SB-210/SB-310

TK 51586-2-MM (Rev. 0, 01/04)

The maintenance information in this manual covers unit models:	
System SB-210 30 Base (920190)	
SB-210 30 Base (002158)	
System SB-210 30 ETV (920044)	
SB-210 30 ETV (002117)	
System SB-210 50 (920045)	
SB-210 50 (002118)	
System SB-310 30 (920046)	
SB-310 30 (002119)	
For further information, refer to:	
SB-210/SB-310 Operator's Manual	**TK 51585**
SB-210 Parts Manual	**TK 51584**
SB-310 Parts Manual	**TK 51609**
SR-2 Microprocessor Control System Diagnostic Manual	**TK 51587**
TK482 and TK486 Engine Overhaul Manual	**TK 50136**
X214, X418, X426 and X430 Compressor Overhaul Manual	**TK 6875**
Diagnosing TK Refrigeration System	**TK 5984**
Tool Catalog	**TK 5955**
Evacuation Station Operation and Field Application	**TK 40612**
ElectroStatic Discharge (ESD) Training Guide	**TK 40282**
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units.	

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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.

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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 16.

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

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

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

Battery Removal

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

This order is important because the frame is grounded to the negative battery terminal. If the negative terminal is still connected, a complete circuit exists from the positive terminal of the battery to the frame. Metal objects contacting the positive side and the frame simultaneously will cause sparks or arcing. If there are sufficient hydrogen gases emitted from the battery, an explosion might occur, causing equipment damage, serious injury, even death.

Refrigerant Hazards

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

DANGER: Store refrigerant in proper containers, out of direct sunlight and away from intense heat. Heat increases pressure inside storage containers, which can cause them to burst.

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

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

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

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

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

Refrigerant Oil Hazards

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

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

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

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

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

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

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

Electrical Hazards

High Voltage

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

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

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

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

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

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

WARNING: Use caution when working with electrical circuits that contain capacitors. Some capacitors hold a significant charge that might cause burns or shocks if accidentally discharged. Allow *** minutes for capacitors to discharge before working on electrical circuits.

Low Voltage

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

WARNING: Do not wear jewelry, watches or rings because they increase the risk of shorting out electrical circuits and damaging equipment or causing severe burns.

Microprocessor Service Precautions

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

Observe the following precautions when servicing a microprocessor control system to avoid damaging electronic components. Refer to the appropriate microprocessor diagnosis manual and the Electrostatic Discharge Training Guide (TK 40282) for more information.

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

Welding Precautions

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

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

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

First Aid

First Aid, Refrigerant

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

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

SKIN: Flush area with large amounts of warm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection. CALL A PHYSICIAN. Wash contaminated clothing before reuse.

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

First Aid, Refrigerant Oil

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

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

First Aid, Engine Coolant

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

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

First Aid, Electrical Shock

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

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

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

Specifications

Engine

Model	TK 486
Number of Cylinders	4
Cylinder Arrangement	In-line vertical, number 1 on flywheel end
Firing Order	1-3-4-2
Direction of Rotation	Counterclockwise viewed from flywheel end
Fuel Type	No. 2 diesel fuel under normal conditions No. 1 diesel fuel is acceptable cold weather fuel
Oil Capacity	13 quarts (12.3 liters) crankcase Fill to full mark on dipstick
Oil Type	API Classification CG-4 or better (ACEA Rating E2-96 or better for Europe)
Oil Viscosity	5 to 122 F (-15 to 50 C): SAE 15W-40 -13 to 104 F (-25 to 40 C): SAE 10W-40 -13 to 86 F (-25 to 30 C): SAE 10W-30 -22 to 32 F (-30 to 0 C): SAE 5W-30
Engine rpm: SB-210 Low Speed Operation SB-210 High Speed Operation SB-310 Low Speed Operation SB-310 High Speed Operation	1450 ± 25 rpm 2200 ± 25 rpm 1450 ± 25 rpm (1720 ± 25 rpm with High Capacity Fresh Option) 2600 ± 25 rpm
Engine Oil Pressure	18 psi (127 kPa) minimum in low speed 45 to 57 psi (310 to 390 kPa) in high speed
Intake Valve Clearance	0.006 to 0.010 in. (0.15 to 0.25 mm)
Exhaust Valve Clearance	0.006 to 0.010 in. (0.15 to 0.25 mm)
Valve Setting Temperature	70 F (21 C)
Fuel Injection Timing: SB-210 SB-310	10 degrees BTDC (timed on No. 1 cylinder) 11 degrees BTDC (timed on No. 1 cylinder)
Low Oil Pressure Switch (Normally Closed)	17 ± 3 psi (117 ± 21 kPa)
Engine Coolant Thermostat	180 F (82 C)

Engine (Continued)

Engine Coolant Type		ELC (Extended Life Coolant), which is “RED” Use a 50/50 concentration of any of the following equivalents: Chevron Dex-Cool Texaco ELC Havoline Dex-Cool® Havoline XLC for Europe Shell Dexcool® Shell Rotella Saturn/General Motors Dex-Cool® Caterpillar ELC Detroit Diesel POWERCOOL® Plus ***CAUTION: Do not add “GREEN” or “BLUE-GREEN” conventional coolant to cooling systems using “RED” Extended Life Coolant, except in an emergency. If conventional coolant is added to Extended Life Coolant, the coolant must be changed after 2 years instead of 5 years.***
Coolant System Capacity		7.5 quarts (7.1 liters)
Radiator Cap Pressure		7 psi (48 kPa)
Drive:	Model 30	Direct to compressor; belts to fans, alternator, and water pump
	Model 50	Centrifugal clutch to compressor; belts to electric standby motor, fans, alternator, and water pump

Belt Tension

Model 30	**Tension No. on TK Gauge P/N 204-427**
Alternator Belt	35
Lower Fan Belt (Engine to Idler)	67
Upper Fan Belt (Fan to Idler)	74
Model 50	
Alternator Belt	29
Compressor Drive Belts	79
Fan Belt	74
Water Pump Belt	35

Refrigeration System

Compressor		Thermo King X430L
Refrigerant Charge—Type:	SB-210 SB-310	13 lb (5.9 kg)—R404A 16 lb (7.3 kg)—R404A
Compressor Oil Charge		4.3 qt (4.1 liters)*
Compressor Oil Type		Polyol Ester type P/N 203-513
Mechanical Throttling Valve Setting (Units without ETV)		27 to 29 psi (186 to 200 kPa)
Heat/Defrost Method:	Engine Operation	Hot gas
	Electric Operation	Hot gas and electric heater strips
High Pressure Cutout		470 +7/-35 psi (3241 + 48/-241 kPa)
		Automatic reset @ 375 ± 38 psi (2586 ± 262 kPa)
**** When the compressor is removed from the unit, oil level should be noted or the oil removed from the compressor should be measured so that the same amount of oil can be added before placing the replacement compressor in the unit.***		

Electrical Control System

Voltage		12.5 Vdc
Battery		One, group C31, 12 volt battery
Fuses		See Unit Description and Electrical Maintenance Chapters
Battery Charging:	Model 30	12 volt, 37 amp, brush type alternator
	Model 50	12 volt, 105 amp, brush type alternator
Voltage Regulator Setting		13.8 to 14.2 volts @ 77 F (25 C)
NOTE: Fuse F4 (Bypass Resistor for Prestolite Alternator) must be removed for the Bosch Alternator. The Bosch alternator has the word "BOSCH" on the end opposite the pulley (see Figure 58 on page 65).		

Electrical Components

NOTE: Disconnect components from unit circuit to check resistance.			
Component		**Current Draw (Amps) at 12.5 Vdc**	**Resistance—Cold (Ohms)**
Fuel Solenoid:	Pull-in Coil	35 to 45	0.2 to 0.3
	Hold-in Coil	0.5	24 to 29
Damper Solenoid		5.7	2.2
High Speed (Throttle) Solenoid		2.9	4.3
Air Heater		89	0.14
Pilot Solenoid		0.7	17.0
Electronic Throttling Valve:			
Coil A (Red [EVA] and Blue [EVB] Wires)		—	20 to 35
Coil B (Black [EVC] and White [EVD] Wires)		—	20 to 35
Hot Gas Bypass Valve		1.1	11.1
Starter Motor—Gear Reduction Type		250-375*	
**** On-the-engine cranking check. Bench test is approximately 80 amps on the gear reduction starter.***			

Electrical Standby (Model 50 Units Only)

Electric Motor and Overload Relay

Voltage/Phase/Frequency	Horsepower	Kilowatts	rpm	Full Load (amps)	Overload Relay Setting (amps)
230/3/60	14.0	10.4	1755	37.8	40
460/3/60	14.0	10.4	1755	18.9	20

Electric Heater Strips

Number	3
Watts	1000 watts (each)
Resistance	48 ohms (each)

Standby Power Cord Requirements

Supply Circuit Breaker:	230/3/60	70 amps
	460/3/60	40 amps
Extension Cord Size:	230/3/60	8 AWG Power Cable, 25 to 50-foot length
	230/3/60	6 AWG Power Cable, 75-foot length
	460/3/60	10 AWG Power Cable, up to 75-foot length

Maintenance Inspection Schedule

Pretrip	Every 1,500 Hours	Every 3,000 Hours*	Annual/ 4,500 Hours	Inspect/Service These Items
				Microprocessor
•				Run Pretrip Test (see “Pretrip Tests” in the Operating Manual).
				Engine
•				Check fuel supply.
•				Check engine oil level.
•	•	•	•	Inspect belts for condition and proper tension (belt tension tool No. 204-427).
•	•	•	•	Check engine oil pressure hot, on high speed (should display “OK”).
•	•	•	•	Listen for unusual noises, vibrations, etc.
•				Check air cleaner restriction indicator (change filter when indicator reaches 25 in.). Replace EMI 3000 air cleaner element (see “EMI 3000 Air Cleaner Assembly” on page 93) at 3,000 hours or two years (whichever occurs first) if indicator has not reached 25 in.
	•	•	•	Drain water from fuel tank and check vent.
	•	•	•	Inspect/clean fuel transfer pump inlet strainer (prefilter).
	•	•	•	Check and adjust engine speeds (high and low speed).
	•	•	•	Check condition of drive coupling bushings per Service Bulletin T&T 171.
			•	Check engine mounts for wear.
		•		Replace fuel filter/water separator.
		•		Change engine oil and oil filter (hot). Requires oil with API Rating CG-4 or better (ACEA Rating E2-96 for Europe).
			—	Change ELC (red) engine coolant every 5 years or 12,000 hours. Units equipped with ELC have an ELC nameplate on the expansion tank (see page 77).
			—	Test fuel injection nozzles at least every 10,000 hours.
				Electrical
	•	•	•	Inspect battery terminals and electrolyte level.
	•	•	•	Inspect wire harness for damaged wires or connections.
•	•	•	•	Check operation of damper door (closes on defrost initiation and opens on defrost termination).
			•	Inspect alternator wire connections for tightness.
			•	Inspect electric motor, replace bearings yearly or every 6,000 hours.

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

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

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

Unit Description

Unit Overview

The Thermo King SB-210/SB-310 is a one piece, self-contained, diesel powered, air cooling/heating unit operating under the control of a programmable microprocessor controller. The unit mounts on the front of the trailer with the evaporator extending through an opening in the front wall.

The SB-210/SB-310 features air cooling and heating using a quiet running Thermo King TK 486, 4-cylinder, water cooled, direct injection diesel engine.

The SB-210 and SB-310 are available in the following three models:

- SB-210 30: Cooling and heating on diesel engine operation.
- SB-210 50: Cooling and heating on diesel engine operations and electric standby operation.
- SB-310 30: Cooling and heating on diesel engine operation.

AJA1617

Figure 1: SB-210/SB-310 Front View

Design Features

The following chart lists key design features and options.

● Standard Features

❍ Option/Factory Installed

❑ Option/Dealer Installed

SB-210/SB-310 Key Features & Options	SB-210 Model 30	SB-210 Model 50	SB-310 Model 30
SMART REEFER SR-2 Controller	●	●	●
OptiSet™ with FreshSet™ Programmable Modes	●	●	●
ETV (Electronic Throttling Valve)	❍	●	●
ServiceWatch™	●	●	●
CargoWatch™	❍	❍	❍
EMI-3000	●	●	●
High-Capacity Condenser Coil	●	●	●
Whisper Quiet Technology	❍	●	●
Easy-access door design	●	●	●
Composite Exterior Panels	●	●	●
Long-Life Coolant/SIlicone Hoses	●	●	●
Remote Status Light	❍	●	●
Standard Unit Color White	●	●	●
Standard Grille Color Black	●	●	●
Directional Air Delivery	●	●	●
Vibration Isolation System	●	●	●
Aluminum Undermount Fuel Tank 50 Gal. (186 Liter)	●	●	●
Fuel Heater	❍	❍	❍
Frost Plug Heater	❍	❍	❍
Alternator, 65 Amp, 12V dc	❍	❍	❍
Special Color Grills	❍	❍	❍
Fresh Air Exchange	❍	❍	❍
i-Box™ Interface	❍ / ❑	❍ / ❑	❍ / ❑
R:COM™ Automatic Data Transmission System	❍ / ❑	❍ / ❑	❍ / ❑
FleetWatch™ Data Manager	❑	❑	❑
TracKing™ Satellite Communications Kit	❑ / ❍	❑ / ❍	❑ / ❍
TracKing™ Cellular Communications Kit	TBA	TBA	TBA
PrimAir™ bulkhead and duct system	❑	❑	❑
Rear Remote Control	TBA	TBA	TBA
CargoWatch™ Accessories:			
Door Switches	❍ / ❑	❍ / ❑	❍ / ❑
Temperature Sensor Kits	❍ / ❑	❍ / ❑	❍ / ❑
Humidity Sensor Kits	❍ / ❑	❍ / ❑	❍ / ❑
Fuel Level Sensor Kits	❍ / ❑	❍ / ❑	❍ / ❑
Megatech Battery, 12V	❑	❑	❑

Diesel Engine

The unit is equipped with a quiet running Thermo King TK 486, a 4-cylinder, water cooled, direct injection diesel engine, rated at 34 continuous horsepower at 2200 rpm. The engine is coupled directly to the compressor on the Model 30. A centrifugal clutch transfers power from the engine to the compressor on the Model 50. Belts transmit power to the unit fans, alternator, and water pump.

Thermo King X430L Reciprocating Compressor

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

Electronic Throttling Valve

The Electronic Throttling Valve (ETV) is optional on the Model SB-210 30 and standard on the Models SB-210 50 and SB-310 30.

The Electronic Throttling Valve (ETV) is a variable position valve operated by a stepper motor. The ETV is located in the suction line between the evaporator and the heat exchanger. Discharge and suction pressure transducers supply pressure information to the microprocessor control system. The microprocessor controls the electronic throttling valve directly. The ETV replaces both the throttling valve and the modulation valve used in other units. The ETV system also uses a hot gas bypass valve like the one used with the modulation valve in other units.

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

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

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

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

Modulation Control: The ETV system replaces the modulation valve. The modulation control algorithm operates much the same as modulation on other units.

SMART REEFER 2 (SR-2) Control System

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

The SR-2 is a microprocessor control system designed for a transport refrigeration system. The SR-2 integrates the following functions:

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

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

See the Operating Instructions Chapter for more information about the SR-2 controller.

CYCLE-SENTRY Start-Stop Controls

WARNING: Press the OFF key on the HMI control panel before opening doors or inspecting any part of the unit. The unit may start at any time without warning if it has been turned on with the ON key.

The CYCLE-SENTRY system automatically starts the unit on microprocessor demand, and shuts down the unit after those conditions are satisfied.

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

Your Thermo King unit provides a wide range of control and programming flexibility. However, pre-programming of the unit controller may prohibit operation in certain temperature ranges within some modes and may also prohibit certain modes of operation. If you have controller programming questions, contact your supervisor before requesting service.

The CYCLE-SENTRY system automatically starts the unit on microprocessor demand, and shuts down the unit when all demands are satisfied. As well as maintaining the box temperature, engine block temperature and battery charge levels are monitored and maintained. If the block temperature falls below 30 F (-1 C), the engine will start and run until the block temperature is above 90 F (32 C). If the battery voltage falls to the programmed limit selected by CYCLE-SENTRY Battery Voltage (typically 12.2 volts) and Diesel CYCLE-SENTRY mode is selected, the engine will start and run until the charge rate falls below that programmed by CYCLE-SENTRY Amps (typically 5 amperes).

Features of the CYCLE-SENTRY system are:

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

Data Logging

Trip data is logged and retrieved as follows:

ServiceWatch™: ServiceWatch™ is standard equipment. It is an integrated data logging system that records operating events, alarm codes and compartment temperatures as they occur and at preset intervals.

CargoWatch™: CargoWatch™ is an optional datalogger systems that logs data of up to six temperature sensor/probes, four door switches, humidity sensor, data averaging and programmable, temperature out of range alarms.

The data can be retrieved using an IBM® PC compatible laptop or desktop computer and Thermo King WinTrac 4.4 (or higher) software. The computer is connected to the Cargo Watch Port on the front of the control box. Detailed graph or table trip reports can then be created.

If optional temperature sensors are installed, a directly connected printer can be used to print a report of the sensor readings. The printer is connected to the Service Watch Port.

Standard and Optional Temperature/Data Management Systems

OptiSet™: Optiset™ allows an entire fleet to be configured to match customers' needs (up to 10 preset conditions). OptiSet™ is standard equipment. Refer to TK 51587 SR-2 Microprocessor Control System Diagnostic Manual for configuration instructions.

FreshSet™: FreshSet™ is a demand base temperature control for fresh products. FreshSet™ modifies and adjusts unit airflow operation to control temperature and to maximize protection of cargo, while keeping operating costs to a minimum. FreshSet™ is standard equipment. Refer to TK51587 SR-2 Microprocessor Control System Diagnostic Manual for configuration instructions.

FleetWatch™: FleetWatch™ is an optional software package designed to allow the fleet manager to retrieve, categorize and analyze collected information and schedule maintenance.

Sequence of Operation

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

Operating Modes

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

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

In electric operation (Model 50 units only) the drive motor operates at a single speed. It does not run in Null. Electric evaporator heaters are also used to increase the Heat and Defrost capacities during electric operation.

Diesel Operation

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

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

Electric Operation

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

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

Defrost

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

Automatic Defrost: The controller is programmed to automatically initiate timed or demand defrost cycles. The unit can enter defrost cycles as often as every 30 minutes if required.

Manual Defrost: In Manual Defrost Mode, the operator initiates a defrost cycle.

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

Defrost is initiated manually using the microprocessor **DEFROST** key. Defrost is initiated automatically on demand by the microprocessor or by a defrost timer.

The evaporator coil temperature must be below 45 F (7 C) to allow defrost. A Demand Defrost cycle will occur if the differences between the return air temperature, discharge air temperature, and coil temperature are greater than predetermined values.

Two defrost timers are used. When the unit is In-Range (within a few degrees of setpoint), Defrost intervals are controlled by the Defrost Interval In-Range timer (DEFI). This timer can be set for 4, 6, 8 or 12 hours. The standard setting is 6 hours. When the unit is not In-Range, Defrost intervals are determined by the Defrost Interval Not In-Range timer (DEFN). This timer can be set for 2, 4, 6, 8 or 12 hours. The standard setting is 4 hours. This feature allows a shorter Defrost interval to be used when the unit is out of range during a pull-down and more frequent Defrost cycles may be beneficial.

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

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

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

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

Engine Compartment Components

The following maintenance items can be checked visually.

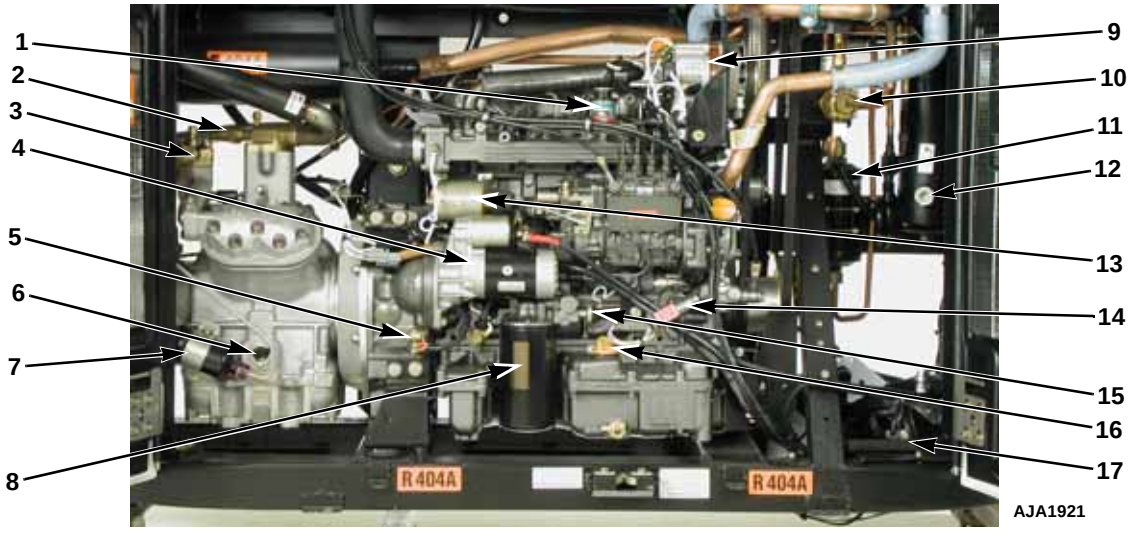
Air Filter Restriction Indicator: The air filter restriction indicator is attached to the engine intake manifold. When the diaphragm indicates 25, service the air filter. Press the button on the bottom of the restriction indicator to reset after servicing the air cleaner.

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

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

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

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



1.	Air Cleaner Indicator	10.	Three-Way Valve
2.	Suction Service Valve	11.	Filter Drier
3.	Discharge Service Valve	12.	Receiver Tank Sight Glass
4.	Engine Starter Motor	13.	Throttle Solenoid
5.	Engine RPM Sensor	14.	Hand Primer Pump
6.	Compressor Sight Glass	15.	Low Engine Oil Pressure Switch
7.	Compressor Oil Filter	16.	Engine Oil Dipstick
8.	Engine Oil Filter	17.	Battery Tray
9.	Alternator		

Figure 2: Engine Compartment Components

Unit Protection Devices

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

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

Fuse Link (Current Limiter): The fuse link is located in the positive battery cable. The fuse link protects the electric system from a short.

Fuses: Various fuses are located on the controller interface board to protect circuits and components. See “Fuses” on page 71 for more information.

High Pressure Cutout Switch: The high pressure cutout switch is located on the compressor discharge manifold. If the compressor discharge pressure becomes excessive, the switch opens the circuit to the fuel solenoid to stop the engine.

High Pressure Relief Valve: This valve is designed to relieve excessive pressure in the refrigeration system.

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

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

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

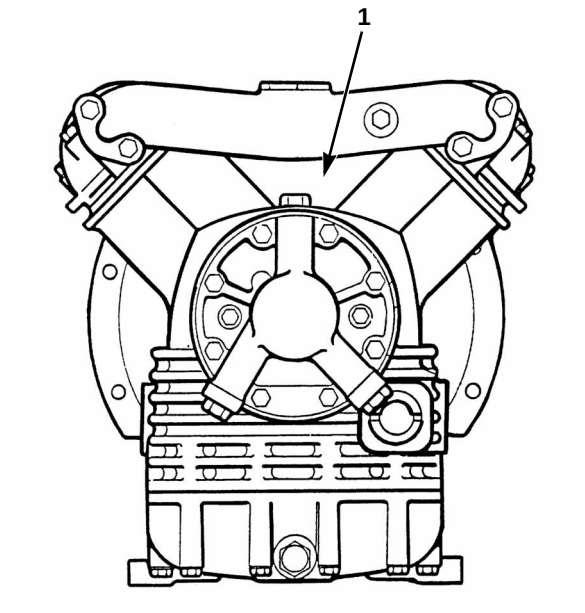
Overload Relay—Manual Reset (Model 50): An overload relay protects the standby electric motor. The overload relay opens the circuit to the electric motor if the motor overloads for any reason (e.g., low line voltage or improper power supply) while the unit is on electric standby operation.

Serial Number Locations

Unit: Nameplates on the bulkhead above the compressor inside the curbside door, and on the top, roadside corner of the evaporator.

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

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

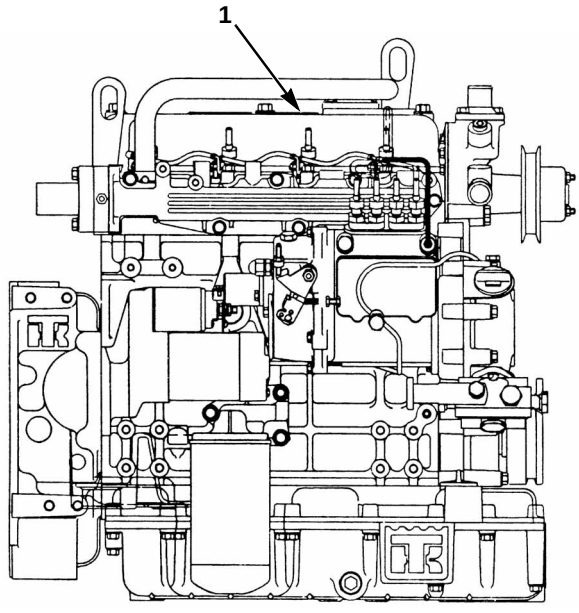


1.	Serial Number Location

Figure 3: Compressor Serial Number Location

1.	Serial Number Location

Figure 4: Unit Serial Number Locations



1.	Serial Number Location

Figure 5: Engine Serial Number Location

Unit Photos

AJA1617

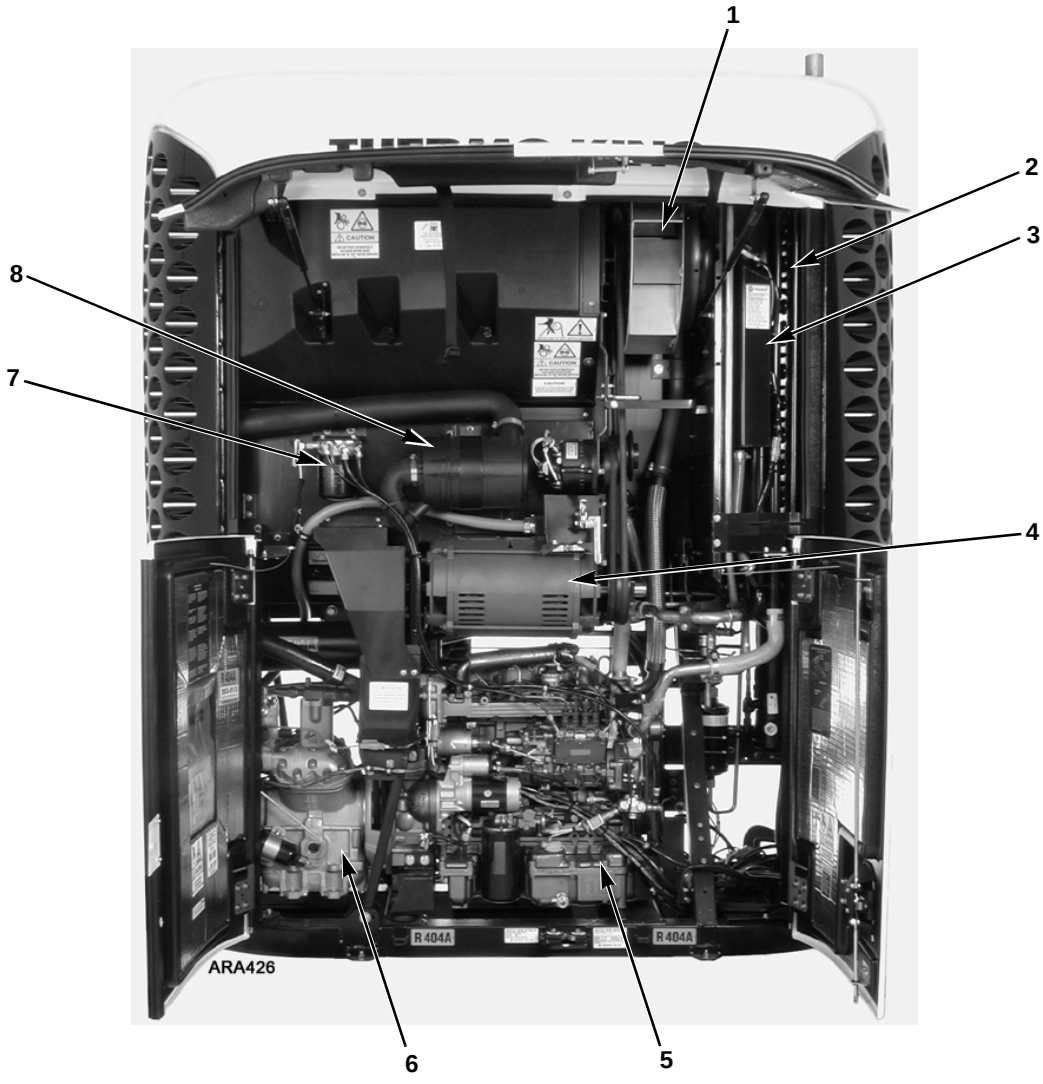
Figure 6: Front View

1.	Defrost Damper
2.	X430L Compressor
3.	TK 486 Engine

Figure 7: Back View

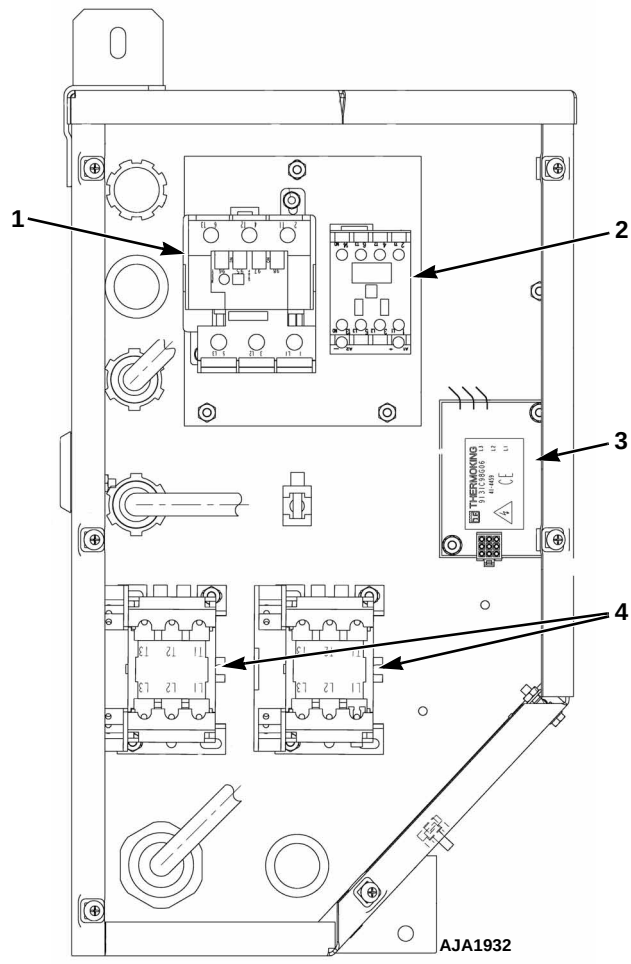
1.	Condenser Fan	5.	X430L Compressor
2.	Condenser Coil	6.	Fuel Filter/Water Separator
3.	Expansion Tank	7.	Air Cleaner
4.	TK 486 Engine		

Figure 8: Front View with Doors Open (Model 30)



1.	Condenser Fan	5.	Electric Motor
2.	Condenser Coil	6.	X430L Compressor
3.	Expansion Tank	7.	Fuel Filter/Water Separator
4.	TK 486 Engine	8.	Air Cleaner

Figure 9: Front View with Doors Open (Model 50)

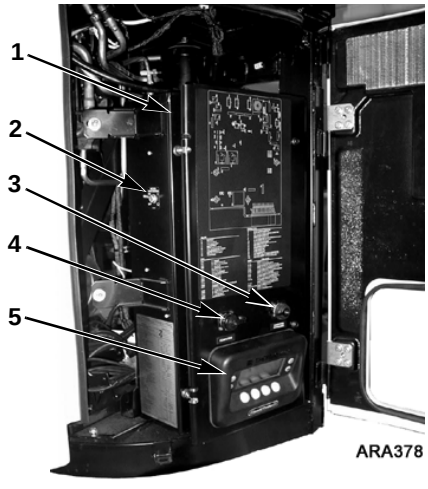


1.	Overload Relay
2.	Heaters Contactor
3.	Phase Selector
4.	Drive Motor Contactors

Figure 10: High Voltage Tray (Model 50 Only)

SMART REEFER 2 (SR-2) Control System

The microprocessor components are located inside the control box, which is located inside the lower roadside service door. The microprocessor is connected to an HMI (Human Machine Interface) Control Panel. It is used to operate the unit. The Cargo Watch and Service Watch ports are used to retrieve data from the data logging system.



1.	Control Box	4.	Cargo Watch Port
2.	Microprocessor On/Off Switch	5.	HMI Control Panel
3.	Service Watch Port		

Figure 11: Control Box With Service Door Open

Microprocessor On/Off Switch

This switch supplies or removes electrical power to the microprocessor. It is located on the left side of the control box.

CAUTION: The microprocessor On/Off switch must be placed in the Off position before connecting or disconnecting the battery or servicing the microprocessor system.

CAUTION: The microprocessor is vulnerable to damage from Electro Static Discharge (ESD). This damage is not always immediately apparent. As a result of ESD, a circuit can be damaged but may continue to operate temporarily, only to fail later.

HMI Control Panel

Use the HMI control panel to operate the unit. Refer to the SB-210/310 Operator's Manual TK 51585 and the SR-2 Microprocessor Control System Diagnostic Manual TK 51587 for more information.

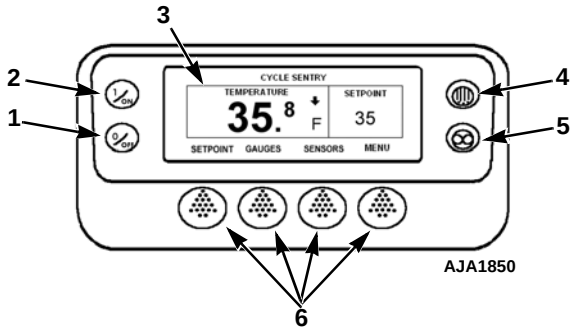
The HMI control panel has a display and eight touch sensitive keys. The display is capable of showing both text and graphics. The four keys on the left and right sides of the display are dedicated keys. The four keys under the display are "soft" keys. The function of "soft" keys change depending on the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

Figure 12: SR-2 HMI Control Panel

Control Panel Display

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

The default display is called the Standard Display. It is shown in Figure 13 and is described in detail later in this chapter.



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

Figure 13: Dedicated and Soft Keys

Control Panel Keys

The four keys on the left and right sides of the display screen are “dedicated keys”. See Figure 13. Their functions are listed below.

On Key: Press this key to turn the unit on. The Thermo King Logo screen will appear briefly. The display will then show the Standard Display of box temperature and setpoint when the unit is ready to run.

Off Key: Press this key to turn the unit off. The engine will stop immediately. Then the HMI control panel will enter the power-down sequence.

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

Mode Key: Press this key to switch back and forth between the CYCLE-SENTRY mode and the Continuous Run mode.

The four “soft” keys under the display are multi-purpose keys (see Figure 13). Their function changes depending on the operation being performed. If a soft key is active, it’s function will be shown in the display directly above the key.

Typical soft key applications:

- Set Point
- Gauges
- Sensors
- Menu
- Next/Back
- Yes/No
- +/ -
- Up /Down
- Select/Exit
- Clear/Help

Unit Operation

Manual Pretrip Inspection (Before Starting Unit)

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

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

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

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

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

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

Battery: The terminals must be clean and tight.

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

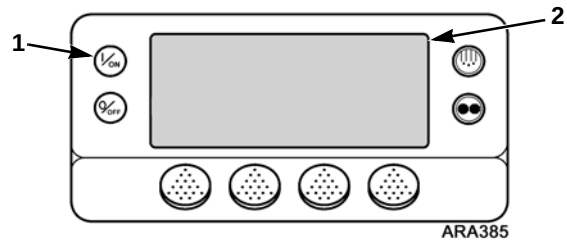
Electrical: The electrical connections should be securely fastened. The wires and terminals should be free of corrosion, cracks or moisture.

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

Turning Unit On

Complete the following steps to turn on the unit:

1. Press the **On** key.



1.	On Key
2.	Display

Figure 14: Press On Key

2. The display briefly shows a Thermo King Logo.

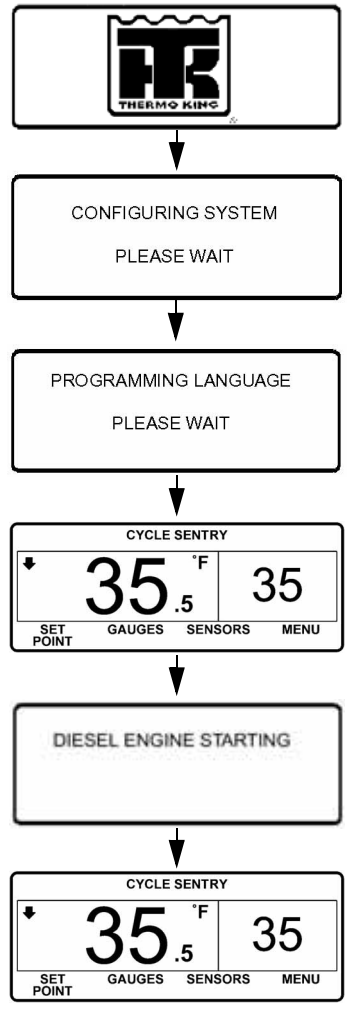


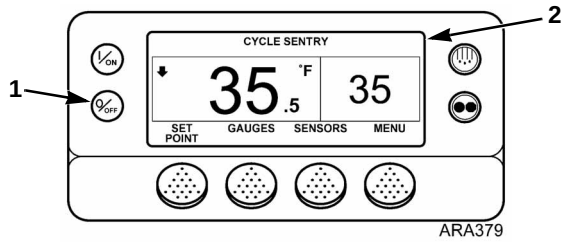
Figure 15: Turning Unit On Screen Sequence

3. The “Configuring System” Screen briefly appears while communications are established between the microprocessor and the HMI control panel.
4. The “Programming Language” Screen briefly appears.
5. The Standard Display showing box temperature and setpoint briefly appears.
6. The “Diesel Engine Starting” Screen briefly appears as the engine preheats and starts.
7. The Standard Display showing box temperature and setpoint reappears when the unit is running.

Turning Unit Off

Complete the following steps to turn unit off:

1. Press the **OFF** key.



1.	Off Key
2.	Display

Figure 16: Press Off Key

2. The engine will immediately shut off.
3. The “System is Powering Down” Screen will briefly appear.

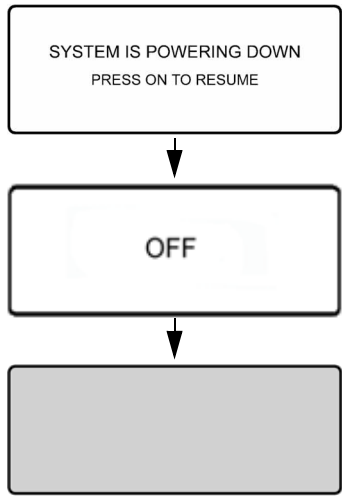
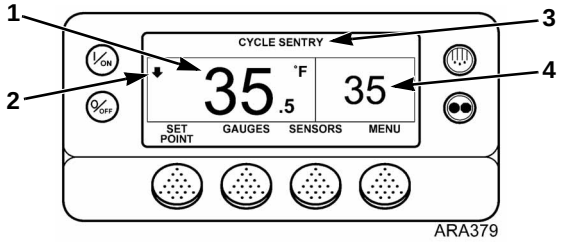


Figure 17: Turning Unit Off Screen Sequence

4. The Off Screen will briefly appear.
5. The screen goes blank when the unit power is off.

Standard Display

The Standard Display is the default display. It appears if no other display function is selected. The Standard Display shows the box temperature and setpoint. The box temperature is measured by the controlling sensor. This is usually the return air sensor. The box temperature shown below in Figure 18 is 35.5 F. The setpoint shown is 35 F. The top of the display shows the unit is operating in the CYCLE-SENTRY mode. The arrow pointing down indicates the unit is cooling.

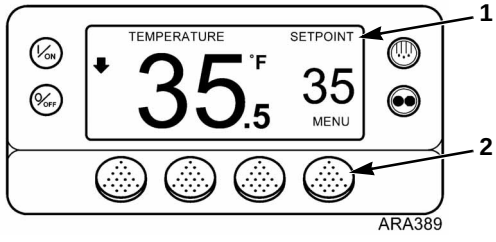


1.	Box Temperature	3.	CYCLE-SENTRY
2.	Cooling	4.	Setpoint

Figure 18: Standard Display

Temperature Watch Display

The Standard Display defaults to the Temperature Watch Display after about 2-1/2 minutes of non-use (when no keys are pressed). The Temperature Watch Display shows the same box temperature and setpoint but in larger fonts. This creates easy operator viewing from a distance. To return to the Standard Display press the **MENU** soft key (or any of the other three soft keys that are not assigned).



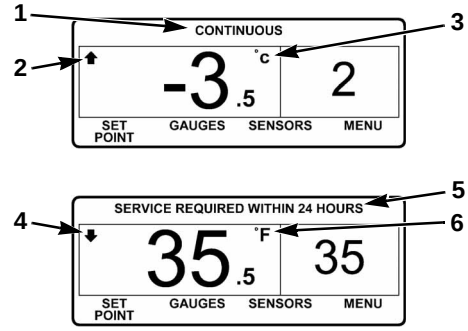
1.	Temperature Watch Display
2.	Menu Soft Key

Figure 19: Temperature Watch Display

Standard Display Variations

The Standard Display has variations. A display showing any of the following variations is still considered a Standard Display.

The top of the display will show that the unit is operating in either CYCLE-SENTRY or Continuous Mode. It may also display a service/alarm message. The temperature can be displayed in degrees Fahrenheit (F) or degrees Celsius (C). See Figure 20. An arrow pointing upwards indicates the unit is heating. An arrow pointing downwards indicates the unit is cooling.



1.	Continuous or CYCLE-SENTRY
2.	Heating
3.	Degrees Celsius
4.	Cooling
5.	Service/Alarm Message
6.	Degrees Fahrenheit

Figure 20: Standard Display Variations

Starting the Diesel Engine

Diesel engine preheats and starts automatically in both Continuous Mode and CYCLE-SENTRY mode. The engine will preheat and start if necessary 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 a key or sequence of keys are pressed on the controller before the engine starts, the engine will preheat and start approximately 10 seconds after pressing the last key.

See “Turning Unit On” on page 39.

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

WARNING: Never use starting fluid.

NOTE: Run a pretrip test if the unit has not been used recently. See “Pretrip Tests” on page 60.

Unit Fails To Start

If the engine fails to start within 15 seconds, take the following steps.

1. Check for and correct any alarm conditions. See “Viewing and Clearing Alarms Screen Sequence” on page 52.
2. Clear all alarms. See “Viewing and Clearing Alarms Screen Sequence” on page 52.
3. Press the **OFF** key to tun the unit off.
4. Press the **ON** key to turn the unit on.
5. The controller will go through the start up screens and then after a 10 second delay the unit will start automatically.
6. If the engine will still not start, turn the unit off. Determine and correct the cause for not starting.
7. Repeat the procedure.

After Start Inspection

After the unit is running, check the following items to confirm that the unit is running properly.

Oil Pressure: Check the engine oil pressure by pressing the **GAUGES** soft key. See “Viewing Gauge Readings” on page 47. The Engine Oil Pressure Display should indicate OK not LOW.

Ammeter: Check the ammeter reading by pressing the **GAUGES** soft key. See “Viewing Gauge Readings” on page 47. The Amps Display should indicate a positive charge amperage rate to the battery. A negative (-) number indicates a discharge condition.

Compressor Oil: The compressor oil level should be visible in the compressor sight glass after 15 minutes of operation.

Pre-Cooling: Make sure that the setpoint is at the desired temperature. See “Changing the Setpoint” on page 43. Allow the unit to run for a minimum of 30 minutes (longer if possible) before loading the trailer.

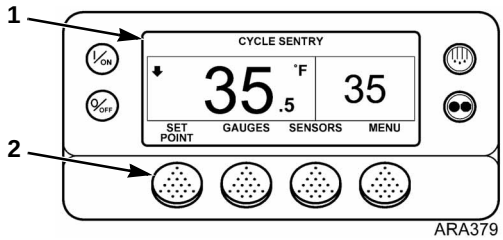
This provides a good test of the refrigeration system while removing residual heat and the moisture from the trailer interior to prepare it for a refrigerated load.

Defrost: When the unit has finished pre-cooling the trailer interior, manually initiate a Defrost cycle. See “Initiating a Manual Defrost Cycle” on page 46. This will remove the frost that builds up while running the unit to pre-cool the trailer.

Changing the Setpoint

To change the setpoint complete the following steps.

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **SETPOINT** soft key on the Standard Display. See Figure 21. The "Current Setpoint" Screen appears. See Figure 22.



1.	Standard Display
2.	Setpoint Soft Key

Figure 21: Changing Setpoint

3. Press the **+** or **-** soft keys to change the setpoint reading. See Figure 22.
4. Press the **YES OR NO** soft key accordingly as described below. See Figure 22.

- If the **NO** key is pressed the setpoint change made with the "+" or "-" soft keys ***will not*** be accepted, the setpoint will not be changed and the display will return to the Standard Display.

  NOTE: This generates an Alarm Code 127 "Setpoint Not Entered". See Figure 22.

- If the **YES** soft key was pressed, the setpoint change made with the "+" or "-" soft keys will be accepted, and the following screens will appear.

5. The "Programming New Setpoint" Screen will appear. See Figure 22.
6. The "New Setpoint Is XX" Screen briefly appears. See Figure 22.
7. The Standard Display appears with setpoint changed to the new setpoint. See Figure 22.

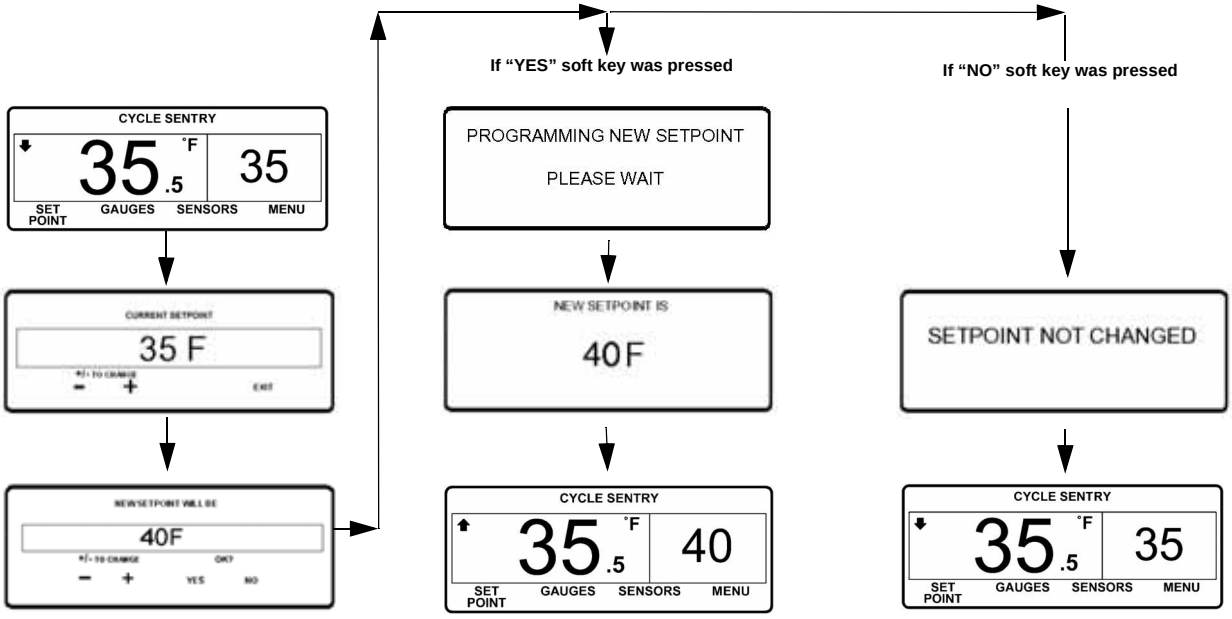


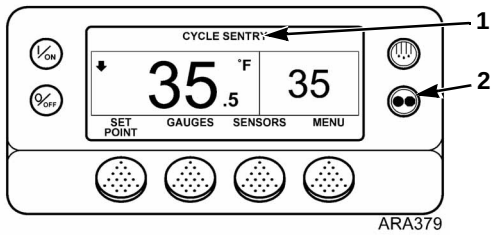
Figure 22: Changing the Setpoint Screen Sequence

Selecting CYCLE-SENTRY or Continuous Mode

When CYCLE-SENTRY mode is selected the unit will start and stop automatically to maintain the 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. Complete the following steps to change modes:

NOTE: The mode can also be changed using the Mode Menu Screen in the Operator Menu. See "Selecting CYCLE-SENTRY or Continuous Mode" on page 56.

1. Press the **MODE** key. See Figure 23.



1.	Shows Mode Selected
2.	Mode Key

Figure 23: Changing Mode

2. The "Programming Continuous Mode" or "Programming CYCLE-SENTRY Mode" Screen briefly appears. See Figure 24 and Figure 25.
3. The "New System Mode is Continuous" Screen or the "New System Mode CYCLE-SENTRY" Screen briefly appears. See Figure 24 and Figure 25.
4. The Standard Display appears and the bar on top of screen reads the new mode. See Figure 24 and Figure 25.
5. Press the **MODE** key again to change the unit back to the previous mode.

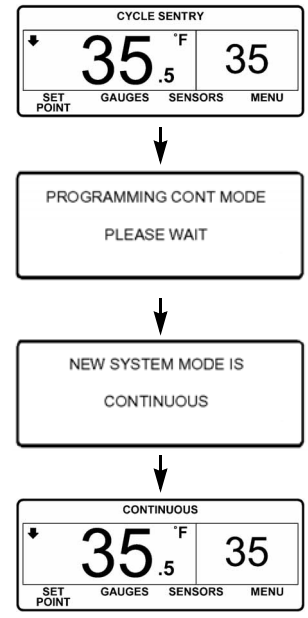


Figure 24: Screen Sequence for Changing from CYCLE SENTRY Mode to Continuous Mode

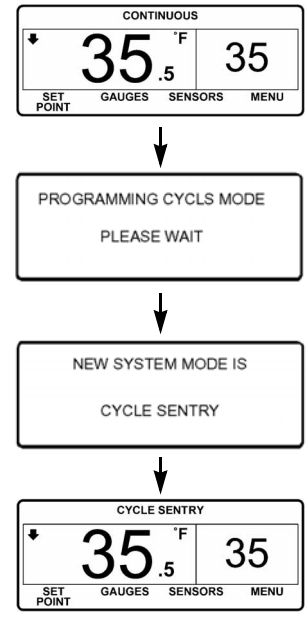


Figure 25: Screen Sequence for Changing from Continuous Mode to CYCLE-SENTRY Mode

Selection of Operating Modes

The Thermo King CYCLE-SENTRY system is designed to save refrigeration fuel costs. The savings vary with the commodity, ambient temperatures and trailer insulation. However, not all temperature controlled products can be properly transported using CYCLE-SENTRY operation. Certain highly sensitive products normally require continuous air circulation.Use the following guidelines to select the proper operating mode to protect the commodity you are transporting.

Examples of products normally acceptable for CYCLE-SENTRY Operation:

- Frozen foods (in adequately insulated trailers)
- Boxed or processed meats Poultry
- Fish
- Dairy products
- Candy
- Chemicals
- Film
- All non-edible products.

Examples of products normally requiring Continuous Run Operation for air flow:

- Fresh fruits and vegetables, especially asparagus, bananas, broccoli, carrots, citrus, green peas, lettuce, peaches, spinach, strawberries, sweet corn, etc.
- Non-processed meat products (unless pre-cooled to recommended temperature).
- Fresh flowers and foliage.

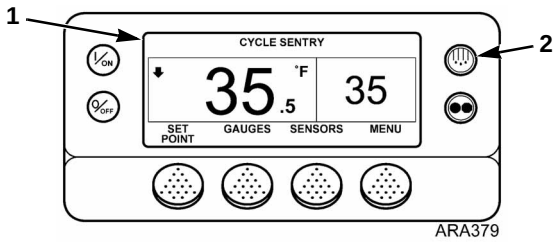
The above listings are not all inclusive. Consult your grower or shipper if you have any questions about the operating mode selection of your type of load.

Initiating a Manual Defrost Cycle

Defrost cycles are usually initiated automatically based on time or demand. Manual Defrost is also available if the unit is running and the coil temperature is less than 45 F (7 C). Other features such as door switch settings may not allow Manual Defrost to be initiated.

Use the following steps to initiate a Manual Defrost:

1. Press the **DEFROST** key. See Figure 26.



1.	Standard Display
2.	Defrost Key

Figure 26: Initiating a Manual Defrost Cycle

2. The “Defrost” Screen briefly appears. See Figure 27.
3. The “Programming Defrost” Screen briefly appears. See Figure 27.
4. The “Defrost Started” Screen briefly appears. See Figure 27.
5. A modified Standard Display appears. The bar indicator will fill in showing time remaining to complete the Defrost cycle. The bar indicator in the figure shows that the Defrost cycle is 50% complete. When the Defrost cycle is complete the display returns to the Standard Display. See Figure 27.

   If the unit is prevented from going into a Manual Defrost (IE: Coil temperature more than 45 F (7 C) or on economy mode etc.). A “Defrost Unavailable” Screen briefly appears. The display returns to the Standard Display. See Figure 27.

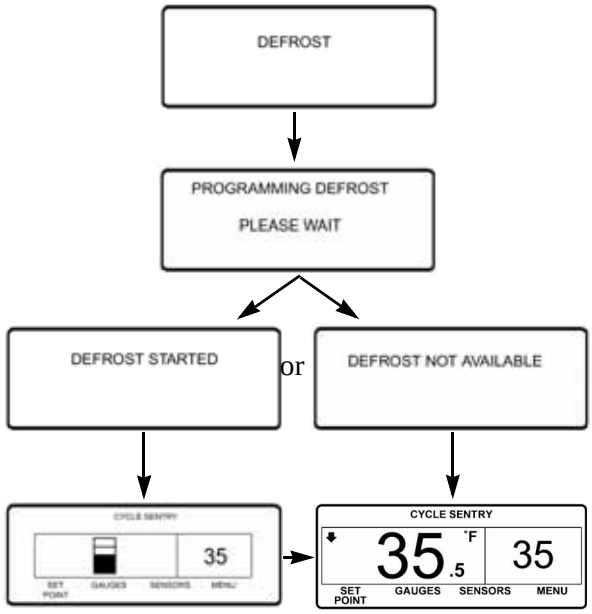


Figure 27: Initiating Manual Defrost Screen Sequence

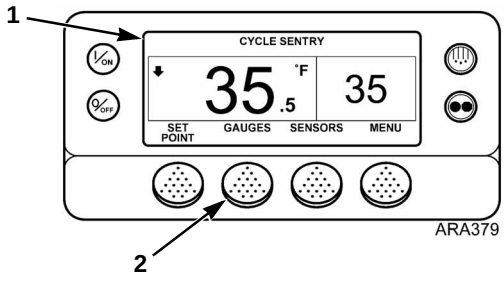
Terminating a Defrost Cycle

The Defrost cycle will terminate automatically when the coil temperature is greater than 58 F (14 C) or the defrost timer expires. Defrost can also be terminated by turning the unit off.

Viewing Gauge Readings

Use the following steps to view miscellaneous gauge readings:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **GAUGES** soft key. See Figure 28.



1.	Standard Display Screen
2.	Gauges Soft Key

Figure 28: Viewing Gauges

3. Press **BACK** or **NEXT** soft keys to scroll through following gauges: Coolant Temperature, Coolant Level, Engine Oil Pressure, Amps, Battery Voltage, Engine RPM, Discharge Pressure, Suction Pressure, ETV Position, and I/O. Selecting I/O enters a group of screens that show the status (On or Off) of the High Speed Relay, Run Relay, Defrost Damper, Heat Output, and Hot Gas Bypass. See Figure 29. If no keys are pressed within 30 seconds, the screen will return to the standard display.

   NOTE: Units without an ETV will not display the Discharge Pressure, Suction Pressure, and ETV Position.

4. Press the **LOCK** soft key to display any Gauge Screen for an indefinite period. Press the key again to unlock the screen.
5. Press the **EXIT** soft key to return to the Standard Display.

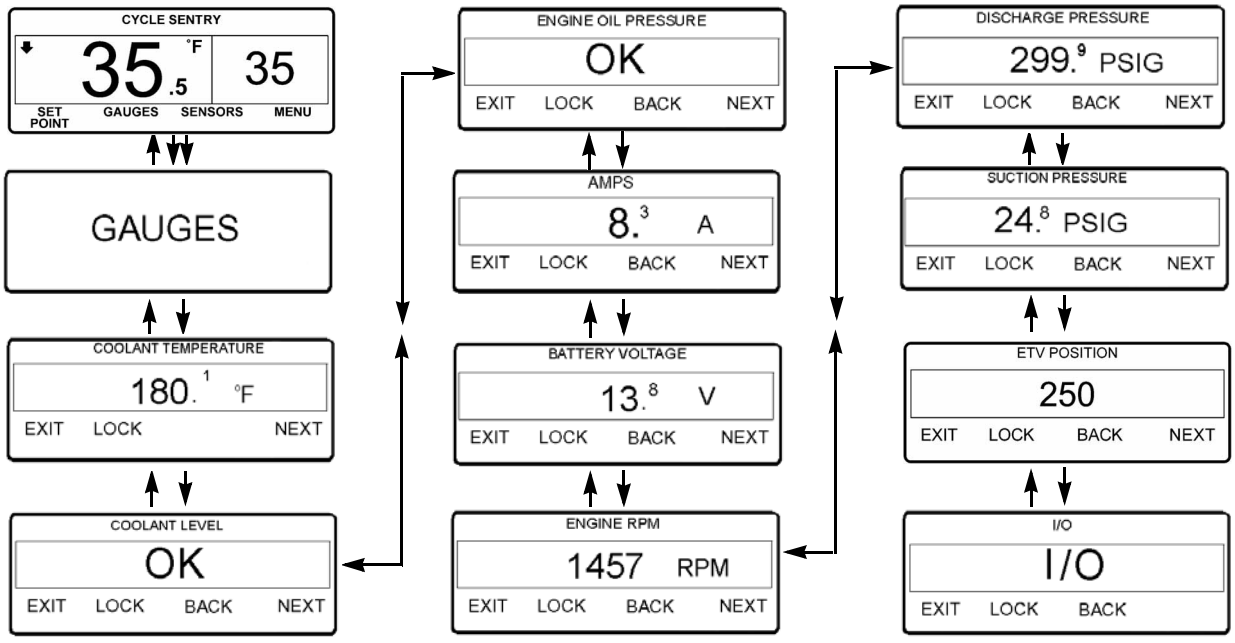
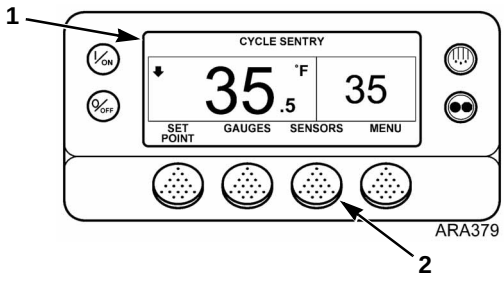


Figure 29: Viewing Gauges Screen Sequence

Viewing Sensor Readings

Use the following steps to view miscellaneous sensor readings.

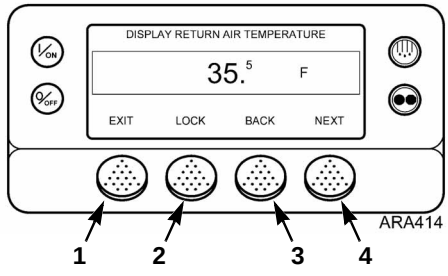
1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **SENSOR** soft key. See Figure 30.



1.	Standard Display
2.	Sensors Soft Key

Figure 30: Viewing Sensors

3. Press the **BACK** or **NEXT** soft keys to scroll through the following sensor screens: Control Return Air Temperature, Display Return Air Temperature, Control Discharge Air Temperature, Display Discharge Air Temperature, Temperature Differential, Evaporator Coil Temperature, Ambient Air Temperature, Spare 1 Temperature, optional Datalogger Temperature Sensors 1-6 and Board Temperature Sensor. See Figure 31 and Figure 32. If no keys are pressed within 30 seconds, the screen will return to the Standard Display.



1.	Exit Soft Key	3.	Back Soft Key
2.	Lock Soft Key	4.	Next Soft Key

Figure 31: Soft Keys

4. Press the **LOCK** soft key to display any sensor screen for an indefinite period. Press the key again to unlock the screen.
5. Press the **EXIT** soft key to return to the Standard Display.

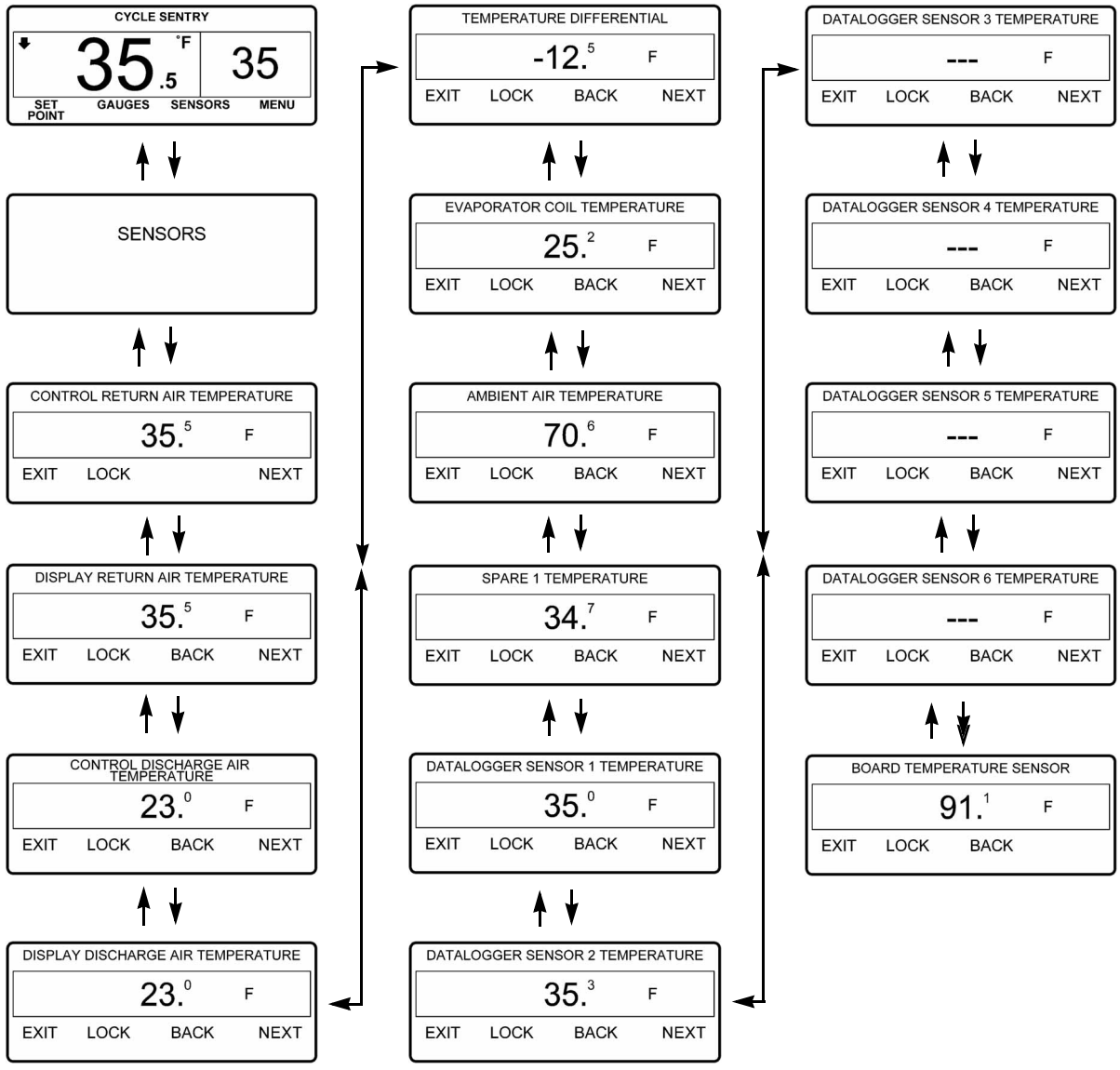


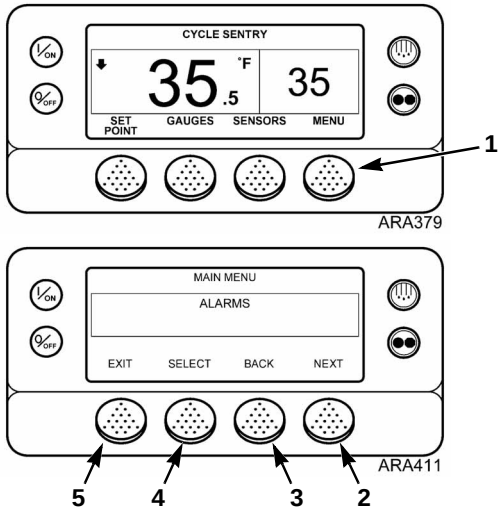
Figure 32: Viewing Sensors Screen Sequence

Navigating the Operator Menu

The Operator Menu contains nine individual menu areas that allow the operator to view information and modify unit operation. Use the following steps to access these menu areas:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key. See Figure 33.
3. Press **NEXT** and **BACK** soft keys to scroll up or down through the nine main menu areas. See Figure 33 and Figure 34.
4. Press the **SELECT** soft key to access a specific menu area when shown on the display screen. See Figure 33.
5. Press the **EXIT** soft key. To return to the Standard Display. The Operator Menu choices are shown on the next page. For detailed information on each menu area, see the individual explanations of each menu item on the following pages of this manual.

NOTE: The Language Menu and the Electric Standby/Diesel Mode Display will not appear unless enabled.



1.	Menu Soft Key	4.	Select Soft Key
2.	Next Soft Key	5.	Exit Soft Key
3.	Back Soft Key		

Figure 33: Accessing Operator Menu

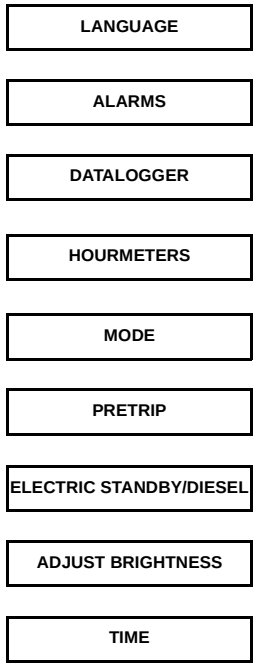


Figure 34: Main Menu Choices

Operator Menu Choices

1. Language Menu: If enabled, allows the operator to select a language from a list of 11 languages. All other subsequent displays are shown in the selected language. English is the default language. See page 51.

2. Alarms Menu: Shows any active alarms and allows alarms to be cleared. See page 52.

3. Datalogger Menu: Allows the operator to view the datalogger displays. See page 53.

4. Hourmeters Menu: If enabled, allows the operator to view the hourmeter displays. See page 55.

5. Mode Menu: Allows the operator to change unit operating modes between CYCLE-SENTRY mode and Continuous Run mode. See page 56.

6. Pretrip: Allows the operator to run a Pretrip. See page 60.

7. Electric Standby/Diesel Mode (Model 50 Only): Allows operator to view Electric Standby displays. See page 62.

8. Adjust Brightness: Allows the operator to adjust the display intensity as required by conditions. See page 63.

9. Time: Allows the operator to view the Time and Date. The Time is displayed in 24 hour military time. See page 64.

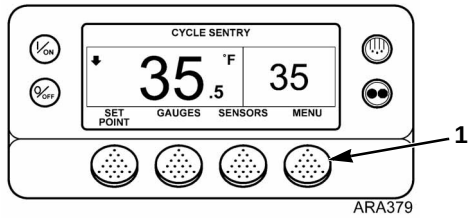
Language Menu

If the Language feature is enabled, an alternate language can be selected from the Language Menu. After a new language is chosen all displays will appear in that language.

Languages currently supported are English, German, Spanish, French Italian, Dutch, Danish, Portuguese, Russian, Japanese and Norwegian. The default language is English. Only languages that have been enabled will appear on this menu.

To select an alternate language:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 35: Standard Display

3. The Language Menu Screen appears. Press the **SELECT** soft key to choose the Language Menu Screen. See Figure 36.
4. The "NEW LANGUAGE WILL BE" Screen will appear. See Figure 36.
5. Press the **+** or **-** soft keys to select the desired language. See Figure 36.
6. When the desired language is shown, press the **YES** soft key to confirm the choice.
7. The "PROGRAMMING LANGUAGE-PLEASE WAIT" Screen briefly appears.
8. The "LANGUAGE SELECTED IS XXX" Screen briefly appears.
9. The display returns to Language Menu Screen. The display will return to the Standard Display if no keys are pressed. Press the **NEXT** soft key to select a different main menu item. Press the **EXIT** soft key to return to the Standard Display.

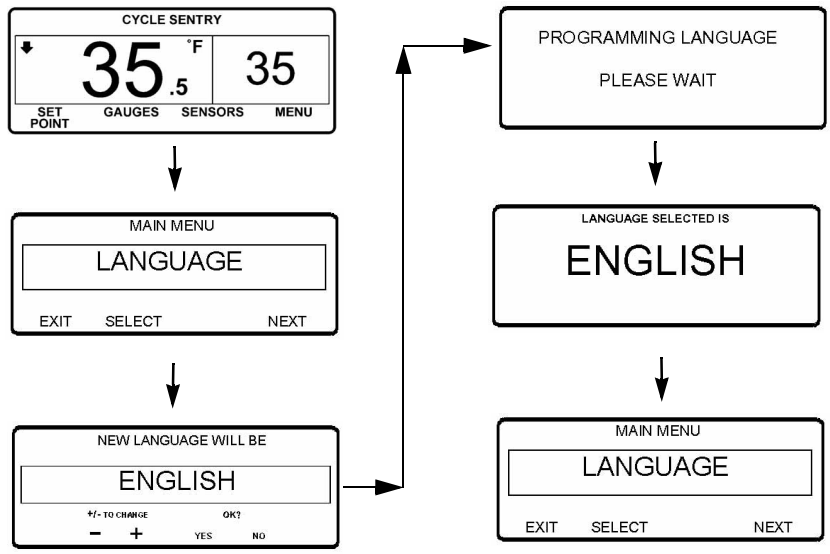
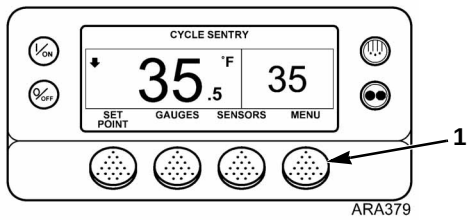


Figure 36: Change Language Screen Sequence

Alarms Menu

Alarms are viewed and cleared using the Alarm Menu as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 37: Standard Display

3. Press the **NEXT** soft key until the Alarm Menu appears.
4. Press the **SELECT** soft key. The Alarm Display will appear.
5. If no alarms are present, the “No Alarm” Screen is shown. Press the **EXIT** soft key to return to the Standard Display.
6. If alarms are present, the quantity of alarms and the most recent alarm code number will be shown. If there is more than one alarm, press the **NEXT** soft key to view each alarm.
7. If a serious alarm 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.
8. To clear an alarm press the **CLEAR** soft key.

   NOTE: Some sensor alarms cannot be cleared in the Alarms Menu. They must be cleared in Guarded Access. Refer to the SR-2 Microprocessor Control System Diagnostic Manual TK 51587 for more information.
9. For additional information regarding the alarm shown on the display press the **HELP** soft key. A help message will appear. Also see the complete Alarm Code list in the “Alarm Codes” chapter in this manual.

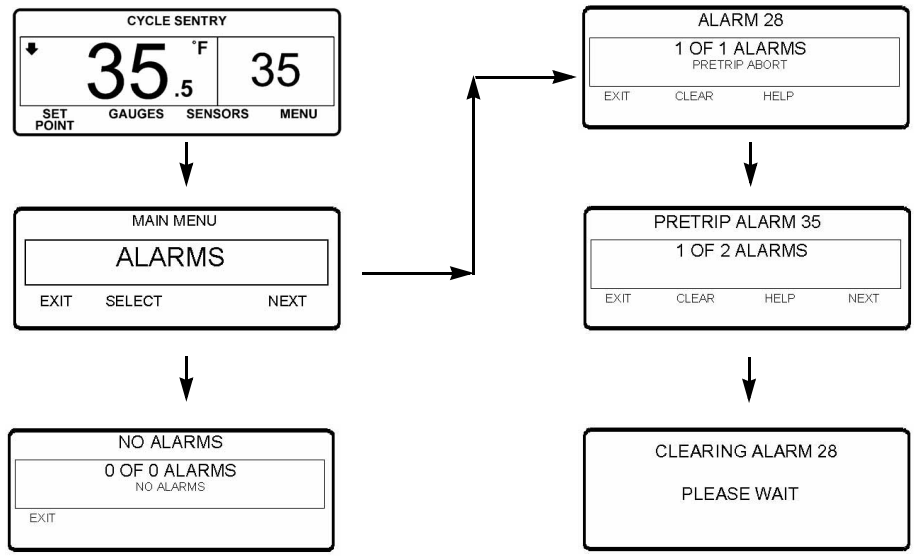


Figure 38: Viewing and Clearing Alarms Screen Sequence

Datalogger Menu

The SR-2 controller is equipped with datalogging capability. Datalogging can store trip information for later use. A “Start of Trip” is initiated to accurately store information,.

Trip data is logged as follows:

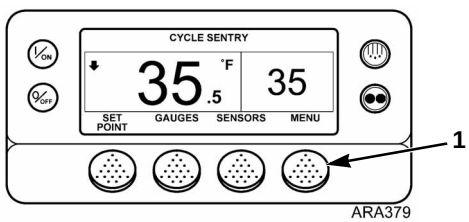
ServiceWatch™: ServiceWatch is standard equipment. It is an integrated datalogging system that records operating events, alarm codes and compartment temperatures as they occur and at preset intervals.

CargoWatch™: CargoWatch is an optional datalogger system that logs data of up to six temperature sensor/probes, four door switches, humidity sensor, data averaging, and programmable, temperature out of range alarms.

Initiating a Start of Trip

A “Start Of Trip” places a marker in the datalogger memory. A Start Of Trip can be initiated through the use of WinTrac datalogging software, or manually in the field. The following procedure covers manual initiation. For more information on datalogging, see the WinTrac Datalogging Software Operating Manual.

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display. See Figure 39.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 39: Standard Display

3. Press the **NEXT** soft key until the Datalogger Menu appears. See Figure 40.
4. Press the **SELECT** soft key on the Datalogger Menu. The “Start Trip” Screen will appear.
5. Press the **SELECT** soft key. The “Start Of Trip” Screen will appear.
6. Press the **SELECT** soft key to initiate a start of trip.
7. A Start Of Trip Marker has been inserted into the datalogger memory.

Printing a Trip Report

This procedure prints the current datalogger record directly to a handheld printer. Only data from the sensors connected to the HMI Cargo Watch data logger can be printed. Graphs are not available with a handheld printer.

1. Connect the printer to the printer port in the control box.
2. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display. See Figure 39.
3. Press the **MENU** soft key on the Standard Display.
4. Press the **NEXT** soft key until the Datalogger Menu appears. See Figure 40.
5. Press the **SELECT** soft key on the Datalogger Menu. The “Start Trip” Screen will appear.
6. Press the **NEXT** soft key. The “Print/View” Screen will appear.
7. Press the **SELECT** soft key. The “Delivery Ticket” Screen will appear. Press the **SELECT** soft key to print a delivery report.
8. Press the **NEXT** soft key to go to the “Trip Ticket” Screen. Press the **SELECT** soft key to print a trip report.

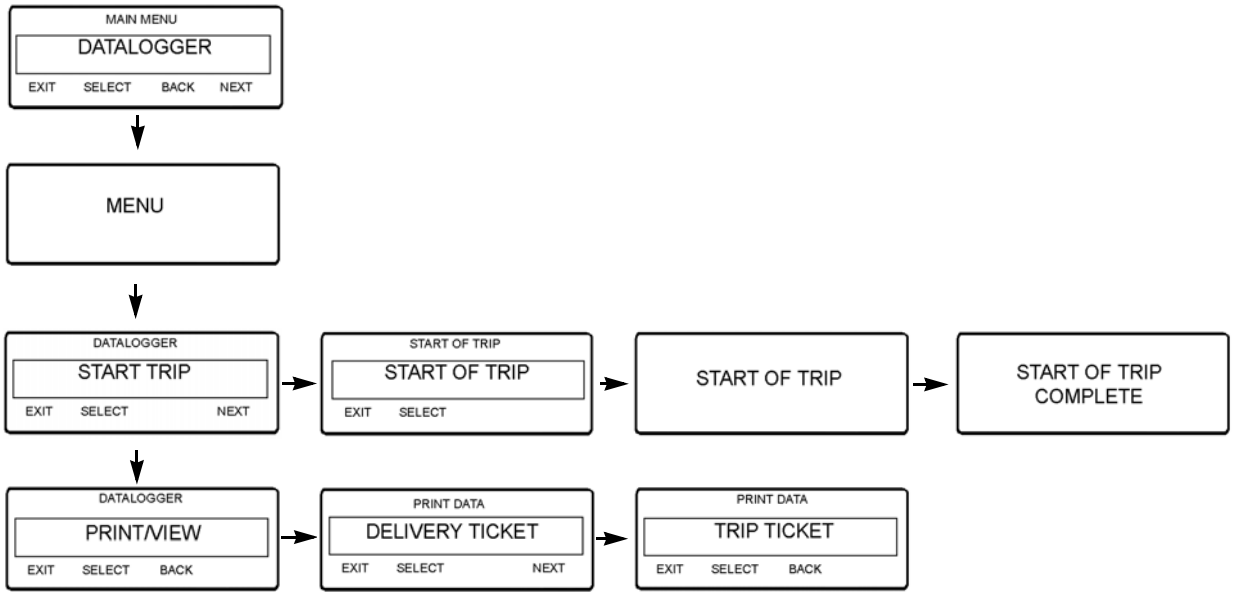


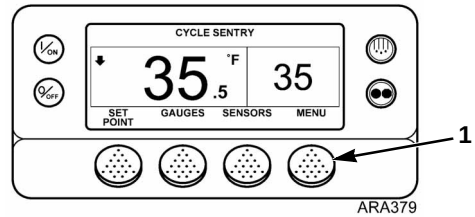
Figure 40: Datalogger Screen Sequence

Hourmeters Menu

Hourmeters that are enabled are displayed. Hourmeters that are not enabled are not displayed, but they do count hours. The default settings display the Total Run Time Hours, the Engine Hours, and the Electric Run Hours (Model 50 only). The Hourmeters Menu will not appear if no hourmeters are enabled.

Hourmeters can be viewed in the Hourmeters Menu as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 41: Standard Display

3. Press the **NEXT** soft key until the Hourmeters Menu appears. See Figure 42.
4. Press the **SELECT** soft key to enter the Hourmeters Menu.
5. Press the **NEXT** and **BACK** soft keys to view the hourmeter displays.

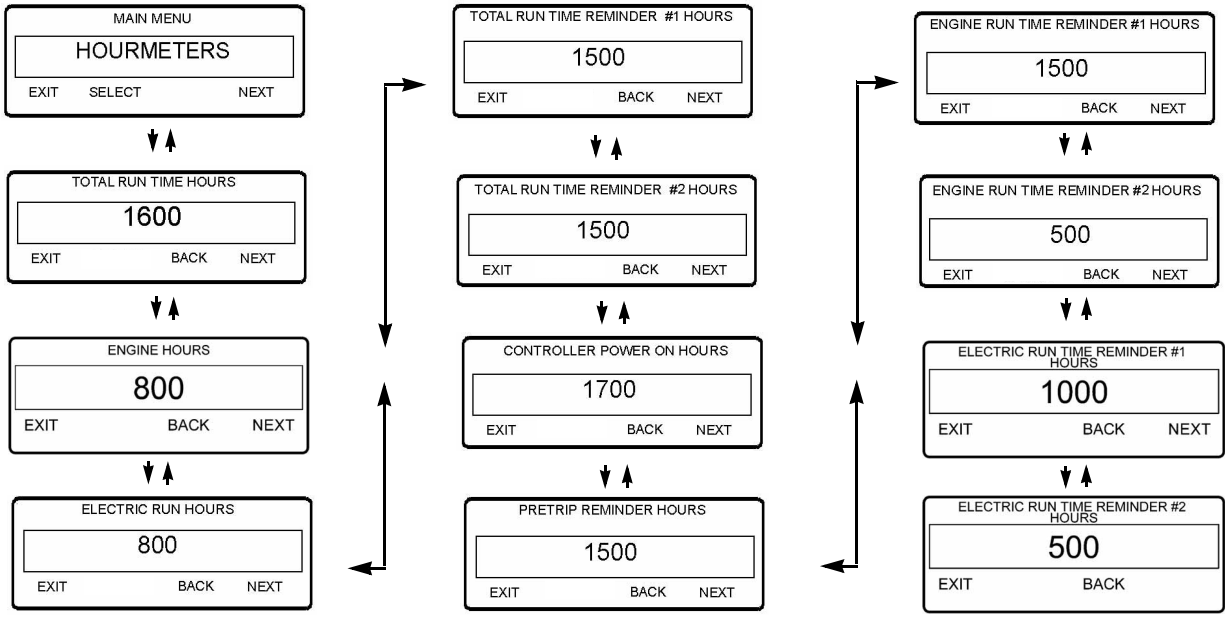


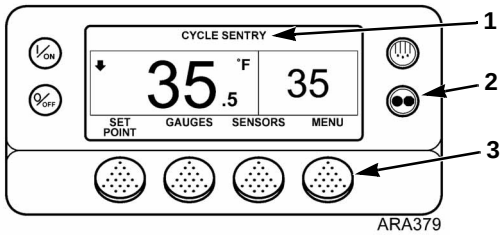
Figure 42: Viewing Hourmeters Screen Sequence

Mode Menu

Selecting CYCLE-SENTRY or Continuous Mode

The easiest way to switch between CYCLE-SENTRY and Continuous Run is to press the Mode key (see page 44). But, you can also switch modes in the Mode Menu as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.



1.	Shows Current Mode
2.	Mode Key
3.	Menu Soft Key

Figure 43: Standard Display

2. Press the **MENU** soft key on the Standard Display.
3. Press the **NEXT** soft key until the Mode Menu appears.
4. Press **SELECT** soft key to enter the Mode Menu. See Figure 44.
5. Press the **SELECT** soft key, to switch between modes.
6. The new mode is then confirmed for 10 seconds.
7. The display then returns to the Mode Menu. Press the **SELECT** soft key again to change the mode again.

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

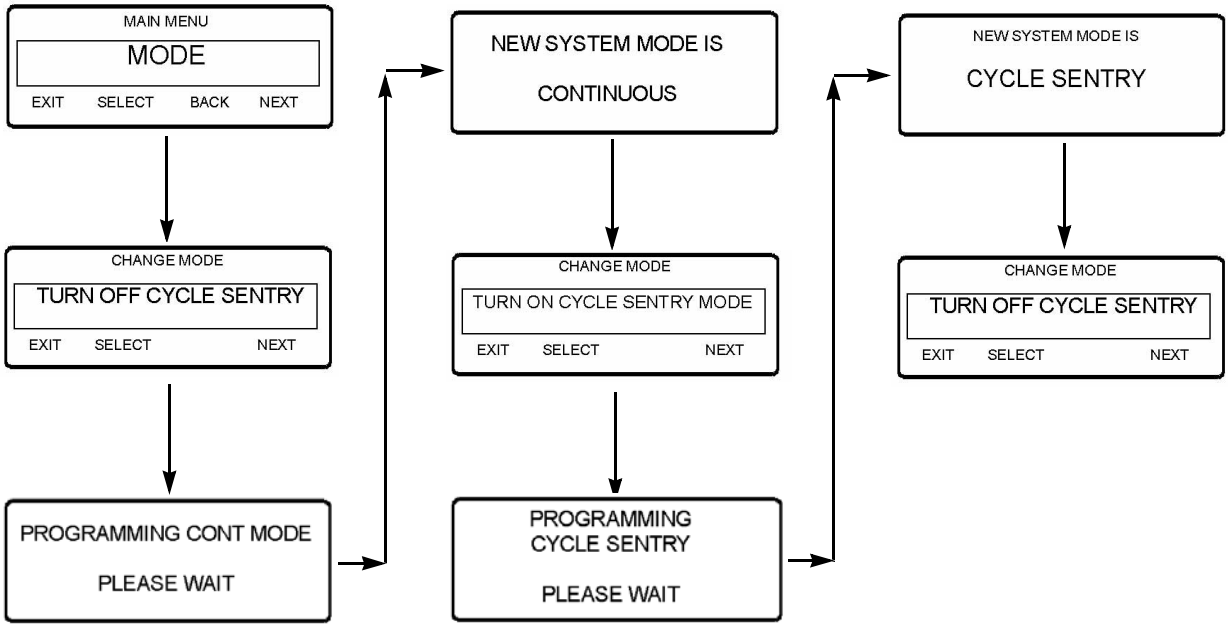


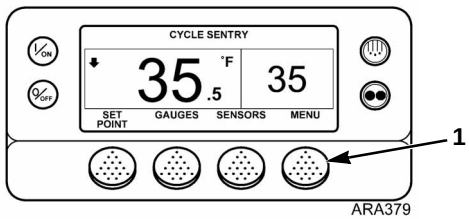
Figure 44: Selecting Mode Screen Sequence

Selecting Economy Mode

Economy mode is used on selected loads that do not require critical temperature control. The temperature control points are relaxed and other features are optimized for maximum fuel economy. Economy mode will be enabled or disabled per your company policy. If it is disabled, the economy screens will not appear on your display.

If enabled, select Economy mode as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 45: Standard Display

3. Press the **NEXT** soft key until the Mode Menu appears.
4. Press **SELECT** soft key to enter the Mode Menu. See Figure 46 and Figure 47.
5. Press the **NEXT** soft key as required to display Economy mode. The current state of Economy mode, either enabled or disabled will appear in the display.
6. Press the **SELECT** soft key to turn the Economy mode on or off. The display will confirm the change. The new mode is then confirmed for 10 seconds.

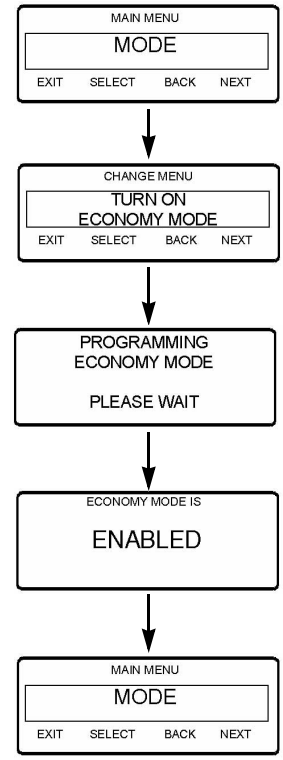


Figure 46: Turning On Economy Mode

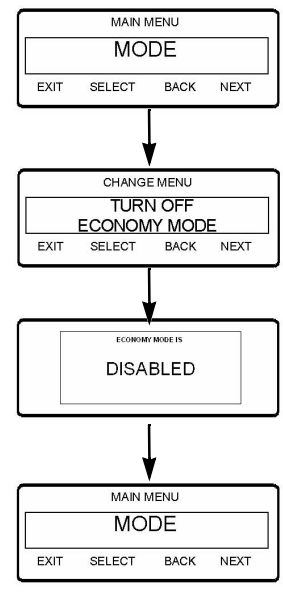


Figure 47: Turning Off Economy Mode

Selecting Sleep Mode

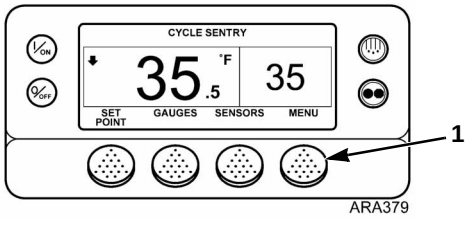
Normal CYCLE-SENTRY mode starts and stops the unit as required to maintain the desired compartment temperature, maintain the unit battery in a charged condition and keep the unit engine warm in cold ambient conditions. Sleep mode does not maintain compartment temperatures – it only keeps the engine warm 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.

Select Sleep Mode as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 48: Standard Display

3. Press the **NEXT** soft key until the Mode Menu appears. See Figure 49.
4. Press **SELECT** soft key to enter the Mode Menu.
5. Press the **NEXT** soft key as required to display the Sleep Mode Screen.
6. Press the **SELECT** soft key to start the Sleep mode.
7. You now choose to program a Sleep mode Wake-up Time or simply enter Sleep mode immediately. Press the **NO** soft key to immediately enter Sleep mode.
   a. The display will show “SLEEP” and the unit will start and stop as required to keep engine warm and/or the battery charged. Sleep mode does not maintain the compartment temperature.
   b. Press the **EXIT** soft key to exit Sleep mode or turn the unit off and back on. The unit will resume normal operation and control to setpoint.
8. To enter a Wake-up Time verify that the unit clock is set properly. Then press the **YES** soft key at the “Program A Wake-Up Time?” Screen.
9. Press the **+** or **-** soft keys to select the day the unit is to restart in normal operation. In this example Monday has been chosen. Press the **YES** soft key to confirm the day.
10. The display will now prompt you for the hour the unit is to restart in normal operation. In this example 18:00 hours has been chosen. Note that 24 hour “military time” is used. Press the **YES** soft key to confirm the hour.
11. The display will now prompt you for the minute the unit is to restart in normal operation. In this example 18:37 hours has been chosen. Press the **YES** soft key to confirm the minute.
12. The display will now prompt you to “Run A Pretrip On Wake-Up?” Press **YES** soft key or the **NO** soft key accordingly and the display will show the unit is programming the Sleep mode.
13. 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 maintain compartment temperatures.
14. The unit will restart at the programmed time (in this example 18:37 hours) and perform a Pretrip (if selected). After the Pretrip is complete the test results will be displayed and the unit will resume normal operation and control to setpoint.

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

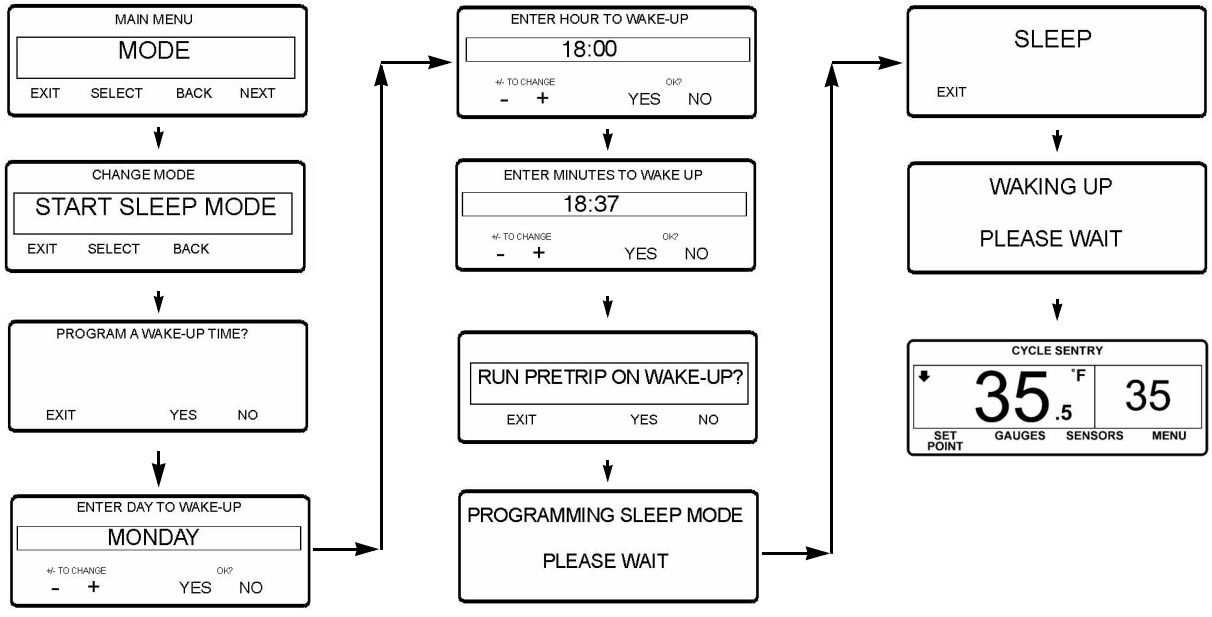


Figure 49: Selecting Sleep Mode Screen Sequence

Pretrip Tests

A Pretrip test verifies unit operation. The Pretrip Menu allows the operator to select and initiate a Pretrip Test. If the Pretrip is entered with the unit not running a Full Pretrip with device amp checks will be performed. If the Pretrip is entered with the unit running in either Diesel or Electric mode a Running Pretrip is performed. Results are reported as “PASS”, “CHECK” or “FAILED” when the Pretrip Test is completed.

Pretrip Test Conditions

- Pretrip Test can be run in either Diesel or Electric mode
- The unit will autoswitch from Diesel to Electric mode or from Electric to Diesel mode during a Pretrip Test if these features are enabled.

Pretrip Tests are not allowed if:

- Any alarms are present
- The unit is in Sleep mode.

Pretrip 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.
- Cool Check – The ability of the unit to cool in low speed is checked
- RPM Check – The engine RPM in high and low speed is checked during the Cool Check
- 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 “FAILED” when the Pretrip is completed. If test results are Check or Failed, alarm codes will exist to direct the technician to the source of the problem.

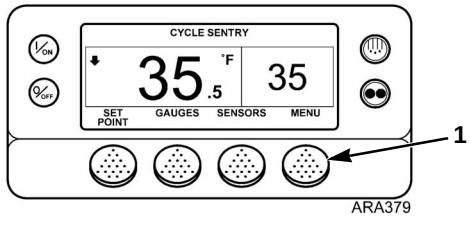
If a Pretrip is initiated with the engine not running, a Full Pretrip will be performed. If a Pretrip is initiated with the engine or motor running a Running Pretrip is performed.

Before initiating a Pretrip, clear all alarm codes.

CAUTION: Monitor the return air temperature when performing a Pretrip Test on a loaded trailer. The controller may not maintain setpoint during the Pretrip Test.

Start a Pretrip as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 50: Standard Display

3. Press the **NEXT** soft key until the Pretrip Screen appears. See Figure 51.
4. Press the **SELECT** soft key to start a Pretrip.
5. A Full Pretrip will be initiated if the unit is not running. If the unit is running in either Diesel or Electric mode a Running Pretrip will be performed.
6. The Pretrip display appears. The top line of the display indicates the unit is performing the non-running Pretrip. Test progress is measured by the number of tests completed

out of a total of 26. The soft keys may be used during the Pretrip Test to select the Hourmeter, Gauge or Sensor menus.

7. Turn the unit off to stop a Pretrip Test at any time. 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.
8. When all tests are complete, the results are reported as “PASS”, “CHECK” or “FAILED”. If “FAILED” appears, the unit will shut down. If the results are Check or Failed, the accompanying alarm codes will direct the technician to the cause of the problem.
9. When the non-running test are complete the unit will start automatically and continue with the Running Pretrip Test.
10. If the Pretrip Test results are Check or Failed the problem should be diagnosed and corrected before the unit is released for service.

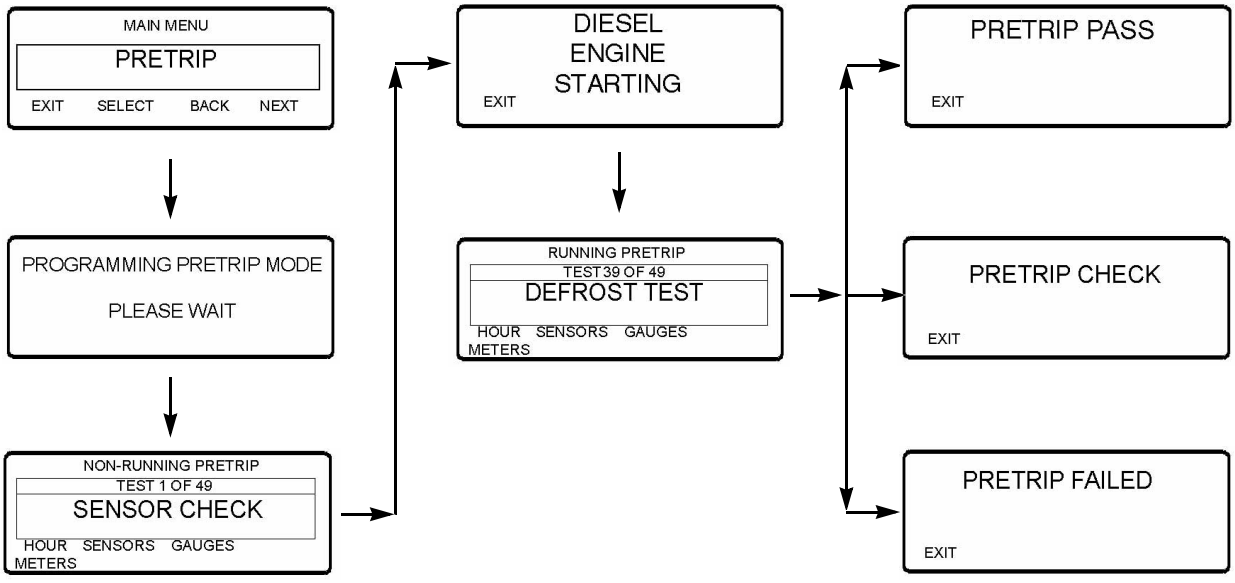


Figure 51: Pretrip Test Screen Sequence

Electric Standby/Diesel Mode

The Electric Standby/Diesel Mode display allows the operator to manually select Electric Standby or Diesel Mode operation. The unit can also be programmed to automatically select Electric Standby operation when standby power is available and 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.

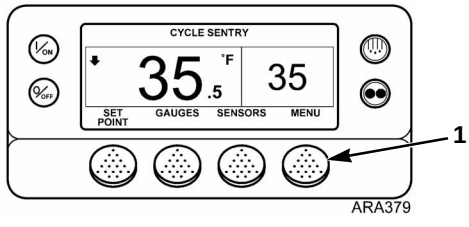
NOTE: Factory units are programmed to automatically switch to Electric mode when standby power becomes available. The unit must be switched to diesel power manually.

The unit must be switched to diesel power manually. If the unit has standby power available and is turned on, the electric standby run screen will appear after the standard screen. The new mode is then confirmed for 10 seconds.

If the unit was switched on in Electric mode and electric standby power is not available, the operator will receive a prompt to return to Diesel mode operation.

If enabled, select Electric Standby/Diesel Mode as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 52: Standard Display

3. Press the **NEXT** soft key until the Electric Standby/Diesel Mode Screen appears. See Figure 53 and Figure 54.

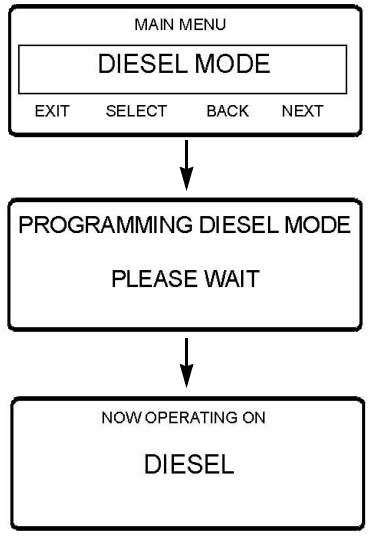


Figure 53: Programming Diesel Mode

4. Press the **SELECT** soft key to select the mode shown on the display.

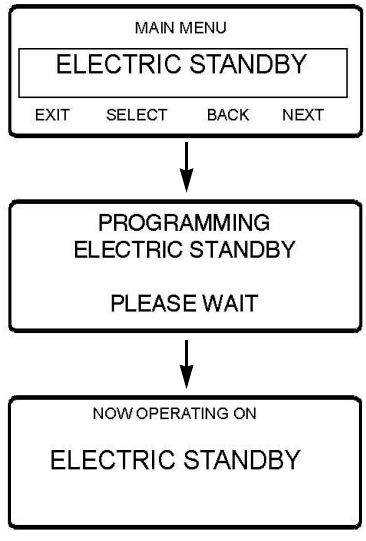
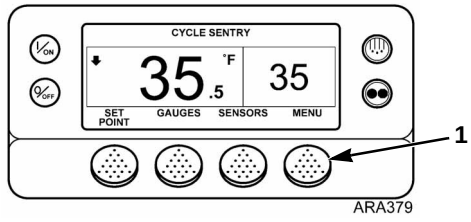


Figure 54: Programming Electric Standby Mode

Adjust Brightness Menu

Adjust the display brightness as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.



1.	Menu Soft Key

Figure 55: Standard Display

3. Press the **NEXT** soft key until the Adjust Brightness Menu appears. See Figure 56.
4. Press the **+** or **-** soft keys to select the desired brightness. See Figure 56. This example shows changing screen brightness from low to medium.
5. Press the **YES** soft key to enter the new brightness level.
6. The selected level appears on the screen.
7. The Adjust Brightness Main Menu Screen reappears and if no keys are pressed the Standard Display appears.

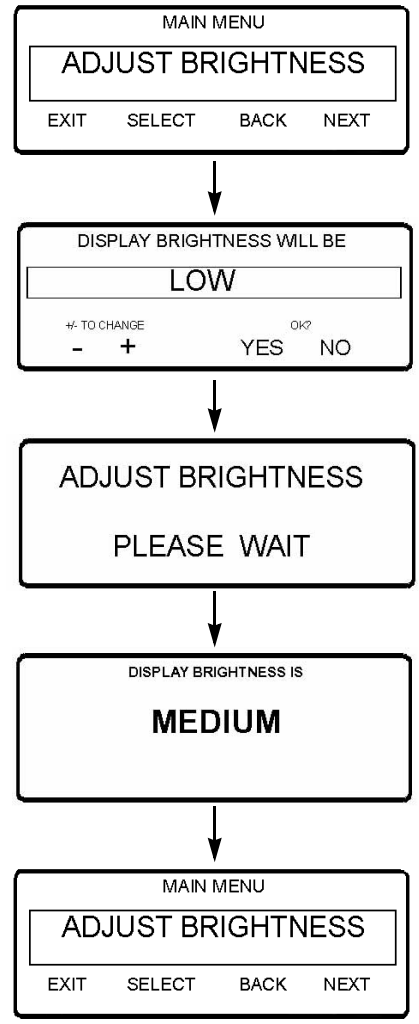
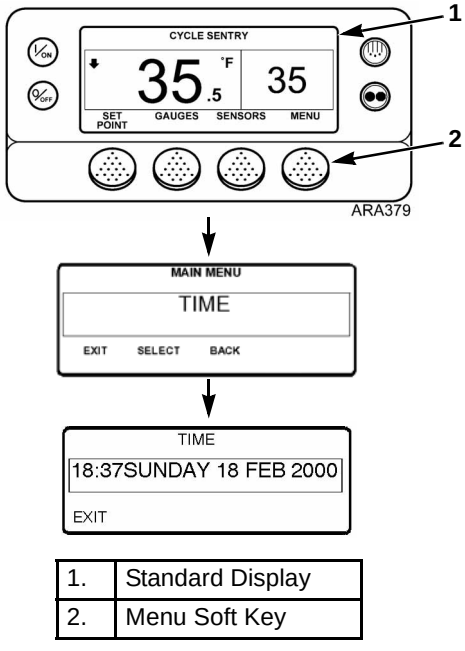


Figure 56: Adjusting Display Brightness Screen Sequence

Time Display

View the time and date as follows:

1. Start at the Standard Display. If the Temperature Watch Display is showing, press the **MENU** soft key once to return to the Standard Display.
2. Press the **MENU** soft key on the Standard Display.
3. Press the **NEXT** soft key until the Time Display appears.
4. Press the **SELECT** soft key to view the time and date.



1.	Standard Display
2.	Menu Soft Key

Figure 57: Time and Date Screens

Loading Procedure

1. Make sure the unit is turned off before opening the doors to minimize frost accumulation on the evaporator coil and heat gain in the trailer. (Unit may be running when loading the trailer from a warehouse with door seals.)
2. Spot check and record load temperature while loading. Especially note any off-temperature product.
3. Load the product so that there is adequate space for air circulation completely around the load. *DO NOT* block the evaporator inlet or outlet.
4. Products should be pre-cooled before loading. Thermo King transport refrigeration units are designed to maintain loads at the temperature at which they were loaded. Transport refrigeration units are not designed to pull hot loads down to temperature.

Post Load Procedure

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

Post Trip Checks

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

Alternator (Australian Bosch) Model 30

Charging System Diagnostic Procedures

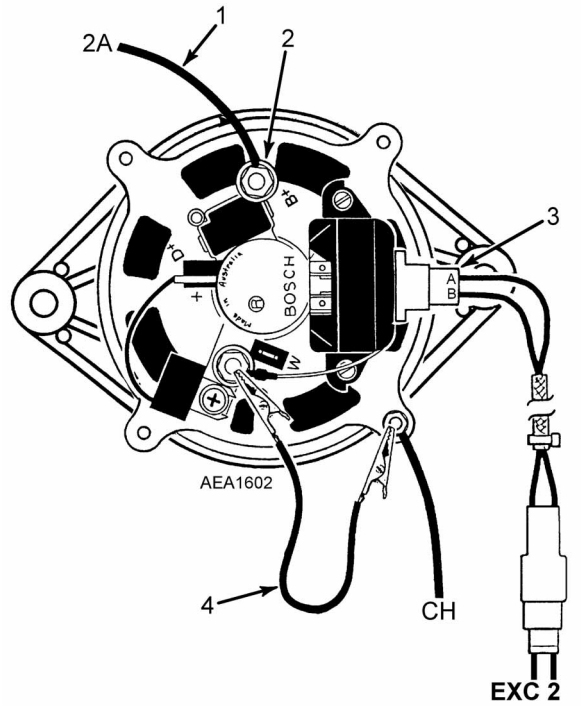
NOTE: Units manufactured with CYCLE-SENTRY and alternators with integral regulators MUST use replacement alternators with integral regulators.

CAUTION: Full-fielding alternators with the integral regulator is accomplished by installing a jumper from terminal F2 to ground. Attempting to full-field the alternator by applying battery voltage to terminal F2 will cause voltage regulator failure.

CAUTION: The F4 fuse must be removed from the interface board on units equipped with the Australian Bosch alternator. The voltage regulator will be damaged if the unit is turned On with the F4 fuse in place on the Interface board.

Complete the following checkout procedure before replacing the voltage regulator or the alternator.

- When testing alternators use accurate equipment such as a Thermo King P/N 204-615 (FLUKE 23) digital multimeter and a Thermo King P/N 204-613 amp clamp or an equivalent.



1.	Check Point for 2A Amperage	3.	Check Point for Sense Circuit and Excitation Circuit Voltages
2.	Check Point for B+ Voltage	4.	Position for Full Fielding Jumper

Figure 58: Check Points for Alternator Test

- Make sure the drive belts and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Worn belts and pulleys or loose belts will lower the output of the alternator.
- The battery must be well charged, the battery cable connections must be clean and tight, and the 2A and excitation circuits must be connected properly.

NOTE: All voltage readings should be taken between the negative battery terminal, or a good chassis ground, and the terminals indicated, unless stated otherwise.

1. Check to make sure that the F4 fuse has been removed from the interface board. If not, it must be removed, however, the voltage regulator has probably already been damaged.
2. Press the **OFF** key to turn the unit off.
3. Check the battery voltage. If the battery voltage is less than 12 volts, the battery must be charged or tested to determine if it should be replaced.
4. Check the voltage at the B+ terminal on the alternator. Battery voltage must be present. If not, check the 2A circuit.
5. Disconnect the alternator harness from the voltage regulator by carefully pushing on the spring clip to release the plug lock.
6. Press the **ON** key to turn the unit on. Access the Service Test Mode screens in the Maintenance Menu before the unit starts. Energize the run relay in the interface board test. See the appropriate Diagnostic Manual for specific information about the Service Test Mode.
7. Check the voltage at the A pin and at the B pin in the two pin connector on the alternator harness.
   a. The A pin is the battery sense circuit and should be at battery voltage. If not, check the sense circuit (2 or equivalent) in the alternator harness and in the main wire harness.
   b. The B pin is the excitation circuit and should be at 10 volts or higher. If not, check the excitation circuit (7K or equivalent) in the alternator harness and in the main wire harness.
8. If battery voltage is present on the sense and excitation circuits, connect the alternator harness to the voltage regulator and check the voltage on the B pin in the two pin connector on alternator harness. The voltage should be 0.7 to 1 volt using the interface board test.
   a. No voltage or a voltage reading below 0.7 volts indicates that the rotor or the voltage regulator may be shorted. Perform the field current test to further isolate the problem.
   b. A voltage reading above 3 volts indicates that the field circuit may be open or have high resistance. The brushes or the rotor are probably defective.
9. Attach a clamp-on ammeter to the 2A wire connected to the B+ terminal on the alternator.
10. Connect a voltmeter between the B+ terminal and a chassis ground.
11. Start the unit and run it in high speed.
12. Connect a jumper wire between the F2 terminal and a chassis ground. This will full field the alternator.

CAUTION: DO NOT full field the alternator for more than seven seconds while checking the meter readings, or the electrical system may be damaged.

13. Check the amperage in the 2A wire and record the reading. Check the voltage at the B+ terminal and continue to observe this voltage for a few seconds to see if it increases, decreases, or stays the same. Note the change in voltage and record the voltage reading.

    Amperage in the 2A wire =____amps.

    Voltage at the B+ terminals =____volts.

    The voltage at the B+ terminal should be 13 to 18 volts and the amperage in the 2A wire should be at least as high as the rated output of the alternator.

NOTE: An alternator can easily exceed its rated output. An alternator MUST at least reach its rated output when full fielded. An alternator that has a defective rectifier diode may reach 75% of its rated output with a full field.

14. Stop the unit.
15. Use the readings obtained previously to determine the problem by referring to the Diagnosis Chart.

    NOTE: This assumes that the alternator did not charge properly prior to the full field test.

Field Current Test (Checks the field windings, brushes and slip rings)

Press the **OFF** key to turn the unit off before performing this test.

1. Attach a clamp-on ammeter to the 2A wire near the B+ terminal on the alternator.
2. Connect a jumper wire between the F2 terminal on the alternator and a chassis ground, and note the ammeter reading.
3. The ammeter reading indicates field current. The following chart shows the field current for each alternator with 12 volts applied to the field:

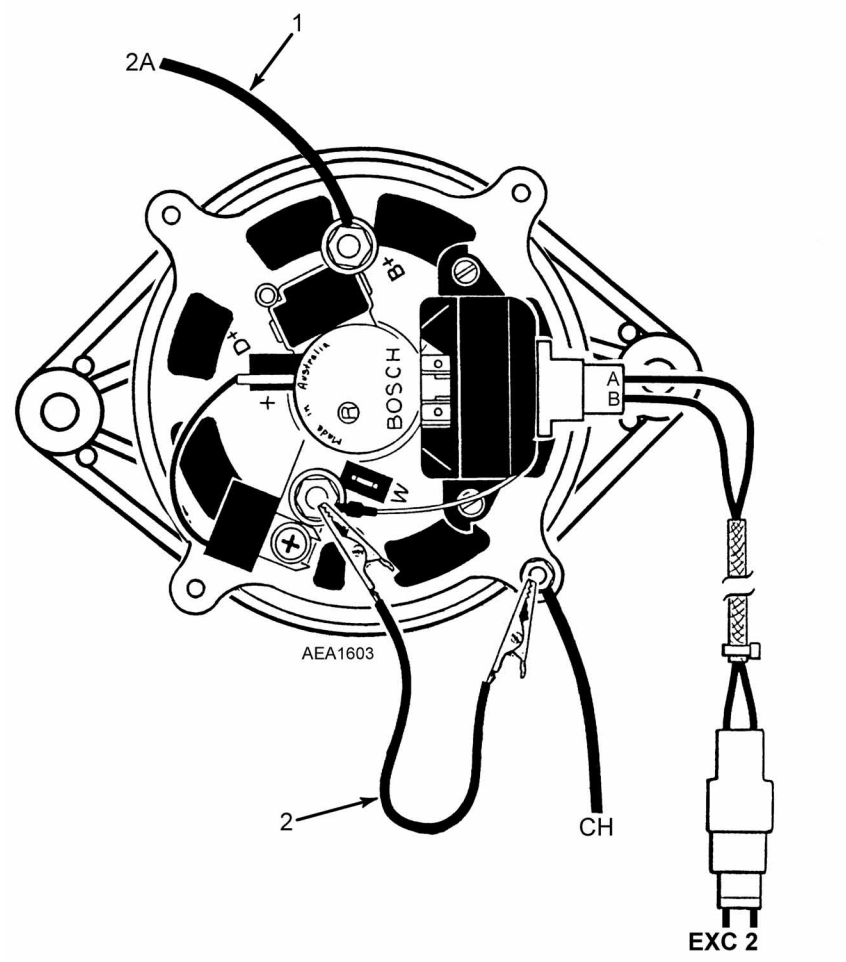
Alternator Rating	Field Current @ 12 Volts
37 Amp	3.5 to 4.5 Amps
65 Amp	4.0 to 5.0 Amps

   a. No field current or a low field current indicates an open circuit or excessive resistance in the field circuit. Replace the voltage regulator and brush assembly, inspect the slip rings and repeat the test. If the brushes are not the problem, replace the rotor or the alternator.

   b. High field current indicates a short in the field circuit. Repair or replace the alternator.

Diagnosis Chart

Amperage in 2A	Voltage at B+	Problem/Solution
At or above rated output	At or above battery voltage and increasing	Voltage regulator defective / Replace voltage regulator and brush assembly
Approximately 60% of rated output	Approximately equal to battery voltage and does not change, or rises slightly	Rectifier diode defective / Repair or replace alternator
Low or no output	Less than or equal to battery voltage and decreasing	Stator windings, field windings, brush or diode defective / Perform Field Current Test to check brushes and field coil, or replace alternator



1.	Check Point for 2A Amperage
2.	Position for Full Fielding Jumper

Figure 59: Full Field Test

Alternator (Prestolite) Model 50

Charging System Diagnostic Procedures

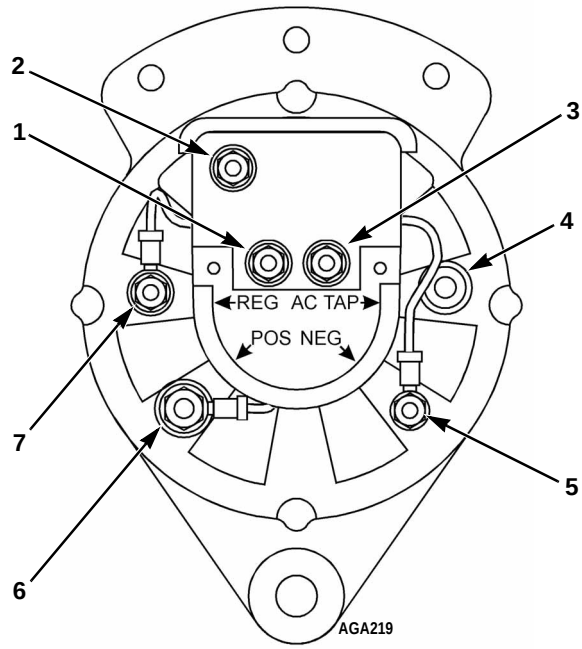
NOTE: Units manufactured with CYCLE-SENTRY and alternators with integral regulators MUST use replacement alternators with integral regulators.

CAUTION: Full-fielding alternators with the integral regulator is accomplished by installing a jumper from terminal F2 to ground. Attempting to full-field the alternator by applying battery voltage to terminal F2 will cause voltage regulator failure.

NOTE: The F4 fuse must be installed on the interface board on units equipped with the Prestolite alternator. If the F4 fuse is not in place, the alternator will not charge properly.

Complete the following checkout procedure before replacing the voltage regulator or the alternator.

- When testing alternators use accurate equipment such as a Thermo King P/N 204-615 (FLUKE 23) digital multimeter and a Thermo King P/N 204-613 amp clamp or an equivalent.



1.	EXC Terminal	5.	NEG—B- Terminal
2.	F2 Terminal	6.	POS—B+ Terminal
3.	VOLT SENSE Terminal	7.	REG—D+ Terminal
4.	AC TAP Terminal		

Figure 60: Prestolite Terminal Locations

- Make sure the drive belts and pulleys of the charging system are in good condition and are adjusted properly before testing the alternator. Worn belts and pulleys or loose belts will lower the output of the alternator.
- The battery must be well charged, the battery cable connections must be clean and tight, and the 2A and excitation circuits must be connected properly.

NOTE: All voltage readings should be taken between the negative battery terminal, or a good chassis ground, and the terminals indicated, unless stated otherwise.

1. Check to make sure that the F4 fuse is in place on the interface board. If not, it must be installed in order for the alternator to charge properly.
2. Press the **OFF** key to turn the unit off.
3. Check the battery voltage. If the battery voltage is less than 12 volts, the battery must be charged or tested to determine if it should be replaced.
4. Check the voltage at the B+ terminal on the alternator. Battery voltage must be present. If not, check the 2A circuit.
5. Check the voltage at the VOLT SENSE terminal on the alternator. Battery voltage must be present. If not, check the 2 circuit.
6. Press the **ON** key to turn the unit on. Access the Service Test Mode screens in the Maintenance Menu before the unit starts. Energize the run relay in the interface board test. See the appropriate Diagnostic Manual for specific information about the Service Test Mode.
7. Check the voltage at the EXC terminal on the alternator. Battery voltage must be present. If not, check the EXC circuit.
8. Attach a clamp-on ammeter to the 2A wire connected to the B+ terminal on the alternator.
9. Connect a voltmeter between the B+ terminal and a chassis ground.
10. Start the unit and run it in high speed.
11. Connect a jumper wire between the F2 terminal and a chassis ground. This will full field the alternator.

CAUTION: Never apply battery voltage to terminal F2 or voltage regulator failure will occur.

a. Full alternator output (the alternators rated output) indicates the alternator is good but the voltage regulator needs replacement.

b. If there is LOW or NO output, the alternator is probably faulty. However, the following items are potential causes for not charging:

- Check the alternator brushes.
- Check the 2A circuit from the alternator to the battery.
- Properly tension the alternator belt.
- Check battery cable connections and the alternator ground. They must be clean and tight.
- The battery must be in good condition and must accept a charge.
- Check for excessive or unusual amperage draw by the unit control circuits.

Battery

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

Unit Wiring

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

Fuses

A number of fuses, located on the interface board, protect various circuits and components. The interface board is located inside the control box. See the SR-2 Microprocessor Controller Diagnostic Manual for a complete list of the size and function of the fuses.

Fuse	Size	Function
F1	1A	HPCO Switch Circuit
F2	15A	2AB Power
F3	40A	Fuel Sol Pull-In/Starter Circuit
F4	None 2A	No Fuse - All Bosch Alternators 2A Fuse - All Prestolite Alternators
F5	60A	Preheat Circuit
F6	15A	Damper and High Speed Circuits
F7	2A	8FP Circuit – CAN bus
F8	3A	CAN Connector J12
F9	3A	CAN Connector J14
F10	7.5A	8X Power (Install fuse in upper position)
F11	10A	Electric Clutch (Not Used)
F12	3A	CAN Connector J13
F13	2A	8FC Circuit (Remote Lights)
F15	P/S	On/Off Relay
F20	2A	Alternator Sense
F4 Remove fuse F4 for Model 30 units with Australian Bosch Alternator. 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.		

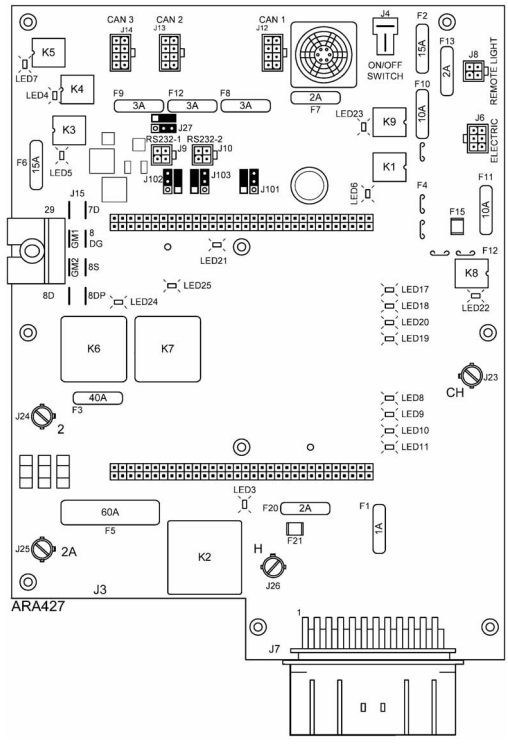


Figure 61: Interface Board

Fuse Link

The fuse link is located in the positive battery cable. The fuse link protects the electrical system from a short in the 2 circuit. If the fuse link burns out, check for a grounded 2 wire before replacing the fuse link. Replace this fuse link by replacing the positive battery cable.

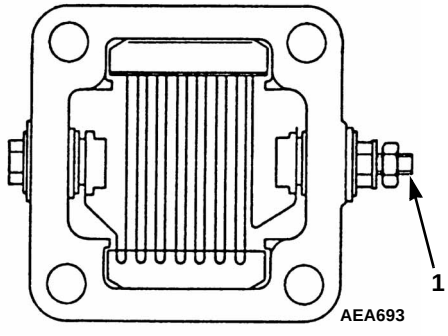
Air Heater

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

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

Check the resistance of the air intake heater with an ohmmeter between the M6 terminal on the front of the heater and the screw on the back of the heater (or the heater case). The resistance should be 0.1 to 0.2 ohms.

Check the current draw of the heater with a clamp-on ammeter at the H1 wire near the M6 terminal on the front of the heater. During preheat the current draw should be approximately 89 amps at 12.5 volts and approximately 77 amps at 11 volts.



1.	M6 Terminal

Figure 62: Air Heater

Smart Reefer 2™ Microprocessor Controller

See the SR-2 Microprocessor Control System Diagnostic Manual TK51587 for complete service information about the Microprocessor Controller and the related components.

AC Components

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

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

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

Auto Phase System

The Auto Phase system automatically adjusts the phase sequence of the power supply to correspond with the wiring of the electric motor. The main components of the system are the phase selection module (PSM), and the two motor contactors (MC1 and MC2). Contactor MC1 is wired to retain the phase sequence. Contactor MC2 is wired to change the phase sequence. The PSM senses the phase sequence at the heater contactor and energizes the appropriate motor contactor.

Troubleshooting the Auto Phase System

If the electric motor runs backwards (unit airflow incorrect):

1. Turn the electric power supply Off and check the unit wiring. See the appropriate wiring diagrams, schematics and to Figure 63.

a. The three wires from the PSM should be connected to the heater contactor terminals as follows: Brown wire to terminal L1, Blue wire to terminal L2, and Black wire to terminal L3.

b. Wires L1, L2, and L3 should be connected respectively to terminals L1, L2, and L3 on the heater contactor and both motor contactors.

c. Wires T1A, T2A, and T3A should be connected respectively to terminals T1, T2, and T3 on MC1.

d. Wires T1A, T2A, and T3A should be connected respectively to terminals T3, T2, and T1 on MC2.

e. Wires T1A, T2A, and T3A should be connected respectively to terminals T1, T2, and T3 on the overload relay.

f. Wires T1 & T7, T2 & T8, and T3 & T9 should be connected respectively to terminals T1, T2, and T3 on the overload relay.

g. Wires Black, Blue, and Brown should be connected respectively to terminals 3, 4, and 5 in the power receptacle.

h. Wires Brown, Blue, and Black should be connected respectively to terminals L1, L2, and L3 on MC1.

i. The 9-pin wire connector between the PSM and the wire harness should be clean and tight.

j. The electric motor must be wired correctly.

2. Check MC1 and MC2 to make sure that one of them is not faulty (contacts stuck closed).

3. If all of the wiring is correct, and the relays and contactors are acceptable, but the electric motor still runs backwards, switch the Brown wire and the Black wire from the PSM at the heater contactor: Black to L1, Blue to L2, and Brown to L3. If the electric motor now runs correctly, it is probably wired incorrectly.

If the electric motor does not run at all:

1. Make sure that the unit is turned On, that Electric Standby has been selected in the Operator Menu, and that the power supply is connected and turned On.

2. Check the CH wire to the PSM for continuity to the CH circuit (chassis ground). If there is no continuity to the CH circuit, check the CH wire for continuity.

3. Check for battery voltage (12 volts) at the 7EA wire to the PSM. Battery voltage should be present. If not, check the 7E circuit, the diesel/electric relay (K5), the run relay (K1), the 8 circuit, the Microprocessor On/Off switch, the 2AB circuit, the F2 fuse, the 2 circuit, the fuse link, and the battery. Also make sure that the microprocessor display is on and that the microprocessor is calling for Heat or Cool.

4. Check for battery voltage at the 7EB and 7EC wires at the PSM. Battery voltage should be present on one of these wires when the correct AC voltage is present on L1, L2, and L3. If battery voltage is not present, the PSM is faulty.

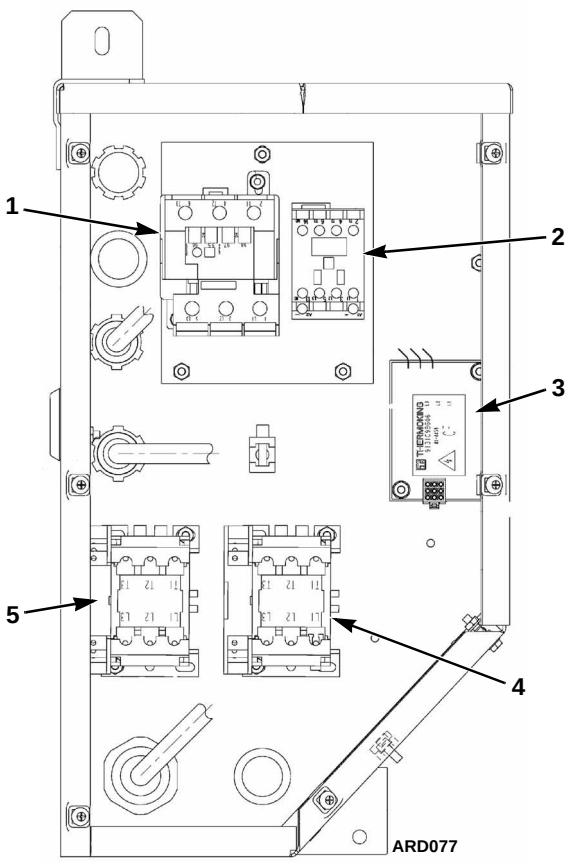
5. Check for battery voltage at the 7EB terminal on MC1 and at the 7EC terminal on MC2. Battery voltage should be present at one of these terminals. If not, check the continuity of the 7EB and 7EC wires.

6. Check the continuity of the RED wires on the motor contactors. The RED wires must have continuity.

7. Check the CH circuit at MC1 and MC2 for continuity to a chassis ground. If the CH circuits do not have continuity to a chassis ground, check the CH wires.

8. Check the continuity of the BLK wires on the motor contactors. The BLK wires must have continuity.

9. If the CH circuits and BLK wires do have continuity to CH, the contactor that has battery voltage present at 7EB (MC1) or at 7EC (MC2) is faulty.



1.	Overload Relay
2.	HC—Heaters Contactor
3.	PSM—Phase Selection Module
4.	MC2—Motor Contactor
5.	MC1—Motor Contactor

Figure 63: High Voltage Tray

Engine Maintenance

EMI 3000

EMI 3000 is an extended maintenance interval package that is standard equipment on this unit. The EMI 3000 package consists of the following key components:

- New EMI 3000-Hour Cyclonic Air Cleaner Assembly and Air Cleaner Element
- New EMI 3000-Hour Fuel Filter (black with gold lettering)
- New EMI 3000-Hour Dual Element Oil Filter (black with gold lettering)
- API Rating CG-4 Mineral Oil (ACEA Rating E2-96 for Europe)
- Five Year or 12,000 Hour ELC (Extended Life Coolant).

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

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

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

Engine Lubrication System

The TK 486 engine has a pressure lubrication system. Refer to the TK 482 and TK 486 Engine Overhaul Manual TK 50136 for a detailed description of the engine lubrication system.

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule. Drain the oil only when the engine is hot to ensure that all the oil drains out. When changing oil, keep unit and trailer level so all the oil can flow from the oil pan. It is important to get as much of the oil out as possible because most of the dirt particles are contained in the last few quarts of oil that drain out of the pan. Refill the pan with 13 quarts (12.3 liters) and check the dipstick level. Run the unit, and then recheck the oil level. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into the oil pan. Never overfill. See the Specifications chapter for the correct type of oil.

Oil Filter Change

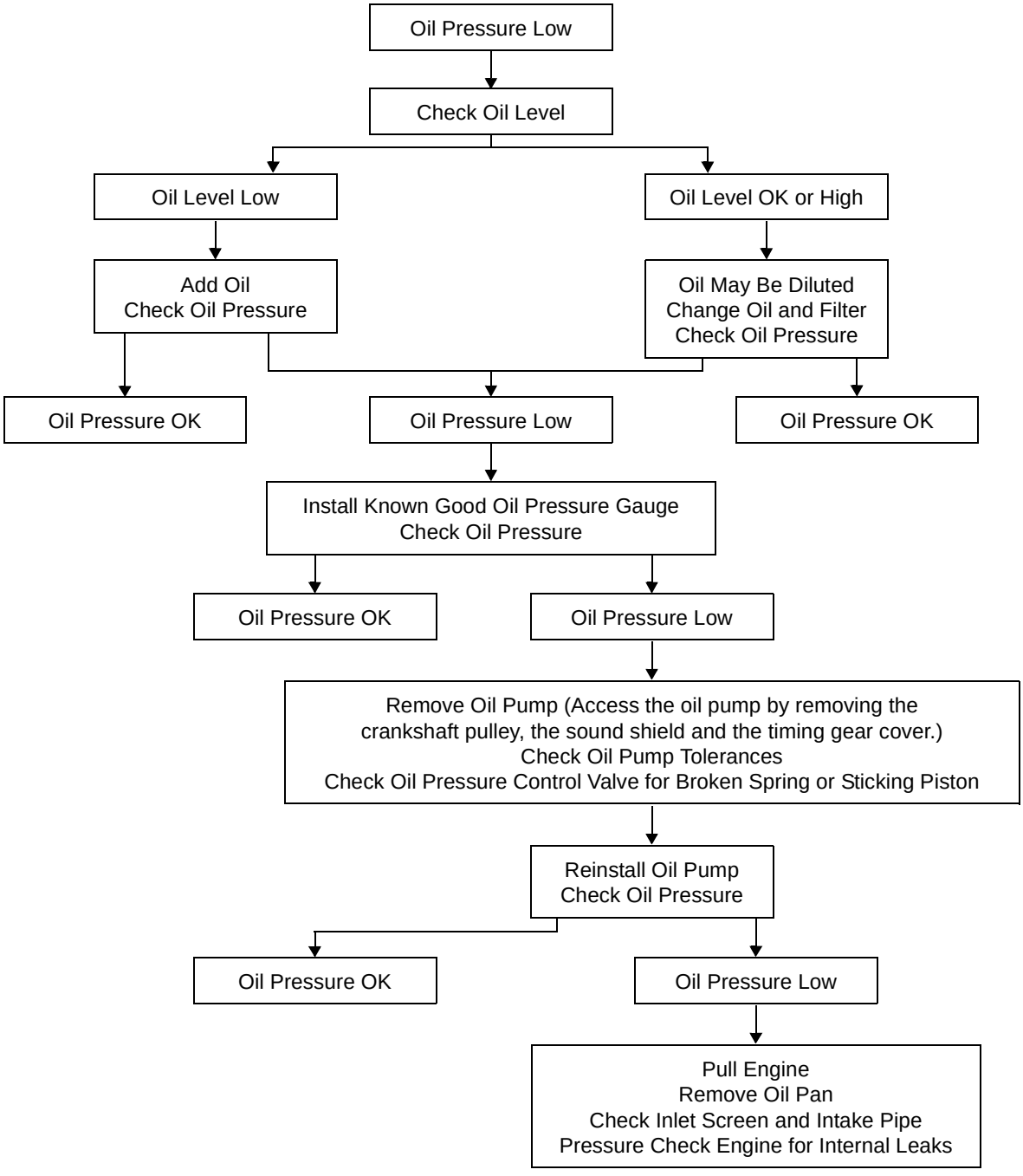
The oil filter should be changed along with the engine oil. Use a genuine Thermo King extended maintenance oil filter.

1. Remove the filter.
2. Apply oil to the rubber ring of the new filter and install the filter.
3. Tighten the filter until the rubber ring makes contact, then tighten 1/2 turn more.
4. Start the unit and check for leaks.

Low Oil Pressure

Oil pressure is affected by oil temperature, oil viscosity, and engine speed. Low oil pressure can usually be traced to the lack of oil, a faulty oil pressure regulating valve, or worn bearings. Low oil pressure is not normally caused by a faulty oil pump. Use the following "Low Oil Pressure Flow Chart" to help diagnose low oil pressure.

Low Oil Pressure Flow Chart



Engine Cooling System

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

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

This provides the following:

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

ELC (Extended Life Coolant)

ELC has been phased into all trailer units equipped with TK 486L, engines. 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.

AJA1947

Figure 64: 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 Procedure

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

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

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

Checking the Antifreeze

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

Changing the Antifreeze

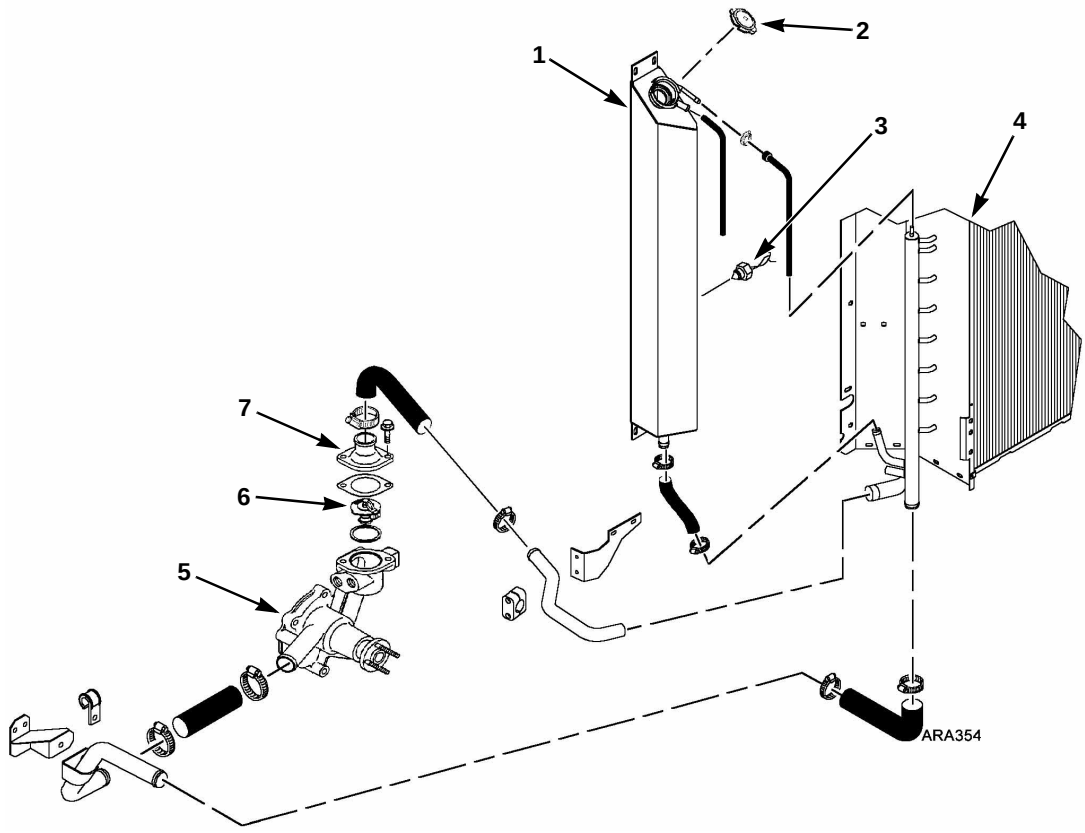
1. Run the engine until it is up to its normal operating temperature. Stop the unit.
2. Open the engine block drain (located behind the starter) and completely drain the coolant. Observe the coolant color. If the coolant is dirty, proceed with a, b, and c. Otherwise go to 3.

CAUTION: Avoid direct contact with hot coolant.

   a. Run clear water into the radiator and allow it to drain out of the block until it is clear.
   b. Close the block drain and install a commercially available radiator and block flushing agent, and operate the unit in accordance with instructions of the flushing agent manufacturer.
   c. Open the engine block drain to drain the water and flushing solution.

CAUTION: Avoid direct contact with hot coolant.

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



1.	Expansion Tank	5.	Water Pump
2.	Radiator Cap	6.	Thermostat
3.	Coolant Level Sensor	7.	Thermostat Housing
4.	Radiator		

Figure 65: Engine Cooling System

Bleeding Air from the Cooling System

Jiggle pin thermostats are original equipment on units that have TK 482/486 engines. Jiggle pin thermostats make it unnecessary to bleed the air out of the engine block because they keep air from being trapped in the engine block. Normally, all but about 1.5 qt (1.4 liters) of coolant drain out of the cooling system when it is drained. If approximately half of the Cooling System Capacity (see Specifications) seems to fill the cooling system after it has been drained, air has been trapped in the block. Bleed the air out of the block using the following procedure:

CAUTION: IF YOU SUSPECT THAT AIR IS TRAPPED IN THE BLOCK, DO NOT START THE ENGINE WITHOUT BLEEDING THE AIR OUT OF THE BLOCK.

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

1. Loosen the plug on the back of the water pump below the thermostat cover until coolant comes out of the plug fitting.
2. Tighten the plug.

3. Pour coolant into the system until it appears to be full.
4. 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.
5. Start the unit on low speed heat, let it run for two minutes, and then shut it off.
6. Check the coolant level and add coolant if necessary.
7. Repeat steps 5 and 6 until the coolant level stabilizes.

Engine Thermostat

For the best engine operation, use a 180 F (82 C) thermostat year-round.

Engine Fuel System

The TK 486 engine is a direct injection diesel that uses an in-line injection pump.

The components of the fuel system are:

1. Fuel tank
2. Inlet strainer (prefilter)
3. Fuel filter/water separator
4. Priming pump
5. Fuel transfer pump
6. Injection pump
7. Injection nozzles

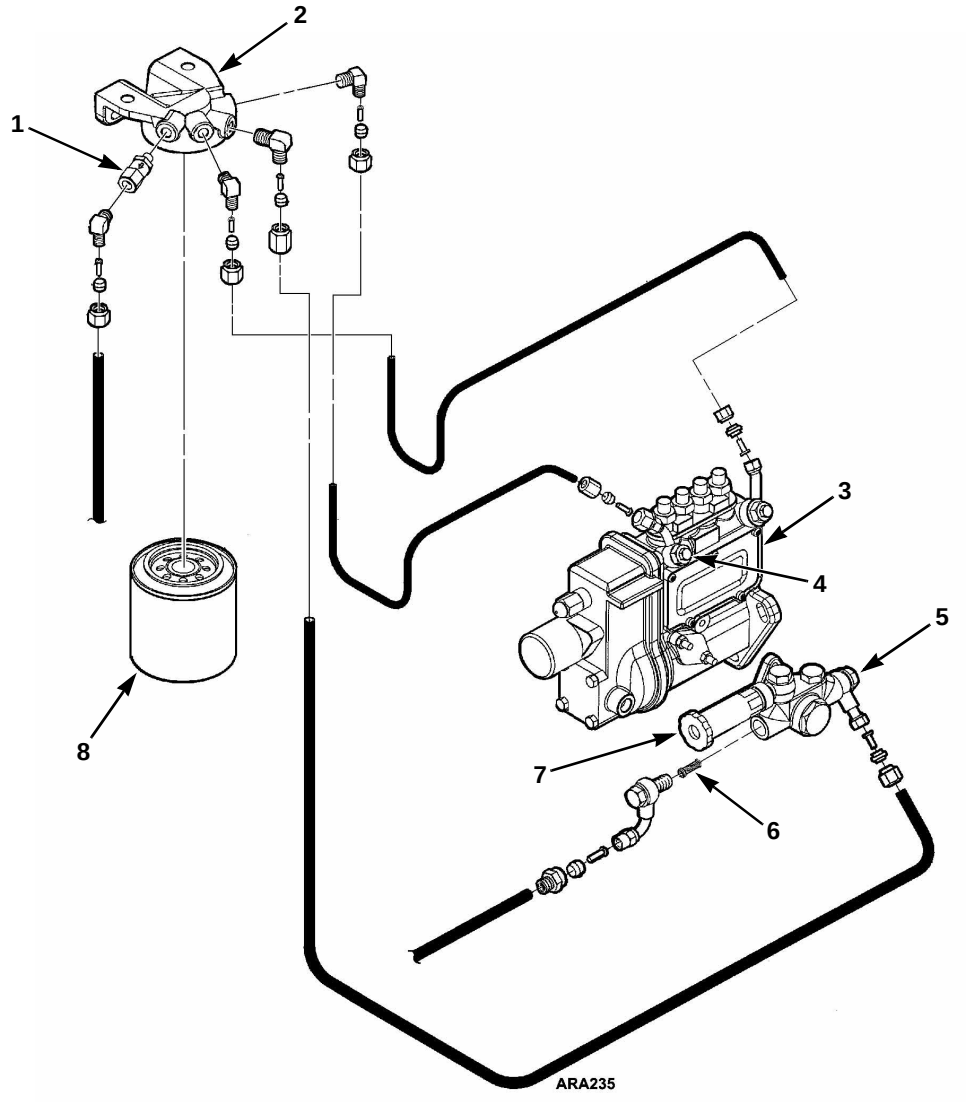
The priming pump is used to manually draw fuel from the tank up to the fuel pump if the unit should run out of fuel.

Operation

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

The injection pump plungers are activated by a gear driven injection pump camshaft. The governor sleeve and weight assembly is mounted on the end of the pump camshaft. The governor's speed requirements are relayed to the injection pump through a linkage arrangement located in the rear cover. 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.

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



1.	Check Valve (Keeps air from entering fuel system when engine is not running.)	5.	Fuel Transfer Pump
2.	Filter Head	6.	Inlet Strainer (Prefilter)
3.	Injection Pump	7.	Priming Pump
4.	Bleed Screw	8.	Fuel Filter/Water Separator

Figure 66: Engine Fuel System

Maintenance

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

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

NOTE: The injection nozzles should be tested (and repaired if necessary) at 10,000 hour intervals when used in normal conditions. 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 TK 482 and TK 486 Overhaul Manual TK 50136 for injection nozzle testing and repair procedures.

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

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

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

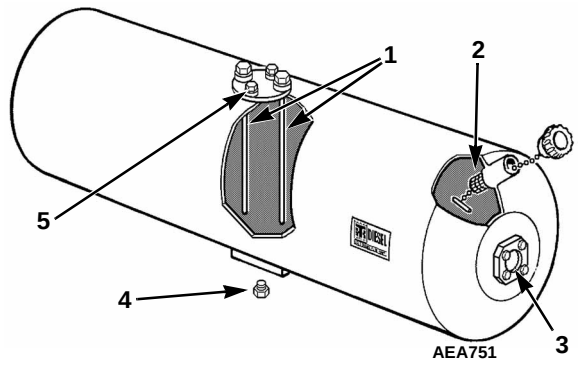
The following procedures can be done under field conditions:

1. Bleeding air from the fuel system.
2. Fuel tank and filter system maintenance.
3. Priming pump (hand) replacement or repair.
4. Fuel pump replacement or repair.
5. Injection line replacement.
6. Injection pump and governor adjustments.
7. Injection pump timing.
8. Nozzle spray pattern testing and adjustment.
9. Minor rebuilding of nozzles.

Bleeding the Fuel System

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

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

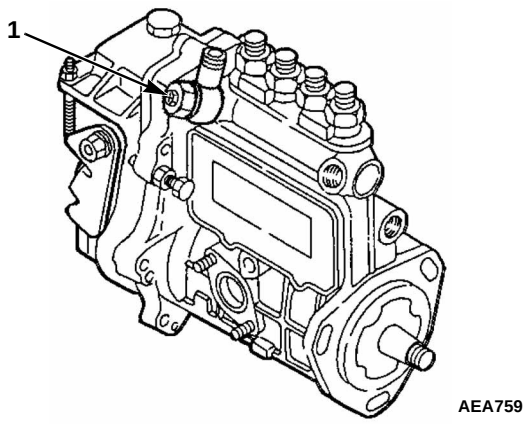


1.	Stand Pipes	4.	Drain Plug
2.	Anti-Siphon Screen (Optional)	5.	Vent
3.	Fuel Gauge		

Figure 67: Fuel Tank

To bleed air from the fuel system:

1. Loosen the bleed screw in the inlet fitting on the injection pump.



1.	Bleed Screw

Figure 68: Injection Pump

2. Unscrew the priming pump handle and manually prime the fuel system until air bubbles are no longer visible in the fuel coming out of the bleed screw.
3. Tighten the bleed screw and screw the priming pump handle back in.
4. Loosen the injection lines at the injection nozzles.
5. Crank the engine until fuel appears at the nozzles.
6. Tighten the injection lines.
7. Start the engine and observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure.

Draining Water from Fuel Tank

Water run through the system may damage the 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.

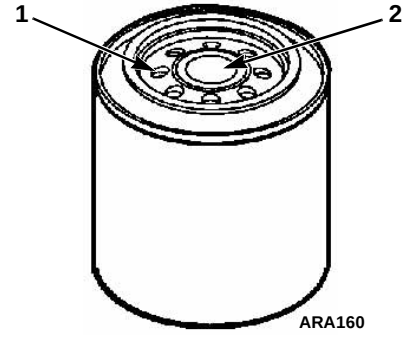
Fuel Filter/Water Separator

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

Fuel Filter/Water Separator Replacement

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

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



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

Figure 69: Filling Fuel Filter/Water Separator

Engine Speed Adjustments

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

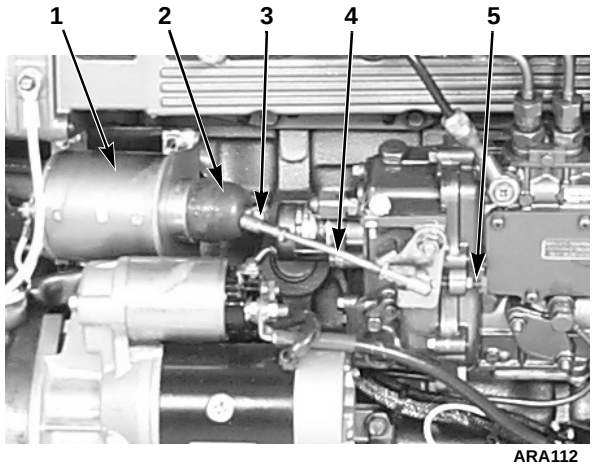
1. Check the fuel inlet strainer. Check the speed.
2. Bleed the air out of the fuel system. Check the speed.
3. Bleed the air out of the nozzles. Check the speed.

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

High Speed

1. Use the Service Test Mode to run the unit in high speed and check the high speed rpm. It should be 2200 ± 25 rpm for the SB-210 and 2600 ± 25 rpm for the SB-310.
2. Shut the unit off.
3. Remove the ball joint from the eye bolt in the high speed solenoid.
4. Remove the boot from the high speed solenoid.
5. Pull the plunger out of the solenoid enough to loosen the jam nut. An Allen wrench placed in the hex opening in the face of the plunger will keep the plunger from turning. Turn the plunger eye bolt clockwise to increase the speed and counterclockwise to decrease the speed.
6. Replace the ball joint, start the unit and check the speed. When the speed is correct, tighten the jam nut and replace the solenoid boot.

NOTE: If the correct speed cannot be set close enough with half turns of the eye bolt, use the Allen wrench to turn the plunger in smaller increments.



1.	High Speed Solenoid
2.	Boot
3.	Ball Joint
4.	Speed Control Rod
5.	Low Speed Adjustment Screw

Figure 70: Engine Speed Adjustments

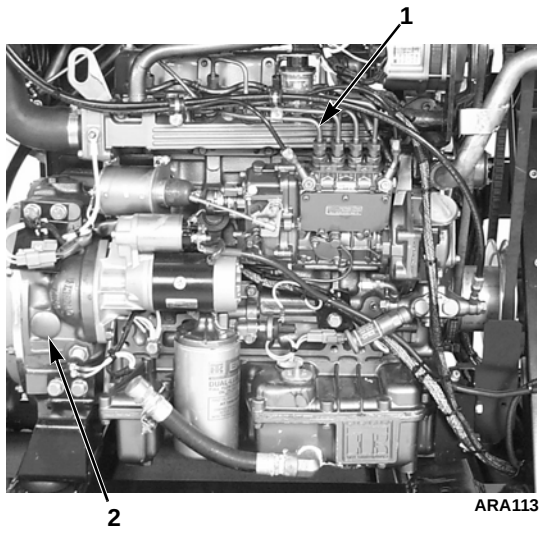
Low Speed

1. Loosen the jam nut on the low speed adjustment screw.
2. Use the Service Test Mode to run the unit in low speed. Adjust the screw to obtain the correct speed. It should be 1450 ± 25 rpm (1720 ± 25 rpm for SB-310 units with High Capacity Fresh).
3. Tighten the jam nut and recheck the speed.

Injection Pump Timing

This timing procedure requires fuel pressure at the injection pump inlet. This can be accomplished by pumping the priming pump by hand, or by using an electric fuel pump to supply fuel to the fuel pump inlet.

1. Press the **OFF** key to turn the unit off.
2. Remove the round cover (plug) from the timing mark access hole on the front of the bell housing. The index marks on either side of this hole and the timing marks on the flywheel are used to check the injection pump timing.



1.	Number One Cylinder Injection Line
2.	Timing Mark Access Hole

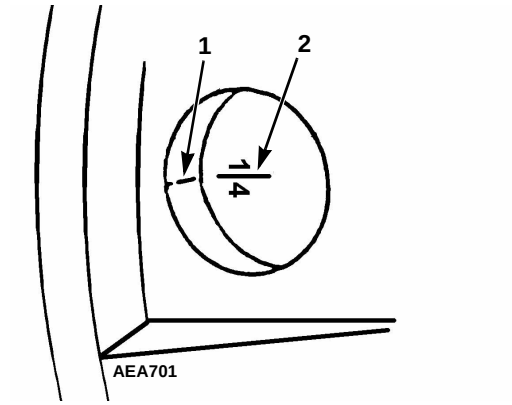
Figure 71: Component Location

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

3. 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.

4. Remove the rocker arm cover.
5. 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 1-4 timing mark on the flywheel lines up with the index mark in the timing mark access hole.

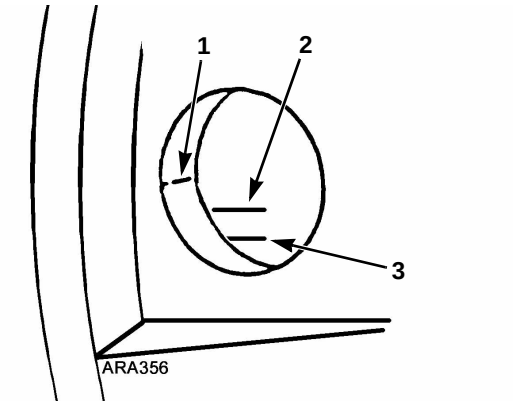


1.	Index Mark
2.	Top Dead Center Mark for 1 and 4

Figure 72: Top Dead Center One and Four

   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.
6. Disconnect the 8S wire from the starter solenoid to prevent the engine from cranking when the unit is turned On.
7. Press the **On** key to turn the unit on.
8. Use the keypad to enter the Interface Board Test Mode. Refer to the appropriate Microprocessor Diagnostic Manual for detailed information about the Service Test Mode.
9. Energize the fuel solenoid by energizing the run relay with the Interface Board Test Mode.
10. Rotate the engine backwards (counterclockwise viewed from the water pump end) until the 10 degree BTDC (before top dead center) timing mark is positioned in the bottom of the timing mark access hole. There are two injection timing marks. The 10 degree BTDC timing mark is a horizontal line stamped on the flywheel approximately 1.0 in.

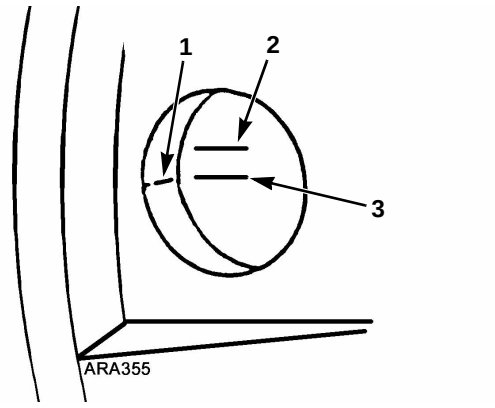
(25 mm) before the top dead center mark.The 12 degree BTDC timing mark is a horizontal line stamped on the flywheel approximately 1.2 in. (30 mm) before the top dead center mark.



1.	Index Mark
2.	12 Degree BTDC Timing Mark
3.	10 Degree BTDC Timing Mark

Figure 73: Timing Mark Alignment

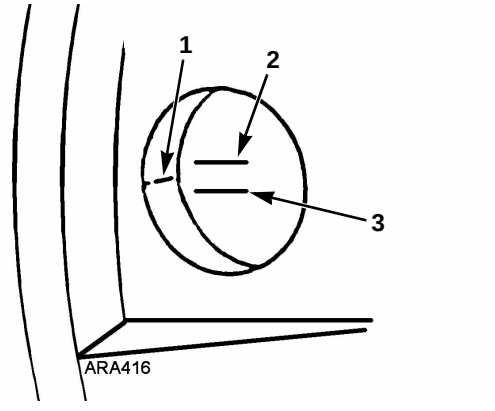
11. Pump the priming pump by hand a few times, or energize the electric fuel pump if an electric fuel is being used.
12. Use a clean towel to remove the fuel from the top end of the delivery valve holder.
13. Slowly turn the engine in the normal direction of rotation until you see the fuel rise in the end of the delivery valve holder. Stop as soon as you see the fuel rise.
14. Check position of the timing marks.
    a. On the SB-210 the 10 degree BTDC timing mark on the flywheel should be aligned with the index mark on the side of the timing mark access hole.



1.	Index Mark
2.	12 Degree BTDC Timing Mark
3.	10 Degree BTDC Timing Mark

Figure 74: Correct Injection Timing Mark Alignment for SB-210

    b. On the SB-310 the index mark should align with the midpoint between the two timing marks on the flywheel.



1.	Index Mark
2.	12 Degree BTDC Timing Mark
3.	10 Degree BTDC Timing Mark

Figure 75: Correct Injection Timing Mark Alignment for SB-310

15. Repeat steps 10 through 14 to recheck the timing.
16. 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.

17. Tighten the injection pump mounting nuts and recheck the timing. Repeat steps 10 through 17 until the timing is correct.

18. Install the cover in the timing mark access hole, install the injection line for the number one cylinder, install the rocker arm cover, tighten the other injection lines and reconnect the 8S wire to the starter solenoid when finished with the procedure.

Injection Pump Removal

The injection pump drive gear will not fit through the gear housing when removing the pump, the gear must be separated from the pump. Using tool P/N 204-1011, it will not be necessary to remove the belts, fuel pump, crankshaft pulley, crankshaft seal or front plate. See Figure 76 “Injection Pump Gear Tool” on page 88.

1. Remove the starter for clearance, remove throttle linkage, fuel lines, harness and mounting hardware from injection pump.

2. Remove the cover plate from the gear case. Remove the nut and lock washer which secure the gear to the injection pump shaft. Use a shop rag to prevent the lock washer or nut from falling into the gear case.

3. Use the hardware from the cover plate to attach the tool plate (with the marked side pointing up and out) to the gear case.

4. Align the threaded holes in the injection pump gear with the two holes in the tool plate by rotating the engine crankshaft. Attach the gear to the tool plate with the screws provided with the tool plate.

5. Thread the long screw supplied with the tool plate into the small end of the adapter, also supplied with the tool plate. Insert the adapter into the tool plate and rotate to provide a solid position to force the injection pump shaft from the gear. Caution should be made to align the screw over the center of the injection pump shaft.

6. Remove the screw and adapter leaving the tool plate in place. This holds the gear in proper tooth alignment until the injection pump is re-installed.

Injection Pump Reinstallation

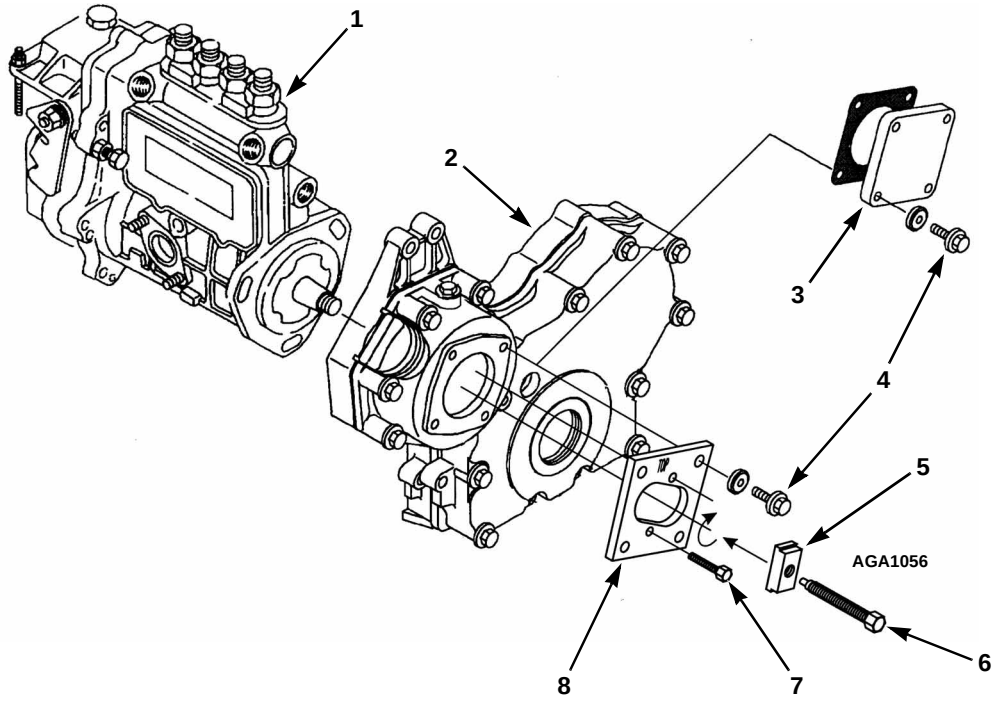
1. Position injection pump shaft into gear, rotating shaft to mate key with keyway in gear.

2. Secure injection pump to gear case with previously removed hardware.

3. Remove hardware holding gear to tool plate, then remove tool plate.

4. Secure gear to injection pump shaft with lock washer and nut, use a shop rag, as before, to prevent the lock washer or nut from falling into the gear case. Torque the nut to 84 to 90 ft-lb (113 to 122 N•m)

5. Fasten cover plate to gear case and reinstall all components removed previously to facilitate injection pump removal.



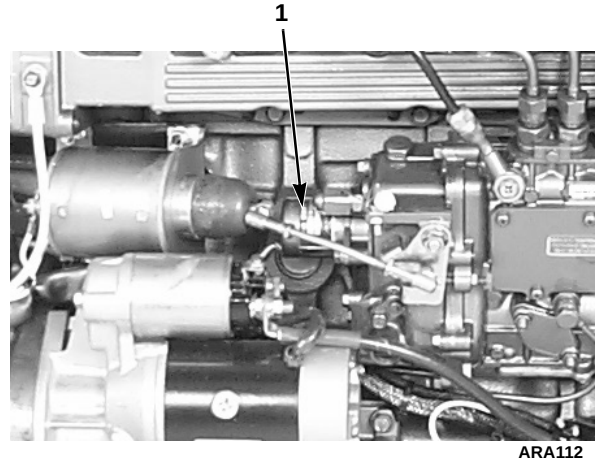
1.	Injection Pump	5.	Adapter
2.	Gear Case	6.	Tool Long Screw
3.	Cover Plate	7.	Tool Short Screw
4.	Cover Plate Bolt	8.	Tool Plate

Figure 76: Injection Pump Gear Tool

Fuel Solenoid

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

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



1.	Fuel Solenoid

Figure 77: Fuel Solenoid Location

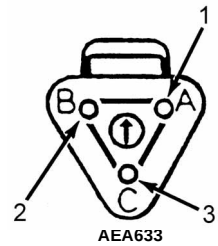
Testing the Fuel Solenoid

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

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

1. Use the microprocessor keypad to enter the 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.



AEA633

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

Figure 78: 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 2 terminal. The fuel solenoid should make a definite click when the hold-in coil is de-energized.

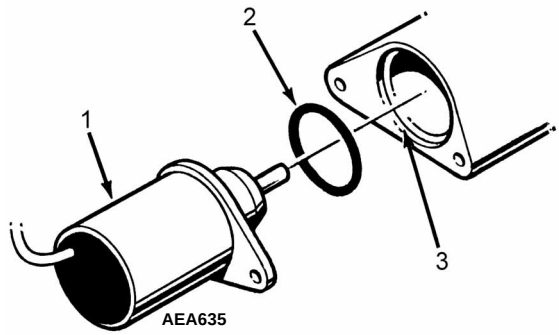
d. If the hold-in coil does not function properly, check the resistance of the hold-in coil by placing an ohmmeter between the red wire (8D—pin A) and the black wire (CH—pin C) in the fuel solenoid connector. The resistance of the hold-in coil should be 24 to 29 ohms. If the resistance of the hold-in 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 microprocessor keypad 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 79: Fuel Solenoid Components

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

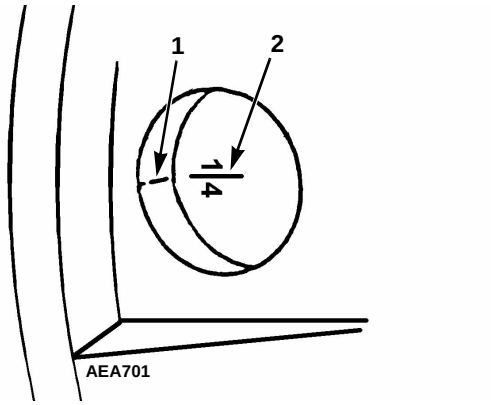
Engine Valve Clearance Adjustment

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

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

3. Place the engine at top dead center of the compression stroke for the number one cylinder. 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 1-4 timing mark on the flywheel lines up with the index mark in the timing mark access hole.



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

Figure 80: Top Dead Center One and Four

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.

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

4. Use a feeler gauge to check the valve clearance on both valves for the number one cylinder, the intake valve for the number two cylinder, and the exhaust valve for the number three cylinder. The valve clearance for both the intake valve and the exhaust valve should be 0.006 to 0.010 in. (0.15 to 0.25 mm).

   NOTE: Check to make sure that the valve stem cap is in good condition and is positioned squarely on the top of the valve stem. Replace the valve stem cap if it shows significant wear.

5. Adjust the valves if necessary by loosening the locknut and turning the adjustment screw until the valve clearance is correct.

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

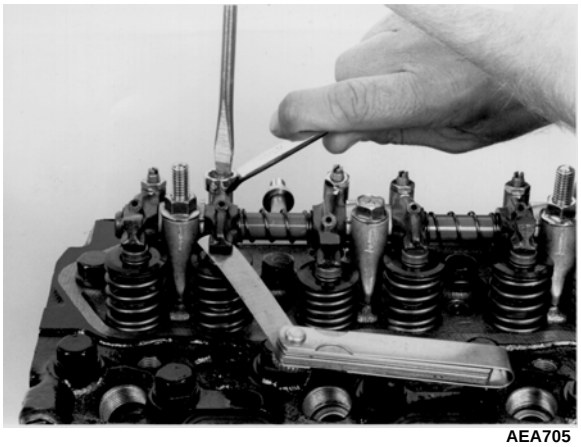


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Figure 81: Adjusting the Valve Clearance

7. Recheck the valve clearance.

8. Rotate the engine one full turn (360°) in the normal direction of rotation (clockwise viewed from the water pump end), and align the 1-4 timing mark on the flywheel with the index mark in the timing mark access hole. This is top dead center of the compression stroke for the number four cylinder.

9. Check and adjust the exhaust valve for the number two cylinder, the intake valve for the number three cylinder, and both valves for the number four cylinder.

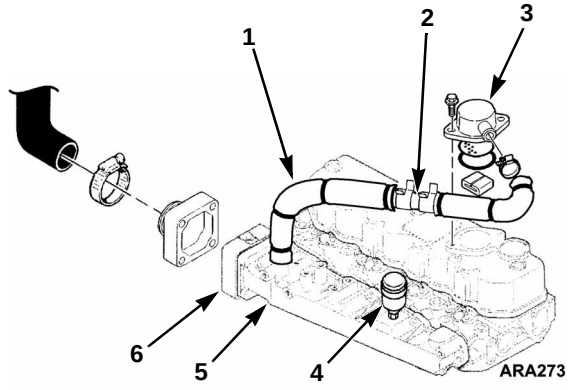
10. Replace the rocker arm cover, the cover for the timing mark access hole, and tighten the fuel injection lines when finished.

Crankcase Breather

The crankcase breather is located on top of the rocker arm cover. 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. A restrictor is placed in the breather hose to limit the flow gas flow from the crankcase to the air intake and keep the crankcase pressure from getting too low.

Normal crankcase pressures with a new air cleaner are 5 to 10 in. (127 to 254 mm) H_2O of vacuum at 1450 rpm and 7 to 11 in. (178 to 279 mm) H_2O of vacuum at 2200 rpm. The vacuum will increase as the air cleaner gets dirty and becomes more restrictive. The crankcase breather and the breather hose should be inspected when the air cleaner element is replaced to make sure they are not plugged or damaged.

NOTE: The breather hose must be routed so it slopes down from the crankcase breather to the intake manifold. This prevents condensation from collecting in the breather hose. The condensation can plug the breather hose if it collects and freezes in the hose.



1.	Insulation (Covers breather Hose to prevent freezing.)
2.	Restrictor
3.	Crankcase Breather
4.	Air Restriction Indicator
5.	Intake Manifold
6.	Intake Air Heater

Figure 82: Crankcase Breather

EMI 3000 Air Cleaner

The EMI 3000 air cleaner is a dry element air cleaner used in late model units. Replace the EMI 3000 air cleaner element when the air restriction indicator reads 25 in. of vacuum, or at 3,000 hours or 2 years, whichever occurs first. The EMI 3000 air cleaner element has a nameplate that reads “EMI 3000.” It cannot be interchanged with air filters used on previous Thermo King trailer units, however it can be retrofit on previous units by using the EMI 3000 Air Cleaner Assembly.

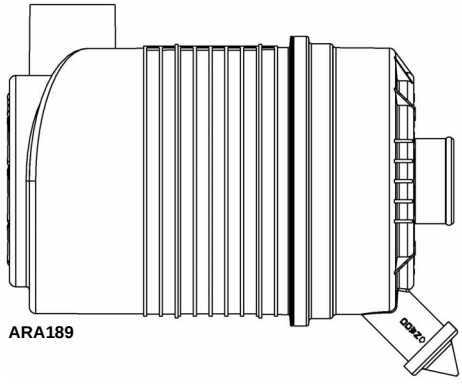
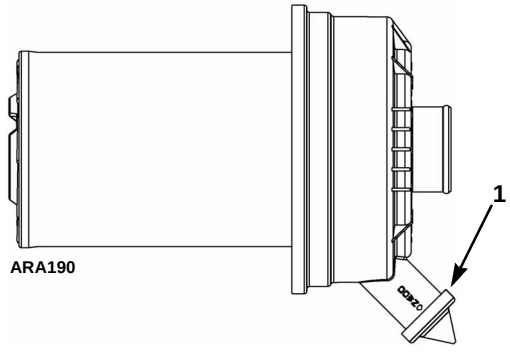


Figure 83: EMI 3000 Air Cleaner Assembly



1.	Dust Ejector Must Point Down When Installed

Figure 84: EMI 3000 Air Filter Element

Air Restriction Indicator

Excessive restriction of the air intake system reduces the flow of air to the engine affecting horsepower output, fuel consumption and engine life.

An air restriction indicator is installed in the air intake manifold. Visually inspect the restriction indicator periodically to assure the air filter is not restricted. Service the air filter when the yellow diaphragm indicates 25 in. of vacuum. Press the reset button on the bottom of the restriction indicator after servicing the air filter.

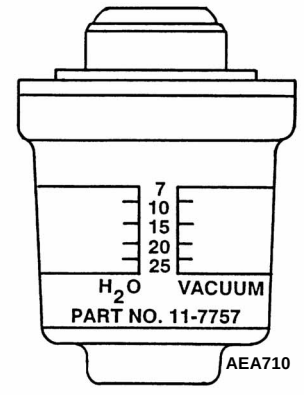


Figure 85: Air Restriction Indicator

Belts

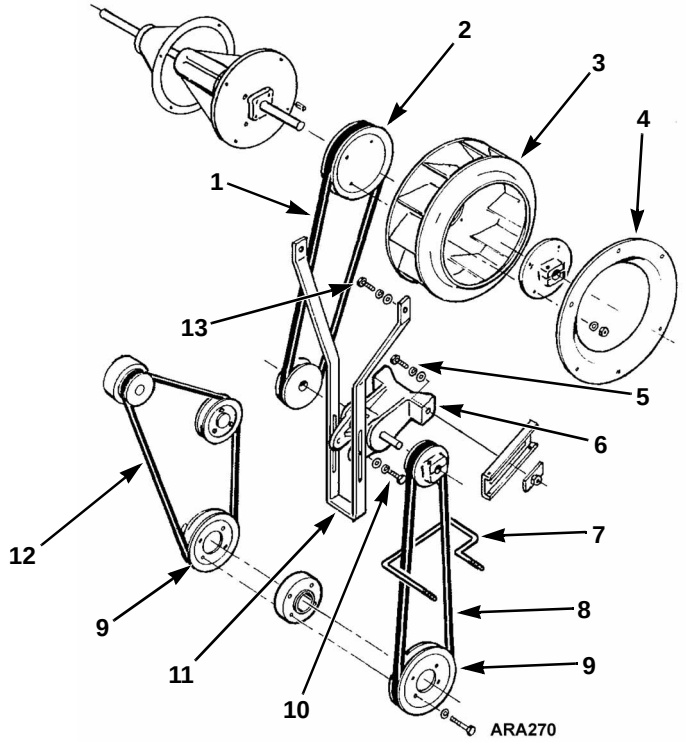
Belts should be regularly inspected during unit pre-trip inspections for wear, scuffing or cracking. Belt tension should also be checked during scheduled maintenance inspections. Belts that are too loose will whip and belts that are too tight put too much strain on the belt fibers and bearings.

Using belt tension gauge, P/N 204-427, is the best method of checking belts for tightness. Install the belt gauge in the center of the longest belt span. Press the plunger so the hook will engage the belt. Make sure the hook is on the face of the belt, not in a notch. Release the plunger with a quick motion and without pulling on the belt. Then read the dial. Use an average of three readings.

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

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

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



1.	Upper Fan Belt	8.	Lower Fan Belt
2.	Condenser Fan Pulley	9.	Engine Pulley
3.	Condenser Fan	10.	Idler Adjusting Arm Bolt
4.	Condenser Inlet Ring	11.	Idler Adjusting Arm
5.	Idler Assembly Pivot Bolt	12.	Alternator Belt
6.	Idler Assembly	13	Idler Adjusting Arm Pivot Bolt
7.	Belt Guide		

Figure 86: Model 30 Belt Arrangement

Model 30 Belt Adjustments

Alternator Belt Adjustment

The alternator belt tension should read 35 on the belt gauge.

1. Loosen the alternator pivot bolt and the adjusting arm bolt.
2. Move the alternator on the adjusting arm slots to adjust the belt to 35 on the belt tension gauge.
3. Tighten the adjusting arm bolt and alternator pivot bolt.

Upper and Lower Fan Belt Adjustment

The upper fan belt should read 74 and the lower fan belt should read 67 on the belt tension gauge.

NOTE: Both the upper and lower fan belts are adjusted at the same time in one procedure.

NOTE: If a fan belt is loose or damaged, replace the belt (see Fan Belt Removal and Installation procedure).

1. Loosen the idler assembly pivot bolts and the idler adjusting arm bolts.
2. Push in or pull out on the idler adjusting arm to “center” the idler assembly between the belts and balance the tension equally between the upper and lower belts.
3. Tighten both idler adjusting arm bolts and both idler assembly pivot bolts.

NOTE: If the idler assembly binds when moving for belt adjustment, loosen the upper idler support bracket mounting bolts to free up the assembly. Check the main idler retainer nut assembly for proper alignment between the nut and the support bracket slots.

Model 30 Fan Belt Replacement

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

Lower Fan Belt

Removal

1. Loosen both idler adjusting arm bolts and both idler assembly pivot bolts.
2. Push the idler adjusting arm IN. The lower fan belt will come off the engine pulley. Move the arm OUT far enough to clear the roadside idler mounting bracket.

Installation

1. Slip the belt into the groove of the idler pulley.
2. Push the idler adjusting arm back in toward the unit.
3. Slip the belt onto the pulley groove on the engine.
4. Pull the idler adjusting arm back OUT and adjust the belts to the proper tension.
5. Tighten the idler assembly pivot bolts and the idler adjusting arm bolts.

Upper Fan Belt

Removal

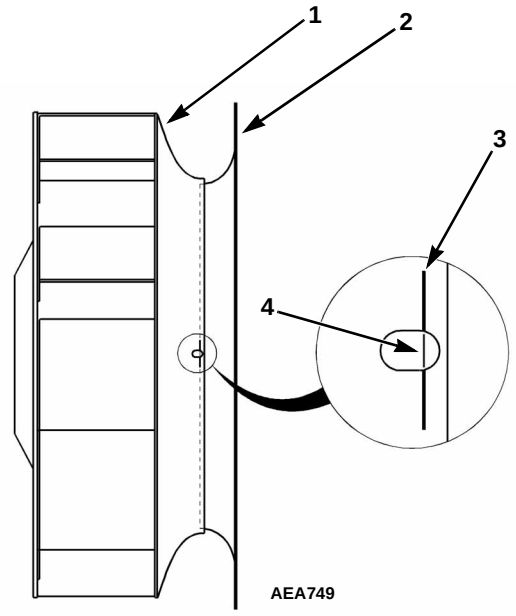
1. Loosen the idler adjusting arm bolts and remove the lower fan belt (see Lower Fan Belt Removal).
2. Push the idler adjusting arm in and the idler assembly up. The upper belt should become slack and slip down out of the idler pulley groove.
3. Pull the idler adjusting arm OUT. The upper fan belt should slip off the idler pulley as the idler pulley hub clears the curbside idler mounting bracket.
4. Loosen the two condenser fan hub to the shaft clamping bolts.
5. Tap the blower wheel with a soft hammer to drive the blower wheel up the fan shaft to provide 1/2 in. (13 mm) clearance between the blower wheel and the inlet ring.

NOTE: If the condenser fan does not slide on the fan shaft with light tapping, remove the small access panel located on the condenser coil header above the expansion tank. Thread a 1/4-20 x 1 in. diameter bolt into the end of the fan shaft. Tighten the bolt and washer down on the condenser fan hub to loosen the blower wheel. Drive the blower wheel back to provide 1/2 in. (13 mm) clearance between the blower wheel and condenser fan inlet ring.

6. Lift the belt up over the condenser blower wheel and remove it from the unit.

Installation

1. Slip the belt over the condenser blower wheel and place it in the condenser fan pulley.
2. Drive the condenser blower wheel out toward the condenser fan inlet ring using a soft hammer.
3. Position the blower wheel so the edge of the inlet ring lines up with the alignment mark on the blower wheel.
4. Check the radial clearance between the blower wheel and inlet ring with a gauge wire. Check around the entire circumference to the inlet ring and blower wheel (see “Condenser and Evaporator Fan Location” in the Structural Maintenance chapter).
5. Torque the blower hub clamping bolts to 18 ft-lb (24 N•m).
6. Seat the upper belt in the blower wheel pulley groove.
7. Push inward on the idler adjusting arm and slip the belt into the idler pulley groove.
8. Pull the idler adjusting arm forward and install the lower fan belt.



1.	Blower Wheel
2.	Inlet Ring
3.	Alignment Mark
4.	Edge of Inlet Ring

Figure 87: Condenser Blower Alignment

Model 50 Belt Adjustments

Alternator Belt Adjustment

The alternator belt tension should read 29 on the belt tension gauge.

1. Loosen the alternator pivot bolt and the adjusting arm bolt.
2. Move the alternator on the adjusting arm slot to adjust the belt to 29 on the belt tension gauge.
3. Tighten the adjusting arm bolt and alternator pivot bolt.

Compressor Belt Adjustment

The compressor drive belts should read 79 on the belt tension gauge.

1. Loosen the back-up hex nut on the belt tensioner compression spring adjustment screw.

2. Move the hex nuts on the compression spring adjustment screw to adjust the belt tension to 79 on the belt tension gauge.
3. With the proper belt tension adjustment, tighten the back-up hex nut to the adjustment hex nut on the compression spring adjustment screw.

Water Pump Belt Adjustment

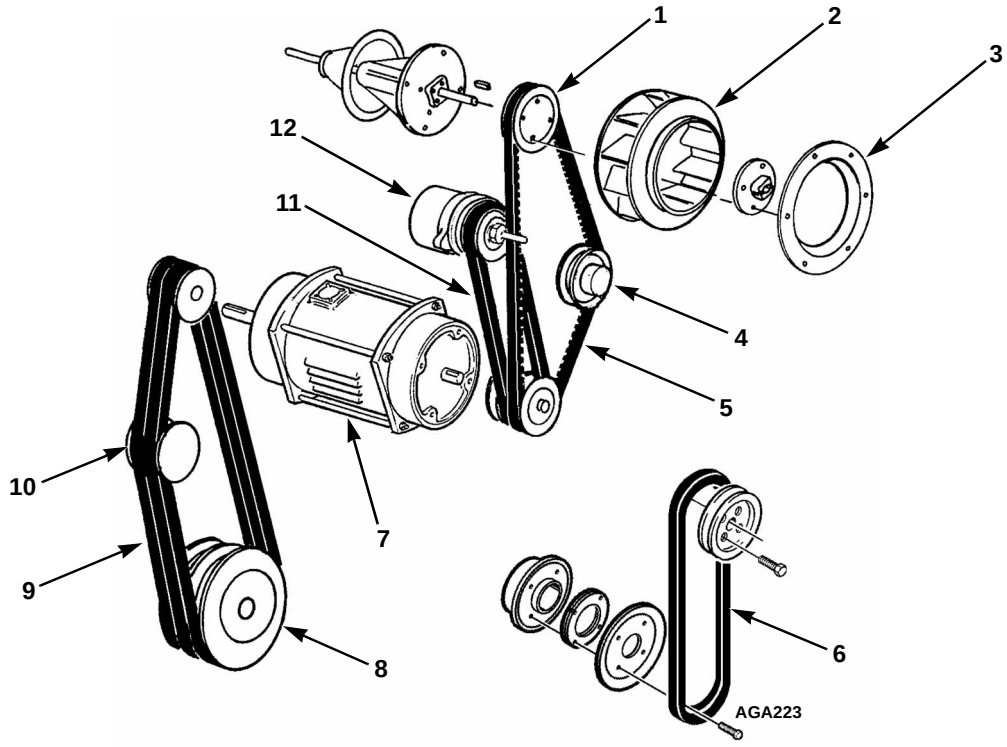
The water pump belt tension should be 35 on the belt tension gauge.

1. Remove the bolts from the water pump pulley.
2. Remove the pulley sliding section and add or remove shims to adjust the belt tension.
3. Reinstall the belt on the pulley and replace the sliding pulley section on the pulley.
4. Tighten the mounting belts on the water pump pulley.
5. The belt tension should read 35 on the belt tension gauge.

Fan Belt Adjustment

The fan belt tension should read 74 on the belt tension gauge.

1. Loosen the idler pulley mounting bolts.
2. Move the idler pulley assembly to adjust the belt tension to 74 on the belt tension gauge.
3. Tighten the idler pulley mounting bolt.



1.	Condenser Fan Pulley	7.	Electric Motor
2.	Condenser Fan	8.	Compressor Pulley
3.	Condenser Inlet Ring	9.	Compressor Belts
4.	Idler Pulley	10.	Belt Tension Adjustment Idler
5.	Fan Belt	11.	Alternator Belt
6.	Water Pump Belt	12.	Alternator

Figure 88: Model 50 Belt Arrangement

Model 50 Compressor Belt Replacement

Removal

1. Loosen the back-up hex on the belt tensioner compression spring adjustment screw.
2. Support the compressor and unbolt the compressor form the flywheel housing (leave the refrigeration lines connected).
3. Move the hex nuts on the compression spring adjustment screw to relieve belt tension.
4. Swing the compressor assembly away from the flywheel housing.
5. Remove the belts through the gap between the clutch and the flywheel.

Installation

1. Install the belts on the clutch pulley through the gap between the clutch and the flywheel.
2. Place the compressor in position and install the mounting bolts.
3. Adjust the hex nuts on the compression spring adjustment to tighten the belts to 79 on the belt tension gauge.
4. Tighten the back-up hex nut on the belt tension compression spring adjustment screw.

Model 50 Fan Belt Replacement

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

Removal

1. Loosen the idler pulley mounting bolts.
2. Move the idler pulley assembly to obtain enough slack to remove the belt from the idler and the electric motor.
3. Loosen the two condenser fan hub to the shaft clamping bolts.
4. Tap the blower wheel with a soft hammer to drive the blower wheel up the fan shaft to provide 1/2 in. (13 mm) clearance between the blower wheel and the inlet ring.

   NOTE: If the condenser fan does not slide on the fan shaft with light tapping, remove the small access panel located on the condenser coil header above the expansion tank. Thread a 1/4-20 x 1 in. diameter bolt into the end of the fan shaft. Tighten the bolt and washer down on the condenser fan hub to loosen the blower wheel. Drive the blower wheel back to provide 1/2 in. (13 mm) clearance between the blower wheel and condenser fan inlet ring.
5. Lift the belt up over the condenser blower wheel and remove it from the unit.

Installation

1. Slip the belt over the condenser blower wheel and place it in the condenser fan pulley.
2. Drive the condenser blower wheel out toward the condenser fan inlet ring using a soft hammer.
3. Position the blower wheel so the edge of the inlet ring lines up with the alignment mark on the blower wheel. See Figure 87 “Condenser Blower Alignment” on page 96.
4. Check the radial clearance between the blower wheel and inlet ring with a gauge wire. Check around the entire circumference to the inlet ring and blower wheel (see “Condenser and Evaporator Fan Location” in the Structural Maintenance chapter).
5. Torque the blower hub clamping bolts to (18 ft-lb) 24 N•m.
6. Seat the upper belt in the blower wheel pulley groove.
7. Place the belt in the idler and electric motor pulleys.
8. Move the idler pulley assembly to adjust the belt tension to 74 on the belt tension gauge.
9. Tighten the idler pulley mounting bolt.

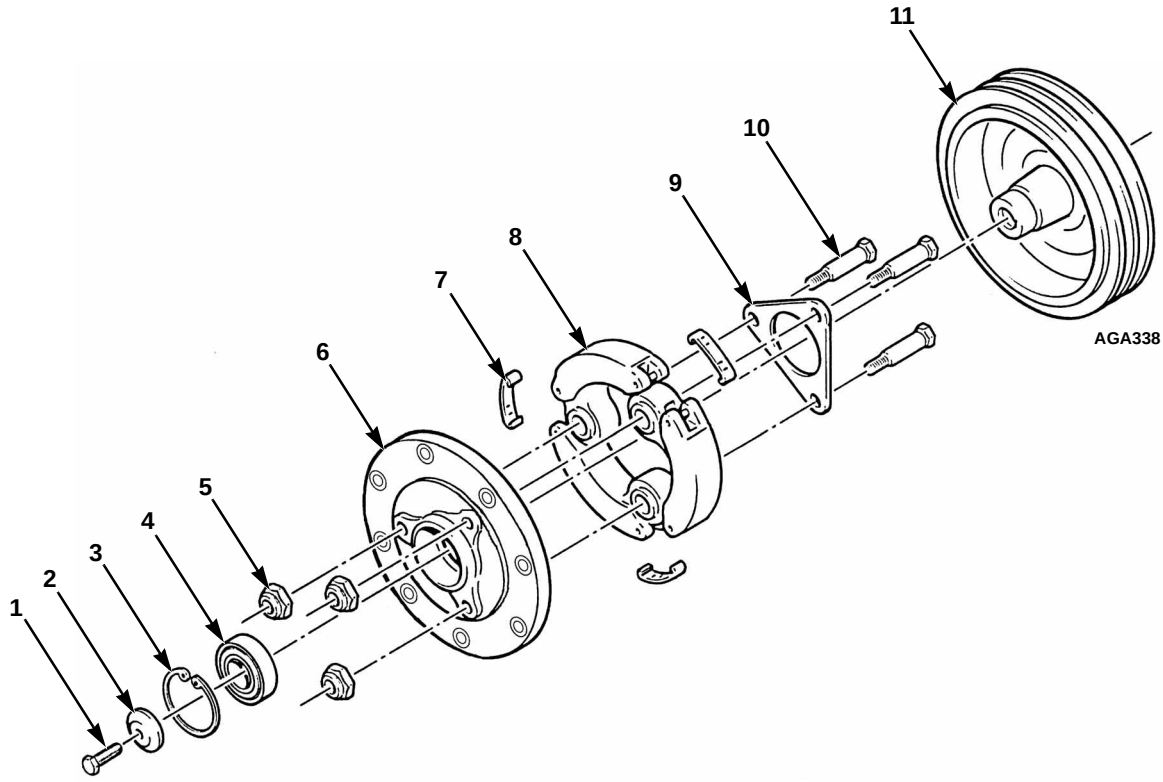
Clutch (Model 50)

Periodically inspect the clutch for worn bearings, worn friction shoes and for broken springs. To inspect the clutch:

1. Loosen the back-up hex nut and move the hex nuts on the compression spring adjustment screw to relieve the tension on the compressor belts.
2. Support the compressor and unbolt the compressor from the bell housing studs.
3. Remove the compressor from the bell housing and turn the compressor to provide better access to the clutch.

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

4. Remove the compressor belts.
5. Remove the clutch mounting bolt and special washer.
6. Remove the clutch with a clutch puller.
7. Remove the key from the compressor crankshaft and inspect the key and the crankshaft for wear, burrs, or damage.
8. To disassemble the clutch, press the pulley out of the bearing.



1.	Clutch Mounting Bolt	7.	Spring
2.	Special Washer	8.	Friction Shoe
3.	Snap Ring	9.	Mounting Bolt Plate
4.	Bearing	10.	Friction Shoe Mounting Bolt
5.	Lock Nut	11.	Pulley
6.	Hub		

Figure 89: Clutch

9. Inspect the friction shoes and springs.
    a. Replace the friction shoes if the linings are worn to a thickness of less than 1/16 to 3/32 in. (1.6 to 2.4 mm).
    b. Replace the springs if they are worn or broken.
10. To replace the friction shoes:
    a. Remove the springs from the friction shoes.
    b. Remove the lock nuts from the friction shoe mounting bolts.
    c. Use a soft hammer to tap the friction shoe mounting bolts out of the hub and remove them from the friction shoes.
    d. Attach the new friction shoes to the hub with the mounting bolt plate, the mounting bolts, and the lock nuts. Torque the lock nuts to 30 to 35 ft-lb (41 to 47 N•m).
11. To replace the bearing:
    a. Remove the snap ring and press the bearing out of the hub.
    b. Press the new bearing into the hub and install the snap ring.
12. To assemble the clutch, press the pulley into the bearing.
13. Place the key in the compressor crankshaft.
14. Place the clutch on the compressor crankshaft and align the keyway with the key.

CAUTION: Do not allow the key to be pushed out of place behind the clutch during clutch installation.

15. Install the special washer and the clutch mounting bolt. Torque the clutch mounting bolt to 90 ft-lb (122 N•m).
16. Reinstall the compressor drive belts.
17. Reinstall the compressor on the bell housing studs.
18. Install and tighten the flatwashers, lockwashers and nuts on the studs.
19. Readjust the compressor drive belts.

Refrigeration Maintenance

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

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

Refrigerant Charge

Testing The Refrigerant Charge With An Empty Trailer

If the unit has an insufficient charge of refrigerant, the evaporator will be "starved" and the box temperatures will rise even though the unit is operating. The suction pressure will drop as the refrigerant charge decreases. If the unit has an overcharge of refrigerant, the unit may not cool properly and the suction and discharge pressure may be high. The charge may be determined by inspection of the refrigerant through the receiver tank sight glasses with the following conditions established:

1. Place a test box over the evaporator.
2. Install a gauge manifold.
3. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
4. Use the microprocessor thermometer to monitor the return air temperature.
5. Run the unit on high speed cool until the air in the box is at 0 F (-18 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-18 C).
6. The suction pressure should be 13 to 18 psi (90 to 124 kPa).
7. The discharge pressure should be at least 275 psi (1896 kPa). If the pressure is below this, it can be raised by covering a portion of the condenser grille with a piece of cardboard to block condenser airflow.
8. Under these conditions, refrigerant should be visible in the receiver tank sight glass. If refrigerant is not visible in the receiver tank sight glass, the unit is low on refrigerant.

Testing the Refrigerant Charge with a Loaded Trailer

1. Install a gauge manifold.
2. Use the Service Test Mode to run the unit in high speed cool. Refer to the appropriate Diagnostic Manual for specific information about the Service Test Mode.
3. Build up and maintain 275 psi (1896 kPa) of head pressure. If the pressure is below this, it can be raised by covering the roadside condenser grille with a piece of cardboard to block condenser air flow.
4. Cool the compartment to the lowest temperature required.
5. Check suction pressure. It should be 13 to 25 psi (90 to 165 kPa).
6. Under these conditions, refrigerant should be visible in the receiver tank sight glass. If refrigerant is not visible in the receiver tank sight glass, the unit is low on refrigerant.

Testing for an Overcharge

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

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

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

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

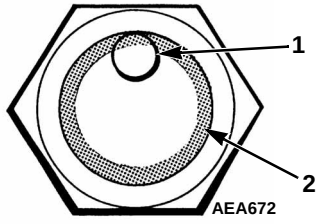
To adjust the refrigerant level:

1. Stop the unit and remove some refrigerant with an approved refrigerant recovery device.
2. Perform a refrigerant level check and repeat the overcharge test.
3. If the liquid level is low, add refrigerant as follows:
   a. Connect a refrigerant tank to the gauge manifold service line and purge the line.
   b. Mid seat the compressor suction service valve.
   c. Set the refrigerant tank for liquid removal and open the hand valve.
   d. Operate the unit in high speed cool.
   e. Observe the suction pressure and slowly open the gauge manifold low pressure hand valve to allow liquid refrigerant to flow into the compressor suction service valve.
   f. Control the liquid flow so the suction pressure increases approximately 20 psi (138 kPa).
   g. Maintain a discharge pressure of at least 275 psi (1896 kPa) while adding refrigerant.
   h. Close the hand valve on the refrigerant tank when the liquid level approaches the top of the receiver sight glass.
4. Repeat the overcharge test.

Moisture Indicating Sight Glass

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

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



1.	Floating Ball
2.	Colored Ring

Figure 90: Moisture Indicating Sight Glass

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

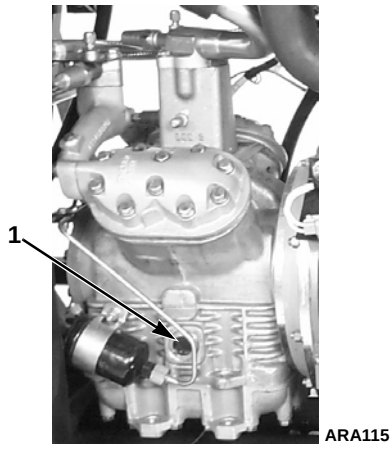
Refrigerant Leaks

Use a reliable leak detector that is suitable for R-404A to leak test the refrigeration system. Inspect for signs of oil leakage, which is the first sign of a leak in the refrigeration system.

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

Checking Compressor Oil

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



1.	Sight Glass

Figure 91: Checking Compressor Oil

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

Install a gauge manifold on the compressor.

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

After the unit has maintained the above conditions for 15 minutes, observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.

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

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

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

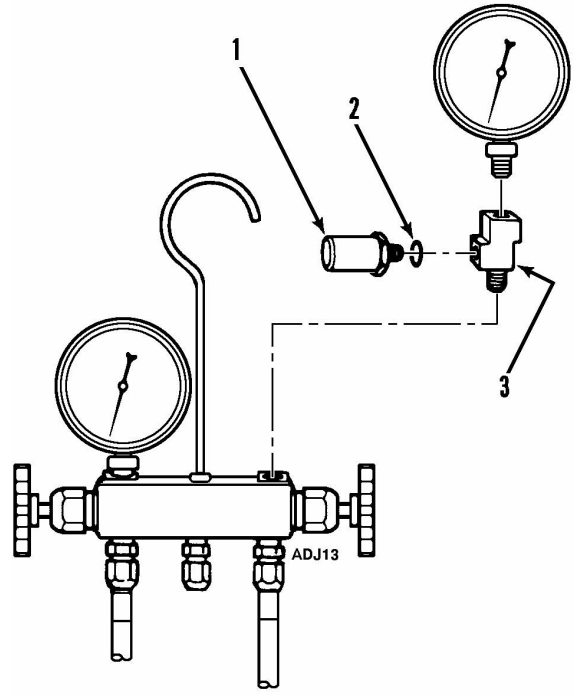
NOTE: Use refrigeration compressor oil ONLY. Polyol Ester P/N 203-513 is required for R-404A.

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

High Pressure Cutout Switch (HPCO)

The HPCO is located on the compressor discharge manifold. If the discharge pressure rises above 470 psig (3241 kPa), the HPCO opens the 8D circuit, de-energizing the fuel solenoid. To test the HPCO, rework a gauge manifold as shown in Figure 92: “High Pressure Cutout Manifold” and use the following procedure.

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



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

Figure 92: High Pressure Cutout Manifold

2. Use the Service Test Mode to run the unit in high speed cool.
3. Raise the discharge pressure of the compressor first by blocking the condenser coil air flow by covering the condenser grille with a piece of cardboard. If this does not raise the discharge pressure to the cutout level of the HPCO, increase the engine speed by overriding the throttle solenoid. This should increase the discharge pressure enough to cause the HPCO to cut out.

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

4. If the HPCO does not open to de-energize the fuel solenoid and stop the engine, it must be replaced.

Three-Way Valve Condenser Pressure Bypass Check Valve

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

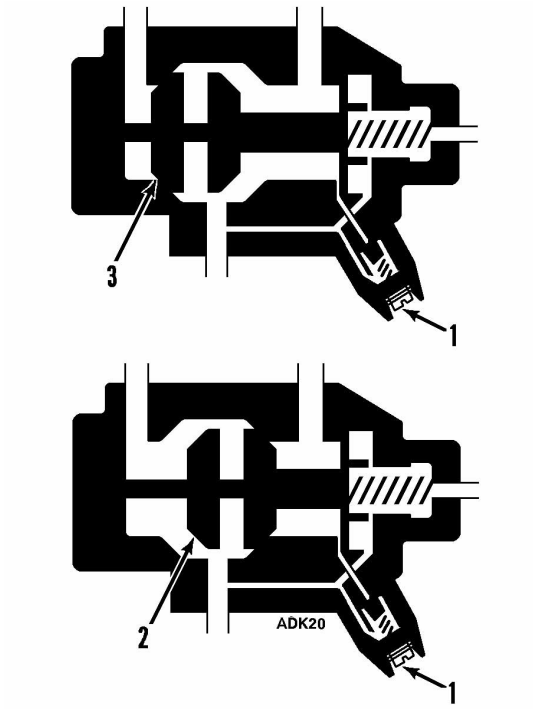
The check valve is closed when the unit is running on cool, or whenever the discharge pressure is higher than the condenser pressure.

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

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

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

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



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

Figure 93: Three-way Valve Condenser Pressure Bypass Check Valve

5. Operate the unit on cool and pump down the low side to 20 in. Hg (-68 kPa) of vacuum.
6. Stop the unit. The condenser and suction pressures should remain stable, indicating no leaks.
7. Shift the three-way valve to the heat position. The low side gauge will raise slightly. The high side gauge will drop to approximately zero. The gauges will equalize.

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

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

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

Electronic Throttling Valve (ETV)

The Electronic Throttling Valve (ETV) is optional on the SB-210 30. It is standard on the SB-210 50 and SB-310 30.

The Electronic Throttling Valve (ETV) is a variable position valve operated by a stepper motor. The ETV is located in the suction line between the evaporator and the heat exchanger. The ETV system also uses discharge and suction pressure transducers, and a hot gas bypass valve.

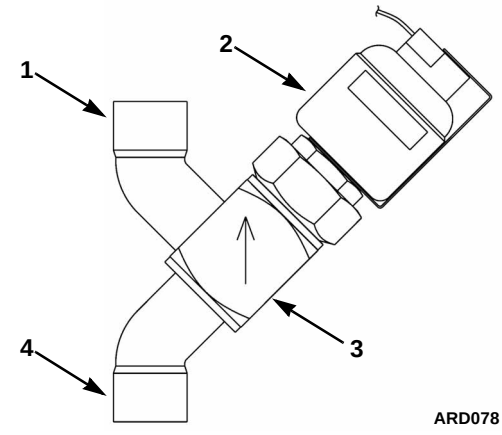
The ETV has two internal coils. The microprocessor operates the valve by energizing the coils with a variable frequency ac signal. The valve position can be monitored with the **GAUGE** key. Zero (0) indicates the valve is fully closed and 800 indicates the valve is fully open.

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

Use the **GAUGE** key to check the operation of the ETV during the ETV test. The valve position should be 0 at the start of the test when the valve is fully closed, and should go to a higher value when the valve is opened. The suction pressure should decrease while the valve is fully closed, and should begin to increase when the valve is opened.

Refer to the SR-2 Microprocessor Control System Diagnostic Manual TK 51587 for complete information about the testing and operation of the ETV.

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



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

Figure 94: Electronic Throttling Valve

Pressure Transducers

The discharge pressure transducer and the suction pressure transducer supply pressure information to the microprocessor. These pressures can be monitored with the **GAUGE** key. Check the readings by comparing them to the readings on a gauge manifold set attached to the compressor. Refer to the SR-2 Microprocessor Control System Diagnostic Manual TK 51587 for more information about the testing and operation of the pressure transducers.

Hot Gas Solenoid

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

Refer to the SR-2 Microprocessor Control System Diagnostic Manual TK 51587 for information about testing the hot gas solenoid. See the Refrigeration Service Operations chapter of this manual for removal and installation procedures.

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

Compressor

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Loosen the compressor belts on Model 50 units.
3. Front seat the discharge and suction service valves.
4. Recover the refrigerant remaining in the compressor.
5. Unbolt the discharge and suction service valves from the compressor.
6. Disconnect the high pressure cutout switch, the pilot solenoid line, and remove the compressor oil filter.
7. Support the compressor and remove the compressor mounting bolts from the flywheel housing.
8. Lift the service valves out of the way.
9. Slide the compressor to the left until the coupling pins are clear, and remove the compressor belts from Model 50 units.
10. Remove the compressor from the front of the unit. Keep the compressor ports covered to prevent dust, dirt, etc., from falling into the compressor.

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

Installation

1. Slide the compressor into the unit.
2. Place the compressor in position, install the compressor belts on Model 50 units, and install the mounting bolts.

    NOTE: The compressor drive coupling or clutch will only slide onto the coupling pins in either of two positions, which are 180 degrees apart.
3. Install the service valves using new gaskets soaked in compressor oil. Connect the high pressure cutout switch, the pilot solenoid valve line, and install the compressor oil filter.
4. Pressurize the compressor and test for refrigerant leaks.
5. If no leaks are found, evacuate the compressor.
6. Back seat the suction and discharge service valves.
7. Tighten the compressor belts on Model 50 units.
8. Operate the unit at least 30 minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.
9. Check the refrigerant charge and add refrigerant if needed.

Compressor Coupling Removal (Model 30)

1. After the compressor has been removed from the unit, use the appropriate Allen tool provided with removal tool P/N 204-991 to loosen the center bolt which holds the coupling to the compressor shaft.
2. Attach the tool to the coupling with the provided socket head screws and spacers. Two sets of spacers are provided with the tool, use the short spacers with shallow compressor mounting flanges and the longer set for deeper flanges. The side with the countersunk holes should be toward the coupling.
3. To prevent the tool and crankshaft from rotating, use one of the compressor to engine mounting screws to pin the tool to the flange. If a nut is used to prevent the bolt from falling out, the nut should not be tightened.

4. Use the appropriate Allen tool to loosen the coupling mounting screw.
5. Once the center screw has been loosened, back the head against the tool and it should push the coupling off the crankshaft as you continuing turning the center screw in a counter-clockwise direction. Using this tool will prevent the coupling from popping off because the center bolt and flatwasher will hold it in place.

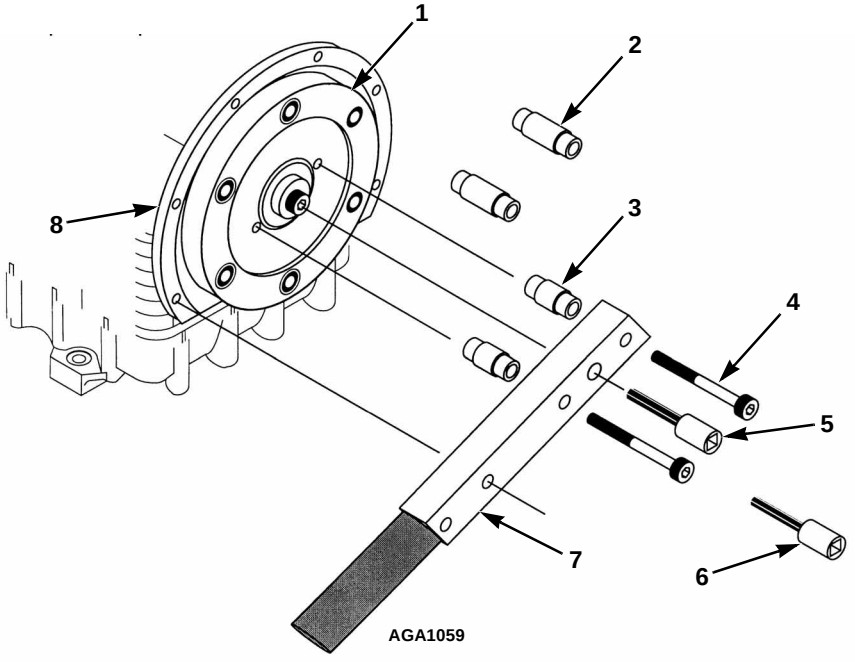
Compressor Coupling Installation (Model 30)

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

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

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

1. Clean the compressor shaft taper and coupling bore taper with a solvent that leaves no oily residue (such as naphtha, lacquer thinner, brake cleaner or the like).
2. Inspect both mating surfaces for burrs, oxidation and other surface imperfections. Dress with crocus cloth if necessary and re-clean as required.



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

Figure 95: Compressor Coupling Removal Tool

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

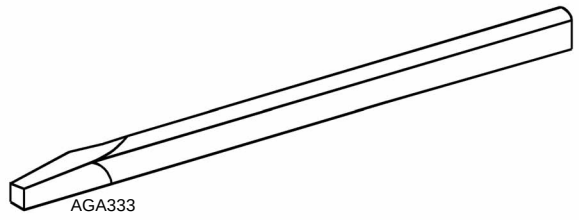
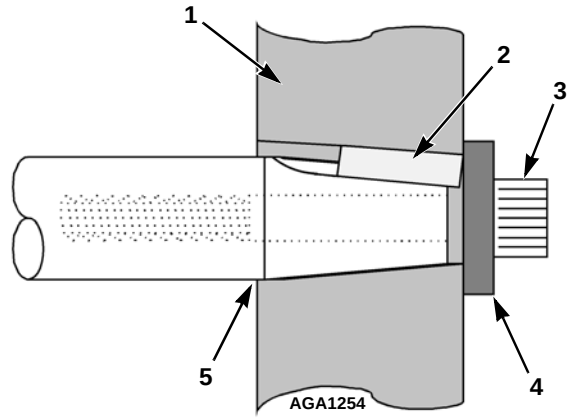


Figure 96: Keyway Tool P/N 204-972

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

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



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

Figure 97: Compressor Coupling Installation

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

Condenser Coil

Removal

1. Recover the refrigerant charge.
2. Open the roadside condenser fan grille.
3. Drain engine coolant from the expansion tank. Unbolt and remove the expansion tank from the condenser coil frame.
4. Remove the condenser coil mounting bolts. Remove the mounting clamps from the condenser inlet line.

5. Unsolder the inlet line and liquid line connections. Lift the coil from the unit.

Installation

1. Clean the fittings for soldering.
2. Place the coil in the unit and install the mounting bolts.
3. Solder the inlet line and liquid line connections.
4. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.
5. Install the clamps on the condenser inlet line.
6. Install the engine coolant expansion tank and refill half way with engine coolant.
7. Close the roadside condenser fan grille.
8. Recharge the unit with proper refrigerant and check the compressor oil.

Discharge Vibrasorber

Removal

1. Recover the refrigerant charge.
2. Heat the connections on the vibrasorber until the vibrasorber can be removed.

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

Installation

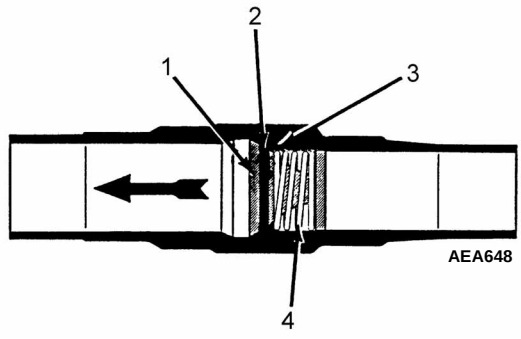
1. Prepare the vibrasorber and tubing fittings by cleaning thoroughly.
2. Solder the vibrasorber connections.

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

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

In-Line Condenser Check Valve

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



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

Figure 98: Cross Section of In-line Condenser Check Valve

Condenser Check Valve Replacement

Removal

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

Installation

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

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

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

Bypass Check Valve

Removal

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

Installation

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

Receiver Tank

Removal

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

Installation

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

Filter Drier

Removal

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

Installation

1. Place the new O-rings in the ORS fittings on the ends of the drier.
2. Install the new drier and tighten the mounting hardware.
3. Install and tighten the inlet nut. Hold the drier with a back-up wrench on the hex behind the inlet fitting.
4. Release a small amount of refrigerant to purge the air through the drier. Then tighten the outlet nut.

5. Pressurize the system and inspect for leaks. If no leaks are found, open the refrigeration valves and place the unit in operation.

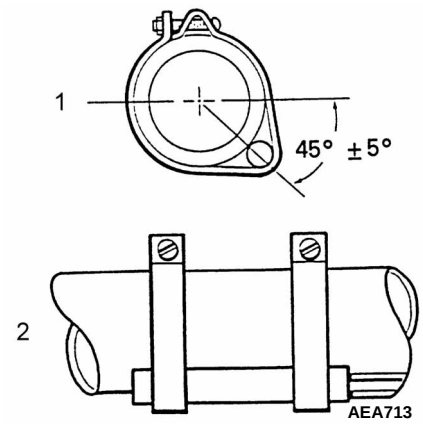
Expansion Valve Assembly

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the feeler bulb from the clamp. Note the position of the feeler bulb on the suction line.
4. Disconnect the equalizer line from the suction line.
5. Disconnect the inlet liquid line and unsolder the distributor from the expansion valve.
6. 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. Connect the inlet liquid line and solder the distributor to the expansion valve.
3. Connect the equalizer line to the suction line.
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 operation will be faulty. Wrap with insulating tape.



1.	End View
2.	Side View

Figure 99: Location of Expansion Valve Bulb

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

Heat Exchanger

Removal

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

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

Installation

1. Clean the tubes for soldering.
2. Place the heat exchanger assembly in the evaporator housing and install the mounting hardware loosely.
3. Solder the liquid inlet and the suction outlet line connections on the condenser side of the bulkhead. Seal the openings through the bulkhead with putty when the refrigerant lines have cooled off.
4. Solder the suction line connection to the evaporator coil.
5. Connect the equalizer line to the suction line and the liquid outlet line to the expansion valve.
6. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
7. Tighten the heat exchanger mounting hardware securely.
8. Clean the suction tube to a brightly polished condition. Install the feeler bulb clamps and the feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or the operation will be faulty. Wrap with insulating tape.
9. Replace the upper and lower evaporator access panels.
10. Open the refrigeration valves and place the unit in operation.

Evaporator Coil

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the upper and lower evaporator access panels.
3. Remove the roadside and curbside evaporator access panel mounting channels.
4. Disconnect the sensors.
5. Remove the feeler bulb from the suction line clamp. Note the position of the feeler bulb on the suction line.
6. Unsolder the distributor from the expansion valve.
7. Unsolder the hot gas line and the suction line from the evaporator coil.
8. Remove the mounting bolts, lift and slide the coil from the housing.

Installation

1. Place the evaporator coil in the evaporator housing and install the mounting bolts.
2. Solder the hot gas line and suction line connections to the evaporator coil.
3. Connect the distributor to the expansion valve.
4. Replace and connect the sensors.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Clean the suction line to a bright polished condition. Install the feeler bulb on the side of the suction line in its former position. The feeler bulb must make good contact with the suction line or its operation will be faulty. Wrap with insulating tape.
7. Replace the roadside and curbside evaporator access panel mounting channels.
8. Replace the evaporator access panels.
9. Open the refrigeration valves and place the unit in operation. Check the refrigerant charge and the compressor oil. Add as required.

Accumulator

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Unsolder the inlet and outlet suction lines from the accumulator.

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

3. Disconnect the tee fitting from the accumulator tank.
4. Unbolt and remove the accumulator from the unit.

Installation

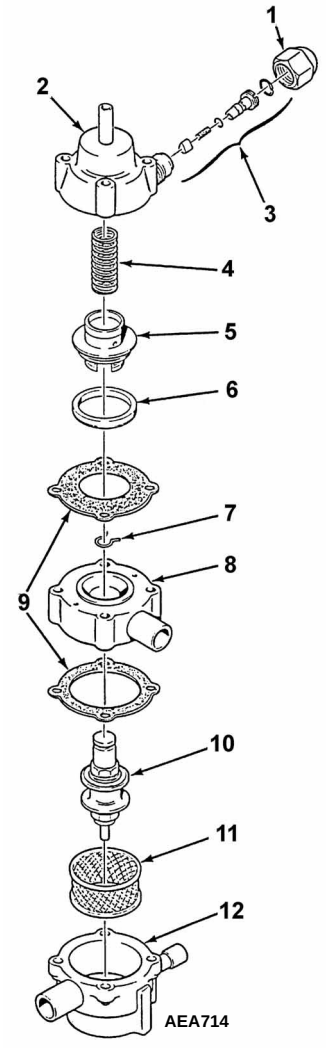
1. Place the accumulator in the unit and tighten the mounting bolts and nuts.
2. Solder the inlet and outlet suction lines to the accumulator.

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

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

Three-Way Valve Repair

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



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

Figure 100: Three-Way Valve

Removal/Disassembly

1. Recover the refrigerant charge.

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

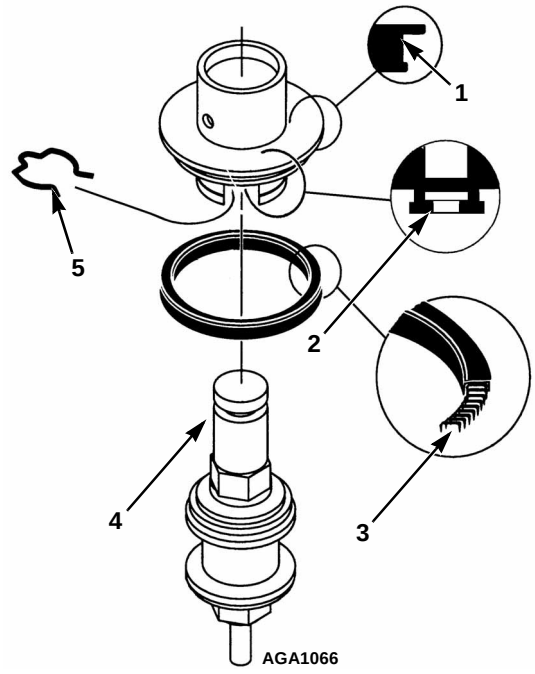
CAUTION: Do not force the tool into the brass or against the bolts.

Figure 101: Gasket Tool P/N 204-424

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

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

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



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

Figure 102: Piston and Stem Parts

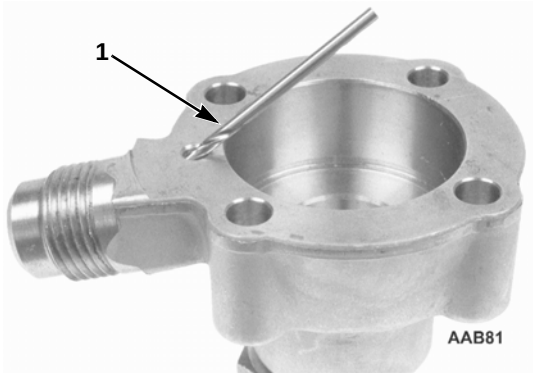
End Cap Checks

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

Check Valve Bleed Hole Diameter

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

4. Deburr the hole in the check valve piston bore. A used drill bit can be modified to use as a deburring tool.

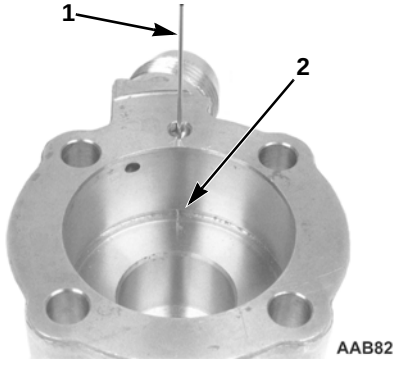


1.	Number 43 Drill

Figure 103: Check Bleed Hole Diameter

Piston Bleed Orifice Check

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



1.	Number 66 Drill
2.	Check for Burr Here

Figure 104: Check Piston Bleed Orifice

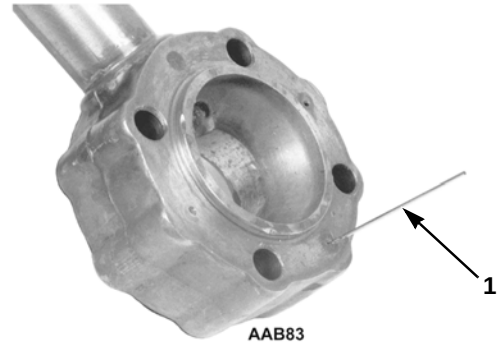
Check Valve Piston Check

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

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

Seat (Center Section) Orifice Check

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



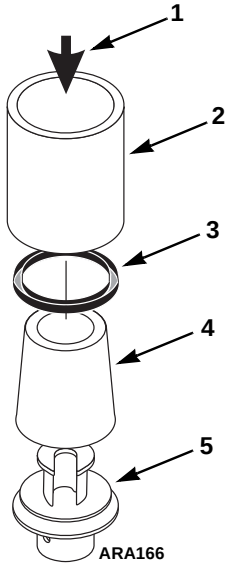
1.	Number 66 Drill

Figure 105: Check Seat Orifice

Assembly/Installation

After cleaning and inspecting all parts, reassemble the valve.

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



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

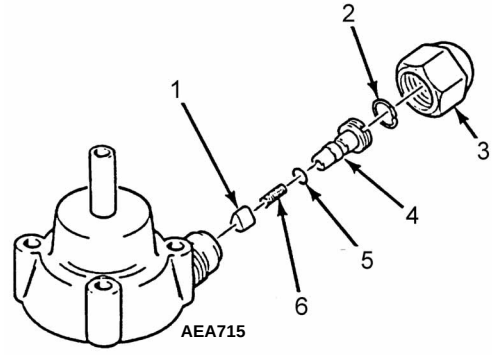
Figure 106: Seal Installation with Tool P/N 204-1008

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

Three-Way Valve Condenser Pressure Bypass Check Valve Repair

Removal

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



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

Figure 107: Teflon Check Valve Assembly

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

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

5. Remove the spring and piston.

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

Installation

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

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

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

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

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

Pilot Solenoid

Removal

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

Installation

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

Suction Vibrasorber

Removal

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

Installation

1. Prepare the suction vibrasorber and tube fittings for soldering by cleaning the thoroughly.
2. Solder the vibrasorber to the suction service valve.

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

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

High Pressure Cutout Switch

Removal

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

Installation

1. Apply a refrigerant Loctite to the threads of the high pressure cutout switch.
2. Install and tighten the high pressure cutout switch and reconnect the wires.
3. Pressurize the compressor and test for leaks.
4. If no leaks are found, open the refrigeration service valves and place the unit in operation.

High Pressure Relief Valve

Removal

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

Installation

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

Discharge Pressure Transducer

Removal

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

Installation

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

Suction Pressure Transducer

Removal

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

Installation

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

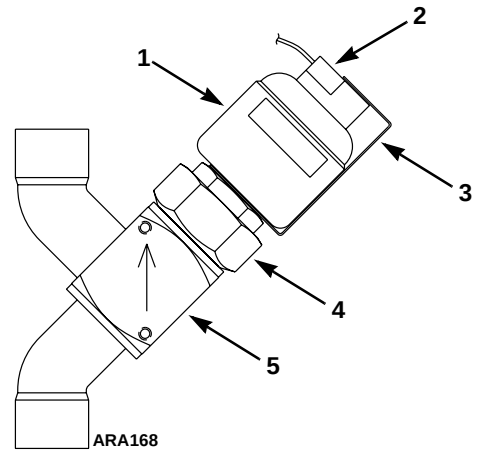
Electronic Throttling Valve (ETV)

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove the evaporator access panels.
3. Remove the clip and disconnect the ETV harness connector from the stepper motor.
4. Unscrew the large nut that attaches the stepper motor and piston assembly to the valve body. The torque on the nut is approximately 100 ft-lb (136 N•m). Hold the valve body with backup wrench to prevent damage to the refrigeration tubing.

CAUTION: Unscrew the large nut. Do not unscrew the small nut.

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



1.	Stepper Motor	4.	Large Nut
2.	Harness Connector	5.	Valve Body
3.	Clip		

Figure 108: Electronic Throttling Valve

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

Installation

1. If an ETV service kit (stepper motor and piston assembly) is being installed, go to step 2. If a complete ETV assembly is being installed, proceed as follows:
   a. Remove the stepper motor and piston assembly from the valve body on the new ETV assembly.
   b. Clean the tubes for soldering.

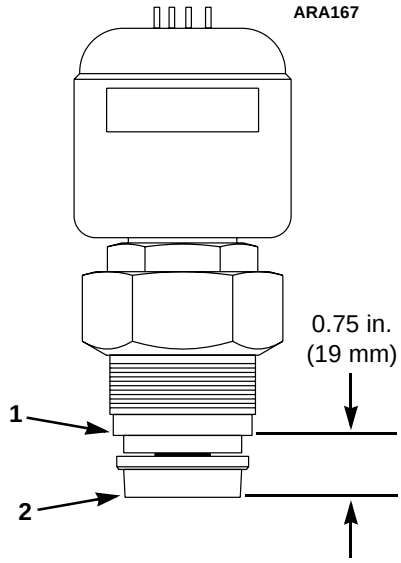
c. Place the new valve body (and any tubes that were removed) in the same position from which the old one was removed. The new ETV could interfere with the evaporator access panel if it is not placed in the same position as the old one. The arrow on the valve body must point up, which is the direction of refrigerant flow from the evaporator to the heat exchanger.

d. Solder the tubing connections. Use a heat sink on the valve body to prevent damage.

e. Allow the valve body to cool before installing the stepper motor and piston assembly.

2. Check the stepper motor and piston assembly to make sure the piston is an open position. In an open position the bottom edge of the piston is 0.75 to 1.25 in. (19 to 32 mm) from the bottom edge of the brass nut. The piston retracts to open and extends to close.

NOTE: The ETV cannot be opened manually. See the following CAUTION.



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

Figure 109: Stepper Motor and Piston Assembly with Piston in Fully Open Position

CAUTION: The ETV may stick in the closed position if the stepper motor and piston assembly is installed with the piston in the closed position. In the closed position the bottom edge of the piston is 1.5 in. (38 mm) from the bottom edge of the brass nut. If there is any doubt about the position of the piston, connect the ETV harness to the stepper motor and piston assembly and use the evacuation mode in the Service Test Mode to place the piston in the fully open position. Refer to the SR-2 Microprocessor Controller Diagnostic Manual TK 51587 for information about placing the unit in the evacuation mode. After placing the piston in the fully open position, disconnect the ETV harness from the stepper motor and piston assembly.

3. Lubricate the piston and threads on the new stepper motor and piston assembly with refrigeration oil.

4. Screw the new stepper motor and piston assembly into the valve body.

5. Torque the nut to approximately 100 ft-lb (136 N•m). Hold the valve body with backup wrench to prevent damage to the refrigeration tubing.

CAUTION: Tighten the large nut. Do not tighten the small nut.

6. Connect the ETV harness connector to the stepper motor. Take care when making the connection. The connector attaches to the ETV in only one position.

7. Install the clip and secure it with a band wrap.

8. Pressurize the low side and test for leaks.

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

10. Install the evaporator access panels.

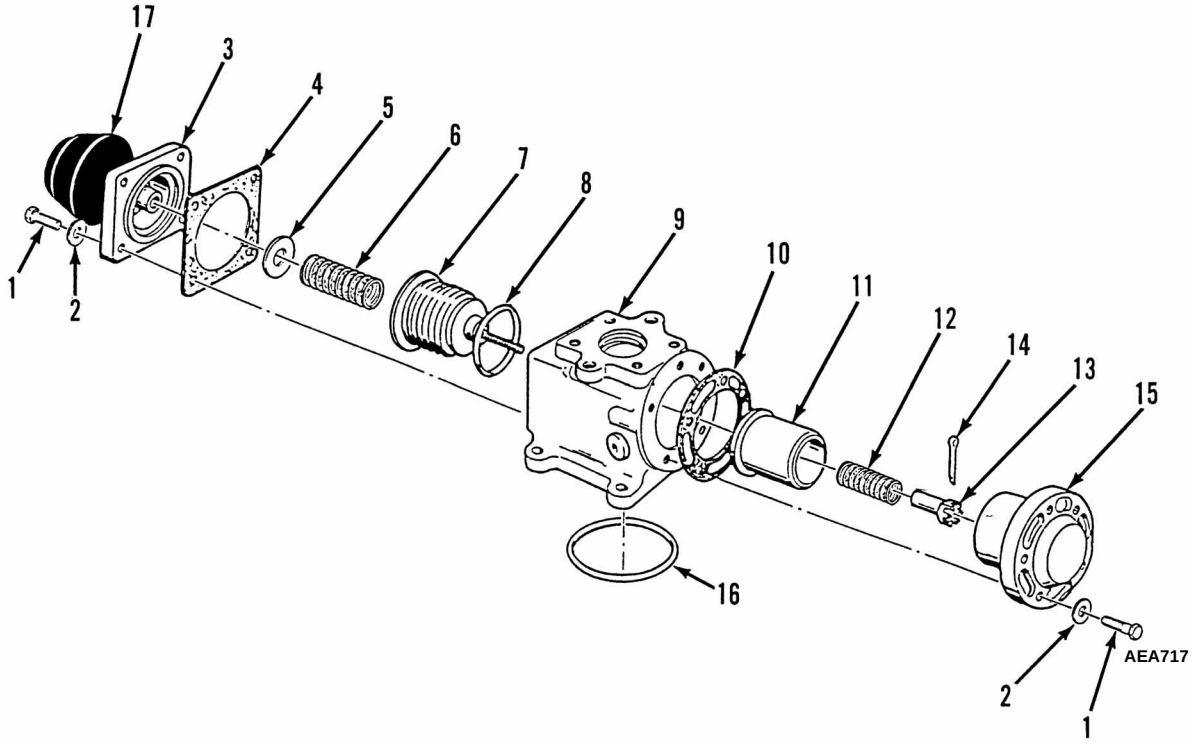
11. Open the refrigeration valves and place the unit in operation. Check the operation of the ETV.

Mechanical Throttling Valve

See Figure 110 for an illustration of the mechanical throttling valve assembly.

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Front seat the discharge and suction service valves. Recover the refrigerant remaining in the compressor.
3. Remove the suction service valve.
4. Unbolt and remove the throttling valve from the unit.



1.	Screw - Mtg Plate	10.	Gasket - Piston Housing
2.	Flatwasher	11.	Piston
3.	Plate - Bellows End	12.	Spring - Piston
4.	Gasket - End Plate	13.	Nut - Adjusting
5.	Washer - Adjusting	14.	Pin - Cotter
6.	Spring - Bellows	15.	Housing - Piston
7.	Bellows & Shaft - Assy	16.	O-ring - Valve to Compressor
8.	O-ring	17.	Cap - Rubber
9.	Housing		

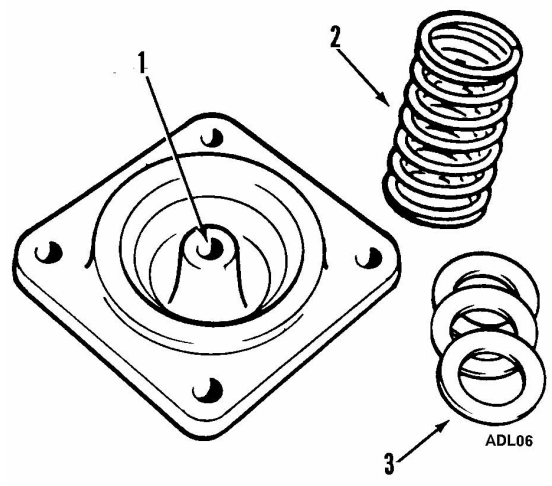
Figure 110: Mechanical Throttling Valve Assembly

Disassembly

1. Remove the piston end cap (round end).
2. Remove the cotter pin from the castle nut and remove the nut.
3. Remove the spring and piston.
4. Loosen all the bolts on the bellows end cap.

CAUTION: This end cap is under slight spring pressure.

5. Break the gasket free and remove the end cap.
6. Note the number of shims next to the cap. These can be reused.

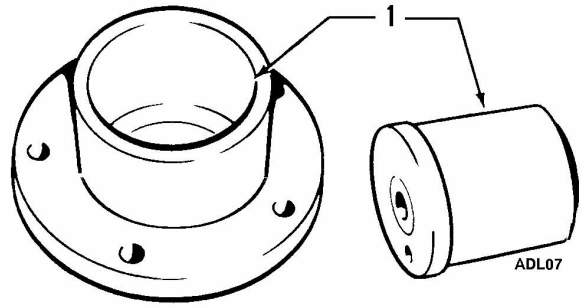


1.	Inspect Cap
2.	Inspect Spring
3.	Shims

Figure 111: Inspect Parts

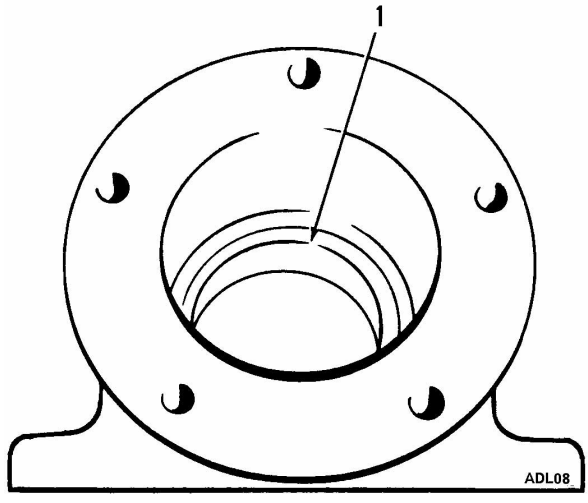
7. Remove the bellows.
8. Inspect all the parts.
   a. Piston and cap for wear (scuff marks).
   b. Body for stripped threads.
   c. Bellows end cap for damage in the pilot hole.

NOTE: The bellows is normally replaced.



1.	Inspect for Wear

Figure 112: Inspect for Wear



1.	Inspect for Damage

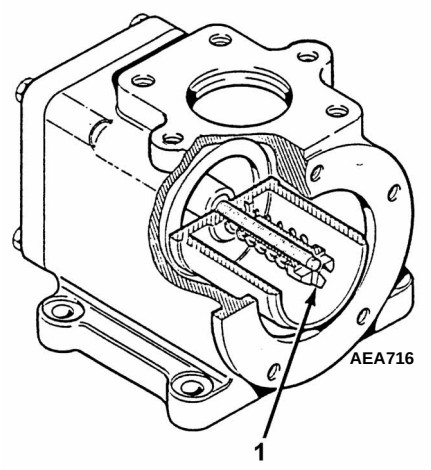
Figure 113: Inspect for Damage

9. Clean the parts that will be reused.

Reassembly

1. Install the bellows with the O-ring in the housing.
2. Center the spring on the bellows shoulder.
3. Oil the gasket, install it on the housing, and place the shims in the end cap (use same number as removed). Tighten the end cap in place with the vent hole closest to the outlet opening of the valve housing.
4. Install the piston, spring and tighten the castle nut until it is firmly seated against the bottom of the piston.

5. Back off the castle nut, one full turn only.
6. Insert the cotter pin.



1.	Tighten castle nut to bottom, then back off 1 turn only. Insert cotter pin

Figure 114: Throttling Valve Reassembly

7. Oil the gasket and install the end cap.
8. The throttling valve will have to be recalibrated on operating unit. (See the Specifications Chapter for the setting.)
9. Adjust the setting by adding or removing shims under the spring.

Installation

1. Install the throttling valve using a new O-ring soaked in compressor oil. Bolt the throttling valve to the compressor.
2. Install the suction valve.
3. Pressurize the compressor and check for leaks. If no leaks are found, evacuate the compressor.
4. Open the refrigeration valves and place the unit in operation.

Hot Gas Solenoid Valve

Removal

1. Recover the refrigerant charge.
2. Disconnect the wires and remove the coil for the valve.
3. Unsolder the lines and remove the valve.

Installation

1. Clean the tubes for soldering.
2. Remove the coil and place the valve in position.
3. Solder the inlet and outlet connections. After the valve cools, install the coil.
4. Pressurize the refrigeration system and test for leaks.
5. If no leaks are found, evacuate the system.
6. Recharge the unit with proper refrigerant and check the compressor oil.

Compressor Oil Filter Change

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

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

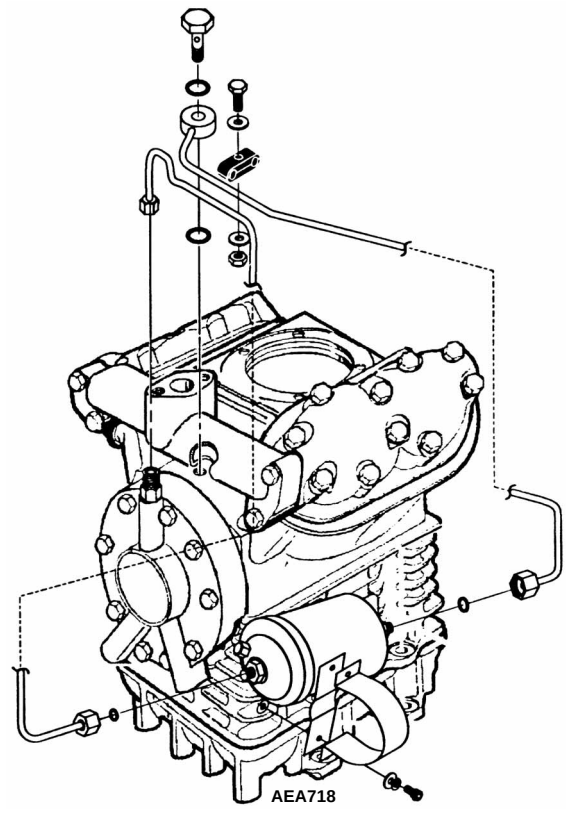


Figure 115: Compressor Oil Filter

Checking Compressor Oil Pressure

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

1. Attach a suitable oil pressure gauge to the oil pressure access port on the compressor oil filter.

2. Attach the low pressure gauge of a gauge manifold to the fitting on the side of the throttling valve. This fitting allows you to monitor the suction pressure in the compressor below the throttling valve.
3. Start the unit and note the pressure at the oil pressure access port and the suction pressure below the throttling valve.
4. Subtract the suction pressure below the throttling valve from the pressure at the oil pressure access port to get the net oil pressure.

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

5. The net oil pressure should be at least 20 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.

1. Attach a suitable oil pressure gauge to the oil pressure access port on the compressor oil filter.
2. Attach the low pressure gauge of a gauge manifold to the fitting on the side of the throttling valve. This fitting allows you to monitor the suction pressure in the compressor below the throttling valve.
3. Disconnect the wires to the fuel solenoid.
4. Disconnect the wires to the high speed solenoid.

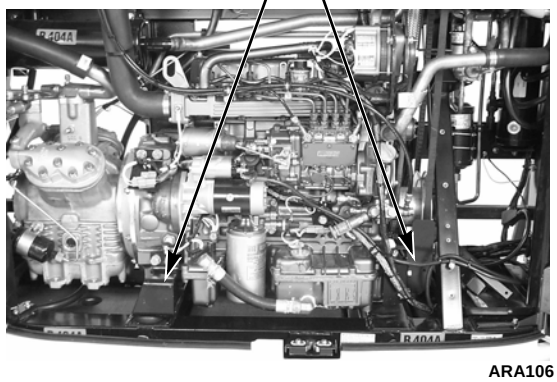
   NOTE: The microprocessor will probably record some alarm codes because the solenoids are disconnected and the engine does not start. Clear these alarm codes as necessary.

5. Turn the unit on and let the engine crank (or crank the engine) for 30 seconds, but do not crank the engine for more than 30 seconds.
   a. Note the pressure at the oil pressure access port and the suction pressure below the throttling valve while the engine is cranking. Subtract the suction pressure below the throttling valve 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.
6. As soon as the compressor develops 10 psi (96 kPa) of net oil pressure, re-connected the fuel solenoid wires, but do not re-connect the high speed solenoid wires.
7. 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 and re-connect the high speed solenoid wires.
8. Run the engine on high speed for at least five more minutes. The compressor oil pump is now primed and broken in.

Structural Maintenance

Unit and Engine Mounting Bolts

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



1.	Check Bolts for Tightness

Figure 116: Unit and Engine Mounting Bolts

Unit Inspection

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

Condenser, Evaporator, and Radiator Coils

Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in the direction opposite the normal airflow. Repair bent fins and any other noticeable damage.

Defrost Drains

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

Unit Installation

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

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

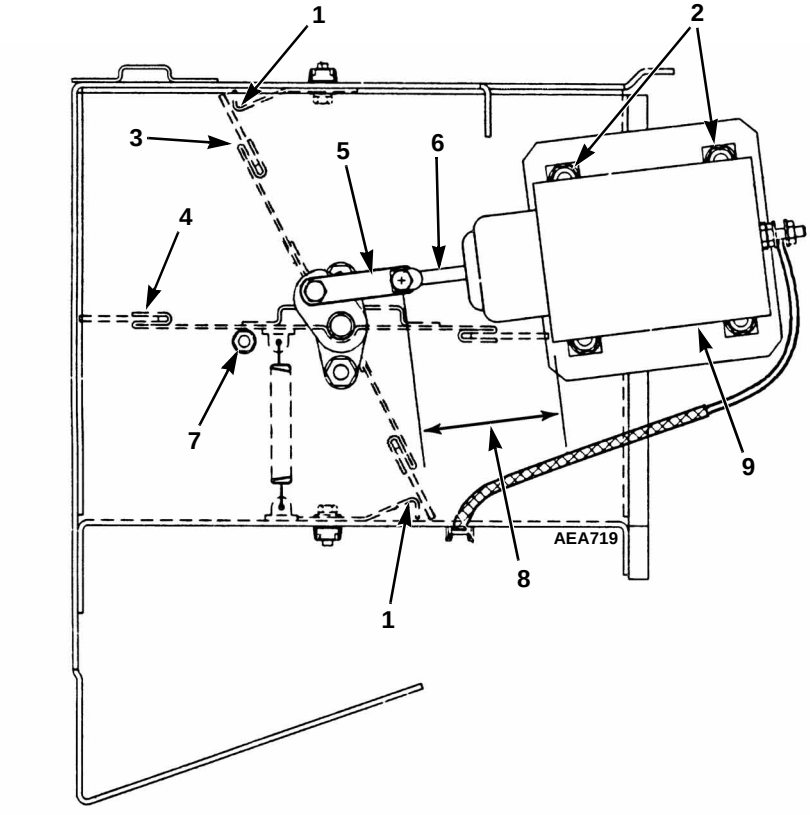
Defrost Damper

Check the damper during scheduled maintenance inspections for shaft wear, end play, and the ability to stop the air flow.

Position the damper so that air flow is stopped on the top and bottom edges with the solenoid plunger bottomed out.

To adjust the damper:

1. Remove the damper assembly from the evaporator.
2. Disconnect the damper link from the eye bolt.
3. Check Distance A, the distance from the shoulder on the solenoid to the center of the hole in the eye bolt. Distance A should be 2.75 in. (69.85 mm) with the solenoid de-energized.
4. If necessary, adjust Distance A to the proper dimension by loosening the locknut on the end of the solenoid plunger and turning the eye bolt. Tighten the locknut when Distance A is correct.
5. Connect the damper link to the eye bolt.
6. Energize the solenoid (apply 12 volts dc) and check the damper blade to make sure that both edges contact the damper housing. If necessary, adjust this by loosening the solenoid mounting bolts and moving the solenoid. Tighten the solenoid mounting bolts when both edges of the damper blade contact the damper housing.
7. Adjust the damper blade stops so they contact the edges of the damper blade. This keeps the damper from sticking closed.



1.	Stop	6.	Eye Bolt
2.	Mounting Bolts	7.	Round Stop
3.	Closed Position	8.	Distance A 2.75 in. (69.85 mm)
4.	Open Position	9.	Solenoid
5.	Damper Link		

Figure 117: Defrost Damper Adjustment

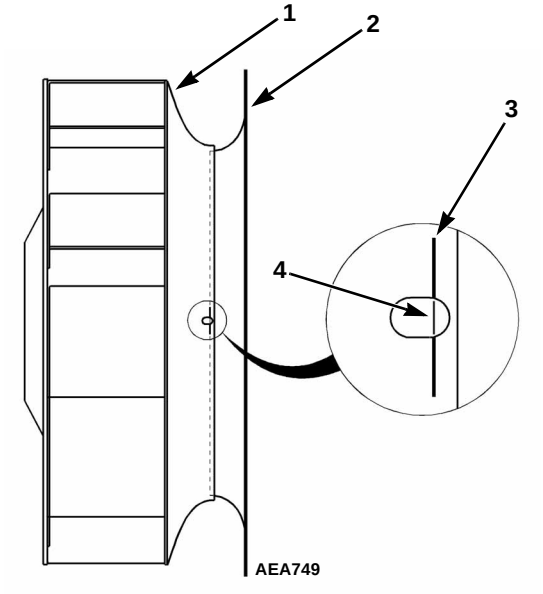
8. De-energize and energize the damper several times to make sure that the damper operates correctly and seals properly.
9. Make sure the damper blade rests on the round stops when the damper is open. Adjust the round stops if necessary.
10. Install the damper assembly in the evaporator.

Condenser and Evaporator Fan Location

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

Condenser Fan Blower

1. Loosen the condenser inlet ring (spinning) on the condenser coil bulkhead.
2. Slide the blower towards the inlet ring until it contacts the inlet ring. This centers the inlet ring in the blower orifice.
3. Tighten the inlet ring securely.
4. Slide the blower away from the inlet ring.



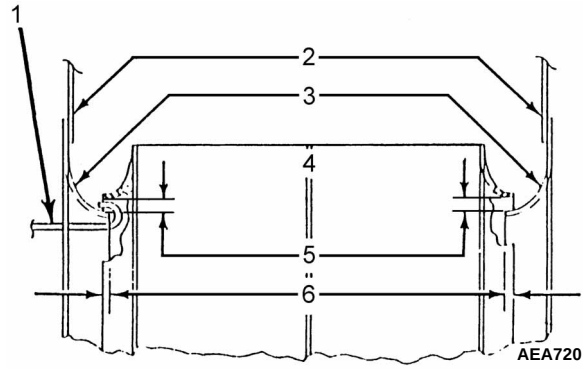
1.	Blower Wheel	3.	Alignment Mark
2.	Inlet Ring	4.	Edge of Inlet Ring

Figure 118: Condenser Blower Alignment

5. Pass a gauge wire completely around the blower orifice to check for uniform clearance.
6. Spin the blower by hand to check for blower distortion.
7. Position the blower so the edge of the inlet ring lines up with the alignment mark on the blower.
8. Torque blower hub bolts to 18 ft-lb (24 N•m).

Evaporator Fan Blower

1. Loosen the inlet rings on the sides of the blower housing.
2. Center the blower wheel in the blower housing with equal overlap on both inlet rings. The overlap on each ring should be approximately 0.15 in. (3.8 mm).
3. Tighten the hub bolts that hold the blower wheel on the fanshaft.
4. Center the inlet rings in the blower orifices. Tighten the inlet rings securely.
5. Check the radial clearance by passing a wire completely around the circumference of the inlet rings and the blower wheel.
6. Torque the blower hub bolts to 18 ft-lb (24 N•m).



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

Figure 119: Evaporator Fan Location

Fan Shaft Assembly

The unit is equipped with a one-piece fan shaft assembly that contains tapered roller bearings in a sealed oil reservoir.

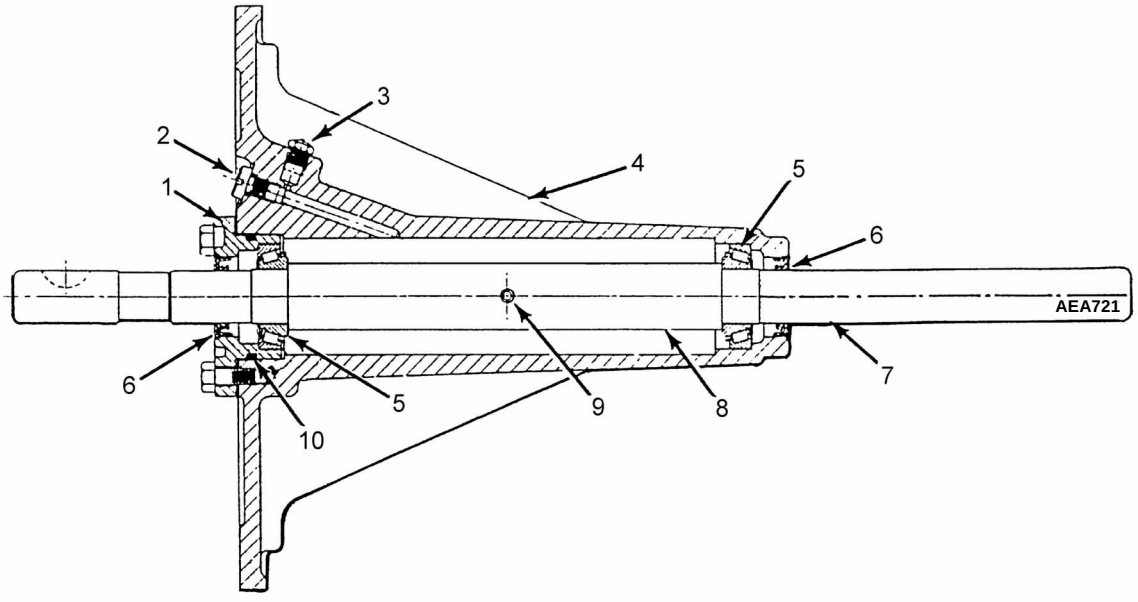
This assembly does not require any maintenance. There is a level plug and a fill plug, but they are not normally used except after removal and repair of the fan shaft assembly. The condenser and evaporator end oil seals should be checked during the pre-trip inspection for oil leakage. If there is any sign of leakage, the fan shaft assembly should be removed and repaired.

NOTE: The fan shaft assembly requires a special lubricant, Thermo King P/N 203-278.

Fan Shaft Assembly Overhaul

Disassembly

1. Remove the fan shaft 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 condenser end of the assembly.
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.
4. Using a punch, remove the oil seal from the evaporator end of the assembly. With the seal removed, clean the housing in clean solvent.
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. If necessary, remove the bearings by tapping them off the shaft with a hammer and a punch. Be careful not to damage the shaft with the punch.
8. The bearing races can now be driven out with a punch and replaced in the same manner.



1.	Cap and Shims	6.	Oil Seal
2.	Oil Plug Screw (Use Oil P/N 203-278)	7.	Shaft
3.	Breather Vent	8.	Sleeve
4.	Housing	9.	Pin
5.	Roller Bearing	10.	O-ring

Figure 120: Fan Shaft Assembly

Reassembly

1. Tap the new bearings on the shaft with a pipe.
2. Install new oil seals after replacing the bearing races.
3. Replace the shaft in the housing. Install a new seal in the retainer cap. Use the original shims and replace the O-ring if needed.
4. Install the retainer cap assembly over the shaft, then install the bolts.
5. Torque the bolts in a criss-cross pattern in equal steps to 80 in-lb (9.04 N•m).
6. Lock the assembly in a vise and set up a dial indicator to read 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. End-play should be 0.001 to 0.005 in. (0.025 to 0.127 mm). If end-play is incorrect, use different shims to obtain correct end-play.

Shims available from the Service Parts Department	
0.020 in. (0.500 mm)	Thermo King P/N 99-4231
0.007 in. (0.177 mm)	Thermo King P/N 99-2902
0.005 in. (0.127 mm)	Thermo King P/N 99-2901

7. After correct end-play is obtained, add oil for the bearings.
8. Lock the assembly in a vise with the vent facing up. Pour the oil (P/N 203-278) through the top plug until it runs out of the side hole. The assembly holds 2.2 oz (65 ml). Check the condition of the O-ring used on the plugs and replace if necessary. Install the top and side plugs. Clean up any spillage.
9. Place the assembly on the workbench with the vent up. Rotate the shaft by hand. The shaft should be free enough to rotate without having to hold the housing.

CAUTION: When installing the fan shaft assembly, make sure that the vent is mounted facing up.

Idler Assembly

The unit is equipped with a one-piece idler assembly that contains tapered roller bearings in a sealed oil reservoir. This assembly does not require any maintenance. There is a level plug and a fill plug, but they are not normally used except after removal and repair of the idler assembly. The roadside end oil seal and the curbside end oil seal should be checked during the pre-trip inspection for oil leakage. If there is any sign of leakage, the idler assembly should be removed and repaired.

Idler Assembly Overhaul

Disassembly

1. Remove the idler 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 curbside end of the assembly.
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 the parts in clean solvent.
4. Using a punch, remove the oil seal from the curbside end of the assembly. With the seal removed, clean the housing in solvent.
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 drive bearing off shaft with a punch at notch in the base of the shaft.

Reassembly

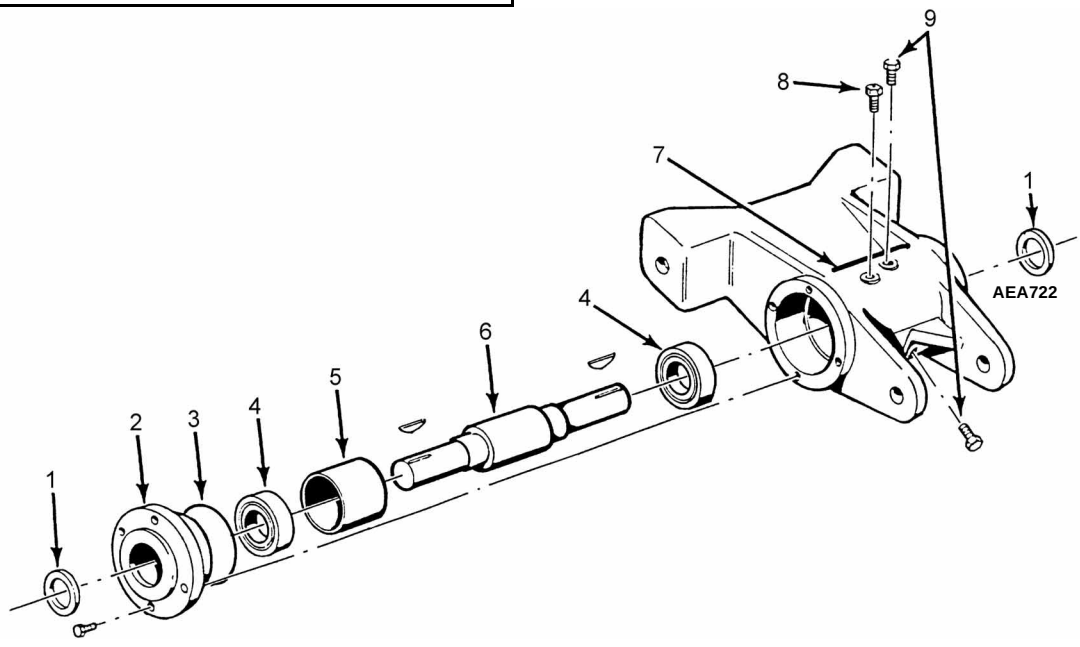
1. Install the new bearings on the shaft with a pipe. Place the pipe over the shaft and drive bearing down. Turn the shaft upside down, and use the pipe to drive the other bearing down.
2. Install a new oil seal on the curbside end of the assembly after replacing the bearing race and splash guard.

3. Replace the shaft in the housing. Install a new seal in the retainer cap. Use the original shims and replace the O-ring if needed.
4. Install the retainer cap assembly over the shaft, then install the bolts.
5. Torque the bolts in a criss-cross pattern in equal steps to 80 in-lb (9.04 N•m).
6. Lock the assembly in a vise and set up a dial indicator to read 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. End-play should be 0.001 to 0.005 in. (0.025 to 0.127 mm). If end-play is incorrect, use different shims to obtain correct end-play.

Shims available from the Service Parts Department	
0.020 in. (0.500 mm)	Thermo King P/N 99-4231
0.007 in. (0.177 mm)	Thermo King P/N 99-2902
0.005 in. (0.127 mm)	Thermo King P/N 99-2901

7. After the correct end-play is obtained, add approximately 1.5 oz (44 ml) of oil (P/N 203-278) for the bearings.
8. Lock the assembly in a vise with the vent facing up. Pour the oil through the top plug until it runs out of the side hole. Check the condition of the O-ring used on the plugs and replace if necessary. Install the top and side plugs. Clean up any spillage.
9. Place the assembly on the workbench with the vent up. Rotate the shaft by hand. The shaft should be free enough to rotate without having to hold the housing.

CAUTION: Reinstall the assembly into the unit, making sure the vent is mounted facing up.



1.	Oil Seal	6.	Shaft
2.	Cap and Shims	7.	Housing
3.	O-ring	8.	Breather Vent
4.	Roller Bearing	9.	Oil Plug Screw (Use Oil P/N 203-278)
5.	Splash Guard Tube		

Figure 121: Idler Assembly

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 CH circuits and fuel solenoid pull-in relay. Check that controller is configured for Yanmar engine. Refer to appropriate Microprocessor Diagnostic Manual.
	Fuel solenoid defective or stuck	Replace
	Fuel injection pump defective	Replace pump
	Air heater defective	Replace
	No fuel or wrong fuel	Fill with proper fuel
	Fuel pump defective	Replace 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
	Defective HPCO	Replace HPCO
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
	Vent of fuel tank obstructed	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines

Condition	Possible Cause	Remedy
Engine does not develop full power	Air intake system clogged	Clean air intake system
	Fuel tank vent clogged	Unclog vent
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
	Speed adjustment wrong	Adjust speed
	Insufficient fuel volume leaving filter	Check for dirty filter or air in system
	Air cleaner clogged	Replace air filter
	Delivery of fuel pump insufficient	Repair pump
	Injection pump timing off	Adjusting timing
	Injection nozzles defective	Repair or replace nozzles
	Compression low or unbalanced	Overhaul engine
	Worn injection pump plungers, delivery valve defective, injection rate too low, gum formations	Repair or replace pump
Engine speed too high	Misadjusted high speed solenoid	Adjust high speed solenoid
	Defective injection pump	Repair injection pump
Engine fails to stop when unit is OFF	Fuel solenoid defective	Replace
	Injection pump defective	Replace pump
Engine knocks heavily	Air in system	Bleed fuel system
	Injection pump not timed	Retime injection pump
	Wrong fuel	Change fuel
	Compression too low	Overhaul engine
	Injection nozzles fouled or opening pressure too low	Clean, repair or replace injection nozzles
	Delivery valve spring broken	Replace spring or repair injection pump
	Valve out of adjustment	Adjust valves
	Fuel return line plugged	Remove return line restriction
	Rod or main bearing worn	Replace rod or main bearings

Condition	Possible Cause	Remedy
Engine runs hot	Dirty radiator	Wash radiator
	Coolant level is low	Add coolant
	Cooling system heavily scaled	Cleaning cooling system
	Cylinder head gasket leaks	Replace cylinder head gasket. Use correct gasket
	Faulty thermostat	Check or replace thermostat
	Loose or worn water pump belt	Replace belt
Oil pressure low	Insufficient oil in pan	Add oil
	Faulty oil pressure switch	Check oil pressure switch. Replace if necessary
	Oil control valve defective	Check oil pressure control valve
	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug	Repair engine
High oil consumption	Oil leakage	Check and eliminate possible causes at rocker arm cover, oil lines, oil filter, front timing cover or crankshaft seals
	Damaged valve seals	Replace seals on valve stem
	Worn valve stem	Replace valves
	Broken piston rings or cylinder bore worn or scored	Have engine repaired and rebored. Replace broken piston rings
	Clogged air cleaner system	Unclog air cleaner

Engine Emits Excessive Smoke

White Smoke

Fuel is not burning

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

Black Smoke

Excessive Fuel to Air Ratio

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

Blue Smoke

Oil Consumption

- Poor compression
- Defective valve seals

Electric Standby Diagnosis

Condition	Possible Cause	Remedy
Unit turned ON—LCD Blank	Battery discharged	Charge or replace battery
	Faulty battery cable connections	Clean battery cables
	Fuse link blown	Check for short circuit and replace fuse link
	Fuse F2 blown	Check for short circuits and replace fuse
	Open circuit	Check HMI Harness
Unit switch ON and LCD backlight ON but motor will not start and run	Diesel operation selected	Select ELECTRIC
	Unit in NULL	Check setpoint and box temperature
	Fuse F1 blown	Check for short circuit and replace fuse
	Faulty HPCO	Check HPCO
	Open or faulty overload relay	Determine cause and rest or replace overload relay
	Faulty PSM	Check PSM
	Faulty motor contactor	Check motor contactors
	Open circuit	Check 8, ER, EOL, 7E, 7EB, 7EC, CH, L1, L2, and L3 circuits
	Faulty drive motor	Check drive motor
	Faulty electric standby power source	Check electric standby power source
Evaporator heaters do not heat	Faulty heater contactor	Check heater contactor
	Open circuit	Check 7EH, 26E, L1, L2, L3, BRN, BLU and BLK circuits
	Faulty heaters	Check heaters

Refrigeration Diagnosis

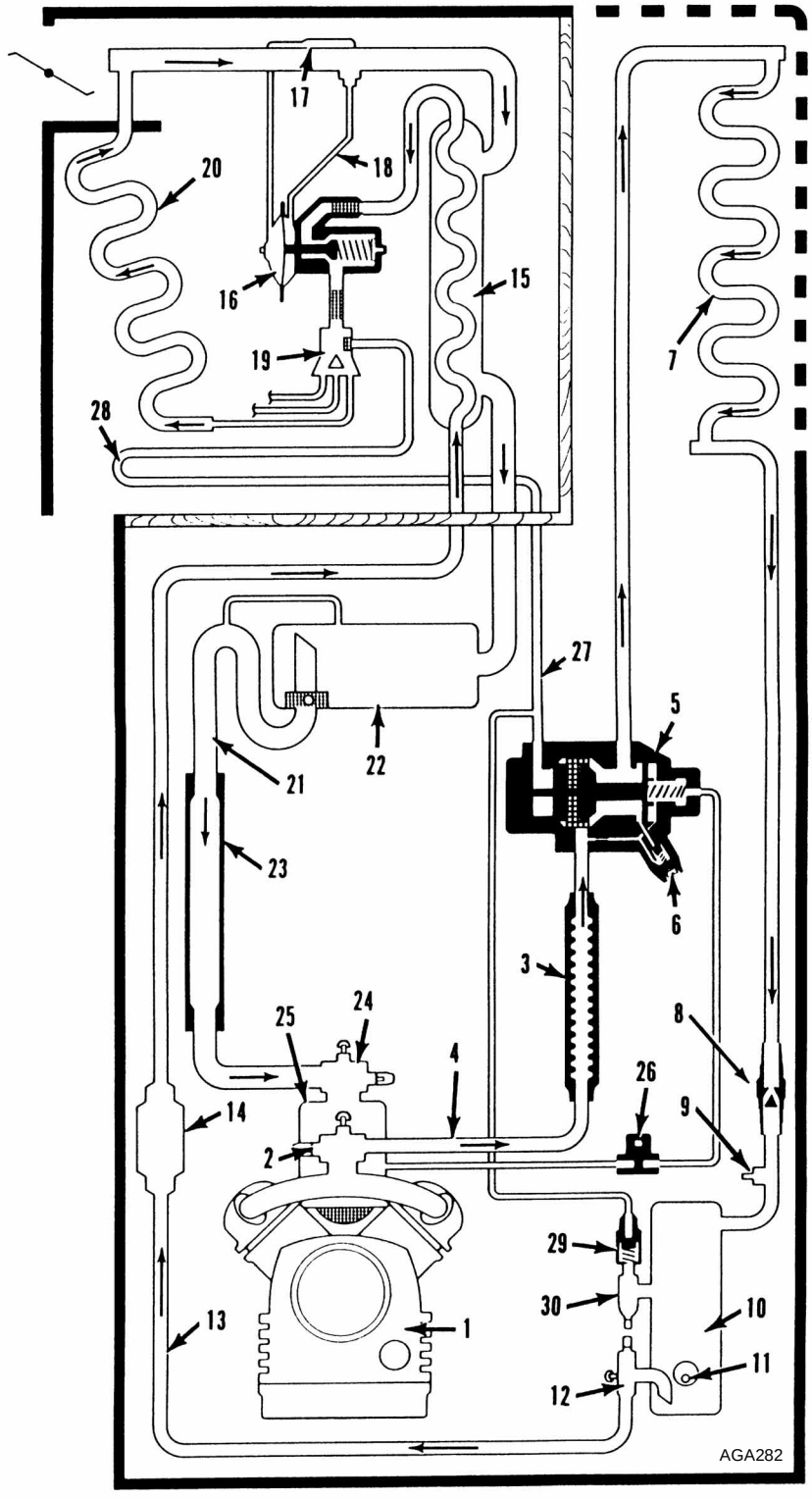
Rapid cycling between cool and heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	Symptom / Possible Causes
			•		•									•	•		Overcharge of refrigerant
				•		•		•	•						•	•	Shortage of refrigerant
				•			•	•							•	•	No refrigerant
			•														Air through condenser too hot (ambient)
			•														Air flow through condenser restricted
				•		•			•								Air through condenser too cold (ambient)
			•											•	•		Air in refrigerant system
			•														Condenser fan blades bent or broken
•																	Air short cycling around evaporator coil
						•											Air through evaporator restricted
						•		•		•				•			Evaporator needs defrosting
				•								•					Compressor discharge valves leaking
					•						•						Compressor suction valves leaking
															•		Too much compressor oil in system
														•			Faulty oil pump in compressor
														•			Faulty compressor drive coupling
														•			Compressor bearing loose or burned out
				•							•	•	•	•			Broken valve plate in compressor
						•									•		Expansion valve power element lost its charge
					•					•							Expansion valve feeler bulb improperly mounted
					•					•					•		Expansion valve feeler bulb making poor contact
					•					•							Expansion valve open too much
						•									•		Expansion valve closed too much
					•					•							Expansion valve needle eroded or leaking
						•		•							•		Expansion valve partially closed by ice, dirt or wax
					•					•				•			Liquid refrigerant entering compressor
						•		•									Restricted line on the low side
			•			•		•							•		Restricted line on the high side
			•			•		•							•		Restricted drier
																•	Defrost damper stays open
						•		•							•		Defrost damper stuck closed
							•										Suction service valve back seated
	•	•		•	•						•		•		•	•	Faulty three-way valve
	•	•									•				•	•	Faulty pilot solenoid

Rapid cycling between cool and heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in a vacuum	Receiver sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in low side	Unable to hold vacuum in low side	Noisy compressor	Unit not refrigerating	Unit not heating or defrosting	**Symptom** **Possible Causes**
	•															•	Loose or broken electrical connections
•					•	•		•							•		Sensor out of calibration
					•	•	•	•									Compound pressure gauge out of calibration
											•						Leaky receiver tank outlet valve
											•						Leaky bypass check valve
																•	Leaky condenser check valve
																•	Faulty three-way condenser pressure bypass check valve
						•	•	•							•	•	Faulty ETV
				•	•						•				•	•	Hot gas bypass valve stuck open or leaking

Refrigeration Diagrams

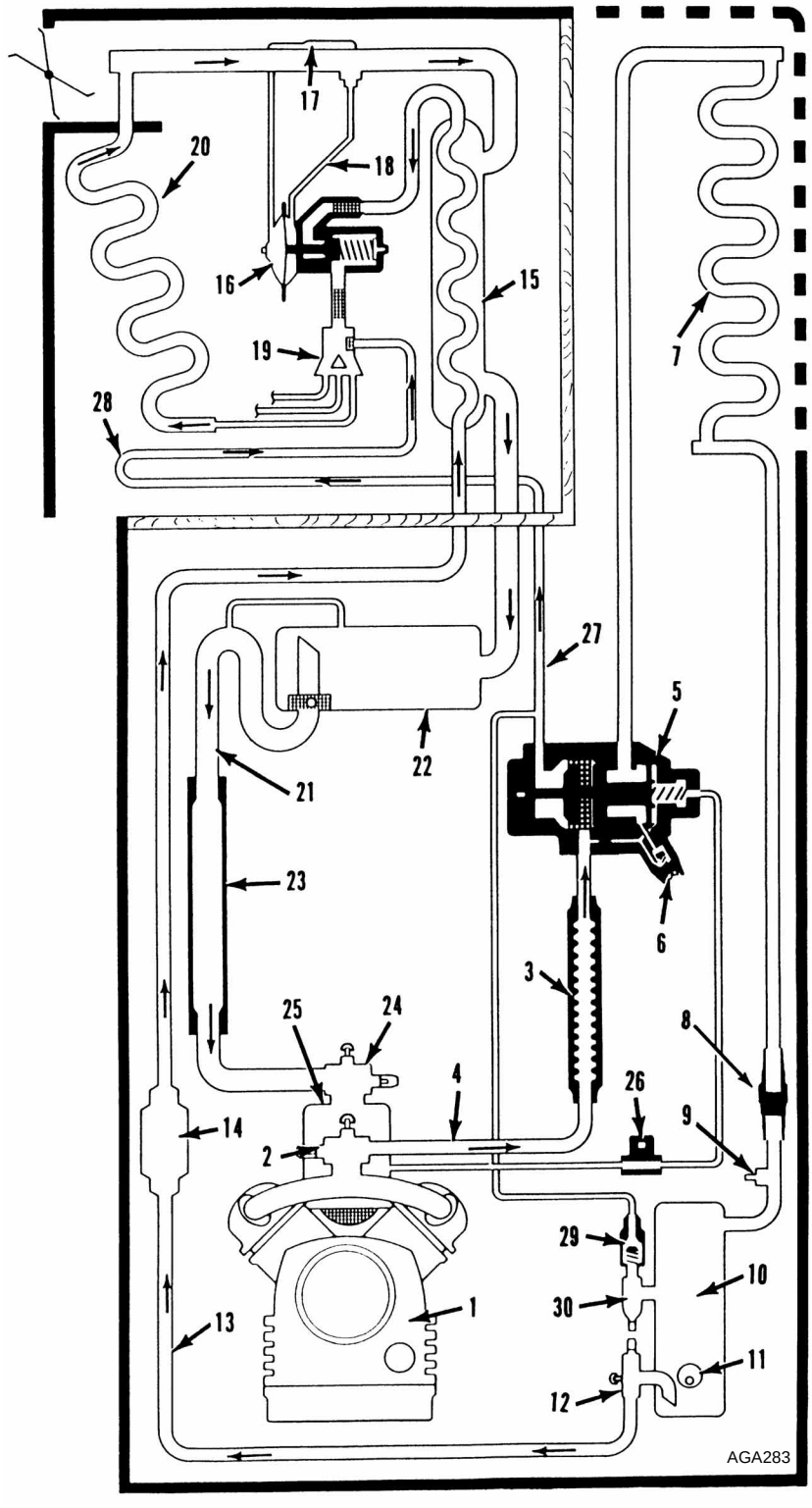
Cool Cycle With Mechanical Throttling Valve

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



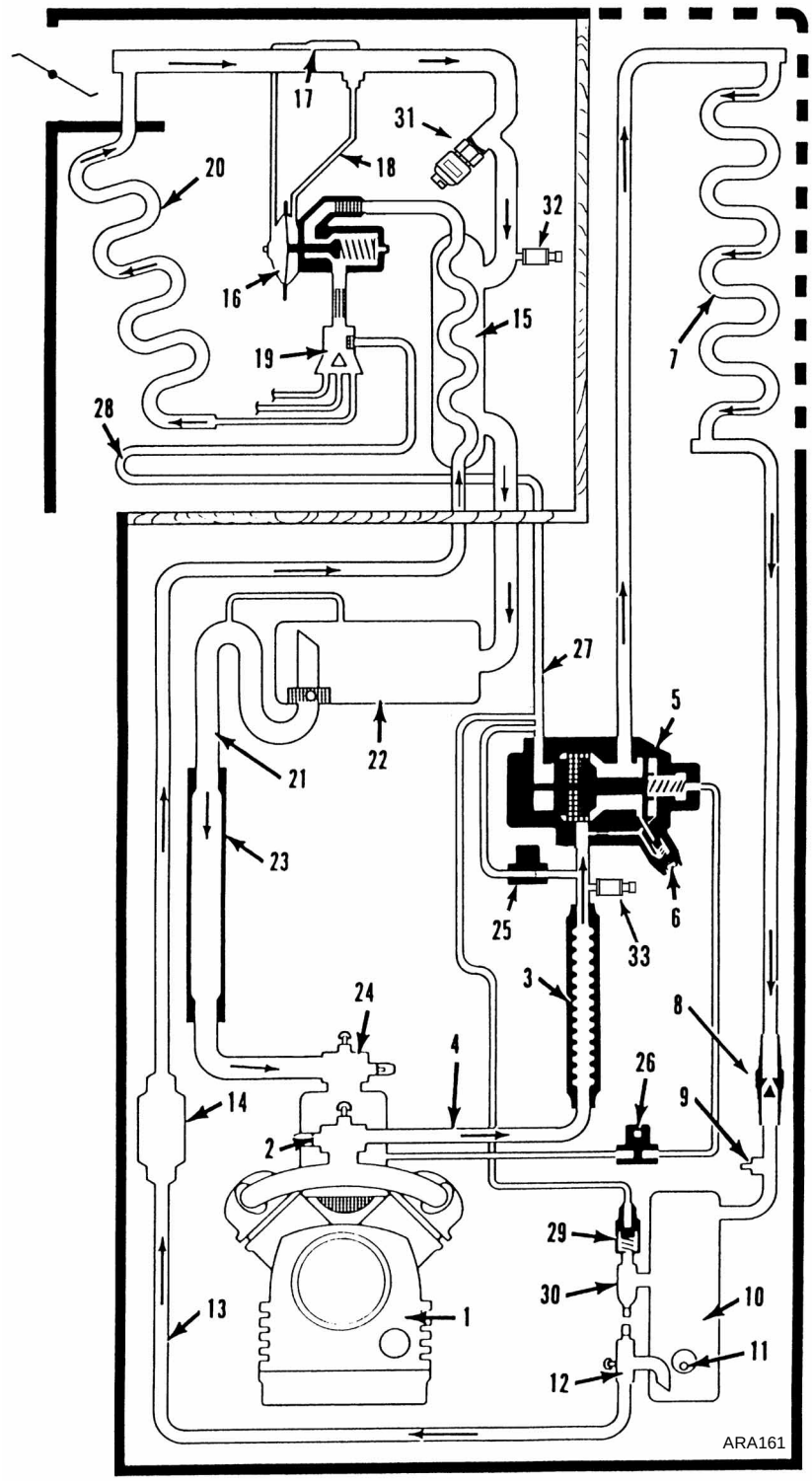
Heat/Defrost Cycle With Mechanical Throttling Valve

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



Cool Cycle With Electronic Throttling Valve

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



Heat/Defrost Cycle With Electronic Throttling Valve

1.	Compressor
2.	Discharge Service Valve
3.	Discharge Vibrasorber
4.	Discharge Line
5.	Three-way Valve
6.	Three-way Valve Bypass Check Valve
7.	Condenser Coil
8.	Condenser Check Valve
9.	High Pressure Relief Valve
10.	Receiver Tank
11.	Sight Glass
12.	Receiver Outlet Valve
13.	Liquid Line
14.	Drier
15.	Heat Exchanger
16.	Expansion Valve
17.	Feeler Bulb
18.	Equalizer Line
19.	Distributor
20.	Evaporator Coil
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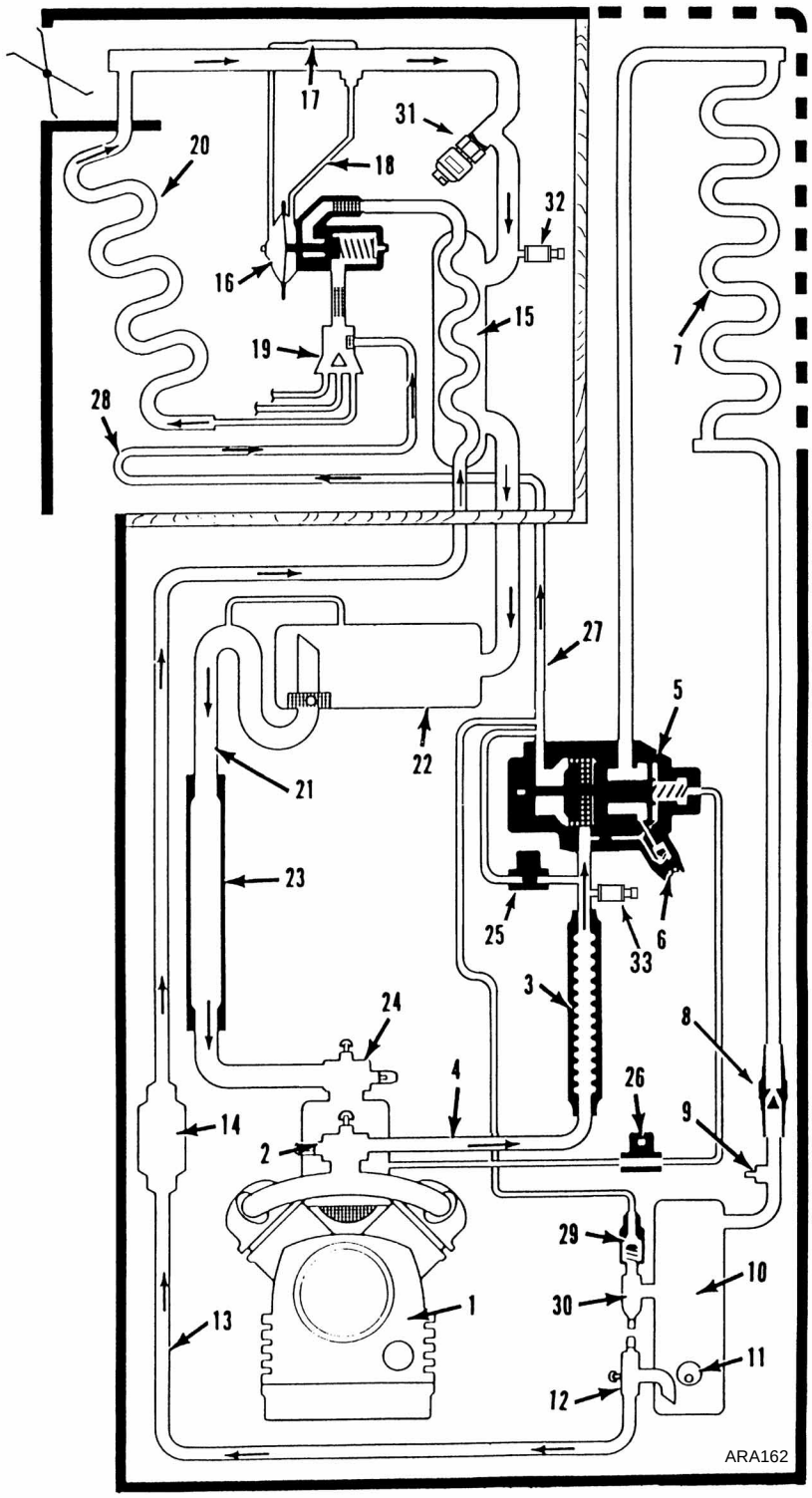

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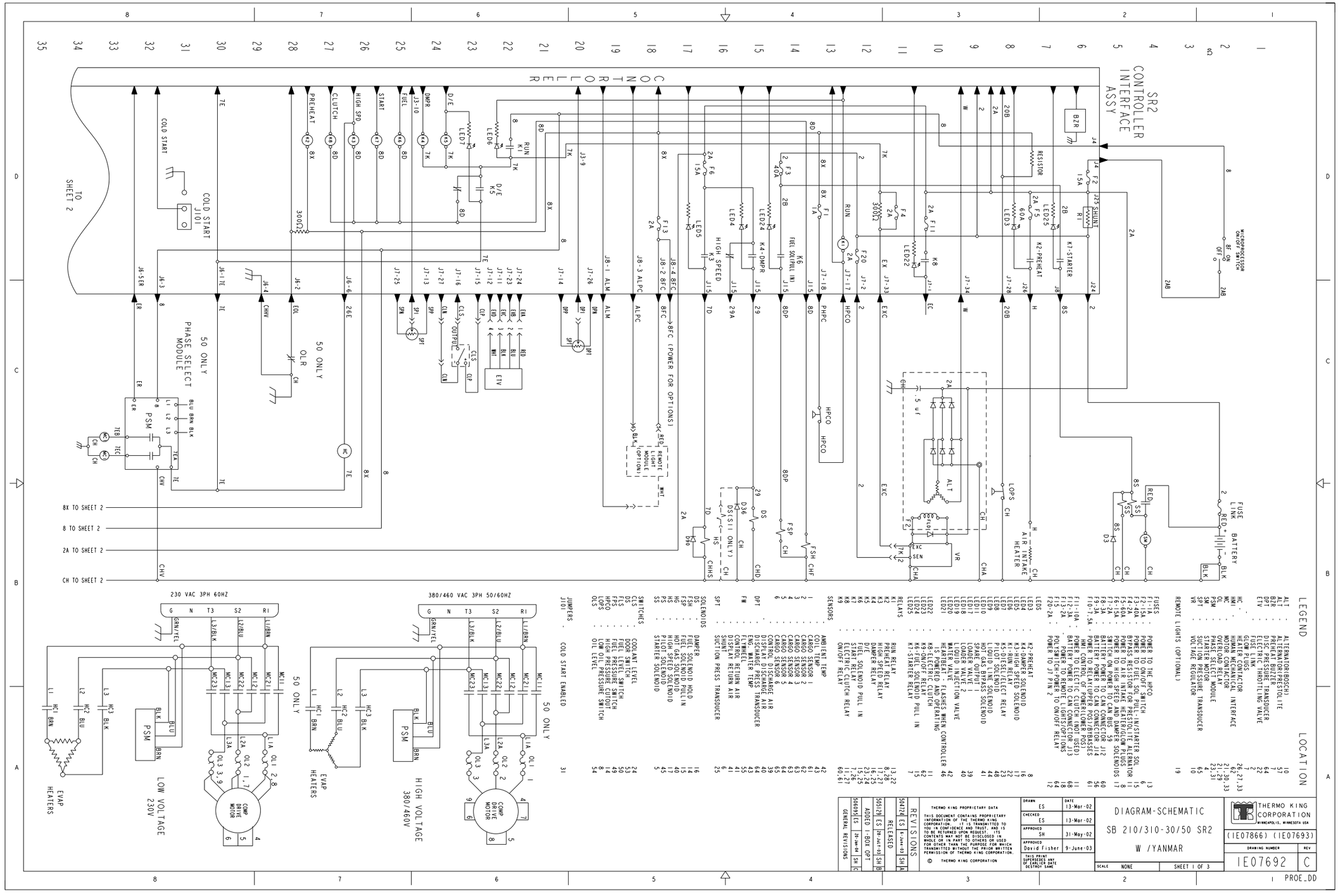

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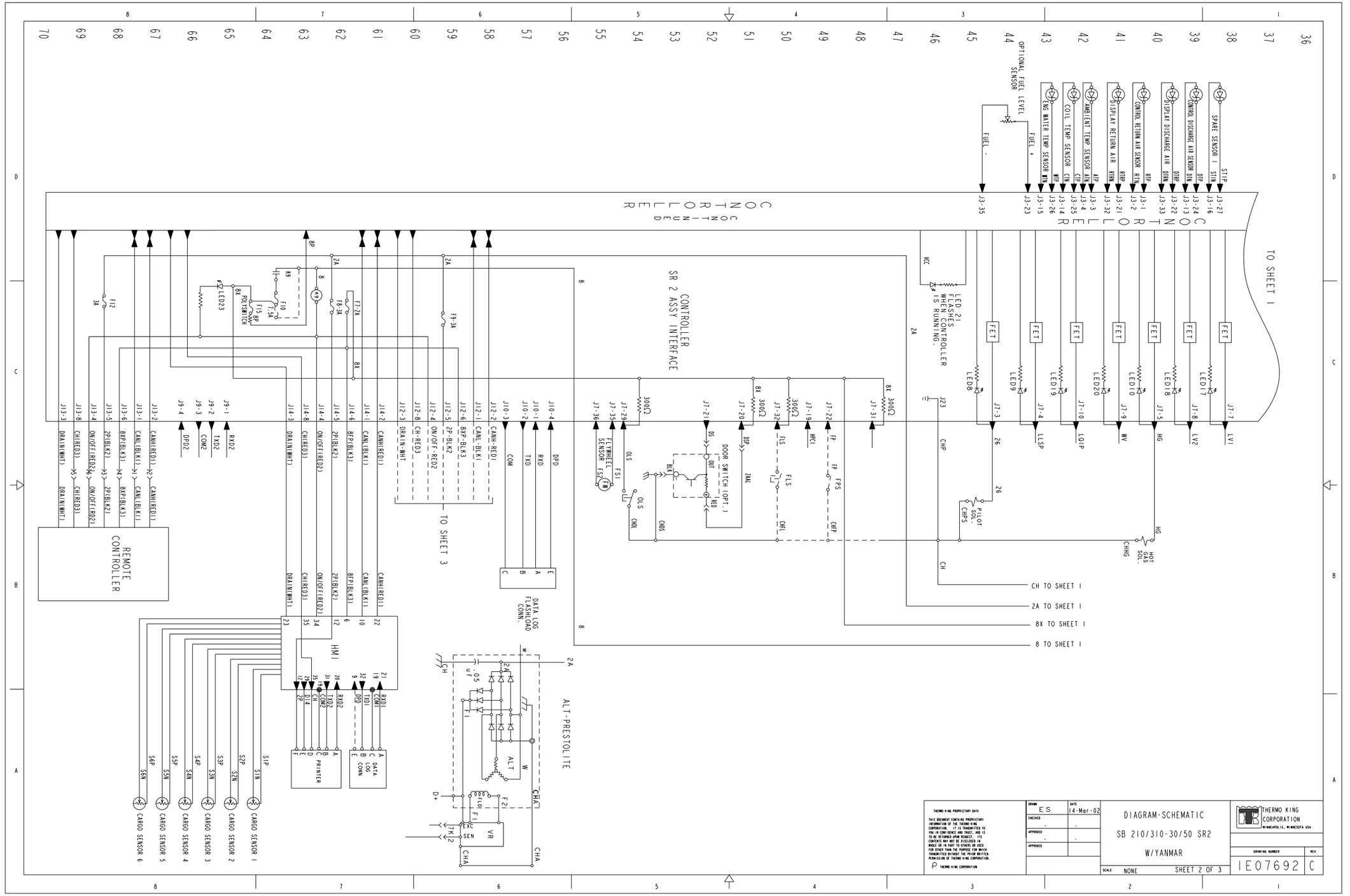

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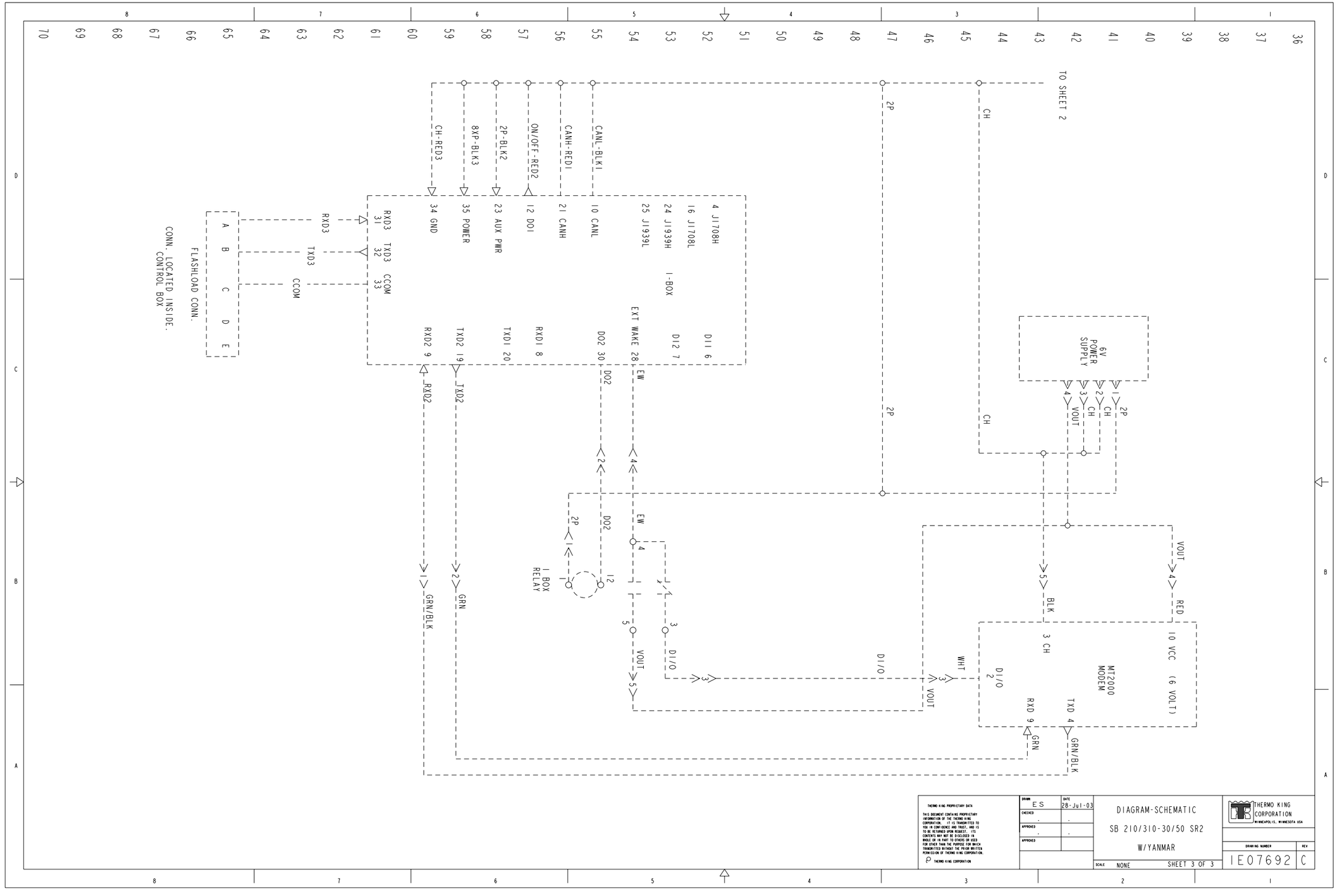

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THERMO KING CORPORATION

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APPROVED		

DIAGRAM-SCHEMATIC

SB 210/310-30/50 SR2

W/YANMAR

THERMO KING CORPORATION
MINNEAPOLIS, MINNESOTA USA

SCALE NONE SHEET 3 OF 3

DRAWING NUMBER 1E07692 REV C

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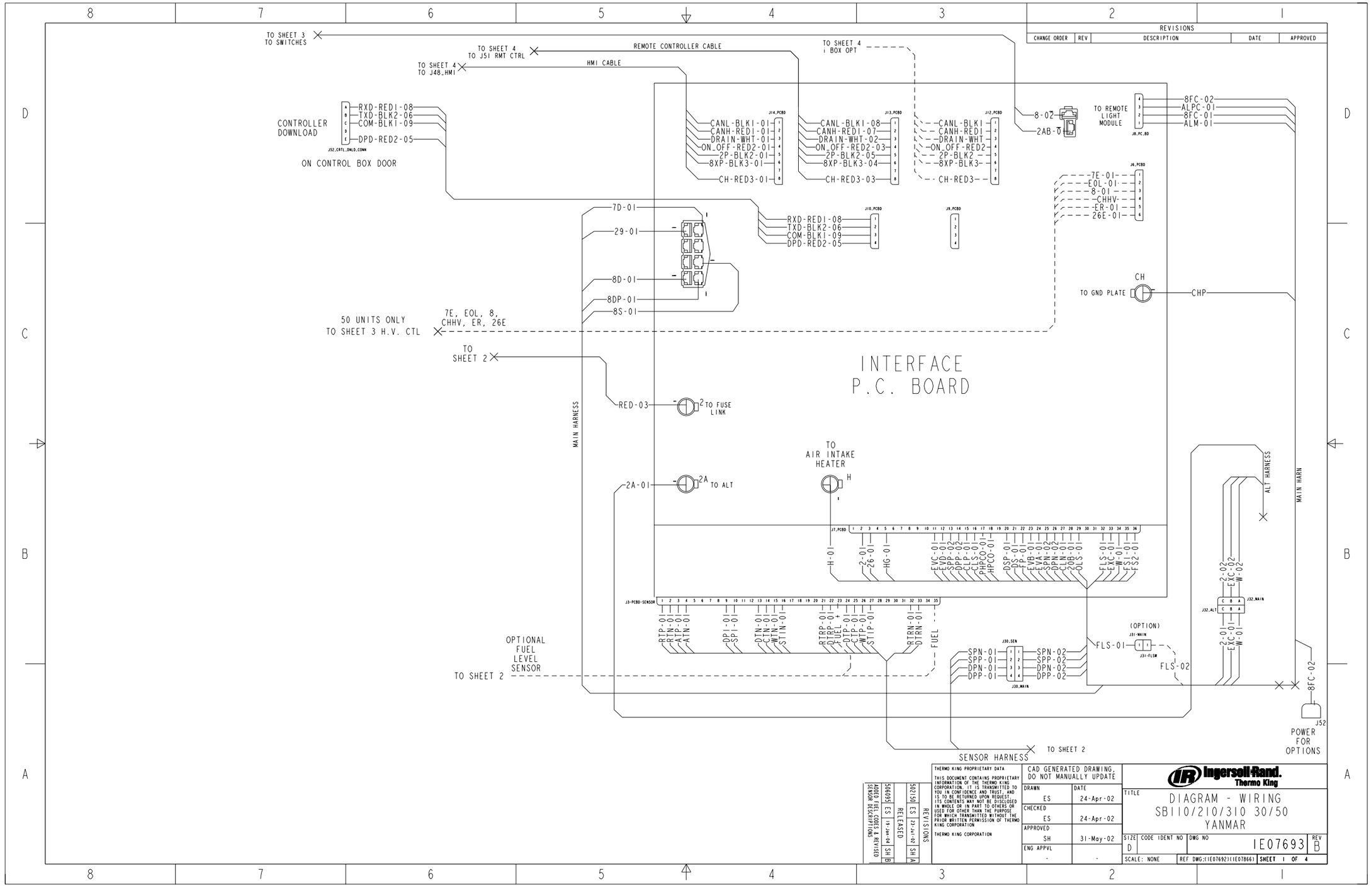

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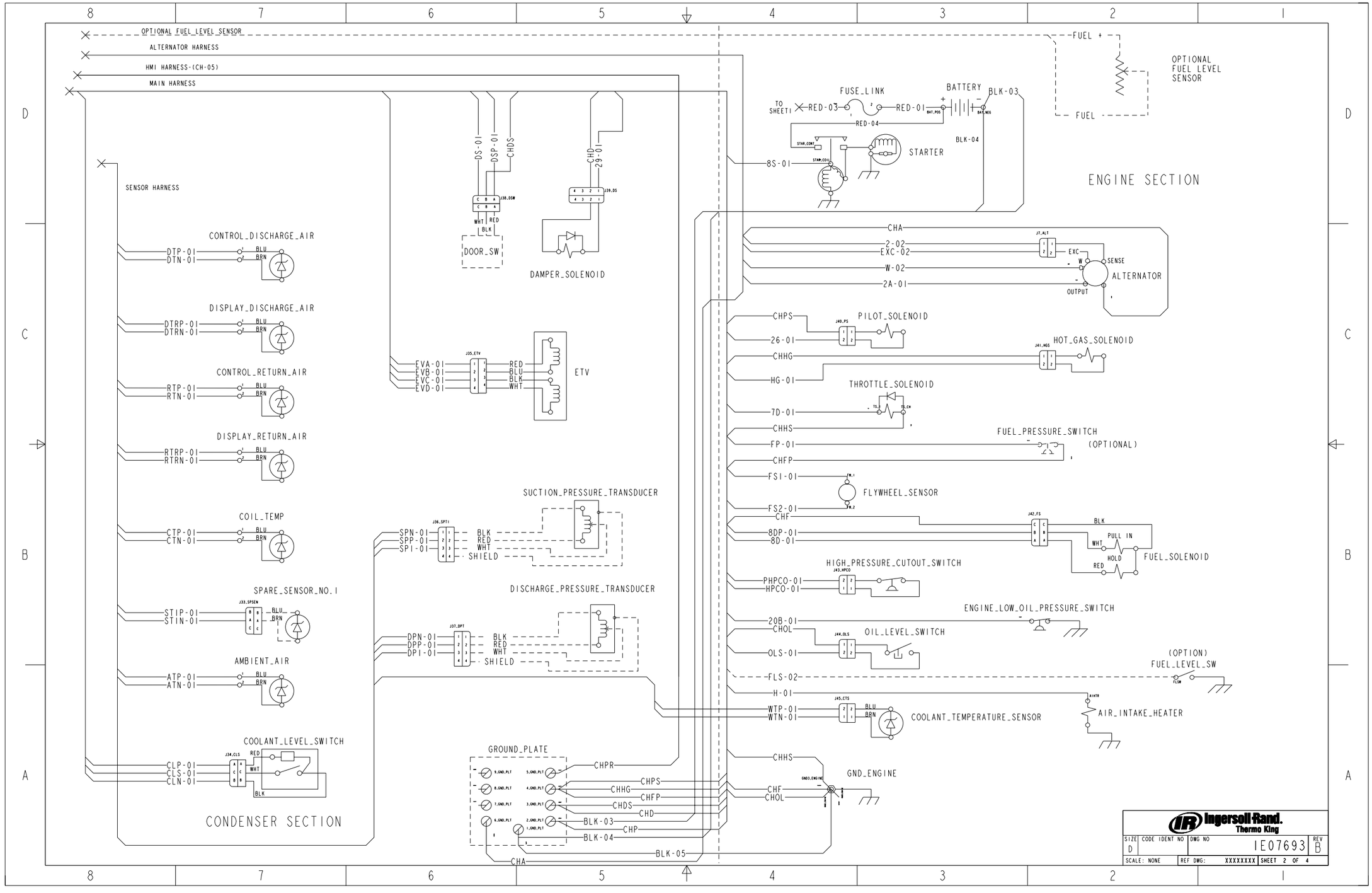

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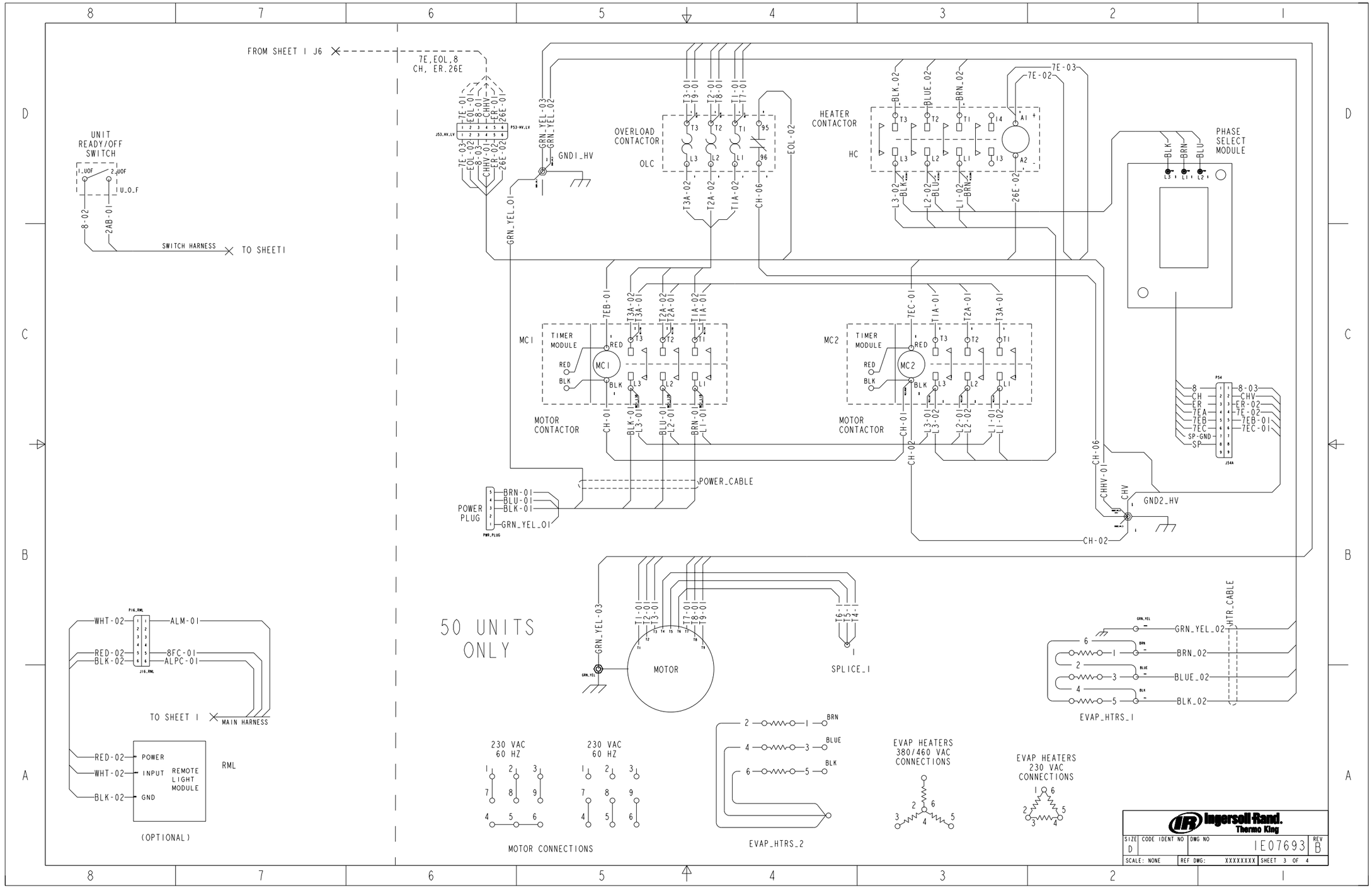

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