THERMO KING

Maintenance Manual

T-600R, T-800R, T-1000R Series

TK 54326-1-MM (Rev. 1, (10/14)

Ingersoll Rand

T-600R, T-800R, T-1000R Series

TK 54326-1-MM (Rev. 1, 10/14)

The maintenance information in this manual covers unit models:

SYSTEM T-600R 30 SR (901400)	**SYSTEM T-600R 50 SR 230/3/50 (901420)**
SYSTEM T-600R 50 SR 230/3/60 (901401)	**SYSTEM T-600R 50 SR 400/3/50 (901422)**
SYSTEM T-600R 50 SR 460/3/60 (901402)	**SYSTEM T-800R 30 SR (901403)**
SYSTEM T-800R 50 SR 230/3/50 (901424)	**SYSTEM T-800R 50 SR 230/3/60 (901404)**
SYSTEM T-800R 50 SR 400/3/50 (901426)	**SYSTEM T-800R 50 SR 460/3/60 (901405)**
SYSTEM T-1000R 30 SR (901406)	**SYSTEM T-1000R 50 SR 230/3/50 (901428)**
SYSTEM T-1000R 50 SR 230/3/60 (901407)	**SYSTEM T-1000R 50 SR 400/3/50 (901431)**
SYSTEM T-1000R 50 SR 460/3/60 (901408)	

For further information, refer to:

T-600R, T-800R and T-1000R with Standard HMI Control Panel Operator's Manual	**TK 54327**
T-600R, T-800R and T-1000R with Premium HMI Control Panel Operator's Manual	**TK 54329**
T-600R Parts Manual	**TK 54559**
T-800R Parts Manual	**TK 54545**
T-1000R Parts Manual	**TK 54546**
Truck SR-2 Single Temp Diagnostic Manual	**TK 54292**
Diagnosing TK Refrigeration System	**TK 5984**
X214, X418, X426 and X430 Compressor Overhaul Manual	**TK 6875**
TK270, TK370, and TK376 Engine Overhaul Manual	**TK 53163**
Tool Catalog	**TK 5955**
Evacuation Station Operation and Field Application	**TK 40612**

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

Revision History

Rev. 1 – 54326-1-MM (Rev. 1, 10/14) Update Oil Fill Procedure, Coolant and Adjust Engine Valve Clearance MIS, engine valve adjustment interval to 1,000 hours, and other general updates.

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.

R-404A

WARNING: Use only Polyol Ester-based refrigeration compressor oil in R-404A. See Thermo King Parts Manual for part number.

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

When servicing Thermo King R-404A unit, use only those service tools certified for and dedicated to R-404A refrigerant and Polyol Ester compressor oils. Residual non-HFX refrigerants or oils will contaminate R-404A systems.

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:

Manual Form Number _____

Section and Page # _____

Your Name _____

Company Name _____

Phone Number _____

Corrections, Comments and Suggestions _____

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Return to:

NORTH AMERICA

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

EUROPEAN SERVED AREA

THERMO KING CORPORATION
Ingersoll Rand Climate Control Technologies
Monivea Road
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 14.***

⚠ ***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.

Auto Start/Stop

CAUTION: The unit may start automatically and at any time when the unit On/Off switch is in the On position. Units with the CYCLE-SENTRY™ start automatically in both CYCLE-SENTRY mode and Continuous mode. Be sure to turn the On/Off switch Off before opening doors or inspecting or working on any part of the unit.

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

WARNING: Make sure the unit On/Off switch is turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.

WARNING: Make sure the unit power plug is clean and dry before connecting it to a power source.

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 diagnostic manual for more information.

- If the microprocessor has a power switch, turn it OFF before connecting or disconnecting the battery.
- Disconnect power to the unit.
- Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
- Wear a wrist strap (P/N 204-622 or 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: T-600R and T-800R T-1000R	TK370 (Tier 4) TK376 (Tier 4)
Fuel Type	No. 2 Diesel fuel under normal conditions No. 1 Diesel fuel is acceptable cold weather fuel
Oil Capacity: T-600R and T-800R Crankcase & Oil Filter T-600R and T-800R w/Bypass Oil Filter T-1000R Crankcase & Oil Filter T-1000R w/Bypass Oil Filter	 9.0 quarts (8.5 liters) 10.0 quarts (9.5 liters) Fill to full mark on dipstick 12.0 quarts (11.4 liters) 13.0 quarts (12.3 liters) 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 5 to 104 F (-15 to 40 C): SAE 10W-30 (Synthetic or Synthetic Blend) -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 86 F (-25 to 30 C): SAE 10W-30 -22 to 122 F (-30 to 50 C): SAE 5W-40 (Synthetic) Below -22 F (-30 C): SAE 0W-30 (Synthetic)
Engine rpm: Low Speed Operation High Speed Operation	1650 ± 25 rpm 2200 ± 25 rpm
Engine Oil Pressure	20 to 50 psig (138 to 345 kPa) in low speed 40 to 60 psig (276 to 414 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)
Fuel Injection Timing	16 ± 1 degrees BTDC
Injection Nozzle Pressure	1784 to 1929 psig (12,300 to 13,300 kPa)
Low Oil Pressure Switch/Sensor	10 ± 2 psig (69 ± 14 kPa)—shutdown
High Coolant Temperature Sensor	220 ± 5 F (104 ± 3 C)—shutdown
Engine 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.

Engine (Continued)

Coolant System Capacity:	
T-600R and T-800R with Tube and Fin Radiator Coil (ending 6/12)	4.5 quarts (4.3 liters) with coolant expansion tank
T-600R and T-800R with Micro-Channel Radiator Coil (starting 6/12)	4.9 quarts (4.6 liters) with coolant expansion tank
T-1000R with Tube and Fin Radiator Coil (ending 6/12)	5.0 quarts (4.7 liters) with coolant expansion tank
T-1000R with Micro-Channel Radiator Coil (starting 6/12)	5.4 quarts (5.1 liters) with coolant expansion tank
Coolant Expansion Tank Cap Pressure	15 psig (103 kPa)

Belt Tension

Belt	**Tension No. on TK Gauge P/N 204-427**		**Frequency Gauge P/N 204-1903 Setting Where Applicable**	
	New Belt	**Field Reset**	**New Belt**	**Field Reset**
Water Pump Belt	40	40		
Engine/Electric Motor (Jackshaft)	81	77	62 Hz	55 Hz
Electric Motor (Jackshaft)/Compressor	Automatically tensioned by tensioner position. See “Belts” in Engine Maintenance Chapter.			

Engine Clutch

Engagement	600 ± 100 RPM
Dynamic Torque	66 ft-lb (89.5 N•m) minimum @ 1600 RPM

Refrigeration System

Compressor Model: T-600R and T-800R	Thermo King X214
T-1000R	Thermo King X426 LSC5
Refrigerant Charge:	
T-600R with Tube and Fin Condenser Coil (ending 6/12)	8.0 lb (3.6 kg) R-404A
T-600R with Micro-Channel Condenser Coil (starting 6/12)	7.0 lb (3.2 kg) R-404A
T-800R with Tube and Fin Condenser Coil (ending 6/12)	8.5 lb (3.9 kg) R-404A
T-800R with Micro-Channel Condenser Coil (starting 6/12)	7.0 lb (3.2 kg) R-404A
T-1000R with Tube and Fin Condenser Coil (ending 6/12)	9.0 lb (4.1 kg) R-404A
T-1000R with Micro-Channel Condenser Coil (starting 6/12)	7.5 lb (3.4 kg) R-404A
*Compressor Oil Charge:	
X214 in T-600R and T-800R	3.2 quarts (3.0 liters)
X426 in T-1000R	4.3 quarts (4.1 liters)
Compressor Oil Type	Ester base P/N 203-513 required
Suction Pressure Regulator Valve Setting:	
T-600R	28 to 31 psig (193 to 214 kPa)
T-800R	35 to 37 psig (241 to 255 kPa)
T-1000R	21 to 23 psig (145 to 159 kPa)

Refrigeration System (Continued)

High Pressure Cutout Switch:	Open Close	470 ± 7 psig (3241 ± 48 kPa) 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. This is to be sure that the same amount of oil can be added before placing the replacement compressor in the unit.*		

Electrical Control System

Control System Voltage	12.5 Vdc
Battery Charging System	12 volt, 37 amp, brush type, Thermo King alternator
Voltage Regulator Setting	13.8 to 14.4 volts @ 77 F (25 C)
NOTE: Fuse F4 (Bypass resistor for Prestolite Alternator) must be removed for the Thermo King Alternator.	

Fuses

Fuse	Size	Function
F2	15A	Power to On/Off Switch
F3	40A	Fuel Sol Pull-In/Starter Circuit
F4	None 2A	No Fuse - All Bosch and Thermo King Alternators 2A Fuse - All Prestolite Alternators
F5	40A	Preheat Circuit
F6	15A	Damper and High Speed Circuits
F7	2A	8XP Circuit - Controller On Feedback to HMI
F8	5A	CAN Connector J12
F9	5A	CAN Connector J14
F10	10A	8X Power (Install fuse in upper position)
F12	5A	CAN Connector J13
F13	2A	8FC Circuit (Remote Lights)
F20	2A	Alternator Sense
F21	60A	Main Fuse (2 Circuit)
F25	7.5A	HPCO/Run Circuit
F4 Remove fuse F4 for Model 30 units with Australian Bosch or Thermo King Alternators. Install fuse F4 for Model 50 units with Prestolite Alternator.		
F10 When fuse F10 is installed in the upper position the On/Off keys on the HMI turn the unit on and off. When fuse F10 is installed in the lower position the unit will start and run without the HMI control panel.		

Electrical Components

Component		Current Draw (Amps) at 12.5 Vdc	Resistance (Ohms)
Glow Plugs (3) Each		4.3	2.3 ± 0.2
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		3.3	3.8

Electrical Components (Continued)

Component	Current Draw (Amps) at 12.5 Vdc	Resistance (Ohms)
Damper Solenoid	5.7	2.2
Condenser Inlet Solenoid (CIS)	1.8	6.9
Hot Gas Solenoid (HGS)	1.1	11.3
Purge Valve (PV)	1.1	11.3
Starter Motor (No Load Bench Test)	90	

Electrical Standby (Model 50 Units Only)

T-600R and T-800R Electric Motor and Overload Relay

Voltage/Phase/Frequency	Horsepower	Kilowatts	rpm	Full Load (amps)	Overload Relay Setting (amps)
230/3/50	6.0	4.5	1460	17.0	19
208-230/3/60	7.2	5.4	1765	19.4	22
400/3/50	6.0	4.5	1460	9.8	11
460/3/60	7.2	5.4	1765	9.7	11

T-1000R Electric Motor and Overload Relay

Voltage/Phase/Frequency	Horsepower	Kilowatts	rpm	Full Load (amps)	Overload Relay Setting (amps)
230/3/50	10.0	7.5	1460	22.5	25
208-230/3/60	12.0	8.9	1750	28.8	32
400/3/50	10.0	7.5	1460	17.0	16
460/3/60	12.0	8.9	1750	14.4	16

Electric Heater Strips (Optional)

Number	3
Watts	750 watts (each)
Resistance	71 ohms (each)

Standby Power Requirements

Supply Circuit Breaker: T-600R and T-800R 200-230/3/50-60 T-1000R 200-230/3/50-60 All 380-460/3/50-60	 30 amps 50 amps 20 amps
Extension Cord Size:	Up to 50 ft—10 gauge 75 ft—8 gauge

Maintenance Inspection Schedule

Pretrip	1,200 Hours	2,000 Hours	Annual/ 3,000 Hours	Inspect/Service These Items
				Microprocessor
•				Run pretrip test (see “Pretrip Test” in Operating Instructions Chapter).
				Engine
•				Check fuel supply.
•	•			Check engine oil level.
•	•			Check condition of belts.
•	•			Check engine oil pressure hot, on high speed.
•	•	•	•	Listen for unusual noises, vibrations, etc.
	•			Check air cleaner hose for damage.
	•			Inspect and clean electric fuel pump filter.
	•			Check engine coolant level every 1,000 hours or 6 months (whichever occurs first).
	•			Check that engine coolant antifreeze protection is at –30 F (–34 C) every 1,000 hours or 6 months year (whichever occurs first).
		•		Dry air cleaner. Replace air cleaner element at 2,000 hours or 1 year (whichever occurs first)
		•		Change EMI 2000 (black) fuel filter.
		•		Change engine oil and oil filters (hot). Requires oil with API Rating CI-4 or better (ACEA Rating E3 for Europe) and EMI 2000 bypass oil filter.
		•		Adjust electric motor (jackshaft)/compressor belt to field reset position. See “Electric Motor (Jackshaft)/Compressor Belt” in Engine Maintenance Chapter.
		•		Check restraining mount (snubber) pre-load adjustment.
			•	Drain water from fuel tank and check vent.
			•	Check and adjust engine speeds (high and low speed).
			•	Check condition of engine mounts.
			•	Test fuel injection nozzles at least every 3,000 hours.*
			—	Adjust engine valve clearance every 1,000 hours.
			—	Replace fuel return lines between fuel injection nozzles every 10,000 hours or sooner, as required.
			—	Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank.

* Based on EPA 40 CFR Part 89.

Pretrip	1,200 Hours	2,000 Hours	Annual/ 3,000 Hours	Inspect/Service These Items
				Electrical
•				Check controller for alarms.
•				Run pretrip test
•				Check battery voltage.
	•			Inspect battery terminals and electrolyte level.
	•			Inspect wire harness for damaged wires or connections.
			•	Inspect alternator bearings and brushes.**
			•	Inspect electric motor bearings (Model 50).**
** With belt removed, spin bearings by hand. Listen for noise (bearings roll freely).				
				Refrigeration
•	•			Check refrigerant level.
	•			Check compressor oil level.
			•	Check suction pressure regulator setting on Defrost or Heat.
			•	Check discharge and suction pressures.
			•	Check compressor efficiency.
			—	Replace dehydrator and compressor oil filter 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 clutch for shoe and anchor bushing wear with a mirror. Check bearings.**
			•	Inspect idlers, fan shafts and jackshaft (if so equipped) for leakage and bearing wear.**
			•	Clean entire unit including condenser coils, evaporator coils, and defrost drains.
	•	•	•	Check all unit, fuel tank, engine, and electric motor mounting bolts, brackets, lines, hoses, etc.
** With belt removed, spin bearings by hand. Listen for noise (bearings roll freely).				

Unit Description

General Description

The T-600R, T-800R and T-1000R are microprocessor based transport temperature control systems that use the SR-2 Truck HMI microcontroller to manage system functions.

The units are one-piece, front-mounted, diesel powered cooling and heating systems designed for straight trucks. The units mount on the front of a truck with the evaporator portion protruding into the box. They are designed for use with chlorine free refrigerants. The basic models provide the following:

Model 30: Cooling and hot gas heating on engine operation.

Model 50: Cooling and hot gas heating on engine operation and electric standby operation. Electric evaporator heaters are optional.

Engine power for the unit is provided by a diesel engine. Optional electric standby power (Model 50) is provided by an electric motor. A clutch on the diesel engine isolates the engine during electric standby operation.

The continuous monitoring function of the SR-2 microprocessor optimizes the unit's performance, reducing fuel consumption and unit down time. The unit has a self check feature that can be run before the daily distribution route to identify possible malfunctions.

The built-in CYCLE-SENTRY, an exclusive Thermo King feature, automatically starts and stops the unit according to temperature demands.

Design Features

- Microprocessor Controller, SR-2 Truck
  - Alarm Code Display
  - Battery Voltage Display
  - Continuous System Monitoring
  - Coolant Temperature Display
  - CYCLE-SENTRY™ Start/Stop Controls
  - Engine and Electric (Model 50) Hour Display
  - In-Cab Remote
  - Smart Defrost
  - Symbolic Controller Interface
  - Unit Self Check-pretripping
- Aerodynamic Thermo Plastic Recyclable Geloy Injection Molded Skins with In-mold Color
- Air Cleaner, Dry Type
- Alternator, 12 Volt, 37 Amp
- Automatic Phase Correction (Model 50)
- Bypass Oil Filter
- Coolant Expansion Tank
- Diesel/Electric Autoswitching (Model 50)
- Economy Mode
- Fahrenheit and Celsius Scales
- Fuel Filter, Spin On
- Low Decible Kit
- Oil Filter, Full Flow
- Poly-V Stretchy Belt System with Quiet Channel Technology
- R-404A Chlorine-free Refrigerant
- Robotic Welded Steel Frame with Automotive Grade 2 Coat Paint Finish
- X214 Compressor (T-600R and T-800R)
- X426 Compressor (T-1000R)
- Stainless Steel Condenser and Evaporator Hardware
- TK370 Tier 4 Diesel Engine (T-600R and T-800R)
- TK376 Tier 4 Diesel Engine (T-1000R)
- Top Cover System

Unit Options

- 134a Refrigerant
- Body Mount HMI Enclosure Systems
- DAS (Data Acquisition System)
- Door Switch
- Easy-Read Thermometer
- Electric Evaporator Heater
- Electric Standby Operation (Model 50)
- Engine Block Heater
- ETV (Electronic Throttling Valve)
- Fuel Tank
- Hand-held SR-2 Electronic Diagnostic Tool
- Hose Management System
- Hybrid SmartPower Operation
- Incremental Heating (electric & over the road)
- Quick Oil Drain Kit
- Rear Remote Control (flushmount)
- Remote Indicator Light
- Snow Cover
- Synthetic Oil
- Telematics
- Whisper™ Plus Sound Kit

Engine

Engine power for the T-600R and T-800R is provided by the TK370, a three-cylinder, EPA Tier 4, special clean and quiet diesel engine rated at 15.0 continuous horsepower (11.2 kW) at 2425 RPM. A belt drive system transfers energy to the compressor, unit fans, and alternator.

Engine power for the T-1000R is provided by the TK376, a three cylinder, EPA Tier 4, special clean and quiet diesel engine rated at 19.6 continuous horsepower (14.6 kW) at 2425 RPM. A belt drive system transfers energy to the compressor, unit fans and alternator.

ELC (Extended Life Coolant)

The maintenance interval for ELC is five years or 12,000 hours. A nameplate on the coolant expansion tank identifies units with ELC (see “Safety Decals and Locations”). The new engine coolant, Texaco Extended Life Coolant, is Red instead of the previous Green or Blue-Green coolants.

CAUTION: Do not add Green or Blue-Green coolants to cooling systems that use Red Extended Life Coolants.

NOTE: The use of 50/50% pre-mixed ELC is recommended to ensure that deionized water is being used. If 100% full strength concentrate is used, deionized or distilled water is recommended instead of tap water to ensure the integrity of the cooling system is maintained.

Clutch

The centrifugal clutch engages fully at 600 ± 100 RPM on engine operation, constantly turning the compressor, alternator, and fans at both high and low speed. The clutch isolates the engine from the belt drive system during electric standby operation on Model 50 units.

Reciprocating Compressor

The T-600R and T-800R feature the X214, 2 cylinder reciprocating compressor with 13.92 cu in (229 cc) displacement..

The T-1000R features the X426, 4-cylinder reciprocating compressor with 25.9 cu in (424 cc) displacement.

Standard HMI Control Panel

The Standard HMI Control Panel (Human/Machine Interface) is used to operate the unit and display unit information. The Control Panel is typically located in the vehicle driver's compartment and communicates with the base controller using a connection on the interface board.

Figure 1: Standard HMI Control Panel

Mechanics HMI Control Panel

The Mechanics HMI Control Panel is available as a hand held diagnostic tool. It is used on units with a Standard HMI Control Panel if it is necessary to access the Maintenance Menu or the Guarded Access Menu to service the unit. Refer to the Truck SR-2 Single Temp Diagnostic Manual TK 54292 for more information about the Mechanics HMI Control Panel.

NOTE: The Mechanics HMI Control Panel and the Premium HMI Control Panel look the same and have the same functionality. The Mechanics HMI Control Panel in enclosed in a protective housing.

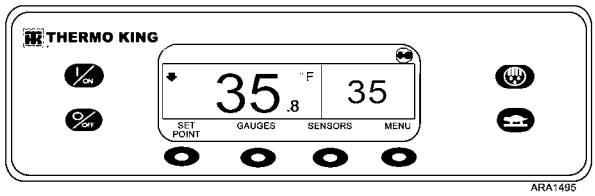


Figure 2: Mechanics/Premium HMI Control Panel

Premium HMI Control Panel (Optional)

The Premium HMI Control Panel is available as an option that replaces the Standard HMI Control Panel. It is used operate the unit and display unit information. It also provides access to all the controller functions and menus. Refer to the Truck SR-2 Single Temp Diagnostic Manual TK 54292 for more information about the Premium HMI Control Panel.

CYCLE-SENTRY™ Start/Stop System

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

WARNING: Turn the unit off by pressing the OFF key before opening doors or inspecting any part of the unit. The unit can start at any time without warning if it has been turned on by pressing the ON key.

The CYCLE-SENTRY system automatically starts the unit on microprocessor demand and shuts down the unit when all demands are satisfied.

The system monitors and maintains the compartment temperature, the engine block temperature, and battery charge levels at a point where quick, easy starts are possible.

Defrost

Frost will gradually build up on the evaporator coils as a result of normal operation. Periodically this frost must be melted to prevent a loss of cooling and airflow.

Defrost is accomplished by passing hot refrigerant gas through the evaporator coil, thus melting the frost (or ice). Melted frost drains out of the unit onto the ground through the drain tubes. The defrost damper closes during defrost to prevent warm air from entering the cargo area. The optional electric heater strips are also energized in defrost during electric standby operation.

Defrost can be initiated at any time the evaporator coil temperature is below 42 F (5.5 C).

There are two methods of defrost initiation:

SR-2 Microprocessor Controller: The Microprocessor Controller is programmed to automatically initiate timed and forced defrost cycles. The SR-2 uses temperature sensors to determine if forced defrost is required.

Manual Defrost: Manual Defrost allows the operator to initiate a defrost cycle by pressing the DEFROST key. See “Initiating a Manual Defrost Cycle.”

DAS - Data Acquisition System (Optional)

The DAS (Data Acquisition System) monitors and records the temperatures of (up to) six additional sensors. The sensors are independent from the microprocessor controller and are normally located in the truck box to monitor load temperatures. DAS data can be downloaded through a serial port to an IBM® PC compatible computer. WinTrac™ 4.0 (or higher) software is used to view and analyze the data. Brief reports can be printed on a microprinter connected to the serial port.

Electric Standby (Model 50 Units Only)

The Electric Standby option allows the unit to be operated on either the diesel engine or external electric power.

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

Standard Model 50 Features

The following features are standard equipment on units equipped with Electric Standby.

Automatic Diesel/Electric Selection: The unit will automatically switch to electric operation when a power cord is connected and the standby power is switched On.

Overload Relay: The overload relay is self-resetting.

Hot Gas Heat: Hot gas heat is utilized on all units.

Automatic Phase Correction: The control system features two motor contactors. This allows correct motor rotation regardless of phase rotation on the incoming power.

Optional Model 50 Features

The following features are available as options on units equipped with Electric Standby.

- Electric Heater Strips
- Auto Switching

Engine Compartment Components

Coolant Expansion Tank: The coolant level and temperature are monitored by the base controller. If the coolant temperature becomes too high or the level becomes too low, an alarm will occur.

The engine must have antifreeze protection to –30 F (–34 C). Check and add coolant in the expansion tank as needed.

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

CAUTION: Do not add Green or Blue-Green coolants to cooling systems that use Red Extended Life Coolants.

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

Receiver Tank Sight Glass: The receiver tank sight glass is used to assist in checking the amount of refrigerant in the system.

Compressor Oil Sight Glass: The compressor oil sight glass is used to check the relative level of compressor oil in the compressor sump.

Unit Protection Devices

High Pressure Cutout Switch (HPCO): This normally closed switch monitors the discharge pressure at the compressor. It opens on high discharge pressure to shut the unit down to prevent damage.

Low Pressure Cutout Switch (LPCO): This normally closed switch monitors the suction pressure at the compressor. It opens on low suction pressure to shut the unit down to prevent damage. The LPCO is used on units equipped with an SPR (Suction Pressure Regulator). It is not used on units equipped with an ETV (Electronic Throttling Valve).

Suction Pressure Regulator (SPR): This component is a mechanical control device used to limit the suction pressure to the compressor. The valve controls suction pressure based on the actual system pressure. The SPR is not used if the unit is equipped with an ETV.

Electronic Throttling Valve (ETV): This component is an electromechanical control device used to limit the suction pressure to the compressor. The valve is controlled by the microprocessor controller. The ETV is not used if the unit is equipped with an SPR.

Engine Oil Pressure Switch/Sensor: The engine oil pressure switch/sensor is located on the filter head above the bypass oil filter. Engine oil pressure should rise immediately on starting. If engine oil pressure drops below 10 ± 2 psig (69 ± 14 kPa), the switch/sensor signals the microprocessor to stop the engine.

Preheat Buzzer: The preheat buzzer sounds when the CYCLE-SENTRY™ system energizes the glow plugs. This should warn anyone near the unit that the CYCLE-SENTRY™ system is about to start the diesel engine.

Coolant Temperature Sensor: This sensor provides an engine coolant temperature input to the microprocessor. If the engine coolant temperature is too high, the controller stops the unit and records an alarm.

Electric Motor Overload Relay (Model 50): The overload relay protects the electric standby motor. The overload relay opens the circuit from the contactor to the electric motor if the motor overloads for any reason and an alarm will occur. The relay resets when the alarm code is cleared.

Fuses: Sizes and functions are described in the Specifications section of this manual.

AMA1210

Figure 3: T-600R Front View

AMA1211

Figure 4: T-1000R Front View

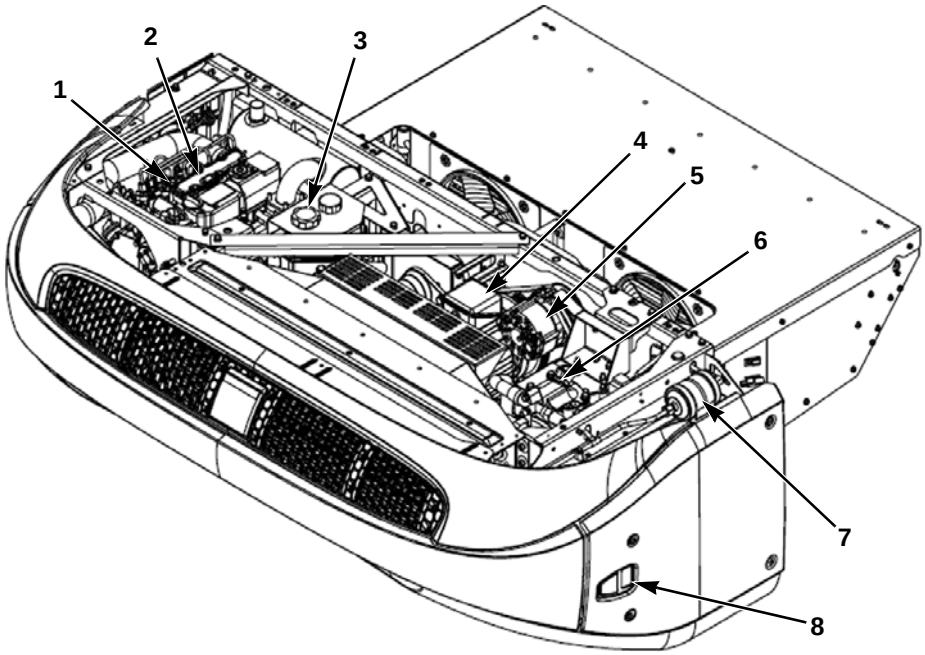


Figure 5: Main Components

1.	Engine Oil Dipstick (on side of engine)	5.	Alternator
2.	Engine	6.	Compressor
3.	Coolant Expansion Tank	7.	Dehydrator (Filter-Drier)
4.	Electric Motor	8.	On/Off Switch

Main Components in Figure 5

Refrigeration System Components

The refrigeration system in these units does not have a three-way valve. Instead, it uses a condenser inlet solenoid (CIS) and a hot gas solenoid similar to multi-temp units. Some of the main components are briefly described below.

Solenoids and Valves

Condenser Inlet Solenoid (CIS)

This valve stops the flow of refrigerant to the condenser. This solenoid is energized (closed) when the unit is operating in the heat and defrost modes. This is a normally open valve.

Hot Gas Solenoid (HGS)

This valve is energized (open) in the heat and defrost modes. It allows hot gas to enter the evaporator coil. This is a normally closed valve.

Purge Valve (PV)

The purge valve is energized (open) in the purge mode (and in heat and defrost modes) to move the refrigerant out of the condenser to ensure adequate refrigerant is available. This is a normally closed valve.

Suction Pressure Regulator (SPR)

This component is a mechanical control device used to limit the suction pressure to the compressor. The valve controls suction pressure based on the actual system pressure. The SPR is not used if the unit is equipped with an ETV.

Condenser Check Valve

This check valve prevents refrigerant from migrating from the receiver tank back into the condenser during the heat and defrost modes.

Purge Check Valve

This check valve prevents refrigerant from migrating from the accumulator back into the condenser during the heat and defrost modes.

Receiver Tank Pressure Check Valve

This check valve allows hot gas to force the liquid refrigerant out of the receiver tank during the heat and defrost modes. It prevents refrigerant from migrating from the receiver tank to the hot gas line during the cool mode.

Sensors, Switches, and Transducers

High Pressure Cutout Switch (HPCO)

This normally closed switch monitors the discharge pressure at the compressor. It opens on high discharge pressure to shut the unit down to prevent damage.

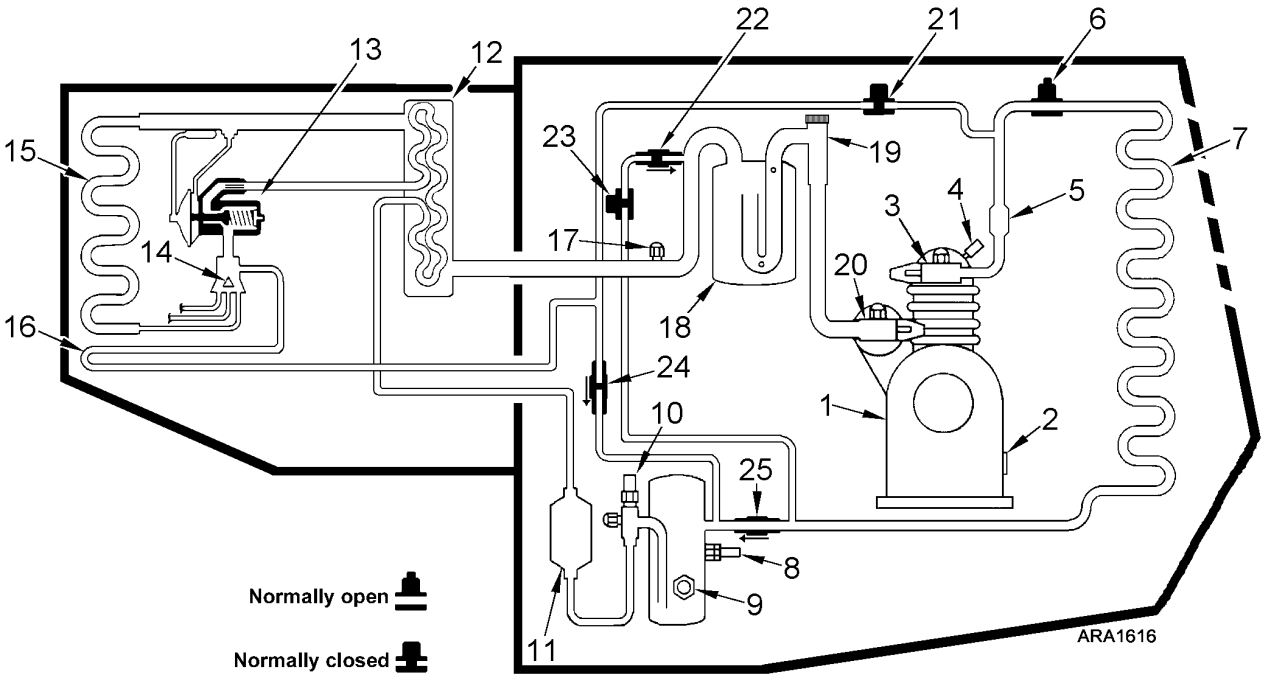
Low Pressure Cutout Switch (LPCO)

This normally closed switch monitors the suction pressure at the compressor. It opens on low suction pressure to shut the unit down to prevent damage. The LPCO is used in these units starting in June 2012.

Refrigeration System Diagrams

The following pages show the refrigeration system and examples of the refrigerant flow in the various modes.

NOTE: The drawings show the refrigeration system with a two-cylinder compressor. The refrigeration system with the four-cylinder compressor is basically the same except for the compressor.



1.	Compressor	14.	Distributor
2.	Compressor Sight Glass	15.	Evaporator Coil
3.	Discharge Service Valve	16.	Drain Pan Heater
4.	High Pressure Cutout Switch (HPCO)	17.	Suction Access Port
5.	Discharge Strainer	18.	Accumulator
6.	Condenser Inlet Solenoid (CIS)	19.	Suction Pressure Regulator (SPR)
7.	Condenser Coil	20.	Suction Service Valve
8.	High Pressure Relief Valve	21.	Hot Gas Solenoid (HGS)
9.	Receiver Tank Sight Glass	22.	Purge Check Valve
10.	Receiver Tank Outlet Valve	23.	Purge Valve (PV)
11.	Dehydrator (Filter-Drier)	24.	Receiver Tank Pressure Check Valve
12.	Heat Exchanger	25.	Condenser Check Valve
13.	Expansion Valve		

Figure 6: Refrigeration System Components

Cool Mode

The refrigerant flow in Cool Mode is a conventional refrigeration cycle. High pressure refrigerant vapor leaves the compressor and flows through the open CIS to the condenser where the refrigerant releases heat and condenses into high pressure liquid. The liquid refrigerant flows through the condenser check valve, receiver tank, drier, heat exchanger, and the expansion valve into the evaporator. There, liquid refrigerant absorbs heat as it evaporates into low pressure vapor. The refrigerant returns to the compressor through the heat exchanger, accumulator, and SPR.

Solenoid and Check Valves

1. Condenser Inlet Solenoid (CIS)-Open/ De-energized
2. Condenser Check Valve-Open
3. Receiver Tank Pressure Check Valve-Closed
4. Purge Valve (PV)-Closed/De-energized
5. Purge Check Valve-Closed
6. Hot Gas Solenoid (HGS)-Closed/ De-energized

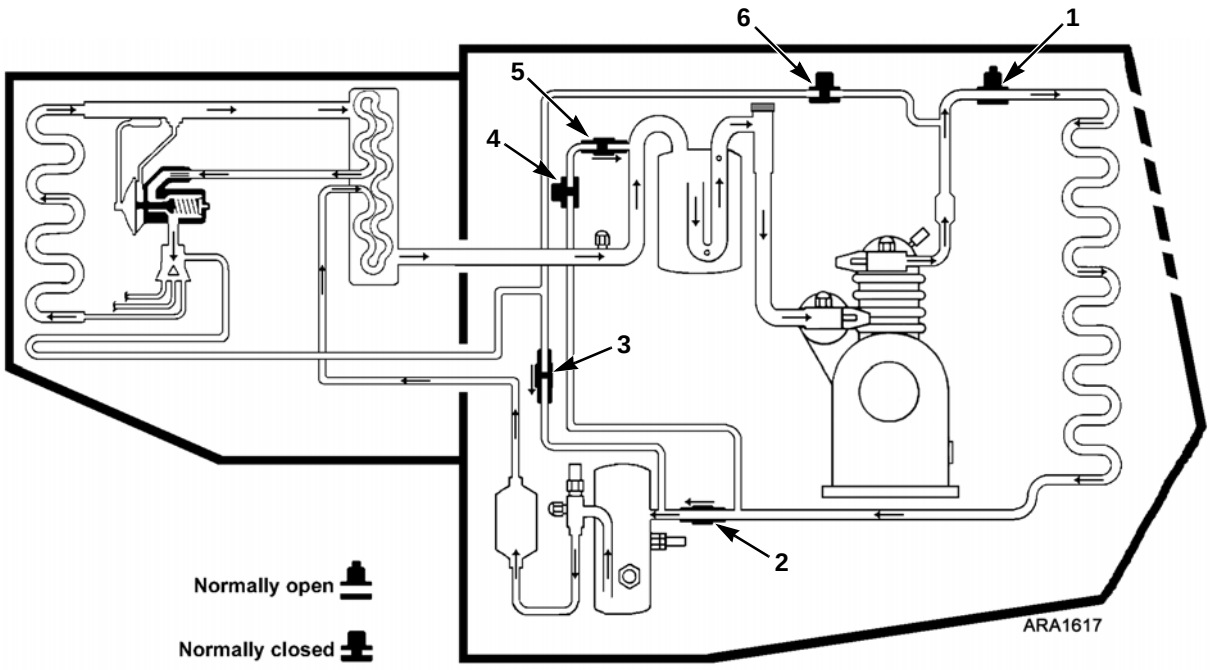


Figure 7: Cool Mode

Purge Mode

Purge Mode is similar to Condenser Evacuation Mode in previous systems. It is used to move the refrigerant out of the condenser into the accumulator when the unit shifts from Cool (or Null) to Heat. The unit goes into Purge Mode for 20 to 100 seconds before shifting to Heat. The ambient and return air temperatures determine the duration. Lower temperatures cause the unit to stay in Purge Mode longer.

High pressure refrigerant vapor leaves the compressor and flows through the open CIS to the condenser. The PV is open so most of the refrigerant flows from the condenser through the PV and the purge check valve to the accumulator. Some of the refrigerant flows through the condenser check valve, receiver tank, drier, heat exchanger, expansion valve, and evaporator to the accumulator. From the accumulator the refrigerant returns to the compressor through the SPR.

Solenoid and Check Valves

1. Condenser Inlet Solenoid (CIS)-Open/ De-energized
2. Condenser Check Valve-Open
3. Receiver Tank Pressure Check Valve-Closed
4. Purge Valve (PV)-Open/Energized
5. Purge Check Valve-Open
6. Hot Gas Solenoid (HGS)-Closed/ De-energized

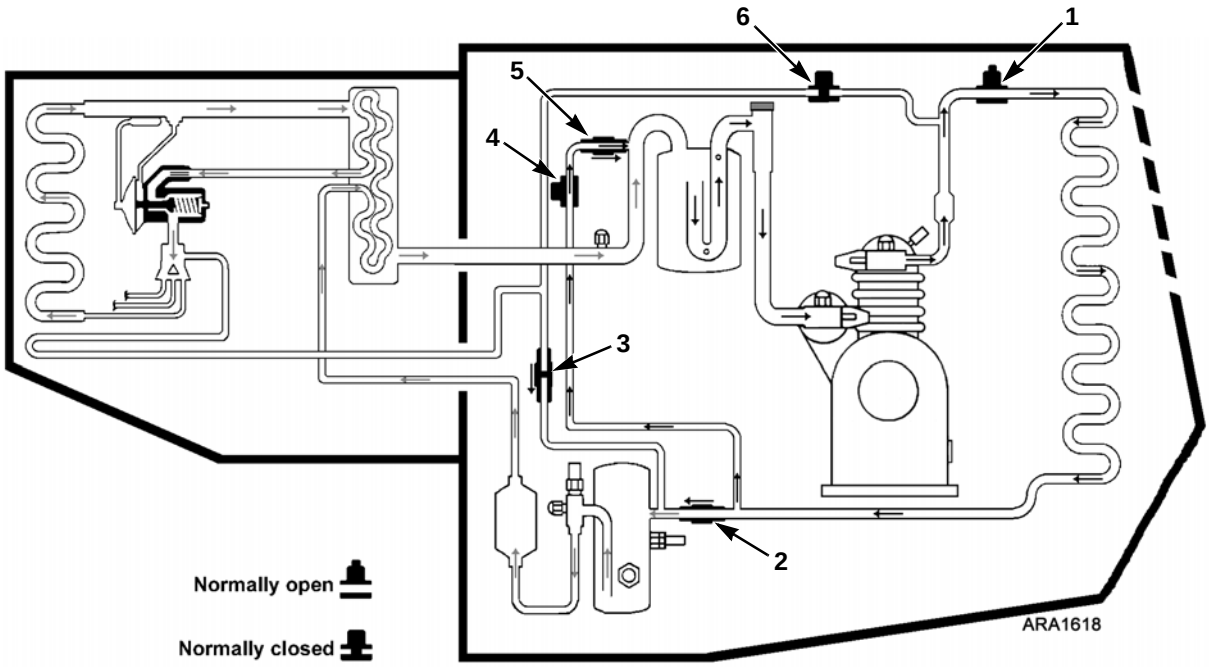


Figure 8: Purge Mode

Heat/Defrost Mode

The refrigerant flow in Heat/Defrost Mode is a conventional hot gas heat cycle. The CIS is closed and the HGS is open so high pressure refrigerant vapor leaves the compressor and flows through the HGS to the hot has line. Most of the refrigerant flows through the hot gas line and the drain pan heater to the evaporator. There, the refrigerant heats the evaporator and returns to the compressor through the heat exchanger, accumulator, and SPR. Some of the refrigerant flows through the receiver tank pressure check valve and forces any liquid refrigerant out of receiver tank through the drier, heat exchanger, and expansion valve to the evaporator. From which it returns to the compressor through the heat exchanger, accumulator, and SPR.

Solenoid and Check Valves

1. Condenser Inlet Solenoid (CIS)-Closed/ Energized
2. Condenser Check Valve-Closed
3. Receiver Tank Pressure Check Valve-Open
4. Purge Valve (PV)-Open/Energized
5. Purge Check Valve-Closed
6. Hot Gas Solenoid (HGS)-Open/Energized

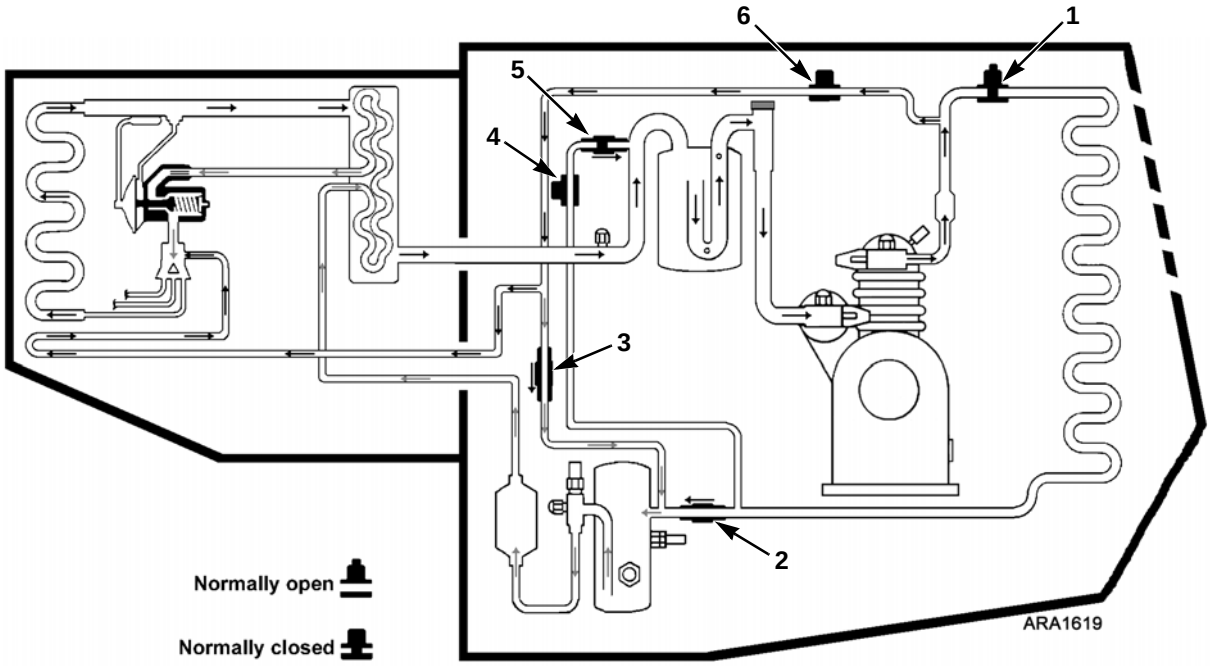


Figure 9: Heat/Defrost Mode

Operating Instructions for Standard HMI Control Panel

SR-2 Truck HMI Controller Description

SR-2 Truck HMI Controller

The SR-2 Standard Truck HMI (Human/Machine Interface) Control Panel is supplied as standard equipment on SR-2 Single Temperature Truck applications. It is used to operate the unit and display some unit information. The SR-2 Standard Truck HMI Control Panel communicates with the base controller via the CAN (Controller Area Network) bus. It is connected to the base controller via CAN Connector J14 on the interface board. The SR-2 Standard Truck HMI Control Panel is typically located in the vehicle driver's compartment. It may be located in the truck dashboard using a DIN mounting ring or under the dashboard using an under dash mounting kit.

Figure 10: SR-2 Truck HMI Controller

- The SR-2 Standard Truck HMI Control Panel consists of a display and nine touch-sensitive keys.
- The display is capable of showing numbers and lighting several icons. It does not display text, thereby making it suitable for use with any language.
- Amber indicator LED's are located next to each of the four function keys below the display. The LED will light when that function is active.
- A red indicator LED is located between the ON Key and OFF Key. This indicator will glow if Alarm Code 91 Check Electric Ready Input occurs. It will also glow if a 15 pin Thermo King data cable is connected to the serial port on the back of the controller (DPD).

Controller Features

- Displays Box Temperature and Setpoint in Fahrenheit or Celsius
- Displays Engine Running and Motor Running Hourmeters
- Changes Setpoint
- Selects and Indicates CYCLE-SENTRY or Continuous Mode Operation
- Selects and Indicates High Speed Lock-Out Operation
- Initiates and Indicates a Defrost Cycle
- Indicates an Alarm Condition Exists, Displays and Clears Alarms
- Initiates and Indicates a Pretrip Test
- Sends a Start of Trip to the ServiceWatch data logger.
- Changes Display Brightness
- Shows HMI Control Panel Serial Number and Software Revision.

Display

The display presents information to the operator. This information includes setpoint and box temperature, hourmeter readings, alarms and several icons as shown below. All display segments and icons are shown in Figure 11.

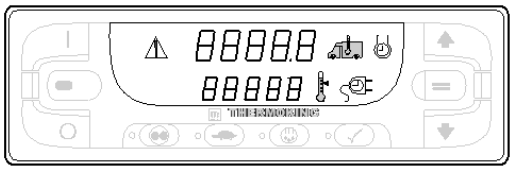


Figure 11: Display

The upper row of numbers can display the Box Temperature, Engine Run Time Hourmeter or Alarm Code(s).

The lower row of numbers can display the Setpoint, Electric Run Time Hourmeter or Total Number of Alarms.

The meaning of the display icons are shown in the table below.

	When this icon is present the upper display is showing the actual box temperature inside the truck box.
	When this icon is present the lower display is showing the current setpoint.
	When this icon is present the upper display is showing the diesel engine run time.
	When this icon is present the lower display is showing the electric motor run time (if the unit equipped with optional ELECTRIC STANDBY).
	When this Alarm Icon is present one or more alarm conditions have occurred. If the display is not flashing any alarms are Check Alarms. If the display is flashing on and off a shutdown alarm has occurred and the unit has been shut down. Immediate action must be taken.

Keys and LED Indicators

There are nine touch sensitive keys. Some of these keys have more than one function as shown in Figure 12.

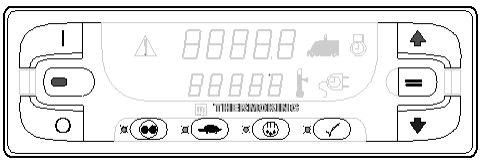


Figure 12: Keys and LED Indicators

There are amber indicator LED's located next to each of the four function keys below the display. The LED will glow amber when that function is active.

A red indicator LED is located between the ON Key and OFF Key at the left side of the display. This indicator will glow if Alarm Code 91 Check Electric Ready Input occurs. It will also light if a 15 pin Thermo King data cable is connected to the serial port on the back of the controller (DPD).

The primary and secondary key uses are shown in the table below. If the key has more than one use the primary use is shown first.

ON Key

Pressing the ON Key will turn the unit on.

Secondary Use - When the unit is on, pressing this key and the PRETRIP Key at the same time will display any alarm codes that are present.

Secondary Use - When the unit is on, pressing and holding this key allows the UP ARROW Key and DOWN ARROW Key to increase or decrease the display brightness.

Secondary Use - When the unit is on, pressing this key will return to the Standard Display of box temperature and setpoint.

POWER OFF Key

Pressing the OFF Key will turn the unit off.

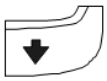
UP ARROW Key

When the unit is turned on and the Standard Display is shown, pressing the UP ARROW Key will increase the setpoint.

Secondary Use - When alarms are being displayed, pressing this key will scroll thru the alarms (if more than one alarm is present).

Secondary Use - While holding ON Key down with the unit turned on, pressing this key will increase the display brightness (Low, Medium, High).

DOWN ARROW Key



When the unit is turned on and the Standard Display is shown, pressing the DOWN ARROW Key will decrease the setpoint.

Secondary Use - While holding ON Key down with the unit turned on, pressing this key will decrease the display brightness (High, Medium, Low).

ENTER Key

If the setpoint has been changed using the UP ARROW Key and/or DOWN ARROW Key, pressing the ENTER Key enters the setpoint into the base controllers memory.

Secondary Use - When alarms are being displayed, pressing this key will clear the alarm shown on the display.

Secondary Use - When the unit is turned on, press and hold this key for 5 seconds to send a Start of Trip (SOT) to the data logger.

CYCLE-SENTRY/Continuous Key

If the unit is turned on and is in Continuous Mode, pressing the CYCLE-SENTRY/CONTINUOUS Key will switch operation to CYCLE-SENTRY Mode and the amber LED indictor will glow. If the unit is running in CYCLE-SENTRY Mode, pressing this key will switch operation to Continuous Mode and the amber LED will turn off.

HIGH SPEED LOCK-OUT Key

If the unit is turned on, pressing the HIGH SPEED LOCK-OUT Key will activate High Speed Lock-Out. The unit will switch to low speed operation and the amber LED indictor will glow. No further high speed operation is allowed until this feature is turned off. Unit may automatically return to high speed operation after a programmed time limit if timer feature is enabled.This feature is typically used in noise sensitive areas to reduce unit noise.

NOTE: The HIGH SPEED LOCK-OUT Key is only used when the unit is operating in Diesel Mode. The HIGH SPEED LOCK-OUT Key does not have any effect in Electric Mode operation.

DEFROST Key

If the unit is turned on, pressing the DEFROST Key will initiate a manual defrost cycle if conditions allow. If the evaporator coil temperature less than 45 F (7 C) the unit will enter a defrost cycle. The amber LED will flash while the defrost cycle is initialized and will glow during the defrost cycle. The defrost cycle will terminate automatically and the amber LED will turn off when the evaporator coil temperature is greater than 52 F (11 C). To manually terminate a defrost cycle turn the unit off and back on.

PRETRIP TEST Key

Pressing and holding the PRETRIP TEST Key for 5 seconds will initiate either a Full Pretrip Test or Engine Running Pretrip Test so long as no alarm conditions exist. If the Alarm Icon is glowing, record and clear the alarms before starting the Pretrip Test.

Press and hold the PRETRIP TEST Key for 5 seconds. If the unit is not running when the PRETRIP TEST Key is pressed the unit will perform a Full Pretrip that includes circuit amps and running system checks. If the unit is running when the PRETRIP TEST Key is pressed the unit will perform the running system checks only. The amber LED may flash while the Pretrip Test is initialized and will glow steady while the Pretrip Test is running. When the Pretrip Test is complete the amber LED will turn off.

- If there are no alarm codes set when the Pretrip Test is complete, the unit passed.
- If there are alarm codes set when the Pretrip Test is complete, the unit failed. Check and correct the alarm conditions and repeat the test.
- If a shutdown alarm occurred, Alarm Code 28 Pretrip Abort will be set and the unit will be shut down. Check and correct the alarm conditions and repeat the test.

Secondary Use - When the unit is turned off press and hold this key for 5 seconds to show the HMI Control Panel Serial Number (in the upper display) and the HMI Control Panel Software Revision (in the lower display).

Turning the Unit On and Off

IMPORTANT: Verify the Base Controller On/Off Switch is turned on before turning on the HMI Control Panel. The Base Controller On/Off switch is located on the outside of the control box side of the unit.

If the Standard Truck HMI Control Panel is turned on and the Base Controller On/Off Switch is turned off, the HMI display screen will flash on and off.

The unit is turned on by pressing the ON Key and off by pressing the OFF Key. When the ON Key is pressed the display briefly shows dashes as the display initializes.

IMPORTANT: If the display flashes on and off continuously when the ON Key is pressed, check to make sure the Base Controller On/Off switch is in the ON position.

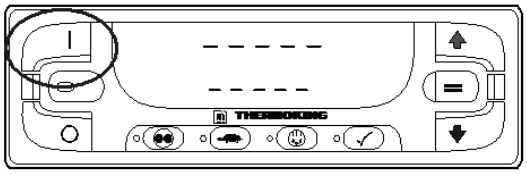


Figure 13: Keys and LED Indicators

Then the unit running time hourmeters are shown for 30 seconds. The diesel engine run time hours and Diesel Icon are shown in the upper display. If the optional Electric Standby Feature is installed, the electric motor run time hours and Electric Icon appear in the lower display as shown in Figure 14.

A Full Pretrip Test is initiated from this display by pressing and holding the Pretrip Key as shown later in this section.

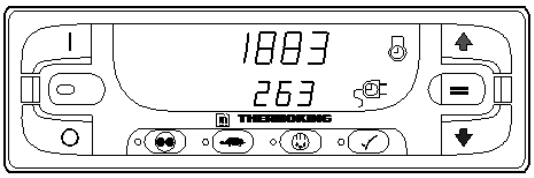


Figure 14: Electric Motor Run Time Hours and Electric Icon

When the unit is ready to run the Standard Display of box temperature and setpoint appears. The box temperature and Box Temp Icon are shown in the upper display. The setpoint and Setpoint Icon are shown in the lower display. The box temperature shown in Figure 15 is 35.8 F (2.1 C) with a 35 F (1.6 C) setpoint.

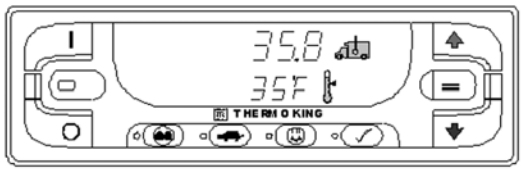


Figure 15: Standard Display of Box temperature and Setpoint

Pressing the OFF Key stops unit operation. The unit shuts down immediately and the display goes blank. To start the unit again, press the ON Key, shown in Figure 16.

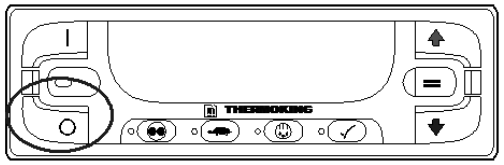


Figure 16: ON Key

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 return air sensor. The box temperature and Box Temperature Icon are shown in the upper display. The setpoint and Setpoint Icon are shown in the lower display. The box temperature in Figure 17 is 35.8 F (2.1 C) with a 35 F (1.6 C) setpoint.

Figure 17: Standard Display

Changing the Setpoint

From the Standard Display, press the UP ARROW Key and/or DOWN ARROW Key until the desired setpoint is shown. In Figure 18 the setpoint has been increased to 40 F (4.4 C) using the UP ARROW Key.

Figure 18: UP ARROW Key

When the desired setpoint has been selected using the UP ARROW Key or DOWN ARROW Key, the ENTER Key must be pressed to confirm and load the new setpoint.

- If the setpoint is changed using the UP ARROW Key and DOWN ARROW Key, the setpoint display will begin to flash 10 seconds after the last press of the UP ARROW or DOWN ARROW key as a reminder to press the ENTER Key.
- The setpoint display will flash for 10 additional seconds. If at the end of this time the ENTER Key still has not been pressed to complete the setpoint change, the setpoint will return to the old setpoint and Alarm Code 127 Setpoint Not Entered will be set. The Alarm Icon will appear in the display.

Figure 19: ENTER Key

The new setpoint of 40 F (4.4 C) will remain on the display after the ENTER Key has been pressed.

Failure to confirm the new setpoint by pressing the ENTER Key within 20 seconds of changing the setpoint will result in no setpoint change. In addition, Alarm Code 127 Setpoint Not Entered is set, to indicate that the setpoint change was started but was not completed.

Figure 20: Alarm Icon and Setpoint

Notice that the setpoint has returned to the old setpoint of 35 F (1.6 C) and the Alarm Icon has lighted indicating that Alarm Code 127 Setpoint Not Entered is set.

IMPORTANT: If the setpoint is changed using the UP ARROW Key or DOWN ARROW Key, the change must be confirmed by pressing the ENTER Key within 20 seconds of changing the setpoint.

- If the ENTER Key is pressed, the setpoint change made with the UP ARROW Key and/or DOWN ARROW Key is accepted, the setpoint is changed, and the display returns to the Standard Display showing the new setpoint.
- If the ENTER Key is not pressed within 20seconds of making a change with the UP ARROW Key and/or DOWN ARROW Key, the setpoint is not changed and the display returns to the Setpoint Display showing the old setpoint. Alarm Code 127 Setpoint Not Entered is set and the Alarm Icon will appear on the display, to indicate that the setpoint change was started but not completed.

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 pre-heat and start sequence will be delayed in Cycle Sentry mode if there is no current need for the engine to run.

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 SR-2 Standard Truck HMI Control Panel will continue to display the Standard Display as shown in Figure 21. The preheat buzzer at the unit (located on the unit Interface Board) sounds during the engine pre-heat and crank sequence.

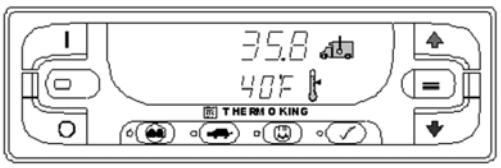


Figure 21: Standard Display

Starting the Electric Motor

Units equipped with the Electric Standby option only

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 in Standby Mode and standby power is connected.
CAUTION: The motor may start automatically any time the unit is turned on.

When the motor is preparing to start, the SR-2 Standard Truck HMI Control Panel will continue to show the Standard Display as shown in Figure 22. The preheat buzzer at the unit (located on the unit Interface Board) sounds for 20 seconds before the electric motor starts.

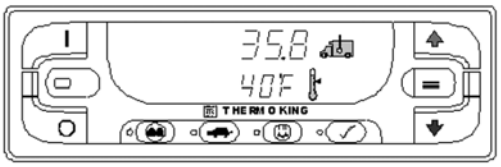


Figure 22: Standard Display

Switching from Diesel to Electric

IMPORTANT: Applies to units with the Electric Standby Option only. The operation of this feature can be changed using the Guarded Access Menu. See the Guarded Access / Unit Configuration Menu / Diesel to Electric Auto Switch Enabled feature in Section 3 of the Diagnostic Manual for details. The Diesel to Electric Auto Switch Enabled feature should be set YES on units equipped with the Standard Truck HMI Control panel.

Diesel to Electric Auto Switch Enabled set YES (Default): If this feature is set YES, the unit will switch automatically from Diesel Mode to Electric Mode when standby power is connected and present.

Diesel to Electric Auto Switch Enabled set NO:

The Diesel to Electric Auto Switch Enabled feature should not be set NO on units equipped with the Standard Truck HMI Control panel.

Switching from Electric to Diesel

IMPORTANT: Applies to units with the Electric Standby Option only. The operation of this feature can be changed using the Guarded Access Menu. See the Guarded Access / Unit Configuration Menu / Electric to Diesel Auto Switch Enabled feature in the Diagnostic Manual.

Electric to Diesel Auto Switch Enabled feature set YES: If this feature is set YES, the unit will switch automatically from Electric Mode to Diesel Mode when standby power is removed or fails.

Electric to Diesel Auto Switch Enabled feature set NO (Default) : If the unit is operating in Electric Mode 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 unit is operating in Electric Mode and standby power is disconnected or fails, Alarm Code 91 Check Electric Ready Input will be set. The red LED between the ON key and OFF Key

will glow, the Alarm Icon will glow and the box temperature and setpoint displays will disappear as shown in Figure 23.

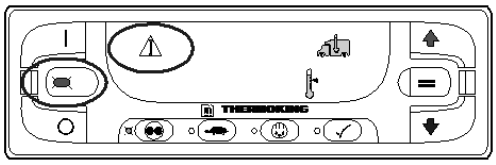


Figure 23: Alarm Icon

Alarm Code 91 Check Electric Ready Input will be cleared and the unit will restart automatically if power is restored.

Pressing the ON Key will clear Alarm Code 91 Check Electric Ready Input and turn the unit back on in Diesel Mode. If unit operation is required, the diesel engine will start as shown previously in STARTING THE DIESEL ENGINE.

Figure 24: Press ON Key

Preferred Method for Manually Switching from Electric Mode to Diesel Mode

1. Press the Standard Truck HMI Control Panel OFF Key to turn the unit off.
2. Turn off the standby power and disconnect the cord.
3. Press the Standard Truck HMI Control Panel ON Key to turn the unit on. The Hourmeters display will briefly appear and then the screen will appear as shown in Figure 25.

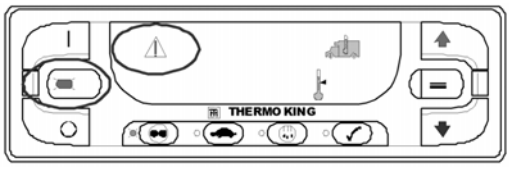


Figure 25: Display, Preferred Method for Manually Switching from Electric Mode to Diesel Mode

4. Press the Standard Truck HMI Control Panel ON Key again to clear Alarm Code 91 Check Electric Ready Input and turn the unit back on in Diesel Mode.

IMPORTANT: When the display shown in Figure 25 is present, do not press the Standard Truck HMI Control Panel OFF Key to turn the unit off. Press the Standard Truck HMI Control Panel ON Key again to clear Alarm Code 91 Check Electric Ready Input and turn the unit back on in Diesel Mode.

If the Standard Truck HMI Control Panel OFF Key is pressed when the display shown in Figure 25 is present, the unit will turn off and the display will be blank.

To restart the unit in Diesel Mode, proceed as follows:

- Press the Standard Truck HMI Control Panel ON Key. The Hourmeters display and a blinking Alarm Icon will appear.
- When the Hourmeters display and a blinking Alarm Icon is shown, press the Standard Truck HMI Control Panel ON Key again. The display will go blank but the blinking Alarm Icon will remain on and blinking.
- When the display goes blank and the blinking Alarm Icon is shown, press the Standard Truck HMI Control Panel ON Key again. The box temperature and setpoint will appear, the blinking Alarm Icon will disappear and the unit will start in Diesel Mode.

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 to provide constant airflow throughout the truck box.

CYCLE-SENTRY Mode or Continuous Mode is selected by pressing the CYCLE-SENTRY/CONTINUOUS Key when the unit is turned on. If the unit is running in Continuous Mode, pressing this key will switch operation to CYCLE-SENTRY Mode and the

amber LED indictor will glow. If the unit is running in CYCLE-SENTRY Mode, pressing this key will switch operation to Continuous Mode and the amber LED will turn off.

The unit shown in Figure 26 is running in CYCLE-SENTRY Mode.

Figure 26: CYCLE-SENTRY/Continuous Key

CAUTION: The engine may start automatically any time the unit is turned on.
CAUTION: If the unit is in CYCLE-SENTRY null and the mode is switched to Continuous Mode, the unit will start automatically.

Selecting the High Speed Lock-Out Feature

If the High Speed Lock-Out feature is enabled and turned on, the unit will run only in low speed until the High Speed Lock-Out feature is turned off or the High Speed Lockout Timer is exceeded. This feature is typically used in noise sensitive areas to reduce unit engine noise.

High Speed Lock-Out is turned on or off by pressing the HIGH SPEED LOCKOUT Key when the unit is turned on. Pressing this key will turn High Speed Lock-Out on, pressing it again will turn High Speed Lockout off. If High Speed Lockout is turned on, unit will switch to low speed operation and the amber LED indictor will glow. No further high speed operation is allowed until this feature is turned off or the High Speed Lockout Timer is exceeded.

IMPORTANT: HIGH SPEED LOCKOUT TIMER: If High Speed Lockout Mode is selected, the High Speed Inhibit Timeout feature may be enabled to return the unit to normal operation after a set time period has expired. This prevents unintended extended operation with high speed operation locked out. The time period may be set from 15 minutes to 2 hours. If a time period is set and exceeded, the unit will return to normal operation with high speed operation allowed and the amber LED indicator will turn off. If necessary to return to High Speed Lockout Mode, press the HIGH SPEED LOCKOUT Key again.

The unit shown in Figure 27 has High Speed Lockout turned on.

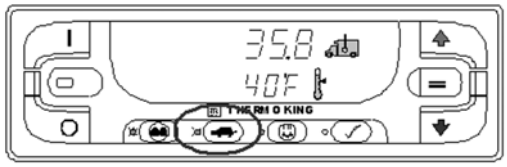


Figure 27: HIGH SPEED LOCKOUT Key

Initiating a Manual Defrost Cycle

Defrost cycles are usually initiated automatically based on time or demand. Manual defrost may also be available. Defrost is only available if the unit is running and the evaporator coil temperature is less than 45 F (7 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 as shown in Figure 28. If conditions allow, the unit will enter a defrost cycle and the amber LED next to the DEFROST Key will glow.

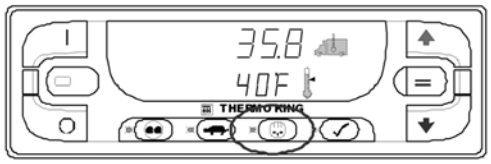


Figure 28: DEFROST Key

IMPORTANT: During the defrost cycle, the box temperature will rise toward 50 F (10 C). This is normal and is caused by the defrost cycle warming the evaporator coil. Since the damper door is closed during the defrost cycle, this warm air is not allowed to pass into the truck box.

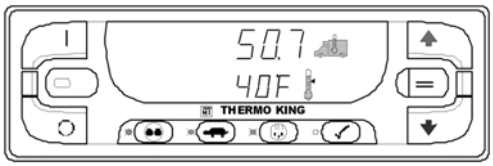


Figure 29: Box temperature will rise toward 50 F (10 C)

Terminating a Defrost Cycle

The defrost cycle terminates automatically when the coil temperature is greater than or equal to 52 F (11 C) or the maximum defrost timer expires. Alarm code 14, Defrost Terminated by Time, will generate if the maximum defrost time is exceeded. When the defrost cycle is completed the amber LED next to the DEFROST Key will turn off. Defrost can also be terminated by turning the unit off and back on.

Alarms

Alarm Code Notification

If an alarm condition occurs, the Alarm Icon will appear on the display. If the alarm is a Check Alarm, the Alarm Icon will turn on but the unit will continue to run. If the alarm is a Shutdown Alarm, the Alarm Icon and the display will flash on and off and the unit will shut down.

Figure 30: Alarm Icon

Displaying Alarm Codes

Alarms are displayed by simultaneously pressing and holding the ON Key and PRETRIP TEST Key. The alarm display will appear as shown below. The upper display shown in Figure 31 indicates that Alarm Code 127 Setpoint Not Entered has been set. The lower display indicates that only one alarm code exists.

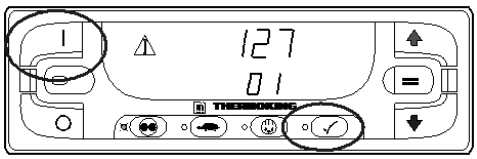


Figure 31: ON and PRETRIP TEST Keys

If more than one alarm code has been set, they are displayed with the most recent alarm shown first. Use the UP ARROW Key to scroll through the alarms.

Clearing Alarm Codes

After the alarm situation is resolved, press the ENTER Key to clear the alarm code currently being shown. When all alarms have been cleared the display will show all zeros to indicate that no alarm codes exist.

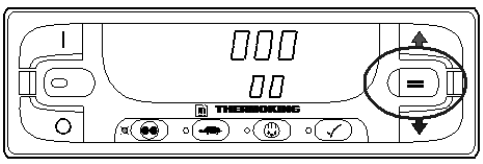


Figure 32: ENTER Key

The display will return to the Standard Display about 30 seconds after all alarms have been cleared.

Figure 33: Standard Display

Important Alarm Notes

- All alarms must be viewed before any of the alarms can be cleared.
- 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.

- Some alarms cannot be cleared using the Standard Truck HMI Control Panel. These alarms must be cleared by maintenance personnel from the Maintenance or Guarded Access Menus.
- Alarm Code 91 Check Electric Ready Input is cleared by turning the unit off and back on. See SWITCHING FROM ELECTRIC TO DIESEL in this section.

Refer to the Truck SR-2 Single Temp Diagnostic Manual TK 54292 for more information about alarm codes and their diagnosis.

Sending a Servicewatch Data Logger Start of Trip

When the unit is turned on, press and hold the ENTER Key for 5 seconds to send a Start of Trip (SOT) marker to the unit ServiceWatch Data Logger and the optional DAS Data Logger (if equipped).

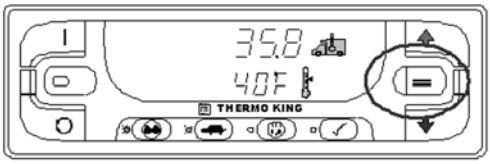


Figure 34: ENTER Key

Pretrip Test

A Pretrip Test verifies unit operation. The PRETRIP Key allows either a Full Pretrip Test or an Engine Running Pretrip Test to be initiated by the operator.

Pretrip Test Conditions

- The current unit settings are saved and restored at the end of the Pretrip Test or if the unit is turned off and back on.
- The 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

- Pretrip Tests are not allowed if any shutdown alarms are present.
- Pretrip tests are allowed with some Check and Log alarms present.

Pretrip Test Sequence

Pretrip tests proceed in the order shown below.

Full Pretrip Test

Full Pretrip Tests include all of the tests shown below.

- 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 when the Pretrip Test is completed. If the Pretrip Test fails, alarm codes will exist to direct the technician to the source of the problem.

Engine Running Pretrip Test

Engine Running Pretrip Tests include all of the tests shown below. They do not include the Amps Check or the Engine Start tests.

- 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 when the Pretrip Test is completed. If the Pretrip Test fails, 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.

- Whenever possible, run the Pretrip Test with an empty truck box.
- If running a Pretrip Test on a truck loaded with dry cargo, insure that proper airflow can occur around the load. If the load restricts airflow, false test results may occur. Also, units have high refrigeration capacity which results in rapid temperature change. Sensitive dry cargo may be damaged as a result.
- If running a Pretrip Test on a truck that has just been washed down, the extremely high humidity inside the truck box may result in false test results.
- If running a Pretrip Test on a truck 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 cargo doors closed to prevent false test results.

Performing a Pretrip Test

Starting a Pretrip Test

The Full Pretrip Test must be started with the unit not running. Turn the unit on and clear all alarm codes. Turn the unit off.

Turn the unit on and wait for the unit running time hourmeters to be shown on the display. When the unit running time hourmeters are shown on the display, press and hold the PRETRIP Key for 5 seconds.

Figure 35: Pretrip Test

- A flashing Pretrip LED indicates that the Pretrip Test is being initialized. When the Pretrip Test starts, the Pretrip LED will glow steady amber. The display will show the Standard Display.
- The Amps Check Test will be preformed and then the unit will start automatically. The balance of the tests will be completed.
- The Pretrip Test will take about 20 - 30 minutes, depending on conditions.

IMPORTANT: The box temperature will vary during the Pretrip Test. This is normal operation.

- When the Pretrip Test is complete or if a Shutdown Alarm occurs, the amber Pretrip LED will turn off.
- Stopping a Pretrip Test: To stop a Pretrip Test at any time, press the POWER OFF Key to 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.

Starting a Engine Running Pretrip Test

The Engine Running Pretrip Test must be started with the unit running. Turn the unit on and clear all alarm codes. Allow the unit to start.

With the unit running, press and hold the PRETRIP Key for 5 seconds.

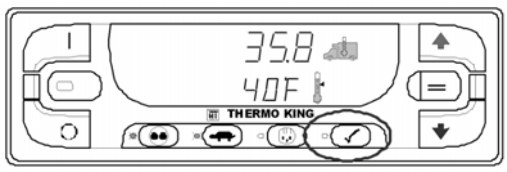


Figure 36: PRETRIP Key

- A flashing Pretrip LED indicates that the Pretrip Test is being initialized. When the Pretrip Test starts, the Pretrip LED will glow steady amber to indicate the test is in progress. The display will show the Standard Display.
- The Pretrip Test will take about 20 - 25 minutes, depending on conditions.

IMPORTANT: The box temperature will vary during the Pretrip Test. This is normal operation.

When the Pretrip Test is complete or if a Shutdown Alarm occurs, the amber Pretrip LED will turn off.

Stopping a Pretrip Test: To stop a Pretrip Test at any time, press the POWER OFF Key to 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.

Pretrip Test Results

Pass Pretrip Test

- If the unit passes the Pretrip Test, the amber Pretrip Test LED will turn off at the completion of the test and the unit will continue to run as required. This signifies that the unit passed the Pretrip Test.

Fail Pretrip Test with Check Alarms

- If the unit fails the Pretrip Test with Check alarms, the Alarm Icon will appear when the alarm condition occurs. The Pretrip Test will continue to run unless a Shutdown Alarm occurs.
- The amber Pretrip Test LED will turn off at the completion of the test, but the Alarm Icon will remain lit. This indicates that one or more Check Alarm conditions occurred during the Pretrip Test. More than one alarm may be present.
- View and record the alarm(s), correct as necessary, clear the alarm(s) and repeat the Pretrip Test.

Fail Pretrip Test with Shutdown Alarms

- If the unit fails the Pretrip Test with a Shutdown alarm, the Alarm Icon will appear when the alarm condition occurs, the unit will immediately shut down and the amber Pretrip Test LED will turn off.
- The Pretrip Test will be aborted.
- Alarm Code 28 Pretrip Abort will be set along with the Shutdown Alarm that was detected. This signifies that a Shutdown Alarm occurred during the Pretrip Test and that the test was aborted. Other alarms may also be present.
- View and record the alarm(s), correct as necessary, clear the alarm(s) and repeat the Pretrip Test.

Display Brightness

The brightness of the SR-2 Standard Truck HMI Control Panel display can be adjusted to allow for changing ambient light conditions. The choices available to the operator are HIGH, MEDIUM and LOW.

To change the display brightness press and hold the ON key then press the UP ARROW Key to increase display brightness and the DOWN ARROW Key to decrease display brightness.

Figure 37: ON Key, UP/DOWN Arrow Keys

Checking Truck HMI Control Panel Software Revision and Serial Number

The Standard Truck HMI Control Panel serial number and software revision can be displayed if necessary.

To display the serial number and software revision press and hold the PRETRIP key for 5 seconds when the unit is turned off.

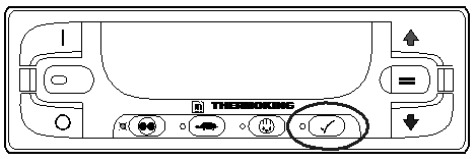


Figure 38: PRETRIP Key

The serial number is shown at the top of the display and the software revision is shown at the bottom of the display. The HMI Control Panel Serial Number shown in Figure 39 is 00212. The software revision shown below is Revision 2200.

Figure 39: Software Revision and Serial Number

Operating Instructions for Premium HMI Control Panel

SR-2 Truck Premium HMI Controller Description

Premium HMI Control Panel

The Premium Truck HMI (Human/Machine Interface) Control Panel is available as an option on SR-2 Truck applications. It is used to operate the unit, display unit information and access all SR-2 Maintenance and Guarded Access Menus. The Premium HMI Control Panel communicates with the base controller via the CAN (Controller Area Network) bus. It is connected to the base controller via CAN Connector J14 on the interface board. The Premium HMI Control Panel is typically located in the vehicle driver's compartment. It may be installed in the truck instrument panel using a DIN mounting ring or under the instrument panel using an under dash mounting kit.

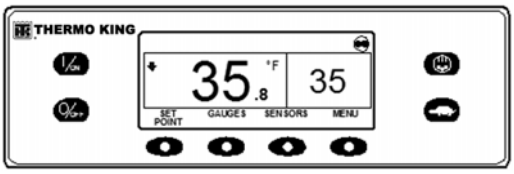


Figure 40: Premium HMI Control Panel

The HMI control panel consists of a display and 8 touch-sensitive keys.

The display is capable of showing both text and graphics.

The keys on the left and right sides of the display are dedicated single function "hard" keys.

The four keys under the display are "soft" keys. The functions of these soft keys change depending on the operation being performed. If a soft key is active the current key function is shown in the display directly above the key.

Controller Features

- Displays Box Temperature and Setpoint in Fahrenheit or Celsius
- Displays Engine Running and Motor Running Hourmeters
- Changes Setpoint
- Indicates Alarm Condition Exists
- Displays and Clears Alarms
- Selects and Indicates CYCLE-SENTRY or Continuous Mode Operation
- Selects and Indicates High Speed Lock-Out Operation
- Initiates and Indicates a Defrost Cycle
- Initiates and Indicates a Pretrip Test
- Sends a Start of Trip to the ServiceWatch data logger.

Display

The display presents information to the operator. This information includes setpoint and temperature, unit operating information, gauge readings, temperatures and other information as selected by the operator.

The Standard Display of box temperature and setpoint is shown here. The CYCLE-SENTRY Icon in the upper right of the display shows the unit is running in CYCLE-SENTRY (Start-Stop) Mode. The unit has a setpoint of 35 F, and an actual box temperature of 35.8 F. The down-pointing arrow at the left side of the display shows the unit is cooling.

The four keys under the display are termed "soft" keys. The functions of these keys change depending on the operation being performed. The function of each soft key is shown by labels in the display located directly above each soft key. In the example shown above, pressing the left soft key accesses the SETPOINT Menu and pressing the right soft key accesses the MAIN Menu. The other two soft keys access the GAUGES menu and SENSORS menu as shown by the labels above the keys.

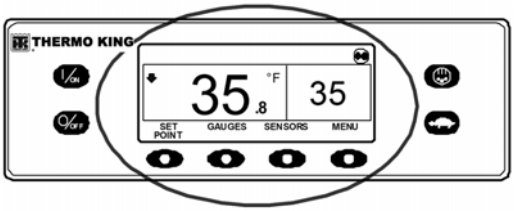


Figure 41: Display

Keys

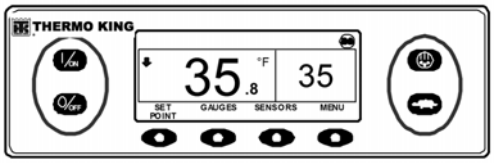


Figure 42: Keys

Hard Keys

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

Hard Key	Description
	This key is used to turn the unit on. First the display will briefly show the Thermo King Logo and then the statement "Configuring System - Please Wait". When the power-up sequence is complete the display shows the Standard Display of box temperature and setpoint. For more information see "Turning the Unit On and Off" later in this section.
	This key is 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.
	This key is used to initiate a manual defrost cycle. For more information see "Initiating a Manual Defrost Cycle" later in this section.
	This key is used to lock out high speed operation in noise sensitive areas. For more information see "Selecting High Speed Lockout" later in this section.

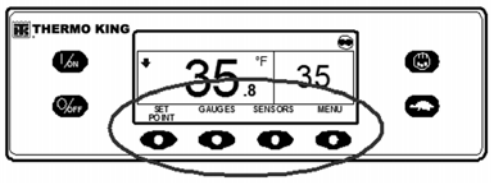


Figure 43: Soft Keys

Soft Keys

Soft Key	Description
	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 functions:

- MENU
- NEXT BACK
- YES NO
- \+ -
- SELECT EXIT
- CLEAR HELP
- HOUR METERS SENSORS
- GAUGES

Turning the Unit On and Off

IMPORTANT: Verify the Base Controller On/Off Switch is turned on before turning on the HMI Control Panel. The Base Controller On/Off switch is located on the outside of the control box side of the unit.

If the Premium Truck HMI Control Panel is turned on and the Base Controller On/Off Switch is turned off, the HMI display screen will briefly show LOST CONTROLLER POWER. The HMI will then power down.

The unit is turned on by pressing the ON key 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 as shown in Figure 44. 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.

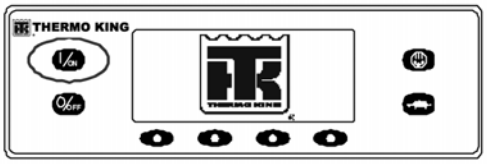


Figure 44: Thermo King Logo

Then the startup screen shown in Figure 45 appears while communications are established and the unit prepares for operation.

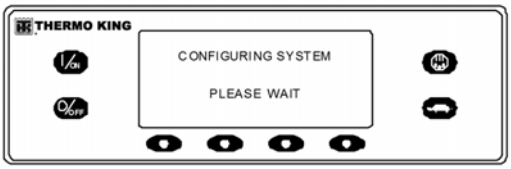


Figure 45: Startup Screen

If More Than One Language is Enabled

If more than one language has been enabled, a prompt will appear to allow the desired language to be chosen as shown below. Only languages enabled from the Guarded Access Menu are available. If a different language is desired, press the NO key as shown in Figure 46.

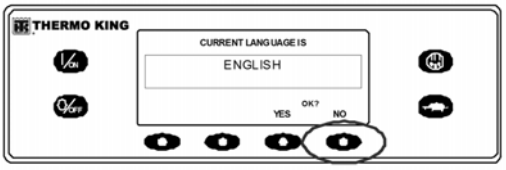


Figure 46: NO key

The Language menu will appear as shown in Figure 47. Press the + or - keys to select the desired language. When the desired language is shown press the YES key to confirm the choice.

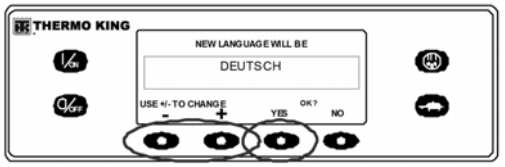


Figure 47: YES Key

The display will briefly show PROGRAMMING LANGUAGE - PLEASE WAIT in the new language as shown in Figure 48.

Figure 48: Programming Language

The new language is confirmed, and then the Standard Display will appear in the new language as shown in Figure 49. The unit is ready to run.

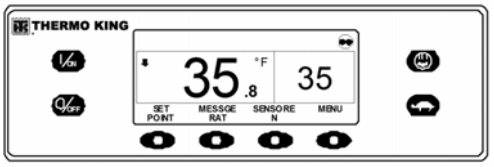


Figure 49: Standard Display

Should it be necessary to change to another language at any time, return to the Standard Display and then press and hold the first and last soft keys for 5 seconds as shown in Figure 50. The Standard Display below is shown in Deutsch (German).

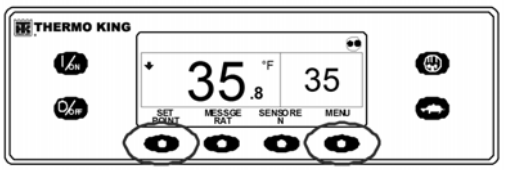


Figure 50: First and Last Soft Keys

The Language Menu will appear in the current language as shown in Figure 51. Press the + or - keys to select the desired language. When the desired language is shown press the YES key to confirm the choice. Note that all languages in the installed software can be selected using this method.

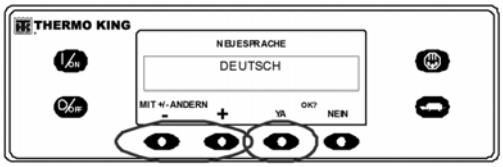


Figure 51: Language Menu

When the unit is ready to run the Standard Display appears.

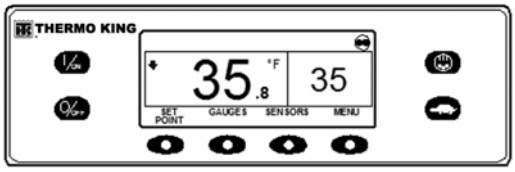


Figure 52: Standard Display

Pressing the OFF key stops unit operation. The unit shuts down immediately and the display briefly shows the power down message.

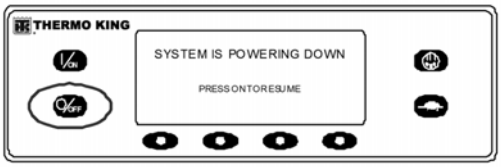


Figure 53: Power Down Message

The display briefly shows OFF and then goes blank. To start the unit again, press the ON key.

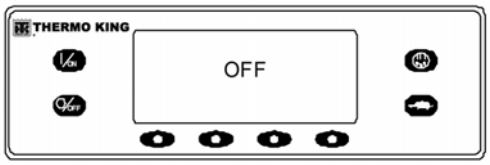


Figure 54: Off Display

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 55 is 35.8 F with a 35 F setpoint.

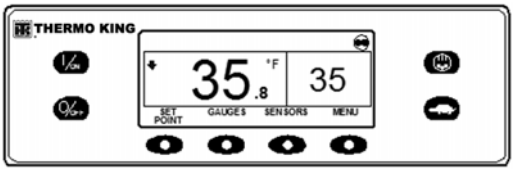


Figure 55: Standard Display

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 operating in Continuous Mode.

The down-pointing arrow indicates that the unit is cooling. If the unit was heating the arrow would be pointing upward.

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.

Changing the Setpoint

From the Standard Display, press the SETPOINT soft key.

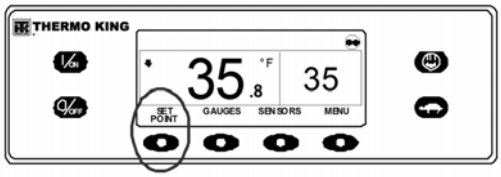


Figure 56: SETPOINT Key

The setpoint display appears as shown in Figure 57.

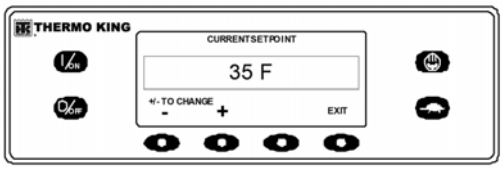


Figure 57: Setpoint Display

The "-" and "+" soft keys are used to increase or decrease the setpoint until the desire setpoint is shown. In Figure 58 the setpoint has been changed to 40 F using the "+" key.

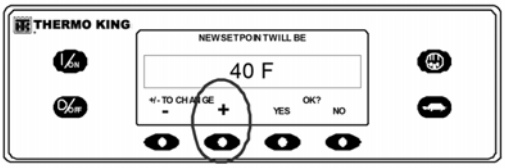


Figure 58: Increase Setpoint

The YES and NO soft keys confirm the setpoint change. When the desired setpoint has been selected using the "+" and/or "-" keys, press the YES soft 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 soft key within 10 seconds of changing the setpoint.

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 the setpoint change was not completed.

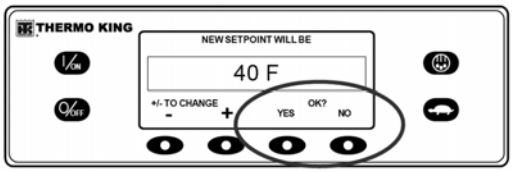


Figure 59: Soft Keys

After the YES soft key has been pressed, the display briefly shows PROGRAMMING NEW SETPOINT - PLEASE WAIT. The display then confirms the new setpoint for several seconds.

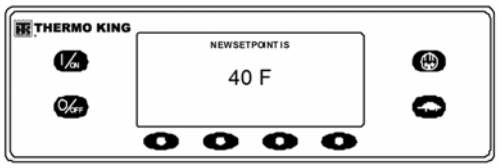


Figure 60: New Setpoint

If the NO soft key is pressed the display will briefly show SETPOINT NOT CHANGED and return to the Standard Display. The Standard Display will show the old setpoint.The display then returns to the Standard Display showing the new setpoint. Notice in Figure 61 that the arrow now points up to indicate that the unit is heating.

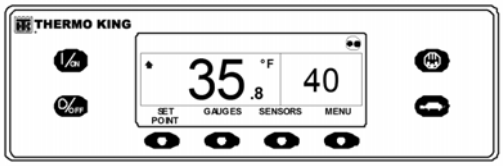


Figure 61: Standard Display, New Setpoint

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

- If the YES 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 either 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 Setpoint Display. The display briefly shows [SETPOINT NOT CHANGED] and **Alarm Code 127 Setpoint Not Entered** is set, to indicate that a setpoint change was started but not completed.

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, as shown in Figure 62. The preheat buzzer sounds during the engine preheat and crank sequence.

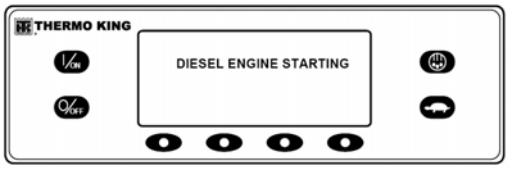


Figure 62: Engine Start Screen

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

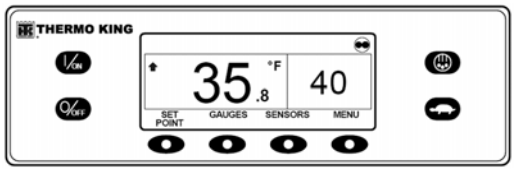


Figure 63: Standard Display of Temperature and Setpoint

Starting the Electric Motor

Units equipped with the Electric Standby option only.

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.

When the motor is preparing to start the HMI control panel will display the motor start screen, as shown in Figure 64. The preheat buzzer sounds for 20 seconds before the electric motor starts.

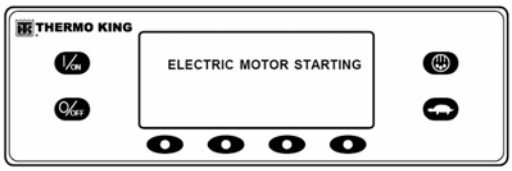


Figure 64: Motor Start Screen

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

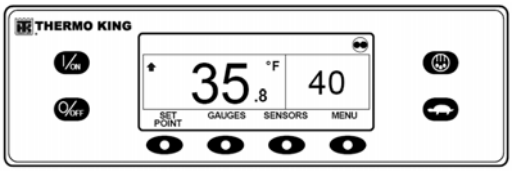


Figure 65: Standard Display of Temperature and Setpoint

Switching from Diesel to Electric

<u>Units equipped with the Electric Standby option only.</u>

If the Diesel to Electric Autoswitch 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 Autoswitch Enabled feature in Guarded Access is set NO then the prompt screen shown in Figure 66 will appear when standby power is connected and available.

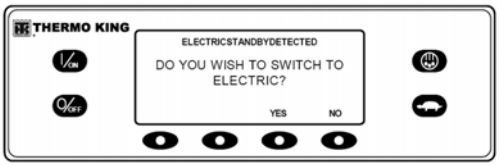


Figure 66: Prompt Screen, Guarded Access Set to No

If YES is selected then the display will briefly show the screen in Figure 67.

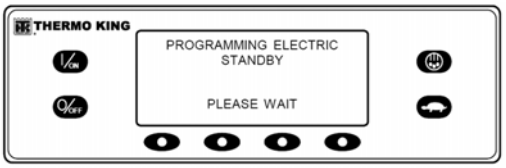


Figure 67: Prompt Screen, Guarded Access Set to Yes

Electric Mode operation will briefly be confirmed. If unit operation is required the electric motor will start as shown in STARTING THE ELECTRIC MOTOR.

Switching from Electric to Diesel

Units equipped with the Electric Standby option only.

If the Electric to Diesel Autoswitch 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 Autoswitch Enabled feature in Guarded Access is set NO then the prompt screen in Figure 68 will appear when standby power is turned off or is no longer available. Alarm Code 91 Check Electric Ready Input and Alarm Code 84 Restart Null will both be set.

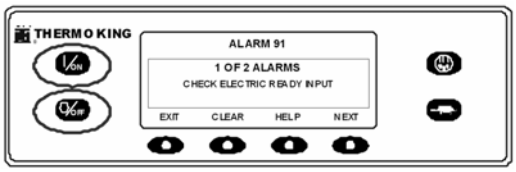


Figure 68: Prompt Screen, standby power is turned off or is no longer available

Turn the unit off and back on using the OFF and ON Keys. This will clear Alarm Code 91 Check Electric Ready Input and Alarm Code 84 Restart Null. NOTE: The CLEAR Soft Key will not clear these two alarms. Then the prompt screen shown in Figure 69 will appear.

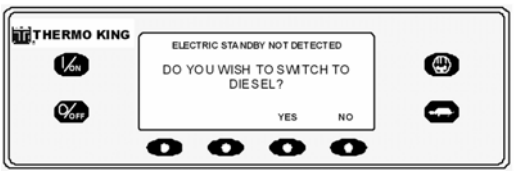


Figure 69: Prompt Screen, after OFF and ON

If YES is selected then the display will briefly show the screen in Figure 70. Then Diesel Mode operation will briefly be confirmed.

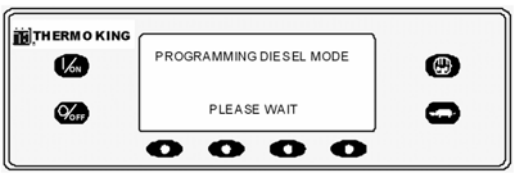


Figure 70: Display is YES is selected

If unit operation is required the diesel engine will start as shown previously in STARTING THE DIESEL ENGINE.

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).

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 as shown in Figure 71.

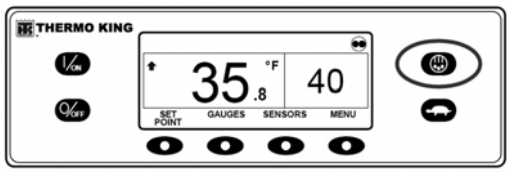


Figure 71: Press Defrost Key

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

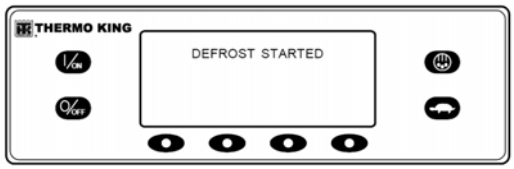


Figure 72: Prompt Screen, Guarded Access Set to Yes

The display then shows the Defrost display. The bar indicator shows approximately how much time remains to complete the defrost cycle. The bar indicator in Figure 72 shows that the defrost cycle is about 25% complete.

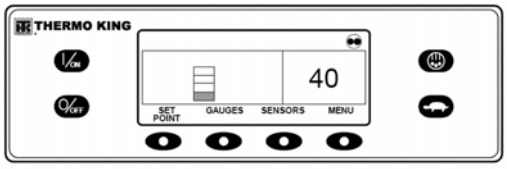


Figure 73: Defrost Display

Terminating a Defrost Cycle

The defrost cycle terminates automatically when the coil temperature is greater than or equal to 52 F (11 C) or the defrost timer expires. Defrost can also be terminated by turning the unit off and back on.

Selecting High Speed Lockout Mode (If Enabled)

High speed operation can be locked out in noise sensitive areas if required.

NOTE: High Speed Lockout Enable must be set to [Enabled] in the Guarded Access/Programmable Features Menu or this feature will not be available.

IMPORTANT: HIGH SPEED LOCKOUT TIMEOUT: If High Speed Lockout Mode is selected, the High Speed Inhibit Timeout feature may be set to return the unit to normal operation after a set time period has expired. This prevents extended operation with high speed operation locked out. The time period may be from 15 minutes to 2 hours. If the time period is set and is exceeded the unit will return to normal operation, with high speed operation allowed. If this occurs, the message HIGH SPEED LOCKOUT ACTIVE at the top of the display will disappear. If necessary to return to High Speed Lockout Mode, press the High Speed Lockout Key again.

The High Speed Lockout Key is a toggle. If high speed is currently allowed, then pressing the High Speed Lockout Key will disable high speed operation. Pressing the High Speed Lockout Key again will allow high speed operation. To change the setting, press the High Speed Lockout key as shown below.

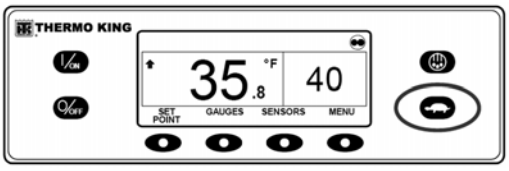


Figure 74: High Speed Lockout Key

The display will briefly show [PROGRAMMING HIGH SPEED LOCKOUT - PLEASE WAIT].

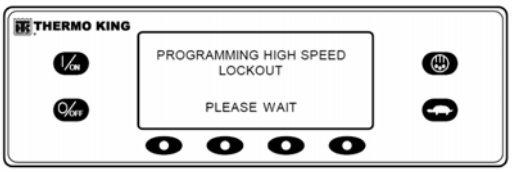


Figure 75: PROGRAMMING HIGH SPEED LOCKOUT - PLEASE WAIT

The change is confirmed by briefly displaying [HIGH SPEED LOCKOUT ACTIVE] or [HIGH SPEED LOCKOUT INACTIVE].

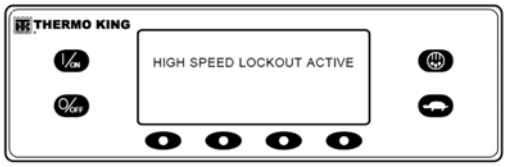


Figure 76: High Speed Lockout Display

The display will then return to the Standard Display. If High Speed Lockout is turned on, the message HIGH SPEED LOCKOUT ACTIVE will be shown at the top of the display.

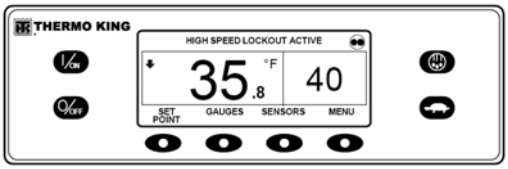


Figure 77: Standard Display, High Speed Lockout Active

Pressing the High Speed Lockout key again will turn the feature off.

Selecting CYCLE-SENTRY or Continuous Mode

With Thermo King Truck unit applications, CYCLE-SENTRY Mode or Continuous Mode operation is selected from the Main Menu - Mode Submenu. See the Main Menu - Mode Submenu material later in this section for complete details.

Using the Gauges Key

The GAUGES key allows the operator to view the unit gauges. To access the GAUGES menu press the GAUGES key.

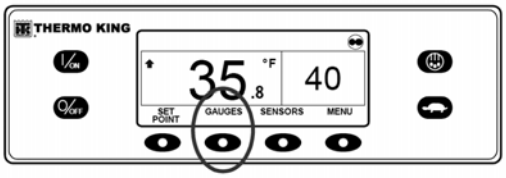


Figure 78: Gauges Key

The first gauge display will appear. Press the NEXT and BACK keys to scroll thru the gauges as desired. The Battery Voltage Gauge is shown in Figure 79. Press the LOCK key to lock the selected gauge on the display.

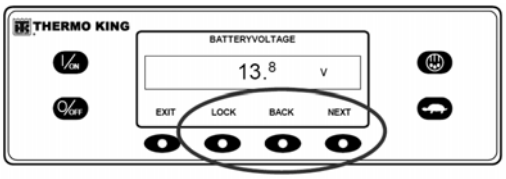


Figure 79: Next, Back, Lock Keys

The gauges available are shown in the following list. The order in which the gauges appear may vary slightly based on software revision. Not all gauges may appear, depending on unit configuration and software revision

To return to the Standard Display press the EXIT key.

Gauges Available

NOTE: Not all gauges or I/O states will appear, dependent upon unit type and configuration

Coolant Temperature - Displays the temperature of the engine coolant.

Coolant Level - Displays the coolant level in the overflow tank as OK or LOW.

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

Oil Level - Displays the engine oil level as OK or LOW.

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

Battery Voltage - Displays the voltage of the unit battery.

Engine RPM - Displays the engine speed in RPMs.

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 Electronic Throttling Valve (ETV). (ETV units only)

Compressor Temperature - Displays the temperature sensed by the compressor temperature sensor.

I/O (Input/Output State) - Displays the current state of the input/output devices listed below as ON or OFF.

- High Speed Relay/Electric Heat
- Run Relay
- Run Relay Feedback
- Alternator Excite Output
- Defrost Damper
- Hot Gas Solenoid
- Alternator Frequency
- Diesel/Electric Relay (Model 50 units only)
- Electric Ready Input (Model 50 units only)
- Electric Overload (Model 50 units only)
- Condenser Inlet Solenoid
- Drain Hose Heater
- Purge Valve

Using the Sensors Key

The SENSORS key allows the operator to view the temperatures read by the unit temperature sensors. To access the SENSORS menu press the SENSORS key.

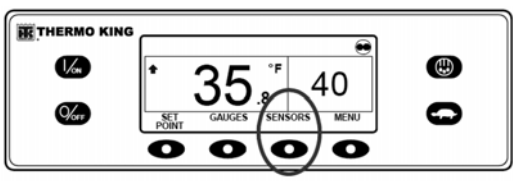


Figure 80: Sensors Key

The first sensor display will appear. Press the NEXT and BACK keys to scroll thru the sensors as desired. The Discharge Air Temperature sensor is shown in Figure 81. Press the LOCK key to lock the current sensor on the display.

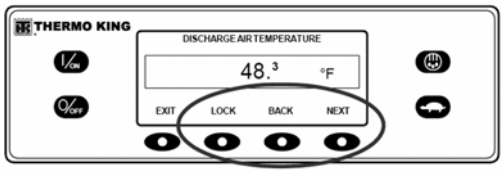


Figure 81: Next, Back, Lock Keys

The sensors available are shown in the following list.

To return to the Standard Display press the EXIT key.

Sensors Available

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

Discharge Air Temperature - Displays the temperature of the control 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.

Data Logger Sensor 1 Temperature - Display the temperature of Data Logger Sensor 1.

Data Logger Sensor 2 Temperature - Display the temperature of Data Logger Sensor 2.

Data Logger Sensor 3 Temperature - Display the temperature of Data Logger Sensor 3.

Data Logger Sensor 4 Temperature - Display the temperature of Data Logger Sensor 4.

Data Logger Sensor 5 Temperature - Display the temperature of Data Logger Sensor 5.

Data Logger Sensor 6 Temperature - Display the temperature of Data Logger Sensor 6

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.

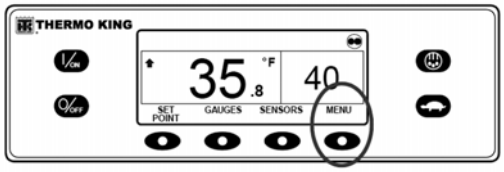


Figure 82: Menu Key

The first Main Menu choice will appear. Press the NEXT and BACK keys to scroll thru the menu choices. When the desired selection is shown on the display, press the SELECT key to access it. The Pretrip submenu is shown in Figure 83.

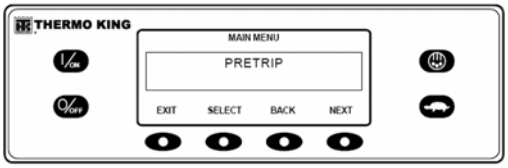


Figure 83: Pretrip Submenu

See “Main Menu Choices.” For detailed information see the individual explanations of each submenu item on the following pages.

To return to the Standard Display press the EXIT key.

Main Menu Choices

LANGUAGE - If more than one language is enabled, this will be the first menu item to appear. If only one language is enabled, this menu will not appear. The Language Menu allows the operator to select a language from a list of up to 11 languages at one time. All subsequent displays are shown in the selected language. Three different language packages with a total of 23 languages are available. English is the default language and is provided in each of the packages.

ALARMS - Allows the operator to view all alarms, and allows most alarms to be cleared. If only one language is enabled this will be the first menu item to appear.

DATA LOGGER - Allows the operator to set a Start of Trip marker to the ServiceWatch data logger. Also allows a Start of Trip and Print requests to be sent to the Optional DAS Data Logger (if installed).

HOURMETERS - 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.

MODE - Allows the operator to change the unit operating modes if allowed. Not all modes may appear depending on the settings selected from the Guarded Access menu and the HMI Control Panel software version.

- "Turn Off CYCLE-SENTRY Mode/Turn On CYCLE-SENTRY Mode (If CYCLE-SENTRY is Off unit runs in Continuous).
- Allow Keypad Lockout to be selected.
- Start Sleep Mode.

PRETRIP - Allows the operator to start a Pretrip Test. If an alarm is active, the Pretrip Test is not allowed and the operator is prompted to clear the alarm(s).

ELECTRIC STANDBY - If the Electric Standby option is present and the Diesel to Electric Auto-switch feature is set NO, this feature allows the operator to manually select electric mode operation. This feature does not appear if the unit does not feature optional Electric Standby or if the Diesel to Electric Auto-switch feature is set YES.

DIESEL MODE - If a unit equipped with electric standby is running in electric mode and the Electric to Diesel Auto-switch feature is set NO, this feature allows the operator to manually select diesel mode operation. This feature does not appear if the unit does not feature optional Electric Standby or if the Electric to Diesel Auto-switch feature is set YES.

ADJUST BRIGHTNESS - Allows the operator to adjust the HMI Control Panel display backlight intensity as required by local conditions.

TIME - Allows the operator to view the unit time and date. The time and date cannot be changed from this menu.

Languages

If the Language feature is enabled, an alternate language can be selected from the Language Menu. After a new language is chosen, all subsequent displays will appear in that language. If the language feature is not enabled this menu does not appear. The default language is English. Only languages that have been enabled in Guarded Access will appear. Exercise care when changing languages, as once changed all HMI Control panel displays will be in the new language. If the user is not familiar with the new language, problems may be experienced returning to the default language.

The languages available are dependent on the HMI control panel software revision.

- Languages currently supported by software revision 65xx are English, Spanish, French, German, Italian, Dutch, Portuguese, Greek, Turkish, Hebrew and Arabic.
- Languages currently supported by software revision 66xx are English, Danish, Russian, Norwegian, Swedish, Finnish, Polish, Hungarian, Romanian, Bulgarian and Czech.
- Languages currently supported by software revision 67xx are English, Japanese and Chinese. Other than the languages supported, software revisions 65xx, 66xx and 67xx are functionally identical.

To select an alternate language, press the MENU key.

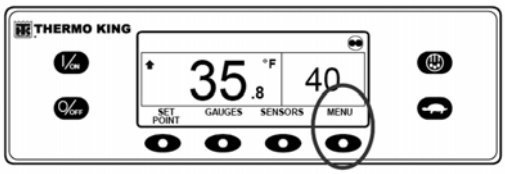


Figure 84: Menu Key

If enabled, the Language Menu is the first menu item to appear as shown in Figure 85. Press the SELECT key to choose the Language menu.

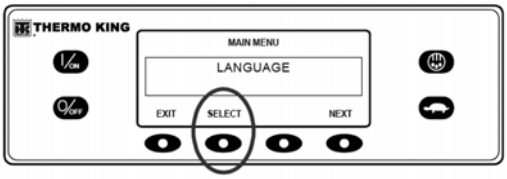


Figure 85: Select Key

The Language menu will appear as shown in Figure 86. Press the + or - keys to select the desired language. When the desired language is shown press the YES key to confirm the choice.

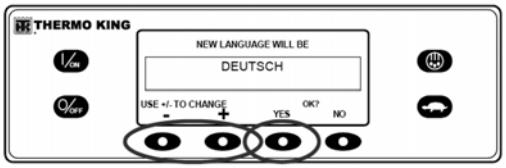


Figure 86: + or - Keys, Yes Key

The display will briefly show PROGRAMMING LANGUAGE - PLEASE WAIT in the new language as shown in Figure 87.

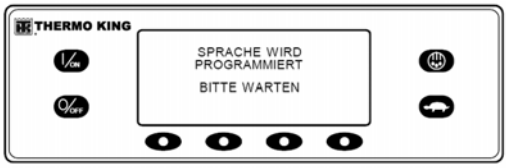


Figure 87: New Language

The new language is confirmed, and then the Standard Display will appear in the new language as shown in Figure 88. The unit is ready to run.

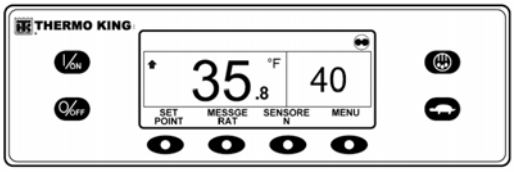


Figure 88: Standard Display in New Language

Repeat the process to select a different language. To select a different Main Menu item press the NEXT key. To return to the Standard Display press the EXIT key.

IMPORTANT: If necessary, English and all other languages in the installed HMI Control Panel software revision may be accessed from the Standard Display.

Should it be necessary to change to another language at any time, return to the Standard Display and then press and hold the first and last soft keys for 5 seconds as shown in Figure 89. The Standard Display below is shown in Deutsch (German).

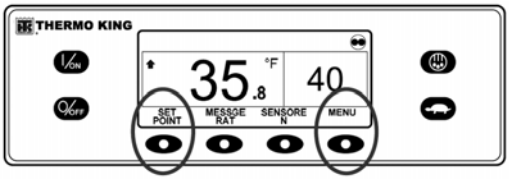


Figure 89: Standard Display in New Language

After 5 seconds the Language Menu will appear in the current language as shown in Figure 90. Press the + or - keys to select the desired language. When the desired language is shown press the YES key to confirm the choice. Note that all languages in the installed HMI Control Panel software (65xx, 66xx or 67xx) can be selected using this method.

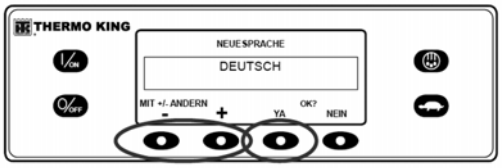


Figure 90: Language Menu

Alarms

Alarm Types

Alarms may be one of four types as shown.

Log Alarms

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 the condition impacts unit performance. Maintenance items such as maintenance hourmeter time-outs are log alarms.

When the unit is turned on the display will show the Thermo King Logo and then the "Configuring System" message. If log alarm(s) are present the Log Alarm notice will appear on the display for 60 seconds as shown. The amber K symbol of the remote indicator alarm light (if installed) will also

be on during this period. The Standard Display will appear and the remote indicator alarm light will go to the white T symbol after 60 seconds.

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

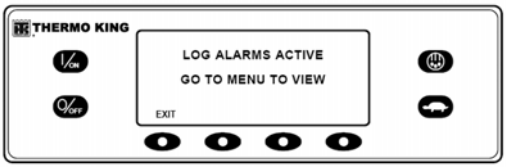


Figure 91: Log Alarm Notice

NOTE: If required, an engine start may occur while the display in Figure 91 is shown. This is normal operation.

Check Alarms

Check Alarms are indicated by an Alarm Icon in the display. The amber K symbol of the remote indicator alarm light (if installed) will be on. This level of alarm serves as a notice to take corrective action before a problem becomes severe. The unit will run with check alarms but some features and functions may be inhibited.

Shutdown Alarms

Shutdown alarms will be set if continued operation could cause damage to the unit or the load. Shutdown Alarms are indicated by the following:

- The Alarm Icon will appear in the display.
- The display and backlight 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.)
- The remote indicator alarm light (if installed) will display only a row of LEDs at the bottom.

Shutdown alarms will force the unit into shutdown to prevent potential damage to the unit or load. The unit will remain in shutdown until the shutdown alarm is manually cleared. Exceptions are some engine and electric shutdown alarms that become log alarms when switched to the alternate operating mode (diesel to electric or electric to diesel).

Prevent Alarms

Prevent Alarms are also indicated by a steady Alarm Icon in the display. The remote indicator alarm light (if installed) will be on. The unit will attempt to resolve the situation as shown below.

- The unit will be temporarily shut down if a Prevent Alarm is active.
- The unit will remain shut down for a timed restart interval or until the fault conditions are corrected.
- If the unit is in a temporary shutdown, Alarm Code 84 Restart Null will be present along with the associated Prevent Alarm.
- The unit will restart and run (in most cases with forced reduced performance) to determine if continued operation is possible. The unit will run in this manner for a timed interval. If the unit is running with forced reduced performance, Alarm Code 85 Forced Unit Operation will also be present under some conditions.
- If the alarm does not reoccur during the timed running interval with reduced performance, the unit will return to full performance to determine if continued operation is possible. The unit will run in this manner for a timed interval. If the unit is successfully able to return to full performance for the timed interval without the alarm re-occurring, the alarm is auto cleared and the unit will run normally.
- All Prevent Alarm events and conditions are logged by the ServiceWatch Data Logger.
- In general, if the alarm condition re-occurs a defined number of times, the alarm is set as a shutdown alarm and no further restarts are possible.

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

Pretrip Alarm Codes

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 autoswitch, it automatically starts and runs in diesel mode if an electric shutdown occurs.

Alarm Code Notification

The Alarm Icon used in previous Thermo King controllers has been incorporated. If a Check alarm condition occurs the Alarm Icon will appear in the display as shown in Figure 92.

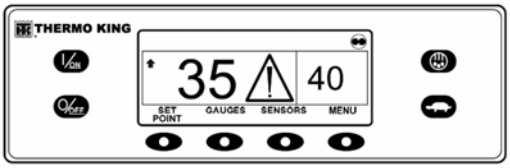


Figure 92: Alarm Icon

If a Shutdown Alarm occurs it will be indicated by all of the following:

1. The Alarm Icon will appear.
2. The display and backlight will flash on and off.
3. The display will switch from normal video to reverse video and back to normal video. (Light areas become dark and dark areas become light.)

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

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.

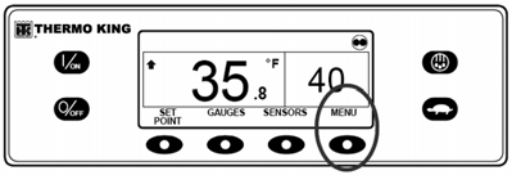


Figure 93: Menu Key

The Language Menu or Alarms Menu will appear. If the Language Menu appears press the NEXT key to show the Alarm Menu. When the Alarms Menu is shown press the SELECT key.

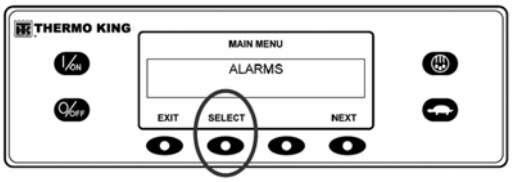


Figure 94: Select Key

The Alarm Display will appear. If no alarms are present NO ALARMS will be shown.

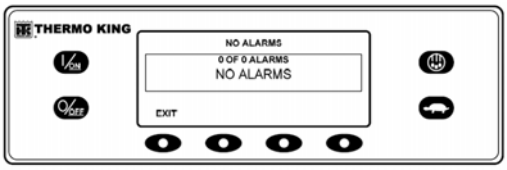


Figure 95: No Alarms

If alarms are present, the quantity of alarms (if more than one) and the most recent alarm code number will be shown. In the example in Figure 96, there are two alarms present. The most recent is Alarm Code 5 (Figure 97). It indicates a problem with the ambient temperature sensor.

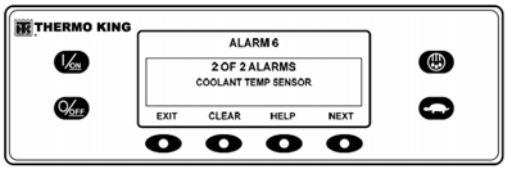


Figure 96: Alarm Code 6

After the alarm situation is resolved press the CLEAR key to clear the alarm. For additional information regarding the alarm shown on the display, press the HELP key. To display the next alarm, press the NEXT key.

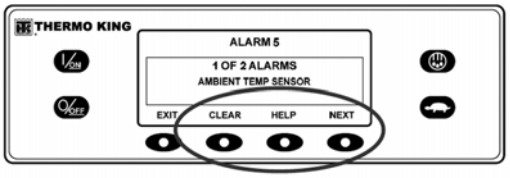


Figure 97: Next Key

If a serious condition occurs, the unit will be shut down to prevent damage to the unit or the load. If this occurs, the display will show that the unit is shut down and display the alarm code that caused the shutdown. In the example in Figure 98, the unit is shut down due to low oil level. For additional information regarding the alarm shown on the display, press the HELP key.

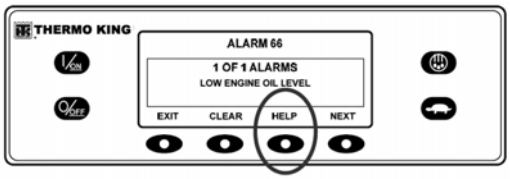


Figure 98: Help Key

A help message will appear. For the alarm shown in Figure 98, the message "CHECK OIL LEVEL. IF UNIT IS SHUT DOWN, REPAIR IMMEDIATELY. OTHERWISE, REPORT ALARM AT END OF THE DAY" will be shown on the display. Check the oil level and add oil as required, clear the alarm and restart the engine.

To select a different Main Menu item press the NEXT key. To return to the Standard Display press the EXIT key.

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.
- All alarms must be viewed before any of the alarms can be cleared.

Refer to the Truck SR-2 Single Temp Diagnostic Manual TK 54292 for more information about alarm codes and their diagnosis.

Datalogger

The unit can be equipped with an optional DAS Data Logger if desired.

A Start of Trip marker can be sent to the unit ServiceWatch Data Logger and the optional DAS Data Logger (if equipped).

If equipped with the optional DAS Data Logger, the most recent DAS trip record can be printed. The most recent trip is defined as the trip following the last Start of Trip marker sent to the data logger.

The ServiceWatch Data Logger and DAS Data Logger (if equipped) are accessed using the Data Logger Menu. From the Standard Display, press the MENU key.

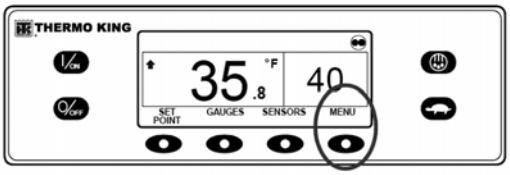


Figure 99: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Data Logger Menu. When the Data Logger Menu is shown press the SELECT key.

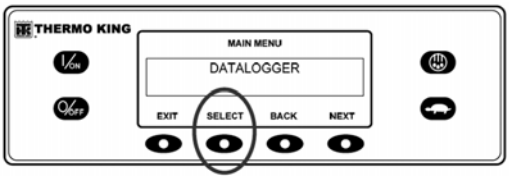


Figure 100: Select Key

The first feature that appears is the Start of Trip. To send a Start of Trip to the ServiceWatch Data Logger and DAS Data Logger (if equipped), press the SELECT key to select the feature, and then press it again to send the Start of Trip. The display will briefly show START OF TRIP COMPLETE to confirm that a Start of Trip marker was set in the data logger(s).

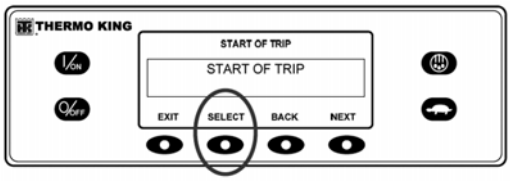


Figure 101: Start of Trip

NOTE: The start of trip marker is sent to both the ServiceWatch Data Logger and DAS Data Logger (if equipped).

Press the NEXT key to select the PRINT feature. The PRINT screen will appear. Press the SELECT key to print the most recent trip record to the optional remote printer.

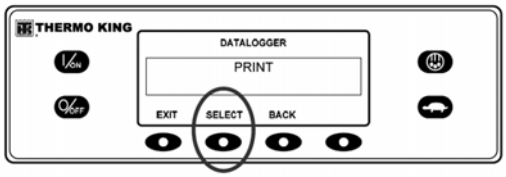


Figure 102: Select Key

Pressing the EXIT key returns the display to the Main Menu.

Hourmeters

Hourmeters are displayed using the Hourmeter Menu. Only hourmeters enabled in the Guarded Access Menu will be shown. From the Standard Display, press the MENU key.

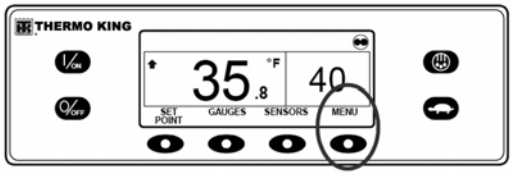


Figure 103: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Hourmeter Menu. When the Hourmeter Menu is shown press the SELECT key. The Hourmeter Display will appear.

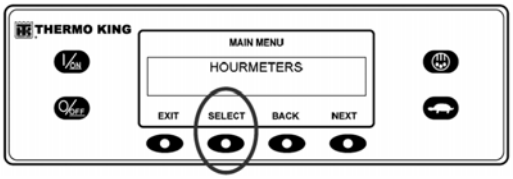


Figure 104: Hourmeter Display

Press the NEXT or PREVIOUS key to scroll through the enabled hourmeters.

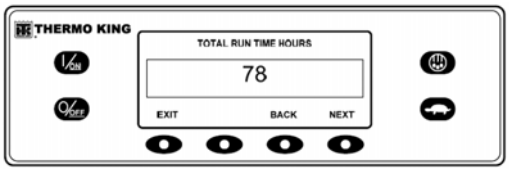


Figure 105: Scroll Through Hourmeters

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

Hourmeter Names and Definitions

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

Various operating modes can be selected using the Mode menu. Not all modes may be available, depending on settings of other programmable features. The following modes may be available.

Turn CYCLE-SENTRY On or Off

CYCLE-SENTRY Mode can be turned On or Off. If CYCLE-SENTRY Mode is turned Off then unit will run in Continuous mode.

Keypad Lockout

If enabled in Guarded Access, the keypad can be locked to prevent unauthorized use. If the keypad is locked only the ON and OFF keys 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.

Start Sleep Mode

If enabled in Guarded Access, Sleep Mode is used to keep the engine warm and the battery charged when the unit is not in use. When the unit is in Sleep Mode the display will show "SLEEP" and the current time. When Sleep Mode is entered the unit will start and run to confirm proper battery charge level and engine temperature.

IMPORTANT: While in Sleep Mode the unit will not monitor or maintain setpoint and load temperature. Fuel level should be monitored as the unit may run periodically, particularly in cold weather.

The following features are available in Sleep Mode.

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 of the week 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.

Mode changes are made using the Mode Menu. From the Standard Display, press the MENU key.

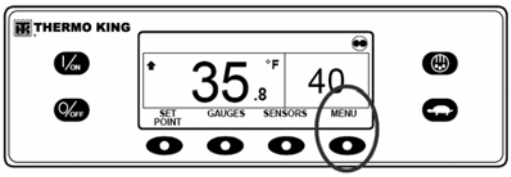


Figure 106: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Mode Menu. When the Mode Menu is shown press the SELECT key.

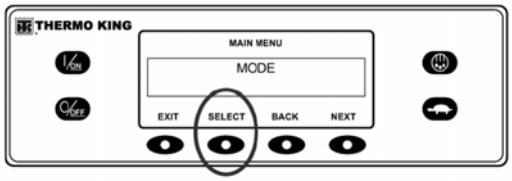


Figure 107: Select Key

The first mode change screen will appear. To choose that function, press the SELECT key. To Scroll thru the Mode Menu press the NEXT key.

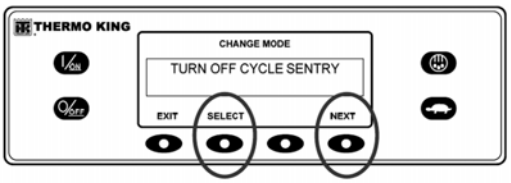


Figure 108: Select and Next Keys

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 will start automatically and run continuously to maintain setpoint and provide constant airflow. From the Standard Display, press the MENU key.

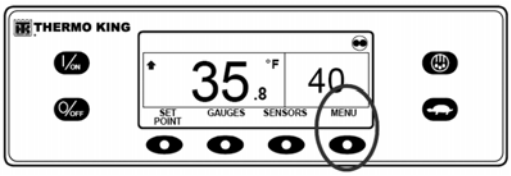


Figure 109: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Mode Menu. When the Mode Menu is shown press the SELECT key.

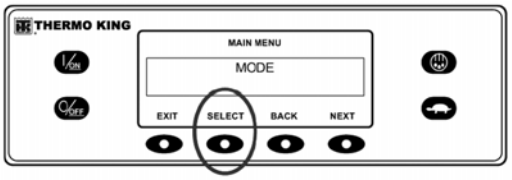


Figure 110: Select Key

The Turn Off/Turn On CYCLE-SENTRY screen will appear. In the display shown below, the unit is operating in CYCLE-SENTRY mode. Turning CYCLE-SENTRY mode off will result in the unit running in Continuous mode.

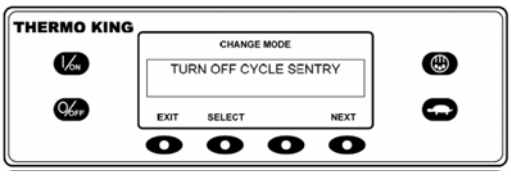


Figure 111: Turn Off/Turn On CYCLE-SENTRY Screen

Pressing the Select key will change the mode from CYCLE-SENTRY to Continuous.

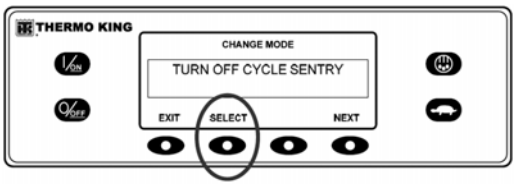


Figure 112: Select Key

The display will confirm the change as shown below.

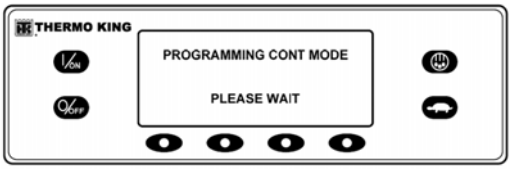


Figure 113: Mode Change Confirmed

The new mode is then confirmed for 10 seconds.

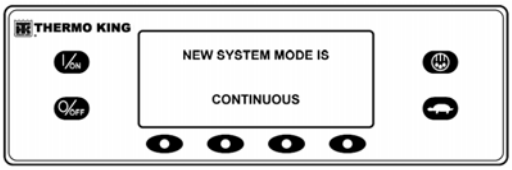


Figure 114: Mode Confirmed

The display then returns to the Mode Menu. In the example here the unit is currently running in Continuous mode. Pressing the Select key again allows the operator to change back to CYCLE-SENTRY mode operation.

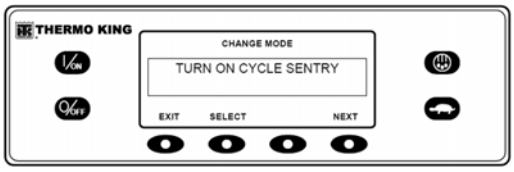


Figure 115: Mode Menu

IMPORTANT: If the unit is in CYCLE-SENTRY null and the mode is switched to Continuous Mode, the unit will start automatically.

Selecting Sleep Mode

Normal CYCLE-SENTRY mode starts and stops the unit as required to maintain the desired setpoint temperature, maintain the unit battery in a charged condition and keep the unit engine warm in cold ambient conditions. Sleep mode does not consider setpoint or maintain cargo temperatures - it only keeps the engine warm and the unit battery charged. This is useful in extremely cold weather or when the unit is to be out of service for an extended time. Sleep mode operates in both Diesel mode and Electric mode. In Diesel mode the unit will start and stop as required to maintain engine temperature and battery charge. In Electric mode the unit starts and stops as necessary to maintain battery charge only.

When Sleep mode is entered, the operator can program an automatic Wake-up Time up to a week away. Using this feature, the unit will automatically restart and run normally at the determined time. If a Wake-up Time is programmed the operator can also program an automatic Pretrip Test when the unit restarts.

Sleep Mode is turned On and Off using the Mode Menu. From the Standard Display, press the MENU key.

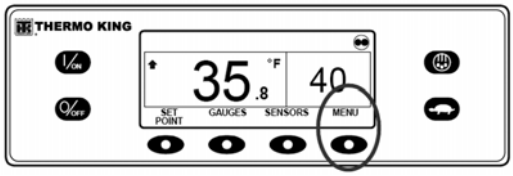


Figure 116: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to show the Mode Menu. When the Mode Menu is shown press the SELECT key.

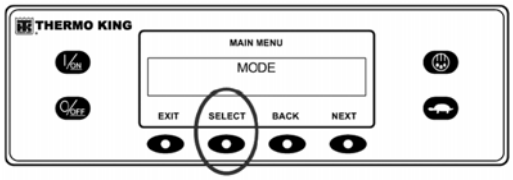


Figure 117: Select Key

Press the Next key as required to display the Sleep Mode prompt. Press the Select key to choose the Sleep Mode menu.

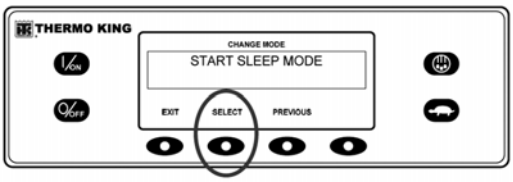


Figure 118: Sleep Mode Menu

The screen shown in Figure 119 will appear..

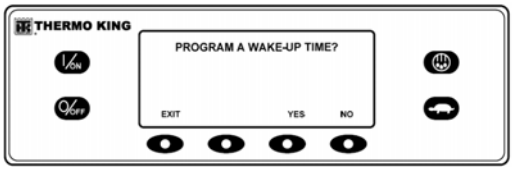


Figure 119: Start of Sleep Mode Menu

The operator can now choose a Sleep Mode Wake-up Time or simply enter Sleep Mode immediately. If NO is pressed the unit will immediately enter Sleep Mode.

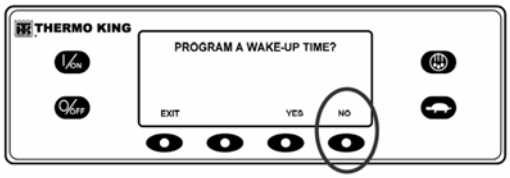


Figure 120: Select No to Enter Sleep Mode

The display will show SLEEP and the unit will start and stop as required to keep the engine warm and/or the battery charged. Sleep mode does not consider setpoint or maintain cargo temperatures. To exit Sleep Mode press the EXIT key or turn the unit off and back on. The unit will resume normal operation and control to setpoint.

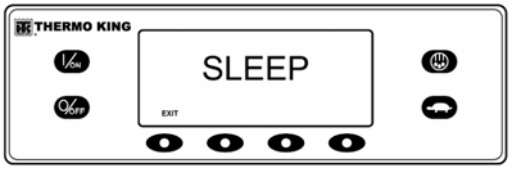


Figure 121: Sleep Mode Display

To enter a Wake-up Time, verify the unit clock is set properly. Then press the YES key at the Sleep Mode menu.

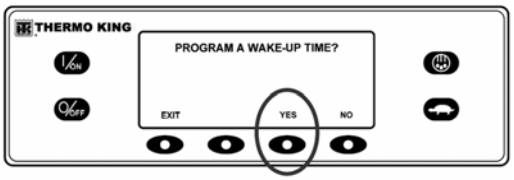


Figure 122: Yes Key

The display will prompt the operator for the DAY the unit is to restart in normal operation. In Figure 123 Monday has been chosen. Press the YES key to confirm the DAY.

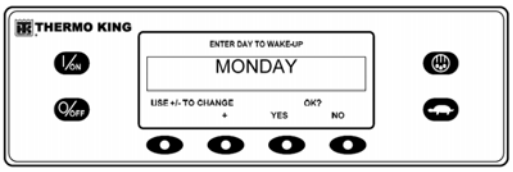


Figure 123: Day Unit is to Restart

The display will now prompt the operator for the Hour the unit is to restart in normal operation. In Figure 124 4:00 am has been chosen. Press the YES key to confirm the HOUR. Note that 24 hour "military time" is used.

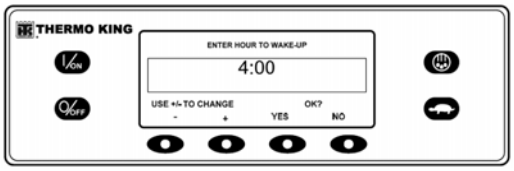


Figure 124: Confirm Hour

The display will now prompt the operator for the MINUTE the unit is to restart in normal operation. In Figure 125 4:30 am has been chosen. Press the YES key to confirm the MINUTE.

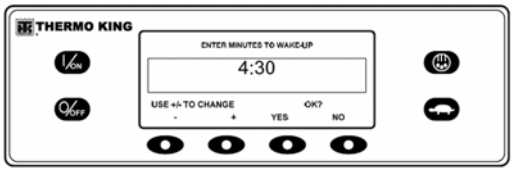


Figure 125: Confirm Minute

The display will now prompt for a Pretrip Test on Wake-up. Press the YES key to perform a Pretrip Test on Wake-up. If the No key is pressed the unit will resume normal operation on Wake-up.

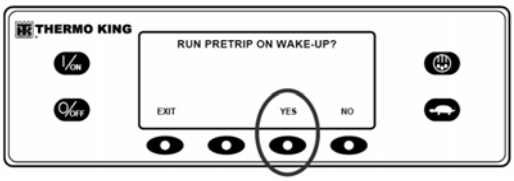


Figure 126: Press Yes Key for Pretrip Test

The display will show SLEEP and the unit will start and stop as required to keep the engine warm and/or the battery charged. Sleep mode does not consider setpoint or maintain cargo temperatures.

NOTE: The unit may start when sleep is enabled to bring battery charge level and engine temperature up to minimum level. It will shut down and then maintain minimum levels.

Figure 127: Sleep Mode

The unit will restart at the programmed time (in this example 4:30 am) and perform a Pretrip Test (if selected). After the Pretrip Test is complete the test results will be displayed and the unit will resume normal operation and control to setpoint.

To exit Sleep Mode before the selected Wake-up time press the EXIT key or turn the unit off and back on. The unit will resume normal operation and control to setpoint.

Pretrip

A 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, but the device amps checks are not performed. Test results are reported as PASS, CHECK or FAIL when the Pretrip Test is completed. If an alarm occurs during a Pretrip Test the alarm code will be displayed as Pretrip Alarm XX, where XX is the alarm code.

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, Interface Board 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 truck or 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, SR-2 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 truck or trailer that has just been washed down, the extremely high humidity inside the truck or trailer may result in false test results.
- If running a Pretrip Test on a truck or trailer loaded with sensitive cargo, monitor the load temperature during the test as normal temperature control is suspended during a Pretrip Test.
- Always perform Pretrip Tests with the truck or 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. Alarm Code 28 Pretrip Abort will be set. Other alarms may also be set, depending upon test in progress when the test was terminated.

Pretrip Tests are initiated using the Pretrip Menu. From the Standard Display, press the MENU key.

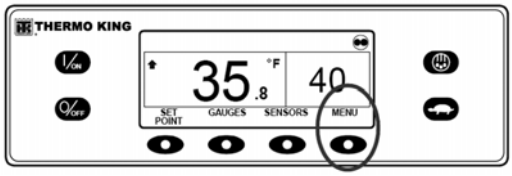


Figure 128: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Pretrip Menu. When the Pretrip Menu is shown press the SELECT key.

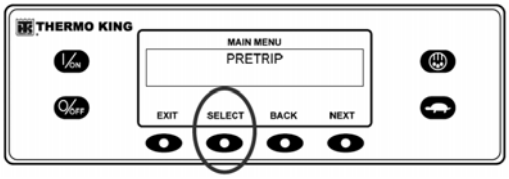


Figure 129: Select Key

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 will be performed.

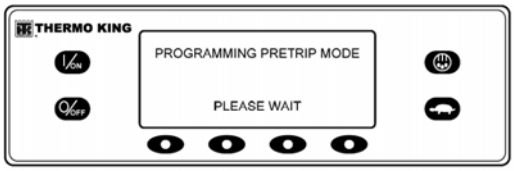


Figure 130: Running Pretrip

If all alarms were not cleared a prompt appears as shown in Figure 131. Exit the Pretrip Test, clear all alarms and restart the Pretrip Test.

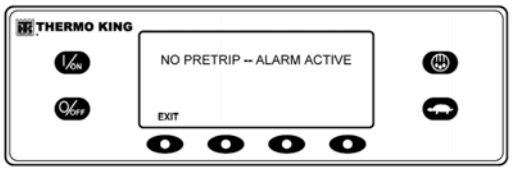


Figure 131: No Pretrip Prompt

If no alarms are present, the Pretrip Test display appears.

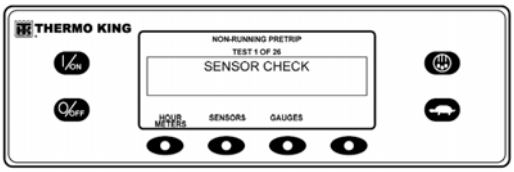


Figure 132: Pretrip Test Display

- 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 Figure 132 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 in Figure 133 the unit is in the Running Pretrip and is performing Test 21 of 26, Cool Test.

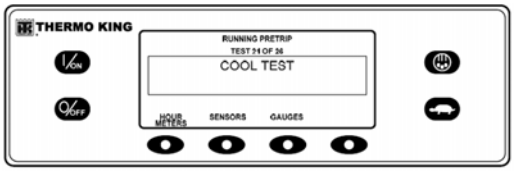


Figure 133: Performing Cool Test

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

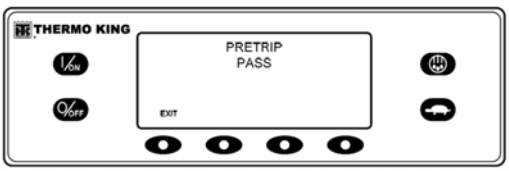


Figure 134: Pass, Check or Fail

If the Pretrip Test results are CHECK or FAIL the problem should be diagnosed and corrected before the unit is released for service.

Diesel/Electric Menu

The Diesel Mode/Electric Standby menu allows the operator to manually select diesel or electric mode operation. The unit can also be programmed to automatically select electric mode operation when standby power is available and to automatically select diesel mode operation if standby power fails or is removed. If the unit is programmed to switch automatically from diesel to electric and electric to diesel these screens do not appear.

Switching from Diesel to Electric - Units equipped with the Electric Standby option only

If the Diesel to Electric Autoswitch 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 Autoswitch Enabled feature in Guarded Access is set NO then the prompt screen shown in Figure 135 will appear when standby power is connected and available.

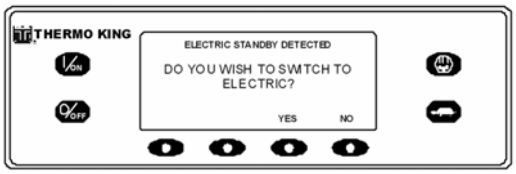


Figure 135: Standby Power connected & available

If YES is selected then the display will briefly show the screen in Figure 136.

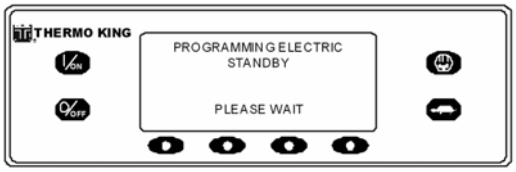


Figure 136: Display when YES is selected

Electric Mode operation will briefly be confirmed. If unit operation is required the electric motor will start as shown previously in STARTING THE ELECTRIC MOTOR.

Switching from Electric to Diesel - Units equipped with the Electric Standby option only

If the Electric to Diesel Autoswitch 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 Autoswitch Enabled feature in Guarded Access is set NO then the prompt screen shown in Figure 137 will appear when standby power is turned off or is no longer available. Alarm Code 91 Check Electric Ready Input and Alarm Code 84 Restart Null will both be set.

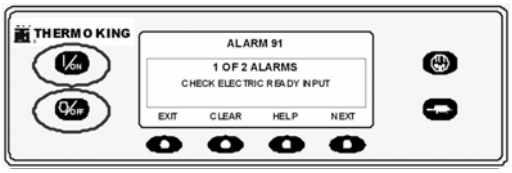


Figure 137: Display when Standby Power not available

Turn the unit off and back on using the OFF and ON Keys. This will clear Alarm Code 91 Check Electric Ready Input and Alarm Code 84 Restart Null. NOTE: The CLEAR Soft Key will not clear these two alarms. Then the prompt screen shown in Figure 138 will appear.

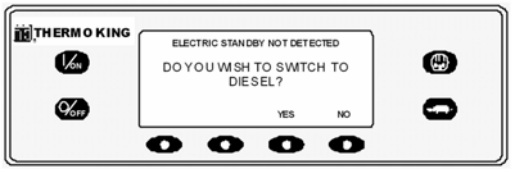


Figure 138: Prompt for Switch to Diesel

If YES is selected then the display will briefly show the screen in Figure 139. Then Diesel Mode operation will briefly be confirmed.

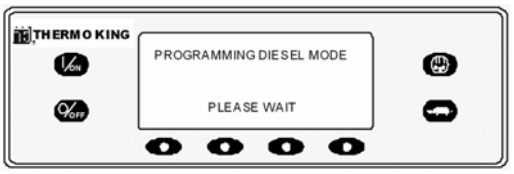


Figure 139: Display when YES is selected

If unit operation is required the diesel engine will start as shown previously in STARTING THE DIESEL ENGINE.

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.

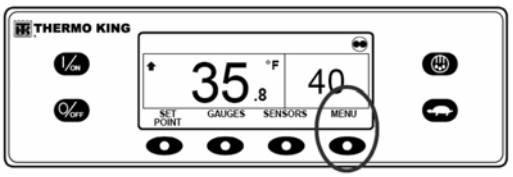


Figure 140: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Adjust Brightness Menu. When the Adjust Brightness Menu is shown press the SELECT key.

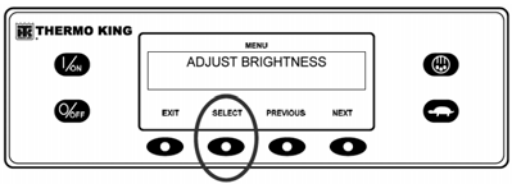


Figure 141: Select Key

The Display Brightness menu will appear as shown below. Press the + or - keys to select the desired display brightness. When the desired brightness is shown press the YES key to confirm the choice.

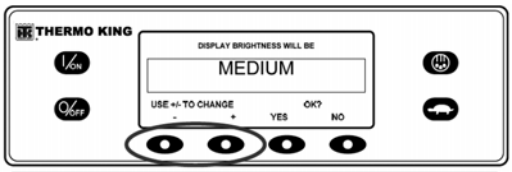


Figure 142: + and - Keys

The display will briefly show ADJUSTING BRIGHTNESS - PLEASE WAIT.

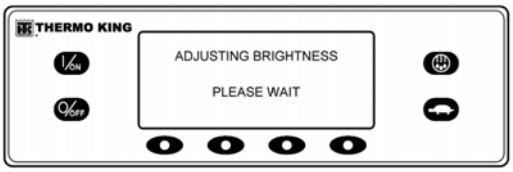


Figure 143: Adjusting Brightness

The display brightness is changed to the new setting.

Time

The system time and date is viewed using the Main Menu. Time and Date cannot be changed from the Main Menu. From the Standard Display, press the MENU key.

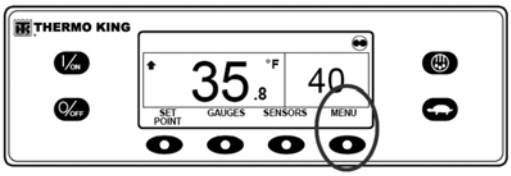


Figure 144: Menu Key

The Language Menu or Alarm Menu will appear. Press the NEXT key as required to display the Time Menu. When the Time Menu is shown press the SELECT key.

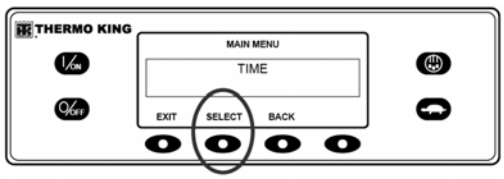


Figure 145: Select Key

The current time and date will appear.

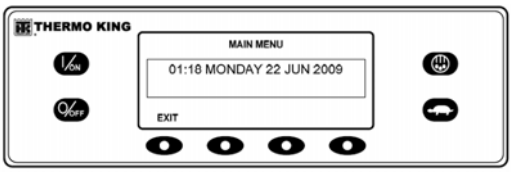


Figure 146: + and - Keys

Alternator Charging System Diagnostic Procedures

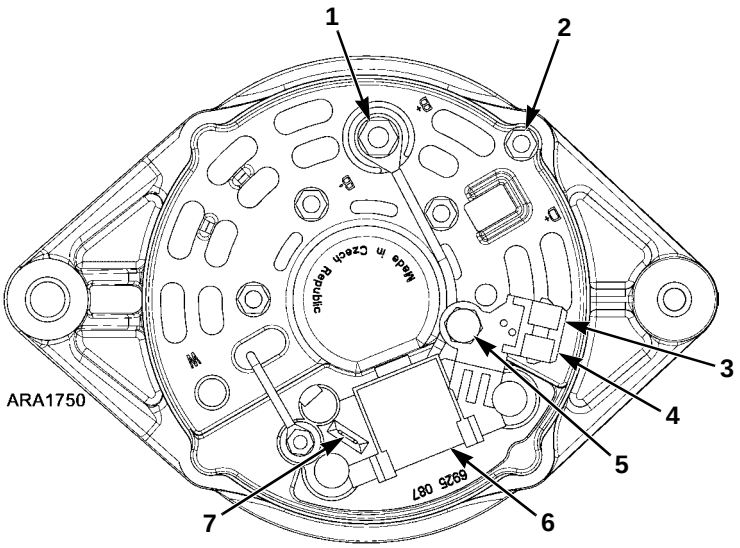
General Information

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 battery. Check for an open 2A circuit, 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 (SENSE 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 147), 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 - 2 Wire)	7.	W Terminal (AC Output)
4.	L Terminal (Regulator Excite - 7K Wire)		

Figure 147: Thermo King Alternator Terminal and Component Locations

Interface Board Fuse F4

The interface board 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 interface board. 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 interface board 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 interface board.

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 2A, SENSE (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 2A circuit.
7. Disconnect the main wire harness from the voltage regulator. On Thermo King alternators, carefully push on the spring clip to release the plug lock.
8. Use the Mechanics/Premium HMI Control Panel to turn the unit on and enter Non-Running Service Test Mode. Place the unit in High Speed Cool. Refer to the appropriate Microprocessor Diagnostic Manual for information about the Service Test Mode.
9. Check the voltage at the sense circuit (SENSE circuit). Battery voltage should be present. If not, check the sense circuit (SENSE circuit) in the main wire harness.
10. Check the voltage at the excitation circuit (EXC circuit). 10 Vdc or more should be present. If not, check the excitation circuit (EXC circuit) in the main wire harness.
11. Turn the unit off and reconnect the main wire harness to the voltage regulator.
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 or defrost.

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

NOTE: The Microprocessor Power switch must be placed in the Off position before connecting or disconnecting the battery terminals. The Microprocessor Power switch is located on the control box side of the unit.

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.

Fuses

A number of fuses protect various circuits and components. All the fuses except F21 are located on the interface board, which is located inside the control box. F21 is located in the fuse holder between the REDB and 2 wires that go from the battery to the 2 terminal on the interface board. Refer to the appropriate Microprocessor Diagnostic Manual for a complete list of the size and function of the fuses.

Fuse	Size	Function
F2	15A	Power to On/Off Switch
F3	40A	Fuel Sol Pull-In/Starter Circuit
F4	None 2A	No Fuse - All Bosch and Thermo King Alternators 2A Fuse - All Prestolite Alternators
F5	40A	Preheat Circuit
F6	15A	Damper and High Speed Circuits
F7	2A	8XP Circuit - Controller On Feedback to HMI
F8	5A	CAN Connector J12
F9	5A	CAN Connector J14
F10	10A	8X Power (Install fuse in upper position)
F11	10A	Power to Drain Tube Heater Relay for Remote Evaporator (Not Used)
F12	5A	CAN Connector J13
F13	2A	8FC Circuit (Remote Lights)
F15	P/S	On/Off Relay
F21	60A	Main Fuse (2 Circuit)
F20	2A	Alternator Sense
F22		Not Used
F23		Not Used
F25	7.5A	HPCO/Run Circuit
F4 Remove fuse F4 for Model 30 units with Australian Bosch or Thermo King Alternators. Install fuse F4 for Model 50 units with Prestolite Alternator.		
F10 When fuse F10 is installed in the upper position the On/Off keys on the HMI turn the unit on and off. When fuse F10 is installed in the lower position the unit will start and run without the HMI control panel.		
F15 The device identified as F15 is a poly switch. These over-current devices reset automatically and are not replaceable.		

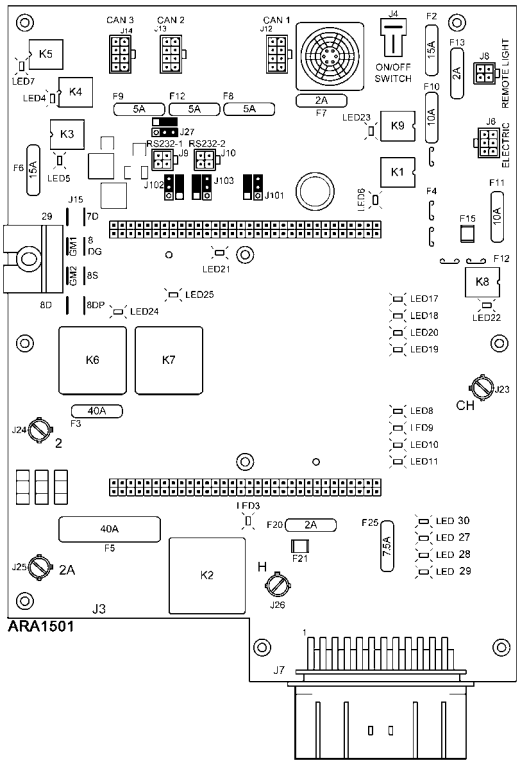


Figure 148: Interface Board

Interface Board LEDs

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

Interface Board LED Functions	
LED #	**Function**
LED 3	K2 Preheat Circuit
LED 4	K4 Damper Circuit
LED 5	K3 High Speed Circuit
LED 6	K1 Run Relay Circuit
LED 7	K5 Diesel/Electric Relay
LED 8	Condenser Inlet Solenoid (CIS) Circuit
LED 9	Receiver Tank Pressure Solenoid Solenoid (RTPS) Circuit (Not Used)
LED 10	Hot Gas Solenoid (HGS) Circuit
LED 11	Purge Valve (PV) Circuit
LED 17	(Not Used)
LED 18	Alternator Excite
LED 19	Liquid Injection Solenoid (LIQ) Circuit
LED 20	(Not Used)
LED 21	Status – Flashes once per second when the base controller is powered and operating normally. Flashes several times per second when flash loading. Is on without flashing during reboot and when under test. Flashes twice within 1 second followed by 1 second off if a CAN communication error is present.
LED 22	K8 Drain Tube Heaters Remote Evaporator (Not Used)
LED 23	K9 On/Off Circuit
LED 24	K6 Fuel Solenoid Pull-In Circuit
LED 25	K7 Starter Circuit
LED 26	(Not Used)
LED 27	ETV*
LED 28	ETV*
LED 29	ETV*
LED 30	ETV*
* May be illuminated even if the ETV outputs are not used.	

Smart FETs

A Smart FET (Field Effect Transistor) is a circuit control device that acts like a relay and a circuit breaker. Smart FETs halt current flow if an overcurrent condition exists, and resume normal operation when current flow is within limits.

Smart FETs are not field repairable. Refer to the appropriate Microprocessor Diagnostic Manual for more information about the Smart FETs.

Interface Board Outputs With Smart FETs	
Output	**Function**
	Run Relay Coil
	High Speed Relay Coil
EVA, EVB, EVC, EVD	ETV Outputs
CIS	Condenser Inlet Solenoid
HG	Hot Gas Solenoid
PV	Purge Valve
LIQ	Liquid Injection Solenoid
EXC	Alternator Excite
ALPC	Alarm Light (Optional)
ALM	Alarm Light (Optional)

SMART REEFER 2 (SR-2) Microprocessor Controller

Refer to the Truck SR-2 Single Temp Diagnostic Manual TK 54292 for complete service information about the Microprocessor Controller and the related components.

Flywheel (RPM) Sensor

The flywheel (RPM) sensor is mounted on the engine starter mounting flange adjacent to, but not touching, the flywheel (backed off 1/4 turn).

The flywheel sensor is a device containing an inductance coil and magnet. When the magnetic field is distorted by the passing ring gear teeth, the inductance coil generates an AC electrical signal that has a voltage and frequency variation proportional to the engine RPM.

By monitoring the frequency of this signal, the controller can monitor the engine speed and precisely control the timing of the starter disengagement.

If the flywheel sensor fails, the starter may not disengage or engage properly and a fault code will be generated.

Testing the Flywheel (RPM) Sensor:

The following equipment is required:

- AC voltmeter capable of reading up to 10 volts

- Ohmmeter

The flywheel sensor may be checked as follows:

1. Position the flywheel so a ring gear tooth is in the center of the sensor mount hole.
2. Turn the flywheel sensor into the starter mounting flange until it contacts the ring gear. Back out the sensor 1/4 turn and tighten the locknut.

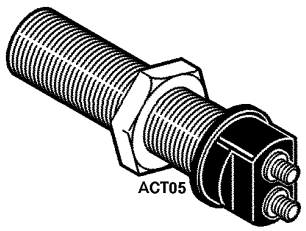


Figure 149: Flywheel (RPM) Sensor

3. Disconnect the FS1 and FS2 wires from the sensor.

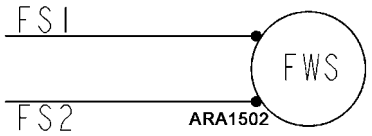


Figure 150: Flywheel (RPM) Sensor Wires

4. Run the unit on low speed and high speed. Check the AC voltage output across the sensor terminals. Use a meter with a high ohms per volt internal resistance. A Simpson 260, Fluke digital or any good VOM will work. However, an automotive type meter may not give an accurate reading because the meter may load the circuit heavily and cause the voltage level to appear lower than it actually is.
   a. The output voltage should be 1.0 to 2.0 Vac on low speed.
   b. The output voltage should be 2.0 to 2.5 Vac on high speed.

   NOTE: If the voltage is slightly off, the voltage may be increased by turning the sensor in more, and the voltage may be lowered by turning the sensor out more.
5. Reconnect the FS1 and FS2 wires to the sensor.

If the flywheel sensor passes the above test, the sensor may be considered good.

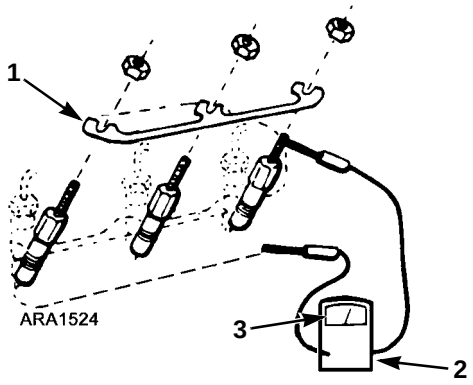
If the engine will not start, an alternate less reliable test may be performed as follows:

Disconnect the sensor from all wires, and measure the resistance across the terminals and from each terminal to the aluminum case. The resistance should be 250 to 300 ohms across the terminals, and there should be no continuity from each terminal to the case.

Glow Plugs

Glow plugs heat the combustion chamber to aid in quick starting. The glow plugs are energized when the microprocessor initiates unit start-up. A defective glow plug (burned out) can be detected by placing a clamp-on ammeter on the H wire to the glow plugs. Normal current draw during preheat is approximately 11 to 13 amps. A current draw in this range means all three glow plugs are working. If the current draw during preheat is less than this, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the wires and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of 2.3 ohms. The current draw for each glow plug should be approximately 4.3 amps.



1.	Remove Wires
2.	Ohmmeter
3.	2.3 Ohms

Figure 151: Glow Plug Ohm Test

NOTE: The cylinder head cover must be removed to access the glow plugs.

A shorted glow plug will show excessive current draw (more than 13 amps) during preheat, and may cause fuse F5 (40 A) to blow. Check each glow plug individually.

Unit Wiring

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

AC Components (Model 50 Units Only)

CAUTION: Model 50 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

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

Test the contactor coil as follows:

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

Evaporator Heaters (Optional)

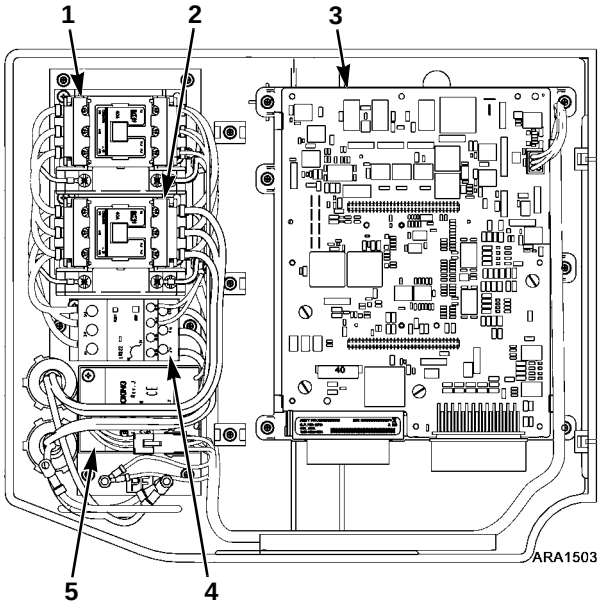
Test the resistance of each evaporator heater by disconnecting it from the circuit and checking it with an ohmmeter. The resistance of each evaporator heater should be approximately 71 ohms.

Condenser Fan Rotation

The condenser fan is belt driven. On electric standby operation, check for correct fan rotation by placing a small cloth or sheet of paper against the condenser fan grille on the front of the unit. Correct rotation will hold the cloth or paper against the grille. Improper rotation will blow the cloth or paper away from the grille. To correct incorrect rotation, check the motor and motor contactor wiring per the unit wiring diagram.

Phase Select Module for Truck Unit Model 50 Applications

The phase select module is designed to monitor both single and 3 phase nominal input voltages between 200 and 480 volts AC.



1.	MCB–Motor Contactor
2.	MCA–Motor Contactor
3.	Base Controller/Interface Board Assembly
4.	Overload Relay
5.	Phase Select Module

Figure 152: Model 50 Control Box Components with High Voltage Cover Removed

Operation

The phase select module will detect missing phases, phase orientation and low voltage on three phase or single phase power. The Brown, Gray, and Black wires are used to sample the power at

L1, L2 and L3 respectively. Operating power from 12 to 24 volts is supplied to the module via the 8 wire and CH wire.

When the voltage sensed rises above 165 volts AC and all three phases are present, the module ER wire will output 12 volts DC after the conditions exist for 2 to 4 seconds. This signal informs the microprocessor that electric standby operation is possible. If the voltage drops below 160 volts AC or a phase is lost, the ER output is turned off after the condition exists for 3 seconds. The module continues to monitor the power and the module ER wire will again output 12 volts DC within 2 to 4 seconds after the voltage rises above 165 volts AC and all three phases are present.

If phase orientation is L1, L2, L3 the 7EB wire will output voltage to energize the appropriate phase rotation contactor MCA. If phase orientation is L1, L3, L2 the 7EC wire will output voltage to energize the appropriate phase rotation contactor MCB. The 7EB and 7EC wires are interlocked to prevent both phase contactors from being energized at once.

If the SP input is grounded, the module will now be set for single-phase operation. In this case only the Brown and Gray wires are used and the Black wire is taped off.

Connections to the module are shown in the tables below.

Power Connections

Input	Description
8	Nominal 12 volt DC power to the phase select module
CH	Chassis ground

Inputs

Input	Description
L1	This Brown wire supplies standby power L1 to the phase select module.
L2	This Gray wire supplies standby power L2 to the phase select module.
L3	This Black wire supplies standby power L3 to the phase select module.
7EA	If 12 volts DC is supplied, then output 7EB or 7EC will be at 12 volts DC
SP	If this wire is connected to chassis ground the module will operate in single-phase mode.
SP-GND	This is an internal ground for the module. If SP-GND is jumpered to SP then the module will be set to operate on single phase.

Outputs

Output	Description
7EB	If phase orientation is L1, L2, L3 then this wire will provide 12 volts DC to energize the appropriate phase rotation contactor MCA. The 7EC wire is interlocked to prevent both phase contactors from being energized at once.
7EC	If phase orientation is L1, L3, L2 then this wire will provide 12 volts DC to energize the appropriate phase rotation contactor MCB. The 7EB wire is interlocked to prevent both phase contactors from being energized at once.
ER	This wire will output 12 volts DC to the microprocessor 2 to 4 seconds after the voltage rises above 165 volts AC and all three phases are present. If the voltage drops below 160 volts AC or a phase is lost and the condition remains for 3 seconds, the output is turned off. The module continues to monitor and will again output 12 volts DC 2 to 4 seconds after the power returns to normal (voltage rises above 165 volts AC and all three phases are present).

Connector Pinout

Pin	Wire	Description
1	8	Power to Module
2	CH/CHV	Chassis ground
3	ER	AC Power OK, output to microprocessor
4	7EA/7E	Power for 7EB or 7EC output
5	7EB	Output to MCA
6	7EC	Output to MCB
7	SP-GND	Internal ground to enable a jumper circuit for SP logic
8	SP	Grounded for single phase mode
9	Unused	

Removal and Replacement

1. Turn unit off.
2. Disconnect the unit battery.
3. Disconnect the standby power.
4. Remove the high voltage cover.
5. Disconnect the three wires from the phase select module at the motor contactor.
6. Unplug the phase select module harness.
7. Remove the old phase select module.
8. Install the new phase select module.
9. (3 Phase Applications) Connect the new phase select module wires to the lower contactor (MCA) as follows:

   Connect the Brown wire to L1 on the contactor.

   Connect the Gray wire to L2 on the contactor.

   Connect the Black wire to L3 on the contactor.

   Use crimp-on terminals as required.

10. (Single Phase Applications) Connect the new phase select module wires to the lower contactor (MCA) as follows:

    Connect the Brown wire to L1 on the contactor.

    Connect the Gray wire to L2 on the contactor.

    Use crimp-on terminals as required.

    Tape the Black wire back onto itself. It is not used on single-phase installations.

11. Connect the plug on the short harness from the phase select module.
12. Install the high voltage cover.
13. Secure wires and wire harnesses as required using cable ties.
14. Connect the unit battery.
15. Perform a Pretrip Test to verify proper operation.

Diagnostics

1. Plug the standby power cord into a know good power supply and turn the unit on.
2. Using a Fluke Meter, test the L1, L2, and L3 circuits at the input to the terminals where the Brown, Blue and Black wires are connected. The voltage should be between 200-480 VAC between the circuits. If not, repair as necessary to supply the needed voltage to the unit.
3. Check the 8 circuit to the phase select module for 12 Vdc. If voltage is not present, check the phase select module connector and the interface board connector for secure connections.
4. If correct AC power is present in step 2 above, then the ER output should measure 12 Vdc. If no voltage is present, replace the phase select module.
5. If voltage is present on the ER output, then LED 7 (K5 Diesel/Electric Relay) on the interface board should be on. If not, check the K5 Diesel/Electric Relay circuit on the interface board.
6. If voltage is measured on the ER output, and LED 7 is on, then the 7EA input should measure 12 Vdc. If voltage is not present, check the phase select module connector and the interface board connector for secure connections.
7. If voltage is present on the ER output and the 7EA input, and LED 7 is on, then either the 7EB or 7EC output should measure 12 Vdc and one of the phase select contactors should

be on. If voltage is not present on either the 7EB or 7EC output, replace the phase select module.

Overload Relay

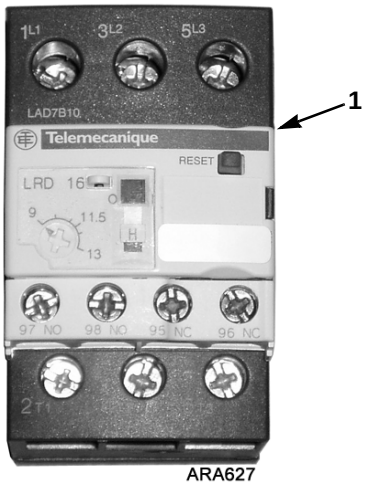
The overload relay protects the standby electric motor. It is located in the control box under the high voltage cover. The overload relay opens the circuit to the electric motor if the current exceeds the overload relay setting. The overload relay resets automatically.

Figure 153: Typical Overload Relay

Overload Relay Replacement

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

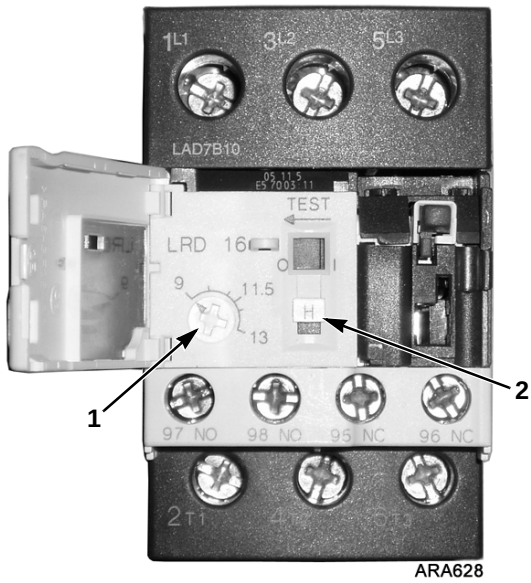
1. Open the clear plastic cover.



1.	Lift Here to Open Cover

Figure 154: Open Cover

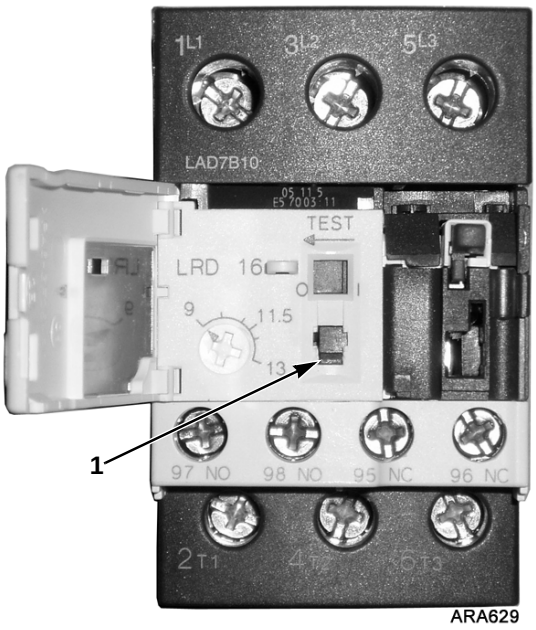
2. Use a small screwdriver to set the opening amperage. See “Electric Motor and Overload Relay” in the “Specifications” chapter for the correct overload relay setting.
3. Use a small screwdriver to remove the tab marked with an “H” to access the switch used to set the overload relay to reset automatically.



1.	Set Opening Amperage
2.	Remove Tab Marked “H”

Figure 155: Set Amperage and Remove Tab

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



1.	Switch Clicks into Place at Bottom of Slot

Figure 156: Move Switch Down

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

EMI 2000

EMI 2000 is an extended maintenance interval package, which is standard equipment on this unit. The EMI 2000 package consists of the following key components:

- New EMI 2000-Hour Cyclonic Air Cleaner Assembly and Air Cleaner Element
- New EMI 2000-Hour Fuel Filter (black with gold lettering)
- New EMI 2000-Hour By-Pass Oil Filter (black with gold lettering)
- API Rating CI-4 Mineral Oil
- Five Year or 12,000 Hour ELC (Extended Life Coolant).

The EMI package allows standard maintenance intervals to be extended to 2,000 hours, or 1 year, whichever occurs first.

NOTE: Units equipped with the EMI 2000 package do require regular inspection in accordance with Thermo King's maintenance recommendations.

NOTE: The new EMI 2000 oil filters and new EMI 2000 air cleaners are NOT interchangeable with the oil filters and air cleaners previously used in truck unit.

Engine Lubrication System

The engine has a pressure lubrication system. See the appropriate Engine Overhaul Manual for a detailed description of the engine lubrication system.

Oil pressure is affected by oil temperature, viscosity and engine speed. Subnormal oil pressures usually may be traced to lack of oil, diluted oil, faulty oil pressure control valve, loose connections in the lubrication system, or worn bearings. Low oil pressure is not normally caused by a faulty oil pump. The use of improper viscosity oil will also produce low oil pressure shutdowns.

Engine Oil Pressure Switch/Sensor

The engine oil pressure switch/sensor is located on the filter head above the bypass oil filter. Engine oil pressure should rise immediately on starting. If engine oil pressure drops below 10 ± 2 psig (69 ± 14 kPa), the switch/sensor signals the microprocessor to stop the engine. See the appropriate Microprocessor Diagnostic Manual for diagnostic information.

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, try to make sure that the truck is not tipped away from the direction that the oil is supposed to flow from the oil pan. It is important to get as much of the residual oil out as possible because most of the dirt particles are in the last few quarts of oil to drain out. Refill the pan with oil (see the “Specifications” chapter) and check the dipstick level. Run the unit, and then recheck the oil level.

CAUTION: The fill port on top of the engine should <u>not</u> be used to add engine oil. To prevent engine lock-up and/or serious internal damage after engine oil is added or changed <u>always add oil through the lower port</u> on the timing gear cover.

NOTE: Starting in the first quarter of 2014 the fill port on top of the engine was removed.

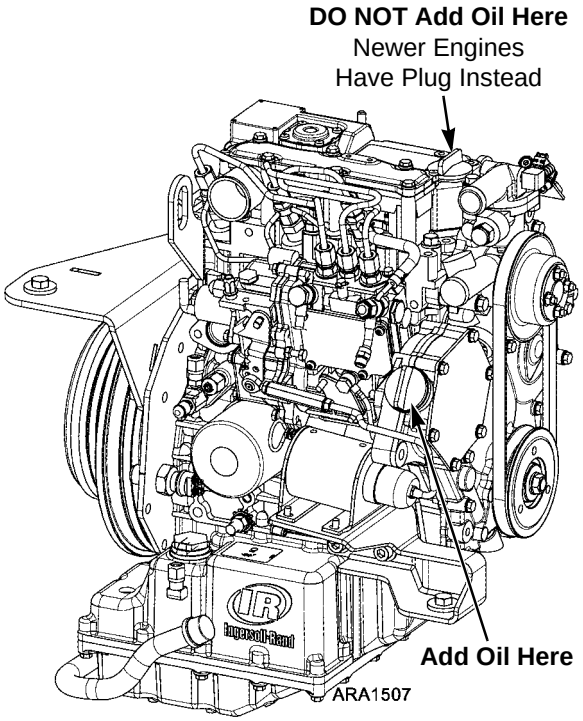


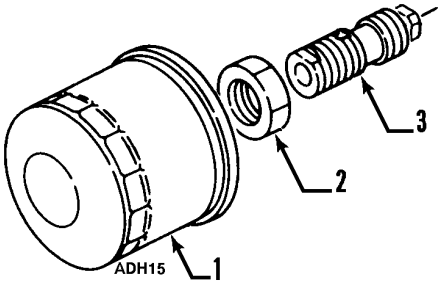
Figure 157: Oil Cap Locations on Engine

Add oil as necessary to reach the full mark. See the “Specifications” chapter of this manual for correct type of oil.

Oil Filter Change

Both oil filters should be changed along with the engine oil. Use genuine Thermo King extended maintenance oil filters.

1. Remove the filter.
2. Apply oil to rubber ring of new filter and install 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.



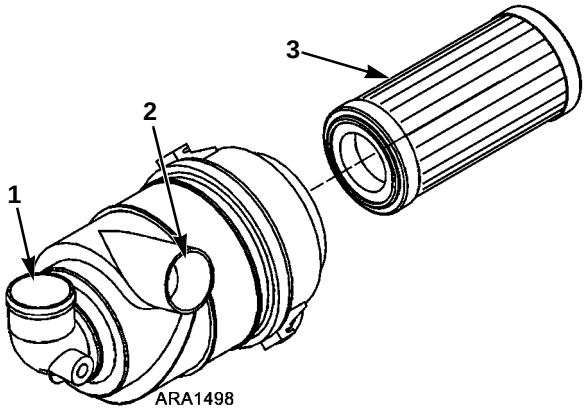
1.	Spin-on Oil Filter
2.	Bypass Valve Nut
3.	Bypass Valve

Figure 158: Oil Filter Parts

Engine Air Cleaner (EMI 2000)

The EMI 2000 air cleaner used with this unit is a dry element air cleaner. The air cleaner filters all of the air entering the engine. Excessive restriction of the air intake system affects horsepower, fuel consumption and engine life. Inspect the element at every oil change.

Replace the EMI 2000 air cleaner filter element at 2,000 hours, or 1 year, whichever occurs first.



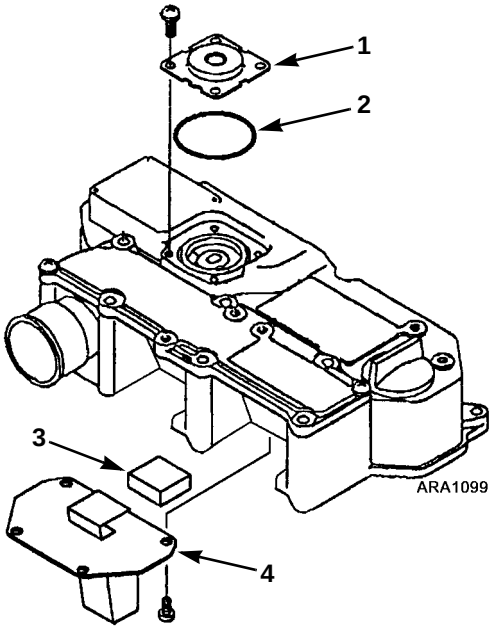
1.	Outlet Connection
2.	Intake Hose Connection
3.	Dry Filter Element

Figure 159: Air Cleaner

Crankcase Breather System

The crankcase breather system ducts crankcase gases formed in the crankcase directly to the air intake. 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 cylinder head cover, which is a combination of valve cover and intake manifold. A restrictor in the cylinder head cover limits the flow of gases from the crankcase to the intake and keeps the crankcase pressure from getting too low.



1.	Breather Cover
2.	O-ring
3.	Baffle
4.	Baffle Plate

Figure 160: Crankcase Breather Components

Normal crankcase pressures with a new air cleaner are shown below:

Unit/Speed	in. (mm) H_2O of vacuum
Truck/Low	0 to 8 in. (0 to 203 mm)
Truck/High	2 to 11 in. (51 to 279 mm)
TriPac	0 to 8 in. (0 to 203 mm)

The vacuum will increase as the air cleaner gets dirty and becomes more restrictive. Remove the breather cover and the baffle plate and check to make sure nothing is plugged or damaged.

See the TK270, TK370, TK374F, TK376, and TK380F Engine Overhaul Manual (TK 53163) for the procedure to check the crankcase pressure. If your readings are significantly more positive than 0 to 11 in. (0 to 279 mm) H_2O of vacuum, you may have excess blowby past the rings. A compression check should be performed to confirm this.

The following items can effect the crankcase pressure readings.

Crankcase Pressure Effect	Typical Cause
Increase	Piston Rings Stuck or Worn
Increase	Restrictor Plugged
Decrease	Air Cleaner Dirty or Plugged

Engine Cooling System

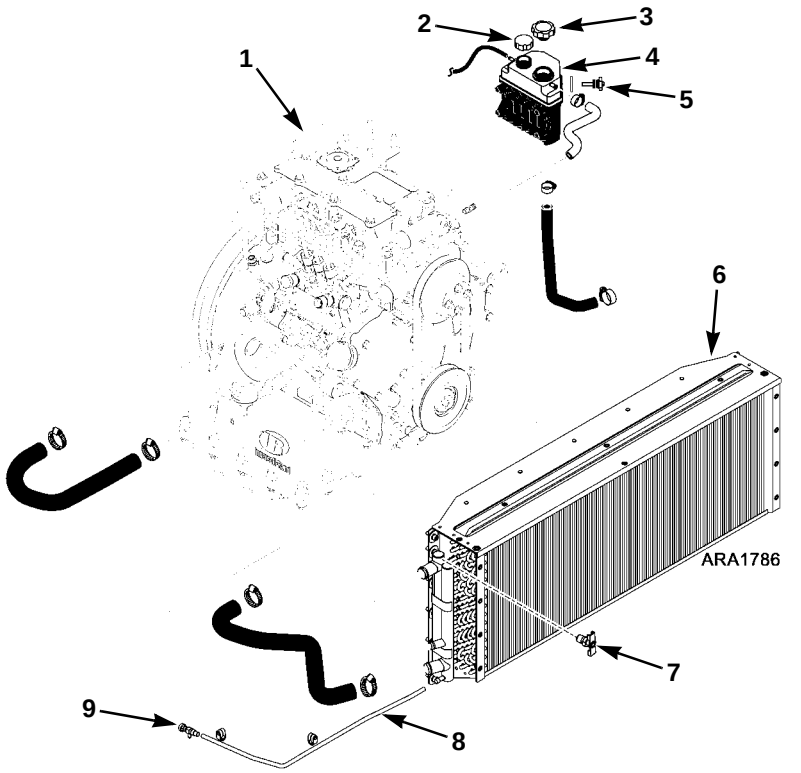
General Description

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 (large header), circulates it through the cylinder block and head, then back to the radiator. A thermostat mounted in the water outlet 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 mixture of 50 percent permanent type antifreeze concentrate and 50 percent water in the engine cooling system.

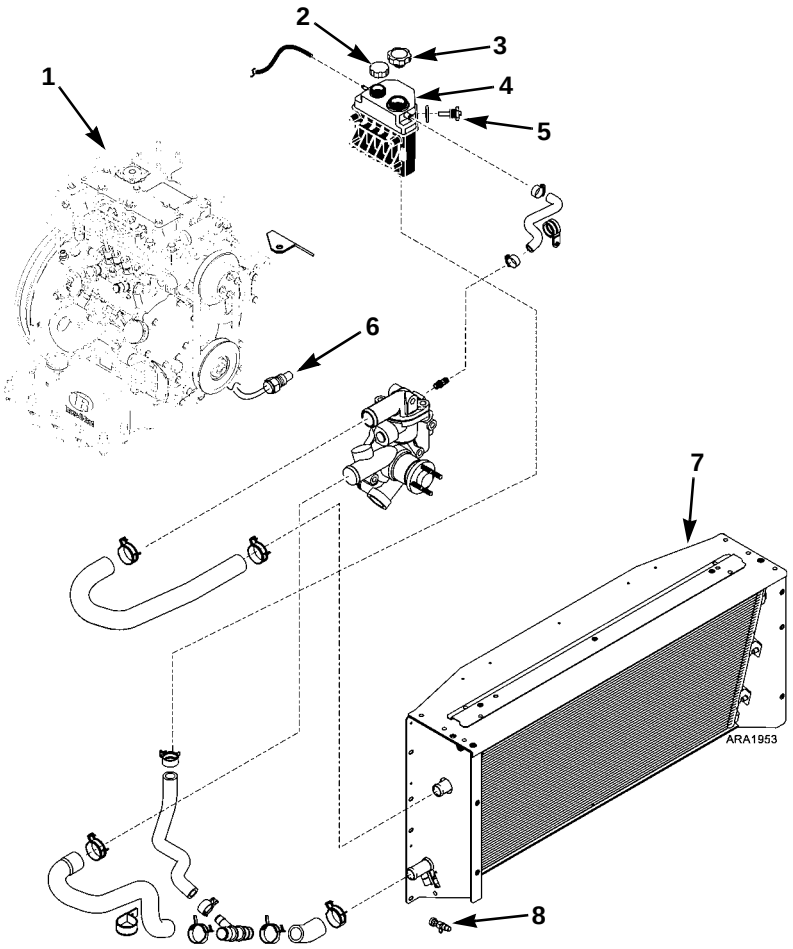
This provides the following:

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.



1.	Engine	6.	Radiator
2.	Overflow Cap	7.	Petcock (Bleed Tap) - Units with TK376 Engines
3.	Expansion Tank Cap	8.	Drain Tubing
4.	Expansion Tank	9.	Drain Cock
5.	Coolant Level Sensor		

Figure 161: Engine Cooling System Components for Units with Tube and Fin Radiator Coil (Ending 06/12)



1.	Engine	5.	Coolant Level Sensor
2.	Overflow Cap	6.	Coolant Temperature Sensor
3.	Expansion Tank Cap	7.	Radiator
4.	Expansion Tank	8.	Drain Cock

Figure 162: Engine Cooling System Components for Units with Micro-Channel Radiator Coil (Starting 06/12)

ELC (Extended Life Coolant)

ELC is standard equipment on these units. The maintenance interval for ELC is 5 years or 12,000 hours. A nameplate on 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.

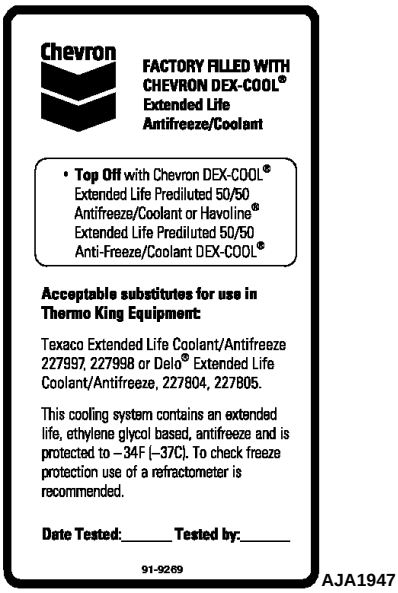


Figure 163: ELC Nameplate Located On Expansion Tank

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 nitrites)
- 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 Procedures

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 green or blue-green engine coolant every two years. 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)” for more information about ELC.

The factory recommends the use of a 50/50 percent 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 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 operating temperature. Stop the unit.
2. Open the drain cock and completely drain coolant. Observe coolant color. If the coolant is dirty, proceed with a, b, and c. Otherwise go to step 3.

CAUTION: Avoid direct contact with hot coolant.

   a. Run clear water into radiator and allow it to drain out of the drain cock until it is clear.

   b. Close the drain cock 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 drain cock to drain 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 drain cock until it is clear. When water has finished draining, close drain cock.
4. Inspect all the hoses for deterioration and the 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. Mix one gallon of the appropriate permanent type antifreeze concentrate and one gallon clean 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 mixture.

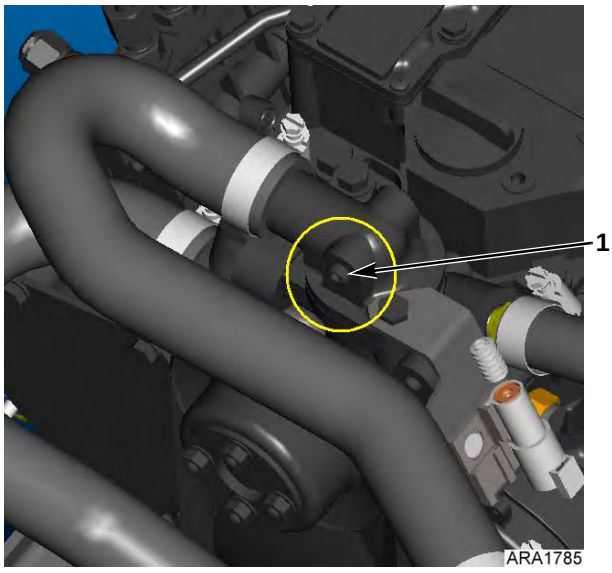
Bleeding Air from the Cooling System

Often when a self powered truck unit cooling system is refilled, air is trapped in the engine block and/or under the thermostat. Use the following procedure to bleed air out of the block and the cooling system:

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 and the loss of coolant.

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

1. Remove the bleeder set screw from the front of the engine thermostat housing. In some applications it may be easier to remove the thermostat and housing. On units with TK376 engines and tube and fin radiator coils, the petcock (bleed tap) on the radiator header should also be opened.



1.	Bleeder Set Screw

Figure 164: Remove Bleeder Set Screw

2. Slowly pour the coolant into the system until you see coolant coming out of the bleeder set screw fitting or coming up to the top of the opening for the thermostat in the water pump.

3. Reinstall the bleeder set screw or reinstall the thermostat and housing.
4. On units with TK376 engines and tube and fin radiator coils only: Continue slowly pour the coolant into the system until you see coolant coming out of the petcock (bleed tap) on the radiator header. Then close the petcock.
5. Fill the coolant expansion tank to the full mark. Then fill the overflow portion of the tank to the full cold level.
6. 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.
7. Run the unit in low speed while watching the unit engine temperature gauge or use a non-contact thermometer pointed at the water pump bleeder bolt located on the curbside of the water pump below the thermostat.
8. When the temperature reaches 150 F (66 C) for units with 160 F (71 C) thermostats, or 170 F (76 C) for units with 180 F (82 C) thermostats, shut off the engine for 2 minutes to allow the thermostat to heat soak and open completely to purge air out of block, head, and water pump.

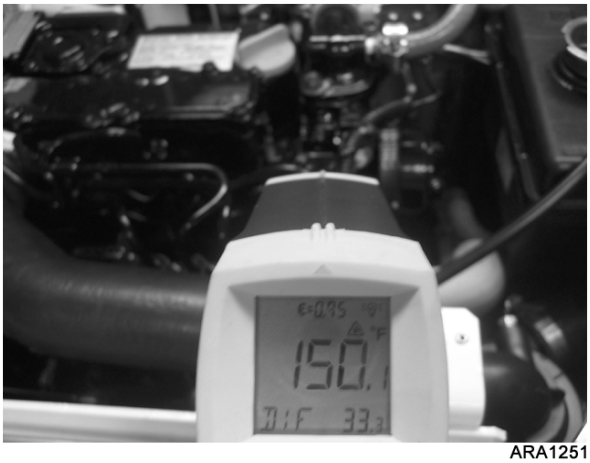


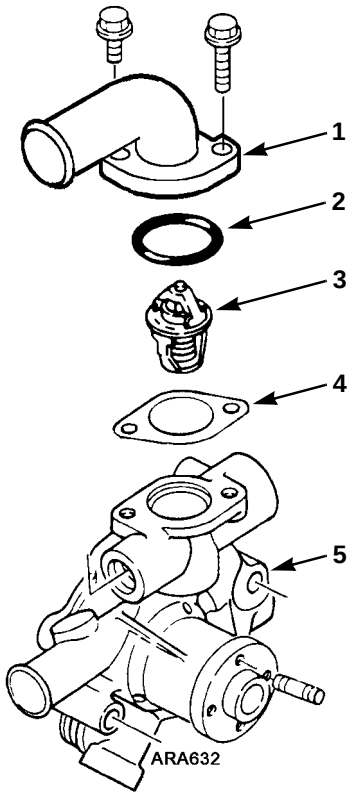
Figure 165: Checking Temperature

9. After 2 minutes, re-start the engine and run it in low speed while filling the expansion tank to the full mark. Install the expansion tank cap fully seated and run the unit for approximately 15 minutes. Shut off the engine and re-check the coolant level after the unit cools down for 15 minutes.

WARNING: Failure to follow this procedure can result in engine damage. Air trapped in the engine block and head can create localized hot spots that can cause permanent damage. Air can also cause the thermostat and engine safety shutdown feature to malfunction, causing further engine damage.

Engine Thermostat

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

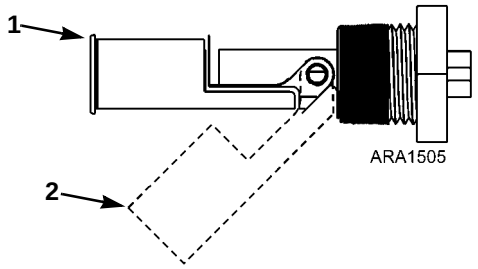


1.	Thermostat Housing
2.	Gasket
3.	Thermostat
4.	Gasket
5.	Water Pump

Figure 166: Water Pump Assembly and Thermostat

Coolant Level Switch

The coolant expansion tank uses a magnetic float type coolant level switch. When the coolant level is at or 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 in Upper Position - Switch Closed
2.	Float in Lower Position - Switch Open

Figure 167: Coolant Level Switch

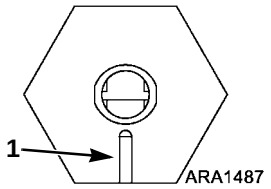
Testing the Coolant Level Switch

You can test the switch in the unit by adjusting the coolant level. You can also remove the coolant level switch from the expansion tank and test the switch by moving the float up and down.

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 switch from the tank, do this check with the float in the upper position.
4. Drain coolant from the expansion tank until the coolant level is well below the switch and check continuity of the switch. The switch should be open. If you removed the switch from the tank, do this check with the float in the lower position.
5. Replace the switch if it is not closed in step 3 and does not open in step 4.

Replacing the Coolant Level Switch

1. Disconnect the wire harness connector from the coolant level switch.
2. Drain coolant from the expansion tank until the coolant level is well below the switch.
3. Remove (unscrew) the coolant level switch from the expansion tank.
4. Install the new coolant level switch and position the orientation mark down as shown in the following drawing.



1.	Orientation Mark Down

Figure 168: Coolant Level Switch

5. Refill the expansion tank with coolant.
6. Connect the wire harness connector to the coolant level switch.

Engine Fuel System

The fuel system used on these diesel engines is a high pressure system used in conjunction with a prechamber.

The components of the fuel system are:

- Fuel tank (may be the truck fuel tank)
- Electric Fuel pump
- Fuel filter
- Injection pump
- Injection nozzles.

Operation

A 10 psig (69 kPa) electric fuel pump pulls fuel from the fuel tank through a prefilter, then pushes it to the fuel filter, and to the injection pump. The prefilter is designed for diesel fuel and is the only type that should be used.

The injection pump raises the pressure of the fuel and meters the correct amount of fuel to the nozzle at the correct time. The increased fuel pressure will lift the spring loaded nozzle to admit fuel into the combustion chamber.

Maintenance

The fuel system is relatively trouble free, and if properly maintained will usually not require major service repairs between engine overhauls.

The most common cause of fuel system problems is contamination. It cannot be stressed enough that the fuel must be clean, fuel tanks must be free from contaminants, and the fuel filter must be changed regularly. Any time that the fuel system is opened up, all possible precautions must be taken to keep dirt from entering the system. This means all fuel lines should be capped when open. The work should be done in a relatively clean area, if possible, and the work should be completed in the shortest time possible.

NOTE: The injection nozzles must be 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 TK270, TK370, TK374F, TK376, and TK380F Overhaul Manual TK 53163 for injection nozzle testing and repair procedures.

Thermo King recommends that any major injection pump or nozzle repairs be done by a quality diesel injection service specialty shop. The investment in equipment and facilities to service these components is quite high. Therefore, this equipment is not found in most repair shops.

The following procedures can be done under field conditions:

- Bleeding air from the fuel system
- Maintenance involving the fuel tank and filter system
- Engine speed adjustments
- Electric transfer pump replacement or repair (10 psig [69 kPa] pump with diesel filter)
- Injection line replacement
- Pump timing
- Nozzle spray pattern testing and adjustment
- Minor rebuilding of nozzles.

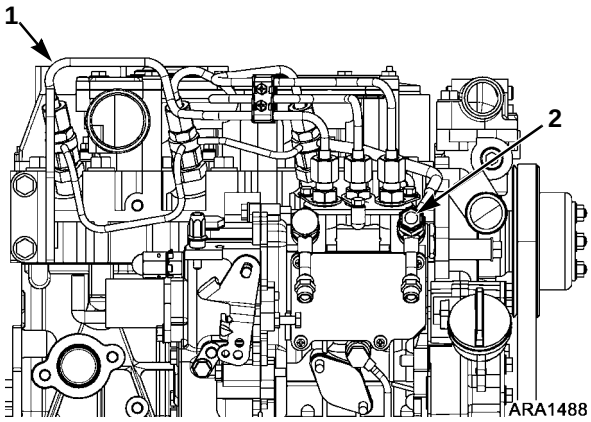
Bleeding the Fuel System

The fuel system will have to have the air bled out if the engine runs out of fuel, if repairs are made to the fuel system, or air gets into the system for any other reason.

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

Proceed as follows:

1. Loosen the bleeder screw on the return fuel fitting of the injection pump.



1.	Injector Line	2.	Bleeder Screw

Figure 169: Injection Pump

2. Turn on the electric fuel pump. The electric fuel pump is energized when the **On** key is pushed. Tighten the bleeder screw on the injection pump when clear flow of fuel appears.

   NOTE: At initial start-up, open the bleeder screw at the injection pump and bleed fuel until a clear flow is noted.

3. Loosen the injector lines on the injection nozzles.
4. Crank the engine until fuel appears at the nozzles. Tighten the injector lines, and start the engine.

   NOTE: Fuel will not appear at the nozzles by merely running the electric pump. The engine must be cranked.

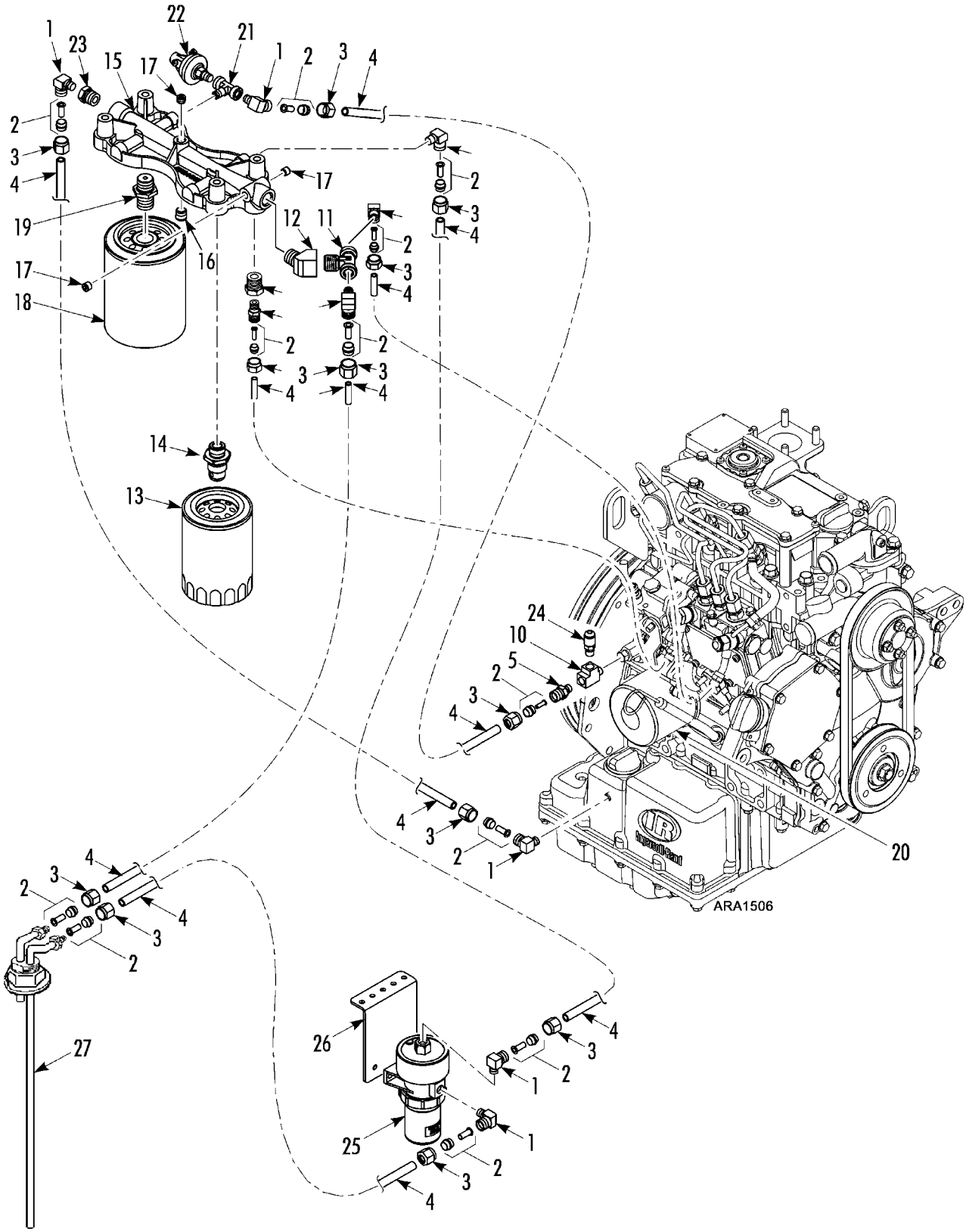


Figure 170: Fuel and Oil System Components

1.	Elbow - hose fitting (3/8)	16.	Plug - pipe
2.	Kit - sleeve & eyelet (3/8)	17.	Plug - pipe
3.	Nut (3/8)	18.	Filter - oil bypass (EMI 2000)
4.	Hose (3/8 od)	19.	Stud - bypass filter
5.	Adapter - oil line	20.	Filter - oil (full flow)
6.	Kit - sleeve & eyelet (1/4)	21.	Tee (with restrictor)
7.	Nut (1/4)	22.	Switch - oil pressure
8.	Elbow - hose fitting (1/4)	23.	Bushing
9.	Hose (1/4 od)	24.	Valve - Schrader
10.	Tee	25.	Pump - fuel (12V)
11.	Tee (with restrictor)		Kit - filter
12.	Elbow (45 degree)		Kit - bowl & gasket
13.	Filter - fuel (EMI 2000)		Gasket - bowl to body
14.	Adapter - fuel pickup	26.	Bracket - fuel pump
15.	Bracket - fuel filter		Screw - bracket
	Screw		Flatwasher
	Flatwasher		Nut
	Nut	27	Tube - fuel pickup

Fuel and Oil System Components for Figure 170

Draining Water from Fuel Tank

Water run through the system may damage the injection pump or nozzles. Damage to the fuel 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 Replacement

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

1. Remove the filter and discard.
2. Lubricate rubber ring of new filter with fuel.
3. Install the filter and tighten until the filter is slightly loose (rubber ring not making contact).
4. Bleed the air from the filter by operating the electric pump until fuel bubbles appear at the top of filter.
5. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.

Electric Fuel Pump

Operation

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

Make sure the harness plug black wire pin completes a good ground with the battery. Check the voltage at the red wire pin of the harness plug. 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.

AMA703

AMA703

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

Figure 171: 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.

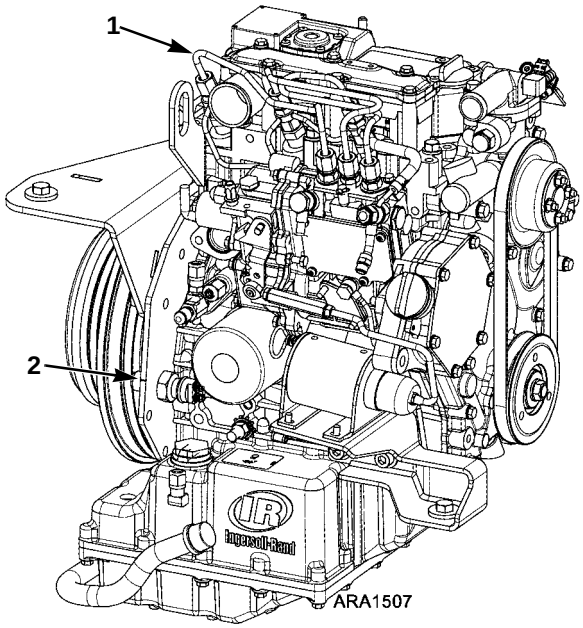
If the pump operates but does not deliver fuel, check for:

- 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.

Injection Pump Timing

This is the only timing procedure for this engine. It is not necessary to check the individual cylinder timing.

CAUTION: The cylinders on the engine are numbered from the flywheel end to the water pump end. The number 1 cylinder is next to the flywheel. The number 2 cylinder is the center cylinder. The number 3 cylinder is next to the water pump. The timing marks on the flywheel are matched to this system.



1.	Number One Cylinder Injection Line
2.	Timing Mark

Figure 172: Component Location

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

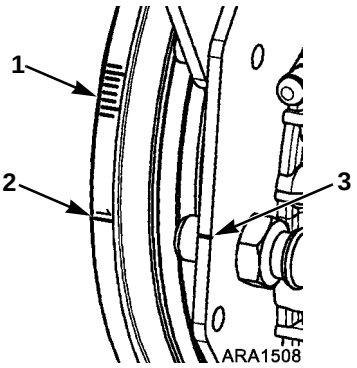
1. Remove the injection line for the number one cylinder from the delivery valve on the injection pump and from the injection nozzle.

   NOTE: The number one cylinder is the cylinder at the flywheel end of the engine.

2. Remove the delivery valve spring for the number 1 cylinder by removing the delivery valve holder and the delivery valve spring, and then reinstalling the delivery valve holder without the delivery valve spring in place.
3. Remove the cylinder head cover (valve cover/intake manifold assembly).
4. Place the engine at top dead center of the compression stroke for the number one cylinder. Refer to steps a through d.

   a. Rotate the engine in the normal direction of rotation (clockwise viewed from the water pump end) until the number one

TDC mark on the flywheel lines up with the timing mark on the starter mounting plate.



1.	Injection Timing Marks
2.	Top Dead Center Mark for Number 1 Cylinder
3.	Index Timing Mark on Starter Mounting Plate

Figure 173: Timing Marks

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.

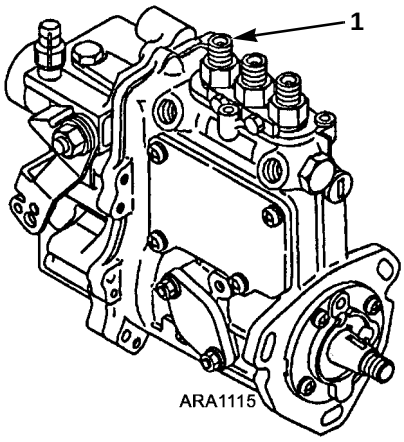
d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number one cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number one cylinder.

5. Disconnect the 8S wire from the starter solenoid to prevent the engine from cranking when the unit is turned On.

6. Energize the fuel solenoid and the fuel pump by turning the unit On (or using the Service Test Mode, see the appropriate Microprocessor Diagnostic Manual).

7. Rotate the engine backwards (counterclockwise viewed from the water pump end) until the injection timing mark is positioned about 1.0 in. (25 mm) below the timing mark on the starter mounting plate.

8. Use a clean towel to remove the fuel from the top end of the delivery valve holder.

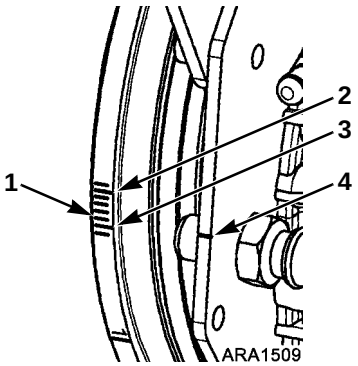


1.	Delivery Valve Holder

Figure 174: Injection Pump

9. Slowly turn the engine in the normal direction of rotation until you see the fuel rise in the end of the delivery valve holder. Stop as soon as you see the fuel rise.

10. Check position of the timing marks. The 16 degrees BTDC timing mark on the flywheel should be aligned with the timing mark on the starter mounting plate. Repeat steps 7 through 10 to recheck the timing.



1.	16 Degrees BTDC Mark (Correct Timing Mark)
2.	20 Degrees BTDC
3.	15 Degrees BTDC
4.	Index Timing Mark on Starter Mounting Plate

Figure 175: Correct Injection Timing Mark Alignment

11. If the timing is off by more than 1 degree (0.1 in. [2.5 mm]), loosen the mounting nuts on the studs that fasten the injection pump to the engine and rotate the injection pump to change the timing.

a. Pull the top of the injection pump away from the engine to advance the timing.

b. Push the top of the injection pump toward the engine to retard the timing.

12. Tighten the injection pump mounting nuts and recheck the timing. Repeat steps 7 through 12 until the timing is correct.

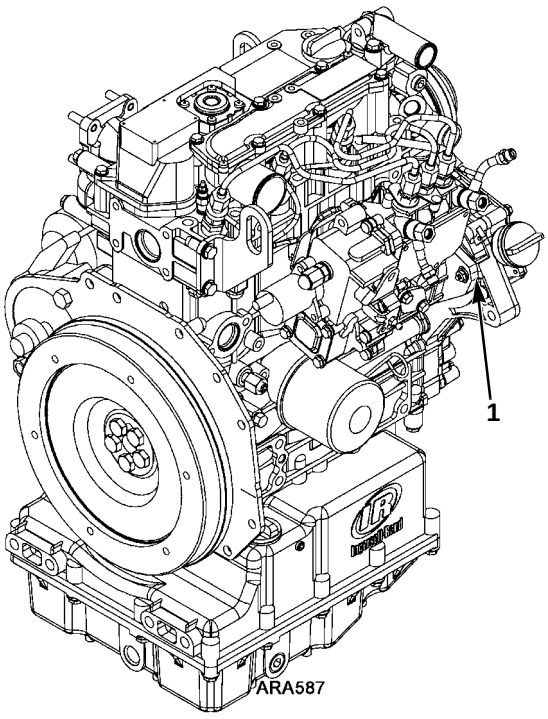
13. Install the delivery valve spring for the number one cylinder by removing the delivery valve holder, installing the delivery valve spring, and then reinstalling the delivery valve holder.

14. Install the injection line for the number one cylinder, the cylinder head cover, tighten the other injection lines, and reconnect the 8S wire to the starter solenoid when finished with the procedure.

Injection Pump Removal and Installation

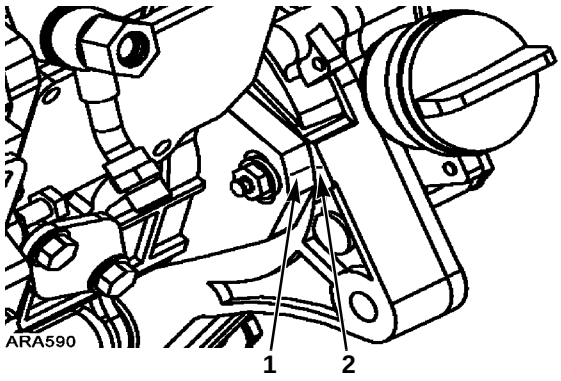
Injection Pump Removal

1. Note the alignment of the index marks on the injection pump and the gear case. If they are not marked, mark them so the injection pump can be returned to the same position when it is reinstalled.



1.	Index Marks

Figure 176: Index Mark Location



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

Figure 177: Index Mark Alignment

2. Remove the throttle linkage, fuel lines, wire harness, and mounting hardware from the injection pump.

3. Remove the injection pump timing cover from the gear case.

4. Loosen the injection pump gear mounting nut, but do not remove it yet.

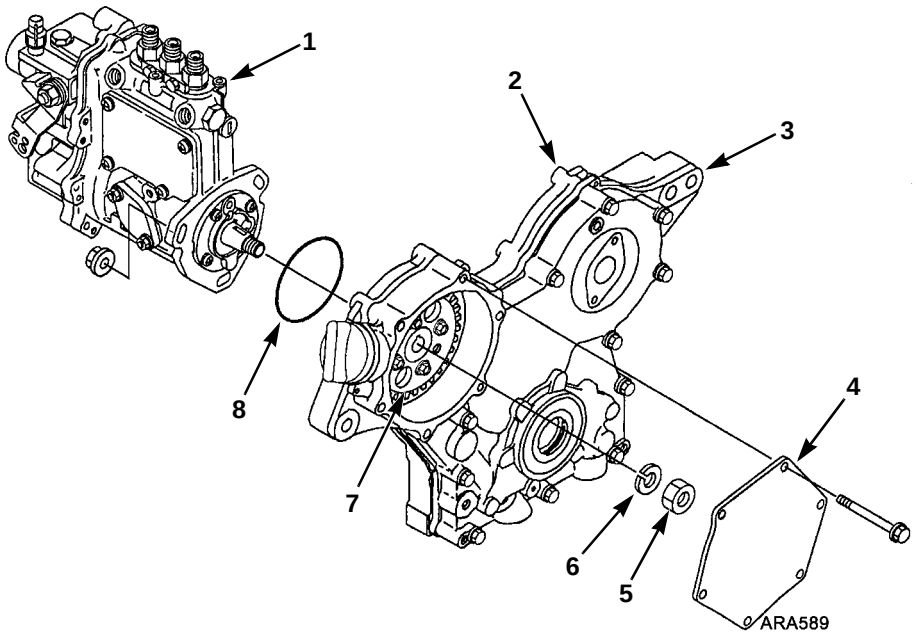
NOTE: The injection pump gear assembly is made of two pieces, the flange and the gear. Do not loosen or remove the four bolts that fasten the gear to the flange because that changes the timing.

5. Use a suitable puller to loosen the injection pump gear from the injection pump shaft.
6. Remove the injection pump gear mounting nut and lock washer. Use a shop rag to prevent the lock washer or nut from falling into the gear case.
7. Remove the injection pump from the gear case, but leave the injection pump gear in the gear case. This keeps the teeth on the injection pump gear aligned properly with the teeth on the idler gear. If you remove the injection pump gear from the gear case you will have to remove the gear case cover to realign the timing marks on the injection pump gear and the idler gear.

Injection Pump Installation

1. Place a new O-ring on the injection pump and lubricate it with engine oil.
2. Place the injection pump in the gear case. Rotate the injection pump shaft to mate the key in the shaft with the keyway in the injection pump gear. Take care to make sure the key mates with the keyway.
3. Secure the 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 to set the timing.
4. Secure the injection pump gear to the injection pump shaft with the lock washer and mounting nut. Use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 43.5 to 50.9 ft-lb (59.0 to 69.0 N•m).
5. Install the injection pump timing cover on the gear case cover, and reinstall all components removed previously to facilitate the injection pump removal.

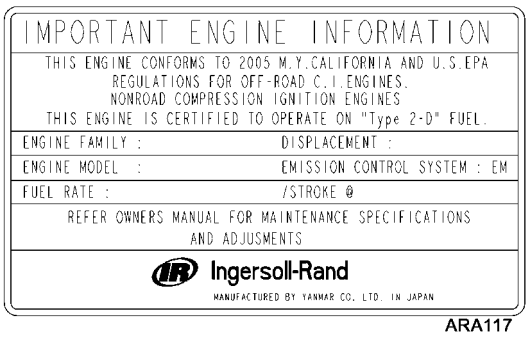


1.	Injection Pump	5.	Injection Pump Gear Mounting Nut
2.	Gear Case	6.	Lock Washer
3.	Gear Case Cover	7.	Injection Pump Gear
4.	Injection Pump Timing Cover	8.	O-Ring

Figure 178: Injection Pump Removal and Installation

Fuel Limit Screw

The fuel limit screw is not adjustable. It is equipped with an anti-tamper cap to fulfill requirements for CARB (California Air Resources Board) emission regulations. Service technicians must be CARB certified to perform service on the fuel limit screw for equipment operating in California.


IMPORTANT ENGINE INFORMATION

THIS ENGINE CONFORMS TO 2005 M.Y. CALIFORNIA AND U.S. EPA REGULATIONS FOR OFF-ROAD C.I. ENGINES.
NONROAD COMPRESSION IGNITION ENGINES
THIS ENGINE IS CERTIFIED TO OPERATE ON "Type 2-D" FUEL.

ENGINE FAMILY :	DISPLACEMENT :
ENGINE MODEL :	EMISSION CONTROL SYSTEM : EM
FUEL RATE :	/STROKE @

REFER OWNERS MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSMENTS

Ingersoll-Rand

MANUFACTURED BY YANMAR CO. LTD. IN JAPAN

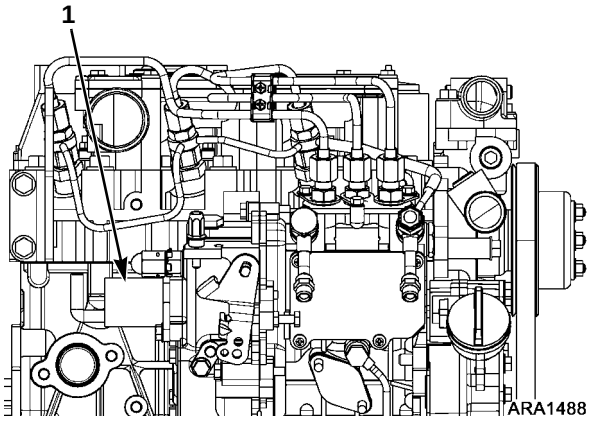
ARA117

Figure 179: Emission Control Label

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



1.	Fuel Solenoid

Figure 180: 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.

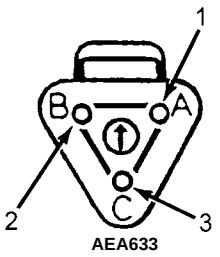
If you suspect that the engine does not run because the fuel solenoid is not operating correctly, use the following procedure:

1. Use the Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
2. Energize the run relay with the Interface Board Test Mode. The fuel solenoid relay is momentarily energized when the run relay is energized with the Interface Board Test Mode. This energizes the fuel solenoid, which makes a definite click when energized.
3. De-energize the run relay with the Interface Board 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 (K1), the fuel solenoid pull in relay (K6), 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 181: Fuel Solenoid Connector Pin Identification

7. Place a jumper wire between the black wire (CH—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 (CH—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 (CH—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

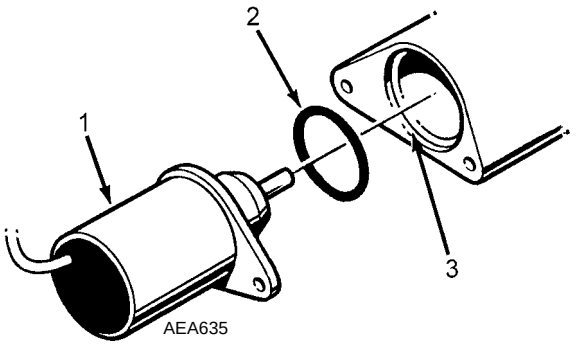
1. Disconnect the fuel solenoid wire connector from the main wire harness and remove the old fuel solenoid.

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 Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Relay Test Mode.
5. Energize the fuel solenoid by energizing the run relay with the Interface Board Test Mode.

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

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

Engine Speed Adjustments

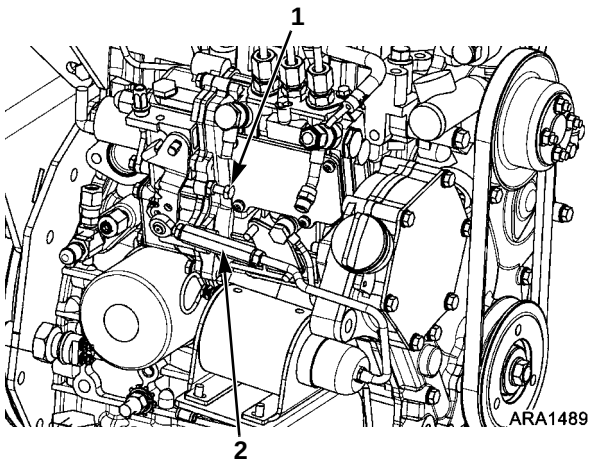
When the diesel engine fails to maintain the correct engine speed, check the following before adjusting the speed:

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

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

Low Speed Adjustment

1. Start the unit and let it run until the engine is warmed up.
2. Adjust the setpoint to make the engine run in low speed (or use Service Test Mode LSC) and check the engine speed. See "Specifications" for the correct low speed.
3. If the engine speed is not correct, loosen the jam nut on the low speed adjustment screw.
4. Turn the low speed adjustment screw to change the engine speed. Turn the screw in to increase the engine speed. Turn the screw out to decrease the engine speed.
5. Set the engine speed at the correct low speed, and tighten the jam nut
6. Recheck the engine speed.



1.	Low Speed Adjustment Screw
2.	High Speed Adjuster

Figure 183: Engine Speed Adjustments

High Speed Adjustment

1. Start the unit and let it run until the engine is warmed up.
2. Adjust the setpoint to make the engine run in high speed (or use Service Test Mode HSC) and check the engine speed. See "Specifications" for the correct high speed.

3. If the engine speed is not correct, loosen the jam nuts at both ends of the high speed adjuster in the throttle linkage.
4. Turn the high speed adjuster to change the engine speed.
5. Set the engine speed at the correct high speed and tighten both jam nuts.
6. Recheck the engine speed.

Adjust Engine Valve Clearance

The valve clearance should be checked after every 1,000 operating hours, maximum. It is important that valves be adjusted to the correct specifications for satisfactory engine operation. Insufficient valve clearance will result in compression loss and misfiring of cylinders resulting in burned valves and seats. Excessive valve clearance will result in noisy valve operation and abnormal wear of the valves and rocker arms. The intake and exhaust valves are adjusted with the valve in the closed position.

NOTE: The cylinders on these engines are numbered from the flywheel end to the water pump end. The number 1 cylinder is next to the flywheel. The number 2 cylinder is in the middle and the number 3 cylinder is next to the water pump. The timing marks on the flywheel are also numbered this way.

The timing marks on the flywheel of the three cylinder engines are stamped 120 degrees apart. The top dead center marks have the cylinder number stamped next to them. The injection timing marks have no identification marks (see Figure 185).

The index timing mark is stamped on the side of the starter mounting plate that faces the flywheel. This index timing mark is on the intake side of the engine.

On the three cylinder engines the order for the flywheel timing marks is 1, 2, 3, but the firing order is 1, 3, 2. The reason for this is that the engine fires every 240 degrees of crankshaft rotation. Therefore, when adjusting the valves, check the number 1 cylinder first. Then rotate the engine past the number 2 cylinder timing marks to the number 3 cylinder timing marks and check the number 3 cylinder. Finally, rotate the engine past the number 1 cylinder timing marks to the number 2 cylinder timing marks and check the number 2 cylinder.

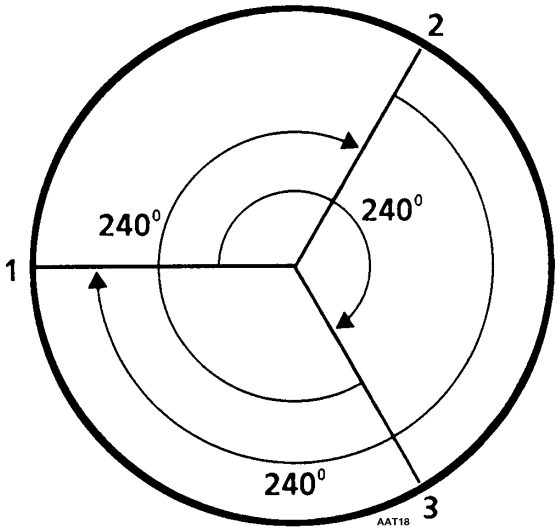
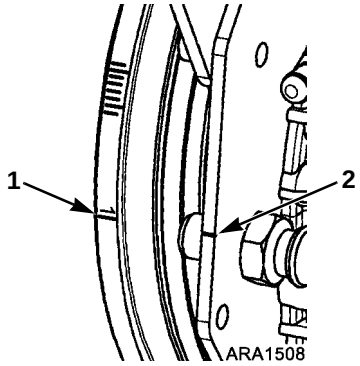


Figure 184: Valve Adjustment and Firing Order

1. Remove the cylinder head cover.

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

2. Place the engine at top dead center of the compression stroke for the number 1 cylinder.
   a. Rotate the engine in the normal direction of rotation (counterclockwise viewed from the flywheel end) until the top dead center timing mark for the number 1 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.



1.	Top Dead Center Timing Mark for Number 1 Cylinder
2.	Index Timing Mark on Starter Mounting Plate

Figure 185: Timing Marks

b. Check the rocker arms on the number 1 cylinder to see if they are loose.

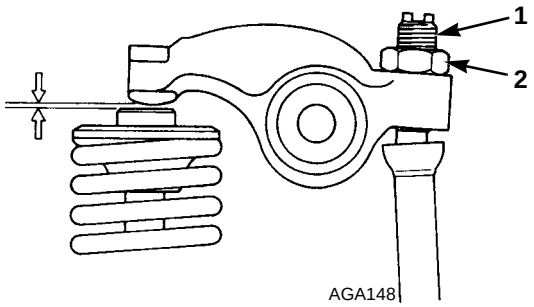
c. If the rocker arms are loose, the engine is at top dead center of the compression stroke for the number 1 cylinder.

d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 1 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 1 cylinder.

3. Use a feeler gauge to check the valve clearance on both valves for the number 1 cylinder. The valve clearance for both the intake valves and the exhaust valves 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.

4. Adjust the valves if necessary by loosening the lock nut and turning the adjustment screw until the valve clearance is correct.



1.	Adjustment Screw
2.	Lock Nut

Figure 186: Valve Clearance

5. Hold the adjustment screw in place and tighten the lock nut.

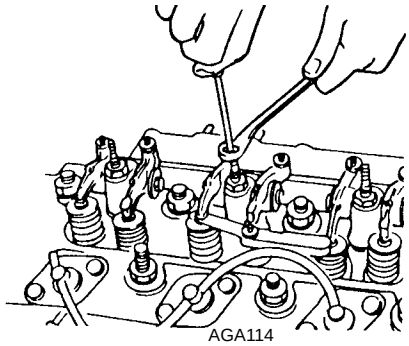


Figure 187: Adjusting Valves

6. Recheck the valve clearance.

7. Place the engine at top dead center of the compression stroke for the number 3 cylinder.

   a. Rotate the engine in the normal direction of rotation (counterclockwise viewed from the flywheel end) until the top dead center timing mark for the number 3 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.

   b. Check the rocker arms on the number 3 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 3 cylinder.

   d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 3 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 3 cylinder.

8. Check and adjust both valves for the number 3 cylinder.
9. Place the engine at top dead center of the compression stroke for the number 2 cylinder.
    a. Rotate the engine in the normal direction of rotation (counterclockwise viewed from the flywheel end) until the top dead center timing mark for the number 2 cylinder on the flywheel lines up with the index timing mark on the starter mounting plate.
    b. Check the rocker arms on the number 2 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 2 cylinder.
    d. If the rocker arms are tight, the engine is at top dead center of the exhaust stroke for the number 2 cylinder. Rotate the engine 360 degrees to place the engine at top dead center of the compression stroke for the number 2 cylinder.
10. Check and adjust both valves for the number 2 cylinder.
11. Replace the cylinder head cover.

Engine Mounts

The engine mounting system contains three vibration mounts and a chain restraining mount (snubber).

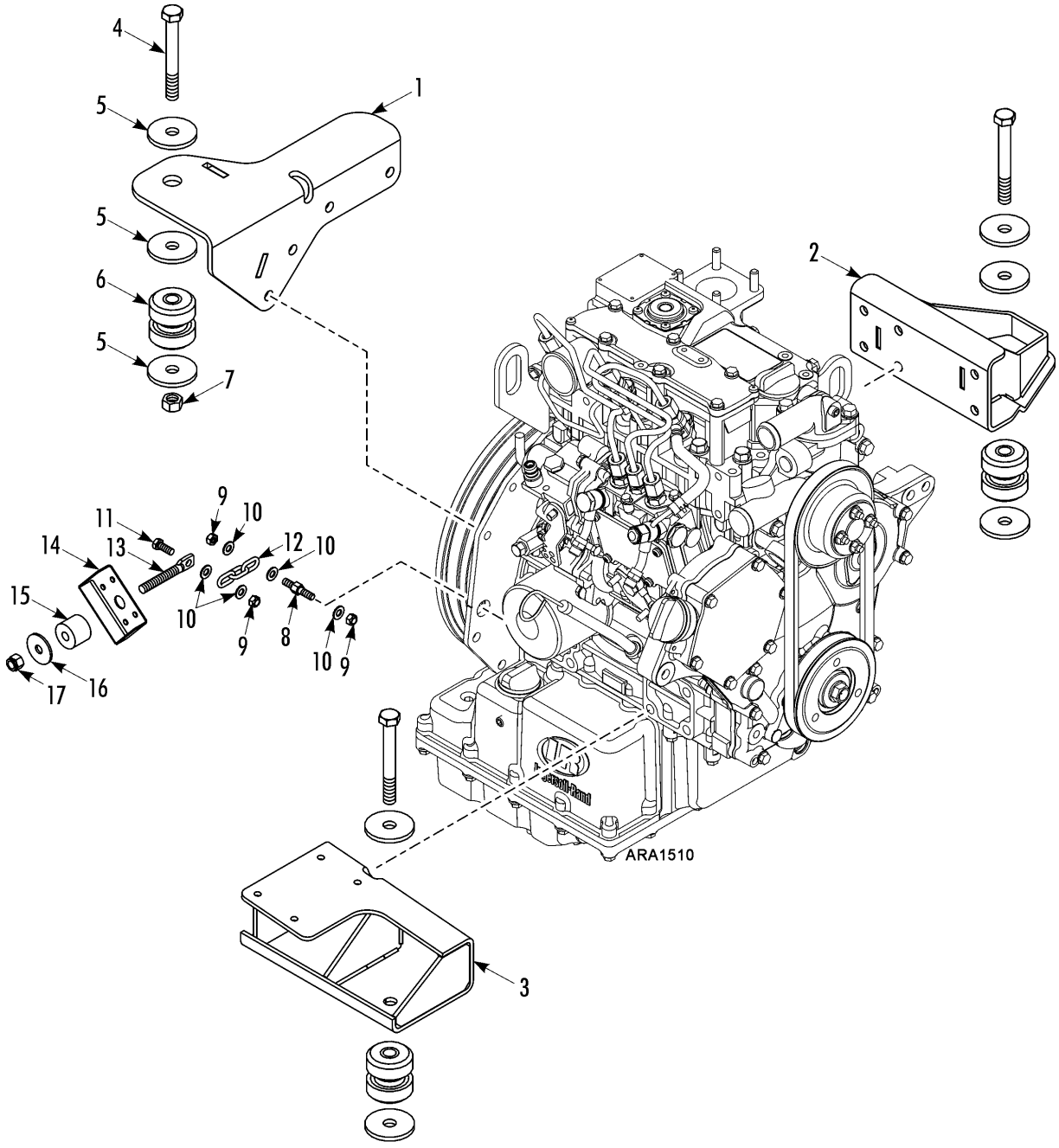


Figure 188: Engine Mounting Components

1.	Bracket - engine (upper rear)	9.	Nut
2.	Bracket - engine (compressor side)	10.	Washer - belleville
3.	Bracket - engine (door side)	11.	Screw - chain
	Screw - plate & bracket (socket head)	12.	Chain - 3 links
	Washer - belleville	13.	Bolt - eye 1/2 in.
	Sealer - thread	14.	Bracket - snubber gauge
4.	Screw - mount		Rivet - bracket
5.	Washer - special	15.	Spacer - eistimer
6.	Mount - vibration (front, set of two)	16.	Washer - special
7.	Nut	17.	Locknut
8.	Stud - snubber		

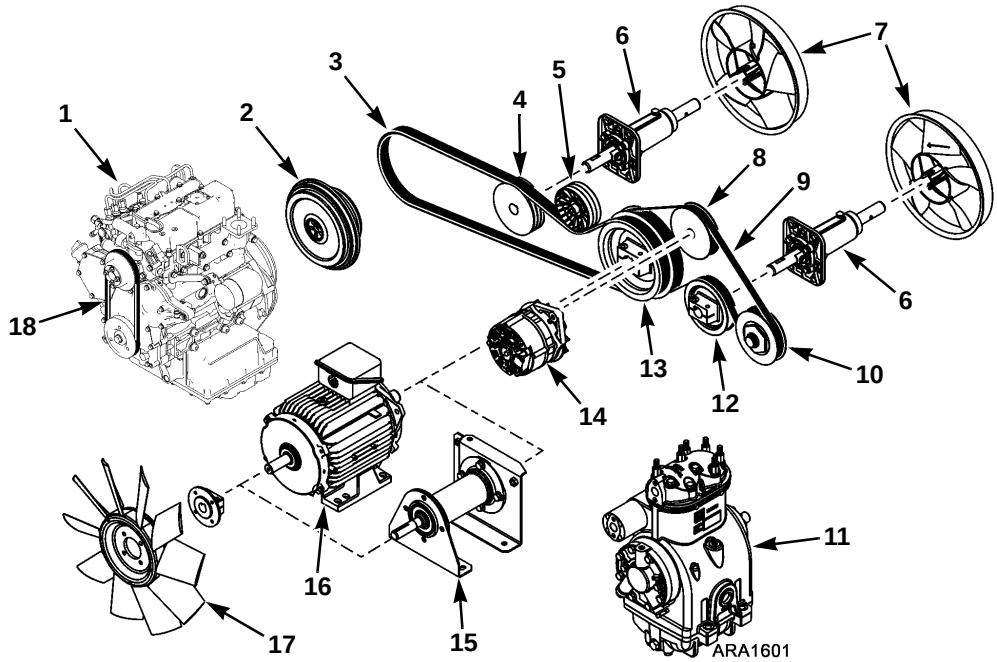
Engine Mounting Components for Figure 188

Restraining Mount (Snubber) Adjustment

The restraining mount (snubber) is adjusted while adjusting the engine/electric motor (jackshaft) belt tension. See “Engine/Electric Motor (Jackshaft) Belt”.

Belts

The unit uses only two belts to transfer power from the engine and the electric motor to the alternator, compressor, and evaporator fans.



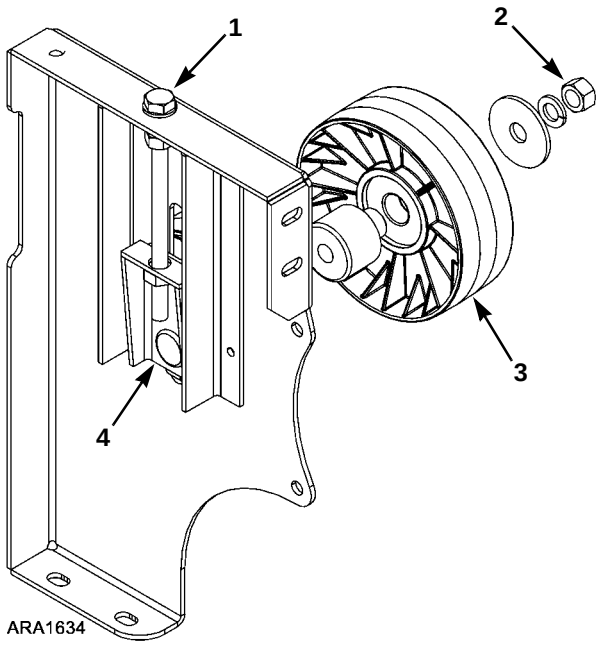
1.	Engine	10.	Compressor Pulley
2.	Clutch	11.	Compressor
3.	Engine/Electric Motor (Jackshaft) Belt	12.	Evaporator Fan Pulley (Compressor Side)
4.	Evaporator Fan Pulley (Engine Side)	13.	Electric Motor (Jackshaft) Pulley
5.	Belt Tensioner Pulley	14.	Alternator
6.	Fan Shaft	15.	Jackshaft
7.	Evaporator Fans	16.	Electric Motor
8.	Alternator Pulley	17.	Condenser Fan
9.	Electric Motor (Jackshaft)/Compressor Belt	18.	Water Pump Belt

Figure 189: Belt Layout (Two-Cylinder Compressor Shown, Similar With Four-Cylinder Compressor)

Engine/Electric Motor (Jackshaft) Belt

The engine/electric motor (jackshaft) belt is a 3V belt that also drives the engine side evaporator fan. A static belt tensioner keeps the belt at the proper tension. Use the following procedure to replace this belt or adjust the belt tension.

1. If replacing the belt, remove the electric motor (jackshaft)/compressor belt.



1.	Adjusting Bolt
2.	Pulley Mounting Nut
3.	Pulley
4.	Adjusting Bracket

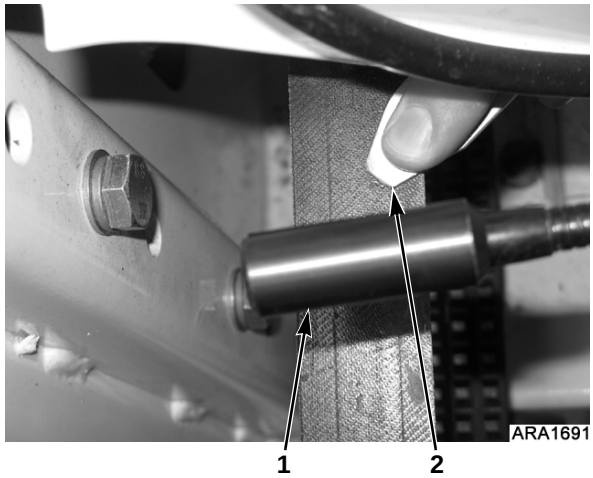
Figure 190: Belt Tensioner Components

2. Loosen the locknut on the restraining mount (snubber) until the chain is loose.
3. Loosen the pulley mounting nut enough to allow the adjusting bracket to slide, but not enough to allow the pulley to tilt.
4. Turn the adjusting bolt clockwise until the belt is loose. If not replacing the belt go to step 7.
5. Remove the old belt and note how it fits on the pulleys.
6. Install the new belt. Make sure it fits on the pulleys correctly.
7. Take a straight edge, place it against the side of the muffler can and mark the frame as shown below. This is the unloaded engine position.

Figure 191: Mark Frame

8. Turn the adjusting bolt counter-clockwise to make the pulley descend and tighten the belt until it is at approximately 10 Hz lower than the correct belt tension setting using the frequency gauge P/N 204-1903 on the top span. This will pull the engine towards the belt. See “Specifications” for the correct belt tension settings.

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

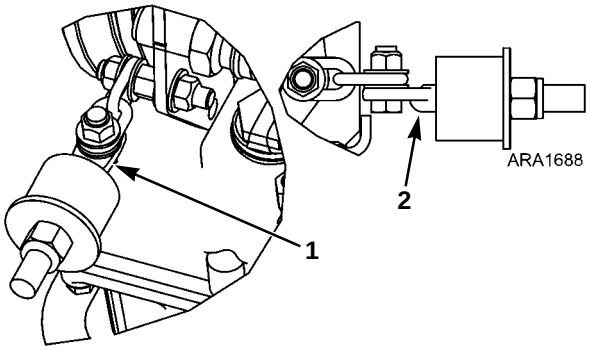


1.	Probe
2.	Metal Tab

Figure 192: Using Frequency Gauge P/N 204-1903

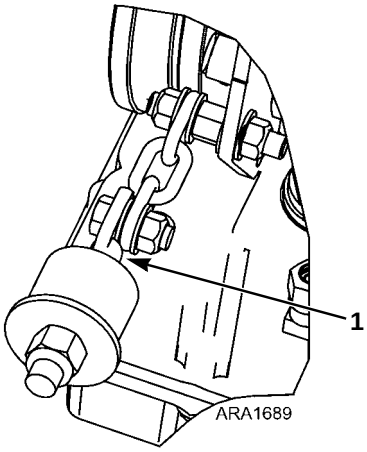
NOTE: Make sure the two nuts under the bracket near the top of the adjusting bolt are locked together to ensure the adjusting bolt forces the pulley down to tighten the belt.

9. Tighten the pulley mounting nut.
10. Check the orientation of the restraining mount (snubber) eye-bolt because the 'eye' is offset. Make sure it is oriented as shown in the following drawings.



1.	Eye-Bolt
2.	Orient Bulge Down

Figure 193: Eye-Bolt Orientation for TK 376 Engine



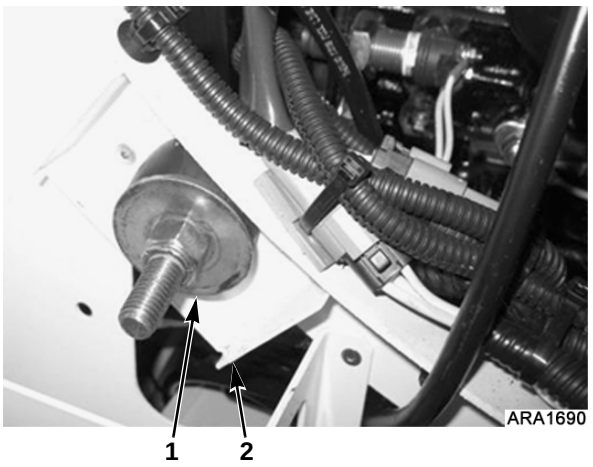
1.	Orient Bulge Forward

Figure 194: Eye-Bolt Orientation for TK 370 Engine

11. Place the straight edge against the side of the muffler can.
12. Tighten the nut on the restraining mount (snubber) until the straight edge lines up with the mark for the initial unloaded engine position in step 7.

NOTE: It is important to turn the belt as the nut is being tightened to prevent tension from building up in the belt.

NOTE: The washer on the restraining mount (snubber) should not go below the bracket side wall height. If it does, the restraining mount (snubber) will be over-compressed.



1.	Washer (Should Not Go Below Bracket Side Wall Height)
2.	Bracket Side Wall

Figure 195: Restraining Mount (Snubber) and Bracket

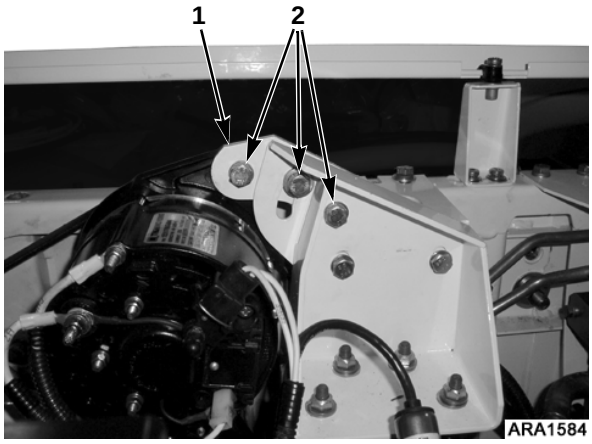
13. Check the belt tension frequency using the frequency gauge P/N 204-1903 and adjust to the correct tension if necessary.
14. Reinstall the electric motor (jackshaft)/ compressor belt if it was removed.

Electric Motor (Jackshaft)/ Compressor Belt

The electric motor (jackshaft)/compressor belt is a polyvee stretch belt that also drives the compressor side evaporator fan and the alternator. The alternator/motor (jackshaft) bracket has two sets of adjustment steps that are aligned with the alternator clevis bracket to set the belt tension. These sets of steps are called the factory setting steps and the field reset setting steps. A new unit is set at the factory setting steps. At the first 2,000 hour service, it should be adjusted to the field reset setting steps. When the belt is replaced, it should be set at the factory setting steps. After 2,000 hours it should be adjusted to the field reset setting steps. Use the following procedure to adjust or replace this belt.

Adjustment

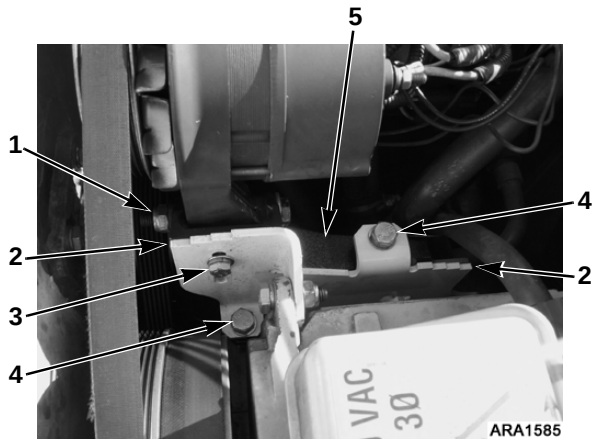
1. Loosen the three alternator link bolts (see Figure 196).



1.	Alternator Link
2.	Alternator Link Bolts

Figure 196: Alternator Brackets - Front View

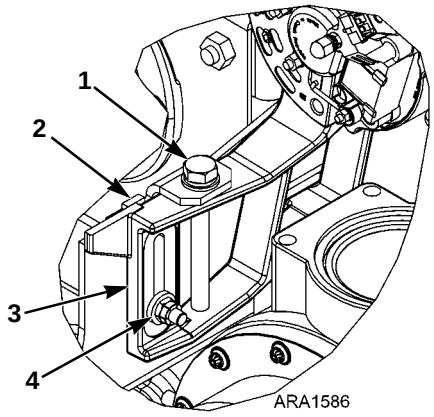
2. Loosen the alternator pivot bolt (see Figure 197).
3. Loosen the locking bolt, which fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket (see Figure 197).



1.	Alternator Pivot Bolt
2.	Adjustment Steps on Alternator/Motor (Jackshaft) Bracket
3.	Locking Bolt
4.	Alternator Adjusting Bolts
5.	Alternator Clevis Bracket

Figure 197: Alternator Brackets - Engine Side View

4. Loosen the locknut that fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket (see Figure 198).

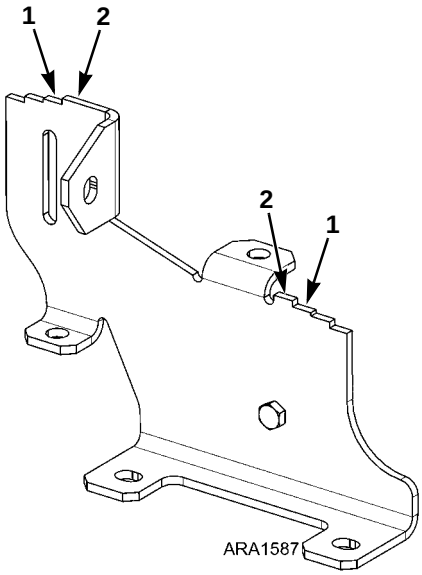


1.	Alternator Adjusting Bolt
2.	Adjustment Step on Alternator/Motor (Jackshaft) Bracket
3.	Alternator Clevis Bracket
4.	Locknut

Figure 198: Alternator Brackets - Compressor Side View

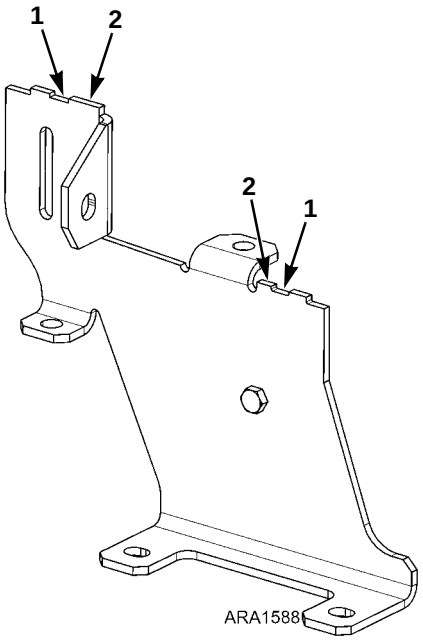
5. Tighten the alternator adjusting bolts until the top of the alternator clevis bracket is aligned with the field reset setting steps on the alternator/motor (jackshaft) bracket (see Figure 199 and Figure 200).

NOTE: The two inside sets of adjustment steps are for single temp units with reciprocating compressors and multi-temp units with scroll compressors. The two outside sets of adjustment steps are for single temp units with scroll compressors and multi-temp units with reciprocating compressors.



1.	Factory Setting Steps (New Belt)
2.	Field Reset Setting Steps (2,000 Hours)

Figure 199: Alternator/Motor (Jackshaft) Bracket Adjustment Steps for T-600R and T-800R Units



1.	Factory Setting Steps (New Belt)
2.	Field Reset Setting Steps (2,000 Hours)

Figure 200: Alternator/Motor (Jackshaft) Bracket Adjustment Steps for T-1000R Units

6. Tighten the locknut that fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket.
7. Tighten the locking bolt, which fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket.
8. Tighten the alternator pivot bolt.
9. Tighten the three alternator link bolts.

Replacement

1. Loosen the three alternator link bolts (see Figure 196).
2. Loosen the alternator pivot bolt (see Figure 197).
3. Loosen the locking bolt, which fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket (see Figure 197).
4. Loosen the locknut that fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket (see Figure 198).
5. Back the alternator adjusting bolts out of the alternator/motor (jackshaft) bracket about 3 in. (76 mm).

6. Push the alternator and the alternator clevis bracket down to loosen the belt.
7. Remove the old belt and note how it fits on the pulleys.
8. Install the new belt. Make sure it fits on the pulleys correctly.
9. Tighten the alternator adjusting bolts until the top of the alternator clevis bracket is aligned with the factory setting steps on the alternator/motor (jackshaft) bracket (see Figure 199 and Figure 200).
10. Tighten the locknut that fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket.
11. Tighten the locking bolt, which fastens the alternator/motor (jackshaft) bracket to alternator clevis bracket.
12. Tighten the alternator pivot bolt.
13. Tighten the three alternator link bolts.

Water Pump Belt

The water pump pulley is a split type. Adjust the tension by adding or removing shims between the pulley sheaves. See “Specifications” for the correct water pump belt tension setting.

1. Remove the bolts from the water pump pulley.
2. Remove the pulley sliding section and add or remove shims to adjusting 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 and readjust if necessary.

Evacuation, Dehydration, and Charging

Evacuation is Important and is Critical to System Performance!

It has been determined through testing and system analysis that refrigeration systems which contain non-condensables such as nitrogen and/or air can be overcharged with refrigerant when charged using the sight glass method. An overcharge of refrigerant will cause high system pressures, system shutdowns, and compressor damage. Moisture in the system will produce acid and other contaminants that lead to compressor failure.

Therefore, Thermo King recommends that all repairs to the refrigeration system include the removal and reclamation (cleaning) of the refrigerant, followed by a thorough evacuation using the proper tools and procedures.

The primary objective of evacuation is to bring the system's pressure into a vacuum to ensure the removal of non-condensables. The objective of dehydration is to bring the system into a very deep vacuum, below 1,000 microns, to remove moisture. There are however, certain other principles which must be observed. These are:

- Evacuate from 3-points, suction service valve, discharge service valve, and receiver tank outlet to access both sides of check valves and solenoids.
- Always leave service valve caps on during evacuation and do not exercise the valve stems while the unit is in a deep vacuum. Packing glands are prone to leak.
- Never attempt evacuation without a micron vacuum gauge. The micron gauge will help determine:
  a. If the pump is capable of pulling a deep vacuum.
  b. When the vacuum pump oil is contaminated.
  c. If the vacuum hoses and valves are leak free.
  d. If the unit is leak free.
  e. How long you should evacuate the unit.
  f. That the unit is still in a deep vacuum before any lines are disconnected or refrigerant is added.

NOTE: The attached evacuation procedures have been written to be used with the Thermo King Evacuation System (P/N 204-725). However, the principles of 3-point evacuation and the use of a micron gauge during evacuation should always be practiced.

See the diagram of the Thermo King Evacuation Station (Figure 201 on page 115) and note the location of the valves and other components.

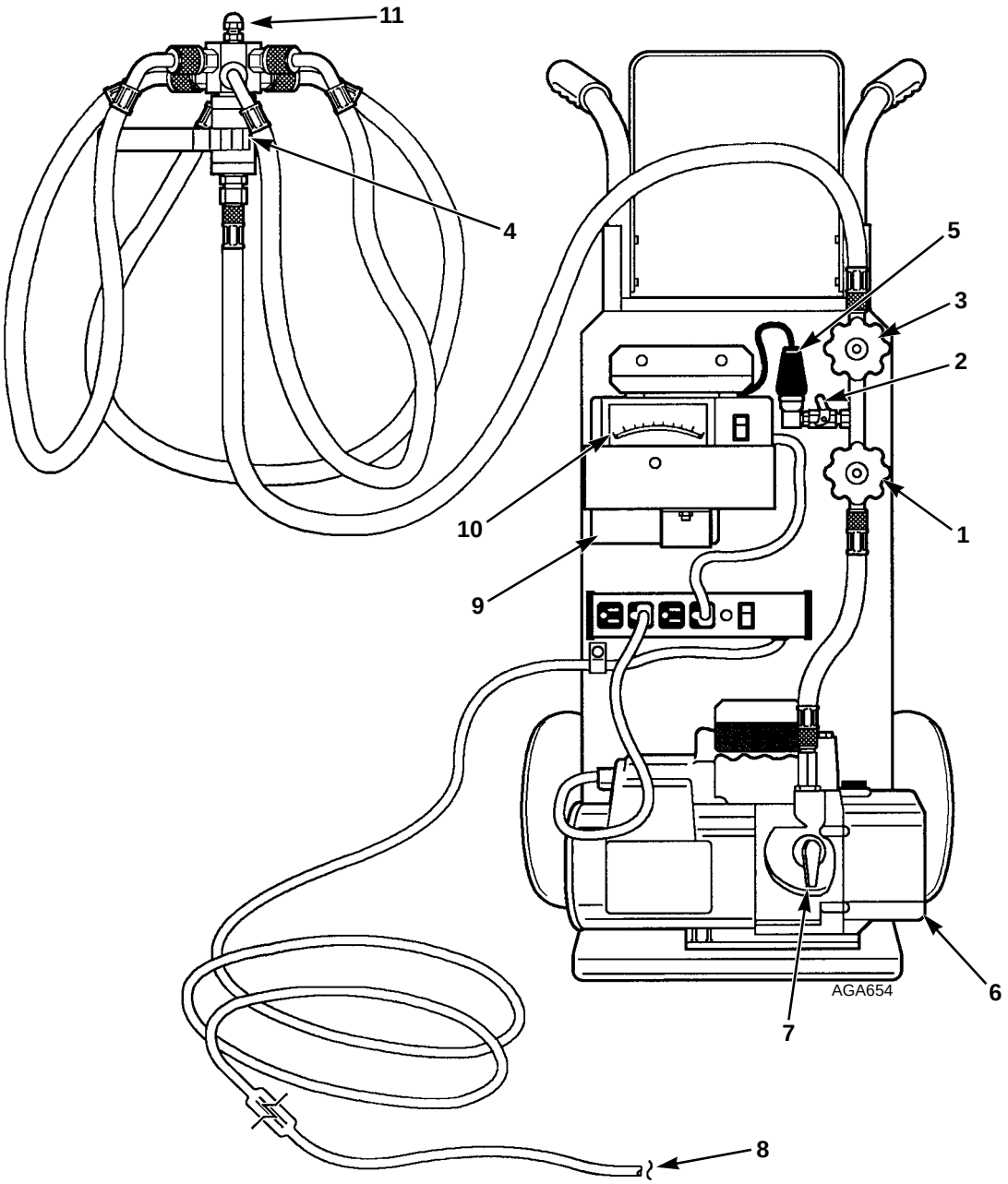
Valve #1 (V-1): Is in the open position when the pump is running to evacuate the hoses and/or the unit. When V-1 is closed, the pump has been isolated from the hoses and/or the unit.

Valve #2 (V-2): Is in the open position during unit evacuation. In the closed position, V-2 isolates the micron gauge and thermistor assembly from the hoses and/or the unit.

Valve #3 (V-3): Is in the open position during unit evacuation. When closed, V-3 isolates the micron gauge and the vacuum pump from the other evacuation hoses.

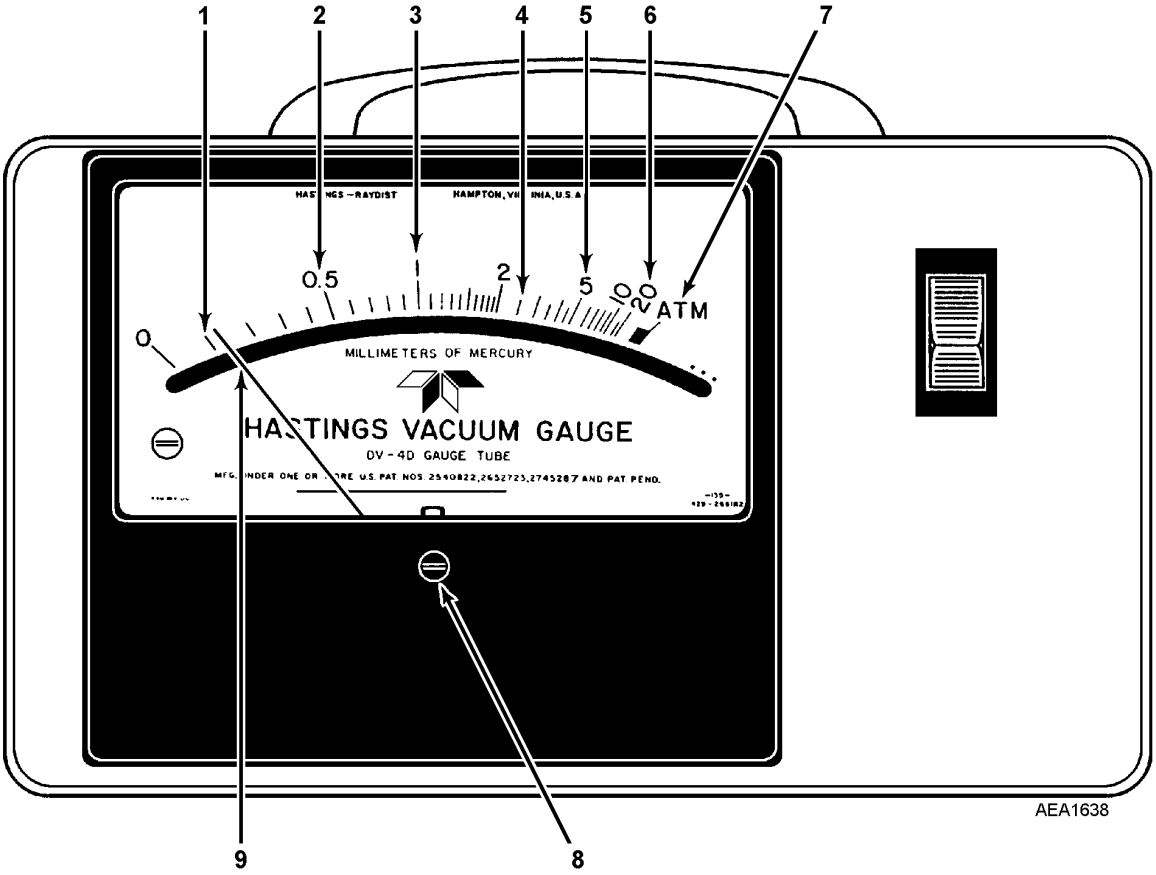
Valve #4 (V-4): Is in the open position during unit evacuation. When closed, V-4 isolates the evacuation hoses and the unit from the evacuation system.

Iso-Valve™: Is in the open position when the vacuum pump is running to evacuate the hoses and/or the unit. When Iso-Valve is closed, the pump has been isolated from the hoses and/or the unit. The Iso-Valve is normally not used because V-1 performs the same function and is more wear resistant.



1.	V-1	7.	Iso-Valve
2.	V-2	8.	To 110 Vac Power
3.	V-3	9.	Calibration Standard
4.	V-4	10.	Vacuum or Micron Gauge
5.	Thermistor	11.	Charging Port
6.	Two Stage Vacuum Pump		

Figure 201: Evacuation Station



1.	100 Microns
2.	500 Microns
3.	1000 Microns
4.	2500 Microns
5.	5000 Microns
6.	20,000 Microns
7.	Atmospheric Pressure
8.	Calibration Adjustment Screw
9.	Example: Meter needle shown at calibration position when Calibration Standard specifies 0.15 mm Hg.

Figure 202: Vacuum Gauge

Set Up and Test of Evacuation Equipment

NOTE: See the previous two pages for the following discussion.

1. Connect the evacuation system to a 110 Vac power supply. Connect a gauge manifold and refrigerant supply to the charging port above valve V-4. Turn the micron gauge On.
2. Close valves V-1, V-3 and V-4. Valve V-2 is open.
3. Turn the vacuum pump On.
4. Open valve V-1 to the pump. The micron gauge needle will move to the left. (See micron gauge scale diagram—previous page).

   NOTE: If the vacuum pump is okay, and there are no leaks between V-1 and V-3, the micron gauge should show less than 500 microns. If not, locate and correct the problem.
5. With the pump still operating, open valve V-3. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.
6. With the vacuum pump still operating, open valve V-4. The micron level will rise momentarily. If the micron reading does not return to a level of less than 500 microns, locate and correct the problem before continuing.
7. Evacuate hoses to 100 microns or lowest achievable level below 500 microns.
8. Once 100 microns is reached, close valve V-1 to the pump. Turn the vacuum pump Off.
9. Observe the micron gauge reading. The vacuum rise should not exceed 2000 microns in 5 minutes.
10. If the rise is above 2000 microns in 5 minutes, check all hoses and connections for leaks. Hoses with moisture present will require additional evacuation time to achieve satisfactory results.

    NOTE: Dirty vacuum pump oil or a defective vacuum pump will prevent a low micron reading. Hoses and fittings can be isolated individually to identify leaks.

Unit Evacuation

NOTE: Do not attempt to evacuate the unit until the evacuation equipment has been tested and its performance has been verified.

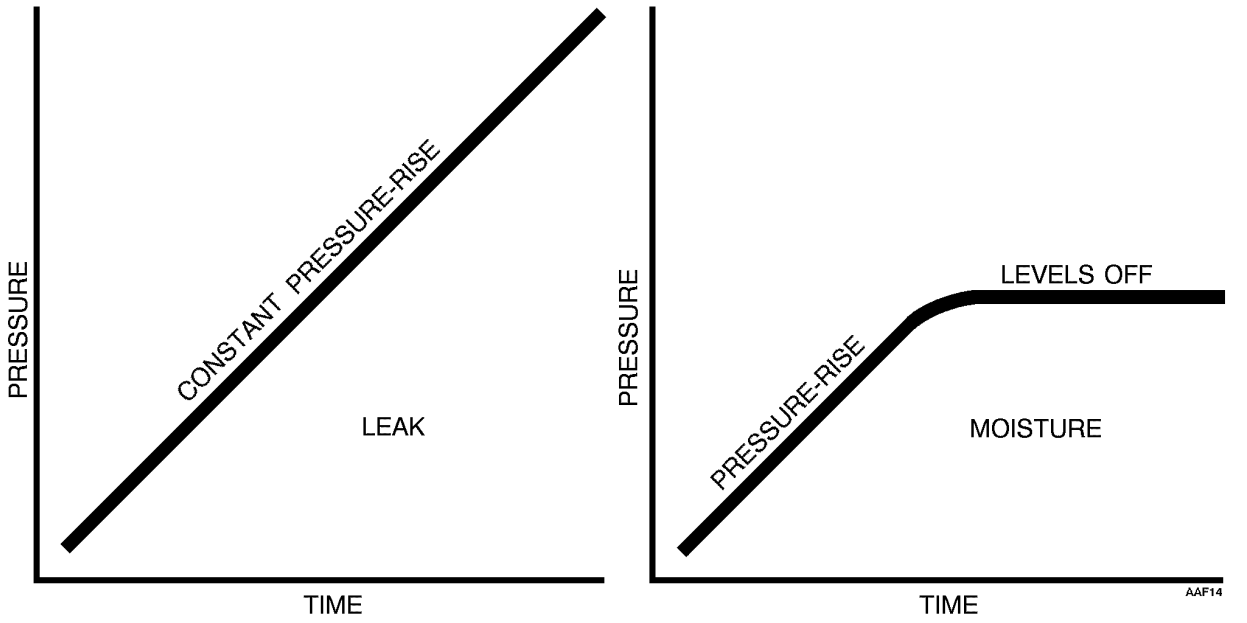
1. Prepare the unit for evacuation. Recover refrigerant to 0 psig (0 kPa).

   NOTE: Federal Regulations require your recovery machine to pull the system's pressures lower than 0 psig [0 kPa].

   CAUTION: Do not attempt to evacuate a unit until you are certain that the unit is leak free. A unit with less than a full refrigerant charge should be thoroughly leak checked and all leaks must be repaired.
2. Install the evacuation station hoses on the receiver tank outlet valve, suction service valve, and discharge service valve.
3. Mid-seat the receiver tank outlet valve, suction service valve, and discharge service valve and install the valve stem caps.
4. Connect a gauge manifold and refrigerant supply to the charging port above valve V-4. Bottle valve closed.
5. Start the vacuum pump and open valves V-1, V-2, V-3, V-4.
6. Evacuate the refrigeration system to 500 microns or the lowest achievable level between 500 and 1000 microns.

NOTE: The presence of refrigerant in the compressor oil may prevent a low micron reading from being achieved. The oil can continue to "outgas" for long periods of time. If the micron level appears to stall after 1/2 hour or 45 minutes between 1000 and 1500 microns, back seat the suction service valve and observe the micron gauge. A sharp drop in the micron reading (300 to 500 microns) would indicate that refrigerant is present in the oil or a leak exists in the compressor area. The micron gauge reads "ATM" if there is a leak to the atmosphere. See Figure 203 "Pressure Rise Graphs" below.

7. When the desired micron level has been achieved (500 to 1000 microns), close valve V-1, stop the pump.
8. Observe the reading on the micron gauge after 5 minutes have elapsed. The vacuum rise should not exceed 2000 microns.
   - If the vacuum level exceeds 2000 microns after 5 minutes, a leak is present or additional evacuation time is required. (See the Figure 203 "Pressure Rise Graphs" below.)
   - If the vacuum level is acceptable, proceed to unit charging.



Leak

Isolate the pump from the system by closing the proper valve. Watch the movement of the vacuum gauge needle. If the needle continues to rise, this is an indication that a leak exists in the unit or the connecting line. The leak must then be located and eliminated.

Moisture

Should the needle show a pressure rise but finally level off to practically a constant mark, this is an indication that the system is vacuum tight but is still too wet, requiring additional dehydration and pumping time.

Figure 203: Pressure Rise Graphs

Unit Charging

NOTE: Before charging, make sure that the refrigerant lines from the gauge manifold to the refrigerant supply bottle have been evacuated or purged.

1. Backseat the suction service valve and make sure the receiver tank outlet valve is still open.
2. Set the refrigerant supply bottle for liquid and open the gauge manifold hand valve. Add liquid refrigerant until the system has the recommended refrigerant charge (see unit serial number nameplate or the "Specifications" chapter), or until the system will take no more liquid. The remainder of the charge will be added as a liquid through the suction service valve if more refrigerant is required.
3. After the liquid refrigerant is added, close the gauge manifold hand valve.
4. Back seat (close) the receiver tank outlet valve, remove the evacuation station hoses, and install the cap on the service port for the receiver tank outlet valve.
5. If the unit is not fully charged, attach the gauge manifold set to the suction service valve and the discharge service valve. Open the suction service valve one turn and open the discharge service valve 1/4 turn.
6. Open the refrigerant supply valve for liquid.
7. Start the unit and use the Service Test mode to run the unit in high speed cool. See the appropriate Microprocessor Diagnostic Manual for information about the Service Test mode.
8. Observe the suction pressure and slowly open the gauge manifold hand valve to allow liquid refrigerant to flow into the suction service valve. Control the liquid flow so the suction pressure increases approximately 20 to 25 psig (138 to 172 kPa).
9. Add refrigerant until the system has the recommended refrigerant charge (see unit serial number nameplate or the "Specifications" chapter). Then close the gauge manifold hand valve and the refrigerant supply bottle hand valve.

Refrigerant Gauge Removal

1. Operate the unit in cool mode.
2. Backseat the discharge service valve.
3. Open both service manifold hand valves.
4. Front seat the suction service valve and pump down the compressor to a 20 in. Hg vacuum (-68 kPa).
5. Stop the unit.
6. Establish a compressor crankcase pressure between 1 and 3 psig (7 and 21 kPa).
7. Remove the gauge line from the suction service valve and cap the service port.
8. Remove the gauge line from the discharge service valve and cap the service port.
9. Back seat the suction service valve.
10. Install and tighten service valve stem caps.
11. Unit is ready for a functional check out.

Refrigerant Leaks

Use a reliable leak detector (e.g., electronic detector) 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.

Refrigerant Charge

Testing the Refrigerant Charge with an Empty Box (Controlled Check)

If the unit has an insufficient charge of refrigerant, the evaporator will be "starved" and the box temperature will rise even though the unit is operating. The suction pressure will drop as the refrigerant charge decreases. The charge may be determined by inspection of the refrigerant through the receiver tank sight glass with the following conditions established:

1. Close the truck box doors.
2. Install a gauge manifold.
3. Run the unit on high speed cool until the air in the box indicates 0 F (-18 C).

4. The discharge or head pressure gauge should read 290 to 310 psig (1999 to 2137 kPa).

   If the pressure is below this, it can be raised by covering a portion of the condenser coil with a piece of cardboard.

5. The suction pressure gauge should be indicating 12 to 20 psig (83 to 138 kPa) gauge pressure.

6. Under these conditions, the ball in the receiver tank sight glass should be floating. If there is no indication of refrigerant in the receiver tank sight glass, the unit is low on refrigerant.

Testing the Refrigerant Charge with a Loaded Box (Quick Check)

1. Install a gauge manifold (optional).

2. Run the unit on the Cool cycle.

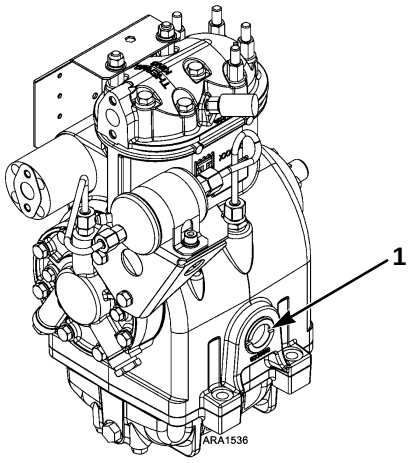
3. Cover at least three quarters of the condenser to drive any excess refrigerant from the condenser into the receiver tank. Do not cover the condenser for more than three minutes.

4. As the head pressure is rising, check the receiver tank sight glass. The ball should be floating. If there is no indication of refrigerant in the receiver tank sight glass, the unit may be low on refrigerant. Perform a Controlled Check.

   NOTE: If the ball floats, there is sufficient refrigerant in the unit for that load at that particular box temperature. This test does not determine if the unit contains a full charge of refrigerant.

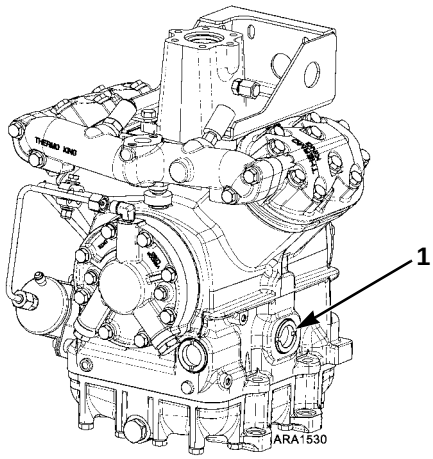
Checking Compressor Oil

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. The oil level in the compressor oil sight glass should be 1/4 to 3/4 full.



1.	Compressor Oil Sight Glass Location

Figure 204: Two-Cylinder Compressor



1.	Compressor Oil Sight Glass Location

Figure 205: Four-Cylinder Compressor

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

Install a gauge manifold.

Operate the unit on high speed cool with a 10 psig (69 kPa) minimum suction pressure and 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 3/4 up in the sight glass.

CAUTION: Oil is under pressure. See instructions for adding oil.

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 3/4 up in the sight glass.

If the evaporator temperature is above 32 F (0 C), it will be necessary to force defrost. To force defrost, use the relay board test.

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. R-404A systems use a special Ester oil (P/N 203-513).

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.

Refrigeration System Checks

1. Attach a gauge manifold to the suction service valve and the discharge service valve.
2. Check the system pressures and the refrigerant flow in heat and cool. The suction and discharge pressures should be within the normal ranges for a standard unit. Check the temperatures of the refrigeration lines by hand to check the refrigerant flow. See the individual test for a component if you suspect it is not functioning properly.
3. Run the unit in high speed cool until the system pressures stabilize.
4. Cover the condenser to raise the discharge pressure to 300 to 350 psig (2068 to 2413 kPa).

   NOTE: It may be necessary to remove the upper grille insert to cover the condenser.
5. Keep the condenser covered and pump down the low side by front seating the receiver tank outlet valve. When the low side pumps down to a 10 in. Hg vacuum (-34 kPa), check the discharge pressure. It should be 200 to 250 psig (1379 to 1724 kPa) or higher. The compressor is probably faulty if the discharge pressure is below 200 psig (1379 kPa).

   NOTE: If the low side will not pump down into a vacuum, the hot gas solenoid, the purge valve, or the receiver tank pressure check valve may be stuck open. See the individual component tests for more information.
6. Continue pumping down the low side until it reaches a 25 in. Hg vacuum (-85 kPa), then turn the unit Off.
7. The low side pressure should remain below a 15 in. Hg vacuum (-51 kPa) for 2 minutes or more.
   - If the low side pressure rises to 0 psig (0 kPa) and stops, there is probably a leak to the atmosphere. Check the low side for leaks.
   - If the low side pressure rises above 0 psig (0 kPa) and continues to rise (until it eventually equalizes with the high side pressure), there is probably a leak from the high side to the low side through one (or more) of the following components: hot gas solenoid, purge valve, receiver tank pressure check valve, or the discharge valve plates in the compressor. Check the temperatures of the refrigeration lines on each side of these components by hand. There is often a temperature difference between the two sides of a leaking component. See the individual component tests for more information.
8. Back seat the receiver tank outlet valve. Perform a “Refrigerant Gauge Removal” procedure.

Low Side Pump Down

NOTE: Operate the unit in cool for 10 minutes before performing the low side pump down.

1. Attach a gauge manifold to the suction service valve and the discharge service valve.
2. Operate the unit in high speed cool.

3. Front seat the receiver tank outlet valve and allow the low side to pump down to a 15 in. Hg vacuum (-51 kPa).
4. Turn the unit Off.
5. Prepare to perform service on the low side by raising the low side pressure through the gauge manifold to 1 to 2 psig (7 to 14 kPa).
6. Back seat the receiver tank outlet valve. Perform a “Refrigerant Gauge Removal” procedure.

R404A

These units use R404A. This refrigerant is classified as a Hydro-fluorocarbon (HFC) because it contains hydrogen fluorine and carbon. It does not contain chlorine.

Unit Identification

Units charged with R404A are identified by the following methods:

1. R404A will be stamped on the unit’s serial plate.
2. Decals will be applied to unit as shown below:

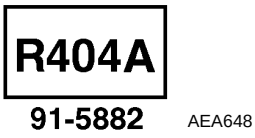


Figure 206: R404A Decal

Availability

R404A is available from wholesalers. The price will depend upon the quantity purchased. Thirty (30), 50 and 125 containers are available.

Leak Detection

Leaks can be detected by an electronic leak detector such as the G.E. H10G or a portable leak detector (see Tool Catalog). See Truck and Trailer Service Bulletin T&T 048 for additional details.

Compressor Oil

Thermo King Corporation has chosen to use a compressor oil called Polyol Ester (POE)—also called ester based oil. POE oil is compatible with R404A and can be used in low temperature applications. This oil is available from service parts (P/N 203-513).

Compressors Shipped with POE Oil

Thermo King compressors are charged with Polyol Ester oil (POE). All gauge fittings are 1/4 inch fittings.

CAUTION: POLYOL ESTER (POE) IS THE ONLY OIL FOR USE WITH THERMO KING UNITS USING R404A. IT SHOULD NOT BE MIXED WITH ANY OTHER TYPE.

Because Polyol Ester has an affinity for moisture, it must be kept in capped containers. In addition, it should be added as the last step in system repair. Rubber gloves are recommended when handling Polyol Ester because it may cause skin irritation.

Equipment Recommendations For Use With R404A

Dedicated Equipment

CAUTION: Equipment that has been used with other refrigerants MUST NOT be used with R404A refrigerants. Mixing R404A with other refrigerants will cause contamination of the refrigerant. Using contaminated refrigerant will cause system failure.

Vacuum Pumps

When evacuating, a two stage, five to seven CFM pump is recommended. It is also recommended that dry nitrogen be used first. Ideally, a new vacuum pump should be used and dedicated for use with R404A systems because residual refrigerants may remain in used vacuum pumps.

Pumps used with other Thermo King refrigerants may be used but extreme care should be taken to prevent contamination of R404A systems with other refrigerants.

The Thermo King Evacuation Station is recommended. This station is available from service parts (see Tool Catalog). See Truck and Trailer Service Bulletin T&T 061 for additional details.

Use only recommended vacuum pump oils and change oil after every major evacuation. Vacuum pump oils are highly refined and the use of contaminated oils will prevent the desired vacuum from being obtained. Failure to follow these recommendations may result in conditions that will destroy the vacuum pump.

Gauge Manifold Sets

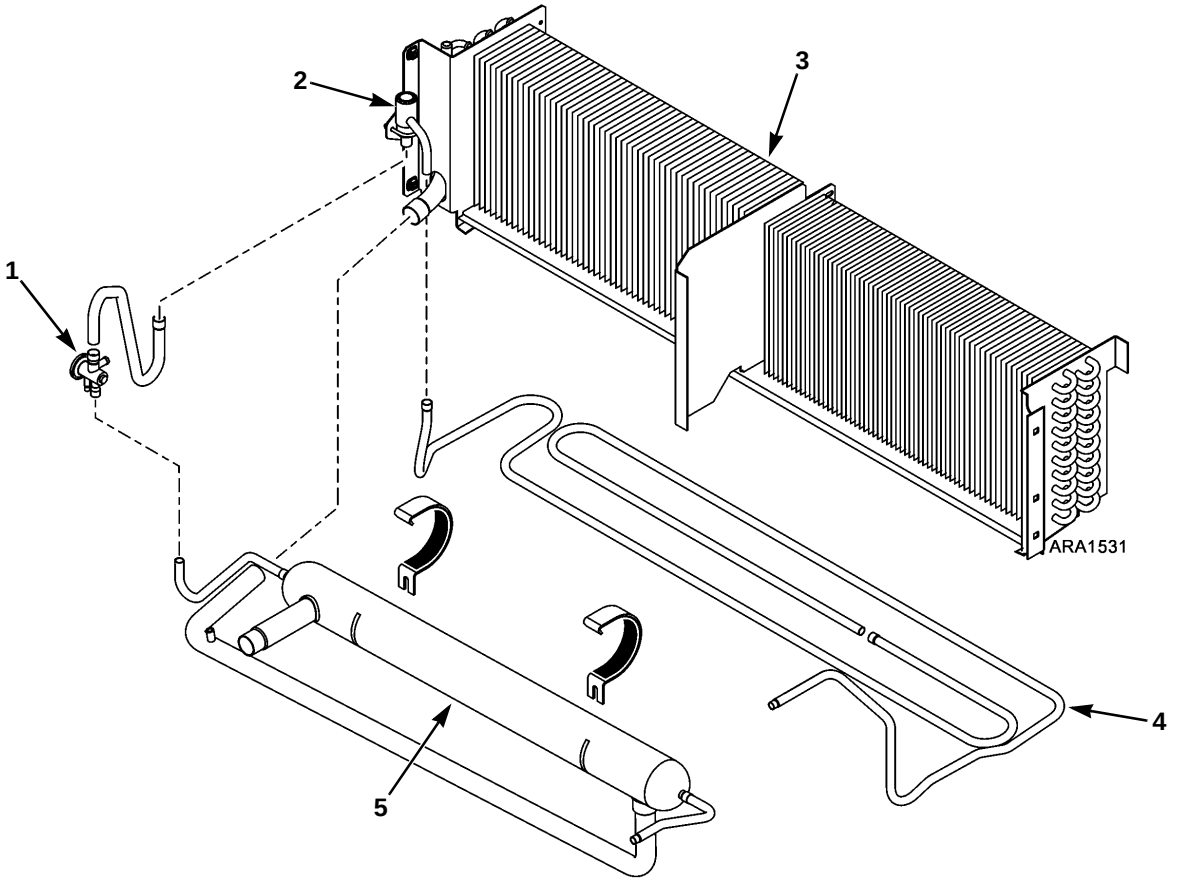
Gauge manifold sets that show the correct pressure-temperature relationship should be used. Gauge manifolds and manifold hoses used with other Thermo King refrigerants maybe used but extreme care should be taken to prevent contamination of the R404A systems with other refrigerants. Purge manifold and hoses with dry nitrogen before using. *Never use equipment that may be contaminated with automotive type Polyalkylene Glycol (PAG) oils.*

Refrigerant Recovery

Systems used for the recovery of R404A should be dedicated to the recovery of this refrigerant. Consult the manufacturer of your recovery equipment for details.

Refrigeration System Component Locations

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



1.	Expansion Valve	4.	Drain Pan Heater
2.	Distributor	5.	Heat Exchanger
3.	Evaporator Coil		

Figure 207: Evaporator Refrigeration Component Locations

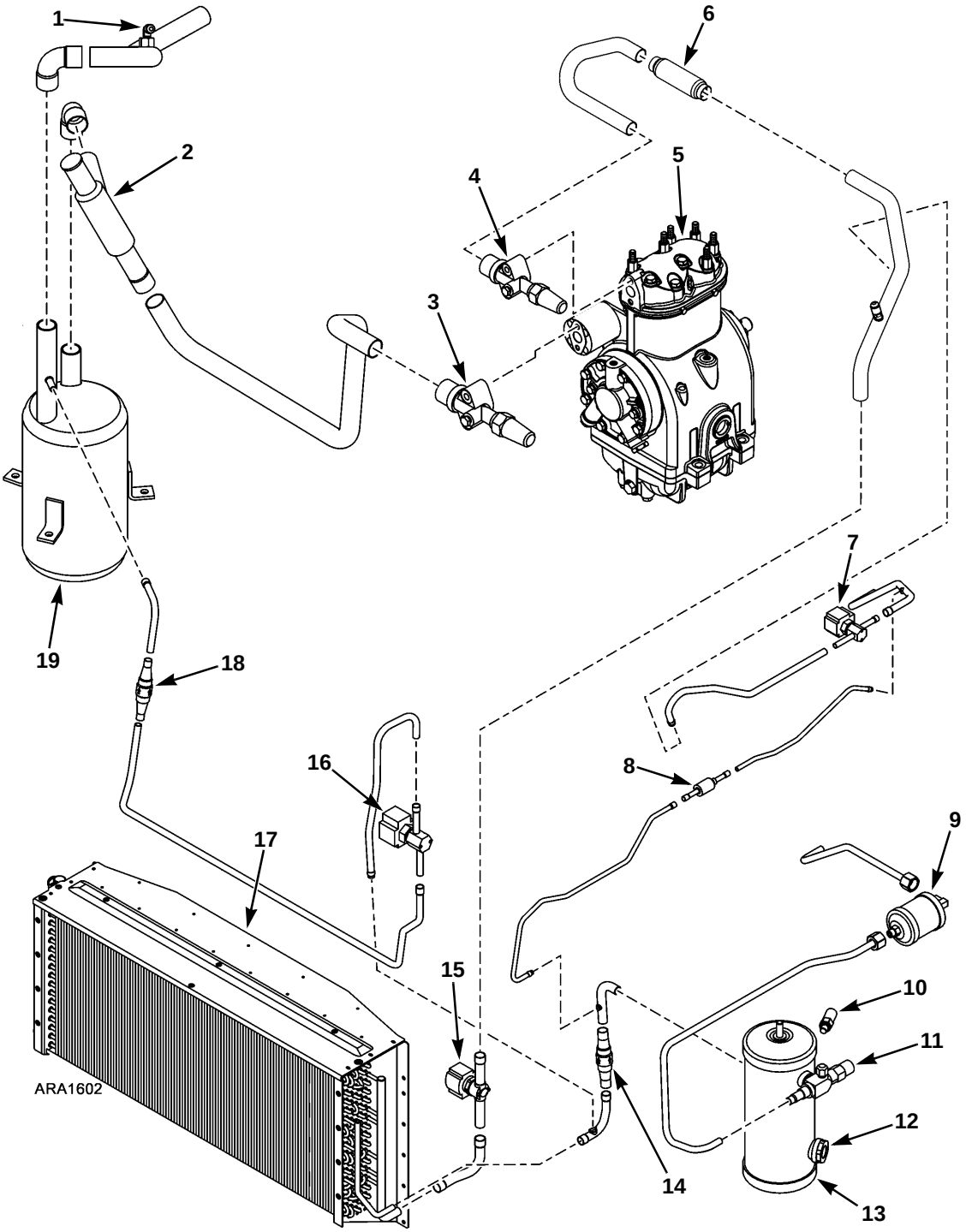


Figure 208: Condenser Refrigeration Component Locations in Units with Tube and Fin Condenser Coils (Ending 06/12) (Two-Cylinder Compressor Shown, Similar with Four-Cylinder Compressor)

1.	Suction Access Port	11.	Receiver Tank Outlet Valve
2.	Suction Pressure Regulator (SPR)	12.	Receiver Tank Sight Glass
3.	Suction Service Valve	13.	Receiver Tank
4.	Discharge Service Valve	14.	Condenser Check Valve
5.	Compressor	15.	Condenser Inlet Solenoid (CIS)
6.	Discharge Strainer	16.	Purge Valve (PV)
7.	Hot Gas Solenoid (HGS)	17.	Condenser/Radiator Coil
8.	Receiver Tank Pressure Check Valve	18.	Purge Check Valve
9.	Dehydrator (Filter-Drier)	19.	Accumulator
10.	High Pressure Relief Valve		

Components for “Condenser Refrigeration Component Locations in Units with Tube and Fin Condenser Coils (Ending 06/12) (Two-Cylinder Compressor Shown, Similar with Four-Cylinder Compressor)” on page 124

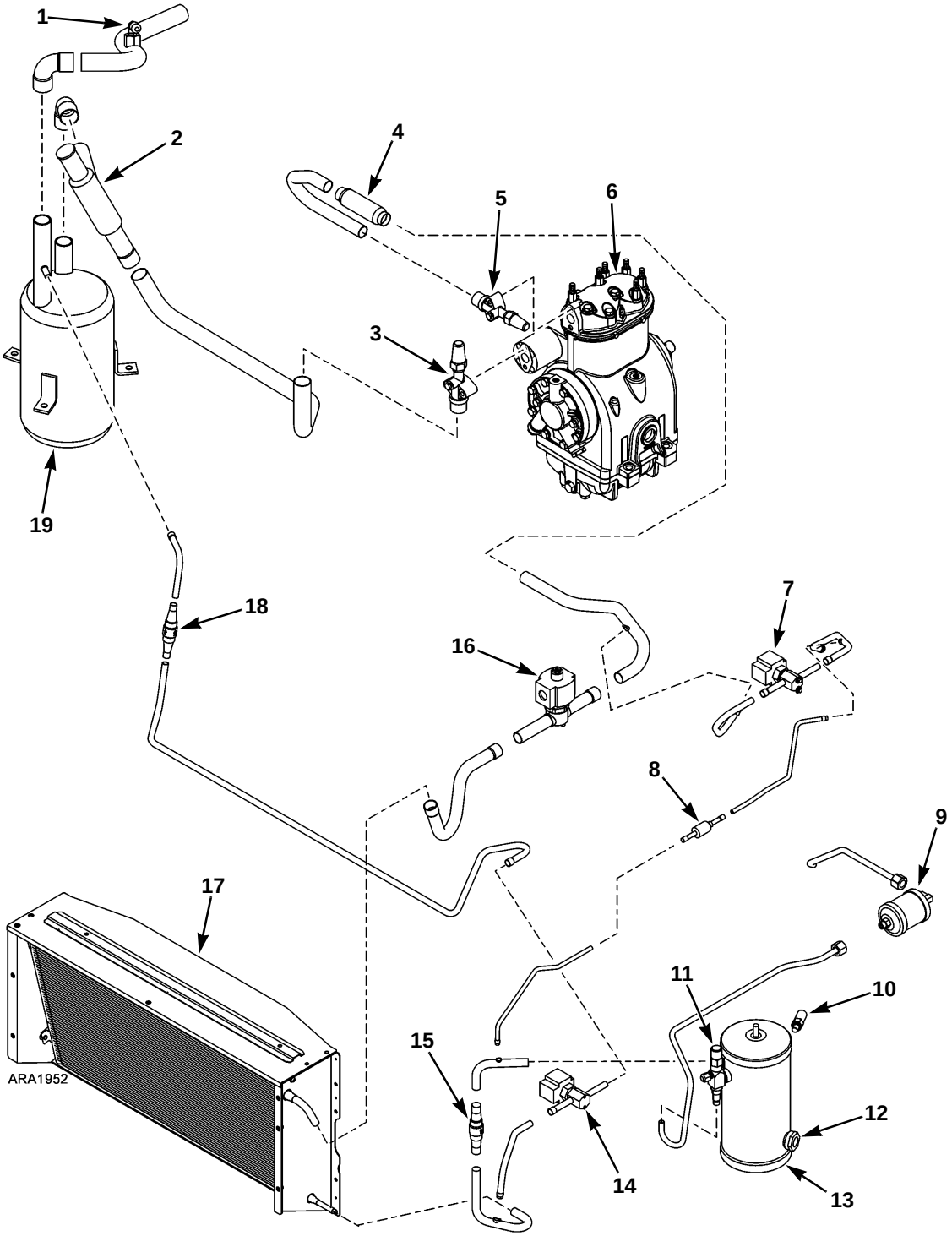


Figure 209: Condenser Refrigeration Component Locations in Units with Micro-Channel Condenser Coils (Starting 06/12) (Two-Cylinder Compressor Shown, Similar with Four-Cylinder Compressor)

1.	Suction Access Port	11.	Receiver Tank Outlet Valve
2.	Suction Pressure Regulator (SPR)	12.	Receiver Tank Sight Glass
3.	Suction Service Valve	13.	Receiver Tank
4.	Discharge Strainer	14.	Purge Valve (PV)
5.	Discharge Service Valve	15.	Condenser Check Valve
6.	Compressor	16.	Condenser Inlet Solenoid (CIS)
7.	Hot Gas Solenoid (HGS)	17.	Condenser/Radiator Coil
8.	Receiver Tank Pressure Check Valve	18.	Purge Check Valve
9.	Dehydrator (Filter-Drier)	19.	Accumulator
10.	High Pressure Relief Valve		

Components for “Condenser Refrigeration Component Locations in Units with Micro-Channel Condenser Coils (Starting 06/12) (Two-Cylinder Compressor Shown, Similar with Four-Cylinder Compressor)” on page 126

Accumulator Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Unsolder the inlet and outlet refrigerant suction lines from the accumulator tank. Make sure to use a heat sink on the SPR.
3. Unsolder the refrigerant line coming from the purge check valve.
4. Unbolt and remove the accumulator from the unit.

Installation

1. Place the accumulator in the unit and tighten the mounting bolts.
2. Reconnect (solder) the refrigerant line coming from the purge check valve.
3. Solder the inlet and outlet suction lines to the accumulator tank. Make sure to use a heat sink on the SPR.
4. Pressurize the low side and check for leaks.
5. If no leaks are found, replace the liquid line drier then evacuate the low side.
6. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil. Add as required.

Compressor Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve.
2. Run the unit in high speed cool until the system pressures stabilize.
3. Cover the condenser to raise the discharge pressure to 300 to 350 psig (2068 to 2413 kPa).
4. Keep the condenser covered and pump down the low side by front seating the receiver tank outlet valve. When the low side pumps down to a 10 in. Hg vacuum (-34 kPa), check the discharge pressure. It should be 200 to 250 psig (1379 to 1724 kPa) or higher. The compressor is probably faulty if the discharge pressure is below 200 psig (1379 kPa).

   NOTE: If the low side will not pump down into a vacuum, the hot gas solenoid, or the receiver tank pressure check valve may be stuck open. See the individual component tests for more information.

Compressor Replacement

Removal

1. Perform a “Low Side Pump Down” to prepare unit to perform service.
2. Front seat the discharge and suction service valves.

3. Open both service manifold hand valves to bleed the pressure in the head, or heads and discharge manifold, into the compressor crankcase.
4. Loosen and remove the electric motor (jackshaft)/compressor belt from the compressor pulley.
5. Disconnect the high pressure cutout switch wires.
6. Unbolt the discharge and suction valves from the compressor.
7. Unsolder and remove the discharge and suction lines where necessary to allow clearance for removing the compressor.
8. Remove the compressor/frame bracket and the compressor mounting bolts.
9. Lift the compressor out 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.

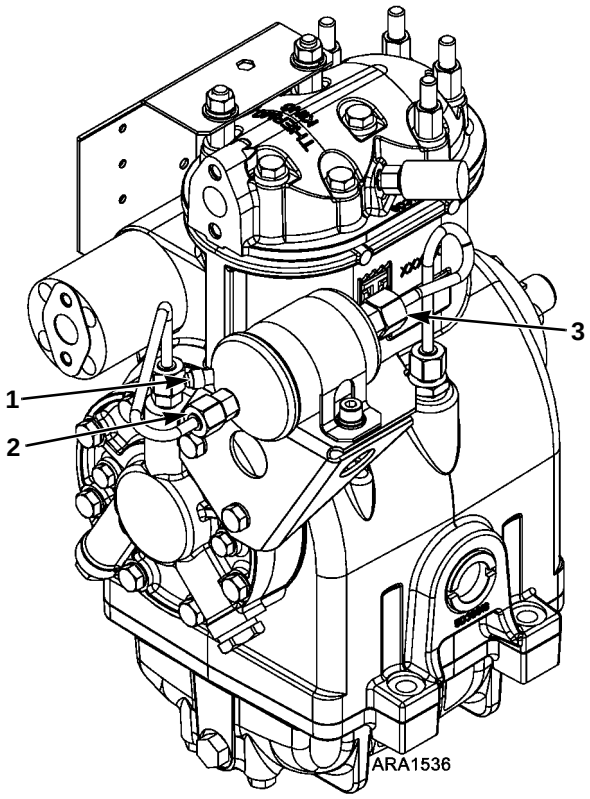
Installation

1. Lift the compressor into the unit and install the mounting bolts and the compressor/frame bracket.
2. Install the discharge and suction lines and attach the discharge and suction service valves to the compressor using new gaskets soaked in refrigeration oil.
3. Reconnect (solder) the discharge and suction lines.
4. Reconnect the high pressure cutout switch wires.
5. Pressurize the compressor and test for refrigerant leaks.
6. If no leaks are found, replace the liquid line drier then evacuate the low side.
7. Replace the compressor/electric motor belt and adjust the tension.
8. Back seat the receiver tank outlet valve. Mid seat the discharge and suction service valves.
9. Operate the unit at least 30 minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.
10. Check the refrigerant charge and add refrigerant if needed.
11. Perform a “Refrigerant Gauge Removal” procedure.

Compressor Oil Filter

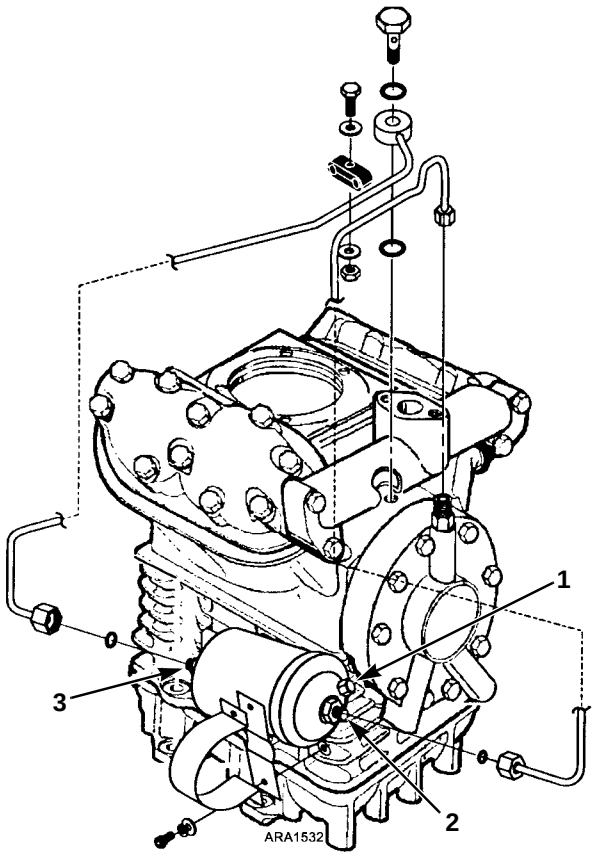
This unit is equipped with a compressor bypass oil filter. The compressor oil filter should be changed when the drier is replaced.

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 210: Compressor Oil Filter (Two-Cylinder Compressor)



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

Figure 211: Compressor Oil Filter (Four-Cylinder Compressor)

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.
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 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 after the electronic throttling valve (ETV) or suction pressure regulator (SPR). This is measured at the suction service valve. Use the following procedure to check the compressor oil pressure.

1. Attach a gauge manifold to the suction service valve and discharge service valve.
2. Attach a suitable oil pressure gauge to the oil pressure access port on the compressor oil filter.
3. Start the unit and note the pressure at the oil pressure access port and the suction pressure at the suction service valve.
4. Subtract the suction pressure from the pressure at the oil pressure access port to get the net oil pressure.

   Pressure at Oil Pressure Access Port
   – Suction Pressure
   = Net Oil Pressure

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

Priming New Compressor Installations

Thermo King remanufactured compressors have had a special break in process to assure that the oil pump is primed, functioning, and broken in. The following procedure is recommended, but not required for factory-remanufactured compressors.

This procedure must be followed to prevent premature pump failure in any compressor that has had an oil pump installed, especially a compressor that has been stored for any length of time. After installing the compressor use the following procedure.

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 suction service. This allows you to monitor the suction pressure in the compressor after the electronic throttling valve (ETV) or suction pressure regulator (SPR).
3. Disconnect the wires to the fuel solenoid.

   NOTE: The microprocessor will probably record some alarm codes because the fuel solenoid is disconnected and the engine does not start. Clear these alarm codes as necessary.

4. Turn the unit on and let the engine crank. Do not crank the engine for more than 30 seconds.
   a. Note the pressure at the oil pressure access port and the suction service valve while the engine is cranking. Subtract the suction pressure from the pressure at the oil pressure access port to get the net oil pressure.
   b. If the compressor does not develop at least 10 psi (96 kPa) of net oil pressure in the first 30 seconds, allow the starter to cool for a few minutes and the crank the engine again for 30 seconds. If 10 psi (96 kPa) of net oil pressure still does not develop, first check the compressor oil level, then check the compressor oil pump and relief valve.

5. As soon as the compressor develops 10 psi (96 kPa) of net oil pressure, re-connected the fuel solenoid wires.
6. Start unit and run the engine on low speed for at least five minutes. If the net oil pressure is above 20 psi (138 kPa) for this period, stop the unit.
7. Run the engine on high speed for at least five more minutes. The compressor oil pump is now primed and broken in.

Condenser Check Valve and Purge Check Valve Test

The condenser check valve and the purge check valve prevent refrigerant from moving into the condenser when the unit is in heat. A unit with a leaking condenser check valve or purge check valve will have good heating capacity when it first goes into the heat mode. But, it will gradually lose heating capacity as refrigerant moves into the condenser. This problem is more noticeable at lower ambient temperatures. Use the following procedure to test the condenser check valve and the purge check valve.

1. Attach a gauge manifold to the suction service valve and the discharge service valve. Attach another low pressure gauge to the suction access port located in the suction line near the accumulator inlet. Attach a high pressure gauge to the service port on the receiver tank outlet valve. A low loss fitting must be used on the hose connected to the suction access port.
2. Operate the unit in low speed cool until the system pressures stabilize.
3. Front seat the receiver tank outlet valve and allow the low side to pump down to 0 to 5 in. Hg vacuum (0 to -17 kPa).
4. Turn the unit Off.
5. Front seat the suction service valve to isolate the low side while it is still in a vacuum.
6. Watch the low pressure gauge attached to the suction access port. The low side pressure should not rise. If it does, there could be a leak through one (or more) of following components: hot gas solenoid, purge valve, or receiver tank pressure check valve.
7. Use the Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
8. From the Interface Board Test Mode select Purge Valve.
9. Energize the purge valve with the Interface Board Test Mode. The discharge pressure and the low side pressure should equalize when the purge valve is energized.
10. De-energize the purge valve with the Interface Board Test Mode when the discharge pressure and the low side pressure have equalized.
11. Watch the gauges attached to the discharge service valve and the receiver tank. The discharge pressure should not rise and the receiver tank pressure should not fall. If the discharge pressure rises, the condenser check valve is probably leaking.
12. Energize the purge valve with the Interface Board Test Mode and leave it energized.
13. Crack the receiver tank outlet valve open and allow refrigerant into the low side until the low side pressure is above the discharge pressure, but below the receiver tank pressure. Close the receiver tank outlet valve when the low side pressure is above the discharge pressure and below the receiver tank pressure.
14. Watch the gauge attached to the discharge service valve. The discharge pressure should not rise. If the discharge pressure rises, the purge check valve is probably leaking.
15. De-energize the purge valve with the Interface Board Test Mode.
16. Back seat the receiver tank outlet valve and suction service valve. Perform a “Refrigerant Gauge Removal” procedure.

Condenser Inlet Solenoid (CIS) Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve. Attach another low pressure gauge to the suction access port located in the suction line near the accumulator inlet. A low loss fitting must be used on the hose connected to the suction access port.
2. Operate the unit in low speed cool.
3. Front seat the receiver tank outlet valve and allow the low side to pump down to 0 to 5 in. Hg vacuum (0 to -17 kPa).
4. Turn the unit Off.
5. Front seat the suction service valve to isolate the low side while it is still in a vacuum.
6. Watch the low pressure gauge attached to the suction access port. The low side pressure should not rise. If it does, there could be a leak through one (or more) of following components: hot gas solenoid, purge valve, or the receiver tank pressure check valve.
7. Use the Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
8. From the Interface Board Test Mode select Condenser Inlet Solenoid.
9. Energize the CIS with the Interface Board Test Mode.
10. Open the receiver tank outlet valve.
11. Watch the high side gauge attached to the discharge service valve. The high side pressure should not drop. If it does, the CIS is not closing. Check the continuity of the wiring and the solenoid coil before assuming the solenoid is faulty.
12. Back seat the suction service valve and perform a “Refrigerant Gauge Removal” procedure.

If the CIS is stuck closed, the unit will stop very quickly after is starts to run and will record Alarm Code 10 (High Discharge Pressure). Use the following procedure to check for a CIS that is stuck closed:

1. Connect a high pressure gauge to the discharge service valve to monitor the discharge pressure.
2. Start the unit in low speed cool while watching the discharge pressure.
   - If the unit stops before the discharge pressure rises to the HPCO opening pressure (see “Specifications”), it is probably a faulty HPCO.
   - If the discharge pressure quickly rises to the HPCO opening pressure (see “Specifications”) before stopping, it is probably a a plugged discharge strainer or the CIS is stuck closed. Go to the next step.
3. Start the unit in low speed heat while watching the discharge pressure.
   - If the discharge pressure quickly rises to the HPCO opening pressure (see “Specifications”) before stopping, it is probably a a plugged discharge strainer.
   - If the discharge pressure does not rise to the HPCO opening pressure (see “Specifications”) and stop the unit, the CIS is probably stuck closed. Check the wiring to the CIS for a short circuit that is energizing the solenoid coil before assuming the solenoid is faulty.

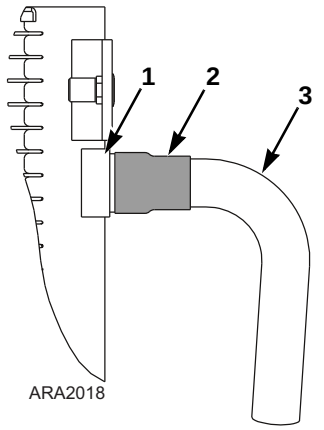
Condenser/Radiator Coil Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the top cap/grille assembly.
3. Drain the engine coolant and disconnect the coolant hoses from the condenser/radiator coil.

4. Unsolder the hot gas inlet and liquid outlet refrigerant line connections. On units with micro-channel coils make sure to use a heat sink on the copper stub tubes.

   IMPORTANT: Micro-channel condenser/radiator coils are used in these units starting in June 2012. Micro-channel coils are made 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 attach the copper stub tubes to the aluminum micro-channel coil. The heat shrink tubing is used to prevent corrosion between the copper and aluminum.



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 212: Micro-Channel Condenser Coil Inlet Connection (Outlet Connection Similar)

5. Unbolt and remove the condenser/radiator coil.

Installation

1. Clean the tubes for soldering.
2. Place the coil in the unit and install the mounting hardware.
3. Solder the hot gas inlet and liquid outlet refrigerant line connections. On units with micro-channel coils make sure to use a heat sink on the copper stub tubes.

   IMPORTANT: Micro-channel condenser/radiator coils are used in these units starting in June 2012. Micro-channel coils are made 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 attach 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 system and test for refrigerant leaks.
5. If no leaks are found, replace the liquid line drier then evacuate the system.
6. Connect the coolant hoses to the radiator and refill the engine cooling system with the 50/50 antifreeze/water solution.
7. Recharge the unit with the proper refrigerant and check the compressor oil.
8. Reinstall the top cap/grille.
9. Bleed the cooling system.

Dehydrator (Filter-Drier) Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive. Make sure to front seat the suction service valve to isolate the low side and use the suction access port to access the low side.
2. Disconnect the nuts at the end 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 check for leaks.
5. If no leaks are found, evacuate the low side.
6. Open the refrigeration valves and place the unit in operation.

Discharge Strainer Test

If the discharge strainer is plugged or restricted, the unit will stop very quickly after is starts to run and will record Alarm Code 10 (High Discharge Pressure). This can also be caused by a faulty HPCO. It can be difficult to determine whether the discharge strainer of the HPCO is causing this problem. See the following procedure and guidelines.

1. Connect a high pressure gauge to the discharge service valve to monitor the discharge pressure.
2. Start the unit while watching the discharge pressure.
   - If the discharge pressure quickly rises to the HPCO opening pressure (see “Specifications”) before the unit stops, it is more likely to be a plugged discharge strainer.
   - If the unit stops before the discharge pressure rises to the HPCO opening pressure (see “Specifications”), it is more likely to be a faulty HPCO.

Because the refrigerant charge must be recovered to replace the discharge strainer, it is best to replace the HPCO and retest the unit if you are not sure which is causing the problem.

NOTE: If the discharge strainer is plugged it is important to determine and repair the cause of the debris.

Discharge Strainer Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the discharge strainer mounting clamp.
3. Unsolder the refrigeration lines from the discharge strainer and remove the discharge strainer from the unit.

Installation

1. Clean the tubes for soldering.
2. Place the discharge strainer in position.
3. Solder the inlet and outlet connections.
4. Install the discharge strainer mounting clamp.
5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, replace the liquid line drier then evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Evaporator Coil Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator top panel.
3. Unsolder the hot gas line and the line to the expansion valve from the distributor.
4. Unsolder the suction line from the evaporator coil.
5. Remove the mounting bolts and slide the coil from the evaporator housing.

Installation

1. Place the evaporator coil in the housing.
2. Install and tighten the mounting bolts.
3. Clean the tubes for soldering.
4. Solder the suction line to the evaporator coil.
5. Solder the hot gas line and the line from the expansion valve to the distributor.
6. Pressurize the system and check for leaks.
7. If no leaks are found, replace the liquid line drier then evacuate and dehydrate the system.
8. Install the evaporator top panel.

9. Recharge the unit with refrigerant and check the compressor oil.

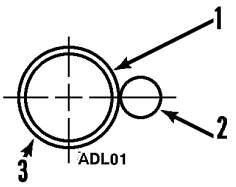
Expansion Valve Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive. Make sure to front seat the suction service valve to isolate the low side and use the suction access port to access the low side.
2. Remove the feeler bulb from the suction line clamp. Note the position of the feeler bulb on the suction line.
3. Unsolder the equalizer line from the expansion valve.
4. Unsolder the inlet liquid line and the line to the distributor from the expansion valve.
5. Remove the expansion valve mounting bolt and remove the expansion valve from the unit.

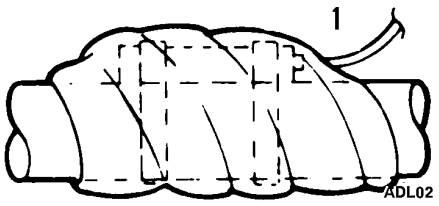
Installation

1. Install and bolt the expansion valve assembly in the unit.
2. Solder (95-5 Solder) the inlet liquid line and the distributor to the expansion valve.
3. Solder (95-5 Solder) the equalizer line to the expansion valve.
4. 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 the operation will be faulty. Wrap with insulating tape.



1.	Suction Line
2.	Capillary Bulb
3.	End View

Figure 213: Location of Expansion Valve Bulb



1.	Top View

Figure 214: Completely Wrap Bulb with Tape

5. Pressurize the low side and check for leaks.
6. If no leaks are found, replace the liquid line drier then evacuate the low side.
7. Open the refrigeration valves and place the unit in operation.
8. Test the unit to see that the expansion valve is properly installed.

Heat Exchanger Replacement

NOTE: It unlikely that the heat exchanger is defective. Carefully review your refrigeration system diagnosis to eliminate all other system components before proceeding. This replacement procedure should only be attempted by qualified technicians.

Removal

1. Recover the refrigerant charge.
2. Remove the evaporator top panel.
3. Remove the mounting hardware that holds the heat exchanger on the bulkhead.
4. Unsolder the equalizer line from the suction line.

5. Unsolder the liquid line to 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 from the condenser side of the bulkhead. Remove putty from around the lines before unsoldering the connections.
9. Lift the heat exchanger assembly out of the evaporator housing.

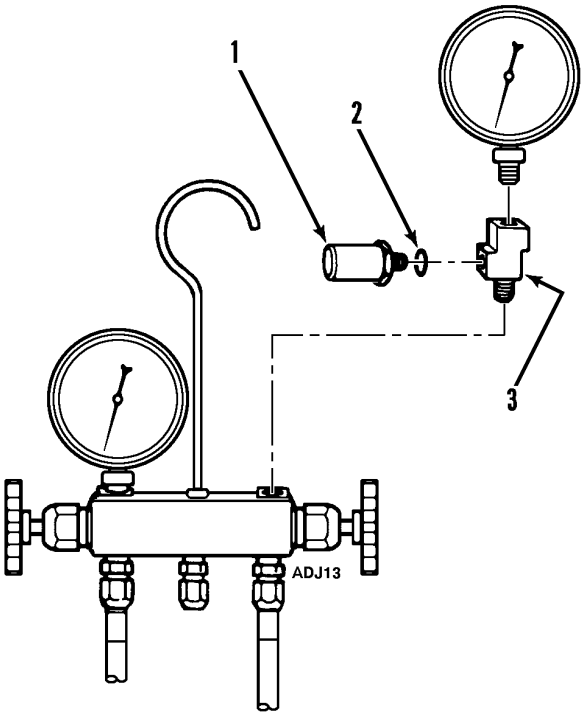
Installation

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 suction outlet line connections on the condenser side of the bulkhead. Seal openings through bulkhead with putty when the refrigerant lines have cooled off.
4. Tighten the heat exchanger mounting hardware securely.
5. Solder suction line connection to the evaporator coil.
6. Solder the liquid line to the expansion valve.
7. Solder the equalizer line to the suction line.
8. Pressurize the system and check for leaks.
9. If no leaks are found, replace the liquid line drier then evacuate and dehydrate the system.
10. Clean the suction tube to a bright polished condition. Install the feeler bulb clamps and feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Wrap with insulating tape.
11. Install the evaporator top panel.
12. Recharge the unit with refrigerant and check the compressor oil.

High Pressure Cutout Switch (HPCO) Test

The HPCO is located on the compressor discharge manifold. If the discharge pressure rises above 470 ± 7 psig (3241 ± 48 kPa), the switch opens the HPCO circuit to the run relay and stops the unit. To test the switch, rework a gauge manifold per the following illustration.

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



1.	Relief Valve
2.	O-ring
3.	Adapter Tee Weather Head

Figure 215: High Pressure Cutout Manifold

2. Set the thermostat well below the box temperature so that the unit will be in High Speed Cool.
3. Raise the discharge pressure of the compressor by blocking the condenser coil air flow by covering the condenser with a piece of cardboard.

NOTE: The discharge pressure should never be allowed to exceed a pressure of 477 psig (3289 kPa) on R-404A systems.

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

High Pressure Cutout Switch (HPCO) Replacement

Removal

1. Pump down the low side to a 20 in. Hg vacuum (-68 kPa) then stop the unit.
2. Front seat the discharge and suction service valves.
3. Open both service manifold hand valves to bleed the pressure in head, or heads and discharge manifold, into the compressor crankcase. If the pressure balances in a vacuum, raise the pressure to 1 to 3 psig (7 to 21 kPa) by cracking the discharge service valve.
4. Disconnect the wires and remove the HPCO from the compressor head or discharge manifold.

Installation

1. Apply a refrigerant Loctite to the threads of the HPCO.
2. Install and tighten the HPCO and reconnect the wires.
3. Pressurize the compressor and test for leaks.
4. If no leaks are found, back seat the refrigeration service valves and place the unit in operation. Check the refrigerant charge.
5. Perform a “Refrigerant Gauge Removal” procedure.

High Pressure Relief Valve Replacement

NOTE: Determine the cause of extremely high discharge pressure before replacing the High Pressure Relief Valve.

Removal

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

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 system and test for leaks.
4. If no leaks are found, replace the liquid line drier then evacuate the system.
5. Recharge the unit with refrigerant and check the compressor oil.
6. Verify proper unit operation.

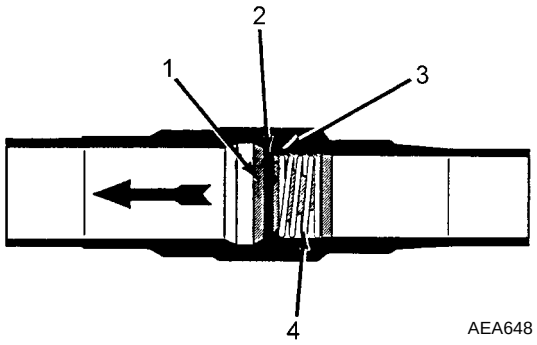
Hot Gas Solenoid (HGS) Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve. Attach another low pressure gauge to the suction access port located in the suction line near the accumulator inlet. A low loss fitting must be used on the hose connected to the suction access port.
2. Operate the unit in low speed cool.
3. Front seat the receiver tank outlet valve and allow the low side to pump down to 0 to 5 in. Hg vacuum (0 to -17 kPa).
4. Turn the unit Off.
5. Front seat the suction service valve to isolate the low side while it is still in a vacuum.
6. Watch the low pressure gauge attached to the suction access port. The low side pressure should not rise. If it does, there could be a leak through one (or more) of following components: hot gas solenoid, purge valve, or the receiver tank pressure check valve.
7. Check the temperatures of the refrigeration lines on each side of the HGS by hand. A temperature difference between the two sides of the HGS indicates it is leaking.

8. Use the Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
9. From the Interface Board Test Mode select Hot Gas Solenoid.
10. Momentarily (for approximately 1 second) energize the HGS with the Interface Board Test Mode. The low side pressure should rise slightly. If the low side pressure does not rise, the HGS is not opening. Check the continuity of the wiring and the solenoid coil before assuming the solenoid is faulty.
11. Back seat the receiver tank outlet valve and the suction service valve. Perform a "Refrigerant Gauge Removal" procedure.

In-Line Check Valve Replacement

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



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

Figure 216: Cross Section of In-line Check Valve

Removal

1. Recover the refrigerant charge.
2. Place a heat sink on the check valve.
3. Unsolder the refrigeration 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, replace the liquid line drier then evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Purge Valve (PV) Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve. Attach another low pressure gauge to the suction access port located in the suction line near the accumulator inlet. A low loss fitting must be used on the hose connected to the suction access port.
2. Operate the unit in low speed cool.
3. Front seat the receiver tank outlet valve and allow the low side to pump down to 0 to 5 in. Hg vacuum (0 to -17 kPa).
4. Turn the unit Off.
5. Front seat the suction service valve to isolate the low side while it is still in a vacuum.
6. Watch the low pressure gauge attached to the suction access port. The low side pressure should not rise. It it does, there could be a leak through one (or more) of following components: hot gas solenoid, purge valve, or receiver tank pressure check valve.
7. Check the temperatures of the refrigeration lines on each side of the PV by hand. A temperature difference between the two sides of the PV indicates it is leaking.

8. Use the Mechanics/Premium HMI Control Panel to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for specific information about the Interface Board Test Mode.
9. From the Interface Board Test Mode select Purge Valve.
10. Momentarily (for approximately 1 second) energize the PV with the Interface Board Test Mode. The low side pressure should rise slightly. If the low side pressure does not rise, the PV is not opening. Check the continuity of the wiring and the solenoid coil before assuming the solenoid is faulty.
11. Back seat the receiver tank outlet valve and the suction service valve. Perform a "Refrigerant Gauge Removal" procedure.

Receiver Tank Pressure Check Valve Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve. Attach another low pressure gauge to the suction access port located in the suction line near the accumulator inlet. A low loss fitting must be used on the hose connected to the suction access port.
2. Operate the unit in low speed cool.
3. Front seat the receiver tank outlet valve and allow the low side to pump down to 0 to 5 in. Hg vacuum (0 to -17 kPa).
4. Turn the unit Off.
5. Front seat the suction service valve to isolate the low side while it is still in a vacuum.
6. Watch the low pressure gauge attached to the suction access port. The low side pressure should not rise. It it does, there could be a leak through one (or more) of following components: hot gas solenoid, purge valve, or receiver tank pressure check valve.
7. Check the temperatures of the refrigeration lines on each side of the receiver tank pressure check valve by hand. A temperature difference between the two sides of the receiver tank pressure check valve indicates it is leaking.
8. Back seat the receiver tank outlet valve and the suction service valve, and remove the gauges to return the unit to normal operation.

Receiver Tank Replacement

Removal

1. Recover the refrigerant charge.
2. Unsolder the inlet tube from the receiver tank.
3. Unsolder the filter drier line from the receiver tank outlet valve.
4. Unbolt the mounting brackets and remove the receiver tank from the unit.

Installation

1. Place the receiver tank in the unit and install the mounting bolts and nuts loosely. Position the receiver tank so the sight glass is clearly visible and the outlet tube lines up.
2. Solder the inlet tube from condenser check valve tube to the receiver tank.
3. Solder the filter drier line to the receiver tank outlet valve.
4. Tighten the receiver tank mounting hardware securely.
5. Pressurize the system and test for leaks.
6. If no leaks are found, replace the liquid line drier then evacuate the system.
7. Recharge the unit with refrigerant and check the compressor oil.

Solenoid Valve Replacement

Removal

1. Recover the refrigerant charge.
2. Remove the coil from the valve.
3. Remove the valve mounting hardware if used.
4. Unsolder the refrigeration lines from the valve and remove the valve from the unit.

CAUTION: Use a heat sink to prevent damage.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and place the valve in position.
3. Install the valve mounting hardware if used.
4. Solder the inlet and outlet connections. After the valve cools, install the coil.

CAUTION: Use a heat sink to prevent damage.

5. Pressurize the refrigeration system and test for leaks.
6. If no leaks are found, replace the liquid line drier then evacuate the system.
7. Recharge the unit with proper refrigerant and check the compressor oil.

Suction Pressure Regulator (SPR) Test

1. Attach a gauge manifold to the suction service valve and the discharge service valve.
2. Operate the unit in high speed heat until the system pressures stabilize.
3. Check the suction pressure on the gauge attached to the suction service port. It should be within the range shown for the SPR setting in the “Specifications” chapter. If the setting is incorrect, remove the protective cap and try to adjust the SPR to the correct setting before assuming it is faulty.
4. Remove the gauges to return the unit to normal operation.

Suction Pressure Regulator (SPR) Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive. Make sure to front seat the suction service valve to isolate the low side and use the suction access port to access the low side.
2. Unsolder and remove the SPR. Note the position of the SPR so the new one will be placed in the same position.

Installation

1. Clean the tubes for soldering.
2. Place the new SPR in the same position from which the old one was removed.
3. Use a heat sink or wrap the SPR with a wet rag to prevent damage and solder the tubing connections.
4. Pressurize the low side and test for leaks.
5. If no leaks are found, replace the liquid line drier then evacuate the low side.
6. Open the refrigeration valves and place the unit in operation.
7. Run the unit and test the SPR. Adjust the setting if necessary.

Suction Pressure Transducer Testing

The suction pressure transducer is located on the suction adapter on top of the compressor.

The suction pressure transducer supplies pressure information to the SR-2 Microprocessor Control System. Alarm Code 87 (Check Suction Pressure Sensor) indicates a possible problem with the suction pressure transducer. The pressure reading can be monitored with a Mechanics/Premium HMI Control Panel by entering the Gauges Menu. Check the reading by comparing it to the reading on a low pressure gauge attached to the suction service valve port. Refer to the appropriate Microprocessor Diagnostic Manual for more information about the testing and operation of the suction pressure transducer.

Suction Pressure Transducer Replacement

Removal

1. Pump down the low side and equalize the pressure to slightly positive. Make sure to front seat the suction service valve to isolate the low side.

2. Disconnect the wires and remove the suction pressure transducer from the suction adapter.

Installation

1. Apply a refrigerant Loctite to the threads of the suction pressure transducer.
2. Install and tighten the suction pressure transducer and reconnect the wires.
3. Open the refrigeration valves and check for leaks before placing the unit in operation.

Centrifugal Clutch

The centrifugal clutch has three belt grooves and its engagement speed is 600 ± 100 RPM.

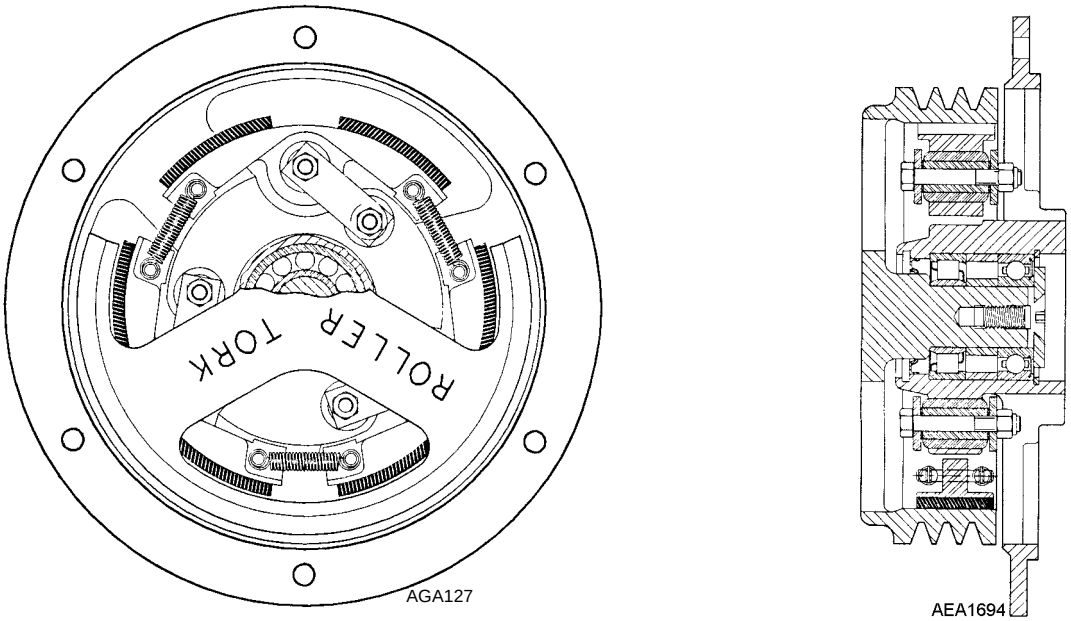
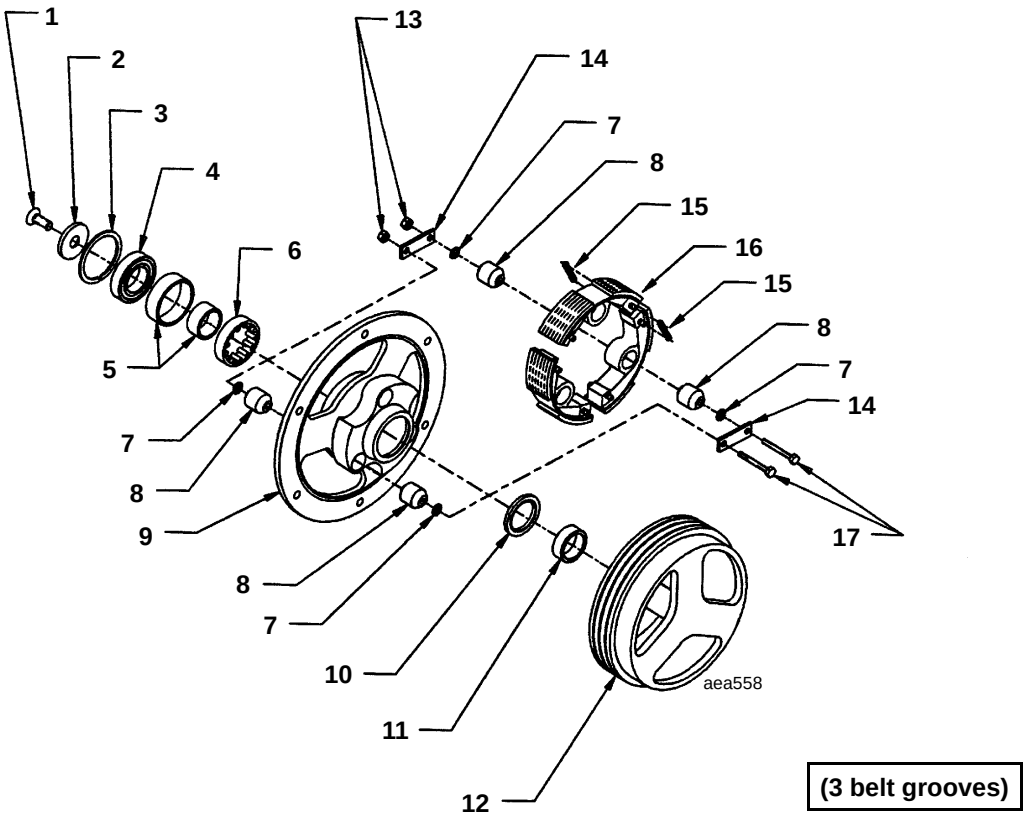


Figure 217: Front View and Cross Section



1.	Screw	10.	Grease Seal
2.	Washer	11.	Roller Bearing Inner Race
3.	Snap-Ring	12.	Pulley Housing
4.	Ball Bearing	13.	Elastic Stop Nuts (6)
5.	Large & Small Spacers	14.	Connector Link (6)
6.	Rolling Bearing	15.	Spring (6)
7.	Lockwasher (12)	16.	Shoe Assembly (3)
8.	Bushing (6)	17.	Screws (6)
9.	Hub		

Figure 218: Centrifugal Clutch

Clutch Maintenance

Using an inspection mirror, inspect the clutch every 1000 hours of operation or yearly, whichever occurs first. If shoe wear is uneven on different shoes, remove the clutch, clean the shoes and drum, regrease bearings or replace if they are worn. Inspect anchor bushings, shoe lining and springs for wear and replace if necessary.

Tools Required

- Internal Retaining Ring Pliers
- 7/16 in. Wrench
- 7/32 in. Allen Wrench or 7/32 x 1/2 in. Socket Drive
- 1/2 in. Impact Tool
- Rubber or Plastic Hammer
- 7/16 in. Socket or Nut Driver
- Arbor Press with Various Sized Arbors
- Bearing Puller
- Ratchet (Optional)
- Torque Wrench

Grease

Mobil™ (Synthetic) (see Tool Catalog).

Disassembly Procedure

1. Remove retaining ring.
2. Remove the 3/8-16 flat head cap screw and washer.

   NOTE: This screw was installed using Loctite (see Tool Catalog) and will require the use of an impact tool for removal.

   NOTE: A small amount of heat (propane or acetylene torch with small heating tip) applied to the cap screw head may be required to help loosen the screw.

3. Remove housing from hub by supporting hub (in a minimum of three places) in spoke area, and pressing on the housing shaft. The inner race of the roller bearing will remain on the housing shaft.

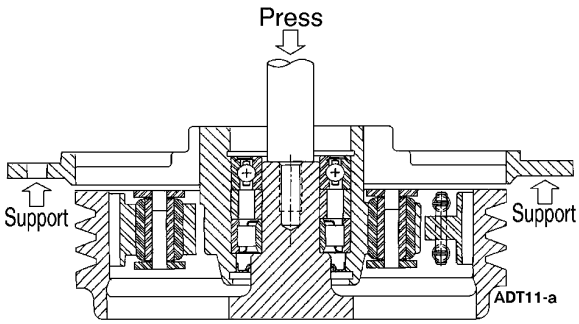


Figure 219: Housing Removal

4. Remove the nuts from six 1/4-28 link screws and remove screws, links, and lockwashers.
5. Remove the springs and shoes.
6. Pull oil seal and press bearings out of hub.

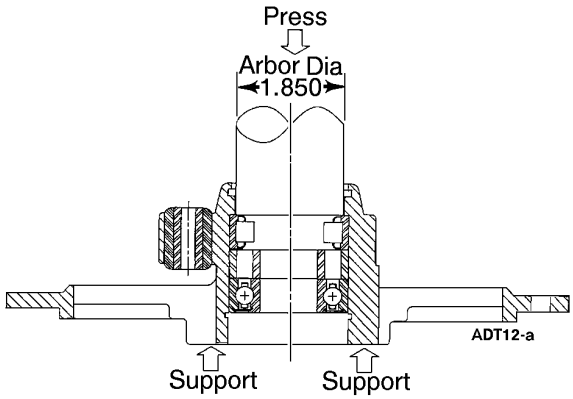


Figure 220: Bearing Removal

NOTE: Press tool should be slightly smaller than hub bore.

NOTE: Make sure the center of the hub is supported and not the outer rim of the hub, when pressing bearing out.

7. Press bushings out of hub.

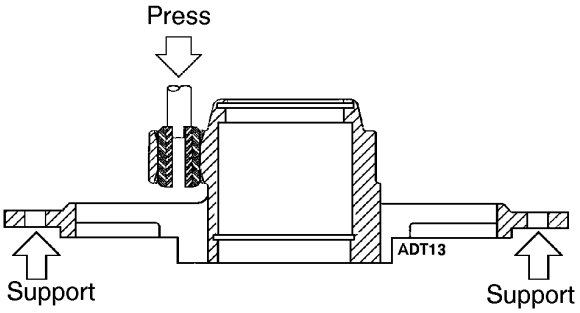


Figure 221: Bushing Removal

8. Remove inner race of roller bearing from the housing shaft.

   NOTE: This race had Loctite applied and was pressed in place. A puller will be required to remove it.

   NOTE: Make sure the center of the housing is supported and not the outer drum of the housing.

Assembly Procedure (Using New Bearings and Seal)

1. Press bushings into hub side opposite flange.

   NOTE: It is important to press bushings in straight.

   The bushings should also be centered in the hub socket leaving relatively equal amounts of bushing sticking out of the hub on each side.

   A suggested simple tool for pressing in bushing to hub is a 1/4 in. screw x 3 in. or 4 in. long and 1/4 in. nut. Thread nut onto screw approximately 3/4 to 1 in.

   Insert threaded end of screw into bushing. Lubricate bushing by dipping in clean water only. Then press into place.

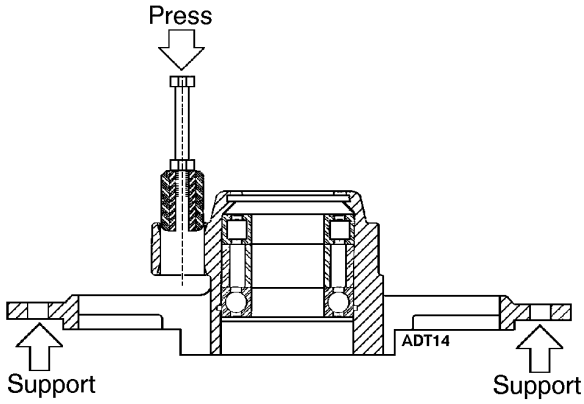


Figure 222: Bushing Insertion

   ****DO NOT USE SOAP OR OIL TO LUBRICATE BUSHING PRIOR TO ASSEMBLY.***

2. Remove the inner race from the roller bearing, apply a small amount of Loctite (see Tool Catalog) to race I.D. and press onto the housing shaft, seating against the step.

   CAUTION: During all bearing assembly, care must be taken to prevent Loctite from entering bearing.

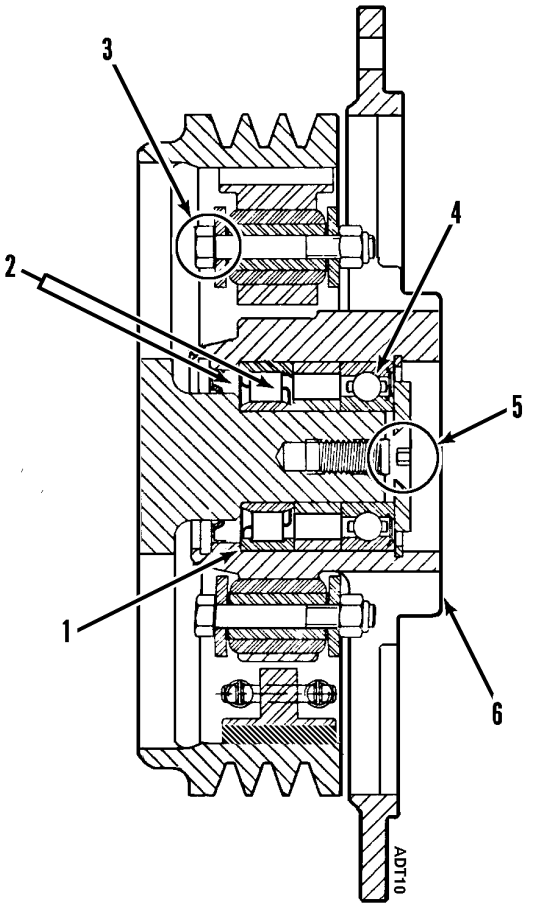
3. Apply Loctite (see Tool Catalog) to O.D. of oil seal, then press seal in end of hub opposite the flange to a depth of approximately 1/16 in. below the surface.

4. Apply a *small* amount of Loctite (see Tool Catalog) to O.D. of roller bearing and press into hub bore from the flange end until seated against the step in bore.

5. Slip large and *small* spacer into hub I.D. seating against the roller bearing.

6. Apply Mobil™ (see Tool Catalog) grease to roller bearing and fill cavity between large and small spacers. A small amount of grease should also be applied to the seal lip and space between the seal and roller bearing.
7. Pack ball bearing with Mobil™ (see Tool Catalog) grease.
8. Apply a *small* amount of Loctite (see Tool Catalog) to O.D. of ball bearing and press into hub until seated against spacer. Wipe excess Loctite from hub.
9. Install retaining ring.
10. Position shoes in a circle on flat surface and install springs on shoes.
11. Position shoes on the hub.
12. Install 1/4-28 x 1-3/4 in. screws through links, then external tooth 1/4 in. lockwasher. Then slide through bushings in shoes and hub.
13. Install remaining lockwashers then links and 1/4-28 in. locknuts, torquing them to 110 ± 5 in.-lbs (12.5 ± 6 N•m).

    NOTE: Shoes MUST be held tightly against hub while nuts are tightened.
14. Place the hub and shoe assembly into the housing and place flatwasher over the bearing.
15. Apply Loctite (see Tool Catalog) to 3/8-16 x 1 in. screw and install through washer into housing shaft. The housing and hub will be drawn together to the proper relative position as the screw is tightened. Tighten the screw to 30 to 35 ft-lbs (41 to 48 N•m).



1.	Roller Bearing, Pack with Mobil™ (see Tool Catalog) grease
2.	Pack These Areas with Mobil™ (see Tool Catalog) grease at Assembly
3.	HEX HD Cap Screw (6X), 1-4/28 UNF X 1.75 Long. Torque to 110 ± 5 in-lbs (12.5 ±.6 N•m) ***NOTE: Shoes must be disengaged while tightening 6 bolts and MUST be held tightly against hub while nuts are tightened.***
4.	Bearing, Fill with Mobil™ (see Tool Catalog) grease Approximately 0.32 oz (70 to 80% full)
5.	3/8-16 UNC x 1.00 Long, Flat Head Socket Cap Screw with Nylox Insert / Apply Loctite (see Tool Catalog) and Torque to 30 to 35 ft-lb (41 to 48 N•m)
6.	Serial Nameplate

Figure 223: Clutch

Structural Maintenance

Unit and Engine Mounting Bolts

Periodically check and tighten all unit and engine mounting bolts. Torque the unit mounting bolts to 60 ft-lb (81 N•m). Torque the engine mounting bolts to 64 ft-lb (87 N•m).

Unit Inspection

Inspect the unit during unit 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 air flow. Repair bent fins and any other noticeable damage.

CAUTION: Air pressure should not be high enough to damage coil fins.

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 225.) The coil will clean in a manner similar to the way lint cleans from the lint trap of a household clothes dryer.

WARNING: The coil fins are very sharp and can cause lacerations.

- 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 226).

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.

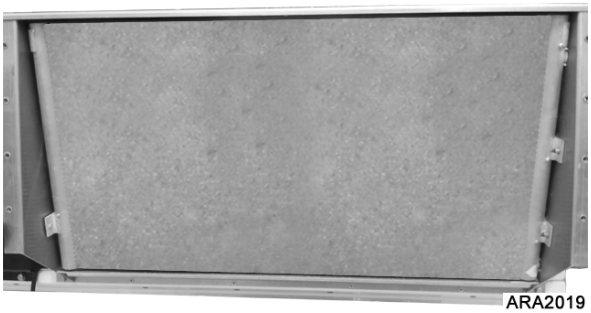


Figure 224: Coil Before Cleaning

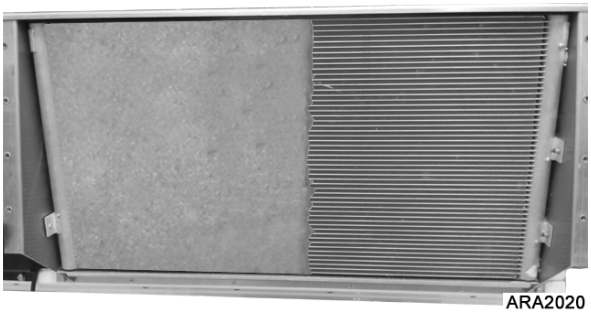


Figure 225: Coil after Wiping Right Hand Side with Cloth

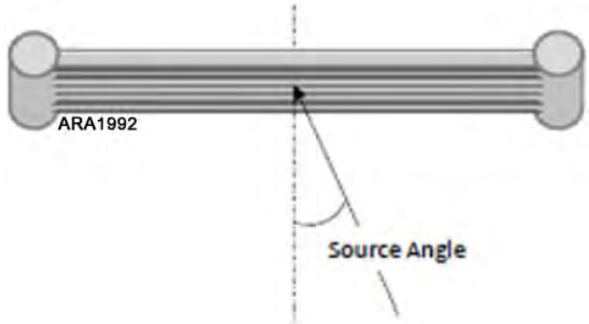


Figure 226: Source Angle for Cleaning with Air

Fan Location

When mounting the fan and hub assembly on the fanshaft, position the assembly in the orifice as follows for proper fan performance:

- For the ten-blade condenser fan, position the fan with 50 percent of the blade width to the air discharge side.

NOTE: One evaporator fan rotates clockwise (CW) and one evaporator fan rotates counterclockwise (CCW—on engine side of unit, viewed from inside the box).

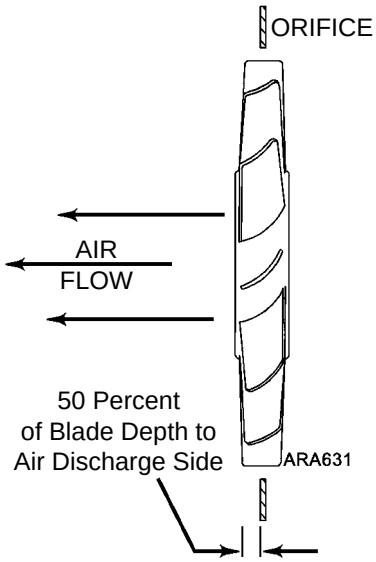
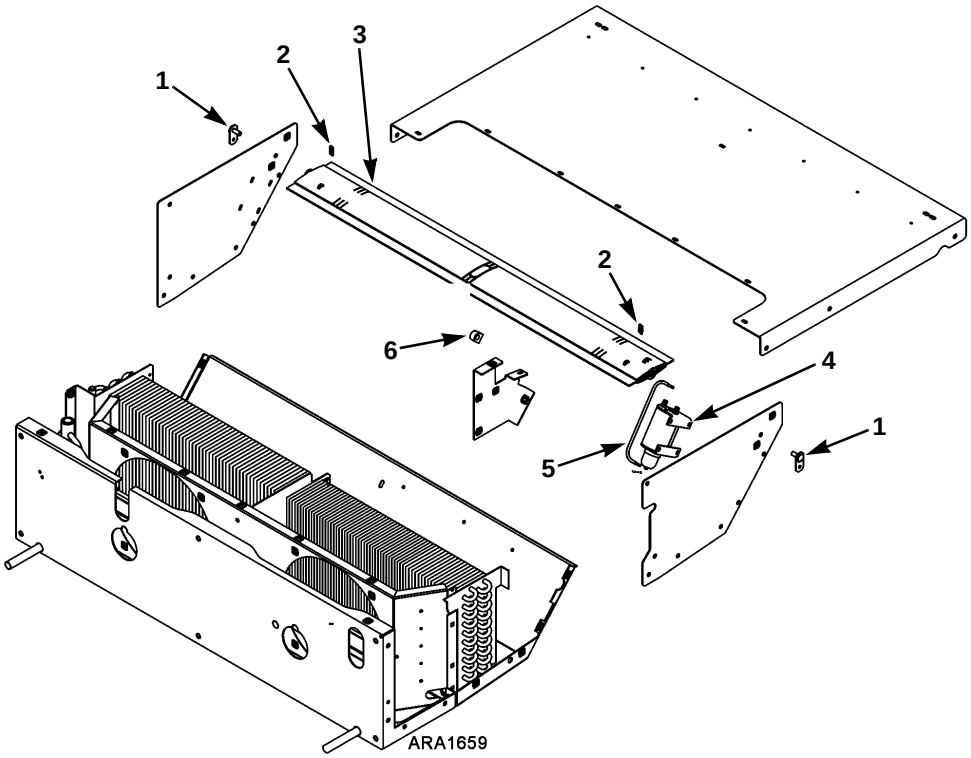


Figure 227: Fan Blade Position in Orifice for Ten-Blade Fan

Plastic Defrost Damper

These units use a plastic defrost damper blade instead of the aluminum defrost damper blade previously used in self powered truck units. The main difference other than the damper blade itself is the hardware on the ends of the damper blade. The plastic damper blade uses a blade pivot on each end. The aluminum damper blade uses a blade rod, a washer, and a damper bushing on each end.

The blade pivots of the ends of the plastic damper blade are not adjustable. However, the position of the damper can be adjusted if necessary by adjusting the position of the eye bolt in the damper solenoid. Check the damper during scheduled maintenance inspections for wear and sealing the air flow.



1.	Blade Pivots	4.	Damper Solenoid
2.	Springs	5.	Damper Solenoid Rod
3.	Plastic Damper Blade	6.	Center Damper Blade Clamp

Figure 228: Plastic Defrost Damper Blade Components

1.	Blade Pivot

Figure 229: Blade Pivot Location

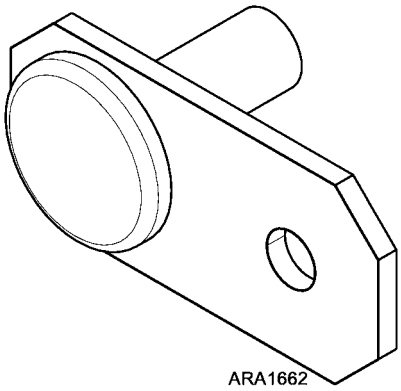


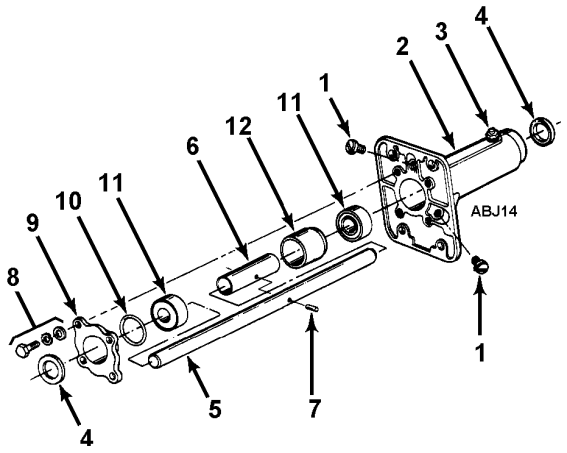
Figure 230: Close Up of Blade Pivot

Figure 231: End of Plastic Damper Blade

Fanshaft Assembly

The unit is equipped with one-piece fanshaft assemblies that contain tapered roller bearings in a sealed oil reservoir. A fanshaft assembly does not require any maintenance. There is a level plug and a fill plug, but they are not normally utilized except after removal and repair of the fanshaft assembly. The condenser end oil seal and the evaporator end oil seal should be checked during the pretrip inspection for oil leakage. If there is any sign of leakage, the fanshaft assembly should be removed and repaired.

NOTE: The fanshaft assembly requires a special lubricant (P/N 203-278).



1.	Oil Plug Screw with O-ring
2.	Housing
3.	Breather Vent
4.	Oil Seal
5.	Shaft
6.	Sleeve
7.	Pin
8.	Screw with Flatwasher and Lockwasher
9.	Cap and Shims
10.	O-ring
11.	Roller Bearing
12.	Splash Guard Tube

Figure 232: Fanshaft Assembly

Disassembly

1. Remove the fanshaft assembly from the unit. Remove both oil plugs and drain the oil from the housing.

2. After draining the oil from the housing, remove the four retaining bolts from the bearing retainer cap.

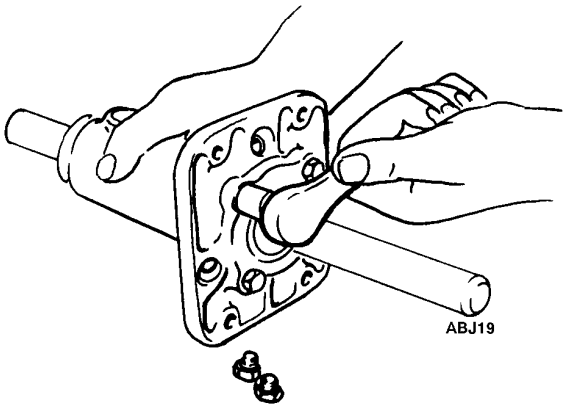


Figure 233: Removing Bearing Retainer Bolts

3. To remove the shaft from the assembly, tap the opposite end of the shaft with a soft hammer. After the shaft has been removed, clean all parts in clean solvent.

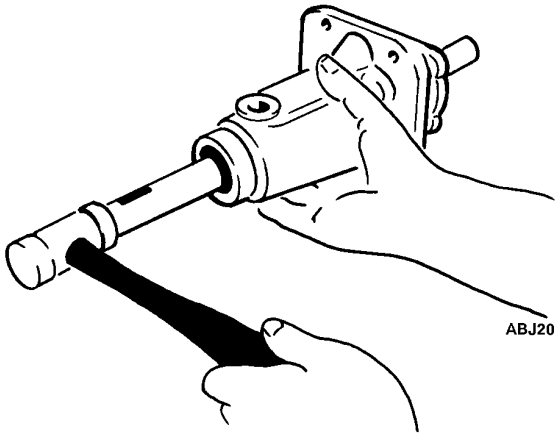


Figure 234: Removing Shaft

4. Using a punch, remove the oil seal from the evaporator end of the assembly. With the seal removed, clean the housing in solvent.

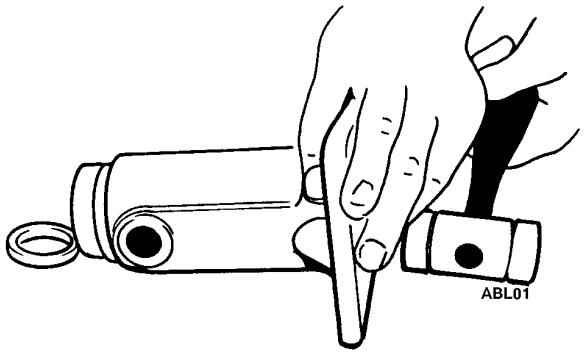


Figure 235: Removing Oil Seal

5. Check the condition of the vent. If it is loose or damaged, it must be repaired or replaced.
6. After all the parts are cleaned, inspect the bearings and bearing races for wear or damage.
7. To replace the bearings, first remove the roll pin that is in the center of the shaft.

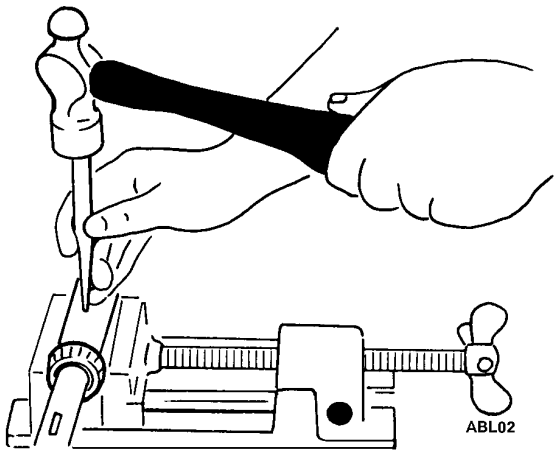


Figure 236: Removing Roll Pin

8. With the roll pin removed, place a pipe over the shaft and drive one bearing down until the opposite bearing and bearing spacer release from the shaft.
9. After removing one bearing and the bearing spacer, turn the shaft upside down and drive the other bearing off, using the pipe.
10. The bearing races can now be driven out with a punch and replaced in the same manner.

Reassembly

1. Install the new bearings on the shaft with a pipe in the same way they were removed.

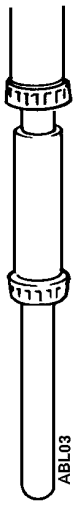


Figure 237: Installing Bearings

2. When replacing the bearing race on the evaporator end of the assembly, the splash guard will come out with the race. Reinstall the splash guard after replacing the bearing race.

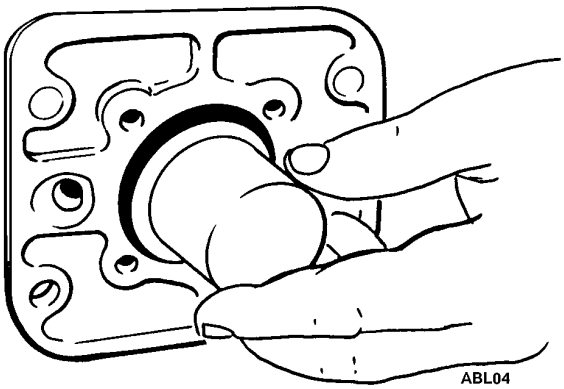


Figure 238: Installing Splash Guard

3. Install a new oil seal after replacing the bearing race and splash guard.

   NOTE: Tape shaft holes or keyway to prevent seal damage.

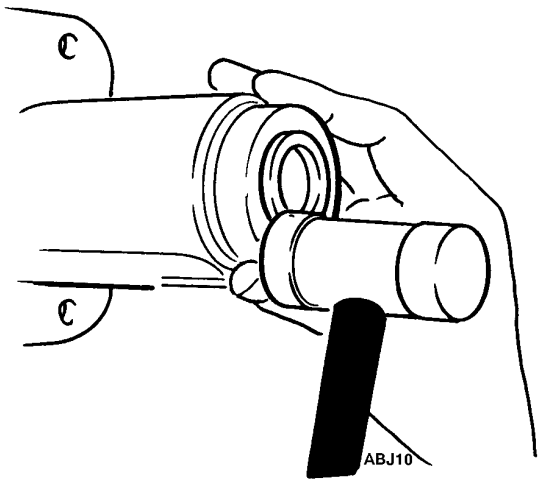


Figure 239: Installing Oil Seal

4. Place the shaft in the housing. Install a new seal in the retainer cap. Use the original shims and replace the o-ring if necessary.

   NOTE: Tape shaft holes or keyway to prevent seal damage.

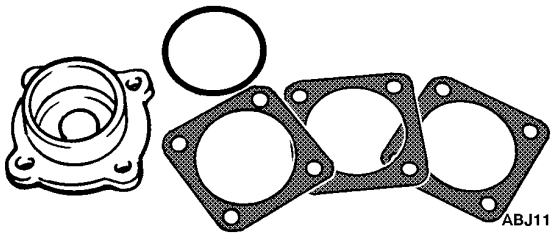


Figure 240: Shims and O-ring

5. Install the retainer cap assembly over the shaft, and then install the bolts.

6. Torque the bolts in a criss-cross pattern in equal steps to 80 in.-lbs (9.04 N•m).

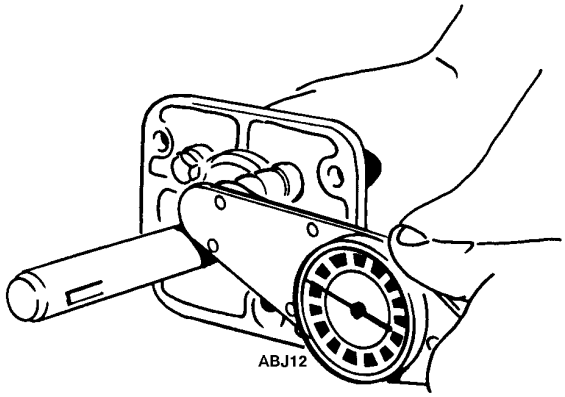


Figure 241: Torquing Retainer Plate Bolts

7. Lock the assembly in a vise and set up a dial indicator to read the end play. To measure the end play, rotate the shaft while pushing in one direction, and set the dial indicator to 0. Now rotate the shaft and pull in the opposite direction while reading the dial indicator. The end play should be 0.001 to 0.005 in. (0.025 to 0.127 mm). If the end play is incorrect, use different shims to obtain the correct end play.

   Shims available from the Service Parts Department:

   - 0.020 in. (0.500 mm)
   - 0.007 in. (0.177 mm)
   - 0.005 in. (0.127 mm)

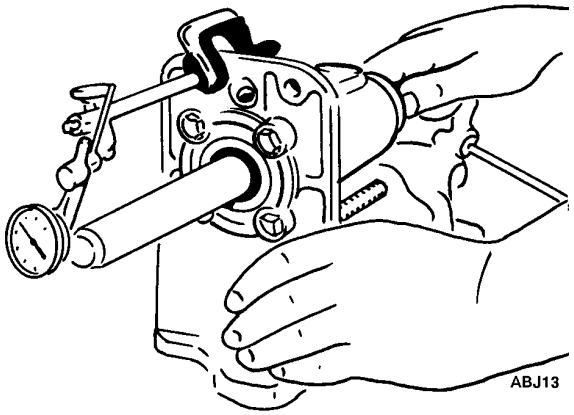
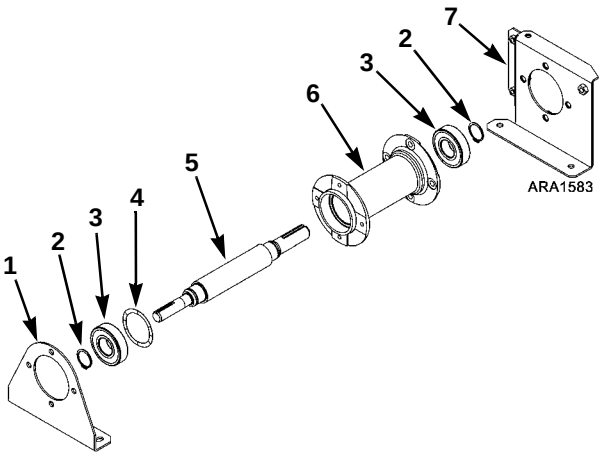


Figure 242: Checking End Play

Jackshaft Assembly

The unit is equipped with a jackshaft that contains special sealed bearings. The jackshaft bearings should be checked when the belts are replaced. Spin the jackshaft with the belts removed and listen. Unusually loud bearing noise indicates the jackshaft bearings should be replaced.

NOTE: The jackshaft assembly can be disassembled and reassembled without removing the brackets from the ends of the housing.



1.	Condenser Side Bracket	5.	Shaft
2.	Snap Ring	6.	Housing
3.	Bearing	7.	Belt Side Bracket
4.	Wave Washer		

Figure 243: Jackshaft Assembly

Disassembly

1. Remove the jackshaft assembly from the unit.
2. Remove the snap rings.
3. Remove the shaft from the housing by tapping on either end of the shaft with a soft hammer.
4. Remove the bearing from the shaft by supporting the bearing and tapping on the end of the jackshaft.
5. Remove the bearing from the housing with a hammer and punch.
6. Clean and inspect the parts, but do not clean the bearings in solvent. Replace the parts that show significant wear or damage.

Reassembly

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

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

1. Install the bearing on the large end of the jackshaft.
2. Install the snap ring on the large end of the jackshaft.
3. Install the shaft and bearing in the housing from the belt side bracket end.
4. Place the wave washer in the condenser side bracket end of the housing.
5. Install the bearing on the small end of the shaft and in the condenser side bracket end of the housing.
6. Install the snap ring on the small end of the shaft.
7. Reinstall the jackshaft assembly in the unit.

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 correct Engine Type. Refer to appropriate Microprocessor Diagnostic Manual.
	Fuel solenoid defective or stuck	Replace
	Fuel injection pump defective	Replace pump
	Glow plugs defective	Replace
	No fuel or wrong fuel	Fill with proper fuel
	Electric fuel pump not operating	Check fuel pump is running and 8 to 10 psig (55 to 69 kPa). Repair or replace fuel pump
	Air in fuel system	Bleed air
	Compression low	Overhaul engine
	Injection nozzles defective	Replace nozzles
	Incorrect timing	Adjust timing
	Air cleaner clogged	Replace air filter
	Exhaust plugged	Clean exhaust
Engine stops after starting	Air in injection pump	Bleed fuel system
	Fuel filter obstructed	Replace filter element
	High head pressure	Eliminate cause of high head pressure
	High engine coolant temperature	Add coolant. Check for leaks
	Low oil pressure	Add oil. Check for leaks
	Vent of fuel tank obstructed	Remove obstruction
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	Electric fuel pump not operating correctly	Check fuel pump is running and 8 to 10 psig (55 to 69 kPa). Repair or replace fuel pump
	Dry air cleaner plugged	Change filter element

Condition	Possible Cause	Remedy
Engine does not reach full power	Air or dirt in fuel system	Repair
	Fuel line leaks	Tighten connections of fuel lines. If necessary, replace damaged lines
	Speed adjustment wrong	Adjust speed
	Electric fuel pump does not run correctly	Check voltage. Repair or replace pump
	Electric fuel pump filter dirty	Clean and replace diesel filter
	Fuel filter plugged	Install new filter
	Fuel tank vent clogged	Unclog vent
	Air in fuel system	Bleed fuel system
	Air filter clogged	Clean air filter
	Air intake system clogged	Clean air intake system
	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 injection pump
	Cylinder head gasket leaking	Replace gasket
	Compression low or unbalanced	Overhaul engine
	Restricted exhaust system	Clean or replace restricted parts
Engine is sooting heavily, emits thick black clouds of smoke (excessive fuel to air ratio)	Wrong fuel	Drain and refill with correct fuel
	Clogged air intake system	Clean air cleaner
	Restricted exhaust system	Clean or replace
	Opening pressure of nozzle is too low or needle sticks	Repair nozzle. Replace if necessary
	Injection amount too great	Have pump repaired
	Injection pump timing	Check timing of injection pump
	Excessive load	Check drive system and engine oil pressure
Engine knocks	Insufficient air	Clean air filter
	Air in fuel system	Bleed fuel system
	Engine is cold	Warm up
	Fuel return line plugged	Remove restriction
	Injection pump not timed	Retime injection pump
	Injection nozzle fouled or opening pressure too low	Clean, repair or replace injection nozzle
	Dirty radiator	Clean radiator
	Worn engine parts	Overhaul engine

Condition	Possible Cause	Remedy
Engine runs hot	Engine coolant is low	Add coolant slowly while engine is in operation
	Dirty or plugged radiator	Clean radiator
	Cooling system heavily scaled	Clean cooling system
	Water pump leaks	Repair or replace water pump
	Worn or loose belt	Replace belt or adjust
	Cylinder head gasket leaks (bubbles appear in radiator if cylinder gasket is leaking)	Replace cylinder head gasket. Correct gasket
	Faulty thermostat	Check or replace the thermostat
Oil pressure too low or drops suddenly	Insufficient oil in pan	Refill oil base after correcting cause of loss
	Leak in oil line	Tighten oil line fittings
	Oil relief valve sticking	Disassemble and clean oil pressure regulator valve
	Faulty oil pressure sensor	Check oil line to oil pressure sensor to see if it is blocked. Check oil pressure sensor. Replace if necessary
	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug, oil in water through crack	Repair engine
High oil consumption	Oil leakage	Check and eliminate possible causes
	Clogged air cleaner	Clean air cleaner
	Damaged valve seals	Replace seals on valve stem
	Worn valve stem or valve guides	Replace valves and valve guides
	Broken piston rings or cylinder bore worn or scored	Have engine repaired. Replace broken piston rings
	Crankcase breather clogged	Clean crankcase breather
Blue Smoke (oil consumption)	Excessive oil consumption	See “High oil consumption”. Repair as necessary
White Smoke (fuel is not burning)	Cold engine	Allow engine to warm up
	Low compression	Check and eliminate possible causes. Repair as necessary
	Incorrect timing	Readjust timing
	Air or water in fuel	Bleed system. Replace filters, clean fuel system, drain and clean tank and check supply tank for water. Use known good fuel
	Insufficient preheat	Check glow plugs

Condition	Possible Cause	Remedy
Battery is not recharging	Loose alternator belt	Tighten belt
	Loose connections in electrical system	Check all electrical connections and charging system
	Worn brushes in alternator	Repair
	Voltage regulator faulty	Replace
	Battery defective	Replace
	Alternator defective	Repair or replace
	Dirty battery terminals	Clean and retighten

Electric Standby (Optional) Diagnosis

Condition	Possible Cause	Remedy
Unit turned On—Microprocessor display does not come on	Battery discharged	Charge or replace battery
	Faulty battery cable connections	Clean battery cables
	Fuse F21 blown	Check for short circuits and replace fuse
	Fuse F2 blown	Check for short circuits and replace fuse
	Open circuit	Check HMI Harness
Unit turned On—Microprocessor display comes on but electric motor does not run	No standby power	Provide power to unit; check power at: 1. Power source 2. Power plug 3. Motor contactor hot side 4. Motor contactor load side (contactor closed) 5. Overload relay 6. Motor terminals
	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 reset or replace overload relay
	Faulty run relay K1	Check run relay K1
	Faulty diesel/electric relay K5	Check diesel/electric relay K5
	Faulty phase select module	Check phase select module
	Faulty motor contactor	Check motor contactors
	Open circuit	Check 8, ER, EOL, 7E, 7EA, 7EB, 7EC, CH, L1, L2, and L3 circuits
	Faulty drive motor	Check drive motor
	Batteries discharged	Charge or replace batteries
Electric motor hums but does not run	Locked rotor (overload relay will open after a period of time)	Remove interference
	Locked compressor	Repair compressor
	Defective clutch on engine (locked up)	Repair or replace clutch
	Low line voltage or no voltage on one leg	Bring voltage up to within 10% of motor rating

Condition	Possible Cause	Remedy
Contact chatter	Low battery voltage	Check voltage condition. Check momentary voltage dip during starting—low voltage prevents magnet sealing
	Defective or incorrect coil	Replace coil
	Poor contact in control circuit	Check auxiliary switch contacts and overload relay contacts. Check for loose connections in control circuits
Contact welding or freezing	Abnormal in-rush of current	Check or grounds, shorts or excessive motor load current
	Low voltage	Correct voltage condition. Check momentary voltage dip during starting
	Foreign matter prevents contacts from closing	Clean contacts
	Rapid cycling	Check for cause of short cycling (such as thermostat)
	Short circuit	Correct fault
Battery is not recharging	Loose alternator belt	Tighten belt
	Loose connections in electrical system	Check all electrical connections and charging system
	Worn brushes in alternator	Repair
	Voltage regulator faulty	Replace
	Battery defective	Replace
	Alternator defective	Repair or replace
	Dirty battery terminals	Clean and retighten

Refrigeration Diagnosis

Rapid cycling between Cool and Heat	Unit cools in Heat and Defrost cycle	Unit heats in Refrigeration (Cool) cycle	High head pressure	Low head pressure	No 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
															•			Loose compressor pulley
															•			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

Rapid cycling between Cool and Heat	Unit cools in Heat and Defrost cycle	Unit heats in Refrigeration (Cool) cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	**Symptom** / **Possible Causes**
			•				•		•							•		Restricted line on the high side
			•				•		•							•		Restricted drier
																	•	Defrost damper stays open
							•		•							•		Defrost damper stuck closed
								•										Suction service valve back seated
	•	•		•		•						•					•	Faulty Condenser Inlet Solenoid (CIS)
	•	•										•		•		•	•	Faulty Hot Gas Solenoid (HGS)
	•																•	Loose or broken electrical connections
•						•	•		•							•		Sensor out of calibration
						•	•	•	•									Suction pressure gauge out of calibration
												•						Leaky receiver tank outlet valve
						•	•	•								•	•	Faulty Suction Pressure Regulator (SPR)
			•			•						•	•	•		•	•	Faulty Purge Valve (PV)
																	•	Faulty Condenser Check Valve
						•						•	•	•		•	•	Faulty Receiver Tank Pressure Check Valve

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Wiring and Schematic Diagrams Index

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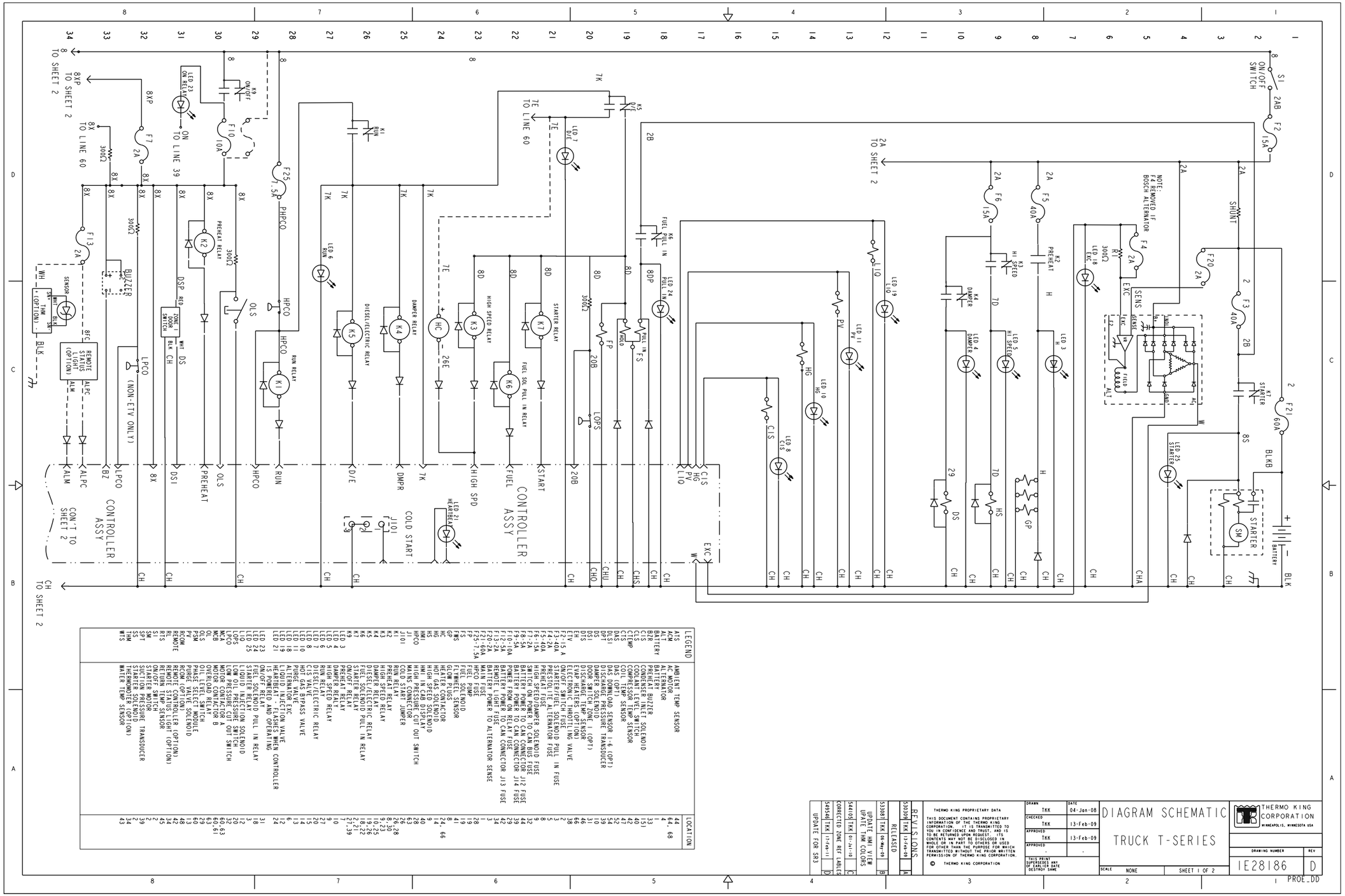
LEGEND
AMBIENT TEMP SENSOR
ALTERNATOR (OPTIONAL)
BATTERY
PREHEAT BUZZER
COOLANT LEVEL SWITCH
COMPRESSOR TEMP SENSOR
COOLANT TEMP SENSOR
COIL TEMP SENSOR
DISCHARGE PRESSURE TRANSDUCER
DAMPER SOLENOID
DISCHARGE TEMP SENSOR
EVAP HEATERS (OPTION)
ELECTRONIC THROTTLING VALVE
STARTER PINION SOLENOID PULL IN FUSE
PRESTOLITE ALTERNATOR FUSE
PREHEAT FUSE
SWITCH POWER TO DAMPER SOLENOID FUSE
SWITCH POWER TO CAN CONNECTOR J12 FUSE
BATTERY POWER TO CAN CONNECTOR J14 FUSE
BATTERY POWER TO CAN CONNECTOR J13 FUSE
BATTERY POWER TO FAN CONNECTOR J13 FUSE
REMOTE LIGHT FUSE
BATTERY POWER TO ALTERNATOR SENSE
HPCO FUSE
FUEL PUMP
FUEL SOLENOID
GLOW PLUGS
GLOW PLUG SENSOR
HEATER CONTACTOR
HOT GAS SOLENOID
HIGH SPEED SOLENOID
HIGH PRESSURE CUT OUT SWITCH
MAINS CONNECTOR
RUN RELAY JUMPER
PREHEAT RELAY
HIGH SPEED RELAY
DIESEL ELECTRIC RELAY
FUEL SOLENOID PULL IN RELAY
STARTER RELAY
DAMPER RELAY
HIGH SPEED RELAY
DIESEL ELECTRIC RELAY
FUEL SOLENOID PULL IN RELAY
STARTER RELAY
DAMPER RELAY
HIGH SPEED RELAY
DIESEL ELECTRIC RELAY
CIS VALVE
HOT GAS BYPASS VALVE
ALTERNATOR EXC
LIQUID INJECTION VALVE
HEARTBEAT - FLASHES WHEN CONTROLLER ON, OPERATING
FUEL SOLENOID PULL IN RELAY
ON/OFF RELAY
STARTER RELAY
LOW OIL PRESSURE SWITCH
LOW PRESSURE CUT OUT SWITCH
MOTOR CONTACTOR A
MOTOR CONTACTOR B
OUTPUT RELAY
OIL LEVEL SWITCH
PHASE SELECT MODULE
RUN SOLENOID
RCOM (OPTION)
REMOTE CONTROLLER (OPTION)
REMOTE STATUS LIGHT (OPTION)
SUCTION TEMP SENSOR
ON/OFF SWITCH
STARTER MOTOR
SUCTION PRESSURE TRANSDUCER
STARTER SOLENOID (ON)
THERMISTOR (OPTION)
WATER TEMP SENSOR
LOCATION
NOTE: REMOVED IF FACTORY BOSCH ALTERNATOR
S1 ON/OFF SWITCH
F2 15A
F3 40A
F4 2A
F5 40A
F6 15A
F7 2A
F10 10A
F13 2A
F20 2A
F21 60A
F25 7.5A
SHUNT
K1 RUN
K2 PREHEAT
K3 HI SPEED
K4 DAMPER
K5 D/E
K7 STARTER
K9 ON/OFF
R1 300Ω
LED 18 EXC
LED 19 LIQ
LED 11 PV
LED 10 HG
LED 8 CIS
LED 24 FUEL PULL IN
LED 7 D/E
LED 6 RUN
LED 5 HI SPEED
LED 4 DAMPER
LED 3 H
LED 25 STARTER
LED 23 ON RELAY
LED 21 HEARTBEAT
LED 2 HEARTBEAT
K6 FUEL SOL PULL IN RELAY
HJC
HFP
FP
FS
HJQ
HPV
HHG
HCIS
HJ1
HJ2
HJ3
HJ4
HJ5
HJ6
HJ7
HJ8
HJ9
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HJ39
HJ40

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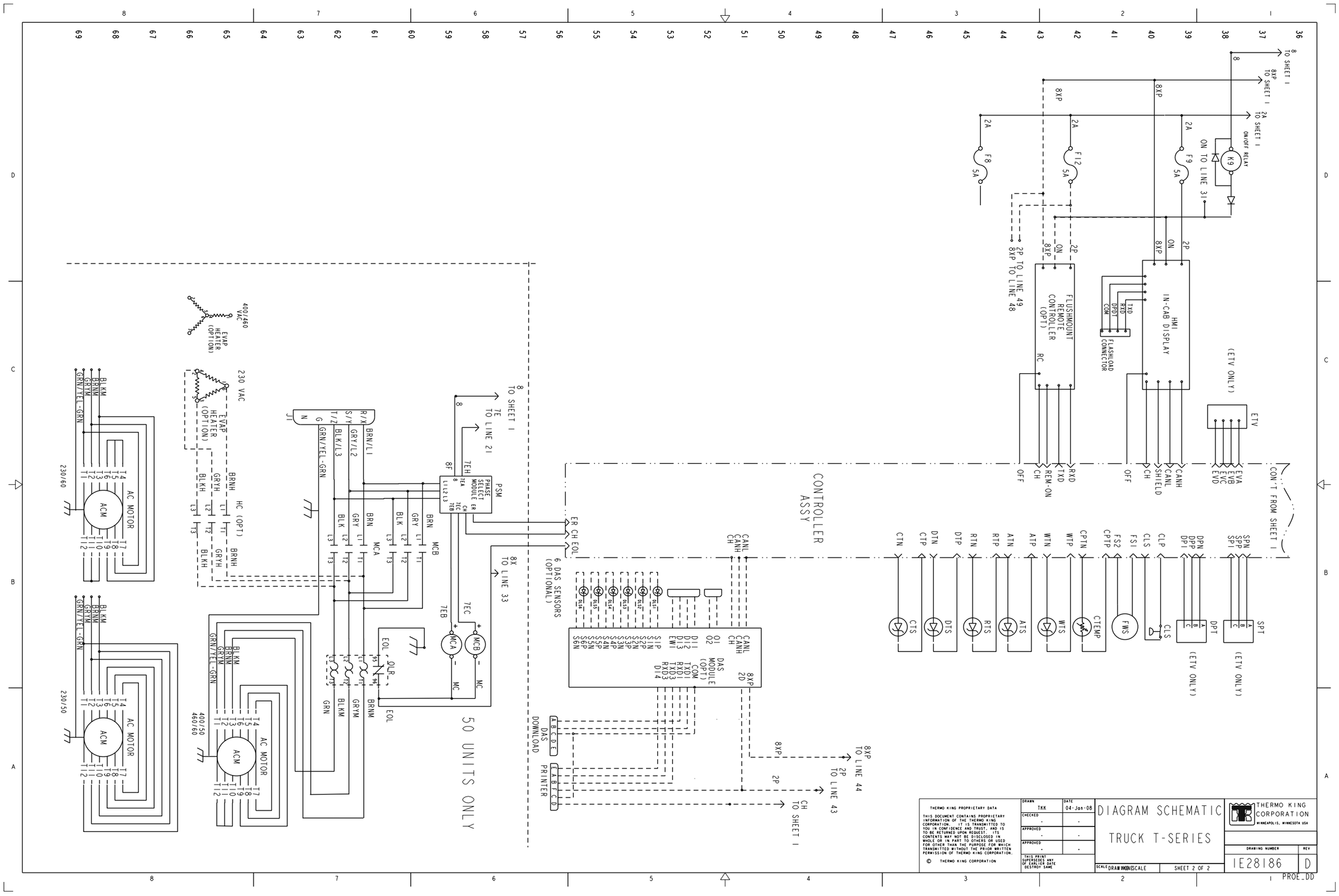

Wiring Diagram - Page 1 of 5

RELEASED 16/Aug/2012

REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
530309	A	RELEASED	13-Feb-09	TKK
533087	B	UPDATE COMMS HARNESS,DOWNLOAD HARNESS,THM COLORS.ADD HMI OPTION.	01-May-09	TKK
549546	C	UPDATE VIEW FOR SR3	17-Feb-11	TKK
606409	F	UPDATE ETV VIEW SHEET 2	9-Apr-12	RLK

CONTROLLER DOWNLOAD CABLE — TO SHEET 3
COMMS HARNESS — TO SHEET 4
COMMS HARNESS — TO SHEET 3
TO SHEET 4 — HMI HARNESS

J14_PCBD: CANL-BLUE, CANH-GREEN, SHLD-01, ON-RED, 2A-BLACK, 8XP-YELLOW, OFF-WHITE, CH-ORANGE — SEE DETAIL A
J13_PCBD: CANL-BLACK, CANH-RED1, SHLD2, ON-ORN, 2A-BLU2, 8XP-BLUE, OFF-YEL, CH-GRN2 — SEE DETAIL A
J12_PCBD — SEE DETAIL A
J8_PCBD: ALPC-01, 8FC-01, ALM-01 — SEE DETAIL B
J6_PCBD: 7E-01, EOL-01, 8-01, CH2, ER-01, 26E — SEE DETAIL B
J27
J15_PCBD: 29-01, 7D-01, 8DF-01, 8S-01, 8D-01, 8DP-01 — SEE DETAIL D
J9_PCBD: RXD-RED, TXD-BLACK, COM-GRN, DPD-BLUE — SEE DETAIL B
J10_PCBD: RXD-BLACK, TXD-RED, REM-ON-BROWN — SEE DETAIL B
50 HARNESS — TO SHEET 3
CH — TO GND PLATE
J102, J103, J101
CHP-01
2-01 — 2 — TO F21
8-02 — 2AB-01 — J4_PCB
2A-01 — 2A — TO ALT
H — TO GLOW PLUGS
H-01

CONTROLLER INTERFACE ASSY

MAIN HARNESS

J7_PCBD: LLS1-01, SENSE-01, CIS-01, RTPS-01, HG-01, PV-01, LIQ-01, EVC-01, EVD-01, SPP-02, DPP-02, CLP-01, CLS-01, PHPCO-01, HPCO-01, LPCO-01, DSP-01, DS-01, EVB-01, EVA-01, SPN-02, DPN-02, 20B-01, OLS-01, EXC-01, W-01, FS1-01, FS2-01

J3_PCBD_SENSOR: RTP-01, RTN-01, ATP-01, ATN-01, DPI-01, SPI-01, CTEMPN-01, DTN-01, CTN-01, WTN-01, DTP-01, CTP-01, WTP-01, CTEMP-01

J_MAIN: SPN-01, SPP-01, DPN-01, DPP-01 — SPN-02, SPP-02, DPN-02, DPP-02 — P_MAIN

MAIN HARNESS — TO SHEET 2
SENSOR HARNESS — TO SHEET 2
2-01 — TO SHEET 2

PIN LOCATIONS SHOWN FROM WIRE END

DETAIL A
DETAIL B
DETAIL C
DETAIL D

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THERMO KING CORPORATION

RELEASED: 530309 TKK 13-Feb-09 — REVISIONS: TKK A

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

DRAWN	TKK	19-Dec-06
CHECKED	TKK	13-Feb-09
APPROVED	TKK	13-Feb-09
ENG APP'VL	-	-

Ingersoll Rand. Thermo King

TITLE: DIAGRAM WIRING TRUCK T-SERIES

SIZE	CODE IDENT NO	DWG NO	REV
D		1E28187	F

SCALE: NONE — REF DWG: - — SHEET 1 OF 5

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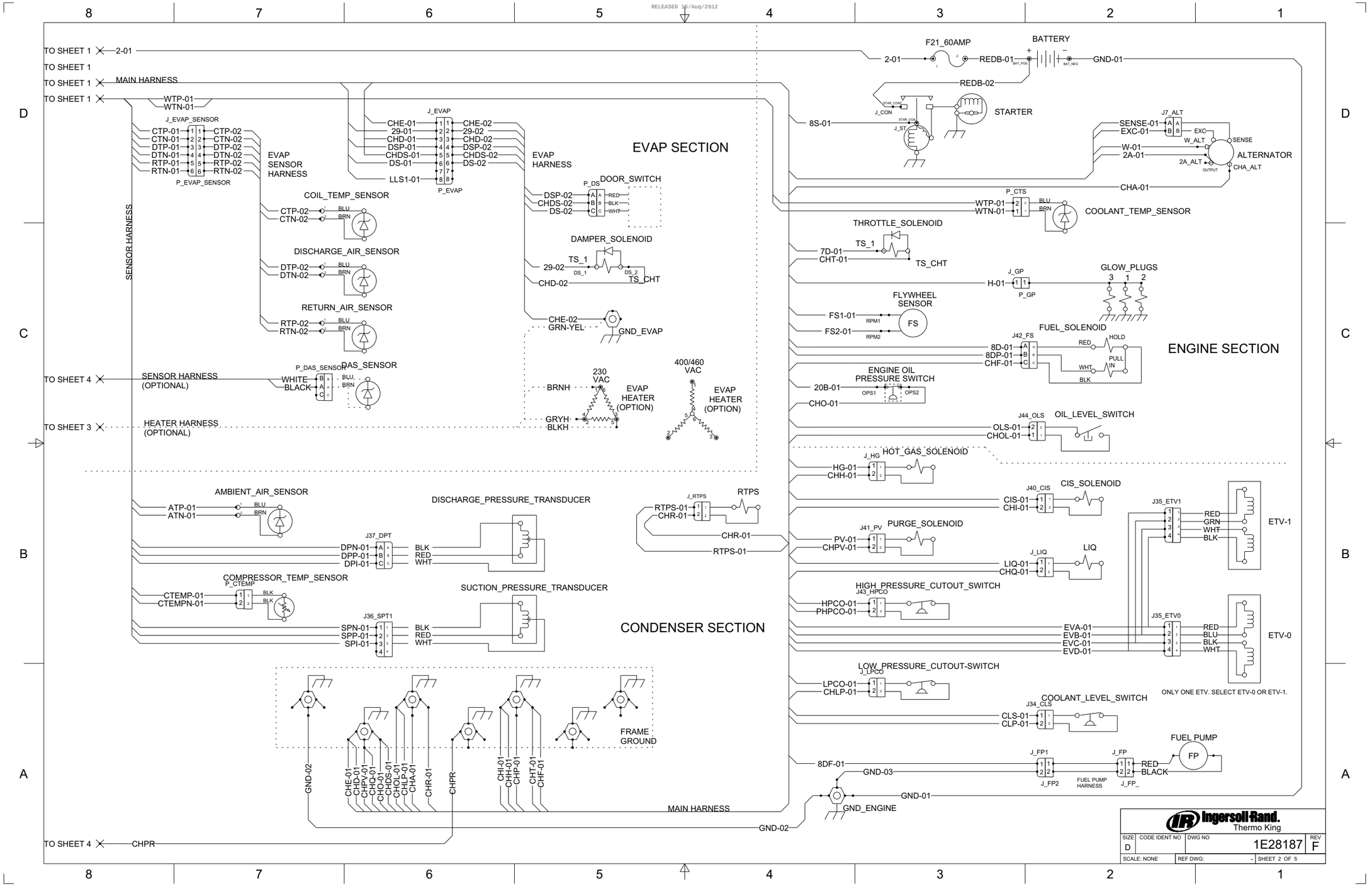

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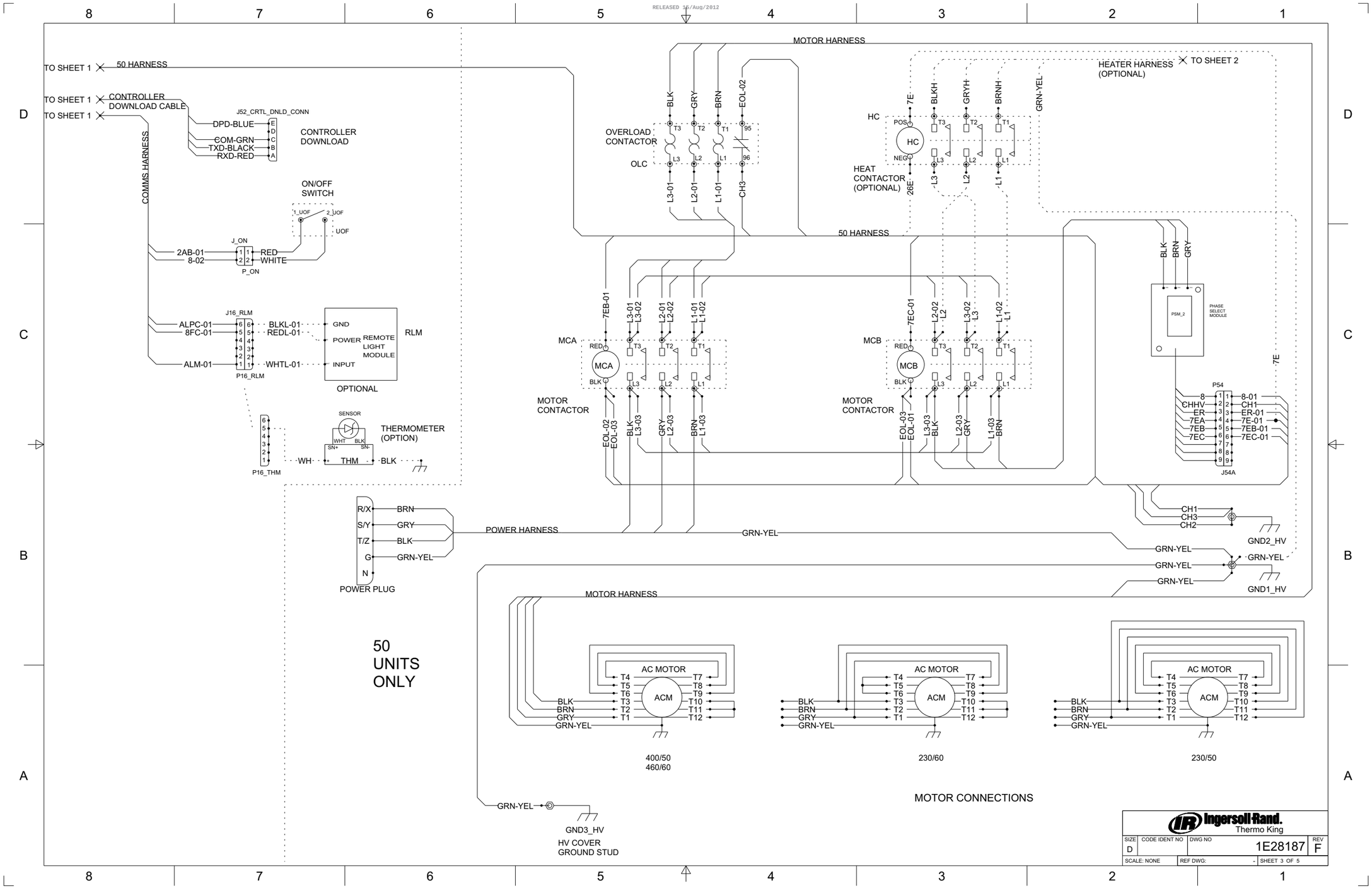

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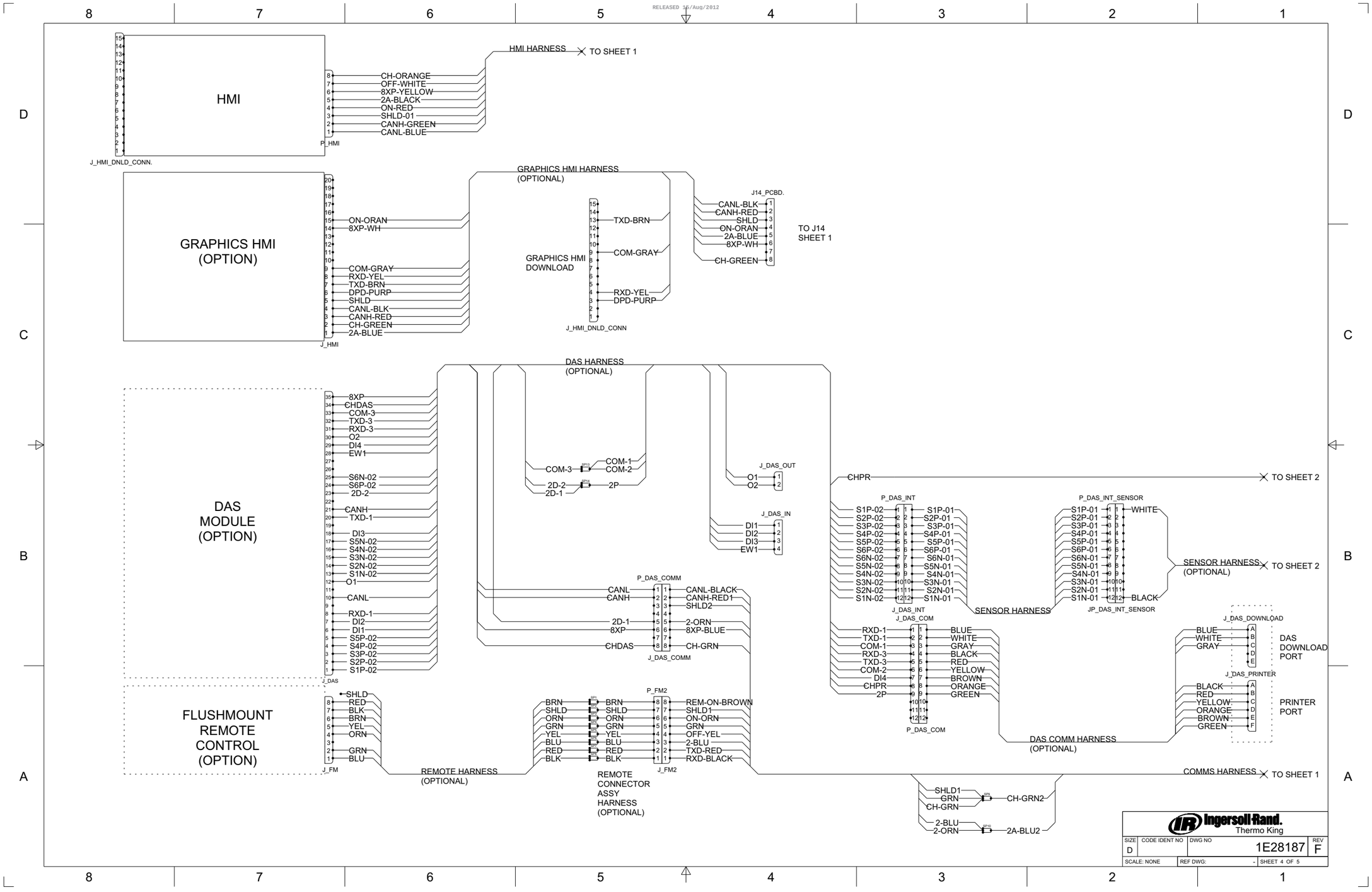

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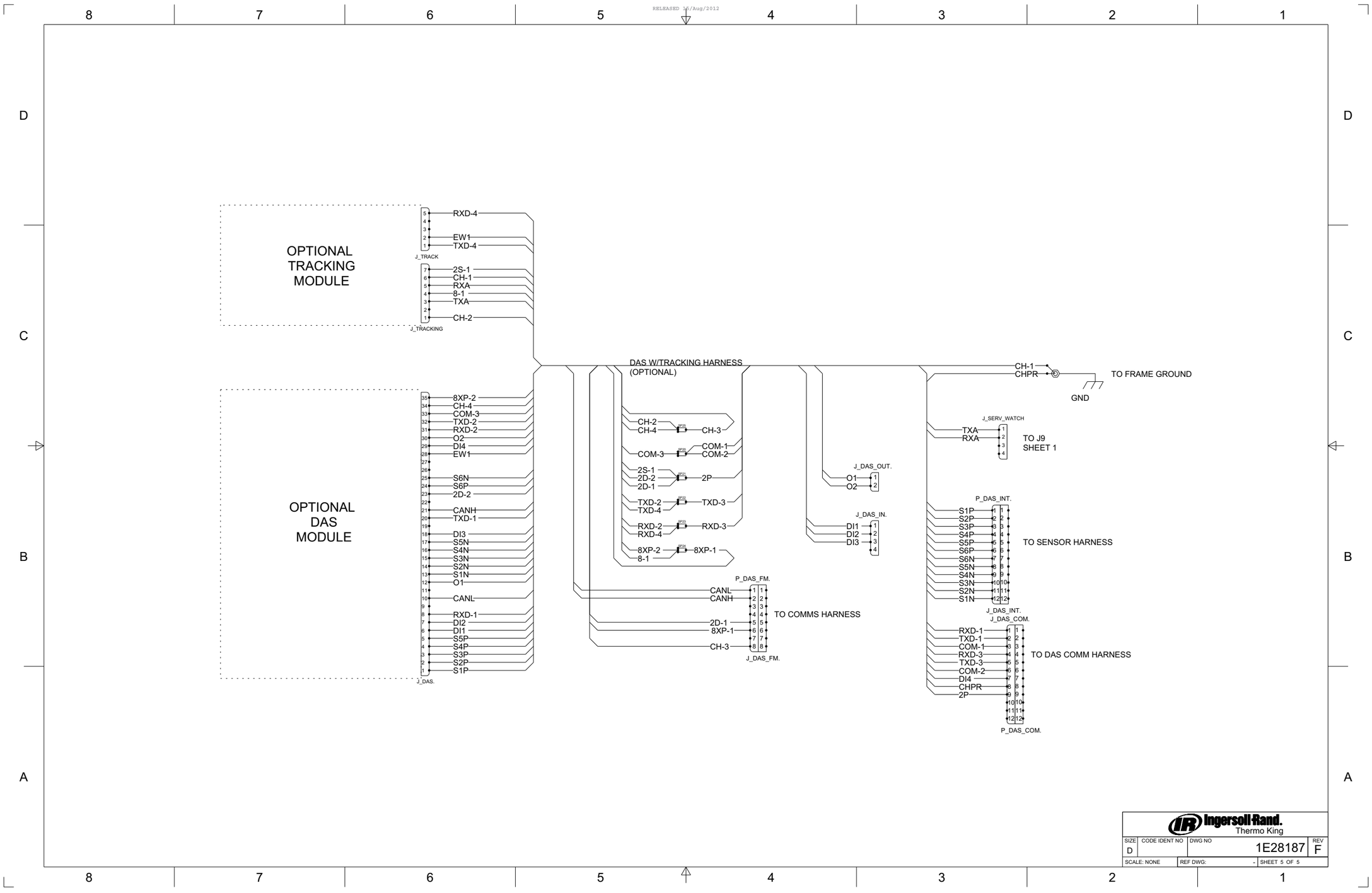

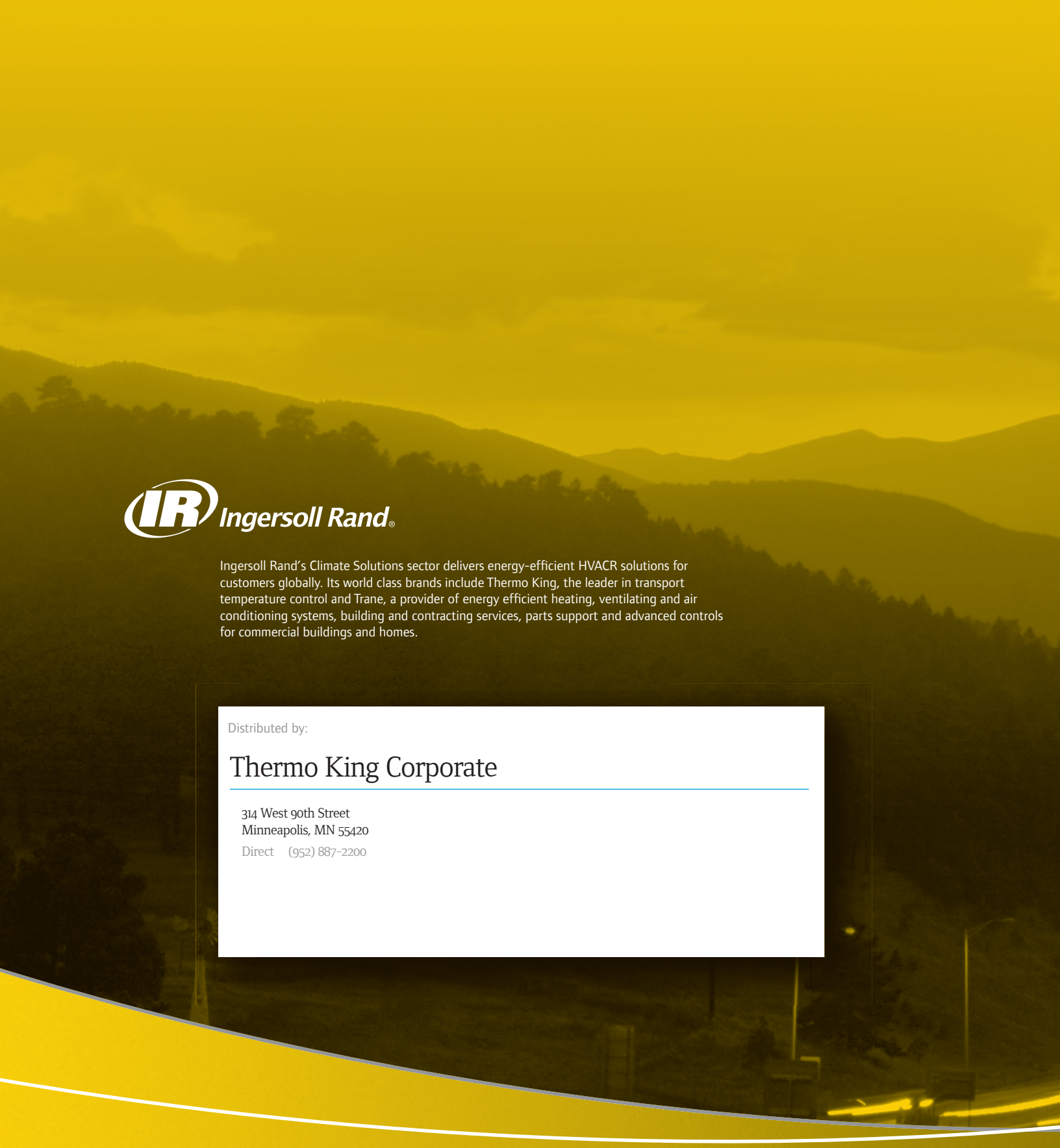

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