THERMO KING

Maintenance Manual

Trailer Edition
Precedent™ S-610M
Multi-Temperature Units

Revision C

July 2020

TK 56302-2-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	(07/16) Original release
Revision B	(03/18) Update engine oil specifications, electric fuel pump location, add PTC, and other general updates.
Revision C	(07/2020) Updated electrical specifications.

General Information

The maintenance information in this manual covers unit models:

System PRECEDENT S-610M (902927) PRECEDENT S-610M (070409)

For further information, refer to:

Precedent C-600M, S-600M, S-610M, S-600DE, and S-610DE Multi-Temperature Units Operator's Manual	TK 56171
Precedent S-610M Parts Manual	TK 56326
SR-4 Trailer Multi-Temperature Diagnostic Manual	TK 55788
Precedent Wiring and Schematic Diagrams Manual	TK 55849
Precedent Multi-Temperature Systems Installation Manuals	TK 55745 and TK 55774
Yanmar TNV Series Engine Service Manual	TK 55584
Yanmar TNV Series Engine Troubleshooting Manual	TK 55740
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.

Customer Satisfaction Survey

Let your voice be heard!

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

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

THERMO KING

Table of Contents

Safety Precautions

Danger, Warning, Caution, and Notice

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

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

⚠ DANGER

Example!

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Example!

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Example!

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury and unsafe practices.

NOTICE

Example!

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.

⚠ WARNING

Strong Magnetic Field!

Separation of the generator and its stator during disassembly will create a strong magnetic field that can interfere with cardiac implants such as pacemakers and defibrillators.

⚠ 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

High Voltage

Important: *All Precedent units utilize nominal 230 Vac power supplied from the diesel engine driven generator to operate the condenser fans and evaporator blower when the unit is operating in Diesel Mode.*

Important: *Do not move the vehicle if the power cable or the electric standby icon is illuminated.*

⚠ DANGER

Hazardous Voltage!

Lethal amounts of voltage are present in some electrical circuits. Use extreme care when working on an operating refrigeration unit.

⚠ WARNING

Hazardous Voltage!

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

⚠ WARNING

Risk of Injury!

On SmartPower electric standby equipped units, the power supply voltage and vehicle voltage requirements must be the same before connecting the electric standby power cable. Refer to the electric standby voltage label located near the vehicle power connector.

⚠ WARNING

Risk of Injury!

On SmartPower electric standby equipped units, always turn off the external standby power source before handling, connecting, or disconnecting the power cable. Always disconnect the standby power cord before servicing the unit.

⚠ WARNING

Hazardous Voltage!

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

⚠ WARNING

Hazardous Voltage!

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

⚠ WARNING

Personal Protective Equipment (PPE) Required!

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

⚠ WARNING

Risk of Injury!

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

⚠ WARNING

Hazardous Voltage w/Capacitors!

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

Low Voltage

⚠ WARNING

Live Electrical Components!

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

Microprocessor Service Precautions

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

Observe the following precautions when servicing a microprocessor control system to avoid damaging electronic components. Refer to the appropriate

microprocessor diagnosis manual for more information.

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

Welding Precautions

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

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

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Disconnect all wire harnesses from the microprocessor. 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.

High Pressure Fuel Hazards

⚠ WARNING

Hazardous Pressures!

After the engine has stopped, wait 10 to 15 minutes before opening the high pressure side of the fuel system.

⚠ WARNING

Risk of Injury!

Do not use your fingers to check high pressure joints for leaks. Use a piece of paper or cardboard.

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

Table 1.

Model		TK488CR (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 ***Note:*** *The sulfur content must be less than or equal to 15 ppm, the fuel must be free of zinc, and comply with the latest release of ASTM D975, EN 590, or JIS K2204.*
Oil Capacity		12 quarts (11.4 liters) crankcase and oil filter Fill to full mark on dipstick
Oil Type		API Classification CJ-4 or CK-4 ACEA Rating E6 ***Note:*** *This oil type must be used together with ULSD fuel to prevent damage to the DOC.*
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	1250 ± 25 RPM 2050 ± 25 RPM
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 - a nitrite-free Extended Life Coolant (ELC) Use a 50/50 concentration
Coolant System Capacity		7.5 quarts (7.1 liters)
Radiator Cap Pressure		15 psig (103 kPa)

Table 1. (continued)

Drive	Standard Units	Direct to compressor; belts to AC generator and alternator
	SmartPower™ Units	Centrifugal clutch to compressor; belts to electric standby motor, AC generator, and alternator

Belt Tension

Table 2.

Belt		Use of Frequency Gauge P/N 204–1903 to measure frequency (Hz) is recommended.	
		New Belt	**Field Reset**
AC Generator and Alternator Belt - Standard Units	37 or 65 Amp Alternator 120 Amp Alternator	106 Hz (111 lbs) 121 Hz (144 lbs)	92 Hz (84 lbs) 105 Hz (108 lbs)
AC Generator Belt - SmartPower Units and Standard Units with Optional Battery Charger		106 Hz (111 lbs)	92 Hz (84 lbs)
Water Pump Belt		126 Hz (40 lbs)	118 Hz (32 lbs)
Compressor Drive Belt - SmartPower Units Only	12 HP Electric Motor 15/16 HP Electric Motor 19 HP Electric Motor	131 Hz (236 lbs) 140 Hz (270 lbs) 150 Hz (300 lbs)	114 Hz (177 lbs) 121 Hz (200 lbs) 130 Hz (223 lbs)
Alternator Belt - SmartPower Units Only	All Alternators	216 Hz (75 lbs)	187 Hz (56 lbs)

Refrigeration System

Table 3.

Compressor		Thermo King X430P®
Refrigerant Type		R404A
Compressor Oil Charge		6.9 qt (6.6 liters)*
Compressor Oil Type		Polyol Ester type P/N 203-513
Heat/Defrost Method	Engine Operation Electric Operation	Hot gas Hot gas and optional electric heater strips
High Pressure Cutout		470 +7/-35 psig (3241 + 48/-241 kPa) Automatic reset @ 375 ± 38 psig (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

Table 4.

Low Voltage	12.5 Vdc
High Voltage	210 Vac from AC generator at engine low speed 345 Vac from AC generator at engine high speed
Battery	One, Group C31, 12 volt battery. The battery must be suitable for deep cycling, heavy duty and rated with a minimum of 95 amp/hr. Thermo King ReliaMax 925N (925 CCA) wet cell battery is recommended for both warm and cold climates. Thermo King EON (1150 CCA) AGM battery is recommended for extreme climates and for Rail Ready (RR), Domestic Refrigerated Container (DRC), and Trailer on Flat Car (TOFC) applications. ***Note:*** *If the unit is not going to be used for an extended period of time, turn the Microprocessor On/Off Power Switch to the OFF position to maximize battery life.*

Table 4. (continued)

Fuses	See Base Controller Fuses, Battery Fusing, and other fuses in "Electrical Maintenance".
Battery Charging (Alternator)	12 volt, 120 amp, brush type, Thermo King Alternator
Voltage Regulator Setting (Alternator)	13.95 to 14.35 volts @ 77 F (25 C)
Battery Charger (Optional)	120 amp. Bulk = up to 15.8v, Absorption = temperature compensation from 14.15v @ 77F (25 C), Float Voltage = Stage 3 @ ~ 13.6v ~ 13.8v

Electrical Components

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

Table 5.

Component		**Current Draw (Amps) at 12.5 Vdc**	**Resistance — Cold (Ohms)**
Glow Plugs (4) Each		4.5	2.8
Condenser Inlet Solenoid		1.0–1.7	7.3–12.2
Liquid Line Solenoid in Host Unit		1.0–1.7	7.3–12.2
Liquid Line Solenoids in Remote Units		1.0–1.7	7.3–12.2
Hot Gas Solenoids		1.0–1.7	7.3–12.2
Suction Line Solenoids		1.0–1.7	7.3–12.2
Receiver Tank Pressure Solenoid		0.7–1.0	13.5–17
Purge Valve		0.7–1.0	13.5–17
Electronic Throttling Valve	Coil A (Red [EVA] and Blue [EVB] Wires)	-	20 to 35
	Coil B (Black [EVC] and White [EVD] Wires)	-	20 to 35
Hot Gas Bypass Valve		1.0–1.7	7.3–12.2
Starter Motor		900 Maximum	
AC Generator	Low Engine Speed (1250 RPM) Output	210 Vac at 54.9 Hz Nominal Vac - Measured Vac, Load Dependent	
	High Engine Speed (2050 RPM) Output	345 Vac at 90 Hz Nominal Vac - Measured Vac, Load Dependent	
Fan Motors - Engine Operation			
Evaporator Fan Motor	Low Speed Power Rating	0.60 hp (0.45 kW)	
	High Speed Power Rating	1.20 hp (0.90 kW)	
	High Fan Speed at Low Engine Speed	1098 RPM at low engine speed (1250 RPM)	
	High Fan Speed at High Engine Speed	1800 RPM at high engine speed (2050 RPM)	
	Low Fan Speed at High Engine Speed	1350 RPM at high engine speed (2050 RPM)	
	High Speed Current Draw at Low Engine Speed	3.5 amps at low engine speed (1250 RPM)	
	Low Speed Current Draw at High Engine Speed	2.0 amps at high engine speed (2050 RPM)	

Table 5. (continued)

Component		Current Draw (Amps) at 12.5 Vdc	Resistance — Cold (Ohms)
	High Speed Current Draw at High Engine Speed	3.1 amps at high engine speed (2050 RPM)	
Condenser Fan Motor (each)	Power Rating	0.50 hp (0.37 kW)	
	Fan Speed	1600 RPM at low engine speed (1250 RPM)	
	Fan Speed at High Engine Speed	2650 RPM at high engine speed (2050 RPM)	
	Current Draw at Low Engine Speed	1.8 amps (per motor) at low engine speed (1250 RPM)	
	Current Draw at High Engine Speed	2.0 amps (per motor) at high engine speed (2050 RPM)	
Fan Motors — Electric Standby Operation 230/3/60 or 460/3/60 (Unit transformer reduces 460/3/60 input voltage to 230/3/60 applied to fan motors.)			
Evaporator Fan Motor	Low Speed Power Rating	0.60 hp (0.45 kW)	
	High Speed Power Rating	1.20 hp (0.90 kW)	
	High Fan Speed	1200 RPM	
	Low Fan Speed	750 RPM	
	High Speed Current Draw	3.5 amps	
	Low Speed Current Draw	2.0 amps	
Condenser Fan Motor (each)	Power Rating	0.50 hp (0.37 kW)	
	Fan Speed	1750 RPM	
	Current Draw	1.8 amps (per motor)	

Electrical Standby (SmartPower Units Only)

Note: *A transformer is used to convert 460 Vac to 230 Vac for the condenser and evaporator fan motors in units configured to use electric standby input voltage of 460 Vac.*

Electric Motor and Overload Relay

Table 6.

Voltage/Phase/ Frequency	Horsepower	Kilowatts	RPM	Overload Relay Setting (amps)
230/3/60	12.0	9.0	1760	34
460/3/60	12.0	9.0	1760	20
460/3/60	15.0	11.2	3500	19
460/3/60	16.0	11.9	3500	21
460/3/60	19.0	14.2	3500	32

Electric Heater Strips (Optional)

Table 7.

Number	3
Watts	1000 watts (each)
Resistance	53 ohms (each)
Overload Relay Settings	9 amps, 230V unit 6 amps, 460V unit

Standby Power Cord Requirements

Table 8.

Supply Circuit Breaker:	12 HP Motor 230/3/60 12, 15, and 16 HP Motors 460/3/60 19 HP Motor 460/3/60	70 amps 40 amps 60 amps
Extension Cord Size:	12 HP Motor 230/3/60	8 AWG Power Cable, 4-Conductor, 2000V, Type W Power Cable, 25 to 50-foot length
	12 HP Motor 230/3/60	6 AWG Power Cable, 4-Conductor, 2000V, Type W Power Cable, 75-foot length
	12, 15, and 16 HP Motors 460/3/60	10 AWG Power Cable, 4-Conductor, 2000V, Type W or SOOW Power Cable, up to 75-foot length
	19 HP Motor 460/3/60	8 AWG, 4-Conductor, 2000V, Type W Power Cable, up to 75-foot length

Electric Fuel Heater (Optional)

Table 9.

Electric Fuel Heater:	Resistance Current Draw at 12.5 Vdc Internal Thermostat Minimum Closing Temp Internal Thermostat Maximum Opening Temp	0.9 to 1.1 Ohms 11.4 to 13.9 Amps 30 F (-1 C) 75 F (24 C)
2FH/2HP Fuse		20 Amps

Maintenance Inspection Schedule

Host Unit

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Microprocessor:
•				Run Pretrip Test (see "Performing a Pretrip Test").
				Engine:
•				Check fuel supply.
•				Check engine oil level.
•	•	•	•	Inspect belts for condition and proper tension.
•	•	•	•	Check engine oil pressure hot, on high speed (should display "OK").
•	•	•	•	Listen for unusual noises, vibrations, etc.
•	•	•	•	Check engine coolant level and antifreeze protection (-30 F [-40 C]).
	•	•	•	Drain water from fuel tank and check vent.
	•	•	•	Inspect/clean electric fuel pump filter.
	•	•	•	Check condition of drive coupling bushings per Service Bulletin TT171.
			•	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.
		•		Change engine oil and oil filter (hot). Requires oil with API Rating CJ-4 or CK-4 (ACEA Rating E6 for Europe).
		•		Inspect/clean EGR system. Cleaning the valve and piping is recommended. Cleaning the cooler is required for emissions compliance.
		•		Adjust engine valve clearance.
			—	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").
				Electrical:
	•	•	•	Inspect battery terminals and electrolyte level.
	•	•	•	Inspect wire harness for damaged wires or connections.
			•	Inspect AC generator and alternator wire connections for tightness.
			•	Inspect electric motors.
			•	Inspect and, if required, re-torque all electrical connections on the contactors in the Fan Control Box to 15 in-lb (1.7 N•m).
			•	Inspect and, if required, re-torque all electrical connections on the contactors in the High Voltage Box in SmartPower units. Torque the connections on the Compressor Motor Contactor, Phase Contactors, and Overload Relay to 22 in-lb (2.5 N•m). Torque the connections on all other contactors to 15 in-lb (1.7 N•m).
				Refrigeration:
•	•	•	•	Check refrigerant level.
	•	•	•	Check for proper suction pressure.

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
	•	•	•	Check compressor oil level and condition.
			•	Check compressor efficiency and pump down refrigeration system.
			•	Empty oil collection container mounted on compressor.
			—	Replace dehydrator and check discharge and suction pressure every two (2) years.
				Structural:
•	•	•	•	Visually inspect unit for fluid leaks.
•	•	•	•	Visually inspect unit for damaged, loose, or broken parts (includes air ducts and bulkheads).
	•	•	•	Inspect 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.*

Remote Unit

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Electrical:
	•	•	•	Inspect wire harness for damaged wires or connections.
	•	•	•	Inspect/replace DC fan motors.
				Structural:
•	•	•	•	Visually inspect unit for fluid leaks.
•	•	•	•	Visually inspect unit for damaged, loose, or broken parts.
	•	•	•	Clean entire unit including evaporator coils and defrost drains.
	•	•	•	Check all unit mounting bolts, brackets, lines, hoses, etc.

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

Unit Description

Unit Overview

The Thermo King Precedent S-610M is a multi-temperature refrigeration system designed to control the temperatures in two or three compartments (zones). The system allows any compartment to be set at any temperature.

In the Precedent S-610M unit the evaporator in the host unit controls one compartment (Zone 1), and a remote evaporator controls the other compartment (Zone 2). A unit with three zones has a second remote evaporator, which controls a third compartment (Zone 3).

Front View

The units feature all-new DDE (Diesel Direct Electric) architecture, the quiet running Thermo King TK488CR engine and the Thermo King X430P reciprocating compressor.

The S-610M is available in the following models:

Standard: Cooling and heating on diesel engine operation.

SmartPower™ Option: Cooling and heating on diesel engine operations and electric standby operation.

See the following Features and Options.

Features and Options

The following chart lists key design features and options.

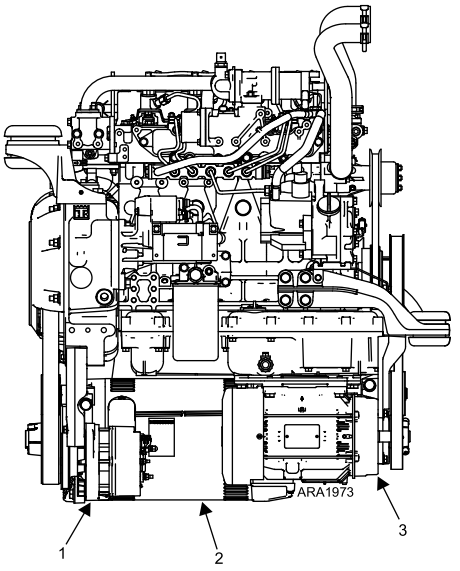
Precedent S-610M Key Features & Options ● **Standard Features** ○ **Option/Factory Installed** ☐ **Option/Dealer Installed**	
SMART REEFER SR-4 Controller	●
SmartPower™ Electric Standby	○
SmartPower High-Output	○
SmartPower Prep Package	○
Electronic Throttling Valve (ETV)	●
ServiceWatch™ Data Logger	●
CargoWatch™ Data Logger	●
CargoLink™ Sensor Kits	○ / ☐
CargoLink™ Wireless Sensors	○ / ☐
EMI-3000	●
High-Capacity Condenser Coils	●
Easy-access Door Design	●
Composite Exterior Panels	●
Long-Life Coolant Hoses	●
Remote Status Display	○ / ☐
Standard Unit Color White	●
Standard Grille Color Black	●
Directional Air Delivery	●
Vibration Isolation System	●
Aluminum Undermount Fuel Tank 50 Gal. (186 Liter)	●
Ultrasonic Fuel Level Sensor	●
Fuel Tanks with Ultrasonic Fuel Level Sensor	☐
Severe Duty Package	○
Electric Fuel Heater	○
Frost Plug Heater	○
Alternator, 120 Amp, 12 Vdc	●
Appearance Packages	○
Fresh Air Exchange	○
Anti-Siphon Device	○
REB Wireless Communication Platform	○
TracKing Telematics	○ / ☐
PrimAir™ Bulkhead and Duct System	☐
Rear Remote Control	☐
Humidity Sensor	☐
Battery Charger	○
Reliamax Battery, 12 Volt, Wet Cell	☐
EON Battery, 12 Volt, Dry Cell	☐
Remote Electric Power Receptacle	○

Diesel Engine

The unit uses the TK488CR, a 4-cylinder, water cooled, direct injection diesel engines. CR stands for "Common Rail" fuel injection system, which use electronically controlled fuel injectors to reduce emissions. An Exhaust Gas Recirculation (EGR) system and Diesel Oxidation Catalyst (DOC) exhaust after-treatment system also reduce emissions so the engines are EPA Tier 4 compliant. An Engine Control Unit (ECU) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.

The engine is coupled directly to the compressor on Standard Units. A centrifugal clutch transfers power from the engine to the compressor on SmartPower Units. Belts transmit power to the AC generator, water pump, and the optional accessory alternator.

Figure 1. TK488CR/CRH



1.	Alternator in SmartPower Unit Location (Standard Unit Location behind AC Generator)
2.	Standby Electric Motor (SmartPower Units Only)
3.	AC Generator

AC Generator

An AC generator provides AC electric power for the condenser and evaporator fan motors during diesel engine operation. The AC generator is mounted under the diesel engine and driven by a belt. The engine speed determines the output frequency of the AC generator, which affects the fan speeds.

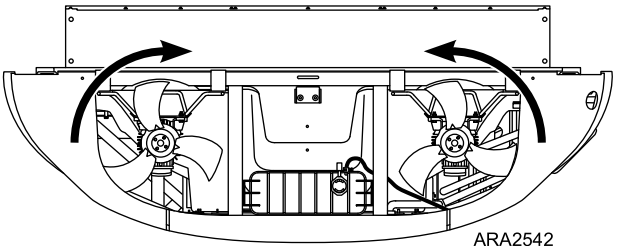
In standard units, an alternator provides 12 Vdc to charge the battery and power the 12 Vdc control system.

An optional battery charger is available to replace the alternator. The battery charger converts AC power from the AC generator (or the electric standby power source) to 12 Vdc to charge the battery and provide power for the 12 Vdc control system.

Condenser Fans

There are two condenser fans located near the top of the unit. Each condenser fan has its own electric motor and contactor, which allows the condenser fans to be controlled separately. The roadside condenser fan rotates counterclockwise when viewed from the top. It draws air through the roadside condenser coil and the radiator coil. It also draws air up through a cooling channel to cool the battery, battery charger (if used), and ECU. The curbside condenser fan rotates clockwise when viewed from the top. It draws air through the curbside condenser coil. During engine operation, the condenser fan speed varies with the engine speed.

Figure 2. Top View Showing Condenser Fans

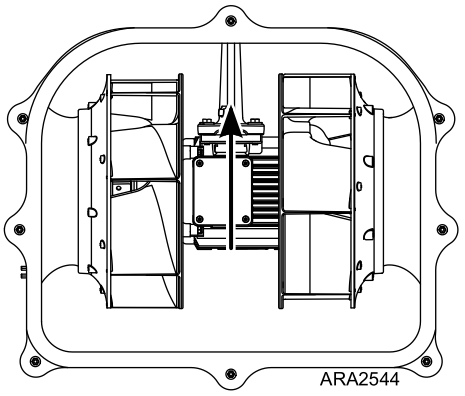


Evaporator Fans

The evaporator fans are axial blower type fans mounted on both ends of a single evaporator fan motor. The evaporator fans (and motor) are mounted in the evaporator, but are accessed from the front of the unit through an access panel located in the top of the unit between the condenser coils. The evaporator fans rotate up (from bottom to top) when viewed from the front of the unit through the access panel.

Because the evaporator fan speed varies with the engine speed, a two-speed motor and two contactors are used. Usually when the engine is running in low speed, the evaporator fan contactor connected to the high speed windings is energized and the evaporator fans run at approximately 1098 rpm. When the engine is running in high speed, the evaporator fan contactor connected to the low speed windings is energized and the evaporator fans run at approximately 1350 rpm. This keeps the evaporator air flow consistent regardless of the engine speed. In certain cases when the engine is running in high speed, the evaporator fan contactor connected to the high speed windings is energized and the evaporator fans run at approximately 1800 rpm.

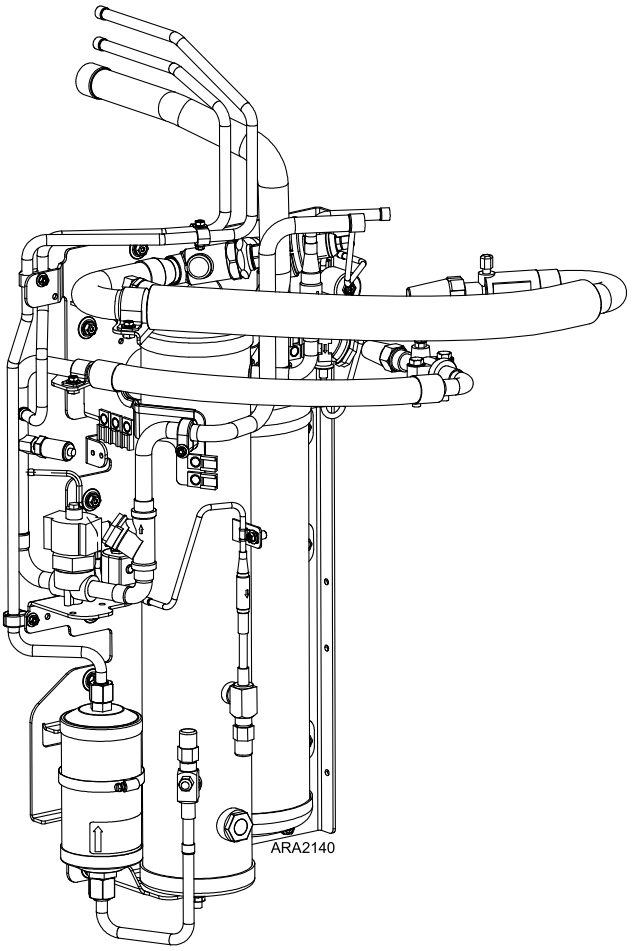
Figure 3. Front View Showing Evaporator Fans Through Access Panel



Refrigeration Cluster

Most of the refrigeration system components are located in the refrigeration cluster on the lower curbside of the unit. This allows good access from the front and side for maintenance, diagnosis, and repair.

Figure 4. Front Left View of Refrigeration Cluster



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 in a multi-temp unit improves the capacity in all zones by maximizing the capacity and controlling the engine load at all times. It can also provide more precise control of the temperatures in the cargo areas by using the ETV (and the hot gas bypass valve if necessary) to reduce the capacity when the return air temperatures approach the setpoints. This provides very smooth and steady temperature control and the temperatures do not oscillate above and below the setpoints as much as they do in a unit that does not have modulation control.

Remote Evaporators

A Remote Evaporator is mounted on the ceiling of each remote compartment to provide temperature control for Zone 2 and Zone 3 (if used). A Remote Evaporator with two fans is called an S-2. A Remote Evaporator with three fans is called an S-3. Two remote

evaporators can be mounted in the same remote compartment to provide more capacity.

Figure 5. S-3 Remote Evaporator

SMART REEFER 4 Multi-Temp (SR-4 MT) Control System

⚠ CAUTION

Risk of Injury!

Do not operate the SR-4 Controller until you are completely familiar with its function.

The SR-4 MT is a microprocessor control system designed for a transport refrigeration system. The SR-4 MT 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 an HMI (Human Machine Interface) 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.

For multi-temp applications an expansion module is connected to the base controller/interface board via a controller area network (CAN) connection. The expansion module provides the inputs and outputs necessary to control the remote zone evaporators. The expansion module is a secondary controller. The "secondary" designation indicates that the expansion module supports inputs and outputs, but it only executes instructions from the base controller. The expansion module must be connected to the controller/interface board, it is not capable of stand-alone operation.

See Operating Instructions for more information about the SR-4 MT Controller.

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-4 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-4 Trailer Multi-Temperature Diagnostic Manual (TK 55788–2–OD) 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 12.2 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 5 amperes).

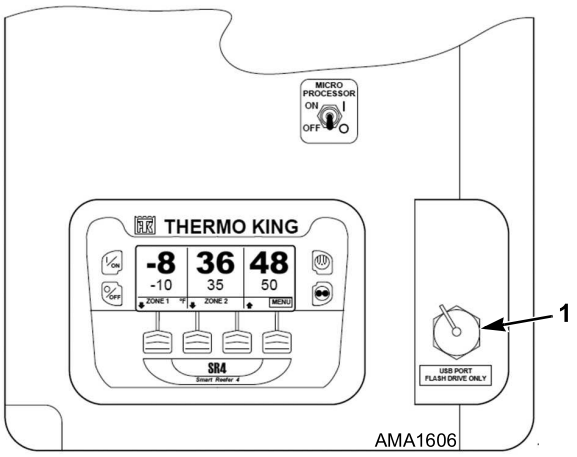
Features of the CYCLE-SENTRY system are:

- 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 the Flash Drive Only USB port on the front of the control box using a flash drive and ThermoServ™ software.

Figure 6. HMI Controller and USB Port



1.	Flash Drive Only USB Port

Flash Drive Only USB Port: Standard USB drives that have been programmed with ThermoServ can be used in the Flash Drive Only USB Port. Use of a USB drive eliminates the need for an on-site computer and does not require cables.

The Flash Drive Only USB port can be used to:

- Download the CargoWatch and ServiceWatch Data Loggers.
- Flashload the Base Controller and HMI Control Panel.

PC Only USB Port: The PC Only USB Port is the J11 connector located on the base controller inside the control box (see "Base Controller," p. 82). It is used to connect the controller to a PC with a standard USB to USB mini cable P/N 204-2000.

The PC Only USB port can be used to:

- Upload trailer ID and Unit Serial Number (For new units and if new controller is installed).
- Data Logger setup.
- Download the CargoWatch and ServiceWatch Data Loggers.
- Flashload the Base Controller and HMI Control Panel.

CAN Diagnosis Port: The CAN Diagnosis Port is used to connect the Yanmar Engine Control Unit (ECU) to a PC running the Yanmar Smart Assist Direct (YSAD) diagnostic program. The CAN Diagnosis Port is a 6-pin connector located inside the control box on a yellow wire harness labeled "CAN DIAGNOSIS".

Refer to the SR-4 Trailer Multi-Temperature Diagnostic Manual (TK 55788-2-OD) for information about using the USB ports and the CAN Diagnosis 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-4 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-4 Trailer Multi-Temperature Diagnostic Manual (TK 55788–2–OD) 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 a 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 "Displaying Sensors," p. 63.

A printer can also be used to print a report of the optional sensor readings. See "Printing CargoWatch Data Logger Reports," p. 65.

TK BlueBox

The TK BlueBox is an option as of July 2017 and standard equipment as of the 1st Quarter of 2018.

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.

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 for all zones. 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 each zone should be in. Therefore, it is difficult to predict which operating mode an evaporator should be in by comparing the setpoint to the compartment temperature.

Each zone that is turned on will operate in one of the following modes:

- Cool
- Heat
- Defrost
- Null

In diesel operation the engine speed is determined by a combination of the requirements of each zone and the discharge pressure. The diesel engine will operate in High or Low Speed accordingly.

In electric operation (SmartPower units only) the drive motor operates at a single speed. It does not run when all zones are in Null. Electric evaporator heaters are also used in the host unit to increase the Heat and Defrost capacities during electric operation.

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. Defrost is initiated in each zone automatically or manually.

Automatic Defrost: The controller is programmed to automatically initiate timed or demand defrost cycles. The SR-4 microprocessor 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 “Initiating a Manual Defrost Cycle”.

The evaporator coil temperature in the selected zone must be below 45 F (7 C) to allow defrost. If the unit is in CYCLE-SENTRY Null mode, the engine will start when defrost is initiated.

The zone will stay in defrost until the evaporator coil temperature rises to 58 F (14.5 C).

System Operation

Several operating characteristics of the unit are:

- All zones can cool at the same time.
- All zones can heat at the same time.
- Any zone can cool while any other zone heats.
- When the host zone is in defrost, it may delay cool or heat in the other zone(s).
- When a zone is in null, the blowers may run but the zone does not cool or heat.
- When a zone is in heat while another zone is in cool, the evaporator in the zone that is in heat acts as the condenser.
- The condenser inlet solenoid and the suction line solenoids are normally open solenoid valves that close when energized.
- The liquid line solenoids, the hot gas solenoids, the receiver tank pressure solenoid and the purge valve are normally closed solenoid valves that open when energized.
- The flow of refrigerant through the system is controlled by the solenoid valves and the check valves.
- If the condenser inlet solenoid is energized (closed) because a zone is in heat or defrost, and if the discharge pressure exceeds 425 psig (2930 kPa), the condenser inlet solenoid is de-energized until the discharge pressure drops below 250 psig (1724 kPa).
- The receiver tank pressure solenoid and the purge valve cycle from energized (open) for 5 seconds to de-energized for 55 seconds every minute when any zone is in heat or defrost and the discharge pressure is between 225 and 300 psig (1551 and 2068 kPa). If the discharge pressure exceeds 300 psig (2068 kPa), the receiver tank pressure solenoid and the purge valve are de-energized until the discharge pressure drops below 220 psig (1517 kPa).
- During engine operation when all zones are in cool, the microprocessor will shift the engine to low speed if the discharge pressure exceeds 425 psig (2930 kPa). High speed is enabled, if required, when the discharge pressure drops below 375 psig (2586 kPa).
- During engine operation when all zones are in heat, the microprocessor will shift the engine to low speed if the discharge pressure exceeds 375 psig (2586 kPa). High speed is enabled, if required, when the discharge pressure drops below 300 psig (2068 kPa).

Precision Temperature Control (PTC)

Precision Temperature Control (PTC) in one remote zone is available starting in the first quarter or 2017 with software revisions CA20/7A45. PTC pulses the Liquid Line Solenoid (LLS) in the selected Zone as necessary to control the cooling capacity for more precise temperature control. PTC is only allowed in one remote zone and only for fresh setpoints.

Use the Precision Temp Control Zone Menu in the Guarded Access > Programmable Features Menu to enable PTC in a remote zone or turn it off. The default setting is Off. Refer to the appropriate Diagnostic Manual for more information.

Use the Add Precision Temp Control Zone to Mode Menu in the Guarded Access > Main Menu Configuration Menu to add The Precision Temp Control Zone Menu to the Mode Menu. This allows the user to access the Precision Temp Control Zone Menu through the Mode Menu in addition to accessing it though the Guarded Access > Programmable Features Menu. The default setting is Disabled.

Refrigeration System Diagrams

The following pages show examples of the refrigerant flow through a three zone system. The two zone system is similar, except the Zone 3 evaporator and its components are removed.

Zone 1 Cool, Zone 2 Cool, and Zone 3 Cool

High pressure refrigerant vapor leaves the compressor and flows through the open CIS to the condenser where the refrigerant condenses into high pressure liquid. The liquid refrigerant flows through the receiver tank into the liquid lines.

The LLS is open so some of the refrigerant flows through the Zone 1 expansion valve into the Zone 1 evaporator. There the liquid refrigerant cools the Zone 1 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS, SLCV, accumulator, and ETV.

The LLS2 is open so some of the refrigerant flows through the Zone 2 expansion valve into the Zone 2 evaporator. There the liquid refrigerant cools the Zone 2 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS2, suction line, SLCV2, accumulator, and ETV.

The LLS3 is open so some of the refrigerant flows through the Zone 3 expansion valve into the Zone 3 evaporator. There the liquid refrigerant cools the Zone 3 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS3, suction line, SLCV3, accumulator, and ETV.

Host Unit and Zone 1 Evaporator

1. Liquid Line Solenoid (LLS)—**Open**
2. Liquid Return Check Valve (LRCV)—**Closed**
3. Suction Line Check Valve (SLCV)—**Open**
4. Suction Line Solenoid (SLS)—**Open**
5. Hot Gas Solenoid (HGS)—**Closed**
6. Condenser Inlet Solenoid (CIS)—**Open**
7. Condenser Inlet Check Valve (CICV)—**Open**
8. Condenser Check Valve (CCV)—**Open**
9. Receiver Tank Pressure Solenoid (RTPS)—**Closed**
10. Bypass Check Valve (BCV)—**Closed**
11. Bypass Hand Valve
12. Purge Valve (PV)—**Closed**
13. Purge Check Valve (PCV)—**Closed**
14. Electronic Throttling Valve (ETV)
15. Hot Gas Bypass Valve (HGB)—**Closed**

Zone 2 Evaporator

1C. Zone 2 Liquid Line Solenoid (LLS2)—**Open**

2C. Zone 2 Liquid Return Check Valve (LRCV2)—**Closed**

3C. Zone 2 Suction Line Check Valve (SLCV2)— **Open**

4C. Zone 2 Suction Line Solenoid (SLS2)—**Open**

5C. Zone 2 Hot Gas Solenoid (HGS2)—**Closed**

Zone 3 Evaporator

1R. Zone 3 Liquid Line Solenoid (LLS3)—**Open**

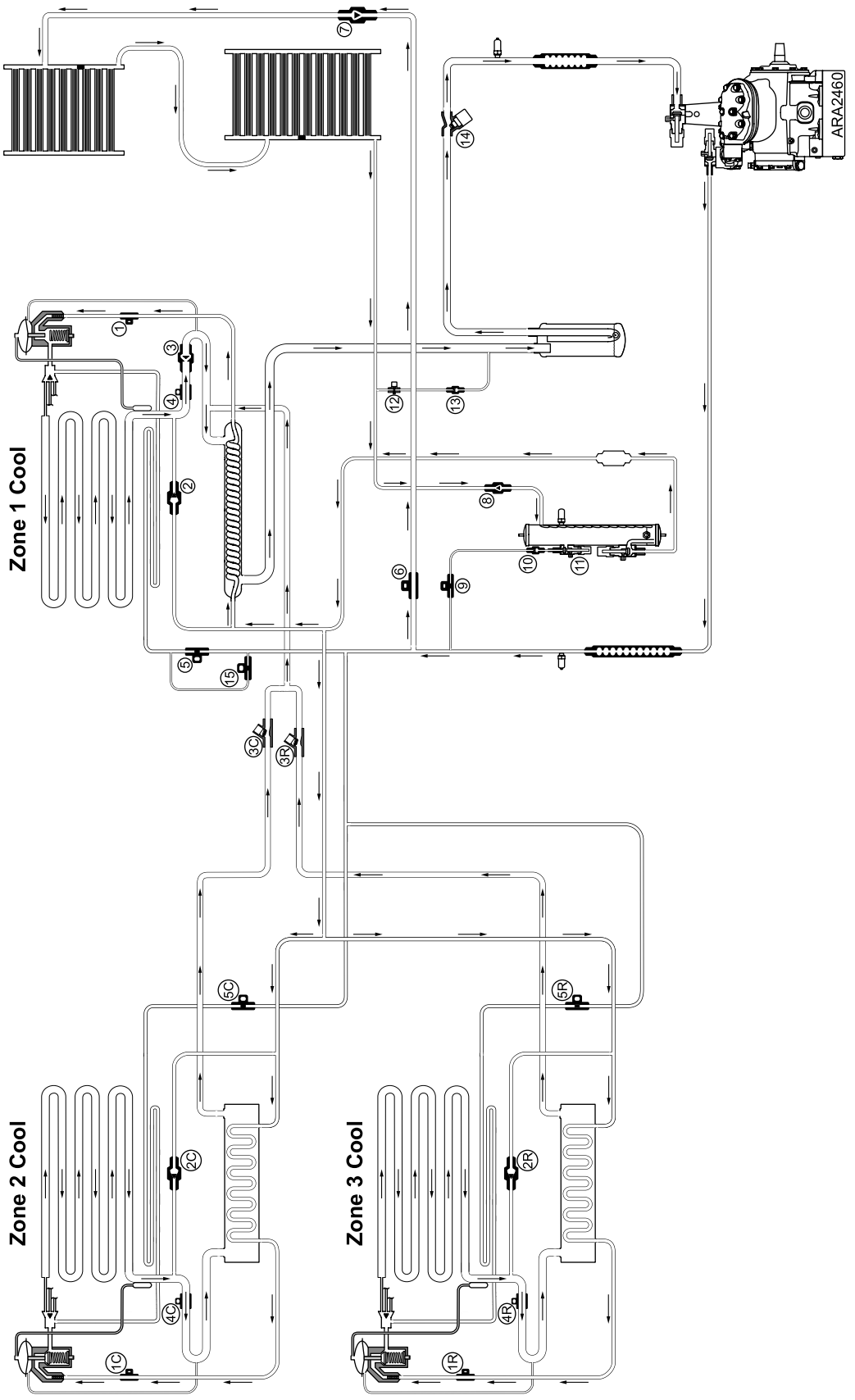
2R. Zone 3 Liquid Return Check Valve (LRCV3)—**Closed**

3R. Zone 3 Suction Line Check Valve (SLCV3)— **Open**

4R. Zone 3 Suction Line Solenoid (SLS3)—**Open**

5R. Zone 3 Hot Gas Solenoid (HGS3)—**Closed**

Figure 7. Zone 1 Cool, Zone 2 Cool, and Zone 3 Cool



Zone 1 Cool, Zone 2 Cool, and Zone 3 Heat

The CIS is closed so high pressure refrigerant vapor leaves the compressor and flows through the hot gas line and the open HGS3 into the Zone 3 evaporator. There the refrigerant heats the Zone 3 evaporator and condenses into high pressure liquid. Because the SLS3 is closed, the liquid refrigerant flows through the LRCV3 and the remote liquid line to LLS and LLS2.

The LLS is open so some of the refrigerant flows through the Zone 1 expansion valve into the Zone 1 evaporator. There the liquid refrigerant cools the Zone 1 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS, SLCV, accumulator, and ETV.

The LLS2 is also open so some of the refrigerant flows through the Zone 2 expansion valve into the Zone 2 evaporator. There the liquid refrigerant cools the Zone 2 evaporator as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the SLS2, the suction line, the SLCV2, accumulator, and ETV.

Host Unit and Zone 1 Evaporator

1. Liquid Line Solenoid (LLS)—**Open**
2. Liquid Return Check Valve (LRCV)—**Closed**
3. Suction Line Check Valve (SLCV)—**Open**
4. Suction Line Solenoid (SLS)—**Open**
5. Hot Gas Solenoid (HGS)—**Closed**
6. Condenser Inlet Solenoid (CIS)—**Closed***
7. Condenser Inlet Check Valve (CICV)—**Closed**
8. Condenser Check Valve (CCV)—**Closed**
9. Receiver Tank Pressure Solenoid (RTPS)—**Open***
10. Bypass Check Valve (BCV)—**Open**
11. Bypass Hand Valve
12. Purge Valve (PV)—**Open***
13. Purge Check Valve (PCV)—**Open**
14. Electronic Throttling Valve (ETV)
15. Hot Gas Bypass Valve (HGB)—**Closed**

* The microprocessor will open and close these valves as required to control the head pressure or compensate for high ambient temperatures.

Zone 2 Evaporator

1C. Zone 2 Liquid Line Solenoid (LLS2)—**Open**

2C. Zone 2 Liquid Return Check Valve (LRCV2)—**Closed**

3C. Zone 2 Suction Line Check Valve (SLCV2)— **Open**

4C. Zone 2 Suction Line Solenoid (SLS2)—**Open**

5C. Zone 2 Hot Gas Solenoid (HGS2)—**Closed**

Zone 3 Evaporator

1R. Zone 3 Liquid Line Solenoid (LLS3)—**Open**

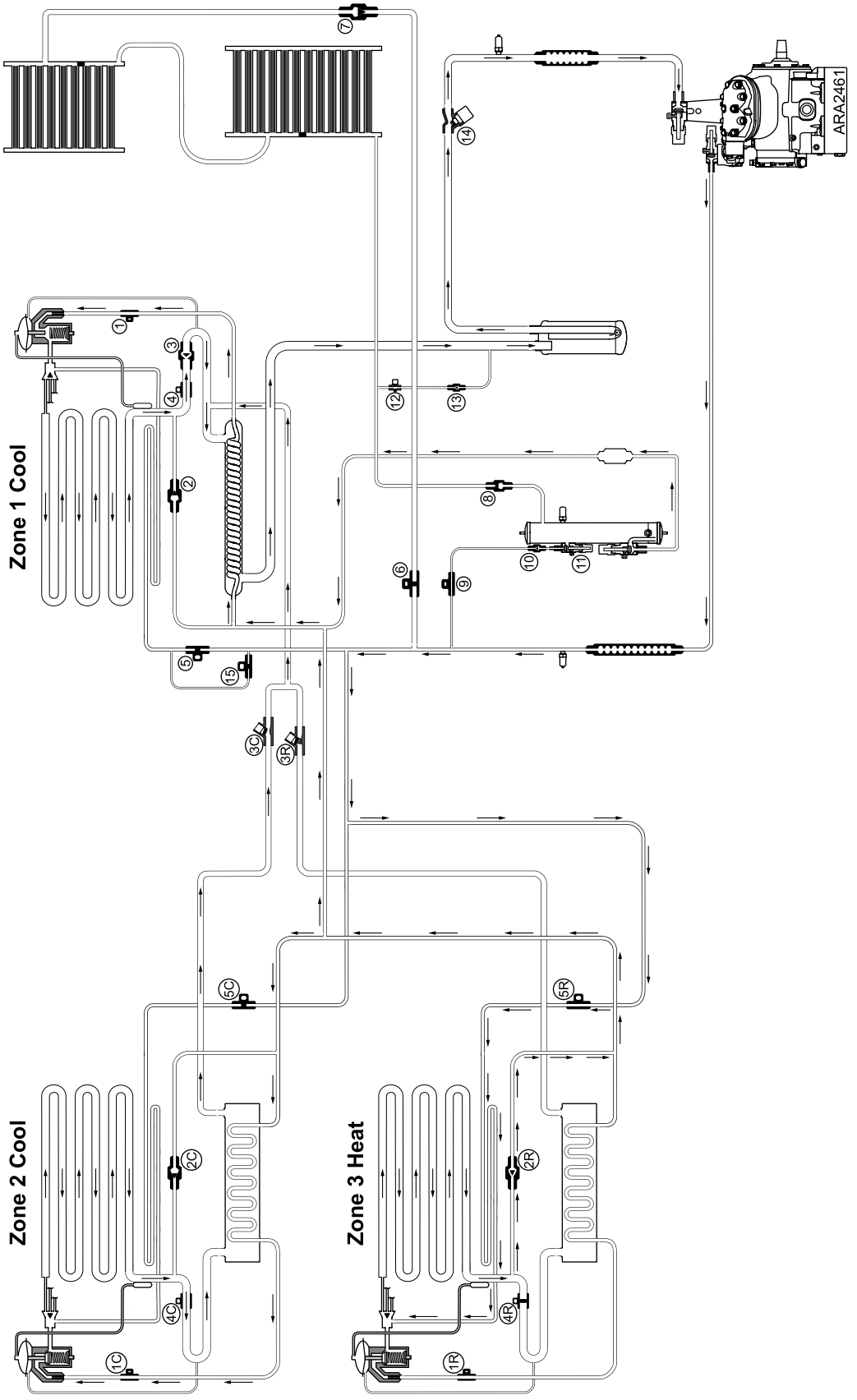
2R. Zone 3 Liquid Return Check Valve (LRCV3)— **Open**

3R. Zone 3 Suction Line Check Valve (SLCV3)— **Closed**

4R. Zone 3 Suction Line Solenoid (SLS3)—**Closed**

5R. Zone 3 Hot Gas Solenoid (HGS3)—**Open**

Figure 8. Zone 1 Cool, Zone 2 Cool, and Zone 3 Heat



Opening the Front Doors

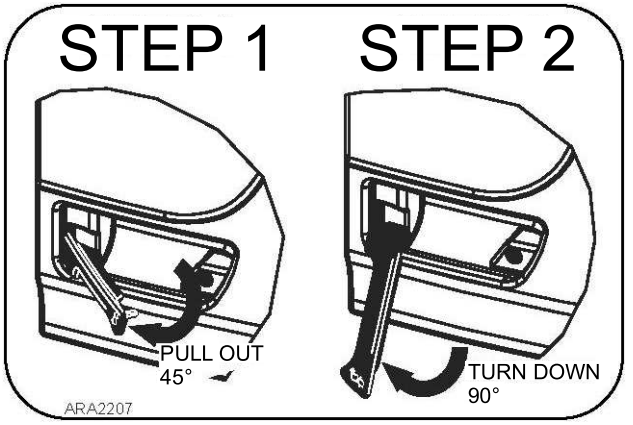
To open the doors and access the engine compartment, pull the right door latch handle out at a 45 degree angle and turn it down (clockwise) 90 degrees (Figure 9, p. 36). To close the door, push the door closed while holding the door latch handle open and then turn it up (counterclockwise) 90 degrees.

Figure 9. Door Latch Location

1.	Door Latch

1.	Door Latch

Figure 10. Door Latch Nameplate



Engine Compartment Components

The following maintenance items can be checked visually (Figure 11, p. 37):

⚠ 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

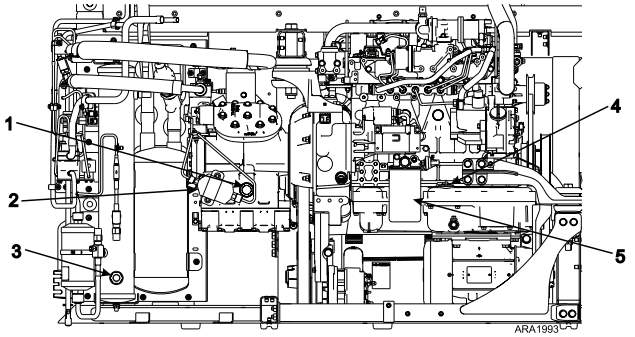
Service Procedures!

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 11. Engine Compartment Components



1.	Compressor Sight Glass	4.	Engine Oil Dipstick
2.	Compressor Oil Filter	5.	Engine Oil Filter
3.	Receiver Tank Sight Glass		

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 gets the engine coolant temperature information from the ECU. 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.

Fuses: Various fuses protect circuits and components. Refer to "Base Controller Fuses," p. 83, "Expansion Module Fuses," p. 85, and "Battery Fusing," p. 87 for more information.

Smart FETs: Smart FETs in the base controller protect circuits and components.

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.

Overload Relay-Automatic Reset (SmartPower Units): An overload relay protects the standby electric motor. The overload relay opens the circuit to the electric motor if the motor overloads for any reason (e. g., low line voltage or improper power supply) while the unit is on electric standby operation. The microprocessor will record Alarm Code 90.

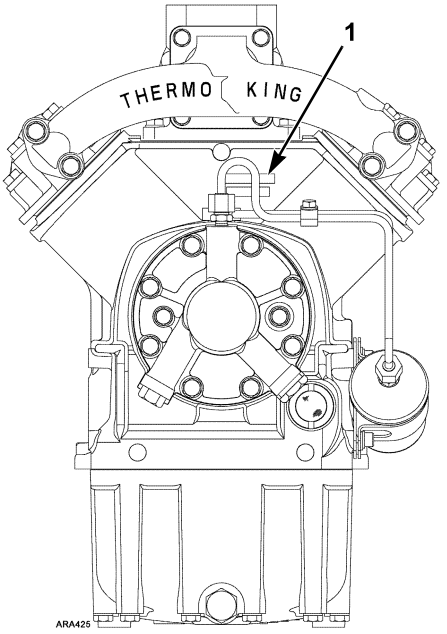
Serial Number Locations

Unit: Nameplates on the frame near the battery, and on the roadside of the evaporator.

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

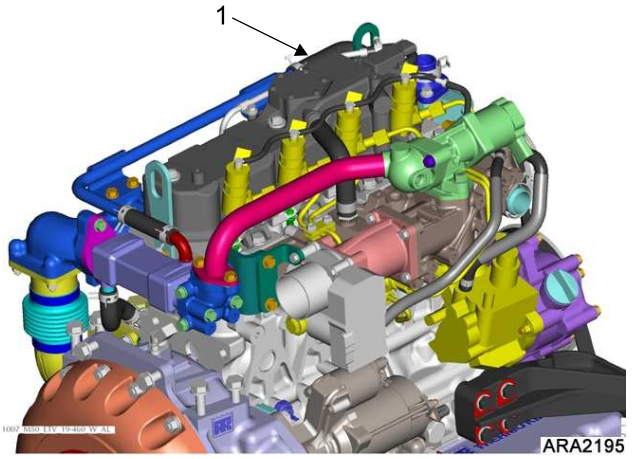
Compressor: Stamped between the cylinders on the front end above the oil pump.

Figure 12. Compressor Serial Number Location



1.	Serial Number Location

Figure 13. Engine Serial Number Location

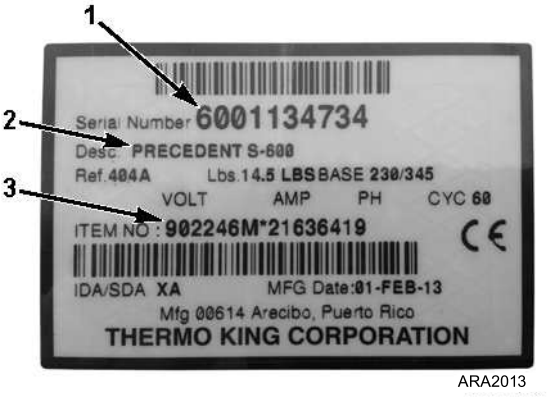


1.	Serial Number Location

Figure 14. Unit Serial Number Locations

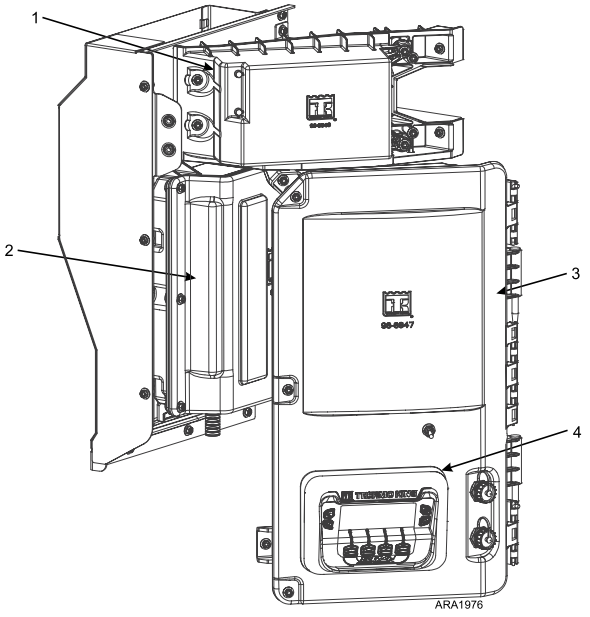
1.	On Evaporator Housing
2.	On Frame In Engine Compartment

Figure 15. Laminated Serial Number Plate (Located Where Shown Above)



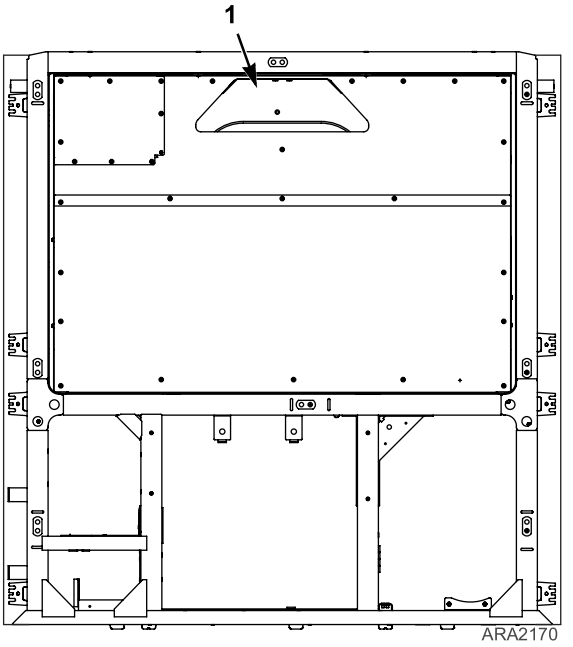
1.	Unit Serial Number
2.	Unit Model
3.	Bill of Material Number

Figure 16. Electrical Control Boxes



1.	Fan Control Box (High Voltage)
2.	High Voltage Box (SmartPower Units Only)
3.	Control Box (Low Voltage)
4.	HMI

Figure 17. Back View



1.	Evaporator Discharge Air Outlet

Operating Instructions

SMART REEFER 4 Multi-Temp (SR-4 MT) Control System

Thermo King has applied the latest advances in computer technology to develop a device that controls temperature and unit function, and displays operating information quickly and accurately.

There is nothing complicated about learning to operate the SR-4 MT Controller, but you will find that a few minutes studying the contents of this manual will be time well spent.

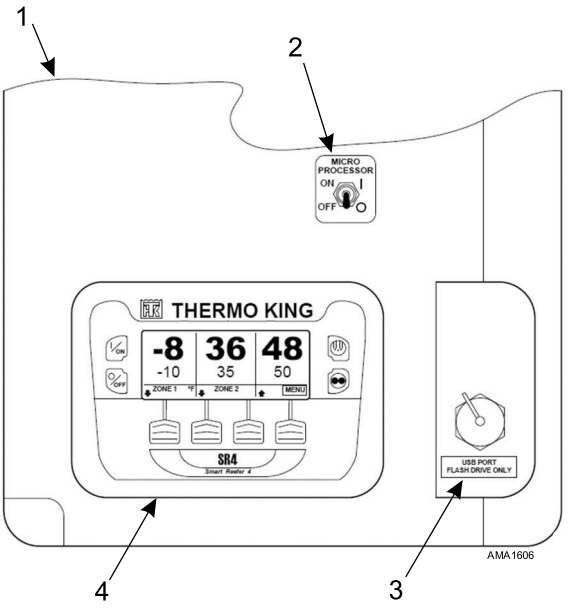
⚠ CAUTION

Risk of Injury!

Do not operate the SR-4 Controller until you are completely familiar with its function.

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 USB port is used to retrieve data from the data logging system.

Figure 18. SR-4 MT Control Panel With Service Door Open



1.	Control Box	3.	Flash Drive Only USB Port
2.	Microprocessor On/ Off Switch	4.	HMI Control Panel

Microprocessor On/Off Switch

This switch supplies or removes electrical power to the microprocessor. It is located above the HMI Control Panel. It is hidden when the lower roadside body panel surrounding the Control Box is closed.

SR-4 HMI Control Panel

⚠ 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.

Use the HMI control panel to operate the unit. Refer to the applicable Precedent Operator's Manual and the SR-4 Trailer Multi-Temperature Diagnostic Manual (TK 55788-2-OD) for more information.

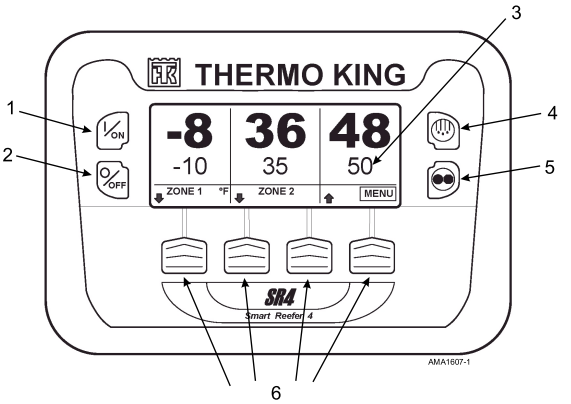
The HMI control panel has a display and eight touch sensitive keys. The display is capable of showing both text and graphics. The four keys on the left and right sides of the display are "hard" (dedicated) keys. The four keys under the display are "soft" keys. The function of soft keys change depending on the operation being performed. If a soft key is active, its function will be shown in the display directly above the key.

Control Panel Display

The display is used to present unit information to the operator. This information can include setpoint and temperature for each zone, unit or zone operating information, gauge readings, temperatures, and other information as selected by the operator.

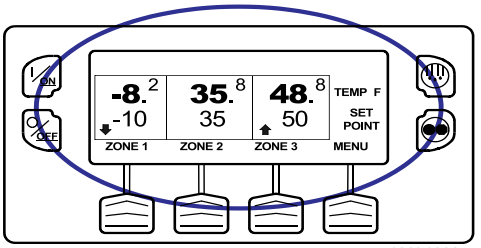
The default display is called the Standard Display (Figure 19, p. 40). It is described in detail later in this section.

Figure 19. Control Panel Display and Keys



1.	On Key (Hard Key)
2.	Off Key (Hard Key)
3.	Display
4.	Defrost Key (Hard Key)
5.	CYCLE-SENTRY/Continuous Mode Key (Hard Key)
6.	Soft Keys

Figure 20. Display



AMA1608

The Standard Display of box temperature and setpoint for three zones is shown (Figure 20, p. 41). The unit is running in Continuous Mode. Zone 1 has a setpoint of -10°F, and a return air temperature of -8.2°F. The downward pointing arrow shows this zone is cooling. Zone 2 has a setpoint of 35°F, and a return air temperature of 35.8°F. The absence of an arrow indicates that this zone is in null. Zone 3 has a setpoint of 50°F, and a return air temperature of 48.8°F. The upward pointing arrow shows this zone is heating.

Note: *The zone temperature shown is always return air temperature.*

Pressing the soft key under each zone allows the setpoint for that zone to be changed. In addition, the soft keys under Zone 2 and Zone 3 are used to turn those zones on and off. Pressing the soft key under MENU accesses the MAIN MENU.

Note: *Zone 1 is always on when the control system is powered up.*

Display Icons

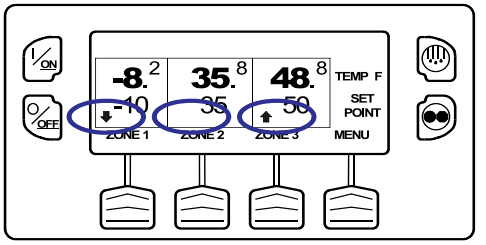
Display symbols or icons are used to indicate the following:

- If a zone is cooling, heating, or in null.
- If the unit is operating in Cycle Sentry or Continuous Mode.
- If unit level or zone level alarm conditions have occurred.

Zone Cooling, Heating, or Null

Arrows are used to indicate if a zone is cooling, heating, or in null.

Figure 21. Cooling, Heating, Null Arrows



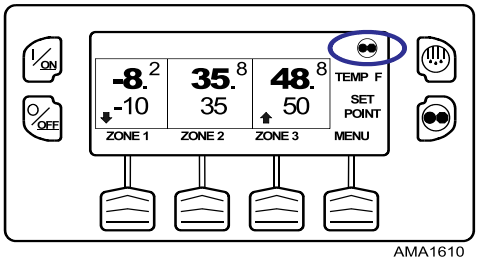
AMA1609

Arrows: (At the left side of the display) Figure 21, p. 41 shows Zone 1 is cooling. If the arrow were pointing upward, Zone 1 would be heating. The absence of an arrow indicates that a Zone is in Null.

CYCLE SENTRY/Continuous Mode Key: If the Cycle Sentry Icon is present as shown (Figure 22, p. 41), the unit is operating in Cycle Sentry Mode. Absence of the Cycle Sentry Icon indicates the unit is operating in Continuous Mode.

If the Standard Display is shown, the Cycle Sentry Icon will appear in the upper right corner of the display as shown (Figure 22, p. 41).

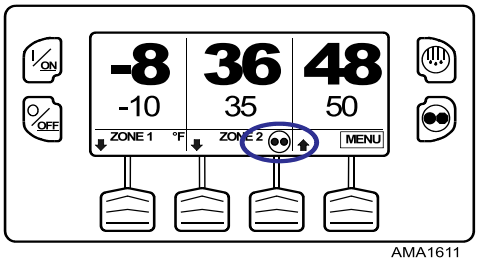
Figure 22. Cycle Sentry Icon



AMA1610

If the TemperatureWatch Display is shown, the Cycle Sentry Icon will appear in the lower part of the display as shown (Figure 23, p. 41).

Figure 23. Three Zone TemperatureWatch Display - Unit in Cycle Sentry Mode



AMA1611

ECO Pulldown Mode

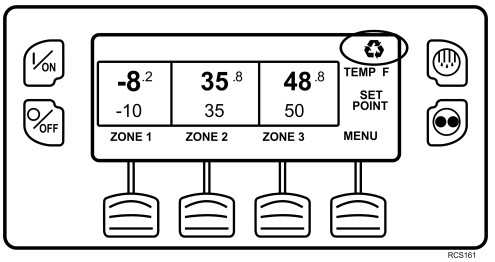
This programmable feature allows the unit to operate in low speed during initial pulldown until the temperature in any one zone inside the trailer reaches 30°F. At this point, it automatically switches the unit to high speed operation.

Operating the unit in low speed pulldown can save up to 15% fuel during the initial pulldown without significantly increasing the overall unit run time.

For set points above 30°F, the unit will operate in ECO Pulldown mode until set point is achieved, possibly never operating in high speed mode.

All Thermo King Multi-Temperature units come factory set with ECO Pulldown Mode enabled. When the Standard Display is shown, the ECO Pulldown icon will appear in the upper right corner of the display.

Figure 24. ECO Pulldown Mode Icon

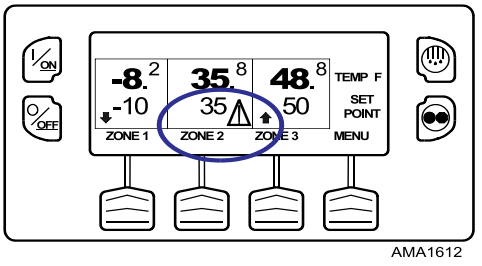


Zone Level or Unit Level Alarm Codes

Alarm Icon: The Alarm Icon is used to indicate the presence of one or more alarm codes. If the Alarm Icon is present, an alarm condition has occurred and an Alarm Code has been set. Absence of the Alarm Icon indicates no Check, Prevent or Shutdown Alarm Codes exist.

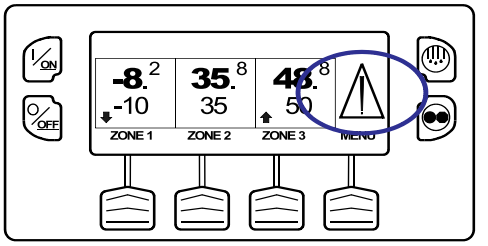
If a Zone Level (an alarm pertaining only to a particular zone) Alarm condition exists, the Alarm Icon will appear in the offending zone as shown (Figure 25, p. 42) (A Zone Level alarm exists in Zone 2).

Figure 25. Zone Level Alarm



If a Unit Level (an alarm pertaining to the entire unit independent of zone) Alarm condition exists, the Alarm Icon will appear at the right side of the display as shown (Figure 26, p. 42).

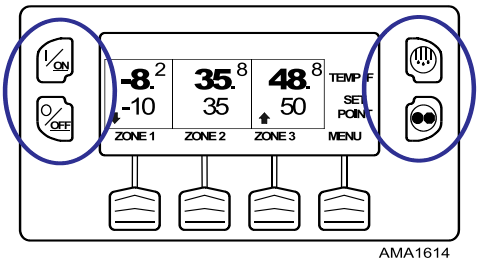
Figure 26. Unit Level Alarm



Hard Keys

The keys on either side of the display are dedicated or hard keys (Figure 27, p. 42). Their function always remains the same.

Figure 27. Hard Keys



On Key: Used to turn the unit on. First the display will briefly show the Thermo King Logo and then the statement "Configuring System - Please Wait". When the power-up sequence is complete, the display shows the Standard Display of box temperature and setpoint. For more information see "Turning the Unit On and Off".

Off Key: Used to turn the unit off. First, the display will briefly show "System is Powering Down - Please Wait. Press On to Resume" and then "Off" will appear momentarily. When the power-down sequence is complete the display will be blank. For more information see "Turning the Unit On and Off".

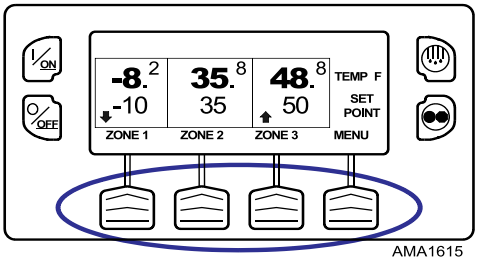
Defrost Key: Press this key to initiate a Manual Defrost cycle. For more information see "Initiating a Manual Defrost Cycle".

CYCLE SENTRY: Used to select Cycle Sentry Mode or Continuous Mode operation. For more information see "Selecting Cycle Sentry or Continuous Mode".

Important: *If the Hard Keys are illuminated, the HMI Control Panel is powered up even if the display is off. Typically, this indicates the CargoWatch Data Logger is active even when the unit is turned off.*

Soft Keys

Figure 28. Soft Keys



The four soft keys under the display are multi-purpose keys (Figure 28, p. 43). Their function changes depending on the operation being performed. If a soft key is active, the key function is shown in the display directly above the key. The keys are numbered from left to right, with Key 1 on the far left and Key 4 on the far right.

Typical soft key applications:

- ZONE ON/OFF and SETPOINT CHANGE
- MENU
- CLEAR
- NO
- NEXT
- HOURMETERS
- SENSORS
- + OR -
- GAUGES
- EXIT
- SELECT
- BACK
- HELP

Display Heater

The HMI Control Panel is equipped with a display heater. This heater is needed to make the display visible in very cold ambient temperatures.

The HMI has its own internal temperature sensor for the display heater. The heater is energized when the unit is turned on and the ambient temperature is below 29.4°F (-2°C). The heater turns off when the temperature sensed by the internal sensor rises above 37.4°F (3°C). The heater draws from 1.4 to 1.7 amps when energized.

The colder the ambient temperature, the longer it will take for the heater to make the display visible on a cold startup. It may take 10-15 seconds for the display to appear with extremely cold temperatures.

Turning The Unit On And Off

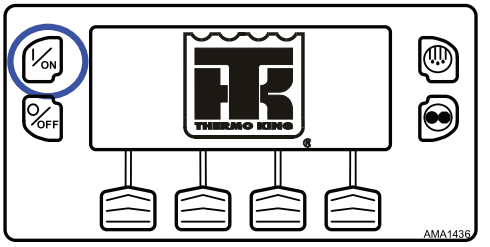
The unit is turned on by pressing the ON Key (Figure 29, p. 43) and off by pressing the OFF Key. When the On Key is pressed the display briefly shows the THERMO KING Logo as the display initializes.

Important: *The ON Key must be held down until the Thermo King Logo appears. If the ON Key is not held down long enough (approximately ½ second), the display may flicker but the unit will not start up. If this occurs, hold the ON Key down until the Thermo King logo appears.*

Note: *With Multi-Temp applications, Zone 1 is turned on any time the host unit is turned on. Zone 1 is turned off when the host unit is turned off.*

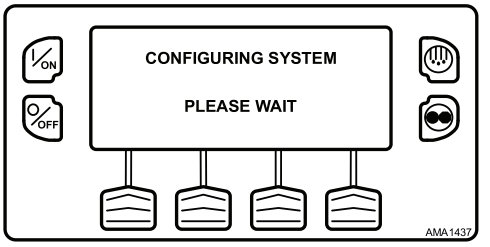
Note: *With extremely cold ambient temperatures, it may take up to 15 seconds for the display to appear on initial startup.*

Figure 29. ON Key



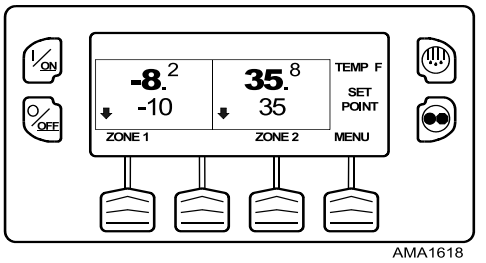
The startup screen appears while communications are established and the unit prepares for operation.

Figure 30. Startup Screen



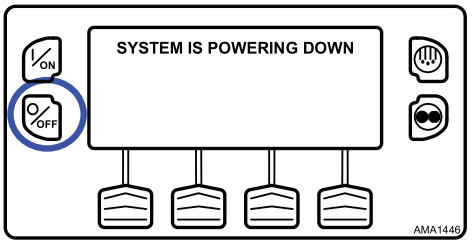
When the unit is ready to run, the Standard Display appears. The Two Zone display is shown (Figure 31, p. 43).

Figure 31. Two Zone Display



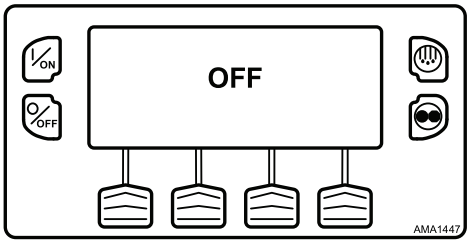
Pressing the OFF hard key stops unit operation. The controller shuts down immediately and the display briefly shows the power down message as shown (Figure 32, p. 44).

Figure 32. Power Down Message



The display briefly shows OFF (Figure 33, p. 44) and then goes blank. To start the unit again, press the ON hard key.

Figure 33. Display Shows OFF

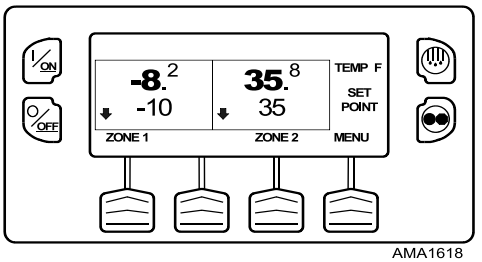


Two Zone Standard Display

Note: *Fahrenheit is shown, Celsius display is similar.*

The Standard Display is the default display that appears if no other display function is selected. The Two Zone Standard Display shows the return air temperature and setpoint for two zones. The absence of the Cycle Sentry Icon at the top of the display shows that the unit is operating in Continuous Mode. The return air temperature for Zone 1 is -8.2°F with a -10°F setpoint. The down-pointing arrow indicates that Zone 1 is cooling. The return air temperature for Zone 2 is 35.8°F with a 35°F setpoint. The down-pointing arrow indicates that Zone 2 is also cooling. The soft key under each zone allows the setpoint for that zone to be changed. In addition, the soft key under Zone 2 is used to turn that zone on and off. The soft key labeled MENU allows the Main Menu to be selected.

Figure 34. Two Zone Standard Display

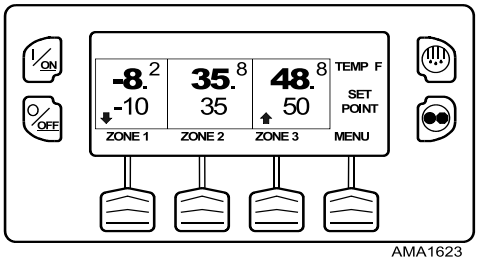


Three Zone Standard Display

Note: *Fahrenheit is shown, Celsius display is similar.*

The Three Zone Standard Display adds a third zone and functions the same way as the Two Zone Standard Display, but with another temperature controlled zone. The absence of the Cycle Sentry Icon at the top of the display (Figure 35, p. 44) shows that the unit is operating in Continuous Mode. The return air temperature for Zone 1 is -8.2°F with a -10°F setpoint. The down-pointing arrow indicates that Zone 1 is cooling. The return air temperature for Zone 2 is 35.8°F with a 35°F setpoint. The absence of the Up or Down pointing arrow indicates that Zone 2 is in Null. The return air temperature for Zone 3 is 48.8°F with a 50°F setpoint. The up-pointing arrow indicates that Zone 3 is heating. The soft key under each zone allows the setpoint for that zone to be changed. In addition, the soft keys under Zone 2 and Zone 3 are used to turn those zones on and off. The soft key labeled MENU allows the Main Menu to be selected.

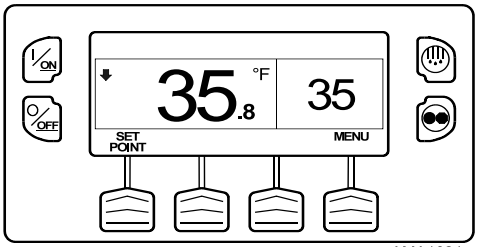
Figure 35. Three Zone Standard Display



Single Zone Control Standard Display

This feature, if enabled in Guarded Access, allows Single Zone Control operation to be selected by choosing the Main Menu and then selecting Single Zone Control from the Mode Submenu. When this feature is selected, all zones will be forced on and will control to the same selected setpoint. The Single Zone Control Standard Display (Figure 36, p. 45) functions the same way as the other Standard Displays. The absence of the Cycle Sentry Icon at the top of the display shows that the unit is operating in Continuous mode. The box temperature for all zones is 35.8°F and all zones are controlling to a 35°F setpoint. The down-pointing arrow indicates that all zones are cooling. The soft key labeled Setpoint allows the setpoint for all zones to be changed. The soft key labeled Menu allows the Main Menu to be selected.

Figure 36. Single Zone Control Standard Display



Operating the Unit in Single Zone Control Mode

The following differences exist when operating the unit in Single Zone Control Mode:

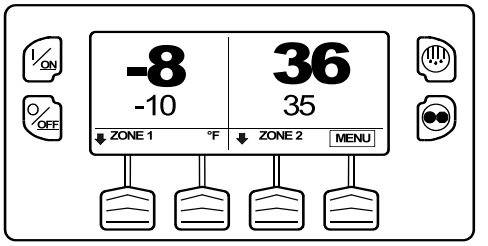
- Single Zone Control Mode will appear in the Mode Menu only if the Single Zone Control feature has been enabled in the Guarded Access/Main Menu Configuration Menu. If the feature is enabled, Single Zone Control will appear in the Main Menu/ Mode Menu.
- If Single Zone Control operation is selected, all zones will be forced on and will control to the same setpoint. The Zone 1 sensors are used to determine box temperature. All dividing wall(s) should be repositioned to create one large compartment. With the exception of defrost, the operating mode of each zone evaporator(s) will be the same when in this mode. Unit control is based on the temperature sensors of Zone 1.
- If Single Zone Control operation is selected, the Single Zone Standard Display provides only one soft key labeled Set Point. This allows the setpoint for all zones to be changed simultaneously.
- If Single Zone Control operation is selected, the individual zones cannot be turned off. The unit and all zones are turned On and Off simultaneously using the On and Off hard keys at the left side of the display.

The TemperatureWatch™ Display

The TemperatureWatch Display appears 2 ½ minutes after the Standard Display appears so long as there is no key activity and no Check, Prevent, or Shutdown alarms present. The TemperatureWatch Display (Figure 37, p. 45) will remain on until any key is pressed or a Check, Prevent, or Shutdown alarm occurs.

The TemperatureWatch Display shows the return air temperature and setpoint for each zone. Tenths of a degree are not shown by the TemperatureWatch display. The large numbers allow unit conditions to be checked from a distance. Pressing any soft key returns the display to the Standard Display.

Figure 37. Two Zone TemperatureWatch Display

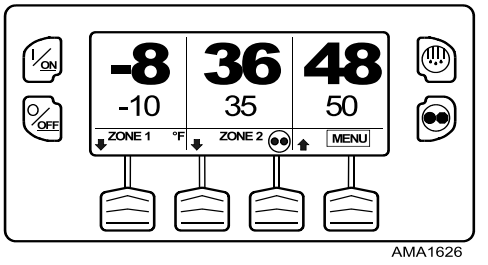


If an alarm condition (other than a Log Alarm) is present, the TemperatureWatch Display will not appear. If an alarm condition occurs while the TemperatureWatch Display is present, the display will return to the Standard Display.

If the Defrost Key or Cycle Sentry Key is pressed, the display will return to the TemperatureWatch Display immediately after the defrost cycle is initiated or the operating mode is changed.

In the Three Zone TemperatureWatch display, the Menu soft key label covers the Zone 3 label as shown (Figure 38, p. 45).

Figure 38. Three Zone TemperatureWatch Display

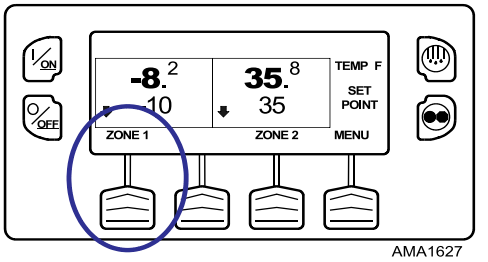


If the unit is operating in Cycle Sentry Mode, the Cycle Sentry icon will appear near Zone 2 as shown. If the unit is operating in Continuous Mode, the Cycle Sentry icon will not be present.

Changing the Setpoint

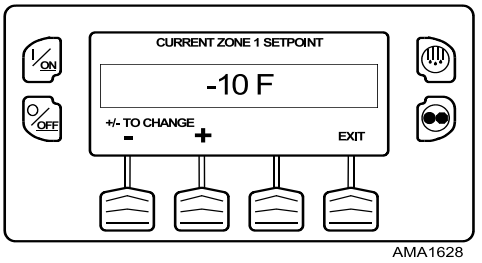
If the TemperatureWatch display is shown, press any soft key to return to the Standard Display. From the Standard Display, press the ZONE soft key for the desired zone. Zone 1 is shown (Figure 39, p. 45).

Figure 39. Zone 1



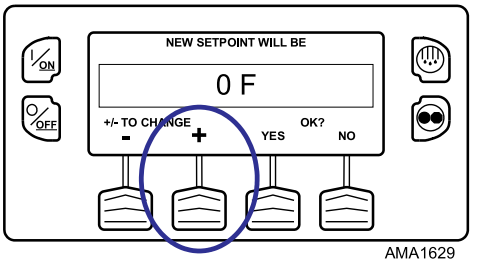
The setpoint display appears as shown (Figure 40, p. 46).

Figure 40. Setpoint Display



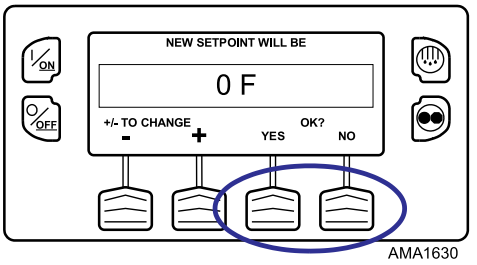
The "-" and "+" soft keys are used to increase or decrease the setpoint until the desired setpoint is shown. The setpoint has been changed to 0°F using the "+" soft key as shown (Figure 41, p. 46).

Figure 41. Setpoint Changed



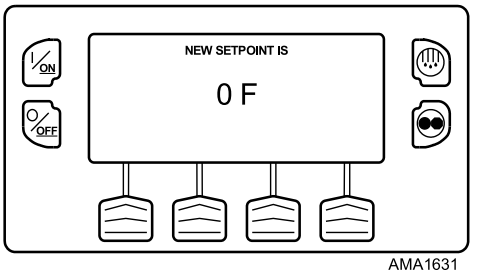
The YES and NO soft keys confirm the setpoint change (Figure 42, p. 46). When the desired setpoint has been selected using the "+" and/or "-" soft keys, press the YES soft key to confirm and load the new setpoint. If the setpoint is changed using the "+" or "-" soft keys, the change must be confirmed or rejected by pressing the YES or NO soft key within 10 seconds of changing the setpoint. A warning beep will sound after five seconds as a reminder. Failure to confirm the new setpoint by pressing YES or NO within 10 seconds of changing the setpoint will result in no setpoint change. If the setpoint is not confirmed, Alarm Code 127 Setpoint Not Entered is set, to indicate that the setpoint change was not completed.

Figure 42. YES and NO Keys



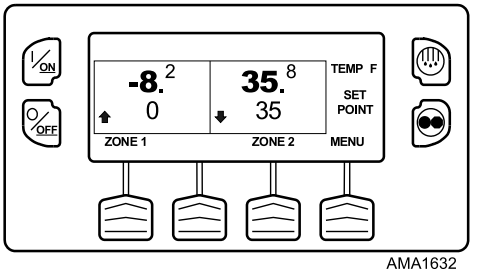
After the YES soft key has been pressed, the display will briefly show PROGRAMMING NEW SETPOINT - PLEASE WAIT. The display then confirms the new setpoint for two seconds (Figure 43, p. 46).

Figure 43. New Setpoint Confirmation



If the NO soft key is pressed, the display will briefly show SETPOINT NOT CHANGED and return to the Standard Display. The Standard Display will show the old setpoint.

Figure 44. Standard Display, New Setpoint



The display then returns to the Standard Display showing the new setpoint. The Zone 1 arrow now points up, to indicate that Zone 1 is heating.

Important: *If the setpoint is changed using the "+" or "-" soft keys, the change must be confirmed or rejected by pressing the YES or NO soft key within 10 seconds of changing the setpoint.*

- If the YES soft key is pressed, the setpoint change made with the "+" or "-" soft key is accepted, the setpoint changes, and the display returns to the Standard Display.
- If the NO soft key is pressed the setpoint change made with the "+" or "-" soft key is not accepted, the setpoint is not changed, and the display returns to the Setpoint Display.
- If the YES or NO soft key is not pressed within 10 seconds of making a change with the "+" or "-" soft key, the setpoint is not changed and the display returns to the Setpoint Display. The display briefly shows [SETPOINT NOT CHANGED] and Alarm Code 127 Setpoint Not Entered is set, to indicate that the setpoint change was started but not completed.

Turning a Zone On and Off

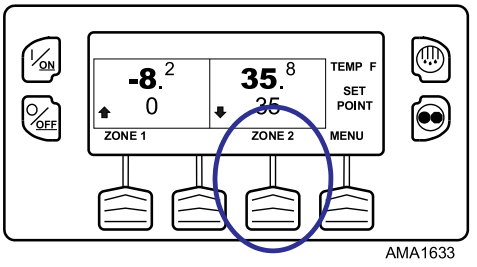
Zone 1 will always be turned on any time the unit is turned on. Zone 2 and Zone 3 (if present) can be turned on and off as desired.

The state of each zone is retained when the unit is turned off and on. For example, on a three zone unit if Zone 2 is turned off and Zone 3 is turned on and the unit is turned off, the zone states remain as they were. When the unit is turned back on Zone 2 will still be off and Zone 3 will still be on.

Note: *Units equipped with a remote control may operate in a slightly different manner. Refer to Rear Remote Control Panel (Optional) in the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788-2-OD) for additional details.*

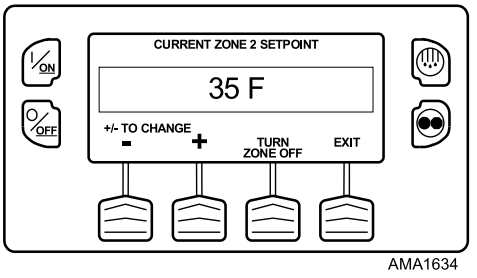
To turn Zone 2 or Zone 3 on or off, press the soft key under the desired zone. Zone 2 is selected (Figure 45, p. 47).

Figure 45. Zone 2 Selected



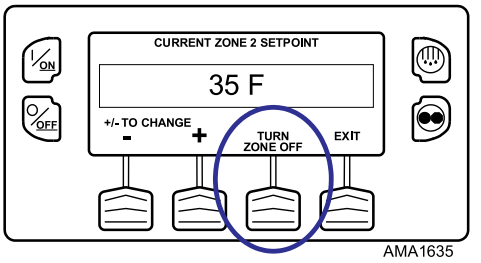
The Zone 2 setpoint display appears as shown (Figure 46, p. 47). If the zone is turned on, the third soft key will be labeled TURN ZONE OFF. If the zone is turned off, the third soft key will be labeled TURN ZONE ON. In this case TURN ZONE OFF is shown.

Figure 46. Zone 2 Setpoint Display



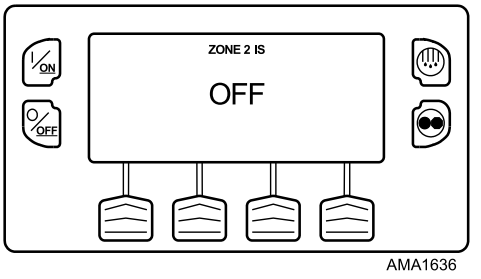
Press the TURN ZONE OFF soft key to turn the zone off (Figure 47, p. 47).

Figure 47. TURN ZONE OFF soft key



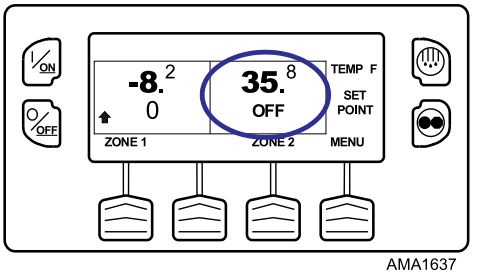
The display briefly shows PROGRAMMING ZONE ON/OFF - PLEASE WAIT. The display then confirms the new Zone 2 setting for several seconds (Figure 48, p. 47).

Figure 48. New Zone 2 Setting



The display returns to the Standard Display showing Zone 2 is off. The setpoint for Zone 2 has been replaced with OFF as shown (Figure 49, p. 47) to indicate that the zone is now off.

Figure 49. Zone Off



Starting the Diesel Engine

Diesel engine preheats and starts are automatic in both Continuous Mode and Cycle Sentry Mode. The engine will preheat and start as required when the unit is turned on. The engine preheat and start will be delayed in Cycle Sentry mode if there is no current need for the engine to run. If any keys are being pressed on the HMI Control Panel, the engine will not preheat and start until 10 seconds after the last key is pressed.

Note: *If the unit is equipped with optional Electric Standby there may be some additional prompts before the engine will start. Refer to "Starting the Electric Motor "for details.*

⚠ CAUTION

Risk of Injury!

The engine may start automatically any time the unit is turned on.

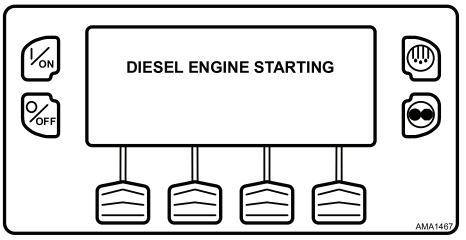
NOTICE

Equipment Damage!

Never use starting fluid. Damage to the engine can occur.

When the engine is preparing to start, the HMI Control Panel will display the engine start screen as shown (Figure 50, p. 48). The preheat buzzer sounds during the engine preheat and crank sequence.

Figure 50. Engine Start Screen



After the engine is started, the display returns to the Standard Display of temperature and setpoint.

Starting the Electric Motor

⚠ CAUTION

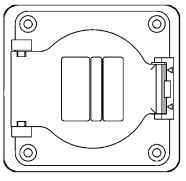
Risk of Injury!

The motor may start automatically any time the unit is turned on.

Note: *Units equipped with the SmartPower option only.*

Electric Power Receptacle: The electric power receptacle is used to connect the unit to an appropriate electric power source for electric standby operation (Figure 51, p. 48). The electric power receptacle is located next to the HMI Control Panel. Verify the unit and the power supply are turned off before connecting or disconnecting a power cord.

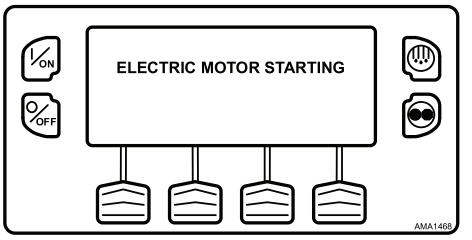
Figure 51. Electric Power Receptacle



Electric motor starting is automatic in both Continuous Mode and Cycle Sentry Mode. The motor will start as required when the unit is turned on. If any keys are being pressed on the HMI Control Panel prior to the motor start, the motor start will be delayed until 10 seconds after the last key is pressed.

When the motor is preparing to start, the HMI Control Panel will display the motor start screen (Figure 52, p. 48). The preheat buzzer sounds for 20 seconds before the electric motor starts.

Figure 52. Motor Start Screen



After the motor is started the display returns to the Standard Display of temperature and setpoint.

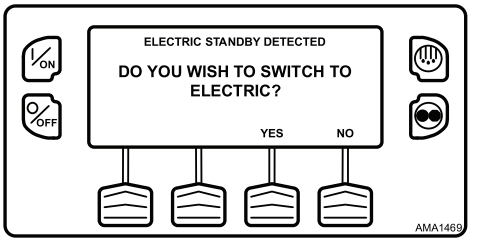
Switching from Diesel to Electric

Note: *Units equipped with the SmartPower option only.*

If the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set YES, the unit will automatically switch to Electric Mode operation when standby power is connected and available.

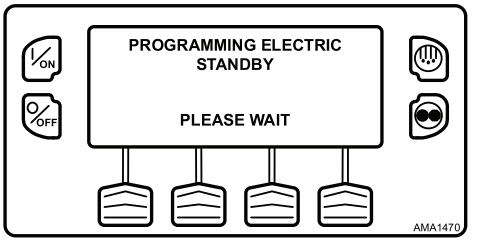
If the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set NO, the prompt screen (Figure 53, p. 48) will appear when standby power is connected and available.

Figure 53. Standby Power Connected



If NO is selected, the unit will continue to operate in Diesel Mode. If YES is selected, the display will briefly show the screen (Figure 54, p. 48).

Figure 54. YES Selected



Electric Mode operation will briefly be confirmed. If unit operation is required the electric motor will start as

shown previously under STARTING THE ELECTRIC MOTOR.

If the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set NO, the unit can also be switched from Diesel mode to Electric mode operation using the Electric Standby Selection from the Main Menu as shown later in this section.

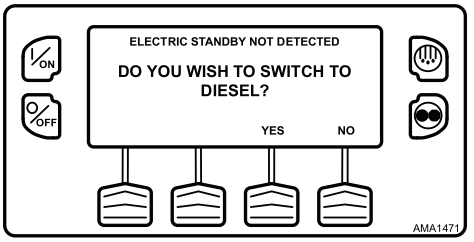
Switching from Electric to Diesel

Note: *Units equipped with the SmartPower option only.*

If the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set YES, the unit will automatically switch to Diesel Mode operation when standby power is turned off or is no longer available.

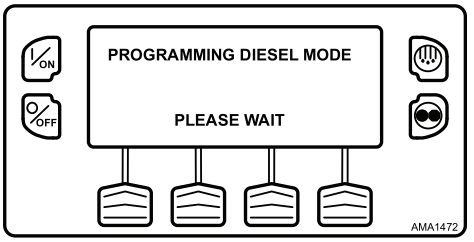
If the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set NO and standby power is disconnected or fails, the unit will not automatically switch to Diesel mode. This is primarily designed to prevent unauthorized diesel engine starts when the truck is indoors or on a ferry where engine operation is strictly prohibited. If the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set NO, the prompt screen (Figure 55, p. 49) will appear when standby power is turned off or is no longer available.

Figure 55. Standby Power is Off



If YES is selected, the display will briefly show the screen (Figure 56, p. 49).

Figure 56. Yes Selected



Diesel Mode operation will briefly be confirmed. If unit operation is required, the diesel engine will start as shown previously under “Starting the Diesel Engine”.

If the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set NO, the unit can also be switched from Diesel mode to Electric mode operation using the Diesel Selection from the Main Menu as shown later in this section.

Initiating a Manual Defrost Cycle

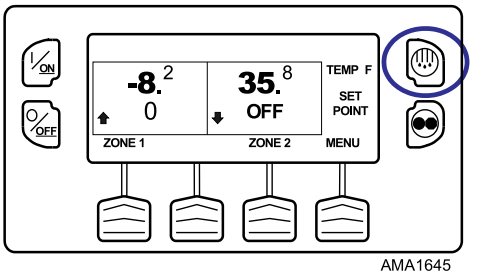
Defrost cycles are usually initiated automatically based on time or demand. Manual defrost is also available.

Manual defrost is only available if the zone is running and the zone evaporator coil temperature is less than or equal to 45°F (7°C). Other features such as door switch settings may not allow manual defrost under some conditions.

Note: *If the Rail Alternate feature is set YES, defrost is allowed with an evaporator coil temperature less than or equal to 55°F (13°C).*

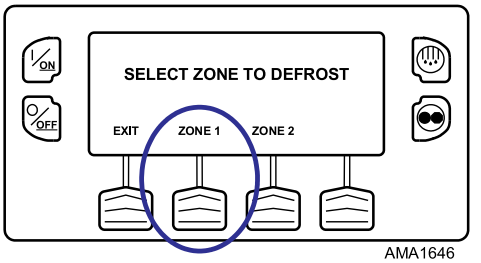
To initiate a manual defrost cycle, press the Defrost Key as shown (Figure 57, p. 49).

Figure 57. Defrost Key



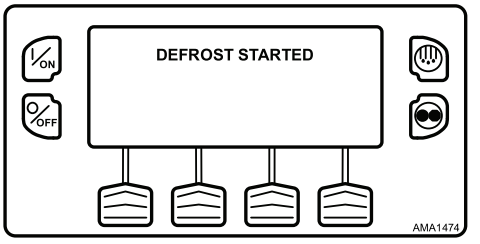
The display will briefly show [DEFROST]. Then the Zone Select display appears. Zone 1 selected is shown (Figure 58, p. 49).

Figure 58. Zone 1 Selected



The display briefly shows [DEFROST], [PROGRAMMING DEFROST - PLEASE WAIT] and then [DEFROST STARTED] (Figure 59, p. 49).

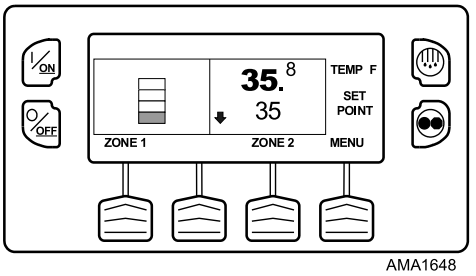
Figure 59. Defrost Started



The display then shows the Defrost display. The bar indicator shows approximately the percentage of time remaining to complete the defrost cycle. The bar

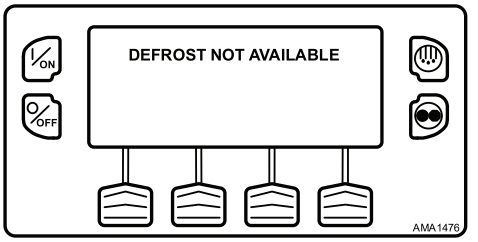
indicator (Figure 60, p. 50) shows that the Zone 1 defrost cycle is approximately 25% complete.

Figure 60. Bar Indicator



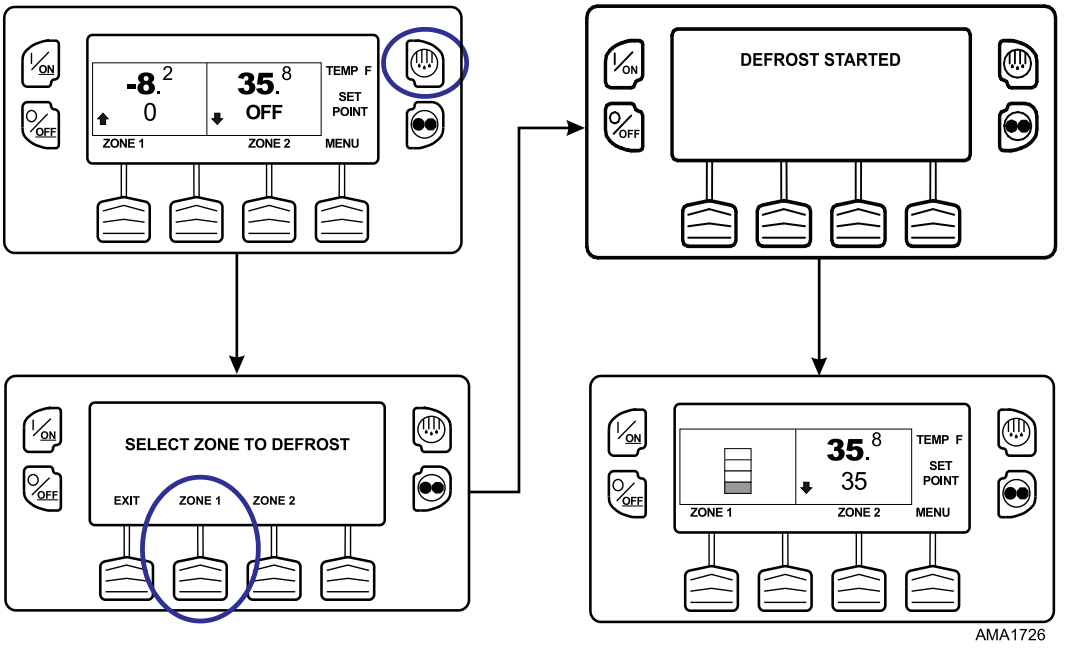
If conditions do not allow a defrost cycle, the display shown (Figure 61, p. 50) will briefly appear. The display will then return to the Standard Display.

Figure 61. Defrost Not Available



See summary of "Initiating a Manual Defrost Cycle" displays (Figure 62, p. 50).

Figure 62. Initiating a Manual Defrost Cycle



Terminating a Defrost Cycle

The defrost cycle terminates automatically when the coil temperature is greater than or equal to 58°F (14°C) or the defrost timer expires. Defrost can also be terminated by turning the unit off and back on.

Note: *If Rail Alternate is set YES, the defrost cycle terminates at 70°F (21°C) or if the defrost timer expires.*

Selecting Cycle Sentry or Continuous Mode

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. The Cycle Sentry/Continuous selection affects all zones.

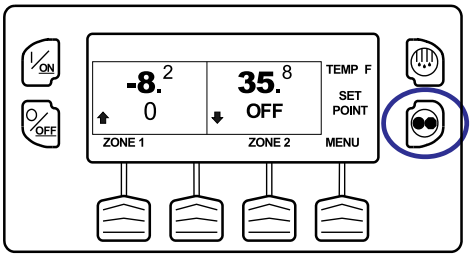
If the unit is operating in Cycle Sentry Mode, the Cycle Sentry Icon will appear in the display.

- The Cycle Sentry Icon appears in the upper right corner of the Standard Display (Figure 66, p. 51).
- The Cycle Sentry Icon appears in the lower right of the TemperatureWatch Display (Figure 67, p. 51).
- If the Cycle Sentry Icon is not shown, the unit is operating in Continuous Mode.

Note: *Cycle Sentry or Continuous Mode operation can also be selected from the Main Menu > Mode Menu.*

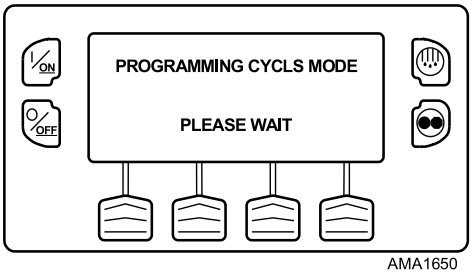
Cycle Sentry or Continuous Mode is selected by pressing the Cycle Sentry/Continuous Key (Figure 63, p. 51). The unit is currently operating in Continuous Mode as shown by the absence of the Cycle Sentry Icon.

Figure 63. Cycle Sentry/Continuous Key



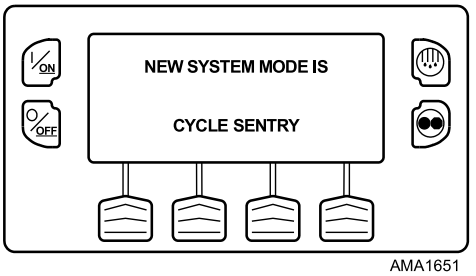
If the unit is operating in Continuous Mode, pressing the Cycle Sentry/Continuous Key changes the mode from Continuous Mode to Cycle Sentry Mode. The display confirms the change, as shown (Figure 64, p. 51).

Figure 64. Mode Change Confirmed



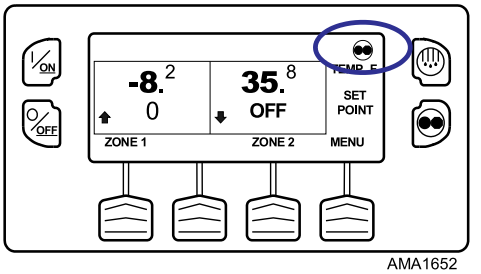
The new mode is confirmed for two seconds (Figure 65, p. 51).

Figure 65. Mode Confirmed



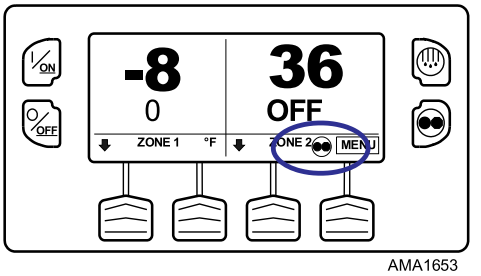
The display then returns to the Standard Display. In the example here, the unit is running in Cycle Sentry Mode as shown by the presence of the Cycle Sentry Icon at the upper right corner of the display (Figure 66, p. 51).

Figure 66. Cycle Sentry Icon, Upper Right Corner



When the TemperatureWatch Display is shown, the Cycle Sentry Icon appears in the lower right corner (Figure 67, p. 51).

Figure 67. Cycle Sentry Icon, Lower Right Corner

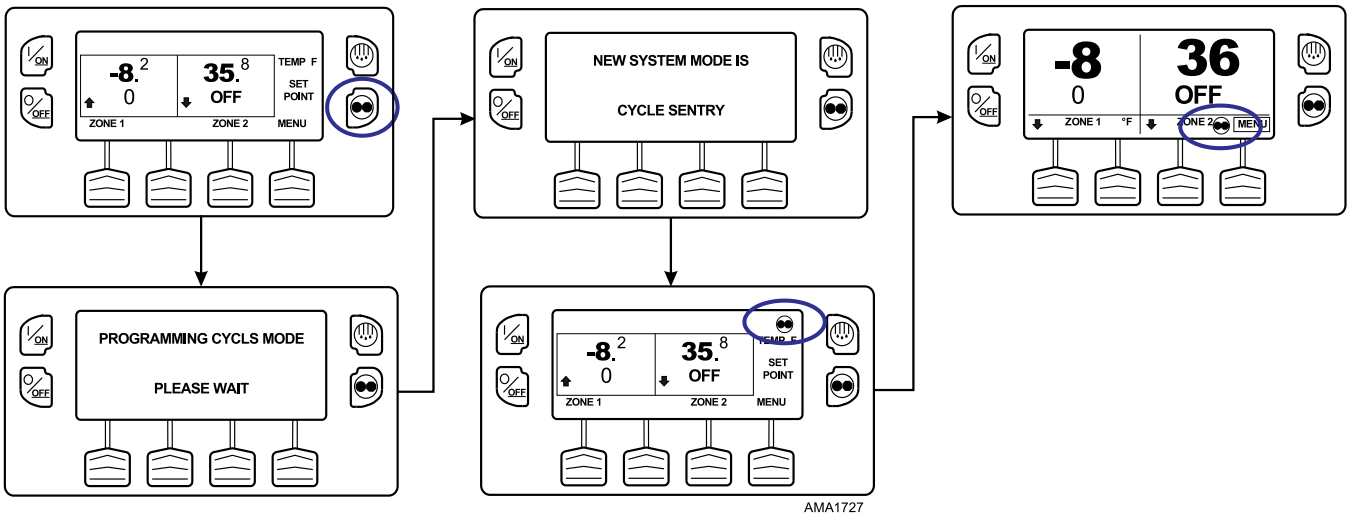


Pressing the Cycle Sentry/Continuous key again allows the operator to change back to Continuous Mode operation.

Important: *If the unit is in Cycle Sentry null and the mode is switched to Continuous Mode, the unit will start automatically.*

See summary of "Selecting Cycle Sentry or Continuous Mode" displays (Figure 68, p. 52).

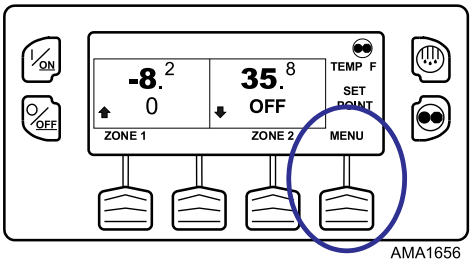
Figure 68. Selecting Cycle Sentry or Continuous Mode



Using the Main Menu

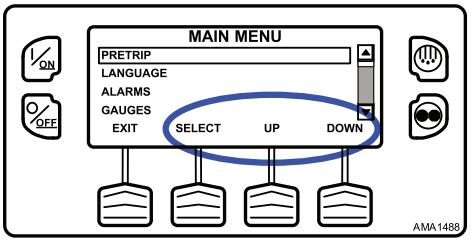
The Main Menu contains submenus that allow the operator to view information and modify unit operation. To access the Main Menu press the MENU soft key (Figure 69, p. 52).

Figure 69. MENU Soft Key



The first Main Menu choice will appear. Press and hold the UP and DOWN Keys to scroll thru the menu choices (Figure 70, p. 52). When the desired selection is shown on the display, press the SELECT Key to access it. The Pretrip Submenu is shown.

Figure 70. Pretrip Submenu



Main Menu Choices

Each of these Main Menu choices will be explained later in this section:

Pretrip: A Pretrip Test verifies unit operation.

Flash Drive: If a properly configured USB Flash Drive is currently connected to the USB Port on the unit Control Panel, the Flash Drive Menu will appear as a Main Menu selection.

Languages: If more than one language is enabled from the Guarded Access > Language Menu, this menu item will appear.

Alarms: The Alarm Menu allows the operator to view any active alarms, and allows most alarms to be cleared.

Gauges: The Gauges Menu allows the operator to view the unit gauges and I/O conditions.

Sensors: The Sensors Menu allows the operator to view the unit and CargoWatch Data Logger temperature sensors.

Data Logger (CargoWatch): The CargoWatch Data Logger is physically located in the HMI Control Panel. It can support up to 6 optional temperature sensors.

Hourmeters: The Hourmeters Menu allows the operator to view the unit hourmeters that have the view feature enabled in the Guarded Access menu.

Mode: The Mode Menu allows the operator to change the unit operating modes that have been enabled in Guarded Access.

Keypad Lockout: If enabled in Guarded Access > Main Menu Configuration, the keypad can be locked to prevent unauthorized use.

Start Sleep Mode: If this feature enabled in Guarded Access > Main Menu Configuration, the operator can select and set Sleep Mode from the Mode Menu.

SmartPower™ Electric Standby Option: The Diesel/Electric Standby selection from the Main Menu allows the operator to manually select diesel or electric mode operation on units equipped with the electric standby SmartPower option.

Adjust Brightness: The brightness of the HMI Control Panel display can be adjusted to allow for changing ambient light conditions.

Time: The Time and Date held by the HMI Control Panel can be checked. Time and Date cannot be changed from the Main Menu.

Clear All ECU Faults: Pressing this key will clear all existing Engine Control Unit (ECU) Fault Codes on applicable units with an ECU.

Fuel Usage: On unit's with an ECU, the engine provides fuel usage (fuel rate, total fuel used) information that can be used to give the operators fuel usage values for various scenarios and over specific durations.

Prime Fuel System: This function runs the fuel pump for up to five minutes to prime the fuel lines. Fuel priming is always shown on the HMI, but the functionality will only be available if the engine/electric motor is not running.

Flashload: The HMI will remind the user of a pending flashload at REB with the help of this screen.

Pretrip

Pretrip Test verifies unit operation. This display allows a Pretrip Test to be selected and initiated by the operator. If the Pretrip Test is entered with the unit not running, a Full Pretrip Test with device amp checks will be performed. If the Pretrip Test is entered with the unit running in either diesel or electric mode a Running Pretrip Test is performed. Test results are reported as PASS, CHECK, or FAIL when the Pretrip Test is completed.

Pretrip Test Conditions

- Current unit settings are saved and restored at the end of the Pretrip Test or if the unit is turned off and back on.
- Pretrip Test can be run in either Diesel or Electric Mode.
- The unit will auto switch from Diesel Mode to Electric Mode or from Electric Mode to Diesel Mode during a Pretrip Test if these features are enabled and the auto switch conditions occur.

Conditions Where Pretrip Tests Are Not Allowed

- If any shutdown alarms are present. Pretrip tests are allowed with some Check and Log alarms.
- If the unit is in Sleep Mode.
- If the unit is in Service Test Mode, Output Test Mode, or Evacuation Mode.

Pretrip Test Considerations

When performing a Pretrip Test, the following issues should be considered:

- If running a Pretrip Test on a trailer loaded with dry cargo, insure that proper airflow can occur around the load. If the load restricts airflow, false test results may occur. Also, these units have high refrigeration capacity which results in rapid temperature changes. Sensitive dry cargo may be damaged as a result.
- If running a Pretrip Test on a trailer that has just been washed down, the extremely high humidity inside the trailer may result in false test results.
- If running a Pretrip Test on a trailer loaded with sensitive cargo, monitor the load temperature during the test as normal temperature control is suspended during pre-trip operation.
- Always perform Pretrip Tests with the trailer cargo doors closed to prevent false test failures.

Pretrip Test Sequence

Pretrip tests proceed in the order shown below. A Full Pretrip Test is started with the engine or motor not running and includes all tests. A Running Pretrip Test is started with the engine or motor running and does not include the Amp Checks or Engine Start Check.

- **Amp Checks:** Each electrical control component is energized and the current drawn is confirmed as within specification.
- **Engine Start:** The engine will start automatically.
- **Defrost:** If the coil temperature is below 45 F (7 C), a defrost cycle is initiated.
- **RPM Check:** The engine RPM in high and low speed is checked during the Cool Check.
- **Zone 1 Cool Check:** The ability of the unit to cool in low speed is checked.
- **Zone 1 Heat Check:** The ability of the unit to heat in low speed is checked.
- **Zone 1 Return to Cool Check:** The ability of the unit to return to cool mode is checked.
- **Zone 2 Cool Check:** The ability of the unit to cool in low speed is checked.
- **Zone 2 Heat Check:** The ability of the unit to heat in low speed is checked.
- **Zone 2 Return to Cool Check:** The ability of the unit to return to cool mode is checked.
- **Zone 3 Cool Check:** The ability of the unit to cool in low speed is checked.
- **Zone 3 Heat Check:** The ability of the unit to heat in low speed is checked.
- **Zone 3 Return to Cool Check:** The ability of the unit to return to cool mode is checked.
- **Report Test Results:** The test results are reported as PASS, CHECK, or FAIL when the Pretrip Test is completed. If test results are CHECK or FAIL, alarm codes will exist to direct the technician to the source of the problem.

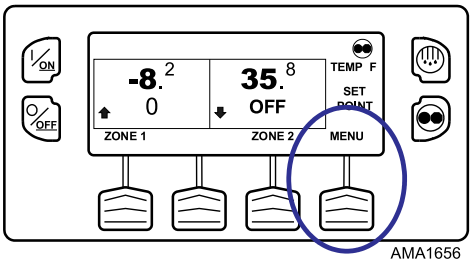
Performing a Pretrip Test

If a Pretrip Test is initiated with the engine shut down, a Full Pretrip Test will be performed. If a Pretrip Test is initiated with the engine or motor running, a Running Pretrip Test is performed.

- Before initiating a Pretrip Test, clear all alarm codes.
- To stop a Pretrip Test at any time, turn the unit off.

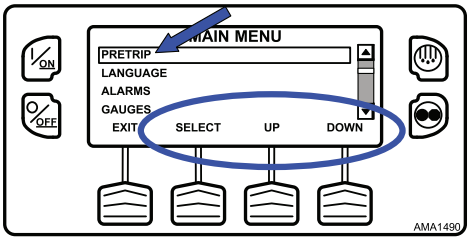
Pretrip Tests are initiated using the Pretrip Menu. From the Standard Display, press the MENU Key (Figure 71, p. 54).

Figure 71. MENU Key



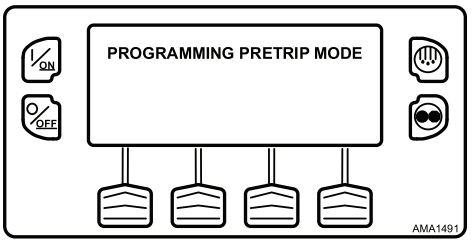
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Pretrip Menu. When the Pretrip Menu is shown press the SELECT Key to start a Pretrip Test (Figure 72, p. 54).

Figure 72. Select Key



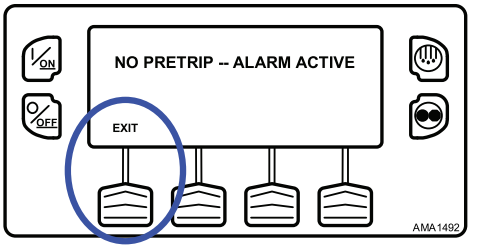
The display will briefly show PROGRAMMING PRETRIP MODE (Figure 73, p. 54). If the unit is not running, a Full Pretrip Test will be initiated. If the unit is running in either diesel or electric mode, a Running Pretrip Test will be performed.

Figure 73. Programming Trip Mode



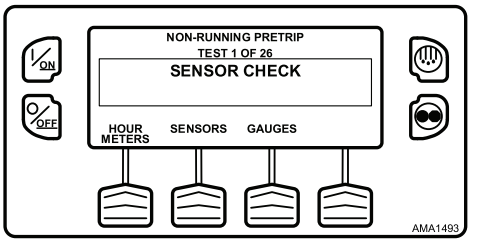
If all alarms were not cleared, a prompt appears (Figure 74, p. 54). Exit the Pretrip Test, clear all alarms, and repeat the Pretrip Test.

Figure 74. Alarms Not Cleared



If all alarms were cleared, the Pretrip Test display appears (Figure 75, p. 54).

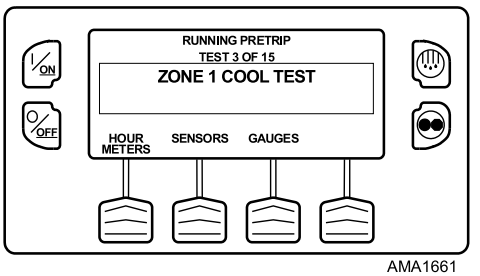
Figure 75. Pretrip Test



- The top line of the display indicates the unit is performing the non-running portion of the Pretrip Test.
- The second line measures test progress. The number of tests completed of the total number of tests to be performed is shown. In the example above, the unit is performing Test 1 of 26, Sensor Check.
- The soft keys may be used during the Pretrip Test to select the Hourmeter, Gauge, or Sensor menus.
- To stop a Pretrip Test at any time turn the unit off. This will generate Alarm Code 28 Pretrip Abort. Other alarm codes may also be generated. This is normal when the Pretrip Test is halted before completion.

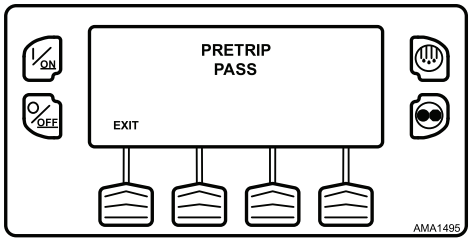
When the non-running tests are complete, the unit will start automatically and continue with the Running Pretrip Test. In the example shown (Figure 76, p. 54) the unit is in the Running Pretrip and is performing Test 3 of 15, Cool Test.

Figure 76. Cool Test



When all tests are complete, the results are reported as PASS, CHECK, or FAIL (Figure 77, p. 55). If the results are CHECK or FAIL, the accompanying alarm codes will direct the technician to the cause of the problem.

Figure 77. Pretrip Pass



If the Pretrip Test results are CHECK or FAIL, the problem should be diagnosed and corrected by a Thermo King service technician before the unit is released for service.

To return to the Main Menu, press the EXIT Key. To return to the Standard display press the EXIT Key again.

See summary of "Performing a Pretrip Test" displays (Figure 78, p. 55) and (Figure 79, p. 55).

Figure 78. Performing a Pretrip Test (1)

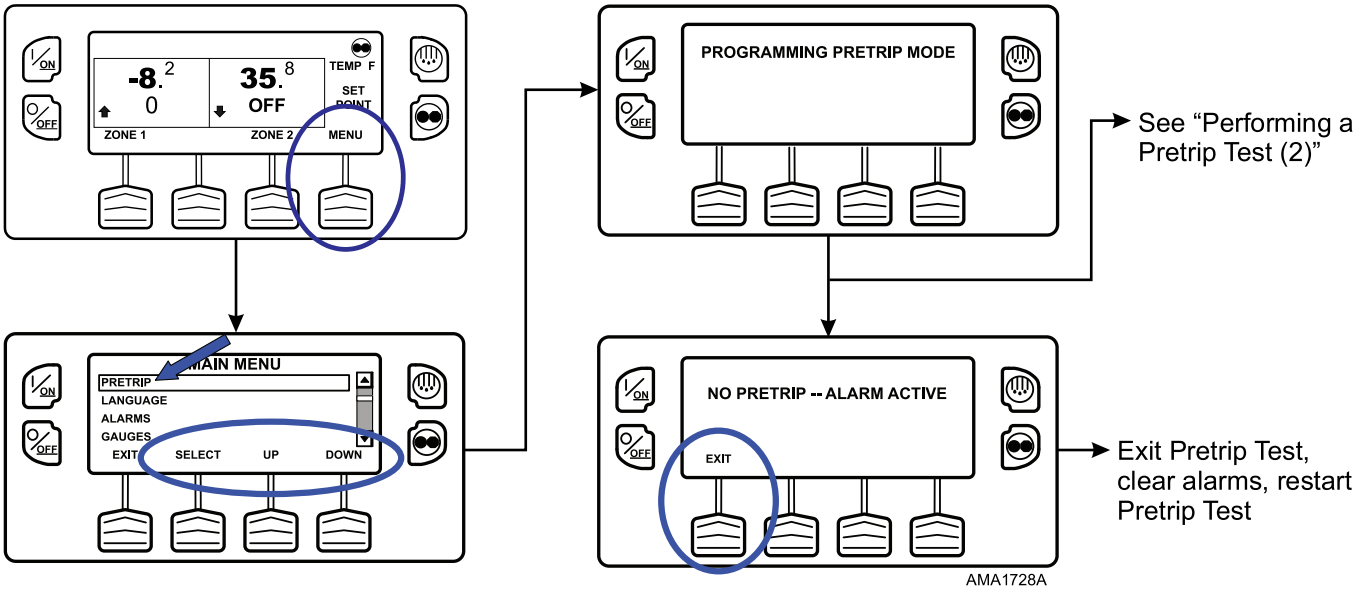
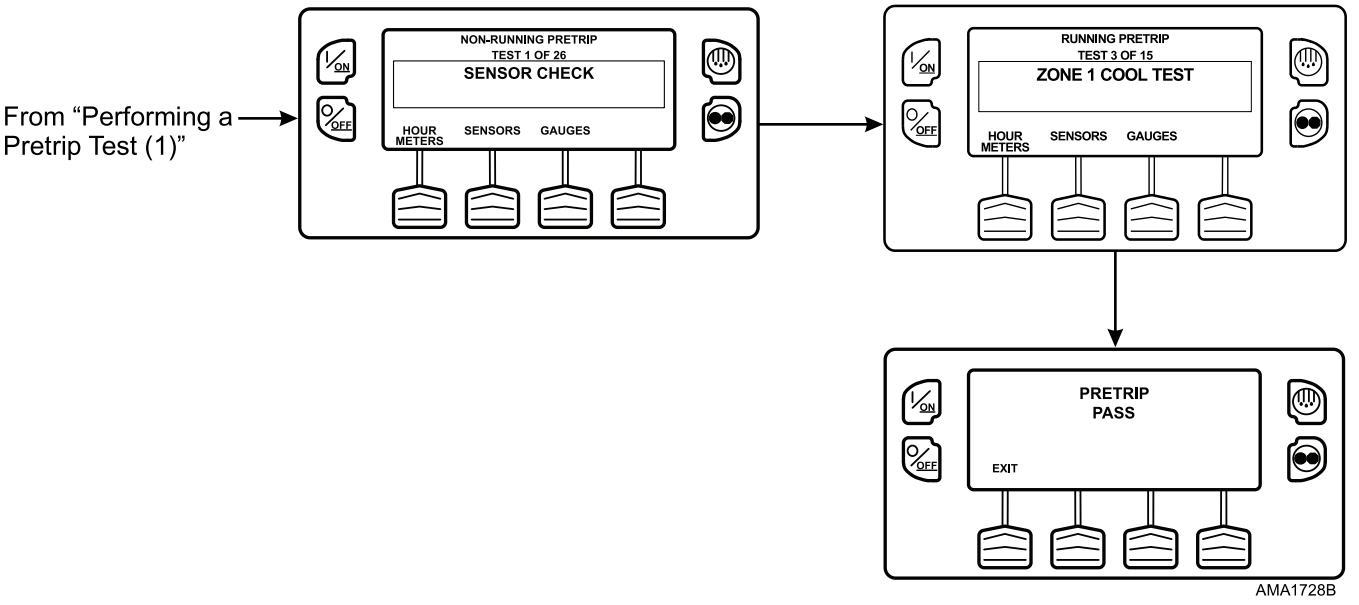


Figure 79. Performing a Pretrip Test (2)



Flash Drive

If a properly configured USB Flash Drive is currently connected to the USB Port on the unit Control Panel, the Flash Drive Menu will appear as a Main Menu selection. If a properly configured USB Flash Drive is connected to the USB Flash Drive connector, this feature allows the operator to select the desired Flash Drive function. If enabled when the Flash Drive was configured, the following functions may be available:

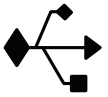
Download

- Download the ServiceWatch Data Logger
- Download the CargoWatch Data Logger

Flashload

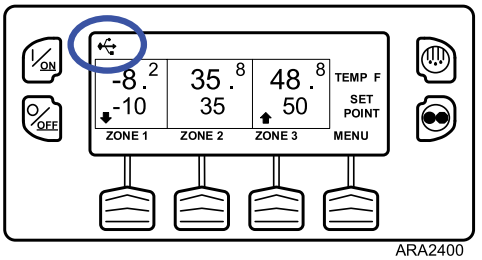
- Flash load Base Controller Software
- Flash load HMI Control Panel Software

Flash Drive Icon



- The USB Icon (Figure 80, p. 56) will appear in the upper left corner of the display as shown below when a USB Flash Drive is inserted in the USB Flash Drive USB Port on the Unit Control Panel.
- The USB Icon will also appear if a computer is connected to the USB PC USB Port on the Unit Control Panel or inside the control box.

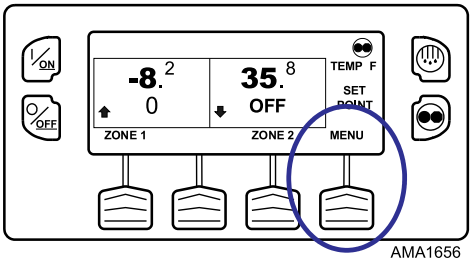
Figure 80. Flash Drive Icon



Selecting the Flash Drive Menu from the Main Menu (If Already Connected)

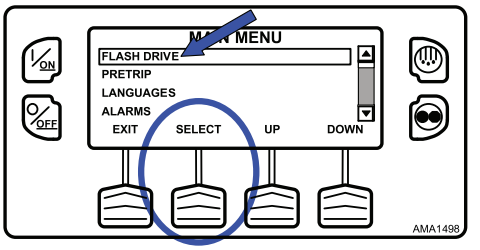
To select the Flash Drive Menu, press the MENU Key (Figure 81, p. 56). The Main Menu will appear.

Figure 81. Menu Key



If a properly configured USB Flash Drive is connected to the Flash Drive Only USB Port on the Control Panel, the Flash Drive Menu will appear as a main Menu selection. Press the UP or DOWN Key as required to choose the Flash Drive Menu. When the Flash Drive Menu is shown, press the SELECT Key to select the Flash Drive Menu (Figure 82, p. 56).

Figure 82. Flash Drive Menu



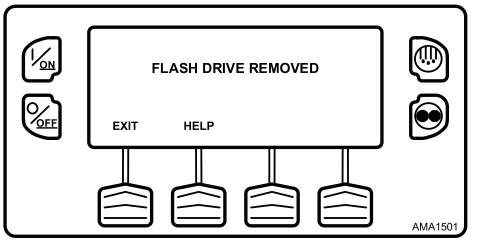
Flash Drive (If Connected While the Unit is Turned On)

If a properly configured USB Flash Drive is connected to the USB Port on the unit Control Panel while the unit is turned on, a Flash Drive indication will appear for several seconds and the Flash Drive Menu will be shown.

Removing the Flash Drive

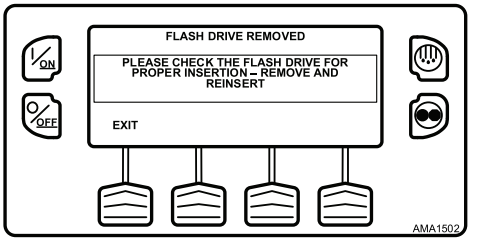
If the Flash Drive is disconnected, the display shown (Figure 83, p. 56) will appear for 30 seconds and the display will return to the Standard Display. To return to the Standard Display, immediately press the EXIT Soft Key.

Figure 83. Flash Drive Removed



If the HELP Soft Key is pressed, the display shown (Figure 84, p. 56) will appear.

Figure 84. Help Soft Key Pressed



Languages

If more than one language is enabled from the Guarded Access > Language Menu, this menu item will appear. If only one language is enabled, this menu will not appear. The Language Menu allows the operator to select a language from a list of up to four enabled languages. All subsequent displays are shown in the selected language. English is the default language. Refer to the Language Setup Menu in Section 3 of the SR-4 Trailer M/T Diagnostic Manual (TK 55788-2) for details.

If Languages are not enabled from the Guarded Access Menu, this feature will not appear in the Main Menu.

Important: *Exercise care when changing languages. Once changed, all HMI Control Panel displays will be in the new language.*

Available Languages

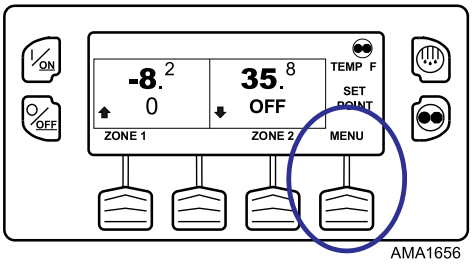
The following languages are available:

English French Spanish Portuguese

Selecting an Alternate Language

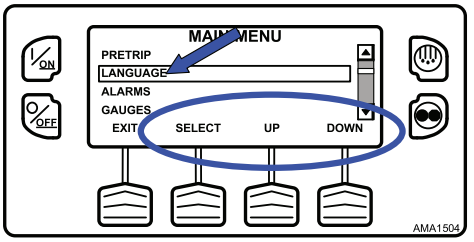
To select an alternate language, press the MENU Key (Figure 85, p. 57).

Figure 85. Menu Key



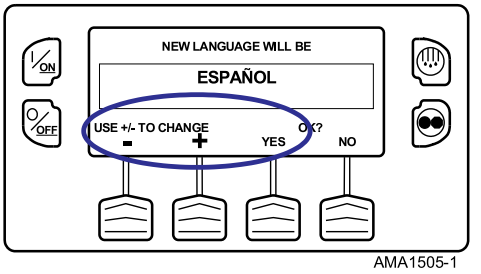
The Main Menu will appear. If more than one language is enabled, the Language Menu will appear as a Main Menu selection (Figure 86, p. 57). Press the UP or DOWN Key as required to choose the Language Menu. When the Language Menu is shown press the SELECT Key to select the Language Menu.

Figure 86. Main Menu



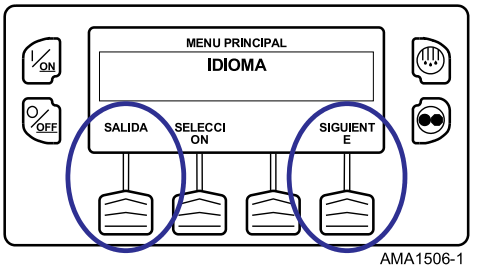
The Language Menu will appear as shown (Figure 87, p. 57). Press the + or - Keys to select the desired language. Only languages enabled from the Guarded Access Menu are available. When the desired language is shown, press the YES Key to confirm the choice.

Figure 87. Language Menu



The display will briefly show PROGRAMMING LANGUAGE - PLEASE WAIT in the new language. The display will then return to the Language Menu, but will show the new language. Spanish is shown in the example (Figure 88, p. 57).

Figure 88. New Language (Example: Spanish)



Repeat the process to select a different language. To select a different Main Menu item, press the NEXT (SIGUIENTE) Key. To return to the Standard Display, press the EXIT (SALIDA) Key. All displays will now be in the new language. Español (Spanish) is shown in the example (Figure 89, p. 57).

See summary of "Languages (If Enabled)" displays (Figure 90, p. 58).

Figure 89. Spanish (Example)

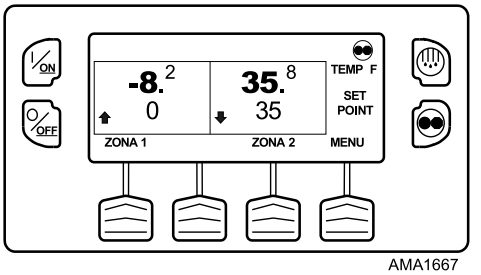
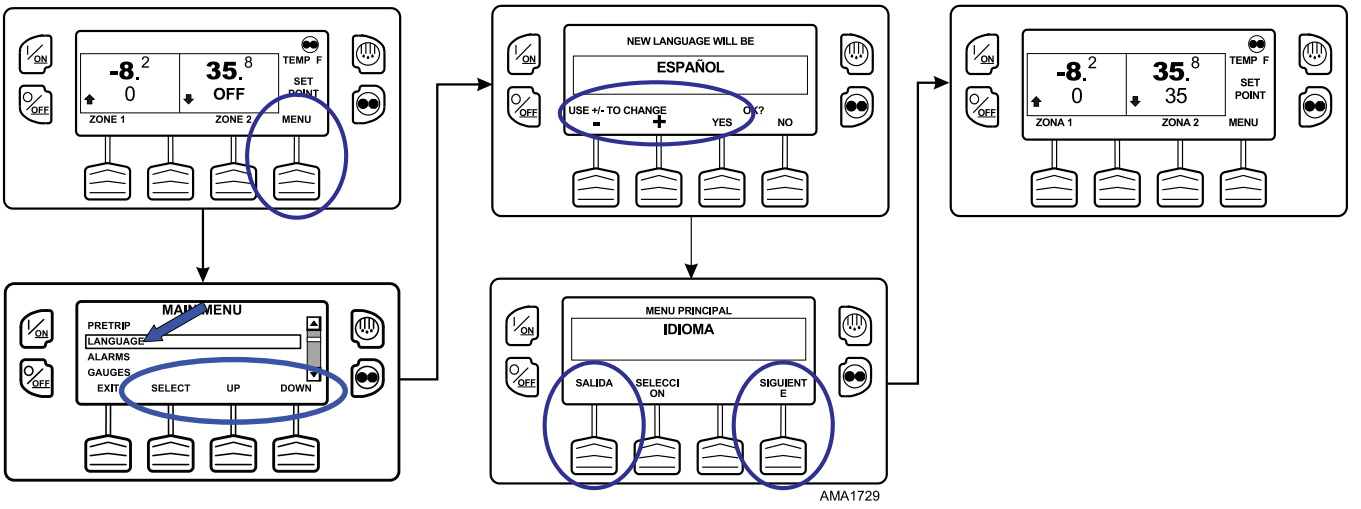


Figure 90. Languages (If Enabled)



Language Menu Quick Access

Should it be necessary at any time to change to English or any other installed language, return to the Standard Display and then press and hold the first and last soft keys for five seconds as shown below. The Standard Display shown (Figure 91, p. 58) is Español (Spanish).

After five seconds, the Language Menu will appear in the current language as shown (Figure 92, p. 58). Press the + or - Keys to select the desired language. When the desired language is shown, press the SI (YES) Key to confirm the choice.

Figure 91. First, Last Keys

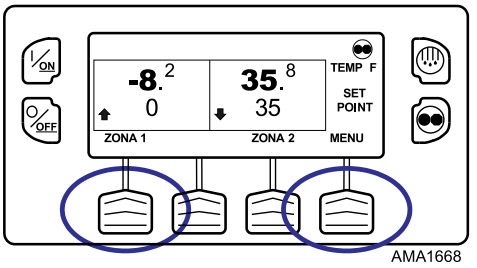
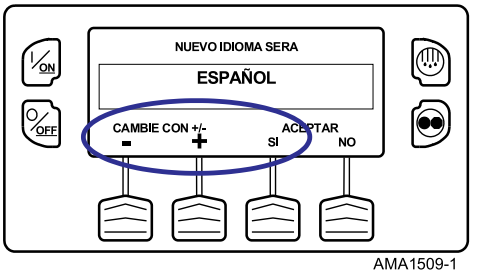


Figure 92. Select Desired Language



Note: *All languages in the installed software can be selected using this method.*

Alarms

The Alarms Menu allows the operator to view all alarms and clear most alarms. Refer to Section 5 of the SR-4 Trailer Multi-Temperature Diagnostic Manual for more information about alarm codes and their diagnosis.

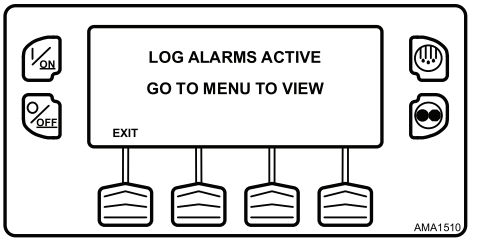
Log Alarm

Log Alarms are indicated for 30 seconds each time the unit is turned on. This level of alarm serves as a notice to take corrective action before a problem becomes severe. Maintenance items such as maintenance hourmeter time-outs are log alarms. The TemperatureWatch screen is not disabled if only log alarm(s) are active.

When the unit is turned on, the display will show the Thermo King Logo and then the “Configuring System” message. If Log Alarm(s) are present, the Log Alarm notice will appear on the display for 30 seconds as shown (Figure 93, p. 58). The remote indicator alarm light (if installed) will also be on during this period. After 30 seconds, the Standard Display will appear and the remote indicator alarm light will go off.

Note: *The Alarm Icon does not appear on startup with log alarms present.*

Figure 93. Log Alarm Notice



Note: *If required, an engine start may occur while the display above is shown. This is normal operation.*

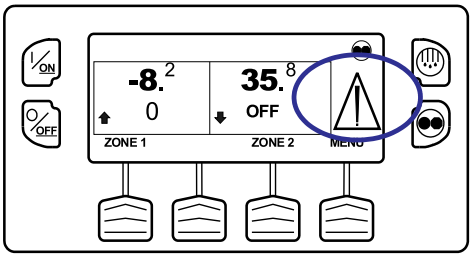
Check Alarm

Check Alarms are indicated by a steady alarm icon at the side of the display. If the alarm is specific to a zone, a smaller alarm icon will appear next to the affected zone. This level of alarm serves as a notice to take corrective action before a problem becomes severe. The unit will run with Check Alarms but some features and functions may be inhibited. The TemperatureWatch screen is disabled if a Check Alarm is active.

Unit Level Check Alarm

If the alarm pertains to the entire system (not an individual zone, e.g, Alarm Code 10), the alarm icon will appear at the right side of the display as shown (Figure 94, p. 59). Both Zone Specific and Unit Specific Alarms can exist at the same time.

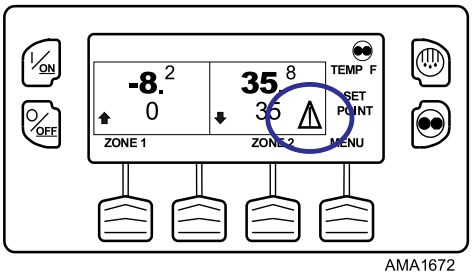
Figure 94. Alarm Icon



Zone Level Check Alarm

If the alarm is zone specific, the Alarm Icon will appear in the offending zone as shown (Figure 95, p. 59). In the example, an alarm exists in Zone 2.

Figure 95. Alarm for Zone 2



Unit Level Prevent Alarm

Unit Level Prevent Alarms are also indicated by a steady alarm icon at the side of the display. The unit will be temporarily shut down if a Prevent Alarm is active. The unit will remain shut down for a timed restart interval or until the fault conditions are corrected and then restart. If the unit is in a temporary shutdown, Alarm Code 84 Restart Null will be present along with the associated Prevent Alarm. In most cases, the unit will restart with reduced performance to determine if continued operation is possible. If the alarm does not reoccur, the unit will then return to full performance. If the unit is operating with reduced performance, Alarm Code 85 Forced Unit Operation may also be present under some conditions. In general, if the alarm condition reoccurs a defined number of times, the alarm is set as a Shutdown Alarm and no further restarts are possible. The TemperatureWatch screen is disabled if a Unit Level Prevent Alarm is active.

Note: *If the Restart After Shutdown feature in the Guarded Access Menu is set for CONTINUOUS, an unlimited number of restart attempts are allowed.*

Zone Level Prevent Alarm

A Zone Level Prevent Alarm will force the affected zone into a temporary shutdown, but allow the unit to continue to run as required by the host unit or other zones. A small alarm icon will appear next to the affected zone. If zone Prevent Alarms occur in all zones, the unit will be forced into a unit level Prevent Shutdown. The TemperatureWatch screen is disabled if a Zone Level Prevent Alarm is active.

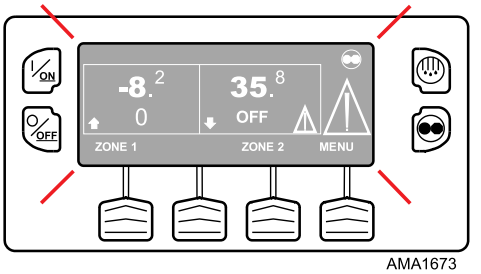
Shutdown Alarm

If a Shutdown Alarm occurs while the unit is running, it will be indicated by all of the following (Figure 96, p. 59):

- The Alarm Icon will appear.
- The display, backlight, and optional remote alarm light will flash on and off.
- The display will alternate from normal to inverted and back (light areas become dark and dark areas become light).

Shutdown Alarms will force the unit into shutdown. The unit will remain in shutdown until the Shutdown Alarm is manually cleared. Exceptions are some engine and electric Shutdown Alarms that become Log Alarms when switched to the alternate operating mode (diesel to electric or electric to diesel). The TemperatureWatch screen is disabled if a unit level Shutdown Alarm is active.

Figure 96. Shutdown Alarm Screen



Unit Level Shutdown Alarm

Unit Level Shutdown Alarms will force the unit into shutdown. The unit will remain in shutdown until the Shutdown Alarm is manually cleared. Exceptions are

some engine and electric Shutdown Alarms that become Log Alarms when switched to the alternate operating mode (diesel to electric or electric to diesel). The TemperatureWatch screen is disabled if a Unit Level Shutdown Alarm is active.

Zone Level Shutdown Alarm

A zone Shutdown Alarm will force the affected zone to shutdown, but allow the unit to continue to run as required by the host unit or other zones. A small alarm icon will appear next to the affected zone and blink with a period of half second on - half second off. If zone Shutdown Alarms occur in all zones, the unit will shut down and Alarm Code 114 Multiple Alarms - Can Not Run will be set.

Pretrip Alarm

If an alarm occurs during a Pretrip Test, the alarm code will be displayed as Pretrip Alarm XX, where XX is the alarm code.

Zone Off Alarm

If the host unit is turned on, zone conditions are monitored even if the zone is turned off. For example, temperature sensor Alarm Codes 02, 03, and 04 can be set for a zone even when that zone is turned off.

Low Battery Voltage

If Alarm Code 61 Low Battery Voltage is set as a Shutdown Alarm, no subsequent alarm codes will be set with the exception of Alarm Code 28 Pretrip Abort.

Alarm Codes When Switching Between Diesel and Electric

If a shutdown alarm occurs that affects only diesel mode operation and the unit is switched to electric, the diesel mode shutdown alarm becomes an electric mode log alarm. This allows the unit to run in electric mode without clearing the shutdown alarm that is preventing diesel mode operation. If the unit is switched back to diesel mode, the alarm again become a diesel mode shutdown alarm and prevents unit operation.

In the same manner, if a shutdown alarm occurs that affects only electric mode operation and the unit is switched to diesel, the electric mode shutdown alarm becomes a diesel mode log alarm to allow diesel mode operation. If the unit is switched back to electric mode, the alarm reverts to an electric mode shutdown alarm and prevents unit operation. If the unit is configured for electric to diesel Auto-Switch, it automatically starts and runs in diesel mode if an electric shutdown occurs.

Clearing Alarm Codes

Most alarm codes can be cleared conventionally from the Alarm Menu using the CLEAR Key.

The following control and display sensor alarm codes can only be cleared from the Guarded Access Menu:

- Alarm Code 03 Check Control Return Air Sensor
- Alarm Code 04 Check Control Discharge Air Sensor
- Alarm Code 74 Controller Reset to Defaults.

The following alarm codes clear automatically:

- Alarm Code 64 Pretrip Reminder - Clears when a Pretrip Test is performed.
- Alarm Code 84 Restart Null - Clears when the unit is no longer in a restart null due to a Prevent Alarm.
- Alarm Code 85 Forced Unit Operation - Clears when the unit is no longer running in a forced mode due to a Prevent Alarm.
- Alarm Code 91 Check Electric Ready Input - Clears automatically when electric power is restored.
- Alarm Code 92 Sensor Grades Not Set - Clears when the sensor grade is changed from 5H.

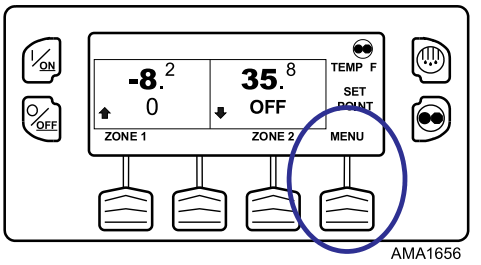
If the Limited Alarm Restarts feature is enabled, the following additional alarm codes may only be cleared from the Guarded Access Menu. If this is the case, the CLEAR soft key will not appear if the alarms are displayed from the Main Menu or the Maintenance Menu.

- Alarm Code 10 High Discharge Pressure
- Alarm Code 23 Cooling Cycle Fault
- Alarm Code 24 Heating Cycle Fault
- Alarm Code 32 Refrigeration Capacity Low

Displaying and Clearing Alarm Codes

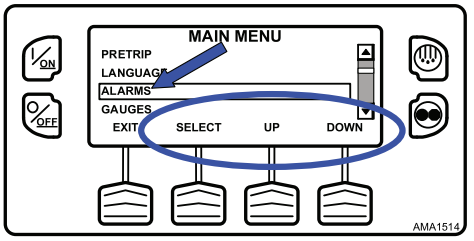
Alarms are displayed and cleared using the Alarm Menu. From the Standard Display, press the MENU Key (Figure 97, p. 60).

Figure 97. Menu Key



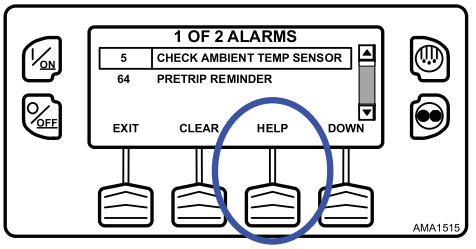
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Alarms Menu (Figure 98, p. 61). When the Alarms Menu is shown, press the SELECT Key to select the Alarms Menu.

Figure 98. Up/Down, Select Keys



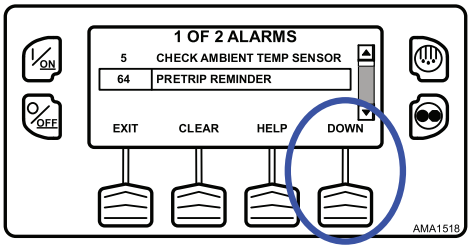
The number of alarms (if more than one) and a list of the alarms with the most recent alarm first will be shown. In the example shown (Figure 99, p. 61), there are two alarms. The most recent is Alarm Code 5 Check Ambient Temp Sensor.

Figure 99. Alarms Menu



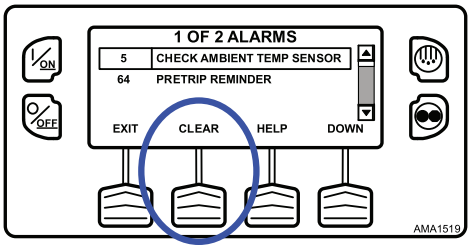
If necessary to view all alarms, scroll down using the DOWN Key (Figure 100, p. 61).

Figure 100. Down Key



If the alarm situation has been resolved, press the CLEAR Key to clear the alarm (Figure 101, p. 61).

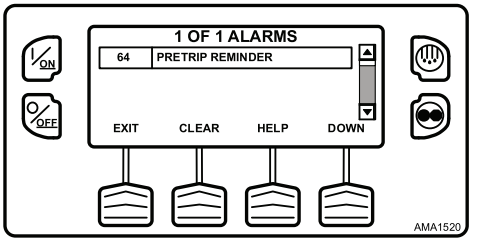
Figure 101. Clear Key



The display will briefly show CLEARING ALARM 5 – PLEASE WAIT and the Alarm Menu will reappear (Figure 102, p. 61).

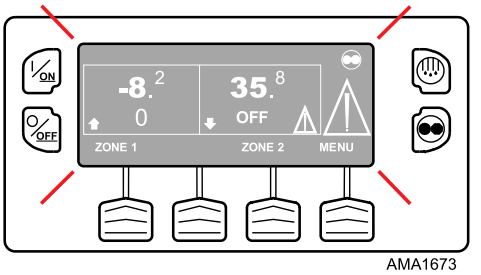
Alarm Code 64 Pretrip Reminder cannot be cleared using the CLEAR Key. This alarm will clear automatically when a Pretrip Test is run.

Figure 102. Pretrip Reminder



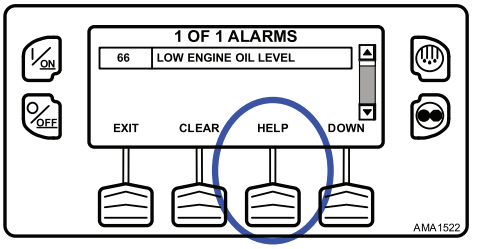
If a serious condition occurs, the unit will be shut down to prevent damage to the unit or the load. If this occurs, the Alarm Icon will appear, the display and backlight will flash on and off (Figure 103, p. 61).

Figure 103. Alarm Screen



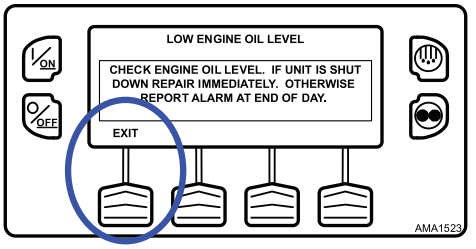
The Alarm Menu display will display the Shutdown Alarm Code. For additional information regarding the alarm shown on the display, press the HELP Key (Figure 104, p. 61).

Figure 104. Help Key



A help message will appear. Press the EXIT Key to return to the Alarms Menu (Figure 105, p. 62). Check the oil level and add oil as required, clear the alarm and restart the engine.

Figure 105. Exit Key



To return to the Main Menu press the EXIT Key. To return to the Standard display press the EXIT Key again.

Important Alarm Notes

- If an alarm will not clear, the condition may still exist. If the alarm is not corrected, it will not clear or may be immediately set again.
- If an alarm cannot be cleared from the Main menu, the Clear Key will not appear. These alarms must be cleared from the Maintenance or Guarded Access Menus.

See summary of “Displaying and Clearing Alarm Codes” displays (Figure 106, p. 62) (Figure 107, p. 62).

Figure 106. Displaying and Clearing Alarm Codes (1)

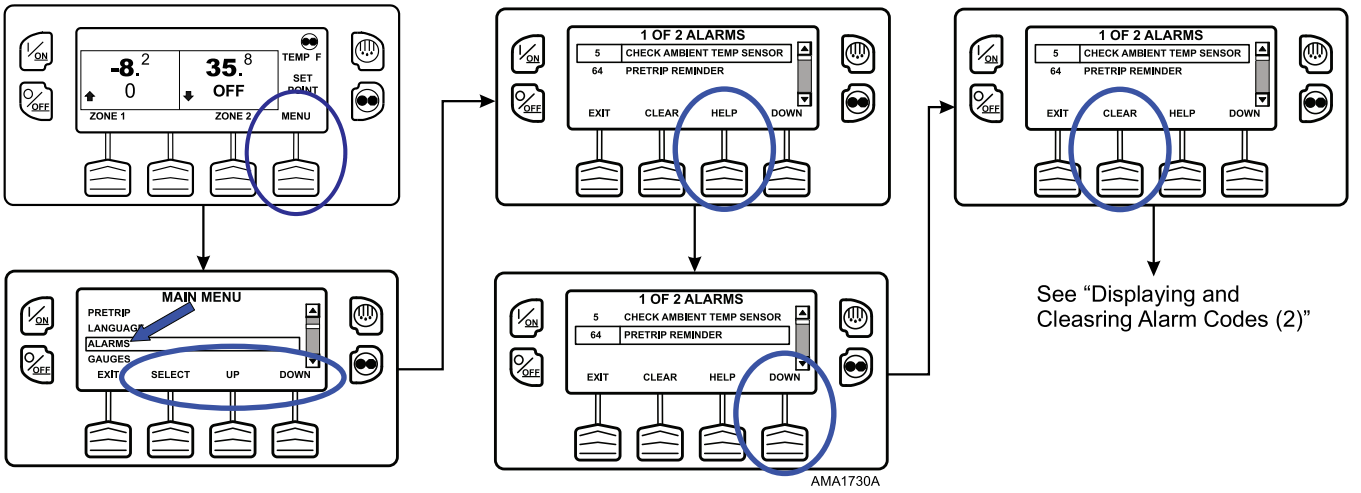
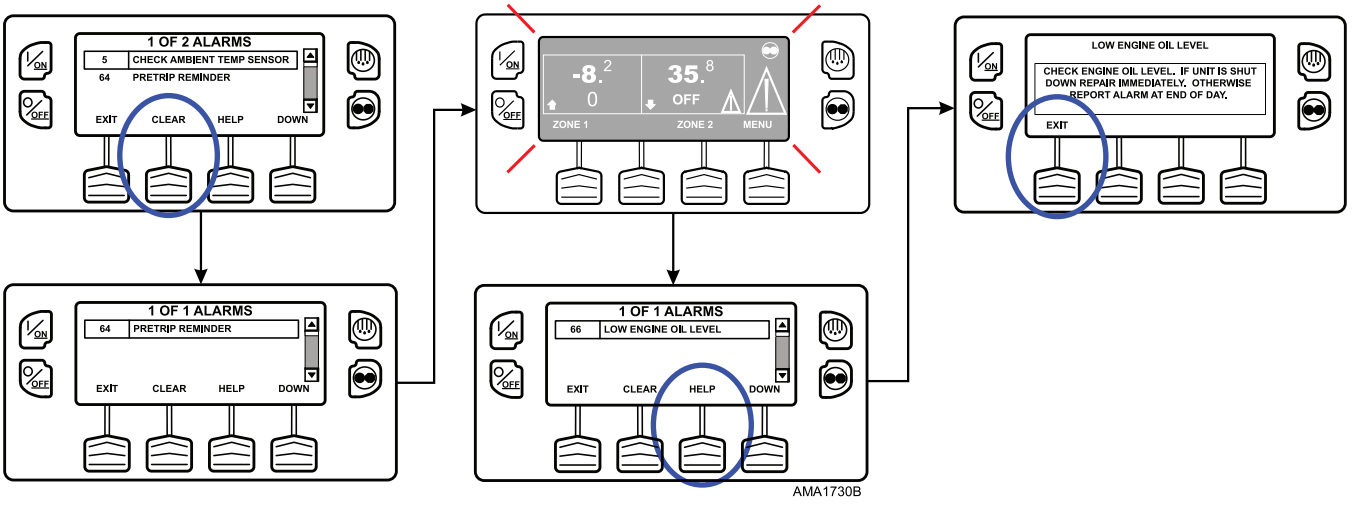


Figure 107. Displaying and Clearing Alarm Codes (2)



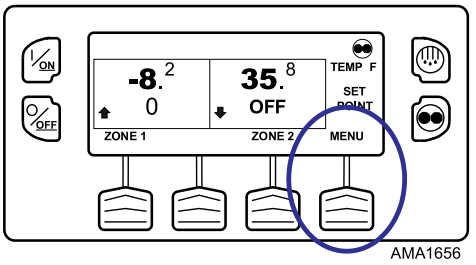
Gauges

The Gauges Menu allows the operator to view the unit gauges and I/O conditions. The unit gauges can always be viewed from the Main Menu and also from the Maintenance Menu.

Displaying Gauges

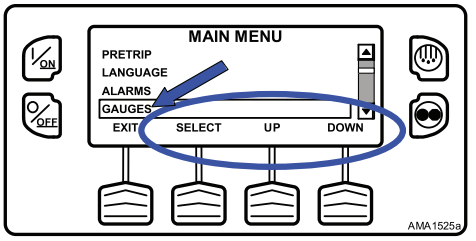
Gauges are displayed using the Gauges Menu. From the Standard Display, press the MENU Key (Figure 108, p. 63).

Figure 108. Menu Key



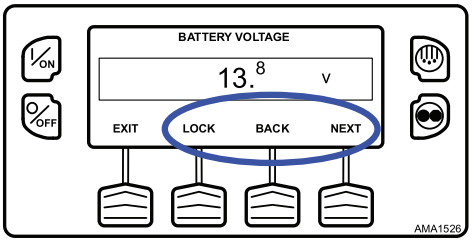
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Gauges Menu. When the Gauges Menu is selected, press the SELECT Key to choose the Gauges Menu (Figure 109, p. 63).

Figure 109. Up, Down, Select Keys



The first gauge display will appear. Press the NEXT and BACK Keys to scroll through the gauges and I/O conditions. Pressing the LOCK Key will lock the current gauge on the display (Figure 110, p. 63).

Figure 110. Next, Back, Lock Keys



The gauges and I/O conditions available are shown below. Not all gauges or I/O conditions may appear depending on unit configuration and software revision.

To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Gauges Available

Coolant Temperature: Displays the temperature of the engine coolant.

Coolant Level: Displays the coolant level in the overflow tank.

Engine Oil Pressure: Displays the engine oil pressure as OK or LOW.

Engine Oil Level Switch: Displays the engine oil level as OK or LOW.

Amps: Displays the current flow in amps flowing to or from the unit battery.

Battery Voltage: Displays the voltage of the unit battery.

Engine RPM: Displays the engine speed in RPMs.

Fuel Level Sensor: Displays the fuel level if a fuel level sensor is installed.

Discharge Pressure: Displays the unit discharge pressure.

Suction Pressure: Displays the unit suction pressure.

ETV Position: Displays the current position of the ETV valve.

Motor RPM: Displays motor RPM.

I/O (Input/Output State): Displays the current state of the input/output devices listed below:

High Speed Relay	Purge Valve	Drain Hose Heater Zone 2
Run Relay	Liquid Line Solenoid Zone 1	Liquid Line Solenoid Zone 3
Run Relay Feedback	Fresh Air Exchange Output (if configured)	Hot Gas Solenoid Zone 3
Alternator Excite Output	Fresh Air Exchange Feedback (if configured)	Suction Line Solenoid Zone 3
Condenser Inlet Solenoid	Diesel/Electric Relay (SmartPower™ units only)	Drain Hose Heater Zone 3
Receiver Tank Inlet Pressure Solenoid	Hot Gas Solenoid Zone 1	Fan Output Zone 2
Motor RPM	Suction Line Solenoid Zone 1	Fan Output Zone 3
Spare Digital Input 1, 2, 3, 4	Liquid Line Solenoid Zone 2	Electric Ready Input (SmartPower™ units only)
Spare Analog Input 1, 2	Hot Gas Solenoid Zone 2	Electric overload (SmartPower™ units only)
Spare Output 1, 2, 3, 4, 5	Suction Line Solenoid Zone 2	

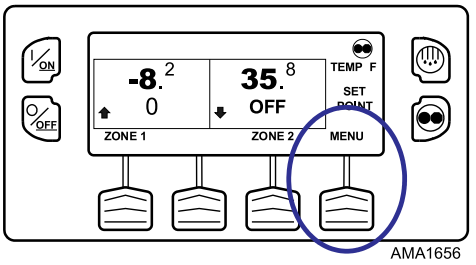
Sensors

The Sensors Menu allows the operator to view the unit and CargoWatch Data Logger temperature sensors. The sensors can always be viewed from the Main Menu and also from the Maintenance Menu.

Displaying Sensors

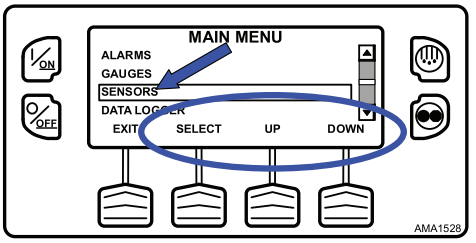
Sensors are displayed using the Sensors Menu. From the Standard Display, press the MENU Key (Figure 111, p. 64).

Figure 111. Menu Key



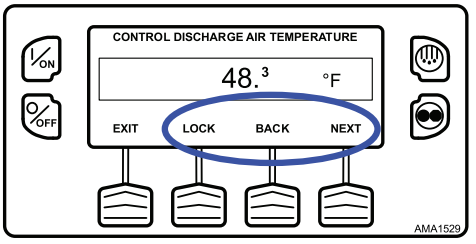
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Sensors Menu. When the Sensors Menu is selected, press the SELECT Key to choose the Sensors Menu (Figure 112, p. 64).

Figure 112. Up, Down, Select Keys



The first sensors display will appear. Press the NEXT and BACK Keys to scroll through the sensors and I/O conditions. Pressing the LOCK Key will lock the current sensor on the display (Figure 113, p. 64).

Figure 113. Next, Back, Lock Keys



The sensors available are shown below.

To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Sensors Available

Zone 1 Return Air Temperature: Displays the temperature of the Zone 1 Return Air Sensor.

Zone 1 Discharge Air Temperature: Displays the temperature of the Zone 1 Discharge Air Sensor.

Zone 1 Temperature Differential: Displays the Zone 1 Temperature Differential.

Zone 1 Evaporator Coil Temperature: Displays the temperature of the Zone 1 Evaporator Coil sensor.

Zone 2 Return Air Temperature: Displays the temperature of the Zone 2 Return Air Sensor.

Zone 2 Discharge Air Temperature: Displays the temperature of the Zone 2 Discharge Air Sensor.

Zone 2 Temperature Differential: Displays the Zone 2 Temperature Differential.

Zone 2 Evaporator Coil Temperature: Displays the temperature of the Zone 2 Evaporator Coil sensor.

Zone 3 Return Air Temperature: Displays the temperature of the Zone 3 Return Air Sensor.

Zone 3 Discharge Air Temperature: Displays the temperature of the Zone 3 Discharge Air Sensor.

Zone 3 Temperature Differential: Displays the Zone 3 Temperature Differential.

Zone 3 Evaporator Coil Temperature: Displays the temperature of the Zone 3 Evaporator Coil sensor.

Ambient Air Temperature: Displays the temperature of the ambient air temperature sensor.

Spare 1 Temperature: Displays the temperature of the Spare 1 temperature sensor.

Spare 2 Temperature: Displays the temperature of the Spare 2 temperature sensor.

Spare 3 Temperature: Displays the temperature of the Spare 3 temperature sensor.

Data Logger Sensor 1 Temperature: Displays the temperature of the CargoWatch Data Logger 1 temp sensor.

Data Logger Sensor 2 Temperature: Displays the temperature of the CargoWatch Data Logger 2 temp sensor.

Data Logger Sensor 3 Temperature: Displays the temperature of the CargoWatch Data Logger 3 temp sensor.

Data Logger Sensor 4 Temperature: Displays the temperature of the CargoWatch Data Logger 4 temp sensor.

Data Logger Sensor 5 Temperature: Displays the temperature of the CargoWatch Data Logger 5 temp sensor.

Data Logger Sensor 6 Temperature: Displays the temperature of the CargoWatch Data Logger 6 temp sensor.

Board Temperature Sensor: Displays the temperature of the HMI control panel PC board.

Data Logger (CargoWatch™)

The CargoWatch Data Logger is physically located in the HMI Control Panel. It can support up to six optional temperature sensors.

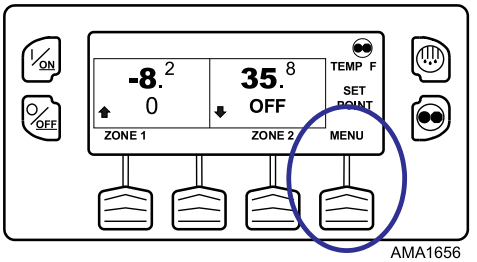
When shipped from the factory, CargoWatch sensors 1 and 2 are turned on to be logged and CargoWatch sensors 3 through 6 are turned off. Also, digital input 1 is turned on to be logged and digital inputs 2 through 4

are turned off. Sensors and digital inputs can be turned on, off, and configured using the CargoWatch menu in Guarded Access or with WinTrac.

A Start of Trip can be sent to the unit ServiceWatch and CargoWatch Data Loggers. In addition, the CargoWatch Data Logger contents can be printed with a hand-held printer.

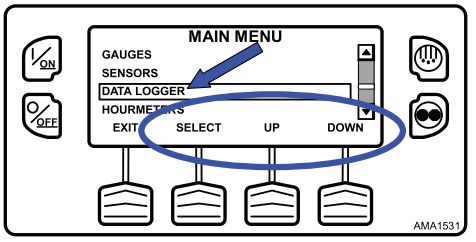
The ServiceWatch and CargoWatch Data Logger are accessed using the Data Logger Menu. From the Standard Display, press the MENU Key (Figure 114, p. 65).

Figure 114. Menu Key



The Main Menu will appear. Press the UP or DOWN Key as required to choose the Data Logger Menu. When the Data Logger Menu is selected, press the SELECT Key to choose the Data Logger Menu (Figure 115, p. 65).

Figure 115. Up, Down, Select Keys

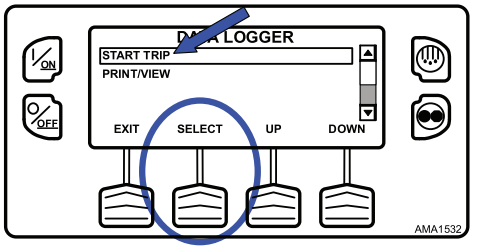


The Data Logger Menu will appear.

Sending Start of Trip Marker to CargoWatch and ServiceWatch Data Loggers

To send a Start of Trip marker to the CargoWatch and ServiceWatch Data Loggers, press the SELECT Key. The display will briefly show START OF TRIP COMPLETE to confirm that a Start of Trip marker was set in the CargoWatch Data Logger (Figure 116, p. 65).

Figure 116. Select Key, Start of Trip Complete

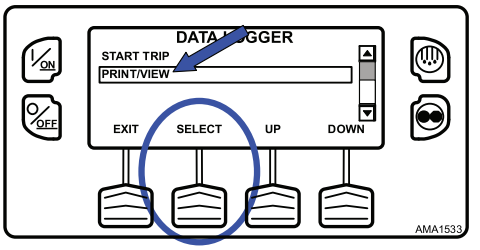


Note: *The start of trip marker is sent to both the CargoWatch and ServiceWatch data loggers.*

Printing CargoWatch Data Logger Reports

Press the DOWN Key to select the PRINT / VIEW feature and press the SELECT Key to choose Print/View (Figure 117, p. 65).

Figure 117. Select Key, Print/View



The Print Data Menu will appear. The first Print Data Menu allows the operator to print a Delivery Ticket using a hand held printer. Pressing the SELECT Key will print the ticket (Figure 118, p. 65). The Delivery Ticket is a short ticket that shows delivery specific details including the current temperature. A Sample Delivery Ticket is shown (Figure 119, p. 65).

Figure 118. Select Key, Print Delivery Ticket

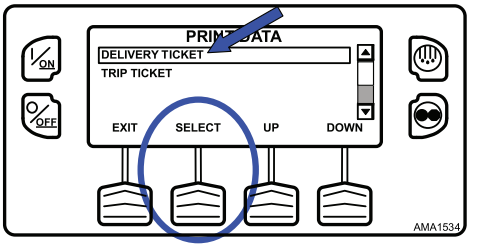
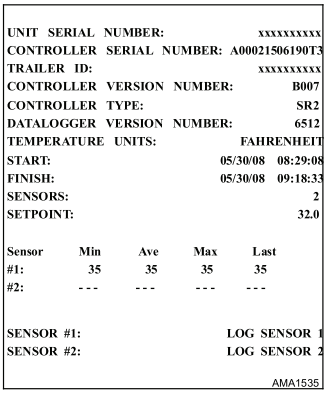


Figure 119. Sample Delivery Ticket



UNIT SERIAL NUMBER: xxxxxxxxxx
CONTROLLER SERIAL NUMBER: A000215061907T3
TRAILER ID: xxxxxxxxx
CONTROLLER VERSION NUMBER: B007
CONTROLLER TYPE: SR2
DATALOGGER VERSION NUMBER: 6512
TEMPERATURE UNITS: FAHRENHEIT
START: 05/30/08 08:29:08
FINISH: 05/30/08 09:18:33
SENSORS: 2
SETPOINT: 32.0

Sensor	Min	Ave	Max	Last
#1:	35	35	35	35
#2:	---	---	---	---

SENSOR #1: LOG SENSOR 1
SENSOR #2: LOG SENSOR 2

AMA1535

Pressing the DOWN Key allows the operator to print a Trip Ticket using a hand held printer. Press the SELECT Key to print the ticket (Figure 120, p. 66). The Trip Ticket is a long ticket that shows details for the current trip including a temperature history. The Trip Ticket is also called a Journey Ticket. A sample Trip Ticket is shown (Figure 121, p. 66).

Figure 120. Select Key, Print Trip Ticket

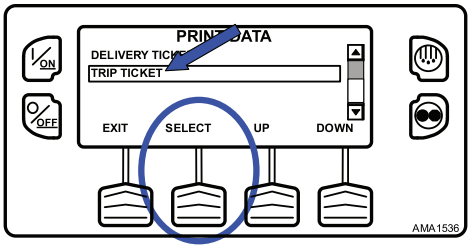


Figure 121. Sample Trip Ticket

```
UNIT SERIAL NUMBER:                    xxxxxxxxxx
CONTROLLER SERIAL NUMBER: A0002150619OT3
TRAILER ID:                            xxxxxxxxxx
CONTROLLER VERSION NUMBER:                  B007
CONTROLLER TYPE:                             SR2
DATALOGGER VERSION NUMBER:                  6512
TEMPERATURE UNITS:                    FAHRENHEIT
START:                          05/30/08  09:50:08
FINISH:                         05/30/08  13:07:33
SENSORS:                                        1
SETPOINT:                                    32.0

30 - MAY - 2008
1305      35.0
1250      35.2
1235      35.1
1220      35.2
1205      35.1
30 - MAY - 2008
1150      35.0
1135      35.0
1120      35.0
1105      34.9
1050      35.0
1035      35.0
1020      35.0
1005      35.1
0950      35.1

SENSOR #1:                          LOG SENSOR 1
SENSOR #2:                          LOG SENSOR 2
                                          AMA1537
```

To return to the Main Menu press the EXIT Key. To return to the Standard display press the EXIT Key again.

Hourmeters

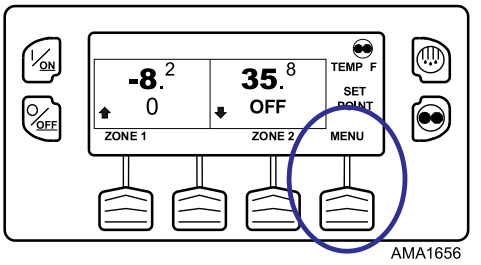
The Hourmeters Menu allows the operator to view the unit hourmeters that have the view feature enabled in the Guarded Access Menu. If the view feature for a particular hourmeter is not enabled, that hourmeter will continue to accumulate time but cannot be viewed from the Main Menu. However, all hourmeters can be viewed from the Maintenance Menu, even if they are not enabled. The hourmeters shown below are implemented.

Viewing Hourmeters

Only Hourmeters that have been enabled in Guarded Access are shown from the Main Menu. The Hourmeters can be viewed only.

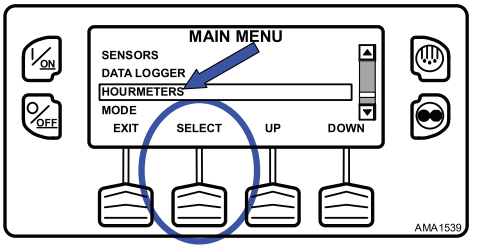
Hourmeters are displayed using the Hourmeter Display. From the Standard Display, press the MENU Key (Figure 122, p. 66).

Figure 122. Menu Key



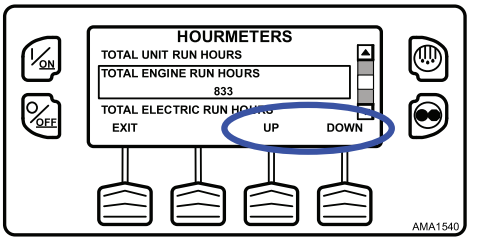
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Hourmeter Menu. When the Hourmeter Menu is selected, press the SELECT Key to choose the Hourmeter Menu (Figure 123, p. 66).

Figure 123. Select Key



Press the UP or DOWN Key to scroll through the hourmeters (Figure 124, p. 66).

Figure 124. Up/Down Keys



Hourmeter names and definitions are shown below in the order they appear. Only hourmeters enabled in the Guarded Access Menu will be shown. To return to the Standard Display, press the EXIT Key.

When shipped from the factory, only these hourmeters are enabled for viewing from the Main Menu:

- Total Unit Run Hours
- Total Engine Run Hours
- Total Electric Run Hours

To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Hourmeter Names and Definitions

Only configured hourmeters that have been enabled in the Viewable Hourmeter Setup Menu will be shown:

Hourmeter Name	Definition
Total Hours	Total number of hours the unit has been turned on (protection hours).
Total Run Time Hours	Total number of hours the unit has run in both diesel and electric mode.
Total Engine Run Hours	Total number of hours the unit has run in diesel mode.
Total Electric Run Hours	Total number of hours the unit has run in electric mode.
Zone 1 Run Time Hours	Total number of hours Zone 1 has run in any mode.
Zone 2 Run Time Hours	Total number of hours Zone 2 has run in any mode.
Zone 3 Run Time Hours	Total number of hours Zone 3 has run in any mode.
Total Run Reminder 1	User Programmable - The number of hours before a Total Unit Run Time Maintenance Reminder 1 occurs.
Total Run Reminder 2	User Programmable - The number of hours before a Total Unit Run Time Maintenance Reminder 2 occurs.
Pretrip Reminder	User Programmable - number of hours before a Pretrip Reminder occurs.
Engine Reminder 1	User Programmable - The number of hours before an Engine Run Time Maintenance Reminder 1 occurs.
Engine Reminder 2	User Programmable - The number of hours before an Engine Run Time Maintenance Reminder 2 occurs.
Electric Reminder 1	User Programmable - The number of hours before an Electric Run Time Maintenance Reminder 1 occurs.
Electric Reminder 2	User Programmable - The number of hours before an Electric Run Time Maintenance Reminder 2 occurs.
Engine Timing Belt Accumulated Hours	Total number of hours the engine timing belt has accrued in diesel mode.

Important: *If a programmable hourmeter is not enabled or the view for that hourmeter is not turned on it will not appear in the display sequence.*

Mode

The Mode Menu allows the operator to change the unit operating modes that have been enabled in Guarded Access. Only Operating Modes that have been enabled from the Guarded Access > Main Menu Configuration Menu will be shown.

- Turns Off Cycle Sentry Mode/Turns On Cycle Sentry Mode (If Cycle Sentry is turned Off, unit runs in Continuous).

  Note: *Selecting Cycle Sentry Mode or Continuous Mode can also be accomplished using the Cycle Sentry Key to the right of the display.*

- Allows Single Zone Control to be selected (if enabled from the Guarded Access > Main Menu Configuration Menu).
- Allows temperatures to be displayed in either Fahrenheit or Celsius degrees (if enabled from the Guarded Access > Main Menu Configuration Menu).
- Allows Keypad Lockout to be selected (if enabled from the Guarded Access > Main Menu Configuration Menu).
- Allows Sleep Mode to be set up and started (if enabled from the Guarded Access > Main Menu Configuration Menu).

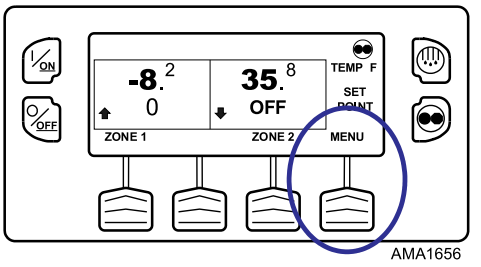
When shipped from the factory, only the Cycle Sentry/ Continuous Mode is enabled.

To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Using the Change Mode Menu

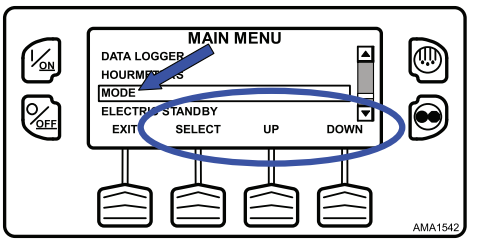
Mode changes are made using the Mode Menu. From the Standard Display, press the MENU Key (Figure 125, p. 67).

Figure 125. Menu Key



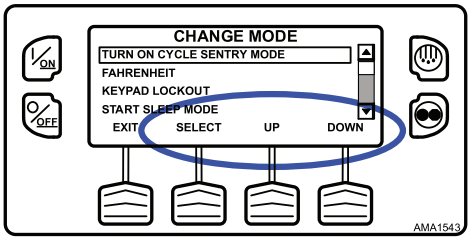
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Mode Menu. When the Mode Menu is selected, press the SELECT Key to choose the Mode Menu (Figure 126, p. 67).

Figure 126. Up, Down, Select Keys



The first enabled Change Mode Menu selection will appear. To choose that function, press the SELECT Soft Key. To Scroll through the enabled features in the Change Mode Menu, press the UP and DOWN Soft Keys (Figure 127, p. 68).

Figure 127. Select, Up, Down Keys



Possible mode selections are shown later in this section.

- Only those modes that have been enabled in Guarded Access > Main Menu Configuration will appear.
- To return to the Standard Display, press the EXIT Key.

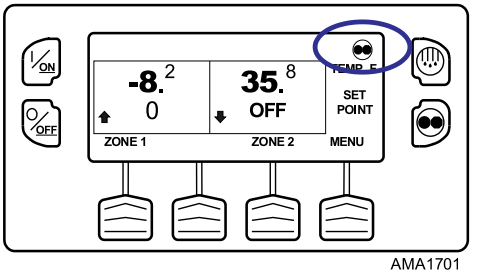
Turn Cycle Sentry On or Off

Cycle Sentry can be turned on and off either by using the Cycle Sentry hard key at the lower right side of the display or from the Main Menu.

Important: *If the unit is in Cycle Sentry Null and the mode is switched to Continuous Mode, the unit will start automatically.*

If the unit is operating in Cycle Sentry Mode, the Cycle Sentry Icon will be present in the upper right corner of the display as shown (Figure 128, p. 68). If the Cycle Sentry Icon is not present the unit is operating in Continuous Mode.

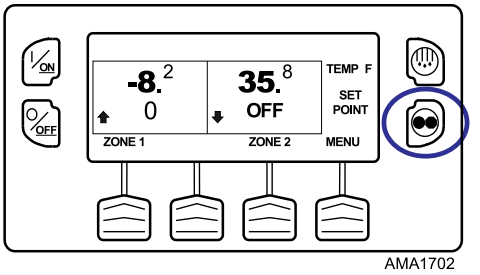
Figure 128. Cycle Sentry Icon



Using the Cycle Sentry Key

Cycle Sentry Mode or Continuous Mode is selected by pressing the Cycle Sentry Key as shown (Figure 129, p. 68).

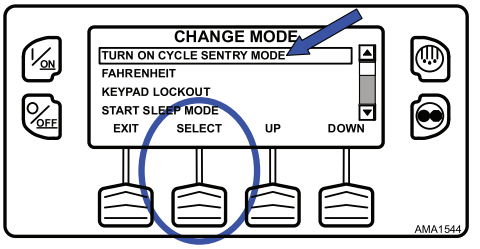
Figure 129. Cycle Sentry Key



Using the Main Menu

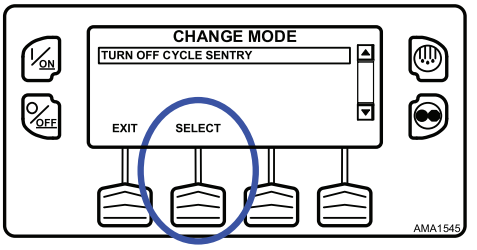
From the Main Menu > Change Mode menu choose Turn On/Off Cycle Sentry Mode and press the SELECT Soft Key.

Figure 130. Select Key



If the unit is running in Cycle Sentry Mode, press the SELECT Soft Key (Figure 131, p. 68) to turn off Cycle Sentry Mode as shown.

Figure 131. Select Key



Confirmation screens will appear briefly, the unit will switch to Continuous Mode operation, and the Cycle Sentry Icon will disappear.

To turn Cycle Sentry back on, press the SELECT Key again.

To leave this menu without changing the setting, press the EXIT Soft Key. To return to the Standard Display, press the EXIT Soft Key again.

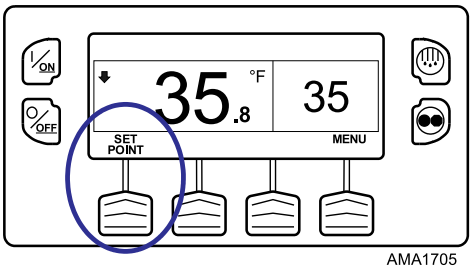
Important: *If the unit is in Cycle Sentry Null and the mode is switched to Continuous Mode, the unit will start automatically.*

Single Zone Control - Multi Zone Control

The following differences exist when operating the unit in Single Zone Control Mode.

- Single Zone Control Mode will appear in the Mode Menu only if the Single Zone Control feature has been enabled in the Guarded Access > Main Menu Configuration Menu. If the feature is enabled, Single Zone Control will appear in the Main Menu > Mode Menu.
- If Single Zone Control operation is selected, all zones will be forced on and will control to the same setpoint. All dividing wall(s) should be repositioned to create one large compartment. With the exception of defrost, the operating mode of each zone evaporator(s) will be same when in this mode.
- Unit control is based on the temperature sensors of one zone. Zone 1 is controlling or host, Zones 2 and 3 are backup.
- If Single Zone Control operation is selected the Single Zone Standard Display provides one soft key labeled Set Point as shown (Figure 132, p. 69). This allows the setpoint for all zones to be changed simultaneously.
- If Single Zone Control operation is selected the individual zones cannot be turned off. The unit and all zones are turned On and Off simultaneously using the On and Off hard keys at the left side of the display.

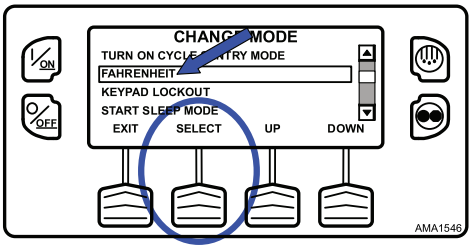
Figure 132. Setpoint



Select Temperature Units

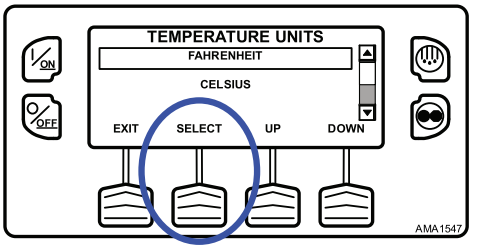
If this feature enabled in Guarded Access > Main Menu Configuration, the operator can select temperature units to be displayed as either degrees Fahrenheit or degrees Celsius. From the Main Menu > Change Mode Menu choose Fahrenheit or Celsius and press the SELECT Soft Key (Figure 133, p. 69).

Figure 133. Fahrenheit or Celsius, Select Key



Choose the desired Temperature Units using the UP and DOWN Soft Keys and press the SELECT Soft Key to select the choice (Figure 134, p. 69).

Figure 134. Up, Down, Select Keys



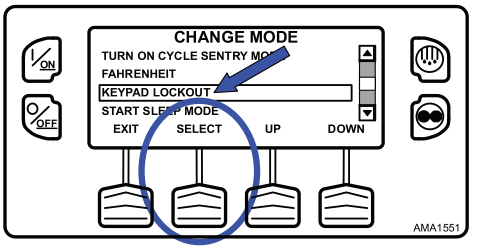
Temperatures will be displayed in the selected units.

- To leave this menu without changing the setting, press the EXIT Soft Key. To return to the Standard Display, press the EXIT Soft Key again.

Keypad Lockout

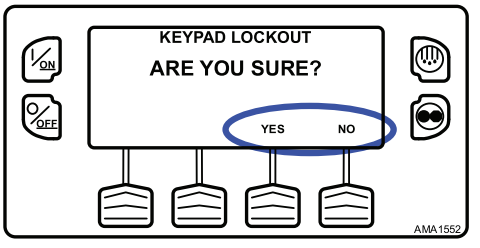
If enabled in Guarded Access > Main Menu Configuration, the keypad can be locked to prevent unauthorized use. If the keypad is locked, only the On Key and Off Key function. The keypad will remain locked even if the unit is turned off and back on. If Keypad Lockout is active, press and hold any soft key for five seconds to deactivate the feature. To turn the feature on, from the Change Mode Menu choose Keypad Lockout and press the SELECT Soft Key (Figure 135, p. 69).

Figure 135. Select Key



A Confirmation Request will appear. To activate Keypad Lockout press the YES Soft Key. To leave this menu without turning the Keypad Lockout feature on, press the NO Soft Key (Figure 136, p. 69).

Figure 136. Yes, No Soft Keys



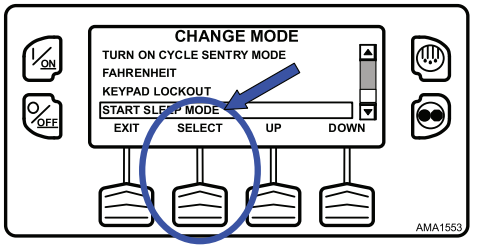
If the YES Soft Key was pressed, Keypad Lockout is active.

- If the keypad is locked, only the On Key and Off Key function. The keypad will remain locked even if the unit is turned off and back on.
- If Keypad Lockout is active, press and hold any soft key for five seconds to deactivate the feature.
- To return to the Standard Display, press the EXIT Soft Key again.

Start Sleep Mode

If this feature enabled in Guarded Access > Main Menu Configuration, the operator can select and set Sleep Mode from the Mode Menu. Sleep Mode is used to keep the engine warm and the battery charged when the unit is not in use. When the unit is Sleep Mode, the display will show “SLEEP” and the current time. To turn the feature on, from the Change Mode Menu choose Start Sleep Mode and press the SELECT Soft Key (Figure 137, p. 70).

Figure 137. Select Soft Key



The following features are available in Sleep Mode. Follow the display prompts to select and set the features.

- **Program Wakeup Time:** This feature allows a wakeup time to be specified. When the selected time is reached, the unit will start and resume normal operation. If a Wakeup Time is selected, the following features are available:
  - Day to Wake Up: This feature allows the day the unit is to wake up to be specified.
  - Hour to Wake Up: This feature allows the hour the unit is to wake up to be specified.
  - Minute to Wake Up: This feature allows the minute the unit is to wake up to be specified.
  - Run Pretrip on Wakeup: This feature allows a Pretrip Test to be automatically run when the unit wakes up.

SmartPower™ Electric Standby Option

The Diesel/Electric Standby selection from the Main Menu allows the operator to manually select diesel or electric mode operation on units equipped with the electric standby SmartPower option. The unit can also be programmed to automatically switch to Electric Mode operation when standby power is available and to automatically switch to Diesel Mode operation if standby power fails or is removed. If the unit is programmed to automatically switch from diesel to electric and/or electric to diesel, the associated screens do not appear.

- If the unit is currently operating in Diesel Mode, the ELECTRIC STANDBY selection will appear in the Main Menu.
- If the unit is currently operating in Electric Mode, the DIESEL MODE selection will appear in the Main Menu.

Electric Mode Operation

If a unit equipped with the electric standby SmartPower option is running in Diesel Mode, the Diesel to Electric Auto-Switch feature is set NO and the unit is connected to a source of standby power, this feature allows the operator to manually select electric mode operation. This feature does not appear if the electric standby SmartPower option is not installed or if the Diesel to Electric Auto-Switch feature is set YES.

Diesel Mode Operation

If a unit equipped with the electric standby SmartPower option is running in Electric Mode and the Electric to Diesel Auto-Switch feature is set NO, this feature allows the operator to manually select diesel mode operation. This feature does not appear if the electric standby SmartPower option is not installed or if the Electric to Diesel Auto-Switch feature is set YES.

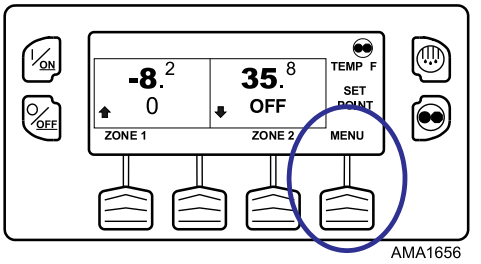
Switching from Diesel to Electric

If the unit is running in Diesel Mode and the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set YES, the unit will automatically switch to Electric Mode operation when standby power is connected and available. The screens shown (Figure 138, p. 70) (Figure 139, p. 71) will not appear.

If the unit is running in Diesel Mode and the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set NO, the unit can be switched to Electric Mode using the Electric Standby selection from the Main Menu.

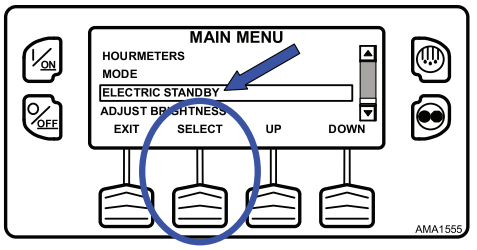
From the Standard Display, press the MENU Key.

Figure 138. Menu Key



From the Main Menu, choose Electric Standby and press the SELECT Soft Key (Figure 139, p. 71).

Figure 139. Select Key



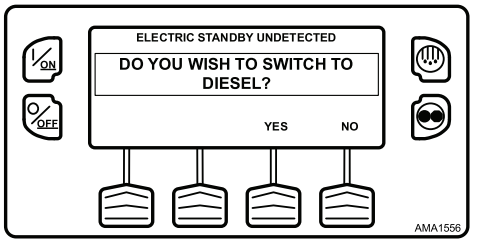
If the unit has standby power available and is turned on, the electric standby run screen will appear. The new mode is confirmed for 10 seconds. The unit will start and run in Electric Mode.

Any engine related Shutdown Alarms become Log Alarms when the unit is switched to Electric Mode operation. If the unit is switched back to Diesel Mode, these alarms again become Shutdown Alarms.

Electric Standby Power Fails or is Disconnected

If the electric standby power source fails or is disconnected and manual switching to Diesel Mode is selected, the unit will prompt for a switch to Diesel Mode (Figure 140, p. 71).

Figure 140. Diesel Mode Prompt



- Pressing the YES Soft Key will switch unit operation back to Diesel Mode.
- Pressing the NO Soft Key will allow the unit to remain in Electric Mode even though standby power is not available.

The unit will not run and Alarm Code 91 Check Electric Ready Input will be set as a Prevent Alarm.

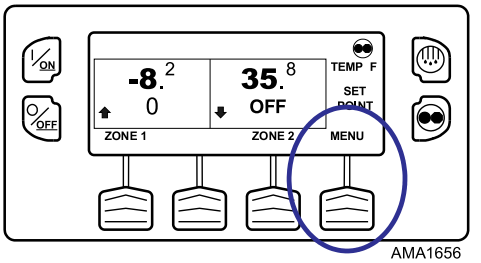
Switching from Electric to Diesel

If the unit is running in Electric Mode and the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set YES, the unit will automatically switch to Diesel Mode operation when standby power is no longer available. The screens shown will not appear.

If the unit is running in Electric Mode and the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set NO and standby power is disconnected or fails, the unit will not automatically switch to Diesel mode. This is primarily designed to prevent unauthorized diesel engine starts when the truck is indoors or on a ferry where engine operation is strictly prohibited.

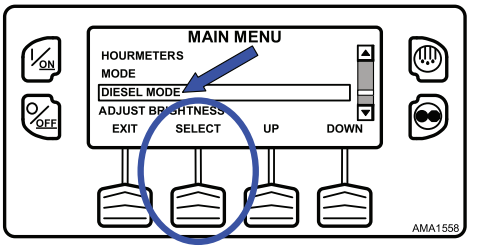
From the Standard Display, press the MENU Key (Figure 141, p. 71).

Figure 141. Menu Key



From the Main Menu, choose Diesel Mode and press the SELECT Soft Key (Figure 142, p. 71).

Figure 142. Select Key



The new mode is confirmed for 10 seconds. The unit will start and run in Diesel Mode.

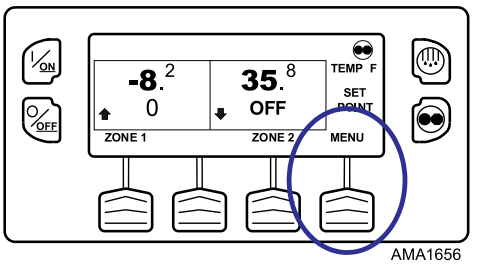
Any electric standby related Shutdown Alarms become Log Alarms when the unit is switched to Diesel Mode operation. If the unit is switched back to Electric Mode, these alarms again become Shutdown Alarms.

Adjust Brightness

The brightness of the HMI Control Panel display can be adjusted to allow for changing ambient light conditions. The choices available to the operator are HIGH, MEDIUM, LOW, and OFF. OFF actually results in a very dim screen suitable for low light conditions.

Display brightness is adjusted using the Adjust Brightness Menu. From the Standard Display, press the MENU Key (Figure 143, p. 71).

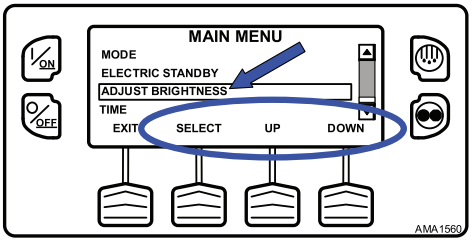
Figure 143. Menu Key



The Main Menu will appear. Press the UP or DOWN Key as required to choose the Adjust Brightness Menu.

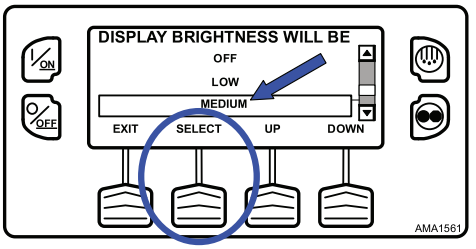
When the Adjust Brightness is selected, press the SELECT Key to choose the Adjust Brightness (Figure 144, p. 72).

Figure 144. Select Key



The Display Brightness menu will appear as shown. Press the UP or DOWN Soft Keys to select the desired display brightness. When the desired brightness is shown, press the SELECT Soft Key to confirm the choice (Figure 145, p. 72).

Figure 145. Select Key

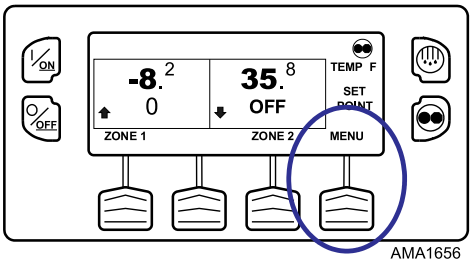


To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Time

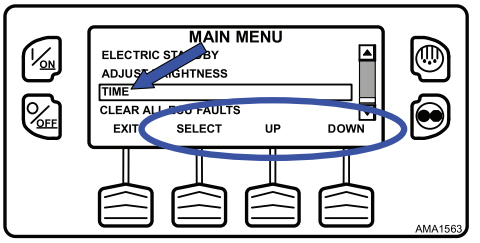
The Time and Date held by the HMI Control Panel can be checked. Time and Date cannot be changed from the Main Menu. The time and date is accessed using the Main Menu. From the Standard Display, press the MENU Key (Figure 146, p. 72).

Figure 146. Menu Key



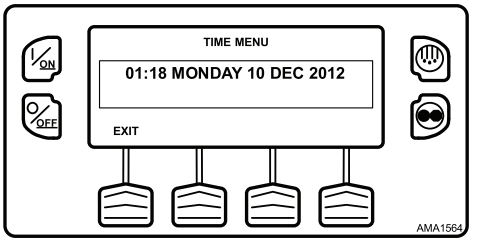
The Main Menu will appear. Press the UP or DOWN Key as required to choose the Time Menu. When the Time Menu is selected, press the SELECT Key to choose the Time Menu (Figure 147, p. 72).

Figure 147. Select Key



The date and time held in the HMI Control Panel will be shown on the display (Figure 148, p. 72). Time and Date cannot be changed from the Main Menu.

Figure 148. Date and Time



To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

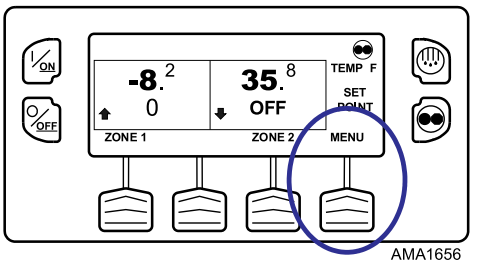
Clear All ECU Faults

Pressing this key will clear all existing Engine Control Unit (ECU) Fault Codes. This may allow continued unit operation should an ECU fault code result in engine shutdown.

- Any Thermo King Alarm Codes associated with the Engine Control Unit (ECU) Fault Codes will also be cleared.
- The Thermo King Alarm Codes and ECU Fault Codes that were cleared can be viewed in the ServiceWatch and ECU Data Loggers.

Engine Control Unit (ECU) Fault Codes are cleared using the Clear All ECU Faults Menu. From the Standard Display, press the MENU Key (Figure 149, p. 72).

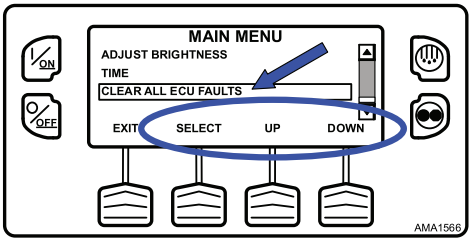
Figure 149. Menu Key



The Main Menu will appear. Press the UP or DOWN Key as required to choose the Clear All ECU Faults

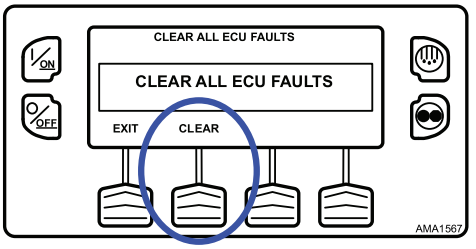
Menu. When the Clear All ECU Faults Menu is selected, press the SELECT Key to choose the Clear All ECU Faults Menu (Figure 150, p. 73).

Figure 150. Select Key



The Clear All ECU Faults Prompt will appear. To clear all ECU Faults and associated Thermo King Faults, press the CLEAR Soft Key (Figure 151, p. 73).

Figure 151. Clear Key



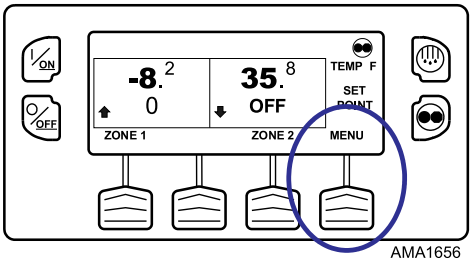
All ECU Faults and associated Thermo King Faults will be cleared.

To return to the Main Menu, press the EXIT Key. To return to the Standard Display, press the EXIT Key again.

Fuel Usage

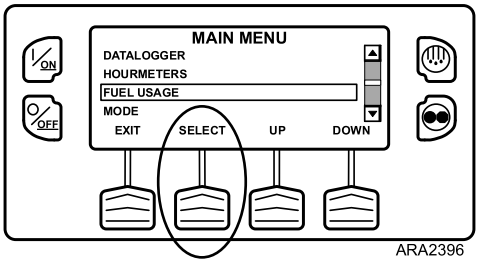
Fuel Usage can be checked from the HMI Control Panel by accessing the Main Menu. From the Standard Display, press the MENU Key (Figure 152, p. 73).

Figure 152. Menu Key



From the Main Menu, choose Fuel Usage and press the SELECT soft key (Figure 153, p. 73).

Figure 153. Select Key

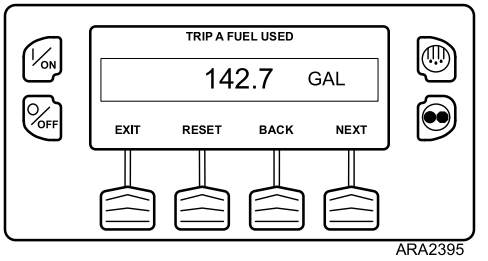


The first of the Fuel Usage screens (Figure 154, p. 73) will appear. The name of the gauge appears in the title of the Fuel Usage screen and the current value of the gauge appears in the main field. To return to the Main Menu, press the EXIT key.

Pressing the RESET key will reset the Trip's Fuel Used, Fuel Used per Temperature Control Hour, and Fuel Used per Engine Run Hour values back to zero.

Pressing the BACK key will return to the previous Fuel Usage parameter screen. Pressing the NEXT key will forward to the next Fuel Usage parameter screen.

Figure 154. Trip A Fuel Used



Fuel Usage parameter screens include:

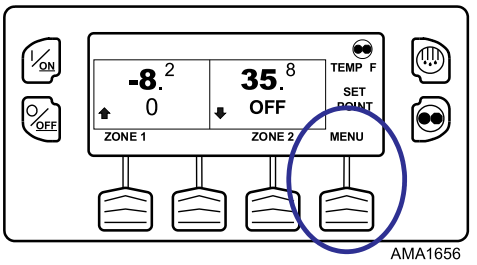
- Instantaneous Fuel Rate
- Trip A Fuel Used
- Trip A Fuel Used per Temperature Control Hour
- Trip A Fuel Used per Engine Run Hour
- Trip B Fuel Used
- Trip B Fuel Used per Temperature Control Hour
- Trip B Fuel Used per Engine Run Hour
- Trip C Fuel Used
- Trip C Fuel Used per Temperature Control Hour
- Trip C Fuel Used per Engine Run Hour
- Lifetime Fuel Used (can only be reset from Guarded Access)
- Lifetime Fuel Used in Temperature Control (can only be reset from Guarded Access)

Prime Fuel System

The Prime Fuel System function runs the fuel pump for up to five minutes to prime the fuel lines. Fuel priming is always shown on the HMI, but the functionality will

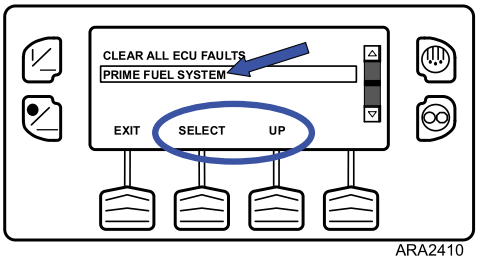
only be available if the engine/electric motor is not running. From the Standard Display, press the MENU Key (Figure 155, p. 74).

Figure 155. Menu Key



From the Main Menu, choose Prime Fuel System and press the SELECT soft key (Figure 156, p. 74).

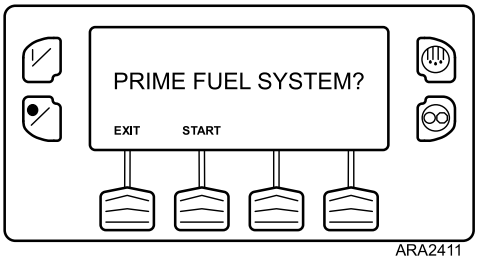
Figure 156. Select Key



The first of the Prime Fuel System screens will appear (Figure 157, p. 74).

- Prime Fuel System will remain active until either Exit or Start is selected. If Start is selected, Priming Fuel System will be displayed.
- Priming Fuel System will remain active while the fuel system is being primed. If either Exit or Stop is selected, Fuel System Prime Failed will display.
- Fuel System Prime Failed will remain active until Exit is selected.
- Fuel System Prime Complete will be displayed when the fuel system priming has been allowed to complete.

Figure 157. Prime Fuel System



Manual Pretrip Inspection (Before Starting Unit)

The following Manual Pretrip Inspection should be completed before starting the unit and loading the trailer. While the pretrip inspection is not a substitute for regularly scheduled maintenance inspections, it is an important part of the preventive maintenance program designed to head off operating problems and breakdowns before they happen.

Fuel: The diesel fuel supply must be adequate to guarantee engine operation to the next check point.

Engine Oil: The engine oil level should be at the FULL mark with the dipstick turned (threaded) into oil pan. Never overfill.

⚠ CAUTION

Hazardous Pressures!

Do not remove expansion tank cap while coolant is hot.

NOTICE

System Contamination!

Do not add "GREEN" or "BLUE-GREEN" conventional coolant to cooling systems using "RED" Extended Life Coolant, except in an emergency. If conventional coolant is added to Extended Life Coolant, the coolant must be changed after 2 years instead of 5 years.

Coolant: The engine coolant must have antifreeze protection to -30 F (-34 C). Alarm Code 37 indicates low coolant. Add coolant in the expansion tank.

Battery: The terminals must be clean and tight.

Belts: The belts must be in good condition and adjusted to the proper tensions.

Electrical: The electrical connections should be securely fastened. The wires and terminals should be free of corrosion, cracks, or moisture.

Structural: Visually inspect the unit for leaks, loose or broken parts, and other damage. The condenser and evaporator coils should be clean and free of debris. Check the defrost drain hoses and fittings to make sure they are open. Verify all the doors are latched securely.

Coils: The condenser and evaporator coils must be clean and free of debris.

Cargo Box: Check the interior and exterior of the cargo box for damage. Any damage to the walls or insulation must be repaired.

Cargo Doors: Verify the cargo doors and weather seals are in good condition. The doors should latch securely and the weather seals should fit tightly.

Defrost Drains: Check the defrost drain hoses to make sure they are open.

Loading Procedure

1. Verify the unit is turned off before opening the doors to minimize frost accumulation on the evaporator coil and heat gain in the trailer (Unit may be running when loading the trailer from a warehouse with door seals).
2. Spot check and record load temperature while loading. Especially note any off-temperature product.

NOTICE

Cargo Loss!

Cargo must be pre-cooled to the proper temperature before loading. The unit is designed to maintain temperature, not cool an above-temperature load.

3. Products should be pre-cooled before loading. Thermo King transport refrigeration units are designed to maintain loads at the temperature at which they were loaded. Transport refrigeration units are not designed to pull hot loads down to temperature.
4. Load the product so that there is adequate space for air circulation completely around the load. DO NOT block the evaporator inlet or outlet.

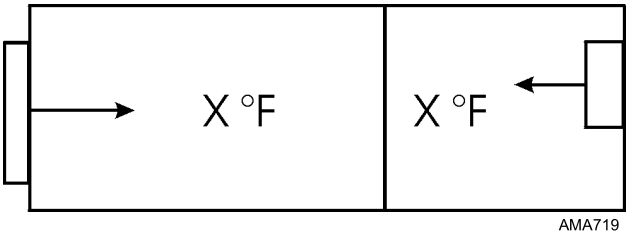
Single Temperature Loading Procedures

Additional steps must be taken to verify load temperature requirements are implemented and maintained when a multi-temp unit is used to refrigerate a single-temperature load. Trailer loading procedures will be different depending on how temperature control is established for each trailer compartment zone. See "Operating the Unit in Single Zone Control Mode," p. 45.

The unit can be operated with each zone individually set to the same setpoint temperature. With this method, bulkheads that separate compartments must be in place.

Figure 158, p. 75 shows two zones that have the same setpoint. The bulkhead separating the compartments is in place. Each zone evaporator senses temperature and controls to the temperature setpoint in that zone.

Figure 158. Two Compartments, Same Setpoint Temperature, Bulkheads In Place



AMA719

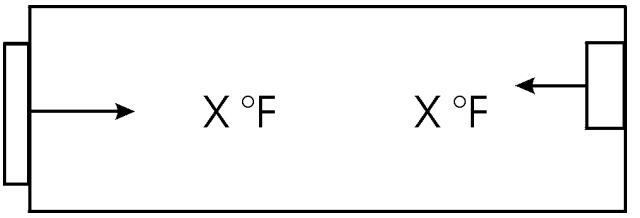
In this example, each zone could be individually set to 35 F. The evaporator in each compartment will then control the temperature in that compartment to the same 35 F setpoint.

Note: *Using the above method, it is recommended that the bulkheads that separate each compartment be in place to isolate the compartments.*

Single Zone Control Mode will appear in the Mode Menu if the Single Zone Control feature has been enabled in the Guarded Access>Main Menu >Configuration Menu. When using Single Zone Control Mode, the bulkhead separating the compartments should be removed as shown (Figure 159, p. 75). The Zone 1 evaporator senses temperature and controls both evaporators to the temperature setpoint.

Note: *When using Single Zone Control Mode, it is recommended that all bulkheads be removed to create one large compartment.*

Figure 159. Two Compartments, Same Setpoint Temperature, Bulkhead(s) Removed



AMA720

Post Load Procedure

1. Verify all the doors are closed and locked.
2. Start the unit if it was shut off to load (see "Turning The Unit On And Off," p. 43).
3. Verify the setpoints are at the desired settings.
4. One-half hour after loading, manually initiate a Defrost cycle.
   a. If the evaporator coil sensor temperature is below 45 F (7 C), the unit will Defrost.
   b. The microprocessor will terminate Defrost automatically when the evaporator coil temperature reaches 58 F (14 C) or the unit has been in the Defrost mode for 30 or 45 minutes (depending on setting).

Post Trip Checks

1. Wash the unit.
2. Check for leaks.
3. Check for loose or missing hardware.
4. Check for physical damage to the unit.

Electrical Maintenance

AC Generator

⚠ WARNING

Hazardous Voltage!

These units use high voltage AC from the AC generator for the condenser and evaporator fans. Lethal voltage potentials can exist on connections in the fan control box. Take appropriate precautions and use extreme care when testing the unit.

The AC generator provides electric power during diesel engine operation. The AC generator is mounted under the diesel engine and driven by a belt. The AC generator provides AC power for the condenser and evaporator fan motors. The battery charger (if used) converts AC power from the AC generator (or the electric standby power source) to 12 Vdc to charge the battery and provide power for the 12 Vdc control system. The engine speed determines the output frequency of the AC generator, which affects the fan speeds.

Test the AC generator output under a load as follows:

1. 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.
2. Remove the cover from wire connection box on the AC generator.
3. Check the AC output voltage between the following terminals: T1 to T2, T2 to T3, and T1 to T3. Approximately 345 Vac should be present between each pair. If not, the AC generator is faulty.

Alternator Diagnostic Procedures

General Information

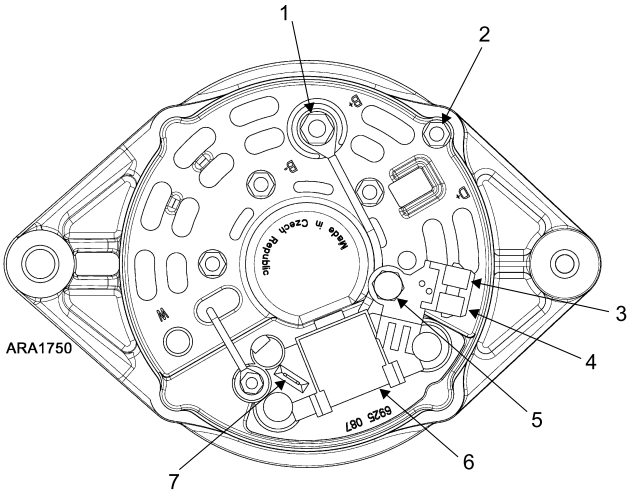
Poor charging performance may not be caused by a bad alternator. The following conditions can cause improper battery charging, even with a good alternator (See Service Bulletin T&T 388 for more information):

- 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, 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 160, p. 76), which are painted black.

Figure 160. 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 - 2Y Wire)	7.	W Terminal (AC Output - WRPM Wire on Standard Units)
4.	L Terminal (Regulator Excite - 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 2, 2A, 2Y (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 2 and 2A circuits.
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 Output Test Mode, and energize the Alternator Excite Output. Refer to the appropriate Diagnostic Manual for information about the Output Test Mode.
9. Check the voltage at the sense circuit (2Y circuit). Battery voltage should be present. If not, check the sense circuit (2Y circuit) in the alternator harness and the main/unified harness, fuse F20 on the base controller, and the 2 circuit in the battery harness.
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 main/unified harness.

    Note: *LED 26 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).

Tempera-ture	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 all zones.
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 multi-meter 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.

Battery Charger (Optional)

The battery charger is used in place of and an alternator. The battery charger converts AC power from the AC generator (or the electric standby power source) to 12 Vdc to charge the battery and provide power for the 12 Vdc control system.

Note: *There are some alarm codes for the battery charger. Check for alarm codes related to the battery charger before testing it.*

Test the battery charger output as follows:

1. Use the Service Test Mode to run the unit in high speed with Zone 1 in cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
2. Use the Gauges Menu to check the Amps Display and the Battery Voltage Display. The Amps reading should show a positive value. The Battery Voltage reading should increase slowly until it stabilizes at approximately 14 Vdc. If not, go to the next step.
3. Check for DC voltage between the BAT and GND terminals at the battery charger. The voltage should be within 1 Vdc of the Battery Voltage reading in step 2. If the voltage is acceptable, check the BAT and CH circuits back to the battery and ground for continuity. If not, go to the next step.
4. Check for AC voltage between the L1, L2, and L3 terminals at the battery charger. Approximately 345 Vac should be present between each pair. If the voltage is acceptable, the battery charger is probably faulty. If not, go to the next step.
5. Check the L1, L2, and L3 circuits (including any contactors) back to the AC generator for continuity. If the L1, L2, and L3 circuits all have good continuity, test the AC generator.

Condenser Fans

There are two condenser fans located near the top of the unit. Each condenser fan has its own electric motor and contactor, which allows the condenser fans to be controlled separately. The roadside condenser fan rotates counterclockwise when viewed from the top. It draws air through the roadside condenser coil and the radiator coil. It also draws air up through a cooling channel to cool the battery, ECU (if used), and battery charger (if used). The curbside condenser fan rotates clockwise when viewed from the top. It draws air through the curbside condenser coil (and intercooler if used). During engine operation, the condenser fan speed varies with the engine speed.

Test the condenser fans as follows:

1. Use the Service Test Mode to run the unit in high speed with Zone 1 in cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
2. Use the Service Test Mode to energize condenser fan you want to test. It should run at approximately 2650 rpm in the correct direction with the engine running in high speed. If it does not run, proceed to the next step. If it runs backwards, proceed to "If Fan Runs Backwards," p. 80.
3. Check for AC voltage between the T1, T2, and T3 terminals on the fan harness side of the contactor for the fan being tested. Approximately 345 Vac should be present between each pair. If the voltage is acceptable, proceed to step 5. If not, proceed to next step.
4. Check for AC voltage between the L1, L2, and L3 terminals on the generator harness side of the contactor for the fan being tested. Approximately 345 Vac should be present between each pair. If the voltage is acceptable, proceed to the next step. If not, proceed to step 8.
5. Turn the unit off and check the connections in the junction box for the fan being tested to verify they are clean and tight.
6. Check the resistance on the three pairs of wires (T1-T2, T2-T3, and T1-T3) at the fan side of the contactor for fan being tested. The resistance should be approximately 7.7 ohms on each pair. If not, proceed to the next step.
7. Check the continuity of the T1, T2, and T3 wires from the contactor for fan being tested to the fan. If

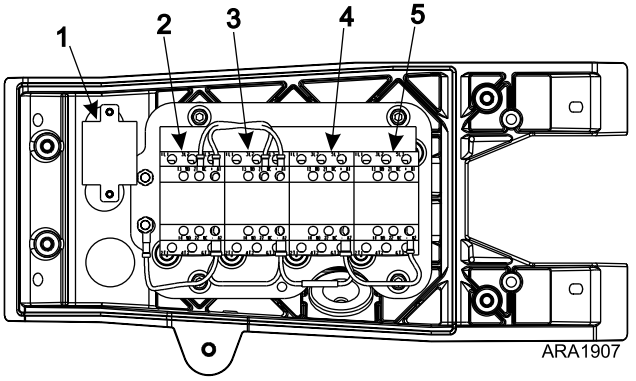
all three wires have good continuity, the fan motor is most likely faulty.

8. Turn the unit off and check the T1/L1, T2/L2, and T3/L3 circuits (including any contactors) back to the AC generator for continuity. If the T1/L1, T2/L2, and T3/L3 circuits all have good continuity, test the AC generator.

If Fan Runs Backwards

1. Verify the unit is turned off.
2. Check the unit wiring to verify it is correct in accordance with the appropriate schematic and wiring diagrams.
3. If all of the wiring is correct but the fan still runs backwards, switch the T1 and T2 wire connections on the fan harness side of the contactor for the fan being tested.
4. If the fan runs correctly, it is most likely wired incorrectly.

Figure 161. Fan Control Box with Cover Removed



1.	Ground Fault Relay
2.	EFHC—Evaporator Fan High Speed Contactor
3.	EFLC—Evaporator Fan Low Speed Contactor
4.	CCFC—Condenser Fan Curbside Contactor
5.	CFRC—Condenser Fan Roadside Contactor

Evaporator Fans

The evaporator fans are axial blower type fans mounted on both ends of a single evaporator fan motor. The evaporator fans (and motor) are mounted in the evaporator, but are accessed from the front of the unit through an access panel located in the top of the unit between the condenser coils. The evaporator fans rotate up (from bottom to top) when viewed from the front of the unit through the access panel.

Because the evaporator fan speed varies with the engine speed, a two-speed motor and two contactors are used. When the engine is running in low speed, the evaporator fan contactor connected to the high speed windings is energized and the evaporator fans run at approximately 1098 rpm. When the engine is running in high speed, the evaporator fan contactor connected to the low speed windings is energized and the evaporator fans run at approximately 1350 rpm. This keeps the evaporator air flow consistent regardless of the engine speed.

Test the evaporator fans as follows:

1. Use the Service Test Mode to run the unit in high speed with Zone 1 in cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode. The evaporator fans should run at approximately 1350 rpm in the correct direction with the EFLC contactor energized and the engine running in high speed. The evaporator fans should run at approximately 1800 rpm in the correct direction with the EFHC contactor energized and the engine running in high speed. If it does not run, proceed to step 3. If it runs backwards, refer to "If Fan Runs Backwards," p. 80.
2. Use the Service Test Mode to run the unit in low speed with Zone 1 in cool. The evaporator fans should run at approximately 1098 rpm in the correct direction with the EFHC contactor energized and the engine running in low speed. If it does not run, proceed to step 7. If it runs backwards, refer to "If Fan Runs Backwards," p. 80.
3. Check for AC voltage between the T1, T2, and T3 terminals on the fan harness side of the EFLC (low speed) contactor when it is energized. Approximately 345 Vac should be present between each pair with engine running in high speed. If the voltage is acceptable, proceed to the next step. If not, proceed to step 6.
4. Turn the unit off and check the resistance on the three pairs of wires (ET1-ET2, ET2-ET3, and ET1-ET3) at the fan side of the contactor for fan being tested. The resistance should be approximately 19.6 ohms for on each pair. If not, proceed to the next step.
5. Check the continuity of the ET1, ET2, and ET3 wires from the EFLC contactor to the fan. If all three wires have good continuity, the fan motor is most likely faulty.
6. Check the T1/L1, T2/L2, and T3/L3 circuits (including any contactors) back to the AC generator for continuity. If the T1/L1, T2/L2, and T3/L3 circuits all have good continuity, test the AC generator.
7. Check for AC voltage between the T1, T2, and T3 terminals on the fan harness side of the EFHC contactor. Approximately 200-210 Vac should be present between each pair with engine running in low speed. If the voltage is acceptable, proceed to the next step. If not, proceed to step 10.
8. Turn the unit off and check the resistance on the three pairs of wires (ET11-ET12, ET12-ET13, and ET11-ET13) at the fan side of the contactor for fan

being tested. The resistance should be approximately 7.1 ohms on each pair. If not, proceed to the next step.

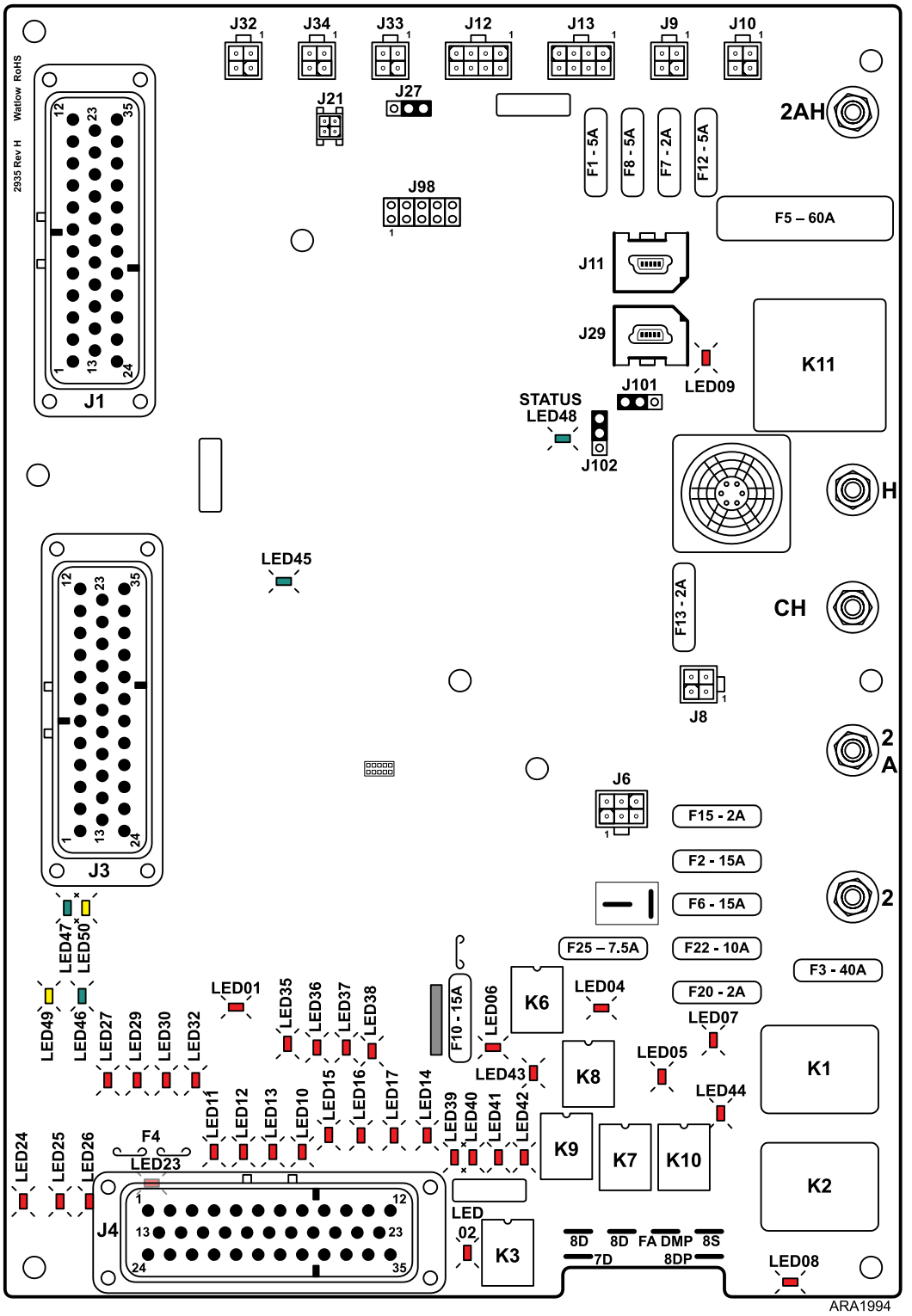
9. Check the continuity of the ET11, ET12, and ET13 wires from the EFHC contactor to the fan. If all three wires have good continuity, the fan motor is most likely faulty.
10. Check the T1/L1, T2/L2, and T3/L3 circuits (including any contactors) back to the AC generator for continuity. If the T1/L1, T2/L2, and T3/L3 circuits all have good continuity, test the AC generator.

Ground Fault Detection Module

The Ground Fault Detection Module trips and sets the Ground Fault Alarm Code 518 if it detects a ground fault (short between the generator phase outputs and unit chassis). Check the AC circuits between the AC generator and the AC Loads (fan motors, battery charger, heaters) for a ground fault if the Ground Fault Alarm Code 518 is set. To check for a ground fault, check for continuity from the AC circuits to a chassis ground.

Base Controller

Figure 162. Base Controller



Base Controller Fuses

A number of fuses, located on the base controller, protect various circuits and components. The Base Controller (Figure 162, p. 82) is located inside the control box. Refer to the appropriate Diagnostic Manual for a complete list of the size and function of the fuses.

Fuse	Size	Function
F1	5A	Radio Expansion Board
F2	15A	On/Off Switch
F3	40A	Fuel Solenoid/Starter Circuit (Note 3)
F4	None or 2A	No fuse - all Bosch and TK alternators 2A fuse - all Prestolite alternators (Note 1)
F5	60A	Preheat Circuit (Note 2, Note 3)
F6	15A	High Speed Solenoid (Note 3)
F7	2A	8X Power for HMI
F8	5A	2A HMI Power for HMI and Printer Port
F10	15A	HMI Bypass - On/Off Relay Circuit
F12	5A	2A Power for CAN Bus J13
F13	2A	Remote Light Module
F15	2A	SR-4 Controller Power Supply
F20	2A	Alternator
F22	10A	Auto Fresh Air Solenoid (AFS)
F25	7.5A	High Pressure Cutout

Notes:

1. *Fuse F4 fuse 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 Yanmar trailer engine air pre-heater. Always replace the fuse with the TK specified fuse. Service Parts Base Controllers are shipped without the F5 fuse.*
3. *Used only on applications with mechanical engines.*

Base Controller LEDs

The Base Controller has LEDs that indicate which outputs are energized. The LED is illuminated when the associated circuit output is energized.

LED #	Function	LED #	Function
LED 1	7K/ECUR Output	LED 24	CIS/LV/Digital Scroll Output
LED 2	K3 High Speed Output	LED 25	Suction Line Solenoid Zone 1 Output
LED 4	K8 Run Relay Output	LED 26	Alternator Excite Output
LED 5	K7 Diesel/Electric Relay Output	LED 27	Evaporator Fan Low Speed Output
LED 6	K6 On/Off Relay Output	LED 29	Evaporator Fan High Speed Output
LED 7	K1 Starter Relay Output	LED 30	Condenser Fan Roadside Output
LED 8	K2 Fuel Solenoid Output	LED 32	Condenser Fan Curbside Output
LED 9	K11 Preheat Relay Output	LED 37	ECU Key Switch Output

LED #	Function	LED #	Function
LED 10	Pilot Solenoid/Hot Gas Solenoid Output	LED 38	Battery Charger Enable Output
LED 11	Purge Valve/Liquid Injection Valve Output	LED 43	K9 Compressor Contactor CC
LED 12	Hot Gas Bypass Output	LED 44	K10 Auto Fresh Air Door Output
LED 13	Receiver Tank Pressure Solenoid Output	LED 45	I/O Micro
LED 14	Spare 1	LED 46	ETV – D Output (See Note 2)
LED 15	Fuel Pump	LED 47	ETV – B Output (See Note 2)
LED 16	Spare 3	LED 48	Heartbeat (Application Micro) (See Note 1)
LED 17	Spare 2	LED 49	ETV – A Output (See Note 2)
LED 23	Liquid Line Solenoid Output	LED 50	ETV – C Output (See 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 ETV LEDs may be illuminated even though there is no ETV present.*

Base Controller Relays

A number of relays are located on the Base Controller. The relays control power to certain loads. The Base Controller (Figure 162, p. 82) is located inside the control box. Refer to the appropriate Diagnostic Manual for a complete list of the size and function of the relays.

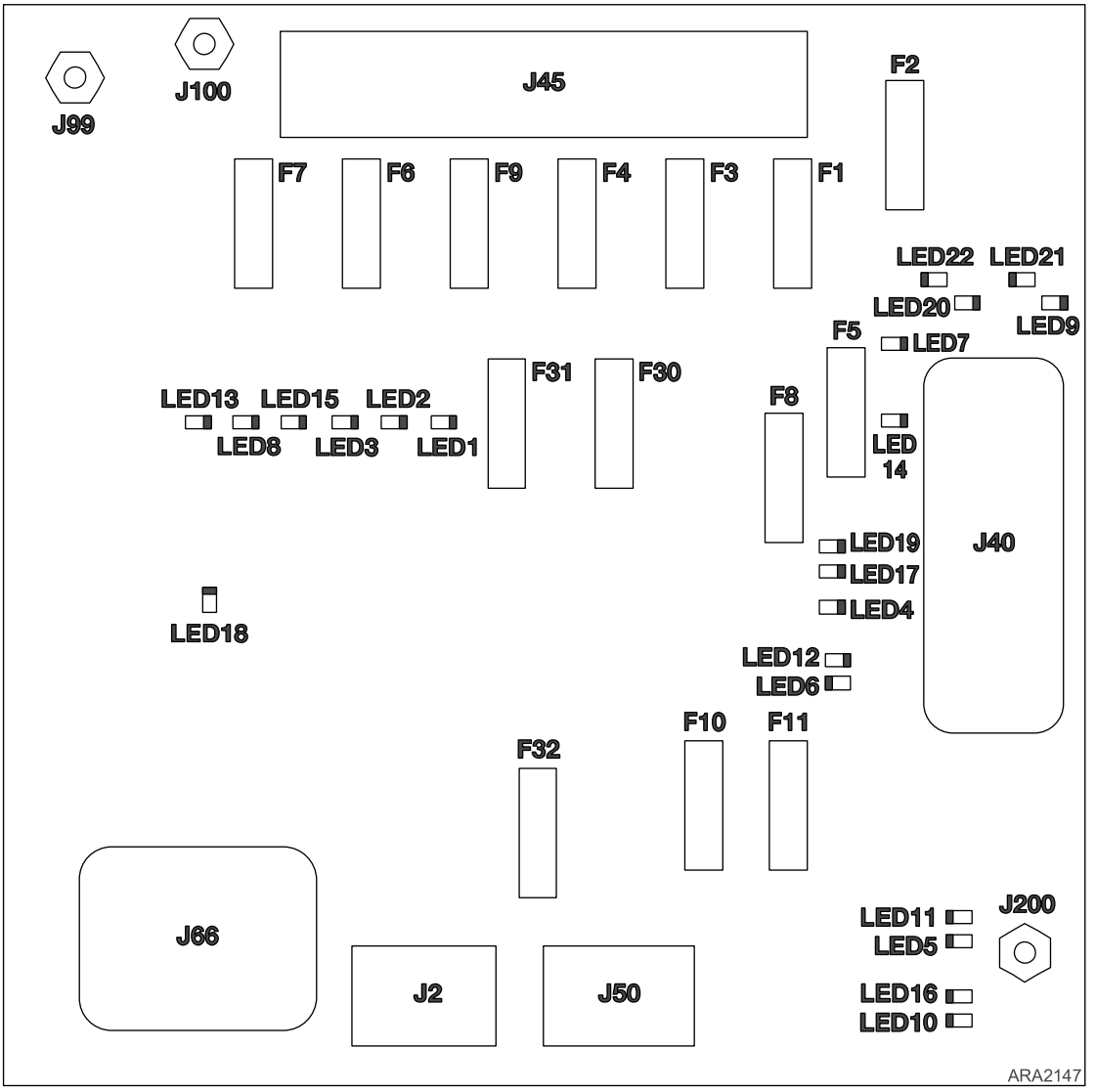
Relay	Function
K1	Starter Solenoid Relay (Note 1)
K2	Fuel Solenoid Pull-In Relay (Note 1)
K3	High Speed Relay (Note 1)
K6	On/Off Relay
K7	Diesel/Electric Relay (Optional)
K8	Run Relay
K9	Electric Standby Motor Relay (Optional)
K10	Fresh Air Exchange Relay (Optional)
K11	Pre-Heat Relay (Note 1)

Notes:

1. *Used only on applications with mechanical engines.*

Expansion Module

Figure 163. Expansion Module



The expansion module is mounted in the control box below the base controller. It allows the addition of up to two additional temperature controlled zones. The expansion module provides the interface between the base controller and the Zone 2 and Zone 3 (if used) multi-temperature components such as sensors, solenoid valves, and fan motors. It also uses Smart FETs to provide overcurrent and short circuit protection for some associated circuits.

Refer to the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788-2-OD) for more information about the expansion module.

Expansion Module Fuses

A number of fuses, located on the expansion module, protect various circuits and components. Depending on unit configuration, not all are used. Refer to the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788-2-OD) for a complete list of the size and function of the fuses.

Fuse	Size	Function
FX1	20A	Fan 1 Zone 2
FX2	5A	Damper Gear Motor
FX3	20A	Fan 2 Zone 2
FX4	20A	Fan 3 Zone 2
FX5	15A	Drain Hose Heater Zone 2
FX6	20A	Fan 5 Zone 3
FX7	20A	Fan 6 Zone 3
FX8	15A	Drain Hose Heater Zone 3

Fuse	Size	Function
FX9	20A	Fan 4 Zone 3
FX10	20A	Liquid Line Solenoids Zone 2 and Zone 3/ Hot Gas Solenoids Zone 3
FX11	20A	Hot Gas Solenoid Zone 2/Suction Line Solenoids Zone 2 and Zone 3
FX30	2A	Spare
FX31	2A	Spare
FX32	5A	Digital Ground

Expansion Module LEDs

The expansion module has LEDs that indicate which outputs are energized. The LED is illuminated when the associated circuit output is energized.

LED #	Function
LEDX 1	Fan 1 Zone 2
LEDX 2	Fan 2 Zone 2
LEDX 3	Fan 3 Zone 2
LEDX 4	Hot Gas Solenoid Zone 3
LEDX 5	Suction Line Solenoid Zone 3
LEDX 6	Liquid Line Solenoid Zone 3
LEDX 7	Drain Hose Heater Zone 2
LEDX 8	Fan 5 Zone 3
LEDX 9	Damper Gear Motor Zone 1 Open
LEDX 10	Hot Gas Solenoid Zone 2
LEDX 11	Suction Line Solenoid Zone 2
LEDX 12	Liquid Line Solenoid Zone 2
LEDX 13	Fan 6 Zone 3
LEDX 14	Drain Hose Heater Zone 3
LEDX 15	Fan 4 Zone 3
LEDX 16	Spare Out 3
LEDX 17	Spare Out 2
LEDX 18	Heartbeat
LEDX 19	Spare Out 1
LEDX 20	Damper Gear Motor Zone 2 Open
LEDX 21	Damper Gear Motor Zone 1 Close
LEDX 22	Damper Gear Motor Zone 2 Close

SMART REEFER 4 Multi-Temp (SR-4 MT) Microprocessor Controller

Refer to the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788–2–OD) 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-4 MT Controller. Therefore, it is recommended that a ServiceWatch download be performed to help diagnose a problem. A ServiceWatch download must be performed before contacting the Thermo King Service Department for assistance in diagnosing a problem. Refer to the Refer to the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788–2–OD) for information about downloading the ServiceWatch Data Logger and viewing the data.*

Radio Expansion Board (REB) Option

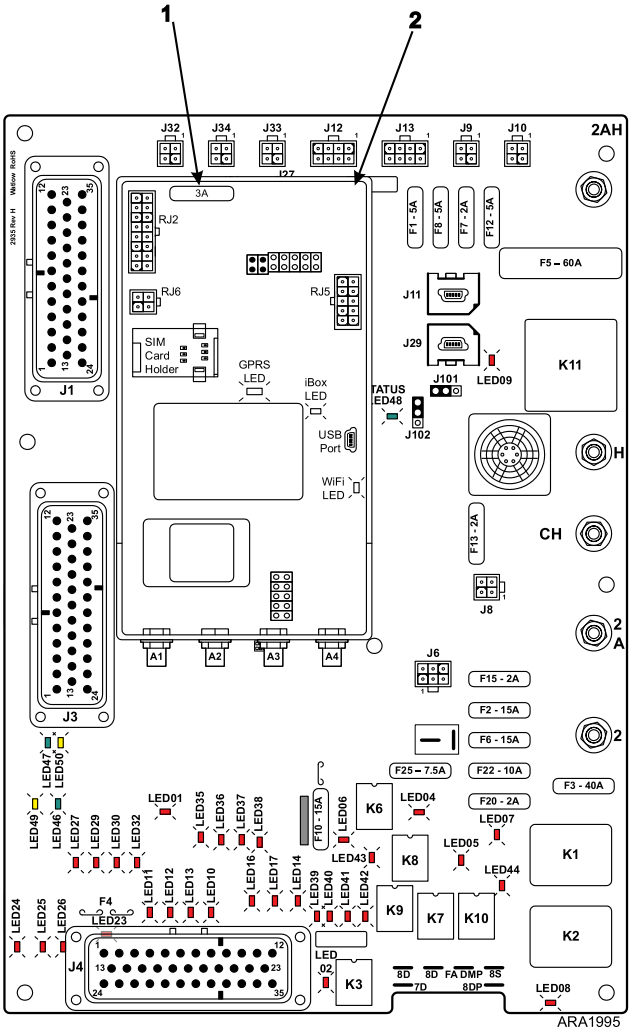
The Radio Expansion Board (REB) option is a wireless communication platform that offers fleet owners the ability to monitor their refrigerated trailers. Cellular, GPS, and Wi-Fi capabilities communicate with Thermo King's web-based TracKing application. A third party interface (using iBox protocol) offers a gateway for telematics providers to communicate with the Thermo King unit.

Currently, REBs with the following capabilities are available. Some combinations of these capabilities are also available:

- REB with Cellular and GPS capabilities for use with the TracKing application.
- REB with Wi-Fi and GPS capabilities for use with the TracKing application.
- REB with iBox protocol for use with third party telematics systems.

Note: *REBs that have iBox and Cellular capabilities can be configured to either use the iBox protocol, or communicate with TracKing. They cannot be configured to do both.*

Figure 164. REB Mounted on Base Controller



1.	REB Fuse (3 Amp)
2.	REB (Radio Expansion Board)

The REB is a "daughter board" that mounts on the base controller as shown (Figure 164, p. 87). The REB communicates with the base controller through the CAN connector J98 on the base controller. Refer to the Radio Expansion Board (REB) Diagnostic Manual (TK 55065) for complete service information about the REB. Refer to the iBox Diagnostic Manual (TK 53242) for complete service information about the REB iBox II.

REBs with cellular capabilities also have a battery mounted near the control box. The REB battery is used to provide back-up power for at least 24 hours if the main battery power is lost or interrupted. The REB only transmits its location during this back-up mode. The REB contains an intelligent battery charger that keeps the REB battery charged during normal unit operation.

Battery Fusing

A fusible link protects the 2 circuit to the base controller.

Another fusible link protects the 2AH circuit to the base controller, which powers the H circuit to the glow plugs through fuse F5.

ECU Fuses

The following fuses protect the Engine Control Unit (ECU):

Inside Low Voltage Control Box

- A 20A Fuse (FS9) protects the EGR Circuit.

At ECU

- A 15A Fuse protects input power to ECU.

Glow Plugs

Glow plugs heat the combustion chambers to help the engine start in cold weather. The glow plugs are energized by the microprocessor during preheat, just before the engine is started.

A defective glow plug (burned out) can be detected by placing a clamp-on ammeter on the H wire to the glow plugs. Normal current draw during preheat is approximately 14 to 16 amps. A current draw in this range means all four glow plugs are working. If the current draw during preheat is less than this, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the wires and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of approximately 2.8 ohms. The current draw for each glow plug should be approximately 4.5 amps.

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.

Electric Standby AC Components for SmartPower Units

Electrical Contactors

⚠ WARNING

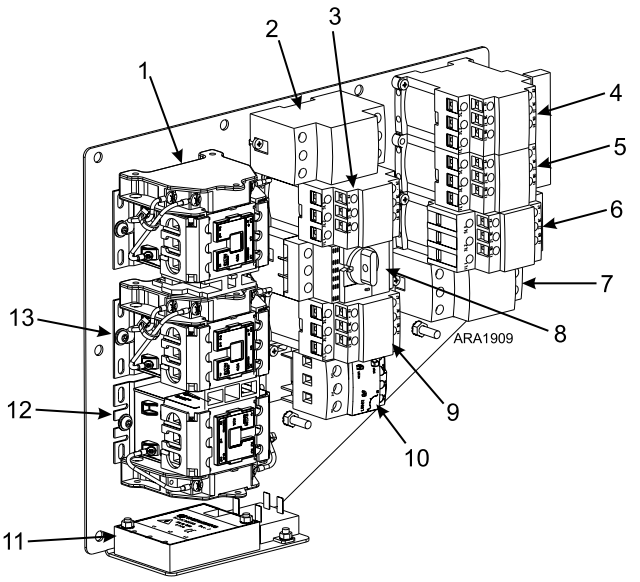
Hazardous Voltage!

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

Periodically inspect all contactor points for pitting or corrosion and repair or replace as necessary. Test the contact points by checking the voltage drop across each set of points when the contactor is energized and the system is operating. If the voltage drop across a set of points is more than 15 Vac, replace the contact points as a set.

Test the contactor coil by checking the voltage across the coil. The contactor coil should be energized by a minimum of 10 Vdc.

Figure 165. High Voltage Box



1.	CC – Compressor Motor Contactor	8.	OLH – Heater Overload Relay
2.	FB1 – Fuse Block 1	9.	HC – Heater Contactor
3.	GC – Generator Contactor	10.	OL – Overload Relay (Compressor Motor)
4.	BC1 – Battery Charger Contactor 1 (460 Vac Only)	11.	PSM – Phase Selection Module
5.	BC2 – Battery Charger Contactor 2 (460 Vac Only)	12.	PC1 – Phase Contactor 1
6.	TRC – Transformer Contactor (460 Vac Only)	13.	PC2 – Phase Contactor 2
7.	FB2 – Transformer Secondary Fuse Block 2 (460 Vac Only)		

Generator Contactor – GC

This contactor is energized while in Diesel operation, and provides 3 Phase AC for the fans and the optional battery charger. It is electrically interlocked with the compressor motor contactor and TRC in 460 Vac systems.

Transformer Contactor – TRC

This contactor is energized while running in electric stand-by and provides the secondary output from the transformer to the fan motors (Condenser and Evaporator). This contactor also provides isolation to the transformer while the unit runs in diesel operation. This contactor is electrically interlocked with the Generator Contactor and BC2.

Battery Charger Contactor 1 – BC1

This contactor is energized while running in electric stand-by and provides 460 Vac three phase power to the optional battery charger. This contactor is mechanically and electrically interlocked with BC2. This contactor is energized at the same time as the TRC.

Battery Charger Contactor 2 – BC2

This contactor is energized while running in diesel operation and provides three phase Vac from the generator to the optional battery charger. This contactor is mechanically interlocked with BC1, and electrically interlocked with the TRC and BC1.

Phase Contactor 1 – PC1

Provides non-corrected three phase power to the system. This is controlled by the Phase Select Module (7EC). This is mechanically interlocked with PC2.

Phase Contactor 2 – PC2

Provides corrected three phase power to the system. This is controlled by the Phase Select Module (7EB). This is mechanically interlocked with PC1.

Compressor Motor Contactor – CC

This contactor provides the three phase power to the motor overload relay. This is electrically interlocked with the GC through the Aux contacts.

Overload Relay – OL

This is the overload relay for the compressor motor. There are three different settings depending on motor size and voltage configuration:

- 230 VAC 12HP, set OL to 34A
- 460 VAC 12HP, set OL to 20A
- 460 VAC 15HP, set OL to 19A
- 460 VAC 16HP, set OL to 21A
- 460 VAC 19HP, set OL to 32A

The OL provides an output to the controller when the overload has tripped (EOL).

Heater Contactor – HC

Is only active when in electric stand-by and the unit requires heat. This contactor is not interlocked with any other contactor.

Heater Overload Relay – OLH

Provides three phase to the Heater Contactor. This is not interlocked with any other contactors.

Fuse Block 1 – FB1

Main fuses for three phase power from Electric Standby (Both 230V and 460V).

Fuse Block 2 – FB2

Fuses for output of transformer (Voltage @ 230 Vac in a 460 Vac system).

Auto Phase System

The Auto Phase System automatically adjusts the phase sequence of the power supply to correspond with the wiring of the electric motor. The main components of the system are the Phase Selection Module (PSM), and the two phase contactors (PC1 and PC1). Contactor PC1 is wired to retain the phase sequence. Contactor PC2 is wired to change the phase sequence. The PSM senses the phase sequence at PC2 and energizes the appropriate phase contactor.

Troubleshooting the Auto Phase System

If the electric motor runs backwards:

1. Turn the electric power supply Off and check the unit wiring. See the appropriate wiring diagrams, schematics, and figure (High Voltage Box "Electrical Contactors," p. 88).
   a. The three wires from the PSM should be connected to the PC2 terminals as follows: Brown wire to terminal T1, Gray wire to terminal T2, and Black wire to terminal T3.
   b. Bus bar/wires L1-01, L2-01, and L3-01 should be connected respectively to terminals T1, T2, and T3 on PC2, and L1, L2, and L3 on PC1.
   c. Bus bar/wires L1A-01, L2A-01, and L3A-03 should be connected respectively to terminals T1, T2, and T3 on PC1, and L3, L2, and L1 on PC2.
   d. Bus bar/wires L1A-02, L2A-02, and L3A-02 should be connected respectively to terminals L3, L2, and L1 on PC2 and L1, L2, and L3 on CC.
   e. Bus bar/wires T1A-01, T2A-01, and T3A-01 should be connected respectively to terminals T1, T2, and T3 on CC and L1, L2, and L3 on OL.
   f. Wires T3 & T9, T2 & T8, and T1 & T7 for the 230 V motor (or T3, T2, and T1 for the 460 V motor) should be connected respectively to terminals T1, T2, and T3 on OL.
   g. Wires L1, L2, and L3 should be connected respectively to terminals X, Y, and Z in the power receptacle.
   h. Wires L1, L2, and L3 should be connected respectively to terminals L1, L2, and L3 on PC1.
   i. The 9-pin wire connector between the PSM and the LV control harness should be clean and tight.
   j. The electric motor must be wired correctly.
2. Check PC1 and PC2 to verify that one of them is not faulty (contacts stuck closed).

3. If all of the wiring is correct, and the relays and contactors are acceptable, but the electric motor still runs backwards, switch the Brown wire and the Black wire from the PSM at PC2: Black to T1, Gray to T2, and Brown to T3. If the electric motor now runs correctly, it is probably wired incorrectly.

If the electric motor does not run at all:

1. Verify that the unit is turned On, that Electric Standby has been selected in the Main Menu, and that the power supply is connected and turned On.
2. Check the CH-06 wire to the PSM for continuity to the CH circuit (chassis ground). If there is no continuity to the CH circuit, check the CH-06 wire for continuity.
3. Check for battery voltage (12 volts) at the 7E-03/7EA wire to the PSM. Battery voltage should be present. If not, check the 7E circuit to pin 1 in the J6 connector on the base controller. Also verify that the microprocessor display is on and that the microprocessor is calling for Heat or Cool.
4. Check for battery voltage at the 7EB-01 and 7EC-01 wires at the PSM. Battery voltage should be present on one of these wires when the correct AC voltage is present on L1, L2, and L3. If battery voltage is not present, the PSM is faulty.
5. Check for battery voltage on the 7EB-01 terminal at PC2 and on the 7EC-01 terminal at PC1. Battery voltage should be present at one of these terminals. If not, check the continuity of the 7EB-01 and 7EC-01 wires.
6. Check the continuity of the RED wires on the phase contactors. The RED wires must have continuity.
7. Check the CH circuits at PC1 and PC2 for continuity to a chassis ground. If the CH circuits do not have continuity to a chassis ground, check the CH wires.
8. Check the continuity of the BLK wires on the phase contactors. The BLK wires must have continuity.
9. If the CH circuits and BLK wires do have continuity to CH, the contactor that has battery voltage present at 7EB-01 (PC2) or at 7EC-01 (PC1) is faulty.

Evaporator Heaters

Test the resistance of each evaporator heater by disconnecting it from the circuit and checking it with an ohmmeter. The resistance of each host evaporator heater should be approximately 53 ohms.

Transformer (460 Vac Units Only)

The transformer is used in units equipped to use 460 Vac for electric standby operation. The transformer converts 460 Vac to 230 Vac to power the condenser and evaporator fans.

Test the transformer as follows:

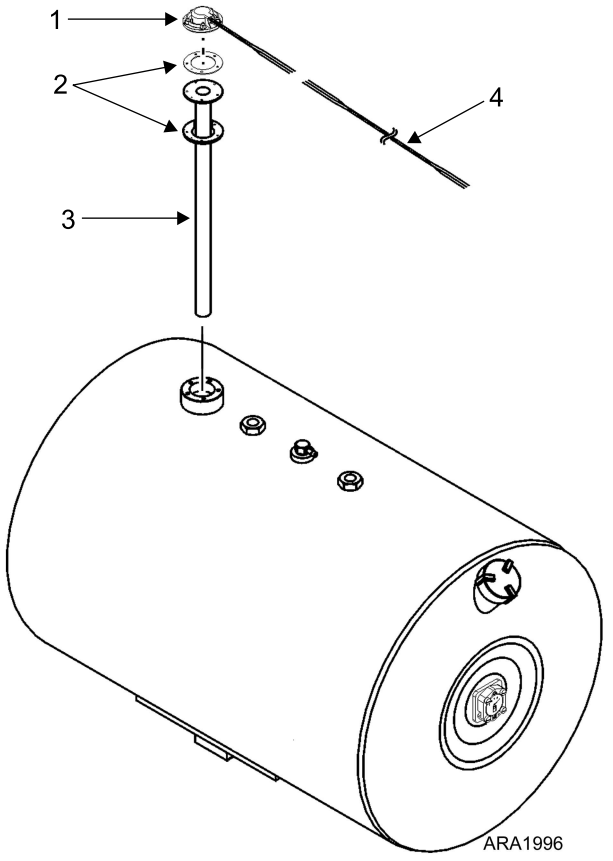
1. Connect the electric standby power receptacle to a 460 Vac power supply.
2. Check for AC voltage between the primary terminals H1, H2, and H3 on transformer.
   a. Approximately 460 Vac should be present between each pair.
   b. If the voltage is not acceptable, check the power supply and check the L1, L2, and L3 circuits (including any contactors), the FB-1, FB-2, and FB-3 fuses, and the TH1-01, TH2-01, and TH3-01 circuits back to the transformer for continuity.
   c. If the voltage is acceptable, proceed to the next step.
3. Check for AC voltage between the secondary terminals X1, X2, and X3 on the transformer.
   a. Approximately 230 Vac should be present between each pair. If not, the transformer is probably faulty.

Ultrasonic Fuel Level Sensor

The ultrasonic fuel level sensor (if used) is mounted to a flange on top of the fuel tank. The ultrasonic fuel level sensor consists of a sensor, a sensor tube (or focus tube), and two gaskets. The sensor is a transducer that emits ultrasonic sound waves. The sound waves reflect off the fuel in the sensor tube and return to the transducer. The transducer senses the reflected sound waves and determines the fuel level in the sensor tube.

Ultrasonic fuel level sensors are calibrated for use with fuel tanks of particular size and shape. Refer to the appropriate unit Parts Manual for the correct part numbers.

Figure 166. Fuel Level Sensor



1.	Ultrasonic Fuel Level Sensor
2.	Gaskets
3.	Sensor Tube
4.	Sensor Cable

The ultrasonic fuel level sensor and the fuel gauge on the end of the fuel tank measure the fuel level differently. The ultrasonic fuel level sensor measures the actual volume of fuel in the tank. The fuel gauge measures the height of the fuel in the tank. Therefore, the fuel level at which fuel level sensor reading and the fuel gauge reading agree closely is at 50% or 1/2 full. The readings at other fuel levels may not agree as closely. If you think the ultrasonic fuel level sensor is not working correctly, the best thing to do is to check the output voltage as shown in step 4 below. The output voltage should be between approximately 1.0 Vdc for an empty tank to 4.0 Vdc for a full tank.

Check the operation of the fuel level sensor as follows:

1. Use the GAUGES Menu to display the Fuel Level Sensor reading and compare it to the reading of the fuel gauge on the end of the fuel tank. The Fuel Level Sensor reading should be approximately 50% when the fuel gauge reads 1/2 full.
2. Check to verify that the Fuel Sensor Type is set to Solid State in Unit Configuration in the Guarded Access Menu.
3. Turn the unit on and check for battery voltage (12 Vdc) between the 8F (J1-1 pin) and FUELN (J1-3 pin) wires in the sensor harness at the J1 connector on the base controller. This is the input voltage. If battery voltage is not present, check the microprocessor.
4. If battery voltage is present, check the output voltage between the FUEL (J1-2 pin) and FUELN (J1-3 pin) wires in the main/unified harness at the J1 connector on the base controller. The voltage should be between 1 and 4 Vdc depending on the fuel level as shown the following table:

Fuel Level	Output Voltage
Empty	Approximately 1.0 Vdc
1/2 Full	Approximately 2.5 Vdc
Full	Approximately 4.0 Vdc

Note: *The output voltages listed above are for the ultrasonic fuel level sensor designed to be used with the SR-2, SR-3, and SR-4 Controllers. Other systems such as third party telematics systems may use sensors with slightly different output voltages. Refer to the sensor specifications for those sensors.*

5. If the output voltage is incorrect, check the continuity of the wires that go from the J1 connector on the base controller to the sensor as shown in the following table and verify the connections are clean and tight.

Note: *The sensor cable wires are connected to the sensor wires with solder connections and heat shrink tubing during installation. See the Precedent Multi-Temperature Systems Installation Manual (TK 55745-2-IM) for more information.*

J1 Connector Pin	Main/Unified Harness Wire	Sensor Cable Wire	Sensor Wire
1	8F-01	Green	Red
2	FUEL-01	White	Yellow
3	FUELN-01	Black	Black

6. If the wires have good continuity and the connections are clean and tight, replace the sensor.

Important USFLS Replacement Information

Note: *This procedure covers replacing the sensor. For information about installing the USFLS Kit on a unit that does not already have a USFLS, see the Precedent Multi-Temperature Systems Installation Manual (TK 55745–2–IM) for more information.*

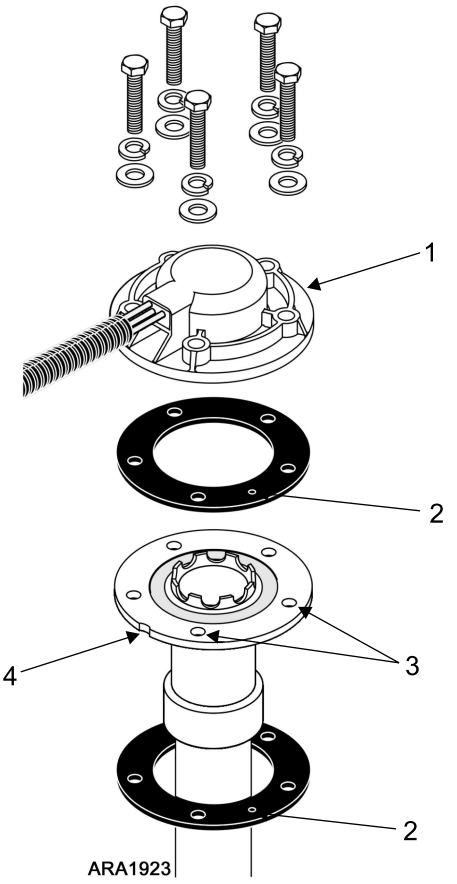
- **DO NOT** connect power to the UFLS until it has been installed into the fuel tank.
- **DO NOT** use thread locking compounds as they can cause stress cracking of the plastic sensor.
- **DO NOT** apply any type of gasket sealer.
- **USE ONLY** new gaskets. Order new gaskets when ordering the replacement sensor.
- **DO NOT** use power tools to tighten the mounting hardware or damage to the plastic sensor will result.
- **DO NOT** overtighten the mounting hardware or damage to the plastic sensor will result.

1. Remove and discard the sensor and the gaskets. DO NOT reuse the gaskets.
2. Check the gasket between the sensor tube and the tank to verify it is in good condition. Replace if necessary.
3. Confirm the gasket surface areas on the tank flange and the sensor tube are clean.

Pre-Assembly

The mounting holes of the sensor, sensor tube, gaskets, and the fuel tank flange are not symmetrical. The holes align only in one position. The distance between the two mounting holes next to the notch (Figure 167, p. 92) are further apart than the others. These two holes will be used as a reference point to correctly align the components.

Figure 167. USFLS Components



1.	Sensor
2.	Pin Holes
3.	Mounting Hole Reference
4.	Notch

4. The UFLS assembly should be pre-assembled before installing it into the fuel tank.
   a. Slide a gasket up the sensor tube to the flange, verifying the pin hole in the gasket is centered between the two mounting holes next to the notch as shown (Figure 167, p. 92).
   b. While holding the lower gasket in place, place the upper gasket onto the sensor tube flange, again verifying the pin hole in the gasket is positioned between the two mounting holes next to the notch as shown (Figure 167, p. 92).
   c. Place the sensor on top of the upper gasket with the harness pointing towards the notch on the sensor tube flange. All holes should now be aligned.
   d. Install the 10-32 screws, lock washers, and flat washers onto the sensor and through the gasket holes to hold the assembly together.

Installation In Tank

5. Insert assembly into fuel tank verifying the notch on the sensor tube is aligned with the notch on the tank flange. When installed correctly, the sensor harness will be pointed towards the fuel fill on the end of the tank.
   a. Hand tighten the five mounting screws in a criss-cross pattern and torque them to 10-15 in-lbs (1.1-1.7 N•m).
   b. DO NOT overtighten the mounting hardware or damage to the plastic sensor will result.
   c. The fuel tank is now ready to be reinstalled.

Wire Connections

6. Cut the sensor cable wires (or old sensor wires) to the appropriate length and splice them to the new sensor wires using solder connectors (P/N 41-5210) and heat shrink tubing (P/N 92-846) as follows:

Sensor Cable Wire	Sensor Wire
Green	Red
White	Yellow
Black	Black

Important: *DO NOT burn the heat shrink. If the heat shrink is burnt, charred, or has bubbles from overheating, the wire connections must be removed and redone correctly.*

Electric Fuel Heater (Optional)

An electric fuel heater is optional equipment on these units.

Operation

The electric fuel heater has an internal thermostat that closes at 30 F (-1 C) minimum, and opens at 75 F (24 C) maximum.

When the unit is turned On (and SmartPower units are in Diesel Mode) and is running, the 8FH circuit is energized. This energizes the Fuel Heater Relay and closes its contacts.

With the relay contacts closed, the 2A circuit provides power to the fuel heater, which will heat up if its internal thermostat is closed. The current through the fuel heater is 11.4 to 13.9 amps at 12.5 Vdc.

Note: *The electric fuel heater does not function when the unit is in the Electric Mode (electric standby operation), the Null Mode, or during the non-running portion of the Pretrip Test.*

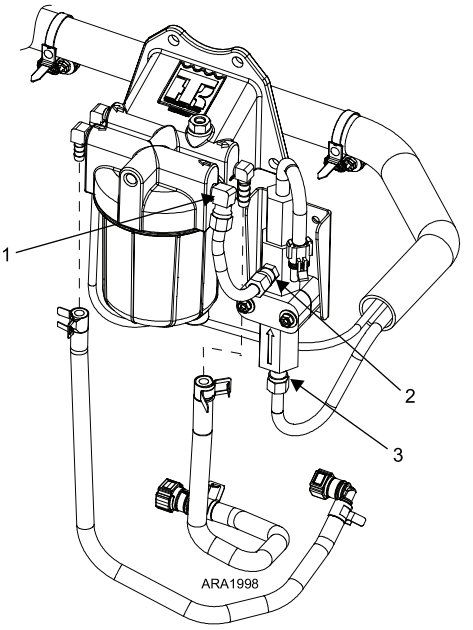
Components

The main components of the electric fuel heater option are listed below:

- Electric Fuel Heater
- Mounting Bracket and Hardware
- Fuel Heater Harness (includes the following)
  - Fuel Heater Relay
  - 2FH/2HP Fuse (20 amp)

The electric fuel heater is mounted next to the fuel filter as shown (Figure 168, p. 93). The inlet line to the fuel filter is moved to the electric fuel heater inlet. A short fuel line is added between the electric fuel heater outlet and the fuel filter inlet. The relay and fuse are mounted inside the control box.

Figure 168. Electric Fuel Heater



1.	Fuel Filter Inlet
2.	Electric Fuel Heater Outlet
3.	Electric Fuel Heater Inlet

The wires in the fuel heater harness are connected to the unit as follows:

- The 2A wire is attached to the 2A (J25) screw terminal on the base controller.
- The 8FH-02 wire is connected to the 8FH-01 wire in the main/unified wire harness (inside the control box), which is connected to pin 22 in the J4 connector on the base controller.
- The CH wires are connected to the CH ground plate behind the battery.

Diagnosis

Use the following procedure to diagnose the electric fuel heater:

1. Disconnect the electric fuel heater from the fuel heater harness at the 2-pin connector located near the electric fuel heater.

2. Check the resistance of the electric fuel heater by checking the resistance between the two terminals in the 2-pin connector on the wires to the electric fuel heater. The resistance should be 0.9 to 1.1 ohms.

   Note: *The temperature of the electric fuel heater must be below 30 F (-1 C) to verify the internal thermostat closes.*

   a. If the resistance is acceptable, proceed to Step 3.

   b. If the resistance is very high, indicating an open circuit, check the temperature of the electric fuel heater using a non-contact thermometer.

   c. The temperature of the electric fuel heater must be below 30 F (-1 C) to close the internal thermostat.

   d. If the temperature of the electric fuel heater is below 30 F (-1 C) and high resistance indicates an open circuit, the electric fuel heater is most likely defective and should be replaced.

   e. If the resistance is significantly less than 0.9 ohms, the heating element is most likely defective and the electric fuel heater should be replaced.

   Note: *The unit must be turned on and running in Diesel Mode for the rest of the procedure.*

3. If the resistance of the electric fuel heater is acceptable, turn the unit on and let the engine start.

   a. Check the voltage between the 2HP and CH wires in the fuel heater harness at the 2-pin connector that was disconnected from the electric fuel heater in Step 1.

   b. Battery voltage should be present between the 2HP and CH wires.

4. If battery voltage is not present, check for continuity to ground on the CH wire between the 2-pin connector and the CH ground plate.

5. If the CH wire has good continuity to ground, check for an open 2FH/2HP Fuse in the fuel heater harness.

6. If the 2FH/2HP Fuse is not open, check the continuity of the 2FH and 2HP wires between the Fuel Heater Relay and the 2-pin connector.

7. If the 2FH and 2HP wires have good continuity, check for battery voltage on the 2A-03 wire at the Fuel Heater Relay.

   a. If battery voltage is not present, check the continuity of 2A-03 wire between the Fuel Heater Relay and the 2A (J25) screw terminal on the base controller.

   b. Verify the 2A-03 wire connection at the 2A (J25) screw terminal is clean and tight.

8. If battery voltage is present on the 2A-03 wire at the Fuel Heater Relay, check for battery voltage on the 8FH-02 wire at the Fuel Heater Relay.

   a. If battery voltage is not present, check the continuity of 8FH-02 and 8FH-01 wires between the Fuel Heater Relay and pin 22 in the J4 connector on the base controller.

   b. Verify the wire connections are clean and tight.

9. If battery voltage is present on the 8FH-02 wire at the Fuel Heater Relay, check for a defective Fuel Heater Relay.

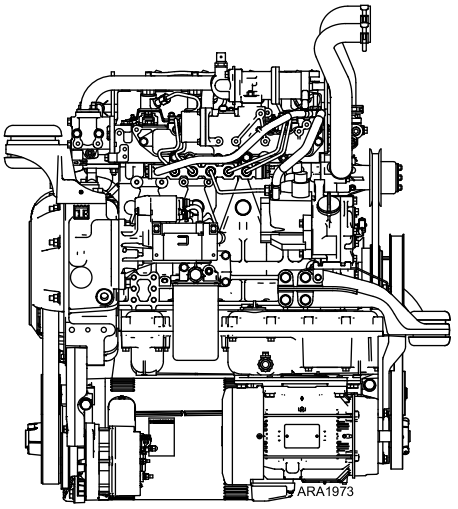
Engine Maintenance

TK488CR Diesel Engine

This unit uses a new engine called the TK488CR. CR stands for “Common Rail” fuel injection system, which used electronically controlled fuel injectors to reduce emissions. An Exhaust Gas Recirculation (EGR) system and Diesel Oxidation Catalyst (DOC) exhaust after-treatment system also reduce emissions so the engine is EPA Tier 4 compliant. An Engine Control Unit (ECU) monitors and controls engine operation. The unit controller indirectly monitors and controls the engine through the ECU.

Other than the fuel system, EGR, and DOC, the TK488CR is mechanically similar to the TK486. The bore of the TK488CR is 88 mm versus 86 mm for the TK486, so the displacement for the TK488CR is 2.2 liters versus 2.1 liters for the TK486.

Figure 169. TK488CR



TK488CR Engine Service

Refer to the Yanmar TNV Series Engine Service Manual (TK 55584) for engine service information not included in this manual.

Connect a PC with the Yanmar Smart Assist Direct (YSAD) diagnostic tool to the ECU to view the Yanmar engine Diagnostic Trouble Codes (DTC) and troubleshoot engine problems. Thermo King alarm codes 600 through 699 indicate DTCs are recorded in the ECU.

Refer to Service Procedure A60A in the SR-4 Multi-Temp Microprocessor Control System Diagnostic Manual (TK 55788) for more information about using YSAD to connect to the ECU.

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.*

Severe Duty Filtration Package (Optional)

The Severe Duty Filtration Package consists of the following items and allows the maintenance interval for these items to be extended to 4,000 hours under normal operating conditions.

- Severe Duty Air Cleaner Element
- Severe Duty Fuel Filter
- Severe Duty Oil Filter (black with white lettering)

Units equipped with the Severe Duty Filtration Package have the nameplate shown below on the air cleaner housing.

Figure 170. Severe Duty Filtration Package Nameplate

Engine Lubrication System

The TK488CR engine uses a pressure lubrication system similar to the that in the TK486.

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 12 quarts (11.4 liters) 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.

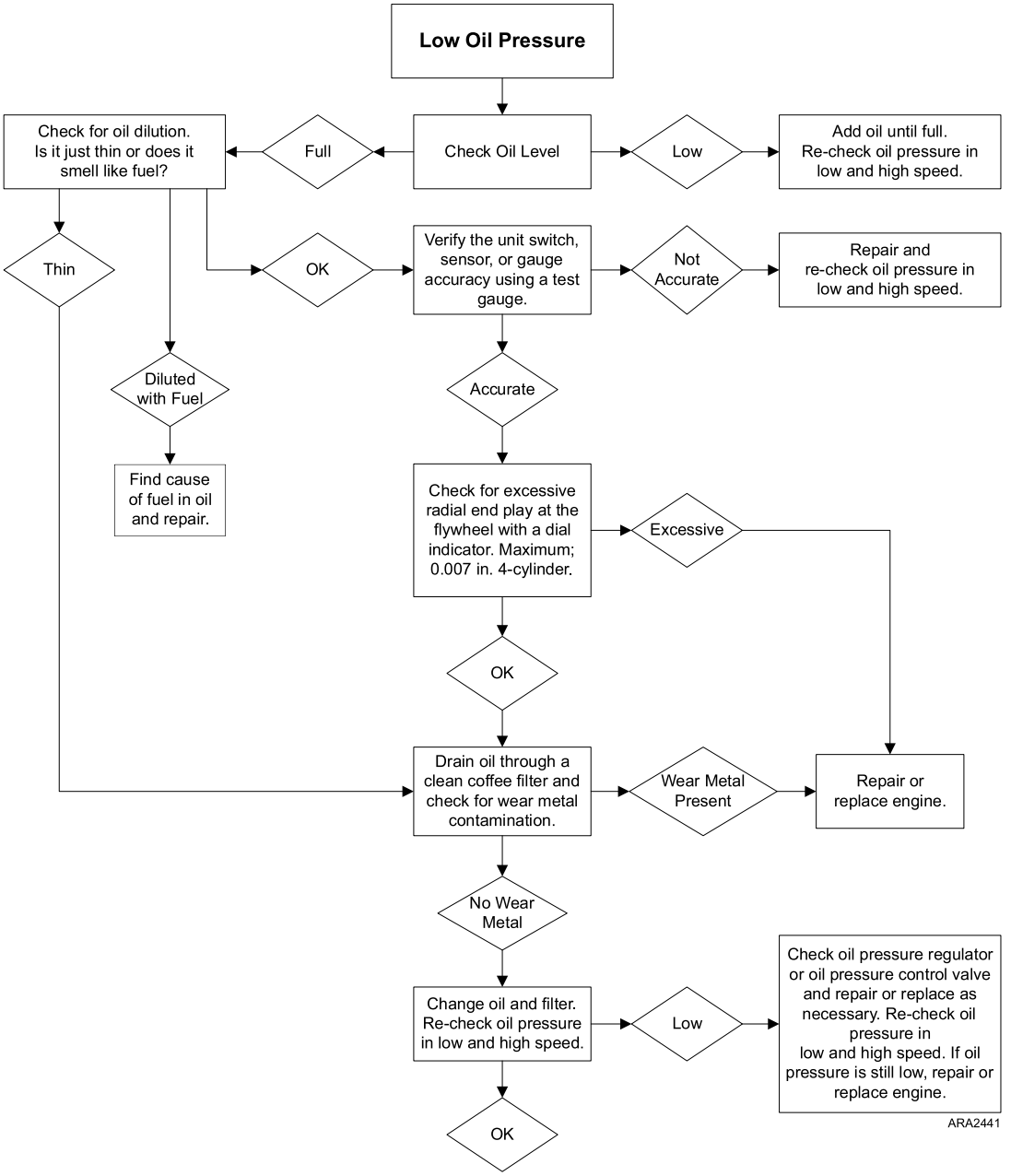
1. Remove the filter.
2. Fill the new oil filter with clean engine oil.
3. Apply oil to the two inner O-rings of the new filter and install the filter.
4. Hand tighten the filter until it seats firmly. The exposed dust seal ring, if equipped, does not need to be compressed.
5. Start the unit and check 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 171, p. 97) to help diagnose low oil pressure.

Figure 171. 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 (located behind the starter) 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 TK488CR/CRH 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

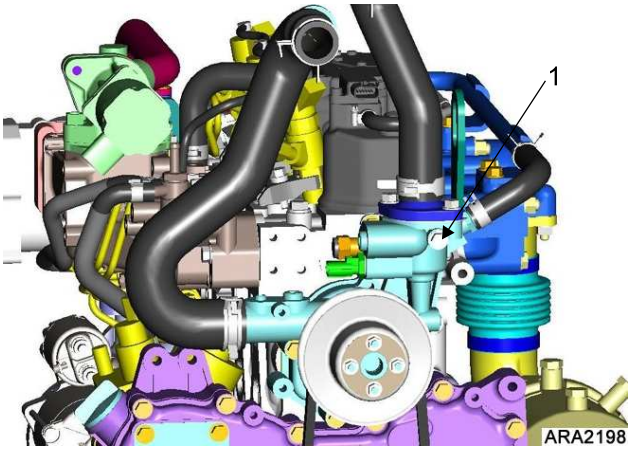
Equipment Damage!

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 172, p. 99).
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 172. 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.

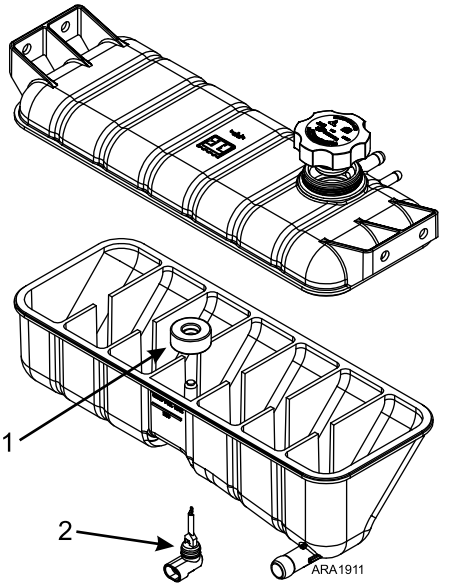
Engine Thermostat

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

Coolant Level Switch

The plastic 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 173. Plastic Expansion Tank



1.	Float
2.	Coolant Level Switch

Note: *Figure 173, p. 99 shows the expansion tank in two pieces. The two pieces are bonded together when the tank is assembled, so it cannot be disassembled, but the coolant level switch can be replaced.*

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. Turn the coolant level switch 1/4 turn to loosen it and remove it from the tank.
3. Place the new coolant level switch in the tank. Align the tabs on the switch with the slots in the tank and turn the switch 1/4 turn to tighten it.
4. Connect the wire harness connector to the coolant level switch.

Engine Fuel System

The TK488CR engine uses a common rail fuel injection system.

The components of the fuel system are:

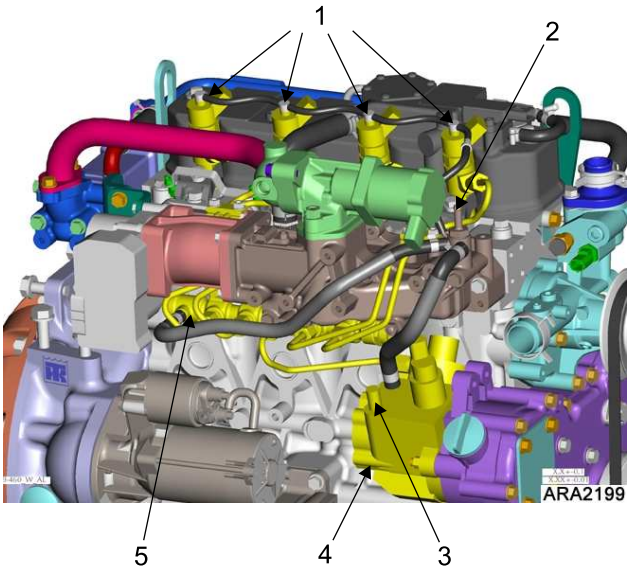
- Fuel tank
- Electric fuel pump (with pre-filter, 30 micron)
- Primary Fuel filter/water separator (5 micron)
- High pressure fuel pump
- Common (high pressure fuel) rail
- Electronic injection nozzles

Operation

Fuel is drawn from the fuel tank by the electric fuel pump, which pushes fuel to the fuel filter/water separator. Filtered fuel passes through a line from the outlet fitting on the filter base to the high pressure fuel pump.

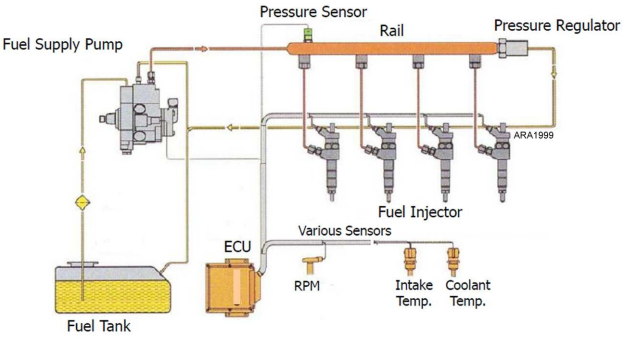
The high pressure fuel pump supplies high pressure fuel to the common rail. The common rail acts as a reservoir for the high pressure fuel and supplies the high pressure fuel to the electronic injection nozzles, which inject fuel when energized by the ECU. The ECU monitors multiple sensors to determine the timing and duration of the fuel injection pulses.

Figure 174. Fuel Injection Components on Engine



1.	Electronic Injection Nozzles
2.	Return Fuel Port
3.	Supply Fuel Port
4.	High Pressure Fuel Pump (Fuel Supply Pump)
5.	Common Rail

Figure 175. Fuel System



Fuel Line Routing

Starting in the second quarter of 2018 the electric fuel pump comes factory installed on a bracket inside the

curbside of all Precedent units. Prior to that only units equipped with the DRC or RBC rail options had the electric fuel pump mounted inside the unit. On other units the electric fuel pump was mounted near the fuel tank during installation in the field.

The fuel lines from the fuel tank connect to fittings on the electric fuel pump and the fuel filter. Do not change the factory routing of the fuel lines from the electric fuel pump to the fuel filter or from the fuel filter to the high pressure fuel pump. Refer to the fuel line routing diagrams in TK 55849-2-DM.

Fuel System Fittings

Important: *Using the wrong fuel system fittings may void your engine warranty! All Thermo King supplied fuel line fittings (except fuel line connector) are nickel plated brass for Precedent units.*

DO NOT use fuel fittings (main body) made of brass, copper, zinc, zinc plated or galvanized steel where it would make direct contact with flowing diesel fuel. Diesel fuel flowing through these types of fittings allows those metals to leach into the fuel forming deposits on the injector tips which fouls them prematurely.

Fuel fitting nuts, compression sleeves, and fuel line connectors made of brass are acceptable because diesel fuel does not flow across their surfaces.

Do not use PTFE (Polytetrafluoroethylene) thread sealing tape on the fuel fittings in a Precedent unit. PTFE tape may allow strands into the fuel system that could plug up the tight clearance fuel injectors causing failures.

Maintenance

Contamination is the most common cause of fuel system problems. To ensure best operating results, the fuel must be clean and fuel tanks free of contaminants. Change the fuel filter/water separator regularly and inspect/clean the electric fuel pump filter.

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

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.

The following procedures can be accomplished under field conditions:

- Bleeding air from the fuel system.
- Fuel tank and filter system maintenance.
- Electric fuel pump replacement or repair.
- High pressure fuel pump replacement or repair.
- Injection line replacement.
- Common (high pressure fuel) rail replacement.
- Electronic injection nozzles replacement.

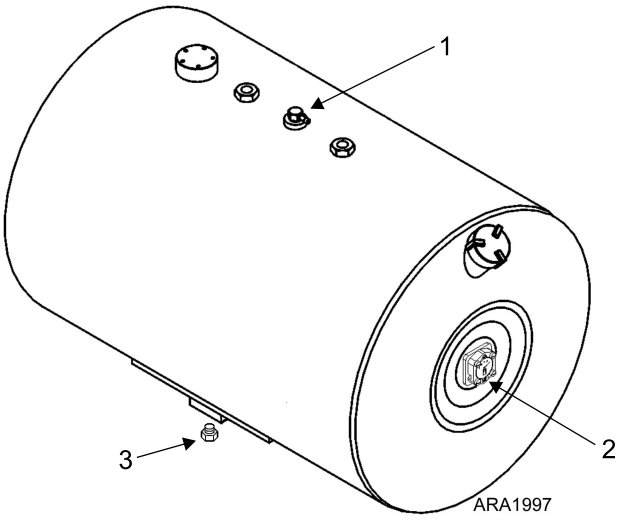
Bleeding the Fuel System

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 to prevent interrupted unit operation or possibly severe damage to the high pressure fuel pump. Never attempt to purge air and prime the high pressure fuel pump by cranking the engine with the starter.

To bleed air from the fuel system:

1. Turn the unit on and use Prime Fuel System in the Main Menu (or energize the Run Relay in the Output Test Mode) to energize the electric fuel pump. Refer to the appropriate Diagnostic Manual for specific information about Prime Fuel System (or the Output Test Mode).
2. Run the electric fuel pump for 1 to 2 minutes to bleed the air from the system.
3. Use Prime Fuel System (or de-energize the Run Relay in the Output Test Mode) to de-energize electric fuel pump.
4. 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.
   a. Verify 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.

Figure 176. Fuel Tank



1.	Vent
2.	Fuel Gauge
3.	Drain Plug

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 Filter/Water Separator

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

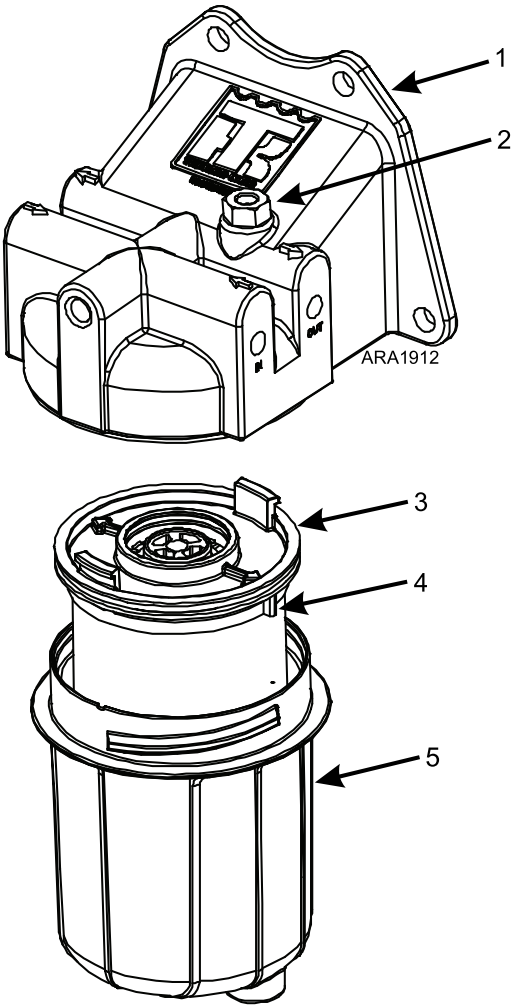
Fuel Filter/Water Separator Replacement

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

1. Unscrew the filter bowl 1/4 turn and remove it and the filter element (Figure 177, p. 103). Drain the fuel from the filter bowl and properly dispose of the filter element.
2. Clean the filter bowl and the filter head.
3. Lubricate the top inside edge of the filter bowl with oil.
4. Lubricate the O-ring in the top of the filter element with oil.
5. Place the filter element in the filter head with the tabs (and arrows) on the filter element aligned with the slots (and arrows) in the filter bowl. Verify that the filter element is fully seated in the filter bowl.
6. Install and tighten the filter bowl about 1/4 turn until you hear and/or feel it click.

   Note: *Do not fill the filter bowl with fuel before installing it.*
7. Loosen the bleed screw on the filter head about one turn.
8. Turn the unit on and use Prime Fuel System in the Main Menu (or energize the Run Relay in the Output Test Mode) to energize the electric fuel pump. Refer to the appropriate Diagnostic Manual for specific information about Prime Fuel System (or the Output Test Mode).
9. Run the electric fuel pump until air bubbles are no longer visible in the fuel coming out of the bleed screw.
10. Tighten the bleed screw and check to verify there are no leaks.
11. Use Prime Fuel System (or de-energize the Run Relay in the Output Test Mode) to de-energize electric fuel pump.
12. 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 procedure steps 7 through 12.

Figure 177. Fuel Filter/Water Separator Assembly

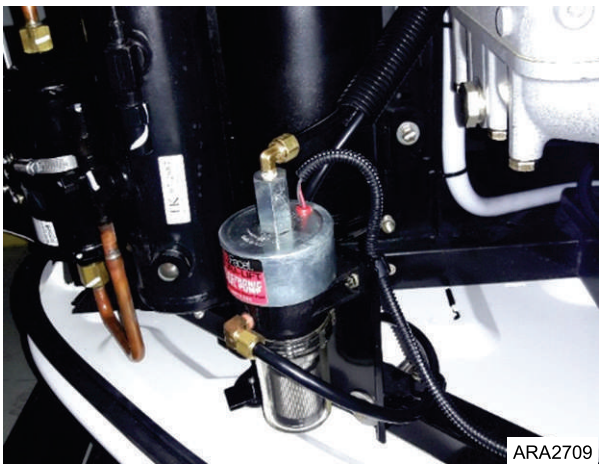


1.	Filter Head	4.	Filter Element
2.	Bleed Screw	5.	Filter Bowl
3.	Filter Element Tab		

Electric Fuel Pump

Starting in the second quarter of 2018 the electric fuel pump comes factory installed on a bracket inside the curbside of all Precedent units. Prior to that only units equipped with the DRC or RBC rail options had the electric fuel pump mounted inside the unit. On other units the electric fuel pump was mounted near the fuel tank during installation in the field.

Figure 178. Electric Fuel Pump Mounted Inside Unit



Operation

1. Verify the CHFP/black wire completes a good ground with the battery.
2. Check the voltage at the 8DF/red wire in the harness. The pump will not operate at less than 9 Vdc.
3. The electric fuel pump is self priming as long as there are no restrictions or leaks in the fuel line and fittings between the fuel tank and the electric fuel pump.

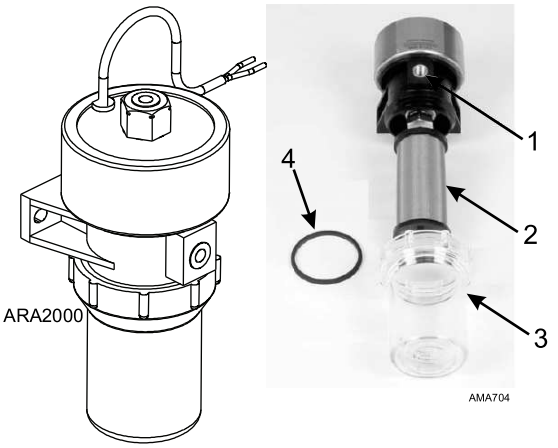
Maintenance

The fuel pump filter should be cleaned whenever the oil is changed. The filter and gasket are replaceable, but the pump cannot be repaired. It must be replaced if it is defective.

Disassembly

1. Unscrew and remove the fuel filter bowl.
2. Unscrew the fuel filter.
3. Wash the fuel filter in cleaning solvent and blow out the dirt and cleaning solvent with compressed air.
4. Clean the fuel filter bowl.
5. Check the fuel filter bowl gasket and replace if necessary.

Figure 179. Electric Fuel Pump



1.	Fuel Inlet	3.	Fuel Filter Bowl
2.	Fuel Filter	4.	Fuel Filter Bowl Gasket

Assembly

1. Screw the fuel filter back into the pump housing (finger tight).
2. Place the fuel filter bowl gasket in place and hand tighten (or 100 in-lb [11.3 N•m]) the fuel filter bowl.

If the pump does not operate, check for:

- A good ground on the black wire pin of the pump harness.
- More than 9 Vdc on the red wire pin of the pump harness.
- Clean and tighten the electrical connections.
- The pump voltage and polarity must be the same as the unit system.

If the pump operates but does not deliver fuel, check for:

- Air leaks in the fuel lines or connections.
- Kinks or other restrictions in the fuel lines.
- A leaking or distorted fuel bowl gasket.
- A clogged or dirty filter.

Electric Fuel Heater (Optional)

See "Electric Fuel Heater (Optional)," p. 93 in Electrical Maintenance for information about the electric fuel heater.

Exhaust Gas Recirculation (EGR) System

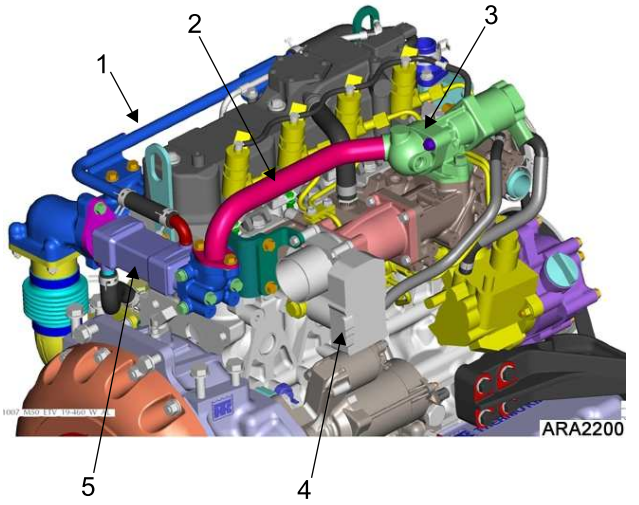
The Exhaust Gas Recirculation (EGR) system recirculates cooled exhaust gas to engine intake to reduce NOx emissions.

The EGR system should be inspected and cleaned (if necessary) every 3,000 hours.

Important: *Always wear appropriate Personal Protective Equipment (PPE) when cleaning the EGR system. This includes safety glasses, rubber gloves, and a respirator.*

1. Remove the EGR pipe from between the EGR cooler and the EGR valve.
2. Inspect the EGR pipe and other components for carbon deposits and clean as necessary.
3. Reinstall the EGR pipe (and other components if removed) and only use new gaskets.

Figure 180. EGR Components



1.	Coolant Pipe to EGR Cooler
2.	EGR Pipe
3.	EGR Valve
4.	Intake Air Throttle Valve
5.	EGR Cooler

Cleaning EGR Valve

The EGR valve should be visually inspected each 3,000 hours for the engine to remain emissions compliant. Clean the valve as necessary. If an EGR valve remains in service longer than 3,000 hours, the difficulty and time required to clean the EGR valve increases. This procedure should also be used if there is an active Diagnostic Trouble Code DTC that indicates a problem with the EGR valve.

Use Active Control in YSAD to open the EGR valve after removing it from the engine as shown in the following drawing. See "Using YSAD to Connect to ECU" for more information about connecting YSAD.

Important Notes About Cleaning the EGR Valve:

- Do not dismantle the EGR valve to clean it. The valve may not function properly when reassembled.

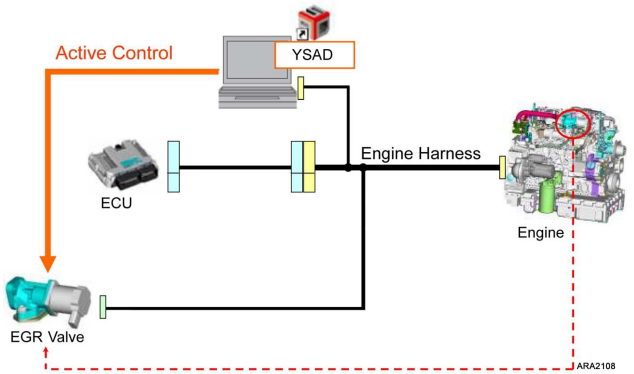
- Do not use liquid solvent to soak the valve, or spray liquid solvent into the valve. If liquid enters the valve motor it may be damaged and will not function properly.
- Use a soft or plastic brush. Do not use a metal brush. A metal brush will scratch the valve face and valve seat, which will cause the valve to leak when fully closed. This will reduce engine performance.
- Use a soft or plastic brush to remove carbon from valve face and valve seat. Carbon deposits on the valve face and valve seat will cause the valve to leak when fully closed. This will reduce engine performance.

⚠ CAUTION

Risk of Injury!

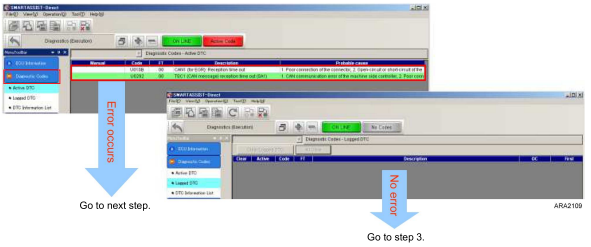
Do not insert your finger into the space between the valve face and valve seat. The valve may close unexpectedly and injure your finger.

Figure 181. Using Active Control to Open EGR Valve



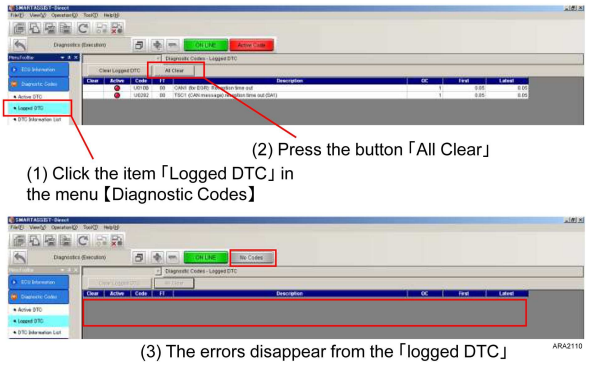
1. Attach YSAD to the ECU/engine harness.
2. Check and clear any Diagnostic Trouble Codes (DTC) as required.
   a. Click on Diagnostic Codes to view any active DTCs.

Figure 182. Check for Active DTCs



   b. Clear the active DTCs as shown below.

Figure 183. Clear Active DTCs



3. Detach the EGR valve from the collector, but keep the EGR valve connected to the harness.
4. Use YSAD Active Control to open the EGR valve for inspection and cleaning as shown below.

Figure 184. Use YSAD Active Control to Open EGR Valve

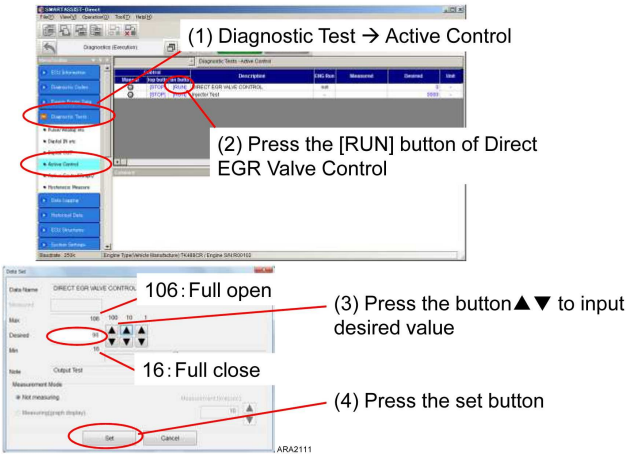
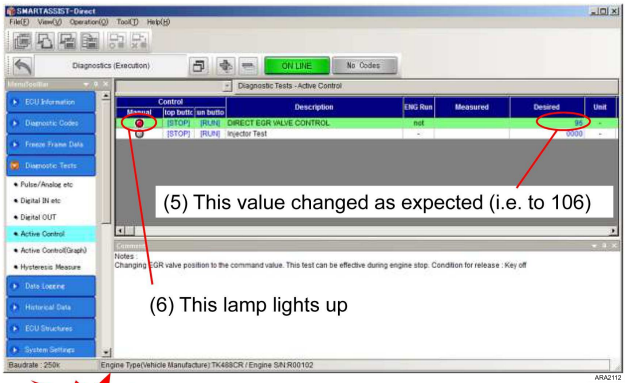


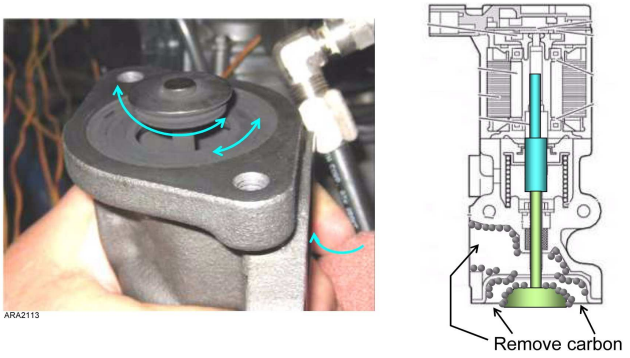
Figure 185. YSAD Showing EGR Valve Opened with Active Control



NOTE: Do not close the ERG valve during cleaning!!!

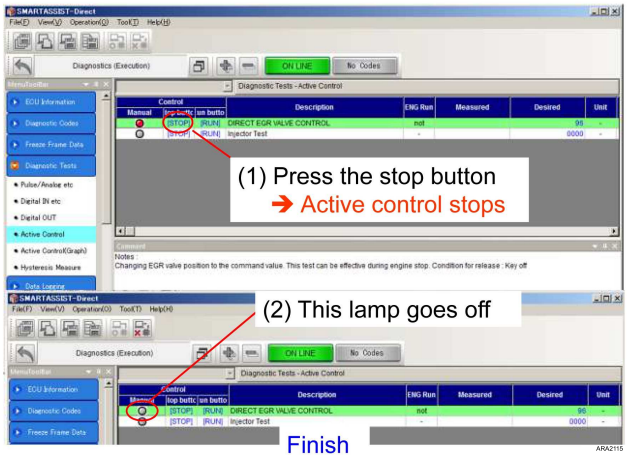
5. Using a soft or plastic brush, remove stubborn deposits (e.g., carbon) from the surfaces of the EGR valve, valve seat, and housing as shown below. Do not use a metal brush or scraper or damage will result. Visually inspect the EGR valve

Figure 186. Removal of Stubborn Deposits



6. Once the deposits are removed from the EGR valve, wipe the valve and seat interface clean using a shop rag dampened with brake parts cleaner or similar solvent. Do not soak the valve guide and valve shaft interface, and do not spray the EGR valve with parts cleaner or damage will result.
7. Dry the EGR valve and return it to service by reattaching it to the collector.
8. Use YSAD to stop Active Control of the EGR valve as shown below.

Figure 187. Use YSAD to Stop Active Control of EGR Valve



9. Close and disconnect YSAD, and reassemble the EGR system components.

Cleaning EGR Cooler

The EGR cooler must be cleaned each 3000 hours for the engine to remain emissions compliant. If an EGR cooler remains in service longer than 3000 hours, the difficulty and time required to clean the EGR cooler increases.

The following procedure along with the Soot Scrubber cleaning solution, is the only approved method to clean the EGR cooler. Soot Scrubber and the black rubber stoppers are included in the EGR System Cleaning Kit (P/N 203-799).

Important:

1. *Always wear appropriate Personal Protective Equipment (PPE) when cleaning the EGR Cooler and the EGR system. This includes safety glasses, rubber gloves, and a respirator.*
2. *Dispose of used soot scrubber solution in accordance with local environmental regulations. The used solution may contain heavy metals and petroleum products. The used solution should be considered hazardous waste unless declared otherwise by your local environmental agency.*

NOTICE

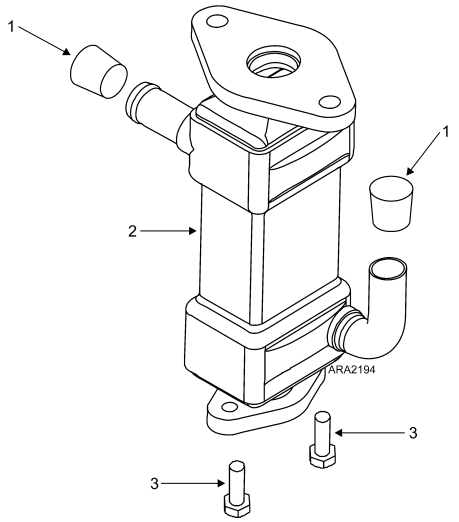
Equipment Damage!

Never use the Soot Scrubber cleaning solution on any material except stainless steel. It will cause accelerated corrosive damage of the material, especially the aluminum body of the EGR Valve.

1. Remove the EGR cooler from the engine.
2. Use the two provided black rubber stoppers to plug coolant inlet and outlet.
3. Thread two screws (use the two screws which mount the EGR cooler to the outlet tube) into the flange end. These serve to space the flanged end of the EGR cooler off of the bottom of the heated bath, allowing natural circulation during the chemical reaction of the Soot Scrubber on the deposits.
4. Mix 1-part standard concentration Soot Scrubber with 3-parts water at 120 F. Use one quart Soot Scrubber for 1-gallon final volume.

   Note: *Thermo King recommends using the TK heated cleaning bath tool (P/N 204-2379) to keep the cleaning solution at 120 F.*
5. Orientate the EGR cooler vertically in the cleaning bath as shown (Figure 188, p. 107) to allow the soot deposits to fall out and not get trapped in the EGR cooler. Continuously heat the solution to 120 F with the EGR cooler submerged.
6. Soak for 2.5 hours.
7. Drain the solution from the EGR cooler and visually inspect.
8. Once the deposits are removed from the EGR cooler, rinse clean with water.
9. Dry the EGR cooler and reinstall on the engine.

Figure 188. Cleaning EGR Cooler

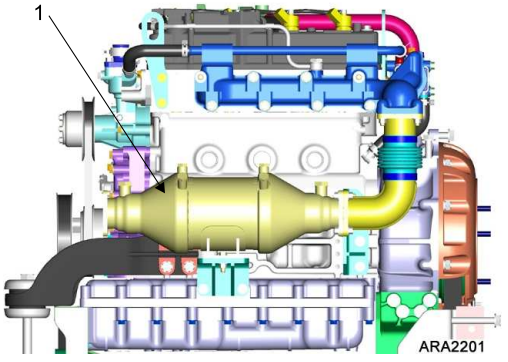


1.	Plug coolant inlet and outlet ports.
2.	EGR Cooler
3.	Thread the two M8 screws which mount the EGR cooler to the outlet tube into flange end.

Diesel Oxidation Catalyst (DOC) System

The Diesel Oxidation Catalyst (DOC) is an exhaust after-treatment system similar to a catalytic converter used on a gasoline engine in a car. It is located on the back of the engine.

Figure 189. Back View of Engine



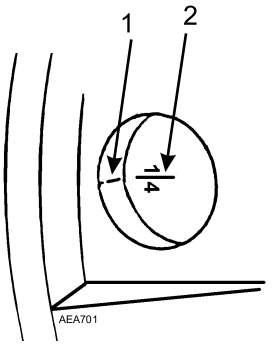
1.	DOC

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.
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.

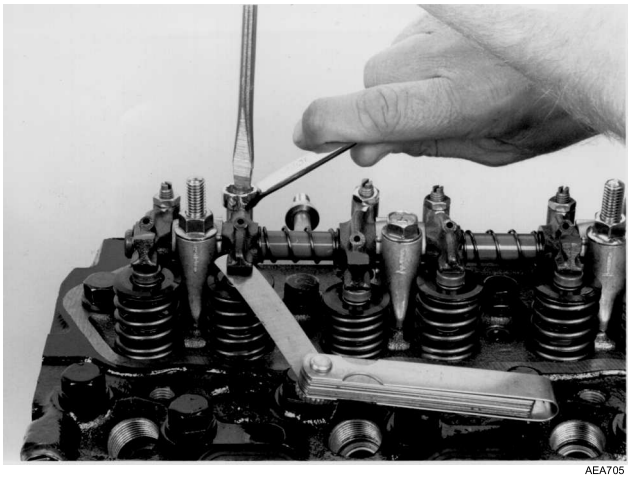
Figure 190. Top Dead Center One and Four



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 191. 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

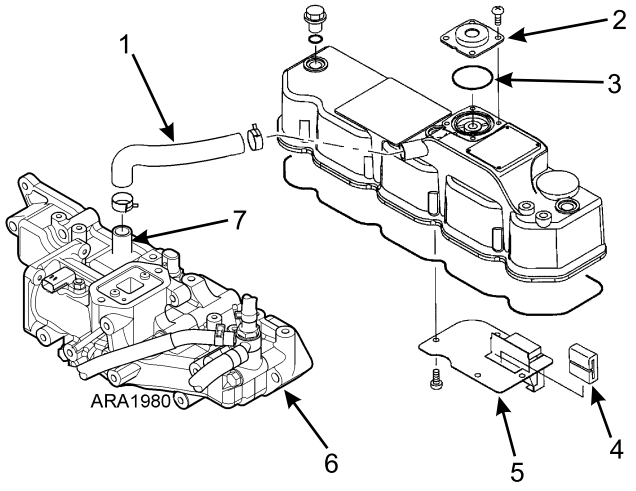
	Rear Flywheel End						**Front Pulley End**	
Cylinder Number	**1**		**2**		**3**		**4**	
Valve arrangement	E	I	E	I	E	I	E	I
Piston in No. 1 cylinder is at TDC on compression stroke	○	○		○	○			
Piston in No. 4 cylinder is at TDC on compression stroke			◎			◎	◎	◎

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 192. Crankcase Breather



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

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 193. EMI 3000 Air Cleaner Assembly

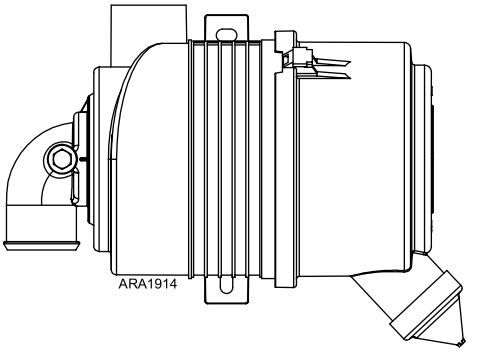
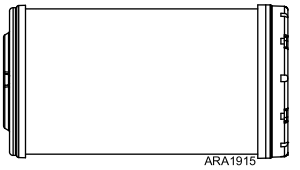


Figure 194. EMI 3000 Air Filter Element



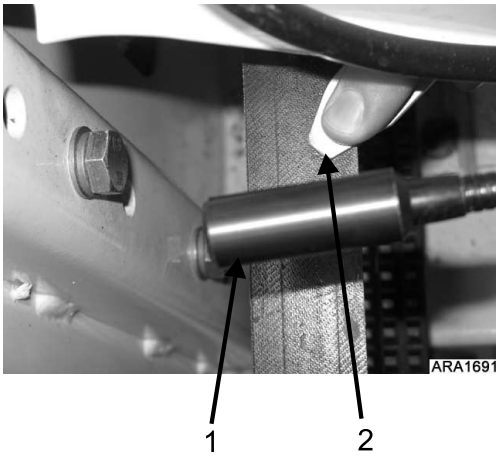
Belts

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 195. 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.*

AC Generator Belt

Note: *The AC generator belt also drives the alternator on Standard units. Units with SmartPower or the Battery Charger option use a shorter belt that goes from the engine pulley to the idler to the AC generator pulley. The procedure to adjust the belt is the same for units with and without the alternator on the AC generator belt.*

⚠ 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!

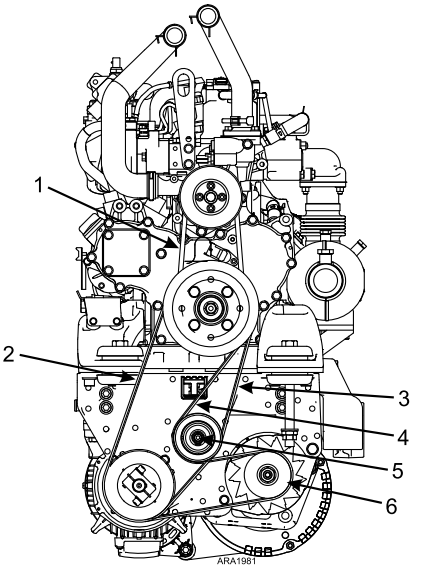
Do not attempt to adjust belts with the unit running.

AC Generator Belt Adjustment

Note: *For the correct AC generator belt tension settings, see "Belt Tension," p. 18.*

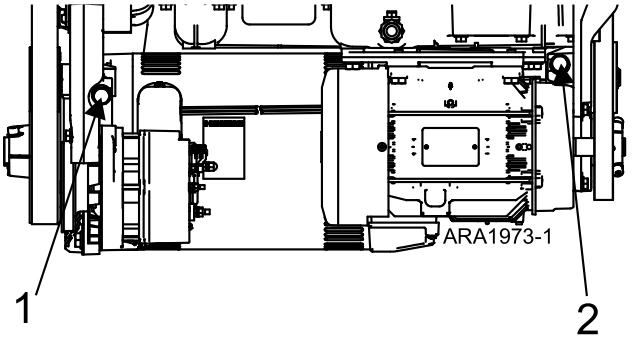
1. Loosen the idler mounting bolt.
2. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.
3. Tighten the idler mounting bolt.
4. Check the belt tension setting and readjust if necessary.

Figure 196. Water Pump Belt and AC Generator Belt (Shown With and Without Alternator)



1.	Water Pump Belt (Check Tension Here)
2.	Check AC Generator Belt Tension Here
3.	AC Generator Belt without Alternator
4.	AC Generator Belt with Alternator
5.	Idler Mounting Bolt
6.	Alternator for Standard Unit

Figure 197. Idler Adjuster Locations - Front View



1.	Compressor Drive Belt Idler Adjuster
2.	AC Generator Belt Idler Adjuster

AC Generator Belt Replacement

⚠ 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.

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

1. Loosen the idler mounting bolt.
2. Turn the idler adjuster as needed to loosen the belt enough to allow you to remove the belt.
3. Install the new belt and verify it fits on the pulleys correctly.
4. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.
5. Tighten the idler mounting bolt.
6. Check the belt tension setting and readjust if necessary.

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. 18 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.

Compressor Drive Belt - SmartPower Units Only

Compressor Drive Belt Adjustment

Note: *See "Belt Tension," p. 18 for the correct compressor drive 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.

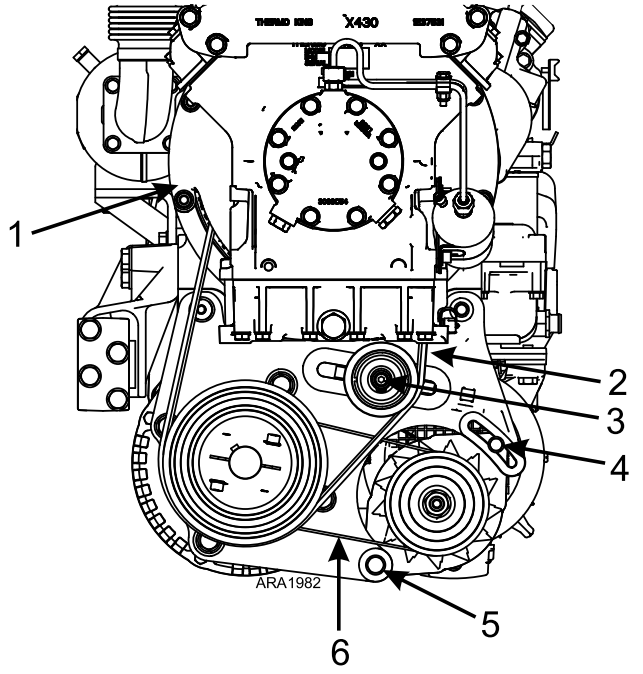
⚠ CAUTION

Risk of Injury!

Do not attempt to adjust belts with the unit running.

1. Loosen the idler mounting bolt.
2. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.
3. Tighten the idler mounting bolt.
4. Check the belt tension setting and readjust if necessary.

Figure 198. Compressor Drive and Alternator Belts



1.	Compressor Mounting Flange
2.	Compressor Drive Belt (Check Tension at Center of this Span)
3.	Idler Mounting Bolt
4.	Alternator Mounting Bolt
5.	Alternator Pivot Bolt
6.	Alternator Belt (Check Tension Here)

Compressor Drive Belt Replacement

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

⚠ 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. Loosen the idler mounting bolt.
2. Turn the idler adjuster as needed to loosen the belt enough to allow you to remove the belt from the electric motor pulley.
3. Support the compressor and unbolt the compressor mounting flange from the engine (leave the refrigeration lines connected).
4. Slide the compressor assembly away from the engine.
5. Remove the belt through the gap between the clutch and the flywheel.
6. Install the new belt on the clutch pulley through the gap between the clutch and the flywheel.
7. Slide the compressor back into position and install the mounting bolts.
8. Place the new belt on the electric motor and idler pulleys. Verify the belt fits on the pulleys correctly.
9. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.
10. Tighten the idler mounting bolt.
11. Check the belt tension setting and readjust if necessary.

Alternator Belt - SmartPower Units Only

Alternator Belt Adjustment

⚠ 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. Loosen the alternator mounting bolt and the alternator pivot bolt.
2. Move the alternator in the alternator mounting bolt slot to adjust the belt to the correct belt tension setting.
3. Tighten the alternator mounting bolt and alternator pivot bolt.
4. Check the belt tension setting and readjust if necessary.

Alternator Belt Replacement

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

⚠ 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.

1. Loosen the compressor drive belt idler mounting bolt.
2. Turn the compressor drive belt idler adjuster as needed to loosen the belt enough to allow you to remove the belt from the electric motor pulley.
3. Loosen the alternator mounting bolt and the alternator pivot bolt.
4. Move the alternator in the alternator mounting bolt slot enough to allow you to remove the alternator belt from the pulleys and remove the alternator belt.
5. Install the new alternator belt and verify it fits on the pulleys correctly.
6. Move the alternator in the alternator mounting bolt slot to adjust the belt to the correct belt tension setting.
7. Place the compressor drive belt on the electric motor pulley and adjust it to the correct belt tension setting.
8. Check the belt tension settings on both belts and readjust if necessary.

Clutch (SmartPower Units)

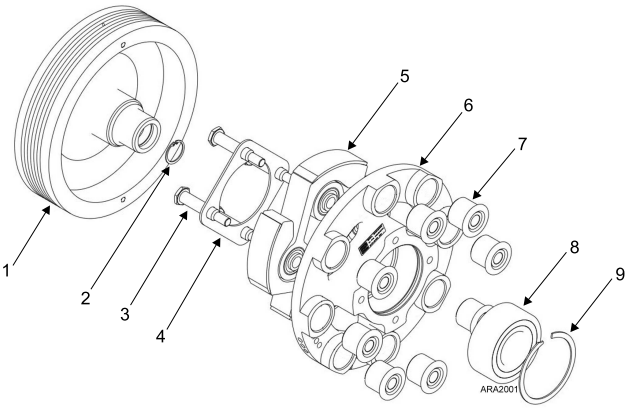
Periodically inspect the clutch for worn bearings, worn friction shoes, shoe support bushings, or isolator drive bushings. To inspect the clutch:

1. Loosen the compressor drive belt idler mounting bolt.
2. Turn the compressor drive belt idler adjuster as needed to loosen the belt enough to allow you to remove the belt from the electric motor pulley.
3. Support the compressor and unbolt the compressor mounting flange from the engine (leave the refrigeration lines connected).
4. Slide the compressor assembly away from the engine and turn the compressor to provide better access to the clutch.

   Note: *The refrigeration lines may be removed from the compressor to allow more movement of the compressor for better access to the clutch.*
5. Remove the compressor drive belt.
6. Remove the clutch mounting bolt and special washer.

   Note: *Use the Spanner Wrench and the appropriate hex driver or an air impact driver with the appropriate hex driver.*
7. Use the Clutch Puller to remove the clutch by threading the puller into the end of the clutch. Apply torque while tapping the clutch body until the clutch loosens form the shaft.
8. Remove the key from the compressor crankshaft and inspect the key and the crankshaft for wear, burrs, or damage.

Figure 199. Clutch Assembly



1.	Clutch Drum/Pulley	6.	Rotor Drive Plate (Hub)
2.	Retaining Ring	7.	Isolator Drive Bushing
3.	Shoulder Bolt	8.	Bearing
4.	Shoe Carrier	9.	Retaining Ring
5.	Shoe Assembly		

9. To disassemble the clutch, press the pulley out of the bearing.
10. Inspect the friction shoes and shoe support bushings.
    a. Replace the friction shoe assemblies if the linings are worn to a thickness of less than 1/16 to 3/32 in. (1.6 to 2.4 mm).
    b. If the shoe support bushings are worn, replace the friction shoe assemblies.
11. To replace the friction shoes:
    a. Remove the shoulder bolts that mount the friction shoes.
    b. Use a soft hammer to tap the friction shoe mounting bolts to remove them from the friction shoes.
    c. Attach the new friction shoe assemblies to the rotor plate with the mounting bolt plate and the shoulder bolts.
    d. Loosely tighten the bolts to hold the shoes in place.

e. Place a large hose clamp around the shoes and tighten clamp until the shoes are compressed to the smallest diameter.

f. Torque the bolts 30 to 35 ft-lb (41 to 47 N•m) and remove the hose clamp.

12. To replace the bearing:

a. Remove the retaining ring and press the bearing out of the hub.

b. Press the new bearing into the hub and install the retaining ring.

13. To assemble the clutch, press the pulley into the bearing.

NOTICE

Equipment Damage!

Do not place the key on the compressor crankshaft before installing the clutch because the key might be pushed out of place behind the clutch when the clutch is installed.

14. Place the clutch on the compressor crankshaft, align the keyways (use Keyway Tool 204-972), and insert the key to be flush with the end of the crankshaft.

15. Install the special washer and the clutch mounting bolt. Torque the clutch mounting bolt to 90 ft-lb (122 N•m). Use the Clutch Restraint Tool or an impact wrench.

16. Reinstall the compressor drive belt on the clutch pulley.

17. Slide the compressor back into position and install the mounting hardware.

18. Place the belt on the electric motor and idler pulleys. Verify the belt fits on the pulleys correctly.

19. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.

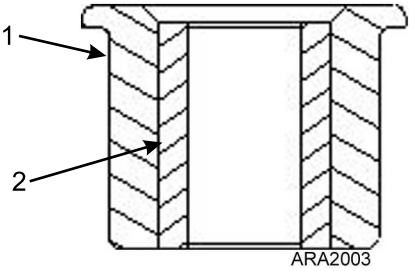
20. Tighten the idler mounting bolt.

21. Check the belt tension setting and readjust if necessary.

Drive Bushing Replacement

Bonded drive bushings are used in this unit.

Figure 200. Bonded Drive Bushing



1.	Elastomer
2.	Inner Bearing Sleeve

The design of the bonded drive bushings requires that the following procedure be used to replace the drive bushings:

1. Loosen the compressor drive belt idler mounting bolt.

2. Turn the compressor drive belt idler adjuster as needed to loosen the belt enough to allow you to remove the belt from the electric motor pulley.

3. Support the compressor and unbolt the compressor mounting flange from the engine (leave the refrigeration lines connected).

4. Slide the compressor assembly away from the engine and turn the compressor to provide better access to the clutch.

Note: *The refrigeration lines may be removed from the compressor to allow more movement of the compressor for better access to the clutch.*

5. Remove the compressor drive belt.

6. Remove the clutch mounting bolt and special washer.

7. Remove the clutch with a clutch puller.

8. Remove the clutch pulley by pressing it out of the bearing. It is not necessary to remove the bearing to replace the drive bushings.

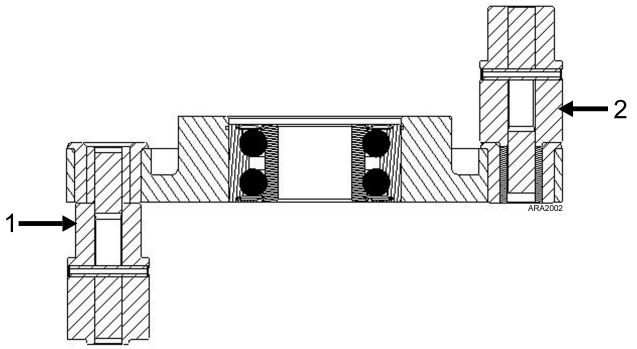
9. Remove the friction shoes.

a. Remove the shoulder bolts that mount the friction shoes.

b. Use a soft hammer to tap the friction shoe mounting bolts to remove them from the friction shoes.

10. Use the small diameter end of the Bushing Replacement Tool 204-1955 to press the old bushings out of the clutch hub/coupling (Figure 201, p. 115).

Figure 201. Bushing Replacement with Bushing Replacement Tool 204-1955



1.	Use small end of tool to press bushings out of hub/coupling.
2.	Use large end of tool to press bushings into hub/coupling.

11. Clean the holes from which the bushings were removed.
12. "Start fit" the bushing in the clutch hub/coupling about 1/8 in. (3 mm) to verify it fits in the hole and does not hang up on something. "Start fit" the bushing in the side of the hub/coupling that faces the flywheel.

    Note: *The Loctite adhesive has a working time of 2 minutes so the bushing must be installed within 2 minutes of when the adhesive was applied. Apply the adhesive and install the bushings one at a time to avoid exceeding the time limit.*

NOTICE

Equipment Damage!

If a thin coating of adhesive is applied all over the bushing before it is started in the hole, the adhesive will begin to cure before the bushing can be pressed completely into place.

13. Put a thick ring of Loctite adhesive 203-535 around the bottom of the new bushing before pressing it into place. The adhesive will squeegee up the entire length of bushing as it is pressed into the hole.
14. Use the large diameter end of the Bushing Replacement Tool 204-1955 to press the new bushing into the hub/coupling until the flange on the bushing contacts the hub/coupling.
    a. Press the new bushing into the hub/coupling from side of the hub/coupling that faces the flywheel (Figure 201, p. 115).

       Note: *Allow the Loctite adhesive to cure for at least 1 hour at 70 F (21 C) before running the unit. The components can be reassembled immediately.*
15. Inspect the clutch components before reassembling the clutch and replace them if necessary.
16. Install the friction shoes, mounting bolt plate, and friction shoe mounting bolts. See previous shoe installation instructions.
17. Torque the mounting bolts for the friction shoes 30 to 35 ft-lb (41 to 47 N•m).
18. Press the clutch pulley into the bearing.

NOTICE

Equipment Damage!

Do not place the key on the compressor crankshaft before installing the clutch because the key might be pushed out of place behind the clutch when the clutch is installed.

19. Place the clutch on the compressor crankshaft, align the keyways (use Keyway Tool 204-972), and insert the key to be flush with the end of the crankshaft.
20. Install the special washer and the clutch mounting bolt. Torque the clutch mounting bolt to 90 ft-lb (122 N•m). Use the Clutch Restraint Tool or an impact wrench.
21. Reinstall the compressor drive belt on the clutch pulley.
22. Slide the compressor back into position and install the mounting hardware.

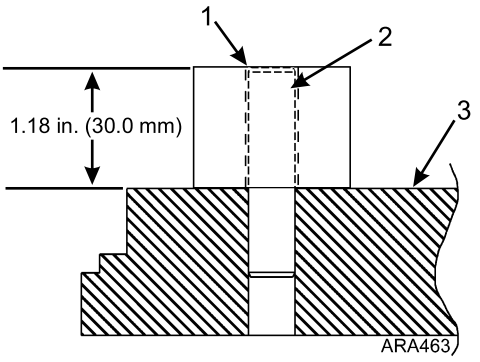
    Note: *Do not place any kind of lubricant on the outside of the dowel pins or on the inside of the drive bushings. Lubricant between the dowel pins and drive bushings will cause premature wear.*
23. Place the belt on the electric motor and idler pulleys. Verify the belt fits on the pulleys correctly.
24. Turn the idler adjuster as needed to adjust the belt to the correct belt tension setting.
25. Tighten the idler mounting bolt.
26. Check the belt tension setting and readjust if necessary.

Dowel Pin Replacement

1. Remove the flywheel.
2. Press the old dowel pins out of the flywheel.
3. Use the Manual Pin Tool or the Impact Pin Tool to press or drive the new dowel pins into the flywheel.
   a. The end of each dowel pin should be 1.18 in. (30.0 mm) from the outer face of the flywheel.
   b. The proper dimension is critical and is set by using either of the tools.
4. Install the flywheel and align it with the dowel pin in the end of the crankshaft.
5. Install the flywheel mounting bolts. Torque the flywheel mounting bolts to 65 ft-lb (88 N•m).

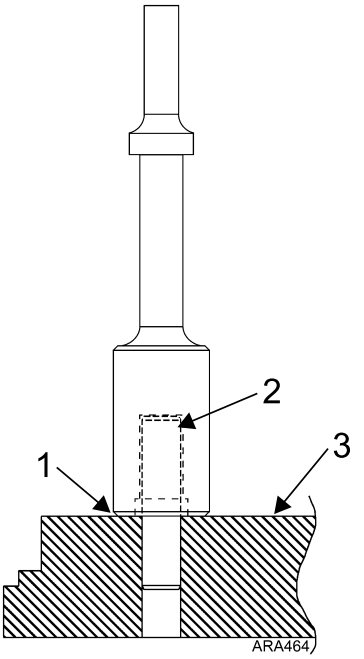
6. Install the compressor and adjust the drive belts.

Figure 202. Pressing New Dowel Pin Into Flywheel Using Manual Pin Tool



1.	Press Dowel Pin In Until Flush With Tool
2.	Dowel Pin
3.	Outer Face Of Flywheel

Figure 203. Driving New Dowel Pin Into Flywheel with Impact Pin Tool



1.	Drive Dowel Pin In Until Tool Hits Flywheel
2.	Dowel Pin
3.	Outer Face Of Flywheel

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 temperatures 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 each evaporator.
2. Install a gauge manifold.
3. Use the microprocessor thermometer to monitor the return air temperatures.
4. Run all the evaporators in cool until the air in each box is at 0 F (-18 C). By allowing a box to leak a small amount, you will be able to maintain 0 F (-18 C).
5. The suction pressure should be 13 to 18 psig (90 to 124 kPa).
6. The discharge pressure should be at least 275 psig (1896 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.
7. 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. Run the unit with all zones in cool.
3. Build up and maintain 275 psig (1896 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 compartments to the lowest temperatures required.
5. Check suction pressure. It should be 13 to 25 psig (90 to 165 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. Operate the host unit in high speed with all zones in cool long enough to stabilize system pressures and reduce the compartment temperatures to approximately 60 F (16 C) or colder.
3. 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 3, the unit is not overcharged and it is not necessary to complete the rest of the procedure.*
4. Remove the condenser cover to rapidly reduce discharge pressure.
5. Observe the receiver tank sight glass and the unit discharge pressure.
6. 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 with all zones in 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 275 psig (1896 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.

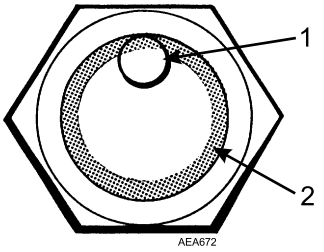
4. Repeat the overcharge test.

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 204. 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-404A 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.*

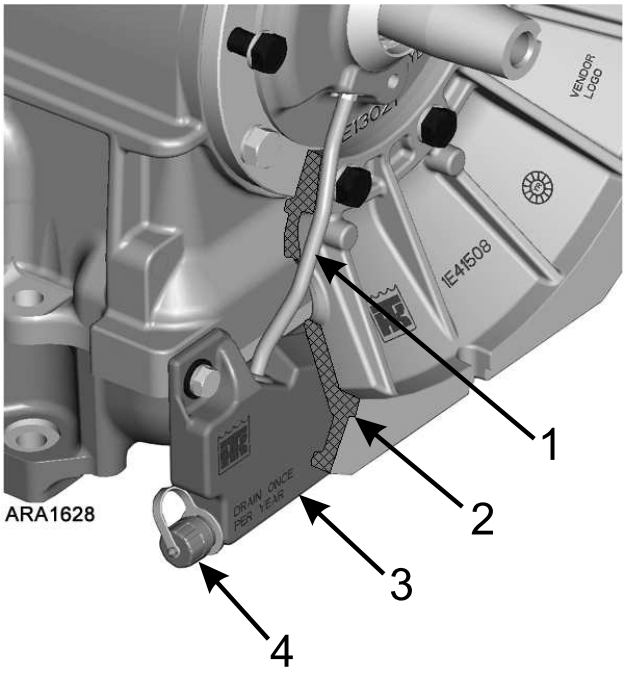
Oil Collection Container

The oil collection container collects the compressor shaft seal seepage to keep the unit clean. This seepage is normal and is necessary for shaft seal durability.

The oil collection container is mounted on the body of the compressor. A tube connects the oil collection container to the compressor shaft seal cover. The oil that seeps from the seal will travel through the tube and collect in the container.

Empty the container once per year during oil changes, or during annual services. The container has a drain spout with a cap. Remove the cap and drain the oil into a cup (not provided) and discard the oil properly. Retighten the cap snugly by hand.

Figure 205. Oil Collection Container Components

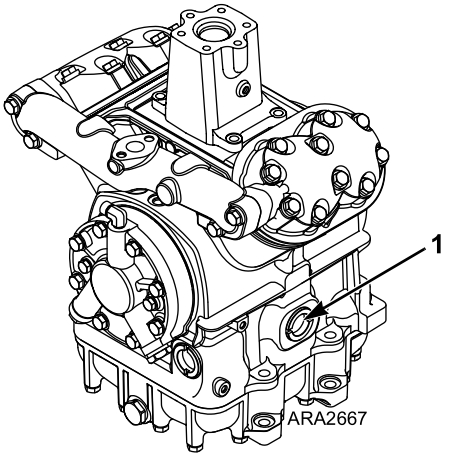


1.	Tube to Compressor Shaft Seal Cover
2.	Compressor Mounting Flange (Sectioned to Show Detail)
3.	Oil Collection Container
4.	Cap (Remove to Drain Oil)

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 206. 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 all zones 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 all zones through a complete defrost cycle.

   Note: *If the compartment is empty, you can run the zone on the heat cycle instead of the defrost cycle.*
2. After completing the defrost cycles, run the unit with all zones 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.*

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 207, p. 120) 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.

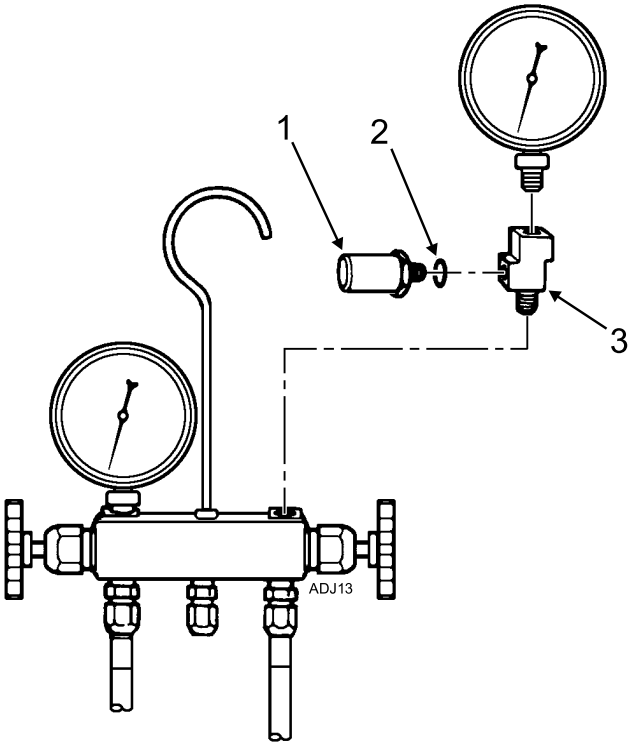
⚠ CAUTION

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 207. High Pressure Cutout Manifold



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

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.

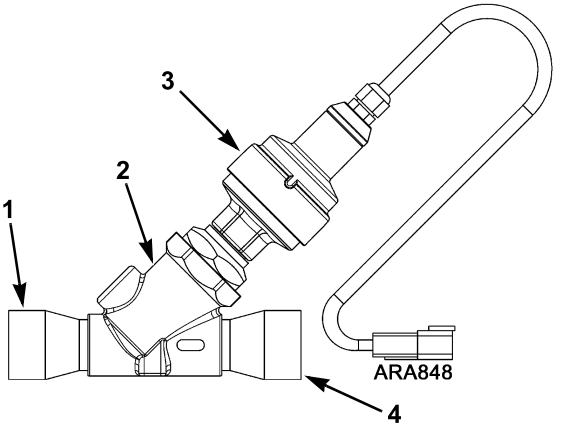
Use the Gauges Menu to observe the ETV position during the ETV test. The expected ETV position observation is a decrease followed by an increase. The suction pressure should decrease when the valve position decreases and increase when the valve position increases.

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.

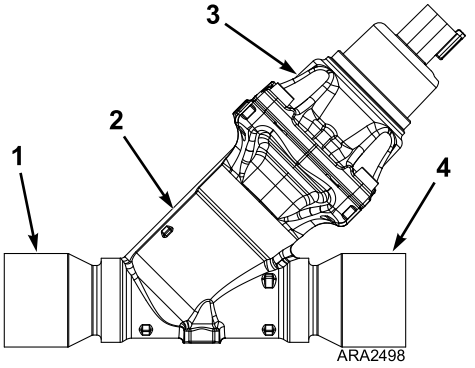
Note: *The Old Style ETV was replaced with the New Style ETV starting in 09/16. There are some physical differences, but they are functionally the same.*

Figure 208. Old Style ETV



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

Figure 209. New 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 Zone 1 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-4 Trailer Muiti-Temperature Diagnostic Manual (TK 55788-2-OD) for information about testing the hot gas solenoid. See Refrigeration Service Operations for removal and installation procedures.

Evacuating and Charging Smart Reefer Multi-Temp Systems

Set-Up Unit

The SR-4 Multi-Temp microprocessor must be placed in the Evacuation Mode to evacuate and charge the unit. When the microprocessor is in the Evacuation Test it opens all the normally closed solenoid valves in the refrigeration system. This allows the refrigeration system to be evacuated properly. Refer to the appropriate Diagnostic Manual for complete information about the microprocessor. Use the following procedure to set-up the unit and place the microprocessor in the Evacuation Test:

1. Press the ON Key to turn the unit on.
2. Before the unit starts, press the MENU Key. The Main Menu will appear.
3. Press the EXIT Key and the unlabeled soft key at the same time, and hold them down for 5 seconds to enter the Maintenance Menu. The Maintenance Menu will appear.
4. Press the DOWN (or UP) Key to scroll through the Maintenance Menu features to the Evacuation Test.
5. Press the SELECT Key to enter the Evacuation Mode.
6. Connect a battery charger to the unit battery. The battery charge must have an output of at least 15 amperes. This will maintain the charge level of the battery during the time required to evacuate and charge the unit. The Evacuation Mode is used to open unit valves as required for evacuation. Failure to connect a battery charger may result in the battery voltage falling too low to reliably operate the microprocessor and valves.
7. The microprocessor is now in the Evacuation Mode. The refrigeration system is set-up for evacuation and charging.

Evacuating the System

NOTICE

Service Procedures!

Do not evacuate the system until it is leak free. A unit with less than full refrigerant charge should be leak checked and all leaks must be repaired.

1. Verify all refrigerant has been recovered from the unit.
2. Connect a vacuum pump and gauge manifold for three-point evacuation to the suction service valve, discharge service valve, and receiver tank outlet valve (see Figure 210, p. 123).

   Note: *The use of the Thermo King Evacuation Station P/N 204-725 or 204-744 is recommended.*
3. Verify proper operation of the Evacuation Station as shown in the Evacuation Station Operation Manual TK 40612.
4. Start the vacuum pump and mid-seat the suction service valve, discharge service valve, and receiver tank outlet valve.
5. Install service valve stem caps with seals and tighten them. The valve stems should remain capped while evacuating the unit.

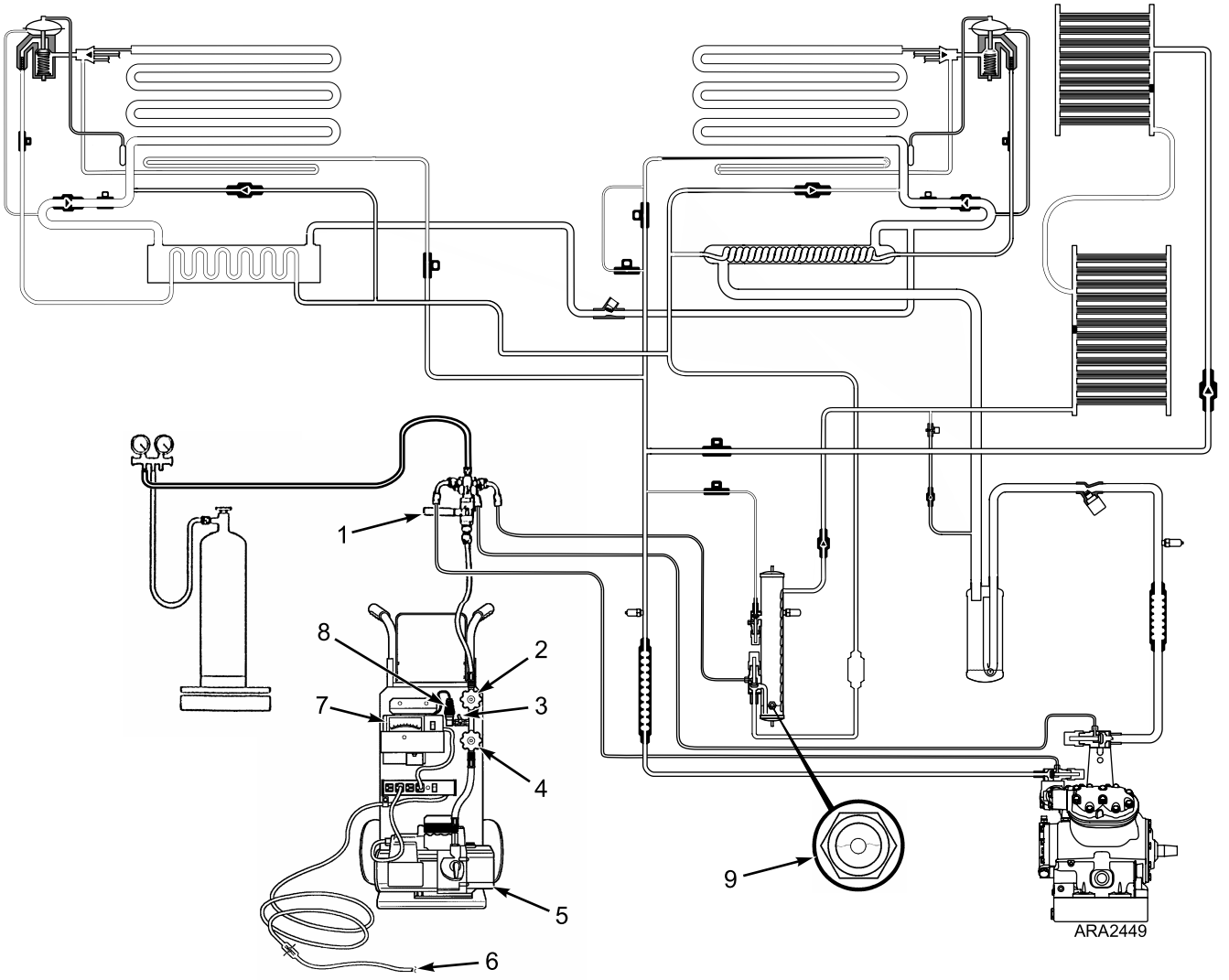
6. Evacuate the unit to 500 microns, or the lowest achievable level between 500 and 1,000 microns.
7. Continue to evacuate the unit for one additional hour after reaching 500 microns, or the lowest achievable level between 500 and 1,000 microns. This insures complete evacuation of the remote evaporators and lines.
8. Close the Evacuation Station valve nearest the vacuum pump (V1) to isolate the vacuum pump from the system. Turn the vacuum pump off.
9. Observe the micron gauge.

   The system pressure should remain below 2000 microns for 5 minutes.

   If the pressure does not hold, check for leaks (if a leak is suspected) or continue evacuation (if system is not dry).
10. Restart the vacuum pump, open the Evacuation Station valve nearest the vacuum pump (V1) and repeat steps 6, 8, and 9 as required until system pressure remains below 2000 microns for 5 minutes.
11. When system pressure remains below 2000 microns for 5 minutes, restart the vacuum pump and open the Evacuation Station valve nearest the vacuum pump (V1).
12. With the vacuum pump running, back seat the suction service valve. Replace the valve cap, re-close the Evacuation Station valve nearest the vacuum pump (V1), and stop the vacuum pump.
13. Close valve V4. The unit is ready to charge.

Note: *Do not exercise the service valves with the unit in a deep vacuum unless the vacuum pump is operating.*

Figure 210. Multi-Temp Evacuation and Charging (Two Zone Unit Shown Other Units Similar)



1.	V-4	6.	To AC Power
2.	V-3	7.	Vacuum or Micron Gauge
3.	V-2	8.	Thermistor
4.	V-1	9.	Correct Refrigerant Level
5.	Two Stage Vacuum Pump		

Charging the System

Note: *The unit must be left in the Evacuation Test.*

1. Verify that all compartment bulkheads are open. Ceiling mounted bulkheads should not be stored close to the evaporator outlets as this will restrict airflow.
2. Before charging system, make sure the refrigerant lines from the gauge manifold to the refrigerant supply bottle have been evacuated or purged, the suction and discharge service valves are back seated, and the receiver tank outlet valve is still open.
3. Set the refrigerant supply bottle for liquid. Open the gauge manifold hand valve and add a partial charge of R-404A through the receiver tank outlet valve. Add 14 lb (6.4 kg) to a unit with one remote evaporator. Add 15 lb (6.8 kg) to a unit with two remote evaporators. Do not add more than this. The remainder of charge will be added through suction service valve while unit is running.
4. Close the gauge manifold hand valve.
5. Back seat (close) the receiver tank outlet valve.

6. Exit the Evacuation Test by turning the unit Off and then back On.
7. Turn all zones On and set all zone setpoints for the lowest possible temperature to insure that all zones run in Cool mode. Allow the unit to start.
8. Front seat the suction service valve and allow the compressor to pump down to 1 to 3 psi (7 to 21 kPa). Stop the unit.
9. Remove the evacuation manifold hoses from the receiver tank outlet valve, the discharge service valve, and the suction service valve. Replace and tighten the service port and valve stem caps on the receiver tank outlet valve.
10. Attach the gauge manifold (with the refrigerant supply bottle still connected) to the compressor. Attach the low side gauge to the suction service valve. Mid-seat the suction service valve. Attach the high pressure gauge on to the discharge service valve. Open the discharge service valve to monitor the discharge pressure.
11. Turn the unit On, turn all zones On (with all zone setpoints set to the lowest possible temperature), and allow the unit to start.
12. Observe the suction pressure and slowly open the gauge manifold hand valve to allow liquid refrigerant to flow into the suction service valve. Control the liquid flow so the suction pressure increases 20 to 25 psi (138 to 172 kPa). Maintain a discharge pressure of 325 to 400 psi (2241 to 2758 kPa).
13. Add refrigerant until the ball in the receiver tank sight glass rises to the middle of the sight glass, then close the gauge manifold hand valve. Make sure the liquid level does not rise above the top of the sight glass.
14. Continue to operate the unit and monitor the sight glass until all compartment temperatures are at or below 0 F (-18 C).
15. Check the position of the ball in the receiver tank sight glass. If the liquid level has dropped, add liquid refrigerant until the level stabilizes near the middle of the sight glass. Do not exceed the recommended refrigerant charge for the unit model.
16. Close the hand valve on the refrigerant supply bottle.
17. Back seat the discharge service valve.
18. Open both hand valves on the gauge manifold.
19. Front seat the suction service valve and allow the compressor to pump down to 1 to 3 psi (7 to 21 kPa). Stop the unit.
20. Remove the gauge line from the suction service valve and cap the service port.
21. Remove the gauge line from the discharge service valve and cap the service port.
22. Back seat the suction service valve and cap the valve stem.
23. Cap the valve stem on the discharge service valve.
24. Secure all the gauge lines to the gauge line anchors.

Refrigeration Service Operations

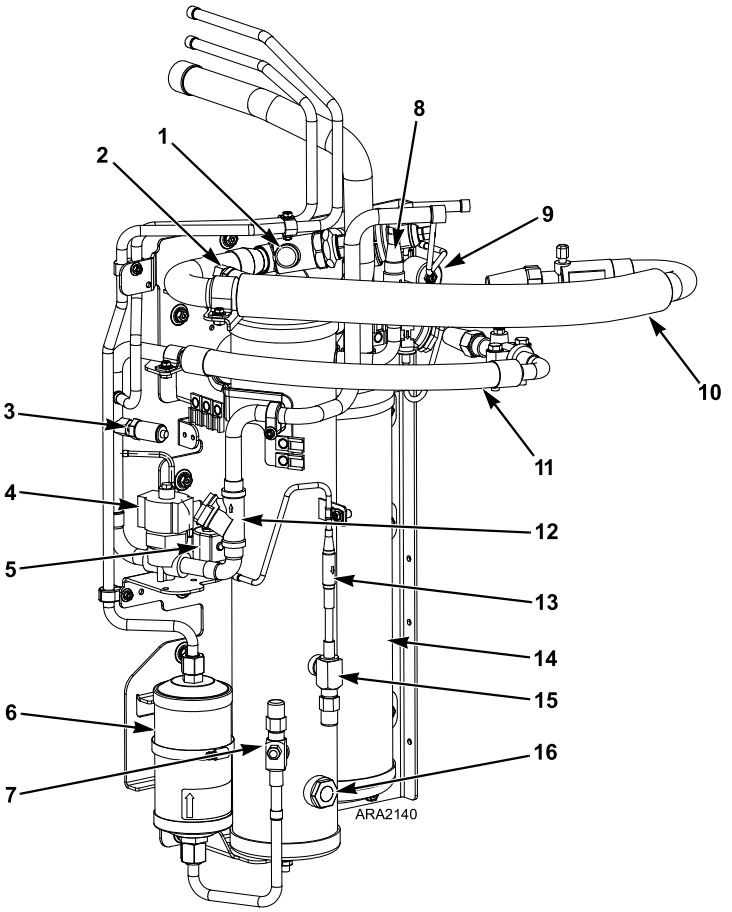
Note: *The following procedures involve servicing the refrigeration system. Some of these service procedures are regulated by Federal, and in some cases, by State and Local laws.*

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 Component Locations

The following figures show the locations of various refrigeration system components. Many of the refrigeration system components are located in the refrigeration cluster on the lower curbside of the unit. This allows good access from the front and side for maintenance, diagnosis, and repair.

Figure 211. Front Left View of Refrigeration Cluster



1.	ETV	9.	Purge Valve (PV)
2.	Suction Pressure Transducer	10.	Suction Vibrasorber
3.	Discharge Pressure Transducer	11.	Discharge Vibrasorber
4.	Condenser Inlet Solenoid (CIS)	12.	Condenser Inlet Check Valve (CICV)
5.	Receiver Tank Pressure Solenoid (RTPS)	13.	Bypass Check Valve (BCV)
6.	Filter-Drier	14.	Accumulator
7.	Receiver Tank Outlet Valve	15.	Bypass Service Valve
8.	Condenser Check Valve	16.	Receiver Tank Sight Glass

Figure 212. Curbside View of Refrigeration Cluster

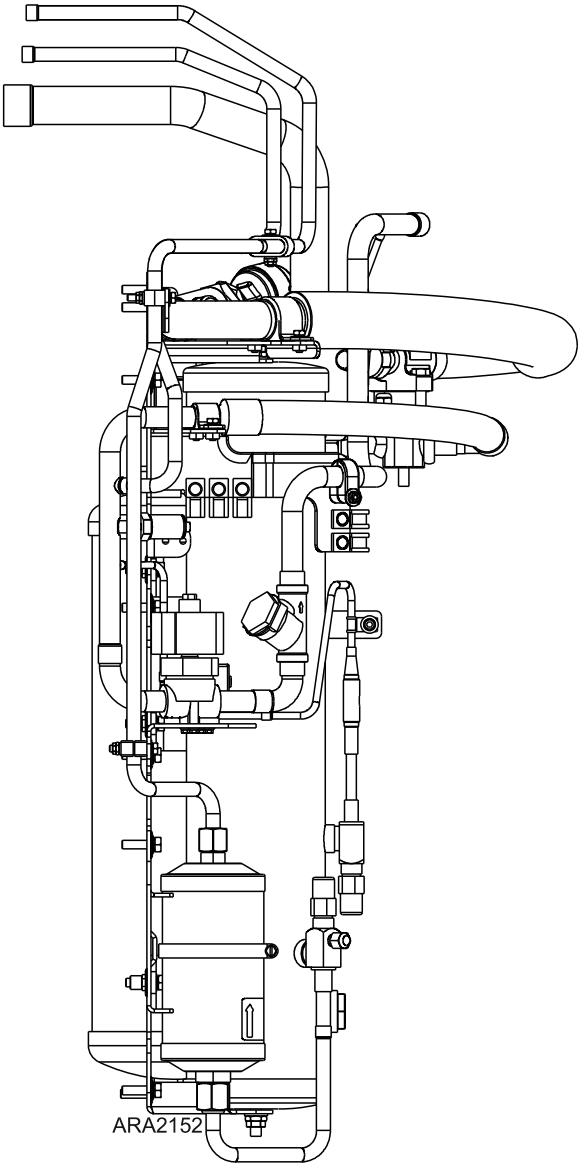
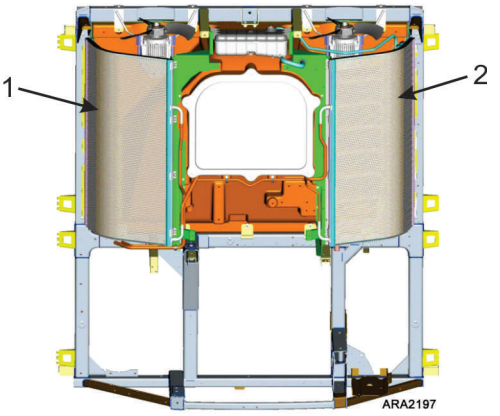
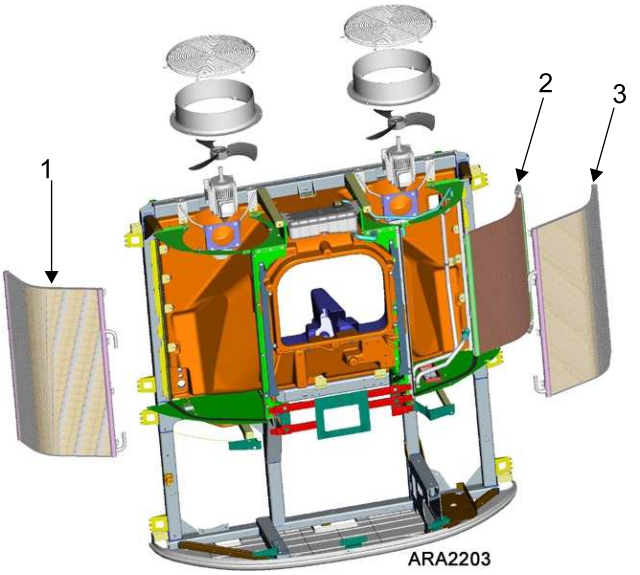


Figure 213. Condenser Coils



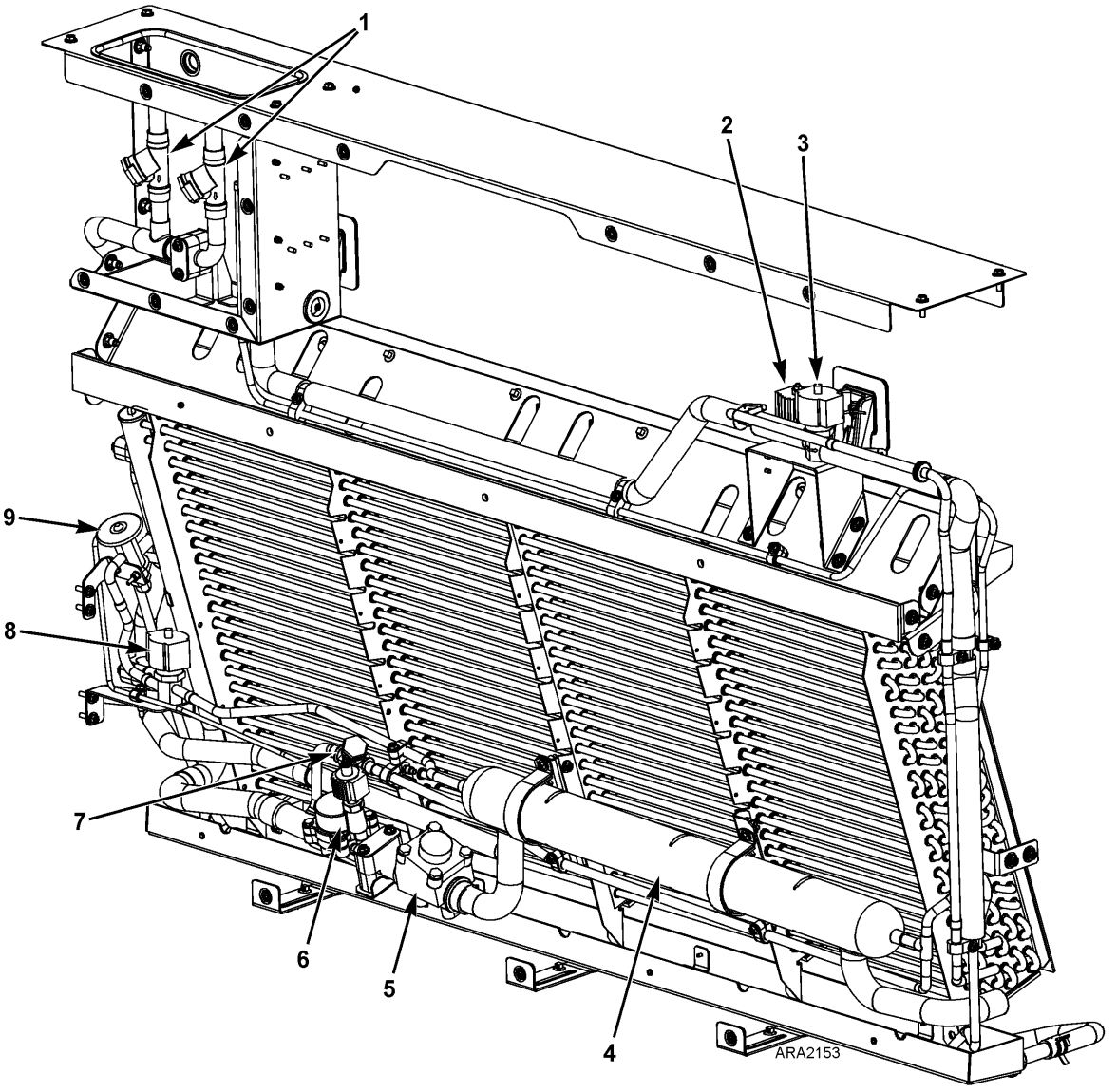
1.	Curbside Condenser Coil
2.	Road Condenser/Radiator Coil

Figure 214. Condenser and Radiator Coils



1.	Curbside Condenser Coil
2.	Radiator Coil
3.	Road Condenser Coil

Figure 215. Host Unit Evaporator Components



1.	Zone 2 and Zone 3 Suction Line Check Valves (SLCV2 and SLCV3)	6.	Suction Line Solenoid (SLS)
2.	Hot Gas Bypass Valve (HGB)	7.	Liquid Return Check Valve (LRCV)
3.	Hot Gas Solenoid (HGS)	8.	Liquid Line Solenoid (LLS)
4.	Heat Exchanger	9.	Expansion Valve
5.	Suction Line Check Valve (SLCV)		

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

Low Side Pump Down

Note: *Operate all the evaporators in Cool for 2 to 5 minutes with the service valves in their normal operating positions before performing the low side pump down. Install a gauge manifold at the compressor.*

1. Run all the evaporators in cool, front seat the receiver tank outlet valve and the bypass hand valve, and pump down the low side to 20 to 25 in. Hg vacuum (-68 to -85 kPa). Turn the unit Off.

   If the unit pumps down acceptably and then holds at least 15 in. Hg vacuum (-51 kPa) for 2 minutes or more, it can be assumed that the receiver tank outlet valve, the compressor discharge valve plates, the HGS solenoid, the HGS2 solenoid, the HGS3 solenoid, and the purge valve solenoid are sealing acceptably.
2. Prepare to perform service on the unit's low side by equalizing the high side and low side pressures.
   a. Disconnect the purge valve solenoid wires from the main/unified wire harness.

   Note: *If the purge valve solenoid wires are not disconnected from the main wire harness, the purge valve is energized when the unit is placed in the Evacuation Test. This allows the refrigerant in the condenser to flow into the accumulator, undoing the low side pump down.*

   b. Place the unit in the Evacuation Test. Refer to the appropriate Microprocessor Diagnostic Manual. The high and low side pressures should equalize in the Evacuation Test.

   Note: *Repeat the pump down procedure if the pressures equalize above 20 psi (138 kPa). If suitably low pressures cannot be achieved after the third pump down, the refrigerant must be recovered to perform service on the low side.*

   c. If the reading on the gauge manifold's high pressure gauge increases after the high and low side pressures have been equalized, the condenser inlet check valve is leaking.
   d. Remember to reconnect the purge valve solenoid wires to the main wire harness when the service procedures have been completed.

Compressor

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Loosen the compressor belt on SmartPower units.
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 pilot solenoid line (if used), and remove the compressor oil filter.
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 compressor belt from SmartPower units.
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 compressor belt on SmartPower units, and install the mounting hardware.

   Note: *The compressor drive coupling or clutch 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 pilot solenoid valve line (if used), and install the compressor oil filter.
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 compressor belt on SmartPower units.
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)

1. After the compressor has been removed from the

unit, remove the center bolt which holds the coupling to the compressor shaft.

2. Use a suitable puller such as Posilock model 110 to remove the coupling from the compressor shaft.

Compressor Coupling Installation (Standard Units)

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

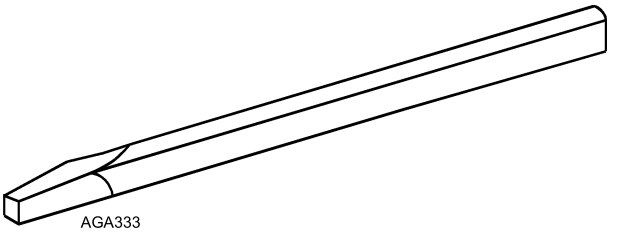
NOTICE

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.

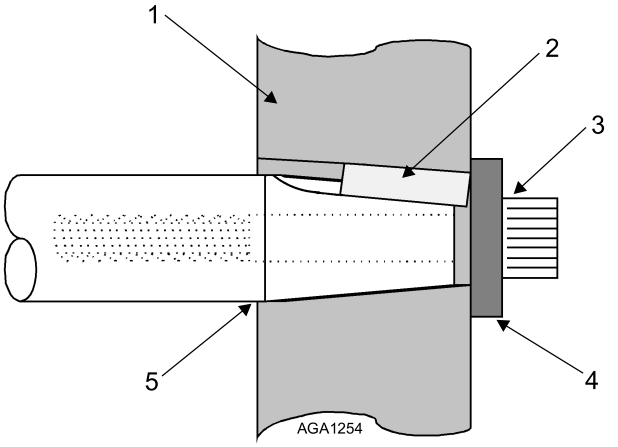
3. **Using no lubricants**, set the coupling on the crankshaft and align the keyways using the Keyway Tool (P/N 204-972). Insert the tapered end of the tool into the keyway and gently move the coupling on the shaft while pressing the tool into the keyway. This will align the keyway in the crankshaft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

Figure 216. 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 217. Compressor Coupling Installation



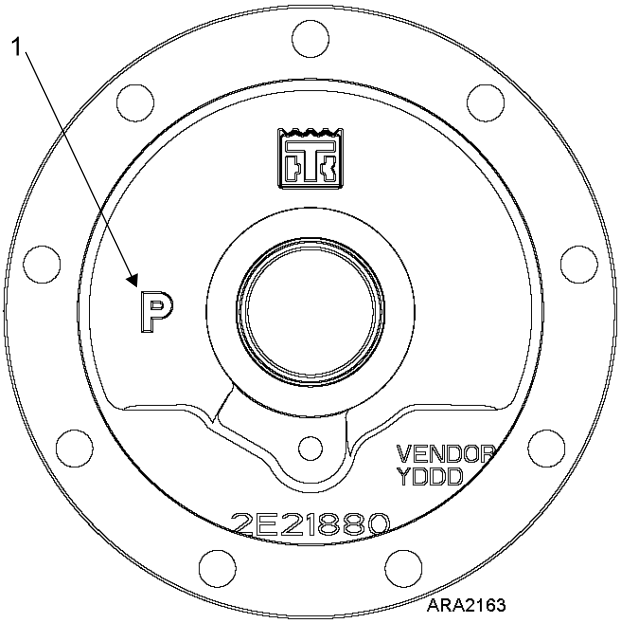
1.	Compressor Coupling or Clutch
2.	Key tapped flush with outside face of coupling. Do not tap key any farther into keyway.
3.	Torque bolt to 90 ft-lb (122 N•m)
4.	Washer
5.	Spray this area with corrosion inhibitor after assembling.

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 2014, 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 218, p. 130). The model number of the compressor has been changed to X430P to signify the Pressurized Seal Cavity as shown (Figure 219, p. 130). 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. 130 for the replacement procedure.

Figure 218. Seal Cover for Compressor with Pressurized Seal Cavity



1.	"P" Indicates Pressurized Seal Cavity

Figure 219. Model Number Location

1.	"X430P" Indicates Pressurized Seal Cavity

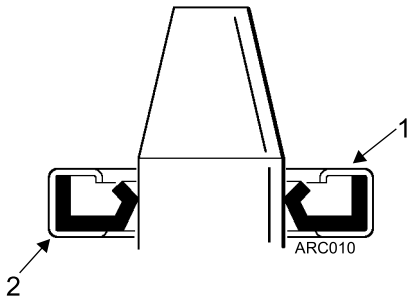
Hex Drive Compressor Seal Replacement

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 220. 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.

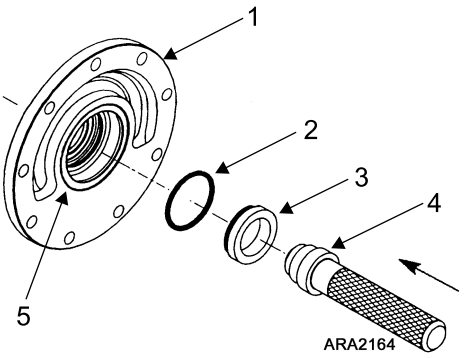
11. Apply clean compressor oil to the new O-ring and install it in the seal plate. Apply clean compressor oil to the new hard ring. Verify the hard ring installation tool (P/N 204-953) is clean. Use the hard ring installation tool to push the hard ring (with the polished surface toward the installation 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 221. Hard Ring Positions

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

Figure 222. Hard Ring Installation

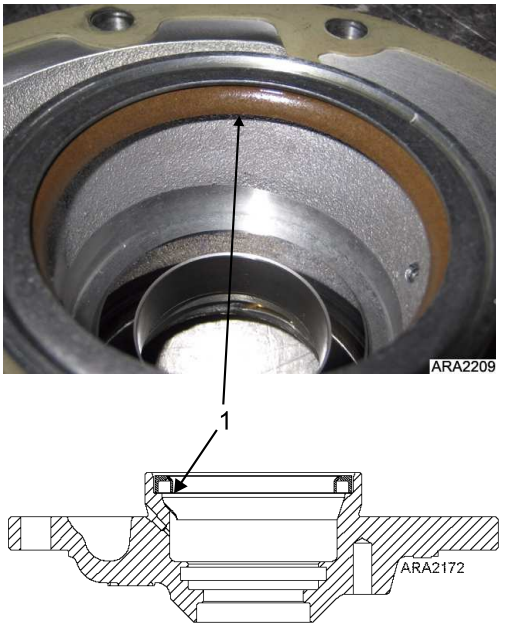


1.	Seal Plate
2.	O-ring
3.	Hard Ring - Install with Polished Surface Toward Compressor
4.	Hard Ring Installation Tool P/N 204-953
5.	Internal Lip Seal

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 223. Internal Lip Seal Installation

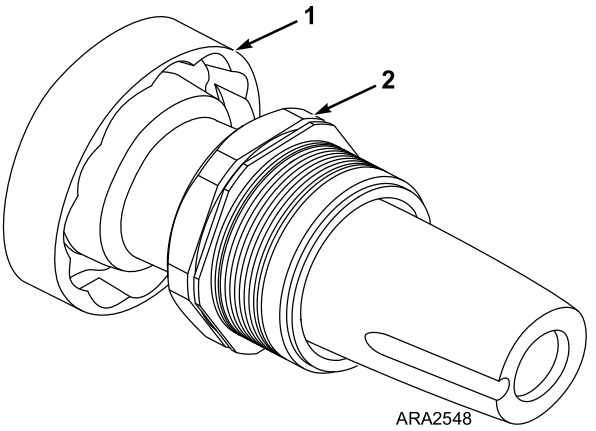


1.	Lip Facing Into Seal Plate

13. Apply clean compressor oil to the O-ring inside the

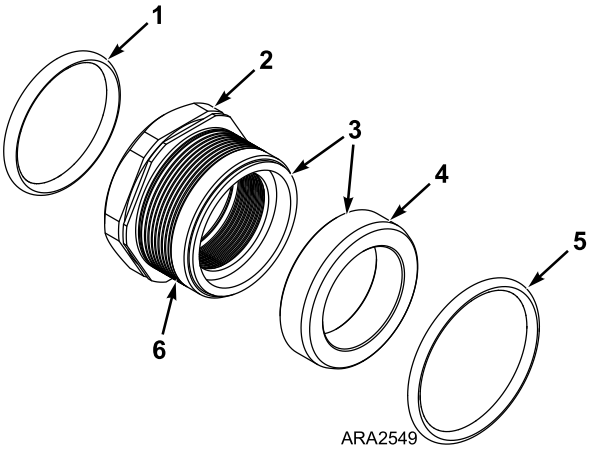
bellows. Slide the bellows on the crankshaft, align the hex drive on the bellows with the hex drive collar, and push the bellows firmly against the hex drive collar. Leave the protective cap in place during installation. If the hex drive does not slide on easily, rotate the assembly 30 degrees.

Figure 224. Hex Drive Bellows Installation (Shown Without Protective Cap)



1.	Hex Drive Collar
2.	Hex Drive

Figure 225. 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.

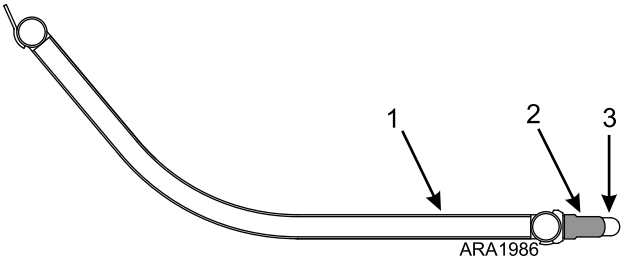
Curbside Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Open the top door and curbside condenser grille.
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 micro-channel condenser coils. 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 heat shrink tubing and brazed connections (and the aluminum) that attached the copper stub tubes to the aluminum micro-channel coil. The heat shrink tubing is used to prevent corrosion between the copper and aluminum.*
4. Remove the condenser coil mounting bolts and lift the coil from the unit.

Figure 226. Top View of Curbside Condenser Coil



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

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 micro-channel condenser coils. Micro-channel coils are make 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 heat shrink tubing and brazed connections (and the aluminum) that attached the copper stub tubes to the aluminum micro-channel coil. The heat shrink tubing 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. Close the curbside condenser grille and top door.
6. Recharge the unit with proper refrigerant and check the compressor oil.

Roadside Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Open the top door and roadside condenser grille.
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 micro-channel condenser coils. Micro-channel coils are make 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 heat shrink tubing and brazed connections (and the aluminum) that attached the copper stub tubes to the aluminum micro-channel coil. The heat shrink tubing is used to prevent corrosion between the copper and aluminum.*
4. Remove the condenser coil mounting bolts and lift the coil from the unit.

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 micro-channel condenser coils. Micro-channel coils are make 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 heat shrink tubing and brazed connections (and the aluminum) that attached the copper stub tubes to the aluminum micro-channel coil. The heat shrink tubing 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. Close the roadside condenser grille and top door.
6. Recharge the unit with proper refrigerant and check the compressor oil.

Radiator Coil

Removal

Note: *The roadside condenser coil must be removed to remove the radiator coil.*

1. Recover the refrigerant charge.
2. Open the top door and roadside condenser grille.
3. Drain engine coolant from the unit.
4. Drain engine coolant from the expansion tank.
5. Remove the roadside condenser coil. Refer to "Roadside Condenser Coil," p. 133 for the removal procedure.
6. Disconnect the coolant hoses from the radiator

coil.

7. Remove the radiator coil mounting bolts and lift the radiator coil from the unit.

Installation

1. Place the radiator coil in the unit and install the mounting bolts.
2. Connect the coolant hoses to the radiator connections on the radiator coil.
3. Install the roadside condenser coil. Refer to "Roadside Condenser Coil," p. 133 for the installation procedure.
4. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
5. Install the engine coolant expansion tank and refill the cooling system with engine coolant.
6. Close the roadside condenser grille and top door.
7. 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!

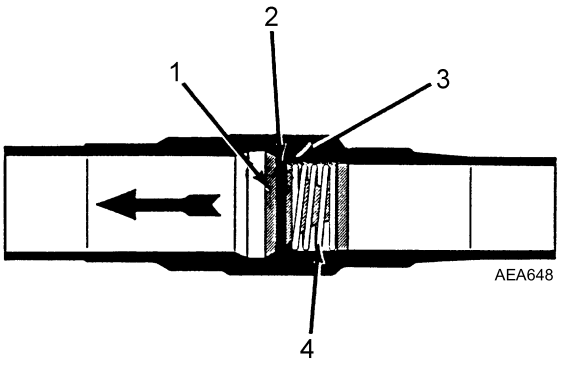
Use a heat sink, P/N 204-584, or wrap the vibrasorber with wet rags to prevent damaging the vibrasorber.

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 Check Valves

This unit uses some in-line check valves. An 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 227. 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 in the high side to slightly positive.

2. Unsolder the bypass check valve line from the bypass check valve. 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.

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 refrigeration system and test for leaks. If no leaks are found, evacuate the system.
4. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

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

Note: *This procedure applies to the Zone 1/Host unit expansion valve.*

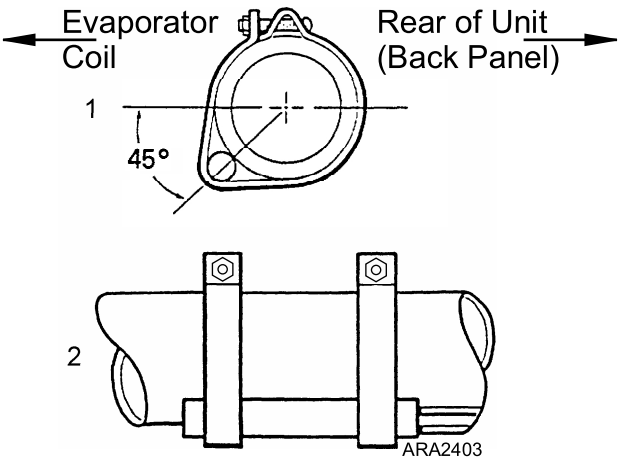
Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
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 228. 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. Replace 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 suction line and liquid line connections.
5. 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 suction line and liquid line connections.
4. Tighten the heat exchanger mounting hardware securely.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Replace the evaporator access panels.
7. Open the refrigeration valves and place the unit in operation.

Evaporator Coil Assembly

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Disconnect the sensors and the defrost drain hoses.
4. Unsolder the liquid line, hot gas line, and suction line connections on the curbside of the evaporator. Remove any putty from around the lines on the curbside of the evaporator before unsoldering the connections.
5. Remove the mounting bolts, lift and slide the evaporator coil assembly from the unit.

Installation

1. Place the evaporator coil assembly in position and install the mounting bolts.
2. Solder the liquid line, hot gas line, and suction line connections on the curbside of the evaporator. Seal the openings through the bulkhead with putty when the refrigerant lines have cooled off.
3. Replace and reconnect connect the sensors, and reconnect defrost drain hoses.
4. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
5. Replace the evaporator access panels.
6. 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.

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.
3. Unsolder the connection to the suction line on the other end 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.
3. Solder the suction vibrasorber connection to the suction line on the other end.
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)

Note: *The Old Style ETV is being replaced with the New Style ETV starting in 09/16. There are some physical differences, but they are functionally the same.*

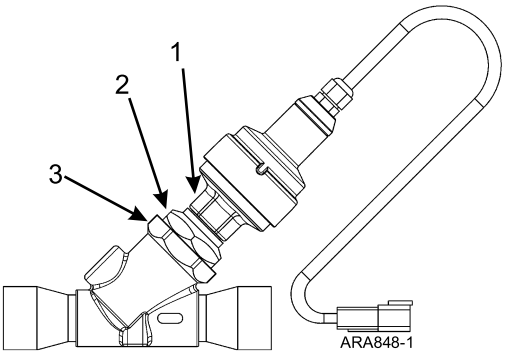
Removal

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

Note: *Make sure to disconnect the purge valve solenoid wires from the main/unified wire harness before placing the unit in the Evacuation Test. If the purge valve solenoid wires are not disconnected from the main/unified wire harness, the purge valve is energized when the unit is placed in the Evacuation Test. This allows the refrigerant in the condenser to flow into the accumulator, undoing the low side pump down. Also see* *"Low Side Pump Down," p. 128**.*

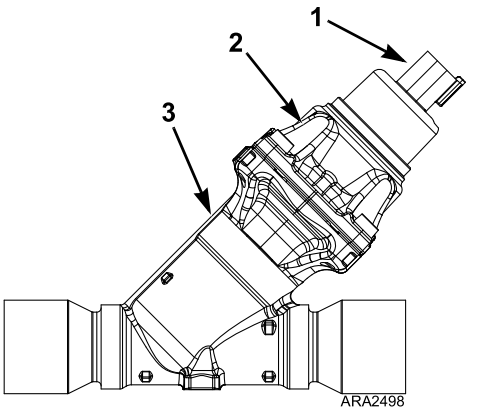
2. The ETV must be open to remove the stepper motor and piston assembly. Open the ETV by placing the unit in the Evacuation Mode/Test, and disconnecting the four-pin connector on the main/unified harness from the four-pin connector on the ETV harness (old style) or ETV (new style) before turning the 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 229. Round Style ETV



1.	Small Hex on Stepper Motor
2.	Large Nut
3.	Valve Body

Figure 230. Square Style 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 square style ETV stepper motor and piston assembly no more than four turns, or unscrew the four screws on the square style ETV 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.

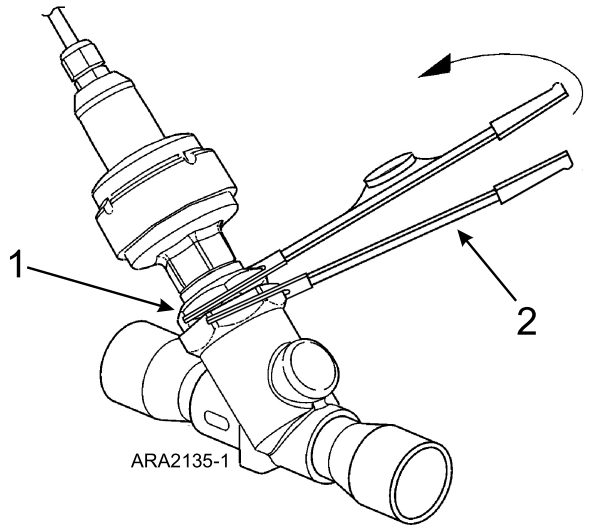
NOTICE

Service Procedures!

Round Style ETV - Unscrew the large nut. Do not unscrew the small hex on the stepper motor.

3. Old Style ETV - Unscrew the large nut that attaches the stepper motor and piston assembly to the valve body. The torque on the nut is approximately 118 ft-lb (160 N•m). Hold the valve body with backup wrench to prevent damage to the refrigeration tubing.

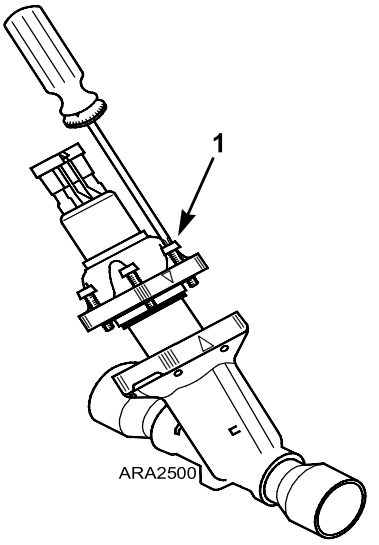
Figure 231. Removing Round Style Stepper Motor



1.	Unscrew Large Nut
2.	Backup Wrench

New Style ETV - Remove the four screws that attach the stepper motor to the valve body.

Figure 232. Removing Round Style 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.

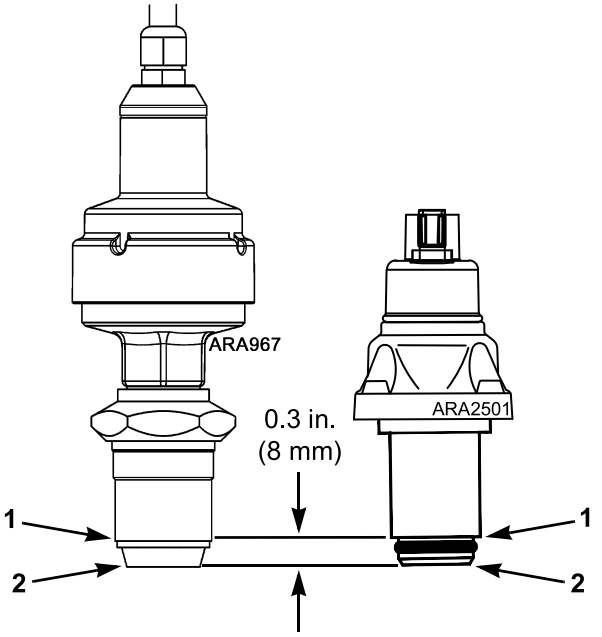
Installation of Service Kit

Note: *Do not connect the ETV harness or ETV to the main/unified wire harness 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 the main/unified 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. Further disassembly is required to reassemble the piston and stepper motor. See "Reassembly of Piston and Stepper Motor on Old Style ETV," p. 141.*

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

brass nut/piston housing. The piston retracts to open and extends to close.

Figure 233. Stepper Motor and Piston Assembly with Piston in Fully Open Position



1.	Bottom Edge of Brass Nut/Piston Housing
2.	Bottom Edge of Piston

2. Old Style ETV Only:
   a. Lubricate the piston and threads on the new stepper motor and piston assembly with refrigeration oil.
   b. Screw the new stepper motor and piston assembly into the valve body.
   c. Torque the nut to approximately 118 ft-lb (160 N•m). Hold the valve body with backup wrench to prevent damage to the refrigeration tubing.
3. New Style ETV Only:
   a. 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 234. Install O-Ring on Stepper Motor and Piston Assembly

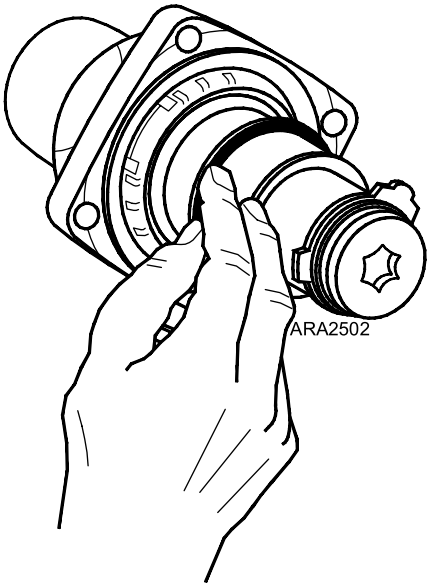
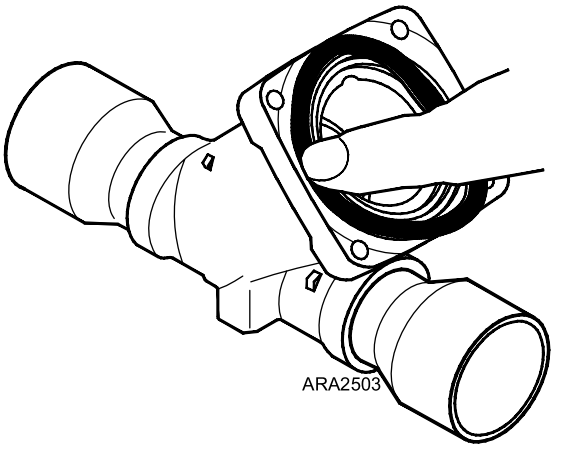
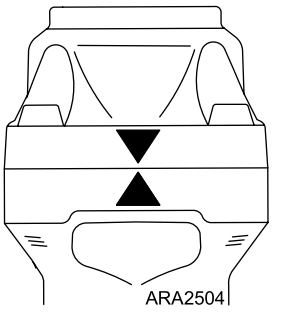


Figure 235. Install O-Ring in Valve Body



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

Figure 236. Align Arrowhead Marks



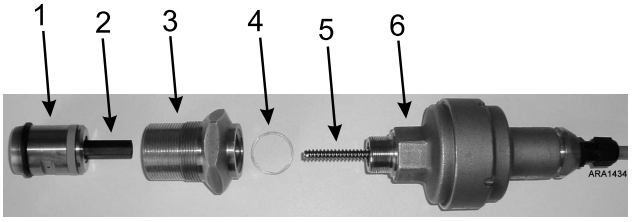
   c. Install the four screws and torque them to 4.4 ± 0.4 ft-lb (6.0 ± 0.5 N•m).

4. Connect the main/unified wire harness to the ETV harness (old style) or ETV (new style) 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. Open the refrigeration valves and place the unit in operation.

Reassembly of Piston and Stepper Motor on Old Style ETV

Use the following procedure to reassemble the piston and stepper motor if the piston has accidentally been turned off of the threaded shaft of the stepper motor.

Figure 237. Stepper Motor and Piston Assembly Components

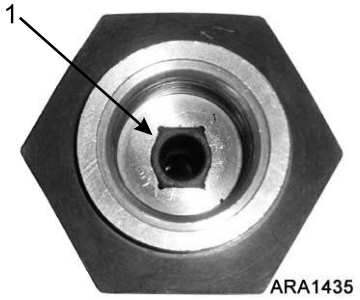


1.	Piston	4.	Copper Washer
2.	Rectangular Shaft on Piston	5.	Threaded Shaft of Stepper Motor
3.	Piston Nut	6.	Stepper Motor

1. Disassemble the stepper motor and piston assembly by unscrewing the stepper motor (small hex) from the piston nut (large nut).

2. Insert the piston into the piston nut. You must align the rectangular shaft on the piston with the rectangular hole in the piston nut to allow the piston to be inserted into the piston nut.

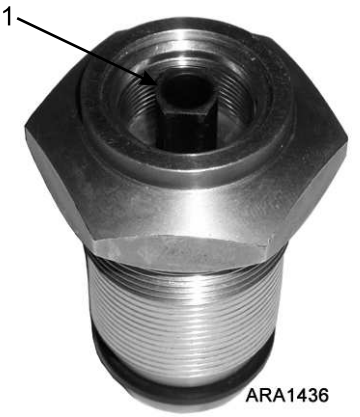
Figure 238. Insert Piston into Piston Nut



1.	Align Rectangular Shaft on Piston with Rectangular Hole in Piston Nut

3. Push the piston into the piston nut until the end of the rectangular shaft is about even with the top of the piston nut.

Figure 239. Push Piston into Piston Nut



1.	Position End of Rectangular Shaft about Even with Top of Piston Nut

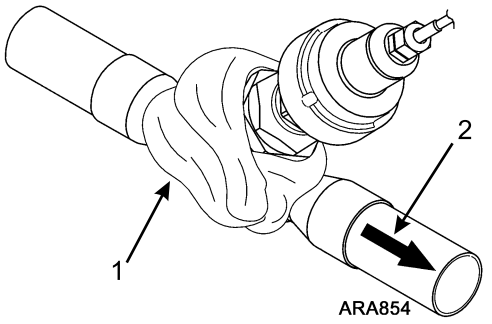
4. Verify the copper washer is in place in the top of the piston nut.
5. Place the threaded shaft of the stepper motor into the rectangular shaft of the piston and turn the piston and piston nut onto the threaded shaft of the stepper motor.
6. When the threads in the top of piston nut reach the threads on the bottom of the stepper motor, carefully continue to turn the piston and piston nut onto the stepper motor. Verify that the copper washer is in place and take care to avoid cross threading the fine threads on the stepper motor and in the top of the piston nut.
7. Continue to turn the piston and piston nut onto the stepper motor until they are tight. Torque the piston nut and stepper motor to 37 ft-lb (50 N•m).

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 240. Installing Complete ETV Assembly (Round Style Shown, New Style Similar)



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 harness (old style) or ETV (new style) 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. Pump down the low side and equalize the pressure in the high side to slightly positive.
2. Remove the evaporator access panels.
3. Disconnect the wires and remove the coil for the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Unsolder the refrigeration lines.
5. 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.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

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. Install the evaporator access panels.
8. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Hot Gas Solenoid Valve (HGS)

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

Removal

1. Pump down the low side and equalize the pressure in the high side to slightly positive.
2. Remove the evaporator access panels.
3. Remove the coil and disassemble the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Unsolder the refrigeration lines.
5. Remove the mounting bolts and remove the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and disassemble 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.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Solder the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Install the evaporator access panels.
8. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Liquid Line Solenoid Valve (LLS)

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

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the coil and disassemble the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Unsolder the refrigeration lines.
5. Remove the mounting bolts and remove the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and disassemble 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.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Solder the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Install the evaporator access panels.
8. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Suction Line Solenoid Valve (SLS)

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

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the coil and disassemble the valve.
4. Remove the mounting hardware.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

5. Unsolder the suction lines from the valve, and remove the valve from the unit.

Installation

1. Clean the tubes for soldering.
2. Remove the coil, disassemble the valve, and place the valve in position.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

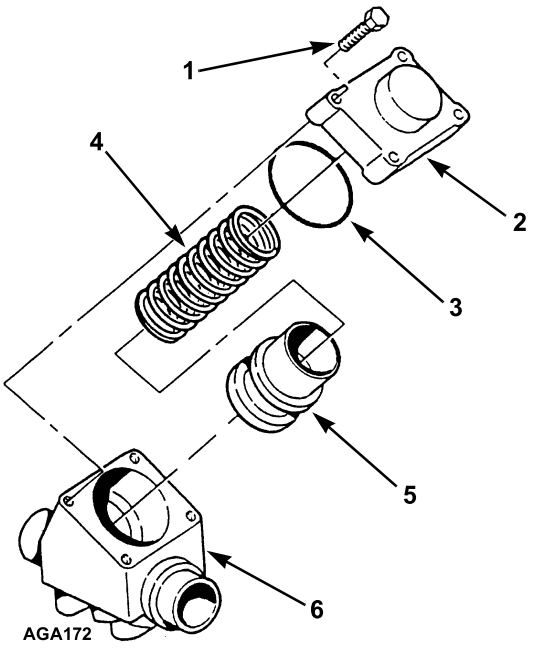
3. Solder the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.
4. Install the mounting hardware.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, evacuate the system.
7. Install the evaporator access panels.
8. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Check Valve Repair (SLCV, SLCV2, SLCV3, LRCV, and PVC)

Removal

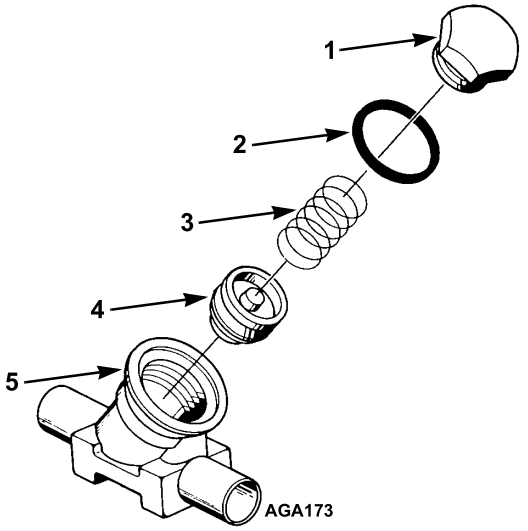
1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels (if necessary).
3. Remove the cap nut, or the four cap mounting screws and the cap, from the check valve and remove the spring and seat.

Figure 241. Suction Line Check Valve



1.	Cap Mounting Screw	4.	Spring
2.	Cap	5.	Seat
3.	Gasket	6.	Body

Figure 242. Check Valve with Cap Nut



1.	Cap	4.	Seat
2.	Gasket	5.	Body
3.	Spring		

Installation

1. Inspect the inside of the check valve body for damage or foreign particles that might adhere to the seat and damage the new seat. If the body is damaged, replace the check valve..
2. Install the new seat and spring. Place a new gasket on the cap and tighten the cap.
3. Pressurize the low side and test for leaks.
4. If no leaks are found, evacuate the system.
5. Install the evaporator access panels (if removed).
6. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Check Valve Replacement (SLCV, SLCV2, SLCV3, LRCV, and PVC)

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels (if necessary).
3. Unsolder the lines and remove the check valve.

   Note: *Disassemble the valve before unsoldering.*

Installation

1. Clean the tubes for soldering.
2. Place the disassembled check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Solder the inlet and outlet connections. After the valve cools, reassemble the valve.
4. Pressurize the low side and test for leaks.
5. If no leaks are found, evacuate the system.
6. Install the evaporator access panels (if necessary).
7. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Condenser Inlet Solenoid Valve (CIS)

Removal

1. Recover the refrigerant charge.
2. Remove the coil and disassemble the valve.

NOTICE

Equipment Damage!

Use a heat sink or wrap the valve with wet rags to prevent damage.

3. Unsolder the hot gas lines from the valve.
4. Remove the mounting bolts and remove the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and disassemble 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.

NOTICE

Equipment Damage!

Use a heat sink or wrap the valve with wet rags to prevent damage.

4. Solder the inlet and outlet connections. After the valve cools, assemble the valve and 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.

Condenser Inlet Check Valve (CICV) Repair

Removal

1. Recover the refrigerant charge.
2. Remove the cap nut from the check valve, and remove the spring and seat.

Installation

1. Inspect the inside of the check valve body for damage or foreign particles that might adhere to the seat and damage the new seat. If the body is damaged, replace the check valve.
2. Install the new seat and spring. Place the new gasket on cap and torque to 45 ft-lb (61 N•m).
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the system.
5. Recharge the unit with proper refrigerant and check the compressor oil.

Condenser Inlet Check Valve (CICV) Replacement

Removal

1. Recover the refrigerant charge.
2. Unsolder the lines and remove the check valve.

Note: *Disassemble the valve before unsoldering.*

Installation

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

Receiver Tank Pressure Solenoid Valve (RTPS)

Removal

1. Recover the refrigerant charge.
2. Remove the coil from the valve.

NOTICE

Equipment Damage!

Use a heat sink or wrap the valve with wet rags to prevent damage.

3. Unsolder the hot gas lines from the valve.
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.

NOTICE

Equipment Damage!

Use a heat sink or wrap the valve with wet rags to prevent damage.

4. Solder the inlet and outlet connections. After the valve cools, install the coil on the valve.
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.

Purge Valve (PV)

Removal

1. Recover the refrigerant charge.
2. Remove the coil from the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

3. Unsolder the refrigeration lines from the valve, and remove the valve from the unit.

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.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Solder the inlet and outlet connections. After the valve cools, install the coil on the valve.
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

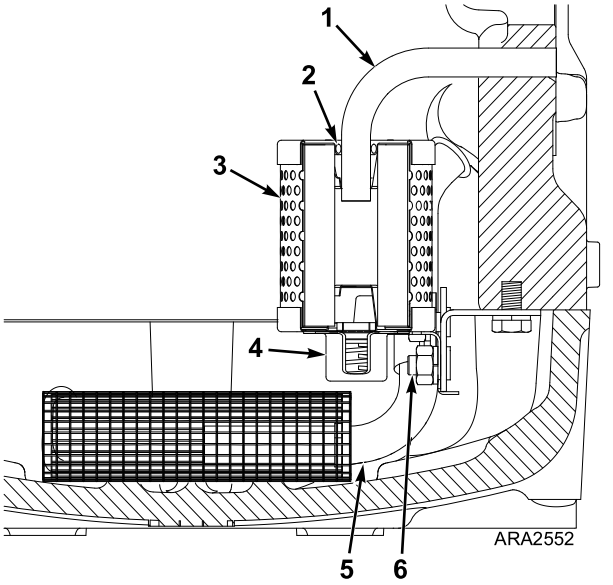
In the first quarter of 2014, four cylinder compressors with an internal oil filter are being phased into truck and trailer units that typically use compressors with external oil filters. The internal oil filter is located in the compressor sump near the oil pickup tube (Figure 243, p. 146).

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.

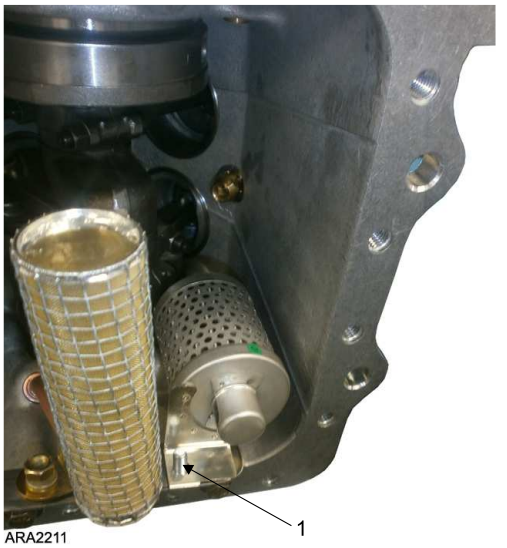
Figure 243. Internal Oil Filter



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.

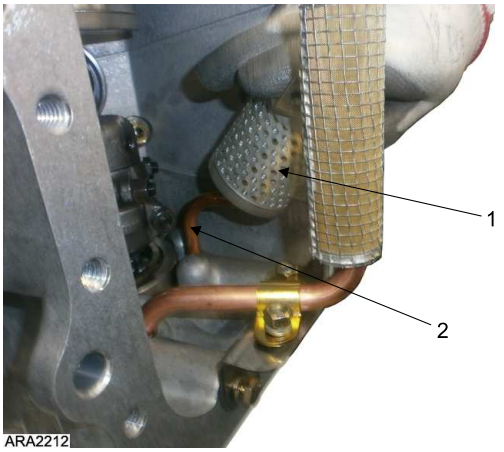
Figure 244. Remove Nut from Stud



1.	Stud On Oil Pickup Tube Bracket

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

Figure 245. 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

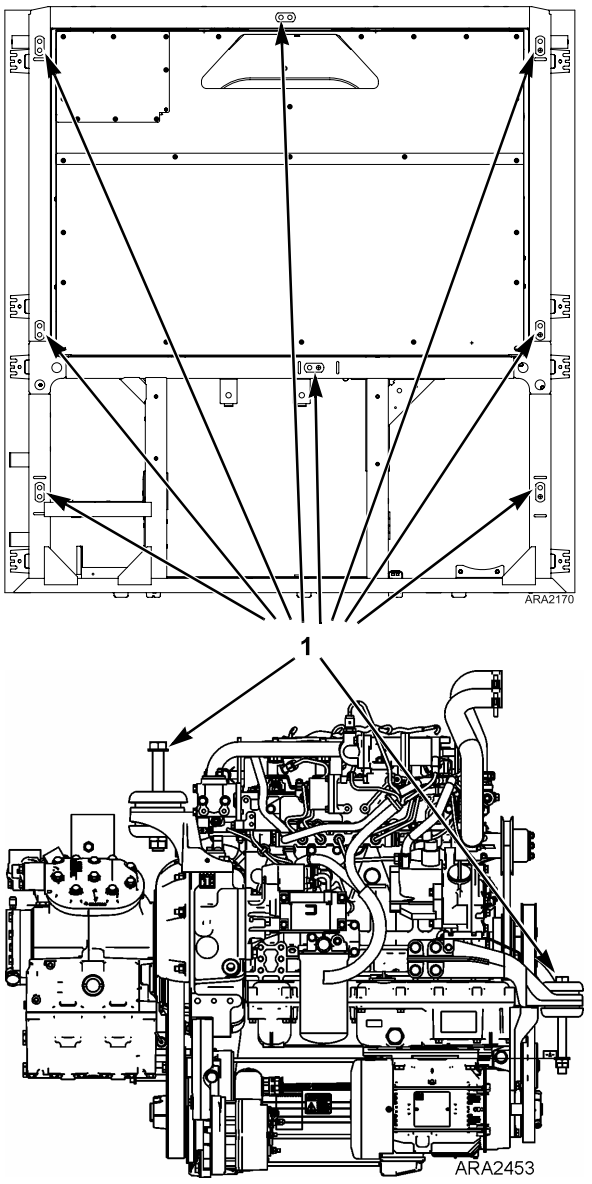
5. The net oil pressure should be at least 20 psig (138 kPa). If the net oil pressure is low, first check the compressor oil level, then check the compressor oil pump and relief valve.

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 246. 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 248, p. 149) 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 249, p. 149).

- 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 249, p. 149).

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 247. Coil Before Cleaning

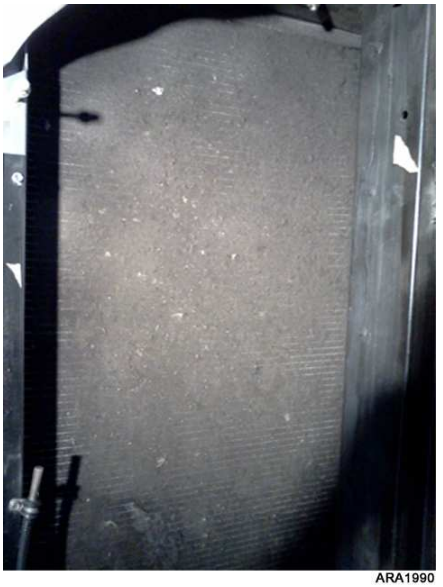
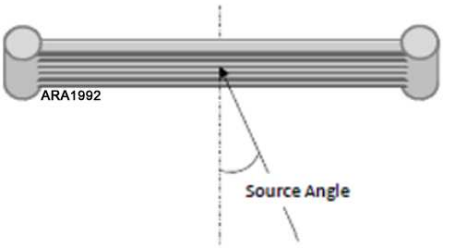


Figure 248. Coil after Wiping Right Hand Side with Cloth

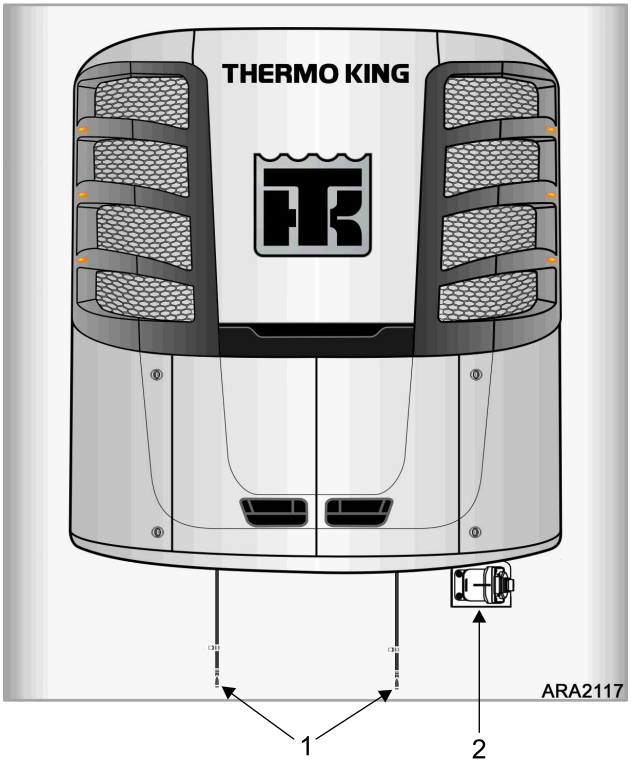
Figure 249. Source Angle for Cleaning with Air or Water



Defrost Drains

1. Clean the defrost drains during scheduled maintenance inspections to verify the lines remain open.
2. Verify that the defrost drain hoses are routed correctly so they do not drain on the power receptacle or power source on units equipped with the SmartPower option.

Figure 250. Defrost Drain Hose Routing



1.	Defrost Drain Hoses
2.	Power Receptacle

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.

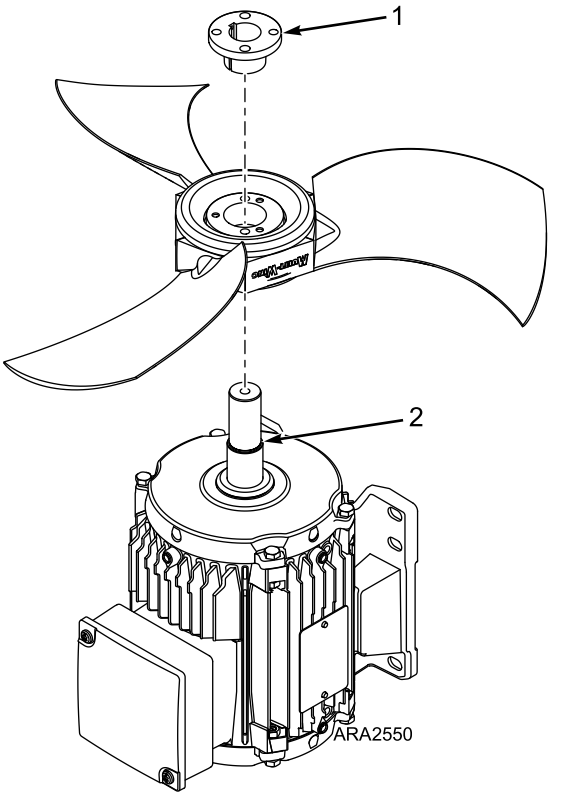
Note: *The nuts for mounting the unit should be elastic stop nuts (Nylock type).*

Condenser Fan Alignment

When mounting a condenser fan and hub assembly on the fan motor, the fan and orifice must be properly aligned for proper air flow and to prevent damage to the fan.

1. Place the fan assembly on the condenser motor shaft so the taper lock bushing is resting on condenser motor shaft shoulder (see "Condenser Fan Installation" below).
2. Finger tighten the hub bolts till the bolt heads are flush with the hub face.
3. Using a wrench, do a full turn on each bolt alternatively. Repeat this step until some torque builds.

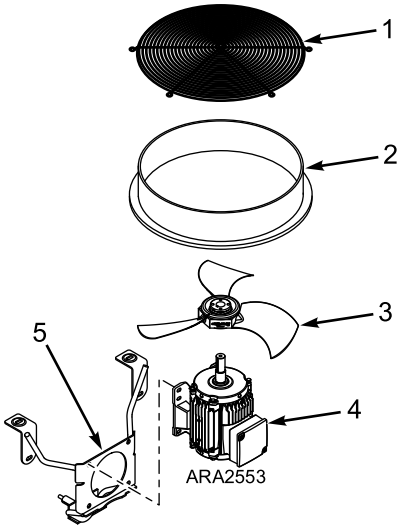
Figure 251. Condenser Fan Installation



1.	Taper Lock Bushing
2.	Condenser Motor Shaft Shoulder

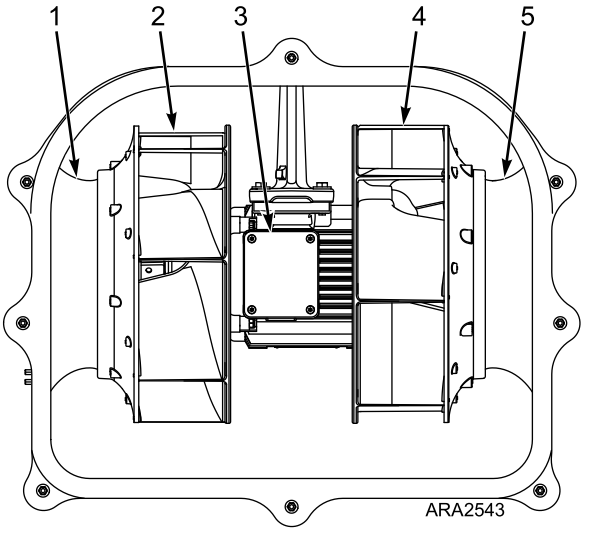
4. Use a torque wrench set to 7 ft-lb (9.5 N•m) [Note: 6.43 ft-lb (8.7 N•m) actual required] to complete the tightening sequence on each bolt alternatively.
5. If necessary, loosen the condenser fan orifice mounting bolts, center the orifice around the fan, and tighten the mounting bolts.

Figure 252. Curbside Condenser Fan Components (Roadside Similar)



1.	Grille	4.	Fan Motor
2.	Orifice	5.	Fan Motor Mounting Bracket
3.	Fan		

Figure 253. Front View Showing Evaporator Fans/Blowers Through Access Panel



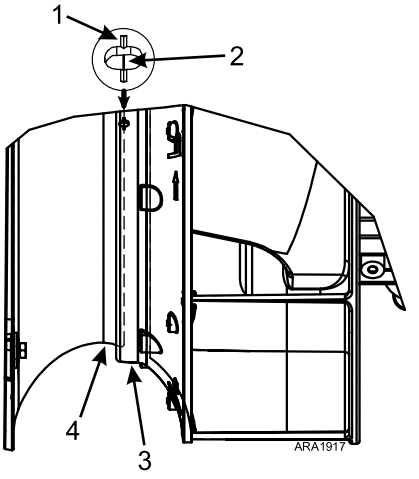
1.	Curbside Orifice	4.	Roadside Blower
2.	Curbside Blower	5.	Roadside Orifice
3.	Fan Motor		

Evaporator Fan/Blower Alignment

When mounting the evaporator blowers on the fan motor shafts, the blowers and inlet orifices must be properly aligned for proper air flow and to prevent damage to the blowers.

1. Loosen the orifice mounting bolts.
2. Slide the blower towards the orifice until it contacts the orifice. This centers the orifice in the blower.
3. Securely tighten the orifice mounting bolts.
4. Slide the blower away from the orifice.
5. Position the blower so the edge of the orifice lines up with the alignment mark on the blower as shown (Figure 254, p. 151) and tighten the blower hub bolts.
6. Spin the blower by hand to check for blower distortion.
7. Pass a 0.09 inch (2.3 mm) diameter gauge wire completely around the circumference of the orifice and the blower wheel to check for uniform clearance.

Figure 254. Evaporator Blower Alignment (Curbside Shown Roadside Similar)



1.	Alignment Mark	3.	Blower Wheel
2.	Edge of Orifice	4.	Orifice

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	Voltage falls below 6 Vdc at ECU while starter cranking	Repair cause of low voltage at ECU while starter cranking
	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
	Electric fuel pump not energized	Check 8DF and CHFP circuits
	Electric fuel pump defective	Replace electric fuel pump
	Air in fuel system	Bleed air
	Compression low	Overhaul engine
	Air cleaner clogged	Replace air filter
	Exhaust plugged	Clean exhaust
Engine stops after starting	Air in fuel system	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
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
	Insufficient fuel volume leaving filter	Check for dirty filter or air in system
	Air cleaner clogged	Replace air filter
	Delivery of electric fuel pump insufficient	Repair pump
	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
	Compression low or unbalanced	Overhaul engine
Engine speed too high	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem
Engine fails to stop when unit is OFF	Problem with ECU controlled engine function	Use YSAD engine diagnostic tool to diagnose problem

CONDITION	POSSIBLE CAUSE	REMEDY
Engine knocks heavily	Air in system	Bleed fuel system
	Wrong fuel	Change fuel
	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	Cleaning 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
High oil consumption	10 hour engine break in running was not successfully completed	Run unit for 10 hours in continuous run as described in the "Unit Check List" section at the end of the Precedent Multi-Temperature Systems with S-3 Remote Evaporators Installation Manual (TK 55774-2-IM)
	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

Blue Smoke

Oil Consumption

- Poor compression
- Defective valve seals

Electric Standby Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit turned ON—LCD Blank	Battery discharged	Charge or replace battery
	Faulty battery cable connections	Clean battery cables
	Fuse link to 2 circuit blown	Check for short circuit and replace fuse link
	Fuse F2, F7, or F8 blown	Check for short circuits and replace fuse
	Open circuit	Check HMI Harness
Unit turned ON and LCD backlight ON but motor will not start and run	Diesel operation selected	Select ELECTRIC
	Unit in NULL	Check setpoint and box temperature
	Fuse F25 blown	Check for short circuit and replace fuse
	Faulty HPCO	Check HPCO
	Open or faulty overload relay	Determine cause and rest or replace overload relay
	Faulty PSM	Check PSM
	Faulty motor contactor	Check motor contactors
	Open circuit	Check 8, ER, EOL, 7E, 7EB, 7EC, CH, L1, L2, and L3 circuits
	Faulty drive motor	Check drive motor
	Faulty electric standby power source	Check electric standby power source
Evaporator heaters do not heat	Faulty heater contactor	Check heater contactor
	Open circuit	Check 7E, 26E, L1, L2, L3, H1A, H2A, and H3A circuits
	Faulty heaters	Check heaters

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
																•	Evaporator fans stay running
						•		•							•		Evaporator fans not running
							•										Suction service valve back seated
	•	•		•	•						•				•	•	Faulty CIS
	•	•									•				•	•	Faulty HGS
	•															•	Loose or broken electrical connections
•					•	•		•							•		Sensor out of calibration
					•	•	•	•									Compound pressure gauge out of calibration
											•						Leaky receiver tank outlet valve
					•	•					•				•	•	Leaky check valve
					•	•					•				•	•	Faulty check valve
			•														Leaky receiver tank pressure solenoid (RTPS)
				•												•	Closed receiver tank pressure solenoid (RTPS)
		•			•										•	•	Leaky hot gas solenoid (HGS)
			•													•	Closed hot gas solenoid (HGS)
					•										•	•	Leaky liquid line solenoid (LLS)
			•			•	•	•							•	•	Closed liquid line solenoid (LLS)
																•	Leaky liquid return check vale (LRCV)
					•										•		Leaky suction line solenoid (SLS)
					•										•	•	Leaky suction line check valve (SLCV)
					•										•		Leaky Zone 2 or 3 hot gas solenoid (HGS2 or 3)
			•			•									•	•	Closed Zone 2 or 3 hot gas solenoid (HGS2 or 3)
															•	•	Leaky Zone 2 or 3 liquid line solenoid (LLS2 or 3)
						•									•	•	Closed Zone 2 or 3 liquid line solenoid (LLS2 or 3)
																•	Leaky Zone 2 or 3 liquid return check valve (LRCV2 or 3)

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
					•										•		Leaky Zone 2 or 3 suction line solenoid (SLS2 or 3)
					•										•	•	Leaky Zone 2 or 3 suction line check valve (SLCV2 or 3)
					•							•	•		•		Leaky purge valve (PV)
						•	•	•							•	•	Faulty ETV
				•	•						•				•	•	Hot gas bypass valve stuck open or leaking

Remote Evaporator Specifications

Refrigeration System

Evaporator Coil Type	Direct Expansion
Refrigerant Type	R404A
Heat/Defrost Method	Hot gas

Electrical

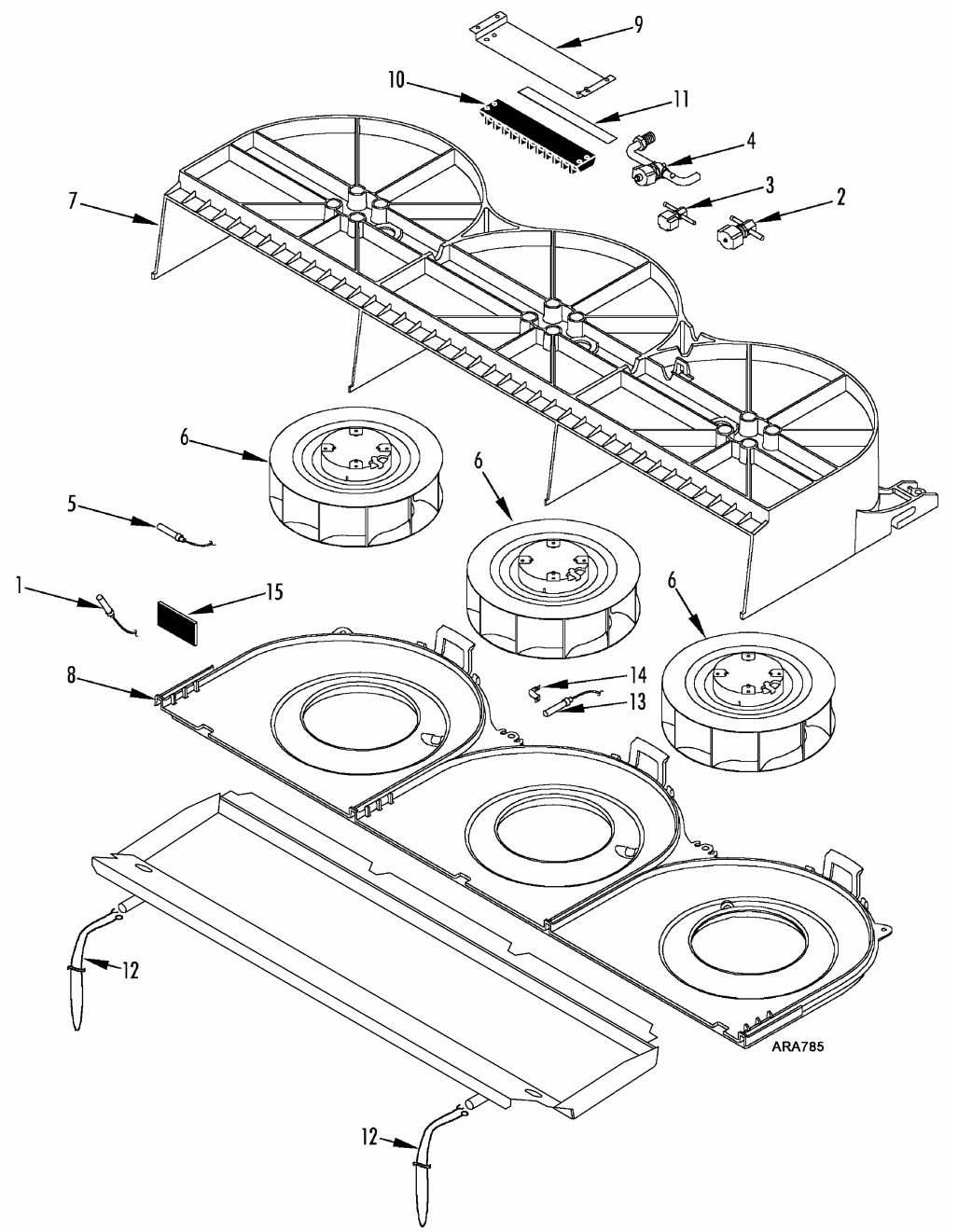
Control System Voltage		12.5 Vdc
Circuit Protection		Fuses on the Expansion Module (see "Expansion Module Fuses," p. 85)
Fan Motors (each):	Power Rating RPM Full Load Amps	0.13 hp (100 Watts) 2350 5.7 amps (per motor)
Remote Liquid Line Solenoid:	Current Draw Resistance	1.3 amps 9.6 ohms
Remote Hot Gas Solenoid:	Current Draw Resistance	1.5 amps 8.3 ohms
Remote Suction Line Solenoid:	Current Draw Resistance	1.5 amps 8.3 ohms
Drain Heaters (each):	Current Draw Resistance	2.0 amps 6.1 ohms

Remote Evaporator Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Electrical:
	•	•	•	Inspect wire harness for damaged wires or connections.
	•	•	•	Inspect/replace DC fan motors.
				Structural:
•	•	•	•	Visually inspect unit for fluid leaks.
•	•	•	•	Visually inspect unit for damaged, loose, or broken parts.
	•	•	•	Clean entire unit including evaporator coils and defrost drains.
	•	•	•	Check all unit mounting bolts, brackets, lines, hoses, etc.

Remote Evaporator Unit Description

Figure 255. S-3 Remote Evaporator Components



1.	Coil Temperature Sensor (Ungraded)	6.	Variable Blower (12 V)	11.	Terminal Board Markstrip
2.	Hot Gas Solenoid	7.	Blower Housing	12.	Drain Heater (Resistance Wire)
3.	Liquid Solenoid	8.	Blower Cover	13.	Return Air Sensor (Graded)
4.	Suction Line Solenoid	9.	Terminal Board Bracket	14.	Sensor Clamp
5.	Discharge Air Sensor (Graded)	10.	Terminal Board	15.	Coil Sensor Delay Pad

Figure 256. S-3 Remote Evaporator - Front View

Figure 257. S-3 Remote Evaporator - Back View

The Precedent multi-temperature refrigeration system provides heavy duty temperature control for multiple compartment trailers. The system provides direct expansion cooling in all trailer compartments. Non-contaminating refrigerant tap-ins in the host unit evaporator provide convenient refrigerant piping connections for the remote evaporator(s).

The host unit mounts on the front of the trailer with the evaporator protruding into the trailer. The remote evaporator(s) is a ceiling mounted unit.

Heat and defrost is provided in all compartments by circulating hot refrigerant gas through the evaporators.

The remote evaporator(s) are controlled by the SR-4 MT Control System through the expansion module. The SR-4 MT Control System is located in the host unit. The expansion module harness connects the remote evaporator(s) to the expansion module. The expansion module is connected to the base controller/interface board assembly through the CAN bus. See "SMART REEFER 4 Multi-Temp (SR-4 MT) Control System," p. 40 and Refer to the SR-4 Trailer Multi-Temperature Diagnostic Manual (TK 55788–2–OD) for more information about the SR-4 MT Control System.

Unit Operation

The remote evaporator cycles between cool, null and heat to maintain the trailer's compartment(s) at the setpoint. The operating modes include Cool, Null, Heat, and Defrost.

Power to run the direct current fan motors is supplied by the alternator or the battery charger in the host unit.

When cooling is required, the SR-4 MT Control System energizes the remote liquid line solenoid valve. Refrigerant flows through the evaporator coil to provide cooling.

When the compartment temperature is near setpoint, the SR-4 MT Control System de-energizes the remote liquid line solenoid valve and switches the remote evaporator to null.

The SR-4 MT Control System energizes the remote hot gas solenoid when the remote compartment requires heat or defrost.

Defrost

The Defrost mode can be initiated any time the evaporator coil temperature is below 45 F (7 C). Defrost is initiated automatically by the controller or manually by selecting defrost from the Defrost Prompt Screen for the desired zone.

The evaporator fans stop during defrost. The Defrost mode will continue until the evaporator coil temperature rises to 58 F (14.5 C), causing the controller to terminate defrost. After Defrost, the evaporator may shift back to Cool, Null or Heat.

Operating Modes

Remote evaporator operating modes are:

- Cool
- Null
- Heat
- Defrost

Note: *The controller locks out heat at setpoints below 15 F (-9.5 C).*

Unit Features

- Direct Expansion Evaporator Coil
- SR-4 MT Control System with Expansion Module
- 12 Vdc Fan Motor
- Aluminum Housing
- Liquid Line Solenoid
- Hot Gas Solenoid
- Suction Line Solenoid
- Liquid Return Check Valve

Unit Protection DevicesSpectrum

- Smart FETs in the expansion module.

Serial Number Location

Unit: Nameplate on the right end of the unit frame.

Figure 258. Serial Number Location

1.	Nameplate on Right End of Unit Frame

Remote Evaporator Electrical Maintenance

SR-4 Multi-Temp Microprocessor Controlled Components

Refer to the SR-4 Trailer Multi-Temp Diagnostic Manual (TK 55788–2–OD) for information about maintenance of the microprocessor controlled components.

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.

Remote Evaporator Refrigeration Service Operations

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

Expansion Valve Assembly

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Disconnect the liquid inlet line and distributor from the expansion valve.
4. Remove the feeler bulb from the clamp. Note the position of the feeler bulb on the suction line.
5. Disconnect the equalizer line.
6. Remove the expansion valve assembly from the unit.

Installation

1. Place the expansion valve in the unit.
2. Connect the equalizer line to the expansion valve.
3. Connect the liquid inlet line and distributor to the expansion valve.
4. Clean the suction line to a bright polished condition. Install the feeler bulb clamps and 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 it with insulating tape.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Install the access panels.
7. Open the refrigeration valves and place the unit in operation.
8. Test the unit to see that the expansion valve is properly installed.

Evaporator Coil

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Disconnect the distributor from the expansion valve.
4. Remove the insulating tape and feeler bulb from the suction line. Note the position of the feeler bulb on the suction line. Disconnect the equalizer line from the suction line.
5. Unsolder the suction line connection to the evaporator coil.
6. Remove the mounting bolts and slide the coil from the housing.

Installation

1. Place the evaporator coil in the evaporator housing and install the mounting bolts.
2. Clean and solder the suction line connections to the evaporator coil.
3. Connect the distributor to the expansion valve.
4. Clean the suction line to a bright polished condition. Install the feeler bulb clamps and 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 it with insulating tape.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Install the access panels.
7. Open the refrigeration valves and place the unit in operation.
8. Test the unit to see that the expansion valve is properly installed.

Solenoid Valves

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

Removal

1. Pump down the low side and equalize the pressure to slightly positive. For the hot gas valve, recover the refrigerant charge.
2. Remove the access panels.
3. Remove the coil and disassemble the valve.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

4. Unsolder the refrigeration lines from the valve, and remove the valve from the unit.

Installation

1. Clean the tubes for soldering.
2. Remove the coil, disassemble the valve, and place the valve in position.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage.

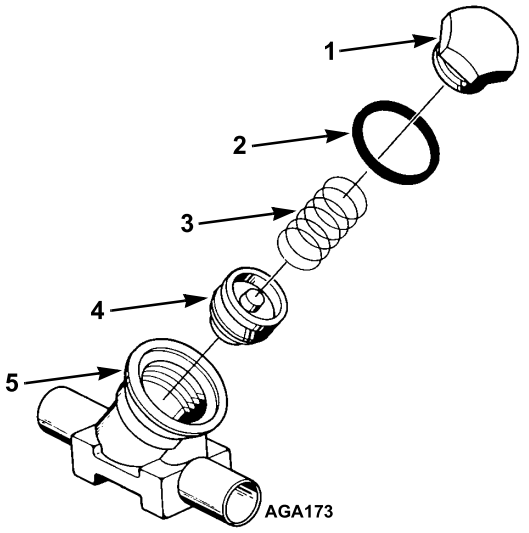
3. Solder the inlet and outlet connections. After the valve cools, assemble the valve and install the coil.
4. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side. For the hot gas valve, pressurize the refrigeration system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Install the access panels.
7. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil. Add as required. For the hot gas valve, recharge the unit with proper refrigerant.

Liquid Return Check Valve Repair

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the access panels.
3. Remove the cap nut from the check valve and remove the spring and seat.

Figure 259. Check Valve with Cap Nut



1.	Cap	4.	Seat
2.	Gasket	5.	Body
3.	Spring		

Installation

1. Inspect the inside of the check valve body for damage or foreign particles that might adhere to the seat and damage the new seat. If the body is damaged, replace the check valve..
2. Install the new seat and spring. Place a new gasket on the cap and tighten the cap nut.
3. Pressurize the low side and test for leaks.
4. If no leaks are found, evacuate the low side.
5. Install the access panels.
6. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Liquid Return Valve Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the access panels.
3. Unsolder the lines and remove the check valve.

   Note: *Disassemble the valve before unsoldering.*

Installation

1. Clean the tubes for soldering.
2. Place the disassembled check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Solder the inlet and outlet connections. After the valve cools, reassemble the valve.
4. Pressurize the low side and test for leaks.
5. If no leaks are found, evacuate the low side.
6. Install the access panels.
7. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Heat Exchanger

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the access panels.
3. Remove the mounting hardware used to mount heat exchanger to the panel.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage to nearby valves.

4. Unsolder the refrigeration lines from the heat exchanger ports and remove it from the unit.

Installation

1. Clean the tubes for soldering.
2. Position the tubes in the proper ports on the heat exchanger.
3. Reinstall the mounting hardware used to mount heat exchanger to the panel.

NOTICE

Equipment Damage!

Use a heat sink to prevent damage to nearby valves.

4. Solder the refrigeration lines from the heat exchanger ports to the tubes.
5. Pressurize the low side and test for leaks.
6. If no leaks are found, evacuate the low side.
7. Install the access panels.
8. Open the refrigeration valves and run the unit. Check the refrigerant charge and compressor oil.

Remote Evaporator Structural Maintenance

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.

Defrost Drains

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

Evaporator Coil

Clean the evaporator coil during scheduled maintenance inspections by blowing compressed air from the top side of the coil down toward the bottom (the direction opposite the normal air flow). The air pressure should not be high enough to damage the coil fins. Be careful not to bend the fins when cleaning a coil. Inspect the coil and fins for damage, and repair if necessary.

Remote Evaporator System Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Load temperature too high	Refrigerant shortage	Repair leak and recharge
	Setpoint too high	Adjust setpoint
	Expansion valve plugged	Clean or replace
	Partial obstruction in low side of refrigeration system	Locate obstruction and repair
	Iced or dirty evaporator coil	Defrost or clean evaporator coil
	Expansion valve open too much	Replace or adjust valve
	Poor fitting trailer door	Repair or replace doors
	Liquid line solenoid partially closed or defective	Repair or replace
	Evaporator fan not operating	Check and correct evaporator fan
Evaporator fan motor does not run	Open in 2A circuit to expansion module	Locate open and repair
	Fuse FX1, FX3, FX4, FX6, FX7, or FX9 blown	Check for short circuits and replace fuse
	Open in FM21, FM22, FM23, FM31, FM32, or FM33 circuit	Locate open and repair
	Defective fan motor	Replace fan motor
	Defective expansion module	Replace expansion module

Diagram Index

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

See the Precedent Diagrams Manual TK 55849-2-DM, which contains these diagrams, and other diagrams relevant to other Precedent units. The schematic and wiring diagrams are also available on TSA Info Central.

Drawing No.	Drawing Title
1H99103	S-610M Schematic Diagram
1H99104	S-610M Wiring Diagram
1H74653	S-600, S-700, S-610DE, and S-610M Fuel Line Routing Diagram

Notes

Thermo King – by Trane Technologies (NYSE: TT), a global climate innovator – is a worldwide leader in sustainable transport temperature control solutions. Thermo King has been providing transport temperature control solutions for a variety of applications, including trailers, truck bodies, buses, air, shipboard containers and railway cars since 1938. For more information, visit www.thermoking.com or www.tranetechnologies.com.

TK 56302-2-MM-EN 01 Jul 2020
Supersedes (New)