



Guide Aids Commissioning of Air Handling Systems

PIER Buildings Program

Research Powers the Future

www.energy.ca.gov/pier

The Problem

Air handlers (**Figure 1**), which move conditioned air throughout a building to keep occupants comfortable, often don't work as designed. Building operators, faced with the challenge of keeping these systems running well, and providers of commissioning services, charged with verifying system performance, have no standardized procedures to direct them in their efforts. The result is uncomfortable occupants and high energy bills.

The Solution

“The Functional Testing Guide for Air Handling Systems” helps building operators and commissioning providers standardize their procedures and raise the quality of their service. The guide explains the benefits of functional testing, which determines whether or not a complete system, as well as the individual components, will operate as expected. It also details the process of commissioning, which includes functional testing and making the adjustments necessary to ensure that a system meets design criteria.

Features and Benefits

The guide is broken into separate chapters for each component of the air-handling system (see **Table 1**) to help commissioners identify and fix malfunctioning equipment. Each chapter covers a variety of topics, including:

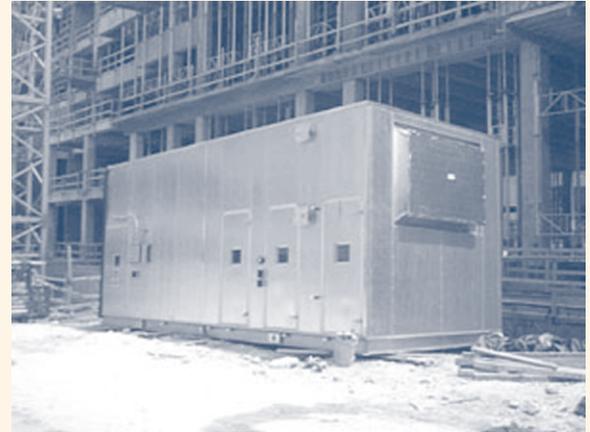
- *Theory and Applications.* Provides general insight and theory regarding the typical applications of the component or system.
- *Functional Testing Benefits.* Describes the benefits associated with testing the component, including energy and resource savings, reliability issues, and indoor environmental quality.

Table 1: Air-handler components covered in the guide
The “Functional Testing Guide” features a chapter on each of the components of an air handler system.

Outdoor air intake	Warmup
Fan casing	Fans and drives
Economizer and mixed air	Distribution
Filtration	Terminal equipment
Preheating	Return, relief, and exhaust
Cooling	Scrubbers
Humidification	Control of fire and smoke
Reheat	Integrated operation and control

Figure 1: Air handler at building site, prior to installation and commissioning

A set of standardized procedures can help ensure that air handlers run properly when installed and throughout their useful life.



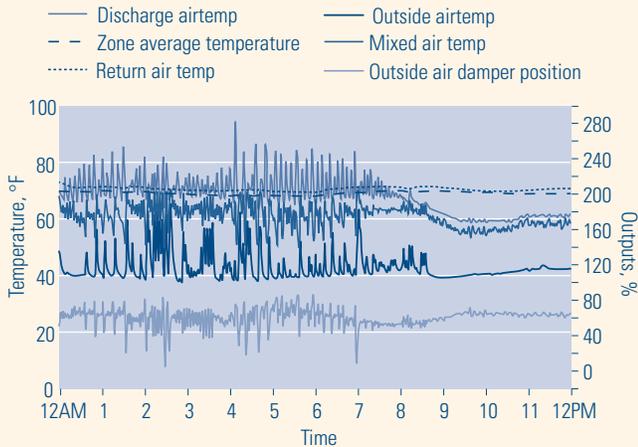
- *Functional Testing Field Tips.* Covers the purpose of the test, the instrumentation required, test conditions, the time required to run a test, test acceptance criteria, and potential problems.
- *Design Issues Overview.* Explains how the design parameters affect the outcome of functional testing.
- *Typical Problems.* Highlights important problems typically uncovered during testing or design review. For example, **Figure 2** shows temperature instabilities that showed up in the course of air-handler testing. Poor sensor placement was a major cause of the problems.
- *Non-Copyrighted Tests.* Provides hyperlink access to the functional tests collected in the Commissioning Test Protocol Library (CTPL) developed by Pacific Gas & Electric Co. The CTPL is the largest existing collection of non-copyrighted functional test procedures that can be customized to suit individual needs.

Applications

The guide can be used to commission air-handler components in both new and existing commercial buildings. Larger buildings will probably benefit the most, because they are more likely to use a complex air handler built from separate components, rather than a packaged system, as typically used in smaller buildings.

Figure 2: Temperature data for air-handler diagnosis

Functional testing showed that, even though the zone temperature in this building remained steady, the system experienced instabilities that were partly caused by the inappropriate location of the outdoor air sensor.



California Codes and Standards

The 2005 version of California's Title 24 introduced acceptance requirements, essentially functional tests, that must be met for certain types of building equipment, including air handlers. For example, builders must verify that the economizer follows the proper control sequence so that it provides the expected energy-savings benefits. Some of these tests are based on the guide, and in the future, the guide will likely serve as a source for additional acceptance requirements.

What's Next

The California Energy Commission's Public Interest Energy Research (PIER) program is collaborating with four state energy offices outside of California to expand the number of functional tests listed in the guide. The PIER project builds on a separate U.S. Department of Energy-funded effort and adds new tests and fully expands the "Integrated Operation" chapter of the guide. The updated

guide will also feature commissioning benefits and tips for chilled water, heating water, and condenser water systems. The revised guide will be used as a key reference in one- and four-day commissioning training programs aimed at commissioning providers, builder operators, designers, and contractors. In the next step, in early 2005, researchers at Portland Energy Conservation will develop an automated checklist that will give test providers a quick way to identify the tests that should be performed for a particular type of project. Separately, researchers at Lawrence Berkeley National Laboratories will develop an automated tool to analyze the data from functional tests and identify the likely causes of equipment failure.

Collaborators

The organizations involved include the Portland Energy Conservation and Lawrence Berkeley National Laboratory.

For More Information

The guide and several reports documenting this project may be downloaded from the web at http://buildings.lbl.gov/hpcbs/Element_5/02_E5_P2_1_1.html. The guide comes packaged with the "Control System Design Guide," which provides design recommendations for HVAC designers.

More information on the ongoing multi-state collaboration focused on improving and expanding the "Functional Testing Guide for Air Handling Systems" can be found at www.peci.org/about/1.htm.

To view Technical Briefs on other topics, visit www.esource.com/public/products/cec_form.asp.

Contacts

Portland Energy Conservation, Dave Sellers, DSellers@peci.org, 503-595-4479

California Energy Commission, Martha Brook, mbrook@energy.state.ca.us, 916-654-4086

About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) program. PIER supports public-interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, Governor

California Energy Commission

Chair Joe Desmond, Vice Chair Jackalyn Pfannenstiel

Commissioners: Arthur H. Rosenfeld, James D. Boyd, John L. Geesman

For more information see www.energy.ca.gov/pier



CEC-500-2005-099-FS
052505