



SUMMER/FALL 2016

## THE BUILDING SYMPTOM DIAGNOSIS TOOL: Your Guide to Uncovering Energy Savings

By Brad Weaver, Northwest Energy Consulting



Brad Weaver

Occupants in one part of the building complain that they are too cold. In another part of the building they are too hot. You, the building engineer, get blamed for it all. You know there's a problem, a symptom, but

you don't have a clue as to its cause. Maybe you alter set-points or equipment schedules to compensate. Yet you don't have time, staff or budget to thoroughly investigate the situation or hire an outside consultant. The result is to fix the problem for as little time and money as possible and get on with putting out another fire. In the meantime your building is wasting energy and you might never know about it.

Does this sound familiar? I have seen problems like this over and over in all kinds of buildings. In my experience, a building can easily reduce its energy consumption 10 percent or more by looking for common problems such as uncontrolled outside air, failed sensors, equipment running more than needed and simultaneous heating and cooling. That's why we developed this simple Building Symptom Diagnosis Tool.

*"In my experience, a building can easily reduce its energy consumption 10 percent or more by looking for common problems such as uncontrolled outside air, failed sensors, equipment running more than needed and simultaneous heating and cooling."*

— Brad Weaver

We aimed to build a "cookbook" for building engineers, as well as design engineers and service contractors, to quickly pinpoint the cause of problems in their facility. The tool currently lists 65 symptoms which can be signs of energy waste. Each symptom has a table of possible underlying causes. Many have been expanded with a guide on how to investigate by physical inspection and the use of Direct Digital Control (DDC) system trend logging capabilities.

This tool doesn't cover all potential problems in all buildings as each building is unique in its construction and HVAC system design and operation. The intent of the tool is to cover the majority of conditions, plus have a feedback mechanism where users can report specific conditions in their facilities that differ from the website content. We will update the tool as more information comes in.

### Using the Symptom Diagnosis Tool

Here are some examples of how I've used the tool to help building engineers discover the root causes of building symptoms and achieve energy savings. I discovered these problems during the course of conducting EPA

ENERGY STAR certifications, or building audits for specific symptoms. These examples all involve symptoms related to problems with the building envelope. All too often envelope issues only manifest themselves

through complaints about the HVAC system, especially during cold weather. The building engineer typically gets the brunt of the blame from the occupants, with the design engineer as a close second.

This is especially true in buildings where the potential for thermal stack effect is present.

These two examples demonstrate the most common symptom: *Symptom #3 - Exterior doors are hard to open or don't close securely.*

### Example 1: A 23-story high-rise in downtown Seattle

This facility has a large lobby with both revolving and standard doors. The standard doors open outward and were very hard to pull, exceeding the minimum pressure required by ADA standards. Occupants could feel cold air over 50 feet away from the doors inside the lobby and building engineers were constantly adjusting the closures to try to maintain uniform operation. During the winter it was necessary to install electric radiant heaters in the lobby for building personnel, who wore overcoats and gloves due to the drafts.

**Figure 1** (page 2) shows the table of possible causes for the symptom. You can find it at [BetterBricks.com/operations](http://BetterBricks.com/operations), then follow these links: > **Tools and Technical Advice** > **Symptom Diagnosis Tool** > **Air Distribution: Exterior doors are hard to open or don't close securely.** The table can be printed out and used as a checklist. The table first list "explanations" which are conditions that may cause the symptom but are either out of the control of the building engineer or would require a capital project to fix. Next lists the most likely "problems" which can be solved with low-cost repairs or operational adjustments.

(Continued on page 2. See **ENERGY SAVINGS**).

### IN THIS ISSUE

|   |       |
|---|-------|
| Your Guide to Uncovering Energy Savings.....                                | 1-2   |
| Equipment Operates During Unoccupied Hours (Credit Quiz) .....              | 3     |
| BOC Grads Making a Difference.....  | 3 & 5 |
| Instructor & Sponsor Interview Q&A .....                                    | 4-5   |
| Six Things to Know about Low Wattage T8s .....                              | 5     |
| BOC Training, Announcements, Certification and Conferences/Symposiums ..... | 6-7   |
| News You Can Use .....  | 7     |
| Contact BOC & Sponsors.....   | 8     |

ENERGY SAVINGS (Continued from page 1).

## Exterior doors are hard to open or don't close securely

| CHECKED | TYPE        | DESCRIPTION   |
|---------|-------------|---|
|         | Explanation | Envelope and/or floor-to-floor integrity is compromised.                          |
|         | Explanation | Exterior doors in another part of the building are open.                          |
|         | Explanation | Building is experiencing an unanticipated wind effect.                            |
|         | Problem     | Seasonal Stack effect is not under control.                                       |
|         | Problem     | Building is improperly pressurized (more exhaust than outside air or vice versa). |
|         | Problem     | HVAC dampers are not operating properly.  |
|         | Problem     | Connection to other buildings is not under control.                               |

Figure 1. Summary Table for Symptom #3

In this case, a combination of the first three problems was uncovered during the physical survey and were quite fixable.

1. The relief/exhaust air fans, meant to adjust airflow to maintain correct building pressure, were operating off faulty space pressure sensors. They were exhausting ten times more air than needed, which caused the building to experience negative pressure.

2. The upper floor mechanical rooms have multiple gravity-operated relief air dampers which were not operating properly during cold weather, allowing stack effect pressure to push them open and let heated air escape. Other dampers were stuck open, and there were 6" air gaps between the frames that were never sealed during construction.

3. Relief air vents at the roof of the stairwells were wide open. The flow of heated air escaping the building through the stairwells was so large that doors in the parking garage 25 stories below, under the facility, would not close on their own.

4. The freight elevator accessed all mechanical floors with no vestibules installed. Large amounts of air were routinely pulled from the relief air floor to the outside air floor through the elevator shaft. This greatly reduced proper outside air quantities.

Corrections to this facility are currently underway. The energy savings from properly controlling outside air should be substantial.

### Example 2: A 5-story office building in downtown Seattle

This building is one of a 3-building complex, all similar in size and design. The facility was benchmarked using EPA's ENERGY STAR Portfolio Manager and was found to be consistently 10 points lower than the other two buildings. A walkthrough revealed that the rooftop HVAC unit relief air fans cycled ON every few minutes. The lobby and retail stores were under negative pressure and

large amounts of cold outside air would enter the building every time a door was opened. We found that the wind was not a factor.



The facility has large amounts of outside air and exhaust ducting passing through it to an adjacent structure, suggesting a problem with an uncontrolled

connection. Wall construction and shaft conditions were investigated to determine if these intake ducts were pulling air from the building instead of outside as designed, however the physical inspection showed no leakage. I was completely puzzled until I received a call from the building engineer disclosing that a series of exterior louvers for tenant use were not properly sealed as he had originally thought. They were difficult to physically inspect, and he had taken the original contractor's word that they were sealed during tenant fit-out. Once sealed, energy performance improved.

### Reduce Consumption 10% or More

As you can see, with simple observations and some guidance from the Building Symptom Diagnosis Tool, a technically savvy facility professional can find and correct problems that waste energy, with the added benefit of better comfort for the occupants. Building engineers can easily reduce energy consumption in their facilities by 10% or more by looking for common problems such as uncontrolled outside air, failed sensors, equipment running more than needed and simultaneous heating and cooling.

For additional information, check out *Common Opportunities: The Top Five*, found at <http://betterbricks.com/articles/common-opportunities-top-five>. To help you get started with your energy savings projects, scroll to the bottom of the page and click on **Symptom Diagnostic Tools**.

## Getting Started

Finding the cause of a symptom of poor energy performance will involve inspecting your building and collecting and analyzing trend logs from your (DDC) system. For general guidance in getting ready for these two activities, see:

- Getting Ready to Find Problems by Inspection (PDF)
- Getting Ready to Find and Confirm Problems by Trend-Logging (PDF)



Now you are ready to tackle specific symptoms and find the underlying cause. This Symptom-Diagnosis Tool helps you identify and better understand what causes a large number of important symptoms.

### To use the Symptom-Diagnosis Tool:

- Select the appropriate equipment type to display a list of possible symptoms.
- Select a candidate symptom from list.
- Read specific advice on what might be causing that symptom in that equipment.

(See companion technical piece – **Equipment Operates** on page 3).

## BOC Bulletin Goes Green!

In the BOC-minded spirit of energy conservation, we're moving from snail mail delivery of the **BOC Bulletin** to digital distribution via email effective with the winter/spring 2017 edition.

We recognize that some of our subscribers may prefer a hardcopy version. If that is your preference, you can opt-in to hard copy delivery at any time by request.

Just contact the BOC Help Desk at **877-850-4793** or **bocinfo@theboc.info** to request hardcopy delivery. Be sure to include your preferred postal mailing address.

CREDIT QUIZ

(Companion piece to technical feature).

# Equipment Operates During Unoccupied Hours

## Introduction

In most buildings with office-function occupancies (including hospitals with office areas), HVAC systems are scheduled to operate only at certain times. This includes a morning warm-up or cool-down period, plus normal occupancy. The systems are shut down after occupants leave the building at night. The occupancy schedule is usually dictated in the space lease agreement.

As you investigate this symptom, remember that each facility has its own unique HVAC system schedule. Some facilities have occupancy schedules that vary for each floor if they have floor-by-floor air handlers.

Buildings with large central systems tend to have strict occupancy schedules for all tenants to conserve energy. Otherwise, a system with several hundred horsepower worth of motors may operate for as few as 5 to 10 tenants who are working late.

Many tenants have terms in their leases that specify charges for using air conditioning after hours. This tends to minimize after-hours energy use because it affects the tenant's bottom line directly.

## How This Wastes Energy

Operating HVAC systems in normal occupied mode when the facility is really unoccupied can waste energy in several ways. Electrical energy is wasted running fans and possibly central plant equipment. Also, the building can ... *Please see below.*

The full text of this article can be found online at the BetterBricks website at <http://betterbricks.com/resource-center/tools>.

The articles here are listed alphabetically. BetterBricks is a commercial building program of the Northwest Energy Efficiency Alliance (NEEA – [www.neea.org](http://www.neea.org)) in partnership with Northwest utilities. The site has a variety of articles, tools, and resources that building operators and facilities maintenance people may find extremely useful.

Also, you can earn one hour of credit towards your BOC credential renewal by taking a quiz on the material in these two companion articles at [www.theBOC.info](http://www.theBOC.info).

# BOC Grads Making a Difference

## Optimization as the Key to Energy Efficiency



Scott White

**Facilities Manager Scott White** has been with Huntington Bank in Columbus, Ohio, since 2012 managing four of the bank's locations in the area for a total of 400,000 square feet. Interested in improving building efficiency, he took one building

and found that with equipment scheduling and other operational adjustments, he got immediate results in energy efficiency performance.

"The schedule I created was so successful that our energy/sustainability manager (Gene Freeman) asked if I'd be interested in BOC training. I made the correct choice saying yes," says White. He took the Level I series in 2014.

White turned his attention to the bank's Northland operations center, with excellent results. Because BOC stresses no-cost/low-cost solutions, that's where he started. "The BOC showed me what to look for and where and how to justify the time spent investigating. It is really that simple...I found savings because I had a map," he explains.

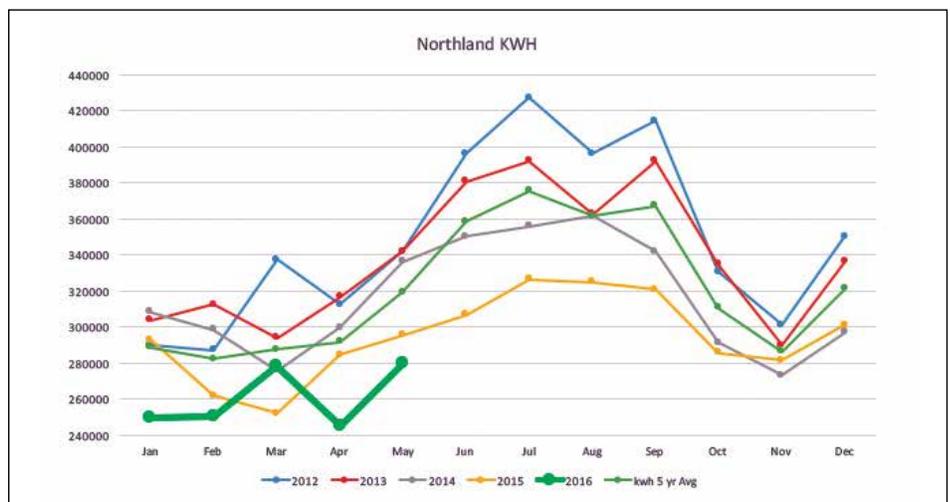
Northland is a 187,000 square foot building, first constructed in the sixties with a renovation in the early 2000's. "Map in hand," White went through all the possible ways he could save with the least amount of money

spent. The result was that, in an 18-month period, the building's baseline EnergyStar rating of 58 was raised to a current rating of 71 – a 22.6 percent improvement.

### Here are some of the no-cost/low-cost changes made:

- Set the building HVAC and lighting schedules to coincide with work schedules
- Enabled the optimal start/ stop function and set the scheduled times to department working hours, enabling the system to decide if an early start was necessary.
- Reduced lighting power density from 1.3 to .8 to mirror California's Title 24 (energy code) recommendations
- Removed one lamp per fixture in main walkways and lobby areas and replaced 32-watt lamps with 28-watt lamps
- Replaced standard fluorescent tubes with LED tubes in spaces that run 24x7
- Fixed broken HVAC system components that had been neglected, doing both repairs and preventative maintenance
- Installed occupancy sensors in ALL office areas that did not have them
- Communicated the need to make energy conservation a building wide movement, such as instructing occupants on the value of using blinds
- Made ALL spaces run on the same, widely-accepted temperature range of 70-74 degrees, and explained the rationale of this policy to occupants.

(Continued on page 5. See **BOC GRADS**).



Year-over-year comparison of energy use at Northland from 2012 to present.

## Q&A With BOC Instructor Steven Taylor



Steven Taylor

### How did you become involved with facilities management?

In 1983, I left the shipping industry as a marine engineer in the UK to start a family in Canada and soon entered

into property operations and management. My projects tended to be new construction buildings and I noticed there was a stark difference in new construction quality between ships and buildings. While ships are fully commissioned during seas trials and marine engineers receive exhaustive training, buildings in the 1980s were not commissioned and building operators largely left to fend for themselves. These observations led me to pursue a career of commissioning and building operator training.

### When and how did you hear about BOC?

I was approached by CIET (the Canadian Institute for Energy Training) in the fall of September 2013 to be one of a pool of instructors to deliver the BOC in Canada. Following initial training, I have been involved, to varying degrees, in the delivery of all Canadian BOC courses over the last two years. A couple of years before, I'd started instructing energy auditor courses for the Association of Energy Engineers.

### You've said your area of expertise is in commissioning. What types of facilities?

I do both new and existing commissioning but for several years now, my focus has been in commissioning new buildings and facilities including airports, five-star hotels, data centers and high-rise office facilities. New construction tends to utilize leading technology where you find advanced integration of automation systems, energy recovery systems – very modern concepts are applied so that is of great interest to me.

### What do you see as the greatest challenge to facilities management in your field and to FM in general?

When I started in commissioning, it was usually from the owner's side and I was astounded by the lack of performance once a new building had been handed over. There was barely any training process or communication to the FM staff of what the design team's intent for the building's systems was.

Much of my initial work in commissioning dealt with documentation and training to explain the design intent, because every building is a unique, special piece of work. A facility's staff wants to run the building properly – they just need to be given the tools.

### Is there anything that surprises you when you teach BOC classes?

Yes, the diversity of background and education experience found in the building industry. We are constantly challenged to keep a class engaged in the materials when some students may be very conversant with the subject matter and others have little-to-no training in the basics. That said, I believe building operators are much more engaged in the performance and energy consumption aspects of the building than they were 20-30 years ago. They didn't own that at all.

### Is there a specific success story that you can relate to the training – either personal or from one of your students?

I recall one project where I was required to teach the students about the chillers that had recently been installed. After I had planned and delivered a fairly technical course on how a centrifugal chiller works, one student asked, "So what do we need chilled water for?"

A learning experience! I realized that I had been delivering the course material that was not relevant to the operators' daily lives. The material should have been directed at an operator's daily operating decisions and not about the inner workings of a chiller. So I start a bit earlier down the road so that students can have their "light-switch" moment. Not everyone pays attention to the prerequisites of the course.

### Do you have any FM tips you'd like to share?

Yes, provide the training that your staff needs to perform an in-depth analysis of your building HVAC systems. With utility costs increasing every year, there is increased pressure to reduce consumption in order to keep cost increases in check.

Without a complete understanding of the design intent of the engineering team who designed the facility, one cannot expect to fully optimize the systems. If you cannot invest in staff to perform this review, then retain a reputable commissioning provider to assess and fine tune the systems for you.

*Steven Taylor is a commissioning authority at SNC Lavalin in Toronto, Ontario.*

## BOC Sponsor Q&A: Missouri Division of Energy



Tim May

### How did you first hear about the BOC program?

The Division of Energy was involved in a rate case settlement with a large utility provider in Missouri, working to provide energy

efficiency programs for the state. The director at the time and utility contact were both members of the Midwest Energy Efficiency Alliance (MEEA) board and were aware of the BOC program that MEEA offered. One of our Energy Specialists, David Harrison, took the lead to bring the program to Missouri. Through his efforts we were able to provide our first series back in 2006 with ten graduates. Since then, we have had nearly 50 series with over 700 graduates.

### Why does your company sponsor the program?

The Division of Energy sponsors the program because it allows us to have a working relationship with the utilities across our state, giving them another option of providing their commercial customers a valuable tool in reducing energy consumption and increasing education in their facilities.

### How do you go about promoting the training to your commercial and institutional customers?

For the most part, we work with the different utilities that hold the series in their territory, reaching out to their key account holders and other large energy users. We also produce direct mailings, market through the Internet, and reach out to past graduates to help spread the word of a new series. A big part of our marketing effort is word of mouth since the program tends to sell itself once attendees go back to work and share the information they have learned with coworkers and supervisors.

### What benefits does BOC provide for your customers?

The BOC program provides sustainable tools to assist the graduates in providing a smarter and more energy efficient facility. The program helps facilities reduce their energy consumption, which in turn allows the utilities to reduce their production.

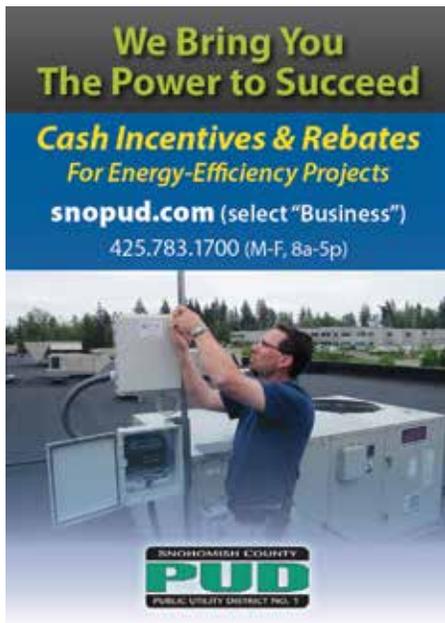
### Do you know of particular success stories from any of your clients that resulted from their BOC training?

Since I was put in charge of the program in 2008, we have engaged all the major utilities across Missouri and provided certification to several hundred of their commercial customers. Another aspect of our program is our BOC certification of state facility operators. In 2009, our governor issued an executive order to reduce energy consumption in all state owned buildings by two percent each year for the next ten years. Through this mandate, and an award of a federal grant intended to help reach these goals, the Division of Energy has been able to hold nearly ten BOC Level I and II series combined for state employees. This has directly impacted the energy usage in state buildings, ranging from our state capitol to several correctional institutions across the state. With the conclusion of two level I series in June, we will have certified over 260 of our state employees.

### Is there anything else you'd like to add?

Our continued success has enabled us to persuade other states in the Midwest to start up their own BOC programs, including Iowa and Kansas. Another highlight of our program is that we led the Midwest in total number of graduates for 2014 with 152. The BOC program complements our overall goal of making energy in Missouri more affordable and efficient, while also working to protect the environment.

*The Division of Energy is a part of the Missouri Department of Economic Development. This discussion was with Program Manager Tim May.*



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### BOC GRADS (Continued from page 3).

Even well-optimized buildings drift out of efficient operation over time. White keeps his eye on things and continues to make tweaks here and there. One example is the heating/cooling settings in hallways and lobby areas. In warmer weather, the setting for these areas is 80 degrees or so, and when it's cold, the setting is 65 degrees. White notes that most people are in these areas for two or three minutes at most. And even then, they're coming in from relatively higher or lower temperatures so it feels fine.

Initially there were some complaints with specific new policies. Requests now have to be made if there is a need for extended hour usage. There was pushback in that some people just wanted to know why lights and HVAC couldn't just be left on. White turns this around. "I see this as an opportunity to explain the actual costs of not being proactive on conservation," he says. "Maybe extended hours are needed a few times a year. If I tell them what the 'leave on' approach means to costs on an annual basis for something done rarely, they get it."

Northland has been a success story for a while now, with an 11 percent decrease in energy use over a five-year period. (See graph on page 3.) Average year-over-year reduction has been between 6 and 7 percent. White sees his approach as making incremental changes – like adding drops in a bucket. "Enough of those drops eventually fill that bucket."

Sustainability Manager Gene Freeman, who originally suggested BOC training for White, says the key is optimization. "I think it's important to drive home the idea that might be obvious to me and to Scott about the BOC training, but not necessarily to others. For the most part, Scott has optimized what he already had without throwing a bunch of money at it." He goes on to explain that while often people keep saying they need money for efficiency projects, it's important to pull back and look at the building. Has the money already spent had results or is the energy use going the wrong way? If it is the latter, that's an issue.

"It's not just about the money, it's about optimizing what you have and the savings that creates. That can be difficult to explain to some who may balk at upfront payment for training – it can be frustratingly short-sighted."

Results such as those at the Northland location will certainly help make the case for training.

## Save Money in Your Building Now:

### Six Things to Know about Low Wattage T8s

*Low wattage linear fluorescent T8 lamps have been on the market for some time. Consider low wattage T8 lamps for your facility maintenance:*

#### Improve Your Bottom Line

Available in 25- and 28-watt versions, they reduce lifetime costs by up to 23 percent when replacing 32-watt linear fluorescent T8 lamps

#### Last Longer

With lifetimes up to 84,000 hours, they can last up to 50 percent longer than 32-watt lamps

#### Reduce Maintenance

Up to 50 percent fewer trips up the ladder for maintenance staff

#### Install Easily

They're usually compatible with the majority of existing 32-watt T8 lamp ballasts, immediately saving up to 20 percent in energy consumption with little to no change in light quality

#### Are Comparably Priced

Many are priced comparably with their 32-watt counterparts

#### Provide Smart Replacement Options

They can be an excellent replacement option for facilities not yet ready to transition to LEDs, but sometimes low wattage T8s aren't the best fit – so be sure to avoid using these in low temperature facilities, and check compatibility with specialty applications.

For case studies or to find a distributor near you, go to: [www.LowWattT8.com](http://www.LowWattT8.com)

- Courtesy of the Northwest Lighting Network



## Check out BOC's Technical Webinar Series!



The BOC web site ([www.theBOC.info](http://www.theBOC.info)) offers both live and recorded webinars available for viewing at your convenience. Complete a quiz at the conclusion of the

session and you can earn 1.5 points towards maintaining your BOC credential. Visit the BOC website to check out current options of recorded webinars, as well as the schedule for the remainder of the 2016 live sessions.

The LIVE webinars offered in 2016 will be held from 11 AM to noon Pacific Standard Time. Topics for the 2016 Series of **Building Tool Diagnostics** are:

### Recorded:

- *Temperature and CO2 Loggers*
- *Managing Your Plug Loads*
- *Occupancy and Lighting Data Loggers*
- *Infrared Cameras*

### Upcoming Live:

- *Addressing Indoor Air Complaints – September 15th*
- *Managing Water Use in Your Facility – October 13th*

Check out the BOC website for details. And remember, BOC graduates who maintain their credential receive a **20% discount** on the BOC webinars series.

## New to BOC?

### Register for a FREE Informational BOC Webcast:

BOC Informational Webcasts are for newcomers to the program. Learn about Level I and Level II course topics, schedules and certification requirements in detail. Listen in and find out who benefits by attending BOC training and how graduates are improving their facilities.

Informational webcasts last approximately one hour, starting at :

**8:30AM - 9:30AM (PST)**

**9:30AM - 10:30AM (MST)**

**10:30AM - 11:30AM (CST)**

**11:30AM - 12:30PM (EST)**

The next live broadcast for 2016 is scheduled for **September 14th**. Please note that pre-recorded webcasts can be downloaded from the BOC website 24/7.

To sign up go to: [www.theBOC.info](http://www.theBOC.info)

## Stay Ahead: Prep for BOC Maintenance Now!

To maintain your BOC credential, graduates must accumulate maintenance points each year following a full calendar year after they've earned their credential. Level I maintenance requires five points each year and Level II requires ten. Points may be earned as follows:

- Continued employment in building operations ..... **2 points/year**
- Continuing education in building operations..... **1 point per hour of classroom time**
- Energy efficiency projects completed at your facility..... **Up to 11 points/year**
- Membership in a building operations association ..... **1 point/year**
- Offices held in membership associations..... **2 points/year**
- Awards received for efficient building operations..... **2 points/award**
- BOC newsletter tech article quiz (see page 8 for details) ..... **1 point/passed quiz**
- Completion of an energy consumption benchmark for the previous twelve-month period using **Energy Star®** Portfolio Manager or alternative energy accounting tool ..... **3 points/year**
- Enrollment in a BOC webinar and completion of its quiz (See webinar announcement on this page) ..... **1.5 points/passed quiz**

BOC graduates whose credential expires March 31, 2017 will receive their applications via email and US mail in early January. To complete the application, graduates will report maintenance points (Level I maintenance requires five points and Level II requires ten) and submit the maintenance application fee (\$65 for either Level I or II).

Use our HELP Desk (1-877-850-4793), whose knowledgeable staff can address questions and assist with the maintenance application. **The deadline for application submission is March 31, 2017.**

### Continuing Education Opportunities for Credential Maintenance Points

There are a number of national organizations that offer continuing education courses that are applicable to annual BOC credential maintenance. Go to the BOC website ([www.theBOC.info](http://www.theBOC.info)) and search for "Resources" (or under About\Resources. There you will find links to many of these organizations. Browse their Education, Professional Development and Events Calendars to see what exciting opportunities there are for you.

### Are you a Current Credential Holder?

#### WIN FREE STUFF! –

Twice a year, current credential-holders may enter a drawing to win merchandise such as BOC gear from our Shop, diagnostic tools, or reference manuals. Our next drawing for a BOC hat, mug or shirt is October 1st.



Congratulations to the winner of our April drawing, **Joseph Kazarian** of Hexagon Metrology, Inc. in North Kingstown, RI!

### Enter to win here:

<https://www.surveymonkey.com/r/winnerOct2016>

### Show Your BOC Pride!

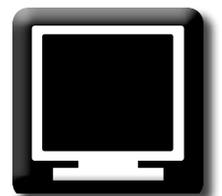
Check out the online BOC Shop where you can purchase t-shirts, polo's, hats, mugs and BOC patches to highlight your well-earned BOC credential. BOC handbooks are also available to keep you up-to-date on the latest in the field! Visit [www.shop.theboc.info](http://www.shop.theboc.info) for available products.

### Another Benefit for BOC Credentialed Operators

BOC graduates who maintain their credential receive a **20% discount** on the BOC webinars series. Watch for details of new offerings at the BOC website ([www.theBOC.info](http://www.theBOC.info)).

### New ETO Video Highlights BOC Training

Long-time BOC sponsor Energy Trust of Oregon (ETO) recently produced a short video featuring staff from Umpqua Community College. Both BOC programs graduates and non-FM staff commented on the benefits of training and how it affects the community. You can check out this video at <http://energytrust.org/commercial/training-and-events/>



Click on "**About Building Operator Certification**" and then "**Watch a short video...**"

## National Conferences & Symposiums 2016-2017

Conferences and Symposiums are a great way to get exposure to new technologies and techniques in facilities management, as well as an opportunity to network with your peers. Attendance at a trade show earns you one point toward maintenance of the BOC credential. Attending educational sessions as part of a conference earns one maintenance point per hour of educational time as well! For a listing of FM trade shows around the country, visit the BOC website at [www.theBOC.info](http://www.theBOC.info) and go to the **Continuing Education** tab.

## Solar Roadways – A New Reality

In the summer/fall 2014 issue of the BOC Bulletin, we highlighted a technology by a new company called Solar Roadways. At that time, the Federal Highways Agency had contracted for an installation of a prototype of the energy-generating photovoltaic “pavers,” a kind of tempered glass used to replace asphalt in parking lots, playgrounds, sidewalks, highways – anywhere pavement would be used. BUT being a type of solar panel, the installations would also generate electricity.

Just this year the Missouri Department of Transportation will promote the first public installation along the nation’s most iconic highway: Route 66. The section is anticipated to be finished and in use by the end of the year. To read more about this exciting technology, go to [www.mentalfloss.com](http://www.mentalfloss.com) and search on “Route 66 solar road”. There’s a video available there as well.



Energy efficiency incentives for your business

[pse.com/mybusiness](http://pse.com/mybusiness)



## Thermal Imaging Camera Diagnostic Tool



Image courtesy of Fluke, Inc.

Diagnostic tools are an important component of the Building Operator’s toolbox for troubleshooting buildings system performance and maintenance issues. A versatile tool that can be used in a variety of troubleshooting situations is the thermal imaging camera. A thermal imaging camera is a device that forms an image using infrared radiation, which is the radiated temperature of the surface. This is similar to a common camera that forms an image using visible light. The image produced is known as a thermogram and is analyzed through a process called thermography. The images can be stored on the camera to be used to document operating conditions. Thermography can be used to inspect and troubleshoot many different types of equipment and systems. Some examples include:

- High resistance connections in electrical systems
- Electric motor bearings and couplings
- Liquid and sludge levels in tanks
- Belts and sheaves drive systems
- Conveyor belt bearings
- Furnace and oven refractories
- Gas leak detection
- Building insulation and air leakage
- Water intrusion and insulation damage
- Argon gas escape in double pane windows

Training and certification in the proper use of thermal imaging cameras is highly recommended. Variables that can affect the accuracy of the thermal image include focus, thermal tuning and range, reflectivity of the surface, resolution and pixels, and the range of field. Several organizations offer training and certification programs in Thermography.

– BOC Instructor Duane Lewellen

## Diagnostic Tool Lending Libraries

Like what you read in Duane Lewellen’s piece on thermal imaging cameras, but not sure it’s in your department’s budget? There is another option in some parts of the country: Diagnostic Tool Lending Libraries (TLLs). TLLs provide a great range of energy diagnostic tools available for measuring your facility’s performance at little or no cost. From thermal imaging cameras to data loggers to power meters – this list goes on, with equipment ranging in cost from \$100 to over \$15,000.

The concept of TLLs has been around since the seventies, starting as residential and community TLLs that lent housing improvement tools. Later, especially on the west coast at companies like Southern California Edison and Pacific Gas & Electric and on the east coast at CUNY’s Building Performance Lab’s TLL, utilities and energy efficiency groups expanded the concept to include more sophisticated, facilities-oriented equipment.

Largely funded by energy efficiency groups and utilities at this point, a number of manufacturers are also supportive. TLLs can benefit manufacturers because they give building operators a chance to “test drive” equipment. In many cases, the benefits are obviously ongoing and the test-driver will make the economic case for purchase.



Each TLL has its own practices but, in general, tools are lent out by request anywhere from two to four weeks, as available. Borrowers may have to pay shipping, if applicable, though most TLLs operate locally. Lewellen, who began working at Seattle’s new Smart Buildings Center’s TLL when it opened in November 2015, opines that there’s no reason this concept cannot expand beyond local lending though because it is basically a “virtual library” that can ship anywhere.

Help make it happen in your area! Get more information by googling “diagnostic tool lending library.” Look for Energy Management entries. There are currently fewer than a dozen Diagnostic TLLs in the country, but the concept catching on. In addition those mentioned above, these groups also support TLLs: San Diego Gas & Electric, Idaho Integrated Design Lab, and Clark Public Utilities in Vancouver. Links to the specific sites can either be googled or found in the web version of this newsletter at [www.theBOC.info](http://www.theBOC.info).



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