ASHRAE GUIDELINE

Field Testing of HVAC Controls Components

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NOTE

When addenda, interpretations, or errata to this guideline have been approved, they can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

(This foreword is not a part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

FOREWORD

This guideline is intended to supplement several related ASHRAE guidelines and standards, including ASHRAE Standard 111-2008, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; ASHRAE Guideline 0-2005, The Commissioning Process; and ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for The Commissioning Process. It presents field testing procedures for specific devices that control the operation of an HVAC system.

The field testing involves the actual installation, location, and access of the various types of control devices used in HVAC systems. The results of the testing procedures define the operability of the device and ultimately the system. In addition to individual device testing, the interaction and sequencing of controls devices is also covered in this guideline.

On some control devices, there can be multiple levels of testing, from a simple on/off check to the computerized verification of set up and performance criteria. This is covered in the description of the tiered testing opportunities.

ASHRAE wishes to recognize the significant contributions of Gerald Kettler and his son, Zachary, in getting Guideline 11 published. Gerald handled many of the project's writing, proofing, and administrative tasks while Zachary volunteered his time to create most of the figures in this guideline. A special thanks goes to both of them.

1. PURPOSE

This guideline provides procedures for field testing and adjusting of control components used in building heating, ventilating, and air-conditioning (HVAC) systems.

2. SCOPE

This guideline covers the procedures, formats, and methods necessary for evaluation and documentation of the performance of devices and systems that control HVAC systems.

3. DEFINITIONS

Definitions of terms used in this guideline may be found in *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration*.[1]

4. GENERAL FORMAT FOR TESTING

4.1 Reasons for Testing

The components of control systems are essential for the heating ventilating, air conditioning and refrigeration systems to properly and efficiently perform their functions. Sensors monitor and report on conditions and equipment performance. Controllers perform the process supervision. Device operators execute the functions to produce proper unit outputs.

Each of these devices is designed to perform its basic function under a set of conditions assumed by the designer. However, the field application or performance of the device may or may not conform to the project intent. To determine the performance level of the device, to verify correct installation, and to assure the correct operation of the system, the controls should be tested after installation under actual operating conditions. The documentation from these tests provides a verification of the device and system design, as well as a record of initial performance. Without initial testing it may never be known whether the system ever operated correctly.

4.2 Testing Parameters and Accessibility for Testing

Two types of parameters are necessary to properly test a device or system. First, the performance characteristics of the device and the system designer's intent should be understood by the tester. Testing should always be done in view of the intended results. Secondly, to make the test results reliable and understandable, testing procedures and equipment should also have a set of standards or parameters. Tests should be done in a standard manner and with proper equipment to be reliable and credible.

Operational testing of devices and equipment assumes that the item being tested is in actual operation in its intended position. To verify operation, the proper test device should be placed in a similar and adjacent position. This requires physical access to the test site sufficient to install the test apparatus and to access the fluid being monitored. For example, testing a water pipe sensor or probe requires an adjacent test port.

4.3 General Testing Procedures

4.3.1 Tiered Strategy. There are several possible levels of testing. In most cases, simple testing of design and installation criteria and performance of control operation is all that is necessary. At other times, the static and dynamic performance characteristics of the device or system may need to be examined to assure expected control performance. In some cases on problem systems, advanced analysis should be performed to solve a control problem.

This guideline distinguishes between the following three tiers of testing: installation verification and basic performance testing (TIER 1); repeatability and stability testing (TIER 2); and diagnostic quantitative testing (TIER 3).

Note: Unless specified by the designer that tier 2 or tier 3 requirements are necessary for basic system verification, tier 1 is the normal expected level to be performed.

TIER 1: Installation Verification and Basic Performance Testing. Design, submittals, and installation of devices and sub-systems are examined to assure proper sizing, selection and installation of a device or system. Sensor output signals (temperature, pressure, flow, humidity, etc.) are measured with a calibrated instrument to determine the accuracy of the installed device or system and to verify simple response under normal operating conditions. Sensors are checked at or near normal operating conditions. Sequence and proper operation of system components are checked for correct direction of travel and full-required travel range in expected modes of operation.

TIER 2: Repeatability and Stability Testing. The stability and repeatability of the device or system are measured against a calibrated standard. Sensitivity and accuracy may be checked over the entire sensing range of the device. The required accuracy, the number and location of test