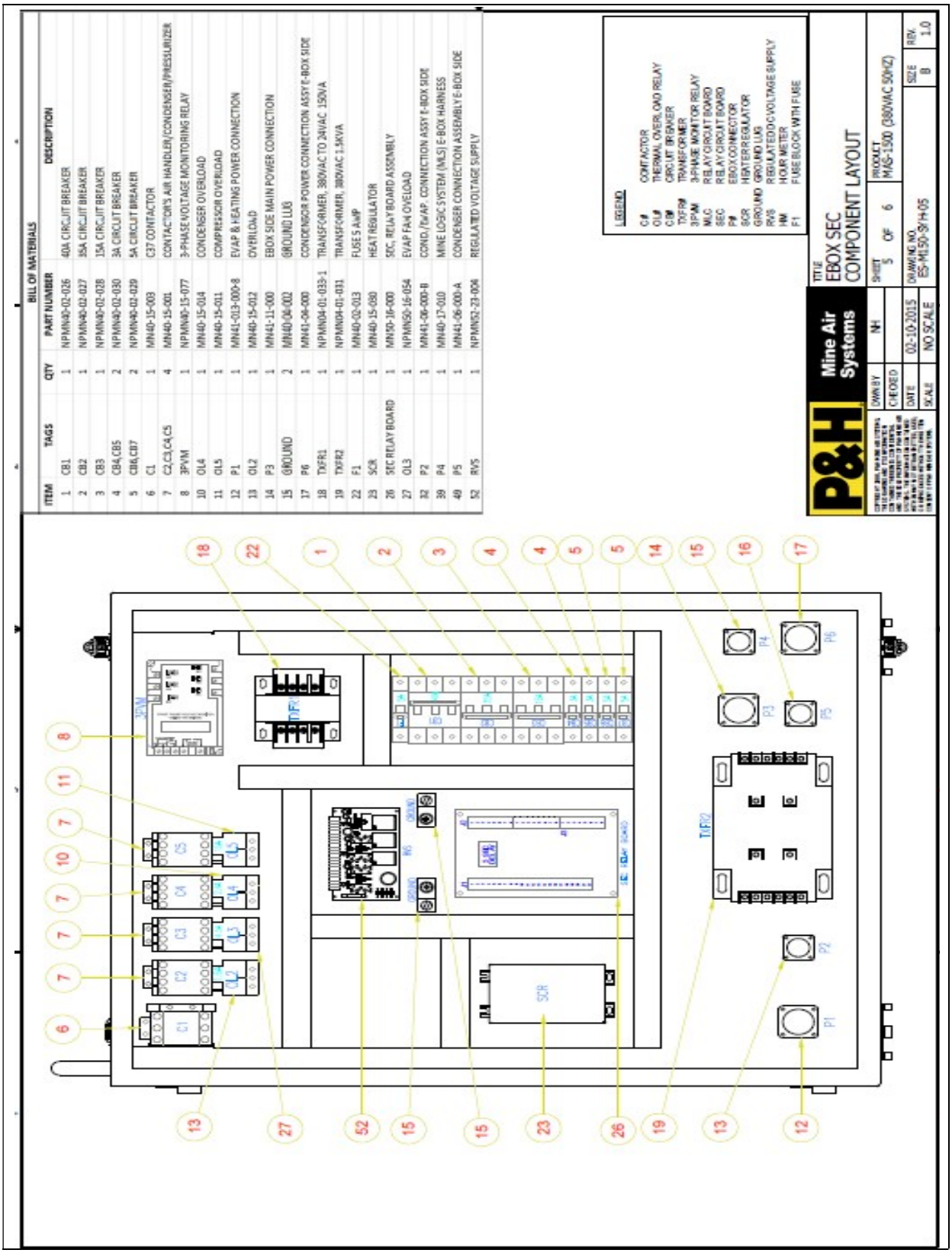


Figure 5 Electrical Box Panel Layout (380V)

1.3 Refrigeration

1.3.1 Overview

The compressor has been charged with Polyester Oil (POE), a synthetic oil compatible with R-407C environmentally friendly refrigerant. When the unit is fully charged, it requires 15.5lbs of R-407C refrigerant.

1.3.2 Operating Pressures

Standard operating pressures of R-407C on the MAS-1500 are as follows:

- Low = 50-70 psig
- High = 100-375 psig

The unit is protected by two pressure switches to control over/under pressure situations.

1.3.3 Process Flow Overview

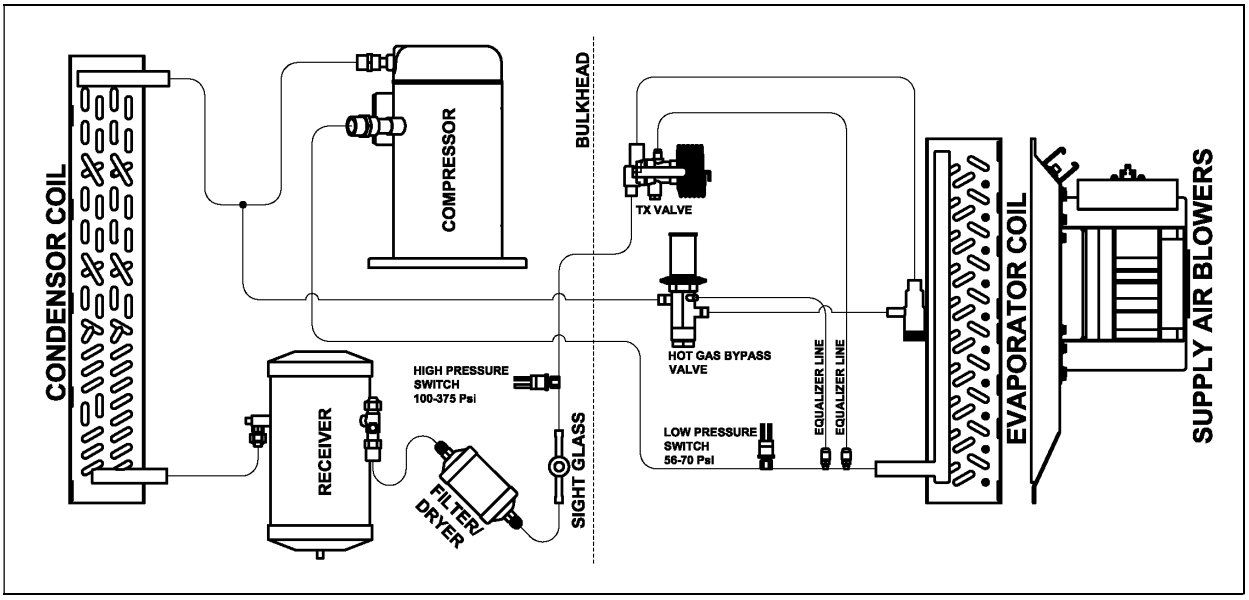


Figure 6 Process and Instrumentation Diagram

1.4 Control Options

1.4.1 Standard Electric Controller (SEC)

The Standard Electric Controller is an analog control module that interfaces the in cab control system with the MAS-1500. The SEC represents the simplest control interface with basic analog buttons and potentiometers. The Standard Electric Controller controls the following functions:

- Turns the unit on and off.
- Turns the pressurizer on and off.
- Controls cab fan speed manually (High/Low)

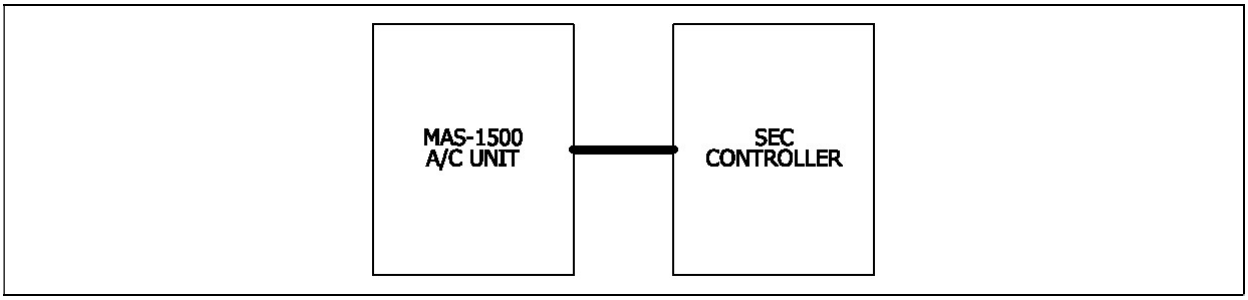


Figure 7 SEC Control Process Block Diagram

Note that the symbology might change between units but the button location and layout is the same.

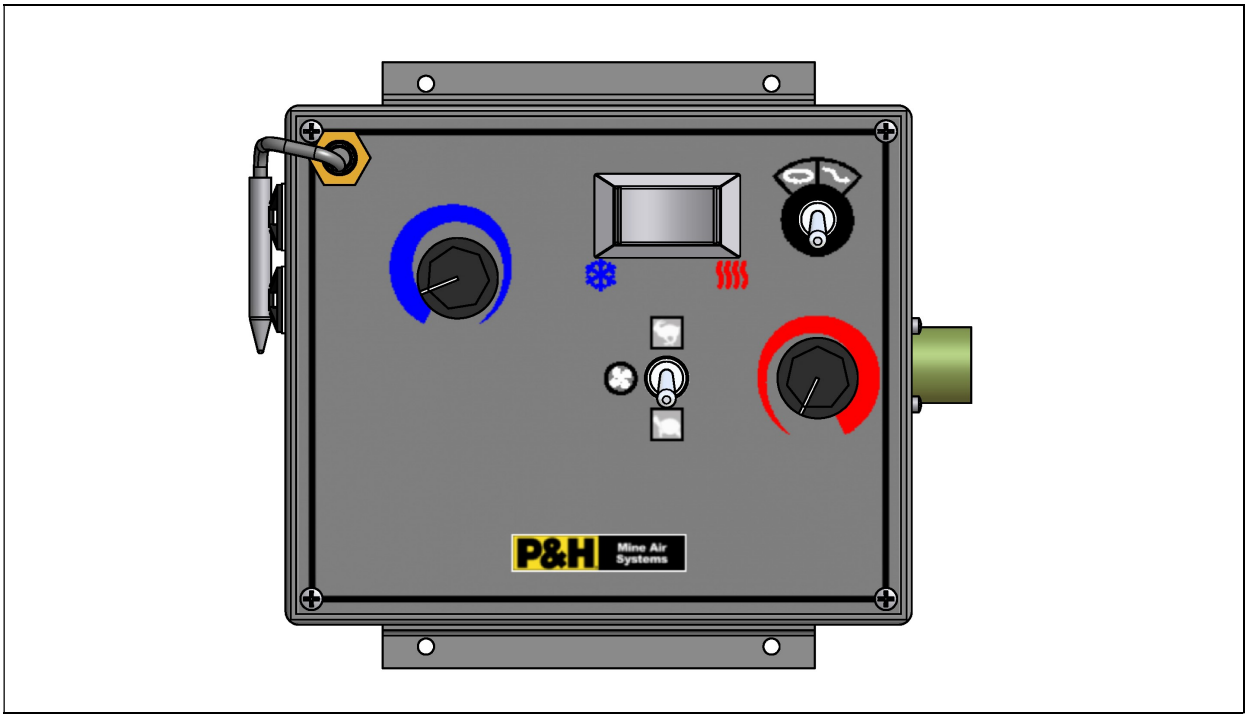


Figure 8 SEC Controller Layout

1.4.2 Mine Logic Controller (MLC)

The Mine Logic Controller is a digital control module that interfaces with the in cab control system with the MAS-1500. This system allows the ability for the controller to be integrated with the shovel GUI. It can also be implemented as a stand alone control unit. The MLC controls the following functions:

- Turns the unit on and off.
- Turns the pressurizer on and off.
- Maintains the cab temperatures to within +/- 2 deg F cooling and +/- 1.5 deg F heating.
- Controls cab fan speed manually (High/Low)
- Allows adjustment of temperature set point.

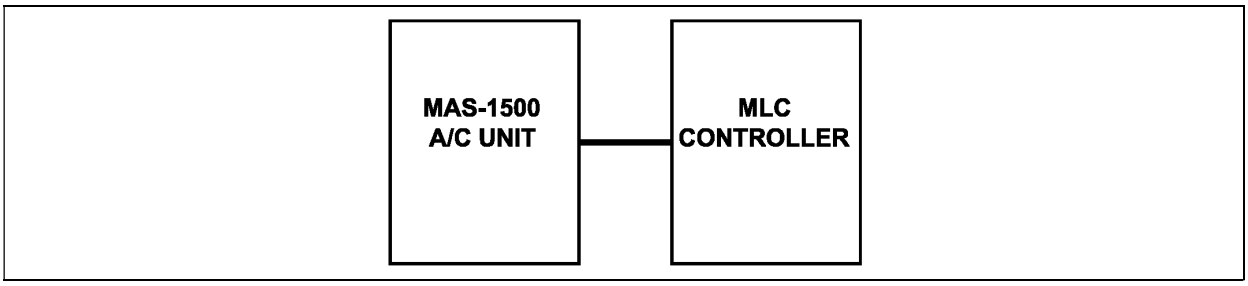


Figure 9 MLC Control Process Block Diagram

Note that the symbology might change between units but the button location and layout is the same. Shown below is the basic stand alone MLC unit.

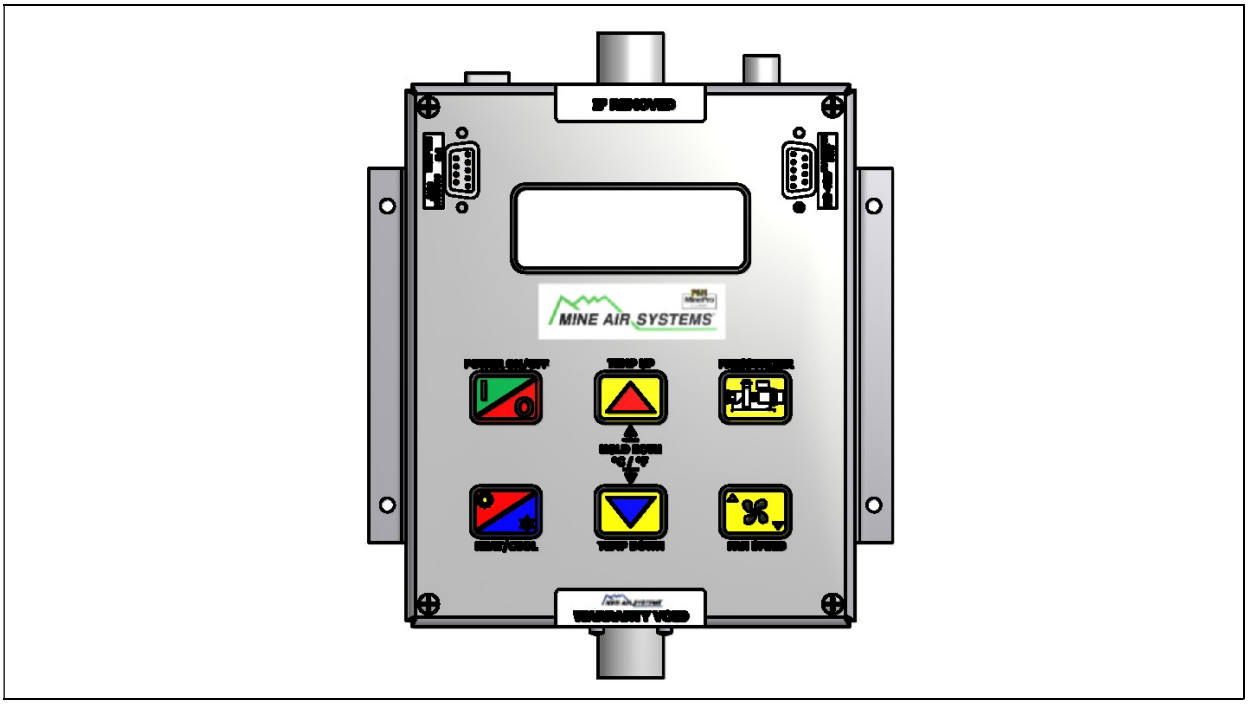


Figure 10 MLC Controller Layout

1.5 Safety Features

There are 5 main safety devices present on the MAS-1500. They are as follows:

- An automatic reset high limit set switch at 180 deg F, located below the electric heaters.
- An auto fan switch set at 130 deg F located above the blower to cycle the high speed fan in the event of high element temperatures.
- Two auto reset high limit switch set at 140 deg F located between the blower fans.
- An automatic reset refrigerant high pressure switch that disengages the compressor at 275 psig and re-engages it at 175 psig.
- An automatic reset refrigerant low pressure switch that disengages the compressor at 10 psig and re-engages it at 25 psig.

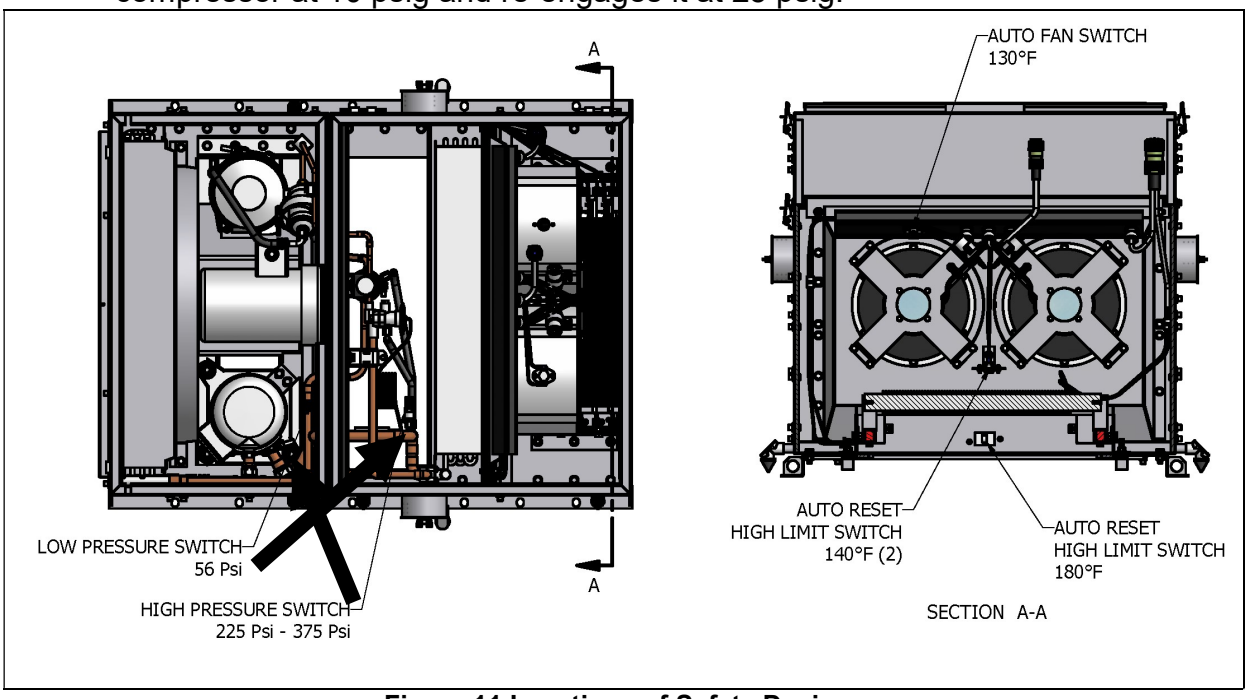


Figure 11 Locations of Safety Devices

2.0 MAINTENANCE

2.1 Overview

Your Mine Air system will be trouble free and give you excellent service for many years if a few simple maintenance up-keep procedures are followed. Maintenance consists of these main areas:

- Filter replacement and cleaning
- MAS-1500 Condenser Module
- MAS-1500 Evaporator Module
- PM Checklist (refer to Section 5.0)

2.2 Filters

2.2.1 Overview

There are two primary filters and a pre-filter within the MAS-1500 unit for the purpose of maintaining a clean particulate free quality of air. These are as follows:

- Return Air Filter (Qty 1)
- Cartridge Filter (Qty 1)
- Cyclonic Separator (Qty 1)

Maintenance procedures are to be carried out as per the Preventative Maintenance Checklist found in section 5.0 of the Operations Manual.

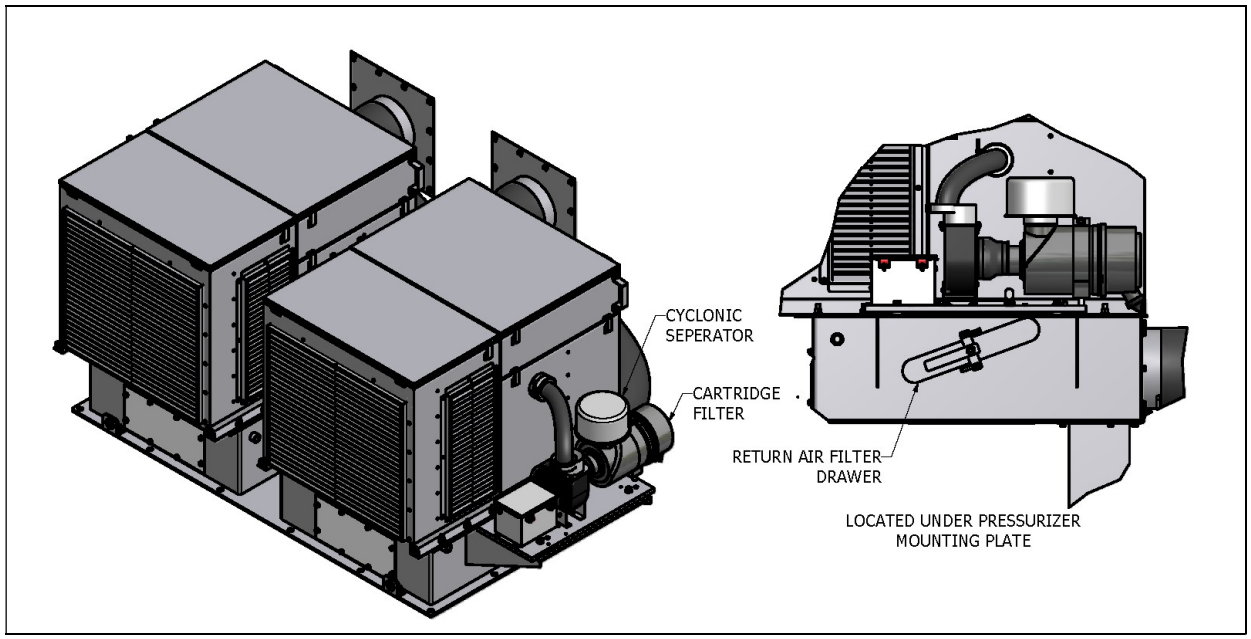


Figure 12 Filter Location Diagram

2.2.2 Cyclonic Separator Self Cleaning Pre-filter

This is a self-purging pre-cleaner. Other than checking this pre-cleaner during standard maintenance and blowing it out with compressed air, there are no required procedures for replacement. (Refer to Fig 2.2.1.1).

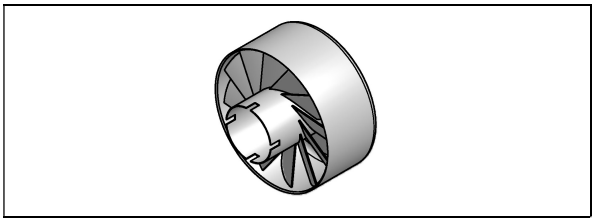


Figure 13 Cyclonic Separator

2.2.3 Cartridge Filter Part # MN80-02-021

This is a cartridge style filter element located in the filter housing. Note: For preventative maintenance reasons, remove and dump the Vacuum Cap/Dust collector when replacing this cartridge. (Refer to Fig 2.2.1.1)

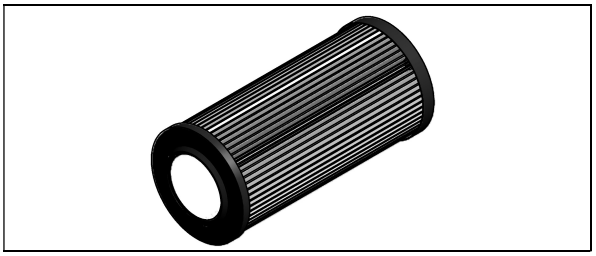


Figure 14 Cartridge Filter

2.2.4 Return Air Filter Health Guard Part# MN80-02-015

This is a standard plenum filter located in the return air housing and can be accessed through the filter drawer below the pressurizer mounting plate on the distribution box. This is a Merv 8 rated filter. Other Merv ratings are available, please contact Mine Air.

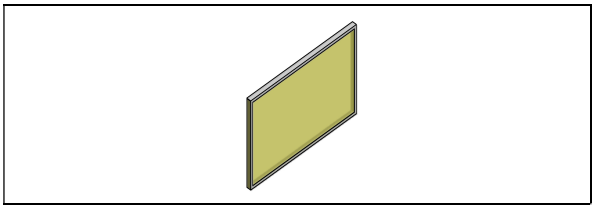


Figure 15 Plenum Filter

2.3 Condenser

2.3.1 Overview

This section of the unit houses the condenser coil and the compressors. Its purpose it to reject waste heat generated by the unit and is cooled by a single blower fan. The efficiency of the unit is affected by the cleanliness of the condenser coil and the ability to move un-obstructed air through this enclosure.

Maintenance procedures are to be carried out as per the Preventative Maintenance Checklist found in section 5.0 of the Operations Manual.

2.3.2 Maintenance Procedure

The following is the recommended maintenance procedure for the Condenser section of the MAS-1500:

1. De-energize the unit at the main disconnect as per standard lockout procedures.
2. Open hinged top cover and visually inspect the hose, pipe, wiring harness and condenser coil. Ensure all electrical cables are in good condition and firmly connected. Ensure all hose and wire are in good condition and un-abraded, ensure there is no damage to the coil fins.
3. Visually inspect the structural integrity of the enclosure.
4. Remove the side panels.
5. Check refrigerant sight glass and ensure indicator is green. If the indicator is yellow the unit has moisture in the R-407C refrigerant system and will require a purge.
6. Using compressed air (and insuring a safe distance from any flying particulates) blow out debris from the condenser coil from the front of the unit and back into the case until the coil is clear of obstructions.
7. Using compressed air and maintaining a safe distance, blow out the inside of the condenser enclosure through the side panels. It is important to exhaust the air through the side so as not to obstruct the coil.
8. Re-Inspect the enclosure and coil to ensure a clean environment.
9. Check gaskets and seals and replace if required.
10. Check drains and ensure that they are un-obstructed.
11. Check fans to ensure free spinning and balanced fan operation.
12. Check compressor for looseness. Tighten if required.
13. Check the refrigerant drier and receiver for looseness. Tighten if required.
14. Check condenser coil for movement. Tighten if required.
15. Re-install side panels and close the top.
16. Re-energize unit at the main disconnect as per standard lockout procedures.

2.4 Evaporator

2.4.1 Overview

This section of the unit houses the evaporator coils, heating elements, return air fans and the dual fan blower assembly. Its purpose is to circulate climate and quality controlled air through the cab.

Maintenance procedures are to be carried out as per the Preventative Maintenance Checklist found in Section 5.0 of the Operations Manual.

2.4.2 Maintenance Procedure

The following is the recommended maintenance procedure for the Evaporator section of the MAS-1500

1. De-energize the unit at the main disconnect as per standard lockout procedures.
2. Open hinged e-box cover and visually inspect the hose, pipe, wiring harnesses and evaporator coil. Ensure all electrical cables are in good condition and firmly connected. Ensure all hose and wire are in good condition and un-abraded, ensure coil fins are not damaged.
3. Visually inspect the structural integrity of the enclosure.
4. Using compressed air, if required, (and insuring a safe distance from any flying particulates) blow out dust and debris from the evaporator coil pushing the detritus into the fan shroud. If required remove the fan shroud and remove debris. Be aware that using compressed air will push debris into the cabin. The plenum filter must be replaced if compressed air has been used in the cleaning process.
5. Re-Inspect the enclosure and coil to ensure a clean environment.
6. Check gaskets and seals and replace if required.
7. Check condensate drains and ensure that they are un-obstructed. Remove rubber flapper check valves and ensure that they are clean and in good working condition.
8. Check supply air fans to ensure free spinning fan operation.
9. Check evaporator coil for looseness. Tighten if required.
10. Re-energize unit at the main disconnect as per standard lockout procedures.

2.5 Electrical Enclosure

2.5.1 Overview

This section of the unit houses the primary electrical and electronic components for the operation of the MAS-1500. It coordinates and controls the interface between the controls in the cab and the MAS-1500 unit itself. It is important to maintain a clean/dry environment within the Electrical Box.

2.5.2 Maintenance Procedure

The following is the recommended maintenance procedure for the Electrical Enclosure.

1. De-energize the unit at the main disconnect as per standard lockout procedures.
2. Open hinged top cover and visually inspect the enclosure, electrical back pan and sub-components.
3. Ensure all cables and wires are firmly mounted. Tighten if required.
4. Inspect the enclosure for structural integrity.
5. Inspect the enclosure for any signs of moisture and dirt.
6. Check gaskets and seals on lids and e-box, replace if required.

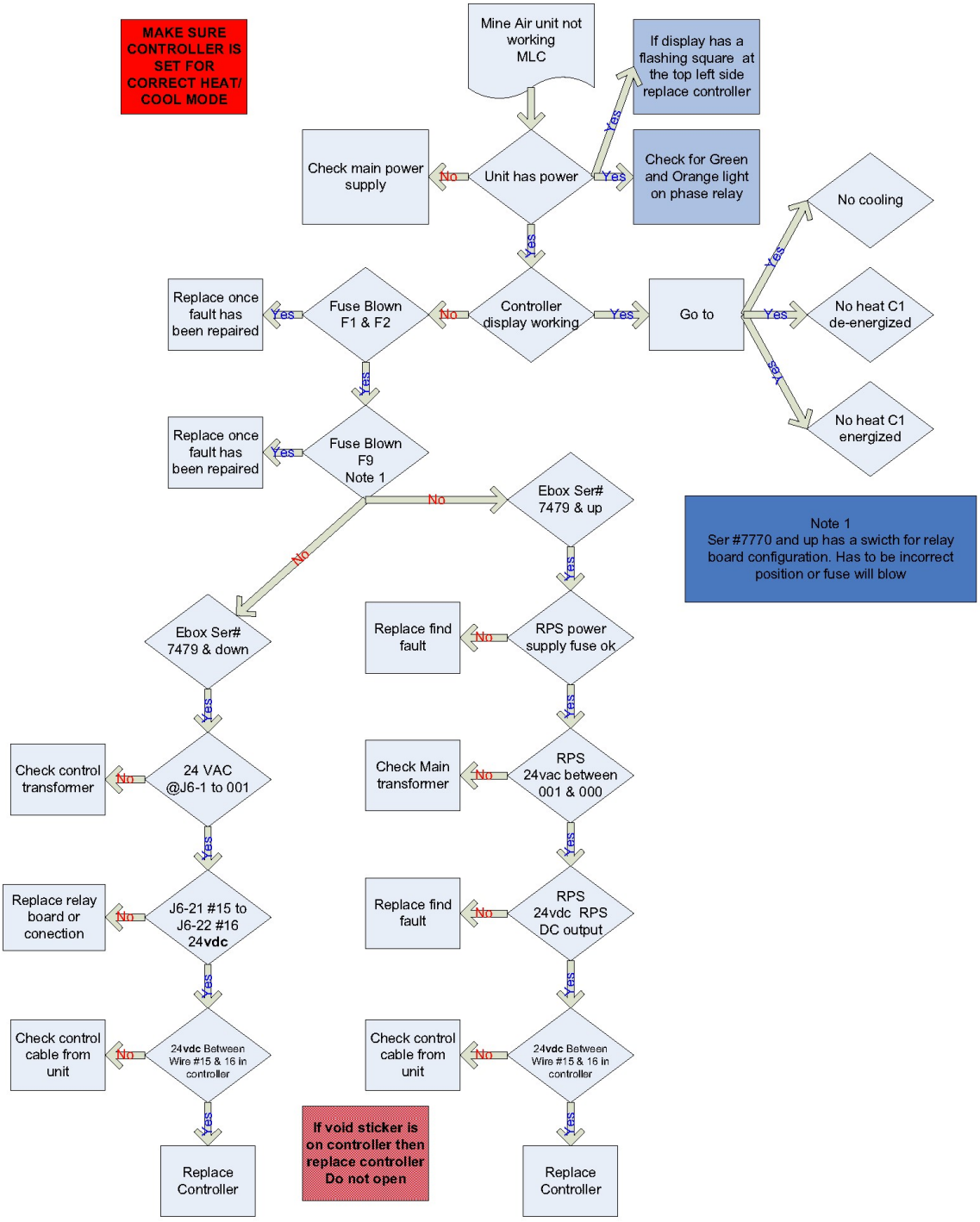
3.0 TROUBLE SHOOTING

3.1 Overview

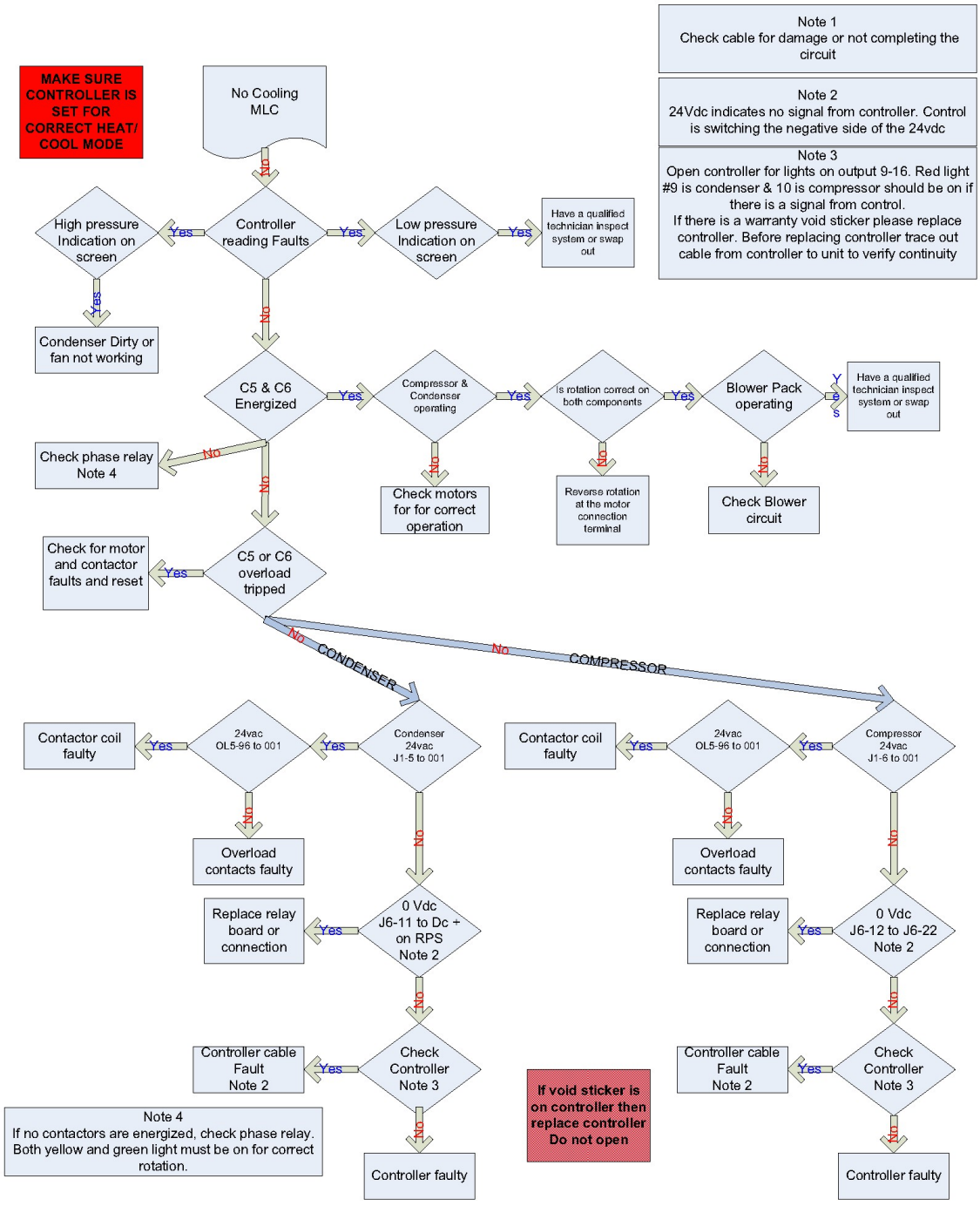
The modular design of the MAS-1500 allows you two options if verification reveals a problem with either the electrical or mechanical functions:

- Option 1: The entire unit can be replaced with an identical model in under 60 minutes at the next convenient work break in the field with a mechanic and a hoist. If spare unit is not available weather guards must be installed on the roof flanges. This option has the following advantages:
  - Minimizes downtime of production equipment
  - Permits the time consuming removal and storage of R-407C according to B52 Mechanical and HVAC codes.
  - Allows for a full service check to be performed in a shop environment by a qualified HVAC mechanic or contractor.
- Option 2: The problem can be diagnosed and solved on the spot. Because of down time and considerations with the refrigeration code, problems solved in the field should be limited to the following:
  - Fuse, breakers and overloads
  - Heating high limits
  - Pressure sensors
  - Modular components like the pressurizer, SEC, MLC or relay boards
  - Condenser coil cleaning
  - Electrical Heating Elements
  - Motors and fan blades

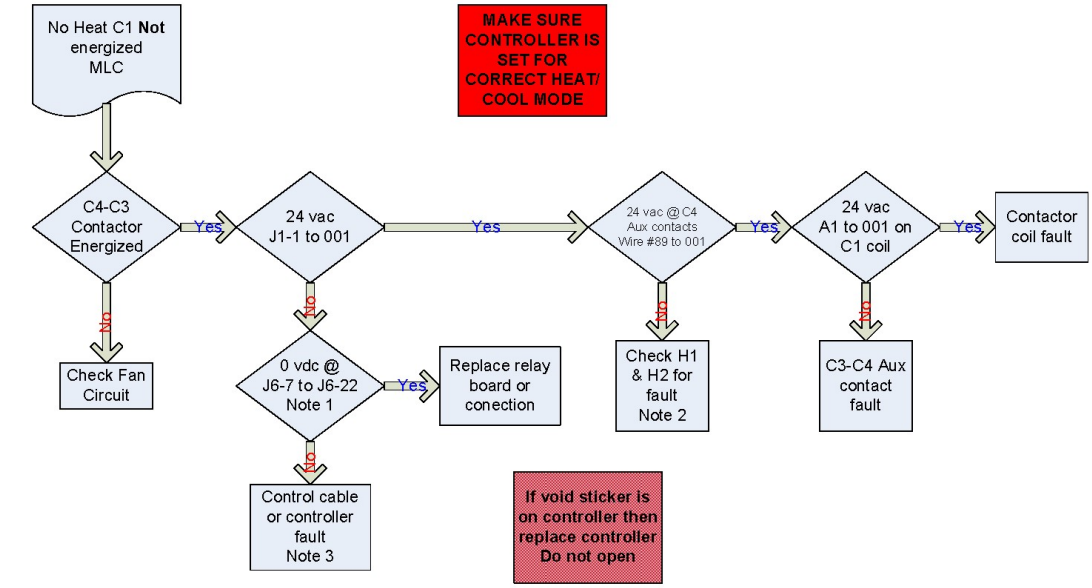
3.1.1 Trouble Shooting Diagram: MAS Unit Not Working (MLC)



3.1.2 Trouble Shooting Diagram: No Cooling (MLC)



3.1.3 Trouble Shooting Diagram: No Heat, C1 Not Energized (MLC)

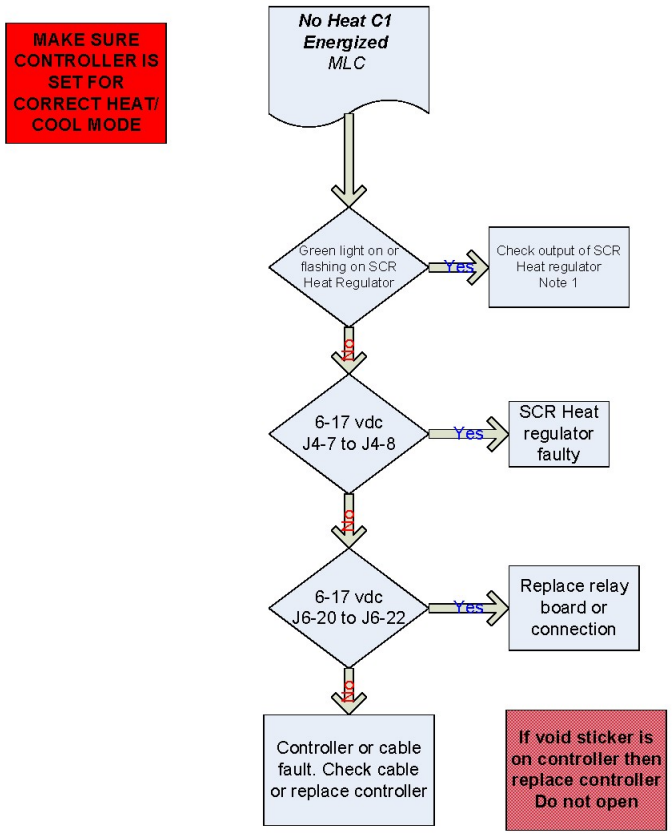


Note 1
If unit has power supply (RPS) Ser# 7770 and up check vdc at J6-7 to pos on RPS power supply.

Note 2
Fault is in blower pack safety's. Check top and bottom side limits. Both are NC. If limits good then check harness
There are 2 Limits one on top of fan shroud & one on the bottom side between the coil and blower

Note 3
Ohm out control cable wire #1 Pin 1 from relay board J6-7 to plug at controller. If good then replace controller. If not replace cable.

3.1.4 Trouble Shooting Diagram: No Heat, C1 Energized (MLC)



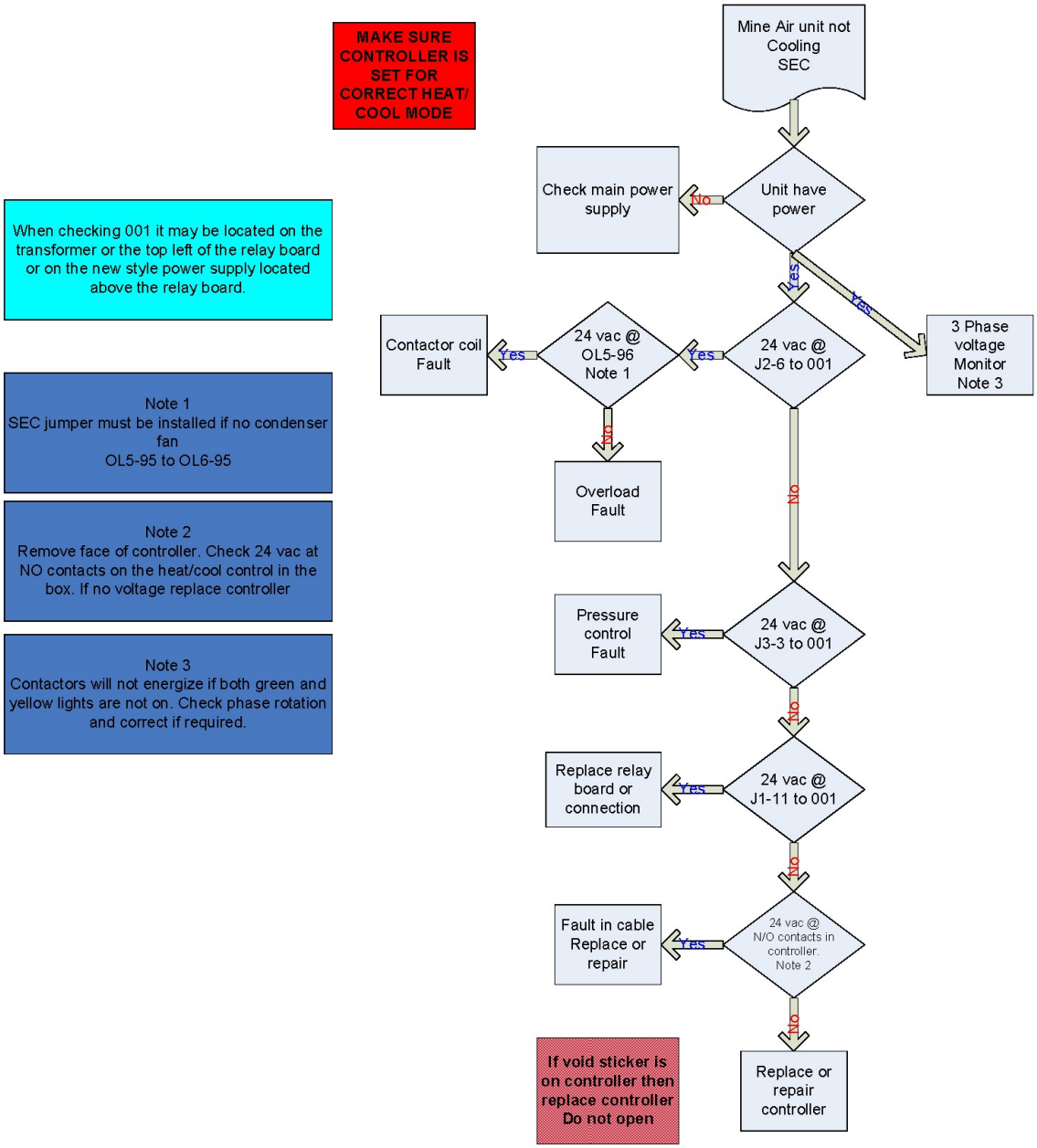
Note 1: Check outputs

- 480 v = 22 - 24 amps
- 380 v = 29 – 31 amps
- 415 v = 22 – 24 amps

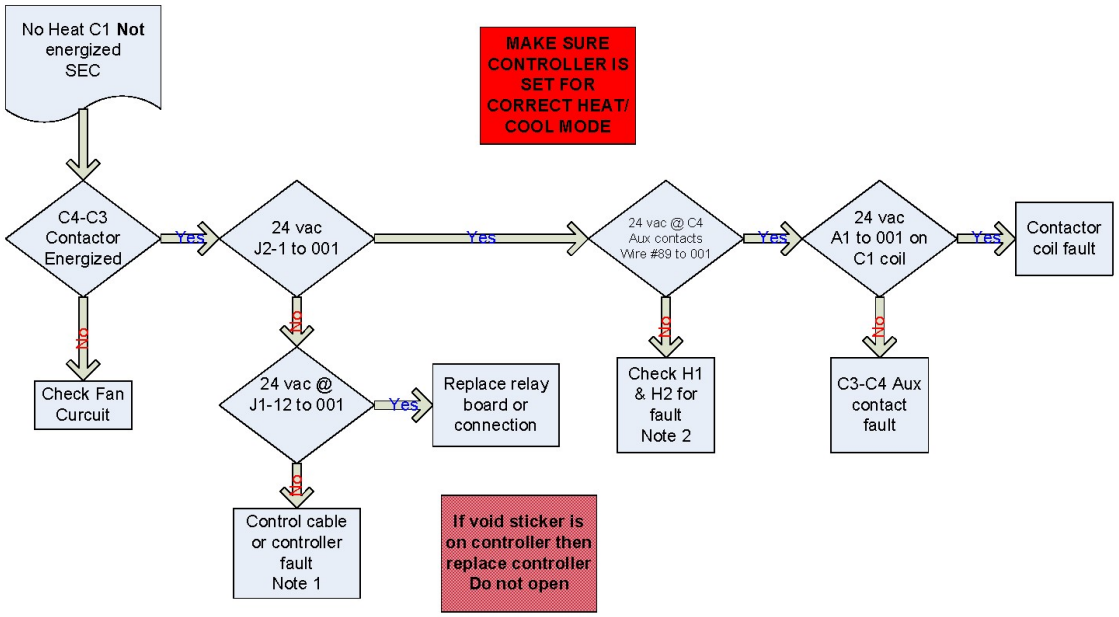
Ohm out elements

- 480 v = 25.5 ohm +/- .5 Measure L1 – L2
- 380 v = 16 ohm +/- .5 L2 – L3
- 415 v = 25.5 ohm +/- .5 L3 – L1

3.1.5 Trouble Shooting Diagram: No Cooling (SEC)



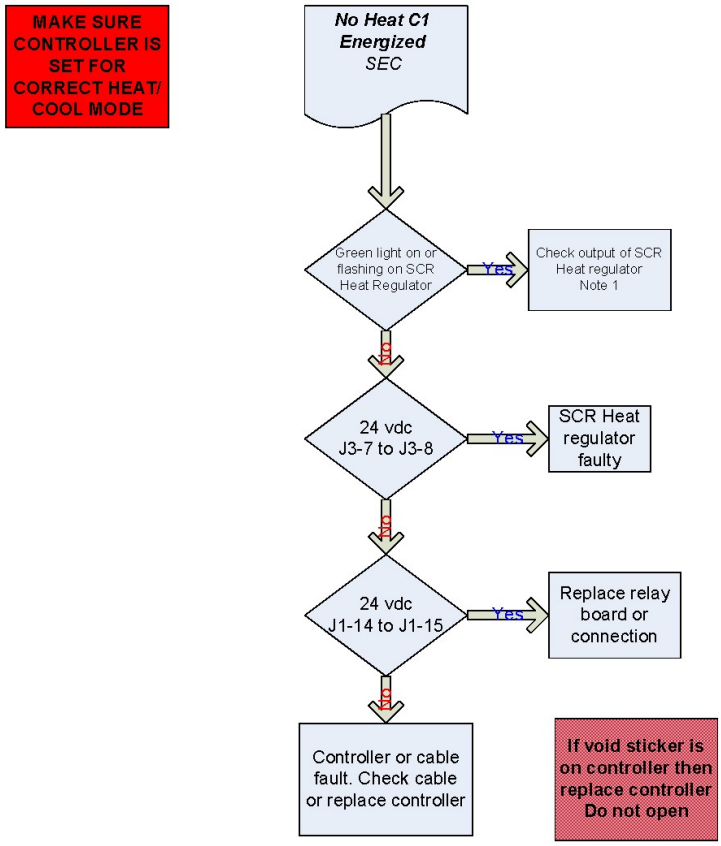
3.1.6 Trouble Shooting Diagram: No Heat, C1 Not Energized (SEC)



Note 1
Ohm out control cable wire #1 Pin 1 (control end) from relay board J1-12 to plug at controller. If good then replace controller. If not replace cable.

Note 2
Fault is in blower pack safety's. Check top and bottom side limits. Both are NC. If limits good then check harness
There are 2 Limits one on top of fan shroud & one on the bottom side between the coil and blower

3.1.7 Trouble Shooting Diagram: No Heat, C1 Energized (SEC)



Note 1: Check outputs

- 480 v = 22 - 24 amps
- 380 v = 29 – 31 amps
- 415 v = 22 – 24 amps

Ohm out elements

- 480 v = 25.5 ohm +/- .5 Measure L1 – L2
- 380 v = 16 ohm +/- .5 L2 – L3
- 415 v = 25.5 ohm +/- .5 L3 – L1

3.1.8 Trouble Shooting 3PH Monitor

Fault Conditions

Press and release fault button to scroll through all saved faults.

Note: *For initial setup, press and hold FAULT for 5 seconds to remove any previously stored faults.*

Fault	Problem	Corrective Action
Back Phase Loss	Not all three of the phases on the load side are present	1. Re-energize the contactor. 2. If the fault reappears after the load energizes: a. Turn all power OFF b. Check all load side connections c. Check the contacts of the contactor for debris or excess carbon.
Back Phase Rev	Loads 1, 2, or 3 are not in sequence (not 120° phase shifted)	1. Turn OFF all power. 2. Swap any 2 phases on the load side of the **ICM450** only (example: swap load 1 and load 2) * 3. Re-apply power.
Back Phase Unbalance	A voltage unbalance between the three load phases exceeds the unbalance setpoint	1. Press the **READ** button to observe the present load voltages. Check system for unbalance cause. 2. Increase the fault interrogation time if necessary. 3. Increase the percent unbalance setting if necessary.
Front Over Voltage	Average phase-phase voltage exceeds the maximum percentage	1. Check system for over-voltage cause. 2. Increase the percent over-voltage setting if necessary. 3. Increase the fault interrogation time if necessary.
Front Phase Loss	Not all three of the phases on the line side are present	1. Press and hold the **READ** button on the phase monitor or use an AC voltmeter to carefully measure all three phase-phase line voltages (***example:*** Line 1 → Line 2, Line 2 → Line 3, Line 3 → Line 1). 2. Repair the missing phase.
Front Phase Reversal	Lines 1, 2, or 3 are not in sequence (not 120° phase shifted)	1. Turn OFF all power. 2. Swap any 2 phases on the line side of the **ICM450** (example: swap Line 1 and Line 2)* 3. Re-apply power.
Front Phase Unbalance	A voltage unbalance between the three line phases exceeds the unbalance setpoint	1. Press the **READ** button to observe the present load voltages. Check system for unbalance cause. 2. Increase the fault interrogation time if necessary. 3. Increase the percent unbalance setting if necessary.
Front Under Voltage	Average phase-phase voltage is below the minimum percentage	1. Check system for under-voltage cause. 2. Increase the percent under-voltage setting if necessary. 3. Increase the fault interrogation time if necessary.

* **Only** swap phases during initial setup, **not** after the **ICM450** has been in operation without errors.

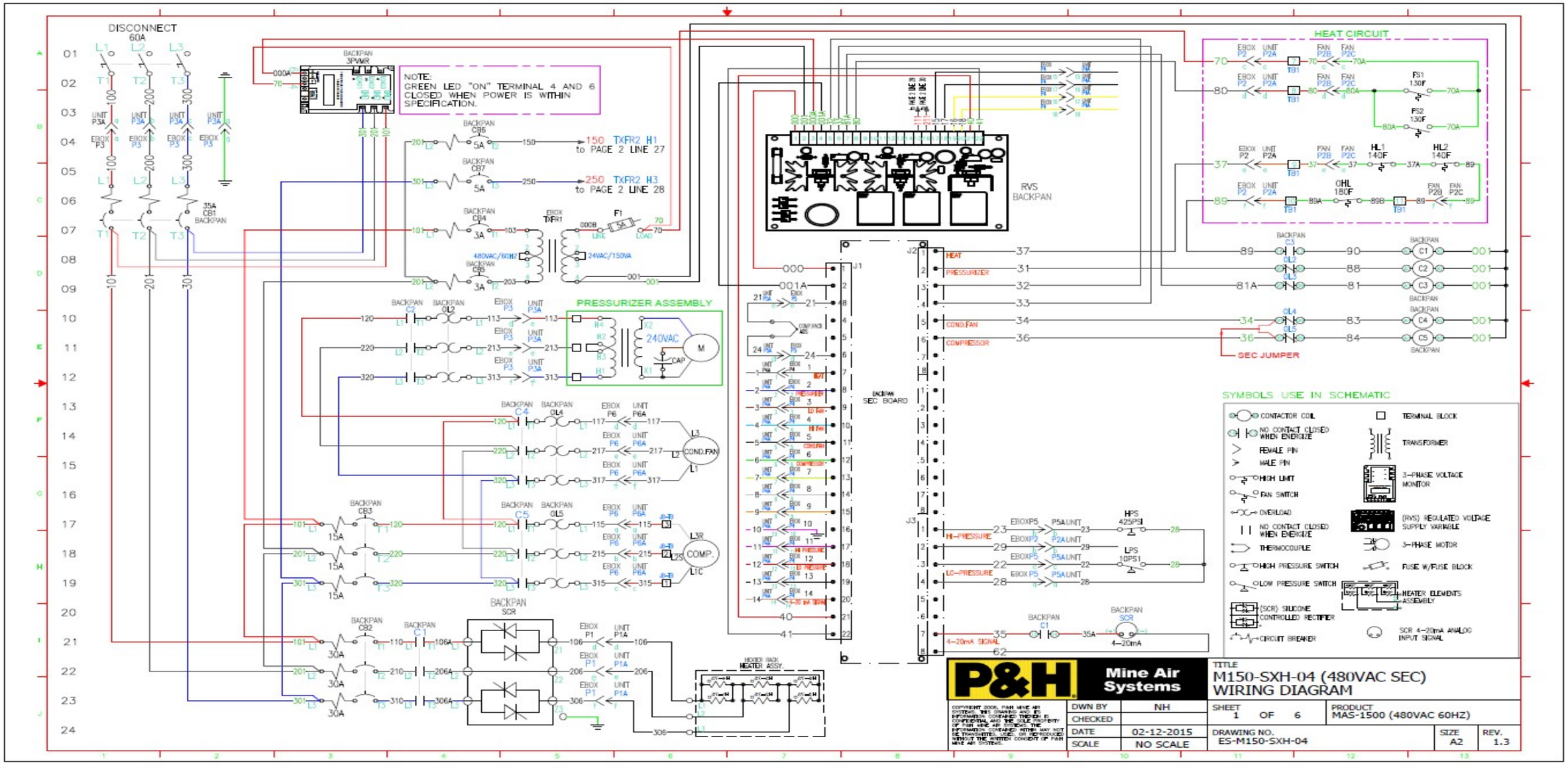
Troubleshooting

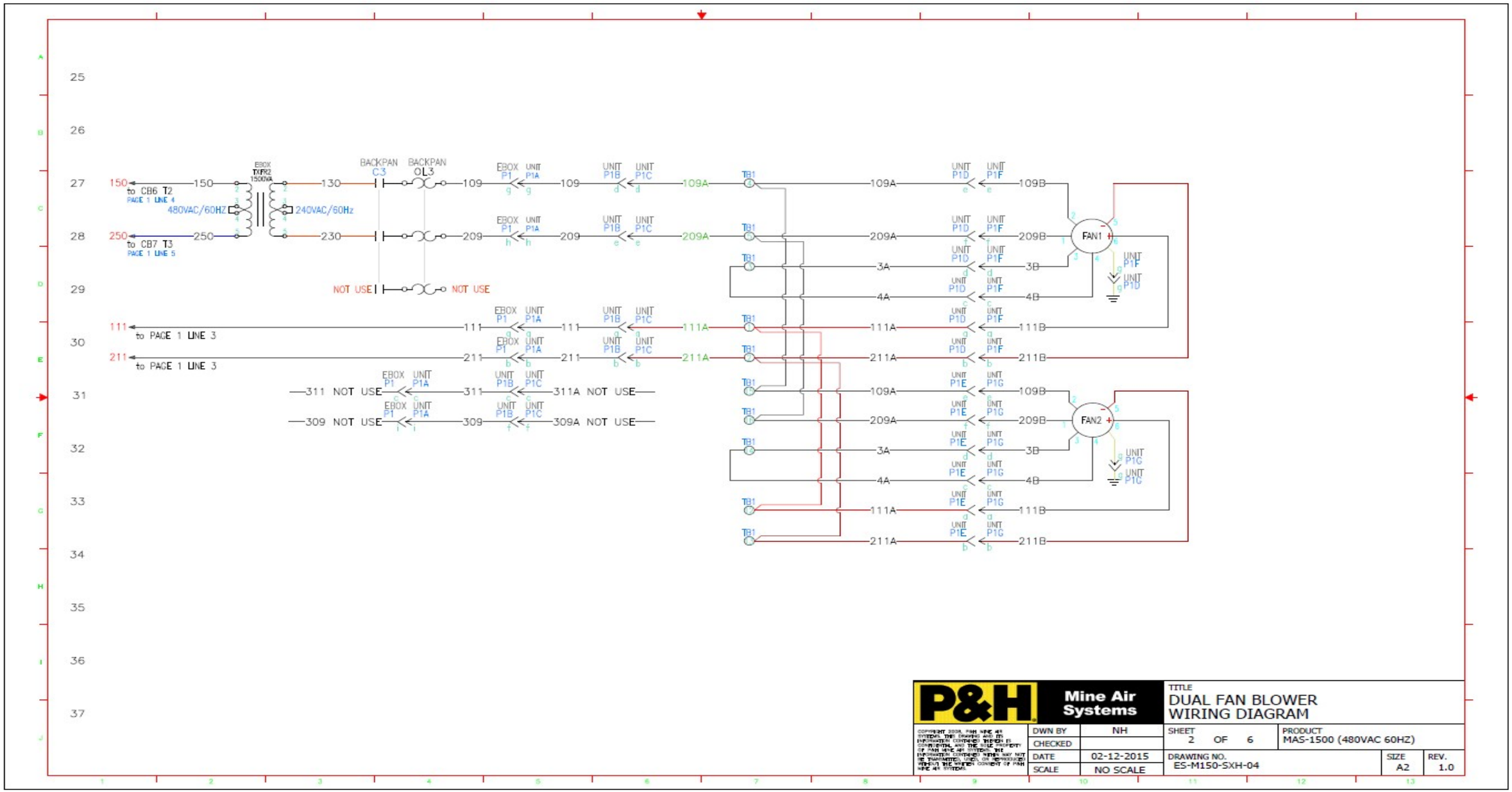
Problem	LCD Readout	LED Status	Corrective Action
Load will not energize	Phase Avgerage	All LEDs Off	Confirm that the control input (terminals 1 & 3) is properly connected and configured
Load will not energize	Phase Avgerage	Load LED Off, Fault LED blinking	Press **FAULT** once to observe the current fault; correct the condition of the first fault that appears (see Fault Conditions above, for a list of corrective actions)
Fault LED blinks repeatedly while load is energized	Phase Avgerage	Fault LED Blinking, Load LED On	Indicates there are faults saved in the memory, press **FAULT** rapidly to scroll through saved faults; to clear the faults, press and hold **FAULT** for more than 5 seconds
Load will not de-energize when control voltage is OFF	Phase Avgerage	Load LED On, Control LED Off	The control mode setting is OFF; press **SETUP** to get to the control mode. Press ∧ to set the control mode ON
Setup LED is on while load is being energized	Anything Other Than Phase Avgerage	Setup LED On, Load LED On	To exit the setup mode, press either **READ** or **FAULT**
Load will not energize	Reset	Fault LED Blinking	Unit in lockout; maximum number of retries in manual reset mode has been reached; to reset unit, press **FAULT** and hold for more than 5 seconds
Load turns ON and OFF repeatedly	Readout is Irrelevant	Fault LED Blinking	Fix load side fault; press **FAULT** to observe condition; the delay on break period may be too short; press **SETUP** to enter the delay on break mode; press ∧ to lengthen the delay

4.0 ELECTRICAL SCHEMATICS

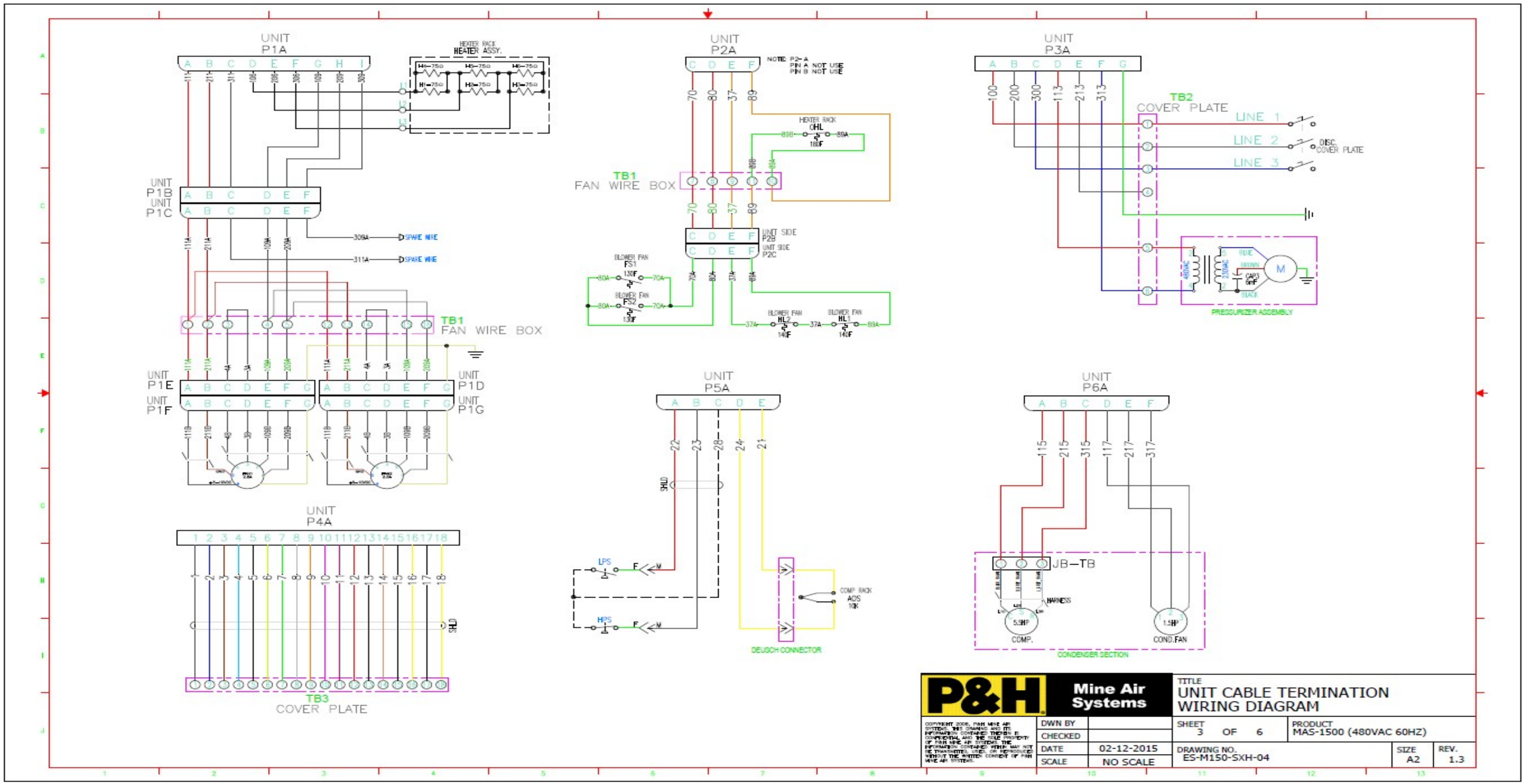
4.1 MAS-1500 Electrical Wiring Diagram, E-M150-48-V1

Applicable to 480V/60Hz units (SXH).





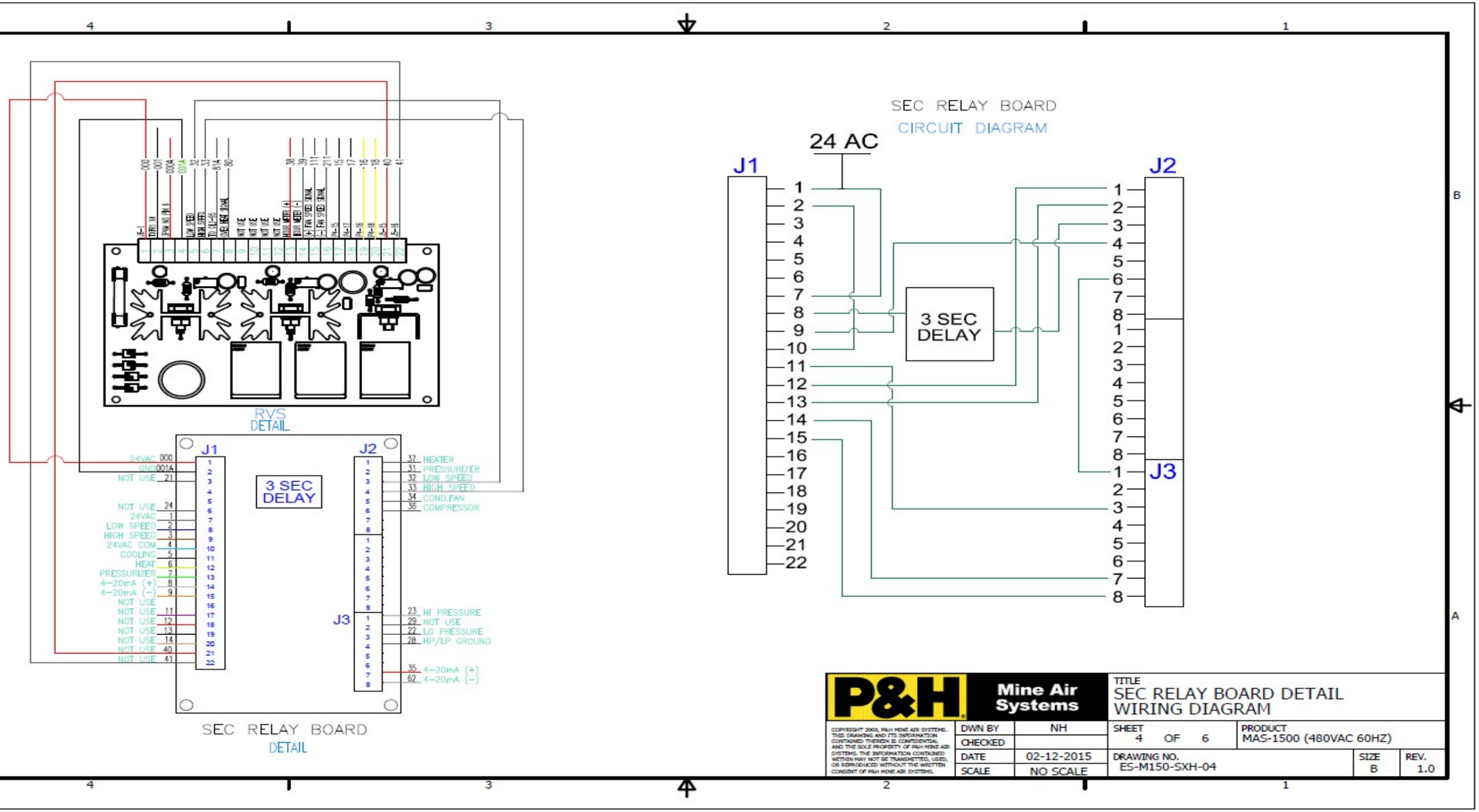
TITLE	DUAL FAN BLOWER WIRING DIAGRAM
DWN BY	NH
CHECKED	
DATE	02-12-2015
SCALE	NO SCALE
SHEET	2 OF 6
PRODUCT	MAS-1500 (480VAC 60HZ)
DRAWING NO.	ES-M150-SXH-04
SIZE	A2
REV.	1.0



P&H Mine Air Systems

TITLE
UNIT CABLE TERMINATION WIRING DIAGRAM

DWN BY		SHEET 3 OF 6	PRODUCT MAS-1500 (480VAC 60HZ)
CHECKED			
DATE	02-12-2015	DRAWING NO. ES-M150-SXH-04	SIZE A2 / REV. 1.3
SCALE	NO SCALE		



P&H Mine Air Systems			TITLE: SEC RELAY BOARD DETAIL WIRING DIAGRAM		
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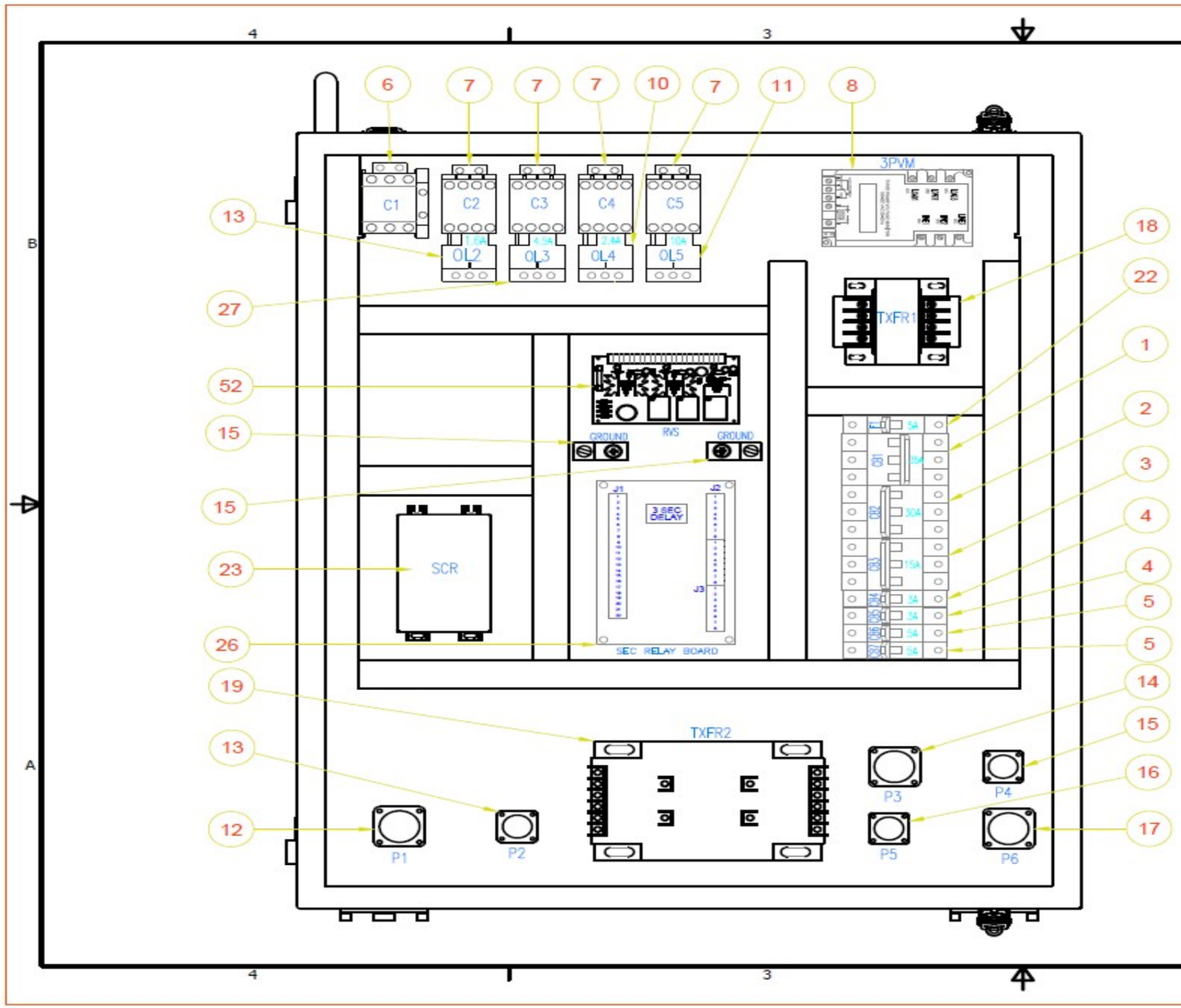
	CHECKED				
	DATE	02-12-2015	DRAWING NO. ES-M150-SXH-04	SIZE B	REV. 1.0
	SCALE	NO SCALE			



BILL OF MATERIALS

ITEM	TAGS	QTY	PART NUMBER	DESCRIPTION
1	CB1	1	NPMN40-02-027	35A CIRCUIT BREAKER
2	CB2	1	NPMN40-02-020	30A CIRCUIT BREAKER
3	CB3	1	NPMN40-02-028	15A CIRCUIT BREAKER
4	CB4,CB5	2	NPMN40-02-030	3A CIRCUIT BREAKER
5	CB6,CB7	2	NPMN40-02-029	5A CIRCUIT BREAKER
6	C1	1	MN40-15-003	C37 CONTACTOR
7	C2,C3,C4,C5	4	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
8	3PVM	1	NPMN40-15-077	3-PHASE VOLTAGE MONITORING RELAY
10	OL4	1	MN40-15-014	CONDENSER OVERLOAD
11	OL5	1	MN40-15-011	COMPRESSOR OVERLOAD
12	P1	1	MN41-013-000-8	EVAP & HEATING POWER CONNECTION
13	OL2	1	MN40-15-012	OVERLOAD
14	P3	1	MN41-11-000	EBOX SIDE MAIN POWER CONNECTION
15	GROUND	2	MN40-04-002	GROUND LUG
17	P6	1	MN41-04-000	CONDENSOR POWER CONNECTION ASSY E-BOX SIDE
18	TXFR1	1	NPMN04-01-032-1	TRANSFORMER, 480VAC TO 24VAC 150VA
19	TXFR2	1	NPMN04-01-030	TRANSFORMER, 480VAC 1.5KVA
22	F1	1	MN40-02-013	FUSE 5 AMP
23	SCR	1	MN40-15-030	HEAT REGULATOR
26	SEC RELAY BOARD	1	MN50-16-000	SEC, RELAY BOARD ASSEMBLY
27	OL3	1	NPMN50-16-054	EVAP FAN OVELOAD
32	P2	1	MN41-06-000-B	COND./EVAP. CONNECTION ASSY E-BOX SIDE
39	P4	1	MN40-17-010	MINE LOGIC SYSTEM (MLS) E-BOX HARNESS
49	P5	1	MN41-06-000-A	CONDENSER CONNECTION ASSEMBLY E-BOX SIDE
52	RVS	1	NPMN52-23-004	REGULATED VOLTAGE SUPPLY

LEGEND

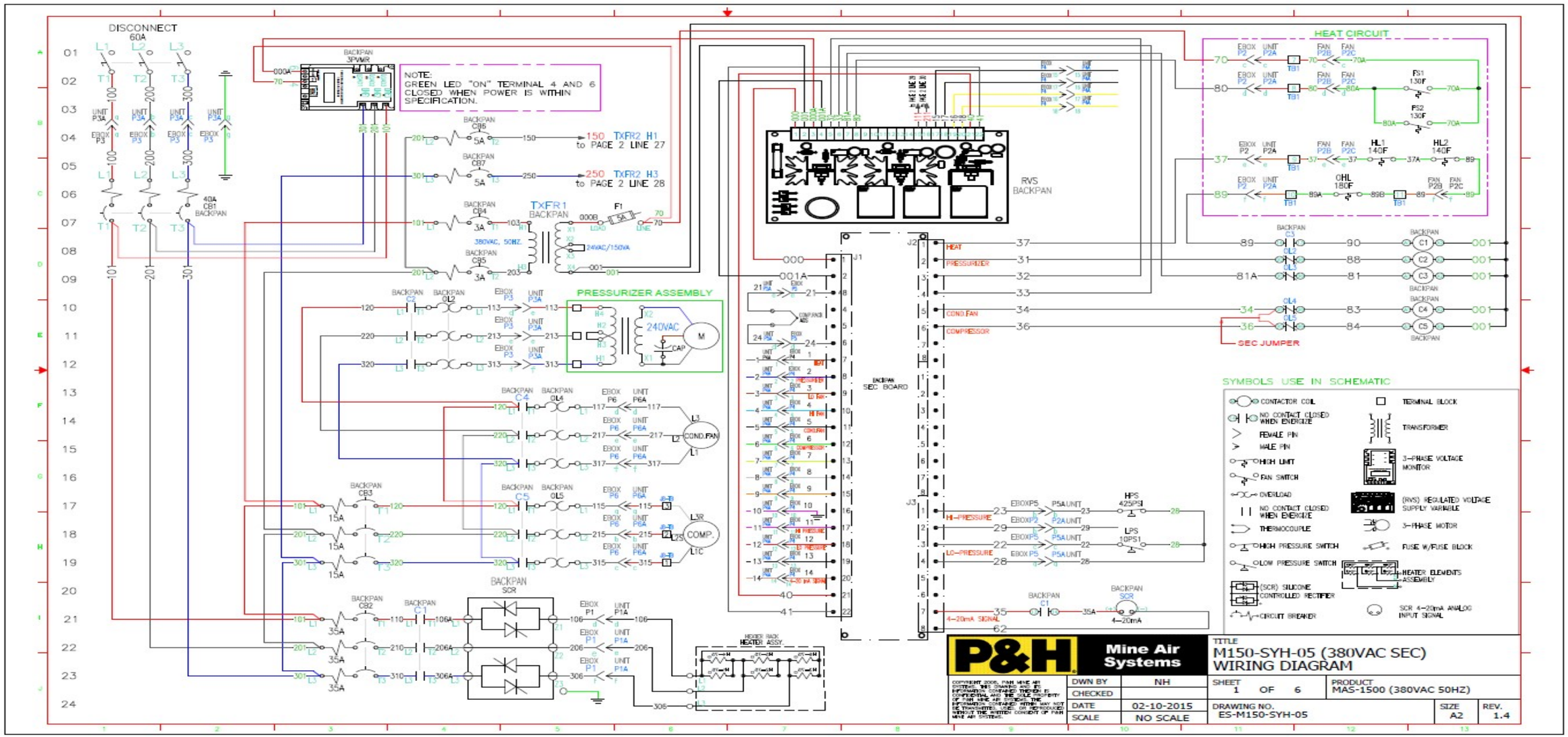
C#	CONTACTOR
OL#	THERMAL OVERLOAD RELAY
CB#	CIRCUIT BREAKER
TXFR#	TRANSFORMER
3PVM	3-PHASE MONITOR RELAY
MLC	RELAY CIRCUIT BOARD
SEC	RELAY CIRCUIT BOARD
P#	EBOX CONNECTOR
SCR	HEATER REGULATOR
GROUND	GROUND LUG
RVS	REGULATED DC VOLTAGE SUPPLY
HM	HOUR METER
F1	FUSE BLOCK WITH FUSE

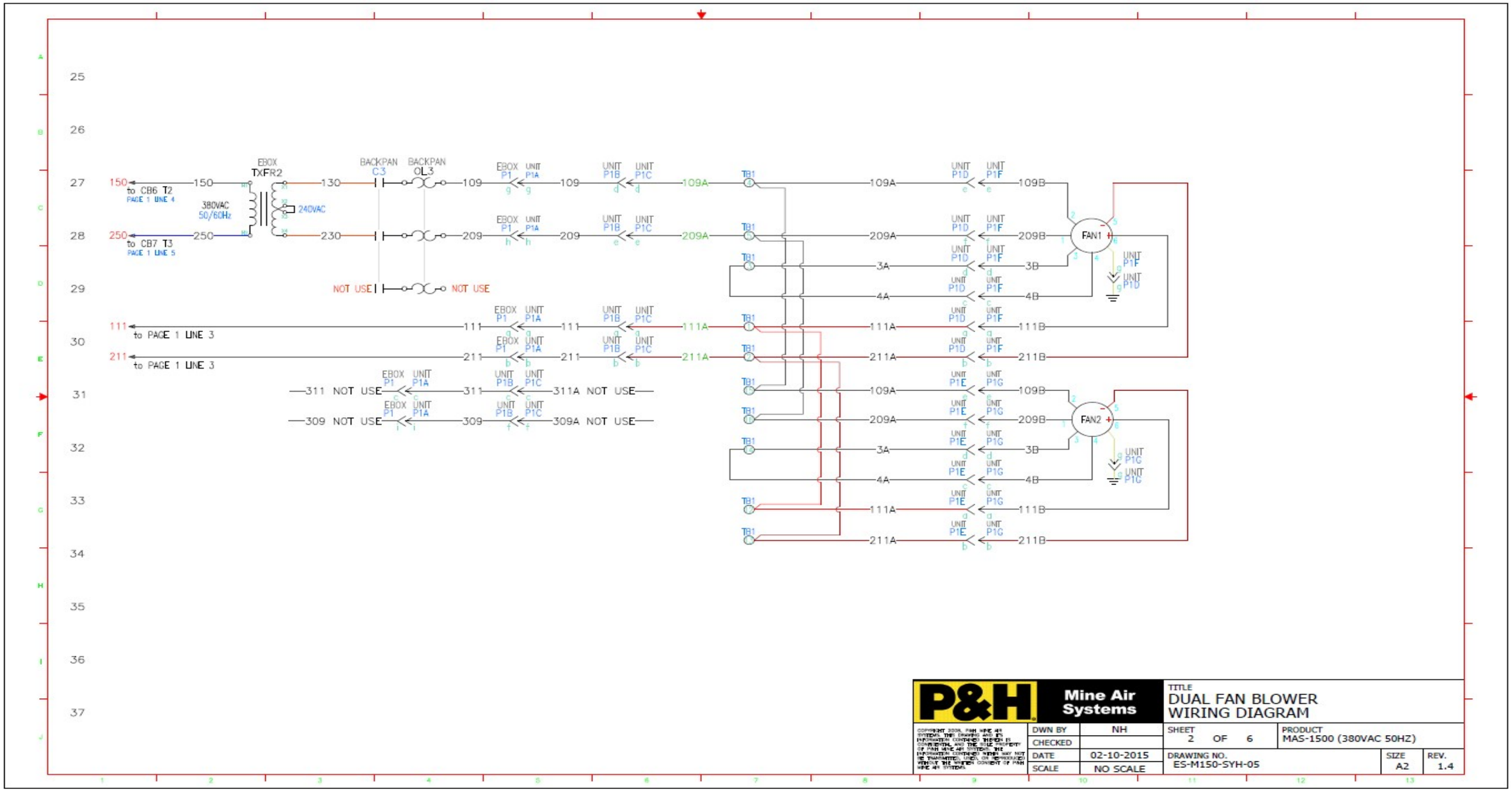
P&H Mine Air Systems

DWN BY	NH	TITLE: EBOX SEC COMPONENT LAYOUT	
CHECKED		SHEET 5 OF 6	PRODUCT MAS-1500 (480VAC 60HZ)
DATE	02-12-2015	DRAWING NO. ES-M150-SXH-04	SIZE B / REV. 1.0
SCALE	NO SCALE		

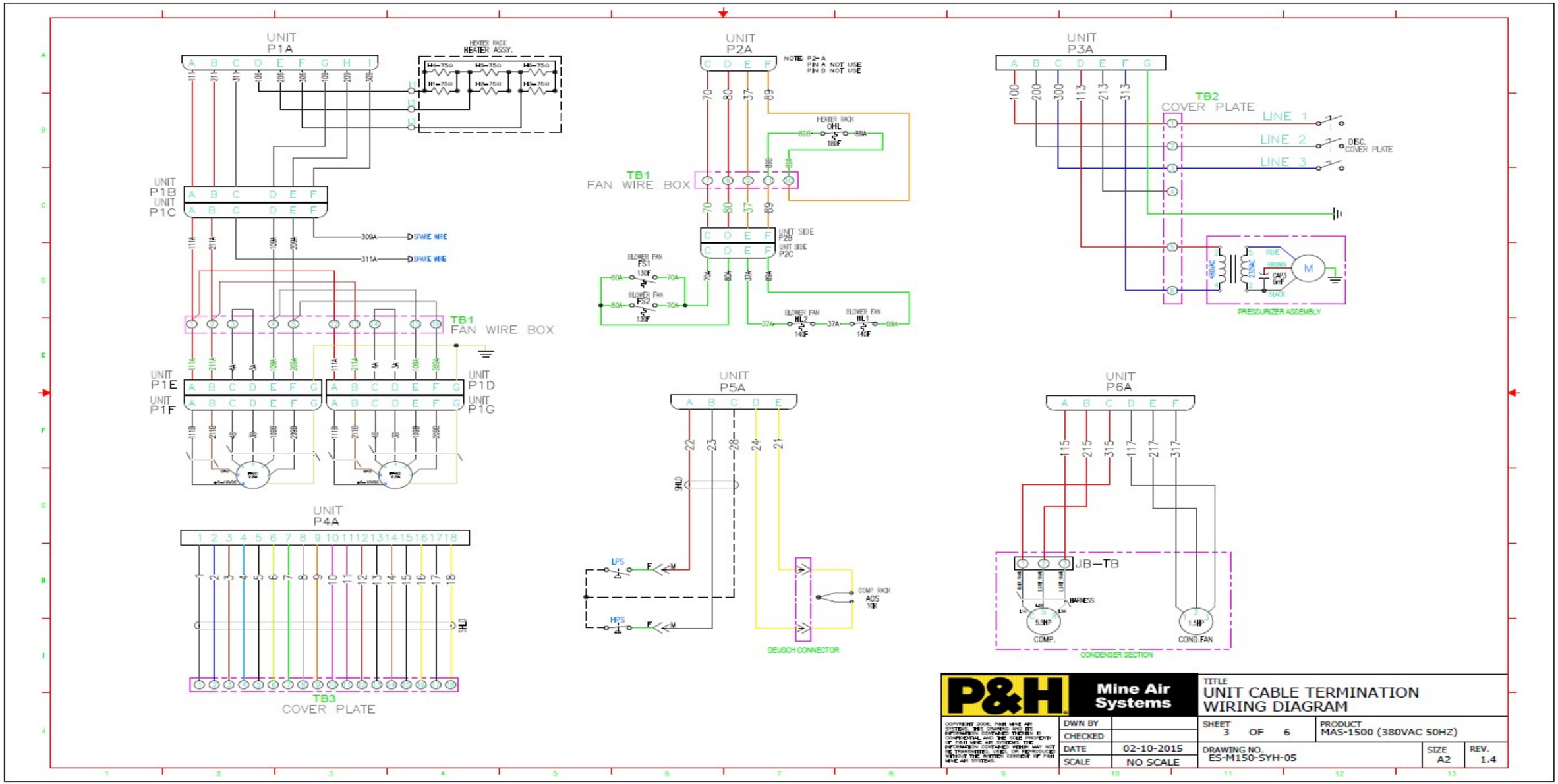
4.2 MAS-1500 Electrical Wiring Diagram, E-M150-38-V1 (380V)

Applicable to 380V/50Hz units (SYH).

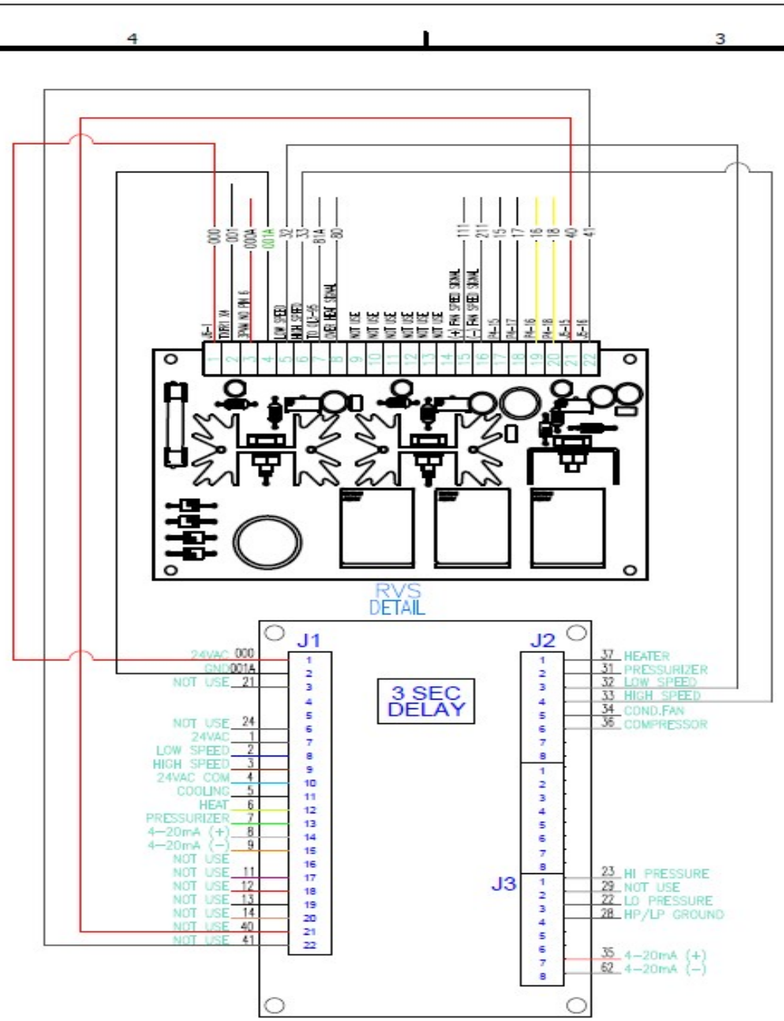


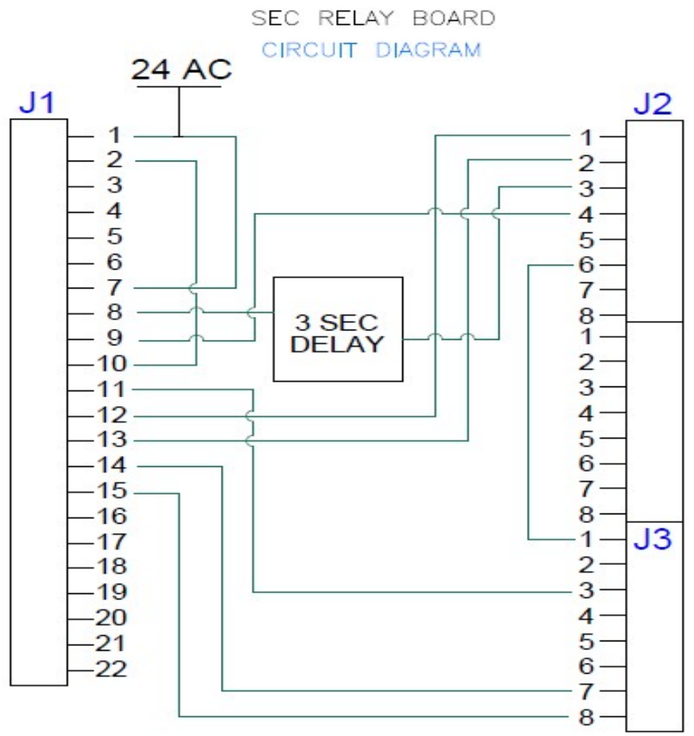


P&H Mine Air Systems		TITLE: DUAL FAN BLOWER WIRING DIAGRAM	
DWN BY	NH	SHEET 2 OF 6	PRODUCT MAS-1500 (380VAC 50HZ)
CHECKED			
DATE	02-10-2015	DRAWING NO. ES-M150-SYH-05	SIZE A2 / REV. 1.4
SCALE	NO SCALE		



TITLE	UNIT CABLE TERMINATION WIRING DIAGRAM
DWN BY	
CHECKED	
DATE	02-10-2015
SCALE	NO SCALE
SHEET	3 OF 6
PRODUCT	MAS-1500 (380VAC 50HZ)
DRAWING NO.	ES-M150-SYH-05
SIZE	A2
REV.	1.4





P&H Mine Air Systems			TITLE: SEC RELAY BOARD DETAIL WIRING DIAGRAM	
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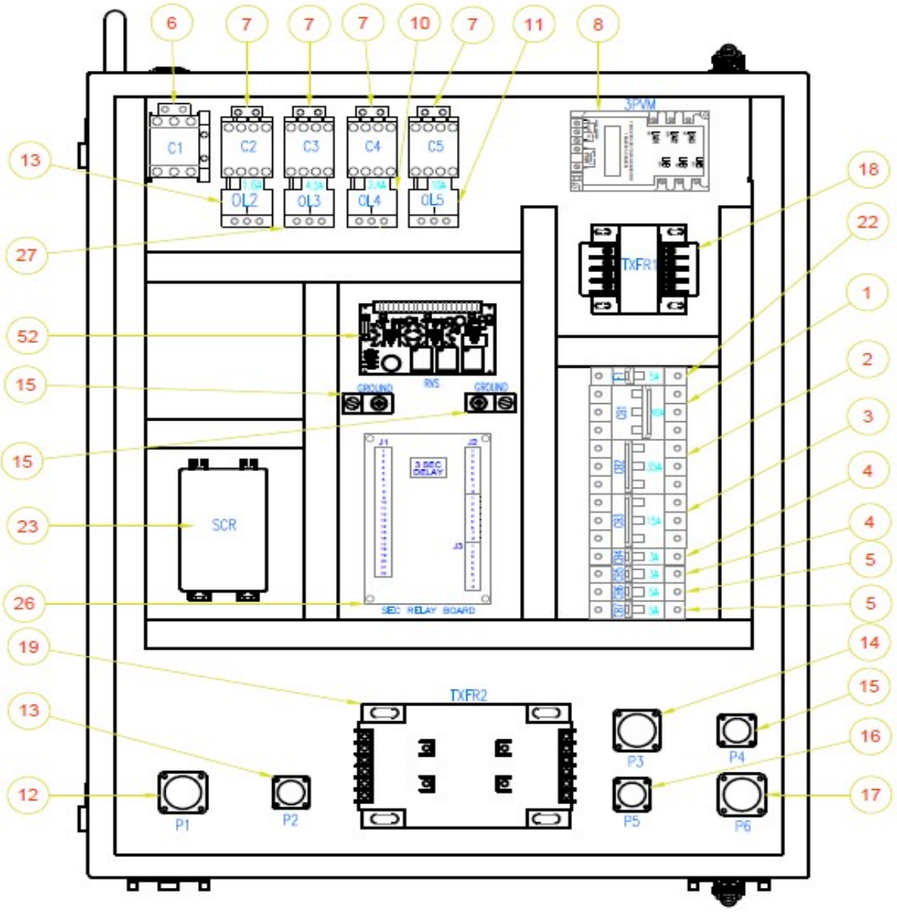
	CHECKED			
	DATE	02-10-2015	DRAWING NO. ES-M150-SYH-05	SIZE B / REV. 1.4
	SCALE	NO SCALE		



BILL OF MATERIALS				
ITEM	TAGS	QTY	PART NUMBER	DESCRIPTION
1	CB1	1	NPMN40-02-026	40A CIRCUIT BREAKER
2	CB2	1	NPMN40-02-027	35A CIRCUIT BREAKER
3	CB3	1	NPMN40-02-028	15A CIRCUIT BREAKER
4	CB4,CB5	2	NPMN40-02-030	3A CIRCUIT BREAKER
5	CB6,CB7	2	NPMN40-02-029	5A CIRCUIT BREAKER
6	C1	1	MN40-15-003	C37 CONTACTOR
7	C2,C3,C4,C5	4	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
8	3PVM	1	NPMN40-15-077	3-PHASE VOLTAGE MONITORING RELAY
10	OL4	1	MN40-15-014	CONDENSER OVERLOAD
11	OL5	1	MN40-15-011	COMPRESSOR OVERLOAD
12	P1	1	MN41-013-000-8	EVAP & HEATING POWER CONNECTION
13	OL2	1	MN40-15-012	OVERLOAD
14	P3	1	MN41-11-000	EBOX SIDE MAIN POWER CONNECTION
15	GROUND	2	MN40-04-002	GROUND LUG
17	P6	1	MN41-04-000	CONDENSOR POWER CONNECTION ASSY E-BOX SIDE
18	TXFR1	1	NPMN04-01-033-1	TRANSFORMER, 380VAC TO 24VAC 150VA
19	TXFR2	1	RMN04-01-044	50 - 60 HZ MULTI VOLTAGE TRANSFORMER
22	F1	1	MN40-02-013	FUSE 5 AMP
23	SCR	1	MN40-15-030	HEAT REGULATOR
26	SEC RELAY BOARD	1	MN50-16-000	SEC, RELAY BOARD ASSEMBLY
27	OL3	1	NPMN50-16-054	EVAP FAN OVELOAD
32	P2	1	MN41-06-000-B	COND./EVAP. CONNECTION ASSY E-BOX SIDE
39	P4	1	MN40-17-010	MINE LOGIC SYSTEM (MLS) E-BOX HARNESS
49	P5	1	MN41-06-000-A	CONDENSER CONNECTION ASSEMBLY E-BOX SIDE
52	RVS	1	NPMN52-23-004	REGULATED VOLTAGE SUPPLY

LEGEND

C#	CONTACTOR
OL#	THERMAL OVERLOAD RELAY
CB#	CIRCUIT BREAKER
TXFR#	TRANSFORMER
3PVM	3-PHASE MONITOR RELAY
MLC	RELAY CIRCUIT BOARD
SEC	RELAY CIRCUIT BOARD
P#	EBOX CONNECTOR
SCR	HEATER REGULATOR
GROUND	GROUND LUG
RVS	REGULATED DC VOLTAGE SUPPLY
HM	HOUR METER
F1	FUSE BLOCK WITH FUSE

REVISIONS				
REV	DESCRIPTION	DATE	RFPD/ECN	BY
1.0	INITIAL REVISION	2/13/2015		NH
1.1	CHANGED WIRE NUMBER OF COMPRESSOR HARNESS AS PER SHOP MARK UP	1/29/2016	ECN#486	NH
1.2	SWITCHED CONDENSER FAN L1 AND L3 AS PER SHOP MARK UP	2/16/2016	ECN#488	NH
1.3	UPDATE COMPRESSOR HARNESS COLOR AS PER MOLDED PLUG SUPPLIED BY VENDOR STARTING SERIAL# 1943 AND UP	2/6/2016	ECN#490	NH
1.4	UPDATE DRAWING TO REFLECT NEW TRANSFORMER CONNECTION	7/22/2016	ECN#500	NH

P&H Mine Air Systems

DWN BY	NH
CHECKED	
DATE	02-10-2015
SCALE	NO SCALE

TITLE
EBOX SEC
COMPONENT LAYOUT

SHEET 5 OF 6	PRODUCT MAS-1500 (380VAC 50HZ)		
DRAWING NO. ES-M150-SYH-05		SIZE B	REV. 1.4

SCHEMATIC BILLS OF MATERIALS

TAGS	QTY	PART NUMBER	DESCRIPTION
F1	1	MN40-02-013	FUSE 5 AMP
TB1	1	MN40-04-003	20 POSITION TERMINAL STRIP
COND.FAN	1	MN40-10-003	1500 CONDENSER FAN MOTOR
C1	1	MN40-15-003	C30 CONTACTOR
C2	1	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
C3,C4,C5	1	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
FS1,FS2	2	MN40-15-005	FAN SWITCH 130F
HL1,HL2	2	MN40-15-006	HIGH LIMIT (140F)
SCR	1	MN40-15-030	HEAT REGULATOR
AOS	1	MN40-15-033	AIR OUTSIDE SENSOR
P1	1	MN41-013-000-8	EVAP & HEATING POWER CONNECTION
P1A	1	RMN40-17-051	EVAP/HEATING DOUBLE END PLUG CABLE ASSY.
P1C	1	RMN40-17-052	6 PIN MALE EVAP/HEATING CABLE ASSY.
P1D,P1E	2	RMN40-17-053	7 PIN FEMALE FAN BLOWER CONTROL CABLE ASSY.
P1F,P1G	2	RMN40-17-054	EVAP FAN ASSY. W/CABLE PLUG
P2	1	MN41-06-000-B	COND./EVAP. CONNECTION ASSY E-BOX SIDE
P2A,P2B	2	RMN40-17-057	6 PIN FEMALE FAN BLOWER CONTROL CABLE ASSY.
P2C	1	RMN40-17-058	6 PIN MALE SAFETY CONTROL CABLE ASSY.
P3	1	MN41-11-000	EBOX SIDE MAIN POWER CONNECTION
P3A	1	MN40-12-002	MAIN POWER CONN. ASSY UNIT SIDE
P4	1	MN40-17-010	MINE LOGIC SYSTEM (MLS) E-BOX HARNESS
P4A	1	MN40-17-001	CABLE ASSY 5' (FORM MLC TO CAB)
P5A	1	MN41-05-000	CONDENSOR CONTROL CONNECTION
P5	1	MN41-06-000-A	CONDENSER CONNECTION ASSEMBLY E-BOX SIDE
P6	1	MN41-04-000	CONDENSOR POWER CONNECTION ASSY E-BOX SIDE
P6A	1	MN41-03-000	CONDENSOR POWER CONNECTION ASSY UNIT SIDE
SEC BOARD	1	MN50-16-000	SEC, RELAY BOARD ASSEMBLY
LPS	1	MN60-10-001	LOW PRESSURE SWITCH
HPS	1	MN60-10-003	HIGH PRESSURE SWITCH
PRESS.FAN	1	MN80-01-200	PRESSURIZER FAN
TXFR2	1	NPMN04-01-030	TRANSFORMER 480VAC 1.5KVA
TXFR1	1	NPMN04-01-032-1	TRANSFORMER, 480 TO 24VAC, 150VA
CAP,CAP3	2	NPMN07-01-044	PRESSURIZER STARTING CAPACITOR
CB1	1	NPMN40-02-027	35A CIRCUIT BREAKER
CB2	1	NPMN40-02-020	30A CIRCUIT BREAKER
CB3	1	NPMN40-02-028	15A CIRCUIT BREAKER
CB4	1	NPMN40-02-030	3A CIRCUIT BREAKER
CB5	1	NPMN40-02-030	3A CIRCUIT BREAKER
CB6	1	NPMN40-02-029	5A CIRCUIT BREAKER
CB7	1	NPMN40-02-029	5A CIRCUIT BREAKER
OL2	2	NPMN40-15-012	OVERLOAD
OL3	1	NPMN50-16-054	EVAP. FAN OVERLOAD
OL4	1	MN40-15-014	CONDENSER OVERLOAD
OL5	1	MN40-15-011	COMPRESSOR OVERLOAD
OHL	2	NPMN40-15-037	OPERATING HIGH LIMIT (180F)
HM	1	NPMN50-16-055	HOUR METER
RVS	1	NPMN52-23-004	REGULATED VOLTAGE SUPPLY
JB-TB	1	NPMNMA-00-006	COMP. JUNCTION BOX ASSY.
HEATER ASSY.	1	NPMNMA-15-075	HEATER ASSEMBLY
COMP.	1	NPMNMA-15-081	M150 COMPRESSOR MOTOR
M	1	PR-PK-251	PRESSURIZER
FAN1,FAN2	2	RMN40-17-054	EVAP FAN ASSY. W/CABLE PLUG

P&H Mine Air Systems

TITLE: SCHEMATIC BILL OF METERIALS

DWN BY	NH	SHEET 6 OF 6	PRODUCT MAS-1500 (480VAC 60HZ)
CHECKED			
DATE	02-12-2015	DRAWING NO. ES-M150-SXH-04	SIZE B / REV. 1.0
SCALE	NO SCALE		

SCHEMATIC BILLS OF MATERIALS

TAGS	QTY	PART NUMBER	DESCRIPTION
F1	1	MN40-02-013	FUSE 5 AMP
TB1	1	MN40-04-003	20 POSITION TERMINAL STRIP
COND.FAN	1	MN40-10-003	1500 CONDENSER FAN MOTOR
C1	1	MN40-15-003	C30 CONTACTOR
C2	1	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
C3,C4,C5	3	MN40-15-001	CONTACTOR'S AIR HANDLER/CONDENSER/PRESSURIZER
FS1,FS2	2	MN40-15-005	FAN SWITCH 130F
HL1,HL2	2	MN40-15-006	HIGH LIMIT (140F)
OL2	2	NPMN40-15-012	OVERLOAD
OL3	1	NPMN50-16-054	EVAP. FAN OVERLOAD
OL4	1	MN40-15-014	CONDENSER OVERLOAD
OL5	1	MN40-15-011	COMPRESSOR OVERLOAD
SCR	1	MN40-15-030	HEAT REGULATOR
AOS	1	MN40-15-033	AIR OUTSIDE SENSOR
P1	1	MN41-013-000-8	EVAP & HEATING POWER CONNECTION
P1A	1	RMN40-17-051	EVAP/HEATING DOUBLE END PLUG CABLE ASSY.
P1C	1	RMN40-17-052	6 PIN MALE EVAP/HEATING CABLE ASSY.
P1D,P1E	2	RMN40-17-053	7 PIN FEMALE FAN BLOWER CONTROL CABLE ASSY.
P1F,P1G	2	RMN40-17-054	EVAP FAN ASSY. W/CABLE PLUG
P2	1	MN41-06-000-B	COND./EVAP. CONNECTION ASSY E-BOX SIDE
P2A,P2B	2	RMN40-17-057	6 PIN FEMALE FAN BLOWER CONTROL CABLE ASSY.
P2C	1	RMN40-17-058	6 PIN MALE SAFETY CONTROL CABLE ASSY.
P3	1	MN41-11-000	EBOX SIDE MAIN POWER CONNECTION
P3A	1	MN40-12-002	MAIN POWER CONN. ASSY UNIT SIDE
P4	1	MN40-17-010	MINE LOGIC SYSTEM (MLS) E-BOX HARNESS
P4A	1	MN40-17-001	CABLE ASSY 5' (FORM MLC TO CAB)
P5	1	MN41-06-000-A	CONDENSER CONNECTION ASSEMBLY E-BOX SIDE
P5A	1	MN41-05-000	CONDENSOR CONTROL CONNECTION
P6	1	MN41-04-000	CONDENSOR POWER CONNECTION ASSY E-BOX SIDE
P6A	1	MN41-03-000	CONDENSOR POWER CONNECTION ASSY UNIT SIDE
SEC BOARD	1	MN50-16-000	SEC, RELAY BOARD ASSEMBLY
LPS	1	MN60-10-001	LOW PRESSURE SWITCH
HPS	1	MN60-10-003	HIGH PRESSURE SWITCH
PRESS.FAN	1	MN80-01-200	PRESSURIZER FAN
TXFR1	1	NPMN04-01-033-1	TRANSFORMER, 380 TO 24VAC, 150VA
TXFR2	1	RMN04-01-044	50 - 60 HZ MULTI VOLTAGE TRANSFORMER
CAP	1	NPMN07-01-044	PRESSURIZER STARTING CAPACITOR
CB1	1	NPMN40-02-026	40A CIRCUIT BREAKER
CB2	1	NPMN40-02-027	35A CIRCUIT BREAKER
CB3	1	NPMN40-02-028	15A CIRCUIT BREAKER
CB4	1	NPMN40-02-030	3A CIRCUIT BREAKER
CB5	1	NPMN40-02-030	3A CIRCUIT BREAKER
CB6	1	NPMN40-02-029	5A CIRCUIT BREAKER
CB7	1	NPMN40-02-029	5A CIRCUIT BREAKER
OHL	2	NPMN40-15-037	OPERATING HIGH LIMIT (180F)
HM	1	NPMN50-16-055	HOUR METER
RVS	1	NPMN52-23-004	REGULATED VOLTAGE SUPPLY
JB-TB	1	NPMNMA-00-006	COMP. JUNCTION BOX ASSY.
HEATER ASSY.	1	NPMNMA-15-075	HEATER ASSEMBLY
COMP.	1	NPMNMA-15-081	M150 COMPRESSOR MOTOR
M	1	PR-PK-251	PRESSURIZER
FAN1,FAN2	2	RMN40-17-054	EVAP FAN ASSY. W/CABLE PLUG

P&H Mine Air Systems

TITLE: SCHEMATIC BILL OF METERIALS

DWN BY	NH	SHEET 6 OF 6	PRODUCT MAS-1500 (380VAC 50HZ)
CHECKED			
DATE	02-10-2015	DRAWING NO. ES-M150-SYH-05	SIZE B / REV. 1.4
SCALE	NO SCALE		

5.0 PREVENTATIVE MAINTENANCE CHECK LIST

5.1 Daily

- Inspect and or blow out pressurizer filter
- Inspect and blow out in cab filter
- Inspect units for any visible damage
- Check power monitor – reset by turning unit ‘ON’ at the controller

5.2 Monthly

- Change cab and pressurizer filters
- Check drain trap vacuum valves, clean if required
- Inspect all diffusers and louvers
- Blow out condenser coil in cooling season
- Blow out evaporator coil
- Check all electrical connections, tighten if required
- Check all gaskets on lids and e-box, replace if required

5.3 Seasonal Cooling

- Blow out evaporator coil
- Blow out condenser coil
- Clean condensate drains
- Check condenser fan blades for tightness and bearing wear
- Check Amp draw of compressor and condenser
- Check Amp draw on high and low blower fan speed
- Check temperature control for correct cooling setting
- Check and tighten all electrical connections
- Visually inspect compressor and lines for breakage or leaks
- Check pressures and temperatures (Qualified HVAC Mechanic Required)
- Check overload settings (See manual for settings)
- Set overloads to manual

5.4 Seasonal Heating

- Change filters
- Ohm out heating elements (26 ohms for MAS-1500/480VAC 16 ohms 380VAC)
- Check Heating contactor
- Check Circuit breakers and fuse
- Check 4 to 20 ma signal for change in Amp draw
- Check heater elements (see page 22 for correct amp readings)
- Check air flow into cab
- Check controller operation
- Check fan and high limits
- Check and tighten all electrical connections

6.0 RECOMMENDED SPARE PARTS LIST

6.1 Spare Parts List, 480V/60Hz Units

PART#	DESCRIPTION	1 UNIT QTY	5 UNITS QTY	10 UNITS QTY
MN40-02-013	FUSE (5AMP- TRANSFORMER)	1	3	5
MN40-15-001	CONTACTOR	3	5	7
NPMN40-15-003	HEATING CONTACTOR	1	2	4
MN40-15-005	KLIXON (SAFETY-FAN)	2	3	5
MN40-15-006	KLIXON (SAFETY-HIGH LIMIT)	2	3	5
MN40-15-037	KLIXON (SAFETY-HIGH LIMIT)	2	3	5
MN40-15-012	OVERLOAD (PRESS. MOTOR)	2	3	5
MN40-15-011	OVERLOAD (COMP. MOTOR)	2	3	5
MN40-15-012	OVERLOAD- BLOWER FAN	1	2	2
NPMN52-23-004	REGULATED VOLTAGE SUPPLY	1	2	2
NPMN04-01-032	TRANSFORMER 480V/24V (CONTROL)	1	2	2
MN40-10-003	MOTOR (CONDENSER) 480V 3PH	1	2	2
RMN40-17-045	EVAP FAN ASSEMBLY WITH CABLE PLUG	1	2	2
MN60-10-001	SWITCH (LOW PRESS. SAFE.)	1	2	4
MN60-10-003	SWITCH (HIGH PRESS. SAFE.)	1	2	4
MN80-02-022	VALVE(PURFAK FILTER CANIS)	2	10	10
MN80-02-015	FILTER (HEALTH GUARD)	8/M0NTH	40/M0NTH	80/M0NTH
MN80-02-021	PRESSURIZER FILTER	1/MONTH	5/MONTH	10/MONTH
MN80-01-200	PR-PK-251 (480V / 60 Hz PRESSURIZER)	1	1	1
MN40-15-030	HEAT REGULATOR	1	2	4
MN40-15-048	HEATER ELEMENT	6	12	24
NPMNMA-15-075	HEATER RACK ASSEMBLY	1	1	1
NPMN04-01-030	TRANSFORMER 480V/240V (EVAP FAN)	1	2	2

6.2 Spare Parts List, 380V/50Hz Units

PART#	DESCRIPTION	1 UNIT QTY	5 UNITS QTY	10 UNITS QTY
MN40-15-001	CONTACTOR	3	5	7
NPMN40-15-003	HEATING CONTACTOR	1	2	4
MN40-15-005	KLIXON (SAFETY-FAN)	2	3	5
MN40-15-006	KLIXON (SAFETY-HIGH LIMIT)	2	3	5
MN40-15-037	KLIXON (SAFETY-HIGH LIMIT)	2	3	5
MN40-15-012	OVERLOAD (PRESS. MOTOR)	2	3	5
MN40-15-011	OVERLOAD (COMP. MOTOR)	2	3	5
MN40-15-012	OVERLOAD-HIGH SPEED BLOWER	1	2	2
MN40-02-013	FUSE (5AMP-TRANSFORMER)	1	3	5
NPMN52-23-004	REGULATED VOLTAGE SUPPLY	1	2	2
NPMN04-01-033	TRANSFORMER 380V/24V (CONTROL)	1	2	2
MN40-10-003	MOTOR (CONDENSER) 380V 3PH	1	2	2
RMN40-17-045	EVAP FAN ASSEMBLY WITH CABLE PLUG	1	2	4
MN60-10-001	SWITCH (LOW PRESS. SAFE.)	1	2	4
MN60-10-003	SWITCH (HIGH PRESS. SAFE.)	1	2	4
MN80-02-022	VALVE(PURFAK FILTER CANIS)	2	10	10
MN80-02-015	FILTER (HEALTH GUARD)	8/M0NTH	40/M0NTH	80/M0NTH
MN80-02-021	PRESSURIZER FILTER	1/MONTH	5/MONTH	10/MONTH
MN80-01-207	PR-PK-251 (380V / 50 Hz PRESSURIZER)	1	1	1
MN40-15-030	HEAT REGULATOR	1	2	4
MN40-15-043	HEATER ELEMENT	6	12	24
NPMNMA-15-075-380	HEATER RACK ASSEMBLY	1	1	1
RMN04-01-044	TRANSFORMER 380V/240V (EVAP FAN)	1	2	3

6.3 MLC Controlled Unit Spare Parts List

PART#	DESCRIPTION	1 UNIT QTY	5 UNITS QTY	10 UNITS QTY
NPMN50-12-000D	CONTROLLER MLC	1	2	2
MN52-23-002	MLC RELAY BOARD (Has 6 Relays)	1	2	2

6.4 SEC Controlled Unit Spare Parts List

PART#	DESCRIPTION	1 UNIT QTY	5 UNITS QTY	10 UNITS QTY
MN50-14-000C	CONTROLLER SEC	1	2	2
MN50-16-000	SEC RELAY BOARD	1	2	2

7.0 NOTES

8.0 UNIT OVERVIEW & SPECIFICATIONS

Feature	Specification	Feature	Specification
Description	Deck Mounted Climate Control System w. Integral Pressurizer	**Exchangeability**	Complete system - 60 min Electrical module - 20 min Control Module - 10 min
Electrical	480 VAC, 3 Phase, 60 Cycle 380 VAC, 3 Phase, 50 Cycle	**Switch Gear**	High Quality contactors and thermal overloads on all circuits. Safety contactor, fuses, auto-reset and main reset limits - heaters. Circuit breakers on main, heater and control circuits
Recirculated Air Flow	High Speed - 1500 CFM Low Speed - 1000 CFM Dual single inlet forward curved fans	**Cooling Capacity**	45,000 Btu/hr @ 75 deg F DB/65 deg F WB.
Safety Controls	Field replaceable without refrigerant loss. Digitally monitored low and high pressure.	**Capacity Control**	Low load idle (hot gas bypass) valve. External equalized thermostatic expansion valve.
Compressor	ROHS Compliant Scroll, hermetically sealed	**Compressor Oil**	Polyolester (POE)
Refrigerant	R-407C	**Heating Capacity**	18.0 kW @ 380 or 480VAC Fully proportional control from 0-100% of capacity (stageless)
Pressurization	170 CFM @ 60 Cycle with clean filter, 20% reduction at change interval. Self cleaning pre-cleaner. Maintainable second stage filter cup. Donaldson radial seal disposable filter element (no fasteners). Cast aluminum, high speed impellor, operating range 7" w.c.	**Control**	Standard Electronic Controller (SEC) – analog control Mine Logic Controller (MLC) – digital control
Filter	Disposable 65%(Merv 8) efficient filter. Custom filters to suit individual requirements available by special order only	**Construction**	Case: 16 gauge 316 stainless steel, polished finish. Coils: copper tube/copper fin - 8 fins/in
Physical Size	46.75” long x 36.50” wide x 33.50” high (1187mm x 927mm x 851mm)	**Weight**	800lbs (363kg)