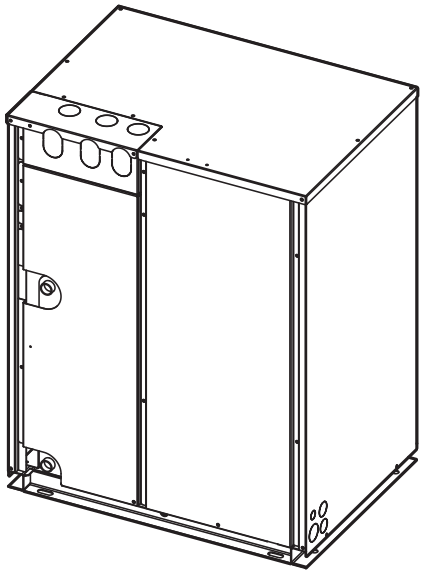
Installation and Maintenance Manual

INVERTER-DRIVEN
MULTI-SPLIT SYSTEM
HEAT PUMP AND
HEAT RECOVERY
AIR CONDITIONERS



Models:

Water Source Units;

208/230V

(H,Y)VWH(P,R)072B32S, (H,Y)VWH(P,R)096B32S,
(H,Y)VWH(P,R)120B32S, (H,Y)VWH(P,R)144B32S,
(H,Y)VWH(P,R)168B32S, (H,Y)VWH(P,R)192B32S,
(H,Y)VWH(P,R)216B32S, (H,Y)VWH(P,R)240B32S,
(H,Y)VWH(P,R)264B32S, (H,Y)VWH(P,R)288B32S,
(H,Y)VWH(P,R)312B32S, (H,Y)VWH(P,R)336B32S,
(H,Y)VWH(P,R)360B32S, (H,Y)VWH(P,R)384B32S,
(H,Y)VWH(P,R)408B32S, (H,Y)VWH(P,R)432B32S,
(H,Y)VWH(P,R)456B32S, (H,Y)VWH(P,R)480B32S,
(H,Y)VWH(P,R)504B32S, (H,Y)VWH(P,R)528B32S,
(H,Y)VWH(P,R)552B32S, (H,Y)VWH(P,R)576B32S

460V

(H,Y)VWH(P,R)072B42S, (H,Y)VWH(P,R)096B42S,
(H,Y)VWH(P,R)120B42S, (H,Y)VWH(P,R)144B42S,
(H,Y)VWH(P,R)168B42S, (H,Y)VWH(P,R)192B42S,
(H,Y)VWH(P,R)216B42S, (H,Y)VWH(P,R)240B42S,
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(H,Y)VWH(P,R)504B42S, (H,Y)VWH(P,R)528B42S,
(H,Y)VWH(P,R)552B42S, (H,Y)VWH(P,R)576B42S

IMPORTANT:

READ AND UNDERSTAND THIS MANUAL BEFORE INSTALLING THIS HEAT PUMP AND HEAT RECOVERY AIR CONDITIONER. KEEP THIS MANUAL FOR FUTURE REFERENCE.

P01378Q

Important Notice

- Johnson Controls Inc. pursues a policy of continuing improvement in design and performance in its products. As such, Johnson Controls Inc. reserves the right to make changes at any time without prior notice.
- Johnson Controls Inc. cannot anticipate every possible circumstance that might involve a potential hazard.
- This heat pump and heat recovery air conditioning unit is designed for standard air conditioning applications only.
  Do not use this unit for anything other than the purposes for which it was intended for.
- The installer and system specialist shall safeguard against leakage in accordance with local codes.
  No part of this manual may be reproduced in any way without the expressed written consent of Johnson Controls Inc.
- This heat pump and heat recovery air conditioning unit is operated and serviced in the United States of America and comes with a full complement of the appropriate Safety, Danger, and Caution, Warnings.
- If you have questions, please contact your distributor or contractor.
- This manual provides common descriptions, basic and advanced information to maintain and service this heat pump and heat recovery air conditioning unit which you operate as well for other models.
- This heat pump and heat recovery air conditioning unit is designed for a specific temperature range. For optimum performance and long life, operate this unit within the range limits according to the table below. The water temperature range stays the same when using antifreeze.

Temperature

Indoor Unit Inlet Air Temperature	Cooling Operation Range	°F WB (°C WB)	59 (15) ~ 73 (23)
	Heating Operation Range	°F DB (°C DB)	59 (15) ~ 80 (27)
Water Source Unit Entering Water Temperature		°F (°C)	50 (10) ~ 113 (45)

DB: Dry Bulb, WB: Wet Bulb

Refer to the Engineering Manual for details of operation limitations.

- This manual should be considered as a permanent part of the air conditioning equipment and should remain with the air conditioning equipment.

Product Inspection upon Arrival

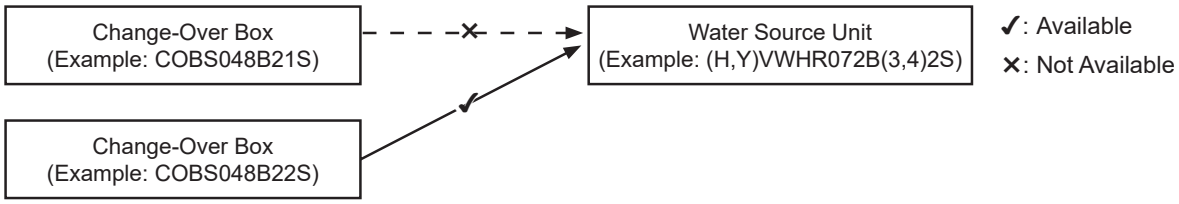
1. Upon receiving this product, inspect it for any damage incurred in transit. Claims for damage, either apparent or concealed, should be filed immediately with the shipping company.
2. Check the model number, electrical characteristics (power supply, voltage, and frequency rating), and any accessories to determine if they agree with the purchase order.
3. The standard use for this unit is explained in these instructions. Use of this equipment for purposes other than what it designed for is not recommended.
4. Please contact your local agent or contractor as any issues involving installation, performance, or maintenance arise. Liability does not cover defects originating from unauthorized modifications performed by a customer without the written consent of Johnson Controls, Inc. Performing any mechanical alterations on this product without the consent of the manufacturer will render your warranty null and void.

Compatibility for Single Port Change-over box models [COBS_B21S(C)], Single Port Change-over box models [COBS_B22S(C)], and Multi Port Change-over box models (COBS_M_B22S)

- Single Port Change-over box models [COBS_B22S(C)], Multi Port Change-over box models (COBS_M_B22S), and Single Port Change-over box models [COBS_B21S(C)] cannot operate in the same system together.
- Single Port Change-over box models [COBS_B22S(C)] and Multi Port Change-over box models (COBS_M_B22S) are only compatible with the water source units [(H,Y)VWHR_B(3,4)2S].

  Single Port Change-over box models [COBS_B21S(C)] are not compatible with the water source unit. The wired controller will display the alarm code 30 and the units will not operate if the Single Port Change-over box models [COBS_B21S(C)] are mismatched with a water source unit.

  Refer to the Heat Recovery Installation and Maintenance Manual for more details.



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1. Introduction

This manual concentrates on the Water Source Heat Pump and Heat Recovery Unit. Read this manual carefully before installation. Read over the installation manual for the Indoor Unit also.

This manual should be considered as a permanent part of the air conditioning equipment and should remain with the air conditioning equipment.

(Transportation/Installation Work) > (Refrigerant Piping Work) > (Electrical Wiring Work) > (Ref. Charge Work) > (Test Run) > (User)

2. Important Safety Instructions

Signal Words	
⚠ WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

General Precautions

⚠ WARNING	To reduce the risk of serious injury or death, read these instructions thoroughly and follow all warnings or cautions included in all manuals that accompanied the product and are attached to the unit. *Refer back to these safety instructions as needed.*

- This system should be installed by personnel certified by Johnson Controls, Inc. Personnel must be qualified according to local codes and regulations. Incorrect installation could cause leaks, electric shock, fire or explosion. In areas where Seismic Performance requirements are specified, the appropriate measures should be taken during installation to guard against possible damage or injury that might occur in an earthquake. If the unit is not installed correctly, injuries may occur due to a falling unit.
- Use appropriate Personal Protective Equipment (PPE), such as gloves and protective goggles and where appropriate, have a gas mask nearby. Also use electrical protection equipment and tools suited for electrical operation purposes. Keep heat shields, fire blankets, and a fire extinguisher nearby during brazing. Use care in handling, rigging, and setting of bulky equipment.
- When transporting, be careful when picking up, moving, and mounting these units. Although the unit may be packed using plastic straps, do not use them for transporting the unit from one location to another. Do not stand on or put any material on the unit. Get a partner to help, and bend with your knees when lifting to reduce strain on your back. Sharp edges or thin aluminum fins on the air conditioner can cut fingers, so wear protective gloves.
- Do not touch or adjust any safety devices inside the indoor or water source units. All safety features, disengagement, and interlocks must be in place and functioning correctly before the equipment is put into operation. If these devices are improperly adjusted or tampered with in any way, a serious accident can occur. Never bypass or jump-out any safety device or switch.
- Johnson Controls will not assume any liability for injuries or damage caused by not following steps outlined or described in this manual. Unauthorized modifications to Johnson Controls products are prohibited as they…
  - May create hazards which could result in death, serious injury, equipment damage, or property damage;
  - Will void product warranties;
  - May invalidate product regulatory certifications;
  - May violate OSHA standards;

NOTICE	Take the following precautions to reduce the risk of property damage.

- Be careful that moisture, dust, or variant refrigerant compounds not enter the refrigerant cycle during installation work. Foreign matter could damage internal components or cause blockages.
- If air filters are required on this unit, do not operate the unit without the air filter set in place. If the air filter is not installed, dust may accumulate and breakdown may result.
- When installing the unit in a hospital or other facility where electromagnetic waves are generated from nearby medical and/or electronic devices, be prepared for noise and electronic interference Electromagnetic Interference (EMI). Do not install where the waves can directly radiate into the electrical box, controller cable, or controller. Inverters, appliances, high-frequency medical equipment, and radio communications equipment may cause the unit to malfunction. The operation of the unit may also adversely affect these same devices. Install the unit at least 10 ft. (approximately 3m) away from such devices.
- When a wireless controller is used, locate at a distance of at least 3.3 ft. (approximately 1m) between the indoor unit and electric lighting. If not, the receiver part of the unit may have difficulty receiving operation commands.
- Do not install the unit with any downward slope to the side of the drain adaptor. If you do, you may have drain water flowing back which may cause leaks.
- Be sure the condensate hose discharges water properly. If connected incorrectly, it may cause overflow.
- Do not install the unit in any place where oil can seep onto the units, such as table or seating areas in restaurants, and so forth. For these locations or social venues, use specialized units with oil-resistant features built into them. In addition, use a specialized ceiling fan designed for restaurant use. These specialized oil-resistant units can be ordered for such applications. However, in places where large quantities of oil can splash onto the unit, such as a factory, even the specialized units cannot be used. These products should not be installed in such locations.
- Do not install the unit where water can seep into the unit or where there is high humidity that can affect the unit.

Installation Precautions

⚠WARNING	To reduce the risk of serious injury or death, the following installation precautions must be followed.

- When installing the unit into…
  - A wall: Make sure the wall is strong enough to hold the unit's weight. It may be necessary to construct a strong wood or metal frame to provide added support.
  - A room: Properly insulate any refrigerant tubing run inside a room to prevent "sweating" that can cause dripping and water damage to walls, floors, or property within the space.
  - Damp or uneven areas: Use a raised concrete pad or concrete blocks to provide a solid, level foundation for the unit to prevent water damage and abnormal vibration.
- Do not install the unit outdoor, do not install the unit in the following places. Doing so can result in an explosion, fire, deformation, corrosion, or product failure.
  - Explosive or flammable atmosphere
  - Where fire, oil, steam, or powder can directly enter the unit, such as in close proximity or directly above a kitchen stove.
  - Where oil (including machinery oil) may be present.
  - Where corrosive gases such as chlorine, bromine, or sulfide can accumulate, such as near a hot tub, hot spring or swimming pool.
  - Where dense, salt-laden airflow is heavy, such as in coastal regions.
  - Where the air quality is of high acidity.
  - Where harmful gases can be generated from decomposition.
- Do not install the unit in the place where water may enter the unit.
- Do not position the condensate pipe for the indoor unit near any sanitary sewers where corrosive gases may be present. If you do, toxic gases can seep into breathable air spaces and can cause respiratory injuries. If the condensate pipe is installed incorrectly, water leakage and damage to the ceiling, floor, furniture, or other property may result. If condensate piping becomes clogged, moisture can back up and can drip from the indoor unit. Do not install the indoor unit where such dripping can cause moisture damage or uneven locations. Use a raised concrete pad or concrete blocks to provide a solid, level foundation for the unit to prevent water damage and abnormal vibration.

- Before performing any brazing work, be sure that there are no flammable materials or open flames nearby.
- Perform a test run to ensure normal operation. Safety guards, shields, barriers, covers, and protective devices must be in place while the compressor/unit is operating. During the test run, keep fingers and clothing away from any moving parts.
- Clean up the site when finished, remembering to check that no tools, metal scraps, or bits of wiring have been left inside the unit being installed.
- During transportation, do not allow the backrest of the forklift make contact with the unit, otherwise, it may cause damage to the unit and also may cause injury when stopped or started suddenly.
- Remove gas inside the pipe closure (cap) when the brazing work is performed. If the brazing filler metal is melted with remaining gas inside, the pipes will be blown off and it may cause injury.
- Be sure to use nitrogen gas for an airtight test. If other gases such as oxygen gas, acetylene gas or fluorocarbon gas are accidentally used, it may cause explosion or gas intoxication.

After installation work for the system has been completed, explain the “Safety Precautions,” the proper use and maintenance of the unit to the customer according to the information in all manuals that came with the system. All manuals and warranty information must be given to the user or left near the Indoor Unit.

Water Piping Precautions

NOTICE	Take the following precautions to reduce the risk of property damage.

- Select the water piping according to local or national regulation.
  Supply water must be clean tap water or industrial water. (Refer to Section 6.4 “Water Quality Requirements” for details.)
- Do not connect the drain outlet to the water piping.
  Install condensate piping to proper drainage. Improper condensate piping may result in water leakage and property damage.
- Perform piping work in such a way no water may drop on the service panels of the water source unit. Securely fasten the service panels. Otherwise, dust or water may enter the unit causing fire or electric shock.
- Water source unit must be used with closed type cooling tower. Open type cooling tower can not be used.
  Be sure to check the water pipeline construction, water quality monitoring, and water treatment.
- This product is equipped with plate type heat exchangers. In the plate type heat exchanger, water flows through a narrow space between the plates.
  Water strainer must be installed at the water inlet side of water piping near the product.
  Otherwise, impurities and water scales will damage heat exchanger. Be sure to regularly clean the strainer according to the clogging degree.
- Perform thermal insulation up to the water inlet/outlet of heat exchanger and the water piping to prevent sweating and freezing.
  Otherwise, damage may be caused by freezing during low ambient temperature and thermal loss.
  Amount of insulation depends on pipe temperature, air temperature, and humidity.
- Be sure to check the position of connection pipe. Do not connect inlet and outlet pipe reversely.
  Connection pipe and pipe joint on heat exchanger should be removal to make operation and clean work more convenient.
- There must be an extra bracer to support piping and piping joints. Use a sleeve to protect the pipes at the point where they go through a wall.
- Perform a thorough inspection of the unit to check for leaks both inside and outside of the system.
  Open fully the water inlet and outlet valves to the unit. Ensure valve flow to the inlet and outlet piping.
  Ensure air purge and drain valves are functioning on the water piping.
  Remove the valve handle to prevent the valve from being opened. If this valve is opened during operation, water blow-off can cause disruption.
  Set the drain valve at lower points in the water system to allow thorough discharge of water to the heat exchanger and system.
- When shutting down the unit for a long period, drain the water from the water piping by opening the drain plug or the air purge plug.

- In winter, when the ambient temperature is low, equipment and piping can be damaged during the shutdown periods at night, because the water in the pump or piping will freeze. To prevent the water from freezing operate the pumps even during the shutdown periods. In case there is still a danger of freezing, completely drain the water from the piping. After a long stoppage, be sure to check and clean the unit in the water system thoroughly before initial startup.

Refrigerant Precautions

⚠ WARNING	To reduce the risk of serious injury or death, the following refrigerant precautions must be followed.

- As originally manufactured, this unit contains refrigerant installed by Johnson Controls. Johnson Controls uses only refrigerants that have been approved for use in the unit's intended home country or market. Johnson Controls distributors similarly are only authorized to provide refrigerants that have been approved for use in the countries or markets they serve. The refrigerant used in this unit is identified on the unit's faceplate and/or in the associated manuals. Any additions of refrigerant into this unit must comply with the country's requirements with regard to refrigerant use and should be obtained from Johnson Controls distributors. Use of any non-approved refrigerant substitutes will void the warranty and will increase the potential risk of equipment damage, property damage, personal injury, or death.
- Take measures to ensure that the refrigerant limitations in ASHRAE Standard 15 (Canada: B52), or other local codes, are followed. If refrigerant gas has leaked during the installation work, ventilate the room immediately.
- Check the design pressure for this product is 601 psi (4.15MPa). The pressure of the refrigerant R410A is 1.4 times higher than that of the refrigerant R22. Therefore, the refrigerant piping for R410A must be thicker than that for R22. Be sure to use the specified refrigerant piping. If not, the refrigerant piping may rupture due to an excessive refrigerant pressure. Pay attention to the piping thickness when using copper refrigerant piping. The thickness of copper refrigerant piping differs depending on its material.
- The refrigerant R410A is adopted. The refrigerant oil tends to be affected by foreign matters such as moisture, oxide film, or other non-condensables. Perform the installation work with care to prevent moisture, dust, or different refrigerant from entering the refrigerant cycle. Foreign matter can be introduced into the cycle from such parts as expansion valve and the operation may be unavailable.
- To avoid the possibility of different refrigerant or refrigerant oil being introduced into the cycle, the sizes of the charging connections have been changed from R407C type and R22 type. It is necessary to prepare the tools listed in Section 3.2 before performing the installation work.
- Use refrigerant pipes and joints which are approved for use with R410A.
- A compressor/unit comprises a pressurized system. Never loosen threaded joints while the system is under pressure and never open pressurized system parts.
- Before installation is complete, make sure that the refrigerant leak test has been performed. If refrigerant gases escape into the air, turn OFF the main switch, extinguish any open flames and contact your service contractor. Refrigerant (Fluorocarbon) for this unit is odorless. If the refrigerant should leak and come into contact with open flames, toxic gas could be generated. Also, because the fluorocarbons are heavier than air, they settle to the floor, which could cause asphyxiation.
- When installing the unit, and connecting refrigerant piping, keep all piping runs as short as possible, and make sure to securely connect the refrigerant piping before the compressor starts operating. If the refrigerant piping is not connected and the compressor activates with the stop valve opened, the refrigerant cycle will become subjected to extremely high pressure, which can cause an explosion or fire.
- Tighten the flare nut in the indoor unit with a torque wrench in the specified manner. Do not apply excessive force to the flare nut when tightening. If you do, the flare nut can crack and refrigerant leakage may occur.
- When maintaining, relocating, and disposing of the unit, dismantle the refrigerant piping after the compressor stops.
- When pipes are removed out from under the piping cover, after the insulation work is completed, cover the gap between the piping cover and pipes by a packing (field-supplied). If the gap is not covered, the unit may be damaged if snow, rain water or small animals enter the unit.

- Do not apply excessive force to the stop valve at the end of opening. Otherwise, the stop valve flies out due to refrigerant pressure. At the test run, fully open the gas and liquid valves, otherwise, these devices will be damaged. (It is closed before shipment.)
- If the arrangement for water source units is incorrect, it may cause flowback of the refrigerant and result in failure of the water source unit.
- The refrigerant system may be damaged if the slope of the piping connection kit exceeds $\pm 15^{o}$.

Electrical Precautions

⚠ WARNING	Take the following precautions to reduce the risk of electric shock, fire or explosion resulting in serious injury or death.

- Highly dangerous electrical voltages are used in this system. Carefully refer to the wiring diagram and these instructions when wiring. Improper connections and inadequate grounding can cause property damage, serious injury, or death.
- Perform all electrical work in strict accordance with this manual and all the relevant regulatory standards.
- Before servicing, open and tag all disconnect switches. Never assume electrical power is disconnected. Check with meter and equipment.
- Only use electrical protection equipment and tools suited for this installation.
- Use specified cables between units.
- The new air conditioner may not function normally in the following instances:
  - If electrical power for the new air conditioner is supplied from the same transformer as the external equipment* referred to below.
  - If the power supply cables for this external equipment* and the new air conditioner unit are located in close proximity to each other.

    External Equipment*: (Example): A lift, container crane, rectifier for electric railway, inverter power device, arc furnace, electric furnace, large-sized induction motor and large-sized switch.

    Regarding the cases mentioned above, surge voltage may be inducted into the power supply cables for the packaged air conditioner due to a rapid change in power consumption of the device and an activation of a switch.
    Check field regulations and standards before performing electrical work in order to protect the power supply for the new air conditioner unit.
- Communication cable shall be a minimum of AWG18 ($0.82mm^2$), 2-Conductor, Stranded Copper. Shielded cable must be considered for applications and routing in areas of high EMI and other sources of potentially excessive electrical noise to reduce the potential for communication errors. When shielded cable is applied, secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local code requirements.
- Use an exclusive power supply for the air conditioner at the unit's rated voltage.
- Be sure to install circuit breakers (ground fault interrupter, isolating switch, molded case circuit breaker and so on), with the specified capacity. Ensure that the wiring terminals are tightened securely to recommended torque specifications.
- Clamp electrical wires securely with a cable clamp after all wiring is connected to the terminal block. In addition, run wires securely through the wiring access channel.
- When installing the power lines, do not apply tension to the cables. Secure the suspended cables at regular intervals.
- Make sure that the terminals do not come into contact with the surface of the electrical box. If the terminals are too close to the surface, it may lead to failures at the terminal connection.
- Turn OFF and disconnect the unit from the power supply when handling the service connector.
  Do not open the service access cover or service panel to the indoor or water source units without turning OFF the main power supply.

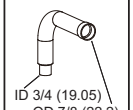
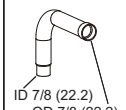
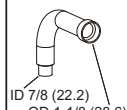
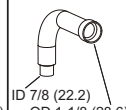
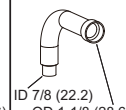
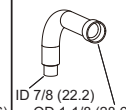
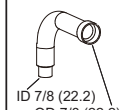
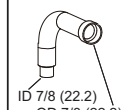
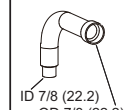
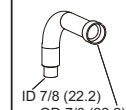
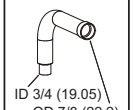
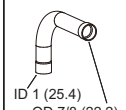
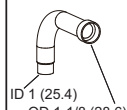
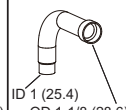
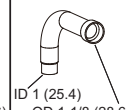
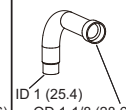
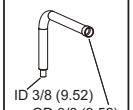
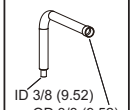
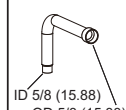
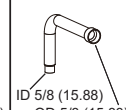
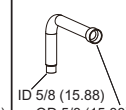
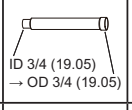
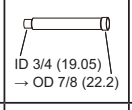
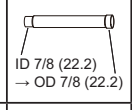
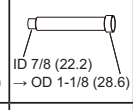
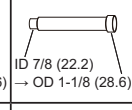
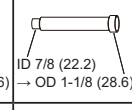
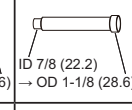
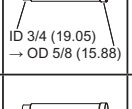
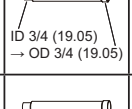
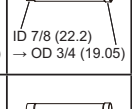
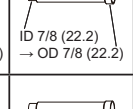
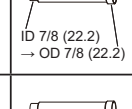
- After ceasing operation, be sure to wait at least five minutes before turning off the main power switch. Otherwise, water leakage or electrical breakdown may result. Disconnect the power supply completely before attempting any maintenance for electrical parts. Check to ensure that no residual voltage is present after disconnecting the power supply.
- Do not clean with, or pour water into, the controller as it could cause electric shock and/or damage the unit. Do not use strong detergent such as a solvent. Clean with a soft cloth.
- Check that the ground wire is securely connected. Do not connect ground wiring to gas piping, water piping, lighting conductor, or telephone ground wiring.
- If a circuit breaker or fuse is frequently tripped, shut down the system and contact your service contractor.
- Perform all electrical work in accordance with this manual and in compliance with all regulations and safety standards.
- Do not open the service access cover or service panel of the indoor or water source unit without first turning OFF the power at the main power supply.
- Do not open the electrical box cover of the water source unit without first removing the condensate buildup on the covers.
- Residual voltage can cause electric shock. At all times, check for residual voltage after disconnecting from the power supply before starting work on the unit.
- This equipment can be installed with a Ground Fault Circuit Breaker (GFCI), which is a recognized measure for added protection to a properly grounded unit. Install appropriate sized breakers / fuses / overcurrent protection switches, and wiring in accordance with local codes and requirements. The equipment installer is responsible for understanding and abiding by applicable codes and requirements.

3. Before Installation

3.1 Factory-Supplied Accessories

Check to ensure that the following accessories are packed with the water source unit.

inch (mm)

Accessory		72 Model	96 Model	120 Model	144 Model	168 Model	192 Model	216 Model	Remarks
Accessory Pipe	90° Elbow Connection for Refrigerant Gas Pipe Front Side Piping	 ID 3/4 (19.05) → OD 3/4 (19.05)	 ID 3/4 (19.05) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	Only for Heat Pump System
	90° Elbow Connection for Refrigerant Gas (High/Low) Pipe Front Side Piping	 ID 3/4 (19.05) → OD 5/8 (15.88)	 ID 3/4 (19.05) → OD 3/4 (19.05)	 ID 7/8 (22.2) → OD 3/4 (19.05)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	Only for Heat Recovery System
	90° Elbow Connection for Refrigerant Gas (Low) Pipe Front Side Piping	 ID 3/4 (19.05) → OD 3/4 (19.05)	 ID 3/4 (19.05) → OD 7/8 (22.2)	 ID 1 (25.4) → OD 7/8 (22.2)	 ID 1 (25.4) → OD 1-1/8 (28.6)	 ID 1 (25.4) → OD 1-1/8 (28.6)	 ID 1 (25.4) → OD 1-1/8 (28.6)	 ID 1 (25.4) → OD 1-1/8 (28.6)	
	90° Elbow Connection for Refrigerant Liquid Pipe Front Side Piping	 ID 3/8 (9.52) → OD 3/8 (9.52)	 ID 3/8 (9.52) → OD 3/8 (9.52)	 ID 1/2 (12.7) → OD 1/2 (12.7)	 ID 5/8 (15.88) → OD 1/2 (12.7)	 ID 5/8 (15.88) → OD 5/8 (15.88)	 ID 5/8 (15.88) → OD 5/8 (15.88)	 ID 5/8 (15.88) → OD 5/8 (15.88)	
	Connection for Refrigerant Gas Pipe Top Side Piping	 ID 3/4 (19.05) → OD 3/4 (19.05)	 ID 3/4 (19.05) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	 ID 7/8 (22.2) → OD 1-1/8 (28.6)	Only for Heat Pump System
	Connection for Refrigerant Gas (High/Low) Pipe Top Side Piping	 ID 3/4 (19.05) → OD 5/8 (15.88)	 ID 3/4 (19.05) → OD 3/4 (19.05)	 ID 7/8 (22.2) → OD 3/4 (19.05)	 ID 7/8 (22.2) → OD 7/8 (22.2)	 ID 7/8 (22.2) → OD 7/8 (22.2)	ID 7/8 (22.2) → OD 7/8 (22.2)	ID 7/8 (22.2) → OD 7/8 (22.2)	Only for Heat Recovery System
	Connection for Refrigerant Gas (Low) Pipe Top Side Piping	ID 3/4 (19.05) → OD 3/4 (19.05)	ID 3/4 (19.05) → OD 7/8 (22.2)	ID 1 (25.4) → OD 7/8 (22.2)	ID 1 (25.4) → OD 1-1/8 (28.6)	ID 1 (25.4) → OD 1-1/8 (28.6)	ID 1 (25.4) → OD 1-1/8 (28.6)	ID 1 (25.4) → OD 1-1/8 (28.6)	
	Connection for Refrigerant Liquid Pipe Top Side Piping	ID 3/8 (9.52) → OD 3/8 (9.52)	ID 3/8 (9.52) → OD 3/8 (9.52)	ID 1/2 (12.7) → OD 1/2 (12.7)	ID 5/8 (15.88) → OD 1/2 (12.7)	ID 5/8 (15.88) → OD 5/8 (15.88)	ID 5/8 (15.88) → OD 5/8 (15.88)	ID 5/8 (15.88) → OD 5/8 (15.88)	
Cable Band	For Securing Open/Close Indication for Stop Valve	× 3	× 3	× 3	× 3	× 3	× 3	× 3	
	For Securing PVC Tube	× 7	× 7	× 7	× 7	× 7	× 7	× 7	
PVC Tube		× 3	× 3	× 3	× 3	× 3	× 3	× 3	ID 1/2 (12)
Rubber Bushing	For Communication Cable	× 2	× 2	× 2	× 2	× 2	× 2	× 2	OD 1-3/4 (45)
Open/Close Indication for Stop Valve	For Indication of “Open”	× 3	× 3	× 3	× 3	× 3	× 3	× 3	

ID: Inner Diameter OD: Outer Diameter

NOTICE

If any of these accessories are not packed with the unit, please contact your distributor.

3.2 Necessary Tools and Instrument List for Installation

No.	Tool	No.	Tool	No.	Tool
1	Hacksaw	8	Pliers	16	Wire Cutters
2	Phillips Screwdriver, Slotted Screwdriver	9	Copper Tube Cutter	17	Gas Leak Detector
		10	Brazing Kit	18	Level
3	Vacuum Pump	11	Hexagon Wrench	19	Crimper for Solderless Terminals
4	Refrigerant Gas Hose	12	Wrenches	20	Hoist (for Indoor Unit)
5	Megohmmeter	13	Scale	21	Ammeter
6	Copper Pipe Bender	14	Charging Cylinder	22	Voltage Meter
7	Manual Water Pump (for Indoor Unit)	15	Gauge Manifold	23	Ratchet Wrench

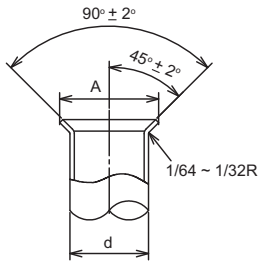
Use specially designated tools for handling R410A refrigerant.

✳: Interchangeability with R407C.
✧: Interchangeability is available with current R22
×: Prohibited
●: Only for Refrigerant R410A (No Interchangeability with R22)
✦: Only for Refrigerant R407C (No Interchangeability with R22)

Measuring Instrument and Tool		Interchangeability with R22		Reason of Non-Interchangeability and Attention (★: Strictly Required)	Use
		R410A	R407C		
Refrigerant Pipe	Copper Tube Cutter, Chamfering Reamer	✧	✧	-	Cutting Pipe Removing Burrs
	Flaring Tool	✧●	✧	* The flaring tools for R407C are applicable to R22. * If using a flaring tube, make the dimension of the tube larger for R410A. * For a hard temper pipe, flaring is not available.	Flaring for Tubes
	Extrusion Adjustment Gauge	●	-		Dimensional Control for Extruded Portion of Tube after Flaring
	Pipe Bender	✧	✧	* For a hard temper pipe, bending is not available. Use an elbow for bending and brazing.	Bending
	Expanding Tool	✧	✧	* For a hard temper pipe, expansion of the tube is not available. Use socket for connecting tube.	Expanding Tubes
	Torque Wrench	●	✧	* For 1/2 inch D. (12.7mm), 5/8 inch D. (15.88mm), spanner size is up 1/16 inch (2mm).	Connection of Flare Nut
		✧	✧	* For 1/4 inch D. (6.35mm), 3/8 inch D. (9.52mm), 3/4 inch D. (19.05mm), spanner size is the same.	
	Brazing Tool	✧	✧	* Perform correct brazing work.	Brazing for Tubes
	Nitrogen Gas	✧	✧	* Strict Control against Contamination (Nitrogen flow during brazing.)	Prevention from Oxidation during Brazing
	Lubrication Oil (for Flare Surface)	●	✦	* Use a synthetic oil which is equivalent to the oil used in the refrigeration cycle. * Synthetic oil absorbs moisture quickly.	Applying Oil to the Flared Surface
Vacuum Drying · Refrigerant Charge	Refrigerant Cylinder	●	✦	* Check refrigerant cylinder color. ★ Liquid refrigerant charging is required for zeotropic refrigerant.	Refrigerant Charging
	Vacuum Pump	✧	✧	★ The current ones are applicable. However, it is required to mount a vacuum pump adapter which can prevent reverse flow when a vacuum pump stops, resulting in no reverse oil flow.	Vacuum Pumping
	Adapter for Vacuum Pump	✳●	✦		
	Manifold Valve	●	✦	* No interchangeability is available due to higher pressures when compared with R22. ★ Use the same ones as for the current refrigerant. Otherwise, mineral oil will flow into the cycle and cause sludge resulting in clogging or compressor failure. Connection diameter is different; R410A: UNF1/2, R407C: UNF7/16.	Vacuum Pumping, Vacuum Holding, Refrigerant Charging and Check of Pressures
	Charging Hose	●	✦		
	Charging Cylinder	×	×	* Use the weight scale to ensure proper charging of the unit.	-
	Weight Scale	✧	✧	-	Measuring Instrument for Refrigerant Charging
	Refrigerant Gas Leakage Detector	✳●	✦	* The current gas leakage detector (R22) is not applicable due to a different detecting method.	Gas Leakage Check

3.3 Flaring and Joint for Indoor Unit Connection

- Flaring Dimension
  Perform the flaring work as shown below.



inch (mm)

Diameter (d)	A +0 -0.02 (-0.4)
	R410A
1/4 (6.35)	0.36 (9.1)
3/8 (9.52)	0.52 (13.2)
1/2 (12.7)	0.65 (16.6)
5/8 (15.88)	0.78 (19.7)
3/4 (19.05)	(✳)

(✳) It is impossible to perform flaring work with hard temper pipe.
Use an accessory pipe with a flare.

- Joint Selection
  If hard temper pipe is used, the flaring work cannot be performed. In this case, use a joint selected from the table below. Do not use any thin joint other than the ones shown in the table at left.

Minimum Thickness of Joint

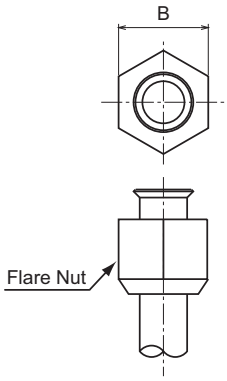
inch (mm)

Diameter	R410A
1/4 (6.35)	0.020 (0.5)
3/8 (9.52)	0.024 (0.6)
1/2 (12.7)	0.028 (0.7)
5/8 (15.88)	0.031 (0.8)
3/4 (19.05)	0.031 (0.8)
7/8 (22.2)	0.035 (0.9)
1-1/8 (28.58)	0.039 (1.0)
1-3/8 (34.93)	0.047 (1.2)
1-5/8 (41.28)	0.057 (1.45)

Flare Nut Dimension B

inch (mm)

Diameter	R410A
1/4 (6.35)	11/16 (17)
3/8 (9.52)	7/8 (22)
1/2 (12.7)	1 (26)
5/8 (15.88)	1-1/8 (29)
3/4 (19.05)	1-7/16 (36)



- Piping Thickness and Material

  Use the pipe as described below.
  The thickness of refrigerant pipe differs depending on design pressure.
  For copper pipe, pay attention to pipe selection, because the piping thickness differs depending on its material.

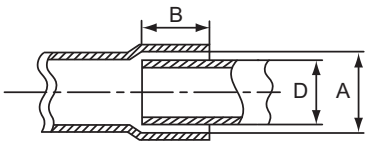
inch (mm)

Outer Diameter	R410A	
	Thickness	Temper
1/4 (6.35)	0.03 (0.76)	Annealed
3/8 (9.52)	0.032 (0.81)	Annealed
1/2 (12.7)	0.032 (0.81)	Annealed
5/8 (15.88)	0.035 (0.89)	Annealed
3/4 (19.05)	0.035 (0.89)	Hard Temper (or Annealed)
7/8 (22.2)	0.045 (1.14)	Hard Temper
1-1/8 (28.58)	0.050 (1.27)	Hard Temper
1-3/8 (34.93)	0.065 (1.65)	Hard Temper
1-5/8 (41.28)	0.072 (1.83)	Hard Temper

NOTES:

- Do not use pipe that has allowable pressure less than 601 psi (4.15MPa).
- The reference value of the refrigerant piping thickness is indicated in the table at left.
  Do not use pipe that is considerably different from the reference value.

- Brazing Connection
  To prevent gas leakage at the brazing connection, refer to the following table for the insertion depth and the gap for the joint pipe.



inch (mm)

Diameter (D)	Min. Insertion Depth (B)	Gap (A - D)
3/16 ≤ D < 5/16 (5 ≤ D < 8)	1/4 (6)	0.002 - 0.014 (0.05 - 0.35)
5/16 ≤ D < 1/2 (8 ≤ D < 12)	9/32 (7)	
1/2 ≤ D < 5/8 (12 ≤ D < 16)	5/16 (8)	0.002 - 0.018 (0.05 - 0.45)
5/8 ≤ D < 1 (16 ≤ D < 25)	3/8 (10)	
1 ≤ D < 1-3/8 (25 ≤ D < 35)	1/2 (12)	0.002 - 0.022 (0.05 - 0.55)
1-3/8 ≤ D < 1-3/4 (35 ≤ D < 45)	9/16 (14)	

3.4 Line-Up of Water Source Units

(1) This water source unit series can build the capacity of 72 to 576 MBH by combining the water source units of 72 to 216 MBH.

(2) The water source units of 240 to 576 MBH consist of the combination of two or three base units. Use the combination of units as shown in the following table. If the combinations are not listed, then they are not available.

3.4.1 Heat Pump System

208/230V

Base Unit

Capacity (MBH)	72	96	120	144
Model	(H,Y)VWHP072B32S	(H,Y)VWHP096B32S	(H,Y)VWHP120B32S	(H,Y)VWHP144B32S
Capacity (MBH)	168	192	216	
Model	(H,Y)VWHP168B32S	(H,Y)VWHP192B32S	(H,Y)VWHP216B32S	

Combination of Base Units

Capacity (MBH)	240	264	288	312
Model	(H,Y)VWHP240B32S	(H,Y)VWHP264B32S	(H,Y)VWHP288B32S	(H,Y)VWHP312B32S
Combination	(H,Y)VWHP120B32S	(H,Y)VWHP144B32S	(H,Y)VWHP144B32S	(H,Y)VWHP168B32S
	(H,Y)VWHP120B32S	(H,Y)VWHP120B32S	(H,Y)VWHP144B32S	(H,Y)VWHP144B32S
Capacity (MBH)	336	360	384	408
Model	(H,Y)VWHP336B32S	(H,Y)VWHP360B32S	(H,Y)VWHP384B32S	(H,Y)VWHP408B32S
Combination	(H,Y)VWHP168B32S	(H,Y)VWHP192B32S	(H,Y)VWHP192B32S	(H,Y)VWHP216B32S
	(H,Y)VWHP168B32S	(H,Y)VWHP168B32S	(H,Y)VWHP192B32S	(H,Y)VWHP192B32S
Capacity (MBH)	432	456	480	504
Model	(H,Y)VWHP432B32S	(H,Y)VWHP456B32S	(H,Y)VWHP480B32S	(H,Y)VWHP504B32S
Combination	(H,Y)VWHP216B32S	(H,Y)VWHP168B32S	(H,Y)VWHP168B32S	(H,Y)VWHP168B32S
	(H,Y)VWHP216B32S	(H,Y)VWHP144B32S	(H,Y)VWHP168B32S	(H,Y)VWHP168B32S
	-	(H,Y)VWHP144B32S	(H,Y)VWHP144B32S	(H,Y)VWHP168B32S
Capacity (MBH)	528	552	576	
Model	(H,Y)VWHP528B32S	(H,Y)VWHP552B32S	(H,Y)VWHP576B32S	
Combination	(H,Y)VWHP192B32S	(H,Y)VWHP192B32S	(H,Y)VWHP192B32S	
	(H,Y)VWHP168B32S	(H,Y)VWHP192B32S	(H,Y)VWHP192B32S	
	(H,Y)VWHP168B32S	(H,Y)VWHP168B32S	(H,Y)VWHP192B32S	

460V

Base Unit

Capacity (MBH)	72	96	120	144
Model	(H,Y)VWHP072B42S	(H,Y)VWHP096B42S	(H,Y)VWHP120B42S	(H,Y)VWHP144B42S
Capacity (MBH)	168	192	216	
Model	(H,Y)VWHP168B42S	(H,Y)VWHP192B42S	(H,Y)VWHP216B42S	

Combination of Base Units

Capacity (MBH)	240	264	288	312
Model	(H,Y)VWHP240B42S	(H,Y)VWHP264B42S	(H,Y)VWHP288B42S	(H,Y)VWHP312B42S
Combination	(H,Y)VWHP120B42S	(H,Y)VWHP144B42S	(H,Y)VWHP144B42S	(H,Y)VWHP168B42S
	(H,Y)VWHP120B42S	(H,Y)VWHP120B42S	(H,Y)VWHP144B42S	(H,Y)VWHP144B42S
Capacity (MBH)	336	360	384	408
Model	(H,Y)VWHP336B42S	(H,Y)VWHP360B42S	(H,Y)VWHP384B42S	(H,Y)VWHP408B42S
Combination	(H,Y)VWHP168B42S	(H,Y)VWHP192B42S	(H,Y)VWHP192B42S	(H,Y)VWHP216B42S
	(H,Y)VWHP168B42S	(H,Y)VWHP168B42S	(H,Y)VWHP192B42S	(H,Y)VWHP192B42S
Capacity (MBH)	432	456	480	504
Model	(H,Y)VWHP432B42S	(H,Y)VWHP456B42S	(H,Y)VWHP480B42S	(H,Y)VWHP504B42S
Combination	(H,Y)VWHP216B42S	(H,Y)VWHP168B42S	(H,Y)VWHP168B42S	(H,Y)VWHP168B42S
	(H,Y)VWHP216B42S	(H,Y)VWHP144B42S	(H,Y)VWHP168B42S	(H,Y)VWHP168B42S
	-	(H,Y)VWHP144B42S	(H,Y)VWHP144B42S	(H,Y)VWHP168B42S
Capacity (MBH)	528	552	576	
Model	(H,Y)VWHP528B42S	(H,Y)VWHP552B42S	(H,Y)VWHP576B42S	
Combination	(H,Y)VWHP192B42S	(H,Y)VWHP192B42S	(H,Y)VWHP192B42S	
	(H,Y)VWHP168B42S	(H,Y)VWHP192B42S	(H,Y)VWHP192B42S	
	(H,Y)VWHP168B42S	(H,Y)VWHP168B42S	(H,Y)VWHP192B42S	

3.4.2 Heat Recovery System

208/230V

Base Unit

Capacity (MBH)	72	96	120	144
Model	(H,Y)VWHR072B32S	(H,Y)VWHR096B32S	(H,Y)VWHR120B32S	(H,Y)VWHR144B32S
Capacity (MBH)	168	192	216	
Model	(H,Y)VWHR168B32S	(H,Y)VWHR192B32S	(H,Y)VWHR216B32S	

Combination of Base Units

Capacity (MBH)	240	264	288	312
Model	(H,Y)VWHR240B32S	(H,Y)VWHR264B32S	(H,Y)VWHR288B32S	(H,Y)VWHR312B32S
Combination	(H,Y)VWHR120B32S	(H,Y)VWHR144B32S	(H,Y)VWHR144B32S	(H,Y)VWHR168B32S
	(H,Y)VWHR120B32S	(H,Y)VWHR120B32S	(H,Y)VWHR144B32S	(H,Y)VWHR144B32S
Capacity (MBH)	336	360	384	408
Model	(H,Y)VWHR336B32S	(H,Y)VWHR360B32S	(H,Y)VWHR384B32S	(H,Y)VWHR408B32S
Combination	(H,Y)VWHR168B32S	(H,Y)VWHR192B32S	(H,Y)VWHR192B32S	(H,Y)VWHR216B32S
	(H,Y)VWHR168B32S	(H,Y)VWHR168B32S	(H,Y)VWHR192B32S	(H,Y)VWHR192B32S
Capacity (MBH)	432	456	480	504
Model	(H,Y)VWHR432B32S	(H,Y)VWHR456B32S	(H,Y)VWHR480B32S	(H,Y)VWHR504B32S
Combination	(H,Y)VWHR216B32S	(H,Y)VWHR168B32S	(H,Y)VWHR168B32S	(H,Y)VWHR168B32S
	(H,Y)VWHR216B32S	(H,Y)VWHR144B32S	(H,Y)VWHR168B32S	(H,Y)VWHR168B32S
	-	(H,Y)VWHR144B32S	(H,Y)VWHR144B32S	(H,Y)VWHR168B32S
Capacity (MBH)	528	552	576	
Model	(H,Y)VWHR528B32S	(H,Y)VWHR552B32S	(H,Y)VWHR576B32S	
Combination	(H,Y)VWHR192B32S	(H,Y)VWHR192B32S	(H,Y)VWHR192B32S	
	(H,Y)VWHR168B32S	(H,Y)VWHR192B32S	(H,Y)VWHR192B32S	
	(H,Y)VWHR168B32S	(H,Y)VWHR168B32S	(H,Y)VWHR192B32S	

460V

Base Unit

Capacity (MBH)	72	96	120	144
Model	(H,Y)VWHR072B42S	(H,Y)VWHR096B42S	(H,Y)VWHR120B42S	(H,Y)VWHR144B42S
Capacity (MBH)	168	192	216	
Model	(H,Y)VWHR168B42S	(H,Y)VWHR192B42S	(H,Y)VWHR216B42S	

Combination of Base Units

Capacity (MBH)	240	264	288	312
Model	(H,Y)VWHR240B42S	(H,Y)VWHR264B42S	(H,Y)VWHR288B42S	(H,Y)VWHR312B42S
Combination	(H,Y)VWHR120B42S	(H,Y)VWHR144B42S	(H,Y)VWHR144B42S	(H,Y)VWHR168B42S
	(H,Y)VWHR120B42S	(H,Y)VWHR120B42S	(H,Y)VWHR144B42S	(H,Y)VWHR144B42S
Capacity (MBH)	336	360	384	408
Model	(H,Y)VWHR336B42S	(H,Y)VWHR360B42S	(H,Y)VWHR384B42S	(H,Y)VWHR408B42S
Combination	(H,Y)VWHR168B42S	(H,Y)VWHR192B42S	(H,Y)VWHR192B42S	(H,Y)VWHR216B42S
	(H,Y)VWHR168B42S	(H,Y)VWHR168B42S	(H,Y)VWHR192B42S	(H,Y)VWHR192B42S
Capacity (MBH)	432	456	480	504
Model	(H,Y)VWHR432B42S	(H,Y)VWHR456B42S	(H,Y)VWHR480B42S	(H,Y)VWHR504B42S
Combination	(H,Y)VWHR216B42S	(H,Y)VWHR168B42S	(H,Y)VWHR168B42S	(H,Y)VWHR168B42S
	(H,Y)VWHR216B42S	(H,Y)VWHR144B42S	(H,Y)VWHR168B42S	(H,Y)VWHR168B42S
	-	(H,Y)VWHR144B42S	(H,Y)VWHR144B42S	(H,Y)VWHR168B42S
Capacity (MBH)	528	552	576	
Model	(H,Y)VWHR528B42S	(H,Y)VWHR552B42S	(H,Y)VWHR576B42S	
Combination	(H,Y)VWHR192B42S	(H,Y)VWHR192B42S	(H,Y)VWHR192B42S	
	(H,Y)VWHR168B42S	(H,Y)VWHR192B42S	(H,Y)VWHR192B42S	
	(H,Y)VWHR168B42S	(H,Y)VWHR168B42S	(H,Y)VWHR192B42S	

3.5 Combinations of Indoor Units and Water Source Units

Table 3.1 Indoor Unit Model List

Indoor Unit Model			Capacity (MBH)													
			6	8	12	15	18	24	27	30	36	48	54	60	72	96
Ducted	Ducted (High Static)	(H,Y)IDH_B21S					○	○		○	○	○			○	○
		(H,Y)IDH_B22S				○	○	○	○	○	○	○	○			
	Ducted (Medium Static)	(H,Y)IDM_B21S	○	○	○	○	○	○		○	○	○				
		(H,Y)IDM_B22S	○	○	○	○	○	○	○	○	○	○	○			
	Ducted (Slim)	(H,Y)IDS_B21S	○	○	○	○	○									
	Air Handler with DX-Kit	(H,Y)MAHP_B21S					○	○		○	○					
		(H,Y)MAHP_C21S									○	○		○		
		(H,Y)MAHP_D21S										○		○		
		(H,Y)MAHP_D22S												○		
Non-Ducted	Ceiling-Mounted 4-Way Cassette	(H,Y)IC4_B21S		○	○	○	○	○		○	○	○				
	Ceiling-Mounted 4-Way Cassette Mini	(H,Y)ICM_B21S		○	○	○	○									
	Ceiling-Mounted 2-Way Cassette	(H,Y)IC2_B21S					○	○								
	Ceiling-Mounted 1-Way Cassette	(H,Y)IC1_B21S	○	○	○	○										
	Wall-Mounted	TIWM_B21S	○	○	○	○	○	○		○						
	Ceiling Suspended	(H,Y)ICS_B21S				○		○		○	○					
	Floor Exposed	(H,Y)IFE_B21S	○	○	○	○										
	Floor Concealed	(H,Y)IFC_B21S	○	○	○	○										

○ : Available

The number of indoor units that can be connected to a water source unit is defined in Table 3.2.
Comply with the following conditions when installing the unit:
A maximum and minimum total capacity as opposed to the nominal water source unit capacity can be obtained through combination of indoor units.

Table 3.2 System Combination

Model: (H,Y)VWH(P,R)_B(3,4)2S

Water Source Unit Capacity (MBH)	Minimum Capacity at Individual Operation (MBH)	Maximum Number of Connectable I.U.	Recommended Number of Connected I.U.	Connectable Indoor Unit Capacity Ratio	
				Maximum	Minimum
72	6	13	8	130%	50%
96		16	8	130%	50%
120		23	8	130%	50%
144		26	10	130%	50%
168		29	12	130%	50%
192		33	14	130%	50%
216		33	14	130%	50%
240		46	16	130%	50%
264		49	18	130%	50%
288		52	20	130%	50%
312		55	22	130%	50%
336		58	24	130%	50%
360		62	26	130%	50%
384		64	28	130%	50%
408		64	28	130%	50%
432		64	28	130%	50%
456		64	28	130%	50%
480		64	28	130%	50%
504		64	28	130%	50%
528		64	28	130%	50%
552		64	28	130%	50%
576		64	28	130%	50%

NOTICE:

The connectable indoor unit capacity ratio can be calculated as follows:

Connectable Indoor Unit Capacity Ratio = Total Indoor Unit Capacity / Total Water Source Unit Capacity

In a system where all the indoor units operate simultaneously, the total indoor unit capacity should be less than the water source unit capacity. Otherwise, a decrease in operating performance and an increase in the operating limit can result in an overload.

In a system where all the indoor units do not operate simultaneously, the total indoor unit capacity is available up to 130% of the water source unit capacity.

The air flow volume for indoor units of 6 and 8 MBH is set higher than that for indoor units of 12 MBH or more. Make sure to select appropriate indoor units for installation where a cold draft may occur during heating operation.

3.6 Caution about Water Source Unit Installation

When the installation and piping work for the multiple water source units is performed, it is required that you determine the arrangement of the water source units and the piping length. Perform the installation work in strict accordance with the following requirements.

NOTICE

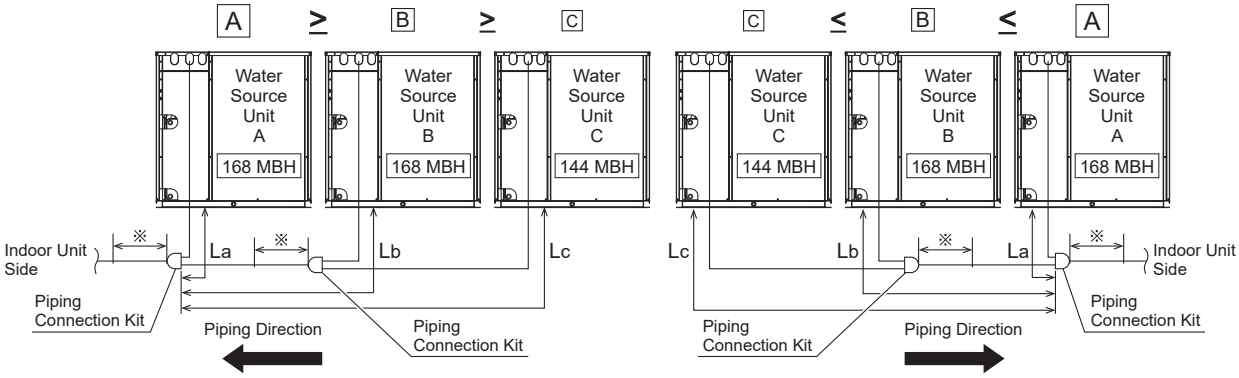
If the arrangement for water source units is incorrect, it may cause flowback of the refrigerant and result in failure of the water source unit.

Requirements for Combining Two and Three Units

(1) When using a combination of two or three water source units, align the water source units from largest capacity to smallest as A ≥ B ≥ C and water source unit “A” is connected to the piping connection kit 1.

(2) The piping length between the piping connection kit 1 and the water source unit should be La ≤ Lb ≤ Lc ≤ 32 ft (10m).

Example: (H,Y)VWH(P,R)480B(3,4)2S



※: Maintain a straight-line distance of 19-11/16 inches (500mm) or more for piping after installing the piping connection kit.

3.7 Piping Work between Water Source Units

When installing a combination unit, a piping connection kit is needed for each additional unit but not for the base unit: (72, 96, 120, 144, 168, 192, 216 Models). For Heat Pump: The piping connection kit (MC-NP**SA1) consists of branch pipes for gas and liquid. For Heat Recovery: The piping connection kit (MC-NP**SX1) consists of branch pipes for low pressure gas, high/low pressure gas and liquid. Interconnecting pipe is not included in these kits (field-supplied).

Water Source Unit Model	Operation	Applicable Water Source Unit		Piping Connection Kit Model	Piping Set	Remarks
		Water Source Unit Capacity (MBH)	Water Source Unit Number			
(H,Y)VWHP_B(3,4)2S	Heat Pump	240 - 432	2	MC-NP21SA1	1	2 Pipes Type * for Gas * for Liquid
		456 - 576	3	MC-NP30SA1	1	
(H,Y)VWHR_B(3,4)2S	Heat Recovery	240 - 432	2	MC-NP21SX1	1	3 Pipes Type * for Low Pressure Gas * for High/Low Pressure Gas * for Liquid
		456 - 576	3	MC-NP30SX1	1	

4. Water Source Unit Installation

4.1 Installation Location and Precautions

⚠WARNING

Install the water source unit to indoors. It is recommended that the water source unit be installed in a mechanical room, to prevent weather damage. To reduce the risk of serious injury or death, the following installation precautions must be followed.

- When installing the unit into…
  - A room: Properly insulate any refrigerant pipe run inside a room to prevent “sweating” that can cause dripping and water damage to walls, floors, equipment, and property.
  - Damp or uneven areas: Use a raised concrete pad or concrete blocks to provide a solid, level foundation for the unit to prevent water damage and abnormal vibration.
  - Install the unit indoor. Do not install the unit in a place where water can enter the unit.
  - Install the water source unit in the shade, not exposed to direct sunshine or direct radiation from any high temperature heat sources.
  - Install the water source unit in a space with limited access to general public.
  - Install the water source in a space where ambient temperature is 35~104°F DB (1.7~40°C DB) and relative humidity is lower than 80%.
  - Install the water source units in a room or closet with ventilation to accommodate any excessive heat removal.
- Do not install the unit outdoor.
- Do not install the unit in the following places (doing so can result in an explosion, fire, deformation, corrosion, or product failure):
  - Explosive or flammable atmosphere
  - Where a fire, oil, steam, or powder can directly enter the unit, such as nearby or above a kitchen stove.
  - Where oil (including machinery oil) may be present.
  - Where corrosive gases such as chlorine, bromine, or sulfide can accumulate, such as near a hot tub, hot spring, or swimming pool.
  - Where dense, self-laden airflow may be present.
  - Where the air quality is of high acidity.
  - Where other harmful gases may be present.
- During heating operation, condensate is discharged. Provide adequate condensate hose (field-supplied).
- Before performing any brazing work, be sure that there are no flammable materials or open flames nearby.
- Perform a test run to ensure normal operation. Safety guards, shields, barriers, covers, and protective devices must be in place while the compressor/unit is operating. During the test run, keep fingers and clothing away from any moving parts.
- Clean up the site when finished, remembering to check that no tools, metal scraps, or bits of wiring have been left behind inside the unit being installed.

After installation work for the system has been completed, explain the “Safety Precautions” and the proper use and maintenance of the unit to the customer according to the information in all manuals that came with the system. All manuals and warranty information must be given to the user or left near the unit.

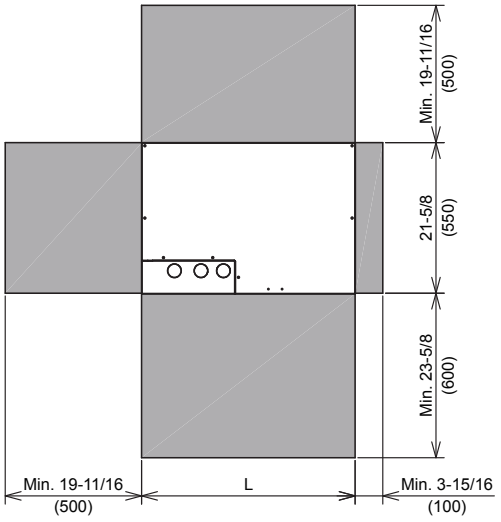
4.2 Service and Installation Space

Install the water source unit with sufficient space around it for operation and maintenance access as shown in the following figures.

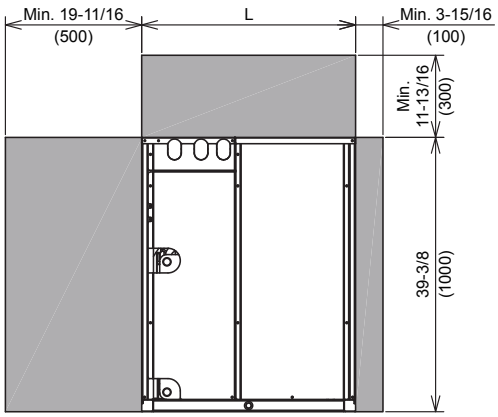
- Service Space

  Secure following space when replacing parts or service maintenance access.

Unit: inch (mm)



Top View

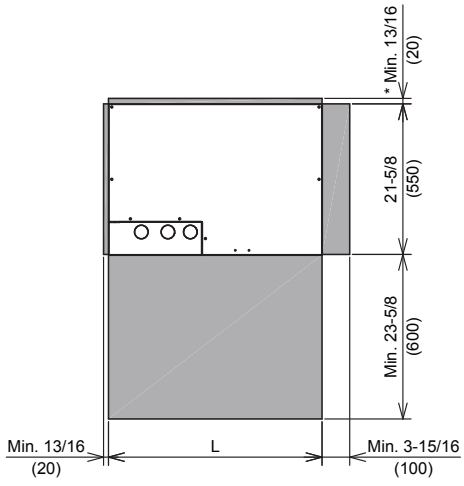


Front View

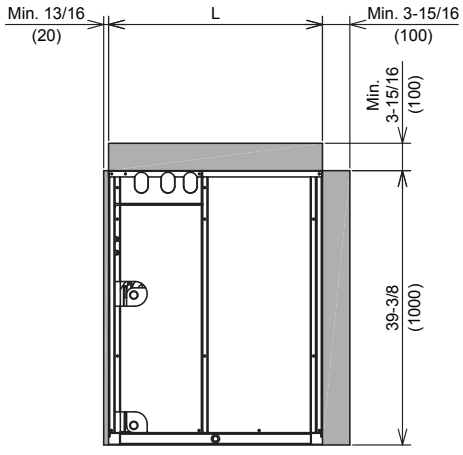
- Installation Space

  Single installation with refrigerant pipes from front side piping cover and condensate pipe from front side of unit.

Unit: inch (mm)



Top View

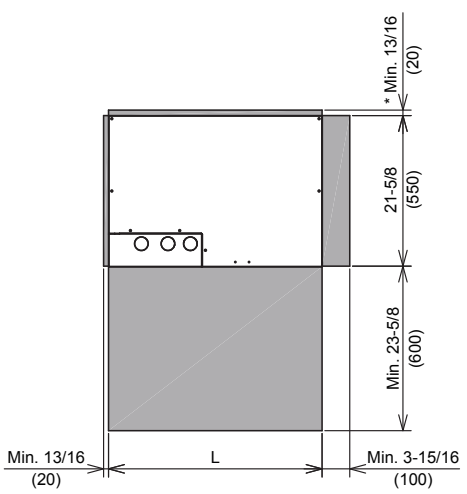


Front View

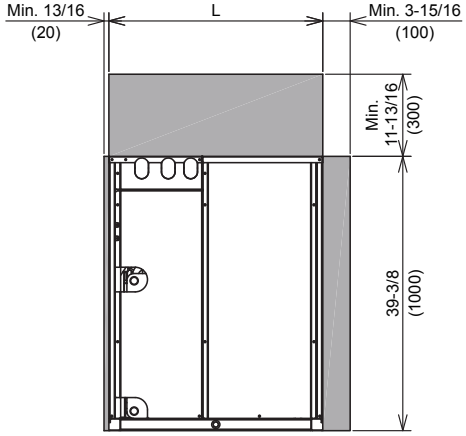
* Provide minimum of 19-11/16 inches (500mm) space for condensate pipe from rear side of unit.

Single installation with refrigerant pipes from top side piping cover and condensate pipe from front side of unit.

Unit: inch (mm)



Top View

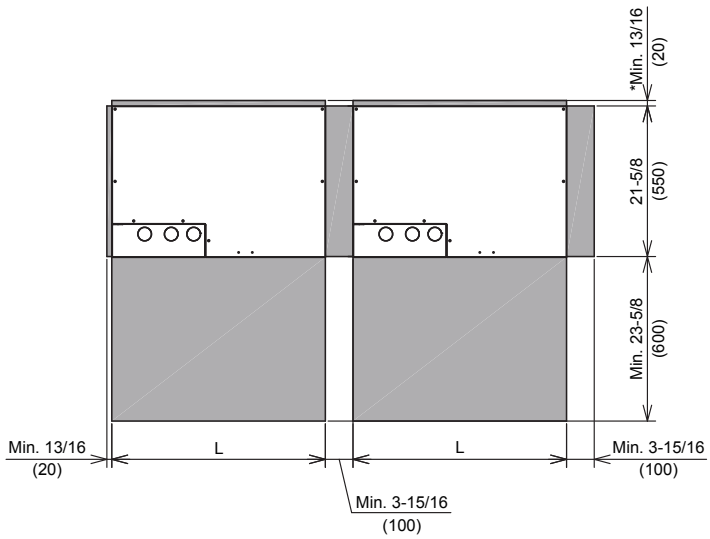


Front View

* Provide minimum of 19-11/16 inches (500mm) space for condensate pipe from rear side of unit.

Multiple installation with condensate pipe from front side of unit.

Unit: inch (mm)



Top View

* Provide minimum of 19-11/16 inches (500mm) space for condensate pipe from rear side of unit.

Model	L
72, 96 and 120	30-11/16 (780)
144, 160, 192 and 216	39-3/8 (1000)

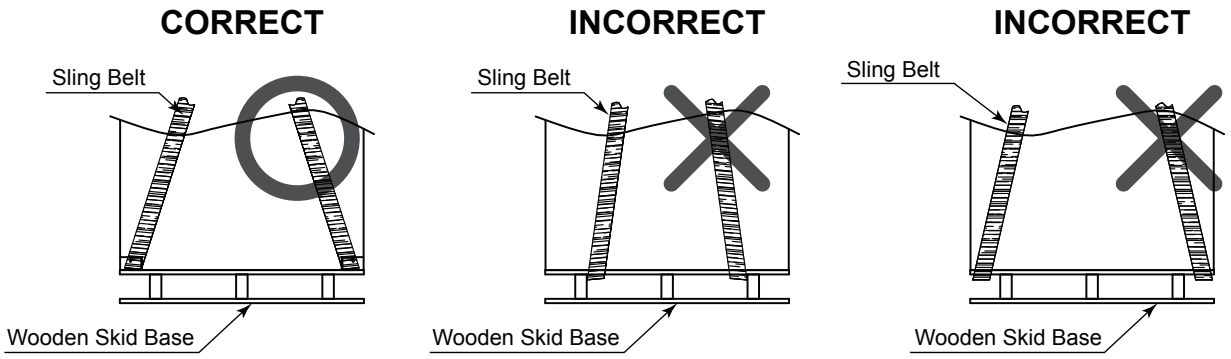
5. Transportation and Installation Work

5.1 Transportation

Transport the product as close to the installation location as practical before unpackaging.
When using a crane, suspend the unit according to the description on the water source unit packaging slip.

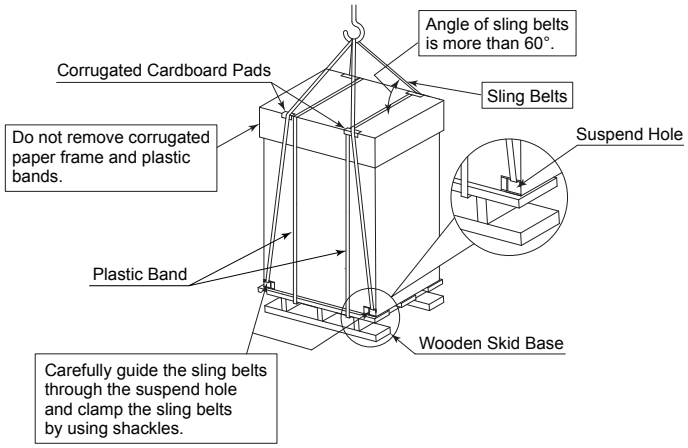
⚠WARNING

- **Do not suspend the unit with the sling belts at the wooden skid base.**



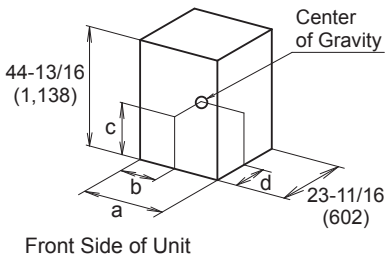
⚠CAUTION

- **Transportation and Storage:**
  - *** The protective corrugated cardboard is not strong enough to resist rough handling.**
  - *** Secure with two sling belts when hoisting the water source unit with a crane.**
- **Transportation and Banding Wire:**
  - *** To protect the unit, do not remove any packaging.**
  - *** Do not stack or place any material on top of the product.**
  - *** Apply banding wire to both sides of the packaged unit as shown at right.**



Take special care when suspending or moving the water source unit because its center of mass is off-center and unbalanced. See the diagram below.

Center of Gravity

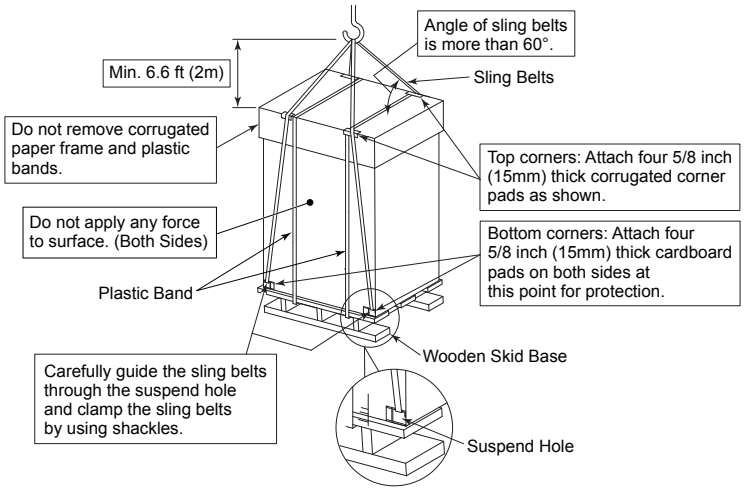


inch (mm)

Voltage	Model	a	b	c	d
208/230V	72	33-7/16 (850)	17-11/16 (450)	19-11/16 (500)	12-3/8 (315)
	96	33-7/16 (850)	17-11/16 (450)	19-11/16 (500)	12-3/8 (315)
	120	33-7/16 (850)	17-5/16 (440)	20-1/16 (510)	12 (305)
	144	42-1/4 (1,073)	21-5/8 (550)	19-1/2 (495)	12-3/8 (315)
	168	42-1/4 (1,073)	21-5/8 (550)	19-1/2 (495)	12-3/8 (315)
	192	42-1/4 (1,073)	21-5/8 (550)	19-1/2 (495)	12-3/8 (315)
	216	42-1/4 (1,073)	21-5/8 (550)	19-1/2 (495)	12-3/8 (315)
460V	72	33-7/16 (850)	18-1/8 (460)	19-1/2 (495)	12-3/16 (310)
	96	33-7/16 (850)	18-1/8 (460)	19-1/2 (495)	12-3/16 (310)
	120	33-7/16 (850)	17-11/16 (450)	19-7/8 (505)	11-13/16 (300)
	144	42-1/4 (1,073)	21-7/8 (555)	19-5/16 (490)	12-3/16 (310)
	168	42-1/4 (1,073)	21-7/8 (555)	19-5/16 (490)	12-3/16 (310)
	192	42-1/4 (1,073)	21-7/8 (555)	19-5/16 (490)	12-3/16 (310)
	216	42-1/4 (1,073)	21-7/8 (555)	19-5/16 (490)	12-3/16 (310)

Suspending Method

(1) Suspend the unit (with wooden skid base) in its packaging with two sling belts as shown in Figure 5.1.
(2) Do not use banding wire.
(3) Ensure that the unit is balanced.
(4) Ensure safety while hoisting the unit gently to prevent the unit from tipping over.



lbs (kg)

Voltage	Model	Net Weight	Gross Weight
208/230V	72	370 (168)	390 (177)
	96	370 (168)	390 (177)
	120	381 (173)	401 (182)
	144	556 (252)	582 (264)
	168	558 (253)	584 (265)
	192	558 (253)	584 (265)
	216	558 (253)	584 (265)
460V	72	379 (172)	399 (181)
	96	379 (172)	399 (181)
	120	390 (177)	410 (186)
	144	564 (256)	591 (268)
	168	567 (257)	593 (269)
	192	567 (257)	593 (269)
	216	567 (257)	593 (269)

Figure 5.1 Suspending Unit on Wooden Skid Base for Transportation

(5) Suspend the unit without a wooden skid base with two sling belts as shown in Figure 5.2.

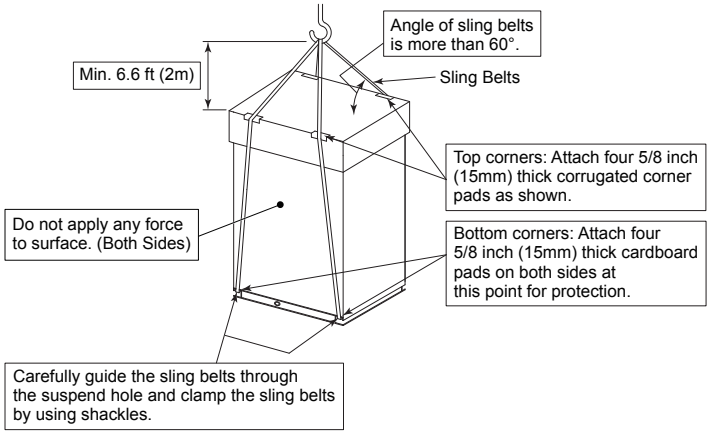
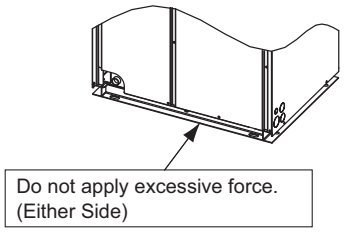


Figure 5.2 Suspending Unit without Wooden Skid Base

Do not apply excessive force to the squared slots with forks or other lifting devices. The bottom of the unit can become deformed.
* Do not push the bottom base with forks.
* Do not use rollers to move the unit.



Wooden Skid Base Removal Method

(1) Remove the hexagon head bolt using the ratchet wrench.
(2) Suspend the unit from the wooden skid base in its packaging with two sling belts.
(3) Ensure safety while hoisting the unit gently to prevent the unit from tipping over as shown in Figure 5.3.

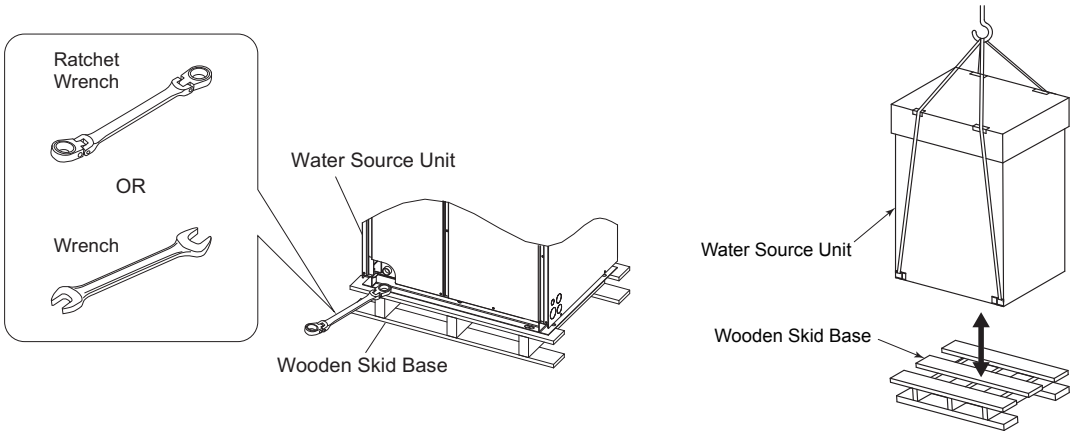
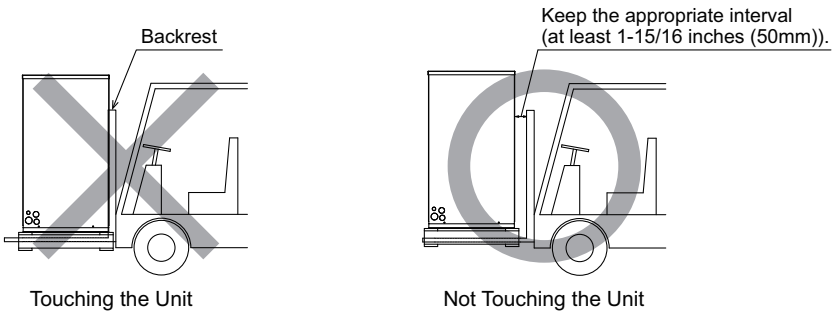


Figure 5.3 Wooden Skid Base Removal Method

⚠CAUTION

During transportation, do not allow the backrest of the forklift to come into contact with the unit. Sudden forward movement on the forklift can cause damage to the unit heat exchanger.



NOTICE

If transporting after unpackaging, protect the unit with corrugated material, styrofoam, or bubble wrap material.

5.2 Handling of Water Source Unit

⚠WARNING

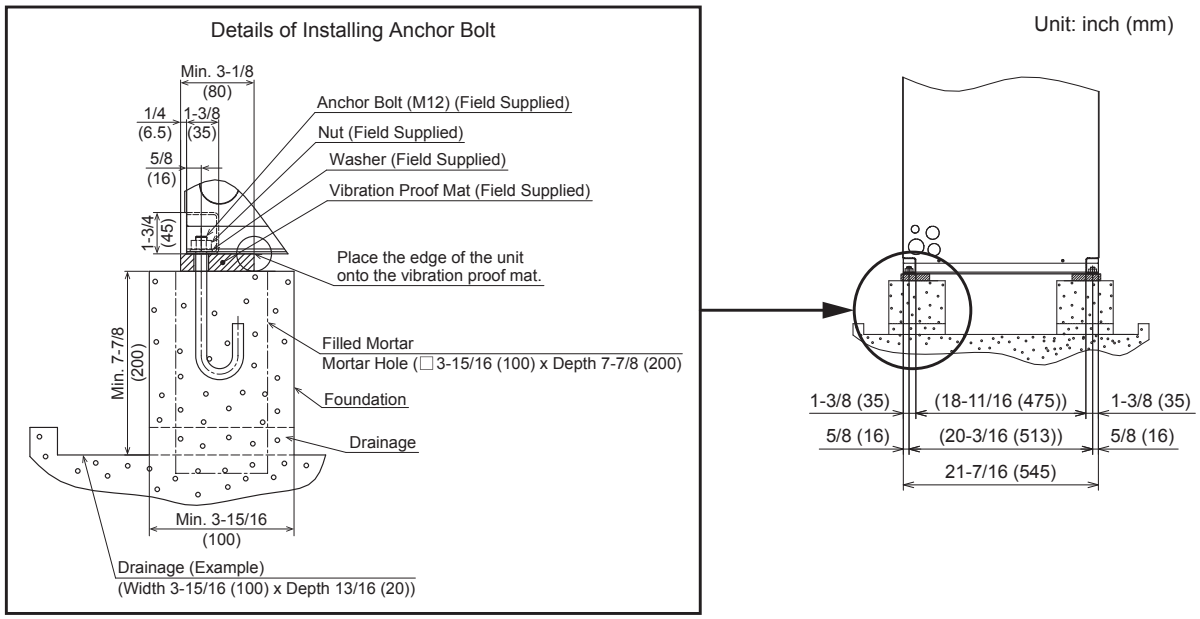
Do not place or leave any foreign objects (cables or tools) inside the water source unit or control module, and verify that nothing remains there prior to installation and test run. Damage and fire can result due to carelessness.

5.3 Installation Work

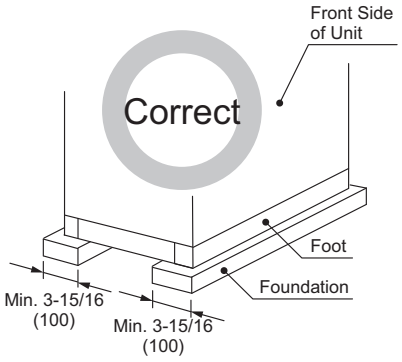
5.3.1 Concrete Foundations

(1) The height of the foundation should be more than 5-7/8 inches (150mm) above the ground.

(2) Provide adequate drainage around the foundation.

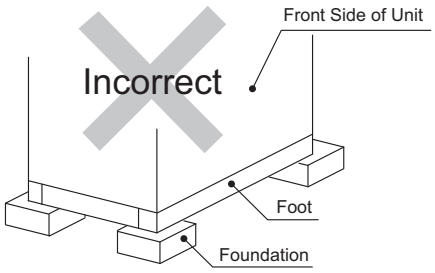


* Provide a concrete foundation as shown below.

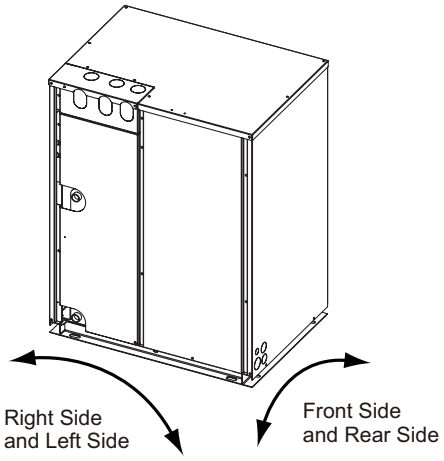


The concrete foundations are installed along the water source unit width direction.

* Do not use a concrete foundation as seen here. The base of the water source unit can become deformed.



(3) Install the water source unit in the front-rear and right-left direction horizontally (Use a level.) Verify that the gradient slope in all four directions (front, rear, right, and left) falls within 3/8 inch (10mm). The unit should be installed so that the front (or back) side of the unit is slightly (0 to 3/16 inch (0 to 5mm)) lower than the back (or front) side to allow and promote condensate drainage.

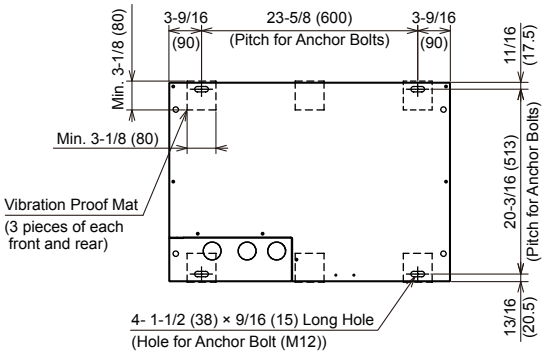


(4) Provide a strong, level, and stable foundation so that:
   a. The water source unit does not lean to one side.
   b. Sound from inside unit are minimal.
   c. The water source unit always remains stable and upright.

(5) When installing the water source unit, secure the unit with anchor bolts and field-supplied vibration-proof mats. Refer to Figure 5.4 for the location of holes for anchor bolts.

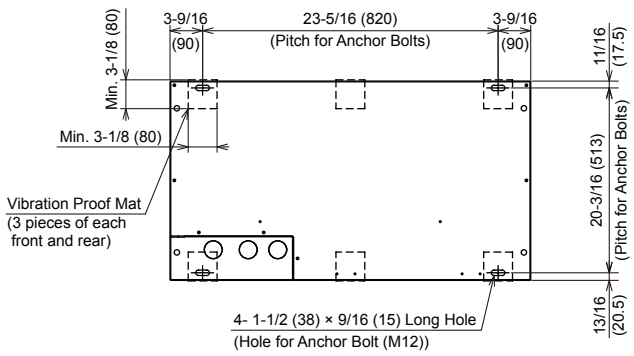
Unit: inch (mm)

72, 96 and 120 Model



Top View

144, 168, 192 and 216 Model



Top View

Figure 5.4 Positions of Anchor Bolts

5.3.2 Condensate Treatment

⚠CAUTION

Install condensate pipe to ensure proper drainage. Improper condensate pipe connection may cause leakage and property damage.

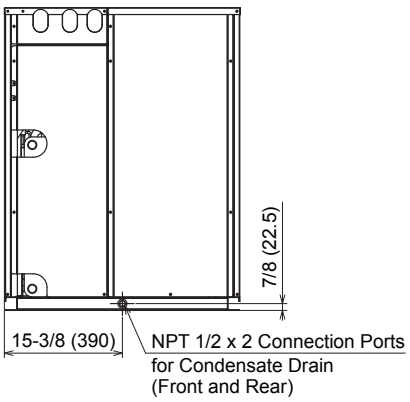
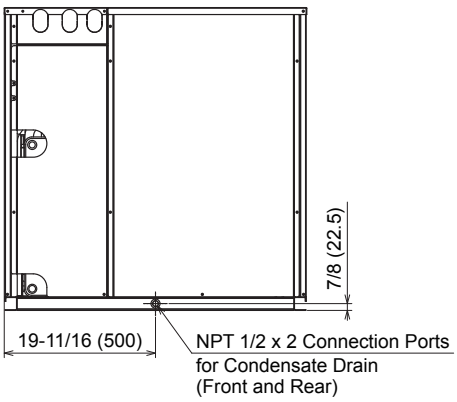
Perform condensate pipe work while paying attention to the following.

(1) The diameter of condensate pipe should be same as the diameter of unit connection (1/2 inch (12.7mm)) or more.
(2) Install condensate pipe with a downward slope of 1/50 or more.
(3) Do not install any traps.
(4) Insulate the condensate pipe to prevent condensation.
(5) After completing the condensate pipe work, make sure that the water runs smoothly without any clogging by dust.

NOTICE:

1. Condensate pipe should be installed at the locations indicated by the following figures.
2. Connection ports for condensate pipe are located in the front and rear side of unit. By default, the condensate plug is attached on the rear side. When using the rear side port, be sure to change the plug from the rear side to the front side and securely close it.

Unit: inch (mm)

Model	72, 96 and 120	144, 168, 192 and 216
Dimension		

Drainage and Water Leakage Check

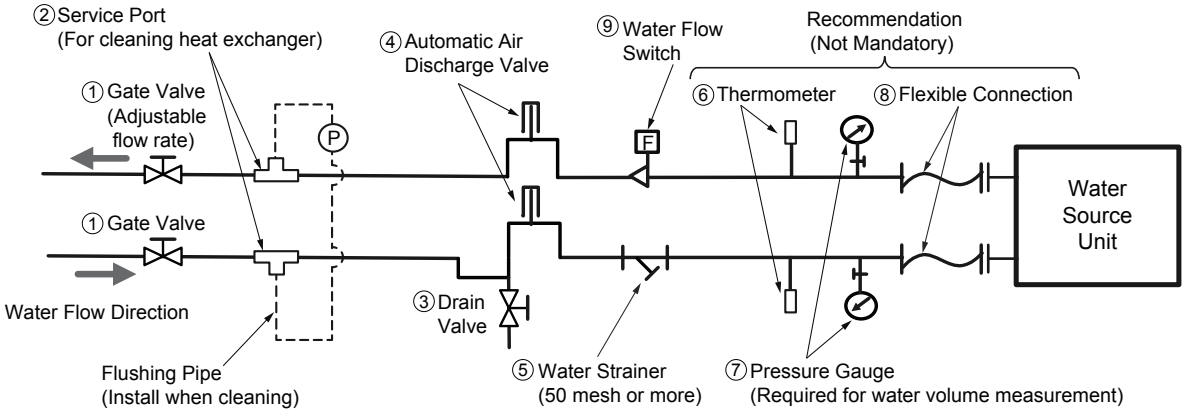
After performing the condensate piping work, check to ensure that water flows smoothly according to the following procedures.
Condensate water is discharged from the unit during operation.
The following are regular procedures to check the drainage and water leakage.

(a) Pour 50 to 67oz (1.5 to 2 liters) of water gradually into the condensate pan.
(b) Check to ensure that water flows smoothly inside the condensate pipe and has drained out fully at the pipe end, and that no leaks occur.
(c) If the end of the condensate pipe cannot be checked visually, pour another 50 to 67oz (1.5 to 2 liters) of water into the condensate pan. If the water overflows from the condensate pan, there may be an issue with the condensate riser pipe or condensate pipe. Recheck all condensate piping.

6. Water Piping Work

6.1 Piping Connection

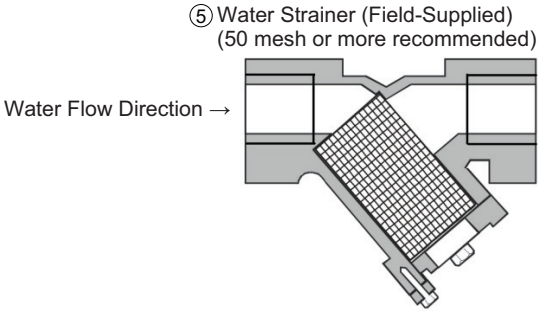
Example of basic water piping connection to the water source unit is shown below.



Basic Water Piping Connection

Perform the piping connection work for the water source unit while paying attention to the following.

- Make sure to select appropriate water pump (field-supplied) depending on water source unit model and number of units. Refer to Section 6.2 for water flow rate and pressure drop for each water source unit.
- Install ①gate valves at the inlet and outlet piping to isolate from other water circuit and allow service of the water source unit.
- It is recommended to install ②service ports to allow convenient chemical cleaning of plate heat exchanger.
- Equip ③drain valve and ④automatic air discharge valves on the water piping.
  The drain valve handle should be removed so that the valve can not be opened under normal circumstances.
  If this valve is opened during operation, water blow-off may occur and be a problem.
  Set the ③drain valve at lower points in water system to discharge water in the plate heat exchanger and system thoroughly.
  Install ④automatic air discharge valves at the higher position where air is likely to collect and to discharge air in piping.
  If air remains inside the water piping then it may decrease the operating performance and cause corrosion.
- Provide a 50 mesh or more ⑤water strainer (field-supplied) at the water inlet side of water piping within 3.3~6.6 ft. (approximately 1~2m) from the water source unit. Otherwise, damage to the plate heat exchanger may occur. In the plate heat exchanger, water flows through a narrow space between the plates.
  Therefore, there is a possibility that freezing or corrosion may occur if foreign particles or dust clog the flow of water between the plates. Also, install a cleanable water strainer at the portion close to the water inlet side of water pump.



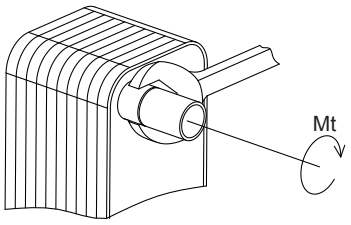
NOTE:

Be sure to install the water strainer horizontally on the water inlet side. In case the water flows downwards, vertical installation is allowed.

- It is recommended to install ⑥thermometer and ⑦pressure gauge at the water inlet and outlet side of water source unit for easy service.
- It is recommended to have ⑧flexible connections to the water inlet and outlet side of water piping, so that vibration is not transmitted, and the piping doesn't crack.
- Provide ⑨water flow switch (field-supplied) at the water outlet side of water piping within 3.3~6.6 ft. (approximately 1~2m) from the water source unit to check the water flow. Refer to Section 6.3 for details.
- Connect water piping to water inlet and outlet of the water source unit. Be sure to check the position of connection piping. Do not connect inlet and outlet piping backwards. Tighten securely the connection of water piping and socket with tightening torque not exceeding the upper limit value in the following table.
- Make sure to use water piping that will not cause electrical corrosion. Water source units use stainless steel water piping connection. If a steel pipe connects directly, electrical corrosion may occur.
- When using antifreeze liquid with a sealing material the antifreeze may dissolve the sealing material. Make sure of the manufacturer and use a sealing material that can not be dissolved.

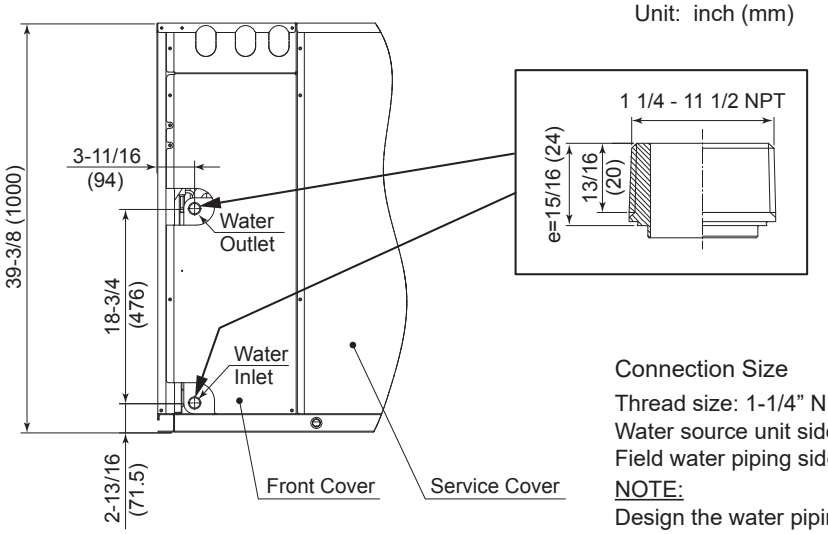
for Heat Exchanger Connection

Maximum Tightening Torque Mt [ft·lbs(N·m)]
177 (240)



Position of Piping Connection
The water piping connection is located in the front side of unit.

Unit: inch (mm)



Connection Size

Thread size: 1-1/4" NPT (Threads per inch :11-1/2 pcs)
Water source unit side: Male thread (outside thread)
Field water piping side: Female thread (inside thread)

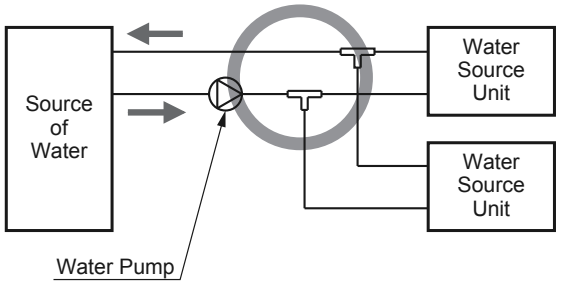
NOTE:

Design the water piping size with consideration for pump size and overall length of piping.

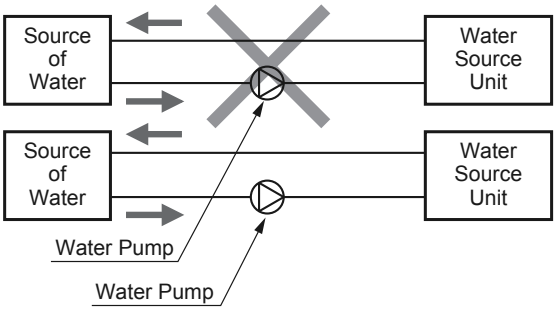
Water Piping Connection and Socket of Heat Exchanger

Position of Water Pump for Combination of Units

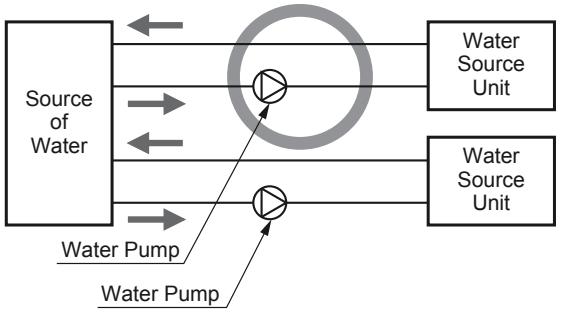
CORRECT



INCORRECT

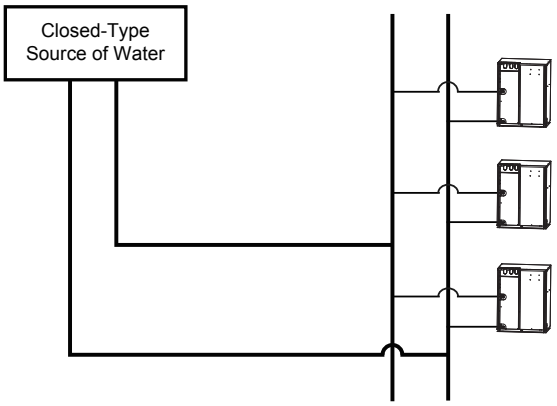


CORRECT

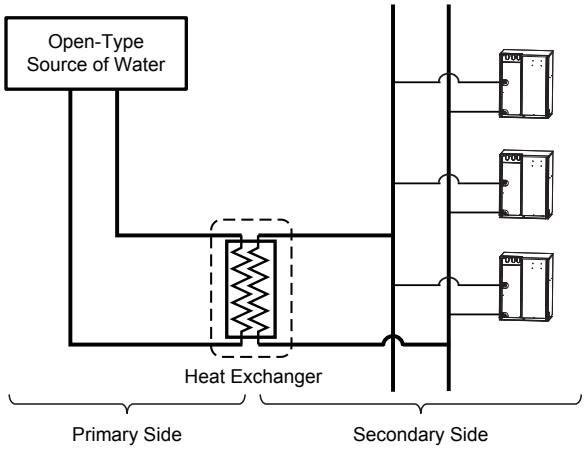


Make sure to connect to same water circuit supply when combining units in the same system.

- Water pressure resistance of the water piping of this water source unit is 285 psi (1.96 MPa).
- Water piping size to the unit should not be less than that of pipe joint on the unit.
- Select the water piping according to local or national regulation.
- Before installation, flush all water piping thoroughly to prevent foreign particles from entering. Be careful not to flush any foreign particle into plate heat exchanger.
- Make sure the water circuit supply to the water source unit is a closed loop water circuit and water is not exposed to the atmosphere. In case open-type cooling tower is used, provide heat exchanger between the cooling tower and water source unit system piping. Make sure the water circuit supply to the water source unit is a closed loop water circuit. Otherwise, corrosion may occur.



Closed-Type Water Circuit



Open-Type Water Circuit with Heat Exchanger

- Sufficiently apply insulation to keep the water piping cool and to prevent sweating of the piping. Thermal loss may also occur.
- If the water is frozen, the plate heat exchanger of the water source unit may damaged. Prepare freeze protection while paying attention to the following:

Examples of freeze protection:

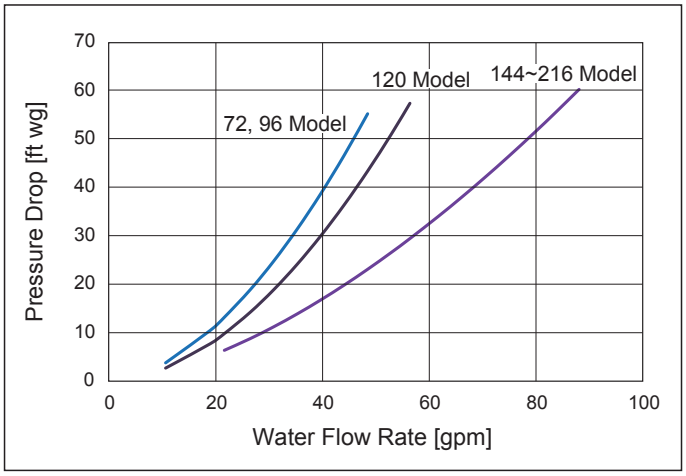
- Use heater or boiler to prevent water from freezing.
- Install water source unit in an environment with an ambient temperature above 35°F DB (1.7°C DB).
- When water piping temperature or water temperature is low, operate the water pump to prevent freezing while the water source unit is stopped.
- When the water source unit is not being used for long periods in low ambient conditions, completely drain the water from the water source system. Be sure to check and clean the water source unit in water system thoroughly before initial startup after a long stoppage.
- Use of ethylene glycol, propylene glycol, or methanol is acceptable.
  Make sure that the concentration of each antifreeze solution is less than 50%. However, the addition of antifreeze may lower performance of the water source unit due to reduced heat transfer and added pressure drop.

6.2 Water Flow Rate and Pressure Drop

Water Flow Rate and Pressure Drop
Select the water pump (field-supplied) according to the following table.

Model		72	96	120	144	168	192	216
Rated Water Flow Rate [gpm (ℓ/m)]		15.1 (57)	20.3 (77)	25.4 (96)	36.5 (138)	44.1 (167)	51.0 (193)	56.0 (212)
Allowable Water Flow Rate [gpm (ℓ/m)]	Maximum	31 (120)	39 (150)	56 (214)	63 (241)	70 (268)	79 (301)	79 (301)
	Minimum	11 (40)	14 (50)	20 (72)	22 (81)	24 (90)	27 (101)	27 (101)

Relation of water flow rate and pressure drop of each water source unit model is shown in the chart below.
This chart is based on inlet water temperature: 68°F (20.0°C).



In case the water source unit operates above the rated water flow rate, the water pump power consumption is increased. It is recommended to operate below the rated water flow rate.
When connecting multiple water source units, the water flow rate for each individual module must be within the Allowable Water Flow Rate range shown in above table. The water flow rate for each individual module should deviate from the Rated Water Flow Rate by the same percentage.

Antifreeze Usage

Use the below table calculations and table to determine pressure drop:

1. Refer to table below and locate the type of antifreeze used and percentage by weight of the antifreeze in the water piping system.
2. Cross reference the antifreeze type row with the antifreeze percentage by weight column to find the pressure drop correction factor.
3. Multiply the water pressure drop by the antifreeze correction factor.

Antifreeze Pressure Drop Correction Factor

Antifreeze Type	Antifreeze Percentage by Weight				
	10%	20%	30%	40%	50%
Ethylene Glycol	1.04	1.10	1.16	1.21	1.27
Propylene Glycol	1.04	1.10	1.17	1.25	1.35
Methanol	1.03	1.05	1.06	1.04	1.02

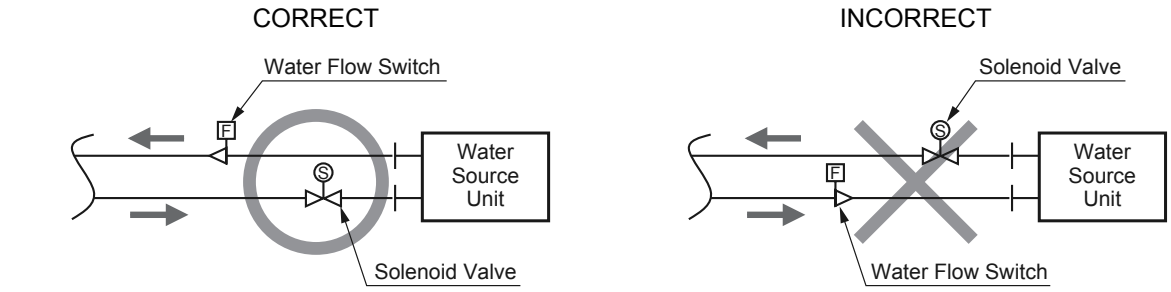
NOTES:

- The values were measured during stop operation with an inlet water temperature of 68°F (20°C).
- In case the water source unit operates above the rated water flow rate with antifreeze, the water pump power consumption is increased, and erosion is likely to occur. It is strongly recommended to operate below the rated water flow rate.

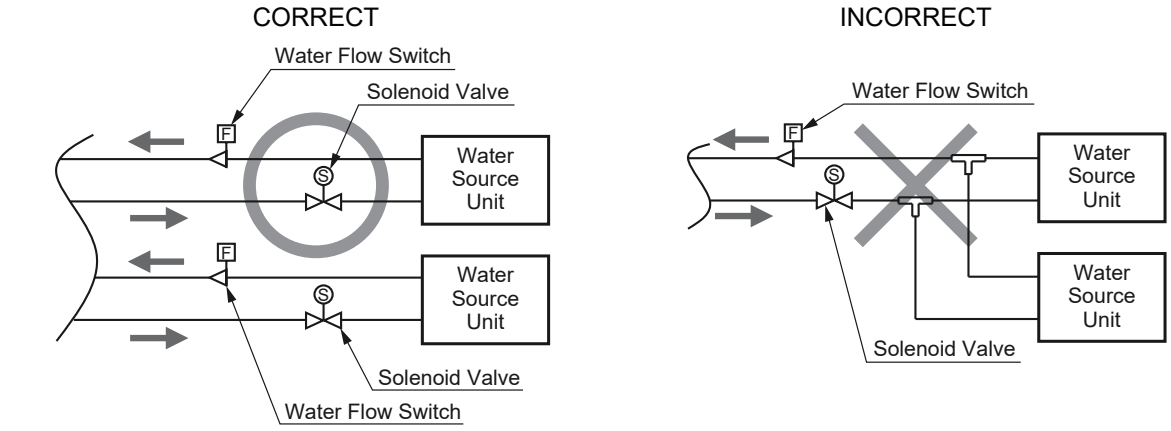
6.3 Water Flow Control

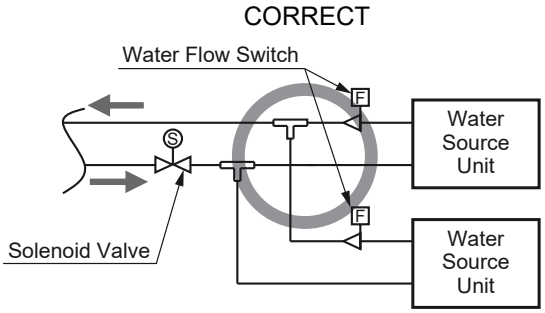
Water source unit will be damaged if it is operated with no water circulating through the water piping.
It is necessary to provide the water flow switch (field-supplied) on water outlet side of water piping within 3.3~6.6 ft. (approximately 1~2m) from each water source unit to realize stop protection.
If water flow switch is OFF (open) while the water source unit is operating, “A2” alarm occurs.
Be sure the water flow switch is turned ON (close) in 240sec. or less after water source unit starts operation.
Water flow switch closes to verify water flow.
Refer to Section 8.3 for the details of wiring to electrical box.

Example for Single Unit



Example for Combination of Units





NOTICE:

- Select water flow switch (field-supplied) which output close signal when minimum flow rate is satisfied for each water source unit. Refer to the table at Section 6.2.
- Install water flow switch by following their installation procedure.
- If water flow switch is NOT properly installed (non-detectable), plate heat exchanger may burst due to water freeze or compressor may damage due to increased pressure. On the other hand, if the water flow switch is detected easily, then the water source unit is forced to stop frequently.
- Water flow switch is not required to detect overflow rate.
  However overflow rate may cause refrigerant cycle trouble.

6.4 Water Quality Requirements

⚠CAUTION

- **Water source unit must be used with closed type cooling tower. Open type cooling tower will face poor water quality, corrosion, and sediment. Be sure to check the water pipeline construction, water quality monitoring, and water treatment.**
- **Make sure to use water piping that will not cause electrical corrosion. Water source units use stainless steel water piping connections. If a steel pipe connects directly, electrical corrosion may occur.**
- **Make sure to use an anti-corrosion agent or a deterioration treatment agent when the steel piping is not protected by protection layers. Corrosion may occur when the water temperature is above 104°F(40°C).**
- **Do not use once-through cooling water. Otherwise, corrosion may occur.**
- **Make sure that any water scales inhibitor or water treatment doesn't damage stainless steel or copper piping associated with the local water treatment facility.**
- **When treated water is used, it rarely causes scale deposits or other damage to equipment. However, well water or river water may contain suspended solid matter, organic matter, or scale in great quantities.**
  Before using such water, filter the water or apply a softening treatment with chemicals. It is also necessary to analyze the quality of water by checking pH, electrical conductivity, ammonia ion content, sulfur content, and other debris. Utilize treated water only if problem is encountered through these checks.

For circulating water and make-up water, used in a closed-type water circuit (such as a closed-type cooling tower), follow the standards in the table below.

Table 6.1 Water Quality Requirements (Reference)

Items Based on Guidelines of Water Quality for Refrigeration and Air Conditioning Equipment (JRA GL02E-1994)			Circulating Water 68~140°F (20~60°C)	Make-up Water	Tendency	
					Corrosion	Scale
Standard Items	pH (77°F (25°C))		7.0~8.0		○	○
	Electrical conductivity (77°F (25°C))	[mS/ft (mS/m)]	< 9.1 (30)		○	○
	Chloride ions	[mg Cl^-/ℓ]	< 50		○	
	Sulfate ions	[mg SO_4^{2-}/ℓ]	< 50		○	
	Acid consumption (pH 4.8)	[mg $CaCO_3$/ℓ]	< 50			○
	Total hardness	[mg $CaCO_3$/ℓ]	< 70			○
	Calcium hardness	[mg $CaCO_3$/ℓ]	< 50			○
	Ionic silica	[mg SiO_2/ℓ]	< 30			○
Reference Items	Iron	[mg Fe/ℓ]	< 1.0	< 0.3	○	○
	Copper	[mg Cu/ℓ]	< 1.0	< 0.1	○	
	Sulfate ions	[mg S^{2-}/ℓ]	—		○	
	Ammonium ions	[mg NH_4^+/ℓ]	< 0.3	< 0.1	○	
	Residual chlorine	[mg Cl/ℓ]	< 0.25	< 0.3	○	
	Free carbon dioxide	[mg CO_2/ℓ]	< 0.4	< 4.0	○	
	Stability Index		—		○	○

NOTE:
These items represent typical causes of corrosion and scale.
The circle marks "○" in the columns "Tendency" indicate a tendency for corrosion or scale to develop.

6.5 Maintenance of Water Circuit

If the water pressure difference at the water inlet and outlet sides of the plate heat exchanger changes compared to Test Run, the water strainer may be clogged.
Be sure to regularly clean the water strainer according to the clogging degree and check the water flow rate (or pressure drop).

- If clogging in the plate heat exchanger is serious, insufficient cooling performance or freezing in the heat exchanger takes place. It is strongly recommended that the plate heat exchanger be cleaned at the same time when the water strainer is cleaned.
- In case of removing the scale formed on the plate heat exchanger, it is recommended to use 5% diluted solutions that contains formic acid, citric acid, oxalic acid, acetic acid or phosphoric acid.
  Do not use corrosive solutions with hydrochloric acid or nitrate.
- Circulate the cleaning solution of 122~144°F (50~62°C) by using a water pump for 2 to 5 hours.
  Cleaning time depends on the change of the dirtiness (color) of cleaning solution.
  After circulating the cleaning solution, remove the solution from the plate heat exchanger.
  Then circulate the neutralization solution such as 1~2% sodium hydroxide (NaOH) or sodium bicarbonate ($NaHCO_3$) for 15~20 minutes.
- When using any cleaning detergent sold in the market, make sure that it does not cause corrosion to stainless steel and copper. For details of cleaning method, contact the manufacturer of cleaning detergent.
- Cleaning of plate heat exchangers must be performed by specialists. Contact your contractor or distributor.
- After cleaning is completed, make sure that the unit operates normally.
  When the freeze protection is activated during operation, make sure to remove the cause before restarting the operation. In case the freezing is repeated, the heat exchanger becomes damaged and refrigerant leakage or water entering the refrigerant pipe may occur.
- When the water pressure difference during operation is over the allowable range, make sure to stop the water source unit and remove the cause.

6.6 Antifreeze Usage Management

When using antifreeze, make sure of the following.
Note that the manufacturer does not take responsibility for any damage caused.

- All the circulating water (antifreeze) and additives (corrosion inhibitor, bacteria inhibitor, and foam inhibitors) must be used after consulting with the business ordering party or supervisor for their impact on environment, toxicity, corrosiveness, harmfulness to humans, and management plan.
- Contractor must take extra care in handling, packaging, and transporting regulations and procedures for the antifreeze.
- Do not use antifreeze that is harmful to humans or equipment. In addition, antifreeze must be injected to the pipe according to the specification and concentration level that is actually required by the system. (Do not directly inject undiluted solution. Consult the consult business ordering party or supervisor when undiluted solution is brought to the site.)
- Before injecting the antifreeze, evacuate any air that may remain in the system, and apply pressure to check for leakage.
- You must monitor and manage periodically to maintain the concentration level initially designed for the antifreeze. If the concentration level decreases due to leakage or over certain period of time, it may cause pipe to freeze or burst.

7. Refrigerant Piping Work

⚠WARNING

- **The pressure for this product is 601 psi (4.15MPa). The pressure required for refrigerant R410A is 1.4 times higher than the refrigerant R22. Therefore, the refrigerant pipes for R410A must be thicker than that for R22. Make sure to use specified refrigerant pipes. Otherwise, the refrigerant pipes may rupture due to an excessive refrigerant pressure. Pay close attention to the pipes thickness when using copper refrigerant pipes. The thickness of copper refrigerant pipes differs depending on its material.**
- **Check to ensure that no pressure exists inside the stop valve before removing the pipe closure (cap).**

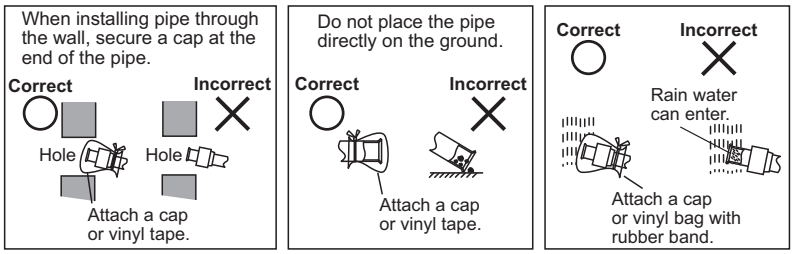
⚠CAUTION

- **Ensure that the corresponding pipe connections for the liquid, low pressure gas, and high/low pressure gas piping are properly connected to the equipment, as specified in the installation instructions.**
- **When handling the refrigerant, be sure to wear leather gloves to prevent injuries.**

7.1 Piping Materials

(1) Obtain locally-supplied copper pipes.
(2) Use copper pipe for refrigerant piping.
(3) Pay close attention to pipe thickness.
(4) Use clean copper pipes. Make sure there is no dust or moisture inside the pipes.
Do not use any tools which produce a lot of metal shavings such as a saw or a grinder.
(5) Take special care to prevent contamination or moisture settling on interior pipe surfaces during piping work.

Cautions for Refrigerant Pipe Ends

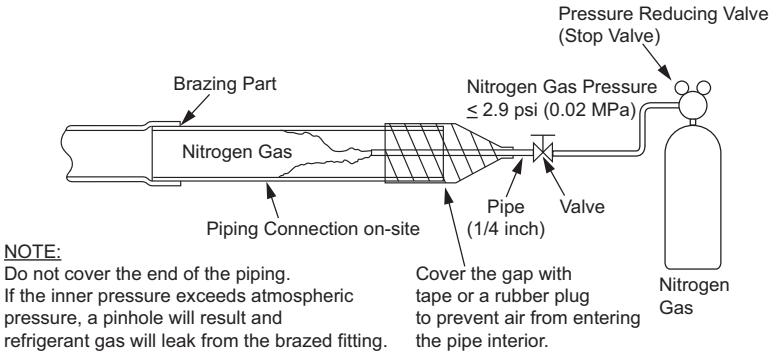


Brazing Work

(1) Brazing work must be performed by an authorized installer.

(2) For refrigerant pipe connections, perform non-oxidation brazing with a nitrogen purge. If refrigerant piping is brazed without nitrogen, a large amount of oxidized scaling is generated in the piping. This oxidized scaling will cause clogging inside the expansion valve, solenoid valve, accumulator, and compressor, which will prevent the unit from operating properly.
Do not use field-supplied antioxidant which can corrode pipes and degrade the refrigerant oil.

- Make sure to use nitrogen. Nitrogen gas pressure shall be 2.9 psi (0.02 MPa) or less.
- Make sure to use the pressure-reducing valve.
- Do not use field-supplied antioxidant.

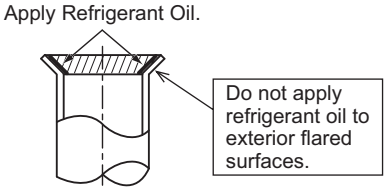


NOTICE:
To avoid oxidation and scaling, perform brazing at the appropriate brazing temperature.

Cautions for Piping Connection Work

(1) Verify that there are no scratches, metal shavings, gaps, or deformations at the flared end before connecting pipe to the system.

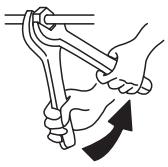
(2) Before tightening the flare nut, apply a small amount of oil (field-supplied) to the outside of the flare. (Do not apply any oil to the threads.) Tighten the liquid pipe flare nut to the specified torque while using a back-up wrench to prevent damage to the unit. Ensure that the flare connections are leak-free upon completion of the work with a proper pressure/leak test.
NOTE:
Refrigerant oil is field-supplied.
[Polyvinyl Ether Oil: FVC68D (Idemitsu Lubricants America)]



(3) Be sure to use the accessory flare nuts for indoor unit connections.
To tighten the torque for liquid stop valve, refer to Section 7.2.1 “Stop Valve” of the tightening torque table.

Required Tightening Torque

Pipe Size	Tightening Torque
1/4 inch (6.35 mm)	10.3 - 13.3 ft·lbs (14 - 18 N·m)
3/8 inch (9.52 mm)	25.1 - 31.0 ft·lbs (34 - 42 N·m)
1/2 inch (12.7 mm)	36.1 - 45.0 ft·lbs (49 - 61 N·m)
5/8 inch (15.88 mm)	50.2 - 60.5 ft·lbs (68 - 82 N·m)
3/4 inch (19.05 mm)	73.8 - 88.5 ft·lbs (100 - 120 N·m)

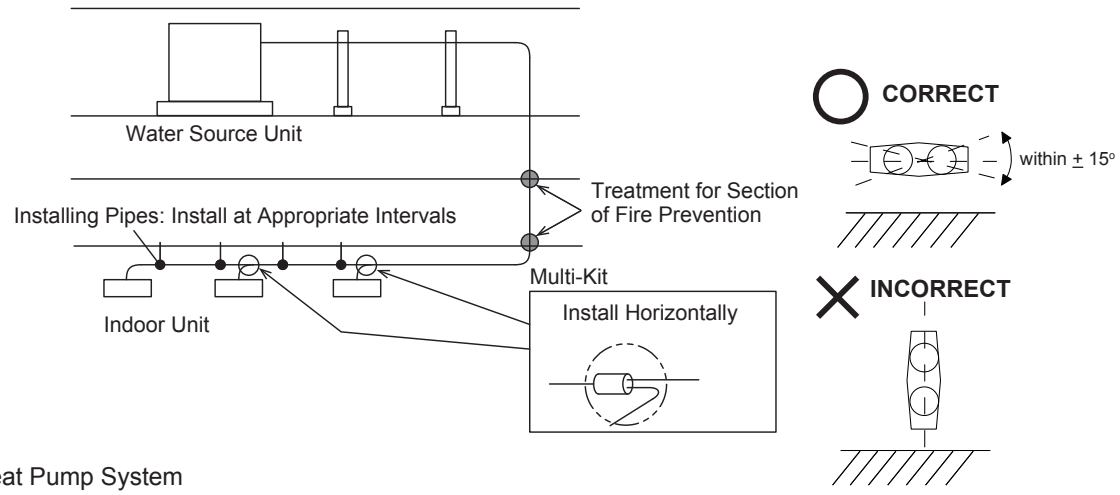

Use two wrenches as shown.

(4) When the temperature and humidity inside the ceiling exceed 80°F (27°C)/RH80%, apply additional insulation of approximately 3/8 inch (10mm) in thickness to the existing insulation. The additional insulation prevents the formation of condensation on the surface of the insulation (refrigerant pipe only).
(5) Perform a leak test at 601 psi (4.15MPa).
(6) Perform cold insulation work by wrapping tape around flared and reducer connections. Also, insulate all the refrigerant pipes.
(7) Connect the indoor/water source units with refrigerant pipe. Secure the pipe to prevent it from coming into contact with structures such as a wall or ceiling. Otherwise, noise will occur due to vibration of the pipe.

Precaution for Installing and Securing Piping

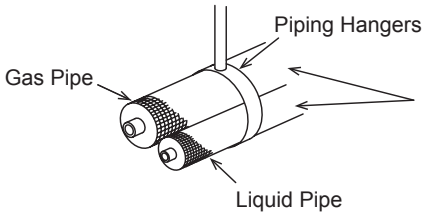
When assembling pipes onsite with hidden elbow or socket joints, provide a service access door to facilitate close-up examination of interconnecting components.

Example for Pipe Support



For Heat Pump System

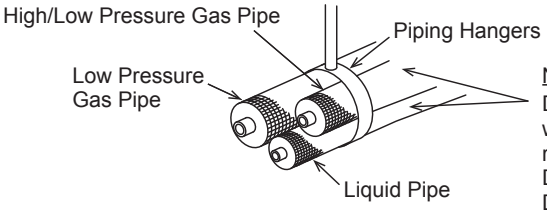
Secure Liquid Pipes and Gas Pipes



NOTICE:
Due to varying chemical properties, gas and liquid pipes will expand or contract at different rates due to changing refrigerant temperatures.
Do not fasten gas and liquid pipes together with tape. Distortion and deformation of the pipes can occur when improperly supported.

For Heat Recovery System

Secure Liquid Pipes, Low Pressure Gas Pipes and High/Low Pressure Gas Pipes



NOTICE:
Due to varying chemical properties, gas and liquid pipes will expand or contract at different rates due to changing refrigerant temperatures.
Do not fasten gas and liquid pipes together with tape. Distortion and deformation of the pipes can occur when improperly supported.

Table 7.1 Piping Sizes of Water Source Unit

Model: (H,Y)VWHP_B(3,4)2S (2 Pipes)

inch (mm)

Water Source Unit Capacity (MBH)	Gas	Liquid
72	3/4 (19.05)	3/8 (9.52)
96	7/8 (22.2)	3/8 (9.52)
120	7/8 (22.2)	1/2 (12.7)
144	1-1/8 (28.58)	1/2 (12.7)
168 - 216	1-1/8 (28.58)	5/8 (15.88)
240	1-1/8 (28.58)	3/4 (19.05)
264 - 336	1-3/8 (34.93)	3/4 (19.05)
360 - 576	1-5/8 (41.28)	3/4 (19.05)

Model: (H,Y)VWHR_B(3,4)2S (3 Pipes)

inch (mm)

Water Source Unit Capacity (MBH)	Gas		Liquid
	Low Pressure	High/Low Pressure	
72	3/4 (19.05)	5/8 (15.88)	3/8 (9.52)
96	7/8 (22.2)	3/4 (19.05)	3/8 (9.52)
120	7/8 (22.2)	3/4 (19.05)	1/2 (12.7)
144	1-1/8 (28.58)	7/8 (22.2)	1/2 (12.7)
168 - 216	1-1/8 (28.58)	7/8 (22.2)	5/8 (15.88)
240	1-3/8 (34.93)	7/8 (22.2)	3/4 (19.05)
264 - 336	1-3/8 (34.93)	1-1/8 (28.58)	3/4 (19.05)
360 - 576	1-5/8 (41.28)	1-3/8 (34.93)	3/4 (19.05)

Table 7.2 Piping Sizes of Indoor Unit

inch (mm)

Indoor Unit Capacity (MBH)	Gas	Liquid
6 - 15	1/2 (12.7)	1/4 (6.35)
18 - 54	5/8 (15.88)	3/8 (9.52)
60 - 72	3/4 (19.05)	3/8 (9.52)
96	7/8 (22.2)	3/8 (9.52)

7.2 Piping Connection Work

Comply with the restrictions for refrigerant piping (permissible length, height difference) in “Piping Work Conditions” and “Piping Branch Restriction” under Section 7.5 or the water source unit can become damaged or fail. The stop valves are closed (factory-setting) when refrigerant piping connections are performed. Do not open these stop valves until all the refrigerant pipes are connected, pressure tested, and evacuated.

7.2.1 Stop Valve

(1) Make sure that all the stop valves are closed.
(2) Connect a manifold to the service port and release any gas inside the pipe.
(3) Cut the end of the pipe closure (cap) and ensure that no residual gas or oil exists inside the gas pipe.
(4) Remove any combustible material from unit before using a torch. (Please see pipe closure (cap) diagram below.)
(5) Remove the pipe closure (cap) from the brazing portion with a torch. The stop valve will be damaged unless protected by a wet cloth or other means.

⚠WARNING

When installing a Heat Pump System, do <u>not</u> cut the end of the pipe closure (cap) of the low pressure gas pipe. If the end of the pipe closure (cap) for the low pressure gas pipe is cut by mistake, reseal it completely to prevent refrigerant leakage.

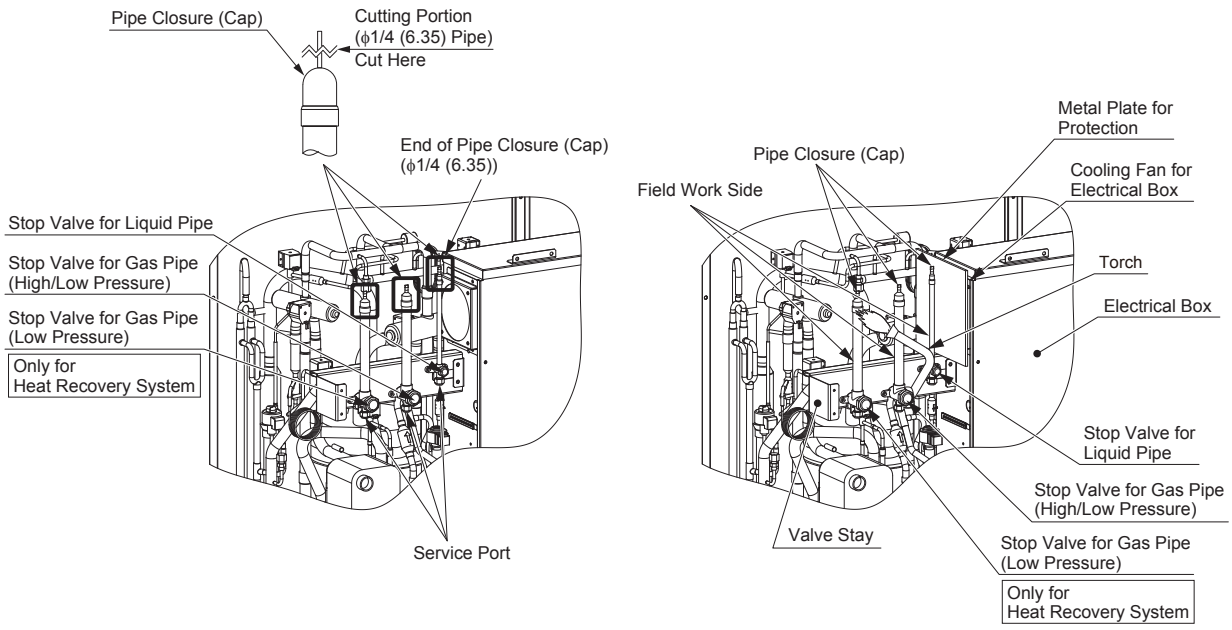
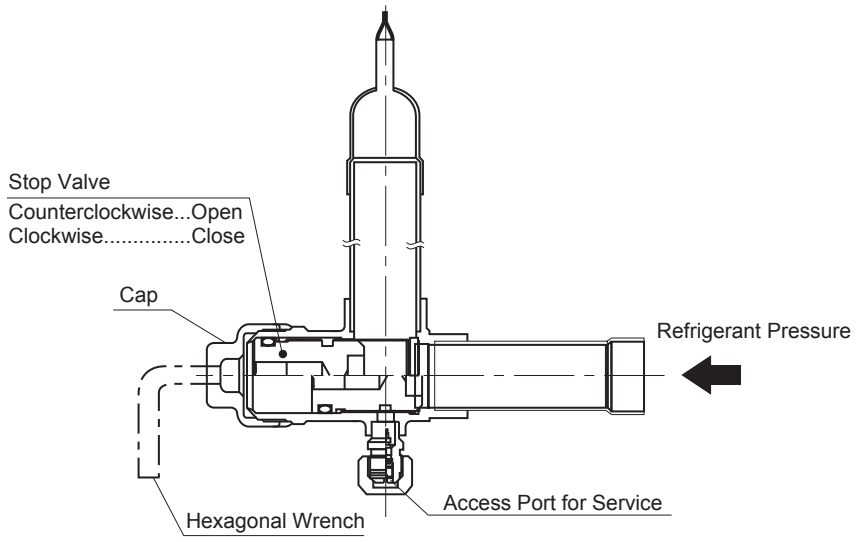


Figure 7.1

⚠WARNING

- **Release the gas inside the pipe closure (cap) before brazing work is performed. If the brazing filler material melts with residual gas inside, the pipe will explode and injuries can result.**
- **Do not expose surrounding parts and the oil return pipe of the compressor to flames when a torch is used. If the oil return pipe is exposed to excessive heat, high temperature oil will escape and cause a fire or injury.**

- The details of stop valves are as follows.



Model	Tightening Torque [ft·lbs (N·m)]								Hexagonal Wrench Size [inch (mm)]	
	Stop Valve				Cap		Access Port			
	Heat Pump	Heat Recovery		Liquid Valve	Gas Valve	Liquid Valve	Gas Valve	Liquid Valve	Gas Valve	Liquid Valve
	Gas Valve	Gas Valve (High/Low)	Gas Valve (Low)							
72, 96	8.9-9.6 (12-13)			4.4-5.2 (6-7)	31-34.7 (42-47)	14.8-18.4 (20-25)	1.5-2.2 (2-3)	1.5-2.2 (2-3)	3/16 (5)	3/16 (5)
120	13.0-16.9 (17.6-22.9)	13.0-16.9 (17.6-22.9)	18.1-23.5 (24.5-31.8)	6.6-7.4 (9-10)	36.1-43.4 (49.0-58.8)	18.4-22.1 (25-30)	6.5-10.8 (8.8-14.7)		3/8 (10)	
144-216				8.1-8.9 (11-12)		22.1-25.8 (30-35)				

⚠CAUTION

- **Do not apply excessive force to the stop valve after fully opening it.**
- **Prior to the test run, fully open the stop valve. If it is not fully opened, the equipment will be damaged.**

7.2.2 Piping Connection Method

Perform the refrigerant piping connection work for each water source unit.

NOTICE:
Ensure that the refrigerant pipe is connected to the same refrigerant system.

- Firmly secure the pipe in order to avoid vibration, excessive force on the valve, and noise.

(1) Piping can be installed from the front side cover.
For vibration protection, properly secure pipe connections and check that no excessive force is applied to the stop valve.
(2) Follow the installation procedures in Section 7.2.1.
(3) Connect the piping in accordance with Figures 7.2 and 7.3 on the following page.
(4) Seal the gaps between the front side cover and pipes with insulation.

For Pipes from Front Side Piping Cover

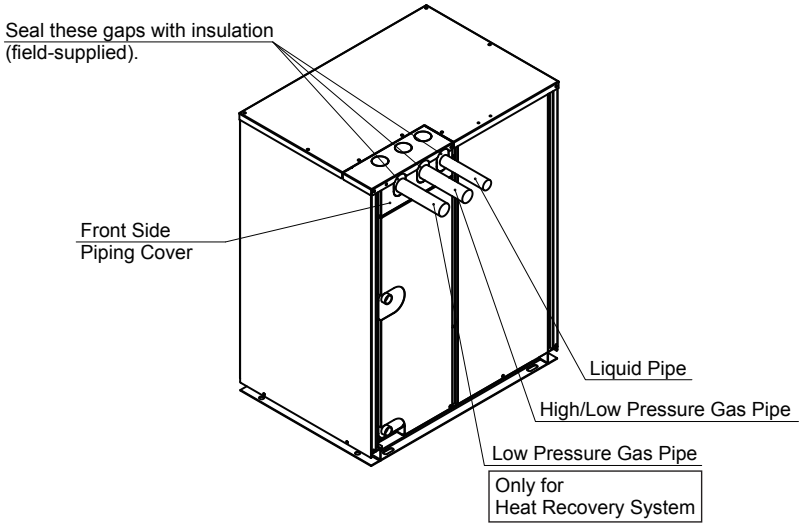


Figure 7.2

For Pipes from Top Side Piping Cover

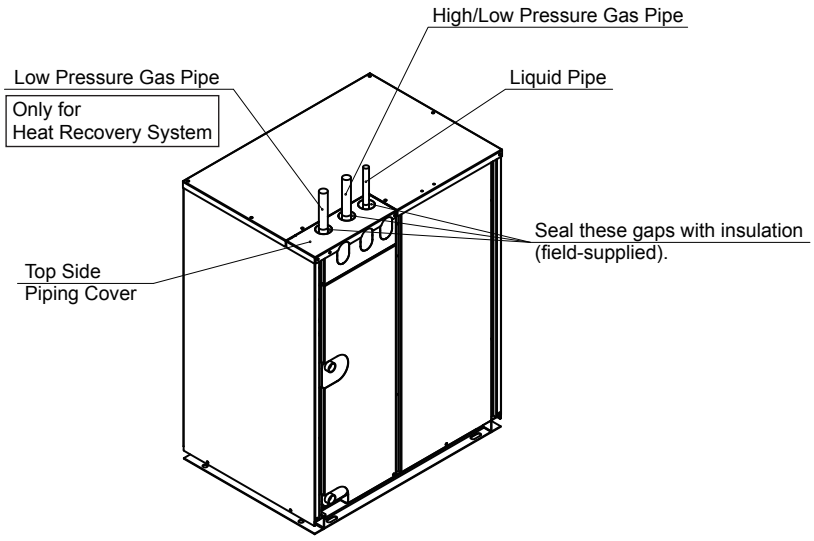
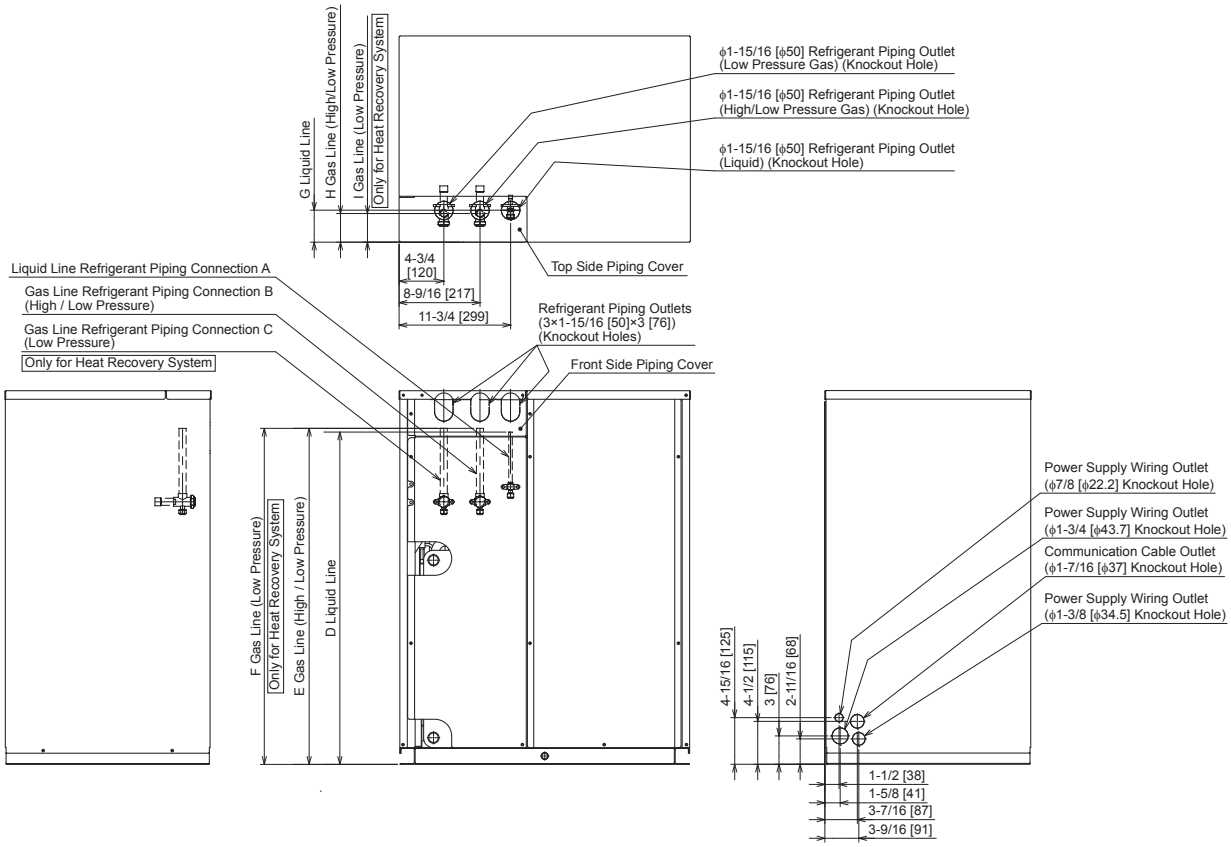


Figure 7.3

- Prepare refrigerant piping for assembly. The following examples illustrate a small cabinet. Refer to Figure 7.4 for the position for piping connections.

Unit: inch [mm]



Model	Stop Valve [1]			A	B		C	D	E	F	G	H	I
	Gas		Liquid		Heat Pump System	Heat Recovery System							
	Low Pressure	High/Low Pressure											
72	ϕ3/4 (19.05)	ϕ3/4 (19.05)	ϕ3/8 (9.52)	ϕ3/8 (9.52)	ϕ3/4 (19.05)	ϕ5/8 (15.88)	ϕ3/4 (19.05)	35-1/16 (891)	35-1/2 (901)	35-1/2 (901)	3-3/8 (86)	3-1/16 (77)	3-1/16 (77)
96	ϕ3/4 (19.05)	ϕ3/4 (19.05)	ϕ3/8 (9.52)	ϕ3/8 (9.52)	ϕ7/8 (22.2)	ϕ3/4 (19.05)	ϕ7/8 (22.2)	35-1/16 (891)	35-1/2 (901)	35-1/2 (901)	3-3/8 (86)	3-1/16 (77)	3-1/16 (77)
120	ϕ1 (25.4)	ϕ7/8 (22.2)	ϕ1/2 (12.7)	ϕ1/2 (12.7)	ϕ7/8 (22.2)	ϕ3/4 (19.05)	ϕ7/8 (22.2)	35-1/4 (895)	35-3/8 (899)	35-1/2 (901)	3-3/8 (85)	3-3/8 (85)	3-3/8 (86)
144	ϕ1 (25.4)	ϕ7/8 (22.2)	ϕ5/8 (15.88)	ϕ1/2 (12.7)	ϕ1-1/8 (28.58)	ϕ7/8 (22.2)	ϕ1-1/8 (28.58)	35-5/8 (905)	35-3/8 (899)	35-9/16 (903)	3-1/4 (82)	3-3/8 (85)	3-5/16 (84)
168	ϕ1 (25.4)	ϕ7/8 (22.2)	ϕ5/8 (15.88)	ϕ5/8 (15.88)	ϕ1-1/8 (28.58)	ϕ7/8 (22.2)	ϕ1-1/8 (28.58)	35-5/8 (905)	35-3/8 (899)	35-9/16 (903)	3-1/4 (82)	3-3/8 (85)	3-5/16 (84)
192	ϕ1 (25.4)	ϕ7/8 (22.2)	ϕ5/8 (15.88)	ϕ5/8 (15.88)	ϕ1-1/8 (28.58)	ϕ7/8 (22.2)	ϕ1-1/8 (28.58)	35-5/8 (905)	35-3/8 (899)	35-9/16 (903)	3-1/4 (82)	3-3/8 (85)	3-5/16 (84)
216	ϕ1 (25.4)	ϕ7/8 (22.2)	ϕ5/8 (15.88)	ϕ5/8 (15.88)	ϕ1-1/8 (28.58)	ϕ7/8 (22.2)	ϕ1-1/8 (28.58)	35-5/8 (905)	35-3/8 (899)	35-9/16 (903)	3-1/4 (82)	3-3/8 (85)	3-5/16 (84)

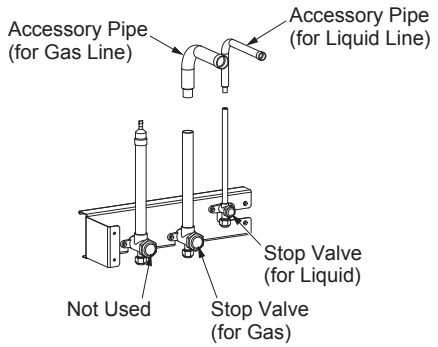
1. Dimension represents the piping diameter of stop valve and before attaching the accessory pipes. Actual piping connection diameter is different.

Figure 7.4 Refrigerant Piping Connection and Wiring Outlet

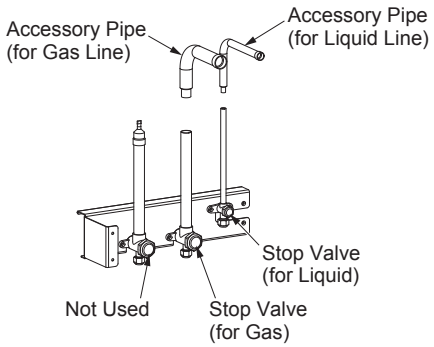
- Details of Stop Valve Piping Connections
  Be sure to remove first the pipe closure (cap) of the gas and liquid stop valves. Refer to Section 3.1 “Factory-Supplied Accessories” for the details of the accessory pipes.

  Heat Pump System with refrigerant pipes from front side

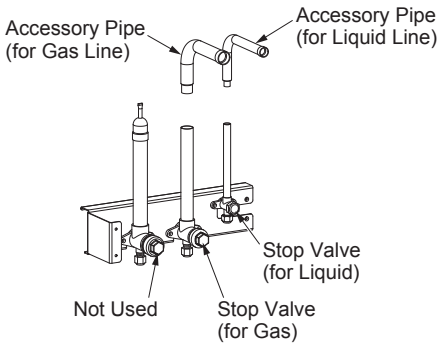
72 Model



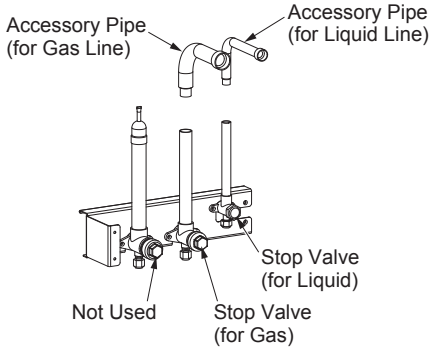
96 Model



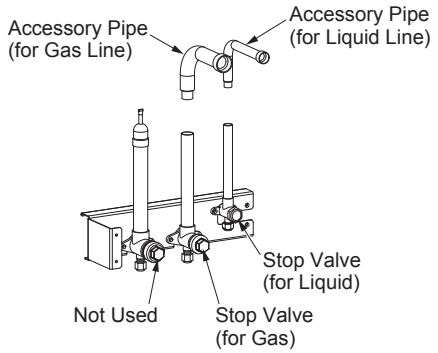
120 Model



144 Model

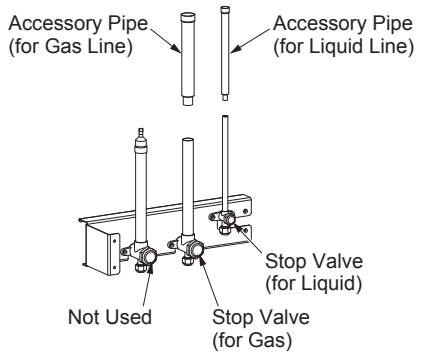


168, 192, 216 Model

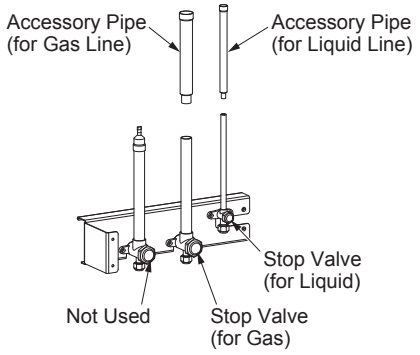


Heat Pump System with refrigerant pipes from top side

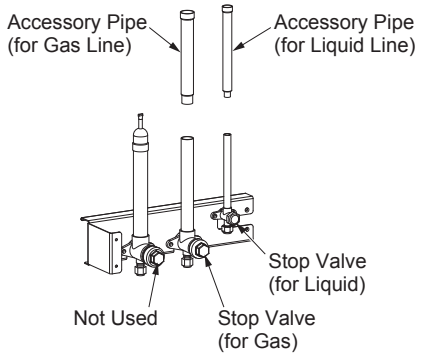
72 Model



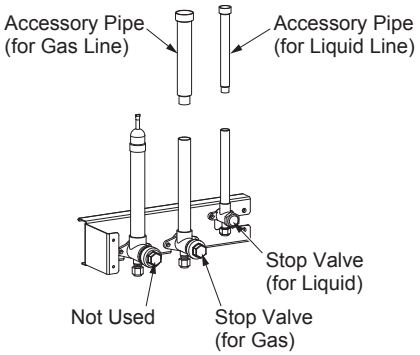
96 Model



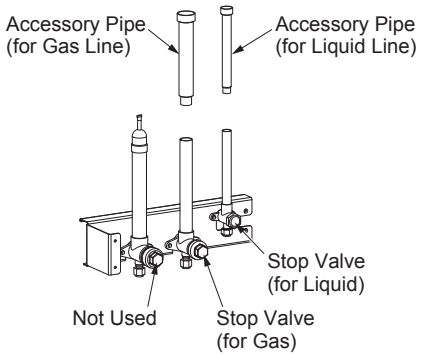
120 Model



144 Model

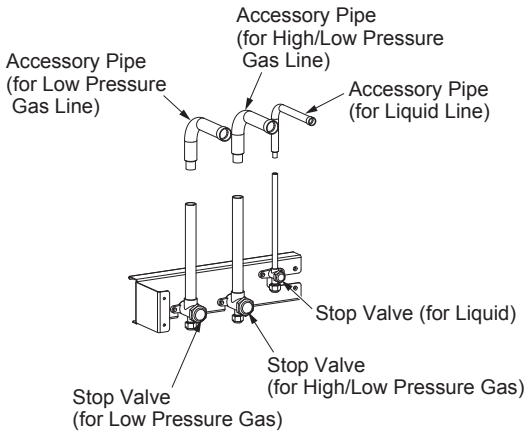


168, 192, 216 Model

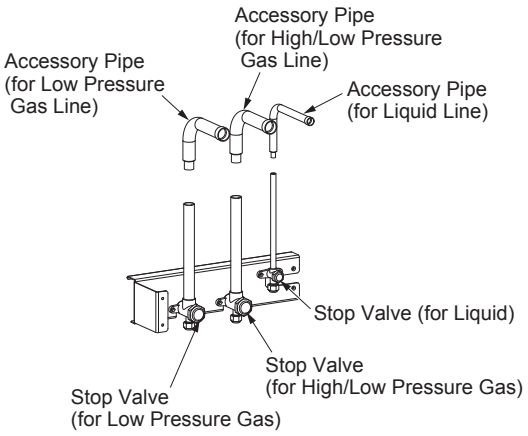


Heat Recovery System with refrigerant pipes from front side

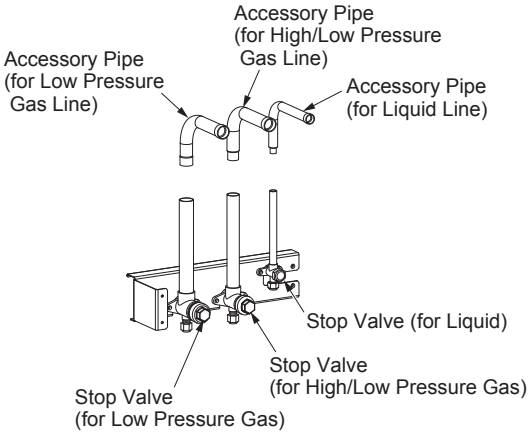
72 Model



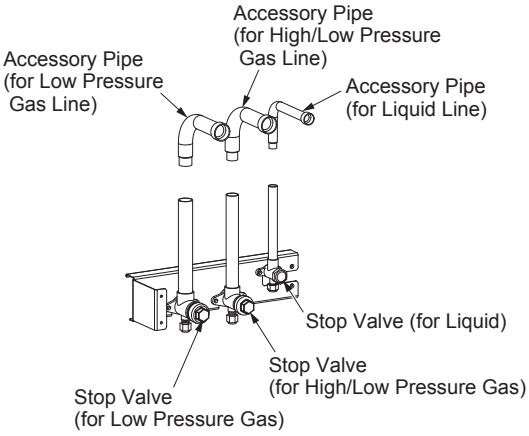
96 Model



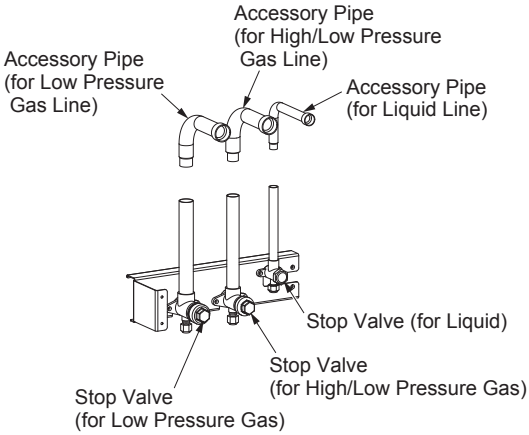
120 Model



144 Model

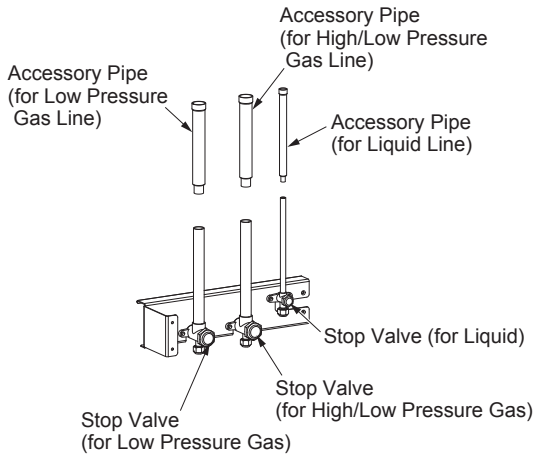


168, 192, 216 Model

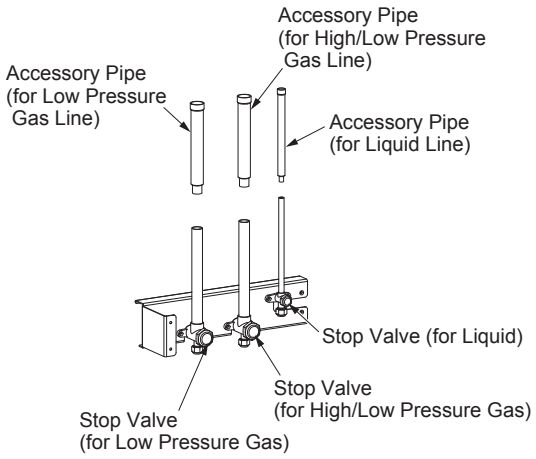


Heat Recovery System with refrigerant pipes from top side

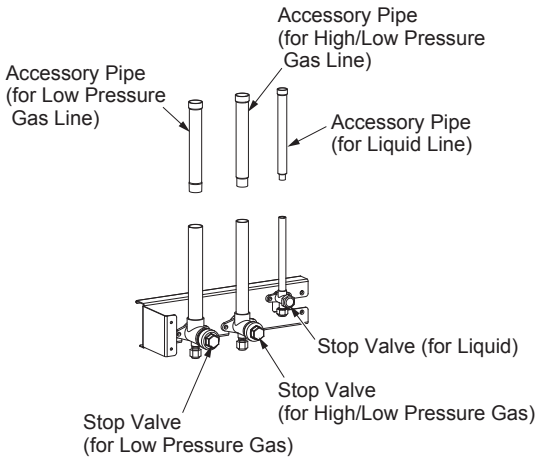
72 Model



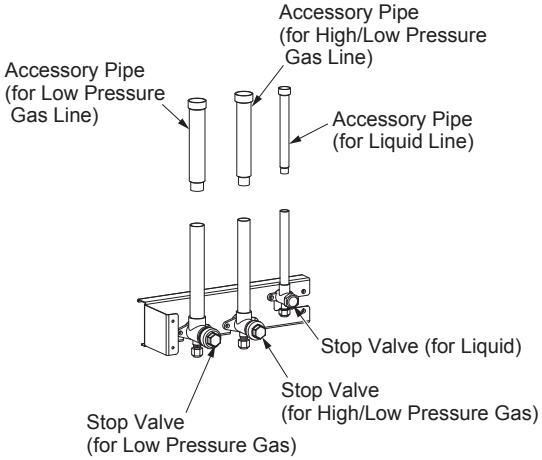
96 Model



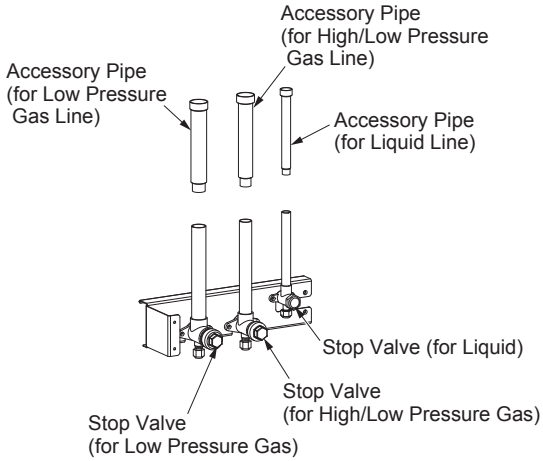
120 Model



144 Model



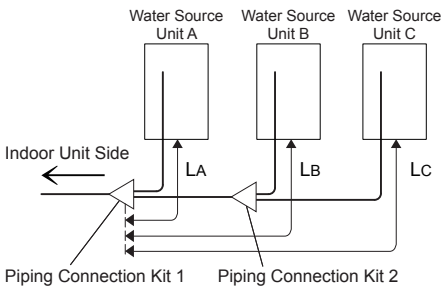
168, 192, 216 Model

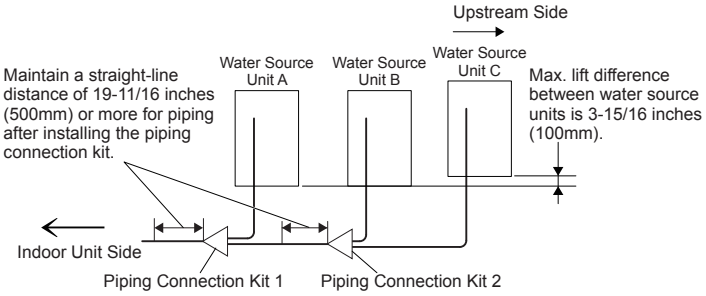


7.3 Piping Work between Water Source Units

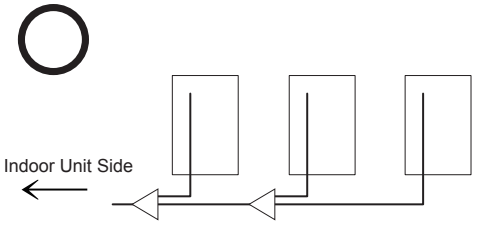
Select the pipe size according to Section 7.4 “Piping Sizes from Water Source Units”.
For refrigerant piping between multiple water source units, use the optional piping connection kit.
The arrangement for water source units should be determined depending on the piping direction when the refrigerant piping work and installation work are planned. When the water source unit is installed, perform the installation work according to the following restrictions.

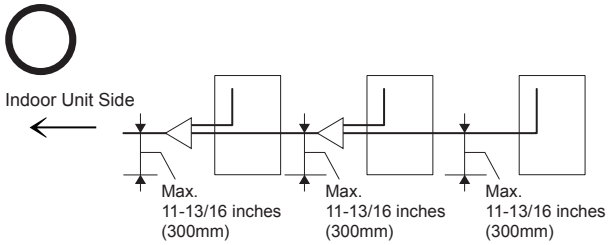
(1) Piping length between piping connection kit 1 and each water source unit should be
$L_A \leq L_B \leq L_C \leq 32$ ft (10m).
Maintain a straight-line distance of 19-11/16 inches (500mm) or more for pipes after the piping connection kit 1.





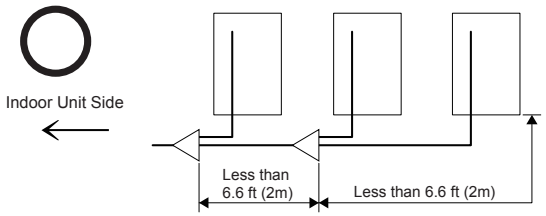
(2) When the piping connection kit is installed, maintain a height of up to 11-13/16 inches (300mm) from the bottom of the water source unit to the piping connection kit.



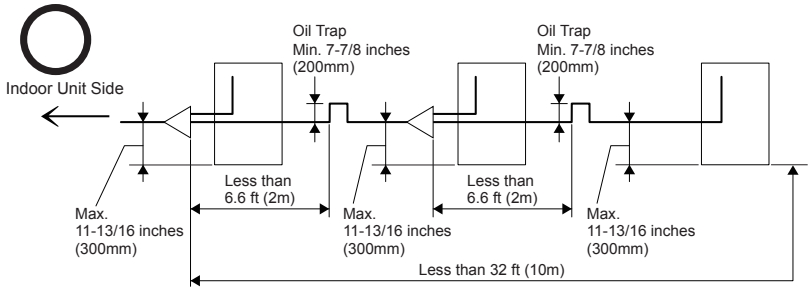


(3) Install an oil trap for the gas piping when the piping length between piping connection kits or the length between water source unit and the piping connection kit exceeds 6.6 ft (2m) to prevent any accumulation of refrigerant oil.

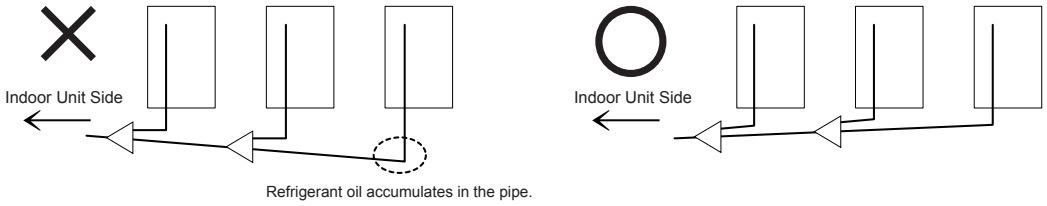
● Less than 6.6 ft (2m)



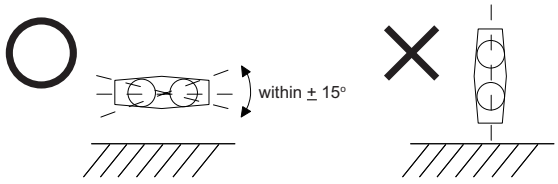
● 6.6 ft (2m) or More



(4) Place the water source unit pipe horizontally or with the pipe slanted downward towards the indoor unit side so that accumulation of refrigerant oil does not occur in the pipe.



(5) Direction of Piping Connection Kit
Place the piping connection kit so it is parallel to the ground (the slope must be within $\pm 15^{o}$) as shown in the figure.



NOTICE

The refrigerant system may be damaged if the slope of the piping connection kit exceeds $\pm 15^{o}$.

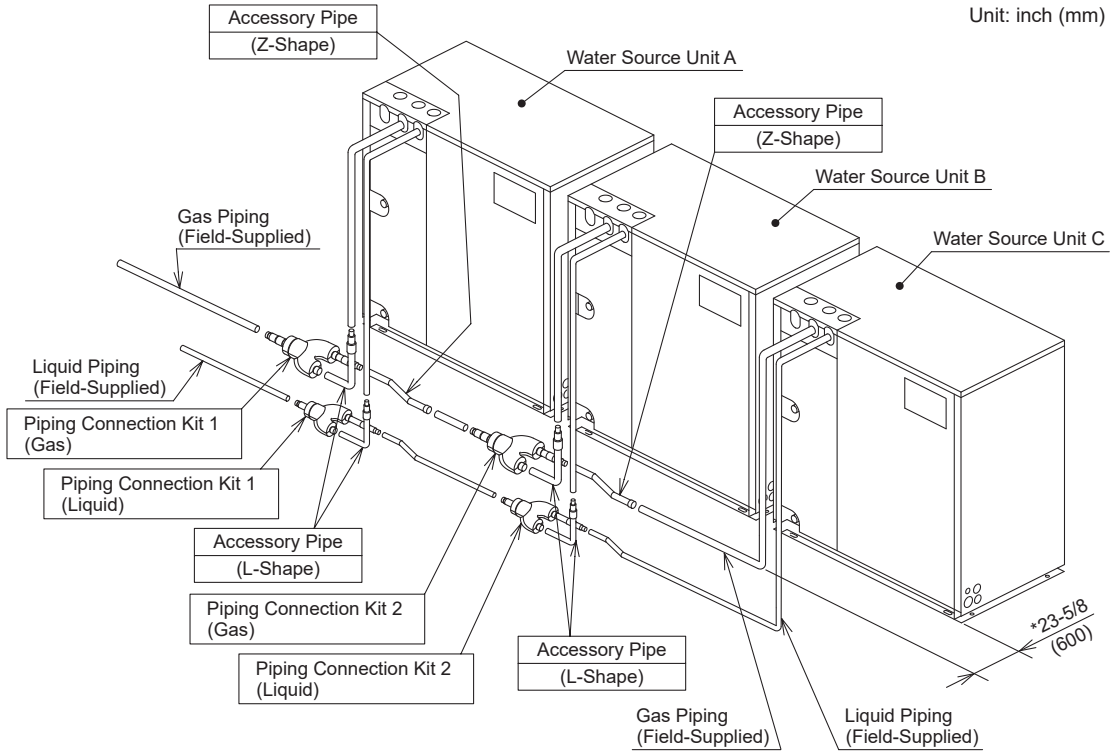
- Construction Example

  The following figures show examples of the three units in combination.
  Regarding the piping work for combining the units, refer to the “Installation and Maintenance Manual” enclosed in the piping connection kit package. Refer to the following figure to perform the piping connections between the water source units.

Heat Pump System

- Perform the piping connections between water source units according to the figure.

Unit: inch (mm)

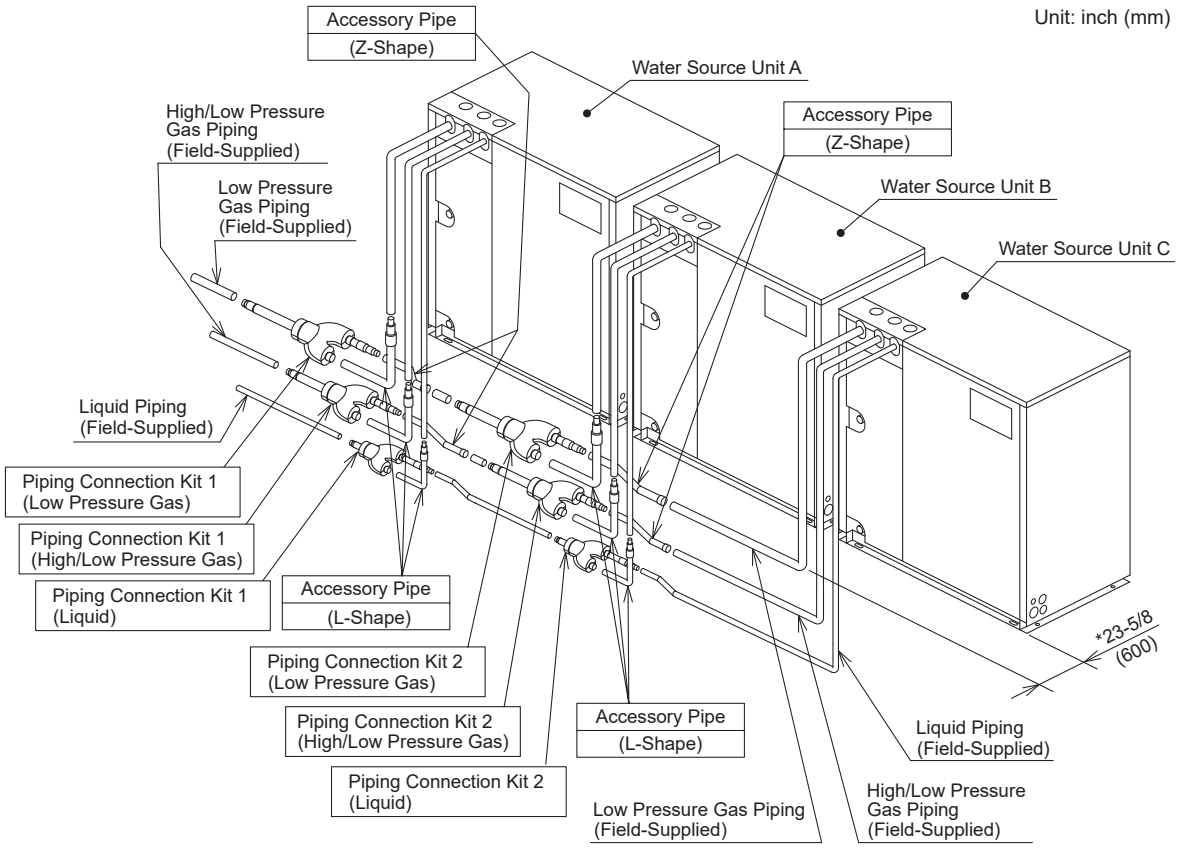


* Secure minimum of 23-5/8 inches (600mm) from front of the unit to the piping.

Heat Recovery System

- Perform the piping connections between water source units according to the figure.

Unit: inch (mm)



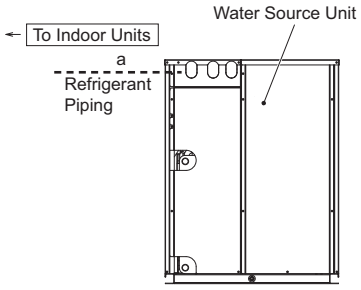
* Secure minimum of 23-5/8 inches (600mm) from front of the unit to the piping.

7.4 Piping Sizes from Water Source Units

Install the water source unit and piping connections in accordance to water source IOM.
Refer to the table for the water source unit model, the piping connection kit model, and the pipe diameter.

7.4.1 Heat Pump System

Base Unit



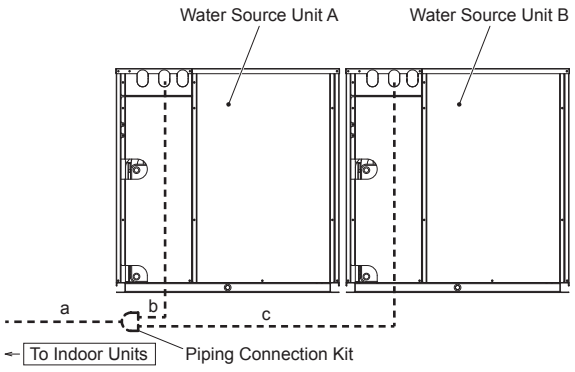
inch (mm)

Model			72	96	120	144	168	192	216
Piping Size	a	Gas	3/4 (19.05)	7/8 (22.2)	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	3/8 (9.52)	3/8 (9.52)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

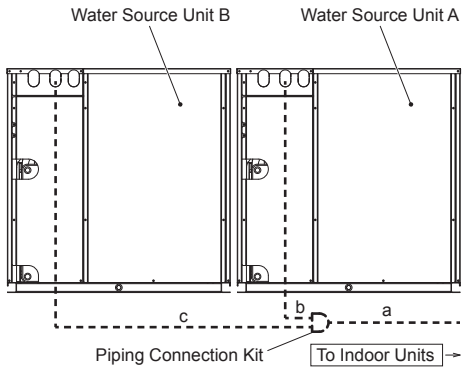
Two Unit Combination

The following drawing is for a 288 model combination.

(Indoor Unit on Left Side)



(Indoor Unit on Right Side)



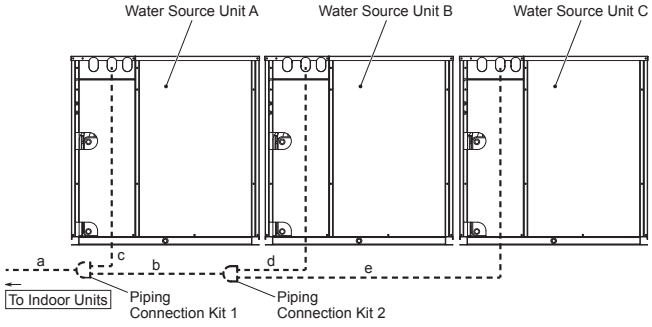
inch (mm)

Model			240	264	288	312	336	360	384	408	432
Combination Unit	Water Source Unit A		120	144	144	168	168	192	192	216	216
	Water Source Unit B		120	120	144	144	168	168	192	192	216
Piping Connection Kit			MC-NP21SA1								
Piping Size	a	Gas	1-1/8 (28.58)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	b	Gas	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	c	Gas	7/8 (22.2)	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

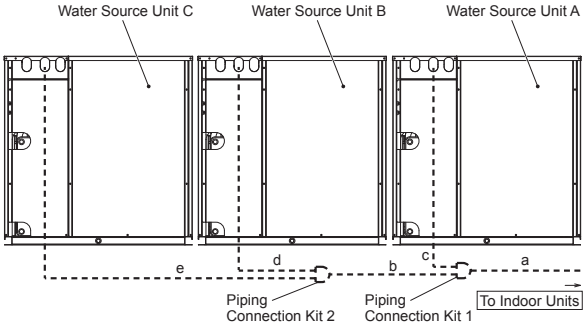
Three Unit Combination

The following drawing is for a 456 model combination.

(Indoor Unit on Left Side)



(Indoor Unit on Right Side)

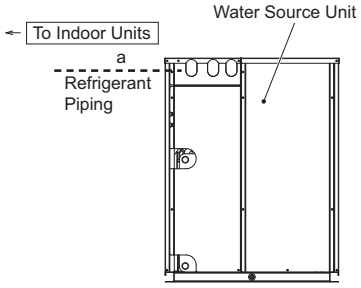


inch (mm)

Model			456	480	504	528	552	576
Combination Unit	Water Source Unit A		168	168	168	192	192	192
	Water Source Unit B		144	168	168	168	192	192
	Water Source Unit C		144	144	168	168	168	192
Piping Connection Kit			MC-NP30SA1					
Piping Size	a	Gas	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	b	Gas	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-5/8 (41.28)	1-5/8 (41.28)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	c	Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	d	Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	e	Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		Liquid	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

7.4.2 Heat Recovery System

Base Unit



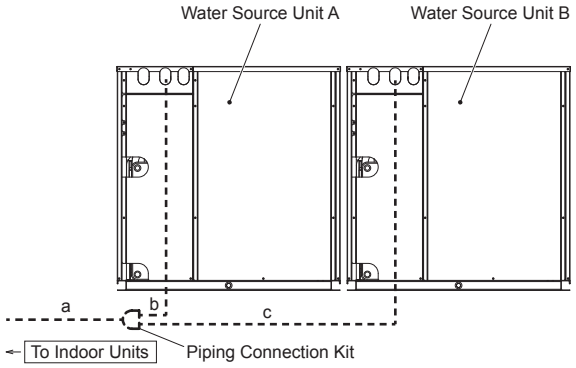
inch (mm)

Model			72	96	120	144	168	192	216
Piping Size	a	Low Pressure Gas	3/4 (19.05)	7/8 (22.2)	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	5/8 (15.88)	3/4 (19.05)	3/4 (19.05)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	3/8 (9.52)	3/8 (9.52)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

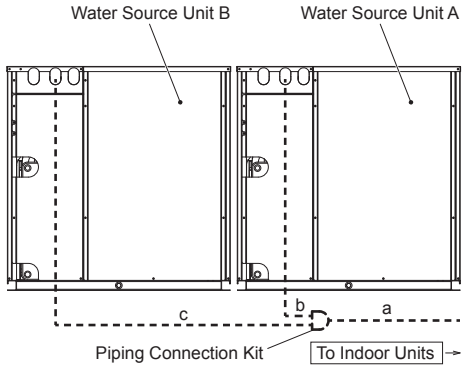
Two Unit Combination

The following drawing is for a 288 model combination.

(Indoor Unit on Left Side)



(Indoor Unit on Right Side)



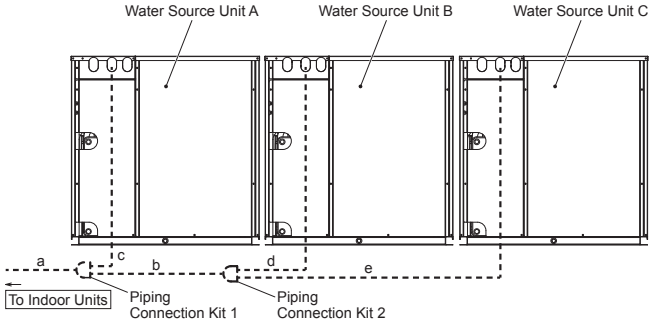
inch (mm)

Model			240	264	288	312	336	360	384	408	432
Combination Unit		Water Source Unit A	120	144	144	168	168	192	192	216	216
		Water Source Unit B	120	120	144	144	168	168	192	192	216
Piping Connection Kit			MC-NP21SX1								
Piping Size	a	Low Pressure Gas	1-1/8 (28.58)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)
		High/Low Pressure Gas	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	b	Low Pressure Gas	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	3/4 (19.05)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	c	Low Pressure Gas	7/8 (22.2)	7/8 (22.2)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	3/4 (19.05)	3/4 (19.05)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

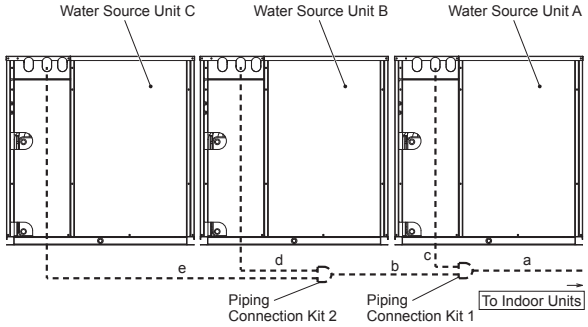
Three Unit Combination

The following drawing is for a 456 model combination.

(Indoor Unit on Left Side)



(Indoor Unit on Right Side)



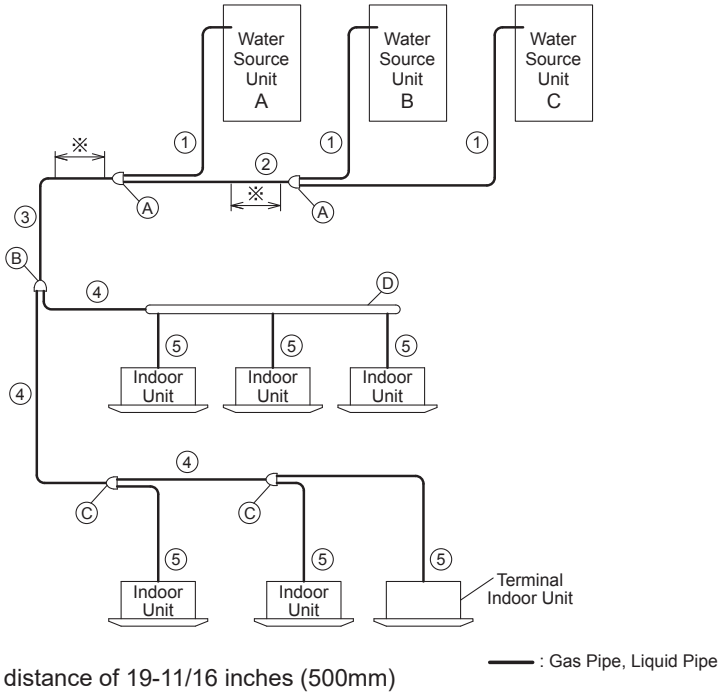
inch (mm)

Model			456	480	504	528	552	576
Combination Unit		Water Source Unit A	168	168	168	192	192	192
		Water Source Unit B	144	168	168	168	192	192
		Water Source Unit C	144	144	168	168	168	192
Piping Connection Kit			MC-NP30SX1					
Piping Size	a	Low Pressure Gas	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)	1-5/8 (41.28)
		High/Low Pressure Gas	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	b	Low Pressure Gas	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-3/8 (34.93)	1-5/8 (41.28)	1-5/8 (41.28)
		High/Low Pressure Gas	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)	3/4 (19.05)
	c	Low Pressure Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	d	Low Pressure Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)
	e	Low Pressure Gas	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)	1-1/8 (28.58)
		High/Low Pressure Gas	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)	7/8 (22.2)
		Liquid	1/2 (12.7)	1/2 (12.7)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)	5/8 (15.88)

7.5 Piping Size and Multi-Kit Selection

7.5.1 Heat Pump System

For selecting the pipe sizes ① between the water source unit and the piping connection kit, and the pipe size ② between the piping connection kits and piping connection kit Ⓐ, refer to Section 7.4 “Piping Sizes from Water Source Units”.

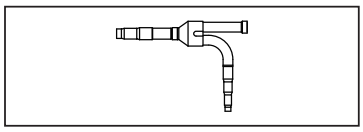


※ Maintain a straight-line distance of 19-11/16 inches (500mm) or more for piping after the piping connection kit.

Multi-Kit (Optional Parts)

Line Branch

Branch using Multi-Kit (MW Model)



Ⓑ Multi-Kit for First Branch

Water Source Unit Capacity (MBH)	Model
72 - 96	MW-NP282A3
120 - 144	MW-NP452A3
168	MW-NP692A3
192 - 576	MW-NP902A3

NOTE:
Header branch can also be used instead of the multi-kit as first branch.

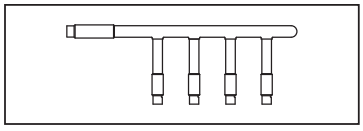
Ⓒ Multi-Kit after First Branch

Total Indoor Unit Capacity (MBH)	Model
≤ 95	MW-NP282A3
96 - 143	MW-NP452A3
144 - 215	MW-NP692A3
≥ 216	MW-NP902A3

If Ⓒ “Multi-Kit after First Branch” is larger than Ⓑ “Multi-Kit for First Branch”, use the same model as Ⓑ “Multi-Kit for First Branch”.

Header Branch

Branch using Multi-Kit (MH Model)



Ⓓ Header Branch

Total Indoor Unit Capacity (MBH)	No. of Header Branches	Model
36 - 60	4	MH-NP224A
36 - 72	8	MH-NP288A

Refer to the figure at the beginning of Section 7.5.1.

Piping Size Unit: inch (mm)

③ Main Pipe Diameter
(Water Source Unit to First Branch)

Model: (H,Y)VWHP_B(3,4)2S

Water Source Unit Capacity (MBH)	Gas	Liquid	
		Equivalent Piping Length between Water Source Unit and Ⓐ "Multi-Kit for First Branch"	
		< 263 ft (80m)	≥ 263 ft (80m) *1
72	3/4 (19.05)	3/8 (9.52)	1/2 (12.7)
96	7/8 (22.2)	3/8 (9.52)	1/2 (12.7)
120	7/8 (22.2)	1/2 (12.7)	5/8 (15.88)
144	1-1/8 (28.58)	1/2 (12.7)	5/8 (15.88)
168 - 216	1-1/8 (28.58)	5/8 (15.88)	3/4 (19.05)
240	1-1/8 (28.58)	3/4 (19.05)	7/8 (22.2)
264 - 336	1-3/8 (34.93)	3/4 (19.05)	7/8 (22.2)
360 - 576	1-5/8 (41.28)	3/4 (19.05)	7/8 (22.2)

*1 In some cases, it is required to prepare the reducer (field-supplied).

④ Diameter of Pipe after First Branch

If the size of ④ "Diameter of Pipe after First Branch" is larger than the size of ③ "Main Pipe Diameter", adjust the size of ④ "Diameter of Pipe after First Branch" to the same size as ③ "Main Pipe Diameter".

Total Indoor Unit Capacity (MBH)	Piping Length between First Branch and Indoor Unit	
	Gas	Liquid
≤ 47	5/8 (15.88)	3/8 (9.52)
48 - 71	3/4 (19.05)	3/8 (9.52)
72 - 95	7/8 (22.2)	3/8 (9.52)
96 - 119	7/8 (22.2)	1/2 (12.7)
120 - 143	1-1/8 (28.58)	1/2 (12.7)
144 - 215	1-1/8 (28.58)	5/8 (15.88)
216 - 299	1-3/8 (34.93)	3/4 (19.05)
≥ 300	1-5/8 (41.28)	3/4 (19.05)

⑤ Diameter of Pipe Connected to Indoor Unit

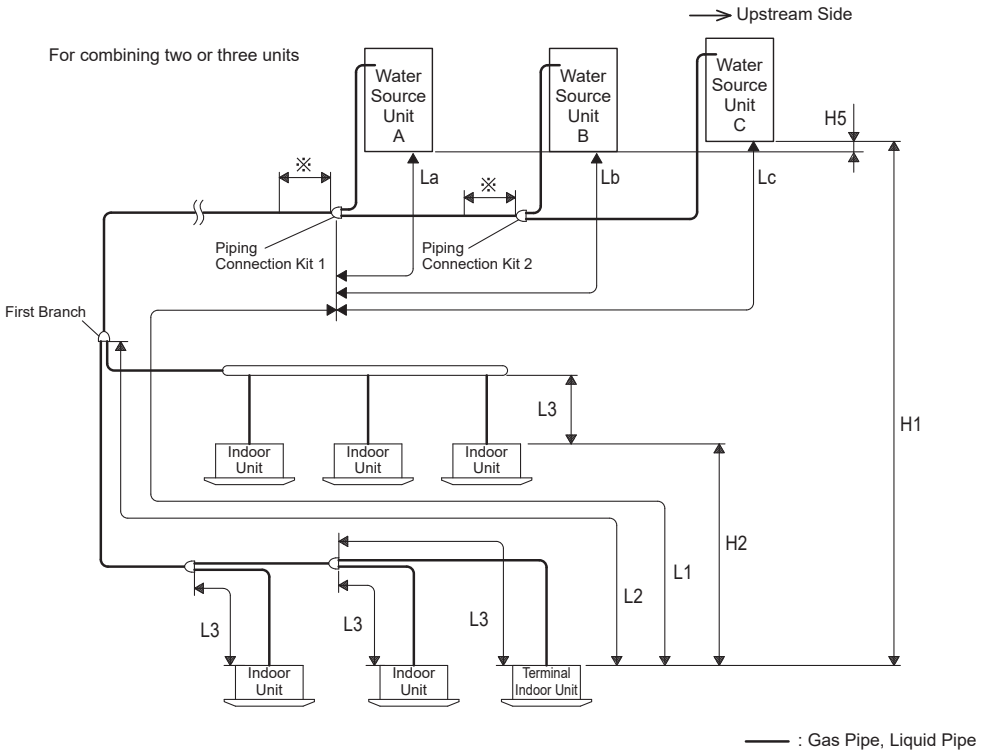
Be sure the pipe diameter is the same as the indoor unit pipe connection size.

Indoor Unit Capacity (MBH)	Gas	Liquid
6 - 15	1/2 (12.7)	1/4 (6.35) *2
18 - 54	5/8 (15.88)	3/8 (9.52)
60 - 72	3/4 (19.05)	3/8 (9.52)
96	7/8 (22.2)	3/8 (9.52)

*2 When liquid piping length is longer than 49 ft (15m), use 3/8 inch (9.52mm) diameter pipe to connect to the indoor unit.

- Piping Work Conditions

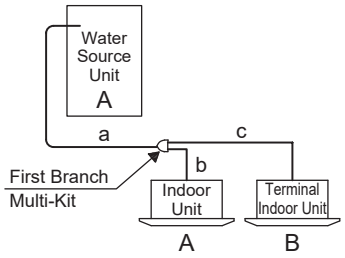
Comply with the following when installing the unit:



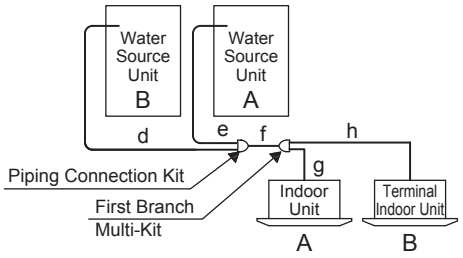
※ Maintain a straight-line distance of 19-11/16 inches (500mm) or more for piping after installing the piping connection kit.

Item	Mark		Details
Total Piping Length	Ex1	a+b+c	The total amount of all piping (actual length).
	Ex2	d+e+f+g+h	
Maximum Piping Length	Ex1	a+c	The actual pipe length between the stop valve of the water source unit or piping connection kit 1 and the terminal indoor unit.
	Ex2	f+h	
Piping Length	-		The actual length of pipe that does not take into account the equivalent lengths for pressure drops of the elbows.
Equivalent Piping Length	-		The combination of the straight pipe length plus the equivalent length of elbows and other pressure drop calculations.

Example 1) If a Line Branch Includes the Main Branch



Example 2) If Utilizing a Piping Connection Kit



ft (m)

Item		Parameter	Allowable Piping Length
Total Piping Length		-	984 (300)
Maximum Piping Length	Actual Length	L1	393 (120)
	Equivalent Length		459 (140)
Maximum Piping Length between Multi-kit of 1st Branch and Terminal Indoor Unit		L2	131 (40)
Maximum Piping Length between Each Multi-kit and Each Indoor Unit	Maximum	L3	98 (30)
	Recommend		49 (15)
Piping Length between Piping Connection Kit 1 and Each Water Source Unit		La, Lb, Lc	32 (10)
Height Difference between Water Source Units and Indoor Units	W.S. is Higher	H1	164 (50)
	W.S. is Lower		131 (40)
Height Difference between Indoor Units		H2	49 (15)
Height Difference between Water Source Units		H5	0.3 (0.1)

NOTICE

Comply with the following conditions when installing the unit:

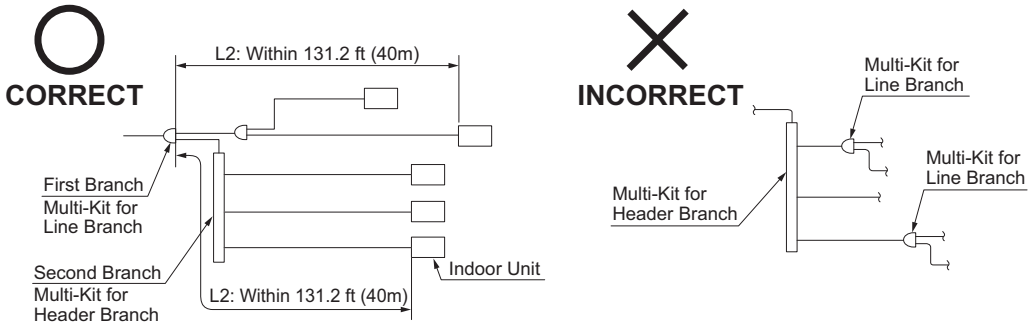
1. For a combination of two or three water source units, the water source unit “A” should be connected to the piping connection of Kit 1. (Refer to Section 7.4 for water source unit models.)
   Refer to the Piping Kit Installation Manual for piping details.
2. The piping length between water source units should be La ≤ Lb ≤ Lc ≤ 32 ft (10m).
   (If the piping length is incorrect, there may be a failure of water source units caused by returned refrigerant.)
3. Maintain a straight-line distance of 19-11/16 inches (500mm) or more for piping after installing the piping connection kit.
4. The condition of refrigerant piping installation is different depending on the number of indoor units that are connected. Refer to Table 3.2 “System Combination” above for details.
5. Allowable total piping length may not exceed 984 ft (300m) because of the limitation of maximum additional refrigerant amount as described in the following table. Make sure that the additional refrigerant volume does not exceed the maximum additional refrigerant amount as shown below.

Water Source Unit Capacity (MBH)	72, 96	120	144, 168	192, 216	240, 264	288 - 432	456 - 576
Maximum Additional Refrigerant Charge: lbs (kg)	61.7 (28.0)	83.8 (38.0)	88.2 (40.0)	99.2 (45.0)	121.3 (55.0)	132.3 (60.0)	140.0 (63.5)

6. If the piping length (L3) between each multi-kit and indoor unit is considerably longer than other indoor unit, refrigerant may not flow well, and the unit’s performance may be decreased.
   (Recommended Piping Length: Within 49 ft (15m))
7. When completing on-site piping, install bent piping or horizontal loop piping to absorb any expansion or contraction due to changing temperatures.

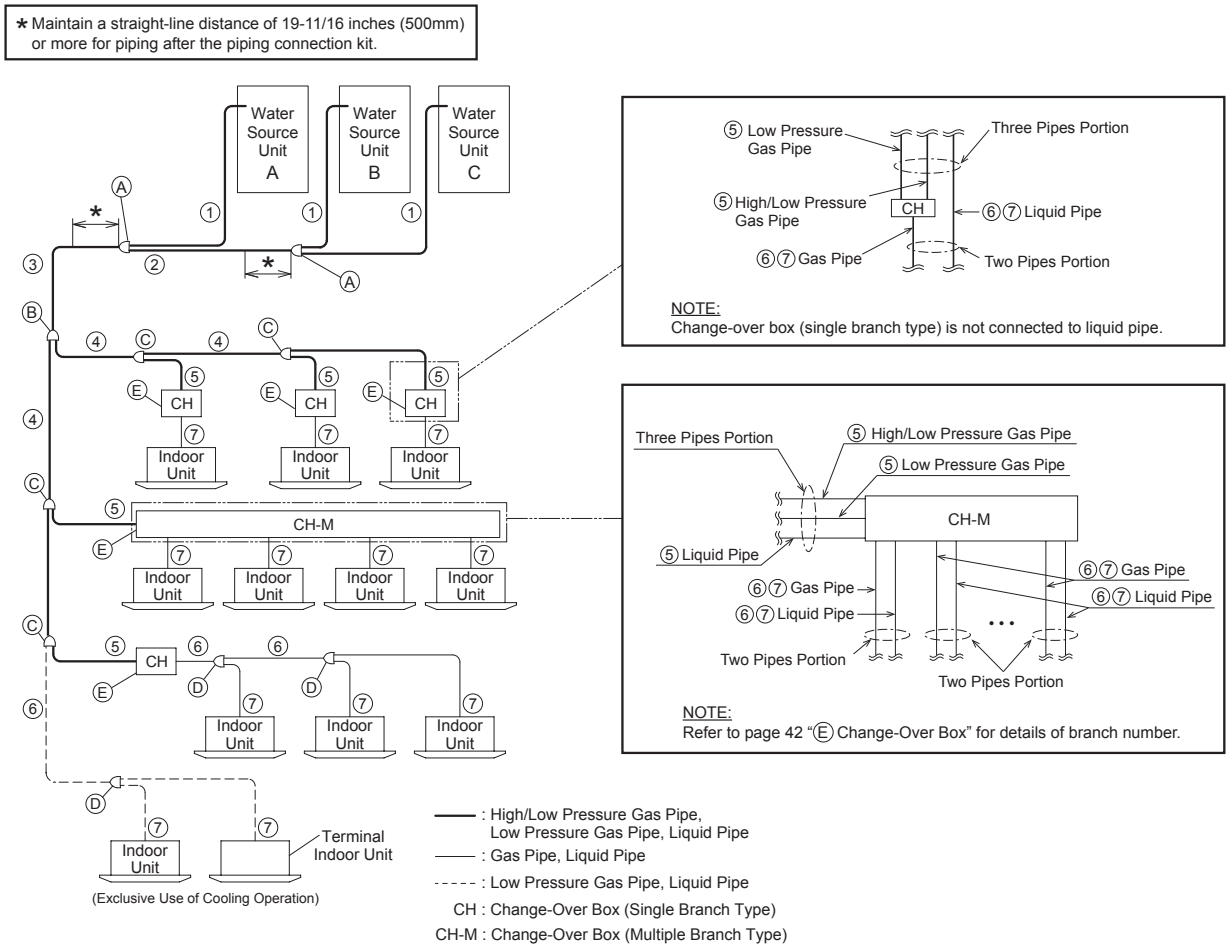
- Piping Branch Restriction

Header branch can be used with a line branch.
Header branch can also be used after the second branch. Do not connect a line branch to a header branch.

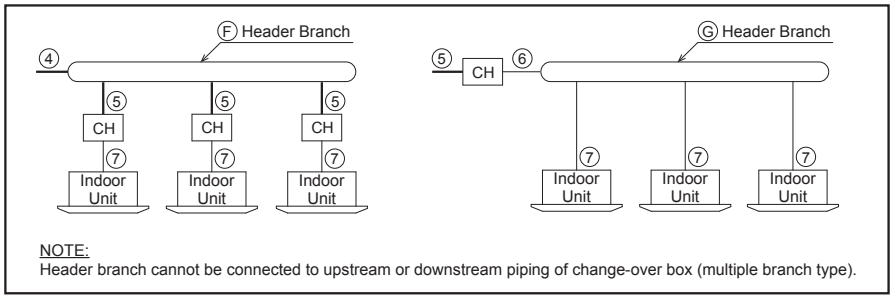


7.5.2 Heat Recovery System

For selecting the pipe sizes ① between the water source unit and the piping connection kit and the pipe size ② between the piping connection kits Ⓐ, refer to Section 7.4 “Piping Sizes from Water Source Units”.



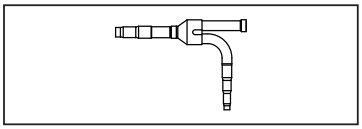
If header branch is used instead of ⒸⒹ multi-kit.



Multi-Kit (Optional Parts)

Line Branch

Branch using Multi-Kit (MW Model)



Ⓑ Multi-Kit for First Branch

Water Source Unit Capacity (MBH)	Model
72 - 96	MW-NP282X3
120 - 144	MW-NP452X3
168	MW-NP562X3
192 - 576	MW-NP902X3

NOTE:
The change-over box (multiple branch type) or header branch can also be used instead of the multi-kit as first branch.

Ⓒ Multi-Kit after First Branch (Three Pipes Portion)

Total Indoor Unit Capacity (MBH)	Model
≤ 47	MW-NP142X3
48 - 95	MW-NP282X3
96 - 143	MW-NP452X3
144 - 215	MW-NP562X3
≥ 216	MW-NP902X3

If Ⓒ “Multi-Kit after First Branch” is larger than Ⓑ “Multi-Kit for First Branch”, use the same model as Ⓑ “Multi-Kit for First Branch”.

Ⓓ Multi-Kit after First Branch (Two Pipes Portion)

Total Indoor Unit Capacity (MBH)	Model
≤ 95	MW-NP282A3
96 - 143	MW-NP452A3
144 - 215	MW-NP692A3
≥ 216	MW-NP902A3

Ⓔ Change-Over Box

● Single Unit for 1 Port

Model	Indoor Unit Side Port Number	Indoor Unit Maximum Connection Capacity	Indoor Unit Maximum Connection Capacity for 1 Port
COBS048B22S	1	≤ 54	≤ 54
COBS096B22S	1	≤ 96	≤ 96
COB04M132B22S	4	≤ 132	≤ 96 *1
COB08M264B22S	8	≤ 264	≤ 96 *1
COB12M264B22S	12	≤ 264	≤ 96 *1

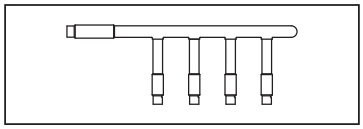
*1 Up to two 60, 72 or 96 type indoor units can be connected to the change-over box within the “Indoor Unit Maximum Connection Capacity” shown in above table.
Make sure to increase the pipe connection size by using the appropriate accessory pipe.

● Multiple Units for 1 Port

Model	Indoor Unit Side Port Number	Maximum Number of Connected Indoor Units for 1 Port	Indoor Unit Maximum Connection Capacity	Indoor Unit Maximum Connection Capacity for 1 Port
COBS048B22S	1	7	≤ 41	≤ 41
COBS096B22S	1	8	≤ 71	≤ 71
COB04M132B22S	4	6	≤ 114	≤ 41
COB08M264B22S	8	6	≤ 216	≤ 41
COB12M264B22S	12	6	≤ 216	≤ 41

Header Branch

Branch using Multi-Kit (MH Model)



Ⓕ for Three Pipes Portion

Total Indoor Unit Capacity (MBH)	No. of Header Branches	Model
36 - 72	8	MH-NP288X

Ⓖ for Two Pipes Portion

Total Indoor Unit Capacity (MBH)	No. of Header Branches	Model
36 - 60	4	MH-NP224A
36 - 72	8	MH-NP288A

Refer to the figure at the beginning of Section 7.5.2.

Piping Size Unit: inch (mm)

③ Main Pipe Diameter
(Water Source Unit to First Branch)

Model: (H,Y)VWHR_B(3,4)2S

Water Source Unit Capacity (MBH)	Low Pressure Gas	High/Low Pressure Gas	Liquid	
			Equivalent Piping Length between Water Source Unit and Ⓐ "Multi-Kit for First Branch"	
			< 263 ft (80m)	≥ 263 ft (80m) *2
72	3/4 (19.05)	5/8 (15.88)	3/8 (9.52)	1/2 (12.7)
96	7/8 (22.2)	3/4 (19.05)	3/8 (9.52)	1/2 (12.7)
120	7/8 (22.2)	3/4 (19.05)	1/2 (12.7)	5/8 (15.88)
144	1-1/8 (28.58)	7/8 (22.2)	1/2 (12.7)	5/8 (15.88)
168 - 216	1-1/8 (28.58)	7/8 (22.2)	5/8 (15.88)	3/4 (19.05)
240	1-1/8 (28.58)	7/8 (22.2)	3/4 (19.05)	7/8 (22.2)
264 - 336	1-3/8 (34.93)	1-1/8 (28.58)	3/4 (19.05)	7/8 (22.2)
360 - 576	1-5/8 (41.28)	1-3/8 (34.93)	3/4 (19.05)	7/8 (22.2)

*2 In some cases, it is required to prepare the reducer (field-supplied).

④ Diameter of Pipe after First Branch *3

Total Indoor Unit Capacity (MBH)	Low Pressure Gas	High/Low Pressure Gas	Liquid
≤ 47	5/8 (15.88)	1/2 (12.7)	3/8 (9.52)
48 - 71	3/4 (19.05)	5/8 (15.88)	3/8 (9.52)
72 - 95	7/8 (22.2)	3/4 (19.05)	3/8 (9.52)
96 - 119	7/8 (22.2)	3/4 (19.05)	1/2 (12.7)
120 - 143	1-1/8 (28.58)	7/8 (22.2)	1/2 (12.7)
144 - 215	1-1/8 (28.58)	7/8 (22.2)	5/8 (15.88)
216 - 299	1-3/8 (34.93)	1-1/8 (28.58)	3/4 (19.05)
≥ 300	1-5/8 (41.28)	1-3/8 (34.93)	3/4 (19.05)

*3 If the size of ④ "Diameter of Pipe after First Branch" is larger than the size of ③ "Main Pipe Diameter", adjust the size of ④ "Diameter of Pipe after First Branch" to the same size as ③ "Main Pipe Diameter".

⑤ Diameter of Pipe between Change-Over Box and Multi-Kit

For Change-Over Box *4

Change-Over Box Model	Total Indoor Unit Capacity (MBH)	Low Pressure Gas	High/Low Pressure Gas	Liquid *5
COBS048/096B22S COB04M132B22S COB08/12M264B22S	≤ 47	5/8 (15.88)	1/2 (12.7)	3/8 (9.52)
	48 - 71	3/4 (19.05)	5/8 (15.88)	3/8 (9.52)
	72 - 95	7/8 (22.2)	3/4 (19.05)	3/8 (9.52)
	96 - 119	7/8 (22.2)	3/4 (19.05)	1/2 (12.7)
	120 - 143	1-1/8 (28.58)	7/8 (22.2)	1/2 (12.7)
	144 - 215	1-1/8 (28.58)	7/8 (22.2)	5/8 (15.88)
	216 - 264	1-3/8 (34.93)	1-1/8 (28.58)	3/4 (19.05)

*4 If the size of ⑤ "Diameter of Pipe between Change-Over Box and Multi-Kit" is larger than the size of ③ "Main Pipe Diameter", adjust the size of ⑤ "Diameter of Pipe between Change-Over Box and Multi-Kit" to the same size as ③ "Main Pipe Diameter"

*5 Change-Over Box (COBS048/096B22S) is not connected to liquid pipe.

Piping Size Unit: inch (mm)

⑥ Diameter of Pipe (Two Pipes Portion)

Total Indoor Unit Capacity (MBH)	Gas *6	Liquid
≤ 47	5/8 (15.88)	3/8 (9.52)
48 - 71	3/4 (19.05)	3/8 (9.52)
72 - 95	7/8 (22.2)	3/8 (9.52)
96 - 119	7/8 (22.2)	1/2 (12.7)
120 - 143	1-1/8 (28.58)	1/2 (12.7)
144 - 215	1-1/8 (28.58)	5/8 (15.88)
216 - 299	1-3/8 (34.93)	3/4 (19.05)
≥ 300	1-5/8 (41.28)	3/4 (19.05)

*6 For the exclusive use of cooling operation, connect the low pressure gas pipe to the gas pipe of line branch or header branch for two pipes portion.

⑦ Diameter of Pipe Connected to Indoor Unit (Two Pipes Portion)

Be sure the pipe diameter is the same as the indoor unit pipe connection size.

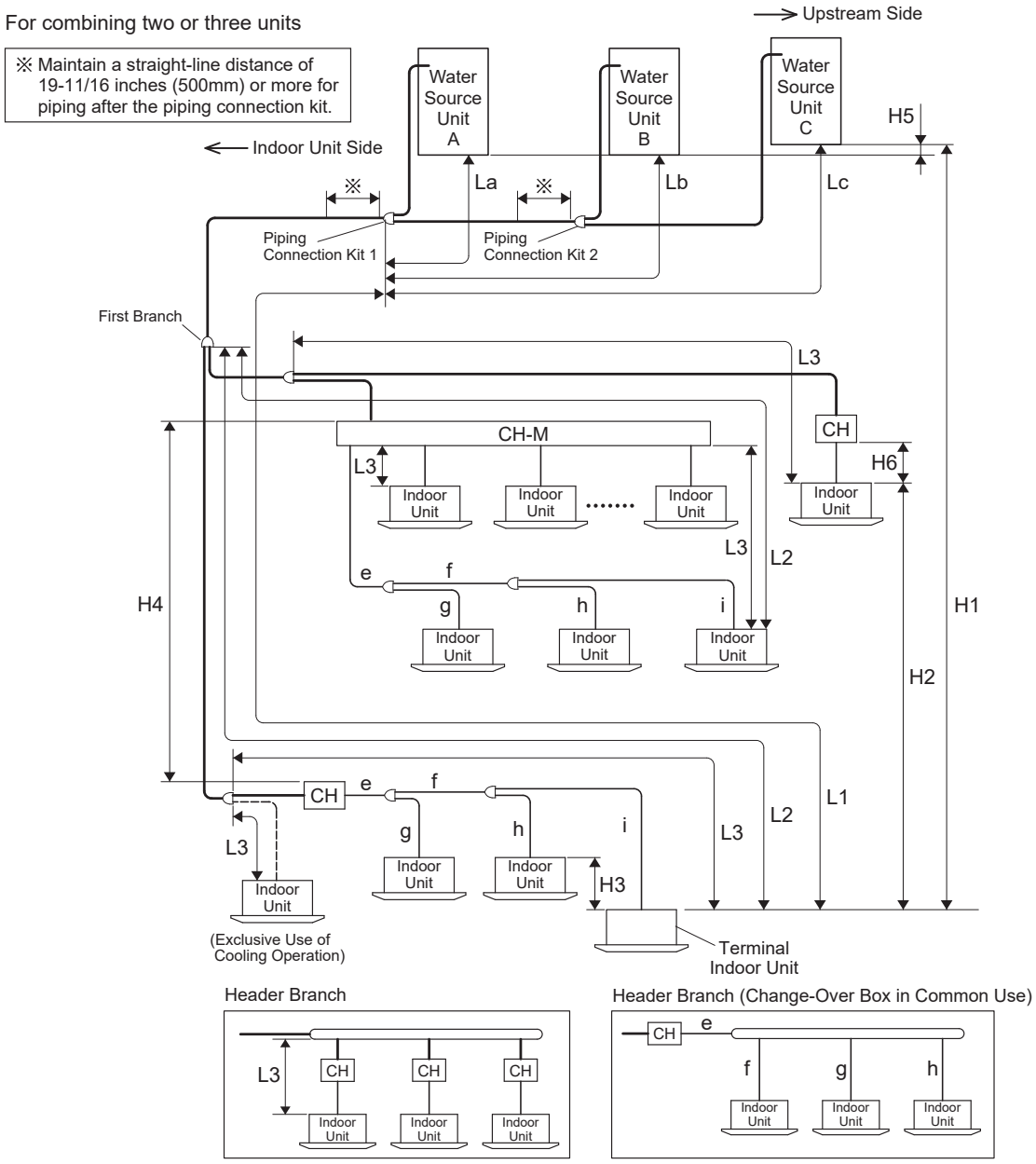
Indoor Unit Capacity (MBH)	Gas *7	Liquid
6 - 15	1/2 (12.7)	1/4 (6.35) *8
18 - 54	5/8 (15.88)	3/8 (9.52)
60 - 72	3/4 (19.05)	3/8 (9.52)
96	7/8 (22.2)	3/8 (9.52)

*7 For the exclusive use of cooling operation, connect the low pressure gas pipe to the gas pipe of the indoor unit.

*8 When liquid piping length is longer than 49 ft (15m), use 3/8 inch (9.52mm) diameter piping, to connect to the indoor unit (two pipes portion).

- Piping Work Conditions

Comply with the following when installing the unit:



——— : High/Low Pressure Gas Pipe, Low Pressure Gas Pipe, Liquid Pipe

——— : Gas Pipe, Liquid Pipe

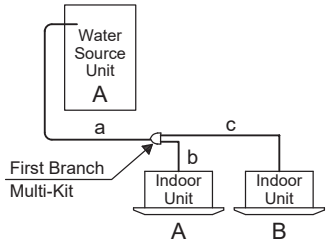
- - - - - : Low Pressure Gas Pipe, Liquid Pipe

CH : Change-Over Box (Single Branch Type)

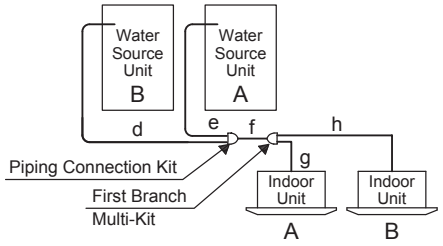
CH-M : Change-Over Box (Multiple Branch Type)

Item	Mark		Details
Total Piping Length	Ex1	a+b+c	The total amount of all piping (actual length).
	Ex2	d+e+f+g+h	
Maximum Piping Length	Ex1	a+c	The actual pipe length between the stop valve of the water source unit or piping connection kit 1 and the terminal indoor unit.
	Ex2	f+h	
Piping Length	-		The actual length of pipe that does not take into account the equivalent lengths for pressure drops of the elbows.
Equivalent Piping Length	-		The combination of the straight pipe length plus the equivalent length of elbows and other pressure drop calculations.

Example 1) If a Line Branch Includes the Main Branch



Example 2) If Utilizing a Piping Connection Kit



ft (m)

Item		Parameter	Allowable Piping Length
Total Piping Length		-	984 (300)
Maximum Piping Length	Actual Length	L1	393 (120)
	Equivalent Length		459 (140)
Maximum Piping Length between Multi-kit of 1st Branch and Each Indoor Unit		L2	131 (40)
Maximum Piping Length between Each Multi-kit or Change-Over Box (Multiple Branch Type) and Each Indoor Unit	Maximum	L3 [8]	98 (30)
	Recommend		49 (15)
Total Piping Length between Change-Over Box and Each Indoor Unit per Port		e+f+g+h+i	131 (40)
Piping Length between Piping Connection Kit 1 and Each Water Source Unit		La, Lb, Lc	32 (10)
Height Difference between Water Source Units and Indoor Units	W.S. is Higher	H1	164 (50)
	W.S. is Lower		131 (40)
Height Difference between Indoor Units		H2	49 (15)
Height Difference between Indoor Units Connected to Same Port of Change-Over Box		H3	13 (4)
Height Difference between Change-Over Box		H4	49 (15)
Height Difference between Water Source Units		H5	0.3 (0.1)
Height Difference between Change-Over Box and Indoor Unit		H6	49 (15)

NOTICE

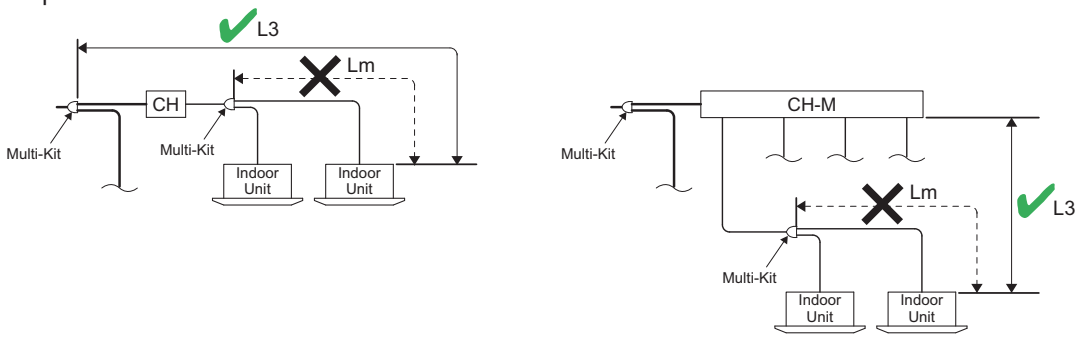
Comply with the following conditions when installing the unit:

1. For a combination of two or three water source units, the water source unit “A” should be connected to the piping connection of Kit 1. (Refer to Section 7.4 for water source unit models.)
   Refer to the Piping Kit Installation Manual for piping details.
2. The piping length between water source units should be La ≤ Lb ≤ Lc ≤ 32 ft (10m).
   (If the piping length is incorrect, there may be a failure of water source units caused by returned refrigerant.)
3. Maintain a straight-line distance of 19-11/16 inches (500mm) or more for pipe after installing the piping connection kit.
4. If an indoor unit is to be used for cooling only operation, connect the low pressure gas line and liquid line directly to the unit without using a change-over box. Be sure the total capacity of the cooling only unit(s) is less than 50% of the total indoor unit capacity.
5. Allowable total piping length may not exceed 984 ft (300m) because of the limitation of maximum additional refrigerant amount as described in the following table. Make sure that the additional refrigerant volume does not exceed the maximum additional refrigerant amount as shown below.

Water Source Unit Capacity (MBH)	72, 96	120	144, 168	192, 216	240, 264	288 - 432	456 - 576
Maximum Additional Refrigerant Charge: lbs (kg)	61.7 (28.0)	83.8 (38.0)	88.2 (40.0)	99.2 (45.0)	121.3 (55.0)	132.3 (60.0)	140.0 (63.5)

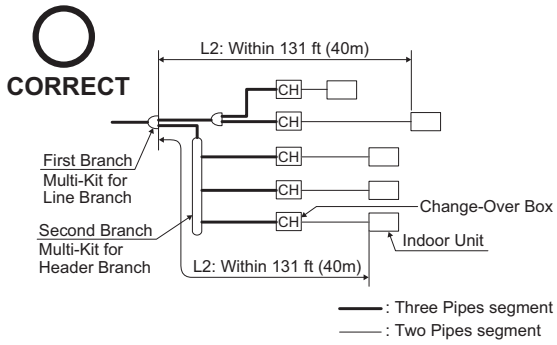
6. If the piping length (L3) between each multi-kit and indoor unit is considerably longer than other indoor unit, refrigerant may not flow well, and the unit’s performance may be decreased.
   (Recommended Piping Length: Within 49 ft (15m))
7. When completing on-site piping, install bent piping or horizontal loop piping to absorb any expansion or contraction due to changing temperatures.
8. The piping length calculation is not included in the multi-kit between change-over box and indoor unit(s).
   (Lm in following examples is NOT L3.)

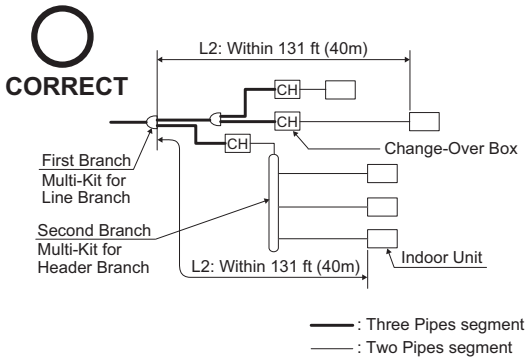
Example

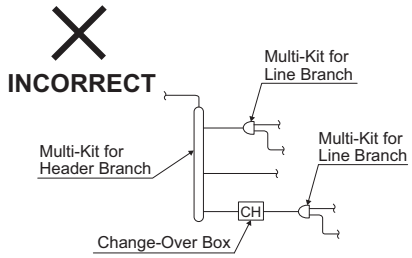


- Piping Branch Restriction

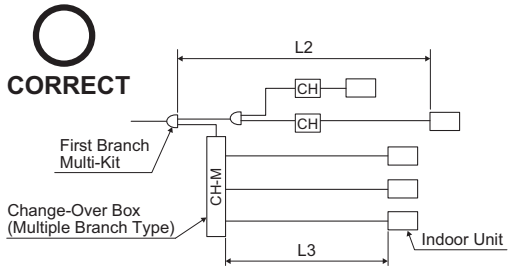
Header branch can be used with a line branch at the three pipes portion and two pipes portion.
Header branch can also be used after the second branch. Do not connect a line branch to a header branch.

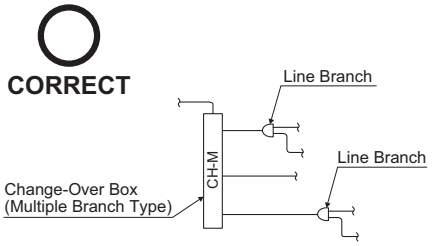




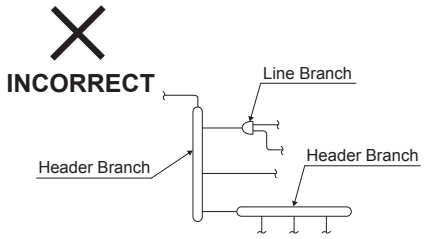


In case of the change-over box (multiple branch type) is connected, the following restrictions apply:

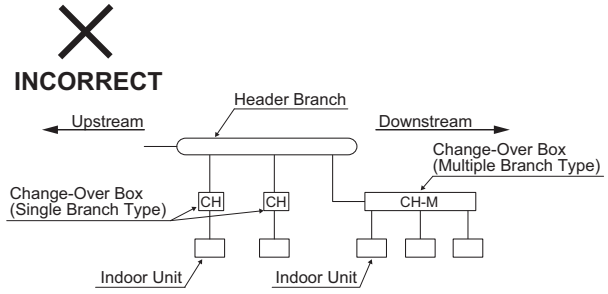


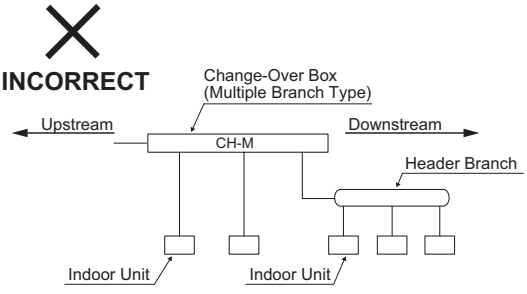


Header branch can not connect to another header branch.



Header branch cannot be connected to upstream or downstream piping of change-over box (multiple branch type).





- The number of indoor units connectable to water source unit is as follows:
  Comply with the following conditions when installing the unit.
- A maximum total capacity and a minimum total capacity against the nominal water source unit capacity can be obtained by combination of the indoor units.

Water Source Unit Capacity (MBH)	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576
Maximum Number of Connectable I.U.	13	16	23	26	29	33	33	46	49	52	55	58	62	64	64	64	64	64	64	64	64	64
Recommended Number of Connectable I.U.	8	8	8	10	12	14	14	16	18	20	22	24	26	28	28	28	32	34	36	38	40	42

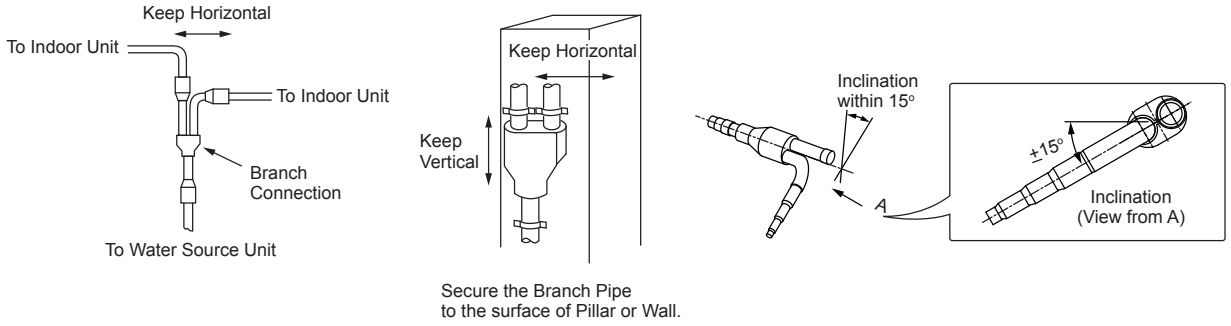
NOTES:

1. For a system under which all the indoor units are supposed to operate simultaneously, the total indoor unit capacity should be less than water source unit capacity. Otherwise, it may cause a decrease of operating performance and operating limit in overload operation.
2. For the system under which all the indoor units are not supposed to operate simultaneously, the total indoor unit capacity is available 100% or more against the water source unit capacity. Refer to Table 3.2 “System Combination” for detail.
3. When operating the water source unit in cold area with temperatures of 14°F (-10°C), or under high heating load conditions, the total indoor unit capacity should be 100% or less against the water source unit capacity and the total piping length should be 984.3ft (300m) or less.
4. The airflow volume for indoor units of 6 and 8 MBH is set higher than that for indoor units of 12 MBH or more. Make sure to select appropriate indoor units when installing indoor units where cold draft may occur during heating operation. If installing indoor units in such places, refer to the recommended number of connectable indoor units.
5. When installing an Energy Recovery Ventilation unit, the additional load must be considered when calculating the maximum units that can be attached.

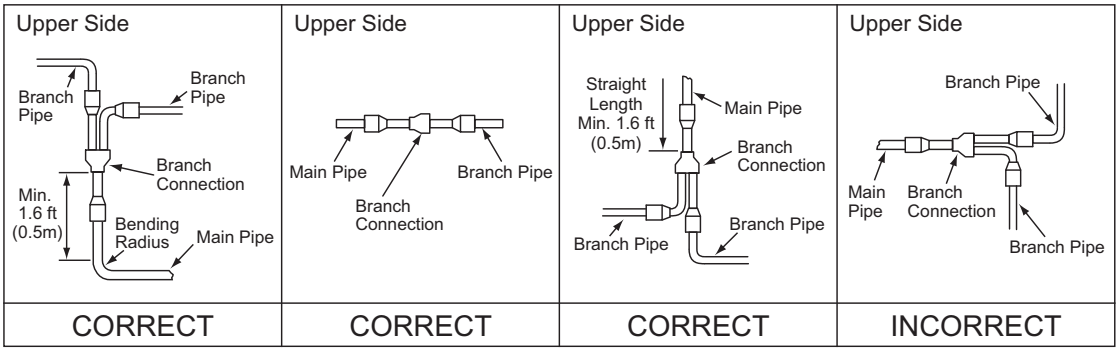
7.6 Multi-Kit Connection

Use the branch piping kit to ensure proper piping.
Do not use a T-Joint. Secure the branch pipes horizontally to a pillar, a wall, or ceiling.

When installing the piping with securing straps, wrap the branch pipe with insulation or a cushioning material between the pipe and the plate. Then secure it to the wall.



Installation Position of Branch Piping



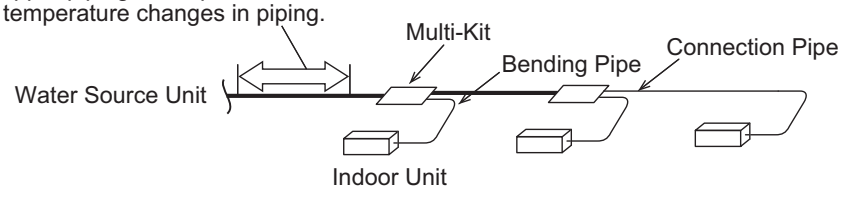
Piping Form from Multi-Kit to Indoor Unit

When on-site piping is installed using soft or hard copper, make sure that the piping is installed to allow for movement of the piping. Temperature changes cause contraction and expansion of the piping.

Example: Recommended

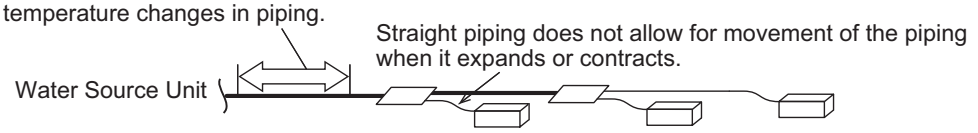
From each Indoor Unit to Multi-Kit, use hard copper pipes that bend to prevent kinking.

Hard copper piping will expand and contract due to temperature changes in piping.



Example: Not Recommended

Hard copper piping will expand and contract due to temperature changes in piping.



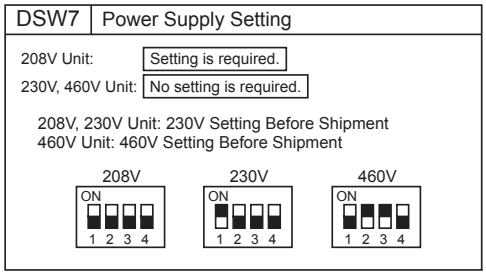
8. Electrical Wiring

⚠WARNING

- **The indoor unit fan may continue to operate for up to five minutes following the heating cycle to dissipate residual heat from the indoor unit.**
- **Check to ensure that the indoor fan and the water source unit fan have stopped before electrical wiring work or a periodical check is performed.**
- **Insulate electrical wiring, condensate piping, and electrical components from threats posed by burrowing animals and temperature extremes. Failure to do so can deteriorate system performance.**
- **Electrical cables should not come into contact with refrigerant piping, plate edges, and electrical components inside the unit.**
- **GFCI may be recommended depending on the application; if not, electric shock or fire can result.**
- **Secure the cables. External forces on the terminals can lead to fire.**
- **Tighten screws according to the following torque.**

  M3.5: 0.5 to 0.7 ft·lbs (0.7 to 0.9 N·m)
  M4: 0.7 to 1.0 ft·lbs (1.0 to 1.3 N·m)
  M5: 1.5 to 1.8 ft·lbs (2.0 to 2.4 N·m)
  M6: 3.0 to 3.7 ft·lbs (4.0 to 5.0 N·m)
  M8: 6.6 to 8.1 ft·lbs (9.0 to 11.0 N·m)
  M10: 13.3 to 17.0 ft·lbs (18.0 to 23.0 N·m)

- **Set DSW7 on the PCB1 according to each power supply shown in the figure below.**



- **Use the specified cables for wiring between the water source unit and indoor units. Selecting incorrect cables will cause electric shock or fire. Communication cable shall be a minimum of AWG18 (0.82mm^2), 2-Conductor, Stranded Copper. Shielded cable must be considered for applications and routing in areas of high EMI and other sources of potentially excessive electrical noise to reduce the potential for communication errors. When shielded cable is applied, secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local code requirements.**
- **Tightly secure the electrical wirings to the terminal block according to the specified torque. If tightening the terminals is not completed, heat generation, electric shock or fire will occur at the terminal connections.**

8.1 General Check

(1) Make sure that the field-supplied electrical components (main power switches, circuit breakers, wires, conduit connectors, and wire terminals) are properly selected according to the electrical characteristics indicated in Table 8.1. Make sure that the components comply with local codes.

- Supply electrical power to each water source unit. This equipment can be installed with a GFCI, which is a recognized measure for added protection to a properly grounded unit. Install appropriate sized breakers / fuses / overcurrent protection switches and wiring in accordance with local codes. The equipment installer is responsible for understanding and abiding by applicable codes and requirements.
- Supply power for the indoor unit and water source unit separately.
  Connect the power supply wiring to each indoor unit group and its respective water source unit.
  This equipment can be installed with a GFCI, which is a recognized measure for added protection to a properly grounded unit. Install appropriate sized breakers / fuses / overcurrent protection switches and wiring in accordance to local codes. The equipment installer is responsible for understanding and abiding by applicable codes.
- As for the heat recovery system, the power supply for the Change-Over Box and Indoor Unit in the same refrigerant system can be supplied with one main switch.

(2) Check to ensure that the power supply voltage is within ±10% of the rated voltage.
If the power supply voltage is too low, the system cannot start due to the voltage drop.

(3) Check the size of the electrical wires.

(4) Communication cable must be a minimum of AWG18 (0.82mm^2), 2-Conductor, Stranded Copper.
Shielded cable must be considered for applications and routing in areas of high EMI and other sources of potentially excessive electrical noise to reduce the potential for communication errors. When shielded cable is applied, secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local codes where:

- The power supply for the packaged air conditioner is supplied from the same power transformer as the device with high electricity consumption*
- The power supply wiring for the device* and for the packaged air conditioner are located close to each other.

  * Example: Lift, container crane, rectifier for electric railway, inverter power device, arc furnace, electric furnace, large-sized induction motor, and large-sized switch.

  In the instances mentioned above, an induction surge of the power supply wiring for the packaged air conditioner could occur due to a rapid change in electricity consumption of the device and activation of the switch. Therefore, check the local codes before performing electrical work in order to protect the power supply wiring of the packaged air conditioner.

(5) Check to ensure that the ground wiring for the water source unit and indoor unit are connected.

8.2 Electrical Wiring Connection

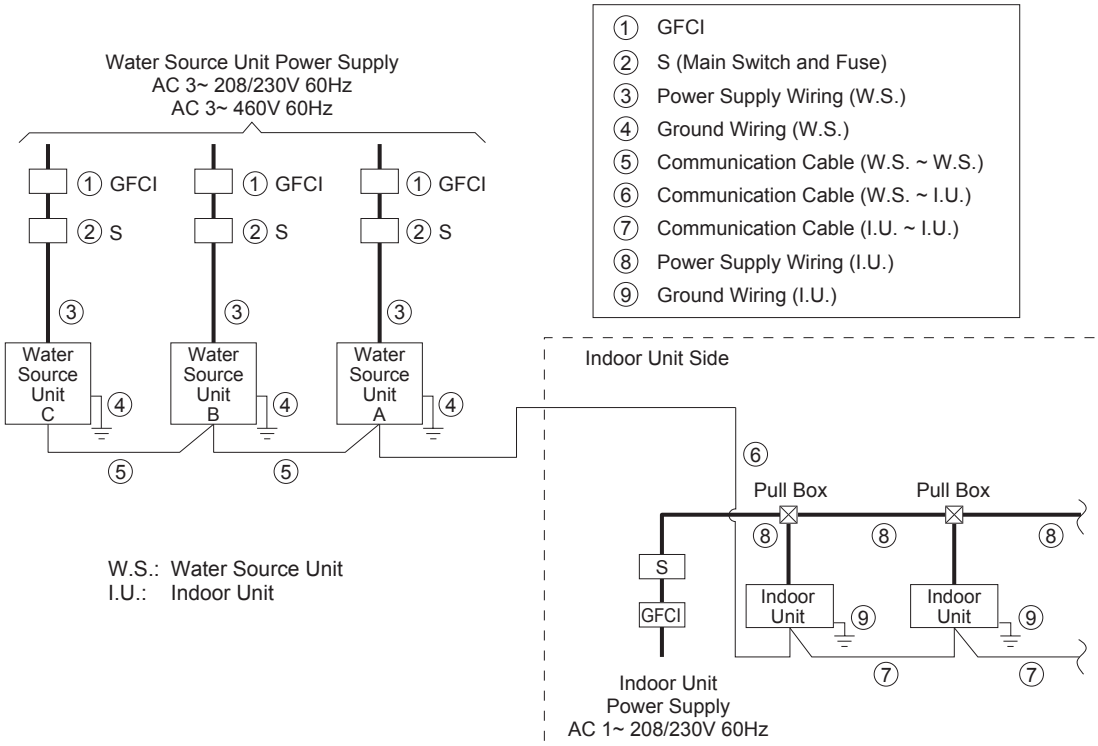
⚠WARNING

- **This equipment can be installed with a GFCI, which is a recognized measure for added protection to a properly grounded unit. Install appropriate sized breakers / fuses / overcurrent protection switches and wiring in accordance to local codes and requirements. The equipment installer is responsible for understanding and abiding by applicable codes and requirements.**
- **Perform the electrical work according to the regulations of each region and this manual.**
  A separate, dedicated electrical circuit must be used. If the electrical wiring work is performed incorrectly or there is a capacity shortage of the power circuit, it will cause electric shock or fire.
- **Check that the ground wire is securely connected. If the unit is not correctly grounded, it may lead to electrical shock.**
  Do not connect the ground wiring to gas piping, water piping, lighting conductor, or telephone ground cables.

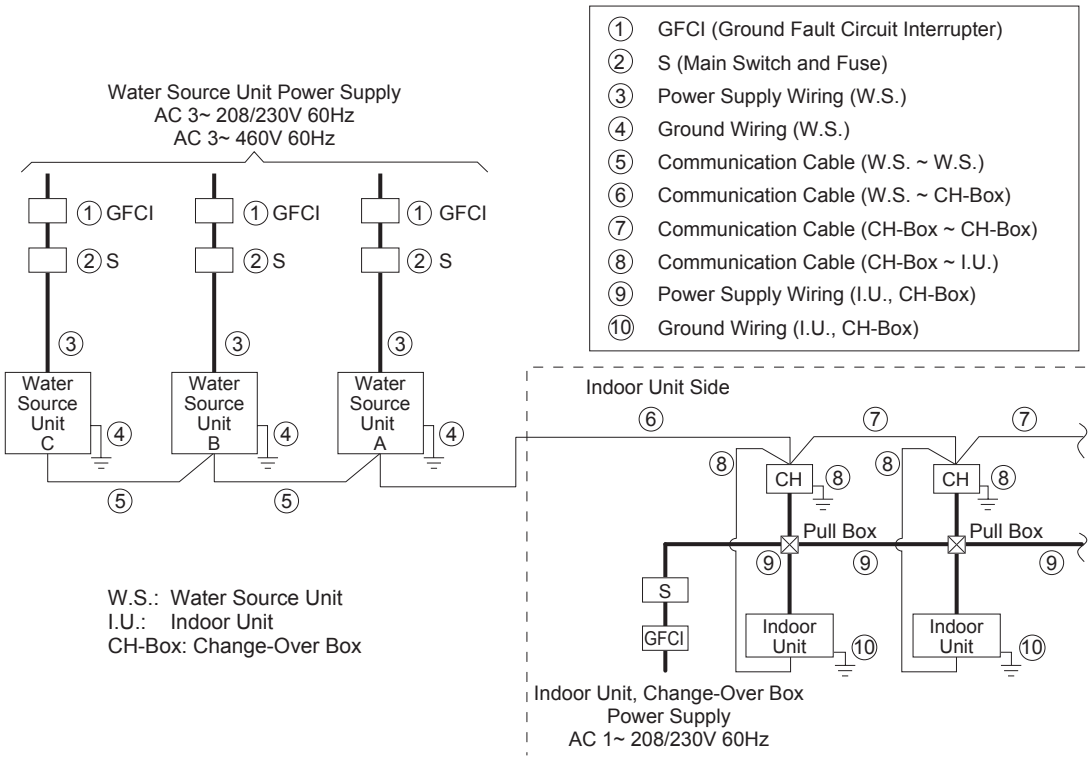
(1) Power Supply Wiring

Supply power supplies to each water source unit and indoor unit group respectively.
This method is a basic principle of power supply wiring.

Heat Pump System



Heat Recovery System



(2) Electrical Characteristics

Note the following when selecting wiring:

- Use the charts below to select appropriate sized breakers / fuses / overcurrent protection switches and wiring in accordance with local codes.
- Ensure communication cable is a minimum of AWG18 (0.82mm^2), 2-Conductor, Stranded Copper. Shielded cable must be considered for applications and routing in areas of high EMI and other sources of potentially excessive electrical noise to reduce the potential for communication errors. When shielded cable is applied, secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local code requirements.

Table 8.1 Electrical Characteristics and Recommended Wiring Size

208/230V

Model	Water Source Unit							Inverter 1	Inverter 2	Fan Motor 1
	Hz (Hz)	Voltage (V)	Max. (V)	Min. (V)	MCA (A)	MOP (A)	Max. Fuse (A)	MOC (A)	MOC (A)	FRA (A)
(H,Y)VWH(P,R)072B32S	60	208/230	253	188	20/18	30/30	30/30	15.4/14.0	-	0.08
(H,Y)VWH(P,R)096B32S	60	208/230	253	188	32/29	50/45	50/45	25.0/22.7	-	0.08
(H,Y)VWH(P,R)120B32S	60	208/230	253	188	38/34	60/50	60/50	29.8/27.0	-	0.08
(H,Y)VWH(P,R)144B32S	60	208/230	253	188	37/34	50/45	50/45	16.4/14.8	16.4/14.8	0.08
(H,Y)VWH(P,R)168B32S	60	208/230	253	188	41/37	50/50	50/50	18.0/16.4	18.0/16.4	0.08
(H,Y)VWH(P,R)192B32S	60	208/230	253	188	55/50	70/60	70/60	24.3/22.0	24.3/22.0	0.08
(H,Y)VWH(P,R)216B32S	60	208/230	253	188	71/64	90/80	90/80	31.2/28.3	31.2/28.3	0.08

Model	INV Comp. 1	INV Comp. 2	Fan Motor 1	Wiring Size		
	LRA (A)	LRA (A)	Output (kW)	Power Supply Wiring (AWG)	Ground Wiring (AWG)	Communication Cable (AWG)
(H,Y)VWH(P,R)072B32S	54	-	0.016	12/14	12/14	18
(H,Y)VWH(P,R)096B32S	54	-	0.016	8/10	8/10	18
(H,Y)VWH(P,R)120B32S	50	-	0.016	8/8	8/8	18
(H,Y)VWH(P,R)144B32S	54	54	0.016	8/8	8/8	18
(H,Y)VWH(P,R)168B32S	54	54	0.016	6/8	6/8	18
(H,Y)VWH(P,R)192B32S	54	54	0.016	6/6	6/6	18
(H,Y)VWH(P,R)216B32S	54	54	0.016	2/4	2/4	18

460V

Model	Water Source Unit							Inverter 1	Inverter 2	Fan Motor 1
	Hz (Hz)	Voltage (V)	Max. (V)	Min. (V)	MCA (A)	MOP (A)	Max. Fuse (A)	MOC (A)	MOC (A)	FRA (A)
(H,Y)VWH(P,R)072B42S	60	460	506	414	11	15	15	8.0	-	0.08
(H,Y)VWH(P,R)096B42S	60	460	506	414	17	25	25	13.0	-	0.08
(H,Y)VWH(P,R)120B42S	60	460	506	414	20	30	30	15.5	-	0.08
(H,Y)VWH(P,R)144B42S	60	460	506	414	20	25	25	8.5	8.5	0.08
(H,Y)VWH(P,R)168B42S	60	460	506	414	22	25	25	9.4	9.4	0.08
(H,Y)VWH(P,R)192B42S	60	460	506	414	29	40	40	12.7	12.7	0.08
(H,Y)VWH(P,R)216B42S	60	460	506	414	37	50	50	16.3	16.3	0.08

Model	INV Comp. 1	INV Comp. 2	Fan Motor 1	Wiring Size		
	LRA (A)	LRA (A)	Output (kW)	Power Supply Wiring (AWG)	Ground Wiring (AWG)	Communication Cable (AWG)
(H,Y)VWH(P,R)072B42S	47	-	0.016	18	18	18
(H,Y)VWH(P,R)096B42S	47	-	0.016	14	14	18
(H,Y)VWH(P,R)120B42S	47	-	0.016	12	12	18
(H,Y)VWH(P,R)144B42S	47	47	0.016	12	12	18
(H,Y)VWH(P,R)168B42S	47	47	0.016	12	12	18
(H,Y)VWH(P,R)192B42S	47	47	0.016	10	10	18
(H,Y)VWH(P,R)216B42S	47	47	0.016	8	8	18

MCA: Minimum Circuit Ampacity (A)
MOP: Maximum Overcurrent Protective Device (A)
MOC: Maximum Operating Current (A)
LRA: Locked Rotor Ampacity (A)
FRA: Fan Motor Running Ampacity (A)

⚠CAUTION

Install a multi-pole main switch with a space of 1/8 inch (3.5mm) or more between each phase.

ATTENTION:

1. When the power supply wiring is longer, select the minimum wiring size that has a voltage drop within 2%.
2. Power supply voltage should be satisfied with the followings.
   Supply Voltage: Rated Voltage within ±10%
   Starting Voltage: Rated Voltage within -15%
   Operating Voltage: Rated Voltage within ±10%
   Imbalance between Phases: within 3%
3. Do not connect the ground wiring to gas piping, water piping, or a lightning conductor.
   Gas Piping: An explosion or ignition may occur if there is escaping gas.
   Water Piping: There is no effective electrical ground provided if hard vinyl piping is used.
   Lightning Conductor: The electrical potential of the earth increases when a lightening conductor is used.

8.3 Electrical Wiring for Water Flow Control

8.3.1 External Input/Output Signal

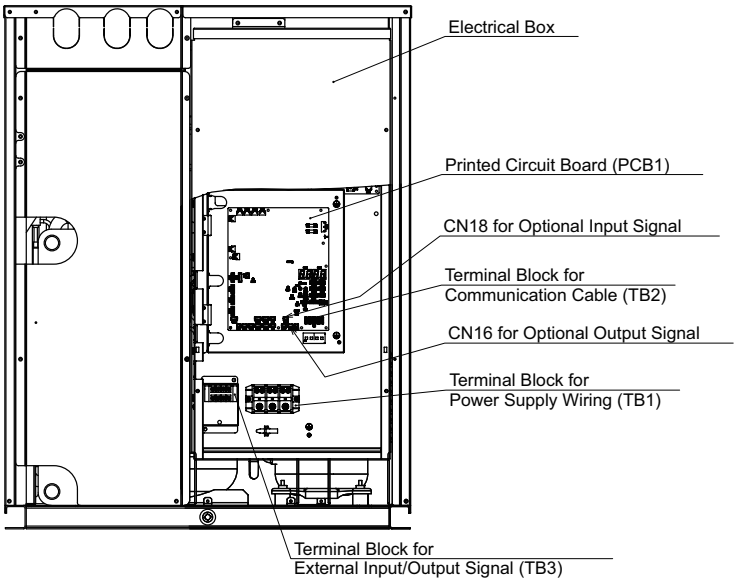


Figure 8.1

NOTES:

- Relay of AC contactor should be connected to terminal block TB3 #5 and #6. Water pump cannot directly operate from terminal block TB3 #5 and #6.
- Water flow switch must be connected to terminal block TB3 #7 and #8 when operating this unit.
- Do not reverse the connections on terminal block TB3 #5 and #6, and terminal block TB3 #7 and #8. Incorrect wiring will short circuit, and printed circuit board (PCB) can be burned or destroyed.

Do not use these terminals for other purposes.

No.		Connection Port	Signal Item	Remarks
Output	1	Terminal Block 3 (TB3) (Terminals No.5-6)	Valve/Pump Operation Request	Output = 208/230VAC (Depending on unit power supply input) Acceptable current: 0.1A or less
	2	Connector on Control PCB (PCB1) (Pins 1 and 2 of CN16)	System Operation Signal	2 output signals can be selected from 4 items. Output = 12VDC Acceptable current: 75mA
			Compressor Operation Signal	
	3	Connector on Control PCB (PCB1) (Pins 1 and 3 of CN16)	Error Signal	
			Defrost Signal (Not Used)	
Input	1	Terminal Block 3 (TB3) (Terminals No.7-8)	Water Flow Switch	This signal must be connected. Contact Close: 12.8VDC, 9mA
	2	Connector on Control PCB (PCB1) (Pins 1 and 2 of CN18)	Forced Stoppage	Input signal can be selected from 5 items. Contact Close: 12.8VDC, 9mA
			Demand (Current Reduction)	
			Sound Noise Reduction	
			Cooling Only	
			Heating Only	

8.3.2 Connection for Water Pump or Solenoid Valve

If “Valve/Pump Operation Request” output signal is used for water pump, separate external power supply to operate water pump is required.

NOTE:
Do not use terminal block 3 (TB3) terminals No.5-6 to supply power for the water pump.
Otherwise, serious accident and malfunction of the water source unit may result.

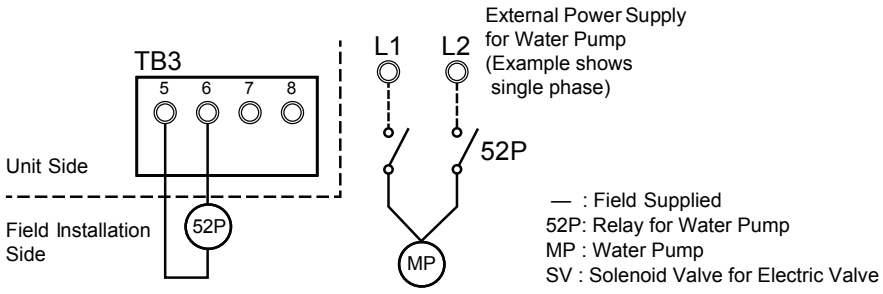


Figure 8.2 Water Pump Wiring

Connection for Solenoid Valve of Electric Valve
Solenoid valve can be connected to terminal block 3 (TB3) terminals No.5-6 directly.
If output is 0.1A or more, be sure to use relay and external power supply same connection as water pump.

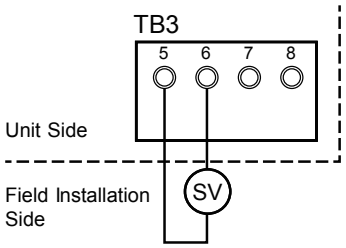


Figure 8.3 Solenoid Valve Wiring

When multiple water source units are connected, depending on the installation method, there are units that do not need to connect the water pump and the solenoid valve.

8.3.3 Connection for Water Flow Switch

Connect water flow switch with shielded cable to the terminal block TB3 of the unit.
Terminal of water flow switch should be placed in proper position for easy wiring.
It must be interlocked with the unit. Wire the circuit as shown below.

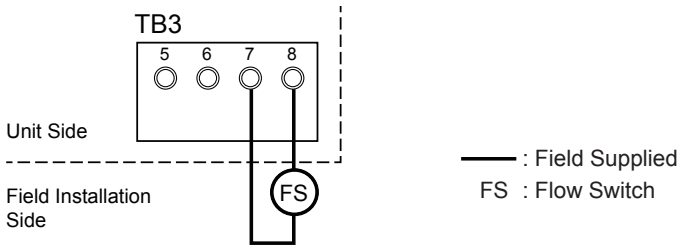


Figure 8.4 Water Flow Switch Wiring

8.4 Electrical Wiring for Water Source Unit

Connect the electrical wiring according to the following figure:

(1) Connect the power supply wires to L1, L2, and L3 for the three-phase power supply on the terminal block TB1 and ground wiring to the terminal in the electrical control box.

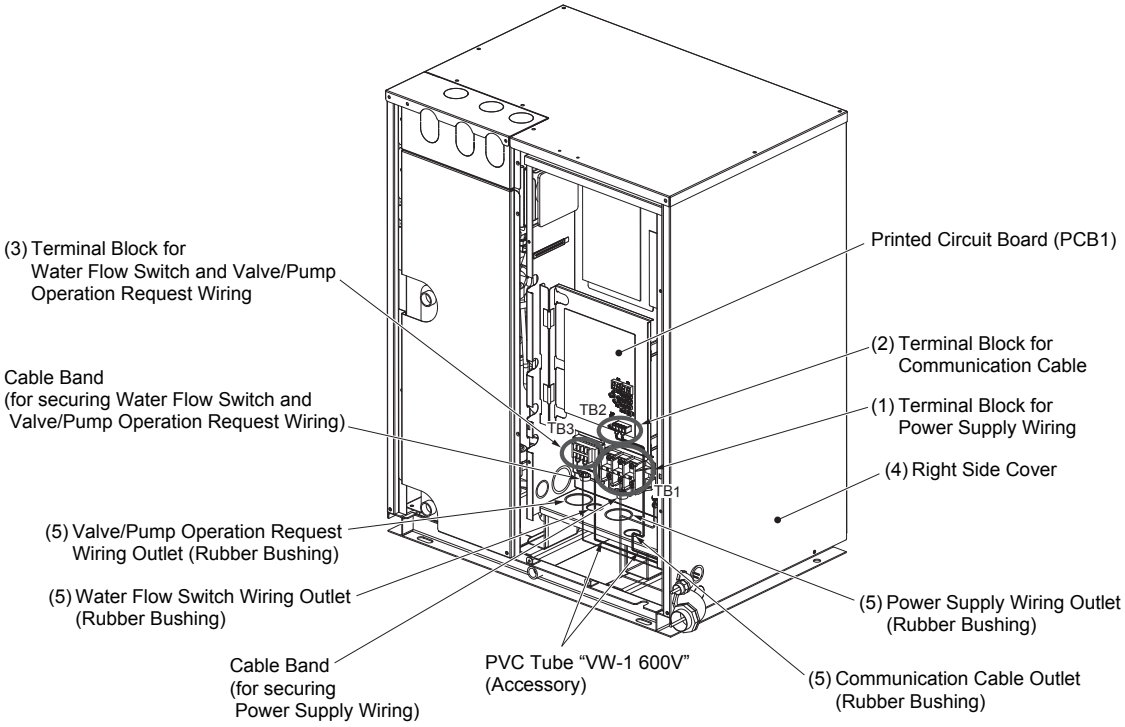
(2) Connect the communication cables between the water source unit and indoor units to the TB2 terminals 1 and 2 on the PCB1. As for the communication cables between water source units in the same refrigerant system, connect them to the TB2 terminals 3 and 4 on the PCB1. When shielded cable is applied (M4), secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local code. Communication cable must be a minimum of AWG18 (0.82mm^2), 2-Conductor, Stranded Copper.

(3) Insert the communication cable and water flow switch cable into the PVC tube “VW-1 600V” (Accessory) to separate from the power supply wirings and the communication cables in the water source unit. Local codes need to be followed.
Then, tighten both ends of the PVC tubing with the cable bands (accessory) in order to secure the PVC tubing to the communication cables.
When the rated voltage of the communication cables (local code) are 600V or more, it is not required to insert them into the PVC tube “VW-1 600V” (accessory).

(4) Tighten screws for the terminal block according to the following table.

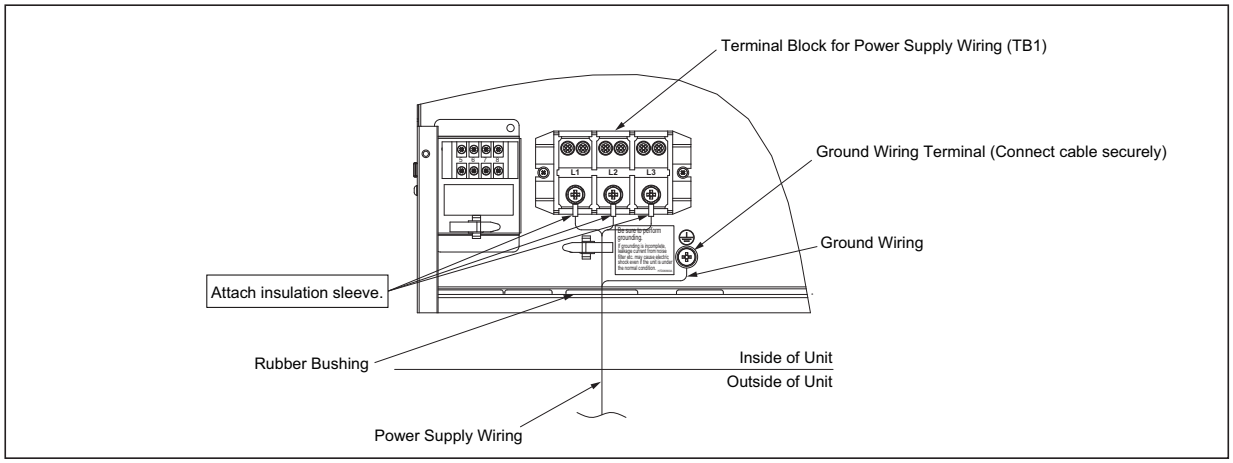
Required Tightening Torque

Size	Tightening Torque
M3.5	0.5 to 0.7 ft·lbs (0.7 to 0.9 N·m)
M4	0.7 to 1.0 ft·lbs (1.0 to 1.3 N·m)
M5	1.5 to 1.8 ft·lbs (2.0 to 2.4 N·m)
M6	3.0 to 3.7 ft·lbs (4.0 to 5.0 N·m)
M8	6.6 to 8.1 ft·lbs (9.0 to 11.0 N·m)
M10	13.3 to 17.0 ft·lbs (18.0 to 23.0 N·m)



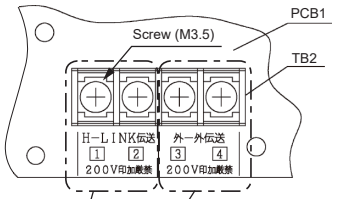
Above figure illustrate the example of a small cabinet (208/230V).

(1) Detail of Terminal Block for Power Supply Wiring (TB1)



(2) Detail of Terminal Block for Communication Cable (TB2)

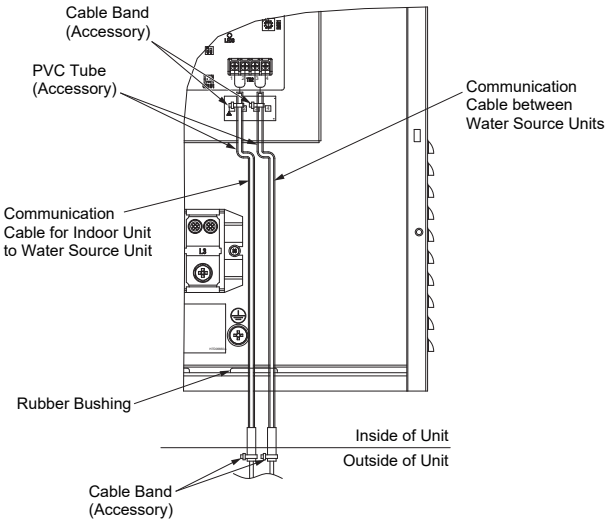
- Do not connect the main power supply wiring to the communication line (Terminals 1, 2, 3 and 4 of TB2). If these are connected, the PCB1 will be destroyed.



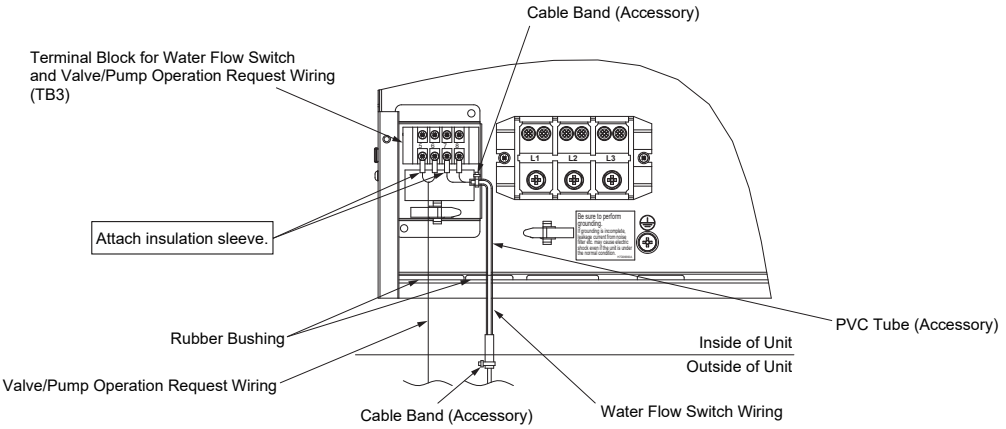
Outdoor to Outdoor Terminal
(Communication cable between water source units used in combination.) *

* This terminal is used only for a combination of water source units and not used for single units.

H-LINK Terminal
(Communication cable between the water source unit and indoor unit, or between the water source unit and a water source unit from another refrigerant system.)



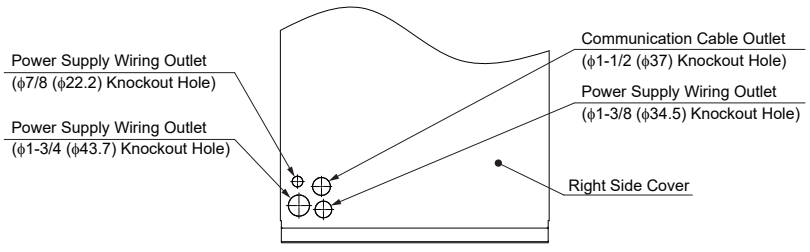
(3) Detail of Terminal Block for Water Flow Switch and Valve/Pump Operation Request Wiring (TB3)



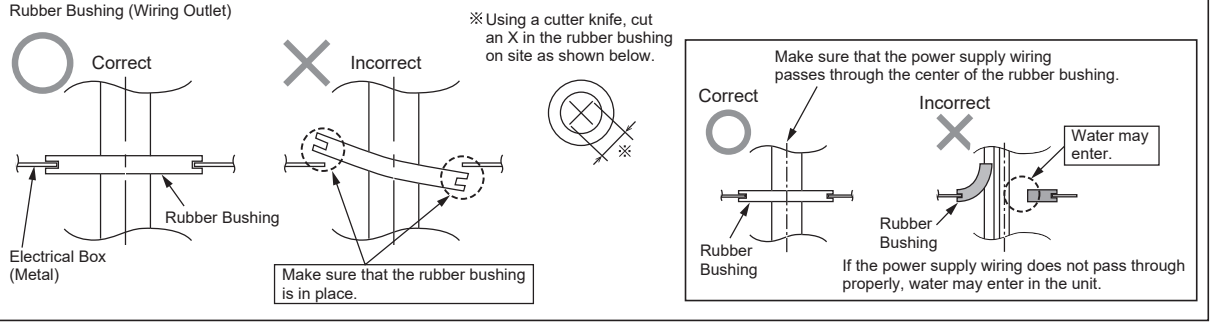
(4) Details of Right Side Cover Wiring Outlet

- Be sure to install accessory rubber bushing to the wiring outlet for communication cable.
- Hermetically seal the end of conduit tubing by using putty to seal against moisture.

Unit: inch (mm)



(5) Details of Wiring Outlets inside the Electrical Box (Rubber Bushing Section)

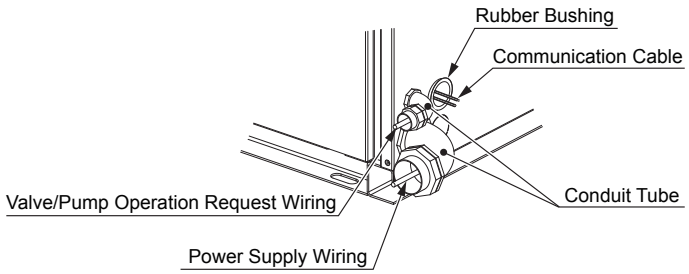


⚠CAUTION

Be sure to note the following points when running cables under the unit using conduit tubing.
(The pipe cover needs to be removed before performing piping and wiring.)

NOTICE:

- When installing the power supply wiring and valve/pump operation request wiring, use the field-supplied conduit tube as shown below.
- When installing the communication cables, run them through the rubber bushing attached to the unit.
- Maintain at least 5 inches (127mm) between the power supply wiring or valve/pump operation request wiring and communication cables.
- Prevent cables from touching or rubbing up against refrigerant piping, plate edges, and electrical components inside the unit.



⚠CAUTION

Tightly secure the power supply wiring using a cable clamp inside the unit.

8.5 Electrical Wiring Connections of Indoor Unit, Water Source Unit and Change-Over Box

(1) Connect a power supply wiring to each water source unit. Connect an optional GFCI, fuse, and main switch (S) to each water source unit.

(2) Connect a power supply wiring to each indoor unit group and change-over box group connected to the same water source unit. (Total operating current be less than 12A.)
Connect an optional GFCI, fuse, and main switch (S) to each indoor unit group.

(3) Connect the communication cable between indoor units, change-over boxes and water source units, as shown in Figure 8.5 and 8.6.

(4) Connect the communication cables in the same refrigerant system unit. (If the refrigerant piping of indoor unit is connected to the water source unit, also connect the communication cables to the same indoor unit.) Connecting the refrigerant piping and communication cables to the different refrigerant systems may lead to malfunction.

(5) Use communication cabling that is a minimum of AWG18 (0.82mm^2), 2-Conductor, Stranded Copper. Shielded cable must be considered for applications and routing in areas of high EMI and other sources of potentially excessive electrical noise to reduce the potential for communication errors. When shielded cabling is applied, secure properly and terminate cable shield as required per Johnson Controls guidelines. Plenum and riser ratings for communication cables must be considered per application and local code requirements. (Do not use Tri-Core or anything beyond.)

(6) Use the same kind of cables in the same H-LINK system.

(7) Maintain at least 5 inches (127mm) between the communication cables and the power supply wiring, and also min. 5 ft (1.5m) between the communication cables and power supply wiring for other electrical device. If these cables are not secured, sleeve the power supply wiring into the metallic conduit tubing to separate them from the other cables. Make sure power supply wiring are well-grounded.

(8) Connect the following communication cables to the terminals 1 and 2 on terminal block (TB2) in the water source unit A (main unit).
  • between water source unit and indoor unit
  • between water source unit and change-over box
  • between water source unit and water source unit in other refrigerant systems

(9) Do not connect the power supply wiring to the terminal block for communication cable (TB2). All the printed circuit boards in the same refrigerant system will be damaged.

(10) For a Heat Recovery System, connect the communication cables from indoor unit exclusively used for cooling to the terminals 1 and 2 on TB2 in the change-over box.

(11) Connect the ground wiring to the water source unit/indoor units and change-over box. The ground wiring work under the condition of 100Ω (max.) ground resistance must be performed by a authorized personnel.

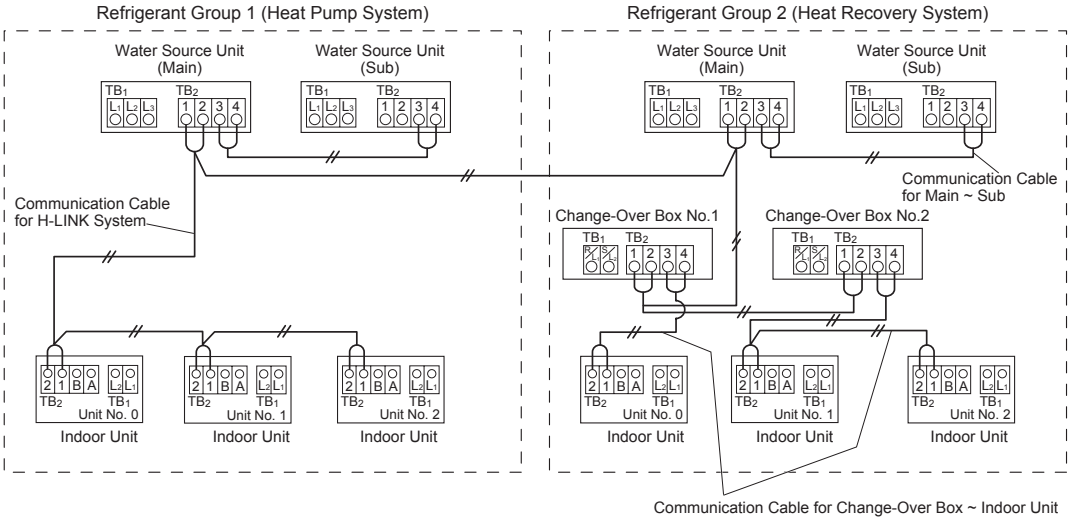
(12) Connect the communication cables between water source units in the same refrigerant system to the terminals 3 and 4 on TB2.

Communication Cable

Install communication cable while paying attention to the following.

For the combination units, DSW settings of Main and Sub.

- An alarm occurs if the communication cables between main water source unit and sub water source units are connected to the terminals 1 and 2 for H-LINK system.
- If an alarm is triggered on the LCD of main water source unit, follow the "7-segment" display at the main water source unit for verification purposes.
- Perform a function setting at the main water source unit.
- Maximum number of refrigerant groups with one central controller is 64 (for H-LINK II). Maximum number of indoor units to be connected is 160 (for H-LINK II).



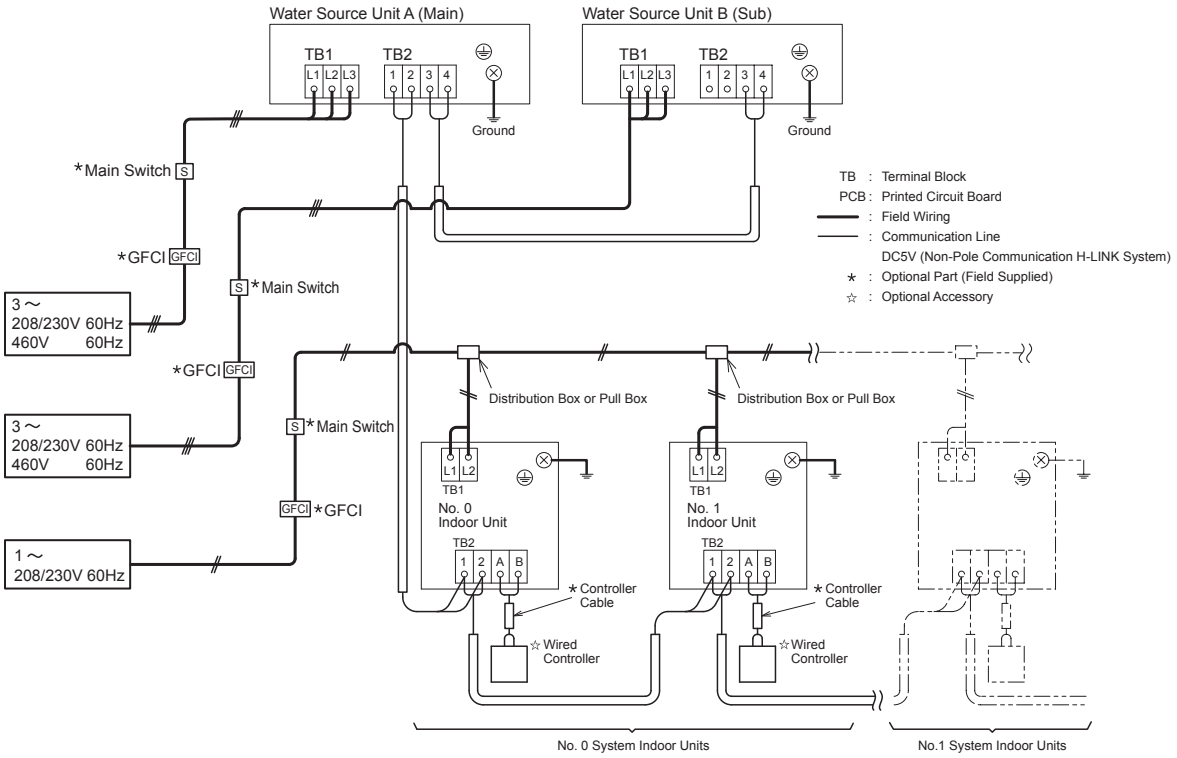


Figure 8.5 Layout for Electrical Wiring Connection (Heat Pump System)

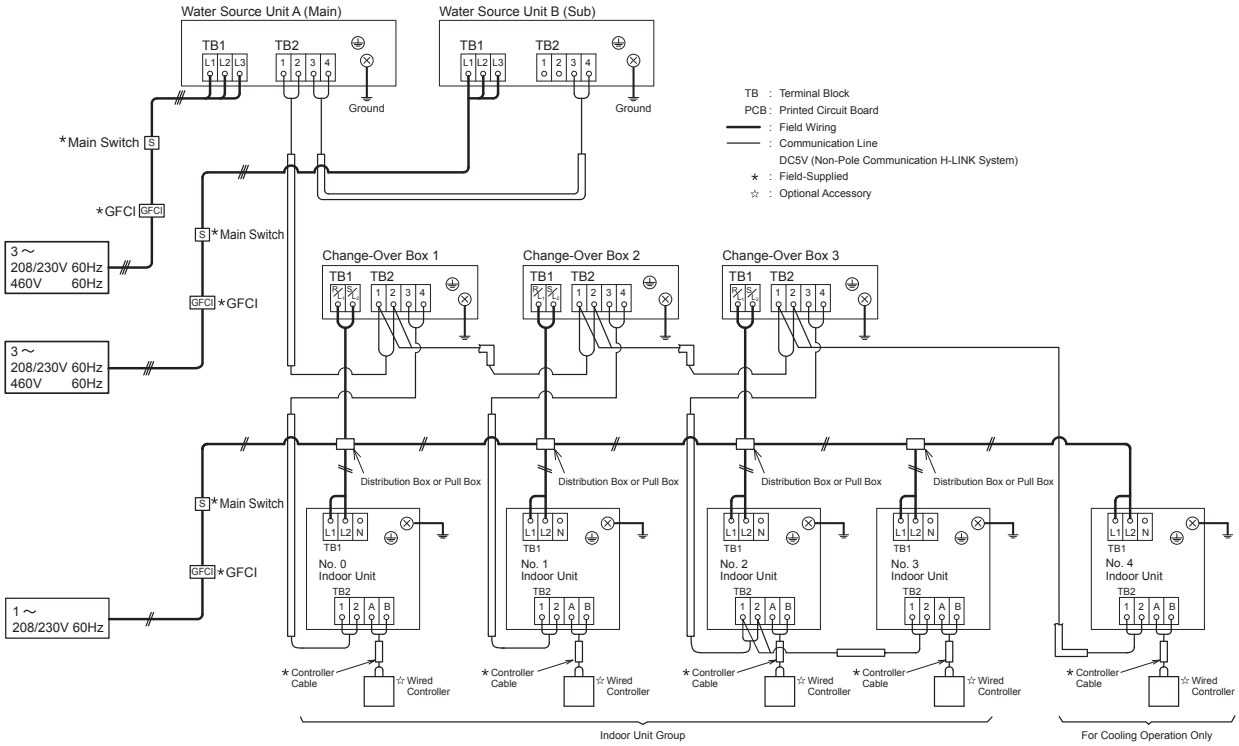


Figure 8.6 Layout for Electrical Wiring Connection (Heat Recovery System)

8.6 DIP Switch Setting of Water Source Unit

Before performing settings:

- Turn OFF <u>all</u> power supplies before performing settings. DIP switch settings cannot be set without first disconnecting them from the power supply. (However, DSW4 , DSW5, and push switches can be operated when power supply is ON.)

The darkened square "■" indicates the position of DIP switches.

NOTICE

- By using DIP switch DSW4, the unit is started 10 to 20 seconds after the switch adjustment is made.
- To simplify service and maintenance, number this water source unit to help distinguish it from the other water source units. Record the unit number in the box on the right.

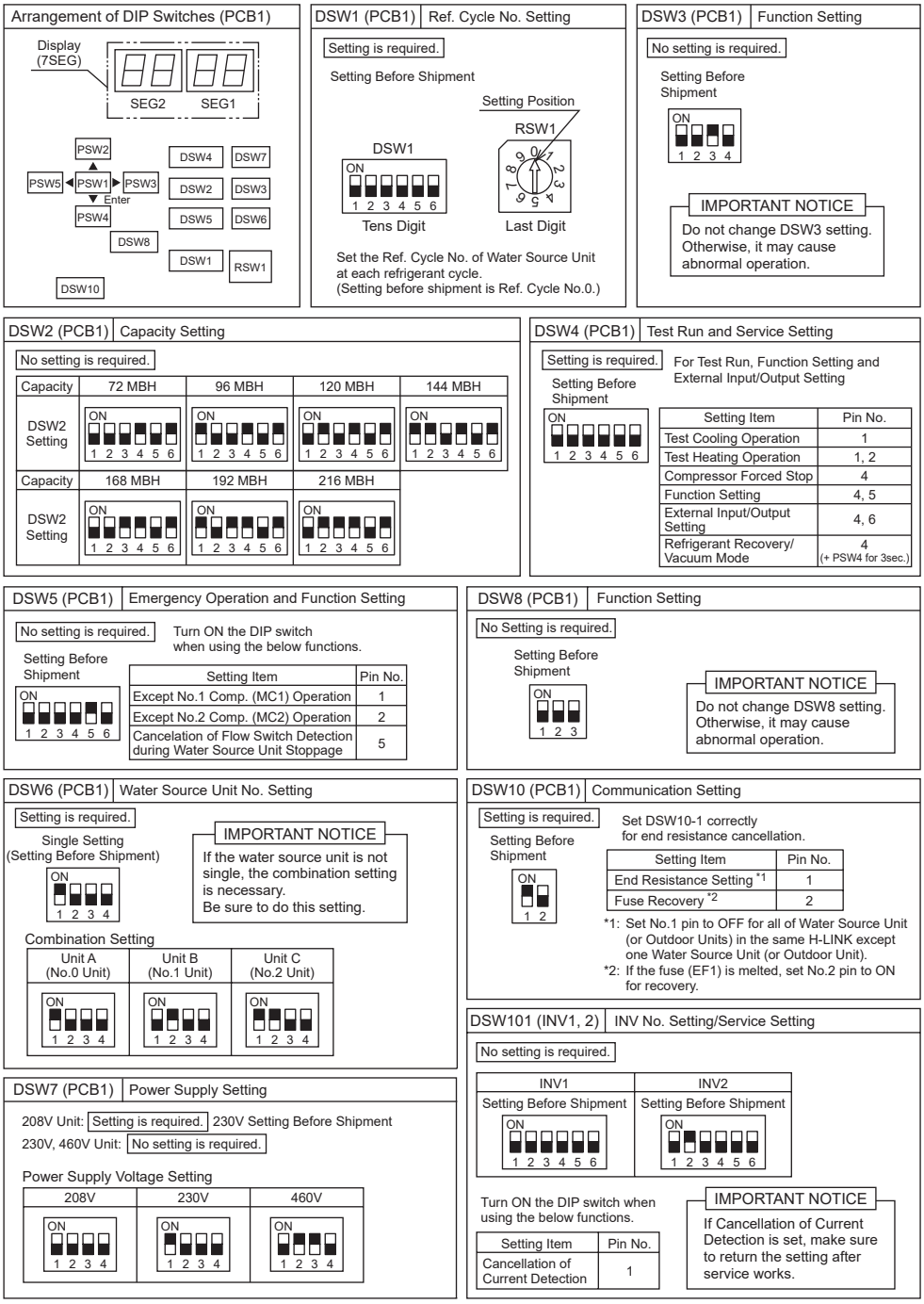


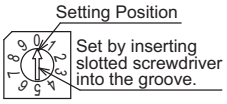
Figure 8.7 DSW Setting

- **Setting for Transmitting**
  Use the following settings for the water source unit numbers, refrigerant system numbers and end terminal resistance for this H-LINK system:

- **Setting of Water Source Unit Number (No.)**
  If there are combined water source units, set DSW6 as shown below:

Base Unit (Before Shipment)	Combination of Base Unit		
	Unit A (No.0)	Unit B (No.1)	Unit C (No.2)
			

- **Setting of Refrigerant System Number**
  In the same refrigerant system, set the same refrigerant system number for the water source unit and the indoor units as shown below.
  Setting water source unit refrigerant system number is required only for the main unit.
  The sub unit settings are not required.
  As for setting indoor unit refrigerant system number, set RSW2 and DSW5 on the indoor unit PCB.

	Setting Switch	
	10 digit	1 digit
		
Water Source Unit	DSW1	RSW1
Indoor Unit (H-LINK II)	DSW5	RSW2

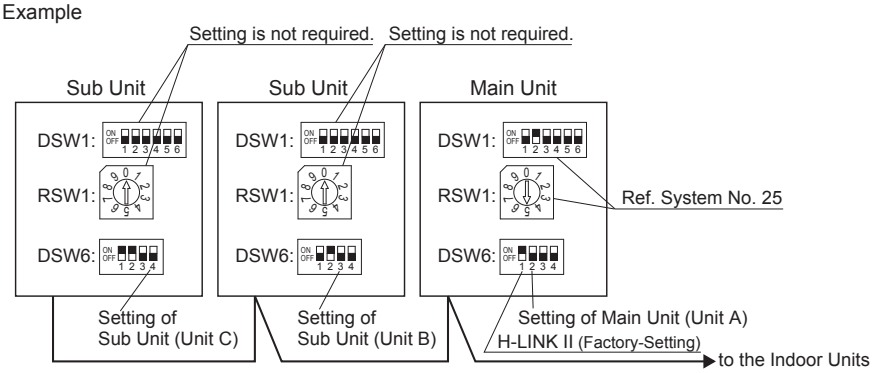
Example: If Setting Refrigerant System No. 25

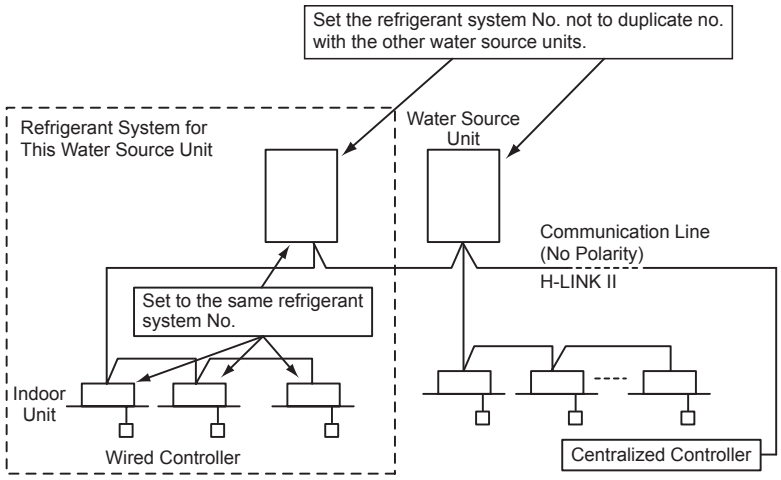
Turn ON No. 2 pin.

Set Dial No.5.

DSW and RSW setting before shipment is 0.
Maximum in setting refrigerant system number is 63.

Setting Example





Maximum Number of Connectable Water Source Units and Indoor Units (for H-LINK II)

Water Source Unit	64
Indoor Unit	160

For installing the water source unit and the indoor unit on the same communication cable, which cannot be used for H-LINK II, maximum number of connectable indoor units is 128.

- **DSW7 Setting for Rated Voltage**

  DSW7 is used for setting the rated voltage for the water source unit as shown at right.
  When the site power supply voltage is different from factory setting, a DSW7 setting is required.

  CAUTION:
  The same voltage setting is required to the main unit and sub unit(s).

Voltage	DSW7 Setting
208V	ON OFF 1 2 3 4
230V	ON OFF 1 2 3 4
460V	ON OFF 1 2 3 4

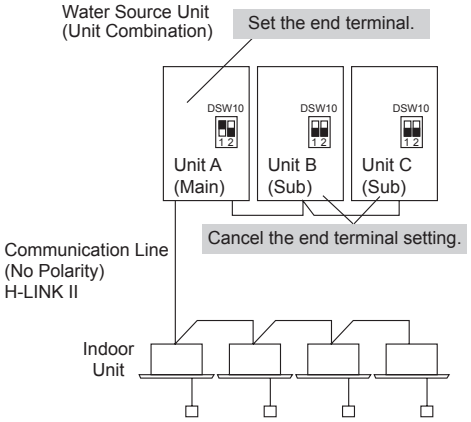
- **Setting of End Terminal Resistance**

  Before shipment, No.1 pin of DSW10 (for the setting of end terminal resistance) is in the “ON” position.
  In the case of one refrigerant system in the same H-LINK II, set all DSW10 No.1 pins to the “OFF” position except in the main water source unit A.

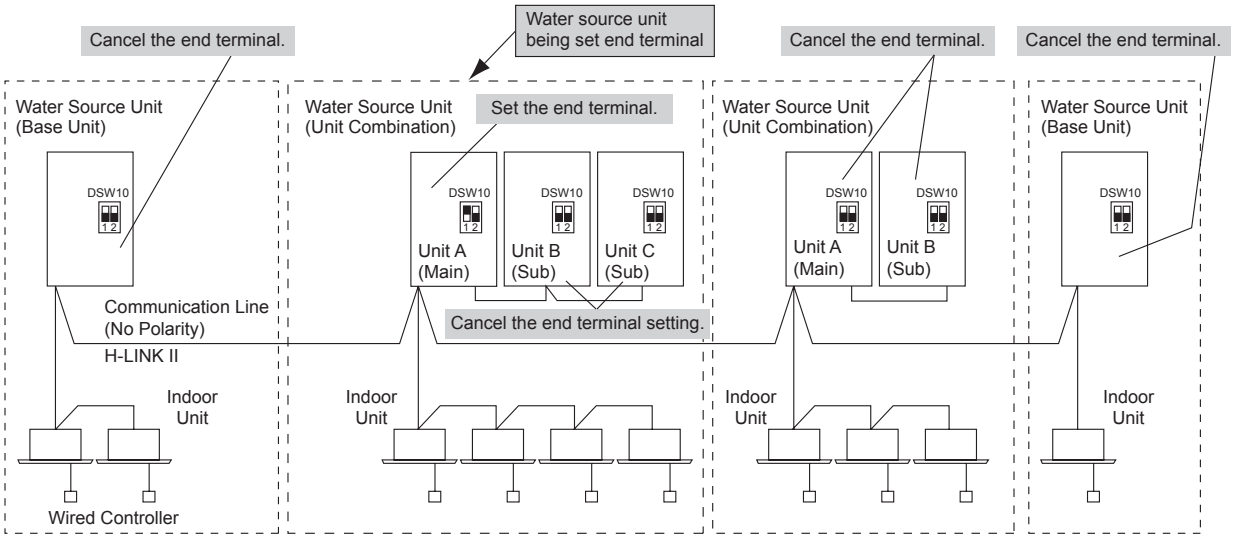
Setting of End Terminal Resistance
DSW10

Before Shipment	Cancellation
ON 1 2 OFF	ON 1 2 OFF

In a situation of one refrigerant system in the same H-LINK II, set all DSW10 No.1 pins to the “OFF” position except the main water source unit A.



If more than one refrigerant system is in the same H-LINK II, set all DSW10 No.1 pins to the “OFF” position except the main water source unit A.



- Function Setting

External Input/Output and Function Setting

Make sure to perform external input/output and function setting while Water Source Unit is stopped.
It cannot be set while Water Source Unit is operating or in check mode.

[External Input/Output Setting]

■ Start of Setting

Turn ON DSW4-No.4.
Turn ON DSW4-No.6.

▼

For the setting mode, refer to ① below.

■ Exit Setting Mode

Turn OFF DSW4-No.6 during indicated External Input/Output Setting Mode.
Turn OFF DSW4-No.4.

[Function Setting]

■ Start of Setting

Turn ON DSW4-No.4.
Turn ON DSW4-No.5.

▼

For the setting mode, refer to ② below.

■ Exit Setting Mode

Turn OFF DSW4-No.5 during indicated Function Setting Mode.
Turn OFF DSW4-No.4.

After setting, confirm DSW4 setting is same as setting before shipment.

NOTE:
Release "Menu Mode" after the setting is completed. Otherwise, the air conditioner may not operate appropriately.

① [External Input/Output Setting]

By pressing the push-switches PSW3 (▶) and PSW5 (◀), the function No. can be selected.
PSW4 (▼): forward, PSW2 (▲): backward

< Example >

Fill out the selected function setting No. in the space of the table as shown.

	Item	SEG2	SEG1	SET
1	Input Setting 1 CN17 [1-2 pin]	i1	4	4
2	Input Setting 2 CN17 [2-3 pin]	i2	2	
3	Input Setting 3 CN18 [1-2 pin]	i3	3	
4	Output Setting 1 CN16 [1-2 pin]	o1	1	
5	Output Setting 2 CN16 [1-3 pin]	o2	2	

(Setting Before Shipment)

Before shipping, the input/output function settings are specified to each input/output terminal according to above table. The details of function No. and external input/output settings are as shown below.
Input Setting 1 can NOT be set to other than Function No.4.
CN17 is connected with cable only for Input Setting 1.
Input Setting 2 (CN17 [2-2 pin]) also can be set.
But if it is used, modification of connector is required.

Setting of External Input and Output Function

Function No.	Input	Output
1	Fixing Heating Operation Mode	Operation Signal
2	Fixing Cooling Operation Mode	Alarm Signal
3	Demand Stoppage	Compressor ON Signal
4	Flow Switch Signal	Defrost Signal (No Need for Water Source Unit)
5	Forced Stoppage	-
6	Demand Current Control 40%	-
7	Demand Current Control 60%	-
8	Demand Current Control 70%	-
9	Demand Current Control 80%	-
10	Demand Current Control 100%	-
11	Low Noise Setting 1	-
12	Low Noise Setting 2	-
13	Low Noise Setting 3	-
14	External Abnormality Detection	-
0	No Setting	No Setting

The same input/output function setting cannot be set to different input/output terminals.
If set, a setting of larger function number becomes invalid.
Example: When setting of input 1 and input 2 are same, input 2 will be invalid.

Function No.14 is valid only when applied to Input Setting 3.

② [Function Setting]

By pressing the push-switches PSW3 (▶) and PSW5 (◀), the setting can be changed.
PSW4 (▼): forward, PSW2 (▲): backward
Refer to the Service Manual for more details.

< Example >

Fill out the selected function setting No. in the space of the table as shown.

	Item	SEG2	SEG1	SET
1	Circulator Function at Heating Thermo-OFF	FA	0	
2	Not Prepared	n1	0	
3	Not Prepared	C5	0	
4	Not Prepared	Jo	0	
5	Heating Start Up Fan Setting	bJ	0	
6	Cancellation of Water Source Unit Hot Start	HF	0	
7	Priority Capacity Mode	nU	0	
8	Not Prepared	Hc	0	
9	Not Prepared	Hh	0	
10	Not Prepared	SC	0	
11	Not Prepared	SH	0	
12	Not Prepared	S1	0	
13	Not Prepared	So	0	
14	Not Prepared	c1	0	
15	Not Prepared	cb	0	
16	Not Prepared	ch	0	
17	Low Noise Setting	db	0	
18	Demand Current Setting	dE	0	
19	Wave Function Setting	UE	0	
20	Protection of Decrease in Outlet Temperature for Cooling	Fb	0	
21	Not Prepared	FF	0	
22	Not Prepared	Fo	0	
23	Not Prepared	LF	0	
24	Not Prepared	d5	0	

	Item	SEG2	SEG1	SET
25	Not Prepared	F1	0	
26	Crankcase Heater Control during Stoppage	F2	0	
27	Not Prepared	F3	0	
28	Not Prepared	F4	0	
29	Not Prepared	F5	0	
30	Not Prepared	F6	0	
31	Not Prepared	F7	0	
32	Not Prepared	F8	0	
33	Not Prepared	F9	0	
34	Not Prepared	FC	0	
35	Convert Unit in Checking Mode	Fd	0	
36	Permit Indoor Fan Operation during Forced Stoppage	FE	0	
37	Not Prepared	FF	0	
38	Not Prepared	FG	0	
39	Not Prepared	FH	0	
40	Not Prepared	F1	0	
41	Not Prepared	FJ	0	
42	Not Prepared	FL	0	
43	Not Prepared	Fn	0	
44	Not Prepared	FP	0	
45	Not Prepared	Fr	0	
46	Not Prepared	FU	0	
47	Not Prepared	F9	0	

9. Additional Refrigerant Charge

9.1 Leak Test

(1) Check to ensure that the stop valves for high/low pressure gas, low pressure gas, and liquid pipes are closed completely before leak testing.

(2) The refrigerant used for this water source unit is R410A. Use the manifold gauge and the charging hose for exclusive use of R410A.

Tightening Check of Stop Valves

After connecting the pipe, remove the caps of stop valves for high/low pressure gas, low pressure gas (for heat recovery system only), and liquid. Tighten the open-close stop valve in the closing direction according to the following tightening torque.

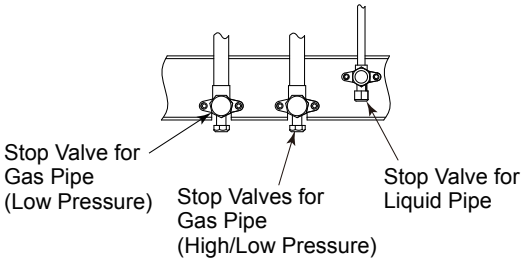
Operation of Stop Valves Caution

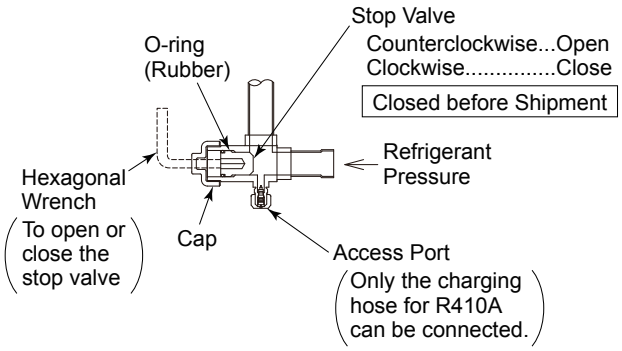
(a) Remove the stop valve caps before performing the airtight test after connecting the refrigerant piping. Tighten the stop valve in clockwise direction.

(b) Perform the work after warming the stop valve with a hair dryer etc. when controlling the stop valve in a cold area. (The stop valve O-ring will harden at low temperature, causing the O-ring material to contract by volume, and refrigerant leakage can occur.)

(c) Do not apply excessive force after fully opening the stop valve (Tightening Torque: < 3.7 ft·lbs (5.0 N·m)). (A back seat (hard stop), is not provided, allowing complete removal of the valve stem.)

(d) Securely tighten the caps according to the torque specifications in Section 7.2.1 after each stop valve is opened.

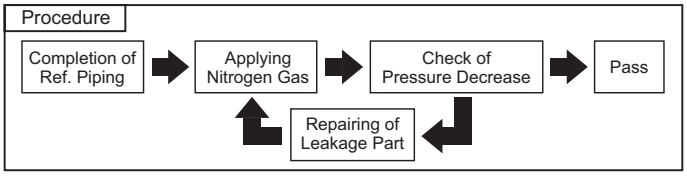




Airtight Test Method

(1) Connect the manifold gauge to the access port of the liquid line and the gas line stop valves using charging hoses with a vacuum pump or a nitrogen cylinder.
Perform the airtight test.
Do not open the stop valves. Apply nitrogen gas pressure of 601 psi (4.15MPa).
For checking gas leakage, use the leak detector or foaming agent. If there is any leakage, fix the leaking part.

(2) Caution for checking gas leakage: do not use a foaming agent which generates ammonia.
Additionally, do NOT use any household detergent as foaming agent with potentially unknown or harmful ingredients.
Use the recommended foaming agent to detect leaking refrigerant gas is shown below.



Recommended Foaming Agent	Manufacturer
Güproflex	Yokogawa & CO.,Ltd

CAUTION:
Nitrogen Gas should be sufficiently charged for each access port (high/low pressure gas line side, low pressure gas line side (for heat recovery system only), and for liquid line side). If not performed in this manner, the expansion valve for the water source unit, indoor unit, or change-over box (for heat recovery system only) can close up, making any airtight test impossible.

⚠WARNING

Be sure to use nitrogen gas for airtight test. If other gases such as oxygen gas, acetylene gas or fluorocarbon gas are accidentally used, it may cause an explosion or gas intoxication.

Insulation Work for Water Piping

Sufficiently perform thermal insulation up to the water inlet/outlet root part of heat exchange and the water piping to prevent sweating and freezing.
Otherwise, damage may be caused by freezing during low ambient temperature and thermal loss.
Insulation should also be performed in the following situation or places:

- Water piping becomes significantly lower than ambient temperature.
- Indoor piping becomes frozen
- Drainage piping

Under the condition where the ambient temperature is low in winter and at night, there is a case where equipment and piping will become damaged during the unit stoppage because the water in the pump or piping will be frozen.
This will cause damage to the heat exchanger. Be sure to take measure to prevent freezing.

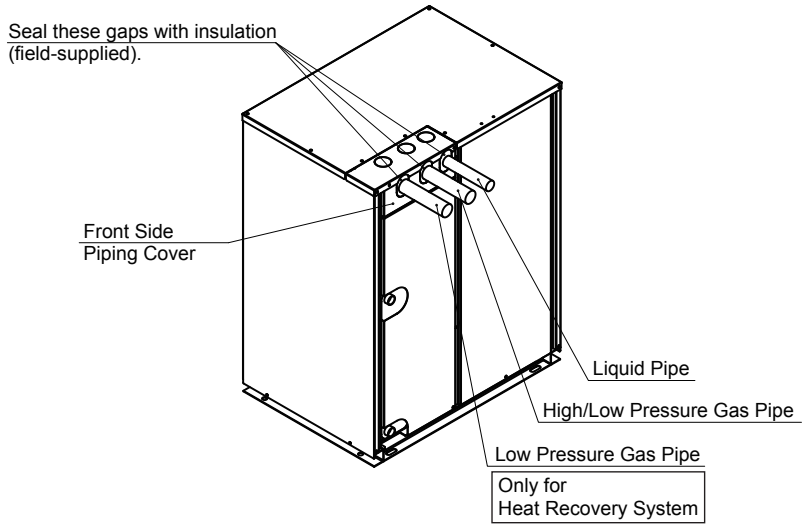
Insulation Work for Refrigerant Piping

(1) Securely insulate the high/low pressure and low pressure (for heat recovery system only) gas piping side and liquid piping side individually.
Make sure to insulate the union flare nut for the piping connection as well.

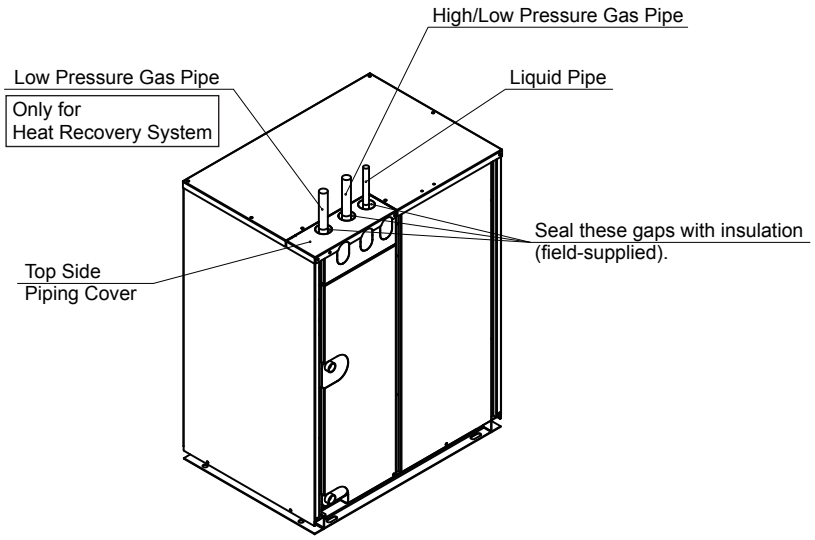
(2) Seal the gap between the bottom base or front piping cover and pipes with the insulation.

CAUTION:
If the gap is not sealed, damage can occur from water, animals, or insects that can gain entry.

For Pipes from Front Side Piping Cover



For Pipes from Top Side Piping Cover



9.2 Vacuuming

Connecting

Connect a manifold gauge, vacuum gauge, and vacuum pump to the following access ports.

Heat Pump System	High/Low Pressure Gas Stop Valve Liquid Stop Valve
Heat Recovery System	High/Low Pressure Gas Stop Valve Low Pressure Gas Stop Valve Liquid Stop Valve

Triple Evacuation Method

According to the following < Step 1 > < Step 2 > < Step 3 > in order, conduct vacuum drying work.

< Step 1 >

(1) Vacuum until the pressure reaches 2000 microns (2 mmHg).
(2) Pressurize with nitrogen up to 50 PSIG (0.3 MPaG) for 15 minutes.
(3) Release pressure to atmosphere level as less than 5 PSIG (0.03 MPaG).

< Step 2 >

(1) Vacuum until the pressure reaches 1000 microns (1 mmHg).
(2) Pressurize with nitrogen up to 50 PSIG (0.3 MPaG) for 15 minutes.
(3) Release pressure to atmosphere level as less than 5 PSIG (0.03 MPaG).

< Step 3 >

(1) Vacuum until the pressure reaches 500 microns (0.5 mmHg).
(2) Stop vacuum pump.
(3) Check that the vacuum 500 microns (0.5 mmHg) can maintain for one hour.

NOTICE

1. If tool or measuring instruments come into contact with the refrigerant, use the tools or the measuring instruments exclusively for R410A.
2. Do not perform vacuum pumping work with valves of the water source units open.
   Otherwise, the refrigerant charged before shipment may leak, and it may result in failure.
   If moisture remains inside the pipes, the compressor may be damaged.

9.3 Charging Work

(1) An additional refrigerant charge is required according to total piping length. Refer to Table 9.1.

(2) After vacuum pumping work, check that the high/low pressure gas valve (low pressure gas valve is for heat recovery system only) and liquid stop valve are fully closed.
Charge the additional refrigerant from the access port of liquid stop valve.

(3) After refrigerant has been charged, fully open the liquid stop valve and gas stop valves.
Gas remaining at the O-ring or screw component may emit a hissing sound when removing the stop valve cap. However, this is not leaking gas.

(4) If it proves impossible to dispense the specified (charged) quantity of refrigerant, follow the procedure below.

(a) Fully open the stop valve at the gas line side (for heat recovery system, both stop valves of high/low pressure and low pressure side).

(b) Operate the compressor in the cooling mode and charge the additional refrigerant from the access port of the liquid stop valve. An acceptable error must fall within 1.1 lbs (0.5 kg). During this step, keep the liquid stop valve slightly open.

(c) After the refrigerant is charged, fully open the liquid stop valve and the gas stop valve.

(d) Carefully calculate any additional refrigerant quantity for charging. If the quantity of additional refrigerant is not correct, it might cause a compressor failure. The additional refrigerant must be charged in a liquid condition.

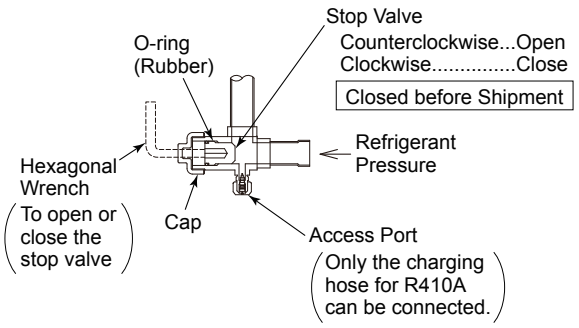
(e) Refrigerant charge from the access port on the gas stop valve can lead to compressor failure. Be sure to charge refrigerant from the access port on the liquid stop valve.

NOTICE

- Acceptable error of refrigerant charging work is within 1.1 lbs (0.5 kg). If the charging error exceeds the acceptable amount, then the water source unit may not be able to operate in the high or low entering water condition for protecting the compressor.
- Do not apply excessive force to the stop valve after fully opening. Otherwise, the stop valve will blow out due to refrigerant pressure. At the test run, fully open the stop valve. Otherwise, these devices will be damaged. (It is closed before shipment.)

Caution for Opening Stop Valve

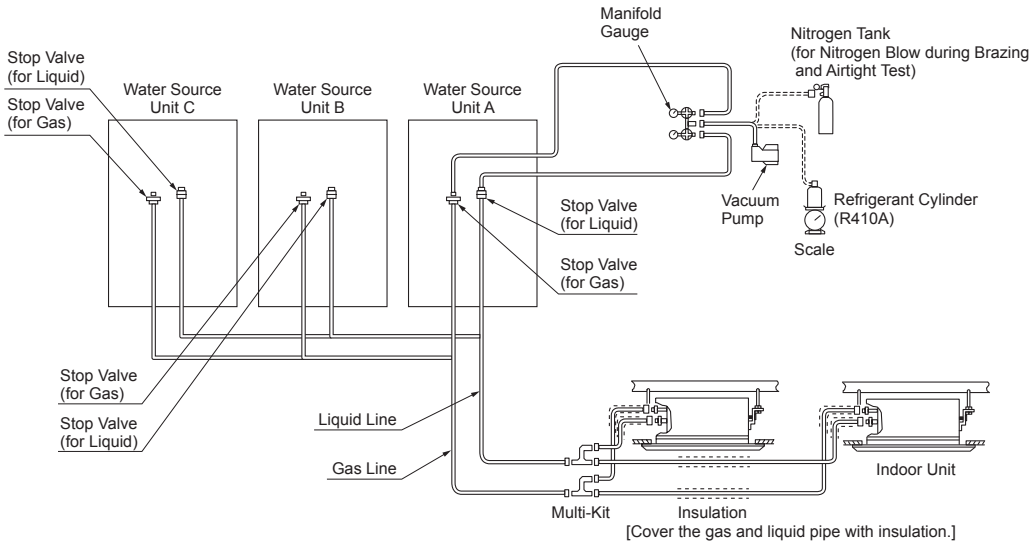
1. Do not apply an excessive force after fully opening the stop valve (Tightening Torque: < 3.7 ft·lbs (5.0 N·m)). (This valve does not have a hard stop when opening, and allows for the complete removal of the valve stem.)
2. Securely tighten the caps according to the torque specifications in Section 7.2.1 after each stop valve is opened.



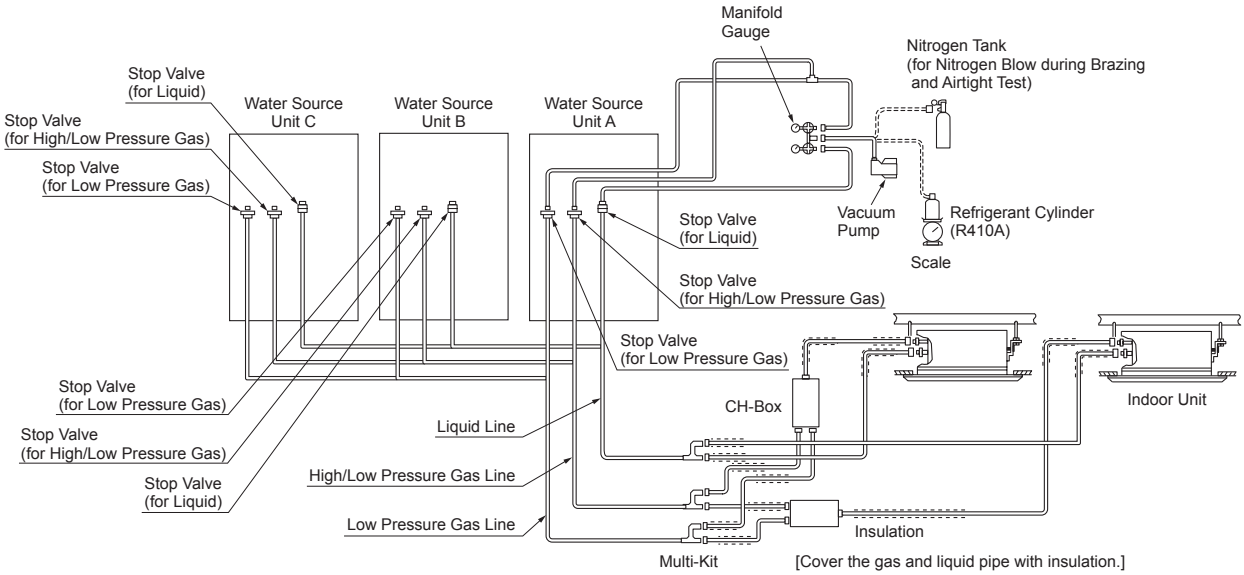
Hexagonal Wrench Size [inch (mm)]

Model	Gas Valve	Liquid Valve
72, 96	3/16 (5)	3/16 (5)
120	3/8 (10)	
144 - 216		

Heat Pump System



Heat Recovery System



Charge the correct refrigerant quantity according to Table 9.1. If not, a compressor may be damaged due to an excess or insufficient refrigerant charge.

Refrigerant charge from access port of gas stop valve may lead to compressor failure. Be sure to charge refrigerant from the access port of liquid stop valve.

Insulate the liquid piping and gas piping completely to avoid decreasing of performance and condensation on the surface of the pipe.

Insulate the flare nut and union of the piping connection with insulation.

Check to ensure that there is no gas leakage. If a large refrigerant leakage occurs, it will cause difficulty with breathing or harmful gases could occur if a fire was being used in the room.

9.4 Additional Refrigerant Charge Calculation

Table 9.1 Additional Refrigerant Charge Calculation

Although this unit has been charged with refrigerant, an additional refrigerant charge is required.

Determine what additional charge of refrigerant is needed according to the following procedures and charge it into the system. Record the additional refrigerant charge on the refrigerant label attached to the back surface of the service cover to facilitate maintenance and servicing activities thereafter.

(1) Calculating Method of Additional Refrigerant Charge WT [lbs (kg)]

<table>
<tr><th>No.</th><th>Symbol</th><th>Step</th><th>Additional Charge</th></tr>
<tr><td>1</td><td>W1</td><td>Additional Refrigerant Charge Calculation for Liquid Piping W1 [lbs (kg)]
<table>
<tr><th>Pipe Diameter [inch (mm)]</th><th>Total Piping Length [ft (m)]</th><th>Refrigerant Charge for 1 ft Pipe [lbs/ft (kg/m)]</th><th>Additional Charge [lbs (kg)]</th></tr>
<tr><td>7/8 (22.2)</td><td></td><td>× 0.20 (0.30) =</td><td></td></tr>
<tr><td>3/4 (19.05)</td><td></td><td>× 0.16 (0.24) =</td><td></td></tr>
<tr><td>5/8 (15.88)</td><td></td><td>× 0.10 (0.15) =</td><td></td></tr>
<tr><td>1/2 (12.7)</td><td></td><td>× 0.06 (0.09) =</td><td></td></tr>
<tr><td>3/8 (9.52)</td><td></td><td>× 0.027 (0.04) =</td><td></td></tr>
<tr><td>1/4 (6.35)</td><td></td><td>× 0.013 (0.02) =</td><td></td></tr>
<tr><td colspan="3">Total Additional Charge For Liquid Piping =</td><td></td></tr>
</table></td><td>lbs (kg)</td></tr>
<tr><td>2</td><td>W2</td><td>Depending on connection of indoor unit capacity, additional refrigerant charge is required.
Select adequate refrigerant charge from the table below.
Additional Refrigerant Charge for Each Indoor Unit Connected W2 [lbs (kg)]
<table>
<tr><th>Indoor Unit Capacity (MBH)</th><th>6, 8</th><th>12-54</th><th>60 or more</th></tr>
<tr><td>Additional Ref. Charge [lbs (kg)/unit]</td><td>0.7 (0.3)</td><td>1.1 (0.5)</td><td>2.2 (1.0)</td></tr>
</table></td><td>lbs (kg)</td></tr>
<tr><td>3</td><td>W3</td><td>Determine the ratio of indoor unit connection capacity.
The Ratio of Indoor Unit Connection Capacity (Indoor Unit Total Capacity/Water Source Unit Capacity) Additional Charge W3 [lbs (kg)]
<table>
<tr><th>Condition</th><th>Additional Charge [lbs (kg)]</th></tr>
<tr><td>I.U. Capacity Ratio is less than 100%</td><td>0.0 (0.0)</td></tr>
<tr><td>I.U. Capacity Ratio is 100% or more</td><td>1.1 (0.5)</td></tr>
</table></td><td>lbs (kg)</td></tr>
<tr><td>4</td><td>W4</td><td>If Change-Over Boxes Multiple Branch type are connected (for heat recovery system only), additional refrigerant charge is required.
Select adequate refrigerant charge from the table below.
Additional Refrigerant Charge for Change-Over Box Model Connected W4 [lbs (kg)]
<table>
<tr><th>Change-Over Box Model</th><th>Additional Charge [lbs (kg)/unit]</th></tr>
<tr><td>COB04M132B22S</td><td>0.3 (0.1)</td></tr>
<tr><td>COB08M264B22S</td><td>0.5 (0.2)</td></tr>
<tr><td>COB12M264B22S</td><td>0.7 (0.3)</td></tr>
</table></td><td>lbs (kg)</td></tr>
<tr><td>5</td><td>WT</td><td>Calculation of Additional Charge WT [lbs (kg)] =
W1 + W2 + W3 + W4 =</td><td>lbs (kg)</td></tr>
</table>

Ensure that the total additional charge WT does not exceed the maximum additional refrigerant charge as shown in the table on the following page.

Maximum Additional Refrigerant Charge Quantity Allowed [lbs (kg)]

Water Source Unit Capacity (MBH)	72, 96	120	144, 168	192, 216	240, 264	288 - 432	456 - 576
Maximum Additional Refrigerant Charge [lbs (kg)]	61.7 (28.0)	83.8 (38.0)	88.2 (40.0)	99.2 (45.0)	121.3 (55.0)	132.3 (60.0)	140.0 (63.5)

Initial Refrigerant Charge Amount of W.S. (Before Shipment) W0 [lbs (kg)]

Water Source Unit Capacity (MBH)	72, 96	120	144	168 - 216
W0 Water Source Unit Refrigerant Charge [lbs (kg)]	7.7 (3.5)	10.4 (4.7)	13.7 (6.2)	15.4 (7.0)

W0 is the water source unit refrigerant charge prior to shipment.

(2) Record of Additional Charge
Total refrigerant charge of this system is calculated in the following formula.

Total Refrigerant Charge = WT [lbs (kg)] + W0 [lbs (kg)] = ☐ lbs (☐ kg)

When refrigerant is recovered or charged due to repairing, operating, or adjusting the unit, record the refrigerant quantity again.

NOTICE

1. Emissions of the fluorocarbons without any reason are prohibited.
2. For disposal and maintenance of this product, recovery of fluorocarbons is required.

- Special Attention Regarding Refrigerant Gas Leakage

Make sure that the entire VRF system meets ASHRAE Standard 15, or any local codes, regarding Safety. The ASHRAE Standard 15-2013 provides safeguards for life, limb, health, property, and prescribes safety requirements.
The standard is recognized as the main guide for personal safety involving refrigeration systems. It strives to ensure a safe application of refrigerant systems by limiting the maximum charge as follows so that a complete discharge due to a leak into a small, occupied, and enclosed room can never exceed the allowable limit for the room.

10. Test Run

Test Run should be performed in accordance with Sections 10.2 and 10.3. Use Table 10.1 for recording the Test Run.

⚠WARNING

An electrical shock will occur if there is residual voltage.
Turn OFF power at the power supply completely before attempting any electrical maintenance work.
Verify that no residual voltage exists after turning OFF the power at the power supply.

NOTICE

Do not activate the system until all issues have been examined and cleared.
Test Run of indoor unit: refer to the installation and maintenance manual which is attached to the indoor unit and change-over box.

10.1 Before Test Run

(1) Check to ensure that the refrigerant piping and communication lines between indoor and water source units are connected into the same refrigerant system. If not, the result will be abnormal operation with a potentially serious accident.
Verify that all DIP switch settings for the refrigerant system numbers (DSW1 and RSW1 for water source unit and DSW5 and RSW2 for indoor unit) and the unit number (DSW6 and RSW1) for indoor units are applicable to the system.
Depending on the indoor unit type RSW is different. Refer to the installation manual attached to each indoor unit. Confirm that all DIP switch settings on the printed circuit board for indoor and water source units are correct. Pay special attention to the setting for water source unit number, the refrigerant system number, and end terminal resistance. Refer to Section 8, “Electrical Wiring”.

(2) Verify that electrical resistance is more than 1 megaohm, by measuring the resistance between ground and the terminal for electrical components. If the electrical resistance is less than 1 megaohm, do not operate the system until the source of electrical current outflow is found and fixed. (Refer to “Caution for Insulation Resistance” for details.)
Do not impress the voltage on the terminals for communication lines (Water Source Unit: TB2 1, 2, 3, 4 / Indoor Unit: TB2 A, B, 1, 2 / Change-Over Box: TB2 1, 2, 3, 4). Otherwise, failure can result.

(3) Verify that each wire L1, L2, and L3 is correctly connected at the power supply.
If any one of those is incorrectly connected, the unit will not operate and the wired controller will display the alarm code “05.” In this case, check and change the phase of the power supply according to the spec sheet attached to the inside back surface of the service cover.

(4) Apply power to water source unit(s) at least 12 hours prior to operation of the system to allow for adequate pre-heating of the compressor oil.
The water source unit does not operate for at most four hours after power supply (Stoppage Code d1-22).
If operation resumes within four hours, release the protection control as follows:
1. Supply power to the water source unit.
2. Wait for 30 seconds.
3. Push PSW5 on the water source PCB for more than three seconds in order to release the d1-22.

If using a wired controller for release:
* Press and hold “Menu” and “Back/Help” simultaneously for at least 3 seconds. The test run menu is displayed.
* Press “△” or “▽” to select “Cancel Preheating Control”. Press “OK” and cancel the pre-heating control.

For other controllers, refer to the manual attached to each controller.

(5) Be sure to close the service cover at the front upper side when the test run is performed.

⚠CAUTION

Caution for Insulation Resistance

If the total unit insulation resistance is lower than one megaohm, the compressor insulation resistance may be lower, due to refrigerant being retained in the compressor. This can occur if the unit has not been used over prolonged periods of time.

1. **Disconnect the cables to the compressor and measure the insulation resistance of the compressor itself. If the resistance value is over one megaohm, then an insulation failure has occurred in other electrical parts.**
2. **If the insulation resistance is less than one megaohm, reconnect the compressor cables from the inverter PCB. Then, turn on the main power to apply current to the crankcase heater.**
   After applying current for more than three hours, measure insulation resistance again. (Depending on the air conditions, length of piping, or refrigerant conditions, it may be necessary to apply the current for a longer period of time.)

If the GFCI is activated, check the recommended size shown in Table 8.1.

NOTICE

Confirm that field-supplied electrical components (main switch fuse, fuse-free breaker, GFCI breakers, wires, conduit connectors and wire terminals) have been properly selected according to the electrical data shown in Table 8.1, and ensure that these components comply with national and local electrical codes.

10.2 Test Run for Water Piping

Before Test Run, make sure that the water piping work has been carried out in a proper manner.
Especially, make sure that the water strainer, automatic air discharge valve, and water flow switch are positioned at their correct places.

(1) Close the gate valves to cut off water flow to the water source unit and circulate water within the common water piping.
After removing any foreign particles and substances from the water piping, clean the water strainer near the water inlet side of water source unit.
For better cleaning of the water strainer, provide short-circuit by using the flexible connection to circulate water to the point just before the water source unit.

(2) Open the gate valves to circulate water to the water source unit.
Be sure that no air has been caught in the water system.

(3) Measure the water pressure drop off before and after the water source unit to make sure the water flow rate is according to design.
Be sure that entering water temperature is within the operation range and then perform Test Run.
Check that the entering water temperature is within the operation range during Test Run.
If any air has been caught or the water flow rate is not enough in the water piping, the plate heat exchanger may freeze.
In case of any abnormality, stop the test run immediately and carry out troubleshooting and resolve the trouble.

(4) When the water flow switch is installed incorrectly, “A2” alarm occurs.
Check that the contact signal is closed when the water pump is operating.

(5) When the water flow switch is selected incorrectly, “0d” alarm occurs.
Check that the water flow switch does not operate when the water flow rate drop below minimum.

(6) Proper inspection should be performed to check for water leaking parts of water piping.

(7) After the Test Run has been completed, inspect the water strainer at the water inlet side of water source unit. Remove any foreign particles and substances from the water strainer.

10.3 Test Run for Water Source Unit

This test run method is for the wired controller. As for other controllers, refer to Installation and Maintenance Manual attached to each controller.

(1) For heat pump system, check to ensure that stop valves for high/low pressure gas and liquid of the water source units are fully opened.
For heat recovery system, check to ensure that stop valves for high/low pressure gas, low pressure gas (only for heat recovery system), and liquid of the water source unit are fully opened.

(2) Perform the test run of indoor units one by one sequentially and then check the accordance of the refrigerant piping system and the electrical wiring system.

(3) Perform the test run according to the following procedure. Ensure that the unit operates without any problem.

If two controllers (main and sub) are installed to the system, perform the test run from the main controller.

Test Run by Wired Controller

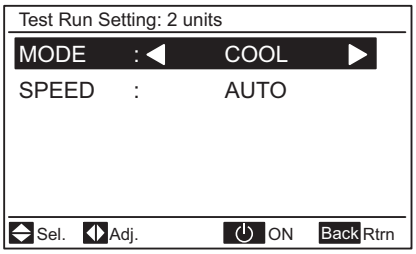
(a) Press and hold “Menu” and “Back/Help” simultaneously for at least 3 seconds. The test run menu is displayed.

(b) Select “Test Run” by pressing “△▽” and press “OK”.
The test run screen is displayed.

- The total number of indoor units connected are displayed on the Liquid Crystal Display (LCD). A twin combination (one set with two indoor units) is identified as “2 units”, and a triple combination (of one set with three indoor units) is identified as “3 units”.

  When a “00 unit” is identified, the auto-address function may be activated. Cancel “Test Run” mode and reset it.

Test Run Screen



- If the indicated number is not equal to the actual number of connected indoor units, the auto-address function is not performed correctly due to incorrect wiring or electronic noise (EMI). Turn OFF the power supply, and correct the wiring after checking the following areas: (Do not repeat turning ON and OFF within 10 seconds.)

  * The power supply for the indoor unit is NOT turned ON or there is incorrect wiring.
  * A loose connection between indoor units or the wired controller.
  * Incorrect Setting of Indoor Unit Address (The indoor unit address is overlapped.)

(c) Start the Test Run.

- Press “⏻ On/Off”. The Test Run operation will start. The operation mode, the airflow volume, the airflow direction, and the Test Run time can be set on the Test Run screen. Select the item by pressing “△▽” and set the detail by pressing “◁▷”.
The default setting for the Test Run time is a two-hour OFF timer.
- Check the temperature conditions.
Unit operation cannot be performed if the conditions are out of range.
Refer to the table in Section “Important Notice” for the working range.

  Example:
  The cooling operation is not performed if the entering water temperature is below 50°F (10°C).

(d) Press “△” or “▽”, select “LOUV.” and select “ ” (auto swing) by pressing “◁” or “▷”.
The auto-swing operation will start. Check the operating sound at the louvers.
If an abnormal sound emanates from the louvers, it may be caused by a deformation in the decorative panel due to incorrect installation. In this case, carefully reinstall the decorative panel without further damage. If no weird sounds are generated, press “◁” or “▷” again to halt the auto-swing operation.

(e) Though the temperature detections by the thermistors are invalid, the protection devices are valid during the Test Run. If an alarm is triggered, refer to Table 10.2 Alarm Code and perform troubleshooting. Then, perform the Test Run again

(f) According to the label “Checking Method by Seven-Segment Display” attached to the back side of the service cover of the water source unit, check the temperature, the pressure, and the operation frequency of the specified portions, and check the number of the connected indoor units on 7-segment displays.

(g) To finish the Test Run, wait two hours (as a default setting) or press “⏻ On/Off” switch again.

- With the operation LED flashing two seconds ON and two seconds OFF, this is an indication that the system is searching for irregularities in communication between indoor units and the wired controller. This could result in loose or disconnected wires, components, and incorrect wiring.
- A small sound may be heard from the water source unit after turning ON at the power supply because the electrical expansion valve is activated to adjust the opening. Therefore, there is no mechanical fault with the unit.
- Sound may be emitted from the water source unit for a few seconds after running or stopping the compressor, and so on. It generates because of the pressure difference inside the compressor piping. Therefore, there is no problem with the unit.

⚠WARNING

Do NOT run the air conditioner units to check the electrical wiring until the Test Run preparations have been completed.

Test Run from Water Source Unit Side

The procedures for the test run from the water source unit side are shown below. Setting this DIP switch is possible with the power supply ON.

Setting of DIP Switch (Factory Setting)

Note that the darkened squares here denote that the switch is in the "OFF" position.

DSW4
Switch for Setting of Service Operation and Function

1. Test Run
2. COOL/HEAT Setting
   (ON: Heating Operation)
3. Not Used
4. Manual Compressor OFF
5. Function Setting
6. External Input/Output Setting

⚠WARNING

- **Do not touch any other electrical part when operating switches on the PCB.**
- **Do not attach or detach a service cover when the power supply for the water source unit is supplied and the water source unit is operated.**
- **Turn all DIP switches of No.1 to 4 pins of DSW4 OFF when the test run operation is completed.**

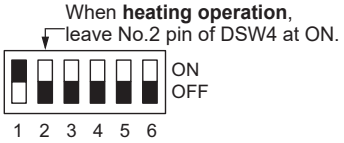
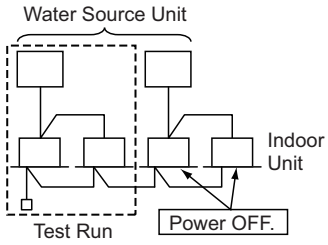
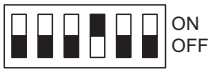
	DIP Switch Setting	Operation	Remarks
Test Run	1. Setting of Operation Mode Cooling: Set No.2 pin of DSW4 OFF.  Heating: Set No.2 pin of DSW4 ON.  2. Starting Test Run Set No.1 pin of DSW4 ON and the operation is started after a few ~ 20 seconds.  	1. The indoor unit automatically starts operating when the test run of the water source unit is set. 2. The ON/OFF operation can be performed from the wired controller or No.1 pin of DSW4 of the water source unit. 3. The operation continues for two hours without Thermo-OFF.	* Note that indoor units operate in conjunction with the test run operation for the water source unit. * If the test run is started from the water source unit and stopped from the wired controller, the test run function of the wired controller is canceled. However, the test run function of the water source unit is not canceled. Be sure that the No.1 pin of DSW4 of the water source unit PCB is turned OFF. * If multiple indoor units are connected with one wired controller, perform the test run operation individually for each refrigerant system, one by one. Then, make sure to turn the power supply OFF for the indoor units in other refrigerant systems not selected for the test run operation.  * A setting of DSW4 is not required for the test run from the wired controller.
Manual OFF of Comp.	1. Setting *Compressor Manual OFF: Set No.4 pin of DSW4 ON.  2. Canceling *Compressor ON: Set No.4 pin of DSW4 OFF.  	1. When No.4 pin of DSW4 is ON during compressor operation, the compressor shuts down immediately and the indoor unit is assumes the condition of Thermo-OFF. 2. Once No.4 pin of DSW4 is placed back into the off position, the compressor is enabled for restart following a three minute safety delay.	* Do not repeat compressor ON/OFF frequently.

Table 10.1 Test Run and Maintenance Record

MODEL: SERIAL. No. COMPRESSOR MFG. No.

CUSTOMER'S NAME AND ADDRESS: DATE:

1. Is the rotation direction of the indoor fan correct? ☐
2. Is the water source unit inlet and outlet water pipe connection correct? ☐
3. Are there any abnormal compressor sounds? ☐
4. Has the unit been operated at least twenty (20) minutes? ☐
5. Check Room Temperature

Inlet:	No. 1	DB	/WB	°F,	No. 2	DB	/WB	°F,	No. 3	DB	/WB	°F,	No. 4	DB	/WB	°F
Outlet:		DB	/WB	°F,		DB	/WB	°F,		DB	/WB	°F,		DB	/WB	°F
Inlet:	No. 5	DB	/WB	°F,	No. 6	DB	/WB	°F,	No. 7	DB	/WB	°F,	No. 8	DB	/WB	°F
Outlet:		DB	/WB	°F,		DB	/WB	°F,		DB	/WB	°F,		DB	/WB	°F

6. Check Water Source Unit Entering and Leaving Water Temperature and Pressure.

Entering Water:	°F,	Psi
Leaving Water:	°F,	Psi

7. Check Refrigerant Temperature

Liquid Temperature:	°F
Discharge Gas Temperature:	°F

8. Check Pressure

Discharge Pressure:	Psi
Suction Pressure:	Psi

9. Check Voltage

Rated Voltage:	V				
Operating Voltage:	L_1-L_2	V,	L_1-L_3	V,	L_2-L_3 V
Starting Voltage:	V				
Phase Imbalance:	$1-\frac{V}{Vm}=$				

10. Check Compressor Input Running Current

Input:	kW			
Running Current:	Comp. No.1	A	Comp. No.2	A

11. Is the water flow adequate? ☐
12. Is the refrigerant charge adequate? ☐
13. Do the water flow switch operate correctly? ☐
14. Do the operation control devices operate correctly? ☐
15. Do the safety devices operate correctly? ☐
16. Has the unit been checked for refrigerant leakage? ☐
17. Is the unit clean inside and outside? ☐
18. Are all cabinet service panel securely closed? ☐
19. Are all cabinet service panel free from rattles? ☐
20. Is the filter clean? ☐
21. Is the heat exchanger clean? ☐
22. Are the stop valves open? ☐
23. Does the condensate water flow smoothly from the condensate pipe? ☐

Table 10.2 Alarm Code

Code	Category	Content of Abnormality	Leading Cause
01	Indoor Unit	Activation of Protection Device (Float Switch)	Activation of Float Switch (High Water Level in Condensate Pan, Abnormality of Condensate Pipe, Float Switch, or Condensate Pan)
02	Water Source Unit	Activation of Protection Device (High Pressure Cut)	Activation of PSH (Pipe Clogging, Excessive Refrigerant, Inert Gas Mixing)
03	Communication	Abnormal Communication between Indoor and Water Source Unit	Incorrect Wiring, Loose Terminals, Disconnected Communication Cable, Blowout of Fuse, Indoor Unit Power OFF
04		Abnormal Communication between Inverter PCB and Water Source Unit PCB	Inverter PCB - Water Source PCB Communication Failure (Loose Connector, Wire Breaking, Blowout of Fuse)
05	Supply Phase	Abnormality of Power Supply Phases	Incorrect Power Supply, Connection to Reversed Phase, Open-Phase
06	Voltage	Abnormal Inverter Voltage	Water Source Unit Voltage Decrease, Insufficient Power Capacity
07	Cycle	Decrease in Discharge Gas Superheat	Excessive Refrigerant Charge, Failure of Thermistor, Incorrect Wiring, Incorrect Piping Connection, Expansion Valve Locking at Opened Position (Disconnect Connector)
08		Increase in Discharge Gas Temperature	Insufficient Refrigerant Charge, Pipe Clogging, Failure of Thermistor, Incorrect Wiring, Incorrect Piping Connection, Expansion Valve Locking at Closed Position (Disconnect Connector)
0A	Communication	Abnormal Communication between Water Source Units	Incorrect Wiring, Breaking Wire, Loose Terminals
0b	Water Source Unit	Incorrect Water Source Unit Address Setting	Duplication of Address Setting for Water Source Units (Sub Units) in Same Refrigerant Cycle Number
0C		Incorrect Water Source Unit Main Unit Setting	Two (or more) Water Source Units (or Outdoor Units) Set as "Main Unit" Exist in Same Refrigerant Cycle Number
0d		Water Temperature Abnormality	Insufficient Water Flow Rate, Abnormally Low Entering Water Temperature, Insufficient Refrigerant, Piping Clogging, Expansion Valve Locking at Close Position
11	Sensor on Indoor Unit	Abnormality of Inlet Air Thermistor	Incorrect Wiring, Disconnecting Wiring, Breaking Wire, Short Circuit
12		Abnormality of Outlet Air Thermistor	
13		Abnormality of Freeze Protection Thermistor	
14		Abnormality of Gas Piping Thermistor	
15		Abnormality of Outdoor Air Thermistor (EconoFresh)	
16		Abnormality of Remote Sensor (DOAS)	
17		Abnormality of Thermistor Built-in Remote Controller (DOAS)	
18	Indoor Fan Motor	Abnormality of Indoor Fan System	Abnormality of Indoor Fan Motor (Step-Out), Indoor Fan Controller Failure
19		Activation of Protection Device for Indoor Fan	Fan Motor Overheat, Lockup
1A	Indoor Fan Controller	Abnormality of Fan Controller Fin Temperature	Abnormality of Fin Thermistor or Fan Controller, Heat Exchanger Clogging, Abnormality of Fan Motor
1b		Activation of Overcurrent Protection	Abnormality of Fan Motor
1C		Problem with Current Sensor	Abnormality of Fan Controller Current Sensor
1d		Activation Fan Controller Protection	Driver IC Error Signal Detection, Instantaneous Overcurrent
1E		Abnormality of Indoor Fan Controller Voltage	Indoor Voltage Decrease, Insufficient Capacity of Power Supply Wiring
21	Sensor on Water Source Unit	Abnormality of High Pressure Sensor	Incorrect Wiring, Disconnecting Wiring, Breaking Wire, Short Circuit
23		Abnormality of Discharge Gas Thermistor on Top of Compressor	
24		Abnormality of Heat Exchanger Liquid Pipe Thermistor	
25		Abnormality of Heat Exchanger Gas Pipe Thermistor	
29		Abnormality of Low Pressure Sensor	
2A		Abnormality of Entering Water Thermistor	
2b		Abnormality of Electrical Box Thermistor	

Code	Category	Content of Abnormality	Leading Cause
30	System	Incorrect Connection of Change-Over Box	Connection of Change-Over Box model (COBS_B21S) to Water Source Unit
31		Incorrect Capacity Setting of Water Source Unit and Indoor Unit	Incorrect Capacity Setting of Water Source Unit and Indoor Unit, Excessive or Insufficient Indoor Unit Total Capacity Code
35		Incorrect Setting of Indoor Unit No.	Duplication of Indoor Unit No. In same Refrigerant Cycle Number
36		Incorrect of Indoor Unit Combination	Indoor Unit is Designed for R22
38		Abnormality of Picking up Circuit for Protection in Water Source Unit	Failure of Protection Detecting Device (Incorrect Wiring of Water Source Unit PCB)
3A	Water Source Unit	Abnormality of Water Source Unit Capacity	Water Source Unit Capacity > 576MBH
3b		Incorrect Setting of Water Source Unit Models Combination or Voltage	Incorrect Setting of Main and Sub Units(s) Combination or Voltage
3d		Abnormal Communication between Main Unit and Sub Unit(s)	Incorrect Wiring, Disconnect Wire, Breaking Wire, PCB Failure
3E		Abnormal Combination between Inverter PCB and Water Source Unit PCB	Incorrect Combination between Inverter PCB and Water Source Unit PCB
43	Protection Device	Activation of Pressure Ratio Decrease Protection	Defective Compression (Failure of Compressor or Inverter, Loose Power Supply Connection)
44		Activation of Low Pressure Increase Protection	Overload at Cooling, High Temperature at Heating, Expansion Valve Locking at Open Position (Loose Connector)
45		Activation of High Pressure Increase Protection	Overload Operation (Heat Exchanger Clogging), Pipe Clogging, Excessive Refrigerant, Inert Gas Mixing
47		Activation of Low Pressure Decrease Protection	Insufficient Refrigerant, Piping Clogging, Expansion Valve Locking at Close Position (Loosen Connector)
48		Activation of Inverter Overcurrent Protection	Overload Operation, Compressor Failure
51	Sensor	Abnormal Inverter Current Sensor	Current Sensor Failure
53	Inverter	Inverter Error Signal Detection	Driver IC Error Signal Detection (Protection for Overcurrent, Voltage Decrease, Short Circuit), Instantaneous Overcurrent
54		Abnormality of Inverter Temperature	Abnormal Inverter Thermistor, Heat Exchanger Clogging, Cooling Fan Failure
55		Inverter Failure	Inverter PCB Failure
A1	External Input	Detection of External Abnormality	Input Signal by External Abnormality Detection Setting
A2		Flow Switch Abnormality	Insufficient Water Flow Rate, Flow Switch Failure, Incorrect Wiring of Flow Switch
b0	Indoor Unit	Incorrect Setting of Unit Model Code	Incorrect Setting of Indoor Unit Model
b1		Incorrect Setting of Unit and Refrigerant Cycle Number	64 or More Number is Set for Address or Refrigerant Cycle
b2		Abnormality of EEPROM	EEPROM failure, Incorrect Data of EEPROM
b5		Incorrect Indoor Unit No. Setting	There are 17 or More Non-Corresponding to H-LINK II Units are Connected to One System.
b6		Abnormal Communication between Indoor PCB and Indoor Fan Controller	Communication Failure, Disconnected Communication Cable, Abnormal Connection
C1	Change-Over Box	Incorrect Change-Over Box Connection	2 or More Change-Over Boxes are Connected between Water Source Unit and Indoor Unit
C2		Incorrect Indoor Unit Connection Number	9 or More Indoor Units Connected to Single Branch Type Change-Over Box, 7 or More Indoor Units Connected per port of Multiple Branch Type Change-Over Box
C3		Incorrect Indoor Unit Refrigerant Number Setting	Indoor Units of Different Refrigerant Cycle Number are Connected to Change-Over Box
C5		Incorrect Connection Port Setting	Indoor Unit is connected to a port that is set to not used for Multiple Branch Type Change-Over Box
E4	Water Source Unit	Cooling Fan Abnormality	Cooling Fan Failure, Blowout of Fuse for Cooling Fan, Abnormally High Ambient Temperature
EE	Compressor	Compressor Protection Alarm (It can not be reset from Wired Controller)	This alarm code appears when the following alarms* occurs three times within 6 hours. *02, 07, 08, 39, 43 to 45, 47

11. Safety and Control Device Setting

Compressor Protection

The compressor is protected by the following devices and their combinations.

(1) High Pressure Switch: This switch cuts out the operation of the compressor when the discharge pressure exceeds the setting.

(2) Oil Heater: This band type heater protects against oil foaming during cold starting, as it is energized while the compressor is stopped.

208/230V 60Hz

Model		(H,Y)VWH(P,R)072B32S	(H,Y)VWH(P,R)096B32S	(H,Y)VWH(P,R)120B32S	(H,Y)VWH(P,R)144B32S	(H,Y)VWH(P,R)168B32S	(H,Y)VWH(P,R)192B32S	(H,Y)VWH(P,R)216B32S
High Pressure Increase Protection		Automatic Reset, Non-Adjustable						
High Pressure Increase Protection Control	psi	551	551	551	551	551	551	551
	(MPa)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)
Pressure Switch		(for each compressor)						
Cut-Out	psi	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}
	(MPa)	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$
Cut-In	psi	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21
	(MPa)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)
For Inverter Compressor		Automatic Reset, Non-Adjustable						
Over Current								
Inverter Current Protection Control	A	38	38	48	38	38	38	38
Fuse	A	40	40	50	40	40	40	40
Over Heat		Automatic Reset, Non-Adjustable						
Discharge Temperature Increase Protection Control								
for 5sec	°F	284	284	284	284	284	284	284
	(°C)	(140)	(140)	(140)	(140)	(140)	(140)	(140)
for 10min	°F	270	270	270	270	270	270	270
	(°C)	(132)	(132)	(132)	(132)	(132)	(132)	(132)
For Fan Motor (Electrical Box)		Automatic Reset, Non-Adjustable						
Fuse	A	3.15	3.15	3.15	3.15	3.15	3.15	3.15

460V 60Hz

Model		(H,Y)VWH(P,R)072B42S	(H,Y)VWH(P,R)096B42S	(H,Y)VWH(P,R)120B42S	(H,Y)VWH(P,R)144B42S	(H,Y)VWH(P,R)168B42S	(H,Y)VWH(P,R)192B42S	(H,Y)VWH(P,R)216B42S
High Pressure Increase Protection		Automatic Reset, Non-Adjustable						
High Pressure Increase Protection Control	psi	551	551	551	551	551	551	551
	(MPa)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)	(3.80)
Pressure Switch		(for each compressor)						
Cut-Out	psi	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}	601^{-7}_{-21}
	(MPa)	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$	$(4.15^{-0.05}_{-0.20})$
Cut-In	psi	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21	464 ±21
	(MPa)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)	(3.20 ±0.15)
For Inverter Compressor		Automatic Reset, Non-Adjustable						
Over Current								
Inverter Current Protection Control	A	26	26	26	26	26	26	26
Fuse	A	25	25	25	25	25	25	25
Over Heat		Automatic Reset, Non-Adjustable						
Discharge Temperature Increase Protection Control								
for 5sec	°F	284	284	284	284	284	284	284
	(°C)	(140)	(140)	(140)	(140)	(140)	(140)	(140)
for 10min	°F	270	270	270	270	270	270	270
	(°C)	(132)	(132)	(132)	(132)	(132)	(132)	(132)
For Fan Motor (Electrical Box)		Automatic Reset, Non-Adjustable						
Fuse	A	3.15	3.15	3.15	3.15	3.15	3.15	3.15

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