A Quick Guide to Validate Air-to-Air Exhaust Energy Recovery

Air-to-air exhaust energy recovery ventilation (ERV) is a powerful energy efficiency technology. In Minnesota cold climate, ERV systems can displace 70% to 80% of the total ventilation load, making their operation as important to overall building energy use as heating and cooling equipment. They do this by exchanging energy between outgoing exhaust air flow and incoming fresh outside air.

However, ERVs have not yet been elevated to the same critical regard as heating and cooling systems. They save energy passively, in the shadow of these other systems, and their operations are easy to overlook. Failed components, errant operational changes, control sequence irregularities, and even serious design and installation mistakes may go unnoticed for long periods of time, particularly absent robust start-up procedures. Inefficiencies in ERVs are typically absorbed by heating and cooling equipment, which then use more energy to satisfy the ventilation load. While the systemic issues that reduce ERV performance may be complicated to overcome, it's fairly easy to validate ERV functionality on a system-by-system level.

Problems with ERVs are easily identified if one:

1. Knows when energy recovery should occur, and
2. Can evaluate if energy recovery systems are active.

Once problems have been identified, they can be reported to the responsible party or investigated further. This short guide emphasizes the validation of energy recovery performance and the identification of lost recovery or ineffective operation. It assumes that up-to-date manufacturer preventative maintenance has been conducted on all components of the air handler and that units are generally in good physical condition.

Validate Major Energy Savings

In Minnesota, the majority of energy recovery occurs between about 0^0 F and 45^0 F outside air temperature. The top priority is to ensure that energy recovery is active between these temperatures. If exhaust and outside air pass through a spinning wheel, energy is recovered. In the case of fixed and membrane plates, energy recovery is virtually guaranteed if air streams pass through the plates (e.g. flow does not bypass). Hence the most important step for validating energy recovery is to physically check that supply and exhaust flows pass through the unit (i.e. not bypass) and, if the unit is a wheel, ensure that it is spinning. Doing this a few times per year and recording observations is the easiest way to ensure 60% to 80% energy recovery savings.

Although energy recovery is less important during cooling season, it's similarly easy to validate. Energy recovery should nearly always be operational above 75^0 F (space temperature). It may or may not operate below these temperatures due to various controls or economizer settings, and that ultimately isn't that important for total savings. Physically validating the wheel performance at very hot conditions (90^0 F/60% RH) will also ensure peak load reduction on cooling systems.

VALIDATE OTHER OPERATIONS

Free Cooling (Economizer):

Energy recovery should be inactive during economizer mode. Between outside air temperatures of 55^0 F and 75^0 F, wheels should not spin and units with face/bypass damper sets should be in bypass configuration. While the exact temperature limits will change depending on the implementation, it should not vary by more than 5^0 F on either side. Operation with respect to temperature may be sporadic with enthalpy-based controls, possibly necessitating checking during a variety conditions.

Frost Control

Frost control (or prevention) is important to prevent blockage and potential damage. In very cold weather (<0^0 F outdoor air temperature), energy recovery is reduced to mitigate frost. Frost controls and implementations vary broadly.

Unbalanced Flows

Savings from ERVs are sensitive to flow rates. Designers usually specify exhaust and supply flow rates that are approximately equal to one another. Installed units may have very different supply and exhaust flow rates. The most common situation is that exhaust flows are less than design values and actual supply flow rates. This means

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exhaust flows are exiting the building elsewhere (i.e. exfiltration, unit exhausts, other AHUs) and energy from these flows is not recovered. In this situation performance (effectiveness) goes up while recovered energy goes down. If no reliable air flow measurements or record of as-operated flows are available, it may make sense to consult a TAB contractor and potentially a system engineer to weigh the benefits of energy recovery versus other air flow or pressurization needs. In addition to helping optimize flows for energy recovery, coordinating net air flow into and out of a building may offer other benefits such as reducing fan energy and cold drafts, and improving the longevity of building wall assemblies.

STEPS FOR BASIC VALIDATION

Step #1: Determine how energy recovery is physically controlled.

Physically validating the operation of the control mechanism (e.g. damper sets or wheel speed) and identifying the associated control points are critical to evaluating energy recovery performance.

- ❑ Wheel speed
- ❑ Face/bypass damper
- ❑ Both wheel speed and bypass dampers

Determine and validate control points associated with energy recovery.

- ❑ Wheel speed (RPM, %),
- ❑ VFD (%, Hz),
- ❑ Face/bypass damper position (%)

Step #2: Determine temperature control points associated with energy recovery. One can substitute approximate values for enthalpy-based controls.

Knowing system control set points is critical for interpreting when energy recovery should be active or inactive.

- ❑ Frost control (Outside temperature or exhaust temperature based)
- ❑ Discharge supply temperature
- ❑ Economizer upper limit

Step #3: Begin physically validating energy recovery and recording control point values at different outside air conditions.

- ❑ See attached visual instructions, example, and record sheet

Quick Shortcut:

- ❑ Check that energy recovery is active between 0ºF and 45ºF
- ❑ Check that energy recovery is inactive between 55ºF and 75ºF
- ❑ Check that energy recovery is active above 75ºF

Figure 1: Visual instructions and example for assessing basic energy recovery functionality

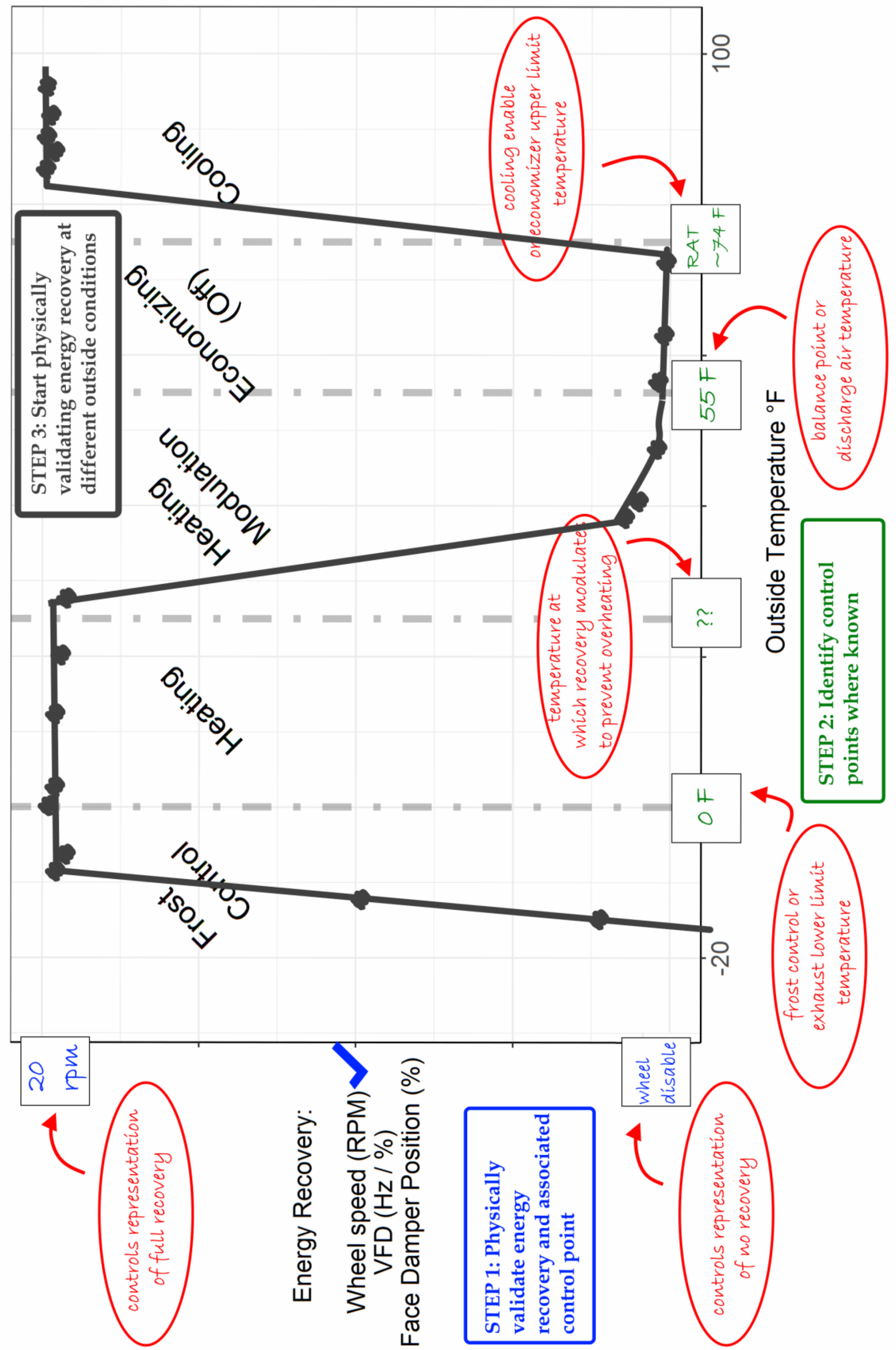

Figure 2: Visual template for assessing basic energy recovery functionality