BACnet TESTING LABORATORIES

GETTING STARTED GUIDE

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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 submitting a BACnet device for the BACnet Testing Lab's (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 testing lab 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, process and methods to the manufacturer so he may perform the tests himself in advance of the BTL's testing.

Although the ideal for the BTL's 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 BTL test lab (the "BTL tester") 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, for devices participating in the BTL listing program. The BTL has published this as the *BTL Device Implementation Guidelines*.

Manufacturers of BACnet products are also encouraged to do interoperability testing. The BI-sponsored BACnet Interoperability Workshop brings together manufacturers of BACnet products for a few days of intensive BACnet interoperability testing.

2 Forms and Files

The following forms and files are created, filled out, or modified by the applicant and, with the exception of the *Script Library*, submitted to the BTL at various stages in the process.

2.1 BTL Application For Testing

This form contains both the application for testing and a Protocol Implementation Conformance Statement (PICS), as found in Annex A of the BACnet *ASHRAE 135*, describing the IUT. The PICS statement will be used as the basis of the BTL listing at the successful end of testing.

2.2 BTL Testing and Listing Agreement

This agreement to the terms of the testing to be conducted and of the subsequent listing of the device by the BTL must be signed and returned to the BTL with the *BTL Application For Testing* and the application fee. These must be received by the BTL before pre-test support can be provided, and before BTL testing can begin.

2.3 EPICS

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

This file is used by the BTL's testing software ("VTS") to perform many of the tests on the IUT. A BTL Sample EPICS file representing a very simple device is provided with this package. The format of the EPICS file can be found in *ASHRAE 135.1*, "Method of Testing Conformance to BACnet," in Clause 4. A tool ("EPICS Wizard") for generating a base EPICS file is available from the BTL.

2.4 BTL/IUT Functionality Checklist

The *BTL Functionality Checklist* serves as the guide for the pre-tester and BTL tester for determining what tests will be applied to the IUT. As the name suggests, it presents lists of BACnet capabilities. For each capability supported by the IUT, the box in the 'Support' column is checked.

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

2.5 IUT Special Test Instructions

This form is used to inform the BTL tester how to make the IUT perform specific operations required for testing.

2.6 Script Library

The *Script Library* contains a set of scripts that can be executed by VTS to automate many of the tests. These scripts are ASCII text files that define the content and order of BACnet messages that are to be sent and expected to be received by VTS.

Which of the scripts are to be used in testing is determined by the items checked in the *BTL Functionality Checklist*; the sections of the *BTL Test Plan* referenced by the checked items list the script(s), if any, that are to be used in the indicated test. Figure 1 illustrates the relationship between these documents. Usually the scripts to be used need to be edited to provide IUT-specific information. A customization section will be provided at the beginning of the scripts for this purpose.

[1] To maximize the interoperability of BTL-listed devices, the BTL has established requirements beyond those in the BACnet standard. These requirements are incorporated in the *BTL Functionality Checklist.*

A description of the script language may be found in the *VTS User's Guide*.

Fig. 1 Relationship between *IUT Functionality Checklist*, *BTL Test Plan*, *ASHRAE 135.1* and the *Script Library*

***BTL Functionality Checklist*:**

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

***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 - 7.3.1.1 - Out_Of_Service, Status_Flags, and Reliability Tests		
	Script	**<script name>**
	Configuration	As per 135.1.
	Test Conditionality	If this property is writable, this test must be executed.
	Testing Hints	
	Results	

***Script Library*:**

coming soon…

***Standard 135.1*:**

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 Documents and EPICS

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

3.1 BTL Getting Started Guide

(This document.) The *BTL 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, by *BTL-Specified Tests* clause number, or by reference to some other document). The section conveys other information about the test, such as whether a script (see the *Script Library*, below) exists for the test or if it is performed manually, conditions under which the test may be skipped, configuration, and so on.

There is also space for the pre-tester to make notes to himself, if necessary, on how to configure the IUT for the test. These could be used as the basis for the *IUT Special Test Instructions* form; the *BTL Test Plan* itself is not submitted to the BTL.

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*).

The BTL Test Plan created by the BTL tester will be a fundamental part of the test log.

3.4 BTL-Specified Tests

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

3.5 BTL Manual Test Instructions

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

3.6 BTL Sample EPICS

The *BTL Sample EPICS* is a text file that provides an example of an EPICS file, illustrating various aspects of the EPICS that must be created to describe the IUT.

3.7 VTS User's Guide: Using VTS for BTL Testing

The *VTS User's Guide* is both a general manual for VTS 3 and a guide to using VTS 3 for BTL testing. This document provides enough guidance to allow the reader to install, configure, and perform manual and script based tests with VTS 3.

4 Additional Documents and Forms

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

4.1 BTL Test Process Management

This document is comprised of directions to the BTL tester for managing and conducting the tests.

4.2 BTL Problem Report Form

This form is filled out by the BTL tester when a problem is found during the IUT tests, and forwarded to the manufacturer.

4.3 BTL Appeals Procedure

This document describes the procedure for appealing a determination that the device failed to pass BTL testing.

4.4 BTL Implementation Guidelines

This document (under construction) contains a number of guidelines for implementing BACnet devices for maximum interoperability with other BTL-listed BACnet devices as well as improved BACnet system performance. Many of these guidelines are incorporated into the BTL's test suite.

4.5 Referenced Standards

ANSI/ASHRAE Standard 135-2001, A Data Communication Protocol for Building Automation and Control Networks

ANSI/ASHRAE Standard 135-2001*b*, A Data Communication Protocol for Building Automation and Control Networks

ANSI/ASHRAE Standard 135-2004, A Data Communication Protocol for Building Automation and Control Networks

ASHRAE Standard 135.1-2003, Method of Testing Conformance to BACnet

5 A Short Guide to BTL Testing

The application, pretesting, testing, and approval 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.

5.1 Testing Procedure Overview

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

1) Obtain the Application Package, Tools and Standards. The first step is to obtain the application package and the VTS tool from the BTL, and any other necessary tools as noted in **5.2**, **Tools used in BTL Testing**. A copy of *ASHRAE 135.1* should be purchased from ASHRAE. Contact information for ASHRAE and the BTL is given in **8, Sources and Contacts**.

2) Preparation. Fill out and submit the *BTL Test Application*, the signed *BTL Testing and Listing Agreement* and the application fee to the BTL. It might be a good idea to contact the BTL Manager to get an idea of the Lab's testing schedule.

3) Set up Tools. The BTL recommends setting up the tools as much in advance as possible, and becoming familiar with them as well as the scripts. Contact the BTL if difficulties are encountered with the tools.

4) 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. Then make a copy of the *BTL Functionality Checklist* form and call it the *IUT Functionality Checklist* form. (Information gathered while filling out the *IUT Functionality Checklist* form may result in a change in the IUT Configuration.)

5) Select the Tests. The tests to be performed are determined by the *IUT Functionality Checklist* and the *BTL Test Plan* as shown in Figure 1. As the tests are being selected, it is possible that that the chosen configuration of the IUT may have to change to accommodate the tests.

6) Create the EPICS File. When the IUT configuration is stable the EPICS file describing the configuration can be created. Creating an accurate and complete EPICS takes time and care; this step is left to the last before testing begins to reduce the need for changing the EPICS.

7) Pretest. Per the *BTL Testing Guide*, perform each test called for by the *IUT Functionality Checklist* and the *BTL Test Plan*. Special instructions for setting up and causing the IUT to perform specific tests are placed in *IUT Special Test Instructions*. Contact the BTL if problems are encountered performing the tests.

8) Submit IUT. When the pre-tester is satisfied with the results of testing, submit the IUT, the *IUT Functionality Checklist* form, the *IUT Special Test Instructions*, the EPICS file and any modified scripts from the *Script Library* to the BTL. The manufacturer may, if it elects, have one or more representatives present at the lab during testing. The BTL recommends that the pre-tester retain an identical copy of the IUT for verifying problem reports, particularly if the pre-tester will not be present at the BTL during testing.

9) Test. During the BTL's tests of the IUT, if problems are found the BTL tester will report them to the submitter in a manner agreed upon (problem by problem, periodically, etc.), using the *BTL Problem Report Form*. The process for delivering a revised IUT to the BTL and regression testing is covered in the *BTL Testing Guide*.

10) Listing. At the successful completion of the test, the manufacturer is entitled to use the BTL Mark per the *BTL Testing and Listing Agreement*. If the manufacturer wishes, public listing of the IUT by the BTL on its website and in other literature may be delayed until a time convenient to the manufacturer.

5.2 Tools used in BTL Testing

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

5.2.1 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 BTL; see **8, Sources and Contacts**.

5.2.2 Oscilloscope

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

5.2.3 Serial Communications Capture Program

A serial communications capture program ("sniffer") is needed for MS/TP devices, to capture and analyze MS/TP messages. Typically such a program runs on a standard personal computer, capturing and displaying data from a COM port. An RS-485 to RS-232 adapter is also required to translate the MS/TP LAN's RS-485 signals into the RS-232 levels required by the COM port.

5.2.4 EPICS Wizard

A tool that aids in the creation of an EPICS file for the IUT. The EPICS Wizard is supplied with this package.

6 Acronyms and Glossary

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

BTL	BACnet Testing Lab
EPICS	The Electronic Protocol Conformance Implementation Statement, as described in Clause 4 of *ASHRAE 135.1*. Typically an ASCII text file. (See 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.
RD	See Reference Device.
RR	See Reference Router.
VTS	Visual Test Shell – a software tool used for testing BACnet devices.
BTL Tester	The tester at the BTL who tests the device to verify the manufacturer's results. See also Pre-tester.
Listing	Recognition that the device is based on an implementation that has passed the BTL testing.
PICS	The Protocol Conformance Implementation Statement, as found in Annex A of *ASHRAE 135*. Typically Word document or paper form. (See EPICS.)
Pre-tester	The manufacturer's tester who performs the tests on the device initially. See also BTL tester.
Reference Device	A trusted, approved 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 trusted, approved 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 135-2001, A Data Communication Protocol for Building Automation and Control Networks *and* ANSI/ASHRAE Standard 135-2001*b*, A Data Communication Protocol for Building Automation and Control Networks *and* ANSI/ASHRAE Standard 135-2004, A Data Communication Protocol for Building Automation and Control Networks
ASHRAE 135.1	ASHRAE Standard 135.1-2003, Method of Testing Conformance to BACnet
TD	See Test Device.
Test Database	The configuration of the IUT submitted for test, including the selection of objects present and the values of configurable properties.
Test Device	The device that is running the test tool (VTS).
Test Planner	The individual that identifies the tests to be executed, the IUT configuration(s) for the tests, and the test parameters. This individual may or may not be the same individual that applies the tests (see BTL Tester, and Pre-tester.)

VTS	The test software used by many of the BTL tests.

7 Documents Checklist

The following is a list of all the documents and files provided by the BTL Working Group.

Testing Application Forms:

- ☐ BTL Application For Testing
- ☐ BTL Testing and Listing Agreement

Listing Application Forms:

- ☐ BTL Listing Application
- ☐ BTL Listing Update Application
- ☐ BTL Listing Template

Test Documentation Package:

- ☐ BTL Functionality Checklist
- ☑ BTL Getting Started Guide (this document)
- ☐ BTL Manual Test Instructions
- ☐ BTL-Specified Tests
- ☐ IUT Special Test Instructions Template
- ☐ BTL Testing Guide
- ☐ BTL Test Plan
- ☐ BTL Appeals Procedure
- ☐ BTL Simple Appeals Procedure

Tool Support Files:

- ☐ Script Library (currently under development) – found in VTS distribution
- ☐ VTS User's Guide – found in the VTS distribution
- ☐ BTL Sample EPICS – found in VTS distribution

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

- ☐ EPICS
- ☐ IUT Functionality Checklist
- ☐ IUT Special Test Instructions

8 Sources and Contacts

ANSI/ASHRAE ASHRAE 135-2001, A Data Communication Protocol for Building Automation and Control Networks
ANSI/ASHRAE ASHRAE 135-2001*b*, A Data Communication Protocol for Building Automation and Control Networks
ANSI/ASHRAE ASHRAE 135-2004, A Data Communication Protocol for Building Automation and Control Networks
ASHRAE 135.1-2003, Method of Testing Conformance to BACnet

These may be purchased from:
ASHRAE Customer Service
1791 Tullie Circle, NE
Atlanta, GA 30329-2305, USA
Phone: 404-636-8400 worldwide
1-800-527-4723 U.S. and Canada
FAX: 404-321-5478
e-mail: orders@ashrae.org
The ASHRAE Bookstore is also online at: http://www.ashrae.org

BTL Testing Application Package
EPICS Wizard
VTS
These may be acquired upon request from: btl-manager@bacnetinternational.org

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