Maintaining and Troubleshooting VRF Systems

Your diligence and expertise are vital for proper system performance

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When you service and troubleshoot variable refrigerant flow (VRF) systems, you're onsite to ensure the equipment consistently gives your customer the best comfort and performance possible. You're not looking to be the go-to provider for costly, inconvenient callbacks. Accurate load calculations, proper installation practices, commissioning and regular maintenance are how your customer's VRF system will live up to the technology's reputation for reliable performance and energy efficiency. Quality product engineering on the manufacturer's part will get you part of the way, but your diligence and expertise are vital for proper performance.

If you've worked with unitary systems, you already have much of the knowledge and experience you need to service a VRF system. You also have most of the necessary tools and gear. You're going to perform the normal tasks: clean filters, blowers, coils and drains, check electrical connections, tighten wires, inspect refrigerant lines and (if necessary) check the refrigerant charge. VRF technology doesn't magically change the foundational elements of air-conditioning systems, but you'll need to supplement what you already know with VRF-specific concepts and training.

Fundamentals

Improving on the direct-expansion (DX) principle, a VRF system uses variable-speed motors and electronic expansion valves to cycle refrigerant and control transfer heat between the outdoor unit and the indoor unit(s) in each zone. Just like a normal heat pump system during heating, the outdoor unit introduces heat drawn from ambient air or a nearby water source. During cooling, the indoor units act as evaporators and send heat to the outdoor unit, where it's rejected. If the VRF system is equipped with a branch circuit controller, it can also use heat recovery to transfer heat from zones requiring cooling to zones that need heat. Repurposing heat rejected from cooling zones for use in heating zones is known as simultaneous heating and cooling.

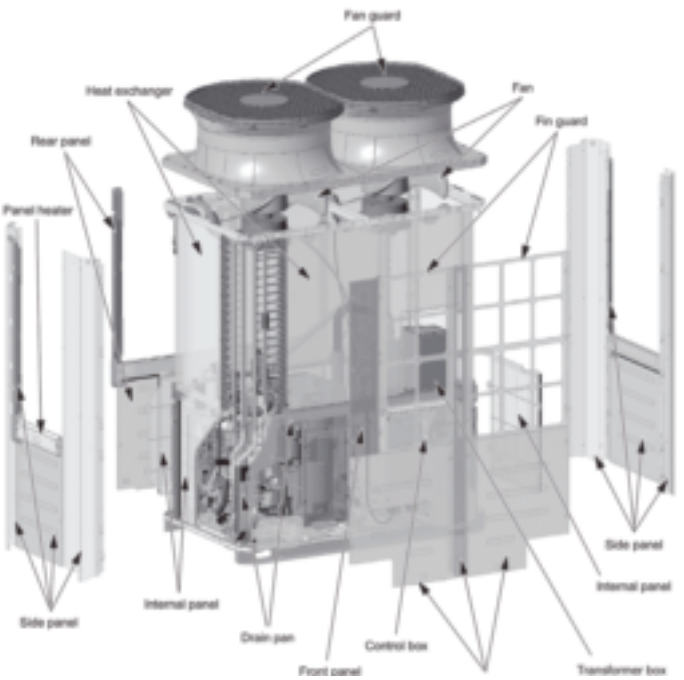
The variable-speed compressor, and fan motors, located in the outdoor unit enable a VRF system to modulate refrigerant flow and capacity to match the load and capacity of a single zone or multiple zones that may be calling inside. In contrast, a fixed-capacity HVAC system uses the same capacity on a mild day as it does on design days. Most of the energy savings associated with VRF systems accrue in part-load conditions.

> Compare your documentation of the VRF system that's described in the manufacturer's literature to the applied VRF system that you're servicing.

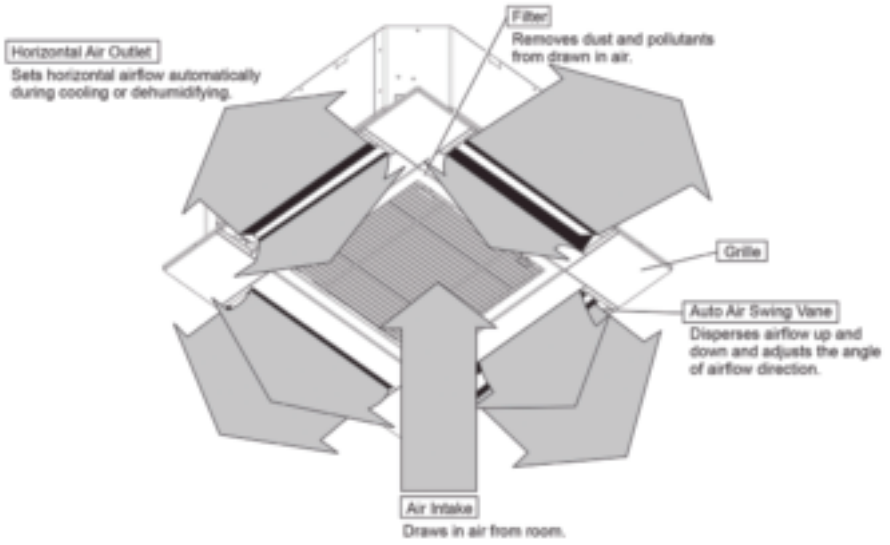
Continuous Communication and Variable Capacity

The ability of the VRF system to vary capacity is reliant on good communication between all of the systems components. Without accurate, continuous information from all system components, the outdoor unit can't adjust refrigerant flow to match internal loads. As a technician servicing VRF equipment, you need to understand how the components interact and communicate with each other.

While the compressor has the same mechanical function in both fixed-capacity and VRF systems, the VRF compressor has different electrical characteristics due to the inverter that controls its motor speeds. You need to account for this during servicing. If you're checking pressures or the refrigerant charge, for example, you may need to put the system in a special mode. Most VRF systems allow



Outdoor Unit



Indoor Unit (Ceiling-Cassette)

you to overconnect your indoor capacity to outdoor capacity for a convergence load. In this scenario, you can use a lesser-capacity outdoor unit with a larger-capacity indoor unit, as long as the unit doesn't constantly have larger capacity. When checking an overconnected system, it's imperative that you avoid using more indoor capacity than your condenser can handle. For example, if you have a 10-ton outdoor unit and 13 tons of air handlers, you shouldn't have more than 10 tons of indoor units running and calling during a test or evaluation.

Know the Specifications

Review and keep manufacturer literature for the products you maintain. Attend manufacturer trainings for the brands that you intend to service. Although the basic logic is the same across systems, VRF manufacturers have different approaches. VRF training and literature helps reduce the amount of time it can take to familiarize yourself with a new system.

Although a pressure temperature chart will help you understand superheat and subcooling, in a VRF system these values can change constantly. Also, unlike in a fixed-speed system, you may have distinct superheat and subcooling numbers in different parts of a VRF system.

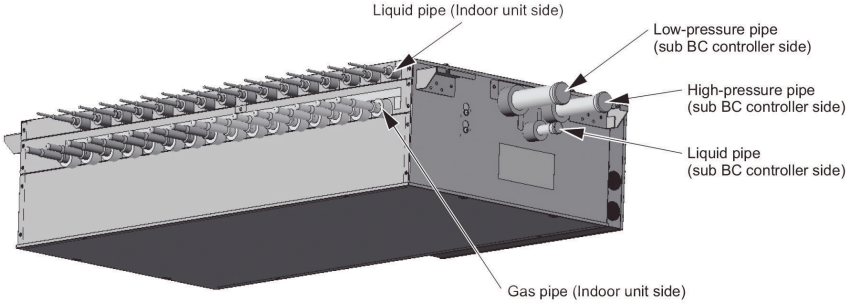
If you're installing a system, pay special attention to guidelines for clearance and serviceability. Knowing installation specifications will help you identify potential problems due to poor installation practices. This also holds true for indoor unit installations as well. Consider proper duct sizing for the rated static pressure of ducted units. Most VRF indoor units are designed to be self-contained with limited ductwork, if any. Make sure that there is enough space between indoor units to prevent cross airflows or one unit's supply air directed at another's intake or return.

VRF heat pumps and heat-recovery systems run throughout the winter, but there are special installation considerations required to maintain their performance. You will want to mount the outdoor unit above the snow line and keep it from being covered during a snowstorm. You will need to account for defrost and prevent icing beneath the units and in areas where people may walk. To maximize performance, you will also need to consider wind direction. Heavy winds can reduce system performance and cause poor defrost cycles.

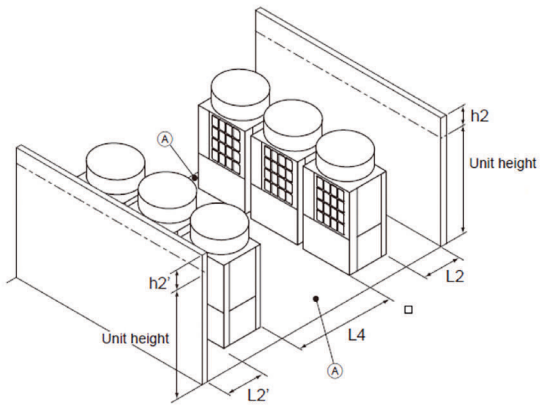
Document Your Inspection

Facility managers and customers are an important source of site-specific details. Start with the basics and work from there. How does your system operate? Where are the units located? Where are the thermostats? Can you show me the controller? Where's the electrical disconnect? Where's the unit's drain line and where does it terminate? You will ask questions and perform a visual inspection to identify potential vulnerabilities.

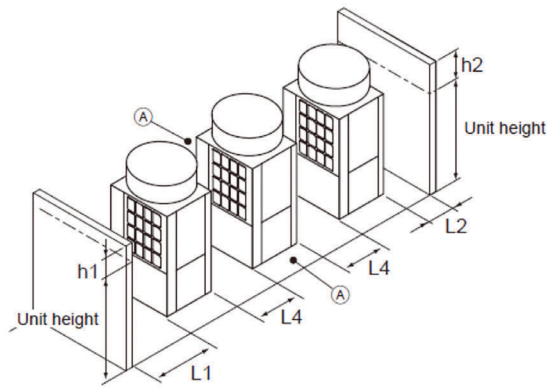
As you directly examine each piece of equipment, document the details and what your customer reveals about the system's performance. Your visual inspection and notes are part of the history you or another technician will use when assessing the VRF system in the future. You'll compare your documentation of the applied VRF system with the VRF system as described in the manufacturer's litera-



Branch Circuit Controller



Required minimum distance [mm (in)]		
L2 (Rear)	L2' (Rear)	L4 (Between)
300 (11-13/16) + h2	300 (11-13/16) + h2'	900 (35-7/16)



Required minimum distance [mm (in)]		
L1 (Front)	L2 (Rear)	L4 (Between)
450 (17-3/4) + h1	100 (3-15/16) + h2	450 (17-3/4)

Installation guidelines on distances between units.

ture. Note any apparent deviations from what is expected.

Document the cleanliness of the equipment and whether there are any obstructions to drainage or airflow. Also, if available, use manufacturer-provided diagnostic software or hardware to obtain an overview of system components, performance and past error codes. Some facilities may also have specialty panels and meters designed to collect performance data such as electrical consumption per unit. You'll sometimes find this equipment in facilities using energy allocation to bill individual tenants for energy use.

You'll also want to document how the VRF system integrates with other systems. Is there a separate building automation system or does the facility manager control multiple systems through the VRF controls? What protocols are used for integration? Ask your customer about their experience controlling the systems.

Communicate with your customer so they'll understand how you're developing a comprehensive view and history of how their VRF system has performed. If you have a service contract with them, you'll update your documentation with each scheduled visit.

Cleaning Takes Time and Saves Time

Before you spend time testing the pressure or airflow, visually inspect outdoor units and indoor units for cleanliness and obstructions. Some performance indicators are easily impacted by cleanliness. For example, low superheat is often caused by a dirty blower wheel or a dirty evaporator coil. Unlike traditional fixed-speed systems, VRF systems have the ability to modulate down and compensate for conditions like this.

This is where experience and thorough inspections pay off. Spend as much time as you need to thoroughly clean each indoor unit and confirm that drainage pans and lines are clear. Taking an extra 30 seconds to make sure you haven't overlooked a detail like restarting an outdoor unit you turned off during service can save your company money and time. Use checklists and follow manufacturer instructions for disassembly and cleaning processes.

Drainage lines are too often overlooked in all systems and especially in VRF systems. Regularly inspect and flush drain lines to prevent potential backups and leaks.

You may also need to perform location-specific cleaning tasks and inspections. If the facility is near the coast or a salty environment, you'll want to inspect metal components that could corrode or rust and clean these components. Be familiar with the brands and how their components work. Salt can corrode coils and electrical connections, which might lead to poor performance and early failures.

Training Makes the Difference

You might feel as if you're sacrificing money by taking time out of the field to attend a manufacturer's training class. But in the long run, you'll more than make up for that cost. You'll reduce the risk of costly callbacks and you'll be able to recognize potential issues before they become challenges. As the VRF market continues to expand, your ability to maintain these systems for optimal performance and comfort will elevate you above contractors who don't have VRF training.

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