⚠WARNING:
RECOGNIZE THIS SYMBOL AS AN INDICATION OF IMPORTANT SAFETY INFORMATION

⚠WARNING

THESE INSTRUCTIONS ARE INTENDED AS AN AID TO QUALIFIED, LICENSED SERVICE PERSONNEL FOR PROPER INSTALLATION, ADJUSTMENT, AND OPERATION OF THIS UNIT. READ THESE INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING INSTALLATION OR OPERATION. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN IMPROPER INSTALLATION, ADJUSTMENT, SERVICE, OR MAINTENANCE POSSIBLY RESULTING IN FIRE, ELECTRICAL SHOCK, PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH.

Do not destroy this manual. Please read carefully and keep in a safe place for future reference by a serviceman.

IMPORTANT: Read Page 2 carefully for best practices with R-454B systems.

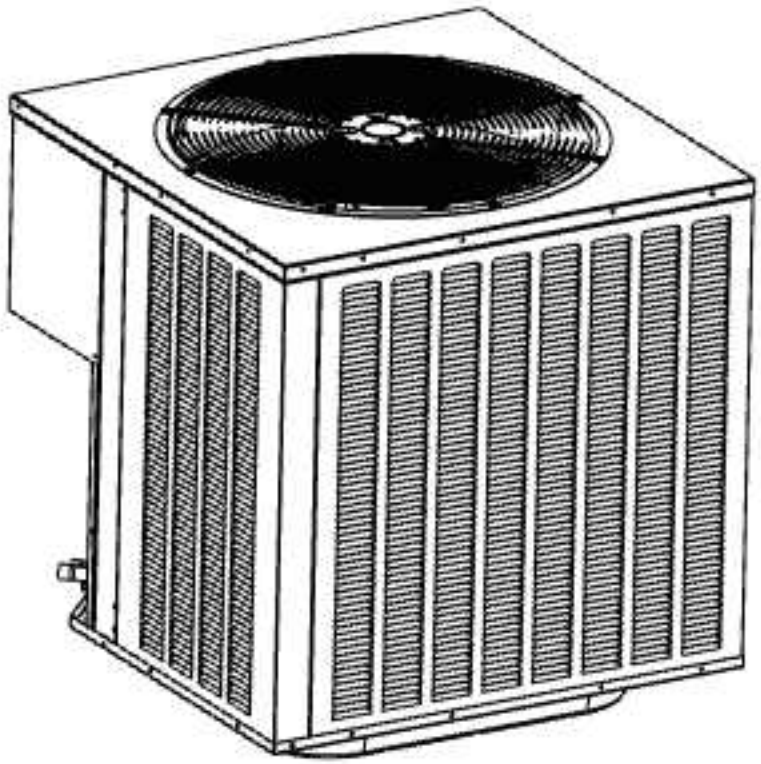
[ ] Indicates metric conversions.

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R-454B HEAT PUMP OUTDOOR UNITS

INSTALLATION INSTRUCTIONS

(-)P14AY (14.3 SEER2) & (-)P15AY (15.2 SEER2) TWO-STAGE NON-COMMUNICATING



ST-A1335-01-00

NOTE: Actual unit appearance may vary.

R-454B BEST PRACTICES

- R-410A systems SHOULD NOT be retrofitted with R-454B. Reference Section 1.0 for more information.
- Only use indoor coils approved for use on R-454B systems. An R-410A or R-22 coil has not been evaluated for use with R-454B and may lack a refrigerant detection system necessary for safe operation of the system. Reference Section 1.0 for more information.
- R–454B is classified as safety group A2L, where the 2L flammability class indicates lower flammability. R-454B and air should never be mixed in tanks or supply lines or be allowed to accumulate in storage tanks due to its flammability. Reference Section 4.1.2 for more information.
- When using a torch during brazing, nitrogen must be flowed while brazing. Reference Section 4.4.1 for more information.
- Existing R-410A or R-22 unit's line sets be purged and flushed with nitrogen if being used as a replacement for a R-454B system. Reference Section 4.4.1 for more information.
- R-454B system refrigerants must be charged in liquid form. Reference Section 5.4 for more information.
- Lines must be cut when replacing R-410A or R-22 systems with a R-454B system.

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1.0 IMPORTANT SAFETY INFORMATION

⚠WARNINGS:

- **Do not use oxygen to purge lines or pressurize system for leak test. Oxygen reacts violently with oil and possibly with R-454B, which can cause an explosion resulting in severe personal injury or death.**
- **R-410A systems should not be retrofitted with R-454B. Such a retrofit violates the product listing and may result in severe personal injury or property damage.**
- These instructions are intended as an aid to qualified, licensed service personnel for proper installation, adjustment, and operation of this unit. Read these instructions thoroughly before attempting installation or operation. **Failure to follow these instructions may result in improper installation, adjustment, service, or maintenance possibly resulting in fire, electrical shock, property damage, personal injury, or death.**
- **The unit must be permanently grounded. Failure to do so can cause electrical shock resulting in severe personal injury or death.**
- **Turn off electric power at the fuse box or service panel before making any electrical connections.**
- **Complete the ground connection before making line voltage connections. Failure to do so can result in electrical shock, severe personal injury, or death.**
- **Disconnect all power to unit before starting maintenance. Failure to do so can cause electrical shock resulting in severe personal injury or death.**
- **Never assume the unit is properly wired and/or grounded. Always test the unit cabinet with a noncontact voltage detector available at most electrical supply houses or home centers before removing access panels or coming into contact with the unit cabinet.**
- **This unit is a PARTIAL UNIT AIR CONDITIONER, complying with PARTIAL UNIT requirements of this Standard, and must only be connected to other units that have been confirmed as complying to corresponding PARTIAL UNIT requirements of this Standard, UL 60335-2-40/ CSA C22.2 No. 60335-2-40, or UL 1995/CSA C22.2 No 236.**
- The top of the scroll compressor shell is hot. Touching the compressor top may result in serious personal injury.
- The manufacturer's warranty does not cover any damage or defect to the unit caused by the attachment or use of any components, accessories, or devices (other than those authorized by the manufacturer) into, onto, or in conjunction with the heat pump. **You should be aware that the use of unauthorized components, accessories, or devices may adversely affect the operation of the heat pump and may also endanger life and property.** The manufacturer disclaims any responsibility for such loss or injury resulting from the use of such unauthorized components, accessories, or devices.
- This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

⚠CAUTIONS:

- **Only use indoor coils approved for use on R-454B systems. An R-410A or R-22 coil has not been evaluated for use with R-454B and may lack a refrigerant detection system necessary for safe operation of the system. The R-410A or R-22 coil could also contain PVE or POE oil which is incompatible with the POE oil used in R-454B systems and could result in reliability issues with the compressor and TXVs.**
- Refrigerant R–454B operates at pressures similar to R–410A. However, it is classified in safety group A2L. Ensure that servicing equipment is compatible with group A2L refrigerants and in particular with R–454B. Use appropriate care when using this refrigerant. Failure to exercise care may result in equipment damage or personal injury.
- Only match this outdoor unit with a matched indoor coil or air handler approved for use with this outdoor unit per the unit manufacturer's specification sheet. The use of unmatched coils or air handler will likely result in a charge imbalance between the cooling and heating modes which can cause unsatisfactory operation including a high-pressure switch lockout condition.
- When coil is installed over a finished ceiling and/or living area, it is required that a secondary sheet metal condensate pan be constructed and installed under the entire unit. Failure to do so can result in property damage.
- The compressor has an internal overload protector. Under some conditions, it can take up to 2 hours for this overload to reset. Make sure overload has had time to reset before condemning the compressor.
- UNIT MAY START SUDDENLY AND WITHOUT WARNING. A flashing red light on the heat pump/ defrost control indicates a call for unit operation is present at the heat pump/defrost control. The heat pump/defrost control will attempt to start unit after the anti-short cycle time expires, when a high or low pressure control automatically resets, or when the

heat pump/defrost control exits the lockout mode as the temperature rises above 5°F [-15°C].

- The fixed wiring insulation must be protected, for example, by insulating sleeving having an appropriate temperature rating. Any means for disconnection must be incorporated in the fixed wiring in accordance with the wiring rules.

⚠WARNING:

- **Single-pole contactors are used on all standard single-phase units through 5 tons. Caution must be exercised when servicing as only one leg of the power supply is broken by the contactor.**
- **Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.**
- **The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater).**
- **Do not pierce or burn.**
- **Be aware that refrigerants may not contain an odor.**

Markings Reference

	[Symbol ISO 7000-1659 (2004-01)]	Service indicator: read technical manual
	A2L Symbol	Warning: low burning velocity material
	[Symbol ISO 7000-1701 (2004-01)]	Pressure
	[Symbol IEC 60417-6140 (2010-08)]	Ultraviolet radiation, instructional safeguard
	[Symbol ISO 7000-1641 (2004-01)]	Operator's manual: operating instructions
	[UN GHS (Globally Harmonized System of Classification and Labeling of Chemicals)]	Refrigerant Safety Group A2X, warning: flammable materials

2.0 GENERAL INFORMATION

⚠WARNING:

Improper installation, or installation not made in accordance with these instructions, can result in unsatisfactory operation and/or dangerous conditions and can cause the related warranty not to apply.

2.1 Introduction

The information contained in this manual has been prepared to assist in the proper installation, operation, and maintenance of the air conditioning system.

Read this manual and any instructions packaged with separate equipment required to make up the system prior to installation. Homeowner should retain this manual for future reference.

2.2 Importance of Quality Installation

A quality installation is critical to assure safety, reliability, comfort, and customer satisfaction. Strict adherence to applicable codes, the information in this installation manual, the outdoor unit installation manual, and the thermostat installation manual are key to a quality installation. Read the entire instruction manuals before starting the installation.

IMPORTANT: This product has been designed and manufactured to meet certified AHRI capacity and efficiency ratings with the appropriate outdoor units. However, proper refrigerant charge, proper airflow, and refrigerant line sizing are critical to achieve optimum capacity and efficiency and to assure reliable operation. Installation of this product should follow the manufacturer's refrigerant charging and airflow instructions located in this installation manual and the charging chart label affixed to the outdoor unit. Failure to confirm proper charge and airflow may reduce energy efficiency and shorten equipment life.

The equipment has been evaluated in accordance with the Code of Federal Regulations, Chapter XX, Part 3280.

Install the unit in accordance with applicable national, state, and local codes. Latest editions are available from: "National Fire Protection Association, Inc., Batterymarch Park, Quincy, MA 02269." These publications are:

- ANSI/NFPA No. 70-(Latest Edition) National Electrical Code.
- NFPA 90A Installation of Air Conditioning and Ventilating Systems.
- NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

Install the indoor unit in such a way as to allow necessary access to the coil/filter rack and blower/control compartment.

2.3 System Sizing and Selection

Before specifying any heat pump equipment, a survey of the structure and a heat loss and heat gain calculation must be made. A heat loss calculation involves identifying all surfaces and openings that lose heat to the surrounding air and quantifying that heat loss. A cooling heat gain calculation makes similar measurements and determines the amount of heat needed to be removed. A heat gain calculation also calculates the extra heat load caused by sunlight and by humidity removal. These factors must be considered before selecting a heat pump system to provide year-round comfort. The Air Conditioning Contractors of America (ACCA) Manual J method of load calculation is one recognized procedure for determining the heating and cooling load.

After the proper equipment combination has been selected, satisfying both sensible and latent requirements, the system must be properly installed. Only then can the system provide the comfort it was designed to provide.

There are several factors that installers must consider.

- Outdoor unit location
- Indoor unit blower speed and airflow
- Proper equipment evacuation
- Supply and return air duct design and sizing
- Refrigerant charge
- System air balancing
- Diffuser and return air grille location and sizing

IMPORTANT: Excessive use of elbows in the refrigerant line set can produce excessive pressure drop. Follow industry best practices for installation. Installation and commissioning of this equipment is to be performed by trained and qualified HVAC professionals. For technical assistance, contact your Distributor Service Coordinator.

2.0 GENERAL INFORMATION

2.4 Importance of Proper Indoor/Outdoor Match-Ups

To assure many years of reliable operation and optimum customer comfort and to assure the outdoor unit warranty remains valid, an air-handler model or indoor coil/furnace combination should be selected that is properly matched to the outdoor unit. This is especially critical for heat pump systems to assure proper refrigerant charge balance between the cooling and heating modes. The recommended approach is to select an air-handler or indoor coil and gas furnace that has an AHRI match with the outdoor unit. Refer to the AHRI directory at www.ahridirectory.org to confirm the air-handler and outdoor unit are a certified combination in the AHRI Directory.

2.5 Checking Product Received

Upon receiving unit, inspect it for any shipping damage. Claims for damage, either apparent or concealed, should be filed immediately with the shipping company. Check model number, electrical characteristics, and accessories to determine if they are correct. Check system components (indoor coil, outdoor unit, air handler/furnace, etc.) to make sure they are properly matched.

2.6 Efficiency Testing Notice

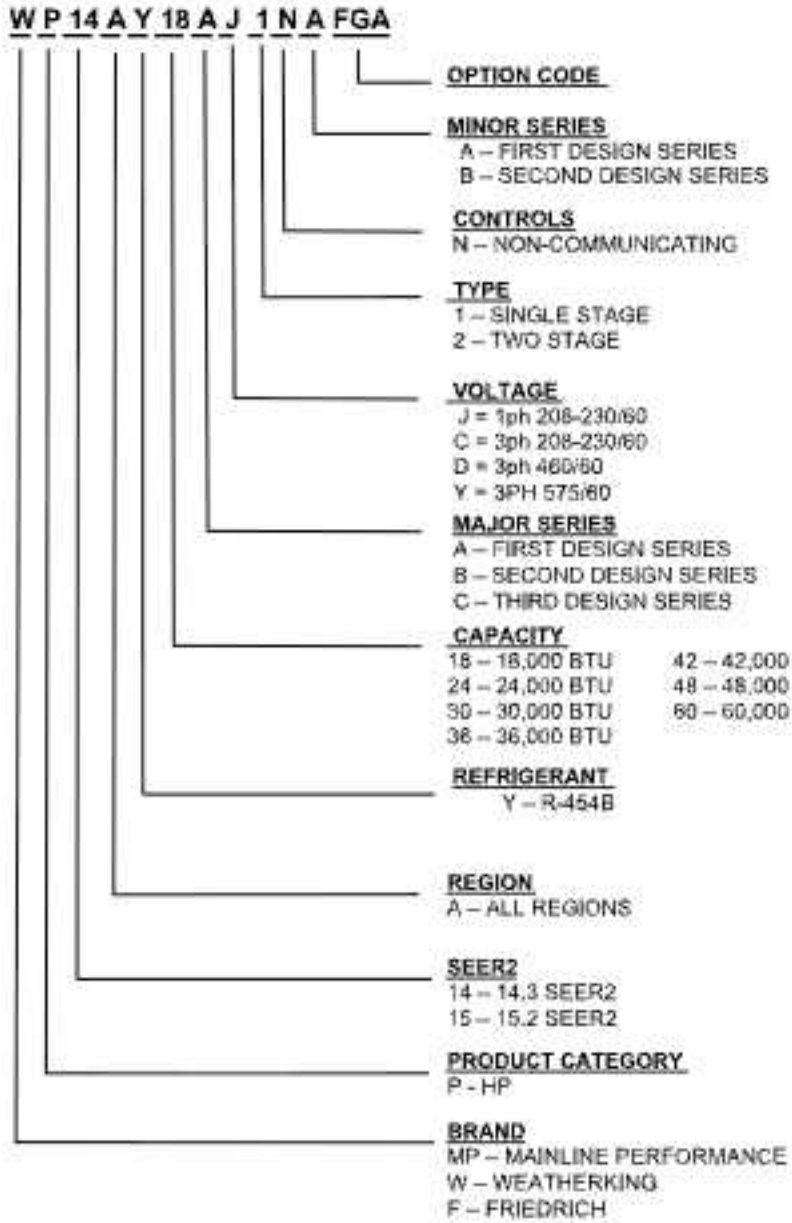
For purposes of verifying or testing efficiency ratings, the test procedure in Title 10 APPENDIX M1 to Subpart B of Part 430 (Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners and Heat Pumps) and the clarifying provisions provided in the AHRI Operations Manual 210/240 that were applicable at the date of manufacture should be used for test set up and performance.

2.7 Compressor Break-In Notice

Prior to agency testing, the unit must be run for 20 hours at 115°F [46.1°C] outdoor ambient temperature with 80°F [26.7°C] dry bulb/75°F [23.9°C] wet bulb indoor ambient temperature to break the compressor in.

3.0 UNIT SPECIFICATIONS

3.1 Model Number Nomenclature



3.2 Available Models

(-)P14AY18AJ2NA	(-)P15AY18AJ2NA
(-)P14AY24AJ2NA	(-)P15AY24AJ2NA
(-)P14AY30AJ2NA	(-)P15AY30AJ2NA
(-)P14AY36AC2NA	(-)P15AY36AC2NA
(-)P14AY36AD2NA	(-)P15AY36AD2NA
(-)P14AY36AJ2NA	(-)P15AY36AJ2NA
(-)P14AY42AC2NA	(-)P15AY42AC2NA
(-)P14AY42AD2NA	(-)P15AY42AD2NA
(-)P14AY42AJ2NA	(-)P15AY42AJ2NA
(-)P14AY48AC2NA	(-)P15AY48AC2NA
(-)P14AY48AD2NA	(-)P15AY48AD2NA
(-)P14AY48AJ2NA	(-)P15AY48AJ2NA
(-)P14AY60AC2NA	(-)P15AY60AC2NA
(-)P14AY60AD2NA	(-)P15AY60AD2NA
(-)P14AY60AJ2NA	(-)P15AY60AJ2NA

3.3 Electrical and Physical Data

(-)P14AY

Model Number	ELECTRICAL DATA										PHYSICAL DATA					
				Compressor			Fan Motor Full Load Amperes (FLA)	Minimum Circuit Ampacity Amperes	Fuse or HACR Circuit Breaker		Outdoor Coil			Refrig. Per Circuit Oz. (g)	Weight	
	Voltage	Phase	Hertz	MFR's Model Number	Rated Load Amperes (RLA)	Locked Rotor Amperes (LRA)			Minimum Amperes	Maximum Amperes	Face Area Sq. Ft. (m²)	No. Rows	CFM (L/s)		Net Lbs. (kg)	Shipping Lbs. (kg)
(-)P14A018A,B1NA	208/230	1	60	YA18K1E-PFV-ASE	9.8	52	0.6	12	20/20	20/20	10.0 (1.01)	1.0	2401 (1134)	82 (2393)	153 (69.4)	160 (72.6)
				YHM018AA	7.2	41		10	15/15	15/15						
(-)P14A024A,C1NA	208/230	1	60	WA21K1E-PFV-ASE	11.9	65	0.8	16	25/25	25/25	10.9 (1.01)	1.0	2808 (1325)	80 (2350)	153 (69.4)	160 (72.6)
				YHM021AA	10.2	58		14	20/20	20/20						
(-)P14A030A,C1NA	208/230	1	60	WA27K1E-PFV-ASE	14.0	82	1.0	20	25/25	30/30	14.4 (1.34)	1.0	3961 (1870)	88 (2501)	169 (76.7)	186 (84.3)
				YHM027AA	12.8	77		18	25/25	30/30						
(-)P14A036A,E1NA	208/230	1	60	WB31K1E-PFV-ASE	14.9	93	1.0	22	25/25	30/30	19.5 (1.81)	1	4077 (1924)	94 (2662)	202 (91.6)	209 (94.8)
				YHM031AA	14.0	79		20	25/25	30/30						
(-)P14A048A,E1NA	208/230	1	60	YA53K1E-TFS-ASE	9.4	82	1.0	13	15/15	20/20						
				YHM053AA	8.6	70		12	15/15	20/20						
(-)P14A036A,E2NA	460	3	60	YA53K1E-TFS-ASE	4	43.3	0.8	7	15/15	15/15						
				YHM053AA	10.2	78		14	20/20	20/20						
(-)P14A048A,E1NA	208/230	1	60	YA53K1E-PFV-ASE	18.2	106	1.0	24	30/30	40/40	19.5 (1.81)	1	4077 (1924)	130 (3685)	232 (105.2)	250 (108.4)
				WM053AAA	18.5	163.5		22	30/30	35/35						
(-)P14A048A,E2NA	208/230	3	60	WA53K1E-TFS-ASE	11.5	114	1.0	16	20/20	25/25						
				YHM053AA	11.2	120		15	20/20	25/25						
(-)P14A048A,E2NA	460	3	60	YA53K1E-TFS-ASE	6.5	58	0.6	9	15/15	15/15						
				YHM053AA	5.8	60		9	15/15	15/15						
(-)P14A060A,E1NA	208/230	1	60	YA54K1E-PFV-ASE	20.1	141	1.0	27	35/35	45/45	19.5 (1.81)	1	4396 (1953)	115 (3260)	239 (107.0)	248 (110.2)
				WM063AAA	18.4	108		23	30/30	40/40						
(-)P14A060A,E2NA	208/230	3	60	YA54K1E-TFS-ASE	13.1	115	1.0	17	20/20	25/25						
				YHM063AA	13.8	102		15	20/20	25/25						
(-)P14A060A,E2NA	460	3	60	YA54K1E-TFS-ASE	7.1	54.8	0.8	10	15/15	15/15						
				YHM063AA	5.9	60		9	15/15	15/15						
(-)P14A060A,J1NA	208/230	1	60	YB51K1E-PFV-ASE	23.2	145.3	1.2	32	40/40	50/50	46.2 (4.29)	2	4396 (2075)	168 (4760)	270 (122.7)	292 (132.5)
				WM063AAA	23.2	125		31	40/40	50/50						
(-)P14A060A,J2NA	208/230	3	60	YA51K1E-TFS-ASE	13.8	150	1.0	18	25/25	30/30						
				YHM063AA	13.1	93		18	25/25	30/30						
(-)P14A060A,J2NA	460	3	60	YA51K1E-TFS-ASE	6.9	88	0.8	10	15/15	15/15						
				YHM063AA	6.3	90		9	15/15	15/15						

(-)P15AY

Model Number	ELECTRICAL DATA										PHYSICAL DATA					
				Compressor			Fan Motor Full Load Amperes (FLA)	Minimum Circuit Ampacity Amperes	Fuse or HACR Circuit Breaker		Outdoor Coil			Refrig. Per Circuit Oz. (g)	Weight	
	Voltage	Phase	Hertz	MFR's Model Number	Rated Load Amperes (RLA)	Locked Rotor Amperes (LRA)			Minimum Amperes	Maximum Amperes	Face Area Sq. Ft. (m²)	No. Rows	CFM (L/s)		Net Lbs. (kg)	Shipping Lbs. (kg)
(-)P15A018A,C1NA	208/230	1	60	WA21K1E-PFV-ASE	9.8	52	0.8	12	20/20	20/20	10.0 (1.01)	2.0	2568 (1212)	82 (2356)	158 (71.8)	157 (71.2)
				YHM018AA	7.2	47		10	15/15	15/15						
(-)P15A024A,C1NA	208/230	1	60	YA21K1E-PFV-ASE	11.9	65	0.8	16	25/25	25/25	10.9 (1.01)	2.0	2568 (1212)	82 (2337)	160 (86.4)	157 (71.2)
				YHM021AA	11.2	79		14	20/20	20/20						
(-)P15A030A,C1NA	208/230	1	60	WA28K1E-PFV-ASE	14.8	82	1.0	20	25/25	30/30	19.5 (1.81)	1.0	4077 (1923)	82 (2410)	202 (91.6)	209 (94.8)
				YHM028AA	12.8	77		18	25/25	30/30						
(-)P15A036A,C1NA	208/230	3	60	WA31K1E-PFV-ASE	14.8	93	1.2	20	25/25	30/30						
(-)P15A036A,C2NA	208/230	3	60	WA31K1E-TFS-ASE	9.4	82	1.0	13	15/15	20/20	21.5 (1.99)	1	4396 (1964)	88 (2498)	214 (97.1)	221 (100.2)
(-)P15A036A,E2NA	460	3	60	YA31K1E-THS-ASE	5	44.3	0.8	8	15/15	15/15						
(-)P15A048A,E1NA	208/230	1	60	YA53K1E-PFV-ASE	18.2	106	1.0	24	30/30	40/40	21.5 (1.99)	1	4396 (2075)	130 (3685)	240 (108.9)	247 (112)
				WM053AAA	18.5	163.5		22	30/30	35/35						
(-)P15A048A,C2NA	208/230	3	60	YA53K1E-TFS-ASE	11.5	114	1.0	16	20/20	25/25						
				YHM053AA	11.2	120		15	20/20	25/25						
(-)P15A048A,E2NA	460	3	60	YA53K1E-THS-ASE	6.5	58	0.6	9	15/15	15/15						
				YHM053AA	5.8	60		9	15/15	15/15						
(-)P15A060A,E1NA	208/230	3	60	YA54K1E-PFV-ASE	20.1	141	1.0	27	35/35	45/45	21.5 (1.99)	1	4396 (2075)	130 (3685)	240 (108.9)	247 (112)
				WM063AAA	18.4	108		23	30/30	40/40						
(-)P15A060A,C2NA	208/230	3	60	YA54K1E-TFS-ASE	12.1	113	1.0	17	20/20	25/25						
				YHM063AA	10.8	120		15	20/20	25/25						
(-)P15A060A,E2NA	460	3	60	YA54K1E-THS-ASE	7.1	54.8	0.8	10	15/15	15/15						
				YHM063AA	5.9	60		9	15/15	15/15						
(-)P15A060A,J1NA	208/230	3	60	YA51K1E-PFV-ASE	23.2	147.3	1.0	33	40/40	50/50	46.2 (4.29)	2	4396 (2075)	234 (6624)	275 (124.7)	292 (132.5)
				WM063AAA	23.2	125		31	40/40	50/50						
(-)P15A060A,C2NA	208/230	3	60	YA51K1E-TFS-ASE	13.8	150	1.0	18	25/25	30/30						
				YHM063AA	13.1	93		18	25/25	30/30						
(-)P15A060A,E2NA	460	3	60	YA51K1E-THS-ASE	6.9	88	0.8	10	15/15	15/15						
				YHM063AA	6.3	90		9	15/15	15/15						

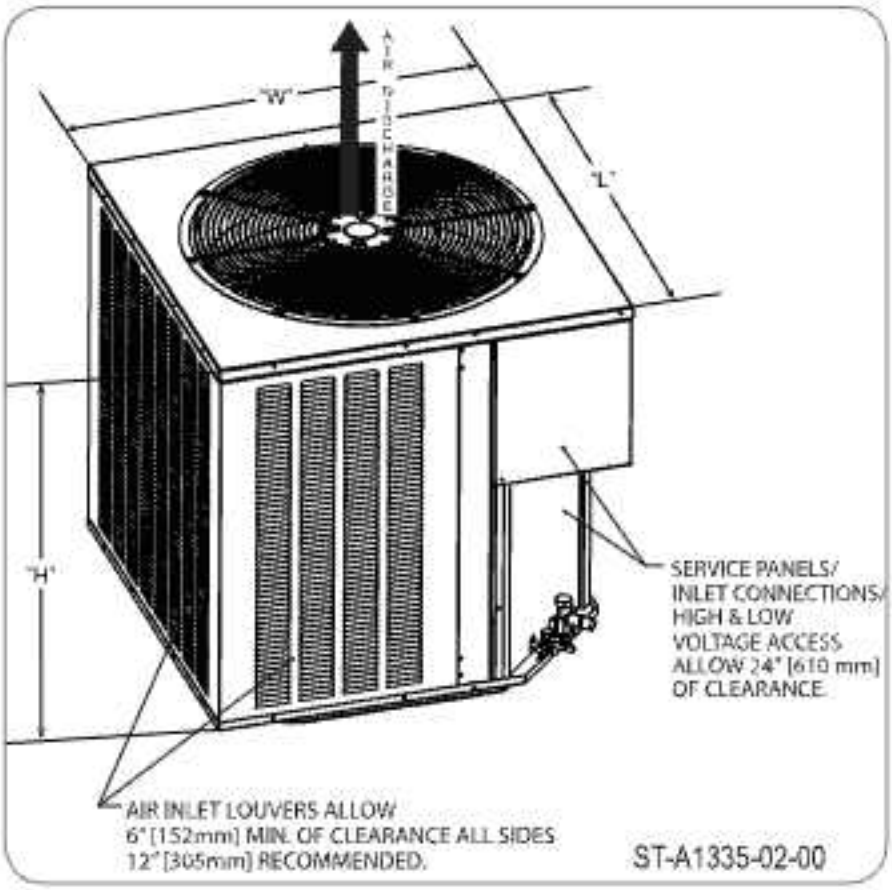
Specifications

3.0 UNIT SPECIFICATIONS

DIMENSIONALS

(-)P14AV	18	24	30	36	42	48	60
Height "H" inches [cm]	27 [68.6]	27 [68.6]	27 [68.6]	35 [88.9]	47 [119.4]	47 [119.4]	47 [119.4]
Length "L" inches [cm]	29.75 [75.6]	29.75 [75.6]	33.75 [85.7]	33.75 [85.7]	33.75 [85.7]	33.75 [85.7]	35.75 [90.8]
Width "W" inches [cm]	29.75 [75.6]	29.75 [75.6]	33.75 [85.7]	33.75 [85.7]	33.75 [85.7]	33.75 [85.7]	35.75 [90.8]

(-)P15AV	18, 24	30	36, 42, 48	60
Height "H" inches [cm]	27 [68.6]	35 [88.9]	39 [99.1]	39 [99.1]
Length "L" inches [cm]	29.75 [75.6]	33.75 [85.7]	33.75 [85.7]	35.75 [90.8]
Width "W" inches [cm]	29.75 [75.6]	33.75 [85.7]	33.75 [85.7]	35.75 [90.8]



NOTE: Actual unit appearance may vary.

4.1 Tools and Refrigerant

4.1.1 Tools Required for Installing and Servicing R-454B Models

Manifold Sets:

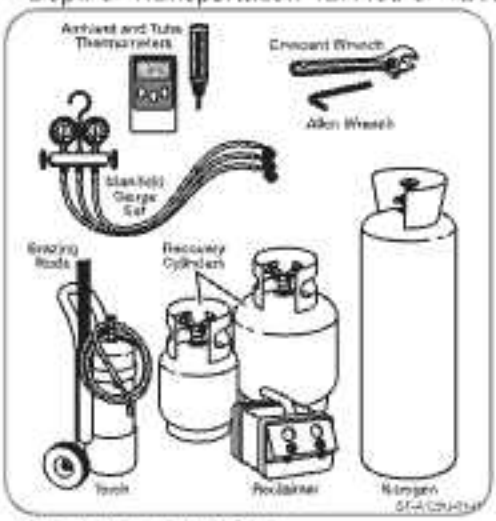
– Up to 800 PSIG [5,516 kPa] High-Side
– Up to 250 PSIG [1,724 kPa] Low-Side
– 550 PSIG [3,792 kPa] Low-Side Retard

Manifold Hoses:

– Service Pressure Rating of 800 PSIG [5,516 kPa]

Recovery Cylinders:

– 400 PSIG [2,758 kPa] Pressure Rating
– Dept. of Transportation 4BA400 or 4BW400



⚠CAUTION: R–454B is classified as safety group A2L per ASHRAE Standard 34. Verify that service equipment and instruments are certified for use with group A2L refrigerants, and in particular with R–454B.

4.1.2 Specifications of R-454B

Application: <u>R–454B is not a drop-in replacement for R–410A and R-22.</u> Equipment design must accommodate the safety group A2L of R–454B. It cannot be retrofitted into R–410A and R-22 heat pumps.

Physical Properties: R–454B has an atmospheric bubble point of –59.6 °F [–50.9 °C] and an atmospheric dew point of –58.0 °F [–50.0 °C]. Its bubble point saturation pressure at 77 °F [25 °C] is 213 psig [1469 kPa] and dew point saturation pressure at 77 °F [25 °C] is 205 psig [1415 kPa].

Composition: R-454B is a non-azeotropic mixture of 68.9% by weight difluoromethane (HFC-32) and 31.1% by weight 2,3,3,3-tetrafluoro-1-propene.

Pressure: The pressure of R-454B is similar to that of R-410A. Recovery and recycle equipment, pumps, hoses, and the like must have design pressure ratings appropriate for R-454B. *Manifold sets need to range up to 800 psig [5,516 kPa] high-side and 250 psig [1,724 kPa] low-side with a 550 psig [3,792 kPa] low-side retard. Hoses need to have a service pressure rating of 800 psig [5,516 kPa]. Recovery cylinders need to have a 400 psig [2,758 kPa] service pressure rating. DOT 4BA400 or DOT 4BW400.*

Flammability: R–454B is classified as safety group A2L, where the 2L flammability class indicates lower flammability. **<u>R-454B and air should never be mixed in tanks or supply lines or be allowed to accumulate in storage tanks. Leak checking should be conducted using Nitrogen ONLY.</u>**

4.1.3 Quick-Reference Guide for R-454B

- Refrigerant R–454B operates at pressures similar to R–410A. However, it is classified in safety group A2L. Ensure that servicing equipment is compatible with R–454B.
- Refrigerant cylinders are no longer color-coded. R–454B cylinders are light green gray in color with a red band on the shoulder or top of the cylinder to indicate flammability.
- R-454B, is only compatible with POE oils.
- Vacuum pumps will not remove moisture from POE oil used in R-454B systems.
- R-454B systems should be charged with liquid refrigerants in liquid phase. R-454B cylinders should be inverted to ensure liquid charging of the equipment.
- Do not install a suction line filter drier in the liquid line.
- A factory-approved bi-flow liquid line filter drier is shipped with every unit and must be installed in the liquid line at the time of installation. Only manufacturer-approved liquid line filter driers should be used. Filter driers must have a working pressure rating of at least 600 psig [4,137 kPa]. The filter drier will only have adequate moisture-holding capacity if the system is properly evacuated.
- Desiccant (drying agent) must be compatible for POE oils and R-454B refrigerant.
- R-454B cylinders containing less than 50 lbs of refrigerant require a CGA 164 fitting. R-454B cylinders containing more than 50 lbs of refrigerant require a CGA 670 fitting.

4.0 INSTALLATION

4.2 Choosing a Location

4.2.1 Allowable Clearances

12" [30.5 cm] to side intake louvers
24" [61.0 cm] to service access panels
60" [152.4 cm] vertical for fan discharge

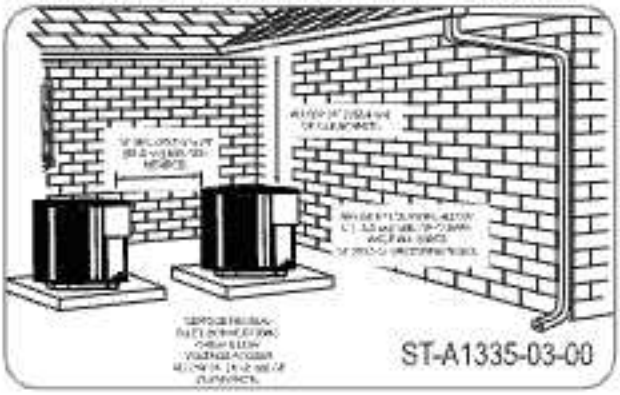
If space limitations exist, the following clearances will have minimal impact to capacity and efficiency and are permitted:

Single-Unit Applications: Minimum of 6" [15.2 cm] to side intake louvers. Do not reduce the 60" [152.4 cm] for fan discharge or the 24" [61.0 cm] service clearances.

Multiple-Unit Applications: For units positioned next to each other, a minimum of 6" [15.2 cm] clearance between units is recommended for 1.5 and 2 ton models and 9" [22.9 cm] for 2.5 ton to 5 ton models. Do not reduce the 60" [152.4 cm] for fan discharge or the 24" [61.0 cm] service clearances.

IMPORTANT: Consult local and national building codes and ordinances for special installation requirements. Following location information will provide longer life and simplified servicing of the outdoor heat pump.

NOTICE: These units must be installed outdoors. No ductwork can be attached, or other modifications made, to the discharge grille. Modifications will affect performance or operation.



4.2.2 Operational Issues Related to Unit Location

IMPORTANT: Locate the unit in a manner that will not prevent, impair, or compromise the performance of other equipment installed in proximity to the unit. Maintain all required minimum distances to gas and electric meters, dryer vents, and exhaust and inlet openings. In the absence of national codes or manufacturers' recommendations, local code recommendations and requirements will take precedence.

- Refrigerant piping and wiring should be properly sized and kept as short as possible to avoid capacity losses and increased operating costs.
- Locate the unit where water runoff will not create a problem with the equipment. Position the unit away from the drip edge of the roof whenever possible. Units are weatherized, but can be affected by the following:
- Water pouring into the unit from the junction of rooflines, without protective guttering. Large volumes of water entering the heat pump while in operation can impact fan blade or motor life, and coil damage may occur to a heat pump if moisture cannot drain from the unit under freezing conditions.
- Freezing moisture or sleeting conditions can cause the cabinet to ice-over prematurely and prevent heat pump operation, requiring backup heat, which generally results in less economical operation It is highly recommended to switch the EcoNet™ Control Center or thermostat to the "Emergency Heat" mode during freezing rain or sleeting conditions to prevent damage to the outdoor coil from ice accumulating on the fan blade.
- Closely follow the clearance recommendations in Section 4.2.1.
  - 24" [61.0 cm] to the service panel access
  - 60" [152.4 cm] above heat pump fan discharge (unit top) to prevent recirculation
  - 6" [15.2 cm] to heat pump coil grille air inlets with 12" [30.5 cm] minimum recommended

4.2 Choosing a Location (cont.)

4.2.3 Corrosive Environment

The metal parts of this unit may be subject to rust or deterioration if exposed to a corrosive environment. This oxidation could shorten the equipment's useful life.

Corrosive elements include, but are not limited to, salt spray, fog or mist in seacoast areas, sulphur or chlorine from lawn watering systems, and various chemical contaminants from industries such as paper mills and petroleum refineries.

If the unit is to be installed in an area where contaminants are likely to be a problem, special attention should be given to the equipment location and exposure.

- Avoid having lawn sprinkler heads spray directly on the unit cabinet.
- In coastal areas, locate the unit on the side of the building away from the waterfront.
- Shielding provided by a fence or shrubs may give some protection, but cannot violate minimum airflow and service access clearances.

⚠WARNING: Disconnect all power to unit before starting maintenance. Failure to do so can cause electrical shock resulting in severe personal injury or death.

Regular maintenance will reduce the buildup of contaminants and help to protect the unit's finish.

- Frequent washing of the cabinet, fan blade, and coil with fresh water will remove most of the salt or other contaminants that build up on the unit.
- Regular cleaning and waxing of the cabinet with a good automobile polish will provide some protection.
- A good liquid cleaner may be used several times a year to remove matter that will not wash off with water.

4.2.4 Customer Satisfaction Issues

- The heat pump should be located away from the living, sleeping, and recreational spaces of the owner and those spaces on adjoining property.
- To prevent noise transmission, the mounting pad for the outdoor unit should not be connected to the structure and should be located a sufficient distance above grade to prevent ground water from entering the unit.

4.3 Mounting Unit

4.3.1 Unit Mounting Methods

The outdoor heat pump unit may be mounted in a number of ways. The most common method is on a ground mounted concrete or pre-fabricated pad. It can also be mounted on a ground or roof mounted metal frame, wooden frame, or 4" x 4" [10.2 cm x 10.2 cm] wooden stringers. It is extremely important to properly secure the unit to the pad or frame so it does not shift during high winds, seismic events, or other outside forces to eliminate the possibility of a safety hazard or physical damage to the unit. Local codes in regions subject to frequent hurricanes and seismic events will dictate specific mounting requirements and must be followed. It is also important to elevate the heat pump in areas that receive a significant amount of snowfall so accumulated snow does not block the outdoor coil and interfere with drainage of water during the defrost cycle. Refer to Section 4.3.4 for typical ground snow levels for different regions of the USA.

4.3.2 High Wind and Seismic Tie-Down Methods

The manufacturer-approved/recommended method is a guide to securing equipment for wind and seismic loads. Other methods might provide the same result, but the manufacturer method is the only one endorsed by the manufacturer for securing equipment where wind or earthquake damage can occur. Additional information is available on the manufacturer's website or from the wholesale distributor.

4.0 INSTALLATION

4.3.3 Elevating Unit

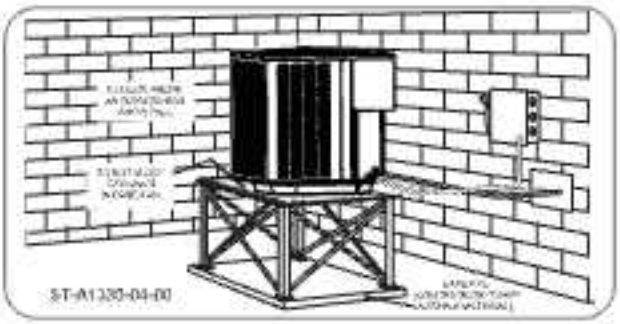
⚠WARNING: Secure an elevated unit and its elevating stand in order to prevent tipping. Failure to do so may result in severe personal injury or death.

If elevating the heat pump, either on a flat roof or on a slab, observe the following guidelines.

- The bottom of the basepan has receptacles for 4" [10.2 cm] schedule 40 PVC pipe that can be cut to length and used as risers for slab applications.
- If elevating a unit on a flat roof, use 4" x 4" [10.2 cm x 10.2 cm] or equivalent stringers positioned to distribute unit weight evenly and prevent noise and vibration.
- Where snowfall is anticipated, raise the unit above the base pad to prevent ice buildup and coil damage. Mount the unit high enough to be above the average accumulated area snowfall. See "Ground Snow Depth" chart below for representative snow depths.

NOTICE: Do not block drain openings on bottom of unit.

- If unit must be elevated because of anticipated snowfall, secure unit and elevating stand such that unit and/or stand will not tip over or fall off. Keep in mind that someone may try to climb on unit.



4.3.4 Ground Snow Depth Table

GROUND SNOW DEPTH – INCHES

ALABAMA		**INDIANA**		**MINNESOTA**		**NEW MEXICO**		**PENNSYLVANIA**		**VIRGINIA**	
Huntsville	7	Evansville	12	Duluth	64	Albuquerque	4	Allentown	23	Dulles Airport	19
ARIZONA		Fort Wayne	17	International Falls	43	Clayton	10	Erie	19	Lynchburg	16
Flagstaff	46	Indianapolis	21	Minneapolis/St. Paul	50	Roswell	8	Harrisburg	23	National Airport	18
Prescott	3	South Bend	44	Rochester	50	**NEW YORK**		Philadelphia	16	Norfolk	9
Winslow	7	**IOWA**		St. Cloud	53	Albany	25	Pittsburgh	22	Richmond	12
ARKANSAS		Burlington	17	**MISSISSIPPI**		Binghamton	30	Scranton	16	Roanoke	17
Fort Smith	5	Des Moines	22	Jackson	3	Buffalo	42	Williamsport	20	**WASHINGTON**	
Little Rock	6	Dubuque	38	**MISSOURI**		NYC – Kennedy Airport	18	**RHODE ISLAND**		Olympia	24
CALIFORNIA		Sioux City	33	Columbia	21	NYC – LaGuardia Airport	15	Providence	21	Quillayute	24
Blue Canyon	25	Waterloo	36	Kansas City	19	Rochester	38	**SOUTH CAROLINA**		Seattle-Tacoma	14
Mt. Shasta	69	**KANSAS**		St. Louis	16	Syracuse	36	Columbia	12	Spokane	41
COLORADO		Concordia	23	Springfield	14	**NORTH CAROLINA**		Greenville	4	Stampede Pass	51
Alamosa	15	Dodge City	12	**MONTANA**		Asheville	12	**SOUTH DAKOTA**		Yakima	25
Colorado Springs	14	Goodland	14	Billings	17	Cape Hatteras	6	Aberdeen	42	**WEST VIRGINIA**	
Denver	15	Topeka	19	Glasgow	17	Charlotte	10	Huron	43	Beckley	51
Grand Junction	16	Wichita	11	Great Falls	16	Greensboro	11	Rapid City	14	Charleston	20
Pueblo	7	**KENTUCKY**		Havre	24	Raleigh-Durham	10	Sioux Falls	38	Elkins	21
CONNECTICUT		Covington	12	Helena	18	Wilmington	9	**TENNESSEE**		Huntington	15
Bridgeport	23	Lexington	12	Kalispell	53	Winston-Salem	17	Bristol	8	**WISCONSIN**	
Hartford	29	Louisville	11	Missoula	23	**NORTH DAKOTA**		Chattanooga	6	Green Bay	36
New Haven	15	**MAINE**		**NEBRASKA**		Bismarck	25	Knoxville	8	La Crosse	32
DELAWARE		Caribou	100	Grand Island	30	Fargo	34	Memphis	5	Madison	32
Wilmington	13	Portland	62	Lincoln	20	Williston	25	Nashville	8	Milwaukee	32
GEORGIA		**MARYLAND**		Norfolk	29	**OHIO**		**TEXAS**		**WYOMING**	
Athens	5	Baltimore	17	North Platte	15	Akron-Canton	15	Abilene	6	Casper	10
Macon	8	**MASSACHUSETTS**		Omaha	20	Cleveland	16	Amarillo	10	Cheyenne	15
IDAHO		Boston	30	Scottsbluff	11	Columbus	10	Dallas	3	Lander	20
Boise	6	Nantucket	19	Valentine	22	Dayton	11	El Paso	5	Sheridan	25
Lewiston	9	Worcester	35	**NEVADA**		Mansfield	17	Fort Worth	6		
Pocatello	7	**MICHIGAN**		Elko	20	Toledo Express	8	Lubbock	10		
ILLINOIS		Alpena	53	Ely	9	Youngstown	12	Midland	2		
Chicago O'Hare	18	Detroit City	9	Reno	11	**OKLAHOMA**		San Antonio	3		
Chicago	22	Detroit Airport	17	Winnemucca	6	Oklahoma City	5	Wichita Falls	5		
Moline	17	Detroit – Willow Run	21	**NEW HAMPSHIRE**		Tulsa	8	**UTAH**			
Peoria	16	Flint	28	Concord	68	**OREGON**		Milford	15		
Rockford	25	Grand Rapids	37	**NEW JERSEY**		Burns City	24	Salt Lake City	8		
Springfield	23	Houghton Lake	56	Atlantic City	11	Eugene	17	Wendover	3		
		Lansing	42	Newark	15	Medford	9	**VERMONT**			
		Marquette	53			Pendleton	11	Burlington	37		
		Muskegon	43			Portland	10				
		Sault Ste. Marie	80			Salem	7				

NOTICE: Local records and experience must be considered when establishing the unit installation height. There is a 2% probability that the ground snow depth shown in this table will be exceeded annually. Drifts have not been considered. This data represents 184 National Weather Service locations at which measurements are made and assumes a nationwide snow density of 12 lb./ft.³

Mounting

4.4 Refrigerant Line Set Selection

4.4.1 Replacing Existing Systems

To prevent failure of a new unit, the existing line set must be correctly sized for the new unit and must be cleaned or replaced. Care must be taken so the expansion device is not plugged. For new and replacement units, a liquid line filter drier must be installed and the line set must be properly sized. Test the oil for acid. If it tests positive for acid, a suction line filter drier is mandatory.

WARNING: **When using a torch during brazing, nitrogen must be flowed while brazing. If an existing R-410A or R-22 unit's line set is being used for a replacement R-454B unit, it must be purged and flushed with nitrogen before use. It is recommended to replace the lineset if possible.**

4.4.1.2 Lineset Joints

Only brazed joints, welded joints, or mechanical joints using fittings listed to UL 207 are permitted on R-454B system linesets. Field-made lineset joints should be leak tested using an A2L compatible leak detector having sensitivity of 0.2 oz/year [5 g/year] or better. The leak detector should be approved for use with group A2L refrigerants, and in particular with R-454B.

IMPORTANT: When replacing an R-410A or R-22 unit with an R-454B unit, verify that the lineset and any joints in the lineset comply with local building code. Only brazed or welded joints and mechanical joints using fittings listed to UL 207 are permitted.

4.4.2 Line Set Length and Fitting Losses

Refrigerant tubing is measured in terms of actual length and equivalent length. Actual length is used for refrigerant charge applications. Equivalent length takes into account pressure losses from tubing length, fittings, vertical separation, accessories, and filter driers. The table below references different commonly used equivalent lengths.

Table 1

Equivalent Length for Fittings (ft) [m]							
Line Size (in) [mm]	90° Short Radius Elbow	90° Long Radius Elbow	45° Elbow	Solenoid Valve	Check Valve	Site Glass	Filter Drier
3/8 [9.53]	1.3 [0.40]	0.8 [0.24]	0.3 [0.09]	6 [1.83]	4 [1.22]	0.4 [0.12]	6 [1.83]
1/2 [12.71]	1.4 [0.43]	0.9 [0.27]	0.4 [0.12]	9 [2.74]	5 [1.52]	0.6 [0.18]	6 [1.83]
5/8 [15.88]	1.5 [0.46]	1 [0.30]	0.5 [0.15]	12 [3.66]	6 [1.83]	0.8 [0.24]	6 [1.83]
3/4 [19.05]	1.9 [0.58]	1.3 [0.40]	0.6 [0.18]	14 [4.27]	7 [2.13]	0.9 [0.27]	6 [1.83]
7/8 [22.23]	2.3 [0.70]	1.5 [0.46]	0.7 [0.21]	15 [4.57]	8 [2.44]	1 [0.30]	6 [1.83]
1-1/8 [28.58]	2.7 [0.82]	1.8 [0.55]	0.9 [0.27]	22 [6.71]	12 [3.66]	1.5 [0.46]	6 [1.83]

4.4.3 Liquid Line Selection

The purpose of the liquid line is to transport warm sub-cooled liquid refrigerant between the outdoor unit to the indoor unit. It is important not to allow the refrigerant to flash into superheated vapor prior to the expansion device of the indoor or outdoor coil. The flashing of refrigerant can occur for the following reasons:

- Low refrigerant charge
- Improperly selected liquid line size
- Absorption of heat prior to expansion device
- Excessive vertical separation between the outdoor unit and indoor coil
- Restricted liquid line or filter drier
- Kinked liquid line

The total pressure drop allowed for the liquid line is 50 PSI [345 kPa]. The procedure for selecting the proper liquid line is as follows:

- Measure the total amount of vertical separation between the outdoor unit and indoor coil.
- Measure the linear length of liquid line needed.
- Add all of the equivalent lengths associated with any fittings or accessories using Table 1 above.
- Add the linear length to the total fitting equivalent length. This will equal your total equivalent line length.
- Reference Table 2 to verify the calculated equivalent length is acceptable with the required vertical separation and diameter of liquid line.

4.0 INSTALLATION

4.4 Refrigerant Line Set Selection (cont.)

Table 2A: Refrigerant Line Sizing Chart (English Units)

Two-Stage Heat Pumps												
Unit Size	Allowable Liquid Line Size	Allowable Suction Line Size	Outdoor Unit ABOVE or BELOW Indoor Unit Equivalent Length (Feet)									
			0-25	26-50	51-75	76-100	101-125	126-150	151-175	176-200	201-225	226-250
			Maximum Vertical Separation / Capacity Multiplier									
1.5 Ton	1/4"	1/2"	25/1	50/0.98	66/0.99	47/0.95	27/0.94	7/0.92	0/0.91	0/0.89	0/0.88	0/0.87
	5/16"	1/2"	25/1	50/0.98	75/0.99	100/0.95	99/0.94	94/0.92	89/0.91	84/0.89	79/0.88	76/0.87
	3/8"	1/2"	25/1	50/0.98	75/0.99	100/0.95	117/0.94	116/0.92	115/0.91	113/0.89	111/0.88	110/0.87
	1/4"	5/8"	25/1	50/1	66/0.99	47/0.99	27/0.98	7/0.98	0/0.99	0/0.97	0/0.97	0/0.96
	5/16"	5/8"	25/1	50/1	75/0.99	100/0.99	99/0.98	94/0.98	89/0.99	84/0.97	79/0.97	76/0.96
	3/8"	5/8"	25/1	50/1	75/0.99	100/0.99	117/0.98	116/0.98	115/0.99	113/0.97	111/0.97	110/0.96
	1/4"	3/4"	25/1	50/1	66/1	47/1	27/0.99	7/0.99	0/0.99	0/0.99	0/0.99	0/0.99
	5/16"	3/4"	25/1	50/1	75/1	100/1	99/0.99	94/0.99	89/0.99	84/0.99	79/0.99	76/0.99
	3/8"	3/4"	25/1	50/1	75/1	100/1	117/0.99	116/0.99	115/0.99	113/0.99	111/0.99	110/0.99
2 Ton	1/4"	5/8"	25/1	50/0.98	33/0.98	3/0.98	0/0.97	0/0.96	0/0.95	0/0.95	0/0.94	0/0.94
	5/16"	5/8"	25/1	50/0.98	75/0.98	91/0.98	82/0.97	73/0.96	65/0.95	56/0.95	48/0.94	42/0.94
	3/8"	5/8"	25/1	50/0.99	75/0.98	100/0.98	110/0.97	107/0.96	104/0.95	101/0.95	98/0.94	95/0.94
	1/4"	3/4"	25/1	50/1	33/0.99	3/0.99	0/0.99	0/0.99	0/0.98	0/0.98	0/0.99	0/0.98
	5/16"	3/4"	25/1	50/1	75/0.99	91/0.99	82/0.99	73/0.98	65/0.98	56/0.98	48/0.99	42/0.98
	3/8"	3/4"	25/1	50/1	75/0.99	100/0.99	110/0.99	107/0.99	104/0.98	101/0.98	98/0.99	95/0.98
2.5 Ton	1/4"	5/8"	25/1	42/0.99	1/0.98	0/0.97	0/0.95	0/0.94	0/0.93	0/0.92	0/0.91	0/0.9
	5/16"	5/8"	25/1	50/0.99	75/0.98	73/0.97	60/0.95	47/0.94	34/0.93	22/0.92	10/0.91	1/0.9
	3/8"	5/8"	25/1	50/0.99	75/0.98	100/0.97	103/0.96	98/0.94	93/0.93	89/0.92	85/0.91	80/0.9
	1/4"	3/4"	25/1	42/1	1/0.99	0/0.99	0/0.98	0/0.98	0/0.97	0/0.97	0/0.97	0/0.96
	5/16"	3/4"	25/1	50/1	75/0.99	73/0.99	60/0.98	47/0.98	34/0.97	22/0.97	10/0.97	1/0.96
	3/8"	3/4"	25/1	50/1	75/0.99	100/0.99	103/0.98	98/0.98	93/0.97	89/0.97	85/0.97	80/0.96
3 Ton	5/16"	5/8"	25/1	50/0.98	71/0.97	53/0.95	35/0.93	17/0.92	0/0.9	0/0.89	0/0.87	0/0.87
	3/8"	5/8"	25/1	50/0.98	75/0.97	100/0.95	94/0.93	87/0.92	81/0.9	75/0.89	68/0.87	62/0.87
	5/16"	3/4"	25/1	50/0.99	71/0.99	53/0.98	35/0.96	17/0.97	0/0.96	0/0.96	0/0.95	0/0.95
	3/8"	3/4"	25/1	50/0.99	75/0.99	100/0.98	94/0.96	87/0.97	81/0.96	75/0.96	68/0.95	62/0.95
	1/2"	3/4"	25/1	50/0.99	75/0.99	100/0.98	119/0.98	118/0.97	116/0.96	115/0.96	114/0.95	113/0.95
	3/8"	7/8"	25/1	50/1	75/0.99	100/0.99	94/0.99	87/0.99	81/0.98	75/0.98	68/0.98	62/0.98
	1/2"	7/8"	25/1	50/1	75/0.99	100/0.99	119/0.99	118/0.99	116/0.98	115/0.98	114/0.98	113/0.98
3.5 Ton	3/8"	3/4"	25/1	50/0.99	75/0.98	92/0.98	83/0.97	75/0.96	67/0.95	59/0.94	50/0.94	42/0.93
	1/2"	3/4"	25/1	50/0.99	75/0.98	100/0.98	117/0.97	115/0.96	113/0.95	112/0.94	110/0.94	109/0.93
	3/8"	7/8"	25/1	50/1	75/0.99	92/0.99	83/0.99	75/0.98	67/0.98	59/0.98	50/0.97	42/0.97
	1/2"	7/8"	25/1	50/1	75/0.99	100/0.99	117/0.99	115/0.98	113/0.98	112/0.98	110/0.97	109/0.97
4 Ton	3/8"	3/4"	25/1	50/0.99	75/0.98	83/0.97	72/0.96	61/0.95	51/0.94	40/0.93	29/0.92	19/0.91
	1/2"	3/4"	25/1	50/0.99	75/0.99	100/0.97	114/0.96	112/0.95	110/0.94	108/0.93	106/0.92	105/0.91
	3/8"	7/8"	25/1	50/1	75/0.99	83/0.99	72/0.98	61/0.98	51/0.97	40/0.97	29/0.96	19/0.96
	1/2"	7/8"	25/1	50/1	75/0.99	100/0.99	114/0.98	112/0.98	110/0.97	108/0.97	106/0.96	105/0.96
5 Ton	3/8"	3/4"	25/1	50/0.98	75/0.97	61/0.95	45/0.94	29/0.92	13/0.9	0/0.89	0/0.87	0/0.86
	1/2"	3/4"	25/1	50/0.98	75/0.97	100/0.95	109/0.94	106/0.92	102/0.9	99/0.89	96/0.87	94/0.86
	3/8"	7/8"	25/1	50/0.99	75/0.99	61/0.98	45/0.97	29/0.97	13/0.96	0/0.95	0/0.95	0/0.94
	1/2"	7/8"	25/1	50/0.99	75/0.99	100/0.98	109/0.97	106/0.97	102/0.96	99/0.96	96/0.95	94/0.94

Maximum Equivalent Line Length may not exceed 250'.

Maximum Actual Line Length may not exceed 200'.

Light Grey shaded areas are considered long line and may require accessories as recommended in Long Line Set Guide.

DO NOT use suction line traps in the suction riser as this adds additional unwanted pressure drop in the system.

Tubing

4.4 Refrigerant Line Set Selection (cont.)

Table 2B: Refrigerant Line Sizing Chart (Metric Units)

Two-Stage Heat Pumps											
Unit Size	Allowable Liquid Line Size	Allowable Suction Line Size	Outdoor Unit ABOVE or BELOW Indoor Unit Equivalent Length (Meters)								
			0-8	8-15	16-23	23-30	31-38	38-46	46-53	54-61	61-69	69-76
			Maximum Vertical Separation / Capacity Multiplier									
1.5 Ton	1/4"	1/2"	8/1	15/0.98	20/0.99	14/0.95	8/0.94	2/0.92	0/0.91	0/0.89	0/0.88	0/0.87
	5/16"	1/2"	8/1	15/0.98	23/0.99	30/0.95	30/0.94	29/0.92	27/0.91	26/0.89	24/0.88	23/0.87
	3/8"	1/2"	8/1	15/0.98	23/0.99	30/0.95	36/0.94	35/0.92	35/0.91	34/0.89	34/0.88	34/0.87
	1/4"	5/8"	8/1	15/1	20/0.99	14/0.99	8/0.98	2/0.98	0/0.99	0/0.97	0/0.97	0/0.96
	5/16"	5/8"	8/1	15/1	23/0.99	30/0.99	36/0.98	29/0.98	27/0.99	26/0.97	24/0.97	23/0.96
	3/8"	5/8"	8/1	15/1	23/0.99	30/0.99	36/0.98	35/0.98	35/0.99	34/0.97	34/0.97	34/0.96
	1/4"	3/4"	8/1	15/1	20/1	14/1	8/0.99	2/0.99	0/0.99	0/0.99	0/0.99	0/0.99
	5/16"	3/4"	8/1	15/1	23/1	30/1	36/0.99	29/0.99	27/0.99	26/0.99	24/0.99	23/0.99
	3/8"	3/4"	8/1	15/1	23/1	30/1	36/0.99	35/0.99	35/0.99	34/0.99	34/0.99	34/0.99
2 Ton	1/4"	5/8"	8/1	15/0.99	10/0.95	1/0.98	0/0.97	0/0.96	0/0.95	0/0.95	0/0.94	0/0.94
	5/16"	5/8"	8/1	15/0.99	23/0.98	28/0.98	25/0.97	22/0.96	20/0.95	17/0.95	15/0.94	13/0.94
	3/8"	5/8"	8/1	15/0.99	23/0.98	30/0.95	34/0.97	33/0.96	32/0.95	31/0.95	30/0.94	29/0.94
	1/4"	3/4"	8/1	15/1	10/0.99	1/0.99	0/0.99	0/0.99	0/0.98	0/0.98	0/0.99	0/0.98
	5/16"	3/4"	8/1	15/1	23/0.99	28/0.99	25/0.99	22/0.99	20/0.98	17/0.98	15/0.99	13/0.98
	3/8"	3/4"	8/1	15/1	23/0.99	30/0.99	34/0.99	33/0.99	32/0.98	31/0.98	30/0.98	29/0.98
2.5 Ton	1/4"	5/8"	8/1	13/0.99	0.3/0.98	0/0.97	0/0.96	0/0.94	0/0.93	0/0.92	0/0.91	0/0.9
	5/16"	5/8"	8/1	15/0.99	23/0.98	22/0.97	18/0.95	14/0.94	10/0.93	7/0.92	3/0.91	0.3/0.9
	3/8"	5/8"	8/1	15/0.99	23/0.98	30/0.97	31/0.95	30/0.94	28/0.93	27/0.92	26/0.91	24/0.9
	1/4"	3/4"	8/1	13/1	0.3/0.99	0/0.99	0/0.98	0/0.98	0/0.97	0/0.97	0/0.97	0/0.96
	5/16"	3/4"	8/1	15/1	23/0.99	22/0.99	18/0.98	14/0.98	10/0.97	7/0.97	3/0.97	0.3/0.96
	3/8"	3/4"	8/1	15/1	23/0.99	30/0.99	31/0.98	30/0.98	28/0.97	27/0.97	26/0.97	24/0.96
3 Ton	5/16"	5/8"	8/1	15/0.98	22/0.97	16/0.95	11/0.93	5/0.92	0/0.9	0/0.89	0/0.87	0/0.87
	3/8"	5/8"	8/1	15/0.98	23/0.97	30/0.95	29/0.93	27/0.92	25/0.9	23/0.89	21/0.87	18/0.87
	5/16"	3/4"	8/1	15/0.98	22/0.99	16/0.98	11/0.96	5/0.97	0/0.96	0/0.96	0/0.96	0/0.95
	3/8"	3/4"	8/1	15/0.98	23/0.99	30/0.98	29/0.96	27/0.97	25/0.98	23/0.98	21/0.98	19/0.95
	1/2"	3/4"	8/1	15/0.98	23/0.99	30/0.98	36/0.98	36/0.97	35/0.98	35/0.98	35/0.96	34/0.95
	3/8"	7/8"	8/1	15/1	23/0.99	30/0.99	29/0.99	27/0.99	25/0.98	23/0.98	21/0.98	19/0.98
	1/2"	7/8"	8/1	15/1	23/0.99	30/0.99	36/0.99	36/0.99	35/0.98	35/0.98	35/0.98	34/0.98
3.5 Ton	3/8"	3/4"	8/1	15/0.99	23/0.98	28/0.98	25/0.97	23/0.96	20/0.95	18/0.94	15/0.94	13/0.93
	1/2"	3/4"	8/1	15/0.99	23/0.98	30/0.98	36/0.97	35/0.96	34/0.95	34/0.94	34/0.94	33/0.93
	3/8"	7/8"	8/1	15/1	23/0.99	28/0.99	25/0.99	23/0.98	20/0.98	18/0.98	15/0.97	13/0.97
	1/2"	7/8"	8/1	15/1	23/0.99	30/0.99	36/0.99	35/0.98	34/0.98	34/0.98	34/0.97	33/0.97
4 Ton	3/8"	3/4"	8/1	15/0.99	23/0.98	25/0.97	22/0.96	19/0.95	16/0.94	12/0.93	9/0.92	6/0.91
	1/2"	3/4"	8/1	15/0.99	23/0.98	30/0.97	35/0.96	34/0.95	34/0.94	33/0.93	32/0.92	32/0.91
	3/8"	7/8"	8/1	15/1	23/0.99	25/0.99	22/0.98	19/0.98	16/0.97	12/0.97	9/0.96	6/0.96
	1/2"	7/8"	8/1	15/1	23/0.99	30/0.99	35/0.98	34/0.98	34/0.97	33/0.97	32/0.96	32/0.96
5 Ton	3/8"	3/4"	8/1	15/0.98	23/0.97	19/0.95	14/0.94	9/0.92	4/0.9	0/0.89	0/0.87	0/0.86
	1/2"	3/4"	8/1	15/0.98	23/0.97	30/0.95	33/0.94	32/0.92	31/0.9	30/0.89	29/0.87	29/0.86
	3/8"	7/8"	8/1	15/0.99	23/0.99	19/0.98	14/0.97	9/0.97	4/0.96	0/0.95	0/0.95	0/0.94
	1/2"	7/8"	8/1	15/0.99	23/0.99	30/0.98	33/0.97	32/0.97	31/0.96	30/0.95	29/0.95	29/0.94

Maximum Equivalent Line Length may not exceed 76 Meters.

Maximum Actual Line Length may not exceed 61 Meters.

Light Grey shaded areas are considered long line and may require accessories as recommended in Long Line Set Guide.

DO NOT use suction line traps in the suction riser as this adds additional unwanted pressure drop in the system.

Example: A 3 Ton outdoor unit is installed 25' below the Indoor unit, requires a 75' of 3/8" diameter liquid line, 3/4" diameter vapor line, 4 3/8" 90° LR elbows and a filter drier.

- Fitting Equivalent Length (ft.) = (4 × .8') + 6' = 9.2'
- Total Equivalent Length (ft.) = 75' + 9.2' = 84.2'

This application is acceptable because the 25' vertical rise is less than the maximum rise of 85' for this application. The application is also considered to have a long line set since 75 linear feet exceeds the limit of 80 feet. Reference the long line set section (4.4.5) of this manual for detail.

4.0 INSTALLATION

4.4 Refrigerant Line Set Selection (cont.)

Unit Size	Allowable Liquid Line Size	Allowable Vapor Line Size	Use Long Line Guidelines for Linear Line Lengths Greater Than Shown Below	Outdoor Unit ABOVE or BELOW Indoor Unit Equivalent Length (Feet)					
				< 25	26-50	51-75	76-100	101-125	126-150
				Maximum Vertical Separation / Capacity Multiplier					
3 Ton	5/16"	5/8"	0	25 / 0.98	50 / 0.97	50 / 0.95	50 / 0.93	35 / 0.91	NR
	3/8"	5/8"	0	25 / 0.99	50 / 0.97	50 / 0.95	50 / 0.93	50 / 0.91	NR
	5/16"	3/4"	0	25 / 1.00	50 / 0.99	50 / 0.99	50 / 0.98	35 / 0.97	20 / 0.96
	3/8"	3/4"	0	25 / 1.00	50 / 0.99	50 / 0.99	50 / 0.98	50 / 0.97	50 / 0.96
	1/2"	3/4"	0	25 / 1.00	50 / 0.99	50 / 0.99	50 / 0.98	50 / 0.97	50 / 0.96

(Excerpt From Table 2A)

4.4.4 Vapor Line Selection

Purpose of the vapor line is to return superheated vapor to the condensing unit from the evaporator in the cooling mode and hot discharge gas to the indoor coil in the heating mode. Proper vapor line sizing is important because it plays an important role in returning oil to the compressor to prevent potential damage to the bearings, valves, and scroll sets. Also, an undersized vapor line can dramatically reduce capacity and performance of the system. The procedure for selecting the proper vapor line is as follows:

- The total amount of suction line needed
- Add all of the equivalent lengths associated with any fittings or accessories using the table on previous page.
- Add the linear length and total fitting equivalent length. This will equal your total equivalent length.
- Reference Table 2 to verify that the calculated equivalent length falls within the acceptable region of the chart.
- Verify the capacity difference is compatible with the application using the multiplier in Table 2.
- Use only vapor line sizes listed in Table 2.

4.4.5 Long Line Set Considerations

Long line set applications are defined as applications that require accessories or alternate construction methods. The following are special considerations that need to be addressed when selecting and installing a long line set:

- Additional refrigerant charge
- Fitting losses and maximum equivalent length considerations
- Refrigerant migration during the off cycle
- Oil return to the compressor
- Capacity losses
- System oil level adjustment

4.4.5.1 Determining if Long Line Set Length Requirements Apply

Table 2 is used to determine if the application is considered to have a long line set. A column is provided that shows the linear line length where long line length requirements apply.

4.4.5.2 Oil Return to Compressor

Small amounts of compressor crankcase oil is picked up and carried out of the compressor by the moving refrigerant and is circulated through the system along with the refrigerant before it returns to the compressor crankcase. It is critical to the life of the compressor for the oil to be able to return to the compressor to maintain an adequate level of oil in the compressor crankcase. Oversized vapor lines result in inadequate refrigerant velocities to carry the oil along with the refrigerant and will cause the oil to accumulate in the low spots in the vapor line instead of being returned to the compressor crankcase. This is especially true for long line lengths. Only use the vapor line sizes listed in Table 2 to assure proper oil return. Do not oversize the vapor line.

4.4.5.3 Refrigerant Migration During Off Cycle

Long line set applications can require a considerable amount of additional refrigerant. This additional refrigerant needs to be managed throughout the entire ambient operating envelope that the system will go through during its life cycle. Off-Cycle migration is where excess refrigerant condenses and migrates to the coldest and/or lowest part of the system. Excessive build-up of refrigerant at the compressor will result in poor reliability and noisy operation during startup. Long line applications require TXV's on both the indoor coil and outdoor unit and a crankcase heater. (See Section 7.12 for additional crankcase heater information.)

4.4 Refrigerant Line Set Selection (cont.)

4.4.5.4 Maximum Liquid Pressure Drop

The total liquid line pressure drop must not exceed 50 psig [345 kPa] to assure a solid column of liquid at the metering device and stable control of superheat. Be sure to account for vertical separation, elbows, filter driers, solenoid valves, sight glasses, and check valves when calculating liquid line pressure drop.

4.4.5.5 Liquid Line Refrigerant Flashing

Excessive pressure drop and heat gain in long liquid lines can result in the refrigerant flashing into a vapor before it reaches the metering device which will dramatically reduce the capacity and efficiency of the system. For this reason, the liquid line must be sized properly using the table in Table 2 and must be insulated in unconditioned spaces.

4.4.5.6 Oil Level Adjustment for Long Line Set Applications

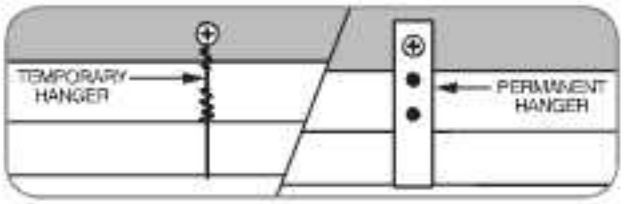
Additional oil will need to be added for long line set applications. (Ref. Table 2). If the system contains more than 20 lbs [9 kg] of refrigerant charge, add 1 fluid oz of POE oil for every 5 lbs [13 ml/kg] of refrigerant charge over 20 lbs [9 kg].

4.4.5.7 Capacity Losses

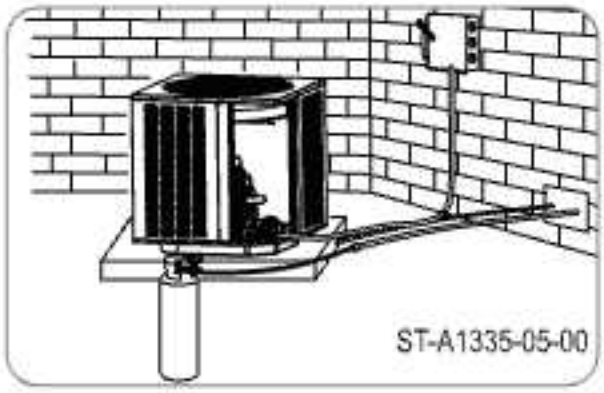
Long line lengths can result in a reduction in capacity due to vapor line pressure drop and heat gain or loss. Refer to Table 2 for capacity loss multipliers for various vapor line diameters and lengths. Only use vapor lines listed in Table 2 to assure proper oil return. This table does not account for any capacity loss due to heat gain or loss from the environment. It is extremely important not to oversize the vapor line to minimize capacity loss at the expense of proper oil return. If the table shows an "NR" for a particular vapor line diameter and length, capacity loss will be excessive. The full length of the vapor line must be insulated to minimize heat gain or loss.

4.5 Line Set Installation

- If tubing is to be run underground, it must be run in a sealed watertight chase.
- Use care in routing tubing and do not kink or twist. Use a good quality tubing bender on the vapor line to prevent kinking.



- Route the tubing using temporary hangers; then straighten the tubing and install permanent hangers. The tubing must be adequately supported.
- Isolate the vapor line from the building structure. If the vapor line comes in contact with inside walls, ceiling, or flooring, the vibration of the vapor line in the heating mode will result in noise inside the structure.
- Blow out the liquid and vapor lines with dry nitrogen before connecting to the outdoor unit and indoor coil to remove debris that can plug the expansion device.

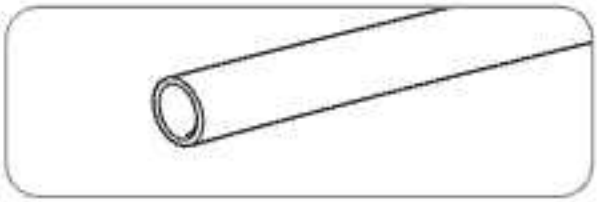


4.0 INSTALLATION

4.5.1 Important Tubing Installation Practices

Observe the following when installing correctly sized type "L" refrigerant tubing between the outdoor unit and indoor coil:

- Check the tables on Table 2 for the correct vapor line size and liquid line size.
- **If a portion of the liquid line passes through a very hot area where liquid refrigerant can be heated to form vapor, insulating the liquid line is required.**
- Use clean, dehydrated, sealed refrigeration-grade tubing.
- Always keep tubing sealed until tubing is in place and connections are to be made.
- A high-quality biflow filter drier is included with all R-454B heat pump units and must be installed in the liquid line upon unit installation.
- When replacing an R-410A or R-22 system with an R-454B system and the line set is not replaced, blow out the lines with dry nitrogen to remove as much of the remaining mineral oil as possible. Check for low spots where oil may be trapped and take measures to drain the oil from those areas.



- If tubing has been cut, debur the ends while holding the tubing in a position to prevent chips from falling into tubing. Burrs such as those caused by tubing cutters can affect performance dramatically, particularly on small diameter liquid lines.
- For best operation, keep tubing run as short as possible with a minimum number of elbows or bends.
- Locations where the tubing will be exposed to mechanical damage should be avoided. If it is necessary to use such locations, the copper tubing should be protected by a housing to prevent damage.

Pipe-work including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed.

After completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements:

- The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system, cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.

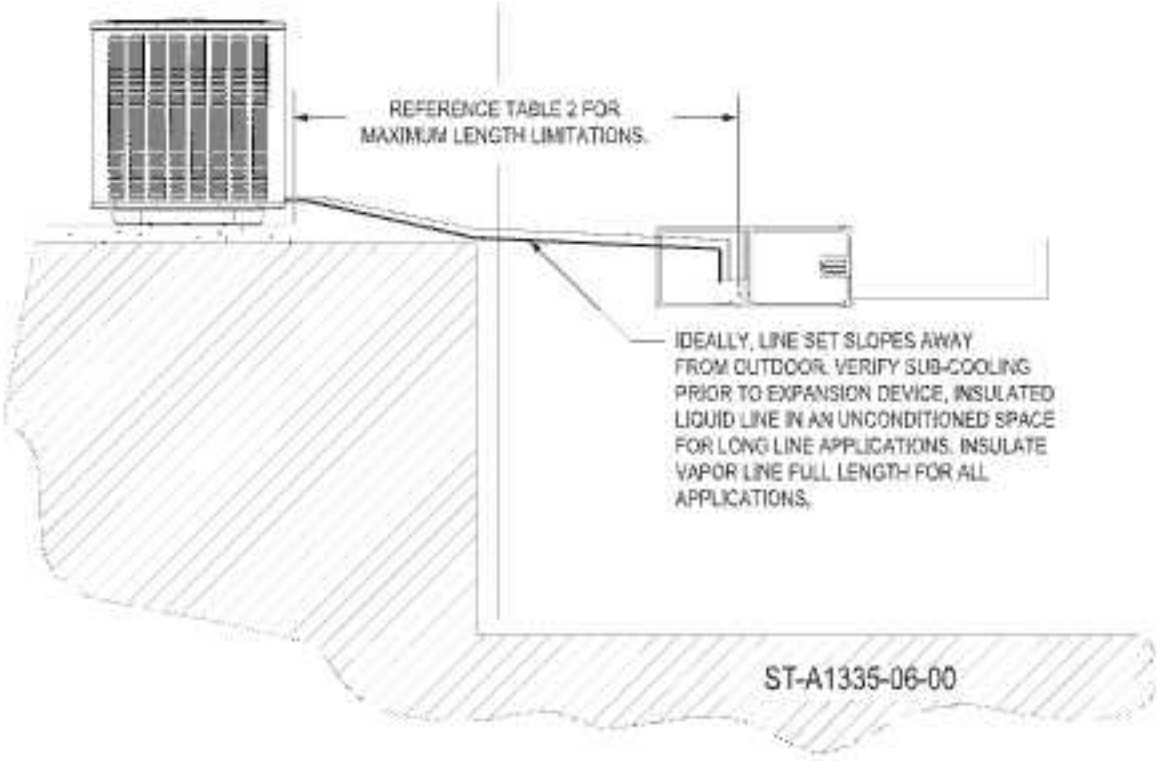
- Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 grams per year of refrigerant or better under a pressure of at least 0.25 times the maximum allowable pressure.

- No leak shall be detected; where addition of charge is required to complete installation, refer to Sections 5.0 to 5.5 of the System start-up % refrigerant charging details for instructions on how to determine the additional REFRIGERANT CHARGE and how to complete the REFRIGERANT CHARGE on the label provided by the manufacturer. Interconnecting refrigerant piping length and diameter shall be taken into consideration as listed in the Line Set Selection.

4.5 Line Set Installation (cont.)

4.5.2 Relative Location of Indoor and Outdoor Units

4.5.2.1 Indoor and Outdoor Unit Near Same Level



For applications that are considered to have a long line set with the outdoor unit and indoor unit near the same level the following is required:

- TXV on the indoor coil
- Start components may be required depending upon quality of voltage (consistently <200vac at outdoor unit)
- Crankcase heater (Some models have factory installed CCH's. Refer to tables in Section 4.5.5.6.)
- Insulated liquid line in unconditioned space only. Insulate vapor line full length.
- Vapor line should slope toward the indoor unit
- Follow the proper line sizing, maximum linear and equivalent lengths, charging requirements, and oil level adjustments spelled out in this manual.
- Verify at least 5°F [2.8°C] liquid sub-cooling at the indoor unit prior to expansion device in the cooling mode.

4.0 INSTALLATION

4.5 Line Set Installation (cont.)

4.5.2.2 Outdoor Unit Below Indoor Unit

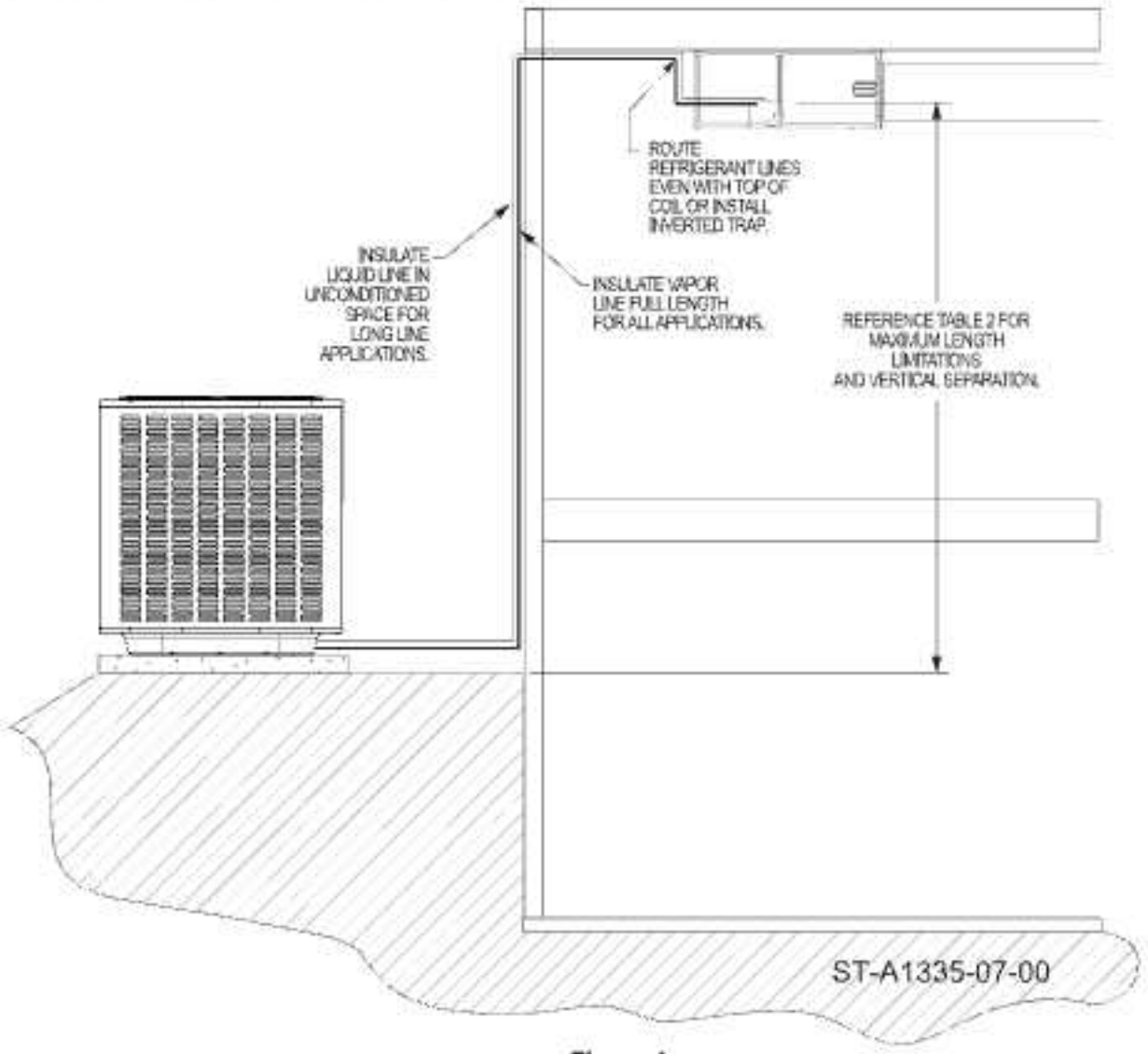


Figure 4

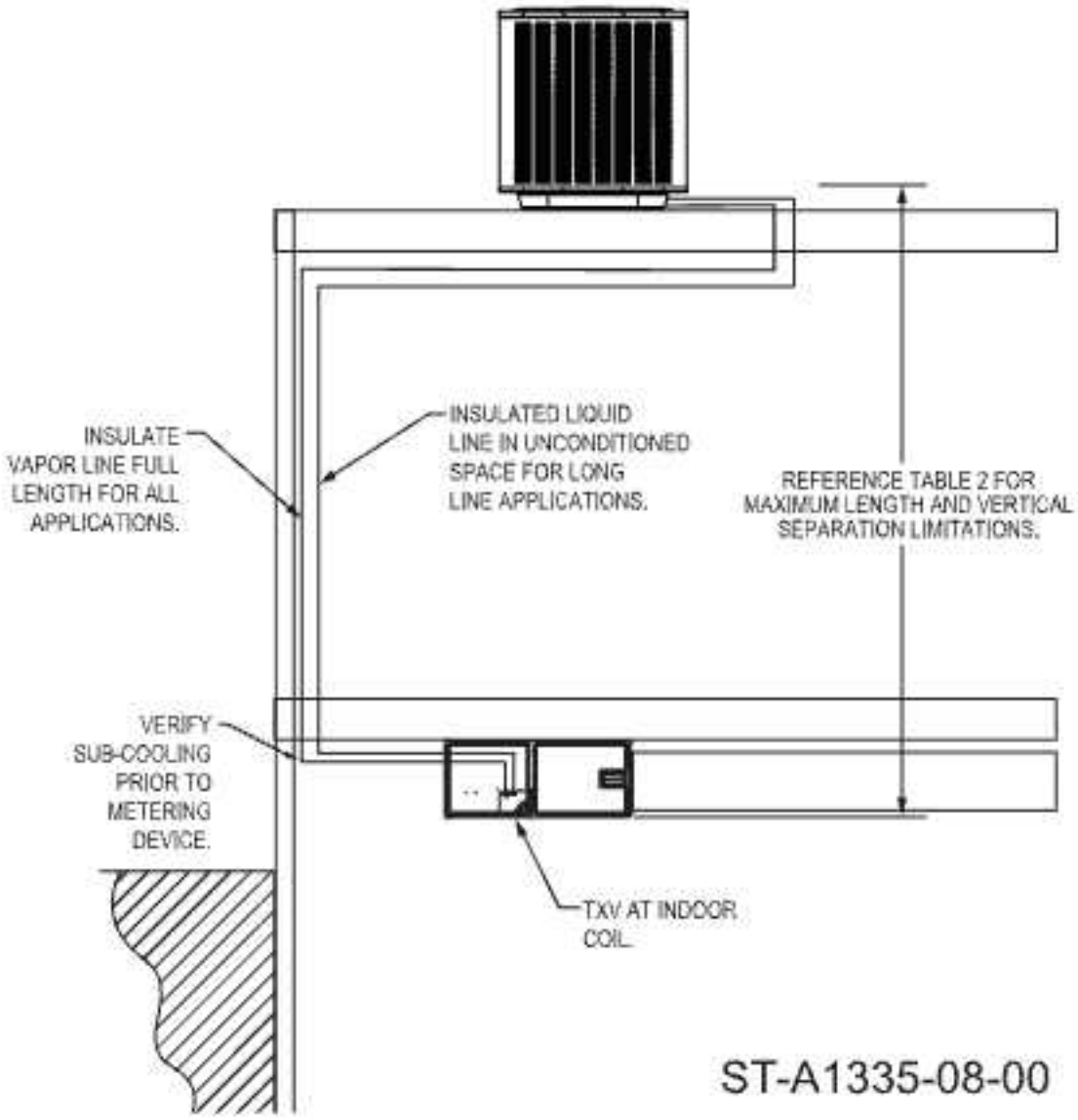
Tubing

For applications that are considered to have a long line set with the outdoor unit below the indoor unit the following is required:

- TXV or at the indoor coil.
- Crankcase heater (Some models have factory installed CCH's. Refer to tables in Section 4.5.5.6.)
- Start components may be required depending upon quality of voltage (consistently <200vac at outdoor unit)
- Refrigerant lines should be routed even with the top of the indoor coil or an inverted trap is to be applied (refer to Figure 4).
- Insulated liquid line in unconditioned space only. Insulate vapor line full length.
- Follow the proper line sizing, maximum linear and equivalent lengths, charging requirements, and oil level adjustments spelled out in this manual.
- Verify at least 5°F [2.8°C] liquid sub-cooling at the indoor unit prior to expansion device in the cooling mode.
- Vertical separations greater that 25' [7.62 m] can expect a lower sub-cooling level.

4.5 Line Set Installation (cont.)

4.5.2.3 Outdoor Unit Above Indoor Unit



ST-A1335-08-00

For applications that are considered to have a long line set with the outdoor unit above the indoor unit the following is required:

- TXV on the indoor coil.
- Crankcase heater (Some models have factory installed CCH's. Refer to tables in Section 4.5.5.6.)
- Start components maybe required depending upon quality of voltage (consistently <200 vac at outdoor unit)
- Insulated liquid line in unconditioned space only. Insulate vapor line full length.
- Follow the proper line sizing, maximum linear and equivalent lengths, charging requirements, and oil level adjustments spelled out in this manual.
- Verify at least 5°F [2.8°C] liquid sub-cooling at the outdoor unit service valve in the heating mode.

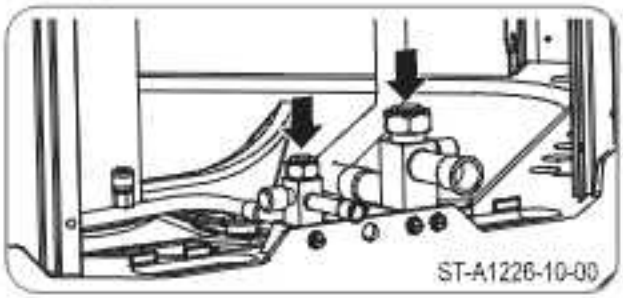
4.0 INSTALLATION

4.5 Line Set Installation (cont.)

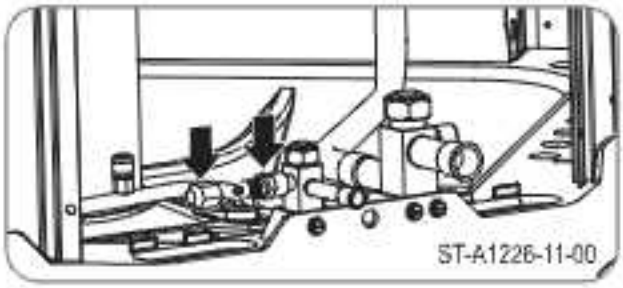
4.5.3 Tubing Connections

Indoor coils have only a holding charge of dry nitrogen. Keep all tube ends sealed until connections are to be made.

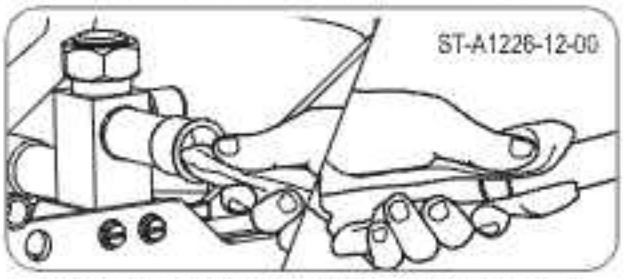
- Use type "L" copper refrigeration tubing. Braze the connections with the following alloys:
  - copper to copper, 5% silver minimum
  - copper to steel or brass, 15% silver minimum



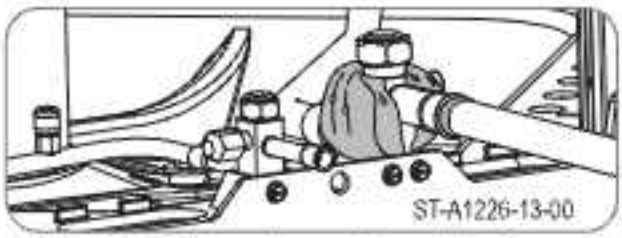
- Be certain both refrigerant shutoff valves at the outdoor unit are closed.



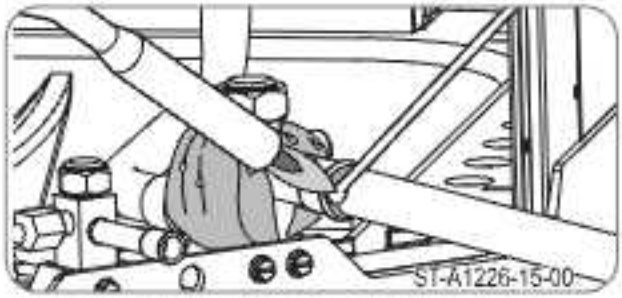
- Remove the caps and Schrader cores from the pressure ports to protect seals from heat damage. Both the Schrader valves and the service valves have seals that may be damaged by excessive heat.



- Clean the inside of the fittings and outside of the tubing with a clean, dry cloth before soldering. Clean out debris, chips, dirt, etc., that enters tubing or service valve connections.



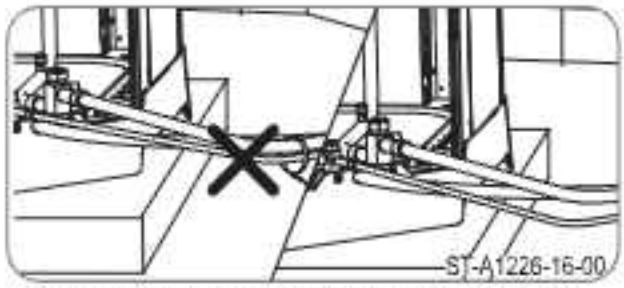
- Wrap valves with a wet rag or thermal barrier compound before applying heat.



- Braze the tubing between the outdoor unit and indoor coil. Flow dry nitrogen into a pressure port and through the tubing while brazing, but do not allow pressure inside tubing which can result in leaks. Once the system is full of nitrogen, the nitrogen regulator should be turned off to avoid pressuring the system.



- After brazing, use an appropriate heatsink material to cool the joint.
- Reinstall the Schrader cores into both pressure ports.

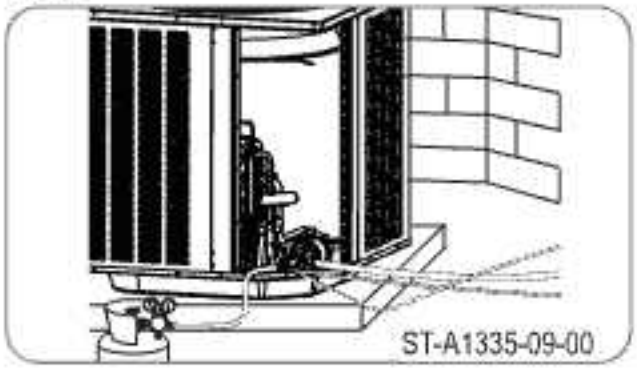


- Do not allow the bare vapor line and liquid line to be in contact with each other. This causes an undesirable heat transfer resulting in capacity loss and increased power consumption.

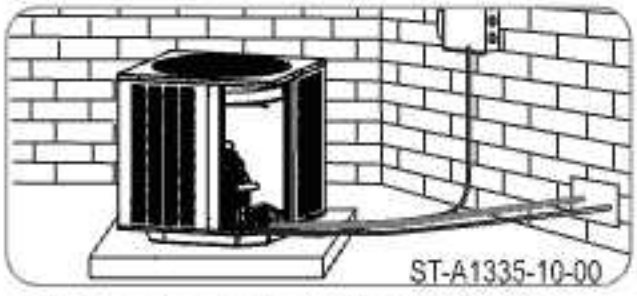
4.6 Initial Leak Testing

Indoor coils have only a holding charge of dry nitrogen. Keep all tube ends sealed until connections are to be made.

⚠WARNING: Do not use oxygen to purge lines or pressurize system for leak test. Oxygen reacts violently with oil, which can cause an explosion resulting in severe personal injury or death.



- Pressurize line set and coil through service fittings with dry nitrogen to the design pressure listed on the unit nameplate. Close nitrogen tank valve, let system sit for 60 minutes, and check to see if the pressure has dropped. If the pressure has dropped, check for leaks at the line set braze joints with soap bubbles and repair leak as necessary. Repeat pressure test. If line set and coil hold pressure, proceed with line set and coil evacuation (see Sections 4.7 and 4.8 for evacuation and final leak testing).



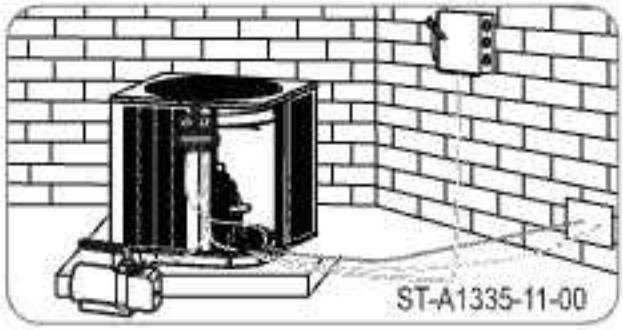
- The vapor line must be insulated for its entire length to prevent dripping (sweating) and prevent performance losses. Closed-cell foam insulation such as Armaflex and Rubatex® are satisfactory insulations for this purpose. Use 1/2" [12.7 mm] minimum insulation thickness. Additional insulation may be required for long runs. The liquid line must be insulated in any unconditioned space when long line sets are used and anytime the liquid line is run through an attic due to hot temperatures that occur there.

4.7 Evacuation

Evacuation is one of the most important parts of the entire installation and service procedure. The life and efficiency of the equipment is dependent upon the thoroughness exercised by the serviceman when evacuating air and moisture from the system.

Air or nitrogen in the system increases condensing temperature and pressure, resulting in increased power consumption, erratic operation, and reduced capacity.

Moisture chemically reacts with the refrigerant and oil to form corrosive acid which attacks the compressor motor windings and internal parts and which can result in compressor failure.



- After the system has been leak-checked and proven sealed, connect the vacuum pump and evacuate system to 500 microns and hold 500 microns or less for at least 15 minutes. The vacuum pump must be connected to both the high and low sides of the system by connecting to the two pressure ports. Use the largest size connections available since restrictive service connections may lead to false readings because of pressure drop through the fittings.

4.8 Final Leak Testing

After the unit has been properly evacuated and service valves opened, an A2L compatible leak detector should be used to detect leaks in the system. All joints and piping within the outdoor unit, indoor coil, and interconnecting tubing should be checked for leaks. If a leak is detected, the refrigerant should be recovered before repairing the leak. The Clean Air Act prohibits releasing refrigerant into the atmosphere.

4.0 INSTALLATION

4.9 Control Wiring

⚠WARNING: Turn off electric power at the fuse box or service panel before making any electrical connections. Also, the ground connection must be completed before making line voltage connections. Failure to do so can result in electrical shock, severe personal injury, or death.

Running low-voltage wires in conduit with line voltage power wires is not recommended. Low-voltage wiring should be attached to the pigtails below the control box.

A thermostat and a 24-volt, 40 VA minimum transformer are required for the control circuit of the system. The furnace or the air handler transformer may be used if sufficient. See the wiring diagram for reference. Use "Wire Size" guide below to size the 24-volt control wiring.

Do not use phone cord to connect indoor and outdoor units and thermostat. This could damage the controls and may not be adequately sized for the control's electrical load.

FIELD WIRE SIZE FOR 24-VOLT THERMOSTAT CIRCUITS:

Runs up to 100 ft [30.5 m]: 18 AWG
Runs over 100 ft [30.5 m]: 16 AWG

NOTICE: Do not use control wiring smaller than No. 18 AWG between thermostat and outdoor unit.

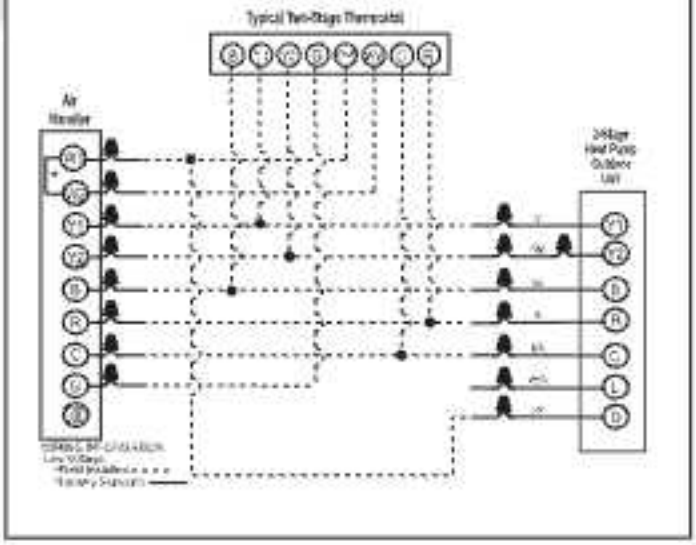
4.10 Typical Control Wiring Connections

The following figures show the typical wiring diagrams for air handlers and a 2-stage heat pump and for dual fuel applications with a gas furnace and a 2-stage heat pump.

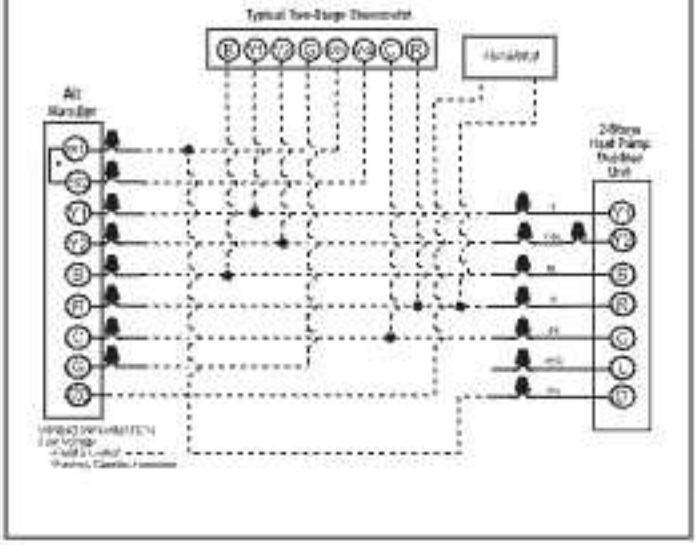
WIRE COLOR CODE		
BK – BLACK	GY – GRAY	W – WHITE
BR – BROWN	O – ORANGE	Y – YELLOW
BL – BLUE	PR – PURPLE	
G – GREEN	R – RED	

Wiring

2-STAGE HEAT PUMP WITH ELECTRIC HEAT USING A TYPICAL 2-STAGE THERMOSTAT



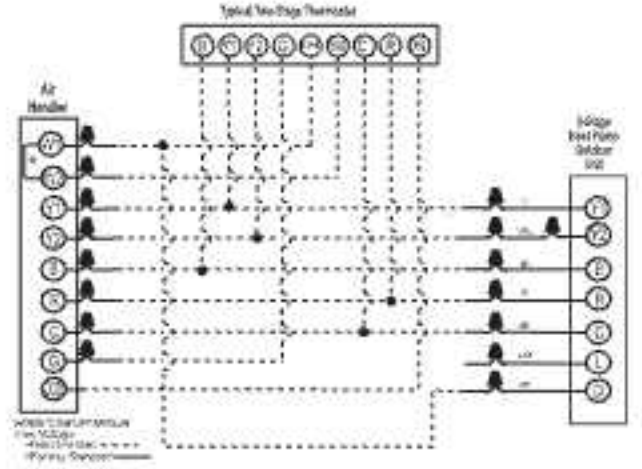
2-STAGE HEAT PUMP WITH ELECTRIC HEAT USING A TYPICAL 2-STAGE THERMOSTAT AND A HUMIDISTAT FOR DEHUMIDIFICATION



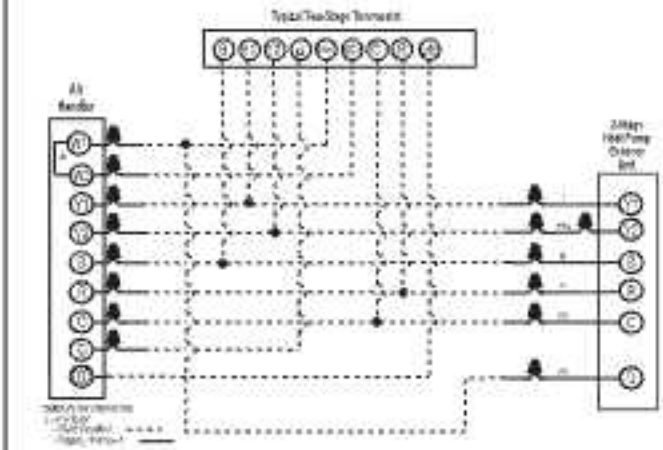
*If maximum outlet temperature rise is desired, it is recommended that W1 and W2 be wired together.

4.10 Typical Control Wiring Connections (Cont.)

2-STAGE HEAT PUMP WITH ELECTRIC HEAT USING A TYPICAL 2-STAGE THERMOSTAT WITH DEHUMIDIFICATION

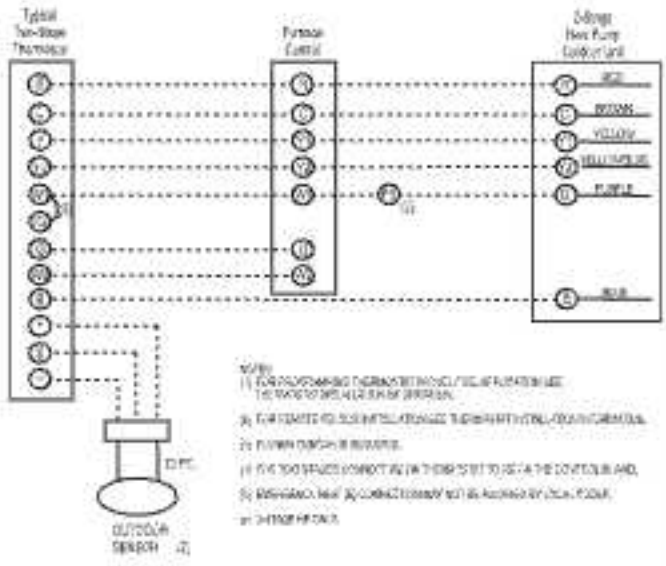


2-STAGE HEAT PUMP WITH ELECTRIC HEAT USING A TYPICAL 2-STAGE THERMOSTAT WITH DEHUMIDIFICATION AND A MAL-FUNCTION LIGHT



*If maximum outlet temperature rise is desired, it is recommended that W1 and W2 be wired together.

TYPICAL DUAL FUEL APPLICATION - 2-STAGE HEAT PUMP USING A TYPICAL 2-STAGE THERMOSTAT



NOTICE: Field wiring must comply with the National Electric Code (C.E.C. in Canada) and any applicable local code.

4.0 INSTALLATION

4.11 Power Wiring

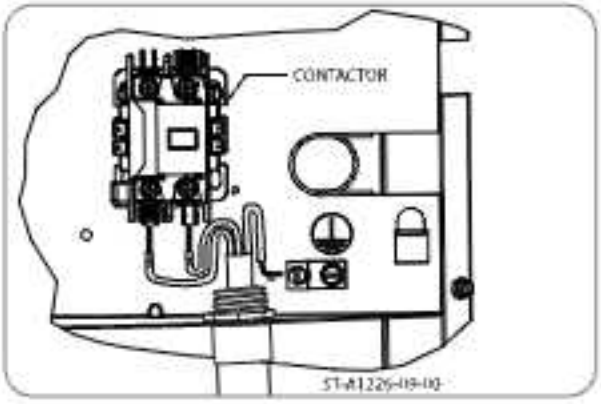
It is important that proper electrical power from a commercial utility is available at the outdoor unit contactor. Voltage ranges for operation are shown below.

VOLTAGE RANGES

Nameplate Voltage	Operating Voltage Range at Maximum Load Design Conditions
208/230	187 - 253

Install a branch circuit disconnect within sight of the unit and of adequate size to handle the minimum circuit capacity (see Section 3.3).

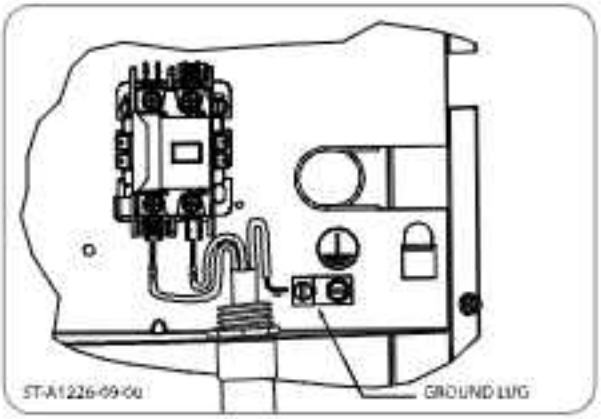
Power wiring must be run in a rain-tight conduit. Conduit must be attached to the hole in the bottom of the control box as shown below.



Connect power wiring to line-voltage lugs on the contactor located in the outdoor unit electrical box. (See wiring diagram attached to unit access panel and above illustration.)

Check all electrical connections, including factory wiring within the unit and make sure all connections are tight.

DO NOT connect aluminum field wire to the contactor lugs.



A grounding lug is provided near the line-voltage power entrance for a ground wire as shown in the above illustration.

4.12 Grounding

⚠WARNING: The unit must be permanently grounded. Failure to do so can cause electrical shock resulting in severe personal injury or death.

5.0 SYSTEM START-UP & REFRIGERANT CHARGING

5.1 System Start-Up Overview

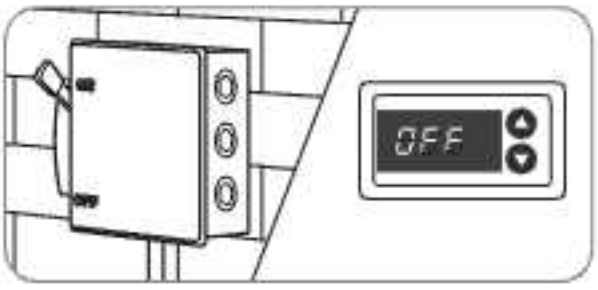
Once the system hardware and wiring has been properly installed, the next step is to start the system up, verify indoor air-flow, and adjust the refrigerant charge. To assure optimum comfort, efficiency, and reliability, it is extremely important to follow the procedures in this section to assure the indoor air-flow and refrigerant charge are correct.

⚠WARNING: Single-pole contactors are used on all standard single-phase units through 5 tons. Caution must be exercised when servicing as only one leg of the power supply is broken by the contactor.

5.2 Initial System Power-Up

After all installation steps have been completed, apply electrical power to the indoor and outdoor unit only until the indoor air-flow is verified (See Section 5.3).

After the indoor air-flow has been verified and the preliminary refrigerant charge has been weighed in (see section 5.4.2), electrical power may be applied to the outdoor unit. If the unit is equipped with a crankcase heater, it is recommended to wait at least 12 hours after electrical power is applied to the outdoor unit before starting the compressor to assure any liquid refrigerant inside the compressor has been driven out by the crankcase heater.



5.3 Verifying Indoor Air-Flow

The air distribution system has the greatest effect on airflow. The duct system is totally controlled by the contractor. For this reason, the contractor should use only industry-recognized procedures.

Duct design and construction should be carefully done. System performance can be lowered dramatically through bad planning or workmanship.

Air supply diffusers must be selected and located carefully. They must be sized and positioned to deliver treated air along the perimeter of the space. If they are too small for their intended airflow, they become noisy. If they are not located properly, drafts can result. Return air grilles must be properly sized to carry air back to the blower. If they are too small, they also cause noise.

The installers should balance the air distribution system to ensure proper and quiet airflow to all rooms in the home. This ensures a comfortable living space.

The correct air quantity is critical to air conditioning systems. Proper operation, efficiency, compressor life, and humidity control depend on the correct balance between indoor load and outdoor unit capacity. Excessive indoor airflow increases the possibility of high humidity problems. Low indoor airflow reduces total capacity and can cause coil icing. Serious harm can be done to the compressor by low airflow, such as that caused by refrigerant flooding.

Heat pump systems require a specified airflow. Each ton of cooling requires between 320 CFM [151 l/s] and 450 CFM [212 l/s]. See the manufacturer's spec sheet or the AHRI Directory (ahridirectory.org) for rated airflow for the system being installed.

The indoor air-flow must be verified to be correct before the refrigerant charging process can begin. Determine the rated indoor air-flow by referring to the AHRI Directory or manufacturer's outdoor unit specifications for the particular indoor and outdoor unit combination being installed. Then refer to the air-handler or gas furnace installation manual to determine how to select the proper air-flow and make the necessary adjustments to achieve as close to the rated indoor air-flow as possible.

5.0 SYSTEM START-UP & REFRIGERANT CHARGING

A2L REFRIGERANT LEAK DETECTION SENSOR APPLICATION TABLES

Total System Charge (oz)	Minimum Indoor Airflow (CFM)	Without Refrigerant Leak Detection Sensor: Room Area of Smallest Conditioned Space Including Space Where Indoor Unit is Installed (sqft)			With Refrigerant Leak Detection Sensor: Minimum Required Total Conditioned Room Area (sqft) Any configuration
		Distance From Floor to Bottom Edge of Lowest Inlet or Outlet Vent Opening			
		2 FT	6 FT	9 FT	
50	65	195	56	38	47
100	169	781	113	75	94
150	254	1758	195	113	141
200	338	3120	347	154	187
250	423	4884	543	241	234
300	507	7032	781	347	281
350	592	9572	1064	473	328
400	676	12502	1389	617	375
450	761	15823	1758	781	422
500	846	19534	2170	963	469
550	930	not permitted - sensor required			515
600	1014				562

Charging

If the Smallest Conditioned Space Room Area is below the specified value in the table for the Total System Charge, a Refrigerant Leak Detection Sensor will need to be installed. Verify that the Minimum Indoor Airflow meets the specified value for the Total System Charge amount using the above tables.

For systems that are factory installed with Refrigerant Leak Detection Sensor, verify that the Smallest Total Conditioned Space Area and Minimum Indoor Airflow values meet the minimum values specified in the above table for the Total System Charge amount.

Two stages of indoor air-flow are required for RP14 & RP15 heat pumps. The air-handler or gas furnace must deliver either 1st or 2nd stage of indoor air-flow depending on which stage the thermostat is calling for. Air-flow verification and refrigerant charging must be done when the system is in the 2nd stage mode. Set the thermostat several degrees above (heating mode) or below (cooling mode) the set-point to assure the system is operating in the 2nd stage mode. Indoor air-flow may be verified using the blinking LED light on the air-handlers and gas furnaces with variable speed ECM motors. Each blink represents approximately 100 CFM [47 l/s]. Example: 8 blinks followed by a pause indicates 800 CFM [376 l/s] is being delivered. Refer to the installation instructions for the air-handler or furnace for further details on determining indoor air-flow using the blinking LED on the indoor unit control board.

For systems that are factory installed with Refrigerant Leak Detection Sensor, verify that the Smallest Total Conditioned Space Area and Minimum Indoor Airflow values meet the minimum values specified in the above table for the Total System Charge amount.

5.0 SYSTEM START-UP & REFRIGERANT CHARGING

Altitude Adjustment Calculator

Installed Altitude (ft) H_{alt}	Altitude Adjustment Factor (AF)
1000	1.025
1500	1.038
2000	1.051
2500	1.064
3000	1.078
3500	1.093
4000	1.107
4500	1.122
5000	1.138
5500	1.154
6000	1.170
6500	1.187

Note: Installing technician to correct the minimum room area of the space Amin or the minimum room area of conditioned space TAmin by multiplying by the altitude adjustment factor (AF) based on the building site ground level altitute (Halt).

If the altitude is between each specified range in the table, the technician may interpolate the altitude adjustement factor or round up the altitude to the next interval and use the adjustment factor.

5.0 SYSTEM START-UP & REFRIGERANT CHARGING

5.4 Refrigerant Charging

⚠WARNING: R-454B systems should be charged with refrigerants in liquid form.

⚠WARNING: The top of the scroll compressor shell is hot. Touching the compressor top may result in serious personal injury.
The refrigerant charge for all systems should be checked against the Charging Chart located inside the access panel cover.

⚠CAUTION: R–454B is classified as safety group A2L per ASHRAE Standard 34. Verify that service equipment and instruments are approved for use with group A2L refrigerants, and in particular with R–454B. Failure to exercise care may result in equipment damage or personal injury.

Charge for all systems should be checked using the Charging Chart inside the access panel cover.

IMPORTANT: Total System Charge Weight must be annotated on the label provided adjacent to the unit nameplate. Total System Charge Weight can be calculated by taking the Factory Refrigerant Charge Weight listed on the nameplate and adding the Field Installation Charge Weight.

IMPORTANT: Do not operate the compressor without charge in the system.

Addition of R-454B will raise high-side pressures (liquid and discharge).

NOTICE: System maintenance is to be performed by a qualified and certified technician.

The optimum refrigerant charge for any outdoor unit matched with an indoor coil/air handler is affected by the application. Therefore, charging data has been developed to assist the field technician in optimizing the charge for all mounting configurations (UF – Upflow, DF – Downflow, LH – Left-Hand Discharge, and RH – Right-Hand Discharge). Refer to the charging chart inside the access panel cover on the unit and choose the appropriate column for the specific application being installed or serviced. New installations utilizing either an RCF indoor coil installed on a gas furnace or an (-)H series air handler in the downflow or horizontal right-hand discharge may require removal of refrigerant since the factory charge could result in an overcharge condition.

IMPORTANT: Refrigerant charging must be performed when the system is operating in the 2nd stage mode.

NOTE: In addition to conventional charging procedures, the following requirements shall be followed:

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

The following method is used for charging systems in the cooling and heating mode. All steps listed should be performed to ensure proper charge has been set. For measuring pressures, the service valve port on the liquid valve (small valve) and the true service port located between the two service valves are to be used.

5.4.1 Measurement Device Set-Up

1. With an R-454B gauge set, attach the high-pressure hose to the access fitting on the liquid line (small) service valve at the OD unit.
2. Attach the low-pressure hose to the exterior true suction port located between the two service valves that is connected to the suction tube between the reversing valve and compressor.
3. Attach a temperature probe within 6" [15.2 cm] of the outside of the unit on the copper liquid line (small line). For more accurate measurements, clean the copper line prior to measurement and use a calibrated clamp-on temperature probe or an insulated surface thermocouple.

5.4.2 Preliminary Charging by Weight

NOTICE: Adjust the system charge by weight for the linear length of the refrigerant line set.

For a new installation, evacuation of inter-connecting tubing and indoor coil is adequate; otherwise, evacuate the entire system. Use the factory charge

5.0 SYSTEM START-UP & REFRIGERANT CHARGING

shown in "Electrical and Physical Data" in Section 3.3 of these instructions or on the unit data plate. Note that the charge value includes charge required for 15 ft. [4.6 m] of standard-size liquid line without a filter drier.

Calculate actual charge required with the actual installed liquid line size and length using:

1/4" [6.4 mm] O.D. = .3 oz./ft. [28.3 g/m]

5/16" [7.9 mm] O.D. = .4 oz./ft. [37.7 g/m]

3/8" [9.5 mm] O.D. = .6 oz./ft. [56.7 g/m]

1/2" [12.7 mm] O.D. = 1.2 oz./ft. [113.3 g/m]

Add 6 oz. [170 g] for field-installed filter drier.

Charge Adjustment = (Line Set (oz./ft.) x Total Linear Length) – Factory Charge for Line Set + 6 oz. (for field installed filter drier)

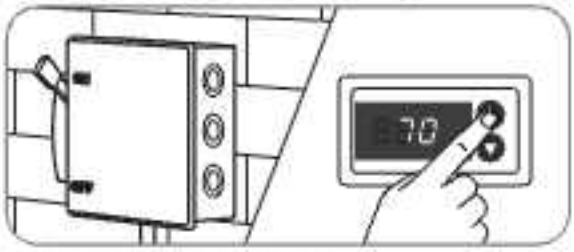
Example: A three-ton heat pump unit requires 75 ft. of line set with a liquid line diameter of 3/8".

Factory Charge for Line Set = 15 ft. × .6 oz. = 9 oz.

Charge Adjustment = (1.2 oz. × 75 ft.) – 9 oz. + 6 oz. = + 87 oz.

With an accurate scale (+/– 1 oz. [28.3 g]) or volumetric charging device, adjust the refrigerant charge based on the actual line set length. If the entire system has been evacuated, add the total calculated charge.

IMPORTANT: Charging by weight is not always accurate since the application can affect the optimum refrigerant charge. Charging by weight is considered a starting point ONLY. Always check the charge by using the Charging Chart and adjust as necessary. CHARGING BY LIQUID SUBCOOLING PER THE SYSTEM CHARGING CHART MUST BE USED FOR FINAL CHARGE ADJUSTMENT.



IMPORTANT: R-454B is a blended refrigerant of R-32 and R-1234YF (68.9/31.1). These two refrigerants have different saturation curves and therefore change state at different pressures and temperatures. If charge is added to the system in the vapor state, it is possible to have a disproportionate amount of each part of the R-454B blend which will cause unstable and inefficient operation. Therefore, it is critical to add R-454B in the liquid form only!

5.4.3 Preliminary Charging by Pressures

1. Following airflow verification and charge weigh-in, run the unit for a minimum of 15 minutes prior to noting pressures and temperatures.

2. Verify that the outdoor unit is operating on 2nd stage and that the air-handler or gas furnace is delivering 2nd stage air-flow

3. Ensure that the maximum operating pressure as listed on the unit nameplate is considered when connecting to any CONDENSER UNIT or EVAPORATOR UNIT and design pressures are not exceeded.

IMPORTANT: Indoor conditions as measured at the indoor coil must be within 2°F [1.1°C] of comfort conditions per the homeowner's preference.

NOTICE: If the indoor temperature is above or below this range, run the system to bring the temperature down or run the electric heat/furnace to bring the temperature within this range.

4. Note the Outdoor Dry Bulb Temperature, ODDB° = _____°F [°C]. Unit charging is recommended under the following outdoor conditions ONLY:

   Cooling Mode ONLY: 55°F [12.8°C] outdoor dry bulb and above
   Heating Mode ONLY: Between 40°F [4.4°C] and 60°F [15.6°C] outdoor dry bulb

5. Locate and note the design pressures. The correct liquid and vapor pressures are found at the intersection of the installed system and the outdoor ambient temperature on the Charging Chart located inside the access panel cover.

   Liquid Pressure: = _____psig [kPa]; Vapor Pressure = _____psig [kPa]

NOTICE: The refrigerant pressures provided are for preliminary charge check ONLY. These pressure values are typical, but may vary due to application. Evaporator load (indoor coil in cooling mode/outdoor coil in heating mode) will cause pressures to deviate. The values listed are for the correct matched indoor coil ONLY!

6. If the measured liquid pressure is below the listed requirement for the given outdoor and indoor conditions, add charge. If the measured liquid pressure is above the listed requirement for the given outdoor and indoor conditions, remove charge.

5.4.4 Final Charging by Liquid Subcooling

1. After preliminary charging by weight or pressures, find the design subcooling value. The correct subcooling value is found at the intersection of the installed system and the outdoor ambient

temperature on the Charging Chart located inside the access panel cover.

SC° from Charging Chart = _____°F [°C].

2. Verify that the outdoor unit is operating on 2nd stage and that the air-handler or gas furnace is delivering 2nd stage air-flow

IMPORTANT: Indoor conditions as measured at the indoor coil are required to be within 2°F (1.1°C) of comfort conditions as preferred by the homeowner and must have operated for at least 15 minutes prior to final charge adjustment. Unit charging is recommended under the following outdoor conditions ONLY:

Cooling Mode: 55°F [12.8°C] outdoor dry bulb and above

Heating Mode: Between 40°F [4.4°C] and 60°F [15.6°C] outdoor dry bulb

NOTICE: Systems should not be charged below 40°F [4.4°C] outdoor temperature.

NOTICE: If the indoor temperature is above or below the recommended range, run the system to bring the temperature down or run the electric heat/furnace to bring the temperature up.

3. Note the measured Liquid Pressure, Pliq = ______psig [kPa], as measured from the liquid (small) service valve. Use the Temperature Pressure Chart below to note the corresponding saturation temperature for R-454B at the measured liquid pressure.

Liquid Saturation Temperature, SAT° = _____°F [°C].

4. Note the liquid line temperature, Liq° = _____°F [°C], as measured from a temperature probe located within 6" [15.2 cm] outside of the unit on the copper liquid line (small line). It is recommended to use a calibrated clamp-on temperature probe or an insulated surface thermocouple.
5. Subtract the liquid line temperature from the saturation temperature to calculate subcooling. SAT°_____°F [°C] - Liq°_____°F [°C] = SC°_____°F [°C]
6. Adjust charge to obtain the specified subcooling value. If the measured subcooling level is below the listed requirement for the given outdoor temperature, add charge. If the measured subcooling level is above the listed requirement for the given outdoor temperature, remove charge.

5.5 Completing Installation

- Disconnect the hoses from the pressure ports. Replace the pressure port caps and tighten adequately to seal caps. **Do not overtighten.**
- Replace the service valve top caps finger-tight and then tighten with a wrench to adequately seal caps. **Do not overtighten.**
- Replace control box cover and service panel and install screws to secure panels.
- Restore power to unit at disconnect if required.
- Configure thermostat per the thermostat installation instructions and set to desired mode and temperature.

Charging

5.4.5 R-454B Temperature Pressure Chart

TEMPERATURE PRESSURE CHART

SATURATION TEMPERATURE °F [°C]	R-454B BUBBLE POINT PSIG [kPa]	R-454B DEW POINT PSIG [kPa]	SATURATION TEMPERATURE °F [°C]	R-454B BUBBLE POINT PSIG [kPa]	R-454B DEW POINT PSIG [kPa]	SATURATION TEMPERATURE °F [°C]	R-454B BUBBLE POINT PSIG [kPa]	R-454B DEW POINT PSIG [kPa]	SATURATION TEMPERATURE °F [°C]	R-454B BUBBLE POINT PSIG [kPa]	R-454B DEW POINT PSIG [kPa]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

6.0 SEQUENCE OF OPERATION

6.1 Cooling Mode

When the 2-stage thermostat calls for the 1st stage of cooling, the outdoor fan motor is energized and the 1st stage of the compressor and indoor blower motor is energized. The system then provides cooling and dehumidification for the conditioned space. If the thermostat calls for the 2nd stage of cooling, the compressor shifts to the 2nd stage of capacity and the indoor blower motor speeds up to deliver the 2nd stage of air-flow. The system will cycle between the 1st and 2nd stages as directed by the thermostat. When the call for cooling has ended or the thermostat is switched to the OFF position, the compressor and outdoor fan motor are de-energized, but the indoor blower motor continues to operate for 30 – 45 seconds to extract the residual cooling capacity in the cold indoor coil before it stops.

6.2 Heating Mode

When the heat pump thermostat is set to "heat" mode, the "B" terminal on the outdoor unit is energized which energizes the reversing valve and switches it to the heating position. When the 2-stage thermostat calls for the 1st stage of heating, the system then provides heating for the conditioned space. If the thermostat calls for the 2nd stage of heating, the compressor shifts to the 2nd stage of capacity and the indoor blower motor speeds up to deliver the 2nd stage of air-flow. The system will cycle between the 1st and 2nd stages as directed by the thermostat. When the call for heating has ended, the compressor and outdoor fan motor are de-energized, but the indoor blower motor continues to operate for 30 – 45 seconds to extract the residual heat in the warm indoor coil before it stops. If the thermostat is switched to the OFF, the reversing valve solenoid is de-energized. If the system is operating in the heating mode when the thermostat is switched to the OFF position, the reversing valve will shift to the cooling position and will remain there until the thermostat is switched back to the HEAT mode and there is a call for heating.

6.3 Supplemental Electric Heat in Heating Mode

If the building load should exceed the heating capacity in extreme outdoor conditions, the thermostat will direct the air-handler to energize supplemental electric heat as required to meet the building load as a 3rd stage of heat. The compressor and outdoor fan will continue to operate at maximum capacity while supplemental electric heat is energized. For 13kW heaters and higher, the electric heater elements are split into 2 stages controlled by energizing the W1 and W2 thermostat pigtails on the air-handler with 24VAC. Unless the W1 and W2 thermostat pigtails are connected together at the air-handler, only the 1st stage of electric heat will be energized when supplemental heat is energized in the heat pump heating mode. If the 1st stage of electric heat is not sufficient for supplemental heat, the W1 and W2 thermostat pigtails on the air-handler should be connected together to provide maximum supplemental heat.

6.4 Dual Fuel Applications – Heating Mode

If the building load should exceed the heat pump heating capacity in extreme outdoor conditions, the thermostat will direct the outdoor unit to shut down and heating responsibility will be transferred to the gas furnace. An outdoor ambient temperature can be set in dual fuel enabled thermostats to direct the system to automatically switch to gas heat when the outdoor ambient temperature drops below that set-point. If the thermostat is set to the EMERGENCY HEAT mode, heating responsibility will be transferred to the gas furnace.

6.0 SEQUENCE OF OPERATION

6.5 Demand Defrost

Defrosting of the outdoor coil in the heating mode is controlled by the defrost control located in the outdoor unit. RP14 heat pumps feature "demand defrost" that initiate a defrost cycle only when frosting is detected on the outdoor coil during heating operation. The defrost control monitors the Outdoor Ambient Temperature Thermistor and Outdoor Coil Temperature Thermistor to determine when a defrost cycle is required. The following sequence is followed for defrost cycles.

- **Defrost Initiation:** A defrost cycle is initiated when the following conditions are met.

    1. The outdoor coil temperature is below 35°F [1.7°C].
    2. The compressor has operated for at least 34 minutes with the outdoor coil temperature below 35°F [1.7°C].
    3. The defrost control determines a defrost cycle is required based on the outdoor ambient and outdoor coil temperatures.

If the above conditions are met, the following action will be taken.

1. The reversing valve is de-energized which will cause it to shift to the cooling position and the outdoor fan motor is de-energized.
2. The compressor is de-energized for a 30 second noise abatement period.
3. The indoor air-handler or gas furnace is directed to supply supplemental heat to prevent cold air from being discharged from the supply registers during the defrost cycle.
4. The compressor is energized after the 30 second delay has been completed and defrosting of the coil begins.

- **Defrost Termination:** The defrost cycle will continue until the coil temperature has reached the termination temperature or 14 minutes have elapsed, whichever comes first. The factory default termination temperature is 70°F [21.1°C], although this temperature can be changed to 50°F [10.0°C], 60°F [15.6°C], or 80°F [26.7°C] by relocating a jumper on the defrost control board. When the coil temperature reaches the termination temperature or 14 minutes have elapsed, the following action is taken.

    1. The reversing valve will be energized, switching it back to the heating position.
    2. The compressor is de-energized for a 30 second noise abatement period.
    3. Supplemental heat is de-energized.
    4. The compressor and outdoor fan motor are energized after the 30 second delay has been completed.
    5. The system returns to normal heating operation as directed by the thermostat.

NOTE: Should the outdoor ambient temperature thermistor fail, the defrost control will initiate a defrost cycle every 34 minutes of operation when the coil temperature is below 35°F [1.7°F].

See Section 7.1 (Demand Defrost Control) for additional information.

7.0 COMPONENTS & CONTROLS

7.1 Demand Defrost Control

When the thermostat calls for cooling, the demand defrost control monitors the outdoor ambient temperature, outdoor coil temperature and the compressor run time to determine when a defrost cycle is required.

The defrost control has high and low pressure control inputs with unique pressure switch logic built into the microprocessor to provide compressor and system protection without nuisance lockouts. The control cycles the compressor off for 30 seconds at the beginning and the end of the defrost cycle to eliminate the increased compressor noise caused by rapidly changing system pressures when the reversing valve switches. See Sections 9.1 and 9.2 for diagnostic flash codes and sensor resistance values at various temperatures.

Defrost Initiation

A defrost will be initiated when the three conditions below are satisfied:

1. The outdoor coil temperature is below 35°F [1.7°C] as measured by a good coil sensor,
2. The compressor has operated for at least 34 minutes with the outdoor coil temperature below 35°F [1.7°C] and
3. The measured difference between the ambient temperature and the outdoor coil temperature is greater than the calculated difference determined by the microprocessor.

Defrost Termination

Once a defrost is initiated, the defrost will continue until 14 minutes has elapsed or the coil temperature has reached the selected termination temperature. The factory setting is 70°F [21.1°C] but can be changed to 50°F [10°C], 60°F [15.6°C] or 80°F [26.7°C] by relocating the jumper on the control board.

Temperature Sensors

The coil sensor is located on the outdoor coil at the point fed by the distribution tubes from the metering device (short 3/8" [9.5 mm] dia. Tube). The ambient air sensor is located below the control box so it can sense outdoor temperatures.

If the outdoor ambient sensor fails, the defrost control will initiate a defrost every 34 minutes of compressor run time with the coil temperature below 35°F [1.7°C].

If the coil sensor fails, the defrost control will not initiate a defrost.

Test Mode

The test mode is initiated by momentarily shorting the two TEST pins. The unit must have an active heat pump heating call to enter the test mode. In this mode of operation, the enable temperature is ignored and all timers are sped up. To initiate a manual defrost, short and hold the TEST pins. Remove the short when the system switches to defrost mode after the compressor noise abatement delay. The defrost will terminate on time (14 minutes) or when the termination temperature has been reached.

Test Sequence of Operation:

1) Provide a heating call to the heat pump.
2) Short test pins to bypass anti-short cycle timer. (If unit is running, this step is not necessary.)
3) Short test pins and hold them shorted to enter defrost mode.
4) Release test pins once control exits noise abatement delay.
5) Monitor coil temperature when control exits defrost.
6) Unit should return to heating mode.

Troubleshooting Demand Defrost

During the test mode the coil temperature should be monitored. If the system exits defrost at approximately the termination temperature, the control is operating normally.

If not, one item to check is the coil and ambient temperature sensor resistance, using the temperature/resistance chart in Section 9.2.

Immerse the sensor in water and measure the resistance of the sensor. At 35°F [1.7°C] the resistance of the sensor should be approximately 30,000 ohms.

Ensure that the coil sensor is properly installed that it is not loose or touching the cabinet.

High/Low Pressure Control Monitoring

Status of high and low pressure controls is monitored and the following actions are taken.

High Pressure Control – Provides active protection in both cooling and heating modes at all outdoor ambient temperatures. The high pressure control is an automatic reset type and opens at approximately 610 psig [4206 kPa] and closes at approximately 420 psig [2896 kPa]. The compressor and fan motor will stop when the high pressure control opens at approximately 610 psig [4206 kPa] and will start again if the high side pressure drops to approximately 420 psig [2896 kPa] where the automatic reset high pressure control resets. If the high pressure control opens 3 times within a particular call for heating or cooling operation, the defrost control will lock out compressor and outdoor fan operation.

7.0 COMPONENTS & CONTROLS

Low Pressure Control – Provides active protection in both heating and cooling modes at all outdoor ambient temperatures. The low pressure control is an automatic reset type and opens at approximately 15 psig [103 kPa] and closes at approximately 40 psig [276 kPa]. Operation is slightly different between cooling and heating modes.

Cooling Mode: The compressor and fan motor will stop when the low pressure control opens at approximately 15 psig [103 kPa] and will start again when the low side pressure rises to approximately 40 psig [276 kPa] where the low pressure control automatically resets. If the low pressure switch opens 3 times within a particular call for cooling operation, the defrost control will lock out compressor and fan operation.

Heating Mode: The compressor and fan motor will stop when the low pressure control opens at approximately 15 psig [103 kPa] and will start again when the low side pressure rises to approximately 40 psig [276 kPa] where the low pressure automatically resets. If the low pressure switch trips 3 times within 120 minutes of operation during a particular call for heating operation, the defrost control will lock out compressor and outdoor fan operation. If the lock out due to low pressure occurs at an outdoor ambient temperature below 5°F [-15°C], the defrost control will automatically exit the lockout mode when the outdoor ambient temperature rises to 5°F [-15°C]. This feature is necessary since the low pressure control could possibly have opened due to the outdoor ambient being very low rather than an actual system fault.

Exiting Lock-Out Mode: To exit the lock-out mode, remove 24 volts to the defrost control by removing power to the indoor air handler/furnace or by shorting the two defrost control test pins together.

7.2 Compressor

2-stage scroll compressors are available in all RP14AY & RP15AY heat pumps. The P14AY18AJ1 comes with a 1-stage scroll compressor. For the 2-stage compressor options, the 2nd capacity stage is activated by a DC signal that energizes a solenoid which shifts the compressor to full capacity. The 24VAC Y2 signal from the thermostat is rectified to DC current by a diode located in the wiring harness that connects to the 2nd stage terminals on the compressor.

7.3 Fan Motor

All models are equipped with single-speed PSC motors.

7.4 Outdoor Fan

All models utilize a standard paddle style 3 blade fan made from coated steel.

7.5 Compressor Contactor

All models utilize a single-pole contactor to power the compressor and fan motor. Field power is connected directly to the terminal lugs on the line side of the contactor.

7.6 Compressor/ Fan Motor Capacitor

All models are equipped with standard PSC fan motors, which utilize a dual capacitor for both the compressor and fan motor.

7.7 Reversing Valve

All models are equipped with a reversing valve that allows the system to reverse the refrigeration cycle to provide either cooling or heating. The reversing valve is energized in the heating mode and is energized anytime the thermostat is set to the "Heat" mode. The outdoor unit has a thermostat pigtail that must be electrically connected to the "B" terminal on the thermostat.

7.8 Charge Compensator

Some models are equipped with a charge compensator that stores a predetermined amount of refrigerant in either the heating or cooling mode so the refrigerant charge is optimized in both the cooling and heating modes. The charge compensator is the cylindrical device with larger tubes coming out each end and a 3/8" [9.53 mm] diameter tube on one end that is connected to the liquid line near the liquid service valve.

7.9 Discharge Line Muffler

All models are equipped with a discharge line muffler to help absorb discharge pulses in the vapor line in the heating mode that can result in unwanted noise inside the building structure.

7.10 Thermal Expansion Valve (TXV)

All models are equipped with a properly sized thermal expansion valve (TXV) to meter the refrigerant flow and provide a consistent superheat level in the heating mode. The TXV's all have an internal check valve that opens in the cooling mode to provide unrestricted flow. All TXV's have a 10% bleed rate to help eliminate "hammering" in the off cycle that sometimes occurs when non-bleed TXV's are used on both the indoor coil and outdoor heat pump unit.

7.11 Compressor Crankcase Heater (CCH)

While scroll compressors usually do not require crankcase heaters, there are instances when a heater should be added. Refrigerant migration during the off cycle can result in a noisy start up. Add a crankcase heater to minimize refrigeration migration, and to help eliminate any start up noise or bearing "wash out."

NOTE: The installation of a crankcase heater is recommended if the system charge exceeds the values in the table below. 3-5 ton models come with a crankcase heater factory installed as indicated by an asterisk.

A crankcase heater is to be located near the bottom of the compressor shell. Its purpose is to drive refrigerant from the compressor shell during long off cycles, thus preventing damage to the compressor during start-up.

At initial start-up or after extended shutdown periods, make sure the heater is energized for at least 12 hours before the compressor is started. (Disconnect switch on and wall thermostat off.)

MAXIMUM SYSTEM CHARGE VALUES (-)P14AY		
MODEL SIZE	COMPRESSOR MODEL NUMBER	CHARGE LIMIT WITHOUT CRANKCASE HEATER
(-)P14AY18A	YA018K1E	8.4 LBS [3.8 KG]
	YPA018	
(-)P14AY24A	YA024K1E	8.4 LBS [3.8 KG]
	YPA024	
(-)P14AY30A	YA030K1E	8.4 LBS [3.8 KG]
	YPA030	
(-)P14AY36A	YA036K1E	8.4 LBS [3.8 KG]
	YPA036	
(-)P14AY42A	YA042K1E	13 LBS [5.9 KG]
	YPA042	
(-)P14AY48A	YA048K1E	12 LBS [5.4 KG]
	YPA048	
(-)P14AY60A	YA060K1E	12 LBS [5.4 KG]
	YPA060	

MAXIMUM SYSTEM CHARGE VALUES (-)P15AY		
MODEL SIZE	COMPRESSOR MODEL NUMBER	CHARGE LIMIT WITHOUT CRANKCASE HEATER
(-)P15AY18A	YA018K1E	8.4 LBS [3.8 KG]
	YPA018	
(-)P15AY24A	YA024K1E	8.4 LBS [3.8 KG]
	YPA024	
(-)P15AY30A	YA030K1E	8.4 LBS [3.8 KG]
	YPA030	
(-)P15AY36A	YA036K1E	8.4 LBS [3.8 KG]
	YPA036	
(-)P15AY42A	YA042K1E	13 LBS [5.4 KG]
	YPA042	
(-)P15AY48A	YA048K1E	12 LBS [5.4 KG]
	YPA048	
(-)P15AY60A	YA060K1E	12 LBS [5.4 KG]
	YPA060	

7.12 High- and Low-Pressure Controls

Standard on all models: These controls keep the compressor from operating in pressure ranges which can cause damage to the compressor. Both controls are in the low-voltage control circuit.

The high-pressure control (HPC) is an automatic-reset which opens near 610 PSIG [4206 kPa] and closes near 420 PSIG [2896 kPa].

The low-pressure control (LPC) is an automatic-reset which opens near 15 PSIG [103 kPa] and closes near 40 PSIG [276 kPa].

⚠CAUTION: The compressor has an internal overload protector. Under some conditions, it can take up to 2 hours for this overload to reset. Make sure overload has had time to reset before condemning the compressor.

7.13 Compressor Hard Start Components

Start components are not usually required with the scroll compressors used in heat pumps, but are availeble for special cases and where start components are desirable to reduce light dimming. Hard start components must be field installed and are available through Rheem Parts or Ruud Parts.

8.0 ACCESSORIES

⚠WARNING: Turn off electric power at the fuse box or service panel before making any electrical connections while installing accessories. Failure to do so can result in electrical shock, severe personal injury, or death.

⚠CAUTION:
SINGLE POLE COMPRESSOR CONTACTOR (CC):

Single pole contactors are used on all single-phase units up through 5 tons. Caution must be exercised when servicing as only one leg of the power supply is broken with the contactor.

8.1 Compressor Time Delay

The time delay (TDC) is in the low voltage control circuit. When the compressor shuts off due to a power failure or thermostat operation, this control keeps it off at least 5 minutes before the next cycle can begin.

8.2 Low Ambient Control

This component senses compressor head pressure and shuts the outdoor fan off when the head pressure drops to approximately 250 PSIG [1,724 kPa]. This allows the unit to build a sufficient head pressure at lower outdoor ambient temperatures (down to 0°F [-18°C]) in order to maintain system balance and capacity. Low ambient control should be used on all equipment frequently operated below 70°F [21°C] ambient. Part No. **RXAD-A08**

8.3 Compressor Hard Start Kit

All Models: Part No. **SK-A1**

8.4 Compressor Crankcase Heater

1.5-3.0 Ton Models: Part No. **44-101884-08** (w/ outdoor temp thermostat) or **44-17402-44** w/o outdoor temp thermostat)

3.5-5.0 Ton Models: part No. **44-103663-13** w/ outdoor temp thermostat or **44-17402-45** (w/o outdoor temp thermostat)

NOTE: 5ton model has factory installed crankcase heater.

8.5 Remote Outdoor Temperature Sensor

This is a kit that has a longer remote sensor that can be installed away from the outdoor unit for better thermostat temperature display.

8.6 Compressor Sound Enclosure

1.5-3.0 Ton Models:
Part No. **68-23427-26**

3.5-5.0 Ton Models:
Part No. **68-23427-25**

9.0 DIAGNOSTICS & TROUBLESHOOTING

9.1 Defrost Control Diagnostic Codes

LED 1	LED 2	Control Board Status
OFF	OFF	No Power
ON	ON	Coil Sensor Failure
OFF	ON	Ambient Sensor Failure
FLASH	FLASH	Normal
OFF	FLASH	Low Pressure Lockout (short test pins to reset)
FLASH	OFF	High Pressure Lockout (short test pins to reset)
ON	FLASH	Low Pressure Control Open
FLASH	ON	High Pressure Control Open
ON	OFF	In Defrost Mode
Alternate Flashing		5 Minute Time Delay

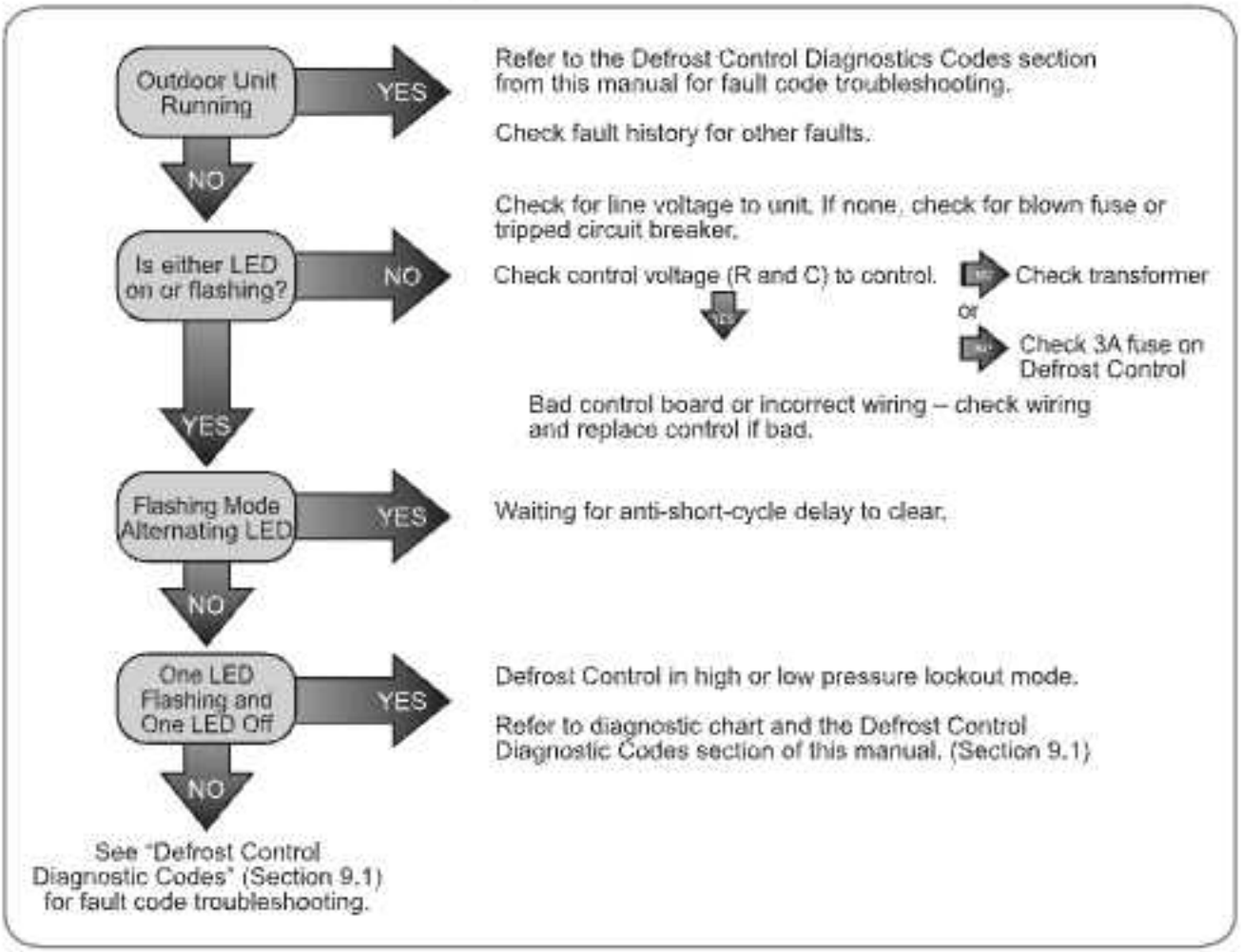
9.2 Outdoor Ambient and Coil Sensor Temperature vs. Resistance Table

Degrees C	Degrees F	Ohms
-20	-4	96,974
-10	14	55,298
0	32	32,650
10	50	19,903
20	68	12,493
25	77	10,000
30	86	8,056
40	104	5,324

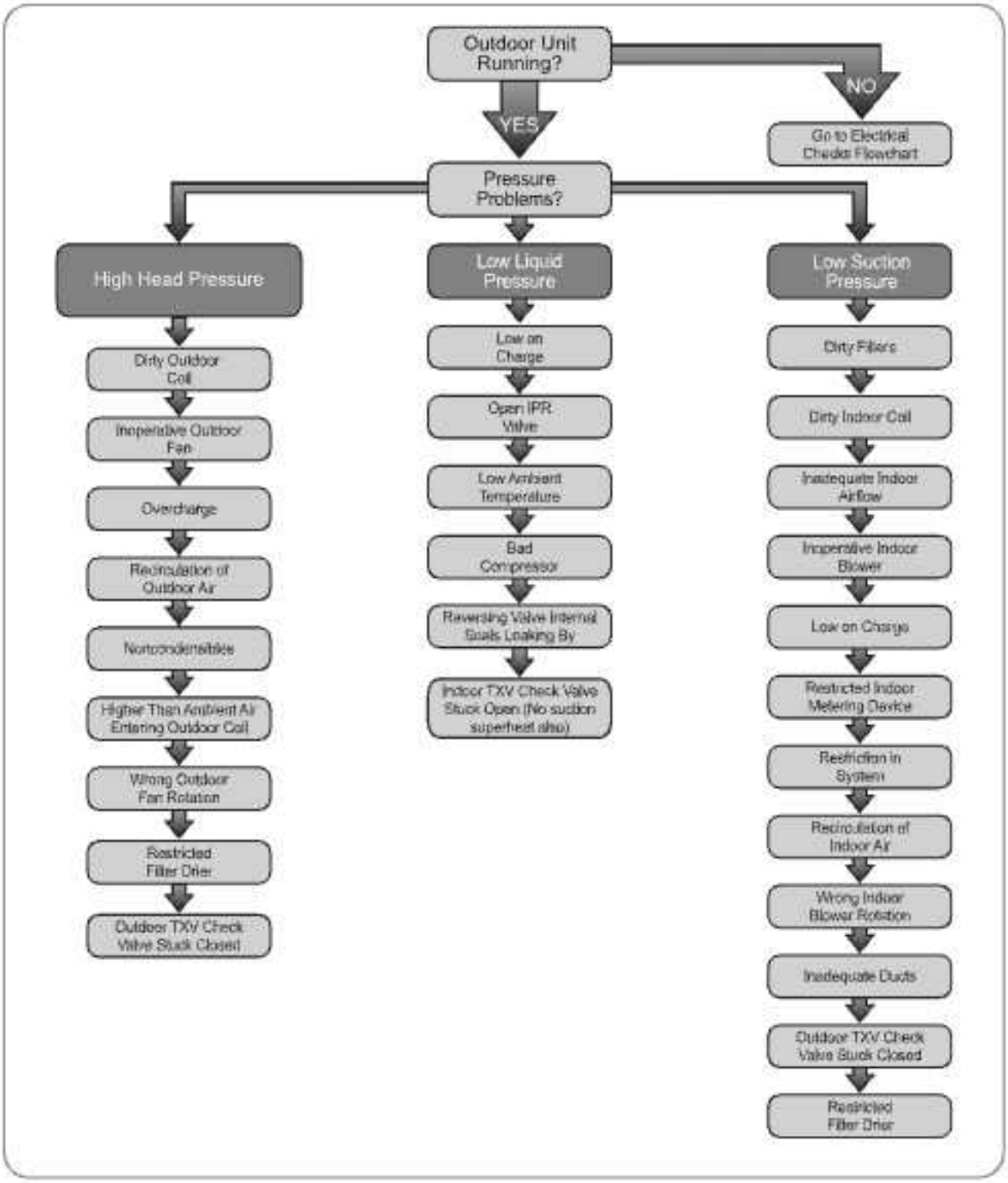
9.0 DIAGNOSTICS & TROUBLESHOOTING

9.3 Electrical Checks Flowchart

THERMOSTAT CALL FOR OPERATION, NO OPERATION

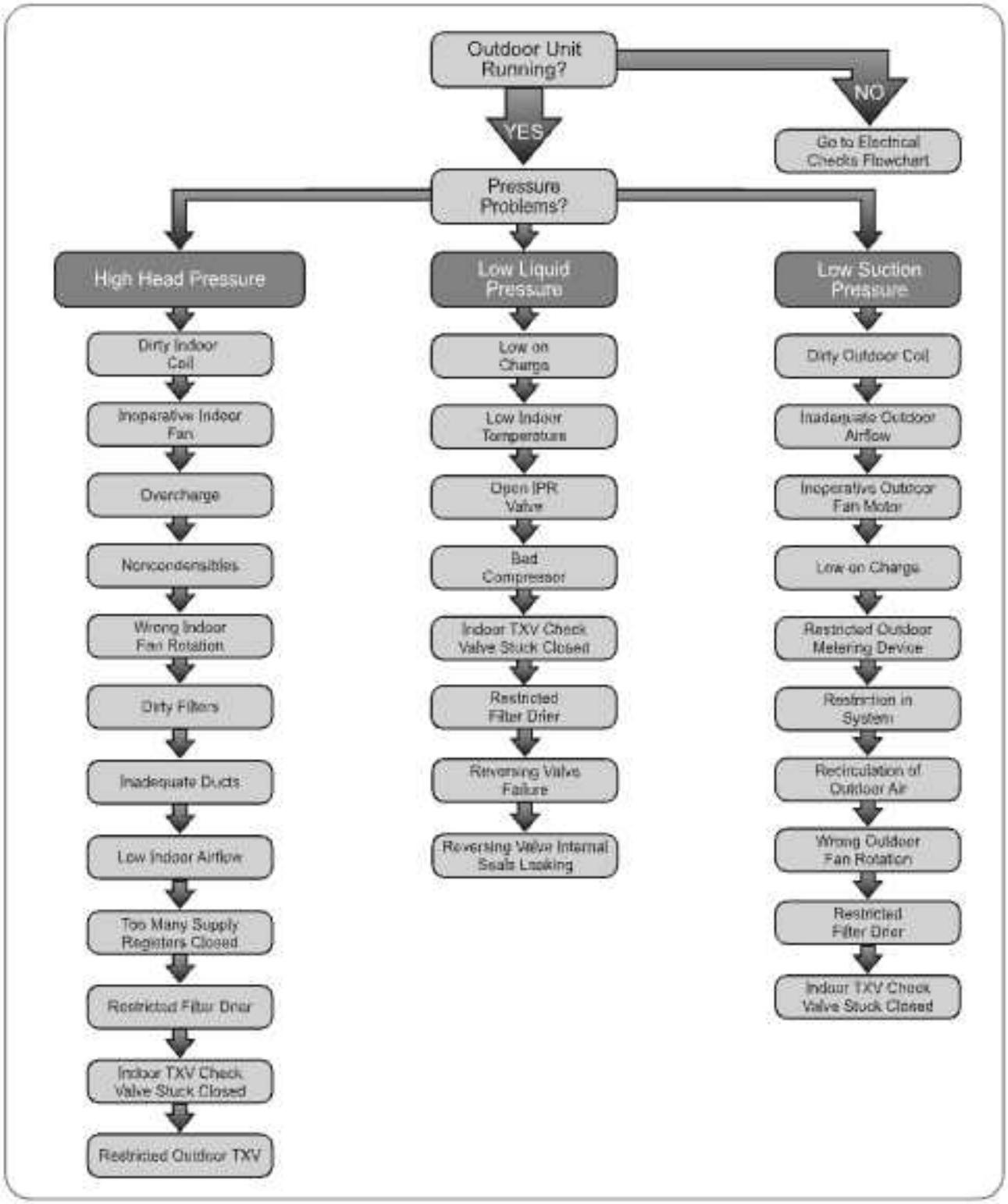


9.4 Cooling Mechanical Checks Flowchart

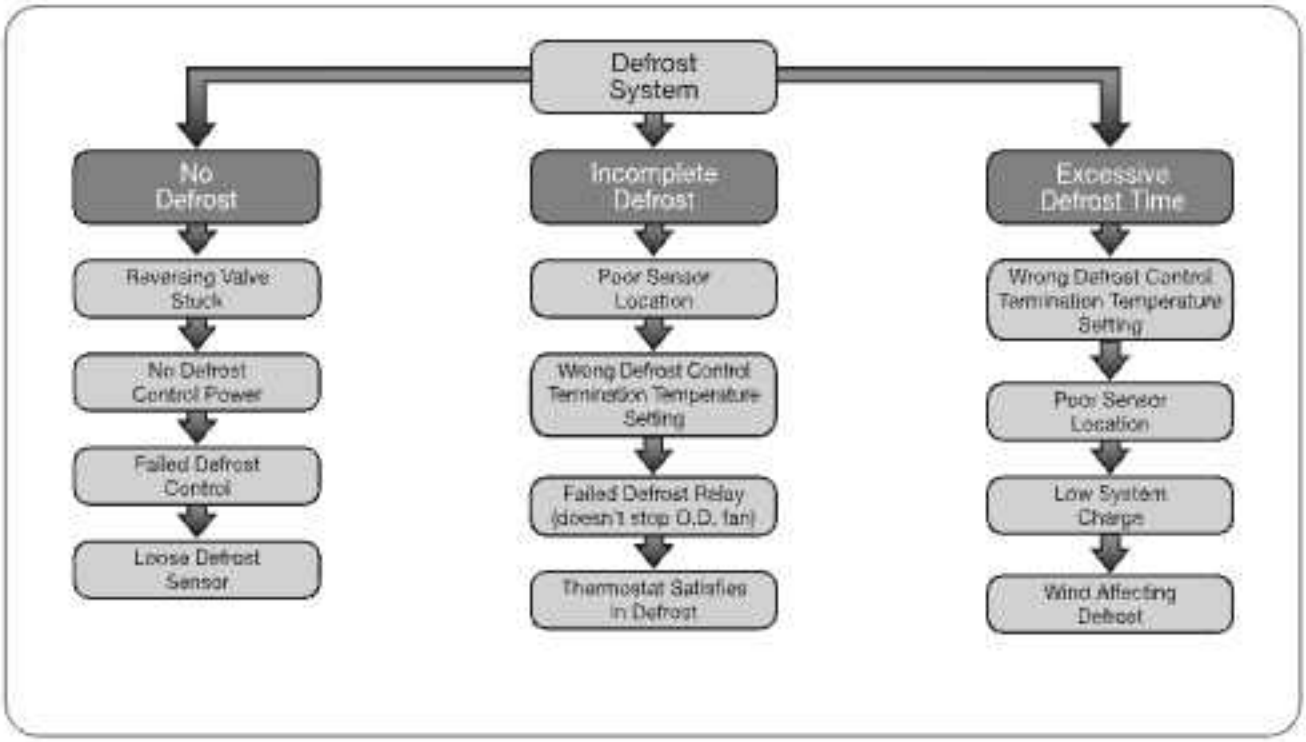


9.0 DIAGNOSTICS & TROUBLESHOOTING

9.5 Heating Mechanical Checks Flowchart



9.6 Defrost Mechanical Checks Flowchart



9.7 Defrost Test Mode (See Section 7.1)

9.0 DIAGNOSTICS & TROUBLESHOOTING

9.8 General Troubleshooting Guide

⚠WARNING: Disconnect all power to unit before servicing. Contactor may break only one side. Failure to shut off power can cause electrical shock resulting in personal injury or death.

SYMPTOM	POSSIBLE CAUSE	REMEDY
Unit will not run	• Power off or loose electrical connection • Thermostat out of calibration – set too low or high • Defective control board • Blown fuses/tripped breaker • Transformer defective • High-pressure or low-pressure control lock-out • Miswiring of thermostat	• Check for correct voltage at line voltage connections in condensing unit. • Reset. • Check control board diagnostic codes. • Replace fuses/reset breaker. • Check wiring. Replace transformer. • Reset by cycling power to unit. Also see high head pressure and low suction pressure remedies. • Check for refrigerant leaks. • Check thermostat wiring
Outdoor fan runs, compressor doesn't	• Run or start capacitor defective • Start relay defective • Loose connection • Compressor stuck, grounded or open motor winding, open internal overload. • Low-voltage condition	• Replace. • Replace. • Check for correct voltage at compressor. Check and tighten all connections. • Wait at least 3 hours for overload to reset. If still open, replace the compressor. • Add start kit components.
Insufficient cooling	• Improperly sized unit • Improper indoor airflow • Incorrect refrigerant charge • Air, noncondensibles, or moisture in system • Restricted refrigerant circuit	• Recalculate load. • Check. Should be approximately 400 CFM [189 L/s] per ton. • Charge per procedure attached to unit service panel. • Recover refrigerant. Evacuate and recharge. Add or replace filter drier. • Locate restriction and clear.
Compressor short cycles	• Incorrect voltage • Defective overload protector • Refrigerant undercharge or overcharge • (HPS or LPC cycling)	• At compressor terminals, voltage must be ± 10% of nameplate marking when unit is operating. • Replace compressor. Check for correct voltage. • Adjust charge per charging chart.
Registers sweat	• Low indoor airflow	• Increase speed of blower or reduce restriction. Replace air filter.
High head, low vapor pressures	• Restriction in liquid line, expansion device, or filter drier • Bad TXV	• Remove or replace defective component. • Replace TXV.
High head, high or normal vapor pressure – Cooling mode	• Dirty outdoor coil • Refrigerant overcharge • Outdoor fan not running • Air or noncondensibles in system	• Clean coil. • Correct system charge. • Repair or replace. • Recover refrigerant. Evacuate and recharge.
Low head, high vapor pressures	• Bad TXV • Bad compressor • Reversing valve leaking by	• Replace TXV. • Replace compressor. • Replace reversing valve.
Low vapor pressure, iced indoor coil	• Low indoor airflow • Operating below 65°F [18°C] outdoors • Moisture in system • Low refrigerant charge	• Increase speed of blower or reduce restriction. Replace air filter. • Add Low Ambient Kit. • Recover refrigerant. Evacuate and recharge. Add filter drier. • Check refrigerant charge and check for leaks.
High vapor pressure	• Excessive load • Defective compressor	• Recheck load calculation. • Replace.
Fluctuating head and vapor pressures	• TXV hunting • Air or noncondensibles in system	• Check TXV bulb clamp. Check air distribution on coil. Replace TXV. • Recover refrigerant. Evacuate and recharge.
Gurgle or pulsing noise at expansion device or liquid line	• Air or noncondensibles in system • Undercharged system	• Recover refrigerant. Evacuate and recharge. • Adjust charge per charging chart.
Defrost control relay chattering during defrost cycle	• Extended low voltage wire lengths • Light gauge low voltage wire	• Verify that the low voltage wires are at a minimum 18 gauge and within 100 ft • Install isolation relay • Check for loose connections

9.9 Service Analyzer Charts

COMPRESSOR OVERHEATING		
SYMPTOM	**POSSIBLE CAUSE**	**CHECK/REMEDY**
High superheat (greater than 15°F [263.7°K] at coil)	Low charge	Check system charge.
	Faulty metering device	Restricted cap tube, TXV
		Power element superheat out of adjustment internally
		Foreign matter stopping flow
	High internal load	Hot air (attic) entering return
		Heat source on; miswired or faulty control
	Restriction in liquid line	Drier plugged.
		Line kinked.
	Low head pressure	Low charge
		Operating in low ambient temperatures
	Vapor or liquid line subjected to high heat source	Hot attic
		Hot water line
Low line voltage	Loose wire connections	Check wiring.
	Power company problem, transformer	Report problem.
	Undersized wire feeding unit	Correct and complete diagnosis.
High line voltage	Power company problem	Report problem.
High head pressure	Overcharge	Check system charge.
	Dirty heat pump coil	Clean coil.
	Faulty or wrong size heat pump fan motor	Check capacitor. Replace fan motor.
	Faulty fan blade or wrong rotation	Replace fan blade.
		Replace with correct rotation motor.
	Recirculation of air	Correct installation.
	Additional heat source	Check for dryer vent near unit.
		Check for recirculation from other equipment.
	Noncondensibles	Recover refrigerant. Evacuate and recharge system.
	Equipment not matched	Correct mismatch.
Short cycling of compressor	Cycling or faulty pressure control	Check pressures and address cause of high or low pressure. Replace pressure control if faulty.
	Loose wiring	Check unit wiring.
	Thermostat	Located in supply air stream
		Differential setting too close
		Customer misuse
	TXV restricted	Internal foreign matter
		Power element failure
		TXV too small
		Equilizer tube plugged
	Distributor tube restricted	Restricted with foreign matter
		Kinked
		Inside diameter reduced from previous compressor failure

9.0 DIAGNOSTICS & TROUBLESHOOTING

9.9 Service Analyzer Charts (cont.)

COMPRESSOR OVERHEATING (cont.)		
SYMPTOM	**POSSIBLE CAUSE**	**CHECK OR REMEDIES**
Short cycling of compressor (cont.)	Low charge	Check system charge.
	Low evaporator airflow	Dirty coil
		Dirty filter
		Duct too small or restricted
	Faulty run capacitor	Replace.
	Faulty internal overload	Replace compressor.
Faulty Compressor Valves or scrolls	Fast equalization/Low pressure difference	Replace compressor and examine system to locate reason.

ELECTRICAL		
SYMPTOM	**POSSIBLE CAUSE**	**CHECK OR REMEDIES**
Voltage present on load side of compressor contactor and compressor won't run	Compressor start components	Check start capacitor.
		Check potential relay.
	Run capacitor	Check with ohmmeter
	Internal overload	Allow time to reset.
	Compressor windings	Check for correct ohms.
Voltage present on line side of compressor contactor only	Thermostat	Check for control voltage to contactor coil.
	Compressor control circuit	High-pressure switch
		Low-pressure switch
		Ambient thermostat
		Solid-state protection control or internal thermal sensors
		Compressor timed off/on control or interlock
No voltage on line side of compressor contactor	Blown fuses or tripped circuit breaker	Check for short in wiring or unit.
	Improper wiring	Recheck wiring diagram.
Improper voltage	High voltage	Wrong unit
		Power supply problem
	Low voltage	Wrong unit
		Power supply problem
		Wiring undersized
		Loose connections
	Single Phasing (3 phase)	Check incoming power and fusing.

FLOODED STARTS		
SYMPTOM	**POSSIBLE CAUSE**	**CHECK OR REMEDIES**
Liquid in the compressor shell	Faulty or missing crankcase heater	Replace or add crankcase heater.
Too much liquid in system	Incorrect piping	Check piping guidelines.
	Overcharge	Check and adjust charge.

9.9 Service Analyzer Charts (cont.)

CONTAMINATION		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
Moisture	Poor evacuation on installation or during service	In each case, the cure is the same. Recover refrigerant. Add filter drier, evacuate, and recharge.
High head pressure	Noncondensibles air	Reclaim refrigerant, evacuate, and recharge.
Unusual head and suction readings	Wrong refrigerant or mixed refrigerants	Reclaim refrigerant, evacuate, and recharge.
Foreign matter – copper filings	Copper tubing cuttings	Reclaim refrigerant, evacuate, and recharge.
Copper oxide	Dirty copper piping or nitrogen not used when brazing	Reclaim refrigerant, evacuate, and recharge.
Welding scale	Nitrogen not used during brazing	Reclaim refrigerant, evacuate, and recharge.
Soldering flux	Adding flux before seating copper partway	Reclaim refrigerant, evacuate, and recharge.
Excess soft solder	Wrong solder material	Reclaim refrigerant, evacuate, and recharge.

LOSS OF LUBRICATION		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
Compressor failures	Vapor line tubing too large	Reduce pipe size to improve oil return.
Low suction pressure	Low charge	Check system charge.
	Refrigerant leaks	Repair and recharge.
Cold, noisy compressor – Slugging	Dilution of oil with refrigerant	Observe piping guidelines.
Noisy compressor	Migration	Check crankcase heater.
Cold, sweating compressor	Flooding	Check system charge.
Low load	Reduced airflow	Dirty filter
		Dirty coil
		Wrong duct size
		Restricted duct
	Thermostat setting	Advise customer.
Short cycling of compressor	Cycling or faulty high or low-pressure control	Check pressure and address cause of high or low pressure. Replace control if faulty.
	Loose wiring	Check all control wires.
	Thermostat	In supply air stream, out of calibration
		Customer misuse

SLUGGING		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
On start-up	Incorrect piping	Review pipe size guidelines.
TXV hunting when running	Faulty TXV	Replace TXV.

9.0 DIAGNOSTICS & TROUBLESHOOTING

9.9 Service Analyzer Charts (cont.)

FLOODING		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
Poor system control using a TXV	Loose sensing bulb	Secure the bulb and insulate.
	Bulb in wrong location	Relocate bulb.
	Wrong size TXV	Use correct replacement.
	Improper superheat setting (less than 5°F [258.1°K])	Replace TXV.
THERMOSTATIC EXPANSION VALVE (TXV)		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
High Superheat, Low Suction Pressure (superheat over 15°F [263.7°K])	Moisture freezing and blocking valve	Recover charge, install filter-drier, evacuate system, recharge.
	Dirt or foreign material blocking valve	Recover charge, install filter-drier, evacuate system, recharge.
	Low refrigerant charge	Correct the charge.
	Vapor bubbles in liquid line	Remove restriction in liquid line. Correct the refrigerant charge.
		Remove noncondensible gases.
		Size liquid line correctly.
	Misapplication of internally equalized valve	Use correct TXV.
	Plugged external equalizer line	Remove external equalizer line restriction.
	Undersized TXV	Replace with correct valve.
	Loss of charge from power head sensing bulb	Replace power head or complete TXV.
	Charge migration from sensing bulb to power head (Warm power head with warm, wet cloth. Does valve operate correctly now?)	Ensure TXV is warmer than sensing bulb.
Valve feeds too much refrigerant, with low superheat and higher than normal suction pressure	Moisture causing valve to stick open.	Recover refrigerant, replace filter-drier, evacuate system, and recharge.
	Dirt or foreign material causing valve to stick open	Recover refrigerant, replace filter drier, evacuate system, and recharge.
	TXV seat leak (a gurgling or hissing sound is heard AT THE TXV during the off cycle, if this is the cause). NOT APPLICABLE TO BLEED PORT VALVES.	Replace the TXV.
	Oversized TXV	Install correct TXV.
	Incorrect sensing bulb location	Install bulb with two mounting straps, in 2:00 or 4:00 position on suction line, with insulation.
	Low superheat adjustment	Replace TXV.
	Incorrectly installed, or restricted external equalizer line	Remove restriction, or relocate external equalizer.

9.9 Service Analyzer Charts (cont.)

THERMOSTATIC EXPANSION VALVES (cont.)		
SYMPTOM	**POSSIBLE CAUSE**	**REMEDY**
Compressor flood back upon start-up	Refrigerant drainage from flooded evaporator	Install trap riser to the top of the evaporator coil.
	Inoperable crankcase heater or crankcase heater needed	Replace or add crankcase heater.
Superheat is low to normal with low suction pressure	Unequal evaporator circuit loading	Ensure airflow is equally distributed through evaporator.
		Check for blocked distributor tubes.
	Low load or airflow entering evaporator coil	Ensure blower is moving proper air-flow.
		Remove/Correct any airflow restriction.
Superheat and suction pressure fluctuate (valve is hunting)	TXV is oversized	Install correct TXV.
	Sensing bulb is affected by liquid refrigerant or refrigerant oil flowing through suction line	Relocate sensing bulb in another position around the circumference of the suction line.
	Unequal refrigerant flow through evaporator circuits	Ensure sensing bulb is located properly.
		Check for blocked distributor tubes.
	Moisture freezing and partially blocking TXV	Recover refrigerant, change filter-drier, evacuate system, and recharge.
Valve does not regulate at all	External equalizer line not connected or line plugged	Connect equalizer line in proper location, or remove any blockage.
	Sensing bulb lost its operating charge	Replace TXV.
	Valve body damaged during soldering or by improper installation	Replace TXV.

9.0 DIAGNOSTICS & TROUBLESHOOTING

9.10 Troubleshooting Tips

COOLING MODE TROUBLESHOOTING TIPS					
SYSTEM PROBLEM	INDICATORS				
	DISCHARGE PRESSURE	SUCTION PRESSURE	SUPERHEAT Normal: 5°–15°F [258.1° – 263.7°K]	SUBCOOLING Normal: See Charging Chart	COMPRESSOR AMPS
Overcharge	High	High	Low	High	High
Undercharge	Low	Low	High	Low	Low
Liquid Restriction (Filter Drier)	Low	Low	High	High	Low
Low Indoor Airflow	Low	Low	Low	Low	Low
Dirty Outdoor Coil	High	High	Low	Low	High
Low Outdoor Ambient Temperature	Low	Low	High	High	Low
Inefficient Compressor	Low	High	High	High	Low
Indoor TXV Sensing Bulb Charge Lost	Low	Low	High	High	Low
Poorly Insulated Indoor Sensing Bulb	High	High	Low	Low	High

HEATING MODE TROUBLESHOOTING TIPS					
SYSTEM PROBLEM	INDICATORS				
	DISCHARGE PRESSURE	SUCTION PRESSURE	SUPERHEAT Normal: 5°–15°F [258.1° – 263.7°K]	SUBCOOLING Normal: See Charging Chart	COMPRESSOR AMPS
Overcharge	High	High	OK	High	High
Undercharge	Low	Low	OK or High	Low	Low
Liquid Restriction (Filter Drier)	Low	Low	High	High	Low
Low Outdoor Airflow	Low	Low	Low	Low	Low
Dirty Indoor Coil	High	High	Low	Low	High
Low Indoor Ambient Temperature	Low	Low	OK	High	Low
Inefficient Compressor	Low	High	High	High	Low
Outdoor TXV Sensing Bulb Charge Lost	Low	Low	High	High	Low
Poorly Insulated Outdoor Sensing Bulb	High	High	Low	Low	High

10.0 OUTDOOR UNIT SERVICING

Servicing shall be performed only as recommended by the manufacturer and by qualified personnel who are trained by a training organization or manufacturer accredited to teach national competency standards that may be set in legislation for servicing equipment with flammable refrigerant. The achieved competence should be documented by a certificate.

10.1 General Guidelines

Prior to beginning work on systems containing A2L REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the REFRIGERATING SYSTEM, the following procedures shall be completed prior to conducting work on the system:

• Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapor being present while the work is being performed.

• All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

• The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

• If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

• No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

• Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

10.2 Checks to the Refrigerant Equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using A2L REFRIGERANTS:

• The actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed.

• The ventilation machinery and outlets are operating adequately and are not obstructed.

• If an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant.

• Marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.

• Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

10.0 OUTDOOR UNIT SERVICING

10.3 Checks to Electrical Devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised. Initial safety checks shall include:

- That capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking.
- That no live electrical components and wiring are exposed while charging, recovering or purging the system.
- That there is continuity of earth bonding.

10.4 Repairs to Sealed Components

During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

- Ensure that the apparatus is mounted securely.
- Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres.
- Replacement parts shall be in accordance with the manufacturer's specifications. Sealed electrical components shall be replaced.

10.5 Repair to Intrinsically Safe Components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating. Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

NOTE: The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components must be replaced and do not have to be isolated prior to working on them.

10.6 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

10.7 Detection of Flammable Refrigerants (WARNING)

Under NO circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall NOT be used.

The following leak detection methods are deemed acceptable for all refrigerant systems:

• Electronic leak detectors may be used to detect refrigerant leaks but, in the case of **FLAMMABLE REFRIGERANTS**, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

• Leak detection fluids (such as bubble method or fluorescent method agents) are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to the next section (10.8 Removal and Evacuation).

10.8 Removal and Evacuation

When breaking into the refrigerant circuit to make repairs or for any other purpose, it is important that best practice is followed for A2L refrigerants. The following procedure shall be adhered to safely remove refrigerant following local and national regulations:

- Evacuate
- Purge the circuit with inert gas (optional for A2L)
- Evacuate (optional for A2L)
- Continuously flush or purge with inert gas when using flame to open circuit
- Open the circuit

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing A2L refrigerants, The system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants.

This process might need to be repeated several times. Compressed air or oxygen shall NOT be used for purging refrigerant systems. The outlet for the vacuum pump shall NOT be close to any potential ignition sources, and ventilation shall be available.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. The outlet for the vacuum pump shall NOT be close to any potential ignition sources, and ventilation shall be available.

10.0 OUTDOOR UNIT SERVICING

10.9 Charging Procedures

Refer to Section 5.4 Refrigerant Charging of the manual.

10.10 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the A2L refrigerant. If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

10.11 Decommissioning and Labeling

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

- Mechanical handling equipment is available, if required, for handling refrigerant cylinders;
- All personal protective equipment is available and being used correctly;
- The recovery process is supervised at all times by a competent person;
- Recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

Equipment shall be labeled stating that it has been decommissioned and emptied of refrigerant. The label shall be dated and signed. Ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

10.0 OUTDOOR UNIT SERVICING

10.12 Outdoor Coil Cleaning

The outdoor fan draws air across the coil during operation which results in contaminants collecting on and between the aluminum fins. These contaminants restrict the air-flow through the coil resulting in reduced capacity and efficiency and increases the temperature of the components that can reduce their life. Therefore, it is recommended that the outdoor coil be cleaned at least annually by a qualified service technician using a non-corrosive coil cleaner and low pressure water hose sprayer. Care must be taken not to damage or flatten out the fins by spraying the fins from an angle. Washing from the top of the coil down from the inside out is the most effective method of cleaning the coil. The exterior louver panels and unit top are easily removable to facilitate the coil cleaning task.

WARNING: Disconnect electrical power to the unit before removing the top panel or any electrical panel as the fan motor could start at any time and live electrical connections will be exposed.

10.13 Cabinet Cleaning and Care

Annual cleaning of the exterior cabinet is recommended using a mild detergent, water, and cloth/sponge to remove dust, mold, and potentially corrosive contaminants that have collected on the cabinet. It is also recommended to apply a good quality automotive wax to the painted metal cabinet parts annually to protect the finish and to restore the gloss of the paint. Do not apply wax to the plastic parts.

10.14 Motor Lubrication

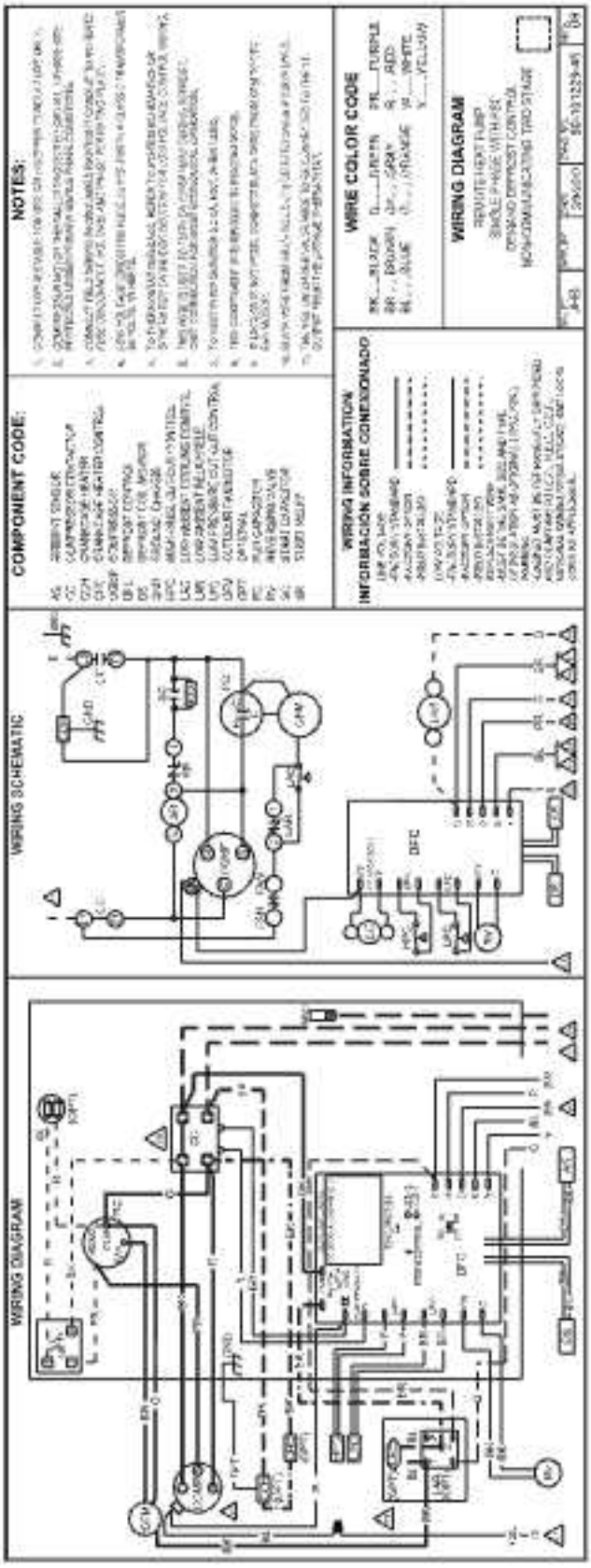
The bearings in the outdoor motor are pre-lubricated by the motor manufacturer and do not have oiling ports. The motor will run for an indefinite period of time without additional lubrication.

10.15 Replacement Parts

Any replacement part used to replace parts originally supplied on equipment must be the same as or an approved alternate to the original part supplied. The manufacturer will not be responsible for replacement parts not designed to physically fit or operate within the design parameters the original parts were selected for.

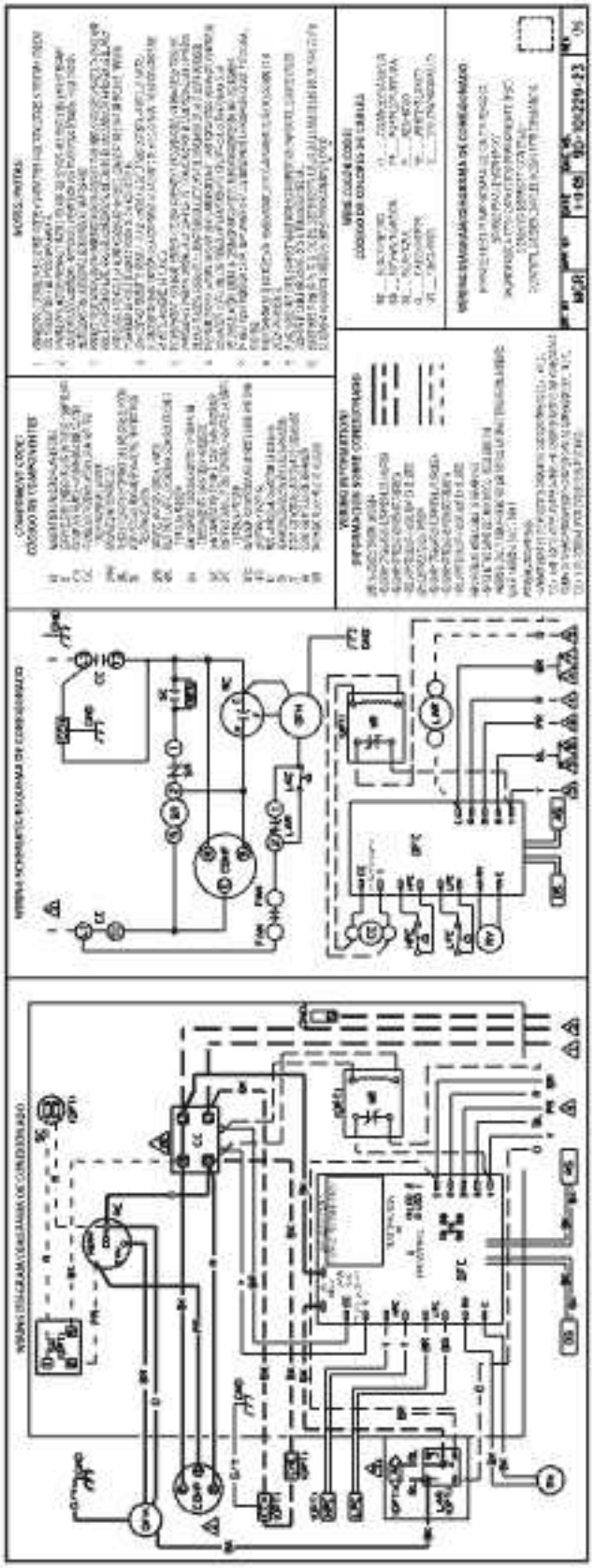
11.0 WIRING DIAGRAM

11.1 Two Stage Wiring Diagram



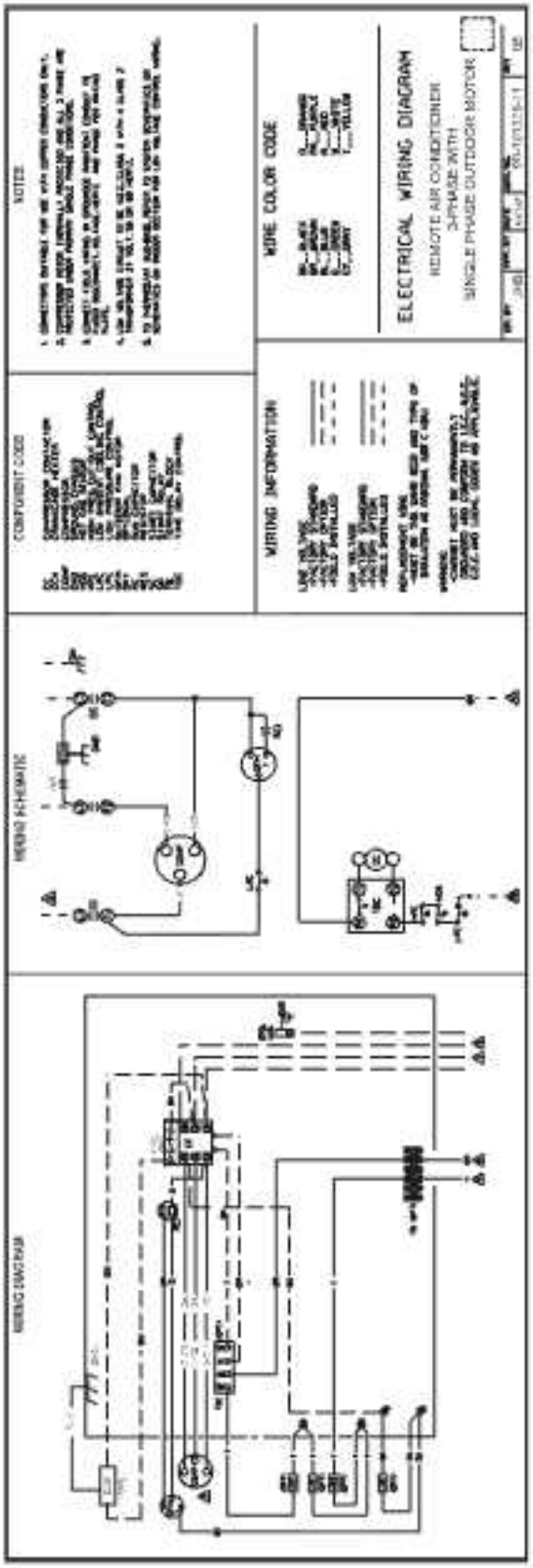
11.0 WIRING DIAGRAM

11.2 Single Stage Wiring Diagram



11.0 WIRING DIAGRAM

11.3 Single Stage 3 Phase Wiring Diagram



11.0 WIRING DIAGRAM

11.4 Two Stage 3 Phase Wiring Diagram

