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The Kennedy Space Center Visitor Complex has a mix of lighting environments. Museum displays are exempt from the requirements of *ASHRAE 90.1*, but lobby areas would not be.

What is *ASHRAE 90.1* and why should you care?

BY DAVID FOX

MUCH LIKE YOU looking at this article and deciding how much you care to read it, I started down this path of discovering *ASHRAE 90.1* not knowing how much I needed to care. I was investigating the latest revisions for changes that might require us to alter the functions in our architectural control systems. I discovered enough changes that if you are not aware, you may want to be.

While you may or may not have heard of *ASHRAE*, I can guarantee that your architect, consultant, contractors, and HVAC team have. *ASHRAE* (American Society of Heating, Refrigerating and Air-Conditioning Engineers) develops and reviews regular guidelines for energy efficiency. Much like the *NFPA* (National Fire Protection Association) develops regular updates to the national electrical code and emergency guidelines. Their

standard *90.1* applies to all buildings except “low-rise residential” (three habitable floors or less).

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Every three years *ASHRAE* publishes a new revision of this code and it is the root everyone else uses to develop their codes and standards. *ICC* (International Code Council) uses it to draft *IECC 90.1* (*International Energy Conservation Code*). The *IES* (Illuminating Engineering Society) adopts it as their energy efficiency standard *IES 90.1*. The *DOE* (US Department of

Energy) uses it to rewrite *ANSI 90.1*. *ANSI 90.1* is then used by states to alter their codes to meet or exceed it. This is why in

a lot of places you will see it referred to as *ASHRAE/IES/ANSI/IECC 90.1* followed by a year.

In addition to lighting, *ASHRAE 90.1* includes sections on air handling, power distribution, water heating, and construction requirements. These sections contain the requirements for new construction and retrofit. Section 9 covers

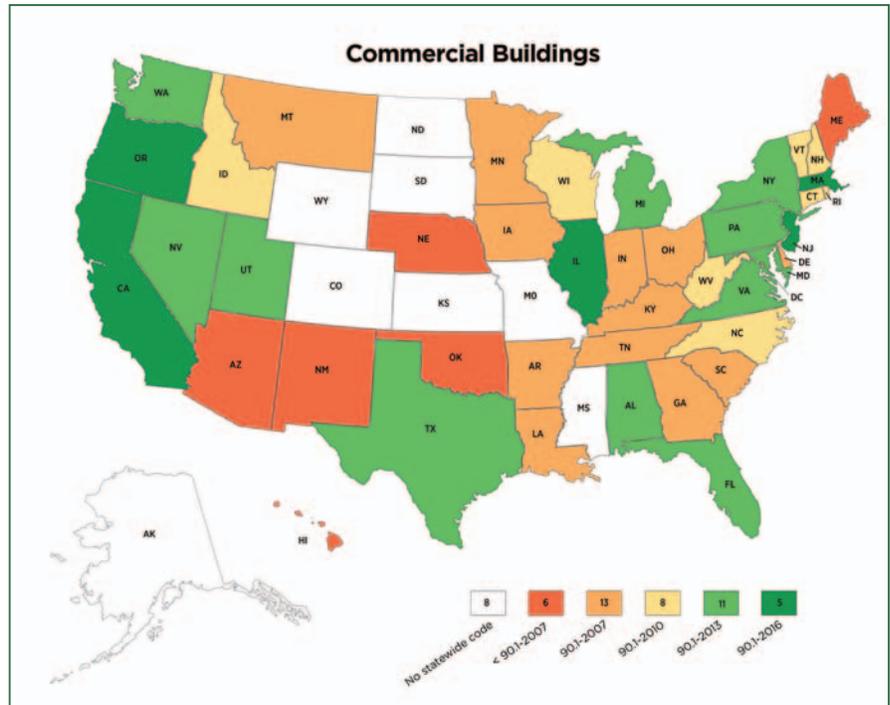
interior and exterior lighting systems and is the section that mostly affects our industry.

These codes are referenced by federal and state legislators to determine tax deductions for commercial buildings and by rating systems such as LEED.

California's *Title 24-2016* is a perfect example of how this works. It was created after *ASHRAE 90.1-2013* was adopted. *ASHRAE 90.1-2013* updated requirements for timed holds and the functions of responsive controls. As a result of these requirement changes, lighting control requirements changed, causing specifications to change, which in turn caused manufacturers to change how products perform.

What further complicates matters is compliance at the national and state levels typically do not match. States are required to meet or exceed the current iteration of *ANSI 90.1*, within a reasonable timeframe. As you can see in this map produced by the DOE in May 2020, states range from having zero code requirements to exceeding compliance with *ASHRAE 90.1-2016*. When it is time for an inspection, what your AHJ (Authority Having Jurisdiction) is going to use to inspect your system is literally all over the map.

The biggest changes to *ASHRAE 90.1-2016* from the 2013 revision are modifications to control requirements



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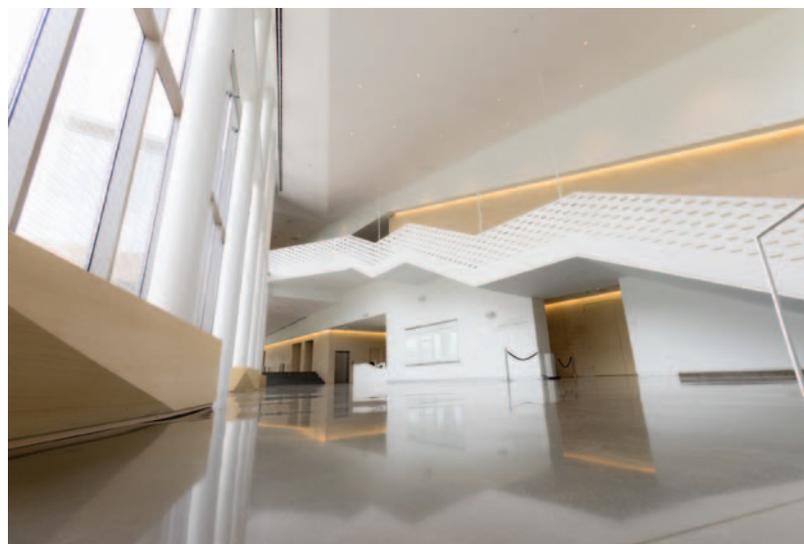
designed to increase energy savings. Some of the major points in Section 9 include:

- New methods of calculating total power

consumption, based either on building size or by classifying the spaces in the building into defined areas, each with



Galleries are exempt from the code requirements, but lighting for artwork in a passageway may not be.



Areas receiving natural light need to be controlled separately from other general lighting and change level in response to daylight.

individual power guidelines.

- Modifications to the allowed watts-per-square-foot that reflect the efficiency gains from LED technology.
- Changes to the rules determining the amount retrofit before that building has to be brought up to current code.
- Significant changes to control philosophy including off as the new default state.

At the same time, *ASHRAE 90.1-2016* exempts the following spaces from the new power calculation and lighting requirements:

- Theatrical, stage, film, and video production spaces
- Exhibit displays for museums, monuments, and galleries
- Interior spaces designated as registered historic landmarks
- Exit signs
- Sale or lighting educational demonstration systems
- Lighting for television broadcasting in sporting activity areas
- Casino gaming areas
- Mirror lighting in dressing rooms
- Accent lighting in religious pulpit, and choir areas

So why should you care?

While many of the spaces we use for events are excluded, the rest of the building is included. While the theatre may not have to meet code changes, the lobby will. If you have a dance studio that is primarily a classroom but is used occasionally for recitals it will need to meet code requirements for a classroom that includes timed lighting and specified maximum watts consumed. The scene shop, dressing rooms, paint shop, and all corridor lighting around the event space are also included in the code with their requirements. This includes scheduled control, switched outlets, specific operating hours, and responsive control requirements.



PHOTO COURTESY CANDELA CONTROLS, INC.

Harrah's Cherokee Casino and Resort has beautifully illuminated spaces, some of which fall within *ASHRAE 90.1's* scope while others fall outside.

Ok, I care now! What do I need to know?

As the primary focus of *ASHRAE 90.1-2016* is reducing energy consumption, Section 9 focuses on several key topics.

1. New power calculations determine the allowed watts-per-square-foot for either the entire building or per space depending on how power is calculated.

This is referred to as LPD (Lighting Power Density) and bases requirements on measured power consumption not measured light output. For example, a space defined as a corridor is allowed 0.6 watts-per-square-foot. These changes favor non-incandescent sources. And, there are multiple provisions to allow for ballasted fixtures and the use of low voltage electronic transformers.

2. To reduce power consumption, lighting should automatically switch off when not in use and default to off outside of normal business hours.

Under the new requirements, each space must have at least one control device for general lighting. This can be a manual switch and a responsive control like an

occupancy sensor, or a manual on with a timer. Manual control must be capable of reducing light either via dimming or selective switching. Systems that support automatic-on can only turn on 50% of the LPD in a space. Automatic-on is also limited to spaces where either life safety is a consideration or manual switching is not possible (like a stairwell or a parking lot). In spaces where lighting is controlled from another space, an indicator must be present to track the state of that control.

Control devices must be installed to ensure that lighting is automatically turned off when a space is not in use. This includes systems that support scheduling, occupancy sensing, and signaling from other building systems.

In spaces controlled from an occupancy sensor (i.e. a bathroom), vacancy timing is set to a maximum of 20 minutes. Spaces that have windows or skylights (i.e. a scene shop or lobby) require areas receiving natural light be controlled separately from other general lighting and change level in response to daylight.

3. While *ASHRAE 90.1-2016* is not retroactive, retrofitting your building can force compliance.

The code stipulates that during a retrofit, if 20% of the existing lighting load is replaced, the entire building now needs to meet the revised code. This is something you want to be very aware of as **lamp replacement counts towards retrofit calculations.**

Replacing old fixtures with new fixtures in your performance area is exempt from these calculations. However, if the facility team replaces all your houselights, lobby lights, or hallway lights, any of these could add up to 20% of the total lighting load.

While controls are not mentioned as part of a retrofit, either compliant occupancy- or time-based automatic shutoff controls become required when more than 20% of the connected lighting load is retrofit.

For buildings that are not undergoing retrofit, but are receiving alterations or additions, all equipment in the new spaces must comply with *ASHRAE 90.1-2016*. This also counts towards replacement equipment. Thankfully, there is an exception built into the code stating that compliance is **not** required for existing equipment that is being reused or relocated.

4. Outside of Section 9, there are a few code changes you should also be aware of.

HVAC requirements now require automatic on and off based on programmed schedules, occupancy sensors, and timed override of automatic control.

Fifty-percent of all 120 V receptacles in offices, conference rooms, classrooms, workstations, and breakrooms must be automatically controlled via automatic scheduling and or occupancy sensing. This includes your shop spaces, so be aware where you are plugging in chargers and anything that needs to remain on, such as the coffeemaker.

New requirements were added stating that outside of scheduled business hours, all lighting, **including egress lighting on emergency circuits**, shall be turned off when the space is unoccupied. Some spaces allow for a minimum level-per-square-foot, but powered-off is the default. Additionally, exterior lighting must be reduced. This

scheduled off needs to be automatic coming from either a time of day device or an automatic device like an alarm or security system. When lights are turned on outside of business hours via manual control, they shall not remain on for more than two hours before turning off and needing to be manually activated again. Be aware of how this may affect late-night work calls and make sure you are involved in setting “work hour” scheduling.

OK, I’m freaking out a little now. What can I do about this?

I offer you three quotes that help.

The first was written by a truly hoopy frood who always knew where his towel was, Douglas Adams: “Don’t Panic.”

The second is a scene from the 1998 film *Shakespeare in Love*:

Philip Henslowe: *Mr. Fennyman, allow me to explain about the theatre business. The natural condition is one of insurmountable obstacles on the road to imminent disaster.*

Hugh Fennyman: *So, what do we do?*

Philip Henslowe: *Nothing. Strangely enough, it all turns out well.*

Hugh Fennyman: *How?*

Philip Henslowe: *I don’t know. It’s a mystery.*

The third was the tag line of every episode of the cartoon series G.I. Joe...

“And now you know... and knowing is half the battle.”

Read the code.

You can purchase printed copies of the code from www.ASHRAE.org or review the free online version at <http://estalink.us/fsi6a>. You can find your state’s code through the DOE website <http://estalink.us/xm56b>.

Review your current system.

While these new control requirements

sound complicated or expensive, most modern architectural systems (i.e. something installed in the last 15 years) have several of these features built in. Most support configurable sweeps, integration with responsive controls, and time clocks. So rather than replacing systems, you may need to look at ways to integrate your existing systems to work for you. And remember, changes in control don’t count as a retrofit.

Make friends in other departments.

If you are not already in regular communication with the facilities department, building committee, or planning group, now is the time. Make sure you are all familiar with retrofit plans and how every system and department is affected. Work together so you all get a say in how things are applied. There is nothing worse than returning from an academic break to discover that your shop lights are all automated, or the house lights were replaced with “dimnable” LEDs, or the HVAC in your space is now 100% controlled based on box office hours. It happens.

Get involved in any building plans NOW.

If you are lucky, your new building/retrofit/addendum is being designed by people who understand our industry. We can all tell stories about the times we weren’t lucky. Getting involved now gives you a chance to address the specific needs of our industry and the particulars of your facility.

Remember that you have always been affected by *ASHRAE 90.1* because it is the background answer to the question “why” behind the water, power, air, and lighting in every place you have worked and will work. The last few revisions have embraced modern control systems and lighting technology, and so *ASHRAE* has moved to the foreground of our collective awareness.

The standard is still evolving and *ASHRAE 90.1-2019* is open for comment. It currently contains larger LPD reductions and further provisions encouraging networked controls. Codes like this can be hard to follow and how much you need to learn is going to depend on your current and future jobs. In my opinion, this is a topic where time invested will be repaid with knowledge worth knowing. ■



After getting his start running lights for a Sinatra Impersonator in the back room of a Chinese restaurant, **David Fox** worked in California as a field service technician, production electrician, house electrician, console

programmer, lighting designer, and monitor engineer for a variety of theatres, live concert venues, feature films, and television productions. For the last 21 years he has been with Electronic Theatre Controls starting on the phones in Technical Support, and currently as a Training and Documentation Specialist developing and presenting live and online training. When not at work, he tries to do as little as possible, and generally fails at it. David can be reached at David.Fox@etcconnect.com .

