Manitowoc®



Reach-In Refrigerators and Freezers

Service Manual

Part No. 80-0899-3
Rev. A 11/96

Recycled Paper

Safety Notices

As you work on the Reach-In, be sure to pay close attention to the safety notices in this manual. Disregarding the notices may lead to serious injury and/or damage to the Reach-In.

Throughout this manual, you will see the following types of safety notices:

⚠ WARNING

Text in a Warning box alerts you to a potential personal injury situation. Be sure to read the Warning statement before proceeding, and work carefully.

⚠ CAUTION

Text in a Caution box alerts you to a situation in which you could damage the reach-in. Be sure to read the Caution statement before proceeding, and work carefully.

Procedural Notices

As you work on the Reach-In, be sure to read the procedural notices in this manual. These notices supply helpful information which may assist you as you work.

Throughout this manual, you will see the following types of procedural notices:

Important

Text in an Important box provides you with information that may help you perform a procedure more efficiently. Disregarding this information will not cause damage or injury, but it may slow you down as you work.

NOTE: Text set off as a Note provides you with simple, but useful, extra information about the procedure you are performing.

We reserve the right to make product improvements at any time.
Specifications and design are subject to change without notice.

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Section 1
General Information

Model and Serial Numbers

- When requesting information from your area Manitowoc distributor, or directly from Manitowoc Equipment Works, you will need to provide the model and serial numbers of the reach-in unit.
- Units assembled at the customer site have separate sets of model and serial numbers on the cabinet and the refrigeration unit.
- Factory-assembled reach-in units have only one model number and one serial number.

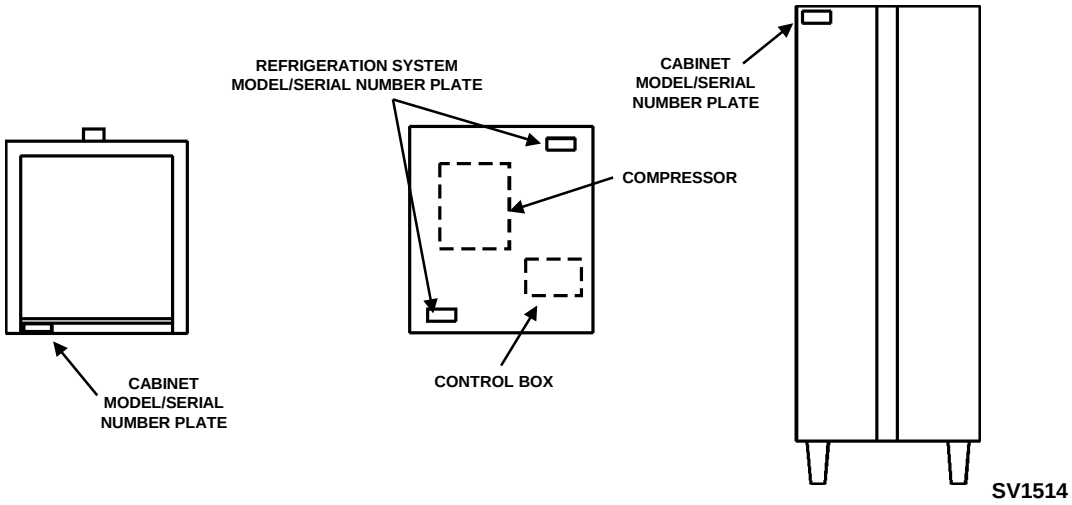


Figure 1-1: Model Number and Serial Number Locations

This service manual covers the following current models:

Cabinets Separate		Refrigeration System Separate				Factory-Assembled Reach-In Units[3]		
		Refrigerators[2]		Freezers		Refrigerators		Freezers
Solid Door(s)	Glass Door(s)[1]	Remote	Self-Contained	Remote	Self-Contained	Solid Door(s)	Glass Door(s)	Solid Door(s)
AV1S	AV1G	RR1	R1	FR1	F1	CRS1	CRG1	CFS1
AV2S	AV2G	RR2	R2	FR2	F2	CRS2	CRG2	CFS2
AV3S	AV3G	RR3	R3	FR3	F3			

[1] Glass door cabinets are available for refrigerators only. Do not install a freezer system into a glass door cabinet.
[2] Use only current model refrigerator head sections (R1, R2, R3) with current model glass door cabinets. Older model head sections (RS1, RS2, RS3) cannot be used with current model glass door cabinets.
[3] Three-door factory-assembled units are not available.

This service manual also covers the following older models:

Cabinets Separate		Refrigeration System Separate	
Solid Doors	Efficient-See™ Glass Door(s)	Refrigerators	Freezers
AV1* AV2* AV3*	AV1*G AV2*G AV3*G	RS1 RS2 RS3	FS1 FS2 FS3

* Door material: A = Aluminum, B = Black Clad Vinyl, S = Stainless Steel

Warranty

Registration

If the refrigeration system and cabinet were purchased as separate components, a warranty registration card is required for each component.

If a factory-assembled reach-in unit was purchased, one warranty registration card covers the entire unit.

Warranty coverage begins on the installation date of the refrigeration system and cabinet or the reach-in unit.

If the warranty registration card(s) is not returned, Manitowoc will use the date of sale to the Manitowoc distributor as the first day of warranty coverage.

Coverage

Read the warranty bond that came with the unit(s) for a detailed explanation of warranty parts and labor coverage, and warranty exclusions. Contact your local Manitowoc distributor, or Manitowoc Equipment Works if you need further warranty information.

PARTS

1. Manitowoc warrants the Refrigeration System and Reach-in Cabinet against defects in materials and workmanship, under normal use and service for two (2) years from the date of original installation.
2. The evaporator coil and compressor are covered by an additional three (3) year (five year total) warranty beginning on the date of the original installation.

NOTE: The additional three (3) year evaporator coil warranty does not apply to parts such as fan motors, defrost elements, housings, electrical wiring or controls that are attached to the evaporator coil.

LABOR

A labor allowance is provided to repair or replace defective components for two (2) years from the date of original installation.

ADDITIONAL WARRANTIES

An Extended Parts and Labor Warranty is available for purchase which covers the Reach-In Refrigerator/Freezer for a third year. Contact your local Manitowoc distributor to verify whether a Reach-In Third Year Warranty is applicable.

EXCLUSIONS

The following items are not included in the Refrigeration System/Reach-In Cabinet warranty coverage:

1. Normal maintenance, adjustments and cleaning (including defrosting evaporator coils).
2. Interior cabinet light bulb.
3. Repairs due to unauthorized modifications to the Refrigeration System/Reach-In Cabinet or the use of non-standard parts without prior, written approval from Manitowoc Equipment Works.
4. Damage caused by improper installation of Refrigeration System/Reach-in Cabinet as outlined in the Installation Instructions, electrical supply, water supply or drainage; floods, storms, or other acts of God.

5. Premium labor rates due to holidays, overtime, etc.; travel time; flat rate service call charges; mileage and miscellaneous tools and material charges not listed on the payment schedule. Additional labor charges resulting from the inaccessibility of the Refrigeration System/Reach-In Cabinet are also excluded.
6. Parts or assemblies subjected to misuse, abuse, neglect or accidents.
7. Damage to the interior of cabinet or Refrigeration System as a result of storing open acidic food containers.
8. Claims for special, indirect or consequential damages including, without limitation, food spoilage or product loss.
9. The Manitowoc Refrigeration System and Manitowoc Reach-In Cabinet are designed for use only with each other.

No warranty coverage applies when a Manitowoc Refrigeration System or Reach-In Cabinet is used in conjunction with other products.

AUTHORIZED WARRANTY SERVICE

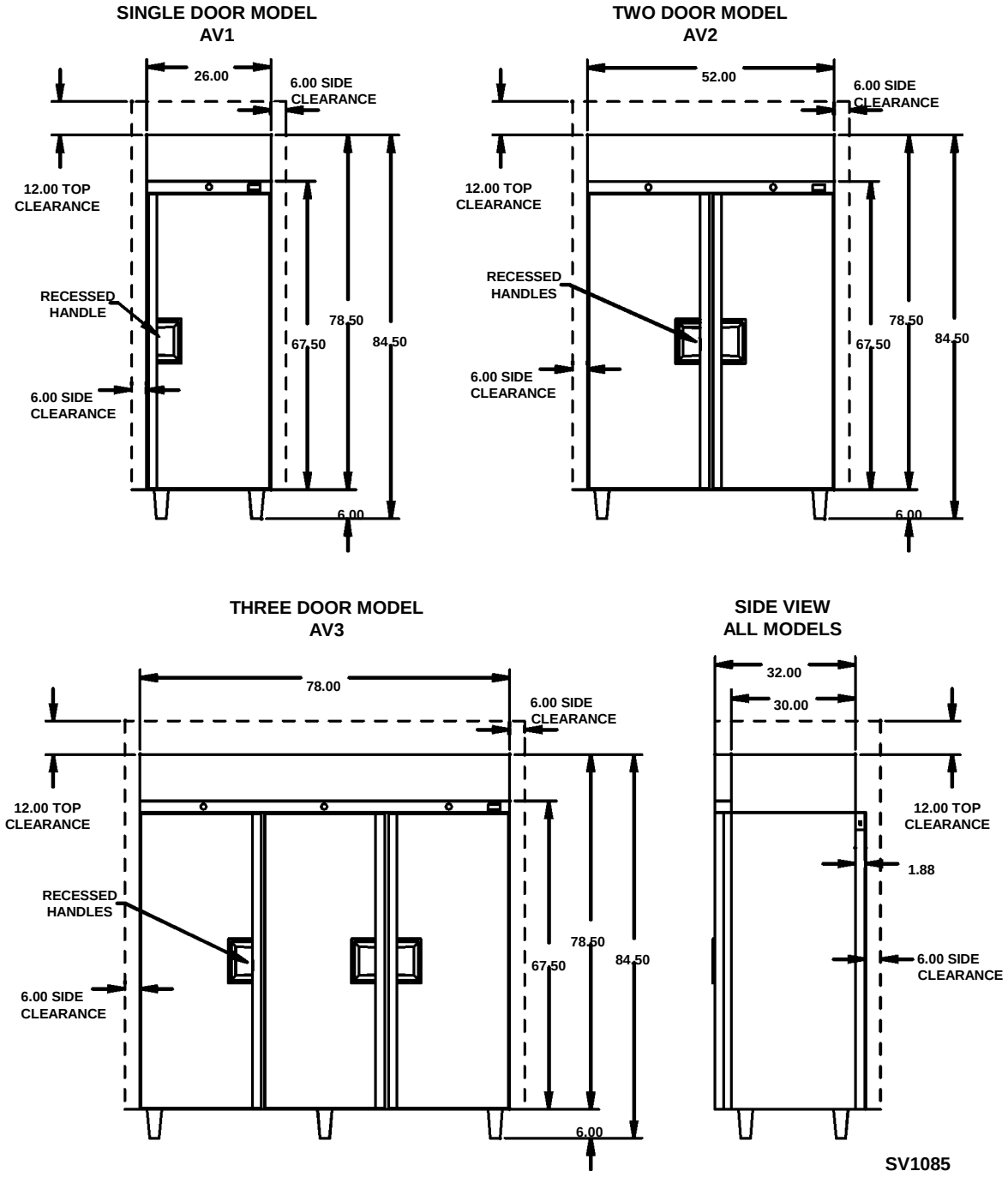
To comply with the provisions of the warranty, a refrigeration service company, qualified and authorized by your Manitowoc distributor, or a Contracted Service Representative must perform the warranty repair.

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Section 2
Installation References

See Reach-In Installation Manual for complete installation information

Dimensions



NOTE: Caster height is 5.00”.

Figure 2-1: Cabinet Dimensions

Clearance Requirements

Check the Reach-In unit for proper clearance from walls, boxes, or other objects. The clearances given below are minimums.

- 6” (15 cm) at the back and each side
- 12” (30 cm) above the condensing unit

⚠ CAUTION

If the minimum clearances are not maintained, cooling capacity will be reduced. This may lead to product loss and premature component failure.

⚠ WARNING

Reach-In units are susceptible to tipping. Never move a Reach-In unit with the door(s) open. Always use two people to move a Reach-In unit.

Air Temperature Entering Condenser	
Minimum	Maximum
50°F (10°C)	110°F (43.3°C)

Electrical Requirements

⚠ CAUTION
All wiring must conform to local, state, and national codes.

⚠ CAUTION
Never use an extension cord.

Current Self-Contained Models

Description/Model #	Voltage/Phase/Cycle	Total Amps	Maximum Fuse Size
One Door Refrigerator R1 CRS1 CRG1	115/60/1	6.0	15
	115 and 208-230/60/1	3.4	15
	220-240/50/1	2.8	15
Two Door Refrigerator R2 CRS2 CRG2	115/60/1	9.4	15
	115 and 208-230/60/1	5.8	15
	220-240/50/1	4.7	15
Three Door Refrigerator R3	115/60/1	12.0	15
	115 and 208-230/60/1	6.9	15
	220-240/50/1	6.8	15
One Door Freezer F1 CFS1	115/60/1	10.6	15
	115 and 208-230/60/1	5.7	15
	220-240/50/1	7.2	15
Two Door Freezer F2 CFS2	115/60/1	12.8	20
	115 and 208-230/60/1	7.8	15
	220-240/50/1	8.0	15

Description/Model #	Voltage/Phase/Cycle	Min. Circuit Amps	Maximum Fuse Size
Three Door Freezer F3	115 and 208-230/60/1	11.2	15
	220-240/50/1	12.1	15

NOTE: These ratings assume the listed Self-Contained Refrigeration System is installed and operating with the appropriate cabinet.
NOTE: Refrigerators have the same ratings with solid or glass doors.
NOTE: 208/230/60/1 Reach ins must have a neutral (4 wires total) to power the cabinet light, door heaters, and drain line heater.

Older Self-Contained Models

Description/Model #	Voltage/Phase/Cycle	Total Amps	Maximum Fuse Size
One Door Refrigerator RS1	115/60/1	7.9	15
	220-240/50/1	3.7	15
Two Door Refrigerator RS2	115/60/1	9.6	15
	220-240/50/1	4.8	15
Three Door Refrigerator RS3	115/60/1	10.6	15
	220-240/50/1	5.6	15
One Door Freezer FS1	115/60/1	11.7	15
	220-240/50/1	4.9	15
Two Door Freezer FS2	115/60/1	13.8	20
	220-240/50/1	6.3	15

Description/Model #	Voltage/Phase/Cycle	Min. Circuit Amps	Maximum Fuse Size
Three Door Freezer FS3	115 and 208-230/60/1	13.1	15
	220-240/50/1	12.1	15

Remote Model Refrigerators

	Evaporator Section Model Number		
	RR1	RR2	RR3
Voltage of Evaporator Section	115/60/1	115/60/1	115/60/1
Power Cord N.E.M.A. Plug Configuration	5-15P	5-15P	5-15P
Total Amperage Evaporator Section Only	1.8 Amps	3.2 Amps	3.8 Amps
Supplied Voltage for Liquid Line Solenoid	115/60/1	115/60/1	115/60/1
Remote Condensing Unit Power Supply	Separate Power Supply Refer to condensing unit manufacturer for specifications		

Remote Model Freezers

	Evaporator Section Model Number		
	FR1	FR2	FR3
Voltage of Evaporator Section	115/60/1	115/60/1	115 and 208-230/60/1
Power Cord N.E.M.A. Plug Configuration	5-15P	5-15P	No Power Cord Hard Wired
Amperage Evaporator Section Only	Total Amps 6.8	Total Amps 14.3	Min. Circuit Amps 10.9 Max. Fuse Size 15
Supplied Voltage for Liquid Line Solenoid	115/60/1	115/60/1	115/60/1
Remote Condensing Unit Power Supply	Separate Power Supply Refer to condensing unit manufacturer for specifications		

Section 3
Maintenance

Interior and Exterior Cleaning

- Use mild hand soap and warm water to clean the Reach-In cabinet interior and exterior surfaces.
- Use a government-approved, food grade classified cleaner with a mineral oil base to remove aluminum oxide deposits (white, powdery spots) from interior aluminum surfaces.

⚠ CAUTION

Never use steel wool; strong acids, or abrasive cleaners to clean any Reach-In cabinet interior or exterior surface

⚠ CAUTION

Acidic products and products containing vinegar must be stored in sealed containers to prevent acid damage to the interior of the Reach-In cabinet and the evaporator coil.

Light Bulb Replacement

1. Unscrew and remove the protective cover over the light bulb.
2. Unscrew and remove the spent light bulb.
3. Install a new 40 watt appliance light bulb. Be sure it is screwed in securely.
4. Install the protective cover over the light bulb. Be sure it is screwed in securely.

Condenser Cleaning

A dirty condenser restricts airflow, resulting in excessively high operating temperatures. This reduces efficiency and shortens component life.

The washable aluminum filter is designed to catch dust, dirt, lint and grease. This helps keep the condenser clean.

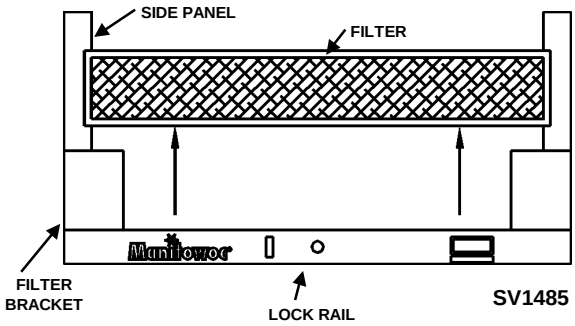


Figure 3-1: Washable Aluminum Filter

NOTE: Older model Reach-Ins do not use a washable aluminum filter.

⚠ WARNING

Disconnect the electric power to the Reach-In before cleaning the condenser.

⚠ CAUTION

The condenser fins are sharp. Use care when cleaning them.

CLEANING PROCEDURE

Use this procedure to clean the condenser once a month:

1. Clean the filter with a mild soap and water solution.
2. Clean the outside of the condenser with a soft brush or a vacuum with a brush attachment. Clean from top to bottom, not side to side. Be careful not to bend the condenser fins.
3. Shine a flashlight through the condenser to check for dirt between the fins. If dirt remains:
   A. Blow compressed air through the condenser from the inside. Be careful not to bend the fan blades.
   B. Use a commercial condenser coil cleaner. Follow the directions and cautions supplied with the cleaner.

   Repeat step 3 until all dirt is removed.
4. Use a fin comb to straighten any bent fins.

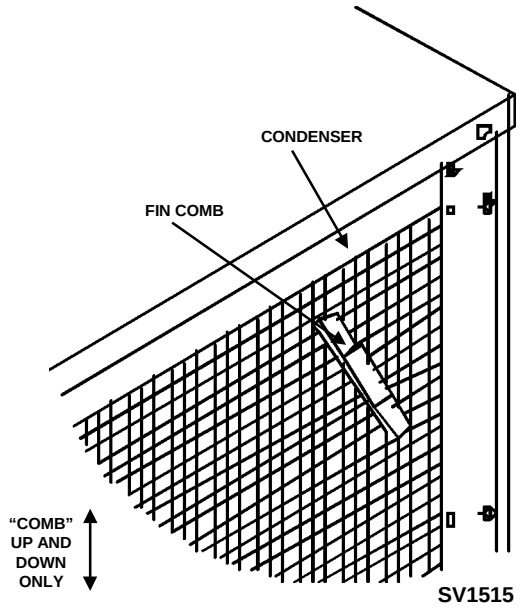


Figure 3-2: Using a Fin Comb

5. Carefully wipe off the fan blades and motor with a soft cloth. Do not bend the fan blades. If the fan blades are excessively dirty, wash with warm, soapy water and rinse thoroughly.

⚠ CAUTION

If you are cleaning the condenser fan blades, cover the fan motor to prevent water damage.

Section 4
Component Identification

Reach-In Cabinet

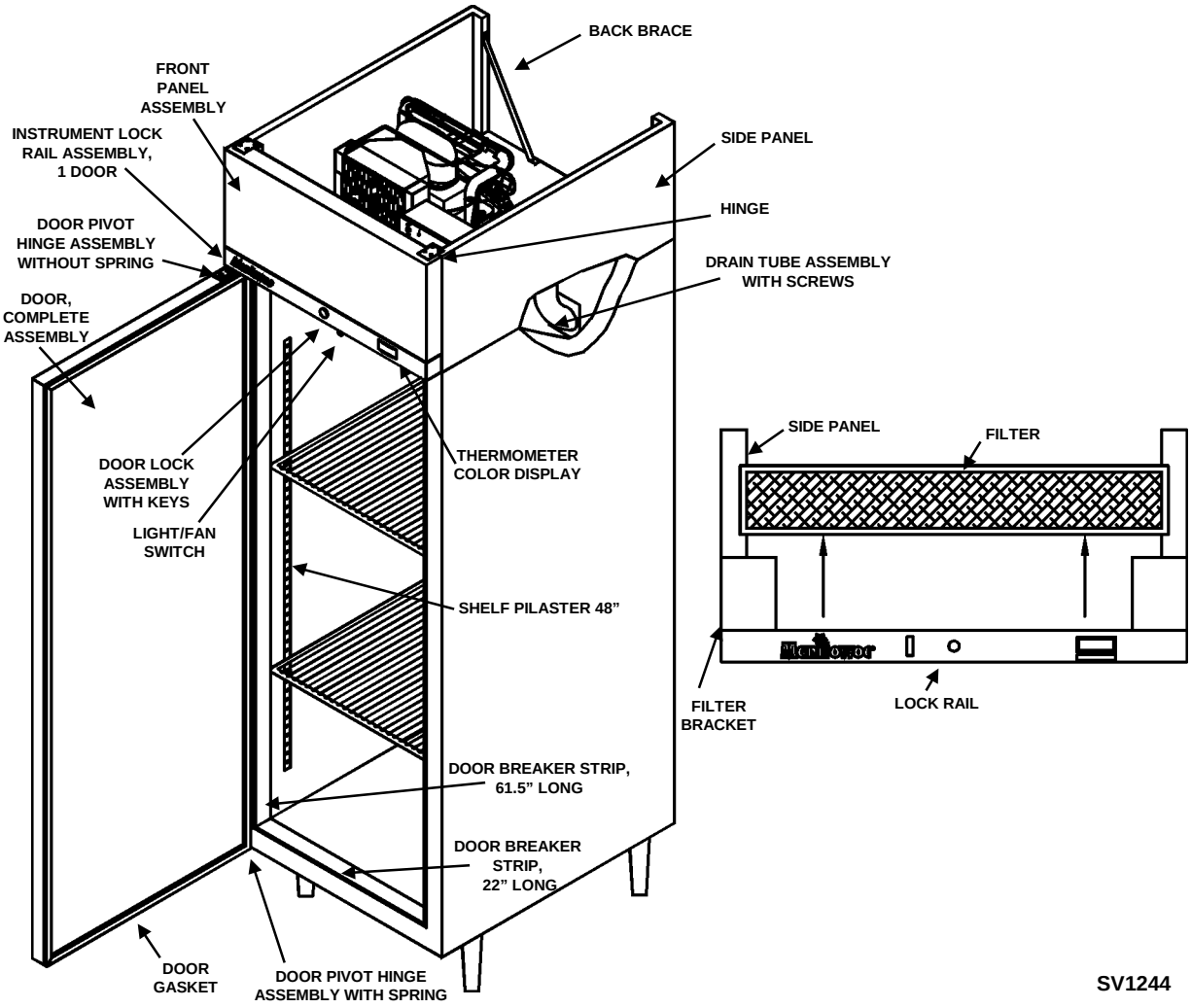


Figure 4-1: Reach-In Cabinet - Refrigerator or Freezer

NOTE: This drawing is a representation only. Your equipment may differ.

Refrigerator

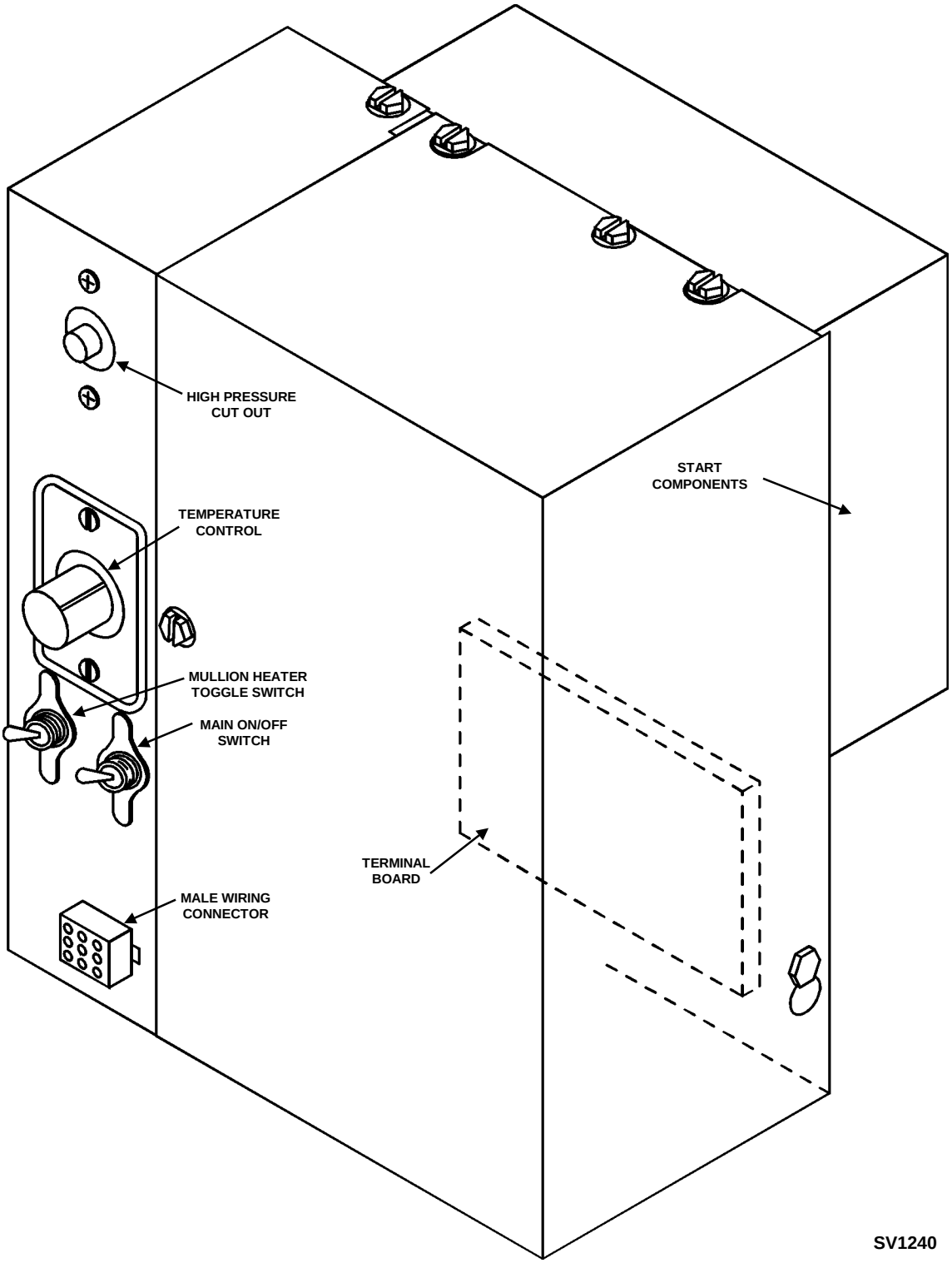


Figure 4-2: Refrigerator - Self-Contained or Remote Electrical Control Box

NOTE: This drawing is a representation only. Your equipment may differ.

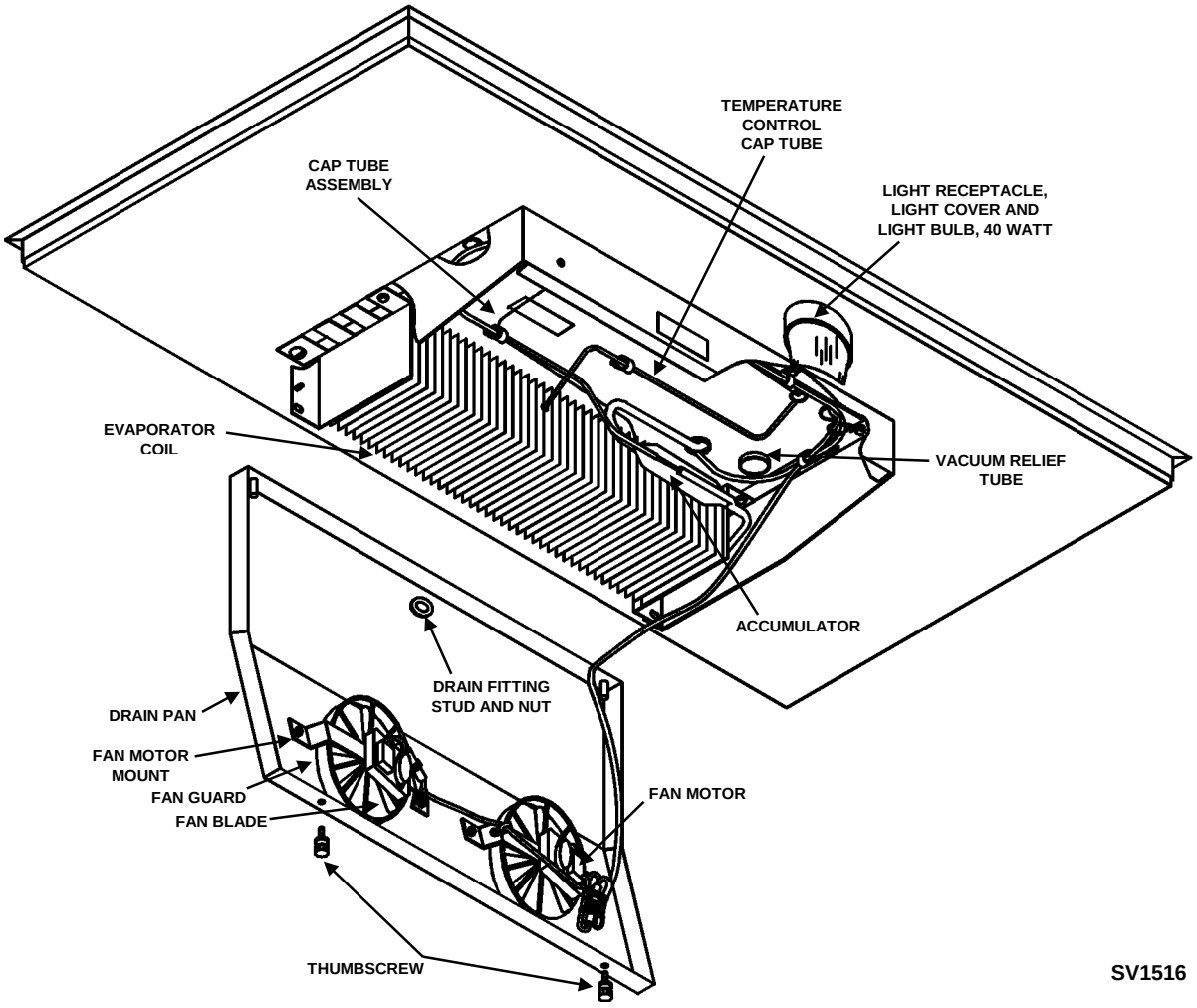


Figure 4-3: Refrigerator - Self-Contained Refrigeration System Evaporator Assembly

NOTE: This drawing is a representation only. Your equipment may differ.

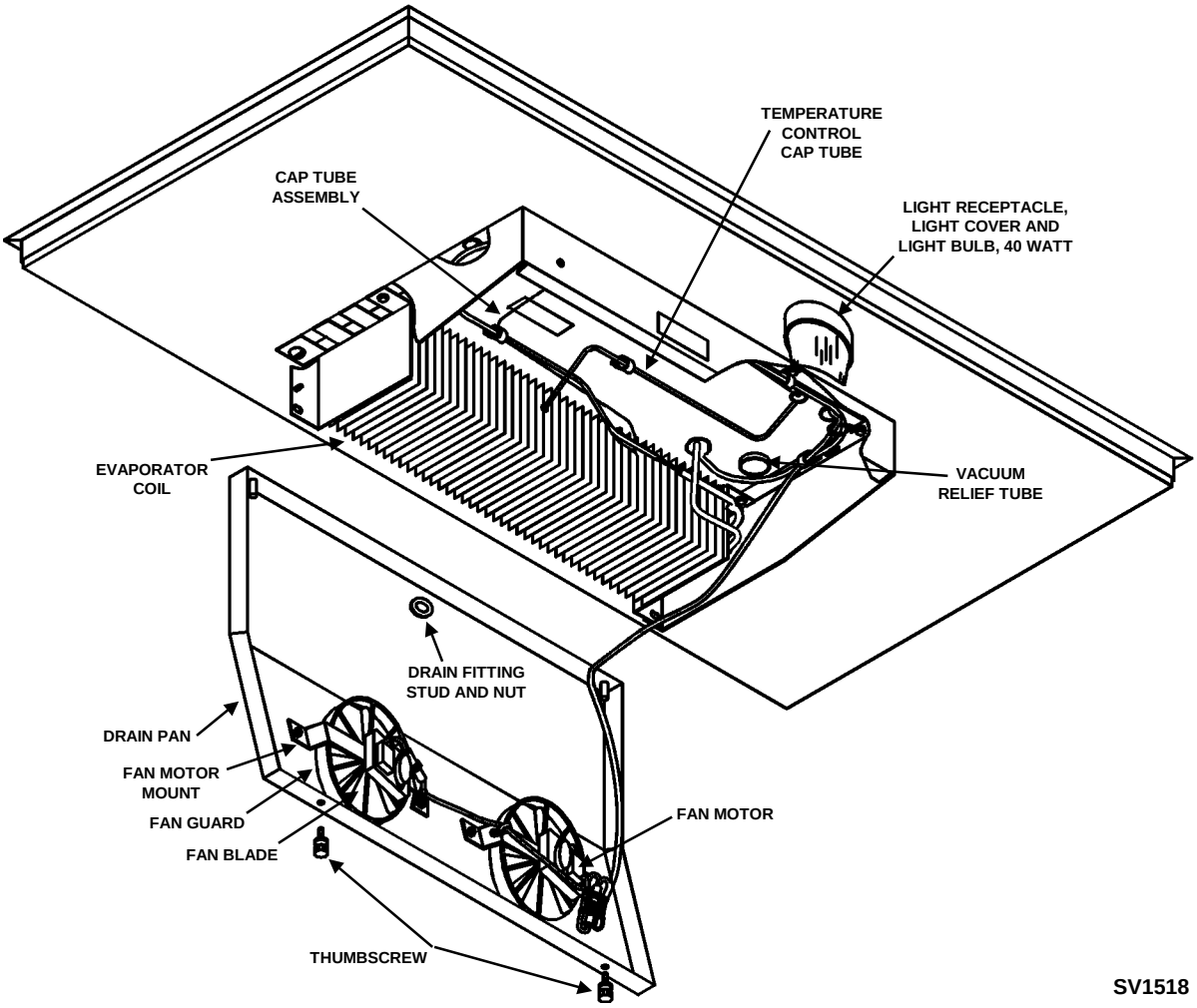


Figure 4-4: Refrigerator - Remote Refrigeration System Evaporator Assembly

NOTE: This drawing is a representation only. Your equipment may differ.

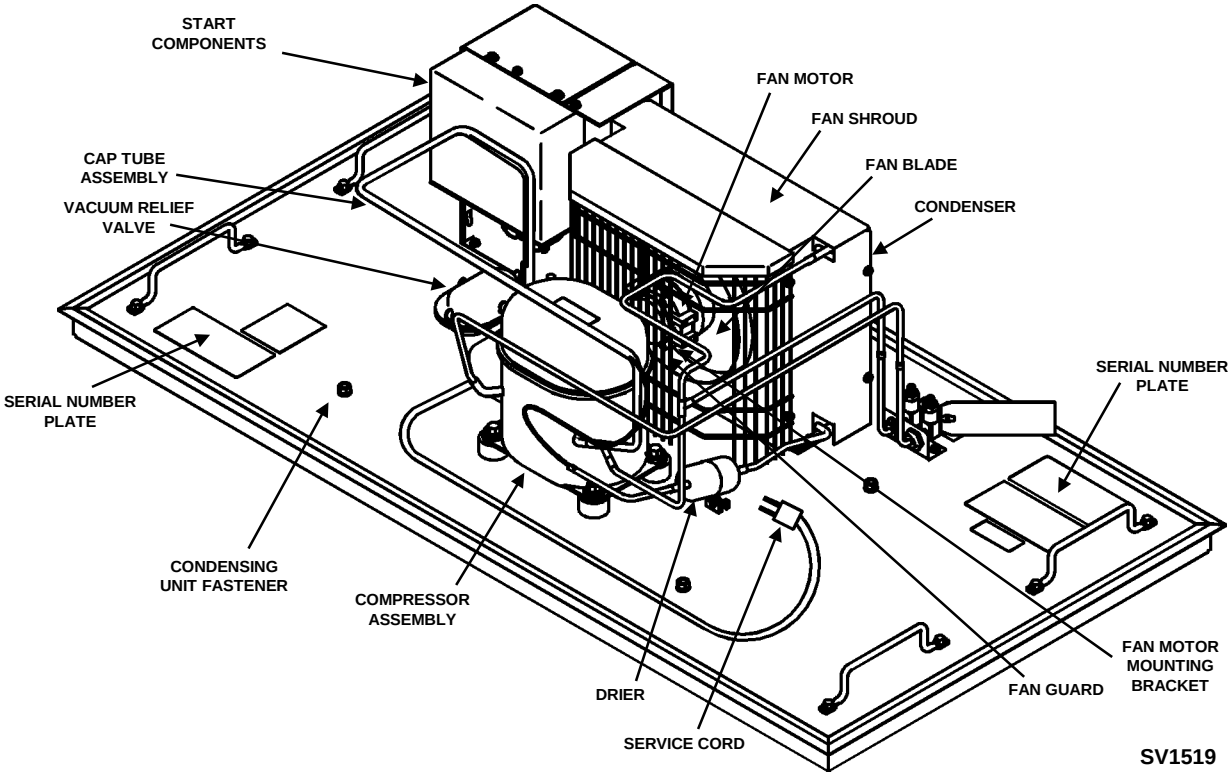


Figure 4-5: Refrigerator - Self-Contained Refrigeration System Compressor Assembly

NOTE: This drawing is a representation only. Your equipment may differ.

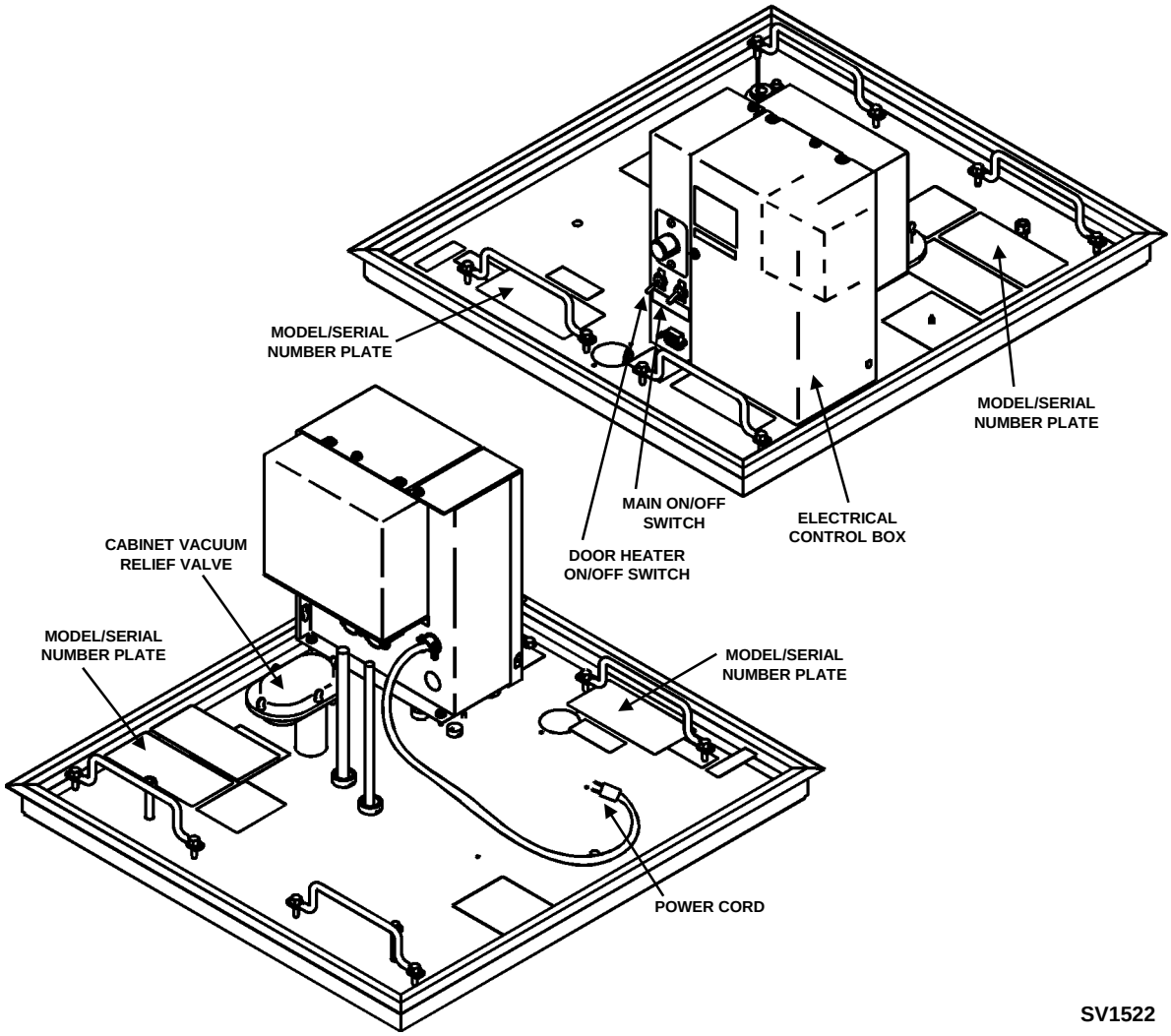


Figure 4-6: Refrigerator - Remote Refrigeration System Head Section

NOTE: This drawing is a representation only. Your equipment may differ.

FREEZER

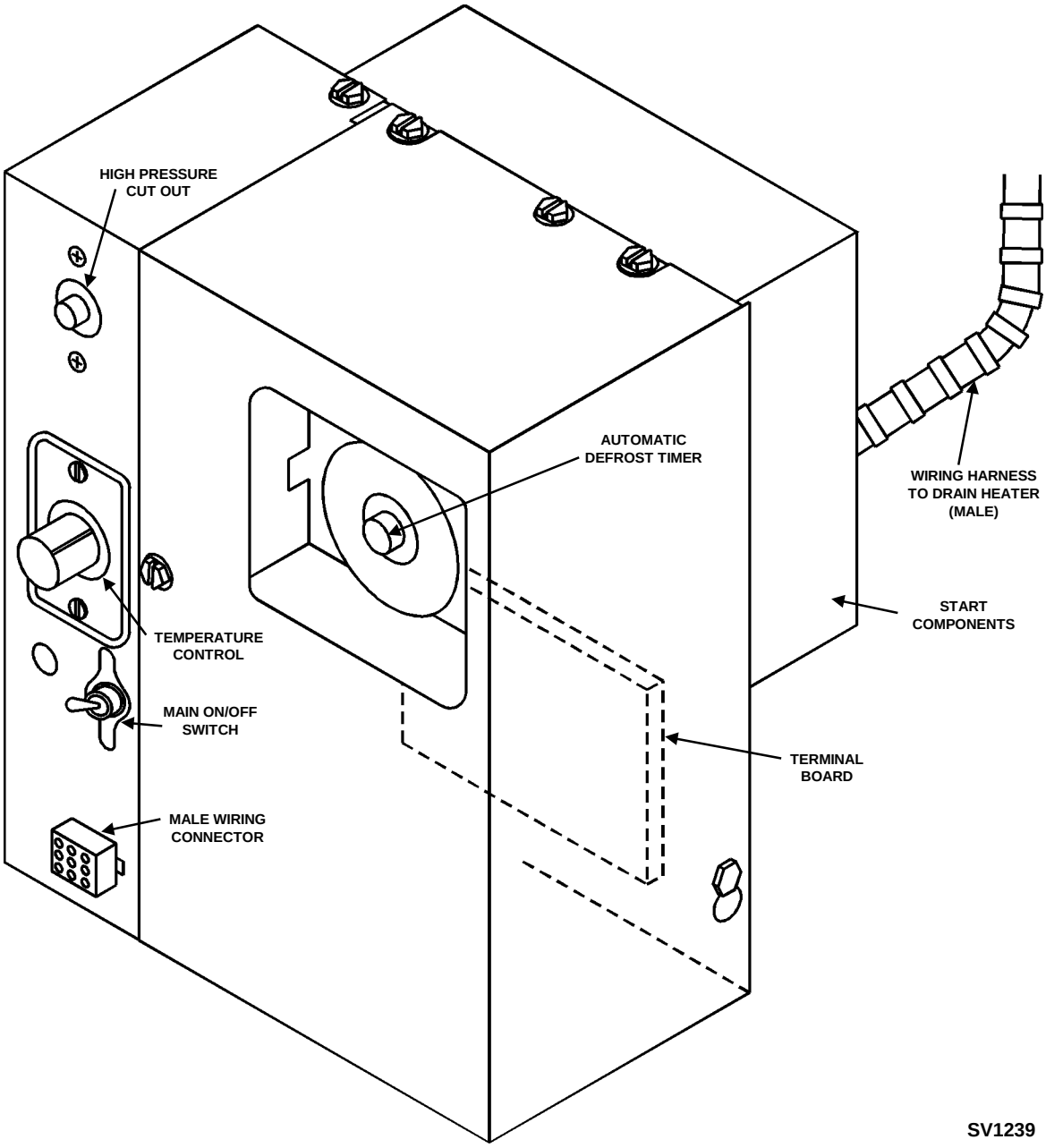


Figure 4-7: Freezer - Self-Contained or Remote Electrical Control Box

NOTE: This drawing is a representation only. Your equipment may differ.

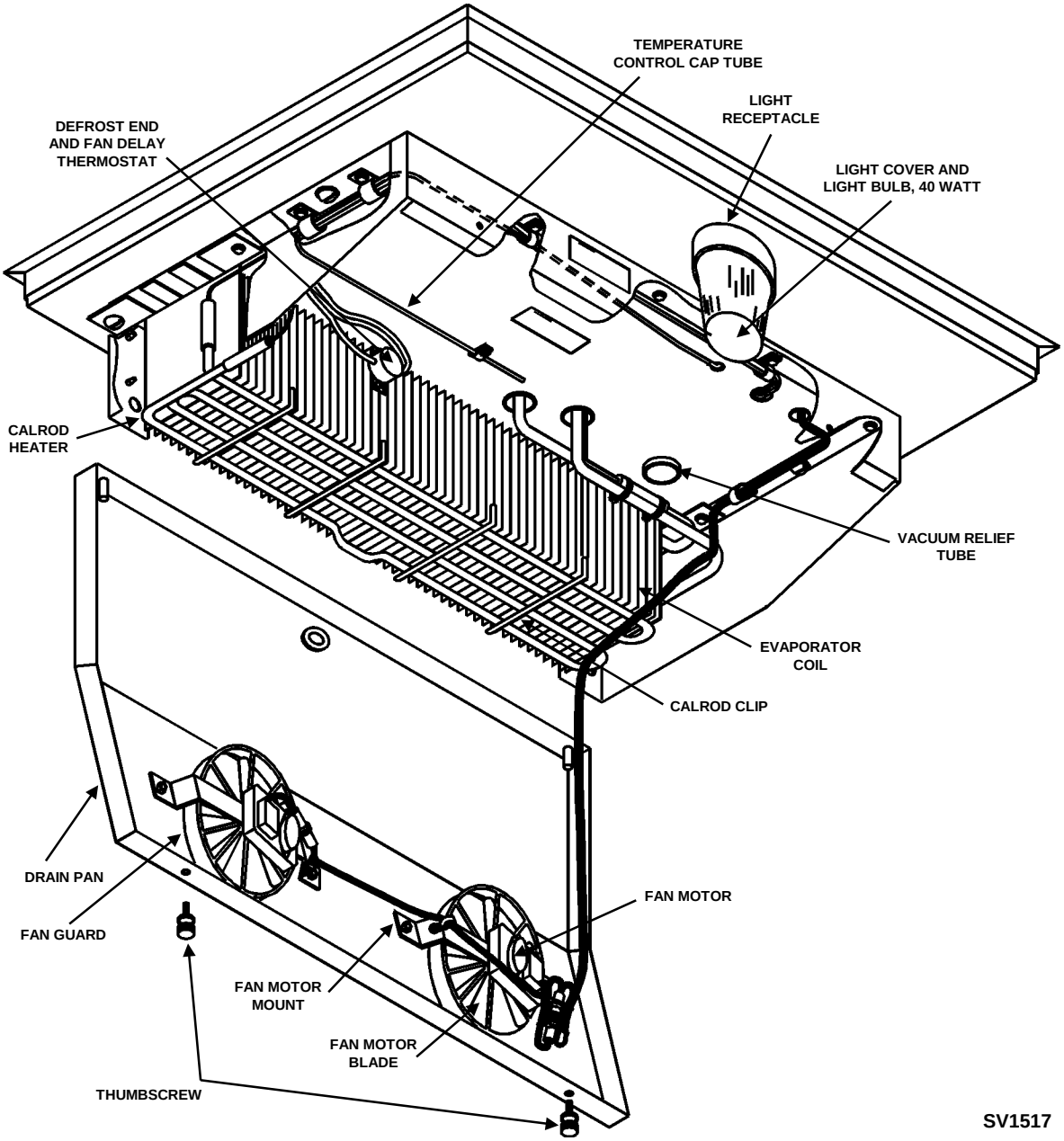


Figure 4-8: Freezer - Self-Contained or Remote Refrigeration System Evaporator Assembly

NOTE: This drawing is a representation only. Your equipment may differ.

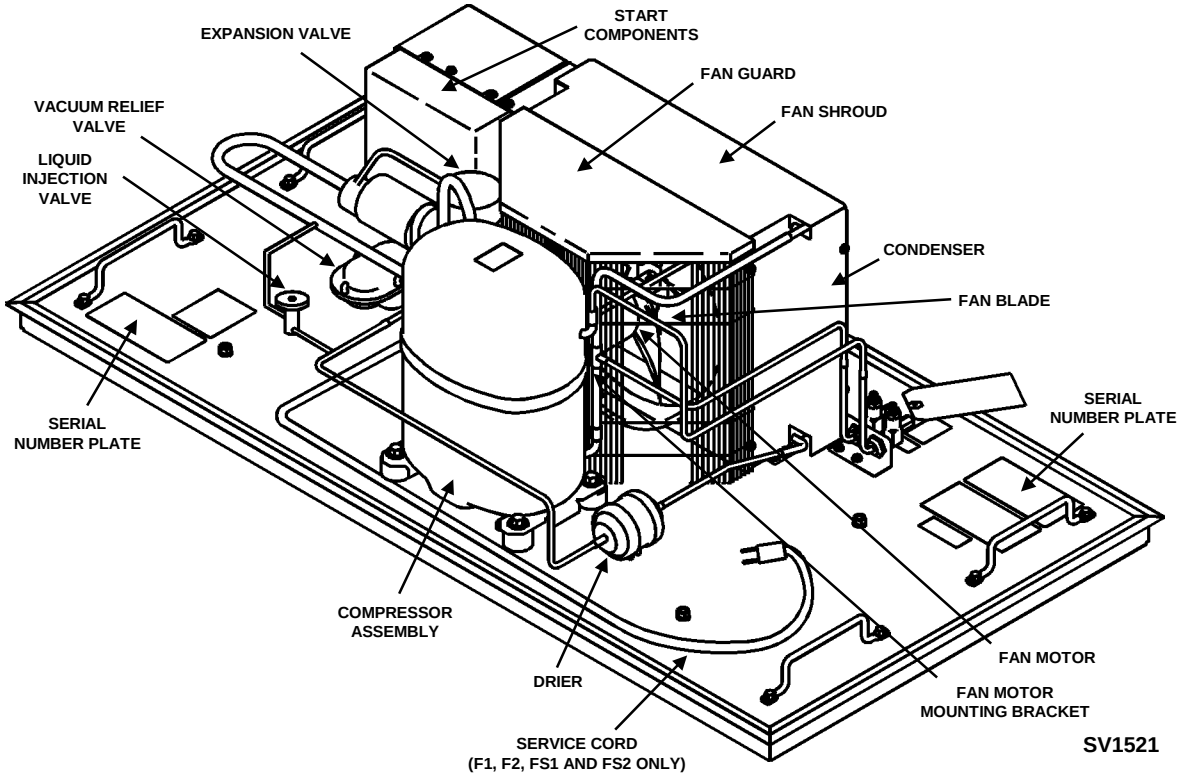


Figure 4-9: Freezer - Self-Contained Refrigeration System Compressor Assembly

NOTE: This drawing is a representation only. Your equipment may differ.

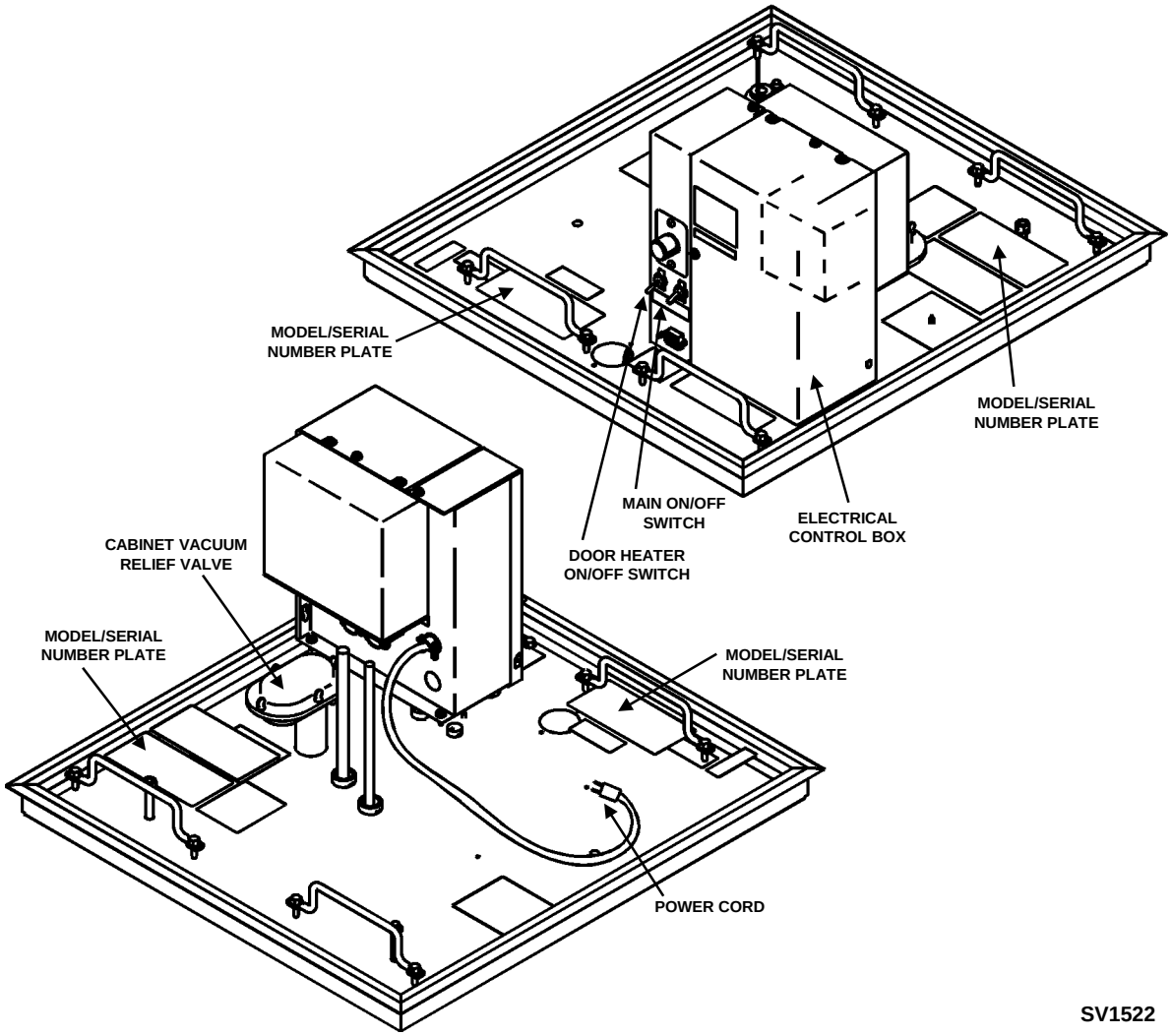


Figure 4-10: Freezer - Remote Refrigeration System Head Section

NOTE: This drawing is a representation only. Your equipment may differ.

Section 5
Electrical System

Electrical Sequence of Operation

Refrigerators - Self-Contained - R1, R2, R3

For wiring diagram, see page 5-5

COOLING CYCLE

With the main ON/OFF switch in the ON position, the current flows, energizing the evaporator fan motors.

Current also flows through the closed contacts of the temperature control, energizing the condenser fan motor and the compressor.

OFF CYCLE

When the temperature control senses the proper temperature, it opens, shutting off the refrigeration system.

The refrigeration system remains off until the temperature control senses approximately 38°F (3.3°C). (This also keeps the evaporator defrosted.) At that time, the temperature control closes and starts the refrigeration system.

Refrigerators - Self-Contained - RS1, RS2, RS3

For wiring diagram, see pages 5-6 and 5-7

COOLING CYCLE

With the main ON/OFF switch in the ON position, the current flows, energizing the evaporator fan motor(s).

Important

On early production RS1, RS2 and RS3 models, the evaporator fan motor(s) are wired through the fan/light switch. Refer to page 7-6 for modification instructions.

Current also flows through the closed contacts of the temperature control, energizing the condenser fan motor and the compressor.

OFF CYCLE

When the temperature control senses the proper temperature, it opens, shutting off the refrigeration system.

The refrigeration system remains off until the temperature control senses approximately 38°F (3.3°C). (This also keeps the evaporator defrosted.) At that time, the temperature control closes and starts the refrigeration system.

Refrigerators - Remote - RR1, RR2, RR3
For wiring diagram, see page 5-8

COOLING CYCLE
With the main ON/OFF switch in the ON position, the current flows, energizing the evaporator fan motors.

Current also flows through the closed contacts of the temperature control, energizing the liquid line solenoid valve. The increase in suction pressure causes the contacts on the low pressure switch to close, energizing the refrigeration system.

OFF CYCLE
When the temperature control senses the proper temperature, it opens, shutting off the liquid line solenoid valve. The drop in suction pressure causes the low pressure switch to open, de-energizing the refrigeration system.

The refrigeration system remains off until the temperature control senses approximately 38°F (3.3°C). (This also keeps the evaporator defrosted.) At that time, the temperature control closes and starts the refrigeration system.

Freezers - Self-Contained - F1, F2, F3
For wiring diagram, see pages 5-9, 5-10, 5-11

COOLING CYCLE
With the main ON/OFF switch in the ON position, the current flows, energizing the automatic defrost time clock.

Current also flows through the closed contacts of the temperature control, energizing the condenser fan motor(s) and the compressor.

With contact N closed on the automatic defrost time clock, current will flow through the normally open (N.O.) light/fan switch contacts (with the door closed).

When the evaporator coil temperature reaches 30 to 35°F (-1.1 to 1.7°C), the defrost end and fan delay thermostat closes, energizing the evaporator fans.

DEFROST CYCLE
At preset times on the automatic defrost time clock, the contacts switch to defrost the evaporator. Contact N opens, de-energizing the evaporator fan motor(s). Contact #4 opens, de-energizing the refrigeration system. Contact #1 closes, energizing the evaporator defrost heater.

As the evaporator temperature rises, the defrost end and fan delay thermostat opens to terminate the defrost cycle. Contact #1 opens, de-energizing the defrost heater. Contacts N and #4 close, energizing the refrigeration system.

OFF CYCLE
When the temperature control senses the proper temperature, it opens, shutting off the refrigeration system.

Freezers - Self-Contained - FS1, FS2, FS3
For wiring diagram, see pages 5-12 and 5-13

Important
The FS3 freezer is a dual voltage reach-in. The electrical controls are identical to the FS1 and FS2 freezers.

COOLING CYCLE
With the main ON/OFF switch in the ON position, the current flows, energizing the automatic defrost time clock. Current also flows through the high pressure cut-out switch, energizing the relay.

With contact #4 closed, current flows through the normally open (N.O.) relay contacts, and with the temperature control closed, the refrigeration system starts. With contact N closed on the automatic defrost time clock, current flows through the normally open (N.O.) light/fan switch contacts (with the door closed).

When the evaporator coil temperature reaches 30 to 35°F (-1.1 to 1.7°C), the defrost end and fan delay thermostat closes, energizing the evaporator fans.

DEFROST CYCLE
At preset times on the automatic defrost time clock, the contacts switch to defrost the evaporator. Contact N opens, de-energizing the evaporator fan motor(s). Contact #4 opens, de-energizing the refrigeration system. Contact #1 closes, energizing the evaporator defrost heater.

As the evaporator temperature rises, the defrost end and fan delay thermostat opens to terminate the defrost cycle. Contact #1 opens, de-energizing the defrost heater. Contacts N and #4 close, energizing the refrigeration system.

OFF CYCLE
When the temperature control senses the proper temperature, it opens, shutting off the refrigeration system.

Freezers - Remote - FR1, FR2, FR3
For wiring diagram, see pages 5-14 and 5-15

COOLING CYCLE
With the main ON/OFF switch in the ON position, the current flows, energizing the automatic defrost time clock.

Current also flows through the closed contacts of the temperature control, energizing the liquid line solenoid valve. The increase in suction pressure closes the contacts on the low pressure switch, energizing the refrigeration system.

With contact N closed on the automatic defrost time clock, current flows through the normally open (N.O.) light/fan switch contacts (with the door closed).

When the evaporator coil temperature reaches 30 to 35°F (-1.1 to 1.7°C), the defrost end and fan delay thermostat closes, energizing the evaporator fans.

DEFROST CYCLE
At preset times on the automatic defrost time clock, the contacts switch to defrost the evaporator. Contact N opens, de-energizing the evaporator fan motor(s). Contact #4 opens, de-energizing the refrigeration system. Contact #1 closes, energizing the evaporator defrost heater.

As the evaporator temperature rises, the defrost end and fan delay thermostat opens to terminate the defrost cycle. Contact #1 opens, de-energizing the defrost heater. Contacts N and #4 close, energizing the refrigeration system.

OFF CYCLE
When the temperature control senses the proper temperature, it opens, shutting off the liquid line solenoid valve. The drop in suction pressure causes the low pressure switch to open, de-energizing the refrigeration system.

Wiring Diagrams

The following pages contain electrical wiring diagrams. Be sure you are referring to the correct diagram for the refrigerator or freezer Reach-In unit which you are servicing.

Wiring Diagram Legend

The following symbols are used on all of the wiring diagrams:

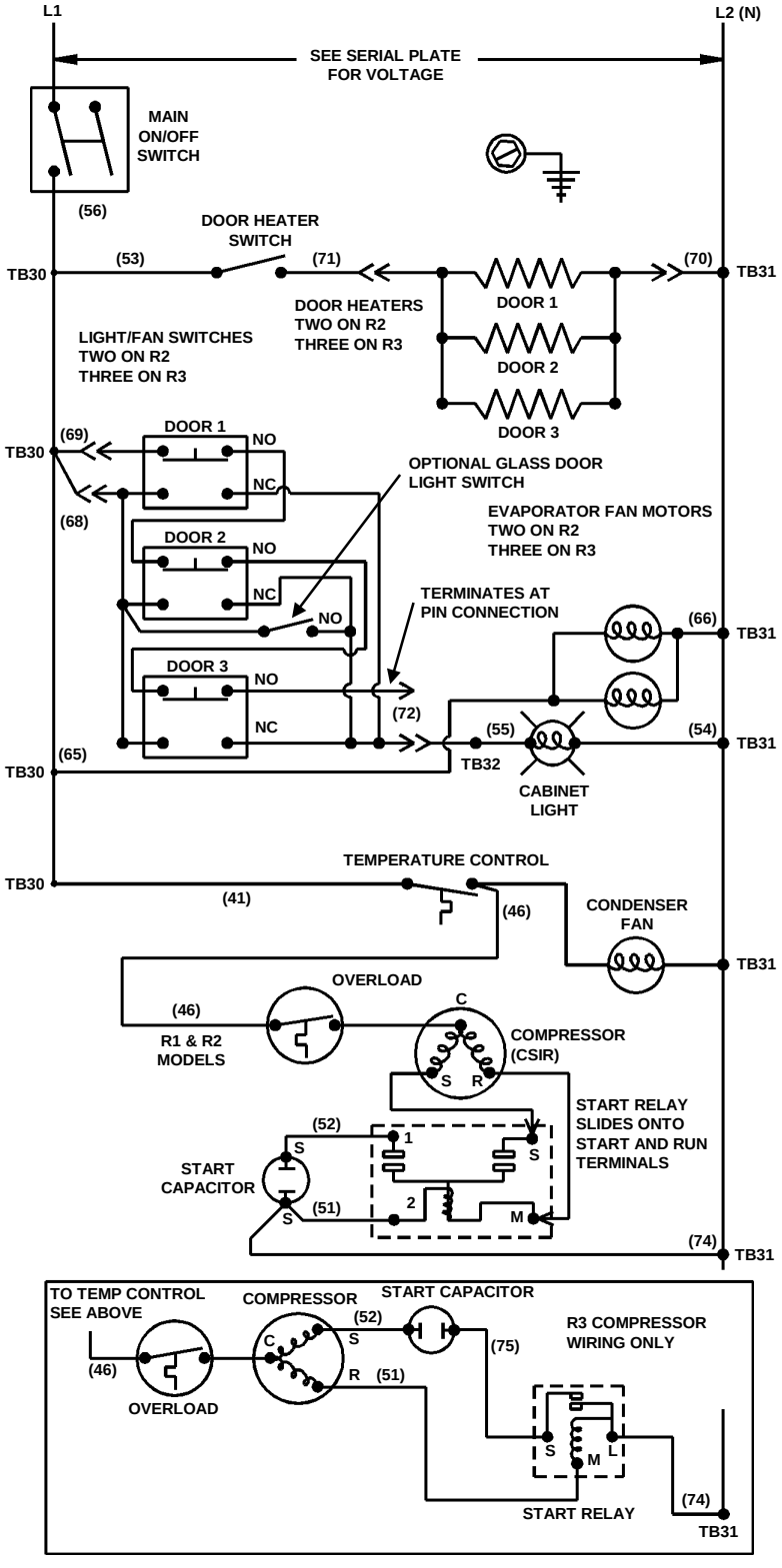
TB Terminal Board Connection

( ) Wire Number Designation
(The number is marked at each end of the wire)

—>>— Multipin Connection
(Cabinet Side) —>>— (Refrigeration System Side)

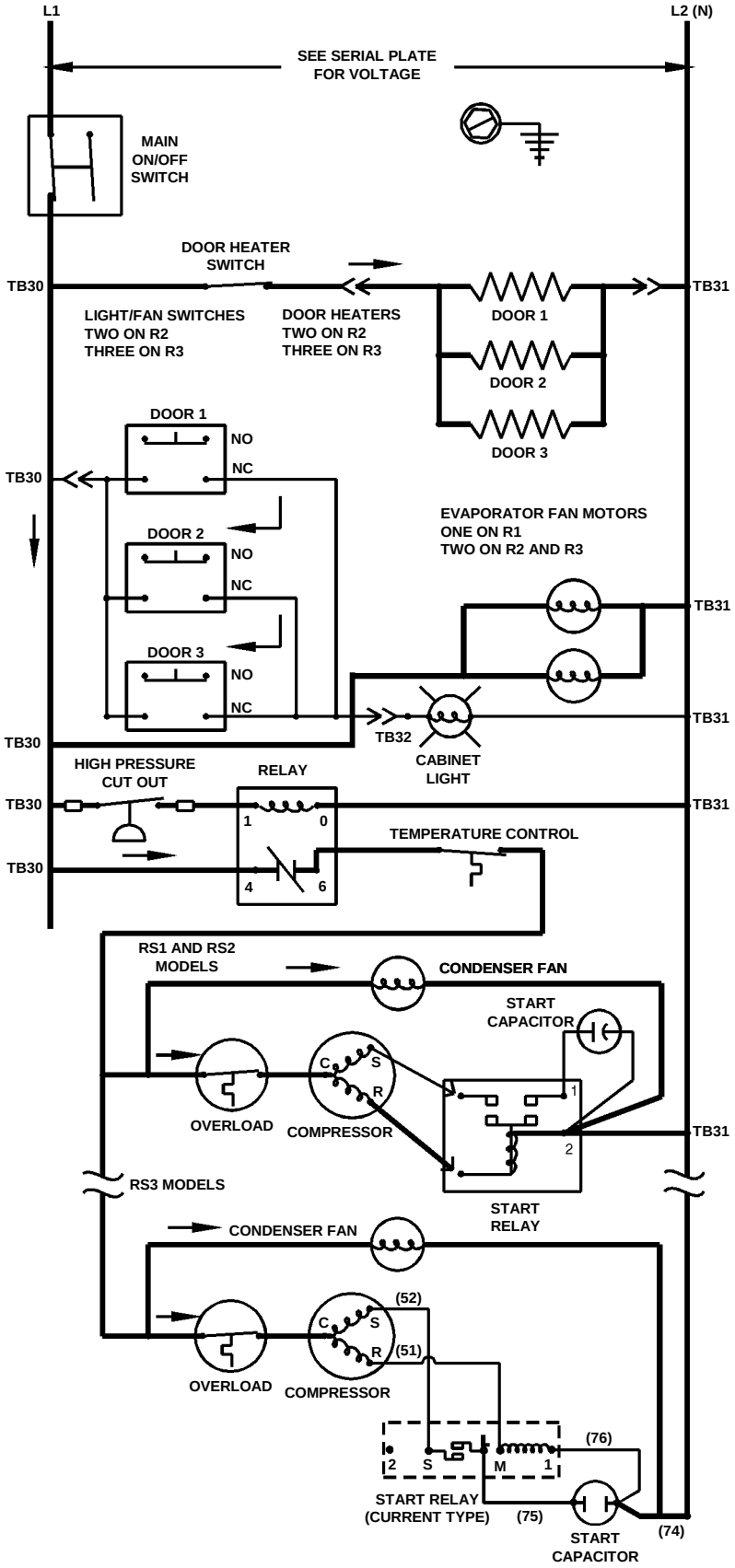
↑ Direction of Electrical Flow

Refrigerators - Self-Contained - R1, R2, R3
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-1.



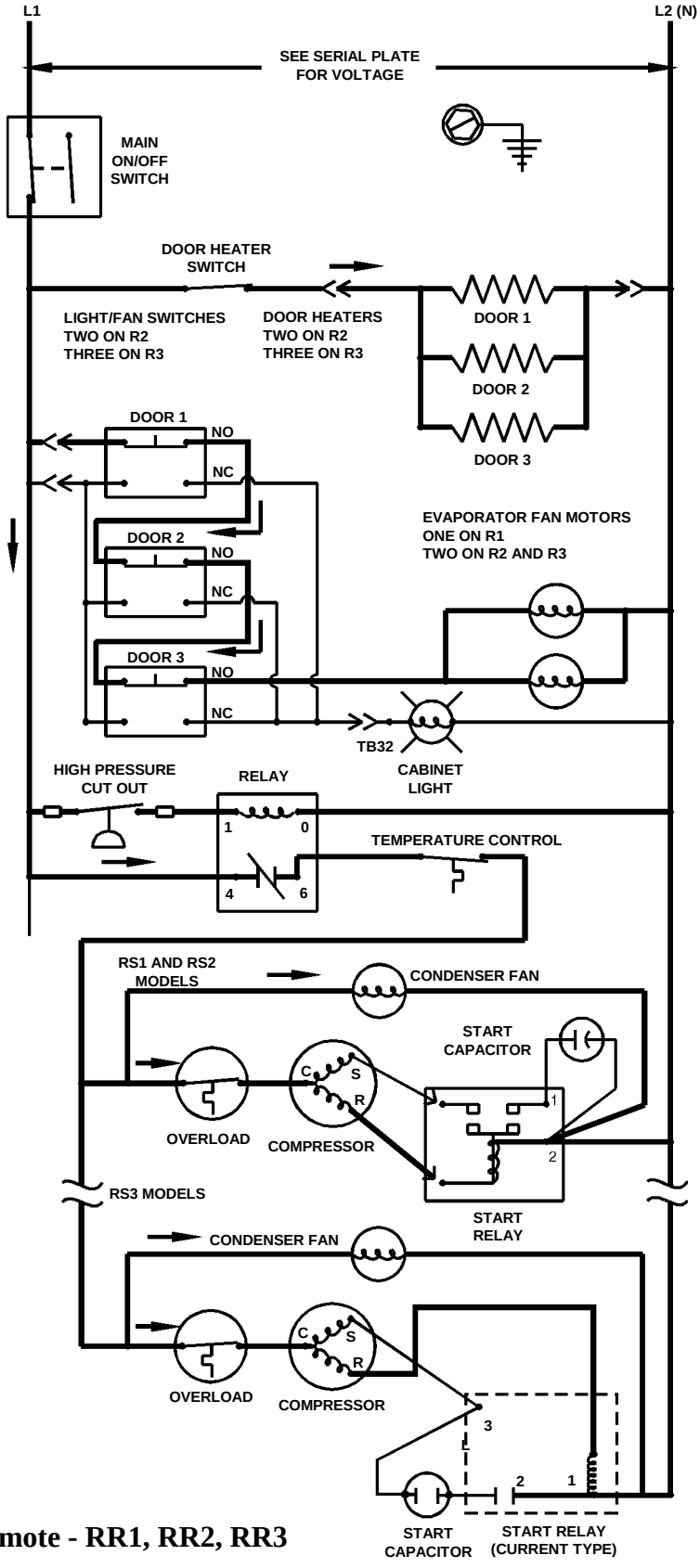
SV1523

Refrigerators - Self-Contained - RS1, RS2, RS3
Evaporator Fans Wired Direct
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-1.



Refrigerators - Self-Contained - RS1, RS2, RS3
Evaporator Fans Wired Through Door Switches
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-1.

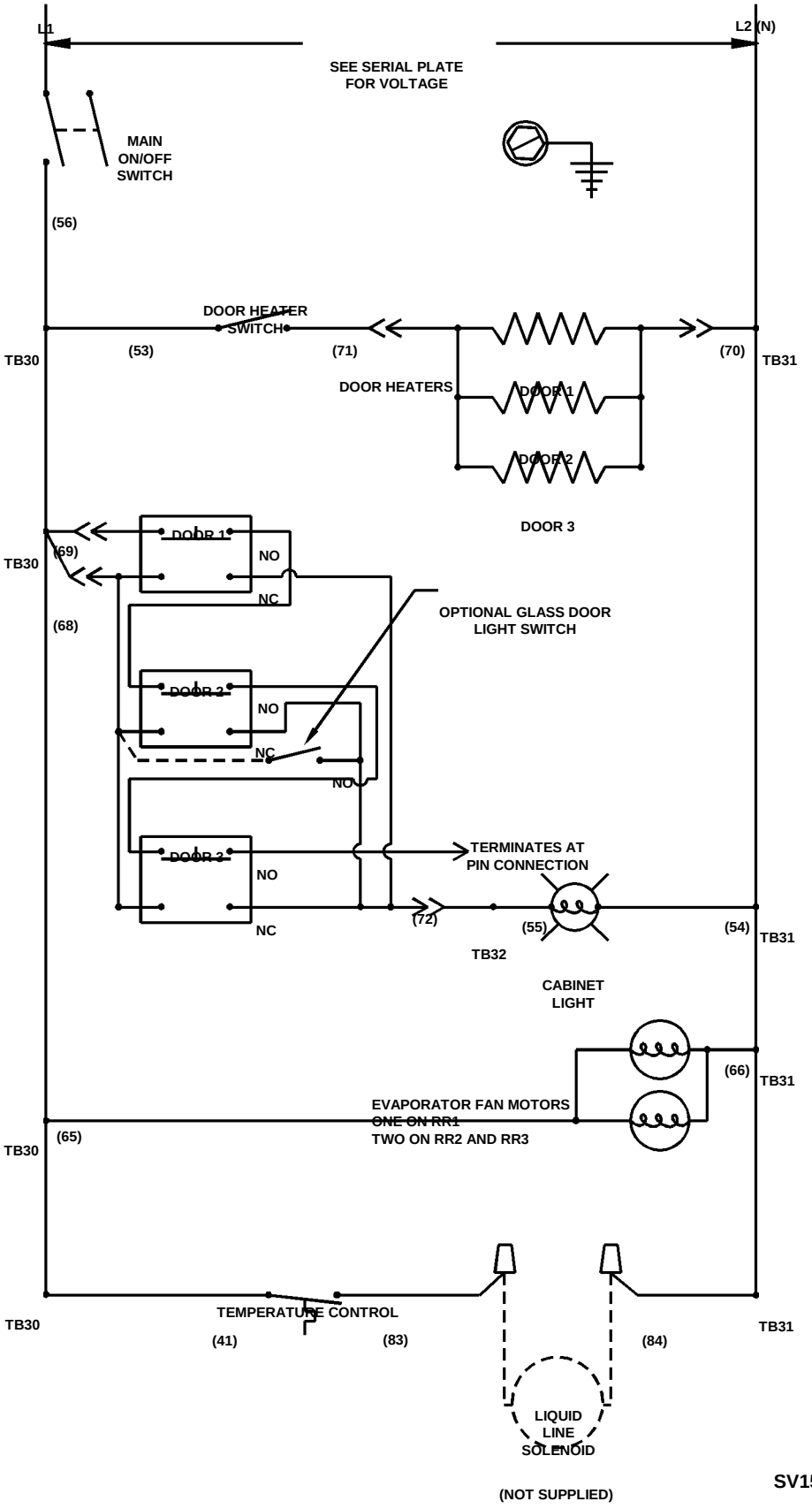
Important
The evaporator fan motor wiring needs to be modified. See page 7-6.



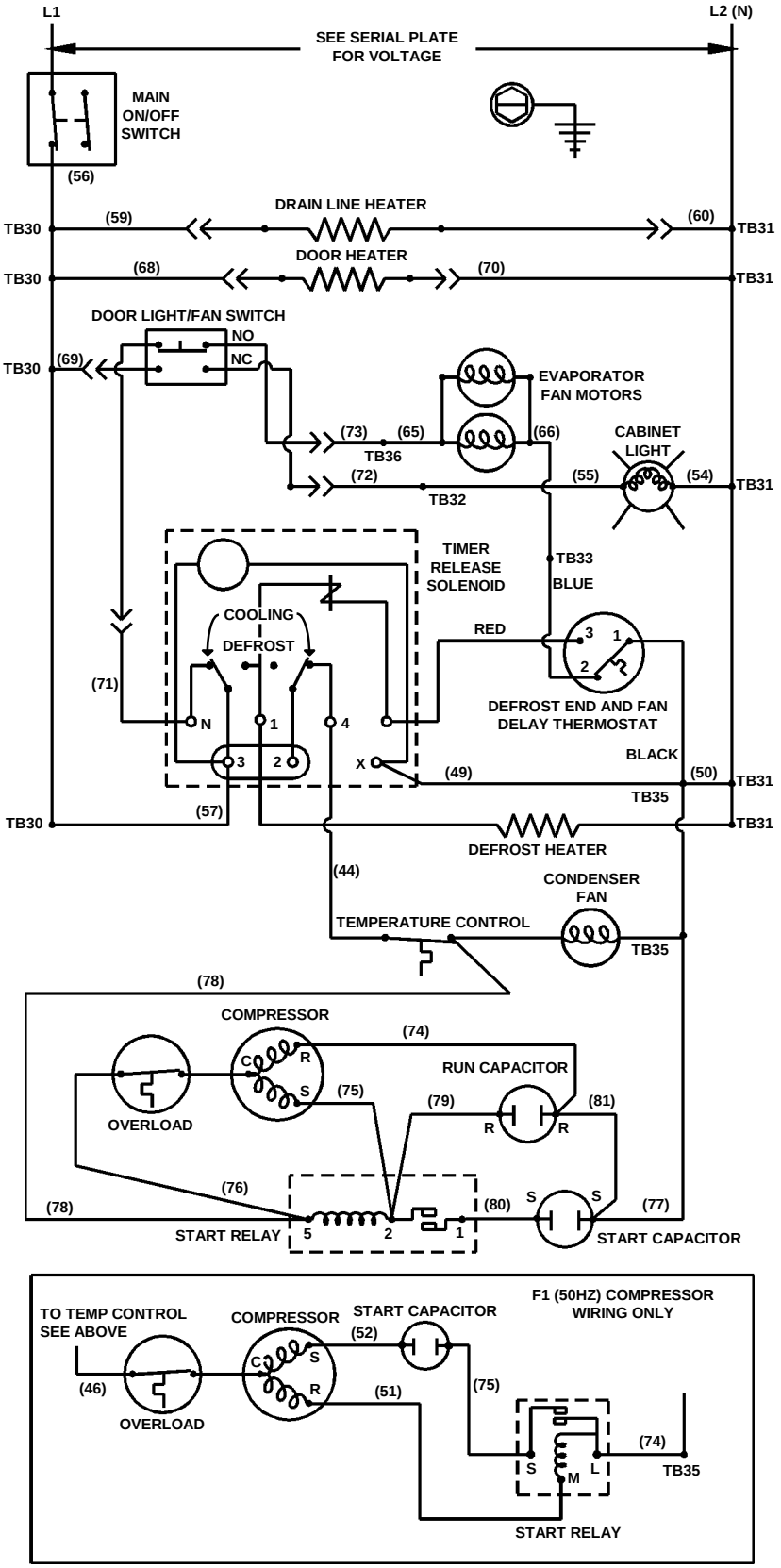
Refrigerators - Remote - RR1, RR2, RR3

SV1237

(Shown in cooling cycle)
For electrical sequence of operation, see page 5-2.

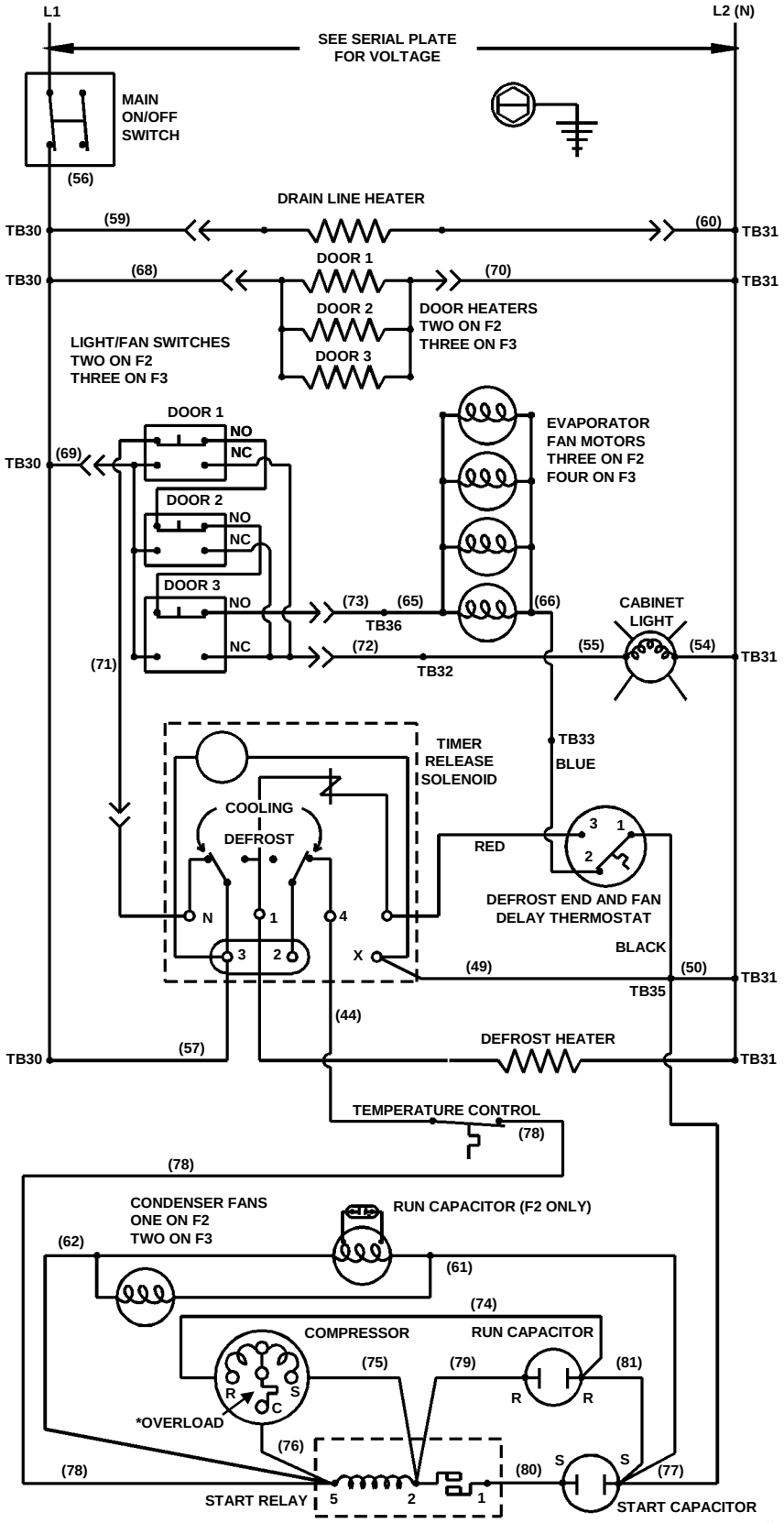


Freezers - Self-Contained - F1 (50/60 Hz)
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-2.



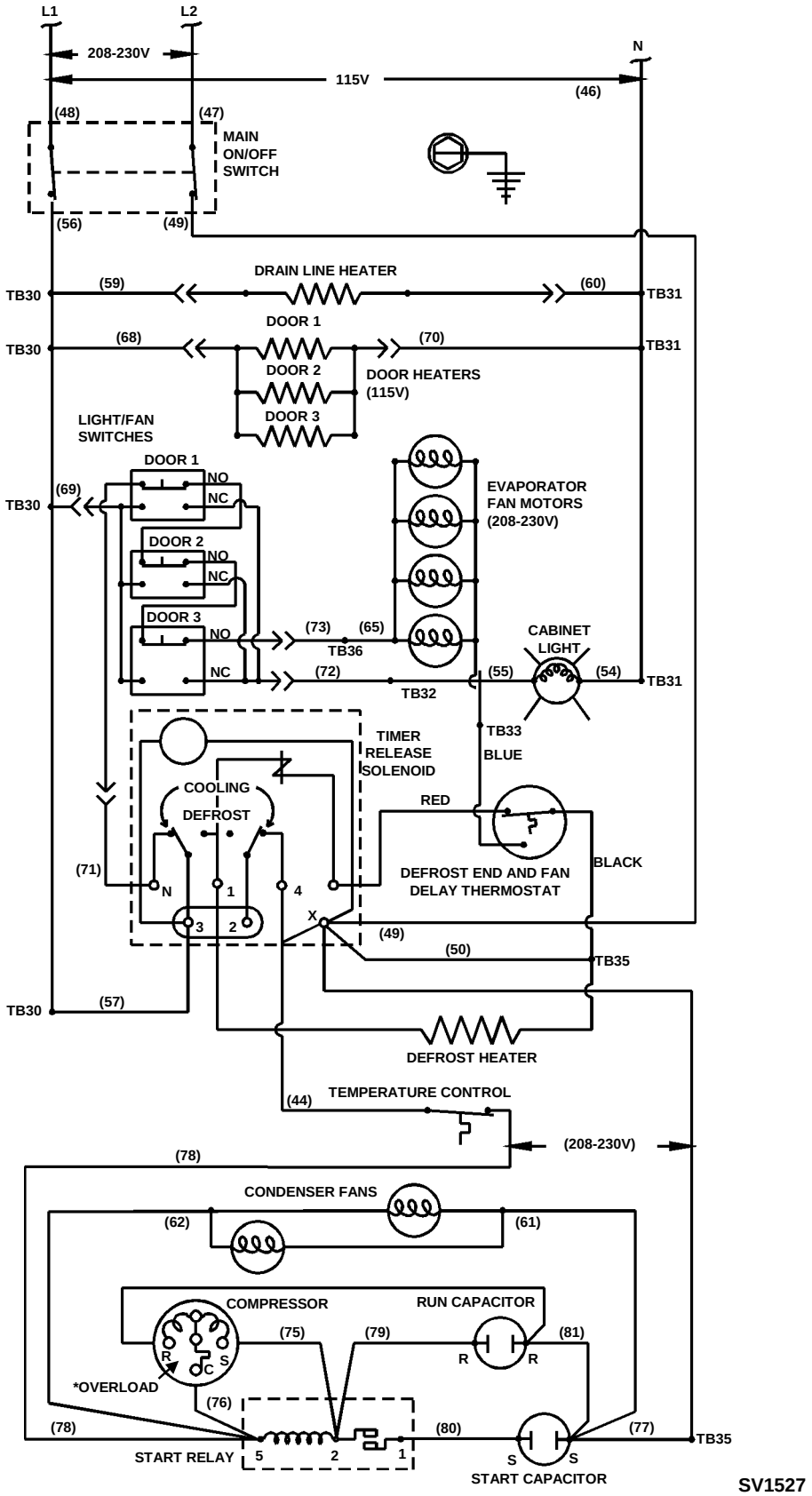
SV1525

Freezers - Self-Contained - F2 (50/60 Hz) and F3 (50 Hz)
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-2.

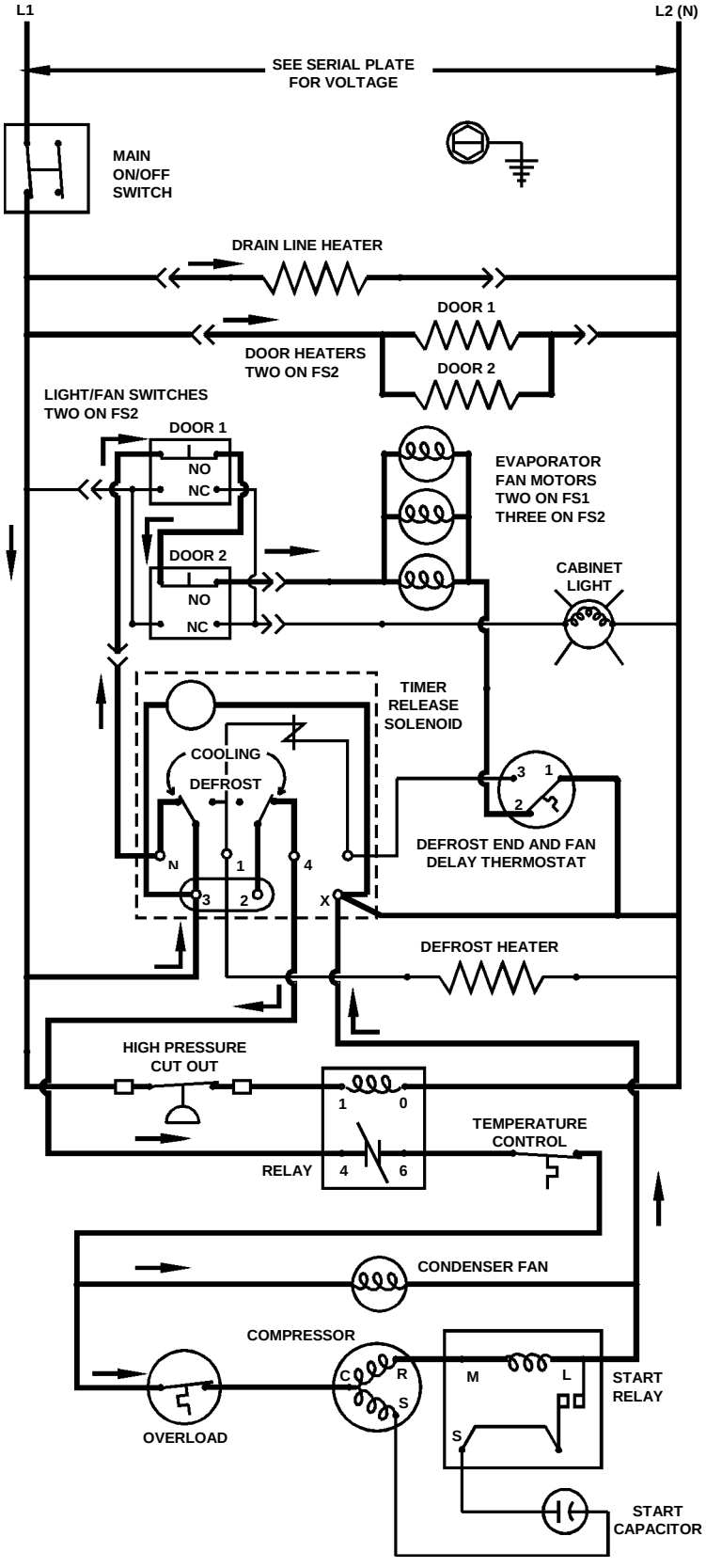


SV1526

Freezers - Self-Contained - F3 (60 Hz)
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-2.

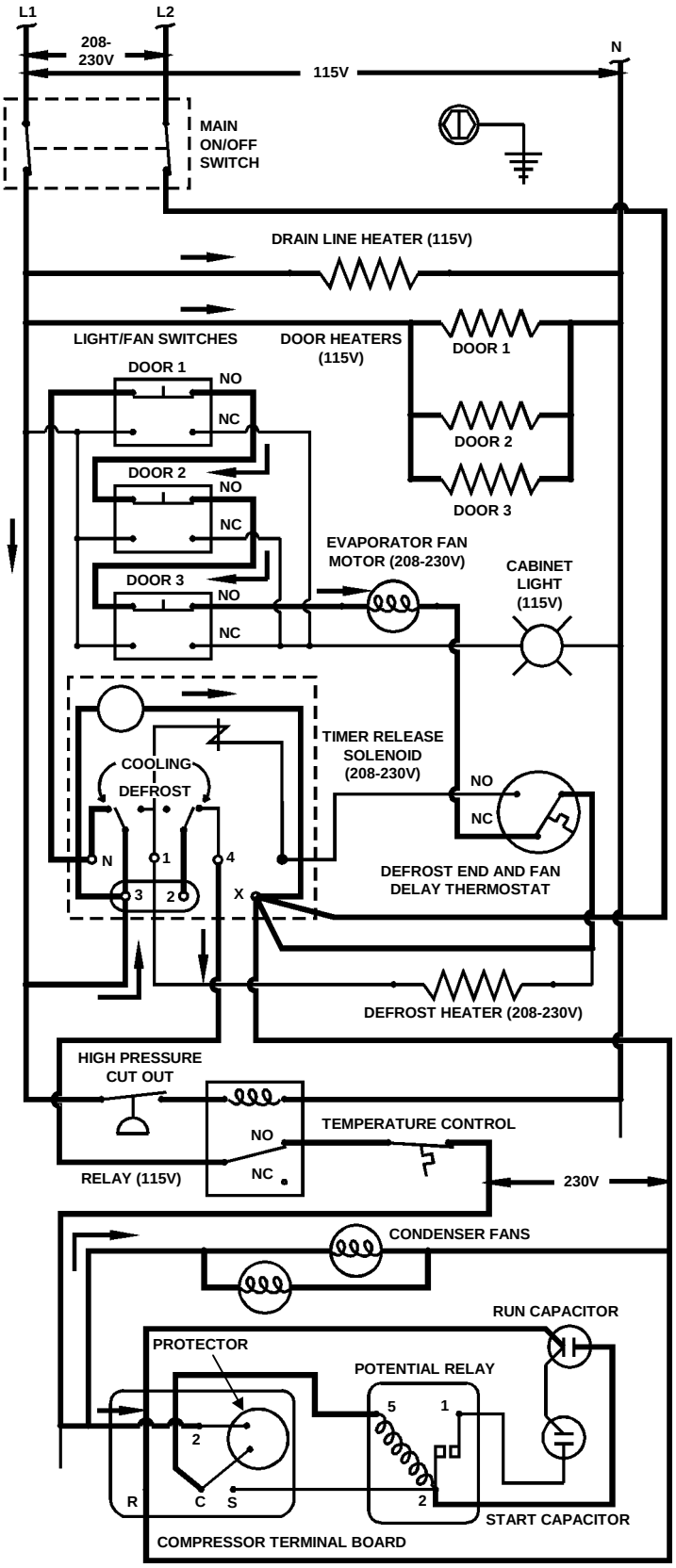


Freezers - Self-Contained - FS1, FS2
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-3.



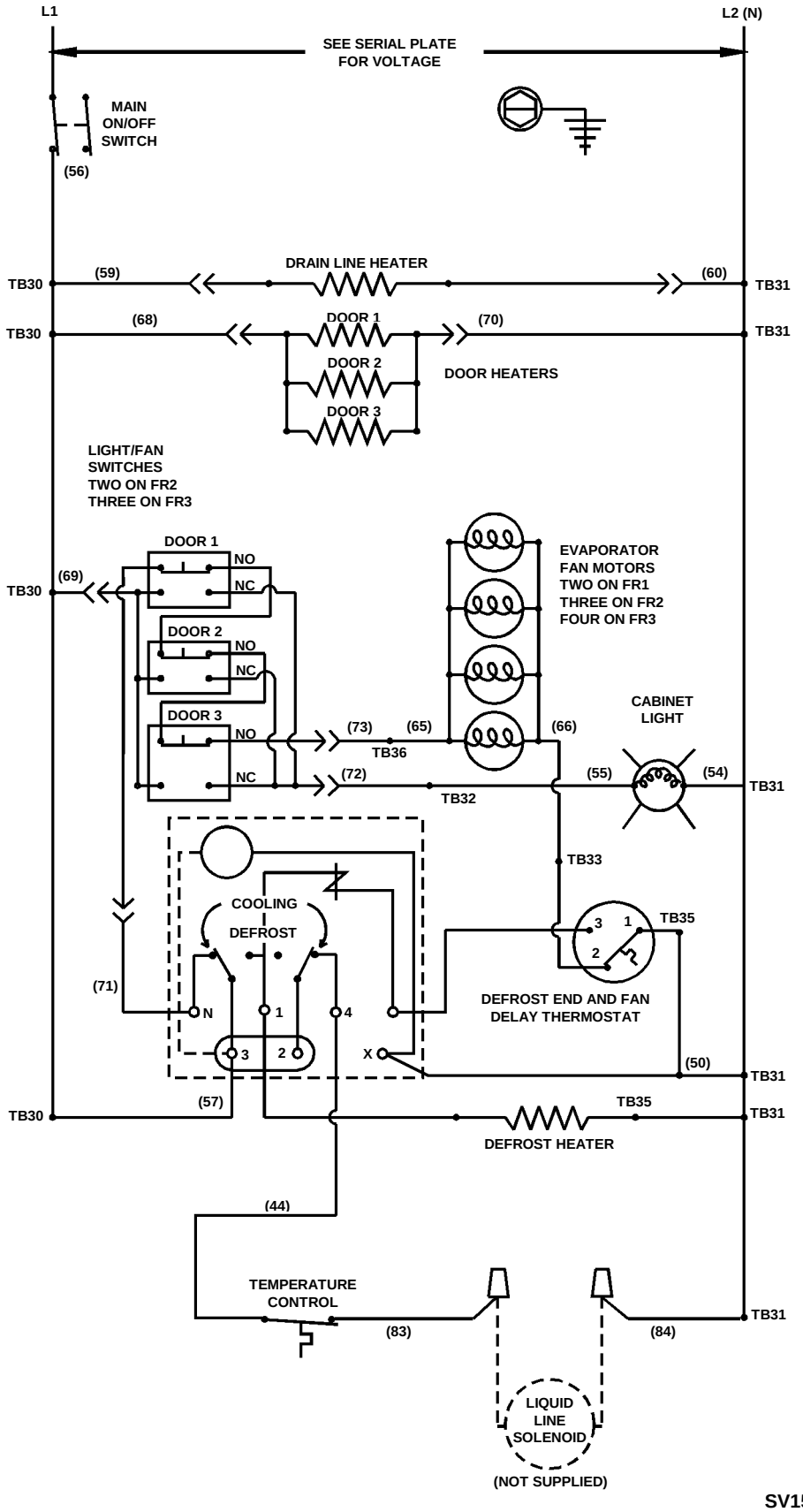
SV1531

Freezers - Self-Contained - FS3
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-3.

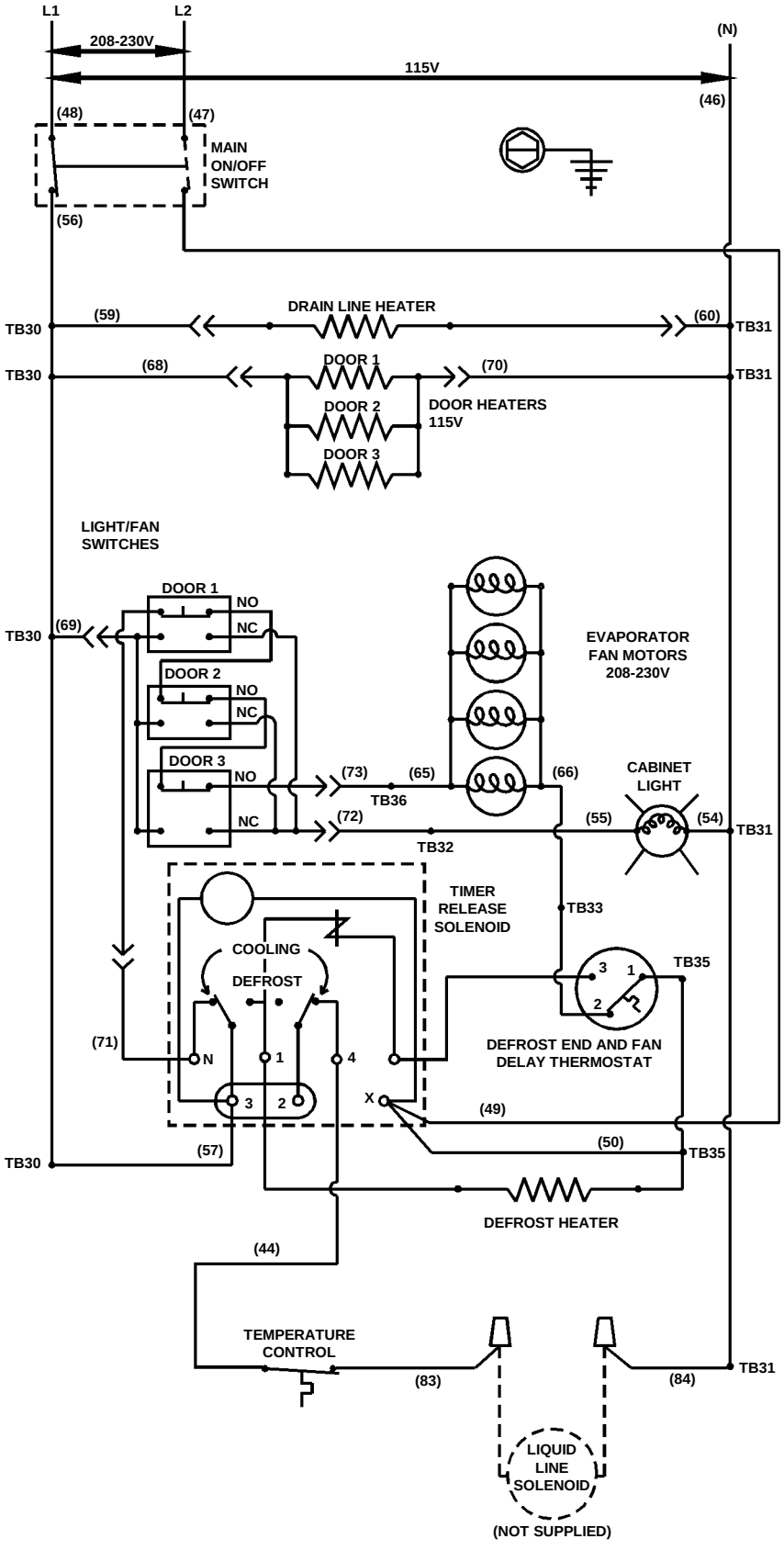


SV1532

Freezers - Remote - FR1, FR2 and FR3 (50 Hz)
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-3.



Freezers - Remote - FR3 (60 Hz)
(Shown in cooling cycle)
For electrical sequence of operation, see page 5-3.



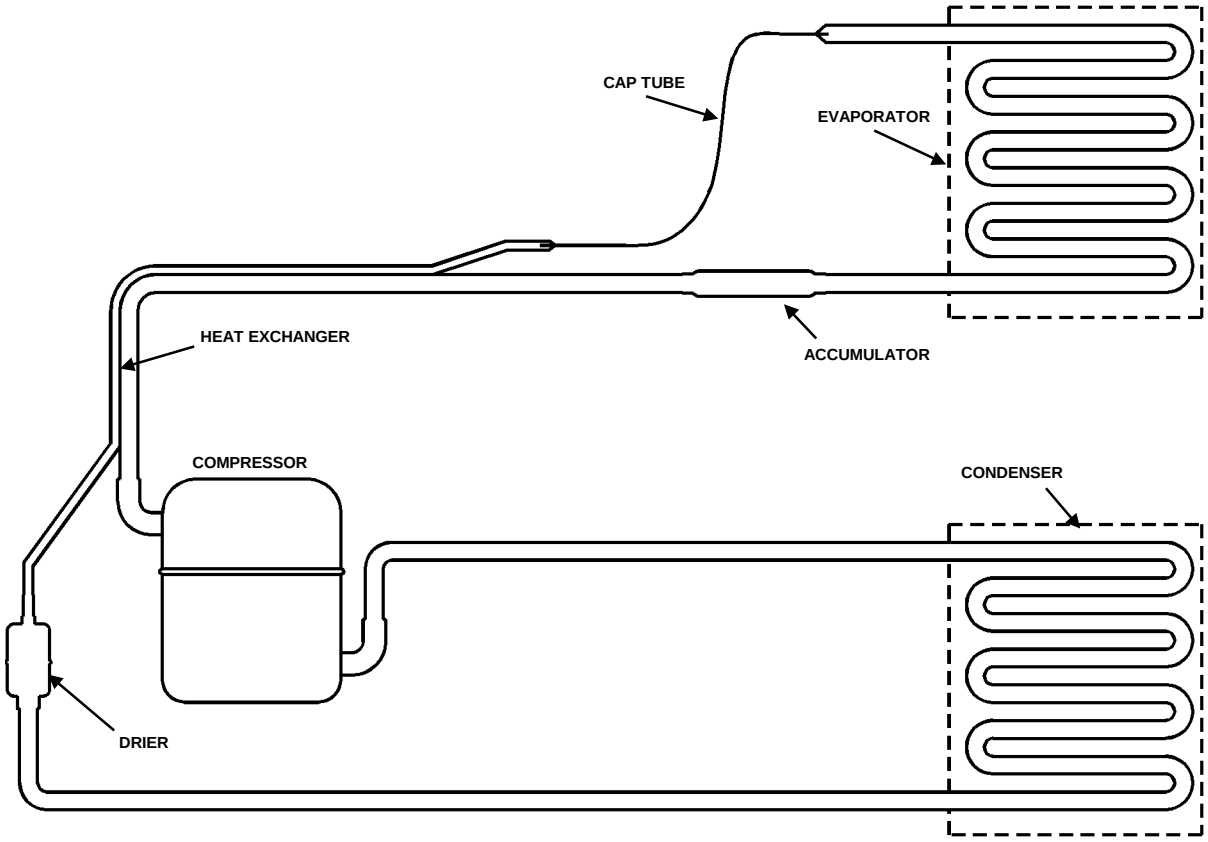
SV1529

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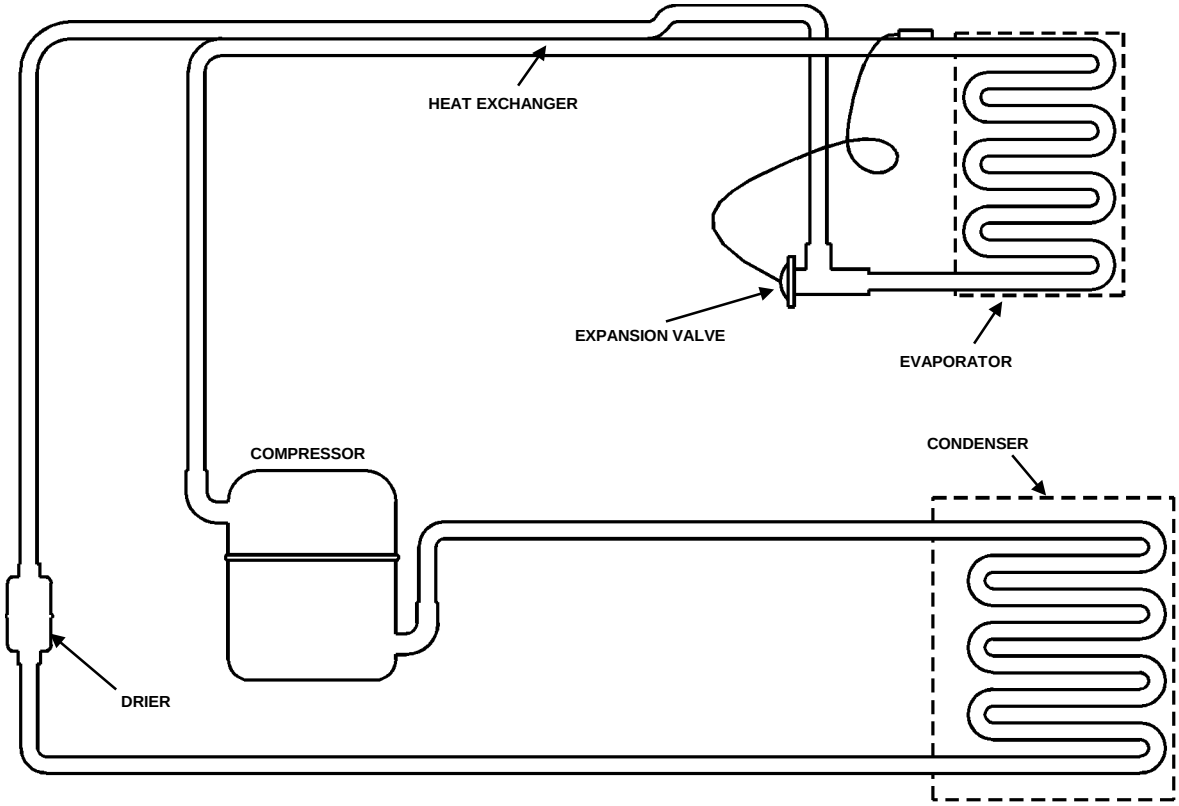
Section 6
Refrigeration System

Refrigeration Tubing Diagrams

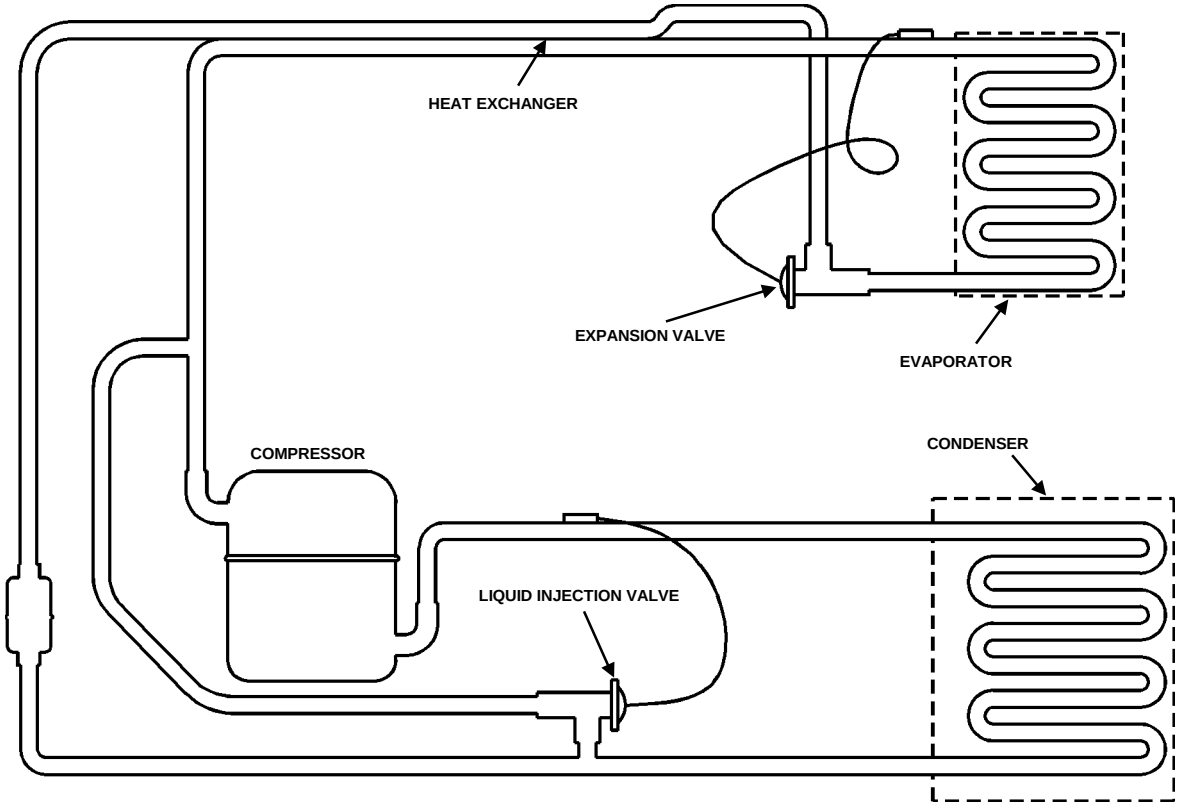
Refrigerators - Self-Contained - R1, R2, R3 and RS1, RS2, RS3



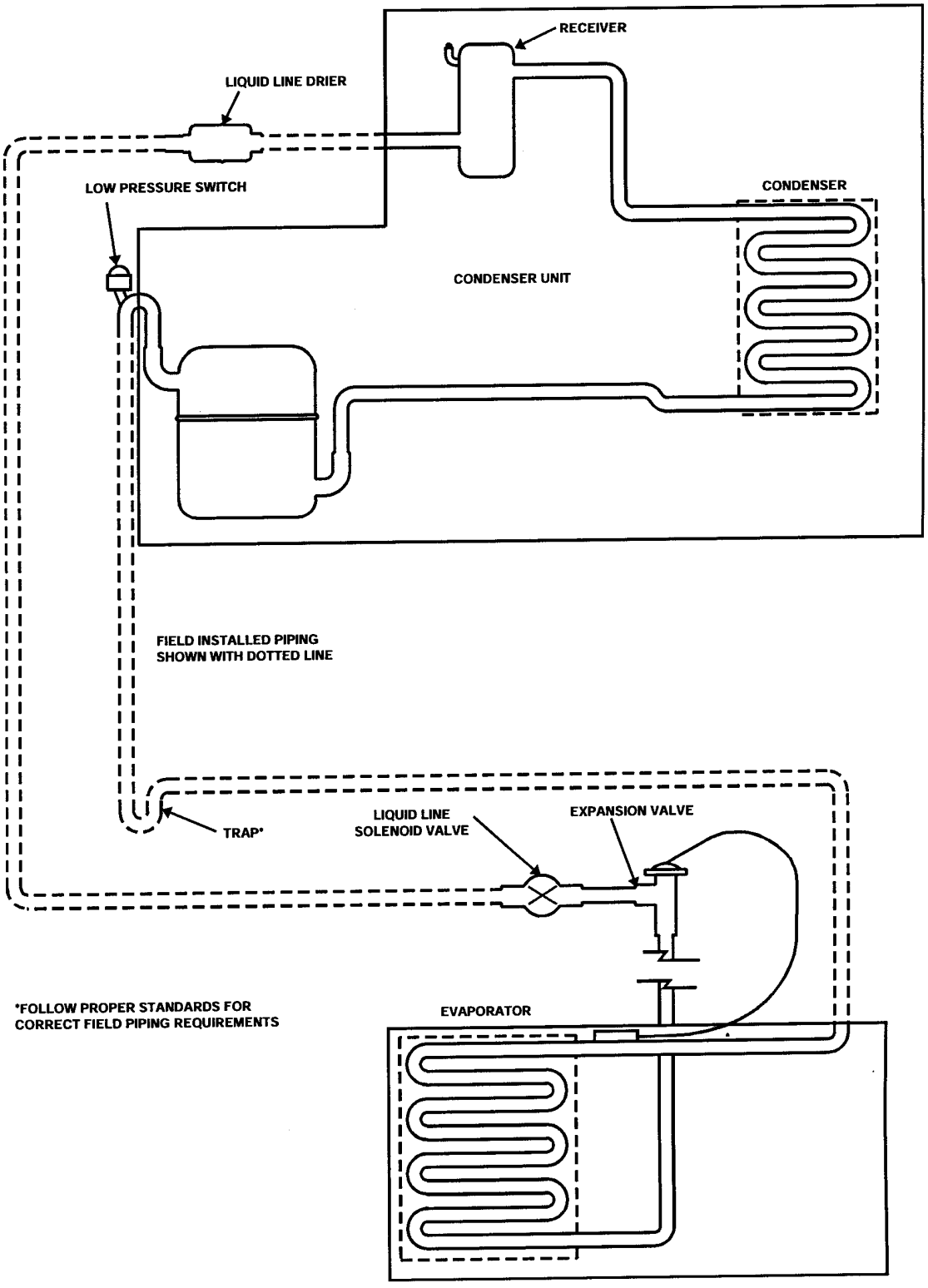
Freezers - Self-Contained - F1, F2, F3, and FS1, FS2, FS3 Without Liquid Injection Valve



Freezers - Self-Contained - FS1, FS2, FS3 With Liquid Injection Valve



Refrigerators and Freezers - Remote - RR1, RR2, RR3 and FR1, FR2, FR3



Refrigeration Specifications

	Self-Contained Refrigerators Using R-134a No Load (empty cabinet) / Door Heaters On /No Door Openings					
MODEL	**R1**		**R2**		**R3**	
Ambient Temperature Around Cabinet	50°F 10°C	100°F 37.8°C	50°F 10°C	100°F 37.8°C	50°F 10°C	100°F 37.8°C
Temperature Control Setting	3.0	3.0	3.0	3.0	3.0	3.0
% Run Time: **Solid Door** **Glass Door**	 20% 24%	 56% 61%	 27% 31%	 55% 69%	 24% 30%	 55% 69%
Average Interior Cabinet Temperature	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 35 10	 35 15	 38 2	 38 15	 35 8	 35 15
Discharge Pressure (psig) (Last 1/3 of cycle)	65-70	160-175	65-75	180-195	80-90	180-195
Heat of Rejection Air Conditioning Peak	2500 3100		3800 4700		6100 7500	
Compressor	1/4 HP		1/3 HP		1/2 HP	
Refrigerant Charge	8 oz.		11 oz.		13 oz.	

	Self-Contained Refrigerators Using R-402B (HP81) No Load (empty cabinet) / Door Heaters On /No Door Openings					
MODEL	**RS1**		**RS2**		**RS3**	
Ambient Temperature Around Cabinet	60°F 15.6°C	100°F 37.8°C	60°F 15.6°C	100°F 37.8°C	60°F 15.6°C	100°F 37.8°C
Temperature Control Setting	3.5	3.5	3.5	3.5	3.5	3.5
Maximum % Run Time:	19%	53%	29%	66%	27%	60%
Average Interior Cabinet Temperature	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 66 29	 88 52	 70 36	 91 52	 75 28	 76 41
Discharge Pressure (psig) (Last 1/3 of cycle)	180-200	340-360	180-200	340-360	195-215	295-320
Heat of Rejection Air Conditioning Peak	3100 3700		3600 4300		4500 5800	
Compressor	1/4 HP		1/3 HP		1/2 HP	
Refrigerant Charge	10 oz.		10.5 oz.		14.5 oz.	

	Self-Contained Refrigerators Using R-22 No Load (empty cabinet) / Door Heaters Off / No Door Openings					
MODEL	**RS1**		**RS2**		**RS3**	
Ambient Temperature Around Cabinet	60°F 15.6°C	100°F 37.8°C	60°F 15.6°C	100°F 37.8°C	60°F 15.6°C	100°F 37.8°C
Temperature Control Setting	7	7	5.5	5.5	5.5	5.5
Maximum % Run Time:	19%	62%	29%	66%	27%	69%
Average Interior Cabinet Temperature	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C	38°F 3.3°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 66 29	 66 37	 70 36	 70 43	 75 28	 76 41
Discharge Pressure (psig) (Last 1/3 of cycle)	160-175	270-285	160-175	270-285	195-215	295-320
Heat of Rejection Air Conditioning Peak	3100 3700		3600 4300		4500 5800	
Compressor	1/4 HP		1/3 HP		1/2 HP	
Refrigerant Charge	10 oz.		10.5 oz.		14.5 oz.	

	Remote Refrigerators Using R-134A, R-22, R-402B, R404A, R-507 No Load (empty cabinet) / Door Heaters On / No Door Openings		
MODEL	**RR1**	**RR2**	**RR3**
Ambient Temperature Around Cabinet	100°F 37.8°C	100°F 37.8°C	100°F 37.8°C
Minimum BTU/Hour Rating at 30°F/-1.1°C Evaporator	2500	3800	6300
Compressor	1/3 HP	1/2 HP	3/4 HP
Refrigerant Compatibility	The evaporators have pressure ratings compatible with: R-134A, R-22, R-402B, R404A, R-507		
Type of Expansion Valve Required	Internally Equalized		

	Self-Contained Freezers Using R-404a No Load (empty cabinet) / Door Heaters On / No Door Openings					
MODEL	**F1**		**F2**		**F3**	
Ambient Temperature Around Cabinet	50°F 10°C	100°F 37.8°C	50°F 10°C	100°F 37.8°C	50°F 10°C	100°F 37.8°C
Temperature Control Setting	3.0	3.0	3.0	3.0	3.0	3.0
% Run Time:	17%	70%	28%	79%	29%	70%
Average Interior Cabinet Temperature	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 34 15	 38 15	 38 15	 38 20	 34 15	 34 15
Discharge Pressure (psig) (Last 1/3 of cycle)	155-170	300-320	145-160	280-295	145-165	290-310
Heat of Rejection **Air Conditioning** **Peak**	 4100 5400		 5800 7700		 10400 13600	
Compressor	3/4 HP		1 HP		1-1/2 HP	
Refrigerant Charge	13 oz.		23 oz.		31 oz.	

	Self-Contained Freezers Using R-402B (HP81) No Load (empty cabinet) / Door Heaters Off / No Door Openings					
MODEL	**FS1**		**FS2**		**FS3**	
Ambient Temperature Around Cabinet	60°F 15.6°C	100°F 37.8°C	70°F 21.1°C	100°F 37.8°C	60°F 15.6°C	100°F 37.8°C
Temperature Control Setting	3	3	3	3	3	3
Maximum % Run Time:	35%	79%	55%	79%	45%	77%
Average Interior Cabinet Temperature	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 34 14	 34 14	 34 16	 35 18	 	 36 18
Discharge Pressure (psig) (Last 1/3 of cycle)	180-195	290-305	180-195	270-290		270-290
Heat of Rejection **Air Conditioning** **Peak**	 3200 4000		 5100 6400		 7200 8600	
Compressor	1/2 HP		3/4 HP		1 HP	
Refrigerant Charge	15 oz.		20 oz.		25 oz.	

	Self-Contained Freezers Using R-502 No Load (empty cabinet) / Door Heaters Off / No Door Openings					
MODEL	**FS1**		**FS2**		**FS3**	
Ambient Temperature Around Cabinet	60°F 15.6°C	100°F 37.8°C	70°F 21.1°C	100°F 37.8°C	70°F 21.1°C	100°F 37.8°C
Temperature Control Setting	3.25	3.25	5.5	5.5	3.25	3.25
Maximum % Run Time:	35%	79%	55%	79%	45%	77%
Average Interior Cabinet Temperature	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C	0°F -17.8°C
Suction Pressure: **Cut-in (psig)** **Cut-out (psig)**	 34 14	 34 14	 34 16	 35 18	 	 36 18
Discharge Pressure (psig) (Last 1/3 of cycle)	160-175	270-285	180-195	270-285		270-290
Heat of Rejection Air Conditioning Peak	3200 4000		5100 6400		7200 8600	
Compressor	1/2 HP		3/4 HP		1 HP	
Refrigerant Charge	15 oz.		20 oz.		20 oz.	

	Remote Freezers Using R-134A, R-22, R-402B, R404A, R-507 No Load (empty cabinet) / Door Heaters On /No Door Openings		
MODEL	**FR1**	**FR2**	**FR3**
Ambient Temperature Around Cabinet	100°F 37.8°C	100°F 37.8°C	100°F 37.8°C
Minimum BTU/Hour Rating at -10°F/-23.3°C Evaporator	3900	5100	9000
Compressor	3/4 HP	1 HP	1-1/2 HP
Refrigerant Compatibility	The evaporators have pressure ratings compatible with: R-134A, R-22, R-402B, R404A, R-507		The evaporator distributor is compatible with: R-402A, R402B, R404A, R-507
Type of Expansion Valve Required	Internally Equalized		Externally Equalized

Control Specifications and Diagnostics

High Pressure Cutout (HPCO) if applicable

FUNCTION

The high pressure cutout control turns the Reach-In unit off if it is subjected to excessive high side pressure. This control is normally closed (N.C.) and opens on a rise in pressure.

SPECIFICATIONS

Cut-out 440 psig +/- 10
Cut-in Manual reset (below 300 psig)

CHECK PROCEDURE

1. Set the ON/OFF switch to OFF.
2. Reset the HPCO if tripped.
3. Hook a voltmeter in parallel across the HPCO, leaving the wires attached.
4. Connect the manifold gauges.
5. Disconnect the condenser fan motor.
6. Set the ON/OFF switch to ON.
7. Lack of air flowing through the condenser will cause the HPCO to open. Watch the high pressure gauge. Record the pressure at which the cut-out occurs.

REPLACEMENT

Replace the HPCO if:

1. The control will not reset.

NOTE: High side pressure must be below 300 psig to enable the manual reset.

2. The control does not open at 440 psig +/- 10.

Liquid Injection Valve
(FS1, FS2, FS3 with R-402B [HP81] Only)

FUNCTION

The liquid injection valve injects saturated vapor into the suction line of the compressor. This is done to keep the discharge line temperature below 245°F (118°C).

SPECIFICATIONS

Valve Settings 237°F (+3°F/-2°F)
114°C (+1.6°C/-1.1°C)

VALVE FAILS CLOSED

Measure the temperature of the discharge line at the sensor bulb. If the temperature rises above specifications and the control does not open, replace the control.

VALVE FAILS OPEN

Suction pressure will be higher than normal. Liquid refrigerant flowing through the valve will “flash off,” causing frost on the suction line.

Refrigerant Conversion Procedures

Refrigerators - RS1, RS2, RS3
Converting R-402B to R-22

⚠ CAUTION
Use only R22 as a retrofit refrigerant. Other replacement refrigerants may cause poor performance and/or component failure.

Equipment Modification Requirements	
Component	Change Required
Compressor	None - No oil change Required
Capillary Tube	None
High Pressure Cutout	None
Fan Cycling Control (air-cooled)	None
Heat Exchanger	None
Electrical Wiring	None
Branch Circuit Fuse Size	None
Air-Cooled Condenser	None
Evaporator	None
Refrigerant Charge	Same amount as old R-402B charge

PERFORMANCE AFTER CONVERSION

- Operating discharge (high side) pressure - Air-cooled models will run 20-70 psig lower than with R-402B
- Operating suction (low side) pressure - Will run 0-20 psig lower than with R-402B
- Interior cabinet temperature - remains the same as with R-402B

Refer to R-22 specification chart on page 6-6.

PROCEDURE

1. Recover R-402B refrigerant from the Reach-In in accordance with local and national governing laws.
2. Refer to the "Equipment Modification Requirements" chart on this page.
3. Remove and replace the liquid line filter drier. Use only a Manitowoc-approved OEM filter drier.

NOTE: The compressor oil does not require changing.

4. Evacuate the Reach-In. (For procedure, refer to page 6-13.)
5. Charge the Reach-In with R-22 refrigerant. The system charge is identical to the R-402B (HP 81) charge listed on the model/serial number tag.

NOTE: Charge with liquid only into the high side of the Reach-In. Use the weighing in method or "Dial-a-Charge." Refer to page 6-14.

6. Remove the R-402B (HP 81) labels from the compressor and near the front of the control box. Do not remove the model/serial number tags.
7. Attach a conversion label next to each serial number plate and next to the service valves or the front of the control box.

Important
Write the service company name and conversion date on each label.

8. Start the Reach-In. Verify that it operates properly.

Freezers- FS1, FS2, FS3
(with Copeland compressors)
Converting R-502 to R-402B

⚠ CAUTION
Use only R-402B (HP 81) as a retrofit refrigerant. Other replacement refrigerants may cause poor performance and/or component failure.

Equipment Modification Requirements	
Component	Change Required
Compressor	None - No oil change Required
Expansion Valve-TXV	None
High Pressure Cutout	None
Fan Cycling Control (air-cooled)	None
All Solenoid Valves	None
Heat Exchanger	Refer to FS1, FS2 special instructions
Electrical Wiring	None
Branch Circuit Fuse Size	None
Air-Cooled Condenser	None
Evaporator	None
Refrigerant Charge	Same amount as old R-502 charge

PERFORMANCE AFTER CONVERSION

- Operating discharge (high side) pressure - Air-cooled models will run 10-30 psig higher than with R-502
- Operating suction (low side) pressure - Will run 1-3 psig higher than with R-502
- Interior cabinet temperature - remains the same as with R-502

Refer to R-402B (HP 81) specification chart on page 6-5.

PROCEDURE

1. Recover R-502 refrigerant from the Reach-In in accordance with local and national governing laws.
2. Refer to the "Equipment Modification Requirements" chart on this page. On FS1 and FS2 models, remove the heat exchanger prior to recharging. See next page.
3. Remove and replace the liquid line filter drier. Use only a Manitowoc-approved OEM filter drier.

NOTE: The compressor oil does not require changing.

4. Evacuate the Reach-In. (For procedure, refer to page 6-13.)
5. Charge the Reach-In with DuPont SUVA®HP81 refrigerant. The system charge is identical to the R-502 charge listed on the model/serial number tag.

NOTE: Charge with liquid only into the high side of the Reach-In. Use the weighing in method or "Dial-a-Charge." Refer to page 6-14.

6. Remove the R-502 labels from the compressor and near the front of the control box. Do not remove the model/serial number tags.

Continued on next page...

7. Attach a SUVA®HP81 conversion label (Part #8134983) next to each serial number plate and next to the service valves or the front of the control box.

Figure 6-1: DuPont SUVA®HP81 Conversion Label

IMPORTANT
This reach-in is converted to
DuPont Suva®HP81 (R402B) Refrigerant
in accordance with Manitowoc guidelines.
REFRIGERANT CHARGE
The Suva®HP81 charge remains the same as R-502 charge specified on the serial plate.
ELECTRICAL/PRESSURE RATINGS
All electrical and pressure ratings listed on serial plate remain the same.
Service Co. _____
Month _____ Year _____

Manitowoc Ice, Inc. 8134983

Important
Write the service company name and conversion date on each label.

8. Start the Reach-In. Verify that it operates properly.

HEAT EXCHANGER REMOVAL
(FS1 and FS2 models only)

⚠ CAUTION
Remove the entire system charge before proceeding.

1. Remove the insulation from the suction line liquid heat exchanger assembly. The liquid line has been soldered to the suction line for about 15" (38 cm).
2. Starting from the evaporator end, carefully remove the liquid line from the suction line. Use a pliers and a low flame torch.
3. Insulate the suction line. Run the removed liquid line along the outside of the suction line insulation.

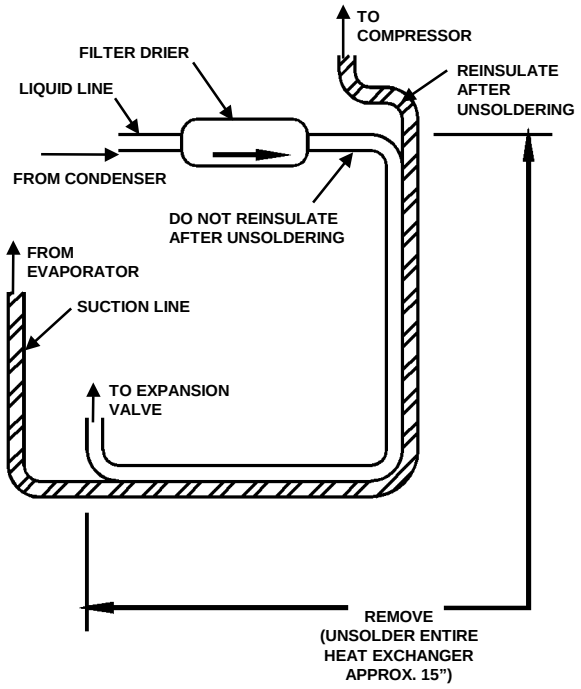


Figure 6-2: Heat Exchanger Removal

Refrigerant Recovery/Evacuation and Recharging

Refrigerant Recovery/Evacuation

Do not purge refrigerant to the atmosphere. Capture refrigerant using recovery equipment. Follow the manufacturer's recommendations.

Important

Manitowoc Ice, Inc assumes no responsibility for the use of contaminated refrigerant. Damage resulting from the use of contaminated refrigerant is the sole responsibility of the servicing company.

Important

Replace the liquid line drier before evacuating and recharging. Use only a Manitowoc (O.E.M.) liquid line filter drier to prevent voiding the warranty.

CONNECTIONS

1. Suction side of the compressor through the suction service valve.
2. Discharge side of the compressor through the discharge service valve.

SELF-CONTAINED RECOVERY/ EVACUATION

1. Place the main ON/OFF toggle switch in the OFF position.
2. Install manifold gauges, charging cylinder/scale, and recovery unit or two-stage vacuum pump.

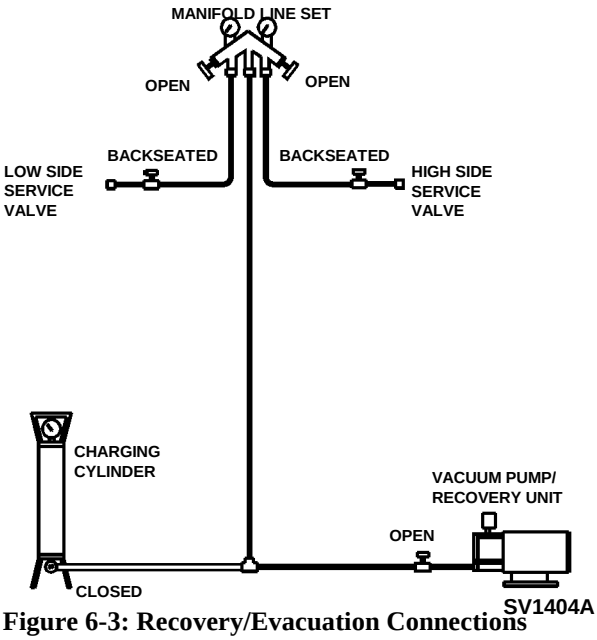


Figure 6-3: Recovery/Evacuation Connections

3. Open (backseat) the high and low side Reach-In service valves.
4. Perform recovery or evacuation:
   A. Recovery: Operate the recovery unit as directed by the manufacturer's instructions.
   B. Evacuation prior to recharging: Pull the system down to 250 microns. Then, allow the pump to run for an additional half hour. Turn off the pump and perform a standing vacuum leak check.

NOTE: Check for leaks using a halide or electronic leak detector after charging the Reach-In.

5. Follow the Charging Procedures on the next page.

Charging Procedures

Important

The charge is critical on all Manitowoc Reach-In units. Use a scale or a charging cylinder to ensure the proper charge is installed.

1. Be sure the main ON/OFF toggle switch is in the OFF position.

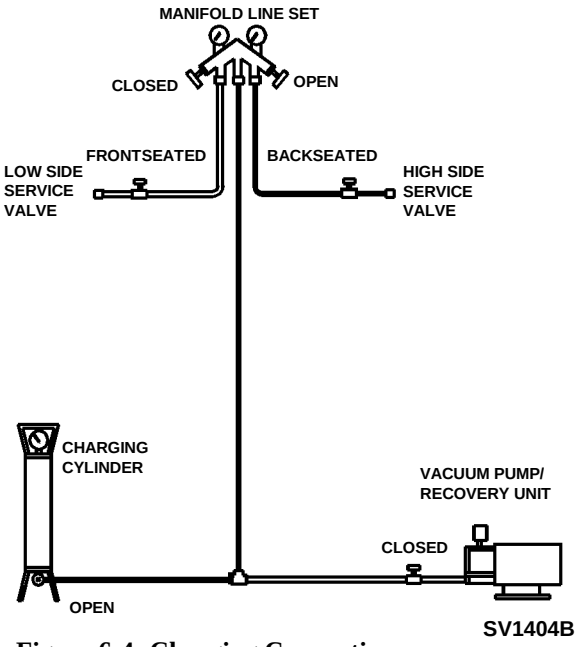


Figure 6-4: Charging Connections

2. Close the vacuum pump valve, the low side service valve, and the low side manifold gauge valve.
3. Open the high side manifold gauge valve and the high side service valve.
4. Open the charging cylinder and add the proper refrigerant charge (shown on nameplate) through the discharge service valve.
5. Let the system "settle" for 2 to 3 minutes.
6. Place the main ON/OFF toggle switch in the ON position.
7. Close the high side on the manifold gauge set. Add any remaining vapor charge through the suction service valve (if necessary).

NOTE: Manifold gauges must be removed properly to ensure that no refrigerant contamination or loss occurs.

8. Make sure that all of the vapor in the charging hoses is drawn into the Reach-In before disconnecting the charging hoses.
   A. Run the Reach-In in cooling mode.
   B. Close the high side service valve at the Reach-In.
   C. Open the low side service valve at the Reach-In.
   D. Open the high and low side valves on the manifold gauge set. Any refrigerant in the lines will be pulled into the low side of the system.
   E. Allow the pressures to equalize while the Reach-In is running.
   F. Close the low side service valve at the Reach-In.
   G. Remove the hoses from the Reach-In and install the caps.

System Contamination Cleanup

GENERAL

This section describes the basic requirements for restoring contaminated systems to reliable service.

Important

Manitowoc Ice, Inc assumes no responsibility for the use of contaminated refrigerant. Damage resulting from the use of contaminated refrigerant is the sole responsibility of the servicing company.

DETERMINING SEVERITY OF CONTAMINATION

System contamination is generally caused by either moisture or residue from compressor burnout entering the refrigeration system.

Inspection of the refrigerant usually provides the first indication of system contamination. Obvious moisture or an acrid odor in the refrigerant indicates contamination.

If either condition is found, or if contamination is suspected, use a Total Test Kit from Totaline or a similar diagnostic tool. These devices sample refrigerant, eliminating the need to take an oil sample. Follow the manufacturer's directions.

If a refrigerant test kit indicates harmful levels of contamination, or if a test kit is not available, inspect the compressor oil.

1. Remove the refrigerant charge from the Reach-In.
2. Remove the compressor from the system.
3. Check the odor and appearance of the oil.
4. Inspect the suction and discharge lines at the compressor for burnout deposits.
5. If no signs of contamination are present, perform an acid oil test.

Check the chart below to determine the type of cleanup required.

Contamination/Cleanup Chart

Symptoms/Findings	Required Cleanup Procedure
No symptoms or suspicion of contamination	Normal evacuation/recharging procedure
Moisture/Air Contamination symptoms • Refrigeration system open to atmosphere for prolonged periods • Refrigeration test kit and/or acid oil test shows contamination • Leak in water-cooled condenser • No burnout deposits in open compressor lines	Mild contamination cleanup procedure
Mild Compressor Burnout symptoms • Oil appears clean but smells acrid • Refrigeration test kit or acid oil test shows harmful acid content • No burnout deposits in open compressor lines	Mild contamination cleanup procedure
Severe Compressor Burnout symptoms • Oil is discolored and smells acrid • Refrigeration test kit or acid oil test shows harmful acid content • Burnout deposits found in the compressor and lines, and in other components	Severe contamination cleanup procedure

MILD SYSTEM CONTAMINATION CLEANUP PROCEDURE

1. Replace any failed components.
2. If the compressor is good, change the oil.
3. Replace the liquid line drier.

NOTE: If the contamination is from moisture, use heat lamps during evacuation. Position them at the compressor, condenser and evaporator prior to evacuation.

Important

Dry nitrogen is recommended for this procedure. This will prevent CFC release.

4. Follow the normal evacuation procedure, except replace the evacuation step with the following:
   A. Pull vacuum to 1000 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi.
   B. Pull vacuum to 500 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi.
   C. Change the vacuum pump oil.
   D. Pull vacuum to 250 microns. Run the vacuum pump for 1/2 hour on self-contained models, 1 hour on remotes.

NOTE: You may perform a standing vacuum test to make a preliminary leak check. You should use an electronic leak detector after system charging to be sure there is no leak.

5. Charge the system with the proper refrigerant to the nameplate charge.
6. Operate the Reach-In unit.

SEVERE SYSTEM CONTAMINATION CLEANUP PROCEDURE

1. Remove the refrigerant charge.
2. Remove the compressor.
3. Remove the liquid line drier.
4. Replace the TXV.
5. Wipe away any burnout deposits from suction and discharge lines at compressor.
6. Sweep through the open system with dry nitrogen.

Important

Refrigerant sweeps are not recommended, as they release CFC's into the atmosphere.

7. Install a new compressor and new start components.
8. Install a suction line filter-drier (with acid and moisture removal capability) of adequate size. Place the filter drier as close to the compressor as possible.
9. Install access valves at the inlet and outlet of the suction line drier.
10. Install a new liquid line drier.

Continued on next page...

11. Follow the normal evacuation procedure, except replace the evacuation step with the following:
    A. Pull vacuum to 1000 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi.
    B. Change the vacuum pump oil.
    C. Pull vacuum to 500 microns. Break the vacuum with dry nitrogen and sweep the system. Pressurize to a minimum of 5 psi.
    D. Change the vacuum pump oil.
    E. Pull vacuum to 250 microns. Run the vacuum pump for 1/2 hour on self-contained models, 1 hour on remotes.

NOTE: You may perform a standing vacuum test to make a preliminary leak check. You should use an electronic leak detector after system charging to be sure there is no leak.

12. Charge the system with the proper refrigerant to the nameplate charge.
13. Operate the Reach-In unit for one hour. Then, check the pressure drop across the suction line filter-drier.
    A. If the pressure drop is less than 1 psi, the filter-drier should be adequate for complete cleanup.
    B. If the pressure drop exceeds 1 psi, change the suction line filter-drier and the liquid line drier. Repeat Steps 8 through 13 until the pressure drop is acceptable.
14. Operate the Reach-In unit for 48-72 hours. Then, remove the suction line filter-drier and change the liquid line drier.
15. Follow normal evacuation procedures.

Replacing Pressure Controls Without Removing Refrigerant Charge

This procedure reduces repair time and cost. Use it when any of the following components require replacement, and the refrigeration system is operational and leak-free.

- High Pressure Cut-Out Control
- High Side Service Valve
- Low Side Service Valve

Important

This is a required in-warranty repair procedure.

1. Disconnect power to the Reach-In unit.
2. Follow all manufacturer's instructions supplied with the pinch-off tool. Position the pinch-off tool around the tubing as far from the pressure control as possible. (See Figure 6-5 on next page.) Clamp down on the tubing until the pinch-off is complete.

⚠ WARNING

Do not unsolder a defective component. Cut it out of the system. Do not remove the pinch-off tool until the new component is securely in place.

3. Cut the tubing of the defective component with a small tubing cutter.
4. Solder the replacement component in place. Allow the solder joint to cool.
5. Remove the pinch-off tool.
6. Re-round the tubing. Position the flattened tubing in the proper hole in the pinch off tool. Tighten the wingnuts until the block is tight and the tubing is rounded. (See Figure 6-5 on next page.)

NOTE: The pressure controls will operate normally once the tubing is re-rounded. Tubing may not re-round 100%.

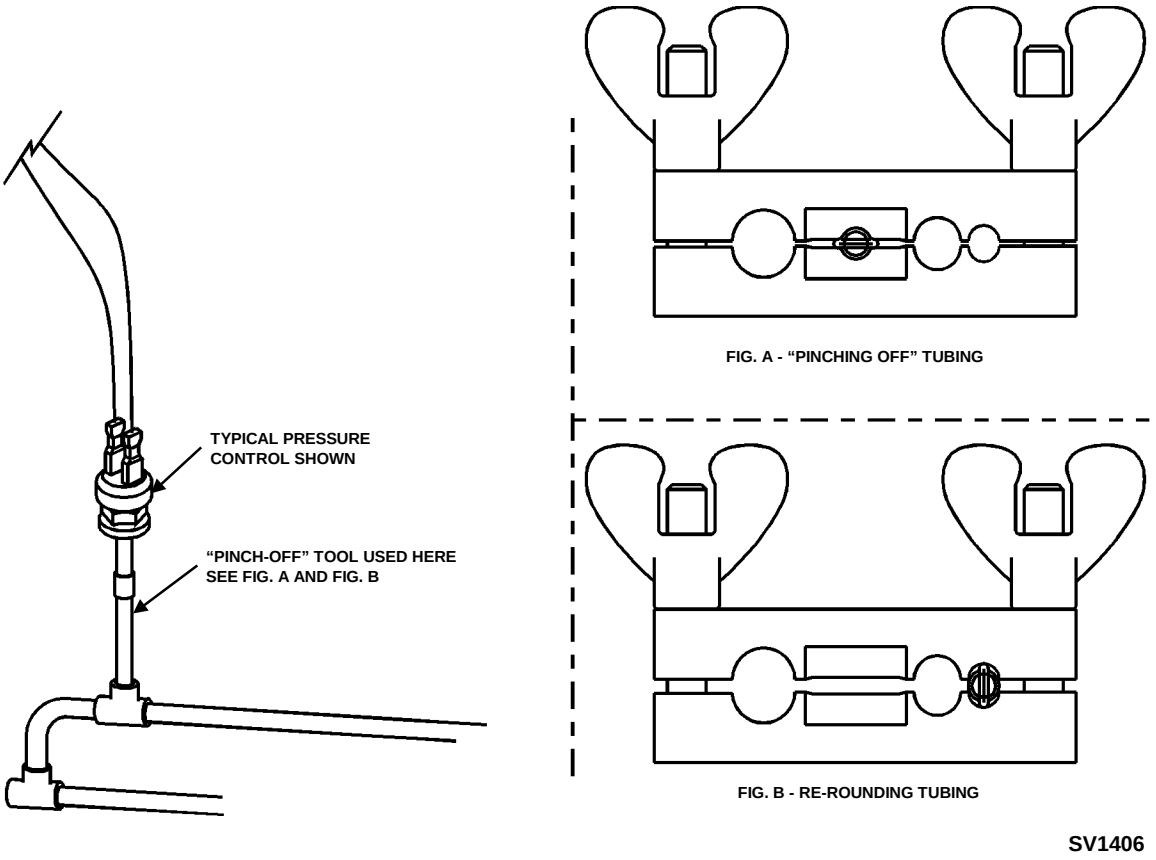


Figure 6-5: Using Pinch-Off Tool

Filter-Driers

The size of the filter-drier is important. Using an improperly sized filter-drier will cause the Reach-In unit to be improperly charged with refrigerant.

Manitowoc driers are compatible with CFC, HCFC, and HFC refrigerants.

Important

Driers are covered as a warranty part. Drier must be replaced any time the system is opened for repairs.

Total System Refrigerant Charges

Important
Refer to the Reach-In serial number tag to verify the system charge.

REFRIGERATORS - SELF-CONTAINED

Model	Charge	Refrigerant
R1	8 oz.	R-134A
R2	11 oz.	
R3	13 oz.	
CRS1	8 oz.	R-134A
CRS2	11 oz.	
CRG1	8 oz.	R-134A
CRG2	11 oz.	
RS1	10 oz.	R-402B
RS2	10.5 oz.	
RS3	14.5 oz.	
RS1	10 oz.	R-22
RS2	10.5 oz.	
RS3	14.5 oz.	

FREEZERS - SELF-CONTAINED

Model	Charge	Refrigerant
F1	15 oz.	R-4O4A
F2	20 oz.	
F3	25 oz.	
CFS1	15 oz.	R-4O4A
CFS2	20 oz.	
FS1	15 oz.	R-402B
FS2	20 oz.	
FS3	25 oz.	
CFS1	15 oz.	R-402B
CFS2	20 oz.	
FS1	15 oz.	R-502
FS2	20 oz.	
FS3	31 oz.	

REFRIGERATORS - REMOTE

Model	Charge and Refrigerant
RR1	Evaporator pressure ratings are compatible with: R-134A R-22 R402B
RR2	R-404A R507
RR3	Refrigerant charge varies depending on installation variables

FREEZERS - REMOTE

Model	Charge and Refrigerant
FR1	Evaporator pressure ratings are compatible with: R-134A[1] R-22[1]
FR2	R402B R-404A R507
FR3	Refrigerant charge varies depending on installation variables

[1]R-134A and R-22 are not compatible with model FR3.

Refrigerant Re-Use Policy
Manitowoc recognizes and supports the need for proper handling, re-use, and disposal of, CFC and HCFC refrigerants. Manitowoc service procedures require recapturing refrigerants, not venting them to the atmosphere.

It is not necessary, in or out of warranty, to reduce or compromise the quality and reliability of your customers' products to achieve this.

Important
Manitowoc Ice, Inc assumes no responsibility for use of contaminated refrigerant. Damage resulting from the use of contaminated, recovered, or recycled refrigerant is the sole responsibility of the servicing company.

Manitowoc approves the use of:

1. New Refrigerant
   - Must be of original nameplate type.

2. Reclaimed Refrigerant
   - Must be of original nameplate type.
   - Must meet ARI Standard 700 (latest edition) specifications.

3. Recovered or Recycled Refrigerant
   - Must be recovered or recycled in accordance with current local, state and federal laws.
   - Must be recovered from and re-used in the same Manitowoc product. Re-use of recovered or recycled refrigerant from other products is not approved.
   - Recycling equipment must be certified to ARI Standard 740 (latest edition) and be maintained to consistently meet this standard.
   - Recovered refrigerant must come from a "contaminant-free" system. To decide whether the system is contaminant free, consider:
     - Type(s) of previous failure(s)
     - Whether the system was cleaned, evacuated and recharged properly following failure(s)
     - Whether the system has been contaminated by this failure
     - Compressor motor burnouts and improper past service prevent refrigerant re-use.
     - Refer to "System Contamination Cleanup" on page 6-15 to test for contamination.

4. "Substitute" or "Alternative" Refrigerant
   - Must use only Manitowoc-approved alternative refrigerants.
   - Must follow Manitowoc-published conversion procedures.

Charging R-402B (HP81)
Using Charging Cylinders

1. Charge the cylinder with R-402B (HP81).
2. Read the pressure indicated on the charging cylinder gauge.
3. Using the R-502 scale, rotate the charging cylinder to the pressure listed below.

Pressure Reading on the Gauge	Rotate Dial to R-502 Scale
75-81	110
82-90	120
91-100	130
101-109	140
110-119	150
120-129	160
130-138	170
139-148	180
149-159	190
160-169	200
170-179	210
180-190	220
191-200	230
201-211	240
212-220	250

Refrigerant Definitions

RECOVER

To remove refrigerant, in any condition, from a system and store it in an external container, without necessarily testing or processing it in any way.

RECYCLE

To clean refrigerant for re-use by oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity and particulate matter. This term usually applies to procedures implemented at the field job site or at a local service shop.

RECLAIM

To reprocess refrigerant to new product specifications (see below) by means which may include distillation. A chemical analysis of the refrigerant is required after processing to be sure that product specifications are met. This term usually implies the use of processes and procedures available only at a reprocessing or manufacturing facility.

Chemical analysis is the key requirement in this definition. Regardless of the purity levels reached by a reprocessing method, refrigerant is not considered “reclaimed” unless it has been chemically analyzed and meets ARI Standard 700 (latest edition).

NEW PRODUCT SPECIFICATIONS

This means ARI Standard 700 (latest edition). Chemical analysis is required to assure that this standard is met.

Questions and Answers
R-402B (DUPONT SUVA HP81)

1. Is R-402B flammable?

No. It is U.L. and ASHRAE classified as "practically non-flammable." The same rating is given to R-22 and R-502. R-402B has an ignition temperature of 1185°F (641°C), which makes it less flammable than R-22, at 1169°F (632°C).

2. Is R-402B toxic?

The EPA exposure limit rating for R-402B is 1000 ppm, the highest rating given by the EPA for a refrigerant. R-402B carries the same rating as R-12, R-22 and R-502.

3. Is a special compressor oil required with R-402B?

No. Manitowoc products use standard mineral or alkylbenzene compressor oil with R-402B, the same as R-22 and R-502.

4. How do I leak-check a system containing R-402B?

Standard soap bubbles, halide torches, and standard electronic leak detectors work.

5. Do I have to recover R-402B?

Yes. Like other refrigerants, government regulations require recovering R-402B.

6. Will R-402B separate if I have a leak in the system?

No. Like R-502, the degree of separation is too small to detect.

7. How do I charge a system with R-402B?

The same as R-502. Manitowoc recommends charging only liquid refrigerant into the high side of the system.

8. Can I put R-402B into R-502 Reach-In freezers?

Yes. R-402B refrigerant can be used as an alternative replacement refrigerant in Manitowoc R-502 Reach-In freezers. Contact your Manitowoc distributor for a field conversion kit.

9. Where can I purchase R-402B?

DuPont refrigerants, including SUVA products, are available through more than 1,300 authorized distributors in the U.S.

10. Is special equipment required to service R-402B?

No. Standard refrigeration gauges, hoses, recovery systems, driers, vacuum pumps, etc. are compatible with R-402B.

HFC REFRIGERANT

Manitowoc uses R-404A and R-134A HFC refrigerants with ozone depletion potential (ODP) factors of zero (0.0). R-404A is used in Reach-In freezers and R-134A is used in Reach-In refrigerators.

1. What compressor oil does Manitowoc require for use with HFC refrigerants?

Manitowoc products use Polyol Ester (POE) type compressor oil. It is the lubricant of choice among compressor manufacturers.

2. What are some of the characteristics of POE oils?

They are hygroscopic, which means they have the ability to absorb moisture. POE oils are 100 times more hygroscopic than mineral oils. Once moisture is absorbed into the oil, it is difficult to remove, even with heat and vacuum. POE oils are also excellent solvents, and tend to "solvent clean" everything inside the system, depositing material where it is not wanted.

3. What do these POE oil characteristics mean to me?

You must be more exacting in your procedures. Take utmost care to prevent moisture from entering the refrigeration system. Keep oil containers and compressors capped at all times to minimize moisture entry. Before removing the system charge to replace a faulty component, be sure you have all of the needed components at the site. Refrigeration systems and compressors with POE oil should not be left open to the atmosphere for more than 15 minutes. Remove new system component plugs and caps just prior to brazing. Be prepared to connect a vacuum pump immediately after brazing.

4. Are there any special procedures required if a POE system is diagnosed with a refrigerant leak?

For systems found with positive refrigerant system pressure, no special procedures are required.

For systems found without any positive refrigerant pressure we will assume moisture has entered the POE oil. After the leak is found and repaired, the compressor oil must be changed. The compressor must be removed and at least 95% of the oil drained from the suction port of the compressor. Use a "measuring cup" to replace the old oil with exactly the same amount of new POE oil such as Mobil EAL22A. Remember, care must be taken to prevent moisture from getting into the refrigeration system during refrigeration repairs.

5. How do I leak-check a system containing HFC refrigerant?

Use equipment designed for HFC detection. Do not use equipment designed for CFC detection. Consult leak detection equipment manufacturers for their recommendations. Also, standard soap bubbles will work with HFC refrigerants.

6. Does Manitowoc use a special liquid line filter-drier with HFC refrigerants?

Yes. Manitowoc uses an ALCO "UK" series filter-drier for increased filtration and moisture removal. During a repair, Manitowoc recommends installing the drier just before hooking up a vacuum pump.

Continued on next page...

7. Is other special equipment required to service HFC refrigerants?

No. Standard refrigeration equipment such as gauges, hoses, recovery systems, vacuum pumps, etc., are generally compatible with HFC refrigerants. Consult your equipment manufacturer for specific recommendations for converting existing equipment to HFC usage. Once designated (and calibrated, if needed) for HFC use, the equipment should be used only with HFC refrigerants.

8. Do I have to recover HFC refrigerants?

Yes. Like other refrigerants, government regulations require recovering HFC refrigerants.

9. Will R-404A or R-134A separate if there is a leak in the system?

No. Like R-502, the degree of separation is too small to detect.

10. How do I charge a system with HFC refrigerant?

The same as R-502. Manitowoc recommends charging only liquid refrigerant into the high side of the system.

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Section 7
Diagnostics

Service Diagnostic Chart

Symptom	Possible Cause	Corrective Action
Reach-In does not run	Main ON/OFF switch is in the OFF position	Set the switch to the ON position
	Circuit breaker is tripped or fuse is blown	Reset the breaker or replace the fuse
	Voltage is too low	Correct the electrical service so it does not vary more than +/-10%
	High pressure cut-out (HPCO) control has tripped	
	• Condenser is dirty	• Clean the condenser
	• Refrigerant was overcharged	• Evacuate and recharge the system
	• High side refrigerant line or component is plugged	• Repair the line or replace the drier, evacuate and recharge the system
	• Condenser fan motor is not running	• Check the motor electrically, replace if defective
	• HPCO control is defective	• Check the control, replace if defective
	• Clearance around the unit is insufficient	• See **Clearance Requirements** on page 2-2
	• Condenser air is recirculating/ ambient temperature is above specification	• Make sure air temperature at the condenser inlet is within specification
(Freezers Only)	• Expansion valve (TXV) does not limit suction pressure	• Replace the TXV
(Freezers Only)	• Liquid injection valve is overfeeding	• See **Liquid Injection Valve** on page 6-9
(Freezers Only)	• Defrost end/ fan delay thermostat is defective	• Check the control, replace if defective
	Relay has de-energized	
	• HPCO control has tripped	• Check the control
	• Coil on relay is defective	• Measure the voltage at the coil, replace if defective
(Freezers Only)	• Automatic defrost time clock is defective	• Check the clock, replace if defective

Symptom	Possible Cause	Corrective Action
Cabinet does not maintain proper temperature	Temperature control problem	
	• Control setting is incorrect	• Set the control to the desired setting
	• Control is defective	• Check the control, replace if defective
	Condenser coil is dirty	Clean the condenser
	Evaporator coil is frozen	
	• Air flow is restricted	• Arrange product for proper interior air flow, check the evaporator coil for debris
	• Refrigerant charge is low	• Find and repair any leaks, replace the drier, evacuate and recharge the system
	• Vacuum relief is leaking	• Check for leaks, repair or replace as necessary
	• Evaporator drain line is not trapped/no water in trap	• Check the trap
	• Evaporator fan motor is not running	• Check: • fan motor • light/fan switch • automatic defrost time clock (freezers only) • defrost end/fan delay thermostat (freezers only)
	• Door is open/gasket is not sealing properly	• Close door, repair or replace gasket as necessary
(Refrigerators Only)	• Cap tube is incorrectly positioned	• Reposition the cap tube
(Refrigerators Only)	• Cap tube is restricted	• Check the tube, repair or replace as necessary
(Freezers Only)	• Insufficient number of defrost settings	• Defrost the evaporator coil, then add another defrost cycle pin to the automatic defrost time clock
(Freezers Only)	• Calrod defrost heater is not energizing	• Check the automatic defrost and the calrod heater
	Refrigeration problem	Refer to **Refrigeration Specifications** on page 6-5

Symptom	Possible Cause	Corrective Action
Compressor does not operate NOTE: Eliminate all possible causes under "Unit Does Not Run" on page 7-1 before diagnosing the compressor.	Wiring problem	Check for and correct any incorrect wiring and loose or open connections
	Start relay is defective	Check the start relay, replace if necessary
	Start capacitor is defective	Check the start capacitor, replace if necessary
	Compressor is defective	Check the compressor, replace if necessary
	Overload open • Condenser is dirty • Refrigerant was overcharged • High side refrigerant line or component is plugged • Condenser fan motor is not running • Voltage is too low	 • Clean the condenser • Evacuate and recharge • Repair the line or change the drier, evacuate and recharge • Check the motor electrically, replace if defective • Correct the electrical service so it is within +/-10% of nameplate rating at start-up
Condensation on cabinet and/or floor	Glass door is sweating	Reduce the relative humidity in the installation location; see chart on page 8-12
	Mullion heater problem • Switch is de-energized • Heater is defective	 • Energize the switch • Check the heater, replace if defective
	Trap is outside of the condensate drain pan	Move the trap inside the drain pan area
	Gasket on door or head section is not sealing properly	Repair or replace gasket as necessary
	Condensate vaporizer is de-energized	Check the vaporizer
Door(s) difficult to open	No vacuum relief valve installed	Install vacuum relief valve
	Vacuum relief valve is not functioning	Check the component, replace if defective
	Incorrect or defective casters	Test caster locks, no more than two may swivel; contact the factory for further assistance

Component Function/Specifications/Check Procedures

Main On/Off Switch

FUNCTION

Switches power to the reach-in on and off.

SPECIFICATIONS

Double pole single throw (DPST)

CHECK PROCEDURES

1. Check for proper line voltage (+/- 10%).
2. Inspect the switch for proper wiring.
3. Inspect the terminals for clean, tight connections.
4. Check across the switch terminals with a voltmeter. Replace the switch if you do not obtain the results below:

Switch Position	Voltage
On	0
Off	line

Relay (if applicable)

FUNCTION

De-energizes the compressor if the high pressure cut-out switch were to open

CHECK PROCEDURES

1. Disconnect power to the reach-in.
2. Disconnect wires from the relay and check continuity at the terminals . Replace the relay if you do not obtain the results below:

Terminals	Continuity
4 and 6 (contact normally open)	no
0-1 (coil)	yes

Temperature Control

FUNCTION

Opens and closes to start and stop the compressor and condenser fan(s) to maintain a constant cabinet temperature.

SPECIFICATIONS

Refrigerator

12° to 45° 16° differential

Freezer

-20° to +10° 10° Differential

CHECK PROCEDURES

If the reach-in continues to run in the cooling cycle:

1. Turn the temperature control to the warmest setting.
2. Hook a voltmeter across the temperature control terminal leads.
3. If the voltmeter reads line voltage, the control has opened and is functioning normally. If the control fails to open, replace it.

If the reach-in does not run:

1. Disconnect electrical power supply.
2. Turn the temperature control to the coldest setting.
3. Isolate the temperature control and hook an ohmmeter across the terminals.
4. If the ohmmeter registers continuity, the control is good. See **Service Diagnostic Chart**, “Reach-In Does Not Run” on page 7-1. If there is no continuity, replace the control. See next page.

REFRIGERATOR SENSING BULB LOCATION

All reach-in refrigerators must have the sensing bulb installed in the evaporator coil, regardless of the original thermostat bulb location. Failure to do so will cause the evaporator coil to frost up.

Angle the cap tube as you insert the sensing bulb. Insert the sensing bulb exactly 6” into the evaporator coil. When replacing a thermostat, be sure to seal the hole in the top of the cabinet through which the sensing bulb is inserted.

FREEZER SENSING BULB LOCATION

All reach-in freezers must have the cap tube mounted without coils or kinks, to sense the air temperature entering the evaporator coil.

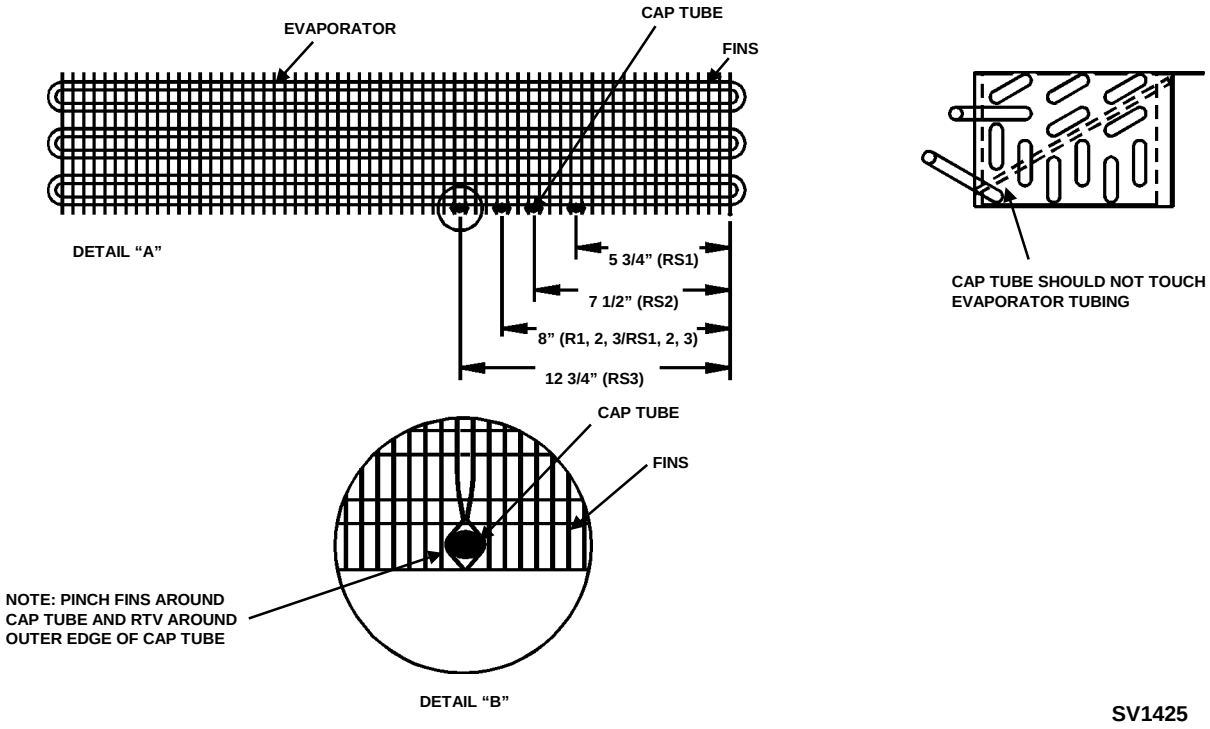


Figure 7-1: Sensing Bulb Location

Light/Fan Switch(es)

FUNCTION for refrigerators (R1, R2, R3, RS1, RS2, RS3, RR1, RR2, RR3)
Turns the interior cabinet light on as the reach-in door is opened.

FUNCTION for freezers (F1, F2, F3, FS1, FS2, FS3, FR1, FR2, FR3)
Turns the evaporator fans off and the interior cabinet light on as the reach-in door is opened.

SPECIFICATIONS
Push button switch (2 circuit)

CHECK PROCEDURES

1. Check for proper line voltage (+/- 10%).
2. Inspect the switch for proper wiring.
3. Inspect the terminals for clean, tight connections.
4. Check across the switch terminals with a voltmeter. Replace the switch if you do not obtain the results below:

Door Position	N.O. Contacts	N.C. Contacts
Closed	0	line
Open	line	0

SELF-CONTAINED REFRIGERATOR FAN MOTOR WIRING CHANGE
The evaporator fan motor(s) on the units listed below must be modified.

The evaporator fan(s) must run continuously, including while the door is open. Otherwise, frost will form on the evaporator coil.

For models BEFORE serial number:

Model	Serial Number
RS1	931080000
RS2	930580000
RS3	930380000

1. Unplug the fan motor wire from terminal board connection #8.
2. Plug it into terminal board connection #1.

For models AFTER serial number:

Model	Serial Number
RS1	931080000
RS2	
RS3	

1. Disconnect evaporator fan lead #65 from the terminal board and plug it in to connection TB30.
2. Disconnect evaporator fan lead #66 from the terminal board and plug it in to connection TB31.

Defrost End and Fan Delay Thermostat (Freezers Only)

FUNCTION

Terminates the defrost cycle, and delays the start of the evaporator fan(s) after defrost.

SPECIFICATIONS

Model	N.C. Position	N.O. Position
F1 FR1	30°F (-1.1°C)	80°F (26.7°C)
F2 FR2 F3 FR3	30°F (-1.1°C)	50°F (10°C)
FS2 FS3	30°F (-1.1°C)	50°F (10°C)
FS1 (After 920880000)	35°F (1.7°C)	55°F (12.8°C)
FS1 (Before 920880000)	35°F (1.7°C)	80°F (26.7°C)

CHECK PROCEDURES

1. Hook a voltmeter across the N.O. terminals. If, during the defrost cycle, the bimetal disc does not open when the evaporator reaches the specified temperature, replace the thermostat.
2. Hook a voltmeter across the N.C. terminals. If, after the defrost cycle, the bimetal disc does not close when the evaporator coil reaches the specified temperature, replace the thermostat.

Automatic Defrost Time Clock

(Freezers Only: F1, F2, F3, FS1, FS2, FS3, FR1, FR2, FR3)

FUNCTION

Initiates the defrost cycle at preset times to prevent evaporator frost buildup.

CHECK PROCEDURES

1. Inspect the terminals for clean, tight connections.
2. Verify that correct line voltage is at terminals X and 3.

Voltage at Terminals X and 3	Action
Correct Line Voltage	If 24-hour dial is not turning, replace automatic defrost time clock
None	Restore line voltage

3. Hook a voltmeter across the switch terminals. Verify the readings below. If you do not get these readings, replace the defrost timer:

Cycle	Terminals	Expected Reading
Cooling	2 and 4	0 volts - closed
	3 and N	0 volts - closed
	3 and 1	Line volts - open
Start of Defrost	2 and 4	Line volts - open
	3 and N	Line volts - open
	3 and 1	0 volts - closed

Continued on next page...

FREEZER DEFROST TIMER SETTINGS

To set the time, grasp the knob in the center of the inner two-hour dial. Turn it counterclockwise to rotate the outer dial. Line up the current time of day on the outer dial with the time pointer.

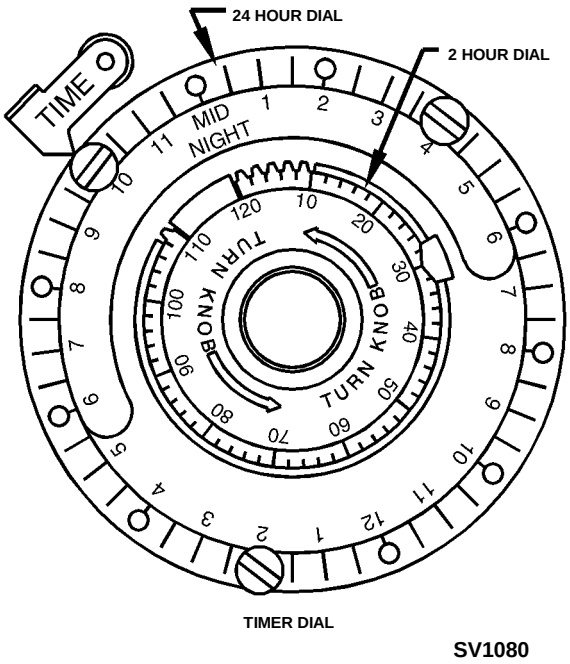


Figure 7-2: Freezer Defrost Timer

The freezer defrost timer is preset for three defrost cycles every 24 hours. To add and/or change defrost times:

1. Remove the pins from the outer (large) dial.
2. Insert the pins into the desired time slots.
3. Adjust the defrost times to maintain equal operational periods between defrosts.

⚠ CAUTION

Leave at least one hole between adjacent pins.

ADJUSTING DEFROST SAFETY TERMINATION

The defrost cycle is normally terminated by a thermodisc. It is automatically terminated if a system malfunction occurs.

The backup defrost termination is preset at the factory for a 30-minute defrost cycle. Normally, no adjustment is needed.

The backup safety defrost length can be reset by pressing down on the inner pointer and rotating until it is aligned with the desired safety time.

Defrost Heater (Calrod Heater) (Freezers Only)

FUNCTION

Defrosts the evaporator coil and warms the drain pan to allow any moisture to drain out.

SPECIFICATIONS*

Model	Volt	Amp	Watt	Ohm
F1, FS1, FR1	115	5.22	600	18-24
F2, FS2, FR2	115	11.4	1430	8-12
F3, FS3, FR3	208/230	6.3	1440	34-39

*Listed ohm values are at room temperature.

CHECK PROCEDURES

1. Turn off the electric power to the reach-in freezer.
2. Disconnect the leads to the defrost heater and check across with an ohmmeter. See Specifications (above) for ohm values.

Results of Check	Action
Continuity and ohm value within specifications	Element is OK
No continuity	Replace the element
Ohm value not within specifications	Replace the element

See page 8-3 for replacement procedures.

Mullion (Door Frame) Heater

FUNCTION

Prevents condensation (sweating) on cabinet and door surfaces.

SPECIFICATIONS*

Heater Type	Ohm Reading (+/- 10%)
3.5 Watt/120 Volt	295
3.5 Watt/240 Volt	1172
5.0 Watt/120 Volt	205
5.0 Watt/240 Volt	820

*Listed ohm values are at 77°F (25°C).

NOTE: All replacement mullion heaters and all mullion heaters after serial number 951170022 are 5.0 watts.

CHECK PROCEDURES

1. Turn off the electric power to the reach-in.
2. Disconnect the mullion heater leads. Check with an ohmmeter. See Specifications (above) for ohm values.

Results of Check	Action
Continuity and ohm value within specifications	Heater is OK
No continuity	Replace the heater
Ohm value not within specifications	Replace the heater

See page 8-4 for replacement procedures.

CONDENSATION ON GLASS DOORS

Glass door refrigerators use two-pane reflective, non-heated glass (NHG). Condensation will form on the glass if the unit is installed in a high humidity area.

Atmospheric conditions vary depending on specific operating conditions. Use the chart below as a guideline when selecting an installation space.

Room Temperature	Relative Humidity
70°F/21.1°C	76%
75°F/23.9°C	72%
80°F/26.7°C	69%
85°F/29.4°C	67%
90°F/32.2°C	65%

*Based on interior cabinet temperature of 38°F/3.3°C.

Mullion (Door Frame) Heater Switch (Refrigerator Only)
NOTE: On a freezer, the door heater wire is connected directly to the power supply. It will be on any time the main power supply switch is on.

FUNCTION
Energizes mullion heaters to prevent condensation (sweating) on cabinet and door surfaces.

SPECIFICATIONS
Single pole single throw (SPST)

CHECK PROCEDURES
1. Check for proper line voltage (+/- 10%).
2. Inspect the switch for proper wiring.
3. Inspect the terminals for clean, tight connections.
4. Check across the switch terminals with a voltmeter. Replace the switch if you do not obtain the results below:

Switch Position	Voltage
On	0
Off	line

Drain Tube Heater (Freezer Only)
FUNCTION
Prevents frost and ice from accumulating in the drain tube.

SPECIFICATIONS*

Heater Type	Ohm Reading
10 Watt/120 Volt	1200 - 1343
10 Watt/240 Volt	5400 - 6600

*Listed ohm values are at 77°F (25°C).

CHECK PROCEDURES
1. Turn off the electric power to the reach-in freezer.
2. Disconnect the leads to the drain tube heater. Check with an ohmmeter. See Specifications (above) for ohm values.

Results of Check	Action
Continuity and ohm value within specifications	Heater is OK
No continuity	Replace the heater
Ohm value not within specifications	Replace the heater

See page 8-5 for replacement procedures.

Condensate Vaporizer Pan
FUNCTION
Vaporizes evaporator condensate if a floor drain is unavailable.

SPECIFICATIONS
120 volts, 1.3 amps

CHECKOUT PROCEDURES
1. Verify that power is supplied to the unit.
2. Check the heater amps. If the reading is not as specified above, replace the heater.

Diagnosing Compressor and Start Components Electrically

General

Perform the following tests, in sequence, using a quality calibrated volt-meter.

Important

Refer to the proper wiring diagram during each test.

1. Verify that the electric power to the reach-in at compressor start-up is +/- 10% of the line voltage rating.
2. Verify that the following control components are in the closed position if the compressor does not try to start:
   - Main ON/OFF switch
   - High pressure cutout control
   - Temperature control
   - Relay
   - Defrost time clock contact #4 (freezer only)

⚠ WARNING

Disconnect electric power to the reach-in and the electric service switch box before proceeding with the following steps.

External Overload Check

Check the continuity of the external overload protector. If the compressor has an internal overload protector, skip this test.

1. Disconnect the overload wires from other components.
2. Check the continuity of the overload protector:

Results of Check	Action
Continuity	Overload protector is OK
No continuity	Allow the compressor to reach room temperature and check again
No continuity at room temperature	Replace the overload protector

Start Relay Check

CURRENT RELAY

1. Disconnect the wires from the start relay. If the relay must be moved, keep it upright.
2. Check continuity at the contact terminals. Refer to wiring diagram for terminal identification.

Results of Check	Action
Continuity	Replace the relay
No continuity	Relay is OK

3. Check continuity at the relay coil terminals. Refer to wiring diagram for terminal identification.

Results of Check	Action
Continuity	Relay is OK
No continuity	Replace the relay

POTENTIAL RELAY

1. Disconnect the wires from the start relay.
2. Check continuity between terminals 1 and 2. (Normally open)

Results of Check	Action
Continuity	Replace the relay
No continuity	Relay is OK

3. Check the continuity between terminals 5 and 1. (Coil)

Results of Check	Action
Continuity	Relay is OK
No continuity	Replace the relay

Compressor Windings
NOTE: The compressor must be at room temperature.

1. Disconnect the wires from the compressor terminals.
2. Check the resistance between terminals C and R:

Results of Check	Action
Resistance	See step 5 below
No resistance	1. Verify external overload is closed. 2. Run winding is open; replace compressor.

3. Check the resistance between terminals C and S:

Results of Check	Action
Resistance	See step 5 below
No resistance	Start winding is open; replace compressor

4. Check the resistance between terminal C and the compressor shell:

Results of Check	Action
Resistance	compressor is grounded; replace compressor
No resistance	compressor is not grounded - OK

5. Check the resistance of the windings. The resistance reading between terminals S and R should equal the readings between terminals C and R, and terminals C and S added together:

S to R = C to R + C to S

Capacitor Check
Capacitors may show visual evidence of failure, such as a bulged terminal end or a ruptured membrane. However, do not assume a capacitor is good just because there are no visual signs of failure.

An effective test is to disconnect the leads from the capacitor and connect them to a known good capacitor.

Use a capacitor analyzer when checking a suspect capacitor. Follow the instructions supplied with the analyzer.

If these capacitor tests prove satisfactory but the compressor still fails to start, replace the start relay. The new start relay will eliminate any faulty electrical characteristics, such as improper pick-up or drop-out, which cannot be determined by the tests.

If the new start relay fails to correct the problem, consider the compressor inoperative due to internal defects. Replace the compressor.

Section 8
Component Replacement Procedures

Accessing Evaporator Assembly

1. Disconnect electrical power to the reach-in.
2. Remove the two screws on the drain tube.
3. Lift up on the refrigeration section until the evaporator drain clears the drain tube.
4. Turn the drain tube to the left.
5. Loosen the thumb screws on the front of the evaporator drain pan. Lower the drain pan.

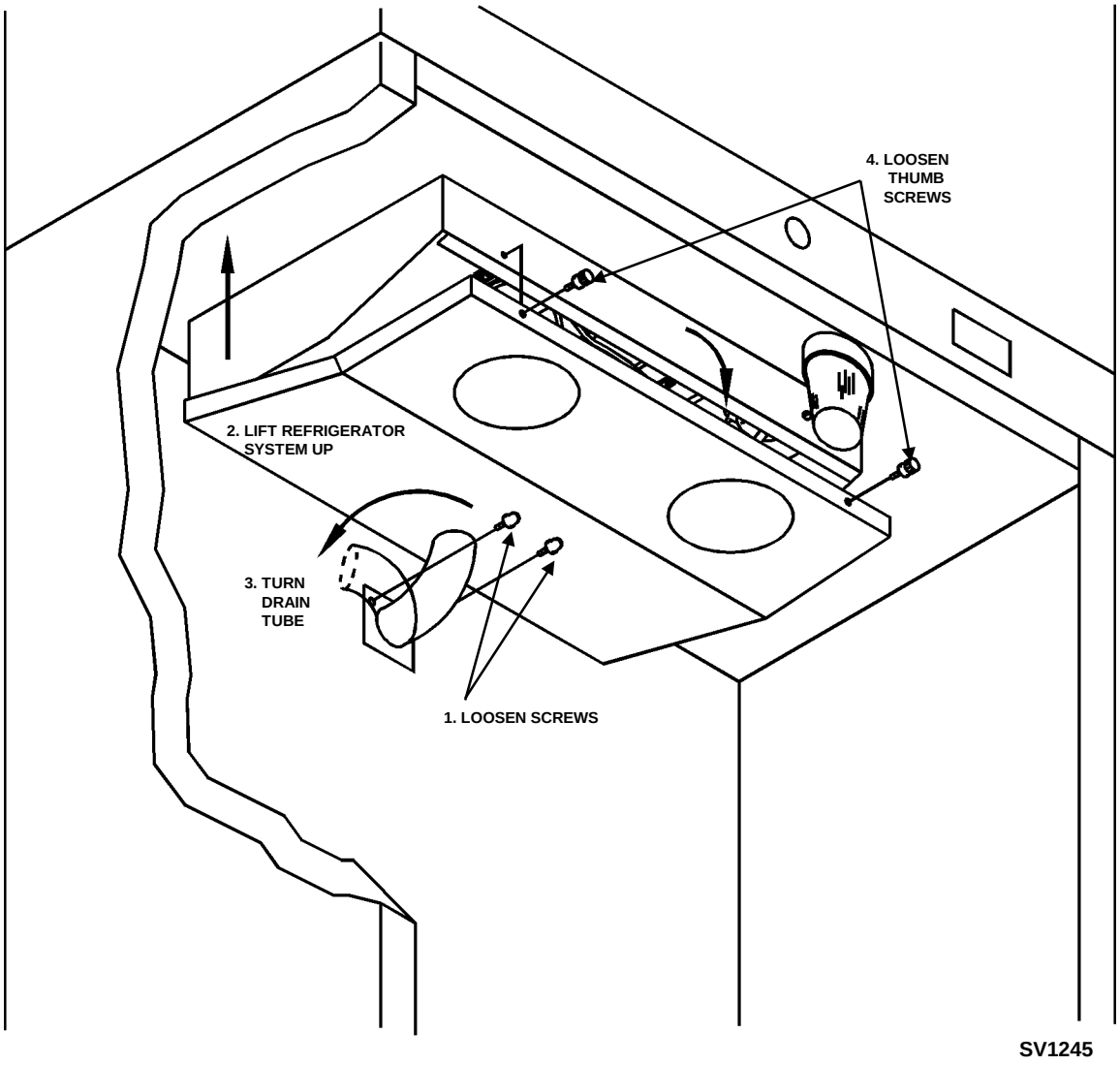


Figure 8-1: Accessing Evaporator Assembly

Evaporator Fan(s)

1. Disconnect electrical power to the reach-in.
2. Lower the evaporator drain pan (see page 8-1).
3. Unplug the fan motor.
4. Remove the evaporator fan bracket screws.
5. Pull the fan blade off the motor shaft and remove the fan motor from the bracket.

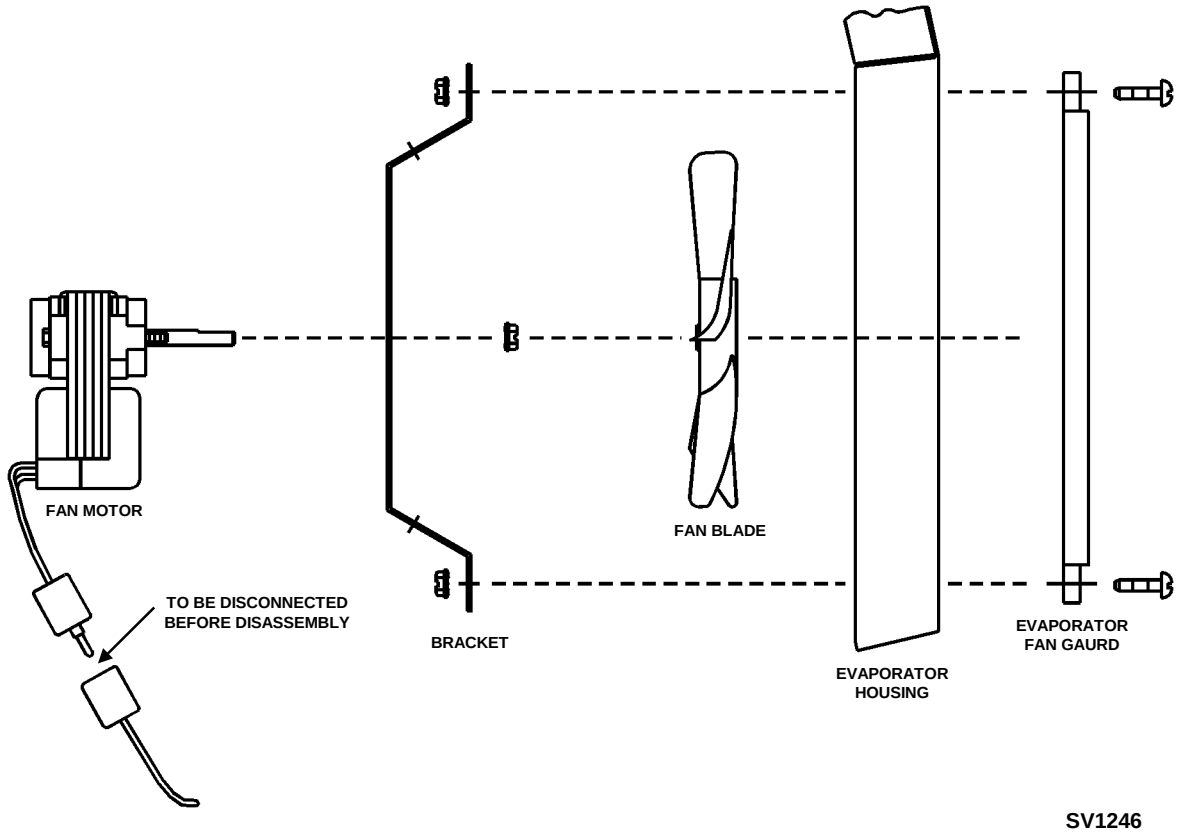


Figure 8-2: Evaporator Fan(s)

Evaporator Defrost (Calrod) Heater (Freezer Only)

1. Disconnect electrical power to the reach-in.
2. Lower the evaporator drain pan (see page 8-1).
3. Unplug the calrod heater at the terminal board and the automatic defrost timer.
4. Carefully pull out the clips and remove the calrod heater.

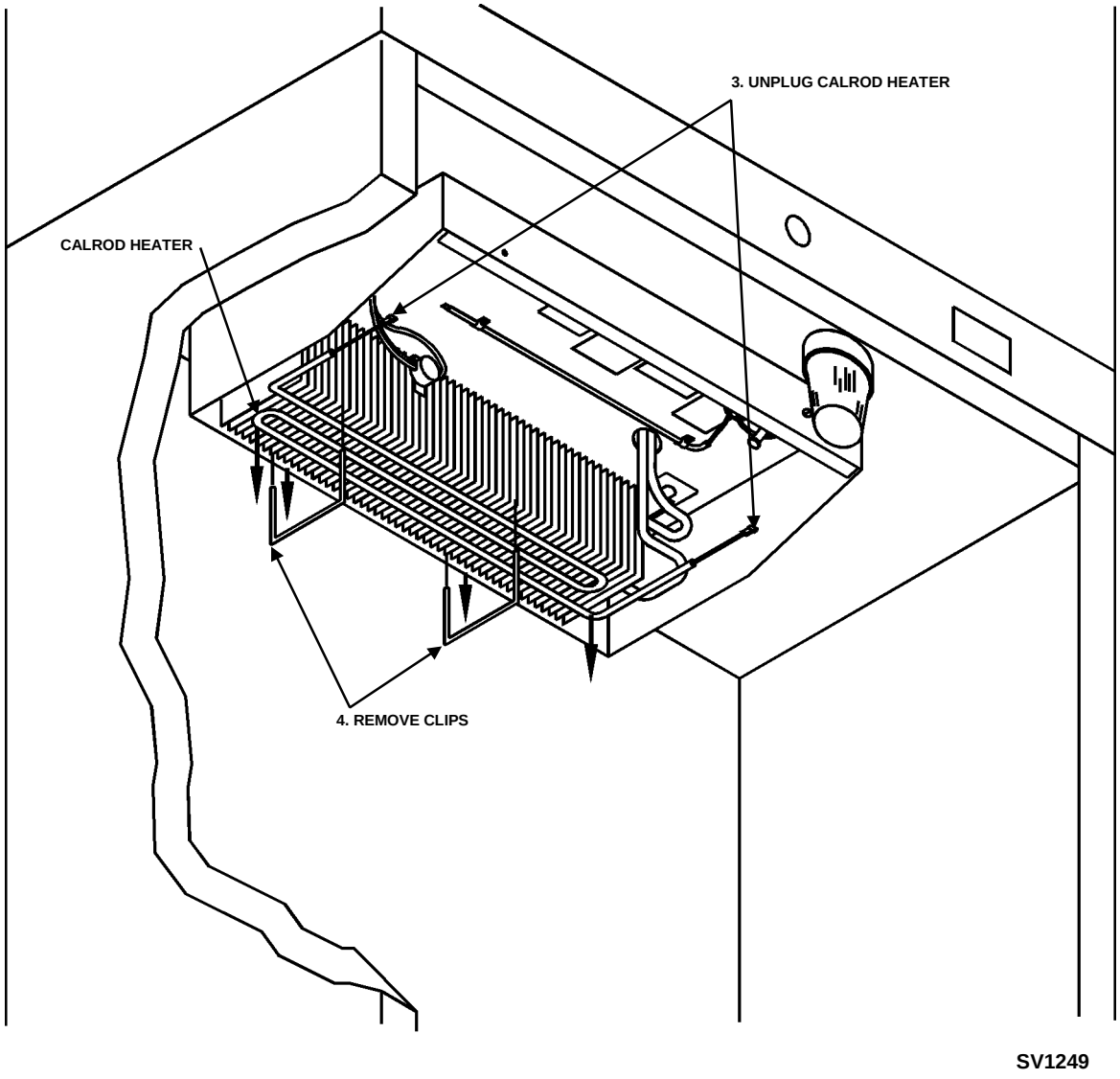


Figure 8-3: Evaporator Defrost (Calrod) Heater

Mullion (Door) Heater

1. Disconnect electrical power to the reach-in.
2. Remove the lock rail cover.
3. Unplug the spade connectors from the door heater.
4. Carefully remove the four door breaker strips.
5. Pull the mullion heater out of the door channel.

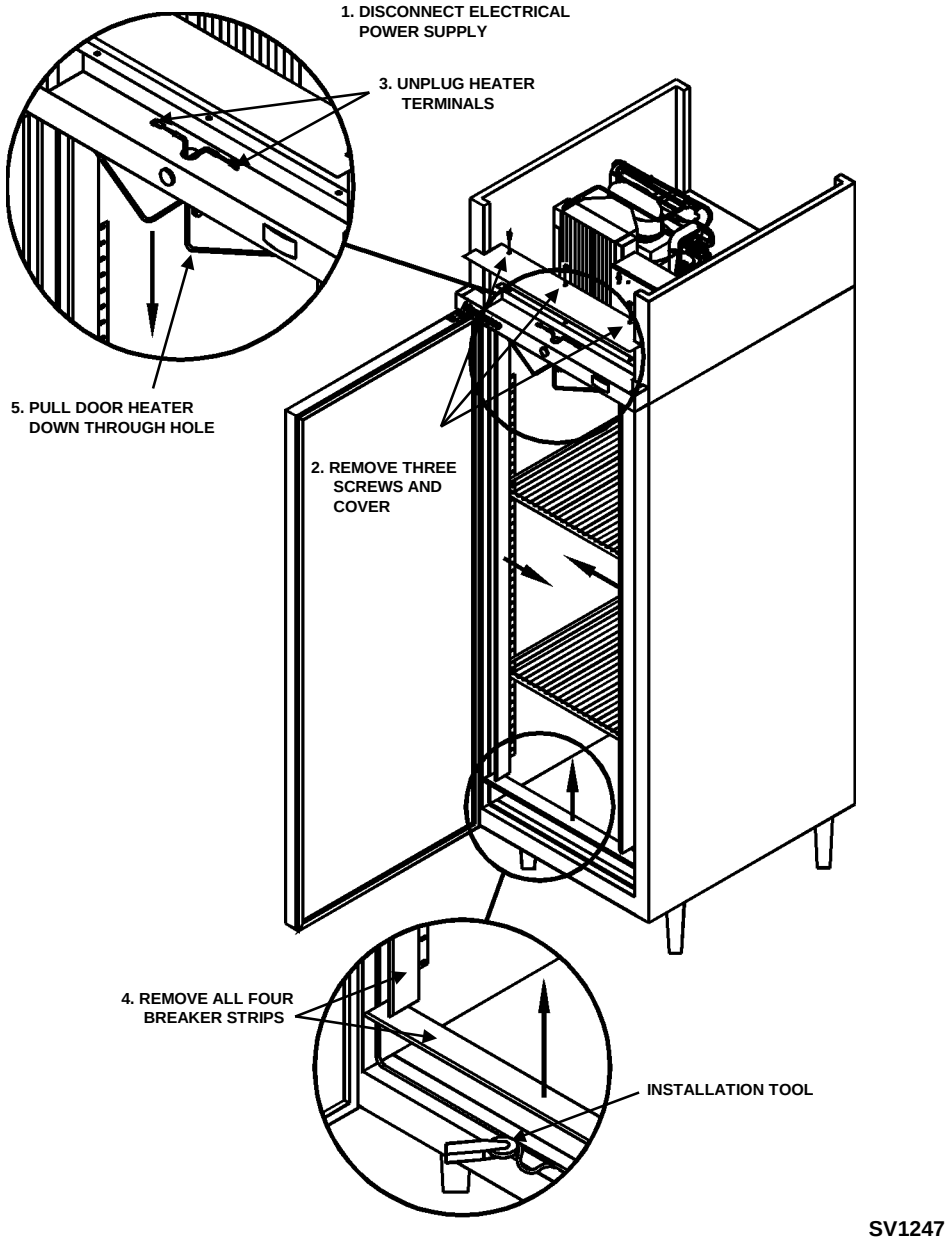


Figure 8-4: Mullion (Door) Heater

NOTE: Use a screen gasket roller tool to install the replacement mullion heater.

Drain Tube Heater

1. Disconnect electrical power to the reach-in.
2. Loosen the mounting screws on the drain cover at the rear of the cabinet. Remove the cover.
3. Unplug the drain line heater.
4. Remove the clamp securing the clear plastic tube to the drain tube.
5. Remove the two mounting screws that fasten the drain tube to the inner liner wall.
6. Pull the drain tube down and forward, pulling the extension out of the rear cabinet wall.

NOTE: Do not try to repair or replace the drain heater. Replace the entire assembly only.

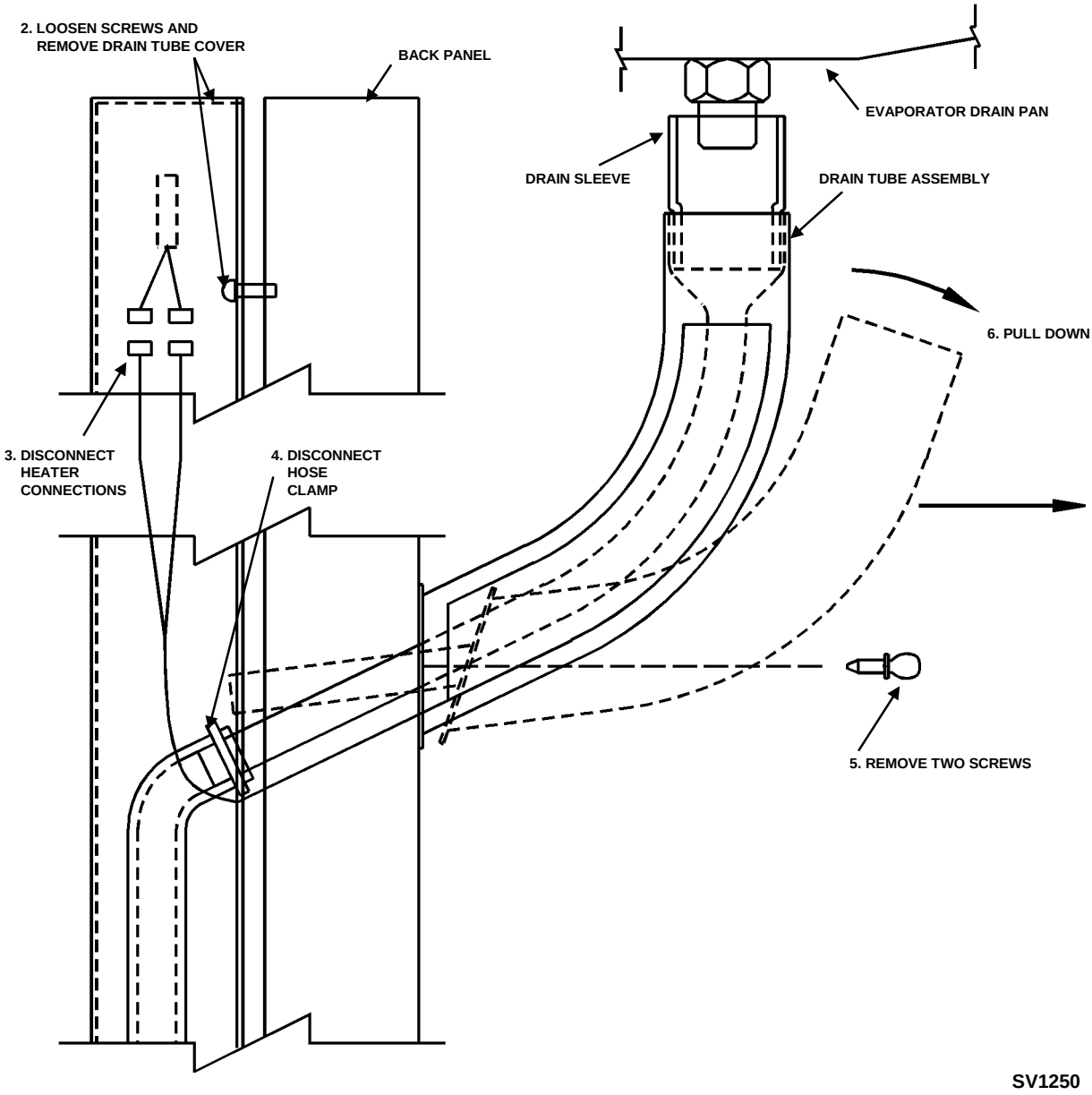


Figure 8-5: Drain Tube Heater

Door Gasket(s)

1. Open the door.
2. Firmly grasp the door gasket in one of the top corners with both hands.
3. Slowly pull the gasket out of the slotted groove. Continue until the gasket is removed.
4. To install the replacement door gasket, start snapping it into the groove at the top of the door.
5. Work the gasket evenly down both sides and then across the bottom.

> **⚠ CAUTION**
> Do not stretch or bind the gasket.

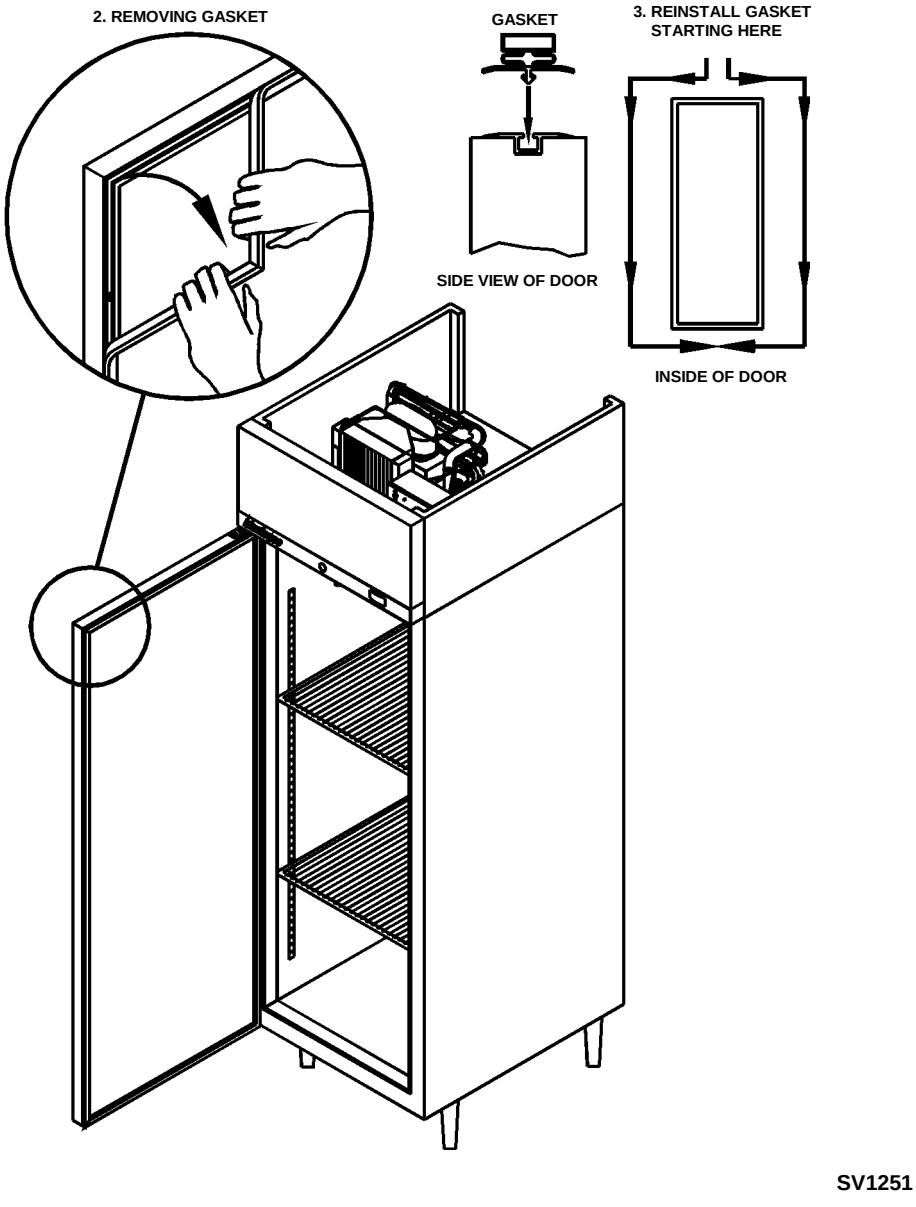


Figure 8-6: Door Gasket(s)

Reversing Door Swing and Adjusting Door Tension

Solid Door

NOTE: To adjust the door tension only, see step 8 of this procedure, page 8-9.

1. Release door spring tension
   A. Insert a small Phillips screwdriver (the same diameter as the holes) into the spring housing.
   B. Remove the tension pin and unload the spring by backing off on the Phillips screwdriver.

Important

Do not release or remove the screwdriver after removing the tension pin.

NOTE: The tension pin on some early production models was pushed in, rather than screwed in. You can just pull it out.

   C. Move the tension pin in the hinge one space at a time to release the spring tension.

NOTE: Be careful not to damage the threads in the tension pin adjustment holes.

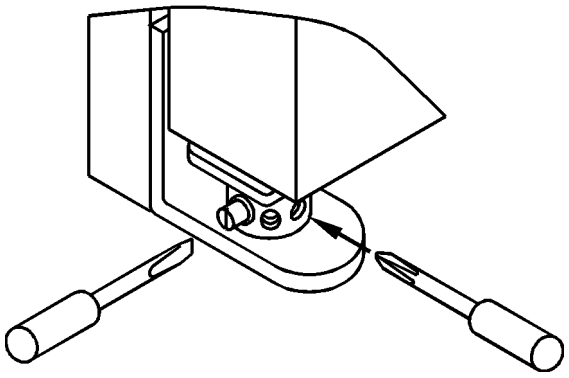


Figure 8-7: Release Door Spring Tension

2. Remove the door.

Important

Release door spring tension before removing the door.

   A. Remove the pivot pin from the bottom hinge assembly.
   B. Slide the door off the bottom hinge and remove it.
3. Remove the hinge brackets from the cabinet. Install the screws without the brackets.

NOTE: Use short screws in the blank holes, and long screws to fasten the hinge.

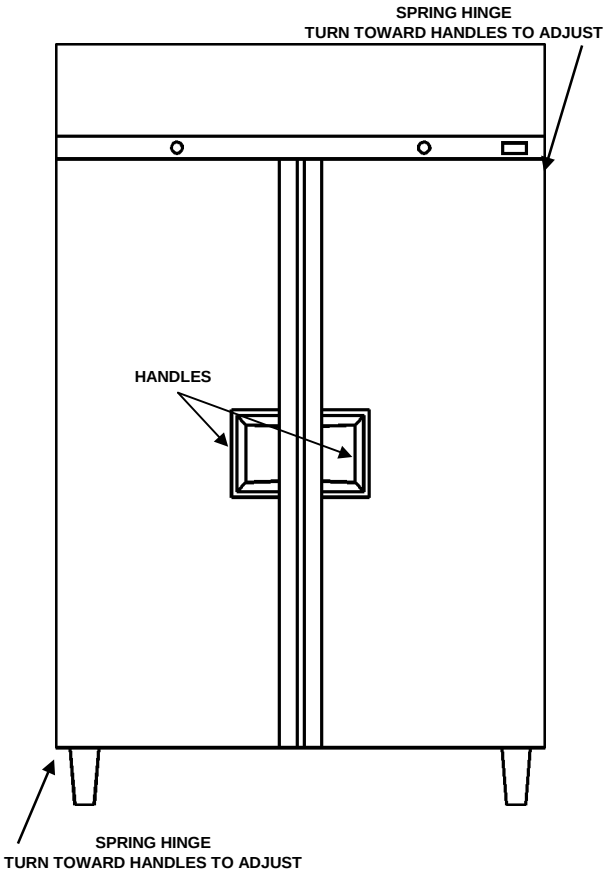


Figure 8-8: Spring Hinges

Continued on next page...

4. Remove the lockrail cover plate.
   A. Raise the top front panel cover to expose the channel assembly holding the door lock and the thermometer.
   B. Remove the lockrail cover screws.

5. Remove the hinge cover plate.

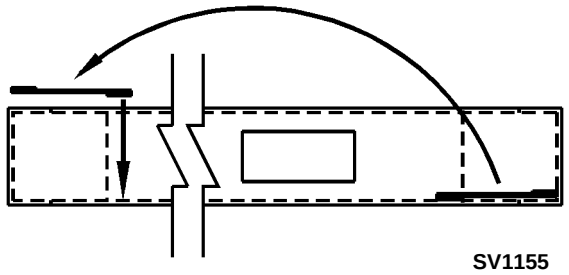


Figure 8-9: Remove Hinge Cover Plate

NOTE: Do not damage the hinge cover plate. It will be reused.

   A. Carefully peel away the two-sided tape securing the hinge cover plate.
   B. Flip the hinge cover plate over.
   C. Install the hinge cover plate (using two-sided tape) over the hole where the hinge bracket was removed.

6. Install the brackets.

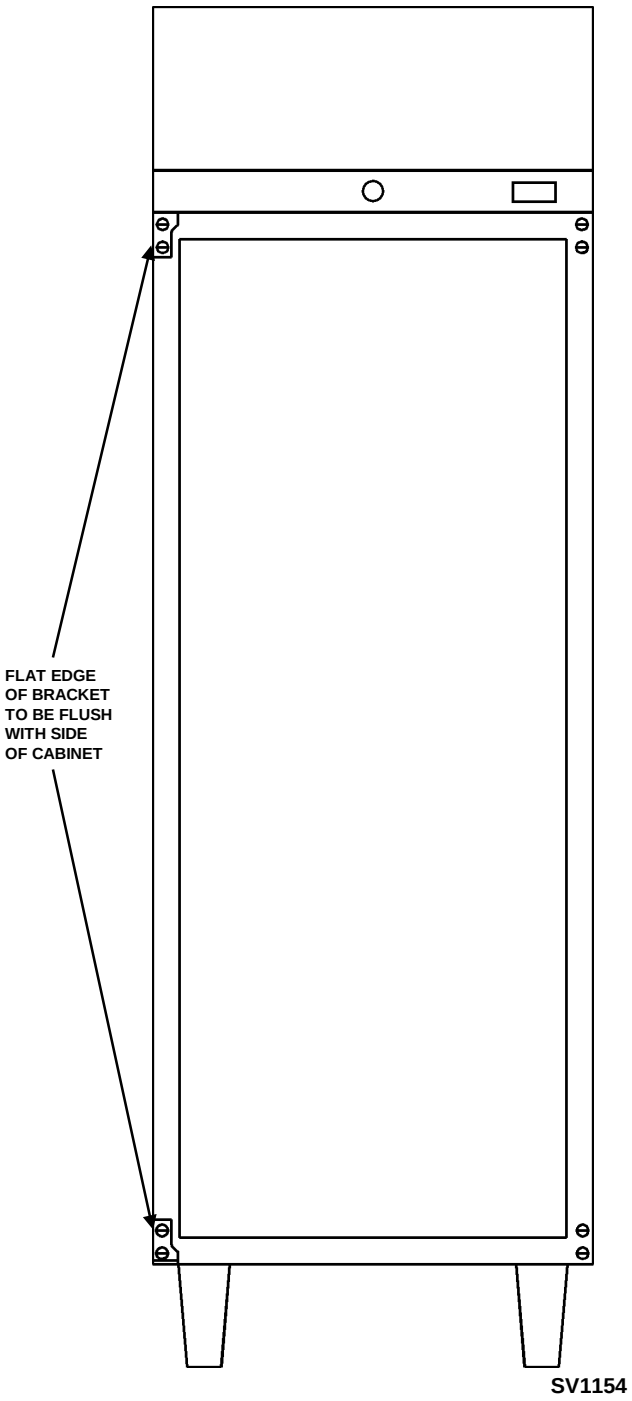


Figure 8-10: Install Brackets

   A. Place the hinge brackets on the cabinet so the flat edge of the brackets face the outer edge of the cabinets.
   B. Install the pivot pin (removed in Step 2) into the top door bracket.
   C. Remove the pivot pin from the bottom door bracket.

Continued on next page...

7. Install the door.

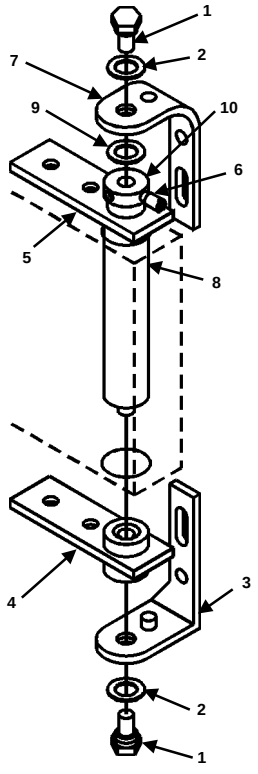


Figure 8-11: Door Hinge Assembly

Key Number	Description
1	Pivot Pin
2	Lockwasher
3	Bracket
4	Plate Assembly
5	Spring Housing Assembly
6	Spring Housing Tension Pin
7	Bracket
8	Spring
9	Washer Spacer
10	Spring Housing Pivot Pin

A. Verify that the door hinge is properly assembled.
B. Slide the door up into the top pivot pin and let the door rest against the bottom bracket.
C. Install the bottom bracket pivot pin.

8. Adjust the door spring tension.

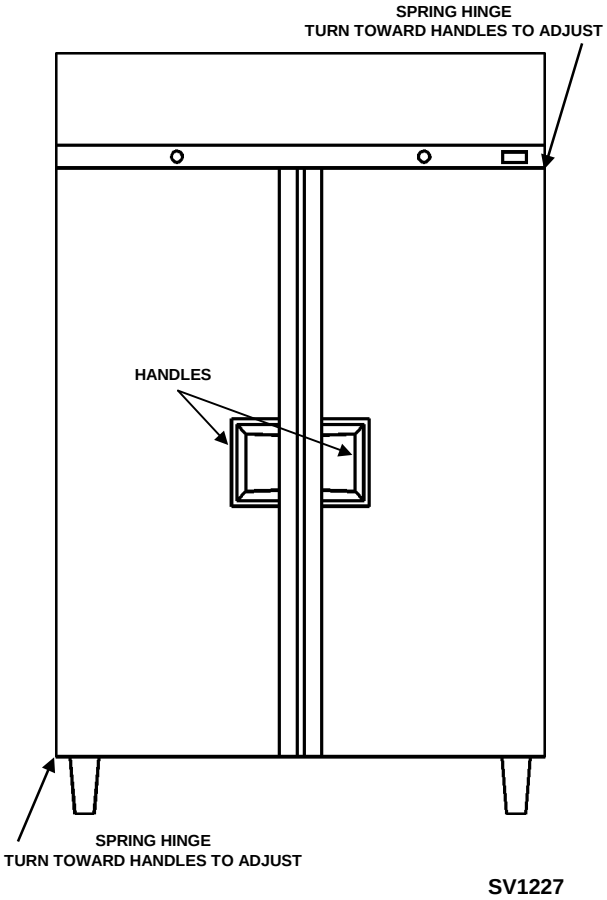


Figure 8-12: Adjust Door Spring Tension

A. Tighten the spring tension by turning the tension pin, one hole at a time, with a Phillips screwdriver.
B. After you begin feeling tension, turn the pin one more full turn. Do not overtighten the spring. Do not tighten more than 1-1/2 turns after you feel tension.

Important

Do not release or remove the screwdriver after removing the tension pin.

C. Screw (or slide) the tension pin into a threaded hole.
D. Verify that the door swings freely and closes by itself.

Glass Door

To reverse the door swing, you will need the proper top and bottom hinge bracket assemblies. Order the appropriate hinge assembly kit below to reverse the door swing:

Desired Swing	Kit Number
Right-hand swing	K00328
Left-hand swing	K00329

1. Release the door tension by turning the door tension adjustment screw clockwise.
2. Remove the door. See Door Removal on page 8-11.
3. Use a 1/2” wrench to remove the top hinge pin from the bracket assembly. Remove the top hinge bracket.

NOTE: The top hinge bracket assembly is not reused. However, save the mounting screws for use with the new hinge brackets.

4. Remove the torquemaster from the bottom hinge assembly. Perform the Door Sag Adjustment, page 8-11, to allow you to access the mounting screw.
5. Remove the bottom hinge bracket.

NOTE: The bottom hinge bracket assembly is not reused. However, save the mounting screws for use with the new hinge brackets.

6. Remove the hole plugs from the new mounting holes. Install new hole plugs into the old mounting holes.
7. Install new top and bottom hinge brackets. Refer to Steps 3, 4 and 5 if necessary.
8. Remove and reconfigure the top plastic hinge sleeve, torque rod, and hold-open arm stud on door as shown.

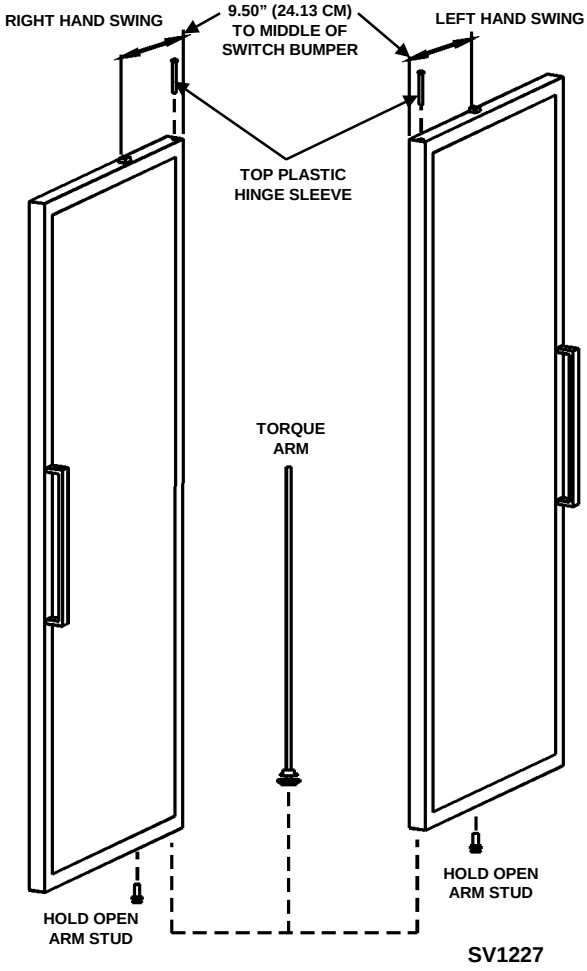


Figure 8-13: Reversing Door Swing

9. Mount the door switch bumper as shown.
10. Install the door. See Door Installation on page 8-12.

TENSION ADJUSTMENT

Use hand tools only for this procedure.

1. Completely release the door tension by turning the door tension adjustment screw clockwise.
2. Open the door approximately 2-3 inches.
3. Without touching the door, slowly turn the door tension adjustment screw clockwise until the door closes.
4. Turn the screw two more complete revolutions.

NOTE: This is the factory tension setting. If desired, you may slightly increase or decrease the tension setting.

DOOR SAG ADJUSTMENT

Use hand tools only for this procedure.

Important

The reach-in cabinet must be level before beginning the adjustment.

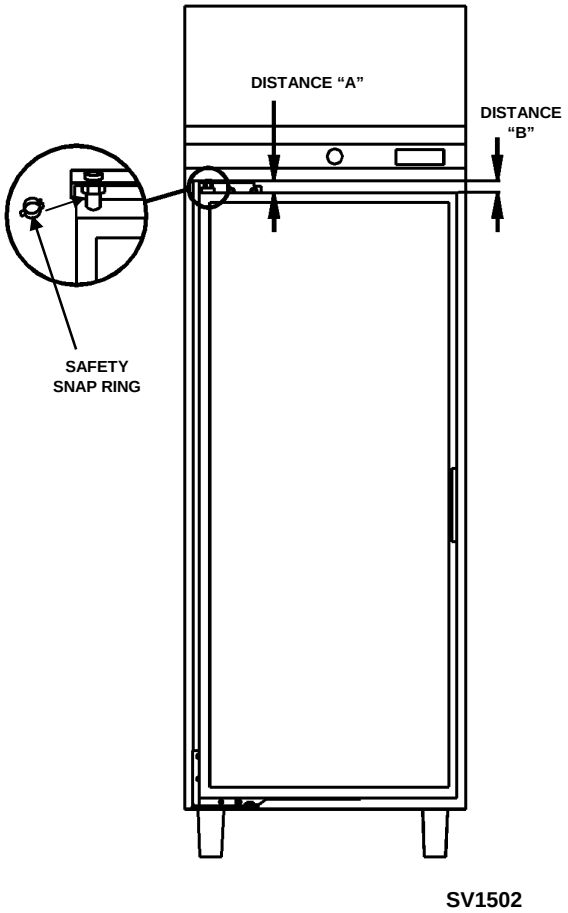


Figure 8-14: Door Sag Adjustment

Turn the door sag adjustment screw clockwise to increase or counterclockwise to decrease dimension B to visually match dimension A.

NOTE: Dimension A is not adjustable.

DOOR REMOVAL

⚠ WARNING

To prevent personal injury and/or cabinet damage, perform this procedure with two people, each capable of lifting 75 lb. (34 kg).

1. Release the door tension by turning the door tension adjustment screw counter-clockwise.
2. Use needle nose pliers to remove the safety snap ring from the top pin shaft.
3. Use a standard screwdriver to carefully pry the outer shaft retainer from the torquemaster.
4. Lift the door up and out of the torquemaster. Do not lower the door yet.
5. Align the hold-open arm stud on the door with the key hole on the hold-open arm. Disengage the door from the hold-open arm.
6. Lower the door to disengage it from the top hinge bracket pin.

DOOR INSTALLATION

⚠ WARNING

To prevent personal injury and/or cabinet damage, perform this procedure with two people, each capable of lifting 75 lb. (34 kg).

1. Be sure the top and bottom hinge brackets are securely mounted to the cabinet.
2. Be sure the top hinge pin and the torquemaster are properly mounted to the hinge brackets.
3. Use a standard screwdriver to carefully pry the outer shaft retainer from the torquemaster.
4. Slide the door up into the top hinge pin bracket.
5. Align and engage the hold-open arm stud on the door with the key hole on the hold-open arm. Do not lower the door yet, or you will bend the hold-open arm.
6. Lift up on the door and slide it into the torquemaster on the bottom hinge bracket.
7. Install the safety snap ring on the top pin shaft.
8. Install the outer shaft retainer on the torquemaster.
9. Adjust the door as necessary. See Tension Adjustment and/or Door Sag Adjustment, both on page 8-11.

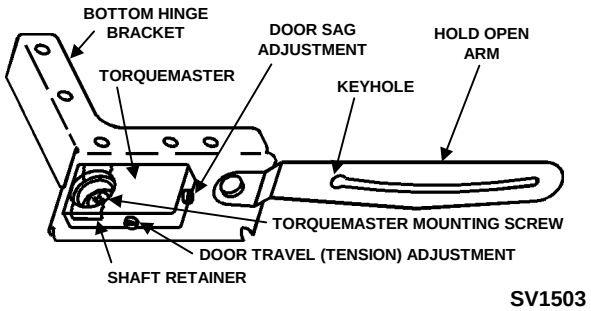


Figure 8-14: Bottom Hinge Bracket Assembly

Temperature/Humidity Chart for Condensation On Glass Doors

Glass door refrigerators use two-pane reflective, non-heated glass (NHG). Condensation will form on the glass if the unit is installed in a high humidity area.

Atmospheric conditions vary depending on specific operating conditions. Use the chart below as a guideline when selecting an installation space.

Room Temperature	Relative Humidity
70°F/21.1°C	76%
75°F/23.9°C	72%
80°F/26.7°C	69%
85°F/29.4°C	67%
90°F/32.2°C	65%

*Based on interior cabinet temperature of 38°F/3.3°C.