Compare Air To Water Heat Pump To VRF (VRV)
2-Pages - Fast Read

This document offers a brief comparison of monoblock air to water (ATW) heat pumps and VRF (Variable Refrigerant Flow) heat pumps, also known as VRV (Variable Refrigerant Volume). Regardless of the name, VRF/VRV heat pumps are commonly known as “multi-head mini-split” heat pump systems, they follow the format of a normal mini-split but use a design which provides several indoor “head” units all interconnected and connected back to a single outdoor unit, using manifolds, valves, and high-pressure refrigerant lines. Monoblock ATW systems on the other hand have all of their refrigerant self-contained in the outdoor unit, and connect to indoor units via insulated (PEX) flexible water lines. The ATW indoor “head” units use water (or water-glycol mix) and as such are similar to fan coil units commonly used in higher-end commercial chilled water or boiler systems.

VRF systems have seen accelerated growth in recent years due to a strong attempt by the USA HVAC industry to leverage the advantages of a ductless system while satisfying consumer demand for serving multiple rooms without an outdoor unit dedicated to each room. And a push by local installers for the higher margins and lower levels of competition that exist with the VRF technology helps things along. As such, VRF has had a lot of marketing success in spite of various performance and safety problems.

While VRF has seen increasing popularity in recent years, Monoblock (self-contained) air to water (ATW) heat pumps are now the fastest growing sector of the HVAC industry due to superior efficiency, safety, and flexibility, among other reasons. As mentioned, monoblock ATW heat pumps are self-contained, meaning that 100% of the refrigerant is located outdoors. Using simple water lines, ATW heat pumps can connect to a virtually unlimited number of indoor units with no real limits on the length of the lines. Indoor units may be ductless (room) units, or ducted air handlers, or may consist of radiant floor heating systems. Any or all of ducted, ductless, or radiant approaches can be used within the same ATW application, further, ATW systems can be a high-efficiency source of domestic water heating when used along with the aforementioned. There is little if any cost difference between a VRF and monoblock ATW.

A real advantage of monoblock ATW heat pumps is the fact that they are self-contained. This means that the installation technician does not need a refrigeration/HVAC license or special HVAC skills to install the system. ATW systems can be installed by HVAC technicians, and also, by plumbers, handymen, general construction crews, remodelers, indeed, many have been installed as DIY by the homeowner. As you may imagine, with a factory sealed self-contained system, nearly all risk of refrigerant leak or improper charging has been eliminated, giving AWT systems far higher reliability than conventional split systems, with reliability more on the order of a “packaged” unit heat pumps, which while not very efficient, do ship with a “factory perfect” level of charge and rarely if ever have leaks since no refrigerant connections need to be made by the installer.

As to VRF, the **US government** has decided that VRF Systems will not be permitted in Air Force facilities. The Army will allow VRF Systems; however, they will be strongly discouraged. The Navy is not restricting VRF systems as long as they comply with ASHRAE 15 Safety Standard for Refrigeration Systems (effectively eliminating VRF). Codified in December 2020, UFC 3-410-01 you can see the original US

ARMY Corps of Engineers document here:
https://www.chiltrix.com/documents/vrf_army_corp_engineers_directive.pdf

Some of the reasons for US Government elimination or restriction of VRF systems include the following:

1. Safety. VRF/VRV systems contain far more than a “normal” amount of refrigerant and make extensive use of high-pressure refrigerant lines *inside* buildings. A typically sized VRF system contains enough refrigerant to silently, and without odor, asphyxiate the buildings occupants in the event of a refrigerant leak.

2. Reliability. Long refrigerant runs are common with VRF systems and generally the lines are branched out with many connections and many points of failure. A refrigerant leak is far more likely to occur at some point, and leaks are very difficult to locate, often requiring drywall demolition to locate a leak and once found, very difficult to repair.

About efficiency, all VRF systems perform below their official rating as additional indoor heads are added. As an example, a high-efficiency VRF system with average seasonal efficiency rating (SEER) of 18 may only have an actual SEER 13 or 14 after 5 or 6 indoor heads have been added, compared to an ATW system that may have an average seasonal efficiency as high as 23, and not suffer degradation of efficiency regardless of the number of indoor units.

Further, it can be noted that only an ATW system can have backup heat fully integrated (it’s in the water) and only ATW can provide domestic hot water and/or radiant heating in addition to space heating and cooling. In a VRF system, once the outdoor temperature drops below a certain point, the compressor stops and heating is fully handled by lower efficiency resistance elements. However, with a properly designed ATW system, the compressor can continue to contribute high efficiency heat, mixed with lower efficiency backup heat, to meet a total heat load. And only ATW systems such as Chiltrix are available with patent-protected DHC (Dynamic Humidity Control) technology which is not possible with VRF systems.

One final point – monobloc ATW systems will become even more advantageous as time passes and refrigerants evolve. For example, the current R410a refrigerant will be discontinued at some point over the next 10 years and for new systems, replaced by candidates such as R32 and R290(propane). And these newer refrigerants are even more dangerous than R410a – in addition to asphyxiation risk, they also present higher flammability and higher toxicity - to the point where the safety of having a large volume of refrigerant indoors becomes extremely undesirable and may not be allowed. Building with an ATW design now can eliminate potential significant system redesign in the future.

In summary, monoblock ATW systems are inherently safer, more reliable, easier to install, and have higher efficiency. ATW systems do not have any dangerous high-pressure refrigerant or refrigerant lines within the building envelope. On a fully installed basis, there is little cost difference between air to water and VRF systems.