V-500 Series

TK 51859-1-MM (Print Date: November 10, 2004)

The maintenance information in this manual covers unit models:	
V-500-10 (920271)	
V-500-20 3PH (920272)	
V-500-20 1PH (920273)	
V-500 MAX-10 (920274)	
V-500 MAX-20 3PH (920275)	
V-500 MAX-20 1PH (920276)	
For further information, refer to:	
V-500 Series Operating Manual	**TK 51878**
V-500 Series Parts manual	**TK 52763**
Diagnosing Thermo King Refrigeration Systems	**TK 5984**
Evacuation Station Operation and Field Application	**TK 40612**
Tool Catalog	**TK 5955**
The information in this manual is provided to assist owners, operators and service people in the proper upkeep and maintenance of Thermo King units. The above manuals may be purchased from your local Thermo King dealer.	

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

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

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

Recover Refrigerant

At Thermo King, we recognize the need to preserve the environment and limit the potential harm to the ozone layer that can result from allowing refrigerant to escape into the atmosphere.

We strictly adhere to a policy that promotes the recovery and limits the loss of refrigerant into the atmosphere.

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

R-134a/R-404A

WARNING: Use only Polyol Ester-based refrigeration compressor oil in R-134a/R-404A units. See Thermo King Parts Manual for part number.

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

When servicing Thermo King R-134a or R-404A units, use only those service tools certified for and dedicated to R134a/R-404A refrigerant and Polyol Ester compressor oils. Residual non-HFC refrigerants or oils will contaminate R-134a and R-404A systems.

About This Manual

Purpose

The purpose of this manual is to provide general maintenance information necessary to maintain the climate control unit at peak operating standards. This includes safety information, unit information such as bills of material and kit numbers, general unit information, maintenance procedures and related information (such as wiring and schematic diagrams), and some diagnostic and troubleshooting information.

NOTE: This manual may cover more than one unit. Therefore, it may contain information not applicable to your unit.

Contents

This manual is organized into the following chapters:

Chapter	Purpose
Safety Precautions	Provides detailed safety information. You should be familiar with the safety precautions before working on any unit.
Model Systems and Update Matrices	These tables list the bills of material and kit options that make up your unit. Use them for the following purposes: 1. To determine if you have the right manual for your unit: the bill of material (B/M) number on your unit serial plate should match one of the bill of material numbers listed in this section. If you cannot find your unit in the matrix, call TK Service for more information.) 2. To communicate with TK Service Department: If you need to call TK Service, you must know your model number so that the service representative to help you.
Specifications	Lists unit specifications.
General Description	Gives an overview description of your unit including standard and optional features, illustrations, and general a/c theory.
Operating Instructions	Provides unit operating instructions.
Maintenance Inspection Schedule	Table of routine maintenance procedures.
Maintenance Chapters	Provide detailed maintenance procedures required for your unit. (Electrical, Refrigeration, Compressor, Structural, Clutch)
Refrigeration Diagnosis	Provides troubleshooting information for diagnosing problems.
Wiring and Schematic Diagrams	Wiring and Schematic diagrams applicable to the unit.

Before you Call Thermo King Service!

Who to call: Your Thermo King Service Representative.

Before you call Thermo King Service, have the following information on hand:

- Bill of Material (usually located on the unit serial plate)
- Model Number - found on side of the unit

Blank Pages

This manual may contain blank pages at the end of chapters. This is normal. There is no information missing from the manual.

Roadside/Curbside Terminology

Roadside/Curbside terminology: These terms can be confusing because of differences between North America and Europe. Please note:

Curbside:	The side of the truck to the driver's right when the driver is in his seat and facing forward.
Roadside:	The side of the truck to the driver's left when the driver is in his seat and facing forward.

Using the Model Tables in "About this Unit"

The model tables in this section (called "About this Unit," "Model Systems and Update Matrices," or something similar) list important unit information that you will need to communicate with the Thermo King Service Department. See the table on the previous page for a description of how to use these tables.

Table of Contents

Compressor Maintenance (continued)

List of Figures

Safety Precautions

General Practices

1. *Always wear goggles or safety glasses.* Refrigerant liquid, refrigeration oil, and battery acid can permanently damage the eyes.
2. Never close the compressor discharge service valve with the unit operating.
3. Never operate the unit with the compressor discharge valve closed.
4. Keep your hands, clothing and tools clear of the fans and belts when the unit is running. This should also be considered when opening and closing the compressor service valves.
5. Make sure gauge manifold hoses are in good condition. Never let them come in contact with a belt, fan motor pulley, or any hot surface.
6. Never apply heat to a sealed refrigeration system or container.
7. Fluorocarbon refrigerants in the presence of an open flame produce toxic gases that are severe respiratory irritants capable of causing death.
8. Make sure all mounting bolts are properly torqued and are of correct length for their particular application.
9. 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. Holes drilled into the refrigeration system will release refrigerant.
10. Use caution when working around exposed coil fins. The fins can cause painful lacerations.
11. Use caution when working with a refrigerant or refrigeration system in any closed or confined area with a limited air supply (for example, a truck body or garage). Refrigerant tends to displace air and can cause oxygen depletion resulting in suffocation and possible death.
12. When using ladder or scaffolding, use caution and follow manufacturer recommendations.

Auto Start/Stop

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

Refrigerant

When removing refrigerant from a unit, a recovery process that prevents or minimizes refrigerant loss to the atmosphere is required by law.

When a refrigerant is exposed to the atmosphere in the liquid state, it evaporates rapidly, freezing anything it contacts. If refrigerant contacts the skin, severe frostbite can result.

First Aid

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

- *Eyes*: For contact with liquid, immediately flush eyes with large amounts of water and get prompt medical attention.
- *Skin*: Flush area with large amounts of lukewarm water. Do not apply heat. Remove contaminated clothing and shoes. Wrap burns with dry, sterile, bulky dressing to protect from infection/injury. Get medical attention. Wash contaminated clothing before reuse.
- *Inhalation*: Move victim to fresh air and use cardiopulmonary resuscitation (CPR) or mouth-to-mouth ventilation if necessary. Stay with victim until arrival of emergency medical personnel.

Refrigeration Oil

Observe the following precautions when working with or around synthetic or polyol ester refrigerant oil:

- Do not allow refrigerant oil to contact your eyes.
- Do not allow prolonged or repeated contact with skin or clothing.
- To prevent irritation, you should wash thoroughly immediately after handling refrigerant oil. Rubber gloves are recommended when handling polyol ester oil.

First Aid

- *Eyes*: Immediately flush eyes with large amounts of water for at least 15 minutes while holding the eyelids open. Get prompt medical attention.
- *Skin*: Remove contaminated clothing. Wash thoroughly with soap and water. Get medical attention if irritation persists.
- *Inhalation*: Move victim to fresh air and restore breathing if necessary. Stay with victim until arrival of emergency personnel.
- *Ingestion*: Do not induce vomiting. Contact a local poison control center or physician immediately.

Electrical Hazards

Microprocessor Service

Precautions must be taken to prevent electrostatic discharge when servicing the microprocessor controller and related components. Potential differences considerably lower than those which produce a small spark from a finger to a door knob can severely damage or destroy solid-state integrated circuit components.

The following procedures must be rigidly adhered to when servicing units to avoid microprocessor damage or destruction.

1. Disconnect all power to the unit.
2. Avoid wearing clothing that generates static electricity (wool, nylon, polyester, etc.).
3. Do wear a static discharge wrist strap (see Tool Catalog) with the lead end connected to the microprocessor's ground terminal. These straps are available at most electronic equipment distributors. Do not wear these straps with power applied to the unit.
4. Avoid contacting the electronic components on the circuit boards of the unit being serviced.
5. Leave the circuit boards in their static proof packing materials until ready for installation.
6. If a defective controller is to be returned for repair, it should be returned in the same static protective packing materials from which the replacement component was removed.
7. After servicing the controller or any other circuits, the wiring should be checked for possible errors before restoring power.
8. Never use testers consisting of a battery and a light bulb to test circuits on any microprocessor based equipment.
9. Before connecting or disconnecting the battery, the Microprocessor Power On/Off switch must be turned to the Off position. It is located on the roadside of the unit, lower left corner.

Welding of Units or Truck Bodies

When electric welding is to be performed on any portion of the temperature control unit, truck or truck chassis when the temperature control unit is attached, it is necessary to ensure that welding currents are *not* allowed to flow through the electronic circuits of the unit.

These procedures must be rigidly adhered to when servicing units to avoid damage or destruction of the controller.

1. Disconnect all power to the unit.
2. Disconnect all wire harnesses from the controller.
3. Switch all of the electrical circuit breakers in the control box to the Off position.
4. Weld unit or container per normal welding procedures. Keep ground return electrode as close to the area to be welded as practical. This will reduce the likelihood of stray welding currents passing through any electrical or electronic circuits.
5. When the welding operation is completed, the unit power cables, wiring and circuit breakers must be restored to their normal condition.

High Voltage

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

Precautions

1. Be certain the Unit On/Off switch is turned Off before connecting or disconnecting the standby power plug. Never attempt to stop the unit by disconnecting the power plug.
2. Be certain the unit power plug is clean and dry before connecting it to a power source.
3. When working on high voltage circuits on the temperature control unit, do not make any rapid moves. If a tool drops, do not grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.
4. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed, energized conductors are within reach.
5. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.
6. Never work alone on high voltage circuits on the temperature control unit. Another person should always be present to shut off the temperature control unit and to provide aid in the event of an accident.
7. Have electrically insulated gloves, cable cutters and safety glasses available in the immediate vicinity in the event of an accident.

First Aid

Immediate action must be initiated after a person has received an electrical shock. Obtain immediate medical assistance if available.

The source of shock must be immediately removed by either shutting down the power or removing the victim from the source. If it is not possible to shut off the power, the wire should be cut with either an insulated instrument (e.g., a wooden handled axe or cable cutters with heavy insulated handles) or by a rescuer wearing electrically insulated gloves and safety glasses. Whichever method is used do not look at the wire while it is being cut. The ensuing flash can cause burns and blindness.

If the victim must be removed from a live circuit, pull the victim off with a non-conductive material. Use the victim's coat, a rope, wood, or loop your belt around the victim's leg or arm and pull the victim off. *Do not touch* the victim. You can receive a shock from current flowing through the victim's body. After separating the victim from the power source, check immediately for the presence of a pulse and respiration. If a pulse is not present, start CPR (Cardiopulmonary Resuscitation) and call for emergency medical assistance. If a pulse is present, respiration may be restored by using mouth-to-mouth resuscitation, but call for emergency medical assistance.

Low Voltage

Control circuits used in the temperature control unit are low voltage (12 Vdc). This voltage potential is not considered dangerous, but the large amount of current available (over 30 amps) can cause severe burns if shorted or ground.

Do not wear jewelry, watch or rings when working on the unit. If these items contact an electrical circuit, severe burns may result.

Model Systems (System Designations)

Thermo King Model V-500 Truck Refrigeration Systems

System Designation	System Number	Power Pack	Install Kit	Refrig	Schematic, Wiring Diagrams
V-500-10	920387		8800002	R-134a	1E24520, 1E24518
V-500-20 3PH	920388	085060	8800002	R-134a	1E18884, 1E24443
V-500-20 1PH	920388	085014	8800002	R-134a	1E24519, 1E24517
V-500 MAX-10	920390		8800002	R-404A	1E24520, 1E24518
V-500 MAX-20 3PH	920391	085060	8800002	R-404A	1E18884, 1E24443
V-500 MAX-20 1PH	920391	085014	8800002	R-404A	1E24519, 1E24517

NOTE: When calling the dealer or factory for information or parts please have the Bill of Material number for your particular unit handy.

Specifications

Electrical System

Fuses		
Fuse 1: Evaporator Fan Motor (EF1)		15 amps
Fuse 2: Evaporator Fan Motor (EF2)		15 amps
Fuse 3: Engine-driven Compressor Clutch Coil, Condenser Solenoid Valve Coil (heating option), Hot Gas Solenoid Valve Coil		15 amps
Fuse 5: Condenser Fan Motor (CFM1)		15 amps
Fuse 6: Condenser Fan Motor (CFM2)		15 amps
Fuse 7: Evaporator Fan Motor (EF3)		15 amps
Fuse 4: Cab Control Box when in Electric Standby		3amps
Fuse 4/1: Cab Control Box		3 amps
Condenser Fan Motors		
Voltage	**Full Load rpm**	**Full Load Current**
13 Vdc	3000	9.2 Amps
Evaporator Fan Motors		
Voltage	Full Load rpm	Full Load Current
13 Vdc	2700	6.2 Amps
Coils for Hot Gas Solenoids, Condenser Solenoids, and Liquid Line Solenoids		
Voltage	Current	Resistance
12 Vdc	2.3 amps	5.2 ohms

Refrigerant System

R-134A REFRIGERATION SYSTEM (V-500)		
Refrigerant Charge	V-500	7.93 lbs (3.6 kg) R-134a
Defrost Termination Switch:	Opens	48.0 ± 5.4 F (8.9 ± 3.0 C)
	Closes	36.0 ± 5.4 F (2.2 ± 3.0 C)
High Pressure Cutout Switch:	Opens	300 ± 10 psi (2068 ± 69 kPa)
	Closes	200 ± 20 psi (1378 ± 69 kPa)
Low Pressure Cutout:	Opens	5 to 11 in. Hg vacuum (-17 to -34 kPa)
	Closes	4 to 7 psi (28 to 48 kPa)
Condenser Fan Speed Control (CFSC) Pressure Cutout Switch:	Opens	200 ± 7 psi (1379 ± 48 kPa)
	Closes	160 ± 7 psi (1103 ± 48 kPa)
R-404A REFRIGERATION SYSTEM (V-500 Max)		
Refrigerant Charge	V-500 Max	8.15 lbs (3.7 kg) R-404A
Defrost Termination Switch:	Opens	48.0 ± 5.4 F (8.9 ± 3.0 C)
	Closes	36.0 ± 5.4 F (2.2 ± 3.0 C)
Liquid Injection Switch:	Opens	200 ± 5 F (93 ± 3 C)
	Closes	230 ± 5 F (110 ± 3 C)
High Pressure Cutout Switch:	Opens	450 ± 10 psi (3100 ± 69 kPa)
	Closes	375 ± 10 psi (2585 ± 69 kPa)
Low Pressure Cutout:	Opens	5 to 11 in. Hg vacuum(-17 to -34 kPa)
	Closes	4 to 7 psi (28 to 48 kPa)
Condenser Fan Speed Control (CFSC) Pressure Cutout Switch:	Opens	300 + 20 psi/-0 psi (2068 ± 138 kPa)
	Closes	200 ± 20 psi (1379 ± 138 kPa)
Condenser Fan Pressure Cutout Switch (CFPS):	Opens	130 ± 10 psi (896 ± 69 kPa)
	Closes	180 ± 10 psi (1241 ± 69 kPa)

Compressors

Main Compressor		SELTEC TM-16XD, Engine Driven, Swash Plate, 6 Cylinder
Electrical Compressor		FRASCOLD D211Y, Reciprocating, 3 Cylinder,
System Oil Capacity		Main: 15.1 oz (150 cc)
		Standby Operation: 40.1 oz (1200 cc)
Compressor Oil Type		Polyol Ester P/N 203-515
Refrigerant		8.1 lbs (3.7 kg) R-404A 8.0 lbs (3.6 kg) R-134a
Defrost Method:		Hot gas
Defrost Timer:	Initiation Interval	Adjustable, 1 hour to 10 hours
	Termination Interval	Termination is not timed. Defrost is terminated by Klixon switch.

CAUTION: Failure to use correct Thermo King recommended oil will invalidate your warranty.

Belt Tension (Using Tool P/N 204-427)

	Field Reset
Engine Driven Compressor Belt	Check vehicle manufacturer specifications

AC Electric Motors

Voltage	Phase	Frequency	Full Load Current
208/230	3	60 Hz	14.1 Amps
208/230	1	60 Hz	16.0 Amps

Electric Standby Power Requirements

Supply Circuit Breaker	30 amp
Extension Cord Size	25 ft - 10 gauge, up to 75 ft - 8 gauge

Electric Heaters

Voltage	Power Rating Watts	Current	Resistance
208/230	2000	14.7 Amps	16.2 ohms at 230 V

Solder Applications

Refrigeration Component	
For general refrigeration tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 15% Silver TK No. 203-364 Use: Flux Type TK No. 203-365
For refrigeration tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

Hot Water Component	
For hot water tubing connections: copper to copper or copper to brass	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 95% Tin and 5% antimony TK No. 204-167 Use: Flux Type TK No. 204-417
For hot water tubing connections of dissimilar metals: copper to stainless steel or brass to stainless steel	Joint Clearances: 0.003 to 0.005 in. (0.076 to 0.127 mm) Use: Solder Type 35% Silver TK No. 203-366 Use: Flux Type TK No. 203-365

NOTE: Some units may be equipped with an compressor pressure regulating valve (CPR). To reduce the chance of overheating the CPR valve, 95-5 solder or equivalent may be used.

Use 95-5 TK No. 204-167

Use Flux TK No. 204-417

General Description

Introduction

The Thermo King V-500 10/20 and V-500 MAX truck refrigeration systems are two piece units. The unit is designed for medium-sized trucks and vans carrying fresh produce and frozen and deep frozen goods.There are two basic models:

There are two basic models:

- Model 10: Cool and defrost on truck engine driven compressor operation.
- Model 20: Cool and defrost on both truck engine driven compressor operation and electric standby compressor operatio

The system consists of three separate assemblies: the condenser, the evaporator, and the compressor.

The condenser is mounted on the front of the truck box or container. The evaporator is mounted on the cargo compartment ceiling. The main compressor is powered by the vehicle engine via a belt. The unit is connected to the compressor by refrigeration hoses. In electric standby operation models, the second compressor is driven by an elecric motor.

Control circuits operate on 12 VDC supplied by the truck batteries for over-the-road operation. The refrigeration system is protected by a high pressure cutout and a low pressure cutout.

The in-cab control includes an on/off switch, manual defrost switch, thermometer, thermostat, thermostat adjustments and indicator lights.

The operating mode is selected automatically: When the unit is connected to an electric power source, engine-driven operation is automatically blocked. If the vehicle engine is started up while the power cable is still connected to the electric power source, the unit will continue to operate in electric standby mode. It is not possible to start the engine-driven compressor until the power cable is disconnected from the unit.=

Condenser

The condenser has a unique design that allows it to be mounted horizontally on the roof, or on the front of the truck box.

Evaporator

An evaporator is mounted on the ceiling inside the truck box.

Compressor

The compressor is mounted on and driven by the truck engine. Refrigeration hoses or lines are used to connect the condenser, the evaporator, the compressor and any other components. Model 20 units have another compressor and an electric motor mounted in the condenser section for electric standby operation.

The engine compressor is driven by a belt from the engine. The electric standby compressor is connected in parallel with the engine-driven compressor. The standby compressor is driven by a belt from the electric motor. Both compressors use the same refrigeration system circuit. Check valves isolate one compressor from the other during operation.

Compressor operation is controlled by the thermostat, which energizes the compressor clutch during engine operation or starts the electric motor and energizes the compressor clutch on electric standby operation. The refrigeration system is protected by a high pressure cutout switch and a low pressure cutout switch.

When plugged into standby power, engine operation is automatically locked out. If the truck engine is turned on while the power cord is still plugged into a power receptacle, the unit will remain working in electric mode; the engine driven compressor cannot be started until the power cord is unplugged from the unit as the selection of engine operation or standby operation is automatic.

Control Circuits

The control circuits operate on 12V supplied by the truck batteries for engine operation. On standby operation, the power is rectified from an AC transformer.

In-Cab Control Box

Unit operation is controlled with an in-cab control box, which is mounted in the truck cab. It includes an On-Off switch, manual defrost switch, thermometer, thermostat, thermostat adjustment, and indicator lights.

Oil Separator

An oil separator is a standard feature. The oil separator separates compressor oil from refrigerant vapor and returns the oil to the compressor through the suction line. The oil separator helps provide positive oil return at high compressor speeds and low operating temperatures. This feature enhances compressor lubrication and extends compressor life.

Refrigerant

- V-500-10 and V-500-20 units use R-134a refrigerant.
- V-500 MAX-10 and V-500 MAX-20 units use R-404A refrigerant.

Liquid Injection System

V-500 MAX units use R-404A and have a liquid injection system to limit discharge temperature of the engine driven compressor. If the discharge gas leaving the compressor reaches a temperature of 230 ± 5 F (110 ± 3 C) the liquid injection switch closes, providing voltage to the liquid injection solenoid. The solenoid opens a valve, allowing liquid refrigerant to flow from the liquid line near the drier inlet to the metering orifice attached to the suction line fitting on the engine driven compressor. As the refrigerant passes through the metering orifice it expands and evaporates, cooling the suction gas entering the compressor. This cooling effect is transferred to the discharge gas leaving the compressor from the adjacent cavity in the compressor head. When the discharge gas is cooled to 200 ± 5 F (93 ± 3 C), the liquid injection switch opens, the liquid injection solenoid closes and refrigerant no longer flows through the liquid injection system.

Evaporator Drain Tube Heaters

Evaporator heaters are used in R-404A units to avoid drain tube blockage because of ice accumulation inside the evaporator. Two harnesses are located inside the drain tube. These resistive wires melt the ice while the unit is in DEFROST mode.

Electric Standby Operation

During electric standby operation, the thermostat controls the operation of the unit by energizing and de-energizing the power relay, the electric relays, and the heat contactor. The thermostat places the unit in cool by energizing the power relay and the electric relays.

The thermostat places the unit in null by de-energizing all the relays and contactors. The thermostat places the unit in heat by energizing the heat contactor.

When the power relay and the electric relays are energized, they close contacts that energize the fan relay, the motor contactor, and the electric standby compressor clutch.

When the heat contactor is energized, it energizes the electric evaporator heaters and the fan relay.

Unit Features

- M-13 In-Cab Control Box with Digital LED Thermometer (Standard)
- Digital Thermometer
- Electronic Thermostat (Standard)
- Defrost Timer (Standard)
- Defrost Thermostat
- Hot Gas Defrost (Standard)
- Manual Defrost Switch (Standard)
- Oil Separator (Standard)
- Liquid Injection (MAX only)
- Main Compressor TM 16 XD
- Electric Compressor D211Y (60 Hz)
- Evaporator Drain Heaters

Protection Features

- High Pressure Cutout Switch - The High Pressure Cutout Switch is a pressure sensitive switch. It is located in the discharge line near the oil separator on Model 10 units. It is located in the discharge check valve on Model 20 units.

  If the discharge pressure rises above the switch's opening pressure, the switch opens the circuit to the PR Relay to stop the unit. The opening pressure for R-134a units is 300 psi (2068 kPa). The opening pressure for R-404A units is 450 psi (3100 kPa).

  When the discharge pressure falls below the switch's closing pressure, the switch closes to restart the unit. The closing pressure for R-134a units is 200 psi (1379 kPa). The closing pressure for R-404A units is 375 psi (2585 kPa).

- Condenser Fan Pressure Switch - V500-20 units with R-134a are equipped with a Condenser Fan Pressure Switch. This switch is located on the discharge line near the oil separator. It helps the unit to keep the condenser head pressure higher in cool ambients and on-road. This feature allows better control of the head pressure and the thermostatic expansion valve, and at the same time increases the evaporator pressure. In cool ambients and on-road, the defrost is carried out quicker.

  When the condenser head pressure rises above 180 psi (1241 kPa), the condenser fan pressure switch closes, starting the condenser fan.

  When the condenser head pressure falls below 130 psi (896 kPa), the condenser fan pressure switch opens, stopping the condenser fan.

- Low Pressure Cutout Switch - The Low Pressure Cutout Switch is a pressure sensitive switch located in the suction line. If the pressure falls below 5 to 11 in. Hg vacuum (-17 to -34 kPa), the switch opens the circuit to the PR Relay to stop unit operation.

Control Box

P.C. Board

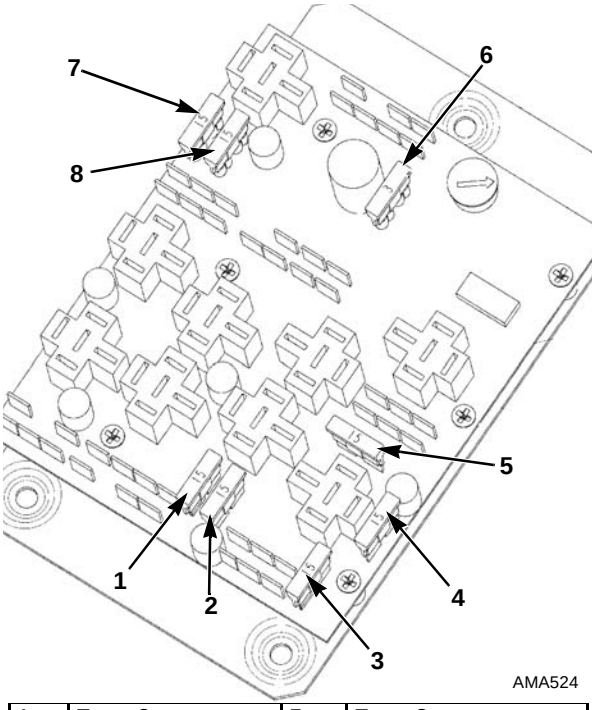
All Printed Circuit Boards manufactured by Thermo King can be easily identified by the Part Number stamped on them.

Even though that all P.C. Boards have a similar layout, there are some differences from one to another depending on the unit model and which functions they carry out.

Connectors

All connector codes (C-1, C-2, etc.) are stamped on the P.C. Board. Pins on the connectors are numbered counter-clockwise.

Fuses



1.	Fuse 2	5.	Fuse 3
2.	Fuse 1	6.	Fuse 4
3.	Fuse 7	7.	Fuse 5
4.	Fuse 8 (not used)	8.	Fuse 6

Figure 1: P.C. Board Fuses

Fuse 1: Protects the evaporator fan motor (EFM1) from possible overload.

Fuse 2: Protects the evaporator fan motor (EFM2) from possible overload.

Fuse 3: Protects:

- The engine-driven compressor clutch coil.
- Condenser solenoid valve coil (heating option).
- Hot gas solenoid valve coil.

Fuse 5: Protects the condenser fan motor (CFM1) from possible overload.

Fuse 6: Protects the condenser fan motor (CFM2) from possible overload.

Fuse 7: Protects the evaporator fan motor (EFM3) from possible overload.

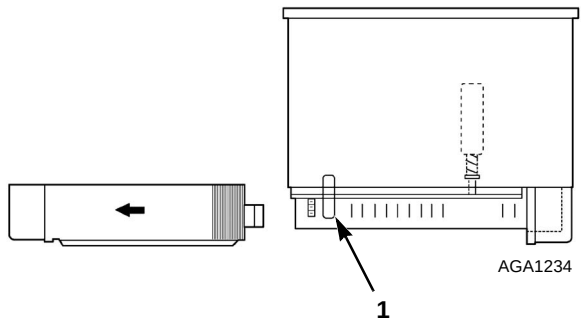
Fuse 4/1: Protects the in-cab control box from possible overload. It is located inside the in-cab control box.

(Fuses 1, 2, 4, 5, 6, 7 and 8 are located on the printed circuit board.)

Electric Standby Operation Fuses:

Fuse 4 protects the in-cab control box when the unit is in electric standby mode.

Fuse 8 is located in the electric box and protects the transformer from possible overload.



1.	Fuse 4/1

Figure 2: Fuse 4/1

Common Relays

The common relays are located on the P.C. Board.

Power Relay (PR)

The Power Relay is energized when the In-Cab Control Box ON/OFF Switch is pressed (Unit Start) and the box temperature is higher than the setpoint temperature.

Evaporator Fan Relay (EFR)

When the Fan Relay is energized, battery voltage energizes evaporator fan motors EF1 and EF2.

DR (D) Defrost Relay

The Defrost Relay controls operation of the defrost cycle.

The Defrost Relay is energized when the In-Cab Control Box Defrost Switch or by the Defrost Timer completes the circuit through the Defrost Termination Switch to ground.

The Defrost Relay will remain energized until the defrost cycle is terminated by the Defrost Termination Switch or the In-Cab Control Box ON/OFF Switch is pressed.

FR2 Condenser Fan Relay

When energized, condenser fans start running at high speed. It is energized depending on the CFPS (Condenser Fan Pressure Cutout Switch). Condenser fans only operate in Cool mode.

PS2R, PS3R Series/Parallel Relays

These are energized depending on the CFSC (Compressor Fan Speed Control). They control condenser fan speed: hihg, low or stopped.

Electric Standby Relays

Relays ER and C1 are located on the P.C. Board in Model 20.

Electric Standby Relay (ER)

When the Electric Standby Relay is energized it turns on the AC Motor of the electric standby compressor and de-energized engine driven compressor clutch.

Overload Relay (OL)

The Overload Relay is located in the Control Box below the P. C. Board.

The Overload Relay switches off the unit when the current draw through the AC Motor is excessive.

C1: Battery Disconnection Relay

When this is energized, power is disconnected from the battery relay coil. This prevents the two power sources for the unit (battery and laternating current) from being connected at the same time. Located in the electic box.

N1: Battery Relay:

When this is energized, the unit is powered from the battery.

N2: Electric Power Relay:

When this is energized, the unit is powered from the power supply through a cable.

CMC: Compressor Motor Contactor

When this is energized, it connects the electric standby operation AC compressor to the power supply.

Unit Operation

These units cycle between Cool and Null to maintain the box temperature at the thermostat setpoint. Heat is available as an option. The operating modes are: Cool, Null, Heat (optional) and Defrost.

The thermostat controls the operation of the unit by energizing and de-energizing the Power Relay (PR). When PR is energized it energizes the evaporator fans, the condenser fans, and the compressor clutch (or the compressor motor contactor during electric stand-by operation). The condenser fan is also controlled by the condenser fan pressure switch (CFPS) on R-134a units. This normally open switch monitors the compressor discharge pressure. When the discharge pressure rises to 180 psi (1241 kPa) the switch closes and energizes the condenser fan. When the discharge pressure drops below 130 psi (896 kpa) the switch opens and de-energizes the condenser fan.

Thermostat Operation

Cool

The thermostat energizes the (PR) at box temperatures higher than 5.4 F (3.0 C) above setpoint. The thermostat keeps PR energized while the box temperature is higher than setpoint. The fans and the compressor run and the unit cools.

Null

The thermostat de-energizes PR at box temperatures lower than setpoint. The thermostat keeps PR de-energized while the box temperature is lower than 5.4 F (3.0 C) above the setpoint temperature. When PR is de-energized the unit does not operate.

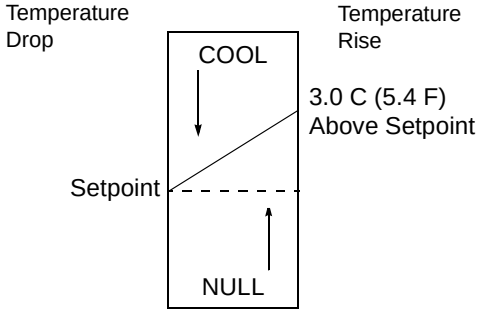


Figure 3: Thermostat Algorithm

Defrost

The defrost cycle can be initiated any time the evaporator coil temperature is below 36 F (2.2 C). Defrost is initiated automatically by the defrost timer, or manually by pressing the manual defrost switch.

The defrost relay energizes the defrost solenoid valve (and the condenser solenoid valve on units equipped with the heat option) to route hot refrigerant gas to the evaporator when PR is energized. The defrost relay also interrupts power to the evaporator and condenser fans during defrost.

The defrost cycle will continue until the evaporator coil temperature rises 48 F (8.9 C), causing the defrost termination switch to open ending the defrost cycle. Defrost cycle can be also terminated stopping the unit pressing the ON/OFF Switch twice.

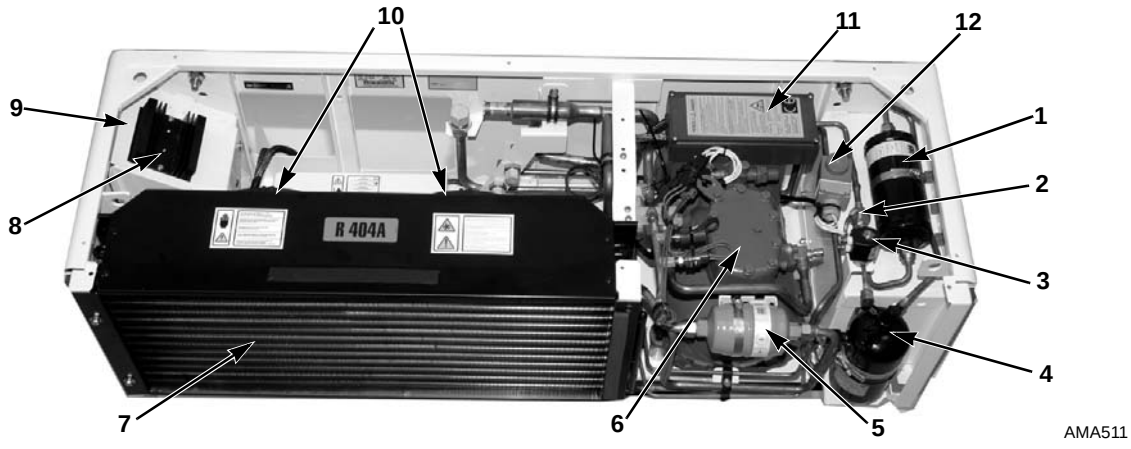
Serial Number Locations

CONDENSER: Nameplate located on the back inside wall of condenser frame.

ENGINE DRIVEN COMPRESSOR: Nameplate located on compressor body. The engine driven compressor is located in the truck engine compartment.

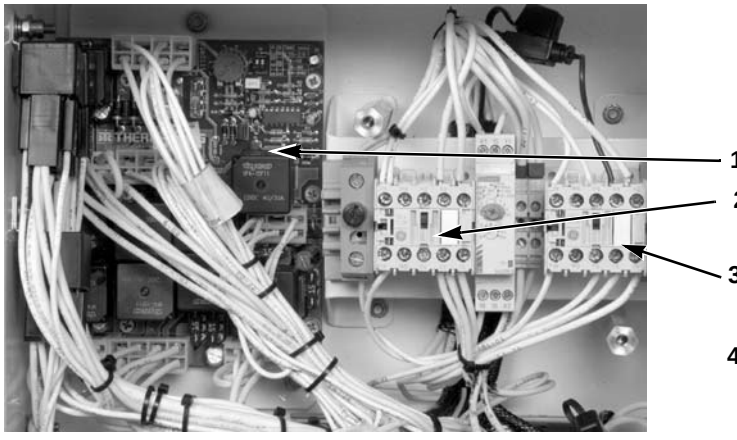
STANDBY COMPRESSOR: Nameplate located on compressor body. The Standby compressor is located inside the Condenser assembly.

Unit Components

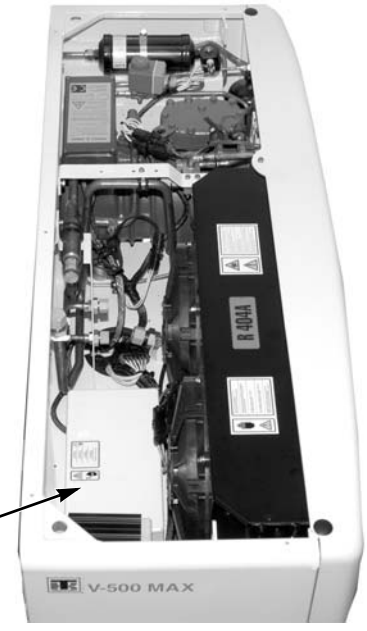


1.	Filter-Drier	5.	Oil Separator	9.	Transformer Cover
2.	Liquid Sight Glass	6.	Electric Standby Compressor	10.	Condenser Fans
3.	Liquid Injection Valve	7.	Condenser Coil	11.	AC Compressor Electric Box
4.	Liquid Tank	8.	Rectifier Heat Sink	12.	Defrost Valve

Figure 4: Unit Components (Model 20)



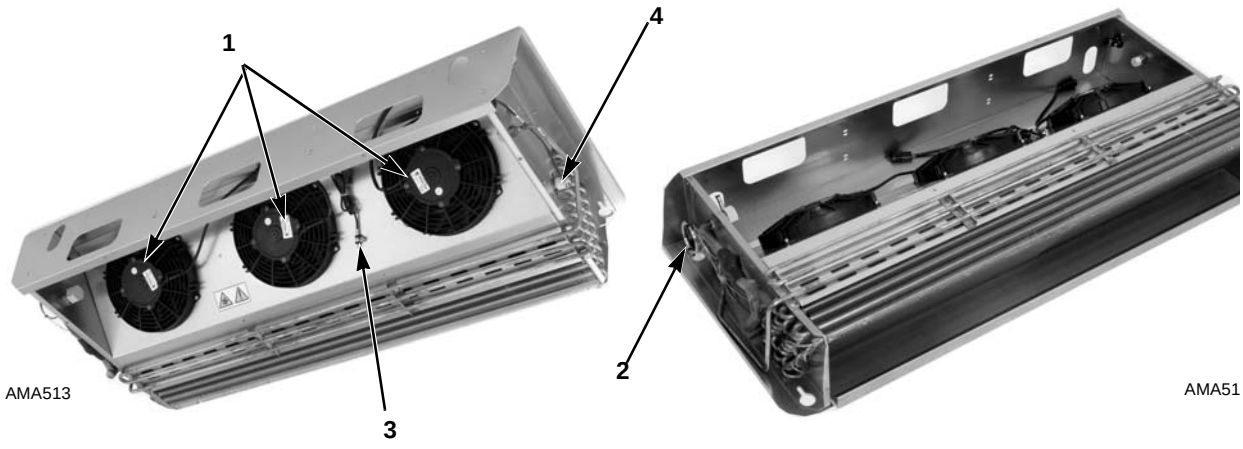
AMA512



AMA532

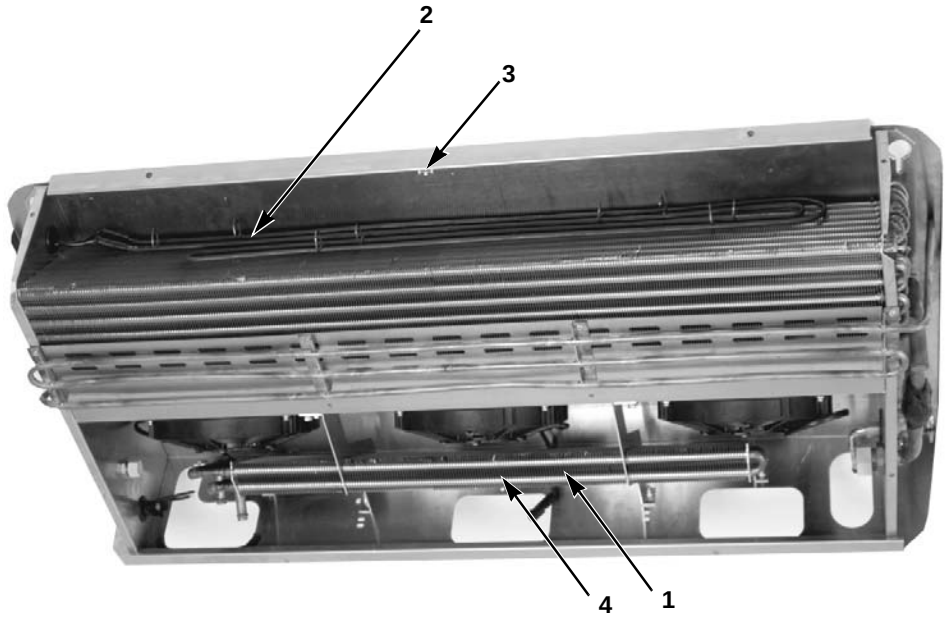
1.	PC Board	3.	Heat Option Contactor
2.	Motor Contactor	4.	Capacitor Box

Figure 5: Condenser Electric and Capacitor Boxes (Model 20)



1.	Evaporator Fans	3.	Temperature Sensor
2.	Expansion Valve	4.	Defrost Switch

Figure 6: Evaporator



AMA525

1.	Hot Water Heat Defrost Coil	3.	High Temperature Limit Switch
2.	Electric Heat Element	4.	Air Temperature Sensor

Figure 7: Evaporator with Hot Water and Electric Heat Options

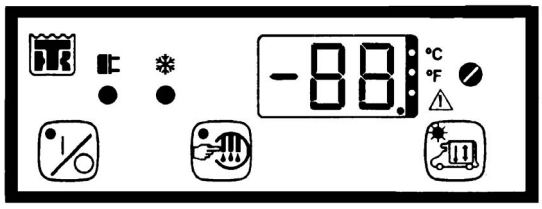


Figure 8: M13 In-Cab Control Box

Introduction

Unit operation is controlled with a in-cab control box, which is mounted in the truck cab. It includes an on-off switch, manual defrost switch, thermometer, thermostat, thermostat adjustment, and indicator lights.

Description

1. ON-OFF KEY
   It is used to start/stop the unit. The internal return air temperature will be automatically displayed.
2. ON LED Indicator
   When on, it indicates that the unit has been started by pressing the on-off key.

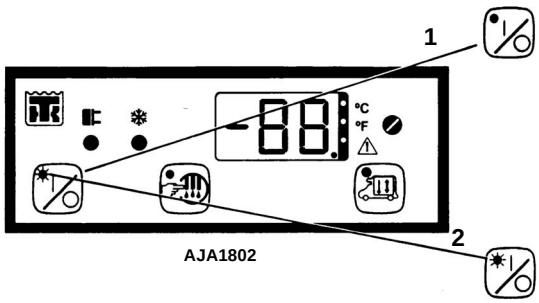


Figure 9: On/Off Key & LED

3. Celsius LED Indicator
   When on, it indicates the temperature being displayed is in degrees celsius.
4. Minus Sign
   Indicates the temperature being displayed is below zero.
5. Fahrenheit LED Indicator.
   When on, it indicates the temperature being displayed is in degrees fahrenheit.

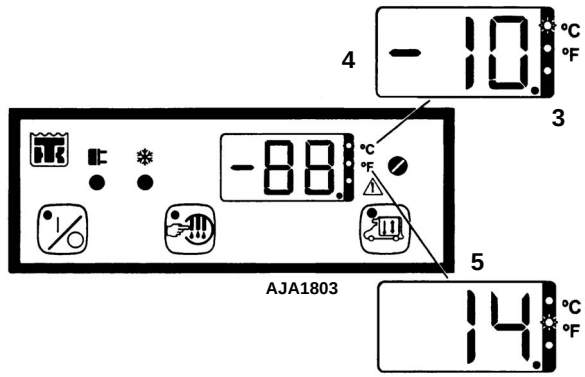


Figure 10: Celsius/Fahrenheit LED

6. Setpoint Adjust Dial
   It is used to adjust the setpoint temperature.
7. Setpoint Key
   It is used to display the setpoint temperature.

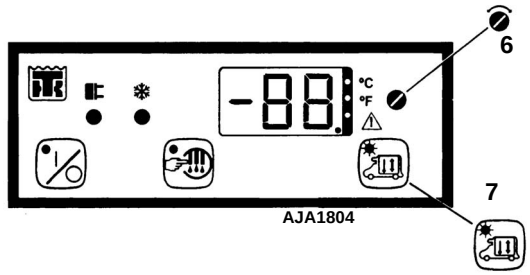


Figure 11: Setpoint Key & Dial

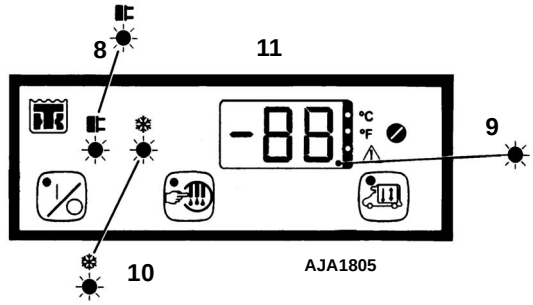


Figure 12: Misc. LED's

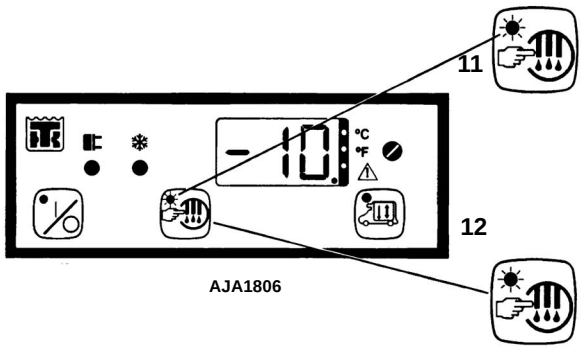


Figure 13: Defrost Key & LED

8. Power Cord LED
   When on, it indicates the unit is plugged to the A.C. voltage power supply.
9. AC Overload LED
   When on, it indicates the unit has been stopped by the AC overload relay.
10. Unit Operation LED
    When on, it indicates the unit is cooling. When the unit is Stopped by the Thermostat, HPCO or LPCO, the Unit Operation LED must be "OFF" and the ON LED Indicator must remain "ON".
11. Defrost LED Indicator
    When on, it indicates the unit is working on defrost mode.
12. Manual Defrost Key
    It is used to initiate the defrost cycle manually.

Selecting the Temperature Scale

Temperature readings can be displayed in the Celsius scale or Farenheit scale. Dip switch 3, located inside the cab control box, is used to select which scale is displayed. See the Electrical Maintenance chapter for complete instructions.

In-Cab Control Box Operating Instructions

Display Return Air (Box) Temperature

During normal operation (unit is ON and cooling), the ON LED Indicator, the Unit Operation LED and Celsius/Fahrenheit LED Indicator should be ON; the return air (box) temperature should be displayed on the screen. (See Figure 14.)

Display Setpoint Temperature

During normal operation, press the Setpoint Key to display the Setpoint Temperature.

Enter Setpoint Temperature

Press and hold the Setpoint Key. The Setpoint Temperature will be displayed on the screen. (See Figure 15.)

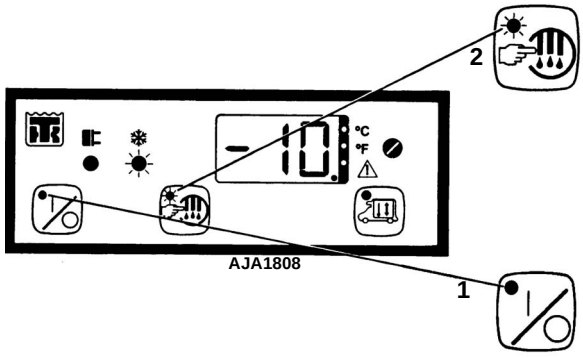
13. At the same time, turn the Setpoint Adjust Dial until the display shows desired temperature.(See Figure 16.)
14. Release the Setpoint Key. The box temperature will be displayed on the screen. (See Figure 15.)

Defrost Mode Operation

Initiate a Manual Defrost : Pressing the Manual Defrost Key will start the defrost cycle if the evaporator coil temperature is below 36 F (2.2 C). The defrost LED will go ON. The unit will return to the cool mode automatically when the defrost cycle is finished. (See Figure 14.)

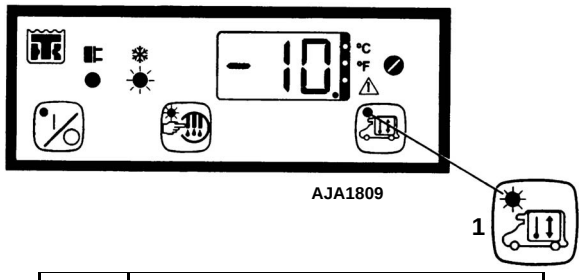
Initiate a Automatic Defrost: If the evaporator coil temperature is below 36 F (2.2 C), the defrost timer will initiate a defrost cycle. The defrost LED will go ON. The unit will return to the cool mode automatically when the defrost is finished.(See Figure 14.)

Stop the Defrost Cycle: Press and release the On-Off Key twice to stop the defrost cycle.



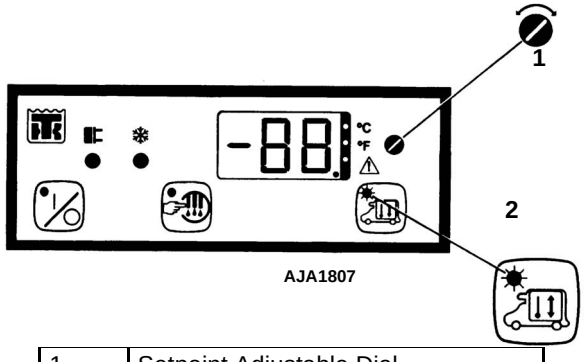
1.	On/Off Key
2.	Manual Defrost Key

Figure 14: On/Off Key and Defrost Key



1.	Setpoint Key

Figure 15: Setpoint Key



1.	Setpoint Adjustable Dial
2.	Setpoint Key

Figure 16: Entering Setpoint

Unit Operation

Weekly Pretrip Inspection

The following Weekly Pretrip Inspection should be completed before loading the truck. While the weekly inspection in not a substitute for regularly scheduled maintenance inspections, it is important part of the preventive maintenance program designed to head off operating problems before they happen.

1. LEAKS. Inspect for refrigerant leaks and worn refrigerant lines.
2. BELTS. Inspect for cracks, wear and proper belt tension.
3. MOUNTING BOLTS. Inspect bolts are properly tightened.
4. ELECTRICAL. Electrical connections should be securely fastened. Wires and terminals should be free of corrosion, cracks or moisture.
5. DEFROST DRAINS. Check the defrost drain hose and fittings to be sure that they are open so condensate can run out during defrosting. Check the bottom end of drain hose to be sure that is not plugged or crushed.
6. STRUCTURAL. Visually check for physical damage.
7. REFRIGERANT CHARGE. Check for proper refrigerant charge level.

Starting the unit

Engine Operation

1. Start the truck engine.
2. Press the On-Off switch on the In-Cab Control Box, the ON/OFF LED must go ON.
3. Adjust the thermostat setting. Electric Standby Operation

1. Connect the external power supply to the power receptacle. Make sure that the power supply voltage is correct for the unit. The Power Cord LED should go ON.
2. Press the On-Off switch in the In-Cab Control Box, the ON LED should go ON.
3. Adjust the thermostat setting.

NOTE: The unit will work on Electric Standby even though the truck engine is started if the power cord is plugged in.

After Start Inspection

1. THERMOSTAT. Dial the thermostat setting above and below the box temperature to check thermostat operation.
2. 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 truck. Pre-cooling will remove residual body heat and moisture from the box interior and provide a good test of the refrigeration system.
3. DEFROST. When the unit has finished pre-cooling the truck interior (evaporator temperature dropped below 36 F [2.2 C), initiate a defrost cycle with the manual defrost switch. The defrost cycle should end automatically.

Loading Procedure

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

Post Load Procedure

1. Be sure all the doors are closed and locked.
2. Adjust the thermostat to the desired temperature setpoint.

3. Start the unit.
4. Half an hour after loading, defrost the unit by momentarily pressing the Manual Defrost switch. If the coil temperature has dropped below 36 F (2.2 C), the unit will defrost. The defrost cycle should stop automatically.

Weekly Post Trip Checks

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

Maintenance Inspection Schedule

NOTE: Thermo King reserves the right to deny warranty coverage on claims due to lack of maintenance or neglect. Claims in question must be supported by maintenance records.

NOTE: See the appropriate chapter in this maintenance manual for instructions on how to correctly perform required maintenance.

Electrical

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
		•	•	Check defrost initiation and termination.
		•	•	Check thermostat cycle sequence.
		•	•	Check operation of protection shutdown circuits.
			•	Check thermostat and thermometer calibration in 0 C (32 F) ice-water bath.
			•	Inspect wire harness for damaged wires or connections.
		•	•	Check defrost initiation and termination.

Refrigeration/Heating

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
		•	•	Check refrigerant level.
			•	Replace dehydrator.

Structural

Weekly	Monthly	Semi-Annual	Annually	Check condition of or service the following:
•	•	•	•	Visually inspect unit and refrigerant hoses for fluid leaks.
•	•	•	•	Visually inspect unit for damaged, loose or broken parts.
•	•	•	•	Clean defrost drains.
	•	•	•	Inspect belts for condition and proper tension
	•	•	•	Clean entire unit including evaporator coil and condenser coil.
		•	•	Check all unit mounting bolts, brackets, lines, hoses, etc.

Electrical Maintenance

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
Check defrost initiation and termination.			•	•
Check thermostat cycle sequence.			•	•
Check operation of protection shutdown circuits.			•	•
Check thermostat and thermometer calibration in 0 C (32 F) ice-water bath.				•
Inspect wire harness for damaged wires or connections.				•
Inspect/replace DC fan motor brushes.				•

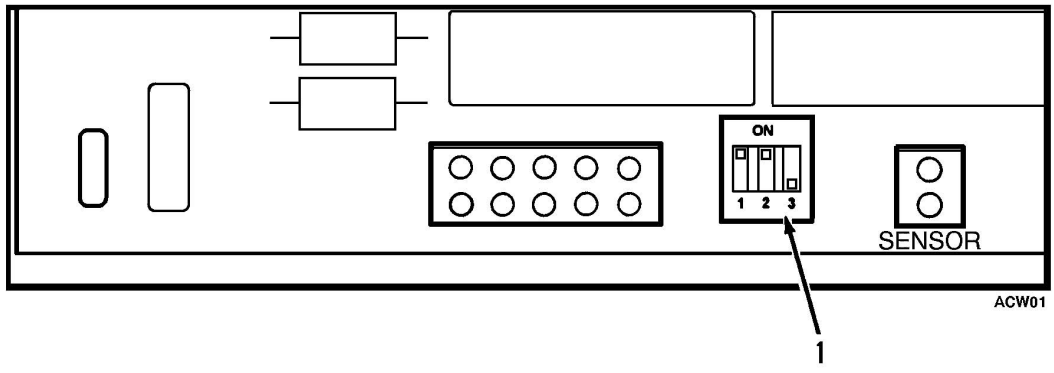
WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system.

Selecting the Temperature Scale

Temperature readings can be displayed in the Celsius scale or Farenheit scale. Dip switch 3 is used to select which scale is displayed. It is located inside the cab control box. Indicator lights next to the digital display show which scale has been selected. Place dip switch 3 in the ON position to display temperatures in degrees Celsius. Place dip switch 3 in the OFF position to display temperatures in degrees Fahrenheit.

To change the temperature scale selection:

1. Remove the cover from the back of the cab control box.
2. Place dip switch 3 in the proper position:
   - ON for Celsius, OFF for Fahrenheit
3. Replace the Cover



1.	Dip Switches

Figure 17: Back of Cab Control Box with Cover Removed

Trouble Shooting In-Cab Control Box M-13 and M-16

Before starting this trouble shooting, verify that the In-Cab Control Box 12/24V selector is placed in the correct position and check the ground circuit through Pin 9 Connector C-9.

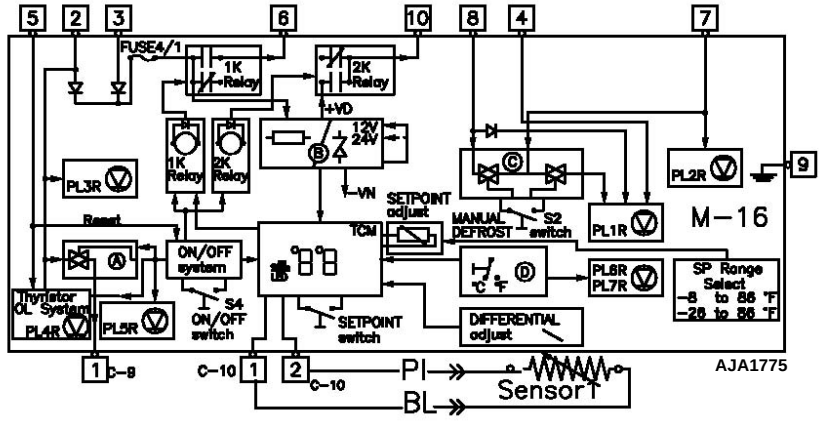


Figure 18: Block Diagram M-13, M-16

IMPORTANT: This trouble shooting only covers In-Cab Control Box functions and should not be considered as all-inclusive or meant to cover all other electric contingencies; on these cases you should check the wiring against a diagram.

SYMPTOMS	REMEDY
Blank display when the On/Off Switch is pressed.	**1st.** Check voltage on **Pin 3 C-9** (Pin 2 when is unit working in electric mode). **2nd.** Check **Fuse 4/1** located inside the Cab Control Box. **3rd.** Replace Cab Control Box.
Unit is not cooling when the Box Temperature is higher than the Setpoint Temperature.	**1st.** Check voltage on **Pin 6 C-9**. **2nd.** Replace Cab Control Box.
Unit Operation LED is OFF when the unit is cooling.	**1st.** Check voltage on **Pin 7 C-9**. **2nd.** Replace Cab Control Box.

SYMPTOMS	REMEDY
Defrost cycle is not initiated when the Manual Defrost Switch is pressed.	**1st.** Box temperature must be higher than Setpoint temperature; unit must be in cool mode. **2nd.** Evaporator coil temperature must be lower than 36.0 ± 5.4 F (2.2 ± 3.0 C) (defrost termination switch closed). **3rd.** While keeping the Manual Defrost Switch pressed, check voltage on **Pin 8 C-9**. **4th.** Replace Cab Control Box.
Defrost LED is OFF when the unit is in Defrost Mode.	**1st.** Check for open circuit on **Wire Y**, between **Pin 4 C-9** and **Pin 2 C-3**. **2nd.** Check voltage on **Pin 8 C-9**. **3rd.** Replace Cab Control Box.
Temperature displayed is out of range.	**1st.** Check that the Cab Control Box 12/24V selector is in the correct position. **2nd.** Check the thermostat sensor.
Unit is not working in Electric Mode.	**1st.** Check the AC Overload Relay (AC Overload Led must be OFF). **2nd.** Check the fuses on the P.C. Board. **3rd.** Check voltage on **Pin 2 C-9**. **4th.** Check voltage on **Pin 1 C-9**. **5th.** Replace Cab Control Box.
Unit is stopped by the AC OL Relay, but the AC Overload LED is OFF.	**1st.** Check voltage on **Pin 5 C-9**. **2nd.** Replace Cab Control Box.

Defrost System

A defrost cycle can be started by pressing the manual defrost switch, or automatically by the defrost timer, when the defrost termination switch is closed and the unit is in cool mode.

The defrost cycle operates by energizing the defrost relay. The defrost relay energizes the defrost solenoid valve (and the condenser solenoid valve on units equipped with the heat option). The defrost relay also interrupts power to the evaporator and condenser fans, which stops the evaporator and condenser fans.

Energizing the defrost solenoid valve diverts hot gas into the evaporator coil, melting ice. A defrost termination switch de-energizes the defrost relay when evaporator temperature rises above 48 F (8.9 C).

To check the defrost cycle, run the unit on Cool to drop the evaporator coil to a temperature below 36 F (2.2 C).

Press the manual defrost switch. The unit should shift from Cool to Defrost Mode. If the unit continues to Cool, double check the evaporator coil temperature, and refer to “Testing the Defrost System.”

On TC units defrost is performed on both evaporators at the same time. Defrost termination is controlled by the defrost termination switch on the main evaporator.

Defrost Timer Settings

NOTE: The defrost timer is directly connected to the battery. This means that the defrost timer is always timing, even if the unit is turned off.

The defrost timer has two selector switches (A and B) and a round red selector that are used to set the timer interval.

The factory setting for the defrost timer is four hours. Use the following information to change the setting of the defrost timer.

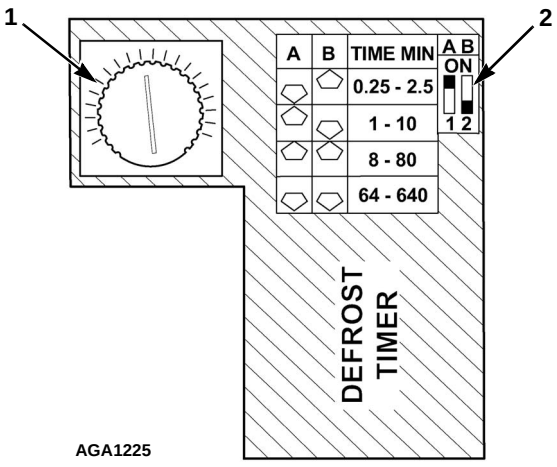


Figure 19: Defrost Timer

1. Refer the following timing table. A similar table is located on the printed circuit board.

TIMING TABLE	Switch		SCALE
	A	B	
0.25 - 2.5	Down	Up	From 0.25 to 2.5 minutes
1 - 10	Up	Down	From 1 to 10 minutes
8 - 80	Up	Up	From 8 to 80 minutes
64 - 640	Down	Down	From 1 to 10 hours

2. Choose the range in the timing table in which your timing needs are included and set switches A and B to the desired position.

   Example: Setting selector switches A and B to positions A: down and B: down chooses the time range of approximately 1 to 10 hours (64 to 640 minutes).

3. Set the round red selector to the desired value. The round red selector multiplies the minimum value of the chosen range by the value it is pointing at.

   Example: If the selector points to position 2, approximately 2 hours (2 x 64 = 128 minutes)

   Example: If the selector points to position 4, approximately 4 hours (4 x 64 = 256 minutes).

Defrost Termination Switch

The switch is mounted in the evaporator coil and controls the defrost cycle in response to the evaporator coil temperature. The switch is closed when the evaporator coil temperature is below 36 F (2.2 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 evaporator fan stops, 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 above 48 F (8.9 C).

Defrost Relay

The defrost relay controls operation of the defrost cycle. When the defrost timer or the manual defrost switch completes the circuit through the defrost termination switch to ground, the defrost relay is energized. This energizes the defrost solenoid valve (wire 26) and de-energizes the fan relay.

The defrost relay stays energized until the defrost cycle is terminated by the defrost termination switch, or the On/Off Key is pressed.

Defrost Solenoid Valve

The defrost solenoid valve is an electrical valve that controls the flow of refrigerant through the refrigeration system.

The defrost solenoid valve is energized by the 26 wire (Pin 1 C-1). When the defrost solenoid valve is energized it routes hot refrigerant gas to the evaporator.

Testing the Defrost System

To test the defrost system, run the unit on cool until the evaporator coil temperature is below 36.0 ± 5.4 F (2.2 ± 3.0 C) and press the manual defrost switch.

If the unit doesn't shift to defrost cycle go to step 1.

1. Check the evaporator temperature.

   Be sure the evaporator temperature is actually below 36.0 ± 5.4 F (2.2 ± 3.0 C), otherwise the unit will not defrost. Use a test thermometer to check the evaporator temperature.

2. Check the defrost termination switch.

If the unit fails to defrost, place a jumper wire between the 12 and CH wires at the defrost termination switch. Press the manual defrost switch.

If the unit shifts to defrost, the defrost termination switch is defective.

If the unit does not shift to defrost, check for an open circuit in the 12 wire back to Pin 2 C-3. If the 12 wire is not open go to step 3.

3. Check voltage on Pin 1 C-3.

   If voltage is present on Pin 1 C-3, replace the defrost relay.

   If voltage is not present, go to step 4.

4. Check for open circuit on wire GR that goes to the in-cab control box (Pin 8 C-9).

   If the wire GR is not open, go to step 5.

5. Press and hold manual defrost switch, check the voltage on Pin 8 C-9.

   If voltage is present on Pin 8 C-9 and the rest of the above mentioned points are correct, replace the printed circuit board.

   If voltage is not present on Pin 8 C-9, check the in-cab control box.

Defrost Timer Test

The defrost timer initiates the defrost cycle.

1. Verify that the evaporator coil temperature is lower than 36.0 ± 5.4 F (2.2 ± 3.0 C). If not, place a jumper wire between the 12 and CH wires at the defrost termination switch.
2. Set the defrost timer to approximately 1 minute (selector switches A: down, B: down and round red selector in position 4).
3. After approximately one minute, defrost should be initiated. The Defrost LED, defrost relay, and defrost solenoid valve must be activated.
4. See the Defrost Timer Settings instructions on preceding pages in this chapter. You should set the defrost timer for your cargo application.

Condenser Fan Pressure Switch (CFPS) R-134a Units Only

When the condenser head pressure rises above 180 ± 10 psi (1241 ± 69 kPa) the condenser fan pressure switch closes, starting the condenser fan.

When the condenser head pressure falls below 130 ± 10 psi (896 ± 69 kPa), the condenser fan pressure switch opens, stopping the condenser fan.

Testing CFPS

The CFPS is located on the discharge line. Electrically it is located between wires CF and CF1.

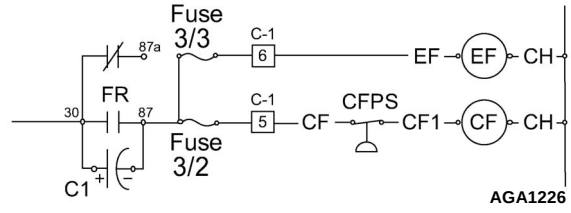


Figure 20: Testing CFPS

Use the following procedure to test the CFPS:

1. Install a manifold gauge set on the compressor.
2. Connect a voltmeter between the CF and the CF1 wires by the CFPS switch connector.
3. Run the unit on Cool. When the condenser head pressure is higher than 180 ± 10 psi (1241 ± 69 kPa) the condenser fan motor must be running and the voltmeter should indicate approximately 0 volts.
4. Run the unit on Cool. When the condenser head pressure is lower than 130 ± 10 psi (896 ± 69 kPa) the condenser fan motor must be stopped and the voltmeter should indicate approximately truck battery voltage.

Liquid Injection System (R-404A Units Only)

This liquid injection switch is a temperature sensitive switch located on the discharge fitting of the truck engine compressor. When the discharge temperature rises above 230 ± 5 F (110 ± 3 C), the

switch closes to open the liquid injection solenoid valve. When the discharge temperature falls below 200 ± 5 F (93 ± 3 C), the switch opens to close the liquid injection solenoid valve.

Testing Liquid Injection Solenoid Valve and Metering Orifice

1. Disconnect the LIS wire from the liquid injection solenoid valve.
2. Install the gauge manifold set on the engine-driven compressor.
3. Set thermostat on the lowest setting.
4. Start and run the unit on the engine-driven compressor until the suction pressure stabilizes.
5. Place a jumper between CH and LIS terminal on the liquid injection solenoid valve. This simulates that the discharge temperature is higher than 230 F (110C).
6. With the jumper wire in place the suction pressure should rise.
7. Remove the jumper. The suction pressure should return to the stabilized pressure in step 4.
8. If the suction pressure does not change, check the CLU wire for voltage, the liquid injection solenoid valve, or the metering orifice.
9. Shut off the unit and the truck, remove the gauge manifold set, and replace the LIS wire.

Electric Standby Circuits

If the unit does not run in the electric standby mode use the following procedure.

Make sure the unit is connected to the proper power source.

Check the power cable receptacle for power. If power is there, check for power at the unit terminal plug.

If the contactor is pulled down and the overload relay is closed, but the standby motor fails to start, the trouble is probably in the standby motor.

If the contactor is not pulling down proceed as follows:

1. Check the AC line voltage and the transformer fuse. If the AC line voltage is acceptable and the transformer fuse is intact, go to step 2.
2. Measure the transformer output voltage (AC) at the terminal board. Measure the voltage between wires X1 and X4. The voltage reading should be approximately 12/24V (depending on the unit voltage). If not, the transformer is defective. If the transformer output voltage is acceptable, go to step 3.
3. Check the rectifier output voltage (DC) on the 2R wire (Pin 3 C-2). If this voltage is less than approximately 12/24V, the rectifier bridge is defective. If the rectifier output voltage is acceptable, go to step 4.
4. Check the voltage on 2R1 wire (Pin 4 C-4). If voltage is not present, check Fuse 4. If Fuse 4 is intact, go to step 5.
5. Check the voltage on Pin 2 C-9. If voltage is not present, check for open circuits on wires 2R1 and R. If voltage is present on Pin 2 C-9, check the in-cab control box.

Refrigeration Maintenance

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
Check refrigerant level.			•	•
Replace dehydrator.				•

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

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

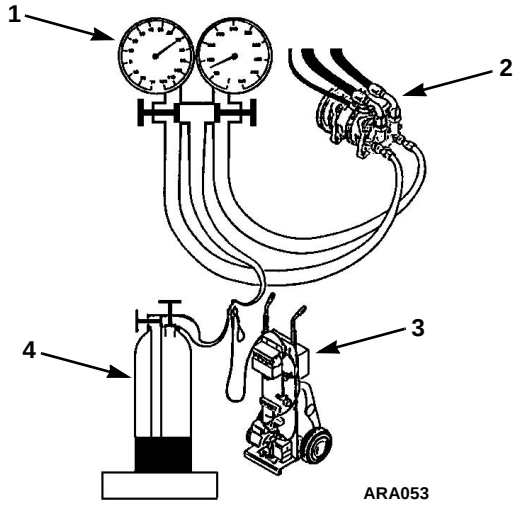
RCharging the Refrigeration System

The liquid line sight glass helps the operator to determine the amount of charge under established operating conditions. These units can be damaged by an overcharge of refrigerant. The amount of refrigerant the system can hold depends on circuit volume which is affected by hose length.

The most satisfactory method of charging the engine driven compressor circuit and the electric standby driven compressor circuit is as follows:

1. Connect a gauge manifold set to the suction and discharge service ports on the engine driven compressor.
2. Connect the center hose of the gauge manifold to the manifold of an evacuation station. The use of Thermo King Evacuation Station P/N 204-725 is recommended.
3. Connect the hose from a drum of refrigerant to the manifold of the evacuation station. Make sure the valve on the refrigerant drum is closed.
4. Open the valves on the gauge manifold and the valves on the evacuation station.
5. Start the vacuum pump and evacuate the system to 500 microns. After the system reaches 500 microns, evacuate the system for an additional hour.

NOTE: If the system will not come down to 500 microns, there is probably a leak in the system or in the evacuation and charging equipment hoses. Find and repair the leak.



1.	Gauge Manifold Set
2.	Engine Driven Compressor
3.	Evacuation Station
4.	Refrigerant Drum

Figure 21: Charging Refrigeration System

6. After the additional hour of evacuation, close the valve at the evacuation pump, stop the vacuum pump, and observe the reading on the vacuum gauge for 5 minutes. The pressure should not exceed 2000 microns.

   NOTE: If the pressure exceeds 2000 microns within 5 minutes, look for a leak in the system or in the evacuation and charging equipment hoses. Find and repair the leak.Then repeat steps 5 and 6.

7. Open the vacuum valve at the vacuum pump, start the vacuum pump, and evacuate the system to 500 microns.

8. When the system reaches 500 microns, close the vacuum valve at the evacuation station manifold. The system is now ready to charge.
9. Close the low side valve on the gauge manifold, leave the high side valve on the gauge manifold open, and open the valve on the refrigerant drum to deliver liquid.
10. Allow 2.60 lb (1.20 kg) of R-134a or 2.75 lb (1.25 kg) of R- 404A refrigerant to enter the system. Then close the valve on the refrigerant drum and the high side valve on the gauge manifold.
11. Start the unit on engine operation and run the truck engine at approximately 1000 rpm.
12. Set the thermostat at 32 F (0 C), and run the unit in cool until the box temperature approaches 32 F (0 C).
13. Make sure that the unit is running in cool, the compressor is running at approximately 1000 rpm, the suction pressure is 2 to 8 psig (14 to 55 kPa), and the head pressure is at least 180 psig (1241 kPa) for R-134a systems or 275 psig (1896 kPa) for R-404A systems. If necessary, raise the head pressure by covering the condenser grille.
14. With these conditions established, open the valve on the refrigerant drum to deliver liquid.
15. Observe the suction pressure and slowly open the low side gauge manifold valve to allow liquid refrigerant to flow into the compressor suction service valve.
16. Control the liquid flow so the suction pressure increases approximately 20 psig (138 kPa).
17. Observe the liquid line sight glass. Close the valve on the refrigerant drum when the bubbles disappear from the sight glass or when the system capacity has been reached (see unit specifications).
18. Close the low side valve on the gauge manifold and operate the unit for 15 minutes.
19. Model 20 only.
    a. Turn the unit Off and shut off the truck engine.
    b. Connect the electric power receptacle to an appropriate electric power supply. Start and run the unit in cool on electric operation for a minimum of 15 minutes.
    c. Turn the unit Off and disconnect the electric power supply. Start the truck and run the unit in cool on engine operation for a minimum of 15 minutes.
20. Check the liquid line sight glass for bubbles. Repeat steps 13 through 20 if bubbles are visible.
21. Stop the unit, shut off the truck engine and remove the gauge manifold set.
22. The above conditions MUST be established each time the refrigerant level is checked, or if refrigerant needs to be added for any reason.

    NOTE: To prevent oil migration from one compressor to another, and for proper oil return when a compressor is operating, operate a compressor for a minimum of 15 minutes. Do not operate a compressor for shorter intervals.

Checking the Refrigerant Charge

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. Also, an insufficient charge does not circulate enough oil to properly lubricate the compressor. The charge can be determined by inspection of the refrigerant through the sight glass with the following conditions established:

Testing the Refrigerant Charge with an Empty Box

1. Place a test box over the evaporator.
2. Install gauge manifold set.
3. Run the unit in cool on engine driven compressor operation until the thermometer reads 32 F (0 C).
4. Establish head pressure of 180 psi (1241 kPa) for R-134a systems or 275 psi (1896 kPa) for R-404A systems. It may be necessary to

partially cover the condenser grille on the front of the unit to create the desired head pressure.

5. Look at the liquid line sight glass. Under these conditions there should be no bubbles in the flow of refrigerant through the liquid line sight glass. Bubbles in the refrigerant indicate the unit is low on refrigerant. Refer to “Charging the Refrigeration System” for information about adding refrigerant.

Testing the Refrigerant Charge with a Loaded Box

1. Install a gauge manifold.
2. Run the unit in cool on engine driven compressor operation.
3. Cover the condenser to drive any excess refrigerant from the condenser into the receiver tank.
4. As the head pressure rises, check the liquid line sight glass. There should be no bubbles in the flow of refrigerant through the liquid line sight glass. Bubbles in the refrigerant indicate the unit is low on refrigerant. Refer to “Charging the Refrigeration System” for information about adding refrigerant.

   NOTE: If no bubbles are present, there is sufficient refrigerant in the unit for that load at that particular box temperature. This test does not determine if the unit contains a full charge of refrigerant.

Checking Compressor Oil Charge

The compressors are furnished with the amount of oil shown in the Specifications chapter. The oil level in the compressor will change after the compressor is initially run, making any level measurements inaccurate.

To ensure an adequate oil supply, the following procedure must be followed whenever the refrigerant charge is lost or removed from a unit:

1. Install a compressor on the system having a residual oil supply and self-lubricating system such as a TK 214 model. Connect an oil separator on the discharge or suction line to collect and drain out circulated oil.

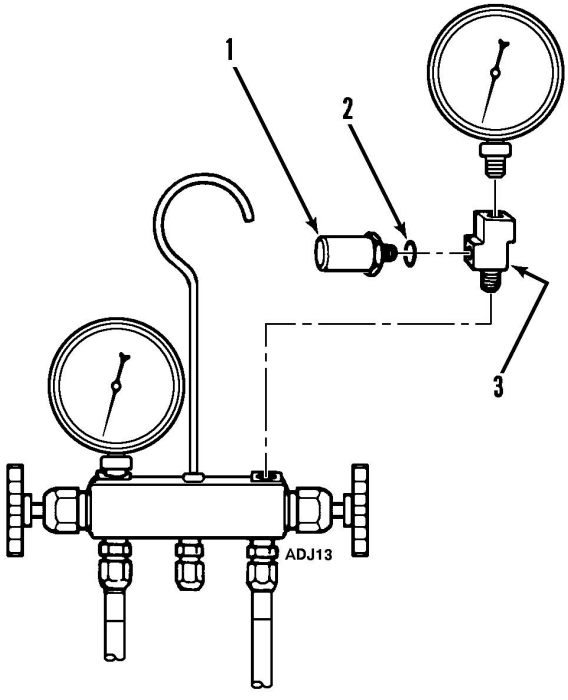
   NOTE: A suction line oil separator can be improvised by installing a suction filter upside down in the suction line near the compressor. Cap off both access ports, and use the lower one to drain off the accumulated oil.

2. Place a normal amount of oil in the cleanup compressor before operating.
3. Charge with 6.0 to 7.0 lb (2.7 to 3.2 kg) of refrigerant.
4. Operate at a low speed (600 to 800 rpm) for 2 hours, or until the compressor oil level reaches a minimum allowable level, whichever occurs first. Drain the collected oil from the oil separator as it fills, taking care to not allow any collected oil to recirculate.
5. Prepare the original compressor that was removed from the unit (or a replacement) by draining out any existing oil and replacing the oil with the amount of oil shown in the Specifications chapter.
6. Install the original compressor (or its replacement), and proceed with the manual evacuation and refrigerant charging procedure.

High Pressure Cutout Switch (HPCO)

The high pressure cutout switch is located on a discharge line inside the condenser unit. If the discharge pressure rises above 300 psig (2068 kPa) on R-134a units or 450 psig (3102 kPa) on R-404A units, the switch opens the 7A circuit de-energizing the power relay.

To test the switch, rework a gauge manifold per Figure 22.



1.	Relief Valve (66-7392)
2.	O-Ring (33-1015)
3.	Adapter Tee Weather Head (No. 552X3)

Figure 22: High Pressure Cutout Manifold

7. Connect the gauge manifold to the compressor discharge service port.

   NOTE: Service manifold hoses must have Schrader valve (tube valve) depressors.

8. Set the thermostat well below the box temperature so that the unit will be in cool.

9. Raise the discharge pressure of the compressor by blocking the condenser coil air flow. When the discharge pressure reaches 300 psig (2068 kPa) on R-134a units, or 450 psig (3102 kPa) on R-404A units, the High Pressure Cutout will stop the compressor.

   NOTE: The discharge pressure should never be allowed to exceed a pressure of 450 psig (3102 kPa).

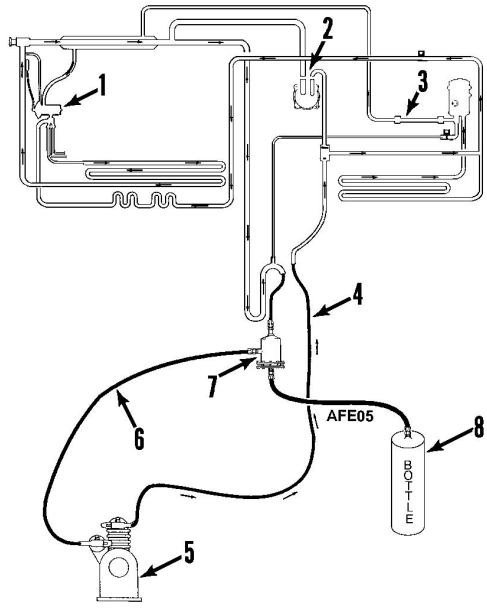
10. Failure of the high pressure cutout system to stop compressor operation should be investigated first by checking the control circuit operation and second by high pressure cutout switch replacement.

Low Pressure Cutout Switch (LPCO)

The low pressure cutout switch is located on the suction line in the evaporator. If the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), it opens the circuit to the power relay to stop the unit. To check the low pressure cutout:

1. Install a gauge manifold at the compressor.
2. Close the receiver tank outlet valve and run the unit in cool.
3. When the suction pressure drops below 5 to 11 in. Hg of vacuum (-17 to -37 kPa), the LPCO should open and the unit should stop.

Cleanup Procedure for Small Truck Units



1.	Remove Internal Parts From Expansion Valve
2.	Disconnect and Cap (If So Equipped)
3.	Replace Drier With Tube
4.	Discharge Line
5.	Flushing Compressor
6.	Suction Line
7.	Suction Oil
8.	Recovered Oil

Figure 23: Connecting Flushing Compressor to Unit

NOTE: If a Van Steenburgh reclaimer is available, do not use this procedure. Follow procedure described in Service Bulletin T&T 134.

Tools Required

- Motor-driven TK 214 “Flushing Compressor”
- Suction Line Filter (P/N 204-498 with Filter P/N 66-2988)
- Pipes (In Place of Oil Separator, Check Valve, Oil Separator and Standby Compressor)

Clean-up Procedure

1. Make sure all hose routing is correct.
2. Make sure that the oil trap is correctly installed.
3. Recover the contaminated refrigerant from the system.
4. Remove the lines from the compressors (engine driven and standby).
5. Flush each compressor using the flushing compressor and an HFC refrigerant. (Always recover the refrigerant before disconnecting the flushing compressor.)
6. Remove the check valve (or check valve seats) from system to ensure flow in all directions.
7. Remove the oil separator and install a connecting pipe.
8. Remove the internal parts from the expansion valve.
9. Open the suction pressure regulator (CPR) valve to its highest setting.
10. Install a temporary suction line filter (P/N 204-498 and P/N 66-2988) in the suction line.
11. Install a connecting pipe in place of the standby compressor.
12. Connect the flushing system to the **engine driven** discharge and suction lines (see illustration).
13. Evacuate the system and check for leaks. Continue to evacuate to remove moisture and air.
14. Install HFC refrigerant and flush the system. (Energize the defrost solenoid during 30% to 40% of the clean-up. Solid contaminants will collect in the suction line filter. Oil from the system and from the flushing compressor will drain out of the suction line filter. (Add compressor oil as required.) Refrigerant oil in the flushing compressor will absorb acids from the system.
15. Test the recovered compressor oil for acid contamination.
16. Continue flushing until the compressor oil is clean.

Putting the Unit Back Into Operation

1. Replace the check valve (or check valve seats).
2. Install a new oil separator.
3. Install a new liquid injection orifice.
4. Install a new drier.
5. Install a new expansion valve.
6. Install the compressors and lines.
7. Use dry nitrogen to pressurize the system to 150 psi (1034 kPa).
8. Use a bubble solution to check for leaks.
9. Install correct amount of oil.
10. If no leaks are found, evacuate the system. A leak-free and dry system will maintain a 1000 micron vacuum for five minutes or longer.
11. Charge the system with proper amount of the correct refrigerant.
12. Operate the unit and check for proper operation. (Adjust the suction pressure regulator.)
13. After two weeks of operation, change the drier.

Structural Maintenance

Maintenance Inspection Schedule

Procedures	Weekly	Monthly	Semi-Annual	Annually
Visually inspect unit and refrigerant hoses for fluid leaks.	•	•	•	•
Visually inspect unit for damaged, loose or broken parts.	•	•	•	•
Clean defrost drains.	•	•	•	•
Inspect belts for condition and proper tension (belt tension tool P/N 204-427).		•	•	•
Clean entire unit including evaporator coil and condenser coil.		•	•	•
Check all unit mounting bolts, brackets, lines, hoses, etc.			•	•

WARNING: Take precautions to ensure the unit will not accidentally start while you are servicing the system.

Evaporator Coil

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

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

Condenser Coil

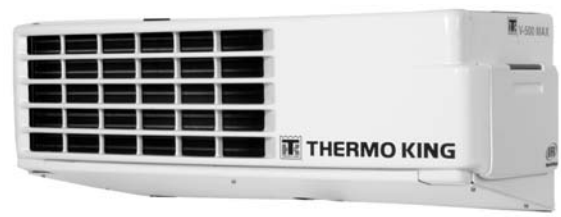
Clean the coils during scheduled maintenance inspections. Remove any debris (e.g., leaves or plastic wrap) that reduces the air flow. Clean dirty coils with compressed air or a pressure washer. Be careful not to bend the fins when cleaning a coil. If possible, blow the air or water through the coil in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

Unit Mounting Bolts

Periodically check and torque the unit mounting bolts.

AMA523

Figure 24: Evaporator



AMA508

Figure 25: Condenser

Compressor Maintenance

Refrigerant Handling Instructions

Refrigerant Handling Safety

DANGER: Explosion Hazard! Never throw or strike refrigerant bottles and never handle the packing carton roughly. Do not use refrigerant bottles that are damaged or dented. Store refrigerant bottles out of reach of children.

DANGER: Explosion Hazard! Never directly heat refrigerant bottles or put them in hot water heated above 104 F (40 C) because the bottle might explode and cause personal injury. When it is necessary to heat refrigerant bottles for charging in cold weather, use warm water at a temperature below 104 F (40 C).

DANGER: Explosion Hazard! Never put refrigerant bottles on the engine or the radiator when charging Excessive heat increases pressure to a dangerous level that might cause the bottle to explode.

DANGER: Explosion Hazard! Never store refrigerant bottles in direct sunlight, near flame, or where the temperature exceeds 104 F (40 C). Always store refrigerant bottles in a cool dry place.

CAUTION: Do not put the charge valve in warm water.

Refrigerant Recovery

Some refrigeration system refrigerant compounds are chlorofluorocarbons, and therefore may be damaging to the earth's ozone layer. Consequently, the release of refrigerant into the atmosphere must be avoided. Whenever refrigerant is to be removed from the refrigeration system, a refrigerant recovery unit must be used to recover the refrigerant. This refrigerant can then be recycled and reused, which is both environmentally safe and economical.

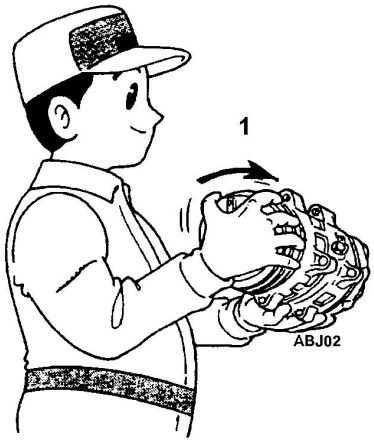
NOTE: Consult the operators manual for your recovery unit for the proper hookup and operating procedures.

Figure 26: Typical Recovery Unit

Compressor Installation Guidelines

Compressor Handling

CAUTION: Do not strike the compressor or turn it upside down. If the compressor is knocked over or turned upside down, rotate the compressor clutch 5 to 6 times by hand to circulate the oil that has settled in the cylinders. Sudden rotation of the compressor with oil in the cylinders can cause valve damage and adversely affect durability.



1.	Rotate Compressor Clutch 5 to 6 Times

Figure 27: Rotate Compressor Clutch

Compressor Storage

Both new and rebuilt compressors should be stored with the correct oil charge. They should be stored within the orientation range shown Figure 28 on page 56. If the compressor is allowed to sit outside that orientation for more than a minute, the compressor must be turned over by hand (slowly) to clear oil from the cylinders.

NOTE: All compressors in storage must have a holding charge of refrigerant or nitrogen to a pressure of between 7 to 21 psig (48 to 145 kPa, 0.5 to 1.5 bar, 0.5Kg/cm² to 1.5 Kg/cm²). This will protect internal parts from moisture and corrosion.

Compressor Installation Position

The compressor should be installed on the vehicle within the range shown below. If installed outside this range, the compressor will be adversely affected. This compressor is equipped with a pressure feed lubrication system that cannot function properly if the compressor is installed outside this range.

As a precaution, it is recommended that once the compressor is mounted in its proper and final position, turn it over by hand at least 10 revolutions before hooking the drive belt up to the pulley. If this is not done before the compressor is put in service, damage to the compressor valves can result from oil slugging. **This is not covered under warranty**!

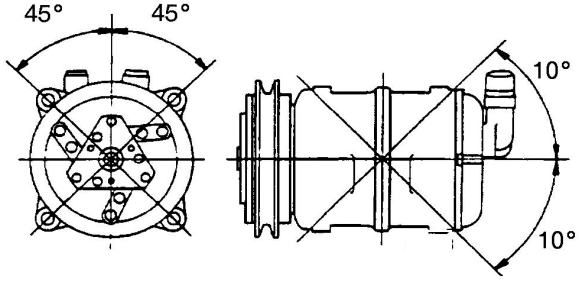


Figure 28: Compressor Installation Range

Compressor Installation Precautions

The new compressor is filled with the specified quantity of compressor oil and nitrogen gas (N_2). When mounting the compressor on the vehicle, take the following steps:

1. Loosen the discharge side connector's cap and slowly release the nitrogen from the compressor.

Figure 29: Loosen Cap Slowly

CAUTION: Take care not to let oil escape.

2. Slowly rotate the compressor's magnetic clutch several times by hand to distribute the oil that has settled in the cylinders.

Figure 30: Rotate Compressor Clutch

3. When replacing the compressor on a system, the amount of oil in the compressor should be adjusted before the compressor is installed (see "Checking Compressor Oil" on page 59.) When installing the compressor on a new system, be sure to follow factory specifications.

Compressor Installation

The compressor is mounted on the truck engine using a special mounting bracket. The side to side mounting angle of the compressor must remain ± 45 degrees from the horizontal. The forward to backward angle must be within ± 10 degrees of horizontal. (see Figure 28 on page 56). Access to the refrigeration system service ports may vary, but usually access to the system can be made from under the engine compartment hood from the front of the truck.

Special care must be used when routing the suction and discharge hoses through the engine compartment. These hoses must be kept away from sharp objects and hot areas of the engine. These things can cause damage to the hoses and leaks of the refrigerant. The hot areas can also rob you of cooling by adding heat into the refrigerant inside the hoses. This added heat must then be removed in the condenser coil. Since each coil has a limited ability to remove heat, that kind of extra heat simply means less cooling inside the box where it is needed.

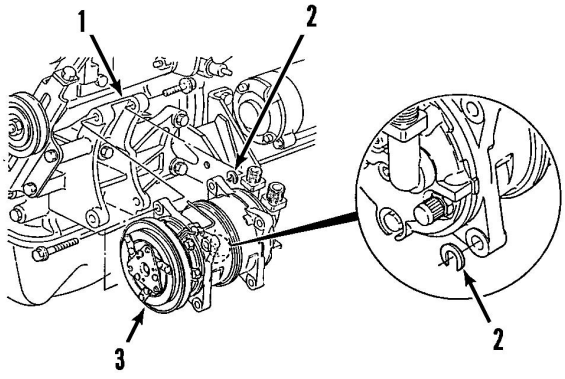
Each compressor kit comes with a standard oil charge. This quantity of oil is enough to supply the compressor lubrication when it is installed in an already "oil wet" system. New systems require an extra quantity of oil be added to "wet" all the interior surfaces of the system.

CAUTION: Be sure to verify the oil that is used in the compressor kit matches the oil used in your system. Failure to use the correct oil will contaminate and damage your system.

During normal operation there is always a quantity of oil that travels around inside the system. This oil lubricates all the components, returns to the compressor for a while, and again travels around the system.

Mounting Compressors

Clearance between the compressor mounting supports and its bracket must be less than 0.004 inches (0.10 mm). Use shims as necessary to adjust this clearance. This will reduce the stresses on the compressor which can cause components to fail. Be sure to maintain proper pulley alignment for the drive belt.



1.	Bracket
2.	Shim
3.	Compressor

Figure 31: Shim Installation

It is important that the compressor be mounted properly when installed. Figure 28 on page 56 shows the maximum range of installation positions for the compressor. Be sure to verify this positioning at both extremes of the belt adjustment.

CAUTION: Keep all containers tightly closed until ready to use. Both Polyalkylene Glycol (PAG) and Polyol Ester (POE) oil will absorb moisture from the air. Moisture that gets into the oil causes a chemical reaction that creates acid. Evacuation of the system will not remove this moisture from the oil. This process is not reversible and will happen in a short period of time.

CAUTION: Do not leave the oil container open to the air any longer than necessary to properly service of the system. Refrigeration oils are hydroscoptic, which means they absorb moisture from the air.

CAUTION: Do not open a refrigeration system unnecessarily. This increases the chance of contamination.

CAUTION: Always discard used containers. These containers are hazardous.

CAUTION: Never store PAG oil in plastic containers. PAG oil will absorb moisture through the plastic container

Adding Extra Oil To System

The initial oil charge into a new system is based on the size of the system and the amount of oil, which remains in the compressor during operation.

CAUTION: Check the system decals and operation manual for the proper oil. The mixing of incompatible oils will cause system damage. Compressor Oil 1L PAG recommended for R-134a Systems.

CAUTION: Be sure to verify the oil that is used in your compressor kit matches the oil that is used your system. Failure to use the correct oil will contaminate and damage your system.

CAUTION: Keep all oil containers tightly sealed from the air. Oil tends to absorb moisture from the air and can become contaminated if left open. If contaminated oil is put into a system, it may damage the components of the system.

Major Loss Of Refrigerant

In case of a major loss of refrigerant, it must be assumed that some system oil is lost also. The oil level should be verified. See “Checking Compressor Oil” below.

Checking Compressor Oil

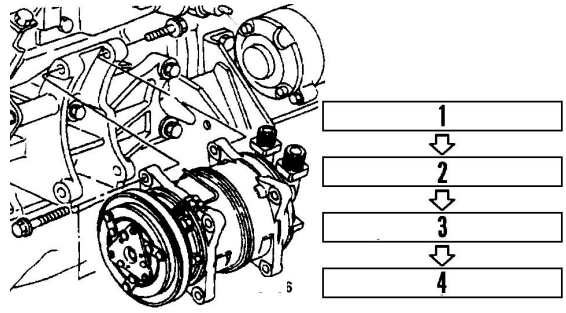
Oil Check Interval

Unlike engine oil, it is not necessary to frequently check or change the compressor oil. However it is necessary to check and replenish or replace the compressor oil in the following cases:

- Every 3,200 miles (5000 km) or every 5 months for commercial vehicles and vehicles that are in constant use.
- When the compressor, evaporator coil, condenser coil, or receiver tank (if used) is replaced.
- When the refrigeration system has leaked refrigerant.
- When the refrigeration system has an oil-related problem.

Oil return procedure (System Operational)

There is a close affinity between oil and refrigerant. During normal operation, some of the oil circulates with the refrigerant in the system. Before checking the oil level, or replacing any system components, we need to place the system in a condition that will return as much oil as possible to the compressor sump. As the oil returns, it will reach a maximum level inside the compressor—this is the point we need to check the oil level. To get the oil to return to the compressor it is necessary to run the system at an elevated load condition for 20 minutes. Place the engine in idle or high idle (if equipped). The compressor speed should be between 800 and 1500 rpm. Open the compartment doors to raise the interior air (unit return air) temperature to between 75 to 80 degrees (24 to 27 C). The condenser inlet air (ambient air temperature) should be above 85 degrees F (29 C). If not, partially block the condenser air flow to raise the compressor discharge pressure above 170 psig (1172 kPa). This condition will return most oil to the compressor.



1.	Oil Return Operation
2.	Refrigerant Recovery
3.	Compressor Removal
4.	Oil Inspection

Figure 32: Oil Inspection Procedure

Compressor Removal

CAUTION: Systems without service valves require that the refrigerant be removed from the system before the compressor is removed.

1. Perform the “Oil return procedure (System Operational)” on page 59 if the compressor is operational. If the compressor is inoperable, go to step 2.
2. Recovery the refrigerant from the system. For more information, see “Refrigerant Recovery” on page 55.
3. Remove the compressor from the system and cap or plug all open connections immediately.
4. Drain the oil from the compressor (see “Draining and Replacing Oil” on page 60).
5. Measure the amount of oil drained from the compressor and check the oil for contamination (see “Oil Contamination” on page 60).

Draining and Replacing Oil

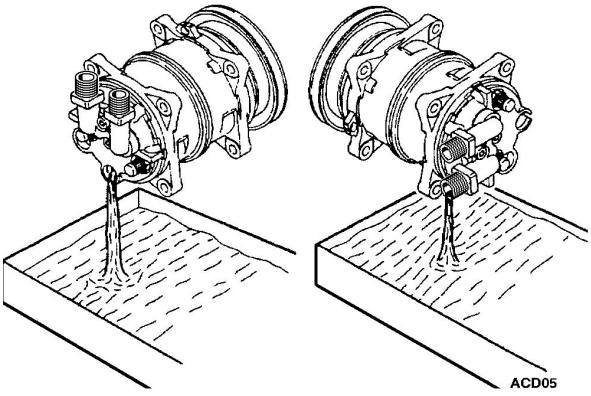


Figure 33: Draining the Oil

Drain the oil from the compressor drain plug and all other ports. Turn the clutch (rotating the internal compressor parts) by hand and drain the oil again. Repeat until all oil is removed from the compressor. Measure the amount oil drained from the compressor and inspect the oil for signs of contamination.

Oil Contamination

Unlike engine oil, no cleaning agent is added to the compressor oil. Even if the compressor is run for a long period (approximately 1 season), the oil never becomes turbid as long as there is nothing wrong with the compressor or the refrigeration system. Inspect the extracted oil for any of the following:

1. Dirt in the oil.
2. Color changed to red, brown, or black.
3. Presence of foreign substances, metal shavings, etc. in the oil.

CAUTION: Check the system decals and operation manual for the proper oil. The mixing of incompatible oils will cause system damage. Compressor Oil 1L PAG recommended for R-134a Systems.

When a System Becomes Contaminated

A severely contaminated system may be indicated by black oil in the compressor. If severe contamination occurs, it will be necessary to flush the complete system. If flushing is required, use industry approved materials.

In all cases when this occurs, the extent of contamination must be determined. Do this by removing the filter-drier and determine if the darker-colored oil is present at that point of the system. If so, flushing the system is recommended.

If the oil appears clean at the filter-drier, install a new filter-drier and replace the compressor oil with clean new oil.

Replacing Oil

Pour the oil into the compressor through the suction port.

NOTE: Always replace the oil with new fresh oil taken only from a sealed metal container.

NOTE: Always replace the filter-drier anytime the system has been opened for service.

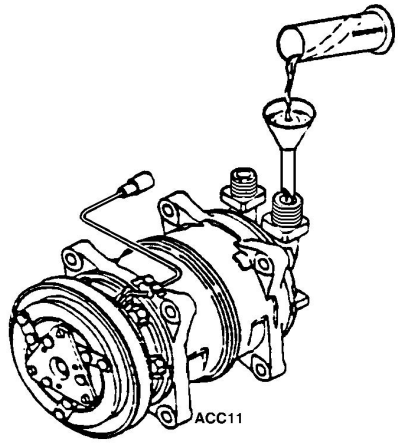


Figure 34: Typical Compressor Oil Fill Procedure

Clutch Test

1. If the field coil lead wire is broken, replace the field coil.
2. Check the amperage and voltage. The amperage range should be 3.6 to 4.2 amps at 12 volts or 1.8 to 2.1 amps at 24 volts. Note the following symptoms and conditions:
   a. A very high amperage reading—a short within the field coil.
   b. No amperage reading—an open circuit in the winding.
   c. An intermittent or poor system ground results in lower voltage at the clutch. Check for tight fit on the coil retaining snap ring or for a good ground at the coil retaining screws.
3. Air Gap—An incorrect air gap can cause erratic engagement or disengagement, and/or clutch rattle. Check the air gap with a feeler gauge. The air gap should be 0.016 to 0.031 in. (0.4 to 0.8 mm). See “Clutch Installation” for information about adjusting the air gap.

Clutch Removal, Inspection, and Installation

NOTE: Make sure the proper tools are available before performing maintenance procedures. Refer to “Special Tools” at the end of this chapter for the tools required. Contact your local Thermo King dealer for further information.

Removal

1. Remove the center armature bolt.

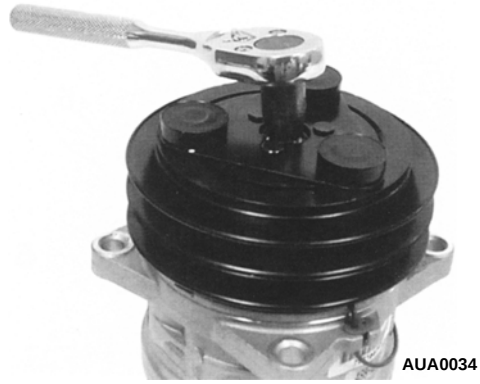
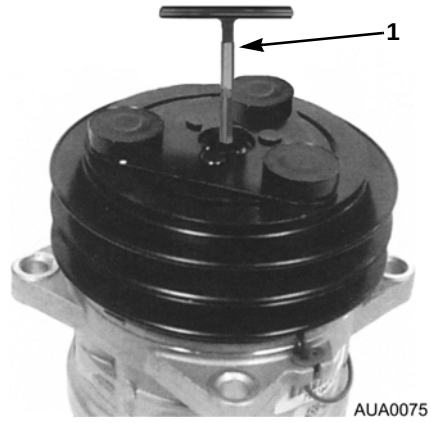


Figure 35: Remove Center Bolt

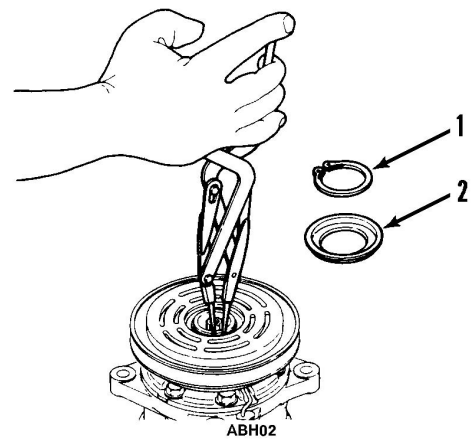
2. Remove the armature plate using the armature plate puller. Then remove the shims from either the drive shaft or the drive plate.



1.	Armature Plate Puller

Figure 36: Remove Armature Plate

3. Remove the snap ring using external snap ring pliers.
4. Remove the cover (if equipped).



1.	Snap Ring
2.	Cover (If Equipped)

Figure 37: Remove Snap Ring and Cover

5. Remove the pulley assembly using the pulley remover and the spacer positioned on the cylinder head hub.

CAUTION: To avoid damaging the pulley groove, the puller claws should be hooked into, not under, the pulley groove.

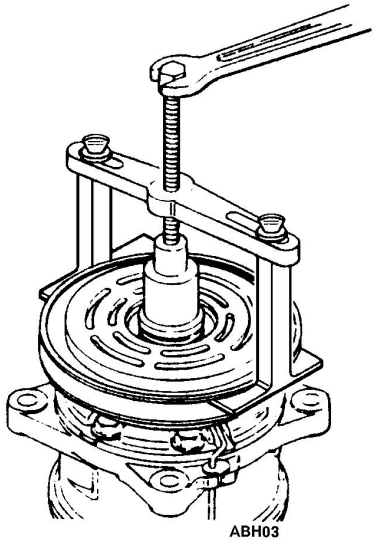


Figure 38: Remove Pulley

6. Remove the coil's lead wire from the holder on the top of the compressor.
7. Remove the three screws that attach the coil to the compressor and remove the coil.

NOTE: DO NOT hold the coil by the lead wire.

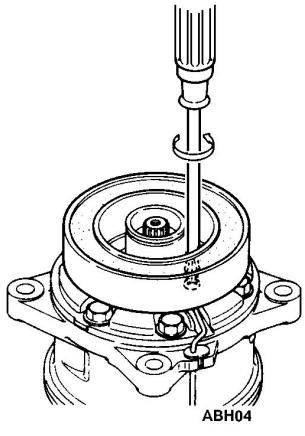
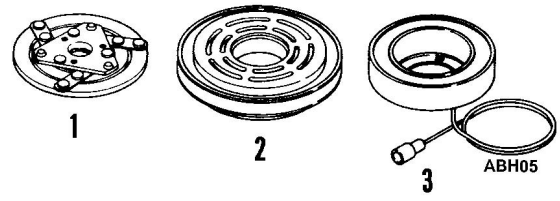


Figure 39: Remove Coil

Inspection

1. **Armature Plate:** If the contact surface is scorched, the armature plate and pulley should be replaced.
2. **Pulley Assembly:** If the pulley's contact surface is excessively grooved due to slippage, both the pulley and armature plate must be replaced. There should also be no foreign matter, such as oil or grit, lodged between the armature plate and pulley. Thoroughly clean these contact surfaces and the armature plate.
3. **Coil:** Inspect the coil for a loose connector or cracked insulation. If the insulation is cracked, replace the coil. Repair or replace the wire or the connector if either is loose or damaged.



1.	Drive Plate
2.	Pulley Assemble
3.	Coil

Figure 40: Inspect Clutch Components

Installation

NOTE: Before installing the clutch, perform the "Inspection" procedures described previously.

1. Install the coil on the compressor (with the lead wire on top). Then torque the mounting screws to 2.9 to 4.3 ft-lb (4 to 6 N•m).
2. Install the lead wire in the wire holder on the compressor.

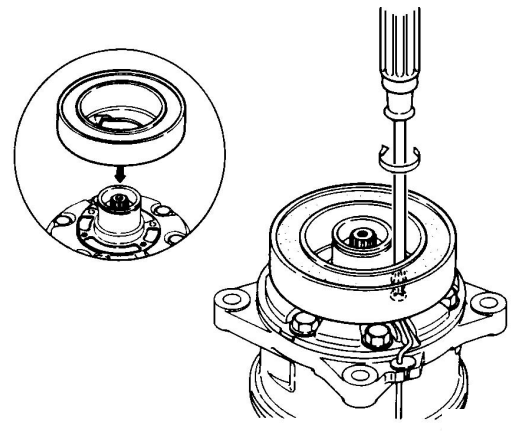


Figure 41: Install Coil

3. Install the pulley assembly using the installer and a hand press.

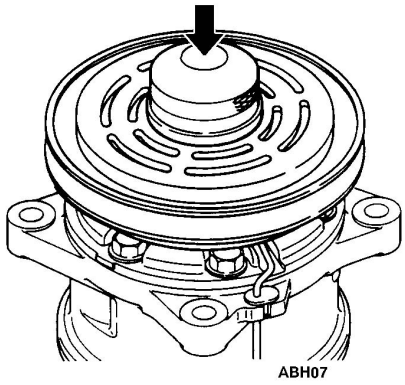
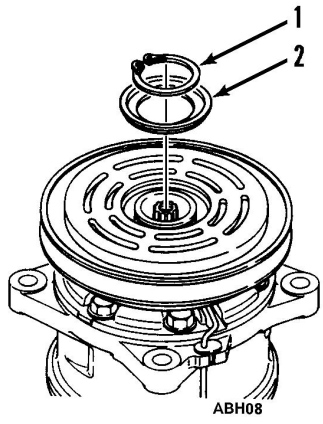


Figure 42: Install Pulley

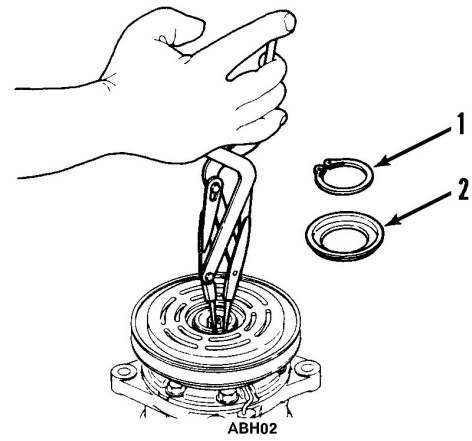
4. Install the cover (if equipped) and the snap ring using external ring pliers.

   NOTE: The snap ring should be installed with the chamfered inner edge outward (facing away from seal).



1.	Snap Ring
2.	Cover (If Equipped)

Figure 43: Install Cover and Snap Ring

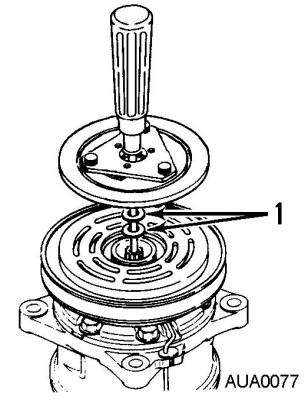


1.	Snap Ring
2.	Cover (If Equipped)

Figure 44: Install Cover and Snap Ring

5. Install the driver plate on the drive shaft, together with the original shim(s). Press the drive plate down by hand.

   NOTE: If replacement or additional shims are required, a clutch hardware kit is available.



1.	Shims

Figure 45: Install Shims and Drive Plate

6. Install the armature bolt and torque it to 8.7 to 10.1 ft-lb (12 to 14 N•m). Use the pulley arbor to prevent armature plate rotation. After tightening the bolt, ensure that the pulley rotates smoothly.

7. Check the air gap with a feeler gauge. The air gap should be 0.016 to 0.031 in. (0.4 to 0.8 mm). If necessary, adjust the air gap by adding or removing shims. Adjusting shims are available in a Clutch Hardware Kit.

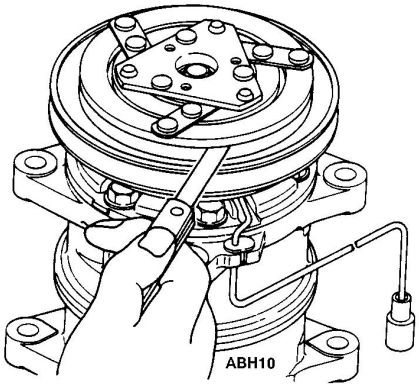


Figure 46: Check Air Gap

Electrical Connection

1. Connect the lead wire to the electrical circuit.

   NOTE: The stationary field is grounded at the factory; therefore, it is necessary only to connect the hot (lead) wire.

2. Engage and disengage the clutch several times to check the clutch engagement. The disc should snap firmly against the pulley.

Clutch Run In

The clutch should be “run in” after it has been installed on the compressor and the compressor has been installed in the system.

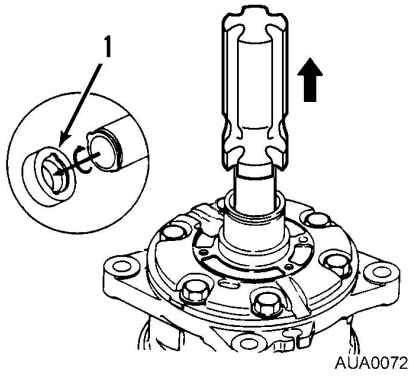
1. Run the truck engine at idle speed.
2. Turn the unit On and Off at 10 second intervals to engage and disengage the clutch. Do this at least ten times.

Shaft Seal Cover and Shaft Seal Removal, Inspection, and Installation

Removal

1. Remove the magnetic clutch assembly (see “Clutch Removal, Inspection, and Installation” on page 61).
2. Use the seal remover (from the shaft seal kit) to remove the shaft seal cover. Turn the seal remover to engage the hook on the seal remover with the hook on the shaft seal cover, then slowly pull the shaft seal cover out of the cylinder head (some models).

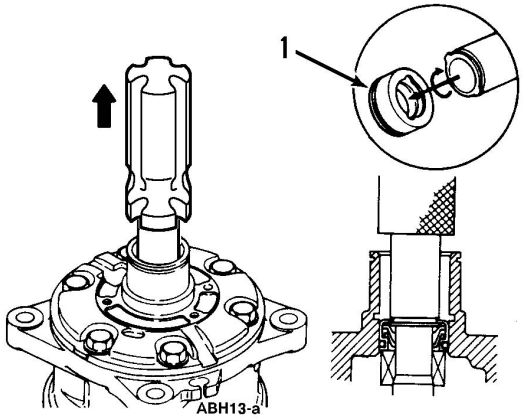
   NOTE: The shaft seal cover SHOULD NOT be reused. Always use a new shaft seal cover when reassembling a compressor (some models).



1.	Shaft Seal Cover (If Equipped)

Figure 47: Shaft Seal Cover Removal

3. Remove the snap ring using an internal snap ring pliers.
4. Use the seal remover (from the shaft seal kit) to remove the shaft seal. Turn the seal remover to engage the hook on the seal remover with the hook on the shaft seal, then slowly pull the shaft seal housing out of the cylinder head.



1.	Shaft Seal

Figure 48: Remove Shaft Seal

Inspection

The shaft seal should not be reused. Always use a new shaft seal when reassembling the compressor. Be extremely careful that the lip of the new shaft seal is not scratched or damaged in any way. Make sure the shaft seal is free from lint and dirt that could damage the shaft seal surface.

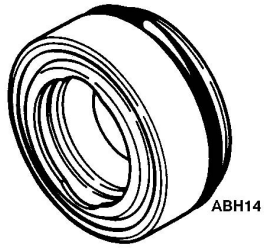
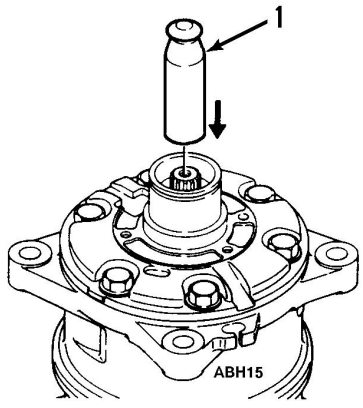


Figure 49: Inspect Shaft Seal

Installation

Before installing a shaft seal inspect it carefully (see “Inspection” above).

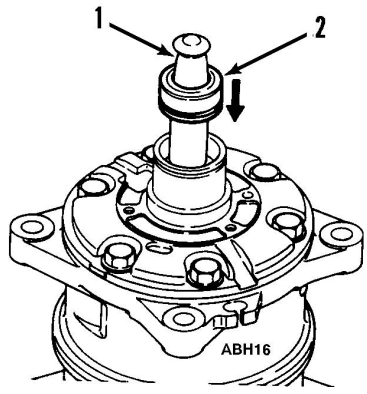
1. Clean the seal section of the front cylinder head that holds shaft seal.
2. Apply clean compressor oil to the new shaft seal and to the front cylinder head. If the slip surfaces are dirty, clean them with thinners, dry the clean surfaces, and apply clean compressor oil — same type that is used in the system.
3. Place the seal guide (from the shaft seal kit) on the end of the spline shaft.



1.	Seal Guide

Figure 50: Place Guide on Shaft

4. Place the shaft seal over the seal guide and slide the seal into the front cylinder head.



1.	Seal Guide
2.	Shaft Seal

Figure 51: Place Shaft Seal on Guide

5. Use the seal installer (from the shaft seal kit) to press the shaft seal into the cylinder head as far as possible.

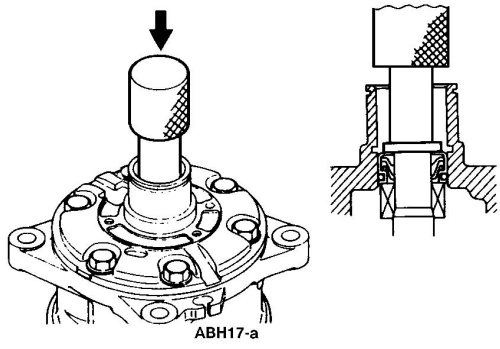
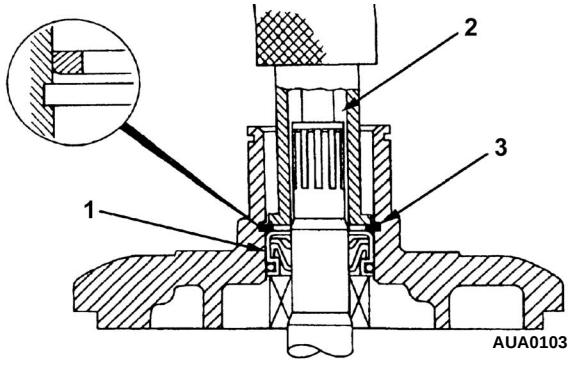


Figure 52: Press Seal Into Cylinder Head

6. Remove the seal guide from the spline shaft.
7. Install the snap ring using internal snap ring pliers.

8. Press the snap ring using the installing end of the remover until a “Click” is heard.

NOTE: When installing the snap ring, the chamfered edge of the snap ring must face upward as shown in the figure below.



1.	Shaft Seal
2.	Guide
3.	Snap Ring

Figure 53: Install Snap Ring

Seal Cover Installation (When Equipped)

1. Place the seal guide (from the shaft seal kit) on the end of the shaft.
2. Place the shaft seal cover on the seal guide and slide the shaft seal cover into the cylinder head.

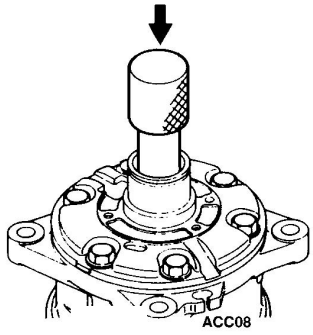
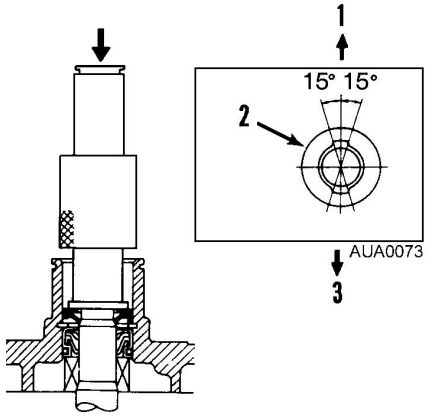


Figure 54: Install Shaft Seal Cover (When Equipped)

3. Use the seal installer (from the shaft seal kit) to press the shaft seal cover into the cylinder.

NOTE: Position the shaft seal cover as shown in the illustration.



1.	Top
2.	Shaft Seal Cover
3.	Bottom

Figure 55: Proper Shaft Seal Cover Position

4. Remove the seal guide from the spline shaft.

Front and Rear Cylinder Head Disassembly, Inspection, and Reassembly

Disassembly

1. Remove the magnetic clutch assembly (see“Clutch Removal, Inspection, and Installation” on page 61).
2. Remove the connector’s caps and the drain plug and then drain the oil.
3. Remove the shaft seal cover and shaft seal (“Shaft Seal Cover and Shaft Seal Removal, Inspection, and Installation” on page 64).

4. Remove the six body bolts securing the head using a socket wrench.

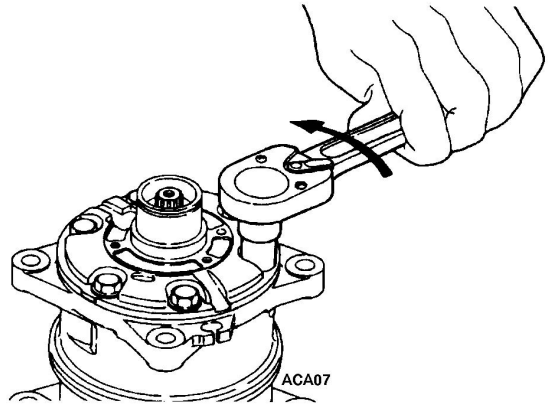


Figure 56: Remove Body Bolts

5. To remove the front cylinder head alternately tap the two projections on the circumference of the front cylinder head with a screwdriver and a plastic mallet.

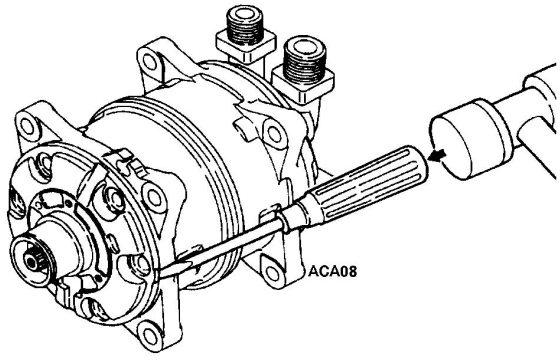
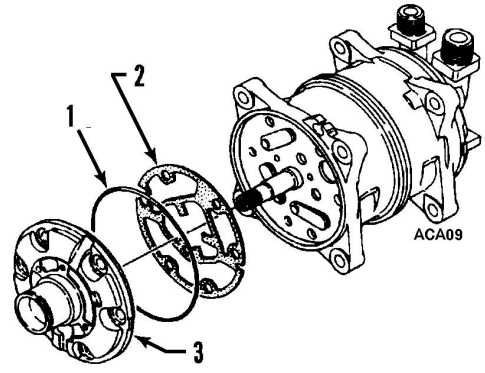


Figure 57: Tap Front Cylinder Head Projections

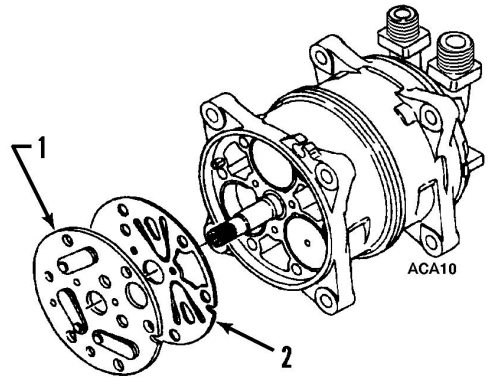
6. Remove the O-ring from the front cylinder head and the remove all the gasket material from the front cylinder head.



1.	O-ring
2.	Gasket
3.	Front Cylinder Head

Figure 58: Front Cylinder Head Assembly

7. Remove the valve plate and suction valve from the cylinder shaft assembly and remove all the gasket material from the valve plate.



1.	Valve Plate
2.	Suction Valve

Figure 59: Front Valve Plate and Suction Valve

8. To remove the rear cylinder head alternately tap the projections on the circumference of the rear head with a screwdriver and a plastic mallet.

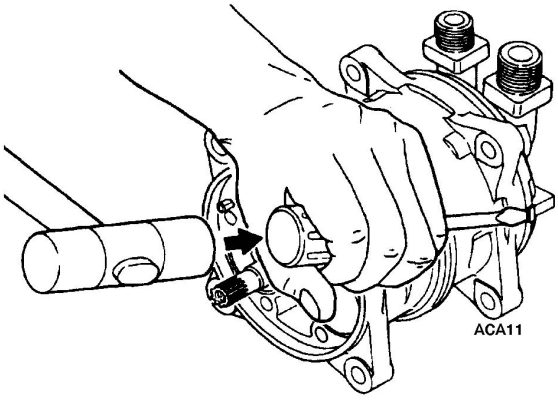
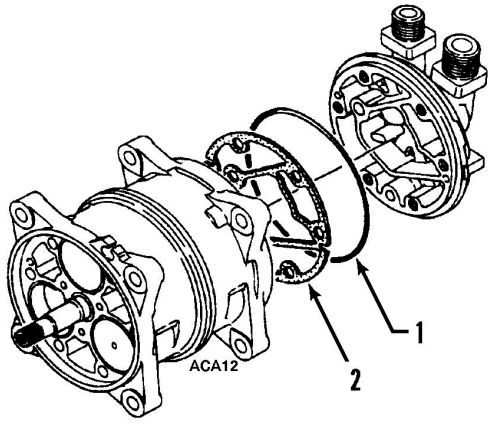


Figure 60: Tap Rear Cylinder Head Projections

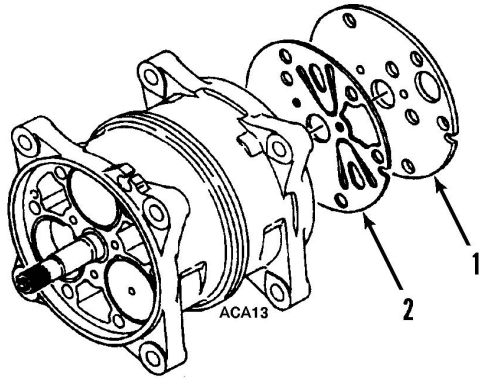
9. Remove the O-ring from the rear cylinder head, and remove all the gasket material from the rear cylinder head.



1.	O-ring
2.	Gasket

Figure 61: Rear O-ring and Gasket

10. Remove the valve plate and suction valve from the cylinder shaft assembly and remove all the gasket material from the valve plate.

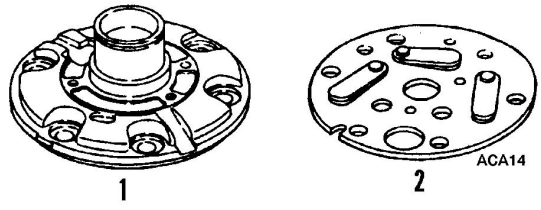


1.	Valve Plate
2.	Suction Valve

Figure 62: Rear Valve Plate and Suction Valve

Inspection

Check the front and rear valve plates for scratched, bent or damaged parts. Inspect both cylinder heads and both valve plate assemblies for nicks and/or burrs on the sealing surfaces. Clean or replace them if damaged. Ensure that all passages in the valve plate are unobstructed. If either the cylinder head or valve plate is cracked, it must be replaced.



1.	Front Cylinder
2.	Valve Plate Assembly

Figure 63: Front Cylinder and Valve Plate

Reassembly

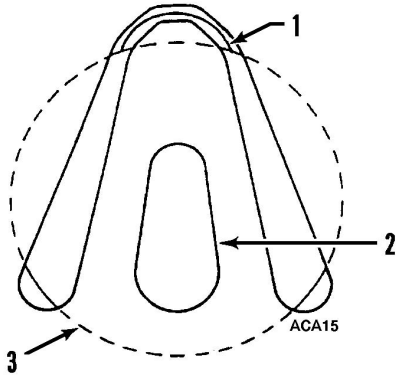
Rear Cylinder Head

1. Place the cylinder shaft assembly on the bench with the rear side up.

Figure 64: Rear View

2. Install the rear suction valve so that it aligns with the alignment pin.

CAUTION: Ensure that the valve is aligned with the valve escape groove of each cylinder.



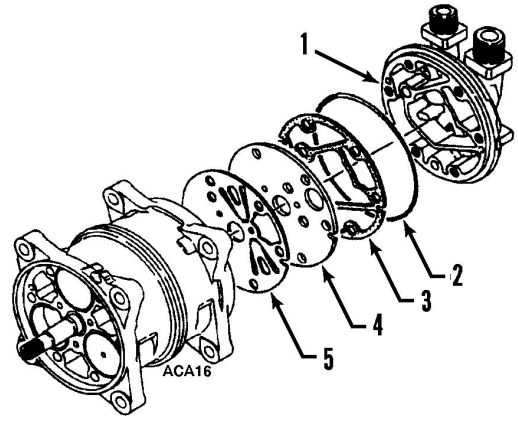
1.	Escape Groove
2.	Suction Valve
3.	Piston

Figure 65: Rear Suction Valve

3. Install the rear valve plate on the rear suction valve.

CAUTION: Be careful not to mistake the front valve plate for the rear valve plate.

4. Coat the new gasket with clean compressor oil and install it on the rear valve plate. Use the same type of oil that is used in the system.
5. Thinly coat the new O-ring with clean compressor oil (same type of oil that is used in the system) and install it on the rear cylinder head.
6. Install the rear cylinder head. If the rear cylinder head is difficult to install, tap the cylinder head lightly with a mallet.



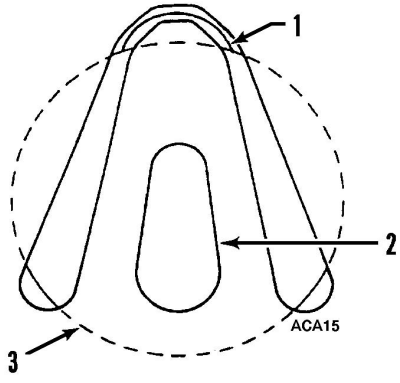
1.	Rear Cylinder Head
2.	O-ring
3.	Gasket
4.	Valve Plate
5.	Suction Valve

Figure 66: Rear Cylinder Head Assembly

Front Cylinder Head

1. Place the cylinder shaft assembly on the bench with the front side up.
2. Install the front suction valve so that it aligns with alignment pin.

CAUTION: Ensure that the valve is aligned with the valve escape groove of each cylinder.



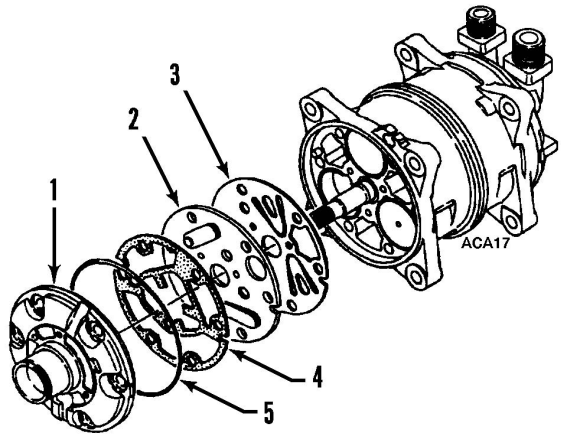
1.	Escape Groove
2.	Suction Valve
3.	Piston

Figure 67: Front Suction Valve

3. Install the front valve plate on the front suction valve.

CAUTION: Be careful not to mistake the rear valve plate for the front valve plate.

4. Coat the new gasket with clean compressor oil (same type of oil that is used in the system) and install it on the front valve plate.
5. Thinly coat the new O-ring with clean compressor oil (same type of oil that is used in the system) and install it on the front cylinder head.
6. Install the front cylinder head. If the front cylinder head is difficult to install, tap the cylinder head lightly with a plastic mallet.



1.	Front Cylinder Head
2.	Valve Plate
3.	Suction Valve
4.	Gasket
5.	O-ring

Figure 68: Front Cylinder Head Assembly

7. Install new gaskets on the body bolts. Insert the six body bolts from the front cylinder head side and tighten them in three or more stages to a torque of 14.5 to 17.3 ft-lb (20 to 24 N•m). The bolts should be tightened in the order shown in Figure 69.

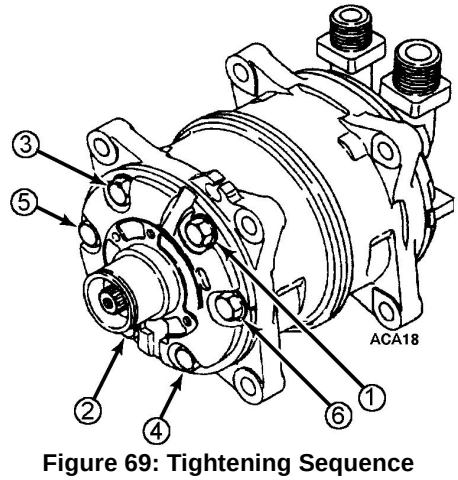
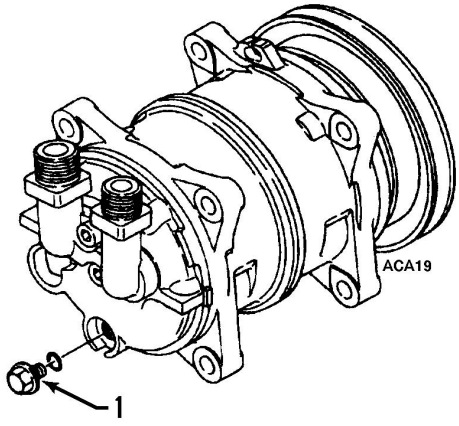


Figure 69: Tightening Sequence

8. Turn the drive shaft two to three times by hand to ensure that the shaft rotates smoothly.

9. Install the oil drain plug with a new O-ring, thinly coated with clean compressor oil, and torque it to 9.4 to 10.8 ft-lb (13 to 15 N•m).



1.	Drain Plug

Figure 70: Compressor Drain Plug Location

10. Fill the compressor with the specified amount of clean compressor oil through the suction-side connector.

CAUTION: Be sure to verify the oil you are using matches what is used in the system. The use of the incorrect oil will damage the system.

11. Install the shaft seal and shaft seal cover (see “Shaft Seal Cover and Shaft Seal Removal, Inspection, and Installation” on page 64).

12. Install the clutch (see “Clutch Removal, Inspection, and Installation” on page 61).

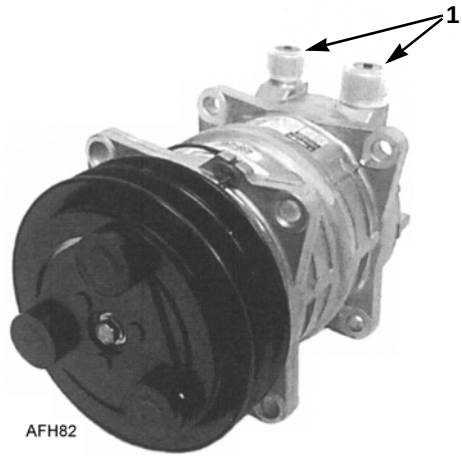
13. Leak test the compressor (see “Compressor Leak Test Procedure”).

14. Check the clutch air gap with a feeler gauge. The air gap should be 0.016 to 0.031 in. (0.4 to 0.8 mm). If necessary, adjust the air gap by adding or removing shims. Adjusting shims are available in the Clutch Hardware Kit.

Compressor Leak Test Procedure

When a compressor is repaired it should be checked prior to installation.

1. Install discharge and suction caps on the connector.



1.	Caps

Figure 71: Discharge and Suctions Caps

2. Fill the compressor with refrigerant gas (same type that is used in the system) through the connector’s suction port raising the pressure to at least 70 psig (483 kPa).

3. Check the compressor for leaks using a reliable leak detector.

NOTE: Be sure that the leak tester being used is capable of detecting fluorine based refrigerants.

CAUTION: Never leave the compressor upside down for more than 30 seconds because the oil inside the compressor will enter the cylinders. This causes liquid compression, which will damage the compressor’s suction and discharge valves.

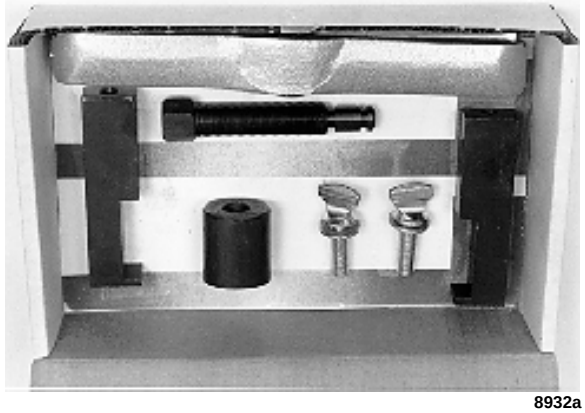
Special Tools

8932f

Figure 72: Pulley Arbor P/N 204-804

8932e

Figure 73: Shaft Seal Kit P/N 204-805



8932a

Figure 74: Clutch Remover P/N 204-806

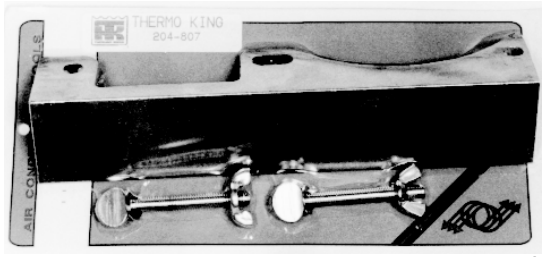


Figure 75: Compressor Holder P/N 204-807

Figure 76: Snap Ring Pliers P/N 204-808

Figure 77: Clutch Installation Kit P/N 204-890

Belt Tensions

Engine Driven Compressor Belt and Pulleys

Correct pulley alignment and proper belt tension are very important factors in compressor installation. The compressor clutch must be perfectly aligned with the engine pulley and any auxiliary idler or belt adjustment pulley components. When installing the clutch, be sure the shaft drive key is in place and the shaft bolt is properly tightened. Check the pulley alignment by holding a 24 to 35 in. (60 to 90 cm) long rod, 0.5 in.(13 mm) in diameter firmly into the V-groove of the clutch pulley and make sure the rod aligns squarely with the engine drive pulley groove. Double check by making sure the belt goes from pulley to pulley in perfect alignment with no indication of a sideward bend.

Adjust the belt tension to vehicle manufacturer specifications. Check the belt tension again after 36 to 48 hours of initial operation of the unit because the belt may stretch slightly during the first hours of use. Remember, good alignment and proper belt tension ensure long belt life.

Over-the-Road Mechanical Diagnosis

If desired box temperature cannot be obtained during engine driven compressor operation, any of the following may be indicated:

1. EXCESSIVE HEAT LOAD. An excessive heat load on the system will be caused by too many, or excessively long, stops with the doors open. Excessive heat loads will also be caused by loose doors, loose body panels, warm loads and poor insulation.
2. DIRT ON COILS. Dirt on the condenser or evaporator coil acts as an insulator reducing the capacity of the unit.
3. INCORRECT BELT TENSION. If the drive belt is not correctly tensioned, the compressor will not be driven at proper speed, and unit efficiency will be reduced. By contrast, too much tension will place an additional load on the bearings causing rapid wear.
4. SHORTAGE OF REFRIGERANT. Shortage of refrigerant reduces capacity of the unit. Find and remedy the cause of the shortage and recharge the system. DO NOT operate the unit if there is an indication of low charge.
5. FAULTY EXPANSION VALVE ADJUSTMENT. High superheat settings will starve the evaporator causing low suction pressure. Low superheat settings will flood the coil causing high suction pressure. The superheat setting should be adjusted ONLY by a trained refrigeration serviceman.
6. EXCESSIVE OIL. Too much compressor oil in the system may result in lower than normal suction pressure as well as lowered capacity.
7. MOISTURE IN THE SYSTEM. Symptom: Expansion valve freeze-up—will not refrigerate. Usually this can be checked by warming the expansion valve with either the hand or hot towels to see if the valve opens. Evacuate the system in the same manner used during installation. Install a new drier.
8. EXPANSION VALVE LOSES ITS CHARGE. If the expansion valve loses its charge, the valve will close causing the system to go into vacuum. Replace the valve.
9. AIR IN SYSTEM. Air is not condensable. Its presence in the system increases head pressure. When the compressor is stopped, air will gather at the high point of the high side. Reclaim the refrigerant, evacuate the system to 500 microns and recharge with the proper amount of refrigerant.
10. TEMPERATURE OF THE LIQUID LINE. During normal operation, the liquid line will be slightly warmer than surrounding air. An extremely hot line indicates either shortage of refrigerant or lack of a liquid seal at the receiver outlet. A cold line indicates a restriction, and some flashing takes place in the liquid line sight glass.
11. DIRTY OR WET FILTER DRIER. If the outlet line of the filter drier is colder than the inlet line, the filter is either saturated with moisture or is dirty and must be replaced.
12. DIRT IN THE EXPANSION VALVE SCREEN. Reclaim the refrigerant charge, remove the screen and clean. Moisture is in the system will collect at the expansion valve and freeze. This is indicated by abnormally low suction pressure. Replace the drier, dry the system and recharge.
13. ICE ON THE EVAPORATOR COIL. Note operation under DEFROST CYCLE.
14. AIR FLOW. Do not load product directly in front of the air return or discharge. Insure that the fan is correctly positioned in the orifice to achieve maximum air flow.
15. COMPRESSOR LIFE. The following will shorten the life of the compressor:
    - Operating a contaminated system
    - No oil trap
    - Clogged oil separator (JetLube™)
    - Clogged liquid injection orifice (JetCool™)
    - Defective liquid injection switch (JetCool™)
    - Insufficient oil charge
    - Wrong or mixed oil

- Lack of compressor lubrication on installation and startup
- Excessive compressor speed (maximum speed 3,000 rpm)

Electric Standby Mechanical Diagnosis

Condition	Possible Cause	Remedy
Compressor does not run	Improperly wired	Check wiring against diagram
	Low line voltage	Check line voltage, determine location of voltage drop
	Relay contacts not closing	Check by operating manually. Replace relay if defective
	Fuses blown	Replace fuses
	Open circuit in motor winding	Check stator leads
	High pressure cutout open	Eliminate cause of excessive pressure
	Thermostat faulty	Repair or replace
	Compressor faulty	Replace compressor
	Shortage of refrigerant	Recharge
	Low pressure cutout open	Recharge leak test
	Overload relay open	Locate overload, reset
Unit short cycles	Shortage of refrigerant (low pressure cutout)	Repair leak and recharge
	Restricted expansion valve	Clean expansion valve
	Refrigerant overcharge (high pressure cutout)	Remove excess charge
	Cycling on high pressure cutout	Check air flow and fan
	Dirty condenser coil	Clean coil
	Defrost timer set too low for application.	Adjust timer to higher interval.

Condition	Possible Cause	Remedy
Unit operates long or continuously	Shortage of refrigerant	Repair leak and recharge
	Discharge valve leaking	Replace leak
	Thermostat faulty	Repair or replace
	Dirty condenser	Clean condenser
	Air in system	Evacuate and recharge system
	Compressor inefficient	Replace compressor
	Plugged expansion valve	Clean expansion valve
	Iced or plugged coil	Defrost or clean coil
	Defective truck body insulation	Correct or replace
	Too many door openings	Keep doors closed, install plastic curtains
	Load too warm	Precool hot product
	Excessive superheat at expansion valve	Adjust superheat
	Door seals worn	Repair/replace
Box temperature too high	Refrigerant shortage	Repair leak and recharge
	Thermostat setpoint too high	Reset thermostat
	Expansion valve or strainer plugged	Clean or replace
	Restricted lines	Clean restriction. Tubing pinched shut
	Hot load	Precool hot product
	Expansion valve superheat too high or too low	Adjust superheat
Head pressure too high	Refrigerant overcharge	Remove excess
	Air in system	Evacuate and recharge system
	Dirty condenser	Clean
	Restricted condenser	Clean condenser
	Condenser fan not running	Check fan motor
	Condenser fan rotation	Check fan motor polarity

Condition	Possible Cause	Remedy
Head pressure too low	Refrigerant shortage	Repair leak and recharge
	Compressor suction or discharge valve inefficient	Replace valve
Noisy unit	Insufficient compressor oil	Add oil to proper level
	Mounting bolts loose	Tighten
	Refrigerant flooding back	Adjust oil level or refrigerant charge. Check expansion valve for proper superheat
Compressor loses oil	Shortage of refrigerant	Repair leak and recharge
	Plugged expansion valve or strainer	Clean expansion valve
	Wrong oil viscosity	Use proper oil
	Short cycling	Refer to unit “short cycling”
	Superheat too high	Adjust expansion valve
Frosted or sweating suction line	Expansion valve set too low, admitting excess refrigerant	Adjust expansion valve
Hot liquid line	Shortage of refrigerant	Repair leak and recharge
	Condenser fan not running	Check fan motor
	Dirty condenser coil	Clean condenser
Frosted liquid line	Restricted dehydrator or strainer	Replace restricted part
Condenser coil is cool when unit is in cool operation	Refrigerant undercharge	Repair leak and recharge
	Compressor inefficient	Replace compressor
Unit in vacuum. Frost expansion valve only	Ice plugging expansion valve orifice	Apply hot wet cloth to expansion valve. Moisture indicated by increase in suction pressure. Replace drier
	Plugged expansion valve strainer	Clean strainer
	Sensor bulb lost charge	Replace expansion valve

Electric Standby Service Checks

1.Compressor does not run.	a.Check for power at source. b.Check for power at plug. c.Check for power at compressor contactor. d.Check for power at overload terminals (contactor closed). e.Check for power at motor terminals.
2.Power at compressor terminals but motor does not run.	a.Replace compressor.

Electric Standby Service Checks

3.Compressor hums but does not run.	a.Check for locked rotor. b.Check for worn bearings. Replace if necessary. c.Check for locked compressor and repair. d.Check power source for single phasing (on three phase units). e.Check capacitors (on single phase units). f.Check start relay.
4.Check transformer.	a.Check for power output.
5.Check rectifier.	a.Check for rectifier output.

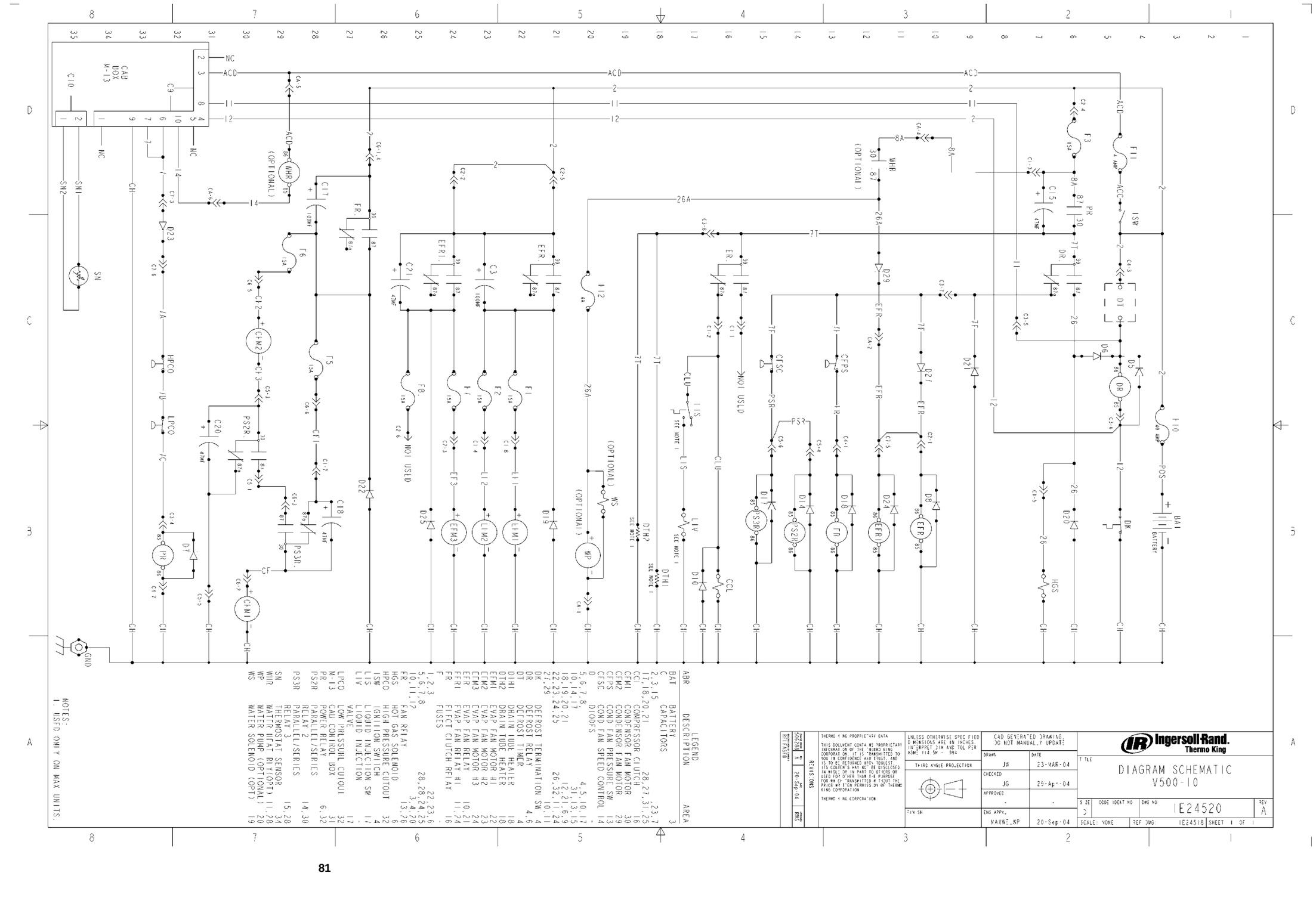
Refrigeration Diagnosis Chart

Unit Not Heating	Rapid cycling	Unit cools in defrost cycle	High head pressure	Low head pressure	No head pressure	High suction pressure	Low suction pressure	No suction pressure	Unit operating in vacuum	Sight glass / empty	Suction line frosting back	Noisy compressor	Unit not refrigerating	Unit not defrosting	SYMPTOM / POSSIBLE CAUSES
			•									•			Overcharge of refrigerant
				•	•		•		•	•			•	•	Shortage of refrigerant
				•	•				•	•	•	•	•	•	No refrigerant
			•												Air through condenser too hot (ambient)
			•												Air flow through condenser restricted (dirty)
				•			•								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
					•								•		Broken engine driven compressor belt
				•											Compressor discharge valves leaking
							•					•	•		Too much compressor oil in system
												•			Loose engine driven compressor pulley
												•			Compressor bearing loose or burned out
				•		•						•	•		Broken valve plate in compressor
							•		•			•	•		Expansion valve power element lost its charge
						•						•	•		Expansion valve feeler bulb improperly mounted
						•					•		•		Expansion valve feeler bulb making poor contact
						•				•	•		•		Expansion valve open too much
							•						•		Expansion valve closed too much
						•					•		•		Expansion valve needle eroded or leaking
				•			•		•				•		Expansion valve partially closed by ice, dirt or wax
		•													Hot gas solenoid stuck open
•															Water valves not open
•															Water pump not working.
•															Truck engine not running
						•					•	•	•		Liquid refrigerant entering compressor
							•		•				•		Restricted line on the low side
			•						•						Restricted line on the high side
							•		•				•		Restricted dehydrator
	•			•											Reverse fan rotation
		•				•							•	•	Faulty pilot solenoid
		•												•	Loose or broken electrical connections
						•	•	•	•						Gauge out of calibration
			•												Condenser fan motor not operating
•							•		•		•	•	•		Evaporator fan motor not operating

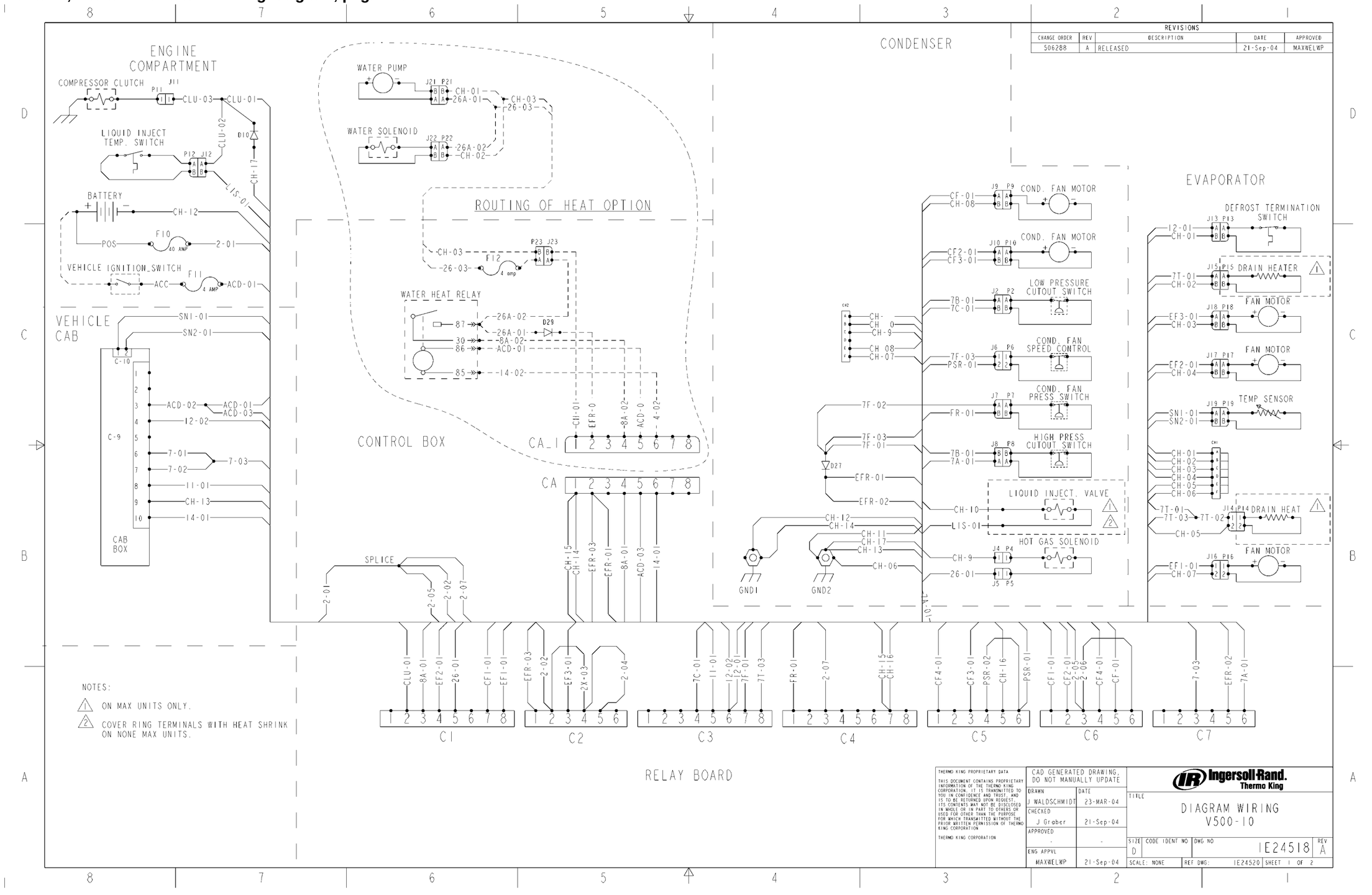
Index

Wiring, Refrigeration and Schematic Diagrams Index

V-500-10, V-500 MAX-10 Schematic Diagram



V-500-10, V-500 MAX-10 3PH Wiring Diagram, page 1 of 2



REVISIONS				
CHANGE ORDER	REV	DESCRIPTION	DATE	APPROVED
506288	A	RELEASED	21-Sep-04	MAXWELWP

THERMO KING PROPRIETARY DATA

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF THE THERMO KING CORPORATION. IT IS TRANSMITTED TO YOU IN CONFIDENCE AND TRUST, AND IS TO BE RETURNED UPON REQUEST. ITS CONTENTS MAY NOT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OR USED FOR OTHER THAN THE PURPOSE FOR WHICH TRANSMITTED WITHOUT THE PRIOR WRITTEN PERMISSION OF THERMO KING CORPORATION

THERMO KING CORPORATION

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE

DRAWN	J WALDSCHMIDT	23-MAR-04
CHECKED	J Graber	21-Sep-04
APPROVED	-	-
ENG APPVL	MAXWELWP	21-Sep-04

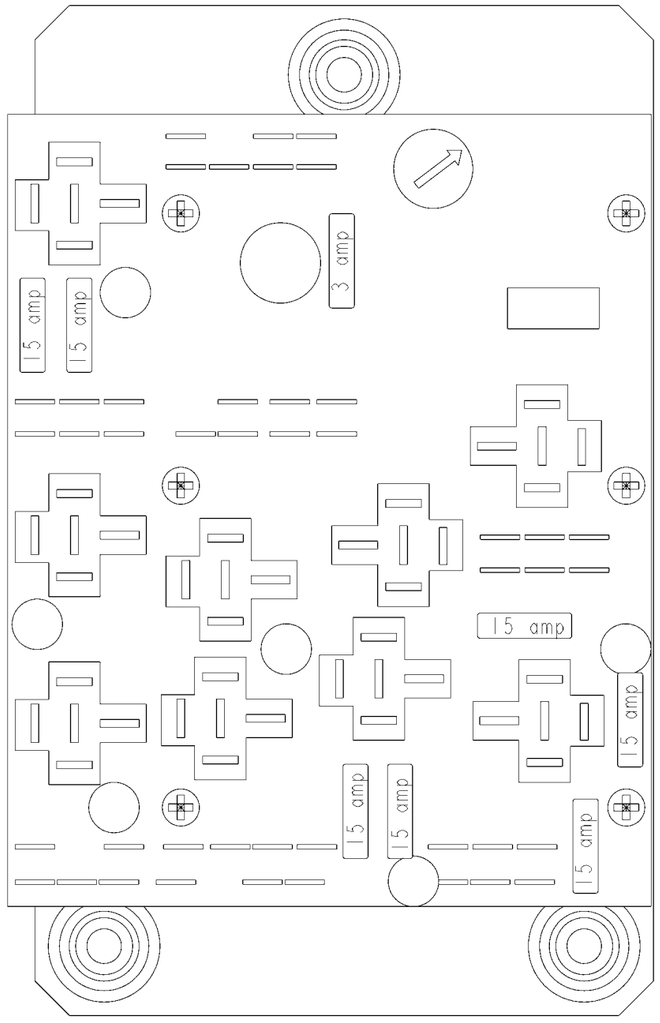
Ingersoll-Rand. Thermo King

TITLE: DIAGRAM WIRING V500-10

SIZE	CODE IDENT NO	DWG NO	REV
D		IE24518	A

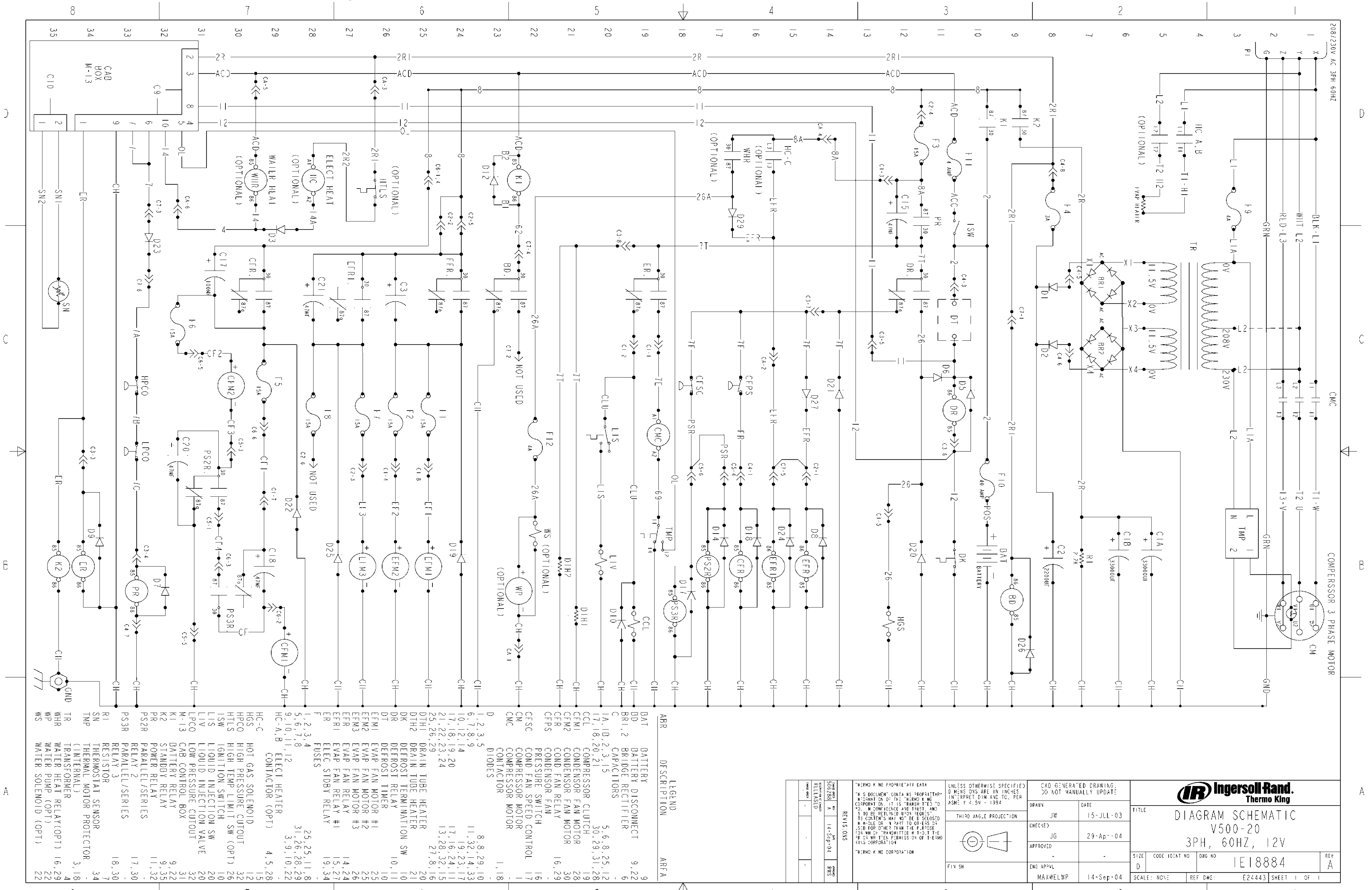
SCALE: NONE | REF DWG: IE24520 | SHEET 1 OF 2

V-500-10, V-500 MAX-10 3PH Wiring Diagram, page 2 of 2

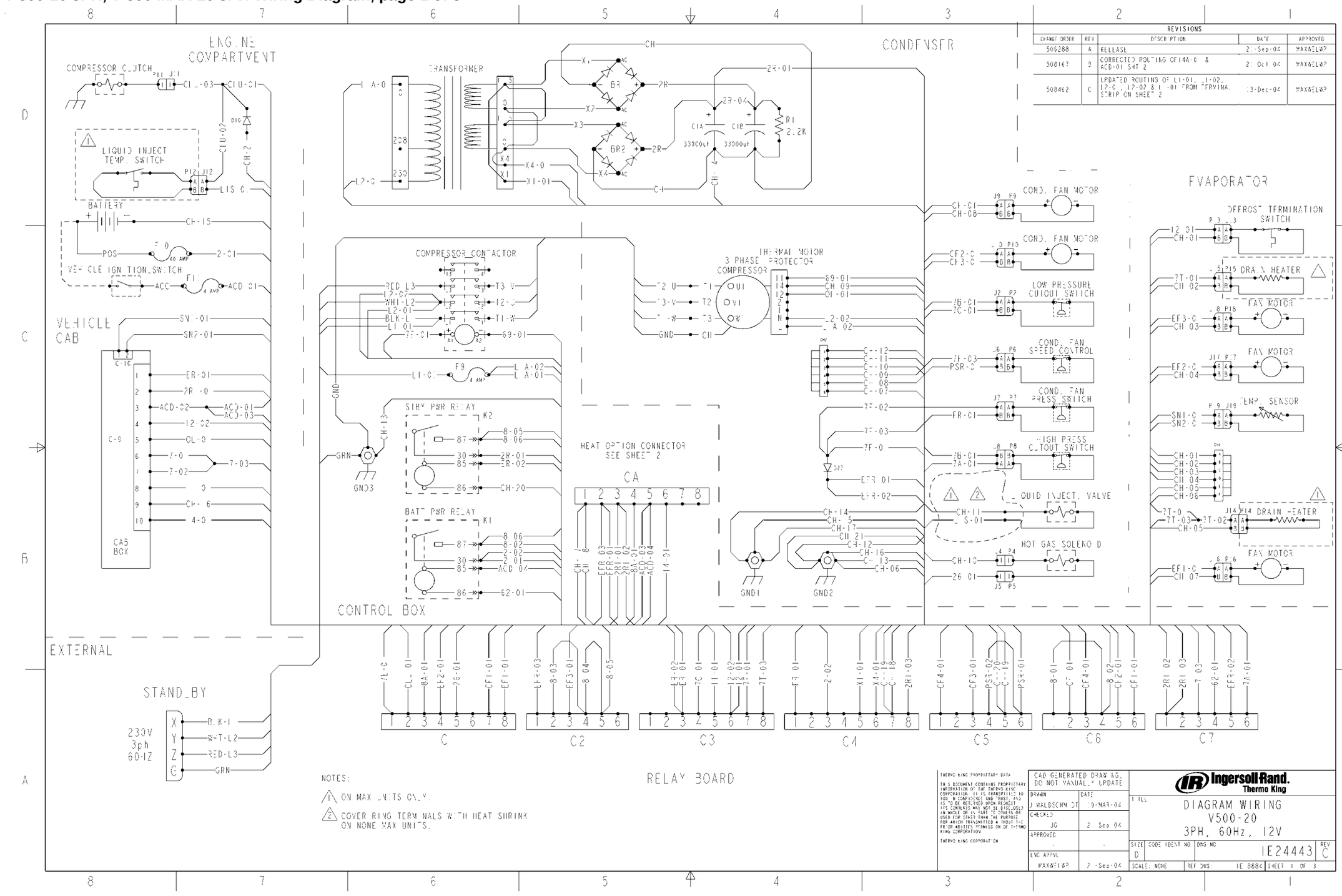


Ingersoll-Rand. Thermo King			
SIZE D	CODE IDENT NO	DWG NO IE24518	REV A
SCALE: NONE	REF DWG: IE24520	SHEET 2 OF 2	

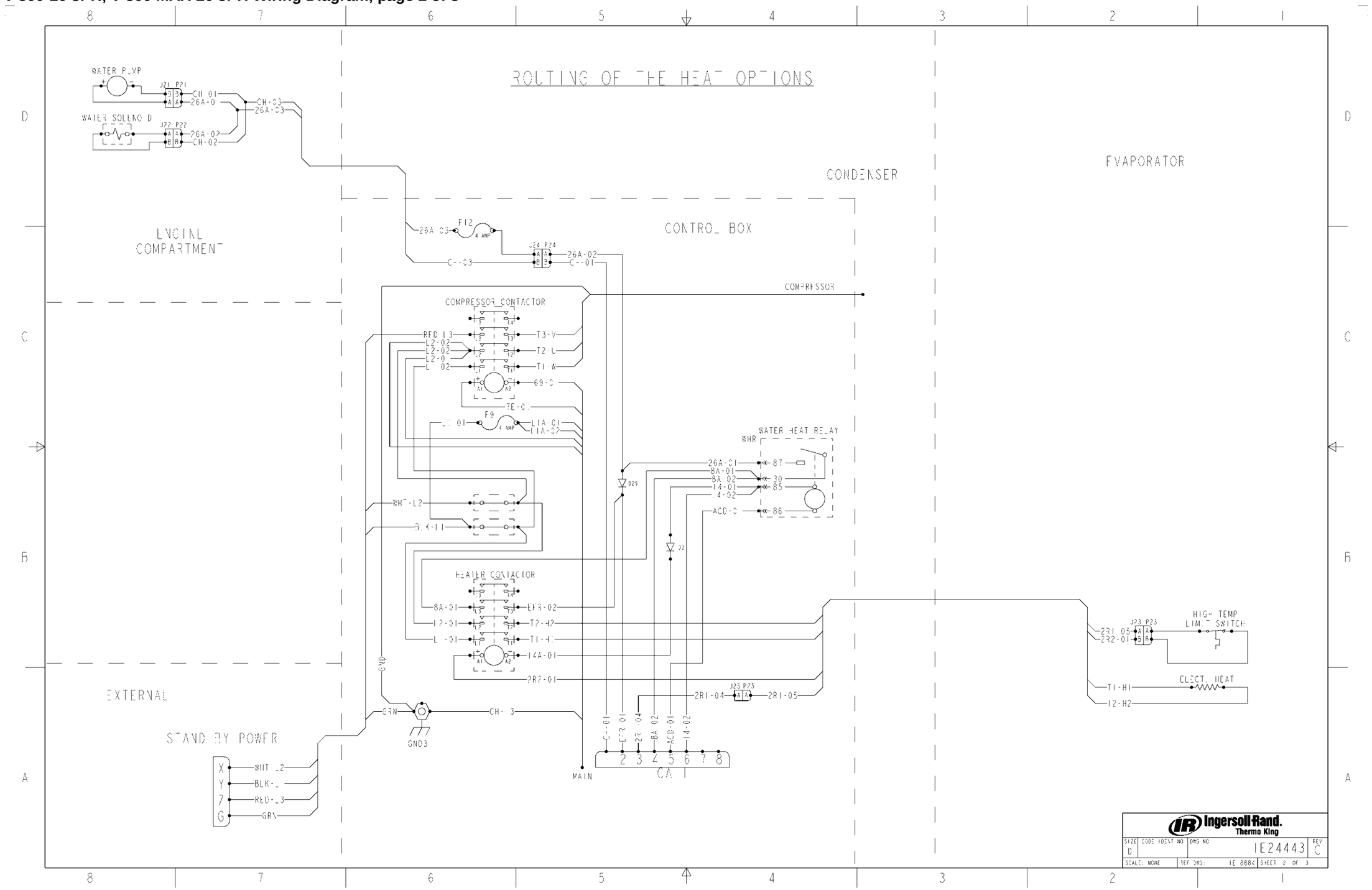
V-500-20 3PH, V-500 MAX-20 3PH Schematic Diagram

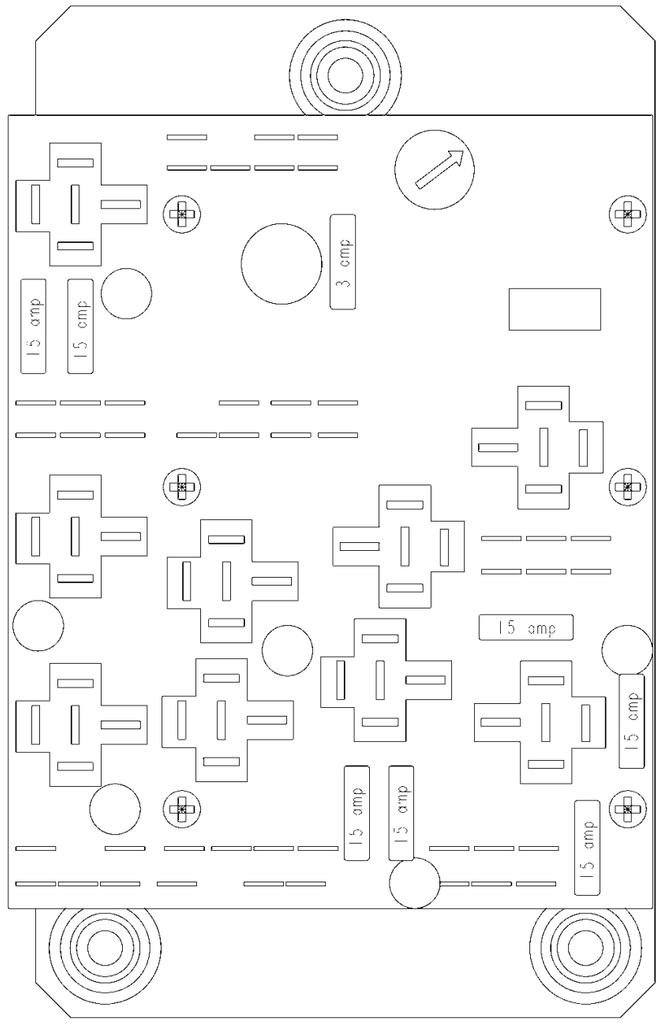


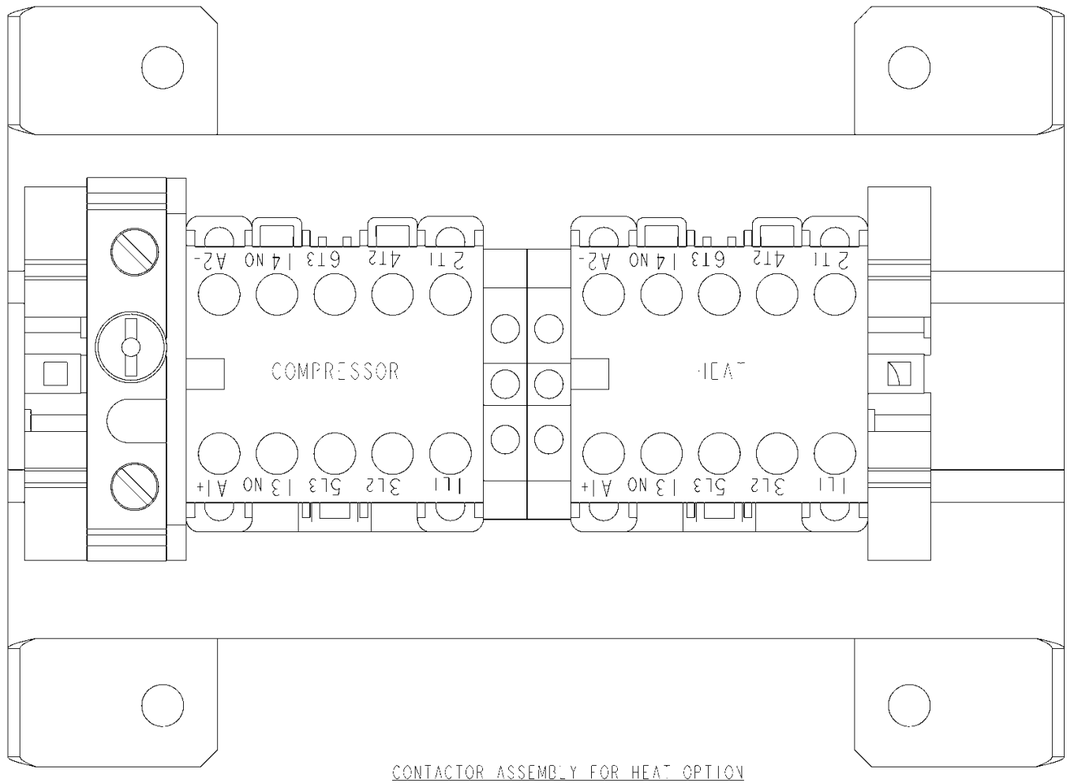
V-500-20 3PH, V-500 MAX-20 3PH Wiring Diagram, page 1 of 3



V-500-20 3PH, V-500 MAX-20 3PH Wiring Diagram, page 2 of 3





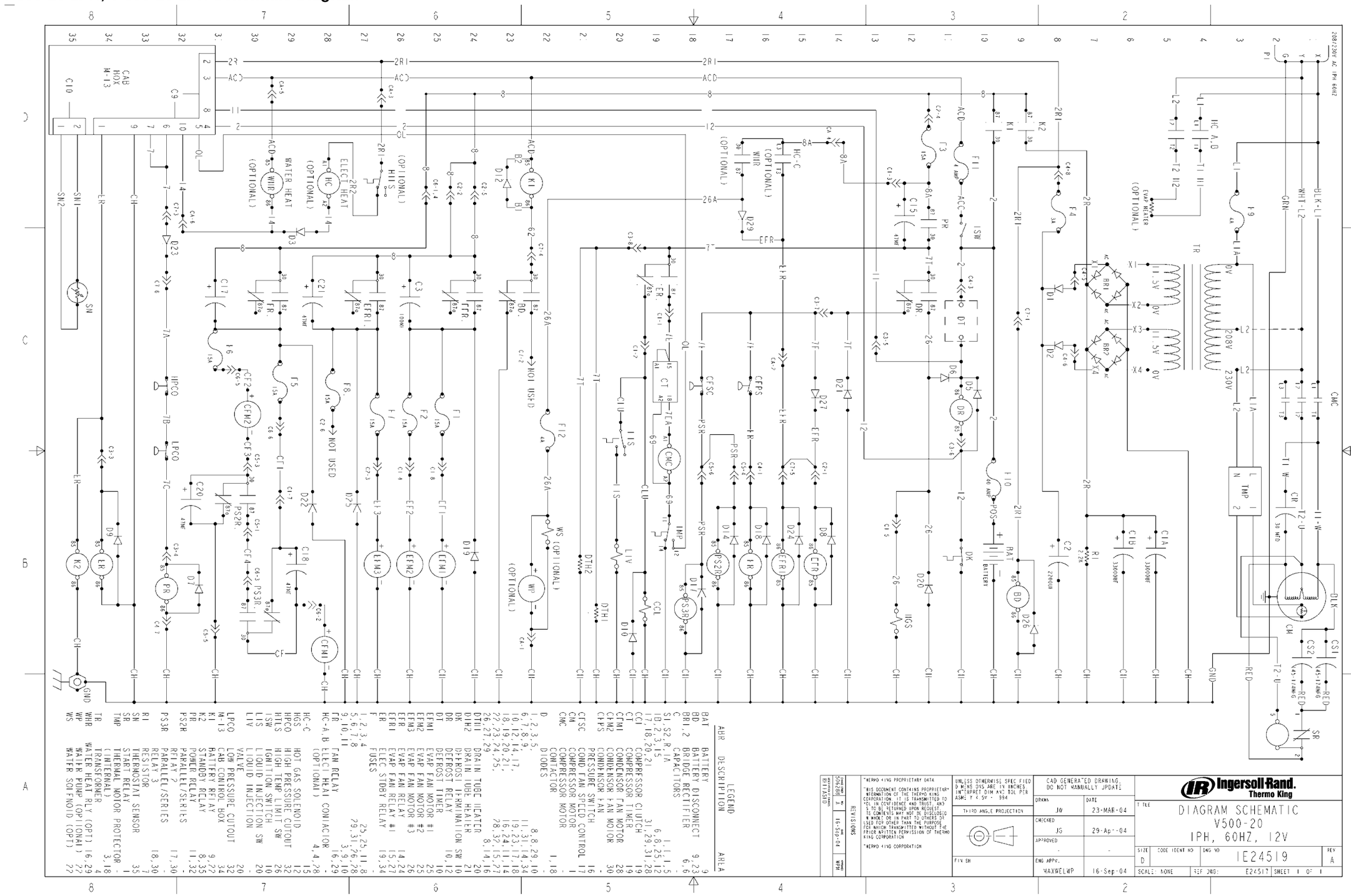


CONTACTOR ASSEMBLY FOR HEAT OPTION

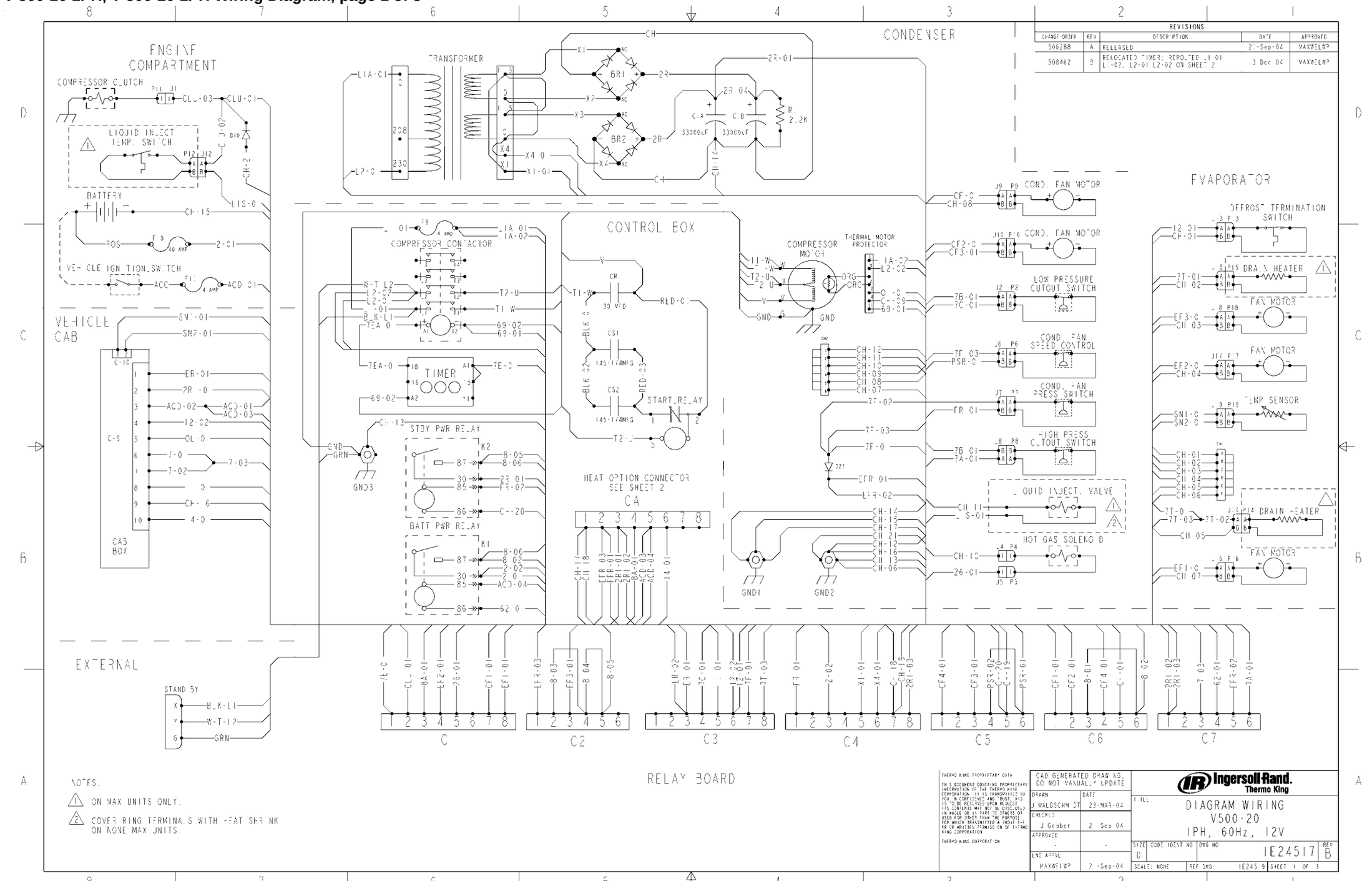
Ingersoll Rand. Thermo King

SIZE	CODE IDENT NO	DWG NO	REV
D		IE24443	C
SCALE: NONE	REF DWG: IE 8884	SHEET 3 OF 3	

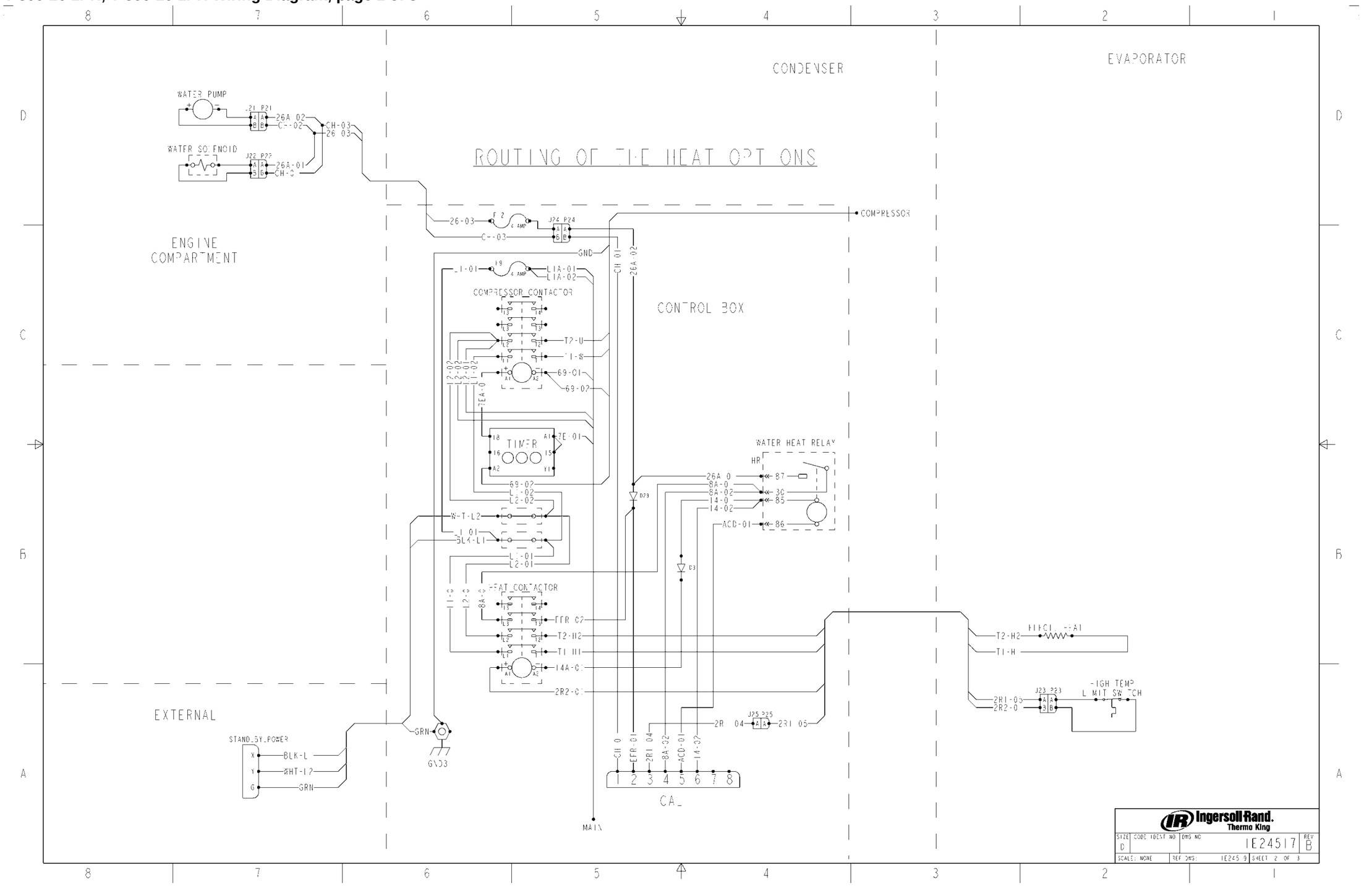
V-500-20 1PH, V-500-20 1PH Schematic Diagram

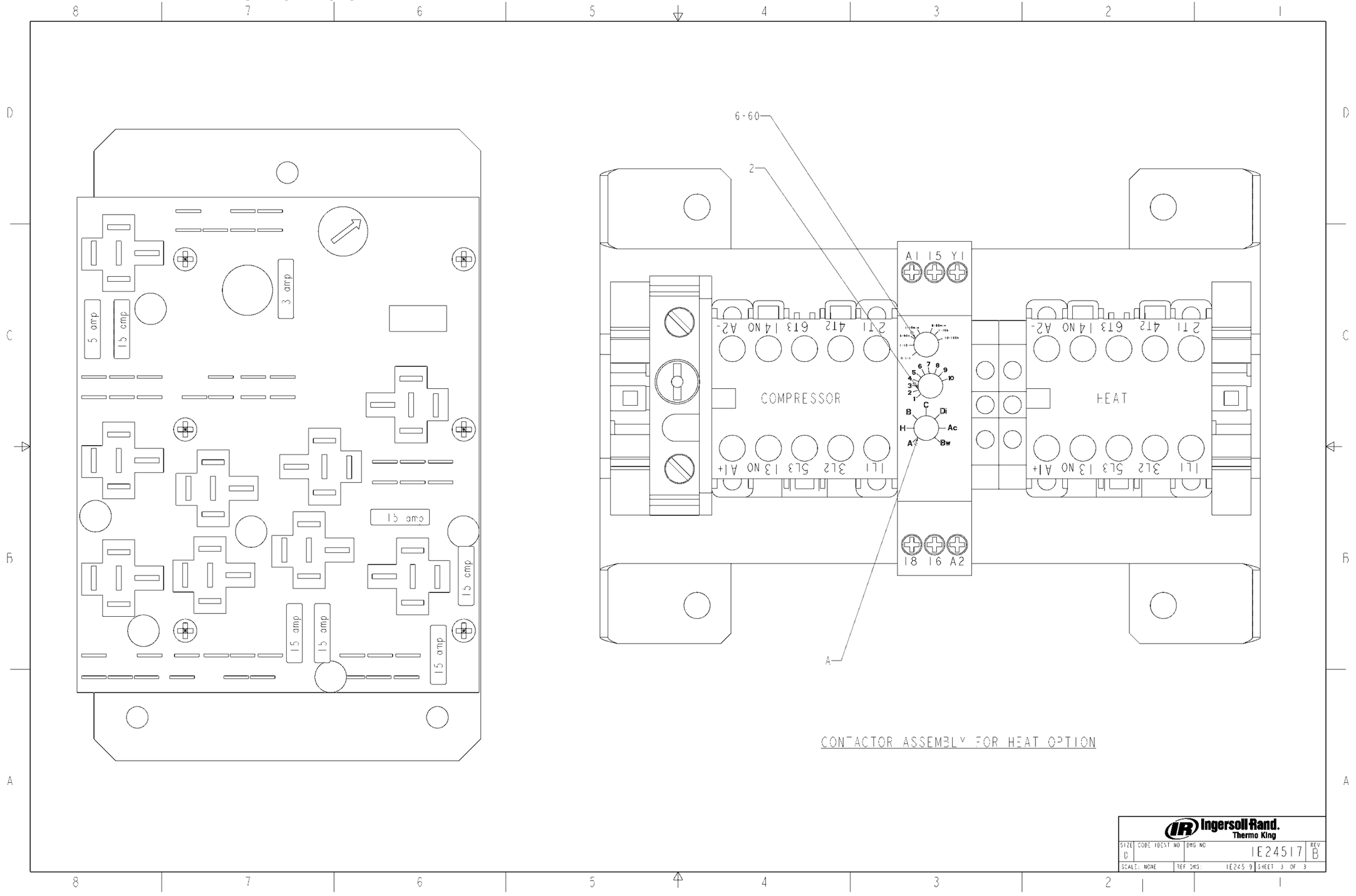


V-500-20 1PH, V-500-20 1PH Wiring Diagram, page 1 of 3



V-500-20 1PH, V-500-20 1PH Wiring Diagram, page 2 of 3



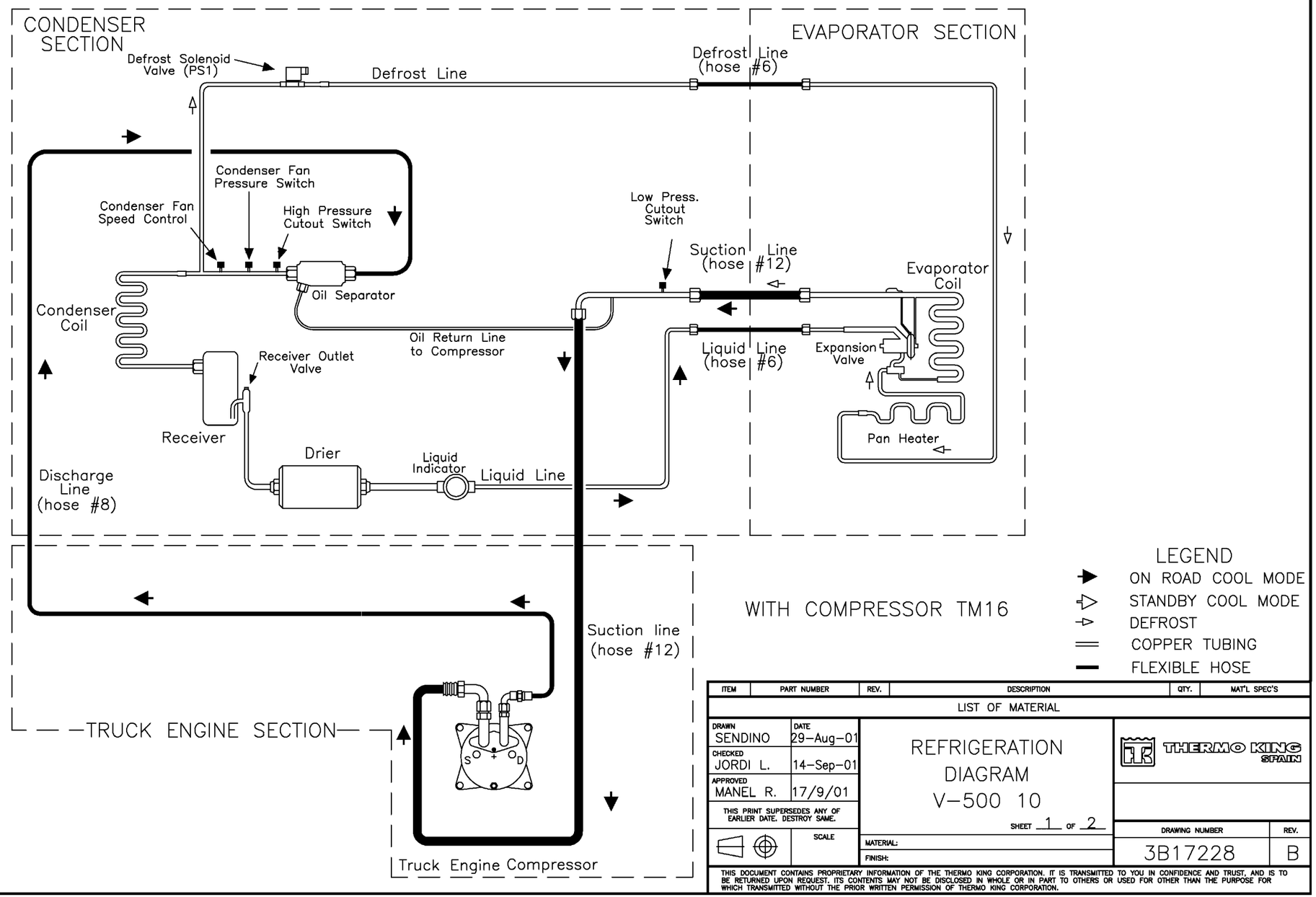


CONTACTOR ASSEMBLY FOR HEAT OPTION

Ingersoll Rand. Thermo King			
SIZE D	CODE IDENT NO	DWG NO IE24517	REV B
SCALE: NONE	REF DWG: IE245 9	SHEET 3 OF 3	

V-500-10 Refrigeration Diagram, page 1 of 2

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP
80402	A	RELEASED	29/08/01	AS	JL	MR
502184	B	ADD PAGE 2	18/07/02	JL	LG	AS



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN: SENDINO	DATE: 29-Aug-01
CHECKED: JORDI L.	14-Sep-01
APPROVED: MANEL R.	17/9/01

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM V-500 10

SHEET 1 OF 2

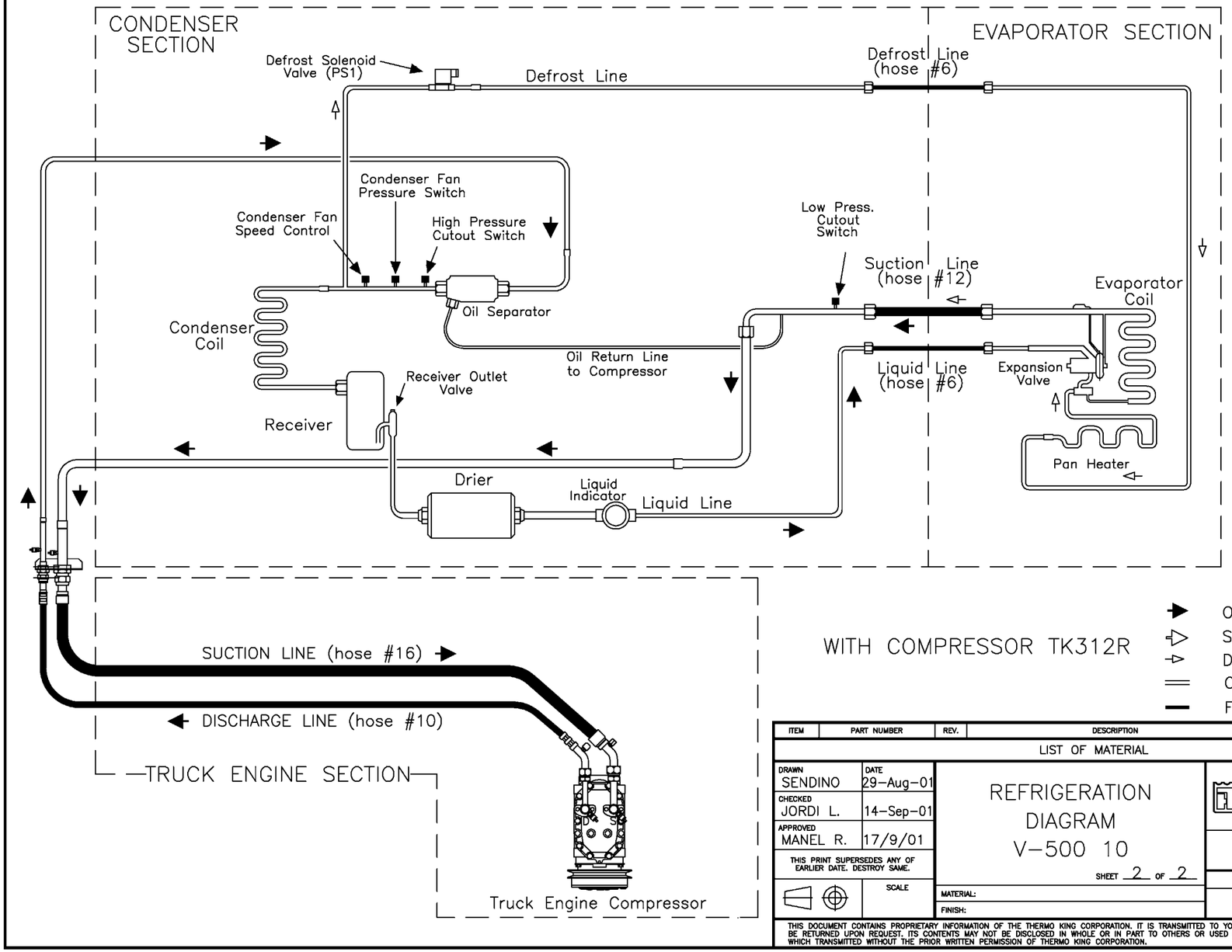
MATERIAL:

FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
3B17228	B

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN SENDINO	DATE 29-Aug-01
CHECKED JORDI L.	14-Sep-01
APPROVED MANEL R.	17/9/01

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM V-500 10

SHEET 2 OF 2

MATERIAL:

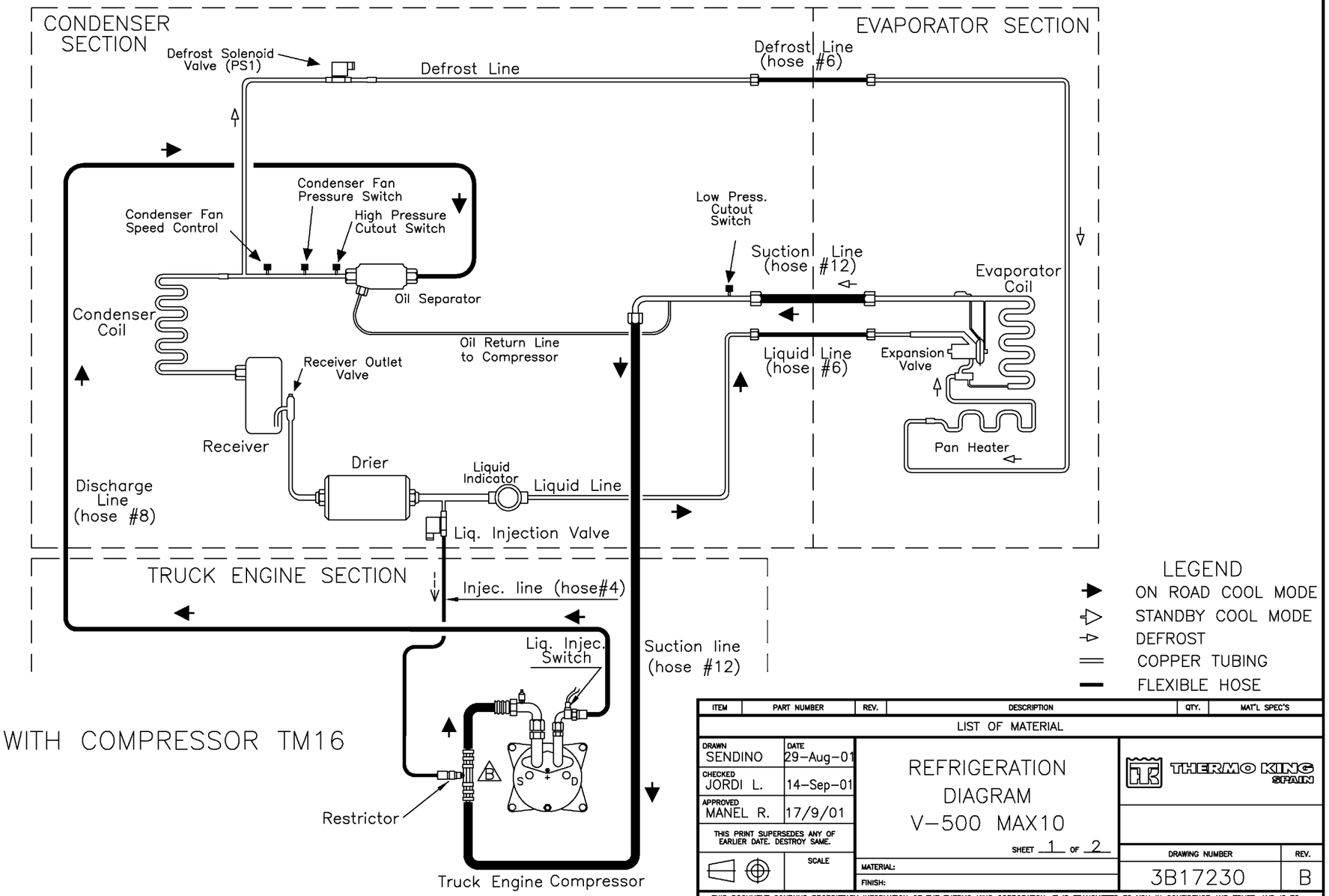
FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
3B17228	B

V-500 MAX 10 Refrigeration Diagram, page 1 of 2

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP
80402	A	RELEASED	29/08/01	AS	JL	MR
502184	B	ADD SPLICE IN PAGE 1. ADD PAGE 2	19/07/02	JL	LG	AS



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN SENDINO	DATE 29-Aug-01
CHECKED JORDI L.	14-Sep-01
APPROVED MANEL R.	17/9/01

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM V-500 MAX10

SHEET 1 OF 2

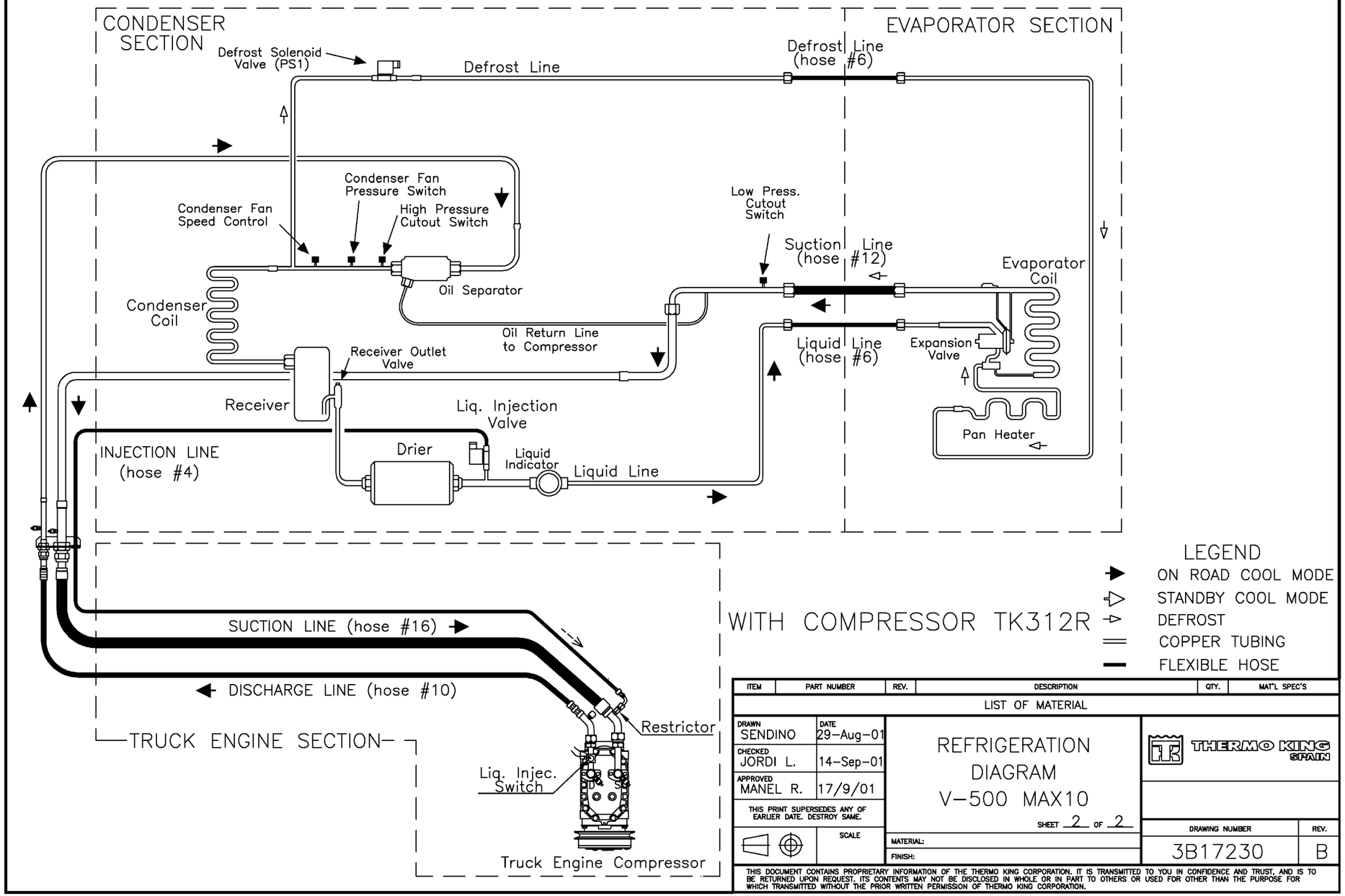
MATERIAL:

FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
3B17230	B

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

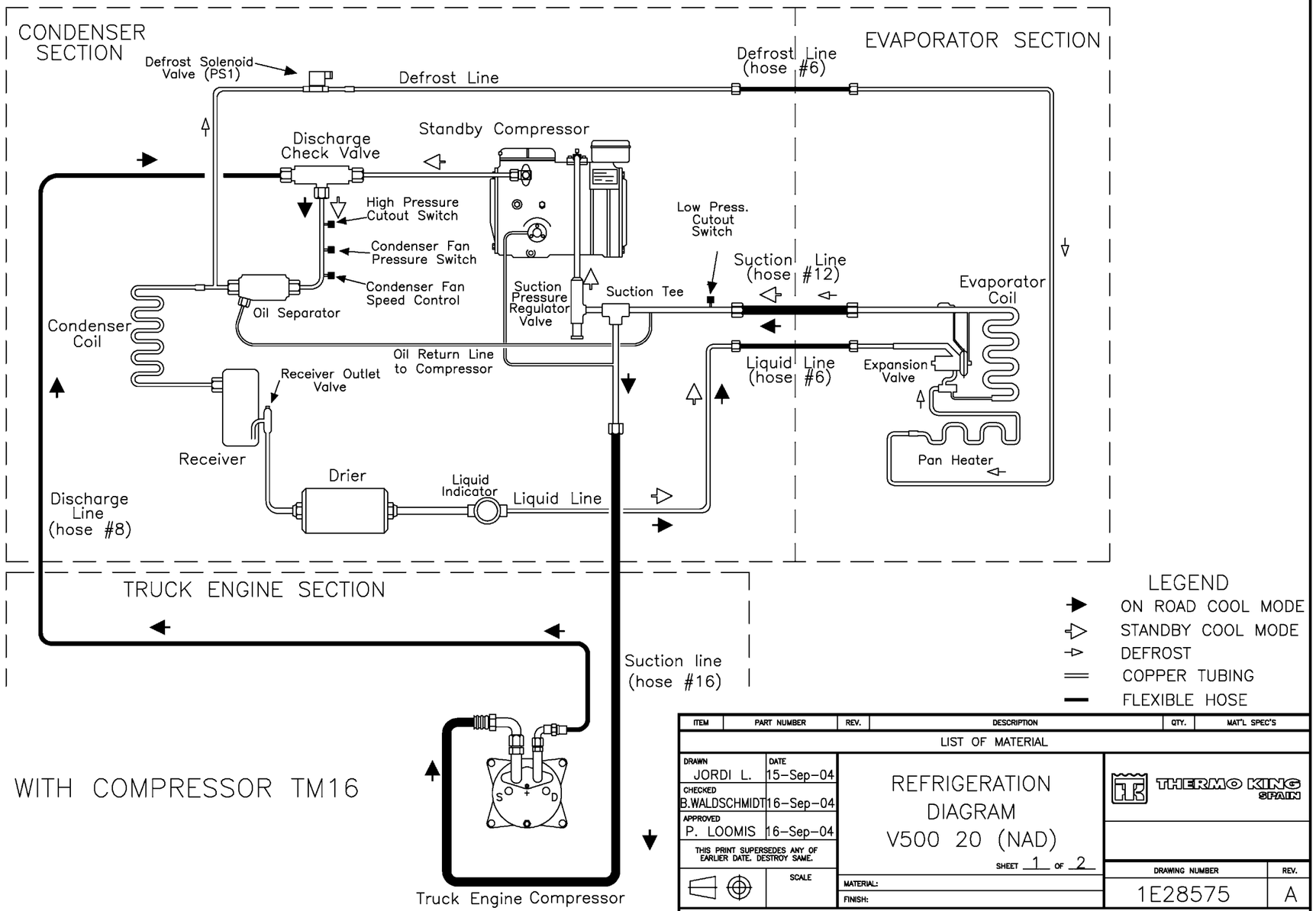
DRAWN: SENDINO	DATE: 29-Aug-01
CHECKED: JORDI L.	14-Sep-01
APPROVED: MANEL R.	17/9/01
THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.	
SCALE	

REFRIGERATION DIAGRAM
V-500 MAX10
SHEET 2 OF 2
MATERIAL:
FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
3B17230	B

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP
506288	A	RELEASED	15/Sep/04	JL	BW	PL



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN: JORDI L.	DATE: 15-Sep-04
CHECKED: B.WALDSCHMIDT	16-Sep-04
APPROVED: P. LOOMIS	16-Sep-04

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM V500 20 (NAD)

SHEET 1 OF 2

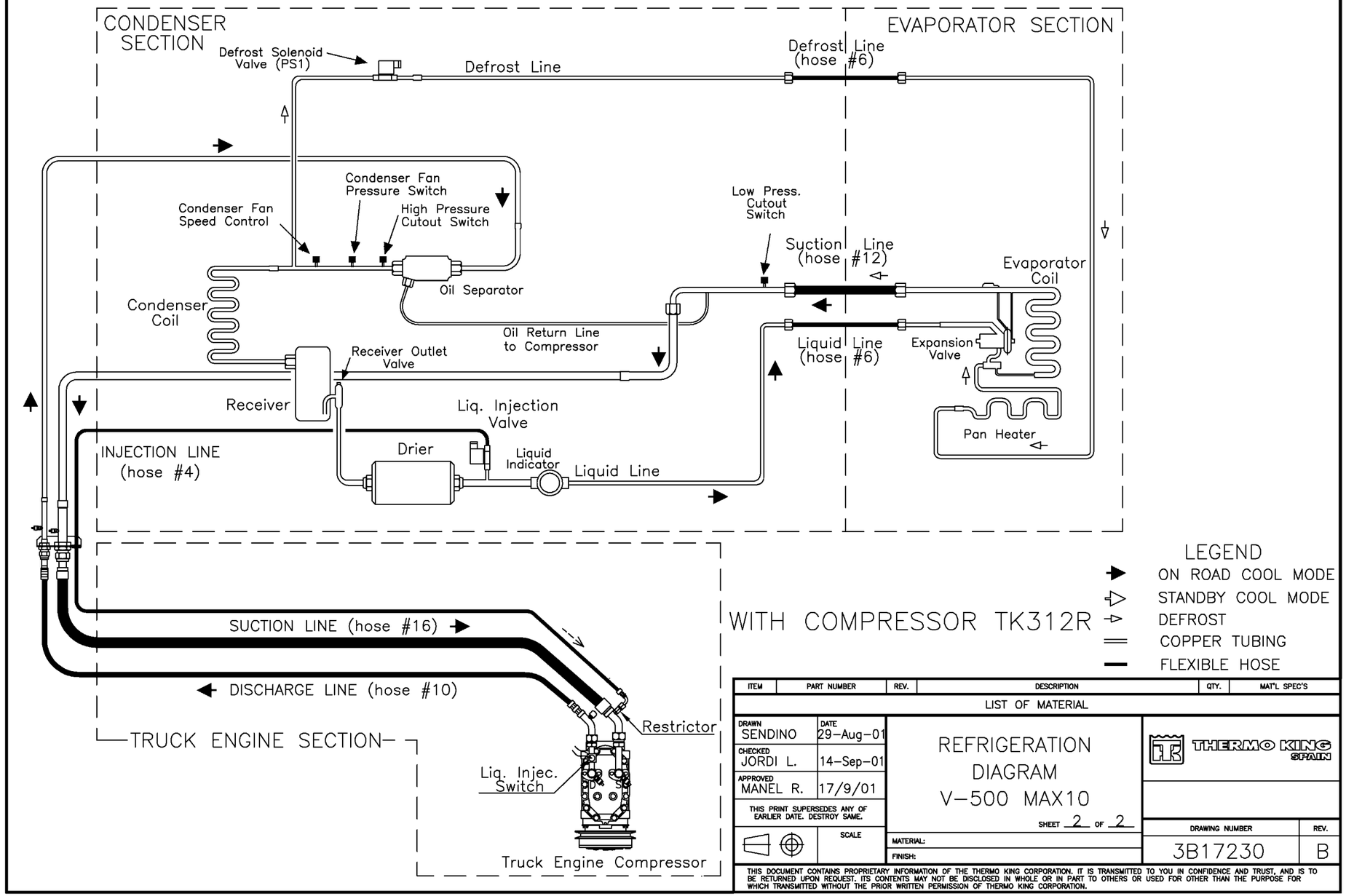
MATERIAL:

FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
1E28575	A

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN SENDINO	DATE 29-Aug-01
CHECKED JORDI L.	14-Sep-01
APPROVED MANEL R.	17/9/01

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM V-500 MAX10

SHEET 2 OF 2

MATERIAL:

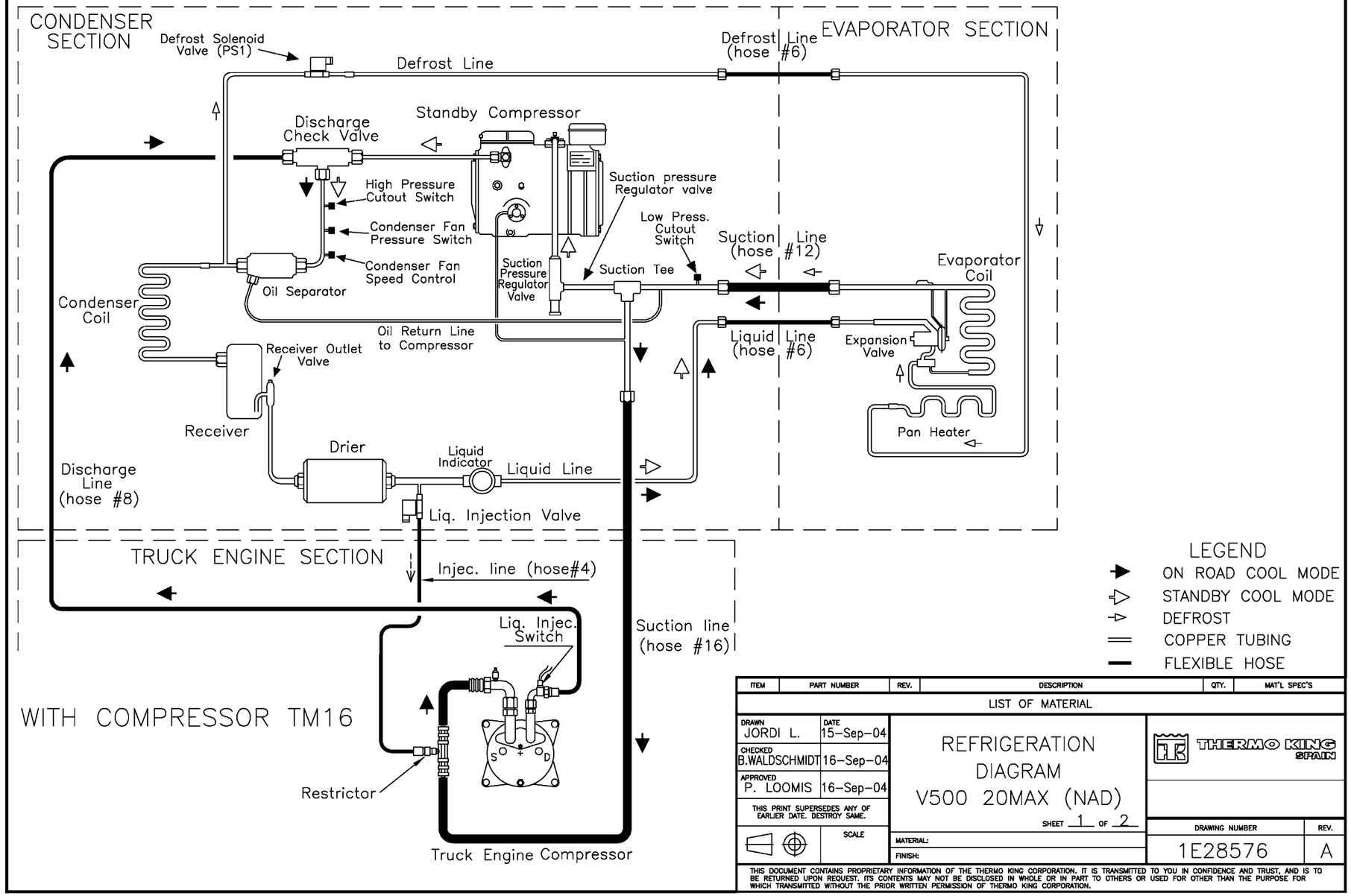
FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
3B17230	B

V-500 MAX 20 Refrigeration Diagram, page 1 of 2

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP
506288	A	RELEASED	15/Sep/04	JL	BW	PL



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN JORDI L.	DATE 15-Sep-04
CHECKED B.WALDSCHMIDT	16-Sep-04
APPROVED P. LOOMIS	16-Sep-04
THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.	
SCALE	

REFRIGERATION DIAGRAM
V500 20MAX (NAD)
SHEET 1 OF 2

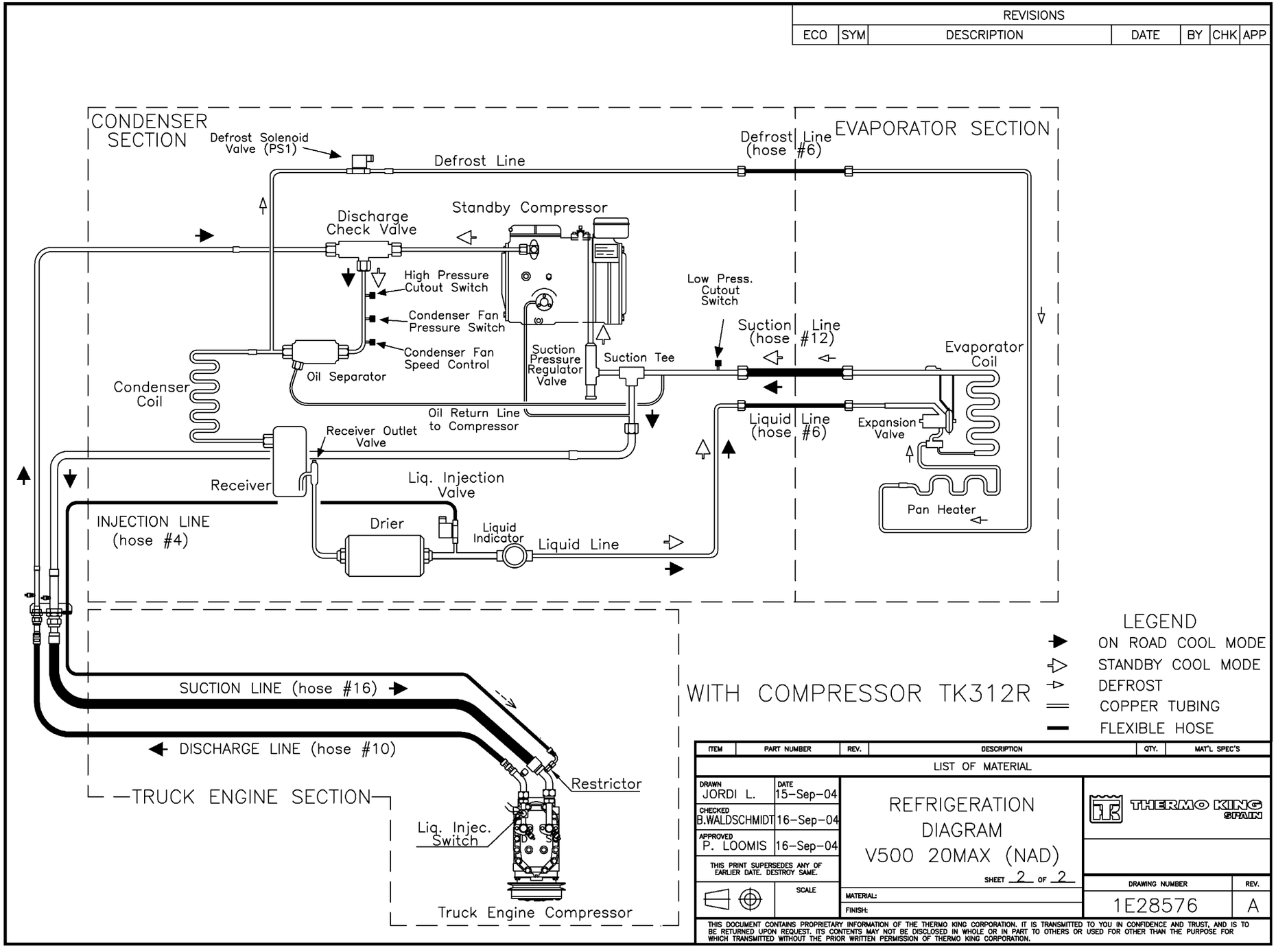
THERMO KING SPAIN

MATERIAL:
FINISH:

DRAWING NUMBER	REV.
1E28576	A

V-500 MAX 20 Refrigeration Diagram, page 2 of 2

REVISIONS						
ECO	SYM	DESCRIPTION	DATE	BY	CHK	APP



ITEM	PART NUMBER	REV.	DESCRIPTION	QTY.	MAT'L SPEC'S

LIST OF MATERIAL

DRAWN: JORDI L.	DATE: 15-Sep-04
CHECKED: B.WALDSCHMIDT	16-Sep-04
APPROVED: P. LOOMIS	16-Sep-04

THIS PRINT SUPERSEDES ANY OF EARLIER DATE. DESTROY SAME.

SCALE

REFRIGERATION DIAGRAM
V500 20MAX (NAD)
SHEET 2 OF 2

MATERIAL:
FINISH:

THERMO KING SPAIN

DRAWING NUMBER	REV.
1E28576	A