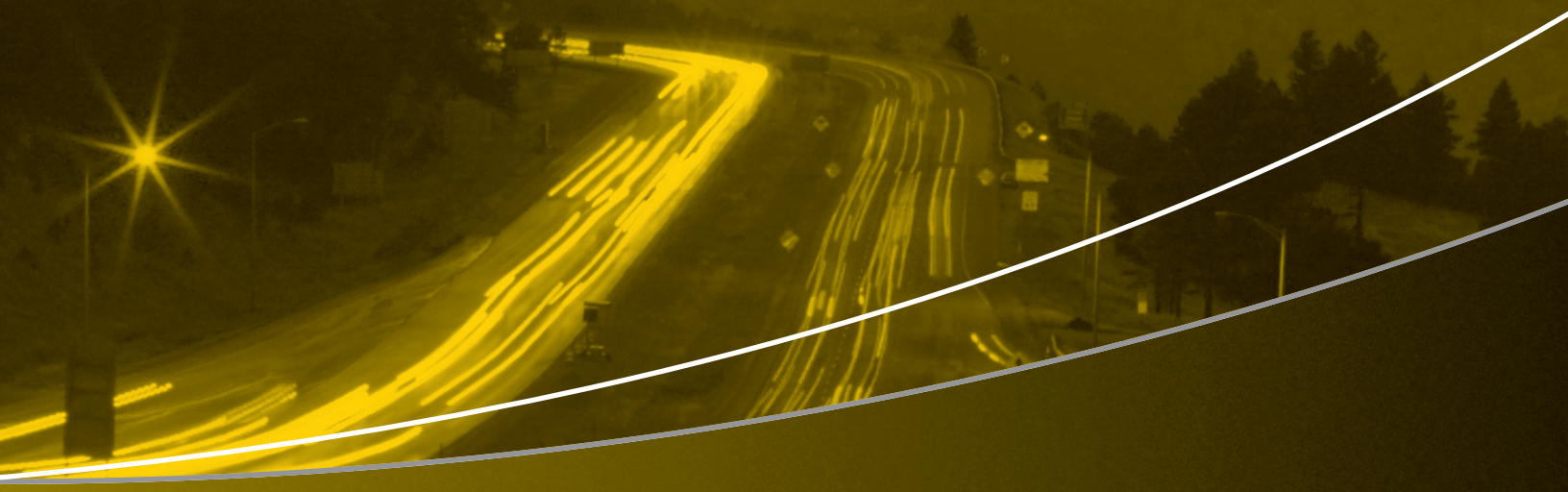
THERMO KING

Maintenance Manual

Precedent™ C-600

TK 55494-2-MM (Rev. 0, 06/13)



Ingersoll Rand

Precedent™ C-600

TK 55494-2-MM (Rev. 0, 06/13)

The maintenance information in this manual covers unit models:

System Precedent C-600 (901819) **Precedent C-600 (070008)**

For further information, refer to:

Precedent C-600 Operator's Manual	**TK 55692**
Precedent C-600 Parts Manual	**TK 55688**
Precedent SR-4 Microprocessor Control System Diagnostic Manual	**TK 55533**
Precedent Single Temperature Systems Installation Manual	**TK 55496**
TK482 and TK486 Engine Overhaul Manual	**TK 50136**
X214, X418, X426 and X430 Compressor Overhaul Manual	**TK 6875**
Diagnosing TK Refrigeration System	**TK 5984**
Tool Catalog	**TK 5955**
Evacuation Station Operation and Field Application	**TK 40612**
ElectroStatic Discharge (ESD) Training Guide	**TK 40282**

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

This manual is published for informational purposes only and the information so provided should not be considered as all-inclusive or covering all contingencies. If further information is required, Thermo King Corporation should be consulted.

Sale of product shown in this manual is subject to Thermo King's terms and conditions including, but not limited to, the Thermo King Limited Express Warranty. Such terms and conditions are available upon request. Thermo King's warranty will not apply to any equipment which has been "so repaired or altered outside the manufacturer's plants as, in the manufacturer's judgment, to effect its stability."

No warranties, express or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, and descriptions contained herein. Manufacturer is not responsible and will not be held liable in contract or in tort (including negligence) for any special, indirect or consequential damages, including injury or damage caused to vehicles, contents or persons, by reason of the installation of any Thermo King product or its mechanical failure.

Recover Refrigerant

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.

In addition, service personnel must be aware of Federal regulations concerning the use of refrigerants and the certification of technicians. For additional information on regulations and technician certification programs, contact your local Thermo King dealer.

CHANGES, COMMENTS and SUGGESTIONS

You are invited to comment on this manual so it can be updated and improved to better meet you needs. Any corrections, comments or suggestions are welcome. Please complete the following information:

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Return to:

NORTH AMERICA

THERMO KING CORPORATION
314 West 90th Street
Mail Stop 38
Minneapolis, MN 55420
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Mervue, Galway, Ireland
Attn: Service Department

Table of Contents

Safety Precautions

Thermo King recommends that all service be performed by a Thermo King dealer. However, you should be aware of several general safety practices:

The ⚠ symbol appears next to a point that is particularly important

⚠ ***DANGER: Denotes the possibility of serious injury or death.***

⚠ ***WARNING: Denotes the possibility of serious equipment damage or serious personal injury.***

⚠ ***CAUTION: Denotes the possibility of minor to severe equipment damage or personal injury.***

General Practices

⚠ ***DANGER: Do not operate the compressor with the discharge service valve closed. This condition increases internal pressure, which can cause an explosion.***

⚠ ***DANGER: Never apply heat to a sealed refrigeration system or container. Heat increases internal pressure, which might cause an explosion.***

⚠ ***DANGER: Refrigerant in the presence of an open flame, spark or electrical short produces toxic gases that are severe respiratory irritants.***

⚠ ***DANGER: Keep your hands, clothing and tools clear of fans when working on a unit that is running. Loose clothing might entangle moving pulleys or belts, causing serious injury or possible death.***

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

⚠ ***DANGER: 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: Make sure your gauge manifold hoses are 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: 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" on page 13.***

⚠ ***WARNING: Use extreme caution when drilling holes in a unit. Holes might weaken structural components. Holes drilled into electrical wiring can cause a fire or explosion.***

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

⚠ ***WARNING: Do not apply heat to a closed cooling system. Before applying heat to a cooling system, drain it. Then flush it with water and drain the water. Antifreeze contains water and ethylene glycol. The ethylene glycol is flammable and can ignite if the antifreeze is heated enough to boil off the water.***

⚠ ***WARNING: Be careful when using ladders or scaffolding to install or service a unit. Observe the manufacture's safety labels and warnings.***

⚠ ***CAUTION: Make sure all mounting bolts are tight and are the correct length for their applications. Improper torque and incorrect bolt lengths can damage equipment.***

NOTE: In the USA, EPA Section 608 Certification is required to work on refrigeration systems.

Battery Installation and Cable Routing

WARNING: Improperly installed battery could result in a fire or explosion! A Thermo King approved battery must be installed and properly secured to the battery tray.

WARNING: Improperly installed battery cables could result in fire or explosion! 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: Do not attach fuel lines or any additional wiring harnesses to the battery cables as this could cause an electrical fire!

CAUTION: Do not connect other manufacturer's equipment or accessories to the Thermo King unit. This could result in severe damage to equipment and void the warranty!

CAUTION: 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.

CAUTION: Always wear protective clothing, gloves and eye wear when handling and installing batteries. Battery acid can cause serious burns when exposed to eyes or skin. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters your eye, immediately flood it with running cold water for at least twenty minutes and get medical attention immediately.

CAUTION: 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.

Battery Removal

DANGER: Disconnect the negative battery terminal (-) first when removing a battery. Connect the positive terminal (+) first when installing a battery.

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: 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.

DANGER: 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.

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

WARNING: Wear butyl lined gloves when handling refrigerant to help prevent frostbite.

CAUTION: Refrigerant in a liquid state evaporates rapidly when exposed to the atmosphere, freezing anything it contacts. Be careful when handling refrigerant to protect your skin from frostbite.

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

CAUTION: When transferring refrigerant, use a process that prevents or greatly restricts refrigerant from escaping into the atmosphere. Refrigerant damages the earth's upper ozone layer.

Refrigerant Oil Hazards

WARNING: Protect your eyes from contact with refrigerant oil. The oil can cause serious eye injuries. Avoid prolonged or repeated contact with refrigerant oil. To prevent irritation, wash your hands and clothing thoroughly after handling the oil.

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

CAUTION: Do not mix refrigerant oils because that can cause system damage.

CAUTION: Use dedicated equipment to prevent contaminating systems with the wrong type of oil.

CAUTION: Store refrigerant oil in an approved sealed container to avoid moisture contamination.

CAUTION: Do not expose the refrigerant oil to the air any longer than necessary. The oil will absorb moisture, which results in much longer evacuation times and possible system contamination.

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

Electrical Hazards

High Voltage

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

WARNING: 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: Use tools with well insulated handles. Never hold uninsulated metal tools near exposed, energized conductors.

WARNING: Treat all wires and connections as if they were high voltage until a meter and wiring diagram indicate otherwise.

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

WARNING: Use caution when working with electrical circuits that contain capacitors. Some capacitors hold a significant charge that might cause burns or shocks if accidentally discharged. Make sure capacitors are discharged before working on electrical circuits.

Low Voltage

WARNING: Control circuits used in refrigeration units are low voltage (12 to 24 volts dc). This voltage is not dangerous, but the large amount of amperage available from the alternator can cause severe burns if accidentally shorted to ground with metal objects, such as tools.

WARNING: 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 and the Electrostatic Discharge Training Guide (TK 40282) 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 its 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. Ensure that welding currents are not allowed to flow through the unit's electronic circuits.

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

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Disconnect all wire harnesses from the microprocessor.
- If there are any electrical circuit breakers in the control box, switch them OFF.
- Close the control box.
- Components that could be damaged by welding sparks should be removed from the unit.
- Use normal welding procedures, but keep the ground return electrode as close to the area being welded as practical. This will reduce the likelihood of stray welding currents passing through any electronic circuits.

First Aid

First Aid, Refrigerant

In the event of frostbite, protect the frozen area from further injury, warm the area rapidly and maintain respiration.

EYES : For contact with liquid, immediately flush eyes with large amounts of water. CALL A PHYSICIAN.

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. CALL A PHYSICIAN. Wash contaminated clothing before reuse.

INHALATION: Move victim to fresh air and use CPR (cardio pulmonary resuscitation) or mouth-to-mouth resuscitation to restore breathing, if necessary. Stay with victim until emergency personnel arrive.

First Aid, Refrigerant Oil

EYES : Immediately flush with water for at least 15 minutes. CALL A PHYSICIAN. Wash skin with soap and water.

INGESTION: Do not induce vomiting. Immediately contact local poison control center or physician.

First Aid, Engine Coolant

EYES : Immediately flush with water for at least 15 minutes. CALL A PHYSICIAN. Wash skin with soap and water.

INGESTION: Do not induce vomiting. Immediately contact local poison control center or physician.

First Aid, 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 CPR (cardio pulmonary resuscitation). If a pulse is present, respiration might be restored by using mouth-to-mouth resuscitation. Call for emergency medical assistance.

Specifications

Engine

Model	TK486V25 (Tier 4)
Number of Cylinders	4
Cylinder Arrangement	In-line vertical, number 1 on flywheel end
Firing Order	1-3-4-2
Direction of Rotation	Counterclockwise viewed from flywheel end
Fuel Type	No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel
Oil Capacity	12 quarts (11.4 liters) crankcase and oil filter Fill to full mark on dipstick
Oil Type	API Classification CI-4 or better (ACEA Rating E3 or better for Europe)
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 -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 86 F (-25 to 30 C): SAE 10W-30 -22 to 122 F (-30 to 50 C): SAE 5W-40 (Synthetic) Below -22 F (-30 C): SAE 0W-30 (Synthetic)
Engine rpm: Low Speed Operation High Speed Operation	1450 ± 25 rpm 2200 ± 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	ELC (Extended Life Coolant), which is “RED” Use a 50/50 concentration of any of the following equivalents: Chevron Dex-Cool Texaco ELC Havoline Dex-Cool® Havoline XLC for Europe Shell Dexcool® Shell Rotella Saturn/General Motors Dex-Cool® Caterpillar ELC Detroit Diesel POWERCOOL® Plus ***CAUTION: 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 System Capacity	7.5 quarts (7.1 liters)
Radiator Cap Pressure	15 psig (103 kPa)

Engine (Continued)

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

Belt Tension

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 19 HP Electric Motor	 131 Hz (236 lbs) 150 Hz (300 lbs)	 114 Hz (177 lbs) 130 Hz (223 lbs)
Alternator Belt - SmartPower Units Only: All Alternators	 216 Hz (75 lbs)	 187 Hz (56 lbs)

Refrigeration System

Compressor		Thermo King X430LSC5
Refrigerant Charge—Type		14.5 lb (6.6 kg)—R404A
Compressor Oil Charge		4.3 qt (4.1 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

Low Voltage	12.5 Vdc
High Voltage	230 Vac from AC generator at engine low speed 345 Vac from AC generator at engine high speed
Battery	One, group C31, 12 volt, (950 CCA recommended for operation below -15 F [-26 C])
Fuses	See “Base Controller Fuses” on page 83, and other fuses on pages 87 and 89.
Battery Charging	12 volt, 37 amp, brush type, Thermo King Alternator
Voltage Regulator Setting	13.95 to 14.35 volts @ 77 F (25 C)

Electrical Components

NOTE: Disconnect components from unit circuit to check resistance.		
Component	**Current Draw (Amps) at 12.5 Vdc**	**Resistance—Cold (Ohms)**
Fuel Solenoid: Pull-in Coil Hold-in Coil	35 to 45 0.5	0.2 to 0.3 24 to 29
High Speed (Throttle) Solenoid	2.9	4.3
Air Heater	60-70*	0.14
Pilot Solenoid	0.7	17.0
Electronic Throttling Valve: Coil A (Red [EVA] and Blue [EVB] Wires) Coil B (Black [EVC] and White [EVD] Wires)	 — —	 20 to 35 20 to 35
Hot Gas Bypass Valve (if used)	1.1	11.1
Starter Motor	350-475**	
**** Typical current draw during preheat.*** ***** On-the-engine cranking check. Bench test is approximately 140 amps.***		

AC Generator	
Low Engine Speed (1450 rpm) Output	230 Vac at 59 Hz Nominal Vac - Measured Vac, Load Dependent
High Engine Speed (2200 rpm) Output	345 Vac at 90 Hz Nominal Vac - Measured Vac, Load Dependent
Fan Motors	
Evaporator Fan Motor: Low Speed Power Rating	1.20 hp (0.90 kW)
High Speed Power Rating	1.75 hp (1.31 kW)
High Fan Speed at Low Engine Speed	1770 rpm at low engine speed (1450 rpm)
Low Fan Speed at High Engine Speed	1800 rpm at high engine speed (2200 rpm)
Low Fan Speed at Low Engine Speed	1180 rpm at low engine speed (1450 rpm)
High Speed Current Draw at Low Engine Speed	3.8 amps at low engine speed (1450 rpm)
Low Speed Current Draw at High Engine Speed	3.1 amps at high engine speed (2200 rpm)
Low Speed Current Draw at Low Engine Speed	2.6 amps at low engine speed (1450 rpm)
Condenser Fan Motor (each: Power Rating	0.50 hp (0.37 kW)
Fan Speed at Low Engine Speed	1770 rpm low engine speed (1450 rpm)
Fan Speed at High Engine Speed	2700 rpm at high engine speed (2200 rpm)
Current Draw at Low Engine Speed	1.8 amps (per motor) at low engine speed (1450 rpm)
Current Draw at High Engine Speed	2.0 amps (per motor) at high engine speed (2200 rpm)

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

Voltage/Phase/Frequency	Horsepower	Kilowatts	rpm	Full Load (amps)	Overload Relay Setting (amps)
230/3/60	12.0	9.0	1760	31.2	34
460/3/60	12.0	9.0	1760	15.6	20
460/3/60	19.0	14.2	3500	21.7	32

Electric Heater Strips

Number	3
Watts	1000 watts (each)
Resistance	48 ohms (each)
Overload Relay Setting	9 amps, 230V unit 6 amps, 460V unit

Standby Power Cord Requirements

Supply Circuit Breaker:	12 HP Motor 230/3/60	70 amps
	12 HP Motor 460/3/60	40 amps
	19 HP Motor 460/3/60	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 HP Motor 460/3/60	10 AWG Power Cable, 4-Conductor, 2000V, Type W 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)

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

Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Microprocessor
•				Run Pretrip Test (see “Performing a Pretrip Test” on page 51).
				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 and adjust engine speeds (high and low speed).
	•	•	•	Check condition of drive coupling bushings per Service Bulletin T&T 171.
			•	Check engine mounts for wear.
		•		Replace EMI 3000 air cleaner element (see “EMI 3000 Air Cleaner” on page 119) at 3,000 hours or two years (whichever occurs first).
		•		Replace fuel filter/water separator.
		•		Change engine oil and oil filter (hot). Requires oil with API Rating CI-4 or better (ACEA Rating E3 for Europe).
		•		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 page 98).
		•		Test fuel injection nozzles at least every 3,000 hours. **
			—	Replace fuel return lines between fuel injection nozzles every 10,000 hours.
				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 Smart Power 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).

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

*** Based on EPA 40 CFR Part 89.*

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Refrigeration
•	•	•	•	Check refrigerant level.
	•	•	•	Check for proper suction pressure.
	•	•	•	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.

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

Unit Description

Unit Overview

The Thermo King Precedent C-600 is a one piece, self-contained, diesel powered, air cooling/heating unit operating under the control of the SMART REEFER™ 4 (SR-4) programmable microprocessor controller. The unit mounts on the front of the trailer with the evaporator extending through an opening in the front wall.

The units feature all-new DDE (Diesel Direct Electric) architecture, the quiet running Thermo King TK486V25 engine and the Thermo King X430L reciprocating compressor.

The C-600 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.

Figure 1: Front View

Features and Options

The following chart lists key design features and options.

● Standard Features

❍ Option/Factory Installed

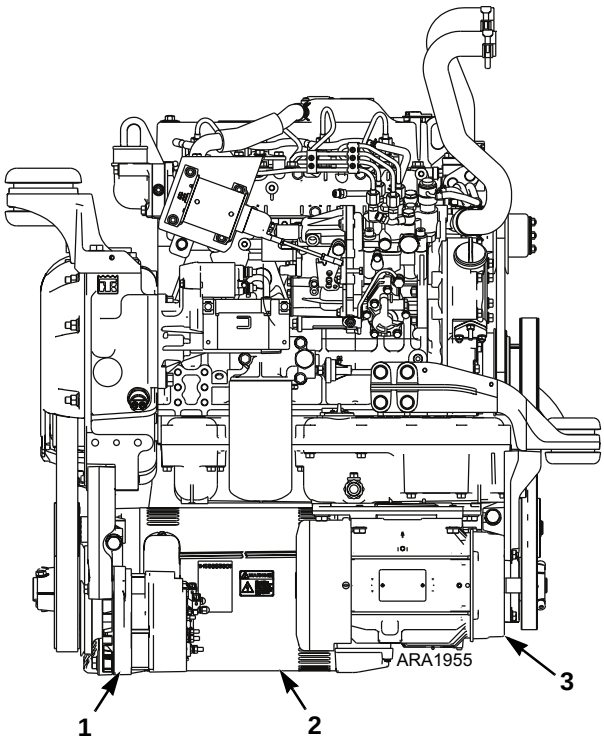
❑ Option/Dealer Installed

Precedent C-600 Key Features & Options	
SMART REEFER SR-4 Controller	●
SmartPower™ Electric Standby	❍
SmartPower High-Output	❍
SmartPower Prep Package	❍
OptiSet™ Plus	●
ETV (Electronic Throttling Valve)	●
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)	●
Fuel Level Sensor	●
Severe Duty Package	❍
Fuel Tanks with Ultrasonic Fuel level Sensor	❍
Electric Fuel Heater	❍
Frost Plug Heater	❍
Alternator, 65 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	❍
Reilamax Battery, 12 Volt, Wet Cell	❑
EON Battery, 12 Volt, Dry Cell	❑
Remote Electric Power Receptacle	❍

Diesel Engine

The unit uses the TK486V25, a 4-cylinder, water cooled, direct injection diesel engine.

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 alternator.



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

Figure 2: TK486V25

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 (and battery charger if used). 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.

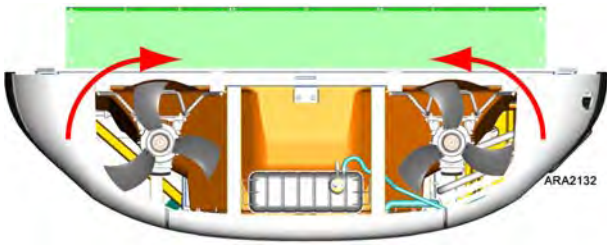


Figure 3: Top View Showing Condenser Fans

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 1770 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 1800 rpm. This keeps the evaporator air flow consistent regardless of the engine speed. In certain cases when the engine is running in low speed, the evaporator fan contactor connected to the low speed windings is energized and the evaporator fans run at approximately 1180 rpm.

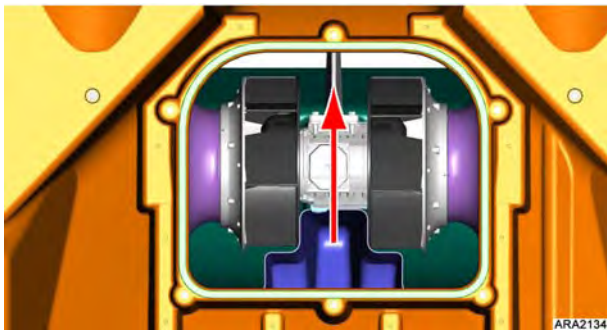


Figure 4: Front View Showing Evaporator Fans Through Access Panel

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.

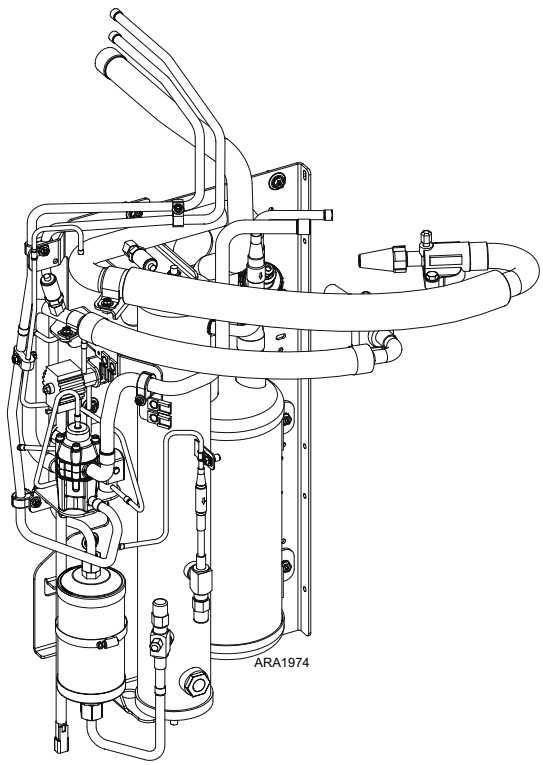


Figure 5: Front View of Refrigeration Cluster

Thermo King X430L Reciprocating Compressor

The unit is equipped with a Thermo King X430L reciprocating compressor with 30.0 cu. in. (492 cm^3) displacement.

Electronic Throttling Valve

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

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

Suction Pressure Control: The suction pressure control algorithm is the primary control used to obtain maximum capacity. This allows the refrigeration system to fully utilize the power capabilities of the engine under varying conditions.

Discharge Pressure Protection: This protection algorithm provides an additional measure of protection against high discharge pressures and possible compressor damage. It will prevent shutdowns in high ambient temperatures by allowing continued operation of the unit at a temporarily reduced refrigeration capacity.

Engine Coolant Temperature Protection: This protection algorithm protects the engine from high coolant temperature shutdowns and possible engine damage. It will reduce the load on the engine by temporarily reducing refrigeration capacity. This lowers the engine temperature while still allowing continued unit operation.

Modulation Control: Modulation control provides precise control of the temperature in the cargo area. As the return air temperature begins to approach the setpoint, the microprocessor begins to close the ETV to reduce the capacity. The microprocessor closes the ETV more as the return air temperature gets closer to the setpoint. When the return air temperature is near setpoint, the ETV may close to its limit and the hot gas bypass

valve may open. When the return air temperature begins to move away from the setpoint, the ETV begins to open and the hot gas bypass valve closes (if it was open). This provides very smooth and steady temperature control and the temperature does not oscillate above and below setpoint as much as it does in a unit that does not have modulation control.

SMART REEFER 4 (SR-4) Control System

WARNING: Do not operate the unit until you are completely familiar with the location and function of each control.

The SR-4 is a microprocessor control system designed for a transport refrigeration system. The SR-4 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.

See the Operating Instructions Chapter for more information about the SR-4 controller.

CYCLE-SENTRY™ Start-Stop Controls

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

WARNING: 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 TK 55533 the SR-4 Microprocessor Control System Diagnostic Manual for information about controller programming.

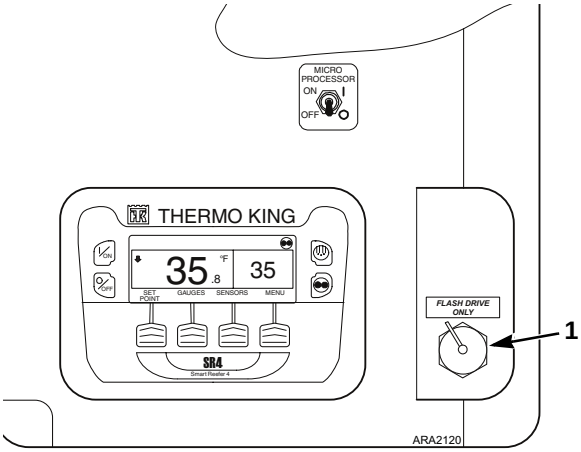
In CYCLE-SENTRY if the block temperature falls below 30 F (-1 C), the engine will start and run until the block temperature is above 90 F (32 C). If the battery voltage falls to the programmed limit selected by CYCLE-SENTRY Battery Voltage (typically 12.2 volts) and Diesel CYCLE-SENTRY mode is selected, 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.



1.	Flash Drive Only USB Port

Figure 6: HMI Controller and 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:

- Upload and download OptiSet Plus files.
- 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 Figure 153 on page 84). 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 (Must be done on new units and if new controller is installed.)
- Upload and download OptiSet Plus files.
- Data Logger setup.
- Download the CargoWatch and ServiceWatch Data Loggers.
- Flashload the Base Controller and HMI Control Panel.

Refer to TK 55533 the SR-4 Microprocessor Control System Diagnostic Manual and for information about using the USB ports.

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 downloaded 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 preformed to help diagnose a problem. A ServiceWatch download must be preformed before contacting the Thermo King Service Department for assistance in diagnosing a problem. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 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 downloaded the CargoWatch data. If optional temperature sensors are installed, their readings are displayed as Datalogger Sensor (1-6) Temperature in the sensor readings. See “Using The Sensors Key” on page 49.

A printer can also be used to print a report of the optional sensor readings. See “Printing CargoWatch Data Logger Reports” on page 61.

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 TK 55151 the Truck and Trailer Edition CargoLink Installation Manual for information

about installing the CargoLink system and sensors, and troubleshooting problems with the system.

OptiSet Plus™

OptiSet Plus is a group of programmable functions that control how the unit will operate with specific setpoints or named products. This assures that when a particular setpoint named product is selected, the unit will always operate the same way. This allows an entire fleet to be configured to match customers' needs. Refer to TK 55533 the SR-4 Microprocessor Control System Diagnostic Manual and ThermoServ Help for configuration instructions.

FreshSet™

FreshSet is included in OptiSet Plus. FreshSet is a demand base temperature control for fresh products. FreshSet modifies and adjusts unit airflow operation to control temperature and to maximize protection of cargo, while keeping operating costs to a minimum. Refer to TK 55533 the SR-4 Microprocessor Control System Diagnostic Manual for configuration instructions.

Sequence of Operation

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

Operating Modes

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

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

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

Diesel Operation

In diesel operation the microprocessor will select the operating mode from the following:

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

Electric Operation

In electric operation the microprocessor will select the operating mode from the following:

- Cool
- Modulated Cool
- Null (CYCLE-SENTRY operation only)
- Modulated Heat (Hot Gas only)
- Hot Gas Heat
- Full Heat (Hot Gas and Electric Heat)
- Defrost (Hot Gas and Electric Heat)

Defrost

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

Automatic Defrost: The controller is programmed to automatically initiate timed or demand defrost cycles. The 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” on page 45.

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

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

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

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

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

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

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

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

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

Opening the Front Doors

Pull the door latch handle to open the doors and access the engine compartment. Do not push the door closed while holding the door latch handle open or the door will not close properly.

1.	Door Latch

Figure 7: Door Latch Location

Engine Compartment Components

The following maintenance items can be checked visually.

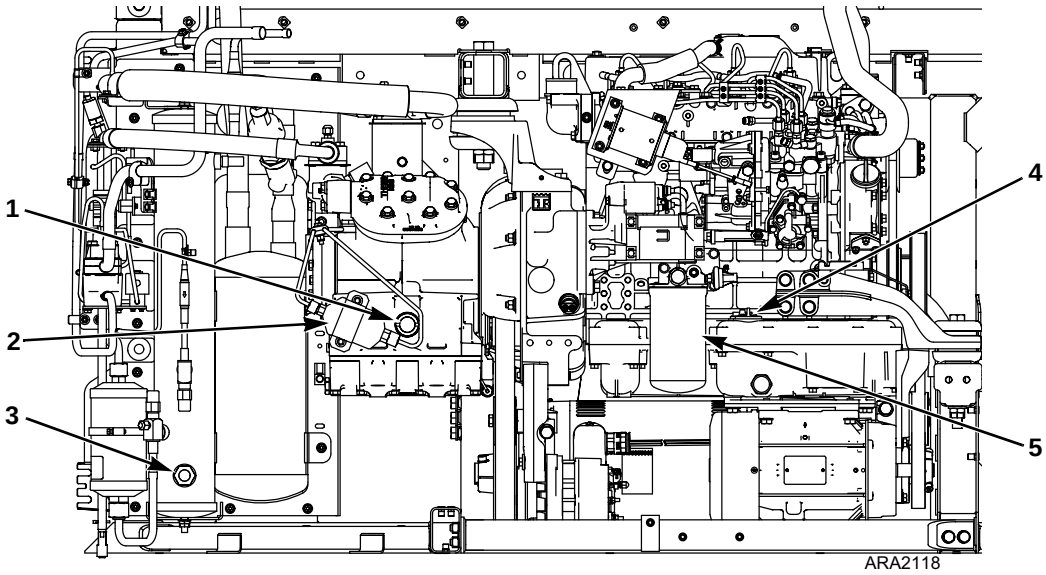
WARNING: The unit can start at any time without warning. Press the Off key on the HMI control panel and place the microprocessor On/Off switch in the Off position before inspecting any part of the unit.

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

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

CAUTION: Make sure the engine is turned off before attempting to check the engine oil.

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



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

Figure 8: Engine Compartment Components

Unit Protection Devices

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

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

Fuses: Various fuses are located on the base controller to protect circuits and components. See “Base Controller Fuses” on page 83 and “Battery Fusing” on page 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.

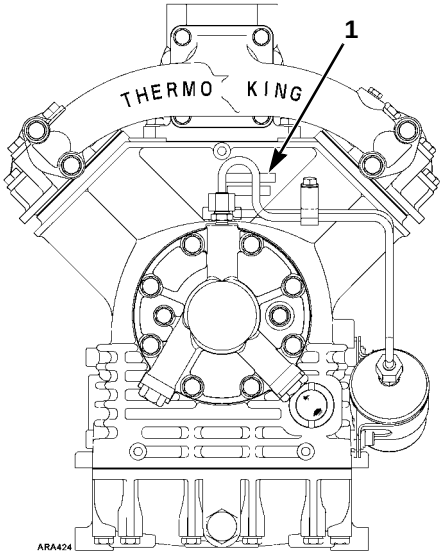
Overload Relay—Automatic Reset (SmartPower Units): An overload relay protects the standby electric motor. The overload relay opens the circuit to the electric motor if the motor overloads for any reason (e.g., low line voltage or improper power supply) while the unit is on electric standby operation.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

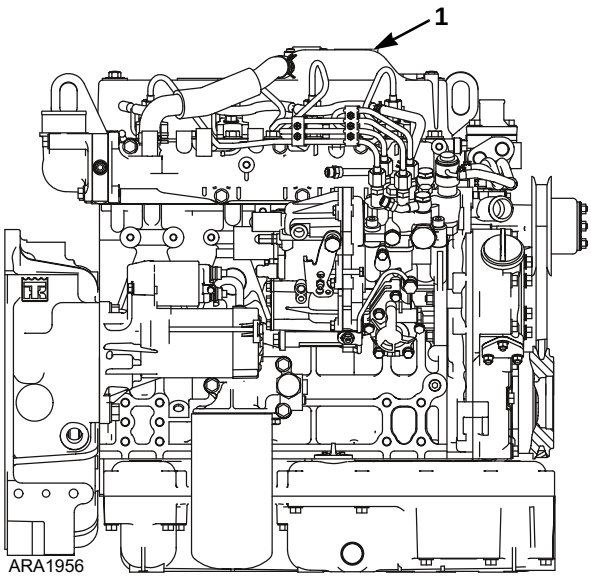
Engine: See the engine identification plate located on the engine valve cover.

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



1.	Serial Number Location

Figure 9: Compressor Serial Number Location

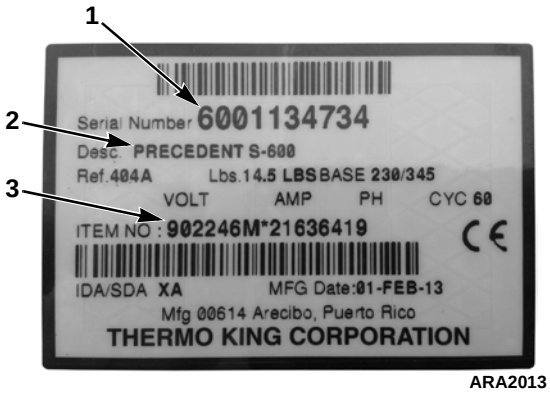


1.	Serial Number Location

Figure 10: Engine Serial Number Location

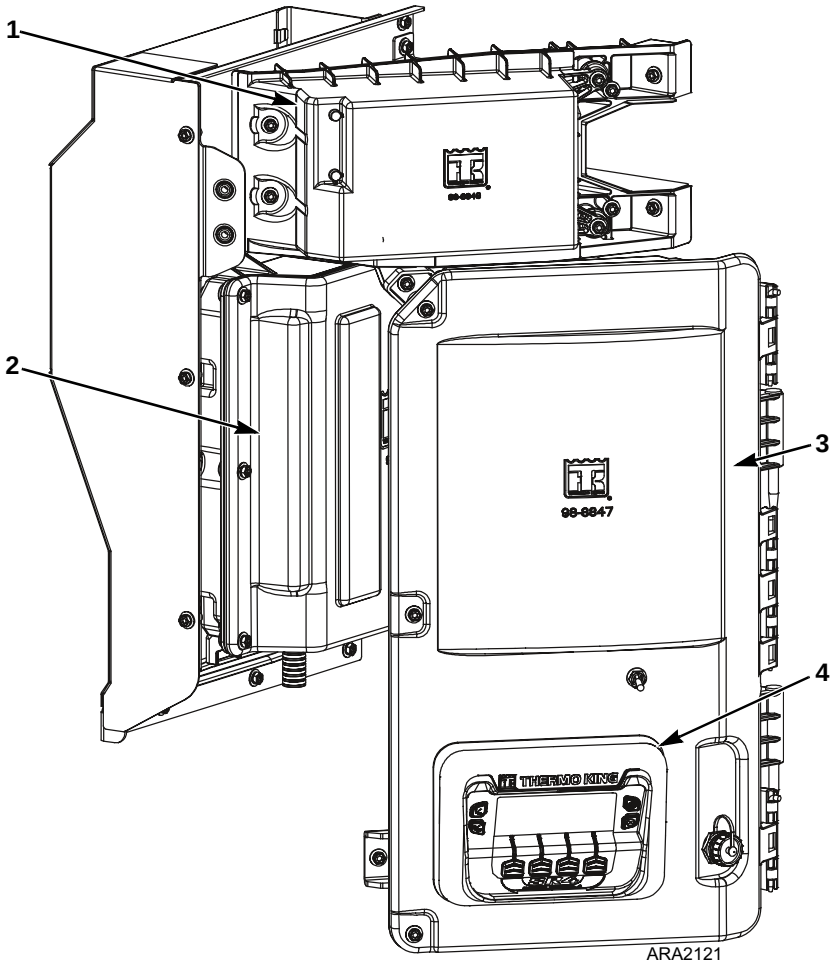
1.	On Evaporator Housing
2.	On Frame In Engine Compartment

Figure 11: Unit Serial Number Locations



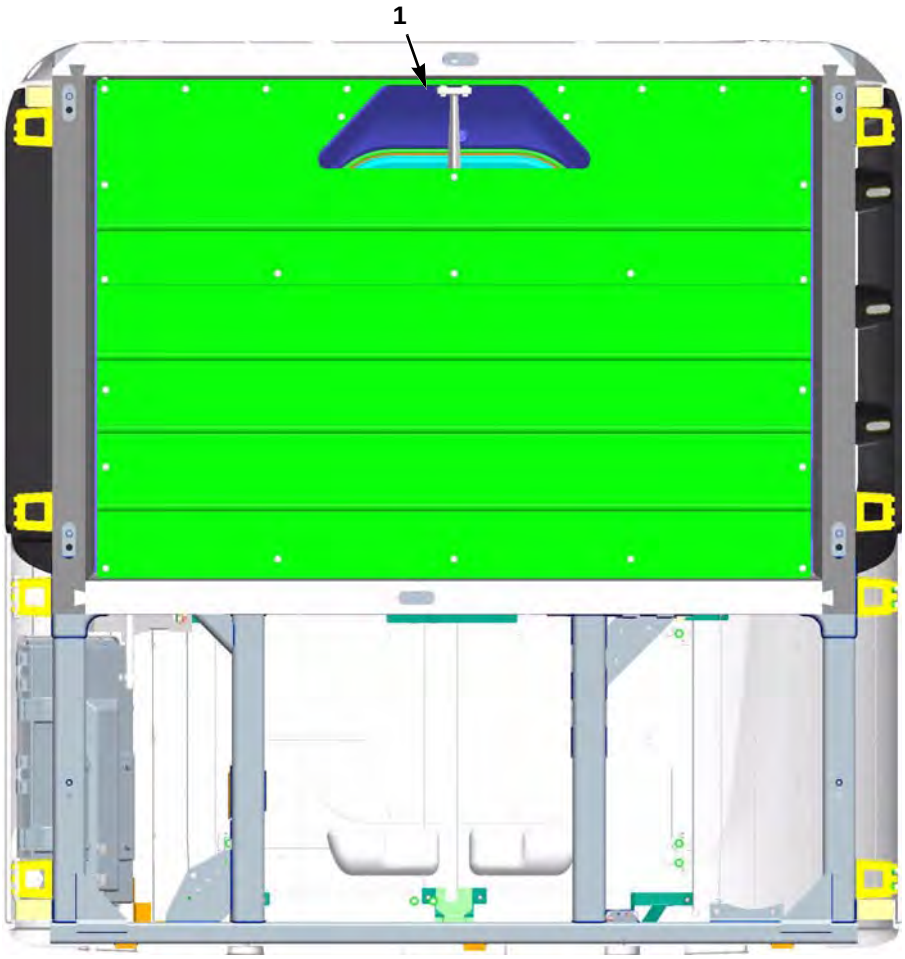
1.	Unit Serial Number
2.	Unit Model
3.	Bill of Material Number

Figure 12: Laminated Serial Number Plate (Located Where Shown Above)



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

Figure 13: Electrical Control Boxes



1.	Evaporator Discharge Air Outlet

Figure 14: Back View

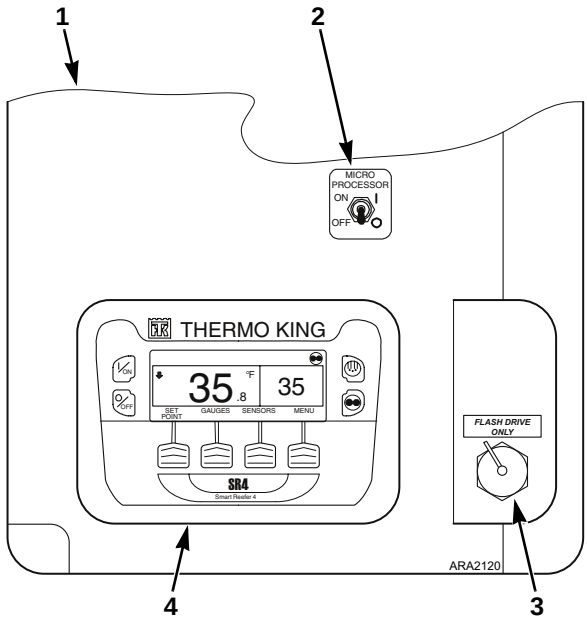
SMART REEFER 4 (SR-4) Control System

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 Controller, but you will find that a few minutes studying the contents of this manual will be time well spent.

WARNING: Do not operate the SR-4 until you are completely familiar with the location and function of each control.

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



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

Figure 15: Control Box With Service Door Open

Microprocessor On/Off Switch

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

WARNING: 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.

HMI Control Panel

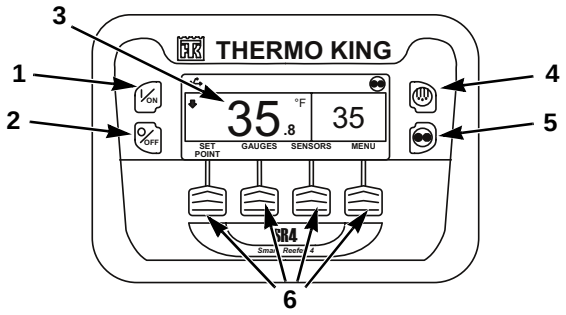
Use the HMI control panel to operate the unit. Refer to the Precedent C-600 Operator's Manual TK 55538 and the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for more information.

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 supply unit information to the operator. This information includes setpoint, current box temperature, operating information, unit gauge readings, system temperatures and other information as selected by the operator.

The default display is called the Standard Display. It is shown in Figure 16 and will be described in detail later in this chapter.



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 16: Control Panel Display and Keys

Display Icons

Display symbols or Icons are used to present additional unit information

Down-Pointing Arrow: (At the left side of the display) Shows the unit is cooling. If the arrow were pointing upward the unit would be heating.

CYCLE SENTRY/Continuous Mode Key: The unit is running in Cycle Sentry Mode as shown by the Cycle Sentry Icon in the upper right corner of the display. If the Cycle Sentry icon is not present, the unit is running in Continuous Mode.

USB: The USB Icon in the upper left corner of the display will appear when a USB device is connected to either the Flash Drive Only USB Port on the Unit Control Panel or the PC Only USB Port inside the control box.

Hard Keys

The keys on either side of the display are dedicated or “hard” keys. Their function always remains the same.

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.

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” later in this section.

Defrost Key: Press this key to initiate a Manual Defrost cycle.

CYCLE SENTRY: Used to select Cycle Sentry Mode or Continuous Mode operation if allowed by OptiSet Plus. For more information see “Selecting Cycle Sentry or Continuous Mode” later in this section.

Soft Keys

The four “soft” keys under the display are multi-purpose keys. 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:

• MENU	• CLEAR	• NO
• NEXT	• HOURMETERS	• SENSORS
• + OR -	• GAUGES	• EXIT
• SELECT	• BACK	• HELP

Turning Unit On

The unit is turned on by pressing the ON Key (Figure 17) 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 extremely cold ambient temperatures it may take up to 15 seconds for the display to appear on initial startup.

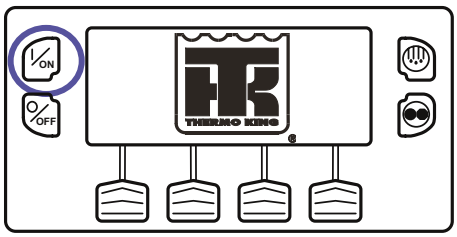


Figure 17: ON Key

Then the startup screen (Figure 18) appears while communications are established and the unit prepares for operation.

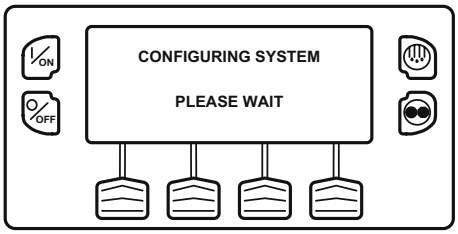


Figure 18: Startup Screen

If a Flash Drive is Connected

If a properly configured USB Flash Drive is inserted in the Flash Drive Only USB Port on the Control Panel when the unit is turned on, the display (Figure 19) will briefly show FLASH DRIVE:

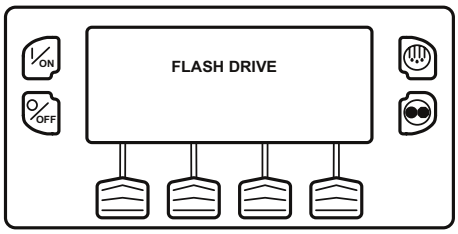


Figure 19: Flash Drive

Then FLASH DRIVE DETECTED and the Flash Drive Menu will appear on the display (Figure 20). The display will be shown for about 30 seconds and then the Standard Display will appear. To go to the Standard Display immediately press the EXIT Soft Key.

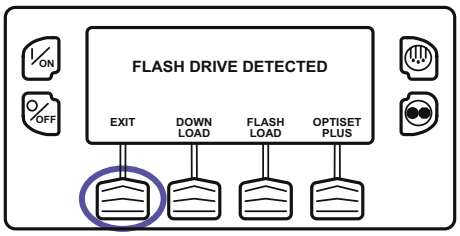


Figure 20: Flash Drive Menu

IMPORTANT: The engine start is not delayed by the Flash Drive Menu shown above. The engine start prompt will appear and the engine will start. After the engine is started the display will return to the Flash Drive Menu or the Standard Display.

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
- OPTISET PLUS
  - SEND
    - Send OptiSet Plus files

- RETRIEVE
    - Retrieve OptiSet Plus files

The Flash Drive is also available from the Main Menu.

The Flash Drive Menu will time out about 30 seconds after the engine starts. When the Flash Drive Menu times out, the Standard Display will appear. To go to the Standard Display immediately press the EXIT Key.

Configurable Soft Keys

When the Standard Display is shown, the default functions of the two center soft keys are GAUGES and SENSORS (Figure 21).

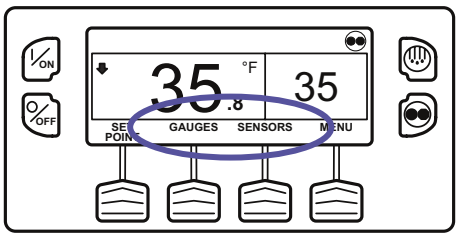


Figure 21: Soft Keys

The functions of these two keys can be changed as required for customer convenience. The functions of these two soft keys on the Standard Display can be re-assigned to any of the following functions using the Guarded Access > Main Menu Configuration menu:

• Gauges	• Pretrip	• SOT (start of trip)
• Sensors	• Data Logger	• Hourmeters

The GAUGES and SENSORS functions are always available from the Maintenance Menu.

In the example shown in Figure 22, the soft key functions from the Standard Display have been changed to PRETRIP and SOT (Start of Trip marker). The GAUGES and SENSORS functions are always available from the Maintenance Menu.

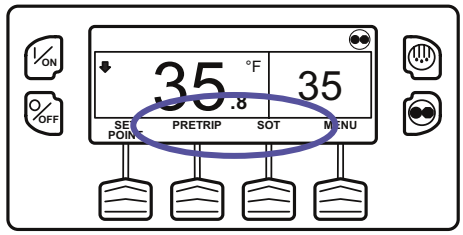


Figure 22: PRETRIP and SOT

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.

If a Language is Enabled

If more than one language has been enabled from the Guarded Access Language Menu, a prompt will appear to allow the desired language to be chosen as shown below. Only languages specifically enabled from the Guarded Access Menu are available. If a different language is desired, press the NO Key (Figure 23).

IMPORTANT: The engine start is not delayed by the language prompt shown below. The prompt will appear for 10 seconds and then the engine will start. After the engine is started the display will return to the prompt shown.

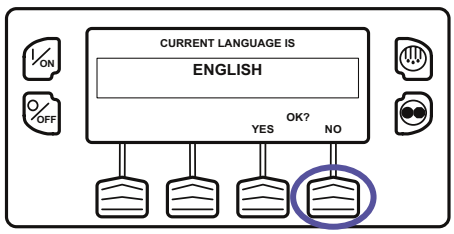


Figure 23: NO Key

The Language menu will appear as shown in Figure 24. Press the + or - Keys to select the desired language. When the desired language is shown press the YES Key to confirm the choice.

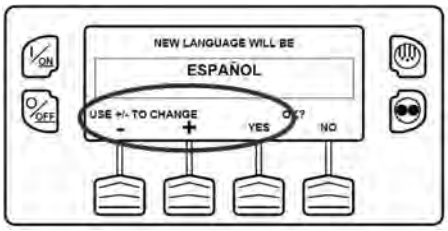


Figure 24: + or -, then YES Key

The display will briefly show PROGRAMMING LANGUAGE - PLEASE WAIT in the new language as shown in Figure 25.

Figure 25: New Language

The new language is confirmed, and then the Standard Display will appear in the new language as shown in Figure 26. The unit is ready to run.

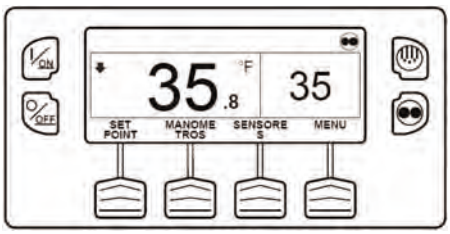


Figure 26: Standard Display, New Language

If Log Alarms are Present

Log Alarms are indicated for 60 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.

If log alarm(s) are present the Log Alarm notice shown in Figure 27 will appear on the display for 60 seconds. The remote indicator alarm light (if installed) will also be on during this period. After 60 seconds the Standard Display will appear and the remote indicator alarm light will go off. Pressing the EXIT soft key (Figure 27) will return to the Standard Display immediately.

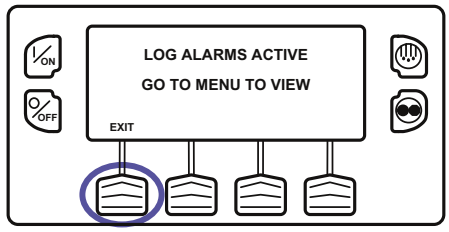


Figure 27: Log Alarms Active

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

When the unit is ready to run the Standard Display appears (Figure 28).

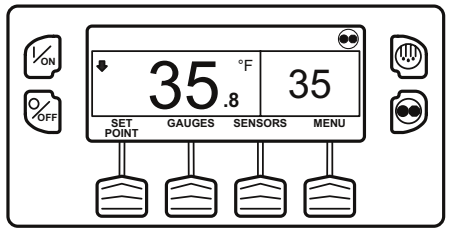


Figure 28: Standard Display

Turning The Unit Off

Pressing the OFF Key stops unit operation. The unit shuts down immediately and the display briefly shows the power down message (Figure 29).

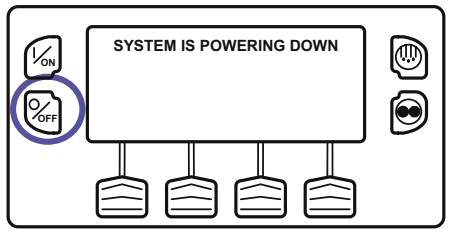


Figure 29: Power Down Message

The display briefly shows OFF (Figure 30) and then goes blank. To start the unit again, press the ON Key.

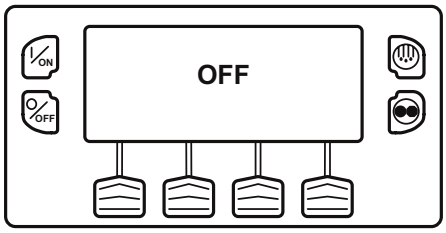


Figure 30: Display Shows OFF

The Standard Display

The Standard Display is the default display that appears if no other display function is selected. The Standard Display shows the box temperature and setpoint. The box temperature is that measured by the controlling sensor, usually the return air sensor. The box temperature in Figure 31 is 35.8 F (2.1 C) with a 35 F (1.7 C) setpoint.

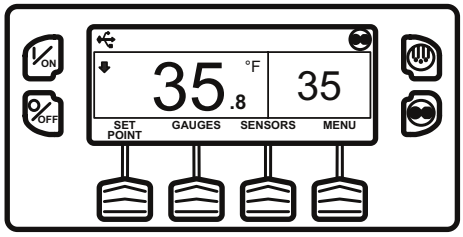


Figure 31: Standard Display

The down-pointing arrow at the left side of the display shows the unit is cooling. If the arrow were pointing upward the unit would be heating.

The unit is running in Cycle Sentry Mode as shown by the Cycle Sentry Icon in the upper right corner of the display. If the Cycle Sentry icon is not present, the unit would be running in Continuous Mode.

The USB Icon in the upper left corner of the display will appear when a USB Flash Drive is connected to the Flash Drive Only USB Port on the Unit Control Panel or a PC computer is connected to the PC Only USB Port inside the control box.

Pressing the left soft key allows the user to change the SETPOINT, and pressing the right soft key accesses the MAIN MENU. The other two soft keys access the GAUGES menu and the SENSORS menu.

NOTE: The functions of the GAUGES and SENSORS soft keys may be re-assigned to better suit customer requirements. The GAUGES and SENSORS functions are always available from the Maintenance Menu.

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 are present. The TemperatureWatch Display will remain on until any key is pressed or a check, prevent or shutdown alarm occurs.

The TemperatureWatch Display shows the box temperature and setpoint. The large numbers allow unit conditions to be checked from a distance. The box temperature is that measured by the controlling sensor, usually the return air sensor. The box temperature in Figure 32 is 35.8 F (2.1 C) with a 35 F (1.7 C) setpoint. The Cycle Sentry icon in the upper right corner of the display shows that the unit is operating in Cycle Sentry mode. If the Cycle Sentry icon is not present, the unit is running in Continuous Mode. The down-pointing arrow indicates that the unit is cooling. Pressing any soft key returns the display to the Standard Display.

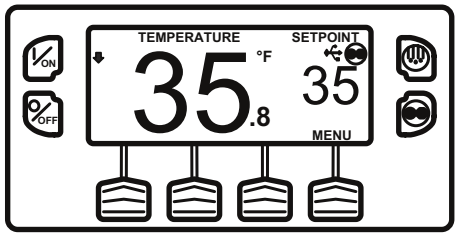


Figure 32: TemperatureWatch Display

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 to indicate that an alarm condition has occurred.

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.

Changing The Setpoint

The Setpoint is changed from the Standard Display. If the TemperatureWatch display is present, press any key to return to the Standard Display.

IMPORTANT: If OptiSet Plus is in use there are several possible options when changing the setpoint.

Numerical Setpoints

If OptiSet Plus is not in use or if only Numerical Setpoints are enabled the left soft key will be labeled SETPOINT (Figure 33).

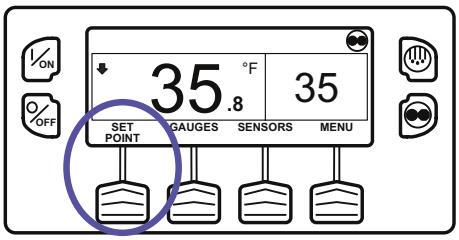


Figure 33: Setpoint

Named Products - OptiSet Plus

OptiSet Plus allows the use of Named Products such as APPLES or BANANAS in place of a numerical setpoint. If only named products are enabled the left soft key will be labeled PRODUCT (Figure 34).

- A single setpoint temperature may be allowed for the specific named product.
- A numerical setpoint range may be allowed for the specific named product.

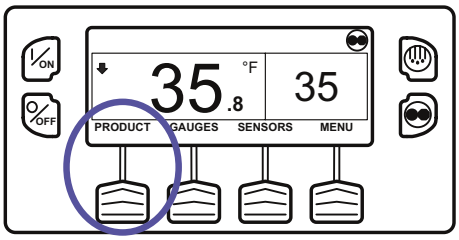


Figure 34: Left Soft Key Labeled "Product"

Both Numerical Setpoints and Named Products

OptiSet Plus can allow the use of both Numerical Setpoints and Named Products. If both numerical setpoints and named products are enabled the left soft key will be labeled PRODUCT/SETPOINT (Figure 35).

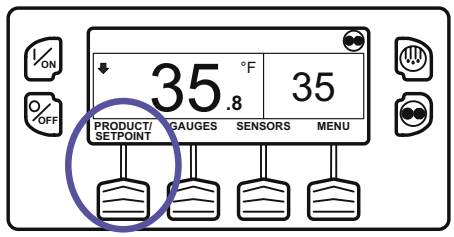


Figure 35: Left Soft Key Labeled "PRODUCT/SETPOINT"

Changing the Setpoint - Numerical Setpoint

If the TemperatureWatch display is shown, press any soft key to return to the Standard Display. From the Standard Display, press the SETPOINT Key (Figure 36).

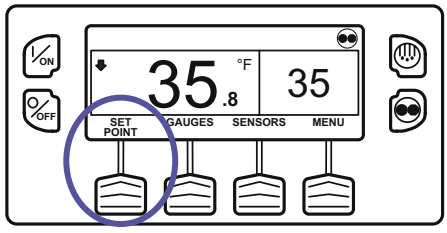


Figure 36: Setpoint Key

The setpoint display appears (Figure 37).

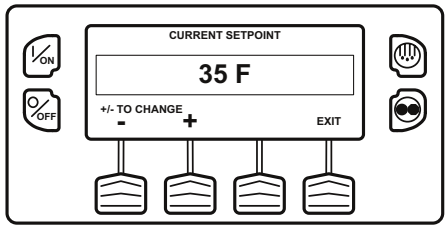


Figure 37: Setpoint Display

The "-" and "+" Keys are used to increase or decrease the setpoint until the desired setpoint is shown. In Figure 38 the setpoint has been changed to 40 F using the "+" Key.

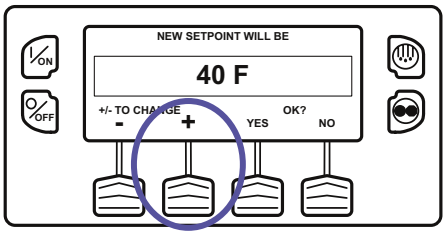


Figure 38: Setpoint Changed Using "+" Key

The YES and NO Keys (Figure 39) confirm the setpoint change. When the desired setpoint has been selected using the "+" and/or "-" Keys, press the YES Key to confirm and load the new setpoint. If the setpoint is changed using the "+" or "-" Keys, the change must be confirmed or rejected by pressing the YES or NO Key within 10 seconds of changing the setpoint. A warning beep will sound for 5 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. In addition, Alarm Code 127 Setpoint Not Entered is set, to indicate that a setpoint change was initiated but not completed.

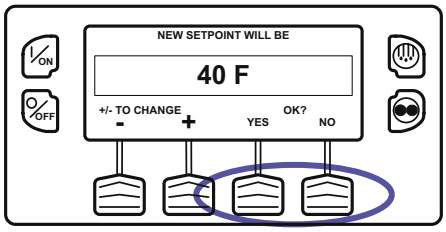


Figure 39: Yes and No Keys

After the YES Key has been pressed, the display briefly shows PROGRAMMING NEW SETPOINT - PLEASE WAIT. The display then confirms the new setpoint for several seconds (Figure 40):

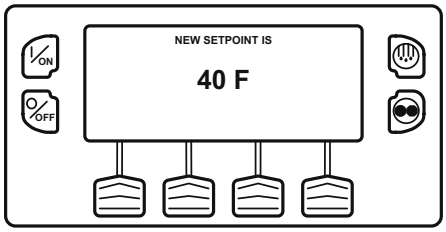


Figure 40: New Setpoint

If the NO 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.

The display then returns to the Standard Display showing the new setpoint. Notice in Figure 41 that the arrow now points up to indicate that the unit is heating.

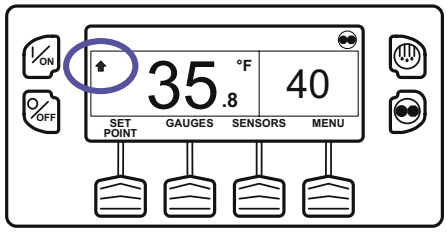


Figure 41: Up Arrow

IMPORTANT: If the setpoint is changed using the "+" or "-" Keys, the change must be confirmed or rejected by pressing the YES or NO Key within 10 seconds of changing the setpoint.

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

See Figure 42 for an overview of the **Changing the Setpoint - Numerical Setpoint** procedure.

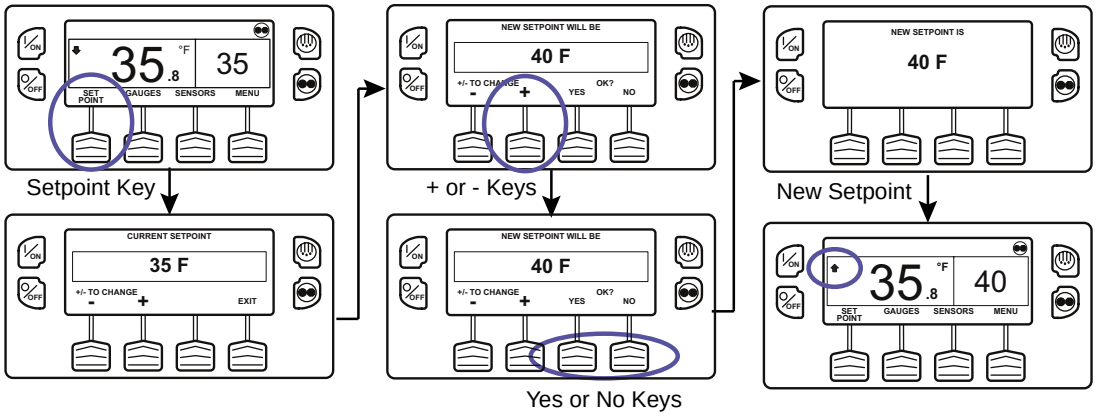


Figure 42: Changing the Setpoint - Numerical Setpoint

Changing the Setpoint - Named Product

If the TemperatureWatch display is shown, press any soft key to return to the Standard Display. From the Standard Display, press the PRODUCT Key. Note that PRODUCT is displayed in place of SETPOINT (Figure 43).

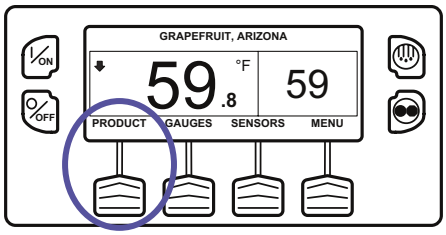


Figure 43: Product Displayed

The display briefly shows PRODUCT and then the setpoint display appears (Figure 44).

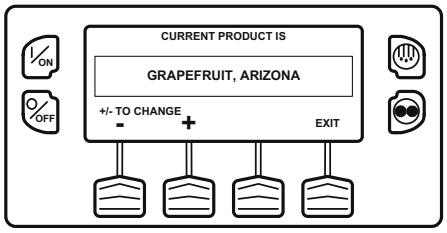


Figure 44: Setpoint Display

The "-" and "+" Keys are used to change the Named Product until the desired product is shown. In Figure 45 the product has been changed to Potato, Late Crop.

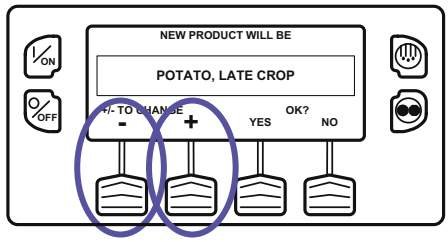


Figure 45: Named Product

The YES and NO Keys confirm the product change (Figure 46). When the desired product has been selected using the "+" and/or "-" Keys, press the YES Key to confirm and load the new product. If the product is changed using the "+" or "-" Keys, the change must be confirmed or rejected by pressing the YES or NO Key within 10 seconds of changing the product. A warning beep will sound for 5 seconds as a reminder.

Failure to confirm the new product by pressing Yes or No within 10 seconds of changing the product will result in no product change. In addition, Alarm Code 127 Setpoint Not Entered is set, to indicate that the product change was initiated but not completed.

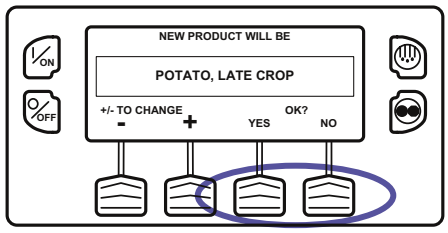


Figure 46: Yes and No Keys

After the YES Key has been pressed, the display briefly shows PROGRAMMING NAMED PRODUCT - PLEASE WAIT. The display then confirms the new setpoint for several seconds.

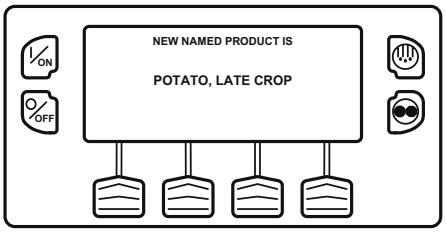


Figure 47: New Named Product

If the NO 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.

The display then returns to the Standard Display showing the new named product. Notice that the arrow points down, to indicate that the unit is cooling (Figure 48).

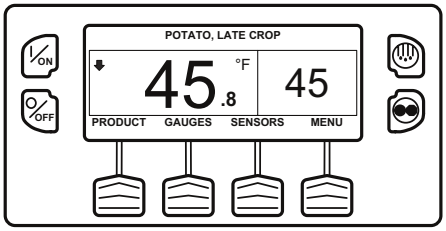


Figure 48: Standard Display

IMPORTANT: If the named product is changed using the "+" or "-" Keys, the change must be confirmed or rejected by pressing the YES or NO Key within 10 seconds of changing the named product.

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

See Figure 49 for an overview of the **Changing the Setpoint - Named Product** procedure.

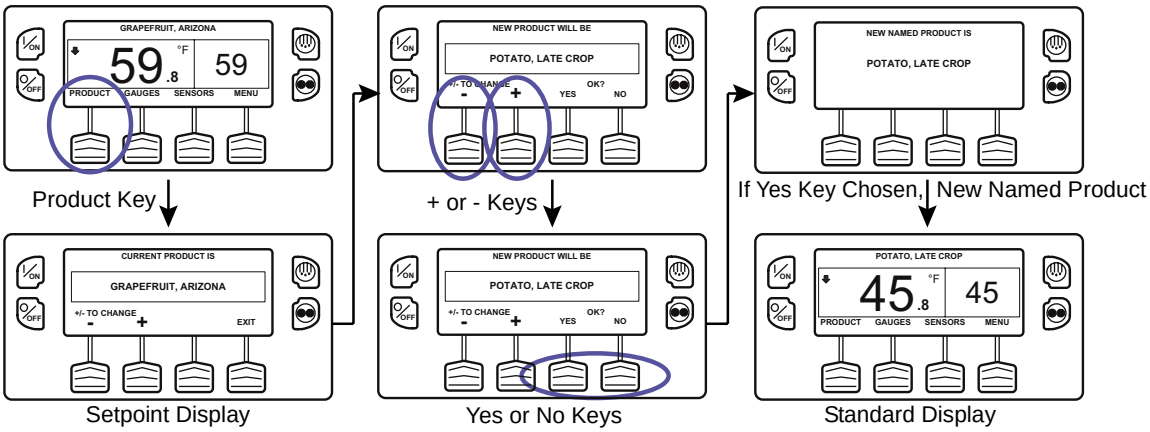


Figure 49: Changing the Setpoint, Named Product

Changing the Setpoint - Both Numerical Setpoint and Named Product Available

If the TemperatureWatch display is shown, press any soft key to return to the Standard Display. From the Standard Display, press the SETPOINT Key. Note that both PRODUCT and SETPOINT are displayed as shown (Figure 50).

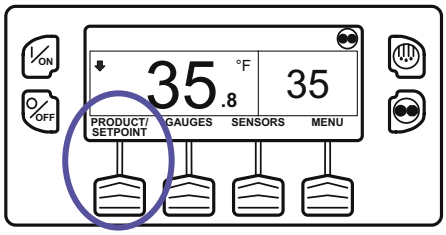


Figure 50: PRODUCT and SETPOINT are Displayed

The NAMED PRODUCT / NUMERIC SETPOINT prompt will appear (Figure 51).

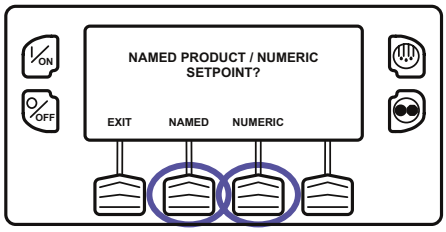


Figure 51: NAMED PRODUCT / NUMERIC SETPOINT Prompt

- Press the NUMERIC Soft Key to proceed with Changing the Setpoint - Numeric Setpoint change as previously shown.
- Press the NAMED Soft Key to proceed with Changing the Setpoint - Named Product change as shown previously.
- Press the EXIT Soft Key to return to the Standard Display.

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. See STARTING THE ELECTRIC MOTOR on the following pages for details.

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

WARNING: Never use starting fluid.

When the engine is preparing to start the HMI Control Panel will display the engine start screen (Figure 52). The preheat buzzer sounds during the engine preheat and crank sequence.

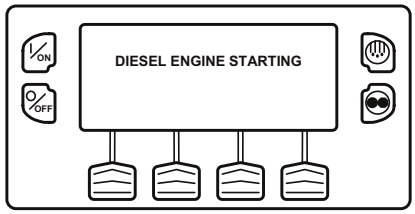


Figure 52: Engine Start Screen

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

Starting the Electric Motor

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 53). The electric power receptacle is usually mounted on the trailer below the HMI Control Panel. Make sure the unit and the power supply are turned off before connecting or disconnecting a power cord.

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.

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

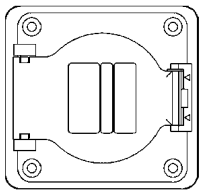


Figure 53: Electric Power Receptacle

When the motor is preparing to start the HMI Control Panel will display the motor start screen (Figure 54). The preheat buzzer sounds for 20 seconds before the electric motor starts.

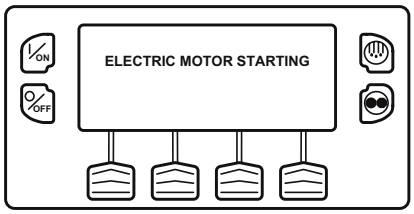


Figure 54: Motor Start Screen

Switching from Diesel to Electric

Units equipped with the SmartPower option only.

If the Diesel to Electric Auto-Switch Enabled feature in Guarded Access is set YES then 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 then the prompt screen (Figure 55) will appear when standby power is connected and available.

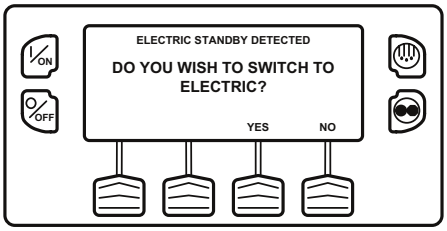


Figure 55: Standby Power Connected

If NO is selected, then the unit will continue to operate in Diesel Mode. If YES is selected then the display will briefly show the screen in Figure 56.

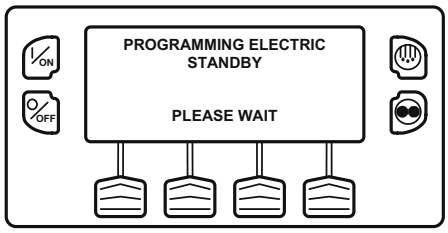


Figure 56: YES Selected

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 then 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

Units equipped with the SmartPower option only.

If the Electric to Diesel Auto-Switch Enabled feature in Guarded Access is set YES then 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 then the prompt screen (Figure 57) will appear when standby power is turned off or is no longer available.

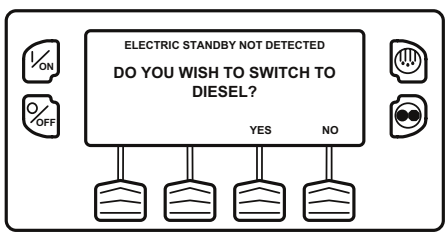


Figure 57: Standby Power is Off

If YES is selected then the display will briefly show the screen in Figure 58.

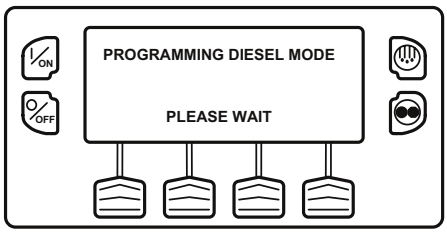


Figure 58: Yes Selected

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 then 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 available if the unit is running and the evaporator coil temperature is less than or equal to 45 F (7 C).

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).

Other features such as door switch settings may not allow manual defrost under some conditions. To initiate a manual defrost cycle, press the Defrost Key (Figure 59).

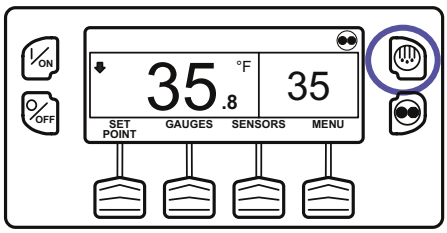


Figure 59: Press Defrost Key

The display briefly shows [DEFROST], [PROGRAMMING DEFROST - PLEASE WAIT] and then [DEFROST STARTED] (Figure 60).

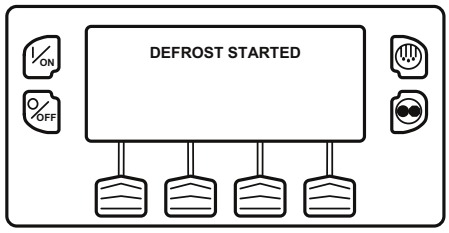


Figure 60: Defrost Started

The display then shows the Defrost display. The bar indicator shows approximately how much time remains to complete the defrost cycle. The bar indicator shows that the defrost cycle is about 25% complete (Figure 61).

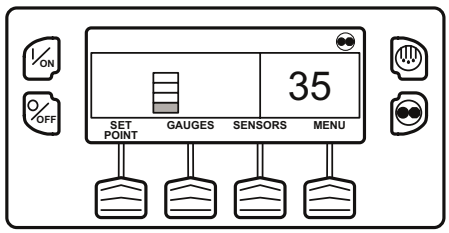


Figure 61: Bar Indicator

If conditions do not allow a defrost cycle, the display shown in Figure 62 will briefly appear. The display will then return to the Standard Display.

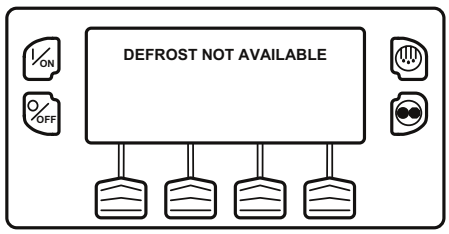


Figure 62: Defrost Not Available

See Figure 63 for an overview of the **Initiating a Manual Defrost Cycle** procedure.

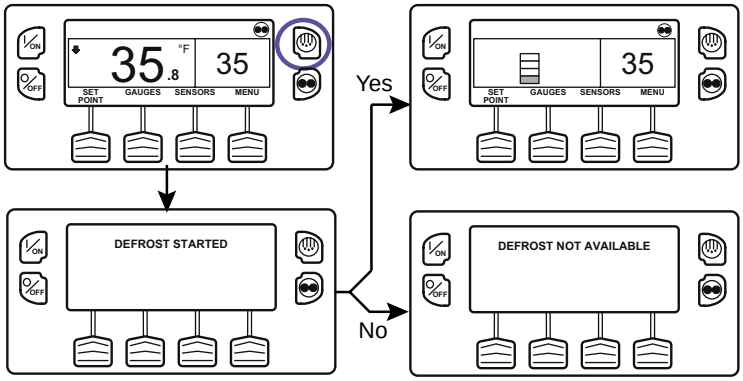


Figure 63: Initiating a Manual Defrost Cycle

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.

IMPORTANT: Cycle Sentry or Continuous Mode may not be selectable if OptiSet Plus is in use.

See Figure 69 for an overview of the S**electing Cycle Sentry or Continuous Mode** procedure.

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 below. If the Cycle Sentry Icon (Figure 64) is not present the unit is operating in Continuous Mode.

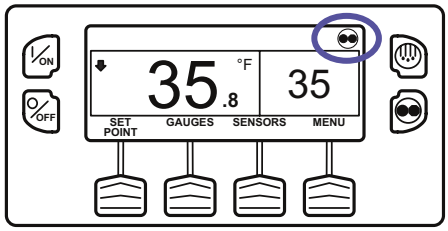


Figure 64: Cycle Sentry Icon

If allowed by OptiSet Plus, Cycle Sentry Mode or Continuous Mode is selected by pressing the Cycle Sentry/Continuous Key as shown (Figure 65).

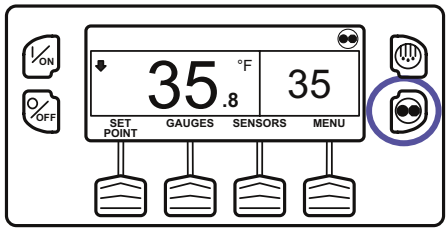


Figure 65: Cycle Sentry/Continuous Key

NOTE: Cycle Sentry Mode or Continuous Mode can also be selected using the Main Menu > Mode Submenu.

If the unit is in Cycle Sentry Mode, pressing the Cycle Sentry/Continuous Key changes the mode from Cycle Sentry Mode to Continuous Mode. The display confirms the change (Figure 66).

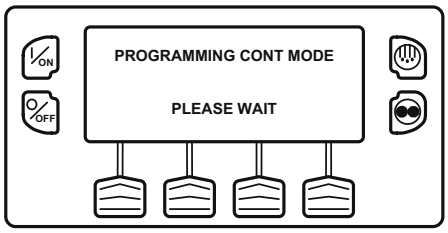


Figure 66: Continuous Mode

The new mode is confirmed for 3 seconds (Figure 67).

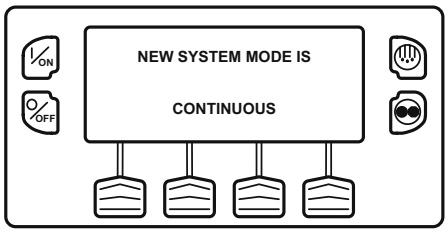


Figure 67: New Mode Confirmed

The display then returns to the Standard Display. In the example shown in Figure 68 the absence of the Cycle Sentry Icon indicates that the unit is running in Continuous Mode.

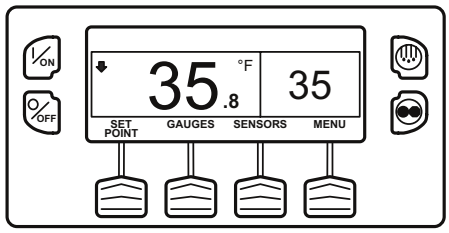


Figure 68: Cycle Sentry Icon Not Shown = Continuous Mode

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

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

IMPORTANT: Cycle Sentry or Continuous Mode may not be selectable if OptiSet Plus is in use.

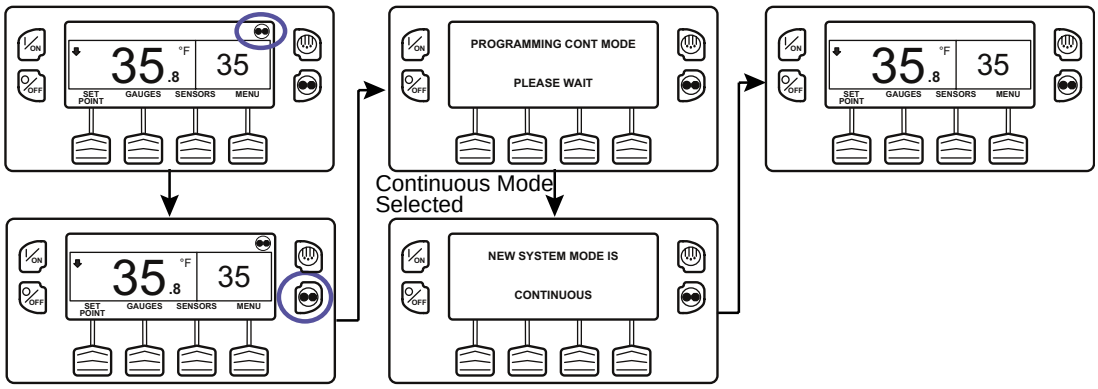


Figure 69: Selecting Cycle Sentry or Continuous Mode

Using the Gauges Key

The GAUGES Key allows the operator to view the unit gauges. If the function of this key has been reassigned, the GAUGES Menu is also available in the Maintenance Menu.

To access the GAUGES Menu, press the GAUGES Key (Figure 70).

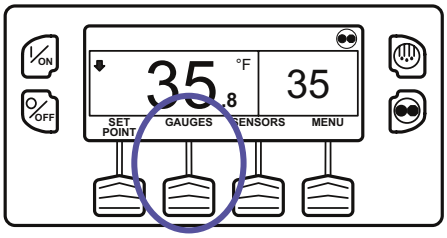


Figure 70: Gauges Key

The first gauge display will appear. Press the NEXT and BACK Keys to scroll through the gauges. Pressing the LOCK Key will lock the current gauge on the display (Figure 71).

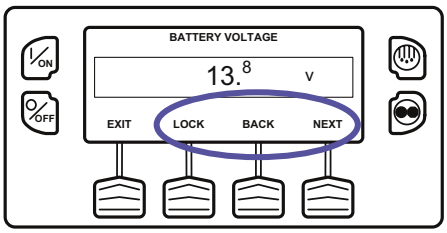


Figure 71: Gauge Display Locked

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

To return to the Standard Display press the EXIT Key.

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.

Accessory Battery Voltage: Displays the voltage at the alternator.

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. (ETV units only)

Suction Pressure: Displays the unit suction pressure. (ETV units only)

ETV Position: Displays the current position of the ETV valve. (ETV equipped units only)

Fresh Air Exchange: Displays the current position of the optional Fresh Air Exchange Door

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

• High Speed Relay/Electric Heat	• Spare Analog Input 2
• Run Relay	• Spare Output 1
• Run Relay Feedback	• Spare Output 2
• Alternator Excite Output	• Spare Output 3
• Defrost Damper	• Spare Output 4
• Heat Output	• Spare Output 5
• Motor RPM	• Fresh Air Exchange Output
• Spare Digital Input 1	• Fresh Air Exchange Feedback
• Spare Digital Input 2	• Diesel/Electric Relay (SmartPower units only)
• Spare Digital Input 3	• Electric Ready Input (SmartPower units only)
• Spare Digital Input 4	• Electric overload (SmartPower units only)
• Spare Analog Input 1	• Hot Gas Bypass (ETV units only)

Using The Sensors Key

The SENSORS Key allows the operator to view the unit gauges. If the function of this key has been reassigned, the SENSORS Menu is also available in the Maintenance Menu.

To access the SENSORS Menu, press the SENSORS Key:

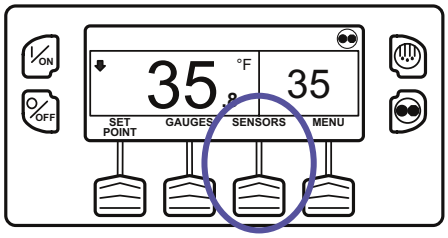


Figure 72: Sensors Key

The first sensor display will appear. Press the NEXT and BACK Keys to scroll through the sensors. Pressing the LOCK Key will lock the current sensor on the display (Figure 73).

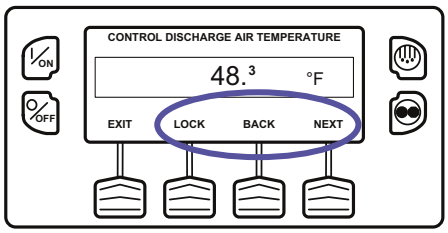


Figure 73: Next, Back, Lock Keys

The sensors available are shown below.

To return to the Standard Display press the EXIT Key.

Sensors Available

Control Return Air Temperature: Displays the temperature of the control return air sensor.

Display Return Air Temperature: Displays the temperature of the display return air sensor.

Control Discharge Air Temperature: Displays the temperature of the control discharge air sensor.

Display Discharge Air Temperature: Displays the temperature of the display discharge air sensor.

Temperature Differential: Displays the calculated difference between the control return air sensor and the control discharge air sensor

Evaporator Coil Temperature: Displays the temperature of the evaporator coil sensor.

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

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

*** Log Sensor 1:** Displays the temperature of the CargoWatch Data Logger temperature sensor 1.

*** Log Sensor 2:** Displays the temperature of the CargoWatch Data Logger temperature sensor 2.

*** Log Sensor 3:** Displays the temperature of the CargoWatch Data Logger temperature sensor 3.

*** Log Sensor 4:** Displays the temperature of the CargoWatch Data Logger temperature sensor 4.

*** Log Sensor 5:** Displays the temperature of the CargoWatch Data Logger temperature sensor 5.

*** Log Sensor 6:** Displays the temperature of the CargoWatch Data Logger temperature sensor 6.

Board Temperature Sensor: Displays the internal temperature of the HMI Control Panel pc board.

* If sensors have been added.

Using the Main Menu

The Main Menu contains several additional submenus that allow the operator to view information and modify unit operation. To access the Main Menu press the MENU Key (Figure 74).

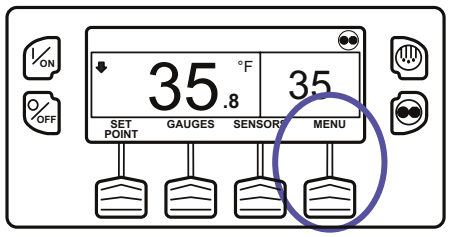


Figure 74: Menu Key

The first Main Menu choice will appear. Press and hold the UP and DOWN Keys to scroll through the menu choices. When the desired selection is shown on the display, press the SELECT Key to access it. The Pretrip submenu is displayed (Figure 75).

To return to the Standard Display press the EXIT Key.

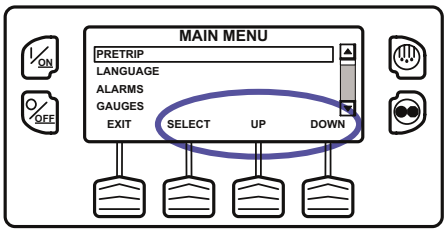


Figure 75: Pretrip Submenu

Main Menu Choices

Each of these Main Menu choices will be explained in following pages of this chapter:

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 Enabled): 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. NOTE: On C-600 units this is only displayed on early versions of HMI software and is not functional. It is not displayed on C-600 units with later versions of HMI software.

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 shut down 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 Sequence

Pretrip tests proceed in the order shown below. A Full Pretrip Test 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.

Cool Check - The ability of the unit to cool in low speed is checked.

Heat Check - The ability of the unit to heat in low speed 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.

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.

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 76).

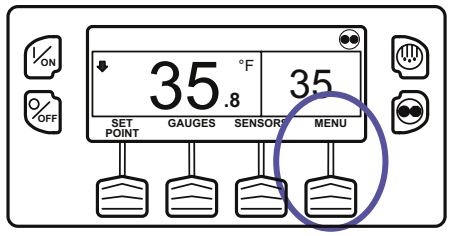


Figure 76: Menu Key

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 77).

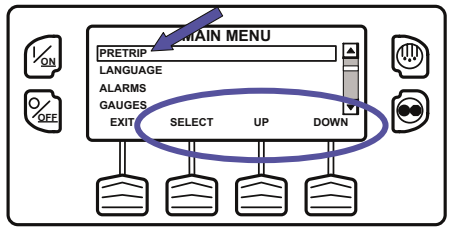


Figure 77: Select Key

The display will briefly show PROGRAMMING PRETRIP MODE (Figure 78). 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.

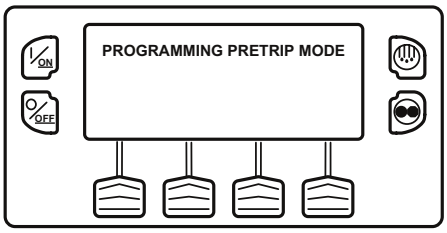


Figure 78: Programming Trip Mode

If all alarms were not cleared a prompt appears (Figure 79). Exit the Pretrip Test, clear all alarms and repeat the Pretrip Test.

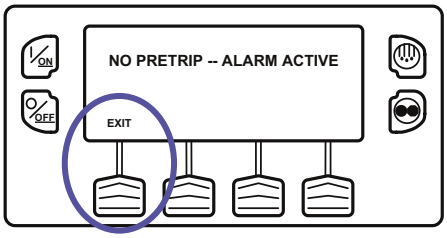


Figure 79: Alarms Not Cleared

If all alarms were cleared, the Pretrip Test display appears (Figure 80).

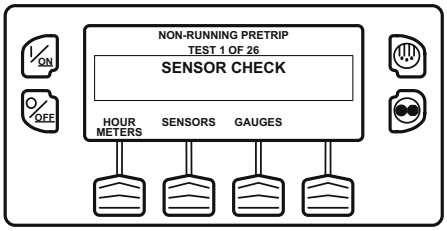


Figure 80: Pretrip Test

- 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 in Figure 81 the unit is in the Running Pretrip and is performing Test 21 of 26, Cool Test.

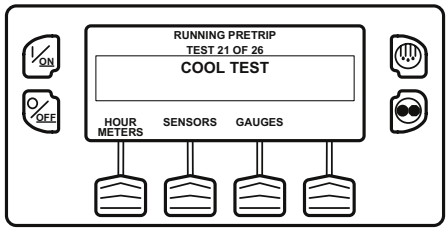


Figure 81: Cool Test

When all tests are complete, the results are reported as PASS, CHECK or FAIL (Figure 82). If the results are CHECK or FAIL, the accompanying alarm codes will direct the technician to the cause of the problem.

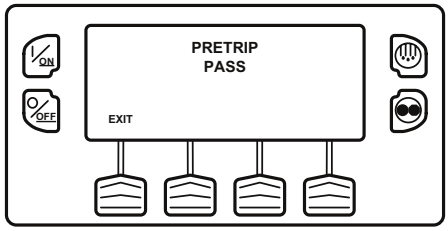


Figure 82: Pretrip Pass

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 Figure 83 for an overview of the **Performing a Pretrip Test** procedure.

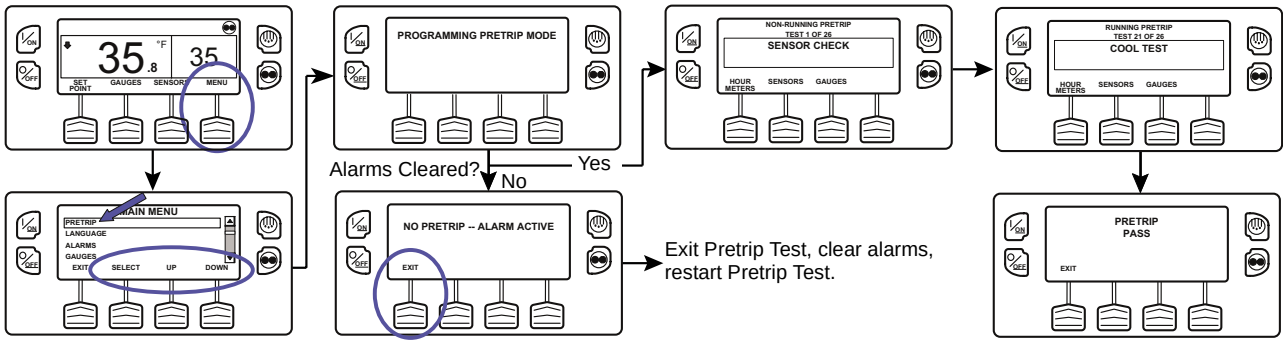


Figure 83: Performing a Pretrip Test

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

OptiSet Plus

- SEND
  - Send OptiSet Plus files
- RETRIEVE
  - Retrieve OptiSet Plus files

If a USB Flash Drive is not connected to the unit, this feature will not appear in the Main Menu.

Flash Drive Icon

- The USB Icon (Figure 84) will appear in the upper left corner of the display as shown below when a USB Flash Drive is inserted into the Flash Drive Only USB Port on the Unit Control Panel.
- The USB Icon will also appear if a computer is connected to the PC Only USB Port inside the control box.

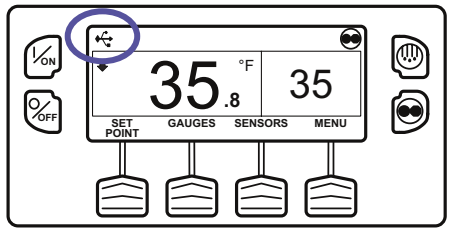


Figure 84: Flash Drive Icon

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

To select the Flash Drive Menu, press the MENU Key (Figure 85). The Main Menu will appear.

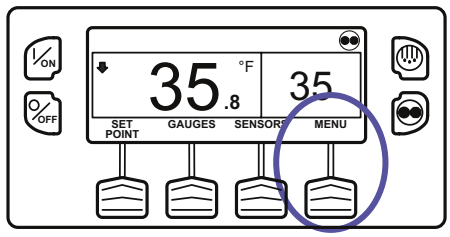


Figure 85: Menu Key

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 86).

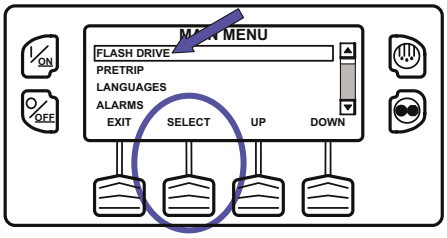


Figure 86: Flash Drive Menu

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. Then the Flash Drive Menu will be shown (Figure 87).

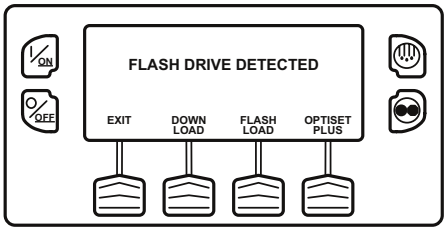


Figure 87: Flash Drive

Removing the Flash Drive

If the Flash Drive is disconnected, the display shown in Figure 88 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.

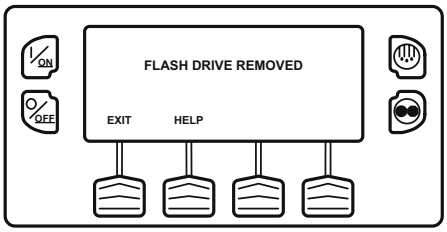


Figure 88: Flash Drive Removed

If the HELP Soft Key is pressed the display shown in Figure 89 will appear.

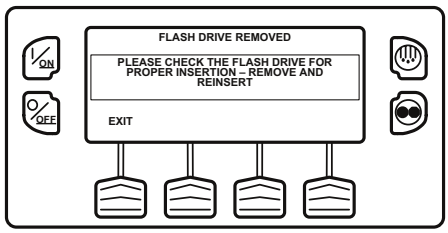


Figure 89: Help Soft Key Pressed

Languages (If Enabled)

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 the enabled languages. All subsequent displays are shown in the selected language. English is the default language. See the Guarded Access Language Setup Menu in Section 3 of SR-4 Microprocessor Control System Diagnostic Manual TK 55533 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, as once changed all HMI Control Panel displays will be in the new language.

Available Languages

The following languages are available:

• English	• French	• Spanish

Selecting an Alternate Language

To select an alternate language, press the MENU Key (Figure 90).

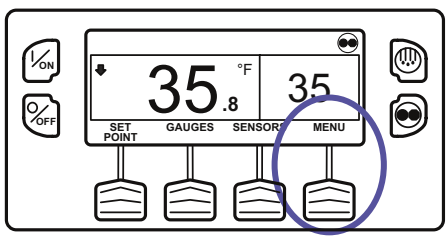


Figure 90: Menu Key

The Main Menu will appear. If more than one language is enabled, the Language Menu will appear as a main Menu selection (Figure 91). 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.

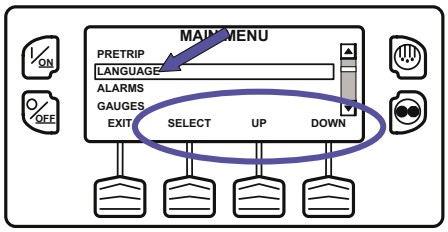


Figure 91: Main Menu

The Language menu will appear as shown in Figure 92. 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 (example is Español [Spanish]) press the YES Key to confirm the choice.

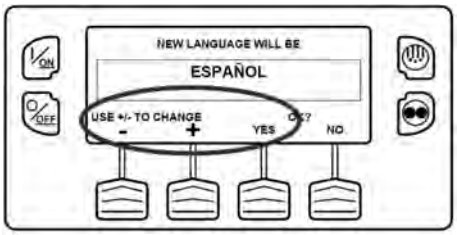


Figure 92: Language Menu

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. Español (Spanish) is shown in Figure 93.

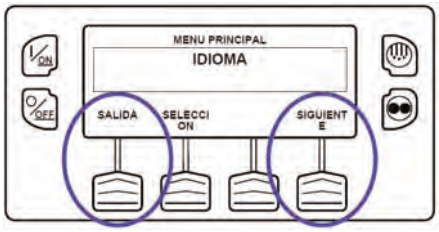


Figure 93: New Language (Example: Español)

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 Figure 94.

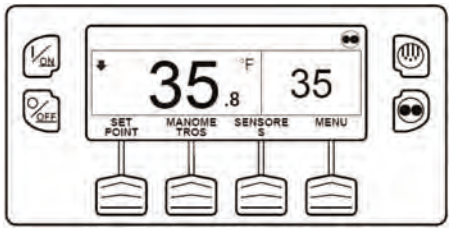


Figure 94: New Language (Example: Español)

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

See Figure 95 for an overview of the **Languages** selection procedure.

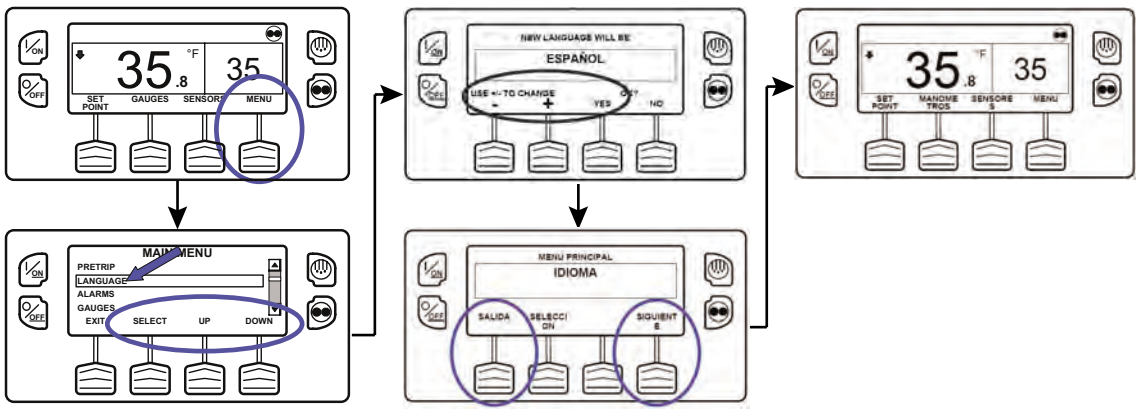


Figure 95: Languages (If Enabled)

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 5 seconds as shown below. The Standard Display shown in Figure 96 is Español (Spanish).

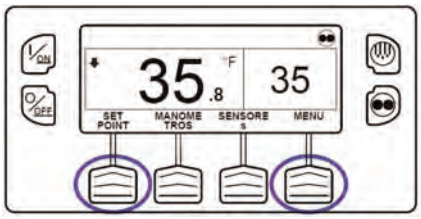


Figure 96: Standard Display in Español

After 5 seconds the Language Menu will appear in the current language as shown below. 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 97).

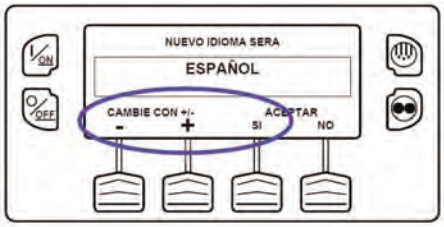


Figure 97: Select Desired Language

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

Alarms

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

See the “Alarm Codes” on page 72 for a table that lists the alarm codes. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for more information about alarm codes and their diagnosis.

Log Alarms

If only Log Alarms exist the display shown in Figure 98 will appear and the optional remote alarm light will light for 30 seconds when the unit is turned on.

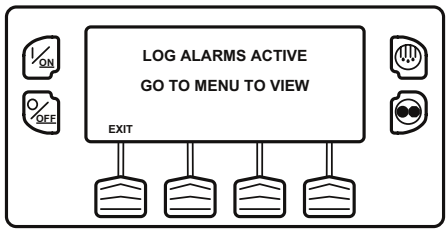


Figure 98: Log Alarms Exist

Check Alarms

If a Check Alarm condition occurs while the unit is running the alarm icon will appear in the display as shown in Figure 99.

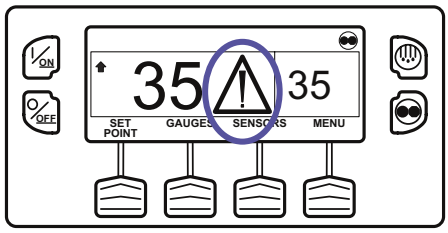


Figure 99: Alarm Icon

Shutdown Alarms

If a Shutdown Alarm occurs while the unit is running it will be indicated by all of the following (Figure 100):

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

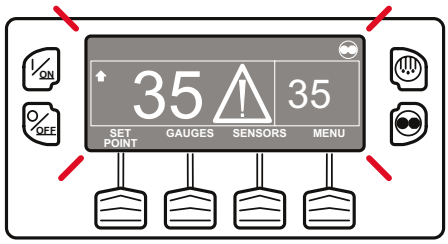


Figure 100: Reverse/Normal Video

Pretrip Alarms

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

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 Maintenance Menu or Guarded Access Menu:

- Alarm Code 03 Check Control Return Air Sensor
- Alarm Code 04 Check Control Discharge Air Sensor
- Alarm Code 203 Check Display Return Air Sensor
- Alarm Code 204 Check Display Discharge Air Sensor

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 the unit starts running.
- 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 101).

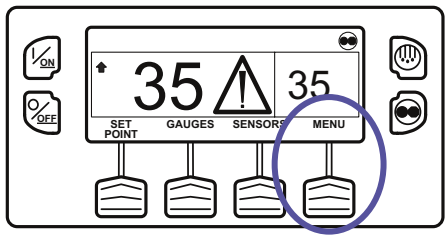


Figure 101: Menu Key

The Main Menu will appear. Press the UP or DOWN Key as required to choose the Alarms Menu (Figure 102). When the Alarms Menu is shown press the SELECT Key to select the Alarms menu.

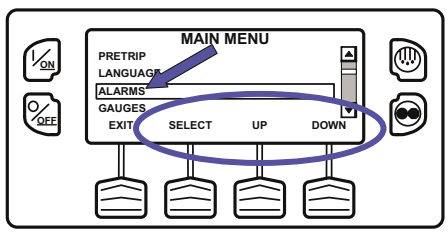


Figure 102: UP/Down, Select Keys

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 below, there are two alarms. The most recent is Alarm Code 5 Check Ambient Temp Sensor (Figure 103).

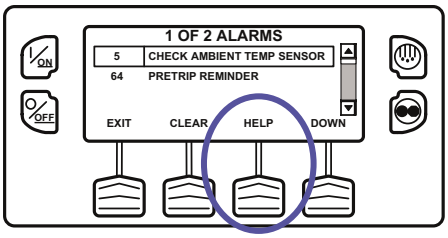


Figure 103: Alarms Menu

If necessary to view all alarms, scroll down using the DOWN Key (Figure 104).

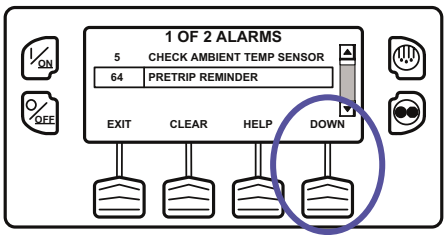


Figure 104: Down Key

If the alarm situation has been resolved press the CLEAR Key to clear the alarm (Figure 105).

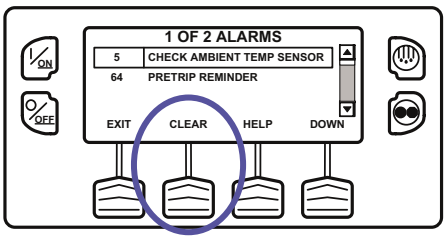


Figure 105: Clear Key

The display will briefly show CLEARING ALARM 5 – PLEASE WAIT. Then the Alarm Menu will reappear (Figure 106).

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

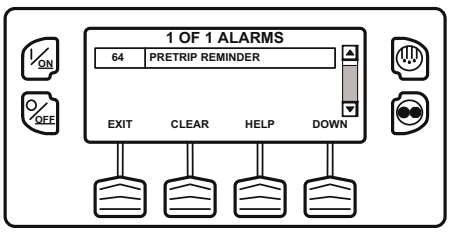


Figure 106: Pretrip Reminder

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 107).

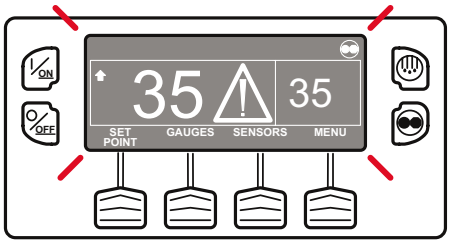


Figure 107: Unit Shutdown

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 108).

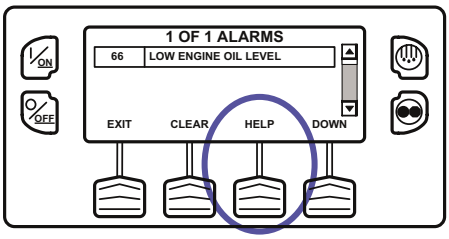


Figure 108: Help Key

A help message will appear. Press the EXIT Key to return to the Alarms Menu (Figure 109). Check the oil level and add oil as required, clear the alarm and restart the engine.

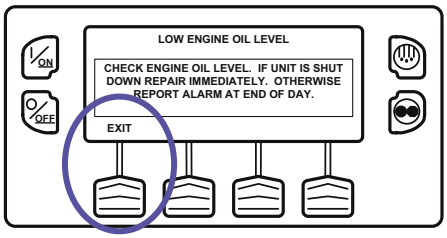


Figure 109: Exit Key

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, it 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 Figure 110 for an overview of the **Displaying and Clearing Alarm Codes** procedure.

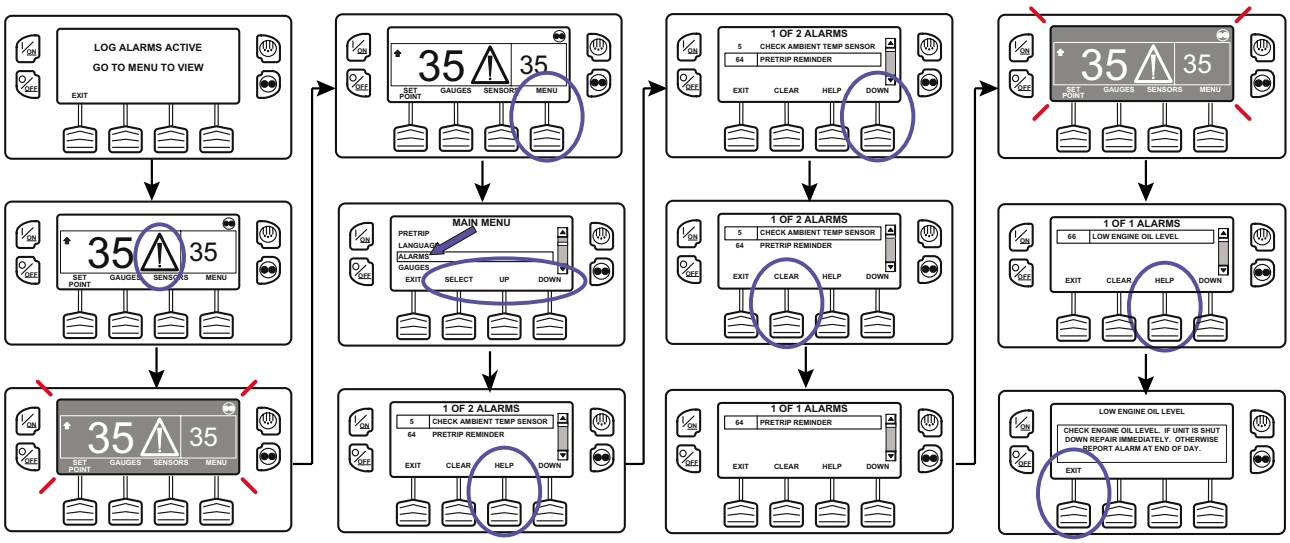


Figure 110: Displaying and Clearing Alarm Codes

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. This is necessary if the GAUGES Soft Key on the Standard Display has been reassigned to a different function.

Displaying Gauges

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

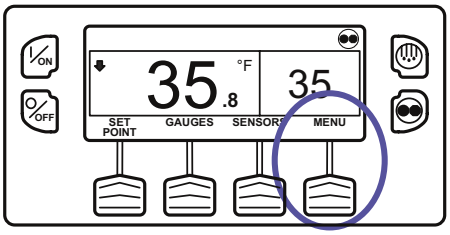


Figure 111: Menu Key

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 112).

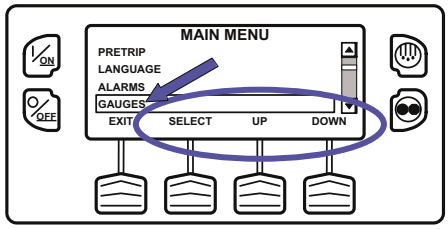


Figure 112: Up, Down, Select Keys

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 113).

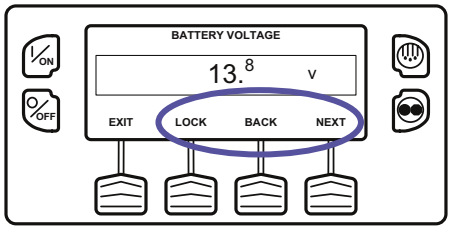


Figure 113: Next, Back, Lock Keys

The gauges and I/O conditions available are described in “Gauges Available” on page 48. 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.

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. This is necessary if the SENSORS Soft Key on the Standard Display has been reassigned to a different function.

Displaying Sensors

Sensors are displayed using the Sensors Menu. From the Standard Display, press the MENU Key (Figure 114).

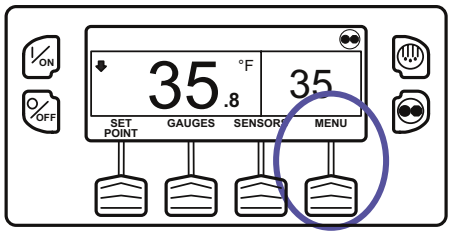


Figure 114: Menu Key

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.

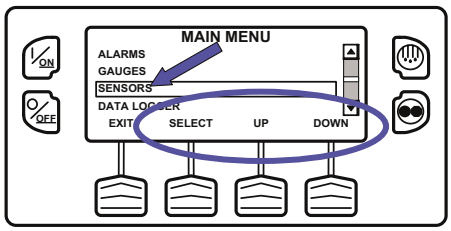


Figure 115: Up, Down, Select Keys

The first sensors display will appear. Press the NEXT and BACK Keys to scroll through the sensors. Pressing the LOCK Key will lock the current gauge on the display (Figure 116).

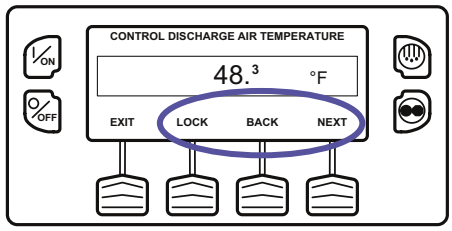


Figure 116: Next, Back, Lock Keys

The sensors available are described in “Sensors Available” on page 49.

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

Data Logger (CargoWatch)

The CargoWatch Data Logger is physically located in the HMI Control Panel. It can support up to 6 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 ThermoServ. The CargoWatch Data Logger can also be configured using the USB Flash Drive OptiSet Plus Feature.

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 117).

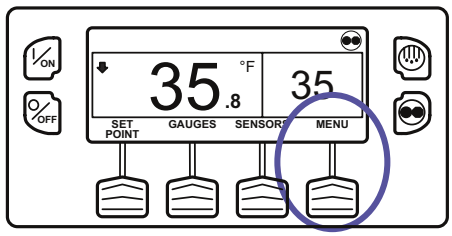


Figure 117: Standard Screen, Menu Key

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 118).

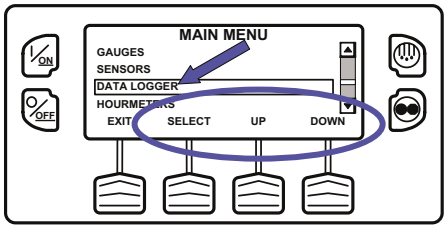


Figure 118: UP, Down, Select Keys

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 119).

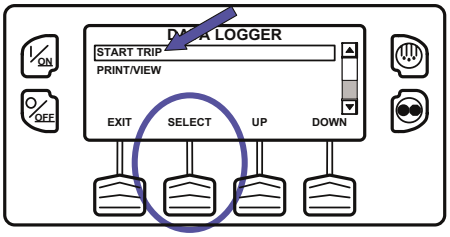


Figure 119: Select Key, Start of Trip Complete

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.

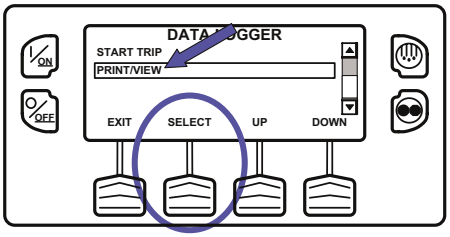


Figure 120: Select Key, Print Delivery Ticket

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 121). The Delivery Ticket is a short ticket that shows delivery specific details including the current temperature. A sample Delivery Ticket is shown in Figure 122.

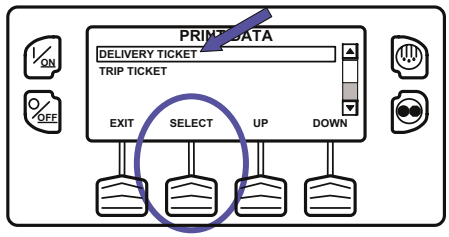
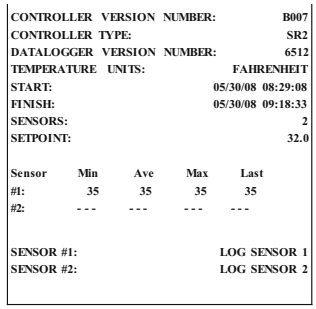


Figure 121: Select Key, Print Delivery Ticket



```
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
```

Figure 122: Sample Delivery Ticket

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 123). 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 in Figure 124.

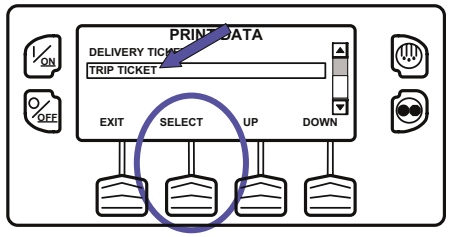
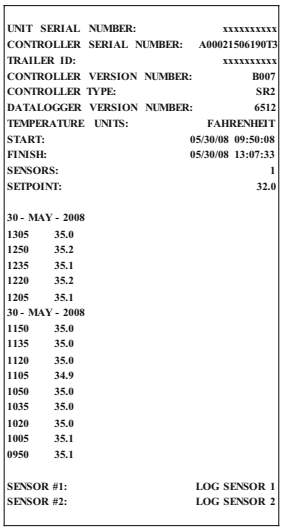


Figure 123: Select Key, Print Trip Ticket



```
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
```

Figure 124: Sample Trip Ticket

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 then 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 125).

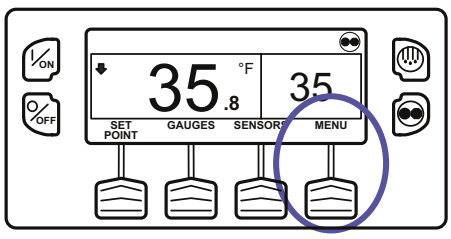


Figure 125: Menu Key

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 126).

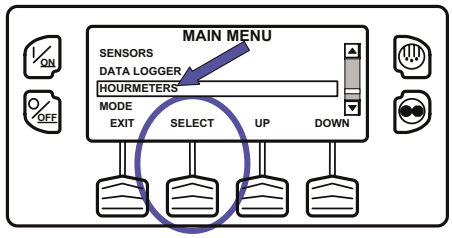


Figure 126: Select Key

Press the NEXT or PREVIOUS Key to scroll through the hourmeters (Figure 127).

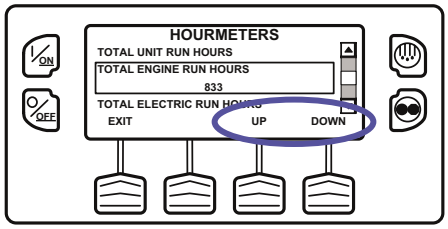


Figure 127: Up/Down Keys

Hourmeter names and definitions are shown in the table on the next page 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.
Engine Hours	Total number of hours the unit has run in diesel mode.
Electric Run Hours	Total number of hours the unit has run in electric 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.
Controller Power On	Total hours the controller and HMI Control Panel have been turned on.
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.

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 that selecting Cycle Sentry Mode or Continuous Mode can also be accomplished using the Cycle Sentry Key to the right of the display.
- Allows temperature to be displayed in either Fahrenheit or Celsius degrees (if enabled from the Guarded Access > Main Menu Configuration Menu).
- Allows the optional Fresh Air Exchange door to be opened or closed (if enabled from the Guarded Access > Hardware Configuration Menu).
- Allows Keypad Lockout to be selected (if enabled from the Guarded Access > Main Menu Configuration Menu).
- Start Sleep Mode (if enabled from the Guarded Access > Main Menu Configuration Menu).

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

If OptiSet Plus is in use some modes may not be available.

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 128).

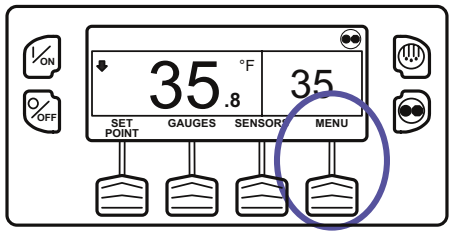


Figure 128: Menu Key

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 129).

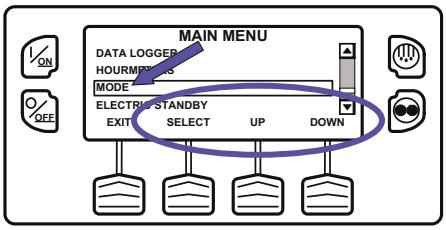


Figure 129: Up, Down, Select Keys

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 130).

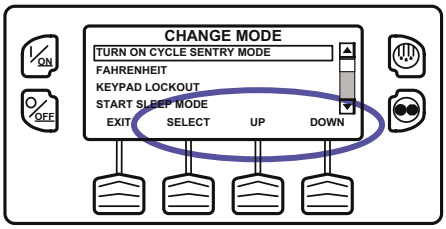


Figure 130: Select, Up, Down Keys

Possible mode selections are shown later in this section.

- Only those modes that have been enabled will appear. Only the Cycle Sentry Menu is enabled on factory units.
- Not all modes may be available, depending on OptiSet Plus usage and the settings of other programmable features.
- To return to the Standard Display press the EXIT Key.
- The modes shown below may be available.

Turn Cycle Sentry On or Off

Cycle Sentry Mode can be turned On or Off if Cycle Sentry Mode is allowed by OptiSet Plus. If Cycle Sentry is turned off the unit runs in Continuous mode, unless Continuous Mode is not allowed by OptiSet Plus. Either Cycle Sentry or Continuous operation can be disabled via OptiSet Plus. From the Main Menu > Change Mode menu choose Turn On/Off Cycle Sentry Mode and press the SELECT Soft Key (Figure 131).

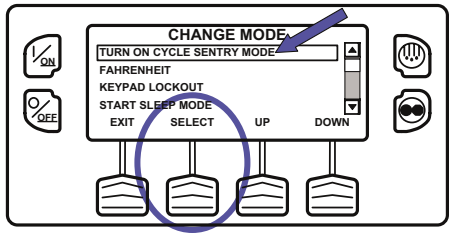


Figure 131: Select Key

If the unit is running in Cycle Sentry Mode, press the SELECT Soft Key (Figure 132) to turn off Cycle Sentry Mode as shown below.

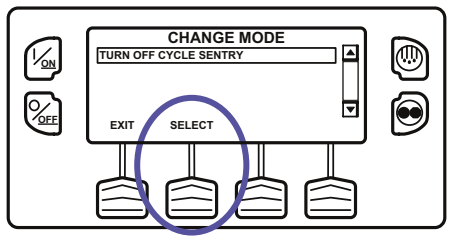


Figure 132: Select Key

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.

NOTE: Cycle Sentry Mode can also be turned on and off using the Cycle Sentry Key on the HMI Control Panel.

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).

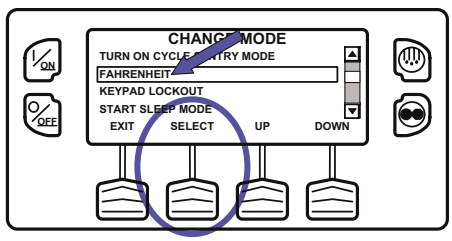


Figure 133: Fahrenheit or Celsius, Select Key

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

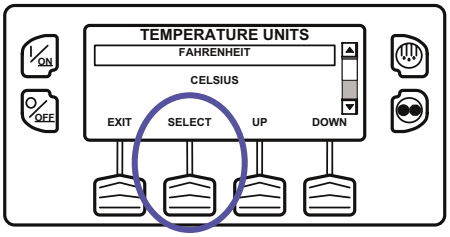


Figure 134: Up, Down, Select Keys

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.

Fresh Air Exchange Open or Closed

If this option is installed and enabled in Guarded Access > Main Menu Configuration, the Fresh Air Exchange option allows fresh outside air to be drawn into the trailer and the interior air to be exhausted by opening the Fresh Air Exchange door. This feature is beneficial when hauling loads that release gas as they ripen, such as potatoes. The Fresh Air Exchange feature is only available with setpoints above 32 F (0 C). The feature is disabled with setpoints of 32 F (0 C) and below. This feature may not be available if OptiSet Plus is in use.

The Fresh Air Exchange feature should be used exactly as specified by the customer.

From the Change Mode menu choose Open Fresh Air Exchange and press the SELECT Soft Key (Figure 135).

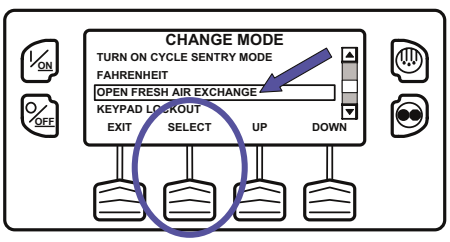


Figure 135: Select Key

To open the Fresh Air Exchange door press the SELECT Key as shown below.

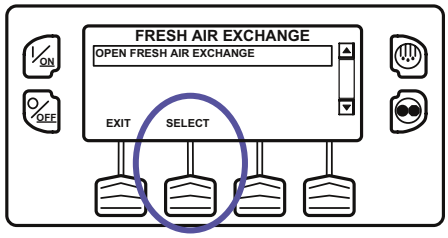


Figure 136: Select Key

The Fresh Air Exchange door will open. To close the Fresh Air Exchange door press the SELECT Key again.

IMPORTANT: The Fresh Air Exchange feature should be used exactly as specified by the customer.

- The Fresh Air Exchange door will only be open when the unit engine is running. The door will close when the engine shuts down to preserve unit battery life.
- The setting of the Fresh Air Exchange door will survive power off/power on cycles - if the door is set to “Open” by the operator it will continue to open any time the engine is running until it is set to “Close” by the operator.
- 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 5 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 137).

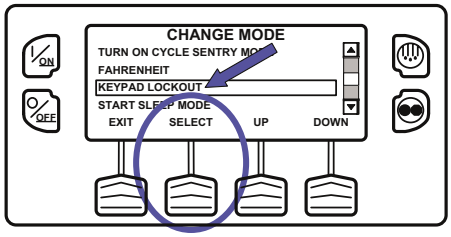


Figure 137: Select Key

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 138).

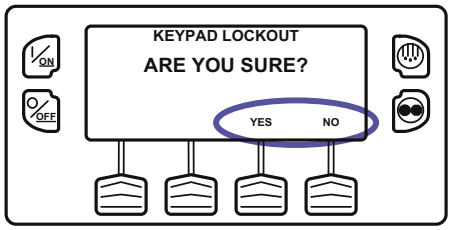


Figure 138: NO Soft Key

If the YES Soft Key was pressed Keypad Lockout is active. Repeat the process to turn the Keypad Lockout feature off.

- 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 5 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 139).

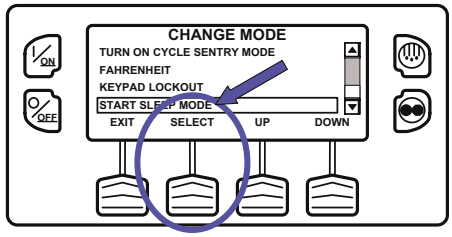


Figure 139: Select Soft Key

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, 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 then the unit will automatically switch to Electric Mode operation when standby power is connected and available. The screens shown below 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 140).

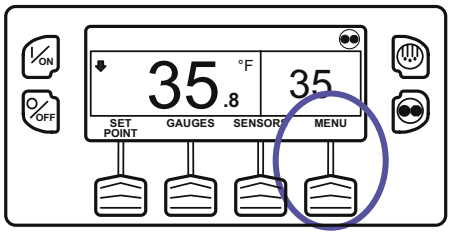


Figure 140: Menu Key

From the Main Menu choose Electric Standby and press the SELECT Soft Key (Figure 141).

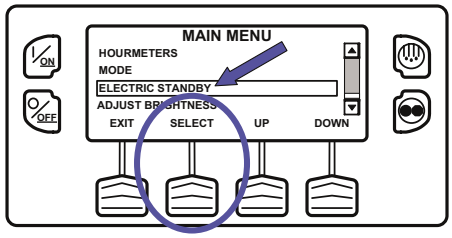


Figure 141: Select Key

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. If electric standby power is not available or fails, the display will prompt for a return to Diesel Mode as shown below.

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 142).

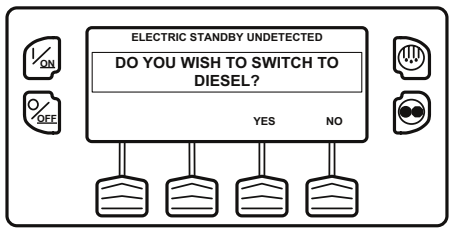


Figure 142: Diesel Mode Prompt

- 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 then the unit will automatically switch to Diesel Mode operation when standby power is no longer available. The screens shown below will not appear.

If the Diesel to Electric 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 143).

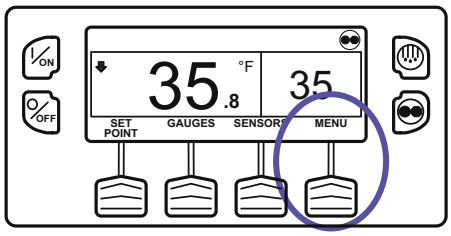


Figure 143: Menu Key

From the Main Menu choose Diesel Mode and press the SELECT Soft Key (Figure 144).

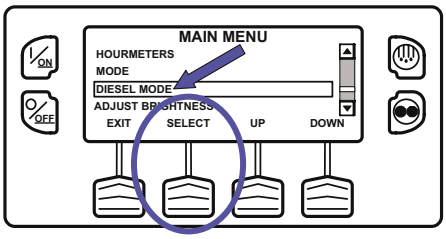


Figure 144: Select Key

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 145).

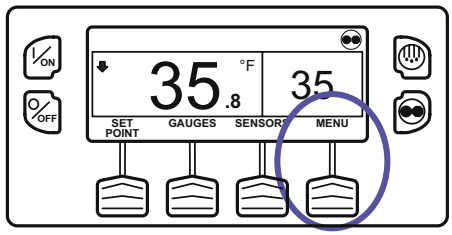


Figure 145: Menu Key

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 146).

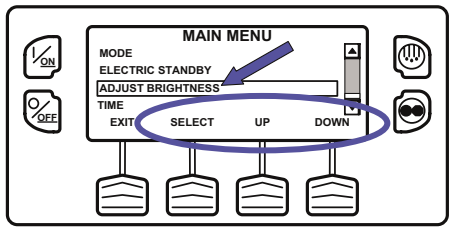


Figure 146: Select Key

The Display Brightness menu will appear as shown below. 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 147).

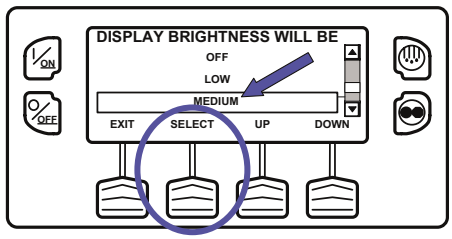


Figure 147: Select Key

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 148).

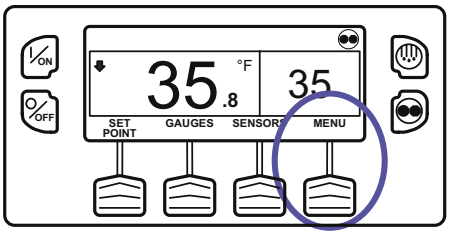


Figure 148: Menu Key

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 149).

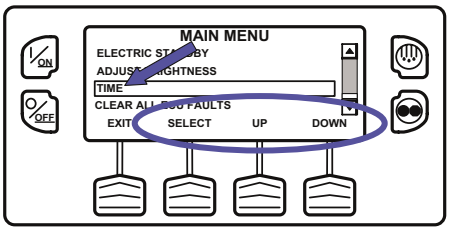


Figure 149: Select Key

The date and time held in the HMI Control Panel will be shown on the display (Figure 150). Time and Date cannot be changed from the Main Menu.

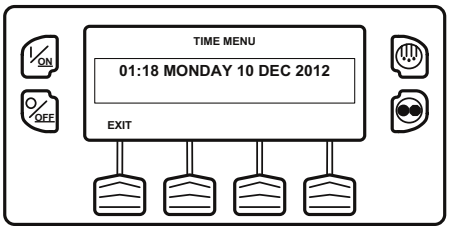


Figure 150: Date and Time

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

NOTE: On C-600 units this menu selection is only displayed on early versions of HMI software and is not functional. It is not displayed on C-600 units with later versions of HMI software.

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.

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

CAUTION: Do not remove expansion tank cap while coolant is hot.

CAUTION: 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.

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. Make sure all the doors are latched securely.

Loading Procedure

1. Make sure 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.
3. Load the product so that there is adequate space for air circulation completely around the load. *DO NOT* block the evaporator inlet or outlet.
4. 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.

Post Load Procedure

1. Make sure all the doors are closed and locked.
2. Start the unit if it was shut off to load (see “Turning Unit On”).
3. Make sure the setpoint is at the desired setting.
4. One-half hour after loading, manually initiate a Defrost cycle. If the evaporator coil sensor temperature is below 45 F (7 C), the unit will Defrost. 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.

Alarm Codes

Thermo King Precedent Unit Alarm Codes

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
00		No Alarms Exist	No action required.
02		Check Evaporator Coil Sensor	Manually monitor load temperature. Report alarm at end of day.
03		Check (Control) Return Air Sensor	Manually monitor load temperature. Report alarm at end of day.
04		Check (Control) Discharge Air Sensor	Manually monitor load temperature. Report alarm at end of day.
05		Check Ambient Temp Sensor	Report alarm at end of day.
06		Check Coolant Temp Sensor	Report alarm at end of day.
07		Check Engine RPM Sensor	Report alarm at end of day.
(09)		High Evaporator Temperature	Manually monitor load temperature. Report alarm at end of the day.
(10)		High Discharge Pressure	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
11		Unit Controlling on Alternate Sensor	Manually monitor load temperature. Report alarm at end of day.
12		Sensor or Digital Input Shutdown	The unit is no longer able to operate and has been shut down. Repair immediately.
13		Sensor Calibration Check	Manually monitor load temperature. Report alarm at end of day.
(17)		Engine Failed to Crank	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(18)		High Engine Coolant Temperature	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(19)		Low Engine Oil Pressure	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(20)		Engine Failed to Start	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(21)		Cooling Cycle Check	Manually monitor load temperature. Report alarm at end of day.
(22)		Heating Cycle Check	Manually monitor load temperature. Report alarm at end of day.
(23)		Cooling Cycle Fault	The unit is no longer able to operate and has been shut down. Repair immediately.
(24)		Heating Cycle Fault	The unit is no longer able to operate and has been shut down. Repair immediately.
25		Alternator Check	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(26)		Check Refrigeration Capacity	Manually monitor load temperature. Report alarm at end of day.
28		Pretrip Abort	Report alarm at end of day.
29		Defrost Damper Circuit Check	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
30		Defrost Damper Stuck	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
31		Check Oil Pressure Switch	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
32		Refrigeration Capacity Low	The unit is no longer able to operate and has been shut down. Repair immediately.
33		Check Engine RPM	Report alarm at end of day.
35		Check Run Relay Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
(36)		Electric Motor Failed to Run	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
37		Check Engine Coolant Level	Check engine coolant level. Do not remove the cap if the engine is hot. Report alarm at end of day.
38		Electric Phase Reversed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
40		Check High Speed Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
42		Unit Forced to Low Speed	Report alarm at end of day.
44		Check Fuel System	Report alarm at end of day.
45		Check Hot Gas or Hot Gas Bypass Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
46		Check Air Flow	Manually monitor load temperature. Report alarm at end of the day.
48		Check Belts or Clutch	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
49		Check Spare Sensor 1	Report alarm at end of day.
50		Reset Clock	Report alarm at end of day.
52		Check Heat Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
53		Check Liquid Line Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
54		Test Mode Timeout	Service Test or Output Test timed out after 15 minutes. Report alarm at end of day.
56		Check Host Evap Fan Low Speed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
57		Check Host Evap Fan High Speed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
61		Low Battery Voltage	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
62		Ammeter Out of Calibration	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
(63)		Engine Stopped	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
64		Pretrip Reminder	Report alarm at end of day.
65		Abnormal Temperature Differential	Report alarm at end of day.
66		Low Engine Oil Level	Check engine oil level. If unit is shut down repair immediately. Otherwise, report alarm at end of day.
67		Check Liquid Line Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
68		Internal Controller Fault Code	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
70		Hourmeter Failure	Report alarm at end of day.
74		Controller Reset to Defaults	Report alarm at end of day.
79		Internal Data Logger Overflow	Report alarm at end of day.
84		Restart Null	Report alarm at end of day.
85		Forced Unit Operation	Report alarm at end of day.
86		Check Discharge Pressure Sensor	Report alarm at end of day.
87		Check Suction Pressure Sensor	Report alarm at end of day.
89		Check Electronic Throttling Valve Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
90		Electric Overload	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
91		Check Electric Ready Input	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
92		Sensor Grades Not Set	Report alarm at end of day.
93		Low Compressor Suction Pressure	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
96		Low Fuel Level	Check engine fuel level and add fuel as required.
98		Check Fuel Level Sensor	Report alarm at end of day.
105		Check Receiver Tank Press Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
106		Check Purge Valve Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
107		Check Condenser Inlet Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
108		Door Open Time-out	Close doors. Report alarm at end of day.
110		Check Suction Line Solenoid Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
111		Unit Not Configured Correctly	Report alarm at end of day.
112		Check Remote Fans	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
113		Check Electric Heat Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
114		Multiple Alarms - Can Not Run	The unit is no longer able to operate and has been shut down. Repair Immediately.
117		Auto Switch from Diesel to Electric	Report alarm at end of day.
118		Auto Switch from Electric to Diesel	Report alarm at end of day.
120		Check Alternator Excite Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
122		Check Diesel/Electric Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
127		Setpoint Not Entered	Be sure setpoint is set to correct temperature.
128		Engine Run Time Maintenance Reminder #1	Report alarm at end of day.

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
129		Engine Run Time Maintenance Reminder #2	Report alarm at end of day.
130		Electric Run Time Maintenance Reminder #1	Report alarm at end of day.
131		Electric Run Time Maintenance Reminder #2	Report alarm at end of day.
132		Total Unit Run Time Maintenance Reminder #1	Report alarm at end of day.
133		Total Unit Run Time Maintenance Reminder #2	Report alarm at end of day.
134		Controller Power On Hours	Report alarm at end of day.
141		Auto-Switch Diesel to Electric Disabled	Report alarm at end of day.
143		Check Remote Zone Drain Hose Heater Output (Zone shown if Multi-Temp)	Report alarm at end of day.
144		Lost CAN Communications to Expansion Module	Unit cannot operate and is shut down. Repair immediately.
145		Loss of Controller “On” 8XP Feedback Signal	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
146		Software Version Mismatch	Report alarm at end of the day.
148		Auto-Switch Electric to Diesel Disabled	Report alarm at end of day.
150		CargoWatch Sensor Out of Range Low	Report alarm at end of day.
151		CargoWatch Sensor Out of Range High	Report alarm at end of day.
152		CargoWatch Sensor Failed	Report alarm at end of day.
153		Expansion Module Flash Load Failure	Report alarm at end of day.
157		OptiSet File Mismatch	Report alarm at end of day.
158		Primary Software failed to load	Report alarm at end of day.
159		Check Battery Condition	Report alarm at end of day.
160		Lost Radio Expansion Board (REB) CAN Communication	Report alarm at end of day.
203		Check Display Return Air Sensor	Manually monitor load temperature. Report alarm at end of day.
204		Check Display Discharge Air Sensor	Manually monitor load temperature. Report alarm at end of day.
233		REB Transitioning From Conservative to Full Null	Report alarm at end of the day.
234		Check Relative Humidity Sensor	Report alarm at end of day.
251		REB Mis-configured	Report alarm at end of day.
252		Check Auto Fresh Air Exchange Door	Report alarm at end of day.
500		Check Host Evaporator Fan Low Speed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
501		Check Host Evaporator Fan High Speed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
505		Check Roadside Condenser Fan Motor Speed Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
506		Check Curbside Condenser Fan Motor Speed Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
508		Speed Request Communications Error	Report alarm at end of day.
509		Engine Control Unit (ECU) Failed to Enable	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
510		Engine Control Unit (ECU) Run Signal Failed	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
511		Engine Wait to Start Time Delay Expired	Report alarm at end of day.
516		I/O Controller to Application Controller Communication Failure	Unit cannot operate and is shut down. Repair immediately.
517		Water In Fuel	Report alarm at end of day.
518		Generator Ground Fault	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
519		Check Battery Charger Input Power	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
520		Check Battery Charger Output	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
521		Battery Charger Overheat Shutdown	Report alarm at end of day.
522		Battery Temperature Sensor Alarm	Report alarm at end of day.
523		Battery Charger Exceeded High Temperature Limit	Report alarm at end of day.
528		Failed CAN Communication Controller and Battery Charger	Report alarm at end of day.
529		Check Fuel Pump Circuit	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
530		Low Pressure Differential	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
538		Engine J1939 CAN Datalink Degraded (Electronic Engine Only)	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
539		Engine J1939 CAN Datalink Failed (Electronic Engine Only)	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
540		Illegal Engine Operating State	If unit is shut down repair immediately. Otherwise, report alarm at end of day.
542		Battery Charger Fault - Unit Forced to Low Speed	Report alarm at end of day.
543		Battery Charger Internal Short	Report alarm at end of day.
544		Battery Charger External Short	Report alarm at end of day.
545		Battery Charger Output DC Voltage Exceeded Limit	Report alarm at end of day.
546		Battery Charger Operating Bulk Voltage Out of Range	Report alarm at end of day.
547		Battery Charger AC Bus Phase Loss	Report alarm at end of day.

COLOR CODE DEFINITIONS	OK TO RUN	CHECK AS SPECIFIED	TAKE IMMEDIATE ACTION

Num		Description	Operator Action
548		Battery Charger Temp Below Operating Range	Report alarm at end of day.
549		Battery Charger Input AC Overvoltage	Report alarm at end of day.
550		Battery Charger Internal Overvoltage Fault	If unit is shut down repair immediately. Otherwise, report alarm at end of the day.
551		Battery Charger Internal Temp Sensor Fault	Report alarm at end of day.
552		Battery Charger Charging - Low Battery	Report alarm at end of day.
553		Battery Charger Operating Derated Due To High Temp Condition	Report alarm at end of day.
599		Engine Service Tool Connected	Maintenance information only. Report alarm at end of the day.

CAUTION: 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.

AC Generator

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. An optional 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. 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

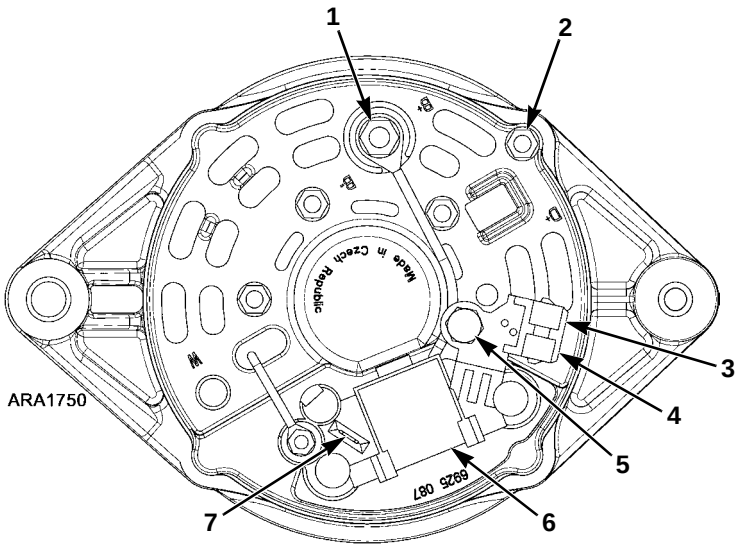
General Information

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, fuse FS8, 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. Be sure 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 (see Figure 151), which are painted black.



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)		

Figure 151: Thermo King Alternator Terminal and Component Locations

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 parts numbers. Be sure 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 an equivalent.
2. Make sure the drive belts and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Be sure 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. If the unit battery is questionable, a known good jumper battery should be substituted for alternator testing.

   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.
4. Check that the resistor bypass fuse (F4) has been removed. Units with Thermo King alternators must have the resistor bypass fuse (F4) removed.

   CAUTION: Energizing the circuit with the resistor bypass fuse installed will damage Thermo King alternators. Be sure the resistor bypass fuse is removed for Thermo King alternators.
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, and fuse FS8.
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 and fuse FS8 in the battery and main/unified harnesses.
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 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 below. Regulator voltage can vary from approximately 15.2 Vdc at -40 F (-40 C) to approximately 13.2 Vdc at 176 F (80 C).

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

    If the voltage does not increase to the anticipated voltage regulator setting, the alternator is defective if there are no problems in the wiring. Recheck the wiring before replacing the alternator.

16. If the voltage does increase until it reaches the anticipated voltage regulator setting, compare the voltage at the B+ terminal to the voltage between the battery terminals. The voltage at the B+ terminal should be no more than 1.0 Vdc higher than the voltage between the battery terminals.

    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.

    If the voltage at the B+ (POS) terminal is more than 1.0 Vdc higher than the voltage between the battery terminals, clean and check the wires and connections in the 2A and 2 circuits and repeat this check.

17. Increase the charging system load as much as possible by running the unit in high speed heat.

18. Monitor the alternator output voltage.

    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.

    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.

Alternator Diode Quick Check:

This check confirms proper diode function.

19. 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.

- 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.
- High field current indicates a short in the field circuit. Replace the rotor or the alternator.

Battery

Inspect/clean the battery terminals and check the electrolyte level during scheduled maintenance inspections. 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. The minimum specific gravity should be 1.235. Add distilled water as necessary to maintain the proper water level.

Battery Cables

These units use 0-gauge battery cables to ensure reliable starting in extremely cold weather. Make sure to use 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 optional battery charger replaces 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.

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 cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
2. Use the **GAUGES** key 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 BATT 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 2BC and GND 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

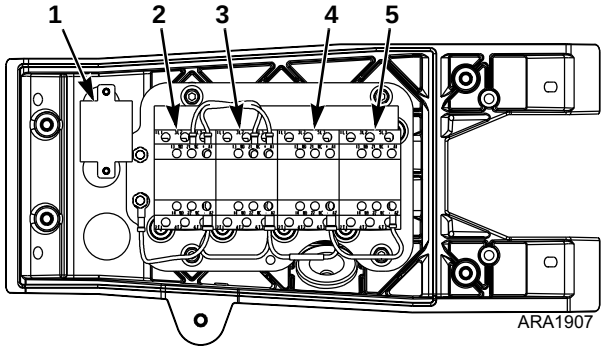
There are two condenser fans located near the top of the unit. Each condenser fan has its own electric motor and contactor, which allows the condenser fans to be controlled separately. The roadside condenser fan rotates counterclockwise when viewed from the top. It draws air through the roadside condenser coil and the radiator coil. It also draws air up through a cooling channel to cool the battery and optional battery charger. 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.

Test the condenser fans 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. Use the Service Test Mode to energize condenser fan you want to test. It should run at approximately 2700 rpm in the correct

direction with the engine running in high speed. If it does not run, go to the next step. If it runs backwards, go to "If Fan Runs Backwards" on page 82.

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, go to step 5. If not, go to the 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, go to the next step. If not, go to step 8.
5. Turn the unit off and check the connections in the junction box for the fan being tested to make sure 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, go 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 probably faulty.



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

Figure 152: Fan Control Box with Cover Removed

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

Make sure the unit is turned off. Check the unit wiring to make sure it is correct per the schematic and wiring diagrams on pages 171-183. 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. If the fan now runs correctly, it is probably wired incorrectly.

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 1770 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 1800 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 cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode. The evaporator fans should run at approximately 1800 rpm in the correct direction with the engine running in high speed.If it does not run, go to step 3. If it runs backwards, go to "If Fan Runs Backwards" on page 82.

2. Use the Service Test Mode to run the unit in low speed cool. The evaporator fans should run at approximately 1180 rpm with the EFLC contactor energized and the engine running in low speed. The evaporator fans should run at approximately 1770 rpm in the correct direction with the EFHC contactor energized and the engine running in low speed. If it does not run, go to step 7. If it runs backwards, go to “If Fan Runs Backwards” on page 82.
3. Check for AC voltage between the T1, T2, and T3 terminals on the fan harness side of the EFLC (low speed) contactor. Approximately 345 Vac should be present between each pair with engine running in high speed. If the voltage is acceptable, go to the next step. If not, go 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 10.4 ohms on each pair. If not, go 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 probably 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 (high speed) contactor. Approximately 230 Vac should be present between each pair with engine running in low speed. If the voltage is acceptable, go to the next step. If not, go 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 5.8 ohms on each pair. If not, go 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 probably 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 Fuses

A number of fuses, located on the base controller, protect various circuits and components. The base controller (see Figure 153) is located inside the control box. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for a complete list of the size and function of the fuses.

Fuses		
Fuse	**Size**	**Function**
F1	5A	2A Circuit for REB
F2	15A	Power to On/Off Switch
F3	40A	Fuel Solenoid/Starter Circuit
F4	None	No Fuse - Alternator Excite Circuit
F5	60A	Preheat Circuit
F6	15A	High Speed Solenoid Circuit
F7	2A	8X Circuit for T-Bus
F8	5A	2A Power to T-Bus Connector J12
F10	10A	On/Off Relay Circuit
F12	5A	2A Power to T-Bus Connector J13
F13	2A	Power to Remote Status Light
F20	2A	Alternator Sense Circuit
F22	10A	Fresh Air Door Circuit
F25	7.5A	HPCO Switch Circuit

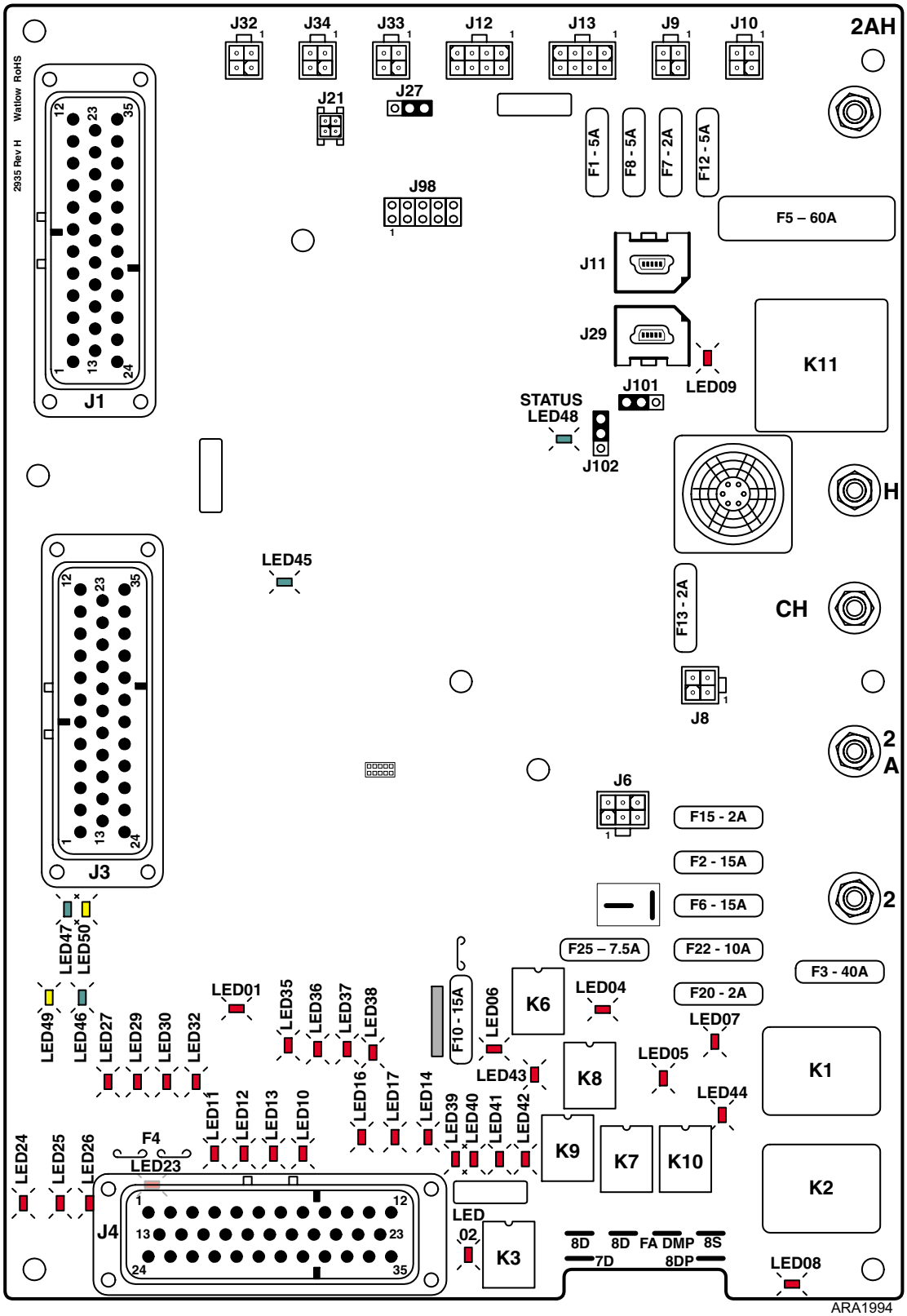


Figure 153: Base Controller

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.

Base Controller LED Functions	
LED #	**Function**
LED 2	K3 High Speed Circuit
LED 4	K8 Run Relay Circuit
LED 5	K7 Diesel/Electric Relay Circuit
LED 6	K6 On/Off Relay Circuit
LED 7	K1 Starter Relay Circuit
LED 8	K2 Fuel Solenoid Relay Circuit
LED 9	K11 Preheat Relay Circuit
LED 10	Pilot Solenoid Circuit
LED 11	Purge Valve/Liquid Injection Valve Circuits
LED 12	Hot Gas Bypass Valve Circuit
LED 13	Receiver Tank Pressure Solenoid Circuit
LED 14	Spare 1
LED 15	Spare 4
LED 16	Spare 3
LED 17	Spare 2
LED 23	Liquid Line Solenoid Circuit (MT)
LED 24	CIS/LV/Digital Scroll Circuits
LED 25	Suction Line Solenoid/Liquid Line Economizer Valve Circuits
LED 26	Alternator Excite Circuit
LED 27	EFL (Evaporator Fan Low) Circuit
LED 29	EFH (Evaporator Fan High) Circuit
LED 30	CFR (Condenser Fan Roadside) Circuit
LED 32	CFC (Condenser Fan Curbside) Circuit
LED 35	
LED 36	
LED 37	ECU (Engine Control Unit) Key Switch Circuit
LED 38	Battery Charger Enable Circuit
LED 39	
LED 40	
LED 41	
LED 42	
LED 43	K9 Electric Standby Motor Circuit
LED 44	K10 Auto Fresh Air Door Circuit
LED 45	
LED 46	ETV – D*
LED 47	ETV – B*

Base Controller LED Functions (Continued)	
LED #	**Function**
LED 48	Heart Beat
LED 49	ETV – A*
LED 50	ETV – C*
* Illuminated when the respective ETV output is energized. On applications without an ETV the ETV LED's 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 (see Figure 153) is located inside the control box. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for a complete list of the size and function of the relays.

Relays	
Relay	**Function**
K1	Starter Solenoid Relay
K2	Fuel Solenoid Pull-In Relay
K3	High Speed Relay
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	Preheat Relay

SMART REEFER 4 (SR-4) Microprocessor Controller

Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for complete service information about the Microprocessor Controller and the related components.

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 preformed to help diagnose a problem. A ServiceWatch download must be preformed before contacting the Thermo King Service Department for assistance in diagnosing a problem. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for information about downloading the ServiceWatch Data Logger and viewing the data.

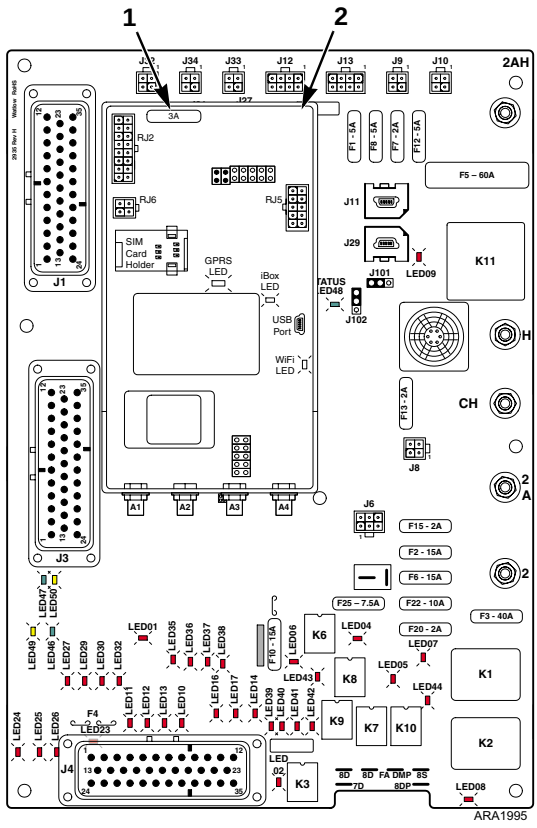
REB (Radio Expansion Board) Option

The REB (Radio Expansion Board) 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.



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

Figure 154: REB Mounted on Base Controller

The REB is a "daughter board" that mounts on the base controller as shown in Figure 154. 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.

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

There is a 40A fuse (FS8) that protects the 2 circuit to the relay and fuse assembly in the control box.

There is a 60A fuse (FS18) that protects the 2AH circuit to the base controller, which powers the 2AH circuit to the air heater through fuse F5.

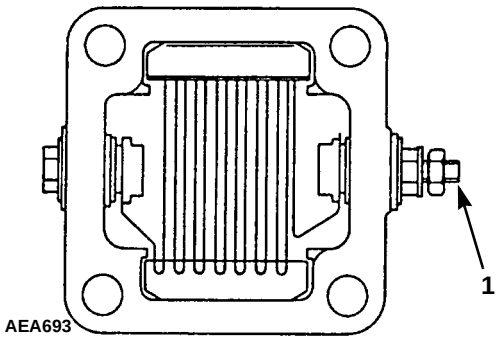
Air Heater

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

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

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

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



1.	M6 Terminal

Figure 155: Air Heater

Unit Wiring

Inspect the unit wiring and the wire harnesses during scheduled maintenance inspections for loose, chaffed 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

CAUTION: 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.

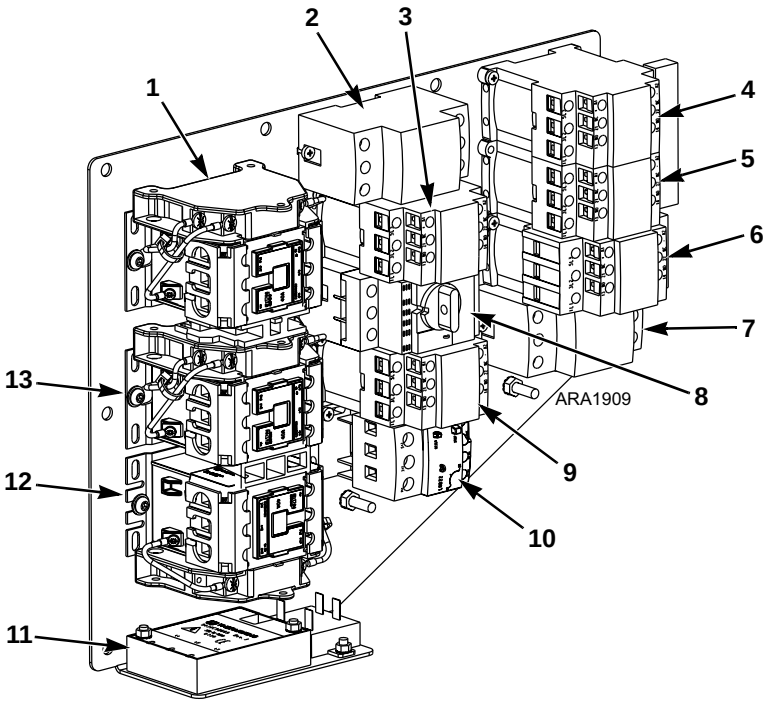
Electrical Contactors

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.

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.



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)		

Figure 156: High Voltage Box

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 3 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 TRC.

Battery Charger Contactor 2 – BC2

This contactor is energized while running in diesel operation and provides 3 phase Vac from the generator to the optional battery charger. This contactor is mechanically interlocked with BC1, and electrically interlocked with TRC and BC1.

Phase Contactor 1 – PC1

Provides non-corrected 3 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 3 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 3 phase power to the motor overload relay. This is electrically interlocked with 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 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 unit requires heat. This contactor is not interlocked with any other contactor.

Heater Overload Relay – OLH

Provides 3 phase to the Heater Contactor. This is not interlocked with any other contactors.

Fuse Block 1 – FB1

Main fuses for 3 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 156.
   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 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 make sure 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. Make sure that the unit is turned On, that Electric Standby has been selected in the Operator 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 make sure 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 evaporator heater should be approximately 122 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.

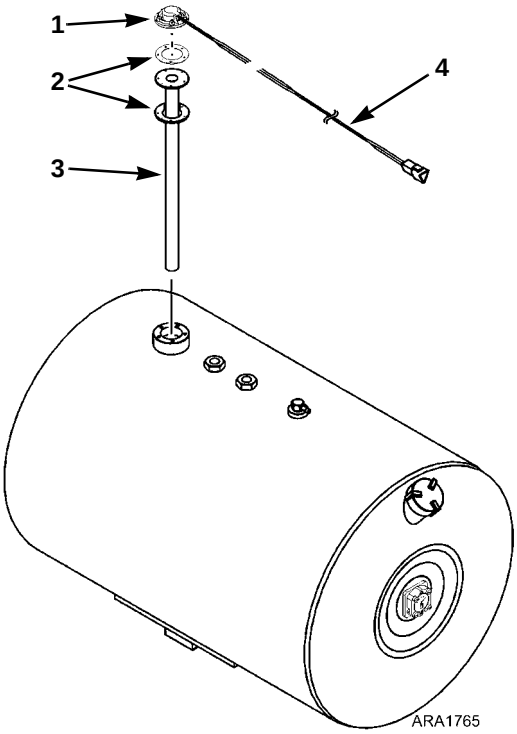
Test the transformer as follows:

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. Approximately 460 Vac should be present between each pair. 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. If the voltage is acceptable, go to the next step.
3. Check for AC voltage between the secondary terminals X1, X2, and X3 on transformer. 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.



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

Figure 157: Fuel Level Sensor

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** soft key 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 make sure 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 the for battery voltage (12 Vdc) between the 8F (J1-1 pin) and FUELN (J1-3 pin) wires in the main/unified 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 make sure 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 Single Temperature Systems Installation Manual TK 55496 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

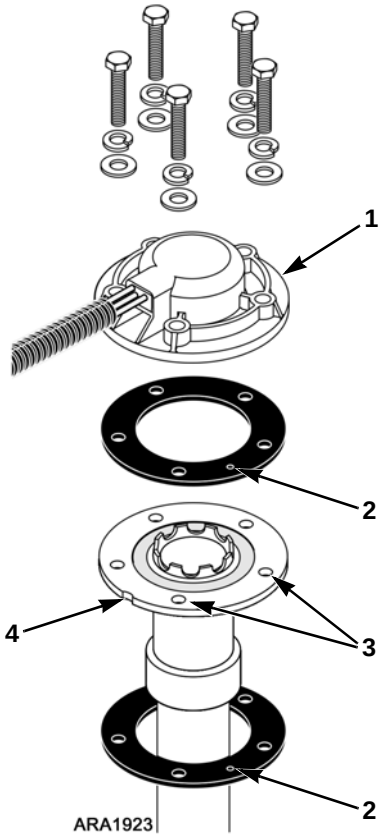
NOTE: This procedure covers replacing the sensor. For information about installing the USFLS Kit on a unit that does not already have a USFLS, see the Precedent Single Temperature Systems Installation Manual TK 55496 for more information.

- **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. Make sure to 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 make sure it is in good condition. Replace it 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 (see Figure 158) are further apart than the others. These two holes will be used as a reference point to correctly align the components.



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

Figure 158: USFLS Components

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, making sure the pin hole in the gasket is centered between the two mounting holes next to the notch as shown in Figure 158.

   b. While holding the lower gasket in place, place the upper gasket onto the sensor tube flange, again making sure the pin hole in the gasket is positioned between the two mounting holes next to the notch as shown in Figure 158.

   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 making sure 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.

   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).

   DO NOT overtighten the mounting hardware or damage to the plastic sensor will result.

   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 closed 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.

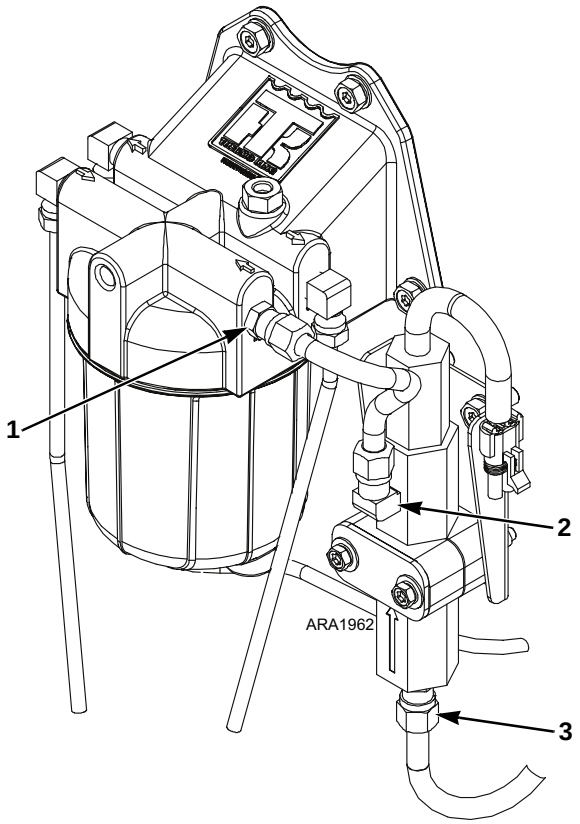
NOTE: The electric fuel heater does not function when the unit is in the Electric Mode (electric standby operation), the Null Mode, or during the non-running portion of the Pretrip Test.

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 in Figure 159. 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.



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

Figure 159: Electric Fuel Heater

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 7 in the J16 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.

   - If the resistance is acceptable, go to Step 3.
   - If the resistance is very high, indicating an open circuit, check the temperature of the electric fuel heater using a non-contact thermometer. The temperature of the electric fuel heater must be below 30 F (-1 C) to close the internal thermostat. 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 probably defective and should be replaced.
   - If the resistance is significantly less than 0.9 ohms, the heating element is probably 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. 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. 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. 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. Also check to make sure 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. If battery voltage is not present, check the continuity of 8FH-02 and 8FH-01 wires between the Fuel Heater Relay and pin 7 in the J16 connector on the base controller. Also check to make sure 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

TK486V25 Diesel Engine

This unit uses a new engine called the TK486V25. It is part of the TK486 family of engines, but it uses an electric fuel pump instead of a mechanical fuel transfer pump.

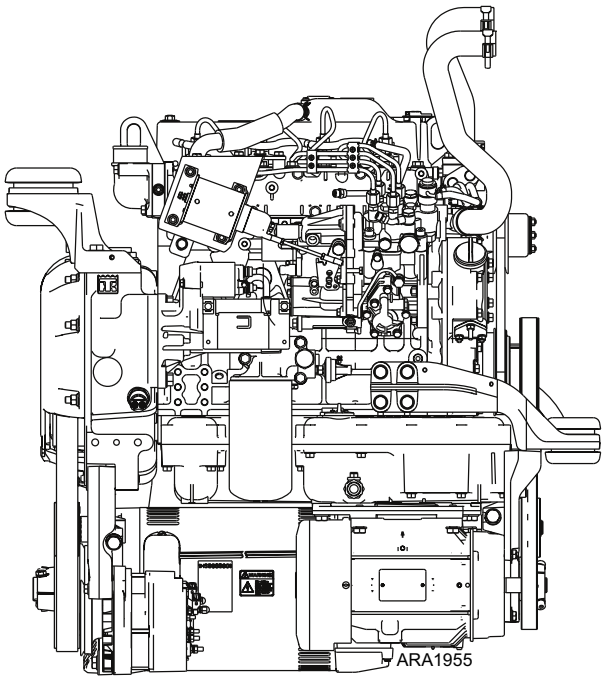


Figure 160: TK486V25

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 (black with gold lettering)
- API Rating CI-4 Mineral Oil (ACEA Rating E3 for Europe)
- Five Year or 12,000 Hour ELC (Extended Life Coolant).

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

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

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

Engine Lubrication System

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

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule. Drain the oil only when the engine is hot to ensure that all the oil drains out. When changing oil, keep unit and trailer level so all the oil can flow from the oil pan. 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. Refill the pan with 12 quarts (11.4 liters) and check the dipstick level. Run the unit, and then recheck the oil level. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into the oil pan. Never overfill. See Specifications Chapter for correct type of oil.

Oil Filter Change

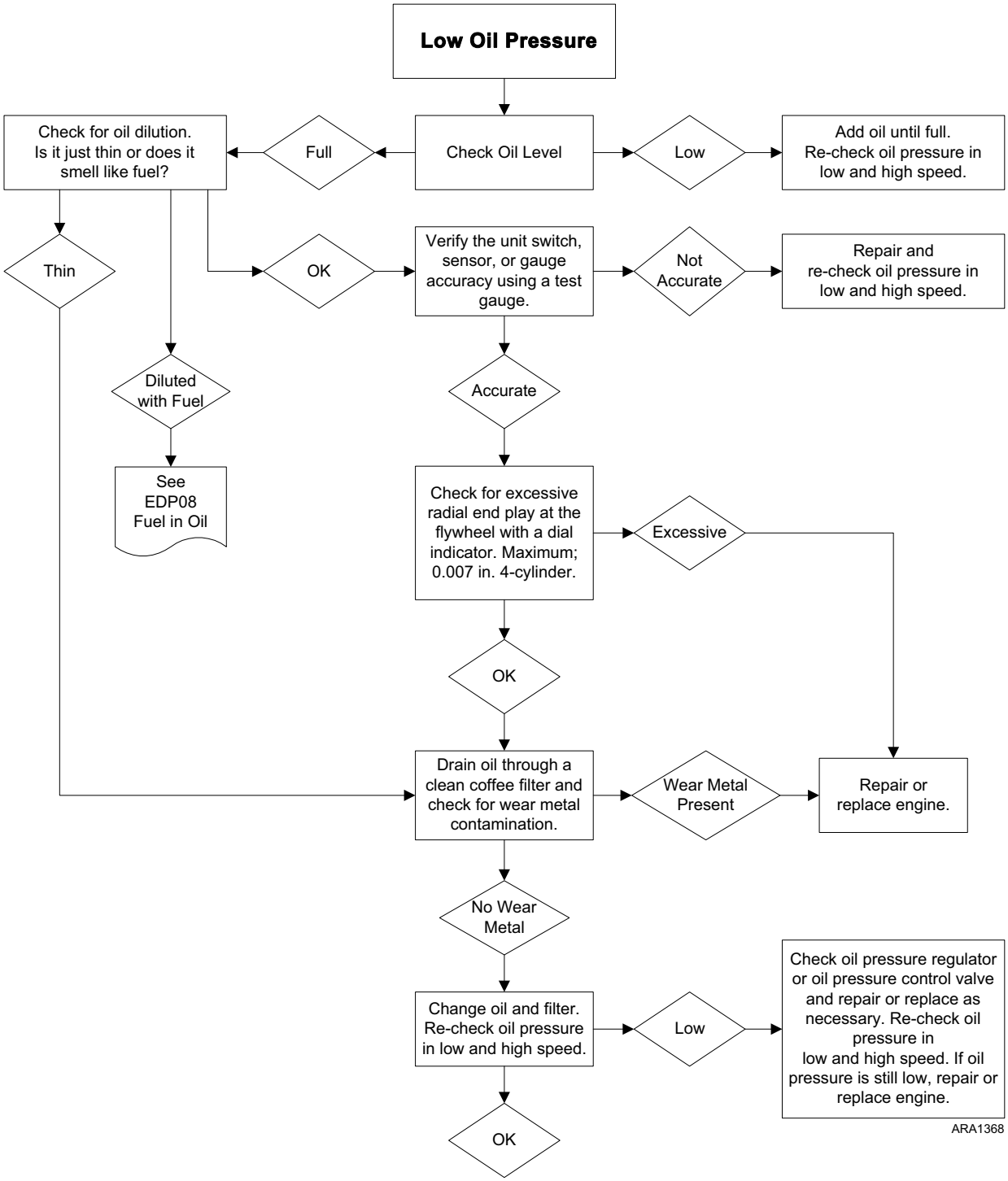
The oil filter should be changed along with the engine oil. Use a genuine Thermo King extended maintenance oil filter.

1. Remove the filter.
2. Apply oil to the rubber ring of the new filter and install the filter.
3. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.
4. 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” on the following page to help diagnose low oil pressure.

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.

ELC (Extended Life Coolant)

ELC is used in this unit. A nameplate near the coolant expansion tank identifies units with ELC.

NOTE: The new engine coolant, Texaco Extended Life Coolant, is RED in color instead of the current GREEN or BLUE-GREEN colored coolants.

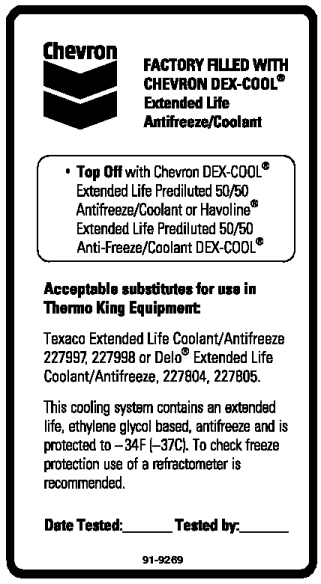


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Figure 161: ELC Nameplate Located Near Expansion Tank

The following are the Extended Life Coolants currently approved by Thermo King for use in ELC units for five years or 12,000 hours:

- Chevron Dex-Cool
- Texaco ELC (nitrite free)
- Havoline Dex-Cool (with nitrates)
- Havoline Dex-Cool (nitrite free)
- Shell Dexcool
- Shell Rotella
- Havoline XLC (Europe)
- Saturn/General Motors Dex-Cool
- Caterpillar ELC
- Detroit Diesel POWERCOOL Plus.

CAUTION: 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.

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 “ELC (Extended Life Coolant)” on page 98 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.
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 a, b, and c. Otherwise go to 3.

CAUTION: Avoid direct contact with hot coolant.

   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.
   c. Open the engine block drain to drain the water and flushing solution.

CAUTION: Avoid direct contact with hot coolant.

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 add 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 make sure to bleed the air from the cooling system as needed.

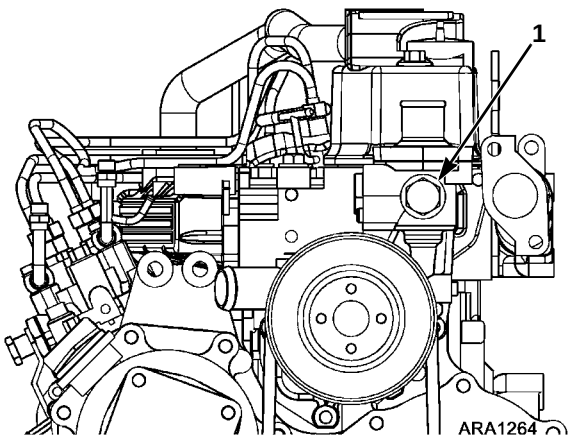
Bleeding Air from the Cooling System

Jiggle pin thermostats are original equipment on units that have TK486V25 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:

CAUTION: 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 in Figure 162.
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.



1.	Plug

Figure 162: Remove Plug from Water Pump

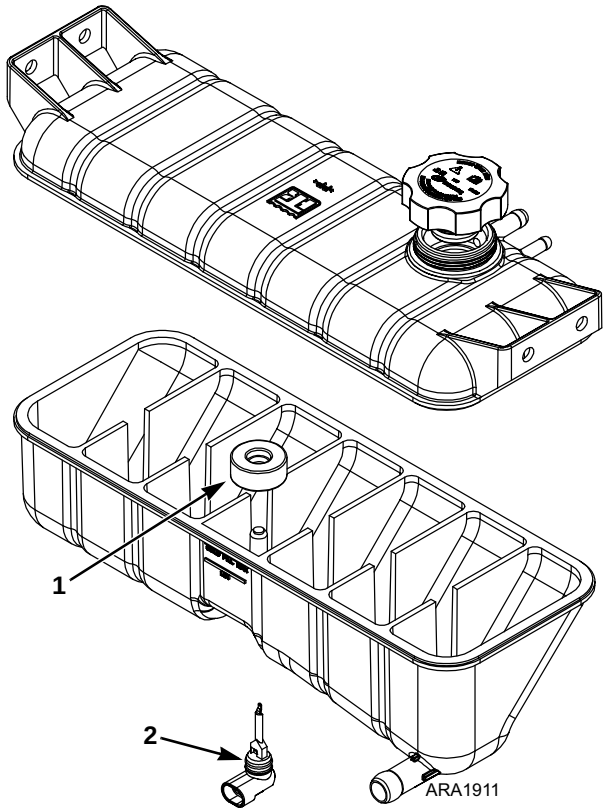
5. Make sure that the amount of coolant that goes back into the system is approximately equal to the amount of coolant that came out of the system.
6. Start the engine. Monitor the coolant temperature with the unit engine coolant temperature gauge, or by using a non-contact thermometer pointed at the thermostat housing in the location of the high water temperature switch or sensor. When the temperature reaches 150 F (66 C), shut the engine off for 2 minutes. 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. 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.



1.	Float
2.	Coolant Level Switch

Figure 163: Plastic Expansion Tank

NOTE: Figure 163 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

You can test the switch in the unit by adjusting the coolant level. You can also remove the expansion tank from the unit and test the switch by flipping the expansion 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. Make sure the coolant level is above the switch and check the continuity of the switch. The switch should be closed. If you removed the tank from the unit, do 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 you removed the tank from the unit, do 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. Make sure 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.

Engine Fuel System

TK486V25 engines use a mono-plunger and distributor injection pump.

The components of the fuel system are:

- Fuel tank
- Electric fuel pump (with prefilter)
- Fuel filter/water separator
- Injection pump
- Trochoid feed pump
- 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 injection pump.

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

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

Fuel Line Routing

The fuel lines from the fuel tank connect to the fittings on the fuel filter. Do not change the factory routing of the fuel lines from the fuel filter to the high pressure fuel pump. See the fuel line routing diagrams in the Diagrams Chapter.

Maintenance

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

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

IMPORTANT: Do not open the fuel system unless required.

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

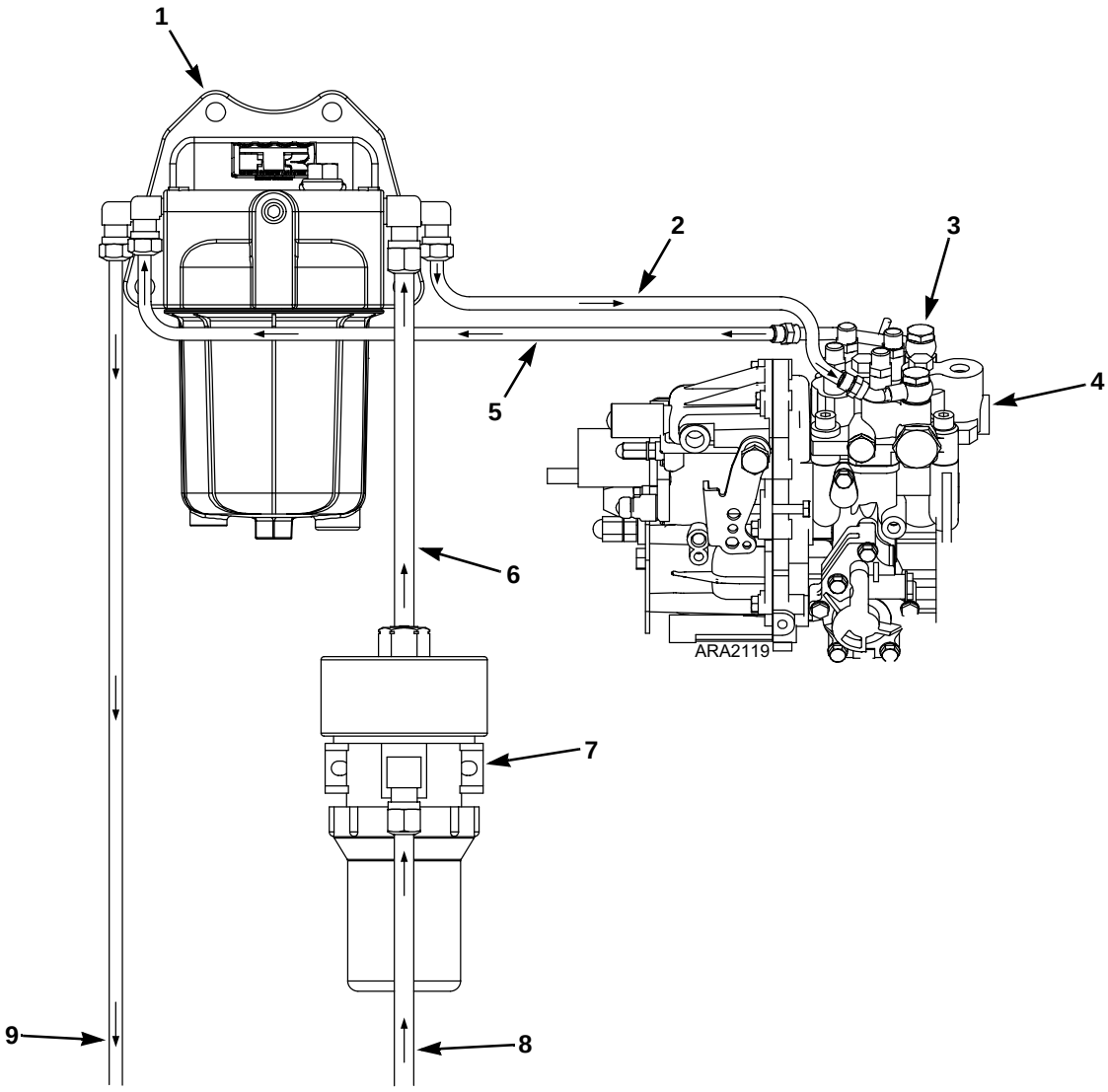
Whenever the fuel system is opened, take the following precautions to prevent dirt from entering the system:

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

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

The following procedures can be done under field conditions:

1. Bleeding air from the fuel system.
2. Fuel tank and filter system maintenance.
3. Electric fuel pump replacement or repair.
4. Injection line replacement.
5. Engine speed adjustments.
6. Injection pump timing.
7. Nozzle spray pattern testing and adjustment.
8. Injection nozzle testing, adjustment, and minor repair.
9. Trochoid feed pump replacement.



1.	Fuel Filter/Water Separator	6.	Feed Line (From Fuel Pump to Fuel Filter)
2.	Feed Line (From Fuel Filter to Injection Pump)	7.	Electric Fuel Pump (With Prefilter)
3.	Injection Pump Return Line Fitting (Bleed Screw	8.	Inlet Line (From Fuel Tank)
4.	Mono-plunger and Distributor Injection Pump	9.	Return Line (To Fuel Tank)
5.	Return Line (From Injection Pump to Fuel Filter)		

Figure 164: Fuel System

Fuel Return Line Replacement

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

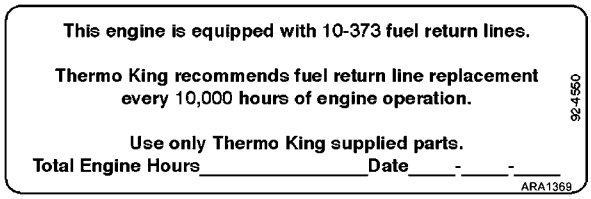
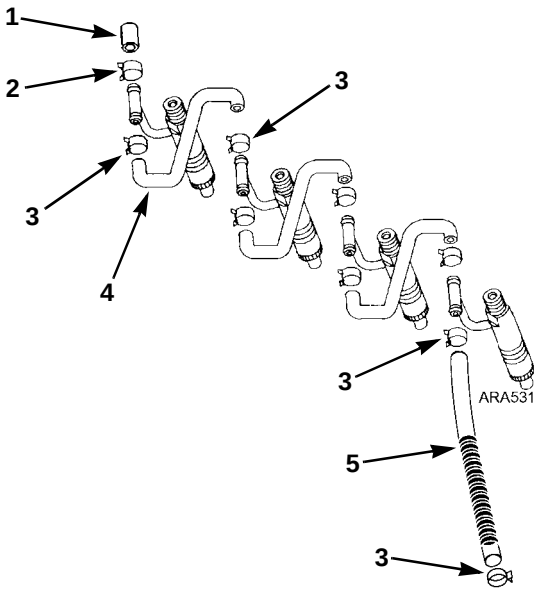


Figure 165: Fuel Return Line Replacement Decal

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

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



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

Figure 166: Fuel Return Line Replacement

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

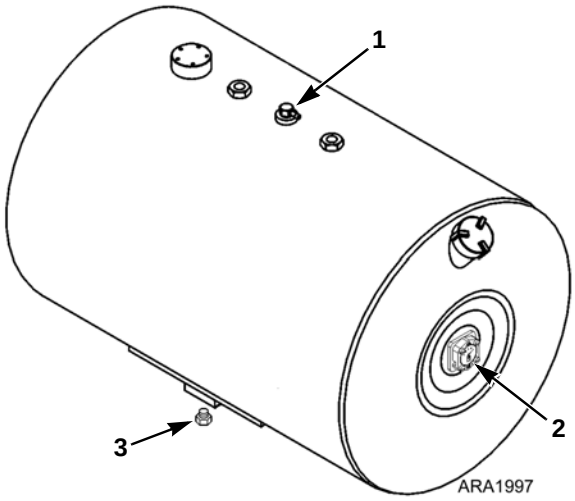
Bleeding the Fuel System

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

To bleed air from the fuel system:

1. Turn the unit on and use the Output Test Mode to energize the Run Relay, which energizes the electric fuel pump. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
2. Loosen the injection pump return line fitting at the injection pump and run the electric fuel pump until fuel is present at the injection pump return line fitting.
3. Tighten the injection pump return line fitting and exit the Output Test Mode.
4. Loosen the injection lines at the injection nozzles.
5. Crank the engine until fuel appears at the nozzles.
6. Tighten the injection lines.
7. Start the engine and observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure.

NOTE: MAKE SURE the fuel tank vent is kept open. If the vent becomes clogged, a partial vacuum develops in the tank, and this increases the tendency for air to enter the system.



1.	Vent
2.	Fuel Gauge
3.	Drain Plug

Figure 167: Fuel Tank

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 off during scheduled maintenance inspections to prevent breakdowns. Drain the water off 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 screw driver 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. 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.

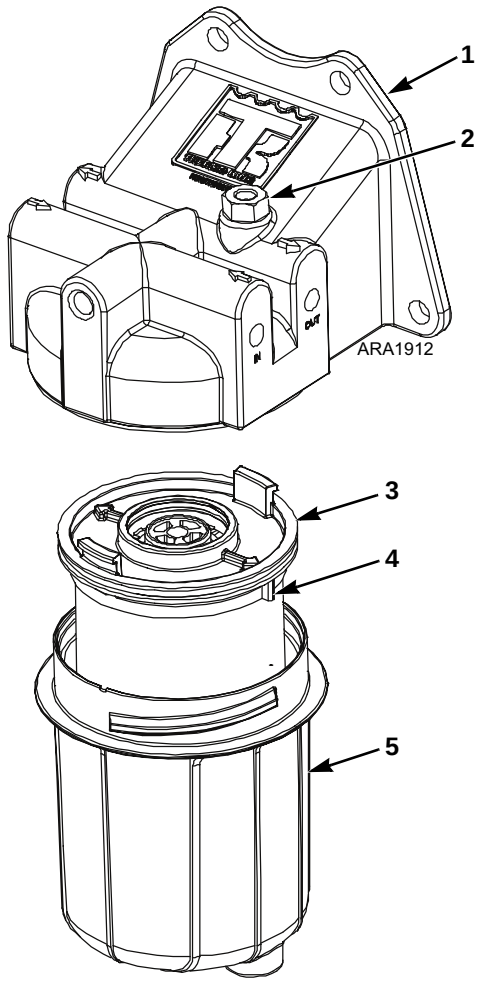
Fuel Filter/Water Separator

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. Drain the fuel from the filter bowl and dispose of the filter element properly.
2. Clean the filter bowl and the filter head.



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

Figure 168: Fuel Filter/Water Separator Assembly

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 the arrows) on the filter element aligned with the slots (and the arrows) in the filter bowl. Make sure that 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 the Output Test Mode to energize the Run Relay, which energizes the electric fuel pump. Refer to the appropriate Diagnostic Manual for specific information about the Service 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 make sure there are no leaks.
11. Exit the Output Test Mode to de-energize the the Run Relay and 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 the procedure steps 7 through 12.

Electric Fuel Pump

The electric fuel pump should be mounted behind the fuel tank to protect it from road debris. The electric fuel pump should be located far enough back to allow fuel filter bowl removal and service.

Operation

The electric fuel pump must be mounted next to the fuel tank. This pump is designed to push fuel rather than pull fuel.

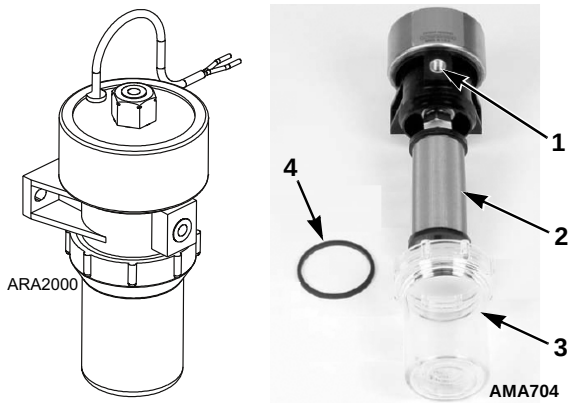
Make sure the CHFP/black wire completes a good ground with the battery. Check the voltage at the 8DF/red wire in the harness. The pump will not operate at less than 9 Vdc. The pump is self priming as long as it is not higher than 30 in. (762 mm) from the fuel in the fuel tank.

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.



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

Figure 169: Electric Fuel Pump

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)” on page 93 for information about the electric fuel heater.

Engine Speed Adjustments

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

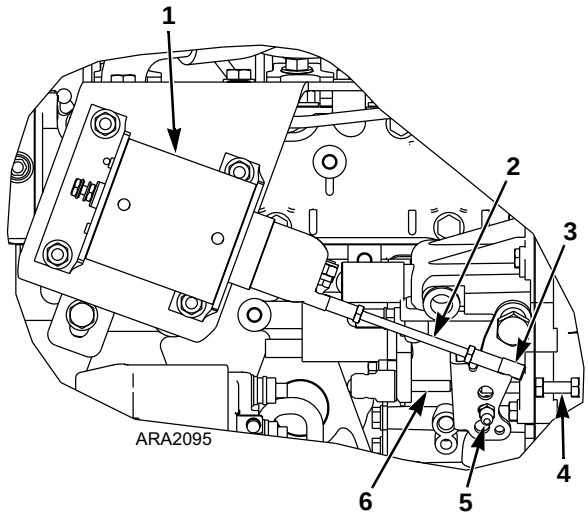
1. Check the fuel filter in the electric fuel pump. Check the speed.
2. Bleed the air out of the fuel system. Check the speed.
3. Bleed the air out of the nozzles. Check the speed.

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

High Speed

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

1. Shut the unit off.
2. Remove the ball socket from the throttle bracket ball (see Figure 170).
3. Energize the throttle solenoid by using the Output Test Mode to energize the high speed solenoid while the engine is not running.
4. Adjust the ball socket on the end of the linkage rod as necessary to make it align with the throttle bracket ball with the throttle bracket held tight against the high speed stop screw.
5. If alignment is not possible or there is a slight gap between the high speed stop screw and throttle bracket, de-energize the solenoid and shorten the linkage by threading the ball socket in up to one turn. Reassemble and energize the solenoid. Verify that the throttle bracket is tight against the high speed stop screw.



1.	High Speed Solenoid
3.	Ball Joint
4.	Linkage Rod
5.	Low Speed Adjustment Screw
6.	High Speed Stop Screw

Figure 170: Engine Speed Adjustments

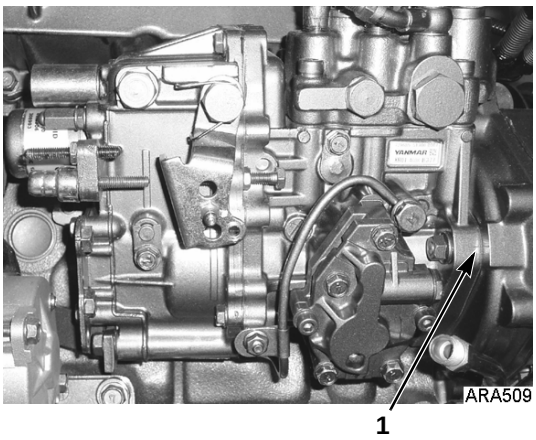
Low Speed

1. Loosen the jam nut on the low speed adjustment screw (see Figure 170).
2. Use the Service Test Mode to run the unit in low speed. Adjust the screw to obtain the correct speed. It should be 1450 ± 25 rpm with a full load.
3. Tighten the jam nut and recheck the speed.

Injection Pump Timing

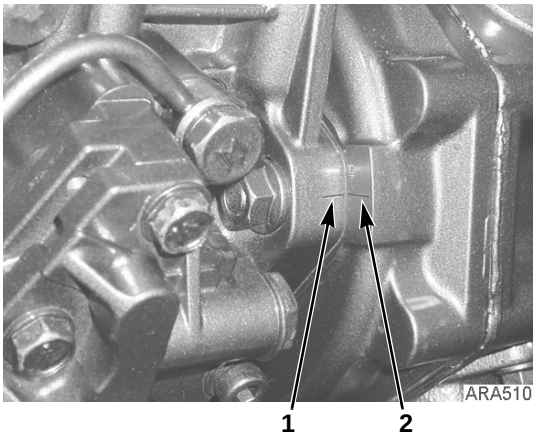
Use this timing procedure when installing a new injection pump. It is not necessary to use this timing procedure when removing and reinstalling the original injection pump. In that case, align the index marks on the injection pump and the gear case as they were before removing the injection pump.

1. Before removing the old injection pump, note the alignment of the index marks on the injection pump and the gear case. The index mark on the injection pump is usually aligned with the index mark on the gear case. If not, make a mark on gear case in line with the index mark on the injection pump (see Figure 173).



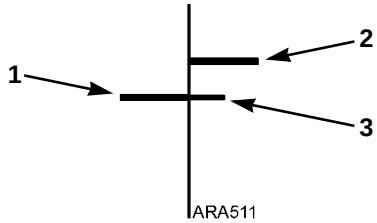
1.	Index Marks

Figure 171: Index Mark Location



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

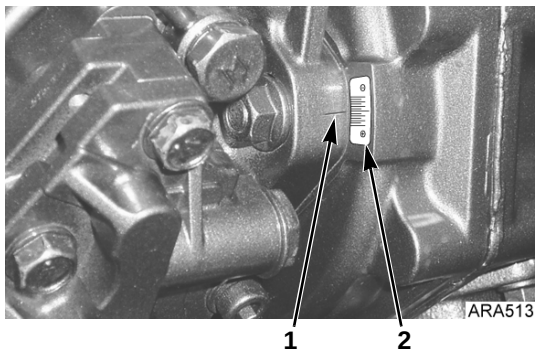
Figure 172: Index Mark Alignment



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

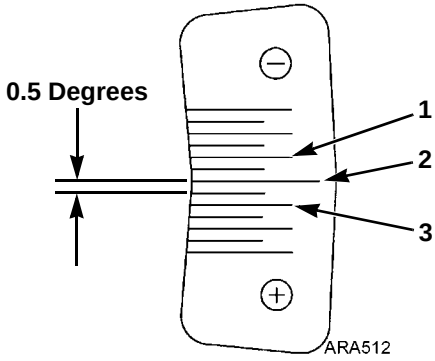
Figure 173: Marking Gear Case

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



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

Figure 174: Place Injection Angle Sticker on Gear Case

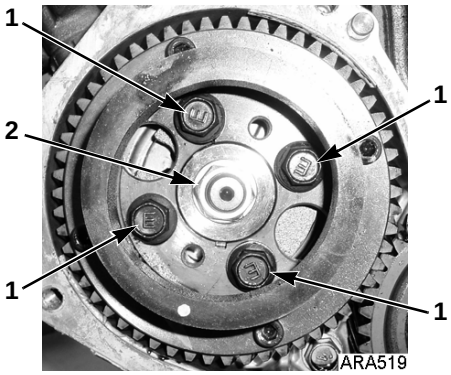


1.	–1.0 Degrees Mark
2.	Center Line (0 Degrees Mark)
3.	+1.0 Degrees Mark

Figure 175: Injection Angle Sticker

3. Remove the old injection pump. Use the injection pump gear tool P/N 204-1011 to remove the injection pump gear without removing the timing gear cover (see “Injection Pump Removal” on page 111).

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

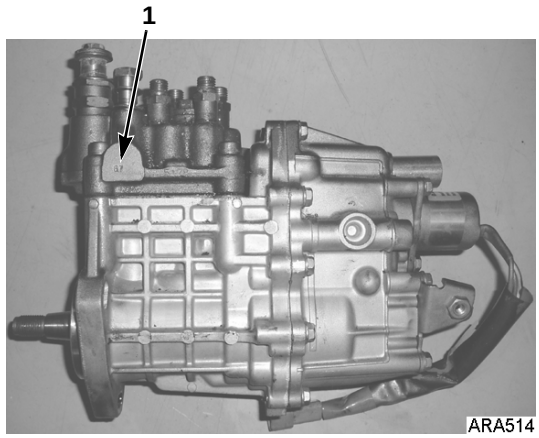


1.	Do Not Loosen or Remove These Four Bolts
2.	Remove Nut and Lock Washer

Figure 176: Removing Injection Pump Gear

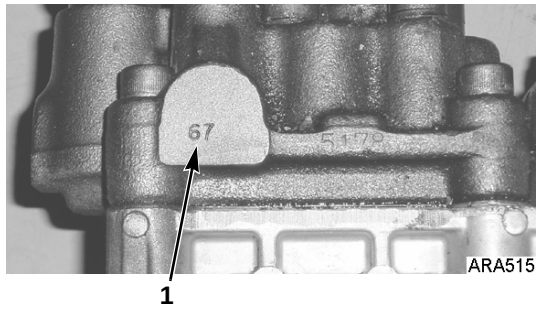
4. Record the injection angle marked on the old injection pump (see the following photographs). The injection angle mark is located on the side of the pump facing the engine. The injection angle mark on the pump does not use a decimal point. Add a decimal point before the last digit of the injection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

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



1.	Injection Angle Mark

Figure 177: Injection Angle Mark Location



1.	Injection Angle Mark

Figure 178: Injection Angle Mark

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

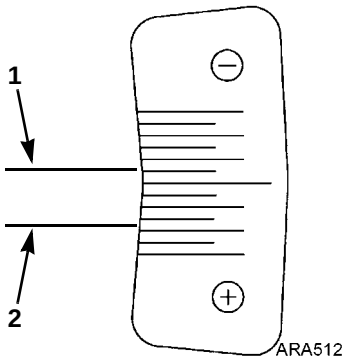
1.	Injection Pump Serial Number

Figure 179: Injection Pump Serial Number Location

5. Record the injection angle marked on the side of the new injection pump.
6. Calculate the injection angle difference by subtracting the injection angle of the old injection pump from the injection angle of the new injection pump.

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

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

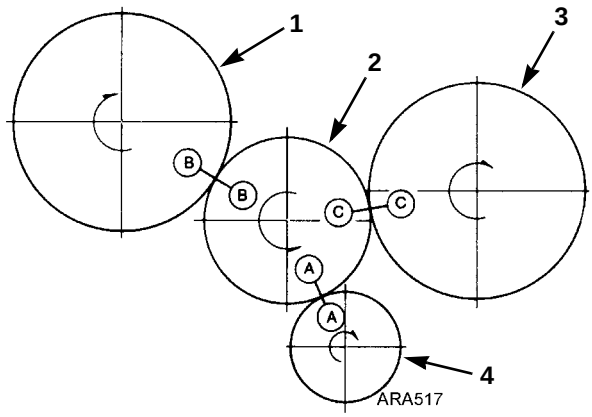


1.	Injection Pump Index Mark at –0.6 Degrees
2.	Injection Pump Index Mark at +1.8 Degrees

Figure 180: Examples of Injection Pump Index Mark Alignment with Injection Angle Sticker

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

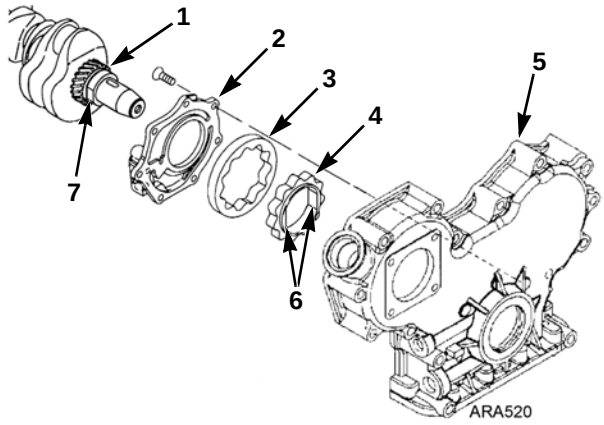
NOTE: If the timing gear cover was removed to remove the injection pump gear, make sure the timing marks on the timing gears are aligned as shown below. It helps to install the idler gear last when aligning the timing marks.



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

Figure 181: Timing Mark Alignment

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



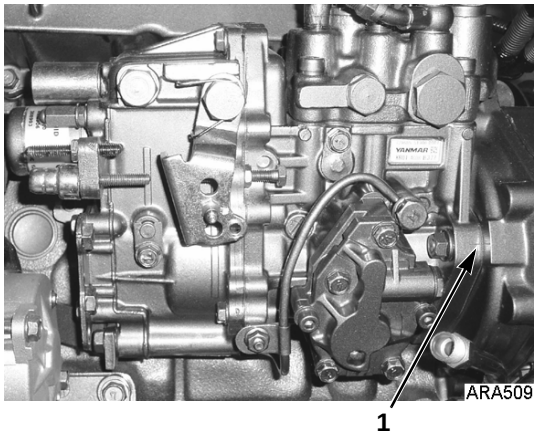
1.	Crankshaft Gear
2.	Oil Pump Cover
3.	Outer Rotor
4.	Inner Rotor
5.	Timing Gear Cover
6.	Flat Sides on Inner Rotor
7.	Flat Side on Crankshaft Gear

Figure 182: Align Flat Sides of Crankshaft Gear with Flat Sides of Inner Rotor in Timing Gear Cover

Injection Pump Removal

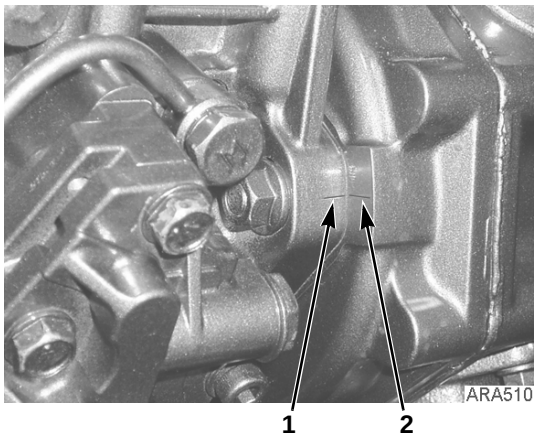
The injection pump drive gear will not fit through the gear housing when removing the pump, the gear must be separated from the pump. Using tool P/N 204-1011, it will not be necessary to remove the belts, crankshaft pulley, crankshaft seal or front plate. See Figure 185 “Injection Pump Gear Tool” on page 112.

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



1.	Index Marks

Figure 183: Index Mark Location

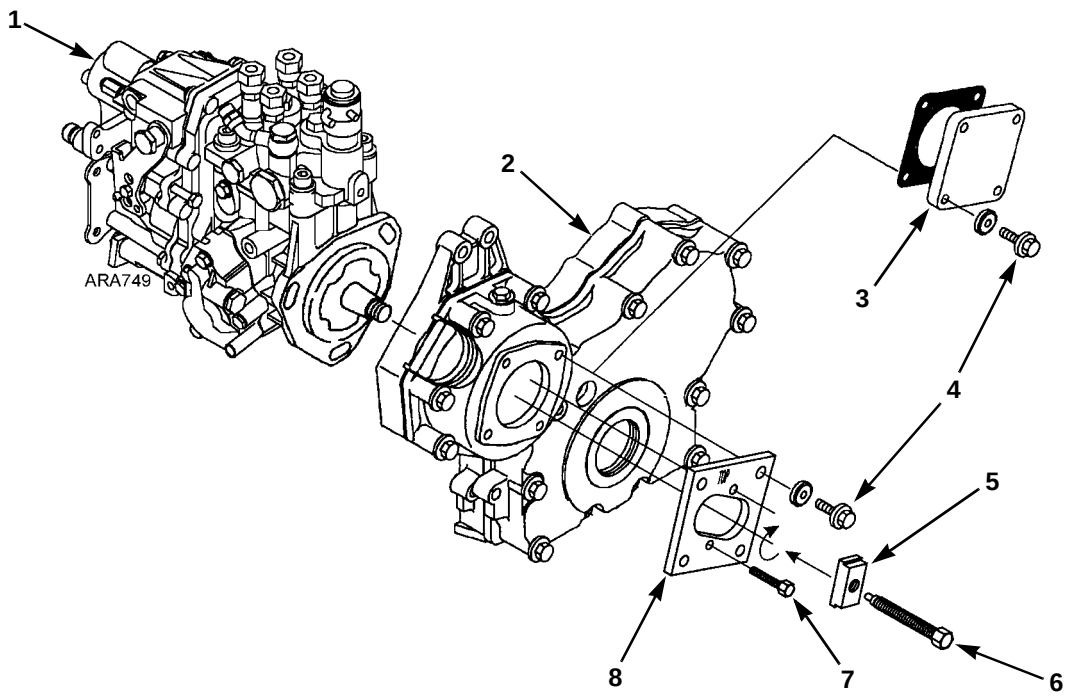


1.	Index Mark on Injection Pump
2.	Index Mark on Gear Case

Figure 184: Index Mark Alignment

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

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



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

Figure 185: Injection Pump Gear Tool

Injection Pump Reinstallation

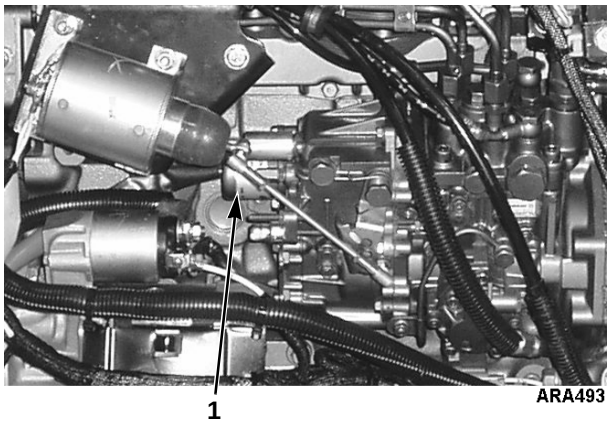
1. Position injection pump shaft into gear, rotating shaft to mate key with keyway in gear. Take care to make sure the key mates with the keyway.
2. Secure injection pump to gear case with previously removed hardware. Make sure to align the index marks on the injection pump and the gear case like they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

   NOTE: If a different injection pump is being installed, see “Injection Pump Timing” on page 108 to set the timing.
3. Remove hardware holding gear to tool plate, then remove tool plate.
4. Secure the gear to the injection pump shaft with the lock washer and nut. Use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 58 to 65 ft-lb (78 to 88 N•m).
5. Fasten cover plate to gear case and reinstall all components removed previously to facilitate injection pump removal.

Fuel Solenoid

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

The pull-in coil must be energized to move the injection pump governor linkage to the fuel on position. Once the injection pump governor linkage has been moved to the fuel on position, the hold-in coil will keep it in fuel on position until the 8D circuit is de-energized. The pull-in coil must be de-energized after a few seconds to keep it from being damaged. The pull-in coil is controlled by the microprocessor through the fuel solenoid pull in relay (K2).



1.	Fuel Solenoid

Figure 186: Fuel Solenoid Location

Testing the Fuel Solenoid

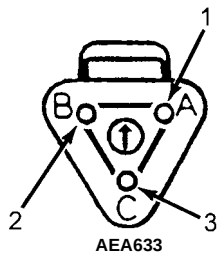
NOTE: The fuel solenoid pull-in coil will require 35 to 45 amps to turn on the fuel. The unit's battery must be in good condition. If the battery has enough power to crank the engine over, it has enough power to energize the fuel solenoid pull-in coil.

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

1. Use the microprocessor keypad to enter the Output Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Output Test Mode.
2. Energize the run relay with the Output Test Mode. The fuel solenoid pull-in relay (K2) is momentarily energized when the run relay is energized with the Output Test Mode. This energizes the fuel solenoid, which makes a definite click when energized.
3. De-energize the run relay with the Output Test Mode. This de-energizes the fuel solenoid, which makes a definite click when de-energized.
4. Repeat steps 2 and 3 a few times to check the operation of the fuel solenoid.

NOTE: The fuel solenoid may be removed from the injection pump to visually check its operation. The fuel solenoid must be energized when it is re-installed in the injection pump. If it is not, the plunger and the linkage may not line up correctly and the fuel solenoid will not function properly.

5. If the fuel solenoid is not operating properly, check the run relay (K8), the fuel solenoid pull in relay (K2), their fuses, and the associated circuits. If the relays, fuses and circuits are acceptable, use steps 6 through 9 to isolate and check the fuel solenoid.
6. Disconnect the fuel solenoid wire connector from the main wire harness.



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

Figure 187: Fuel Solenoid Connector Pin Identification

7. Place a jumper wire between the black wire (CHF—pin C) in the fuel solenoid connector and a good chassis ground.
8. Test the pull-in coil by momentarily placing a jumper between the white wire (8DP—pin B) in the fuel solenoid connector and the positive battery terminal. The fuel solenoid should make a definite click when the pull-in coil is energized and should click again when the pull-in coil is de-energized.

   NOTE: The pull-in coil will draw 35 to 45 amps so do not leave the jumper connected to the white wire (8DP—pin B) for more than a few seconds.

   a. If the pull-in coil does not energize, check the resistance of the pull-in coil by placing an ohmmeter between the white wire (8DP—pin B) and the black wire (CHF—pin C) in the fuel solenoid connector. The

resistance of the pull-in coil should be 0.2 to 0.3 ohms. If the resistance of the pull-in coil is not in this range, replace the fuel solenoid.

b. If the pull-in coil does energize, go to step 9.

9. Test the hold-in coil.

a. Energize the hold-in coil by placing a jumper between the red wire (8D—pin A) in the fuel solenoid connector and the positive battery terminal.

b. Momentarily energize the pull-in coil by placing a jumper between the white wire (8DP—pin B) in the fuel solenoid connector and the positive battery terminal. The fuel solenoid should make a definite click when the pull-in coil is energized, but should not click when the pull-in coil is de-energized.

c. De-energize the hold-in coil by removing the jumper from the red wire (8D—pin A) and the positive battery terminal. The fuel solenoid should make a definite click when the hold-in coil is de-energized.

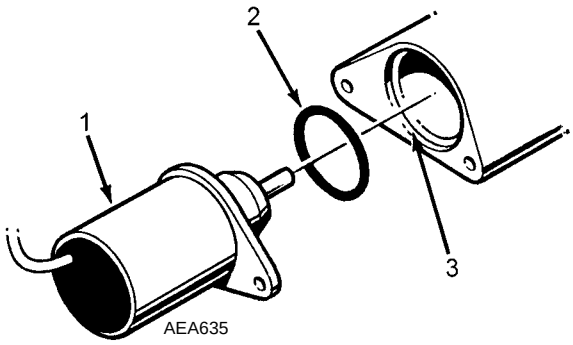
d. If the hold-in coil does not function properly, check the resistance of the hold-in coil by placing an ohmmeter between the red wire (8D—pin A) and the black wire (CHF—pin C) in the fuel solenoid connector. The resistance of the hold-in coil should be 24 to 29 ohms. If the resistance of the hold-in coil is not in this range, replace the fuel solenoid.

Fuel Solenoid Replacement

1. Disconnect the fuel solenoid wire connector from the main/unified wire harness and remove the old fuel solenoid.
2. Connect the new fuel solenoid wire connector to the main wire harness.
3. Press the **ON** key to turn the unit on.
4. Use the microprocessor keypad to enter the Output Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Output Test Mode.
5. Energize the fuel solenoid by energizing the run relay with the Output Test Mode.

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

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



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

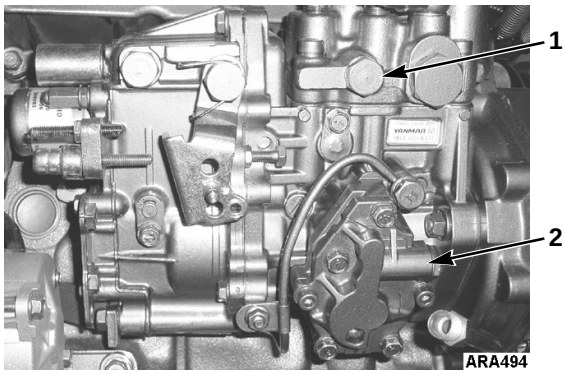
Figure 188: Fuel Solenoid Components

7. Install the new fuel solenoid.
8. Press the **OFF** key to turn the unit off after installing the fuel solenoid.

Trochoid Feed Pump

The TK486V25 engine has a trochoid feed pump on the fuel injection pump. The trochoid feed pump supplies fuel to the injection pump at a pressure of 65 to 87 psi (450 to 600 kPa). Check the outlet pressure of the trochoid feed pump by removing the plug and attaching a pressure gauge to the port shown in Figure 189. The plug has M12x1.25 threads. You will have to make an adaptor to attach a pressure gauge. Replace the trochoid feed pump if the outlet pressure is below the pressure specifications in the following table.

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



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

Figure 189: Trochoid Feed Pump Location

Trochoid Feed Pump Leaks

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

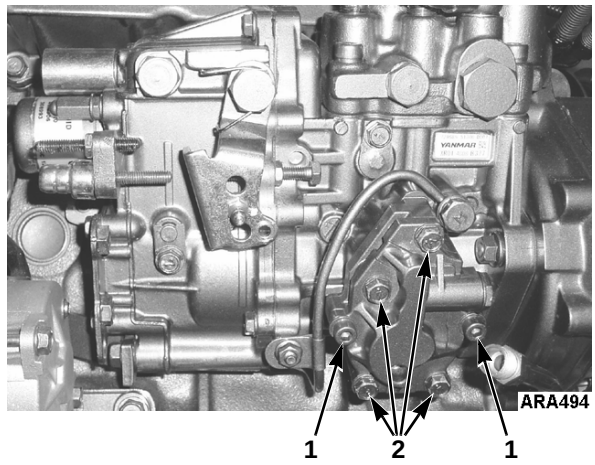
External – Replace the O-ring seal between the trochoid feed pump and the injection pump if oil is leaking. Torque the bolts to prevent leaks (6 to 7 ft-lb [8 to 10 N•m]).

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

Trochoid Feed Pump Replacement

Use the following procedure to replace the trochoid feed pump.

1. Remove the four hex head screws that attach the trochoid feed pump to the injection pump (see Figure 190). Do not remove the two Allen head screws.



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

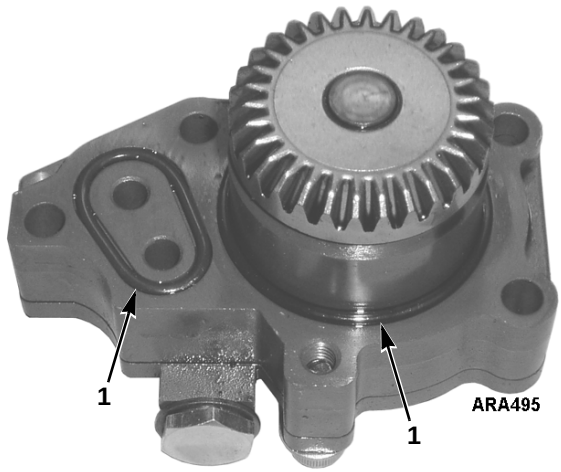
Figure 190: Trochoid Feed Pump Removal

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

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

3. Clean the area on the injection pump from which the trochoid feed pump was removed.

4. Place new O-rings on the new trochoid feed pump and make sure it is clean.



1.	O-Rings

Figure 191: Trochoid Feed Pump

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

Cold Start Device

The TK486V25 engine has a cold start device located on the fuel injection pump. The cold start device has a plunger that retracts at engine coolant temperatures below 41 F (5 C) to advance the injection timing approximately 2 degrees. The plunger controls the position of a piston in the injection pump to change the timing. The plunger is extended and the injection timing is normal at engine coolant temperatures above 41 F (5 C). Check the operation of the cold start device if it is difficult to start the engine in cold weather.

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

1.	Plunger (Extended)

Figure 192: Cold Start Device

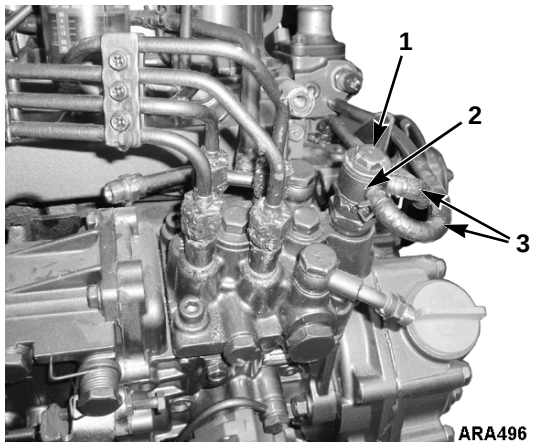
Checking Cold Start Device Operation

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

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

Cold Start Device Replacement

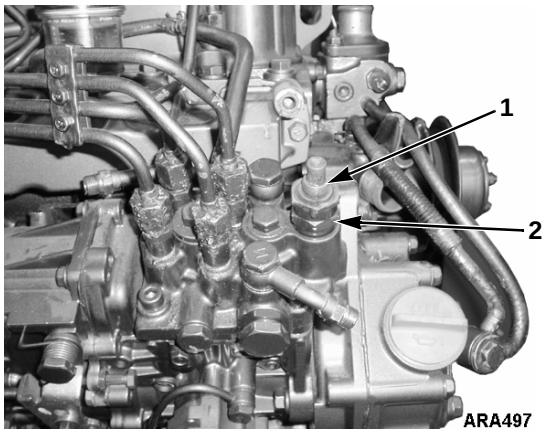
1. Drain the engine coolant.
2. Remove the banjo bolt that fastens the engine coolant fitting to the cold start device. Use a backup wrench on the cold start device if necessary.



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

Figure 193: Remove Engine Coolant Fitting

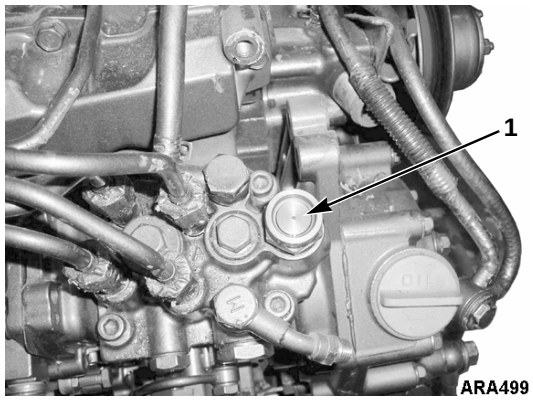
3. Remove the cold start device from the injection pump fitting. Use a backup wrench on the injection pump fitting if necessary.



1.	Cold Start Device
2.	Injection Pump Fitting

Figure 194: Remove Cold Start Device

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



1.	Piston

Figure 195: Clean Piston

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

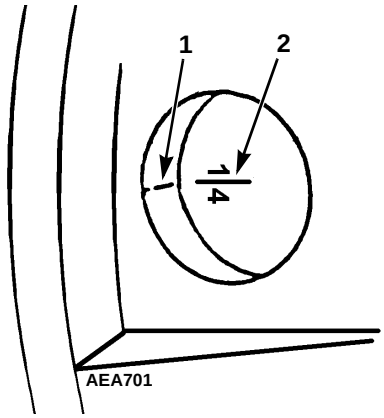
Engine Valve Clearance Adjustment

The valve clearance should be adjusted every 3.000 hours.

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

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

3. Place the engine at top dead center of the compression stroke for the number one cylinder. See steps a through d.



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

Figure 196: Top Dead Center One and Four

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.

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).

   NOTE: Check to make sure 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.

6. Hold the adjustment screw in place and tighten the locknut.

AEA705

Figure 197: Adjusting the Valve Clearance

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.

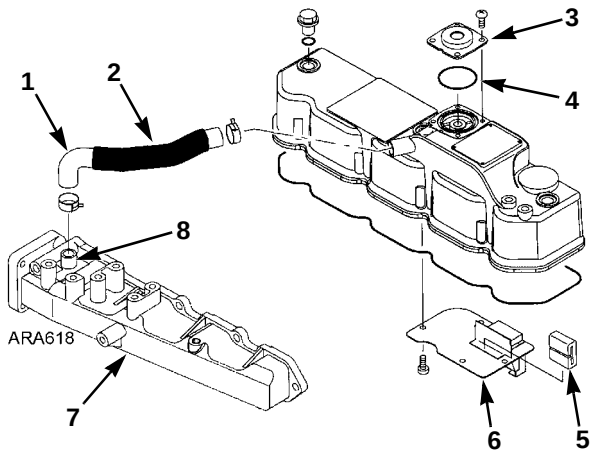
10. Replace the rocker arm cover, the cover for the timing mark access hole, and tighten the fuel injection lines when finished.

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.



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

Figure 198: Crankcase 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 make sure they are not plugged or damaged. Inspect the insulation to make sure it is in place and undamaged. The insulation is used to prevent freezing in cold weather.

The following items can effect 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.

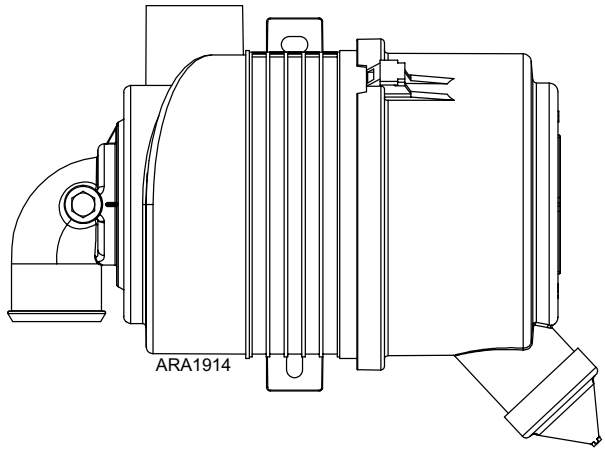


Figure 199: EMI 3000 Air Cleaner Assembly

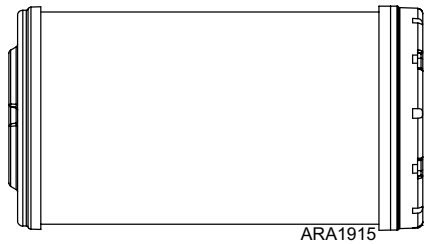


Figure 200: EMI 3000 Air Filter Element

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: 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.

CAUTION: Do not attempt to adjust belts with the unit running.

CAUTION: Turn the unit off before performing maintenance or repair procedures. When the unit is turned on, it can start at any time without warning.

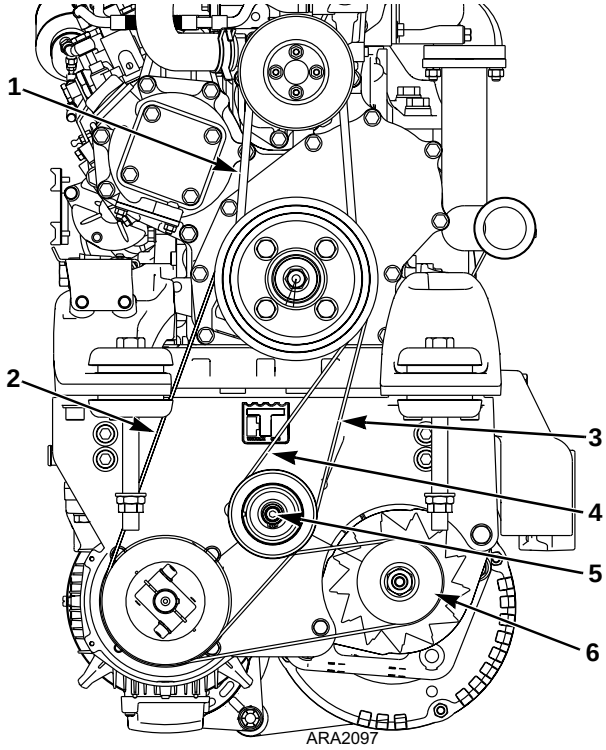
AC Generator Belt

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.

AC Generator Belt Adjustment

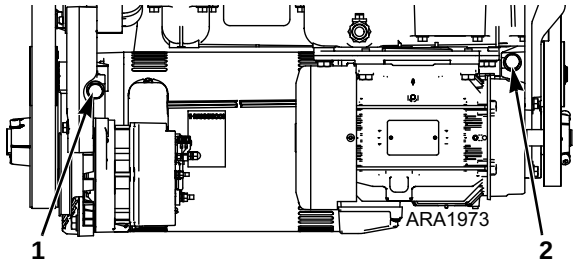
See “Belt Tension” on page 16 in the “Specifications” chapter for the correct AC generator belt tension settings.

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.



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 201: Water Pump Belt and AC Generator Belt (Shown Both With and Without Alternator)



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

Figure 202: Idler Adjuster Locations - Front View

AC Generator 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.

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. Make sure 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” on page 16 in the “Specifications” chapter for the correct water pump belt tension settings.

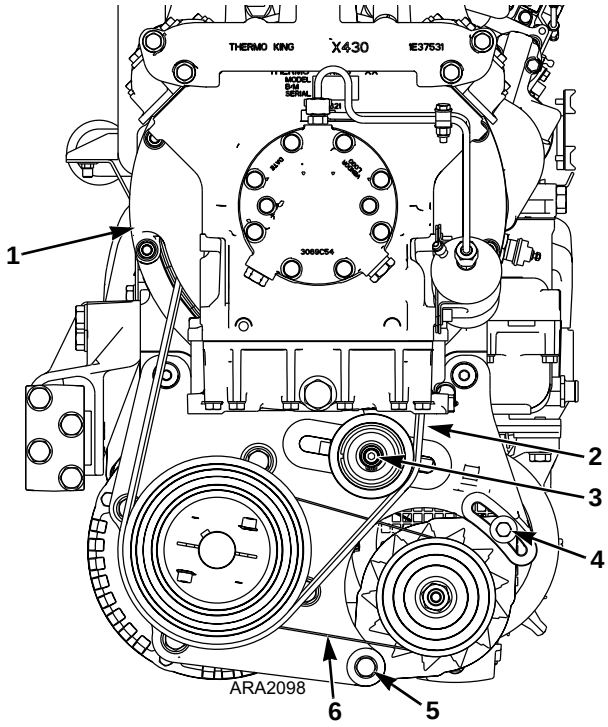
1. Remove the bolts from the water pump pulley.
2. Remove the pulley sliding section and add or remove shims to adjust the belt tension.
3. Reinstall the belt on the pulley and replace the sliding pulley section on the pulley.
4. Tighten the mounting belts on the water pump pulley.
5. Check the belt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

Compressor Drive Belt - SmartPower Units Only

Compressor Drive Belt Adjustment

See “Belt Tension” on page 16 in the “Specifications” chapter for the correct compressor drive belt tension settings.

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.



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)

Figure 203: Compressor Drive and Alternator Belts

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.

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. Make sure 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

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.

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. Make sure 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.

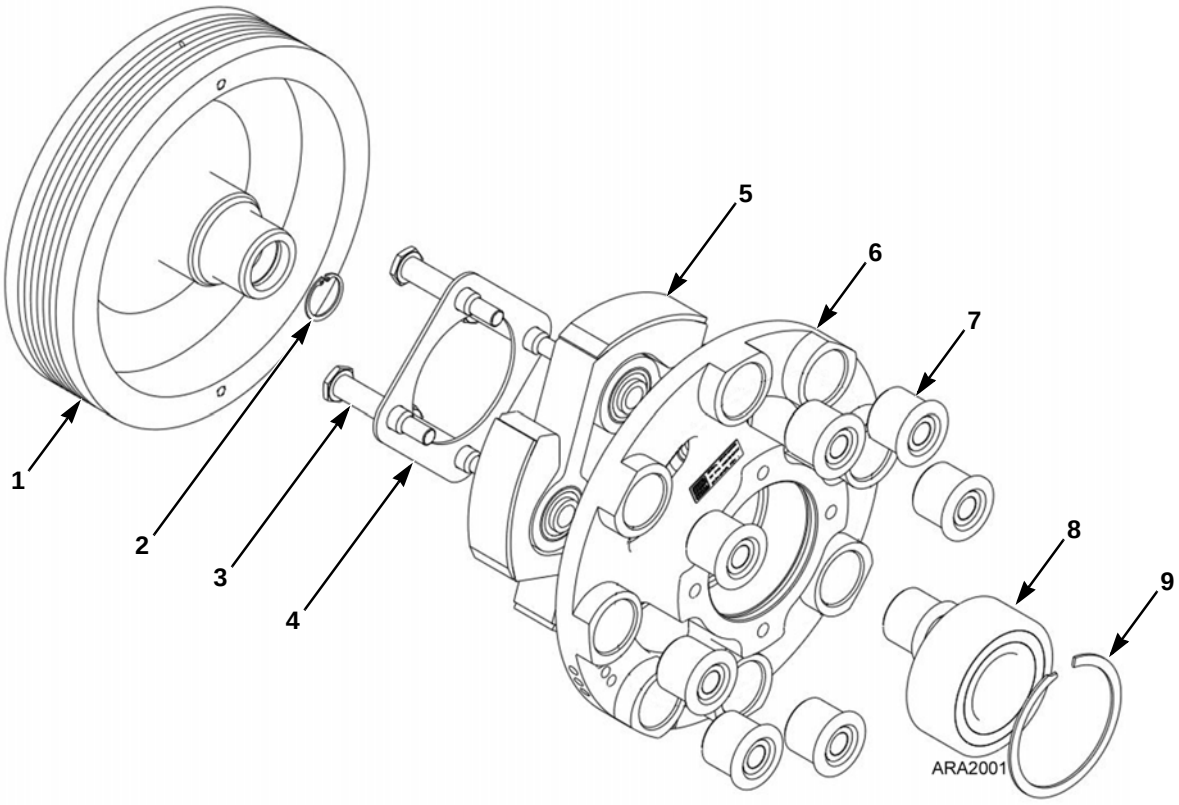
Clutch (SmartPower Units)

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. (Use the Spanner Wrench and the appropriate hex driver or an air impact driver with the appropriate hex driver.)
7. Using 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.



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		

Figure 204: Clutch Assembly

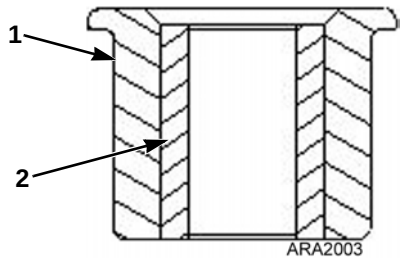
9. To disassemble the clutch, press the pulley out of the bearing.
10. Inspect the friction shoes and shoe support bushings.
    a. Replace the friction shoe assemblies if the linings are worn to a thickness of less than 1/16 to 3/32 in. (1.6 to 2.4 mm).
    b. If the shoe support bushings are worn replace 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. Loosely tighten the bolts to hold the shoes in place. Place a large hose clamp around the shoes and tighten clamp until the shoes are compressed to the smallest diameter. Torque the bolts to 30 to 35 ft-lb (41 to 47 N•m). 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.
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.

CAUTION: 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.

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. Make sure 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.



1.	Elastomer
2.	Inner Bearing Sleeve

Figure 205: Bonded Drive Bushing

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

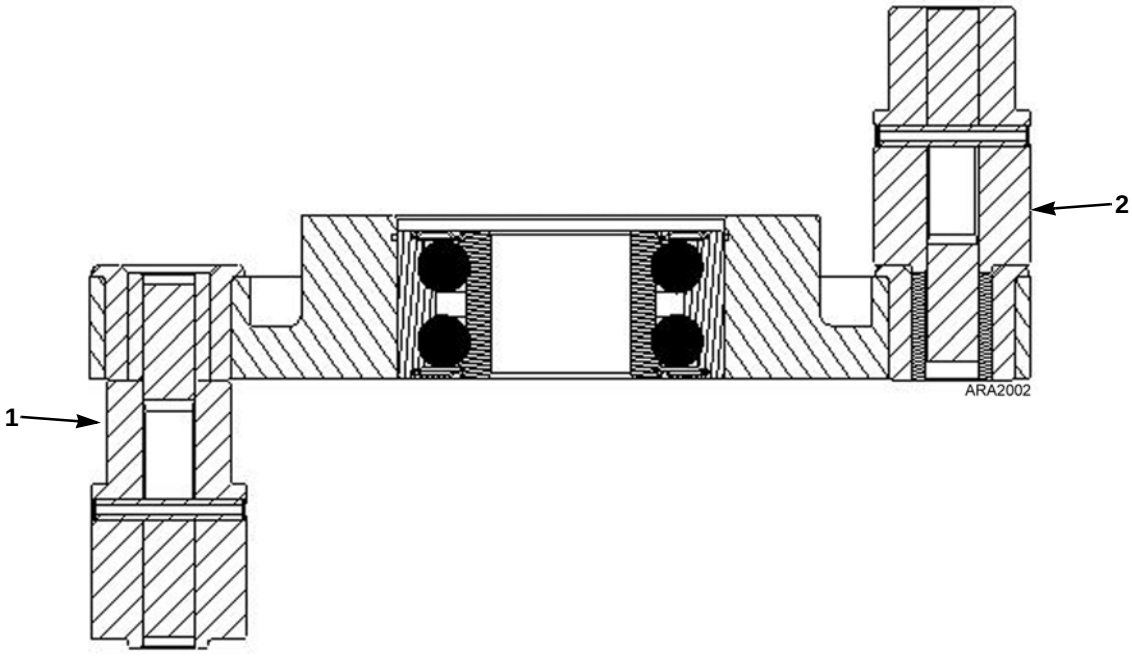
1. Loosen the compressor drive belt idler mounting bolt.
2. Turn the compressor drive belt idler adjuster as needed to loosen the belt enough to allow you to remove the belt from the electric motor pulley.
3. Support the compressor and unbolt the compressor mounting flange from the engine (leave the 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 (see Figure 206).
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 make sure 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.
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.

WARNING: 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.



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.

Figure 206: Bushing Replacement with Bushing Replacement Tool 204-1955

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. Press the new bushing into the hub/coupling from side of the hub/coupling that faces the flywheel (see Figure 206).

    NOTE: Let the Loctite adhesive 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 shoe installation instructions above (page 124).
17. Torque the mounting bolts for the friction shoes to 30 to 35 ft-lb (41 to 47 N•m).
18. Press the clutch pulley into the bearing.
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.

    CAUTION: 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.

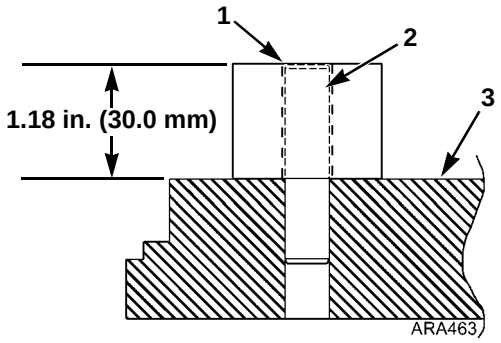
20. Install the special washer and the clutch mounting bolt. Torque the clutch mounting bolt to 90 ft-lb (122 N•m). Use the Clutch Restraint Tool or an impact wrench.
21. Reinstall the compressor drive belt on the clutch pulley.
22. Slide the compressor back into position and install the mounting hardware.

    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. Make sure 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.

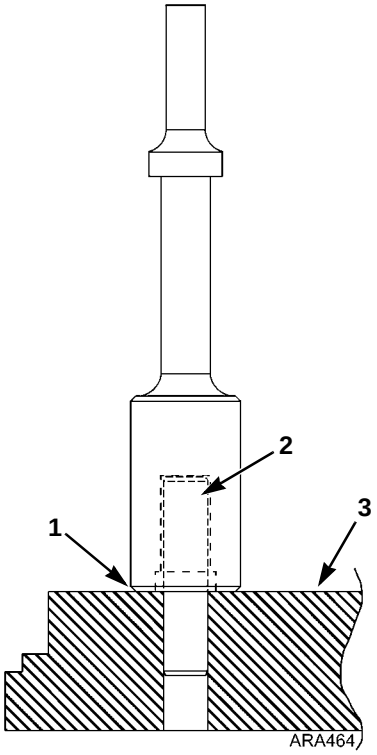
Dowel Pin Replacement

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. The end of each dowel pin should be 1.18 in. (30.0 mm) from the outer face of the flywheel. The proper dimension is critical and is set by using either of the tools.



1.	Press Dowel Pin In Until Flush With Tool
2.	Dowel Pin
3.	Outer Face Of Flywheel

Figure 207: Pressing New Dowel Pin Into Flywheel Using Manual Pin Tool



1.	Drive Dowel Pin In Until Tool Hits Flywheel
2.	Dowel Pin
3.	Outer Face Of Flywheel

Figure 208: Driving New Dowel Pin Into Flywheel with Impact Pin Tool

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.

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 the evaporator.
2. Install a gauge manifold.
3. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
4. Use the microprocessor thermometer to monitor the return air temperature.
5. Run the unit on high speed cool until the air in the box is at 0 F (-18 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-18 C).
6. The suction pressure should be 13 to 18 psig (90 to 124 kPa).
7. The discharge pressure should be at least 275 sag (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.
8. Under these conditions, refrigerant should be visible in the receiver tank sight glass. If refrigerant is not visible in the receiver tank sight glass, the unit is low on refrigerant.

Testing the Refrigerant Charge with a Loaded Trailer

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

NOTE: If the liquid level in the receiver sight glass drops during step 4, the unit is not overcharged and it is not necessary to complete the procedure.

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

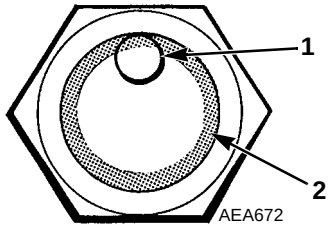
To adjust the refrigerant level:

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



1.	Floating Ball
2.	Colored Ring

Figure 209: Moisture Indicating Sight Glass

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.

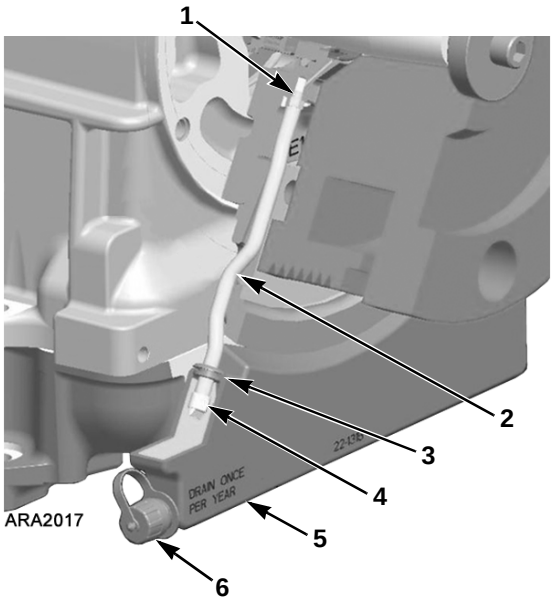
NOTE: It is normal for compressor shaft seals to have a slightly oily film.

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 cap and drain the oil into a cup (not provided) and discard the oil properly. Retighten the cap snugly by hand.



1.	Seal Cover Drain Barb
2.	Tube from Seal Cover to Oil Collection Container
3.	Grommet
4.	Check Valve
5.	Oil Collection Container
6.	Cap (Remove to Drain Oil)

Figure 210: Oil Collection Container

The check valve improves the shaft seal reliability by ensuring oil stays on the shaft seal when the suction pressure is in a vacuum. It is made of silicone rubber, a material that can be damaged easily. The check valve is located on the end of the tube inside the container. It is a very tight fit between the check valve and the grommet in the oil collection container.

If maintenance in the area requires removal of the oil collection container or the tube, caution should be observed to prevent damage to the check valve. Although the check valve was glued to the tube at production, pulling the check valve back through the grommet may cause the Valve to fall off or be damaged.

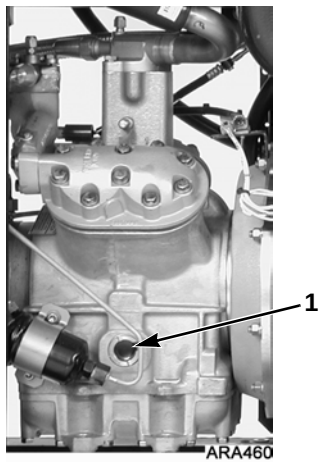
Several options are available:

1. If possible, disconnect the tube at the seal cover drain barb and leave the tube in the oil collection container.
2. The grommet can be pried off the bottle with the tube still inserted, allowing the tube and check valve to be easily removed from the container.
3. If option 1 or 2 are not feasible and it is necessary to pull the check valve back through the grommet, gently twist as pulling back.

If the check valve does come off the tube, install a new check valve from stock.

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.



1.	Sight Glass

Figure 211: Checking Compressor Oil

To check compressor oil level with an ambient air temperature above 50 F (10 C):

Install a gauge manifold on the compressor.

Operate the unit on cool with a 20 psig (138 kPa) minimum suction pressure and a 185 psig (1275 kPa) minimum discharge pressure for 15 minutes or more.

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.

To check compressor oil level with an ambient air temperature below 50 F (10 C):

Run the unit through a complete defrost cycle. After completing the defrost cycle, run the unit on cool for ten minutes. Observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.

If the box is empty, you can run the unit on the heat cycle instead of the defrost cycle.

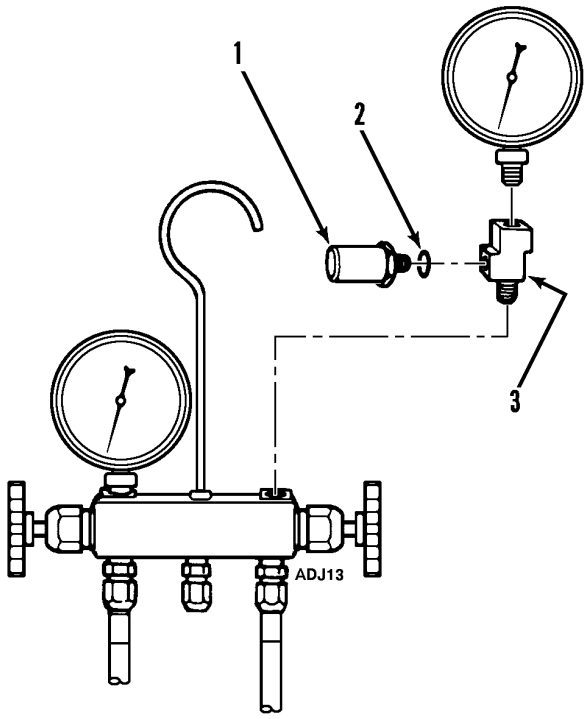
NOTE: Use refrigeration compressor oil ONLY. Polyol Ester P/N 203-513 is required for R-404A.

To add compressor oil pump down the compressor and equalize the pressure to slightly positive. Disconnect the compressor oil filter return line from the top of the compressor and add the oil. Reattach the oil filter return line to the compressor. Evacuate the compressor before opening the service valves.

High Pressure Cutout Switch (HPCO)

The 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 in Figure 212 “High Pressure Cutout Manifold” 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.



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

Figure 212: High Pressure Cutout Manifold

2. Use the Service Test Mode to run the unit in high speed cool.
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.

CAUTION: 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).

4. If the HPCO does not open to de-energize the run relay and stop the unit, it must be replaced.

Three-Way Valve Condenser Pressure Bypass Check Valve

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

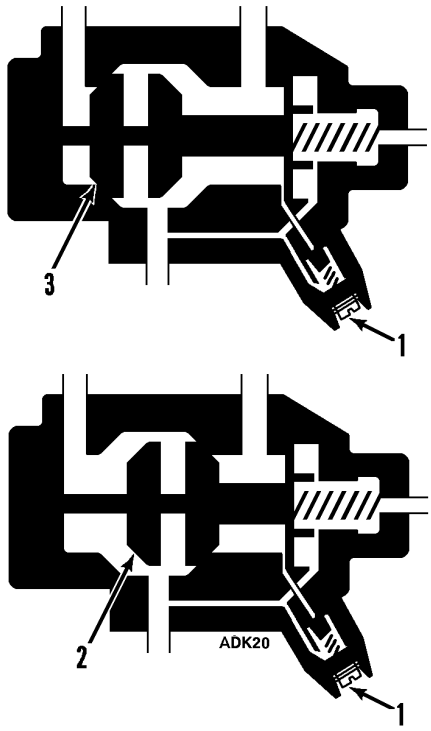
The check valve is closed when the unit is running on cool, or whenever the discharge pressure is higher than the condenser pressure.

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

If a three-way valve does not shift back to cool immediately after the pilot solenoid closes, and finally shifts to cool when the temperature rise puts the unit into high speed, the three-way valve end cap should be checked. See “End Cap Checks” in the Refrigeration Service Operations Chapter.

To check the operation of the condenser pressure bypass check valve:

1. Remove the condenser pressure bypass check valve cap from the three-way valve.
2. Using a screwdriver, gently turn the check valve stem in until the valve is front seated.
3. Install a gauge manifold set on the compressor.
4. Close (front seat) the receiver tank outlet valve.
5. Operate the unit on cool and pump down the low side to 20 in. Hg (-68 kPa) of vacuum.
6. Stop the unit. The condenser and suction pressures should remain stable, indicating no leaks.
7. Shift the three-way valve to the heat position. The low side gauge will raise slightly. The high side gauge will drop to approximately zero. The gauges will equalize.



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

Figure 213: Three-way Valve Condenser Pressure Bypass Check Valve

8. The gauges will remain in this position, approximately zero, if the three-way valve seals properly toward the condenser and the condenser pressure bypass check valve seals properly.
9. Back seat condenser pressure bypass check valve stem against the snap ring. Both gauges should rise indicating the condenser pressure bypass check valve is properly releasing condenser pressure into the discharge tube and evaporator.
10. Replace the cap on the condenser pressure bypass check valve.

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

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

Electronic Throttling Valve (ETV)

The Electronic Throttling Valve (ETV) is standard on the these units. The 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. The ETV system also uses discharge and suction pressure transducers, and a hot gas bypass valve.

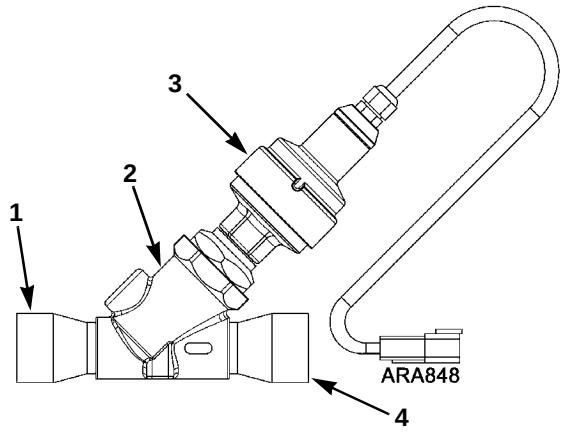
The ETV has two internal coils. The microprocessor operates the valve by energizing the coils with a variable frequency ac signal. The valve position can be monitored with the **Gauges** key. Zero (0) indicates the valve is fully closed and 800 indicates the valve is fully open.

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** key to observe of 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 SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for complete information about the testing and operation of the ETV.

See “Electronic Throttling Valve” in the Refrigeration Service Operations chapter of this manual for removal and installation procedures.



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

Figure 214: Electronic Throttling Valve

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** key. Check the readings by comparing them to the readings on a gauge manifold set attached to the compressor. Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for more information about the testing and operation of the pressure transducers.

Hot Gas Bypass Valve

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

Refer to the SR-4 Microprocessor Control System Diagnostic Manual TK 55533 for information about testing the hot gas solenoid. See the Refrigeration Service Operations chapter of this manual for removal and installation procedures.

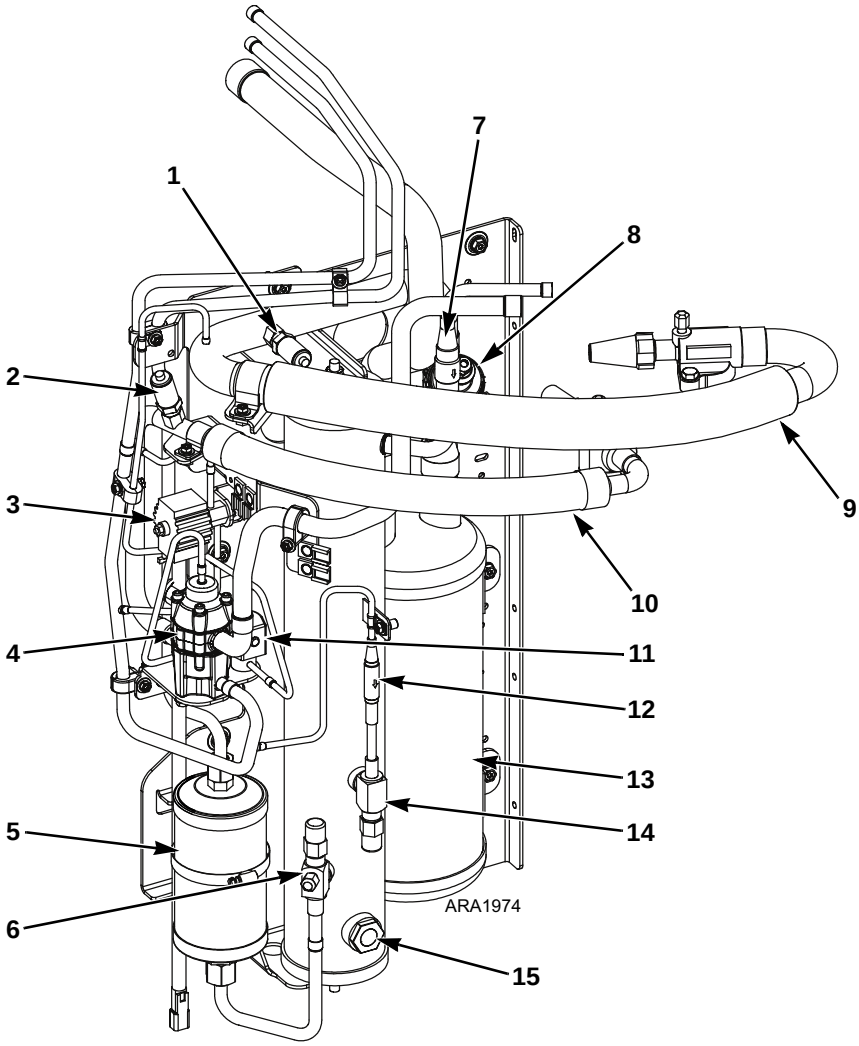
Refrigeration Service Operations

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

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

Refrigeration System Component Locations

The following drawings show the locations of various refrigeration system components. 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.



1.	Suction Pressure Transducer	9.	Suction Vibrasorber
2.	Discharge Pressure Transducer	10.	Discharge Vibrasorber
3.	Hot Gas Bypass Valve	11.	Pilot Solenoid
4.	Three-Way Valve	12.	Bypass Check Valve
5.	Filter-Drier	13.	Accumulator
6.	Receiver Tank Outlet Valve	14.	Bypass Service Valve
7.	Condenser Check Valve	15.	Receiver Tank Sight Glass
8.	ETV		

Figure 215: Front Left View of Refrigeration Cluster

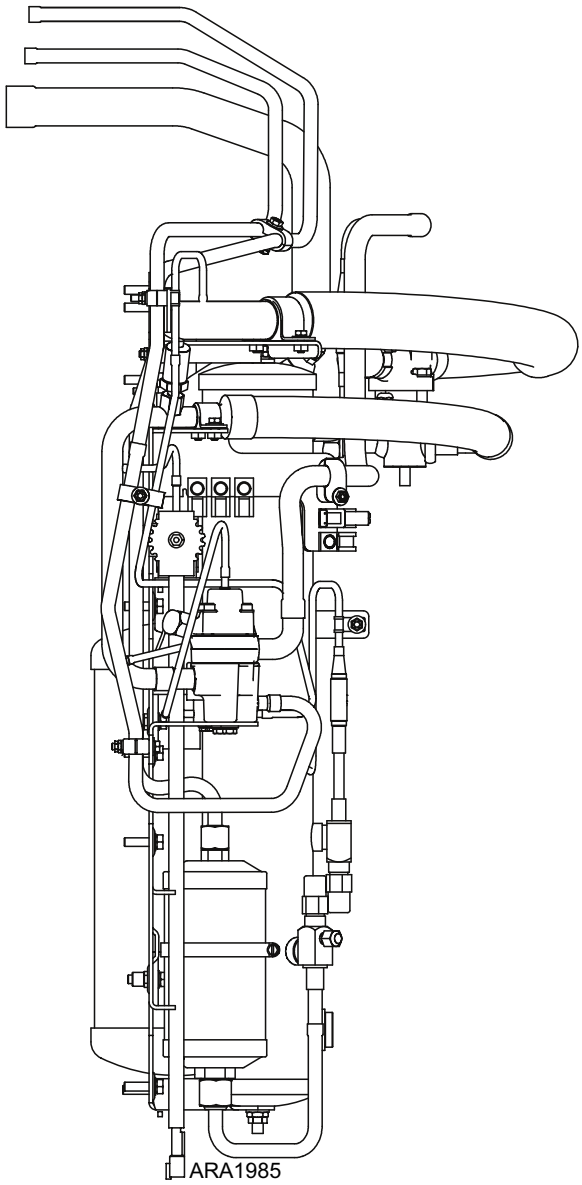
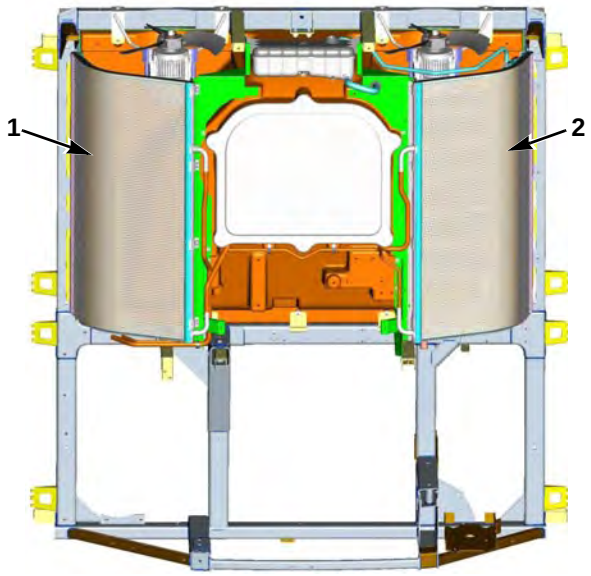
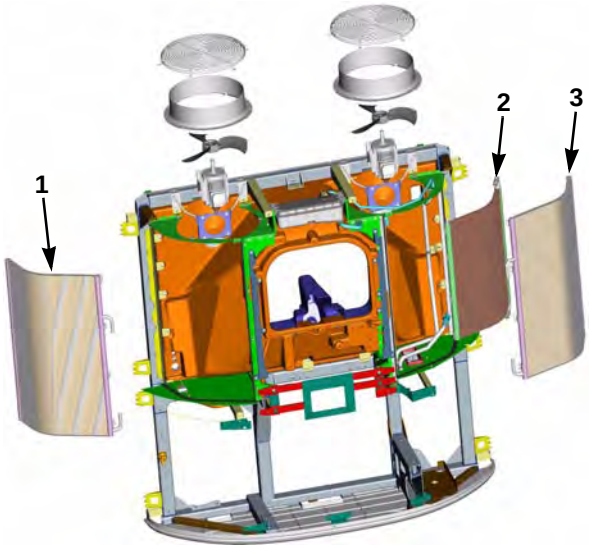


Figure 216: Curbsibe View of Refrigeration Cluster



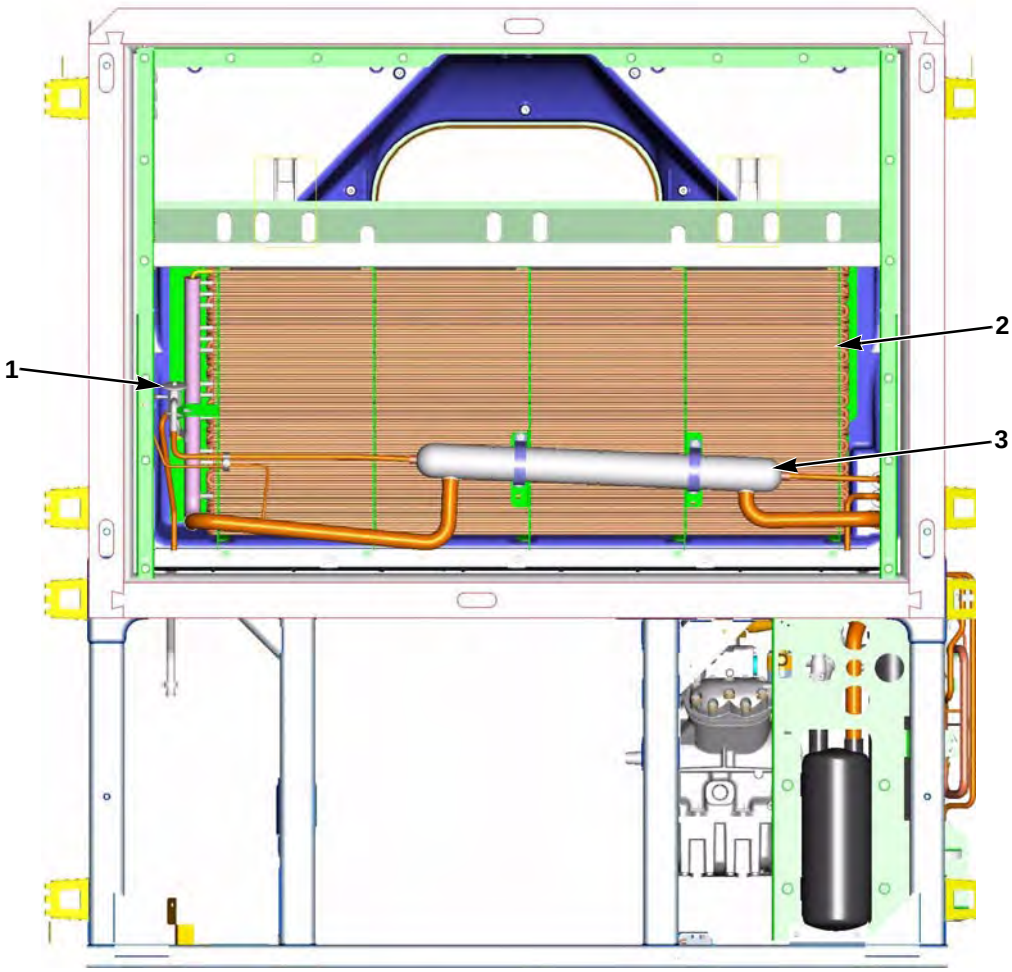
1.	Curbsibe Condenser Coil
2.	Road Condenser/Radiator Coil

Figure 217: Condenser Coils



1.	Curbsibe Condenser Coil
2.	Radiator Coil
3	Road Condenser Coil

Figure 218: Condenser and Radiator Coils



1.	Expansion Valve
2.	Evaporator Coil
3.	Heat Exchanger

Figure 219: Evaporator with Access Panel Removed

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 then 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, use the appropriate Allen tool provided with removal tool P/N 204-991 to loosen the center bolt which holds the coupling to the compressor shaft.
2. Attach the tool to the coupling with the provided socket head screws and spacers. Two sets of spacers are provided with the tool, use the short spacers with shallow compressor mounting flanges and the longer set for deeper flanges. The side with the countersunk holes should be toward the coupling.
3. To prevent the tool and crankshaft from rotating, use an appropriately sized bolt to pin the tool to the flange. If a nut is used to prevent the bolt from falling out, the nut should not be tightened.
4. Use the appropriate Allen tool to loosen the coupling mounting screw.
5. Once the center screw has been loosened, back the head against the tool and it should push the coupling off the crankshaft as you continuing turning the center screw in a counter-clockwise direction. Using this tool will prevent the coupling from popping off because the center bolt and flatwasher will hold it in place.

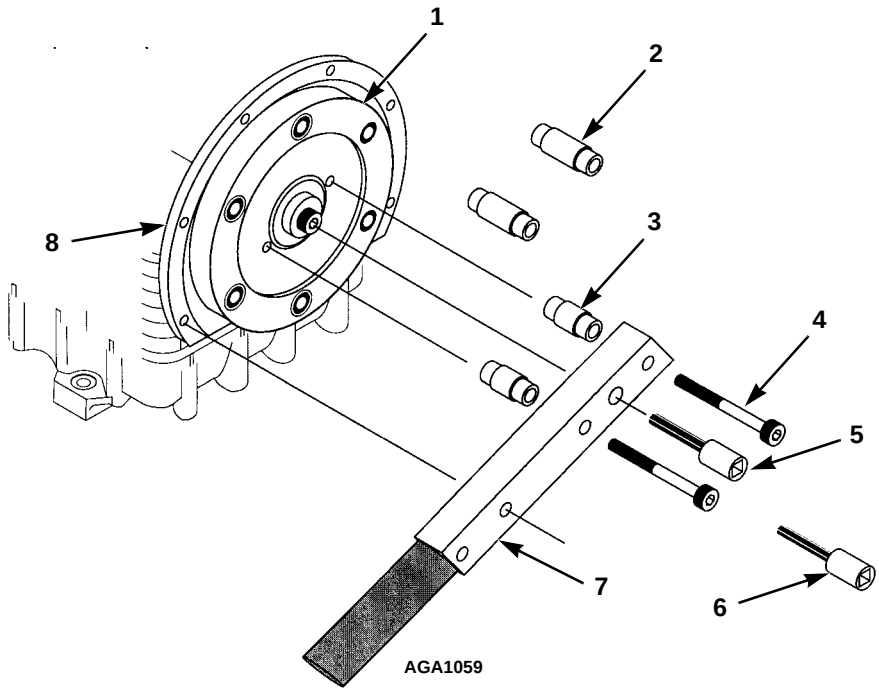
Compressor Coupling Installation (Standard Units)

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 insures 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).



1.	Coupling	5.	10 mm Allen Tool (for large shaft compressor)
2.	Long Spacers (supplied with tool)	6.	5/16 Allen Tool (for small shaft compressors)
3.	Short Spacers (supplied with tool)	7.	Coupling Removal Tool (P/N 204-991)
4.	Socket Head Bolts (supplied with tool)	8.	Engine Mounting Flange

Figure 220: Compressor Coupling Removal Tool

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

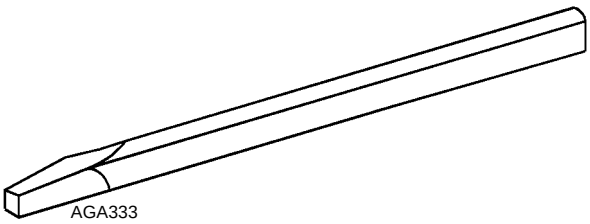
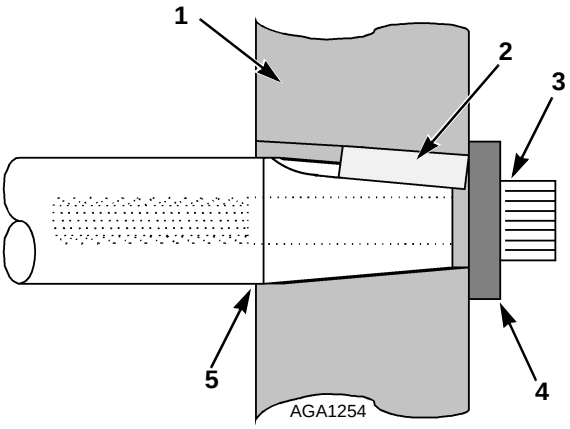


Figure 221: Keyway Tool P/N 204-972

CAUTION: 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.

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.



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.

Figure 222: Compressor Coupling Installation

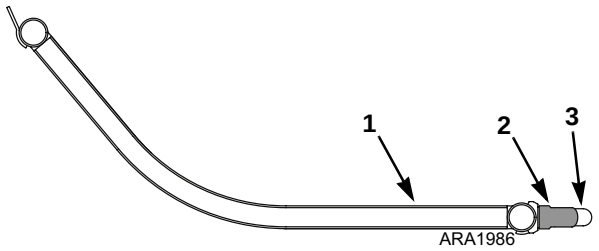
9. Re-install the bolt and heavy flat washer and snug the bolt down by hand. Torque the bolt to 90 ft-lb (122 N•m).
10. Spray a corrosion inhibitor (such as spray paint) on the exposed part of the shaft and the joint between the shaft and the coupling. This prevents moisture from wicking into the joint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

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. Make sure to 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. Make sure to 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.



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

Figure 223: Top View of Curbside Condenser Coil

Installation

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

NOTE: The roadside condenser coil must be removed to remove the radiator coil.

Removal

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. See “Roadside Condenser Coil” on page 140 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. See “Roadside Condenser Coil” on page 140 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.
2. Heat the connections on the vibrasorber until the vibrasorber can be removed.

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

Installation

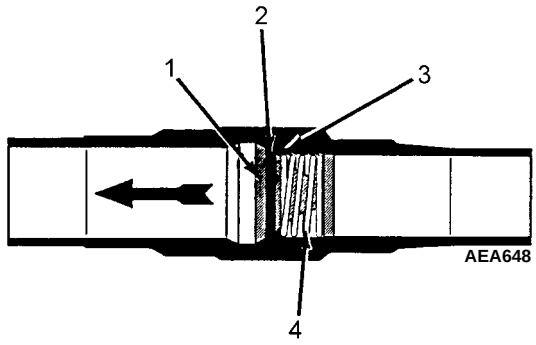
1. Prepare the vibrasorber and tubing fittings by cleaning thoroughly.
2. Solder the vibrasorber connections.

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

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

In-Line Condenser Check Valve

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



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

Figure 224: Cross Section of In-line Condenser Check Valve

Condenser Check Valve Replacement

Removal

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

Installation

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

1. Clean the tubes for soldering.
2. Place the check valve in position. The arrow on the valve body indicates the direction of refrigerant flow through the valve.
3. Place a heat sink on the check valve.
4. Solder the inlet and outlet connections.
5. Pressurize the refrigeration system and test for leaks.

6. If no leaks are found, evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Bypass Check Valve

Removal

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

Installation

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

Receiver Tank

Removal

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

Installation

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

Filter-Drier

Removal

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

Installation

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

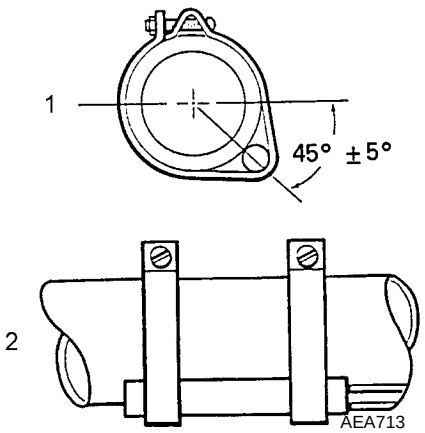
Expansion Valve Assembly

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
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.



1.	End View
2.	Side View

Figure 225: Location of Expansion Valve Bulb

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 equalizer line from the suction line.
5. Unsolder the liquid outlet line from the expansion valve.
6. Note the position of the feeler bulb on the side of the suction line. Remove the expansion valve feeler bulb from the suction tube.
7. Unsolder the suction line at the evaporator coil end.
8. Unsolder the remaining outlet suction line and inlet liquid line connections. Remove any putty from around the lines before unsoldering the connections.
9. Slide the heat exchanger assembly out of the evaporator housing.

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the evaporator housing and install the mounting hardware loosely.
3. Solder the liquid inlet and the suction outlet line connections on the curbside of the evaporator. Seal the openings through the bulkhead with putty when the refrigerant lines have cooled off.
4. Solder the suction line connection to the evaporator coil.

5. Solder the equalizer line to the suction line and the liquid outlet line to the expansion valve.
6. Tighten the heat exchanger mounting hardware securely.
7. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
8. Clean the suction tube to a brightly polished condition. Install the feeler bulb clamps and the feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or the operation will be faulty. Wrap with insulating tape.
9. Replace the evaporator access panels.
10. Open the refrigeration valves and place the unit in operation.

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. Remove any putty from around the lines 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.
2. Unsolder the inlet and outlet suction lines from the accumulator.

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

3. Unbolt and remove the accumulator from the unit.

Installation

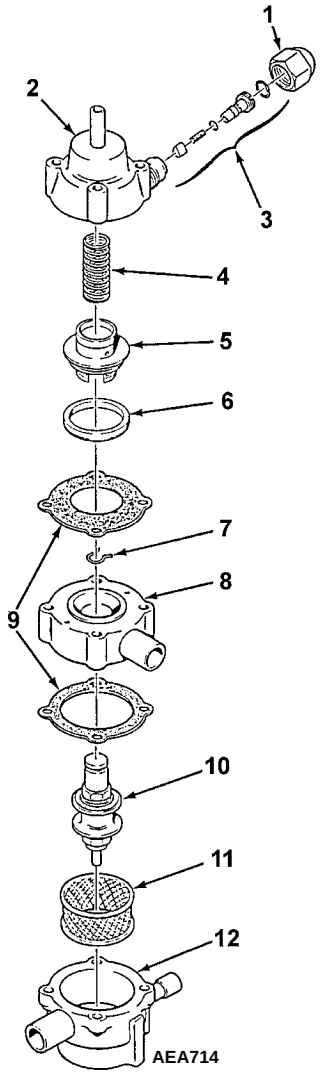
1. Place the accumulator in the unit and tighten the mounting bolts and nuts.
2. Solder the inlet and outlet suction lines to the accumulator.

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

3. Pressurize the low side and test for refrigerant leaks. If no leaks are found, evacuate the low side.
4. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil. Add as required.

Three-Way Valve Repair

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



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

Figure 226: Three-Way Valve

Removal/Disassembly

1. Recover the refrigerant charge.
2. Clean the exterior surface of the valve.
3. Remove the line from the three-way valve to the pilot solenoid.
4. Loosen the four 1/4 in. Allen head screws (DO NOT REMOVE OR CAP MAY POP OFF); use tool P/N 204-424 to break the gasket at each side of the center section.

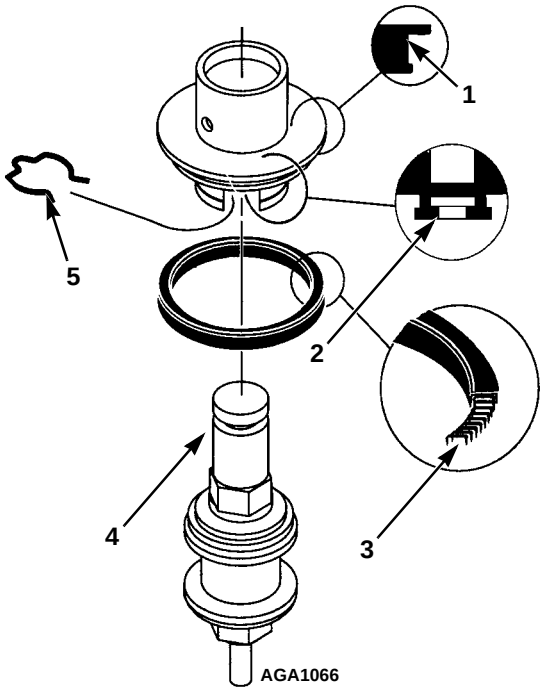
CAUTION: Do not force the tool into the brass or against the bolts.

Figure 227: Gasket Tool P/N 204-424

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

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

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



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

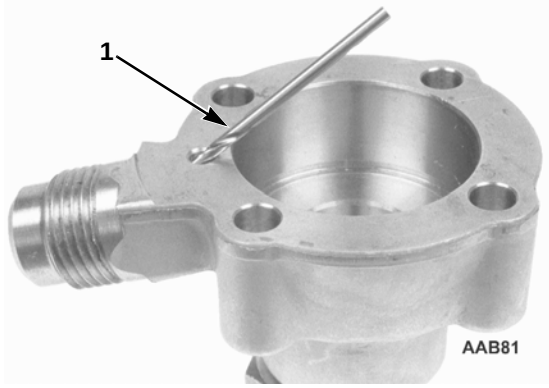
Figure 228: Piston and Stem Parts

End Cap Checks

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

Check Valve Bleed Hole Diameter

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

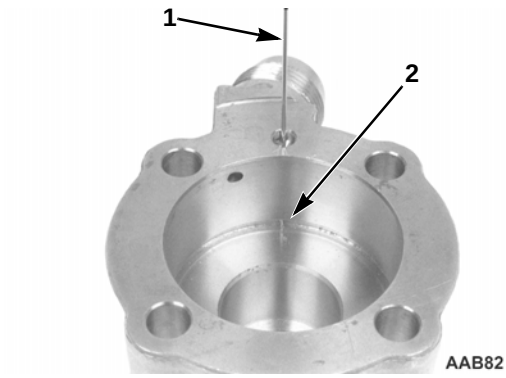


1.	Number 43 Drill

Figure 229: Check Bleed Hole Diameter

Piston Bleed Orifice Check

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



1.	Number 66 Drill
2.	Check for Burr Here

Figure 230: Check Piston Bleed Orifice

Check Valve Piston Check

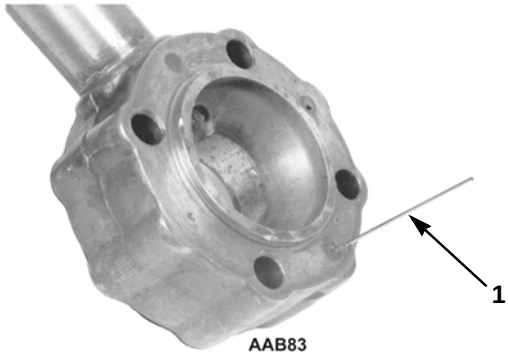
1. Reassemble the end cap using a new check valve piston, spring, stem, and snap ring (Kit P/N 60-163).
2. Leave the stem back seated against the snap ring. Use a paper clip bent into a 90 degree angle to push the check valve piston back in its bore. Make sure you can feel the piston working against the spring.

3. With the piston pushed all the way back in its bore, use a strong light to look down the 0.089 in. (2.26 mm) hole towards the back of the piston and determine how much of the end of the hole is covered by the piston. If the piston covers more than three-quarters of the hole replace the end cap.

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

Seat (Center Section) Orifice Check

There are three 0.033 in. (0.84 mm) holes located in the three-way valve seat (center section). Only one is used depending on how the valve is configured. If the hole is too large the valve will be slow to shift from heat to cool when the condenser pressure is higher than discharge pressure because gas will flow to the discharge line instead of behind the piston. If the hole is too small the valve will be slow to shift from heat to cool when discharge pressure is higher than condenser pressure because the flow is restricted. **Do not enlarge this hole larger than 0.033 in. (0.84 mm)!** Whenever you disassemble a three-way valve you should check that all three of the holes are drilled cleanly.



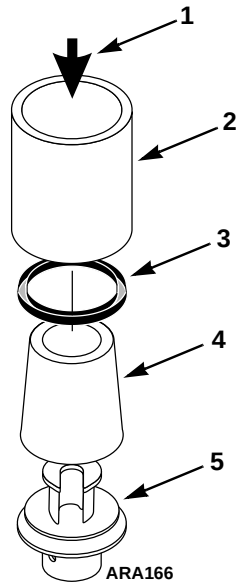
1.	Number 66 Drill

Figure 231: Check Seat Orifice

Assembly/Installation

After cleaning and inspecting all parts, reassemble the valve.

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



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

Figure 232: Seal Installation with Tool P/N 204-1008

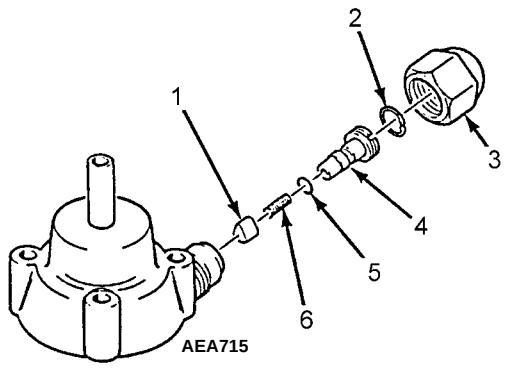
5. Place the piston slot on the stem and secure with spring clip. The open part of the clip should be on the opposite side of the piston slot.
6. Install the spring and end cap.
7. Line up the passageways in the cap and body. Failure to line up the holes will result in improper operation of the valve.
8. Install the bolts and tighten in rotating sequence. Torque to 160 in-lb (18 N•m).

9. Install the pilot solenoid line and pressurize the system with refrigerant to check for leaks.
10. If there are no leaks, evacuate the system and recharge with the proper refrigerant.
11. Run the unit to check for proper three-way valve operation.

Three-Way Valve Condenser Pressure Bypass Check Valve Repair

Removal

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



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

Figure 233: Teflon Check Valve Assembly

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

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

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

Installation

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

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

4. Screw the check valve stem into the three-way valve until the snap ring can be installed.
5. Install the snap ring.
6. Unscrew (back seat) the check valve stem against the snap ring.

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

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

Pilot Solenoid

Removal

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

Installation

1. Remove the coil from the valve.

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

Suction Vibrasorber

Removal

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

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

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. See 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.

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

3. Apply a refrigerant Loctite to the threads of the suction pressure transducer.
4. Install and tighten the suction pressure transducer and reconnect the wires.
5. Pressurize the low side and check for leaks. If no leaks are found, evacuate the low side.
6. Open the refrigeration valves and place the unit in operation.

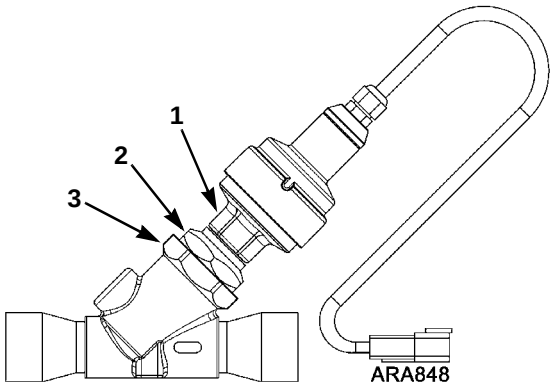
Electronic Throttling Valve (ETV)

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. The ETV must be open to remove the stepper motor and piston assembly. Open the ETV by placing the unit in the Evacuation Mode/Test, and then disconnecting the ETV harness from the four-pin connector on the main/unified harness before turning the unit off. The microprocessor closes the ETV when the unit is turned off. Refer to the appropriate Microprocessor Diagnostic Manual for information about the Evacuation Mode/Test.
3. 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.

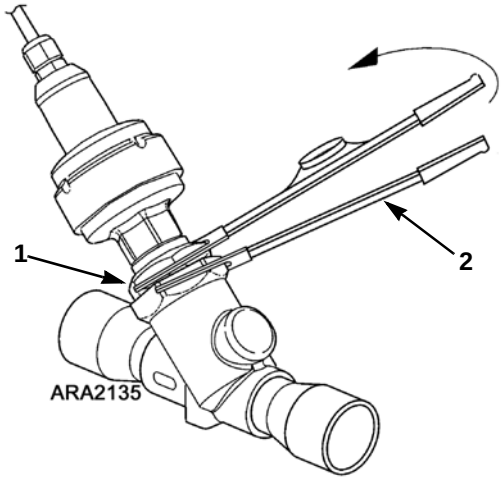
CAUTION: Unscrew the large nut. Do not unscrew the small hex on the stepper motor.

WARNING: 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 stepper motor and piston assembly no more than four turns 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.



1.	Small Hex on Stepper Motor
2.	Large Nut
3.	Valve Body

Figure 234: Electronic Throttling Valve



1.	Unscrew Large Nut
2.	Backup Wrench

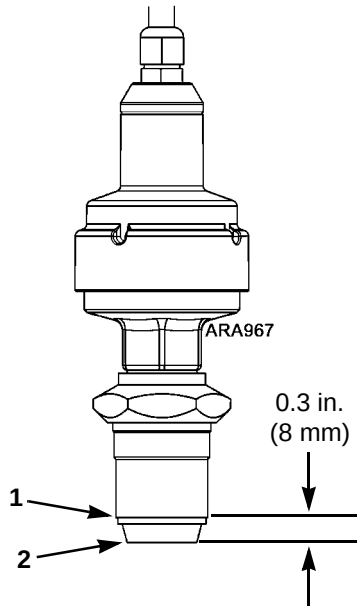
Figure 235: Removing Electronic Throttling Valve

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 to main 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 harness connected to main wire harness, the controller will attempt to close the ETV. This will cause the piston to be turned (screwed) off the threaded shaft of the stepper motor because the valve body is not present to stop it. Further disassembly is required to reassemble the piston and stepper motor. See "Reassembly of Piston and Stepper Motor".

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. The piston retracts to open and extends to close.



1.	Bottom Edge of Brass Nut
2.	Bottom Edge of Piston

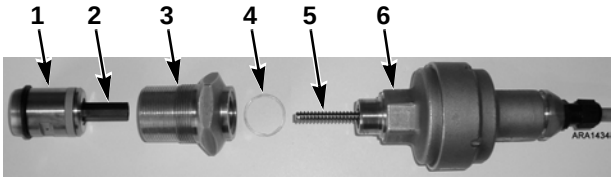
Figure 236: Stepper Motor and Piston Assembly with Piston in Fully Open Position

2. Lubricate the piston and threads on the new stepper motor and piston assembly with refrigeration oil.
3. Screw the new stepper motor and piston assembly into the valve body.
4. 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.
5. Connect the ETV harness to the main wire harness at the four-pin connector.
6. Pressurize the low side and test for leaks.
7. If no leaks are found, evacuate the low side.
8. Install the evaporator access panels.
9. Open the refrigeration valves and place the unit in operation.

Reassembly of Piston and Stepper Motor

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.

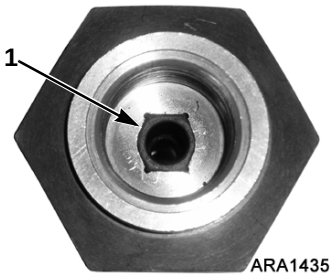
1. Disassemble the stepper motor and piston assembly by unscrewing the stepper motor (small hex) from the piston nut (large nut).



1.	Piston
2.	Rectangular Shaft on Piston
3.	Piston Nut
4.	Copper Washer
5.	Threaded Shaft of Stepper Motor
6.	Stepper Motor

Figure 237: Stepper Motor and Piston Assembly Components

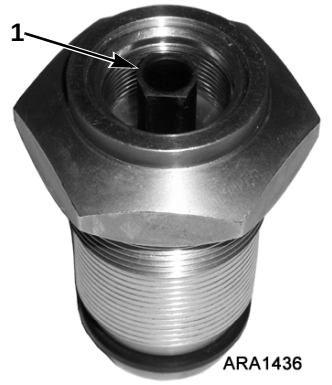
2. Insert the piston into the piston nut. You must align the rectangular shaft on the piston with the rectangular hole in the piston nut to allow the piston to be inserted into the piston nut.



1.	Align Rectangular Shaft on Piston with Rectangular Hole in Piston Nut

Figure 238: Insert Piston into 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.



1.	Position End of Rectangular Shaft about Even with Top of Piston Nut

Figure 239: Push Piston into Piston Nut

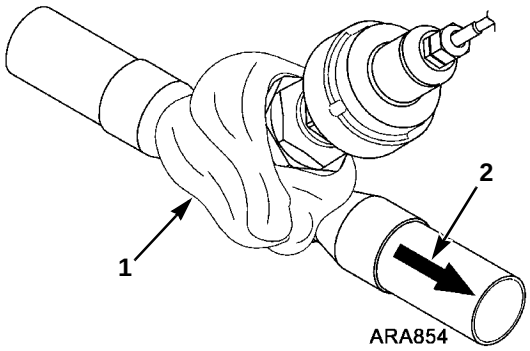
4. Make sure the copper washer is in place in the top of the piston nut.
5. Place the threaded shaft of the stepper motor into the rectangular shaft of the piston and turn the piston and piston nut onto the threaded shaft of the stepper motor.
6. When the threads in the top of piston nut reach the threads on the bottom of the stepper motor, carefully continue to turn the piston and piston nut onto the stepper motor. Make sure 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 evaporator to the heat exchanger.

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



1.	Use Heat Sink
2.	Direction of Refrigerant Flow

Figure 240: Installing Complete ETV Assembly

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 ETV harness to the main wire harness at the four-pin connector.
5. Pressurize the low side and test for leaks.
6. If no leaks are found, evacuate the low side.
7. Install the components that were removed to access the ETV.
8. Open the refrigeration valves and place the unit in operation.

Hot Gas Bypass Valve

Removal

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

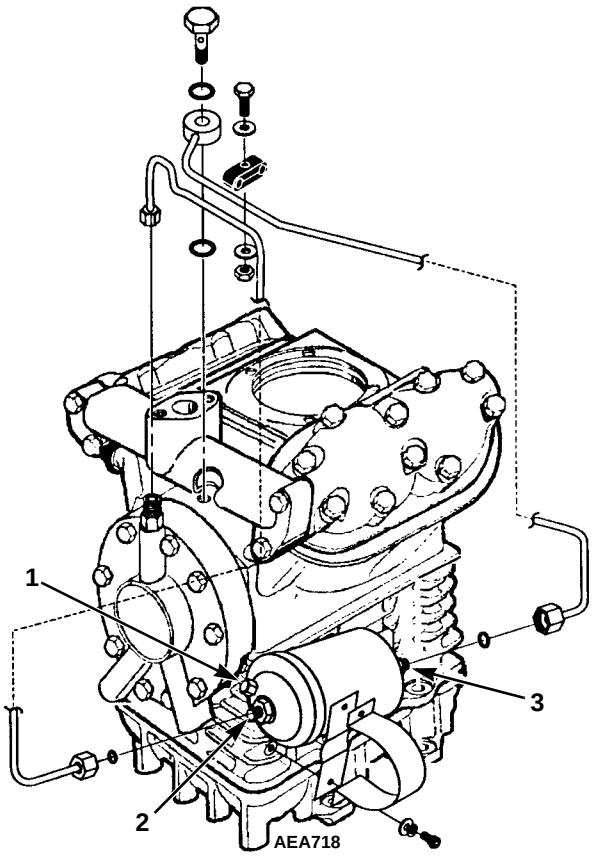
Installation

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

Compressor Oil Filter

This unit is equipped with a compressor oil filter. The compressor oil filter should be changed when the drier is replaced.

The outlet fitting is larger than the inlet fitting, so the compressor oil filter cannot be put on backwards. There are two fittings on the inlet end of the compressor oil filter. The inlet fitting contains a check valve that prevents reverse flow through the compressor oil filter. The capped fitting is called the oil pressure access port and is used to check the compressor oil pressure (see “Checking Compressor Oil Pressure”).



1.	Oil Pressure Access Port
2.	Inlet Fitting
3.	Outlet Fitting

Figure 241: Compressor Oil Filter

Use the following procedure to change the compressor oil filter.

1. Pump down the low side and equalize the pressure to slightly positive.
2. Front seat the discharge and suction service valves. Recover the remaining refrigerant from the compressor.
3. Disconnect the oil lines from the compressor oil filter. Hold the oil filter with back-up wrench on the hex behind the ORS fitting.
4. Remove the clamp and the compressor oil filter.
5. Coat the new O-rings with clean compressor oil and place them in the ORS fittings on the ends of the new compressor oil filter.
6. Fasten the new compressor oil filter in place with the clamp.
7. Attach and tighten the oil lines to the compressor oil filter. Hold the oil filter with a back-up wrench on the hex behind the ORS fitting.
8. Evacuate the compressor and filter to a maximum of 500 microns to remove trapped air.
9. Open the service valves, operate the system, and check the compressor oil filter for leaks.

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.

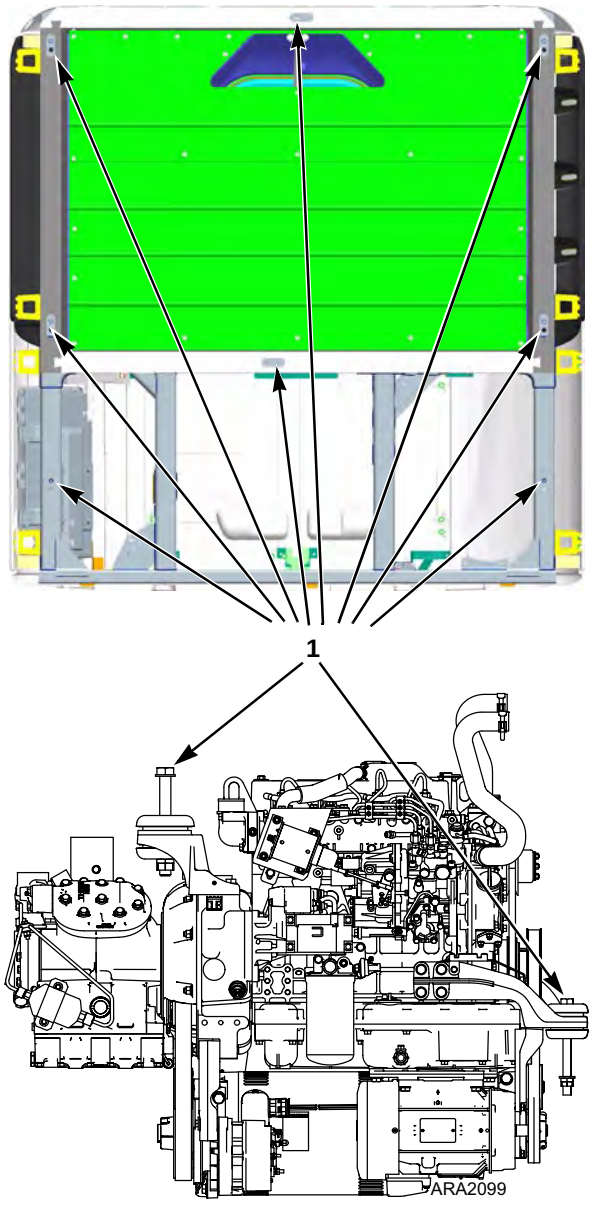
1. Attach a suitable oil pressure gauge to the oil pressure access port on the compressor oil filter.
2. Attach the low pressure gauge of a gauge manifold to the fitting on the side of the throttling valve (or suction valve adapter). This fitting allows you to monitor the suction pressure in the compressor 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.

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).



1.	Check Bolts for Tightness

Figure 242: Unit and Engine Mounting Bolts

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 (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. (Results shown in Figure 244.) 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 (see Figure 245).
- 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 (see Figure 245).

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

In some instances in 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.

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

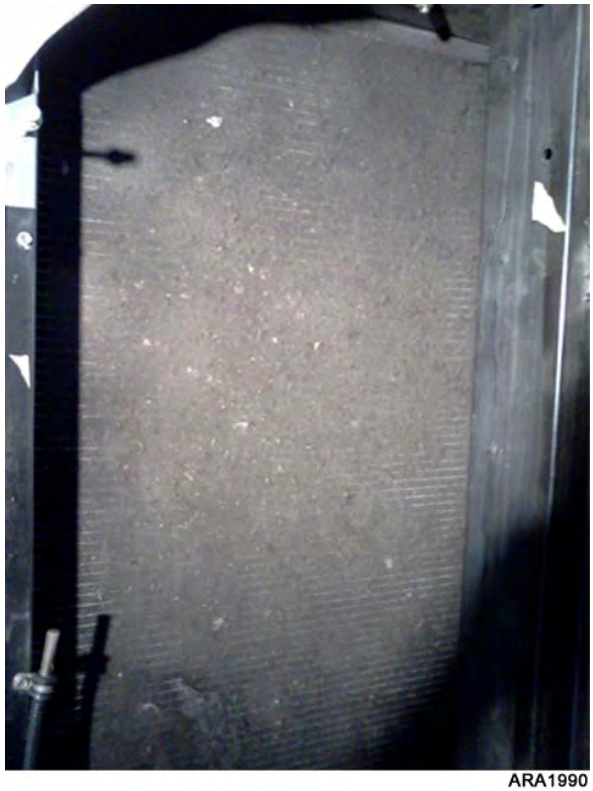


Figure 243: Coil Before Cleaning

Figure 244: Coil after Wiping Right Hand Side with Cloth

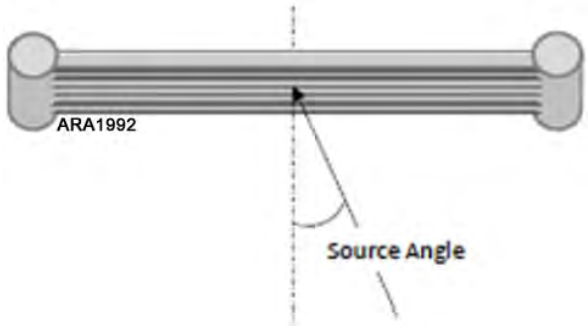


Figure 245: Source Angle for Cleaning with Air or Water

Defrost Drains

1. Clean the defrost drains during scheduled maintenance inspections to be sure the lines remain open.
2. Make sure 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.

1.	Defrost Drain Hoses
2.	Power Receptacle

Figure 246: Defrost Drain Hose Routing

Unit Installation

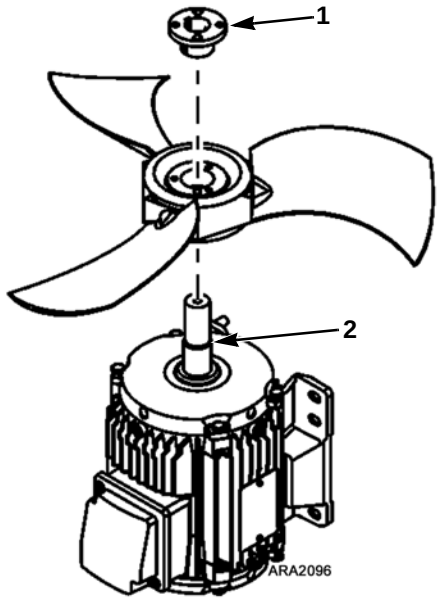
All nuts that hold the unit to the trailer are accessible using an impact wrench with a 10 in. extension, ball-type swivel and a deep-well socket.

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.

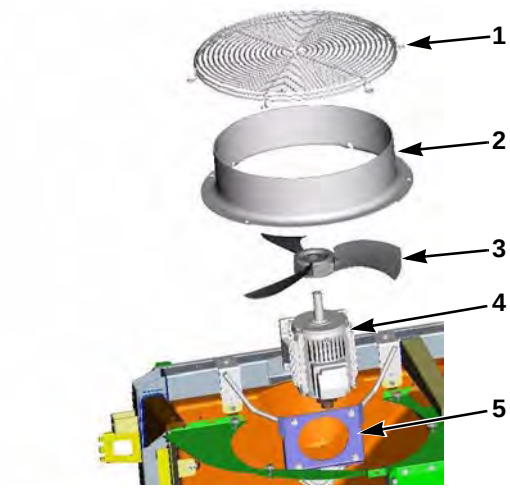
1. Place the fan assembly on the condenser motor shaft so the taper lock bushing is resting on condenser motor shaft shoulder. See Figure 247.
2. Finger tighten the hub bolts till the bolt heads are flush with the hub face.
3. Using a wrench, do a full turn on each bolt alternatively. Repeat this step until some torque builds.



1.	Taper Lock Bushing
2.	Condenser Motor Shaft Shoulder

Figure 247: Condenser Fan Installation

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.



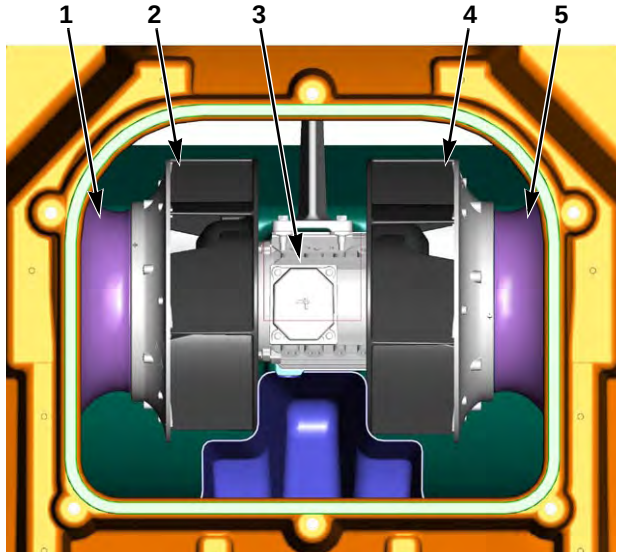
1.	Grille	4.	Fan Motor
2.	Orifice	5.	Fan Motor Mounting Bracket
3.	Fan		

Figure 248: Curbside Condenser Fan Components (Roadside Similar)

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.

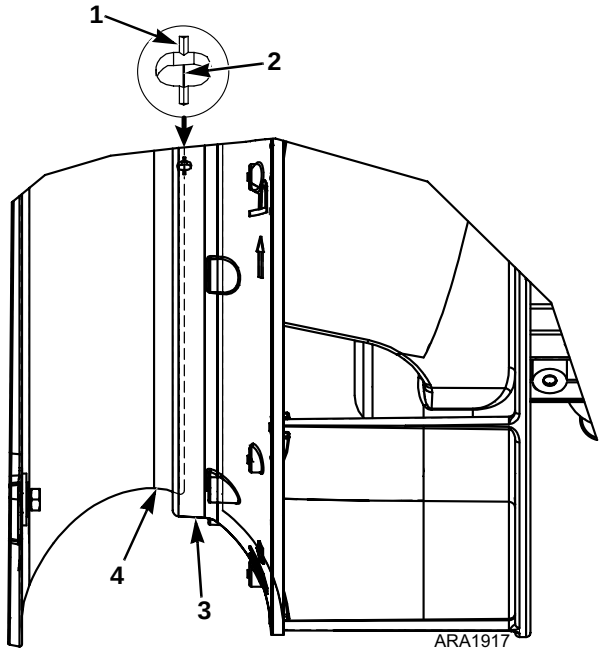
1. Loosen the orifice mounting bolts.
2. Slide the blower towards the orifice until it contacts the orifice. This centers the orifice in the blower.
3. Tighten the orifice mounting bolts securely.
4. Slide the blower away from the orifice.
5. Position the blower so the edge of the orifice lines up with the alignment mark on the blower as shown in Figure 250 and tighten the blower hub bolts.
6. Spin the blower by hand to check for blower distortion.



1.	Curbside Orifice	4.	Roadside Blower
2.	Curbside Blower	5.	Roadside Orifice
3.	Fan Motor		

Figure 249: Front View Showing Evaporator Fans/Blowers Through Access Panel

7. Pass a 0.09 in. (2.3 mm) diameter gauge wire completely around the circumference of the orifice and the blower wheel to check for uniform clearance.



1.	Alignment Mark	3.	Blower Wheel
2.	Edge of Orifice	4.	Orifice

Figure 250: Evaporator Blower Alignment (Curbside Shown Roadside Similar)

Mechanical Diagnosis

Condition	Possible Cause	Remedy
Engine will not crank	Electrical problem	Check and repair electrical system
	Defective starter solenoid	Replace solenoid
	Defective starter	Repair starter
	Water in cylinders	Check for hydrostatic lock. Remove injectors and turn engine slowly
Starter motor turns but engine does not crank	Starter clutch defective	Replace
Engine cranks but fails to start	Fuel solenoid not energized	Check 8D and 8DP and CHF circuits and fuel solenoid pull-in relay. Check that controller is configured for the correct engine. Refer to appropriate Microprocessor Diagnostic Manual.
	Fuel solenoid defective or stuck	Replace fuel solenoid
	Fuel injection pump defective	Replace injection pump
	Air heater defective	Replace air heater
	No fuel or wrong fuel	Fill with proper fuel
	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
	Injection nozzles defective	Replace nozzles
	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

Condition	Possible Cause	Remedy
Engine does not develop full power	Air intake system clogged	Clean air intake system
	Fuel tank vent clogged	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	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
	Injection pump timing off	Adjusting timing
	Injection nozzles defective	Repair or replace nozzles
	Worn injection pump plungers, delivery valve defective, injection rate too low, gum formations	Repair or replace pump
	Compression low or unbalanced	Overhaul engine
Engine speed too high	Misadjusted high speed solenoid	Adjust high speed solenoid linkage and check high speed stop screw
	Defective injection pump	Repair injection pump
Engine fails to stop when unit is OFF	Fuel solenoid defective	Replace
	Injection pump defective	Replace pump
Engine knocks heavily	Air in system	Bleed fuel system
	Wrong fuel	Change fuel
	Injection pump not timed	Retime injection pump
	Injection nozzles fouled or opening pressure too low	Clean, repair or replace injection nozzles
	Delivery valve spring broken	Replace spring or repair injection pump
	Compression too low	Overhaul engine
	Valve out of adjustment	Adjust valves
	Fuel return line plugged	Remove return line restriction
	Rod or main bearing worn	Replace rod or main bearings
Engine runs hot	Dirty radiator	Wash radiator
	Coolant level is low	Add coolant
	Cooling system heavily scaled	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

Condition	Possible Cause	Remedy
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 Installation Manual TK 55496
	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
- Improperly installed 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 FS8 blown	Check for short circuit and replace fuse
	Fuse F2, F8, or F12 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

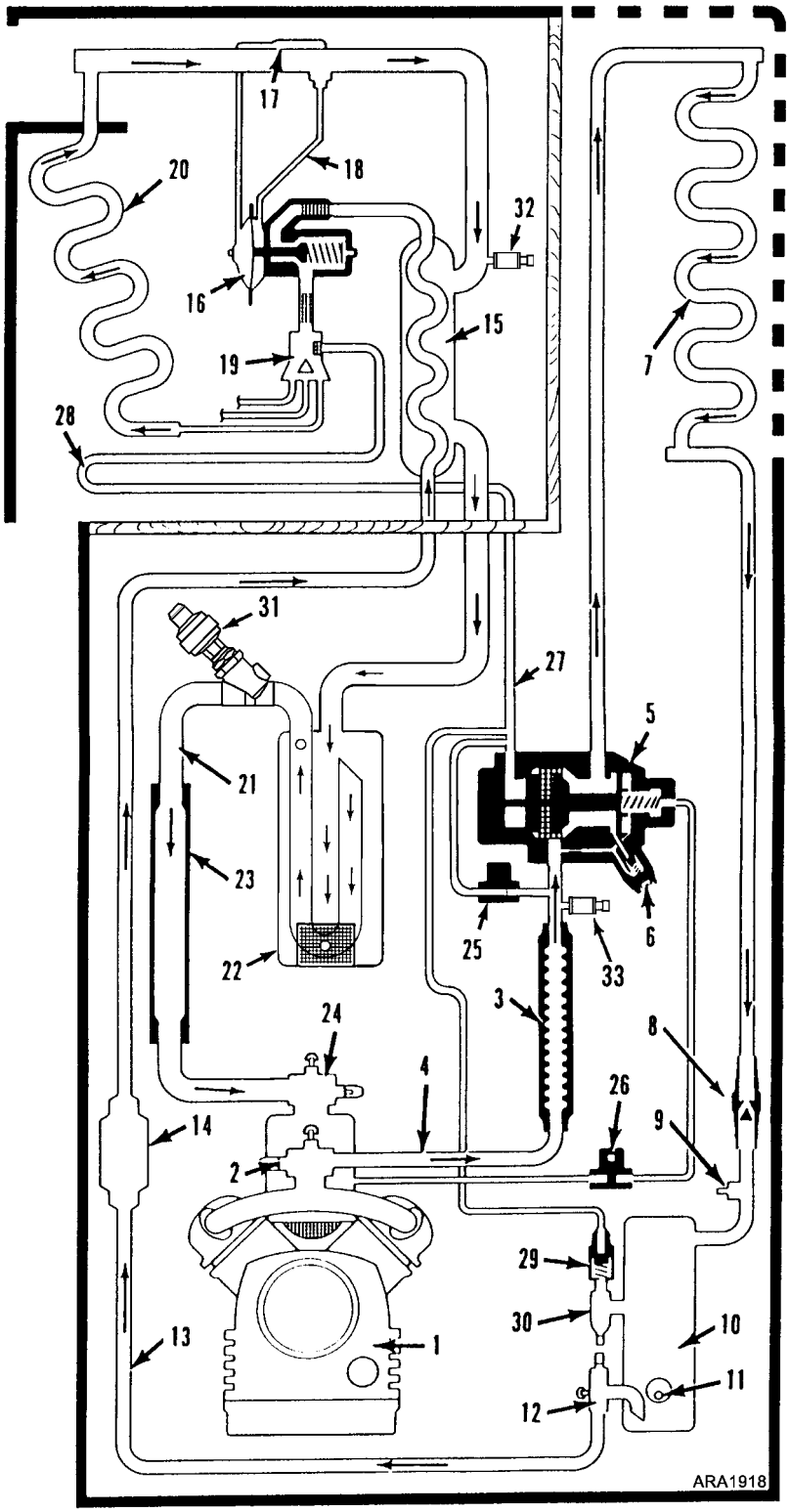
Rapid cycling between cool and heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump 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
						•		•									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 three-way valve
	•	•									•				•	•	Faulty pilot solenoid

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**
	•															•	Loose or broken electrical connections
•					•	•		•							•		Sensor out of calibration
					•	•	•	•									Compound pressure gauge out of calibration
											•						Leaky receiver tank outlet valve
											•						Leaky bypass check valve
																•	Leaky condenser check valve
																•	Faulty three-way condenser pressure bypass check valve
						•	•	•							•	•	Faulty ETV
				•	•						•				•	•	Hot gas bypass valve stuck open or leaking

Refrigeration Diagrams

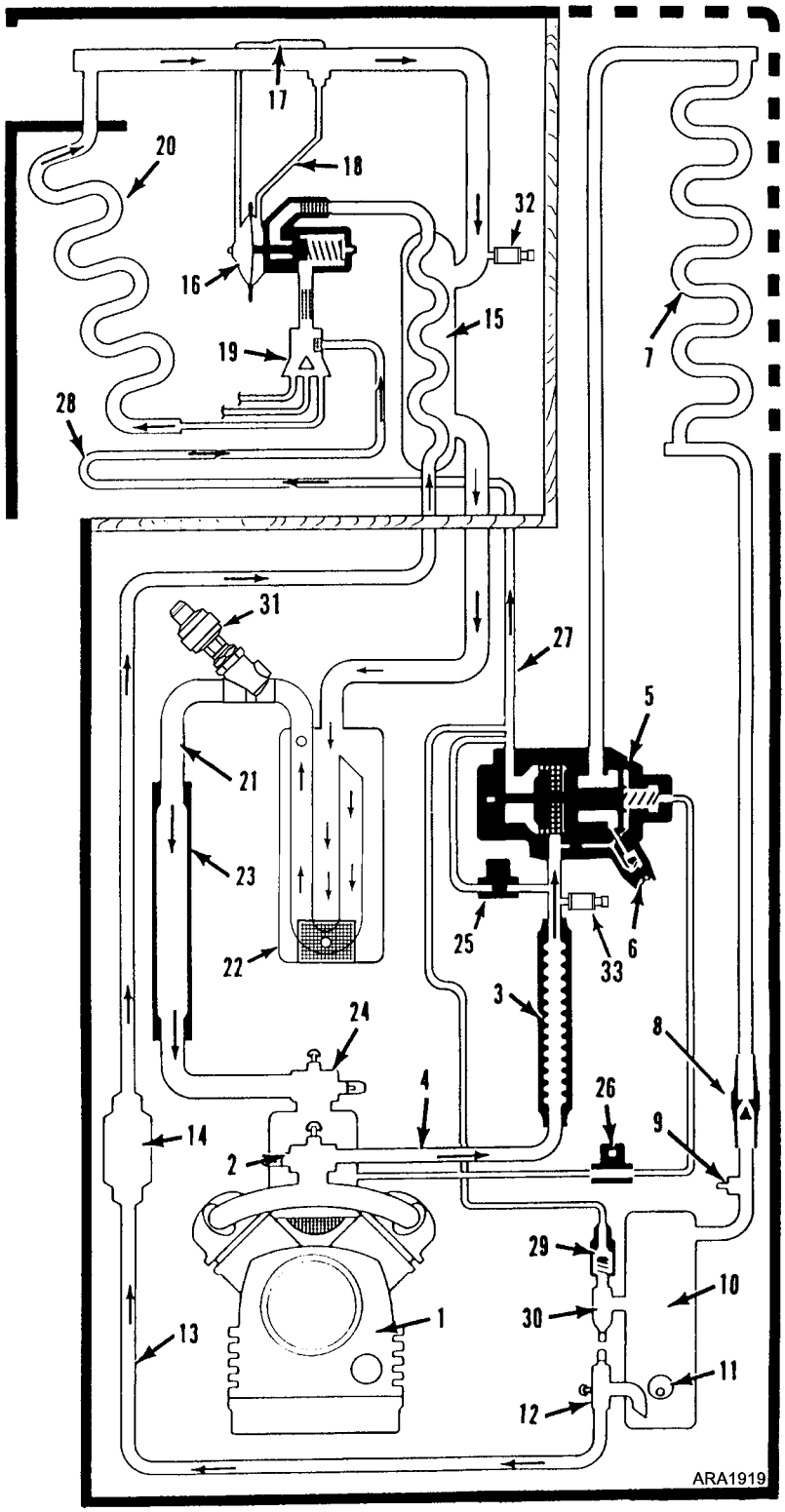
Cool Cycle With Electronic Throttling Valve

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



Heat/Defrost Cycle With Electronic Throttling Valve

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



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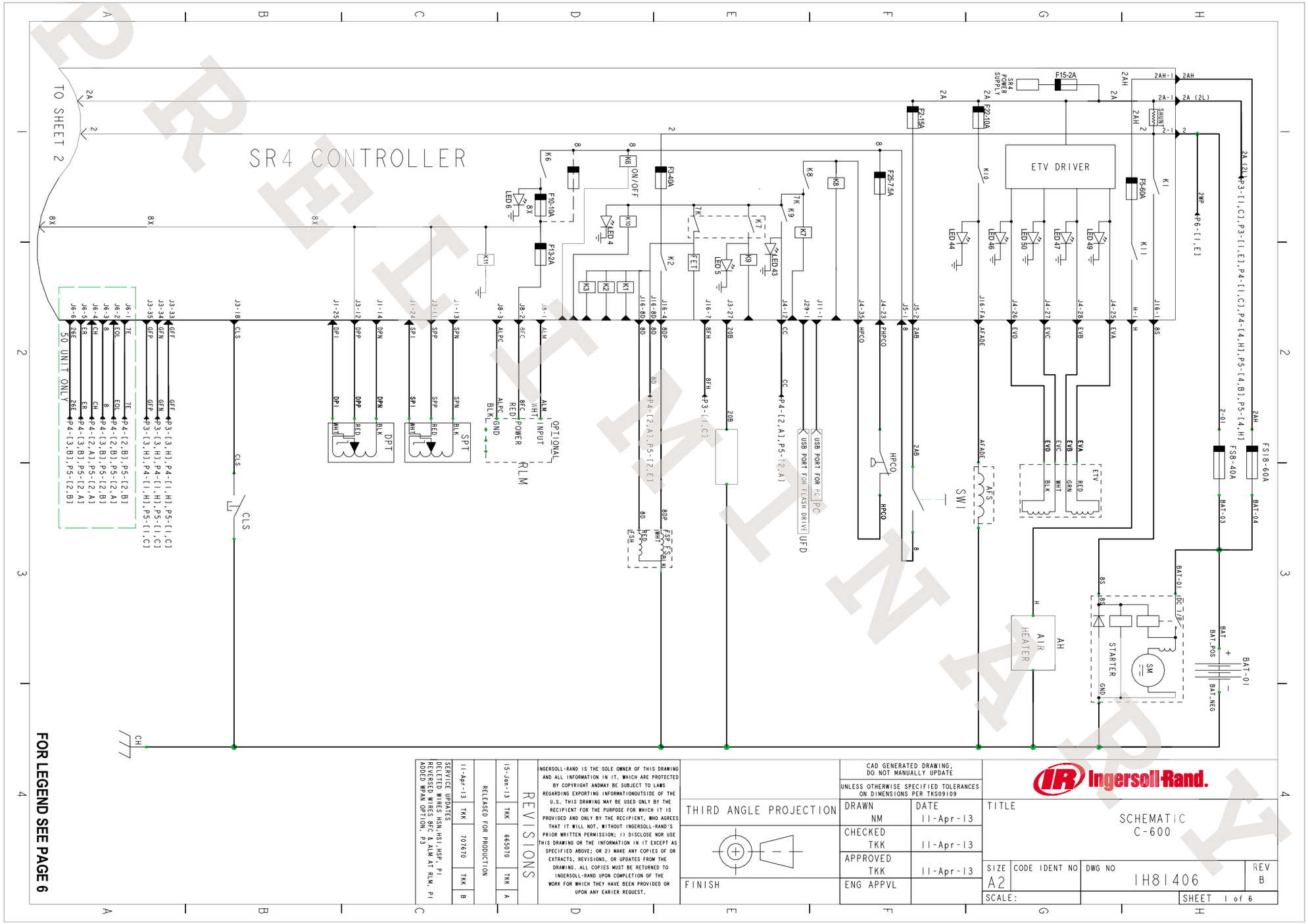

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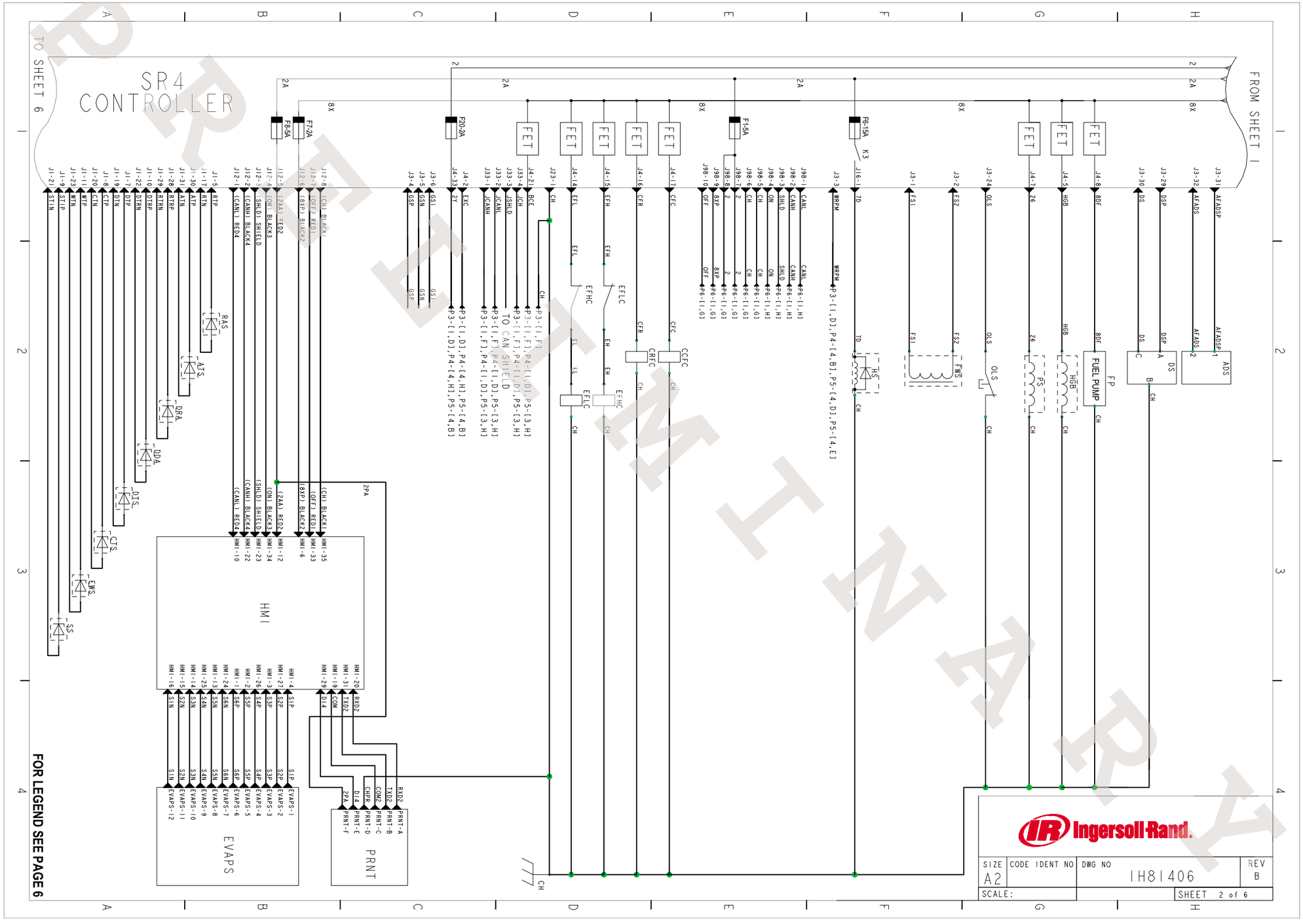

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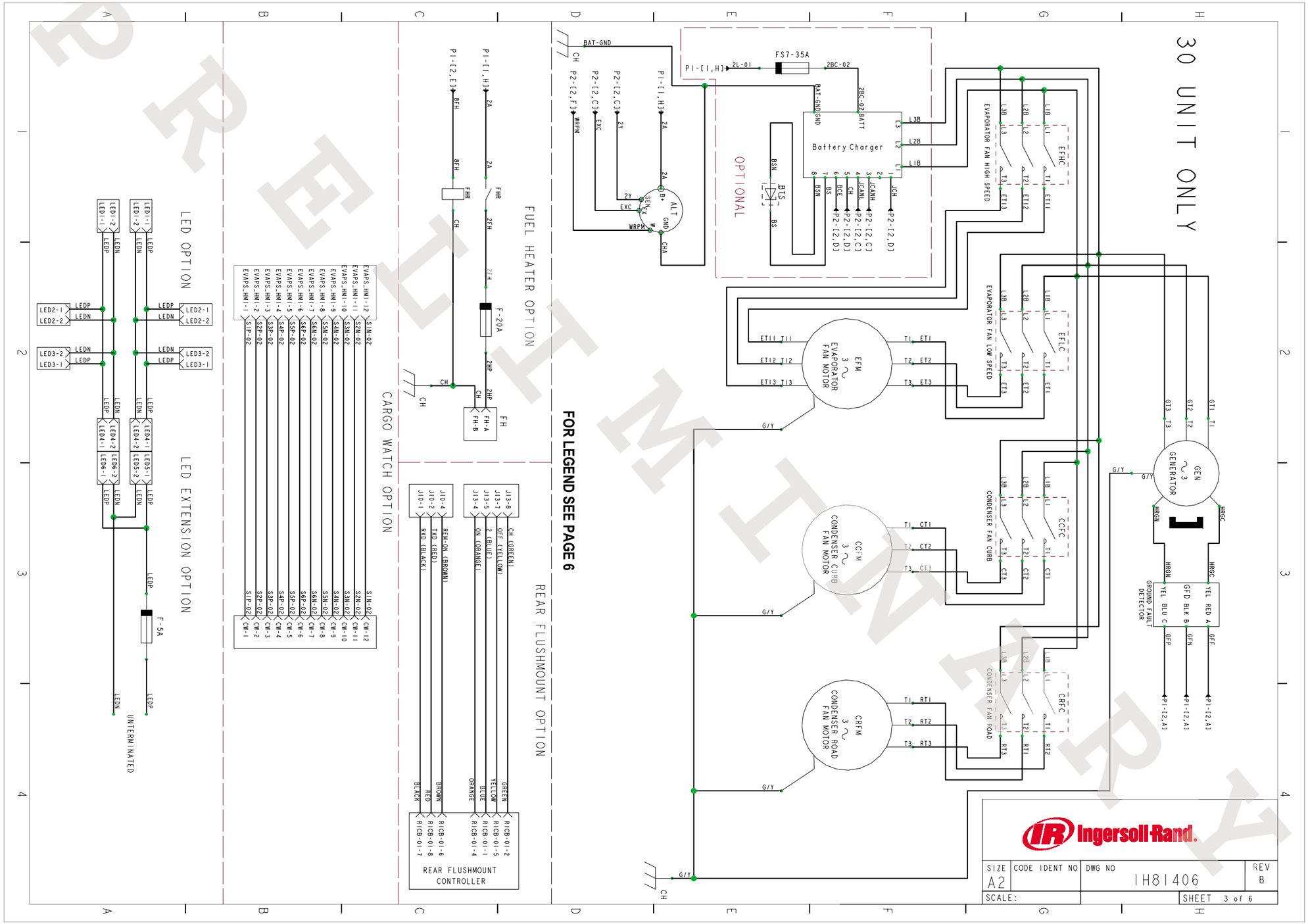

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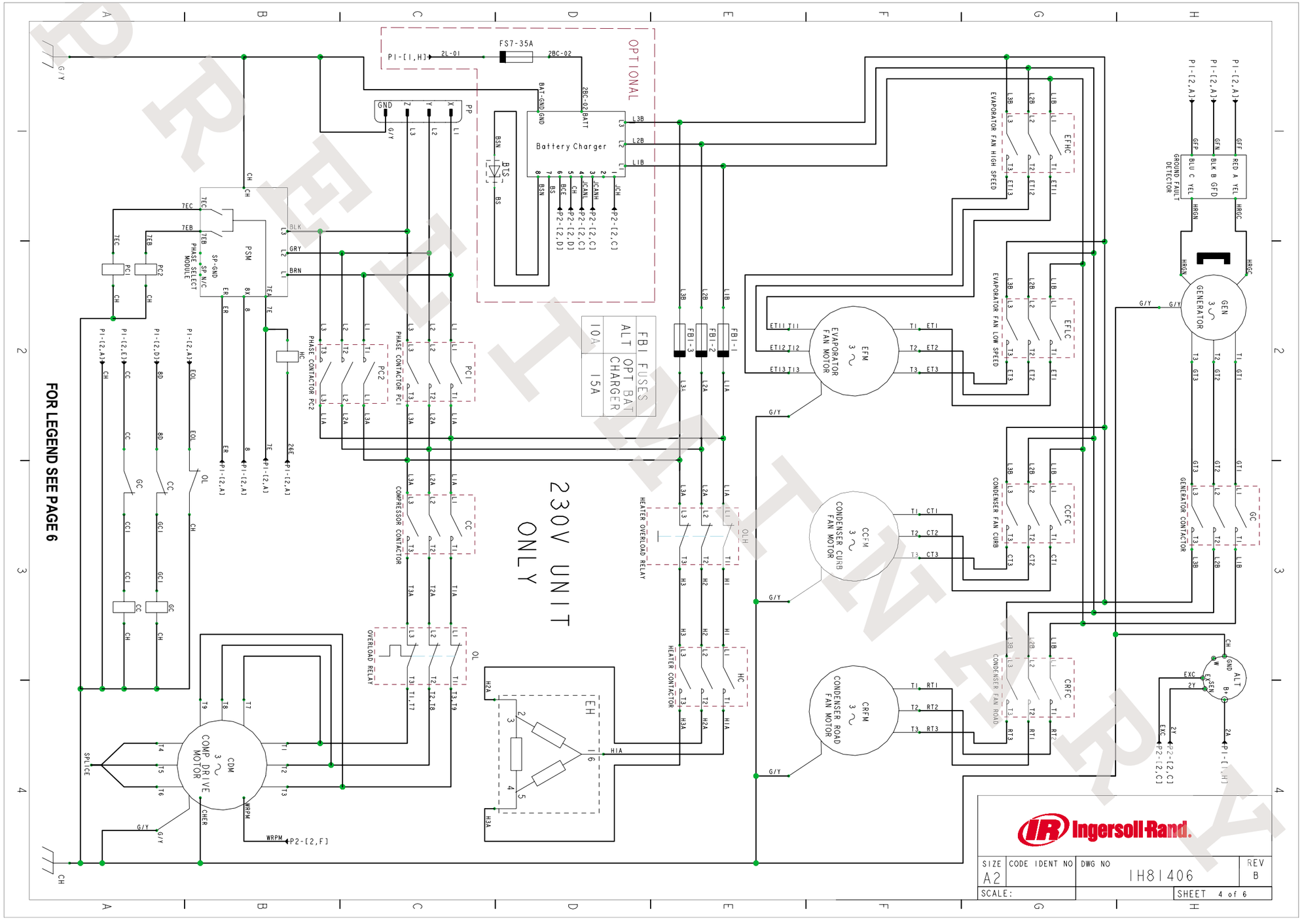

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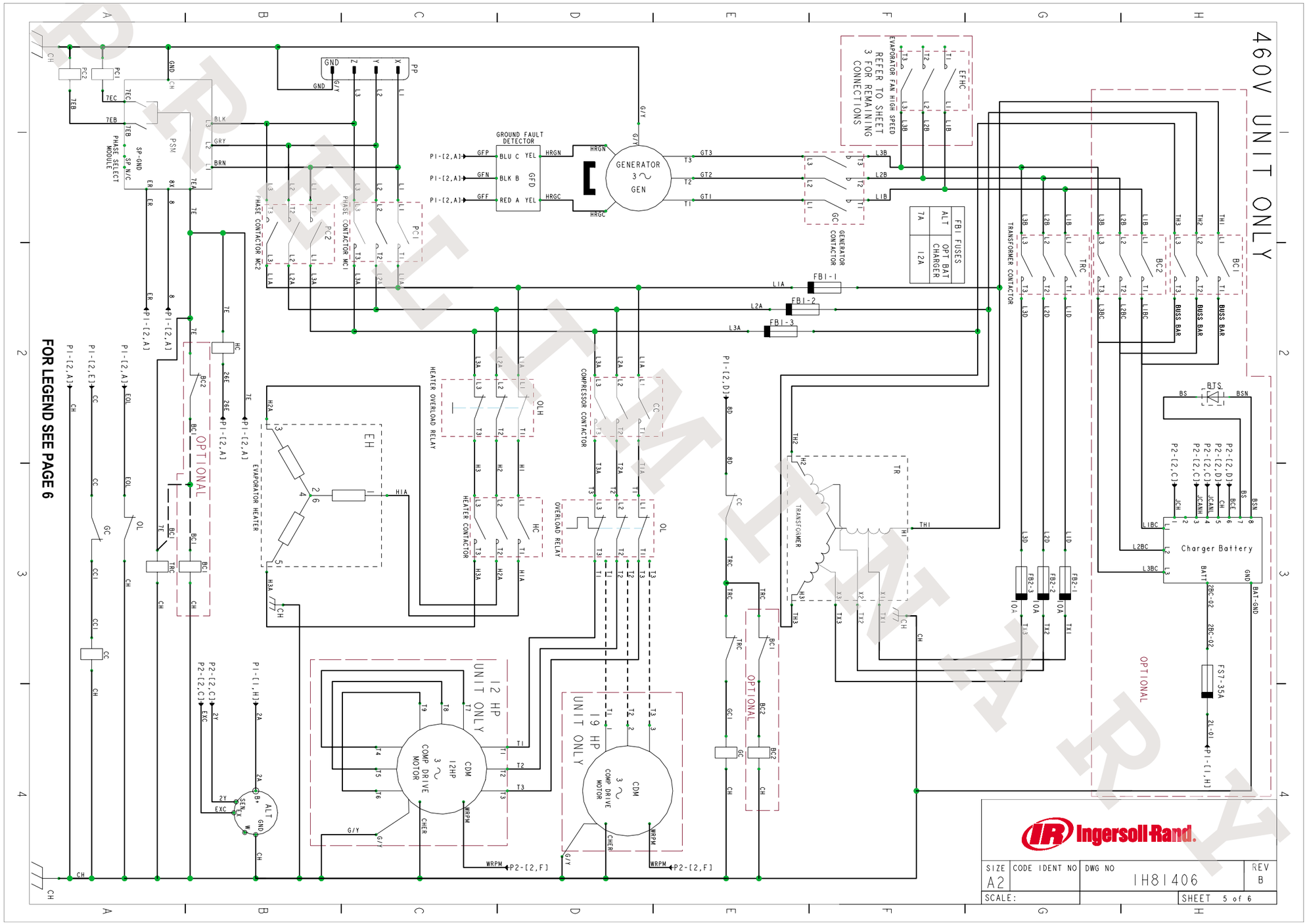

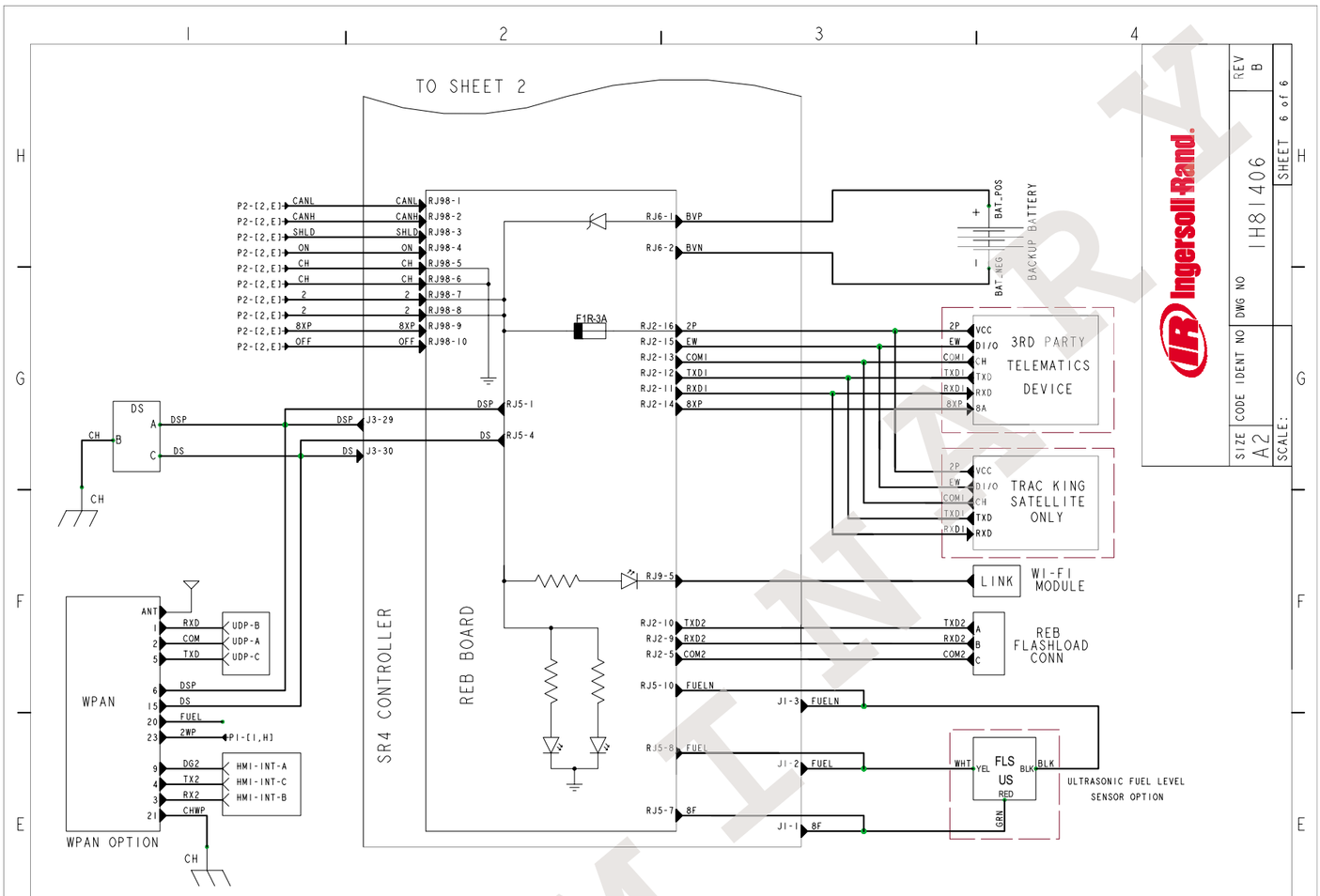

SCHEMATIC LEGEND

REF DES	DESCRIPTION	LOCATION
ADS	AIR DOOR SWITCH	2-2H
AFS	AUTO FRESH AIR SOLENOID	1-3G
ALT	ALTERNATOR	3-1E, 4-3H, 5-4B
ATS	AMBIENT AIR TEMP SENSOR	2-2B
BC1	BATTERY CHARGER CONTACTOR 1	5-2H, 5-3B, 5-3E
BC2	BATTERY CHARGER CONTACTOR 2	5-2H, 5-4E, 5-2B
BTS	BATTERY TEMPERATURE SENSOR	3-1E, 4-1D, 5-2H
CC	COMPRESSOR CONTACTOR	4-3A, 4-3C, 5-2D, 5-3A, 5-3E
CCFC	CONDENSER CURB SIDE FAN CONTACTOR	2-2E, 3-3G, 4-3G
CCFM	CONDENSER CURB SIDE FAN MOTOR	3-3F, 4-3F
CDM	COMPRESSOR DRIVE MOTOR	4-4B, 5-4C, 5-4D
CLS	COOLANT LEVEL SWITCH	1-3B
CRFC	CONDENSER ROAD SIDE FAN CONTACTOR	2-2D, 3-4G, 4-4G
CRFM	CONDENSER ROAD SIDE FAN MOTOR	3-4F, 4-4F
CTS	COIL TEMP SENSOR	2-3A
DDA	DISPLAY DISCHARGE AIR TEMP SENSOR	2-2A
DPT	DISCHARGE PRESSURE TRANSDUCER	1-2C
DRA	DISPLAY RETURN AIR TEMP SENSOR	2-2A
DS	DOOR SWITCH	2-2H, 6-1G
DTS	DISCHARGE AIR TEMP SENSOR	2-3A
EFHC	EVAPORATOR FAN HIGH SPEED CONTACTOR	2-2D, 3-1G, 4-1G, 5-1F
EFLC	EVAPORATOR FAN LOW SPEED CONTACTOR	2-2D, 3-2G, 4-2G
EFM	EVAP FAN MOTOR	3-2F, 4-2F
EH	EVAPORATOR HEATERS	4-4D, 5-3B
ETV	ELECTRIC THROTTLE VALVE	1-3G
EVAPS	EVAPORATOR SENSORS	2-4B
EWS	ENGINE WATER SENSOR	2-3A
F-20A	FUSE FUEL HEATER	3-2C
F-5A	FUSE LED EXTENSION HARNESS	3-3A
F1-5A	FUSE ON SR4 TO RADIO EXPANSION BOARD	2-1E
F10-10A	FUSE ON SR4 FROM K6, BYPASS HMI CONTROL	1-1D
F13-2A	FUSE ON SR4 TO RLM	1-2D
F15-2A	FUSE ON SR4 TO SR4 POWER SUPPLY	1-1G
F1R-3A	POWER TO 3RD PARTY RADIO	6-2G
F2-15A	FUSE ON SR4 TO ON/OFF SWITCH	1-1F
F20-2A	FUSE ON SR4 TO ALTERNATOR	2-1C
F22-10A	FUSE ON SR4 TO AFS	1-1G
F25-7.5A	FUSE ON SR4 TO HPCO	1-1F
F3-40A	FUSE ON SR4 TO FUEL SOLENOID POWER	1-1E
F5-60A	FUSE ON SR4 TO AIR HEATER	1-1H
F6-15A	FUSE ON SR4 TO HIGH SPEED SOLENOID	2-1F
F7-2A	FUSE ON SR4 TO HMI	2-1B
F8-5A	FUSE ON SR4 TO HMI & PRINTER PORT	2-1B
FB1-10A	FUSE BLOCK FANS & BATTERY CHARGER (230V)	4-2E
FB1-7A	FUSE BLOCK FANS & BATTERY CHARGER (460V)	5-2E
FB2-10A	FUSE BLOCK TRANSFORMER SECONDARY	5-3G
FH	FUEL HEATER	3-2C
FHR	FUEL HEATER RELAY	3-1C
FLS	FUEL LEVEL SENSOR	6-4E
FP	FUEL PUMP	2-2G
FS	FUEL SOLENOID	1-3D

REF DES	DESCRIPTION	LOCATION
FS18-60A	FUSE PRE-HEAT	1-2H
FS7-35A	FUSE BATTERY CHARGER TO LOAD	3-1E, 4-1D, 5-3H
FS8-40A	FUSE BATTERY TO K1 STARTER	1-2H
FWS	FLYWHEEL SENSOR	2-2F
GC	GENERATOR CONTACTOR	4-3A, 4-3H, 5-1F, 5-3A, 5-4E
GEN	GENERATOR	3-3H, 4-2H, 5-1D
GFD	GROUND FAULT DETECTOR	3-3H, 4-1H, 5-1D
HC	HEATER CONTACTOR	4-2B, 4-3E, 5-3D, 5-2B
HGB	HOT GAS BYPASS SOLENOID	2-2G
HMI	HUMAN/MACHINE INTERFACE	2-3B
HPCO	HIGH PRESSURE CUTOUT SWITCH	1-2F
HS	HIGH SPEED SOLENOID	2-2F
K1	RELAY STARTER ON SR4 PCB	1-2D, 1-1H
K10	RELAY AUTO FRESH AIR ON SR4 PCB	1-1D, 1-1G
K11	RELAY AIR HEATER ON SR4 PCB	1-2C, 1-2G
K2	RELAY FUEL SOLENOID POWER ON SR4 PCB	1-2D
K3	RELAY HIGH SPEED SOLENOID ON SR4 PCB	1-2D, 2-1F
K6	RELAY ON/OFF ON SR4 PCB	1-1D
K7	RELAY DIESEL/ELECTRIC ON SR4 PCB	1-1E
K8	RELAY RUN ON SR4 PCB	1-1F, 1-1E
K9	RELAY COMPRESSOR DRIVE MOTOR ON SR4 PCB	1-2E
LED 4	RUN RELAY 7K	1-1D
LED 43	COMPRESSOR CONTACTOR CC	1-2E
LED 44	AUTO FRESH AIR AFADE	1-1F
LED 46	ELECTRIC THROTTLING VALVE - EVD	1-1G
LED 47	ELECTRIC THROTTLING VALVE - EVB	1-1G
LED 49	ELECTRIC THROTTLING VALVE - EVA	1-1G
LED 5	FUEL PUMP 8D	1-2E
LED 50	ELECTRIC THROTTLING VALVE - EVC	1-1G
LED 6	ON/OFF 8X	1-1D
LOPS	LOW OIL PRESSURE SWITCH	1-2E
OL	OVERLOAD RELAY COMPRESSOR DRIVE MOTOR	4-3B, 4-3C, 5-3A, 5-3D
OLH	OVERLOAD RELAY HEATERS	4-3E, 5-2C
OLS	OIL LEVEL SWITCH	2-2G
PC	USB PORT FOR PC	1-2F
PC1	PHASE CONTACTOR (NOT REVERSED)	4-2A, 4-2C, 5-1A, 5-1C
PC2	PHASE CONTACTOR (REVERSED)	4-2A, 4-2C, 5-1A, 5-1B
PP	POWER PLUG	4-1C, 5-1C
PRNT	PRINTER PORT	2-4C
PS	PILOT SOLENOID	2-2G
PSM	PHASE SELECT MODULE	4-2B, 5-1A
RAS	RETURN AIR TEMP SENSOR	2-2B
RLM	REMOTE LIGHT MODULE	1-2D
SM	STARTER MOTOR	1-3H
SPT	SUCTION PRESSURE TRANSDUCER	1-2C
SS	SPARE SENSOR	2-3A
SW1	ON/OFF SWITCH	1-3F
TR	TRANSFORMER	5-3F
TRC	TRANSFORMER CONTACTOR	5-3A, 5-2G, 5-3E
UFD	USB PORT FOR FLASH DRIVE	1-2E

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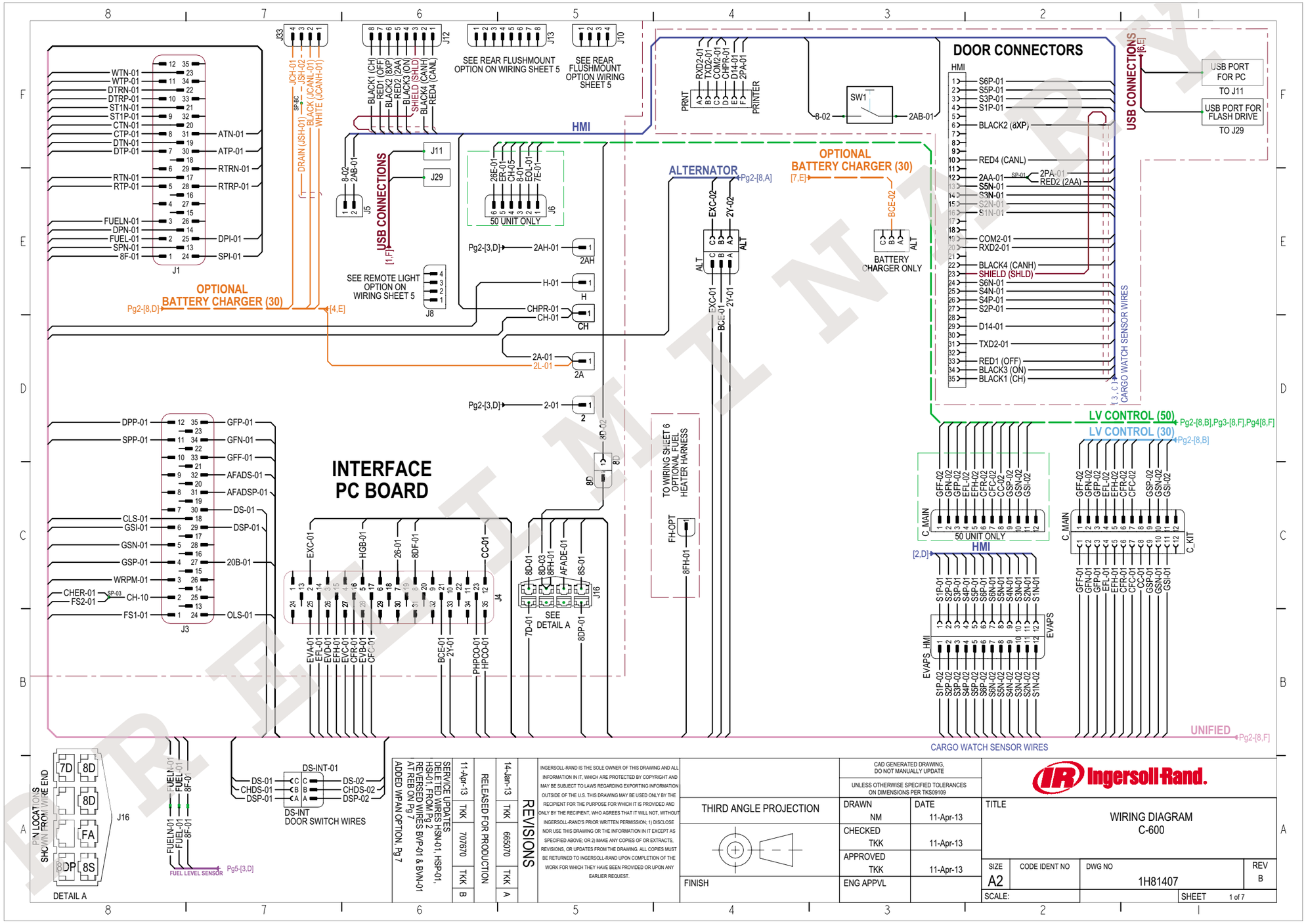

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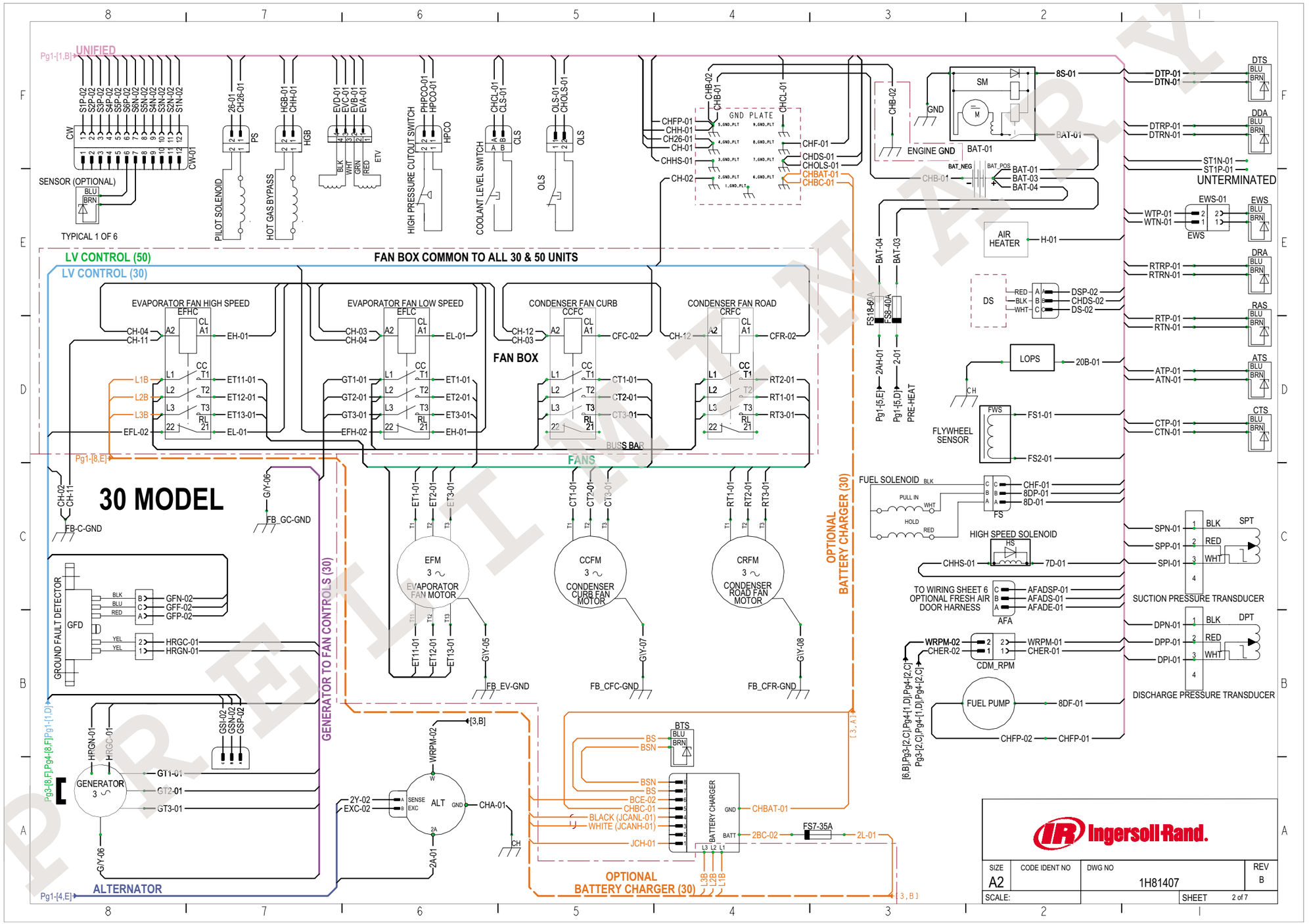

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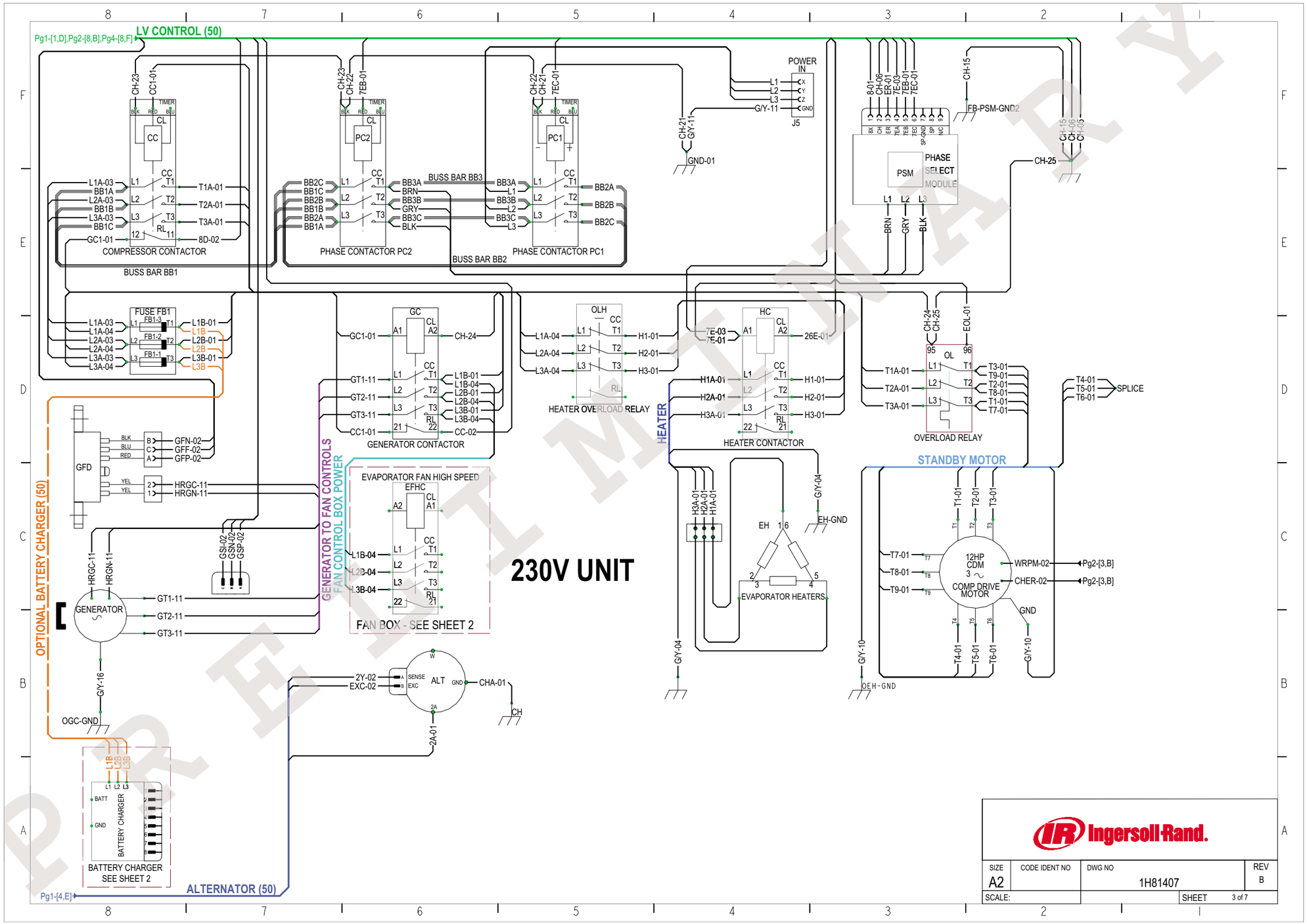

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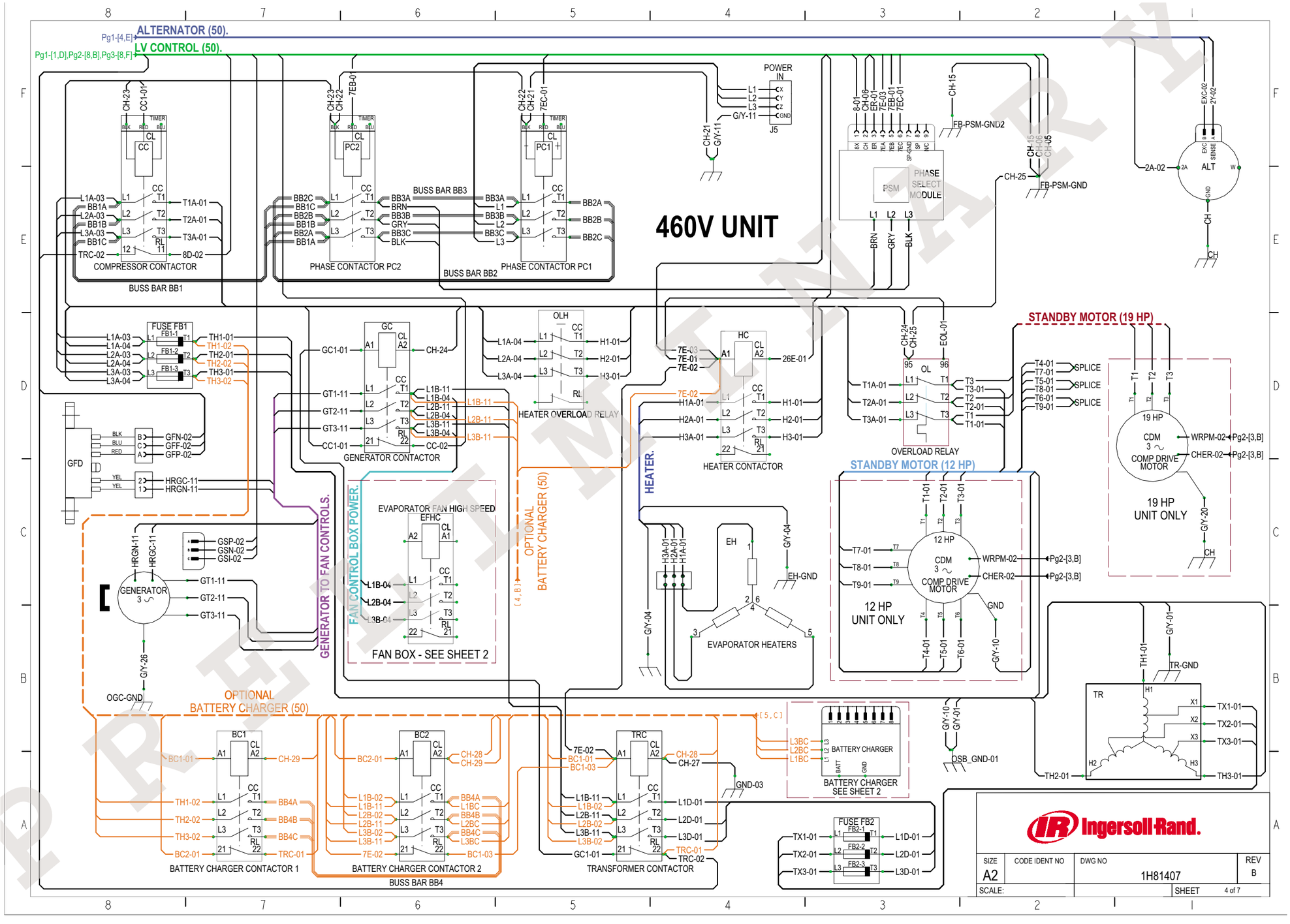

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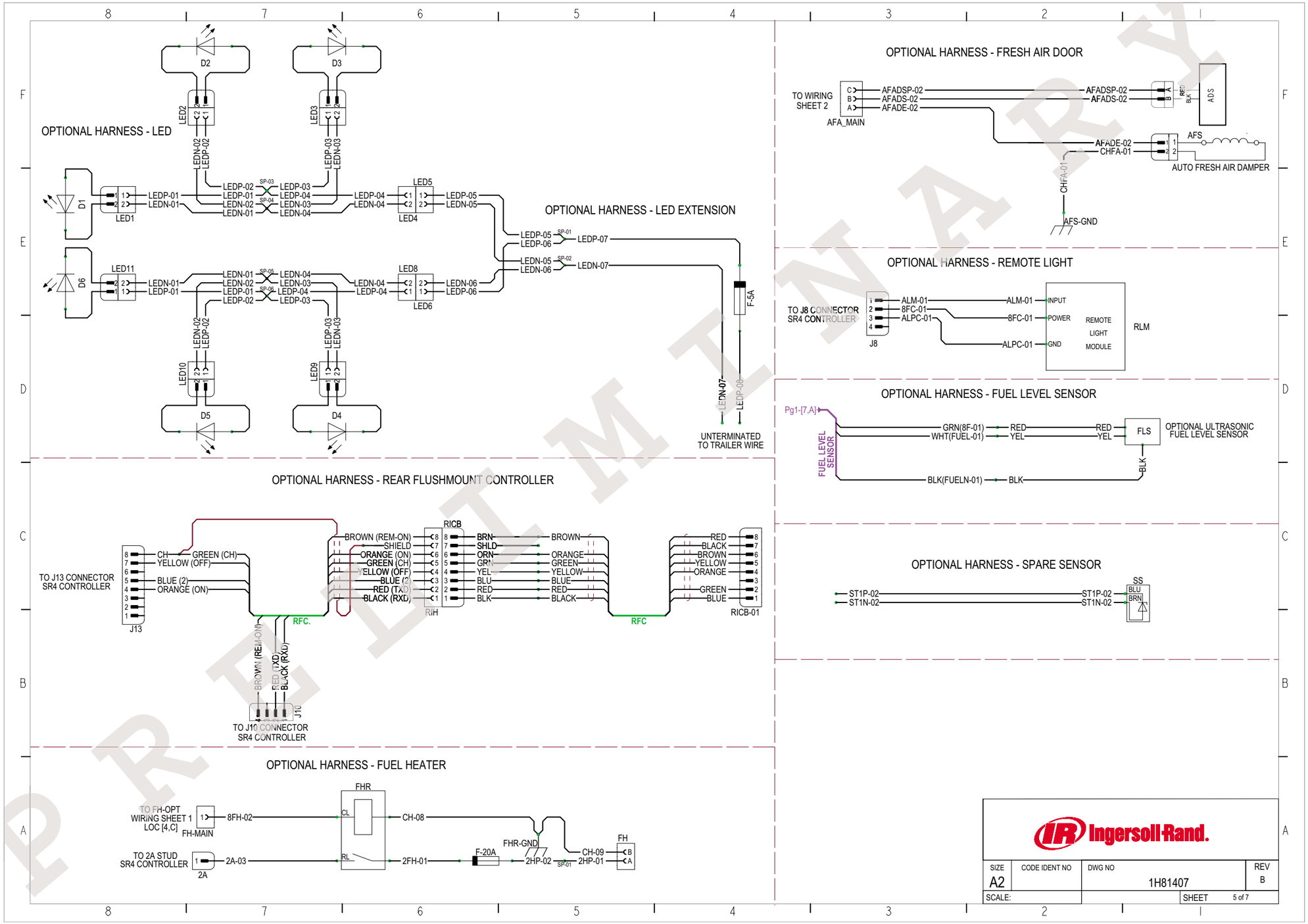

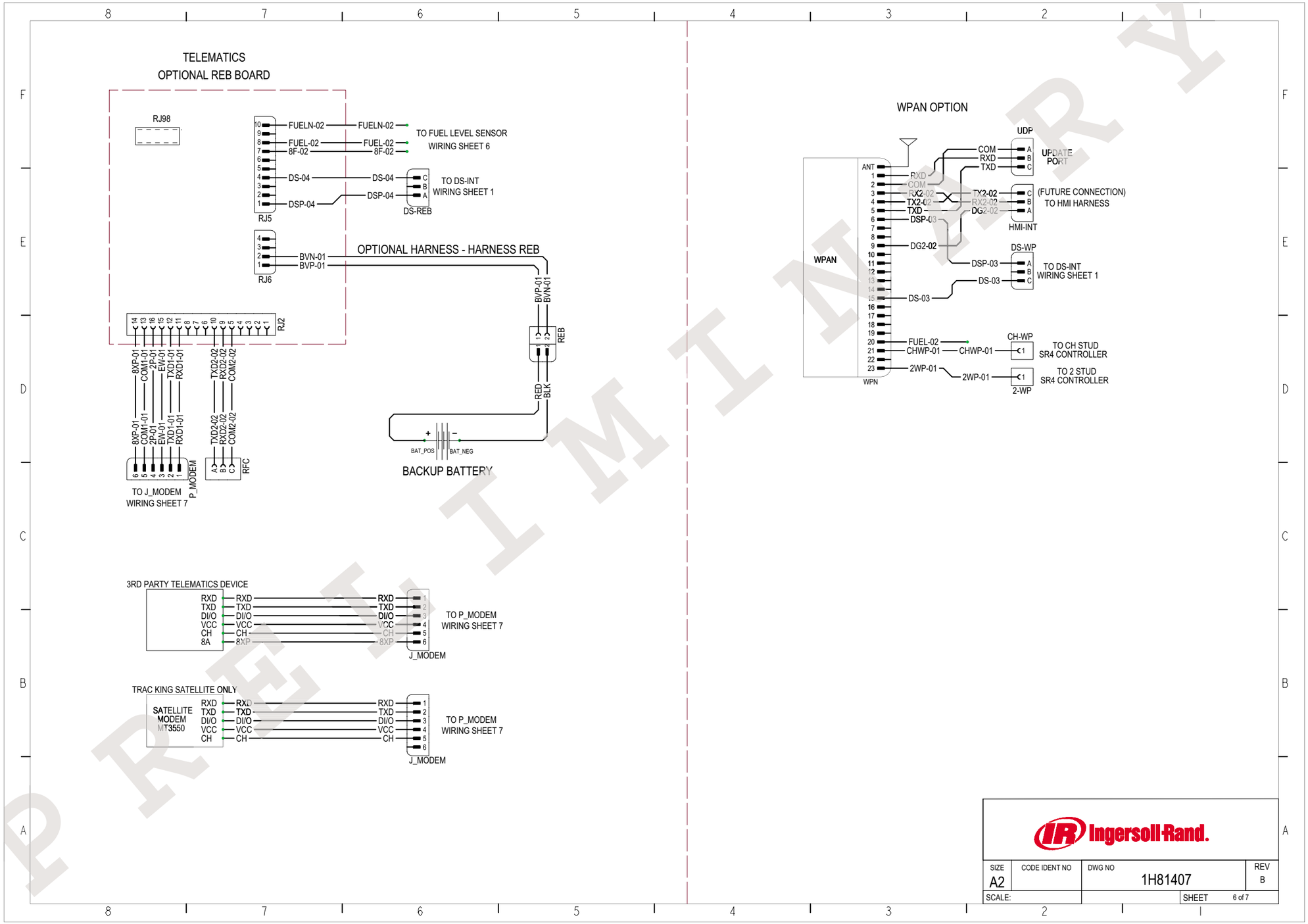

SIZE	CODE IDENT NO	DWG NO	REV
A2		1H81407	B
SCALE:		SHEET 6 of 7	

Wiring Diagram - Page 7 of 7

WIRE CODE	SIGNAL DESCRIPTION
2-01	FS8 FUSE to SR4 BOARD
20B-01	LOW OIL PRESSURE SWITCH
26-01	PILOT SOLENOID
26E-01	HEATER CONTACTOR NEGATIVE
2A-01	ALTERNATOR POWER
2AA	J12-5 TO HMI-12
2AB-01	ON/OFF SWITCH
2AH-01	PREHEAT
2FH-01	FUEL HEATER POWER
2HP-01	FUEL HEATER FUSE POWER
2HP-02	FUEL HEATER FUSE POWER
2P-01	REB TO J_MODEM
2PA-01	PRINTER PORT-F TO HMI-12
2WP-01	WPAN TO SR4
2Y-01	ALTERNATOR SENSE
7D-01	HIGH SPEED SOLENOID
7E-01	HEATER CONTACTOR POSITIVE
7EB-01	PHASE CONTACTOR REVERSED
7EC-01	PHASE CONTACTOR NOT REVERSED
8-01	ON/OFF SWITCH
8D-01	FUEL SOLENOID
8D-02	COMPRESSOR CONTACTOR AUX NC
8DF-01	FUEL PUMP
8DP-01	FUEL SOLENOID POSITIVE
8F-01	FUEL LEVEL POSITIVE
8FC-01	REMOTE LIGHT OPTION POSITIVE
8FH-01	FUEL HEATER
8S-01	STARTER
8XP	J12-6 TO HMI-6
AFADE-01	AUTO FRESH AIR DOOR ENABLE
AFADS-01	AUTO FRESH AIR DOOR SWITCH
AFADSP-01	AUTO FRESH AIR DOOR SWITCH POSITIVE
ALM-01	REMOTE LIGHT OPTION
ALPC-01	REMOTE LIGHT OPTION
ATN-01	AMBIENT TEMPERATURE NEGATIVE
ATP-01	AMBIENT TEMPERATURE POSITIVE
BAT-01	BATTERY +VE
BC1-01	BATTERY CHARGER CONTACTOR 1 TO TRANSFORMER CONTACTOR
BC2-01	BATTERY CHARGER CONTACTOR 1 TO BATTERY CHARGER CONTACTOR 2
BCE-01	BATTERY CHARGER ENABLE
BS	BATTERY TEMPERATURE SENSOR
BSN	BATTERY TEMPERATURE SENSOR NEGATIVE
BVN-01	REB HARNESS TO BACKUP BAT NEG
BVP-01	REB BOARD TO BACKUP BAT POS
CANH	J12-2 TO HMI-22
CANL	J12-1 TO HMI-10
CC-01	GENERATOR CONTACTOR AUX NC
CC1-01	COMPRESSOR CONTACTOR
CFC-01	CONDENSER FAN CURB SIDE CONTACTOR
CFR-01	CONDENSER FAN ROAD SIDE CONTACTOR
CH	J12-8 TO HMI-35
CH-01	CHASSIS GROUND
CH26-01	PILOT SOLENOID GROUND
CHA-01	ALTERNATOR GROUND
CHCL-01	COOLANT LEVEL GROUND
CHDS-01	DOOR SWITCH GROUND
CHER-01	COMPRESSOR DRIVE MOTOR RPM GROUND
CHF-01	FUEL SOLENOID GROUND
CHFP-01	FUEL PUMP GROUND
CHH-01	HOT GAS BYPASS GROUND
CHHS-01	HIGH SPEED SOLENOID GROUND
CHOLS-01	OIL LEVEL SWITCH GROUND
CHPR-01	PRINTER GROUND
CHWP-01	WPAN MODULE TO CH STUD ON SR4
CLS-01	COOLANT LEVEL SWITCH
COM	WPAN MODULE TO UPDATE PORT
COM2-01	PRINTER-C TO HMI-19
CTN-01	COIL TEMPERATURE NEGATIVE
CTP-01	COIL TEMPERATURE POSITIVE
D14-01	PRINTER PORT
DG2-02	WPAN MODULE TO HMI
DI/O	3RD PARTY TELEMATICS TO P_MODEM
DPI-01	DISCHARGE PRESSURE TRANSDUCER
DPN-01	DISCHARGE PRESSURE TRANSDUCER NEGATIVE
DPP-01	DISCHARGE PRESSURE TRANSDUCER POSITIVE
DS-01	DOOR SWITCH
DS-03	WPAN MODULE TO DS-WP

WIRE CODE	SIGNAL DESCRIPTION
DSP-01	DOOR SWITCH POSITIVE
DSP-03	WPAN MODULE TO DS-WP
DTN-01	DISCHARGE AIR SENSOR NEGATIVE
DTP-01	DISCHARGE AIR SENSOR POSITIVE
DTRN-01	DISCHARGE AIR DISPLAY NEGATIVE
DTRP-01	DISCHARGE AIR DISPLAY POSITIVE
EFH-01	EVAPORATOR FAN LOW SPEED CONTACTOR
EFL-01	EVAPORATOR FAN HIGH SPEED CONTACTOR
EH-01	EVAPORATOR FAN HIGH SPEED CONTACTOR
EL-01	EVAPORATOR FAN LOW SPEED CONTACTOR
EOL-01	COMPRESSOR DRIVE MOTOR OVERLOAD
ER-01	ELECTRIC RELAY TO PHASE SELECT MODULE
EVA-01	ELECTRIC THROTTLING VALVE
EVB-01	ELECTRIC THROTTLING VALVE
EVC-01	ELECTRIC THROTTLING VALVE
EVD-01	ELECTRIC THROTTLING VALVE
EW-01	REB TO J_MODEM
EXC-01	ALTERNATOR EXCITATION
FS1-01	FLYWHEEL SENSOR 1
FS2-01	FLYWHEEL SENSOR 2
FUEL-01	FUEL LEVEL SENSOR
FUELN-01	FUEL LEVEL NEGATIVE
G/Y-01	GREEN/YELLOW HIGH VOLTAGE GROUND
GC1-01	GENERATOR CONTACTOR COIL/TRANSFORMER NC AUX
GFF-01	GROUND FAULT FAILURE
GFN-01	GROUND FAULT NEGATIVE
GFP-01	GROUND FAULT POSITIVE
GSI-02	GENERATOR CURRENT SENSOR
GSN-02	GENERATOR CURRENT SENSOR NEGATIVE
GSP-02	GENERATOR CURRENT SENSOR POSITIVE
GT1-01	GENERATOR OUTPUT
GT2-01	GENERATOR OUTPUT
GT3-01	GENERATOR OUTPUT
H-01	AIR HEATER
H1-01	HEATER OVERLOAD TO HEATER CONTACTOR
H1A-01	EVAPORATOR HEATERS
H2-01	HEATER OVERLOAD TO HEATER CONTACTOR
H2A-01	EVAPORATOR HEATERS
H3-01	HEATER OVERLOAD TO HEATER CONTACTOR
H3A-01	EVAPORATOR HEATERS
HGB-01	HOT GAS BYPASS
HPCO-01	HIGH PRESSURE CUTOUT
HRGC-01	HIGH RESISTANCE GROUND
HRGN-01	HIGH RESISTANCE GROUND NEGATIVE
JCANH-01	J33-1 TO BAT CHARGER - 3
JCANL-01	J33-2 TO BAT CHARGER - 4
JCH-01	J33-4 TO BAT CHARGER - 1
JSH-01	J33-3
JSH-02	J33-2
L1	POWER PLUG TO PC1 & PC2
L1A-03	COMP CONT TO FUSE FB1 TO OLH
L1B-01	GENERATOR CONTACTOR TO FAN CONTACTORS
L1BC	BATTERY CHARGER TO BATTERY CHARGER CONTACTOR 2
L1D-01	TRANSFORMER CONTACTOR TO FUSE FB2
L2	POWER PLUG TO PC1 & PC2
L2A-03	COMP CONT TO FUSE FB1 TO OLH
L2B-01	GENERATOR CONTACTOR TO FAN CONTACTORS
L2D-01	TRANSFORMER TO FUSE FB2
L3	POWER PLUG TO PC1 & PC2
L3A-03	COMP CONT TO FUSE FB1 TO OLH
L3B-01	GENERATOR CONTACTOR TO FAN CONTACTORS
L3D-01	TRANSFORMER CONTACTOR TO FUSE FB2
LEDN-01	LED NEGATIVE
LEDP-01	LED POSITIVE
OFF	J12-7 TO HMI-33
OLS-01	OIL LEVEL SWITCH
ON	J12-5 TO HMI-34
PHPCO-01	HIGH PRESSURE CUTOUT POSITIVE
RTN-01	RETURN AIR NEGATIVE
RTP-01	RETURN AIR POSITIVE
RTRN-01	RETURN AIR DISPLAY NEGATIVE
RTRP-01	RETURN AIR DISPLAY POSITIVE
RX2-02	WPAN MODULE TO HMI
RXD	WPAN MODULE TO UPDATE PORT
RXD2-01	PRINTER-A TO HMI-20
S1N-01	CARGO WATCH SENSOR 1 NEGATIVE
S1P-01	CARGO WATCH SENSOR 1 POSITIVE

WIRE CODE	SIGNAL DESCRIPTION
S2N-01	CARGO WATCH SENSOR 2 NEGATIVE
S2P-01	CARGO WATCH SENSOR 2 POSITIVE
S3N-01	CARGO WATCH SENSOR 3 NEGATIVE
S3P-01	CARGO WATCH SENSOR 3 POSITIVE
S4N-01	CARGO WATCH SENSOR 4 NEGATIVE
S4P-01	CARGO WATCH SENSOR 4 POSITIVE
S5N-01	CARGO WATCH SENSOR 5 NEGATIVE
S5P-01	CARGO WATCH SENSOR 5 POSITIVE
S6N-01	CARGO WATCH SENSOR 6 NEGATIVE
S6P-01	CARGO WATCH SENSOR 6 POSITIVE
SHLD	J12-3 TO HMI-23
SPI-01	SUCTION PRESSURE TRANSDUCER
SPN-01	SUCTION PRESSURE TRANSDUCER NEGATIVE
SPP-01	SUCTION PRESSURE TRANSDUCER POSITIVE
ST1N-01	SPARE SENSOR NEGATIVE
ST1P-01	SPARE SENSOR POSITIVE
T1-01	COMPRESSOR DRIVE MOTOR
T2-01	COMPRESSOR DRIVE MOTOR
T3-01	COMPRESSOR DRIVE MOTOR
TH1-01	TRANSFORMER PRIMARY
TH2-01	TRANSFORMER PRIMARY
TH3-01	TRANSFORMER PRIMARY
TRC-01	COMP CONT TO TRANSFORMER CONTACTOR
TX1-01	TRANSFORMER SECONDARY
TX2-01	TRANSFORMER SECONDARY
TX2-02	WPAN MODULE TO HMI
TX3-01	TRANSFORMER SECONDARY
TXD	WPAN MODULE TO UPDATE PORT
TXD2-01	PRINTER-B TO HMI-31
VCC	3RD PARTY TELEMATICS TO P_MODEM
WRPM-01	COMPRESSOR DRIVE MOTOR RPM
WTN-01	ENGINE WATER SENSOR NEGATIVE
WTP-01	ENGINE WATER SENSOR POSITIVE

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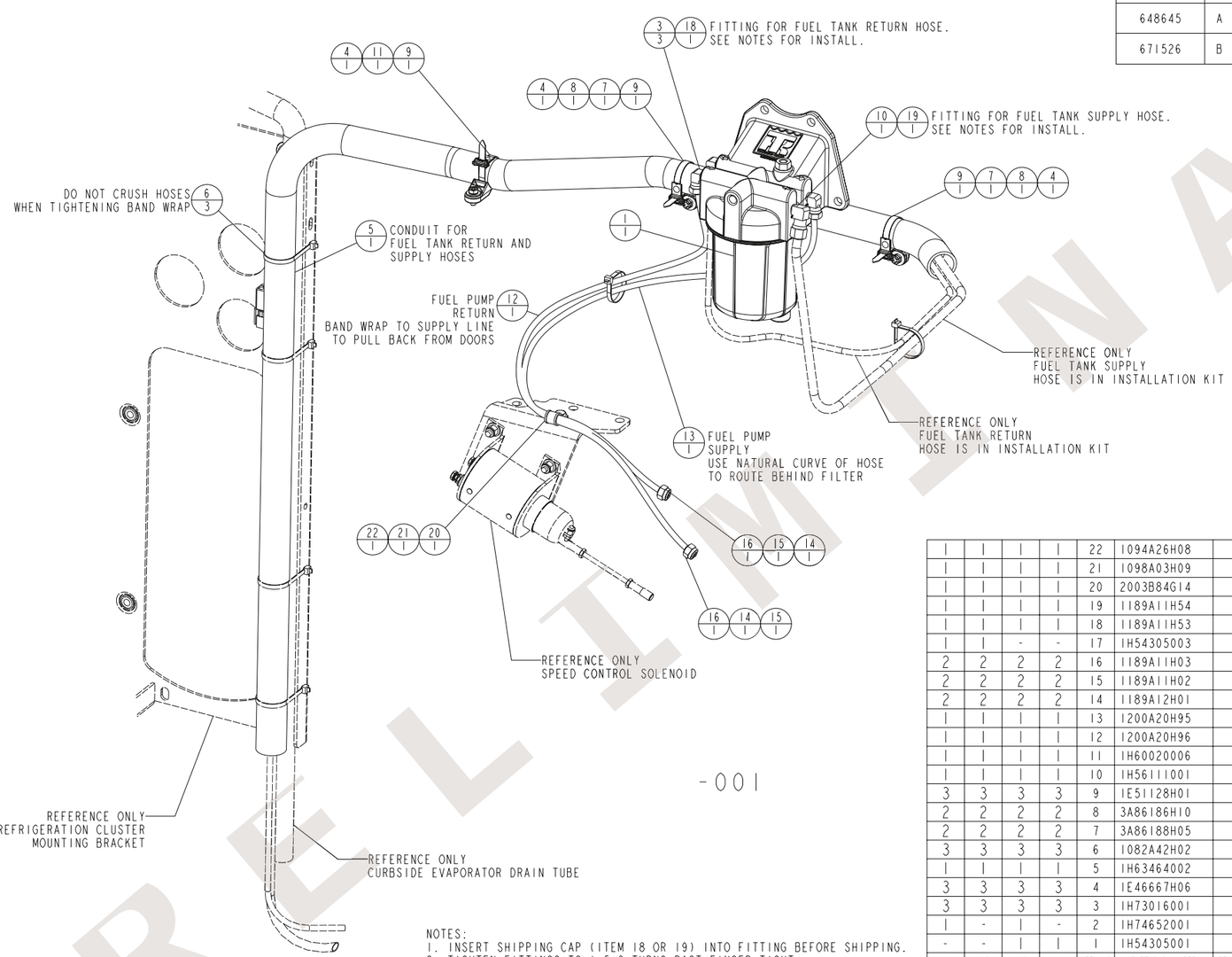
SIZE	CODE IDENT NO	DWG NO	REV
A2		1H81407	B
SCALE:		SHEET 7 of 7	

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
648645	A	P/N WAS IH58940001 THRU -004, RELEASED FOR C-600 PRODUCTION	11-Sep-12	SCOTT MILTON
671526	B	REROUTED FUEL LINES SHORTENED CONDUIT TO AVOID RUBBING	13-DEC-12	SCOTT MILTON



004	003	002	001	ITEM NO	PART/DWG NUMBER	REV.	DESCRIPTION	MATERIAL SPEC	WEIGHT
1	1	1	1	22	1094A26H08		SCREW, HH 1/4-20 X .50 SZN		
1	1	1	1	21	1098A03H09		WASHER, FLAT 1/4 SZN NARROW		
1	1	1	1	20	2003B84G14		CLAMP, SS .500 CLAMP DIA		
1	1	1	1	19	1189A11H54		FITTING 3/8		
1	1	1	1	18	1189A11H53		FITTING 1/4		
1	1	-	-	17	IH54305003		FILTER-FUEL, ASSY 3000 HR		
2	2	2	2	16	1189A11H03		NUT, FTG HOSE 1/4		
2	2	2	2	15	1189A11H02		SLEEVE, FTG HOSE 1/4		
2	2	2	2	14	1189A12H01		EYELET-FTG HOSE 1/4		
1	1	1	1	13	1200A20H95		HOSE- FUEL 6.3MM OD X 873		
1	1	1	1	12	1200A20H96		HOSE- FUEL 6.3MM OD x 726		
1	1	1	1	11	IH60020006		SCREW - SEMS M6 X 1.0 X 16 STL		
1	1	1	1	10	IH56111001		FITTING - 3/8 HOSE PLATED		
3	3	3	3	9	IE51128H01		CABLE TIE-STD 9.0 LG		
2	2	2	2	8	3A86186H10		WASHER, FLAT M6 SS		
2	2	2	2	7	3A86188H05		NUT, HEX LOCK M6X1.0 SZN		
3	3	3	3	6	1082A42H02		BAND WRAP, 1.75 DIA BLACK		
1	1	1	1	5	IH63464002		CONDUIT FUEL HOSE 34.50 OD X 3.2 WALL		
3	3	3	3	4	IE46667H06		CABLE TIE MOUNTS 5/16 HARDWARE		
3	3	3	3	3	IH73016001		FITTING - 1/4 HOSE X 1/8 NPT PLATED		
1	-	1	-	2	IH74652001		ASSEMBLY, BRACKET FUEL HEATER		
-	-	1	-	1	IH54305001		FILTER-FUEL, ASSY 3000 HR		
B	B	B	B	REV	LIST OF MATERIAL				

NOTES:
1. INSERT SHIPPING CAP (ITEM 18 OR 19) INTO FITTING BEFORE SHIPPING.
2. TIGHTEN FITTINGS TO 1.5-3 TURNS PAST FINGER TIGHT. ORIENT FITTING STRAIGHT DOWN.

PART NUMBER	DESCRIPTION
-001	ASSY- FUEL FILTER- 3000 HR
-002	ASSY- FUEL FILTER- 3000 HR/FUEL HEATER
-003	ASSY- FUEL FILTER- 4000 HR
-004	ASSY- FUEL FILTER- 4000 HR/FUEL HEATER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM. INTERPRET DIM AND TOL PER ASME Y14.5M - 1994

THIRD ANGLE PROJECTION

FINISH -

CAD GENERATED DRAWING; DO NOT MANUALLY UPDATE

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS PER TKS09109

DRAWN	S.MILLER	11-Sep-12
CHECKED	K.RICKE	11-Sep-12
APPROVED	R.NELSON	11-Sep-12
ENG APPVL	-	-

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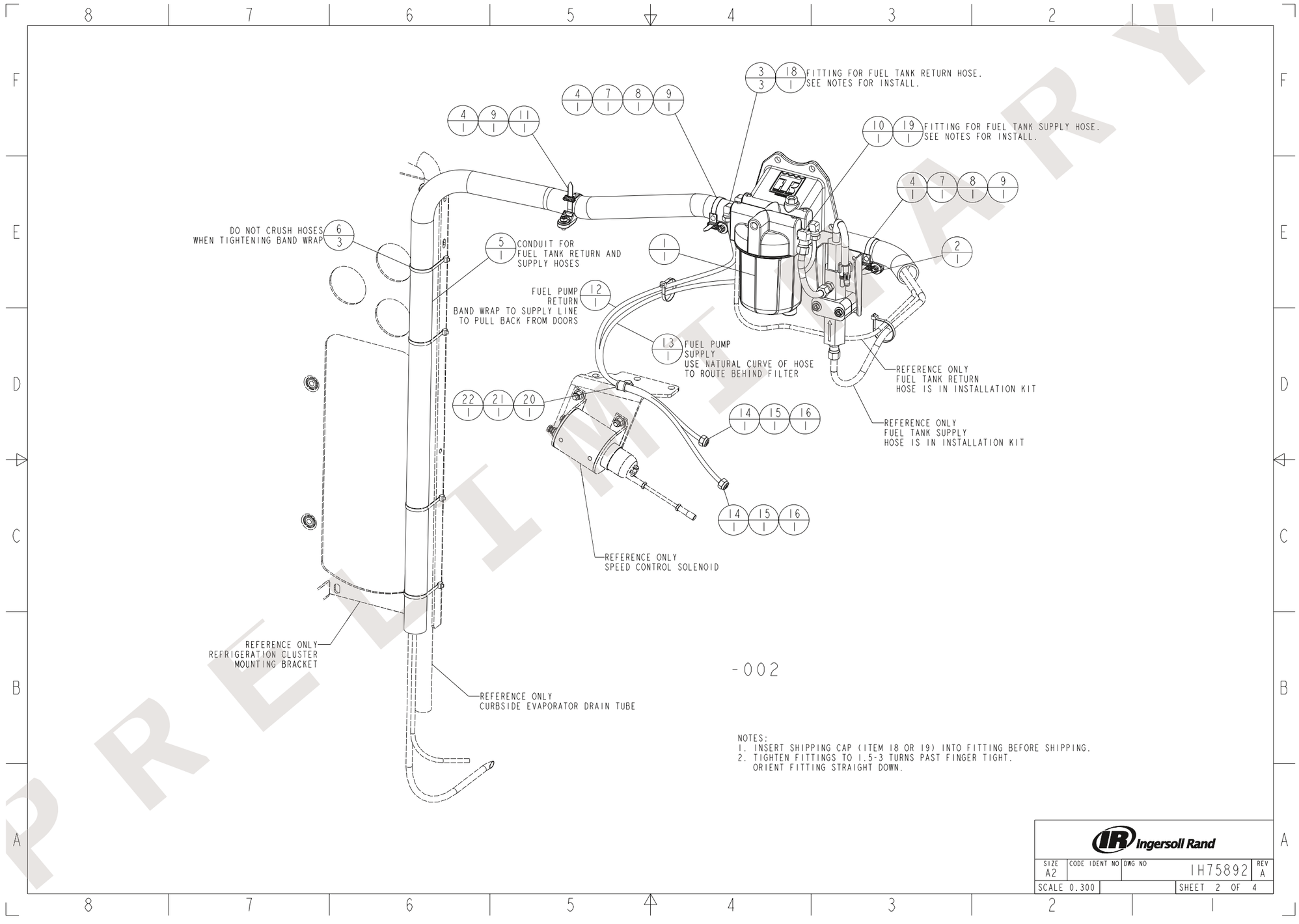
TITLE ASSY FUEL FILTER - LINES

SIZE	CODE IDENT NO	DWG NO	REV
A2		IH75892	B

SCALE 0.300 SHEET 1 OF 4

Fuel Line Routing Diagram - Page 2 of 2



NOTES:
1. INSERT SHIPPING CAP (ITEM 18 OR 19) INTO FITTING BEFORE SHIPPING.
2. TIGHTEN FITTINGS TO 1.5-3 TURNS PAST FINGER TIGHT. ORIENT FITTING STRAIGHT DOWN.

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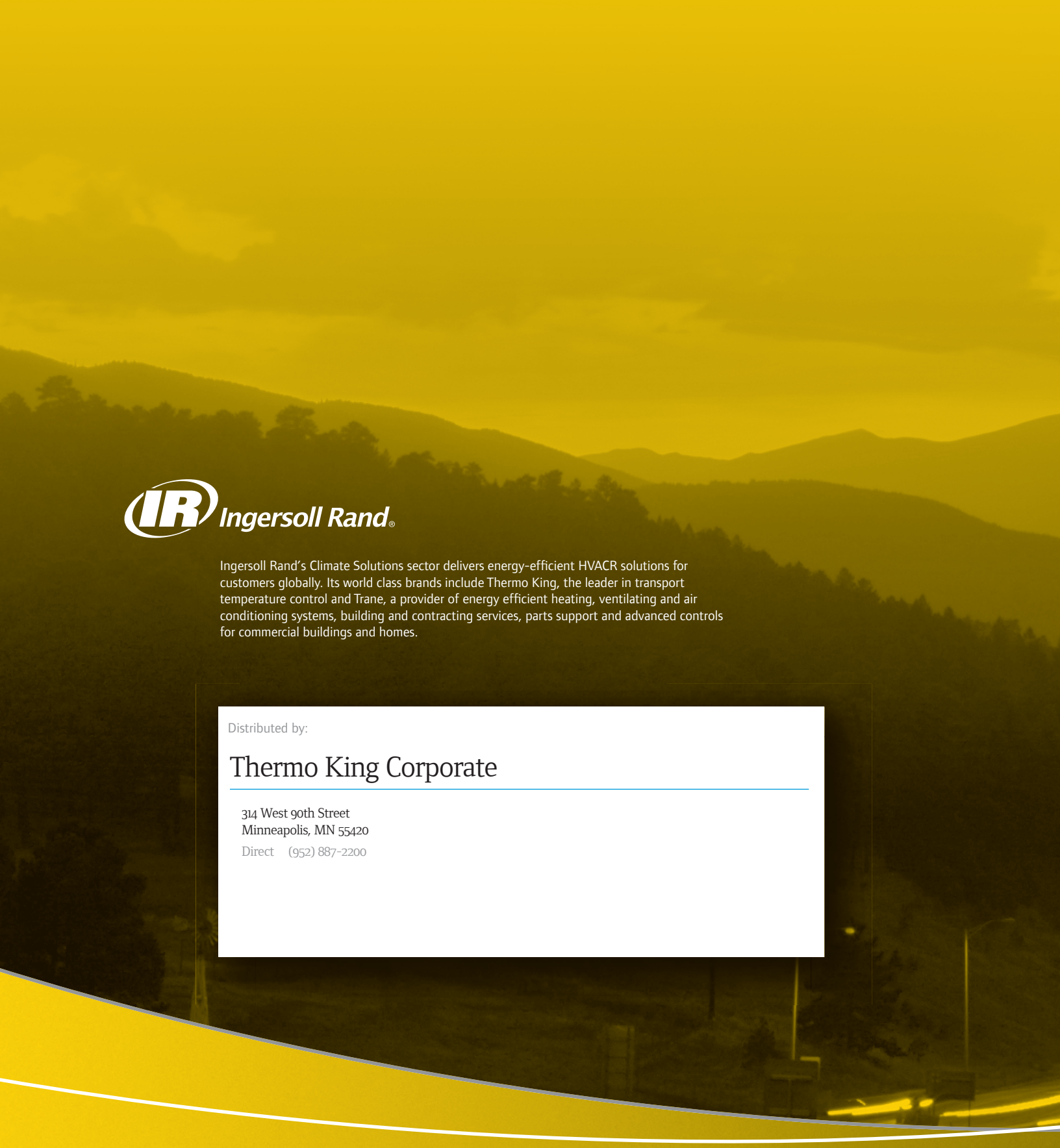
SIZE A2	CODE IDENT NO	DWG NO IH75892	REV A
SCALE 0.300		SHEET 2 OF 4	



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