THERMO KING

Maintenance Manual

Truck Edition
V-220/V-320 Series

Revision B

September 2018

TK 56342-18-MM-EN

TRANE TECHNOLOGIES

THERMO KING

Introduction

This manual is published for informational purposes only. Thermo King® makes no representations warranties express or implied, with respect to the information recommendations and descriptions contained herein. Information provided should not be regarded as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation Service Department should be consulted.

Thermo King's warranty shall not apply to any equipment which has been "so installed, maintained, repaired or altered as, in the manufacturer's judgment, to affect its integrity."

Manufacturer shall have no liability to any person or entity for any personal injury, property damage or any other direct, indirect, special, or consequential damages whatsoever, arising out of the use of this manual or any information, recommendations or descriptions contained herein. The procedures described herein should only be undertaken by suitably qualified personnel. Failure to implement these procedures correctly may cause damage to the Thermo King unit or other property or personal injury.

Revision History

Revision A	(06/17) Original release
Revision B	(12/17) Update condenser fan fuse (F30) to 20 amps, expansion valve feeler bulb location, and other general updates.

General Information

The maintenance information in this manual covers unit models:

V–220 10 (903495)	V–320 10 (903497)
V–220 20 (903496)	V–320 20 (903498)
V–220 MAX 10 (903491)	V–320 MAX 10 (903493)
V–220 MAX 20 (903492)	V–320 MAX 20 (903494)
	V–320 MAX 30 (903677)
	V–320 MAX 50 (903678)

For further information, refer to:

V-220/V-320 Series Vehicle Powered Truck Units Operator's Manual	TK 56322
V-220 Series Parts Manual	TK 56428
V-320 Series Parts Manual	TK 56429
Direct Smart Reefer III Microprocessor Control System Diagnostic Manual	TK 61096
V-220/V-320 Series Diagrams Manual	TK 56454
V-220/V-320 Installation Manual	TK 56321
V-220/V-320 Heat Kit Installation Manual	TK 56340
Vehicle Powered Truck Installation Standards and Procedures	TK 56430
Diagnosing Thermo King Truck and Trailer Refrigeration Systems	TK 5984
Tool Catalog	TK 5955
Evacuation Station Operation and Field Application	TK 40612

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.

Recover Refrigerant

Note: *In the USA, EPA Section 608 Certification is required to work on refrigeration systems. In the EU, local F-gas Regulations must be observed when working on refrigeration systems.*

At Thermo King®, we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

When working on transport temperature control systems, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law. In addition, service personnel must be aware of the appropriate European Union, National, Federal, State, and/or Local regulations governing the use of refrigerants and certification of technicians. For additional information on regulations and technician programs, contact your local THERMO KING dealer.

Service Tools - Use the proper service tools. Gauge manifold sets should include appropriate shutoff valves or disconnects near the end of each service line.

Recovery Equipment - Recovery equipment must be used. Proper recovering, storing and recycling of refrigerants is an important part of all service work.

Service Procedures - Recommended procedures must be used to minimize refrigerant loss.

Components may be isolated by closing service valves and performing system pump-downs.

Components unable to be isolated for service must be repaired only after refrigerant is properly recovered.

R-134a/R-404A

R-134aR-404A

NOTICE

Equipment Damage!

Use only Polyolester-based refrigeration compressor oil in R-134a/R-404A systems. See Thermo King Parts Manual for part number.

NOTICE

System Contamination!

Do not mix Polyolester and standard synthetic compressor oils. Keep Polyolester compressor oil in tightly sealed containers. If Polyolester oil becomes contaminated with moisture or standard oils, dispose of properly–DO NOT USE.

NOTICE

System Contamination!

When servicing Thermo King R-134a or R-404A units, use only those service tools certified for and dedicated to R-134a/R-404A refrigerant and Polyolester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a/R-404A systems.

About This Manual

Purpose

The purpose of this manual is to provide general maintenance information necessary to maintain the climate control unit at peak operating standards. This includes safety information, unit information such as bills of material and kit numbers, general unit information, maintenance procedures and related information (such as wiring and schematic diagrams), and some diagnostic and troubleshooting information.

Note: *This manual may cover more than one unit. Therefore, it may contain information not applicable to your unit.*

Contents

This manual is organized into the following chapters:

Chapter	Purpose
Safety Precautions	Provides detailed safety information. You should be familiar with the safety precautions before working on any unit.
Model Systems (Systems Designations) Table	This table lists the bills of material and kit options that make up your unit. Use them for the following purposes: 1. To determine if you have the right manual for your unit: the bill of material (B/M) number on your unit serial plate should match one of the bill of material numbers listed in this section. If you cannot find your unit in the matrix, call TK Service for more information. 2. To communicate with TK Service Department: If you need to call TK Service, you must know your model number(s) in order for the service representative to help you.
Specifications	Lists unit specifications.
Unit Description	Gives an overview description of your unit including standard and optional features, illustrations, and general a/c theory.
Maintenance Inspection Schedule	Table of routine maintenance procedures.
Maintenance Chapters	Provide detailed maintenance procedures required for your unit. (Electrical, Refrigeration, Compressor, Clutch, Structural)
Diagnosis Chapters	Provides troubleshooting information for diagnosing problems.
Diagrams	Wiring, Schematic and Refrigeration diagrams applicable to the unit.

Before you Call Thermo King Service!

Who to call: Your Thermo King Service Representative.

Before you call Thermo King Service, have the following information on hand:

- Bill of Material (usually located on the unit serial plate)
- Model Number - found on side of the unit

Blank Pages

This manual may contain blank pages at the end of chapters. This is normal. There is no information missing from the manual.

Roadside/Curbside Terminology

Roadside/Curbside terminology: These terms can be confusing because of differences between North America and Europe. Please note:

Curbside:	The side of the truck to the driver's right when the driver is in his seat and facing forward.
Roadside:	The side of the truck to the driver's left when the driver is in his seat and facing forward.

Using the Model Systems Tables in "Model Systems (System Designations)"

The Model Systems Tables in this section list important unit information that you will need to communicate with the Thermo King Service Department.

Customer Satisfaction Survey

Let your voice be heard!

Your feedback will help improve our manuals. The survey is accessible through any internet-connected device with a web browser.

Scan the Quick Response (QR) code or click or type the web address https://tranetechnologies.iad1.qualtrics.com/jfe/form/SV_2octfSHoUJxsk6x?Q_CHL=qr&Q_JFE=qdg to complete the survey.

THERMO KING

Table of Contents

Safety Precautions

Danger, Warning, Caution, and Notice

Thermo King® recommends that all service be performed by a Thermo King dealer and to be aware of several general safety practices.

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this unit depend upon the strict observance of these precautions.

⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury and unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

General Practices

⚠ DANGER

Hazard of Explosion!

Never apply heat to a sealed refrigeration system or container. Heat increases internal pressure, which might cause an explosion resulting in death or serious injury.

⚠ DANGER

Hazardous Gases!

Refrigerant in the presence of an open flame, spark, or electrical short produces toxic gases that are severe respiratory irritants which can cause serious injury or possible death.

⚠ DANGER

Risk of Injury!

Keep your hands, clothing, and tools clear of fans and/or belts when working on a unit that is running or when opening or closing compressor service valves. Loose clothing might entangle moving pulleys or belts, causing serious injury or possible death.

⚠ DANGER

Refrigerant Vapor Hazard!

Do not inhale refrigerant. Use caution when working with refrigerant or a refrigeration system in any confined area with a limited air supply. Refrigerant displaces air and can cause oxygen depletion, resulting in suffocation and possible death.

⚠ WARNING

Hazard of Explosion!

Never close the compressor discharge service valve when the unit is operating. Never operate the unit with the discharge valve closed (front seated). This condition increases internal pressure, which can cause an explosion.

⚠ WARNING

Proper Equipment Condition!

Gauge manifold hoses must be in good condition before using them. Never let them come in contact with moving belts, fans, pulleys or hot surfaces. Defective gauge equipment can damage components or cause serious injury.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Always wear goggles or safety glasses when working on a unit. Refrigerant liquid, oil, and battery acid can permanently damage your eyes. See "First Aid".

⚠ WARNING

Equipment Damage and Risk of Injury!

Never drill holes into the unit unless instructed by Thermo King. Holes drilled into high voltage cables could cause an electrical fire, severe personal injury, or even death.

⚠ WARNING

Risk of Injury!

When using ladders to install or service refrigeration systems, always observe the ladder manufacturer's safety labels and warnings. A work platform or scaffolding is the recommended method for installations and servicing.

⚠ CAUTION

Sharp Edges!

Exposed coil fins can cause lacerations. Service work on the evaporator or condenser coils is best left to a certified Thermo King technician.

NOTICE

Equipment Damage!

All mounting bolts must be the correct length for their applications and torqued to specification. Incorrect bolt lengths and improper torque specifications can damage equipment.

Auto Start/Stop

⚠ CAUTION

Risk of Injury!

The unit can start and run automatically any time the unit is turned on. Turn the Microprocessor On/Off switch Off before doing inspections or working on any part of the unit. Please note that only Qualified and Certified personnel should attempt to service your Thermo King unit.

⚠ CAUTION

Risk of Injury!

The vehicle's engine may be equipped with Auto Start/Stop. The vehicle must be turned off before servicing the unit.

Battery Installation and Cable Routing

⚠ WARNING

Hazard of Explosion!

An improperly installed battery could result in a fire, explosion, or injury. A Thermo King approved battery must be installed and properly secured to the battery tray.

⚠ WARNING

Hazard of Explosion!

Improperly installed battery cables could result in a fire, explosion, or injury. Battery cables must be installed, routed, and secured properly to prevent them from rubbing, chaffing, or making contact with hot, sharp, or rotating components.

⚠ WARNING

Fire Hazard!

Do not attach fuel lines to battery cables or electrical harnesses. This has the potential to cause a fire and could cause serious injury or death.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

A battery can be dangerous. A battery contains a flammable gas that can ignite or explode. A battery stores enough electricity to burn you if it discharges quickly. A battery contains battery acid that can burn you. Always wear goggles or safety glasses and personal protective equipment when working with a battery. If you get battery acid on you, immediately flush it with water and get medical attention.

⚠ WARNING

Hazard of Explosion!

Always cover battery terminals to prevent them from making contact with metal components during battery installation. Battery terminals grounding against metal could cause the battery to explode.

⚠ CAUTION

Hazardous Service Procedures!

Set all unit electrical controls to the OFF position before connecting battery cables to the battery to prevent unit from starting unexpectedly and causing personal injury.

NOTICE

Equipment Damage!

Do not connect other manufacturer’s equipment or accessories to the unit unless approved by Thermo King. Failure to do so can result in severe damage to equipment and void the warranty.

Refrigerant Hazards

⚠ DANGER

Hazardous Pressures!

Always store refrigerant in proper containers, out of direct sunlight and away from intense heat. Heat increases pressure inside storage containers, which can cause them to burst and could result in severe personal injury.

⚠ DANGER

Combustible Hazard!

Do not use oxygen (O_2) or compressed air for leak testing. Oxygen mixed with refrigerant is combustible.

⚠ WARNING

Hazardous Gases!

Do not use a Halide torch. When a flame comes in contact with refrigerant, toxic gases are produced. These gases can cause suffocation, even death.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Refrigerant in a liquid state evaporates rapidly when exposed to the atmosphere, freezing anything it contacts. Wear butyl lined gloves and other clothing and eye wear when handling refrigerant to help prevent frostbite.

NOTICE

Equipment Damage!

When being transferred, refrigerant must be in liquid state to avoid possible equipment damage.

Refrigerant Oil Hazards

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Protect your eyes from contact with refrigerant oil. The oil can cause serious eye injuries. Protect skin and clothing from prolonged or repeated contact with refrigerant oil. To prevent irritation, wash your hands and clothing thoroughly after handling the oil. Rubber gloves are recommended.

NOTICE

Equipment Damage!

Use the correct oil in Thermo King systems to avoid damaging equipment and nullifying its warranty.

NOTICE

Equipment Damage!

Do not mix refrigerant oils. Mixing incompatible oils will damage the system.

NOTICE

Equipment Damage!

Use dedicated refrigeration equipment to prevent contaminating refrigeration systems with the wrong type of oil or refrigerant.

NOTICE

System Contamination!

Do not expose the refrigerant oil to the air any longer than necessary. Store refrigerant oil in an approved sealed container to avoid moisture contamination. The oil will absorb moisture, which results in much longer evacuation times and possible system contamination.

NOTICE

Material Damage!

Wipe up spills immediately. Refrigerant oil can damage paints and rubber materials.

Electrical Hazards

High Voltage

⚠ DANGER

Hazardous Voltage!

When servicing or repairing a temperature control unit, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with a refrigeration unit that is connected to a source of operating power, even if the unit is not operating. Lethal voltage potentials can exist at the unit power cord, inside the control box, at the motors and within the wiring harnesses.

⚠ WARNING

Hazardous Voltage!

The unit On/Off switch must be turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.

⚠ WARNING

Risk of Injury!

The unit power plug must be clean and dry before connecting it to a power source.

⚠ WARNING

Risk of Injury!

Do not make rapid moves when working on high voltage circuits in refrigeration units. Do not grab for falling tools because you might accidentally touch a high voltage source.

⚠ WARNING

Hazardous Voltage!

Treat all wires and connections as if they were high voltage until a meter and wiring diagram indicate otherwise. Only use tools with insulated handles. Never hold uninsulated metal tools near exposed, energized conductors.

⚠ WARNING

Hazardous Voltage!

Never work alone on high voltage circuits in the refrigeration unit. Another person should be nearby to shut off the unit and provide aid in the event of an accident.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Safety glasses, rubber-insulated gloves, and cable cutters should be near your work area in the event of an electrical accident.

⚠ WARNING

Hazardous Voltage w/Capacitors!

Be careful when working with electrical circuits that contain capacitors. Some capacitors hold a significant electrical charge that might cause burns or shocks if accidentally discharged. Capacitors must be discharged before working on electrical circuits.

Low Voltage

⚠ WARNING

Live Electrical Components!

Control circuits used in refrigeration units are low voltage (12 to 24 volts dc). However, the large amount of amperage available can cause severe burns if accidentally shorted to ground with metal objects, such as tools. Do not wear jewelry, watches, or rings because they increase the risk of shorting out electrical circuits and damaging equipment or causing severe burns.

Microprocessor Service Precautions

Take precautions to prevent electrostatic discharge when servicing the microprocessor and its related components. Even tiny amounts of current can severely damage or destroy electronic components.

Observe the following precautions when servicing a microprocessor control system to avoid damaging electronic components. Refer to the appropriate microprocessor diagnosis manual for more information.

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Wear a wrist strap (P/N 204-622 or equivalent) with the lead end connected to the microprocessor's ground terminal. These straps are available from most electronic equipment distributors. DO NOT wear these straps with power applied to the unit.
- Avoid unnecessary contact with the electronic components.
- Store and ship electronic components in antistatic bags and protective packaging.
- Leave electronic components in their antistatic packing materials until you're ready to use them.
- After servicing any electronic components, check the wiring for possible errors before restoring power to the unit.
- Never use a battery and a light bulb to test circuits on any microprocessor-based equipment.

Welding Precautions

Take precautions before electrically welding any portion of the unit or the vehicle to which it is attached. Verify that welding currents are not allowed to flow through the unit's electronic circuits.

Observe the following precautions when welding to avoid damaging electronic components.

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Disconnect all wire harnesses from the microprocessor.
- If there are any electrical circuit breakers in the control box, switch them OFF.
- Close the control box.
- Components that could be damaged by welding sparks should be removed from the unit.

- Use normal welding procedures, but keep the ground return electrode as close to the area being welded as practical. This will reduce the likelihood of stray welding currents passing through any electronic circuits.

First Aid

REFRIGERANT

- **Eyes:** For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- **Skin:** Flush area with large amounts of warm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection. Get prompt medical attention. Wash contaminated clothing before reuse.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Frost Bite:** In the event of frost bite , the objectives of First Aid are to protect the frozen area from further injury, warm the affected area rapidly, and to maintain respiration.

REFRIGERANT OIL

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Inhalation:** Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

ENGINE COOLANT

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention.
- **Skin:** Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- **Ingestion:** Do not induce vomiting. Immediately contact local poison control center or physician.

BATTERY ACID

- **Eyes:** Immediately flush with large amounts of water for at least 15 minutes. Get prompt medical attention. Wash skin with soap and water.

ELECTRICAL SHOCK

Take IMMEDIATE action after a person has received an electrical shock. Get quick medical assistance, if possible.

The source of the shock must be quickly stopped, by either shutting off the power or removing the victim. If the power cannot be shut off, the wire should be cut with an non-conductive tool, such as a wood-handle axe or thickly insulated cable cutters. Rescuers should wear insulated gloves and safety glasses, and avoid looking at wires being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim away with a non-conductive material. Use wood, rope, a belt or coat to pull or push the victim away from the current. DO NOT TOUCH the victim. You will receive a shock from current flowing through the victim's body. After separating the victim from power source, immediately check for signs of a pulse and respiration. If no pulse is present, start Cardio Pulmonary Resuscitation (CPR). If a pulse is present, respiration might be restored by using mouth-to-mouth resuscitation. Call for emergency medical assistance.

ASPHYXIATION

Move victim to fresh air and use Cardio Pulmonary Resuscitation (CPR) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.

Model Systems (System Designations)

V-220 and V-320 Truck Refrigeration Systems

System Designation	System Number	Install Kit	Refrigerant	Schematic, Wiring Diagrams
V-220 10	903495	801131	R-134a	3E34872, 3E34873
V-220 20	903496	801132	R-134a	3E34870, 3E34871
V-220 MAX 10	903491	801096	R-404A	3E34872, 3E34873
V-220 MAX 20	903492	801093	R-404A	3E34870, 3E34871
V-320 10	903497	801133	R-134a	3E34872, 3E34873
V-320 20	903498	801134	R-134a	3E34870, 3E34871
V-320 MAX 10	903493	801094	R-404A	3E34872, 3E34873
V-320 MAX 20	903494	801095	R-404A	3E34870, 3E34871
V-320 MAX 30	903677	801094	R-404A	3E34868, 3E34869
V-320 MAX 50	903678	801095	R-404A	3E34864, 3E34865

Specifications

Electrical System

Fuses	
Fuse 3: Evaporator Fan Motor (EFM1)	15 amps
Fuse 4: Evaporator Fan Motor (EFM2)	15 amps
Fuse 5: Roadside (Engine) Compressor Clutch (CLU1), Hot Gas Solenoid (HGS), Liquid Injection Switch (LISW), Liquid Injection Solenoid (LIS), Electric Standby Compressor Clutch (CLU2), Compressor Motor Contactor (CMC), CPR Bypass Solenoid (BYPS), Condenser Inlet Solenoid (CIS)	20 amps
Fuse 6: Drain Line Heaters (DH1 and DH2)	2 amps
Fuse 14: Vehicle Ignition Switch	4 amps
Fuse 15: Controller Battery Power Supply (located in 2 wire near battery.)	4 amps
Fuse 16: Controller Standby Power Supply (located at capacitor in condenser section)	5 amps
Fuse 20: Transformer AC Power Supply (located at compressor motor contactor in condenser section)	5 amps
Fuse 21: Battery Power Supply (located in 2 wire near battery)	60 amps
Fuse 26: Evaporator Fan Motor 2 (EFM2) (located in 2A wire near terminal strip in condenser section Electric Heat Option only)	15 amps
Fuse 30: Condenser Fan Motor (CFM) (located in CF1 wire near terminal strip in condenser section)	20 amps
Condenser Fan Motor	
Full Load Current	10.0-10.8 amps at 13 Vdc
Resistance	1.3 ohms
Evaporator Fan Motors (Each)	
Full Load Current	7.3-7.9 amps at 13 Vdc
Resistance	1.7 ohms
Coil for Hot Gas Solenoid (HGS)	
Current	1.2 amps at 12 Vdc
Resistance	10.0 ohms
Coil for Liquid Injection Solenoid (LIS) – MAX Only	
Current	1.2 amps at 12 Vdc
Resistance	10.0 ohms
Coil for Condenser Inlet Solenoid (CIS) - Model 30 and 50 Only	
Current	2.3 amps at 12 Vdc
Resistance	5.2 ohms
Coil for CPR Bypass Solenoid (BYPS) - Model 30 and 50 Only	
Current	2.3 amps at 12 Vdc
Resistance	5.2 ohms
Coil for Coolant Heat Valve Solenoid (CV) - Truck Engine Coolant Heat Option Only	
Current	1.5 amps at 12 Vdc
Resistance	8.0 ohms

Coolant Heat Pump Motor (CP) - Truck Engine Coolant Heat Option Only		
Current		1.5 Amps at 12 Vdc
Resistance		8.0 ohms
Drain Line Heaters (Each) - MAX Only		
Current		0.9 amps ± 5% at 68 F (20 C) at 12 Vdc
Resistance		13.8 ohms ± 5% at 68 F (20 C)
Battery Power Relay (BPR)		
Type		Single Pole Single Throw (SPST)
Contacts	Terminals 30 to 87	Normally Open (NO)
Coil Resistance	Terminals 85 to 86	90 ohms
Electric Standby Power Relay (ESR)		
Type		Single Pole Single Throw (SPST)
Contacts	Terminals 30 to 87	Normally Open (NO)
Coil Resistance	Terminals 85 to 86	90 ohms
Battery Disconnect Relay (BDR)		
Type		Single Pole Double Throw (SPDT)
Contacts	Terminals 30 to 87 Terminals 30 to 87A	Normally Open (NO) Normally Closwe (NC)
Coil Resistance	Terminals 85 to 86	90 ohms

Refrigeration System

R-134a Refrigeration System V-220/V-320

Refrigerant Charge:	V-220 - Model 10 V-220 - Model 20 V-320 - Model 10 V-320 - Model 20	2.8 lb (1.27 kg) R-134a 2.8 lb (1.27 kg) R-134a 3.3 lb (1.50 kg) R-134a 3.4 lb (1.54 kg) R-134a
Defrost Termination Switch:	Opens Closes	48.0 ± 5.0 F (8.9 ± 2.8 C) 36.0 ± 5.0 F (2.2 ± 2.8 C)
Low Pressure Cutout Switch (LPCO):	Opens Closes	5 to 11 in. Hg vacuum (-17 to -37 kPa) 4 to 7 psig (28 to 48 kPa)
Over Temperature Switch - Electric Heater Option Only:	Opens Closes	105 ± 5 F (41 ± 3 C) 90 ± 5 F (32 ± 3 C)

R-404A Refrigeration System V-220/V-320 MAX

Refrigerant Charge:	V-220 MAX - Model 10 V-220 MAX - Model 20 V-320 MAX - Model 10 V-320 MAX - Model 20 V-320 MAX - Model 30 V-320 MAX - Model 50	2.5 lb (1.13 kg) R-404A 2.6 lb (1.18 kg) R-404A 3.0 lb (1.36 kg) R-404A 3.1 lb (1.41 kg) R-404A 3.1 lb (1.41 kg) R-404A 3.2 lb (1.45 kg) R-404A
Defrost Termination Switch:	Opens Closes	48.0 ± 5.0 F (8.9 ± 2.8 C) 36.0 ± 5.0 F (2.2 ± 2.8 C)
Liquid Injection Switch (LISW):	Opens Closes	200 ± 5 F (93 ± 3 C) 230 ± 5 F (110 ± 3 C)
Low Pressure Cutout Switch (LPCO):	Opens Closes	5 to 11 in. Hg vacuum (-17 to -37 kPa) 4 to 7 psig (28 to 48 kPa)
Over Temperature Switch - Electric Heater Option Only:	Opens Closes	105 ± 5 F (41 ± 3 C) 90 ± 5 F (32 ± 3 C)

Compressor Pressure Regulator (CPR) Valve Setting - Model 30 and 50 Only	24 ± 2 psig (165 ± 14 kPa)
Electric Standby Suction Pressure Regulator (SPR) Valve Setting - Model 20 MAX Only	24 ± 2 psig (165 ± 14 kPa)

Compressors

Standard Engine Driven Compressor:	V-220 V-320	TK-13, 8 cu. in. (131 cc), Swash Plate, 6 Cylinder TK-15, 9 cu. in. (147 cc), Swash Plate, 6 Cylinder
Optional Engine Driven Compressor		TK-208R, 7.6 cu. in. (125 cc), Reciprocating, 2 Cylinder
Electric Standby Compressor - Model 20 and 50 Only		TK-13, 8 cu. in. (131 cc), Electric Motor Driven, Swash Plate, 6 Cylinder
System Oil Capacity - Swash Plate Compressors:	Model 10 Model 20 Model 30 Model 50	13 oz (384 cc) 17 oz (503 cc) 17 oz (503 cc) 21 oz (621 cc)
System Oil Capacity - Reciprocating Compressor:	Model 10 Model 20 Model 30 Model 50	26 oz (769 cc) 30 oz (887 cc) 30 oz (887 cc) 34 oz (1006 cc)
Compressor Oil Type:		POE 120 2030515 33.8 oz. (1 Liter) POE 120 2030505 8 oz. (236 ml)
Compressor Clutch Coil - Swash Plate:	Voltage Resistance	12 Vdc 3.2 ohms at 77 F (25 C)
Compressor Clutch Coil - Reciprocating:	Voltage Resistance	12 Vdc 3-4 ohms
Defrost Method		Hot Gas
Defrost Timer Initiation Interval		Adjustable, 0 to 8 hours, default is 4 hours
Defrost Termination Interval		Defrost is terminated by Klixon switch, or by Defrost Termination Timer [dtt] adjustable, 5 to 50 minutes, default is 30 minutes.

NOTICE

Equipment Damage!

Use the correct oil in Thermo King systems to avoid damaging equipment and nullifying its warranty.

AC Electric Compressor Motors and Overload Relays

Voltage/Phase/ Frequency	Horsepower	Kilowatts	RPM	Full Load (amps)	Overload Relay Setting (amps)
115/1/60	1.5	1.1	1710	14	14
208/1/60	2.0	1.5	1740	9.5	9.5
230/1/60	2.0	1.5	1750	9	9
208/3/60	2.4	1.8	1730	7.2	7.2
230/3/60	2.4	1.8	1750	6.9	7

Contactors

Compressor Motor Contactor (CMC) and Optional Electric Heat Contactor (HC)	
Contacts	Normally Open
Coil Voltage	12 Vdc

Coil Current	0.25 amps
Coil Resistance	48 ohms

Capacitors

Capacitor	**Capacitance**
Smoothing Capacitor (C1) – all voltages	6800 µF
Electric Motor Run Capacitor 1 (RC1) – 115/1/60 units	60 µF
Electric Motor Run Capacitor 2 (RC2) – 115/1/60 units	60 µF
Electric Motor Start Capacitor (SC) – 115/1/60 units	300 µF
Electric Motor Run Capacitor (RC) – 208-230/1/60 units	40 µF
Electric Motor Start Capacitor (SC) – 208-230/1/60 units	150 µF

Transformer

Power	500 VA
Frequency	50/60 Hz
Primary Inputs	115-208-230 Vac
Secondary Nominal Voltage	11.7 Vac (21.4 Amps)

Start Relay (SR)

Type		Single Pole Single Throw (SPST)
Contacts	Terminals P to J	Normally Closed (NC)
Coil Resistance	Terminals B to J	560 ohms (115 Vac Black Cover) 3,600 ohms (208-230 Vac Gray Cover)

Electric Standby Power Supply Requirements

				Power Cord Length Power Cord Size (AWG)		
Voltage	**Phase**	**Hz**	**Power Supply Circuit Breaker**	**25 ft**	**50 ft**	**75 ft**
115 Vac	1	60	30 amp	10	10	None
208-230 Vac	1	50/60	20 amp	14	12	12
208-230 Vac	3	50/60	20 amp	14	12	12

Optional Electric Heaters

Voltage	Power Rating Watts	Current	Resistance
115 Vac	1500	13 amps	8.8 ohms
208-230 Vac	1500	6.5 amps	35.4 ohms

Belt Tension

Belt	Field Reset
Engine Driven Compressor Belt	Check vehicle manufacturer specifications
Electric Motor Driven Compressor Belt	43-63 Using TK Gauge P/N 204-427

Solder Applications

Refrigeration Components	
For general refrigeration tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 15% Silver TK No. 203-364 Use: Flux Type TK No. 203-365
For refrigeration tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

Hot Water Component	
For hot water tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 95% Tin and 5% antimony TK No. 204-167 Use: Flux Type TK No. 204-417
For hot water tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

NOTE: Some units may be equipped with compressor pressure regulator (CPR) valve and/or suction pressure regulator (SPR) valve. To reduce the chance of overheating the CPR/SPR/DPR valve, 95-5 solder or equivalent may be used.

Use 95-5 TK No. 204-167

Use Flux TK No. 204-417

Unit Description

Introduction

The Thermo King V-220/V-320 and V-220/V-320 MAX truck refrigeration systems are designed for applications on vans and small-sized trucks with one compartment. There are four models of units:

- Model 10: Cool and defrost on truck engine driven compressor operation.
- Model 20: Cool and defrost on both truck engine driven compressor operation and electric standby compressor operation.
- Model 30: Cool, heat, and defrost on truck engine driven compressor operation. Only available on V-320 MAX units.
- Model 50: Cool, heat, and defrost on both vehicle engine driven compressor operation and electric standby compressor operation. Only available on V-320 MAX units.

The system consists of at least three separate assemblies: the condenser, the evaporator, and the compressor.

Condenser

The condenser has a unique design that allows it to be mounted vertically or horizontally on the roof, or on the front of the truck box.

Evaporator

An evaporator is mounted on the ceiling inside the cargo compartment.

Compressor

The compressor is mounted to the trucks engine and driven by the engine by a belt-drive system. Model 20 and 50 units also have an additional compressor driven by an electric motor in the condenser section for electric standby operation. The evaporator, condenser and engine driven compressor are connected with refrigeration hoses that are assembled during the installation process.

The engine driven compressor and the standby compressor are connected in parallel to the same refrigeration system circuit. The compressors share refrigerant, but check valves isolate one compressor from the other during operation.

Control Circuits

The control circuits operate on 12 Vdc supplied by the vehicle batteries for engine operation. On standby operation, the power is rectified through an AC transformer.

DSR Control System

The DSR Control System is composed of an Electronic Control Module (ECM) located in the control box, and the In-Cab Control Box. This In-Cab Control Box, also called the HMI, allows the truck driver to operate the Thermo King refrigeration unit.

Refer to the V-220/V-320 Series Vehicle Powered Truck Units Operator's Manual TK 56322 for information about basic unit operation.

Oil Separator

An oil separator is a standard feature. The oil separator separates compressor oil from refrigerant vapor and returns the oil to the compressor through the suction line. The oil return line is attached to the splice fitting in the suction line near the engine driven compressor on Model 10 and Model 30 units. The oil return line is attached to the evaporator on Model 20 Units and to the suction line near the accumulator on Model 50 units. The oil separator helps provide positive oil return at high compressor speeds and low operating temperatures. This feature enhances compressor lubrication and extends compressor life.

Refrigerant

- V-220/V-320 units use R-134a refrigerant.
- V-220/V-320 MAX units use R-404A refrigerant.

Liquid Injection System

MAX units use R-404A or R-452A. These units have a liquid injection system to limit discharge temperature of the engine driven compressor. Liquid injection is activated when the temperature switch is closed or when the unit is running in heat mode on Model 30 and Model 50 units. If the discharge gas leaving the compressor reaches a temperature of 230 ± 5 F (110 ± 3 C) the liquid injection switch closes, providing voltage to the liquid injection solenoid. The solenoid opens a valve, allowing liquid refrigerant to flow from the liquid line in the evaporator to the metering orifice. The metering orifice is attached to the splice fitting in the suction line near the engine driven compressor. As the refrigerant passes through the metering orifice it expands and evaporates, cooling the suction gas entering the compressor. This cooling effect is transferred to the discharge gas leaving the compressor from the adjacent cavity in the compressor head. When the discharge gas is cooled to 200 ± 5 F (93 ± 3 C), the liquid injection switch opens, the liquid injection solenoid closes and refrigerant no longer flows through the liquid injection system.

Evaporator Drain Line Heaters

Evaporator drain line heaters are used in these units to avoid drain line blockage because of ice accumulation inside the evaporator. Two harnesses are located inside the drain lines. These resistive wires melt the ice when energized/while in defrost mode. These drain line heaters are standard on all MAX units, but can be an option with R-134A units. Please contact your Thermo King Dealer for more information.

Electric Standby Operation

When the unit is connected to an electric power source, the battery relay is de-energized, and the standby relay is energized to provide rectified power from the transformer to the electronic control system.

During electric standby operation, the electronic control system controls the operation of the unit by energizing and de-energizing the compressor contactor and standby compressor clutch (if applicable) and places the unit in cool, heat, or defrost mode by energizing the compressor contactor and standby compressor clutch (if applicable).
The electronic control system places the unit in null by de-energizing the compressor contactor and standby compressor clutch.

Unit Features

Standard Features

- In-Cab Controls with Digital LCD Thermometer
- Hot Gas Defrost
- Defrost Termination Switch
- Oil Separator
- Evaporator Drain Line Heaters (MAX Units Only, Optional on R-134a Units)
- Liquid Injection (MAX Units Only)
- Electric Standby Compressor (Model 20 and 50 Units Only)
- Hot Gas Heat (V-320 Model 30 and 50 Units Only)

Optional Features

- Door Switch Kit
- Discharge Muffler Kit
- Heat, Truck Engine Coolant (Only available for Model 10 and 20 Units)
- Heat, Truck Engine Coolant and Electric Standby Heater Strip (Only available for Model 20 Units)
- Snow Covers
- Roof Top Mounting Kit
- Electric Standby Plug (115Vac, 230Vac 1 phase, 230Vac 3 phase)

Door Switch Kit

A door switch is typically installed to stop unit operation when the cargo compartment door is opened to improve temperature control.

Discharge Muffler Kit

A discharge muffler is used to reduce the noise from the engine driven compressor. It is mounted in the compressor discharge line and is adjustable to reduce noise as much as possible.

Heat, Truck Engine Coolant

This option is added to Model 10 and 20 units to allow the unit to use engine coolant to heat the cargo compartment as require during truck engine operation. The main components are the heater assembly, coolant pump assembly (coolant pump and coolant valve), and connecting hoses. The heater assembly is mounted on the bottom of the evaporator. The coolant pump assembly is typically mounted in the truck engine compartment. The connecting hoses connect the engine cooling system to the coolant pump assembly and the heater assembly. See the V-220/V-320 Heat Kit Installation Manual TK 56340 for more information.

Heat, Truck Engine Coolant and Electric Standby Heater Strip

This option is added to Model 20 units. It allows the unit to use engine coolant to heat the cargo compartment as require during truck engine operation, and to use an electric heater strip during electric standby operation. In addition to the engine coolant heat components (see above), the main components are the electric heater strip, the heater contactor, and the electric heating harness. The electric heater strip is mounted in the heater assembly, the heater contactor is mounted in the contactor box in the heater assembly, and the heater harness connects the heater assembly to the unit control box. See the V-220/V-320 Heat Kit Installation Manual TK 56340 for more information.

Snow Covers

A snow cover is available to keep snow from collecting on the condenser fan and keep it from operating properly.

Electric Standby Plug

Electric plugs that mate with the unit power receptacles are available for installation on power supply cords.

Protection Features

- Discharge (High) Pressure Transducer - The discharge pressure transducer is a pressure sensitive device. It is located in the condenser section discharge line near the oil separator.

  If the discharge pressure rises above a certain pressure, the ECM opens the circuit to the compressor clutch to stop unit operation.

  For units with R-134a, the ECM opens the compressor clutch circuit at 300 psig (2068 kPa) and shuts down the unit. The ECM closes the

compressor clutch circuit when the pressure drops to 200 psig (1379 kPa).

For units with R-404A or R-452A, the ECM opens the compressor clutch circuit at 450 psig (3103 kPa) and shuts down the unit. The ECM closes the compressor clutch circuit when the pressure drops to 375 psig (2586 kPa).

- Low Pressure Cutout Switch - The Low Pressure Cutout Switch is a pressure sensitive switch located on the suction line assembly in the evaporator. If the suction pressure falls below 5 to 11 in. Hg vacuum (-17 to -34 kPa), the switch opens the LPCO/CH circuit. This signals the ECM to open the circuit to the compressor clutch to stop unit operation. The ECM closes the compressor clutch circuit when the pressure rises to 4 to 7 psig (28 to 48 kPa).

Control Box

P.C. Boards

All Printed Circuit Boards within this unit, supplied by Thermo King can be easily identified by the Part Number stamped on them.

Electronic Control Module (ECM)

The ECM, located inside the unit's control box, contains the system's microprocessor(s), I/O connectors, output relays, fuses, and discrete electronic components mounted on two or three printed circuit boards (platforms). The microprocessor(s) receives output signals from the load compartment return air sensor and electronic thermostat. Based on setpoint temperature and other parameters, the microprocessor determines when to adjust the temperature-control state in the compartment to Cool, Heat, or Null mode, or to initiate a Defrost cycle. Refer to your units Diagnostic Manual for complete service information about the Electronic Control Module.

Refrigeration System Components

Solenoids and Valves

Hot Gas Solenoid (HGS)

This valve is energized (open) in the defrost mode, and in the heat mode. It allows hot gas to enter the evaporator coil. This is a normally closed valve. SPECTRUM units have one in each evaporator.

Condenser Inlet Solenoid (CIS)

Suction Pressure Regulator Valve (SPR)

Liquid Line Check Valve

This valve is only used on Model 30 and Model 50 units. It prevents refrigerant from moving into the condenser during heat and defrost modes.

Switches and Transducers

Low Pressure Cutout Switch (LPCO)

This normally closed switch monitors the suction pressure in the evaporator. It opens on low suction pressure to stop the unit and prevent damage to the compressor.

Liquid Injection Switch (LISW)

This switch is only used on MAX units. It is a normally open switch that monitors the discharge temperature on the engine driven compressor. It closes on high discharge temperature to energize the liquid injection valve and cool the compressor.

Discharge Pressure Transducer (DPT)

This transducer supplies the discharge pressure from the discharge line in the condenser to the microprocessor. This information is used by the microprocessor and software to determine the unit operating conditions.

Unit Operation

Standard Model 10 and 20 units (without heat options) operate in Cool mode or Null mode, as required, to maintain the load compartment temperature at the setpoint temperature.

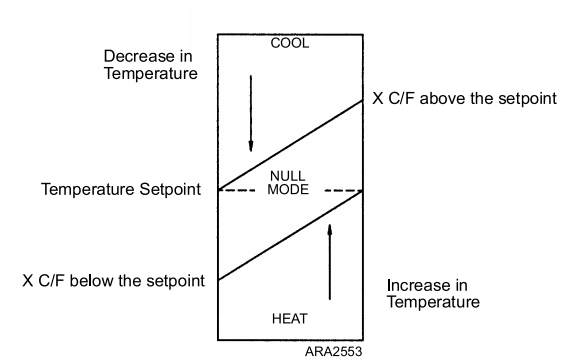
Model 30 and 50 units, and 10 and 20 units with heat options (coolant or electric heat), operate in Cool, Null, or Heat as required, to maintain the load compartment temperature at the setpoint temperature.

Defrost cycles occur manually or automatically, as required.

If power is shut off, the unit comes back in Null mode when the unit is restarted. There is a momentary delay at auto start-up for circuit protection.

Note: *The compressor will "bump start" five times while coming out of Null or when the unit is first started. In a "bump start" the compressor is turned on for about one second and then goes off for about four seconds.*

Figure 1. Thermostat Algorithm



Options:

- Coolant Heat - This option provides auxiliary heating by circulating hot engine coolant through the evaporator.
- Electric Heat - Provides auxiliary heat through resistive heat strips in the evaporator when connected to electric standby.

Operation

The vehicle engine must be running and the unit must be turned on. On units with Electric Standby, connect the external power cord and the unit switches to Electric mode operation. Unit operation can be tailored, as required, using programmable settings as shown in the Direct Smart Reefer III Microprocessor Control System Diagnostic Manual TK 61096.

Cool Mode

When cooling is required (when there is a requirement to lower the evaporator return air temperature in the load compartment), the controller energizes the compressor clutch (and compressor motor contactor in model 20/50 units) and evaporator fans. The controller monitors the discharge pressure through the discharge pressure transducer (DPT). The condenser fan is energized if necessary and turn on and off as determined by the controller.

The unit operates in Cool mode until the setpoint temperature is reached. The unit then enters Null mode. When the temperature rises to a pre-determined number of degrees (programmable setting), the unit restarts in Cool mode.

Cool Mode Model 10

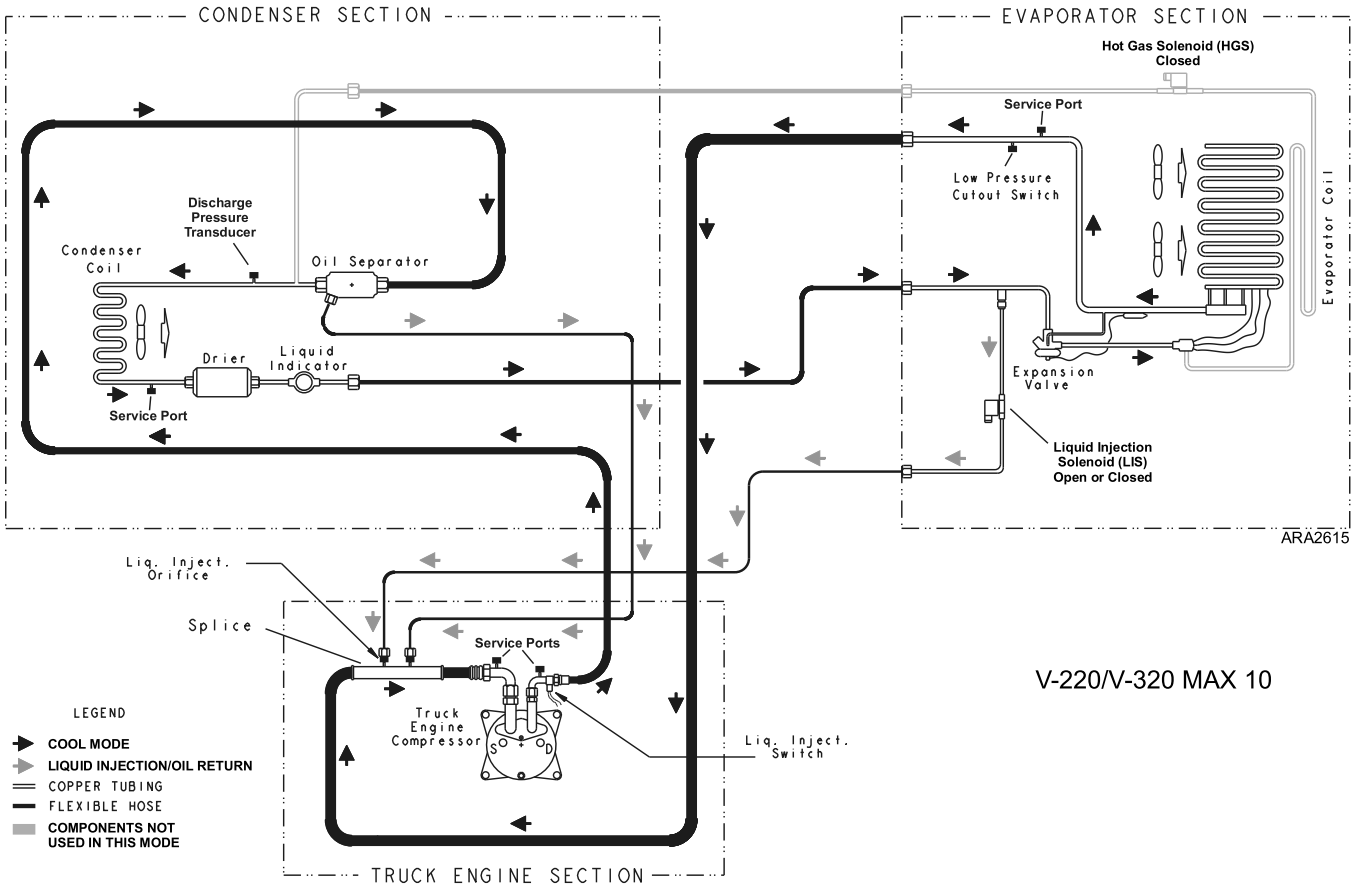
Note: *The following shows the Model 10 MAX unit. The standard Model 10 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the compressor and flows through the oil separator where oil is separated and returned to the splice fitting in the suction line. The refrigerant flows through the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the suction line.

If the compressor discharge temperature rises enough to close the liquid injection switch, the liquid injection valve opens and liquid refrigerant flows through the liquid injection line, liquid injection orifice and splice fitting in the suction line to cool the compressor. When the compressor discharge temperature falls enough to open the liquid injection switch, liquid injection valve closes to stop liquid injection.

- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) when the liquid injection switch is closed to control the engine driven compressor temperature.

Figure 2. Cool Mode Model 10



Cool Mode Model 20 Engine Operation

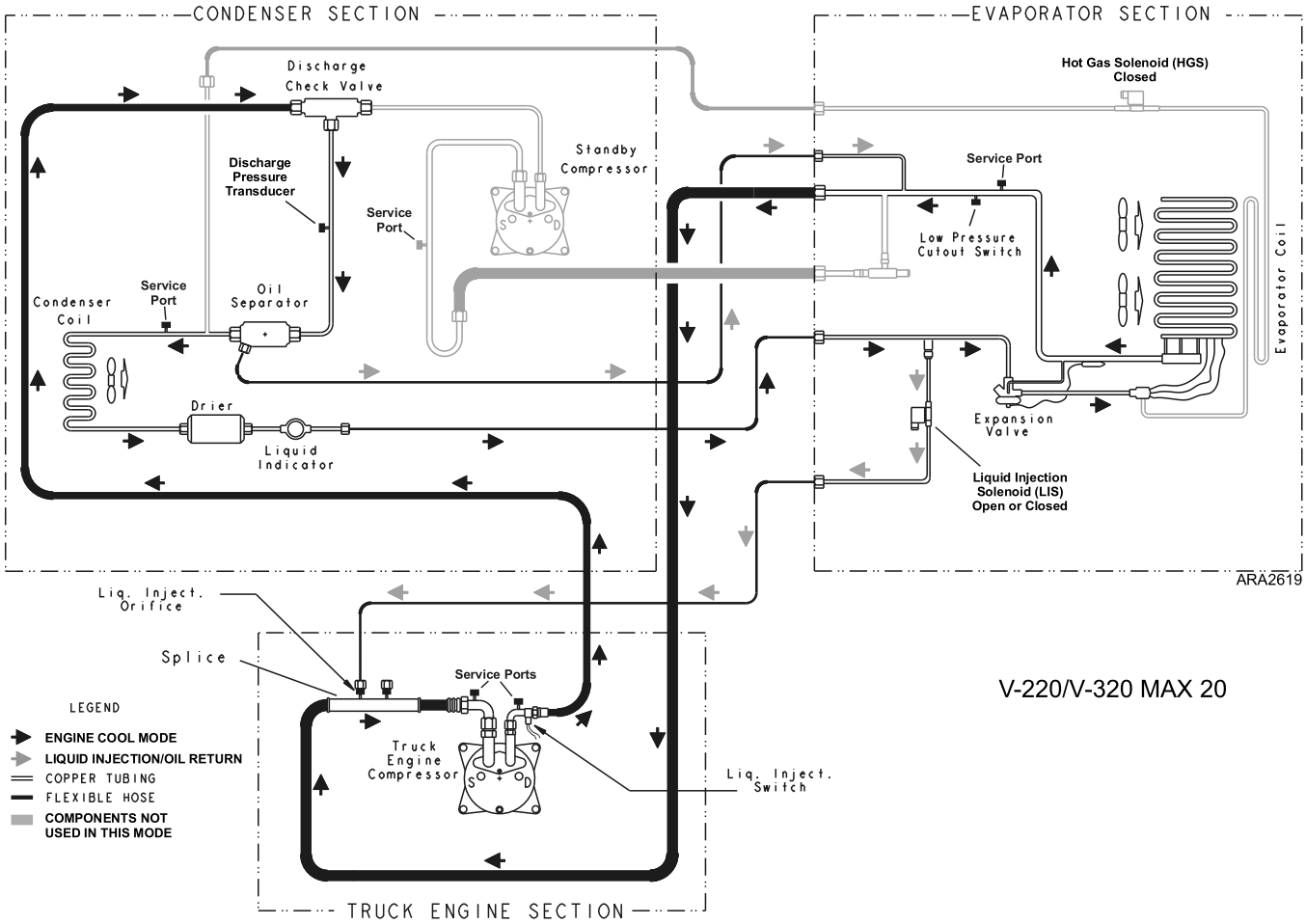
Note: *The following shows the Model 20 MAX unit. The standard Model 20 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, splice fitting, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the engine driven compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The refrigerant flows through the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the suction line.

If the compressor discharge temperature rises enough to close the liquid injection switch, the liquid injection valve opens and liquid refrigerant flows through the liquid injection line, liquid injection orifice and splice fitting in the suction line to cool the compressor. When the compressor discharge temperature falls enough to open the liquid injection switch, liquid injection valve closes to stop liquid injection.

- Discharge Check Valve – Open to engine driven compressor, closed to electric standby compressor
- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) when the liquid injection switch is closed to control the engine driven compressor temperature.

Figure 3. Cool Mode Model 20 Engine Operation



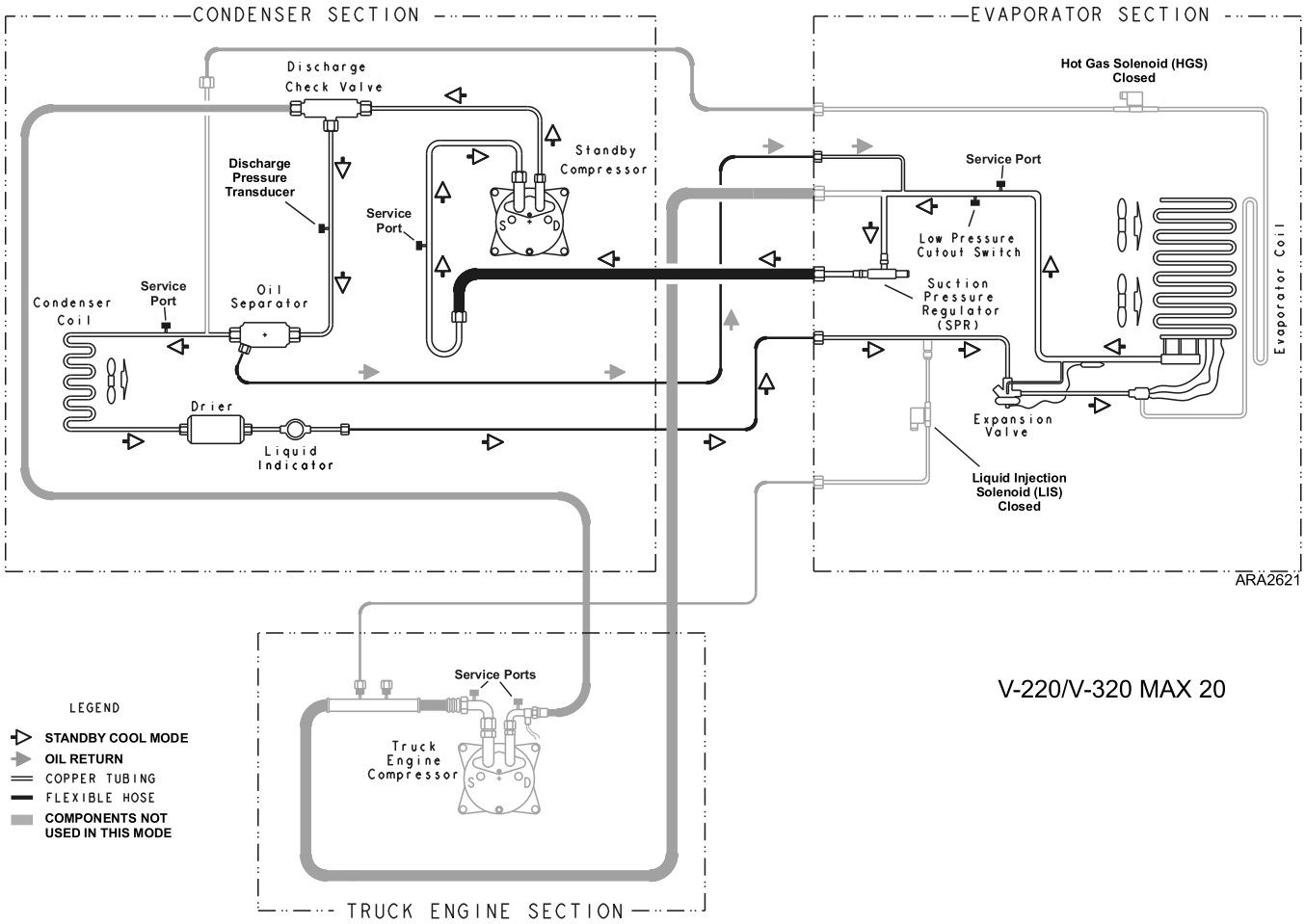
Cool Mode Model 20 Electric Standby Operation

Note: *The following shows the Model 20 MAX unit. The standard Model 20 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, splice fitting, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the electric standby compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The refrigerant flows through the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the suction pressure regulator.

- Discharge Check Valve – Closed to engine driven compressor, open to electric standby compressor
- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized

Figure 4. Cool Mode Model 20 Electric Standby Operation



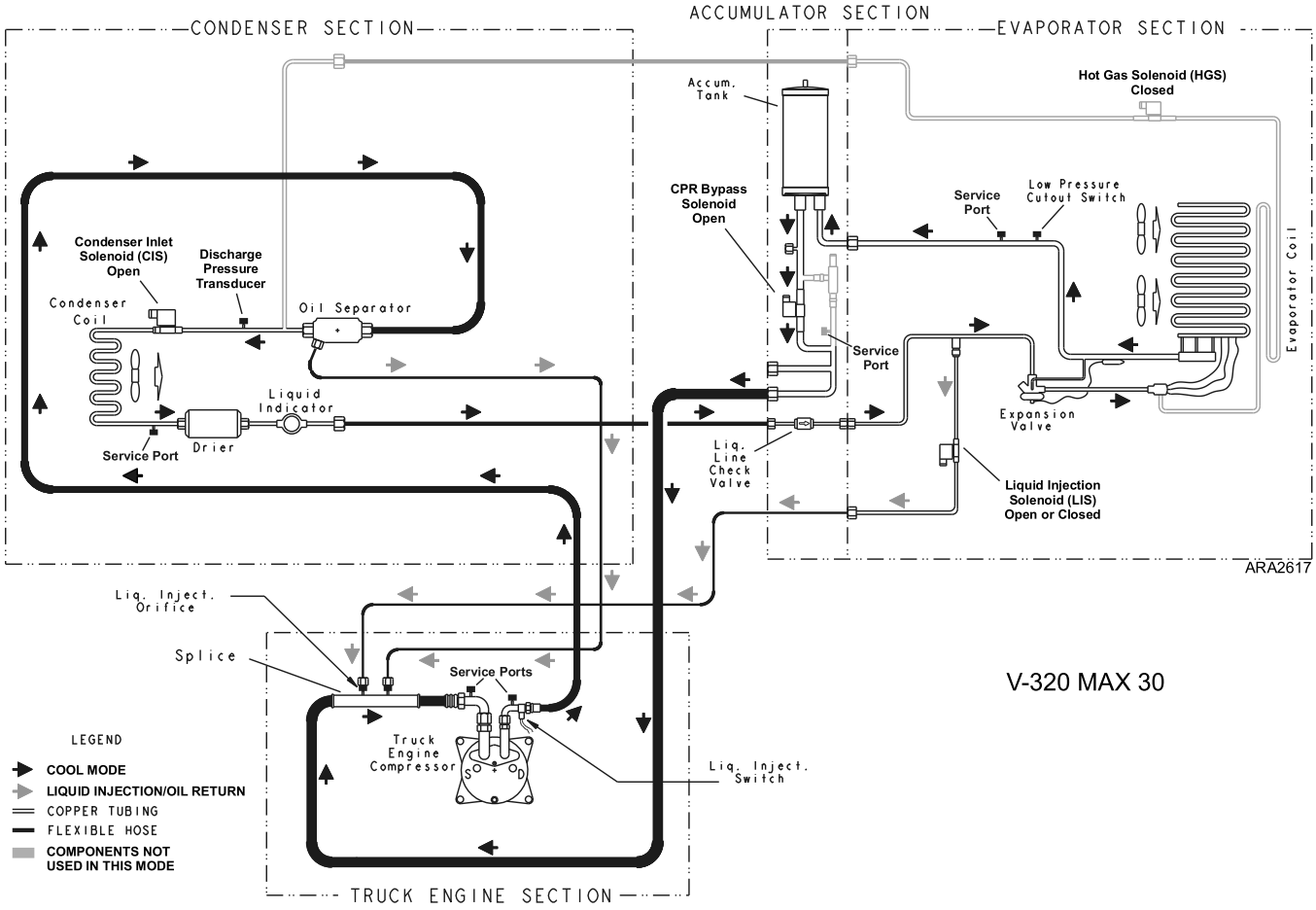
Cool Mode Model 30

High pressure refrigerant vapor leaves the compressor and flows through the oil separator where oil is separated and returned to the splice fitting in the suction line. The refrigerant flows through the open condenser inlet solenoid to the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, liquid line check valve, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the accumulator and open CPR bypass solenoid.

If the compressor discharge temperature rises enough to close the liquid injection switch, the liquid injection valve opens and liquid refrigerant flows through the liquid injection line, liquid injection orifice and splice fitting in the suction line to cool the compressor. When the compressor discharge temperature falls enough to open the liquid injection switch, liquid injection valve closes to stop liquid injection.

- Condenser Inlet Solenoid (CIS) – Open/De-energized
- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Line Check Valve – Open
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) when the liquid injection switch is closed to control the engine driven compressor temperature.
- CPR Bypass Solenoid – Open/De-energized

Figure 5. Cool Mode Model 30



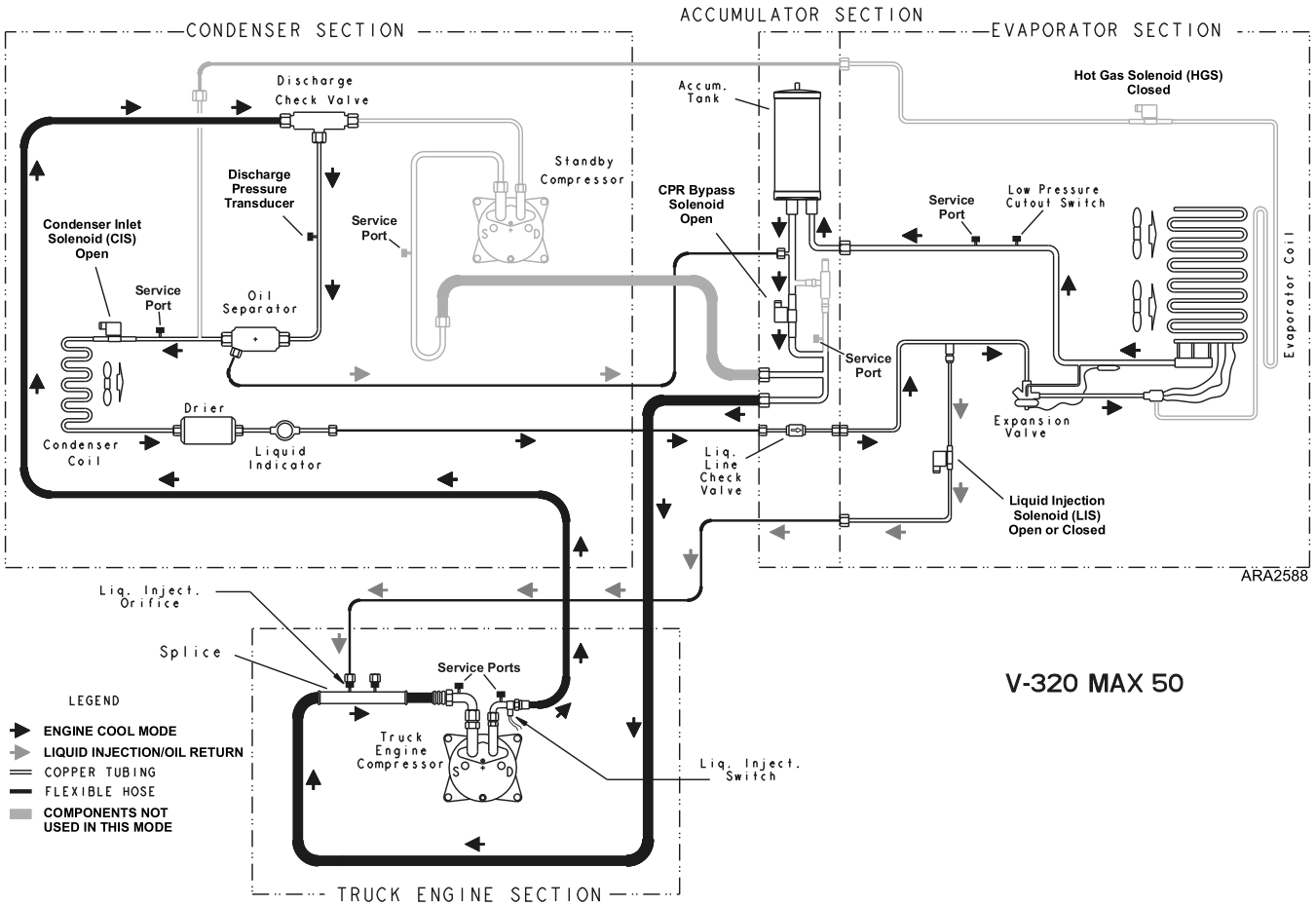
Cool Mode Model 50 Engine Operation

High pressure refrigerant vapor leaves the engine driven compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The refrigerant flows through the open condenser inlet solenoid to the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, liquid line check valve, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the accumulator and open CPR bypass solenoid.

If the compressor discharge temperature rises enough to close the liquid injection switch, the liquid injection valve opens and liquid refrigerant flows through the liquid injection line, liquid injection orifice and splice fitting in the suction line to cool the compressor. When the compressor discharge temperature falls enough to open the liquid injection switch, liquid injection valve closes to stop liquid injection.

- Discharge Check Valve – Open to engine driven compressor, closed to electric standby compressor
- Condenser Inlet Solenoid (CIS) – Open/De-energized
- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Line Check Valve – Open
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) when the liquid injection switch is closed to control the engine driven compressor temperature.
- CPR Bypass Solenoid – Open/De-energized

Figure 6. Cool Mode Model 50 Engine Operation

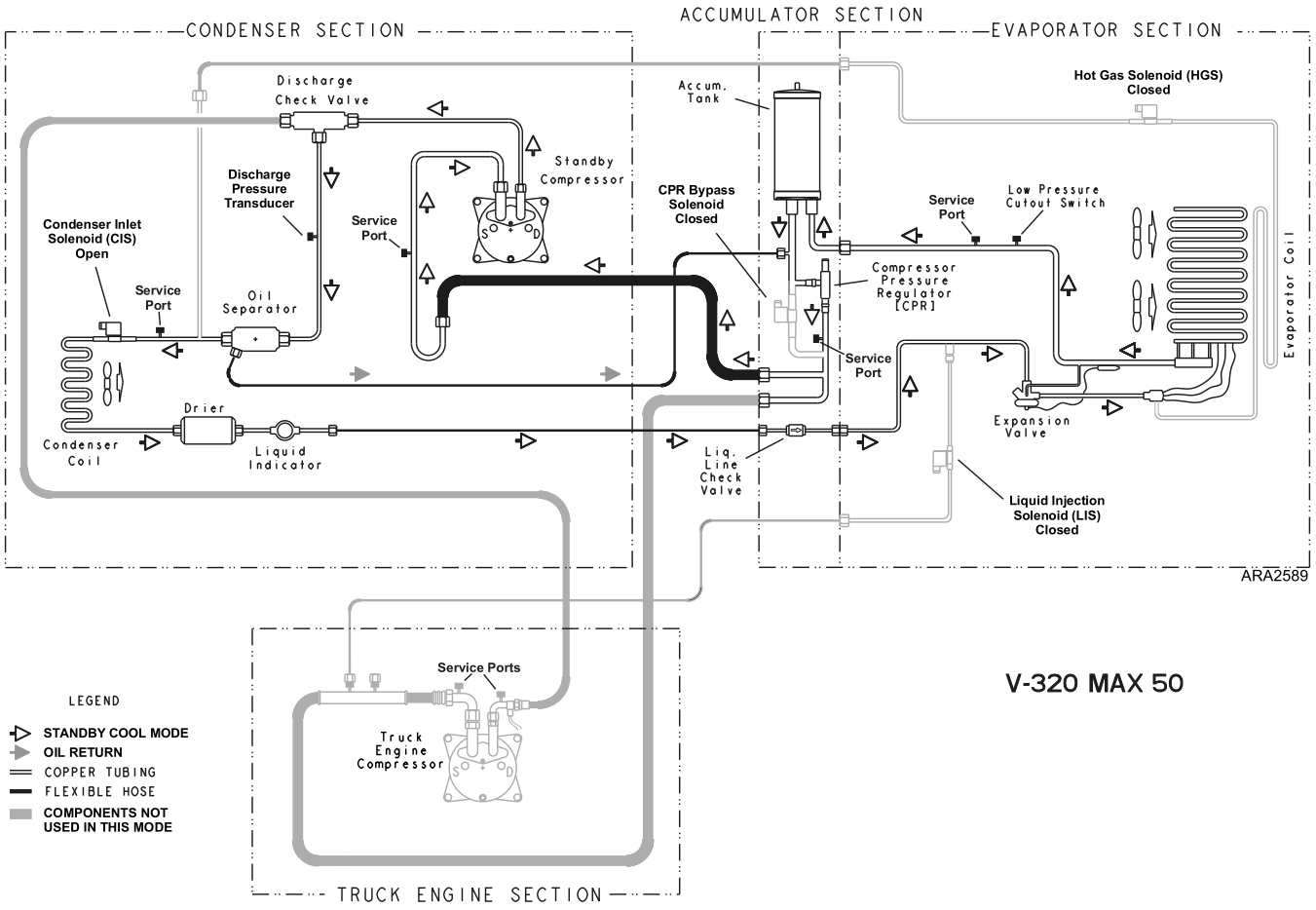


Cool Mode Model 50 Electric Standby Operation

High pressure refrigerant vapor leaves the electric standby compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The refrigerant flows through the open condenser inlet solenoid to the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the drier, liquid indicator, liquid line check valve, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the accumulator and the compressor pressure regulator because the CPR bypass solenoid is closed.

- Discharge Check Valve – Closed to engine driven compressor, open to electric standby compressor
- Condenser Inlet Solenoid (CIS) – Open/De-energized
- Hot Gas Solenoid (HGS) – Closed/De-energized
- Liquid Line Check Valve – Open
- Liquid Injection Solenoid (LIS) – Closed/De-energized
- CPR Bypass Solenoid – Closed/Energized

Figure 7. Cool Mode Model 50 Electric Standby Operation



Null Mode

The unit operates in Null mode when the setpoint temperature is reached and cooling (or heating) is not required. All outputs are de-energized. If the temperature rises a pre-determined number of degrees (programmable setting), the unit restarts in Cool mode. If the temperature falls a pre-determined number of degrees, and a heat option is present, the unit restarts in Heat mode.

In addition, the evaporator fans might operate during Null mode if evaporator fan constant blow feature is enabled. See the Direct Smart Reefer III Microprocessor Control System Diagnostic Manual TK 61096.

Purge Mode – Model 30 and Model 50 Units Only

When the temperature falls a pre-determined number of degrees below the setpoint temperature, the controller prepares the unit for the Heat mode by placing the unit in the Null mode for 10 seconds, and then placing the unit in the Purge mode for 45 seconds before shifting to the Heat mode. In the Purge mode the compressor clutch is energized but the evaporator fans are not. This moves the refrigerant from the condenser to the low side to increase the heating capacity. The refrigerant flow is the same as shown previously in the Cool mode.

Heat Mode – Model 30 and Model 50 Units Only

If a Heat option is present, the unit enters Heat mode when the temperature falls a pre-determined number of degrees below the setpoint temperature. When heat is required, the outputs of the microprocessor energize the compressor clutch, the evaporator fans, the hot gas solenoid and the condenser inlet solenoid. (For units with Electric Standby, the compressor motor contactor and compressor clutch are energized.)

The unit operates in Heat mode until the setpoint temperature is reached. The unit then enters Null mode.

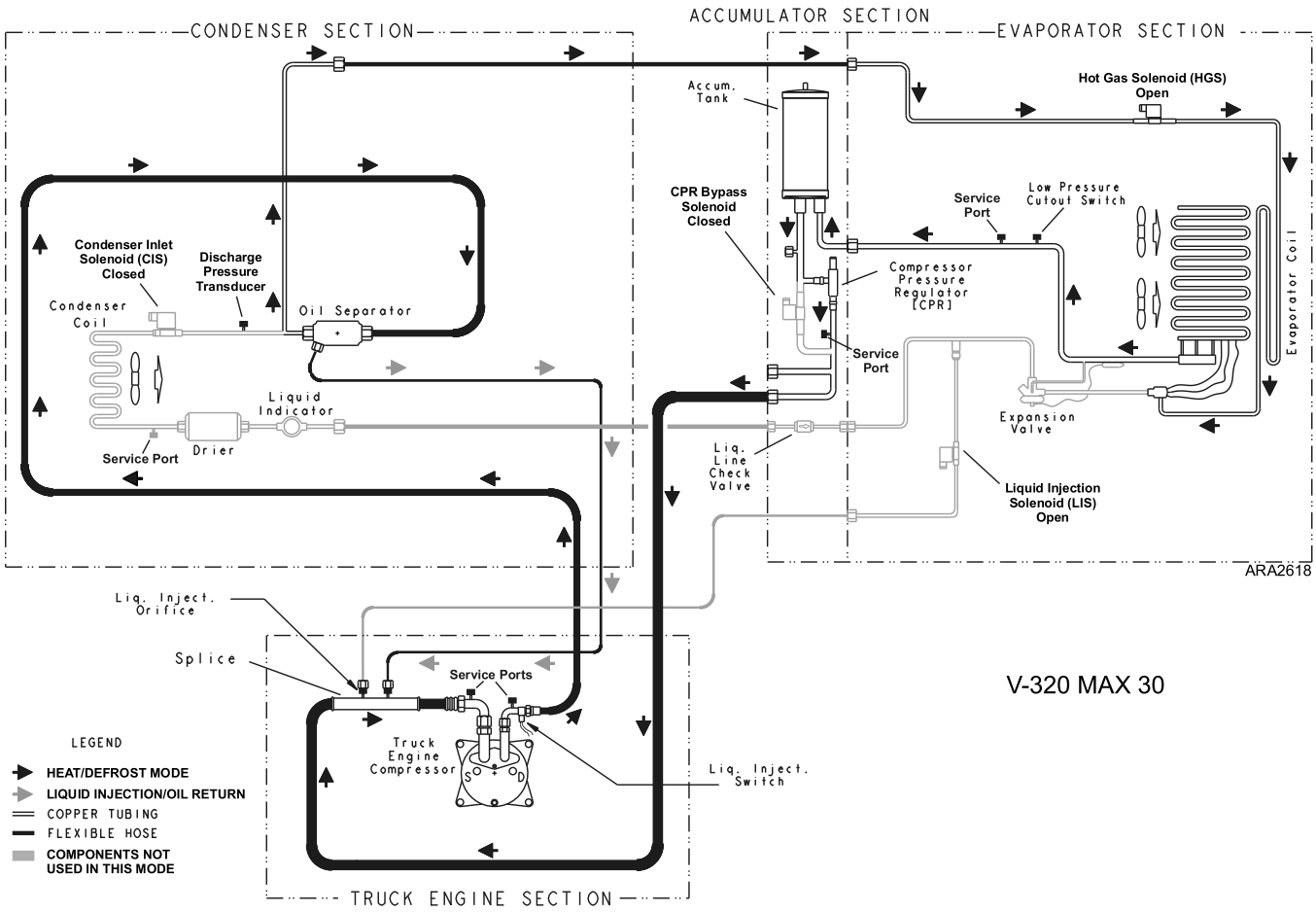
- If the temperature falls a pre-determined number of degrees, the unit restarts in Heat mode.
- If the temperature rises a pre-determined number of degrees, the unit restarts in Cool mode.

Heat Mode Model 30

High pressure refrigerant vapor leaves the compressor and flows through the oil separator where oil is separated and returned to the splice fitting in the suction line. The condenser inlet solenoid is closed and the hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the accumulator and the compressor pressure regulator because the CPR bypass solenoid is closed.

- Condenser Inlet Solenoid (CIS) – Closed/Energized. To control the discharge pressure the controller will open the CIS briefly if the discharge pressure rises to a certain level and will then close it when the discharge pressure drops to a lower level.
- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Line Check Valve – Closed
- Liquid Injection Solenoid (LIS) – Open/Energized
- CPR Bypass Solenoid – Closed/Energized

Figure 8. Heat Mode Model 30

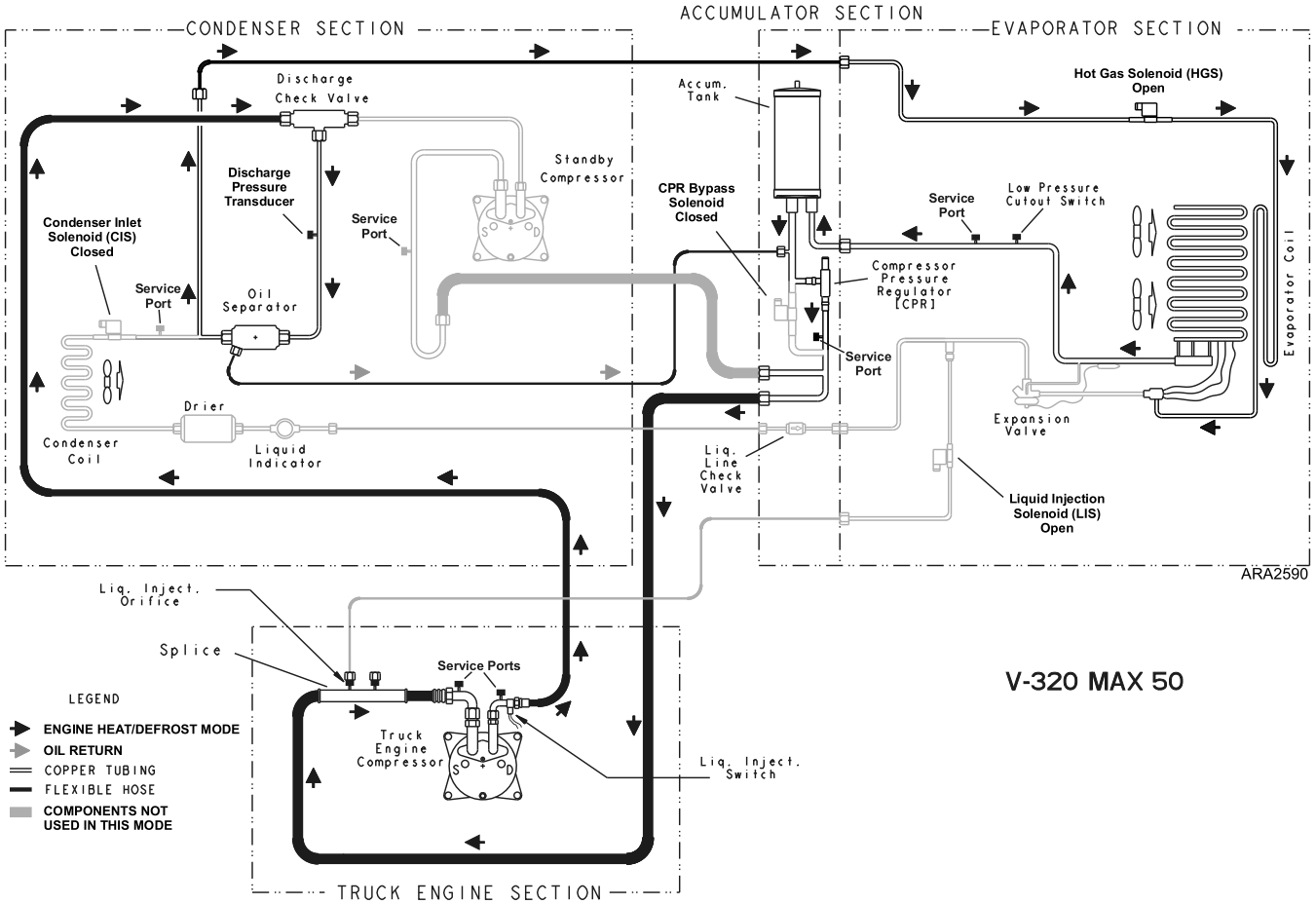


Heat Mode Model 50 Engine Operation

High pressure refrigerant vapor leaves the engine driven compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The condenser inlet solenoid is closed and the hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the accumulator and the compressor pressure regulator because the CPR bypass solenoid is closed.

- Discharge Check Valve – Open to engine driven compressor, closed to electric standby compressor
- Condenser Inlet Solenoid (CIS) – Closed/Energized. To control the discharge pressure the controller will open the CIS briefly if the discharge pressure rises to a certain level and will then close it when the discharge pressure drops to a lower level.
- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Line Check Valve – Closed
- Liquid Injection Solenoid (LIS) – Open/Energized
- CPR Bypass Solenoid – Closed/Energized

Figure 9. Heat Mode Model 50 Engine Operation

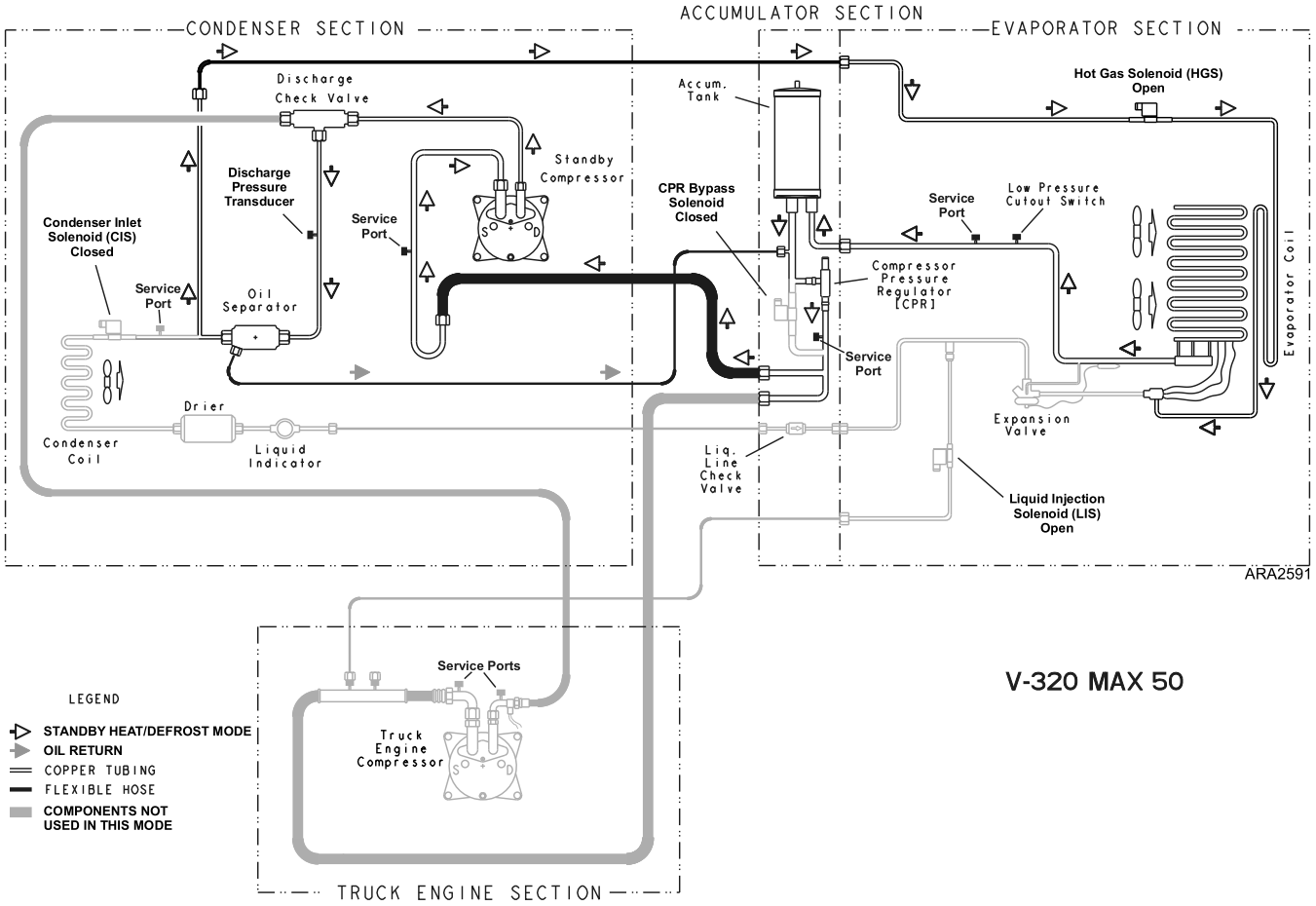


Heat Mode Model 50 Electric Standby Operation

High pressure refrigerant vapor leaves the electric standby compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The condenser inlet solenoid is closed and the hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the accumulator and the compressor pressure regulator because the CPR bypass solenoid is closed.

- Discharge Check Valve – Closed to engine driven compressor, open to electric standby compressor
- Condenser Inlet Solenoid (CIS) – Closed/Energized. To control the discharge pressure the controller will open the CIS briefly if the discharge pressure rises to a certain level and will then close it when the discharge pressure drops to a lower level.
- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Line Check Valve – Closed
- Liquid Injection Solenoid (LIS) – Open/Energized
- CPR Bypass Solenoid – Closed/Energized

Figure 10. Heat Mode Model 50 Electric Standby Operation



Defrost Mode

Defrost can be initiated any time the evaporator coil temperature is below 36 F (2.2 C), causing the defrost termination switch to close. Defrost is initiated automatically by the defrost timer, or manually using the In-Cab Control Box.

Defrost will continue until the evaporator coil temperature rises to 48 F (8.9 C) causing the defrost termination switch to open or the defrost termination timer has expired (whichever occurs first), ending the defrost cycle. Defrost cycle can be also terminated by pressing the On/Off Key to turn the unit off, and then pressing it again to turn the unit back on.

The drain hose heaters are also energized during defrost (if so equipped).

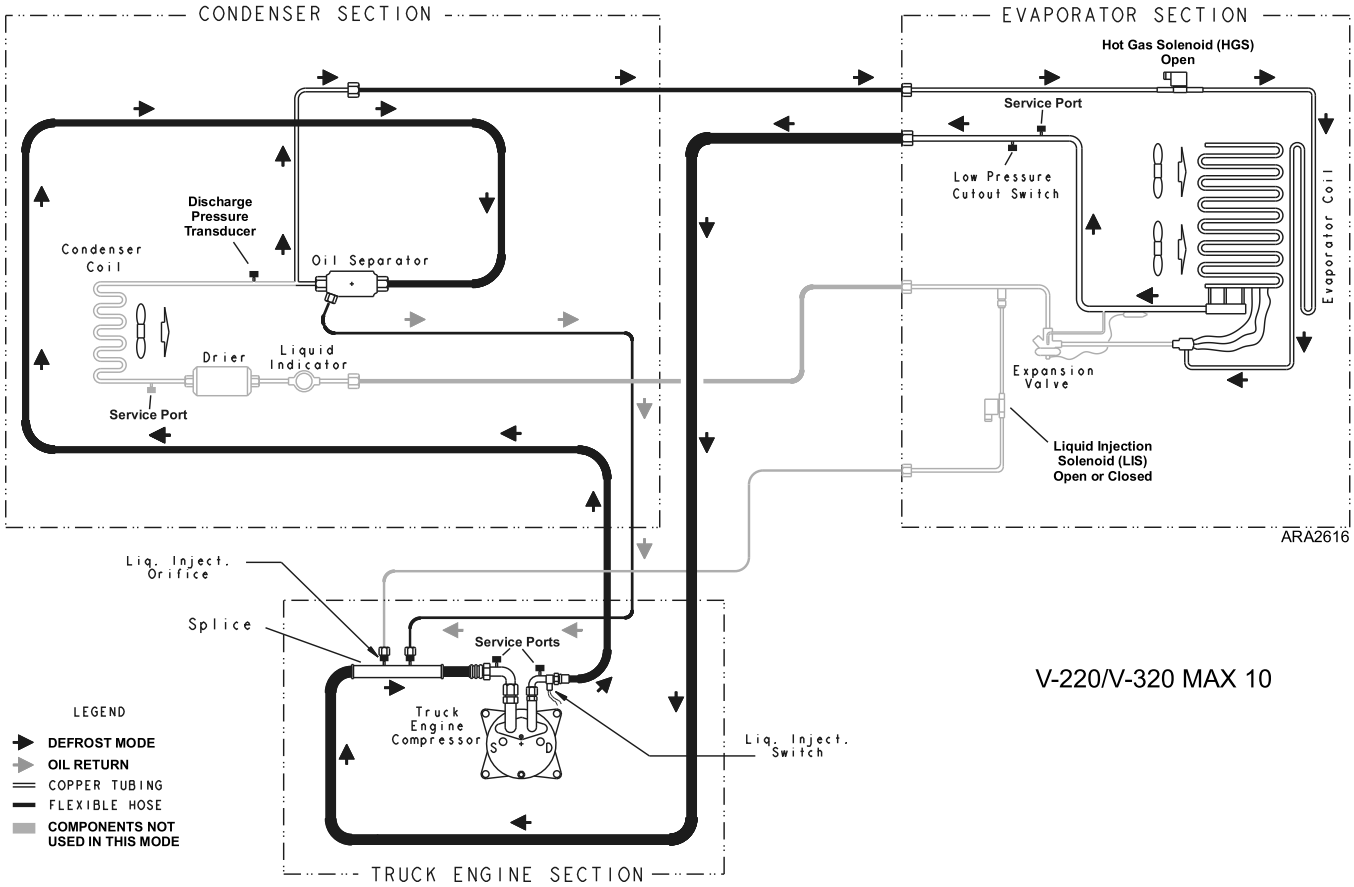
Defrost Mode Model 10

Note: *The following shows the Model 10 MAX unit. The standard Model 10 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the compressor and flows through the oil separator where oil is separated and returned to the splice fitting in the suction line. The hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the suction line.

- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) if the liquid injection switch closes.

Figure 11. Defrost Mode Model 10



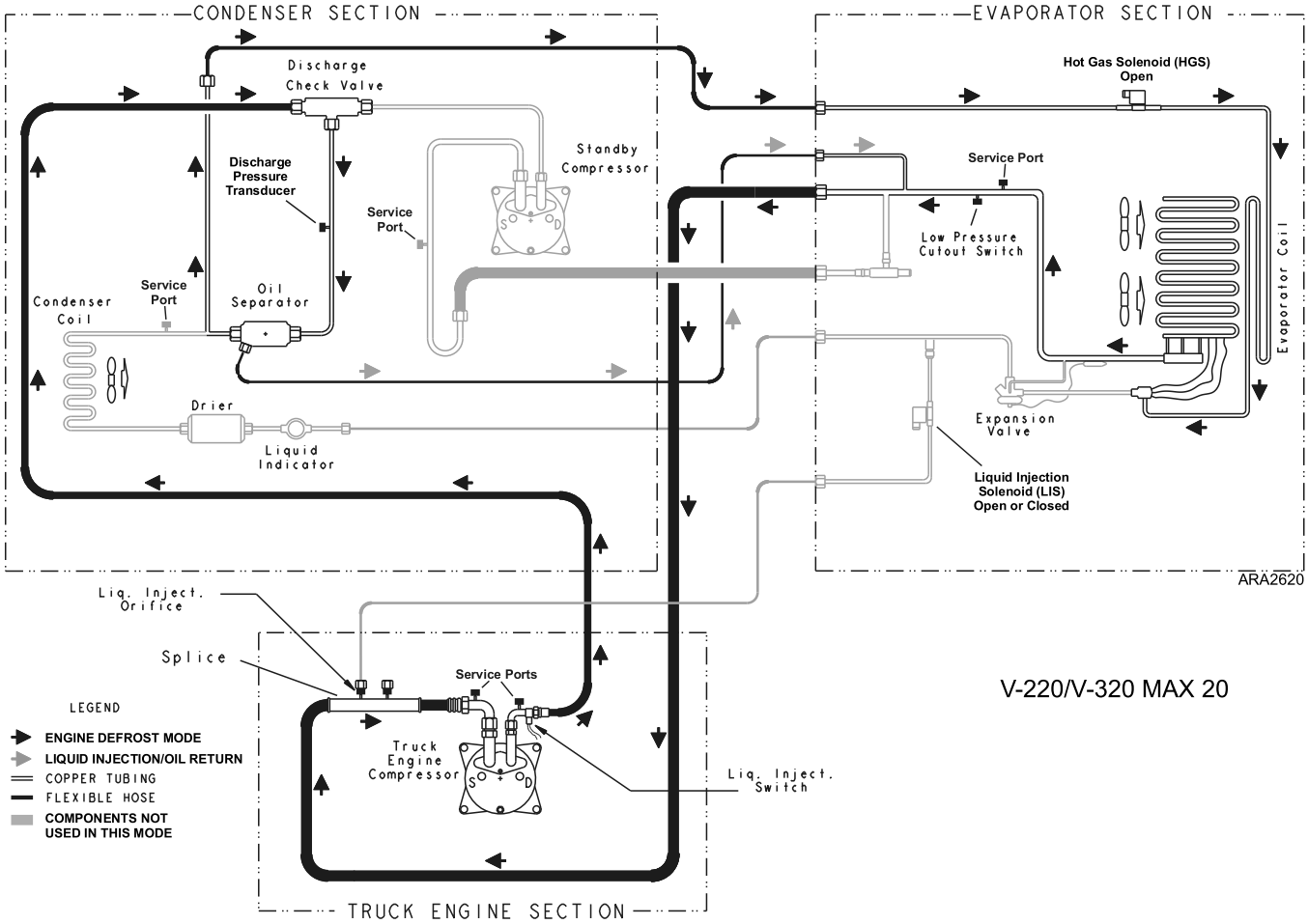
Defrost Mode Model 20 Engine Operation

Note: *The following shows the Model 20 MAX unit. The standard Model 20 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, splice fitting, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the engine driven compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The the hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the suction line.

- Discharge Check Valve – Open to engine driven compressor, closed to electric standby compressor
- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized, but will open (energize) if the liquid injection switch closes.

Figure 12. Defrost Mode Model 20 Engine Operation



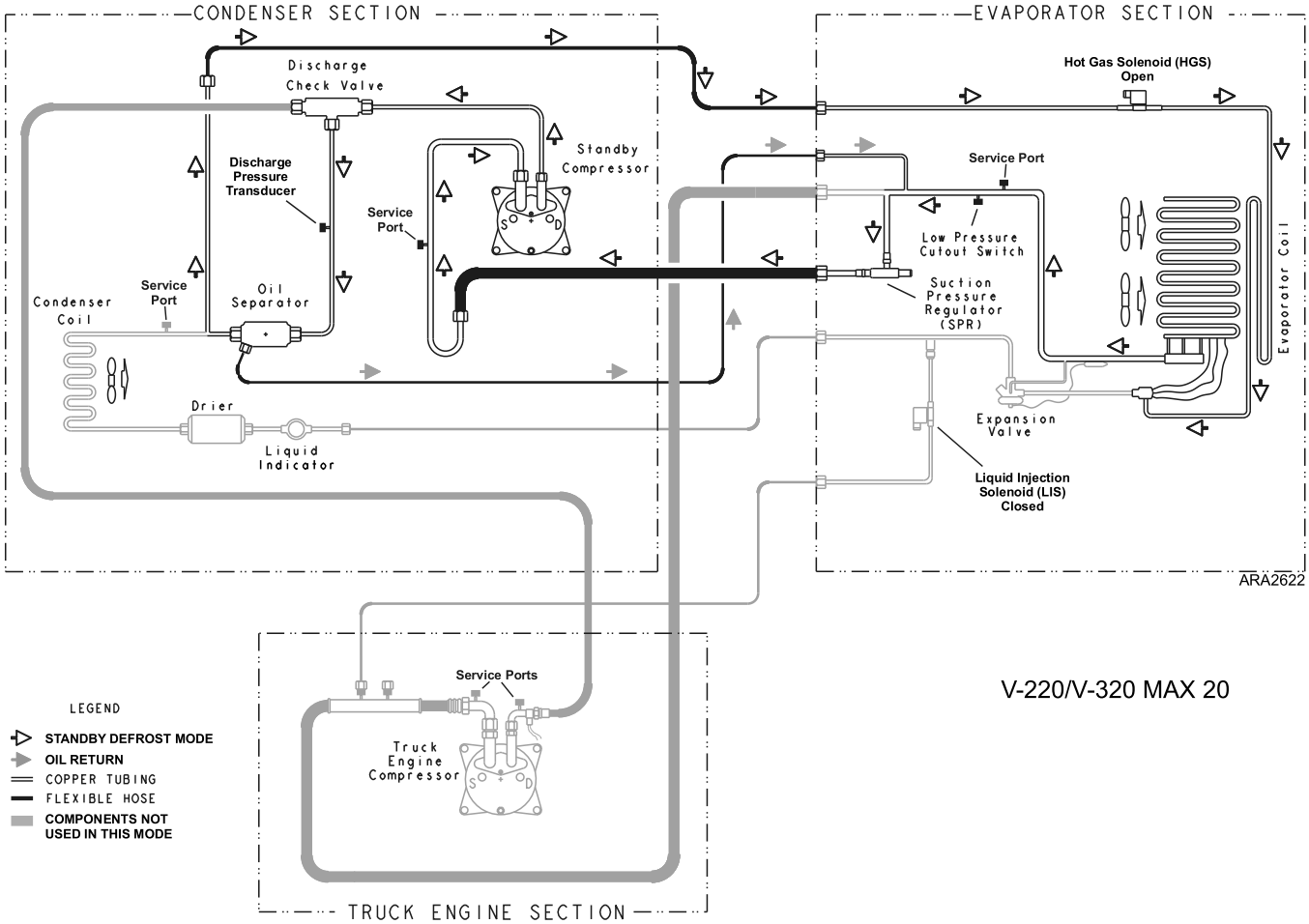
Defrost Mode Model 20 Electric Standby Operation

Note: *The following shows the Model 20 MAX unit. The standard Model 20 is similar but does not have the liquid injection system (liquid injection solenoid (LIS), liquid injection orifice, splice fitting, connecting lines, and liquid injection switch).*

High pressure refrigerant vapor leaves the electric standby compressor and flows through the discharge check valve and the oil separator where oil is separated and returned to a suction line. The hot gas solenoid is open so the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator. The refrigerant returns to the compressor through the suction pressure regulator.

- Discharge Check Valve – Closed to engine driven compressor, open to electric standby compressor
- Hot Gas Solenoid (HGS) – Open/Energized
- Liquid Injection Solenoid (LIS) – Closed/De-energized

Figure 13. Defrost Mode Model 20 Electric Standby Operation



Defrost Mode Model 30 and 50 Units

Defrost in Model 30 and 50 units is basically the same as Heat mode in Model 30 and 50 Units except the evaporator fans are not energized. The refrigerant flow is the same as shown previously in the Heat mode.

Serial Number Locations

CONDENSER: Nameplate located on the front inside edge of condenser frame.

Unit Components

Figure 14. Condenser

Figure 15. Evaporator

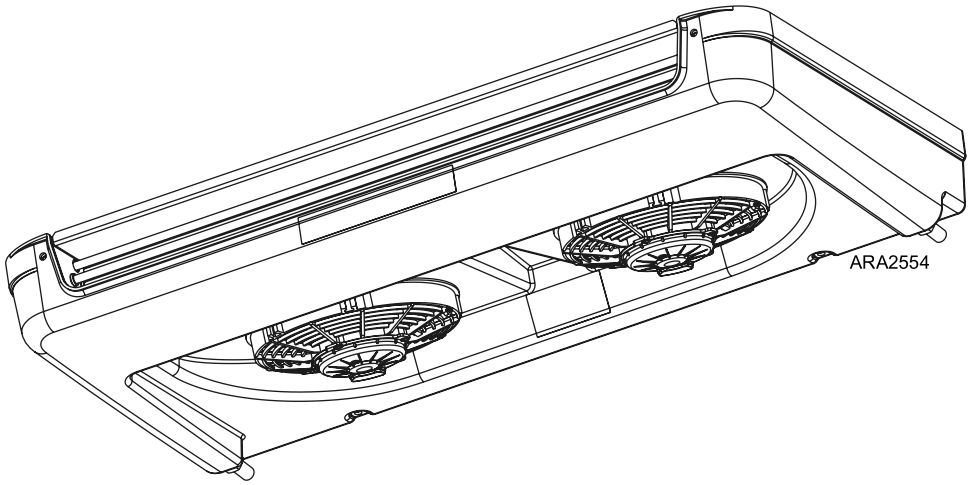
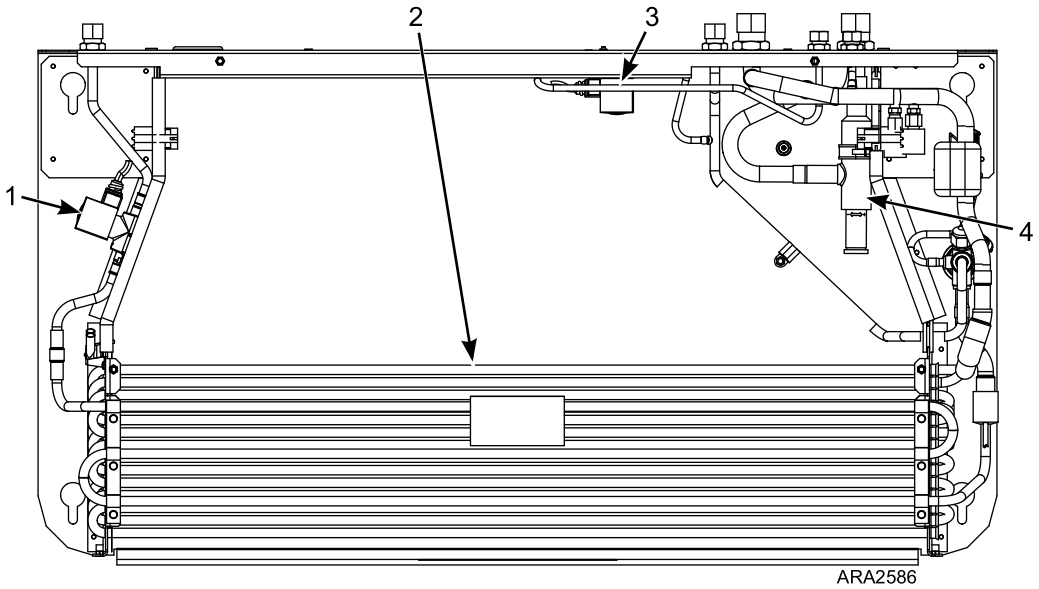
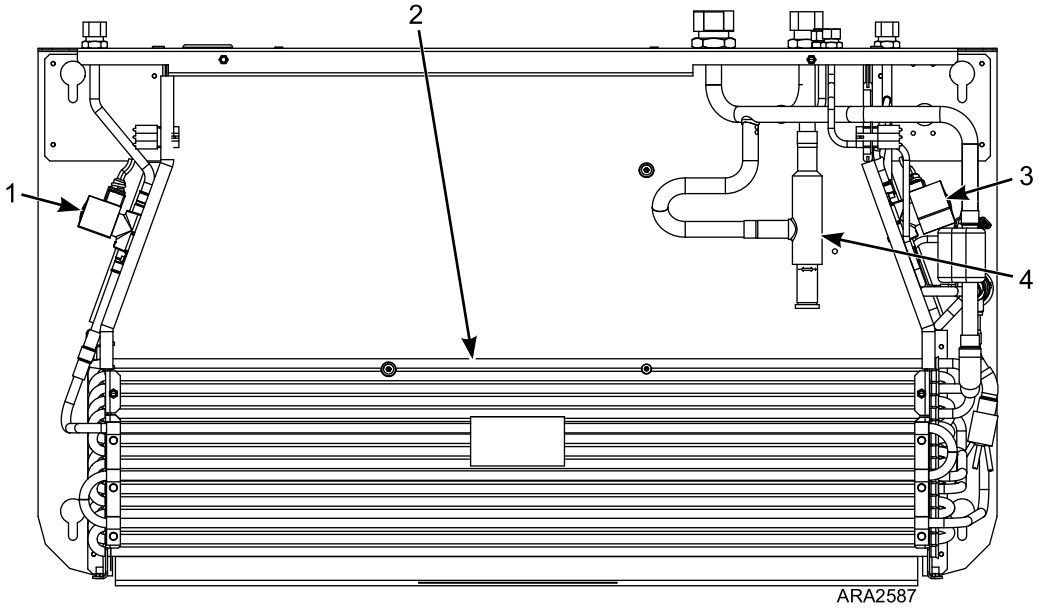


Figure 16. ES220 Evaporator with Covers Removed



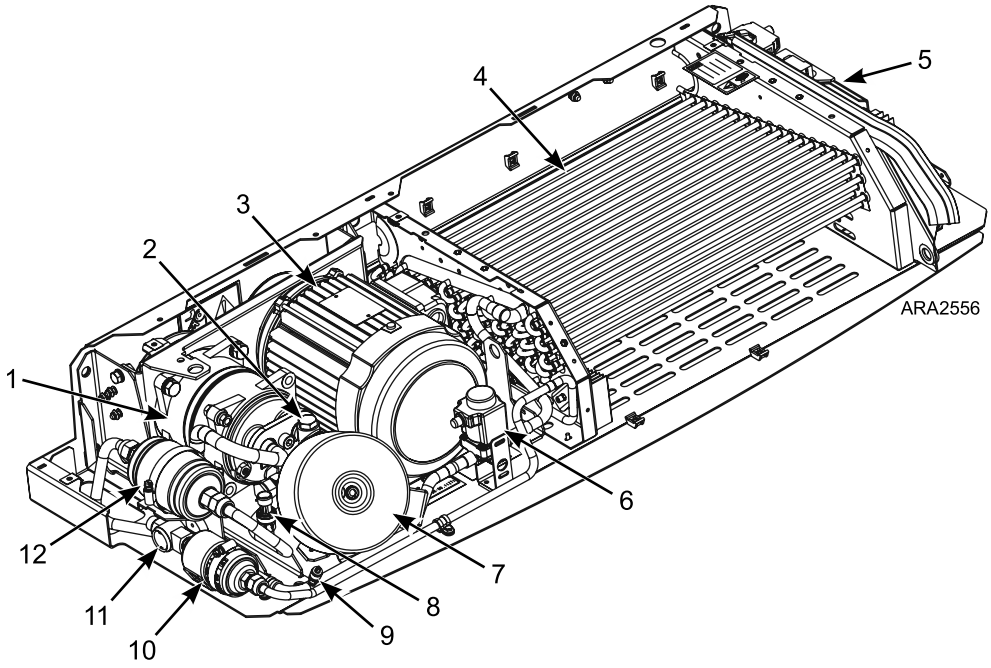
1.	Hot Gas Solenoid (HGS)	3.	Liquid Injection Solenoid (LIS) (MAX Units Only)
2.	Evaporator Coil	4.	Suction Pressure Regulator Valve (Model 20 MAX Units Only)

Figure 17. ES320 Evaporator with Covers Removed



1.	Hot Gas Solenoid (HGS)	3.	Liquid Injection Solenoid (LIS) (MAX Units Only)
2.	Evaporator Coil	4.	Suction Pressure Regulator Valve (Model 20 MAX Units Only)

Figure 18. Condenser with Covers Removed



1.	Electric Standby Compressor (Model 20 and 50 Only)	7.	Transformer (Model 20 and 50 Only)
2.	Discharge Check Valve (Model 20 and 50 Only)	8.	Discharge Pressure Transducer
3.	Electric Standby Compressor Motor (Model 20 and 50 Only)	9.	Discharge Service Port
4.	Condenser Coil	10.	Drier
5.	Control Box	11.	Liquid Line Sight Glass
6.	Condenser Inlet Solenoid (CIS) (Model 30 and 50 Only)	12.	Oil Separator

Maintenance Inspection Schedule

Note: *Thermo King reserves the right to deny warranty coverage on claims due to lack of maintenance or neglect. Claims in question must be supported by maintenance records.*

Note: *See the appropriate chapter in this maintenance manual for instructions on how to correctly perform required maintenance.*

Electrical

Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours	Inspect/Check/Service These Items
•				Check unit for any active alarms.
	•			Check unit for proper defrost operation.
		•		Inspect wiring harnesses and connectors.
		•		Check return air temperature sensor calibration.
			•	Inspect ground terminals.

Refrigeration/Heating

Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours	Inspect/Check/Service These Items
		•		Inspect moisture indicator and refrigerant level.
		•		Inspect refrigerant hoses.
		•		Inspect refrigerant hose connections for leaks.
			•	Check suction/compressor pressure regulator setting (20, 30, 50 MAX Models Only).
			•	Replace filter dryer.

Structural

Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours	Inspect/Check/Service These Items
•				Inspect exterior of evaporator and condenser.
•				Inspect evaporator air inlet and outlet for blockage (dirt, debris, cargo, etc.).
•				Inspect condenser air inlet and outlet for blockage (dirt, debris, etc.).
•				Adequate air space above and around cargo.
	•			Inspect evaporator drain hoses. (Verify water is not collecting in drain pan).
		•		Clean evaporator drain hoses.
		•		Clean evaporator and condenser coils. ***More frequent cleaning may be required based on operating environment (dusty conditions, etc.)***
		•		Inspect roadside (engine driven) compressor drive belt condition and tension.
		•		Inspect standby compressor drive belt condition and tension (20 and 50 Models Only).
			•	Inspect evaporator and condenser mounting hardware.

Electrical Maintenance

Maintenance Inspection Schedule

Inspect/Check/Service These Items	Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours
Check unit for any active alarms.	•			
Check unit for proper defrost operation.		•		
Inspect wiring harnesses and connectors.			•	
Check return air temperature sensor calibration.			•	
Inspect ground terminals.				•

⚠ WARNING

Risk of Injury!

Take precautions to ensure the unit will not accidentally start while you are servicing the system. Always turn off the On/Off Switch when inspecting or servicing any components.

Electronic Control System

Refer to the Direct Smart Reefer III Microprocessor Control System Diagnostic Manual TK 61096 for complete service information about Electronic Control System and the related components.

Defrost System

Defrost is initiated automatically by the programmable defrost timer, or manually by means of the In-Cab Control Box. If demand defrost is enabled, a demand defrost cycle occurs, based on the Defrost Initiation Timer (DIT) and the Defrost Termination Switch (DK1) being closed. The evaporator coil temperature must be below 36 F (2.2 C) to allow defrost.

When defrost is required, the microprocessor output energizes the hot gas solenoid to supply hot refrigerant to the evaporator coil and de-energizes the evaporator fans. The Defrost Initiation Timer (DIT) has counted-down its required time-setting, and the Defrost Termination Switch (DK1) is closed.

The unit remains in Defrost mode until the Defrost Termination Switch setpoint is reached (that is, when the evaporator coil temperature rises to 48.0 F (8.9 C), or until the Defrost Termination Timer (DTT) count is completed). If the evaporator coil temperature does not rise above 48.0 F (8.9 C) within the defrost duration time limit, the microprocessor terminates the defrost operation.

The startup of the evaporator fans is delayed for several seconds after Defrost mode ends to prevent water from the melting ice from being sprayed on the load.

Defrost initiation and termination settings are accessed through the Guarded Access Menu. Refer to the Direct Smart Reefer III Microprocessor Control System Diagnostic Manual TK 61096 for instructions on the use of Guarded Access Menu features.

The Defrost Initiation Timer offers programming choices of 0 to 480 minutes, in increments of 30 minutes. The factory setting is 240 minutes. This parameter allows maintenance personnel to set the Defrost Initiation Timer. When it times-out, it switches the unit from Cool mode to Defrost mode. The timer counts all the time that the unit is in Cool mode. The count resets when Defrost mode starts. If the timer is set at 0 (zero), this is a test position. Defrost mode starts in 15 seconds.

The Defrost Termination Timer offers programming choices of 5 to 50 minutes, in increments of 5 minutes. The factory setting is 30 minutes. This parameter allows maintenance personnel to set the Defrost Termination Timer, which begins counting from the initiation of a Defrost mode. When the timer times-out, the unit is switched from Defrost mode to Null mode. The timer resets at the end of a Defrost mode, or after the Defrost Termination Timer has timed-out. If the timer is set at 0 (zero), this is a test position. Defrost mode stops in 15 seconds.

Defrost Termination Switch

The switch is mounted in the evaporator coil and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 36 F (2.2 C), which allows the unit to enter the defrost cycle.

When the unit does shift into a defrost cycle, the evaporator fan stops, and heat from the hot refrigerant gas melts the frost from the evaporator coil. The switch opens and terminates the defrost cycle when the evaporator coil temperature rises above 48 F (8.9 C).

Defrost Termination Switch Replacement

Removal

1. Remove the evaporator cover, and disconnect the evaporator fan motor wires as needed.
2. Disconnect the wires from the switch.
3. Remove the mounting hardware and remove the switch.

Installation

1. Place the switch in position and install the mounting hardware.
2. Connect the wires to the switch.
3. Connect the evaporator fan motor wires if needed and install the evaporator cover.

Liquid Injection System (R-404A Units Only)

The liquid injection switch (LISW) is a temperature sensitive switch located on the discharge fitting of the truck engine compressor. When the discharge temperature rises above 230 ± 5 F (110 ± 3 C), the switch closes to open the liquid injection solenoid valve. When the discharge temperature falls below 200 ± 5 F (93 ± 3 C), the switch opens to close the liquid injection solenoid valve.

Testing Liquid Injection Solenoid Valve and Metering Orifice

1. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the LISW at the compressor.
2. Install a gauge manifold set on the engine driven compressor.
3. Set thermostat on the lowest setting.
4. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
5. Place a jumper between LIS and CLU wires in the 2-pin connector on the main wire harness that was disconnected in step 1. This simulates that the discharge temperature is higher than 230 F (110 C).
6. With the jumper wire in place the suction pressure should rise.
7. Remove the jumper. The suction pressure should return to the stabilized pressure in step 4.
8. If the suction pressure does not change, check the CLU wire for voltage, the LIS wire for continuity, the resistance of the liquid injection solenoid valve coil, and the metering orifice. See the Specifications chapter for the solenoid coil resistance.
9. Shut off the unit and the truck, remove the gauge manifold set, and reconnect the LIS and CLU wires to the LISW.

Testing Liquid Injection Switch (LISW)

1. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the LISW at the compressor.
2. Check the continuity of the LISW. It should be open at temperatures below 230 ± 5 F (110 ± 3 C).
3. Install a gauge manifold set on the engine driven compressor.
4. Set thermostat on the lowest setting.
5. Start and run the unit in Cool on the engine driven compressor.
6. Cover the condenser to raise the discharge pressure and temperature.
7. Monitor the discharge temperature with a non-contact thermometer such as P/N 2041059, and monitor the continuity of the LISW. When the discharge temperature rises to 230 ± 5 F (110 ± 3 C) the LISW should close.
8. Shut off the unit and the truck, and continue to monitor the discharge temperature and the continuity of the LISW. When the discharge temperature falls to 200 ± 5 F (93 ± 3 C) the LISW should open.
9. Remove the gauge manifold set, and reconnect the LIS and CLU wires to the LISW.

Liquid Injection Switch (LISW) Replacement

Removal

1. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the LISW at the compressor.
2. Remove the metal spring clip that holds the plastic clip of the LISW to the discharge fitting on the compressor.
3. Remove the LISW from the discharge fitting on the compressor.

Installation

Refer to Liquid Injection Temperature Sensor Installation Procedures in Section 5 – Compressor Selection and Installation Standards of the Vehicle Powered Truck Installation Standards and Procedures TK 56430 for detailed information about installing the LISW.

1. Inspect the alignment of sensing pad with respect to plastic clip of the LISW. The curves in the two parts should be perfectly aligned with each other.
2. Clip the LISW onto the straight portion of the compressor discharge fitting.

3. Verify the temperature sensing pad is touching the fitting by looking down the fitting. If a gap is present, thermal paste should be applied between the fitting and the temperature sensing pad. This will ensure the correct temperature is being read.
4. Place the metal spring clip over the plastic clip to ensure the LISW stays on the fitting.
5. Connect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the LISW at the compressor.

Condenser Fan Motor

Note: *Non-repairable fan motor assemblies are used. If a motor malfunctions, it must be replaced.*

⚠ WARNING

Risk of Injury!

Take precautions to ensure the unit will not accidentally start while you are servicing the system. Always turn off the On/Off Switch when inspecting or servicing any components.

The condenser fan motors are maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured while proper voltage is applied. The current draw for a condenser fan motor is approximately 10.0 to 10.8 amps at 13 volts.

If the condenser fan motor does not run at all, check the fuses in the condenser fan motor circuit and the output to the condenser fan when it should be energized.

Condenser Fan Motor Removal and Installation

Removal

1. Turn the unit off.
2. Remove the condenser cover and fan shroud.
3. Remove the fan guard / motor mounting screws (4).
4. Lift the fan motor and disconnect the motor power plug.
5. Remove the fan motor from the condenser.

Installation

1. Connect the fan motor power plug.
2. Place the fan motor in the fan shroud. Install and tighten the fan motor mounting screws (4).
3. Install the fan shroud and condenser cover.
4. Start the unit and verify correct fan motor operation.

Evaporator Fan Motors

Note: *Non-repairable fan motor assemblies are used. If a motor malfunctions, it must be replaced.*

⚠ WARNING

Risk of Injury!

Take precautions to ensure the unit will not accidentally start while you are servicing the system. Always turn off the On/Off Switch when inspecting or servicing any components.

The evaporator fan motors are maintenance free. If erratic or intermittent operation is observed, the current draw of the motor should be measured while proper voltage is applied. The current draw for a evaporator motor is approximately 7.3 to 7.9 amps at 13 volts.

If any of the evaporator fan motors do not run at all, check the fuses in the evaporator fan motor circuits and the outputs to the evaporator fans when they should be energized.

Evaporator Fan Motor Removal and Installation

Removal

1. Turn the unit off.
2. Remove the fan motor mounting clips (4).
3. Disconnect the motor power plug.
4. Remove the fan motor.

Installation

1. Connect the fan motor power plug.
2. Attach the fan motor to the evaporator and tighten the fan motor mounting clips (4).
3. Ensure the wires do not contact the fan blades inside the evaporator.
4. Start the unit and verify correct fan motor operation.

Drain Line Heaters – DH1 and DH2

Drain line heaters are used on MAX units to prevent ice build-up in the evaporator drain pan and drain hoses. They are activated when the defrost termination switch is closed.

Check the operation of a drain line heater as follows:

1. Set the thermostat on the lowest setting.
2. Start and run the unit in Cool on the engine driven compressor until the return air temperature is below 32 F (0 C).

3. Disconnect the 2-pin wire connector from the drain line heater and check for 12 Vdc between the 27/27A and CH1/CHN wires.
   - If voltage is present, check the resistance of the drain line heater. It should be approximately 14.0 ohms.
   - If voltage is not present, Check the continuity of the 27/27A circuit back to the ECM, Fuse F6, and the continuity of the CH1/CHN circuit to ground.

Drain Line Heater Replacement

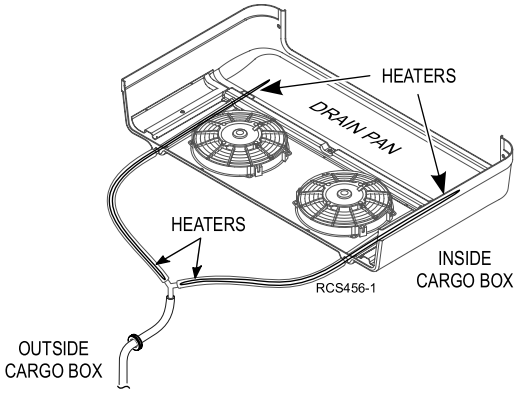
Removal

1. Remove the evaporator cover and disconnect the evaporator fan motor wires.
2. Disconnect the drain line heater wires from the wire harness.
3. Remove the heater wires from the drain hose.

Installation

1. Insert the heater wires into the drain hose drain hose as far as they will go. Note the following:
   - Heater wires must extended into drain pan and be inserted into each drain hose as far as they will go.
   - NEVER CUT HEATER RESISTANCE WIRES!
   - DO NOT install more than one heater wire into each drain tube.
   - DO NOT use band wraps to hold heater wires.
   - DO NOT cover or wrap heater wires.
   - DO NOT pinch the end of the heater wires tight.

Figure 19. Drain Line Heater Installation

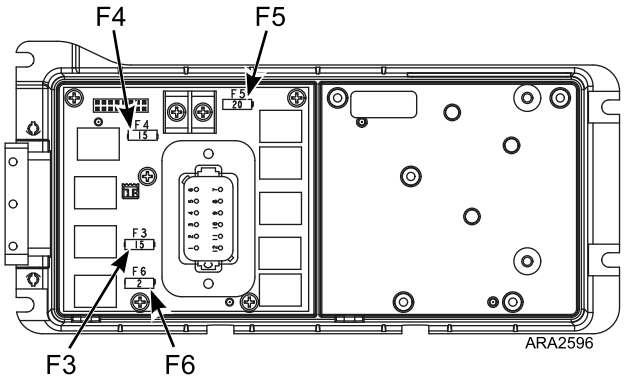


2. Connect the drain line heater wires to the wire harness.
3. Connect the evaporator fan motor wires and install the evaporator cover.

Fuses

Controller Fuses: These fuses are located on the controller.

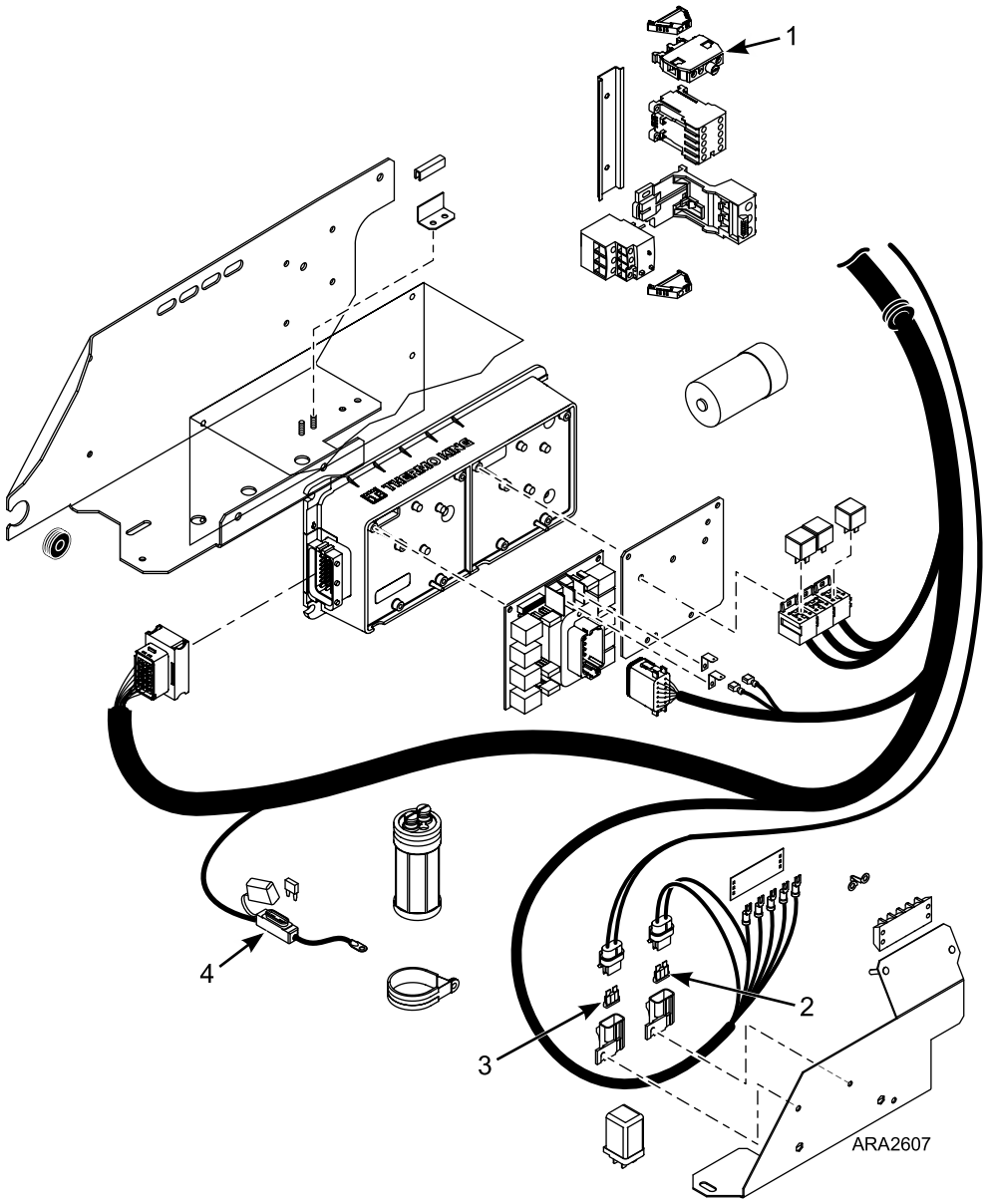
Figure 20. Controller Fuses



F3.	Fuse F3 - 15 amps	F5.	Fuse F5 - 20 amps
F4.	Fuse F4 - 15 amps	F6.	Fuse F6 - 2 amps

Control Box Fuses: These fuses are located inside the control box and are not on the controller.

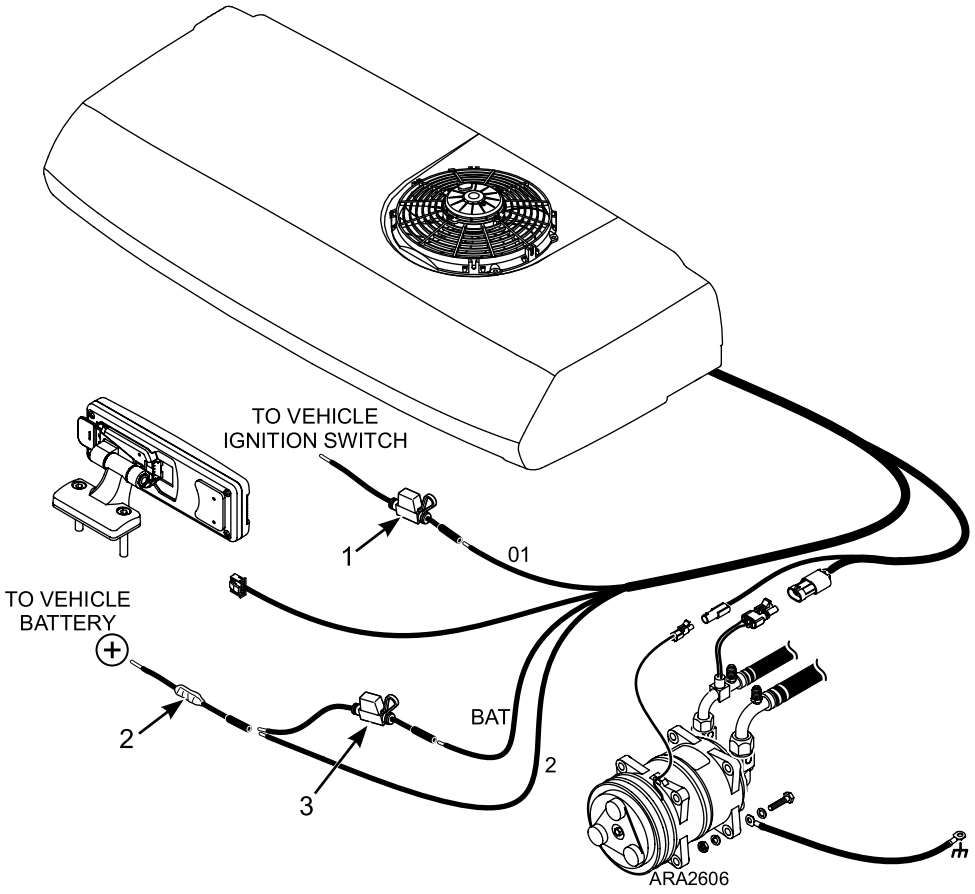
Figure 21. Control Box Fuses



1.	Fuse F20 - 5 amps (Model 20 and Model 50 only)	3.	Fuse 26 - 15 amps (Electric Heat Option only)
2.	Fuse F30 - 20 amps	4.	Fuse F16 - 5 amps (Model 20 and Model 50 only)

Harness Fuses: These fuses are located in wiring harnesses outside of the control box.

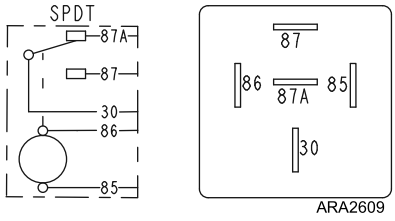
Figure 22. Harness Fuses



1.	Fuse F14 - 4 amps	3.	Fuse F15 - 4 amps
2.	Fuse F21 - 60 amps		

Relays

Figure 23. Single Pole Double Throw (SPDT) Relay



Relay Testing

A relay is energized when 12 Vdc power is applied to the relay coil across pins 85 and 86. When energized the normally open (NO) contacts close and the normally closed (NC) contacts open.

1. Remove covers as needed to access the relays.
2. To check the battery power relay, turn the truck ignition switch on. To check the electric standby power relay and the battery disconnect relay, connect the unit to an appropriate electric standby power supply.
3. Remove the relay from its socket and check for 12 Vdc between pins 85 and 86 in the relay socket. If voltage is not present, check the circuits that supply power and ground to the relay coil.
4. Check the resistance between pins 85 and 86 on the relay. It should be approximately 90 ohms. If not, replace the relay.
5. On a SPDT relay, check the NC contacts by checking for continuity between pins 30 and 87A. If the continuity is not acceptable, replace the relay.
6. Use jumper wires and a 12 Vdc power supply to attached to pins 85 and 86 to energize the relay.

7. Check the NO contacts by checking for continuity between pins 30 and 87. If the continuity is not acceptable, replace the relay.

Relay Replacement

1. Turn the truck ignition switch off and disconnect the electric standby power supply if applicable.
2. Remove covers as needed to access the relays.
3. Remove the relay from its socket.
4. Insert the new relay into the relay socket.
5. Reinstall any covers that were removed.

Diode Assemblies

Diode Assemblies V220 V320

LIS Diode Assembly (R-404A Units Only)

The LIS diode assembly uses two diodes in a rectifier to isolate the LIS and 26A circuits from each other.

- Diode D4 prevents the 26A circuit from energizing the engine driven compressor clutch (CLU1).
- Diode D5 prevents the LIS circuit from energizing the 26A circuit.

BYPS Diode Assembly (Model 30 and Model 50 Units Only)

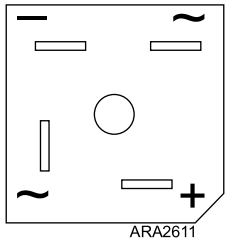
The BYPS diode assembly uses two diodes in a rectifier to isolate the CMC and 26 circuits from each other.

- Diode D2 prevents the 26 circuit from energizing the compressor motor contactor (CMC).
- Diode D3 prevents the CMC circuit from energizing the 26 circuit.

Diode Assembly Testing

1. Disconnect the wires from the diode assembly to remove it from the circuit. Note which wires are attached to which terminals so they can be reattached correctly.
2. Use the diode function on a digital multimeter to test each diode. There is a diode between each of the ~ terminals and the + terminal.
    a. A diode should have low resistance with the positive (+) test lead on the ~ terminal and the negative (–) test lead on the + terminal.
    b. A diode should have high resistance with the negative (–) test lead on the ~ terminal and the positive (+) test lead on the + terminal.
3. Replace the diode assembly if either of the diodes fails either of these tests

Figure 24. Diode Assembly



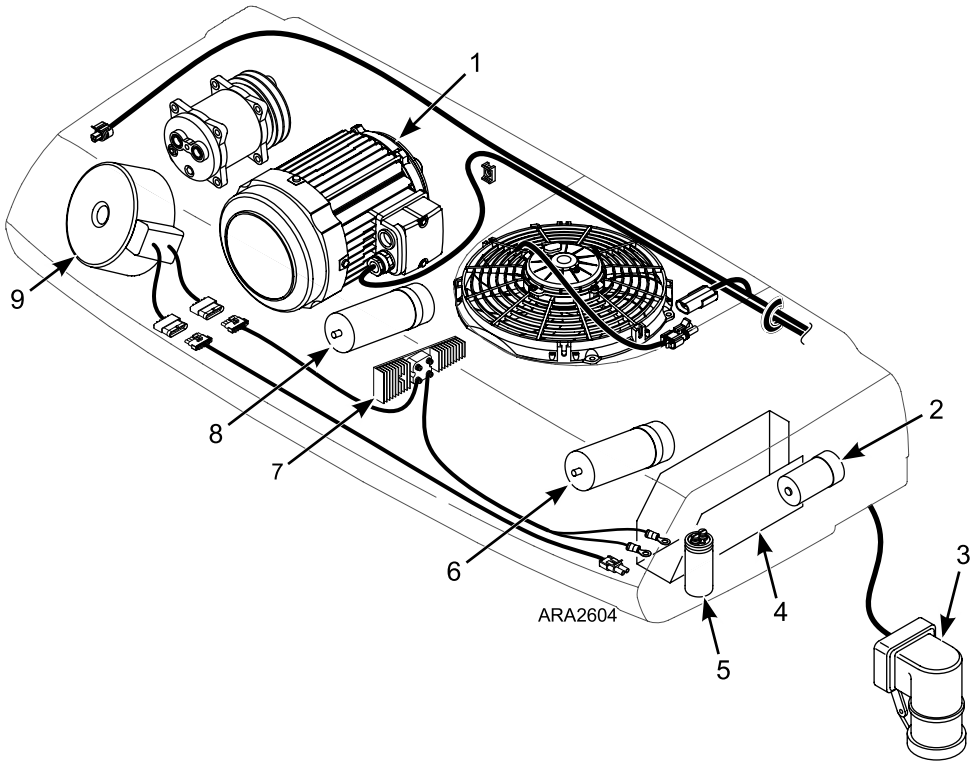
AC Components Model 20 and Model 50 Units Only

⚠ WARNING

Hazardous Voltage!

Model 20 and Model 50 units use high voltage AC for electric standby operation. Lethal voltage potentials can exist on connections in the high voltage circuits. Take appropriate precautions and use extreme care when testing the unit.

Figure 25. AC Components in Condenser



1.	Electric Standby Compressor Motor	6.	Electric Motor Run Capacitor 2 (115/1/60 units only)
2.	Electric Motor Start Capacitor (115/1/60 and 208-230/1/60 units only)	7.	Rectifier and Heat Sink Assembly
3.	Electric Standby Power Receptacle	8.	Electric Motor Run Capacitor 1 (115/1/60 units only) Electric Motor Run Capacitor (208-230/1/60 units only)
4.	Control Box	9.	Transformer
5.	Smoothing Capacitor		

Electrical Contactors

Test the contact points by checking the voltage drop across each set of points when the contactor is energized and the system is operating. If the voltage drop across a set of points is more than 0.25 Vac, replace the contactor.

Test the contactor coil as follows:

1. Check the voltage to the coil. It should be at approximately 12 Vdc. If not, check for an open circuit.
2. Check the voltage after the coil. It should be 0 volts. If not, check for an open or high resistance in the circuit to ground. If the voltage is 0 but the contactor does not pull-in, the coil is probably open. Check the resistance to verify. It should be approximately ohms.

Compressor Motor Contactor – CMC

This contactor provides the AC power to the compressor motor overload relay. It is energized for Electric Standby Operation.

Compressor Motor Contactor Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove the condenser cover.
3. Disconnect the wires from the compressor motor contactor. Note which wires are attached to which terminals so they can be reattached correctly.
4. Remove the compressor motor contactor mounting hardware and remove the compressor motor contactor.

Installation

1. Place the compressor motor contactor in position and install the mounting hardware.
2. Connect the wires to the compressor motor contactor. Make sure to connect the wires to the same terminals from which they were removed.
3. Reinstall the condenser cover.

Electric Heat Contactor – HC (Model 20 Option Only)

This contactor only used on Model 20 units with the Electric Heat Option. It provides AC power to the electric heat element. It is energizes in the Heat Mode during Electric Standby Operation.

Electric Heat Contactor Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove the condenser cover.
3. Disconnect the wires from the electric heat contactor. Note which wires are attached to which terminals so they can be reattached correctly.
4. Remove the electric heat contactor mounting hardware and remove the electric heat contactor.

Installation

1. Place the electric heat contactor in position and install the mounting hardware.
2. Connect the wires to the electric heat contactor. Make sure to connect the wires to the same terminals from which they were removed.
3. Reinstall the condenser cover.

Compressor Motor Overload Relay – OL

The compressor motor overload relay protects the compressor motor. It opens the circuit to the compressor motor if the current exceeds the overload relay setting. The overload relay resets automatically. The overload relay setting depends on the voltage and phase configuration of the unit (see the Specifications chapter).

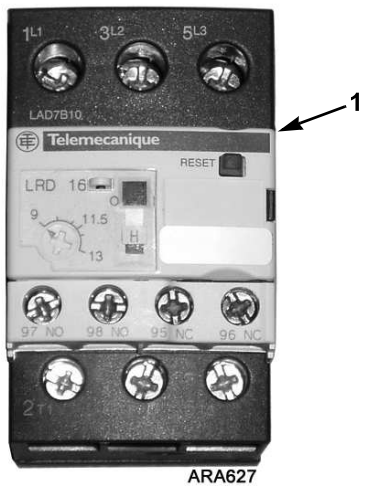
Compressor Motor Overload Relay Replacement

Set Up

When an overload relay is replaced, the new overload relay must be set up to open at the correct amperage and reset automatically. See the following procedure to set up a new overload relay.

1. Open the clear plastic cover.

Figure 26. Open Cover

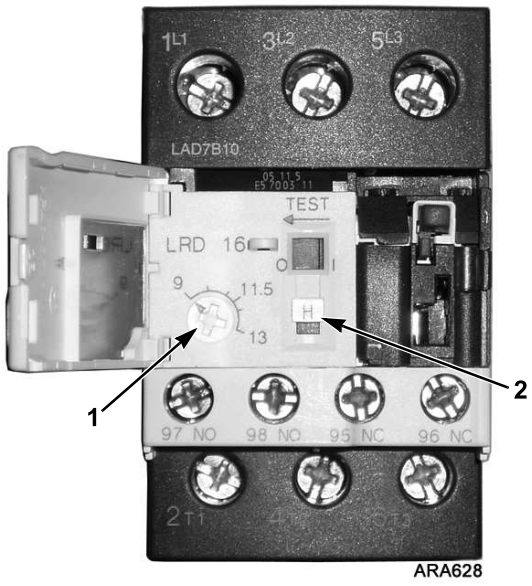


1.	Lift Here to Open Cover

2. Use a small screwdriver to set the opening amperage. See the Specifications chapter for the correct overload relay setting.

3. Use a small screwdriver to remove the tab marked with an "H" to access the switch used to set the overload relay to reset automatically.

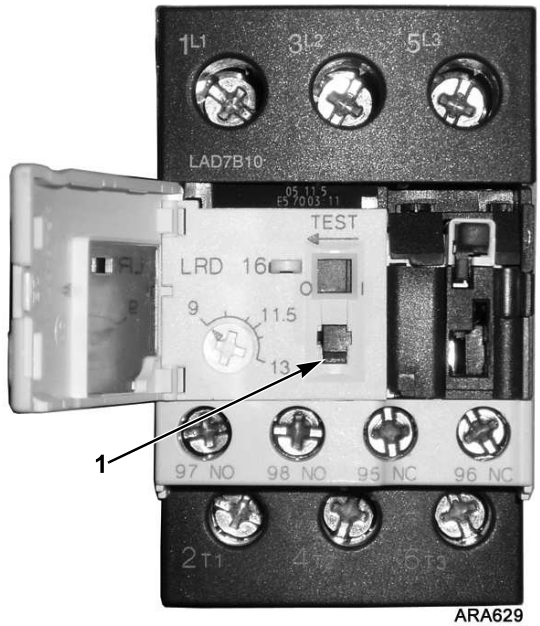
Figure 27. Set Amperage and Remove Tab



1.	Set Opening Amperage
2.	Remove Tab Marked "H"

4. Move the slide switch down until it clicks into place at the bottom of the slot (from which the tab marked "H" was removed). This sets the overload relay to reset automatically.

Figure 28. Move Switch Down



1.	Switch Clicks into Place at Bottom of Slot

The new overload relay is now set up correctly. Note which wires go to which terminals when removing the old overload relay so the wires are connected correctly when the new overload relay is installed.

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove the condenser cover.
3. Disconnect the wires from the compressor motor overload relay. Note which wires are attached to which terminals so they can be reattached correctly.
4. Remove the compressor motor overload relay mounting hardware and remove the compressor motor overload relay.

Installation

1. Place the compressor motor overload relay in position and install the mounting hardware.
2. Connect the wires to the compressor motor overload relay. Make sure to connect the wires to the same terminals from which they were removed.
3. Reinstall the condenser cover.

Transformer – T1

The transformer converts 115 Vac or 230 Vac to 12 Vac to provide power to the bridge rectifier. The bridge rectifier converts the 12 Vac to 12 Vdc to supply power to the 12 Vdc control circuits.

Transformer Testing

Test the transformer as follows:

1. Disconnect the 6-pin connector in the wire harnesses to the transformer.
2. Connect the electric standby power receptacle to an appropriate AC power supply.
3. Check for AC voltage between the H1 and H2 wires in the 6-pin connector.
4. Approximately 115 or 230 Vac (depending on input voltage) should be present between H1 and H2. If not, check the continuity of the H2 wire to the CMC, the continuity of the H1 wire to fuse F20, fuse F20, the continuity of the L1 wire to the CMC, the continuity of the standby power harness, and the power supply.
5. Disconnect the AC power supply.
6. Reconnect the 6-pin connector in the wire harnesses to the transformer.
7. Reconnect the AC power supply.
8. Check for AC voltage between the X1 and X4 wires at the rectifier.

9. Approximately 12 Vac should be present between X1 and X4. If not, check the continuity of the X1 and X4 wires to the transformer. If the X1 and X4 wires have continuity, the transformer is probably defective.

Transformer Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove the condenser cover.
3. Disconnect the wire harnesses connected to the transformer.
4. Remove the transformer mounting hardware and remove the transformer.

Installation

1. Place the transformer in position and install the mounting hardware.
2. Connect the wire harnesses to the transformer.
3. Reinstall the condenser cover.

Bridge Rectifier – BR

The bridge rectifier converts the 11.7 Vac power from the transformer to 11.7 Vdc to supply power to the 12 Vdc control circuits. The bridge rectifier is located on a heat sink below the left side of the condenser coil when viewed from the front of the condenser.

Test the bridge rectifier as follows:

1. Connect the electric standby power receptacle to an appropriate AC power supply.
2. Check for AC voltage between the X1 and X4 wires at the rectifier.
3. Approximately 12 Vac should be present between X1 and X4. If not, check the continuity of the X1 and X4 wires to the transformer, the transformer, and the AC circuits back to the power supply.
4. Check the rectifier output voltage (DC) between the 2R wire and the CH wire at the rectifier. If this voltage is less than approximately 12 Vdc the rectifier bridge is defective.

Capacitors

Several capacitors are used in Model 20 and Model 50 units.

- Smoothing Capacitor (all voltages)
- Electric Motor Run Capacitor (one used in 208-230/1/60 units, two used in 115/1/60 units)
- Electric Motor Start Capacitor (115/1/60 and 208-230/1/60 units)

⚠ WARNING

Hazardous Voltage w/Capacitors!

Be careful when working with electrical circuits that contain capacitors. Some capacitors hold a significant electrical charge that might cause burns or shocks if accidentally discharged. Capacitors must be discharged before working on electrical circuits.

To safely discharge a capacitor: Turn the unit off and disconnect the electric standby power supply. Connect a 20,000 ohm, 5-watt resistor across the capacitor terminals for five seconds. Use a multimeter to confirm the capacitor is fully discharged.

Capacitor Testing

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove covers as needed to access the capacitor.
3. Visually check the capacitor for leaks, cracks, bulges or other signs of damage. If any damage is apparent, replace the capacitor.
4. Discharge the capacitor as described above.
5. Disconnect the wires from the capacitor to remove it from the circuit.
6. Use a digital multimeter such as a Fuke 77 set to the Capacitance Measurement Mode.
7. Connect the multimeter test leads to the capacitor terminals and keep them connected for a few seconds to allow the multimeter to obtain a reading.
8. The capacitance should be within 10% of the value listed in the Specifications chapter. If not, replace the capacitor.
9. Reconnect the wires that were disconnected and reinstall any covers that were removed when finished with the test.

Capacitor Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove covers as needed to access the capacitor.
3. Discharge the capacitor as described above.
4. Disconnect the wires from the capacitor.
5. Remove the capacitor mounting hardware and remove the capacitor.

Installation

1. Place the capacitor in position and install the mounting hardware.
2. Connect the wires to the capacitor.
3. Reinstall any covers that were removed.

Start Relay – SR

The start relay is a normally closed (NC) single pole single throw (SPST) relay. It is used to open the circuit between the start capacitor (SC) and the C1 circuit when the compressor motor gets up to speed after the compressor motor contactor (CMC) is energized to supply AC power to the compressor motor.

Start Relay Testing

1. Turn the unit off and set thermostat so the unit will run in Cool.
2. Connect the electric standby power receptacle to an appropriate AC power supply.
3. Remove covers as needed to access the start relay.
4. Remove the cover from the start relay.
5. Turn the unit on and watch the start relay to see if it energizes. If not, check for AC voltage between the T1-02 and the C1-03 wires at the B and J terminals on the start relay. If AC voltage is not present, check the continuity of the T1-02 wire to the overload relay, and check the continuity of the C1-03 wire and the C1 circuits to the U2 terminal on the compressor motor.
6. Turn the unit off and disconnect the AC power supply.
7. Disconnect the wires from the start relay.
8. Check for continuity between pins P and J on the start relay. If the continuity is not acceptable, replace the start relay.
9. Check the coil resistance between pins P and J on the start relay. If the resistance not acceptable (see Specifications chapter), replace the start relay.

Start Relay Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove covers as needed to access the start relay.
3. Remove the relay from its socket.
4. Disconnect the wires from the start relay. Note which wires are attached to which terminals so they can be reattached correctly.
5. Remove the start relay mounting hardware and remove the start relay.

Installation

1. Place the start relay in position and install the mounting hardware.
2. Connect the wires to the start relay. Make sure to connect the wires to the same terminals from which they were removed.
3. Reinstall any covers that were removed.

Compressor Motor

Testing 115/1/60 Units

1. Connect the electric standby power receptacle to an appropriate AC power supply.
2. Set the thermostat so the unit will run in Cool.
3. Start the unit and run it in Cool on electric standby.
4. Check for AC voltage between the T1A and T2A wires at the compressor motor contactor.
5. Approximately 115 Vac should be present. If not, check the compressor motor contactor, the continuity of the standby power harness, and the power supply. If the compressor motor contactor is not being energized (pulling down) see “Electric Standby Circuits” below.
6. Check for AC voltage between the T1A and T2A wires at the compressor motor overload relay.
7. Approximately 115 Vac should be present. If not, check the continuity of the T1A and T2A wires.
8. Check for AC voltage between the T1-01 and T2-01 wires at the compressor motor overload relay.
9. Approximately 115 Vac should be present. If not, check the continuity of the PO wire on the compressor motor overload relay and the compressor motor overload relay.
10. Turn the unit off, disconnect AC power supply, and check the connections in the junction box on the compressor motor for to verify they are clean and tight.
11. Check the continuity of the T1-01 and T2-01 wires from the compressor motor overload relay to the compressor motor. If both wires have good continuity, check the start relay, the start capacitor, the run capacitors and the associated circuits. If those components are good, the compressor motor is most likely faulty.

Testing 208-230/1/60 Units

1. Connect the electric standby power receptacle to an appropriate AC power supply.
2. Set the thermostat so the unit will run in Cool.
3. Start the unit and run it in Cool on electric standby.
4. Check for AC voltage between the T1A and T2A wires at the compressor motor contactor.
5. Approximately 208-230 Vac should be present. If not, check the compressor motor contactor, the continuity of the standby power harness, and the power supply. If the compressor motor contactor is not being energized (pulling down) see “Electric Standby Circuits” below.
6. Check for AC voltage between the T1A and T2A wires at the compressor motor overload relay.
7. Approximately 208-230 Vac should be present. If not, check the continuity of the T1A and T2A wires.

8. Check for AC voltage between the T1-01 and T2-01 wires at the compressor motor overload relay.
9. Approximately 208-230 Vac should be present. If not, check the continuity of the PO wire on the compressor motor overload relay and the compressor motor overload relay.
10. Turn the unit off, disconnect AC power supply, and check the connections in the junction box on the compressor motor for to verify they are clean and tight.
11. Check the continuity of the T1-01 and T2-01 wires from the compressor motor overload relay to the compressor motor. If both wires have good continuity, check the start relay, the start capacitor, the run capacitor and the associated circuits. If those components are good, the compressor motor is most likely faulty.

Compressor Motor Replacement

Removal

1. Turn the unit off and disconnect the electric standby power supply.
2. Remove the condenser cover.
3. Loosen and remove the compressor drive belt.
4. Remove the junction box cover from the compressor motor to access the wire connections.
5. Disconnect the wires from the compressor motor. Note which wires are attached to which terminals so they can be reattached correctly.
6. Remove the compressor motor mounting hardware and remove the compressor motor.

Installation

1. Place the compressor motor in position and install the mounting hardware and the belt.
2. Adjust the belt to the proper tension (see Specifications).
3. Remove the junction box cover from the compressor motor to access the wire connections.
4. Connect the wires to the compressor motor. Make sure to connect the wires to the same terminals from which they were removed.
5. Reinstall the junction box cover.
6. Reinstall the condenser cover.

Electric Standby Circuits

If the unit does not run in the electric standby mode use the following procedure.

Make sure the unit is connected to the proper power source.

Check the power cable receptacle for power. If power is there, check for power at the unit terminal plug.

If the contactor is pulled down and the overload relay is closed, but the standby compressor motor fails to start, the trouble is probably in the standby compressor motor.

If the contactor is not pulling down proceed as follows:

1. Check the AC line voltage and the transformer input fuse F20. If the AC line voltage is acceptable and the transformer input fuse is intact, go to step 2.
2. Measure the transformer output voltage (AC). The voltage reading should be approximately 12 Vac. If not, the transformer is defective. If the transformer output voltage is acceptable, go to step 3.
3. Check the rectifier output voltage (DC) on the 2R wire at the smoothing capacitor (C1) and check for continuity to ground on the CHK wire at the smoothing capacitor (C1). If this voltage is less than approximately 12 Vdc, and if the 2R circuits to the bridge rectifier (BR) and the X1 and X4 circuits from the bridge rectifier (BR) to the transformer have good continuity, the bridge rectifier (BR) is defective. If the rectifier output voltage is acceptable go to step 4.
4. Check fuse F16 on the X1 wire at the smoothing capacitor (C1).
5. Check the rectifier output voltage (DC) on the X1 wire (pin B8 at Connector 1 on PCB1 in the ECM). If voltage is not present, check the continuity of the X1 wire from the smoothing capacitor (C1). If the rectifier output voltage is acceptable, go to step 6.
6. Check the voltage on 2R wire at the electric standby power relay (ESR). If voltage is not present, check the continuity of the 2R wire from the smoothing capacitor (C1). If the voltage on the 2R wire at the electric standby power relay (ESR) is acceptable, go to step 7.
7. Check the voltage on the 2RB and 2RB1 wires at the electric standby power relay (ESR). If voltage is not present, check the continuity of the 2RB wire. If the voltage on both the 2RB and 2RB1 wires is acceptable, go to step 8.
8. Check the voltage on the 2RB1 wire at the battery disconnect relay (BDR). If voltage is not present, check the continuity of the 2RB1 wire from the electric standby power relay (ESR). If the voltage on the 2RB1 wire at the battery disconnect relay (BDR) is acceptable, go to step 9.
9. Check for continuity to ground on the CH1 wire at the battery disconnect relay (BDR). If continuity to ground on the CH1 wire at the battery disconnect relay (BDR) is not present, check the continuity of the CH1 wire from the battery disconnect relay (BDR) to the chassis ground. If there is good continuity to ground on the CH1 wire at the battery disconnect relay (BDR), go to step 10.
10. Check for continuity to ground on the SWS wire at the electric standby power relay (ESR). If continuity to ground is not present, check the continuity of the

SWS wire from the battery disconnect relay (BDR). If the SWS wire has good continuity, go to step 11. If there is good continuity to ground on the SWS wire at the electric standby power relay (ESR), go to step 12.

11. Check for continuity to ground on the CH4 wire at the battery disconnect relay (BDR). If the CH4 wire has good continuity to ground, the battery disconnect relay (BDR) is probably defective. If continuity to ground on the CH4 wire at the battery disconnect relay (BDR) is not present, check the continuity of the CH4 wire from the battery disconnect relay (BDR) to the chassis ground.
12. Check the voltage on the 2RA wire at the electric standby power relay (ESR). If voltage is not present, the electric standby power relay (ESR) is probably defective. If the voltage on the 2RA wire at the electric standby power relay (ESR) is acceptable, go to step 13.
13. Check the voltage on the PC1 wire at Pin 2 in the PSC1 Connector on PCB1 in the ECM. If voltage is not present, check the continuity of the PC1 circuit to the terminal board (TB) and the 2RA circuit to the electric standby power relay (ESR). If the voltage on the PC1 wire is acceptable, go to step 14.
14. Check the voltage on the CMC wire at the compressor contactor (CMC). If voltage is not present, check the continuity of the CMC circuit to Pin 10 in Connector 2 on PCB1 in the ECM and Fuse 5 on the ECM. If the CMC wire has good continuity and Fuse 5 is good, the ECM may be defective. If the voltage on the CMC wire is acceptable, go to step 15.
15. Check for continuity to ground on the CHE wire at the compressor motor contactor (CMC). If there is good continuity to ground on the CHE wire at the compressor motor contactor (CMC), the compressor motor contactor is probably defective. If continuity to ground on the CHE wire at the compressor contactor (CMC) is not present, go to step 16.
16. Check the continuity of the CHE wire from the compressor motor contactor (CMC) to the chassis ground.

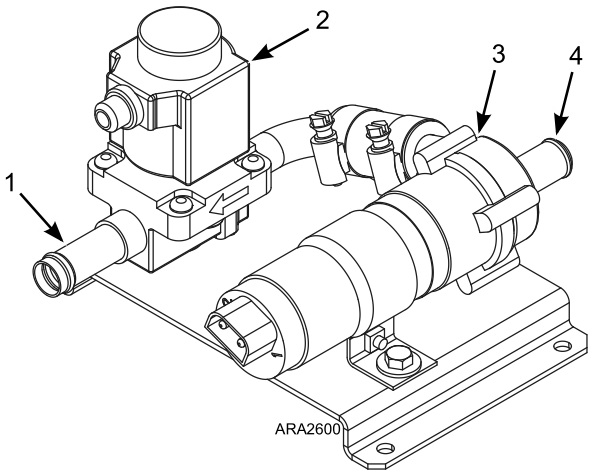
Heat Option – Truck Engine Coolant

This option is added to Model 10 and 20 units to allow the unit to use engine coolant to heat the cargo compartment as require during truck engine operation. The main components are the heater assembly, coolant pump assembly (coolant pump and coolant valve), and connecting hoses. The heater assembly is mounted on the bottom of the evaporator. The coolant pump assembly is typically mounted in the truck engine compartment. The connecting hoses connect the engine cooling system to the coolant pump assembly and the heater assembly. See the V-220/V-320 Heat Kit Installation Manual TK 56340 for more information.

Check the operation of Truck Engine Coolant Heat as follows:

1. Set the thermostat on the highest setting.
2. Start and run the unit in Heat on the engine driven compressor until the truck engine is warmed up.
3. Check the temperature of the coolant hoses connected to the inlet and outlet connections on the coolant pump assembly by hand. Both coolant hoses should be hot. If not, go to the next step.
4. Check the coolant pump by touching it to see if it is running. If it is running, go to the next step. If not go to step 6.

Figure 29. Coolant Pump Assembly



1.	Coolant Outlet	3.	Coolant Pump
2.	Coolant Valve	4.	Coolant Inlet

5. Disconnect the 2-pin wire connector from the coolant valve and check for 12 Vdc between the 26A-02 and CH-02 wires. If voltage is present, the coolant valve is probably defective. If voltage is not present, check the continuity of the 26A circuit back to the ECM, Fuse F5, and the continuity of the CH circuit to ground.
6. If the coolant pump is not running, Disconnect the 2-pin wire connector from the coolant pump and check for 12 Vdc between the 26A-2 and CH-03 wires. If voltage is present, the coolant pump is probably defective. If voltage is not present, check the continuity of the 26A circuit back to the ECM, Fuse F5, and the continuity of the CH circuit to ground.

Heat Option – Truck Engine Coolant and Electric Standby Heater Strip

This option is added to Model 20 units. It allows the unit to use engine coolant to heat the cargo compartment as require during truck engine operation, and to use an electric heater strip during electric standby operation. In addition to the engine coolant heat components (see "Heat Option – Truck Engine Coolant above), the main components are the electric heater strip, the over temperature switch, the heater contactor, and the electric heating harness. The electric heater strip and the over temperature switch are mounted in the heater assembly, the heater contactor is mounted in the contactor box in the heater assembly, and the heater harness connects the heater assembly to the unit control box. See the V-220/V-320 Heat Kit Installation Manual TK 56340 for more information.

See "Heat Option – Truck Engine Coolant" above to check the operation of Truck Engine Coolant Heat.

Check the operation of Electric Standby Heater Strip as follows:

⚠ DANGER

Hazardous Voltage!

High voltage AC power is present whenever the unit is operating in the Electric Standby mode and whenever the unit is connected to external standby power. Voltages of this magnitude can be lethal. Exercise extreme caution when working on the unit.

1. Set the thermostat on the highest setting.
2. Connect the electric standby power receptacle to an appropriate AC power supply.
3. Start and run the unit in Heat on electric standby operation.
4. Check the electric heater strip to see if it is hot. If not, go to the next step.
5. Check for AC voltage between the L1 and H2 wires at the heater contactor (HC). Approximately 115 or 230 Vac (depending on input voltage) should be present.
   a. If voltage is not present, check the continuity of the L1 and H2 wires to the CMC, the continuity of the standby power harness, and the power supply.
   b. If voltage is present, go to the next step.
6. Check for AC voltage between the wires from the electric heater strip (EHE) at the HC. Approximately 115 or 230 Vac (depending on input voltage) should be present.
   a. If voltage is present disconnect the EHE and check the resistance. It should be approximately 8.8 ohms for 115 Vac units or 35.3 ohms for 208-230 Vac units.
   b. If voltage is not present, go to the next step.
7. Check for DC voltage on the EF2-HC wire at the HC. Approximately 12 Vdc should be present.
   a. If voltage is not present, check the continuity of the EF2-HC and EF2 circuits back to the ECM. If these circuits have good continuity, check to make sure that the controller has been programmed for the electric heater option. Refer to the Vehicle Powered Truck Installation Standards and Procedures TK 56430 (Section 9 – Configuring Software and Controller Procedures).
   b. If voltage is present, go to the next step.
8. Check for DC voltage on the OTS wire connected to the A2 terminal on the HC.
   a. If voltage is not present, check the resistance of the HC coil. See the Specifications chapter for the coil resistance.
   b. If voltage is present, go to the next step.
9. Check for DC voltage at the OTS and CHZ wires connected to the 22 terminal on the HC. Approximately 0 Vdc should be present. If voltage is present, go to the next step.
   a. If voltage is present, check the continuity of the CHZ and CH-08 circuits back to the curbside unit ground stud in the condenser.
   b. If voltage is not present, go to the next step.
10. Disconnect the OTS wires from the HC and check the continuity of the over temperature switch (OTSW). The OTSW should have continuity (be closed) at temperatures below 90 ± 5 F (32 ± 3 C), and open at temperatures above 105 ± 5 F (41 ± 3 C).

Refrigeration Maintenance

Maintenance Inspection Schedule

Inspect/Check/Service These Items	Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours
Inspect moisture indicator and refrigerant level.			•	
Inspect refrigerant hoses.			•	
Inspect refrigerant hose connections for leaks.			•	
Check suction/compressor pressure regulator setting (20, 30, 50 MAX Models Only).				•
Replace filter dryer.				•

Note: *The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.*

All regulated refrigeration service procedures must be performed by an EPA certified technician, using approved equipment and complying with all Federal, State and Local laws.

Evacuating and Charging the Refrigeration System

Checking the Refrigerant Charge

If the unit has an insufficient charge of refrigerant, the evaporator will be "starved" and the box temperature will rise even though the unit is operating. Also, an insufficient charge does not circulate enough oil to properly lubricate the compressor. The charge can be determined by inspection of the refrigerant through the sight glass with the following conditions established:

Testing the Refrigerant Charge with an Empty Box

1. Install gauge manifold set on the on the engine driven compressor.
2. If the unit is equipped with Electric Standby, operate the unit in Cool on Electric Standby for 5 minutes.
   a. Connect the power cord.
   b. Turn the unit ON and place the unit in Cool Mode for 5 minutes.
   c. Turn the unit OFF and disconnect the power cord.
3. Start the vehicle's engine and operate it at 1000 RPM.
4. Turn the unit ON and place the unit in Cool Mode. Lower the setpoint(s) to the following:
   - R-134a: 25 degrees F (-4 degrees C)
   - R-404A: 0 degrees F (-18 degrees C)
   - R-452A: 0 degrees F (-18 degrees C)
5. Operate the unit until the following box temperature(s) are reached:
   - R-134a: 35 degrees F (2 degrees C)
   - R-404A: 10 degrees F (-12 degrees C)
   - R-452A: 10 degrees F (-12 degrees C)
6. Check to ensure the following discharge pressures are met or exceeded:
   - R-134a: 180 psig (1241 kPa)
   - R-404A: 275 psi (1896 kPa)
   - R-452A: 275 psi (1896 kPa)

   Note: *Partially blocking the condenser grille may be necessary to achieve these pressures.*
7. Inspect the sight glass.
   - NO BUBBLES PRESENT: The system is full of refrigerant. Proceed to Step 8.
   - BUBBLES PRESENT: The system is low on refrigerant. Proceed to the "Suction (Low Side) Bump Charging" procedure listed below.
8. Verify the unit is not over charged. Elevate engine RPM to 3000-4000 RPM for three minutes. Verify that the unit does not shutdown on high head pressure. If unit shuts down on high head pressure the system is overcharged. Reduce the refrigerant charge amount until the unit no longer shuts down on high head pressure.

   Note: *If the condenser coil was covered in previous Step 6 leave the condenser coil covered for Step 8.*

Testing the Refrigerant Charge with a Loaded Box

1. Install gauge manifold set on the on the engine driven compressor.

2. Run the unit in Cool on engine driven compressor operation.
3. Cover the condenser to drive any excess refrigerant from the condenser into the receiver tank.
4. As the head pressure rises, check the liquid line sight glass. There should be no bubbles in the flow of refrigerant through the liquid line sight glass. Bubbles in the refrigerant indicate the unit is low on refrigerant. Refer to the "Suction (Low Side) Bump Charging" procedure listed below to top-off the system.

   Note: *If no bubbles are present, there is sufficient refrigerant in the unit for that load at that particular box temperature. This test does not determine if the unit contains a full charge of refrigerant.*

Suction (Low Side) Bump Charging

Important: *Failure to properly charge the system with refrigerant will result in immediate damage to the compressor.*

1. Connect the gauge manifold set to the liquid port on the refrigerant bottle and purge the gauge manifold set (if not already completed in the previous procedure).
2. Connect the gauge manifold set Low Side, blue hose, to a Suction (Low Side) service port (if not already completed in the previous procedure).

   Note: *Select a service port that is as far away from the engine driven compressor as possible. Do NOT connect the Suction (Low Side) hose to the Suction service port at the engine driven compressor. Compressor damage may occur.*
3. Connect the gauge manifold set High Side, red hose, to a Discharge (High Side) service port (if not already completed in the previous procedure).
4. Start the vehicle's engine and operate it at 1000 RPM.
5. Turn the unit ON and place the unit in Cool Mode. Lower the setpoints) to the following:
   - R-134a: 25 degrees F (-4 degrees C)
   - R-404A: 0 degrees F (-18 degrees C)
   - R-452A: 0 degrees F (-18 degrees C)
6. Operate the unit until the following box temperature(s) are reached:
   - R-134a: 35 degrees F (2 degrees C)
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7. Check to ensure the following discharge pressures are met or exceeded:
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   - R-404A: 275 psi (1896 kPa)
   - R-452A: 275 psi (1896 kPa)

   Note: *Partially blocking the condenser grille may be necessary to achieve these pressures.*
8. Open the Low Side valve on the gauge manifold set for one second and close.
9. **Wait a minimum of ten seconds.** Inspect the sight glass.
   - NO BUBBLES PRESENT: The system is full of refrigerant. Proceed to Step 10.
   - BUBBLES PRESENT: The system is low on refrigerant. Repeat Steps 8 and 9 until no bubbles are present in the sight glass.
10. Close the gauge manifold valves and refrigerant bottle valve. Turn off the unit and shut off the vehicle's engine.

Checking Compressor Oil Charge

The compressors are furnished with the amount of oil shown in the Specifications chapter. The oil level in the compressor will change after the compressor is initially run, making any level measurements inaccurate.

To ensure an adequate oil supply, the following procedure must be followed whenever the refrigerant charge is lost or removed from a unit:

1. Install a compressor on the system having a residual oil supply and self-lubricating system such as a TK 214 model. Connect an oil separator on the discharge or suction line to collect and drain out circulated oil.

   Note: *A suction line oil separator can be improvised by installing a suction filter upside down in the suction line near the compressor. Cap off both access ports, and use the lower one to drain off the accumulated oil.*
2. Place a normal amount of oil in the cleanup compressor before operating.
3. Charge with the recommended amount of refrigerant for your model. Refer to the Specifications Chapter for recommended refrigerant amount.
4. Operate at a low speed (600 to 800 rpm) for 2 hours, or until the compressor oil level reaches a minimum allowable level, whichever occurs first. Drain the collected oil from the oil separator as it fills, taking care to not allow any collected oil to recirculate.
5. Prepare the original compressor that was removed from the unit (or a replacement) by draining out any existing oil and replacing the oil with the amount of oil shown in the Specifications chapter.
6. Install the original compressor (or its replacement), and proceed with the manual evacuation and refrigerant charging procedure.

Refrigeration System Checks

1. Connect a gauge manifold set to the suction and discharge service ports on the engine driven compressor.

Cleanup Procedure for Small Truck Units

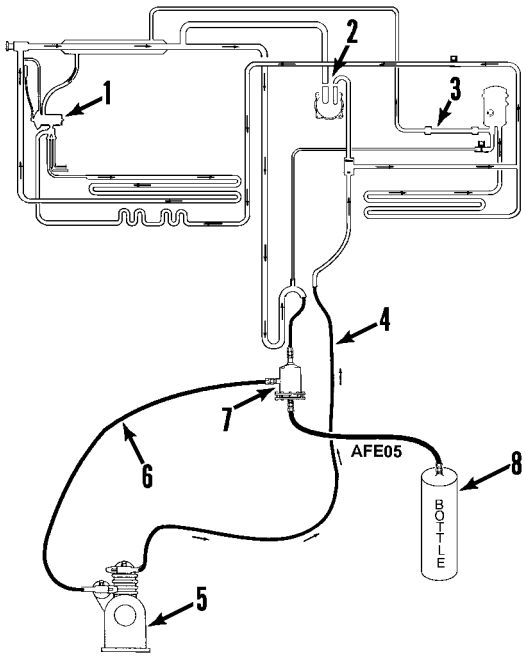
Tools Required

- Motor-driven TK 214 "Flushing Compressor"
- Suction Line Filter (P/N 2040498 with Filter P/N 662292)
- Pipes (In Place of Oil Separator, Check Valve, Oil Separator and Standby Compressor)

Clean-up Procedure

1. Make sure all hose routing is correct.
2. Make sure that the oil trap is correctly installed.
3. Recover the contaminated refrigerant from the system.
4. Remove the lines from the compressors (engine driven and standby).
5. Flush each compressor using the flushing compressor and an HFC refrigerant. (Always recover the refrigerant before disconnecting the flushing compressor.)

Figure 30. Connecting Flushing Compressor to Unit



1.	Remove Internal Parts From Expansion Valve
2.	Disconnect and Cap (If So Equipped)
3.	Replace Drier With Tube
4.	Discharge Line
5.	Flushing Compressor
6.	Suction Line
7.	Suction Line Filter
8.	Recovered Oil

6. Remove any check valves (or check valve seats) from system to ensure flow in all directions.
7. Remove the oil separator and install a connecting pipe.
8. Remove the internal parts from the expansion valve.
9. Open any suction pressure regulator valves to their highest setting.
10. Install a temporary suction line filter (P/N 2040498 and P/N 662292) in the suction line.
11. Install a connecting pipe in place of the standby compressor.
12. Connect the flushing compressor system to the engine driven compressor discharge and suction lines (see illustration).
13. Evacuate the system and check for leaks. Continue to evacuate to remove moisture and air.
14. Install HFC refrigerant and run the flushing compressor to flush the system. Energize (open) the defrost solenoid during 30% to 40% of the clean-up. Solid contaminants will collect in the suction line filter. Oil from the system and from the flushing compressor will drain out of the suction line filter. (Add compressor oil as required.) Refrigerant oil in the flushing compressor will absorb acids from the system.
15. Test the recovered compressor oil for acid contamination.
16. Continue flushing until the compressor oil is clean.

Putting the Unit Back Into Operation

1. Replace any check valves (or check valve seats).
2. Install a new oil separator.
3. Install a new liquid injection orifice.
4. Install a new drier.
5. Install a new expansion valve.
6. Install the compressors and lines.
7. Use dry nitrogen to pressurize the system to 150 psig (1034 kPa).
8. Use a bubble solution to check for leaks.

9. Install correct amount of oil.
10. If no leaks are found, evacuate the system. A leak-free and dry system will maintain a 1000 micron vacuum for five minutes or longer.
11. Charge the system with proper amount of the correct refrigerant.
12. Operate the unit and check for proper operation. (Adjust any suction pressure regulators.)
13. After two weeks of operation, change the drier.

Refrigeration Service Operations

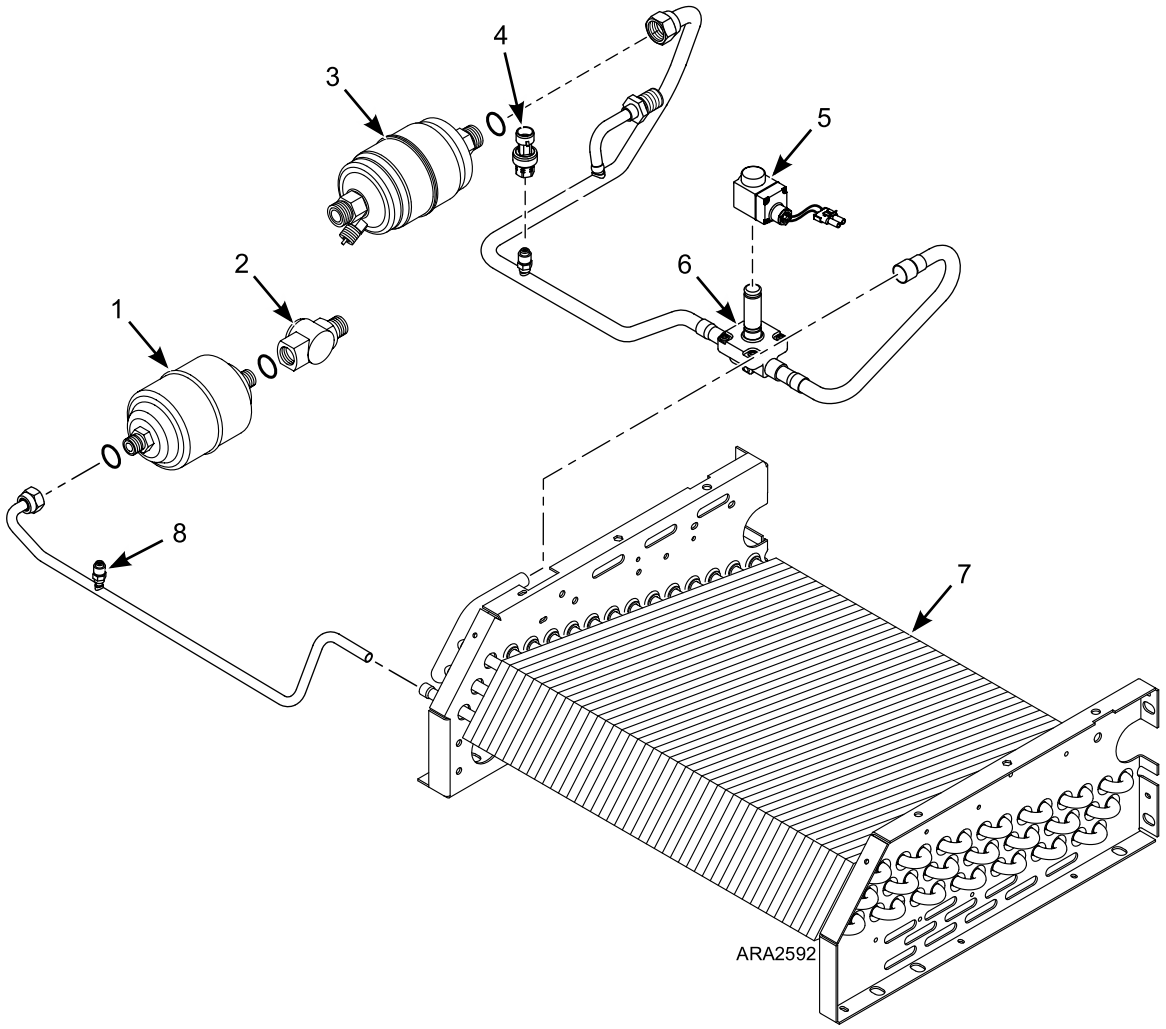
Note: *It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time.*

⚠ WARNING

Risk of Injury!

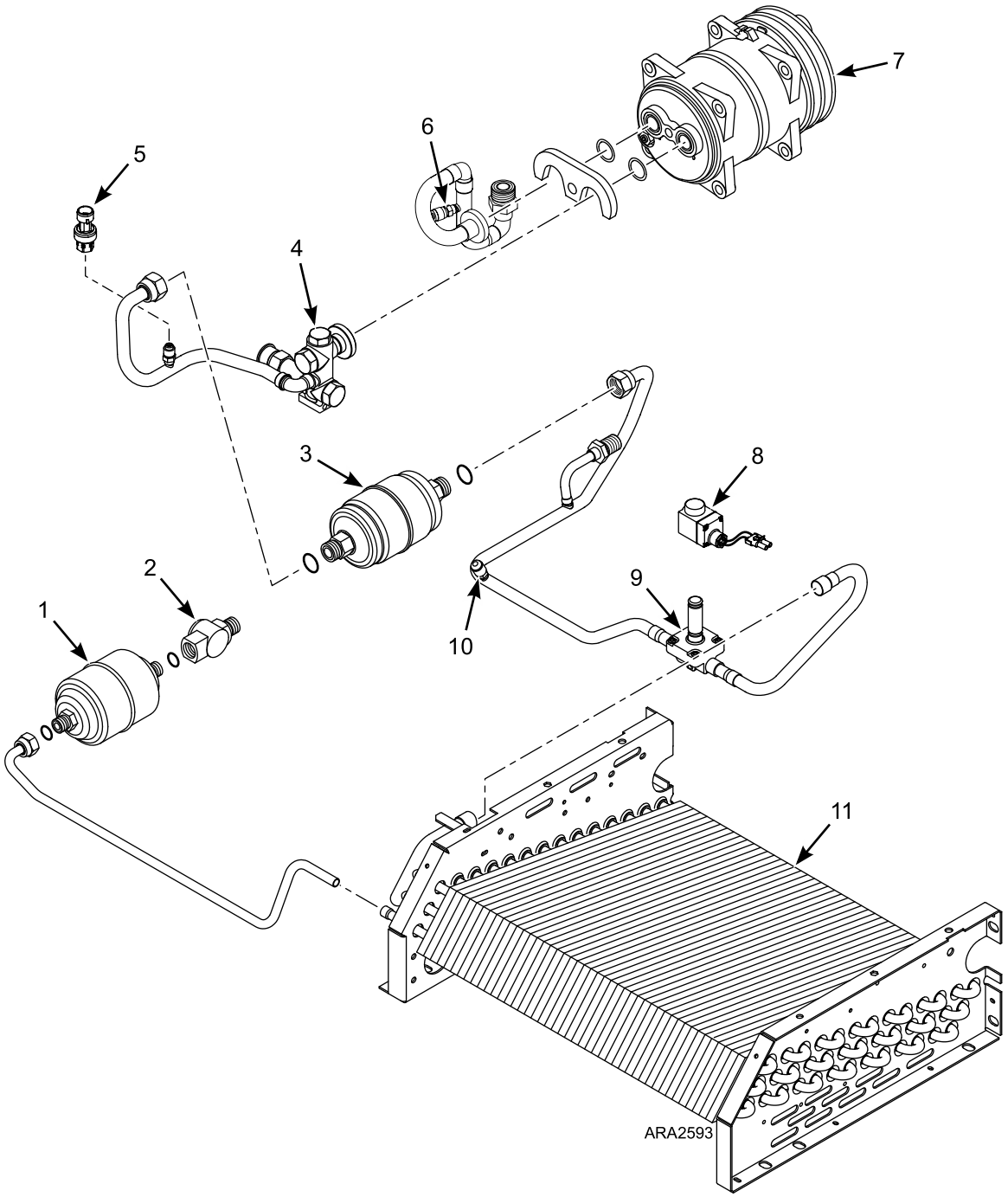
Disconnect the power supply before servicing the unit to prevent personal injury.

Figure 31. Condenser Components Model 10 and Model 30



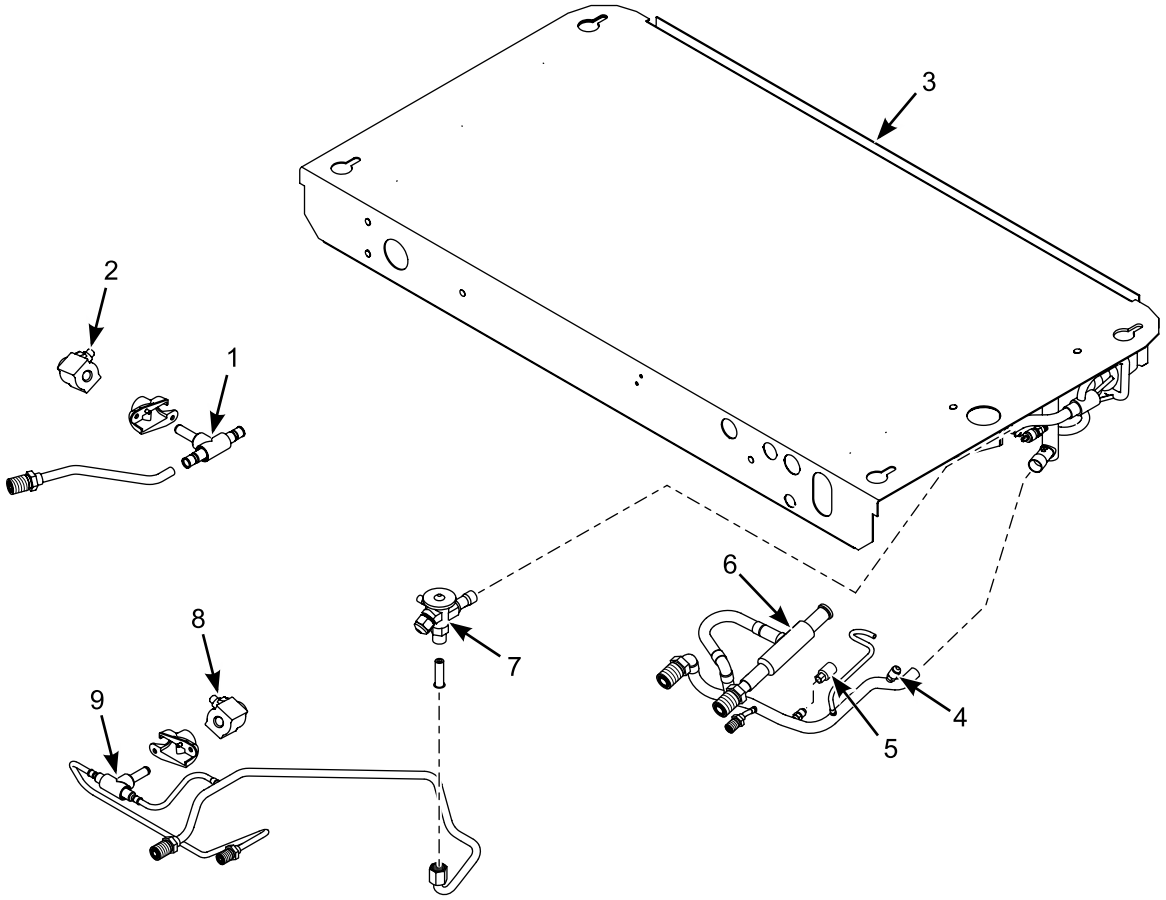
1.	Drier	5.	Condenser Inlet Solenoid (CIS) Coil (Model 30 Units Only)
2.	Liquid Line Sight Glass	6.	Condenser Inlet Solenoid (CIS) (Model 30 Units Only)
3.	Oil Separator	7.	Condenser Coil
4.	Discharge Pressure Transducer	8.	Discharge Service Port

Figure 32. Condenser Components Model 20 and Model 50



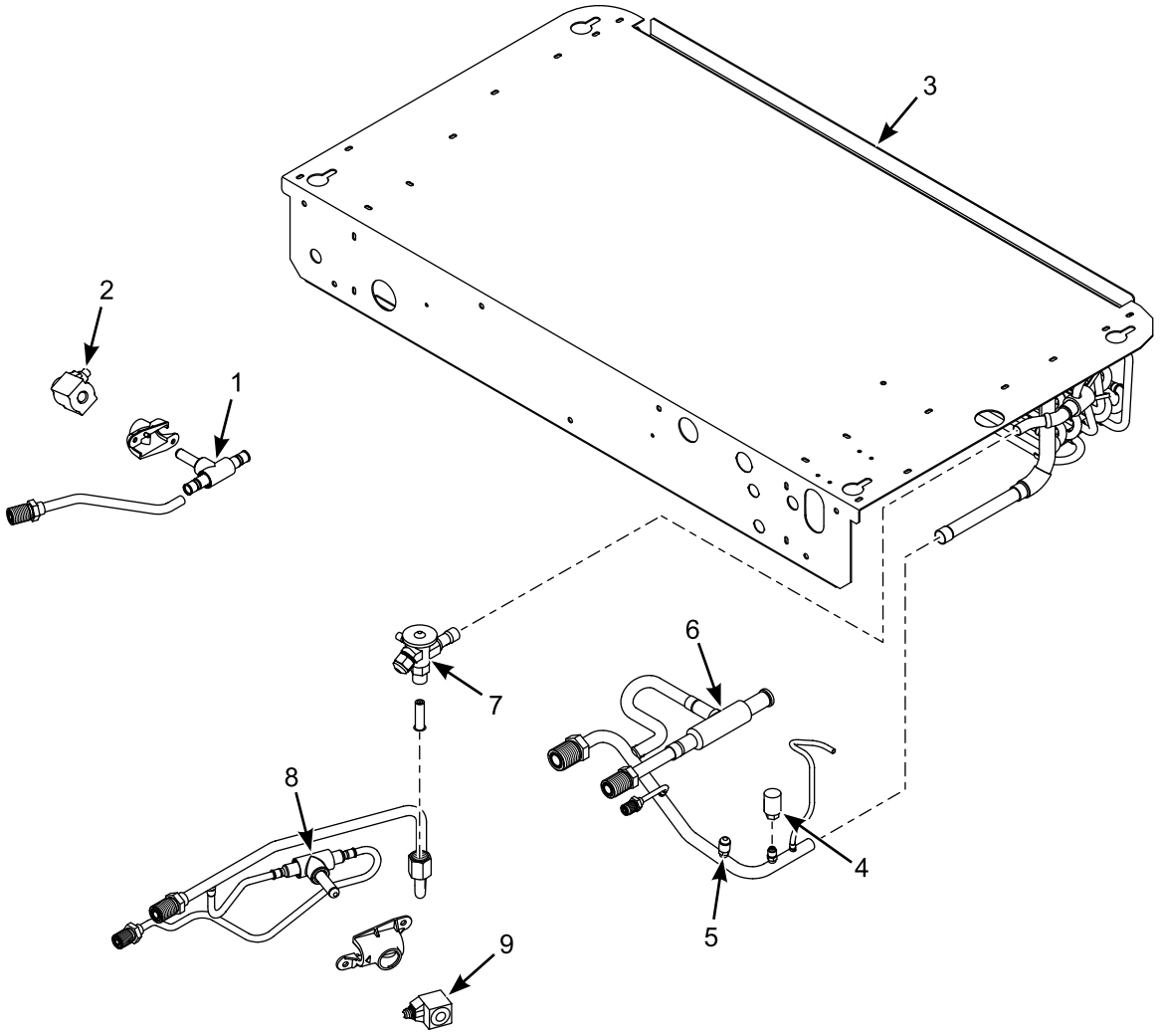
1.	Drier	7.	Electric Standby Compressor
2.	Liquid Line Sight Glass	8.	Condenser Inlet Solenoid (CIS) Coil (Model 50 Units Only)
3.	Oil Separator	9.	Condenser Inlet Solenoid (CIS) (Model 50 Units Only)
4.	Discharge Check Valve	10.	Discharge Service Port
5.	Discharge Pressure Transducer	11.	Condenser Coil
6.	Suction Service Port		

Figure 33.



1.	Hot Gas Solenoid (HGS)	6.	Suction Pressure Regulator Valve (SPR) (Model 20 MAX Units Only)
2.	Hot Gas Solenoid (HGS) Coil	7.	Expansion Valve
3.	Evaporator Coil	8.	Liquid Injection Solenoid (LIS) Coil (MAX Units Only)
4.	Suction Access Port	9.	Liquid Injection Solenoid (LIS) (MAX Units Only)
5.	Low Pressure Cutout Switch (LPCO)		

Figure 34.



1.	Hot Gas Solenoid (HGS)	6.	Suction Pressure Regulator Valve (SPR) (Model 20 MAX Units Only)
2.	Hot Gas Solenoid (HGS) Coil	7.	Expansion Valve
3.	Evaporator Coil	8.	Liquid Injection Solenoid (LIS) (MAX Units Only)
4.	Low Pressure Cutout Switch (LPCO)	9.	Liquid Injection Solenoid (LIS) Coil (MAX Units Only)
5.	Suction Access Port		

Engine Driven Compressor

Removal

1. Recover the refrigerant charge from the system.
2. Loosen and remove the compressor drive belt.
3. Disconnect the clutch and liquid injection switch wires (if used).
4. Disconnect the discharge and suction lines.
5. Keep the compressor ports and the suction and discharge lines for the compressor covered to prevent contamination of system components.
6. Remove the compressor mounting screws and remove the compressor.

Installation

Note: *Any compressor installed in this system must contain 4 oz. (118 ml) of POE 120 compressor oil. Always check to make sure that the compressor contains the proper amount and type of oil. Follow the system cleanup procedures to remove old oil from the system.*

1. Place the compressor in position and install the mounting screws and the belt.
2. Adjust the belt tension to the vehicle manufacturer specifications.
3. Connect clutch and liquid injection switch wires, and the refrigeration hoses. Pour the correct amount of oil for the unit (see Specifications chapter) into the suction hose before installation.
4. Pressurize the system and test for leaks.
5. Evacuate the system and recharge.

Electric Standby Compressor

Removal

1. Recover the refrigerant charge from the system.
2. Remove the condenser cover.
3. Disconnect and remove the transformer.
4. Loosen and remove the compressor drive belt.
5. Disconnect the compressor clutch wires.
6. Disconnect the discharge, suction and oil return lines.
7. Keep the compressor ports and the suction and discharge tubes for the compressor covered to prevent contamination of system components.
8. Remove the compressor mounting bolts and remove the compressor.

Installation

Note: *Any compressor installed in this system must contain 4 oz. (118 ml) of POE 120 compressor oil. Always check to make sure that the compressor contains the proper amount and type of oil. Follow the system cleanup procedures to remove old oil from the system.*

1. Place the compressor in position and install the mounting bolts and the belt.
2. Adjust the belt to the proper tension (see Specifications).
3. Connect the discharge and suction tubes.
4. Connect the compressor clutch wires.
5. Reinstall the transformer.
6. Pressurize the system and test for leaks.
7. Reinstall the condenser cover.
8. Evacuate the system and recharge.

Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Remove the condenser cover and fan shroud.
3. Remove the bridge rectifier.
4. Unsolder the inlet and liquid lines.
5. Drill out the 12 mounting rivets.
6. Remove the condenser coil.

Installation

1. Clean the tubes for soldering.
2. Place the coil in the unit and rivet the coil in place using 12 TK specified rivets (see the appropriate Parts Manual).
3. Solder the inlet and liquid line connections.
4. Pressurize the system and test for leaks.
5. Evacuate the system.
6. Reinstall the bridge rectifier.
7. Reinstall the fan shroud and condenser cover.
8. Recharge the unit with the proper refrigerant.

Drier

Removal

1. Remove the condenser cover.
2. Disconnect the ORS nuts at the end of the drier and sight glass.
3. Loosen the mounting hardware and remove the drier and sight glass.
4. Separate the drier and sight glass.

Discharge Pressure Transducer (DPT)

Removal

1. Remove the condenser cover.
2. Disconnect the wires and remove the transducer.

Installation

1. Install and tighten the transducer and reconnect the wires.
2. Pressurize the system and test for leaks.
3. Install the condenser cover.

Hot Gas Solenoid (HGS) Test

1. Install a gauge manifold set on the engine driven compressor.
2. Disconnect the 2-pin connector with the LIS and CLU wires in main wire harness from wires to the liquid injection switch at the engine driven compressor.
3. On Model 30 and 50 units disconnect the 2-pin connector with the 26A2 and CHS (or 26 and CHM

depending on your unit) wires in main wire harness from the wires to the condenser inlet solenoid (PS5).

4. Set the thermostat(s) on the lowest setting(s).
5. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
6. Check the temperatures of the refrigeration lines on both sides of the hot gas solenoid (HGS) by hand. A temperature difference between the two sides of the hot gas solenoid (HGS) indicates it is leaking.
7. Use the In-Cab Control Box to place the unit in defrost.

   Note: *The defrost termination switch must be closed for the unit to enter defrost. Use a jumper wire to connect the 12 and CHB circuits in the main wire harness at the 2-pin connector for the defrost termination switch if the evaporator temperature is not low enough to close the defrost termination switch.*
8. The suction pressure should rise. If the suction pressure does not rise, the hot gas solenoid (HGS) is not opening. Check the continuity of the wiring and the resistance of the hot gas solenoid (HGS) coil before assuming the solenoid is faulty. See the Specifications chapter for the solenoid coil resistance.
9. Reconnect the wires that were disconnected and remove the gauge manifold set when finished with the test.

Liquid Injection Solenoid (LIS) Test

See "Testing Liquid Injection Solenoid Valve and Metering Orifice" under Liquid Injection System in the Electrical Maintenance Chapter.

Condenser Inlet Solenoid (CIS) Test

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat(s) on the lowest setting(s).
3. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
4. Check the temperatures of the refrigeration lines on both sides of the condenser inlet solenoid (CIS) by hand. Both sides should be hot. If not, the CIS might be stuck closed.
5. Set the thermostat on the highest setting to make the unit shift to Heat. On SPECTRUM units set both zones to the highest setting.
6. The suction pressure should rise and the discharge pressure should fall as the condenser inlet solenoid (CIS) closes, and the hot gas solenoid (HGS) and liquid injection solenoid (LIS) open when the unit shifts to heat.
7. Let unit run in Heat until the suction and discharge pressures stabilize.
8. Check the temperatures of the refrigeration lines on both sides of the condenser inlet solenoid (CIS) by hand. Both sides should be about the same temperature, but should not be hot.
   - If both sides are hot, the condenser inlet solenoid (CIS) is probably not closing. Check the continuity of the wiring, the hot gas heat relay/ heat option relay/RY5 relay, and the resistance of the condenser inlet solenoid (CIS) coil before assuming the solenoid is faulty. See the Specifications chapter for the solenoid coil resistance.
   - If the side of the condenser inlet solenoid (CIS) going to the condenser is significantly colder than the side coming from the oil separator, the condenser inlet solenoid (CIS) is probably leaking.
9. Remove the gauge manifold set when finished with the test.

CPR Bypass Solenoid Test

1. Install a gauge manifold set on the engine driven compressor. Attach an additional compound gauge to the evaporator suction service port to monitor suction pressure in the evaporator.
2. Set the thermostat on the highest setting.
3. Start and run the unit in Heat on the engine driven compressor until the pressure on the additional compound gauge attached to the evaporator suction service port stabilizes at a pressure above 50 psig (345 kPa).
4. Check the suction pressure on the gauge attached to the suction service port at the compressor. It should be close to the CPR setting. (see Specifications chapter for the CPR setting). If it is approximately equal to the pressure at the evaporator suction service port, the CPR bypass solenoid is probably not closing. Check the continuity of the wiring, the BYPS diode assembly, the RY4 relay, and the resistance of the CPR bypass solenoid coil before assuming the solenoid is faulty. See the Specifications chapter for the solenoid coil resistance.
5. Disconnect the BYP and CHF wires from the CPR bypass solenoid at the 2-pin connector in the accumulator module.
6. Check the suction pressure on the gauge attached to the suction service port at the compressor. It should be approximately equal to the pressure at the evaporator suction service port. If it is still close to the CPR setting, the CPR bypass solenoid is

probably stuck closed.

7. Reconnect the wires that were disconnected and remove the gauge manifold set and the additional compound gauge when finished with the test.

Solenoid Valve Replacement

Note: *Valves that have nylon seats must be disassembled before soldering.*

Removal

1. Recover the refrigerant charge.
2. Remove covers as necessary to access the solenoid valve.
3. Remove the coil and disassemble the valve if unsoldering the valve.
4. Unsolder or disconnect the refrigeration lines from the valve, and remove the valve from the unit. Note the direction of the flow arrow on the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damaging the valve when soldering.

Installation

1. Clean the tubes for soldering if necessary.
2. Remove the coil and disassemble the valve if soldering.
3. Place the valve in position with the flow arrow pointing in the direction noted when removed.
4. Solder or connect the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.

NOTICE

Equipment Damage!

Use a heat sink to prevent damaging the valve when soldering.

5. Pressurize the refrigeration system and test for leaks.
6. Evacuate the system.
7. Reinstall any covers .
8. Recharge the unit with the proper refrigerant.

Oil Separator

The oil separator must be replaced if a compressor has failed and is being replaced. Also check the oil return line to make sure it is not plugged by blowing air through it when replacing the oil separator.

Removal

1. Recover the refrigerant charge.
2. Remove the condenser cover / grille.
3. Disconnect the ORS nuts at the ends of the oil separator.
4. Loosen the mounting hardware and remove the oil separator.

Installation

1. Coat the new O-rings with refrigerant oil (same type that is used in the system) and place the new O-rings in the ORS fittings on the ends of the oil separator.
2. Install and tighten the inlet and outlet ORS nuts. Hold the oil separator with a backup wrench on the hex behind the ORS fitting.
3. Pressurize the system and check for leaks.
4. Evacuate the system.
5. Reinstall the condenser cover / grille.
6. Recharge the unit with the proper refrigerant.

Splice Fitting

The splice fitting is used on all units except the Model 20 units with R-134a. It is mounted in the suction line near the engine driven compressor and has two 1/4 SAE flare access fittings. The liquid injection metering orifice and the liquid injection line from the liquid injection solenoid are attached to one of the access fittings on MAX units. The oil return line from the oil separator is attached to the other access fitting on Model 10 and Model 30 units.

Important: *Make sure that a liquid injection metering orifice is installed on the fitting to which the liquid injection line is attached, and that a metering orifice is not installed on the fitting to which the oil return line is attached.*

Liquid Injection Metering Orifice

Removal

1. Recover the refrigerant charge.
2. Disconnect the refrigeration hose from the metering orifice and remove the metering orifice from the splice fitting at the engine driven compressor.

   Note: *This orifice can become plugged with dirt. The refrigeration line / hose and solenoid valve must be kept clean.*

Installation

1. Install the metering orifice on the splice fitting.

2. Connect the refrigeration hose to the metering orifice fitting.
3. Pressurize the system and check for leaks.
4. Evacuate the system.
5. Recharge the unit with the proper refrigerant.

Discharge Check Valve (Model 20 and 50 Only)

Testing the Discharge Check Valve

Model 20 and 50 units are equipped with a discharge check valve. It isolates the engine driven compressor from the electric standby compressor, ensuring the compressor oil and refrigerant do not migrate between compressors. The check valve should be tested when the system is initially charged and operating, and anytime the system has been opened for service or repair. Testing the check valve requires two gauge manifold sets.

1. Disconnect the liquid injection solenoid valve wires.
2. With the unit off, install a gauge manifold set on each compressor.
3. Observe the gauge manifold readings of the electric standby compressor. If the high side and low side readings are not the same, open the gauge manifold valves and equalize the pressures. Close the gauge manifold valves.
4. Set the thermostat so the unit will run in cool.
5. Start the truck and run the unit in Cool on the engine driven compressor.
6. Observe the gauge manifold readings of the engine driven compressor. The head pressure should increase and the suction pressure should decrease.
7. Observe the gauge manifold readings of the electric standby compressor. The high side pressure should remain the same as the pressure in step 3 after the high and low sides were equalized. If the high side pressure is increasing or has increased noticeably, the discharge check valve to the standby compressor is leaking internally.
8. Turn the unit off and shut off the truck engine. Connect the remote control box to an appropriate electric power source.
9. Observe the gauge manifold reading of the engine driven compressor. If the high side and low side readings are not the same, open the gauge manifold valves and equalize the pressures. Close the gauge manifold valves.
10. Set the thermostat so the unit will run in cool.
11. Start the unit and run it in Cool on electric standby.
12. Observe the gauge manifold readings of the electric standby compressor. The head pressure should increase and the suction pressure should decrease.
13. Observe the gauge manifold readings of the engine driven compressor. The high side pressure should remain the same as the pressure in step 9 after the high and low sides were equalized. If the high side pressure is increasing or has increased noticeably, the discharge check valve to the engine driven compressor is leaking internally. Stop the unit.
14. Remove the gauge manifold sets and the electric standby power source. Connect the wires to the liquid injection solenoid valve.
15. If the discharge check valve assembly is leaking internally it should be replaced, refer to the replacement procedure.

Discharge Check Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the condenser cover.
3. Disconnect the check valve assembly from the standby compressor outlet, the oil separator, and the discharge line from engine driven compressor.

Installation

1. Coat the new O-rings with refrigerant oil (same type that is used in the system) and place the new O-rings in position.
2. Place the check valve in position.
3. Connect the discharge line from engine driven compressor to the check valve assembly.
4. Connect the oil separator to the check valve assembly.
5. Connect the check valve assembly to the standby compressor outlet.
6. Pressurize the system and test for leaks.
7. Reinstall the condenser cover.
8. Evacuate and recharge the system.

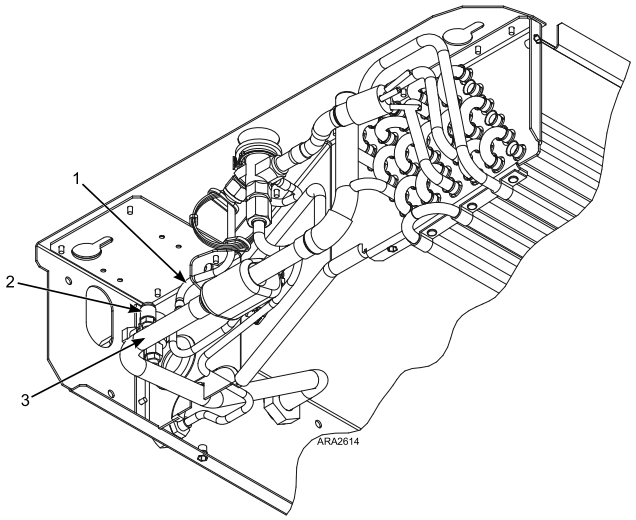
Expansion Valve Assembly

Refer to Expansion Valve Check/Adjustment in Diagnosing Thermo King Truck and Trailer Refrigeration Systems TK 5984 for information checking and adjusting the expansion valve.

Checking Superheat

1. Examine and/or clean the evaporator and condenser coils.
2. Attach an accurate compound gauge to the suction access port nearest to where the equalizer line is connected to the suction line. See the drawing below, which shows a typical evaporator.
3. Attach an accurate thermometer sensor to the suction line beside the suction access port. Secure it and insulate it well.

Figure 35. Checking Superheat



1.	Equalizer Line
2.	Attach Compound Gauge to Suction Access Port
3.	Attach Thermometer Sensor Here and Insulate

4. Defrost the evaporator.
5. Run the unit in Cool until the box temperature approaches 0 F (-18 C).
6. Read the suction line pressure and temperature simultaneously. Make several readings approximately every 2 minutes.
7. The superheat should be between 6 °F (-3 °C) and 12 °F (-7 °C) at 0 °F (-18 °C) box temperature.

   Calculate superheat according to the sample below for R-134a.

   22 °F (-6 °C) = Suction Line Temperature

   12 psig (83 kPa) = Suction Line Pressure

   Convert equalizer line pressure to temperature using a pressure/temperature chart. **For R-134a 12 psig (83 kPa) = 10 °F (-12 °C)**

   Superheat = 22 °F - 10 °F = 12 °F

   Superheat = -6 °C - (-12 °C) = 6 °C

Expansion Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator cover. Disconnect the evaporator fan motor wires.
3. Remove the feeler bulb from the suction line clamps. Note the position of the feeler bulb on the suction line.
4. Disconnect the equalizer line from the expansion valve.
5. Remove the expansion valve from the unit.

Installation

1. Install the expansion valve assembly in the unit.
2. Connect the equalizer line to the expansion valve.
3. Clean the suction line to a bright, polished condition. Install the feeler bulb clamps and the feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Wrap the bulb with insulating tape.

Figure 36. Location of Expansion Valve Bulb with Evaporator Installed on Ceiling

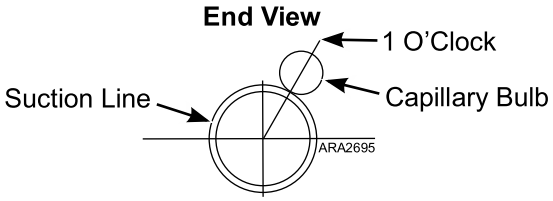
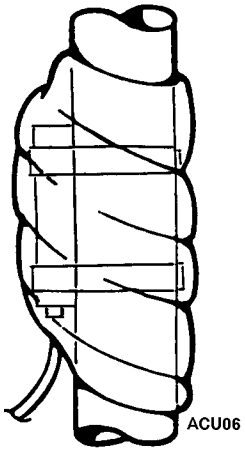


Figure 37. Completely Wrap Bulb with Tape



4. Pressurize the refrigeration system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Connect the evaporator fan motor wires. Install the evaporator cover.
7. Recharge the unit with the proper refrigerant.

Low Pressure Cutout Switch (LPCO)

The low pressure cutout switch is located on the suction line in the evaporator.

If the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), it opens the LPCO circuit to the controller to stop the unit.

Low Pressure Cutout Switch Test

1. Install a gauge manifold at the compressor.
2. Disconnect the 2-pin connector with the LPCO and CHV/CHJ (depending on unit) wires in main wire harness from wires to the low pressure cutout switch.
3. Set the thermostat(s) on the lowest setting.
4. Start and run the unit in Cool.
5. Check the continuity between the low pressure cutout switch wires. The low pressure cutout switch should be closed when the suction pressure is above 5 to 11 in. Hg of vacuum (-17 to -37 kPa). If the suction pressure falls below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), the low pressure cutout switch should open.
6. Reconnect the wires that were disconnected and remove the gauge manifold set when finished with the test.

Low Pressure Cutout Switch Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator cover.
3. Disconnect the wires and remove the switch.

Installation

1. Install and tighten the switch and reconnect the wires.
2. Pressurize the refrigeration system and test for leaks.
3. If no leaks are found, evacuate the system.
4. Connect the evaporator fan motor wires and install the evaporator cover.
5. Recharge the unit with the proper refrigerant.

Suction Pressure Regulator Valve (Model 20 MAX Only)

Model 20 MAX (R-404A/R-452A) units are equipped with a suction pressure regulator valve (SPR). The suction pressure regulator valve is used to limit the load on the electric standby compressor. This also affects the current draw of the electric motor. If the suction pressure gets too high, it can cause the overload relay to open. Monitor the current drawn of the electric motor when making this adjustment and keep it at least 1.5 amps below the overload relay setting (see the Specifications chapter).

Suction Pressure Regulator Valve Test

1. Install a gauge manifold set on the electric standby compressor. Attach an additional compound gauge to the suction service port on the suction tube assembly in the evaporator to monitor suction pressure at the inlet to the suction pressure regulator.
2. Connect the unit power receptacle to an appropriate electric power source.
3. Place a jumper wire between the 12 and CHB wires at the defrost termination switch to ensure the unit will run in Defrost.
4. Start the unit and run it in Defrost on the electric standby compressor until the pressure on the additional compound gauge attached to the suction service port stabilizes at a pressure above 45 psig (310 kPa).
5. Remove the gauge manifold set, the additional compound gauge, and the jumper wire when finished with the test.

Suction Pressure Regulator Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator cover.
3. Unsolder the suction pressure regulator valve from the suction tubes.

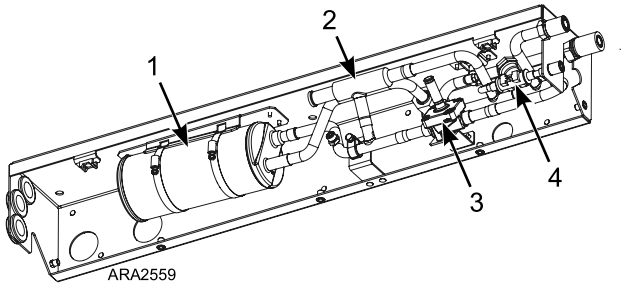
Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connections.
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the system.
5. Install the evaporator cover.
6. Recharge the unit with the proper refrigerant.

Compressor Pressure Regulator Valve (Model 30 and 50 Only)

The compressor pressure regulator valve (CPR) is located in the optional accumulator module mounted on the back of the evaporator. It is used to limit the suction pressure during heat. This also affects the current draw of the electric motor on Model 50 units in electric standby. If the suction pressure gets too high, it can cause the overload relay to open. Monitor the current drawn of the electric motor when making this adjustment on Model 50 units and keep it at least 1.5 amps below the overload relay setting (see the Specifications chapter).

Figure 38. Accumulator Module Components



1.	Accumulator Tank
2.	Compressor Pressure Regulator Valve
3.	Bypass Solenoid (PS10) with Coil Removed
4.	Liquid Line Check Valve

Compressor Pressure Regulator Valve Test

1. Install a gauge manifold set on the engine driven compressor on Model 30 units or the electric standby compressor on Model 50 units. Attach an additional compound gauge to the evaporator suction service port to monitor suction pressure in the evaporator.
2. Set the thermostat on the highest setting.
3. Start and run the unit in Heat on the engine driven compressor on Model 30 units, or the electric standby compressor on Model 50 units, until the pressure on the additional compound gauge attached to the evaporator suction service port stabilizes at a pressure above 45 psig (310 kPa).
4. Check the suction pressure on the gauge attached to the suction service port at the compressor. See the Specifications chapter for the correct settings. If the setting is incorrect, remove the protective cap and try to adjust the compressor pressure regulator valve to the correct setting before assuming it is faulty.
5. Remove the gauge manifold set and the additional compound gauge when finished with the test.

Compressor Pressure Regulator Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the mounting hardware from the compressor pressure regulator valve.
3. Unsolder the compressor pressure regulator valve.

Installation

1. Clean the tubes for soldering.
2. Place the valve in position and solder the connections.
3. Install the mounting hardware.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

Accumulator (Model 30 and 50 Only)

The accumulator is located in the accumulator module, which is mounted on the back of the evaporator.

Removal

1. Recover the refrigerant charge.
2. Remove the mounting hardware from the accumulator.
3. Unsolder the accumulator and remove it from the accumulator module.

Installation

1. Clean the tubes for soldering.
2. Place the accumulator in position and solder the connections.
3. Install the mounting hardware.
4. Pressurize the system and test for leaks.
5. Evacuate and recharge the system.

Liquid Line Check Valve

Liquid Line Check Valve Test

1. Install a gauge manifold set on the engine driven compressor.
2. Set the thermostat on the lowest setting.
3. Start and run the unit in Cool on the engine driven compressor until the suction pressure stabilizes.
4. Check the temperatures of the refrigeration lines on both sides of the liquid line check valve by hand. A temperature difference between the two sides of the liquid line check valve indicates it is not opening completely.
5. Set the thermostat on the highest setting to make the unit shift to Heat.
6. Let unit run in Heat until the suction and discharge pressures stabilize.
7. Check the temperatures of the refrigeration lines on both sides of the liquid line check valve by hand. A temperature difference between the two sides of the liquid line check valve indicates it is leaking.
8. Remove the gauge manifold set when finished with the test.

Liquid Line Check Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the accumulator module cover and the evaporator cover.
3. Disconnect the ORS nuts at the ends of the check valve assembly.
4. Remove the nut that fastens the check valve assembly to the accumulator module frame and remove the check valve assembly from the unit.

Installation

1. Place the check valve assembly in position and install the nut that fastens it to the accumulator module frame.
2. Coat the new O-rings with refrigerant oil (same type that is used in the system) and place the new O-rings in the ORS fittings for the ends of the check valve assembly.
3. Install and tighten the inlet and outlet ORS nuts. Hold the tubes with a backup wrench on the hex behind the ORS fitting.
4. Pressurize the system and test for leaks.
5. Reinstall the accumulator module cover and the evaporator cover.
6. Evacuate and recharge the system.

Replacing Refrigerant Hoses (Speedy Clip System)

Refer to the Vehicle Powered Truck Installation Standards and Procedures Section 6 – Refrigerant Hose and Fittings Standards for service information about replacing refrigerant hoses.

Compressor Maintenance

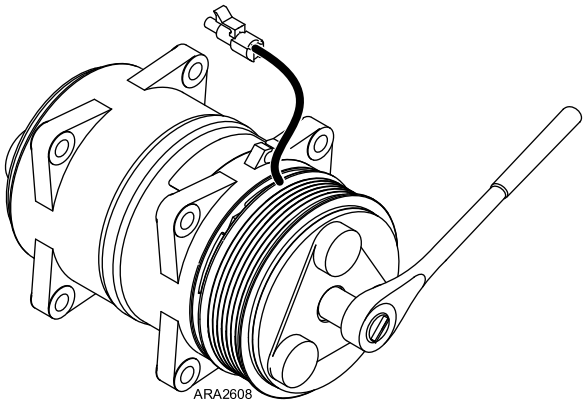
Compressor Failures

Whenever a compressor fails check the compressor speed to verify it is within our guidelines. If the compressor speed exceeds guidelines, a larger pulley needs to be install on the compressor. See Service Bulletin SB644 and the Vehicle Powered Truck Installation Standards and Procedures Section 5 – Compressor Selection and Installation Standards for detailed information.

Compressor Test

1. Rotate the compressor shaft by hand. It should rotate smoothly without catching or binding. If not, replace the compressor.

   Figure 39. Rotate Compressor Shaft

2. Spin the pulley with the clutch de-energized. The pulley should spin freely with no wobbling or roughness. If not, it should be replaced.
3. Check the clutch air gap. It should be 0.016-0.03 inches (0.4-0.8 mm). The clutch might not engage if the air gap is excessive. See Setting Clutch Air Gap later in this chapter for details.
4. Check the clutch coil resistance. See the Specifications chapter for the coil resistance.
5. Check for voltage between the CLU (or CLU1 depending on your unit) wire at the compressor clutch and the compressor body when the unit is in Cool and the compressor should be running. A minimum of 11.5 Vdc should be present. If not, check the CLU circuit back to the ECM and fuse F5. Also check that there is good continuity between the compressor body and the chassis ground (CH).

   Note: *The engine driven compressor must be equipped with a ground strap when installed. Refer to Ground Strap Installation in Section 5 – Compressor Selection and Installation Standards of the Vehicle Powered Truck Installation Standards and Procedures TK 56430 for detailed information about the ground strap.*

6. Check the compressor discharge pressure. A good compressor should be able to raise the discharge pressure to 200 psig (1379 kPa) for R-134a, or 350 psig (2413 kPa) for R-404A/R-452A, with the condenser covered.

   Important: *This test must be performed with a full system charge. Confirm the system is fully charged before proceeding.*

   a. Install a gauge manifold set on the compressor being tested.
   b. Set thermostat on the lowest setting.
   c. Start and run the unit in Cool with the compressor being tested.
   d. Cover the condenser to raise the discharge pressure.
   e. A good compressor should be able to raise the discharge pressure to the following:
      - R-134a: 200 psig (1379 kPa)
      - R-404A/R-452A: 350 psig (2413 kPa)

   Important: *This test should only be run for a short time. Shut the system down immediately once the target pressure is reached.*

Belt Tensions

Engine Driven Compressor Belt and Pulleys

Correct pulley alignment and proper belt tension are very important factors in compressor installation. The compressor clutch must be perfectly aligned with the engine pulley and any auxiliary idler or belt adjustment pulley components. Check the pulley and belt alignment by referring to “Belt Alignment” in Section 5 of the Vehicle Powered Truck Installation Standards and Procedures. Double check by making sure the belt goes from pulley to pulley in perfect alignment with no indication of a sideward bend.

Adjust the belt tension to vehicle manufacturer specifications. Check the belt tension again after 36 to 48 hours of initial operation of the unit because the belt may stretch slightly during the first hours of use. Remember, good alignment and proper belt tension ensure long belt life

Electric Standby Compressor Belt

Loosen the four mounting bolts on the end of the electric motor. Move electric motor (rotate it on the gyrator axis) to obtain a belt tension of 43 to 63 on TK Gauge P/N 204-427. Tighten the electric motor mounting bolts and recheck the belt tension. Readjust the belt tension if necessary. Check the belt tension again after 36 to 48 hours of initial operation of the unit because the belt may stretch slightly during the first hours of use.

Structural Maintenance

Maintenance Inspection Schedule

Inspect/Check/Service These Items	Daily	Weekly	12 Months or 2000 Hours	24 Months or 4000 Hours
Inspect exterior of evaporator and condenser.	•			
Inspect evaporator air inlet and outlet for blockage (dirt, debris, cargo, etc.).	•			
Inspect condenser air inlet and outlet for blockage (dirt, debris, etc.).	•			
Adequate air space above and around cargo.	•			
Inspect evaporator drain hoses. (Verify water is not collecting in drain pan).		•		
Clean evaporator drain hoses.			•	
Clean evaporator and condenser coils. ***More frequent cleaning may be required based on operating environment (dusty conditions, etc.)***			•	
Inspect roadside (engine driven) compressor drive belt condition and tension.			•	
Inspect standby compressor drive belt condition and tension (20 and 50 Models Only).			•	
Inspect evaporator and condenser mounting hardware.				•

⚠ WARNING

Risk of Injury!

Take precautions to ensure the unit will not accidentally start while you are servicing the system. Always turn off the On/Off Switch when inspecting or servicing any components.

Condenser and Evaporator Coils

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils as described in Coil Cleaning Recommendations below. Be careful not to bend the fins when cleaning a coil. Repair bent fins and any other noticeable damage.

NOTICE

Equipment Damage!

The air pressure should not be high enough to damage coil fins.

Coil Cleaning Recommendations

Cleaning Intervals

- The coils should be cleaned a Minimum of once a year.
- It is recommended that any time the unit is in for service or maintenance that the coils be inspected and cleaned if needed.
- The coil should be cleaned if there are visible accumulations that obstruct the view of the fins or tubes of the coil.
- The coils should be cleaned if there is debris imbedded in the tubes and fins.

The area and conditions in which the unit operates will dictate the cleaning intervals and method(s) needed.

Cleaning Methods

⚠ CAUTION

Sharp Edges!

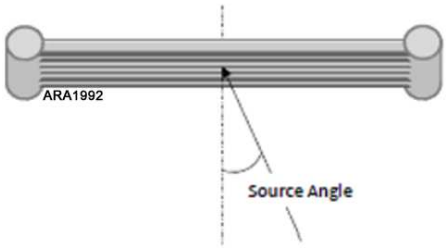
Use extreme care when working with exposed coil fins. Contact with fins can cause painful lacerations. Use gloves while handling coils.

Note: *Listed in order of recommended method.*

- Take a cloth or towel and wipe the air side of the coil going with the fins, across the tubes. The coil will clean in a manner similar to the way lint cleans from the lint trap of a household clothes dryer.
- Use a soft bristled brush (DO NOT USE A WIRE BRUSH) and brush the coil going with the fins, across the tubes. The coil will clean in a manner similar to the way lint cleans from the lint trap of a household clothes dryer.
- A vacuum with a soft attachment can be used to suck the debris off the face as well as in the fins and tubes from the air side of the coil.
- Compressed air can be used and will work best when blown thru the coil from the non-air side

when possible. Blowing thru from the airside may imbed debris in the coil that was only on the surface. It is recommended to start with one of the first three options before using compressed air if the non-air side is not accessible. The angle at which the air should be directed at the coil should not be less than 75 degrees.

Figure 40. Source Angle for Cleaning with Air



Chemicals to aid in cleaning WILL VOID WARRANTY and are NOT RECOMMENDED.

In some instances, it may take a combination of two methods to result in a clean coil. Such as, first wiping the coil to clean the surface and then using a vacuum or compressed air to clean down in the fins. This will depend on the type of debris that needs to be cleaned from the coil.

Do not contact the coil with any hard vacuum nozzle, air nozzle, or any other tool. This will damage the tubes of the coil.

Unit Mounting Bolts

Periodically check and torque the unit mounting bolts.

Figure 41. Condenser

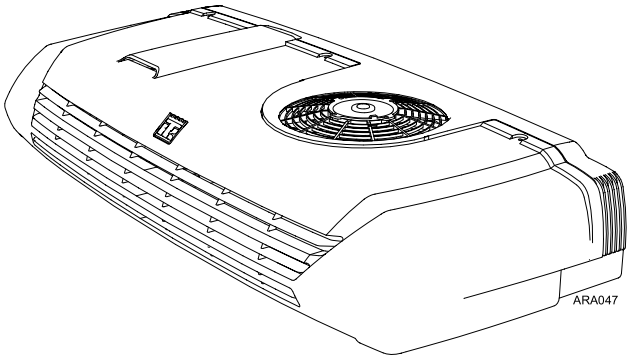
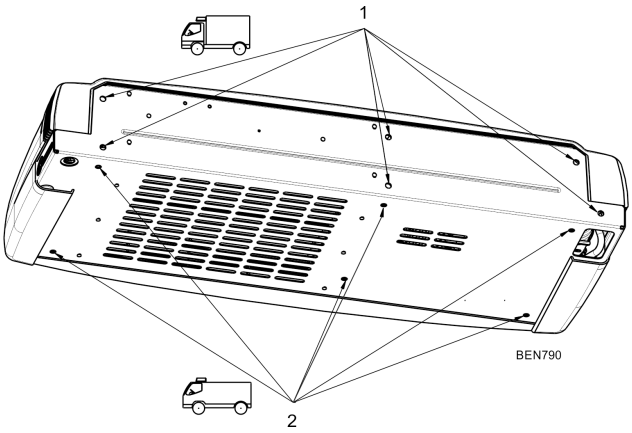


Figure 42. Condenser Mounting Bolts



1.	Mounting holes when unit is mounted on the Front of the Truck (5)
2.	Mounting holes when unit is mounted on the Roof of the Truck (4)

Figure 43. Evaporator

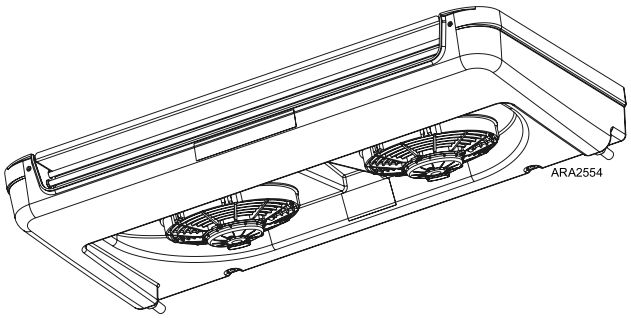
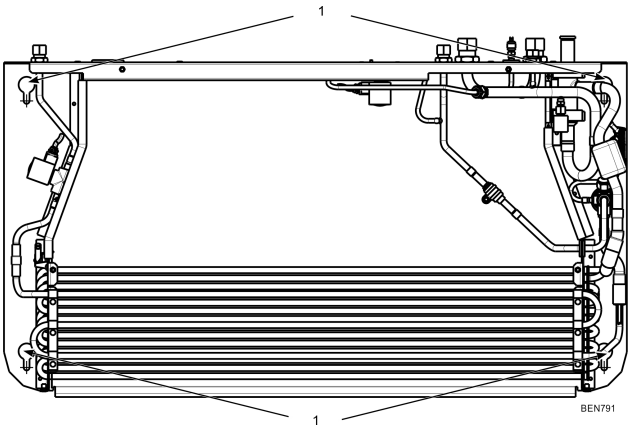


Figure 44. ES Evaporator Mounting Bolts (Cover Removed)



THERMO KING

Over-the-Road Mechanical Diagnosis

Electric Standby Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit turned On—In-Cab Control Box display does not come on	Unit not connected to Standby power or Standby power is turned off.	Connect power cord. Verify that the Electric Standby power is turned on and is the correct voltage.
	Transformer AC Power Supply Fuse F20 blown	Check for short circuits and replace fuse
	Faulty transformer	Check transformer
	Faulty bridge rectifier	Check bridge rectifier
	Controller Standby Power Supply Fuse F16 blown	Check for short circuits and replace fuse
	In-Cab Control Box harness disconnected or faulty	Check In-Cab Control Box harness and repair or replace
	In-Cab Control Box faulty	Repair or replace
	ECM faulty	Repair or replace
Unit turned On—In-Cab Control Box display comes on but compressor motor does not run	No standby power to compressor motor	Provide power to unit; check power at: 1. Motor contactor hot side 2. Motor contactor load side (contactor closed) 3. Overload relay 4. Motor terminals
	Electric Standby Power Relay (ESR) faulty	Check ESR
	Fuse F5 blown	Check for short circuits and replace fuse
	Compressor Motor Contactor (CMC) faulty	Check CMC
	Open or faulty overload relay	Determine cause and reset or replace overload relay
	Compressor motor faulty	Check compressor motor
	ECM faulty	Repair or replace
Compressor motor hums but does not run	Locked rotor (overload relay will open after a period of time)	Remove interference or replace motor
	Locked compressor	Replace compressor
	Low line voltage or no voltage on one leg	Check power source for correct voltage, phase, and frequency. Bring voltage up to within 10% of motor rating
	Capacitor faulty	Check capacitors (on single phase units)
	Start Relay (SR) faulty	Check SR (on single phase units)
Compressor motor runs but compressor does not	Electric standby compressor belt loose	Check belt tension
	Compressor clutch faulty	Check compressor clutch

Refrigeration Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit short cycles	Shortage of refrigerant (low pressure cutout)	Repair leak and recharge
	Restricted expansion valve	Clean expansion valve
	Refrigerant overcharge (high discharge pressure)	Remove excess charge
	Cycling on high discharge pressure	Check condenser air flow and fan
	Dirty condenser coil	Clean coil
	Defrost timer set too low for application.	Adjust timer to higher interval
Unit operates long or continuously	Shortage of refrigerant	Repair leak and recharge
	Dirty condenser	Clean condenser
	Air in system	Evacuate and recharge system
	Compressor inefficient	Replace compressor
	Plugged expansion valve	Clean expansion valve
	Iced or plugged evaporator coil	Defrost or clean coil
	Defective truck body insulation	Correct or replace
	Too many door openings	Keep doors closed, install plastic curtains
	Load too warm	Precool hot product
	Door seals worn	Repair/replace
	Excessive superheat at expansion valve	Adjust superheat
	ECM faulty	Repair or replace
Box temperature too high	Thermostat setpoint too high	Reset thermostat
	Refrigerant shortage	Repair leak and recharge
	Expansion valve or strainer plugged	Clean or replace
	Restricted lines	Clean restriction. Tubing pinched shut
	Hot load	Precool hot product
	Expansion valve superheat too high or too low	Adjust superheat
Head pressure too high	Refrigerant overcharge	Remove excess
	Air in system	Evacuate and recharge system
	Dirty condenser	Clean
	Restricted condenser	Clean condenser
	Condenser fan not running	Check fan motor
	Condenser fan rotation	Check fan motor polarity
	Restricted dehydrator	Replace
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Expansion valve or strainer plugged	Clean or replace
	Compressor inefficient	Replace compressor

CONDITION	POSSIBLE CAUSE	REMEDY
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Mounting bolts loose	Tighten
	Refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for proper superheat
Compressor loses oil	Shortage of refrigerant	Repair leak and recharge
	Plugged expansion valve or strainer	Clean expansion valve
	Wrong oil viscosity	Use proper oil
	Short cycling	Refer to unit "short cycling"
	Superheat too high	Adjust expansion valve
Frosted or sweating suction line	Expansion valve set too low, admitting excess refrigerant	Adjust expansion valve
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
	Condenser fan not running	Check fan motor
	Dirty condenser coil	Clean condenser
Frosted liquid line	Restricted dehydrator	Replace
Condenser coil is cool when unit is in cool operation	Refrigerant undercharge	Repair leak and recharge
	Compressor inefficient	Replace compressor
Unit in vacuum, frost on expansion valve only	Ice plugging expansion valve orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace drier
	Plugged expansion valve strainer	Clean strainer
	Sensor bulb lost charge	Replace expansion valve

Refrigeration Diagnosis Chart

Unit Not Heating (Model 30/50)	Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in vacuum	Sight glass / empty	Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting	SYMPTOM POSSIBLE CAUSES
			•				•					•	•		Overcharge of refrigerant
				•	•		•		•	•			•	•	Shortage of refrigerant
				•	•			•	•	•		•	•	•	No refrigerant
			•												Air through condenser too hot (ambient)
			•												Air flow through condenser restricted
				•			•								Air through condenser too cold (ambient)
			•									•	•		Air in refrigerant system
	•														Air short cycling around evaporator coil
							•		•	•	•				Air through evaporator restricted
							•		•	•	•	•	•		Evaporator needs defrosting
				•											Compressor discharge valves leaking
							•					•	•		Too much compressor oil in system
												•			Compressor bearing loose or burned out
				•		•						•	•		Broken valve plate in compressor
							•		•				•		Expansion valve power element lost its charge
						•					•		•		Expansion valve feeler bulb improperly mounted
						•					•		•		Expansion valve feeler bulb making poor contact
						•				•	•				Expansion valve open too much
							•						•		Expansion valve closed too much
						•					•				Expansion valve needle eroded or leaking
				•			•		•				•		Expansion valve partially closed by ice, dirt or wax
						•					•	•	•		Liquid refrigerant entering compressor
							•		•				•		Restricted line on the low side
			•				•		•				•		Restricted line on the high side
			•				•		•				•		Restricted dehydrator
•		•											•	•	Loose or broken electrical connections
			•												Condenser fan motor not operating

Refrigeration Diagnosis Chart

Unit Not Heating (Model 30/50)	Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in vacuum	Sight glass / empty	Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting	SYMPTOM POSSIBLE CAUSES
•							•		•		•	•	•		Evaporator fan motor not operating
	•		•	•			•				•		•		Reverse fan rotation
•		•											•	•	Faulty Hot Gas Solenoid (HGS)
•													•	•	Faulty Condenser Inlet Solenoid (CIS)
						•						•			Faulty Liquid Injection Solenoid (LIS)
						•	•					•			Faulty CPR Bypass Solenoid (BYPS)
•														•	Faulty Liquid Line Check Valve

Diagram Index

The following table lists the diagrams that are relevant to these units.

The diagrams are available on TSA Info Central and in the V-220/V-320 Series Diagrams Manual TK 56454-18-DM.

Drawing No.	Drawing Title
3E34872	V-220/V-320/MAX 10 Schematic Diagram
3E34873	V-220/V-320/MAX 10 Wiring Diagram
3E34870	V-220/V-320/MAX 20 Schematic Diagram
3E34871	V-220/V-320/MAX 20 Wiring Diagram
3E34868	V-320 MAX 30 Schematic Diagram
3E34869	V-320 MAX 30 Wiring Diagram
3E34864	V-320 MAX 50 Schematic Diagram
3E34865	V-320 MAX 50 Wiring Diagram

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