Back2Basics

Based on Cx-3 ATC/FPT and TAB-3 software

BY HOWARD MCKEW, P.E., C.P.E.

Refer to January 2010 Back2Basics for an introduction to energy auditing and energy retrocommissioning. A good guideline for implementing an energy audit is ASHRAE"s *Procedures for Commercial Building Energy Audits* manual. We also recommend you refer to ASHRAE handbooks for discussion on air terminals:

- Refer to chapter 47 in the *2011 ASHRAE Handbook – HVAC Applications*, "Design and Application of Controls" for air terminals
- Refer to chapter 4 in the *2008 ASHRAE Handbook – HVAC Systems and Equipment*, "Air Handling and Distribution"

Our goal for this B2B series is to provide methodology and guidelines by which you can increase equipment and system performance, save energy, and improve the environment. The energy retrocommissioning team/auditors for this three-month test series includes the facility manager, existing building ATC technician, retrocommissioning engineer, and TAB engineer. If pursuing LEED® EB (existing building), a LEED Accredited Professional will be required to be part of the energy retrocommissioning team.

HVAC ENERGY AUDIT AND RESULTS

Auditing air terminals is seldom done in sufficient detail to assess each unit's performance, but it is necessary to do if an energy retrocommissioning team is going to fine-tune the reduction of energy consumption, as well as reduce over-heating, under-heating, over-cooling, and/or under-cooling complaints.

VAV and VAVRH are commonly found in most building applications (office space applications, health care applications, pharmaceutical applications, etc.). These terminal devices can serve anywhere from 2,000 sq ft of space down to 100 sq ft.

For some facility managers in these institutions, they will complete planned maintenance on air terminals (see this June's "The Facility Files" for an example of a scheduled maintenance workorder) when responding to an occupant's complaint rather than have a predetermined timed for routine maintenance. The reason for this is that the maintenance manager has to prioritize the completion of maintenance workorders based on available maintenance technicians (always a budget constraint). One pharmaceutical firm's approach to scheduled maintenance has been: Priority 1 is life safety equipment and IAQ equipment. Priority 2 is the major infrastructure equipment, such as boilers, chillers, process compressors, etc. Priority 3 is the central AHUs, and Priority 4 is the terminal equipment. Based on available workforce, their only way of getting to complete maintenance workorders for terminal equipment may be to "run until it breaks" or run until a complaint. At that point in time, planned maintenance will be completed in sync with the unscheduled workorder response.

DATA COLLECTION

The energy retrocommissioning team should begin its process based on the following:

- Review existing HVAC record drawings and record specification to find or to create a Basis of Design (BofD) (see "The Facility Files" for an abbreviated example of BofD).
- Create system flow diagrams to document and create a visual survey aid for the air terminals to be retrocommissioned.
- Create an air terminal unit matrix to inventory and document all the terminals to be retrocommissioned, noting unit number, location, area served, design cfm (minimum and maximum), inlet static pressure, hot water supply and return temperature if applicable, supply air temperature (primary air, discharge air, and reheated air), and modes of operation (24/7, occupied-unoccupied, morning warm-up, morning cool-down, etc.)
- If possible, complete system trending and control loop verification for automatic temperature control (ATC) system performance and accuracy of ATC devices.
- Document ATC strategy via functional performance test (FPT) to compare current operating conditions and setpoints vs. original ATC sequence of operation using the Cx-3 software and the FPT system flow diagram and pass-fail test.
- Document current air and water flows and pressure drops vs. original design using the TAB 1-2-3 process, including design-to-actual data (refer to next month's B2B for this issue)

This month's test requires the energy retrocommissioning team auditors to implement an FPT of the air terminals VAV, VAVRH, FPB, and FPBRH based on the existing ATC sequence of operation, mode-by-mode on page two of this B2B.

The existing ATC sequence will be inputted into the FPT retrocommissioning Cx-3 software, with the reaction device-by-device embedded into the checklist below the flow diagram. The auditors will check each sequence to confirm each control device "passes" the design ATC reaction to verify the existing system ATC/FPT is operating per the original design intent. The answers can be found at *www.esmagazine.com.*

The sequences selected are Off-Manual Shutdown, On-Maximum Cooling, and On-Minimum Heating for this B2B test, but there can be several other sequences of operation, as well as verification of alarms and safeties to be confirmed (not part of this B2B test).

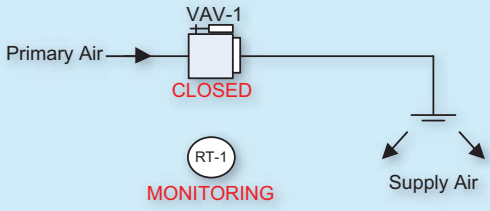
When the retrocommissioning engineer and the ATC technician have completed the ATC/FPT process, all deficiencies (devices failed) will have automatically been inventoried into the Cx-3 software's corrective action log, requiring further action by the technician for those "failed" reactions.

ATC DATA ANALYSIS

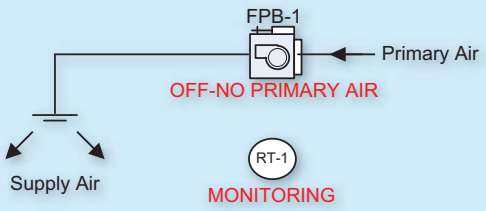
After completing the initial ATC/FPT process, the energy retrocommissioning team will begin the data analysis, solution planning, and completion of the energy retrocommissioning report, outlining the various energy conservation measure (ECM) opportunities. With each ECM there will be an estimated energy savings, operating cost savings, ROI, and carbon footprint reduction. This report will then be presented and discussed in pursuit of energy conservation funding and utility company rebate incentives.

Energy Retro-Cx

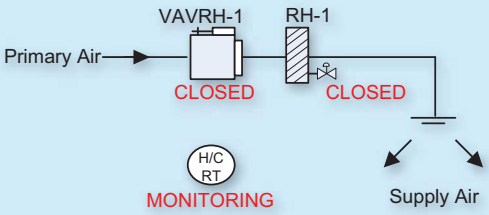
Month 1- The Energy Conservation Opportunity: Air Terminals For Most Building Applications



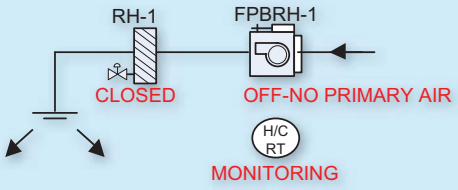
Typical Variable Air Volume Terminal



Typical Variable Air Volume (Primary Air) - Fan Powered Box Terminal



Typical Variable Air Volume Terminal With Reheat



Typical Variable Air Volume (Primary Air) - Fan Powered Box Terminal With Reheat

Energy Retro-CX - Existing Air Terminal Application			**Mode:**	Off-Manual Shutdown		On-Max Cooling		On-Min Heating	
			Status:	**1**		**2**		**3**	
Device	**Tag**	**Description**	**Reaction**	**Status**	**Result**	**Status**	**Result**	**Status**	**Result**
FPB-1	FPB-1	Fan-powered box	On-max primary air On-min primary air Off-no primary air On-no primary air Heating Cooling	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail
FPBRH-1	FPBRH-1	Fan-powered box w/reheat	On-max primary air On-min primary air Off-no primary air On-no primary air Heating Cooling	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail
RH-1	RH-1	Reheat coil with two-way ATC valve	Closed Open Modulating Heating	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail
RH-1	RH-1	Reheat coil with two-way ATC valve	Closed Open Modulating Heating	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail
VAV-1	VAV-1	VAV terminal	Closed Open Modulating Cooling	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail
VAVRH-1	VAVRH-1	VAVRH terminal w/reheat	Heating Cooling Closed Open Modulating	X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail	X X X X X	Pass/Fail Pass/Fail Pass/Fail Pass/Fail Pass/Fail
H/C RT	H/C RT	Room thermostat	No signal Monitoring	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail
H/C RT	H/C RT	Room thermostat	No signal Monitoring	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail
RT-1	RT-1	Room thermostat	No signal Monitoring	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail
RT-1	RT-1	Room thermostat	No signal Monitoring	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail	X X	Pass/Fail Pass/Fail

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