THERMO KING

Maintenance Manual

Rail Edition
SLXi-DRC
Single Temperature Units

Revision B

August 2018

TK 56433-5-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	(08/17) Original release
Revision B	(08/18) Update R-404A to R-452A.

General Information

The maintenance information in this manual covers unit models:

System SLXi-DRC (903708)

For further information, refer to:

SLXi-DRC Operator's Manual	TK 56402
SLXi-DRC Parts Manual	TK 56471
SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual	TK 56487
SLXi-DRC Diagrams Manual	TK 56504
SLXi-DRC Single Temperature Installation Manual	TK 56403
TK482 and TK486 Engine Overhaul Manual	TK 50136
X214, X418, X426 and X430 Compressor Overhaul Manual	TK 6875
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.

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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.

⚠ DANGER

Confined Space Hazards!

Avoid engine operation in confined spaces and areas or circumstances where fumes from the engine could become trapped and cause serious injury or 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.

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.

Battery Removal

⚠ WARNING

Hazard of Explosion!

When removing battery cables, ALWAYS disconnect the negative battery terminal first. Then remove the positive terminal. When reconnecting the battery terminals, connect the positive terminal (+) first, and connect the negative (-) terminal last.

This order is important because the frame is grounded to the negative battery terminal. If the negative terminal is still connected, a complete circuit exists from the positive terminal of the battery to the frame. Metal objects contacting the positive side and the frame simultaneously will cause sparks or arcing. If there are sufficient hydrogen gases emitted from the

battery, an explosion might occur, causing equipment damage, serious injury, even death.

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

Low Voltage

Important: *Some components are connected directly to un-switched battery power. All connections and circuits labeled with a "2" prefix are connected directly to battery power. Always disconnect the battery before servicing the unit.*

⚠ 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. Disconnect the ECU and the battery charger if so equipped.
- 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.

Specifications

Engine

Model		TK486V25X (Tier 4)
Number of Cylinders		4
Cylinder Arrangement		In-line vertical, number 1 on flywheel end
Firing Order		1-3-4-2
Direction of Rotation		Counterclockwise viewed from flywheel end
Fuel Type		No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel
Oil Capacity		13 quarts (12.3 liters/litres) crankcase and oil filter Fill to full mark on dipstick
Oil Type		API Classification CJ-4 or CK-4 ACEA Rating E6
Oil Viscosity		14 F to 122 F (-10 C to 50 C): SAE 15W-40 (Synthetic) 5 to 104 F (-15 to 40 C): SAE 15W-40 5 to 104 F (-15 to 40 C): SAE 10W-30 (Synthetic or Synthetic Blend) -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 86 F (-25 to 30 C): SAE 10W-30 -22 to 122 F (-30 to 50 C): SAE 5W-40 (Synthetic) Below -22 F (-30 C): SAE 0W-30 (Synthetic)
Engine RPM	Low Speed Operation High Speed Operation	1450 ± 25 rpm Adjusted so throttle bracket is tight against high speed stop screw. Engine speed will be well above 2200 rpm in light refrigeration load situations.
Engine Oil Pressure		18 psig (127 kPa) minimum in low speed 45 to 57 psig (310 to 390 kPa) in high speed
Intake Valve Clearance		0.006 to 0.010 in. (0.15 to 0.25 mm)
Exhaust Valve Clearance		0.006 to 0.010 in. (0.15 to 0.25 mm)
Valve Setting Temperature		70 F (21 C)
Low Oil Pressure Switch (Normally Closed)		17 ± 3 psig (117 ± 21 kPa)
Engine Coolant Thermostat		160 F (71 C)
Engine Coolant Type ***NOTICE*** **System Contamination!** **Do not add other types of coolant to cooling systems using Chevron/Delo XLC except in an emergency. If another type of coolant is added, the coolant must be changed to Chevron/Delo XLC when available.**		Chevron/Delo XLC (Havoline XLC for Europe) - a nitrite-free Extended Life Coolant (ELC) Use a 50/50 concentration
Coolant System Capacity		7 quarts (6.6 liters/litres) with overflow tank
Radiator Cap Pressure		7 psi (0.48 bar)
Drive		Direct to compressor; belts to fans, alternator, and water pump

Belt Tension

		Use of Frequency Gauge P/N 204-1903 to measure frequency (Hz) is recommended.	
Model 30/50		**New Belt**	**Field Reset**
Electric Motor/Compressor Drive Belt	Units fitted with original SLX clutch (up until build date 13 August 2013)	73-76	67-72
	Units fitted with SLX clutch retrofit (P/N 78-1884)	Use service tool P/N 204-2436 to set belt tension. Distance of 139.0 mm as set by service tool equates to 78-81 Hz for a new belt, and 69-73 Hz for a field reset belt.	
	Units fitted with SLXe/SLXi clutch (P/N 77-3189)	Use service tool P/N 204-2436 to set belt tension. Distance of 139.0 mm as set by service tool equates to 95 Hz for a new belt.	
Fan Drive Belt	SLX/SLXe/SLXi	106-118	95-106
Water Pump Belt	Tension Number on TK Gauge 204–427 Field Reset: 35-40		

		Use of Frequency Gauge P/N 204-1903 to measure frequency (Hz) is recommended.	
Model 30		**New Belt**	**Field Reset**
Engine/Cross Shaft (Jackshaft) Belt	Clutch Tensioner (P/N 77-3189)	Use service tool P/N 204-2436 to set belt tension. Distance of 139.0 mm as set by service tool equates to 95 Hz for a new belt.	
Fan Drive Belt	TK Belt Tension Tool 204-3185	106-118 Hz	95-106 Hz
Water Pump Belt	Tension Number on TK Gauge 204-0427 Field Reset: 35-40		

Refrigeration System

Compressor	Thermo King X430P®
Refrigerant Charge - Type	12.5 lb (5.7 kg) – R452A
Compressor Oil Charge	4.3 qt (4.1 liters/litres)*
Compressor Oil Type	Polyol Ester type P/N 203-513
Heat/Defrost Method	Hot gas
High Pressure Cutout	470 +/-7 psi (3241 +/-48 kPa) Automatic reset @ 375 ± 38 psi (2586 ± 262 kPa)
* When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor in the unit.	

Electrical Control System

Voltage	12.5 Vdc (nominal)
Battery	One, Group C31, 12 volt battery (950 CCA recommended for operation below -15°F or -26°C)
Fuses	See Fuses in "Electrical Maintenance"
Battery Charging (Alternator)	37 ampere brush type
Voltage Regulator Setting (Alternator)	13.8 to 14.2 volts @ 25°C

Electrical Components

Note: *Disconnect components from the unit circuit to check resistance.*

Component		Current Draw (Amps) at 12.5 Vdc	Resistance — Cold (Ohms)
Fuel Solenoid	Pull-in Coil Hold-in Coil	35 to 45 0.5 or 1.0	0.2 to 0.3 24 to 29
High Speed (Throttle) Solenoid		2.9	4.3
Air Heater		60 to 70*	0.14
Damper Gear Motor		2.5 to 3.1	4.0 to 5.0
Pilot Solenoid		0.7	17.0
Electronic Throttling Valve	Coil A (Red [EVA] and Blue [EVB] Wires) Coil B (Black [EVC] and White [EVD] Wires)	- -	20 to 35 20 to 35
Hot Gas Bypass Valve		1.5	8.0
Starter Motor		350 to 475**	

* Typical current draw during preheat.
** On-the-engine cranking check. Bench test is approximately 140 amps.

Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Microprocessor
•				Run Pretrip Test.
				Engine
•				Check fuel supply.
•	•	•	•	Check engine oil level.
•	•	•	•	Inspect belts for condition and proper tension.
•	•	•	•	Inspect all belt tensioners and belt idler pulleys for condition and correct operation. Lubricate as needed.
•	•	•	•	Check engine oil pressure hot, on high speed (should display "OK").
•	•	•	•	Listen for unusual noises, vibrations, etc.
		•	•	Visually inspect exhaust system for leakage and abnormal smoke or particulate emissions.
•	•	•	•	Check engine coolant level and antifreeze protection (-30 F [-40 C]).
	•	•	•	Drain water from fuel tank and check vent.
	•	•	•	Inspect/clean fuel transfer pump inlet strainer.
	•	•	•	Check and adjust engine speeds (high and low speed).
	•	•	•	Check condition of drive coupling bushings per Service Bulletin TT171.
	•			Inspect air filter element - Dependent on operating conditions, assess fitness to continue to next service.
			•	Check engine mounts for wear.
		•		Replace EMI 3000 air cleaner element (see "EMI 3000 Air Cleaner") at 3,000 hours or two years (whichever occurs first).
		•		Replace EMI 3000 fuel filter/water separator. See Note.
		•		Change engine oil and oil filter (hot). Requires oil with API Classification CJ-4 or CK-4 (ACEA Rating E9).
		•		Adjust engine valve clearance.
		•		Test fuel injection nozzles at least every 3,000 hours. Based on EPA 40 CFR Part 89.
			—	Replace all belts every 6,000 hours or every 48 months (whichever occurs first).
			—	Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank (see "Engine Cooling System").
			—	Replace fuel return lines between fuel injection nozzles every 10,000 hours.
				Electrical
•	•	•	•	Check operation of defrost damper (closes on defrost initiation and opens on defrost termination).
	•	•	•	Inspect battery terminals.
	•	•	•	Inspect wire harness for damaged wires or connections.
			•	Inspect alternator wire connections for tightness and corrosion.

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
		•		Inspect alternator brushes.
			—	Change alternator brushes and regulator at 6,000 hours.
				Refrigeration
•	•	•	•	Check refrigerant level.
	•	•	•	Visually inspect condenser/radiator and evaporator coils for damage and dirt ingress.
	•	•	•	Check for proper suction and discharge pressures and ETV operation.
	•	•	•	Check compressor oil level and condition.
			•	Check compressor efficiency and pump down refrigeration system.
		•	—	Replace dehydrator and check discharge and suction pressure every two (2) years or 3,000 hours.
				Structural
•	•	•	•	Visually inspect unit for fluid leaks.
•	•	•	•	Visually inspect unit for damaged, loose, or broken parts (includes air ducts and bulkheads).
	•	•	•	Inspect cross shaft, fanshaft, and idlers for bearing wear (noise).
	•	•	•	Clean entire unit including condenser and evaporator coils and defrost drains.
	•	•	•	Check all unit and fuel tank mounting bolts, brackets, lines, hoses, etc.

Note: ** 3,000 hours or two years, whichever occurs first.*

Unit Description

Unit Overview

The Thermo King SLXi-DRC is a one piece, self-contained, diesel powered, air cooling/heating units operating under the control of the SMART REEFER 3 (SR-3) programmable microprocessor controller. The unit mounts on the front of the container with the evaporator extending through an opening in the front wall.

The unit features the quiet running Thermo King TK486V25X engine, and the Thermo King X430P reciprocating compressor.

Figure 1. Front View

Design Features

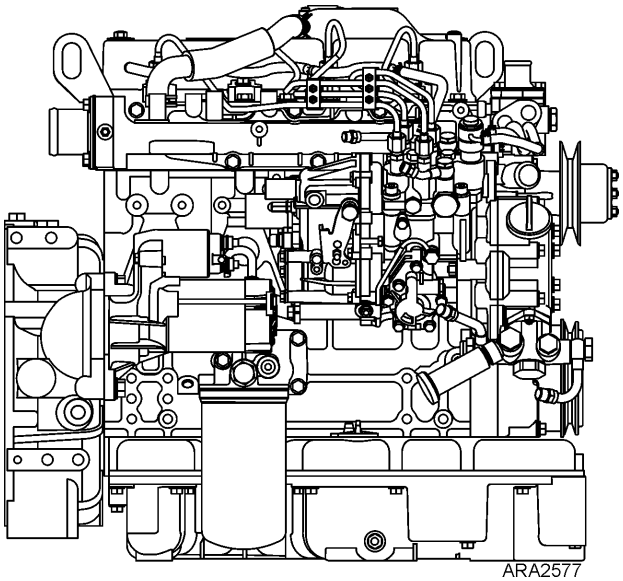
- SMART REEFER SR-3 Controller
- OptiSet™ Plus
- ServiceWatch™ Data Logger
- CargoWatch™ Data Logger
- Electronic Throttling Valve (ETV)
- EMI-3000
- Solar Panel (36 W)

Diesel Engine

The unit uses the TK486V25X, a 4-cylinder, water cooled, direct injection diesel engine.

The engine is coupled directly to the compressor. Belts transmit power to the unit fans, alternator, and water pump.

Figure 2. TK486V25X



Thermo King X430 Series Reciprocating Compressor

The unit is equipped with a Thermo King X430 Series four cylinder reciprocating compressor with 30.0 cu. in. (492 cm^3) displacement.

Electronic Throttling Valve

The Electronic Throttling Valve (ETV) is a variable position valve operated by a stepper motor. The ETV is located in the suction line between the accumulator and the suction vibrasorber. Discharge and suction pressure transducers supply pressure information to the microprocessor control system. The microprocessor controls the electronic throttling valve directly. The ETV replaces the mechanical throttling valve used in other units.

The ETV system provides enhanced control of the refrigeration system as follows:

- **Suction Pressure Control:** The suction pressure control algorithm is the primary control used to obtain maximum capacity. This allows the refrigeration system to fully utilize the power capabilities of the engine under varying conditions.
- **Discharge Pressure Protection:** This protection algorithm provides an additional measure of protection against high discharge pressures and possible compressor damage. It will prevent shutdowns in high ambient temperatures by

allowing continued operation of the unit at a temporarily reduced refrigeration capacity.

- **Engine Coolant Temperature Protection:** This protection algorithm protects the engine from high coolant temperature shutdowns and possible engine damage. It will reduce the load on the engine by temporarily reducing refrigeration capacity. This lowers the engine temperature while still allowing continued unit operation.
- **Modulation Control:** Modulation control provides precise control of the temperature in the cargo area. As the return air temperature begins to approach the setpoint, the microprocessor begins to close the ETV to reduce the capacity. The microprocessor closes the ETV more as the return air temperature gets closer to the setpoint. When the return air temperature is near setpoint, the ETV may close to its limit and the hot gas bypass valve may open. When the return air temperature begins to move away from the setpoint, the ETV begins to open and the hot gas bypass valve closes (if it was open). This provides very smooth and steady temperature control and the temperature does not oscillate above and below setpoint as much as it does in a unit that does not have modulation control.

SMART REEFER 3 (SR-3) Control System

⚠ CAUTION

Risk of Injury!

Do not operate the SR-3 Controller until you are completely familiar with its function.

The SR-3 is a microprocessor control system designed for a transport refrigeration system. The SR-3 integrates the following functions:

- Changing setpoint and operating mode
- Viewing gauge, sensor, and hourmeter readings
- Initiating Defrost cycles
- Viewing and clearing alarms

The microprocessor components are located inside the control box, which is located inside the lower roadside service door. The microprocessor is connected to a Human Machine Interface (HMI) Control Panel. It is used to operate the unit. The HMI control panel is mounted on the face of the control box. It is clearly visible through an opening in the lower roadside service door.

Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for complete operation and service information about the SR-3 Control System and the related components.

Refer to the Operator's Manual for information about basic unit operation.

CYCLE-SENTRY™ Start-Stop Controls

The CYCLE-SENTRY Start-Stop fuel saving system provides optimum operating economy.

⚠ WARNING

Risk of Injury!

The unit can start at any time without warning. Press the OFF key on the HMI control panel and place the microprocessor On/Off switch in the Off position before inspecting or servicing any part of the unit.

When CYCLE-SENTRY Mode is selected, the unit will start and stop automatically to maintain setpoint, keep the engine warm, and the battery charged. When Continuous Mode is selected, the unit starts automatically and runs continuously to maintain setpoint and provide constant airflow.

Note: *The SR-3 Controller provides a wide range of control and programming flexibility. However, pre-programming of the unit controller may prohibit operation in certain temperature ranges within some modes and may also prohibit certain modes of operation. Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/ SLXi Series Diagnostic Manual TK 56487 for information about controller programming.*

In CYCLE-SENTRY, if the block temperature falls below 30 F (-1 C), the engine will start and run until the block temperature is above 90 F (32 C). If the battery voltage falls to the programmed limit selected by CYCLE-SENTRY Battery Voltage (typically 12.6 volts) and Diesel CYCLE-SENTRY mode is selected, the engine will start and run until the charge rate falls below that programmed by CYCLE-SENTRY Amps (typically 2 amperes).

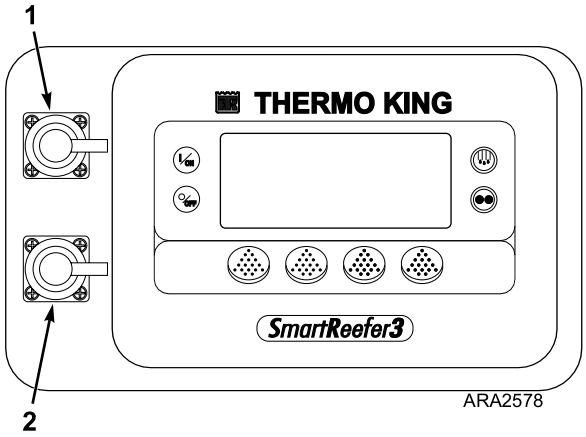
Features of the CYCLE-SENTRY system are:

- Offers either CYCLE-SENTRY or Continuous Run operation.
- Controller regulated all season temperature control.
- Maintains minimum engine temperature in low ambient conditions.
- Battery Sentry keeps batteries fully charged during unit operation.
- Variable preheat time.
- Preheat indicator buzzer.

Data Logging

There are two separate data loggers. The data is downloaded through one of the data ports using a flash drive or a PC and WinTrac software.

Figure 3. HMI Controller and Data Ports



1.	CargoWatch Port
2.	USB Port

ServiceWatch™ : ServiceWatch is standard equipment. It records operating events, alarm codes, and compartment temperatures as they occur and at preset intervals. This information is typically used to analyze unit performance. Use a USB port to download the ServiceWatch data.

Important: *A ServiceWatch download can be helpful when diagnosing a problem in a unit with an SR-3 Controller. Therefore, it is recommended that a ServiceWatch download be performed to help diagnose a problem. A ServiceWatch download must be preformed before contacting the Thermo King Service Department for assistance in diagnosing a problem. Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for information about downloading the ServiceWatch Data Logger and viewing the data.*

CargoWatch™ : CargoWatch data logging requires the installation of optional sensors. Up to six temperature sensor/probes and four door switches can be installed. CargoWatch also logs the setpoint. Use the USB Port to download the CargoWatch data. If optional temperature sensors are installed, the readings are displayed as Datalogger Sensor (1-6) Temperature in the sensor readings. See the appropriate Diagnostic or Operator's Manual for more information.

A printer can also be used to print a report of the optional sensor readings. See the appropriate Diagnostic or Operator's Manual for more information.

USB Port: A Universal Serial Bus (USB) port is provided on certain units. If installed, it is located on the unit control panel. Standard USB flash drives that have been programmed with WinTrac can be used. Use of a flash drive eliminates the need for an on-site computer and does not require cables.

Important: *The flash drive must be properly configured and the desired features must be enabled using WinTrac software.*

Using a properly configured and enabled flash drive, the following functions may be available:

- Download the ServiceWatch Data Logger
- Download the CargoWatch Data Logger
- Flash load Base Controller Software
- Flash load HMI Control Panel Software
- Send OptiSet Plus Files
- Retrieve OptiSet Plus Files

CargoWatch Port: The CargoWatch port is used to download the CargoWatch Data Logger and to flash load software to the HMI Control Panel. It is located on the Control Panel.

ServiceWatch Port: The ServiceWatch port is used to download the ServiceWatch data logger and to flash load software to the Base Controller. It is located inside the engine bay above the engine.

Printer Port: This port is used to print trip records from the CargoWatch Data Logger. It is located inside the control box.

TK BlueBox

The TK BlueBox is standard equipment on this unit.

This is a wireless communication platform for the SR-3/SR-4 Controller that offers fleet owners the ability to monitor their refrigerated units. Cellular, GPS, and Bluetooth capabilities communicate with Thermo King's web-based TracKing™ application, and Bluetooth with the TK Reefer App. A third party interface with the TK BlueBox offers a gateway for telematics providers to communicate with the Thermo King unit. Refer to the applicable TK BlueBox Diagnostic Manual (TK 56391 or TK 56469) for more information about the TK BlueBox.

CargoLink™

CargoLink™ is a wireless sensor system. The main components are the coordinator module, interconnect harness, antenna, and wireless sensors. The coordinator module receives information from the wireless sensors through the antenna, and communicates with the controller through the interconnect harness. Currently, only wireless door switches are available. Other wireless sensors will be available in the future. Refer to the Truck and Trailer Edition CargoLink Installation Manual (TK 55151) for information about installing the CargoLink system and sensors, and troubleshooting problems with the system.

OptiSet Plus™

OptiSet Plus is a group of programmable functions that control how the unit will operate with specific setpoints or named products. This assures that when a particular setpoint or named product is selected, the unit will always operate the same way. This allows an entire fleet to be configured to match customers' needs. Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 and OptiSet Plus Help for configuration instructions..

FreshSet™

FreshSet is included in OptiSet Plus. FreshSet is a demand base temperature control for fresh products. FreshSet modifies and adjusts unit airflow operation to control temperature and to maximize protection of cargo, while keeping operating costs to a minimum. Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for configuration instructions.

Sequence of Operation

When the Microprocessor On/Off switch is turned on and Controller ON key is pressed, the LCD display is illuminated and shows the setpoint and the return air temperature. If the CYCLE-SENTRY mode has been selected, the unit will start and stop automatically. If the Continuous mode has been selected, the unit will start and run automatically.

Operating Modes

The microprocessor uses a complex program to determine which operating mode the unit should be in. Therefore, it is difficult to predict which operating mode the unit should be in by comparing the setpoint to the box temperature.

The diesel engine operates at either low speed or high speed as determined by the microprocessor. The unit will Cool or Heat in either high or low speed. The unit will Defrost in low speed only. Heat and Defrost consists of hot gas delivered to the evaporator coil distributor.

The microprocessor will select the operating mode from the following:

- High Speed Cool
- Low Speed Cool
- Low Speed Modulated Cool
- Null (CYCLE-SENTRY operation only)
- Low Speed Modulated Heat
- Low Speed Heat
- High Speed Heat
- Defrost

Defrost

Frost gradually builds-up on evaporator coils as a result of normal operation. The unit uses hot refrigerant to defrost the evaporator coils. Hot refrigerant gas passes through the evaporator coil and melts the frost. The water flows through collection drain tubes onto the ground. The methods of Defrost initiation are Automatic and Manual.

Automatic Defrost: The controller is programmed to automatically initiate timed or demand defrost cycles. The controller can be programmed to initiate timed defrost cycles at intervals of 2, 4, 6, 8, or 12 hours. Demand defrost cycles occur if the differences between the return air temperature, discharge air temperature, and coil temperature exceed certain limits. The unit can enter defrost cycles as often as every 30 minutes if required.

Manual Defrost: In Manual Defrost Mode, the operator initiates a defrost cycle. See the appropriate Diagnostic or Operator's Manual.

Note: *The unit will not perform a Manual Defrost cycle unless the unit has been turned on with the ON key, the unit is running in Continuous or CYCLE-SENTRY mode (or shut down in CYCLE-SENTRY Null mode), and the coil temperature is below 45 F (7 C).*

The evaporator coil temperature must be below 45 F (7 C) to allow defrost.

The following four defrost timers are used. These timers can be set for intervals of 2, 4, 6, 8 or 12 hours.

- Defrost Interval In Range with Fresh Setpoint (standard setting 6 hours)
- Defrost Interval Not In Range with Fresh Setpoint (standard setting 4 hours)
- Defrost Interval In Range with Frozen Setpoint (standard setting 6 hours)
- Defrost Interval Not In Range with Frozen Setpoint (standard setting is 4 hours)

This feature allows a shorter Defrost interval to be used when the unit is out of range during a pull-down and more frequent Defrost cycles may be beneficial.

Normally, longer defrost timer intervals are used for colder loads. The defrost interval may need to be changed if the unit will not hold the compartment temperature at setpoint.

Use a longer defrost interval if defrost is not being initiated on demand.

Use a shorter defrost interval if defrost is frequently being initiated on demand.

If the unit is in CYCLE-SENTRY Null mode, the engine will start when defrost is initiated. The unit will stay in defrost until the evaporator coil temperature rises to 58 F (14 C).

Engine Compartment Components

The following maintenance items can be checked visually.

⚠ WARNING

Risk of Injury!

The unit can start at any time without warning. Press the OFF key on the HMI control panel and place the microprocessor On/Off switch in the Off position before inspecting or servicing any part of the unit.

Compressor Oil Sight Glass: Use this sight glass to check the compressor oil level. See the Refrigeration Maintenance section for the correct procedure.

⚠ CAUTION

Service Procedures!

Turn the unit off before attempting to check the engine oil.

Engine Oil Dipstick: Use the engine oil dipstick to check the engine oil level.

Receiver Tank Sight Glass: Use this sight glass to check the level of refrigerant in the receiver tank. See the Refrigeration Maintenance section for the correct procedure.

Figure 4. Engine Compartment Components

1.	Compressor Sight Glass	3.	Engine Oil Filter
2.	Engine Oil Dipstick		

Unit Protection Devices

Coolant Level Switch: The coolant level switch closes if the coolant level drops below an acceptable level. If it stays closed for a specified time, the microprocessor records Alarm Code 37.

Engine Coolant Temperature Sensor: The microprocessor uses the engine coolant temperature sensor to monitor the engine coolant temperature. If the engine coolant temperature rises above an acceptable level, the microprocessor records Alarm Code 41 and possibly 18. The microprocessor might also shut the unit down.

Fuse Link (Current Limiter): The fuse link is located in the positive battery cable. The fuse link protects the electric system from a short. If the fuse link burns out, replace it by replacing the positive battery cable.

Fuses: Various fuses are located on the base controller to protect circuits and components. See “Fuses” in the Electrical Maintenance Chapter for more information.

Smart FETs: Smart FETs in the base controller protect circuits and components. See “Smart FETs” in the Electrical Maintenance Chapter for more information.

High Pressure Cutout Switch: The high pressure cutout switch is located on the compressor discharge manifold. If the compressor discharge pressure becomes excessive, the switch opens the circuit to the run relay to stop the unit. The microprocessor will record Alarm Code 10.

High Pressure Relief Valve: This valve is designed to relieve excessive pressure in the refrigeration system. It is located on the receiver tank. The valve is a spring-loaded piston that lifts off its seat when refrigerant pressure exceeds 500 psig (3447 kPa). The valve will reseat when the pressure drops to 400 psig (2758 kPa). The valve could possibly leak refrigerant after it has relieved excess pressure. Tapping the valve lightly may help the valve reseat and seal properly. The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, recover the refrigerant charge and replace the valve.

Low Oil Level Switch: The low oil level switch closes if the oil drops below an acceptable level. If it stays closed for a specified time, the microprocessor shuts the unit down and records Alarm Code 66.

Low Oil Pressure Switch: The low oil pressure switch closes if the oil pressure drops below an acceptable level. If it stays closed for a specified time, the microprocessor shuts the unit down and records Alarm Code 19.

Preheat Buzzer: The preheat buzzer sounds when the controller energizes the preheat relay. This warns anyone near the unit that the controller is about to start the engine.

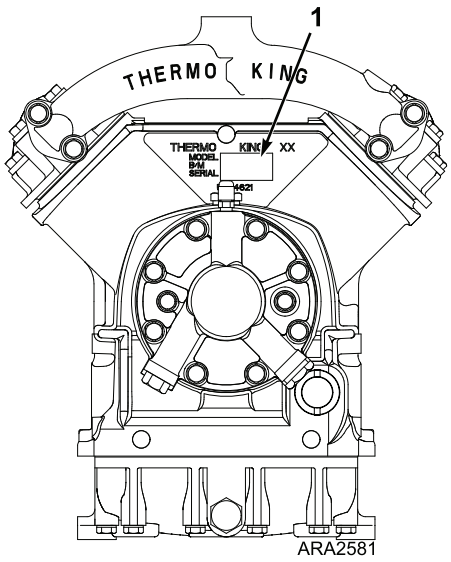
Serial Number Locations

Unit: Nameplate on the frame inside the front doors.

Engine: Engine identification plate is located on the engine valve cover.

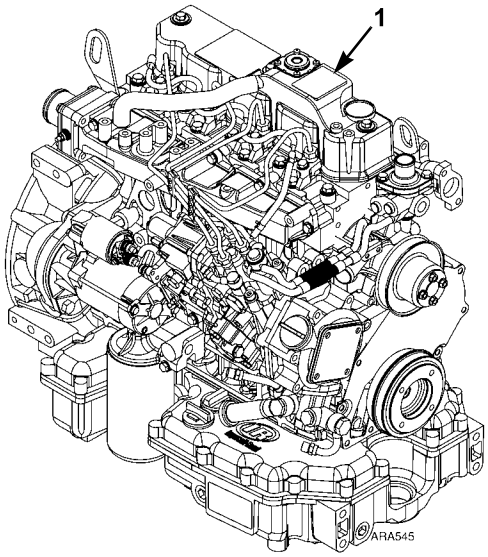
Compressor: Stamped between the cylinders on the front end above the oil pump.

Figure 5. Compressor Serial Number Location



1.	Serial Number Location

Figure 6. Engine Serial Number Location

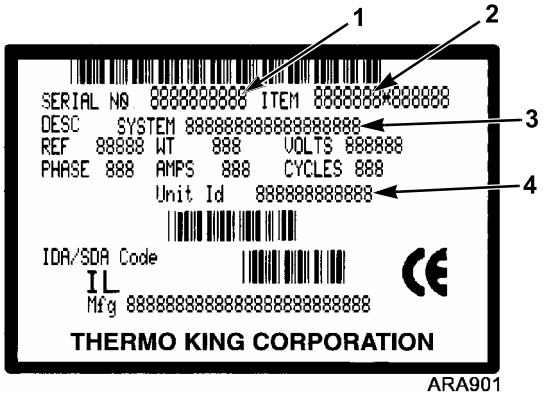


1.	Serial Number Location

Figure 7. Unit Serial Number Location

1.	On Frame In Engine Compartment

Figure 8. Laminated Serial Number Plate (Located Where Shown Above)



1.	Unit Serial Number
2.	Unit Model
3.	Bill of Material Number

Electrical Maintenance

Alternator Diagnostic Procedures

General Information

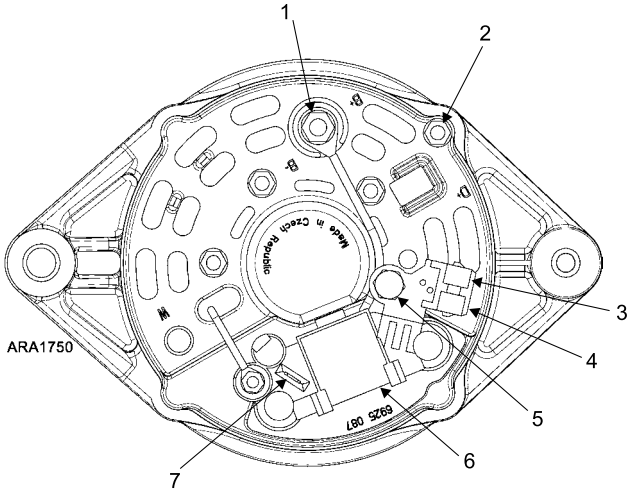
Poor charging performance may not be caused by a bad alternator. The following conditions can cause improper battery charging, even with a good alternator (See Service Bulletin T&T 388 for more information):

- A problem may exist in the 2A output circuit from the alternator to the base controller or in the 2 circuit from the base controller to the battery. Check for an open 2 or 2A circuits, fuses FS8 and FS10 if used, loose connections, defective battery cables, or dirty battery terminals.
- The battery must be in good condition and capable of accepting a charge. Check for a damaged battery, correct electrolyte level, and loose or corroded connections.
- The alternator charging output will be low if the alternator belt or pulleys are defective or the belt is not properly adjusted. Verify the belt is not loose or cracked and the pulleys are the correct size and in good condition.
- The excitation circuit (EXC circuit) must supply voltage to the excite terminal of the alternator.
- The sense circuit (2Y circuit) must supply voltage to the sense terminal of the alternator.
- The alternator must be properly grounded.
- The unit control circuits or installed accessories may be drawing excessive current.
- An overcharged battery is usually caused by a defective voltage regulator.

Alternator Identification

These units use Thermo King Alternators (Figure 9, p. 25), which are painted black.

Figure 9. Thermo King Alternator Terminal and Component Locations



1.	B+ Terminal (Positive Output - 2A Wire)	5.	F2 Terminal (Do Not Ground)
2.	B- Terminal (Negative Ground - CH Wire)	6.	Voltage Regulator and Brush Assembly
3.	S Terminal (Regulator Sense - 2 Wire)	7.	W Terminal (AC Output)
4.	L Terminal (Regulator Excite - 7K/EXC Wire)		

Base Controller Fuse F4

The base controller has a 300 ohm resistor and a resistor bypass fuse (F4) in the alternator excitation circuit. The fuse and resistor are connected in parallel and are located on the base controller. Removing the resistor bypass fuse places the 300 ohm resistor in the excitation circuit as required for Thermo King alternators (and Australian Bosch alternators). Installing the resistor bypass fuse removes the 300 ohm resistor from the excitation circuit as required for Prestolite alternators. See the specific unit wiring diagram for exact details.

Note: *The F4 fuse must be removed from the base controller on units equipped with Thermo King alternators. The voltage regulator on the Thermo King alternators will be damaged if the unit is turned On with the F4 fuse in place on the base controller.*

Test Equipment for Checking Voltage and Current

Always use accurate test equipment such as the Fluke 23 Digital Multi-Meter and the Fluke Clamp-On Ammeter accessory when checking alternator circuit voltage and amperage. See the table below for Thermo

King service part numbers. Verify voltages are measured from the designated terminal to the alternator chassis ground. All voltages are DC voltages unless otherwise noted.

Meter	Service Part Number
Fluke 23 Digital Multi-Meter	204-1079
Clamp-On Ammeter for above Meter	204-947

Alternator Load Test

Thermo King no longer recommends a full field test for determining the alternator current output. Full fielding an alternator can cause increases in alternator output voltage that may damage internal alternator or unit components. This damage may not be readily apparent.

To test the alternator under load, Thermo King recommends the use of a clamp-on ammeter to monitor output current, both on initial startup and under full unit load conditions. For example, on multi-temp units, all remote evaporators should be turned on.

General Diagnostic and Warranty Evaluation Procedure

Complete the following diagnostic procedures before replacing an alternator or the voltage regulator:

1. When testing an alternator, use accurate equipment such as a Thermo King P/N 204-1079 digital multimeter and a Thermo King P/N 204-947 amp clamp or equivalent.
2. Verify the drive belts and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Verify the pulleys are the correct size. Worn belts, loose belts, and worn or improperly sized pulleys will lower the output of the alternator.
3. The battery must be charged and in good condition, the battery cable connections must be clean and tight, and the 2A, 2 (sense), and EXC (excitation) circuits must be connected properly. All charging circuit connections must be clean and secure.

   Note: *If the unit battery is questionable, a known good jumper battery should be substituted for alternator testing.*

   Note: *Do not perform this test with a battery charger connected to the unit battery.*

   Note: *All voltage readings should be taken between the chassis ground on the alternator and the terminals indicated, unless stated otherwise.*

NOTICE

Equipment Damage!

Energizing the circuit with the resistor bypass fuse installed will damage Thermo King alternators. The resistor bypass fuse must be removed for Thermo King alternators.

4. Check that the resistor bypass fuse (F4) has been removed. Units with Thermo King alternators must have the resistor bypass fuse (F4) removed.
5. Check and note the battery voltage at the battery with the unit turned off.
6. With the unit off, check the voltage at the B+ terminal on the alternator. Battery voltage must be present. If not, check the 2A circuit and fuse F2 if used.
7. Disconnect the alternator harness from the voltage regulator. On Thermo King alternators, carefully push on the spring clip to release the plug lock.
8. Turn the unit on, enter the Interface Board Test Mode, and energize the Alternator Excite Output. Refer to the appropriate Diagnostic Manual for information about the Interface Board Test Mode.
9. Check the voltage at the sense circuit (2 circuit). Battery voltage should be present. If not, check the sense circuit (2 circuit) in the alternator harness and the main wire harness, and fuse F20 on the base controller.
10. Check the voltage at the excitation circuit (EXC circuit). 10 Vdc or more should be present. If not, check the excitation circuit (EXC circuit) in the alternator harness and the unified harness.

    Note: *LED 18 lights up when the EXC circuit is energized. The EXC circuit is operated by a Smart FET so during normal operation the unit must be running for the EXC circuit to be energized.*

11. Turn the unit off and reconnect the alternator harness.
12. Attach a clamp-on ammeter around the 2A wire connected to the B+ terminal on the alternator. All wires connected to the B+ terminal must pass through the clamp-on ammeter.
13. Connect a digital multi-meter between the B+ terminal at the alternator and chassis ground.
14. Turn the unit on and allow it to start. Using the clamp-on ammeter, check the current flow in the 2A wire.
    - A positive reading indicates the alternator is charging. On unit startup, the current flow should momentarily increase to allow for battery current used during preheat and cranking. Within a short time the current should fall to normal unit load plus charge current to the unit battery (typically 5-10 amps).

- A reading on the clamp-on ammeter at or near 0 amps indicates the alternator is not charging. Checking the unit ammeter will show a discharge condition. The alternator is defective if there are no problems in the wiring. Recheck the wiring before assuming the alternator is defective.

15. Check the voltage at the B+ terminal. The voltage should increase until it reaches the anticipated voltage regulator setting as shown in the table below. Record the voltage.
    - The voltage regulator setting varies inversely with the temperature as shown in the table below. Regulator voltage can vary from approximately 15.2 Vdc at -40 F (-40 C) to approximately 13.2 Vdc at 176 F (80 C).

Temperature	Anticipated Regulator Voltage
-40 F (-40 C)	From 15.2 Vdc to 14.0 Vdc
77 F (25 C)	From 14.4 Vdc to 13.6 Vdc
176 F (80 C)	From 14.2 Vdc to 13.2 Vdc

    - If the voltage does not increase to the anticipated voltage regulator setting, the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.
16. If the voltage does increase until it reaches the anticipated voltage regulator setting, compare the voltage at the B+ terminal to the voltage between the battery terminals. The voltage at the B+ terminal should be no more than 1.0 Vdc higher than the voltage between the battery terminals.
    a. If the voltage at the B+ terminal is no more than 1.0 Vdc higher than the voltage between the battery terminals, continue with Step 17.
    b. If the voltage at the B+ (POS) terminal is more than 1.0 Vdc higher than the voltage between the battery terminals, clean and check the wires and connections in the 2A and 2 circuits and repeat this check.
17. Increase the charging system load as much as possible by running the unit in high speed heat.
18. Monitor the alternator output voltage.
    a. With the increased load, the alternator output voltage should decrease no more than 0.5 Vdc. The voltage may increase as much as 1.0 Vdc. If the alternator output voltage decreases no more than 0.5 Vdc the alternator is good.
    b. If the alternator output voltage decreases more than 0.5 Vdc, the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.
19. **Alternator Diode Quick Check:**

    Note: *This check confirms proper diode function.*

    a. With the unit still running, set the digital multimeter connected from the alternator B+ output to chassis ground for AC volts. No more than 1.0 Vac should be present. A reading of more than 1.0 Vac indicates damaged alternator diodes.
20. Turn the unit off.

Field Current Test

Use this test to determine if the alternator can be repaired. Perform this test with the unit turned off.

1. Attach a clamp-on ammeter to the 2A wire near the B+ terminal on the alternator.
2. Energize the field on the Thermo King alternator by connecting a jumper wire between the F2 terminal and the B+ terminal. Do not connect the F2 terminal to ground or the alternator will be damaged.
3. Note the ammeter reading. The ammeter reading indicates the field current, which should be 2.0 to 6.0 amps at 12 volts.
    a. No field current or a low field current indicates an open circuit or excessive resistance in the field circuit. Remove the voltage regulator and brush assembly and inspect the slip rings. If the slip rings and are acceptable, install a new voltage regulator and brush assembly and repeat the test. If the brushes are not the problem, replace the alternator.
    b. High field current indicates a short in the field circuit. Replace the rotor or the alternator.

Battery

Filler Cap Batteries

1. Inspect/clean the battery terminals and check the electrolyte level during scheduled maintenance inspections.
2. A dead or low battery can be the cause of an ammeter indicating discharge due to lack of initial excitation of the alternator even after the unit has been boosted for starting.
3. The minimum specific gravity should be 1.235.
4. Add distilled water as necessary to maintain the proper water level.

Maintenance Free Batteries

1. Inspect/clean the battery terminals and check the electrolyte level using the integrated sight glass during scheduled maintenance inspections.
2. A dead or low battery can be the cause of an ammeter indicating discharge due to lack of initial excitation of the alternator even after the unit has been boosted for starting.

Battery Load Test

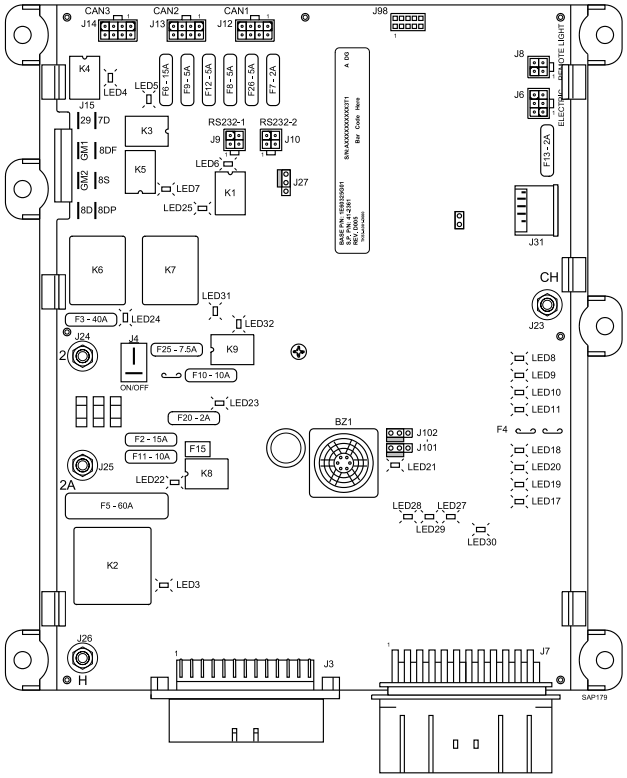
1. Verify battery voltage of at least 12.5v before load testing.
2. Apply 50% Cold Cranking Amps (CCA) load for 15 seconds and verify minimum voltage of 9.6v.

Battery Cables

The units use 0-gauge battery cables to ensure reliable starting in extremely cold weather. Verify the use of the 0-gauge battery cables when replacing the battery cables. Refer to the unit Parts Manual for the correct part numbers.

Base Controller

Figure 10. SR-3 Base Controller



Base Controller Fuse Size & Function

Fuse	Size	Function
F2	15A	Power to On/Off Switch
F3	40A	Power to Fuel Sol Pull-In/Starter Solenoid
F4	None or 2A	No fuse - all Bosch and TK alternators (See Note) 2A fuse - all Prestolite alternators (See Note)
F5	60A	Preheat Circuit (See Note)
F6	15A	Power to Damper and High Speed Solenoids
F7	2A	Switch On Power to CAN Bus
F8	5A	2A power to CAN Connector J12
F9	5A	2A power to CAN Connector J14
F10	10A	Power to On Relay (Right Position) Bypass HMI Control of Power (Left Position)
F11	10A	Power to Auto Fresh Air Solenoid
F12	5A	2A power to CAN Connector J13
F13	2A	Power to Remote Lights
F15	P/S	On/Off Relay (See Note)
F20	2A	Power to Alternator Sense
F25	7.5A	Power to HPCO

Notes:

1. *Fuse F4 must be in place for Prestolite alternators to charge. Fuse F4 must be removed for Bosch and Thermo King alternators. Service Parts Base Controllers are shipped without the F4 fuse.*
2. *The F5 preheat fuse is a "slow blow" type fuse. It is designed for use with the engine air pre-heater. Always replace the fuse with the TK specified fuse. Service Parts Base Controllers are shipped without the F5 fuse.*
3. *The device identified as F15 is a polyswitch. This polyswitch provides over-current protection for the On/Off relay. The polyswitch will reset automatically and is not field repairable.*

Fuse F10

There are three in-line fuse clips that allow for two configurations of the F10 fuse. The right position is the normal position. This position has a white bar below it on the circuit board. When fuse F10 is installed in the right position, control power is routed to the K9 On/Off Relay contacts. The On/Off keys on the HMI Control Panel energize and de-energize the K9 On/Off Relay. When the K9 On/Off Relay is energized, power is supplied through the normally open K9 contacts to turn the unit on.

When fuse F10 is installed in the left position, power bypasses the K9 On/Off relay contacts and the unit will start and run without the HMI Control Panel connected. **This fuse position is for emergency bypass operation only.** Do not operate the unit with the F10 fuse installed in the left position unless absolutely necessary.

Important: *If fuse F10 is installed in the left position, the unit may start and run. If the HMI Control Panel is connected and functional, the On and Off keys will still work. The Off key will turn the unit off if fuse F10 is in the left position, but the Base Controller will remain powered up.*

Important: *If fuse F10 is installed in the left position and the unit is turned off using the Off key, the unit will shut down but the Base Controller will remain powered up. Leaving the unit turned off in this manner for an extended period may result in a dead battery.*

Fuse F15

The device identified as F15 is a poly switch. This over-current device resets automatically and is not replaceable.

LED Functions

The LED is illuminated when the associated circuit output is energized. Not all output LEDs shown are used on single temperature trailer applications.

LED #	Function	LED #	Function
LED 3	K2 Preheat	LED 19	Liquid Injection Valve (Not Used)
LED 4	K4 Damper Solenoid	LED 20	Loader Valve 3 (Not Used)
LED 5	K3 High Speed Solenoid	LED 21	Heartbeat (Note 1)
LED 6	K1 Run Relay	LED 22	K8 Auto Fresh Air Solenoid (Optional)
LED 7	K5 Diesel/Electric Relay	LED 23	K9 On/Off Relay
LED 8	Pilot Solenoid or Condenser Inlet Solenoid	LED 24	K6 Fuel Solenoid Pull-In
LED 9	Receiver Tank Pressure Solenoid/ Liquid Line Solenoid	LED 25	K7 Starter Relay
LED 10	Hot Gas Bypass/ Loader Valve 2	LED 27	ETV-D (Note 2)
LED 11	Purge Valve (Not Used)	LED 28	ETV-B (Note 2)
LED 17	Loader Valve 1 (Not Used)	LED 29	ETV-A (Note 2)
LED 18	Alternator Excite	LED 30	ETV-C (Note 2)

Notes:

1. *The Status LED flashes once per second when the Base Controller is powered and operating normally. The Status LED flashes several times per second during a flash load. The Status LED is on without flashing during reboot and when the Base Controller is under test. The Status LED flashes twice within one second followed by one second off if a CAN communication error is present.*
2. *ETV LEDs are illuminated when the respective ETV output is energized. On applications without ETV, the LEDs may be illuminated.*

Smart FET Outputs

A Smart FET is a self protecting output device used for the functions shown in the table. Smart FETs halt current flow if an over-current condition exists and generate an alarm. The Smart FET will resume normal operation when the alarm is cleared and current flow is within limits. Smart FETs are not field repairable. A fuse is not required.

Output	Function
EVA, EVB, EVC, EVD	ETV Outputs
26/PS	Pilot Solenoid
HG/HGS	Hot Gas/Hot Gas Bypass Solenoid
LV1	Not Used
LV3	Not Used
EXC	Alternator Excitation
LQI	Liquid Injection Valve
LLS	Not Used
GM1, GM2	Damper Gear Motor (See Note)
CIS	Not Used
RTPS	Not Used
PV	Not Used

Note: *Gear motor circuitry not present on all Base Controllers.*

SMART REEFER 3 (SR-3) Microprocessor Controller

Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for complete service information about the Microprocessor Controller and related components.

Important: *A ServiceWatch download can be helpful when diagnosing a problem in a unit with an SR-3 Controller. Therefore, it is recommended that a ServiceWatch download be preformed to help diagnose a problem. A ServiceWatch download must be preformed before contacting the Thermo King Service Department for assistance in diagnosing a problem. Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for information about downloading the ServiceWatch Data Logger and viewing the data.*

Fuse Link

The fuse link is located in the positive battery cable. The fuse link protects the electric system from a short in the 2 circuit. If the fuse link burns out, check for a

grounded 2 wire before replacing the fuse link. Replace the fuse link by replacing the positive battery cable.

Air Heater

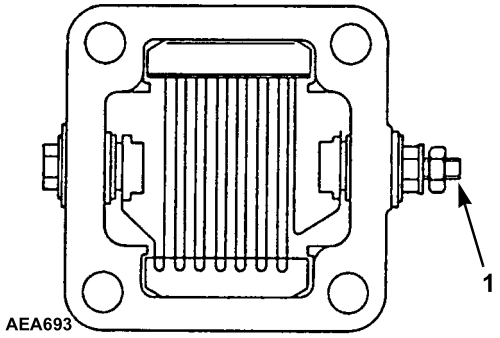
The air heater is mounted on the open end of the intake manifold. It heats the intake air to help the engine start in cold weather. The air heater is energized by the microprocessor during preheat, just before the engine is started.

The heater is probably defective if the resistance is more than 0.2 ohms and the current draw is less than 60 amps, or if the current draw is more than 100 amps.

Check the resistance of the air intake heater with an ohmmeter between the M6 terminal on the front of the heater and the screw on the back of the heater (or the heater case). The resistance should be 0.14 ± 0.02 ohms.

Check the current draw of the heater with a clamp-on ammeter at the H1 wire near the M6 terminal on the front of the heater. During preheat the current draw should be approximately 70 amps.

Figure 11. Air Heater



1.	M6 Terminal

Unit Wiring

Inspect the unit wiring and the wire harnesses during scheduled maintenance inspections for loose, chafed, or broken wires to protect against unit malfunctions due to open or short circuits.

Wire Harness Routing

Do not change the factory routing of the wire harnesses inside the unit.

Engine Maintenance

EMI 3000

EMI 3000 is an extended maintenance interval package. The EMI 3000 package consists of the following key components:

- EMI 3000-Hour Cyclonic Air Cleaner Assembly and Air Cleaner Element
- EMI 3000-Hour 5-Micron Fuel Filter
- EMI 3000-Hour Dual Element Oil Filter (blue with white lettering)
- API Classification CJ-4 or CK-4 Oil
- Five Year or 12,000 Hour Extended Life Coolant (ELC)

The EMI package allows standard maintenance intervals to be extended to 3,000 hours, or 2 years, whichever occurs first.

Note: *Units equipped with the EMI 3000 package do require regular inspection in accordance with Thermo King's maintenance recommendations.*

Note: *The new EMI 3000 oil filters and new EMI 3000 air cleaners are NOT interchangeable with the oil filters and air cleaners previously used in trailer units.*

Engine Lubrication System

The TK486 family of engines use a pressure lubrication system. Refer to the TK482 and TK486 Engine Overhaul Manual (TK 50136-2-OM) for a detailed description of the engine lubrication system.

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule.

1. Drain the oil only when the engine is hot to verify that all the oil drains out.
2. When changing oil, keep unit and trailer level so all the oil can flow from the oil pan.

   Note: *It is important to get as much of the oil out as possible because most of the dirt particles are contained in the last few quarts of oil that drain out of the pan.*
3. Refill the pan with oil and check the dipstick level. The new oil filter must also be filled with oil before it is installed, therefore use a total of approximately 13 quarts (12.3 liters/litres) to fill the oil filter and refill the pan.
4. Run the unit, and recheck the oil level.
5. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into the oil pan. Never overfill.
6. See Specifications for correct type of oil.

Oil Filter Change

The oil filter should be changed along with the engine oil. Use a genuine Thermo King extended maintenance oil filter.

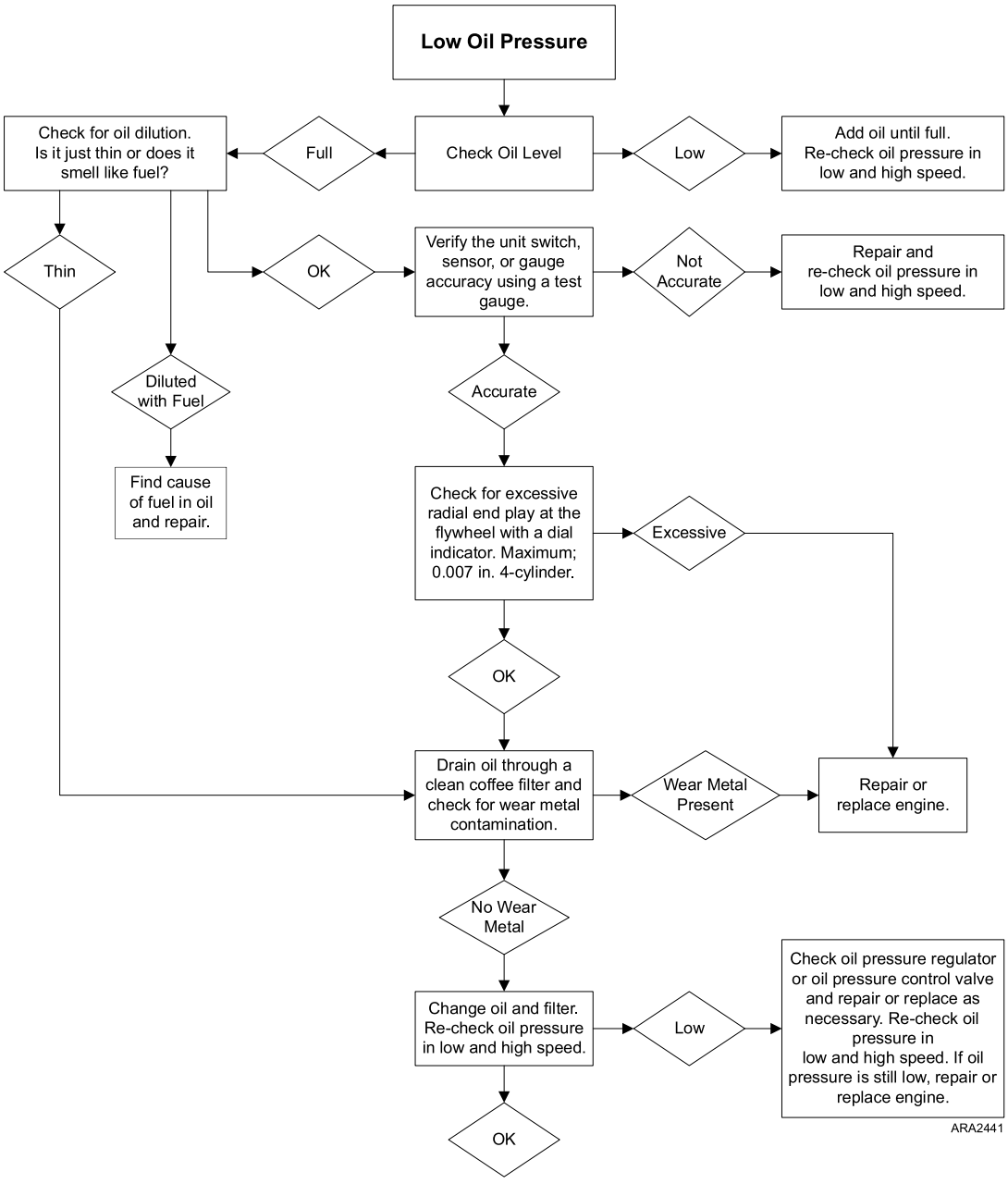
1. Remove the filter.
2. Fill the new oil filter with clean engine oil.
3. Apply oil to the two inner O-rings of the new filter and install the filter.
4. Hand tighten the filter until it seats firmly. The exposed dust seal ring, if equipped, does not need to be compressed.
5. Start the unit and check for leaks.

Low Oil Pressure

Oil pressure is affected by oil temperature, oil viscosity, and engine speed.

- Low oil pressure can usually be traced to the lack of oil, a faulty oil pressure regulating valve, or worn bearings.
- Low oil pressure is not normally caused by a faulty oil pump.
- Use the “Low Oil Pressure Flow Chart” (Figure 12, p. 32) to help diagnose low oil pressure.

Figure 12. Low Oil Pressure Flow Chart



Engine Cooling System

The engine employs a closed, circulating type, pressurized cooling system. Correct engine temperatures are controlled and maintained by a radiator, fan, and thermostat. The coolant is circulated through the system by a belt driven centrifugal pump. The pump draws the coolant from the side of the radiator, circulates it through the cylinder block and head and returns it to the radiator. A thermostat mounted in the coolant outlet line from the cylinder head to the radiator automatically maintains coolant temperature within the specified temperature range.

All water cooled engines are shipped from the factory with a 50 percent permanent type antifreeze concentrate and 50 percent water mixture in the engine cooling system.

This provides the following:

1. Prevents freezing down to -30 F (-34 C).
2. Retards rust and mineral scale that can cause engine overheating.
3. Retards corrosion (acid) that can attack accumulator tanks, water tubes, radiators, and core plugs.
4. Provides lubrication for the water pump seal.

Extended Life Coolant (ELC)

Chevron/Delo XLC is currently the only Extended Life Coolant approved by Thermo King for use in these units for five years or 12,000 hours:

NOTICE

System Contamination!

Do not add other types of coolant to cooling systems using Chevron/Delo XLC except in an emergency. If another type of coolant is added, the coolant must be changed to Chevron/Delo XLC when available.

Note: *The use of 50/50 percent pre-mixed Extended Life Coolant (ELC) is recommended to assure that de-ionized water is being used. If 100 percent full strength concentrate is used, de-ionized or distilled water is recommended over tap water to insure the integrity of the cooling system is maintained.*

Antifreeze Maintenance Procedure

As with all equipment containing antifreeze, periodic inspection on a regular basis is required to verify the condition of the antifreeze. Inhibitors become worn out and must be replaced by changing the antifreeze. Change ELC (red) engine coolant every five years or 12,000 hours (whichever occurs first).

Do not mix green or blue-green engine coolant with ELC (red) engine coolant. See "Extended Life Coolant (ELC)" for more information about ELC.

The factory recommends the use of a 50/50 antifreeze mixture in all units even if they are not exposed to freezing temperatures. This antifreeze mixture will provide the required corrosion protection and lubrication for the water pump.

Checking the Antifreeze

Check the solution concentration by using a temperature compensated antifreeze hydrometer or a refractometer (P/N 204-754) designed for testing antifreeze. Maintain a minimum of 50 percent permanent type antifreeze concentrate and 50 percent water solution to provide protection to -30 F (-34 C). Do not mix antifreeze stronger than 68 percent permanent type coolant concentrate and 32 percent water for use in extreme temperatures.

Changing the Antifreeze

1. Run the engine until it is up to its normal operating temperature. Stop the unit.

⚠ CAUTION

Risk of Injury!

Avoid direct contact with hot coolant.

2. Open the engine block drain and completely drain the coolant. Observe the coolant color. If the coolant is dirty, proceed with steps a, b, and c. Otherwise proceed to step 3.
   a. Run clear water into the radiator and allow it to drain out of the block until it is clear.
   b. Close the block drain and install a commercially available radiator and block flushing agent, and operate the unit in accordance with instructions of the flushing agent manufacturer.

⚠ CAUTION

Risk of Injury!

Avoid direct contact with hot coolant.

   c. Open the engine block drain to drain the water and flushing solution.
3. Run clear water into the radiator, and allow it to drain out of the block until it is clear.
4. Inspect all hoses for deterioration and hose clamp tightness. Replace if necessary.
5. Loosen the water pump belt. Check the water pump bearing for looseness.
6. Inspect the radiator cap. Replace the cap if the gasket shows any signs of deterioration.
7. If using ELC concentrate, mix one gallon of ELC concentrate and one gallon of de-ionized or distilled water in a container to make a 50/50 mixture (Do not add antifreeze and then water to the unit. This procedure may not give a true 50/50 mixture because the exact cooling system capacity may not always be known).
8. Refill the radiator with the 50/50 antifreeze mixture and verify to bleed the air from the cooling system as needed.

Bleeding Air from the Cooling System

Jiggle pin thermostats are original equipment on units that have engines from the TK486 family of engines. Jiggle pin thermostats make it unnecessary to bleed the air out of the engine block because they keep air from being trapped in the engine block. Normally, all but about 1.5 qt (1.4 liters) of coolant drain out of the cooling system when it is drained. If approximately half of the Cooling System Capacity (see Specifications Chapter) seems to fill the cooling system after it has been drained, air has been trapped in the block. Bleed the air out of the block using the following procedure:

NOTICE

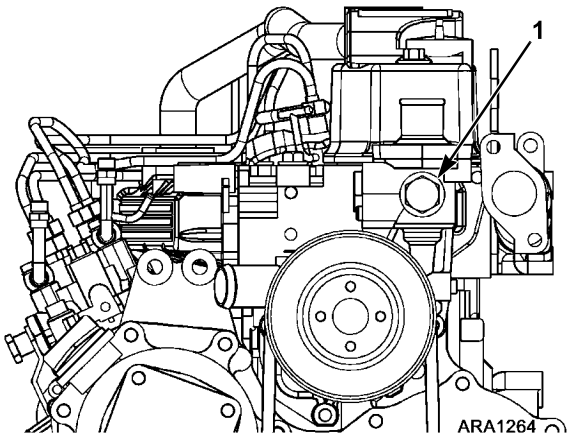
Equipment Damage!

Do not start the engine without bleeding the air out of the block.

Note: *If an engine runs with air trapped in the block, the engine may be damaged. The high water temperature switch may not protect an engine that has air trapped in the block, because the high water temperature switch is designed to protect an engine from overheating due to failures in the cooling system.*

1. Remove the plug from the front end of the water pump below the thermostat housing as shown (Figure 13, p. 34).
2. Slowly pour the coolant into the system until you see coolant at the plug fitting.
3. Reinstall the plug.
4. Pour coolant into the system until it appears to be full.

Figure 13. Remove Plug from Water Pump



1.	Plug

5. Verify that the amount of coolant that goes back into the system is approximately equal to the amount of coolant that came out of the system.
6. Start the engine and monitor the coolant temperature with the unit engine coolant temperature gauge, or by using a non-contact thermometer pointed at the thermostat housing in the location of the high water temperature switch or sensor.
   a. When the temperature reaches 150 F (66 C), shut the engine off for two minutes.

      Note: *This allows time for the thermostat to heat soak and open fully, ensuring that any remaining air will be purged out of the engine block when the engine is restarted.*
7. Restart the engine and run it in low speed.
   a. Remove the cap from the expansion tank and slowly pour coolant into expansion tank until it is full, then reinstall the expansion tank cap.
8. Repeat steps 6 and 7 until the coolant level stabilizes.

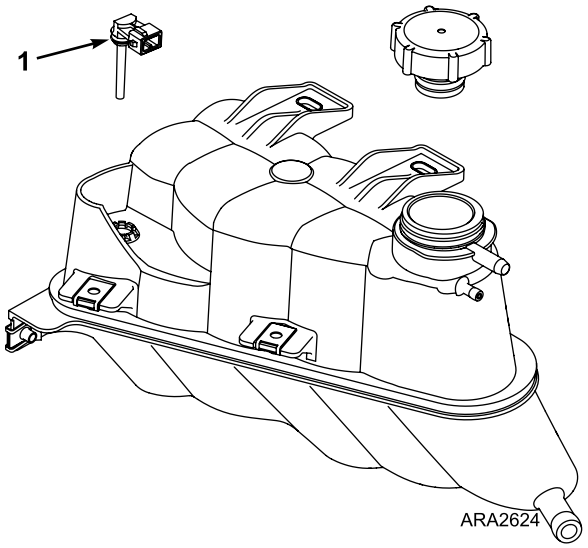
Engine Thermostat

For the best engine operation, use a 160 F (71 C) thermostat year-round.

Coolant Level Switch

The expansion tank uses a reed type coolant level switch. The coolant level switch senses the position of the magnetic float inside the expansion tank. When the coolant level is above the switch, the float is in the upper position and the switch is closed. When the coolant level is below the switch, the float is in the lower position and the switch is open.

Figure 14. Expansion Tank



1.	Coolant Level Switch

Testing the Coolant Level Switch

Testing the switch in the unit is accomplished by adjusting the coolant level and also by removing the expansion tank from the unit by flipping the tank upside down and right side up.

1. Remove the wire harness connector from the coolant level switch.
2. Use an ohmmeter to check the continuity of the switch at the connection pins.
3. Verify the coolant level is above the switch and check the continuity of the switch. The switch should be closed. If the tank was removed from the unit, accomplish this check with the tank upside down.
4. Drain coolant from the expansion tank until the coolant level is well below the switch level and check continuity of the switch. The switch should be open. If the tank was removed from the unit,

accomplish this check with the tank right side up.

5. Replace the switch if it is does not close in step 3 and does not open in step 4.

Checking the Float

The float is made of polypropylene foam. It is unlikely that the float would fail unless it sticks inside the tank so it cannot move.

1. Verify the coolant level is above the float.
2. Slowly drain coolant from the expansion tank and watch the float. The float should drop with the coolant level.
3. If the float did not drop with the coolant level, remove the expansion tank from the unit.
4. Flip the expansion tank upside down and right side up to see if the float moves inside the expansion tank. Replace the expansion tank with a new one if the float is stuck or does not move with the coolant level.

Replacing the Coolant Level Switch

1. Disconnect the wire harness connector from the coolant level switch.
2. Pull the coolant level switch straight up to remove it from the tank. It may be necessary to use a small pry bar or screwdriver. Take care to avoid damage to the tank or switch.
3. Place the new coolant level switch in the tank and press it straight down until it snaps into place. Check to make sure it is securely in place.
4. Connect the wire harness connector to the coolant level switch.

Engine Fuel System

The TK486V25X engine uses a mono-plunger and distributor injection pump.

The components of the fuel system are:

- Fuel tank
- Fuel pre-strainer
- Inlet strainer (in fuel transfer pump)
- Priming pump
- Fuel transfer pump
- Fuel filter/water separator
- Injection pump
- Trochoid feed pump
- Injection nozzles

The priming pump is used to manually draw fuel from the tank up to the fuel transfer pump if the unit should run out of fuel.

Operation

Fuel is drawn from the fuel tank and through the fuel pre-strainer and inlet strainer by the fuel transfer pump. The fuel transfer pump delivers fuel to the fuel filter/water separator. Two orifices in the filter head control the pressure in the fuel system by allowing a certain amount of fuel to return to the tank. One orifice is located in the center of the filter head. It bleeds off water. The other orifice is located off-center on the filter head. It bleeds off air. Filtered fuel passes through a line from the outlet fitting on the filter base to the injection pump.

The injection pump forces the fuel, at a very high pressure, through the injection nozzles. The injection nozzles atomize the fuel as it is injected directly into the combustion chambers.

Injection pump leakage, injection nozzle overflow and excess fuel from the fuel filter orifice are then all sent back to the fuel tank in the return line.

Fuel Line Routing

The fuel lines from the fuel tank connect to the fittings on the fuel filter. Do not change the factory routing of the fuel lines from the fuel filter to the injection pump.

Maintenance

The injection pump and fuel transfer pump are relatively trouble-free and if properly maintained will usually not require major service repairs between engine overhauls.

Contamination is the most common cause of fuel system problems. Therefore, to ensure best operating results, the fuel must be clean and fuel tanks must be free of contaminants. Change the fuel filter/water separator regularly, inspect/clean the fuel pre-strainer, and clean the inlet strainer on the inlet side of the fuel transfer pump.

Important: *Do not open the fuel system unless required.*

Note: *The injection nozzles must be cleaned and tested (and repaired if necessary) at least every 3,000 hours in accordance with EPA 40 CFR Part 89. Normal conditions are considered to be the use of clean high quality fuel, no used oil blending, and regular maintenance of the fuel system according to the Maintenance Inspection Schedule. Refer to the TK482 and TK486 Overhaul Manual TK 50136 for injection nozzle testing and repair procedures.*

Whenever the fuel system is opened, take the following precautions to prevent dirt from entering the system:

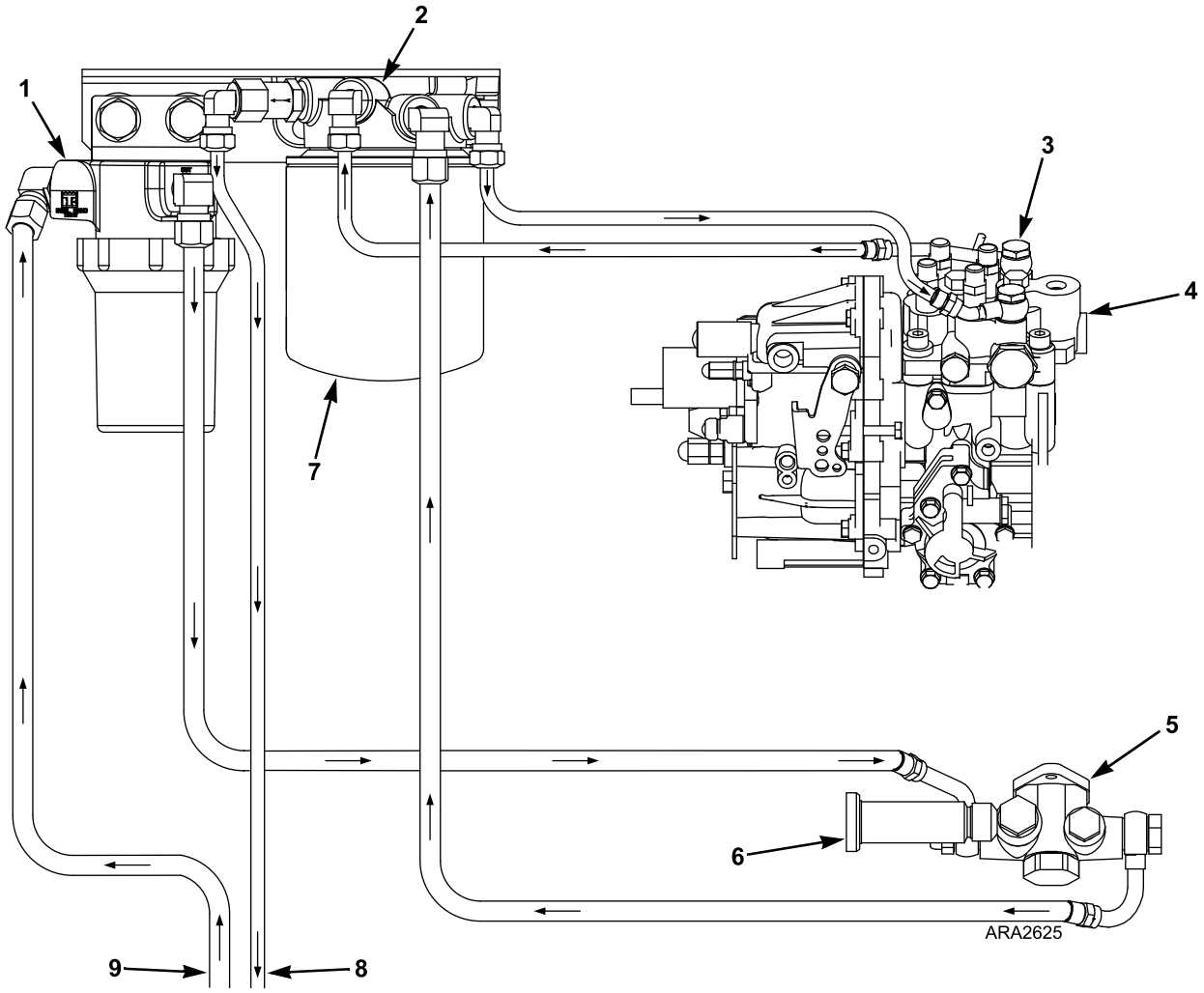
- Cap all fuel lines.
- Work in a relatively clean area whenever possible.
- Complete the work in the shortest possible time.

Any major injection pump or nozzle repairs should be done by a quality diesel injection service shop. The necessary service equipment and facilities are not found in most engine rebuild shops because of the large investment required.

The following procedures can be accomplished under field conditions:

- Bleeding air from the fuel system.
- Fuel tank and filter system maintenance.
- Priming pump (hand) replacement or repair.
- Fuel transfer pump replacement or repair.
- Injection line replacement.
- Engine speed adjustments.
- Injection pump timing.
- Nozzle spray pattern testing and adjustment.
- Injection nozzle testing, adjustment, and minor repair.
- Trochoid feed pump replacement.

Figure 15. Fuel System SLXi DRC

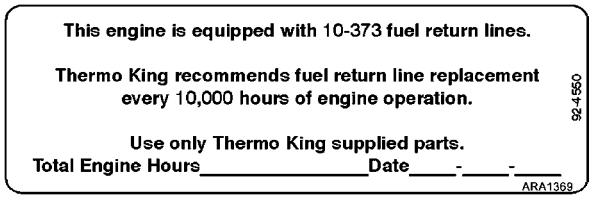


1.	Fuel Pre-Strainer	6.	Priming Pump
2.	Filter Head	7.	Fuel Filter/Water Separator
3.	Bleed Screw	8.	Return Line (To Fuel Tank)
4.	Mono-plunger and Distributor Injection Pump	9.	Inlet Line (From Fuel Tank)
5.	Fuel Transfer Pump		

Fuel Return Line Replacement

The fuel return lines (hoses) and end cap on the fuel injection nozzles should be changed every 10,000 engine operating hours. The return line kit (P/N 10-373) contains new return lines, clamps, an end cap, and a decal like the one shown below. The decal is located near the unit serial plate. The date and engine hours must be entered on the decal when the fuel return lines are changed.

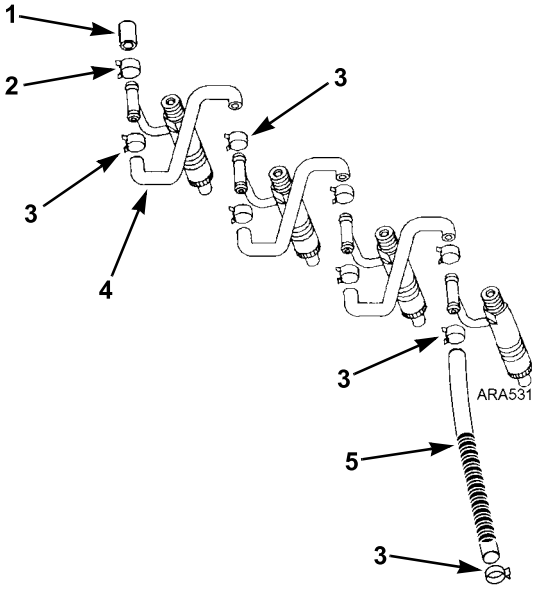
Figure 16. Fuel Return Line Replacement Decal



Use the following procedure to replace the fuel return lines and end cap.

1. Remove the clamps, the end cap, the short fuel return lines between the injection nozzles, and the long fuel return line from the injection nozzle to the banjo fitting on the injection pump.

Figure 17. Fuel Return Line Replacement



1.	End Cap	4.	Short Fuel Return Lines
2.	Larger Clamp	5.	Long Fuel Return Lines
3.	Smaller Clamps		

2. Discard the old clamps, end cap, and fuel return lines.
3. Install the end cap and clamp. Note that the end cap has a larger OD than the other hoses and requires the larger clamp.
4. Install the fuel return lines and clamps. It may be necessary to adjust the banjo fitting slightly to obtain the straightest routing for the long return line.
5. Be sure all the fittings are tight and check for leaks.
6. Write the date and engine hours on the decal.

Bleeding the Fuel System

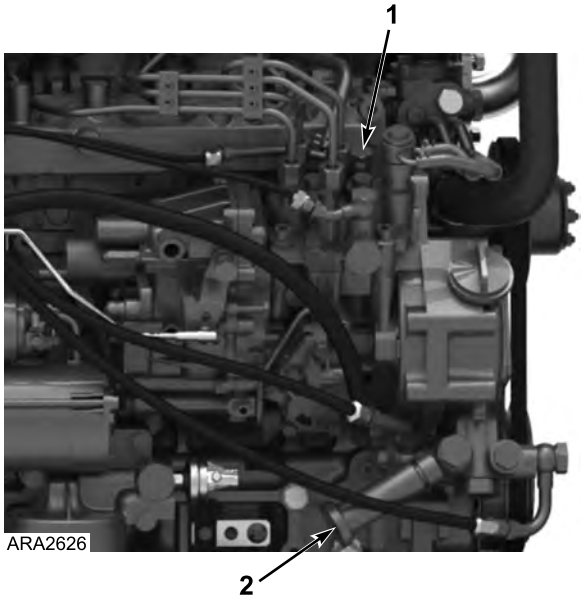
If the engine runs out of fuel, repairs are made to the fuel system, or if air gets into the system for any other reason, the air must be bled out of the fuel system.

Note: *Make sure the fuel tank vent is kept open. If the vent becomes clogged, a partial vacuum develops in the tank, and this increases the tendency for air to enter the system.*

To bleed air from the fuel system:

1. Loosen the bleed screw about one turn.

Figure 18. Injection Pump



1.	Bleed Screw
2.	Priming Pump

2. Unscrew the priming pump handle and manually prime the fuel system until air bubbles are no longer visible in the fuel coming out of the bleed screw.
3. Tighten the bleed screw and screw the priming pump handle back in.
4. Loosen the injection lines at the injection nozzles.
5. Crank the engine until fuel appears at the nozzles.
6. Tighten the injection lines.
7. Start the engine and observe the engine run for a

few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure.

Draining Water from Fuel Tank

Water run through the system may damage the fuel injection system components. Damage to the fuel injection system will subsequently cause more expensive damage to the engine. A large accumulation of water in the bottom of the fuel tank will stop a diesel engine. Water should be drained during scheduled maintenance inspections to prevent breakdowns. Drain the water after the fuel tank and unit have remained idle for an hour.

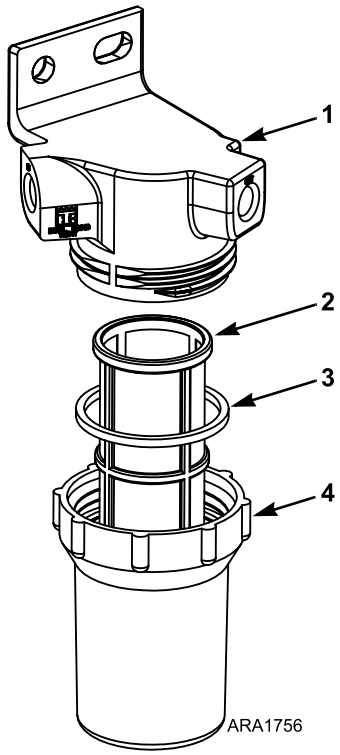
1. Place a container under the fuel tank to catch the draining water and fuel.
2. Remove the drain plug from the bottom of the fuel tank.

   Note: *Some fuel tanks have a check valve in the drain plug fitting. Push the check valve open with a small screwdriver to drain the tank.*
3. Let the water and fuel drain into the container until no water is visible in the fuel draining from the tank.
   a. If the water and fuel do not drain freely, the vent may be plugged. If so, clean or replace the vent.
4. Install the drain plug.

Fuel Pre-Strainer

The fuel pre-strainer removes the larger contaminant particles from the fuel before it goes through the fuel transfer pump and the fuel filter/water separator. Inspect the fuel pre-strainer during pretrip inspections and scheduled maintenance inspections. Remove the bowl and clean the screen if it looks dirty. Fill the bowl with clean fuel when reinstalling the screen and bowl.

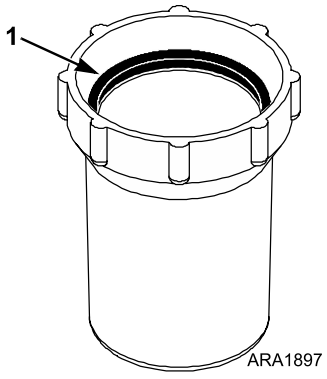
Figure 19. Fuel Pre-Strainer Components



1.	Head	3.	Seal
2.	Screen	4.	Bowl

Note: *You must lubricate the seal with diesel fuel and reseat the seal fully into the groove in the bowl when reinstalling the screen and bowl. Proper lubrication of the seal is necessary to insure an air tight seal between the pre-strainer head and the plastic bowl.*

Figure 20. Reseat Seal Fully in Groove in Bowl



1.	Lubricate seal with diesel fuel and reseat seal fully into groove in bowl.

Fuel Filter/Water Separator

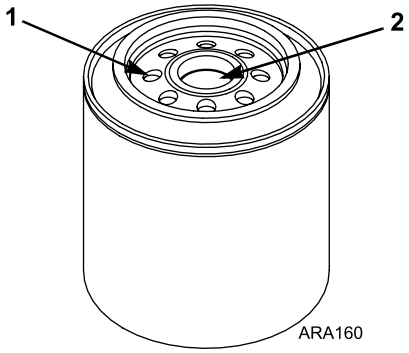
The fuel filter/water separator filters the fuel, and removes water from the fuel and returns it to the fuel tank.

Fuel Filter/Water Separator Replacement

Replace the fuel filter/water separator at intervals according to the Maintenance Inspection Schedule.

1. Unscrew the fuel filter/water separator canister with a strap wrench. Drain, and dispose of properly.
2. Clean the filter head seal surface.
3. Lubricate the canister seal with clean fuel.
4. Through one of the small openings in the top of the canister, fill the new fuel filter/water separator canister with clean fuel. This will purge the air from the canister. Do not fill canister through the center hole.

Figure 21. Filling Fuel Filter/Water Separator



1.	Fill Through Small Openings
2.	Do Not Fill Through Center Hole

5. Screw the new canister on hand-tight. Using a strap wrench, tighten another 1/4 turn.

Engine Speed Adjustments

When the diesel engine fails to maintain the correct engine speed, check the following before adjusting the speed:

1. Check the fuel pre-strainer and the inlet strainer. Check the speed.
2. Bleed the air out of the fuel system. Check the speed.
3. Bleed the air out of the nozzles. Check the speed.

Make the engine speed adjustments with the engine fully warmed up.

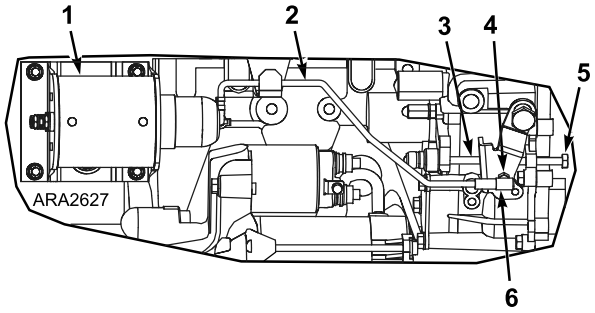
High Speed

Note: *To achieve proper refrigeration system capacity in High Speed engine operation, it is important to ensure the engine high speed throttle is set properly.*

1. Shut the unit off.
2. Remove the ball socket from the throttle bracket ball.
3. Energize the high speed solenoid by using the Interface Board Test Mode to energize the high speed solenoid while the engine is not running.
4. Adjust the ball socket on the end of the linkage rod as necessary to make it align with the throttle bracket ball with the throttle bracket held tight against the high speed stop screw.
5. If alignment is not possible or there is a slight gap between the high speed stop screw and throttle bracket, de-energize the solenoid and shorten the linkage by threading the ball socket in up to one turn. Reassemble and energize the solenoid. Verify that the throttle bracket is tight against the high speed stop screw.

   Note: *The engine speed will be well above 2200 RPM in light refrigeration load situations.*

Figure 22. Engine Speed Adjustments



1.	High Speed Solenoid	4.	Throttle Bracket Ball
2.	Linkage Rod	5.	Low Speed Adjustment Screw
3.	High Speed Stop Screw	6.	Ball Socket

Low Speed

1. Start the unit and use the Service Test Mode to run the unit in Defrost. The engine should run in low speed.
2. Go to the Gauges Menu, select Suction Pressure, and lock it on the display.
3. Wait until the Suction Pressure rises to 40 psig (276 kPa) or higher.
4. Set the low speed to 1450 ± 25 rpm.
   a. Loosen the jam nut on the low speed adjustment screw (see Figure “Engine Speed

Adjustments" above).

b. Adjust the low speed adjustment screw to obtain the correct speed.

c. Tighten the jam nut and recheck the speed.

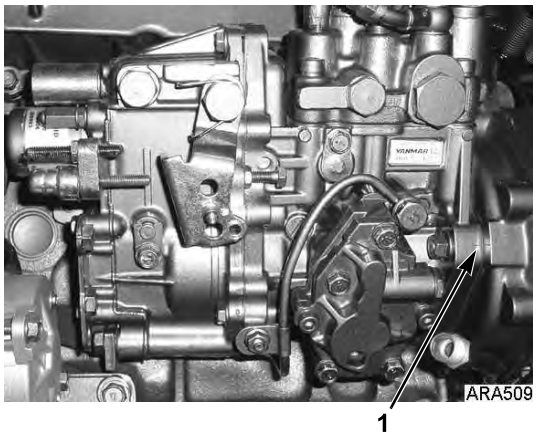
5. Exit the Service Test Mode.

Injection Pump Timing

Use this timing procedure when installing a new injection pump. It is not necessary to use this timing procedure when removing and reinstalling the original injection pump. In that case, align the index marks on the injection pump and the gear case as they were before removing the injection pump.

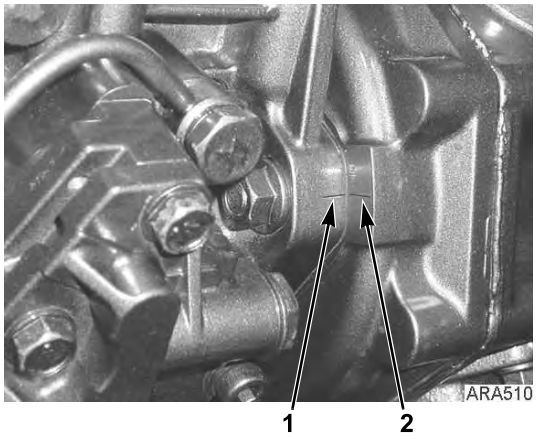
1. Before removing the old injection pump, note the alignment of the index marks on the injection pump and the gear case. The index mark on the injection pump is usually aligned with the index mark on the gear case. If not, make a mark on gear case in line with the index mark on the injection pump (see Figure 25, p. 40).

Figure 23. Index Mark Location



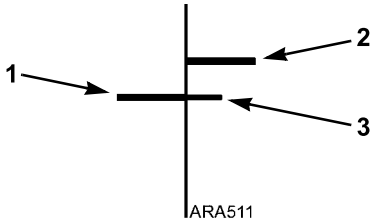
1.	Index Marks

Figure 24. Index Mark Alignment



1.	Index Mark on Injection Pump
2.	Index Mark on Gear Case

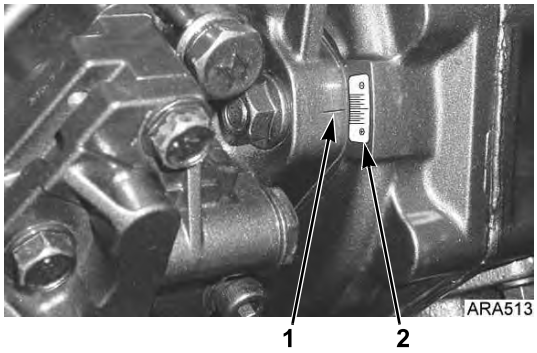
Figure 25. Marking Gear Case



1.	Index Mark on Injection Pump
2.	Existing Index Mark on Gear Case
3.	Make New Mark on Gear Case If Needed

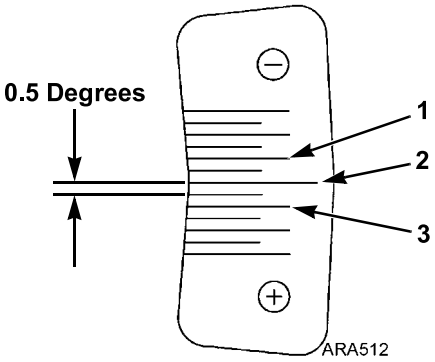
2. Clean the area with brake cleaner or something similar. Place an injection angle sticker on the gear case so the center line on the sticker is aligned with the index mark on the injection pump. An injection angle sticker is provided with the new injection pump.

Figure 26. Place Injection Angle Sticker on Gear Case



1.	Index Mark on Injection Pump
2.	Injection Angle Sticker

Figure 27. Injection Angle Sticker

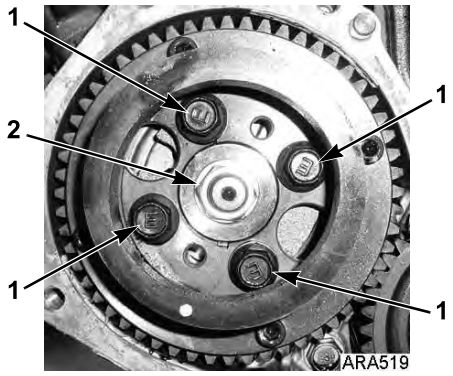


1.	–1.0 Degrees Mark
2.	Center Line (0 Degrees Mark)
3.	+1.0 Degrees Mark

3. Remove the old injection pump. Use the injection pump gear tool P/N 204-1011 to remove the injection pump gear without removing the timing gear cover (see "Injection Pump Removal," p. 43).

   Note: *Remove the injection pump gear by removing the nut and lock washer that secure the injection pump gear assembly to the injection pump shaft. The injection pump gear assembly is made of three pieces; the flange, the gear, and the transfer pump cam. Do not loosen or remove the four bolts that fasten the gear to the flange because that changes the factory-set timing. The EPA certification is based on the factory-set timing. If the factory-set timing is changed, the EPA certification is void.*

Figure 28. Removing Injection Pump Gear

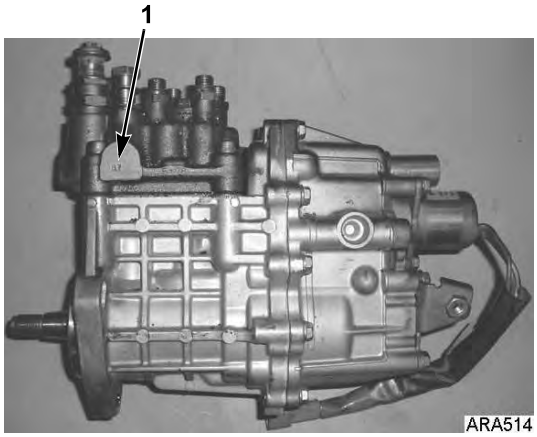


1.	Do Not Loosen or Remove These Four Bolts
2.	Remove Nut and Lock Washer

4. Record the injection angle marked on the old injection pump (see the following photographs). The injection angle mark is located on the side of the pump facing the engine. The injection angle mark on the pump does not use a decimal point. Add a decimal point before the last digit of the injection angle mark to get the injection angle. The injection angle mark in the following photographs is 67. That equals an injection angle of 6.7 degrees.

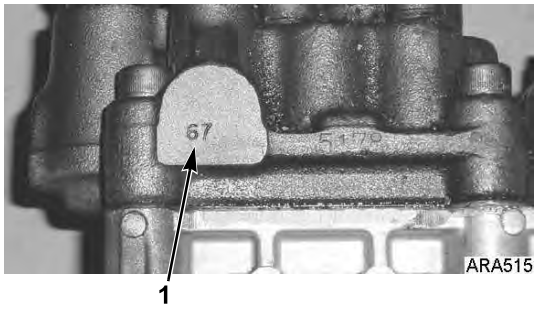
Examples	
Injection Angle Mark	Injection Angle
67	6.7 Degrees
85	8.5 Degrees

Figure 29. Injection Angle Mark Location



1.	Injection Angle Mark

Figure 30. Injection Angle Mark



1.	Injection Angle Mark

Note: *If you cannot read the injection angle mark, contact the Thermo King Service Department with the injection pump serial number or the engine serial number and they will provide the injection angle. The injection pump serial number is located on the bottom of the sticker on the injection pump.*

Figure 31. Injection Pump Serial Number Location

1.	Injection Pump Serial Number

5. Record the injection angle marked on the side of the

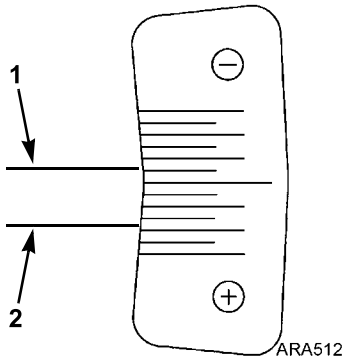
new injection pump.

6. Calculate the injection angle difference by subtracting the injection angle of the old injection pump from the injection angle of the new injection pump.

Examples		
Injection Angle of New Injection Pump (Degrees)	8.5	6.1
– Injection Angle of Old Injection Pump (Degrees)	– 6.7	– 6.7
= Injection Angle Difference (Degrees)	= +1.8	= –0.6

7. Install the new injection pump on the gear case and position it so the index mark on the injection pump is aligned with the mark equal to the injection angle difference on the injection angle sticker (see the following examples). Tighten the injection pump mounting nuts when the index mark is aligned as necessary with the injection angle sticker.

Figure 32. Examples of Injection Pump Index Mark Alignment with Injection Angle Sticker

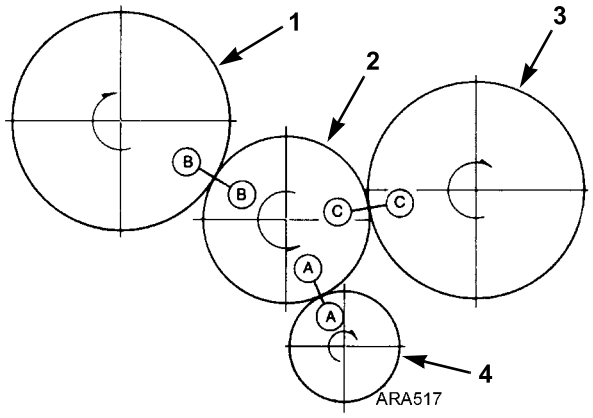


1.	Injection Pump Index Mark at –0.6 Degrees
2.	Injection Pump Index Mark at +1.8 Degrees

8. Install the injection pump gear, lock washer, and nut. Torque the nut to 58 to 65 ft-lb (78 to 88 N•m).

Note: *If the timing gear cover was removed to remove the injection pump gear, make sure the timing marks on the timing gears are aligned as shown below. It helps to install the idler gear last when aligning the timing marks.*

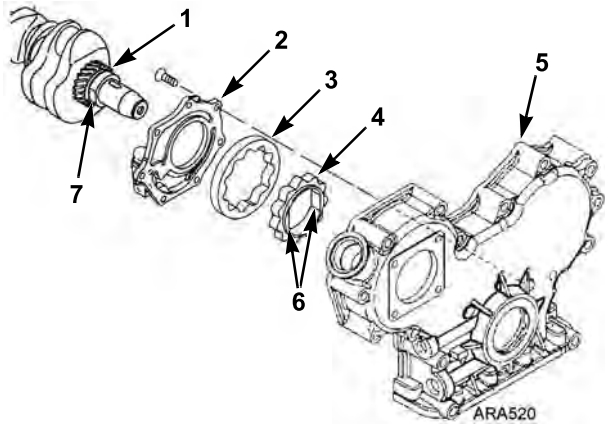
Figure 33. Timing Mark Alignment



1.	Fuel Injection Pump Gear
2.	Idler Gear
3.	Camshaft Gear
4.	Crankshaft Gear

Note: *The oil pump is located in the timing gear cover on TK486V25/TK486V25L/TK486VHA engines. The inner rotor of the oil pump fits around the crankshaft gear. Make sure that the flat sides of the inner rotor are aligned with the flat sides on the crankshaft gear when installing the timing gear cover.*

Figure 34. Align Flat Sides of Crankshaft Gear with Flat Sides of Inner Rotor in Timing Gear Cover



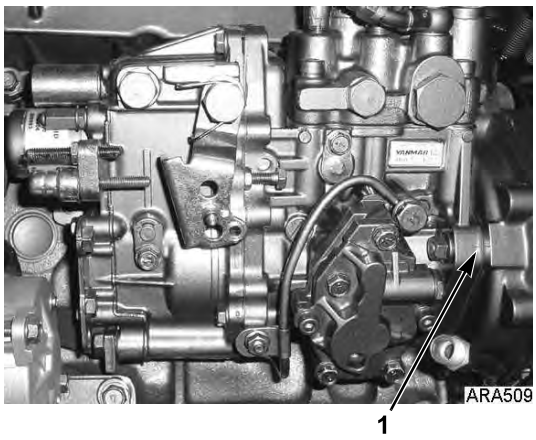
1.	Crankshaft Gear
2.	Oil Pump Cover
3.	Outer Rotor
4.	Inner Rotor
5.	Timing Gear Cover
6.	Flat Sides on Inner Rotor
7.	Flat Side on Crankshaft Gear

Injection Pump Removal

The injection pump drive gear will not fit through the gear housing when removing the pump, the gear must be separated from the pump. Using tool P/N 204-1011, it will not be necessary to remove the belts, crankshaft pulley, crankshaft seal or front plate. See Figure 37, p. 44.

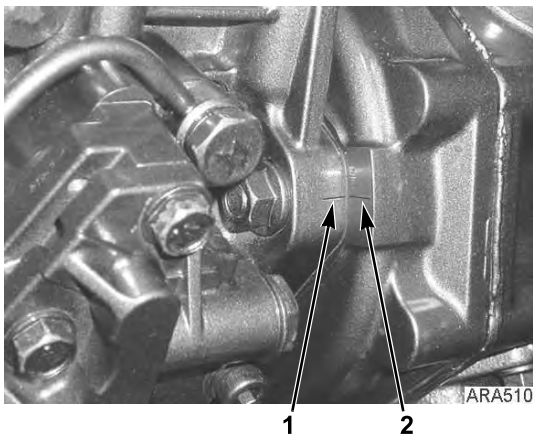
1. Note the alignment of the index marks on the injection pump and the gear case. The index mark on the injection pump is usually aligned with the single index mark on the gear case. If not, mark it so the injection pump can be returned to the same position when it is reinstalled.

Figure 35. Index Mark Location



1.	Index Marks

Figure 36. Index Mark Alignment

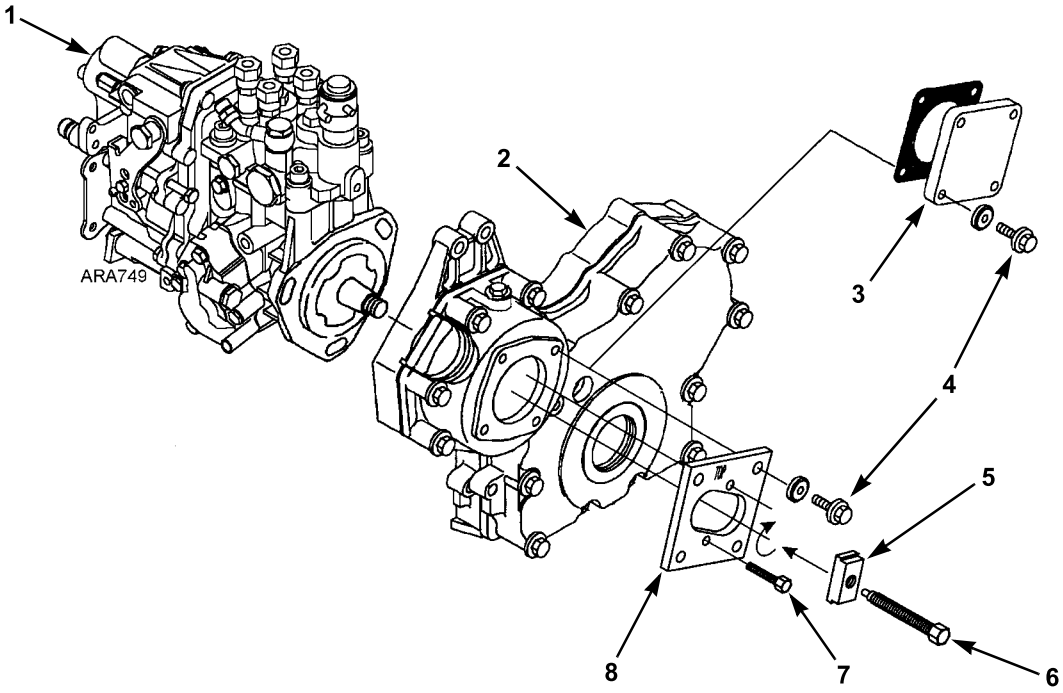


1.	Index Mark on Injection Pump
2.	Index Mark on Gear Case

2. Remove the starter for clearance, remove throttle linkage, fuel lines, harness and mounting hardware from injection pump.
3. Remove the cover plate from the gear case. Remove the nut and lock washer which secure the gear to the injection pump shaft. Use a shop rag to prevent the lock washer or nut from falling into the gear case.

   Note: *The injection pump gear assembly is made of three pieces; the flange, the gear, and the transfer pump cam. Do not loosen or remove the four bolts that fasten the gear to the flange because that changes the timing.*
4. Use the hardware from the cover plate to attach the tool plate (with the marked side pointing up and out) to the gear case.
5. Align the threaded holes in the injection pump gear with the two holes in the tool plate by rotating the engine crankshaft. Attach the gear to the tool plate with the screws provided with the tool plate.
6. Thread the long screw supplied with the tool plate into the small end of the adapter, also supplied with the tool plate. Insert the adapter into the tool plate and rotate to provide a solid position to force the injection pump shaft from the gear. Caution should be made to align the screw over the center of the injection pump shaft.
7. Remove the screw and adapter leaving the tool plate in place. This holds the gear in proper tooth alignment until the injection pump is re-installed.

Figure 37. Injection Pump Gear Tool



1.	Injection Pump	5.	Adapter (Tool)
2.	Gear Case	6.	Tool Long Screw (Tool)
3.	Cover Plate	7.	Tool Short Screw (Tool)
4.	Cover Plate Bolt	8.	Tool Plate (Tool)

Injection Pump Reinstallation

1. Position injection pump shaft into gear, rotating shaft to mate key with keyway in gear. Take care to make sure the key mates with the keyway.
2. Secure injection pump to gear case with previously removed hardware. Make sure to align the index marks on the injection pump and the gear case like they were in step 1 of "Injection Pump Removal," p. 43.

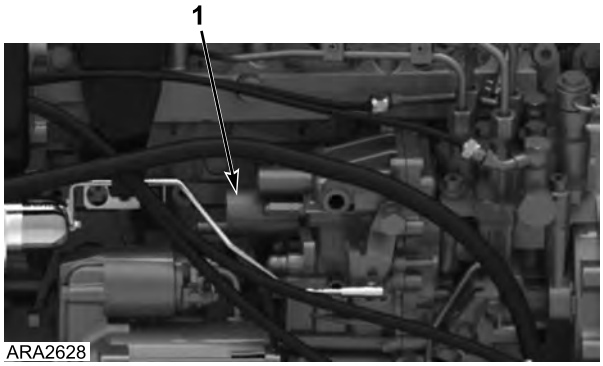
   Note: *If a different injection pump is being installed, see "Injection Pump Timing," p. 40 to set the timing.*
3. Remove hardware holding gear to tool plate, then remove tool plate.
4. Secure the gear to the injection pump shaft with the lock washer and nut. Use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 58 to 65 ft-lb (78 to 88 N•m).
5. Fasten cover plate to gear case and reinstall all components removed previously to facilitate injection pump removal.

Fuel Solenoid

The fuel solenoid is located on the end of the injection pump. It contains two coils: the pull-in coil, and the hold-in coil. The pull-in coil draws approximately 35 to 45 amps at 12 volts. The hold-in coil draws approximately 0.5 amps at 12 volts.

The pull-in coil must be energized to move the injection pump governor linkage to the fuel on position. Once the injection pump governor linkage has been moved to the fuel on position, the hold-in coil will keep it in fuel on position until the 8D circuit is de-energized. The pull-in coil must be de-energized after a few seconds to keep it from being damaged. The pull-in coil is controlled by the microprocessor through the fuel solenoid pull in relay (K6).

Figure 38. Fuel Solenoid Location



1.	Fuel Solenoid

Testing the Fuel Solenoid

If you suspect that the engine does not run because the fuel solenoid is not operating correctly, use the following procedure:

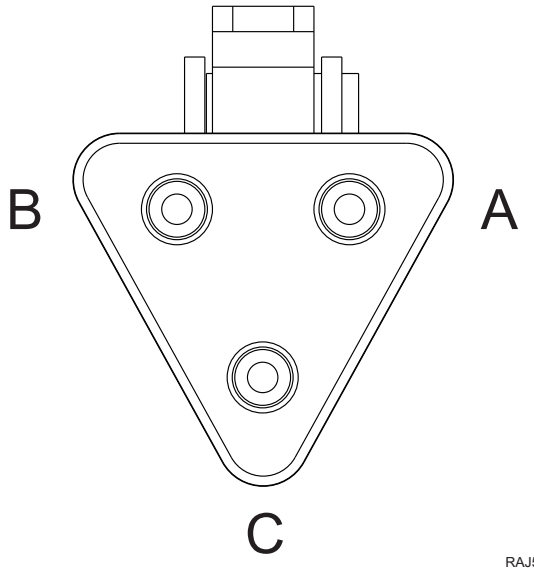
1. Measure battery voltage.
   a. With engine and controller off, check the voltage between the positive and negative battery terminals. If the voltage is below 12.2 Vdc, the battery needs to be charged or replaced.
2. Remove the fuel solenoid from the engine and disconnect it from the wire harness.
3. Check the resistance of the hold-in coil.
   a. Check the resistance of your meter leads first. Subtract these values from the resistance values you measure.
   b. Check the hold-in coil resistance between pins A and C as shown (Figure 39, p. 45).
   c. The resistance of the hold-in coil should be 22 to 27 ohms at 76 F (24 C).

   Note: *The resistance specifications above are for measurement at 76 F (24 C). If it is not possible to measure at room temperature, use the following table as a guide for the expected resistance:*

Temperature		Hold-In Coil Resistance	
		Low End	High End
-25 F	-32 C	17.3 Ohms	21.1 Ohms
-10 F	-23 C	18.0 Ohms	22.0 Ohms
0 F	-18 C	18.5 Ohms	22.6 Ohms
25 F	-4 C	19.6 Ohms	24.0 Ohms
50 F	10 C	20.8 Ohms	25.4 Ohms
76 F	24 C	22.1 Ohms	27.0 Ohms
100 F	38 C	23.2 Ohms	28.3 Ohms
125 F	52 C	24.4 Ohms	29.8 Ohms
150 F	66 C	25.6 Ohms	31.2 Ohms

   d. If the resistance is out of specifications, proceed to “Fuel Solenoid Replacement” (below). If the resistance is OK, continue to step 4.

Figure 39. Fuel Solenoid Connector Pin Identification



1.	Red (8D)
2.	White (8DP)
3.	Black (CH)

4. Re-connect the fuel solenoid to the wire harness but do not reinstall on the engine. Leave the fuel solenoid hanging from the wire harness so that it is in sight.
5. Connect an amp clamp on the white wire at the solenoid OR the wire labeled “8DP” on the other side of the Deutsch connector (if it is more accessible there). If your meter is equipped, put it in “Inrush” or “Min/Max” mode so that it records the current measured during the time that the pull coil is energized.
6. Use the microprocessor keypad to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
7. Check the pull-in coil current.
   a. Energize the run relay with the Interface Board Test Mode. Verify the pull-in coil measurement is recorded during the first two seconds the run relay is energized.
   b. **Important: Check that the pull-in coil amperage (on 8DP) drops off after 2 seconds.**

If this coil continues drawing current for more than 3 seconds there is a relay, controller, or wiring issue. Check unit repair history for similar issues.

c. The current through the pull-in coil should be 26 to 32 amps at 76 F (24 C).

Note: *The current specifications above are for measurement at 76 F (24 C). If it is not possible to measure at room temperature, use the following table as a guide for the expected current:*

Temperature		Pull-In Coil Current	
		Low End	High End
-25 F	-32 C	31.8 Amps	38.9 Amps
-10 F	-23 C	30.8 Amps	37.7 Amps
0 F	-18 C	30.4 Amps	37.2 Amps
25 F	-4 C	28.7 Amps	35.0 Amps
50 F	10 C	27.2 Amps	33.2 Amps
76 F	24 C	26.0 Amps	31.8 Amps
100 F	38 C	24.9 Amps	30.4 Amps
125 F	52 C	23.3 Amps	28.4 Amps
150 F	66 C	23.3 Amps	28.5 Amps

d. If the current is out of specifications, examine the circuit (fuses, relays, wires, etc.) for faults. If the circuit is OK, proceed to "Fuel Solenoid Replacement" (below).

e. If the current is within specifications, proceed to step 8 for a visual check.

8. Visual functionality check (no measurements required).

⚠ CAUTION

Risk of Injury!

The fuel solenoid casing may get hot during this rapid cycling, use caution when handling.

a. Using the microprocessor keypad, energize the fuel solenoid circuit for 4 seconds. Turn off. Repeat ten times.

b. During each of these cycles, watch that the fuel solenoid plunger retracts completely and stays retracted until you de-energize the circuit.

c. If the fuel solenoid plunger fails to actuate or hold during this test, check that the circuit is OK. If it appears normal, proceed to "Fuel Solenoid Replacement" (below).

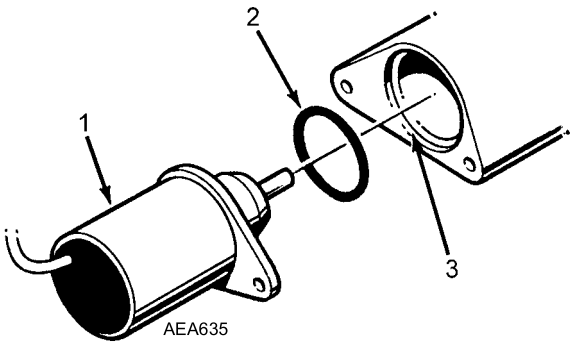
Fuel Solenoid Replacement

1. Disconnect the fuel solenoid wire connector from the main/unified wire harness and remove the old fuel solenoid.
2. Connect the new fuel solenoid wire connector to the main/unified wire harness.
3. Press the ON Key to turn the unit on.
4. Use the microprocessor keypad to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
5. Perform a visual functionality check per step 8 in "Testing the Fuel Solenoid" above to verify the fuel solenoid operates correctly.
6. Energize the fuel solenoid by energizing the run relay with the Interface Board Test Mode.

   Note: *The fuel solenoid must be energized when it is installed. If not, the plunger and the linkage may not line up correctly and the fuel solenoid will not function properly.*

7. Place the O-ring in the groove in the end of the fuel injection pump. Make sure that the O-ring is positioned correctly during installation to avoid damage and leaks.

Figure 40. Fuel Solenoid Components



1.	Fuel Solenoid
2.	O-ring
3.	Groove in Fuel Injection Pump

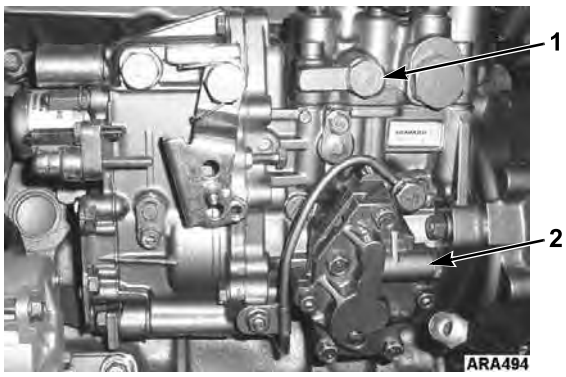
8. Install the new fuel solenoid.
9. Press the OFF Key to turn the unit off after installing the fuel solenoid.

Trochoid Feed Pump

The TK486V25X engine has a trochoid feed pump on the fuel injection pump. The trochoid feed pump supplies fuel to the injection pump at a pressure of 65 to 87 psi (450 to 600 kPa). Check the outlet pressure of the trochoid feed pump by removing the plug and attaching a pressure gauge to the port shown in Figure 41, p. 47. The plug has M12x1.25 threads. You will have to make an adaptor to attach a pressure gauge. Replace the trochoid feed pump if the outlet pressure is below the pressure specifications in the following table.

Trochoid Feed Pump Outlet Pressure	
Cranking	15-30 psi (103-206 kPa)
Low Speed	30-50 psi (206-345 kPa)
High Speed	65-87 psi (450-600 kPa)

Figure 41. Trochoid Feed Pump Location



1.	Trochoid Feed Pump Outlet Pressure Port
2.	Trochoid Feed Pump

Trochoid Feed Pump Leaks

Internal – If the seal in the trochoid feed pump fails, it could allow some fuel to leak into the engine oil. A faulty injection nozzle can also dilute the engine oil with fuel. Replace the trochoid feed pump if the engine oil is being diluted with fuel and a faulty injection nozzle or fuel transfer pump is not the cause.

External – Replace the O-ring seal between the trochoid feed pump and the injection pump if oil is leaking. Torque the bolts to prevent leaks (6 to 7 ft-lb [8 to 10 N•m]).

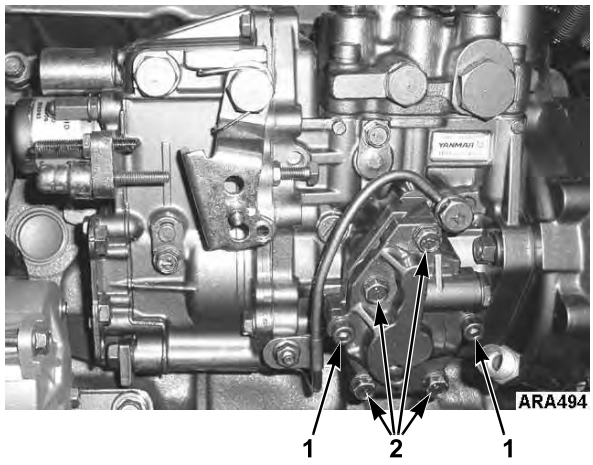
Replace all O-rings if fuel is leaking. Torque the Allen head screws and Hex head bolts to prevent leaks (6 to 7 ft-lb [8 to 10 N•m]).

Trochoid Feed Pump Replacement

Use the following procedure to replace the trochoid feed pump.

1. Remove the four hex head screws that attach the trochoid feed pump to the injection pump (see Figure 42, p. 47). Do not remove the two Allen head screws.

Figure 42. Trochoid Feed Pump Removal



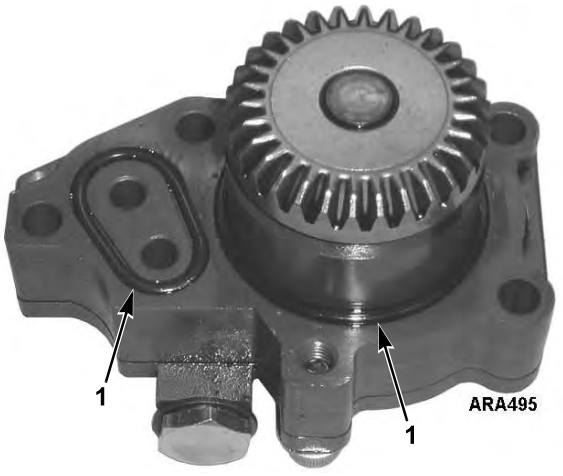
1.	Allen Head Screws (Do Not Remove)
2.	Hex Head Screws

2. Remove the trochoid feed pump from the injection pump.

   Note: *The gear on the trochoid feed pump is lubricated with engine oil. Some engine oil might leak out of the injection pump when the trochoid feed pump is removed. The trochoid feed pump does not need to be timed when it is installed.*

3. Clean the area on the injection pump from which the trochoid feed pump was removed.
4. Place new O-rings on the new trochoid feed pump and make sure it is clean.

Figure 43. Trochoid Feed Pump



1.	O-Rings

5. Place the new trochoid feed pump on the injection pump.

6. Install and tighten four hex head screws that attach the trochoid feed pump to the injection pump. Torque the hex head screws to 6 to 7 ft-lb (8 to 10 N•m).

Cold Start Device

The TK486V25X engine has a cold start device located on the fuel injection pump. The cold start device has a plunger that retracts at engine coolant temperatures below 41 F (5 C) to advance the injection timing approximately 2 degrees. The plunger controls the position of a piston in the injection pump to change the timing. The plunger is extended and the injection timing is normal at engine coolant temperatures above 41 F (5 C). Check the operation of the cold start device if it is difficult to start the engine in cold weather.

Note: *Do not pull the plunger out of a cold start device because that will damage it.*

Figure 44. Cold Start Device

1.	Plunger (Extended)

Checking Cold Start Device Operation

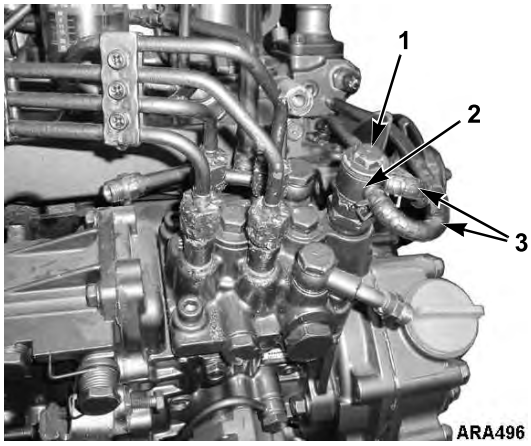
Use the following procedure to check the operation of the cold start device. The engine coolant temperature must be below 32 F (0 C) to start the procedure.

1. Press the ON Key to turn the unit on.
2. Enter the Gauges Menu before the engine starts and check the coolant temperature to make sure it is below 32 F (0 C).
3. Let the engine start, then check the engine rpm in the Gauges Menu. The engine rpm should be approximately 100 rpm higher than normal (see Specifications).
4. Let the engine run to warm up and use the Gauges Menu to check the coolant temperature and engine rpm. When the coolant temperature rises above 41 F (5 C), the engine rpm should drop back to normal. Replace the cold start device if the engine rpm does not drop approximately 100 rpm when the engine warms up.

Cold Start Device Replacement

1. Drain the engine coolant.
2. Remove the banjo bolt that fastens the engine coolant fitting to the cold start device. Use a backup wrench on the cold start device if necessary.

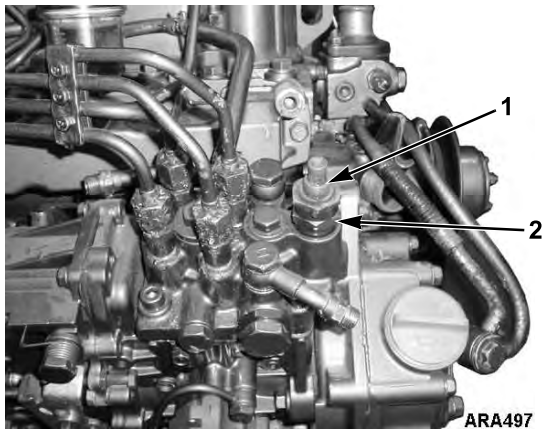
Figure 45. Remove Engine Coolant Fitting



1.	Banjo Bolt
2.	Engine Coolant Fitting
3.	Coolant Hoses to Cold Start Device

3. Remove the cold start device from the injection pump fitting. Use a backup wrench on the injection pump fitting if necessary.

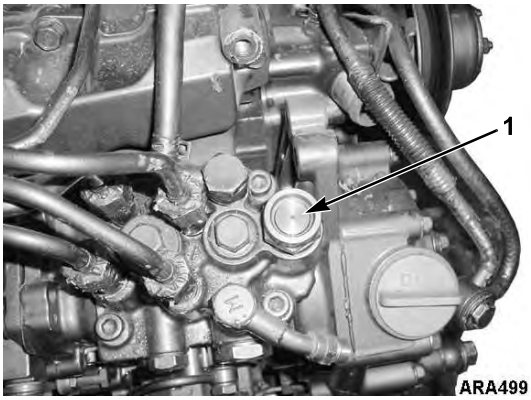
Figure 46. Remove Cold Start Device



1.	Cold Start Device
2.	Injection Pump Fitting

4. Make sure the piston inside the injection pump fitting is clean.

Figure 47. Clean Piston



1.	Piston

5. Install the new cold start device with a new O-ring in the injection pump fitting. Torque the cold start device to 22 to 26 ft-lb (30 to 35 N•m).
6. Install the coolant fitting and banjo bolt on the cold start device. Torque the banjo bolt to 16 to 18 ft-lb (22 to 25 N•m).
7. Refill the engine cooling system and make sure to bleed the air from the cooling system.

Engine Valve Clearance Adjustment

The valve clearance should be adjusted every 3,000 hours.

1. Remove the rocker arm cover.
2. Remove the round cover (plug) from the timing mark access hole on the front of the bell housing.

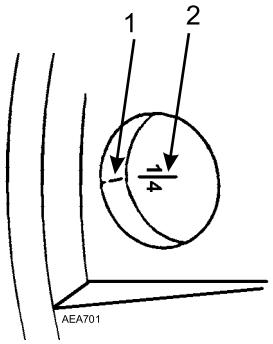
⚠ WARNING

Risk of Injury!

Loosen all of the injection lines at the injection nozzles to prevent the possibility of the engine firing while it is being rotated.

3. Place the engine at top dead center of the compression stroke for the number one cylinder. See steps a through d.
   a. Rotate the engine in the normal direction of rotation (clockwise viewed from the water pump end) until the 1-4 timing mark on the flywheel lines up with the index mark in the timing mark access hole.

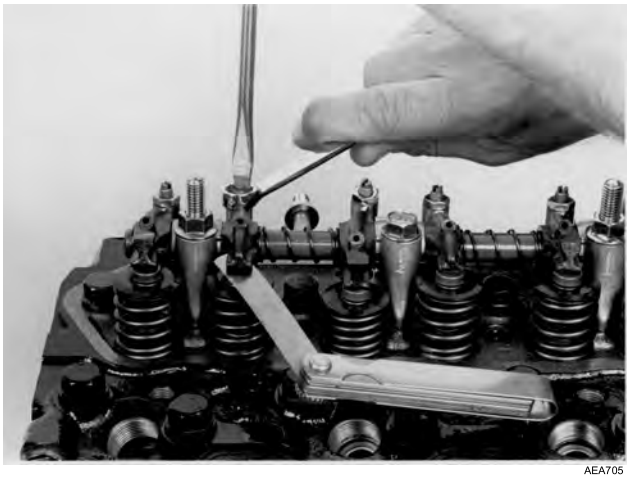
Figure 48. Top Dead Center One and Four



1.	Index Mark
2.	Top Dead Center Mark for 1 and 4

   b. Check the rocker arms on the number one cylinder to see if they are loose.
   c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number one cylinder.
   d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number one cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number one cylinder.
4. Use a feeler gauge to check the valve clearance on both valves for the number one cylinder, the intake valve for the number two cylinder, and the exhaust valve for the number three cylinder. The valve clearance for both the intake valve and the exhaust valve should be 0.006 to 0.010 in. (0.15 to 0.25 mm).
   a. Check to verify that the valve stem cap is in good condition and is positioned squarely on the top of the valve stem. Replace the valve stem cap if it shows significant wear.
5. Adjust the valves if necessary by loosening the locknut and turning the adjustment screw until the valve clearance is correct.

Figure 49. Adjusting the Valve Clearance



6. Hold the adjustment screw in place and tighten the locknut.
7. Recheck the valve clearance.
8. Rotate the engine one full turn (360 degrees) in the normal direction of rotation (clockwise viewed from the water pump end), and align the 1-4 timing mark on the flywheel with the index mark in the timing mark access hole. This is top dead center of the compression stroke for the number four cylinder.
9. Check and adjust the exhaust valve for the number two cylinder, the intake valve for the number three cylinder, and both valves for the number four cylinder.
10. Replace the rocker arm cover, the cover for the timing mark access hole, and tighten the fuel injection lines when finished.

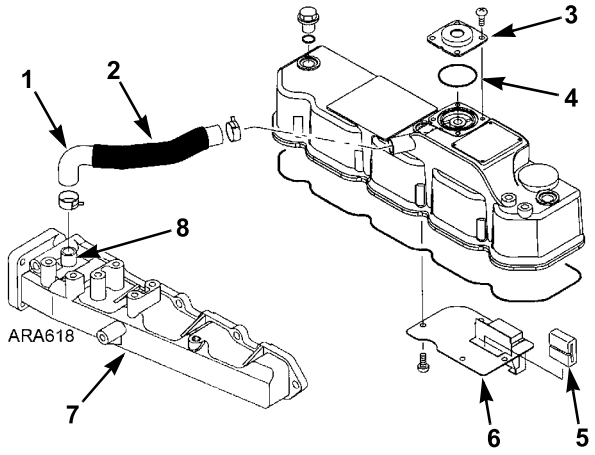
Valve Adjustments and Cylinder Configurations								
	Rear Flywheel End						Front Pulley End	
Cylinder Number	**1**		**2**		**3**		**4**	
Valve arrangement	E	I	E	I	E	I	E	I
Piston in No. 1 cylinder is at TDC on compression stroke	○	○		○	○			
Piston in No. 4 cylinder is at TDC on compression stroke			◎			◎	◎	◎

Crankcase Breather

Gases formed in the crankcase are directed to the intake manifold. Harmful vapors that would otherwise collect in the crankcase and contaminate the oil, or escape to the outside, are drawn back into the engine and burned.

The crankcase breather is located in the valve cover. A restrictor is cast into the fitting for the breather hose on the intake manifold. The restrictor limits the flow of gases from the crankcase to the intake manifold and keeps the crankcase pressure from getting too low in vacuum. A breather hose connects the crankcase breather to the intake manifold.

Figure 50. Crankcase Breather



1.	Breather Hose	5.	Baffle Breather
2.	Insulation	6.	Baffle Plate
3.	Breather Cover	7.	Intake Manifold
4.	O-Ring	8.	Restrictor Location

Normal crankcase pressures with a new air cleaner are 0 to 12 in. (0 to 300 mm) H_2O of vacuum. The vacuum

will increase as the air cleaner gets dirty and becomes more restrictive. Check the air restriction indicator before checking the crankcase pressure. Replace the air cleaner if the reading on the air restriction indicator exceeds 20 in. (508 mm) H_2O of vacuum. A dirty air cleaner may cause excessive vacuum, leading to oil carry over and high oil consumption.

The crankcase breather and the breather hose should be inspected when the air cleaner element is replaced to verify they are not plugged or damaged. Inspect the insulation to verify it is in place and undamaged. The insulation is used to prevent freezing in cold weather.

The following items can affect the crankcase pressure readings:

Crankcase Pressure Effect	Typical Cause
Increase	Piston Rings Stuck or Worn
Increase	Breather Hose or Restrictor Plugged with Dirt or Ice
Decrease	Air Cleaner Dirty or Plugged

EMI 3000 Air Cleaner

The EMI 3000 air cleaner is a dry element air cleaner. Replace the EMI 3000 air cleaner element at 3,000 hours or 2 years, whichever occurs first.

Note: *The severe duty air cleaner is similar to the EMI 3000 air cleaner but allows the air cleaner element to be replaced at 4,000 hour intervals under normal operating conditions.*

Figure 51. EMI 3000 Air Cleaner Assembly

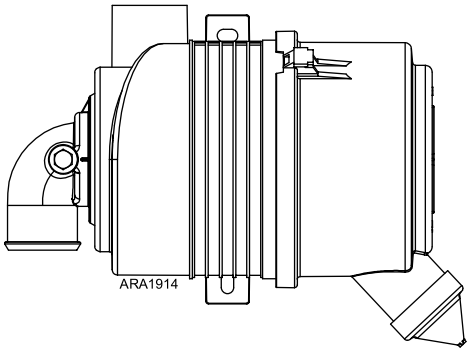
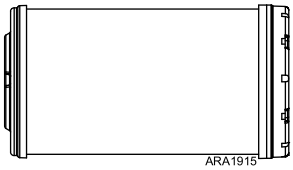


Figure 52. EMI 3000 Air Filter Element



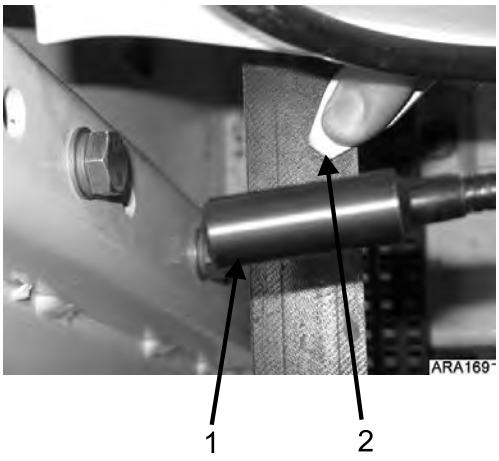
Belts

Belts should be regularly inspected during unit pretrip inspections for wear, scuffing, or cracking. Belt tension should also be checked during scheduled maintenance inspections. Belts that are too loose will whip and belts that are too tight put too much strain on the belt fibers and bearings.

Using Frequency Gauge P/N 204-1903 is the best method to check belt tension. Other commercially available tension gauges that measure the frequency or the tension in pounds are also acceptable.

Note: *When using the frequency gauge P/N 204-1903, place the probe near the belt with the LED shining on the belt. Pluck the belt with a metal tab as shown below to get an accurate reading. Take three readings and average them.*

Figure 53. Using Frequency Gauge P/N 204-1903

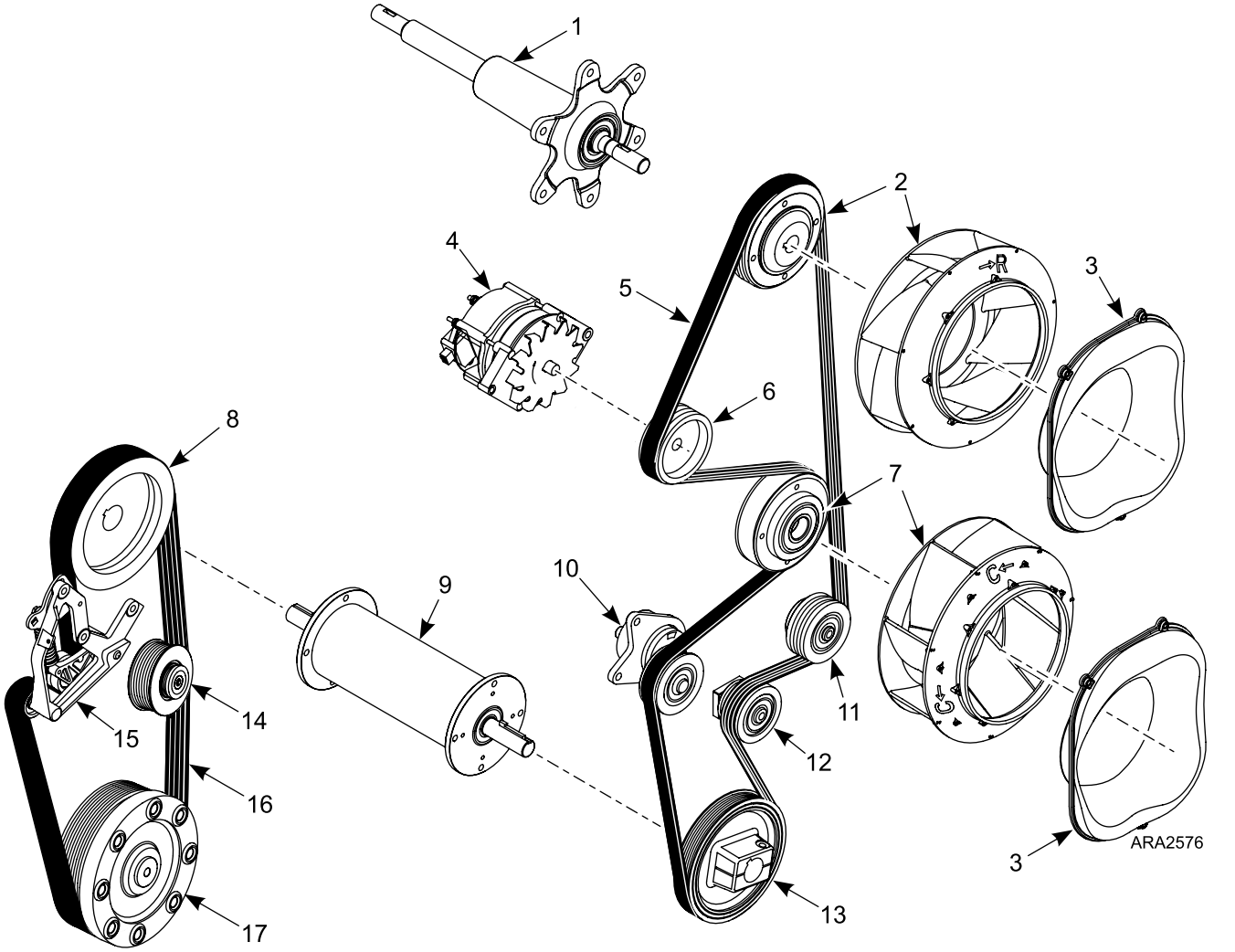


1.	Probe
2.	Metal Tab

Note: *Do not attempt to remove or install belts without loosening adjustments. Belts that are installed by prying over pulleys will fail prematurely due to internal cord damage.*

Fan Drive Belt

Figure 54. Belt Arrangement



1.	Fan Shaft	10.	Fan Drive Belt Tensioner
2.	Upper Condenser Blower	11.	Idler Pulley
3.	Condenser Inlet Orifice	12.	Sliding Idler Pulley
4.	Alternator	13.	Cross Shaft/Fan Pulley
5.	Fan Drive Belt	14.	Idler Pulley
6.	Alternator Pulley	15.	Engine/Cross Shaft Belt Tensioner Clutch
7.	Lower Condenser Blower	16.	Compressor/Clutch Belt
8.	Cross Shaft/Engine Pulley	17.	Compressor Coupling
9.	Cross Shaft (Jackshaft)		

Fan Drive Belt Replacement

1. Place a 17 mm socket wrench over the head of the fan drive belt tensioner bolt in a horizontal starting position. Slowly pull down on the tensioner until the belt is loose enough to remove from the tensioner. Do not pull the tensioner down farther than needed to remove the belt.

⚠ WARNING

Risk of Injury!

Do not put fingers between the belt and the tensioner pulley.

2. Slide the belt from the tensioner pulley by hand in the direction shown below.

Figure 55. Remove Belt from Tensioner Pulley

3. Slowly release the downward pressure on the wrench to remove it from the tensioner bolt. The wrench will rise above the horizontal starting position under the force of the spring.
4. Loosen (or remove) the mounting screws for the upper blower condenser spinning enough to allow the condenser spinning to be moved away from the upper blower and the belt to be passed between the upper blower and its condenser spinning.
5. Remove the old belt.
6. Slide the new belt between the upper blower and its condenser spinning and install the new belt on the pulleys in stages as shown below, and to tighten the mounting screws for the upper blower condenser spinning.

Figure 56. Stage 1

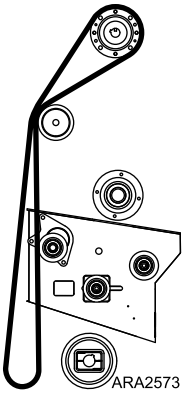


Figure 57. Stage 2

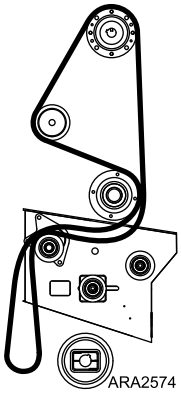
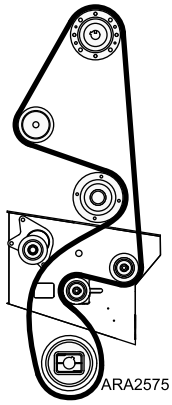
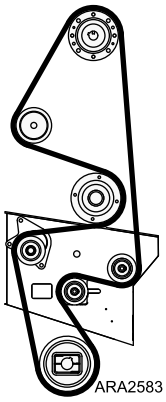


Figure 58. Stage 3



7. Ensure that the new belt is fitted correctly into the grooves on all pulleys except the tensioner pulley prior to beginning next step.
8. Slowly pull down on the tensioner bolt with a 17 mm socket wrench and slide the new belt onto the tensioner pulley until it is correctly fitted into the grooves of the pulley.
9. Slowly release the downward pressure on the wrench to remove it from the tensioner bolt. The belt should be aligned as shown below.

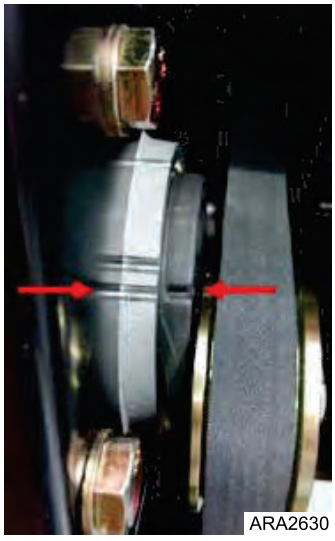
Figure 59. Final Fan Drive Belt Alignment



10. Check the belt tension with Frequency Gauge P/N 2041903. The recommended setting for a new belt is 106-118 Hz. If the tension is in this range, the mark on the tensioner arm should align close to the lower mark on the tensioner housing as shown below. If the belt tension frequency is not in the recommended range, the sliding idler pulley position can be adjusted to increase/decrease belt tension. See "Fan Drive Belt Adjustment" below.

Note: *The belt tension frequency measurement should be the primary method used to determine the correct belt tension. The markings on the tensioner arm and housing exist to provide a rough visual reference of the belt tension.*

Figure 60. Tensioner Mark Alignment



11. Monitor belt tension regularly during the run in period (initial 10 hours). After the belt has run in, the mark on the tensioner arm should rest between the two marks on the tensioner housing.

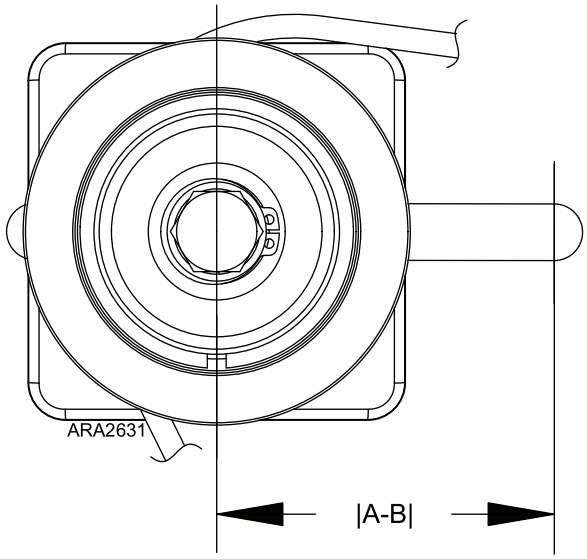
Fan Drive Belt Adjustment

The sliding idler pulley position is set during factory production for the correct belt tension. If required, its position can be adjusted in the field to achieve the required tension as follows.

Note: *The distance given below is the nominal starting point and the exact location will depend on the variation of the drive system layout.*

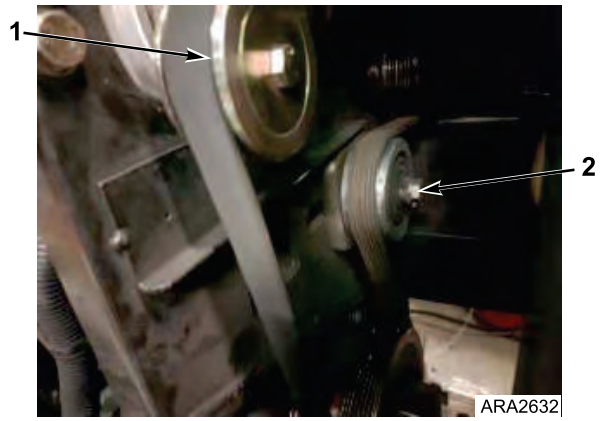
1. Measure from the center of the sliding idler pulley bolt to the center of the end of the slot in the frame as shown below. The factory setting is 2.81 in. (71.5 mm).

Figure 61. Sliding Idler Pulley Position



2. Perform steps 1-3 of "Fan Drive Belt Replacement" above to loosen the belt tension.
3. Loosen the sliding idler pulley bolt and adjust sliding idler position as required.
4. Tighten the sliding idler pulley bolt.
5. Perform steps 7-10 of "Fan Drive Belt Replacement" above (reset belt position and measure belt frequency to ensure correct belt tension).

Figure 62. Sliding Idler Pulley Adjustment



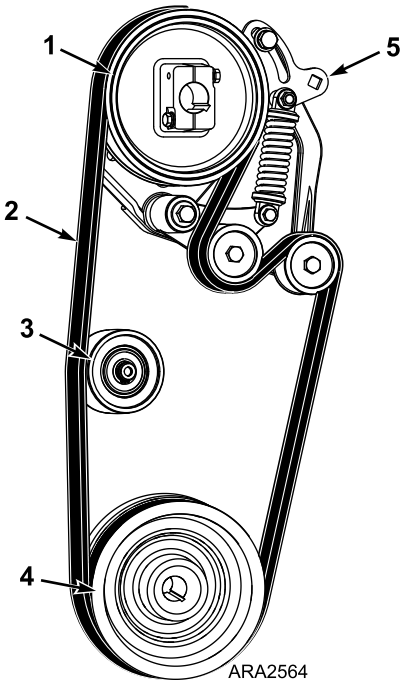
1.	Tensioner Pulley
2.	Sliding Idler Pulley – Move Forward/Backward

Engine/Cross Shaft Belt

Important: *When replacing the compressor belt, service tool (2042436 - Tension Tool, 139mm) must be used to set the belt tension, this will ensure that the correct tension is set at all times.*

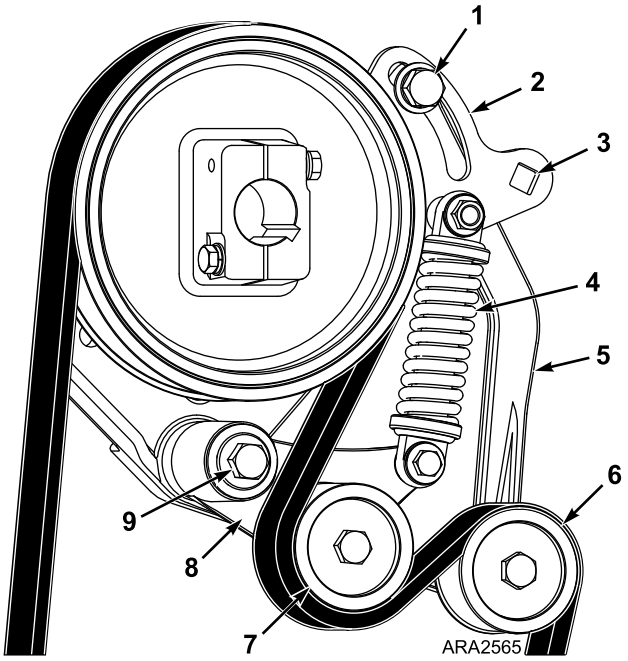
Important: *When checking the alignment of the pulleys the service tool (2042435 - Pulley Alignment Tool) must be used to verify the correct positioning of theCross Shaft/ Engine Pulley / Electric Motor Belt so that alignment is maintained.*

Figure 63. Engine/Cross Shaft Belt Arrangement



1.	Cross Shaft/Engine PulleyCross Shaft / Electric Motor Pulley	4.	Compressor Coupling
2.	Engine to Motor/Cross Shaft Belt	5.	Tensioner Clutch
3.	Back Idler Pulley		

Figure 64. Tensioner Clutch Components



1.	Plate Adjustment Bolt	6.	Grooved Idler
2.	Eccentric Plate	7.	Flat Idler
3.	1/2 in. Square Hole	8.	Arm
4.	Spring Damper Strut	9.	Arm Pivot Bolt
5.	Support Bracket		

Assembly of Tensioner Clutch

1. Remove the retainer from the arm pivot bolt.
2. Place the tensioner components on the support bracket.

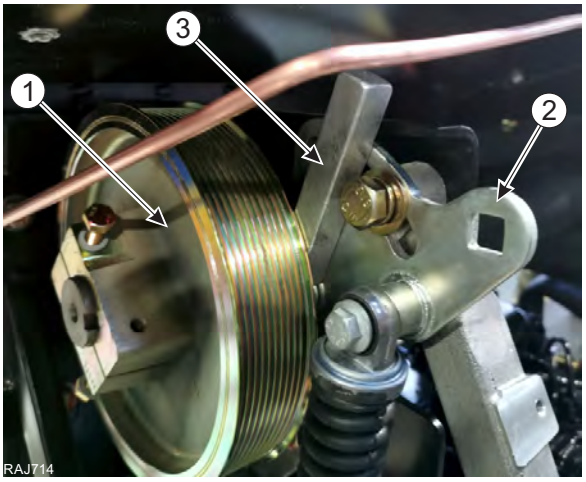
1.	Eccentric Plate Pivot Bolt
2.	Eccentric Plate Adjustment Bolt
3.	Arm Pivot Bolt

3. Install the arm pivot bolt, and the eccentric plate adjustment and pivot bolts, and tighten them finger tight.

1.	Eccentric Plate Pivot Bolt
2.	Eccentric Plate Adjustment Bolt
3.	Arm Pivot Bolt

4. Torque the arm pivot bolt to 106 to 114 ft-lb (144 to 155 N•m). Do not tighten the eccentric plate bolts, they will be tighten when the belt is installed.
5. Install the cross shaft/engine pulley. Position pulley axially using block P/N 2042435 between the pulley and the cross shaft mounting bracket. This should place the pulley 0.65 in. (16.6 mm)from the end of the cross shaft housing). Tighten the pulley.

1.	Cross Shaft/Engine Pulley
2.	Cross Shaft Mounting Bracket



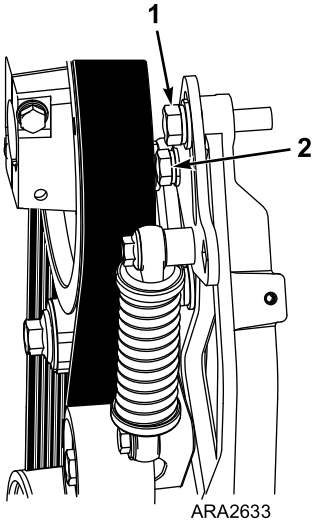
1.	Cross Shaft / Engine Pulley
2.	Cross Shaft Mounting Bracket
3.	Pulley Alignment Tool 2042435

6. Install the belt following steps 10-15 of “Engine/ Cross Shaft Belt Replacement” below.

Engine/Cross Shaft Belt Replacement

1. Loosen the pivot bolt for the eccentric plate. The the pivot bolt is located behind the cross shaft/engine pulley (see below).

Figure 65. Eccentric Plate Bolts



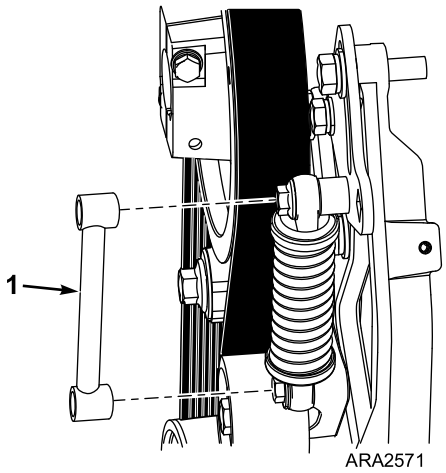
1.	Adjustment Bolt	2.	Pivot Bolt

2. Place a 1/2 in. drive wrench in the 1/2 in. square hole in the eccentric plate use it to hold the eccentric plate when the adjustment bolt is loosened in the next step.
3. Loosen the adjustment bolt for the eccentric plate and use the 1/2 in. drive wrench to slowly raise the eccentric plate to its highest position and release the belt tension.
4. Remove the belt from the cross shaft/engine pulley and the idler pulleys.
5. Support the compressor and unbolt the compressor mounting flange from the engine (leave the refrigeration lines connected).
6. Slide the compressor assembly away from the engine.
7. Remove the belt through the gap between the compressor coupling and the flywheel.
8. Install the new belt on the compressor coupling through the gap between the compressor coupling and the flywheel.
9. Slide the compressor back into position and install the mounting bolts.
10. Use use the 1/2 in. drive wrench to slowly raise the eccentric plate its highest position.
11. Place the new belt on the cross shaft/engine pulley and idler pulleys. Verify the belt fits on the pulleys correctly and is fitted correctly into the grooves in the grooved pulleys.
12. Use use the 1/2 in. drive wrench to slowly lower the eccentric plate against the belt pressure until the Gauge Tool P/N 2042436 fits over the heads of the spring damper strut bolts.

Important: *Care must be taken when installing the belt to ensure it s correctly seated in pulley grooves. The belt will be damaged if the correct installation into the pulley grooves is not observed. The belt only has to be out of place on the grooved idler by one groove for it to fail.*

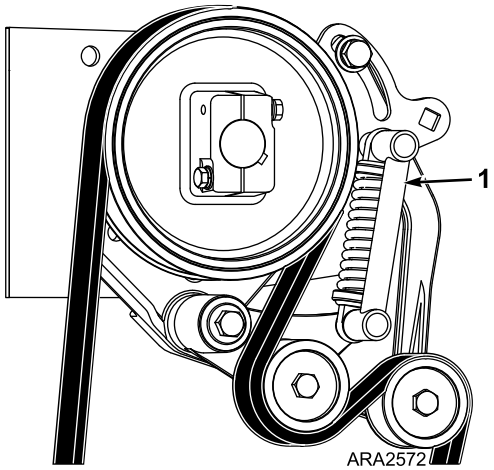
Important: *The gauge tool must not be locked on the bolt heads but must move freely on and off the bolt heads. The center to center dimension of 5.472 in. (139.0 mm) between the bolt heads of the spring damper strut is verified using Gauge Tool P/N 2042436, which is a checking gauge not a setting gauge and should not be used to hold the spring damper strut in position prior to tightening the holding hardware.*

Figure 66. Place Gauge Tool on Strut Bolts



1.	Gauge Tool P/N 2042436

Figure 67. Gauge Tool on Strut Bolts



1.	Gauge Tool P/N 2042436

13. Once the gauge tool fits perfectly and freely on the screw heads of the spring damper strut, remove it and tighten the adjustment bolt and the pivot bolt to lock the eccentric plate in that position.
14. Place the gauge tool over the heads of the spring damper strut bolts again to verify the setting is correct.
15. Remove the gauge tool and torque the strut bolts to 20–24 ft-lbs (27 to 33 N•m).

Water Pump Belt

The water pump pulley is a split type. Adjust the tension by adding or removing shims between the pulley sheaves. See "Belt Tension," p. 14 for the correct water pump belt tension settings.

⚠ WARNING

Risk of Injury!

The unit can start at any time without warning. Press the OFF key on the HMI control panel and place the microprocessor On/Off switch in the Off position before inspecting or servicing any part of the unit.

⚠ CAUTION

Risk of Injury!

Do not attempt to adjust belts with the unit running.

1. Remove the bolts from the water pump pulley.
2. Remove the pulley sliding section and add or remove shims to adjust the belt tension.
3. Reinstall the belt on the pulley and replace the sliding pulley section on the pulley.
4. Tighten the mounting bolts on the water pump pulley.
5. Check the belt tension setting and readjust if necessary.

Refrigeration Maintenance

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.*

In the USA 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.

Refrigerant Charge

Testing The Refrigerant Charge With An Empty Trailer

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. The suction pressure will drop as the refrigerant charge decreases. If the unit has an overcharge of refrigerant, the unit may not cool properly and the suction and discharge pressure may be high. The charge may be determined by inspection of the refrigerant through the receiver tank sight glasses with the following conditions established:

1. Place a test box over the evaporator.
2. Install a gauge manifold.
3. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
4. Use the microprocessor thermometer to monitor the return air temperature.
5. Run the unit on high speed cool until the air in the box is at 0 F (-18 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-18 C).
6. The suction pressure should be 15 to 20 psig (103 to 138 kPa).
7. The discharge pressure should be at least 290 psig (2000 kPa). If the pressure is below this, it can be raised by covering a portion of the condenser grille with a piece of cardboard to block condenser airflow.
8. Under these conditions, refrigerant should be visible in the receiver tank sight glass. If refrigerant is not visible in the receiver tank sight glass, the unit is low on refrigerant.

Testing the Refrigerant Charge with a Loaded Trailer

1. Install a gauge manifold.
2. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
3. Build up and maintain 290 psig (2000 kPa) of head pressure. If the pressure is below this, it can be raised by covering the roadside condenser grille with a piece of cardboard to block condenser air flow.
4. Cool the compartment to the lowest temperature required.
5. Check suction pressure. It should be 15 to 20 psig (103 to 138 kPa).
6. Under these conditions, refrigerant should be visible in the receiver tank sight glass. If refrigerant is not visible in the receiver tank sight glass, the unit is low on refrigerant.

Testing for an Overcharge

Use the following procedure to identify a Thermo King unit with an excessive refrigerant charge:

1. Install a calibrated gauge manifold on the compressor.
2. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
3. Operate the unit in high speed cool long enough to stabilize system pressures and reduce the box temperature to approximately 60 F (16 C) or colder.
4. Observe discharge pressure and cover the condenser to increase the discharge pressure approximately 75 to 100 psig (500 to 690 kPa) above observed pressure.

   Note: *If the liquid level in the receiver sight glass drops during step 4, the unit is not overcharged and it is not necessary to complete the rest of the procedure.*
5. Remove the condenser cover to rapidly reduce discharge pressure.
6. Observe the receiver tank sight glass and the unit discharge pressure.
7. By the time the discharge pressure drops approximately 50 psig (345 kPa), the liquid level in the receiver tank should drop.
   a. When the discharge pressure stabilizes, the liquid level will rise.
   b. If the liquid level will not drop, the unit most likely has an overcharge of refrigerant. The refrigerant level should be adjusted.

To adjust the refrigerant level:

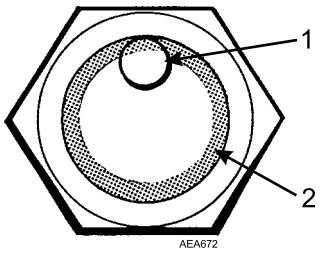
1. Stop the unit and remove some refrigerant with an approved refrigerant recovery device.
2. Perform a refrigerant level check and repeat the overcharge test.
3. If the liquid level is low, add refrigerant as follows:
   a. Connect a refrigerant tank to the gauge manifold service line and purge the line.
   b. Mid seat the compressor suction service valve.
   c. Set the refrigerant tank for liquid removal and open the hand valve.
   d. Operate the unit in high speed cool.
   e. Observe the suction pressure and slowly open the gauge manifold low pressure hand valve to allow liquid refrigerant to flow into the compressor suction service valve.
   f. Control the liquid flow so the suction pressure increases approximately 20 psig (138 kPa).
   g. Maintain a discharge pressure of at least 290 psig (2000 kPa) while adding refrigerant.
   h. Close the hand valve on the refrigerant tank when the liquid level approaches the top of the receiver sight glass.
4. Repeat the overcharge test.

Moisture Indicating Sight Glass

The receiver tank is equipped with a moisture indicating sight glass. The outer edge of the sight glass has a colored ring approximately 0.1 in. (2.5 mm) thick. The color of the ring indicates the moisture content of the refrigerant, but it is not completely reliable.

- Green = Dry
- Chartreuse = Caution
- Yellow = Wet

Figure 68. Moisture Indicating Sight Glass



1.	Floating Ball
2.	Colored Ring

A system has to run for at least 15 minutes to change the color of the indicator ring after the moisture content of the system has been changed. For example, evacuating a system to remove the moisture will not change the color of the indicator ring until the system has been recharged and then operated for at least 15 minutes.

Refrigerant Leaks

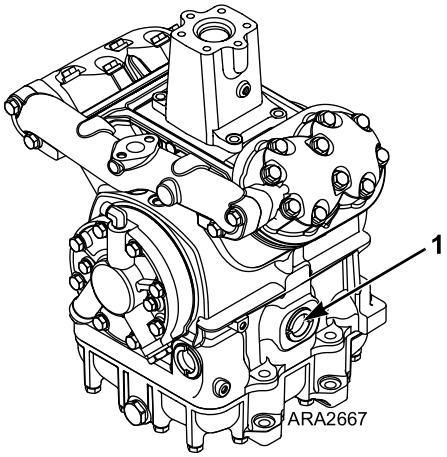
Use a reliable leak detector that is suitable for R-452A to leak test the refrigeration system. Inspect for signs of oil leakage, which is the first sign of a leak in the refrigeration system.

Note: *It is normal for compressor shaft seals to have a slightly oily film.*

Checking Compressor Oil

The compressor oil should be checked when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

Figure 69. Compressor Oil Sight Glass - Location



1.	Sight Glass

Check Compressor Oil Level - Ambient Air Temp Above 50 F (10 C)

1. Install a gauge manifold on the compressor.
2. Operate the unit on cool with a 20 psig (138 kPa) minimum suction pressure and a 185 psig (1275 kPa) minimum discharge pressure for 15 minutes or more.
3. After the unit has maintained the above conditions for 15 minutes, observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.

Check Compressor Oil Level - Ambient Air Temp Below 50 F (10 C)

1. Run the unit through a complete defrost cycle.

   Note: *If the box is empty, you can run the unit on the heat cycle instead of the defrost cycle.*
2. After completing the defrost cycle, run the unit on cool for ten minutes.

3. Observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.

Adding Compressor Oil

Note: *Use refrigeration compressor oil ONLY. Polyol Ester P/N 203-513 is required for R-404A or R-452A.*

1. Pump down the compressor and equalize the pressure to slightly positive.
2. Disconnect the compressor oil filter return line or remove the oil fill plug from the top of the compressor and add the oil.
3. Reattach the oil filter return line to the compressor or reinstall the oil fill plug.
4. Evacuate the compressor before opening the service valves.

High Pressure Cutout Switch (HPCO)

The High Pressure Cutout Switch (HPCO) is located on the compressor discharge manifold. If the discharge pressure rises above 470 psig (3241 kPa), the HPCO opens the HPCO circuit to the run relay and stops the unit. To test the HPCO, rework a gauge manifold as shown (Figure 70, p. 61) and use the following procedure:

1. Connect the gauge manifold to the compressor discharge service valve with a heavy duty, black jacketed thick wall #HCA 144 hose with a 900 psig (6204 kPa) working pressure rating.

2. Use the Service Test Mode to run the unit (or host unit) in high speed cool.

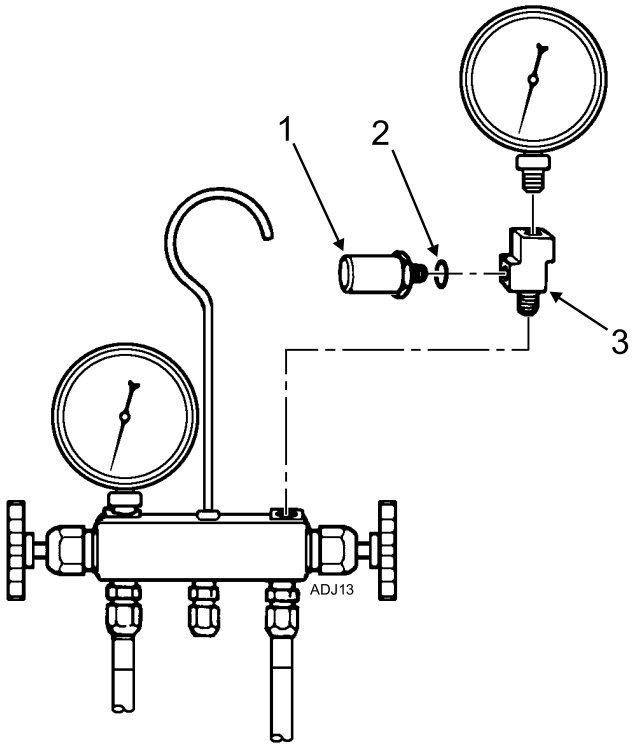
⚠ CAUTION

Hazardous Pressures!

If the discharge pressure reaches 477 psig (3289 kPa), shut the unit off immediately. Do not allow the discharge pressure to exceed 477 psig (3289 kPa).

3. Raise the discharge pressure of the compressor by blocking the condenser coil air flow by covering the condenser grilles with pieces of cardboard. This should increase the discharge pressure enough to cause the HPCO to cut out.
4. If the HPCO does not open to de-energize the run relay and stop the unit, it must be replaced.

Figure 70. High Pressure Cutout Manifold



1.	Relief Valve (66-6543)
2.	O-Ring (33-1015)
3.	Adapter Tee Weather Head No. 552X3

Three-Way Valve Condenser Pressure Bypass Check Valve

A three-way valve condenser pressure bypass check valve is used in this unit. This check valve controls the bypass flow of refrigerant gas between the condenser inlet line and the compressor discharge line.

The check valve is closed when the unit is running on cool, or whenever the discharge pressure is higher than the condenser pressure.

When the unit is running on defrost or heat, if the condenser pressure is higher than the discharge pressure, the check valve opens and the condenser pressure is bled off until it drops to the level of the discharge pressure. The purpose of the valve is to improve the three-way valve response time when shifting from heat to cool.

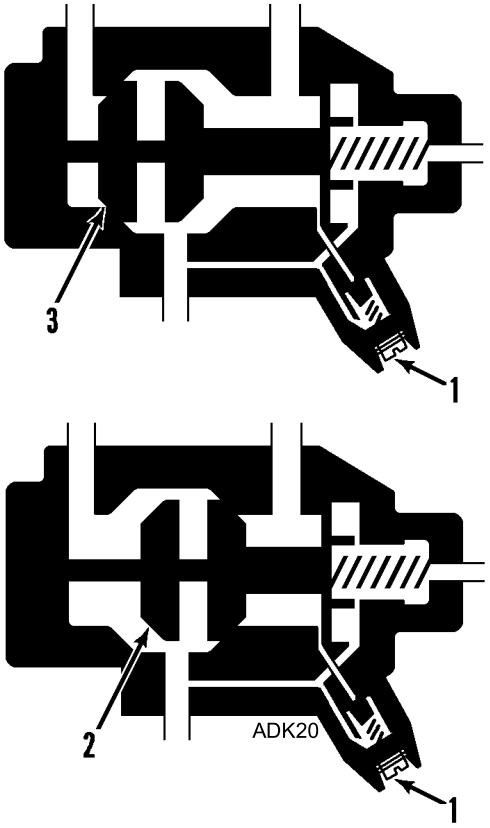
If a three-way valve does not shift back to cool immediately after the pilot solenoid closes, and finally shifts to cool when the temperature rise puts the unit into high speed, the three-way valve end cap should be checked. See "Three-Way Valve Repair," p. 74 in Refrigeration Service Operations.

Check the operation of the condenser pressure bypass

check valve as follows:

1. Remove the condenser pressure bypass check valve cap from the three-way valve.
2. Using a screwdriver, gently turn the check valve stem in until the valve is front seated.
3. Install a gauge manifold set on the compressor.
4. Close (front seat) the receiver tank outlet valve.

Figure 71. Three-way Valve Condenser Pressure Bypass Check Valve



1.	Check Valve
2.	Heating/Defrost Position
3.	Cooling Position

5. Operate the unit on cool and pump down the low side to 20 in. Hg (-68 kPa)of vacuum.
6. Stop the unit. The condenser and suction pressures should remain stable, indicating no leaks.
7. Shift the three-way valve to the heat position. The low side gauge will raise slightly. The high side gauge will drop to approximately zero. The gauges will equalize.
8. The gauges will remain in this position, approximately zero, if the three-way valve seals properly toward the condenser and the condenser pressure bypass check valve seals properly.
9. Back seat condenser pressure bypass check valve stem against the snap ring. Both gauges should rise indicating the condenser pressure bypass check valve is properly releasing condenser pressure into the discharge tube and evaporator.
10. Replace the cap on the condenser pressure bypass check valve.

    Note: *Valve stem MUST be back seated during normal unit operation.*

11. Open the receiver tank return outlet valve, remove the gauges and return the unit to normal operation.

Electronic Throttling Valve (ETV)

The Electronic Throttling Valve (ETV) is standard on the these units. The ETV is a variable position valve operated by a stepper motor. The ETV is located in the suction line between the accumulator and the suction vibrasorber. The ETV system also uses discharge and suction pressure transducers, and a hot gas bypass valve.

The ETV has two internal coils. The microprocessor operates the valve by energizing the coils with a variable frequency AC signal. The valve position can be monitored with the Gauges Menu. Zero (0) indicates the valve is fully closed and 800 indicates the valve is fully open.

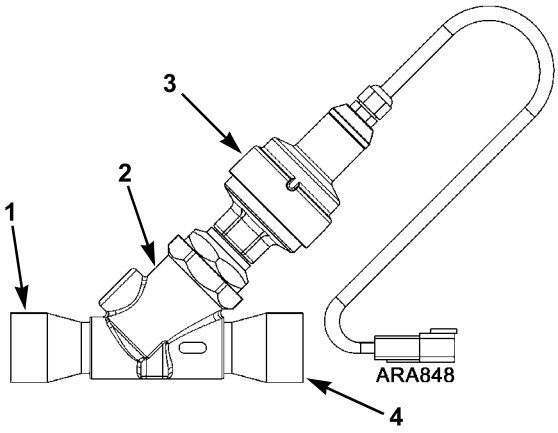
The microprocessor tests the ETV if required when the unit is started. Alarm Code 89 indicates the refrigeration system pressures did not respond as expected during the test. This may be caused by a malfunction of the ETV or by a refrigeration system problem such as low refrigerant level, a frozen expansion valve, or a restriction in suction line. The microprocessor ignores the test results if the box temperature or the ambient temperature is below 10 F (-12 C). The ETV test can also be performed using the Service Test Mode.

Use the Gauges Menu to observe the ETV position during the ETV test. The expected ETV position observation is a decrease followed by an increase. The suction pressure should decrease when the valve position decreases and increase when the valve position increases.

Refer to the appropriate Diagnostic Manual for complete information about the testing and operation of the ETV.

Refer to “Electronic Throttling Valve” in Refrigeration Service Operations for removal and installation procedures.

Figure 72. Old Style ETV



1.	Inlet
2.	Valve Body
3.	Stepper Motor
4.	Outlet

Pressure Transducers

The discharge pressure transducer and the suction pressure transducer supply pressure information to the microprocessor. These pressures can be monitored with the Gauges Menu. Check the readings by comparing them to the readings on a gauge manifold set attached to the compressor. Refer to the appropriate Diagnostic Manual for more information about the testing and operation of the pressure transducers.

Hot Gas Bypass Valve

The hot gas bypass valve is used in conjunction with the electronic throttling valve to reduce the capacity of the unit during modulation. This normally closed solenoid valve is located in the refrigeration line that connects the discharge line to the hot gas line. The hot gas bypass valve is energized (opened) at full modulation. The hot gas bypass valve is de-energized (closed) when modulation is discontinued.

Refer to the SR-3 Trailer Single Temperature SL-400e, SLX/SLXe/SLXi Series Diagnostic Manual TK 56487 for information about testing the hot gas solenoid. See Refrigeration Service Operations for removal and installation procedures.

Refrigeration Service Operations

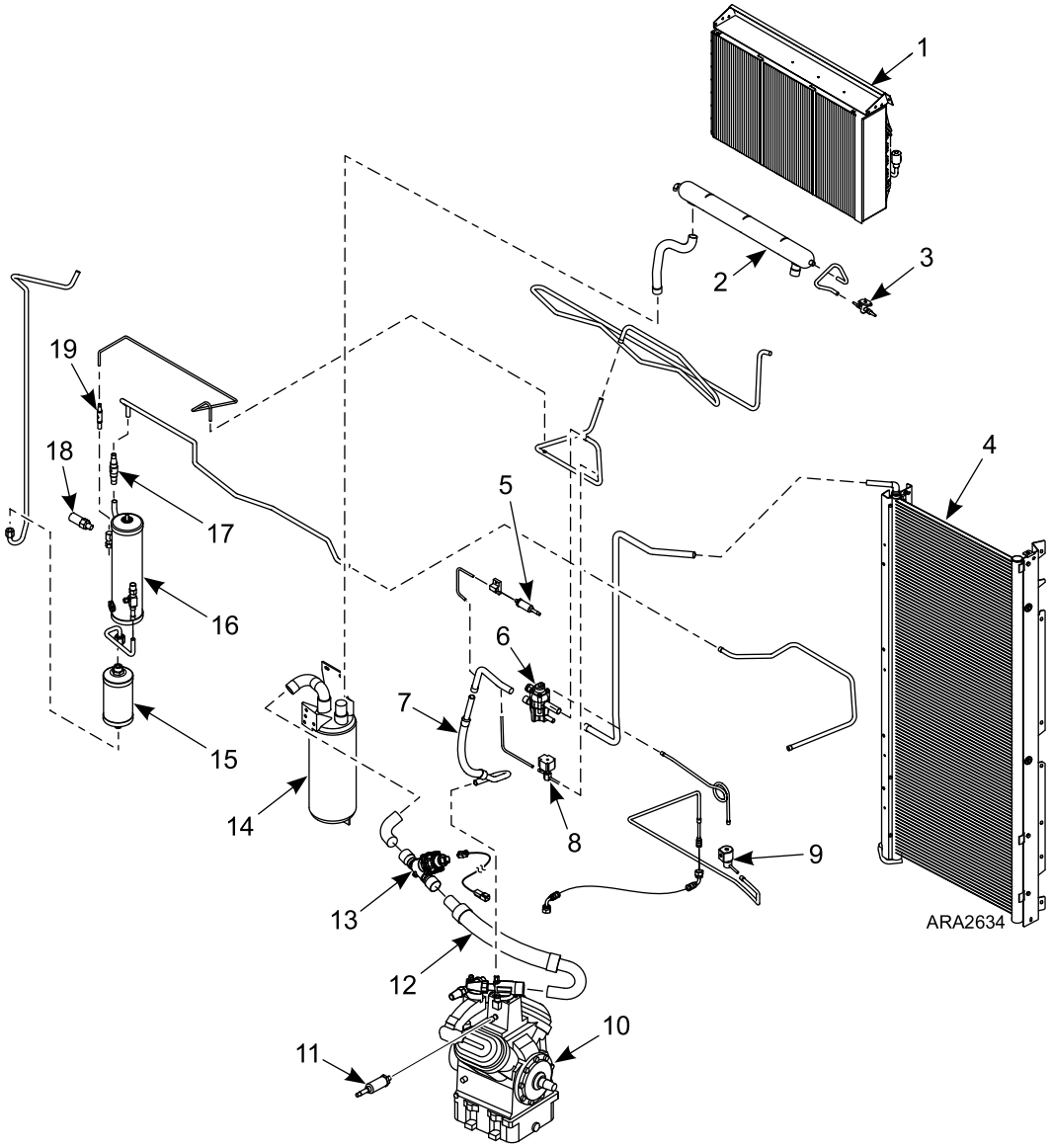
Note: *The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.*

In the USA 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.

Refrigeration System Components

The following figure shows various refrigeration system components.

Figure 73. Refrigeration System Components



1.	Evaporator Coil	11.	Suction Pressure Transducer
2.	Heat Exchanger	12.	Suction Vibrasorber
3.	Expansion Valve	13.	ETV
4.	Condenser Coil	14.	Accumulator
5.	Discharge Pressure Transducer	15.	Filter-Drier
6.	Three-Way Valve	16.	Receiver Tank
7.	Discharge Vibrasorber	17.	Condenser Check Valve
8.	Hot Gas Bypass Valve	18.	High Pressure Relief Valve
9.	Pilot Solenoid	19.	Bypass Check Valve
10.	Compressor		

Compressor

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Loosen the engine/cross shaft belt.
3. Front seat the discharge and suction service valves.
4. Recover the refrigerant remaining in the compressor.
5. Unbolt the discharge and suction service valves from the compressor.
6. Disconnect the high pressure cutout switch, the suction pressure transducer, and the pilot solenoid line.
7. Support the compressor and unbolt the compressor mounting flange from the engine.
8. Lift the service valves out of the way.
9. Slide the compressor to the left until the coupling pins are clear, and remove the engine/cross shaft belt
10. Remove the compressor from the front of the unit. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.

Note: *When the compressor is removed from the unit, the oil level should be noted, or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor in the unit.*

Installation

1. Slide the compressor into the unit.
2. Place the compressor in position, install the engine/cross shaft belt, and install the mounting hardware.

Note: *The compressor drive coupling will only slide onto the coupling pins in either of two positions, which are 180 degrees apart.*

3. Install the service valves using new gaskets soaked in compressor oil. Connect the high pressure cutout switch, the suction pressure transducer, and the pilot solenoid valve line.
4. Pressurize the compressor and test for refrigerant leaks.
5. If no leaks are found, evacuate the compressor.
6. Back seat the suction and discharge service valves.
7. Tighten the engine/cross shaft belt.
8. Operate the unit at least 30 minutes and inspect the oil level in the compressor. Add or remove oil if necessary.
9. Check the refrigerant charge and add refrigerant if needed.

Compressor Coupling Removal (Standard Units)

Note: *If the puller tool 2040991 is unavailable or does not fit, a suitable commercially available puller tool can be used.*

1. After the compressor has been removed from the unit, use the appropriate Allen tool provided with removal tool P/N 2040991 to loosen the center bolt which holds the coupling to the compressor shaft.
2. Attach the tool to the coupling with the provided socket head screws and spacers. Two sets of spacers are provided with the tool, use the short spacers with shallow compressor mounting flanges and the longer set for deeper flanges. The side with the countersunk holes should be toward the coupling.
3. To prevent the tool and crankshaft from rotating, use an appropriately sized bolt to pin the tool to the flange. If a nut is used to prevent the bolt from falling out, the nut should not be tightened.
4. Use the appropriate Allen tool to loosen the coupling mounting screw.
5. Once the center screw has been loosened, back the head against the tool and it should push the

coupling off the crankshaft as you continuing turning the center screw in a counter-clockwise direction. Using this tool will prevent the coupling from popping off because the center bolt and flat washer will hold it in place.

Compressor Coupling Installation (Standard Units)

Note: *If the puller tool 2040991 is unavailable or does not fit, a suitable commercially available puller tool can be used.*

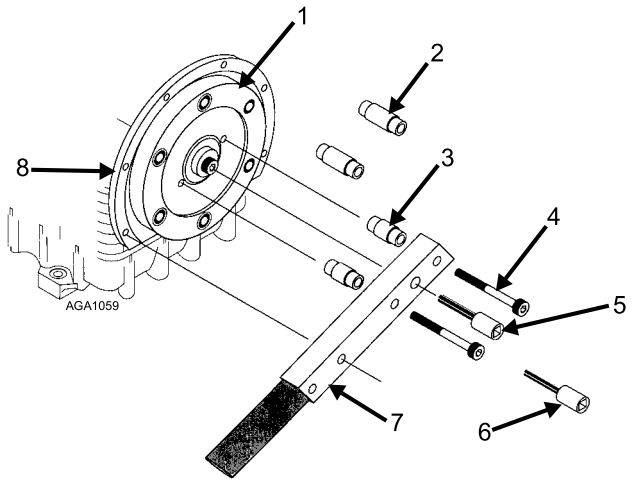
In a tapered fit joint, the entire twisting load should be handled by the friction fit between the two tapered parts. The key is only a backup and is used to index the parts correctly. When a taper fit is machined and assembled properly, a key is not needed. In fact, if the key is not installed correctly, it may be worse than no key at all. If the key does not fit easily into the keyway, it will push the tapered components apart and the reduced friction could lead to slippage and premature failure.

The following procedure requires the key to be fitted after the tapers are pulled together with 20 ft-lb (27 N•m) torque. This verifies that the key cannot hold the tapers apart when the final bolt torque is applied.

Use the following procedure to install a compressor coupling on the compressor crankshaft:

1. Clean the compressor shaft taper and coupling bore taper with a solvent that leaves no oily residue (such as naphtha, lacquer thinner, brake cleaner, or the like).

Figure 74. Compressor Coupling Removal Tool



1.	Coupling	5.	10 mm Allen Tool (for large shaft compressor)
2.	Long Spacers (supplied with tool)	6.	5/16 Allen Tool (for small shaft compressors)
3.	Short Spacers (supplied with tool)	7.	Coupling Removal Tool (P/N 2040991)
4.	Socket Head Bolts (supplied with tool)	8.	Engine Mounting Flange

2. Inspect both mating surfaces for burrs, oxidation, and other surface imperfections. Dress with crocus cloth if necessary and re-clean as required.

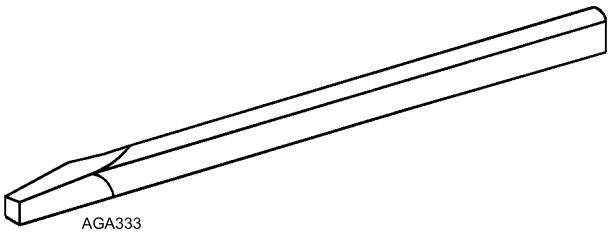
NOTICE

Equipment Damage!

If you are assembling a used coupler or crankshaft and the tool does not fit easily, there is a problem with one of the keyways. Do not remove the coupler and place the key in the crankshaft keyway and then drop the coupler on. If the tool does not fit, the key will not fit, and it will hold the taper in the coupler off the taper on the shaft. Check both keyways for burrs or corrosion. A key can be coated with fine lapping compound and used as a lapping tool to clean the keyways.

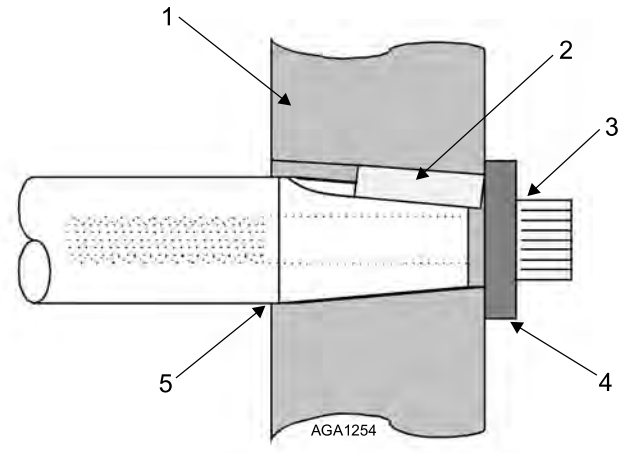
3. **Using no lubricants**, set the coupling on the crankshaft and align the keyways using the Keyway Tool (P/N 204-972). Insert the tapered end of the tool into the keyway and gently move the coupling on the shaft while pressing the tool into the keyway. This will align the keyway in the crankshaft with the keyway in the coupler.

Figure 75. Keyway Tool P/N 204–972



4. Remove the Keyway Tool and check the fit of the key (P/N 55-9024). It should fit into the keyway with a light press fit requiring only a minimum of light tapping. If the key does not fit properly, remove the coupler and inspect the keyways and key for burrs or other problems. Recheck the fit as shown above.
5. When the key fits properly, remove the coupling and key from the shaft.
6. Re-install the coupling and align the keyways with the Keyway Tool.
7. **Do not install the key at this time**. Install the flat washer and bolt and pre-torque to 20 ft-lb (27 N•m). Remove the bolt and washer.
8. Install the key in the keyway. As above, it should fit with a light press fit requiring only a minimum of light tapping. **Do not install the key into the keyway beyond the front face of the coupling**. If tapped in farther, it may cause the coupling to move off center on the shaft.

Figure 76. Compressor Coupling Installation



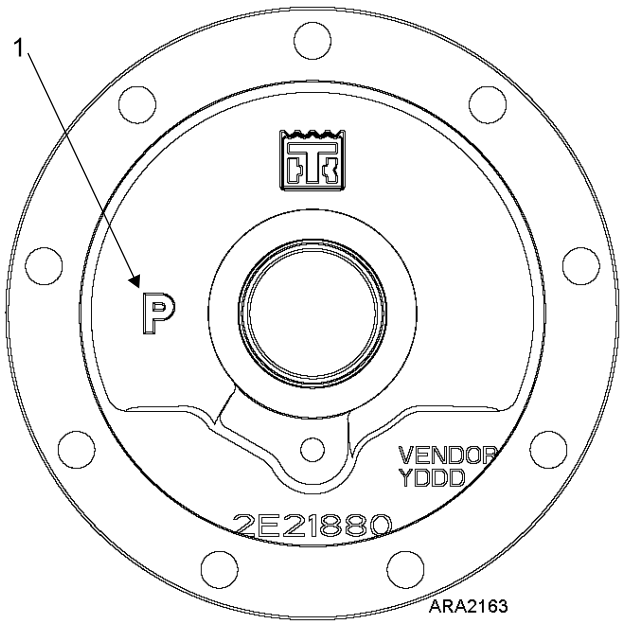
1.	Compressor Coupling or Clutch
2.	Key tapped flush with outside face of coupling. Do not tap key any farther into keyway.
3.	Torque bolt to 90 ft-lb (122 N•m)
4.	Washer
5.	Spray this area with corrosion inhibitor after assembling.

9. Re-install the bolt and heavy flat washer and snug the bolt down by hand. Torque the bolt to 90 ft-lb (122 N•m).
10. Spray a corrosion inhibitor (such as spray paint) on the exposed part of the shaft and the joint between the shaft and the coupling. This prevents moisture from wicking into the joint and causing corrosion.

Compressors with Pressurized Seal Cavity

Starting in the first quarter of 2017, the pressurized seal cavity was phased into use on large shaft four cylinder compressors. Compressors with a pressurized seal cavity can be identified by the "P" on the seal cover as shown (Figure 77, p. 67). The model number of the compressor has been changed to X430P to signify the Pressurized Seal Cavity as shown (Figure 78, p. 68). The pressurized seal cavity uses a new compressor seal with a hex drive and a new crankshaft with a hex drive collar. See "Hex Drive Compressor Seal Replacement," p. 68 for the replacement procedure.

Figure 77. Seal Cover for Compressor with Pressurized Seal Cavity



1.	"P" Indicates Pressurized Seal Cavity

Figure 78. Model Number Location

1.	"X430P" Indicates Pressurized Seal Cavity

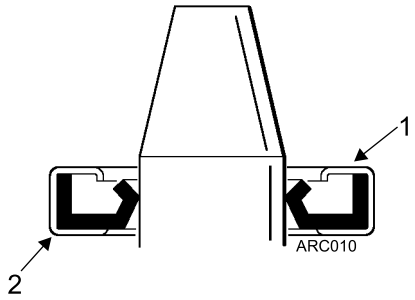
Hex Drive Compressor Seal Replacement

1. Remove the compressor from the unit.
2. Remove the six mounting flange bolts and remove the mounting flange.
3. Remove the three seal plate bolts and use a slide hammer to remove the seal plate.

   Note: *Use slide hammer P/N 204-638 and adapter P/N 204-640 to obtain the 5/16-18 male thread needed to fit the seal plate.*
4. Place the seal plate gasket side down on a work bench and push the hard ring out of the seal plate.

   Note: *Provide a clean soft surface for hard ring to fall onto when pushed out of the seal plate.*
5. Remove the small lip seal from the seal plate, but do not remove the larger, internal lip seal unless it is damaged.
6. Remove the bellows assembly from the shaft by prying evenly on each side with small pry bar.
7. Retain all old seal parts for warranty return if required.
8. Clean all parts thoroughly to remove all oil and gaskets.
9. Polish the crankshaft with crocus cloth if it is rusted or dirty. Do not allow abrasives to contaminate the compressor.
10. Install the new lip seal in the seal plate with the lip side facing out and the flat side facing toward the compressor.

Figure 79. Lip Seal Installation



1.	Lip Side Facing Out
2.	Flat Side Toward Compressor

NOTICE

Equipment Damage!

DO NOT touch or damage the polished seal face surfaces on the hard ring. Keep the protective cap in position on the bellows until final assembly.

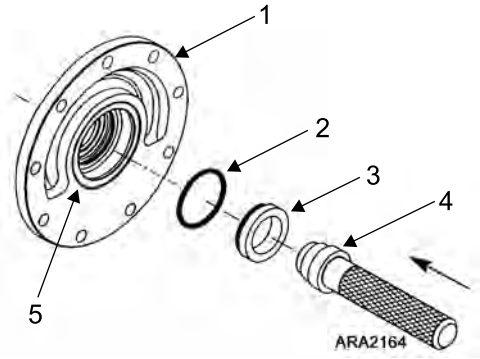
11. Apply clean compressor oil to the new O-ring and install it in the seal plate. Apply clean compressor oil to the new hard ring. Verify the hard ring installation tool (P/N 204-953) is clean. Use the hard ring installation tool to push the hard ring (with the polished surface toward the installation tool) fully into the seal plate. Do not pinch the O-ring.

    Note: *If the installation tool is not available, use the pad in the new seal packaging to protect the polished surface of the hard ring during assembly.*

Figure 80. Hard Ring Positions

1.	This Side Toward Seal Plate
2.	This Side Toward Compressor

Figure 81. Hard Ring Installation

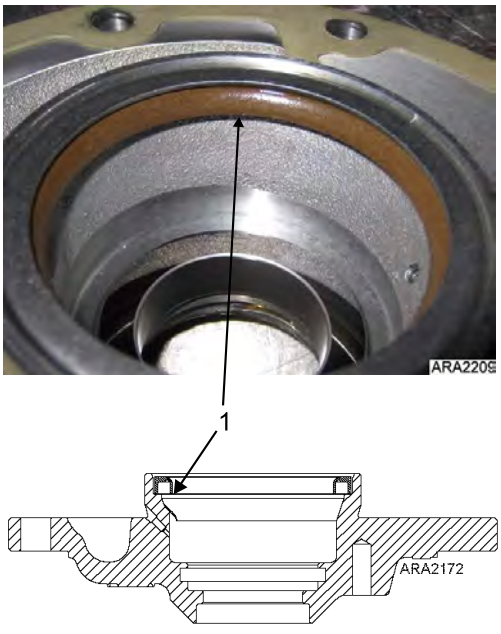


1.	Seal Plate
2.	O-ring
3.	Hard Ring - Install with Polished Surface Toward Compressor
4.	Hard Ring Installation Tool P/N 204-953
5.	Internal Lip Seal

12. If damaged, replace the internal lip seal by prying the old one out and press the new one into place with the lip facing into the seal plate. Verify the lip seal is pressed all the way down into the seal plate. Oil the lip seal with supplied compressor oil.

    Note: *Do not replace the internal lip seal unless it is damaged.*

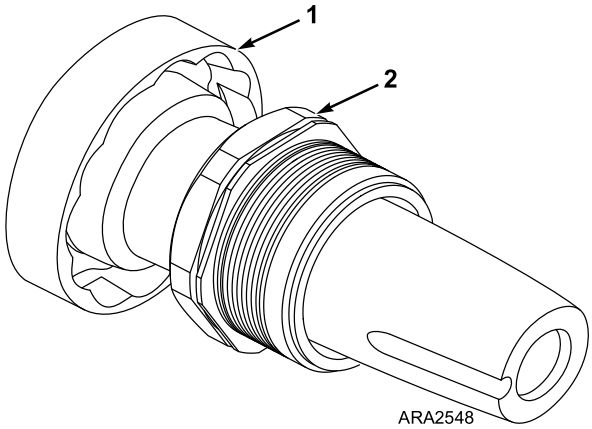
Figure 82. Internal Lip Seal Installation



1.	Lip Facing Into Seal Plate

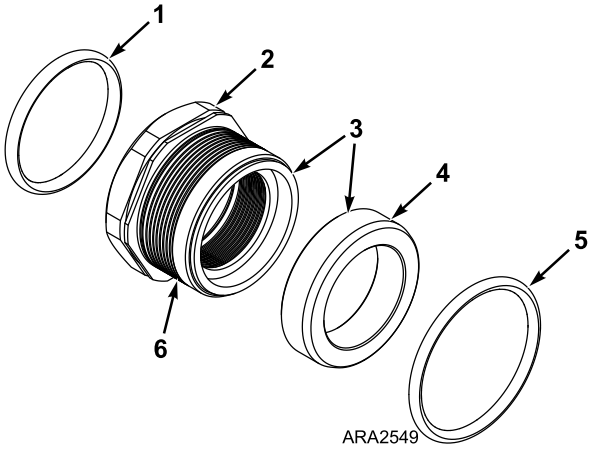
13. Apply clean compressor oil to the O-ring inside the bellows. Slide the bellows on the crankshaft, align the hex drive on the bellows with the hex drive collar, and push the bellows firmly against the hex drive collar. Leave the protective cap in place during installation. If the hex drive does not slide on easily, rotate the assembly 30 degrees.

Figure 83. Hex Drive Bellows Installation (Shown Without Protective Cap)



1.	Hex Drive Collar
2.	Hex Drive

Figure 84. Hex Drive Type Bellows Seal



1.	O-ring (Inside Bellows)
2.	Hex Drive
3.	Seal Faces
4.	Hard Ring
5.	O-ring (In Seal Plate)
6.	Bellows

NOTICE

Equipment Damage!

Oil applied to the seal faces must be absolutely clean.

14. Remove the yellow protective cap. Clean the hard ring and the primary ring (bronze ring) with the alcohol wipes found in package labeled "1". Clean the polished mating surfaces of both rings with the lint free dry wipes from package number "2". Apply clean compressor oil to the polished surfaces of the seal, the lip seals, and the seal plate gasket from the package number "3" before assembling.
15. Install the seal plate and gasket to the compressor body. Do not bump the seal hard ring on the end of the crankshaft during assembly.
16. Install the seal plate mounting bolts and washers. Torque the seal plate bolts to 28 ft-lb (38 N•m) in two steps using a criss-cross pattern.
17. Install the mounting flange and torque the bolts to 28 ft-lb (38 N•m) in two steps using a criss-cross pattern.
18. Install the compressor in the unit.

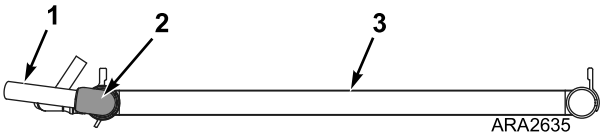
Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Remove the condenser grille and belt panel.
3. Unsolder the inlet and outlet refrigeration line connections from the copper stub tubes on the micro-channel condenser coil. Use a heat sink on the copper stub tubes.

   Important: *This unit uses a micro-channel condenser coil. Micro-channel coils are made of aluminum but have copper stub tubes at the inlet and outlet connections. Use a heat sink on the copper stub tubes to prevent damage to the uniseal tape and brazed connections (and the aluminum) that attach the copper stub tubes to the aluminum micro-channel coil. The uniseal tape is used to prevent corrosion between the copper and aluminum.*
4. Remove the condenser coil mounting bolts and remove the coil from the unit.

Figure 85. Top View of Curbside Condenser Coil



1.	Copper Stub Tube
2.	Uniseal Tape (Protects Brazed Connection between Copper Stub Tube and Aluminum Micro-Channel Condenser Coil)
3.	Aluminum Micro-Channel Condenser Coil

Installation

1. Clean the fittings for soldering.
2. Place the coil in the unit and install the mounting bolts.
3. Solder the inlet and outlet refrigeration line connections to the copper stub tubes on the micro-channel condenser coil. Use a heat sink on the copper stub tubes.

   Important: *This unit uses a micro-channel condenser coil. Micro-channel coils are made of aluminum but have copper stub tubes at the inlet and outlet connections. Use a heat sink on the copper stub tubes to prevent damage to the uniseal tape and brazed connections (and the aluminum) that attach the copper stub tubes to the aluminum micro-channel coil. The uniseal tape is used to prevent corrosion between the copper and aluminum.*
4. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
5. Reinstall the condenser grille and belt panel..
6. Recharge the unit with proper refrigerant and check the compressor oil.

Discharge Vibrasorber

Removal

1. Recover the refrigerant charge.

NOTICE

Equipment Damage!

Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

2. Heat the connections on the vibrasorber until the vibrasorber can be removed.

Installation

1. Prepare the vibrasorber and tubing fittings by

cleaning thoroughly.

NOTICE

Equipment Damage!

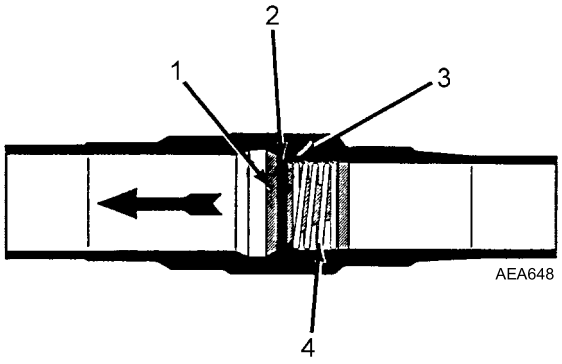
Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

2. Solder the vibrasorber connections.
3. Pressurize the system and test for leaks. If no leaks are found, evacuate the system.
4. Charge the unit with the proper refrigerant and check the compressor oil level.

In-Line Condenser Check Valve

This unit uses an in-line condenser check valve. The in-line check valve is not repairable and must be replaced if it fails. A heat sink must be used on the in-line check valve when it is being soldered in place to prevent damage to the neoprene seal.

Figure 86. Cross Section of In-line Condenser Check Valve



1.	Valve	3.	Valve Seat
2.	Neoprene Seal	4.	Spring

Condenser Check Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Place a heat sink on the check valve.
3. Unsolder the lines and remove the check valve.

Installation

Note: *A heat sink must be used on the in-line check valve when it is being soldered in place to prevent damage to the neoprene seal.*

1. Clean the tubes for soldering.
2. Place the check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Place a heat sink on the check valve.
4. Solder the inlet and outlet connections.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Bypass Check Valve

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Close the bypass service valve.
3. Unsolder the bypass check valve line from the bypass check valve. Use a heat sink on the bypass check valve.
4. Unsolder and remove the bypass check valve from the receiver tank. Use a heat sink on the bypass check valve.

Installation

1. Solder the bypass check valve onto the receiver tank. Use a heat sink on the bypass check valve.
2. Solder the bypass check valve line to the bypass check valve. Use a heat sink on the bypass check valve.
3. Pressurize the low side and test for leaks. If no leaks are found, evacuate the system.
4. Open the suction service valve and the bypass service valve and place the unit in operation.

Receiver Tank

Removal

1. Recover the refrigerant charge.
2. Unsolder the inlet, outlet, and bypass check valve lines from the receiver tank. Use a heat sink on the bypass check valve.
3. Unsolder and remove the bypass check valve from the receiver tank. Use a heat sink on the bypass check valve.
4. Remove the high pressure relief valve from the receiver tank.
5. Unbolt the mounting brackets and remove the receiver tank from the unit.

Installation

1. Install the high pressure relief valve in the receiver

tank.

2. Solder the bypass check valve onto the receiver tank. Use a heat sink on the bypass check valve.
3. Place the receiver tank in the unit and install the mounting bolts and nuts loosely.
4. Solder the inlet, outlet, and bypass check valve lines to the receiver tank. Use a heat sink on the bypass check valve.
5. Tighten the receiver tank mounting hardware securely.
6. Pressurize the refrigeration system and check for leaks. If no leaks are found, evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Filter-Drier

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Disconnect the nuts at the ends of the drier.
3. Loosen the mounting hardware and remove the drier.

Installation

1. Place the new O-rings in the ORS fittings on the ends of the drier.
2. Install the new drier and tighten the mounting hardware.
3. Install and tighten the ORS nuts by holding the drier with a back-up wrench on the hex behind the ORS fitting.
4. Pressurize the low side and inspect for leaks. If no leaks are found, evacuate the low side.
5. Open the refrigeration valves and place the unit in operation.

Expansion Valve Assembly

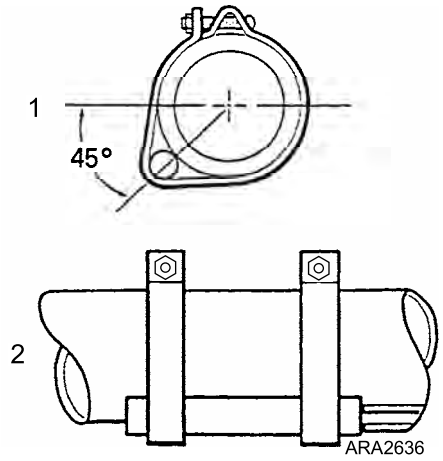
Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels as needed.
3. Remove the feeler bulb from the clamp. Note the position of the feeler bulb on the suction line.
4. Unsolder the equalizer line, inlet liquid line, and distributor from the expansion valve.
5. Remove the expansion valve mounting bolt and remove the expansion valve from the unit.

Installation

1. Install and bolt the expansion valve assembly in the unit.
2. Solder the equalizer line, inlet liquid line, and distributor 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 with insulating tape.

Figure 87. Location of Expansion Valve Bulb



1.	End View
2.	Side View

4. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
5. Reinstall the access panels.
6. Open the refrigeration valves and place the unit in operation.
7. Test the unit to see that the expansion valve is properly installed.

Heat Exchanger

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the mounting bolts that hold the heat exchanger on the bulkhead.
4. Unsolder the equalizer line from the suction line.
5. Unsolder the liquid outlet line from the expansion valve.
6. Note the position of the feeler bulb on the side of the suction line. Remove the expansion valve feeler

bulb from the suction tube.

7. Unsolder the suction line at the evaporator coil end.
8. Unsolder the remaining outlet suction line and inlet liquid line connections. Remove any putty from around the lines before unsoldering the connections.
9. Slide the heat exchanger assembly out of the evaporator housing.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the evaporator housing and install the mounting hardware loosely.
3. Solder the liquid inlet and the suction outlet line connections on the curbside of the evaporator. Seal the openings through the bulkhead with putty when the refrigerant lines have cooled off.
4. Solder the suction line connection to the evaporator coil.
5. Solder the equalizer line to the suction line and the liquid outlet line to the expansion valve.
6. Tighten the heat exchanger mounting hardware securely.
7. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
8. Clean the suction tube to a brightly 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 the operation will be faulty. Wrap with insulating tape.
9. Replace the evaporator access panels.
10. Open the refrigeration valves and place the unit in operation.
11. Check refrigerant charge and compressor oil level

Evaporator Coil Assembly

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the sensors.
4. Remove the heat exchanger mounting hardware.
5. Remove the feeler bulb from the suction line clamp. Note the position of the feeler bulb on the suction line.
6. Unsolder the distributor from the expansion valve.
7. Unsolder the hot gas line and the suction line from the evaporator coil.
8. Remove the mounting bolts and remove the coil from the evaporator housing.

Installation

1. Place the evaporator coil assembly in position and install the mounting bolts.
2. Solder the hot gas line and suction line connections to the evaporator coil.
3. Solder the distributor to the expansion valve assembly.
4. Reinstall the heat exchanger mounting hardware.
5. Reinstall the sensors.
6. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
7. Clean the suction line to a bright polished condition. Install 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 its operation will be faulty. Wrap with insulating tape.
8. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
9. Reinstall the evaporator access panels.
10. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil. Add as required.

Accumulator

Removal

1. Pump down the low side and equalize the pressure to slightly positive.

NOTICE

Equipment Damage!

Use a heat sink or wrap ETV with wet rags to prevent damaging the ETV.

2. Unsolder the inlet and outlet suction lines from the accumulator.
3. Unbolt and remove the accumulator from the unit.

Installation

1. Place the accumulator in the unit and tighten the mounting bolts and nuts.

NOTICE

Equipment Damage!

Use a heat sink or wrap ETV with wet rags to prevent damaging the ETV.

2. Solder the inlet and outlet suction lines to the accumulator.
3. Pressurize the low side and test for refrigerant

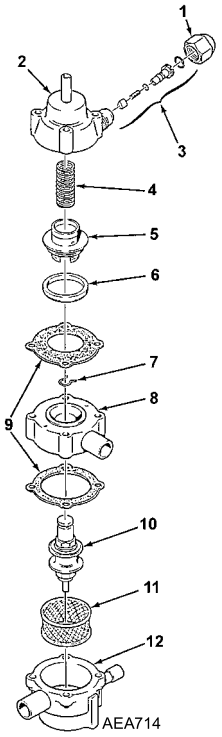
leaks. If no leaks are found, evacuate the low side.

4. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil. Add as required.

Three-Way Valve Repair

Note: *The three-way valve can be repaired in the unit if leakage or damage to the PTFE seals should occur. There is usually enough give in the copper tubing to separate the three sections of the valve without unsoldering any tubes.*

Figure 88. Three-Way Valve



1.	Cap	7.	Clip
2.	End Cap	8.	Seat
3.	Check Valve	9.	Gaskets
4.	Spring	10.	Stem Assembly
5.	Piston	11.	Screen
6.	Seal	12.	Bottom Cap

Removal/Disassembly

1. Recover the refrigerant charge.
2. Clean the exterior surface of the valve.
3. Remove the line from the three-way valve to the pilot solenoid.

NOTICE

Equipment Damage!

Do not force the tool into the brass or against the bolts.

4. Loosen the four 1/4 inch Allen head screws (DO NOT REMOVE OR CAP MAY POP OFF); use tool P/N 204-424 to break the gasket at each side of the center section.

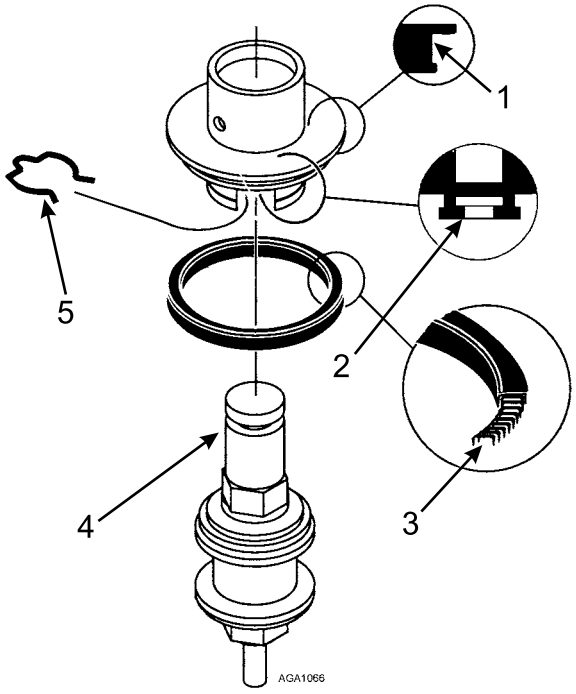
Figure 89. Gasket Tool P/N 204-424

5. Remove the four bolts from the valve.
6. Remove the end cap and spring.
7. Remove the spring clip which secures the stem to the piston. Slide piston off the stem.
8. Remove the seat and stem assembly.
9. Inspect the following parts for wear or damage:
   - Bottom cap, sealing, and support area.
   - Seat, sealing surface.
   - End cap, sealing, and support surface.

   The following parts will be discarded:
   - Stem assembly.
   - All gaskets.
   - Piston seal.
10. Remove the screen. If any particles drop from the screen into the discharge line, the discharge line must be removed at the compressor.

    Note: *The valve body cannot be reconditioned. Seat positions change and improper sealing will result.*

Figure 90. Piston and Stem Parts



1.	Seal Groove in Piston
2.	Connecting Notch in Piston
3.	Internal Spring in Seal
4.	Connecting Groove in Stem
5.	Retaining Clip

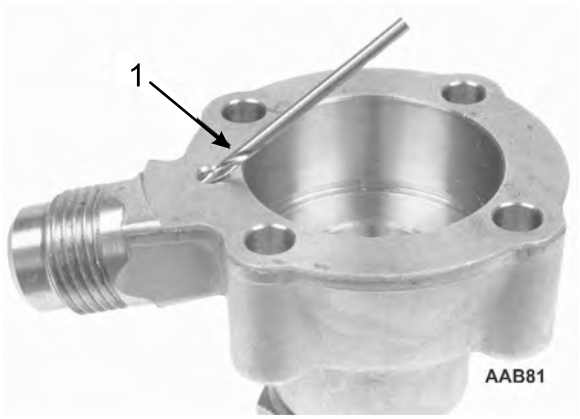
End Cap Checks

All end caps, even new ones, should be checked as follows. See Service Bulletin T&T 260 for more information.

Check Valve Bleed Hole Diameter

1. Remove the condenser pressure bypass check valve snap ring, stem, spring, and piston from the end cap.
2. Use a number 43 (0.089 in. [2.26 mm]) drill bit to check the size of the hole from the end cap gasket face to the check valve piston bore as shown.
3. If the drill does not go all the way into the bore, drill the hole completely through.
4. Deburr the hole in the check valve piston bore. A used drill bit can be modified to use as a deburring tool.

Figure 91. Check Bleed Hole Diameter

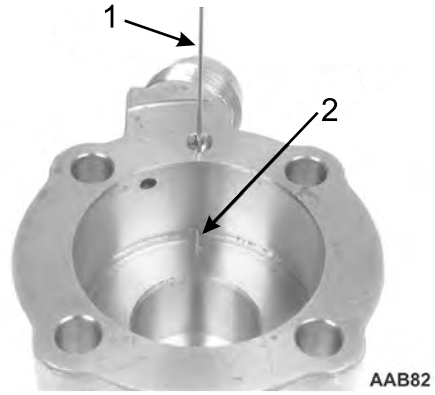


1.	Number 43 Drill Bit

Piston Bleed Orifice Check

1. Use a number 66 (0.033 in. [0.84 mm]) drill bit to check the orifice in the bleed hole from the gasket surface to the groove in the bottom of the piston bore.
2. Carefully check to see that the drill projects down into the groove and that there are no burrs at the end of the hole in the groove. Do not enlarge this hole.

Figure 92. Check Piston Bleed Orifice



1.	Number 66 Drill Bit
2.	Check for Burr Here

Check Valve Piston Check

1. Reassemble the end cap using a new check valve piston, spring, stem, and snap ring (Kit P/N 60-163).
2. Leave the stem back seated against the snap ring. Use a paper clip bent into a 90 degree angle to push the check valve piston back in its bore. Verify you can feel the piston working against the spring.
3. With the piston pushed all the way back in its bore, use a strong light to look down the 0.089 in. (2.26 mm) hole towards the back of the piston and

determine how much of the end of the hole is covered by the piston. If the piston covers more than three-quarters of the hole replace the end cap.

Note: *When front seating a condenser bypass check valve DO NOT over-tighten the stem. Excessive torque will deform the piston and the deformed piston can increase the hole blockage.*

Seat (Center Section) Orifice Check

There are three 0.033 in. (0.84 mm) holes located in the three-way valve seat (center section). Only one is used depending on how the valve is configured.

- If the hole is too large the valve will be slow to shift from heat to cool when the condenser pressure is higher than discharge pressure because gas will flow to the discharge line instead of behind the piston.
- If the hole is too small the valve will be slow to shift from heat to cool when discharge pressure is higher than condenser pressure because the flow is restricted.

Do not enlarge this hole larger than 0.033 in. (0.84 mm).

Whenever you disassemble a three-way valve you should check that all three of the holes are drilled cleanly.

Figure 93. Check Seat Orifice

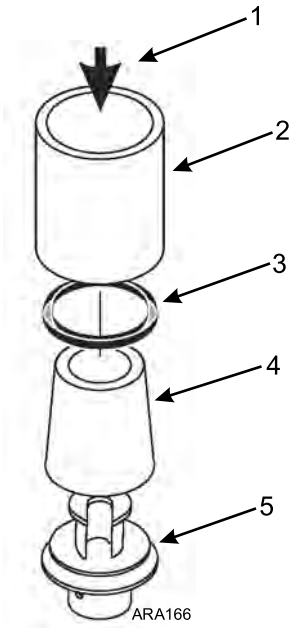
1.	Number 66 Drill Bit

Assembly/Installation

After cleaning and inspecting all parts, reassemble the valve as follows:

1. Install the screen in the bottom cap.
2. Install the new stem in the bottom cap.
3. Install new gaskets on both sides of the seat. Oil the gaskets in compressor oil before installing.
4. Use the three-way valve seal installation tool P/N 204-1008 to install a new seal on the piston. This prevents the seal from being stretched and damaged.
   a. Place the tapered tool over the piston.
   b. Lubricate the seal with refrigeration oil.
   c. Slide the seal onto the tapered tool with the spring side facing away from the piston.
   d. Use the pipe to hand press the seal onto the piston.

Figure 94. Seal Installation with Tool P/N 204-1008



1.	Press by Hand	4.	Tapered Tool
2.	Pipe	5.	Piston
3.	Seal		

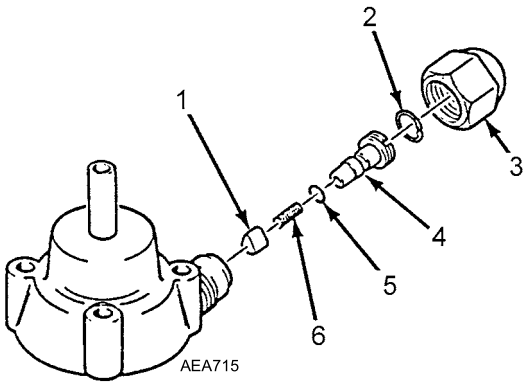
5. Place the piston slot on the stem and secure with spring clip. The open part of the clip should be on the opposite side of the piston slot.
6. Install the spring and end cap.
7. Line up the passageways in the cap and body. Failure to line up the holes will result in improper operation of the valve.
8. Install the bolts and tighten in rotating sequence. Torque to 160 in-lb (18 N•m).
9. Install the pilot solenoid line and pressurize the system with refrigerant to check for leaks.
10. If there are no leaks, evacuate the system and recharge with the proper refrigerant.
11. Run the unit to check for proper three-way valve operation.

Three-Way Valve Condenser Pressure Bypass Check Valve Repair

Removal

1. Recover the refrigerant charge.
2. Unscrew the condenser pressure bypass check valve cap from the three-way valve.
3. Remove the snap ring.

Figure 95. Check Valve Assembly



1.	Piston	4.	Stem
2.	Snap Ring	5.	O-ring
3.	Cap	6.	Spring

4. Unscrew the check valve stem by using a screwdriver in the slot provided.

   Note: *The spring and piston are held in by the stem. While removing the stem, use care so the spring and piston are not lost.*

5. Remove the spring and piston.
6. Inspect the check valve seat in the three-way valve.
7. If replacement parts are needed, a kit P/N 60-163 must be used which includes the piston, spring, O-ring, valve stem, and snap ring.

Installation

1. Coat the O-ring with compressor oil and install it on the check valve stem.
2. Insert the spring into the hole in the check valve stem and then install the piston on the other end of the spring with the hole in the piston towards the spring.

NOTICE

Equipment Damage!

The piston must be inserted with the flat side against the valve seat to ensure proper sealing.

3. Coat the entire assembly with compressor oil and install the assembly into the check valve seat in the three-way valve.
4. Screw the check valve stem into the three-way valve until the snap ring can be installed.
5. Install the snap ring.
6. Unscrew (back seat) the check valve stem against the snap ring.

   Note: *The valve stem must be back seated during normal unit operation.*

7. Coat the sealing area in the cap with compressor oil, install and tighten the cap on the three-way valve.
8. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
9. Recharge the unit with the proper refrigerant.

Pilot Solenoid

Removal

1. Recover the refrigerant charge.
2. Disconnect the wires and remove the coil from the valve.
3. Unsolder the refrigeration lines.
4. Remove the mounting bolts and remove the valve.

Installation

1. Remove the coil from the valve.
2. Place the valve in the unit and install the mounting bolts. The arrow on the valve indicates the direction of flow through the valve. Verify that the arrow points in the proper direction.
3. Solder the refrigeration lines to the valve.
4. Install the coil and connect the wires.
5. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
6. Recharge the unit with the proper refrigerant and check the compressor oil.

Suction Vibrasorber

Removal

1. Pump down the low side and equalize pressure to slightly positive.
2. Unsolder the suction vibrasorber from the suction service valve.

NOTICE

Equipment Damage!

Use a heat sink or wrap ETV with wet rags to prevent damaging the ETV.

3. Unsolder the other end of the suction vibrasorber from the ETV and remove the vibrasorber from the unit.

Installation

1. Prepare the suction vibrasorber and tube fittings for soldering by cleaning the thoroughly.

NOTICE

Equipment Damage!

Use a heat sink or wrap vibrasorber with wet rags to prevent damaging the vibrasorber.

2. Solder the vibrasorber to the suction service valve.

NOTICE

Equipment Damage!

Use a heat sink or wrap ETV with wet rags to prevent damaging the ETV.

3. Solder the other end of the suction vibrasorber to the ETV.
4. Pressurize the low side and check for leaks. If no leaks are found, evacuate the system.
5. Open the refrigeration valves and place the unit in operation.

High Pressure Cutout Switch

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Front seat the discharge and suction service valves. Recover the refrigerant remaining in the compressor.
3. Disconnect the wires and remove the high pressure cutout switch from the compressor discharge manifold.

Installation

1. A new high pressure cutout switch does not have a connector installed. Use the old connector and just install new wire terminals, or install a new connector and wire terminals. Refer to the appropriate Parts Manual for the correct connector and terminal part numbers.
2. Place a new copper sealing washer on the high pressure cutout switch.
3. Install the high pressure cutout switch and torque it to 20 ± 2 ft-lb (27 ± 3 N•m).
4. Connect the wires.
5. Pressurize the compressor and test for leaks.
6. If no leaks are found, open the refrigeration service valves and place the unit in operation.

High Pressure Relief Valve

Removal

1. Recover the refrigerant charge.
2. Unscrew and remove the high pressure relief valve.

Installation

1. Apply a refrigerant oil to the O-ring of the high pressure relief valve.
2. Install and tighten the high pressure relief valve.
3. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
4. Recharge the unit with the proper refrigerant and check the compressor oil level.

Discharge Pressure Transducer

Removal

1. Recover the refrigerant charge.
2. Disconnect the wires and remove the discharge pressure transducer.

Installation

1. Apply a refrigerant Loctite to the threads of the discharge pressure transducer.
2. Install and tighten the discharge pressure transducer and reconnect the wires.
3. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
4. Recharge the unit with the proper refrigerant and check the compressor oil.

Suction Pressure Transducer

Removal

1. Pump down the low side and equalize pressure to slightly positive.
2. Disconnect the wires and remove the suction pressure transducer.

Installation

1. Apply a refrigerant Loctite to the threads of the suction pressure transducer.
2. Install and tighten the suction pressure transducer

and reconnect the wires.

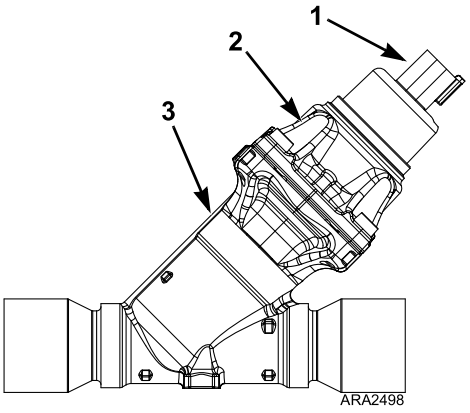
3. Pressurize the low side and check for leaks. If no leaks are found, evacuate the low side.
4. Open the refrigeration valves and place the unit in operation.

Electronic Throttling Valve (ETV)

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. The ETV must be open to remove the stepper motor and piston assembly. Open the ETV by placing the unit in the Evacuation Mode/Test, and disconnecting the four-pin connector on the main/unified harness from the four-pin connector on the ETV before turning the unit off. The microprocessor closes the ETV when the unit is turned off. Refer to the appropriate Diagnostic Manual for information about the Evacuation Mode/Test.

Figure 96. ETV



1.	Four-Pin Connector
2.	Stepper Motor
3.	Valve Body

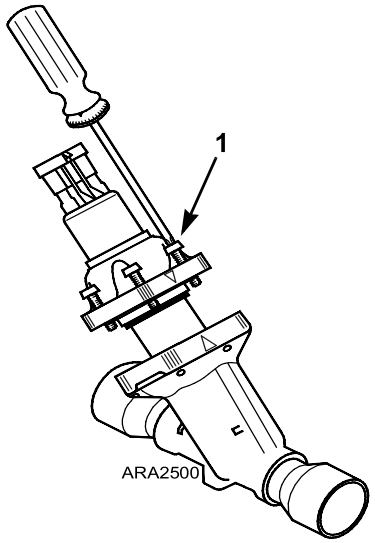
⚠ CAUTION

Risk of Injury!

If the ETV is stuck in the closed position, much of the refrigerant charge may be trapped in the evaporator and accumulator. If you hear refrigerant begin to flow through the valve when the stepper motor and piston assembly are loosened, unscrew the four screws on the stepper motor no more than four turns each and check the suction (low side) pressure on the gauge manifold. If the suction pressure has increased from the pressure to which it was equalized after the low side pump down, refrigerant is trapped and must be recovered. Screw the stepper motor and piston assembly back into the valve body. Attach a refrigerant recovery device to the service port on the receiver tank outlet valve. Midseat the receiver tank outlet valve, and recover the refrigerant charge. The stepper motor and piston assembly may then be removed.

3. Remove the four screws that attach the stepper motor to the valve body.

Figure 97. Removing Stepper Motor



1.	Remove Four Screws

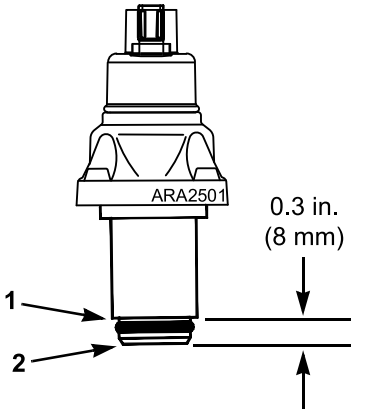
4. If the complete ETV assembly is being replaced, unsolder and remove the valve body. It may be necessary to unsolder the tubes above or below the valve body to obtain enough clearance to remove the valve body. Note the position of the valve body so the new one will be placed in the same position. The new ETV could interfere with other components if it is not placed in the same position as the old one.

Installation of Service Kit

Note: *Do not connect the main/unified wire harness to the ETV and turn the unit on before the stepper motor and piston assembly is installed in the valve body. The controller is programmed to close the ETV when the unit is turned on. If the unit is turned on with the ETV connected to main wire harness, the controller will attempt to close the ETV. This will cause the piston to be turned (screwed) off the threaded shaft of the stepper motor because the valve body is not present to stop it.*

1. The new stepper motor and piston assembly is supplied with the piston in the open position. In the open position the bottom edge of the piston is 0.3 to 0.7 in. (8 to 18 mm) from the bottom edge of the piston housing. The piston retracts to open and extends to close.

Figure 98. Stepper Motor and Piston Assembly with Piston in Fully Open Position



1.	Bottom Edge of Piston Housing
2.	Bottom Edge of Piston

2. Lubricate the O-rings with refrigeration oil. Place one on the stepper motor and piston assembly and place the other in the valve body.

Figure 99. Install O-Ring on Stepper Motor and Piston Assembly

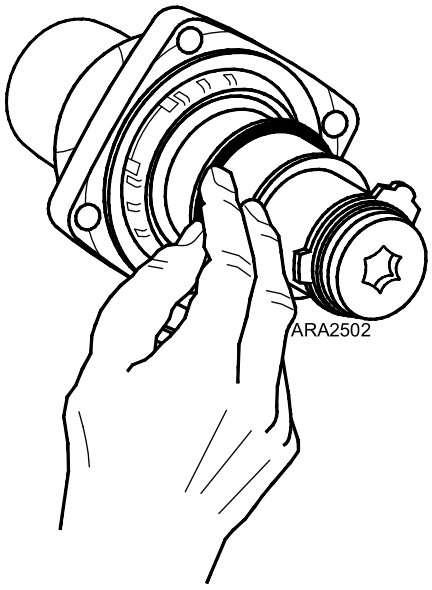
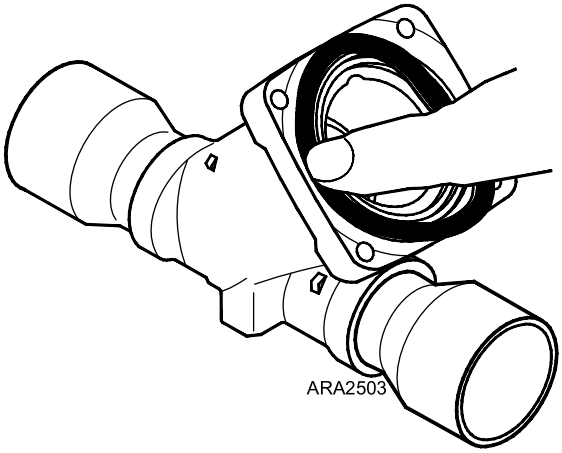
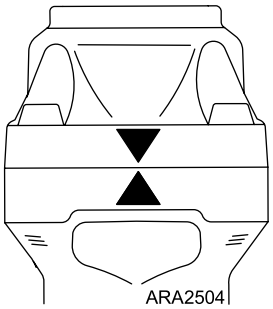


Figure 100. Install O-Ring in Valve Body



3. Place stepper motor and piston assembly into the valve body and make sure the arrowhead marks on them are aligned as shown below.

Figure 101. Align Arrowhead Marks



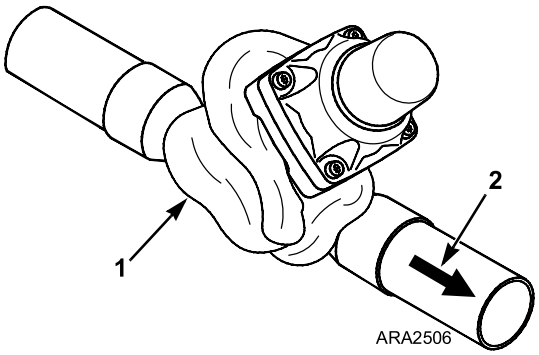
4. Install the four screws and torque them to 4.4 ± 0.4 ft-lb (6.0 ± 0.5 N•m).
5. Connect the main/unified wire harness to the ETV at the four-pin connector.
6. Pressurize the low side and test for leaks.
7. If no leaks are found, evacuate the low side.
8. Open the refrigeration valves and place the unit in operation.

Installation of Complete ETV Assembly

1. Clean the tubes for soldering.
2. Place the new complete ETV assembly (and any tubes that were removed) in the same position from which the old one was removed. The new ETV could interfere with other components if it is not placed in the same position as the old one. The ETV assembly must be installed as shown below relative to the direction of refrigerant flow from the accumulator to the compressor.

   Note: *Do not disassemble the new ETV to solder it in place.*

Figure 102. Installing Complete ETV Assembly



1.	Use Heat Sink
2.	Direction of Refrigerant Flow

3. Use a heat sink or wrap the valve body with a wet rag to prevent damage and solder the tubing connections with 95-5 soft solder.
4. Connect the main/unified wire harness to the ETV at the four-pin connector.
5. Pressurize the low side and test for leaks.
6. If no leaks are found, evacuate the low side.
7. Install the components that were removed to access the ETV.
8. Open the refrigeration valves and place the unit in operation.

Hot Gas Bypass Valve

Removal

1. Recover the refrigerant charge.
2. Disconnect the wires and remove the coil for the valve.
3. Unsolder the refrigeration lines.
4. Remove the mounting bolts and remove the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil from the valve.
3. Place the valve in the unit and install the mounting bolts. The arrow on the valve indicates the direction of flow through the valve. Verify that the arrow points in the proper direction.
4. Solder the inlet and outlet connections. After the valve cools, install the coil.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Compressors with Internal Oil Filter

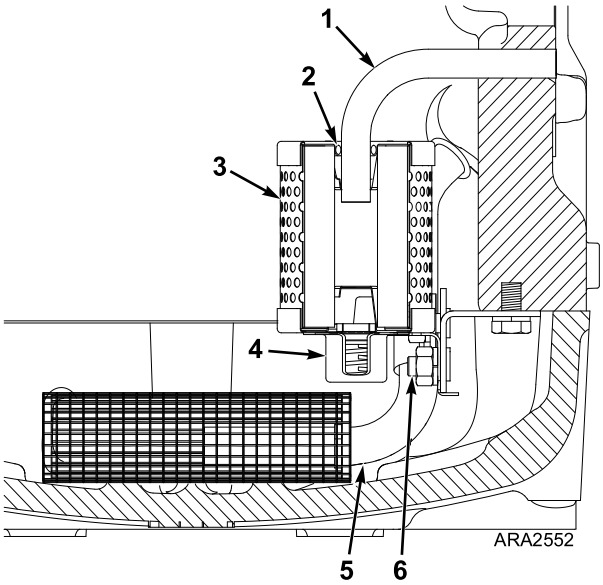
In the first quarter of 2014, four cylinder compressors with an internal oil filter are being phased into truck and trailer units that typically use compressors with external oil filters. The internal oil filter is located in the compressor sump near the oil pickup tube (Figure 103, p. 82).

Note: *These units use compressors with oil filters. If the compressor does not have an external oil filter, it has an internal oil filter.*

Internal Oil Filter Replacement

The internal oil filter should be replaced in the same situations in which the external oil filter was replaced, such as when the drier is replaced or the compressor oil is changed.

Figure 103. Internal Oil Filter



1.	Oil Discharge Tube	4.	Pressure Relief Valve
2.	O-Ring	5.	Oil Pickup Tube
3.	Internal Oil Filter	6.	Stud On Oil Pickup Tube Bracket

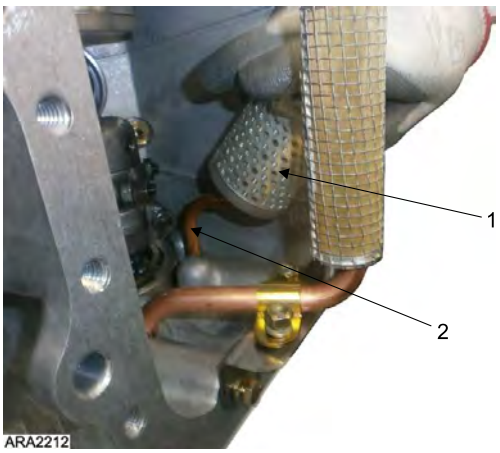
1. Remove the compressor from the unit if needed to access the oil sump.
2. Remove the oil sump.
3. Remove the nut that fastens the internal oil filter to the stud on the oil pickup tube bracket.

Figure 104. Remove Nut from Stud

1.	Stud On Oil Pickup Tube Bracket

4. Remove the internal oil filter from the oil discharge tube.

Figure 105. Remove Internal Oil Filter from Oil Discharge Tube



1.	Internal Oil Filter
2.	Oil Discharge Tube

5. Place the new internal oil filter on the oil discharge tube and the stud on the oil pickup tube bracket. Be careful to avoid damaging the O-ring in the oil filter.
6. Install and tighten the nut that fastens the internal oil filter to the stud on the oil pickup tube bracket.
7. Install the oil sump.
8. Install the compressor in the unit if it was removed.

Checking Compressor Oil Pressure

The oil pressure at the oil pressure access port varies with the suction pressure in the compressor. Therefore, we need to calculate the "net oil pressure" to determine the actual compressor oil pressure. The net oil pressure is the pressure at the oil pressure access port minus the suction pressure below the throttling valve. Use the following procedure to check the compressor oil pressure.

1. Attach a suitable oil pressure gauge to the oil pressure access port on the compressor oil filter, or to the oil pressure access port on the oil pump cover.
2. Attach the low pressure gauge of a gauge manifold to the fitting on the side of the throttling valve (or suction valve adapter). This fitting allows you to monitor the suction pressure in the compressor below the throttling valve.
3. Start the unit and note the pressure at the oil pressure access port and the suction pressure below the throttling valve.
4. Subtract the suction pressure below the throttling valve from the pressure at the oil pressure access

port to get the net oil pressure.

	Pressure at Oil Pressure Access Port
–	Suction Pressure Below Throttling Valve
=	Net Oil Pressure

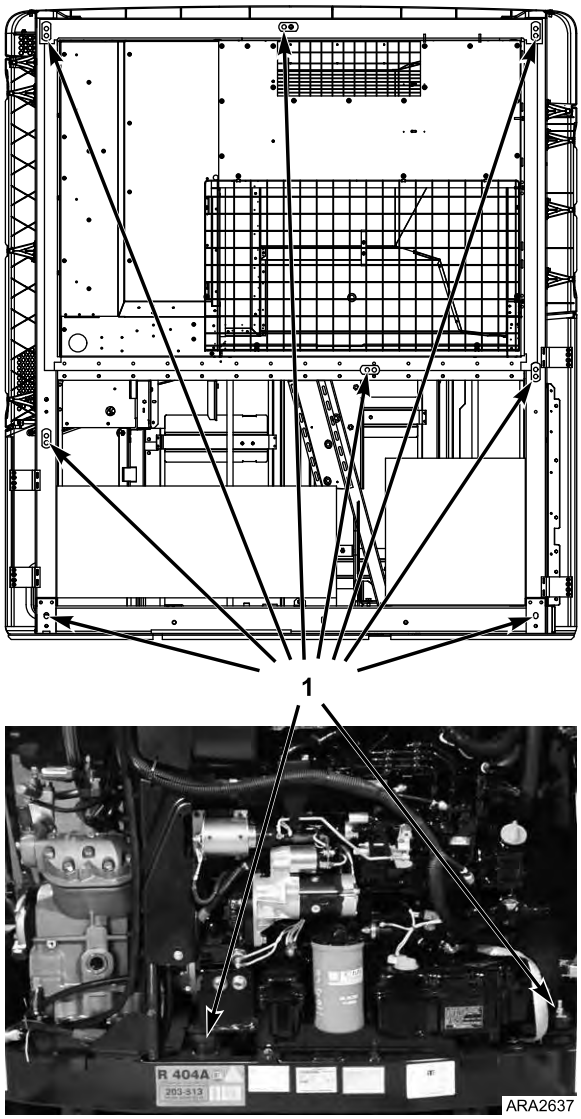
5. The net oil pressure should be at least 20 psig (138 kPa). If the net oil pressure is low, first check the compressor oil level, then check the compressor oil pump and relief valve.

Structural Maintenance

Unit and Engine Mounting Bolts

Check and tighten all unit and engine mounting bolts during scheduled maintenance inspections.Torque the unit mounting bolts to 60 ft-lb (81 N•m). Torque the engine mounting bolts to 150 ft-lb (203 N•m).

Figure 106. Unit and Engine Mounting Bolts



1.	Check Bolts for Tightness

Unit Inspection

Inspect the unit during pretrip inspection and scheduled maintenance inspections for loose or broken wires or hardware, compressor oil leaks, or other physical damage which might affect unit performance and require repair or replacement of parts.

Condenser, Evaporator, and Radiator 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 with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal airflow. Repair bent fins and any other noticeable damage.

Micro-Channel 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

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. See (Figure 108, p. 85) for results. 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 109, p. 85).

- Power water sprayer may be used in pressures under 600 psi. Water will work best when blown thru the coil from the non-air side when possible. Spraying 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 water if the non-air side is not accessible. The angle at which the water should be directed at the coil should not be less than 75 degrees (Figure 109, p. 85). The spray nozzle should be kept between 1 inch and 3 inches (25 to 75 millimetres) from the coil surface.

Notes:

1. *Chemicals to aid in cleaning WILL VOID WARRANTY and are NOT RECOMMENDED.*
2. *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, water 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.*
3. *Do not contact the coil with any hard vacuum nozzle, air nozzle, or any other tool. This will damage the tubes of the coil.*

NOTICE

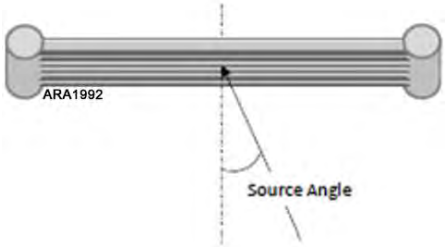
Equipment Damage!

Failure to comply with above mentioned guidelines will lead to a shortened life of the equipment to an indeterminable degree.

Figure 107. Coil Before Cleaning

Figure 108. Coil after Wiping Right Hand Side with Cloth

Figure 109. Source Angle for Cleaning with Air or Water



Defrost Drains

Clean the defrost drains during scheduled maintenance inspections to verify the lines remain open.

Unit Installation

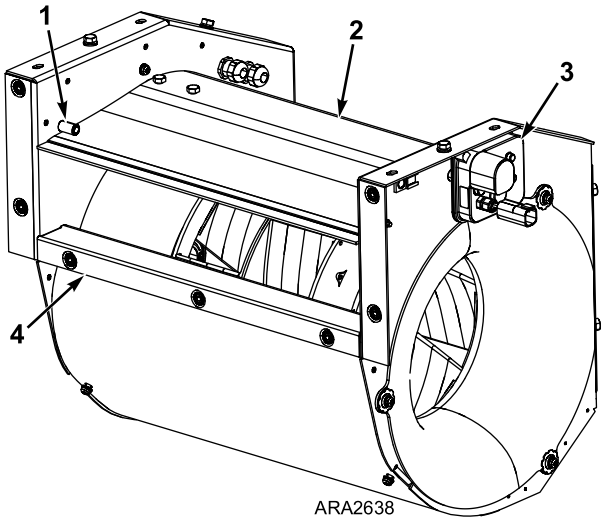
All nuts that hold the unit to the trailer are accessible using an impact wrench with a 10 inch (25 cm) extension, ball-type swivel, and a deep-well socket.

Note: *The nuts for mounting the unit should be elastic stop nuts (Nylock type).*

Defrost Damper

This unit uses a defrost damper that is actuated by a damper gear motor. The damper door is attached directly to the damper gear motor shaft to simplify the linkage.

Figure 110. Evaporator Blower Housing



1.	Damper Stop	3.	Damper Gear Motor
2.	Damper Door (Open)	4.	Scroll Panel

The unit is equipped with a base controller that contains a a damper gear motor drive to control the damper gear motor. The base controller used in trailer units without the damper gear motor will not work with the damper gear motor. Make sure to order the correct base controller if it is being replaced.

The defrost damper is open when the unit is in Cool or Heat, and closes when the unit is in Defrost. To close, the damper gear motor moves the damper door down until it contacts the top of the scroll panel. To open, the damper gear motor moves the damper door up until it contacts the damper stops.

Alarm Code 29 – Check Defrost Damper Circuit and Alarm Code 30 – Defrost Damper Stuck are associated with the defrost damper.

- Alarm Code 29 is set during the Pretrip Test if the controller senses a fault in the damper gear motor operation.
- Alarm Code 30 is set any time the controller tries to move the damper and the damper gear motor draws excessive current for a specified time.

In some conditions, such as when the unit is turned off, the damper is left in the last position to minimize operation and wear on the damper gear motor.

Testing Defrost Damper

The damper operation can be tested as part of the Pretrip Test, or by using the Interface Board Test Mode.

Pretrip Test

- Closes then opens the damper
- Checks amp draw while damper moving
- Alarm Code 29 is recorded if the damper fails the test.

Interface Board Test Mode

- This test is used to verify the damper will move.
- LED 31 Damper Door Open and LED 32 Damper Door Close illuminate as required.
- The initial (breakaway) current draw occurs over a very short period of time and cannot be accurately measured. Once the motor is running, the current draw should not exceed 0.8 amps.
- A technician must visually verify the damper will move.

Troubleshooting Defrost Damper

A problem with a damper will usually generate Alarm Code 29 or Alarm Code 30.

Alarm Code 29 – Check Defrost Damper Circuit

Alarm Code 29 indicates that the amp draw on the damper gear motor circuit was out of the expected range.

1. Visually check the damper door to see that is not damaged and is attached to the damper gear motor shaft.
2. Use the Interface Board Mode to see if the damper moves. Verify LED 31 Damper Door Open and LED 32 Damper Door Close illuminate as required.
3. Check the continuity of the GMRED and GMBLK circuits from the J15 connector on the base controller to damper gear motor.
4. Disconnect the damper gear motor harness from the main harness at the J16 connector near the damper motor. Check the resistance of the damper gear motor between pins 1 and 2 in connector on the damper gear motor harness. The resistance should be 4 to 5 ohms. If the resistance is out of this range, check the continuity of the wires from the connector to the damper gear motor. If these wires have good continuity, the damper gear motor is probably defective.

Alarm Code 30 – Defrost Damper Stuck

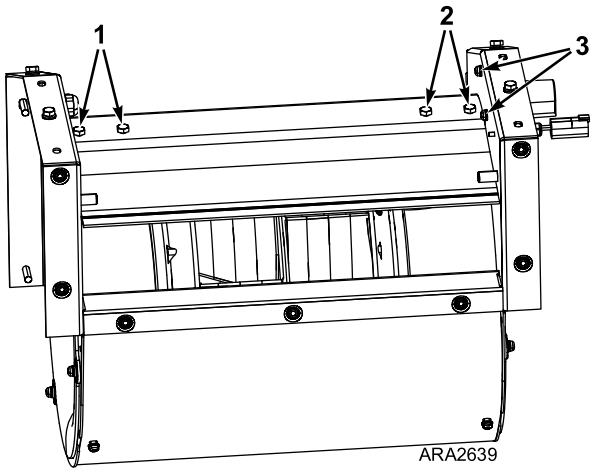
1. Visually check the damper door to see that is not damaged, stuck, or frozen in place.
2. Use the Interface Board Mode to see if the damper moves. Verify LED 31 Damper Door Open and LED 32 Damper Door Close illuminate as required.
3. Check the continuity of the GMRED and GMBLK circuits for a short to ground.
4. Disconnect the damper gear motor harness from the main harness at the J16 connector near the damper motor. Check the resistance of the damper gear motor between pins 1 and 2 in connector on the damper gear motor harness. The resistance should be 4 to 5 ohms. If the resistance is out of this range, check the continuity of the wires from the

connector to the damper gear motor. If these wires have good continuity, the damper gear motor is probably defective.

Replacing Damper Gear Motor

1. Remove the evaporator access panels as necessary to access the damper gear motor and damper door.
2. Remove the two bolts that attach the damper door to the damper door shaft.

Figure 111. Removing Damper Door and Gear Motor



1.	Remove Bolts from Damper Door Shaft
2.	Remove Bolts from Damper Gear Motor Shaft
3.	Remove Screws from Damper Gear Motor (one not shown)

3. Remove the two bolts that attach the damper door to the damper gear motor shaft and remove damper door.
4. Disconnect the damper gear motor harness from the main harness.
5. Remove the three screws that attach the damper gear motor to the evaporator blower housing and remove the damper gear motor. These screws are located on the inside of the evaporator blower housing.
6. Place the new damper gear motor in position and fasten it to the evaporator blower housing with the three screws.
7. Reconnect the damper gear motor harness to the main harness.
8. Place the damper door in position and fasten it to the damper gear motor shaft with the two bolts.
9. Fasten the damper door to the damper door shaft with the two bolts.
10. Replace the evaporator access panels that were removed to access the damper gear motor and damper door.

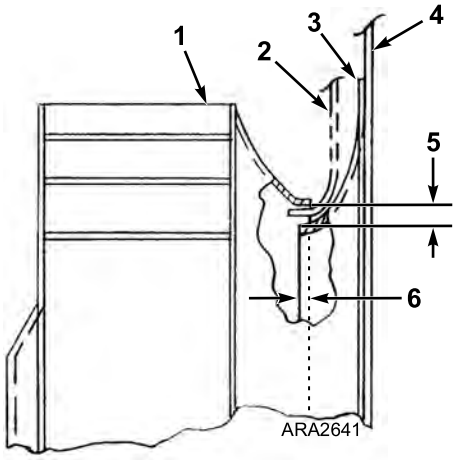
Condenser and Evaporator Fan Location

When mounting the condenser or evaporator fan and hub assembly on the fanshaft, the blowers and inlet orifices must be properly aligned for proper air flow and to prevent damage to the blower.

Condenser Inlet Orifice Alignment

1. Loosen the condenser inlet orifice on the condenser coil bulkhead.
2. Center the inlet orifice in the condenser blower and tighten the inlet orifice mounting hardware to hold the inlet orifice in this position.
3. Check the radial clearance of the blower by passing a 0.09 in. (2.3 mm) gauge wire completely around the circumference of the condenser orifice and the condenser blower.

Figure 112. Condenser Inlet Orifice Alignment



1.	Condenser Blower	4.	Condenser Coil Bulkhead
2.	Check Clearance with Wire	5.	Radial Clearance
3.	Inlet Orifice	6.	Overlap 0.10-0.15 in. (2.5-3.8 mm)

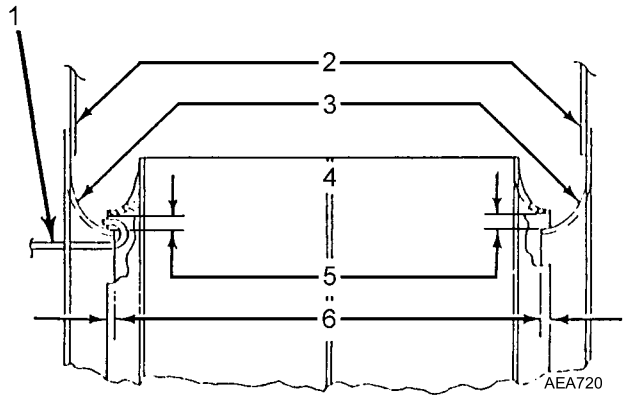
Evaporator Fan Blower Alignment

1. Loosen the inlet orifices on the sides of the blower housing.
2. Center the blower wheel in the blower housing with equal overlap on both inlet orifices. The overlap on each orifice should be approximately 0.15 in. (3.8 mm).
3. Tighten the hub pinch bolts that hold the blower

wheel on the fan shaft to a torque of 13 ft-lb (18 N•m).

4. Center the inlet orifices in the blower orifices. Tighten the inlet orifices securely.
5. Check the radial clearance by passing a 0.187 in. (4.75 mm) gauge wire completely around the circumference of the inlet rings and the blower wheel.

Figure 113. Evaporator Fan Location



1.	Check Clearance with Wire	4.	Evaporator Blower
2.	Blower Housing Sides	5.	Radial Clearance
3.	Inlet Orifices	6.	Equalize Blower Inlet Overlap

Fan Shaft Assembly

The unit is equipped with a fan shaft assembly that contains special sealed bearings. The bearings should be checked when the belt is replaced. Spin the fan shaft with the belt removed and listen. Unusually loud bearing noise indicates the fan shaft bearings should be replaced.

Removal

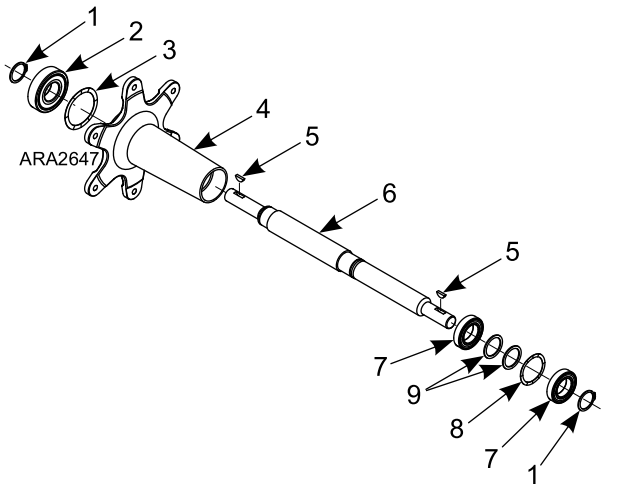
1. Remove the fan drive belt. See “Fan Drive Belt” in the Engine Maintenance Chapter.
2. Remove the mounting hardware for the upper condenser inlet orifice and remove it.
3. Loosen the hub pinch bolts on the upper condenser blower, slide the blower off the fan shaft and remove it. Make sure to remove and keep the key.
4. Loosen the hub pinch bolts on the evaporator blower so it can slide on the fan shaft.
5. Remove the fan shaft mounting bolts.
6. Remove the fan shaft while sliding the evaporator blower off the end of the fan shaft. Make sure to remove and keep the key.

Note: *Make sure to avoid hitting the machined surface of the shaft against the structure because that could cause damage, making it difficult to remove/install the bearings and create a starting point for further corrosion.*

Disassembly

1. Remove the snap ring from the condenser end.
2. Press the fan shaft out from condenser end to the evaporator end.
3. Remove the snap ring from the evaporator end.
4. Remove the bearings from the shaft by supporting the bearing and tapping on the end of the shaft with a soft hammer. Make sure to avoid damaging the end of the shaft, which can make it difficult to remove/install the bearings.
5. Remove the bearing from the housing with a hammer and punch.
6. Clean and inspect the parts, but do not clean the bearings in solvent. Replace the parts that show significant wear or damage.

Figure 114. Fan Shaft Assembly



1.	Snap Ring	6.	Fan Shaft
2.	Bearing (Condenser End)	7.	Bearing (Evaporator End)
3.	Wave Washer	8.	Wave Washer
4.	Housing	9.	Washer
5.	Key		

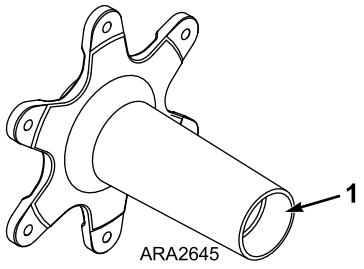
Reassembly

Important: *To prevent damage to the bearings, use bearing drivers (or other suitable tools) on the bearing races when installing the bearings.*

1. Install one of the bearings on the evaporator end of the fan shaft.

2. Install the two washers on the evaporator end of the fan shaft.
3. Install the wave washer on the evaporator end of the fan shaft.
4. Install the other bearing on the evaporator end of the fan shaft (with the washers between the two bearings).
5. Install the snap ring on the evaporator end of the fan shaft.
6. Use a wire brush in the machined bore in the evaporator end of the housing to remove oxide and other contaminants.

Figure 115. Fan Shaft Housing

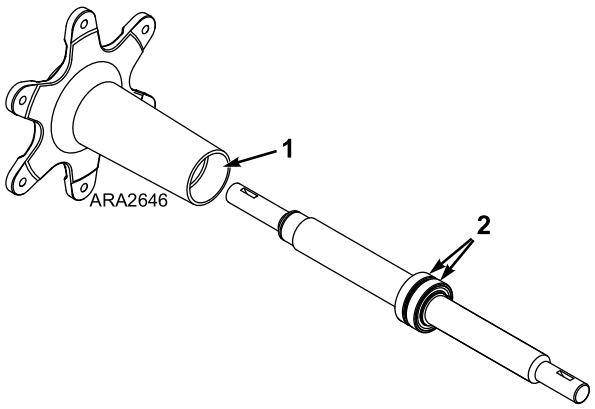


1.	Use Wire Brush to Clean Bore

7. Clean the machined bore in the evaporator end of the housing and the outer races of the bearings on the evaporator end of the fan shaft with Loctite 7063 cleaner. The cleaner needs to be sprayed on, wiped down and then allowed to evaporate dry.

   Important: *The cleaner must be allowed to evaporate before the next step.*

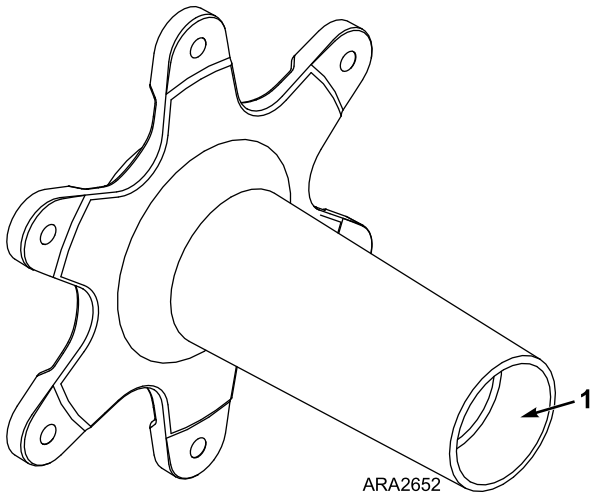
Figure 116. Fan Shaft and Housing



1.	Clean Bore with Loctite 7063 Cleaner
2.	Clean Outer Races with Loctite 7063 Cleaner

8. Apply Loctite 7240 (activator) to the machined bore (inner surface) in the evaporator end of the housing and allow it to dry by evaporation.

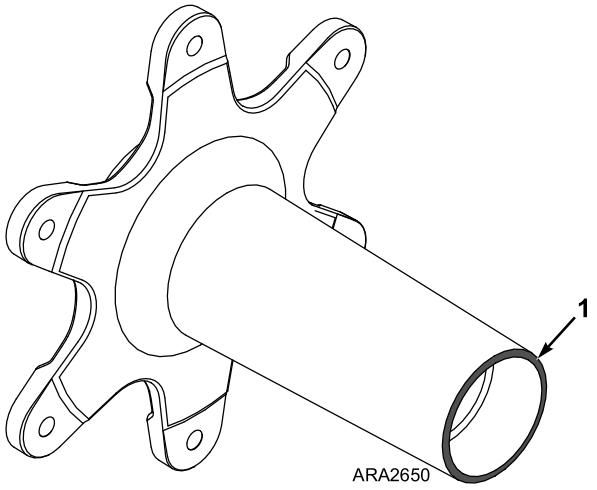
Figure 117. Fan Shaft Housing



1.	Apply Loctite 7240 (Activator) to Machined Bore (Inner Surface)

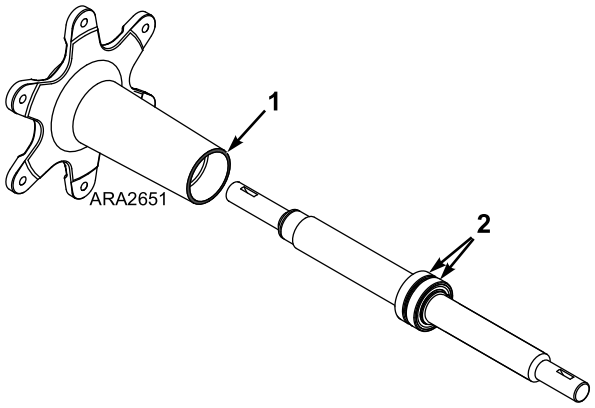
9. Apply a bead of Loctite 603 to the leading edge of the machined bore in the evaporator end of the housing and to the outer races of the bearings on the evaporator end of the fan shaft.

Figure 118. Fan Shaft Housing



1.	Apply Bead of Loctite 603 to Leading Edge of Machined Bore

Figure 119. Fan Shaft and Housing



1.	Apply Bead of Loctite 603 to Leading Edge
2.	Apply Bead of Loctite 603 to Outer Races

10. Insert the fan shaft and bearings into the evaporator end of the housing. Make sure the bonding surfaces of the housing and bearings are well covered with Loctite 603.

    Note: *Loctite 603 and Loctite 7240 (activator) will begin to bond within seconds upon contact.*

    Note: *Curing time for Loctite 603 is 6 hours when Loctite 7240 (activator) has been used. Do not install the fan shaft in the unit until the Loctite has cured.*

11. Install the wave washer on the condenser end of the fan shaft.
12. Install the bearing on the condenser end of the fan shaft.
13. Install the snap ring on the condenser end of the fan shaft.

Installation

1. Make sure the key is in place in the evaporator end of the fan shaft.
2. Install the fan shaft while sliding the evaporator blower onto the end of the fan shaft.
3. Install and tighten the fan shaft mounting bolts.
4. Center the evaporator blower in the blower housing with equal overlap on both inlet orifices and tighten the hub pinch bolts (see "Evaporator Fan Blower Alignment" above).
5. Make sure the key is in place in the condenser end of the fan shaft.
6. Place the upper condenser blower on the fan shaft and slide it into position to where its pulley is aligned correctly with the other pulleys and tighten the hub pinch bolts.
7. Install the upper condenser inlet orifice. Center it in the upper condenser blower and tighten the mounting hardware (see "Condenser Inlet Orifice Alignment" above).
8. Install the fan drive belt. See "Fan Drive Belt" in the Engine Maintenance Chapter.

Lower Condenser Blower Assembly

The lower condenser blower assembly contains special sealed bearings. The bearings should be checked when the belt is replaced. Spin the lower condenser blower with the belt removed and listen. Unusually loud bearing noise indicates the lower condenser blower bearings should be replaced.

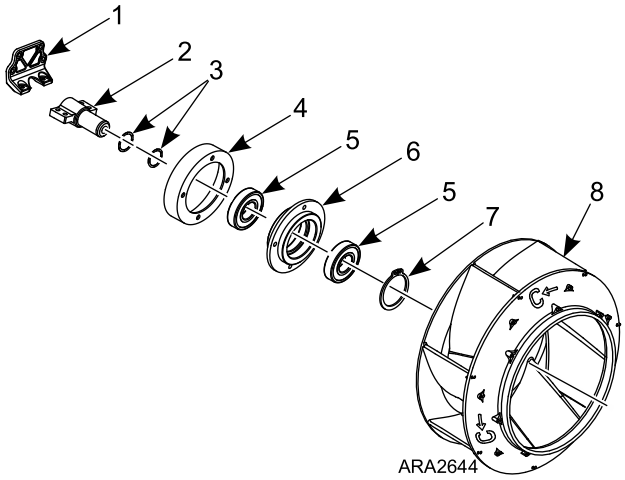
Removal

1. Remove the fan drive belt. See "Fan Drive Belt" in the Engine Maintenance Chapter.
2. Remove the mounting hardware for the lower condenser inlet orifice and remove it.
3. Remove the hardware that fastens the blower spindle to the spindle mounting bracket and remove the lower condenser blower assembly.

Disassembly

1. Remove the snap ring.
2. Remove the spindle and wave washers from the blower hub.
3. Remove the bearings from the blower hub with a hammer and punch.
4. Clean and inspect the parts, but do not clean the bearings in solvent. Replace the parts that show significant wear or damage.

Figure 120. Lower Condenser Blower Assembly



1.	Spindle Mounting Bracket	5.	Bearing
2.	Blower Spindle	6.	Blower Hub
3.	Wave Washer	7.	Snap Ring
4.	Blower Pulley	8.	Blower

Reassembly

Important: *To prevent damage to the bearings, use bearing drivers (or other suitable tools) on the bearing races when installing the bearings.*

1. Install the bearings in the hub.
2. Place the wave washers on the spindle.
3. Insert the spindle and wave washers into the blower hub.
4. Install the snap ring.

Installation

1. Place the lower condenser blower assembly in position and install the hardware that fastens the blower spindle to the spindle mounting bracket.
2. Install the lower condenser inlet orifice. Center it in the lower condenser blower and tighten the mounting hardware (see "Condenser Inlet Orifice Alignment" above).
3. Install the fan drive belt. See "Fan Drive Belt" in the Engine Maintenance Chapter.

Cross Shaft Assembly

The unit is equipped with a cross shaft assembly that contains special sealed bearings. The bearings should be checked when the belt is replaced. Spin the cross shaft with the belt removed and listen. Unusually loud bearing noise indicates the cross shaft bearings should be replaced.

Removal

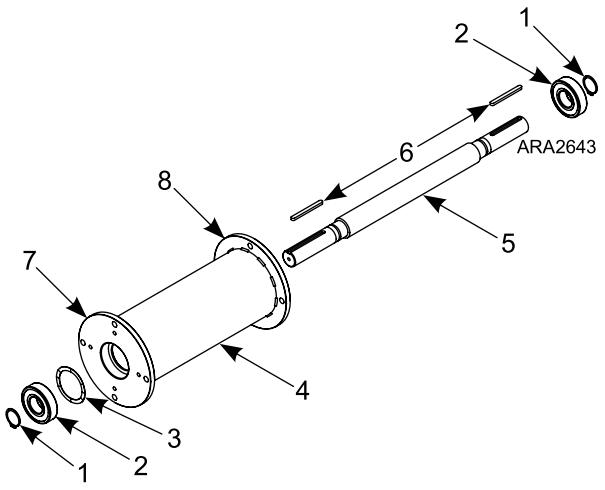
1. Remove the fan drive belt. See "Fan Drive Belt" in the Engine Maintenance Chapter.
2. Remove the engine/cross shaft belt. See "Engine/Cross Shaft Belt" in the Engine Maintenance Chapter.
3. Loosen the pinch bolts on the cross shaft/fan pulley and remove it from the cross shaft.
4. Loosen the pinch bolts on the cross shaft/engine pulley and remove it from the cross shaft.
5. Mark one or both ends of the cross shaft housing to identify which is the engine pulley end and which is the fan pulley end.
6. Remove the cross shaft mounting bolts and remove the cross shaft.

Disassembly

1. Remove the snap rings.
2. Remove the cross shaft from the housing by tapping on either end of the cross shaft with a soft hammer. Make sure to avoid damaging the end of the shaft, which can make it difficult to remove/install the bearings.

   Note: *The engine pulley end of the cross shaft has a threaded hole in it, and the fan pulley end does not.*
3. Remove the bearing from the shaft by supporting the bearing and tapping on the end of the shaft with a soft hammer.
4. Remove the bearing from the housing with a hammer and punch.
5. Clean and inspect the parts, but do not clean the bearings in solvent. Replace the parts that show significant wear or damage.

Figure 121. Cross Shaft Assembly



1.	Snap Ring	5.	Cross Shaft
2.	Bearing	6.	Key
3.	Wave Washer	7.	Engine Pulley End
4.	Housing	8.	Fan Pulley End

Reassembly

Important: *To prevent damage to the bearings, use bearing drivers (or other suitable tools) on the bearing races when installing the bearings.*

Note: *Place a thin layer of grease (Mobil 28 or its equivalent) on the inner and outer bearing races before assembly.*

1. Install a bearing on the fan pulley end of the cross shaft. The fan pulley end does not have a threaded hole.
2. Install the snap ring on the fan pulley end of the cross shaft.
3. Insert the cross shaft and bearing into the fan pulley end of the housing.
4. Install the wave washer on the engine pulley end of the cross shaft.
5. Install the other bearing on the engine pulley end of the cross shaft.
6. Install the snap ring on the engine pulley end of the cross shaft.

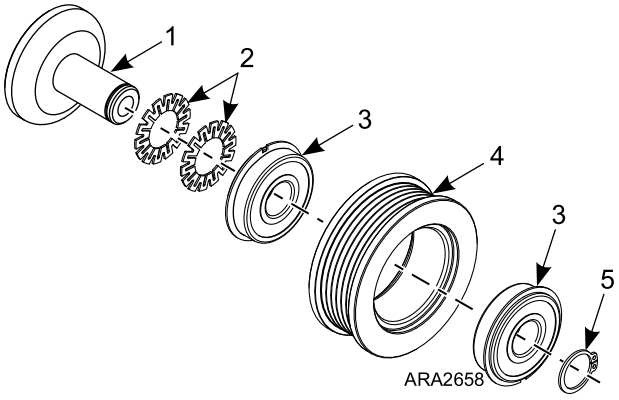
Installation

1. Place the cross shaft in position. Make sure with the engine pulley end is located on the engine/cross shaft belt side.
2. Install and tighten the cross shaft mounting bolts.
3. Make sure the key is in place in the engine pulley end of the cross shaft.
4. Place the cross shaft/engine pulley on the cross shaft. Position it axially using block P/N 2042435 between the pulley and the cross shaft mounting bracket and tighten the pinch bolts.
5. Make sure the key is in place in the fan pulley end of the cross shaft.
6. Place the cross shaft/fan pulley on the cross shaft, slide it into position to where it is aligned correctly with the other pulleys and tighten the pinch bolts.
7. Install the engine/cross shaft belt. See “Engine/Cross Shaft Belt” in the Engine Maintenance Chapter.
8. Install the fan drive belt. See “Fan Drive Belt” in the Engine Maintenance Chapter.

Idler Assemblies

The idler assemblies contains special sealed bearings. The bearings should be checked when the belt is replaced. Spin the idler pulley with the belt removed and listen. Unusually loud bearing noise indicates the idler bearings should be replaced. The idler assembly for the idler pulley in the engine/cross shaft belt is shown below. The other idler assemblies are similar. See the appropriate Parts Manual.

Figure 122. Typical Idler Assembly



1.	Spindle	4.	Idler Pulley
2.	Washer	5.	Snap Ring
3.	Bearing		

Disassembly

1. Remove the appropriate belt. See “Engine/Cross Shaft Belt” or “Fan Drive Belt” in the Engine Maintenance Chapter.
2. Remove the snap ring and discard it.
3. Remove the idler pulley and bearings from the spindle.
4. Remove the washers from the spindle and discard them.

5. Remove the bearings from the idler pulley with a hammer and punch.
6. Clean and inspect the parts, but do not clean the bearings in solvent. Replace the parts that show significant wear or damage.

Reassembly

Important: *To prevent damage to the bearings, use bearing drivers (or other suitable tools) on the bearing races when installing the bearings.*

1. Install the bearings in the idler pulley.
2. Place new washers on the spindle.
3. Place the idler pulley and bearings on the spindle.
4. Install a new snap ring.
5. Install the belt. See “Engine/Cross Shaft Belt” or “Fan Drive Belt” in the Engine Maintenance Chapter.

Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Engine will not crank	Electrical problem	Check and repair electrical system
	Defective starter solenoid	Replace solenoid
	Defective starter	Repair starter
	Water in cylinders	Check for hydrostatic lock. Remove injectors and turn engine slowly
Starter motor turns but engine does not crank	Starter clutch defective	Replace
Engine cranks but fails to start	Fuel solenoid not energized	Check 8D and 8DP and CHF circuits and fuel solenoid pull-in relay. Check that controller is configured for the correct engine. Refer to appropriate Microprocessor Diagnostic Manual.
	Fuel solenoid defective or stuck	Replace
	Fuel injection pump defective	Replace pump
	Air heater defective	Replace
	No fuel or wrong fuel	Fill with proper fuel
	Fuel transfer pump defective	Replace transfer pump
	Air in fuel system	Bleed air
	Compression low	Overhaul engine
	Injection nozzles defective	Replace nozzles
	Incorrect timing	Adjust timing
	Air cleaner clogged	Replace air filter
	Exhaust plugged	Clean exhaust
Engine stops after starting	Air in injection pump	Bleed fuel system
	Fuel filter obstructed	Replace filter element
	Vent of fuel tank obstructed	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	High head pressure	Eliminate cause of high head pressure

CONDITION	POSSIBLE CAUSE	REMEDY
Engine does not develop full power	Air intake system clogged	Clean air intake system
	Fuel tank vent clogged	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	Speed adjustment wrong	Adjust speed
	Insufficient fuel volume leaving filter	Check for dirty filter or air in system
	Air cleaner clogged	Replace air filter
	Delivery of fuel pump insufficient	Repair pump
	Injection pump timing off	Adjusting timing
	Injection nozzles defective	Repair or replace nozzles
	Worn injection pump plungers, delivery valve defective, injection rate too low, gum formations	Repair or replace pump
	Compression low or unbalanced	Overhaul engine
Engine speed too high	Misadjusted high speed solenoid	Adjust high speed solenoid
	Defective injection pump	Repair injection pump
Engine fails to stop when unit is OFF	Fuel solenoid defective	Replace
	Injection pump defective	Replace pump
Engine knocks heavily	Air in system	Bleed fuel system
	Wrong fuel	Change fuel
	Injection pump not timed	Retime injection pump
	Injection nozzles fouled or opening pressure too low	Clean, repair or replace injection nozzles
	Delivery valve spring broken	Replace spring or repair injection pump
	Compression too low	Overhaul engine
	Valve out of adjustment	Adjust valves
	Fuel return line plugged	Remove return line restriction
	Rod or main bearing worn	Replace rod or main bearings
Engine runs hot	Dirty radiator	Wash radiator
	Coolant level is low	Add coolant
	Cooling system heavily scaled	Clean cooling system
	Cylinder head gasket leaks	Replace cylinder head gasket. Use correct gasket
	Faulty thermostat	Check or replace thermostat
	Loose or worn water pump belt	Replace belt
Oil pressure low	Insufficient oil in pan	Add oil
	Faulty oil pressure switch	Check oil pressure switch. Replace if necessary
	Oil control valve defective	Check oil pressure control valve
	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug	Repair engine

CONDITION	POSSIBLE CAUSE	REMEDY
High oil consumption	10 hour engine break in running was not successfully completed	Run unit for 10 hours on high speed continuous run with trailer doors open as described in the "Unit Check List" section at the end of the appropriate Installation Manual
	Oil leakage	Check and eliminate possible causes at rocker arm cover, oil lines, oil filter, front timing cover, or crankshaft seals
	Damaged valve seals	Replace seals on valve stem
	Worn valve stem	Replace valves
	Broken piston rings or cylinder bore worn or scored	Have engine repaired and rebored. Replace broken piston rings
	Clogged air cleaner system	Unclog air cleaner

Engine Emits Excessive Smoke

White Smoke

Fuel is not burning

- Air or water in fuel
- Incorrect timing
- Poor compression
- Faulty injectors

Black Smoke

Excessive Fuel to Air Ratio

- Type of fuel used
- Cold engine
- Excessive load
- Clogged air intake system
- Faulty nozzles
- Poor compression
- Restricted exhaust
- Faulty injection pump

Blue Smoke

Oil Consumption

- Poor compression
- Defective valve seals

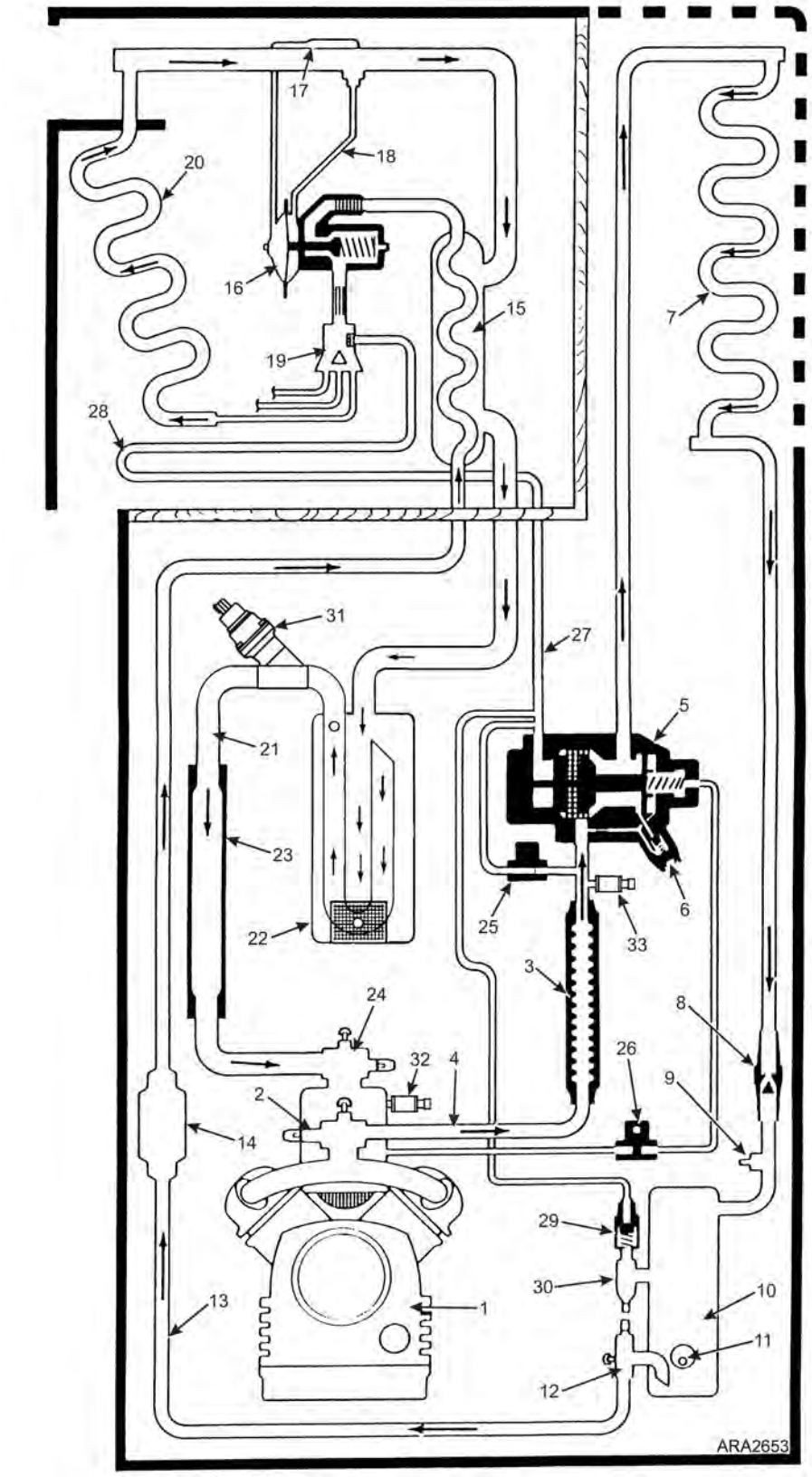
Refrigeration Diagnosis

Rapid cycling between cool and heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or 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
			•														Condenser fan blades bent or broken
•																	Air short cycling around evaporator coil
						•											Air through evaporator restricted
						•		•		•				•			Evaporator needs defrosting
				•								•					Compressor discharge valves leaking
					•						•						Compressor suction valves leaking
															•		Too much compressor oil in system
														•			Faulty oil pump in compressor
														•			Faulty compressor drive coupling
														•			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

Rapid cycling between cool and heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	SYMPTOM POSSIBLE CAUSES
						•		•									Restricted line on the low side
			•			•		•							•		Restricted line on the high side
			•			•		•							•		Restricted drier
																•	Defrost damper stays open
						•		•							•		Defrost damper stuck closed
																•	Evaporator fans stay running
						•		•							•		Evaporator fans not running
							•										Suction service valve back seated
	•	•		•	•						•		•		•	•	Faulty three-way valve
	•	•									•				•	•	Faulty pilot solenoid
	•															•	Loose or broken electrical connections
•					•	•		•							•		Sensor out of calibration
					•	•	•	•									Compound pressure gauge out of calibration
											•						Leaky receiver tank outlet valve
											•						Leaky bypass check valve
																•	Leaky condenser check valve
																•	Faulty three-way condenser pressure bypass check valve
						•	•	•							•	•	Faulty ETV
				•	•						•				•	•	Hot gas bypass valve stuck open or leaking

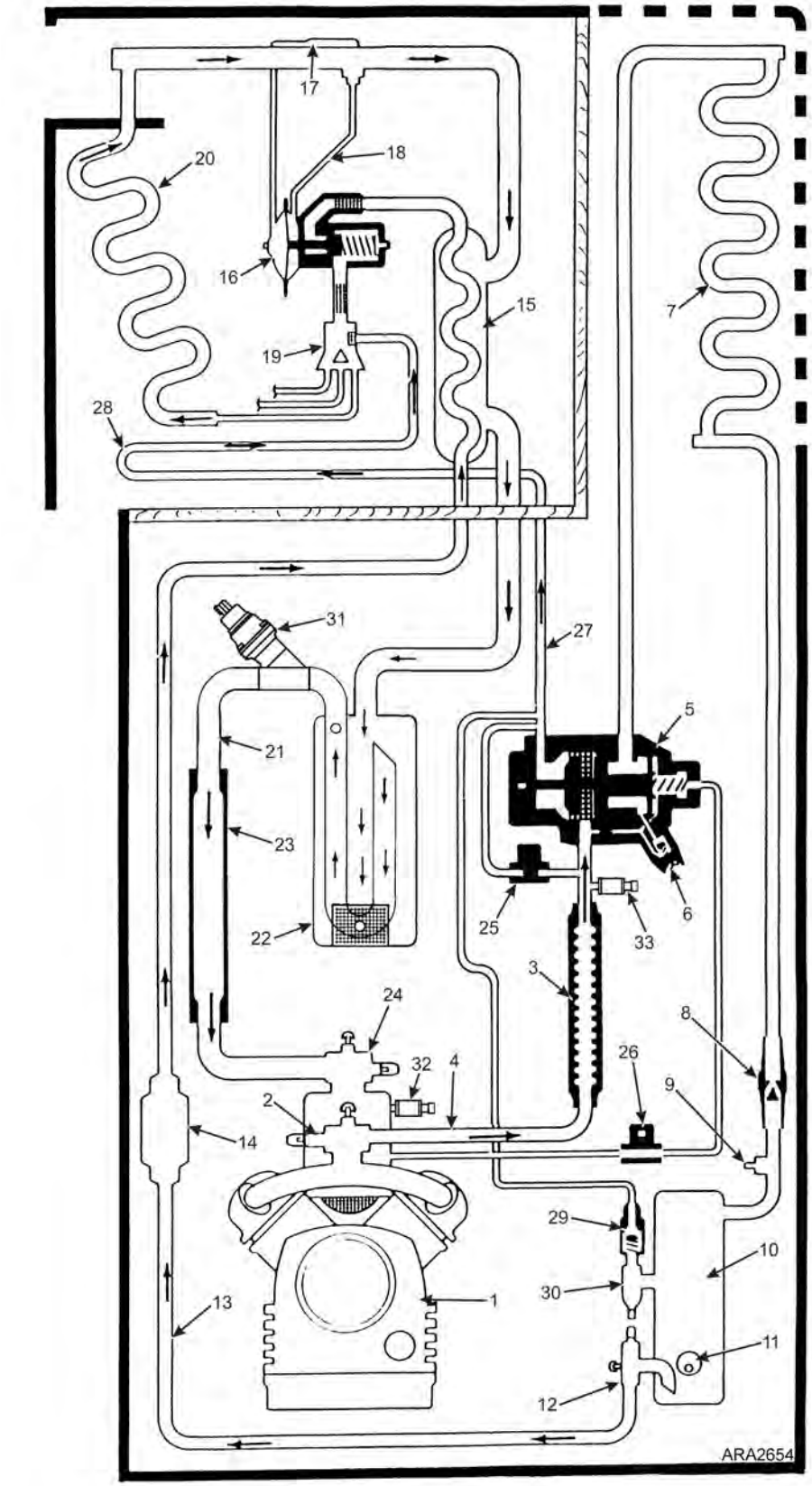
Refrigeration Diagrams

Cool Cycle



1.	Compressor	18.	Equalizer Line
2.	Discharge Service Valve	19.	Distributor
3.	Discharge Vibrasorber	20.	Evaporator Coil
4.	Discharge Line	21.	Suction Line
5.	Three-Way Valve	22.	Accumulator
6.	Three-Way By-pass Check Valve	23.	Suction Vibrasorber
7.	Condenser Coil	24.	Suction Service Valve
8.	Condenser check valve	25.	Hot Gas Bypass Solenoid
9.	High Pressure Relief Valve	26.	Pilot Solenoid
10.	Receiver Tank	27.	Hot Gas Line
11.	Sight Glass	28.	Defrost Pan Heater
12.	Receiver outlet valve	29.	Bypass Check Valve
13.	Liquid Line	30.	Bypass Service Valve
14.	Drier	31.	Electronic Throttling Valve
15.	Heat Exchanger	32.	Suction Solenoid
16.	Expansion Valve	33.	Discharge Transducer
17.	Feeler Bulb		

Heat/Defrost Cycle



1.	Compressor	18.	Equalizer Line
2.	Discharge Service Valve	19.	Distributor
3.	Discharge Vibrasorber	20.	Evaporator Coil
4.	Discharge Line	21.	Suction Line
5.	Three-Way Valve	22.	Accumulator
6.	Three-Way By-pass Check Valve	23.	Suction Vibrasorber
7.	Condenser Coil	24.	Suction Service Valve
8.	Condenser check valve	25.	Hot Gas Bypass Solenoid
9.	High Pressure Relief Valve	26.	Pilot Solenoid
10.	Receiver Tank	27.	Hot Gas Line
11.	Sight Glass	28.	Defrost Pan Heater
12.	Receiver outlet valve	29.	Bypass Check Valve
13.	Liquid Line	30.	Bypass Service Valve
14.	Drier	31.	Electronic Throttling Valve
15.	Heat Exchanger	32.	Suction Solenoid
16.	Expansion Valve	33.	Discharge Transducer
17.	Feeler Bulb		

Diagram Index

The following table lists the diagrams that are relevant to this unit.

The diagrams are available on TSA Info Central and in the SLXi-DRC Diagrams Manual TK 56504.

Drawing No.	Drawing Title
3E31534	Schematic Diagram
2E98198	Wiring Diagram

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