

Service Manual

NWP500 Electric Heat Pump Water Heaters

Getting Service

If your water heater requires service:

- All repairs require pre-authorization by Technical Support.
- Request for your installer or any licensed professional to contact Technical Support at 1-800-519-8794 Option 2 once at the installation site.
- A short list of independent service providers in your area can be found on the website: www.navieninc.com/installers.
- Contact a licensed professional for the affected system (for example, a plumber or electrician).

When you contact Technical Support, please have the following information at hand:

- Model number
- Serial number
- Date purchased
- Installation location and type
- Error code, if any appears on the front panel display

Version: 1.0 (March, 2025)



Navien, Inc.
800.519.8794 www.navieninc.com
20 Goodyear, Irvine, CA 92618

Service Manual

NWP500 Electric Heat Pump Water Heaters

Model | NWP500-50
NWP500-65
NWP500-80



- Conforms to UL STD 60335-1, 60335-2-40 and 174
- Certified to CSA STD C22.2 # 60335-1, 60335-2-40 and 110



Contains :
FCC ID : P53-EMC3290
IC ID : 23507-EMC3290



ALWAYS read and follow this manual completely before repairing the water heater.

Tested and Certified to NSF/ANSI 372 for lead free* compliance.

* The wetted surface of this product contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight.

WARNING

- Improper installation, operation, or service can damage the water heater, your home, and other property and can create hazards such as fire, burns, electric shock, and explosion, which can result in serious injury or death.
- Read this manual and the water heater's label before installing, operating, or servicing. If you have difficulty following the instructions or are not sure that you can safely and properly perform this work yourself, contact a qualified installer or service organization for installation and servicing.
- Do not destroy this manual; read it carefully and keep it in a safe place for future reference.

Contents

1. About the Water Heater	9	3. Key Components Description	22
1.1 Included Items	9	3.1 Temperature Sensor	22
1.2 Specifications	10	3.2 Energy Cut Off (ECO) Switch	23
1.3 The Front Panel	11	3.3 Heat Element	24
1.4 Components	13	3.4 Fan Assembly	25
1.5 Dimensions	14	3.5 CT Sensor	26
1.6 Rating Plate	17	3.6 Water Leak Sensor	27
		3.7 EEV (Electric Expansion Valve) Coil	28
2. Operating the Water Heater	18	4. Troubleshooting Error Codes	29
2.1 Turning the Water Heater On or Off	18	4.1 Error Codes	29
2.2 Start-Up Wizard	18	4.2 Troubleshooting Error Code Flowcharts	31
2.3 Selecting the Operation Mode & Adjusting Water Temperature	18	4.2.1 E096 - Abnormal Upper Heat Element (UHE)	31
2.4 About Operating Modes	19	4.2.2 E097 - Abnormal Lower Heat Element (LHE)	32
2.4.1 Energy Saver (Hybrid: Efficiency) – Default	19	4.2.3 E326 - Dry Fire	33
2.4.2 High Demand (Hybrid: Boost)	19	4.2.4 E407 - Abnormal Hot Water Temp Sensor	33
2.4.3 Heat Pump	19	4.2.5 E480 - Abnormal Tank Upper Temp Sensor	34
2.4.4 Electric	19	4.2.6 E481 - Abnormal Tank Lower Temp Sensor	34
2.4.5 Vacation - Default: OFF	20	4.2.7 E515-25 - Upper Heat Element Relay Fault	35
2.5 Water Heater Protection Features	20	4.2.8 E515-26 - Lower Heat Element Relay Fault	35
2.5.1 Heat Pump Operation Prevention	20	4.2.9 E515-27 - Compressor Relay Fault	36
2.5.2 Freeze Prevention	20	4.2.10 E517 - Abnormal DIP Switch Setting	36
2.5.3 Anti-Seize	20	4.2.11 E593 - Abnormal Panel Key	37
2.5.4 Alternating from Heat Pump to Electric Operation	20	4.2.12 E594 - Abnormal EEPROM	37
2.6 Component Test Features	20	4.2.13 E595 - Abnormal Power Meter	37
2.6.1 Evaporator Fan Test	20	4.2.14 E596 - Abnormal Wi-Fi Connection	37
2.6.2 Electronic Expansion Valve (EEV) Test	20	4.2.15 E598 - Abnormal (Real-Time Clock)	38
2.6.3 Heat Element Test	20	4.2.16 E615 - Abnormal Control Assembly	38
2.7 Additional Features	21	4.2.17 E781 - Abnormal CTA-2045 Module Communication	38
2.7.1 Hot Water Charge Display	21	4.2.18 E799 - Water Leak Detected	39
2.7.2 Hot Water Availability Display	21	4.2.19 E901 - Abnormal ECO	40
2.7.3 Anti-Legionella - Default: Disable	21	4.2.20 E908 - Abnormal Compressor Operation	41
2.7.4 Demand Response (CTA 2045-B) - Default: Disable	21	4.2.21 E909 - Abnormal Evaporator Fan Operation	42
2.7.5 Weekly Schedule - Default: Disable	21	4.2.22 E910 - Abnormal Discharge Temperature Sensor	43
2.7.6 Intelligent Preheating - Default: Disable	21	4.2.23 E911 - Abnormal Discharge Temperature (High)	44
		4.2.24 E912 - Abnormal Suction Temperature Sensor	45
		4.2.25 E913 - Abnormal Suction Temp Low	46
		4.2.26 E914 - Abnormal Evaporator Temperature Sensor	47
		4.2.27 E915 - Abnormal Discharge, Suction Temperature Difference	48

4.2.28	E916 - Abnormal Evaporator Temperature	49
4.2.29	E920 - Abnormal Ambient Temp Sensor	50
4.2.30	E990 - Condensate Water Overflow	50

5. Replacement of Parts 51

5.1	Preparing for Replacement	51
5.2	Components Replacement Instructions	52
5.2.1	Energy Cut Off (ECO) Switch	52
5.2.2	Intake Filter	53
5.2.3	Valve (Drain, Relief)	53
5.2.4	CT Sensor	54
5.2.5	Capacitor	54
5.2.6	Water Leak Sensor	54
5.2.7	EEV Coil (Electric Expansion Valve Coil)	55
5.2.8	Temperature Sensor (Outside Air)	55
5.2.9	Temperature Sensor (Heater)	56
5.2.10	Fan Assembly	56
5.2.11	Main Controller	57
5.2.12	Heat Element	57

6. Component Assembly Diagrams and Parts Lists 58

7. Appendixes 60

7.1	Wiring Diagram	60
7.2	R-T Table	61

Important Safety Information



The following Safety Alert Symbols are used in this manual. They are used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible serious injury or death. This Safety Alert Symbol precedes any safety message about risk of personal injury. It may also be accompanied by one of the following signal words. If the information in these instructions is not followed exactly, a fire or explosion may result, causing property damage, personal injury or death.

DANGER

Indicates a hazardous situation that if not avoided will result in death or serious injury.

WARNING

Indicates a hazardous situation that if not avoided could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that if not avoided could result in minor or moderate injury.

NOTICE

Indicates information considered important but not hazard-related (such as property damage).

DANGER

Electric Shock Hazards



- Contact with electrical parts in the junction box, behind access doors, and inside the top shroud can result in severe injury or death due to electric shock.
- Disconnect power by opening the circuit breaker or removing the fuses before installation or servicing.
- Use a non-contact circuit tester to confirm that the power is off before working on or near any electrical parts.
- Replace the junction box cover and access doors after servicing.
- When making electrical connections for your water heater, follow the Wiring Diagram carefully to ensure safety and proper operation. Use 10-gauge solid copper wire for all connections to handle the electrical load effectively. It is also important to use a UL-listed or CSA-approved strain relief to secure the wires and prevent them from being pulled or damaged. Finally, connect the ground wire securely to the green ground screw to ensure proper grounding and reduce the risk of electrical shock.

DANGER

Scald Hazards



Water temperatures over 125°F (52°C) can cause severe burns instantly or death from scalds. Children, disabled and elderly are at highest risk of being scalded. Feel water with your elbow before bathing or showering. Temperature limiting valves are available, contact a licensed plumber for more information.

To prevent burns:

- Set the operating temperature to the lowest level that still meets your needs.
- If your household has children or elderly or disabled residents, consider using a lower temperature setting.
- Check local codes for maximum water temperature setting allowed when used in nursing homes, schools, day care centers and other public applications.
- Do not leave children, the elderly, or disabled persons unsupervised.
- Do not allow small children to play unsupervised in the bathroom.
- Do not allow anyone to change the water temperature while hot water is running.
- Read all the instructions in this manual carefully before changing the temperature setting.
- Feel the water before using it on children, the elderly, or the disabled.
- If it is necessary to set the water temperature above 125°F (52°C), consider installing a thermostatically-controlled mixing valve or temperature-limiting valve. Contact a licensed plumber or your local plumbing authority for more information.

DANGER

This water heater's water temperature is set to 120°F (49°C) at the factory for your safety and comfort. Increasing the temperature increases the risk of accidental scalding. Water temperatures at or above 125°F (52°C) can cause instant scalding, severe burns, or death. Before you decide to change the temperature setting, read the following table carefully.

Temperature	Time to Produce Serious Burn
120°F (49°C)	More than 5 minutes
125°F (52°C)	1.5 to 2 minutes
130°F (54°C)	Approx. 30 seconds
135°F (57°C)	Approx. 10 seconds
140°F (60°C)	Less than 5 seconds
145°F (62°C)	Less than 3 seconds
150°F (65°C)	Approx. 1.5 seconds
154°F (68°C)	Approx. 1 second

- Regardless of the water heater's set temperature, higher temperatures may occur in certain circumstances:
 - In some cases, repeated small draws of water can cause the hot and cold water in the tank to "stack" in layers. If this happens, the water temperature can be as much as 30°F (15°C) hotter than the set temperature. This temperature variation is the result of your usage pattern and is not a malfunction.
 - Water temperature will be hotter if someone adjusted the thermostat(s) to a higher setting. Problems with the thermostat(s), or other malfunctions may result in higher than expected water temperatures.
 - If the water heater is in a hot environment, the water in the tank can become as hot as the surrounding air, regardless of the set temperature.
 - If the water supplied to the water heater is pre-heated, the temperature in the tank may be higher than the water heater's set temperature. Connecting an additional heat source, such as a solar water heating system, to the water heater inlet is not recommended, as it may reduce efficiency or cause malfunctions.
- According to the national standard American Society of Sanitary Engineering (ASSE 1070) and most local plumbing codes, the water heater's thermostat should not be used as the sole means to regulate water temperature to avoid scalds.

WARNING

To prevent death, serious injury, or property damage:

- **Do not use or store flammable products, such as gasoline, solvents, or adhesives in the same room or area as the water heater.**

Keep all flammable products far away from the water heater and store them in approved containers. Keep the containers closed tightly and out of the reach of children and pets.

- Ensure the junction box cover and the element access door covers are in place. These covers keep debris from entering and potentially being ignited, and help keep any internal fires from spreading.

- **Prevent the water heater from getting wet.**

If the wiring, thermostat, or surrounding insulation becomes exposed to water, immediately turn off the water heater and have it inspected by a qualified professional. Water exposure can cause serious damage, and if the water heater is submerged in water due to flooding, or if the thermostat has been submerged, the entire unit must be replaced. Regularly inspect your water heater to ensure it remains dry, and take immediate action if it comes into contact with water.

- **High temperatures and pressures in the water heater may lead to an explosion.**

Ensure the included temperature and pressure (T&P) relief valve, which meets ANSI Z21.22 standards, is properly maintained and not blocked, capped, or plugged, as it discharges hot water to prevent such risks.

CAUTION

- **The water heater is heavy.** Always lift the unit with assistance. Be careful not to drop the water heater while lifting or handling it to avoid bodily injury or damage to the unit.



- California law requires that all new and replacement water heaters and all existing residential water heaters be braced, anchored, or strapped to prevent falling or horizontal displacement due to earthquakes. At a minimum, all water heaters must be protected in accordance with the California Plumbing Code, or Section 17958.5, as amended by the city, county, or city and county. The California General Guidelines, entitled "Guidelines for Seismically-Reinforced Residential Water Heaters," are available through relevant government resources for homeowners and installers to ensure compliance with these safety standards.

California law requires the following Prop 65 warning to be provided:

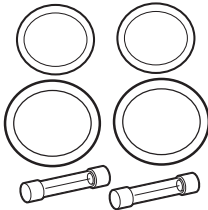
WARNING

Cancer and Reproductive Harm -
www.P65Warnings.ca.gov

1. About the Water Heater

1.1 Included Items

When you open the box, you will find the following items with the water heater. Check the box for each of the following items before installing the water heater.

	
Installation Manual, User's Information Manual	Emergency Part Kit

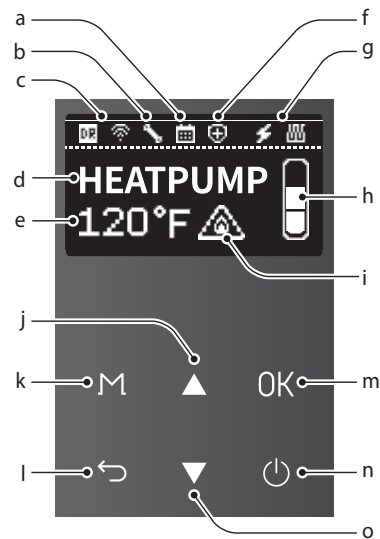
1.2 Specifications

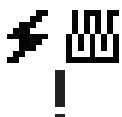
The following table lists the specifications for the water heater. Additional specifications about water, electric, and air supplies appear in the Installation section.

Items		50 Gal	65 Gal	80 Gal
Capacity & Efficiency				
Nominal Capacity (gallons)		50	65	80
Rated Storage Volume (gallons)		45.2	63.2	76.1
UEF (Uniform Energy Factor)		3.91	4.07	4.12
First Hour Rating (gallons)		64	80	85
Product General Data				
Installation Location		Indoor		
Water Pressure		15–150 psi		
Connections Size	Cold Water Inlet	¾ in. NPT		
	Hot Water Outlet			
	Drain			
	T&P Relief Valve			
	Condensate Drain	¾" NPT Plastic connection		
	Heating Element	1" NPSM (Thread per Inch 11 ½)		
Materials	Casing	Cold Rolled Carbon Steel		
	Storage Tank	Stainless Steel		
	Condenser	Aluminum Coil		
Air In/Out Size	Air Intake	Ø8"		
	Air Exhaust	Ø8"		
Safety Devices		Condensate Level Sensor, ECO (Energy Cut Off), Temperature & Pressure (TP) Relief Valve.		
Dimensions		Ø21.8" × 63" (Ø 552 mm × 1,600 mm)	Ø25" × 63" (Ø 636 mm × 1,600 mm)	Ø25" × 71.6" (Ø 636 mm × 1,819 mm)
Shipping Weight (lbs)		229	265	282
Electrical Data				
Power Supply		208-240 V AC, 60 Hz, 1 Phase		
MCA		208 V (25.9A) / 240 V (28.8A)		
CKT BKR Amps		30A		
Wire Size		Up to 10 AWG (Suitable for 167°F (75°C))		
Component Data				
Compressor [LRA]		11.6A		
Fan Motor [FLA]		0.22A		
Volts		208 V	240 V	
Compressor [RLA]		2.0A	1.75A	
Heating Element	Upper	3,755 W	5,000 W	
	Lower	3,755 W	5,000 W	
Max. Pressure	Discharge	2.654 MPa / 385 PSIG		
	Suction	1.724 MPa / 250 PSIG		
Refrigerant		R-134a		
Refrigerant Charge		28.2 Oz / 800 g		

1.3 The Front Panel

The front panel allows you to adjust the water temperature and view the operating status or error codes. Remove the protective sheet from the front panel before using it.

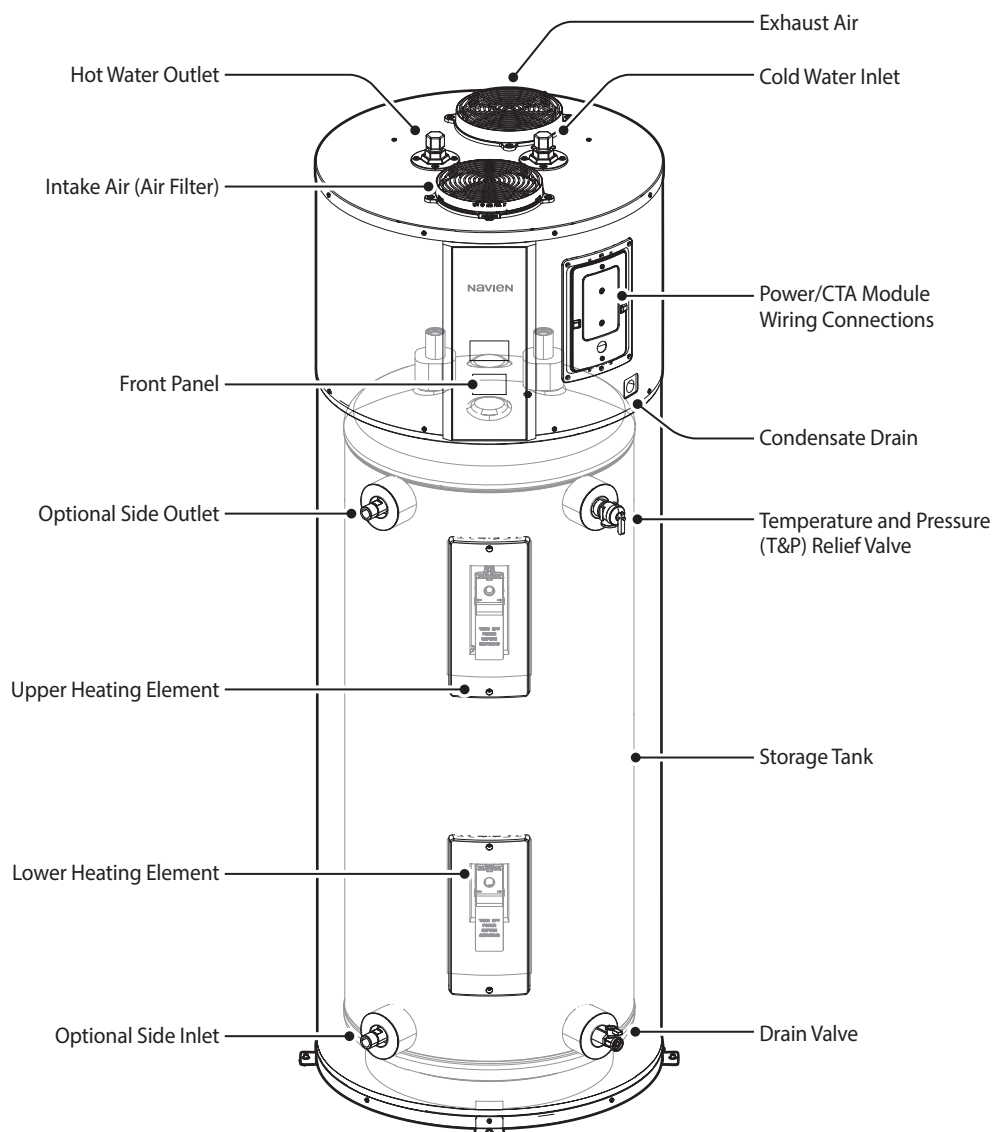


a		Schedule Displays the schedule settings.	b		Error status Displays error status.
c		Demand Response / Wi-Fi Displays the when the DR module and Wi-Fi is connected	d	E-SAVER HI-DEM IDLE ELECTRIC VAC-90 HEATPUMP	Operation Mode Displays the current operation mode.
e	120 °F	Set Hot Water Temperature Displays the set hot water temperature.	f		Anti-Legionella function status Displays the anti-legionella function operation status.
g		Heating Element status  Displays when the electric heater is operating.  Displays when the heat pump is operating.  Displays when the heat pump's operation stops.	h		Hot water charge rate Displays the current hot water charge rate.
i		Scald warning / Antifreeze  Displays a warning to alert you to the danger of scalding from hot water temperatures.  Displays when the antifreeze function is operating.	j		Up button Increases the temperature setting, parameter or moves down.

k	M	Menu button Change the operation mode and access to the menu screen.	l		Back Button Access to the previous screen.
m	OK	OK button Access to the selected item.	n		Power Button Turns the water heater on or off.
o		Down button Decreases the temperature setting, parameter or moves down.			

1.4 Components

The following diagram shows the key components of the water heater. Component assembly diagrams and particular parts lists are included in the Appendixes.

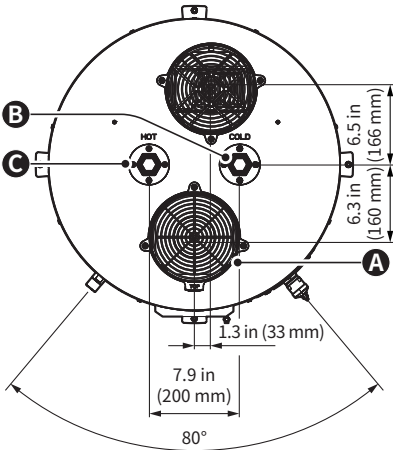


1.5 Dimensions

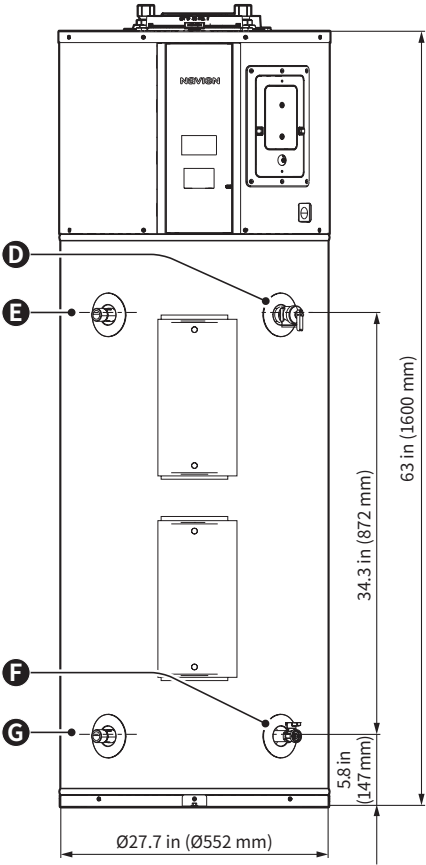
The following diagrams show the dimensions of the water heater and the table lists the supply connections.

NWP500-50

	Description	Diameter
A	Intake Exhaust	Ø8"(Ø203 mm)
B	Cold water inlet	NPT ¾"
C	Hot water outlet	
D	Temperature and pressure (T&P) relief valve	
E	Hot water outlet	
F	Drain valve	
G	Cold water inlet	



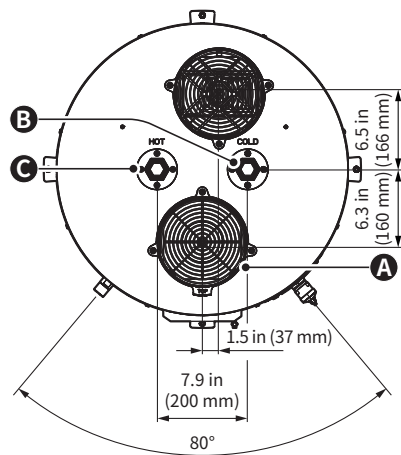
[Top View]



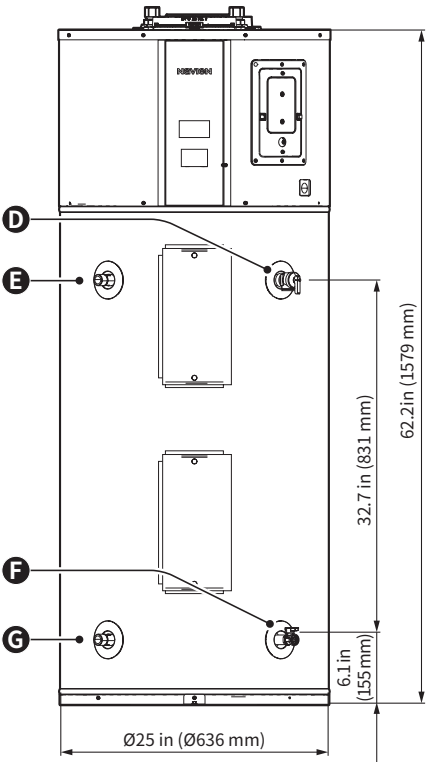
[Front View]

NWP500-65

	Description	Diameter
A	Intake Exhaust	Ø8"(Ø203 mm)
B	Cold water inlet	NPT ¾"
C	Hot water outlet	
D	Temperature and pressure (T&P) relief valve	
E	Hot water outlet	
F	Drain valve	
G	Cold water inlet	



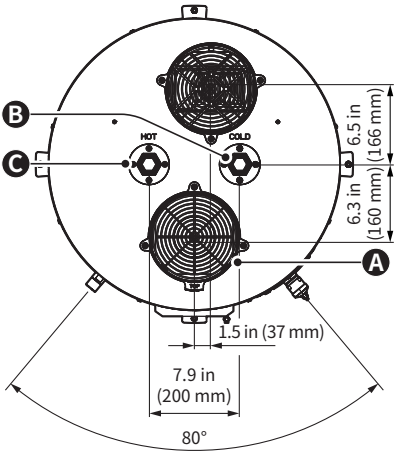
[Top View]



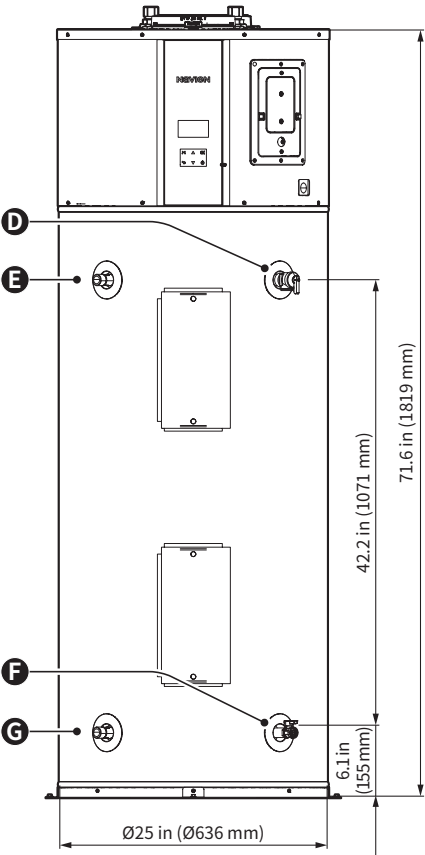
[Front View]

NWP500-80

	Description	Diameter
A	Intake Exhaust	Ø8"(Ø203 mm)
B	Cold water inlet	NPT ¾"
C	Hot water outlet	
D	Temperature and pressure (T&P) relief valve	
E	Hot water outlet	
F	Drain valve	
G	Cold water inlet	



[Top View]



[Front View]

1.6 Rating Plate

The Navien NWP500 electric heat pump water heater comes pre-configured from the factory to operate on 208V/240V 60Hz power. Before beginning the installation, check the rating plate on the side of the unit to confirm that the electrical supply and water pressure at the installation site are compatible with the water heater.

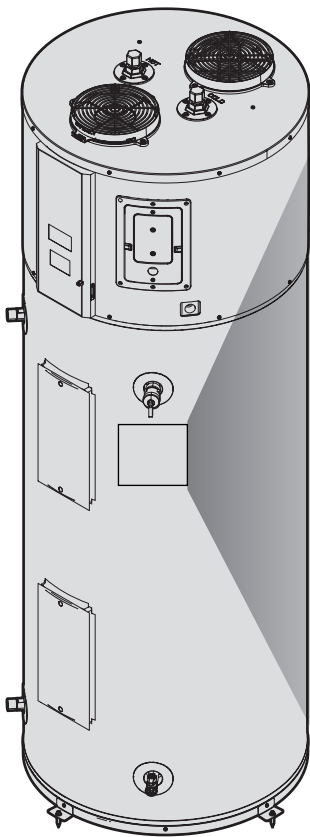
 WARNING

To prevent death, serious injury, or property damage:

Before starting installation, check the rating plate to ensure that the electrical supply specifications available at the installation location match the water heater. Do not install the water heater if it does not match the contents of this rating plate. Using an incorrect type of electrical power supply may cause the water heater to operate abnormally or malfunction.

The electrical supply must be connected by a licensed professional electrician. Grounding must be connected during electrical construction. Use wires with a gauge of AWG10 or higher and suitable for 167°F (75°C). Install a power breaker with a capacity greater than that specified on the rating plate.

Navien Inc. is not responsible for property damage, fatal injuries, and death caused by improper installation.



Heat Pump Water Heater
Chauffe-eau à thermopompe
Indoor installation (Installation à l'intérieur)

Navien, Inc. / 20 Goodyear, Irvine, CA 92618 / Tel: 1-800-519-8794			
Model No. *Numéro de modèle		NWP500S080AUMB	
Nominal Volume *Volume nominal		80 Gal	
Max. Working Press *Pression de service max.		150 PSI (1,034 kPa)	
Fan Motor (FLA) *Moteur du ventilateur (FLA)		0.11	
Min Supply Circuit Ampacity *Courant admissible min. du circuit d'alimentation		28.5 A	
Design Pressure High *Pression nominale max.		385 psig / 2654 kPa	
Refrigerant *Réfrigérant		R-134a	
Temperature&Pressure (TP) Relief Valve Capacity *Capacité de la soupape de détente de température et de pression (TP)		150 PSI, 210°F, ANSI Z21.22	
Volts	208 / 240	Hertz	60
		Phase	1
Rated Volume *Volume nominal		76.1 Gal	
Compressor (LRA) *Compresseur (LRA)		11.6 A	
Max. Fuse or Circuit BRK Size, *Capacité max. du fusible ou du disjoncteur		30 A	
Design Pressure Low *Pression nominale min.		250 psig / 1724 kPa	
Refrigerant Factory Charge *Charge de réfrigérant à l'usine		28.2 Oz / 800 g	

Volts AC *Volts AC	Compressor *Compresseur (LRA)	Upper Elements *Éléments supérieur	Lower Elements *Éléments inférieurs
240 V	1.56 A	5.0 Kw	5.0 Kw
208 V	1.75 A	3.8 Kw	3.8 Kw





Bar code

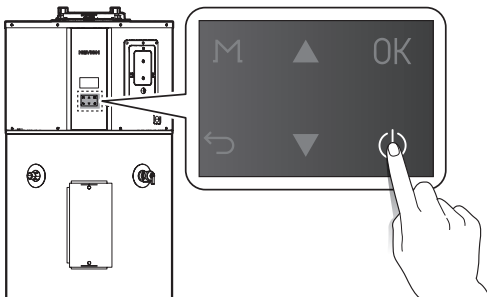
2. Operating the Water Heater

NOTICE

Do not turn on the water heater without ensuring that all air has been purged from the tank and that the tank is completely filled with water. This water heater is equipped with a "Dry Fire" protection function that detects if the tank is not fully filled with water at the initial power connection. However, if the element operates when the tank is empty, there is a risk of fire or electric shock. Therefore, before turning on the water heater, ensure the tank is filled with water and all air is removed. The "Dry Fire" protection function operates only at the initial power connection.

2.1 Turning the Water Heater On or Off

To turn the water heater on or off, press the Power button.



When the power is turned on, the product performs the Self Diagnostic operation. (This operation is performed each time the power is turned on after being in an unpowered state.)

The Self Diagnostic process takes approximately 10 minutes, during which the front panel will display [Self Diagnostic in Progress].

If an issue is detected during the Self Diagnostic process, an error code will be displayed. If the error is one that prevents the product from operating, the product will remain in a stopped state until the issue is resolved.

WARNING

Do not disconnect the power from the product during the Self Diagnostic operation. Disconnecting the power during the Self Diagnostic process may damage the product. Additionally, if the power is disconnected and then turned on, the Self Diagnostic process will start again from the beginning.

2.2 Start-Up Wizard

The setup wizard should run the first time the unit is powered on. The wizard must be completed before the furnace can be used.

When the setup wizard is displayed after turning on the water heater first time, press the Up button (▲) or the Down button (▼) to switch between the items in the Start-Up Wizard, and then, press the OK Button (OK) to confirm and continue. To return to the setup wizard menu, press the Back button (↶).

1. Set the time.
 - YYYY:MM:DD:HH:MM:SS:AM
2. Set the units to display.
 - °F
 - °C

2.3 Selecting the Operation Mode & Adjusting Water Temperature

After the 10-minute Self Diagnostic mode is completed, the product will enter Idle mode.

You can select the desired operation mode according to your preferences or usage environment. For a description of each mode, refer to "2.4 About Operating Modes" on page 19.

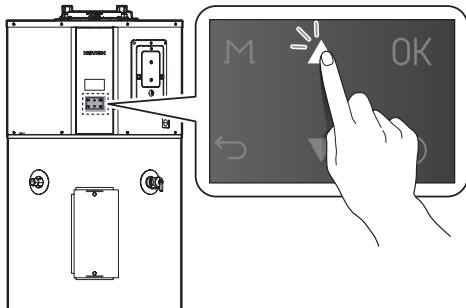
The same tank temperature can be set for all provided operation modes. The setting range is 95°F (35°C) to 150°F (65.5°C). If it is set to 120°F or higher, [Scald Risk] will be displayed on the front panel.

WARNING

Before adjusting the water temperature, read "To prevent burns:" on page 7 carefully. Water above 120 °F can cause instant scalding, severe burns, or death.

The water heater is set to 120 °F (49 °C) by default. To adjust the water temperature:

1. Make sure that all hot water faucets are closed.
2. Press the Up button (▲) or the Down button (▼) until the desired temperature appears on the display. You can adjust the temperature while the display is flashing. Once the display stops flashing, the temperature setting is stored.



Note The water heater will retain your settings during a power outage.

You can adjust the temperature by 1 degree increments as shown below, depending on the temperature range:

Temperature Range	Temperature Increment
95°F–150°F (Fahrenheit mode) 35°C–65.5°C (Celsius mode)	1°F or 0.5°C increments

2.4 About Operating Modes

2.4.1 Energy Saver (Hybrid: Efficiency) – Default

This mode combines the heat pump and electric heater (heating element) as the heat source to heat the tank. The heat pump is primarily used to enhance energy efficiency, while the electric heater is used to reduce the recovery time. This mode is the default operating mode applied during initial shipment and factory reset.

2.4.2 High Demand (Hybrid: Boost)

This mode controls the tank's heating by combining the heat pump and electric heater (heating element). The electric heater is used more frequently than when it is in the Energy Saver mode to further shorten the recovery time. This mode is set when a higher supply of hot water is desired.

2.4.3 Heat Pump

This mode controls the heating of the tank using only the heat pump as the heat source. It is the most energy-efficient mode among the available operating modes, but it also has the longest recovery time. When operating solely with the heat pump, the energy efficiency and recovery time may vary depending on the ambient temperature and relative humidity (the higher the ambient temperature and relative humidity, the greater the energy efficiency and the shorter the recovery time).

2.4.4 Electric

This mode controls the heating of the tank using only the electric heater (upper and lower). It is the least energy-efficient mode, but it offers the shortest recovery time. When this mode is set, it can be used continuously for up to 72 hours (3 days), after which it will automatically return to the previous operating mode. (The upper and lower heaters do not operate simultaneously.)

2.4.5 Vacation - Default: OFF

This mode is provided to prevent unnecessary tank heating operations during vacations or long absences. The number of days for the Vacation mode can be set from **0 days (OFF) to 1 to 99 days**. When this mode is set, the tank heating operation is suspended for the set number of days, and only minimal operations (such as freeze protection and anti-seize) are performed to protect the product. However, 9 hours before the set number of days is reached, the mode automatically reverts to the previous operating mode and performs tank heating operations until the set temperature is reached.

Mode	Efficiency	Recovery
Electric	Very Low	Fast
Heat Pump	High	Very Slow
High Demand	Low	Very Fast
Energy Saver	Very High	Fast
Vacation	Very High	None

2.5 Water Heater Protection Features

2.5.1 Heat Pump Operation Prevention

The heat pump will only operate when the ambient temperature around the product is between 41°F (5°C) and 113°F (45°C), and the water temperature inside the tank is between 50°F (10°C) and 149°F (65°C). Outside of these temperature ranges, the heat pump does not operate, and the front panel displays “Operation Prevention in Progress.”

2.5.2 Freeze Prevention

This protection feature prevents the freezing of water inside the tank. When the water temperature inside the tank falls below the set threshold (default: 43°F (6°C)), the electric heater is activated to raise the water temperature inside the tank. Once the water temperature inside the tank rises to a certain level, this operation stops. While the freeze prevention feature is active, the front panel displays “Freeze Prevention in Progress.”

2.5.3 Anti-Seize

The shut-off valve and electronic expansion valve (EEV) will operate for a set period at regular intervals to prevent seizing.

2.5.4 Alternating from Heat Pump to Electric Operation

If there is a problem with the heat source used in the selected operating mode and that heat source cannot be operated, tank heating will continue with the remaining alternative heat source that is confirmed to be in normal condition until the problematic heat source returns to normal.

- If the heat pump cannot operate, the electric heater will be used to heat the tank.
- If the electric heater cannot operate, the heat pump will be used to heat the tank.
- If the upper electric heater cannot operate, the lower electric heater will be used to heat the tank.

2.6 Component Test Features

These tests can be performed using the front panel to check each device's normal operation and identify any faults.

2.6.1 Evaporator Fan Test

This test will run and then stop the evaporator fan for 20 seconds. During operation, the current RPM value of the evaporator fan is displayed on the front panel.

2.6.2 Electronic Expansion Valve (EEV) Test

This test allows you to check the status by controlling the electronic expansion valve (EEV) between the minimum and maximum range. During the test, “SOUND CHECK” is displayed on the front panel. The water heater then adjusts the valve to the minimum range and waits 2 seconds, adjusts to the maximum range and waits 2 seconds, and then finally returns to the state before the test started.

2.6.3 Heat Element Test

This test selects either the upper or lower heat element for testing. When the test starts, the ON/OFF cycle repeats three times, and the ON/OFF status and current power consumption are displayed on the front panel.

2.7 Additional Features

2.7.1 Hot Water Charge Display

This feature calculates the thermal energy (energy storage) status inside the tank based on the current water temperature and displays it on the front panel.

2.7.2 Hot Water Availability Display

When this icon is displayed on the front panel, it ensures the supply of hot water at the set temperature. However, even if the icon disappears, hot water at the set temperature can still be supplied for a certain period, depending on the flow rate of the hot water being used.

2.7.3 Anti-Legionella - Default: Disable

CAUTION

A mixing valve must be installed to prevent the risk of burns from high-temperature water when the anti-legionella feature is activated.

When the anti-legionella function is enabled, the water temperature in the tank will be heated to 140°F (60°C) at a set interval (default: 7 days, adjustable from 1 to 30 days) to prevent Legionella bacteria.

2.7.4 Demand Response (CTA 2045-B) - Default: Disable

NOTICE

In demand response applications, a thermostatic mixing valve certified to ASSE 1017 is required to be installed on the hot water outlet pipe. Refer to the installation instructions provided by the valve manufacturer.

If the CTA-2045 Module (or EcoPort Module) is connected to the product and the DR (Demand Response) function is enabled in the front panel settings menu, power usage control will be performed according to DR commands sent by the Electric Utility. Various commands, such as Shed or Load Up, can be received. Upon receiving a command from the Grid, normal operation will immediately stop, and the corresponding action will be performed. While performing actions in response to a DR command, the front panel will display the DR label. If necessary, you can disable the DR function to operate in normal mode, which will remain in effect for up to 72 hours (3 days).

2.7.5 Weekly Schedule - Default: Disable

When the weekly reservation feature is enabled, the tank's thermal storage operation is performed according to the reservation type and settings. There are three reservation types available: [1Day (same settings for all days)], [3Days (Mon-Fri, Sat, Sun)], and [7Days (separate settings for each day)].

Once a reservation type is selected, the reservation time, operating mode, and tank temperature settings can be configured. While operating using the reservation settings, if you change any settings (such as operating mode or tank temperature), the product will immediately operate according to the new settings. When the next scheduled reservation time is reached, it will continue operating according to the previously reserved settings.

2.7.6 Intelligent Preheating - Default: Disable

This feature monitors hot water usage to perform optimized thermal storage operations in the tank. It reduces energy consumption while providing hot water based on the necessary thermal storage operations.

When this feature is enabled, the system needs an initial learning period of one week to observe your hot water consumption and usage patterns, during which it performs the usual tank thermal storage operations. After the first week, it will begin optimized thermal storage operations based on the learned data. The learning process will proceed continuously, and it profiles data over a period of up to 4 weeks.

Based on the profiling results, the system will automatically determine the optimal temperature and heating duration for the water tank.

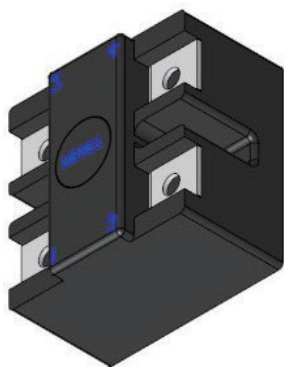
3. Key Components Description

3.1 Temperature Sensor

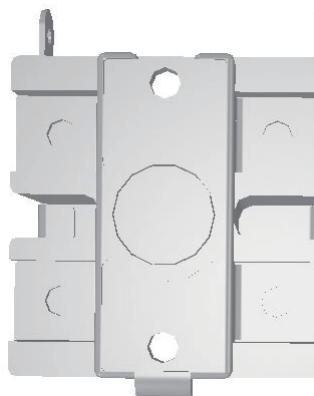
Item	Description
Function	• Measurement of temperatures related to the heat pump cycle (discharge, suction, evaporator, ambient air) • Measurement of tank temperatures (upper, lower)
Failure Event	• Measurement of temperatures related to the Heat Pump cycle is not possible. • Measurement of tank temperatures is not possible.
Effects	• If the temperature sensor related to the heat pump cycle fails, the heat pump cannot operate. • If the upper tank temperature sensor fails, the upper heat element cannot operate. • If the lower tank temperature sensor fails, the lower heat element and the heat pump cannot operate.
Error Code	E480, E481, E910, E912, E914, E920
Diagnostic	• Visually check the connection status of the temperature sensor, and as well look as for any breaks or shorts. • Measure the resistance value of the temperature sensor. Refer to "7.2 R-T Table" on page 61.
	

3.2 Energy Cut Off (ECO) Switch

Item	Description
Function	When overheating is detected at the upper tank temperature, cut off the power supply to the heat pump and heat element.
Failure Event	Unable to prevent temperature overheating and cut off power supply in the case of ECO failure.
Effects	- ECO failure (stuck in power supply cut-off state): heat pump and heat element cannot operate. - ECO failure (stuck in power supply cut-off impossible state): Unable to determine the fault status.
Error Code	- ECO malfunction (stuck in power supply cutoff state): E901 - ECO malfunction (stuck in state where the power supply cannot be cut off): Unable to determine fault.
Diagnostic	- ECO failure (stuck in the power supply cutoff state): Open the cover of the upper heat element of the tank and check the status of the ECO's manual reset switch. - Check the wiring status of the ECO.

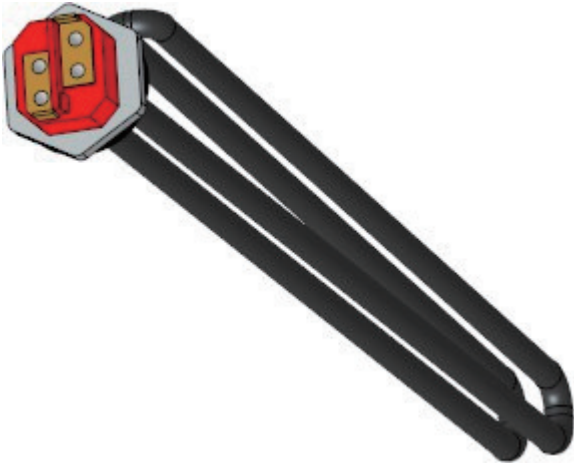


[ECO Switch]



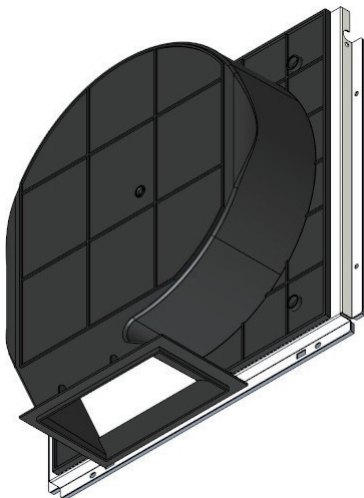
[ECO Switch Cover]

3.3 Heat Element

Item	Description
Function	Electric operating mode: operates as a tank heat storage source.
Failure Event	• Upper tank heat element failure • Lower tank heat element failure
Effects	• If the upper heat element of the tank fails: Heat cannot be stored in the upper tank. • If the lower heat element of the tank fails: Heat cannot be stored in the lower tank.
Error Code	E096, E097, E515-25, E515-26, E615-29, E615-30
Diagnostic	• Check the connection status of the power supply lines for each heat element, including the open circuits and short circuits. • Verify the resistance values of each heat element if they are 11.52Ω. • Confirm the operation of the relays for each heat element. • Check the frequency of the power supply (within 60Hz ± 25%).
Testing/inspection Information	The panel provides a “Heat Element Test” function.
	

3.4 Fan Assembly

Item	Description
Function	Perform fan operation for heat exchange in the evaporator during heat pump operation.
Failure Event	• Unable to control the evaporator fan normally: around 0 rpm • Fan malfunction or connector disconnection • Fan assembly screws are loose or disconnected.
Effects	• Unable to control the target's RPM • Fan not operating (no airflow) • Abnormal vibration or noise
Error Code	E909
Diagnostic	• Visually check the fan mounting status. • Visually check the fan connector fastening status and look for any breaks or shorts. • Check for fan seizure. • Check the cleanliness of the air filter. • Check the VSP voltage and VCC 15 V voltage.
Testing/inspection Information	The panel provides the “Evaporator Fan Test” function.



1	2	3	4
5	6	7	8

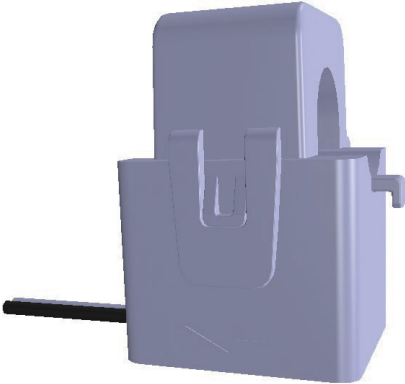
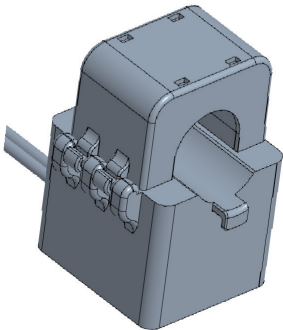
1 : white
2 : orange
3 : x
4 : red

5 : yellow
6 : black(GND)
7 : x
8 : x

Check DC Voltage
- Check VSP : terminal 2(+) & 6(-)
- Check VCC : terminal 5(+) & 6(-)

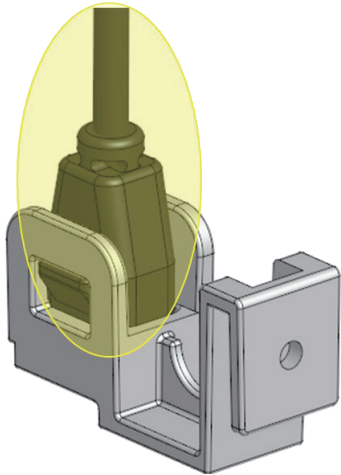
3.5 CT Sensor

Item	Description
Function	Measurement of the product's power consumption
Failure Event	Unable to measure power consumption.
Effects	• The heat pump and heat element cannot operate • Unable to determine errors for anomaly detection based on the power consumption values
Error Code	E096, E097, E908
Diagnostic	• Check the connection status of the CT sensor's connector, including open circuits and short circuits. • Verify that the CT sensor is securely fastened in the correct position (power supply line).

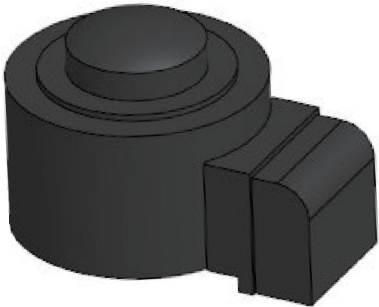


3.6 Water Leak Sensor

Item	Description
Function	Detection of leaks in the product (detection of water accumulation in the drain pan installed at the bottom of the product)
Failure Event	Unable to detect leaks in the product.
Effects	Maintain system shutdown and shut off valve closed status when a leak is detected.
Error Code	E799
Diagnostic	• Check the settings for the leak sensor and shut off valve usage options. (Enable/Disable) • Verify the connection status of the leak sensor's connector and check for open circuits and short circuits.



3.7 EEV (Electric Expansion Valve) Coil

Item	Description
Function	Adjusting the refrigerant amount during heat pump operation (superheat control)
Failure Event	• EEV stuck at a specific opening • EEV opening rate control not functioning • EEV malfunction or connector disconnection status
Effects	Overheating control is not functioning properly.
Error Code	E911, E913, E915, E916
Diagnostic	• Visually check the installation status of the EEV. • Visually check the connection status of the EEV connector and look for any breaks or shorts. • Confirm operation of the EEV by checking for sound and vibration.
Testing/inspection Information	The EEV test option is provided on the panel.
	

4. Troubleshooting Error Codes

4.1 Error Codes

When an error code appears on the front panel, refer to the following table for a definition and possible remedy for the situation.

Note If any of these remedies do not resolve the problem, contact Technical Support at 1-800-519-8794.

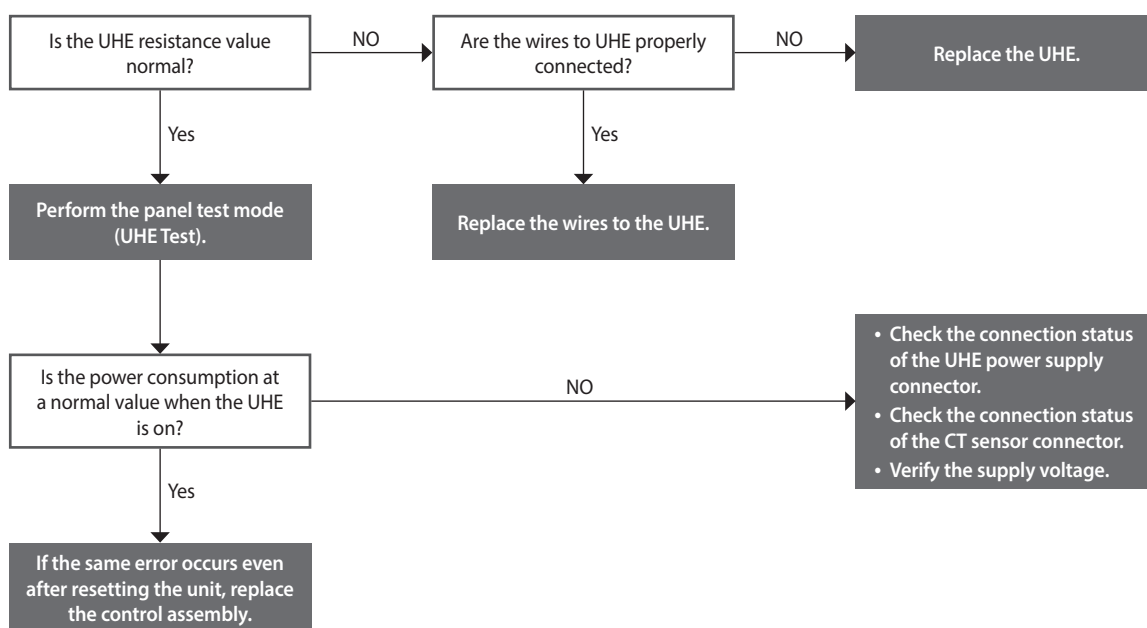
Error Code	Sub Code	Reason	Self-diagnostic/Action
E096	00	Abnormal upper electric heater operation	1. Check the resistance of the element. 2. Check the wiring of the element. 3. Replace the control board. 4. Replace the element. 5. Replace the relay. 6. Contact technical support at 1-800-519-8794.
E097	00	Abnormal lower electric heater operation	
E326	00	Dry fire	Refill water until all air is expelled from the outlet and water flows.
E407	01	Abnormal hot water-temp sensor operation for lower limit	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
	02	Abnormal hot water-temp sensor operation for upper limit	
E480	01	Abnormal tank upper temperature sensor operation for lower limit	1. Check and reconnect the wiring. 2. Check for disconnection in Service Mode. 3. If there is no wiring issue, replace the temperature sensor. • If the tank temperature sensor is faulty, operate in a reduced capacity using the opposite element.
	02	Abnormal tank upper temperature sensor operation for upper limit	
E481	01	Abnormal tank lower temperature sensor operation for lower limit	
	02	Abnormal tank lower temperature sensor operation for upper limit	
E515	25	Upper electric heater relay fault	1. Check and reconnect the wiring. 2. Check the ECO. 3. Press the ECO reset button. 4. If there are no issues with the inspection items, replace the control assembly.
	26	Lower electric heater relay fault	
	27	Compressor relay fault	
E517	00	Abnormal DIP switch settings	Check and reset the DIP switch configuration.
E593	00	Abnormal panel key	Contact technical support at 1-800-519-8794.
E594	00	Abnormal EEPROM operation	
E595	00	Abnormal power meter	1. Check and reconnect the wiring. 2. Replace the power meter.
E596	00	Abnormal Wi-Fi connection	Contact technical support at 1-800-519-8794.
E598	00	Abnormal RTC (Real-Time Clock)	
E615	04	Abnormal ADC reference voltage	1. Check the element. 2. Check the thermistor. 3. Replace the control board.
	27	Abnormal ECO feedback	
	28	Abnormal compressor feedback	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
	29	Abnormal upper element feedback	1. Check and reconnect the wiring. 2. Replace the element.
	30	Abnormal lower element feedback	

Error Code	Sub Code	Reason	Self-diagnostic/Action
E781	00	Abnormal CTA-2045 communication	1. Check and reconnect the wiring. 2. Replace the module.
E799	00	Water leak detected	1. Check for piping leaks. 2. If there is a tank leak, replace the entire tank assembly.
E901	00	Abnormal ECO operation	1. Check the element. 2. Check the thermistor. 3. If there are no issues with the inspection items, replace the control assembly.
E908	00	Abnormal compressor operation	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
E909	01	Abnormal evaporator fan operation	
E910	01	Abnormal compressor's discharge temperature sensor operation for lower limit	
	02	Abnormal compressor's discharge temperature sensor operation for upper limit	
E911	00	Abnormally high compressor's discharge temperature	Contact technical support at 1-800-519-8794.
E912	01	Abnormal compressor's suction temperature sensor operation for lower limit	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
	02	Abnormal compressor's suction temperature sensor operation for upper limit	
E913	00	Abnormally low compressor's suction temperature	Contact technical support at 1-800-519-8794.
E914	01	Abnormal evaporator temperature sensor operation for lower limit	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
	02	Abnormal evaporator temperature sensor operation for upper limit	
E915	00	Abnormal difference of (compressor's discharge temperature) - (compressor's suction temperature)	Contact technical support at 1-800-519-8794.
E916	00	Abnormal evaporator temperature	Contact technical support at 1-800-519-8794.
E920	01	Abnormal ambient air temperature sensor operation for lower limit	1. Check and reconnect the wiring. 2. Contact technical support at 1-800-519-8794.
	02	Abnormal ambient air temperature sensor operation for upper limit	
E990	00	Condensate overflow detected	Check for and remove any foreign objects from the condensate tubing.

4.2 Troubleshooting Error Code Flowcharts

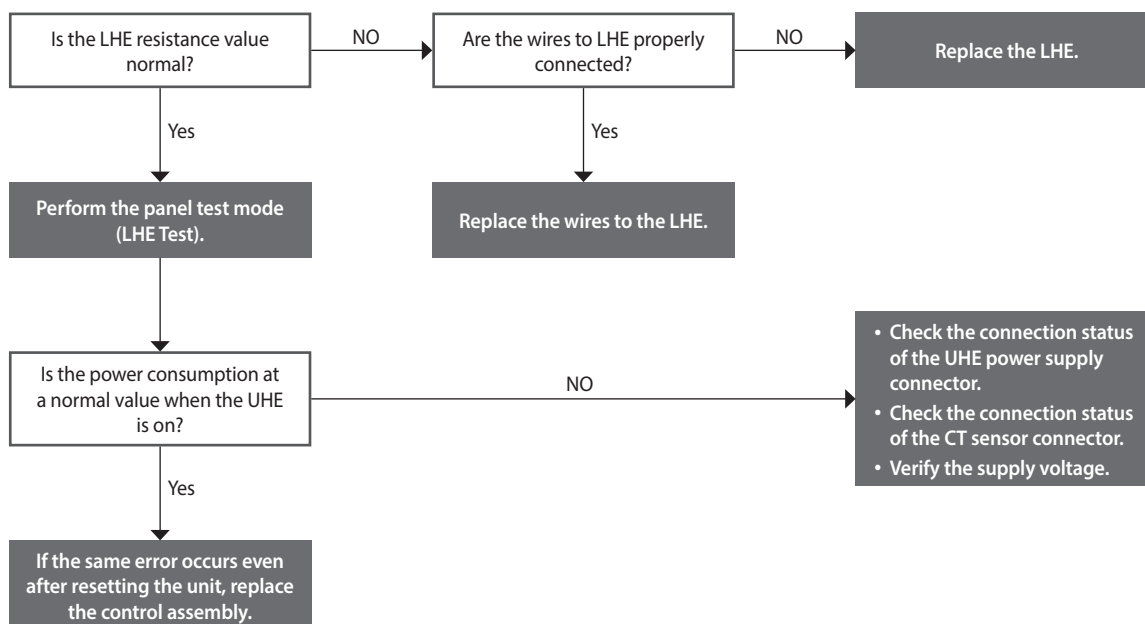
4.2.1 E096 - Abnormal Upper Heat Element (UHE)

Error	Description
E096	If the power consumption remains at 2,560W or below for 10 seconds while the upper heat element is turned on, it will be automatically turned off. If this happens three consecutive times, E096 will occur.
Check Items	• Check the connection status of the power supply line to the upper heat element for disconnection or short circuit. • Measure the resistance of the upper heat element (Normal: 11–13 Ohms, Short circuit: Below 10 Ohms, Open circuit: ∞ Ohms). • Replace the upper heat element if necessary. • Check the connection status of the CT sensor connector for disconnection or short circuit. • Replace the CT sensor if necessary. • Verify the supply voltage (Rated voltage: 208–240V).



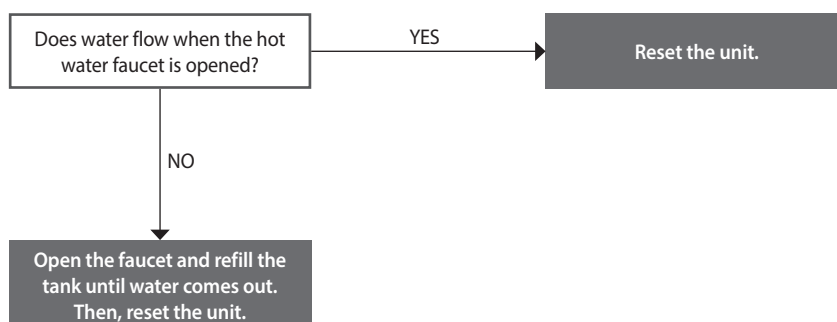
4.2.2 E097 - Abnormal Lower Heat Element (LHE)

Error	Description
E097	If the power consumption remains at 2,560W or below for 10 seconds while the lower heat element (LHE) is turned on, it will be automatically turned off. If this happens three consecutive times, E097 will occur.
Check Items	• Check the connection status of the power supply line to the lower heat element for disconnection or short circuit. • Measure the resistance of the lower heat element (Normal: 11–13 Ohms, Short circuit: Below 10 Ohms, Open circuit: ∞ Ohms). • Replace the lower heat element if necessary. • Check the connection status of the CT sensor connector for disconnection or short circuit. • Replace the CT sensor if necessary. • Verify the supply voltage (Rated voltage: 208–240V).



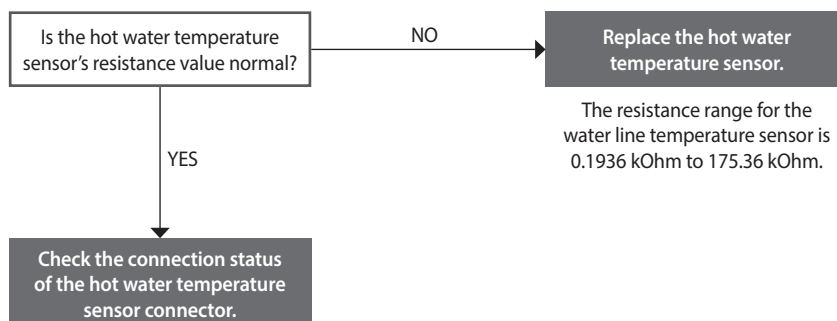
4.2.3 E326 - Dry Fire

Error	Description
E326	When the initial power is supplied to the unit, the temperature increase inside the tank is measured while the upper heat element (UHE) is turning on or off. If the temperature increases rapidly, it indicates that the tank is not full, and E326 will occur.
Check Items	- Check the water level in the tank (turn on the hot water faucet to see if water flows). - Supply the power to the unit again to verify its operation.



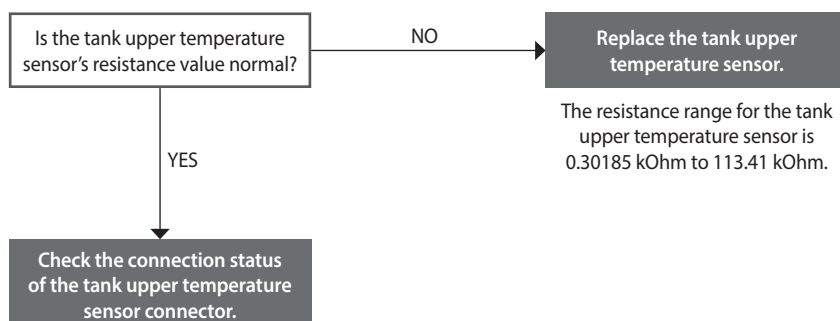
4.2.4 E407 - Abnormal Hot Water Temp Sensor

Error	Description
E407	If the mixing valve is set to be used and the discharge temperature sensor is short-circuited or disconnected, E407 will occur.
Check Items	- Check the connection status of the discharge temperature sensor connector for disconnection or short circuit. - Replace the discharge temperature sensor if necessary. - Replace the control assembly if needed.



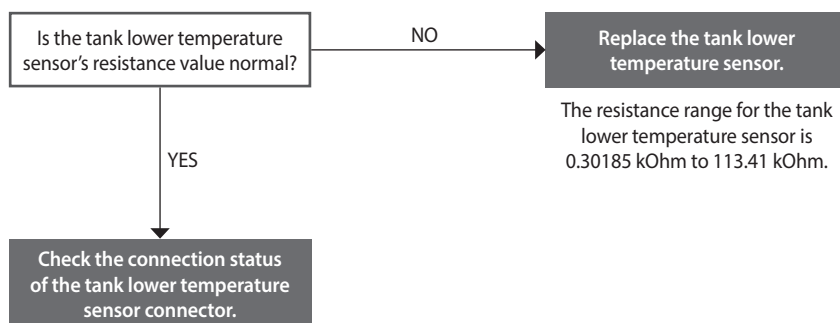
4.2.5 E480 - Abnormal Tank Upper Temp Sensor

Error	Description
E480	If the tank upper temperature sensor is short-circuited or disconnected, E480 error will occur.
Check Items	• Check the connection status of the tank upper temperature sensor connector for disconnection or short circuit. • Replace the tank upper temperature sensor. • Replace the control assembly.



4.2.6 E481 - Abnormal Tank Lower Temp Sensor

Error	Description
E481	If the tank lower temperature sensor is short-circuited or disconnected, E481 error will occur.
Check Items	• Check the connection status of the tank lower temperature sensor connector for disconnection or short circuit. • Replace the tank lower temperature sensor. • Replace the control assembly.



4.2.7 E515-25 - Upper Heat Element Relay Fault

Error	Description
E515-25	If an error occurs in the internal circuit for the control assembly (such as resistance, transistor, or relay failure), E515 will occur.
Check Items	• Check the power supply status (voltage and frequency). • Check the upper heater connector connection status (open or short circuits). • Check the ECO. • Press the ECO reset button. • Replace the control assembly.

Check Method

Fault	Possible Causes	Check Method
PCB or Electrical supply	Defective PCB	Replace the PCB if there is an error with the PCB internal circuit.
	Power supply error	Check with a multimeter if the PCB is supplied with the proper voltage. • Check with a multimeter if the voltage at the electrical outlet is AC 208–240V.
	Power supply grounding noise	Power supply grounding noise causes malfunction. • Disconnect ground from the grounding terminal inside the unit, and check if the PCB is operating normally.

4.2.8 E515-26 - Lower Heat Element Relay Fault

Error	Description
E515-26	If an error occurs in the internal circuit for the control assembly (such as resistance, transistor, or relay failure), E515 will occur.
Check Items	• Check the power supply status (voltage and frequency). • Check the lower heater connector connection status (open or short circuits). • Check the ECO. • Press the ECO reset button. • Replace the PCB.

Check Method

Fault	Possible Causes	Check Method
PCB or Electrical supply	Defective PCB	Replace the PCB if there is an error with the PCB internal circuit.
	Power supply error	Check with a multimeter if the PCB is supplied with the proper voltage. • Check with a multimeter if the voltage at the electrical outlet is AC 208–240V.
	Power supply grounding noise	Power supply grounding noise causes malfunction. • Disconnect ground from the grounding terminal inside the unit, and check if the PCB is operating normally.

4.2.9 E515-27 - Compressor Relay Fault

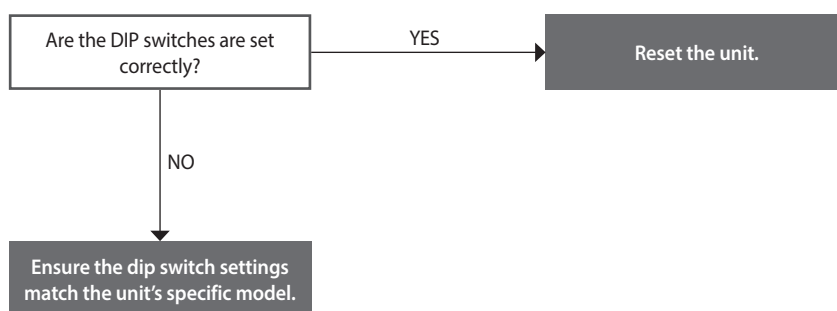
Error	Description
E515-27	If an error occurs in the internal circuit for the control assembly (such as resistance, transistor, or relay failure), E515 will occur.
Check Items	• Check the power supply status (voltage and frequency). • Check the compressor connector connection status (open or short circuits). • Replace the PCB.

Check Method

Fault	Possible Causes	Check Method
PCB or Electrical supply	Defective PCB	Replace the PCB if there is an error with the PCB internal circuit.
	Power supply error	Check with a multimeter if the PCB is supplied with the proper voltage. • Check with a multimeter if the voltage at the electrical outlet is AC 208–240V.
	Power supply grounding noise	Power supply grounding noise causes malfunction. • Disconnect ground from the grounding terminal inside the unit, and check if the PCB is operating normally.

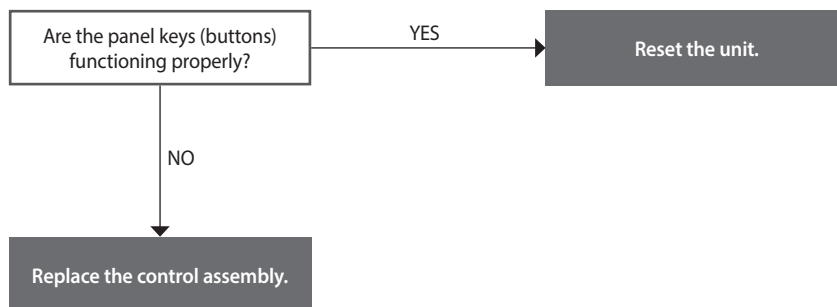
4.2.10 E517 - Abnormal DIP Switch Setting

Error	Description
E517	If the DIP switches are set improperly, E517 will occur.
Check Items	Check the DIP switch settings.



4.2.11 E593 - Abnormal Panel Key

Error	Description
E593	If the keys (buttons) on the front panel are not functioning properly, E593 will occur.
Check Items	Replace the control assembly.



4.2.12 E594 - Abnormal EEPROM

Error	Description
E594	If a data input/output error occurs in the EEPROM (Electrically Erasable Programmable Read-Only Memory) inside the control assembly, E594 will occur.
Check Items	Replace the control assembly.

4.2.13 E595 - Abnormal Power Meter

Error	Description
E595	If the power meter inside the control assembly malfunctions, E595 will occur.
Check Items	Replace the control assembly.

4.2.14 E596 - Abnormal Wi-Fi Connection

Error	Description
E596	If the Wi-Fi module malfunctions inside the control assembly, E596 will occur.
Check Items	Replace the control assembly.

4.2.15 E598 - Abnormal (Real-Time Clock)

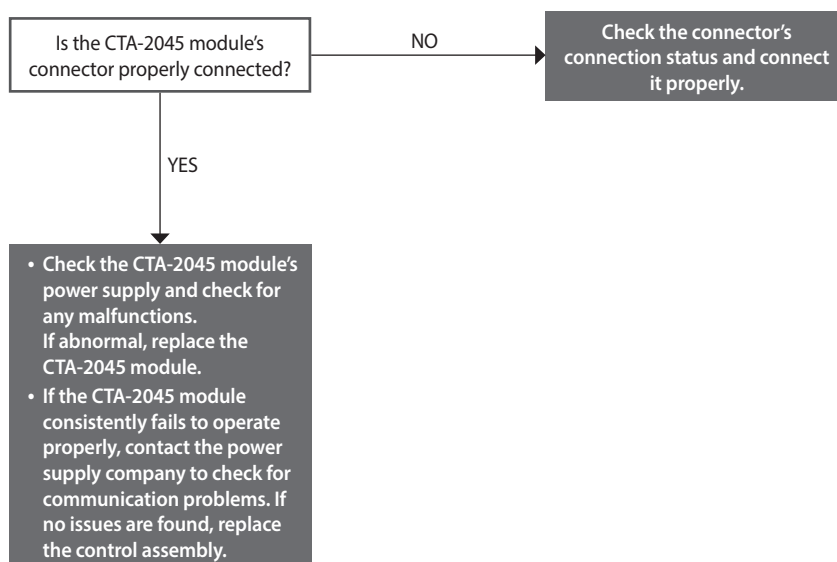
Error	Description
E598	If an errors occurs in the RTC (Real-Time Clock), E598 will occur.
Check Items	Replace the control assembly.

4.2.16 E615 - Abnormal Control Assembly

Error	Description
E615	If an internal error occurs in the control assembly, E615 will occur.
Check Items	• Check the power supply status (voltage and frequency). • Check the connection status of the connectors on the control assembly and check for open or short circuits on them. • Replace the control assembly.

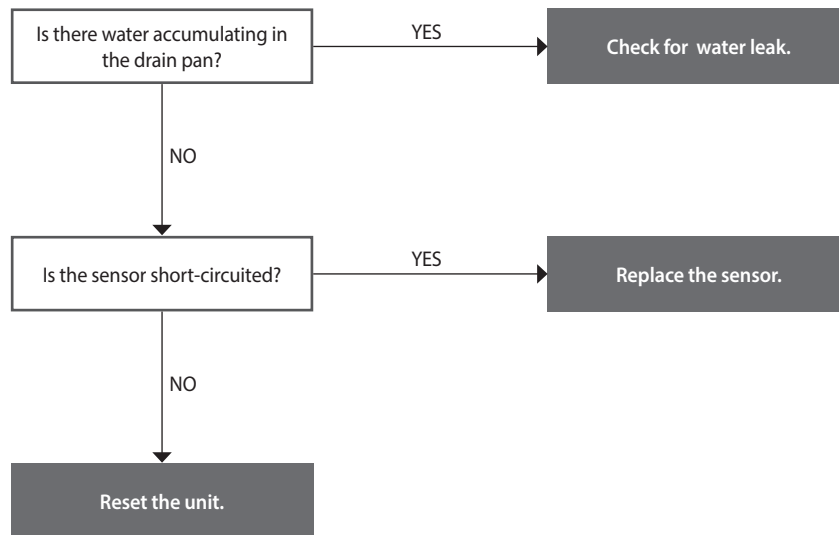
4.2.17 E781 - Abnormal CTA-2045 Module Communication

Error	Description
E781	If a communication error with CTA-2054 module occurs, E781 will occur.
Check Items	• Check the CTA-2045 module connector connection status (open or short-circuit). • Check for any malfunctions of the CTA-2045 module. • Replace the CTA-2045 module or control assembly.



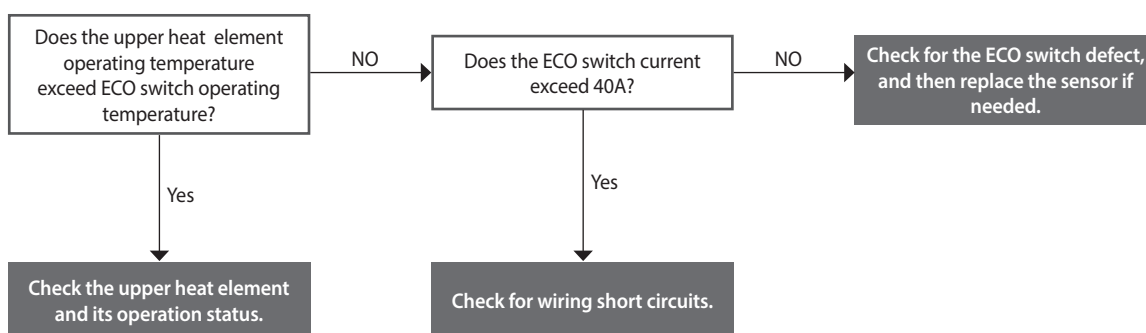
4.2.18 E799 - Water Leak Detected

Error	Description
E799	If the water leak is detected for more than 3 seconds, E799 will occur.
Check Items	• Check if water leak actually occurred. • Check the shut off valve and leak sensor usage option (enabled or disabled). • Check the leak sensor connection status (open or short-circuits).



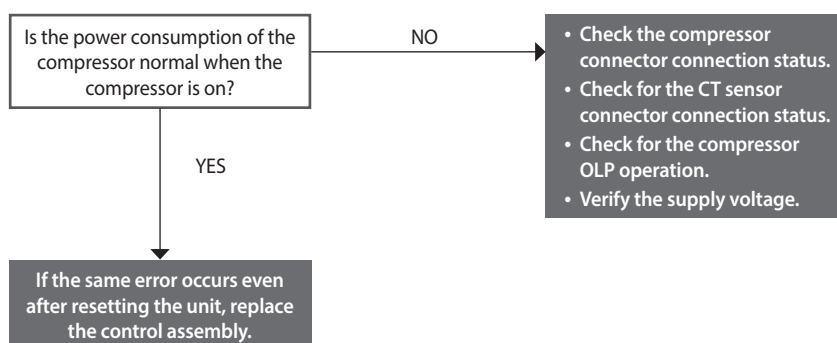
4.2.19 E901 - Abnormal ECO

Error	Description
E901	If the ECO switch feedback signal is detected for more than 10 seconds, E901 will occur.
Check Items	• Check if the upper heat element is operating. • Measure the resistance of the upper heat element (Normal: 11–13 Ohms, Short- circuit: Below 10 Ohms, Open circuit: ∞ Ohms). • Check for any malfunctions of the ECO switch. • Check if the ECO switch is operating normally, and then measure the upper tank temperature (ECO sensor operating temperature: $170\pm5^{\circ}\text{F}$). • Verify the ECO sensor current (Maximum current: 40A).

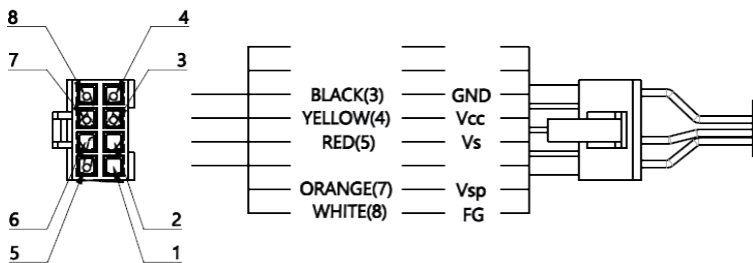


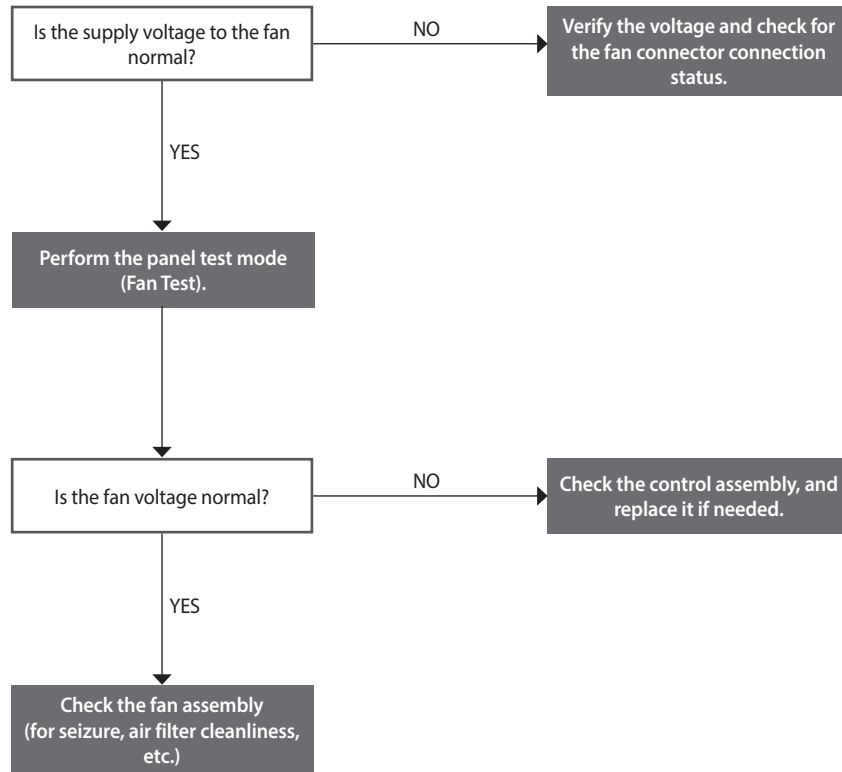
4.2.20 E908 - Abnormal Compressor Operation

Error	Description
E908	If the compressor consumes less than 160W (or less than 2560W if the heater element is on) power for more than 10 seconds, it turns off automatically. If this occurs more than three consecutive times, E908 will occur.
Check Items	• Check the compressor power supply connector connection status (open or short-circuit). • Verify the current when the compressor is on. • Check for the compressor OLP (Overload protector) operation. • Check the CT sensor connection status (open or short-circuit). • Replace the CT sensor.



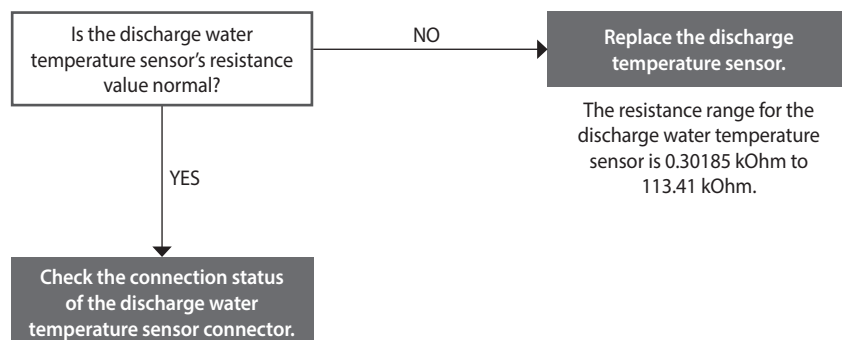
4.2.21 E909 - Abnormal Evaporator Fan Operation

Error	Description																										
E909	If evaporator fan rpm is 0 for more than 3 seconds when it is on, E909 will occur.																										
Check Items	• Visually check the fan installation status. • Visually check the fan connector connection status (open and short-circuits). • Check for the fan seizure. • Check the fan connector with a multimeter if the voltage at the Vs pin is DC 300–400 V. • Check the fan connector with a multimeter if the voltage at the Vcc pin is DC 15±1.5 V.																										
	 The diagram shows a 2x4 pin connector. The pins are numbered 1 through 8. The wire colors and functions are listed as follows: <table><tr><th>Pin</th><th>Wire Color</th><th>Function</th></tr><tr><td>1</td><td>Red</td><td>Vs</td></tr><tr><td>2</td><td>-</td><td>-</td></tr><tr><td>3</td><td>Black</td><td>GND</td></tr><tr><td>4</td><td>White</td><td>Vcc</td></tr><tr><td>5</td><td>Yellow</td><td>Vsp</td></tr><tr><td>6</td><td>Blue</td><td>FG</td></tr><tr><td>7</td><td>Orange</td><td>Vsp</td></tr><tr><td>8</td><td>Black</td><td>GND</td></tr></table>	Pin	Wire Color	Function	1	Red	Vs	2	-	-	3	Black	GND	4	White	Vcc	5	Yellow	Vsp	6	Blue	FG	7	Orange	Vsp	8	Black
Pin	Wire Color	Function																									
1	Red	Vs																									
2	-	-																									
3	Black	GND																									
4	White	Vcc																									
5	Yellow	Vsp																									
6	Blue	FG																									
7	Orange	Vsp																									
8	Black	GND																									



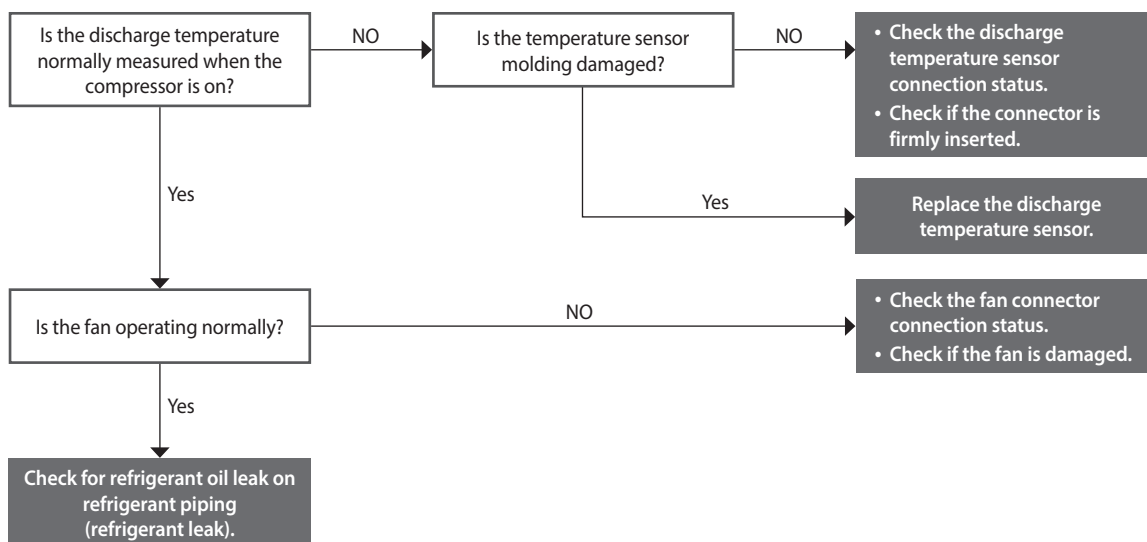
4.2.22 E910 - Abnormal Discharge Temperature Sensor

Error	Description
E910	If the discharge temperature sensor is short-circuited or disconnected, E910 will occur.
Check Items	- Check the discharge temperature sensor connector connection status (open or short-circuits). - Replace the discharge temperature sensor. - Replace the PCB.



4.2.23 E911 - Abnormal Discharge Temperature (High)

Error	Description
E911	If the compressor's discharge temperature exceeds 203°F(95°C) more than three consecutive times after 6 minutes turning on the compressor, E911 will occur.
Check Items	• Check for the incorrect compressor wiring (Check if the compressor is running in reverse phase). • Check for refrigerant leak. • Check for the temperature sensor. • Check if the fan is operating normally.

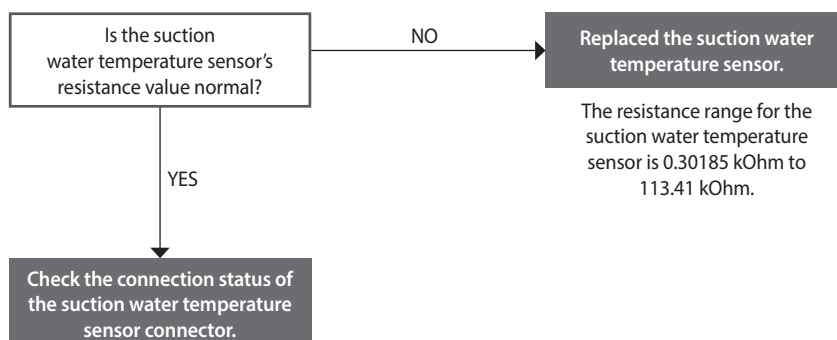


Note

Product replacement is necessary when refrigerant leaks or cycle component problems occur.

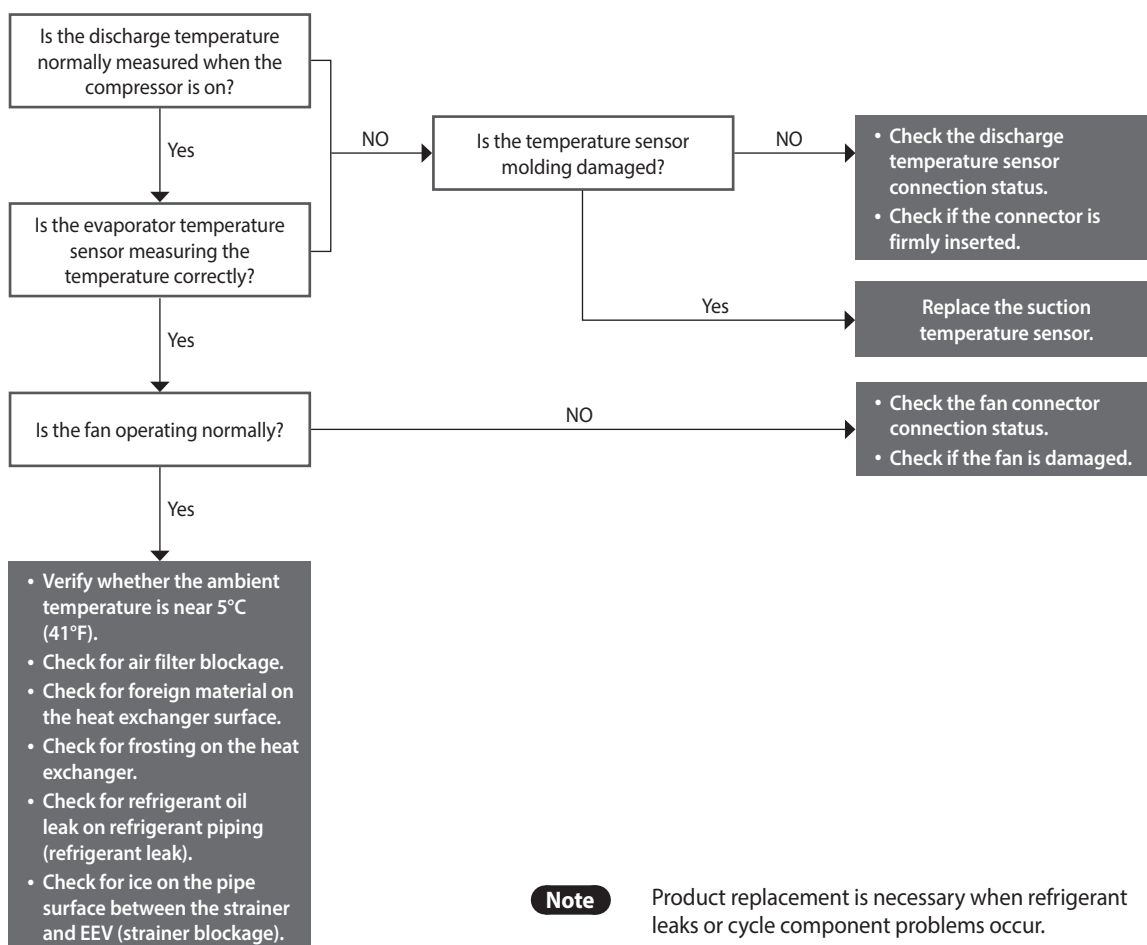
4.2.24 E912 - Abnormal Suction Temperature Sensor

Error	Description
E912	If the suction temperature sensor is short-circuited or disconnected, E912 will occur.
Check Items	• Check the suction temperature sensor connector connection status (open or short-circuits). • Replace the suction temperature sensor. • Replace the control assembly.



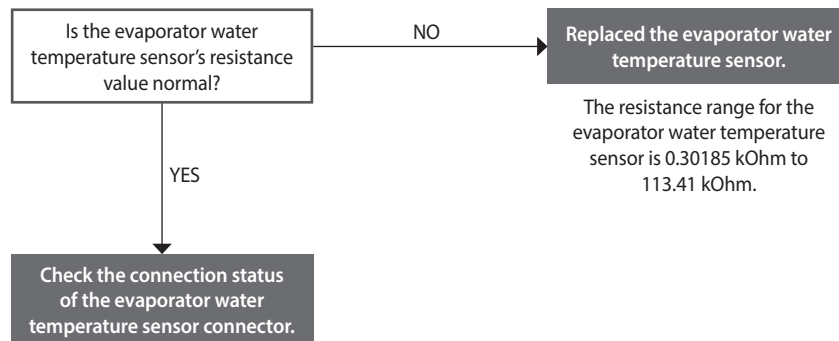
4.2.25 E913 - Abnormal Suction Temp Low

Error	Description
E913	If the compressor's suction temperature drops below 23°F(-5°C) for more than three consecutive times after 6 minutes turning on the compressor, E913 will occur.
Check Items	• Check if the air filter is clean. • Verify the fan RPM. • Check for the evaporator frosting.



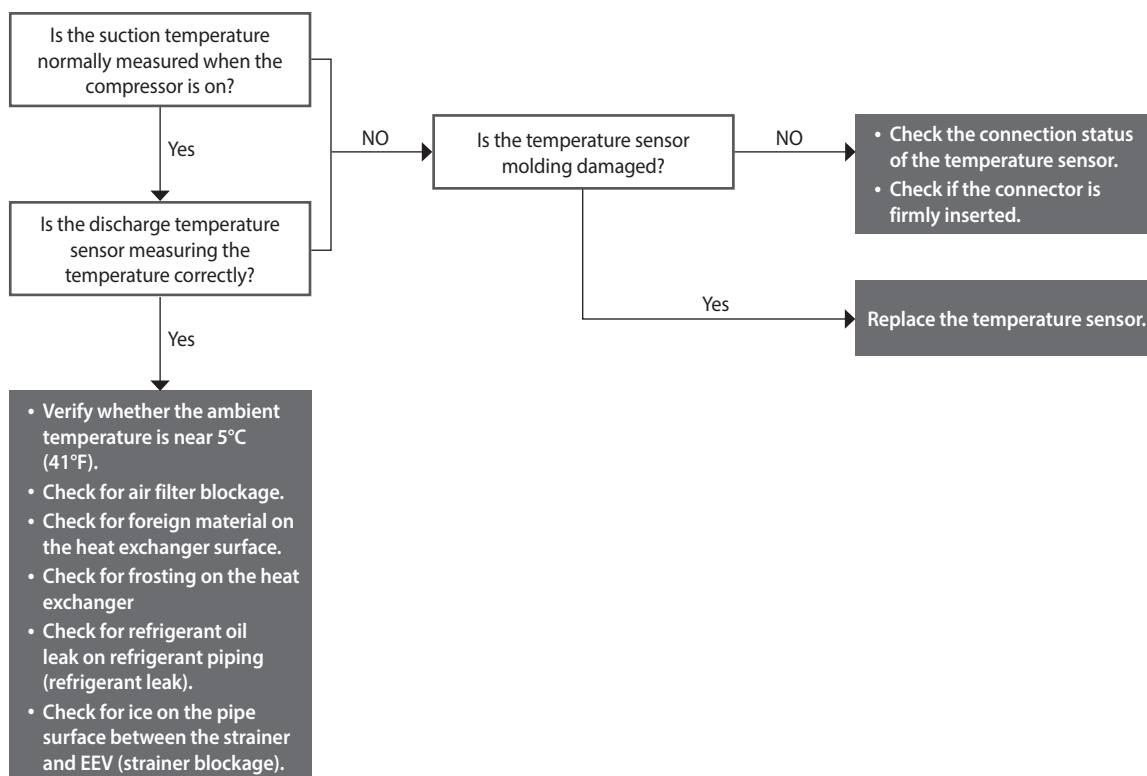
4.2.26 E914 - Abnormal Evaporator Temperature Sensor

Error	Description
E914	If the evaporator temperature sensor is short-circuited or disconnected, E914 will occur.
Check Items	• Check the evaporator temperature sensor connector connection status (open or short-circuits). • Replace the evaporator temperature sensor. • Replace the control assembly.



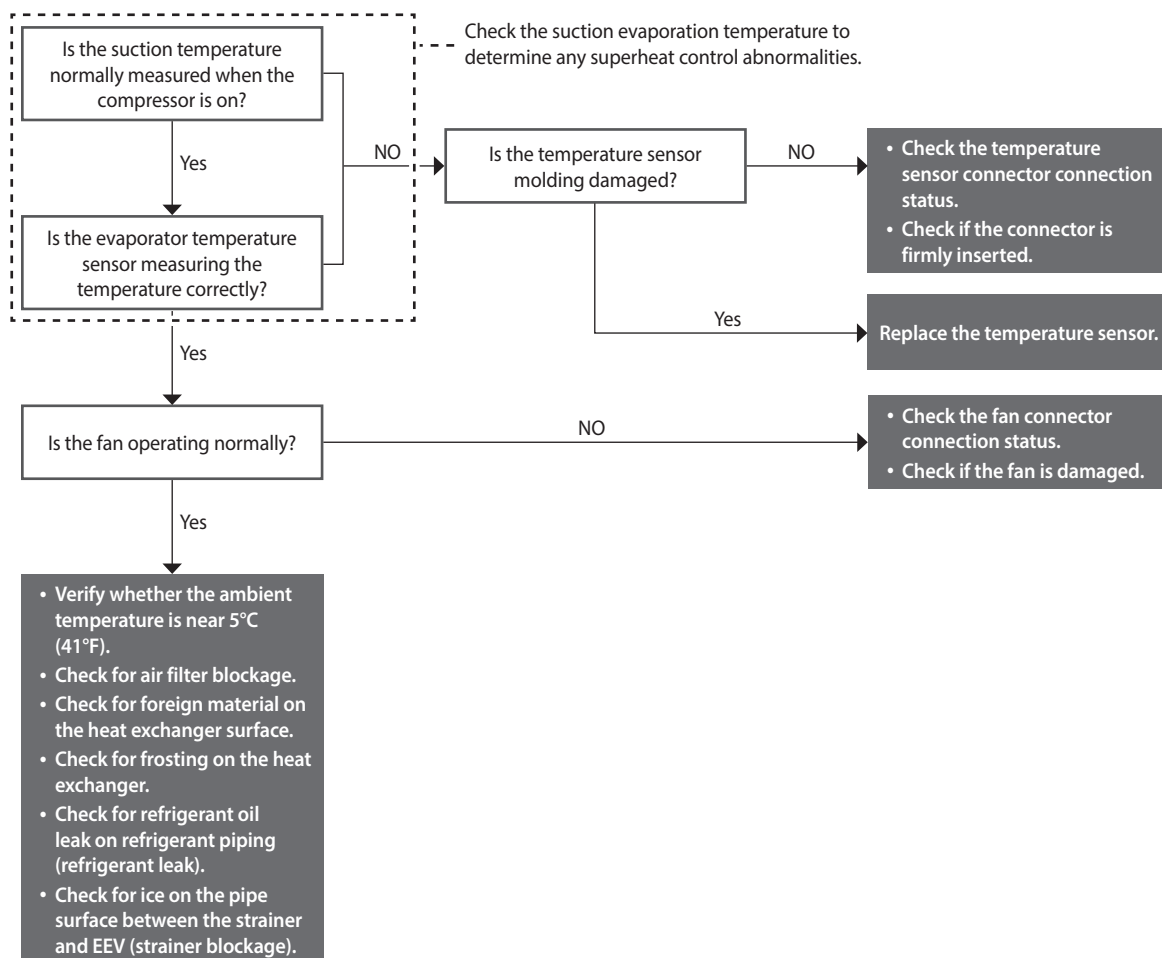
4.2.27 E915 - Abnormal Discharge, Suction Temperature Difference

Error	Description
E915	Five minutes after compressor startup, E915 will occur if either: (a) the lower heat element temperature is below 30°C (86°F) and the discharge-suction temperature difference is less than 9°F (5°C), or (b) the lower heat element temperature exceeds 30°C (86°F) and the discharge-suction temperature difference is less than 18°F (10°C).
Check Items	• Check if the EEV is operating normally. • Check if the compressor is operating normally.



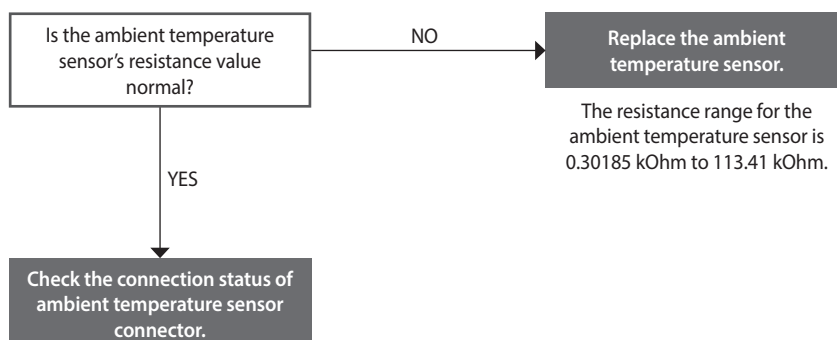
4.2.28 E916 - Abnormal Evaporator Temperature

Error	Description
E916	If the compressor's suction temperature is under 23°F (-5°C) or over 86°F (30°C) for more than 3 minutes three consecutive times while the compressor is running, E916 will occur.
Check Items	• Check for the evaporator frosting. • Check for the refrigerant leak.



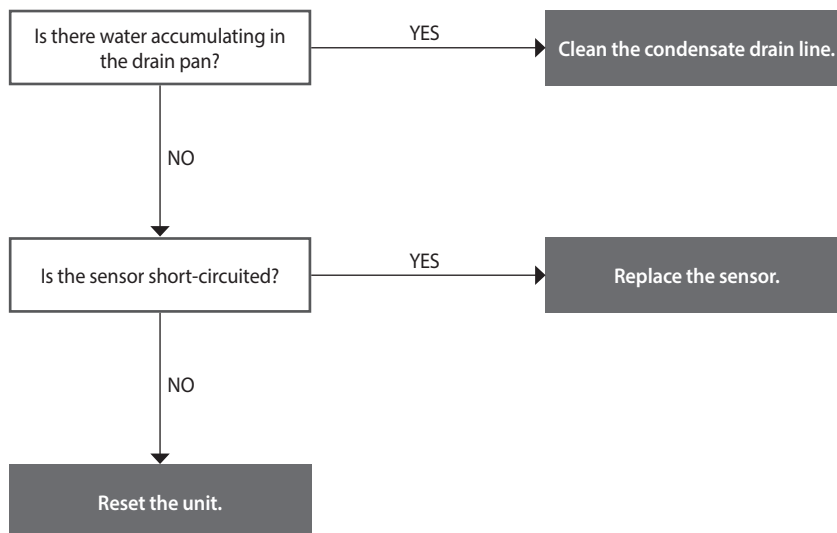
4.2.29 E920 - Abnormal Ambient Temp Sensor

Error	Description
E920	If the ambient temperature sensor connector is short-circuited or disconnected, E920 will occur.
Check Items	- Check the ambient temperature sensor connector connection status (open or short-circuits). - Replace the ambient temperature sensor. - Replace the control assembly.



4.2.30 E990 - Condensate Water Overflow

Error	Description
E990	If the condensate water overflow is detected for over 3 minutes, E990 will occur.
Check Items	- Check if water overflowed on the drain pan. - Check for the condensate drain line blockage. - Check for the condensate overflow sensor connector connection status. (open or short-circuits).



5. Replacement of Parts

5.1 Preparing for Replacement

CAUTION

- When performing maintenance and/or servicing the heat pump, always turn off the electric power and water shut-off valve. Wait for the heat pump to become cool. Be careful to avoid injury to your fingers on sharp edges.
- Before any disassembly, make sure that all issues and error codes are properly diagnosed.
- Handle all parts carefully.
- When reassembling, prevent any foreign substance (i.e. dust, etc.) from entering back into the heat pump.
- Check the performance and operation after the heat pump has been serviced.

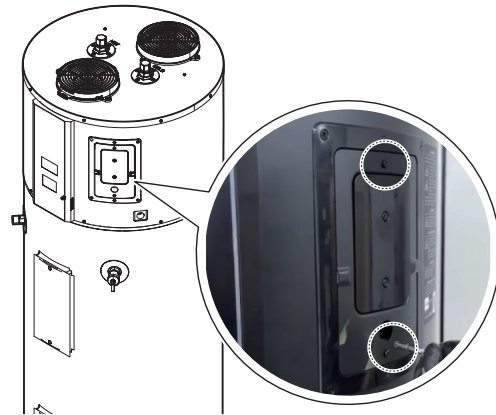
When performing maintenance, use appropriate tools to disassemble and reassemble the heat pump. A flashlight and magnetic tip are also recommended. Navien recommends the use of a parts tray to hold small parts and screws. All of the hardware is essential to the proper operation of the unit upon reassembly.

NOTICE

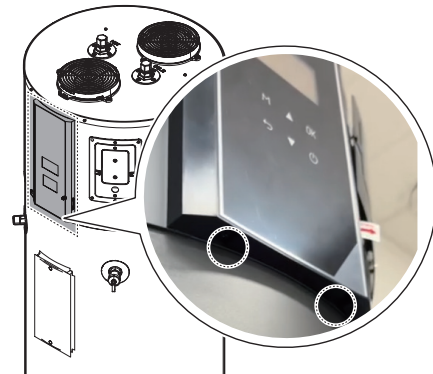
When disassembling and reassembling the heat pump, refer to the "6. Component Assembly Diagrams and Parts Lists" on page 58.

Accessing the Internal Components

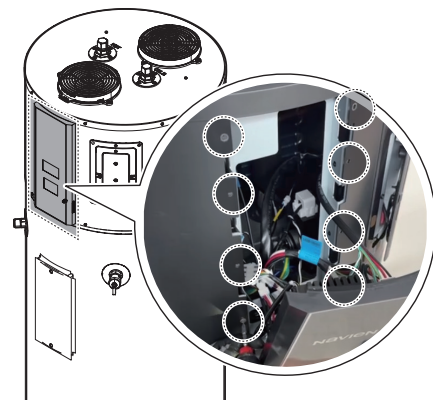
1. Turn off the power to the product.
2. Remove the 2 screws from the power module cover to access the power module, and then disconnect all wiring connectors.



3. Remove the 2 screws on the bottom side of the front panel to remove the panel from the top case.



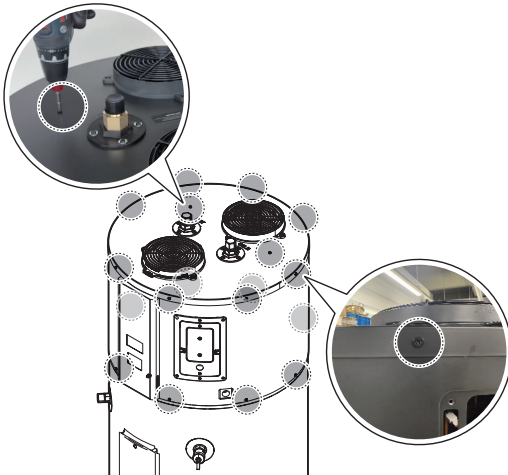
4. Remove the 8 screws that fix the front panel assembly and top case.



5. Disconnect all wiring connectors from the front panel.



6. Remove the 18 screws from the top case, and then remove the top case.



5.2 Components Replacement Instructions

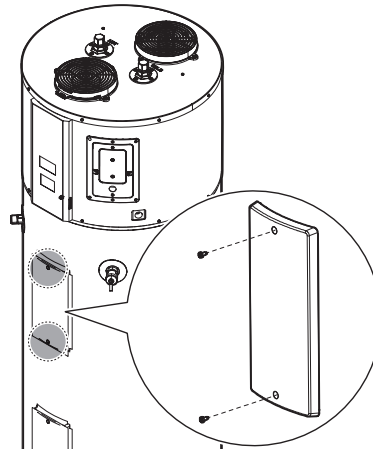
⚠ CAUTION

When performing maintenance or servicing the heat pump, always turn off the electric power and shut off the water valve. Do not clean or perform maintenance without disconnecting power from the heat pump.

Doing so may result in electric shock. The heat pump may remain hot for several minutes after it is turned off. To prevent burns, wait until the heat pump has cooled down before cleaning.

5.2.1 Energy Cut Off (ECO) Switch

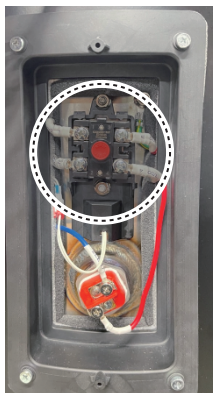
1. Turn off the respective circuit breaker.
2. Remove the 2 screws from the element cover and open it.



3. Remove the safety cover to access the ECO switch.



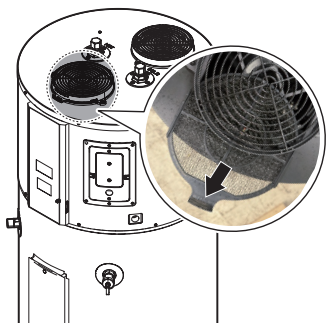
4. Remove the element personnel protector, and then disconnect all wiring connectors from the ECO switch.



5. Remove the old ECO switch and replace it with a new sensor.
6. Reattach all wiring connectors to the ECO switch.
7. Close the cover and reattach the screws.
8. Turn on the power.

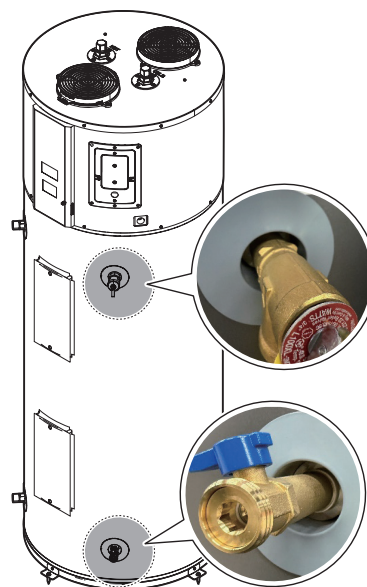
5.2.2 Intake Filter

1. Turn off the respective circuit breaker.
2. Hold the filter handle and pull it forward to remove it.



5.2.3 Valve (Drain, Relief)

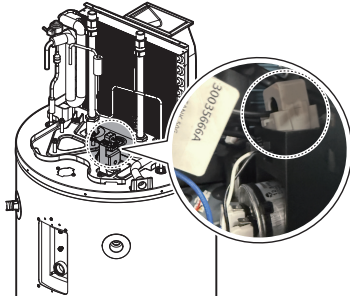
1. Turn off the respective circuit breaker.
2. Drain any remaining water from the water heater.



3. Remove the old valve, and then replace it with a new valve.

5.2.4 CT Sensor

1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Open the top cover of the sensor and disconnect the wires.



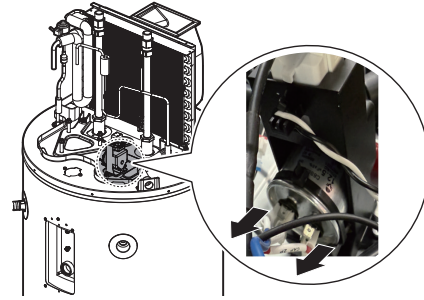
4. Lift the sensor up to remove it.



5. Replace it with a new sensor, and then reconnect the wires.

5.2.5 Capacitor

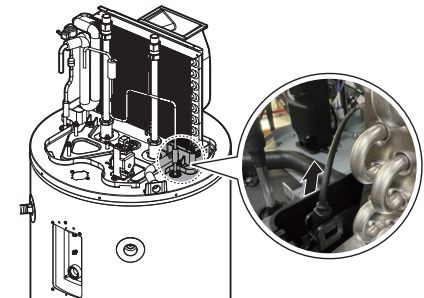
1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Remove the capacitor's connector.



4. Remove the cable tie from the capacitor and remove it.
5. Replace it with a new capacitor, secure it with a cable tie, and then reconnect the connector.

5.2.6 Water Leak Sensor

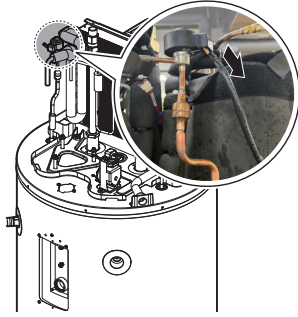
1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Remove the water leak sensor's connector.



4. Press the holder on the front of the sensor to remove it.
5. Replace it with a new water leak sensor, and then reconnect the connector.

5.2.7 EEV Coil (Electric Expansion Valve Coil)

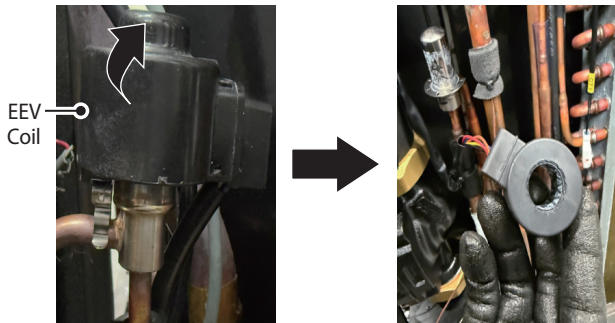
1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Remove the EEV coil's connector



Note

Refer to "7.1 Wiring Diagram" on page 60 for more information.

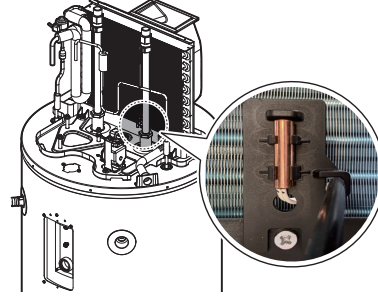
4. Pull the EEV coil upwards to detach it from the body.



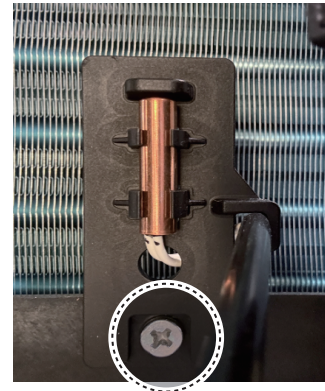
5. Replace it with a new EEV coil, and then reconnect the connector.

5.2.8 Temperature Sensor (Outside Air)

1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Remove the temperature sensor's connector.



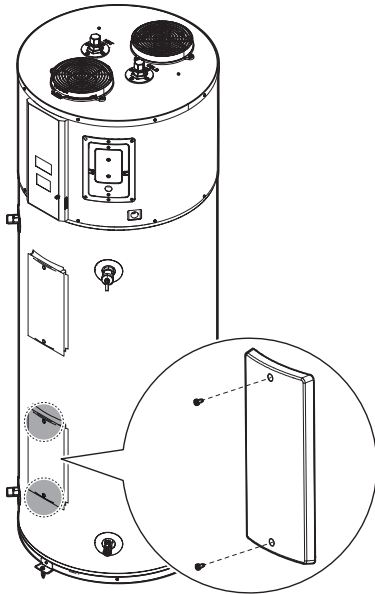
4. Remove the screw from the sensor bracket to detach it.



5. Remove the sensor through the hole in the bracket.
6. Replace it with a new temperature sensor, and then reconnect the connector.

5.2.9 Temperature Sensor (Heater)

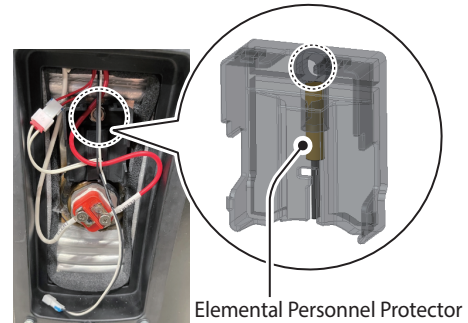
1. Turn off the respective circuit breaker.
2. Remove the 2 screws from the element cover and open it.



3. Remove the safety cover to access the temperature sensor assembly.



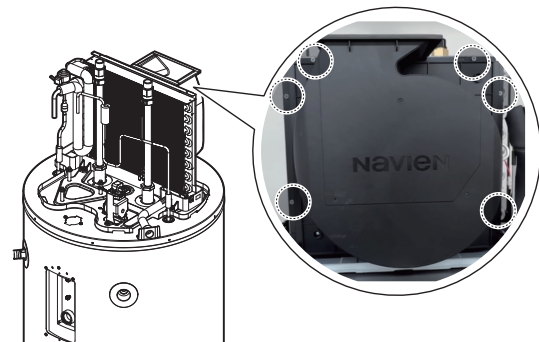
4. Remove the screw from the temperature sensor assembly to remove the elemental personnel protector.



5. Pull the temperature sensor downward to remove it, then disassemble the connector.
6. Replace it with a new temperature sensor, and then reconnect the connector.

5.2.10 Fan Assembly

1. Turn off the respective circuit breaker.
2. Remove the top case from the water heater. Refer to "Accessing the Internal Components" on page 51.
3. Remove the fan assembly's connector.
4. Remove the 6 screws on the side of the fan assembly to detach it.



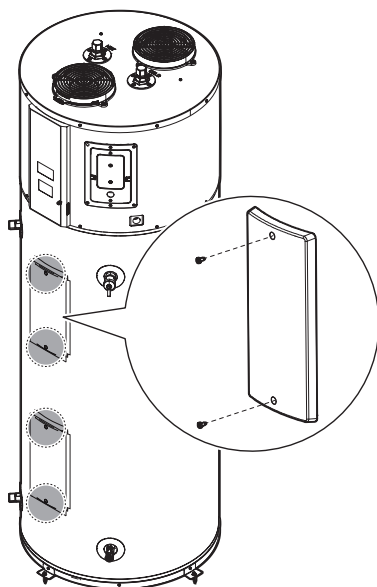
5. Replace it with a new fan assembly, and then reconnect the connector.

5.2.11 Main Controller

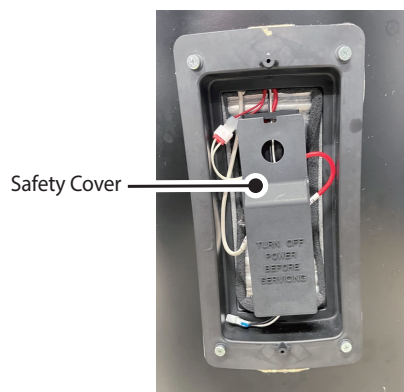
1. Turn off the respective circuit breaker.
2. Remove the front panel from the water heater. Refer to steps 3–5 in “Accessing the Internal Components” on page 51.
3. Replace it with a new main controller, and then reconnect the connectors.

5.2.12 Heat Element

1. Turn off the respective circuit breaker.
2. Remove the 2 screws from both the top and bottom element cover and open them.



3. Remove the safety cover to access the element.



4. Remove the 2 screws on the element to detach the wirings.

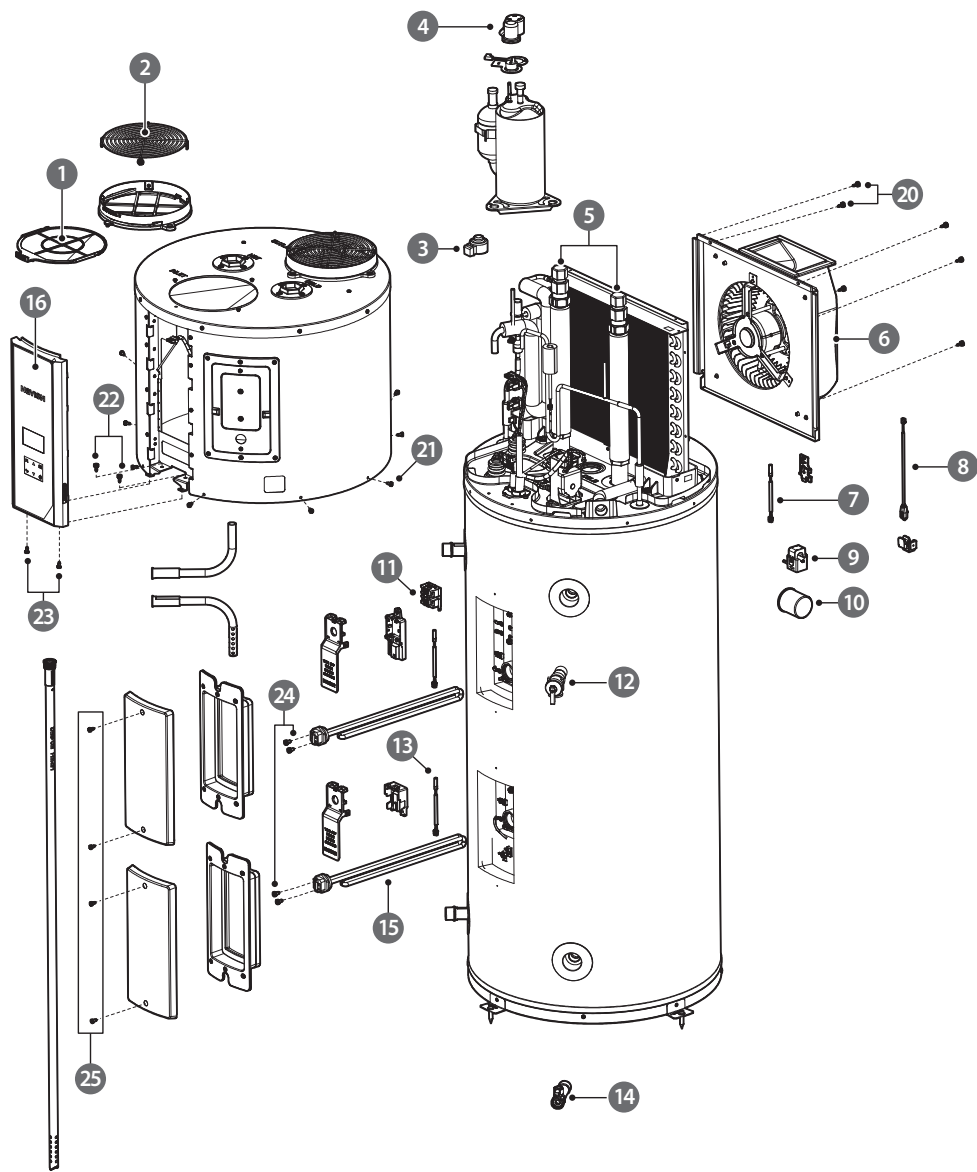


5. Use a socket wrench to turn and remove the element.



6. Replace it with a new element, and then reconnect the connector.

6. Component Assembly Diagrams and Parts Lists



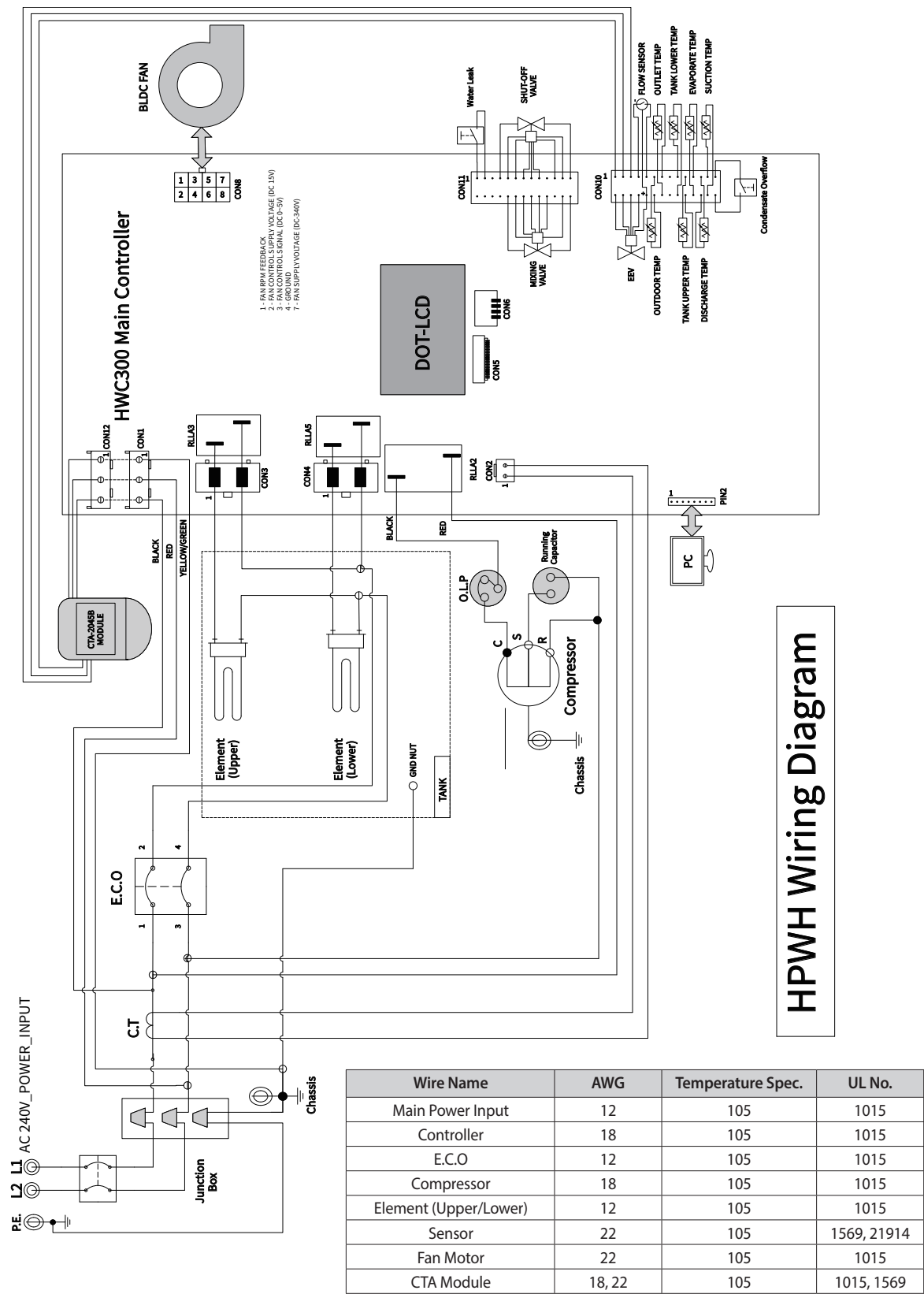
* Harness Details



#	Part name	Service Code	Remark
1	Intake Filter	20068915*	
2	Intake Filter Grille	20072241*	
3	Electronic Expansion Valve (EEV) Coil	30036215*	
4	Overload Protector	30036800*	
5	Upper Inlet & Outlet Pipe	30036106*	
6	Fan Assembly	30035398*	
7	Outside Air Temp sensor	30038926*	
8	Water Leak Detection Sensor	30031685*	
9	CT Sensor	20071987*	
10	Capacitor	20071120*	
11	Energy Cut Off (ECO) Switch	30035521*	
12	Temperature and Pressure (T&P) Relief Valve (150 psi)	30036068*	
13	Heat Element Temperature sensor	30038926*	
14	Drain Valve	30036062*	
15	Heat Element	30036069*	
16	Control Assembly	30036828*	
17	Harness Top Part	30035106*	
18	Harness CTA	30035104*	
19	Harness COMPOWER	30035105*	
20	Fan Assembly Fixing Screw	20072676*	
21	Top Kit Fixing Screw (Side)	20072409*	
22	Top Kit Fixing Screw (Bottom)	20072676*	
23	Main Controller Screw	20072408*	
24	Heat Element Wire Screw	20077432*	
25	Heat Element Case Fixing Screw	20072407*	

7. Appendixes

7.1 Wiring Diagram



7.2 R-T Table

Tank Upper/Lower Temperature Sensor, Exhaust/Intake/Evaporation Temperature Sensor, Ambient Air Temperature Sensor

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
-30	113.41	117.41	121.54	3.519	0.664
-29	107.64	111.38	115.23	3.464	0.658
-28	102.19	105.69	109.26	3.410	0.652
-27	97.057	100.32	103.69	3.356	0.646
-26	92.210	95.265	98.411	3.302	0.640
-25	87.634	90.490	93.431	3.249	0.634
-24	83.312	85.984	88.732	3.197	0.627
-23	79.229	81.728	84.298	3.144	0.621
-22	75.370	77.709	80.112	3.092	0.615
-21	71.722	73.910	76.158	3.041	0.608
-20	68.272	70.320	72.422	2.989	0.602
-19	65.009	66.926	68.892	2.938	0.595
-18	61.921	63.715	65.555	2.888	0.589
-17	58.997	60.677	62.399	2.838	0.582
-16	56.229	57.802	59.413	2.788	0.576
-15	53.607	55.080	56.588	2.738	0.569
-14	51.122	52.502	53.914	2.689	0.562
-13	48.767	50.060	51.381	2.640	0.556
-12	46.535	47.745	48.983	2.591	0.549
-11	44.417	45.551	46.710	2.543	0.542
-10	42.408	43.471	44.555	2.495	0.535
-9	40.502	41.497	42.513	2.448	0.528
-8	38.692	39.625	40.576	2.400	0.521
-7	36.974	37.848	38.738	2.353	0.514
-6	35.342	36.161	36.995	2.307	0.507
-5	33.791	34.558	35.339	2.260	0.500
-4	32.317	33.036	33.768	2.214	0.493
-3	30.916	31.590	32.275	2.168	0.486
-2	29.584	30.215	30.857	2.123	0.478
-1	28.317	28.908	29.509	2.078	0.471
0	27.111	27.665	28.227	2.033	0.464

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
1	25.963	26.482	27.009	1.988	0.456
2	24.871	25.357	25.850	1.944	0.449
3	23.831	24.286	24.747	1.900	0.441
4	22.840	23.266	23.698	1.856	0.434
5	21.896	22.295	22.699	1.813	0.426
6	20.996	21.370	21.748	1.770	0.419
7	20.138	20.488	20.842	1.727	0.411
8	19.320	19.648	19.978	1.684	0.403
9	18.540	18.846	19.156	1.642	0.395
10	17.796	18.082	18.372	1.600	0.388
11	17.086	17.354	17.624	1.558	0.380
12	16.408	16.658	16.911	1.517	0.372
13	15.761	15.995	16.231	1.475	0.364
14	15.142	15.361	15.582	1.434	0.356
15	14.552	14.756	14.962	1.394	0.348
16	13.988	14.179	14.370	1.353	0.340
17	13.449	13.627	13.806	1.313	0.331
18	12.933	13.099	13.266	1.273	0.323
19	12.440	12.595	12.750	1.233	0.315
20	11.969	12.113	12.258	1.194	0.307
21	11.518	11.652	11.787	1.155	0.298
22	11.087	11.212	11.337	1.116	0.290
23	10.674	10.790	10.906	1.077	0.282
24	10.279	10.386	10.494	1.038	0.273
25	9.9000	10.000	10.100	1.000	0.264
26	9.5303	9.6302	9.7302	1.038	0.276
27	9.1764	9.2761	9.3759	1.076	0.288
28	8.8375	8.9369	9.0364	1.114	0.300
29	8.5130	8.6119	8.7110	1.151	0.312
30	8.2022	8.3005	8.3991	1.188	0.323
31	7.9044	8.0020	8.1001	1.225	0.335
32	7.6189	7.7159	7.8133	1.262	0.347
33	7.3454	7.4415	7.5382	1.299	0.360
34	7.0831	7.1784	7.2742	1.335	0.372

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
35	6.8315	6.9259	7.0209	1.372	0.384
36	6.5903	6.6837	6.7778	1.408	0.396
37	6.3588	6.4512	6.5444	1.444	0.409
38	6.1367	6.2281	6.3202	1.479	0.421
39	5.9235	6.0139	6.1050	1.515	0.434
40	5.7189	5.8081	5.8981	1.550	0.446
41	5.5224	5.6105	5.6994	1.585	0.459
42	5.3337	5.4206	5.5085	1.620	0.472
43	5.1524	5.2382	5.3249	1.655	0.485
44	4.9782	5.0629	5.1484	1.690	0.498
45	4.8109	4.8943	4.9787	1.724	0.510
46	4.6500	4.7322	4.8155	1.759	0.523
47	4.4953	4.5764	4.6584	1.793	0.537
48	4.3466	4.4265	4.5073	1.826	0.550
49	4.2036	4.2823	4.3619	1.860	0.563
50	4.0661	4.1435	4.2220	1.894	0.576
51	3.9337	4.0099	4.0872	1.927	0.590
52	3.8064	3.8814	3.9575	1.960	0.603
53	3.6838	3.7576	3.8325	1.993	0.617
54	3.5658	3.6384	3.7121	2.026	0.630
55	3.4522	3.5236	3.5961	2.059	0.644
56	3.3427	3.4130	3.4844	2.092	0.657
57	3.2373	3.3064	3.3767	2.124	0.671
58	3.1358	3.2038	3.2728	2.156	0.685
59	3.0380	3.1048	3.1727	2.188	0.699
60	2.9437	3.0094	3.0762	2.220	0.713
61	2.8528	2.9174	2.9831	2.252	0.727
62	2.7652	2.8286	2.8932	2.284	0.741
63	2.6807	2.7431	2.8066	2.315	0.755
64	2.5993	2.6605	2.7229	2.346	0.770
65	2.5207	2.5809	2.6422	2.377	0.784
66	2.4449	2.5040	2.5643	2.408	0.798
67	2.3717	2.4298	2.4891	2.439	0.813
68	2.3011	2.3582	2.4164	2.470	0.827

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
69	2.2330	2.2890	2.3463	2.500	0.842
70	2.1672	2.2223	2.2785	2.531	0.857
71	2.1037	2.1577	2.2130	2.561	0.871
72	2.0423	2.0954	2.1497	2.591	0.886
73	1.9831	2.0352	2.0886	2.621	0.901
74	1.9258	1.9771	2.0295	2.651	0.916
75	1.8705	1.9208	1.9723	2.680	0.931
76	1.8171	1.8665	1.9171	2.710	0.946
77	1.7654	1.8140	1.8636	2.739	0.961
78	1.7155	1.7632	1.8120	2.768	0.977
79	1.6672	1.7140	1.7620	2.797	0.992
80	1.6205	1.6665	1.7136	2.826	1.007
81	1.5754	1.6205	1.6668	2.855	1.023
82	1.5317	1.5760	1.6215	2.883	1.038
83	1.4895	1.5330	1.5776	2.912	1.054
84	1.4486	1.4913	1.5352	2.940	1.070
85	1.4090	1.4510	1.4941	2.969	1.085
86	1.3707	1.4120	1.4543	2.997	1.101
87	1.3337	1.3742	1.4157	3.025	1.117
88	1.2978	1.3376	1.3784	3.052	1.133
89	1.2631	1.3021	1.3422	3.080	1.149
90	1.2294	1.2677	1.3071	3.108	1.165
91	1.1968	1.2345	1.2732	3.135	1.181
92	1.1653	1.2022	1.2402	3.162	1.198
93	1.1347	1.1710	1.2083	3.190	1.214
94	1.1050	1.1407	1.1774	3.217	1.230
95	1.0763	1.1113	1.1474	3.244	1.247
96	1.0485	1.0829	1.1183	3.270	1.263
97	1.0215	1.0553	1.0901	3.297	1.280
98	0.99532	1.0285	1.0627	3.324	1.296
99	0.96994	1.0025	1.0361	3.350	1.313
100	0.94534	0.97735	1.0103	3.376	1.330
101	0.92147	0.95292	0.98534	3.402	1.347
102	0.89832	0.92921	0.96107	3.429	1.364

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
103	0.87585	0.90620	0.93750	3.454	1.381
104	0.85406	0.88387	0.91463	3.480	1.398
105	0.83290	0.86219	0.89242	3.506	1.415
106	0.81237	0.84115	0.87085	3.532	1.432
107	0.79245	0.82071	0.84991	3.557	1.450
108	0.77310	0.80087	0.82956	3.582	1.467
109	0.75431	0.78160	0.80980	3.608	1.484
110	0.73607	0.76288	0.79060	3.633	1.502
111	0.71835	0.74470	0.77194	3.658	1.520
112	0.70114	0.72703	0.75381	3.683	1.537
113	0.68442	0.70987	0.73618	3.707	1.555
114	0.66818	0.69319	0.71905	3.732	1.573
115	0.65240	0.67697	0.70240	3.757	1.591
116	0.63706	0.66121	0.68621	3.781	1.609
117	0.62215	0.64589	0.67047	3.805	1.627
118	0.60766	0.63099	0.65515	3.830	1.645
119	0.59357	0.61650	0.64026	3.854	1.663
120	0.57987	0.60241	0.62577	3.878	1.681
121	0.56655	0.58871	0.61168	3.902	1.699
122	0.55359	0.57538	0.59797	3.925	1.718
123	0.54099	0.56241	0.58462	3.949	1.736
124	0.52874	0.54980	0.57164	3.973	1.755
125	0.51681	0.53752	0.55900	3.996	1.773
126	0.50521	0.52557	0.54670	4.020	1.792
127	0.49392	0.51394	0.53472	4.043	1.811
128	0.48293	0.50262	0.52306	4.066	1.829
129	0.47224	0.49160	0.51170	4.089	1.848
130	0.46183	0.48087	0.50064	4.112	1.867
131	0.45170	0.47042	0.48987	4.135	1.886
132	0.44183	0.46024	0.47938	4.158	1.905
133	0.43222	0.45033	0.46916	4.180	1.924
134	0.42286	0.44068	0.45920	4.203	1.944
135	0.41375	0.43128	0.44950	4.225	1.963
136	0.40487	0.42211	0.44004	4.248	1.982

TEMP (°C)	MIN (kΩ)	MEAN (kΩ)	MAX (kΩ)	R.Tol (±%)	T.Tol (±°C)
137	0.39623	0.41319	0.43083	4.270	2.002
138	0.38780	0.40449	0.42185	4.292	2.021
139	0.37959	0.39601	0.41309	4.314	2.041
140	0.37159	0.38774	0.40456	4.336	2.060
141	0.36379	0.37969	0.39624	4.358	2.080
142	0.35620	0.37183	0.38812	4.380	2.100
143	0.34879	0.36418	0.38021	4.402	2.120
144	0.34157	0.35671	0.37249	4.423	2.140
145	0.33453	0.34943	0.36496	4.445	2.160
146	0.32766	0.34233	0.35762	4.466	2.180
147	0.32096	0.33540	0.35045	4.488	2.200
148	0.31443	0.32865	0.34346	4.509	2.220
149	0.30807	0.32205	0.33664	4.530	2.241
150	0.30185	0.31562	0.32999	4.551	2.261

Piping Temperature Sensor (Mixing Valve)

Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax	Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax
-40.0°C	175.36	188.14	201.67	-6.79%	7.19%	20.0°C	9.781	10.190	10.610	-4.04%	4.11%
-39.0°C	164.59	176.47	189.04	-6.73%	7.12%	21.0°C	9.415	9.808	10.210	-4.00%	4.07%
-38.0°C	154.61	165.67	177.36	-6.67%	7.06%	22.0°C	9.065	9.439	9.819	-3.96%	4.03%
-37.0°C	145.36	155.65	166.53	-6.62%	6.99%	23.0°C	8.729	9.086	9.449	-3.93%	3.99%
-36.0°C	136.76	146.36	156.49	-6.56%	6.92%	24.0°C	8.408	8.748	9.094	-3.89%	3.95%
-35.0°C	128.76	137.72	147.16	-6.50%	6.86%	25.0°C	8.100	8.425	8.754	-3.85%	3.91%
-34.0°C	121.33	129.69	138.50	-6.45%	6.79%	26.0°C	7.805	8.115	8.429	-3.82%	3.87%
-33.0°C	114.40	122.21	130.43	-6.39%	6.73%	27.0°C	7.522	7.818	8.118	-3.78%	3.84%
-32.0°C	107.94	115.24	122.92	-6.33%	6.67%	28.0°C	7.251	7.533	7.819	-3.74%	3.80%
-31.0°C	101.91	108.74	115.93	-6.28%	6.61%	29.0°C	6.991	7.260	7.533	-3.71%	3.76%
-30.0°C	96.29	102.68	109.40	-6.23%	6.54%	30.0°C	6.741	6.999	7.259	-3.67%	3.72%
-29.0°C	91.03	97.01	103.31	-6.17%	6.48%	31.0°C	6.502	6.748	6.996	-3.64%	3.68%
-28.0°C	86.11	91.72	97.61	-6.12%	6.42%	32.0°C	6.272	6.507	6.744	-3.60%	3.65%
-27.0°C	81.50	86.77	92.29	-6.07%	6.36%	33.0°C	6.052	6.276	6.502	-3.57%	3.61%
-26.0°C	77.19	82.13	87.31	-6.02%	6.31%	34.0°C	5.840	6.054	6.270	-3.53%	3.57%
-25.0°C	73.14	77.78	82.64	-5.97%	6.25%	35.0°C	5.637	5.841	6.048	-3.50%	3.53%
-24.0°C	69.34	73.70	78.27	-5.92%	6.19%	36.0°C	5.442	5.637	5.834	-3.47%	3.50%
-23.0°C	65.78	69.88	74.17	-5.87%	6.14%	37.0°C	5.254	5.441	5.629	-3.43%	3.46%
-22.0°C	62.43	66.29	70.32	-5.82%	6.08%	38.0°C	5.074	5.252	5.432	-3.40%	3.42%
-21.0°C	59.29	62.91	66.70	-5.77%	6.02%	39.0°C	4.901	5.071	5.243	-3.36%	3.39%
-20.0°C	56.32	59.74	63.31	-5.72%	5.97%	40.0°C	4.734	4.897	5.061	-3.33%	3.35%
-19.0°C	53.54	56.75	60.11	-5.67%	5.91%	41.0°C	4.574	4.730	4.887	-3.30%	3.32%
-18.0°C	50.91	53.94	57.11	-5.62%	5.86%	42.0°C	4.420	4.569	4.719	-3.26%	3.28%
-17.0°C	48.44	51.30	54.27	-5.57%	5.81%	43.0°C	4.272	4.415	4.558	-3.23%	3.24%
-16.0°C	46.10	48.80	51.61	-5.53%	5.75%	44.0°C	4.130	4.266	4.403	-3.20%	3.21%
-15.0°C	43.90	46.45	49.09	-5.48%	5.70%	45.0°C	3.993	4.123	4.254	-3.16%	3.17%
-14.0°C	41.82	44.22	46.72	-5.43%	5.65%	46.0°C	3.861	3.985	4.111	-3.13%	3.14%
-13.0°C	39.86	42.13	44.48	-5.39%	5.60%	47.0°C	3.734	3.853	3.973	-3.10%	3.10%
-12.0°C	38.00	40.14	42.37	-5.34%	5.55%	48.0°C	3.612	3.726	3.840	-3.06%	3.07%
-11.0°C	36.24	38.27	40.37	-5.30%	5.50%	49.0°C	3.494	3.603	3.712	-3.03%	3.03%
-10.0°C	34.58	36.50	38.49	-5.25%	5.45%	50.0°C	3.380	3.485	3.590	-3.00%	3.00%
-9.0°C	33.01	34.82	36.70	-5.21%	5.40%	51.0°C	3.269	3.371	3.474	-3.03%	3.03%

Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax	Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax
-8.0°C	31.52	33.23	35.01	-5.16%	5.35%	52.0°C	3.162	3.262	3.362	-3.06%	3.07%
-7.0°C	30.11	31.73	33.41	-5.12%	5.30%	53.0°C	3.059	3.156	3.254	-3.10%	3.10%
-6.0°C	28.77	30.31	31.90	-5.08%	5.25%	54.0°C	2.959	3.055	3.151	-3.13%	3.14%
-5.0°C	27.50	28.96	30.46	-5.03%	5.20%	55.0°C	2.863	2.957	3.051	-3.16%	3.17%
-4.0°C	26.30	27.68	29.10	-4.99%	5.16%	56.0°C	2.771	2.862	2.954	-3.19%	3.20%
-3.0°C	25.15	26.46	27.81	-4.95%	5.11%	57.0°C	2.682	2.772	2.861	-3.22%	3.24%
-2.0°C	24.07	25.31	26.59	-4.90%	5.06%	58.0°C	2.597	2.684	2.772	-3.25%	3.27%
-1.0°C	23.03	24.21	25.43	-4.86%	5.02%	59.0°C	2.514	2.599	2.685	-3.28%	3.30%
0.0°C	22.05	23.17	24.32	-4.82%	4.97%	60.0°C	2.434	2.518	2.602	-3.31%	3.34%
1.0°C	21.12	22.18	23.27	-4.78%	4.92%	61.0°C	2.358	2.439	2.521	-3.35%	3.37%
2.0°C	20.23	21.24	22.28	-4.74%	4.88%	62.0°C	2.283	2.363	2.444	-3.38%	3.40%
3.0°C	19.39	20.35	21.33	-4.70%	4.83%	63.0°C	2.212	2.290	2.369	-3.41%	3.43%
4.0°C	18.59	19.49	20.43	-4.66%	4.79%	64.0°C	2.143	2.219	2.296	-3.44%	3.47%
5.0°C	17.82	18.68	19.57	-4.62%	4.74%	65.0°C	2.077	2.151	2.227	-3.47%	3.50%
6.0°C	17.09	17.91	18.75	-4.57%	4.70%	66.0°C	2.013	2.085	2.159	-3.50%	3.53%
7.0°C	16.40	17.18	17.98	-4.53%	4.66%	67.0°C	1.951	2.022	2.094	-3.53%	3.56%
8.0°C	15.74	16.48	17.24	-4.50%	4.61%	68.0°C	1.891	1.961	2.031	-3.56%	3.59%
9.0°C	15.10	15.81	16.53	-4.46%	4.57%	69.0°C	1.833	1.901	1.970	-3.59%	3.63%
10.0°C	14.50	15.17	15.86	-4.42%	4.53%	70.0°C	1.778	1.844	1.912	-3.62%	3.66%
11.0°C	13.93	14.56	15.22	-4.38%	4.49%	71.0°C	1.724	1.789	1.855	-3.64%	3.69%
12.0°C	13.38	13.98	14.61	-4.34%	4.44%	72.0°C	1.672	1.736	1.800	-3.67%	3.72%
13.0°C	12.85	13.43	14.02	-4.30%	4.40%	73.0°C	1.622	1.684	1.747	-3.70%	3.75%
14.0°C	12.35	12.90	13.47	-4.26%	4.36%	74.0°C	1.573	1.634	1.696	-3.73%	3.78%
15.0°C	11.88	12.40	12.93	-4.22%	4.32%	75.0°C	1.526	1.586	1.647	-3.76%	3.81%
16.0°C	11.42	11.92	12.43	-4.19%	4.27%	76.0°C	1.481	1.540	1.599	-3.79%	3.85%
17.0°C	10.98	11.46	11.94	-4.15%	4.23%	77.0°C	1.437	1.495	1.552	-3.82%	3.88%
18.0°C	10.56	11.02	11.48	-4.11%	4.19%	78.0°C	1.395	1.451	1.508	-3.85%	3.91%
19.0°C	10.16	10.60	11.04	-4.07%	4.15%	79.0°C	1.354	1.409	1.464	-3.87%	3.94%

Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax	Temp.	Rmin	Rcent	Rmax	△Rmin	△Rmax
-40.0°C	175.36	188.14	201.67	-6.79%	7.19%	20.0°C	9.781	10.190	10.610	-4.04%	4.11%
-39.0°C	164.59	176.47	189.04	-6.73%	7.12%	21.0°C	9.415	9.808	10.210	-4.00%	4.07%
-38.0°C	154.61	165.67	177.36	-6.67%	7.06%	22.0°C	9.065	9.439	9.819	-3.96%	4.03%
-37.0°C	145.36	155.65	166.53	-6.62%	6.99%	23.0°C	8.729	9.086	9.449	-3.93%	3.99%
-36.0°C	136.76	146.36	156.49	-6.56%	6.92%	24.0°C	8.408	8.748	9.094	-3.89%	3.95%
-35.0°C	128.76	137.72	147.16	-6.50%	6.86%	25.0°C	8.100	8.425	8.754	-3.85%	3.91%
-34.0°C	121.33	129.69	138.5	-6.45%	6.79%	26.0°C	7.805	8.115	8.429	-3.82%	3.87%
-33.0°C	114.40	122.21	130.43	-6.39%	6.73%	27.0°C	7.522	7.818	8.118	-3.78%	3.84%
-32.0°C	107.94	115.24	122.92	-6.33%	6.67%	28.0°C	7.251	7.533	7.819	-3.74%	3.80%
-31.0°C	101.91	108.74	115.93	-6.28%	6.61%	29.0°C	6.991	7.260	7.533	-3.71%	3.76%
-30.0°C	96.29	102.68	109.40	-6.23%	6.54%	30.0°C	6.741	6.999	7.259	-3.67%	3.72%
-29.0°C	91.03	97.01	103.31	-6.17%	6.48%	31.0°C	6.502	6.748	6.996	-3.64%	3.68%
-28.0°C	86.11	91.72	97.61	-6.12%	6.42%	32.0°C	6.272	6.507	6.744	-3.60%	3.65%
-27.0°C	81.50	86.77	92.29	-6.07%	6.36%	33.0°C	6.052	6.276	6.502	-3.57%	3.61%
-26.0°C	77.19	82.13	87.31	-6.02%	6.31%	34.0°C	5.840	6.054	6.270	-3.53%	3.57%
-25.0°C	73.14	77.78	82.64	-5.97%	6.25%	35.0°C	5.637	5.841	6.048	-3.50%	3.53%
-24.0°C	69.34	73.70	78.27	-5.92%	6.19%	36.0°C	5.442	5.637	5.834	-3.47%	3.50%
-23.0°C	65.78	69.88	74.17	-5.87%	6.14%	37.0°C	5.254	5.441	5.629	-3.43%	3.46%
-22.0°C	62.43	66.29	70.32	-5.82%	6.08%	38.0°C	5.074	5.252	5.432	-3.40%	3.42%
-21.0°C	59.29	62.91	66.7	-5.77%	6.02%	39.0°C	4.901	5.071	5.243	-3.36%	3.39%
-20.0°C	56.32	59.74	63.31	-5.72%	5.97%	40.0°C	4.734	4.897	5.061	-3.33%	3.35%
-19.0°C	53.54	56.75	60.11	-5.67%	5.91%	41.0°C	4.574	4.730	4.887	-3.30%	3.32%
-18.0°C	50.91	53.94	57.11	-5.62%	5.86%	42.0°C	4.420	4.569	4.719	-3.26%	3.28%
-17.0°C	48.44	51.30	54.27	-5.57%	5.81%	43.0°C	4.272	4.415	4.558	-3.23%	3.24%
-16.0°C	46.10	48.80	51.61	-5.53%	5.75%	44.0°C	4.130	4.266	4.403	-3.20%	3.21%
-15.0°C	43.90	46.45	49.09	-5.48%	5.70%	45.0°C	3.993	4.123	4.254	-3.16%	3.17%
-14.0°C	41.82	44.22	46.72	-5.43%	5.65%	46.0°C	3.861	3.985	4.111	-3.13%	3.14%
-13.0°C	39.86	42.13	44.48	-5.39%	5.60%	47.0°C	3.734	3.853	3.973	-3.10%	3.10%
-12.0°C	38.00	40.14	42.37	-5.34%	5.55%	48.0°C	3.612	3.726	3.840	-3.06%	3.07%
-11.0°C	36.24	38.27	40.37	-5.30%	5.50%	49.0°C	3.494	3.603	3.712	-3.03%	3.03%
-10.0°C	34.58	36.50	38.49	-5.25%	5.45%	50.0°C	3.380	3.485	3.590	-3.00%	3.00%
-9.0°C	33.01	34.82	36.70	-5.21%	5.40%	51.0°C	3.269	3.371	3.474	-3.03%	3.03%
-8.0°C	31.52	33.23	35.01	-5.16%	5.35%	52.0°C	3.162	3.262	3.362	-3.06%	3.07%
-7.0°C	30.11	31.73	33.41	-5.12%	5.30%	53.0°C	3.059	3.156	3.254	-3.10%	3.10%

Temp.	Rmin	Rcent	Rmax	Δ Rmin	Δ Rmax	Temp.	Rmin	Rcent	Rmax	Δ Rmin	Δ Rmax
-6.0°C	28.77	30.31	31.90	-5.08%	5.25%	54.0°C	2.959	3.055	3.151	-3.13%	3.14%
-5.0°C	27.50	28.96	30.46	-5.03%	5.20%	55.0°C	2.863	2.957	3.051	-3.16%	3.17%
-4.0°C	26.30	27.68	29.10	-4.99%	5.16%	56.0°C	2.771	2.862	2.954	-3.19%	3.20%
-3.0°C	25.15	26.46	27.81	-4.95%	5.11%	57.0°C	2.682	2.772	2.861	-3.22%	3.24%
-2.0°C	24.07	25.31	26.59	-4.90%	5.06%	58.0°C	2.597	2.684	2.772	-3.25%	3.27%
-1.0°C	23.03	24.21	25.43	-4.86%	5.02%	59.0°C	2.514	2.599	2.685	-3.28%	3.30%
0.0°C	22.05	23.17	24.32	-4.82%	4.97%	60.0°C	2.434	2.518	2.602	-3.31%	3.34%
1.0°C	21.12	22.18	23.27	-4.78%	4.92%	61.0°C	2.358	2.439	2.521	-3.35%	3.37%
2.0°C	20.23	21.24	22.28	-4.74%	4.88%	62.0°C	2.283	2.363	2.444	-3.38%	3.40%
3.0°C	19.39	20.35	21.33	-4.70%	4.83%	63.0°C	2.212	2.290	2.369	-3.41%	3.43%
4.0°C	18.59	19.49	20.43	-4.66%	4.79%	64.0°C	2.143	2.219	2.296	-3.44%	3.47%
5.0°C	17.82	18.68	19.57	-4.62%	4.74%	65.0°C	2.077	2.151	2.227	-3.47%	3.50%
6.0°C	17.09	17.91	18.75	-4.57%	4.70%	66.0°C	2.013	2.085	2.159	-3.50%	3.53%
7.0°C	16.40	17.18	17.98	-4.53%	4.66%	67.0°C	1.951	2.022	2.094	-3.53%	3.56%
8.0°C	15.74	16.48	17.24	-4.50%	4.61%	68.0°C	1.891	1.961	2.031	-3.56%	3.59%
9.0°C	15.10	15.81	16.53	-4.46%	4.57%	69.0°C	1.833	1.901	1.970	-3.59%	3.63%
10.0°C	14.50	15.17	15.86	-4.42%	4.53%	70.0°C	1.778	1.844	1.912	-3.62%	3.66%
11.0°C	13.93	14.56	15.22	-4.38%	4.48%	71.0°C	1.724	1.789	1.855	-3.64%	3.69%
12.0°C	13.38	13.98	14.61	-4.34%	4.44%	72.0°C	1.672	1.736	1.800	-3.67%	3.72%
13.0°C	12.85	13.43	14.02	-4.30%	4.40%	73.0°C	1.622	1.684	1.747	-3.70%	3.75%
14.0°C	12.35	12.90	13.47	-4.26%	4.36%	74.0°C	1.573	1.634	1.696	-3.73%	3.78%
15.0°C	11.88	12.40	12.93	-4.22%	4.32%	75.0°C	1.526	1.586	1.647	-3.76%	3.81%
16.0°C	11.42	11.92	12.43	-4.19%	4.27%	76.0°C	1.481	1.540	1.599	-3.79%	3.85%
17.0°C	10.98	11.46	11.94	-4.15%	4.23%	77.0°C	1.437	1.495	1.552	-3.82%	3.88%
18.0°C	10.56	11.02	11.48	-4.11%	4.19%	78.0°C	1.395	1.451	1.508	-3.85%	3.91%
19.0°C	10.16	10.60	11.04	-4.07%	4.15%	79.0°C	1.354	1.409	1.464	-3.87%	3.94%