SUPER II 30 MAX

TK 40095-1 MM (REV. 7/91)

The maintenance information in this manual covers unit models:

Super II MAX (092.039)

For further information refer to ...

Super II MAX Parts Manual	TK 40088
di 2.2 Engine Overhaul	**TK 8009**
X426 & X430 Compressor Overhaul	**TK 6875**
Diagnosing TK Refrigeration System	**TK 5984**
Refrigeration Systems	**TK 5715**
Tool Catalog	**TK 5955**
CYCLE-SENTRY II Diagnosis	**TK 7897**

The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. For detailed descriptions of Thermo King engines, compressors or refrigeration systems, see the appropriate Thermo King Overhaul Manual or Refrigeration Systems Maintenance Manual.

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.

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Safety Precautions

GENERAL PRACTICES

1. ALWAYS WEAR GOGGLES OR SAFETY GLASSES. Refrigerant liquid and battery acid can permanently damage the eyes (see First Aid).
2. Never operate the unit with the compressor discharge valve closed.
3. Keep your hands clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
4. Be sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan motor pulley, or any hot surface.
5. Never apply heat to a sealed refrigeration system or container.
6. Fluorocarbon refrigerants, in the presence of an open flame or electrical short, produce toxic gases that are severe respiratory irritants capable of causing death.
7. Be sure all mounting bolts are tight and are of the correct length for their particular application.
8. Use extreme caution when drilling holes in the unit. The holes may weaken structural components, and holes drilled into electrical wiring can cause fire or explosion.
9. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
10. Use caution when working with a refrigerant or refrigeration system in any enclosed or confined area with a limited air supply (for example, a trailer, container or in the hold of a ship). Refrigerant tends to displace air and can cause oxygen depletion which may result in death by suffocation.

REFRIGERANT

Although fluorocarbon refrigerants are classified as safe refrigerants, certain precautions must be observed when handling them or servicing a unit in which they are used. When released to the atmosphere from the liquid state, fluorocarbon refrigerants evaporate rapidly, freezing anything they contact.

First Aid

In the event of frost bite, the objectives of First Aid are to protect the frozen area from further injury, to warm the affected area rapidly and to maintain respiration.

1. Cover the frozen part.
2. Provide extra clothing and blankets.
3. Give the victim a warm drink (not alcohol).
4. Warm the frozen part quickly by immersing it in water that is warm, NOT HOT.
5. If warm water is not available or practical to use, wrap the affected part gently in a sheet and warm blankets.
6. If refrigerant contacts the eyes, flush them immediately with water.
7. Obtain medical assistance as soon as possible.

REFRIGERATION OIL

Avoid refrigeration oil contact with the eyes. Avoid prolonged or repeated contact of refrigeration oil with skin or clothing. Wash thoroughly after handling refrigeration oil to prevent irritation.

First Aid

In case of eye contact, immediately flush with plenty of water for at least 15 minutes. CALL A PHYSICIAN. Wash skin with soap and water.

Specifications

ENGINE — di 2.2

Model		Thermo King di 2.2
Fuel Type		No. 2 Diesel fuel under normal conditions No. 1 Diesel fuel is acceptable cold weather fuel
Oil Capacity:	Crankcase	16 qt Crankcase (15.2 litre)
	w/Primary Oil Filter Only	17 qt Total (16.1 litre)
	w/Primary & Bypass Oil Filter	18 qt. Total (17 litre) Fill to full mark on dipstick
Oil Type*		API Petroleum Type CD API Synthetic Type CD after first 500 hours
Oil Viscosity**		Above 80 F (27 C): SAE 40 50 to 90 F (10 to 32 C): SAE 30 20 to 70 F (-7 to 21 C): SAE 20-20W -15 to 40 F (-26 to 4 C): SAE 10W Below 0 F (-18 C) continuously: SAE 5W
Engine rpm:	Low Speed operation	1400-1425 rpm
	High Speed operation (R502)	2200-2225 rpm
Engine Oil Pressure		50-65 psi (345-448 kPa) Low Speed engine operation
Intake Valve Clearance		.016 in. (0.40 mm)
Exhaust Valve Clearance		.016 in. (0.40 mm)
Valve Setting Temperature		70 F (21 C)
Fuel Injection Timing		.02 in. (0.5 mm) at 14° BTDC (timed on No. 1 cylinder)
Low Oil Pressure Switch (normally closed)		15 to 20 psi (103 to 138 kPa)
High Coolant Temperature Switch:	Closed	215 to 225 F (102 to 107 C)
	Open	190 F (88 C)
Engine Coolant Thermostat		180 F (82 C)
Cooling System Capacity		11 qts (10.4 litre)
Radiator Cap Pressure		7 psi (48 kPa)
Drive: Model 30		Direct to compressor; Belts to fans, 12V alternator and water pump

Thermo King synthetic oil is compatible with petroleum lubricants so there is no danger if accidental mixing occurs or if an emergency requires addition of petroleum oil. Mixing is not recommended, however, since it will dilute the superior performance properties of the synthetic oil.

****Multi-viscosity weight oil with the recommended API classification may be used based on the ambient temperature and straight weight viscosity recommendations above. The above recommendations are written for mineral oil based lubricants.***

BELT TENSION (using Tool No. 204-427)	**Tension No. on TK Gauge 204-427**
12V Alternator Belt	15
Fan Belt	50

THERMOSTAT

Type	Thermoguard IV Thermostat
Dial Range	-20 to 80 F (-29 to 27 C)

REFRIGERATION SYSTEM

Compressor Model	Thermo King X430
Refrigerant Charge	14 lb (6.35 kg) — R-502
Compressor Oil Charge	4 qts 6 oz (3.96 litre)*
Compressor Oil Type	Synthetic type 67-404 (required)
Throttling Valve Setting	24-26 psi (166-179 kPa)
Defrost Timer	Selectable 4, 8 or 12 hour time
Defrost Termination Switch:	
Before 1-30-89: Opens	56 F (13.3 C)
Closes	38 F (3.3 C) minimum
After 1-30-89: Opens	49 F (9.4 C)
Closes	37 F (2.8 C) minimum
High Pressure Cutout	450 ±10 psi (3103 ±69 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.

AIR SWITCH SETTING

Before 1-30-89	1.0 ±.05 in. (25.4 ±1.3 mm)
After 1-30-89	1.4 ±.08 in. (35.6 ±2.0 mm) H_2O

ELECTRICAL CONTROL SYSTEM

Voltage	12.5V dc
Batteries	One Group C27, 12 Volt battery with 625 CCA
Current Limiter Circuit Breaker	40 amps (50 amps with optional 65 amp alternator)
Control Circuit dc Circuit Breaker	30 amp auto reset
Battery Charging	12 volt Alternator 37 amp Brush type
Voltage Regulator Setting:	
Before 4-11-89	14.2-14.6V ⁹ 75 F (24 C)
After 4-11-89	13.7-14.3V @ 75 F (24 C)

ELECTRICAL COMPONENTS

NOTE: Disconnect components from unit circuit to check resistance.

	Current Draw (Amps) at 12.5V dc	Resistance — Cold (Ohms)
Fuel Solenoid	1.3	8.8
Damper Solenoid (large)	5.68	2.2
(small)	2.91	4.3
Throttle Solenoid & Damper Solenoid	2.91	4.3
Glow Plugs (one)	7.1	1.55
Pilot Solenoid	0.657	19.0
Starter Motor — gear reduction type	250-375*	
Unloader Solenoid (Fuelsaver I)	1.1	10.6

***On-the-engine cranking check. Bench test is approximately 100 amps on the direct drive starter and approximately 80 amps on the gear reduction starter.**

Maintenance Inspection Schedule

Pre-trip	Every 1,500 Hours*	Annual/ 4,500 Hours	Inspect/Service these Items
			Engine
■			Check fuel supply.
■			Check engine oil level.
■	■	■	Check engine coolant level and antifreeze protection (-30 F[-34 C]) **(CAUTION: Do not remove radiator cap while coolant is hot).**
■	■	■	Inspect belts for condition and proper tension (belt tension tool No. 204-427).
■	■	■	Check engine oil pressure, hot at high speed. Record _____ psi.
■	■	■	Listen for unusual noises, vibrations, etc.
	■	■	Change engine oil* (hot), oil filters and fuel filters.
	■	■	Clean crankcase breather, check air cleaner indicator.
	■	■	Drain water from fuel tank and check vent.
	■	■	Inspect/clean fuel transfer pump inlet strainer.
	■	■	Torque crankshaft bolt on di 2.2 to 161 ft-lb (218 N·m).
		■	Check and adjust engine speeds (high and low speed).
		■	Check condition of engine mounts.
		■	Replace coolant every two years.
	■	■	Replace fuel filter. Remove water from water separator. (Replace separator every 3000 hours.)
			Electrical
■	■	■	Check ammeter for charge and discharge (glow plug) operation.
■	■	■	Check defrost initiation and termination (test defrost timer every 1,500 hours).
■	■	■	Check thermostat cycle sequence on all modes (e.g., "Continuous Run" and "CYCLE-SENTRY" [Start/Stop modes).
	■	■	Inspect battery terminals and electrolyte level.
	■	■	Check operation of protection shutdown circuits.
	■	■	Check thermostat and thermometer calibration in 32 F (0 C) ice water bath.
	■	■	Inspect wire harness for damaged wires or connections.
		■	Check air switch setting.
		■	Inspect DC (battery charging) alternator.
			Refrigeration
■	■	■	Check refrigerant level.
■	■	■	Check for proper suction pressure.
	■	■	Check compressor oil level.
	■	■	Check throttling valve regulating pressure on defrost.
		■	Check compressor efficiency and pump down refrigeration system.
		■	Replace dehydrator and check discharge and suction pressure.
			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, fuel tank mounting bolts, brackets, lines, hoses, etc.
	■	■	Check evaporator damper door adjustment and operation.

NOTE: Petroleum oil rated "CD" must be used in the engine to allow 1,500 hour extended maintenance intervals.

Unit Description

The Thermo King Super II MAX is a one-piece, self-contained, diesel powered refrigeration-heating unit. The unit mounts on the front of the trailer with the evaporator portion extending into the trailer.

The Super II MAX incorporates a spin-on bypass oil filter and "CD" rated petroleum engine oil for extended 1500 hour maintenance intervals.

Power is provided by a di 2.2 4-cylinder, water-cooled, direct injection diesel engine rated at 34.8 continuous horsepower at 2200 rpm. An in-line powerpack provides direct drive power transfer from the engine to the compressor.

A belt drive system transfers energy to the unit fans and alternator.

Additional unit features are the Thermo King X430 compressor, THERMOGUARD solid state thermostat and a fuelsaver module (FSM).

Thermo King X430 Compressor

The Super II MAX unit features the Thermo King X430, four-cylinder compressor with 30 cu. in. (492 cm^3) displacement. The X430 compressor includes the same proven features as the Thermo King X426 compressor including a 50 to 1 compression ratio for high performance.

THERMOGUARD Solid State Thermostat

Accurate temperature control of the cargo area is provided by a solid state electronic thermostat sensing the return air temperature. When the thermostat is set below 15 ±3 F (-9.4 ±1.7 C), the thermostat locks out High Speed Heat. High Speed Heat is locked out on standard units. Special units may have High Speed Heat or no heat at settings below 15 F (-9.4 C).

FUELSAVER

The Super II MAX unit uses a new fuelsaver module (FSM). The module has sockets for two plug-in relays. Fuelsaver II is standard on these units and uses one relay. Fuelsaver I is an option and uses a compressor unloader and two relays.

Fuelsaver I (Optional)

Features of the Fuelsaver I system are a compressor unloader and an 8-minute high speed delay timer.

The compressor unloader decreases the engine load when the temperature reaches the thermostat setpoint.

The 8-minute high speed delay timer delays the high speed heat cycle on temperature drop and the high speed cool cycle on temperature rise.

Fuelsaver II

The Fuelsaver II system features an 8-minute high speed delay timer that delays the high speed heat cycle on temperature drop and the high speed cool cycle on temperature rise.

OPERATION

Standard Units

- High Speed Cool
- Low Speed Cool
- Low Speed Heat
- High Speed Heat

The unit runs continuously and automatically selects the correct operating mode.

Cycle-Sentry V Start/Stop Operation

- High Speed Cool
- Low Speed Cool
- Null (engine off)
- Low Speed Heat (8-minute time delay)
- High Speed Heat

A CYCLE-SENTRY-V Start/Stop fuel saving system is available to provide optimum operating economy.

WARNING: With the selector switch in the Auto Start/Stop position and unit On/Off switch in the On position, the unit may start at any time without prior warning.

The CYCLE-SENTRY-V system automatically starts the unit on thermostat demand and shuts down the unit when the trailer temperature reaches the thermostat set point.

The CYCLE-SENTRY-V system automatically maintains engine temperature in cold ambients by restarting the unit if the engine block temperature drops to 30 F (-1.1 C).

When the unit starts because of low engine block temperature, it will run in the operating mode signified by the unit thermostat until the battery is fully charged and the engine block temperature reaches 90 F (32 C).

Features of the CYCLE-SENTRY-V system are:

- Offers either Auto Start/Stop or Continuous Run operation
- Thermostat controlled all season temperature control
- Maintains minimum engine temperature in low ambient conditions
- Battery Sentry keeps batteries fully charged during unit operation
- Variable glow plug preheat time
- Preheat indicator buzzer

Defrost

The defrost mode can be initiated by the manual defrost switch, air switch or defrost timer any time the evaporator coil temperature is below 37 F (2.8 C). If the unit is in Null mode (Auto Start/Stop operation), intiating defrost will cause the unit to start and operate in the defrost mode. When a defrost cycle is initiated, the defrost relay energizes the damper solenoid and pilot solenoid. The throttle solenoid WILL NOT be energized immediately by the defrost relay. However, when the unit goes into defrost, the delay time is reduced by a factor of 256. The maximum time delay before high speed operation is 1.5 seconds.

The unit remains on defrost until the evaporator coil temperature rises to 49 F (9.4 C) causing the defrost termination switch to open. When the defrost termination switch opens, the unit will return to the Null mode (Auto Start/Stop operation) or operate in a cooling or heating mode, depending on thermostat demand.

If the thermostat calls for the Null mode while the unit is defrosting, the unit will continue to run until defrosting is complete, then the unit will stop.

SEQUENCE OF OPERATION

FUELSAVER II Equipped Units (High Speed Delay)

Continuous Run Operation

On temperature drop, unit operating modes are:

- **High Speed Cool**
  Trailer temperatures over 3.4 F (1.9 C) above set point.
- **Low Speed Cool**
  Trailer temperatures from approximately 3.4 F (1.9 C) above set point down to set point.
- **Low Speed Heat**
  Trailer temperatures from set point down to 3.4 F (1.9 C) below set point.

  NOTE: The unit will cycle between Low Speed Cool and Low Speed Heat as long as the temperature remains between 3.4 F (1.9 C) below set point and 5.1 F (2.8 C) above set point.
- **Low Speed/High Speed Heat**
  Trailer temperatures lower than 3.4 F (1.9 C) below set point.

  NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Heat for the first 8 minutes. If the box temeprature rises to 1.7 F (0.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Heat.

  If the box temperature is still more than 1.7 F (0.9 C) below the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Heat.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).

On temperature rise, unit operating modes are:

- **High Speed Heat**
  Trailer temperatures up to 1.7 F (0.9 C) below set point.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).
- **Low Speed Heat**
  Trailer temperatures between 1.7 F (0.9 C) below set point up to 1.7 F (0.9 C) above set point.
- **Low Speed Cool**
  Trailer temperatures from 1.7 F (0.9 C) above set point up to 5.1 F (2.8 C) above set point.

  NOTE: The unit will cycle between Low Speed Heat and Low Speed Cool as long as the temperature remains between 3.4 F (1.9 C) below set point and 5.1 F (2.8 C) above set point.
- **Low Speed/High Speed Cool**
  Trailer temperatures higher than 5.1 F (2.8 C) above set point.

NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Cool for the first 8 minutes. If the box temperature drops to 3.4 F (1.9 C) above the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Cool.

If the box temperature is still more than 3.4 F (1.9 C) above the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Cool.

Auto Start/Stop Operation

On temperature drop, unit operating modes are:

- **High Speed Cool**
  Trailer temperatures over 3.4 F (1.9 C) above set point.
- **Low Speed Cool**
  Trailer temperatures from 3.4 F (1.9 C) above set point down to set point.
- **Null**
  Trailer temperatures from set point down to 3.4 F (1.9 C) below set point.

  NOTE: On CYCLE-SENTRY V systems operating in Auto Start/Stop, the Low Speed Heat cycle is locked out by the CYCLE-SENTRY selector switch.
- **Low Speed/High Speed Heat**
  Trailer temperatures lower than 3.4 F (1.9 C) below set point.

  NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Heat for the first 8 minutes. If the box temperature rises to 1.7 F (0.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Null.

  If the box temperature is still more than 1.7 F (0.9 C) below the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Heat.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (9.4 C).

On temperature rise, unit operating modes are:

- **High Speed Heat**
  Trailer temperatures up to 1.7 F (0.9 C) below set point.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).
- **Null**
  Trailer temperatures between 1.7 F (0.9 C) below set point up to 5.1 F (2.8 C) above set point.

  NOTE: On CYCLE-SENTRY V systems operating in Auto Start/Stop, the Low Speed Heat cycle is locked out by the CYCLE-SENTRY selector switch. Low Speed Cool is replaced with the Null cycle on temperature rises.
- **Low Speed/High Speed Cool**
  Trailer temperatures higher than 5.1 F (2.8 C) above set point.

  NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Heat for the first 8 minutes. If the box temperature rises to 1.7 F (0.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Null.

  If the box temperature is still more than 3.4 F (1.9 C) above the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Cool.

SEQUENCE OF OPERATION

Optional FUELSAVER I Equipped Units (Unloader & High Speed Delay)

Continuous Run Operation

On temperature drop, unit operating modes are:

- **High Speed Cool**
  Trailer temperatures higher than 3.4 F (1.9 C) above set point.
- **Low Speed Cool**
  Trailer temperatures from approximately 3.4 F (1.9 C) above set point down to set point.
- **Low Speed Unloaded Heat**
  Trailer temperatures from set point down to 3.4 F (1.9 C) below set point.

  NOTE: The unit will cycle between Low Speed Unloaded Cool and Low Speed Unloaded Heat as long as the temperature remains between 3.4 F (1.9 C) below set point and 5.1 F (2.8 C) above set point.
- **Low Speed/High Speed Heat**
  Trailer temperatures lower than 3.4 F (1.9 C) below set point.

NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Heat for the first 8 minutes. If the box temperature rises to 1.7 F (0.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Unloaded Heat.

If the box temperature is still more than 1.7 F (0.9 C) below the thermostat setting when the 8 minutes are up, the unit automatically shifts to High Speed Heat.

NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).

On temperature rise, unit operating modes are:

- **High Speed Heat**
  Trailer temperatures up to 1.7 F (0.9 C) below set point.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).

- **Low Speed Unloaded Heat**
  Trailer temperatures between 1.7 F (0.9 C) below set point up to 1.7 F (0.9 C) above set point.

- **Low Speed Unloaded Cool**
  Trailer temperatures from 1.7 F (0.9 C) above set point up to 5.1 F (2.8 C) above set point.

  NOTE: The unit will cycle between Low Speed Unloaded Heat and Low Speed Unloaded Cool as long as the temperature remains between 3.4 F (1.9 C) below set point and 5.1 F (2.8 C) above set point.

- **Low Speed/High Speed Cool**
  Trailer temperatures higher than 5.1 F (2.8 C) below set point.

  NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Cool for the first 8 minutes. If the box temperature drops to approximately 3.4 F (1.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Unloaded Cool.

  If the box temperature is still more than 3.4 F (1.9 C) above the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Cool.

Auto Start/Stop Operation

On temperature drop, unit operating modes are:

- **High Speed Cool**
  Trailer temperatures over 3.4 F (1.9 C) above set point.

- **Low Speed Cool**
  Trailer temperatures from 3.4 F (1.9 C) above set point down to set point.

- **Null**
  Trailer temperatures from set point down to 3.4 F (1.9 C) below set point.

  NOTE: On CYCLE-SENTRY V systems operating in Auto Start/Stop, the Low Speed Unloaded Heat cycle is locked out by the CYCLE-SENTRY selector switch.

- **Low Speed/High Speed Heat**
  Trailer temperatures lower than 3.4 F (1.9 C) below set point.

  NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Heat for the first 8 minutes. If the box temperature rises to 1.7 F (0.9 C) below the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Unloaded Heat.

  If the box temperature is still more than 1.7 F (0.9 C) unit below the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Heat.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C).

On temperature rise, unit operating modes are:

- **High Speed Heat**
  Trailer temperatures up to 1.7 F (0.9 C) below set point.

  NOTE: The thermostat locks out High Speed Heat at set points below 15 F (-9.4 C)

- **Null**
  Trailer temperatures between 1.7 F (0.9 C) below set point up to 5.1 F (2.8 C) above set point.

  NOTE: On CYCLE-SENTRY V systems operating in Auto Start/Stop, the Low Speed Unloaded Cool and Low Speed Unloaded Heat cycles are locked out by the CYCLE-SENTRY selector switch. Low Speed Unloaded Cool is replaced with the Null cycle on temperature rises.

- **Low Speed/High Speed Cool**
  Trailer temperatures higher than 5.1 F (2.8 C) above set point.

NOTE: An 8 minute timer is activated. The unit will operate on Low Speed Cool for the first 8 minutes. If the box temperature drops to 3.4 F (1.9 C) above the thermostat setting before 8 minutes have elapsed, the unit shifts back to Low Speed Cool.

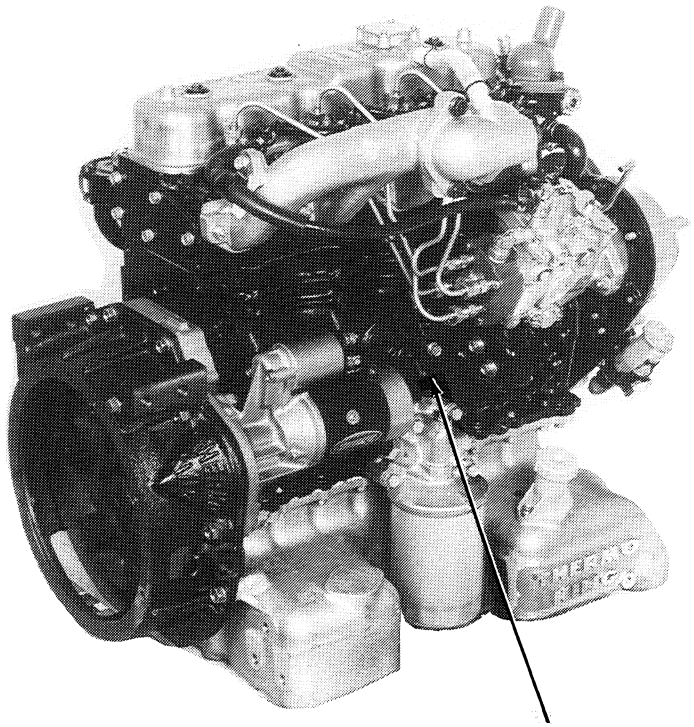
If the box temperature is still more than 3.4 F (1.9 C) above the thermostat setting when the 8 minutes are up, the unit shifts to High Speed Cool.

SERIAL NUMBER LOCATIONS

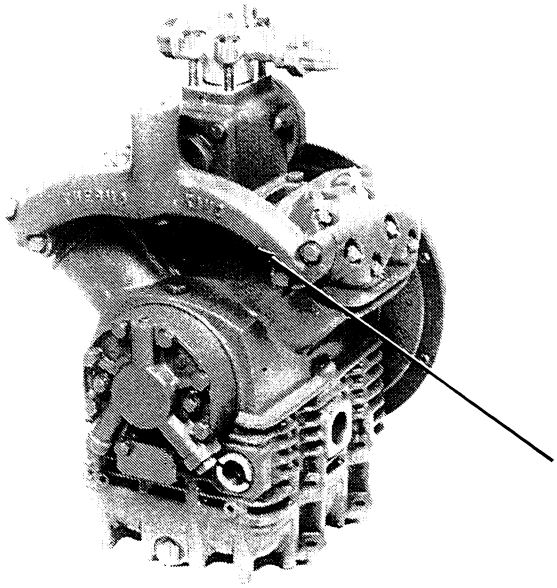
Unit: Nameplates on the bottom of the frame inside the front door.

Engine: Stamped on the engine block above the oil filter.

Compressor: Stamped on the end above the oil pump.

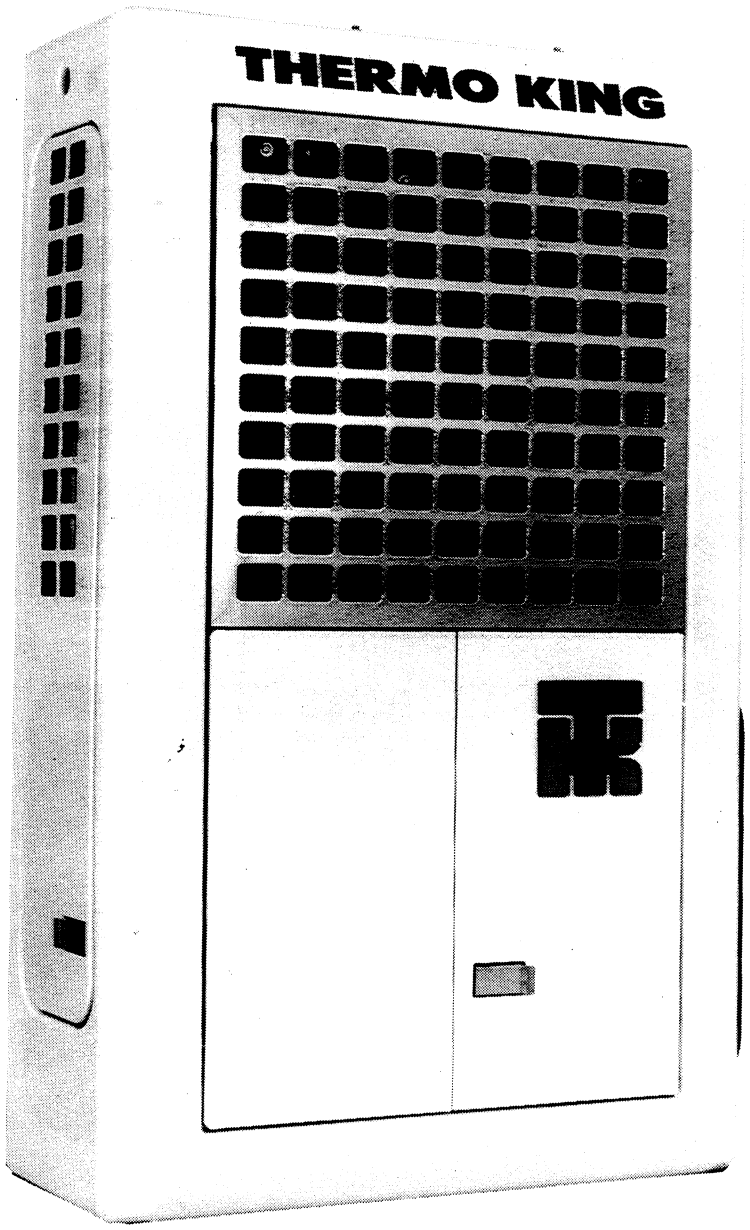


Serial No. location

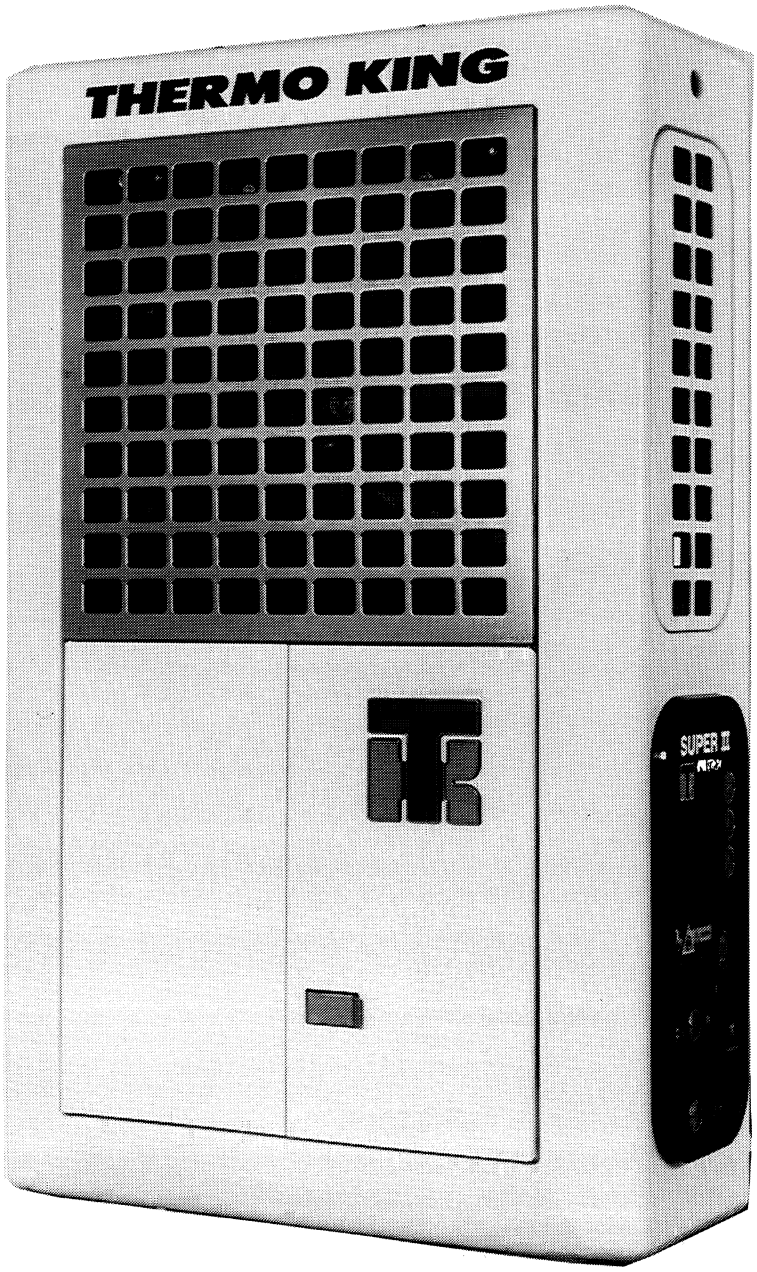


Serial No. location

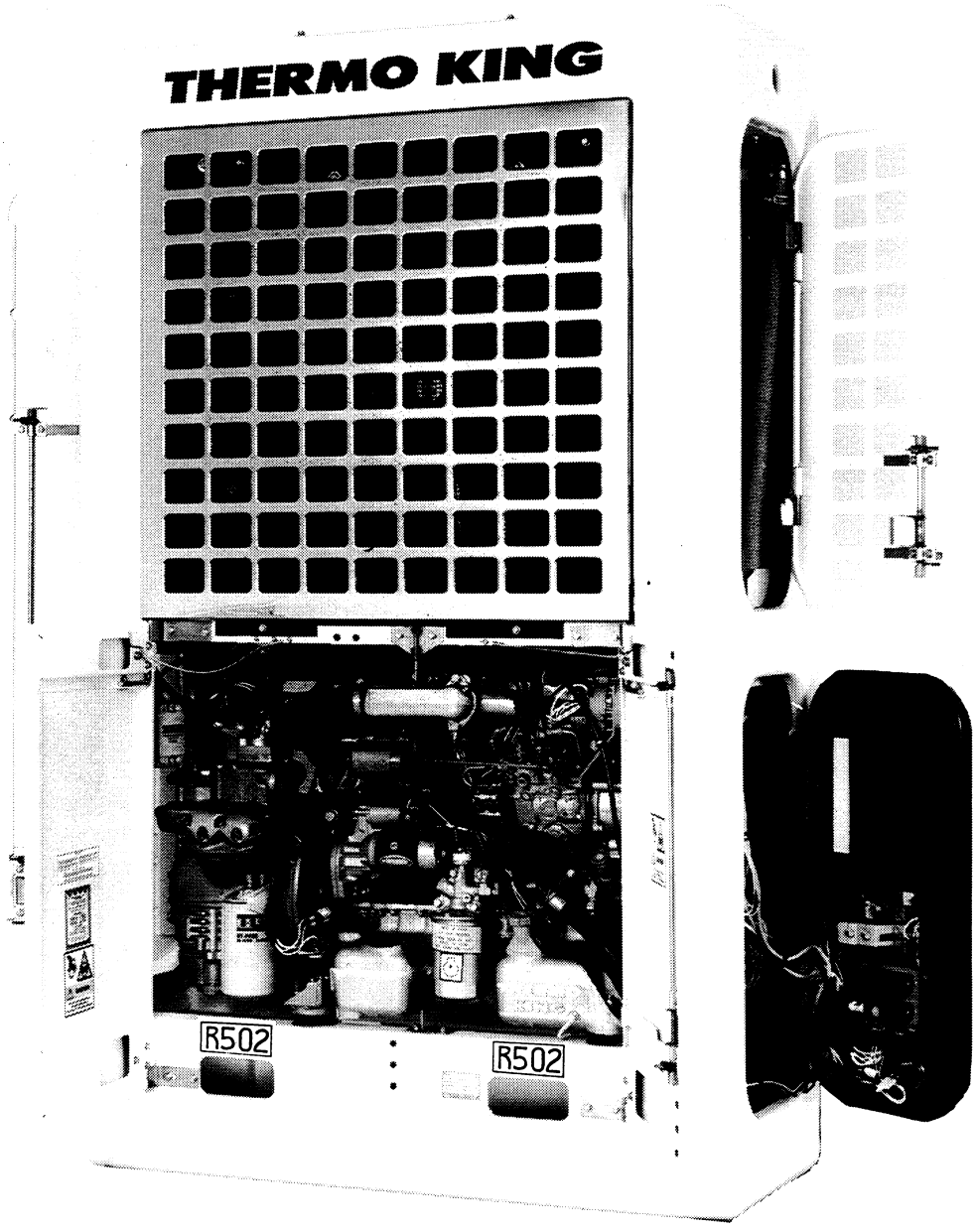
DESIGN FEATURES	Super II 30 MAX
di 2.2 Diesel Engine	●
X430 Compressor w/Synthetic Compressor Oil	●
Thermo King Radiator	●
Stainless Steel Grille	●
Stainless Steel Exterior Condenser Hardware	●
Stainless Steel Evaporator Hardware	●
Tapered Roller Bearing Fanshaft & Idlers	●
Silicone Coolant Hoses	Opt
Heavy Duty Dry Element Air Cleaner	●
Thermoguard Thermostat	●
Fuel Filter with Water Separator	●
Spin-On Full Flow Oil Filter	●
Spin-On Bypass Oil Filters, Extra Capacity	●
Dealer Installed Synthetic Engine Oil	Opt
Digital Thermometer	●
Side Mount Coolant Expansion Tank	●
Defrost Timer — electronic solid state	●
CYCLE-SENTRY System	Opt
37 amp Alternator	●
65 amp Alternator	Opt
Fuel Heater	Opt
Frost Plug Heater	Opt
Low Speed Start	Opt
Remote Lights	Opt
Simpson Lead	Opt
Water in Fuel Indicator	●
Mode Indicator Lights	●
Coolant Level Indicator Light	●
Fuelsaver I (unloaders)	Opt
Fuelsaver II (high speed delay)	●
Digital Hourmeter	Opt
Sentinel Light	Opt
Temperature Sentry	Opt
Dual Thermostat Sensors	Opt
PROTECTION DEVICES	
Engine High Coolant Temperature Switch	●
Engine Low Oil Pressure Switch	●
Refrigerant High Pressure Cutout Switch	●
Circuit Breaker (Current Limiter)	●
High Refrigerant Pressure Relief Valve	●
Circuit Breaker in Control Circuit	●
Compressor Low Oil Pressure Switch	Opt



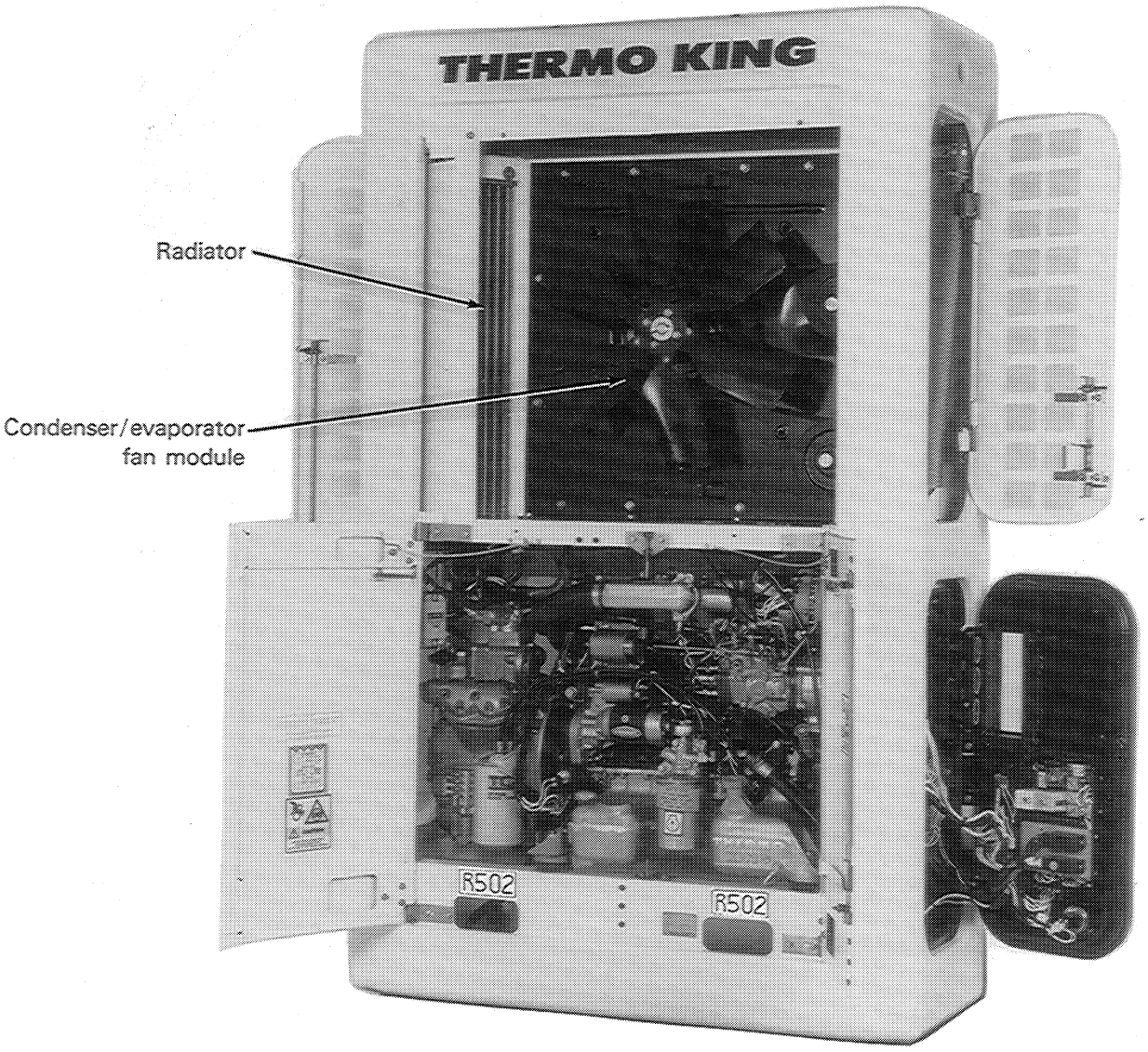
Super II MAX — Right 3/4 View



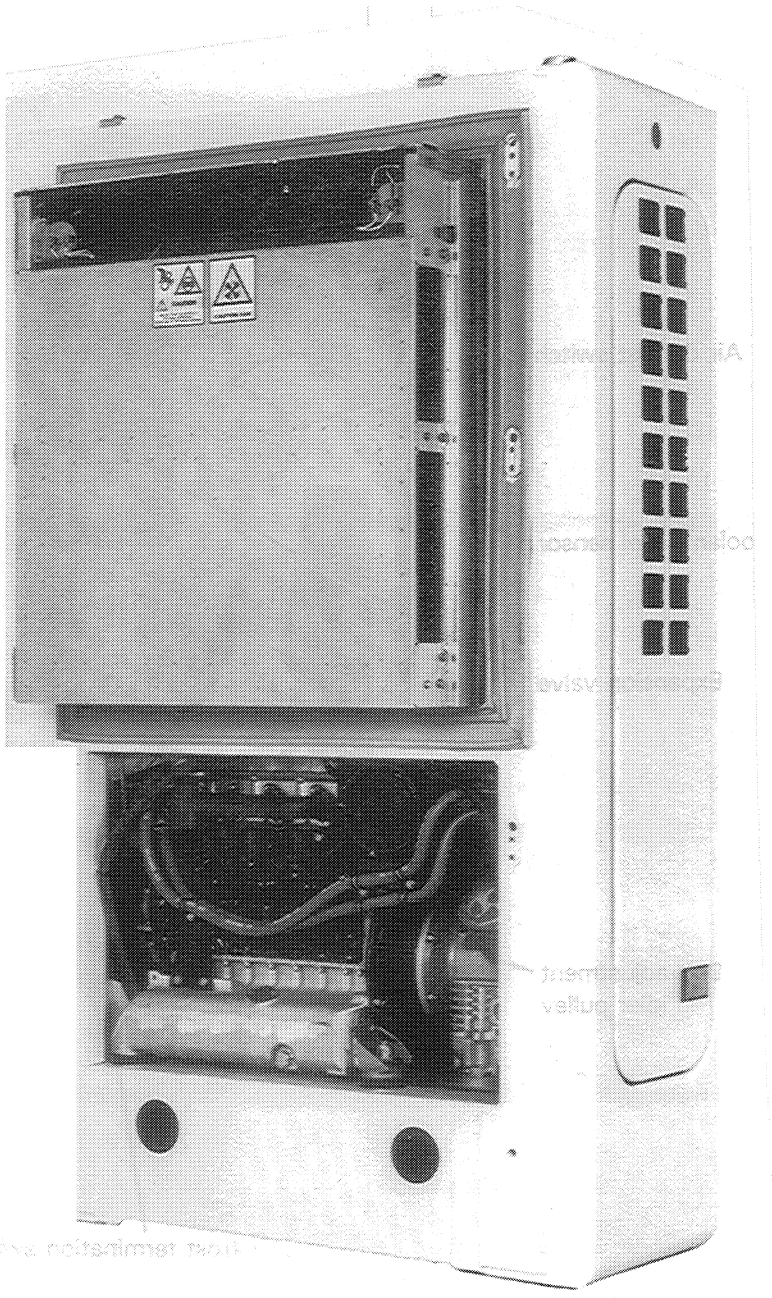
Super II MAX — Left 3/4 View



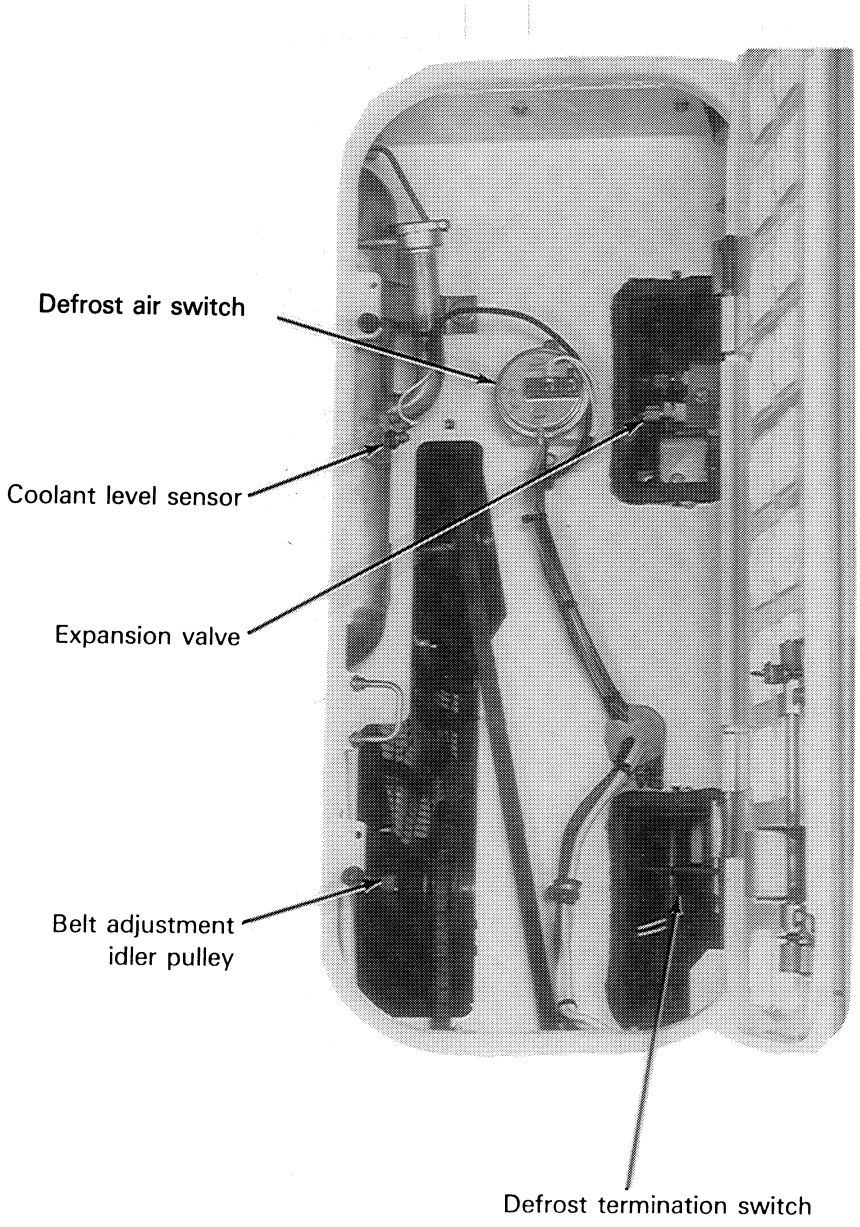
Super II MAX — Front View with Doors Open



Super II MAX with Doors Open and Grille Removed



Super II MAX — Rear View



Super II MAX — Inside Upper Left Door

Operating Instructions

UNIT CONTROLS

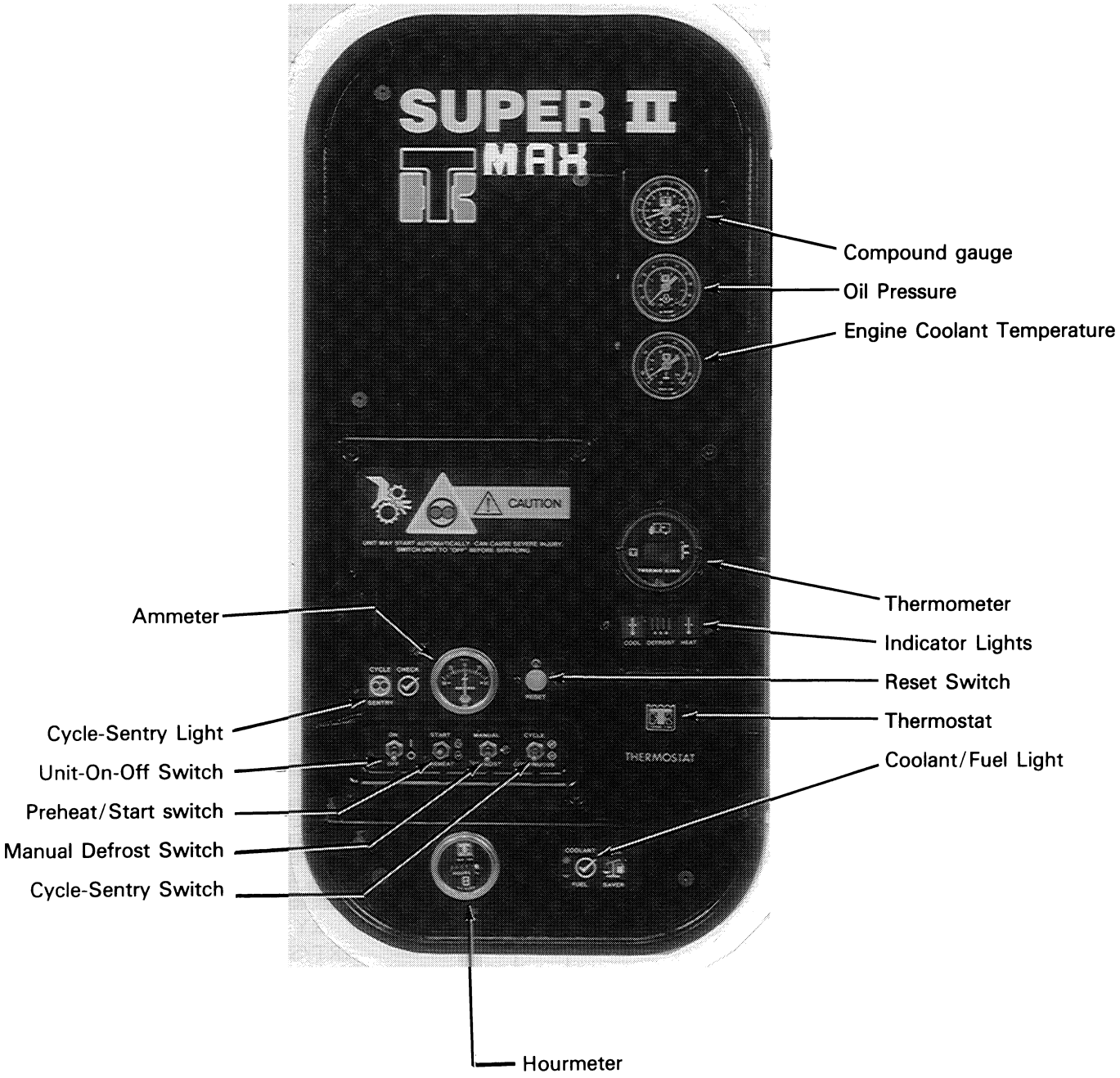
1. ON-OFF SWITCH. This switch energizes the electrical system of the unit.
   a. ON position. The unit will operate in response to the thermostat setting and the trailer air temperature.
   b. OFF position. The fuel solenoid that controls the supply of fuel is de-energized to stop the engine. The unit will not operate.
2. PRE-HEAT/START SWITCH. When held on PRE-HEAT, the Pre-Heat/Start Switch energizes only the glow plugs to aid in starting the diesel engine. When held on START, the Pre-Heat/Start Switch energizes both the glow plugs and the starting motor. Hold the switch on START until the engine starts to fire and pick up speed. DO NOT release the switch from the START position prematurely if the engine is extremely cold.
3. MANUAL DEFROST SWITCH. The unit can be placed on defrost by depressing the manual defrost switch located on the control panel. The evaporator coil temperature must be below 37 F (2.8 C) before the unit will defrost. Otherwise the unit will continue normal operation.
4. THERMOSTAT. A solid state THERMOGUARD IV thermostat controls unit operation to maintain the trailer temperature at set point.

   Set the thermostat at the required temperature. Setting the dial lower than required will not make the unit cool faster.

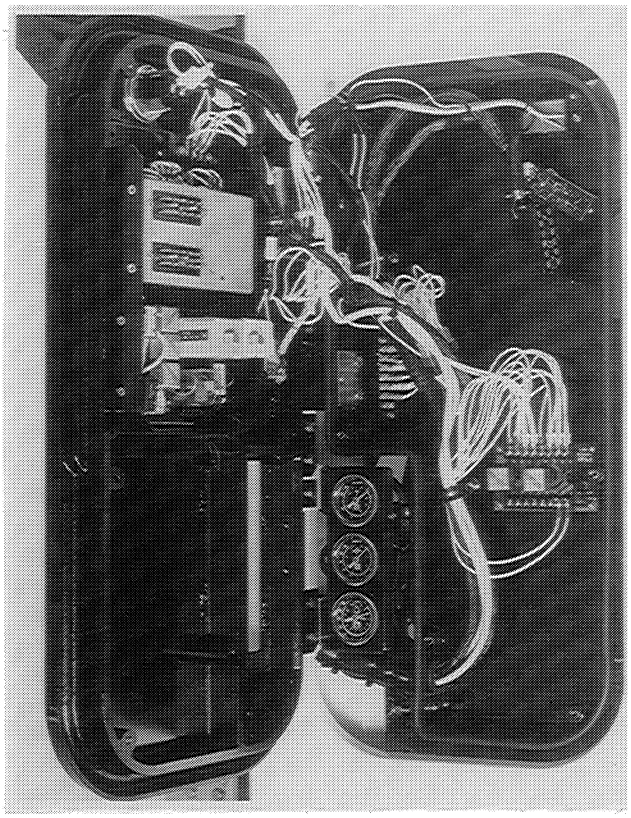
   NOTE: Thermoguard thermostats have low voltage and open circuit protection. If there is no power from the battery to the thermostat or if battery leads to the thermostat are reversed, the thermostat switches the unit to Low Speed Cool. If the sensor circuit is open, the unit also switches to Low Speed Cool.
5. DEFROST AIR SWITCH. The defrost air switch senses the air pressure difference between the evaporator coil inlet and outlet. The switch automatically places the unit on defrost when ice or frost on the coil builds up to a point where the air flow across the coil is restricted 40 to 50% of normal.
6. DEFROST TIMER. A solid state defrost timer automatically places the unit on Defrost every 4 hours on Standard 4-Mode units and every 12 hours on CYCLE-SENTRY-V equipped units.
7. DEFROST TERMINATION SWITCH. The electronic defrost termination switch uses solid state components to control the defrost circuit. The switch has short circuit protection and solid state reliability. The switch is mounted in the evaporator and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 37 F (2.8 C) completing the defrost circuit to ground and preparing the electrical system for the defrost cycle. The switch opens and terminates the defrost cycle when the evaporator temperature rises to 49 F (9.4 C).
8. CYCLE-SENTRY SWITCH. This switch selects conventional continuous run operation or automatic Start/Stop operation.
   a. CONTINUOUS RUN position. The unit must be started manually with the Unit On/Off switch and Pre-heat/Start switch. After startup, the unit operates continuously until the unit On/Off switch is turned off or a unit protection circuit shutdown occurs due to a malfunction in the fuel, engine oil, engine coolant or unit refrigeration system.
   b. AUTO START/STOP position. All unit starting operations are performed automatically on thermostat demand. Starting functions such as glow plug pre-heat, fuel and throttle solenoid control, and cranking are performed automatically.

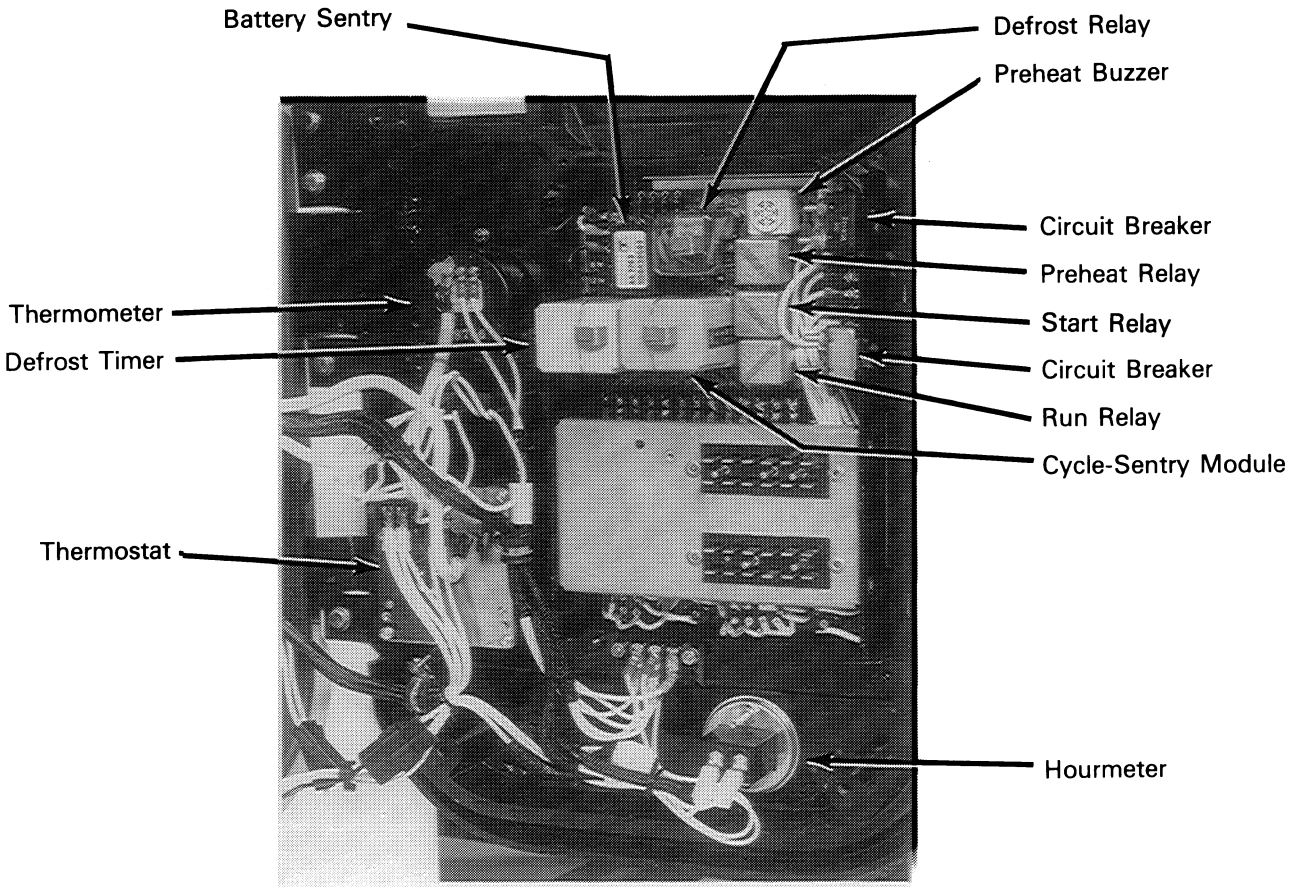
      The unit operation is controlled automatically by the unit thermostat, engine block temperature switch, Battery Sentry and defrost controls. The engine starts automatically whenever the thermostat calls for cooling or heating, the defrost timer initiates defrost, or the engine block temperature drops to 30 ±8 F (-1.1 ±4.4 C). The engine runs until the thermostat demand is satisfied, the battery is fully charged and the block temperature reaches 90 ± 18 F (32 ± 10 C). The engine is automatically stopped by the CYCLE-SENTRY V control module.

      CAUTION: With the selector switch in AUTO START/STOP position and unit ON/OFF switch in ON position, the unit may start at any time without prior warning.

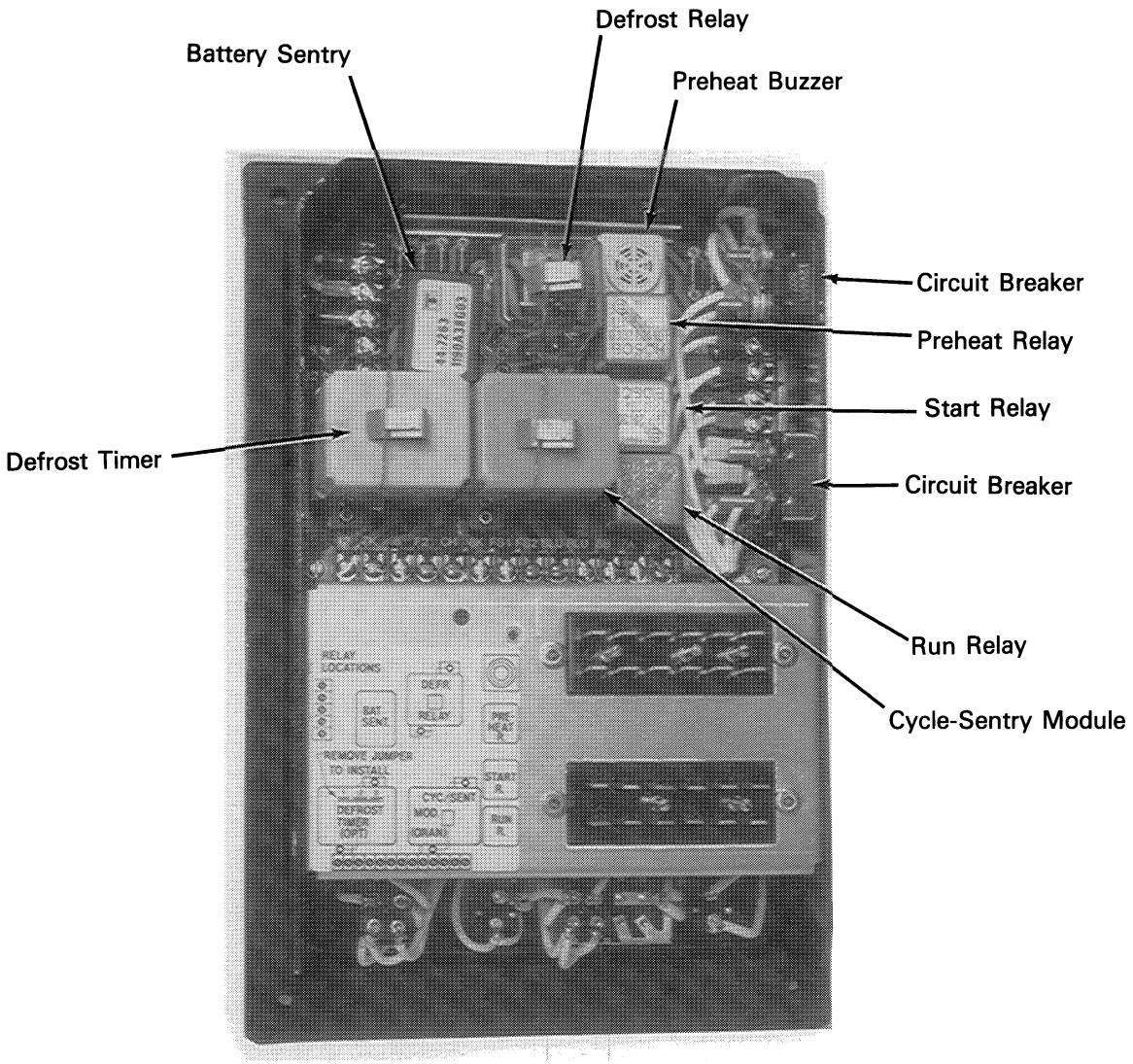


Super II MAX Control Box Cover





Super II MAX Control Box with Cover Open



Rear View of Switch Panel

UNIT INSTRUMENTS

1. AMMETER. The ammeter indicates battery charge and discharge amperage during engine operation. The charging amperage varies according to the needs of the battery. The ammeter also indicates the amount of current draw by the glow plugs during pre-heat.

2. HOURMETER-ENGINE. The engine hourmeter records the total hours that the engine is in operation for proper maintenance intervals.

3. INDICATOR LIGHTS. Indicator lights indicate the following: WHITE—Cooling; TAN—Defrost; AMBER—Heating.

   NOTE: The defrost light is connected in the defrost circuit. Both the white and tan lights may be lit when the unit is on defrost.

   A GREEN light indicates the CYCLE-SENTRY V system is functioning normally. If the GREEN CYCLE-SENTRY V light is out with the selector in the AUTO START/STOP position and the ON/OFF switch in the ON position, a malfunction has occurred. The reset switch will be tripped.

   A RED light on constantly indicates the engine coolant level is low. Refer to "Engine Cooling System".

   CAUTION: Do not remove the radiator cap when coolant is hot.

   A flashing red light indicates water must be removed from the water separator. Refer to "Engine Fuel System".

   An BLUE light indicates the optional Fuelsaver I unloader is energized.

4. COMPOUND PRESSURE GAUGE. The compound gauge indicates the pressure in the suction line at the compressor.

   When the unit is on cooling, the compound gauge will read approximately 28 psi (193 kPa) when the trailer temperature is above 10 F (-12.2 C). When the unit is heating or defrosting, the suction pressure will climb and also stabilize at 28 psi (193 kPa).

   When the unit is on cooling with a 0 F (-18 C) return air temperature, the suction pressure should be 13-18 psi (90-124 kPa).

   When the return air temperature is below 0 F (-18 C), the suction pressure should be 5-13 psi (34-90 kPa).

5. DIGITAL THERMOMETER. A digital thermometer indicates the temperature of the air returning to the evaporator from the trailer.

6. OIL PRESSURE GAUGE. The oil pressure gauge indicates engine oil pressure. The engine oil pressure should rise immediately on starting. A low pressure switch will trip the Reset Switch and stop the engine if oil pressure drops below 15 ±3 psi (103 ±21 kPa) for 30-50 seconds.

7. COOLANT TEMPERATURE GAUGE. The engine coolant temperature gauge indicates the temperature of the engine coolant in the engine block.

8. RECEIVER TANK SIGHT GLASS. The receiver tank sight glass indicates the level of refrigerant in the receiver tank for checking the refrigerant charge in the unit.

9. COMPRESSOR OIL SIGHT GLASS. The compressor oil sight glass indicates the relative level of compressor oil in the compressor sump.

10. AIR FILTER REPLACEMENT INDICATOR. An air restriction indicator shows the amount of intake air restriciton caused by the air filter.

11. EXPANSION TANK LIQUID INDICATOR. An indicator light on the control panel connected to a coolant level detector on the expansion tank lets you know when it is necessary to add engine coolant.

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

UNIT PROTECTION DEVICES

1. RESET SWITCH. A thermal type manual reset switch protects the engine. The reset switch contains a resistor that is attached to a sensor switch in the engine oil system, engine coolant system, compressor oil system (optional), and CYCLE-SENTRY-V system (optional).

   When the engine oil pressure or compressor oil pressure (optional) is too low, the engine coolant temperature is too high, or when the starter exceeds the cranking limit on Auto Start/Stop operation, the resistor in the switch starts to heat up. In 30-50 seconds, the heat melts a soldered shaft inside a tube, allowing the switch to trip and shut down the unit. The switch must be manually reset after the resistor cools.

2. CONTROL SYSTEM CIRCUIT BREAKER. A 30 amp automatic reset circuit breaker protects the unit control system. The breaker is located on the back of the switch panel.

3. CURRENT LIMITER CIRCUIT BREAKER. A 40 amp (50 amp with optional 65 amp alternator) manual reset circuit breaker protects the unit against high current draws during preheat and starting.

4. HIGH PRESSURE CUTOUT. The high pressure cutout (HPCO) is a pressure sensitive switch located in the compressor discharge manifold. If the discharge pressure becomes excessive, the HPCO switch opens the circuit to the fuel solenoid stopping the engine. Within 30-50 seconds, the reset switch will also trip because of a lack of oil pressure in the engine.
5. HIGH PRESSURE RELIEF VALVE. The high pressure relief valve is designed to relieve excess pressure within the refrigeration system. The valve is a spring-loaded piston that lifts off its seat when refrigerant pressure exceeds 500 ±50 psi (3,448 ±345 kPa). The valve will reseat when the pressure drops to 400 psi (2758 kPa). The valve could possibly leak refrigerant after it has relieved excess pressure. Tapping the valve lightly may help the valve reseat and SEAL PROPERLY. The valve is non-repairable and requires no adjustment. If the valve fails to reseat properly, remove the refrigerant charge and unscrew and replace the valve.

   The high pressure relief valve is located on a high pressure line near the condenser. Its location is such that when the pressure is expelled from the valve, it would be directed away from anyone servicing the unit.

UNIT OPERATION

Pre-Trip Inspection

The following Pre-trip Inspection should be completed before loading the trailer. While the Pre-trip 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.

1. FUEL The diesel fuel supply must be sufficient to guarantee engine operation to the next check point.
2. ENGINE OIL. The engine oil level should be at the FULL mark with the dipstick turned (threaded) into oil pan. Never overfill.
3. COOLANT. The engine coolant must have anti-freeze protection to -30 F (-34 C). Check the coolant level indicator light.

   CAUTION: Do not remove the radiator cap while coolant is hot.
4. BATTERY. The terminals must be clean and tight.
5. BELTS. The belts must be in good condition and adjusted to proper tension.
6. ELECTRICAL. The electrical connections should be securely fastened. The wires and terminals should be free of corrosion, cracks or moisture.
7. STRUCTURAL. Visually inspect the unit for leaks, loose or broken parts and other damage. The condenser and evaporator coils should be free of debris. Check the drain hoses and fittings to be sure they are open. The damper in the evaporator outlet must move freely with no sticking or binding. Be sure all doors are latched securely.

Starting Standard Units

1. Hold the PRE-HEAT—START Switch in the PRE-HEAT position for the required time. The ammeter should show glow plug discharge.

Ambient Temperature	Pre-Heat Time
0 to 32 F (-18 to 0 C)	30 seconds
Below 0 F (-18 C)	60 seconds

2. Turn the unit On/Off switch to On.
3. Hold the PRE-HEAT—START Switch in the START position to crank the engine. Release when the engine starts. DO NOT release prematurely when the engine is extremely cold.
4. If the engine fails to start, turn the On-Off switch Off, and repeat steps 1 through 4.

   CAUTION: Never use starting fluid.

Starting CYCLE-SENTRY-V Start/Stop Equipped Units

Selection of Operating Modes on CYCLE-SENTRY V Equipped Units

The Thermo King CYCLE-SENTRY-V Start/Stop 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 without continuous air circulation.

Since highly sensitive products will normally require continuous air circulation, CYCLE-SENTRY-V units come equipped with a selector switch for "Auto Start/Stop" or "Continuous Run" operation. Your selection of operation mode for the proper protection of a particular commodity should use the following guidelines.

Examples of Products Normally Acceptable for CYCLE-SENTRY-V 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, shipper or USDA if you have any questions about the operating mode selection on your type of load.

Continuous-Run Operation

With the selector switch in the "Continuous-Run" position, the CYCLE-SENTRY V unit will operate in its regular cooling and heating modes. Refer to Starting Instructions for Standard Units.

Auto Start/Stop Operation

With the selector switch placed in the "Auto Start/Stop" position, the CYCLE-SENTRY-V system shuts down the unit when the trailer temperature reaches the thermostat setpoint, and restarts the unit on thermostat demand.

On CYCLE-SENTRY-V equipped units, the unit start-ups may also be initiated by defrost cycle initiation or engine block temperature switch demand.

If defrost is initiated either manually or automatically, the unit will start and run on high speed. When the defrost cycle is complete, the unit will run in whichever operating mode the thermostat is calling for until the trailer temperature reaches set point.

In cold ambients, the CYCLE-SENTRY-V system automatically maintains engine temperature by restarting the unit if the engine block temperature drops to 30 F (-1.1 C). When the unit starts up because of low engine block temperature, the unit will run in whichever operating mode the unit thermostat is calling for until the battery is fully charged and the engine block temperature rises to 90 F (32 C).

After the unit starts from thermostat demand, defrost initiation or engine block temperature switch demand, a Battery Sentry monitors the voltage across the field of the alternator and will keep the unit running until the battery is recharged sufficiently. The unit runs in whichever operating mode the thermostat is calling for to properly maintain the trailer temperature. When the battery is sufficiently recharged, the unit will shut down on thermostat demand.

CAUTION: With the selector switch in "Auto Start/Stop" position and unit "On/Off switch in the "On" position, the unit may start at any time without prior warning.

The Cycle-Sentry system will activate a buzzer during automatic pre-heat. However, if the engine temperature is high enough, the pre-heat time may be only a few seconds long or eliminated completely.

NOTE: Trailer units equipped with CYCLE-SENTRY-V should be manually started if the units have been non-operative (turned off), resulting in cold soaked engine temperatures below 30 F (-1.1 C). Place the selector switch in the "Continuous Run" position and refer to Starting Instructions for "Continuous Run Operation" for manual starting instructions. After this initial cold start, the selector switch can be switched to "Auto Start/Stop" operation. CYCLE-SENTRY-V sensors will then automatically maintain temperatures and provide reliable unit restarts on demand.

Fully charged batteries in good condition are essential for reliable unit operation. This is especially true on CYCLE-SENTRY-V equipped units in cold weather.

1. Set the thermostat at the desired temperature. DO NOT set thermostat lower than required (lowering the thermostat setting does not make the unit cool faster).
2. Place the selector switch in the "Auto Start/Stop" position.
3. Place the unit On-Off switch in the "On" position. The green indicator light will come on. (This green light must be on at all times while unit is on Auto Stop/Start operation). If a malfunction occurs preventing a restart, this green light being out will be the only indication a malfunction has occurred.
4. If the thermostat calls for cooling or heating, the cool or heat light will be on and the glow plugs will automatically heat for the required amount of time depending on the engine temperature (5 seconds at 150 F [66 C] to 120 seconds at -20 F [-29 C]).

5. At the end of the preheat period, the engine will begin cranking. The glow plugs remain energized during the cranking period. If the engine rpm does not exceed 50 rpm during the first 4 seconds of cranking, or if the engine does not start after 30 seconds of cranking, the cranking cycle terminates.

   NOTE: If the engine fails to start, the unit reset switch will open, interrupting current to the control system approximately 40 seconds after the cranking cycle begins.

6. If the engine fails to start, place the unit switch in the "Off" position, determine and correct the cause for not starting, then push in the reset button and repeat the starting procedure.

After Start Inspection

1. OIL PRESSURE. Check the engine oil pressure at high speed, it should register higher than 40 psi (276 kPa).
2. AMMETER. The needle should indicate CHARGE for a short period of time after startup.
3. COMPRESSOR OIL. The compressor oil level should be visible in the sight glass.
4. REFRIGERANT. The suction pressure should not drop to zero unless the trailer temperature is very low. Suction pressure will drop as the trailer temperature drops (see "Compound Pressure Gauge" under Unit Instruments).
5. THERMOSTAT. Dial the thermostat setting above and below the trailer temperature to check the cycle sequence and switch differential (see "Operation" under Unit Description).

   NOTE: On units equipped with CYCLE-SENTRY-V Start/Stop controls, if the engine has not run long enough to thoroughly warm up or if the battery is not fully charged, the unit may not shut off in the Null mode.

6. PRE-COOLING. With the thermostat set at the desired temperature, allow the unit to run for one-half to one hour (longer if possible) before loading the trailer. Pre-cooling will remove residual body heat and moisture from the trailer interior and provide a good test of the refrigeration system.
7. DEFROST. When the unit has finished pre-cooling the trailer interior (trailer temperature dropped below 37 F [2.8 C]), initiate a defrost cycle with the manual defrost switch. The defrost cycle should end automatically.

Loading Procedure

1. Be sure unit is OFF before opening the doors to minimize frost accumulation on the evaporator coil and heat gain in the trailer. (The unit may be running when loading the trailer from a warehouse with door seals.)
2. Spot check and record the 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.

Post Load Procedure

1. Be sure all the doors are closed and locked.
2. Adjust the thermostat dial to the desired temperature setpoint.
3. Start the unit.
4. One-half hour after loading, defrost the unit by momentarily pressing the Manual Defrost switch. If the trailer temperature has dropped below 37 F (2.8 C), the unit will defrost. The defrost cycle should stop automatically.

Post Trip Checks

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

Electrical Maintenance

ALTERNATOR

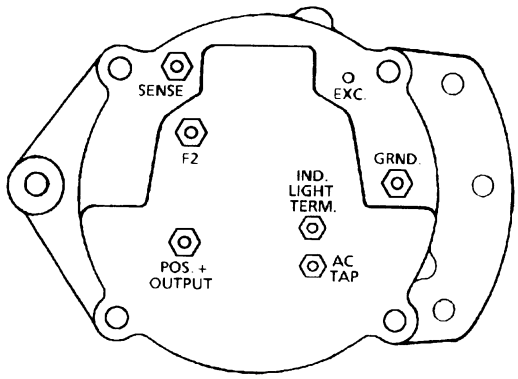
Charging System Diagnostic Procedures

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.

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

1. With the unit switch "off', attach a voltmeter to terminal "Sense (2)" and the alternator chassis. Voltmeter should indicate battery voltage.



Terminal Location

2. With the unit switch "on", attach a voltmeter to terminal "F1" and the alternator chassis. Voltmeter should indicate battery voltage.
3. To determine whether the alternator or regulator is faulty, attach a test lead between terminal F2 and chassis ground. Run the engine on high speed.

   CAUTION: Never apply battery voltage to terminal F2.

   a. Full alternator 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.

NOTE: A loss of battery voltage to either terminal F1 or TERMINAL "Sense (2)" will cause the alternator to stop charging.

Alternator Removal

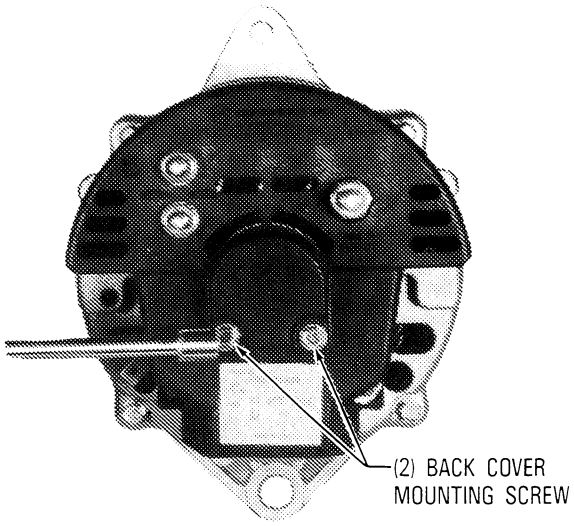
1. Disconnect battery power from the unit.
2. Remove wires from alternator terminals.
3. Remove the mounting bolts and remove the alternator.

Alternator Installation

1. Mount alternator to the bracket, but do not tighten the bolts.
2. Install the alternator drive belt, tension properly and tighten mounting bolts.
3. Install wires on alternator terminals and the nuts.
4. Connect the battery power to the unit.

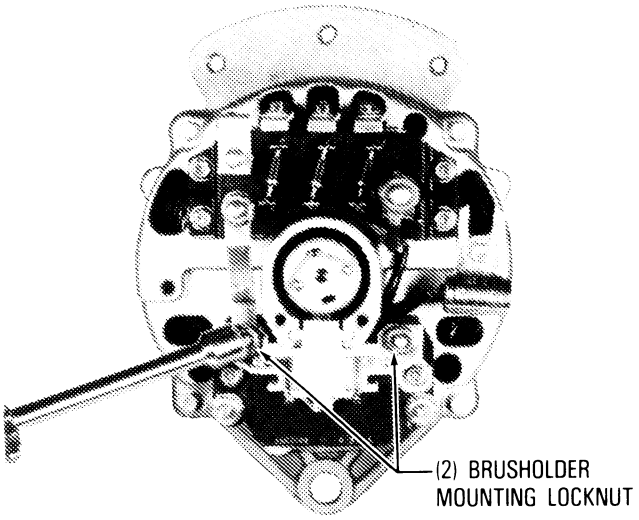
Alternator Disassembly

1. DETACH BACK COVER. Remove nuts from terminals. Remove two screws securing back cover to rear housing.



REMOVING BACK COVER

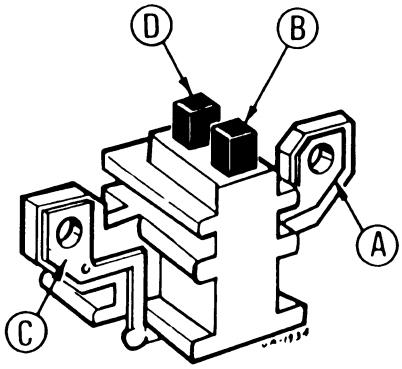
2. REMOVE BRUSH HOLDER. Remove two locknuts securing brush holder. Pull out brush holder.



REMOVING BRUSH HOLDER

3. INSPECT AND TEST BRUSH ASSEMBLY. The original brush set may be reused if the brushes are 3/16 in. or longer and if brushes are not oil soaked, cracked or show evidence of grooves on the sides of the brushes caused by vibration.

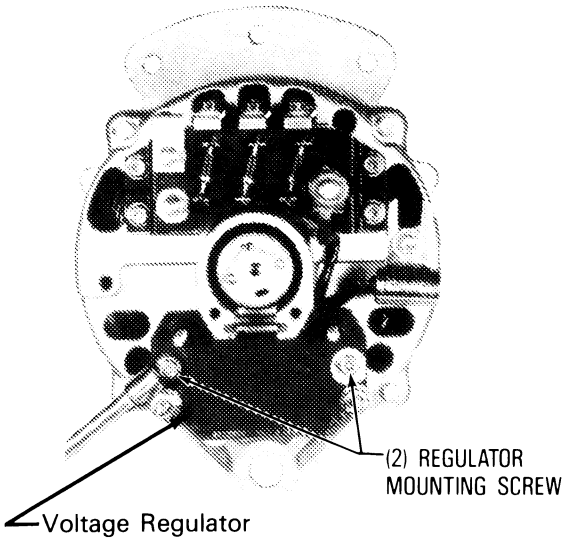
TEST
CONTINUITY FROM A TO B FROM C TO D
NO CIRCUIT: FROM A OR B TO C OR D



TEST WITH 12 VOLT DC
TEST LAMP OR OHMMETER

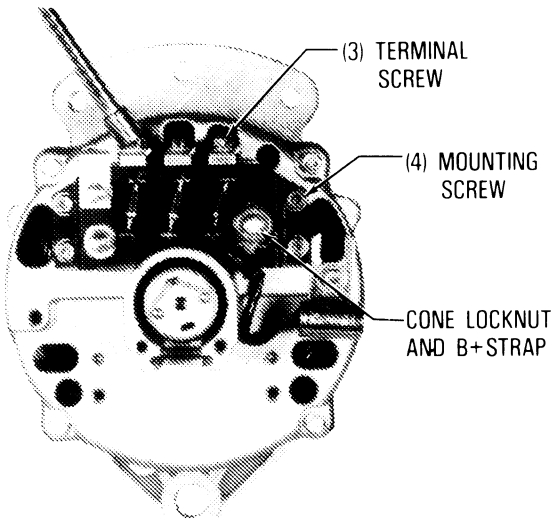
BRUSH TEST

4. REMOVE INTEGRAL VOLTAGE REGULATOR. Remove two screws securing integral voltage regulator to rear housing.



REMOVING VOLTAGE REGULATOR

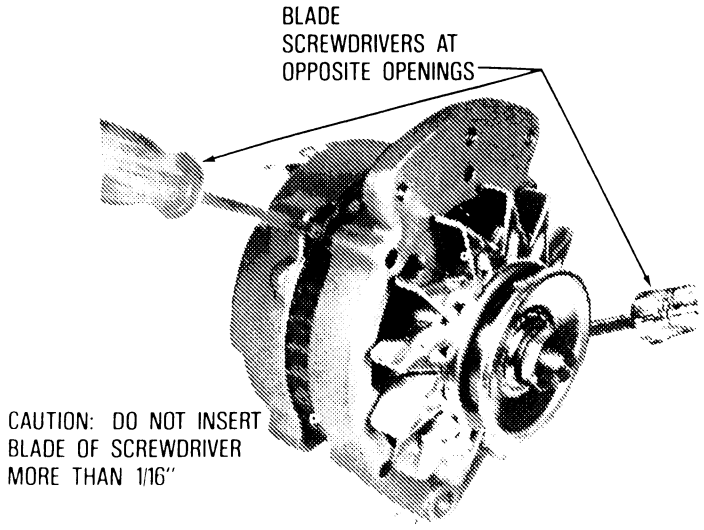
5. REMOVE DIODE-TRIO AND RECTIFIER DIODE BRIDGE. The diode-trio and rectifier diode bridge are detached as an assembly. Remove cone locknut from positive output (B+) terminal. Straighten B+ strap. Remove three terminal screws and four diode-trio mounting screws. Detach assembly from rear housing and separate diode-trio assembly from rectifier bridge.



REMOVING DIODE-TRIO AND RECTIFIER DIODE BRIDGE

6. SEPARATE STATOR/REAR HOUSING ASSEMBLY FROM FRONT HOUSING.
   a. Remove four thru-bolts.
   b. Carefully insert two screwdriver blades in opposite openings between the stator and front housing. Pry units apart.

   CAUTION: DO NOT insert screwdriver blades deeper than 1/16 in. to avoid damaging stator winding.



STATOR-REAR HOUSING SEPARATION

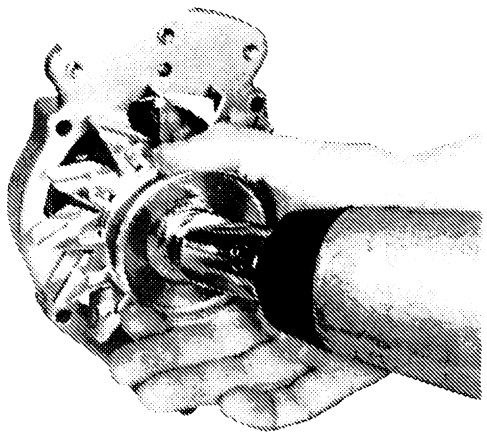
7. REMOVE PULLEY, FAN AND SPACER. The pulley is a slip-fit on the rotor shaft, positioned with a Woodruff key. Remove the nut and lockwasher from the shaft using an impact wrench or other suitable tool.

   After nut and lockwasher are removed, the alternator can be separated from the pulley.

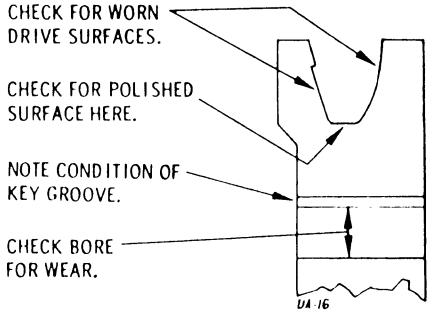
   The fan will slide over the key. The key may be removed with diagonal pliers or with a screwdriver.

   Inspect the fan for cracked or broken fins and note the condition of the mounting hole. If worn from running loose, replace the fan to ensure balance.

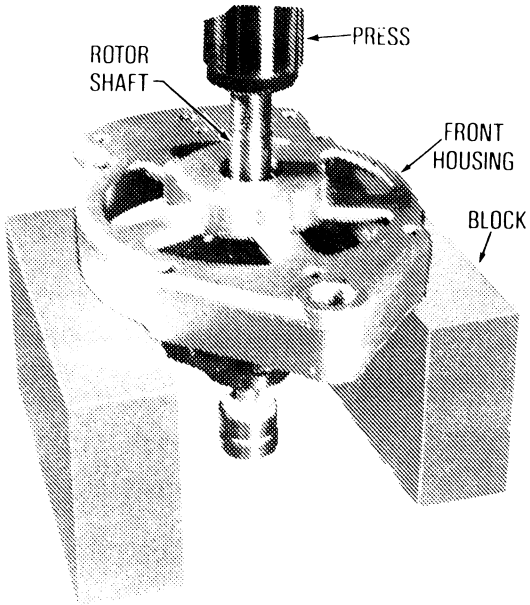
   Inspect pulley for possible faults.



PULLEY REMOVAL

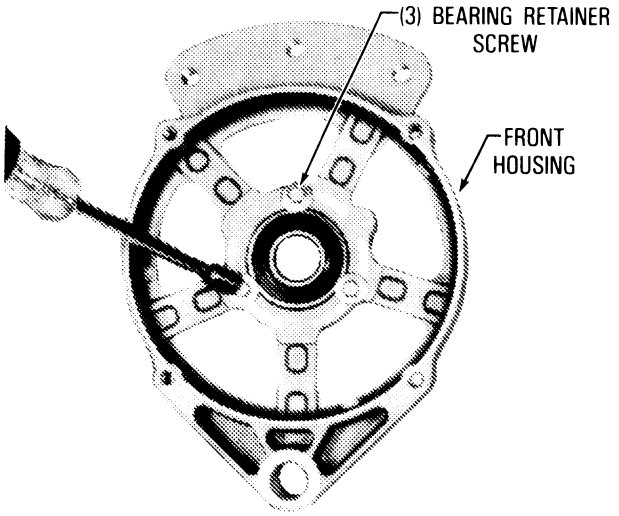


8. SEPARATE ROTOR FROM FRONT HOUSING. Position front housing on support blocks placed on an arbor press. Push rotor assembly from housing.

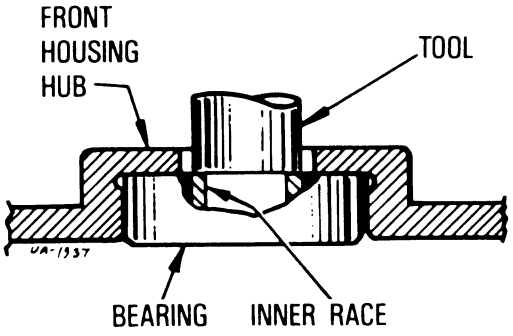


SEPARATING ROTOR FROM FRONT HOUSING

9. REMOVE FRONT BEARING FROM HOUSING. Remove three bearing retainer screws. Position housing on support blocks placed on an arbor press. Using a tool that contacts inner race of bearing, press out front bearing.



REMOVING RETAINER SCREWS

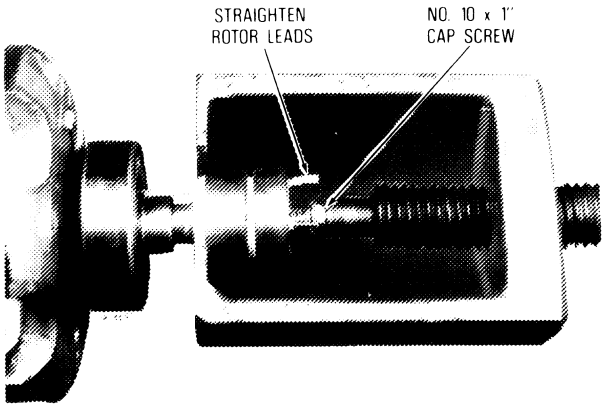


PRESSING OUT BEARING

10. REMOVE SLIP RINGS FROM ROTOR ASSEMBLY. Unsolder the rotor leads from the slip ring terminals. Carefully unwind the ends of the rotor coil leads from the slip ring terminals.

Straighten rotor leads. Insert a No. 10x1'' cap screw into opening at center of slip ring assembly. Position bearing puller and pull slip ring assembly off rotor shaft.

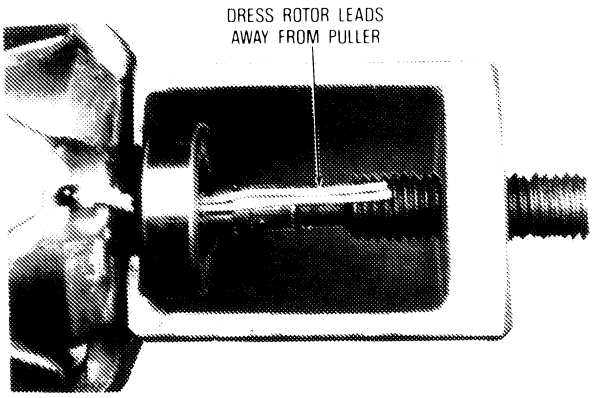
CAUTION: When holding rear end of rotor shaft in vise, be sure not to grip bearing area of rotor shaft.



REMOVING SLIP RING ASSY.

11. REMOVE REAR BEARING FROM ROTOR. Dress rotor leads away from the bearing puller contact area. Adjust puller to contact inner bearing race and carefully remove bearing from the shaft.

This completes the disassembly of the alternator.

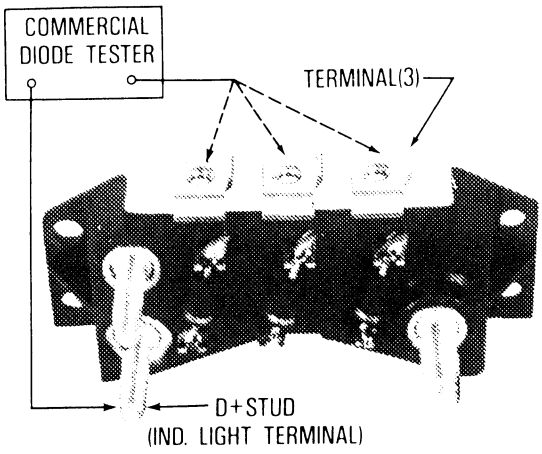


REMOVING REAR BEARING

Alternator Test

Diode Trio Assembly Test

Using a commercial diode tester or 12V dc test lamp; check for continuity from each terminal separately to the D+ stud; continuity should be observed in one direction (polarity) only, and all diodes should check alike. If any diode is defective, replace the entire diode trio assembly.

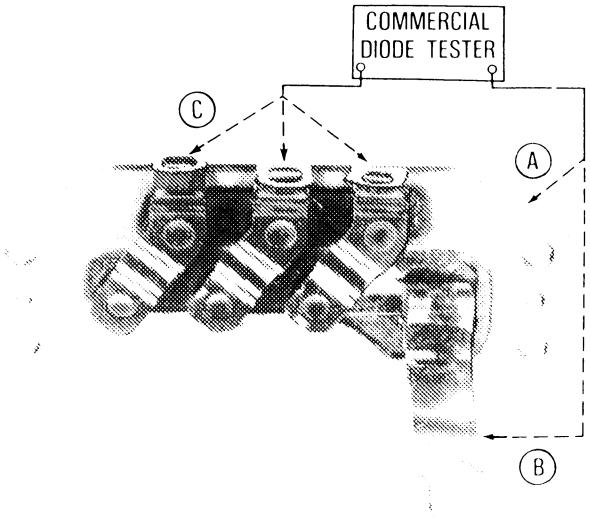


TESTING DIODE-TRIO

Diode Rectifier Bridge Assembly Test

Using a commercial diode tester, check for continuity. Check between point A and each of three terminals C for negative diodes. Continuity should be observed in one direction (polarity) only, and all diodes should check alike. Then check between point B (B+ strap) and each of the three terminals C for positive diodes. Continuity should be observed in one direction only, and all diodes should check alike.

If any diode is defective, replace the entire diode rectifier bridge assembly.



TESTING RECTIFIER BRIDGE

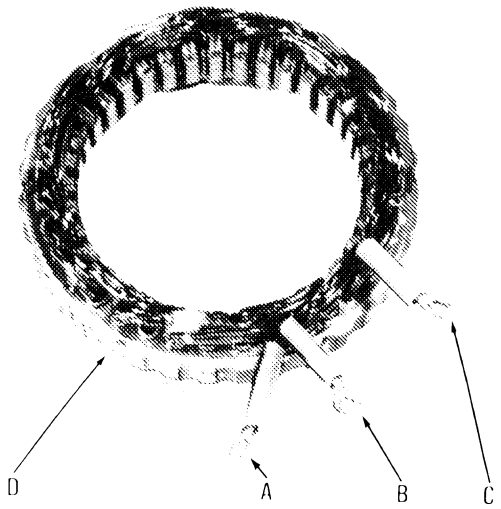
Rear Housing Inspection

Inspect the rear housing for a cracked or broken casting, stripped threads or evidence of severe wear in the bearing bore due to a worn rear bearing.

If casting is to be reused, clean in solvent, dry with compressed air, and install a new rear bearing retainer if retainer is damaged.

Stator Test

The stator assembly consists of three individual windings terminated in the delta-type connections. Using an ohmmeter or a test lamp, check for winding continuity between terminals A, B and C. There should be no continuity from any terminal to point D (laminations). Also, stators showing any signs of winding discoloration should be discarded.



STATOR WINDING TESTS

Front Housing Inspection

Check housing for cracks. Check condition of threads in adjusting ear. Check bore in mounting foot. Discard housing if bore shows signs of elongation (oval or out-of-roundness).

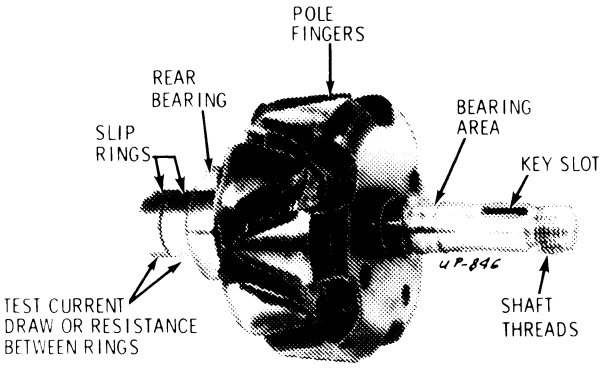
Rotor Inspection and Electrical Testing

Check the rotor assembly for the following electrical properties.

Current Draw or Resistance of the Winding

CAUTION: Turn off DC power source before removing test leads to avoid arc damage to slip ring surfaces.

1. Current draw @70 to 80 F (21.1 to 26.6 C) should be 3.7-4.2 amperes at 15V.
2. Resistance of winding @70 to 80 F (21.1 to 26.6C) should be 3.5 to 4.0 ohm.



NOTE: PLACE TEST LEADS ON EDGES OF SLIP RINGS TO AVOID CREATING ARCS ON BRUSH CONTACT SURFACES.

ROTOR INSPECTION & ELECTRICAL TESTING

Grounded Slip Ring or Winding

Use 12V dc test lamp, ohmmeter or 110V ac test lamp. Place one test lead to the rotor body and the other on either slip ring. Open circuit from either slip ring to the rotor body is a correct condition.

Condition of Slip Rings

1. Clean brush contacting surfaces with fine crocus cloth, wipe dust and residue away.
2. If surfaces are worn beyond this restoration, replace the entire rotor assembly.

Rotor Shaft and Pole Pieces

1. Stripped threads on shaft
2. Worn key slot
3. Worn bearing surface
4. Scuffed pole fingers
5. Worn or dry rear bearing

Replace rotor assembly if any of the above faults are noted, with the exception of item 5.

NOTE: New rotors include a new rear bearing and new slip rings as part of the assembly.

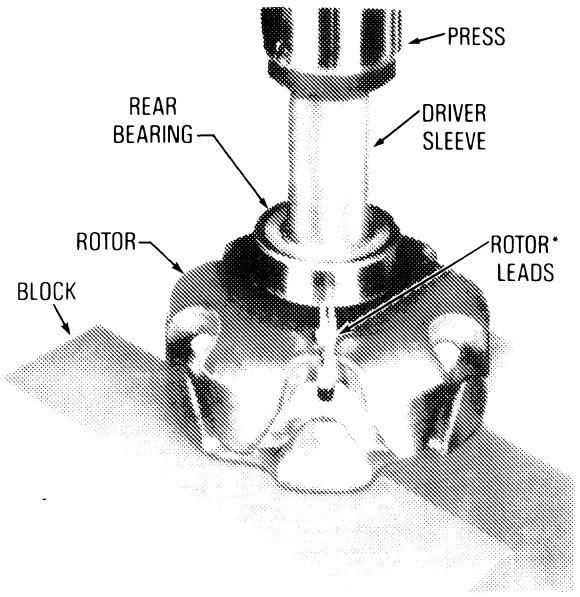
If rear bearing requires replacement, follow instructions for this operation.

Alternator Reassembly

The general reassembly instructions are in reverse order to the procedures given for disassembly. Therefore, only information pertaining to special reassembly requirements will be covered in this section.

Rear Bearing Installation

Place rotor on a press. Choose a drive sleeve that exerts pressure on inner race only, and press bearing on rotor shaft until it contacts shoulder. New replacement bearings should be used whenever bearing is removed during repair procedures or when bearing is rough, dry or noisy.



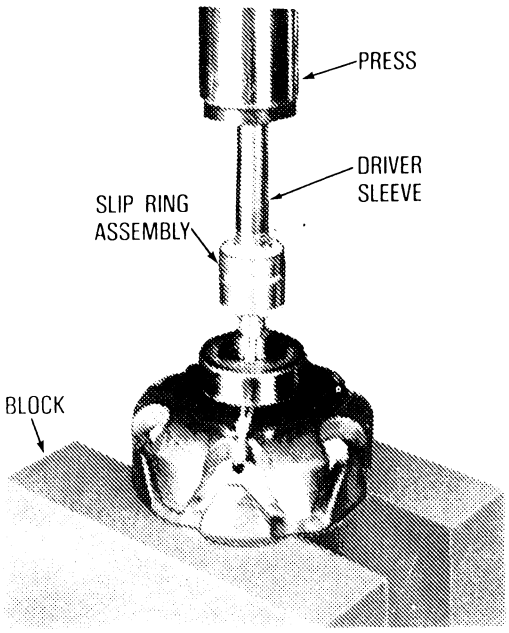
*CAUTION: BE SURE LEADS ARE IN GROOVES OF SHAFT

INSTALLING REAR BEARING

Slip Ring Assembly Installation

Guide rotor leads through one of the oval passages in the slip ring assembly. Be sure oval passage is in line with groove in rotor shaft. Place rotor on a press. Choose a driver sleeve with a diameter that clears leads.

Press slip ring assembly on shaft. Solder rotor leads to leads on slip ring. Trim excess ring leads extending above solder connections.

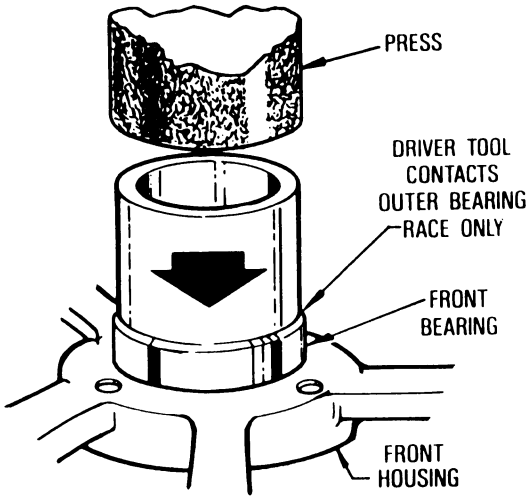


INSTALLING SLIP RING ASSEMBLY

Front Bearing Installation

Place front bearing and housing in an arbor press. Select a driver tool to contact the outer race only, and press bearing into housing bore.

Bearing replacement is recommended whenever bearing is removed during alternator repair procedures or if bearing is rough, dry or noise. Install three bearing retainer screws. Torque to 25-35 in.-lb (2.8-3.9 N·m).



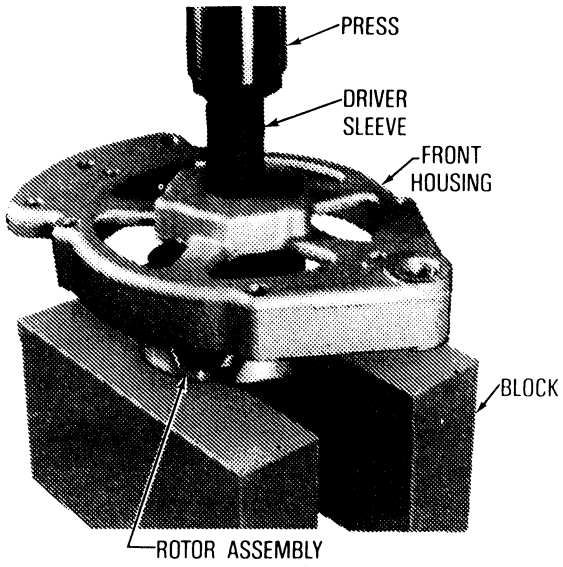
INSTALLING FRONT BEARING

Rotor and Front Housing Assembly

Place the rotor on the bed of an arbor press using two steel blocks for support. Place front housing over shaft.

Using driver sleeve that contacts inner bearing race only, press front housing down until inner bearing race contacts shoulder on the shaft.

*CAUTION: **Be sure rotor leads clear blocks.***



ASSEMBLING FRONT HOUSING TO ROTOR

Spacer, Fan and Pulley Assembly

Place pulley spacer over shaft. Install Woodruff key and install fan. Install pulley, lockwasher and nut. Mount pulley and tighten to 50 ft-lb (67.8 N·m).

Spin rotor by hand to test freedom of bearing.

Front and Rear Housing Assembly

Place stator into front housing with stator leads at top and notches in laminations aligned with bolt holes. Position rear housing over slip rings with housing bolts aligned and stator leads extending through openings at top of rear housing. Install thru-bolts, and tighten evenly to between 50-60 in.-lb (5.6-6.8 N·m). Spin rotor by hand to test freedom of bearings.

*NOTE: **New front housings contain thru-bolts that are not tapped. Therefore, a socket wrench rather than a nut driver will be required to supply sufficient torque to drive the "thread forming" thru-bolts.***

Diode Rectifier Bridge and Diode Trio Installation

Insert B+ strap through slot in diode trio body. Bend strap over B+ terminal and secure with cone locknut. Apply thin film of heat sink compound to back of diode rectifier bridge and to mating area on rear housing.

Install assembly to rear housing (4 screws). Place strap (AC tap) in position and connect stator leads (3 screws).

Install capacitor (where applicable).

Integral Regulator Installation

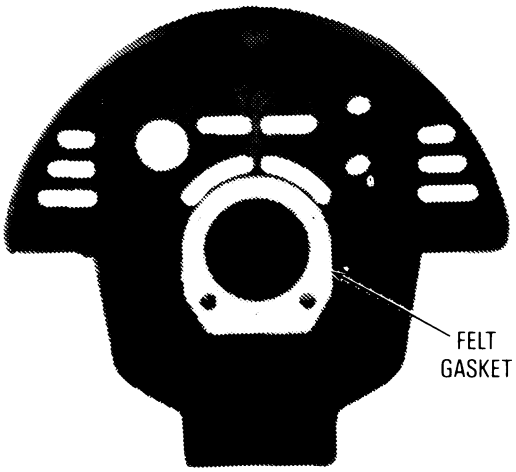
Install 2 brush mounting screws through openings in regulator body. Secure regulator to rear housing (2 screws).

Brush Assembly Installation

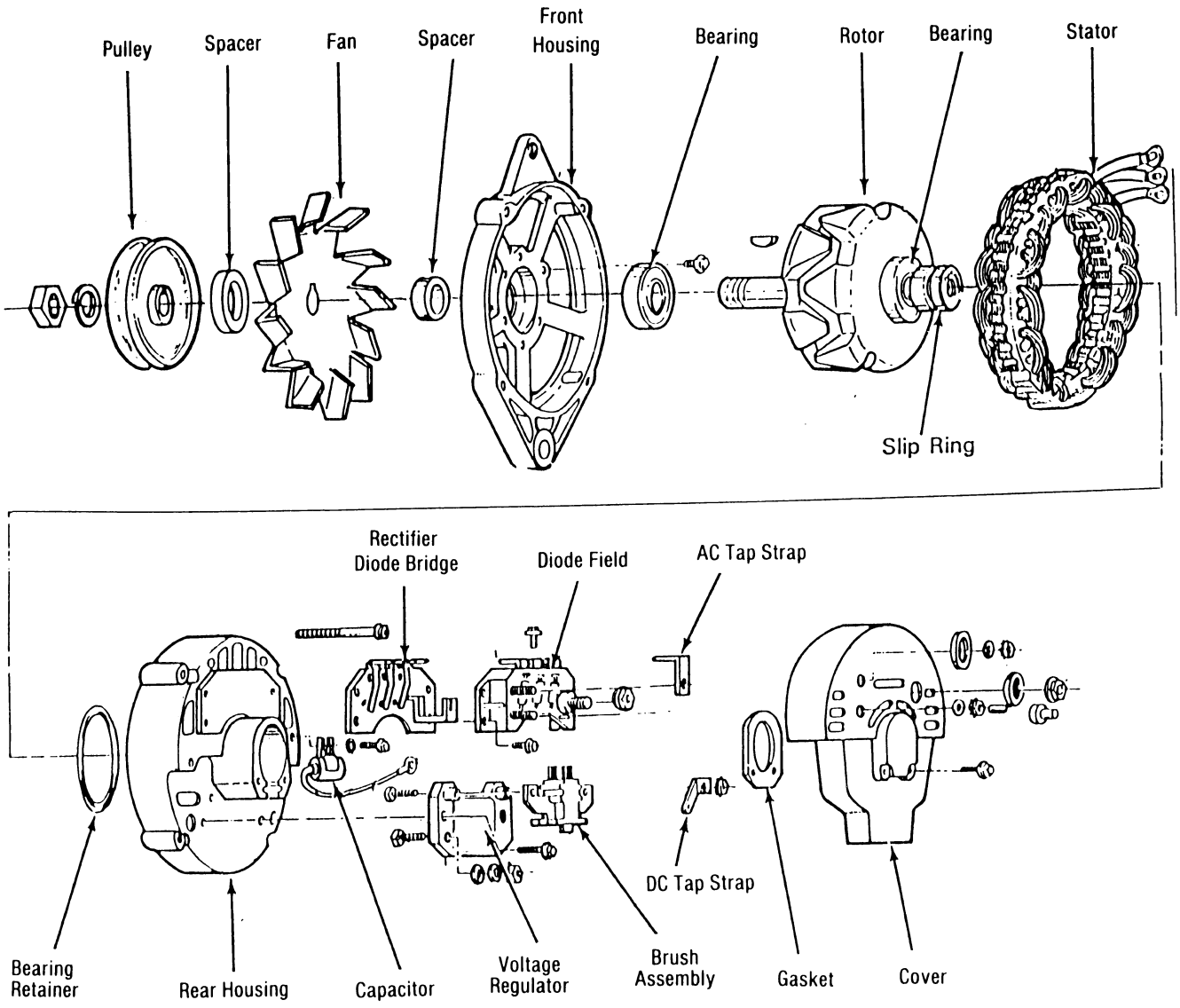
Insert brush holder into grooves in hub of rear housing. Place D+ strap (or male terminal where applicable) on stud and secure brush holder with locknuts (2 places). Secure other end of D+ strap.

Rear Cover Installation

Be sure felt gasket is in place. Position rear cover on rear housing and secure with 2 screws.



INSTALLING REAR COVER


Pulley
Spacer
Fan
Spacer
Front Housing
Bearing
Rotor
Bearing
Stator
Slip Ring
Rectifier Diode Bridge
Diode Field
AC Tap Strap
Bearing Retainer
Rear Housing
Capacitor
Voltage Regulator
Brush Assembly
DC Tap Strap
Gasket
Cover

BATTERY

Inspect/clean the battery terminals 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 proper water level.

UNIT WIRING

Inspect unit wiring and wire harnesses during scheduled maintenance inspections for loose, chafed or broken wires to protect against unit malfunction due to opens or shorts.

CHARGING SYSTEM (12V dc)

Immediately after startup, the ammeter may show a discharge condition on systems with brush type alternators. This is due to light film buildup on the alternator slip rings. The film buildup occurs primarily on units that have been sitting unused for long periods of time. The film should disappear after a minute or two, and the ammeter should show a high charge rate that will continue until the battery voltage is brought back up to normal. Under normal running conditions, the ammeter will show a slight charge condition. If the ammeter shows a discharge after startup, check the alternator belt tension and all charging circuit connections including the battery.

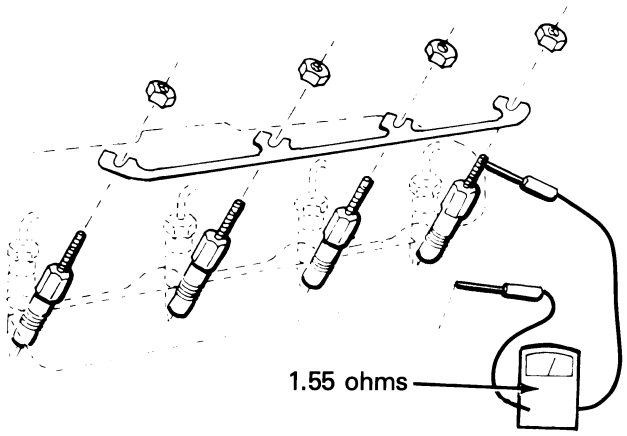
GLOW PLUGS

Glow plugs heat the combustion chamber to aid in quick starting. The glow plugs are energized when the PRE-HEAT/START switch is held in the PRE- HEAT or START position or when the CYCLE-SENTRY-V control module initiates unit startup (selector switch in the "Auto Start/Stop" position).

A open glow plug (burned out) can be detected with the unit ammeter. The unit ammeter should show 28 to 30 amps discharge while the PRE-HEAT/START Switch is held in the PRE-HEAT position and the ON-OFF Switch is in the OFF position. A discharge of 28 to 30 amps means all four glow plugs are working. If the discharge rate drops below 28 amps on PRE-HEAT, at least one glow plug is bad.

To isolate an open circuit glow plug, remove the bus bar and test each glow plug individually with an ohmmeter or a jumper wire and ammeter. Each glow plug should have a resistance of approximately 1.55 ohms or a current draw of about 7.1 amps.

A shorted glow plug will be indicated by the ammeter showing full discharge when the pre-heat switch is pressed or when the current limiter circuit breaker, between the 2AA and 2A wires, is tripped and must be reset manually. Check each glow plug with an ohmmeter. A shorted glow plug will have very low resistance.



Testing Glow Plugs

RESET SWITCH

The engine is protected by a manually reset thermo-breaker reset switch. The reset switch contains a resistor that is attached to two sensors. One sensor switch is in the engine oil system and the other is in the engine cooling system (a third sensor is located on the compressor on units equipped with optional compressor low oil pressure switch). The CYCLE-SENTRY-V system also connects the resistor to ground whenever the run relay is energized.

If any sensor is grounded due to an abnormal condition (low oil pressure or high water temperature), the resistor attached to the reset switch heats up. The heat melts a soldered shaft inside a tube, allowing the reset switch to trip and stop the engine.

It takes approximately 40 seconds for the resistor to heat up and trip the reset switch.

The two most common causes of reset switch failure are loss of solder and burned out resistors. If some of the solder is lost, the switch may reset, but from then on a slight jar or small amount of heat from the resistor may cause the button to pop out.

When a reset switch is suspected of being defective, check the resistor for an open circuit.

Replacing the resistor is the only repair possible. The reset switch must be replaced if it is defective.

Summary of reasons for the reset switch (Red button) tripping:

1. High coolant temperature.
2. Lack of engine oil pressure.
3. Lack of fuel to the engine (switch trips because of a lack of engine oil pressure).

   NOTE: If the unit switch is "On" with Auto Stop/Start-Continuous Run selector switch in the "Continuous Run" position and the engine is not running, the engine low oil pressure sensor will cause the reset switch to open.

4. High pressure in the refrigeration system (high pressure cutout shuts down the engine, then reset switch trips because of low engine oil pressure).
5. Compressor low oil pressure (optional). A sensor in the compressor oil system closes if the compressor oil pressure falls below 15 ±3 psi (103 ±21 kPa), causing the reset switch to trip and stop the engine.
6. Unit exceeds cranking limit on CYCLE-SENTRY V operation. If the engine cranks continuously for approximately 30 seconds and fails to start, the CYCLE-SENTRY V module stops further cranking attempts. After this occurs, the reset switch trips approximately 40 seconds after cranking began because of low engine oil pressure.
7. Reset switch becoming defective. The switch may get to a point where it will open due to vibration.
8. A ground fault in the No. 20 or 20A wires to the sensor is also a possible cause.

   NOTE: A ground or short circuit in the electrical system does not cause the reset switch to pop out.

ENGINE LOW OIL PRESSURE SWITCH

Engine oil pressure should rise immediately on starting. The switch will trip the reset switch and stop the engine if the oil pressure drops below 15 to 20 psi (103 to 138 kPa). A continuity tester is needed to check the oil pressure switch.

1. Remove the 20A wire from the switch.
2. The continuity tester should indicate a complete circuit between each terminal and ground.
3. Start the engine. Tester should show an open circuit between each terminal and ground.

Repair consists of replacing the switch.

HIGH COOLANT TEMPERATURE SWITCH

The high coolant temperature switch will close and trip the reset switch if the coolant temperature is greater than 220 F (104 C). Use a continuity tester to check the switch, and observe the coolant temperature gauge to check the temperature.

1. Remove the 20A wire from the switch.
2. Run the unit until it reaches normal operating temperature, approximately 180 F (82 C). There should be no continuity from the switch to ground.
3. If the engine runs hot and the reset switch does not trip run the unit until it reaches 220 F (104 C). The switch should have continuity to ground.

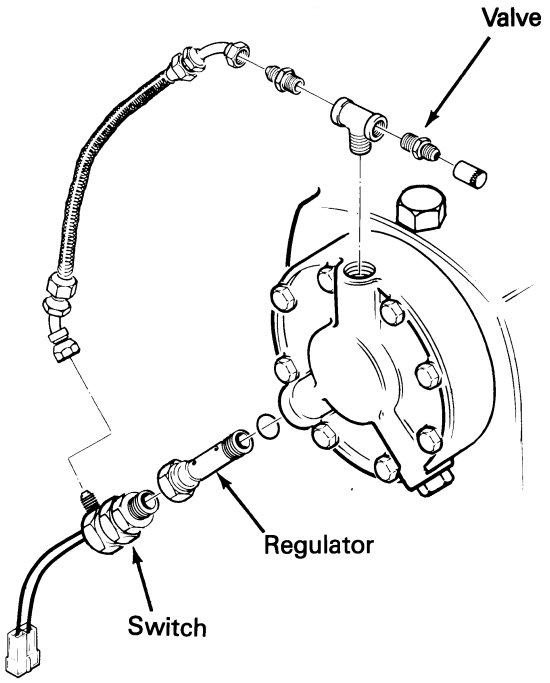
Replace the switch as necessary.

COMPRESOR LOW OIL PRESSURE SWITCH (OPTIONAL)

The compressor oil pressure should rise immediately on starting. The switch will close and trip the reset switch and stop the engine if the oil pressure drops below 15 psi (103 kPa). A continuity tester is needed to check the oil pressure switch, but make sure the oil pressure is greater than 15 psi (103 kPa).

1. Remove the 20A wire from the switch.
2. The continuity tester should indicate a complete circuit between the terminal and the ground.
3. Start the engine. The tester should show an open circuit between the terminal and ground.

Repair consists of replacing the switch.



Compressor Low Oil Pressure Switch Components

DIGITAL THERMOMETER (with LCD display)

The digital display shows the temperature and is continuously backlighted. Digital range is approximately -40 to 158 F (-40 to 70 C). The accuracy is ±1° at 32 F (.5 at 0 C).

Display interpretations:

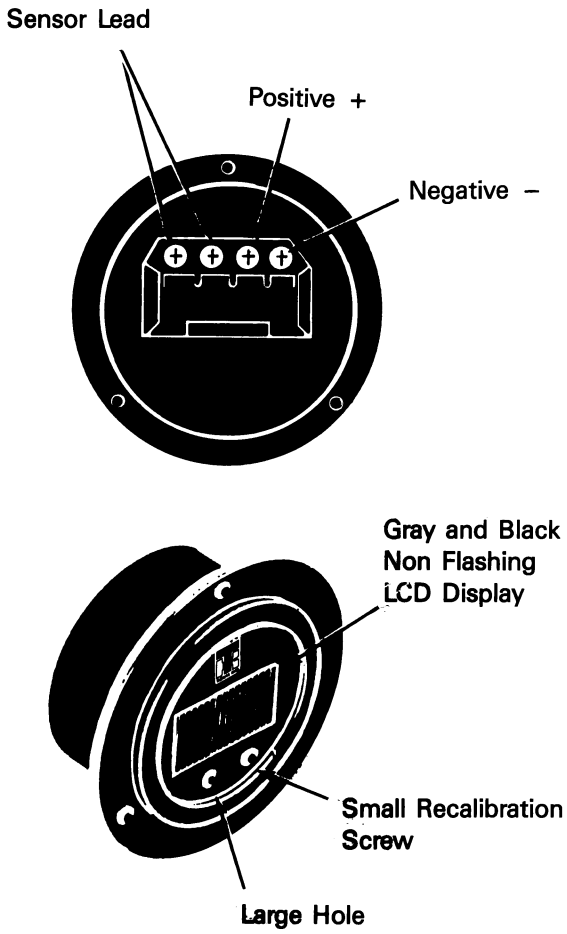
- BLANK Low power
- -188 Open or shorted sensor lead
- -188 Sensor above or below temperature range

The sensor is connected to the two left side terminals on the rear of the case (as you look at the back of the thermometer). These terminals are labeled SENSOR below them. The sensor leads may be attached to either terminal.

The 12V dc power is connected to the two right side terminals on the rear of the case. The positive terminal is next to the sensor terminals labeled (+) and the negative terminal is on the right end labeled (-).

Checkout Procedure

1. Check the voltage and polarity applied to the terminals located on the rear case. The voltage must be 10-15V dc, and the positive must be on the + terminal and negative on the - terminal.



Thermometer

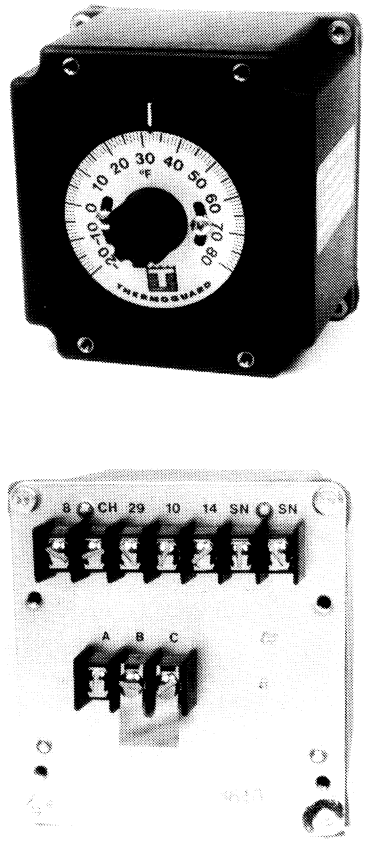
2. If the problem is still uncorrected, then disconnect the sensor from the case and check the resistance of the sensor and compare with the specifications listed. If the sensor is ok, replace the temperature display head. If the sensor is bad, replace the sensor.

Temperature	Resistance (ohms)
-20 F (-28.9 C)	3012
-10 F (-12 C)	3061
32 F (0 C)	3266
50 F (10 C)	3354
80 F (26.6 C)	3498

3. Slight recalibration adjustments can be made by turning the smallest screw located on the face of the thermometer. The thermometer can be adjusted approximately ±4 F (2.2 C).

THERMOGUARD THERMOSTAT (TG-IV)

The TG-IV Thermoguard is an electronic thermostat module that uses external relays. The TG-IV module is replaceable as an assembly, and no internal repair is available.



THERMOGUARD IV Front and Rear Views

Thermostat Calibration

The TG-IV normally does not need calibration, but if required, it can be recalibrated. The factory calibration is marked by a notch in the dial at 32 F (0 C) that lines up with a matching notch in the plastic back plate.

Procedure

1. Prepare an ice water bath. Fill an insulated container with ice. Add just enough water to cover the top of the ice. Stir the water for at least 3 minutes to bring the water temperature down to 32 F (0 C). Check the temperature of the ice water bath with an accurate thermometer.
2. Remove the thermostat sensing bulb from the mounting clamps in the evaporator.
3. Place the sensor bulb in the ice water bath. Be sure the bulb is entirely submerged in the ice water solution and is not in contact with the insulated container.
4. Start the unit and check thermostat calibration setpoint. When the unit changes from low speed cool to low speed heat, the dial setting should be 32 F (0 C). To adjust the dial, loosen the dial screws, align the dial notch with the indicator mark, and tighten the screws.

Thermostat Checkout

The thermostat checkout procedure is performed in the following order:

Thermostat Switch Sequence Test (on unit)

The thermostat switch sequence test verifies that the thermostat switches to the four modes of operation at the proper temperatures as described in the accompanying chart.

NOTE: The thermostat switch sequence test can be accomplished only if the thermostat dial is first set 6 F (3.3 C) or more below the sensor temperature before starting the unit. The dial must then be turned counterclockwise (CCW). Use a calibrated Simpson thermometer or equivalent to determine the sensor temperature.

1. The sensor temperature and thermostat dial setting must be well above 15 F (-9.4 C) to eliminate the heat lockout function.
2. Set the thermostat dial 6 F (3.3 C) or more below the sensor temperature.
3. Start the unit. The unit should operate in Mode 1 (see the chart).
4. Slowly rotate the dial CCW until the dial setting reaches approximately 3.4 F (1.9 C) below the sensor temperature. The unit should operate in Mode 2.
5. Slowly rotate the dial CCW until the thermostat dial reaches the approximate sensor temperature. The unit should operate in Mode 3.
6. Slowly rotate the dial CCW until the dial setting is approximately 3.4 F (1.7 C) above the sensor temperature. The unit should operate in Mode 4.

If the thermostat settings provide the proper modes of operation, then the thermostat and associated circuitry is operating properly.

Check thermostat calibration and adjust if needed.

If Mode 2 (Low Speed Cool) fails to operate, proceed to the Sensor test and the Thermostat Module Test.

If Mode 2 (Low Speed Cool) operates and any other mode fails to operate, proceed to the Thermostat Harness and Relay Assembly test.

Temperature Switch Sequence Chart

	Mode	Continuous Run Operation • Fuelsaver units • Cycle-Sentry units with Fuelsaver	Auto Start/Stop Operation • Cycle-Sentry units with Fuelsaver
6 F (3.3 C) or more below the sensor temperature	Mode 1	High Speed Cool	High Speed Cool
Between 3.4 F (1.9 C) below and up to the sensor temperature	Mode 2	Low Speed Cool	Low Speed Cool
Between the sensor temperature and 3.4 F (1.9 C) above the sensor temperature	Mode 3	Low Speed Heat or Low Speed Unloaded Heat	Null or Low Speed Heat or Low Speed Unloaded Heat
3.4 F (1.9 C) or more above the sensor temperature	Mode 4	Low Speed Heat (for 8 minutes—then High Speed Heat)	Low Speed Heat (for 8 minutes—then High Speed Heat)

Thermostat Harness and Relay Assembly Test (on unit)

This test should be performed after a thermostat swich sequence test. It determines if the thermostat harness and relay assembly function properly.

Perform the following tests with the unit running on Continuous Run and the thermostat calling for Low Speed Cool.

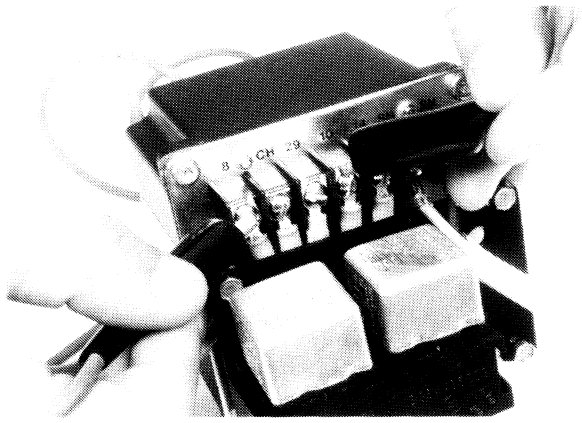
1. Using a voltmeter, check for voltage between the No. 8 terminal and the CH terminal on the back of the thermostat housing. Approximately 12 volts should be present. If no voltage or low voltage is present, there is an open or excessive resistance in the No. 8 wire or the ground (CH) wire.

Checking Terminals 8 and CH

2. Connect a jumper between terminals No. 8 and No. 10 on the rear of the thermostat housing. The 2K speed relay should actuate, and the unit should shift to High Speed.

Jumping Terminals 8 and 14

3. Connect a jumper wire between terminals No. 8 and No. 14 on the rear of the thermostat housing. The 1K heat relay should actuate, and the unit should shift to the Heat mode. Disconnect jumper.



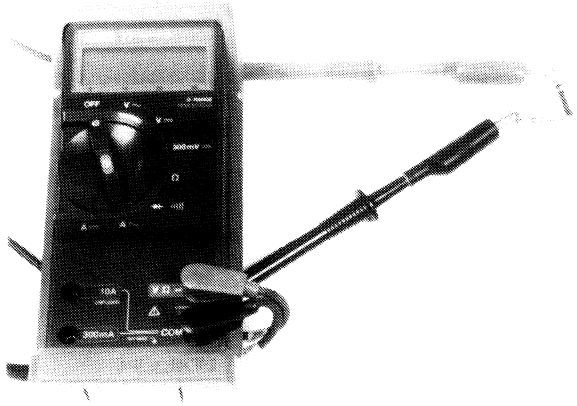
Jumping Terminals 8 and 10

If any relay fails to actuate, then the problem is in the harness or relays, and the problem must be identified and corrected.

Thermostat Sensor Test

NOTE: The sensor can be checked either on the unit or bench tested. In either case, determine the temperature of the sensor probe using an accurate thermometer.

1. Remove the sensor leads from the two SN terminals on the rear of the thermostat module.
2. Check the resistance of the sensor using a suitable ohmmeter capable of reading at least 4000 ohms.



Checking Sensor

3. The sensor resistance should be between 3000 and 3500 ohms. More accurately:

   3012 ohms at -20 F (-28.9 C)
   3061 ohms at -10 F (-12 C)
   3266 ohms at 32 F (0 C)
   3354 ohms at 50 F (10 C)
   3498 ohms at 80 F (26.6 C)

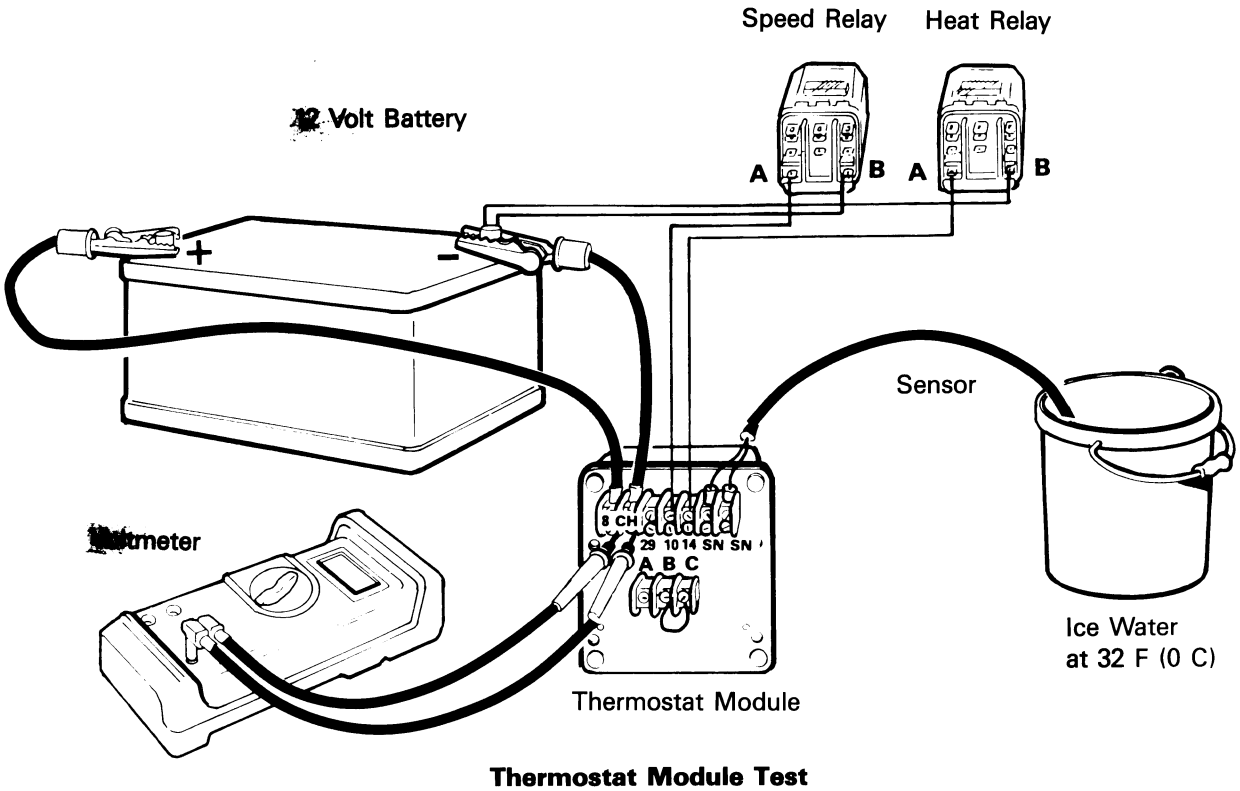
   If the sensor is defective, replace the sensor. If the sensor is good and the harness and relay assembly is good and the problem still exists, then the thermostat module is defective and must be replaced. To confirm the thermostat module condition, perform the Thermostat Module Bench Test.

   CAUTION: When reconnecting the sensor, be sure the thermostat sensor terminal ends cannot short to each other or to the thermostat housing.

Thermostat Module (bench test)

1. Turn unit On/Off switch to OFF.
2. Disconnect wires No. 8, CH, 29 (if used), 10 and 14 from the thermostat module. Also remove the relay bracket from the rear of the module if necessary, and remove sensor wires from the SN terminals on the rear of the thermostat module.
3. Remove the thermostat module from the unit, and connect a known good sensor (yellow jacketed) to the terminals labeled SN on the rear of the thermostat module.
4. To obtain accurate voltage readings during thermostat module checkout, circuits No. 10 and 14 must be tested under normal load. This is provided by connecting two defrost relays (Part No. 44-3186) as follows:

   Connect pin "B" of both relays to the NEG (-) terminal of a 12V dc power source. Connect pin "A" of one relay to the No. 10 terminal to simulate the speed relay. Connect pin "A" of the second relay to the No. 14 terminal to simulate the heat relay.
5. Place the sensor bulb in a 32 F (0 C) ice water bath.
6. Connect the POS (+) 12V dc power source to the No. 8 terminal. Connect the NEG (-) power source to the CH terminal.
7. Check for voltage between terminals 8 and CH. Be sure approximately 12 volts is present.
8. Set the thermostat module dial to 24 F (-4.4 C). The thermostat is now in Mode 1 — High Speed Cool.
   a. Check voltage between terminals 10 and CH. Twelve (12) volts should be present. The Speed relay should be energized.
   b. Check for voltage between terminals 14 and CH. Zero (0) volts should be present. The Heat relay should be de-energized.



Thermostat Module Test

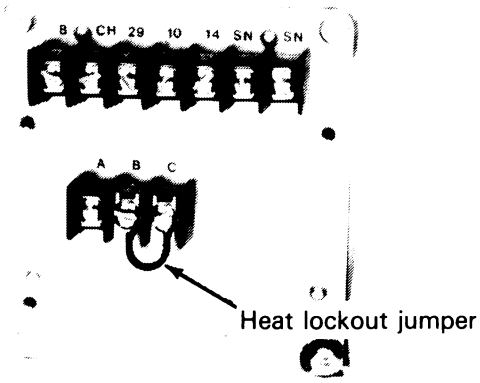
9. Slowly turn the thermostat dial upward to approximately 29 F (-1.7 C). The thermostat is now in Mode 2 — Low Speed Cool.
   a. Check for voltage between terminals 10 and CH. Zero (0) volts should be present. The Speed relay should be de-energized.
   b. Check for voltage between terminals 14 and CH. Zero (0) volts should be present. The Heat relay should be de-energized.
10. Slowly dial the thermostat upward to approximately 33 F (0.6 C). The thermostat is now in Mode 3 — Low Speed Heat.
   a. Check for voltage between terminals 10 and CH. Zero (0) volts should be present. The Speed relay should be de-energized.
   b. Check voltage between terminals 14 and CH. Twelve (12) volts should be present. The Heat relay should be energized.
11. Slowly dial the thermostat upward to approximately 36 F (2.2 C). The thermostat is now in Mode 4 — High Speed Heat.
   a. Check for voltage between terminals 10 and CH. Twelve (12) volts should be present. The Speed relay should be energized.
   b. Check voltage between terminals 14 and CH. Twelve (12) volts should be present. The Heat relay should be energized.
12. Reset the thermostat dial to between 29 and 32 F (-1.7 and 0 C), The thermostat should now be in Mode 2 — Low Speed Cool.
   a. Check for voltage between terminals 10 and CH. Zero (0) volts should be present. The Speed relay should be de-energized.
   b. Check for voltage between terminals 14 and CH. Zero (0) volts should be present. The Heat relay should be de-energized.
13. Connect a jumper wire between terminals 8 and 29.
   a. Check for voltage between terminals 10 and CH. Twelve (12) volts should be present. The Speed relay should be energized.
   b. Check voltage between terminals 14 and CH. Twelve (12) volts should be present. The Heat relay should be energized.

If the thermostat settings provide the proper modes of operation and steps 11 and 12 are performed successfully, then the thermostat module is ok.

Heat Lockout Switch

The Heat Lockout switch functions below 15 ±3 F (-9.4 ±1.7 C) dial settings. The thermostat is normally delivered in the High Speed Heat lockout position. To change the heat lockout mode of operation, reposition the wire jumper(s).

1. High Speed Heat Lockout: jumper wire between B and C.
2. All Heat locked out: jumper between B and A, and a jumper between B and C.
3. No Heat locked out: jumpers removed.



Heat Lockout Switch Location

CYCLE-SENTRY-V CHECK

Refer to the CYCLE-SENTRY II Operation and Diagnosis Manual for all operation and diagnosis procedures.

DEFROST SYSTEM

CAUTION: CYCLE-SENTRY-V Equipped Units — Place the selector switch on "Continuous Run" before performing any diagnosis and service operations on the unit. The unit may start at any time without prior warning if the On/Off switch is in ON position and the selector switch is in "Auto Start/Stop" position.

The unit should be run through a defrost cycle during Unit Pre-load Operation and scheduled maintenance inspections to test the defrost system components. To check the defrost cycle, run the unit on cooling and adjust the thermostat to drop the evaporator coil temperature below 37 F (2.8 C). Press the manual defrost switch. The unit should shift from the cooling cycle to the defrost cycle.

If the unit continues on cooling, double check the evaporator coil temperature and refer to the defrost cycle checkout section.

Check the defrost timer during scheduled maintenance inspections.

The defrost air switch setting should be checked annually. Refer to the defrost air switch checkout and adjustment section.

Defrost Cycle

The defrost cycle can be initiated by the manual defrost switch, defrost air switch or defrost timer when the defrost termination switch is closed.

The initiation of the defrost cycle energizes the defrost relay, the pilot solenoid, damper solenoids, throttle solenoid and tan defrost indicator light.

The pilot solenoid allows the 3-way valve to shift and divert heated refrigerant vapor to the evaporator coil, melting the frost. The damper solenoids close the damper in the discharge opening of the evaporator housing to hold the heat within the evaporator and prevent warm air from passing over the load. The throttle solenoid shifts the unit to high speed to increase defrost capability.

*NOTE: **The unit will not defrost during normal unit operation unless the defrost cycle is initiated while the evaporator temperature is below 37 F (2.8 C).***

The defrost termination switch opens and de-energizes the defrost relay when the frost has melted and the evaporator temperature rises above 49 F (9.4 C). The damper solenoids and pilot solenoid are also de-energized, opening the defrost damper and returning the 3-way valve and throttle solenoid to the control of the unit thermostat.

Defrost Cycle Checkout Procedure

*CAUTION: **CYCLE-SENTRY V Equipped Units — Place the Auto-Start/Stop—Continuous Run switch on "Continuous Run" before performing any diagnosis and service operations. The unit may start at any time without prior warning if the On/Off switch is in On position and the selector switch is in "Auto Start/Stop" position.***

To check the defrost cycle, run the unit on cooling until the evaporator coil temperature is below 37 F (2.8 C). Press the manual defrost switch. If the unit will not shift to defrost, or if the defrost cycle will not terminate, see the following defrost checkout procedures.

*CAUTION: **Do not forget to remove the jumper wires from the unit after checking or testing unit components.***

Unit Does Not Defrost

1. Check the Evaporator Temperature:

   Be sure the evaporator temperature is actually below 37 F (2.8 C) if the unit will not defrost. Use a test thermometer to check the evaporator temperature.

2. Check the operation of the defrost termination switch:

   If the unit fails to defrost, place a jumper wire from the No. 12 wire to ground at the manual defrost switch. Press the manual defrost switch. If the unit shifts to Defrost, check the No. 12 wire to the defrost termination switch for an open and check for a defective defrost termination switch.

   If the unit still fails to defrost, move to step 3.

3. Check the manual defrost switch:

   If the unit failed to defrost, place a jumper wire from the No. 11 wire to ground at the manual defrost switch. If the unit shifts to defrost immediately, replace the manual defrost switch. If the unit does not shift to defrost, move to step 4.

4. Check the defrost timer:

   If the unit still fails to defrost, place a jumper from the No. 11A to ground at the defrost relay. If the unit shifts to defrost immediately, replace the defrost timer. If the unit does not shift to defrost, move to step 5.

5. Check the defrost relay:

   If the unit fails to defrost, check the No. 8 wire at the defrost relay for 12V dc. If the No. 8 wire has 12 volts, the defrost relay is defective and should be replaced. A lack of voltage indicates an open in the No. 8 circuit.

6. If the defrost relay works, the defrost indicator light comes on and the damper closes, but the unit continues to cool; check for a stuck 3-way valve, faulty pilot solenoid or open in the No. 26 wire.

   To test the coil on the pilot solenoid valve, turn the unit switch On. Place a jumper wire with an ammeter in the circuit from the No. 26 to the No. 8 wire at the defrost relay. The pilot solenoid should energize and the heat indicator light should come on. If the unit does not shift to Heating, the pilot solenoid is not being energized. Check the No. 26 wire for opens or replace the solenoid coil. If the solenoid is energized and the current draw is greater than 1 ampere, there is a short in the No. 26 wire or the coil of the valve.

   To check the 3-way valve, run the unit in heat by dialing up the thermostat. If the unit goes into heat, there will be a rise in suction pressure and a drop in the discharge pressure. If the unit does not go into heat, refer to the procedure described in TK5984, Diagnosing the Thermo King Refrigeration System.

Unit Will Not Terminate Defrost

NOTE: On units equipped with a defrost timer, the defrost timer should automatically terminate the defrost cycle 45 minutes after it is initiated.

Unit Sticks on Defrost Indefinitely

If the unit remains stuck on Defrost indefinitely, check the defrost relay, the No. 11A wire and the defrost timer.

1. Check the defrost relay:

   If the unit remains on defrost indefinitely, disconnect the No. 11A wire from the defrost relay. The relay should open (de-energize) immediately. If the relay opens (de-energizes), move to step 2. If the relay fails to open, replace the defrost relay.

2. Check the No. 11A wire for a ground:

   If the defrost relay opened (de-energized) when the No. 11A wire was disconnected, use an ohmmeter to check the wires for a ground. Repair the grounded wire. If no ground is found, move to step 3.

3. Check the defrost timer:

   If the unit is equipped with a defrost timer and is still stuck on Defrost, replace the defrost timer. The defrost timer should terminate the defrost cycle after 45 minutes regardless of the evaporator temperature or amount of frost or ice on the evaporator coil.

Unit Continuously Fails to Terminate Defrost (in Less than 45 Minutes

If the unit continually fails to complete the defrost cycle in less than 45 minutes and cycles between cooling and defrost, check the evaporator coil temperature, 3-way valve condenser seal, refrigerant charge, throttle solenoid circuit, damper solenoid circuit, defrost termination switch and the No. 11 and No. 12 wires.

1. Check the Evaporator Temperature:
   Be sure the evaporator temperature is actually above 49 F (9.4 C) if the unit will not terminate defrost. Use a test thermometer to check the temperature. If the evaporator temperature does not rise enough to bring the unit out of defrost, the condenser seal in the three-way valve or the condenser heck valve may be leaking, or the unit may be low on refrigerant.

   To check the condenser seal in the 3-way valve or the condenser check valve, refer to the procedures described in TK5984, Diagnosing the Thermo King Refrigeration System.

   To check the refrigerant charge, refer to Refrigerant Charge in the Refrigeration Maintenance Section.

   Failure of the throttle solenoid circuit or damper solenoids may also delay or prevent the evaporator coil temperature from rising.

   If the unit shifts to defrost but the engine does not shift to high speed, check the circuits from the defrost relay to the throttle solenoid.

   To test the damper solenoids, turn the unit switch on. Place a jumper wire with an ammeter in the circuit between No. 29 and No. 8 terminals at the defrost relay. The damper solenoids should be energized, and the defrost damper should close. If the defrost damper does not close, the damper solenoids are not being energized. Check the No. 29 wire for opens or replace the defective solenoid.

2. Check the operation of the defrost termination switch.

   If the unit will not come out of defrost, disconnect the No. 12 wire from the defrost termination switch. If the unit shifts back to Cool, the defrost termination switch is not opening and should be replaced. If the unit remains in defrost, move to step 3.

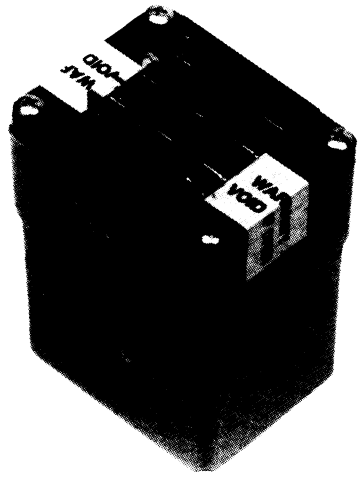
3. Check the No. 11 and No. 12 wires for a ground:

   If the unit remains in defrost, use an ohmmeter to check the No. 11 and No. 12 wires for a ground. If the No. 11 or No. 12 wire is grounded, find the grounded portion and repair it.

Defrost Timer

The defrost timer both initiates and terminates the defrost cycle.

First, the timer will initiate a defrost cycle at 4, 8, or 12 hour intervals. The position at which the common timer lead is connected on the terminal strip determines the time interval.



Defrost Timer Module

The timing cycle begins when the defrost termination switch closes. If the defrost termination switch opens during the timing cycle, the timer will reset at zero when the defrost termination switch closes.

Second, the defrost timer terminates the defrost cycle after 45 minutes if the defrost termination switch has not opened.

Temporary Defrost Timer Bypass Procedure

If the timer fails and a replacement is not available, bypassing the timer will allow the air switch to provide defrost control.

Bypass Procedure:

1. Remove the defrost timer module.
2. On the timer scoket, jumper terminals 1, 2 and 3 together.
3. To install a new timer, remove the jumper and plug the timer into the socket.

Defrost Timer Test:

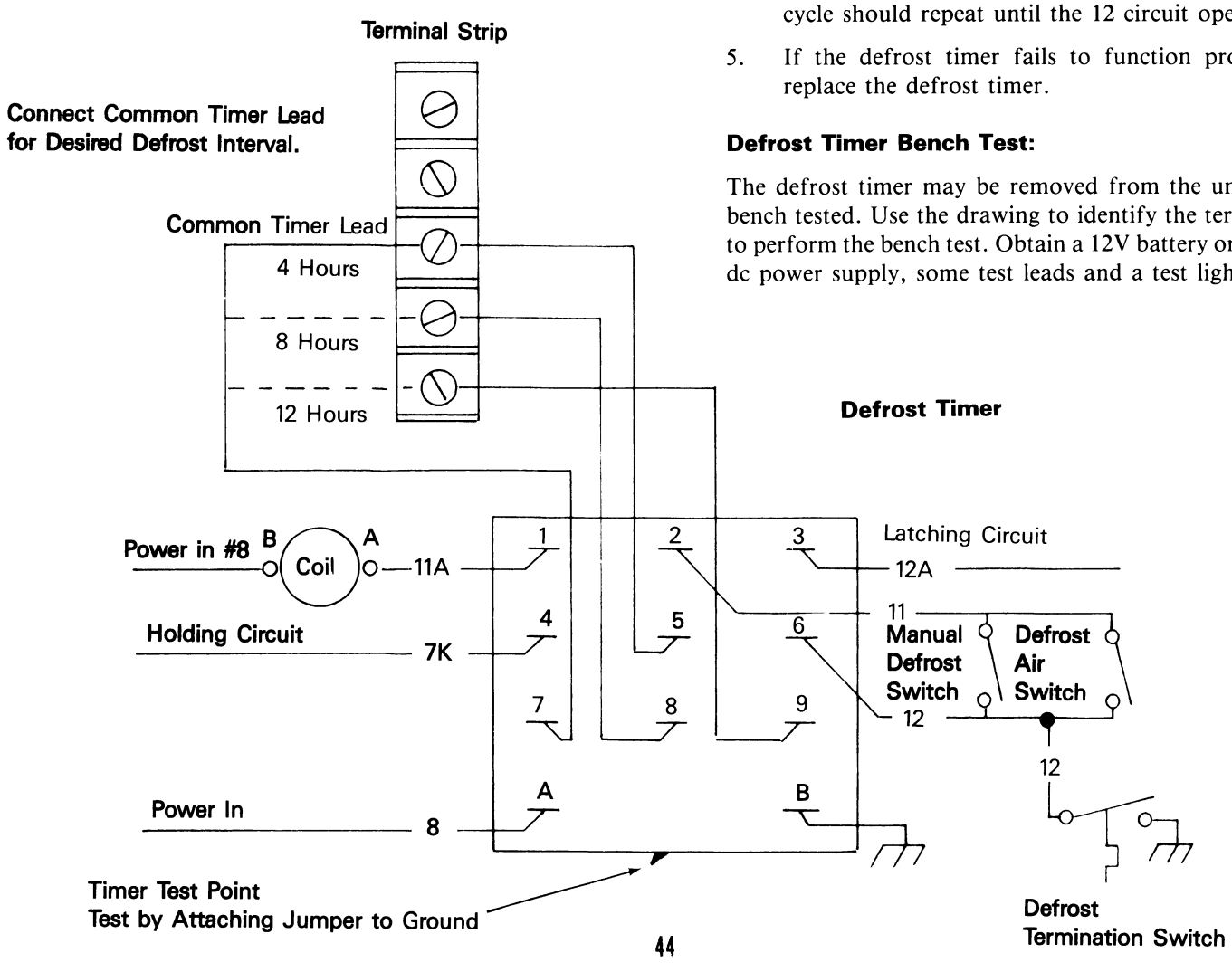
1. With the defrost termination switch open, depress the manual defrost switch. The unit should not go into defrost.
2. Connect the defrost termination thermostat (12 circuit) to CH. Depress the manual defrost switch. The unit should go into defrost. Disconect the CH circuit from the 12 circuit. The defrost relay should open.
3. Connect a jumper from the timer test point to ground. Reconnect the CH circuit to the 12 circuit, then depress the manual defrost switch. The unit should go into defrost for about 10 seconds, then terminate even thought the 12 circuit is still connected to CH.

Cycle interval	Test duration
4 hours	.9 min.
8 hours	1.9 min.
12 hours	2.8 min.

4. Approximately 1 to 3 minutes after the timer terminated defrost, the defrost cycle should reinitiate for another brief period of time. This "On-Off" cycle should repeat until the 12 circuit opens.
5. If the defrost timer fails to function properly, replace the defrost timer.

Defrost Timer Bench Test:

The defrost timer may be removed from the unit and bench tested. Use the drawing to identify the terminals to perform the bench test. Obtain a 12V battery or a 12V dc power supply, some test leads and a test light.



1. Attach a test lead to the test terminal and to the negative terminal of the power source.
2. Attach a test lead to the B terminal and to the negative terminal of the power source.
3. Attach a test lead to the #6 terminal and to the negative terminal of the power source.
4. Connect a test light between the A terminal and the #1 terminal.
5. Attach a test lead to the #7 terminal and to the #5, #8 or #9 terminal. The terminal selected will determine the "off" time of the test.
   a. #5 - 4-hour selectionApproximately 1 minute
   b. #8 - 8-hour selectionApproximately 2 minutes
   c. #9 - 12-hour selectionApproximately 3 minutes
6. Attach a test lead ot the A terminal and to the positive terminal of the power source.
7. Attach a test lead to the #4 terminal and to the positive terminal of the power source.
8. The test light should come on for approximately 10 seconds, this is the speedup mode of the 45 minute maximum defrost interval.
9. The test light should then turn off for approximately 1 to 3 minutes depending on which terminal #7 is connected to. This is the speedup mode of the interval between defrost cycles.
10. A good timer will alternate between the 10 second "on" time and the 1 to 3 minute "off" time until the #6 terminal is disconnected from the negative terminal of the power source. Replace the timer if it fails to function properly.

Manual Defrost Switch

The manual defrost switch is located on the unit switch panel. Pressing the manual defrost switch initiates the defrost cycle if the defrost termination switch is closed.

Defrost Termination Switch

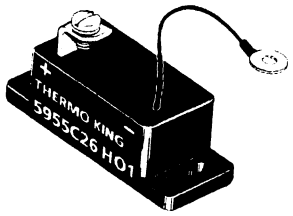
The electronic defrost termination switch uses solid state components to control the defrost circuit. The switch is mounted in the evaporator and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 37 F (2.8 C), completing the defrost circuit to ground and preparing the electrical system for the defrost cycle.

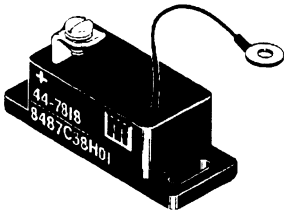
When the unit does shift into a defrost cycle, the defrost damper blade closes, and heat from the hot refrigerant gas melts the frost from the evaporator coil. The switch opens and terminates the defrost cycle when the evaporator coil temperature rises to 49 F (9.4 C).

Installation

The proper polarity must be observed when installing the switch. The wire from the switch is negative and must be attached to the chassis ground of the unit. This chassis ground wire must be grounded on a screw separate from the switch mounting screws or an improper ground may result. The No. 12 wire from the unit attaches to the terminal mounted solid on the switch. If the polarity is reversed on the device, it will conduct continuously and act similar to a switch stuck closed.

Before 1-30-89
Part No. 44-6692





After 1-30-89
Part No. 44-7818

Defrost Termination Switches

Defrost Termination Switch Bench Test

1. Connect a test light between the screw terminal on the switch and the positive battery terminal.

   NOTE: Attempting to test the electronic defrost termination switch with an ohmmeter is generally not satisfactory because of the low voltage available at the meter leads.
2. Connect the negative lead of the switch to the negative battery terminal.
3. Raise the temperature of the defrost termination switch above 49 F (9.4 C). The light should be off indicating an open switch.

4. Cool the defrost termination switch below 37 F (2.8 C). The light should come on indicating the switch has closed.

   NOTE: Allow adequate time for the temperature change to saturate the switch before performing the test.

Defrost Relay

The defrost relay controls the operation of the unit on the defrost cycle. When the defrost air switch, defrost timer or manual defrost switch complete the circuit through the defrost termination switch to ground, the defrost relay pulls in to energize the damper solenoids, pilot solenoid and the tan defrost light. The No. 29 circuit to the damper solenoids is also connected to the throttle solenoid circuit and the fuelsaver module causing the unit to shift into high speed whenever the unit goes into defrost. A holding circuit in the defrost relay keeps the unit on Defrost until the defrost termination switch opens.

Pilot Solenoid

The pilot solenoid is an electrical valve that controls the operation of the three-way valve in the refrigeration system. When the pilot solenoid coil is energized, it lifts the pilot solenoid valve piston and allows refrigerant pressure to shift the three-way valve, placing the unit on heat or defrost.

Defrost Air Switch

The defrost air switch automatically places the unit on defrost when ice accumulation on evaporator coil builds up to a point where the air flow across the coil is restricted.

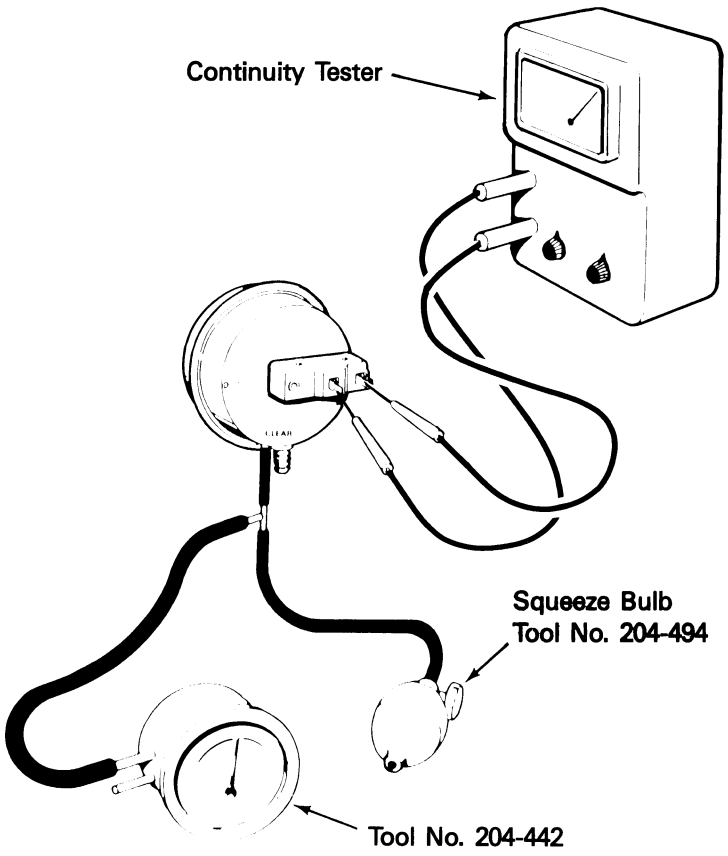
Restricted air flow results in a pressure difference between the evaporator coil inlet and outlet. The air switch senses the pressure differential across the coil and initiates the defrost cycle.

The defrost air switch is preset at the factory. Normally readjustment is not necessary unless the switch has been tampered with or does not function properly due to factors affecting air circulation, such as bulkhead construction and duct work.

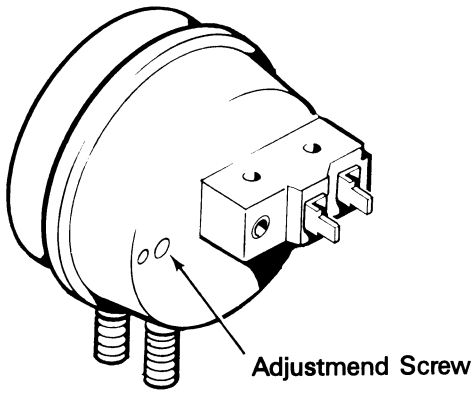
Defrost Air Switch Testing and Adjustment

Before testing or adjusting the air switch, check the clear plastic tubing and black plastic tubing to the evaporator coil. Be sure they are not obstructed or crushed. Check the probes in the evaporator housing to be sure they are in proper position and make sure they are not obstructed.

1. Remove plastic sensing tubing from both sides of the defrost air switch.
2. Disconnect one wire at the switch terminal. Connect a test light or continuity tester to the two terminals used on the switch.
3. Connect the test equipment (TK204-442 and TK204-494) to the hose fitting on the side of the air switch stamped BLACK.



Testing Air Switch



Air Switch

4. Pressurize the hose until the continuity tester indicates a completed circuit. Now read the dial of the test gauge. This is the setpoint of the air switch (correct reading is 1.0 ±.05 in. [25.4 ±1.3 mm] before 1-30-89 and 1.4 ±.08 in. [35.6 ±2.03 mm] after 1-3-89 H_2O). Release the pressure.
5. If the switch is out of calibration, pressurize the hose again until the tester indicates 1.0 in. (25.4 mm) or 1.4 in. (35.6 mm) H_2O. Turn the adjustment screw clockwise or counterclockwise until the switch closes and the continuity tester indicates a completed circuit with the gauge reading 1.0 in. (25.4 mm) or 1.4 in. (35.6 mm) H_2O. Release the pressure.
6. Repeat test procedure several times to be sure the setting is correct.
7. Remove the test equipment. Connect the wire and air sensing tubes to the switch. The BLACK hose from the high pressure or air inlet side of the evaporator coil goes on the hose fitting on the side of the evaporator coil goes on the hose fitting on the side of the air switch stamped BLACK. The CLEAR hose from the low pressure or air outlet side of the evaporator coil goes on the hose fitting on the side of the air switch stamped CLEAR.

NOTE: Route the hoses for continuous slope to avoid condensate traps.

If too much frost continues to accumulate before defrosting, decrease the pressure setting. Turn the adjustment screw counterclockwise.

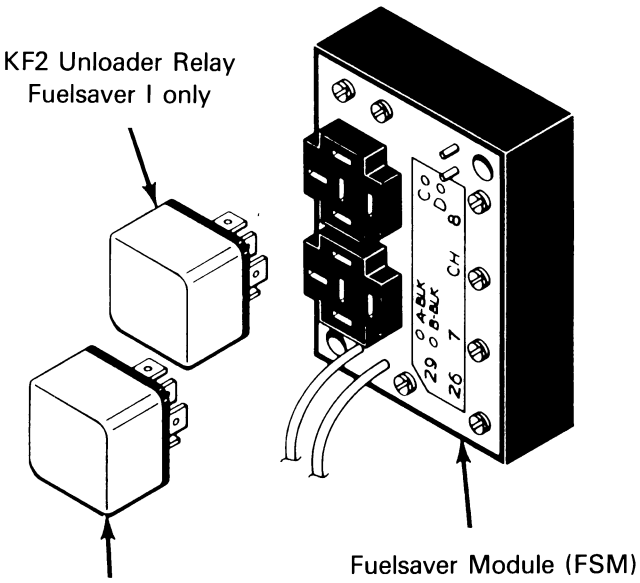
If defrost action occurs with too little frost accumulation, increase the pressure setting. Turn the adjustment screw clockwise.

FUELSAVER

The Fuelsaver system features plug-in relays on a solid state module. The high speed relay and the unloader relay are replaceable components. The time delay is a built-in feature of the module.

When the unit goes into defrost operation, power is applied to the 29 wire. This reduces the 8 minute time-out time to 2 seconds, allowing the unit to run on high speed during defrost.

The Super II MAX uses the new fuelsaver module (FSM). The module has a space for two plug-in relays, KF1 and KF2. Fuelsaver II is a standard on these units and uses one relay (KF1). Fuelsaver I is an option and uses an unloader and two relays (KF1 and KF2).



Fuelsaver Module

Fuelsaver II (High Speed Time Delay Only)

The fuelsaver module (FSM) uses one relay, KF1, to control high speed. The high speed solenoid circuit is completed through the normally closed contacts. When the unit cycles to low-speed heat the FSM module energizes KF1 to latch open the high-speed solenoid circuit. When the thermostat again calls for high speed the KF1 relay remains energized and an 8 minute timer starts. This keeps the unit in low speed for an additional 8 minutes to save fuel.

When the unit goes into defrost operation, power is applied to the 29 wire. This reduces the 8 minute time-out time to 2 seconds, allowing the unit to run on high speed during defrost.

Fuelsaver I (High Speed Time Delay and Unloaders)

The fuelsaver module (FSM) uses two relays to control high speed and the unloader solenoid. Relay KF1 functions as it does in Fuelsaver II.

When de-energized, relay KF2 opens the unloader solenoid circuit. When the unit cycles to low-speed heat the FSM module energizes KF2 to complete the circuit to the unloader solenoid to unload the compressor. The unloader will remain energized until the thermostat selects high speed.

Cycle Sentry Operation

The unit will re-start in low speed when operating in the start/stop mode.

On-Unit Checkout

1. Operate the unit in standard continuous run and cycle the box temperature thermostat to low-speed heat for 3 seconds or more.
   a. Units equipped with unloaders will unload the compressor and the fuelsaver light should come on.
b. Units without unloaders will have no visible change.
2. Cycle the box temperature thermostat so it calls for high speed (cool or heat).
   a. The unit should remain in low speed for approximately 8 minutes.
   b. Unloaded compressors should begin to operate under fulload.
3. Place the unit into defrost or supply positive 12VDC to wire #29 or terminal #29 at the fuelsaver module. The unit should cycle to high speed.

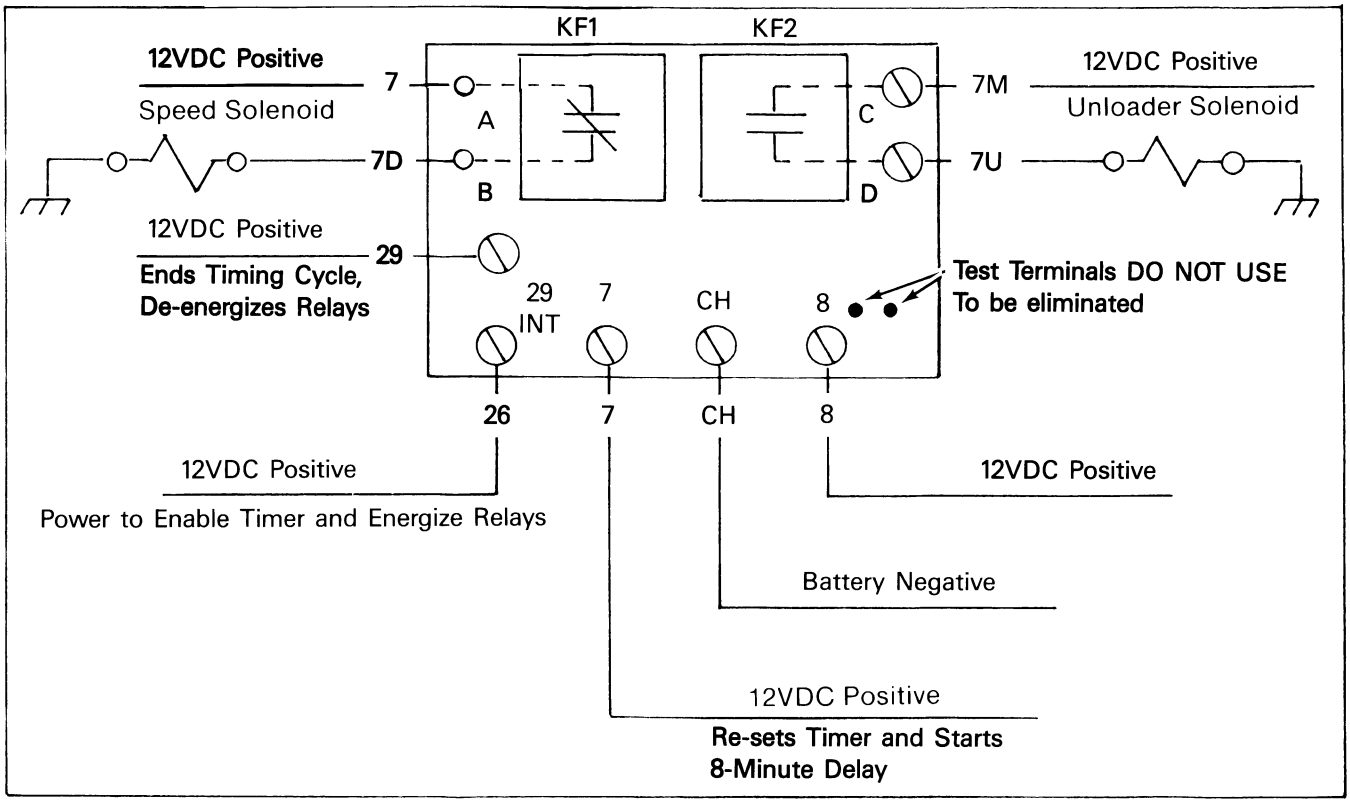
Bench Test for the FSM Module

The fuelsaver module (FSM) may be removed from the unit and bench tested. Use the drawing to identify the terminal functions to perform the test. Obtain a 12V battery or 12V dc power supply, some tet leads and two test lights. Install two good relays in the FSM.

1. Connect a test light labeled "A" between terminals B and CH.
2. Connect a second test light labeled "B" between terminals D and CH.
3. Attach a test lead to the CH terminal and to the negative terminal of the power source.
4. Attach test leads from the A, C and #8 terminals to the positive terminal of the power source.

   Both relays should remain de-energized, test light "A" should be on, and test light "B" should be off.
5. Connect the #26 terminal to the positive terminal of the power source for approximately three seconds.

   Both relays should energize, test light "A" should go off, and test light "B" should come on.



Fuelsaver Module

6. Connect the #29 terminal to the positive terminal of the power source for approximately three seconds.

   Both relays should de-energize, test light "A" should come on, and test light "B" should go off.

7. Test the 8 minute timer. Connect the #26 terminal to the positive terminal of the power source for approximately three seconds.

   Both relays should energize, test light "A" should go off, and test light "B" should come on.

8. Attach a test lead to the #7 terminal and to the positive terminal of the power source.

   Both relays should remain energized, test light "A" should be off, and test light "B" should be on.

After approximately 8 minutes both relays should de-energize, test light "A" should come on and test light "B" should go off.

Replace the FSM if it fails any of the above tests.

Engine Maintenance

ENGINE LUBRICATION SYSTEM

The di 2.2 diesel engine has a pressure lubrication system. Oil is circulated by a gear-type oil pump driven off a gear on the camshaft. The pump has several times the capacity required by the engine; excess oil is returned to the crankcase. The oil pump extends down into the oil pan, but is positioned far enough away from the bottom of the oil pan that any residue that settles to the bottom is not picked up by the screened inlet.

From the oil pump, the oil passes through the oil supply pipe to the oil filter assembly. The oil filter assembly contains the oil pressure relief valve, the bypass valve and the oil filter the oil is forced through the oil filter into the main oil gallery. The main oil gallery supplies oil to the main bearings, camshaft and camshaft idler gear support.

Oil passes from the main bearings, through drilled passages in the crankshaft, to the connecting rod bearings. The tappets and cylinder walls are lubricated by oil thrown from connecting rod bearings as the crankshaft rotates.

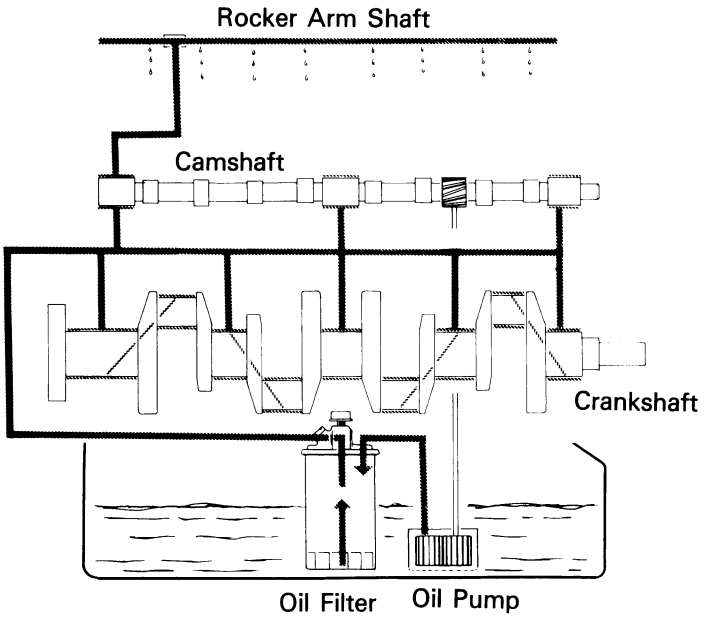
From the rear camshaft bearing passageway, oil passes through an oil gallery inside the engine to the rocker arm shaft where the surplus drains back into the crankcase. Oil at the camshaft idler gear support lubricates the idler bushing and passes through the transfer pump cam oil feed line to lubricate the transfer pump cam and the injection pump idler gear.

Oil pressure is automatically regulated to 40-65 psi (275-448 kPa) by a spring-loaded relief valve. Oil pressure may exceed this setting when the oil is cold.

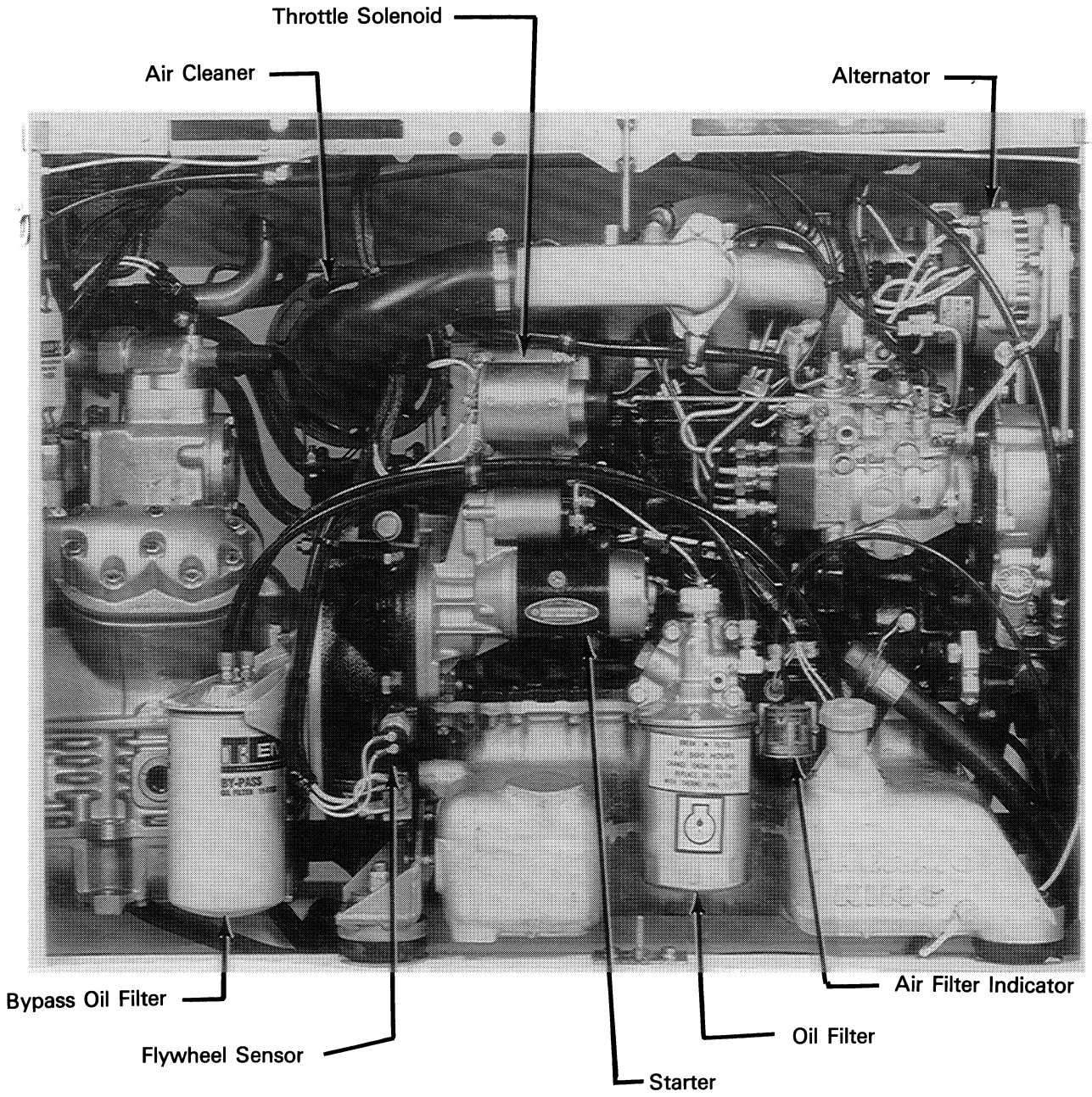
Oil pressure is affected by oil temperature, viscosity and engine speed. Subnormal oil pressures usually may be traced to lack of oil, faulty relief valve, loose oil connections or worn bearings.

Low Oil Pressure Switch

If the oil pressure drops below 15 to 20 psi (103 to 108 kPa) for approximately 40 seconds, the low oil pressure switch causes the reset switch to open and stop the engine.



Lubrication System



Super II MAX Engine Compartment

Engine Oil Change

The engine oil should be changed according to the Maintenance Inspection Schedule chart. 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 in the last few quarts of oil to drain out. Refill the pan with 16 to 17 quarts and check the dipstick level. Run the unit, and then recheck the oil level. Add oil as necessary to reach the full mark. See specifications page for correct type of oil.

Oil Filter Change

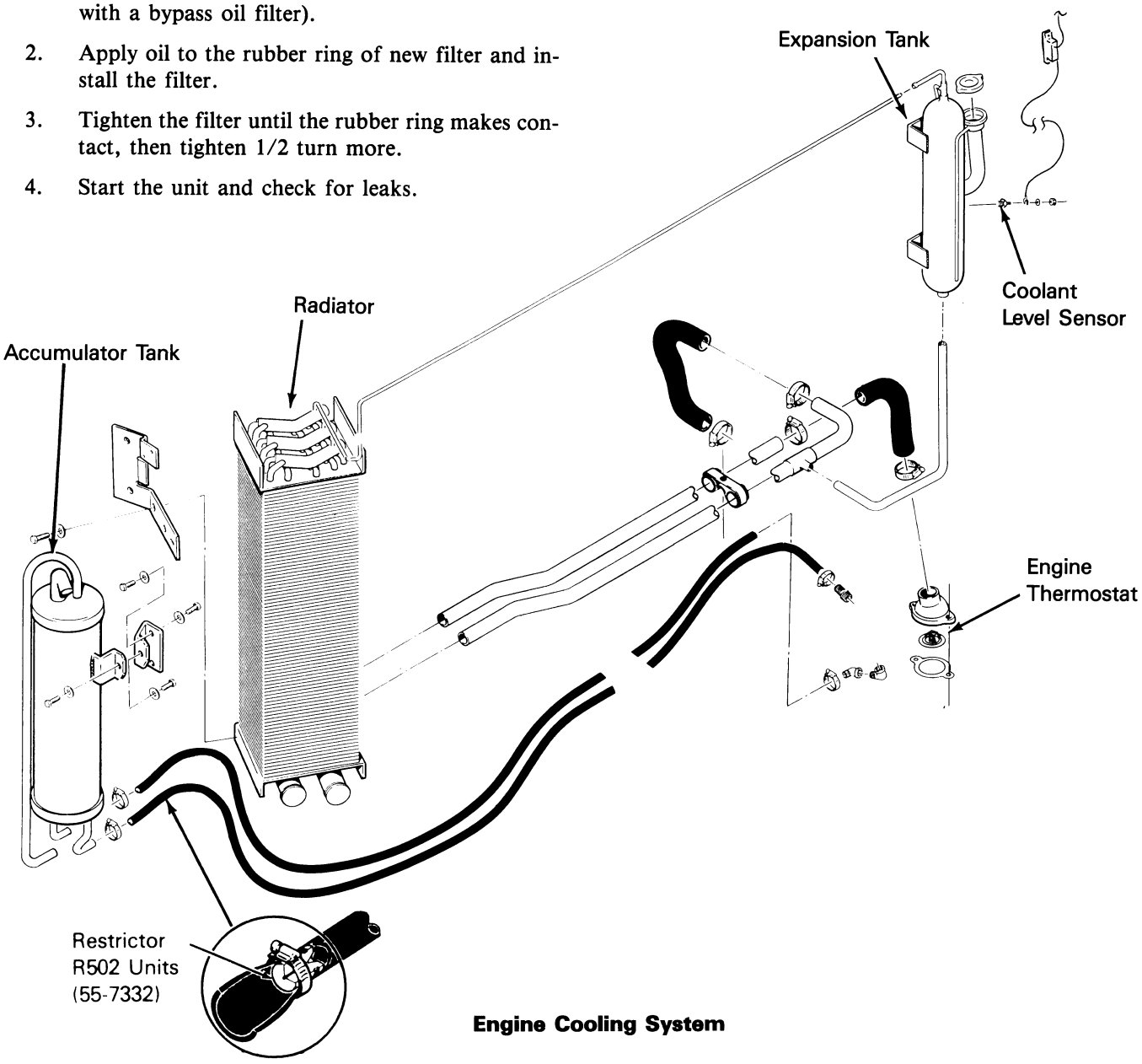
Oil filters should be changed along with the engine oil.

1. Remove the filters (some units are also equipped with a bypass oil filter).
2. Apply oil to the rubber ring of 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.

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, then back 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% permanent type antifreeze concentrate and 50% water mixture in the engine cooling system.



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.

CHECK LIGHT (Low Coolant Level & Water Separator Water Level)

One light is used to indicate two separate areas that may need servicing.

STEADY ON alerts the driver that the unit is low on engine coolant.

FLASHING alerts the driver that water should be removed from the water separator.

COOLANT LEVEL (check light steady on).

The "CHECK COOLANT" indicator light is activated when the engine coolant level in the expansion tank drops below the sensor level.

The low coolant level indicator consists of a level detector module and a fluid probe. When engine coolant level in the expansion tank is above the probe level, the output of the module is off.

When the engine coolant level drops below the probe, the ground circuit is interrupted causing the output signal from the level detector to turn the indicator light on after a delay of approximately 3 seconds.

FUEL LIGHT (Flashing)

The sensor for the fuel check light is lcoated in the fuel water separator. When water collected in the separator reaches the level of the sensor, the level detector turns on the check light (flashing). Refer to "Water Separator/Fuel Filter" for service instructions.

Failure modes

1. If supply power to level detector module is interrupted, the Red check light will not light.
2. If the coolant sensor fails, or if the probe sensor lead becomes open or disconnected, the Red low coolant check light will come on.
3. If the fuel water-sensor lead shorts out, the check light will flash.

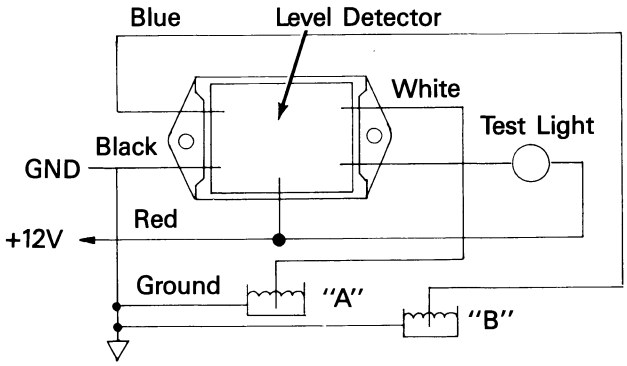
Testing Level Detector

Equipment required:

- 12 Volt Battery
- Jumper Wires
- Voltmeter or Test Light not over 250 milliamps
- Two small containers of water or coolant

The fluid level detector can be checked by using the following procedure:

1. Attach a voltmeter or test light (not over 250 milliamps) between the orange and red detector leads.



2. Disconnect both sensor leads.
3. Connect the positive 12 volt battery terminal to the red detector lead.
4. Connect the negative 12 volt battery terminal to the black detector lead. The voltmeter or test light should indicate current flow. It is sensing a low coolant situation.
5. Connect jumper wires from the black detector lead to each coolant container.
6. Connect a sensor to the white detector lead and place the sensor into one of the coolant containers. The voltmeter or test light should now indicate zero current flow.
7. Connect a sensor to the blue detector lead and place the sensor into the other coolant container. The voltmeter or test light should now indicate a flashing output.

Antifreeze Maintenance Procedure

As with all equipment containing antifreeze, periodic inspection on a regular basis is required to verify the condition of the antifreeze. After one year of service, inhibitors become worn out and must be replaced by changing the antifreeze.

Every year, drain, flush and replace the total antifreeze mixture to maintain total cooling system protection. When the antifreeze is replaced, use ethylene glycol type engine coolant concentrate meeting the GM 6038-M specification. The factory recommends the use of a 50/50 antifreeze mixture in all units even if they are not exposed to freezing temperatures. Even in summer, the accumulator tank can get cold enough to freeze the water in the heat transfer coil. This antifreeze mixture will provide the required corrosion protection and lubrication for the water pump.

Checking the antifreeze

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

Changing the antifreeze

1. Run the engine until it's up to operating temperature. Stop the unit.
2. Open the engine block drain 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 radiator and allow it to drain out of the block until it is clear.

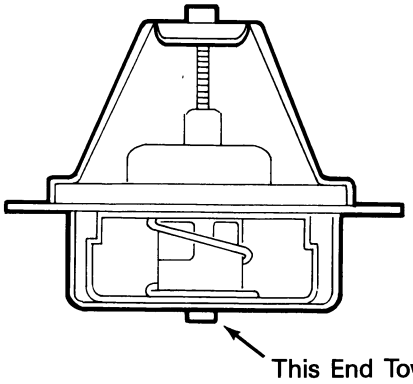
   b. Close the block drain and install a commercially available radiator and block flushing agent, and operate the unit in accordance with instructions of the flushing agent manufacturer.

   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. Mix one gallon of permanent type antifreeze concentrate meeting GM 6038-M specification and one gallon clean water in a container to make a 50/50 mixture. (Do not add antifreeze and then add water to the unit. This procedure may not give a true 50/50 mixture because the exact cooling system capacity may not always be known.)
8. Refill the radiator with the 50/50 antifreeze mixture. Run the unit up to operating temperature, and purge air from cooling system as needed.

Engine Thermostat

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



ENGINE FUEL SYSTEM

The fuel system used on the Thermo King di 2.2 diesel is a high pressure distributor (VE type) injection pump. The governor, timing device, fuel supply and other components are located within the pump itself.

The components of the fuel system are:

1. Fuel tank.
2. Fuel strainer.
3. Fuel filter.
4. Hand fuel pump.
5. Transfer pump.
6. Injection pump.
7. Injection nozzles.

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

Operation

Fuel is drawn from the fuel tank by the transfer pump. The transfer pump delivers fuel to the primary filter and then to the the secondary filter. The outlet fitting at the secondary filter contains a fitting with an orifice. The orifice controls the pressure in the fuel system by allowing a certain amount of fuel to return to the tank. Filtered fuel then passes through a line from the fitting between the secondary filter and the orifice, to the injection pump. Fuel enters the injection pump and then a fuel supply pump. Pressure in the injection pump is set by a relief valve located in the output of the fuel supply pump and a small drilled orifice in the outlet banjo bolt on the top of the pump. Excess fuel is recycled back through the fuel supply pump. As engine speed increases so does the internal injection pump fuel pressure. The increased pressure moves a piston which in turn advances the timing of the engine. The banjo fitting also acts as a transfer point for overflow fuel coming from the nozzles and a point to bleed air from the system.

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.

CAUTION: Do not switch banjo bolts from one injection pump to another. When calibrating an injection pump, use the hollow bolt that belongs to that pump. Using a different bolt after calibration can affect engine timing.

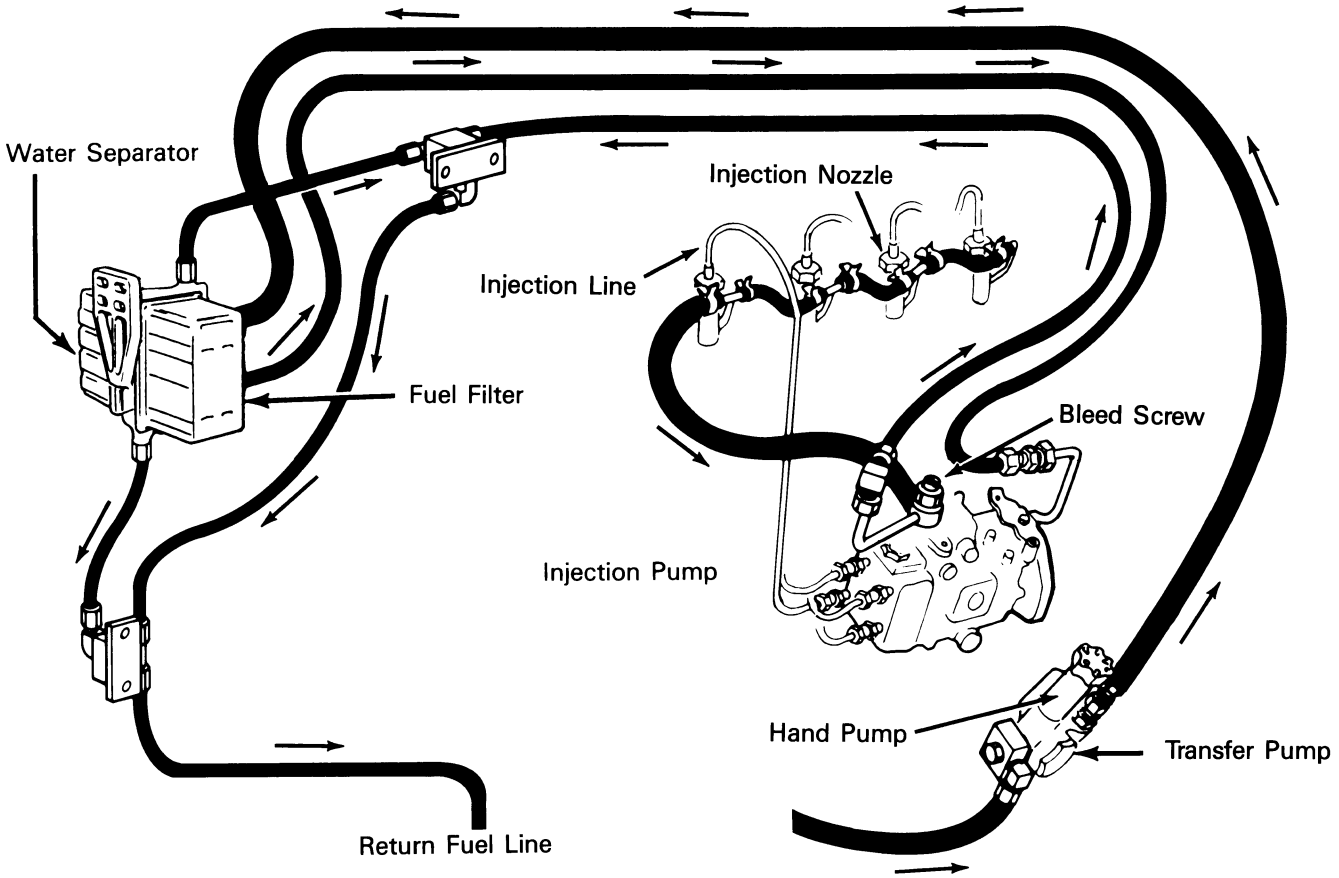
Maintenance

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

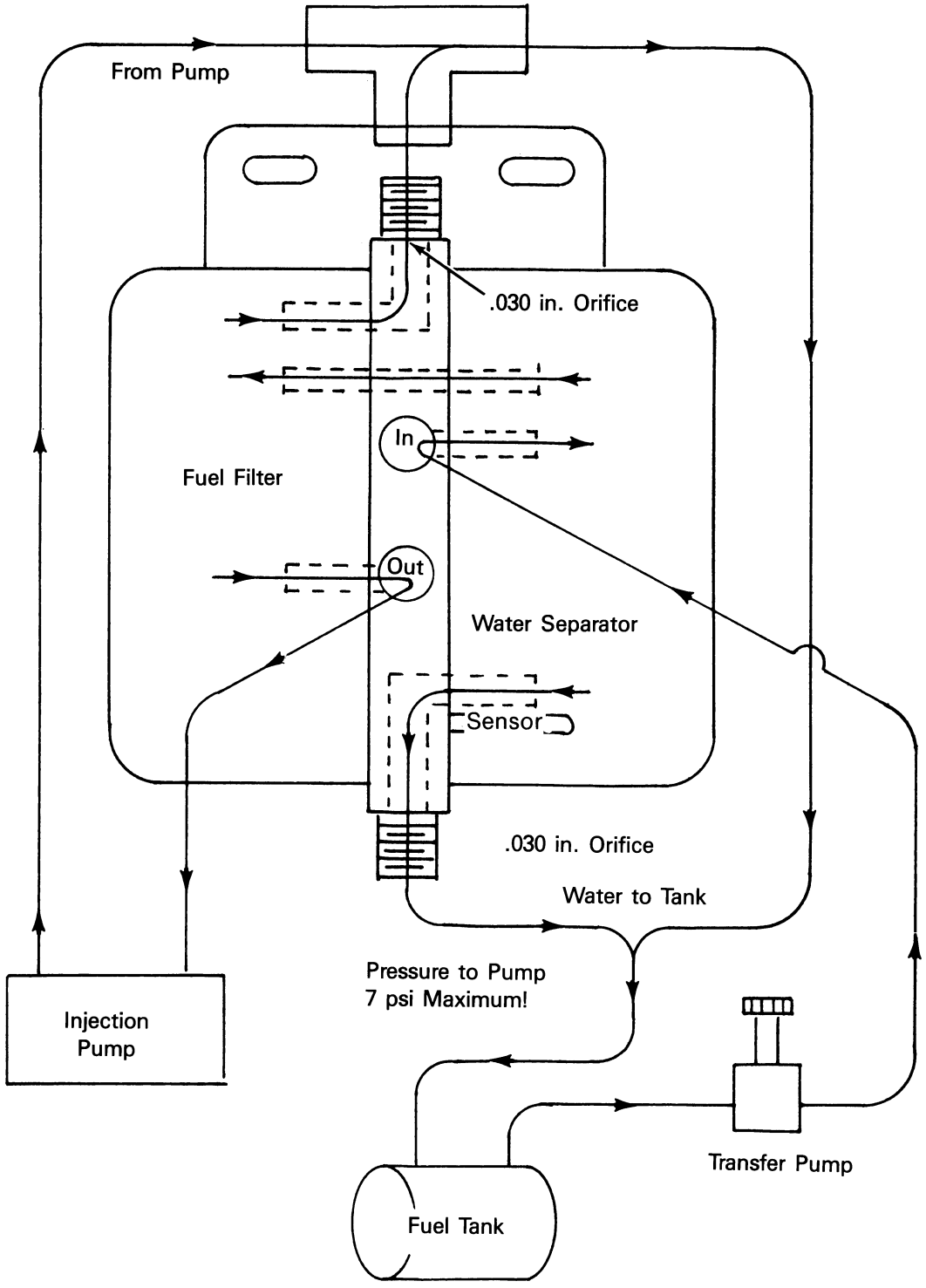
Contamination is the most common cause of fuel system problems. Therefore, to ensure best operating results, the fuel must be clean and fuel tanks free from contaminants. Change the fuel filters regularly and clean the fuel strainer on the inlet side of the transfer pump.

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.



Engine Fuel System



Water Separator/Fuel Filter Schematic

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. Prime pump (hand) replacement or repair.*
4. Transfer pump replacement or repair.*
5. Injection line replacement.*
6. Pump and governor adjustments.
7. Pump timing.
8. Nozzle spray pattern testing and adjustment.*
9. Minor rebuilding of nozzles.*

*These procedures are covered in the di 2.2 Overhaul Manual TK8009.

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 fuel system will have to have the air bled out.

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

To bleed air from the fuel system:

1. Loosen the bleed screw on top of the injection pump about one turn.
2. Unscrew the hand 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 hand pump handle back in.
4. Start the engine and observe the engine run for a few minutes. If the engine fails to start, or starts but stops in a few minutes, repeat the procedure.

NOTE: If the engine stops due to lack of fuel, the oil pressure will fall to zero and the reset switch will trip. It must be reset before cranking or restarting the engine.

Water in the System

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.

Water Separator/Fuel Filter

The water separator removes water from the fuel and stores it. When the stored water reaches the level of the sensor, the FUEL INDICATOR LIGHT will flash. If the water is not removed, it will reach a bleed port and return to the fuel tank through the fuel return hose.

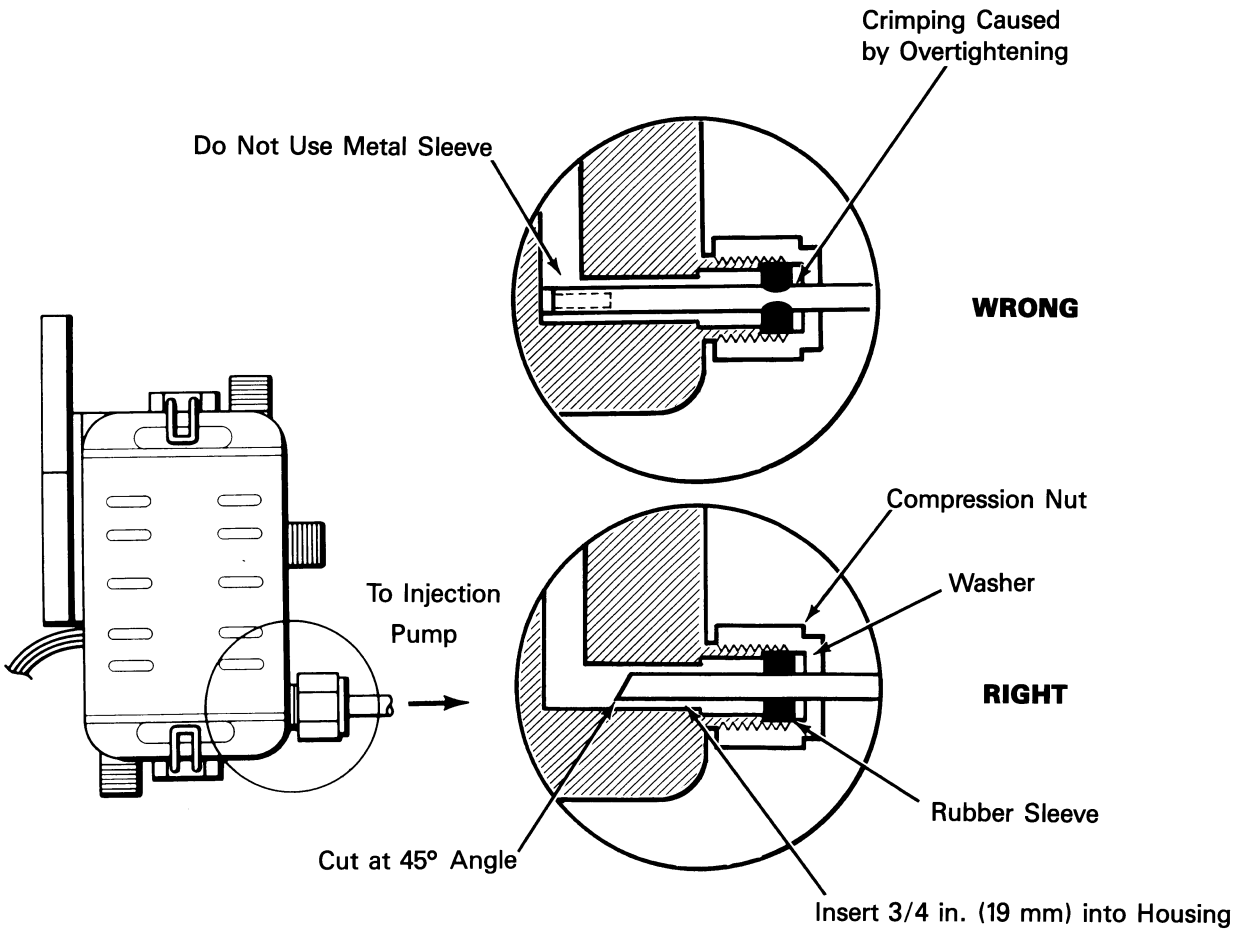
To remove water from the water separator, spread the retaining clips, and remove the separator from the base. Shake the water out of the separator. Water separators should be replaced every 3000 hours.

Replace the fuel filter every 1500 hours.

If the engine in a Super II does not come up to full speed or loses speed under full load conditions, it may be caused by fuel starvation. The fuel filter to injection pump line may be inserted too far into the fuel filter housing, or the line may be crimped from overtightening of the compression nut, resulting in reduced fuel flow.

To prevent reduced fuel flow to the engine:

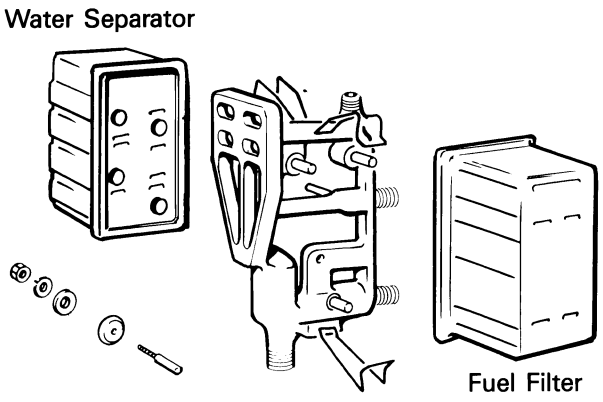
1. Trim the 1/4 in. fuel line at a 45° angle.
2. Do not insert the line more than 3/4 in. (19 mm) into the filter housing.
3. Do not use an internal metal sleeve as it may drift forward, contact the filter housing wall and block fuel flow.
4. Do not overtighten the compression nut—one or two turns after contacting the rubber sleeve is sufficient. Do not tighten the compression nut until it bottoms, or severe crimping of the line will result.



Fuel Filter Assembly

Water Separator/Fuel Filter Replacement

1. Spread the retaining clips.
2. Pull the filter away from the base.
3. Place the new filter onto the base, and secure with the retaining clips.



Fuel Filter-Water Separator

Injection Pump Adjustments

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

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

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

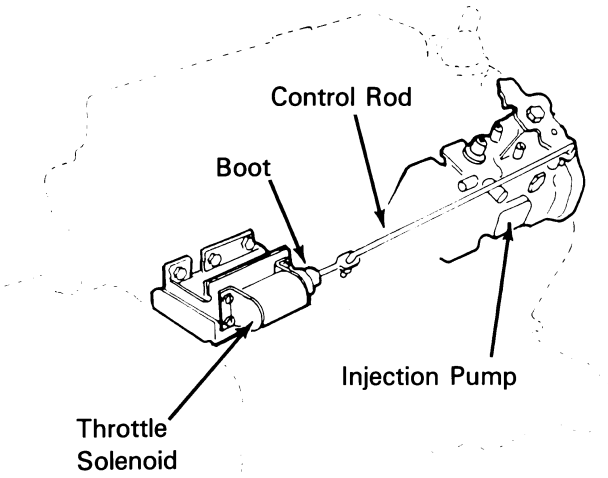
High Speed

1. Start the unit and check the high speed rpm.
2. Shut the unit off.
3. Remove the control rod from the high speed solenoid.
4. Remove the boot from the high speed solenoid.

5. Pull plunger out of solenoid enough to loosen 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 control rod, 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 small increments.



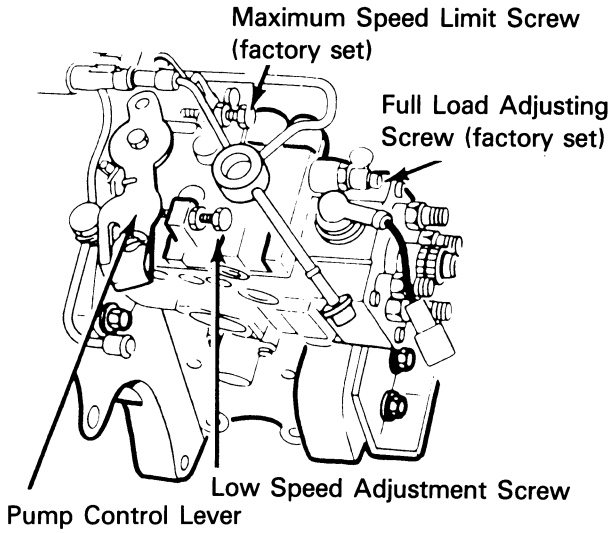
High Speed Adjustment

Low Speed

1. Loosen the jam nut on the low speed adjustment screw.
2. Run the unit with the speed solenoid de-energized. Adjust the screw to the speed desired.
3. Shut the unit off and retighten jam nut.

Maximum Speed

The maximum speed limit screw is adjusted and sealed at the factory. It should not need adjustment. If it has been tampered with, it should be adjusted to give .020 in. (0.5 mm) clearance to the pump control lever when the unit is in High Speed.



Full Load Adjusting Screw

The full load screw is reset and sealed at the factory and should not need adjustment. If the adjustment has been tampered with, the injection pump should be recalibrated by a diesel injection service.

In an emergency, a rough setting for the screw is approximately .61 in. (1.55 mm) from the tip of the screw to the face of the nut.

CAUTION: The adjustment of the full load screw can damage the engine and may void the warranty.

Injection Pump Service

NOTE: The procedure outlined will assume the pump is being removed and replaced on the engine. If the pump has not been removed, only the last portion of the procedure is used for timing.

Injection Pump Removal

1. Remove the fuel injection lines. Cover all injection lines and fuel lines with plastic covers or tape. The smallest amount of dirt can damage the fuel system.
2. Remove inlet and outlet fuel lines from the transfer pump. Cap all lines.
3. Remove the high speed linkage.
4. Remove the 6 mounting bolts that fasten the timing cover to the pump mount flange.

NOTE: Do not remove the two bolts that fasten the pump to the pump mount flange.

5. Remove the two block-to-bracket bolts on the lower injection pump mounting bracket.
6. Remove the injection pump.

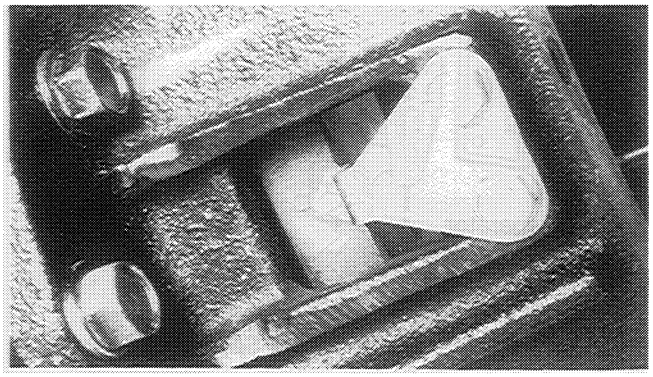
Injection Pump Installation & Timing

1. Remove valve cover and rotate engine in direction of rotation, clockwise from the front, until both push rods on No. 1 cylinder are loose and the injection mark on the flywheel lines up with the pointer in the bellhousing.

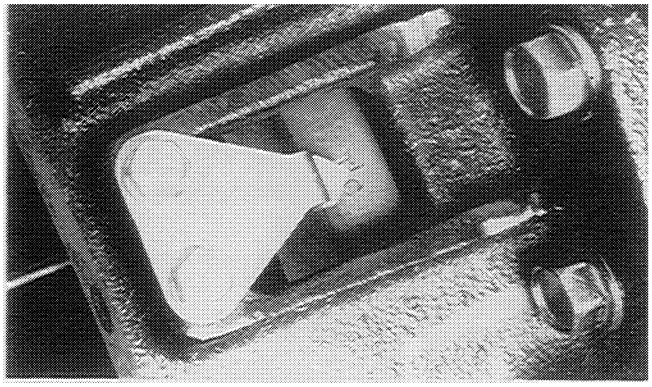
   An alternative method is to remove both access covers from the timing gear cover and rotate the engine in the direction of rotation until the "O" on the cam gear lines up with the pointer in the cam gear access hole, and the injection timing mark lines up with the pointer in the bellhousing.

   NOTE: The injection timing mark is a line scribed in the flywheel approximately 1-3/8 in. (35 mm) from the TC mark. The injection timing mark has no identification markings.

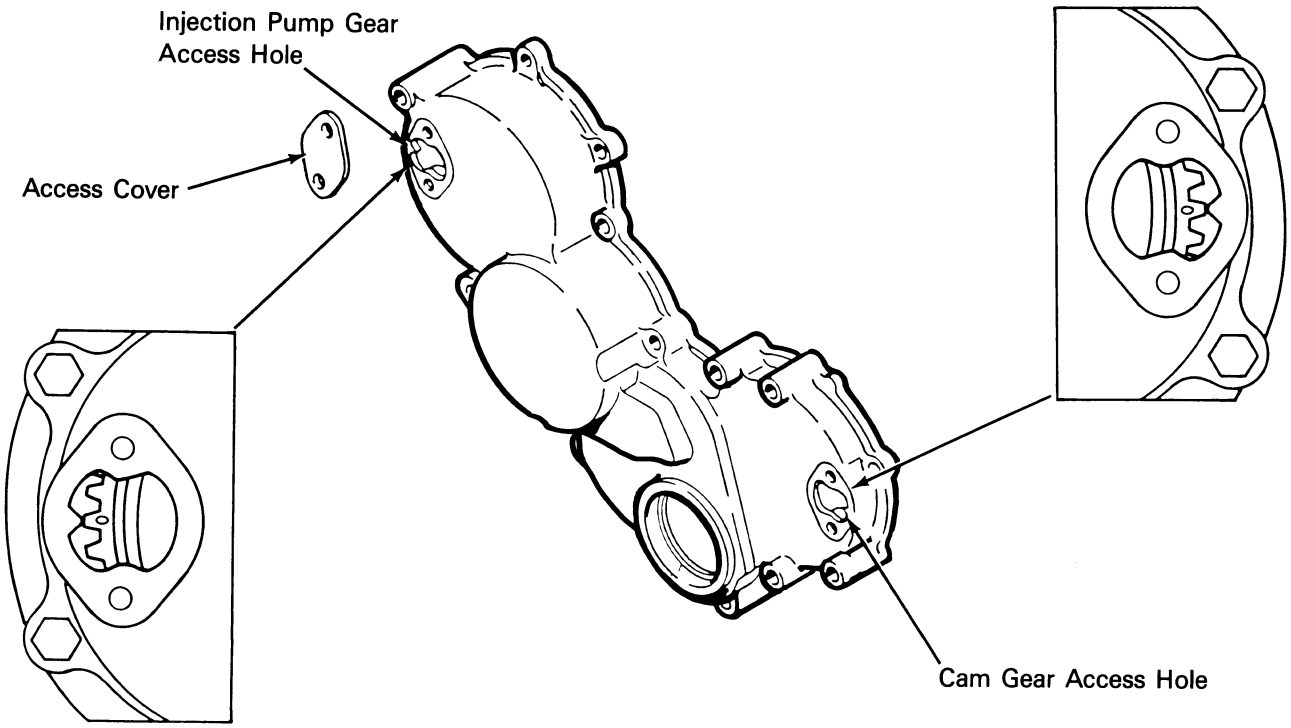
   The engine now has No. 1 cylinder at the fuel injection mark of its compression stroke.



Injection Timing Mark

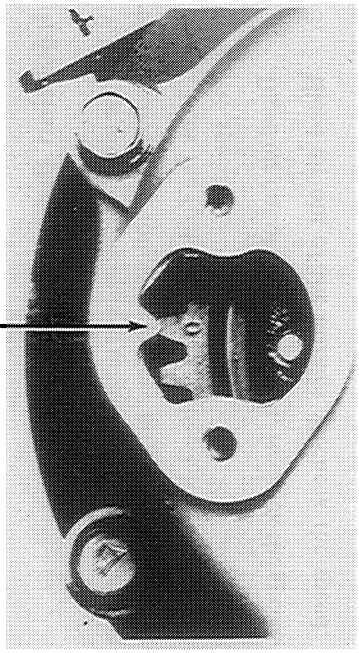


TC Mark on Flywheel



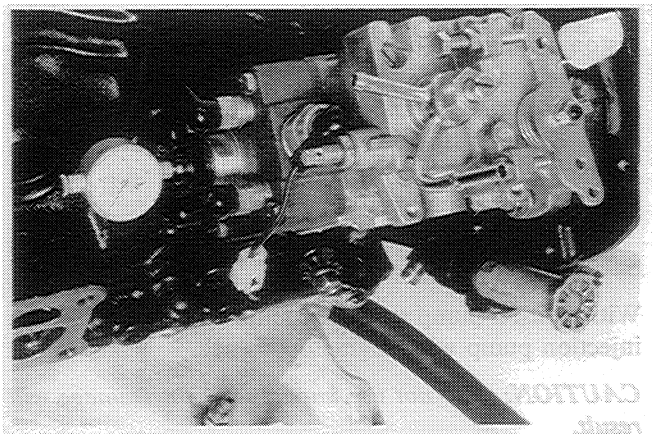
Timing Gear Marks

2. Before installing the pump, rotate the gear until the "O" marked on gear is approximately in the 10 o'clock position as you face the gear end of the pump.
3. Remove the access cover from the timing gear cover.
4. Install the pump in the engine, lining up the "O" with the timing mark cast into the access hole.
5. Install and torque the injection pump mounting bolts.



Injection Pump Timing Mark

6. Remove the 8 mm bolt located at the back of the injection pump in the middle of the injection lines. Install the special dial indicator, TK Part No 204-589 in its place. Make sure the adapter bottoms out tightly on the pump housing. Insert the dial indicator into the adaptor until the dial indicator contacts the pump plunger. Preload the dial indicator at least .080 in. (21 mm) and lock the dial indicator in place by tightening the locking collar.
7. Rotate the engine backwards, counterclockwise from the front, to approximately 3.5 in. (89 mm) from the TC mark on flywheel.



Dial Indicator Installation

8. Adjust the dial indicator to zero. The pump plunger should be at the bottom of its stroke. To check this, rotate the engine back and forth no more than .5 in. (13 mm). The dial indicator should stay at zero.
9. Rotate the engine forward, clockwise from front, to the injection timing mark.

   NOTE: The injection timing mark is a line scribed in the flywheel approximately 1-3/8 in. (35 mm) from the TC mark. The injection timing mark has no identification markings.
10. The dial indicator should now show the pump plunger is at .020 in. (0.5 mm) from the bottom of its stroke and is ready to inject fuel.
11. If the timing position is not correct, loosen the two bolts on the front flange of the pump.
12. If the dial indicator shows a figure larger than .020 in. (0.5 mm), rotate the top of the pump away from the engine until the dial indicator reads the correct value. A smaller figure requires the pump be turned in towards the engine until the correct value is reached. Tighten the two bolts and lock the pump in position.
13. Perform a final check by turning the engine backwards, counterclockwise from the front, beyond the injection timing mark and then clockwise back to the injection timing mark. The dial indicator should now show .020 in. (0.5 mm). Slight adjustments may be necessary.
14. Remove the dial indicator and replace the timing bolt.

BELTS

Belts should be regularly inspected during unit pre-trip 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 tool, Thermo King No. 204-427, is the best method of checking belts for tightness. Install the belt gauge in the center of the longest belt span. Depress plunger so the hook will engage the belt. Be 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 3 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.

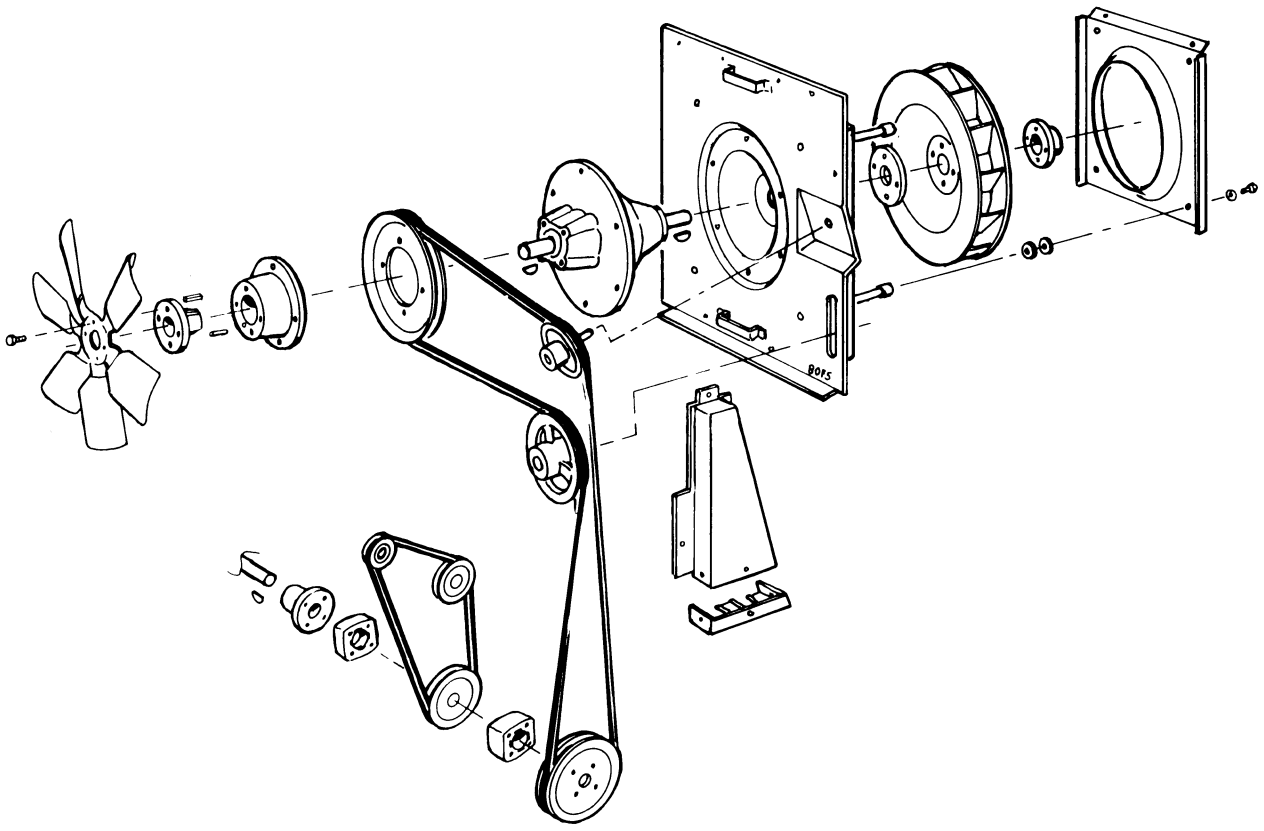
CAUTION: Do not attempt to adjust belts with the unit running.

CAUTION: With the CYCLE-SENTRY V Continuous Run—Auto Start/Stop selector switch in Auto Start/Stop position and unit On/Off switch in On position, unit may start operation at any time without prior warning. Switch unit On/Off switch to Off position before performing maintenance or repair procedures.

12V dc Alternator Belt Adjustment

The alternator belt tension should read 40 on the belt tension tool.

1. Loosen the alternator pivot bolt and adjusting arm bolt.
2. Move the alternator on the adjusting arm slot to adjust the belt to 40 on the belt gauge.
3. Tighten the adjusting arm bolt and alternator pivot bolt.

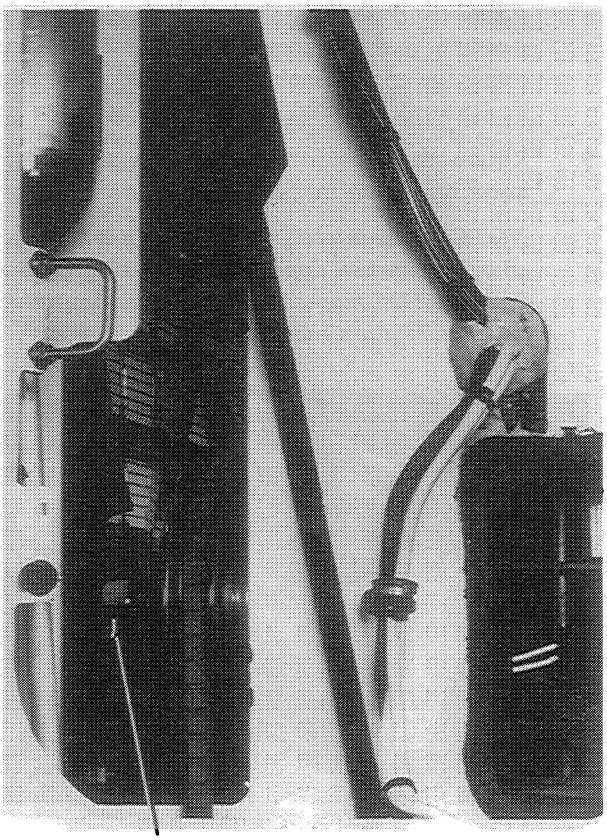


Super II MAX Belt Arrangement

Fan Belt Adjustment

Using the belt gauge, the Super II Dehumidifier fan belt tension should read 40.

1. Remove the fan guard.
2. Loosen the lower idler assembly.
3. To increase belt tension, pry upward on the idler pulley. Hold tension on the pulley and tighten.



Belt adjustment pulley

Fan Belt Adjustment

STARTER

Starter Removal

1. Disconnect the battery ground cable.
2. Disconnect wires from starter.
3. Remove mounting bolts and remove the starter.

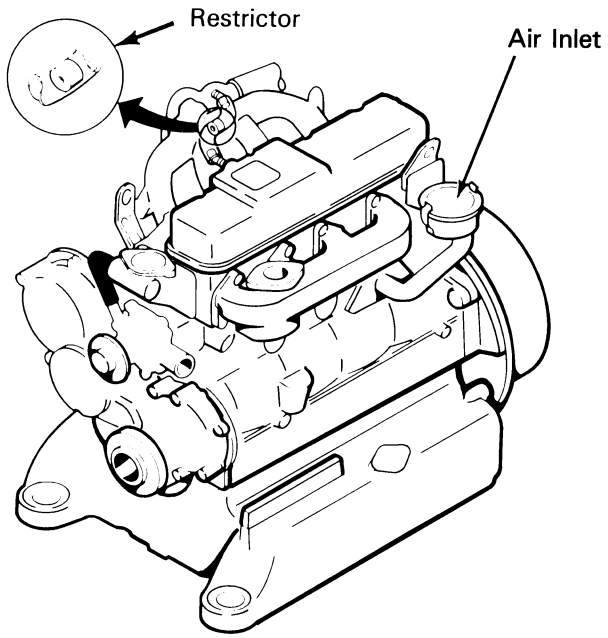
Starter Installation

1. Reinstall starter.
2. Attach starter cable and wires to starter.
3. Reconnect battery ground cable.

CRANKCASE BREATHER

The crankcase breather system ducts gases formed in the crankcase directly to the intake elbow. Harmful vapors that would otherwise collect in the crankcase and contaminate the oil, or escape to the outside, are now drawn back into the engine and burned.

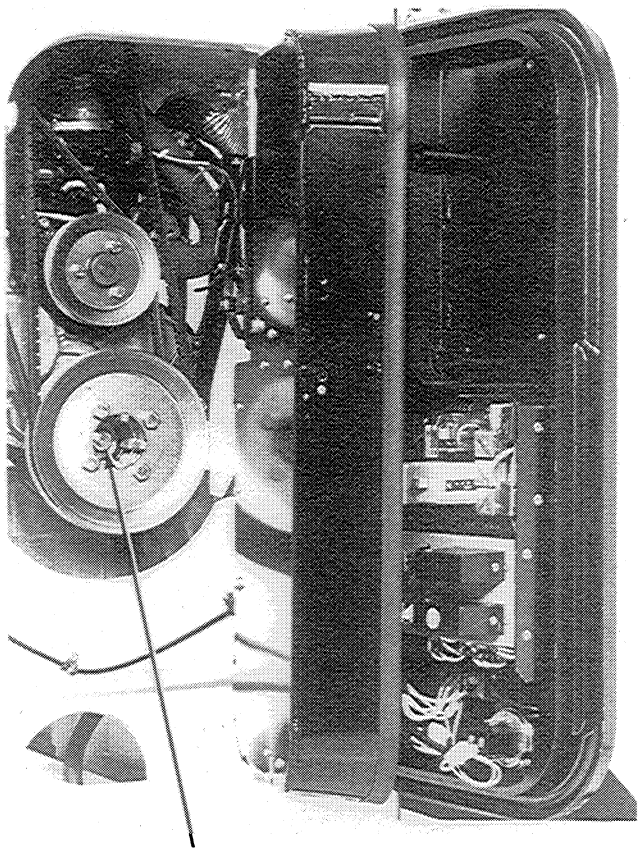
To prevent the crankcase from drawing into a deep vacuum, fresh air is drawn into the engine through a block air inlet mounted on the back of the engine block. The air inlet should be cleaned during scheduled maintenance inspections.



Crankcase Breather System

FRONT CRANKSHAFT PULLEY BOLT

The front crankshaft pulley bolt should be torqued during scheduled maintenance inspections. The bolt should be torqued to 161 ft-lb (218 N·m).



Crankshaft Bolt

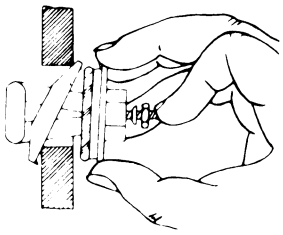
NOTE: The crankshaft bolt requires a special hard steel washer. Substituting or eliminating this washer could lead to premature crankshaft bolt failure due to the bolt bottoming or inadequate bolt head load distribution.

FROST PLUG HEATER (Unit Option)

The frost plug heats the engine to aid in quick starting in low ambient temperatures. A defective frost plug heater can be detected by unplugging the frost plug heater and testing with an ohmmeter. The frost plug heater should have a resistance of approximately 24 ohms.

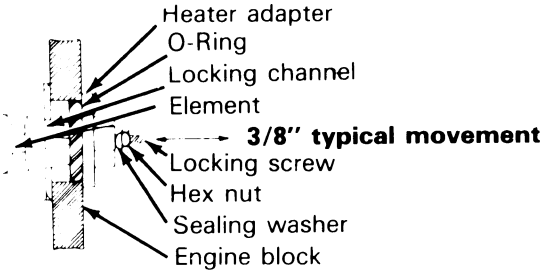
Installation

1. Drain the coolant.
2. Remove the front frost plug, being careful not to damage the frost plug hole.
3. Clean the frost plug hole, removing any burrs, sealing compound, paint or rough spots.
4. Apply a coating of grease to the frost plug hole and to the heater O-ring (to facilitate installation and prevent O-ring damage).
5. Back-off the heater nut as far as possible.
6. Hold the heater with the element pointing up and a finger on the end of the screw. Insert the element and one end of the locking channel into the frost plug hole.

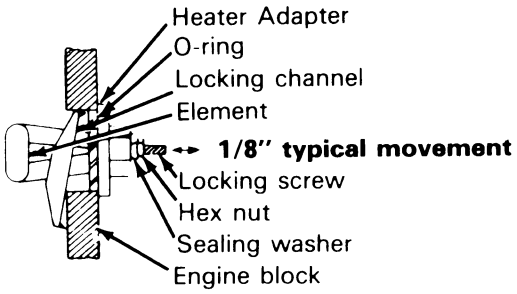


Installing Position

7. Center the heater in the hole, and press in on the end of the screw. Check that the clamping bar went fully through the frost plug hole by the looseness of the screw (typically 3/8 in. [9.5 mm] movement in-out).



CORRECT



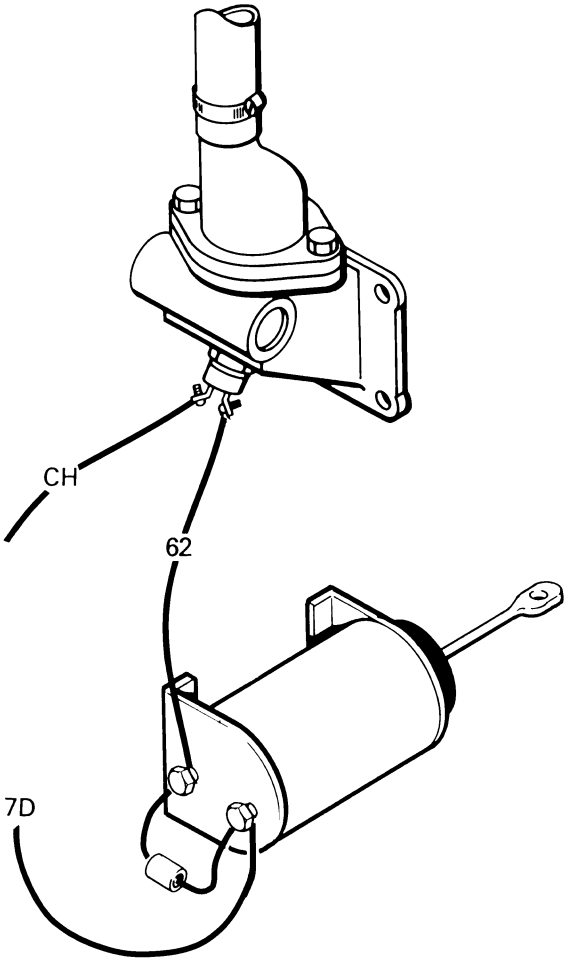
INCORRECT

8. To ensure that bolt head is in the channel, pull the bolt outward, and turn it to lock the bolt in the channel.

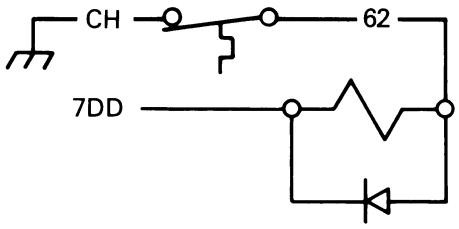
9. Tighten the nut to 25 in-lb (2.8 N·m).
10. Install the power cord and route it to a convenient location. Band wrap where necessary so the cord does not touch the engine, exhaust pipe or moving parts.
11. Refill with coolant, and operate the unit to check for leaks.
12. Return to service.

LOW SPEED START (Unit Option)

The low speed start control system interrupts the control power to the throttle solenoid to force the unit engine to start on low speed when the engine coolant temperature is below 100 F (37.8 C). When the engine coolant temperature exceeds 100 F (37.8 C), the low speed start switch closes, returning control of the throttle solenoid to the unit thermostat.



Low Speed Start Installation



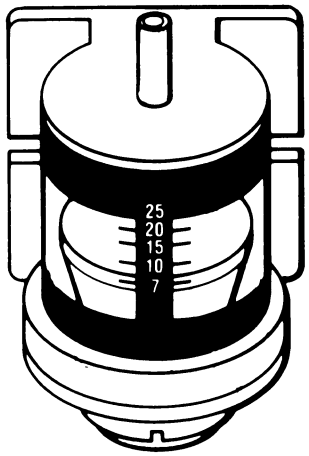
Low Speed Start Schematic

ENGINE AIR CLEANER

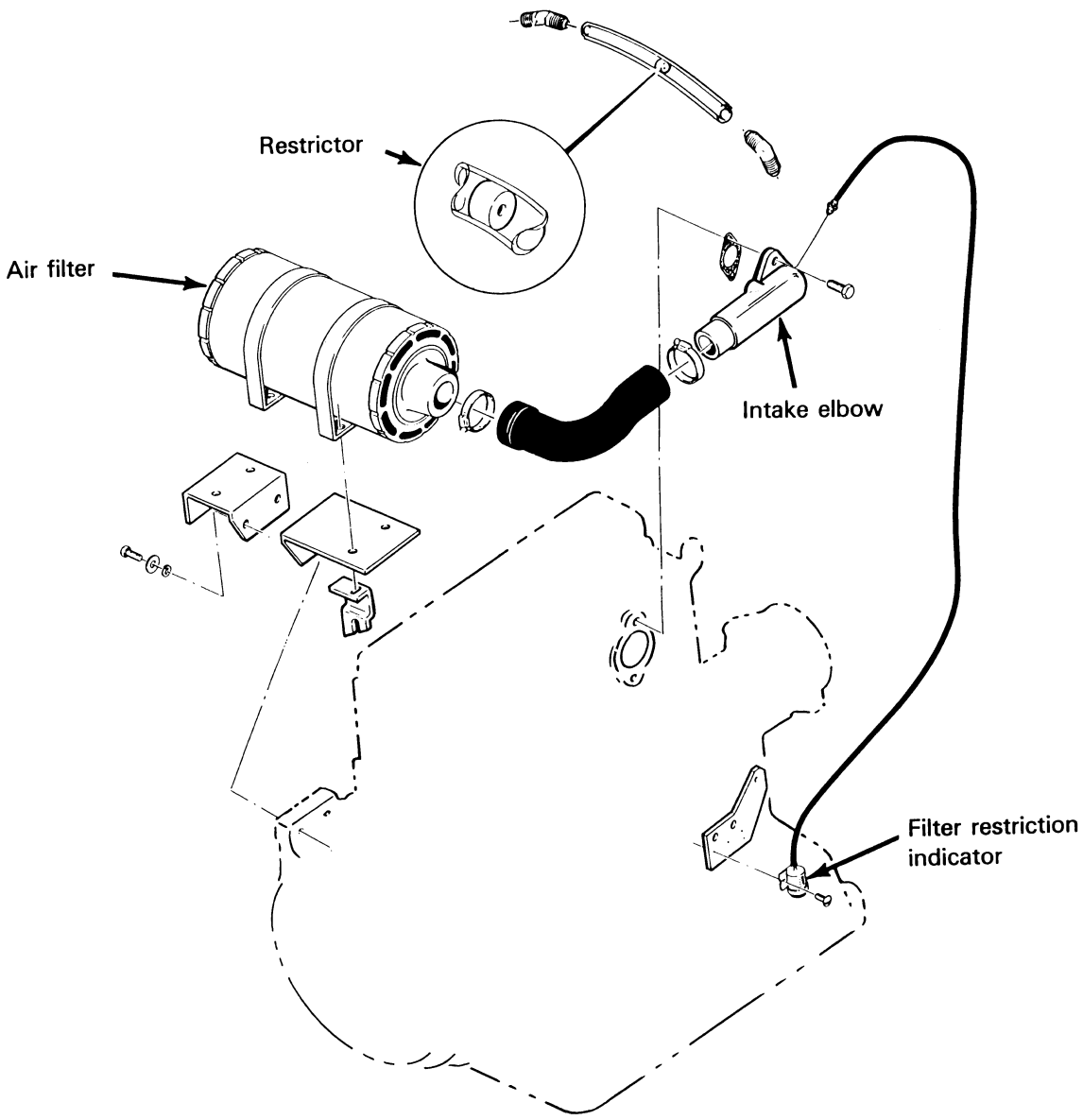
Dry Type

A heavy duty, dry air cleaner filters all of the air entering the engine. 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 elbow. Visually inspect the restriction indicator periodically to assure the air filter is not restricted. Service the air filter when the yellow diaphram indicates 20 in. of vacuum. Press the reset button on the bottom of the restriction indicator after servicing the air filter.



Air Cleaner Restriction Indicator



Engine Air Cleaner

Refrigeration Maintenance

REFRIGERANT CHARGE

Testing the Refrigerant Charge with an Empty Trailer

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

1. Place a test box over the evaporator.
2. Place thermometer (204-135) lead in the box near the evaporator return air opening.
3. Install gauge manifold.
4. Run unit on Cool until the air in the box indicates 0 F (-17.2 C). By allowing the box to leak a small amount, you will be able to maintain 0 F (-17.2 C)
5. The compound gauge should be indicating 13-18 psi (90-124 kPa) gauge pressure.

   If there is any doubt about the unit gauge, check the calibration.
6. The discharge or head pressure gauge should read 275 psi (1896 kPa).

   If the pressure is below this, it can be raised by covering a portion of the roadside condenser grille with a piece of cardboard to block condenser airflow.
7. Under these conditions, the ball in the receiver tank sight glass should be floating.

Testing the Refrigerant Charge with a Loaded Trailer

1. Install a gauge manifold.
2. Run the unit on the Cooling.
3. Build up and maintain 150 psi (1034 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 trailer to lowest temperature required.
5. Check suction pressure — should be proper for corresponding temperature (see "Compound Gauge" under Unit Instruments in Operating Instructions).
6. Under these conditions, the ball in the receiver tank sight glass should be floating. If there is no indication of refrigerant in the receiver tank sight glass, the unit is low on refrigerant.

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

REFRIGERANT LEAKS

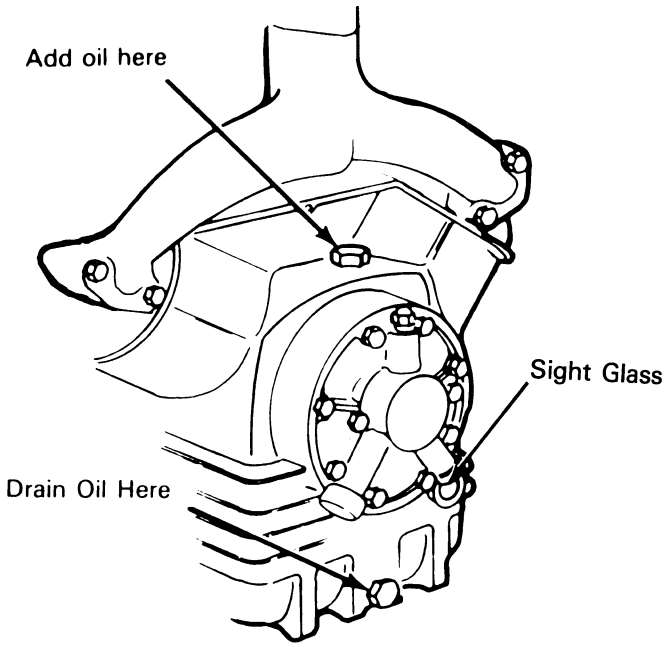
Use a reliable leak detector (e.g., electronic detector or Halide torch) to leak test the refrigeration system. Inspect for signs of oil leakage which is the first sign of a leak in the refrigeration system.

CHECKING COMPRESSOR OIL

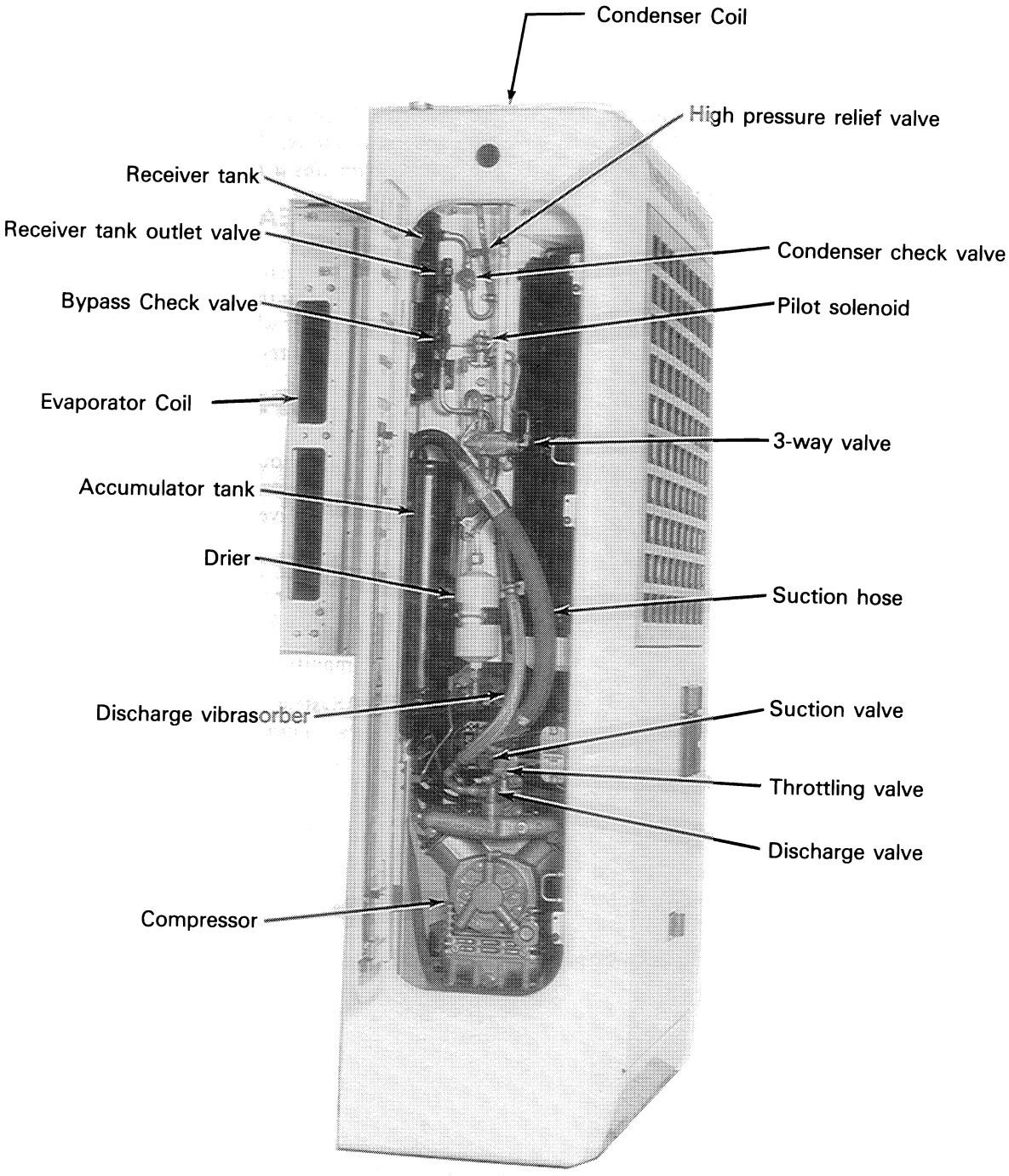
The compressor oil should be checked when there is evidence of oil loss (oil leaks) or when components in the refrigeration system have been removed for service or replacement.

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

Install a gauge manifold on the compressor.



Checking Compressor Oil



Super II MAX Refrigeration Components

Operate the unit on Cool with a 20 psi (138 kPa) minimum suction pressure and 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 COOLING for ten minutes. Observe the oil level. The oil should be 1/4 to 1/2 up in the sight glass.

If the evaporator temperature is above 37 F (2.8 C), it will be necessary to force defrost. To force defrost, use a jumper wire and jump the No. 12 wire at the defrost relay to ground. Then push the manual defrost switch. Allow evaporator temperature to rise to approximately 45 F (7.2 C). Remove the jumper wire from the defrost relay.

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, synthetic type, TK Part No. 67-404 is recommended on R-12 systems and required in R-502 systems.

COMPOUND PRESSURE GAUGE

The suction pressure at the compressor is shown on the compound pressure gauge. The compound gauge monitors the low side of the refrigeration system and indicates the expansion valve is working.

The compound pressure gauge should be recalibrated occasionally by comparing it with a gauge of known accuracy or by adjusting to zero at atmospheric pressure.

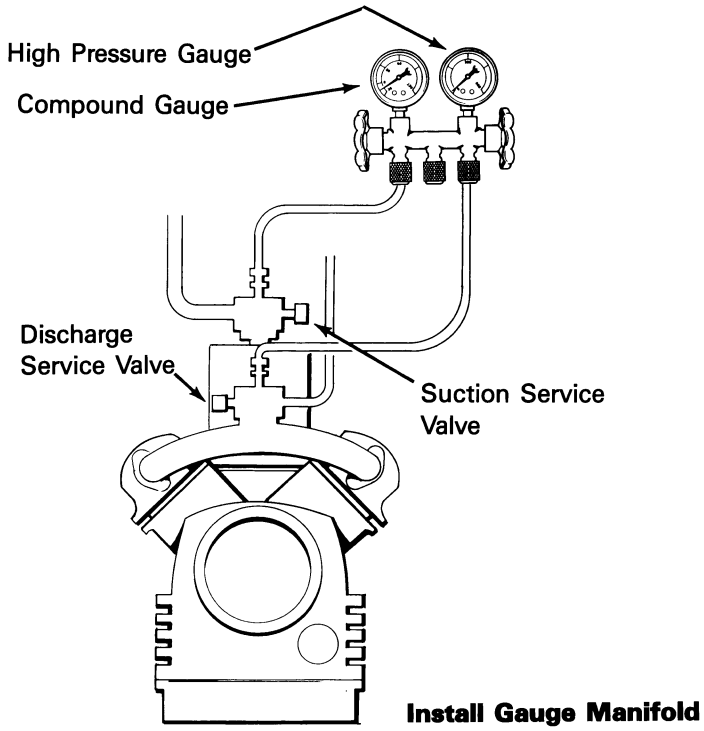
To recalibrate the compound gauge with a gauge of known accuracy, install the check gauge on the suction service valve fitting. Operate the unit on Cool. Turn the adjustment screw on the unit gauge to match the reading on the check gauge.

To zero the gauge, pump down the unit and pressurize the low side to slightly positive (2-5 psi [14-34 kPa]). Disconnect the gauge line and turn the adjustment screw on the unit gauge to bring the reading to zero.

NOTE: If the compound gauge does not stay in calibration, replace the compound gauge.

COMPRESSOR PUMP DOWN AND CHECKOUT

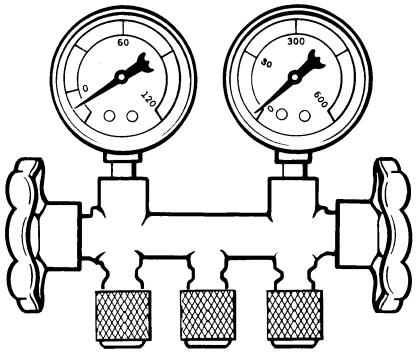
1. Install a gauge manifold set on the compressor. Open the service valves (crack the valves off of the back seated position) to access system pressure.



Install Gauge Manifold

2. Set the thermostat dial well below box temperature, and run the unit in cooling mode until the temperature is stabilized (at least 5 minutes).

3. Close (front seat) the receiver tank outlet valve. Allow the unit to run until it reaches a stable 15 to 20 in. (-51 to -68 kPa) vacuum on the compound gauge (approximately 10 minutes). Then shut the unit down manually.



Compound Gauge Indicating 20" Vacuum

4. Close (front seat) the suction service valve and repeat step 3. If the suction pressure does not ruse above 10 psig (69 kPa) in 2 minutes, perform checkout procedures on the 3-way valve and the bypass check valve. If the pressure does rise, go to step 6.

5. Front seat discharge service valve and equalize the compressor pressure to slightly positive. Disassemble and inspect the unloader. Next, disassemble and inspect the discharge valve plates.

6. If the unloader and the valve plates are not leaking, the suction service valve is probably leaking. This is of no consequence during unit operation.

COMPRESSOR UNLOADER OPERATION (Optional)

Full Capacity

When the compressor is operating at full capacity, the unloading solenoid is de-energized. Piston (A) is down (closed) and check valve (B) is up (open). See Figure A.

1. Discharge gas passes through the check valve (B) port into the solenoid.
2. With the solenoid de-energized, the gas flows through the port to the top of the unloader valve (A).
3. The discharge gas pressure on the top of the piston overcomes the spring tension, forcing the valve down and sealing off the bypass passage.
4. Discharge gas pressure overcomes spring pressure and forces the check valve (B) off its seat allowing discharge gas to flow through the check valve area to the discharge manifold for full capacity operation.

Unloaded

When the compressor is operating in the unloaded mode, the unloader solenoid is energized electrically. Piston (A) is up (open), and check valve (B) is down (closed). See Figure B.

1. The energized solenoid prevents the flow of discharge gas from the check valve port to the piston (A).

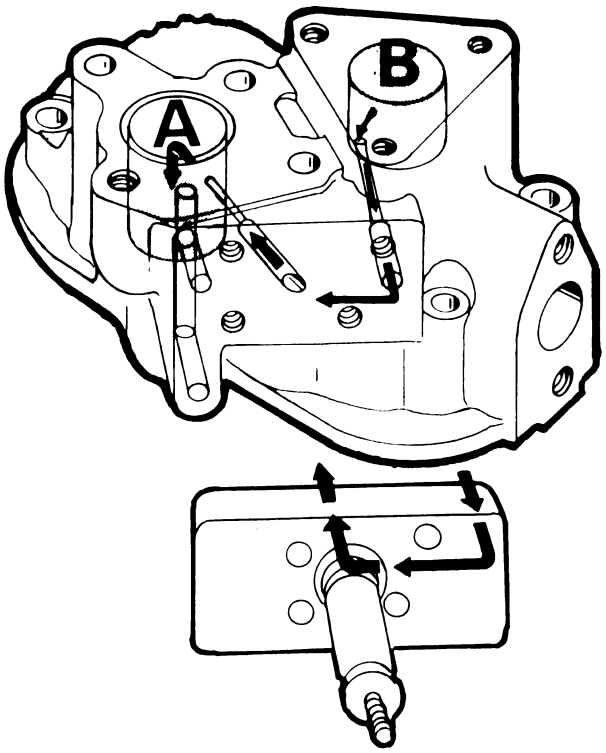


Figure A. Full Capacity Mode

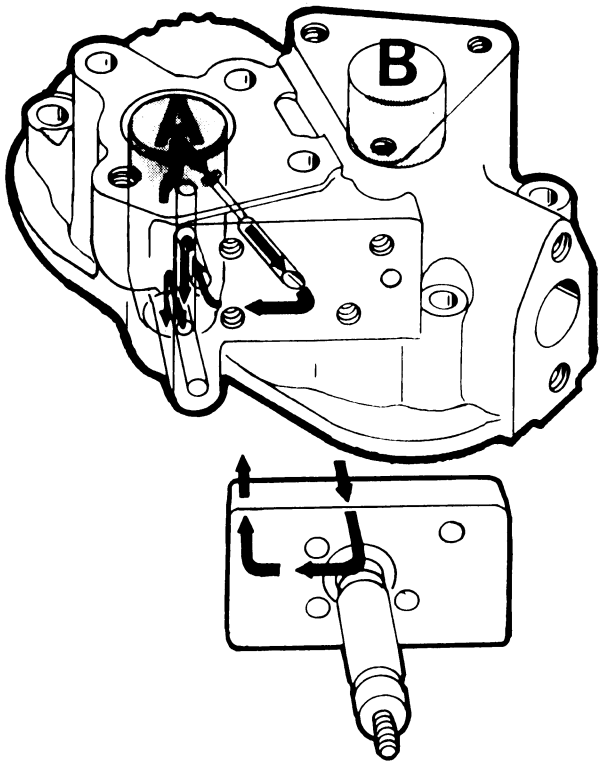


Figure B. Unloaded Mode

2. The pressure holding piston (A) is released through the solenoid into the suction cavity, allowing suction pressure to be applied to the top of the piston.
3. Suction gas pressure is now applied to the top and bottom of piston (A) equalizing the pressure on both sides of the piston allowing the spring tension to pull the piston up.
4. The discharge gas flow is now through the bypass passage directly to the suction cavity of the compressor.
5. At this time, the check valve (B) is closed by spring pressure and held to its seat by discharge manifold pressure. This prevents discharge gas from the other cylinder bank (which is operating normally) from flowing into the unloader head from the discharge manfiold.
6. This provides the fuel saving unloader mode of operation.

Diagnosing Unloader Head Operation

1. Run unit in High Speed Cool until temperature and pressure stabilizes (2 to 5 minutes).
2. Disconnect wire 7D from throttle solenoid. Operate the unit in low speed cool with a minimum difference between discharge and suction pressure of 20 psi (138 kPa).

3. Record unit pressures:

   Suction pressure
   Discharge pressure

4. Using a jumper wire, supply 12V dc "+" to energize the unloader solenoid.

5. Observe unit pressures:

   Suction pressure should rise 2 psi (14 kPa) or more
   Discharge pressure should drop 3 psi (21 kPa) or more.

6. Remove jumper (there should be one audible click).

7. Unit pressures should return to their original values (obtained in step 3) within 1 minute.

8. To assure that the unloader head and valve assembly is operating normal, repeat steps 4 through 7, 2 to 5 times. Reconnect 7D wire to throttle solenoid.

9. If unloader head fails to function properly, refer to unloader head troubleshooting section.

10. If this procedure checks out but unloader fails to operate during normal unit operation, look for an electrical malfunction.

11. Set thermostat for unloader mode (with unit switch on, turn thermostat within 2 to 3 F [1.1 to 1.7 C] of the trailer temperature).

12. During the unloaded mode of operation, there should be 12V dc current on wire No. 7U at all times.

13. Check unloader solenoid coil:

    Volts: 12 dc
    Amperage: 1 (approximately)
    Ohms: 10.6 cold
          15.5 hot
    Watts: 9

Troubleshooting

Electrical

If there is an electrical malfunction, determine if the thermostat, fuelsaver module or harness is faulty.

A. Thermostat

1. Use the standard thermostat checkout procedure.

B. Harness

1. Check harness for open, shorts, grounds or bad connections.

C. Fuelsaver Module

1. Use the procedures in the Electrical Maintenance section.

Unloader Head

Unloader head fails to shift.

NOTE: A new unloader head may fail to shift until the ring on the valve assembly has a chance to seat. A new unloader head should be cycled 40 times to assure normal operation.

A. Cycle the unloader head about 40 times by making and breaking the solenoid valve circuit.

B. If unloader fails to shift, check solenoid valve assembly.

1. Pump down the low side. Turn unit off and shift the 3-way valve to the heat/defrost position. This should equalize pressures so that only a slight positive pressure surrounds the unloader head.

2. Remove the entire unloader head. Disassemble and carefully check the following:

   a. Check the piston bore. It must be honed clean to the bottom. The bottom of the bore is the most critical.

   b. Remove piston ring and check for proper end gap clearance. Specifications are .002-.007 in. (0.051-0.178 mm) new. The ring must be replaced when end gap exceeds .012 in. (0.305 mm). Refer to "Valve Ring Replacement" when installing new ring.

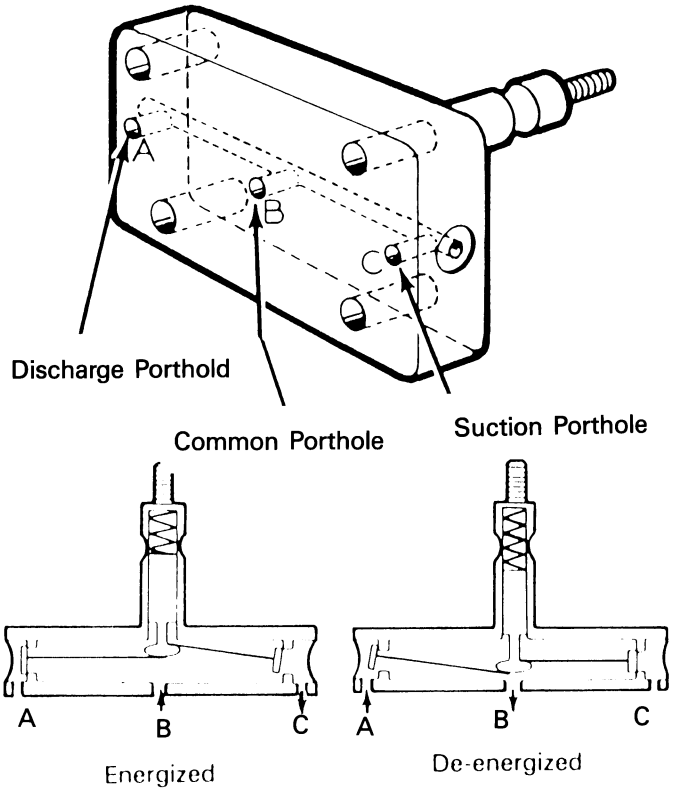


Figure C. Unloading Valve

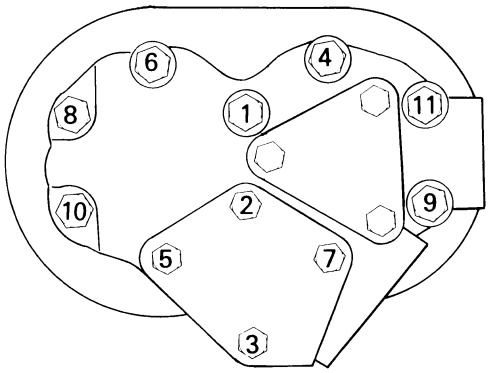


Figure D. Torque Sequence

3. Check solenoid valve assembly.
   a. Check ports "A" and "C" of the solenoid base for weld metal.
   b. **De-energize position.**
      Apply air pressure gently to discharge porthole "A". Air should bleed out of common porthole "B" and not suction porthole "C".
      Apply air pressure to common porthole "B". Air should bleed out of discharge porthole "A".
   c. **Energize position.**
      Apply air pressure gently to discharge porthole "A". Air should not bleed out of suction porthole "B".
      Apply air pressure to common porthole "B". Air should bleed out of suction porthole "C".
   d. If problem still exists, replace unloader head.
4. Clean all parts, orifices, etc. Oil and reassemble the head using new head gasket. Install and snug up manifold bolts. Torque head to 23 ft-lb (31.2 N·m), refer to torque sequence, Figure D. Torque manifold bolts.
5. Retest for shifting as outlined in "Diagnosing Unloader Head Operation" section.

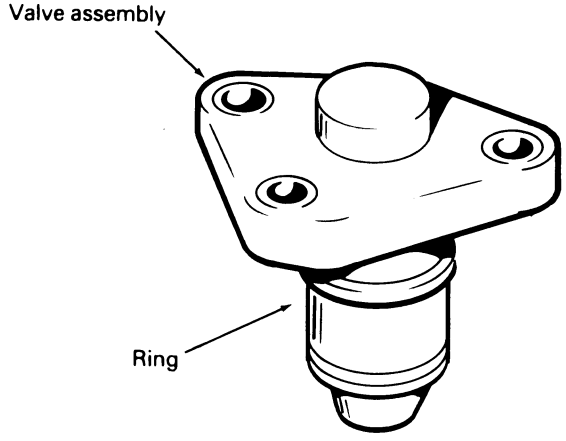


Figure E. Valve Assembly

Valve Ring Replacement

1. Remove valve assembly.
2. Check end gap of new ring.
   End gap when new: .002-.007 in. (0.051-0.178 mm)
   End gap: maximum .012 in. (0.305 mm)
3. Install new ring on valve.
4. Reinstall valve assembly using new gasket.
5. Torque in sequence (refer to Figure F) to 23 ft-lb (31.2 mm)
6. Back seat both service valves.
7. Operate unit. Cycle unloader approximately 40 times by using a jumper wire to supply 12V dc "+" to unloader solenoid.

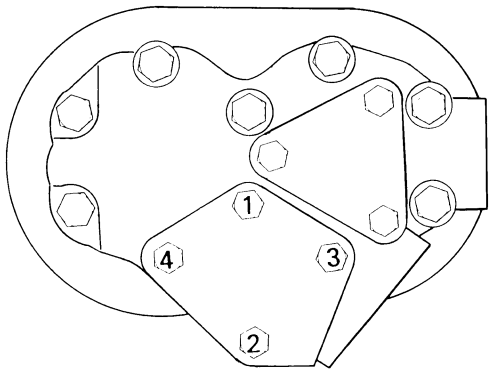


Figure D. Torque Sequence

HIGH PRESSURE CUTOUT

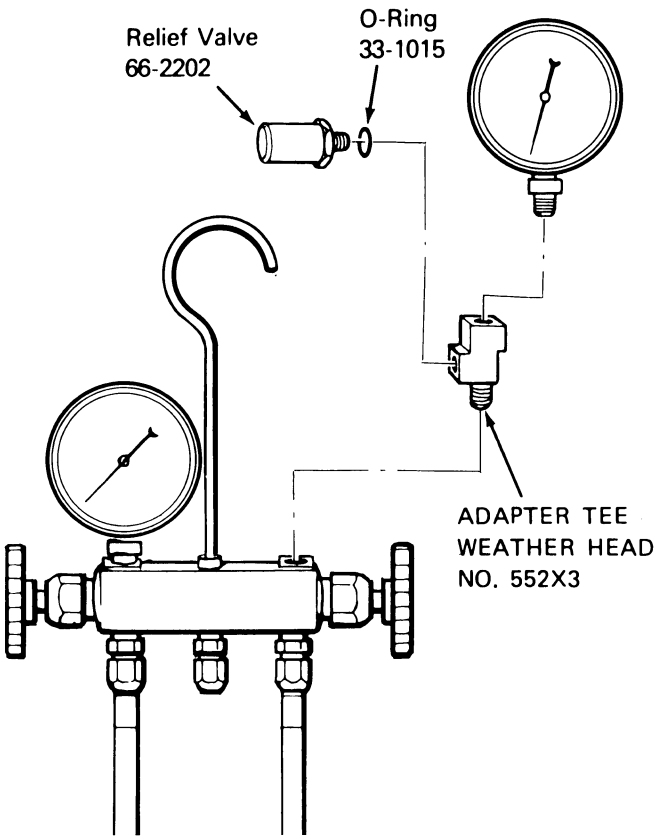
The high pressure cutout is located on the compressor discharge manifold. If the discharge pressure rises above 450 psi (3103 kPa), the switch opens the 8 circuit, de-energizing the fuel solenoid. To test the switch, rework a gauge manifold per "High Pressure Cutout Manifold" figure.

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 psi (6204 kPa) working pressure rating.
2. Set the thermostat well below the box temperature so that the unit will be in High Speed Cool.

3. Raise the discharge pressure of the compressor first by blocking the condenser coil air flow by covering the roadside condenser grille with a piece of cardboard. If this does not raise the discharge pressure to the cutout level of the HPCO switch, increase the engine speed by over-riding the high speed solenoid. This should increase the discharge pressure enough to cause the switch to cut out.

NOTE: The discharge pressure should never be allowed to exceed a pressure of 450 psi (3103 kPa).

4. Failure of the HPCO system to stop compressor operation should be investigated first by checking the control circuit operation and secondly by HPCO switch replacement.



High Pressure Cutout Manifold

THREE-WAY VALVE CONDENSER PRESSURE BYPASS CHECK VALVE

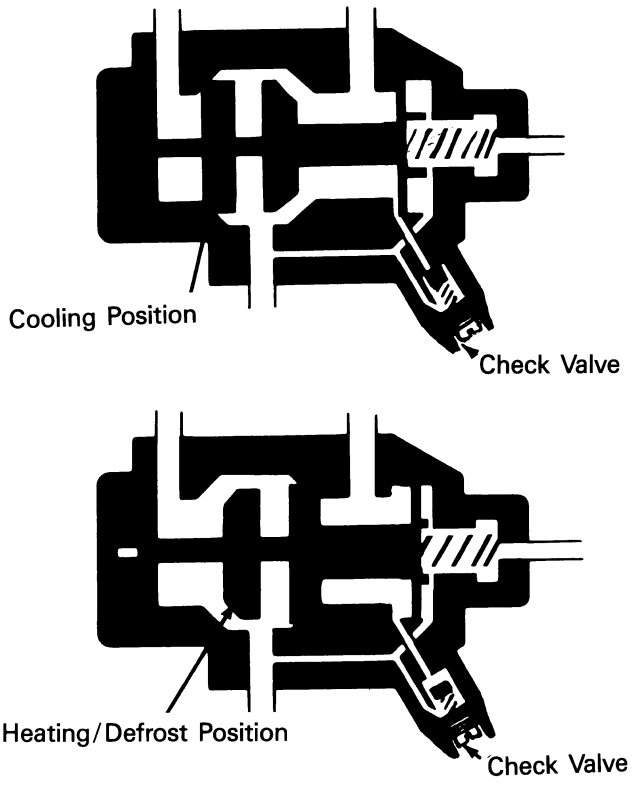
A three-way condenser pressure valve bypass check valve is added to all Super II units. This check valve controls the bypass flow of refrigerant gas between the condenser inlet line and compressor discharge line.

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 heating/defrosting ability and 3-way valve response.

To check the operation of the valve:

1. Remove the condenser pressure bypass check valve cap from the 3-way valve.
2. Using a screwdriver, gently turn the check valve stem in until the valve is front seated.
3. Install a service gauge manifold set on compressor.



Three-Way Valve Condenser Pressure Bypass Check Valve

4. Close (front seat) the receiver tank outlet valve.
5. Operate unit on cooling and pump down the low side to 20 in. (-68 kPa) of vacuum.
6. Stop the unit. The condenser and suction pressures should remain stable, indicating no leaks.

7. Shift the 3-way valve to the Heat position. The suction pressure should rise and equalize with the condenser pressure. This indicates a leak from the high side to the low side.

8. Gauges will remain in this position (approximately zero) if the 3-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 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 cap on condenser pressure bypass check valve.

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

11. Open receiver tank return outlet valve and return unit to normal operation.

Refrigeration Service Operations

NOTE: It is generally good practice to replace the filter drier whenever the high side is opened or when the low side is opened for an extended period of time. Refer to the Refrigeration Manual (Thermo King Manual number TK5715) for system cleanup after a compressor failure or repair or replacement of basic components.

COMPRESSOR

Removal

1. Pump down the low side and equalize pressure to slightly positive.
2. Front seat the discharge and suction service valves. Release remaining refrigerant pressure from compressor.
3. Unbolt and remove bypass oil filter bracket from flywheel housing.
4. Unbolt discharge valve and suction valves from compressor.
5. Disconnect the high pressure cutout switch and pilot valve line.
6. Support compressor and remove compressor mounting bolts from flywheel housing.
7. Lift the service valves out of the way.
8. Slide the compressor to left until coupling pins are clear.
9. Remove compressor out 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, 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 compressor into the unit.
2. Place compressor in position and install mounting bolts.
3. Install service valves using new gaskets soaked in compressor oil. Connect high pressure cutout switch and pilot solenoid valve line.
4. Pressurize the compressor and test for refrigerant leaks.
5. If no leaks are found, evacuate the compressor.
6. Re-install bypass oil filter bracket on flywheel housing.
7. Tighten belts.
8. Back seat the suction and discharge service valves.
9. Operate the unit at least thirty minutes and then inspect the oil level in the compressor. Add or remove oil if necessary.
10. Check the refrigerant charge and add refrigerant if needed.

CONDENSER COIL

Removal

1. Remove the refrigerant charge.
2. Remove the top screen.
3. Remove mounting bolts.
4. Unsolder the inlet line and liquid line connections. Lift coil from unit.

Installation

1. Clean the fittings for soldering.
2. Place the coil in the unit and install 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. Recharge the unit with proper refrigerant and check compressor oil.
6. Install top screen.

DISCHARGE VIBRASORBER

Removal

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

   CAUTION: Use a heat sink, TK 204-388 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, TK204-388 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 proper refrigerant and check the compressor oil level.

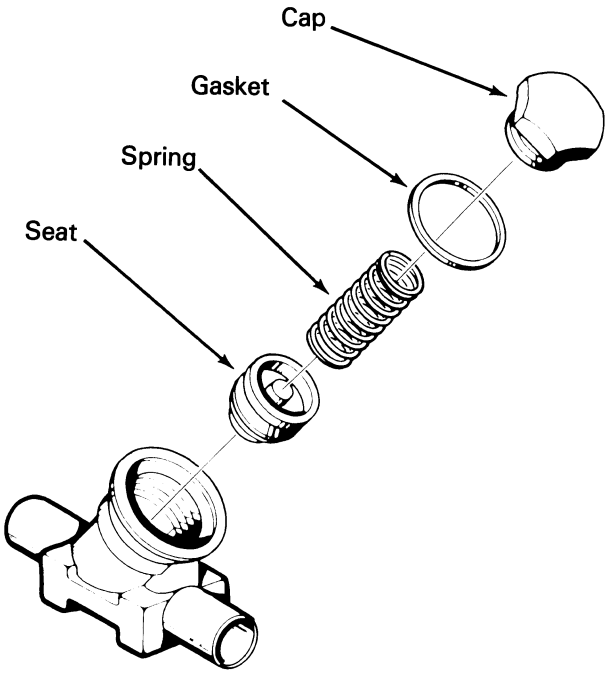
CONDENSER CHECK VALVE REPAIR

Removal

1. Remove the refrigerant charge.
2. Remove cap nut from check valve.

Installation

1. Inspect the seat in the check valve for damage or foreign particles which might adhere to the seat and would damage the new seat. If damaged, go to "Condenser Check Valve And Reheat Check Valve Replacement".



2. Install the new seat and spring. Place new gasket on cap and torque to 45 ft-lb (61 N·m).
3. Pressurize the refrigeration system and test for leaks.
4. If no leaks are found, evacuate the system.
5. Recharge the unit with proper refrigerant and check compressor oil.

CONDENSER CHECK VALVE REPLACEMENT

Removal

1. Remove the refrigerant charge.
2. Unsolder lines and remove check valve.

   NOTE: Disassemble valve before unsoldering.

Installation

1. Clean the tubes for soldering.
2. Place disassembled check valve in position. Arrow on valve body indicates direction of refrigerant flow through valve.
3. Solder the inlet and outlet connections. After the valve cools, reassemble valve.
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 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. Unscrew flare nut from check valve.
4. Unscrew check valve from bypass valve.

Installation

1. Coat fittings on bypass check valve with compressor oil and install on service valve fitting. Tighten securely.
2. Install and tighten bypass flare nut on check valve outlet. Hold the check valve with a backup wrench on the hex.

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 unit in operation.

RECEIVER TANK

Removal

1. Remove the refrigerant charge.
2. Unsolder check valve line from receiver tank. Unscrew filter drier inlet and bypass check valve flare nuts. Remove check valve from receiver tank outlet tube.
3. Unbolt mounting brackets and remove receiver tank from unit.
4. Tighten bypass check valve and filter drier inlet line flare nuts.
5. Pressurize the refrigeration system and check for leaks. If no leaks are found, evacuate the system.
6. Recharge the unit with proper refrigerant.

FILTER DRIER

Removal

1. Pump down the refrigeration system and equalize the pressure to slightly positive.
2. Disconnect the flare nuts at the end of the drier.
3. Loosen mounting hardware and remove the drier.

Installation

1. Install the new drier and tighten mounting screws and nuts.
2. Install and tighten the inlet flare nut. Hold the drier with a backup wrench on the hex behind the flare fitting.
3. Release a small amount of refrigerant to purge the air through the drier. Then tighten outlet flare nut.
4. Pressurize the sytem and inspect for leaks. If no leaks are found, open the refrigeration valves and place the unit in operation.

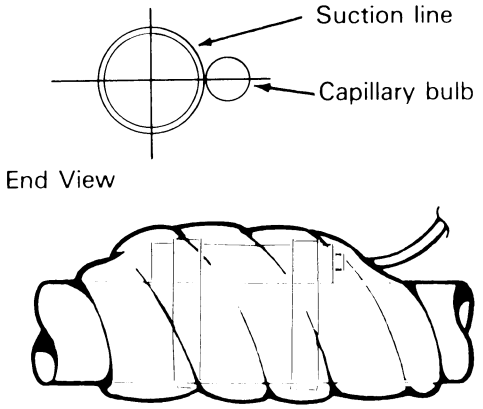
EXPANSION VALVE ASSEMBLY

Removal

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

Installation

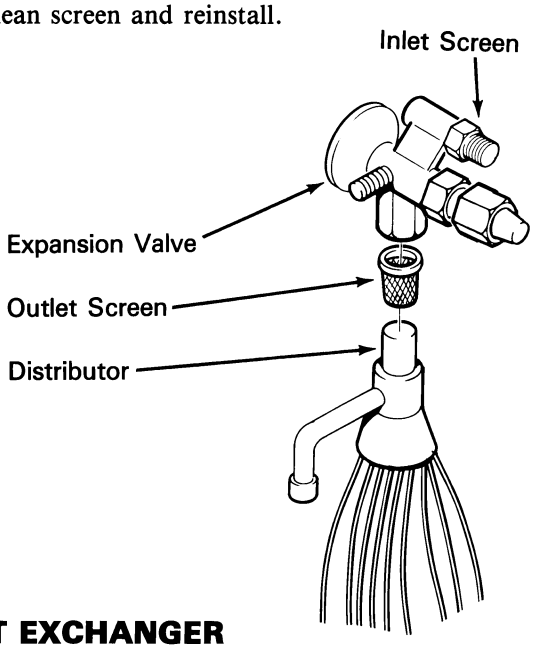
1. Install and bolt the expansion valve assembly in the unit.
2. Connect the inlet liquid line and distributor to the expansion valve.
3. Connect the equalizer line to expansion valve.
4. Clean suction line to bright polished condition. Install the feeler bulb clamps and feeler bulb on the side of the suction line in former position. The feeler bulb must make good contact with the suction line or operation will be faulty. Wrap with insulating tape.
5. Pressurize the low side and test for leaks. If no leaks are found, evacuate the low side.
6. Open the refrigeration valves and place the unit in operation.
7. Test the unit to see that the expansion valve is properly installed.



Location of Expansion Valve Bulb

Cleaning In-Line Screen

1. Perform a low side pump down; bleed pressure back to 1 psi (6.9 kPa).
2. Remove liquid line fitting.
3. A small tool with slight hook may be needed to pull screen from expansion valve.
4. Clean screen and reinstall.



HEAT EXCHANGER

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Remove both idler pulleys.
3. Remove fan belt.
4. Remove fan module mounting screws and pull module out front of unit.
5. Remove heat exchanger mounting bolts.
6. Unsolder the suction and liquid lines connections.
7 Remove the heat exchanger from the unit.

Installation

1. Place the heat exchanger in the unit, and install mounting bolts.
2. Solder the liquid and suction outlet line connections.
3. Pressurize the low side and check for leaks. If no leaks are found, evacuate the low side.
4. Place the fan module in the unit and install mounting screws.
5. Install idler pulleys.
6. Install fan belt and tighten to proper tension.
7. Install grille.
8. Open 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 rear panel from the evaporator housing.
3. Disconnect defrost termination thermostat and air switch hose.
4. Remove feeler bulb from suction line clamp. Note the position of the feeler bulb on the suction line.
5. Disconnect the distributor from the expansion valve.
6. Unsolder hot gas line and suction line from the evaporator coil.
7. Remove mounting bolts, lift and remove from housing.

Installation

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

ACCUMULATOR

Removal

1. Pump down the low side and equalize the pressure to slightly positive.
2. Disconnect water lines from accumulator tank.

CAUTION: Water may be hot.

3. Unsolder inlet and outlet suction lines from accumulator tank.

   CAUTION: Use a heat sink TK204-387 or wrap vibrasorber with wet rags to prevent damaging the vibrasorber.

4. Unbolt and remove accumulator from unit.

Installation

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

   CAUTION: Use a heat sink TK204-387 or wrap vibrasorber with wet rags to prevent damaging the vibrasorber.

3. Connect water lines to accumulator tank.
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 refrigerant charge and compressor oil and 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.

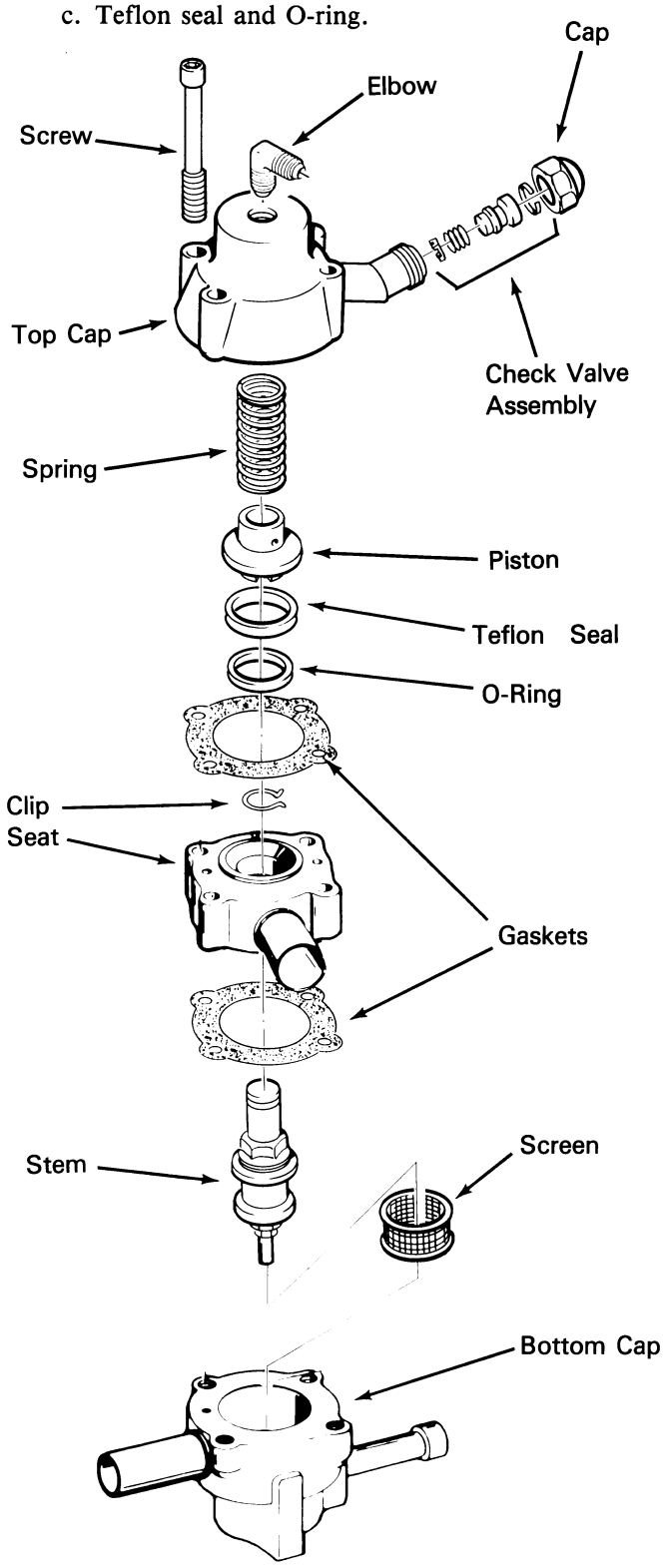
Removal/Disassembly

1. Remove the refrigerant charge.
2. Clean the exterior surface of the valve.
3. Remove the 1/4 in. copper line from the 3-way valve to the pilot solenoid.
4. Loosen the four 1/4 in. Allen head screws (DO NOT REMOVE); use tool No. 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.

5. Remove the 4 bolts from the valve.
6. Remove the top cap and spring.
7. Remove the spring clip. Observe the slot in the piston and slide piston off the stem.
8. Remove center section and stem assembly.
9. Inspect the following parts for wear or damage:
   a. Bottom cap, sealing and support area.
   b. Seat, sealing surface.
   c. Top cap, sealing and support surface.

   The following parts will be discarded:
   a. Stem assembly.
   b. All gaskets.
   c. Teflon seal and O-ring.



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.

Assembly/Installation

NOTE: Three-way valve Kit No. 60-156 is supplied to repair 3-way valves.

After cleaning and inspecting all parts, reassemble the valve.

1. Place the screen in the bottom cap.
2. Place new stem in the bottom cap.
3. Install new gaskets on both sides of the seat. Dip gaskets in compressor oil before installing.
4. Install the piston on the stem and attach with spring clip.
5. Install a new O-ring on the piston, then place the Teflon seal over the O-ring.

   NOTE: The Teflon seal will stretch when it is installed. To prevent this stretch from becoming permanent (and possibly malfunction), the top cap must be installed immediately.
6. Install the spring and top cap.
7. Line up the passageways in the cap and seat. Failure to line up the holes will result in improper operation of the valve.
8. Install the screws and tighten in rotating sequence.
9. Install pilot line and pressurize system with refrigerant to check for leaks.
10. If there are no leaks, evacuate system and recharge with proper refrigerant.
11. Run the unit to check for proper 3-way valve operation.

PILOT SOLENOID

Removal

1. Pump down the low side and equalize pressure to slightly positive.
2. Disconnect the lines to the solenoid and immediately plug to prevent moisture and air from entering system.

   NOTE: The lines from the three-way valve to the pilot solenoid will leak refrigerant at a high velocity and should be capped with a 1/4x1/4 flare and cap.
3. Disconnect electrical wires and remove the pilot solenoid.

Installation

1. Replace the pilot solenoid in the unit.
2. Remove the plugs from the lines and connect lines to pilot solenoid. Connect line from the three-way valve first. Connect wires to valve.
3. Open refrigeration valves and place unit in operation.
4. Check for leaks.

SUCTION VIBRASORBER

Removal

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

Installation

1. Prepare the suction hose and tube fittings for soldering by cleaning thoroughly.
2. Inspect and place O-ring on fitting. Bolt vibrasorber to suction service valve.
3. Solder the suction hose connection to the accumulator.

   CAUTION: Use a heat sink TK204-837 or wrap vibrasorber with wet rags to prevent damaging the vibrasorber.
4. Pressurize the low side and check for leaks. If no leaks are found, evacuate the system.
5. Open refrigeration valves and place the unit in operation.

HIGH PRESSURE CUTOUT SWITCH

Removal

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

Installation

1. Apply a refrigerant locktite to the threads of the high pressure cutout switch.
2. Install and tighten high pressure cutout switch and reconnect wires.
3. Pressurize the refrigeration system 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. Remove the refrigerant charge.
2. Unscrew and remove the high pressure relief valve.

Installation

1. Apply a refrigerant locktite to the threads of the high pressure relief valve.
2. Install and tighten 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 proper refrigerant and check compressor oil.

THROTTLING VALVE

Removal

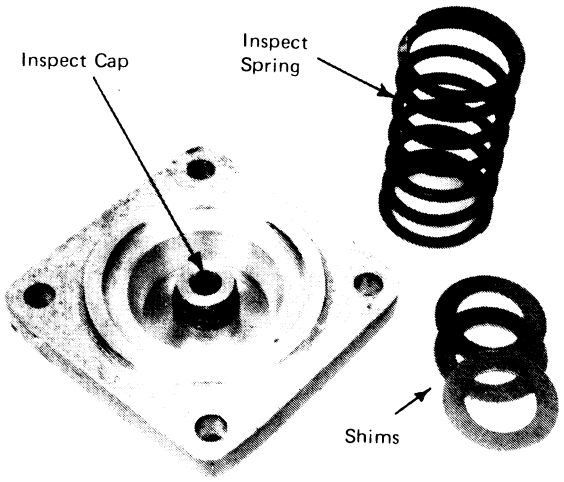
1. Pump down the low side and equalize pressure to slightly positive.
2. Front seat the discharge and suction service valves. Release remaining pressure.
3. Remove the suction valve and line from compound gauge.
4. Unbolt and remove the throttling valve from the unit.

Repair

DISASSEMBLY

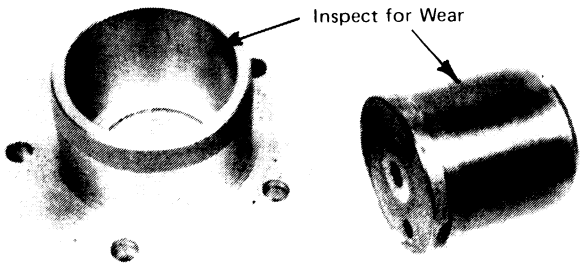
1. Remove piston end cap (round end).
2. Remove cotter pin from castle nut and remove nut.
3. Remove spring and piston.
4. Loosen all bolts on bellows end cap.

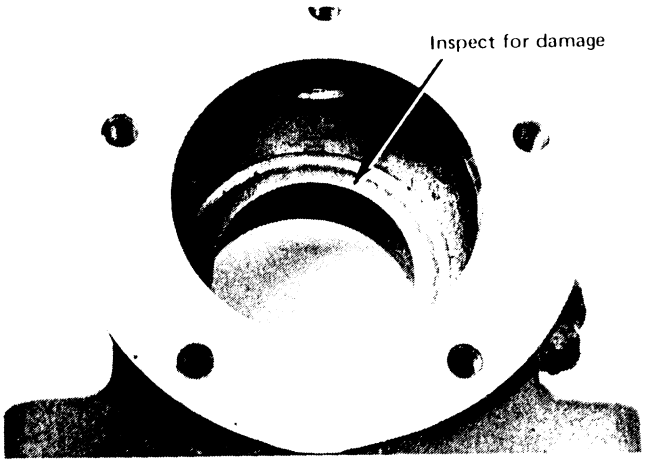
   CAUTION: This end cap is under slight spring pressure.
5. Break gasket free and remove end cap.
6. Note the number of shims next to cap. These can be reused.



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

   NOTE: Bellows is normally replaced.
9. Clean part to be reused.

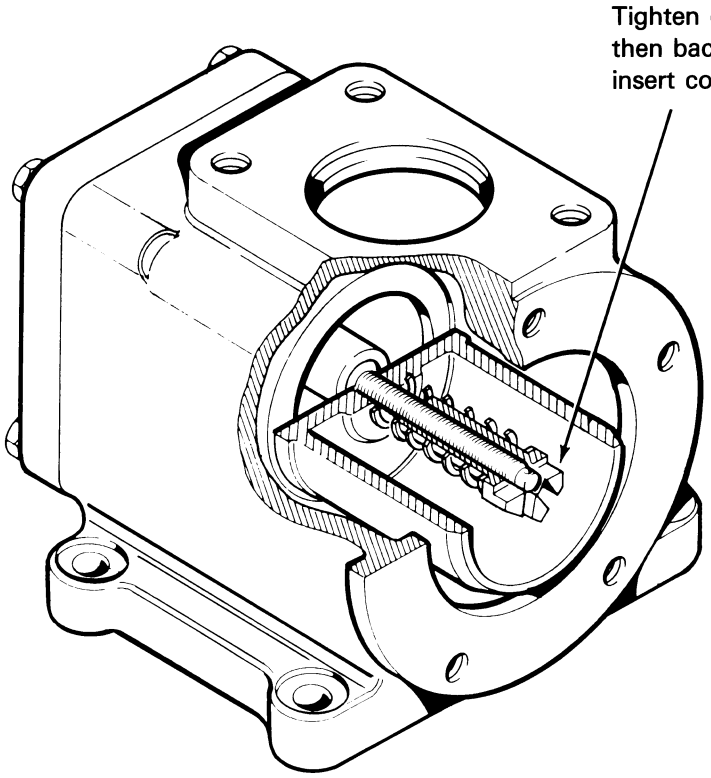


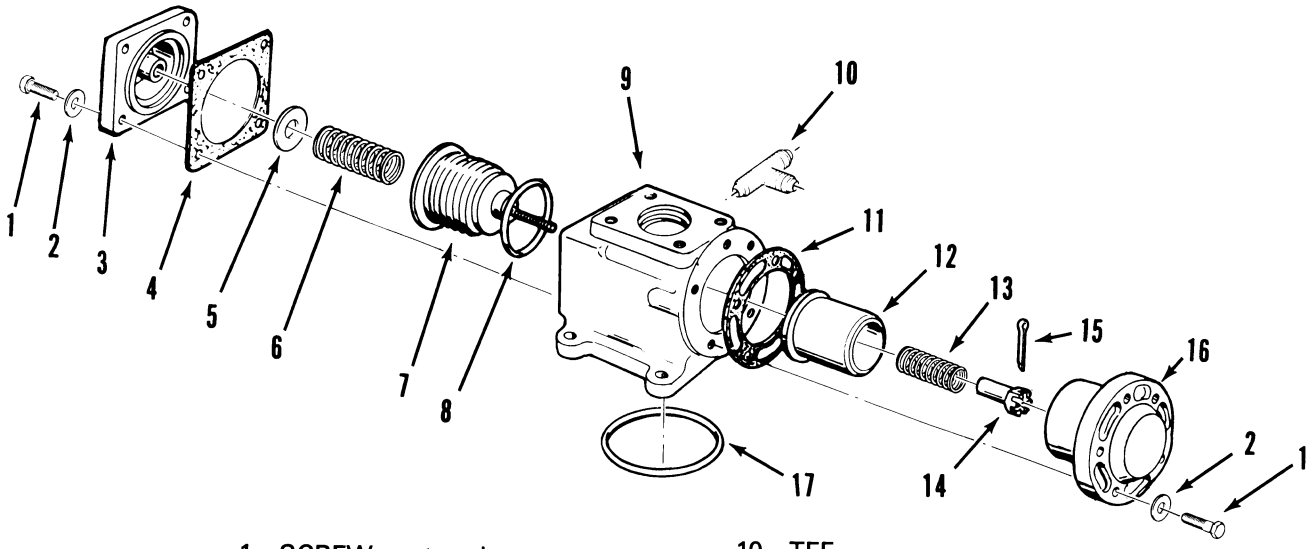


5. Back off the castle nut, one full turn only.
6. Insert the cotter pin.
7. Oil gasket and install end cap.
8. Throttling valve will have to be recalibrated on operating unit. (Refer to Spec section for setting.)
9. Adjust by adding or removing shims under spring.

REASSEMBLY

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





1 SCREW - mtg. plate
2 WASHER - flat
3 PLATE - bellows end
4 GASKET - end plate
5 SHIM - adjusting
6 SPRING - bellows
7 BELLOWS & SHAFT - assy
8 O-RING
9 HOUSING
10 TEE
11 GASKET - piston housing
12 PISTON
13 SPRING - piston
14 NUT - adjusting
15 PIN - cotter
16 HOUSING - piston
17 O-RING - valve to compr.

Installation

1. Install throttling valve using new O-ring soaked in compressor oil. Bolt throttling valve to compressor.
2. Connect suction hose from the throttling valve to the accumulator tank. Install line from compound gauge.
3. Pressurize the system and check for leaks. If no leaks are found, evacuate the system.
4. Open refrigeration valves and place the unit in operation.

THREE-WAY VALVE CONDENSER PRESSURE BYPASS CHECK VALVE

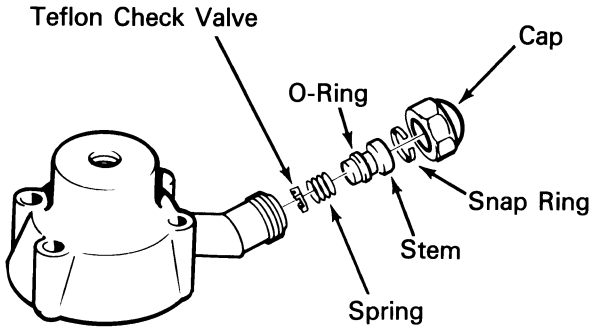
Removal

1. Remove the refrigerant charge.
2. Unscrew the condenser pressure bypass check valve cap from 3-way valve.
3. Remove snap ring.
4. Unscrew the check valve stem by using a screwdriver in the slot provided.

   NOTE: Spring and valve are held in by the stem. While removing the stem, use care so spring and valve are not lost.
5. Remove spring and teflon valve.
6. Inspect the check valve in the 3-way valve.
7. If replacement parts are needed, a 60-163 kit must be used which includes the teflon valve, 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 teflon check valve on the other end of the spring with the hole in the valve towards the spring.



3. Coat the entire assembly with compressor oil and install the assembly into the check valve seat in the 3-way valve.

   CAUTION: The teflon valve must be inserted with the flat side down to ensure proper sealing.

4. Screw the check valve stem into the 3-way valve until the snap ring can be installed.

5. Install snap ring.

6. Unscrew (back-seat) the check valve stem against the snap ring.

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

7. Coat sealing area in cap with compressor oil, install and tighten cap on 3-way valve.

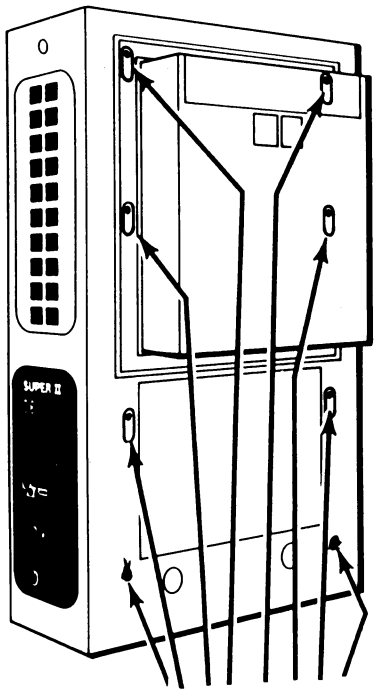
8. Pressurize the refrigeration system and test for leaks. If no leaks are found, evacuate the system.

9. Recharge the unit.

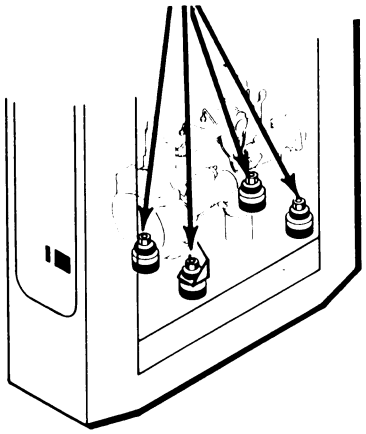
Structural Maintenance

UNIT AND ENGINE MOUNTING BOLTS

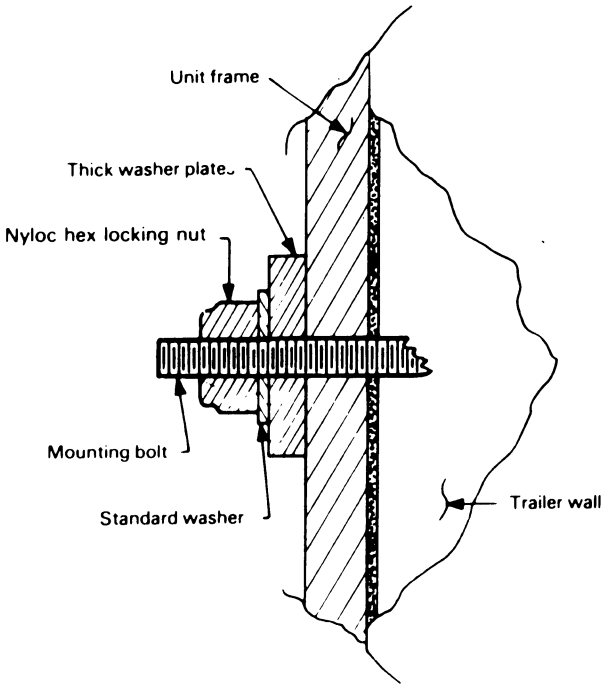
Check and tighten all unit and engine mounting bolts during scheduled maintenance inspections. Torque the unit mounting bolts to 60 ft-lb (81.3 N·m). Torque the engine mounting bolts to 150 ft-lb (203 N·m).



Check Bolts for Tightness



Unit and Engine Mounting Bolts



Installation of the Washer Plate

UNIT INSPECTION

Inspect the unit during unit pre-trip 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 COIL

Clean the condenser coil during scheduled maintenance inspections by blowing compressed air from the inside of the coil out toward the roadside of the unit (the direction opposite normal air flow). Use blower access panel on coil header plate for access to fin area. Inspect the coil and fins for damage and repair if necessary.

CAUTION: Air pressure should not be high enough to damage coil fins.

DEFROST DRAINS

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

EVAPORATOR COIL

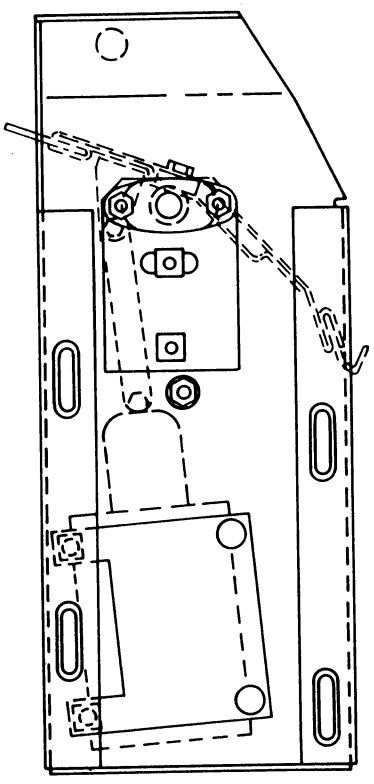
Clean the evaporator coil during scheduled maintenance inspections by blowing compressed air from the back of the coils (the direction opposite the normal air flow). Inspect the coils and fins for damage and repair if necessary.

CAUTION: Air pressure should not be high enough to damage coil fins.

DEFROST DAMPER

Clean the damper during scheduled maintenance inspections for shaft wear and sealing against air flow.

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



Defrost Damper

FAN MODULE

Fan Module Removal

1. Remove the condenser grille.
2. Remove the condenser screen.
3. Remove the condenser frame mount bolts and remove the condenser frame and orifice.
4. Loosen the lower idler and remove the belt.
5. Remove both idlers.
6. Remove the fan module mount bolts and remove the fan module.

Installation

1. Place the fan module in the frame and loosely install all of the mount bolts.
2. Tighten the fan module mount bolts.
3. Install the upper idler.
4. Install the lower idler but do not tighten the idler.
5. Install the fan belt, adjust the belt to the proper tension and tighten the lower idler.
6. Install the condenser orifice and frame, loosely install the mount bolts and center the fan in the orifice opening.
7. Check the radial clearance by passing a .15 in. (3.8 mm) gauge wire completely around the circumference of the orifice and tighten the mount bolts.
8. Install the condenser screen.
9. Install the condenser grille.

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 normally utilized except after removal and repair of the fan shaft assembly. The condenser end oil seal and hte evaporator end oil seal 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 Part No. 203-278.

Fan Shaft Assembly Overhaul

Disassembly

1. Remove the fan shaft assembly from the fan module. 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 retainer cap.
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 retainer cap and from the evaporator end of the assembly. With the seals removed, clean the housing and cap 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 remove the roll pin that is in the center of the shaft.
8. With the roll pin removed, place a pipe over the shaft and drive one bearing down until the opposite bearing and bearing spacer release from the shaft.
9. After removing one bearing and the bearing spacer, turn the shaft upside down, and using the pipe drive the other bearing off.
10. The bearing races can now be driven out with a punch and replaced in the same manner.

Reassembly

1. Install the new bearings on the shaft with a pipe in the same way they were removed.
2. When replacing the bearing race on the evaporator end of the assembly, the splash guard will come out with the race. Reinstall the splash guard after replacing the bearing race.
3. Install a new oil seal on the evaporator end of the assembly after replacing the bearing race and splash guard.
4. Place the shaft in the housing. Install a new seal in the retainer cap. Use the original shims and replace the O-ring if needed.
5. Place the retainer cap assembly over the shaft, then isntall the bolts.
6. Torque the bolts in a criss-cross pattern in equal steps to 6.7 ft-lb (9.0 N·m).
7. Lock the assembly in a vise and set up a dial indicator to read the end play. To measure the end-play, rotate the shaft while pushing in one direction, and set the dial indicator to '0'. Now rotate the shaft and pull in the opposite direction while reading the dial indicator. The end play should be .001-.005 in. (0.025-0.127 mm). If the end-play is incorrect, use different shims to obtain the correct end-play.

   Shims available from Service Parts Department:

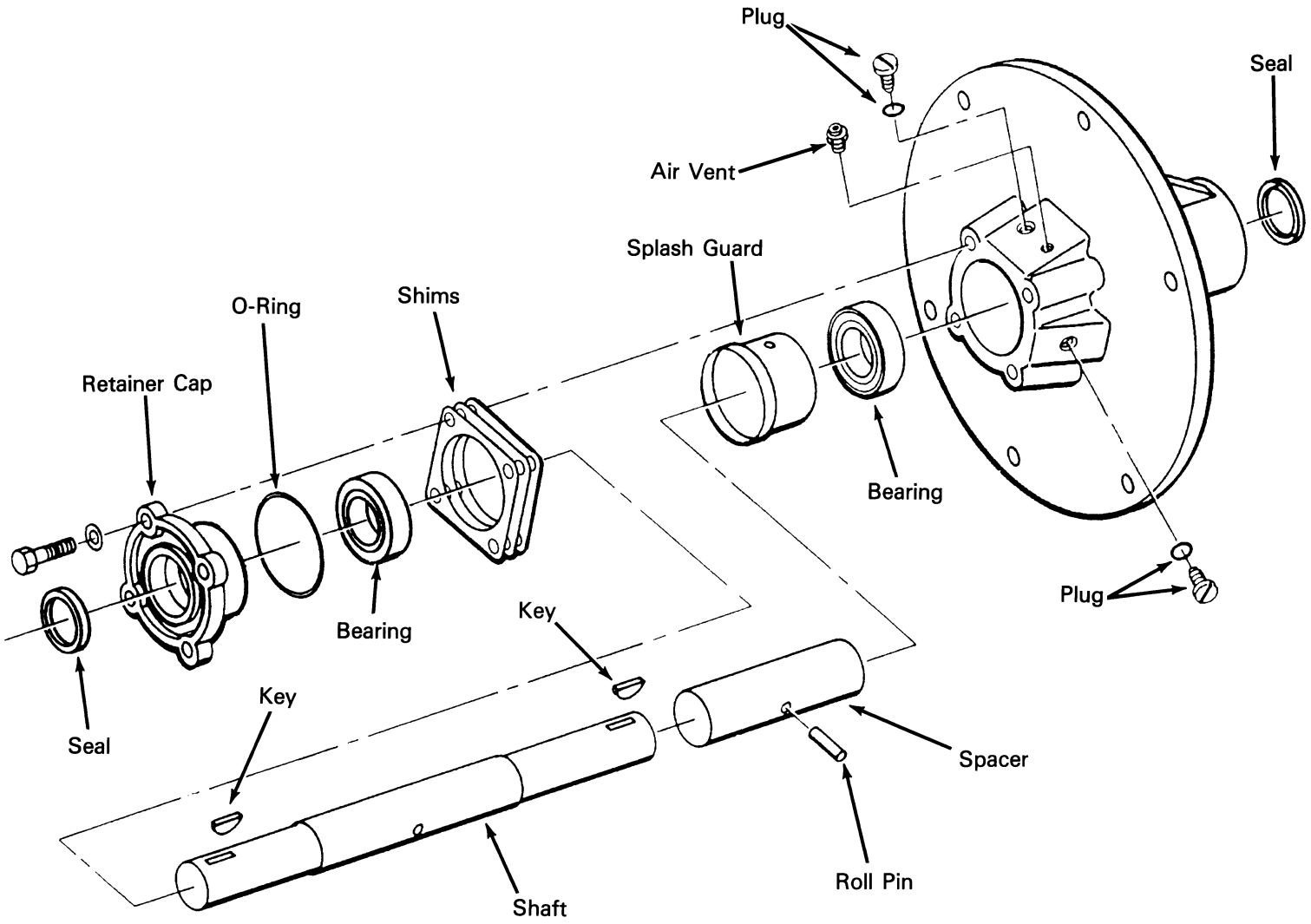
.020 in. (0.500 mm)	TK Part No. 99-4231
.007 in. (0.177 mm)	TK Part No. 99-2902
.005 in. (0.127 mm)	TK Part No. 99-2901

8. After the correct end-play is obtained, add oil for the bearings.

   NOTE: Use ONLY Thermo King special fan shaft oil in this assembly.

   Lock the assembly in a vise with the vent facing up. Pour oil through the top plug until it runs out of the side hole. The assembly holds 2.2 ozs. (62.9 gms). Check the condition of the O-ring used on the plugs and replace if necessary. Install 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: Install the assembly in the fan module. Make sure the vent is mounted facing up.

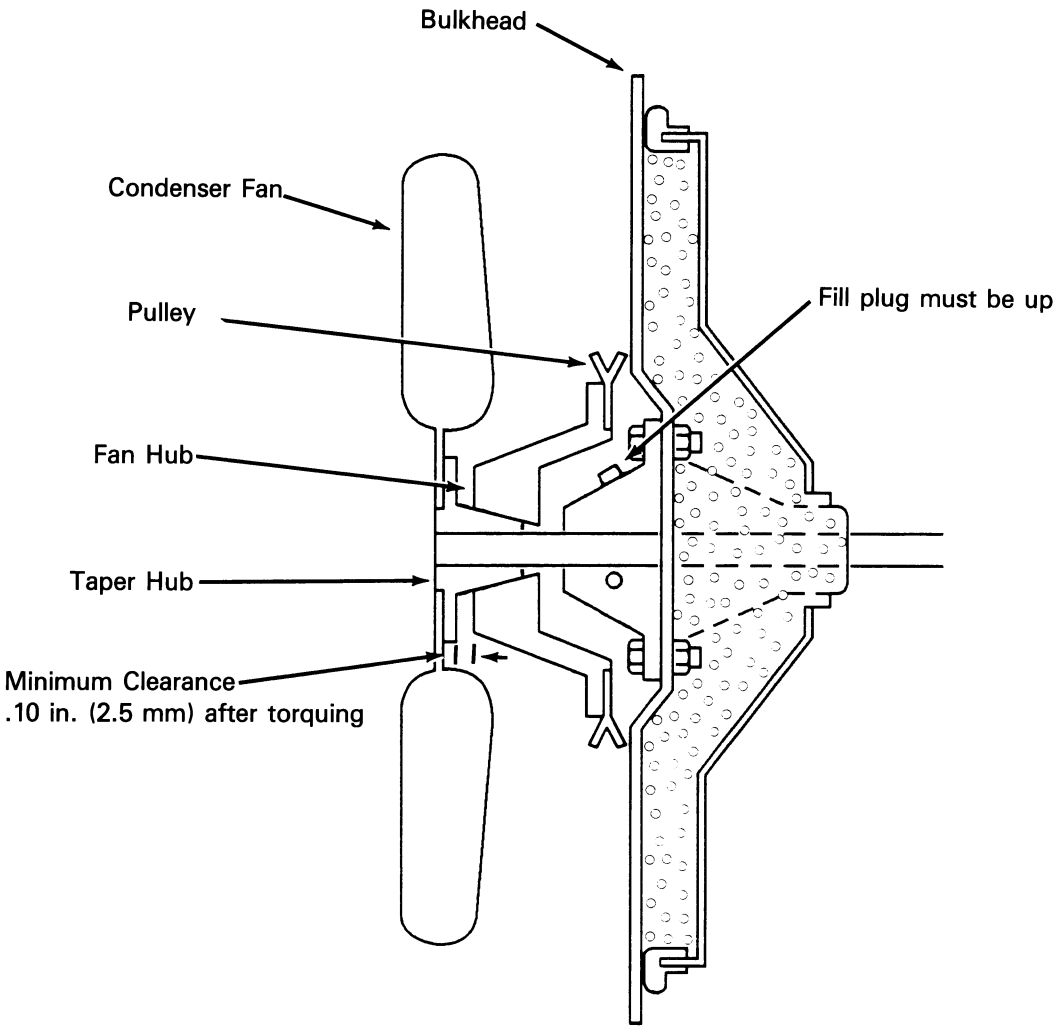


Fanshaft Assembly

Condenser Fan Positioning

When installing the condenser fan on the fanshaft, the fan must be positioned correctly.

1. Fasten the condenser fan hub and pulley together.
2. Place the taper hub and the fan on the condenser hub and install the taper hub bolts loosely.
3. Slide the fan assembly on the fanshaft till there is only enough clearance between the pulley and the bulkhead to allow the fan to rotate. This will assure minimum clearance when the taper hub bolts are tightened.
4. Tighten the taper hub bolts in a crossing pattern to 15-17 ft-lb (20-23 N·).
5. Check the clearance between the taper hub and the fan hub. A minimum clearance of .10 in. (2.5 mm) assures the taper hub is properly seated.

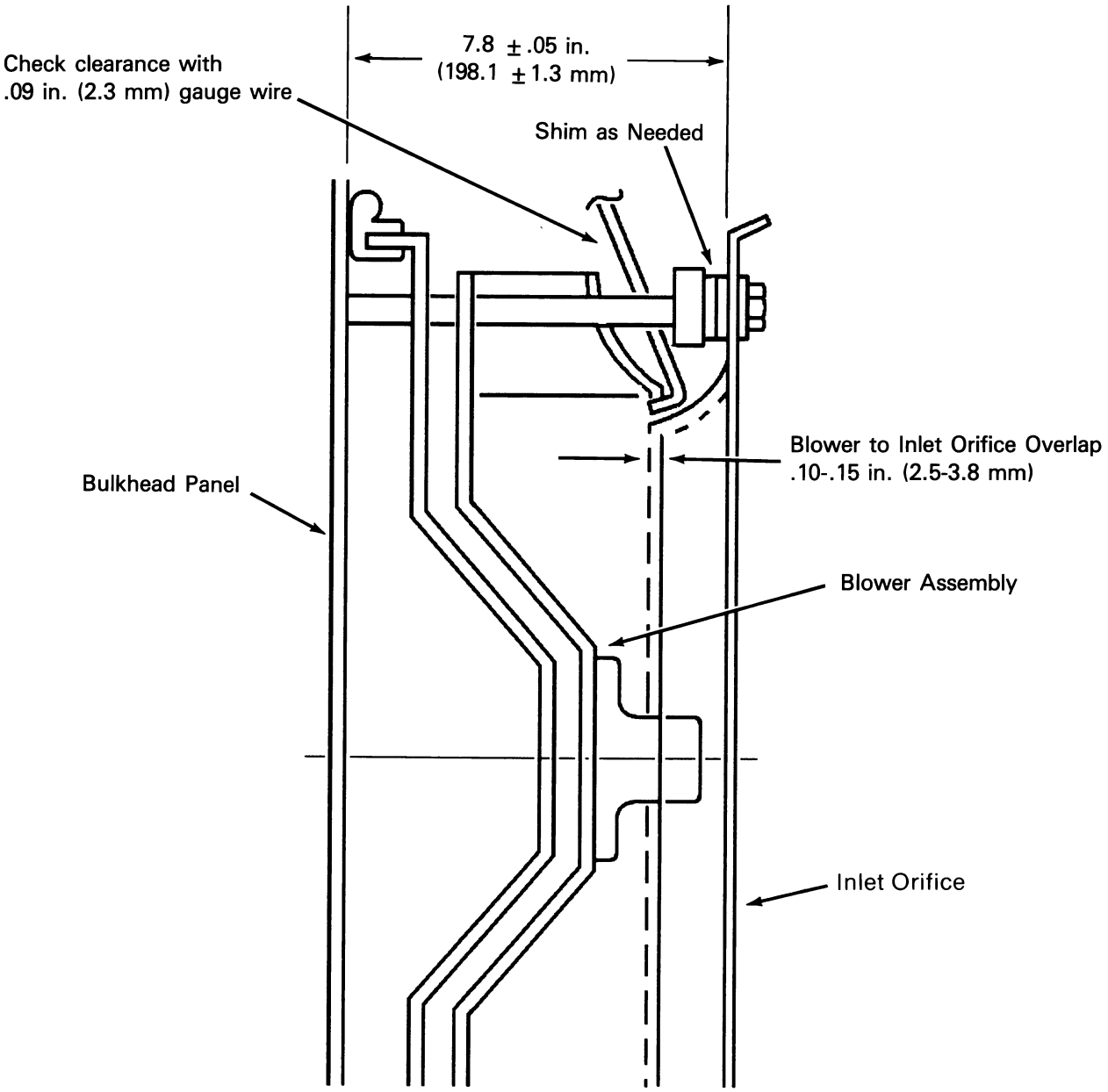


Condenser Fan Positioning

EVAPORATOR BLOWER ALIGNMENT

When mounting the evaporator blower assembly on the fanshaft, the blower and inlet orifice must be properly aligned for proper air flow and to prevent damage to the blower.

1. Slide the blower onto the fanshaft.
2. Shim the inlet orifice to position it 7.8 ±.05 in. (198.1 ±1.3 mm) from the bulkhead panel.
3. Center the inlet orifice in the blower orifice. Check the radial clearance with a .09 in. (2.3 mm) gauge wire and tighten the inlet orifice in position.
4. Position the blower on the fanshaft so the blower overlaps the inlet orifice by .10-.15 in. (2.5-3.8 mm). Snug the blower hub bolts.
5. Check the radial clearance by passing the gauge wire completely around the circumference of the inlet orifice and blower.
6. Adjust the inlet orifice as necessary and torque the blower hub bolts to 13 ft-lb (18 N·m).



Evaporator Blower Alignment

Mechanical Diagnosis

CONDITION	POSSIBLE CAUSE	REMEDY
Unit switch ON — indicator lights do not come on	Batteries discharged	Charge or replace batteries
	Red button out on Reset Switch	Check engine oil, coolant level, compressor oil pressure (optional) and CYCLE-SENTRY system (optional). Push in red button
	Corroded battery connections	Clean and tighten
	Circuit breaker tripping	Check for short circuit in unit wiring
Indicator lights come on but engine does not crank	Batteries discharged	Replace or recharge battery
	Defective Pre-heat/Start Switch	Replace switch
	Defective starter solenoid	Replace solenoid
	Corroded battery connections	Clean and tighten
	Defective starter	Repair starter
	Water in cylinders	Check for hydrostatic lock. Remove glow plugs and turn engine slowly
Starter motor turns but engine does not crank	Starter clutch defective	Replace
Engine cranks but fails to start	Injection pump defective	Replace pump
	Glow plugs defective	Replace defective glow plugs
	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
	Defective high pressure cutout	Replace high pressure cutout switch

CONDITION	POSSIBLE CAUSE	REMEDY
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
	Red button pops out on Reset switch	Check engine oil, coolant level, compressor oil pressure (optional) and CYCLE-SENTRY system (optional). Push in red button
	Circuit breaker tripping	Check for short circuit in unit wiring
	Clogged fuel tank or fuel lines	Clean fuel tank and fuel lines
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 tnak and fuel lines
	Speed adjustment wrong	Adjust speed
	Insufficient fuel volume leaving filter	Check for dirty filters or air in system
	Delivery of fuel pump insufficient	Repair pump
	Injection pump timing off	Adjust timing
	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 injection pump
Engine speed too high	Misadjusted speed solenoid	Adjust speed solenoid
	Control rod sticks	Replace injection pump
Engine fails to stop when unit is OFF	Injection pump defective	Replace pump

CONDITION	POSSIBLE CAUSE	REMEDY
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
	Valves out of adjustment	Adjust valves
	Fuel return line plugged	Remove return line restriction
	Rod or main bearing worn	Replace rod or main bearings
Engine runs hot	Dirty radiator	Wash radiator
	Coolant level is low	Add coolant
	Cooling system heavily scaled	Clean cooling system
	Cylinder head gasket leaks	Replace cylinder head gasket. Use correct gasket
	Faulty thermostat	Check or replace thermostat
	Loose or worn water pump belt	Replace belt
	Condenser shutters don't open	Adjust shutters or check power element
Oil pressure too low or drops suddenly. Minimum oil pressure for a hot engine is 15 psi (103 kPa) setting on the low oil pressure cutout	Insufficient oil in pan	Add oil
	Oil relief valve sticking	Disassemble and clean oil pressure regulator valve
	Faulty oil pressure gauge	Check oil line to oil pressure gauge to see if it is blocked. Check oil pressure gauge. Replace if necessary
	Worn oil pump, camshaft, main or connecting rod bearings, loose oil gallery plug	Repair engine

CONDITION	POSSIBLE CAUSE	REMEDY
High oil consumption	Oil leakage	Check and eliminate possible causes at cylinder head 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
	Clogged crankcase breather	Clean breather system
Battery is not recharging or is overcharging	Loose connections in electrical system	Check all electrical connections and charging system
	Alternator defective	Repair alternator
	Voltage regulator faulty	Replace regulator
	Battery defective	Replace battery
	Voltage regulator wire harness defective	Replace wire harnes
	Loose alternator belt	Replace alternator belt
	Defective Battery Sentry module	Replace Battery Sentry module

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

CYCLE-SENTRY Diagnosis

Condition	Probable Cause	Test Procedure
Run relay and preheat relay won't energize when required	Open 7A circuit from selector switch to run and preheat relay	Test 7A circuit
	Defective selector switch	Test circuit from 7M to 7A on switch in the start/stop position
	Open 7M circuit from terminal strip to selector switch	Test 7M circuit
	Open diode from 7X to 7M on terminal strip	Test diode
	Open jumper circuit from 7 to 7X in CYCLE-SENTRY V plug to thermostat harness	Test jumper circuit
	Open 7 circuit form the thermostat to CYCLE-SENTRY V plug	Test 7 circuit
	Defective load temperature thermostat not supplying power to the 7 circuit when thermostat calls for high speed.	Check 7 circuit with thermostat in high speed mode
	Open or resistance in the chassis ground circuit fromm the printed circuit board	Check the chassis ground circuit from the printed circuit board to the battery
Run relay won't energize. Preheat relay does energize	Defective run relay	Test or replace run relay
	Defective CSM	Replace CSM
Preheat relay won't energize. Run relay does energize	Defective preheat relay	Test or replace preheat relay
	Defective CSM	Test or replace CSM

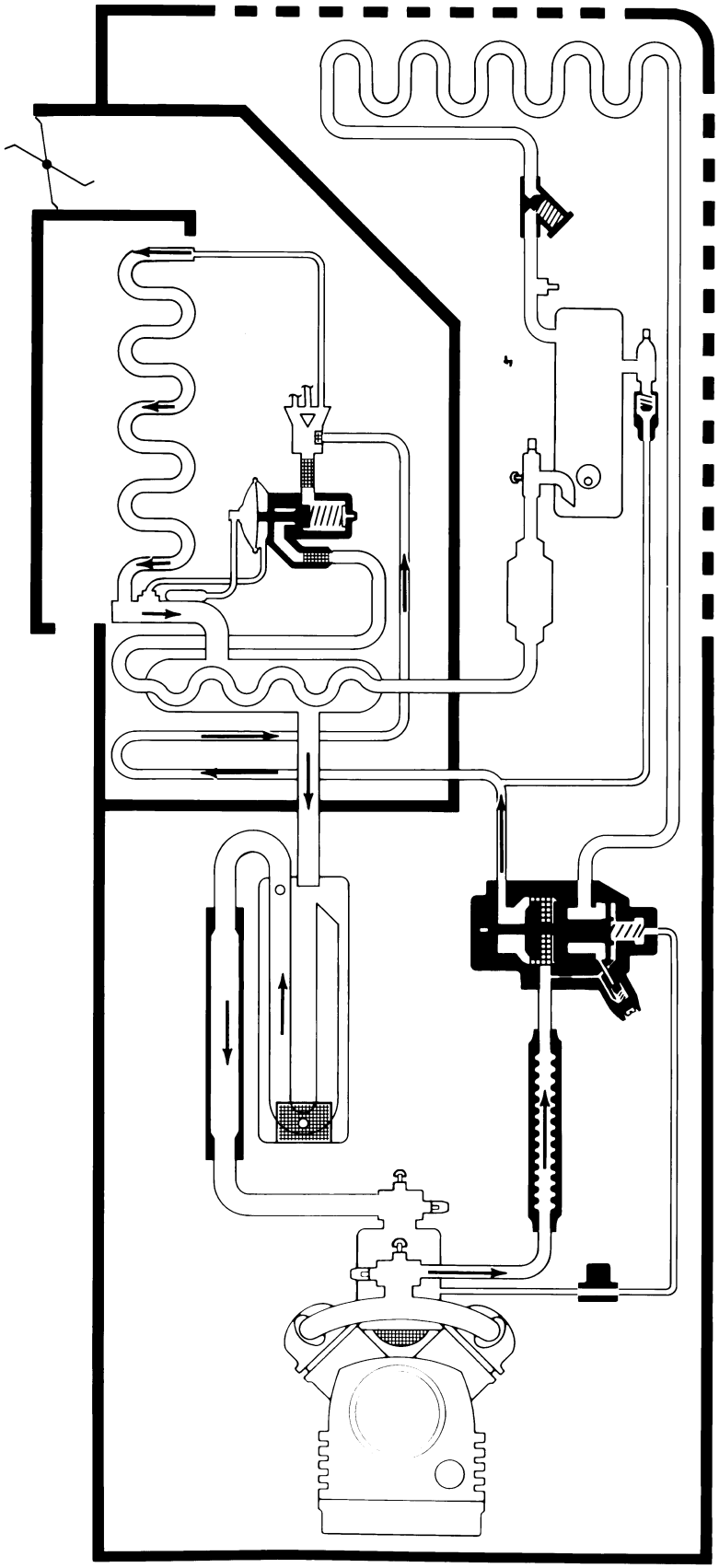
Condition	Probable Cause	Test Procedure
Unit will not automatically preheat but will preheat manually	Deffective preheat relay	Test or replace preheat relay
	Defective CSM	Test or replace CSM
	Open H circuit from preheat relay to glow plugs	Test H circuit
	Open 2A circuit to preheat relay	Test 2A circuit
Fuel solenoid energizes on continuous operation but will not energize on CYCLE-SENTRY operation	Defective run relay	Test or replace run relay
	Defective selector switch	Test circuit from 8V to 8B on switch in stop/start position
	Open 8B circuit from selector switch to terminal strip	Test 8B circuit
Unit will not automatically crank but cranks manually and preheats automatically	Defective start relay	Test or replace start relay
	Defective CSM	Test or replace the CSM
	Open 2A circuit to start relay	Test 2A circuit
Unit cranks prematurely before proper heat has occurred	Defective engine temperature thermistor	Test engine temperature thermistor
	Shorted blue wires from terminal strip to engine temperature thermistor	Check wiring
	Defective CSM	Test or replace CSM
Unit cranks only after preheat has occurred for approximately 6 minutes	Defective engine temperature thermistor	Test engine temperature thermistor
	Open blue wires from terminal strip to engine temeprature thermistor	Check wiring
	Defective CSM	Test or replace CSM

Condition	Probable Cause	Test Procedure
Starter cranks 4-5 seconds only and disengages	Defective or improperly adjusted RPM sensor	Test RPM sensor
	Open FS-1 or FS-2 circuit from the RPM sensor to the terminal strip	Test FS-1 and FS-2 circuits
	Starter not cranking engine above 50 rpm	Test starter, battery voltage and cranking speed
	Defective CSM	Test or replace CSM
Starter disengages before 4-5 seconds and before engine starts	Defective CSM	Replace CSM with known good one. Do not rely on bench test of CSM
	Low battery voltage or condition	Test battery
	Poor connection or excessive voltage drop from battery positive post to 7A circuit on the terminal strip or from CH on the terminal strip to negative battery post	While starter is engaging, voltage drop test from battery positive post to 7A terminal on terminal strip and voltage drop test from battery negative post to CH on terminal strip
Unit does not disengage starter when engine is started	Defective CSM	Test or replace CSM
	Defective start relay	Test or replace start relay
Unit keeps starter engaged for approximately 4 seconds even if engine starts in less than 4 seconds	Defective or improperly adjusted RPM sensor	Test RPM sensor
	Open FS-1 or FS-2 circuit from the RPM sensor to the terminal strip	Test FS-1 and FS-2 circuits
	Defective CSM	Test or replace CSM

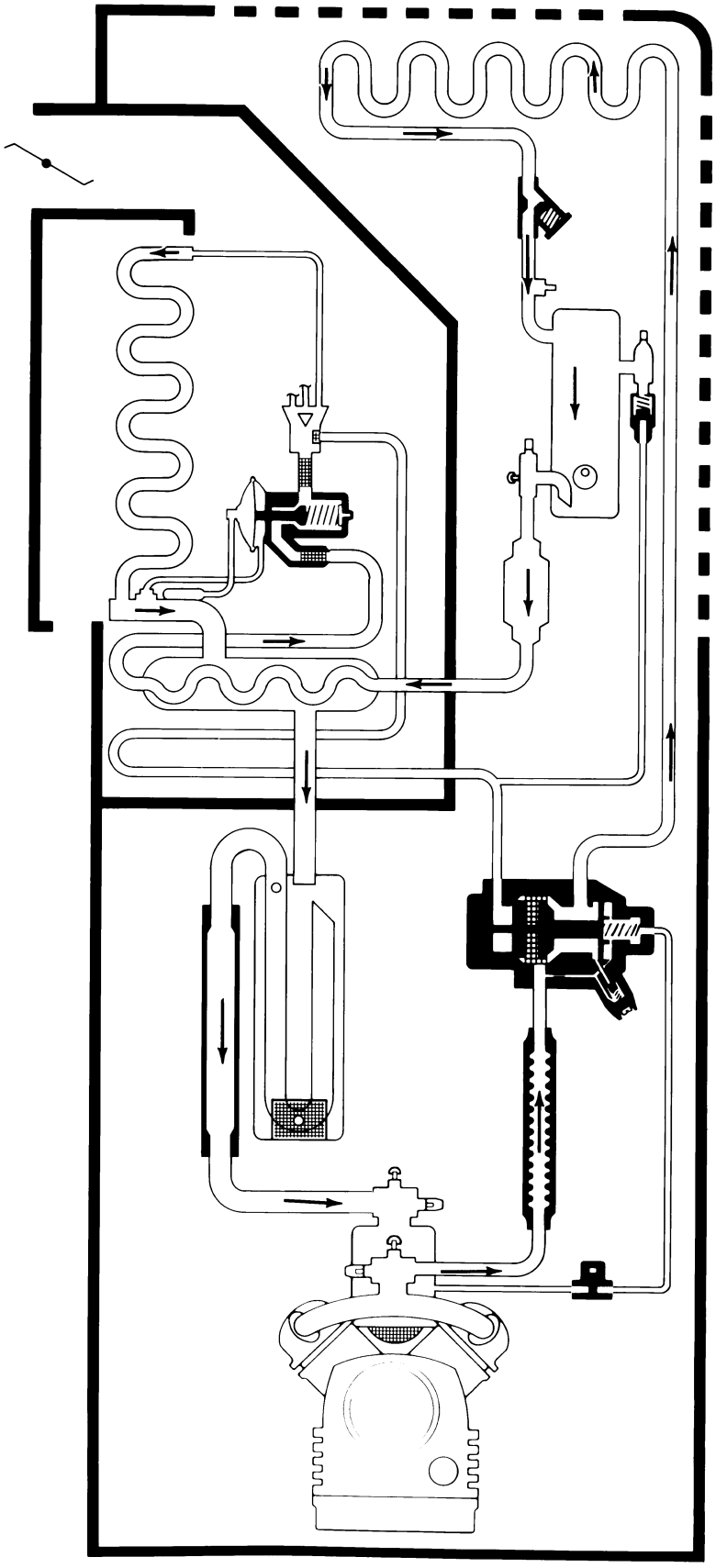
Refrigeration Diagnosis

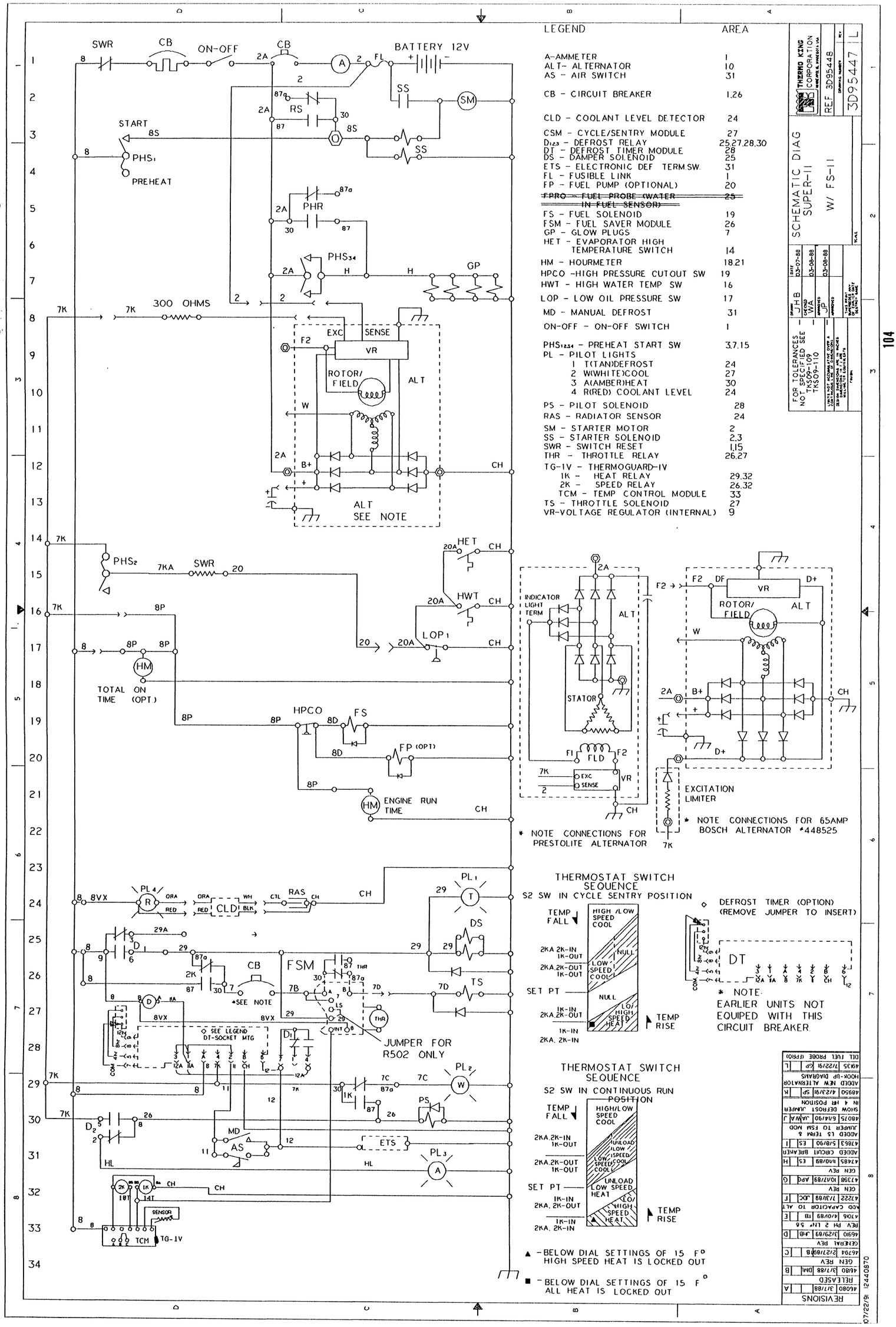
Rapid cycling between Cool and Heat	Unit cools in heat and defrost cycle	Unit heats in refrigeration cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in vacuum	Bubbles in liq. sight glass/sight glass empty	Suction line frosting back	Unable to pump down system	Unable to pull vacuum in compressor	Unable to hold vacuum in compressor	Noisy compressor	Unit not refrigerating	Unit not defrosting	CAUSE
			●			●									●	●		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 improverly 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 dehydrator
																	●	Eaporator shutter open
							●		●							●		Evaporator shutter stuck closed
					●													Discharge service valve back seated
								●										Suction service valve back seated
	●	●		●		●					●		●				●	Faulty 3-way valve
	●	●														●	●	Faulty Pilot solenoid
	●																●	Loose or broken electrical connections
●						●	●		●							●		Thermostat or thermometer out of calibration
			●	●	●	●	●	●	●									Suction pressure gauge out of calibration
											●	●	●					Leaky receiver tank outlet valve
											●							Leaky bypass check valve
																	●	Leaky condenser check valve
																	●	Faulty 3-way condenser pressure bypass check valve

Super II Defrost and Heating Cycle



Super II Refrigeration Cycle





LEGEND

	AREA
A-AMMETER	1
ALT- ALTERNATOR	10
AS - AIR SWITCH	31
CB - CIRCUIT BREAKER	1,26
CLD - COOLANT LEVEL DETECTOR	24
CSM - CYCLE/SENTRY MODULE	27
D_{123} - DEFROST RELAY	25,27,28,30
DT - DEFROST TIMER MODULE	28
DS - DAMPER SOLENOID	25
ETS - ELECTRONIC DEF TERM SW	31
FL - FUSIBLE LINK	1
FP - FUEL PUMP (OPTIONAL)	20
~~FPRO - FUEL PROBE (WATER IN FUEL SENSOR)~~	~~25~~
FS - FUEL SOLENOID	19
FSM - FUEL SAVER MODULE	26
GP - GLOW PLUGS	7
HET - EVAPORATOR HIGH TEMPERATURE SWITCH	14
HM - HOURMETER	18,21
HPCO -HIGH PRESSURE CUTOUT SW	19
HWT - HIGH WATER TEMP SW	16
LOP - LOW OIL PRESSURE SW	17
MD - MANUAL DEFROST	31
ON-OFF - ON-OFF SWITCH	1
PHS_{1234} - PREHEAT START SW	3,7,15
PL - PILOT LIGHTS	
1 T(TAN)DEFROST	24
2 W(WHITE)COOL	27
3 A(AMBER)HEAT	30
4 R(RED) COOLANT LEVEL	24
PS - PILOT SOLENOID	28
RAS - RADIATOR SENSOR	24
SM - STARTER MOTOR	2
SS - STARTER SOLENOID	2,3
SWR - SWITCH RESET	1,15
THR - THROTTLE RELAY	26,27
TG-1V - THERMOGUARD-IV	
1K - HEAT RELAY	29,32
2K - SPEED RELAY	26,32
TCM - TEMP CONTROL MODULE	33
TS - THROTTLE SOLENOID	27
VR-VOLTAGE REGULATOR (INTERNAL)	9

THERMOSTAT SWITCH SEQUENCE
S2 SW IN CYCLE SENTRY POSITION

THERMOSTAT SWITCH SEQUENCE
S2 SW IN CONTINUOUS RUN POSITION

▲ -BELOW DIAL SETTINGS OF 15 F° HIGH SPEED HEAT IS LOCKED OUT

■ -BELOW DIAL SETTINGS OF 15 F° ALL HEAT IS LOCKED OUT

◇ DEFROST TIMER (OPTION) (REMOVE JUMPER TO INSERT)

* NOTE- EARLIER UNITS NOT EQUIPED WITH THIS CIRCUIT BREAKER.

THERMO KING CORPORATION
REF 3D95448
3D95447 L

SCHEMATIC DIAG
SUPER-II W/ FS-II

FOR TOLERANCES NOT SPECIFIED SEE TK50-100 TK50-110

REVISIONS				
46080	3/17/88			A
RELEASED				
46180	3/17/88	DML		B
GEN REV				
46704	2/27/89	RB		C
GENERAL REV				
46910	3/29/89	JHB		D
REV PH 2 LN* 56				
47106	4/09/89	TB		E
ADD CAPACITOR TO ALT				
47222	7/3/89	JDC		F
GEN REV				
47238	10/17/89	APC		G
GEN REV				
47485	11/09/89	ES		H
ADDED CIRCUIT BRE AKER				
47863	5/8/90	ES		I
ADDED LS TERM & JUMPER TO FSM MOD				
48075	6/14/90	JM	MA	J
SHOW DEFROST JUMPER IN 4 HR POSITION				
48950	4/23/91	SP		K
ADDED NEW ALTERNATOR HOOK-UP DIAGRAMS				
DEL FUEL PROBE (FPRO)				
49135	7/22/91	SP		L

07/22/91 12440870

104

NOTES:
1. EARLIER UNITS NOT EQUIPED WITH THIS CIRCUIT BREAKER
2. JUMPER FOR R502 ONLY

DEFROST TIMER OPTION (REMOVE JUMPER TO INSERT)

DEFROST RELAY

PC BD

DEFROST TIMER SOCKET (SEE ABOVE)

JUMPER

SWITCH PANEL

RESET SWITCH

AMMETER

CB #1

CB #2

MAN DEF SWITCH

PREHEAT

START

ON-OFF SW

14-PIN CONN

INDICATOR LIGHTS
COOL HEAT
DEFROST

DIGITAL THERMOMETER

EVAP SENSOR

TCM

TG-IV

LS SEE NOTE 2

INT 7

THERMOSTAT RELAY BD

TIE 7U OFF

10T-14T

2K

1K

SEE NOTE 1 CIRCUIT BREAKER

ALTERNATOR DIAGRAMS

CONNECTIONS FOR PRESTOLITE ALTERNATOR

CONNECTIONS FOR 65 AMP BUSCH ALTERNATOR #448525

THERMOMETER SENSOR

ELECTRONIC TEMPERATURE SWITCH

EVAPORATOR HIGH TEMPERATURE SWITCH

DAMPER SOLENOID

DEFROST AIR SWITCH

EVAP SECTION

ENGINE SECTION

ALTERNATOR

SEE OTHER ALTERNATOR DIAGRAMS

BOX TBD

RAD SENSOR

FOR REMOTE LIGHTS (OPTIONAL)

STARTER SOLENOID

STARTER

FUSIBLE LINK

HIGH COOLANT TEMPERATURE SWITCH

FUEL SHUTOFF SOLENOID

ENGINE LOW OIL PRESSURE SWITCH

CLOP (OPT)

THROTTLE SOLENOID

12V BATTERY

GLOW PLUGS

COOLANT LEVEL DETECT

COOLANT CHECK LIGHT

FUEL (FLASHING)

ENGINE RUN HOURMETER

PILOT SOLENOID

HIGH PRESSURE CUTOUT SWITCH

FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS09-110

UNITS NOT ACCUMULATIVE OVER A CONTINUOUS 1 DR. OF DIMENSIONS

DESIGN DIMENSIONS ARE IN INCHES DIMENSIONS IN [ ] ARE MILLIMETER EQUIVALENTS

FINISH

DRAWN	MTN 3/6/88
CHECKED	WA 3/8/88
APPROVED	JP 3/8/88
APPROVED	

THIS PRINT SUPERSEDES ANY OF EARLIER DATE DESTROY SAME.

WIRING DIAGRAM
SUPER-II
W/FS II

SHEET #1 OF 1

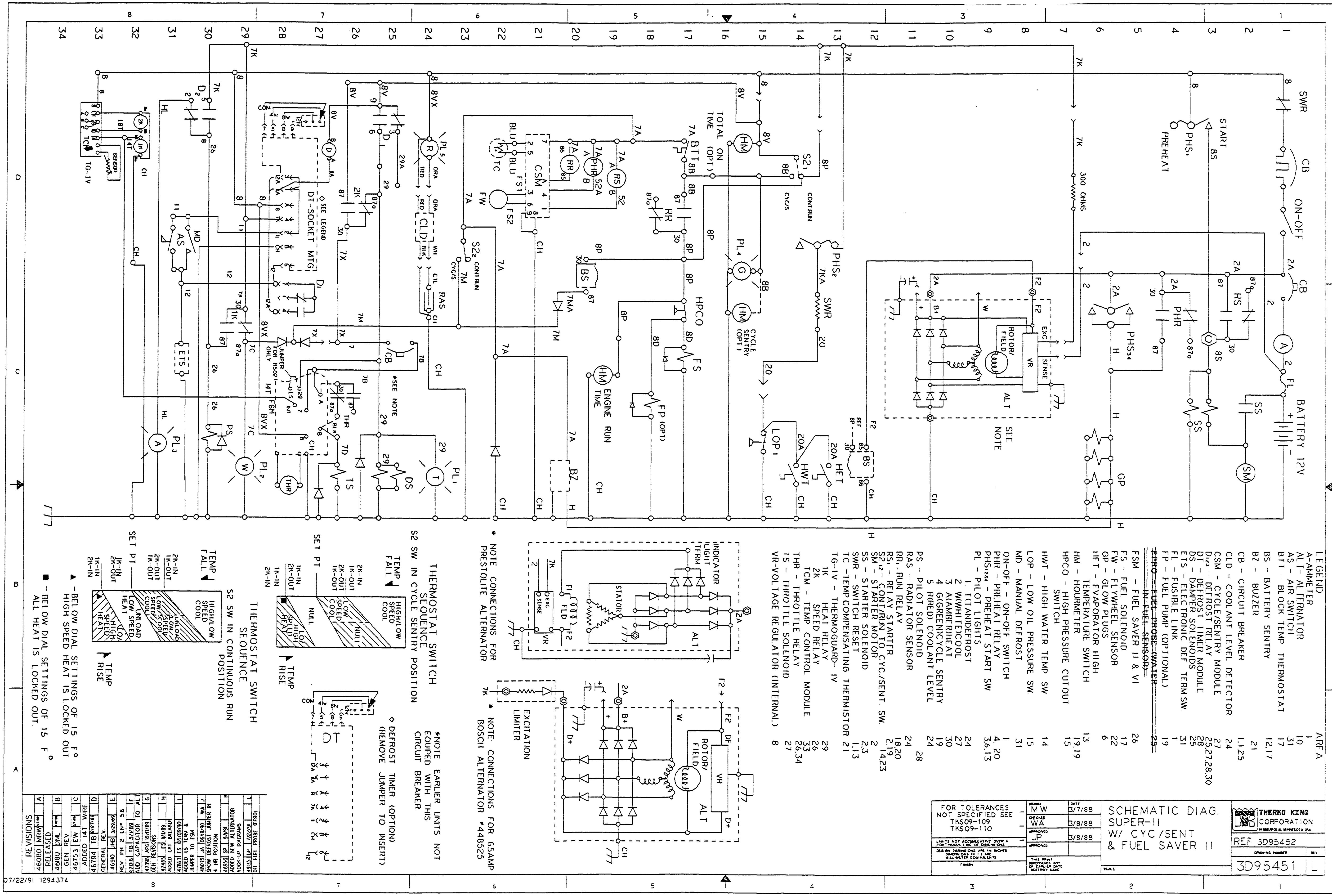
SCALE

THERMO KING CORPORATION MINNEAPOLIS MINNESOTA USA

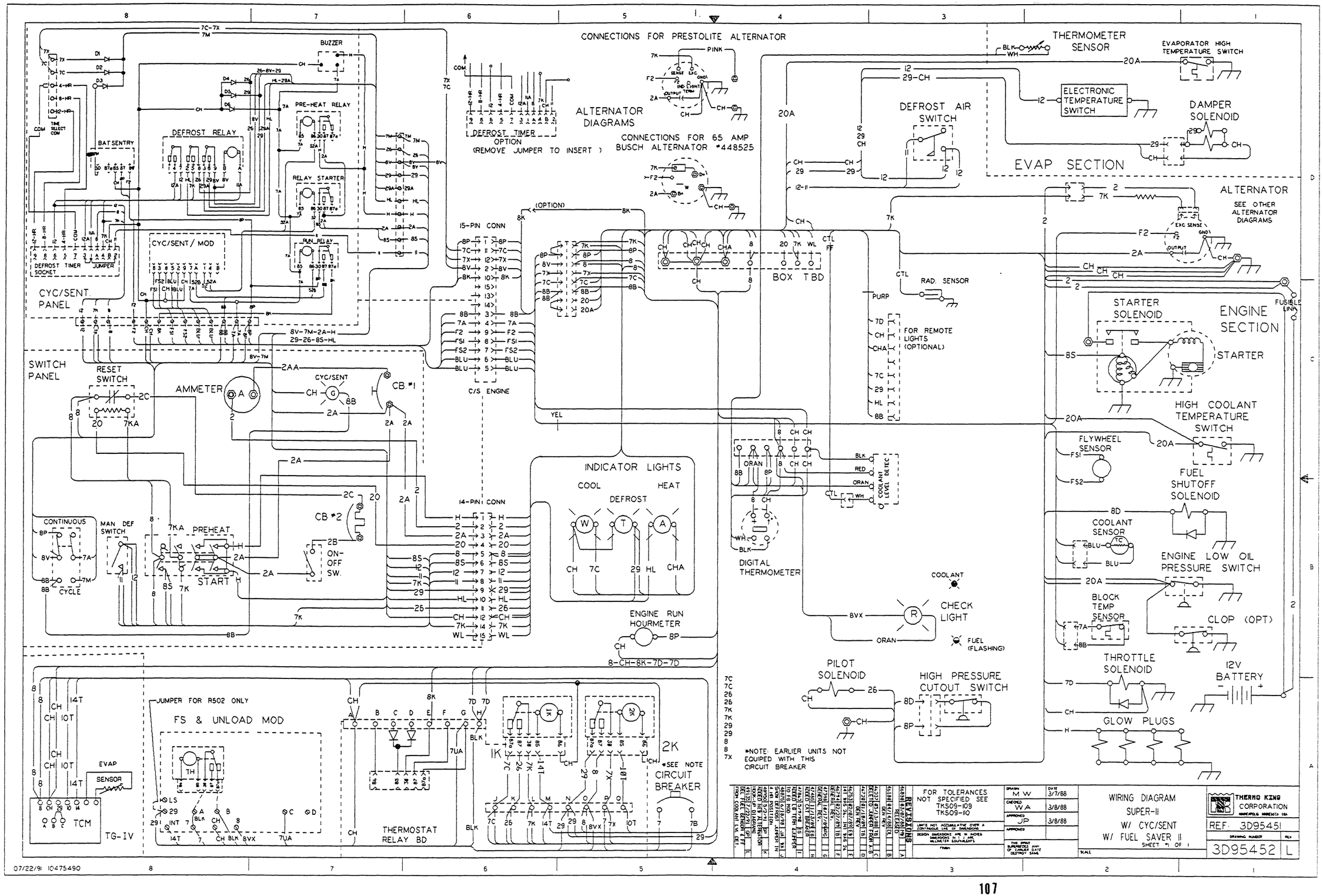
REF 3D95447

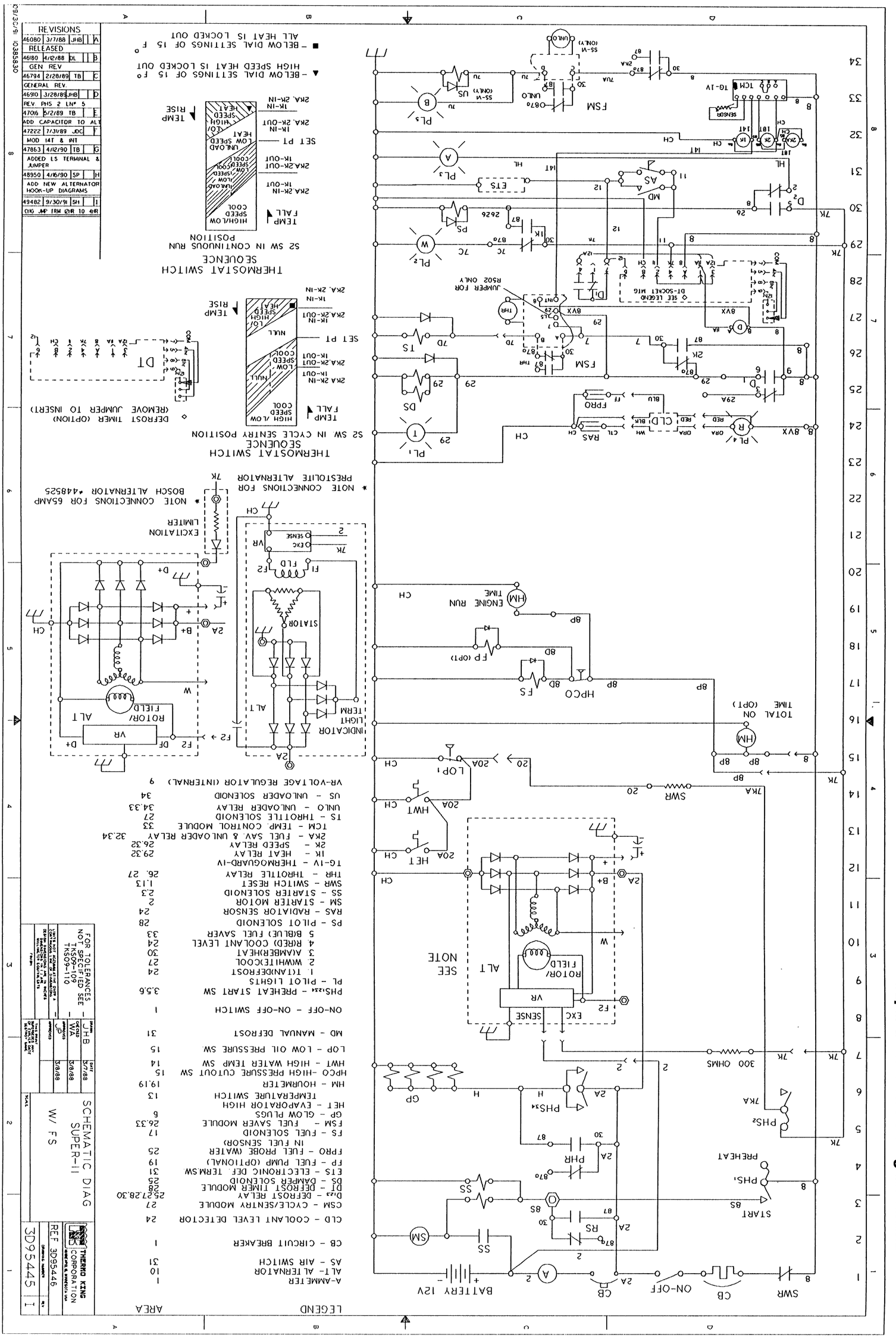
DRAWING NUMBER 3D95448 REV L

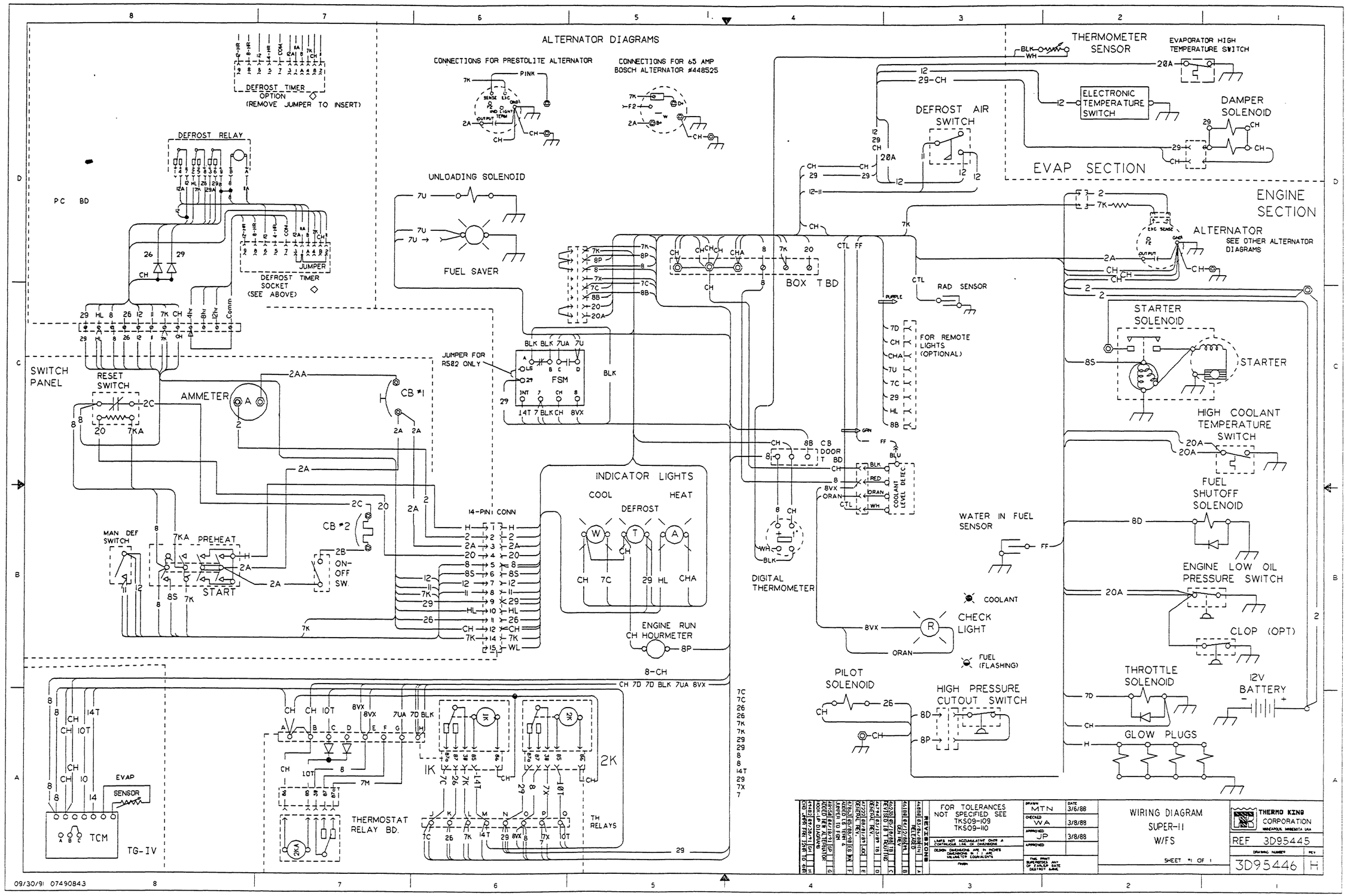
07/22/91 11494958

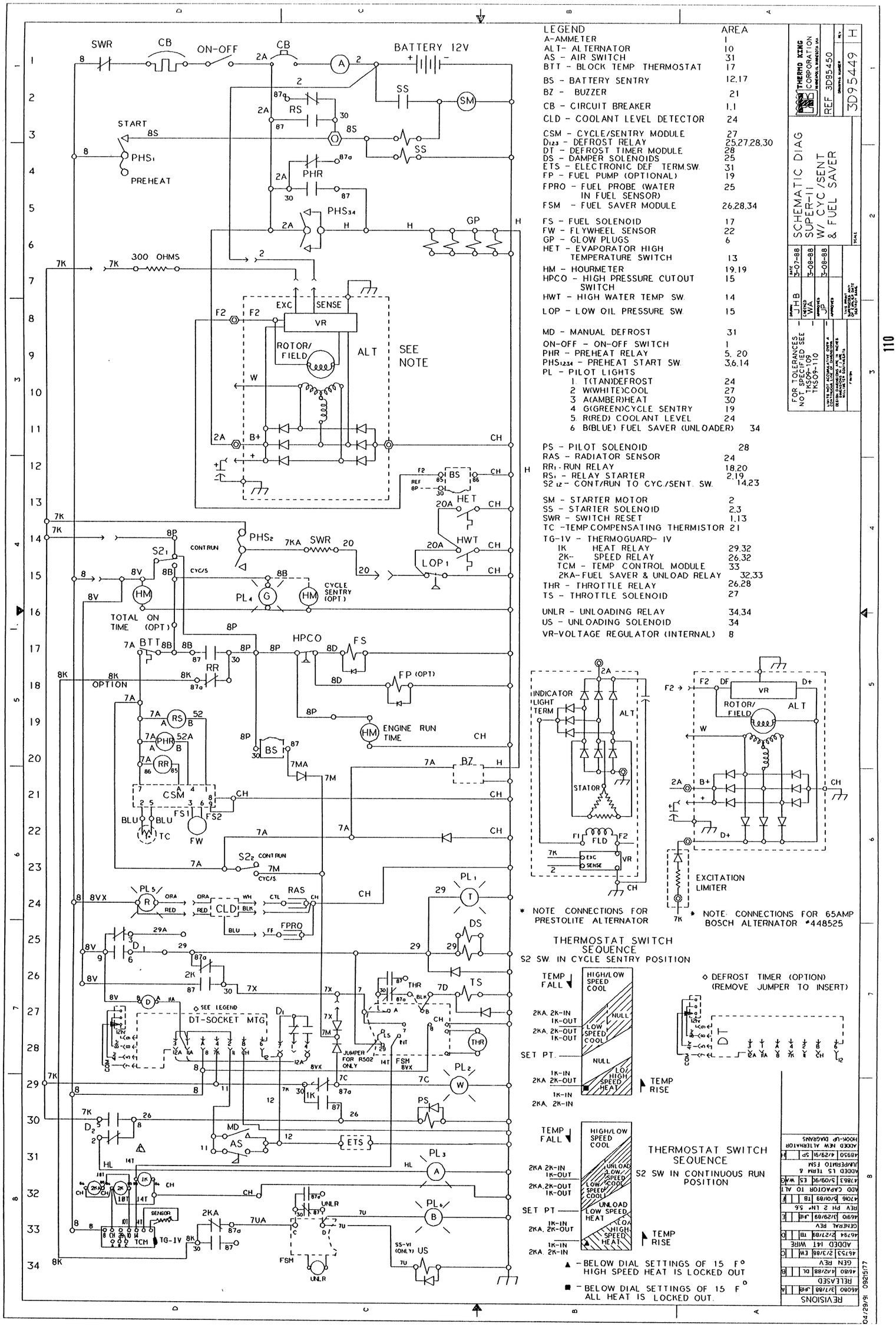

LEGEND AREA
A - AMMETER 1
ALT - ALTERNATOR 10
AS - AIR SWITCH 31
BTT - BLOCK TEMP THERMOSTAT 12,17
BS - BATTERY SENTRY
BZ - BUZZER 21
CB - CIRCUIT BREAKER 1,11,25
CLD - COOLANT LEVEL DETECTOR 24
CSM - CYCLE/SENTRY MODULE 27
D1,2,3 - DEFROST RELAY 25,27,28,30
DT - DEFROST TIMER MODULE 28
DS - DAMPER SOLENOIDS 25
ETS - ELECTRONIC DEF TERM SW 31
FL - FUSIBLE LINK 1
FP - FUEL PUMP (OPTIONAL) 19
FPRO - FUEL PROBE (WATER IN FUEL SENSOR) 25
FSM - FUEL SAVER II & VI 26
FS - FUEL SOLENOID 17
FW - FLYWHEEL SENSOR 22
GP - GLOW PLUGS 6
HET - EVAPORATOR HIGH TEMPERATURE SWITCH 13
HM - HOURMETER 19,19
HPCO - HIGH PRESSURE CUTOUT SWITCH 15
HWT - HIGH WATER TEMP SW 14
LOP - LOW OIL PRESSURE SW 15
MD - MANUAL DEFROST 31
ON-OFF - ON-OFF SWITCH 1
PHR - PREHEAT RELAY 4,20
PHS1,2,3,4 - PREHEAT START SW 3,6,13
PL - PILOT LIGHTS
1 T(TANDEM) 24
2 W(WHITE)COOL 27
3 A(AMBER)HEAT 30
4 G(GREEN)CYCLE SENTRY 19
5 R(RED) COOLANT LEVEL 24
PS - PILOT SOLENOID 28
RAS - RADIATOR SENSOR 24
RR - RUN RELAY 18,20
RS - RELAY STARTER 2,19
S2 - CONT/RUN TO CYC/SENT. SW 14,23
SM - STARTER MOTOR 2
SS - STARTER SOLENOID 2,3
SWR - SWITCH RESET 1,13
TC - TEMP COMPENSATING THERMISTOR 21
TG-IV - THERMOGUARD - IV
1K HEAT RELAY 29
2K SPEED RELAY 26
TCM - TEMP CONTROL MODULE 33
THR - THROTTLE RELAY 26,34
TS - THROTTLE SOLENOID 27
VR - VOLTAGE REGULATOR (INTERNAL) 8
* NOTE CONNECTIONS FOR PRESTOLITE ALTERNATOR
* NOTE CONNECTIONS FOR 65AMP BOSCH ALTERNATOR #448525
EXCITATION LIMITER
*NOTE EARLIER UNITS NOT EQUIPED WITH THIS CIRCUIT BREAKER
◇ DEFROST TIMER (OPTION) (REMOVE JUMPER TO INSERT)
THERMOSTAT SWITCH SEQUENCE
S2 SW IN CYCLE SENTRY POSITION
THERMOSTAT SWITCH SEQUENCE
S2 SW IN CONTINUOUS RUN POSITION
▲ - BELOW DIAL SETTINGS OF 15 F° HIGH SPEED HEAT IS LOCKED OUT
■ - BELOW DIAL SETTINGS OF 15 F° ALL HEAT IS LOCKED OUT
SCHEMATIC DIAG.
SUPER-II
W/ CYC/SENT
& FUEL SAVER II
THERMO KING CORPORATION
REF 3D95452
3D95451 L
REVISIONS

Super II MAX CS Wiring Diagram (after 4-11-89)




SCHEMATIC DIAG
SUPER-II
W/ FS
3D95445
REF 3D95446
THERMO KING CORPORATION
REVISIONS
LEGEND
AREA
A-AMMETER
ALT- ALTERNATOR
AS - AIR SWITCH
CB - CIRCUIT BREAKER
CLD - COOLANT LEVEL DETECTOR
CSM - CYCLE/SENTRY MODULE
D1,2 - DEFROST RELAY
DT - DEFROST TIMER MODULE
DS - DAMPER SOLENOID
ETS - ELECTRONIC DEF. TERM.SW
FP - FUEL PUMP (OPTIONAL)
FPRO - FUEL PROBE (WATER IN FUEL SENSOR)
FS - FUEL SOLENOID
FSM - FUEL SAVER MODULE
GP - GLOW PLUGS
HET - EVAPORATOR HIGH TEMPERATURE SWITCH
HM - HOURMETER
HPCO -HIGH PRESSURE CUTOUT SW
HWT - HIGH WATER TEMP SW
LOP - LOW OIL PRESSURE SW
MD - MANUAL DEFROST
ON-OFF - ON-OFF SWITCH
PHS1,2,3,4 - PREHEAT START SW
PL - PILOT LIGHTS
1 (TAN)DEFROST
2 WWHITE)COOL
3 AAMBER)HEAT
4 RED) COOLANT LEVEL
5 BBLUE) FUEL SAVER
PS - PILOT SOLENOID
RAS - RADIATOR SENSOR
SM - STARTER MOTOR
SS - STARTER SOLENOID
SWR - SWITCH RESET
TAR - THROTTLE RELAY
TG-1V - THERMOGUARD-1V
1K - HEAT RELAY
2K - SPEED RELAY
2KA - FUEL SAV. & UNLOADER RELAY
TCM - TEMP. CONTROL MODULE
TS - THROTTLE SOLENOID
UNLO - UNLOADER RELAY
US - UNLOADER SOLENOID
VR-VOLTAGE REGULATOR (INTERNAL)
THERMOSTAT SWITCH SEQUENCE
S2 SW IN CONTINUOUS RUN POSITION
S2 SW IN CYCLE SENTRY POSITION
DEFROST TIMER (OPTION)
(REMOVE JUMPER TO INSERT)
NOTE CONNECTIONS FOR PRESTOLITE ALTERNATOR
NOTE CONNECTIONS FOR 65AMP BOSCH ALTERNATOR #448525
BATTERY 12V
ENGINE RUN TIME
TOTAL ON TIME (OPT)
INDICATOR LIGHT TERM
EXCITATION LIMITER
ROTOR/ FIELD
SEE NOTE
START
PREHEAT
ON-OFF
SWR
300 OHMS
FOR TOLERANCES NOT SPECIFIED SEE TK5O9-109 TK5O9-110


ALTERNATOR DIAGRAMS
CONNECTIONS FOR PRESTOLITE ALTERNATOR
CONNECTIONS FOR 65 AMP BOSCH ALTERNATOR #448525
DEFROST TIMER OPTION (REMOVE JUMPER TO INSERT)
DEFROST RELAY
PC BD
DEFROST TIMER SOCKET (SEE ABOVE)
JUMPER
UNLOADING SOLENOID
FUEL SAVER
THERMOMETER SENSOR
EVAPORATOR HIGH TEMPERATURE SWITCH
ELECTRONIC TEMPERATURE SWITCH
DAMPER SOLENOID
DEFROST AIR SWITCH
EVAP SECTION
ENGINE SECTION
ALTERNATOR
SEE OTHER ALTERNATOR DIAGRAMS
STARTER SOLENOID
STARTER
BOX T BD
RAD SENSOR
FOR REMOTE LIGHTS (OPTIONAL)
SWITCH PANEL
RESET SWITCH
AMMETER
CB #1
CB #2
MAN DEF SWITCH
PREHEAT
START
ON-OFF SW.
14-PIN CONN
JUMPER FOR RS82 ONLY
FSM
INDICATOR LIGHTS
COOL
HEAT
DEFROST
ENGINE RUN CH HOURMETER
DIGITAL THERMOMETER
8B CB DOOR T BD
COOLANT LEVEL DETEC
WATER IN FUEL SENSOR
COOLANT
CHECK LIGHT
FUEL (FLASHING)
HIGH COOLANT TEMPERATURE SWITCH
FUEL SHUTOFF SOLENOID
ENGINE LOW OIL PRESSURE SWITCH
CLOP (OPT)
THROTTLE SOLENOID
12V BATTERY
GLOW PLUGS
PILOT SOLENOID
HIGH PRESSURE CUTOUT SWITCH
8-CH
EVAP SENSOR
TCM
TG-IV
THERMOSTAT RELAY BD.
TH RELAYS
1K
2K
FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS09-110
WIRING DIAGRAM SUPER-II W/FS
THERMO KING CORPORATION
REF 3D95445
3D95446 H
SHEET #1 OF 1
09/30/91 07490843



LEGEND	AREA
A-AMMETER	1
ALT- ALTERNATOR	10
AS - AIR SWITCH	31
BTT - BLOCK TEMP THERMOSTAT	17
BS - BATTERY SENTRY	12,17
BZ - BUZZER	21
CB - CIRCUIT BREAKER	1,1
CLD - COOLANT LEVEL DETECTOR	24
CSM - CYCLE/SENTRY MODULE	27
D1,2,3 - DEFROST RELAY	25,27,28,30
DT - DEFROST TIMER MODULE	28
DS - DAMPER SOLENOIDS	25
ETS - ELECTRONIC DEF. TERM.SW.	31
FP - FUEL PUMP (OPTIONAL)	19
FPRO - FUEL PROBE (WATER IN FUEL SENSOR)	25
FSM - FUEL SAVER MODULE	26,28,34
FS - FUEL SOLENOID	17
FW - FLYWHEEL SENSOR	22
GP - GLOW PLUGS	6
HET - EVAPORATOR HIGH TEMPERATURE SWITCH	13
HM - HOURMETER	19,19
HPCO - HIGH PRESSURE CUTOUT SWITCH	15
HWT - HIGH WATER TEMP. SW.	14
LOP - LOW OIL PRESSURE SW.	15
MD - MANUAL DEFROST	31
ON-OFF - ON-OFF SWITCH	1
PHR - PREHEAT RELAY	5, 20
PHS1,2,3,4 - PREHEAT START SW.	3,6,14
PL - PILOT LIGHTS	
1. T(TAN)DEFROST	24
2. W(WHITE)COOL	27
3. A(AMBER)HEAT	30
4. G(GREEN)CYCLE SENTRY	19
5. R(RED) COOLANT LEVEL	24
6. B(BLUE) FUEL SAVER (UNLOADER)	34
PS - PILOT SOLENOID	28
RAS - RADIATOR SENSOR	24
RR1 - RUN RELAY	18,20
RS1 - RELAY STARTER	2,19
S21,2 - CONT/RUN TO CYC./SENT. SW.	14,23
SM - STARTER MOTOR	2
SS - STARTER SOLENOID	2,3
SWR - SWITCH RESET	1,13
TC -TEMP.COMPENSATING THERMISTOR	21
TG-1V - THERMOGUARD- IV	
1K HEAT RELAY	29,32
2K- SPEED RELAY	26,32
TCM - TEMP. CONTROL MODULE	33
2KA- FUEL SAVER & UNLOAD RELAY	32,33
THR - THROTTLE RELAY	26,28
TS - THROTTLE SOLENOID	27
UNLR - UNLOADING RELAY	34,34
US - UNLOADING SOLENOID	34
VR-VOLTAGE REGULATOR (INTERNAL)	8

* NOTE CONNECTIONS FOR PRESTOLITE ALTERNATOR

* NOTE: CONNECTIONS FOR 65AMP BOSCH ALTERNATOR #448525

THERMOSTAT SWITCH SEQUENCE
S2 SW. IN CYCLE SENTRY POSITION

◇ DEFROST TIMER (OPTION)
(REMOVE JUMPER TO INSERT)

THERMOSTAT SWITCH SEQUENCE
S2 SW IN CONTINUOUS RUN POSITION

▲ - BELOW DIAL SETTINGS OF 15 F° HIGH SPEED HEAT IS LOCKED OUT

■ - BELOW DIAL SETTINGS OF 15 F° ALL HEAT IS LOCKED OUT.

THERMO KING CORPORATION
REF 3D95450
3D95449 H
SCHEMATIC DIAG
SUPER-II
W/ CYC/SENT
& FUEL SAVER
3-07-88
3-08-88
3-08-88
FOR TOLERANCES NOT SPECIFIED SEE TKS09-109 TKS09-110

REVISIONS				
46080	3/1/88	JHB	A
RELEASED			
46180	4/2/88	DL	B
GEN REV			
46253	2/3/88	EM	C
ADDED 141 WIRE			
46754	2/27/88	TB	D
46690	3/29/88	JHB	E
REV PH 2 LNK 56			
47106	5/01/89	TB	F
ADDED LS TERM & FSM			
47863	5/09/89	ES	W/C
ADD CAPACITOR TO ALT			
46850	4/29/91	SP	H
ADDED NEW ALTERNATOR HOOK-UP DIAGRAMS			

04/29/91 09215177

Super II MAX FS-I CS Wiring Diagram