Air Handling Unit Assessment Guidelines

General Air Handling Unit Assessment Procedure
1. Get copies of mechanical drawings (determine air handling unit [AHU] layout and site plan).
2. Determine type of AHUs throughout the building (constant volume, variable air volume, multi-deck, etc.).
3. Determine type of fan and fan engineering specification sheets (i.e., forward curved or backward curved and fan pressure versus flow performance).
   - Determine total fan system efficiency, mechanical efficiency, and part load performance.
4. Print a copy of the AHU mechanical schedules.
   - Analyze design flow rates for supply, outside, and return air versus as-found conditions.
5. Take screen shots of the AHU through the direct digital control (DDC) system.
6. Fill out AHU data collection forms.
7. Visually inspect coils to make sure they are clean.
8. Count all dampers, valves, and temperature sensors.

Note: The following retro-commissioning information was taken directly from PECI's functional testing guide (www.peci.org/ftguide/) and modified for this energy assessment training.

Analyze Operation and Control of the AHUs.
- Count all outdoor air, return air, and exhaust air dampers.
  - Record current position (% open).
  - Record actuator type (electronic or pneumatic).
  - Note condition of current actuator and damper bank.
- Verify proper stroke for outdoor, return, and exhaust dampers to ensure that they open, close, and modulate as intended. This can be accomplished by having a DDC operator command a damper to open, close, and modulate and visually observe the operation.
  - Have one person stand next to the AHU with a walky-talky and have the DDC operator command the damper to open and close.

  - Watch to make sure the actuator modulates and the dampers modulate.
  - Check to make sure the dampers fully open and close.
  - Make sure the control signal varies between 0–15 psi for pneumatic systems and 0–10 V or 4–20 mA for electronic actuators.
- Verify that the outdoor air ventilation is maintained at or above the minimum specified value (minimize outside air as much as possible, i.e., 17 CFM/person in office space).
  - Use a handheld anemometer to measure outside airflow rates. Measurements should be taken across the damper bank and averaged.
  - Calculate total exhaust airflow rate and make sure it is 10% greater than outside air when reducing outside air flow rates.
- Count all heating and cooling coils and valves.
  - Record current valve position (% open).
  - Record actuator type (electronic or pneumatic).
  - Note condition of current valve.
  - Make sure valve position hasn't been manually overridden.
- Verify proper stroke for control valves to ensure that they open, close, and modulate as intended. This can be accomplished by having a DDC operator command a valve to fully close.
  - While sitting at the DDC screen, manually close a valve and record the mixed air temperature and discharge air temperature.
  - If the valve fully closes, the system should reach an adiabatic state and the temperatures will be the same. (If the supply air fan is in the air stream the discharge air temperature might be a couple of degrees hotter since it is picking up the waste heat off of the motor.)
  - If the temperatures don't reach an adiabatic state then the valve is leaking and needs to be repaired or replaced.

– For chilled water systems, check the supply and return water temperature at the coil to see how it compares with the temperatures in the secondary loop.

➢ Verify that the control valves close off completely through DDC overrides.

➢ Verify proper control of the heating coil, economizer, and cooling coil in each air handler through DDC overrides.

➢ Verify proper supply and return fan control per specified sequence of operations, including (but not limited to) morning warm-up, building pressure control, heating and cooling mode, economizer mode, and fire/life safety mode.

➢ Visually inspect the heating and cooling coils to make sure they are clean. Dirty coils can drastically reduce the overall heat transfer coefficient of the coil.

➢ Visually inspect the air filters to make sure they are clean.

Setpoints and Reset Controls Assessment Procedure

1. Verify the proper supply fan variable frequency drive (VFD) control static pressure setpoint in variable air volume systems. Oftentimes, the setpoint (whether specified by design engineer or estimated by controls contractor) is set artificially high, wasting fan energy for the life of the building if not corrected.

   ➢ Record the current static pressure setpoint of all AHUs.

   ➢ Determine if the static pressure is reset. If not, have the DDC operator analyze the applicability of reducing static pressure on one AHU. Trend supply air temperature, return air temperature, variable air volume (VAV) box position, supply fan VFD percent flow, and return fan VFD percent flow. The static pressure should be incrementally decreased until the VAV box in the worst case zone is 90% open.

   ➢ Record outside air temperature and humidity when doing the test and help them develop reset guidelines (see energy assessment training presentations for more information).

2. Verify the static pressure reset control strategy in VAV systems. The supply fan static pressure setpoint may be reset downward based on dynamic load requirements to further reduce fan energy.

3. Verify that the maximum setpoint does not exceed the specified design pressure value.

4. Verify the discharge air temperature reset control strategy. Typically the discharge air temperature setpoint will be reset based on a parameter(s) that characterizes system load (such as outdoor air temperature, terminal unit valve, or damper position).

5. Verify proper coordination between individual setpoints and reset strategies.

Airside Economizer Assessment Procedure

The purpose of functionally testing an economizer cycle is to verify that the process and its related functions perform satisfactorily under all building operating conditions—providing free cooling using outdoor air quantities beyond ventilation requirements.

1. Verify that the control process provides reliable free cooling when conditions are appropriate under all building and system operating modes (including automatic and manual control modes) and under all climate conditions (including seasonal extremes outside the statistical design envelope).

2. Verify the cycle is integrated properly with other building processes and systems in both normal and emergency control modes.

3. Verify that interlocks return the economizer dampers to safe and efficient positions when the air handling system is shut down.

4. Verify that interlocks disable the economizer cycle when it no longer provides an energy savings benefit. The setpoints of these interlocks are appropriate for the loads served and the local environmental conditions.

5. Verify that interlocks protect the air handling system and building areas served by the economizer from damage in the event of a failure of the economizer control process or a component of the system. These interlocks include low temperature cut-outs, high and low static pressure cut-outs, pressure relief doors, and limit switches.

AHU Morning Warm Up Assessment Procedure

Because the heating elements used for warm-up usually perform other functions in the HVAC system they serve, the purpose of the test procedure for the warm-up process will verify that the warm-up function is properly integrated with the other heating functions and the overall operation of the system. Where dedicated warm-up elements are provided, additional testing to verify valve stroke, pressure, flushing, and capacity may also be required.

1. If warm-up uses the terminal unit reheat coils for warm-up, verify that the flow rate used by the terminal unit maximizes the heat available for warm-up and minimizes the cycle length without sacrificing energy efficiency. Higher flow rates at the terminal reheat coils do not necessarily translate into quicker warm-up times and more warm-up capacity. When ventilation loads cannot be eliminated, the terminal unit flow rate should be at a minimum.

2. Where appropriate, verify that makeup air, ventilation air, and exhaust systems are not operated during the warm-up cycle (typical sequence of operations). This will result in energy savings due to lower makeup air heating requirements and less fan energy.

3. Verify that the warm-up cycle length is not too long during extremely cold weather. This is best verified through trending. If the warm-up cycle is too long, the night setback control sequence and setpoints may need to be adjusted.

4. Verify that heat is available for warm-up during moderate weather (i.e., the heating plant is locked out based on atmospheric conditions). The lockout setpoint may need to be overridden during testing.

AHU Instrumentation and Metering Assessment Procedure

1. Use a hand-held anemometer to measure outside airflow rate and diffuser flow rate, temperature, and humidity.

2. Install HOBO data loggers in return air ducts to monitor CO_2, temperature, and humidity.

3. Use a handheld infrared (IR) gun to measure space temperatures versus DDC readings.
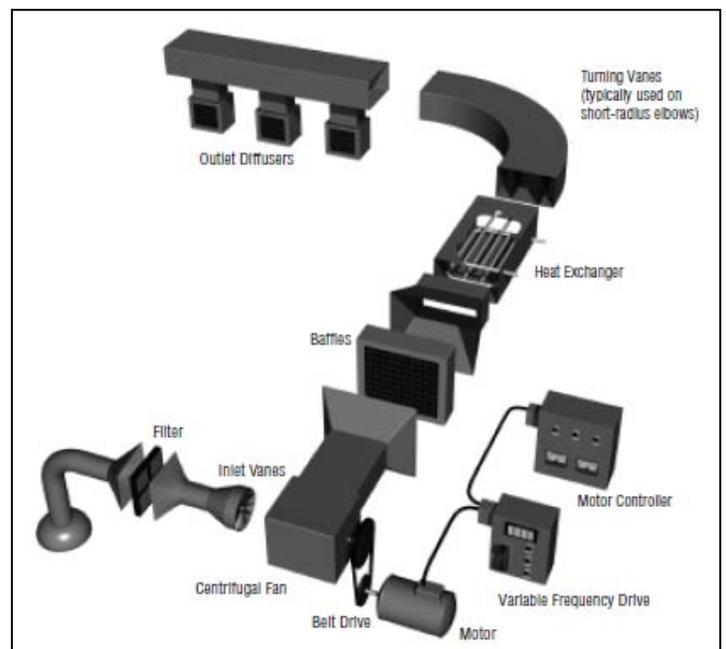

Figure 1. Example of fan system components.[1]
Illustration from Lawrence Berkeley National Laboratory

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[1] *Improving Fan System Performance: A Sourcebook for Industry.* DOE/GO-102003-1294. Prepared by Lawrence Berkeley National Laboratory for U.S. Dept. of Energy. www.eere.energy.gov/industry/bestpractices/pdfs/fan_sourcebook.pdf. April 2003.