BACnet® TESTING LABORATORIES

A GETTING STARTED GUIDE

Revision 15.1.final
Revised February 15, 2018

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1 Introduction to BTL Testing

The BTL ***Getting Started Guide*** provides a general overview of the documents, tools and process for pre-testing a BACnet device for the BACnet Testing Laboratories' (BTL) product testing and listing program.

Conformance testing is potentially a very expensive process, particularly when problems are found that require the manufacturers to make changes to the implementation under test (IUT) and the recognized BACnet testing organization (RBTO) to repeat tests. Accordingly, the BTL has designed its testing process to be as cost-efficient as is possible to the manufacturer. To accomplish this goal of reduced cost, the BTL provides its tools, processes and methods to the manufacturer so he may perform the tests himself in advance of the conformance testing.

Although the ideal for the conformance testing is simply to verify the results already obtained by the manufacturer's testing, this has not always been the case. It is essential that the manufacturer's tester (the pre-tester) follow the provided methods and procedures carefully, leaving no errors for the RBTO to find.

It is also important to note that in order to achieve the greatest interoperability between listed devices; the BTL has produced recommendations and requirements over and above what appears in the BACnet standard. These requirements are noted on the BTL Functionality Checklist as BTL-R, or BTL-C. Other helpful hints about BACnet implementations can be found in the ***BTL Implementation Guidelines***.

Manufacturers of BACnet products are also encouraged to do interoperability testing. BACnet Interoperability Workshops (PlugFest) bring manufacturers of BACnet products together annually, for a few days of intensive BACnet interoperability testing.

2 BTL Testing Forms and Files

The following forms are filled out by the applicant and submitted to the desired RBTO in the testing process.

2.1 BTL Testing Application

The application form is obtained directly from the RBTO.

2.2 BTL Functionality Checklist

The ***BTL Functionality Checklist*** serves as the guide for the pre-tester and BTL tester, determining the tests that will be applied to the IUT. It presents a list, arranged in sections of BACnet capabilities. For each capability supported by the IUT, the box in the 'Support' column must be checked.

A copy of the ***BTL Functionality Checklist*** should be completed for use by the pre-tester in pretesting. It must be received by the RBTO before testing on the IUT can begin.[1] Directions for filling out the ***BTL Functionality Checklist*** are found in the ***BTL Testing Guide***.

2.3 EPICS

The EPICS ("Electronic Protocol Implementation Conformance Statement") is an ASCII text file that describes the IUT in detail. It includes every property of every object, and the value if a constant, along with information about whether the property is writable, what range limitations it may have, and so on.

This file is used by testing software to perform several of the automated tests on the IUT. An example EPICS file representing a device containing all object types can be obtained from the BTL Coordinator. The format of the EPICS file can be found in ASHRAE 135.1, "Method of Testing Conformance to BACnet," in Clause 4.

2.4 IUT Special Test Instructions

This form is completed by the pre-tester and used to inform the RBTO tester how to make the IUT perform specific operations required for testing.

[1] To maximize the interoperability of BTL listed devices, the BTL has established some requirements that go beyond those in the BACnet standard. These requirements are expressed in the *BTL Functionality Checklist* with Listing column codes that have a BTL- prefix.

Fig. 1 Relationship between the ***BTL Functionality Checklist***, ***BTL Test Plan***, ASHRAE 135.1.

BTL Functionality Checklist:

Analog Output Object		
X	R	Base Requirements
X	R	Supports command prioritization
X	S	Contains writable Out_Of_Service properties

BTL Test Plan:

3.2.2 Contains Writable Out_Of_Service Properties

The Out_Of_Service property in Analog Output objects contained in the IUT are writable.

135.1 - 2007 - 7.3.1.1 - Out_Of_Service, Status_Flags, and Reliability Tests		
	Test Method	Manual
	Configuration	As per ASHRAE 135.1 - 2007.
	Test Conditionality	If this property is writable, this test must be executed.
	Testing Hints	
	Results	

ASHRAE 135.1-2007 Standard:

7.3.1.1 Out_Of_Service, Status_Flags, and Reliability Tests

Dependencies: ReadProperty Service Execution Tests, 9.15; WriteProperty Service Execution Tests, 9.19.

BACnet Reference Clauses: 12.1.7, 12.1.9, 12.1.10...

Purpose: This test case verifies that Present_Value is writable when Out_Of_Service is TRUE. It also verifies the interrelationship between the Out_Of_Service, Status_Flags, and Reliability properties. If the PICS indicates that the Out_Of_Service property of the object under test is not writable, and if the value of the property cannot be changed by other means, then this test shall be omitted. This test applies to Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Life Safety Point, Life Safety Zone, Multi-state Input, Multi-state Output, Multi-state Value, and Loop objects.

Test Concept: The IUT will select one instance of each appropriate object type and test it as described. If the Reliability property is not supported then step 4 shall be omitted.

Test Steps:

```
1.      IF (Out_Of_Service is writable) THEN
                WRITE Out_Of_Service = TRUE
        ELSE
                MAKE (Out_Of_Service TRUE)
2.      VERIFY Out_Of_Service = TRUE
3.      VERIFY Status_Flags = (?, FALSE, ?, TRUE)
4.      REPEAT X = (all values meeting the functional range requirements of 7.2.1) DO {
                WRITE Present_Value = X
                VERIFY Present_Value = X
                }
5.      WRITE Present_Value = (any value that corresponds to an Event_State of NORMAL)
6.      IF (Reliability is writable) THEN
…
```

3 Useful Informational Documents

The documents that the applicant needs to refer to during the process of preparing, and pre-testing the IUT are described here.

3.1 Getting Started Guide

(This document.) The ***Getting Started Guide*** provides a brief overview of the BTL testing process, documents and tools, and a glossary of terms used in these documents.

3.2 BTL Testing Guide

The ***BTL Testing Guide*** provides the detailed procedure for preparing and applying the BTL test suite on the IUT.

3.3 BTL Test Plan

The ***BTL Test Plan*** is a worksheet that provides information about each of the actual tests performed by the pre-tester and the BTL tester.

Each entry in the Option column of the ***BTL Functionality Checklist*** corresponds to the title of a section in the ***BTL Test Plan***. Each section in the ***BTL Test Plan*** identifies where the test is to be found (by ASHRAE 135.1 clause number, or by ***BTL Specified Tests*** clause number). The section conveys other information about the test, such as conditions under which the test may be skipped, configuration, and so on.

The ***BTL Test Plan*** itself is not submitted to the lab, but any needed annotations are provided via the ***IUT Special Test Instructions***.

Figure 1 illustrates the relationship between the ***BTL Functionality Checklist***, ***BTL Test Plan*** and the other documents which give instructions on how to perform the tests (ASHRAE 135.1, ***BTL Specified Tests*** and ***BTL Manual Test Instructions***).

3.4 BTL Specified Tests

The ***BTL Specified Tests*** contains additional and corrected tests determined by the BTL to be necessary for verifying BACnet implementations, and which are not (yet) included in ASHRAE 135.1**,** "Method of Testing Conformance to BACnet." These tests are referenced from the ***BTL Test Plan***.

3.5 BTL Manual Test Instructions

The ***BTL Manual Test Instructions*** describe performing tests manually. This includes, but is not limited to, tests that cannot be performed by using scripts.

4 BACnet Listing and Certification Services

Once a product has successfully completed BTL Testing, the vendor may apply for a BTL Certification. See the BTL Certification section on the BACnet International website for more details.

5 Additional Documents and Forms

Other documents that are related to the testing process are listed here.

5.1 BTL Policy Document

This document describes all of the policies in place regarding BTL Testing.

5.2 BTL Implementation Guidelines

This document contains a number of guidelines for implementing BACnet devices for maximum interoperability with other BACnet devices as well as improved BACnet system performance. The latest version is always posted on BTL Website. Many of these guidelines are incorporated into the BTL's test suite.

5.3 Referenced Standards

ANSI/ASHRAE Standard 135, A Data Communication Protocol for Building Automation and Control Networks

ASHRAE Standard 135.1 Method of Testing Conformance to BACnet

6 A Short Guide to BTL Testing

The pretesting, and testing phases are briefly outlined herein. This is provided as an overview; the details of many steps are provided in the referenced documents. The tools used by the BTL are also identified along with their sources.

6.1 Testing Procedure Overview

The following is an overview of the suggested procedure for preparing, submitting, pre-testing and having an IUT undergo BTL testing. The complete procedure is given in the ***BTL Testing Guide***.

1) The first step is to obtain the BTL Test Package, and any necessary tools as noted in **6.2**, **Tools used in BTL Testing**. A copy of ASHRAE 135.1 can be purchased from ASHRAE. Contact information for ASHRAE and the BTL are given in **9, Sources and Contacts**.

2) Preparation. Fill out the ***BTL Functionality Checklist***. Contact one of the RBTO to get a test application and to get an idea of their testing schedule.

3) Determine IUT Configuration. Select the objects to be present in the IUT submitted for testing. If the set of objects is predetermined (they cannot be created or deleted) this step is easy. Also determine values for modifiable properties in the device.

4) Create the EPICS File. When the IUT configuration is decided, the EPICS file is created describing the configuration. Create an accurate and complete EPICS as you believe the IUT will be at delivery. This is before testing, so that it can be compared to the actual implementation testing. Discrepancies are often informative.

5) Select the Tests. The tests to be performed are determined by the ***BTL Functionality Checklist*** according as the ***BTL Test Plan*** shown in Figure 1 illustrates.

6) Pre-test. Per the ***BTL Testing Guide***, perform each test called for by the ***BTL Functionality Checklist*** and the ***BTL Test Plan***. During your testing, place any special instructions for setting up and causing the IUT to perform specific tests in the ***IUT Special Test Instructions***. As the tests are being selected and performed, it is possible that the chosen configuration of the IUT may have to change to meet Test Conditionality and Test Directives. Also note, it may be necessary to create and submit to the RBTO more than one IUT configuration in order to accommodate the configuration of all of the tests required. If you will be submitting multiple configurations to the lab, please include instructions for the lab in IUT Special Test Instructions which include how to load different configurations, and which tests require which configuration.

7) Submit IUT. You are now prepared to submit your device to one of the RBTO. It is recommended that you submit your application in advance of your pre-testing in order to schedule your device testing. The RBTO will provide you with an estimate of when your device can be tested.

8) Test. During the testing of the IUT, if problems are found, the RBTO will report them to the submitter. Discuss how often you wish to receive reports with your selected RBTO to make sure you receive the updates you are looking for. The amount and types of regression testing then required, is covered in the ***BTL Testing Guide***.

6.2 Tools used in BTL Testing

These are the tools that the pre-tester might expect to use during his pre-testing process.

6.2.1 BACnet Test Framewaork

The BACnet Test Framework (BTF) is an automated test tool used by all of the RBTOs. BTF can be purchased from MBS Software at www.mbs-software.de.

6.2.2 VTS

VTS is a program developed for testing a BACnet device by exchanging BACnet messages with the device. This can be done manually by the operator or automatically using scripts. It can be obtained from the http:sourceforge/projects/vts

6.2.3 Oscilloscope

An oscilloscope is necessary for MS/TP devices, to verify the network timing restrictions specified in ASHRAE 135 in Clause **9.5.3, Parameters**.

6.2.4 Other commercial testing tools

Other commercial test tools are available for purchase. See our website for further information.

6.2.5 Protocol Analysers Used

6.2.5.1 Wireshark

Wireshark is a network protocol analyzer which can be used to view and analyze BACnet traffic. This program is used to capture the exchange of BACnet traffic during the execution of a test. See www.wireshark.org for more information.

7 Acronyms and Glossary

The following are acronyms and terms used in the BTL documents.

BTL	BACnet Testing Laboratories. An organization dedicated to maintaining BACnet interoperability through development of test plans and tests.
EPICS	The Electronic Protocol Conformance Implementation Statement, as described in ASHRAE 135.1, "Method of Testing Conformance to BACnet," in Clause 4. Typically an ASCII text file. (cf. PICS.)
IUT	Implementation Under Test – the device or product being tested
LAN	Local-area network
MS/TP	Master-Slave Token Passing – a type of LAN specified in ASHRAE 135.
OD	Other Device, similar to TD, but when a third device is needed in the test.
RBTO	Recognized BACnet Testing Organization
RD	See Reference Device.
VTS	Visual Test Shell – a software tool used for testing BACnet devices.
BTL Tester	The tester at a recognized BACnet Testing organization who tests the device to verify the manufacturer's results. (cf. Pre-tester.)
BTL Mark	Is a graphic displayed on products that have completed the BTL approved conformance testing process and are listed on the BTL website.
BTL Listing	Indicates that a product has been tested at a qualified BACnet Testing Laboratory and found to comply with all the necessary interoperability requirements in place on the published test date. This listing represents the tested capability of the Listed

	Products.
Certificate of Conformance	Is a formal document attesting to the fact that a product has been independently tested by a recognized test organization and has passed all BTL testing requirements. It was created because it is required as a part of project submittals in some regions of the world.
BTL Certification	Granted for products that have successfully passed BTL Testing. A BTL Certification includes a BTL Listing, a BTL Certificate of Conformance, and permission to use the BTL Mark per Usage Agreement.
PICS	Protocol Conformance Implementation Statement, in the style found in Annex A of *ASHRAE 135*. Typically a Word or .PDF document. (See also EPICS.)
Pre-tester	The manufacturer's tester who performs the tests on the device initially.
Reference Device	A correctly implemented or perfectly simulated device that sits on the network with the IUT for the purpose of independently exchanging messages. Some tests require a reference device.
Reference Router	A BTL Listed BACnet router used to route messages between the TD and the IUT.
Script	A file that contains a sequence of commands executable by VTS.
ASHRAE 135	ANSI/ASHRAE Standard 135, A Data Communication Protocol for Building Automation and Control Networks
ASHRAE 135.1	ASHRAE Standard 135.1, Method of Testing Conformance to BACnet
Test case	The selection of applicable tests, based on the configuration of the IUT submitted for test, including the selection of objects present and the values of configurable properties.
TD	A device that is responding to requests sent by the IUT (can be a simulator).

8 Documents

The following is a list of the documents associated with the BTL Test Package and provided by the BTL-WG for the manufacturer to prepare for testing:

- ☑ A Getting Started Guide (this document)
- ☐ BTL Testing Policies
- ☐ BTL Testing Guide
- ☐ BTL Manual Testing
- ☐ BTL Functionality Checklist
- ☐ BTL Specified Tests
- ☐ BTL Test Plan

Tool Support Files:

- ☐ exampleTestEpics.tpi – available from the BTL Coordinator

The following are files furnished by the manufacturer during test preparation.

- ☐ EPICS
- ☐ IUT Special Test Instructions

9 Sources and Contacts

ANSI/ASHRAE ASHRAE 135, A Data Communication Protocol for Building Automation and Control Networks
ASHRAE 135.1, Method of Testing Conformance to BACnet

These may be purchased from:
ASHRAE Bookstore online at: http://www.techstreet.com/ashrae/products/1873280

BTL Testing Application Package
This may be acquired from: http://www.bacnetlabs.org/test_documentation

BACnet International
Attention: BTL Coordinator
BACnet International
1827 Powers Ferry Road
Building 14, Suite 100
Atlanta, Ga. 30339
e-mail: btl-coordinator@bacnetinternational.org
Phone: +1 (770) 971-6003
Fax: +1 (678) 229-2777

You can find a list of the current RBTOs on the BTL website.

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Version	Date	Author	Change
0.13	25-Jan-2005	Carl Neilson	• Updated the reference to ASHRAE 135
3.1.1	11-Nov-2006	Lori Tribble	• Updated addresses, references, document list
3.1.final	16-Nov-2006	Carl Neilson	• Accepted changes and removed highlighting
4.0.1	16-Nov-2006	Carl Neilson	• Copied from 3.1.final
4.0.2	28-Mar-2008	Lori Tribble	• Updated procedures and document names.
4.0.3	22-May-2008	Lori Tribble	• Refined procedures
4.0.5	15-Jul-2008	Lori Tribble	• Updated phone and source information • Updated Figure 1.
5.0.1	3-Nov-2008	Lori Tribble	• Changed 135.1 references • Added shipping description documents and expedited testing documents to list of available documents from the BTL. • Updated version from 4.0.5 to 5.0.1
5.0.2	24-Feb-2009	Lori Tribble	• Updated BI phone number • Updated version from 5.0.1 to 5.0.2
5.0.3	8-Jun-2009	Lori Tribble	• Updated Testing Procedure Overview description slightly per discussion on June 2nd teleconference.
5.0.final	26-Jun-2009	Lori Tribble	• Accepted all changes per BTL-WG meeting June 18, 2009
5.1.0	8-Jul-2009	Lori Tribble	• Initial changes to remove BI managed lab specifics.
6.0.1	24-Jan-2011	Duffy O'Craven	• Updated to current BTL Manager's name • Revised document references to use their current names
9.0.1	29-Oct-2011	Duffy O'Craven	• Updated to the Delk Road address • Completed revising document references to their current names. • Removed the BTL Listing Update and BTL Simple Appeals Procedure, as those processes are no longer in use. • Described the testing process in language that no longer implies that there is only one available lab. • Referred to VTS directly at sourceforge.net rather than as though it is available only from the BTL Manager.
9.0.final	01-Dec-2011	Duffy O'Craven	• Updated BACnet International and BTL Manager fax numbers, then to 9.0.final
12.0.final	07-Aug-2012	Duffy O'Craven	• Updated to mention exampleTestEpics.tpi, referenced document name consistently as BTL Functionality Checklist, and made 12.0.final
14.0.final	17-Nov-2014	Duffy O'Craven	• Updated to 14.0.final without change.
14.1.1	23-Sep-2015	Duffy O'Craven	• Updated ASHRAE references to 2012/2013 and the URLs for the bookstore and the Testing Package. •
14.1.3	12/3/2015	Lori Tribble	• Updated to remove test organization specific document references.
15.0.01	25-Sep-2017	Lori Tribble	• Updated document to use RBTO, and added definitions for Certification.
15.0.final	25-Sep-2017	Lori Tribble	• Accepted all changes and renamed to final.
15.1.final	15-Feb-2018	Lori Tribble	• Updated Version in preparation for release of 15.1