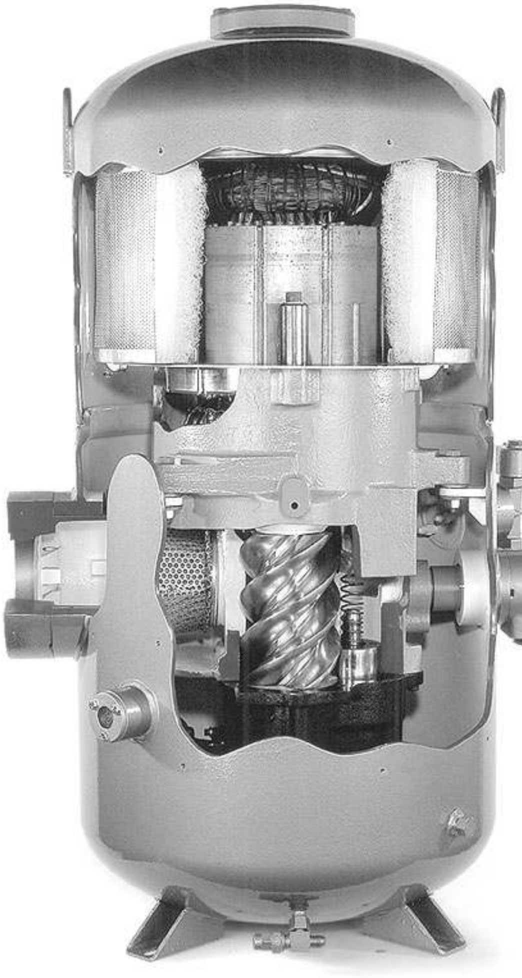
MSC-127 Series

Installation, Operation & Maintenance Instructions

Medium Screw Compressors



HARTFORD®
COMPRESSORS
Pioneers in Screw Compressor Technology

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INTRODUCTION

To ensure satisfactory operation and to avoid costly damage to the compressor, the installation, pre-start checkup and start-up, as well as maintenance, must be done by a service person who is qualified and authorized by the original equipment manufacturer.

Start-up documentation must be provided for new and replacement compressors at time of installation, in order to validate the warranty.

It is not the intent of this manual to give complete compressor specifications, but only to provide information necessary to guard against some common installation and operation problems. Only in regard to specific warnings and cautions will this manual take precedence over instruction supplied by the manufacturer of the package equipment.

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I. GENERAL INFORMATION

A. COMPRESSOR OUTLINE DRAWINGS

Figure 1. Compressor Outline Drawing (in inches unless specified)

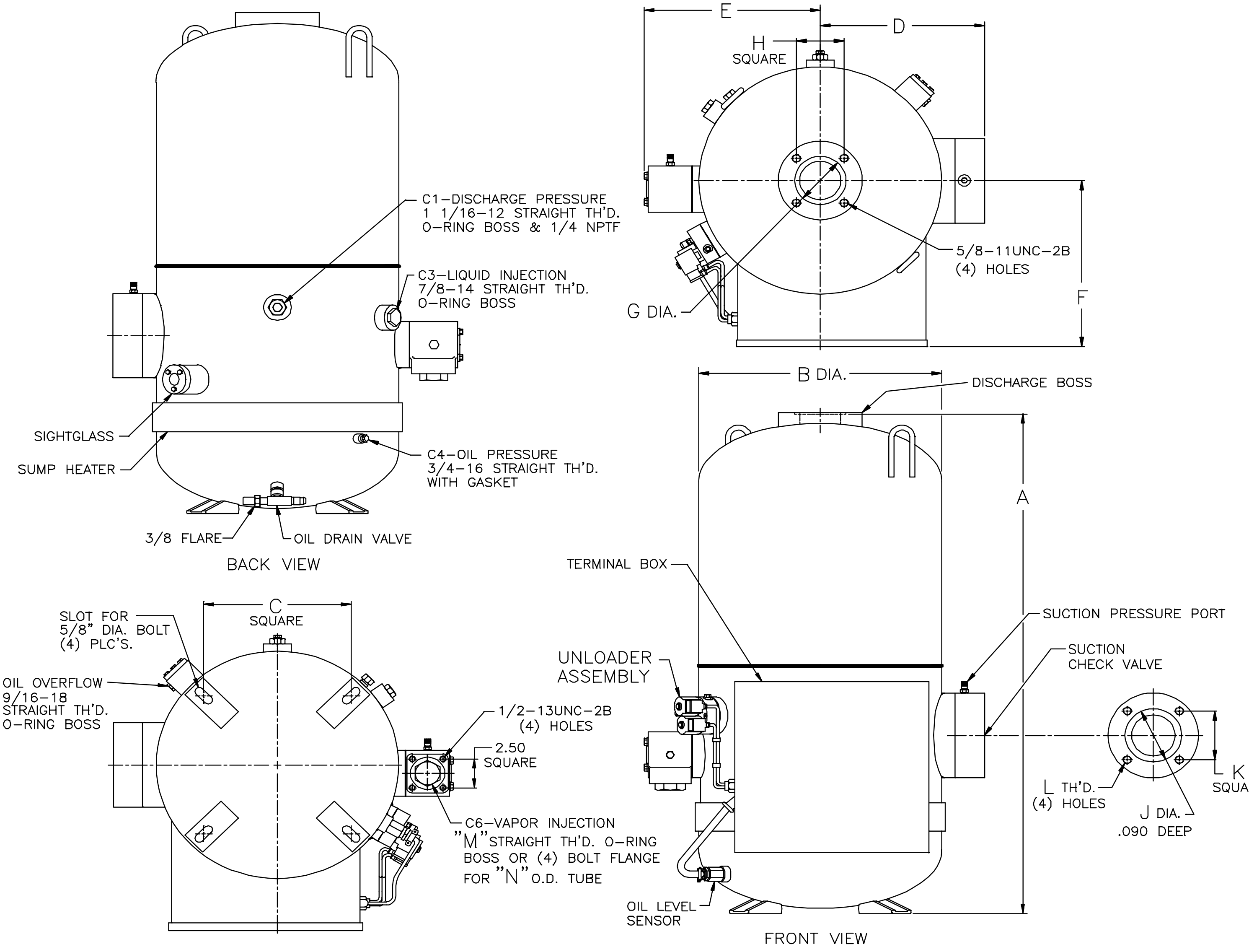


Table 1. Compressor Dimensions in inches (mm)

Models	A	B	C	D	E	F	G	H	J	K	L	M	N
1210K/1212K	43.4 (1102)	19.8 (502)	12.0 (305)	13.1 (332)	14.3 (364)	14.4 (366)	4.2 (106)	3.9 (99)	4.6 (118)	4.3 (108)	$^{5}/_{8}$ - 11	$1^{5}/_{8}$ - 12	$1^{3}/_{8}$ O.D.
1215K/1218K	47.3 (1200)	21.8 (555)	14.0 (356)	14.2 (361)	15.3 (389)	16.5 (419)	4.6 (118)	4.3 (108)	5.2 (132)	4.8 (122)	$^{3}/_{4}$ - 10	$1^{7}/_{8}$ - 12	$1^{5}/_{8}$ O.D.

I. GENERAL INFORMATION *(cont.)*

B. MODEL NOMENCLATURE

*

12 15 N H F 6 W 4 K 0EM BJ O C

ROTOR DIAMETER

12 = 127 mm

ROTOR L/D RATIO

10 = 1.00

12 = 1.25

15 = 1.50

18 = 1.80

COMPRESSOR TYPE

B = Flanged semi-hermetic female drive

N = Fully hermetic female drive

TEMPERATURE APPLICATION

H = High temperature

L = Commercial temperature

U = Low temperature

REFRIGERANT

F = R22, R404A, R407C, R507

L = R134a

UNLOADING CONFIGURATION

6 = Automatic unloaded start (spring)

INJECTION MODE

V = Vapor & liquid injection	(water cooled)
W = Vapor injection only	(water & air cooled)
X = Vapor & liquid injection	(air cooled)

CONTROL VOLTAGE

C = 115/1/50-60

J = 230/1/50-60

START METHOD

0 = Two step-double-delta

MOTOR VOLTAGE

AK = 200/3/60

AM = 220/3/50

BJ = 400-460/3/50-60

BK = 200-230/3/50-60

CA = 500-575/3/50-60

CS = 346-400/3/50-60

ASSEMBLY LEVEL

0EM = Original Equipment Mfg.

RMF = Remanufactured

COMPRESSOR VERSION

K = w/cast iron main housing and inlet needle bearings

J = 1215 / 1216 RMF only

MOTOR SIZING

3 = Undersize by 2 steps

4 = Undersize by 1 step

5 = Nominal

6 = Oversized by 1 step

* For special engineered compressors, these six characters would be replaced by "SE".
Example: 1215SE1271KOEMBJO

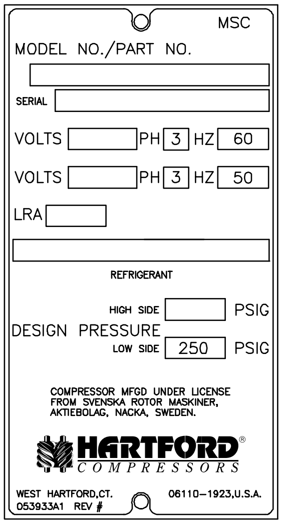


FIGURE 3. Nameplate

C. APPROVED REFRIGERANTS AND OIL

1. Refrigerants: R22, R407C, R404A, R507, and R134a are approved for use in this compressor. For refrigerant conversions please contact the HCI Application Engineering Department.
2. Refrigerant Oils: Several readily available refrigerant oils have been approved. The compressor is shipped with a charge of 68 ISO (300 SUS or 68 ISO) mineral refrigerant oil except for R134a (NHL) models unless otherwise specified.

Note: Synthetic oils are required for R134a, R407C, R404A, R507 and special applications. Please consult the HCI Application Engineering department.

WARNING: Use only Hartford Compressors approved refrigeration oil. Warranty will be void if other oil is used.

Initial compressor oil charge is listed by compressor size in ***Table 2***.

Table 2. Approximate Oil Charge

MODEL	U.S. GALLONS	LITERS
1210K	9.9	37.3
1212K	8.9	33.5
1215K	12.0	45.2
1218K	11.5	43.3

D. OIL ANALYSIS

HCI recommends the use of an oil analysis program as a preventative maintenance tool. To receive the maximum benefit of this program, samples should be taken three times per year for compressors operating twelve months annually and twice per year for seasonal operation such as seasonal air conditioning. This will allow you to analyze the samples as trend analysis. The recommended test will include analysis for wear metal contamination, contaminants, moisture, acid and viscosity. If you do not have a local laboratory that can provide this analysis, we provide this service with our Oil Kare® Program. Oil Kare® Kits may be ordered from our Customer Service department. The kit number is 053498A.

E. COMPRESSOR WEIGHTS

The approximate weights for hermetic compressors are listed by model number in ***Table 3***. For flanged compressors, add 170 lb. (77 kg) for 1210/1212 models and 200 lb. (91 kg) for 1215/1218 models to the weights listed below.

Table 3. Hermetic Compressor Weights (uncrated)

MODEL	LB	KG
1212NUF6V5K	1002	455
1212NLF6V5K	1002	455
1212NHL6V5K	884*	402*
1212NHF6W3K	963	438
1212NHF6W4K	983	447
1212NHF6X6K	1020	464
1210NUF6V5K	990	450
1210NLF6V5K	990	450
1210NHL6V5K	867*	394*
1210NHF6W3K	948	431
1210NHF6W4K	968	440
1210NHF6X6K	1010	459

MODEL	LB	KG
1215NHF6X6K	1265	575
1215NHF6W4K	1225	557
1215NHF6W3K	1205	548
1215NHL6V5K	1109*	504*
1215NLF6V5K	1250	568
1215NUF6V5K	1250	568
1218NHF6X6K	1260	573
1218NHF6W4K	1230	559
1218NHF6W3K	1214	552
1218NHL6V5K	1120*	509*

* Compressor shipped less oil

II. INSTALLATION

A. RECEIVING INSPECTION

The compressor, whether received as part of a unit or as a bare compressor, must be checked in the presence of the carrier's representative for any evidence of damage during shipping. Any damage or missing parts must be immediately documented with the carrier.

Should the compressor, carton, or skid show any signs of being dropped or mishandled, such damage must be reported since it may have caused internal damage to the compressor. A damage claim should then be filed by the purchaser against the delivering carrier, since all shipments are made at the purchaser's risk.

B. COMPRESSOR STORAGE

These compressors have hermetic motors which must be protected from contaminants, whether introduced during operation via refrigerant and oil or during storage.

During storage the compressor must be maintained under positive pressure. A gauge and a monthly inspection log are required and must be verifiable for warranty purposes. A nominal charge of dry refrigerant, or nitrogen of 35 psig (241 kPa) is required. Charge must be added to maintain a minimum of 25 psig (172 kPa). Dry air is not allowable in the compressor under any circumstances.

For prolonged storage, place a plastic cover over the entire compressor to protect the electrical terminal box from dust and other atmospheric contaminants. Also, the torques should be checked annually (see ***Table 4*** & ***Table 5***).

Table 4. Torque Values

DESCRIPTION	NOMINAL BOLT SIZE	TORQUE (LB-FT)	MODELS
Discharge shipping cover	5/8-11 Hex	80	ALL
Suction shipping cover	3/4-10 Hex	100	1215K/1218K
Suction shipping cover	5/8-11 Hex	80	1210K/1212K
Four post feed through	#10-32 Soc	5	ALL
Vapor injection transfer tube	3/8-16 Hex	30	ALL
Sight glass to sight glass boss	1/4-20 Hex	8	ALL

C. PIPING CONNECTIONS

1. General: The compressor is shipped with a holding charge. Care must be taken to relieve the holding charge when the cover plates are removed.

   The compressor is supplied with the suction check valve. No discharge check valve is provided. Cover plates are used for shipping purposes.

2. Discharge Relief Valve (not supplied as standard): This valve is required by the national and local codes if a discharge service valve is used. Relief valve venting must conform to local codes and ARI requirements. MSC-127 models use a nominal 3/4 inch size set at 400 psig (2760 kPa).

3. Discharge Line Check Valve: Discharge check valves must be used when systems have compressors connected in parallel, remote condensers, or multiple circuits with common condensing water supply. This is to prevent refrigerant migration which degrades the viscosity of the oil when a given compressor is in the off cycle. The check valve should have a soft seat and positive seal. They are required whether the compressors have discharge service valves or not. Line sizes in ***Table 6***.

Table 5. Valve Kits

VALVE KIT	MODEL #	PART #	COMMENTS
Suction Service Valve	1210K/1212K	053572A2	Torque bolts to 150 lb-ft (204 N-m)
	1215K/1218K	053572A6	Torque bolts to 260 lb-ft (354 N-m)
Discharge Service Valve	1210K/1212K	053572A1	Torque bolts to 150 lb-ft (204 N-m)
	1215K/1218K	053572A2	Torque bolts to 150 lb-ft (204 N-m)
Relief Valve	ALL	054047A1	Kit includes relief valves and elbow fitting
Discharge Check Valve	1210K/1212K	055989A1	Kit includes check valve, gasket, spacer ring and bolts
	1215K/1218K	055989A2	

Table 6. Displacement and Line Sizes

	SUCTION DISPLACEMENT		LINE SIZES	
MODEL	60 HZ	50 HZ	SUCTION	DISCHARGE
1210K	186.2 CFM	262.1 M^3/HR	3 5/8” ODS	3 1/8” ODS
1212K	232.7 CFM	327.6 M^3/HR	3 5/8” ODS	3 1/8” ODS
1215K	278.9 CFM	392.6 M^3/HR	4 1/8” ODS	3 5/8” ODS
1218K	334.7 CFM	468.6 M^3/HR	4 1/8” ODS	3 5/8” ODS

D. LIQUID INJECTION

Liquid injection is used to control the compressor discharge temperature. Liquid is injected to an intermediate pressure which is isolated from the compressor suction, thus having a negligible impact on compressor capacity.

Compressors require liquid injection under certain operating conditions in order to provide additional motor cooling or discharge temperature control. Compressors on systems with air-cooled condensers are equipped with liquid injection arrangements as standard. Compressors on water-cooled or evaporative-cooled systems may require liquid injection under one or more of the following conditions:

1. High suction superheat.
2. High saturated discharge temperature with low saturated suction temperature.
3. Continuous operation near full unload.
4. Unbalanced Line Voltage.
5. Voltage over or near limits in ***Table 7***.

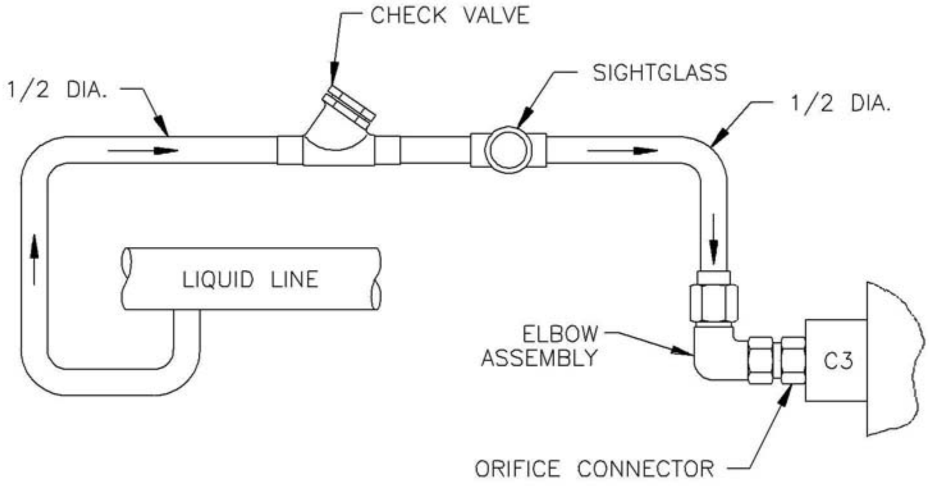
The liquid supply to the TX valve or orifice fitting must be subcooled to a minimum of 10°F (5°C) to ensure proper liquid flow. The liquid injection piping must be steel and a sight glass is recommended prior to the restriction.

The liquid connection must be made to the main liquid supply line, downstream from the main filter/drier and main liquid line solenoid valve. The liquid connection must be to the bottom of the main liquid line. The total length of steel tubing connection should be kept to a minimum.

Three types of liquid injection are offered depending upon the compressors operating conditions.

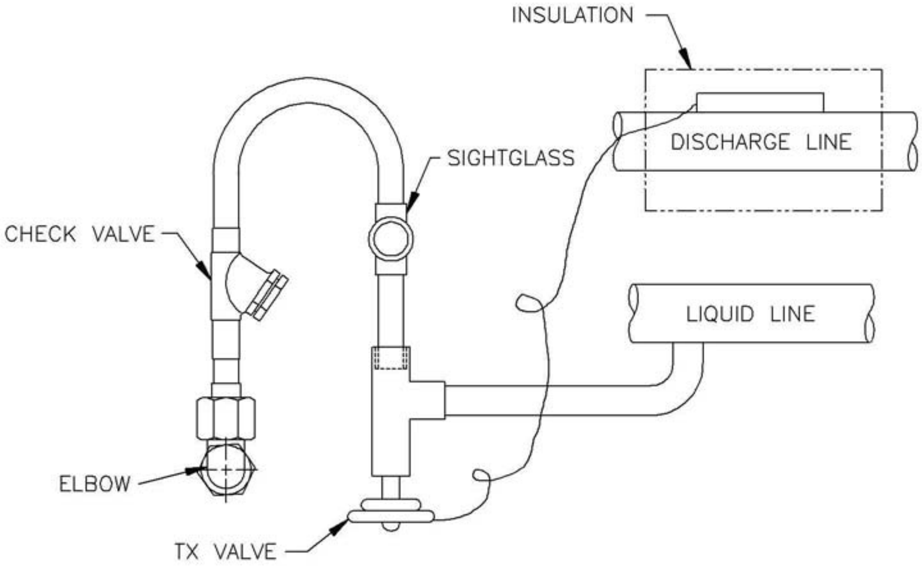
1. **Liquid Injection with Orifice (*Figure 3*) -** When using R22, a fixed orifice allows a continuous flow of liquid to the compressor when it is operating. This liquid injection arrangement is designed for operation 115°F (46 °C) to 130°F (54.4°C) SDT and 20°F (-7°C) to 50°F (10°C) SST. Operation outside of these limits with this arrangement is not allowed.

Figure 3. Liquid Injection with Orifice



2. **Liquid Injection with TX Valve (see Figure 4) -** This type utilizes an expansion valve to control the liquid feed to the compressor, reacting to and controlling the discharge temperature. This TX valve must be adjusted to maintain a maximum discharge temperature of 170°F (76°C) and a minimum discharge superheat of 20°F (11°C) under all conditions.This method is specified for two types of applications:
   a) **Low Temperature Applications -50°F (-46°C) to 20°F (-7°C) SST:** When condensing temperature is less than 125°F (51.7°C), which applies to all NLF and NUF Models.
   b) **Condensing Temperature up to 145°F (62.8°C) for R22 Compressors:** Applicable for NHF6X6 Models.

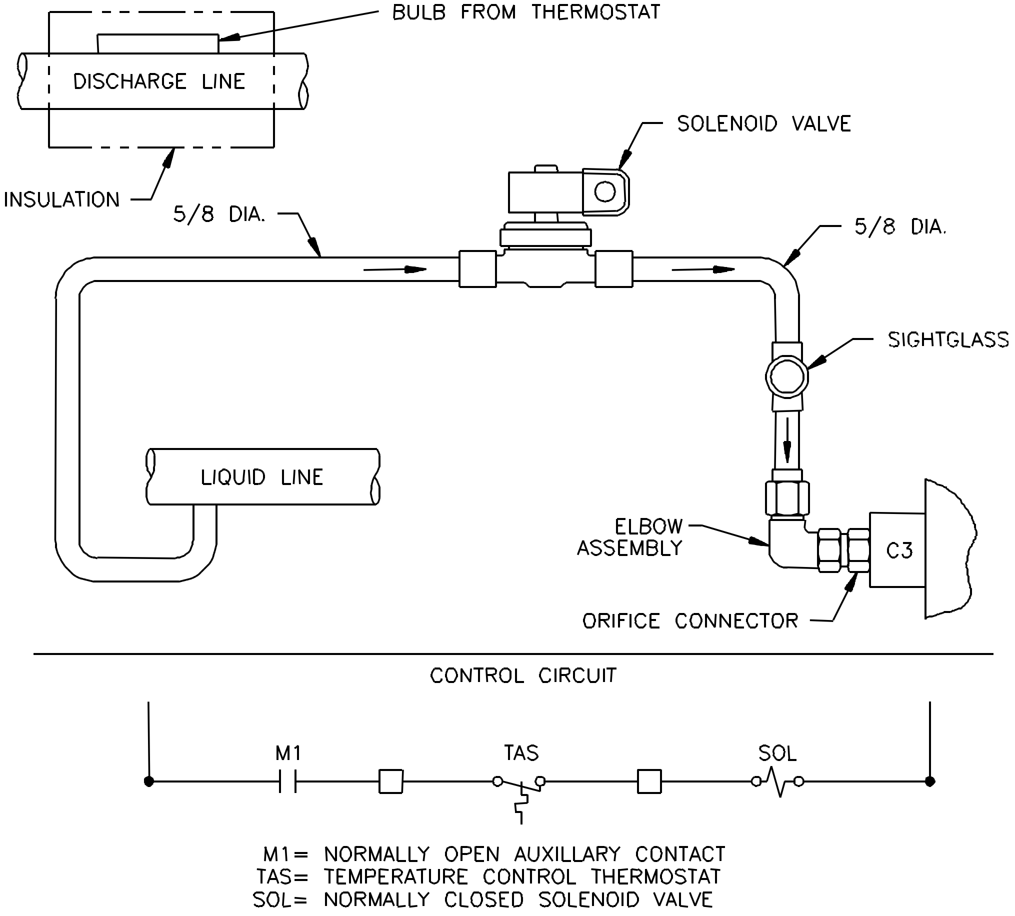
Figure 4. Liquid Injection with TX Valve



3. **Liquid Injection with Orifice, Solenoid Valve, and Thermostat (*Figure 5*) -** This type is only applicable for R134a applications from 115-145°F (46-63°C) SDT. It utilizes a fixed orifice and a solenoid valve which opens responding to a thermostat connected to the discharge pipe.

   The thermostat bulb controlling the solenoid valve, must be located within 12 inches of the discharge connection at the compressor. The bulb must be installed in a bulbwell in direct contact with the discharge line, with heat transfer paste and insulated to minimize response time.

Figure 5. Liquid Injection Arrangement with Orifice, Solenoid Valve, and Thermostat



E. EVACUATION AND DEHYDRATION

The compressor is shipped with a positive pressure holding charge of dry nitrogen to protect the motor and other components from moisture contamination. During the installation of the compressor, when individual connections are being made, precautions must be taken to:

1. Keep ports closed until just prior to making individual connections.
2. Provide dry nitrogen flow in the direction away from the compressor when brazing or welding.
3. Ensure that no water is introduced while cooling (wet-ragging) the brazed or welded joints.
4. Ensure that all the lines and fittings used are clean and no solid contaminants are introduced.

The complete unit, including the compressor, has to be dehydrated and evacuated of all the nitrogen holding charge and/or other non-condensables, as well as moisture, using the following procedure:

1. Open all the shut-off valves and/or control isolation valves (do not back-seat).
2. Connect a vacuum line to the most convenient available fitting that is equipped with a shut-off valve.
3. Pull the vacuum down to a minimum 300 microns.
4. Shut off or isolate the vacuum pump and observe the loss of vacuum for 30 minutes. If vacuum reading rises above 800 microns, the process must be repeated.
5. If more than one compressor is piped into the circuit, wait an additional 30 minutes for each compressor to take the vacuum reading.

Do not operate any compressor until this procedure has been successfully completed.

F. ELECTRICAL

The medium screw compressor requires special attention to the following items:

Motor terminal connections
Correct motor rotation
Moisture
Control Wiring

Proceed with the following checks before starting the compressor:

1. VOLTAGES: Main power and control circuit voltages are shown in the model nomenclature located on the nameplate.

   Hartford Compressors' policy is to nameplate the compressor with the design voltage and allow its use on networks where the voltage never goes outside the minimum and maximum voltages for that motor. See ***Table 7*** for Voltage Ranges. In no case will the compressor be nameplated with the network voltage as this may imply an acceptable voltage range for which the motor may not be designed.

   Voltages should be balanced as closely as possible. Unbalanced voltages will cause unbalanced currents approximately 5 times higher than the voltage unbalance.

   To avoid possible damage to the motor and operate most efficiently, the voltage unbalance should never reach 2%. Should an unbalance of over 1% persist, the power supply line load distribution should be checked and corrected or the power company should be contacted to correct the situation.

   Unbalance can be calculated as follows:

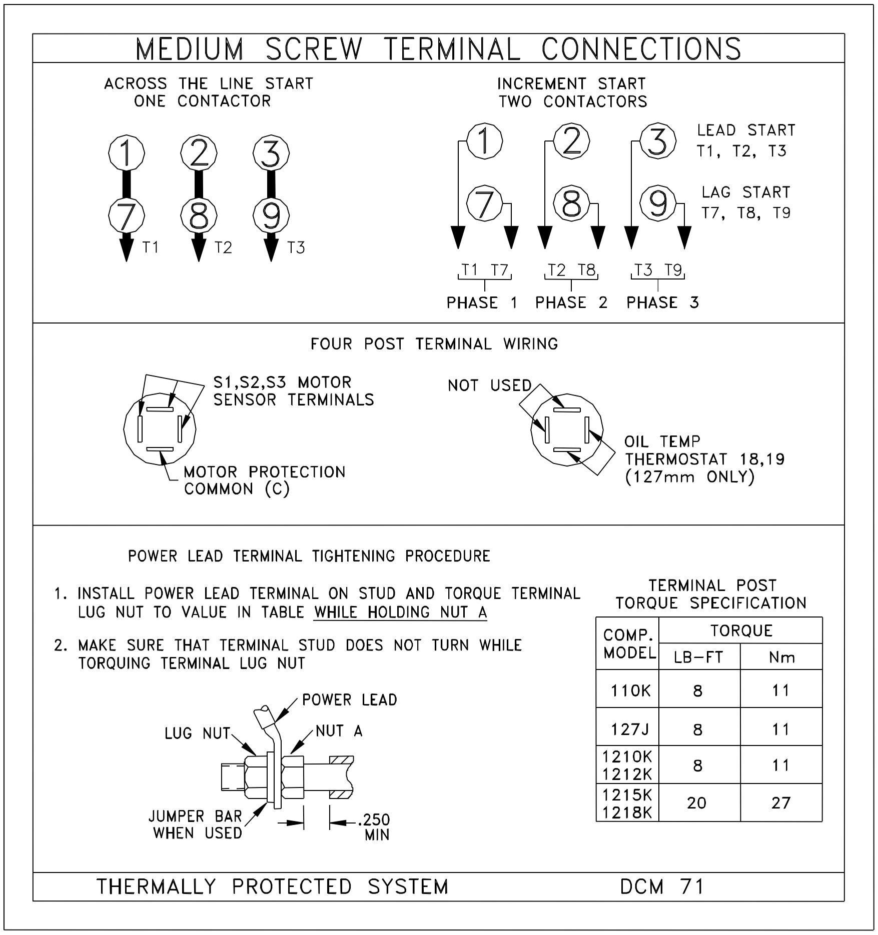
   % Voltage Unbalance = 100 x (Maximum Voltage Deviation)/(Average Voltage)

Table 7. Voltage Ranges

DESIGN VOLTAGE	VOLTAGE RANGES		STANDARD NETWORK VOLTAGES
	MIN.	MAX.	
200/3/60	180	220	200, 208
230/3/60	207	253	220, 230, 240
400/3/60	360	440	380, 400, 415
460/3/60	414	506	440, 460, 480
575/3/60	518	632	550, 575, 600
200/3/50	180	220	200
220/3/50	198	242	220
346/3/50	311	380	346
400/3/50	360	440	380, 400, 415
500/3/50	450	550	500

2. ROTATION: Medium screw compressors must not be allowed to rotate in the reverse direction. This will cause serious damage to the compressor and void the warranty. To verify and ensure the correct rotation, it is mandatory that the power leads are checked for proper phase sequence just before startup.

Figure 6. Terminal Box Decal



MEDIUM SCREW TERMINAL CONNECTIONS

POWER LEAD TERMINAL TIGHTENING PROCEDURE

1. INSTALL POWER LEAD TERMINAL ON STUD AND TORQUE TERMINAL LUG NUT TO VALUE IN TABLE <u>WHILE HOLDING NUT A</u>
2. MAKE SURE THAT TERMINAL STUD DOES NOT TURN WHILE TORQUING TERMINAL LUG NUT

TERMINAL POST TORQUE SPECIFICATION

COMP. MODEL	TORQUE	
	LB-FT	Nm
110K	8	11
127J	8	11
1210K 1212K	8	11
1215K 1218K	20	27

THERMALLY PROTECTED SYSTEM DCM 71

3. MOTOR WIRING: Follow the wiring diagram instruction located on the inside of the terminal box cover (***Figure 6***) when connecting the motor terminal leads.

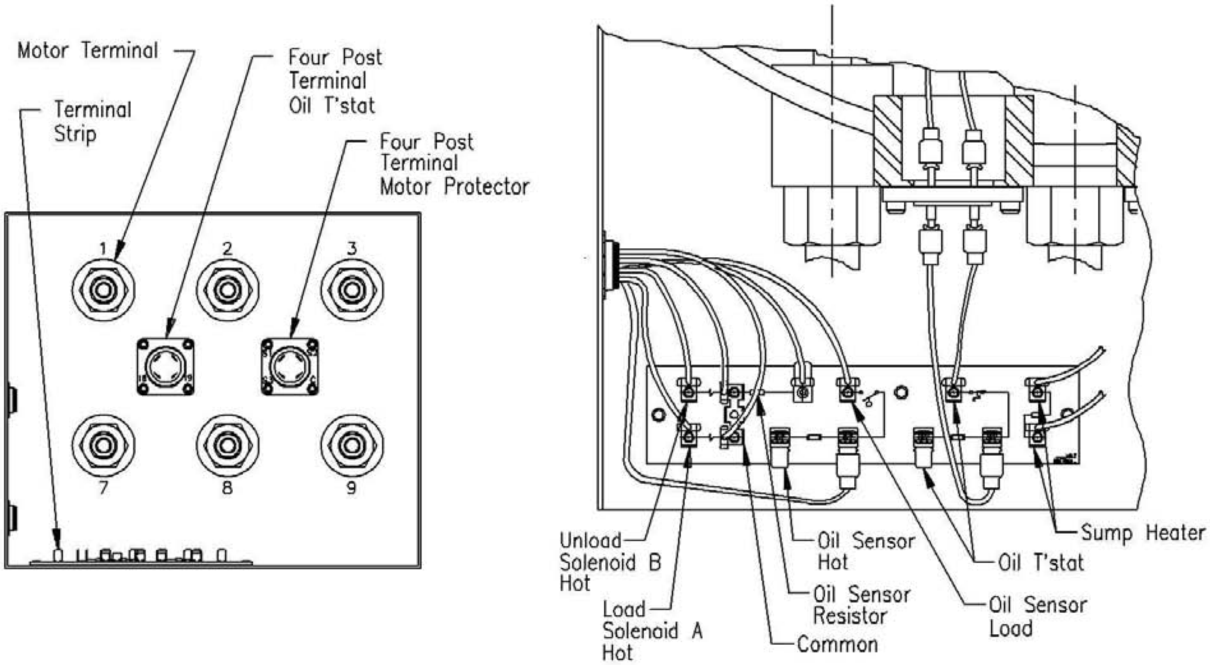
   For Double-Delta (stepped) start, the transition time between the lead and lag contactors must be less than 1 second.

   For across-the-line start, jumper bar kits are available for 1210K and 1212K models only. Hartford Compressors Part #053622A2

   For information on contactor and current overload sizing, contact the original equipment manufacturer.

4. CONTROL WIRING: Control wiring connections for the motor protector, sump heater, oil level sensor, thermostat, and unloader coils is located inside the compressor terminal box. The connections are 1/4 inch push-on terminals and the voltage is either 115 or 230 Volts depending on the compressor model number. See ***Figure 7*** for schematic.

Figure 7. Terminal Box



Terminal Box, Front View

Terminal Strip, Top View

a) Standard Motor Protector: All connections are to be made in accordance with the wiring diagrams in ***Figures 8*** and ***9***. Identify all terminals before connecting the motor protector. The motor protector switch must show a closed circuit with the common, marked “C”, and the resistance readings should be in accordance with the values given in ***Table 8***.

The internal motor protection sensors are to be wired directly to the motor protection module without going through any terminal board. The terminal with the four connections is located on the compressor within the terminal box identified by sensor terminals “S1”, “S2”, “S3” and “C” for common. The module is shipped loose and should be mounted remotely in the unit control panel.

Caution: Do not apply more than 6 Volts to the motor sensor leads!

Figure 8. Sample Control Wiring Diagram with RobertShaw Motor Protector

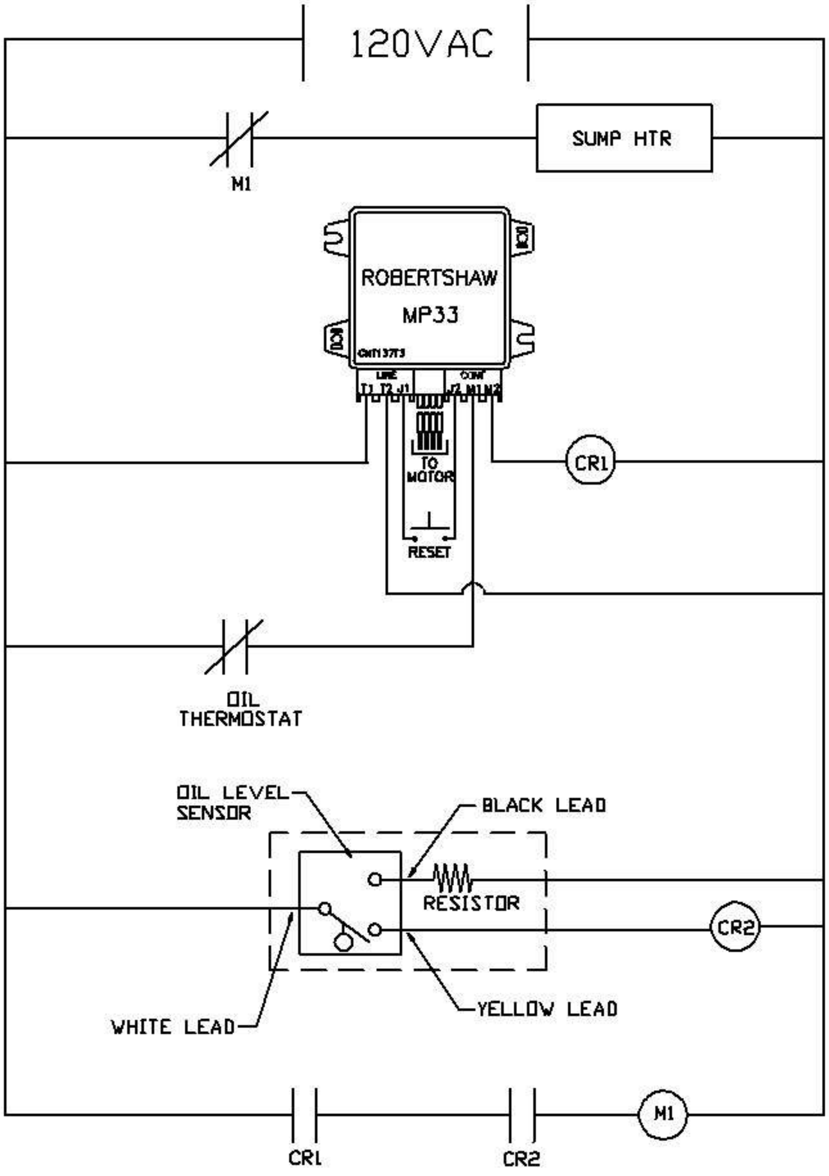


Figure 9. Sample Control Wiring Diagram with TI Klixon Motor Protector

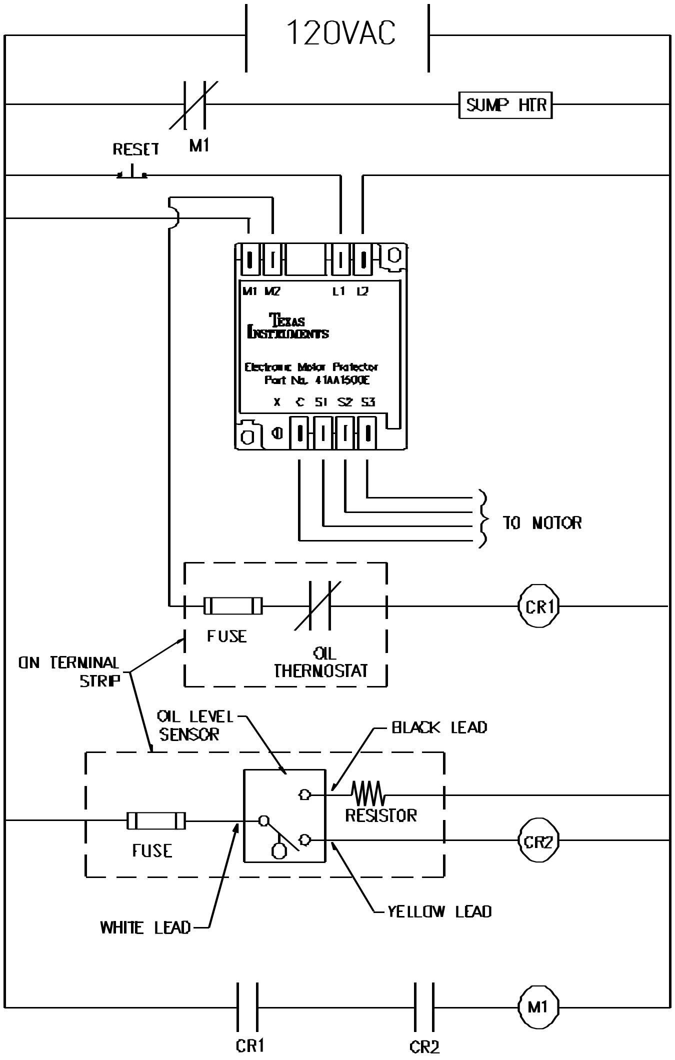
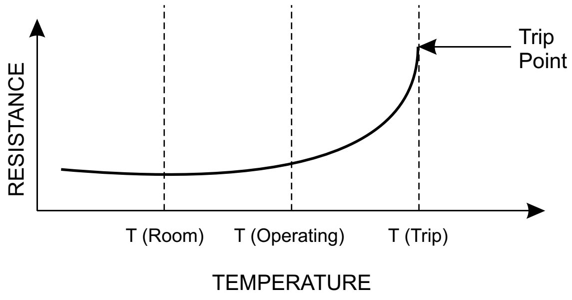


Table 8. Motor Sensor Resistances and Trip Points

SENSOR	**ROOM TEMP 77°F (25°C)**	**OPERATING TEMP 170°F (76.7°C)**	**TRIP POINT TEMP AT MODULE 305°F (152°C)**
ROBERTSHAW	76	94	124
Texas Instruments	500 2,500	< 2,500	5000
Kriwan	10-100	< 100	13,500

NOTE: The T.I. and the Kriwan sensors will have low resistance readings until just before reaching the trip points. At that point, the resistance will increase rapidly until it reaches the trip point.



b) TI 2ACE Motor Protector: The 2ACE solid state motor protection module provides current and thermal overload protection. This device monitors motor temperature via thermistor sensors installed in the motor windings. The module responds to the change in resistance when one or more of the sensors is exposed to trip temperature. The module will in turn shut off the output control relay, de-energizing the motor's pilot circuit.

To protect against current overload, the module monitors the current in each phase and reacts just like a solid state overload relay; it utilizes a trip curve based on an adjustable must hold amp setting. The current transducers are also used to protect against phase loss, current unbalance and miswire.

Calibrate the module using the 8 position DIP switch on the back of the module. The calibration is set using binary logic and can be set in 1 amp increments from 25 - 225 amps. The DIP switches are labeled 1 to 8 with 1 representing the most significant bit and 8 representing the least significant bit. The value of each switch in the on position is tabulated below. Add together the values of the on DIP switches to arrive at the MHA value.

Table 9. DIP Switch Values

DIP switch #	1	2	3	4	5	6	7	8
DIP switch amp value (on)	128	64	32	16	8	4	2	1

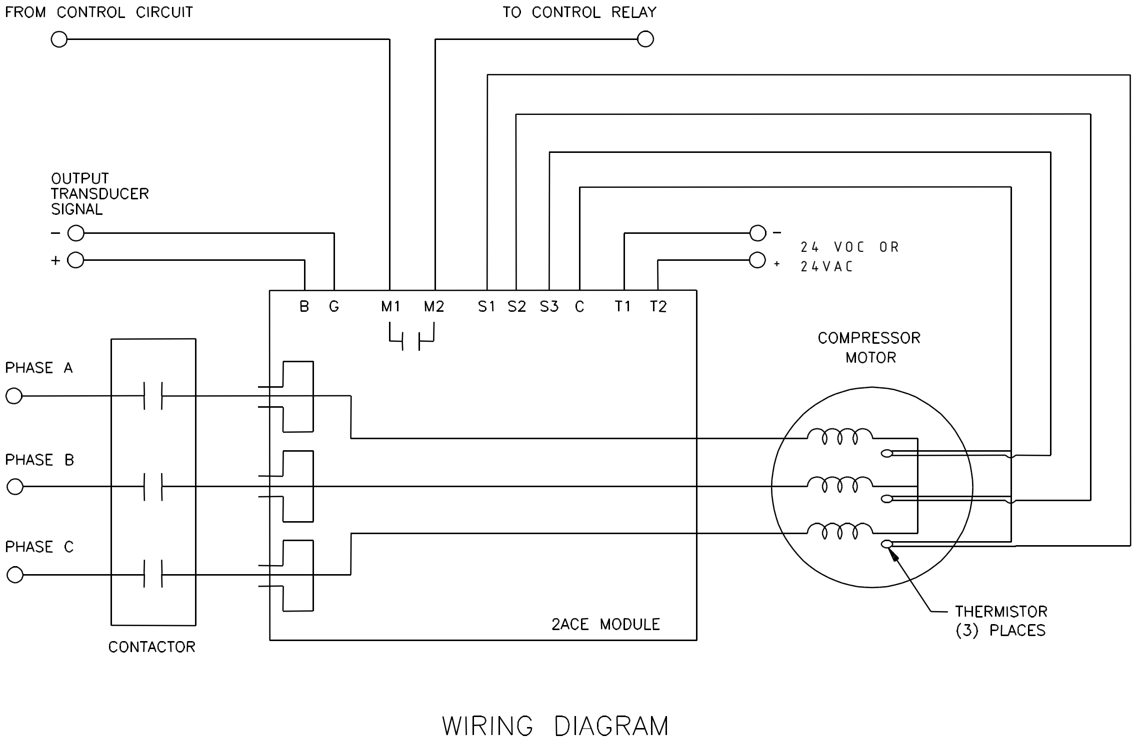
Ex: To get 121 amps, turn on switch 2, 3, 4, 5, and 8. This gives 64 +32 + 16 + 8 + 1 = 121.

Module display codes: When the module is energized, it utilizes a seven segment display to provide operating status and fault diagnostic information. To reset the module, remove power from the T1 and T2 terminals for a minimum of two seconds.

Table 10. Display Value Definitions

DISPLAY VALUE	DEFINITION
0	Normal - no fault detected, module on, compressor on
HA xxx	Normal - compressor off. Five digit cycling display - reads “H”, ”A” followed by the three digit MHA setting. Ex: If calibrated at 121A, the display will repeatedly flash H, A, 1, 2, 1
1	Fault - current overload
2	Fault - loaded unbalance: >17% unbalance, current >.65 MHA
3	Fault - unloaded unbalance: >25% unbalance, .40 MHA< current <.65 MHA
4	Fault - improper phase sequence/miswire
5	Fault - over temperature
6	Fault - out of range of MHA calibration
7	Fault - unloaded unbalance: >50% unbalance, current <.40 MHA
8	Fault - phase loss: >60% unbalance

Figure 10. TI 2ACE Motor Protector Wiring Diagram



c) Oil Level Sensor: The compressor is equipped with an optical level switch to protect the compressor from low oil level. See ***Figures 8*** and ***9*** for wiring diagrams. A fuse is provided on the terminal board to protect the switch from fluctuations in control voltage. See ***Table 11*** for fuse specifications.

Wire the hot lead to the white sensor lead. Wire the lead to load to the yellow/red (115/230 Volt) lead. The black lead is wired through a resistor directly to the unloader common (no other wiring is required for the black lead).

Table 11. Terminal Board Replacement Kits *(compressors with oil sensors)*

CONTROL VOLTAGE	TERMINAL STRIP PART #	OIL SENSOR PART #	OIL SENSOR FUSE RATING	OIL T'STAT FUSE RATING
115 V	053888A5	055820A1	1.50 A	3.00 A
230 V	053888A6	055820A2	0.75 A	1.50 A

Consult factory for compressors with oil float switches.

d) Sump Heater: The compressor's oil sump heater must be energized at least 24 hours prior to start up or sump heated to a minimum of 30°F (17°C) above ambient. Under normal operation the heater should be energized when the compressor is not running. The unit should never be left in service if the sump heater is inoperative.

e) Unloader Coils: The compressor is equipped with a 3-way solenoid valve for compressor capacity control. The two solenoid valves are wired to the compressor terminal box. The "load" coil is marked "A"; the "unload" coil is marked "B". See ***page 19*** for further information.

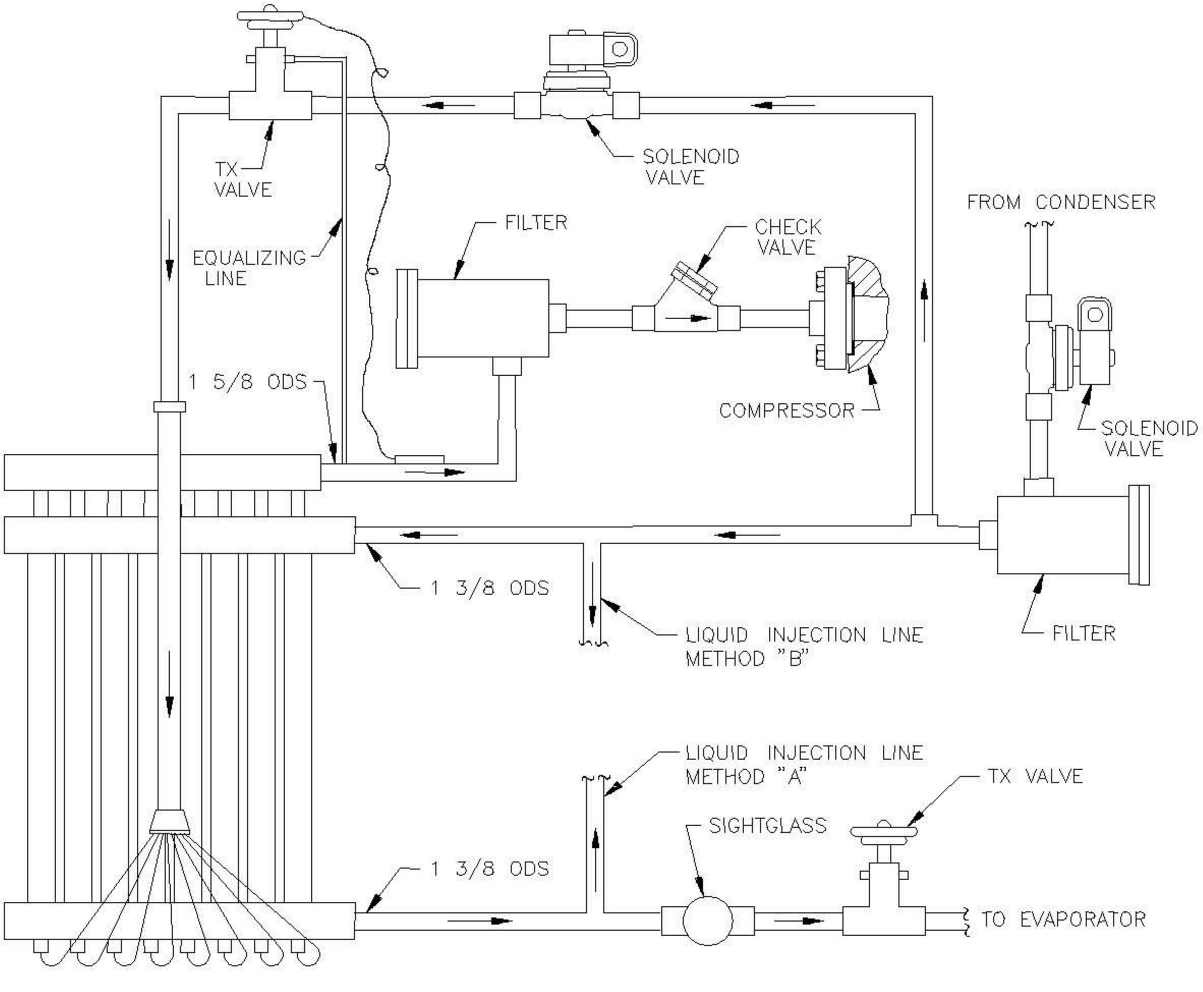
f) Oil Thermostat: The thermostat will open at 240°F. It is a secondary thermal protection device preventing the compressor from operating at excessive temperatures.

G. VAPOR INJECTION

This allows a single compressor to operate in a 2-stage refrigerant cycle resulting in increased capacity and improved system efficiency. Several configurations are possible, but the following examples are most common:

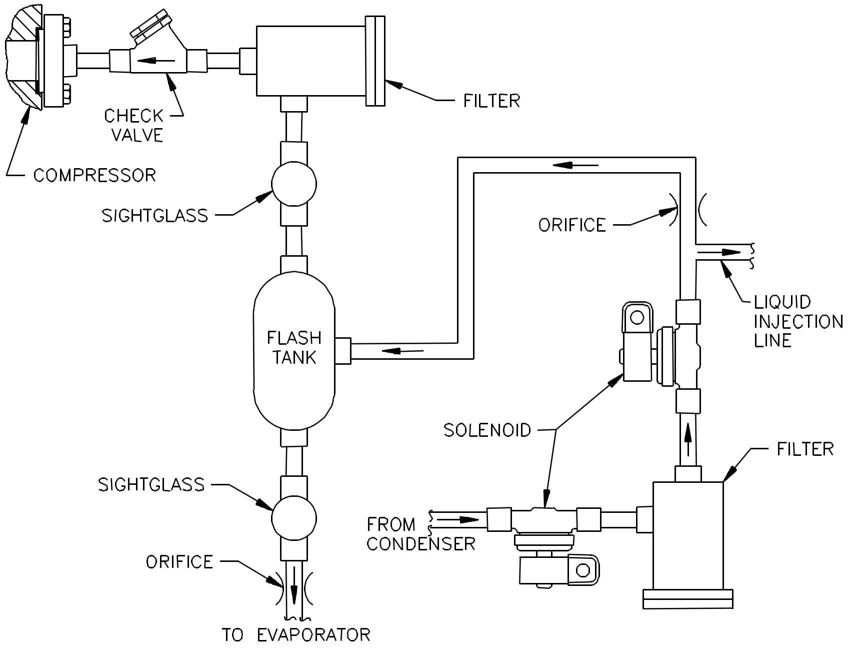
1. Direct Expansion (DX) Subcooler (***Figure 11***): Liquid refrigerant is taken from the liquid line of the condenser, through an expansion valve, to a heat exchanger. The refrigerant boils-off at an intermediate pressure and is injected into the vapor injection port. The cooled fluid may be the balance of the high pressure liquid refrigerant from the condenser or an independent "side" load.

Figure 11. Vapor Injection with Direct Expansion (DX) Subcooler



2. Flash Tank (***Figure 12***): This is a flooded vessel at an intermediate pressure where 2-phase refrigerant enters from the first expansion device and is separated. The saturated vapor exits the top of the tank and is injected into the vapor injection port. The saturated liquid forms a liquid seal at the bottom of the tank and is then expanded into the evaporator. The flash tank arrangement has the benefit of maximum possible system efficiency, but with added complications of a flooded vessel and controls.

Figure 12. Vapor Injection with Flash Tank (Flange Connection)



If vapor injection is used, some added precautions must be taken.

1. The vapor injection port is another means of liquid refrigerant entering the compressor, which can cause compressor damage resulting from liquid stress.
2. A check valve or solenoid valve must be installed in the vapor injection line to prevent rotor backspin at shutdown.
3. The liquid line feeding the flash tank or subcooler must be completely closed at shutdown to prevent liquid entering the compressor or slugging the compressor at startup.
4. The flash tank or subcooler must not allow the vapor injection port to be directly exposed to discharge pressure. This can result in excessive internal loads possibly damaging the compressor.

H. SYSTEM CLEANING

The system should be cleaned per the package manufacturer's recommendations. Filters and drier cores should be changed and an acid test performed. If the oil is acidic, change the oil, and repeat the acid test process. Take an oil sample and send it for analysis (see *I. General Information, Section D. Oil Kare® Program*).

III. OPERATION

A. OPERATING LIMITS

Specific operating limits are shown in ***Tables 12,*** and ***13***. These limits must be strictly observed. Any application outside these limits without explicit written approval from Hartford Compressors will void the warranty.

Table 12. Operating Limits

MODEL	REFRIGERANT	SST				SDT			
		MINIMUM		MAXIMUM		MINIMUM		MAXIMUM	
		°F	°C	°F	°C	°F	°C	°F	°C
1210NHF6X6K	R22/R407C**	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1210NHF6W4K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	115°F	46°C
1210NHF6W3K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	110°F	43°C
1210NHL6V5K	R134a	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1210NLF6V5K	R22/R507/R404A	0°F	-18°C	20°F	-7°C	65°F	18°C	125°F	52°C
1210NUF6V5K	R22/R507/R404A	-50°F	-46°C	0°F	-18°C	65°F	18°C	125°F	52°C
1212NHF6X6K	R22/R407C**	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1212NHF6W4K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	115°F	46°C
1212NHF6W3K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	110°F	43°C
1212NHL6V5K	R134a	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1212NLF6V5K	R22/R507/R404A	0°F	-18°C	20°F	-7°C	65°F	18°C	125°F	52°C
1212NUF6V5K	R22/R507/R404A	-50°F	-46°C	0°F	-18°C	65°F	18°C	125°F	52°C
1215NHF6X6K	R22/R407C**	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1215NHF6W4K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	115°F	46°C
1215NHF6W3K*	R22/R407C**	20°F	-7°C	50°F	10°C	65°F	18°C	110°F	43°C
1215NHL6V5K	R134a	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C
1215NLF6V5K	R22/R507/R404A	0°F	-18°C	20°F	-7°C	65°F	18°C	125°F	52°C
1215NUF6V5K	R22/R507/R404A	-50°F	-46°C	0°F	-18°C	65°F	18°C	125°F	52°C
1218NHF6X6K	R22/R407C**	0°F	-18°C	50°F	10°C	65°F	18°C	145°F	63°C

* "NHF6W4" and "NHF6W3" models can operate down to 10°F (-12°C) SST, however, the maximum allowable SDT is 105°F (40°C)

** These compressors may also operate with R404a / R507 (consult HCI Application Engineers for more info.

Table 13. Operating Limits

Maximum Discharge Pressure	410 PSIG	2825 kPa
Maximum Suction Temperature	80°F	27°C
Maximum Discharge Temperature	210°F	99°C
Minimum Discharge Superheat	20°F	11°C
Minimum Suction and Discharge Differential	*30 PSID	*210 kPad
Minimum Differential for Unloader Operation	60 PSID	420 kPad

* The compressor can safely operate with less than 30 psid (210 kPad) for a maximum of 3 minutes.

B. CYCLING LIMITS

To maximize the life of wear components, cycling should be minimized:

1. Starting: The compressor must not be stopped and started more than 4 times in one hour.
2. Unloading/Loading: The slide-valve should not travel a full stroke more than once every three minutes.

C. OIL LEVEL

The sight glass on the side of the compressor is used to determine the oil level in which the compressor can safely operate. It is extremely important that the compressor is never started with the oil level over the sight glass. If the level is above the glass prior to start-up, sufficient oil must be drained until the level is at the center of the sight glass.

Oil level should be monitored after start-up to ensure oil returning from the system does not rise above the sight glass nor trip the oil level sensor. The compressor can safely operate with the oil level below the sight glass as the oil level sensor will protect the compressor against a low oil condition.

D. CAPACITY CONTROL

1. Unloader Operation: The compressor is equipped with two solenoid valves to control loading and unloading of the compressor slide-valve. Loading is accomplished when high pressure oil is supplied to the unloader piston. Unloading is accomplished when the unloader piston cavity is drained to suction pressure. The slide-valve will hold its position when the unloader piston is isolated. See ***Figure 13*** for unloader schematic and ***Table 14*** for sequence of solenoid actuation.

Figure 13. Unloader Schematic

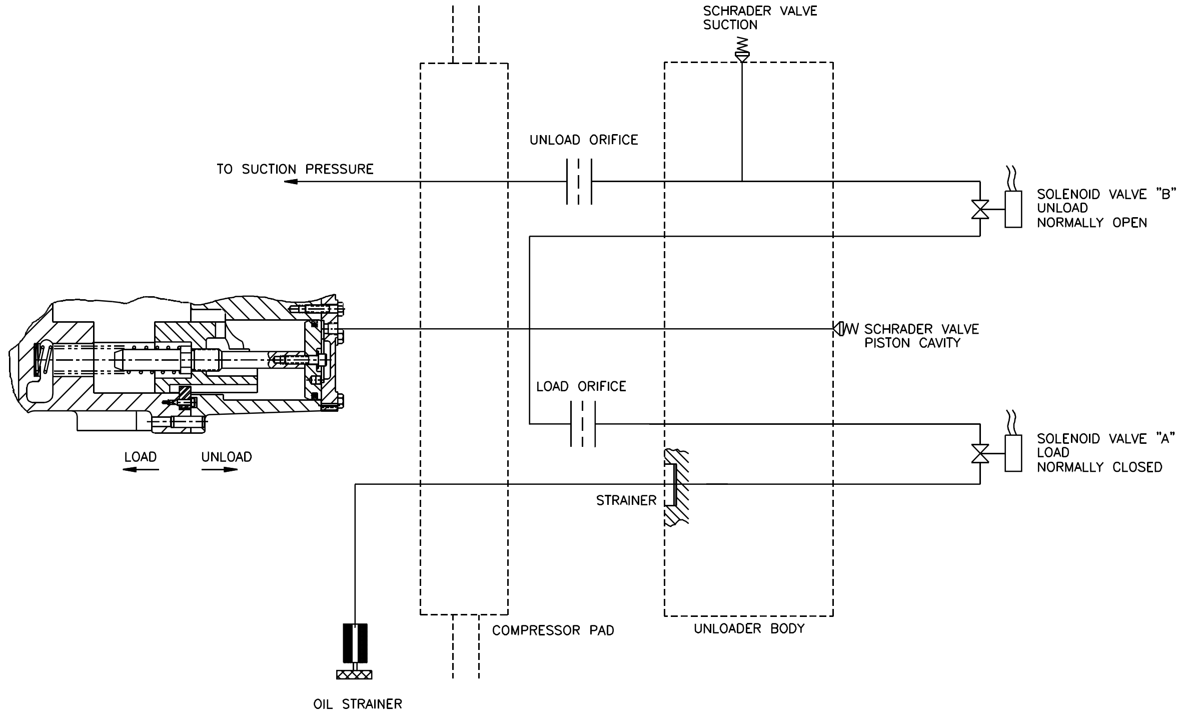


Table 14. Solenoid Actuation

	Solenoid A Normally Closed	**Solenoid B Normally Open**
Unload	OFF	OFF
Load	ON	ON
Hold	OFF	ON

2. Unloader Rates: The unloader rates are determined by fixed orifices, which control the load and unload sequence. The rates of loading and unloading are 30 to 60 seconds.

3. Field Unloader Checks: There are two schrader valves on the unloader pad, which allow three pressures to be measured inside of the compressor for start-up and trouble-shooting purposes.

   a) Suction Schrader Valve (located on the side of the unloader): Suction pressure can be read from this additional schrader valve while the compressor is in the “HOLD” position. This is used for measuring the suction pressure after or downstream of the suction filter.

   b) Piston Cavity Schrader Valve (located on the face of the unloader): Discharge pressure can be read when the compressor is in the load position. The most accurate reading is when the compressor is in the fully-loaded position. Suction pressure is read when the unloader is in the “UNLOAD” position. This is most accurately measured when the compressor is in the fully-unloaded position.

E. SUCTION FILTER

The compressor is equipped with a removable suction filter. Pressure drop across this filter must be checked within the first several hours after start-up and whenever excessive pressure drop is suspected. To determine the pressure drop, a differential pressure gauge should be used. If a standard gauge is used, first connect downstream and then upstream from the filter.

Using the pad mounted unloader, the downstream pressure (low pressure) can be determined by conducting the “Suction Pressure” check in the Field Unloader Check Section. The upstream pressure can be read from the Schraeder valve located on the suction boss.

The filter should be changed when there are certain changes in the pressure drops. See ***Table 15*** for these pressure drops. Excessive pressure drop across the filter could be due to moisture freezing on the filter material causing a substantial loss of capacity. In this case the dryer blocks in the condenser liquid line will need to be replaced.

Table 15. Pressure Drops Requiring a Filter Change

MODEL	PSID	kPad
1210	1.5	10
1212/1215	2.0	14
1218	2.5	17

Replacement Filter Kits: Hartford Compressors Part #054145A5 for 1210K and 1212K Models; Part #054145A6 for 1215K and 1218K Models. These kit includes suction filter, o-ring, check-valve gasket, suction gasket, and instructions.

IV. TROUBLESHOOTING

A. High Discharge Temperature

Check for excessive suction superheat

Check liquid injection arrangement for proper operation

Check refrigerant charge

B. Motor Tripping on Thermal Protection

Discharge temperature too high *(see A)*

Excessive current draw

Voltage is unbalanced or outside of limits

Bad sensor (check resistance in ***Table 8***), if a sensor is defective, a spare (fourth) sensor is accessible internal to the compressor

Bad control module — with compressor off, read resistance and check contacts on control module

C. Low Discharge Superheat

Check liquid injection settings and operation

Ensure refrigerant exiting evaporator has sufficient superheat

D. Compressor tripping on low oil level

Check fuses and voltages at the connections on the terminal strip in the compressor terminal box

Check oil level and quality (i.e., no foaming in the sight-glass during operation)

High discharge/oil temperature: Sensor will "trip" at approximately 240°F (115.6°C) *(see A)*

Bad resistor: Remove connections around resistor on terminal strip. Resistance should be approximately 24 k for 115V and 47k for 230V, if not, replace the terminal strip.

Bad sensor: Remove electronics from sensor housing and check if oil is visible in the prism. With control circuit energized, expose sensor to light for "trip" condition and matte surface (clothing) for "good" condition. If unresponsive, replace sensor.

Note: sensor has a built-in time delay of ten seconds.

E. Compressor will not restart

Check fuses and connections on terminal strip

Ensure oil level is not above sight glass

Check all safety controls and manual resets

Check contactor coils and contacts

Check motor terminals to ground

F. Unloader not operating correctly

Ensure that the solenoids are actually being energized and in the proper sequence.

Compressor won't load:

Read pressure at the suction schrader valve. Excessive pressure drop across the filter can give the appearance of the compressor not loading by reducing mass-flow and capacity.

Read pressure at the piston cavity in the "LOAD" position. If the cavity pressure reads at or near suction pressure, then the problem is most likely a clogged strainer or orifice on the pad. Disassemble and check the pad for signs of dirt or debris.

IV. TROUBLESHOOTING *(cont.)*

Compressor won't hold:

Read pressure of the piston cavity with the compressor in the “HOLD” position. If this equals or approaches suction pressure, then there is a leak on the gasket or unload solenoid valve. If this reads discharge pressure, then the leak may be on the gasket, solenoid valve, or internal to the compressor.

Compressor won't unload:

Read pressure of the piston cavity with the compressor in the “UNLOAD” position. If this reads discharge pressure, there may be a leak between the piston cavity and the gasket, solenoid valve or internal to the compressor.

Slide valve is “stuck”:

If the cavity pressure reads normally, and no movement can be detected, then the valve may be “stuck”. This can be checked by removing the pad, and pressurizing the piston cavity with dry air or nitrogen. Note that there is no fitting to connect to, but a small amount of pressure supplied to the piston cavity port should be enough to move the valve. A metallic “clink” can be heard when the valve is forced to the fully loaded position, and when the spring returns the valve to the fully unloaded position.

G. Compressor motor is suspected to be damaged

Check motor terminals to ground

Measure resistance between the following motor terminals using a double bridge:

1. Terminals 1 to 2, 2 to 3, 1 to 3, 7 to 8, 8 to 9, and 7 to 9
2. Terminals 1 to 7, 2 to 8, and 3 to 9
3. Terminals 1 to 8, 1 to 9, 2 to 7, 2 to 9, 3 to 7, 3 to 8

The resistance of the six measurements in 1 should all be approximately the same. The resistance in 2 should be 1.124 times the measurements in 1. The measurements in 3 should be .625 times the resistance in 1.

If the relationship described above does not hold, there may be a problem with the motor assembly. Contact Hartford Compressors for the resistance of any given model.

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