AURORA
North America LLC

VARIO HVAC SYSTEM SERVICE MANUAL R02

2016.VV.01

Abstract

This document is the official service manual for the REV RV Diesel HVAC project. This document is intended to help diagnose and determine service requirements for the HVAC system. The details found herein for this project are confidential and only to be shared with parties involved directly in the Mutual Non-Disclosure Agreement signed on the onset of this project. Please do not share without expressed written consent from an authorized member of Aurora North America LLC.

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Contents

Safety Precautions and Warnings

Servicing Refrigerant Systems

1. Per the Environmental Protection Agency (EPA) section 609 “Since January 1, 1993, any person, repairing or servicing motor vehicle air conditioners for consideration must certify to the EPA that such person has acquired, and is properly using, approved equipment, and that each individual authorized to use the equipment is properly trained and certified under Section 609 of the Clean Air Act. In addition, only Section 609 Certified Motor Vehicle A/C technicians can purchase refrigerants in containers of 20 pounds or less. Mainstream is approved by the EPA as a certifying agency for 609 MVAC Technician Certification and 608 Type I, II, III, and Universal HVAC Technician Certification Exams”
2. Always wear protecting clothing and protective eyewear before working on any refrigeration system. Refrigerant in the air conditioning system may possibly reach pressures exceeding 500 PSI. If any part of the system were to burst, it could cause serious injury. If refrigerant gets in your eye it may freeze the eyeball, causing permanent damage or blindness.
3. Always stay clear of any belts and fan blades.
4. Always wear work gloves as many parts including evaporator and condenser cores have sharp edges and may cause serious cuts.
5. Always work in an area with good ventilation. Avoid breathing any lubricant vapor, refrigerant vapor or mist while working on the refrigeration system. Exposure to these may irritate your nose, eyes and throat (especially PAG oil).
6. Always follow EPA guidelines and only use DOT-approved tanks for storing used and recycled refrigerants.
7. To prevent cross contamination of refrigerants, verify that the AC system has the correct label and service fittings needed for the refrigerant being used. If no label is found or there is doubt about the system, use a refrigerant identifier to check the system.
8. Never use compressed air to leak test or pressure test an R-134a system or service equipment. Pressurized mixtures of R-134a and air can be combustible under certain conditions, and moisture added to the system may cause acid to form. If a positive leak test is needed, use dry nitrogen.
9. Always follow the proper instructions for your recycling equipment. Not following the proper instructions could end up causing personal injury or damaging the equipment.

How to Use This Manual

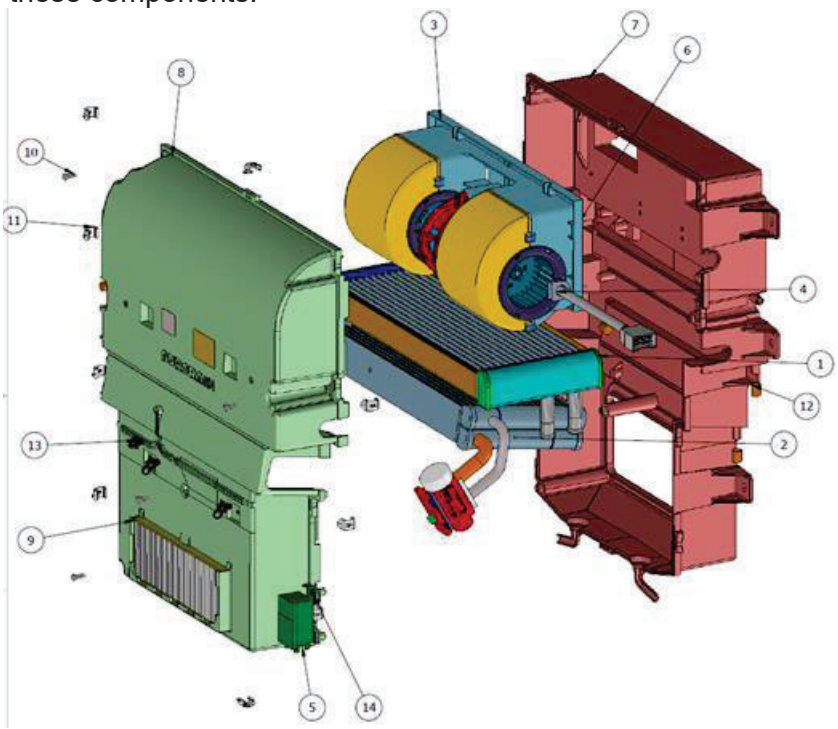
This manual is intended for service technicians working on REV RV recreational vehicles with Aurora North America LLC. HVAC systems. These systems will be clearly marked with a label like the one below:

Figure 1: Aurora HVAC Unit Label example.

This manual will help to troubleshoot issues with the HVAC system and allow service technicians access to information for determining what the root cause of an issue could be. This manual is laid out by component. Please see the table of contents to find the failure mode or visual observation to match with the possible component for root cause.
For troubleshooting or symptom diagnosis, go to the troubleshooting section to determine the likely problem. Then if more detail is needed on a specific component, go to the components section for that detail.

HVAC System Overview

This system utilizes an HVAC system kit consisting of an HVAC unit with a plastic housing with a separately mounted air distribution box. The two exploded drawings below show the make-up of these components:



Item NO.	Aurora Part Number	Description	Qty
1	283-CT1-0200	Aluminum Heater Core	1
2	283-VV4-0204	Evaporator Assembly	1
3	131-461-0400	12VDC DRG Blower 4 speed	1
4	214-VV1-1501	Main HVAC Wire Harness	1
5	412-310-0037	Thermostat	1
6	492-990-0031	#8 Plastite Screw	6
7	431-110-0265	Plastic Housing (Recirc Side)	1
8	431-110-0266	Plastic Housing (Fresh Side)	1
9	436-440-0347	Fresh Air Filter	1
10	492-114-0001	#8 Tapscrew	4
11	433-910-0007	Holding Clip	10
12	485-830-0086	Drain Plug	7
13	494-500-0013	Push RivNut	4
14	492-114-0026	#8 Screw	2

Figure 2: Exploded View REV RV Plastic Vario HVAC Unit.

The air distribution box housing is metal for this project. The ports on the box for connecting flex hoses are plastic. The breakdown of the service parts on the air distribution box is shown below:

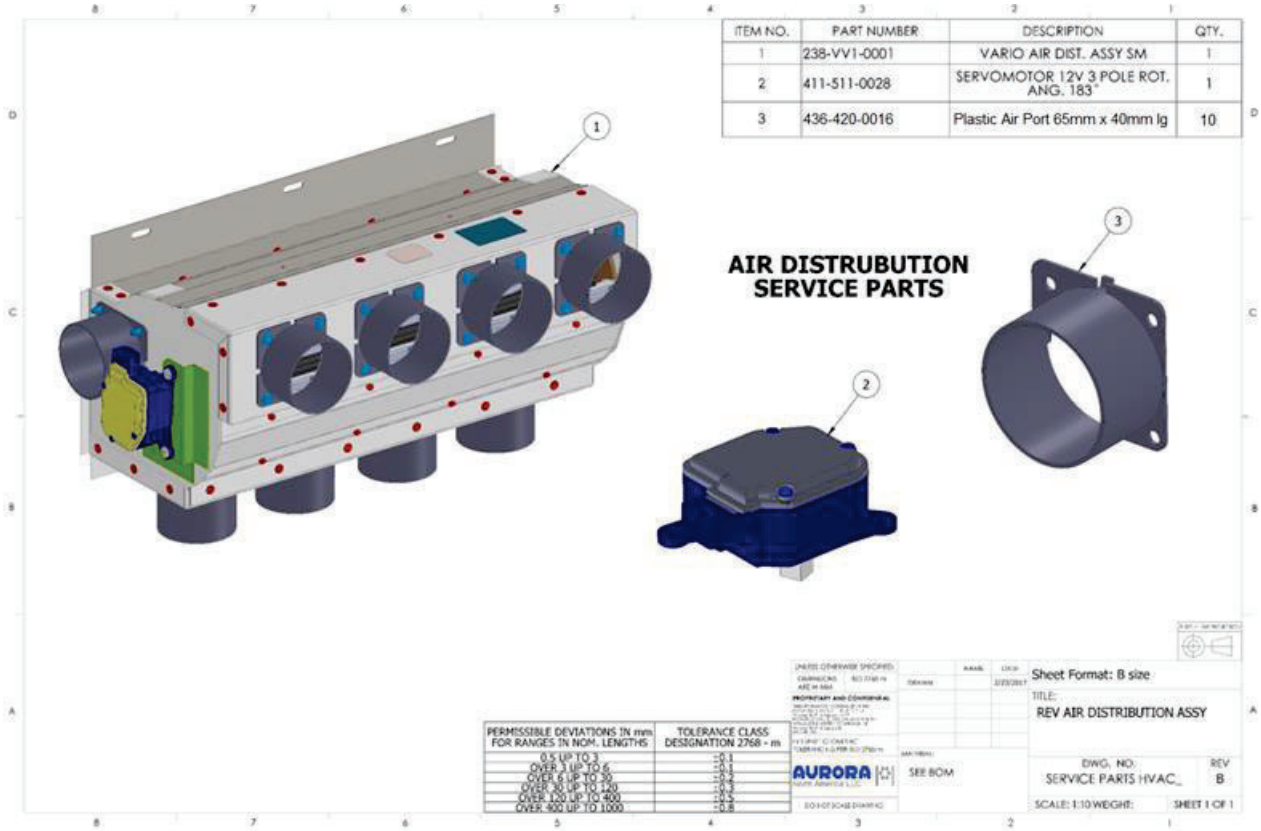


Figure 3: Exploded View of REV RV Air Distribution Box

Also included with this system are the following kits (shown with components):

- Accessory Kit 188-VV1-0200 consisting of the following:
  - Water Valve 381-000-0451
  - Fresh Air Filter 436-440-0347
- Electrical Kit 188-VV1-0201 consisting of the following:
  - Control Panel 335-544-0220
  - Control Panel Jumper Wire Harness 214-VV1-1504
  - DIN Installation Frame 433-290-0187
- Hose Kit 188-VV1-0202 consisting of the following:
  - Hose Liquid Diesel with Pressure Port 285-FT3-0001
  - Hose Suction Diesel 285-FT3-0002
  - Pressure Switch 2 Pol 412-500-0020

Troubleshooting and System Diagnosis

Table 1: Troubleshooting and System Diagnosis

Symptom/Problem	Items to Check (in order)	Likely Causes	Solution/Diagnosis
No A/C	Compressor Clutch	Clutch is not engaging. Clutch could be damaged, or not getting an electric signal.	Confirm if voltage is being supplied to the clutch. If voltage is being supplied, but clutch is not engaging, power clutch direct from battery to confirm. If still not engaging, compressor clutch is damaged and needs to be replaced. If there is no voltage, use electrical schematic and multimeter to determine where the voltage stops. (Compressor is not Aurora content)
	AC Fuse	Fuse may be blown, preventing power to clutch.	Replace fuse (fuse is not Aurora content)
	Thermostat	Thermostat may be damaged or not connected. Thermostat may also be frozen which will shut off power to compressor	Check for continuity on both sides of thermostat. If there is no continuity, confirm that the probe is not in freezing conditions. Replace thermostat if there is no continuity and not freezing.
	Pressure Switch	Pressure switch may be damaged or not connected. Pressure switch may also shut off the AC system if system pressures are outside of boundary conditions.	Check for continuity on both sides of pressure switch. If there is no continuity confirm that system pressure is within boundary conditions. If pressure is within conditions, then replace damaged pressure switch.
	AC switch	AC switch may be damaged or not connected, preventing voltage from passing the switch. AC switch may also be reversed causing on to be off and off to be on.	Check continuity of switch in both positions and confirm that there is continuity when switch is turned on. If there is no continuity, replace switch.
	Blower Switch	Blower switch must be engaged past the off position. AC will not be possible while blower switch is in the off position. Blower switch may also be damaged or not connected.	Check that blower switch is engaged and that voltage is leaving the blower switch and entering the AC switch. If switch is not functioning properly, replace switch
	Compressor Relay	Compressor clutch should be powered by a relay. Relay may be damaged and not working properly	Confirm that relay is operating correctly. (Relay is not Aurora content)
No Heat	Water Valve	Water valve may not be operating properly. Water valve may be stuck in the closed position, may not have power, or may not be receiving the proper signal.	Check valve for proper rotation. Determine if coolant is passing through valve when it should be. Check fuses and check electrical connection and schematic
	Temperature Control	Wiring may be reversed or disconnected at control panel. This may cause the water valve to not work at all, or to work opposite of intention.	Check schematic for proper connection and repair the connection. If parts are damaged, replace damaged parts
	Coolant Temperature	The engine may not be providing hot enough coolant to heat the cab.	Check temperature of hose lines to the water valve. Are they hot? Where do they stop being hot? Is there something blocking the flow?
Heating when Cooling or Cooling when Heating	Water Valve	Water valve may not be operating properly. Water valve may not be able to close fully, or may be rotating in the wrong direction.	Check water valve for proper rotation. Check temperature of hoses on both sides of water valve to see if coolant is leaking through valve. Clamp hoses closed to mimic a shut water valve to determine if problem desists. Replace damaged parts as needed.
	Temperature Control	Wiring may be reversed or disconnected at control panel. This may cause the water valve to not work at all, or to work opposite of intention.	Check schematic for proper connection and repair the connection. If parts are damaged, replace damaged parts
	Compressor Clutch	Compressor clutch may not be engaged at the proper time.	Check compressor clutch to see if it is engaging when it should engage. Use electrical schematic to determine which item is causing the break in the signal. (compressor is not Aurora content)
	AC Signal	The AC signal may not be working properly. Maybe it is on when it should be off or vice versa.	Use electrical schematic to determine proper connection and connect the pins properly. If parts are damaged, replace damaged parts
No Backlight on Control Panel	Backlight Fuse	Power is not being supplied to backlight because of a blown fuse. Water valve and flap actuator will also not be powered.	Replace fuse (fuse is not Aurora content)
	Wiring/Connection	Wiring may be reversed or disconnected at control panel	Check schematic for proper connection and repair the connection. If parts are damaged, replace damaged parts

Symptom/Problem	Items to Check (in order)	Likely Causes	Solution/Diagnosis
Air From Wrong Outlet(s)	Flap Actuator	Internal gear to actuator may be damaged. Actuator may make clicking sounds and may not rotate the flap properly. Flap may rotate in only one direction, may rotate erradically, or may not rotate at all.	Replace actuator
	Wiring/Connection	Wires may be disconnected, or connected incorrectly. This may result in flap rotating in the opposite direction as indicated by control panel. It may also result in no movement of flap, or movement in only one direction. Connection at control panel potentiometer is most likely location for this.	Use electrical schematic to determine proper connection and connect the pins properly. If parts are damaged, replace damaged parts
	Actuator/Water Valve Fuse	If no power is being supplied to motor, there will be no rotation of the flap. The power for the motor is fused on the vehicle. This powers both the flap actuator and the water valve. If either of these is operating, the fuse is not the problem.	Replace fuse (fuse is not Aurora content)
No Temperature Control	Water Valve	Water valve may be damaged or disconnected. Water valve may not be rotating at all, or rotating improperly.	Check that water valve is rotating when the temperature dial is turned. If valve does not rotate, check connection for power. If part is wired correctly and has correct power, replace valve.
	Wiring/Connection	Wires may be disconnected, or connected incorrectly. This may result in valve rotating in the opposite direction as indicated by control panel. It may also result in no movement of valve, or movement in only one direction. Connection at control panel potentiometer is most likely location for this.	Check the connections and the wiring with the electrical schematic. If wiring is correct and electrical connections are correct, replace valve.
	Actuator/Water Valve Fuse	Fuse may be blown, preventing power to valve	Check the fuse and replace if necessary (fuse is not Aurora content)
Improper Fan/Blower Operation	Blower Fuse	Fuse may be blown, preventing power to blower which will result in no blower operation	Check the fuse and replace if necessary (fuse is not Aurora content)
	Blower Speed Switch	The switch may be damaged or disconnected. Which may result in no blower operation, incorrect blower speeds, or the blower may not operate on all the speeds	Check the switch on the control panel to determine if it is connected fully. Check to see that voltage goes through the correct pins as the switch is moved through the speed options. Replace switch if damaged.
	Wiring or Wiring Connection	The wiring to the blower switch, or to the blower itself may be incorrect. This may result in no blower operation, incorrect blower speeds, or the blower may not operate on all the speeds.	Check the switch on the control panel to determine if it is connected fully. Check the electrical schematic and confirm that the correct pins are in the correct locations. Confirm that the wires have proper continuity all the way to the blower connection. Replace or repair damaged wire harnesses and connections as needed.
	Blower Resistor	The blower resistor (mounted to the blower in the air stream) may be damaged. This normally results in missing speeds or the blower only operating in one speed.	The resistor itself may show signs of damage (brown discoloration, broken pins, or cracks in resistor. Check that the resistor has continuity to each pin. Check the resistance from each pin to confirm if it is correct. Replace damaged resistor if needed.
	Blower Motor	The blower motor itself may be damaged. This may result in a seized motor (wheels and shaft will not rotate) or blower operating poorly. There may be reduced air flow, or increased noise levels.	Check the motor for physical damage. With blower disconnected from power, rotate the wheels. If wheels and shaft do not rotate, it may be a seized motor (replace blower). Check blower amperage levels to confirm proper function. Replace blower if needed.
	Blockage	There may be a foreign item that is lodged in the wheels, or otherwise preventing the blower from operating properly.	Visually check blower for obstructions. Replace blower if needed.
Noise Under Dash	Flap Actuator	The flap actuator may have damaged internal gears. If this happens, the actuator will make clicking noises as it attempts to move the flap to the proper positions. The flap may still reach the correct positions, but will most likely fail soon. The flap will usually only stay in one position, or may be erratic.	Confirm that the actuator is making the clicking noises as it rotates. Replace damaged actuator if needed.
	Blue/White Filter	In some few cases, a low repetitive thumping noise may be heard through the air stream. This may occur at low blower speeds under very humid conditions.	The situation can be remedied with Service kit 188-VV1-0203

Symptom/Problem	Items to Check (in order)	Likely Causes	Solution/Diagnosis
Noise Under Hood	Blower	If the blower is damaged, or otherwise not working properly, it may result in an unusually noisy blower.	Check the blower for proper function and operation. Replace blower if needed
	Expansion Valve	The expansion valve will make noise as it increases and decreases it's opening size.	If this noise is repetitive and continuous, it may mean the refrigeration system is hunting. This can result in low cooling. Check system for proper fill.
Engine Coolant Leak	Hose Clamps	The primary location for coolant leaks is at the hose clamps.	Check that hose clamps are tightened properly and in the proper locations. (hose clamps are not Aurora content)
	Hose Fittings	Hose fittings may have leaking crimps, or leaking seals	Visually inspect and replace as needed (heater hoses are not Aurora content)
	Hoses	Hoses may crack or split to cause leaks	Visually inspect and replace as needed (heater hoses are not Aurora content)
	Water Valve	Water valve may leak through the body by the shaft of the actuator	Inspect the valve and ensure that the leak is not due to clamps and is confirmed that it is leaking through the body. Replace valve as needed
	Heater Core	Heater core may be damaged and may leak inside the HVAC. The tubes external to the HVAC may also leak if damaged.	Check for oily areas on heater core. Pay special attention to where the tubes meet the tanks. If a leak is found, replace the heater core.
Refrigerant Leak	Fittings	Hose fittings may have leaking crimps, or leaking seals	Inspect the fittings for oil residue or staining. Evacuate the system of refrigerant and charge with dry nitrogen while spraying fittings with a bubble solution to find leaks. Other methods of leak determination may also be used
	O-rings	O-rings may be missing or damaged. An o-ring should not have any indents or cuts along the surface. They should be circular with uniform shape.	Visually inspect the o-rings and confirm that they are in good condition and in place. Use the bubble method described in the fittings section or another leak determination method to find leaks.
	Expansion Valve	The connection to the expansion valve is a key area to look for leaks.	Inspect connection for missing O-rings and for properly seated hose fittings. Use bubble method or another leak determination method to find the leaks.
	Evaporator or Condenser Core	The evaporator or the condenser may have damage that will result in leaks.	Inspect cores for damage or oily residue. Use bubble method or another leak determination method to pin point the leaks. (Condenser is not Aurora content) Replace parts as needed.
Low Air Flow	Blower	The blower may be damaged or only operating in low speed.	Use blower section to determine blower functionality
	Dirty Filter	The filter may be dirty or clogged which may result in low system air flow.	Replace filter
	Core Blockage	The evaporator core may be dirty or clogged which may result in low system air flow. The core may also be covered in ice which will cause this blockage.	Carefully clean evaporator fins of dirt and debris. (do not spray with high powered water! May damage fins) If core blockage is due to ice buildup on the evaporator core, check the thermostat for proper operation and placement.

Symptom/Problem	Items to Check (in order)	Likely Causes	Solution/Diagnosis
Poor Heating	Low Air Flow	Low air flow can result in low heating performance.	Check air speeds at vents and compare to normal operating conditions. See low air flow section for diagnosis
	Air Filter	If the fresh air filter is missing, the system may be pulling in too much cold fresh air resulting in low performance.	Replace air filter
	Core Blockage	Heater core or evaporator core may be partially blocked by dirt or debris resulting in a less effective core which may reduce heating performance. There may also be a blockage inside of the core resulting in less of the core being used.	Visually inspect cores for external blockages. Clean/clear away external blockages. A heater core without internal blockages will be generally uniform in temperature. Internal blockages may be evident by sections of the core that are considerably lower in temperature than others. Replace heater core if needed.
	Water Valve	Water valve may not be operating properly. It may not be opening fully, or it may be moving in the wrong direction.	Use water valve section to diagnose
	AC is on	If the AC is on and the compressor clutch is engaged, the performance of the heating system will be reduced.	Confirm that the AC button is not on. Confirm that the compressor clutch is not engaging. Use AC and compressor sections for diagnosis.
	Low Engine Temp	If the engine is not providing enough temperature or flow to the heater core, the system may have reduced heating performance.	Confirm that temperatures and flows are at normal operating conditions. Determine cause for low flow/temperature. (Aurora content only includes water valve and heater core. All connections and hoses are not Aurora content)
Poor Cooling	Refrigerant Fill	If the system is underfilled or overfilled it can result in low cooling performance. This can usually be determined by looking at the system pressures and confirming the system subcooling value is within the appropriate range. Some common symptoms of a poor refrigerant fill include a hunting TXV, low-low side pressures, high-high side pressures, and frost build up on fittings (most typically on the low side of the system)	System should be filled to the quantity listed on the HVAC label. Evacuate the refrigeration system and determine how much refrigerant was removed, and add the proper amount of refrigerant in the system. (note: must be done by an EPA section 609 certified technician)
	Low Air Flow	Low air flow can result in low cooling performance. This may result in lower core temperatures which may lead to freezing conditions and cycling the compressor.	Use the low air flow diagnosis above
	Core Blockage	Evaporator core may be partially blocked by dirt or debris resulting in a less effective core which may reduce cooling performance. Condenser core may be blocked by dirt or debris as well. This may result in higher than normal pressures, and reduced system performance	Visually check cores for dirt and debris. Carefully clean cores with slow flowing water. Be careful not to damage fins. (condenser is not Aurora content)
	Heating System is on	If the heat is turned on, or the water valve is open, the systems cooling performance will be reduced.	Ensure that the heat is not turned on and that the water valve is not open. If the valve is not operating properly, use the water valve diagnosis
	Refrigerant Line Restriction	A blockage or restricition in a refrigerant line can result in reduced performance. This can be caused by a kinked refrigertion line, or could be debris inside the refrigerant lines getting caught somewhere. Common locations for restrictions are at fittings, the receiver drier, the expansion valve, and at the condenser and evaporator cores.	Look for visible frost forming on fittings or on hoses. This most likely indicates a restriction in the system. (low side) Typically a restriction will cause a change in refrigerant temperature after the restriction, look for temperature changes across things that should have very little change. The receiver dryer is a common problem for this and should have very little temperature change on either side of it. (Receiver drier is not Aurora content)
	Low Compressor RPM	If the compressor RPM is reduced the system performance may be reduced as well.	Check belts for wear and slippage, check compressor clutch for slippage or visible damage. Confirm compressor RPM to normal system conditions. (compressor and belts are not Aurora content)
	Refrigeration Hoses	If refrigeration hoses are exposed to too much heat, the system performance may be decreased. The high temperatures will increase the temperature of the refrigerant in the hoses and will decrease capacity and performance.	Look for refrigeration hoses that are bundled together without insulation. Look for hoses that are bundled with heater lines or hydraulic fluid. Check that hoses are not touching hot surfaces that can transfer that heat. (Hose location and routing not determined by Aurora)

HVAC Components

This section will detail the components utilized in the HVAC system

Water Valve

(Aurora Content)

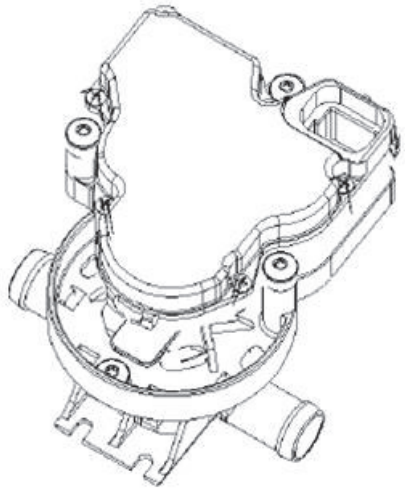


Figure 4: Actual representation of system water valve used

Part Number: 381-000-0451

Purpose:

The water valve is designed to control the flow of coolant through the system's heater core.

How it works:

The water valve is controlled by the temperature control knob on the control panel. As the temperature control knob is rotated clockwise, (towards the red side) the water valve will open in the counter clockwise direction (from the top of the motor). The motor has 3 wires leading to it: Power to pin A, Ground to Pin C, and Signal to Pin D. The signal voltage will increase from approximately 0-12V as the water valve opens, and will decrease as the water valve closes.

Key Notes:

Ground to Pin C, and Signal to Pin D. The signal voltage will increase from approximately 0-12V as the water

- The valve is not bi-directional. There is an arrow on the valve that indicates flow direction. If the flow is in the wrong direction, the seal inside the valve may be displaced which may prevent the valve from opening or closing fully
- The valve is rated for a maximum pressure of 1 bar. Anything exceeding this pressure may damage the valve.
- If it appears that the valve is leaking coolant, first check the hose clamps. Confirm that the hose clamp location is not the actual cause of the leak before attempting to replace valve.

Compressor

(NOT Aurora Content)

Figure 5: Visual representation of a refrigerant compressor (not actual representation of system compressor)

Purpose:

The compressor pumps the refrigerant through the refrigerant circuit.

How it works:

When the compressor clutch is engaged, the compressor constricts gaseous refrigerant from the low side of the system and pushes out a hot gas into the high side of the system. The clutch is engaged when voltage reaches the compressor. The signal for this voltage needs to pass through the system's AC switch, the anti-icing sensor or thermostat, and the system pressure switch before activating a relay which brings power to the compressor clutch.

Key Notes:

The compressor can be the easiest way to determine if the system AC is active or not. If the clutch is engaged and is rotating with the pulley, the system AC is active. If it is not engaged, the system AC is not active.

Condenser

(NOT Aurora Content)

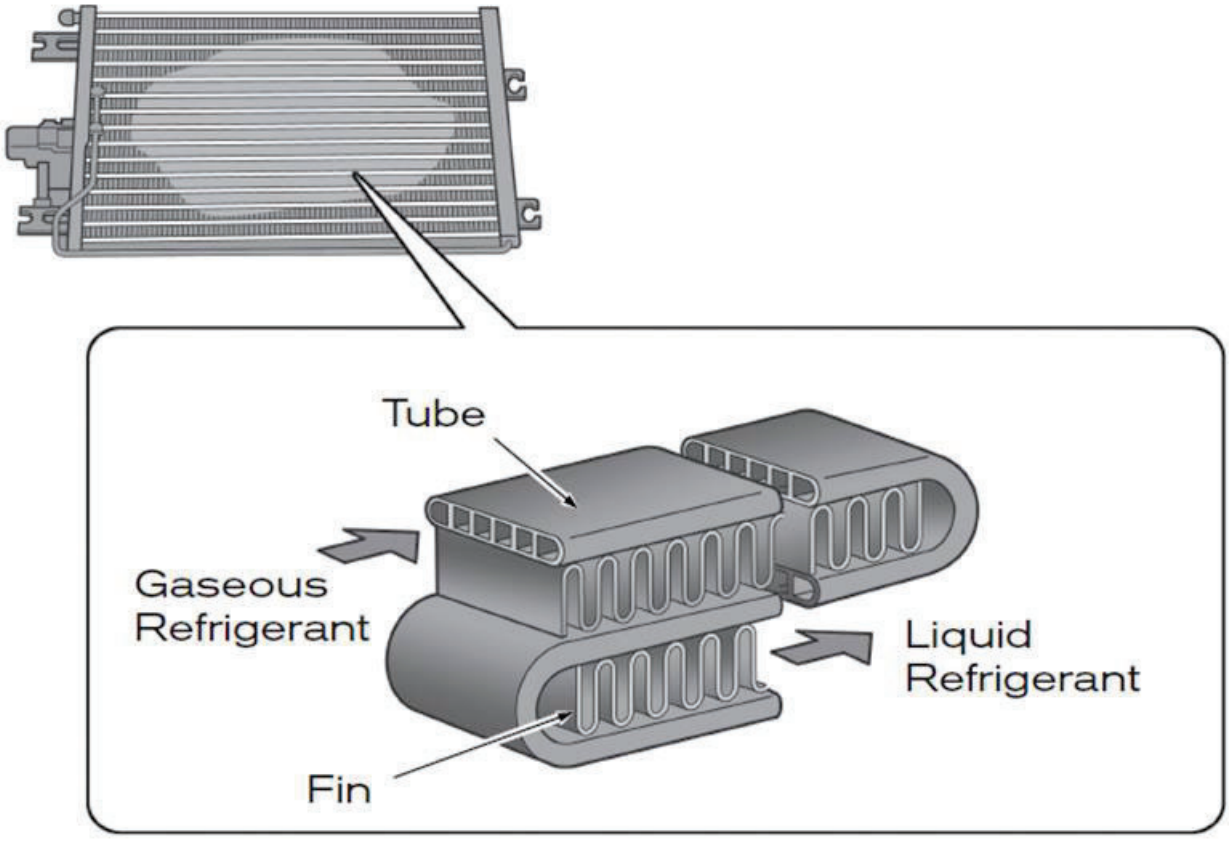


Figure 6: Visual Representation of a refrigerant condenser (not actual representation of system condenser)

Purpose:

The condenser condenses hot, high pressure gases into a liquid and dissipates heat to outside air.

How it works:

Inside the condenser, the refrigerant vapor is compressed and forced through a heat exchange coil, condensing it into a liquid and rejecting some of the heat from that refrigerant into the air.

Key Notes:

Condensers need to be cleaned of debris to work properly. Typically there is no filter preventing dirt or leaves or other such debris from getting sucked up by the fan and stuck in the condenser fins. As the condenser becomes clogged, the effective size is reduced which will result in lower performance and higher system pressures. The fins should be cleaned carefully with low pressure water to prevent the likelihood of bending the fins and blocking airflow.
Condensers are also common leak locations, as sometimes rocks or other debris may kick up while driving and damage the core.

Receiver Drier

(Not Aurora Content)

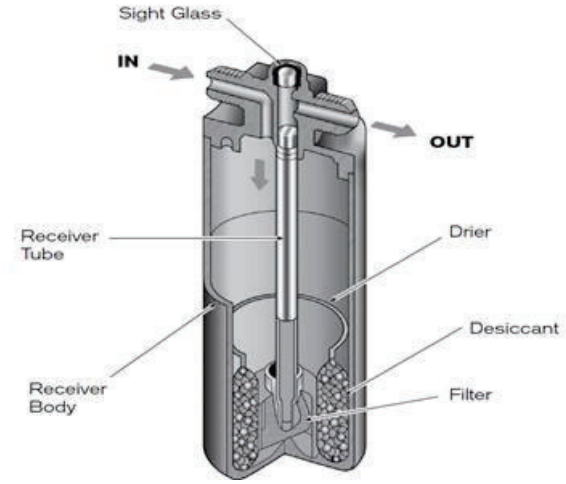


Figure 7:Visual representation of a receiver drier (not actual representation of system receiver drier)

Purpose:

The receiver drier can act as a storage tank for extra refrigerant, and it also contains a filter and a desiccant material to help remove moisture and debris in the system.

How it works:

The outlet of the receiver drier connects to a siphon tube that goes to the bottom of the container. This acts as a liquid/vapor separator and ensures only liquid refrigerant is supplied to the expansion valve. The desiccant material also holds moisture and removes this from the refrigerant.

Key Notes:

A receiver drier should be replaced every time the system is open to the atmosphere. The desiccant can only hold so much moisture and if left open can become fully saturated and unusable in as little as 10 minutes.

The temperature of the refrigerant entering and exiting the receiver drier should be very close to the same temperature. If there is a noticeable difference in temperature across this device, it is a good sign that the receiver drier needs to be replaced.

Some receiver driers have sight glasses on them. The sight glass used to be a good indicator of system charge. With older refrigerants, the system would be charged until the bubbles in the sight glass disappeared. With R-134a, this is not a good indication of system charge. The oil used in R-134a tends to keep bubbles in the system even when the system is fully charged. If the system is charged until there are no bubbles remaining, it is likely the system will be overcharged.

Expansion Valve

(Aurora Content)

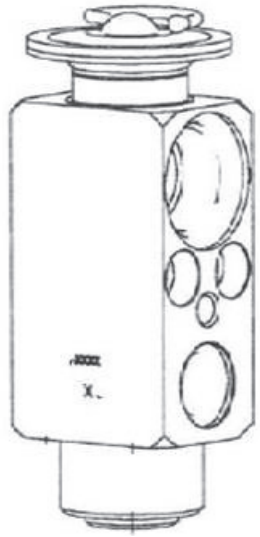


Figure 8: Actual representation of system expansion valve used

Purpose:

The expansion valve is a restricting orifice that sits between the high side and the low side of the refrigerant system. This restriction causes a pressure differential to occur which is used to promote a refrigerant phase change inside the evaporator.

How it works:

The expansion valve has a very small opening to the entrance of the evaporator. The size of this opening can be automatically adjusted, or metered, by the expansion valve due to system conditions. The expansion valve is increasing and decreasing the size of this opening in order to maintain a specific system superheat. Warm, high-pressure liquid refrigerant flows to the expansion valve, then a low-pressure spray of cold refrigerant droplets pass through the expansion valve and into the evaporator. As the cold spray contacts the relatively warm tubing of the evaporator, the refrigerant vaporizes (becomes a gas) and absorbs heat from the evaporator and the air surrounding the evaporator.

Key Notes:

The expansion valve is designed to be oriented vertically(+/- 45°), with the bulb on top. The oil in the refrigerant may get trapped in the top half of the expansion valve causing improper superheat readings if the expansion valve is oriented improperly. This may result in low or erratic cooling performance.

The expansion valve is one of the more likely places for debris to get caught in the refrigeration system. A visual check for debris at the entrance to the expansion valve may be helpful for diagnosing failures. Many times an expansion valve failure is indicative of something else in the system failing first.

Evaporator

(Aurora Content)

Figure 9:Actual representation of system evaporator

Purpose:

The evaporator provides cold air to the interior of the cabin.

How it works:

As warm high pressure refrigerant liquid passes through the expansion valve and then through the various routes of the evaporator, the refrigerant moves from a high pressure liquid to a low pressure vapor. This transition, or phase change, requires a lot of energy to occur. As air is passed over the fins of the evaporator, the energy required for the phase change is taken from the heat in the air. This energy loss of the air results in low temperature air exiting the fins and entering the cabin. Since the surface temperature of the evaporator is usually colder than the air flowing past is, any moisture (water vapor) in the air tends to condense and form liquid droplets on the fins. This process is called dehumidification, and is important for passenger comfort as well as windshield defogging.

Key Notes:

The evaporator has a fairly tight density of fins, and is therefore an easy location for dirt and debris from the air to clog. This is why it is so important to ensure that filters are in place to prevent this. When the evaporator begins to clog, the air cannot flow over it properly. This will reduce total system airflow as well as performance.

The evaporator reaches very low temperatures and may begin to freeze the moisture that is gathered on the fins. A thermostat or de-icing sensor is used to help prevent this, but if this thermostat is not placed properly, or is blocked, or not working properly, the core may slowly build up ice and will reduce both performance and airflow.

Thermostat

(Aurora Content)

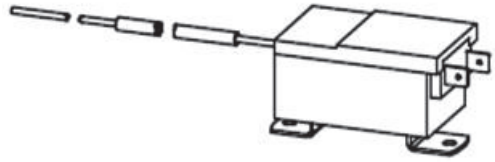


Figure 10: Actual representation of system thermostat

Purpose:

The thermostat, or anti-icing switch, is a switch designed to detect when the evaporator core is at freezing conditions. The purpose is to protect the refrigeration circuit.

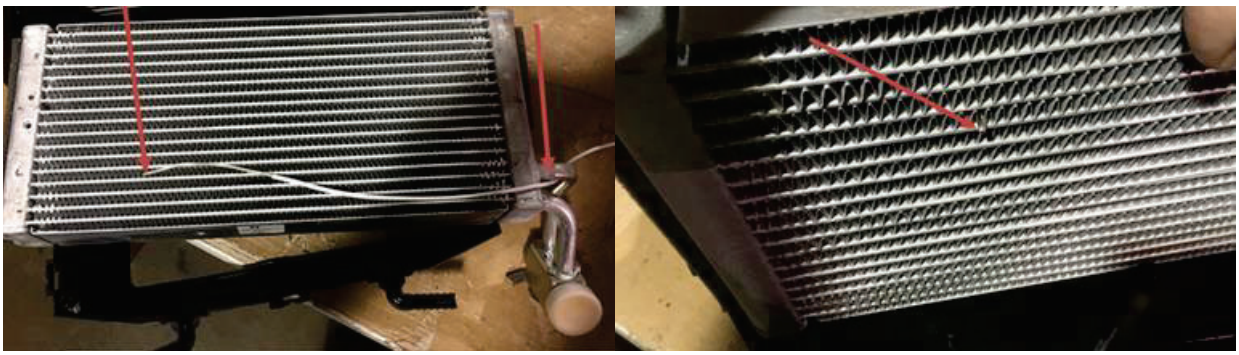
How it works:

The thermostat has a probe that extends into the fins of the evaporator core. This probe senses the temperature of the evaporator and will shut the AC circuit off if the temperature gets too cold.

Key Notes:

The thermostat will open the circuit (shut AC off) at 30.2°F +/- 1.1°F and will close the AC circuit (turn AC on) at 36.0°F +/- 1.1°F.

The thermostat probe carries a gas inside that allows the thermostat to function properly. If the probe is damaged, this gas may leak out and the thermostat will no longer function. The circuit will be left open and AC will be inoperable. Look for kinks or bare copper showing on the probe for visual indications of this. Below is the proper location of the probe in the evaporator core.



Pressure Switch

(Aurora Content)

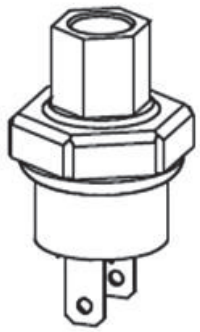


Figure 11: Actual representation of system pressure switch

Purpose:

The pressure switch protects the system from operating outside of a suitable pressure range.

How it works:

The pressure switch is located on the high side of the refrigeration circuit on the liquid line leading to the expansion valve. This pressure switch will open the AC circuit (shut AC off) if the pressure is too low or too high.

Key Notes:

The pressure switch will open the AC circuit (shut AC off) when the pressure is below 28 PSI or above 398 PSI. The pressure switch will close the AC circuit (turn AC on) when the pressure is above 29.9 PSI or below 298.7 PSI.

Air Flap Actuator

(Aurora Content)

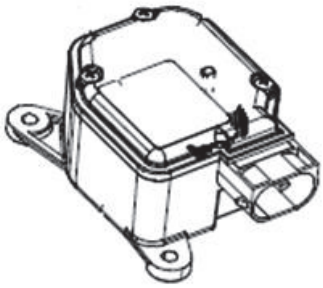


Figure 12: Actual representation of system flap actuator

Purpose:

The actuator is a motor that rotates the air distribution flap through all the flap positions.

How it works:

The flap actuator has 3 wires. Power (+12VDC) to pin 4, Ground to pin 6, and Poti Feedback, or signal, to pin 2. As the power from the signal wire is increased or decreased, the flap actuator will rotate to the corresponding position.

Key Notes:

When power is provided to the actuator, it will go through a calibration cycle. This cycle involves the actuator rotating in one direction until it hits a stop, and then rotating in the other direction until it hits a stop, and then moving to the position the signal wire is providing for it. This calibration cycle takes approximately 5-8 seconds and happens every time the actuator is given power. The signal wire is connected to a potentiometer, and as the potentiometer is rotated, the voltage of the signal wire is adjusted between approximately 0-12V. This correlates to a position between the two stops encountered during the calibration cycle.

HVAC System Electrical Schematic

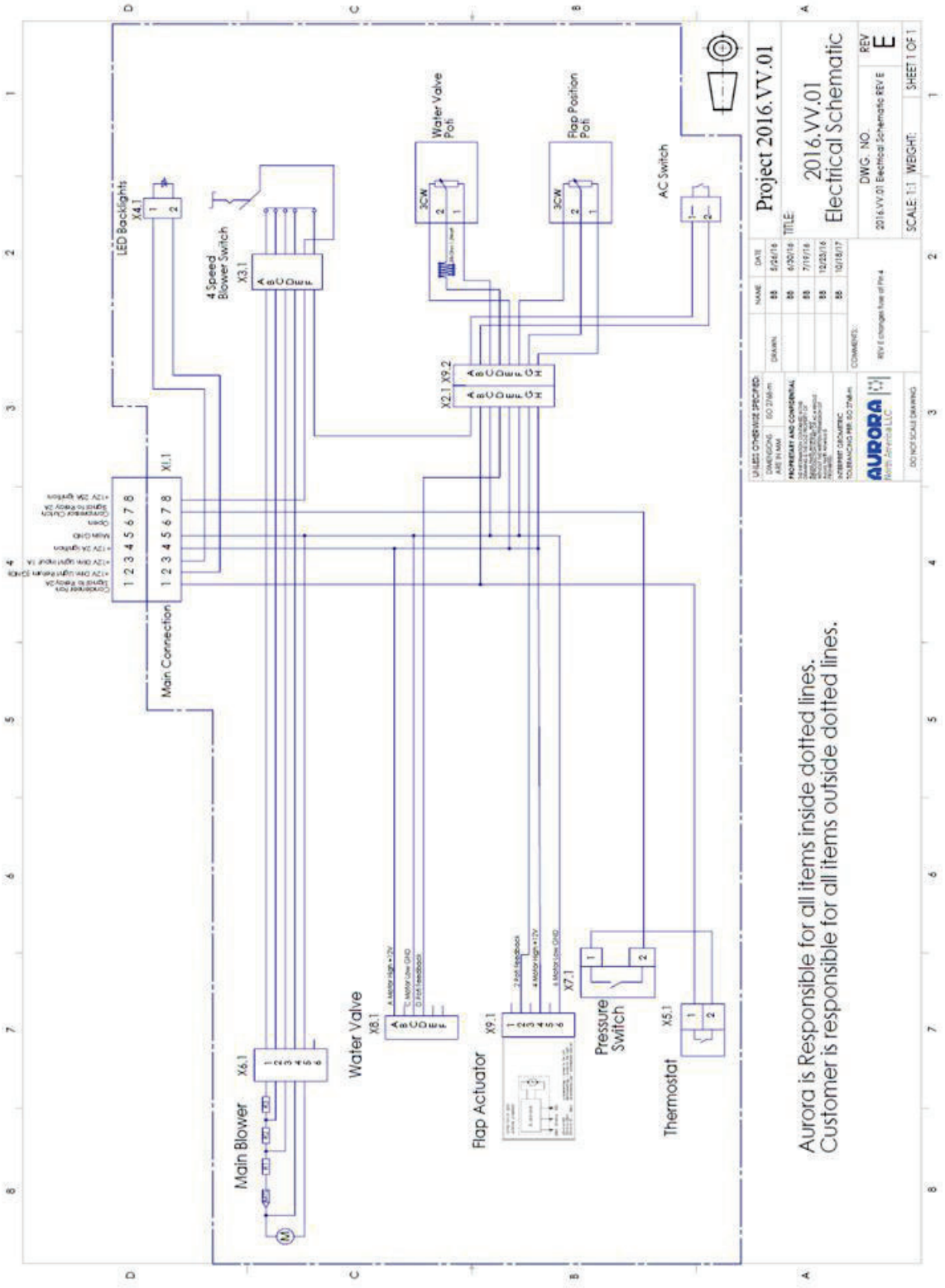


Figure 13: HVAC System Electrical Schematic

Flat Rate Schedule

Item	Aurora Part Number	REV Part Number (If available)	Time Approved
Blower	131-461-0400	10283955 & 10283956	42 Minutes
Heater Core	283-CT1-0200	10283954	1 Hour
Evaporator Core	283-VV4-0204	10283952	42 Minutes
Thermostat	412-310-0037	10283959	42 Minutes
Actuator	411-511-0028	10283962	30 Minutes
Airbox	238-VV1-0001	10283961	1Hour 30 Minutes
Expansion Valve	451-100-0054	10283954	42 Minutes
Pressure Switch	412-500-0020	10283972	6 Minutes
Refrigeration Hose(s)	285-FT3-0001 (w/Pressure Switch Port)	10283970	1 Hour
	285-FT3-0002 (Suction)	10283973	1 Hour
Water Valve	381-000-0451	10283968	18 Minutes
Control Panel	335-544-0220	10511370	12 Minutes

MANUFACTURERS WARRANTY

MANUFACTURER'S REPRESENTATIONS AND WARRANTIES

These Representations and Warranties are applicable to all end-customers (the "Customers" and each, individually, a "Customer") purchasing products (the "Products") manufactured by AURORA NORTH AMERICA, Inc., (the "Company").

1. Warranty and Limitations:

1.1. Company warrants solely to the original purchaser of the Products that for the Warranty Period (as defined below), the Products will be free from defects in materials and workmanship under normal use, and will conform to Company's published specifications of the Products. Notwithstanding the foregoing, Company retains its right to deviate from its published specifications due to the latest innovations and improvements in function and design of the Products. The foregoing warranty is subject to the proper storage, transportation, installation and use of the Products, and does not include defects due to normal wear and tear, deterioration, improper installation, alteration or modification.

1.2. Upon delivery, Customer shall immediately inspect the Products for conformity and visible defects. Customer shall give Company immediate written notice of any non-conformities or visible defects regarding the Products and contact Company in writing concerning return or repair, as the case may be.

1.3. Customer shall notify Company in writing of any defects of the Products. Company's sole obligation under the foregoing warranty is, at Company's option, to repair or correct any such covered defect or to replace or exchange the Product. Any repaired, corrected, replaced or exchanged Products shall be subject to the warranty set forth in 1.1., following their repair, correction, replacement or exchange. If Company has received notification from Customer, and no defects of the Product could be discovered, Customer shall bear the costs that Company incurred as a result of the notice.

1.4. With respect to orders made to custom, any defects of the Products caused by Customer's specifications are excluded from the warranty set forth in 1.1.

1.5. Company also makes no warranty that the Products manufactured under an order made to custom do not infringe the intellectual property or other proprietary rights of any third party and Customer is solely responsible for assuring that such Products do not so infringe.

1.6. The "Warranty Period" begins on the date on which the Products are being physically delivered to Customer's site, and continues to be in effect for the earlier of 15 months or 12,000 miles.

1.7. Company does not authorize any person or party to assume or create for it any other obligation or liability in connection with the Products except as set forth herein.

1.8. Any Software provided to Customer in conjunction with the Products shall be used in accordance with and subject to the terms and conditions of the End User Software License Agreement provided concurrently with these Representations and Warranties.

1.9. All requests and notices under this warranty shall be directed to:

AURORA North America, Inc.
Attn. Joseph Hamilton
6995 Dutton Industrial Park Dr. SE
Caledonia, MI 49316
Phone: 616-698-8545; Fax: 616-698-8579;
Email: auna@aurora-eos.com

1.10. THE WARRANTY SET FORTH IN SECTION 1.1 IS MADE IN LIEU OF ALL OTHER WARRANTIES (WHETHER EXPRESS OR IMPLIED), RIGHTS OR CONDITIONS, AND CUSTOMER ACKNOWLEDGES THAT EXCEPT FOR SUCH LIMITED WARRANTY, THE PRODUCTS ARE PROVIDED "AS IS." COMPANY SPECIFICALLY DISCLAIMS, WITHOUT LIMITATION, ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF ANY KIND, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, AND THOSE WARRANTIES ARISING FROM A COURSE OF PERFORMANCE, A COURSE OF DEALING OR TRADE USAGE.

2. Exclusion from Warranty:

THIS WARRANTY SHALL NOT APPLY TO:

A. Any part or parts of products becoming defective as a result of negligence, lack of preventative maintenance, accident or other casualty.

B. Owner's failure to provide nominal maintenance such as: the proper tightening of compressor drive belts, added amounts of refrigerant due to natural permeation, fittings and component mounting hardware tensioning, cleaning coils, replacement of filter drier in accordance with standard refrigeration practices, improper voltage or loose electrical connectors; and maintaining proper refrigerant and refrigerant oil levels.

C. Improper installation, repairs or alterations not approved by authorized Company personnel.

D. Operation in any manner contrary to Company's operation and service procedures.

E. Any parts or products which have been modified outside of Company's factory unless specific written authorization for such modification has been issued by Company engineering personnel.

F. Defects caused by any repair facility during system maintenance or repair to include system contamination, loose fittings or wiring, torn or crimped O-rings, etc.

G. Consumable or expendable items including but not limited to: filters, belts, lubricants, motor brushes, receiver/filter driers replaced in accordance with standard refrigeration practices, etc.

3. Limitation of Liability:

3.1. IN NO EVENT SHALL COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO, DAMAGES FOR LOSS OF PROFITS, REVENUE, GOODWILL OR USE, INCURRED BY CUSTOMER OR ANY THIRD PARTY, WHETHER IN AN ACTION IN CONTRACT, TORT, STRICT LIABILITY, OR IMPOSED BY STATUTE, OR OTHERWISE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. COMPANY'S LIABILITY FOR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT SHALL IN NO EVENT EXCEED THE PURCHASE PRICE OF THE PRODUCTS. IT IS AGREED AND ACKNOWLEDGED THAT THE PROVISIONS OF THIS AGREEMENT ALLOCATE THE RISKS BETWEEN COMPANY AND CUSTOMER, THAT COMPANY'S PRICING REFLECTS THIS ALLOCATION OF RISK, AND BUT FOR THIS ALLOCATION AND LIMITATION OF LIABILITY, COMPANY WOULD NOT HAVE ENTERED INTO THIS AGREEMENT.

3.2. IN JURISDICTIONS THAT LIMIT THE SCOPE OF OR PRECLUDE LIMITATIONS OR EXCLUSION OF REMEDIES OR DAMAGES, OR OF LIABILITY, SUCH AS LIABILITY FOR GROSS NEGLIGENCE OR WILLFUL MISCONDUCT OR DO NOT ALLOW IMPLIED WARRANTIES TO BE EXCLUDED, THE LIMITATION OR EXCLUSION OF WARRANTIES, REMEDIES, DAMAGES OR LIABILITY SET FORTH ABOVE ARE INTENDED TO APPLY TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW. CUSTOMER MAY ALSO HAVE OTHER RIGHTS THAT VARY BY STATE, COUNTRY OR OTHER JURISDICTION.

NO FURTHER WARRANTY IS EXPRESSED OR IMPLIED THAT IS NOT MENTIONED IN THE ABOVE TEXT. THIS IS THE COMPLETE AND FULL WARRANTY OF THE COMPANY FOR THE PRODUCTS.

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