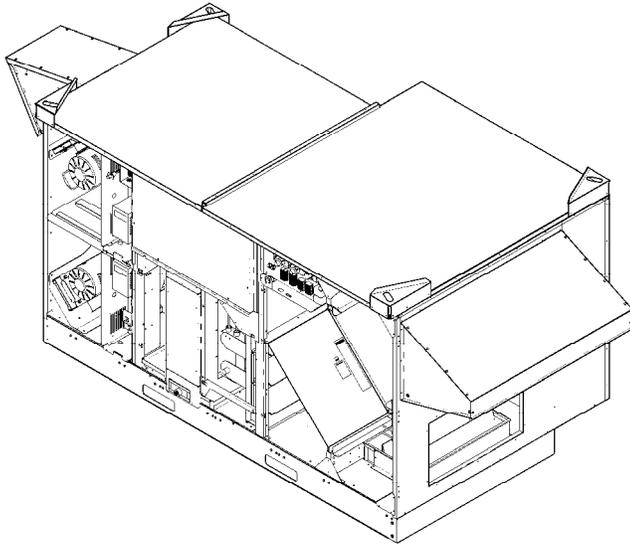


## RD2XRT INSTALLATION AND OPERATION MANUAL

# BOOK 1

## OVERVIEW



### ABOUT BOOK 1:

This book provides an overview of function and principles of operation of the RD2XRT. While it provides some guidelines, Specification Documents provided by a qualified Specifying Engineer are to be considered the Basis of System Design.

See Book 2 for product and performance specifications.

See Book 3 for the mechanical installation of the RD2XRT.

See Book 4 for basic electrical connections and wiring schematics.

See Book 5 for control system connections, VFD adjustment, Start-Up, Commissioning or Maintenance.

Following these instructions does not necessarily assure compliance with local codes and standards, which must always be observed.

### Table of Contents

<b>BOOK 1: Overview</b>	
Product Features	2
De-Coupled and DOAS System Overview	3
RD2X Psychrometrics	4
System Integration	6
Critical Warnings	7
Checklist for Specifying Engineer	8
<b>BOOK 2: Specifications</b>	
Product Features	2
Available Features	3
Descriptive Drawings	4
Configuration Codes	6
Condensed Specifications	8
Dimensions	10
Ratings	12
Modes of Operation	19
Unit Controls and Operating Sequences	20
Connections to External Equipment	22
Guide Specifications	23
<b>BOOK 3: Mechanical Installation</b>	
Product Features	2
Order of Installation	3
Critical Dimensions	4
Curb and Rail Dimensions	5
Service Clearances	6
Curb and Rail Installation Considerations	7
Rigging Information	8
Securing the Unit Against Wind Loads	9
Ducting	10
Coil and Drain Connections	11
How to Reconfigure the Inlet and Outlet (opt.)	12
How to Install Field-Supplied Coil (opt.)	14
<b>BOOK 4: Electrical Installation</b>	
Product Features	2
Power Connections	3
Disconnect Switch Ratings	5
On-Board Transformer	6
Control Connections	7
Electrical Installation Checklists	8
Schematics	10
Ladder Schematics	18
<b>BOOK 5: Start-Up, Commissioning and Maintenance</b>	
Initial Checks	3
Balance Air Flow	4
Review / Adjust On-Board Controls (opt.)	6
VFD Parameters	8
Control Connection Examples: On/Off and 3-speed	11
Analog Control of the VFDs -- General	16
Scaling to VFD Response to Analog Inputs	17
Control Connection Examples: Analog Controllers	22
Control Connection Examples: Mixed Analog & On/Off/35	
To Reset VFD Parameters	39
Service Parts	40
Warranty Information	48
Records	49

# BOOK 1: RD2XRT OVERVIEW

## PRODUCT FEATURES

The RD2XRT is an Energy Recovery Ventilator with available features designed for Dedicated Outdoor Air Systems.

Standard features include:

- Energy recovery by fixed-plate enthalpic energy exchanger
- Enthalpy- and temperature-controlled bypass of energy recovery
- Isolation dampers that shut down when ventilation is not needed
- Variable-Frequency Drive (VFD)-controlled direct-drive fresh air and exhaust air blowers
- Integrated disconnect switch
- Airflow measurement stations

Available features include:

- Heating and/or cooling coils for post-treatment of fresh air
- Double-wall construction

### PRINCIPLE OF OPERATION

The RD2XRT can operate in up to four modes depending on options installed:

- Energy Recovery mode: the unit transfers heating or cooling energy from the exhaust air to the fresh air.
- Recovery Bypass mode: the unit takes advantage of free cooling from the outside air and doesn't transfer energy between air streams.
- Dehumidification mode: the unit conditions the fresh air to 53°F.
- Heating mode: the unit tempers the fresh air to 75°F.

The RD2XRT operates automatically. The unit receives an external call for ventilation. Its isolation dampers open and turn on the variable frequency drives and blowers. The unit determines the operating mode by continuously monitoring the air streams for temperature and enthalpy.

The RD2XRT does not include a condensing unit, chiller, heat pump or boiler. When a coil for dehumidification or cooling is part of the RD2XRT unit, the condensing unit, chiller, heat pump or boiler is separately installed to meet the needs of the complete system. RD2X units equipped with coils include electrical connection points to call for operation of the separate heating or cooling equipment. **However, no fluid or refrigerant flow control valve (TX valve) is provided, and must be specified by the designer of the overall system for separate sourcing.**

### OPERATING CONTROLS

A wide variety of low voltage (24VAC) control schemes may be selected to meet the ventilation needs of the facility. These may include time clock, occupancy sensor, carbon dioxide sensor, and others. DDC systems may also control the unit with external control by other. **TX valves are not provided.**

### WARNING

#### **RISK OF FIRE, ELECTRIC SHOCK, OR INJURY. OBSERVE ALL CODES AND THE FOLLOWING:**

1. The installation manual shows the suggested installation method. Additional measures may be required by local codes and standards.
2. Installation work and electrical wiring must be done by qualified professional(s) in accordance with all applicable codes, standards and licensing requirements.
3. Any structural alterations necessary for installation must comply with all applicable building, health, and safety code requirements.
4. This unit must be grounded.
5. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment that might be installed in the area affected by this equipment. If this unit is exhausting air from a space in which chimney-vented fuel burning equipment is located, take steps to assure that combustion air supply is not affected. Follow the heating equipment manufacturer's requirements and the combustion air supply requirements of applicable codes and standards.
6. Use the unit only in the manner intended by the manufacturer. If you have questions, contact the manufacturer.
7. This unit is intended for general ventilating only. Do not use to exhaust hazardous or explosive materials and vapors. Do not connect this unit to range hoods, fume hoods or collection systems for toxics.
8. This unit must be properly ducted to the outdoors.

### CAUTION

**To avoid motor bearing damage and noisy and/or unbalanced impellers, keep drywall spray, construction dust etc, out of unit.**

# BOOK 1: RD2XRT OVERVIEW

## DE-COUPLED AND DEDICATED OUTDOOR AIR SYSTEMS OVERVIEW

### DE-COUPLED SYSTEMS

There is great interest today in HVAC systems in which the function of providing and conditioning the outside ventilation air is de-coupled from the function of circulating, heating and cooling the air inside the building.

This is particularly interesting when the Outside Air fraction is greater than 30%, as is true with moderate- to high-density occupancies such as schools and offices. In these applications, the sensible heating or cooling loads are not well-coordinated in time or magnitude with the latent loads. The latent loads are primarily associated with the outside air ventilation, which is largely driven by occupancy schedules, not sensible loads. Thus proper control of latent loads and humidity can be difficult when just one piece of equipment is expected to handle sensible loads, latent loads and provide the outside air ventilation.

In addition, when multiple spaces are handled by a central air conditioner, often using Variable-Air-Volume (VAV) approaches, the ventilation needs of each space are not often well-matched to the air delivery needs imposed by the space's sensible and latent loads. As a result, the overall outside air delivery to the building is typically higher than necessary, in order to ensure that each of the separate spaces is receiving the necessary amount of outside air.

Decoupled systems in many cases are more efficient and less expensive to operate, as well. In short, de-coupled systems in many cases offer several benefits:

- the latent loads are properly controlled, often without reheat;
- the correct amount of outside air can be delivered to each space, without having to over-ventilate some spaces;
- the overall energy efficiency of the HVAC system is enhanced.

### DOAS SYSTEMS

Dedicated Outdoor Air Systems (DOAS) are a refinement of the De-coupled System concept. DOAS systems use two separate pieces of equipment:

- 1) Outside ventilation air is provided and pretreated by one piece of equipment that uses energy recovery to greatly reduce the sensible and latent loads of the outside air, then additionally cools air to address the remaining internal latent loads.
- 2) Sensible loads are addressed by a parallel piece of equipment, sometimes with separate ductwork, that provides the remaining circulation air needs. VAV, fan-coil, and radiant systems all have been used successfully.

Many DOAS units available on the market today are designed to provide very tight control of humidity, and some are capable of delivering air at very low wet bulbs, while reheating the supply air to room temperature but the tighter the control, the more complex and expensive.

### RENEWAIRE'S RD2XRT

The RD2XRT brings the DOAS concept to smaller, less-demanding applications where the benefits of de-coupled systems and energy recovery are still important and valuable.

The RD2XRT includes the features you need to meet ASHRAE 62.2 and 90.1 requirements, such as energy recovery, recovery bypass, and isolation dampers.

Internal logic for the RD2XRT is provided by simple, easy-to-understand temperature and enthalpy controls, and the unit can be controlled by a variety of stand-alone controls or a Building Automation System.

Its direct-drive blowers with NEMA Premium motors are controlled by Variable Frequency Drives for maximum delivered efficiency at the required system airflow.

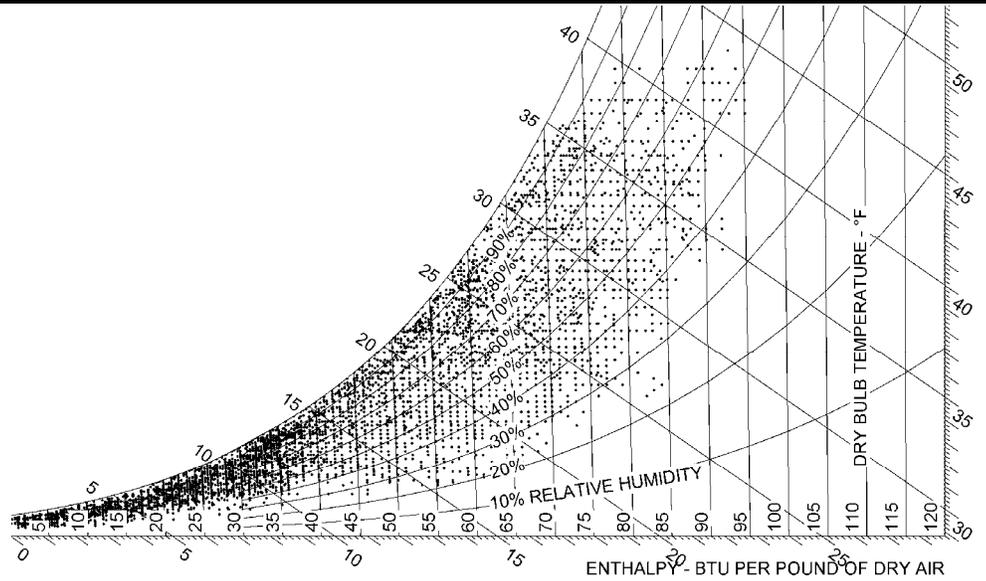
Finally, a range of factory-installed heating and cooling coils are available for integration of the RD2XRT units with the DX, heat pump, chilled or hot water systems which you are designing to best meet the overall HVAC needs of your project. Since the heating and cooling components other than the coil are specified by you, those components can be the ones you are most comfortable with and can be sourced most efficiently for the lowest delivered cost to your customer.

# BOOK 1: RD2XRT OVERVIEW

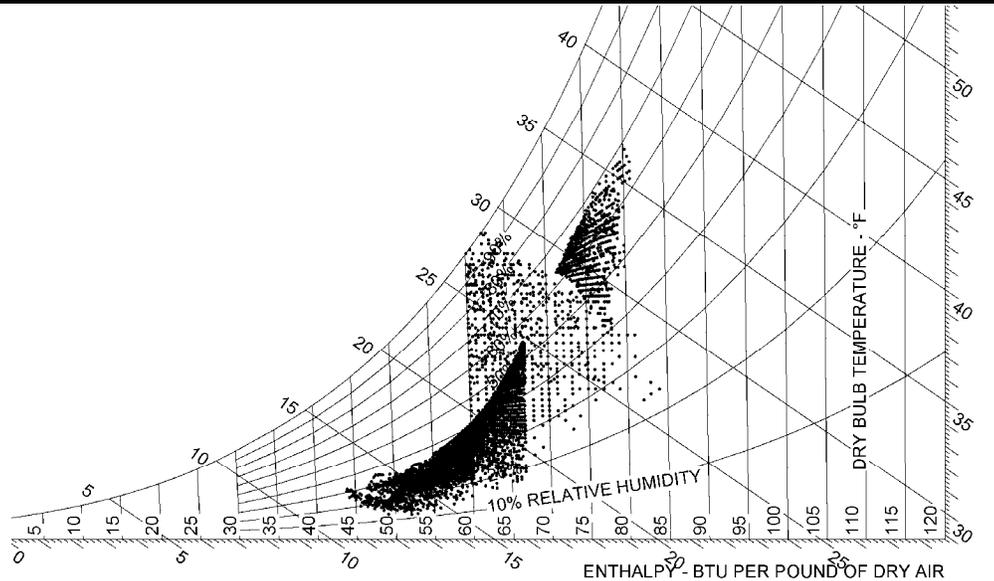
## RD2X PSYCHROMETRICS

### ENERGY RECOVERY WEATHER COMPRESSOR

Energy Recovery in the RD2XRT compresses the range of temperature and humidity of the outside ventilation air. This reduces the energy needed to condition the outside ventilation air. It also reduces the range of conditions that the downstream air conditioning equipment must be able to handle.



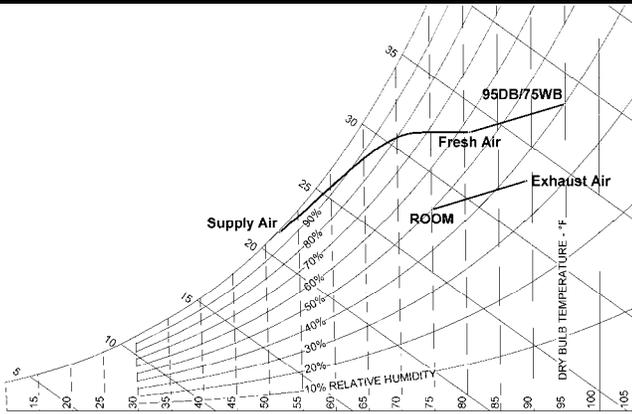
**FIGURE 1-1**  
Typical Meteorological Year (TMY) bin data for outside air in Madison, Wisconsin.



**FIGURE 1-2**  
The same outside air bins after Weather Compression by Energy Recovery in the RD2XRT. In this example Recovery is Bypassed when the Outside Air is above 60°F and below the Room Air Enthalpy.

# BOOK 1: RD2XRT OVERVIEW

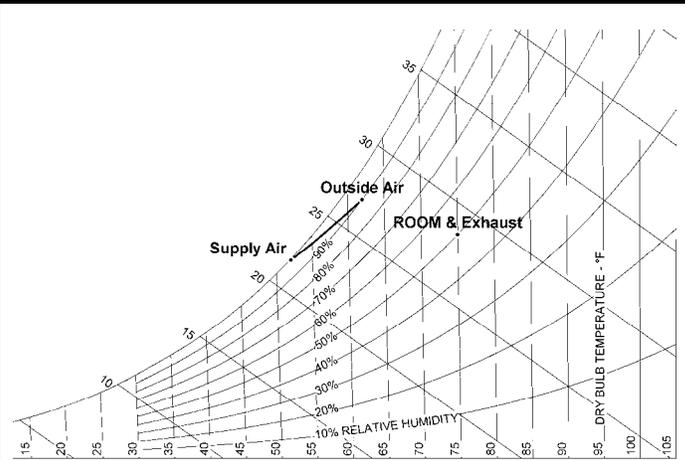
## RD2X PSYCHROMETRICS



**FIGURE 1-3**

### Full-Load Cooling

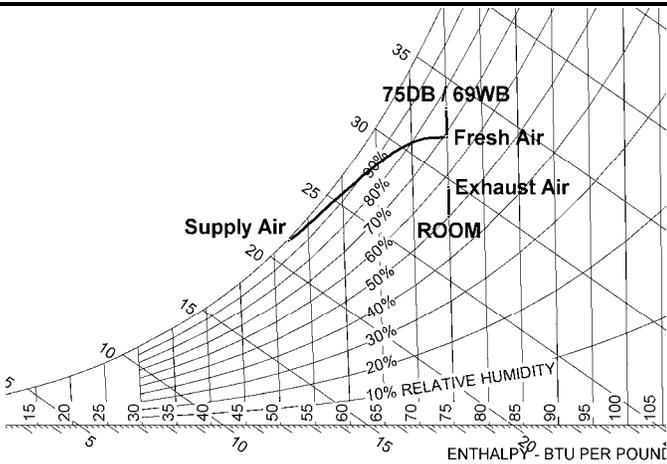
In this typical summer design condition, Room air is exhausted through the Energy Recovery Component, giving up coolness and dryness. Outside Air passing through the Energy Recovery Component is substantially reduced in temperature, moisture content and enthalpy (“Fresh Air” point). The air then passes through the dehumidification coil for delivery as cool, dry air to the space (“Supply Air” point).



**FIGURE 1-4**

### Energy Recovery Bypass

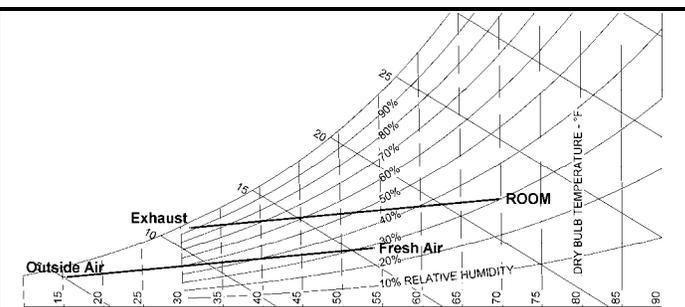
In this example, Outside Air is cooler than the Room Air, has somewhat more humidity, but is lower in Enthalpy. Energy Recovery is bypassed, so Room Air is exhausted without changing condition. The Outside Air still requires energy reduction to control inside humidity loads, so it passes through the dehumidification coil for delivery as cool, dry air to the space (“Supply Air” point).



**FIGURE 1-5**

### Part-Load Cooling

In this case, Outside Air is the same temperature as the Room Air, but has much more humidity. Room air exhausted through the Energy Recovery Component, gives up dryness. Outside Air passing through the Energy Recovery Component is reduced in moisture content (“Fresh Air” point). The air then passes through the dehumidification coil for delivery as cool, dry air to the space (“Supply Air” point).



**FIGURE 1-6**

### Heating

In this example, Outside Air is much cooler and also is dryer than the Room Air. Room air is exhausted through the Energy Recovery Component, giving up heat and humidity. Outside Air passing through the Energy Recovery Component is substantially increased in temperature, moisture content and enthalpy (“Fresh Air” point). Because the Room air gives up humidity as it cools, it stays below the saturation point and cannot freeze.

# BOOK 1: RD2XRT OVERVIEW

## SYSTEM INTEGRATION

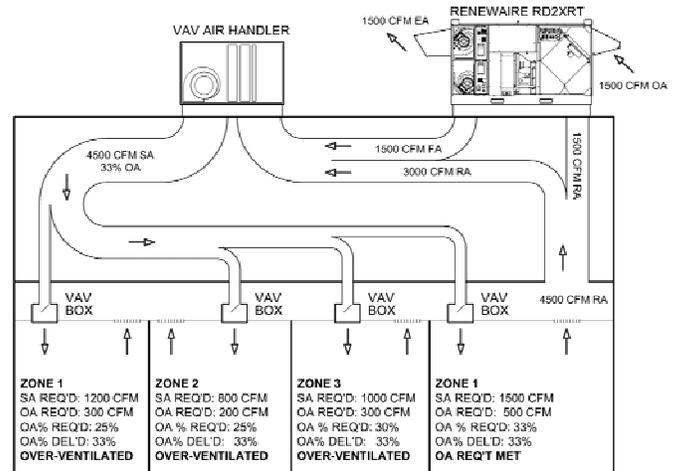
### SYSTEM INTEGRATION

The RD2XRT can be integrated with many types of HVAC systems. Following are three extremely simplified examples.

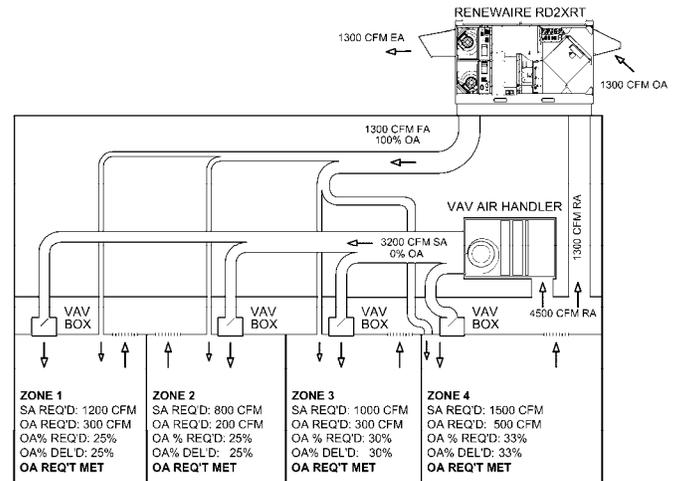
A simple but not ideal system uses the RD2XRT to provide outside ventilation air to the return of a Variable Air Volume (VAV) air handler (see Figure 1-7, this page). But as illustrated, if different zones require different outside air fractions, the total amount of outside air that must be delivered exceeds the sum of the zone requirements.

A better VAV-based system uses parallel delivery of the outside ventilation air to each zone (see Figure 1-8, this page). Only the required amount of outside air is delivered to each zone, so the RD2XRT need not provide excess air. Since the VAV air handler need provide only enough air volume to address the sensible loads, it can be smaller.

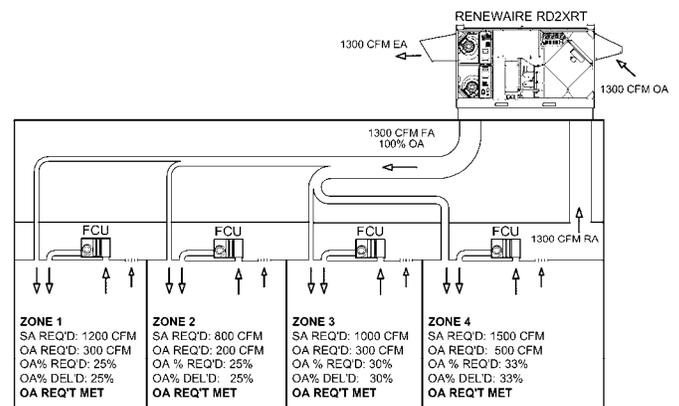
Another system with similar advantages uses Fan-Coil Units or radiant heating/cooling with parallel delivery of the outside ventilation air to each zone (see Figure 1-9, this page). Again, only the minimum required outside ventilation air volume need be delivered.



**FIGURE 1-7**  
**RD2XRT with Series VAV System**



**FIGURE 1-8**  
**RD2XRT with Parallel VAV System**



**FIGURE 1-9**  
**RD2XRT with Parallel Fan Coil Units**

### REHEAT

When the volume of outside air delivered to each space is properly controlled by use of a de-coupled system, reheat is rarely needed.

### OPERATING CONTROLS

A wide variety of low voltage (24VAC) control schemes may be selected by the engineer, installer, or owner to meet the ventilation needs of the facility. These may include time clock, occupancy sensor, carbon dioxide sensor, and others. DDC systems may also control the unit with external control by other. Most control schemes will operate the unit only when needed.

# BOOK 1: RD2XRT OVERVIEW

## CRITICAL WARNINGS

### SAFETY WARNINGS

Be aware of the following safety warnings found in Books 3 & 4:

#### WARNING

**DO NOT SUSPEND OR HANG UNIT.** Secure the unit to meet applicable seismic requirements.

See "BOOK 3: MECHANICAL", page 7.

#### WARNING

**Danger of roof damage or severe injury if high winds move this unit. Secure unit to structure. Observe local code requirements.**

See "BOOK 3: MECHANICAL", page 9.

#### WARNING

**The fresh air inlet should be at least 10' away from any exhaust, such as dryer vents, chimneys, furnace and water heater exhausts, or other sources of contamination or carbon monoxide. Do not locate the fresh air inlet where vehicles may be serviced or left idling. Never locate the fresh air inlet inside a structure.**

See "BOOK 3: MECHANICAL", page 10.

#### WARNING

**Danger of Electrical Shock! Variable Frequency Drive capacitors retain charge after power is removed. Disconnect power and wait a minimum of three minutes before servicing drive.**

**Do not cycle input power to drive more than once every two minutes**

See "BOOK 4: ELECTRICAL", page 5.

### SERVICE DISCONNECT

The unit comes from the factory with a load switch installed in the blower module door. To open the blower module door the switch must be turned to the 'OFF' position. However, line voltage is still present at the input to the load switch. Local codes may require installation of another Disconnect Switch.

See "BOOK 4: ELECTRICAL", page 5.

### DAMAGE CAUTIONS

Be aware of the following damage cautions found in Books 3 & 5:

#### CAUTION

**To avoid motor bearing damage and noisy and/or unbalanced impellers, keep drywall spray, construction dust etc, out of unit.**

See "BOOK 3: MECHANICAL", page 2.

#### CAUTION

**Danger of condensation and resultant equipment damage or biological growth if ducts are not properly installed, sealed and insulated. Observe guidelines above as well as all applicable codes.**

See "BOOK 3: MECHANICAL", page 10.

#### CAUTION

**Make sure clean filters are installed in the RD2X before balancing air flow. Dirty or clogged filters reduce air flow through the unit.**

See "BOOK 5: START-UP, COMMISSIONING AND MAINTENANCE", page 4.

#### CAUTION

**Filters must be used or the energy exchange core will become blocked by dust and the unit will not do its job. In extreme cases components may be damaged.**

See "BOOK 5: START-UP, COMMISSIONING AND MAINTENANCE", page 5.

#### CAUTION

**Very low air flow rates may result in fouling of the energy exchanger core. Do not reduce air flow to below 500cfm.**

See "BOOK 5: START-UP, COMMISSIONING AND MAINTENANCE", page 4.

# BOOK 1: RD2XRT OVERVIEW

## CHECKLIST FOR SPECIFYING ENGINEER

ITEM	REQUIREMENT	MORE INFORMATION
Location	Outside	Book 2, page 10 Book 3, pages 4-10
Service Access	Access to front and rear of unit is required.	Book 2, page 10 Book 3, page 6
Ducting	2 required, must be insulated and sealed inside and outside if exposed to non-conditioned spaces. Design for low pressure drop for maximum system efficiency. Pressure drop must be determined for proper specification of unit.	Book 3, pages 10
Power Requirements	Unit is available in all North American voltages except 115VAC 1P. Desired voltage must be specified so the unit can be properly ordered.	Book 2, pages 6, 8
Service Disconnect	Integrated Service Disconnect Provided with Unit. Check for compliance with local codes.	Book 2, page 9
Unit Configuration	A variety of inlet/outlet locations are possible and should be specified so that unit can be properly ordered.	Book 2, pages 6-7
Configuration Code	Defines the inlet/outlet configuration, coil type and capacity, input voltage and optional features. Required so the unit can be properly ordered.	Book 2, page 6
Optional Features	Must be specified so that unit can be properly ordered.	Book 2, page 3, 6
Unit Mounting/Securing	Unit must be secured against wind and seismic loads.	Book 3, page 9
Coil Specification	If coil is desired, it must be selected along with external heating/cooling equipment to meet required system output conditions.	Book 2, pages 12-18
Coil Connections	(see above)	Book 2, page 10, 12-18 Book 3, page 11
External Heating/Cooling Equipment	(see above)	Book 2, pages 12-22 Book 4, pages 6, 17
Drain Connections	If cooling coil is provided, the condensate drain must be plumbed.	Book 2, page 10 Book 3, page 11
Control System	Must be specified	Book 2, pages 2, 3, 19-22 Book 4, pages 6, 10-17 Book 5, pages 11-38
Airflow	Must be specified for both supply and exhaust.	Book 2, pages 8, 12
Control Temperature Setpoints	Factory defaults can be adjusted	Book 5, page 6
VFD parameters	Factory defaults can be adjusted	Book 4, page 9 Book 5, pages 8-39