

### **Upcoming Meeting**

**Date:** September 26, 2018

**Time:** 6:00pm to 8:00pm

**Place:** Olive Grove Restaurant

**Topic:** Legionella Facts, ASHRAE 188,  
and Minimizing Risks

**Speaker:** Craig Boyce - Kemper AIP Metals

#### Meeting Format

6-6:30 Social

6:30-6:45 Announcements and Table Tops

6:45 Dinner Served

7:00-8:00 Speaker



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### **MEETING LOCATION**



**Olive Grove**  
Restaurant & Lounge

**705 North Hammonds Ferry Road  
Linthicum, Maryland 21090  
Phone: 410.636.1385**

**WWW.BALTIMOREASPE.COM**



**Jeffrey W. Edwards, CPD ,GPD  
President**

## President's Report

Hello to all and I hope everyone had a great summer. This past July I was able to spend a week with my family in Sedona, AZ. and if you've never been there, please add Sedona to your must see bucket list to experience their beautiful red rock mountain scenery.

A lot of hard work has been spent the past several months by the chapter board with planning and scheduling our technical presentation meetings along with other events that will be announced in our newsletters moving forward.

For a list and topics of our scheduled technical meetings this season, please refer to the last page of our newsletter.

The chapter has been very fortunate to have new sponsors join us this year as well as many original sponsors remaining loyal to us. The entire board thanks all our sponsors for helping to support our proud chapter.

Because of the many sponsors who have come on board this year, we have decided to eliminate the need for meeting sponsors each month. We will still offer table tops each month to those manufacturers and/or reps who would like to present a product. Please contact me or Kathy Dwyer if you are interested in having a table top at upcoming meetings.

At the end of this month is ASPE's big Convention & Expo in Atlanta, GA. I will be attending along with several of our chapter board members. If you are planning on attending, please let me know so I can try to touch base with you while there.

I'm am very excited to announce that later this year, the chapter will be handing out awards to select members of our chapter. These awards are long overdue and we will be announcing more about this great event once final plans have be finalized.

I am very happy to welcome Steve Hudson, PE, CPD, Chris Imhof, PE, CPD, and George Gruner, PE, to our chapter board. Steve will be our new chapter Historian, Chris is our new Education Committee Chair and George will be our new Administration Secretary. Please welcome them at the next meeting you attend.

Best Regards,  
Jeff Edwards, CPD, GPD  
President-ASPE Baltimore Chapter

# Project Spotlight

## SCHOOL OF HEALTH PROFESSIONS VIRGINIA COMMONWEALTH UNIVERSITY RICHMOND, VA

Completion date: 2018  
Construction cost: \$87.3 million

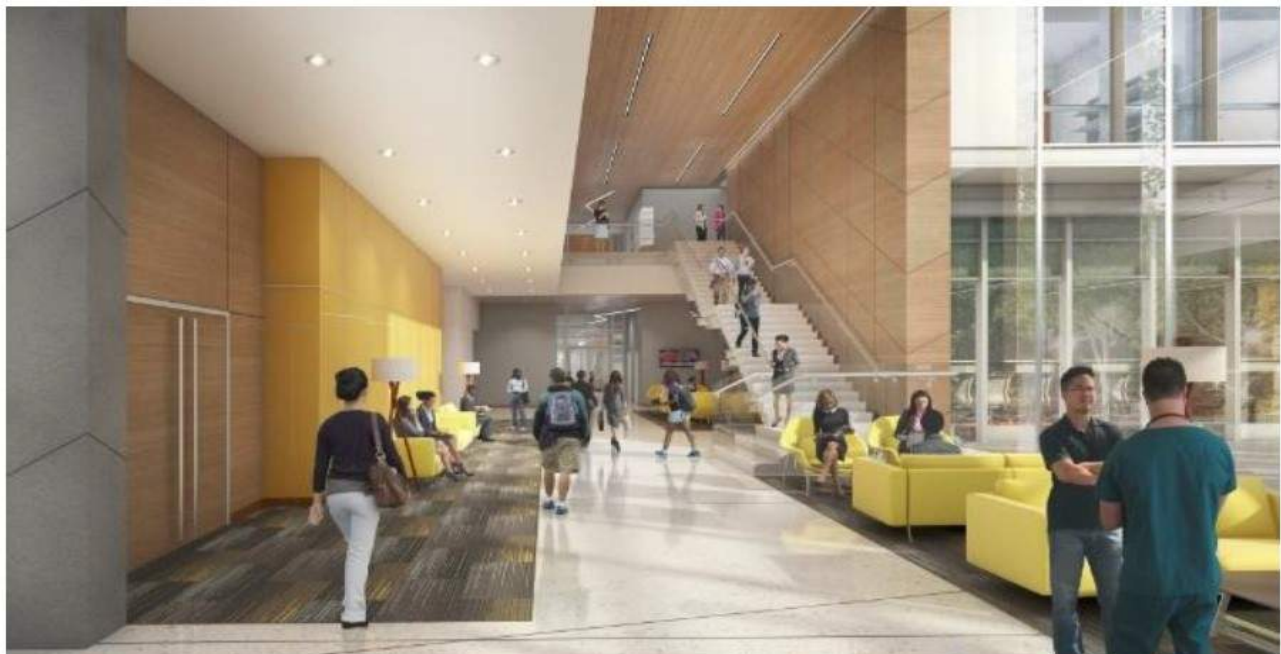


The project entails a New Allied Health Professions Building at VCU, consisting of classrooms, conference rooms, laboratories and support spaces, offices, and informal student gathering spaces. The project floor area is approximately 154,000 gsf.

The new facility is designed to unite Gerontology, Health Administration, Nurse Anesthesia, Occupational Therapy, Patient Counseling, Physical Therapy, Radiation Sciences, Rehab Counseling, and the Technology Center, as well as the Dean's Office and the Virginia Center on Aging. Departments and programs share teaching amenities and technologies, such as synchronous distance-learning classrooms; audiovisual capture of directed instruction; and observation of patient-care simulation.

The building houses a dedicated Nurse Anesthesia simulation suite, as well as one shared by all of the allied health disciplines working individually or in teams across specialties. Simulated hospital environments will be provided for operating rooms, acute care patient rooms, recovery rooms, and a range of imaging spaces including a high-tech virtual linear accelerator. The therapy departments will share a state-of-the-art Smart Home Apartment for training students.

The program also includes a double-height biomechanics research lab and several maker labs, where students and faculty can research, create, and test their own adaptive aids for therapy.



If you would like to contribute a project to this section, please email Jeff Edwards at [jedwards@muellerassoc.com](mailto:jedwards@muellerassoc.com) or Jason Eagles at [jason@bayassociates.com](mailto:jason@bayassociates.com)

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# Welcome Incoming Board Members



**Stephen Hudson, PE, CPD  
Historian**

Stephen Hudson has lived in Maryland his entire life. After graduating from high school he started working for James Posey Associates, Inc, a MEP engineering firm. Starting as a draftsman, Steve later advanced to mechanical designer, register professional engineer, project manager, and finally as president/managing principal & chairman of the 100 year old Baltimore firm. During his 48 years with James Posey Associates Steve has worked on over 1000 projects in his career including many historic structures. The resume includes renovations of the Historic Inns of Annapolis, Reynolds Tavern, several buildings at St. John College, Maryland State Senate & House Buildings, Historic Officers Club at the Naval Academy, Charles Carroll House, Museum & Visitor's Center at George Washington's Mount Vernon home, Schmucker Hall Seminary Ridge Museum - Gettysburg, original Mount Royal Train Station in Baltimore to name a few. Some additional career accomplishments include 7 engineering design awards, plumbing engineering teacher at the Engineering Society of Baltimore for over 10 years, and was the engineering reviewer for proposed changes to the National Standard Plumbing Code for 2 years.

Since his retirement in 2013 Steve has devoted his time and expertise doing volunteer engineering work for several clients who have made his career successful. He presently assisting facility departments at Anne Arundel County Public School, Calvert County Public School, and Asbury Solomons Retirement Community where he presently live with his wife of 47 years.

If there are any additional questions about Stephen Hudson, he can be reached at [shudson124@outlook.com](mailto:shudson124@outlook.com) or see his profile in LinkedIn.



**Christopher Imhof, PE, CPD  
Education Committee Chair**

Education: BS in Aerospace and Ocean Engineering Virginia Tech 2005

Credentials: PE, CPD

Experience: 13 years of plumbing design(8 with Dwyer Engineering and 5 with JPA), on a wide range of projects including retail, grocery, restaurant, office buildings, K-12, Higher Ed, performing arts, laboratory, and medical. Currently a project manager with WSSC plan review.

Hobbies: Fishing and DC United.

If there are any additional questions about Christopher Imhof, he can be reached at [Christopher.imhof@wsscwater.com](mailto:Christopher.imhof@wsscwater.com) .

**Please join us in welcoming Steve and Chris to the board!**

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**Chuck Swope, PE, CPD, LEED AP BD+C  
Vice President—Technical**

## Technical Report

I'd like to welcome you all back to another exciting presentation season for the Baltimore Chapter of ASPE. We've been hard at work discussing how to make the chapter even better this year. We've brought two new board members to fill the Education Chair and Historian positions and have an informative technical presentation for September.

Chris Imhof will take the Education Chair position. Chris is a qualified professional mechanical engineer with 13 years of experience in plumbing design through Dwyer Engineering and James Posey Associates. He holds a BS in Aerospace and Ocean Engineering from Virginia Tech. Chris is also our inside man at WSSC (hopefully) with his new position in Plans Review and is also putting together a presentation for our October meeting with a WSSC 2016 Plumbing Code update.

Our new historian will be Steve Hudson. Steve served as our education chair for many years and has recently retired from his Chairman position at James Posey Associates after 48 years. However, he has certainly not retired from our industry. Steve volunteers with organizations such as the maintenance department at several school systems, advisory board for ACE (Architects Contractors Engineers) scholarship program for high school students, and advisory board for the Chase/Lloyd House in Annapolis.

As for our upcoming technical presenter, Craig Boyce is educated in Business Administration at the University of Cincinnati and is a professional with over 30 years consultative selling experience. Specializing in plumbing system technologies, Craig consults with facilities engineers, architects, designers and construction engineering firms. He is currently employed as Sales Director by Kemper AIP Metals and is responsible for the US introduction of Kemper's engineered solution for minimizing the risk of Legionella in domestic water systems. Craig has completed a Career Diploma Degree in Plumbing at Ashworth College and is an active presenter at ASPE Chapter meetings throughout the country.



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Please Contact [Jason Eagles](#) or [Jeff Edwards](#)

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## Water Safety in Buildings

It is proven that water stagnation and water temperature can impact the growth of Legionella in potable water systems. Stagnation encourages biofilm growth and provides a safe haven for the colonization of Legionellae. Water temperatures between 68 degrees (F) and 122 degrees (F) are ideal for the growth and propagation of the Legionella bacteria. If building managers and engineers could guarantee a constant flow of water and consistently maintain water temperatures outside of this range then the risk of Legionella is greatly reduced and the need for supplemental actions and control measures is minimized.

A constant flow of water within a plumbing system helps eliminate stagnation while positively impacting water temperatures. For these reasons, a flushing protocol (requiring the regular flushing of devices) has been proven to be effective in minimizing the growth and colonization of the Legionella bacteria within our potable water supply (both hot and cold). The challenge to building engineers is twofold: (1) how to eliminate dead legs and effectively move water when there is limited or zero demand at the device, and (2) how to effectively maintain water temperatures outside of the Legionella growth range when there exists extended runs of piping throughout the hot water system and no accepted process for circulating cold water.

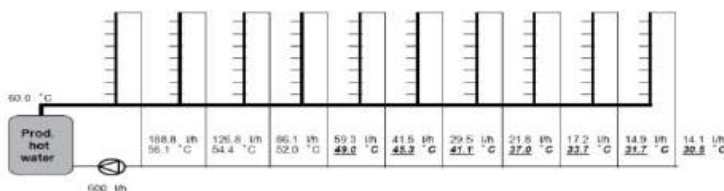
Proven engineered devices (valves) exist that are effective in keeping water moving in both the hot and cold water supply. These devices are commonly misunderstood, misused and/or are unfamiliar to plumbing designers, engineers and contractors. These devices help to eliminate stagnation and control water temperatures. As a result, biofilm growth is reduced and the risk of water borne pathogens is minimized. However, in many cases, the devices are often miscalculated, installed incorrectly and/or do not perform as expected due to erroneous integration within the whole of the plumbing system. Engineered solutions include thermal balancing valves, Venturi flow splitter valves, temperature sensors, flow sensors, timers, automatic flushing valves and more.

There is also a concern for wasting energy and resources as water is dumped down the drain and heaters and circulation pump times are regulated. A happy medium can be reached with an effectively engineered hydronic balancing scheme.

An in depth description of how these devices work is provided along with an analysis of other available means to curtail the colonization of biofilm in our water systems. Analysis regarding the effectiveness of chemicals, filters, ionization, UV treatment and other means are reviewed in comparison to engineered valve solutions.

### Box 4.8 Legionella hazard due to unbalanced looped hot-water systems

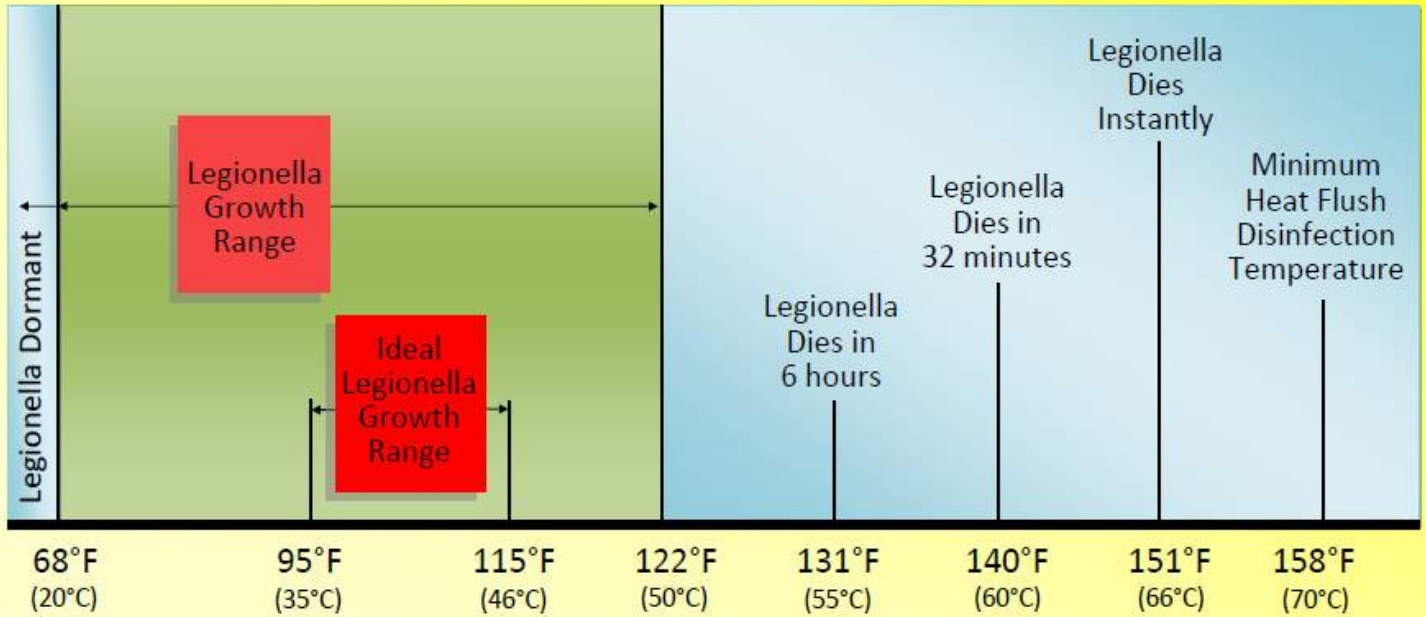
Looped hot-water networks are designed in such a way that the temperature in the loops is maintained because the loops are insulated and a minimum flow rate is maintained in each loop. For a given loop, the difference in temperature between the two points where it is connected to the main distribution circuit ("departure" and "arrival") is inversely proportional to the flow rate in the loop. For example, in a typical building with six levels, a 5 °C temperature difference may be maintained only under the condition that the flow rate in the loop is equal to or above 40 litres per hour. Very often, this condition can be attained only by specific valves that equilibrate flows among the loops. However, if the design or construction of such networks is poor, flows may not be balanced—that is, the first loops take the largest part of the flow rate, so that there is not enough flow for the last loops. As the figure below shows, this frequent type of fault can directly affect the temperature of the last loops, which can then become incubators of *Legionella* and other environmental pathogens at temperatures below 50 °C.



Example of unbalanced flow rates in a looped hot water system and its consequences on the temperature of circulated water



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Karen Schulte, PE, CPD, LEED AP BD+C  
AYP & WOA Liaison

Welcome to the 2018-2019 ASPE chapter year. Based on the success of last year's AYP and WOA events we will be planning events for our young professionals and Women of ASPE once again this year. As a reminder the AYP events are open to our 35 and under contingent. We encourage the over 35 ASPE members to pass along the event information to your younger engineers and reps (regardless of ASPE membership). We welcome the younger staff that you work with to attend the AYP events as a way of getting involved in ASPE.

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Contact Karen Schulte for more information on the Baltimore Chapter AYP and WOA at [kschulte@muellerassoc.com](mailto:kschulte@muellerassoc.com)



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Stephen Hudson, PE, CPD  
Historian

## WHEN PLUMBING WAS MORE SIMPLE

For many centuries plumbing was easy, build a privy to handle human waste. How to properly build privies are still in many of today's plumbing code because they are still being used in many remote areas of the United States. I can remember in the early 1950's visiting my aunt who lived a block off of Monument Street, a major commercial business street in Baltimore City. She had a privy in the rear of her yard by the alley along with all the other row homes on her block. Several times a week a truck would go down the alley at night to empty the privies from a door in the rear of the wooden structure with a long handled ladle and placed the waste in a tank on the back of the truck. The people called the man on the truck the "honey dipper". By the mid 1950's indoor plumbing was being installed in the homes on her block.

As indoor plumbing became more main stream for homes, the plumbing industry became very busy. As the plumbing industry grew so did the jokes and sayings increased. The one still used today is the 3 most important things that plumbers should remember;

- Never chew your finger nails
- Waste flows down hill
- Payday is Friday

Many of the plumbing codes in the 1950's and before basically stated to install a vent pipe after the first fixture and another vent pipe just before the sanitary main leaves the building, period. It was assumed that on medium or large buildings you would have multiple sanitary mains leaving the building. These older systems we use to call "talking plumbing systems" because when you would flush a water closet you hear the gurgle sound of the fixture traps being pulled throughout the structure. I have only experienced one project where sewer gas leaked into the building due to the trap seal. It was a historic renovation project that still had bell traps on the lavatories and only two vent pipe on the system. If you are working on a project with old plumbing plans, don't be surprised to see designs shown this way.

In the late 1960's many new and detailed plumbing codes emerged from various cities and counties in Maryland. An example is Baltimore City that had their version of the 1955 National Standard plumbing code with amendments. In 1966 Baltimore City published a new plumbing code that was a least twice the size of their 1955 code. The chief plumbing inspector at the time, Harley Fickes, in 1967 gave classes at the local union plumber's hall and local design engineers were invited so all plumbing specialist, installers and engineers understood how to meet the new code requirements, which were extensive at the time.

This was the start of today's plumbing codes in Maryland. I was very young at that time, but I believe that these changes were being made to many plumbing codes Nation wide. Before ASPE started ASHRAE was the source of plumbing information for designers, but things were changing. ASPE organization started in 1964 in California, promoting the need for better and safer plumbing systems. Plumbing is one thing that simpler is not always better.

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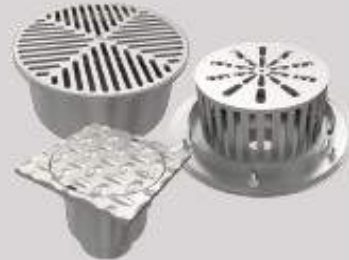
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## WHO

Attendees Include:

- Designers
- Engineers
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- Master plumbers
- Students

## WHERE

Georgia World Congress Center (GWCC), Hall A - Atlanta, Georgia  
285 Andrew Young International Blvd NW, Atlanta, GA 30313

## WHEN

Convention: September 28 - October 3

Exposition:

October 1, 2018 | 11:00 am - 5:00 pm

October 2, 2018 | 10:00 am - 3:00 pm

## WHY

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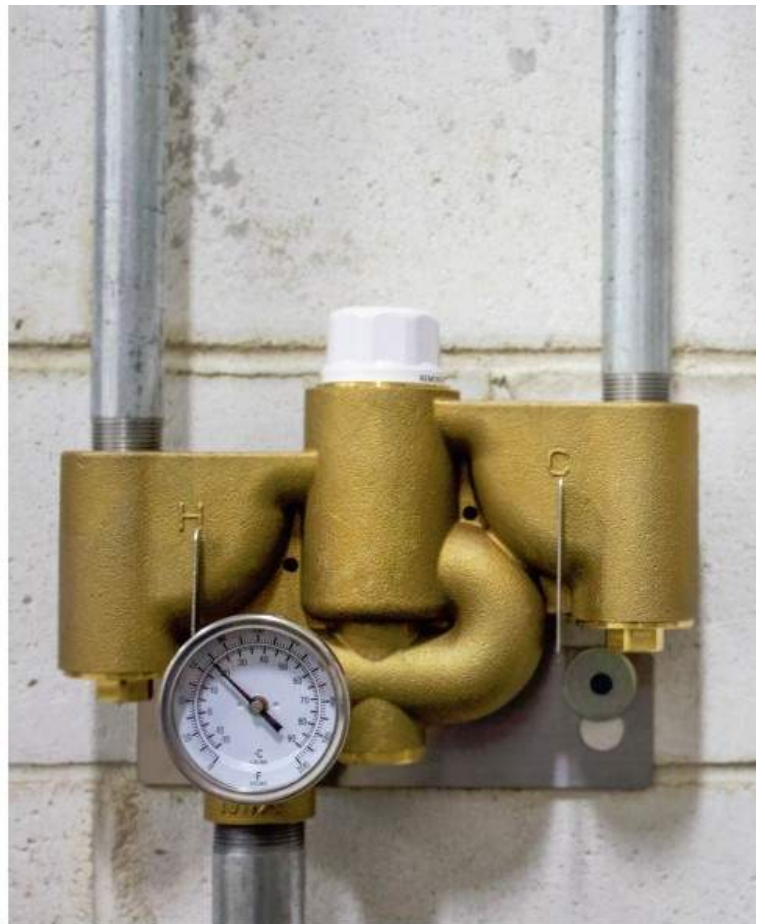
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**Kathy Dwyer**  
Treasurer

## Treasurer's Report

Welcome to 2018-2019 ASPE kickoff newsletter. We have a year with the new website under our belts and feel that we are all using it well. Please give me a shout if you are having any troubles. You can pay when you make your online reservation at our new website.

I am happy to report our chapter is in solid financial position. We have had many supportive companies step up and advertise which is much appreciated. I hope you will support those who support ASPE. If you have any questions or issues with putting your credit card information onto the website, please let me know.

We will be having tabletops again this year and if you would like to be in the newsletter you will need to give us at least one-month notice. The raffles are all possible because of the price of tabletop. If the engineers who attend would like another raffle ticket for the engineer only raffle the tabletop folks will be happy to give you a ticket if you stop by their display.

I look forward to seeing all of you in a couple of weeks.

**Kathleen Dwyer**  
kdwyer@ejdwyer.com

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## Hot water systems: A Balancing Act Between Legionella Prevention and Scald Prevention.

By: Ron George, CPD, President, Plumb-Tech Design & Consulting Services LLC



### The **Balancing Act** between Scalding and Legionella and other Microorganism Growth in Building Water Systems

2018 ASHRAE Conference – Chicago, IL

Speaker: Ron George, CPD, President,  
*Plumb-Tech Design & Consulting Services, LLC.*

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Phone: (734) 322-0225  
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### Confusion in the industry.

There has been a lot of confusion about how to properly design, install and maintain a domestic hot water system to simultaneously control both scalding hazards and legionella bacteria growth. Many people mistakenly believe that controlling hot water system temperatures is like a balancing act performed by simply adjusting the thermostat dial on the water heater to a temperature somewhere between scalding temperatures and Legionella bacteria growth temperatures. Unfortunately, there is no middle ground temperature. Any temperature that will minimize scalding in accordance with temperature limits in the model plumbing codes will be in the Legionella bacteria growth temperature range. The only solution to this dilemma is to use hot water

temperature control valves to keep storage and distribution temperatures above the Legionella growth temperature range and reduce the temperatures at the fixtures to a safe temperature for bathing, showering and washing.

### **Water Heater Thermostat Accuracy**

Many people have made the mistake of assuming the thermostat dial on a water heater accurately controls the outlet temperature flowing from a water heater. Water heater thermostats do not accurately control the outlet temperature of a water heater. Using the thermostat on a water heater to prevent scalding is prohibited by the model plumbing codes because the industry knows the thermostat dial on a storage-type water heater is not designed to accurately control hot water coming from a water heater. There are several types of water heaters on the market and the most common is the storage-tank-type water heater. Other tankless or instantaneous water heater types have their own unique water temperature control vs flow challenges that typically result in the use of temperature actuated control valves as part of the equipment or as part of the system design. The thermostat on a storage-tank-type water heater is not designed to accurately control the outlet temperature of a water heater because the thermostat is located near the bottom of the water heater to sense incoming cold water temperatures and “turn-on” the energy to the heating element or “turn-on” the fuel to the burner. The thermostats do not sense or control the hot water that accumulates at the top of a water heater. The design of the water heater thermostats have an inherent delay in sensing hot water temperature because the heat must flow from the heated water through a boundary layer of water adhering to the thermostat, through the wall of the thermostat, through an air space in the thermostat, and to a metal rod that expands and contracts in order to open and close contacts in the thermostat device. I was told this heat transfer delay causes a lag time and overshoot temperature of about 11 to 15 degrees depending on the thermostat manufacturer. One water heater manufacturer’s representative told me the technicians in their factory had witnessed temperature lags as much as 18 degrees on some water heater models they had tested. This thermal delay results in a temperature chart that looks like a roller coaster. The water temperature at the thermostat element drops below the set point before the burner comes on and rises above the set point before the burner shuts off. This is why two different water temperature tests of a water heater at different times can yield vastly different results even though no adjustments have been made to the thermostat setting.

### **Stacking**

In addition to the above mentioned thermal cycling, there can be stacking of hot water at times when there are intermittent short draws of hot water. Stacking occurs when cold water is drawn into the bottom of the water heater intermittently and causes the burner to cycle on even when the hot water at the top of the heater is well above the desired temperature setting. With each consecutive short draw of hot water and resulting burner cycle, the hot water temperature in the top of the water heater continues to rise and the outlet temperature can be as much as 30 degrees or more, above the

thermostat set point. Therefore, the model plumbing codes do not allow the thermostat on a water heater to control the outlet temperature of a water heater for purposes for scald prevention at fixtures.

### **What are scalding Temperatures?**

The scald burn injury studies done many years ago at Harvard Medical School by doctor's Moritz and Henriques showed that it took approximately five to eight minutes of exposure to temperatures in the range of 120° Fahrenheit(F) for adults to develop a serious, irreversible scald burn: Someone exposed to water at 120°F would have approximately five to more minutes to get out of harm's way before an irreversible burn injury develops. It should be noted that children and the elderly have skin that is thinner than the adult male and baby pig skin from the Moritz and Henriques burn injury studies and therefore children & the elderly could develop burns sooner than five minutes in the Moritz & Henriques study. The 120°F temperature limit was a result of these studies and recommendations by various code and standard committees to allow bathers to get out of harm's way before a serious scald injury occurs. Code change proposals were submitted during the previous code change cycle to increase the maximum allowable shower and bathing temperatures from 120 F to 130 F to allow the thermostat on the water heater to be set at 130 F to address both Legionella bacteria growth and scalding concerns without requiring temperature actuated mixing valves in the hot water system. The problem is the code change would have significantly increased the chances of scalding and Legionella by operating in a temperature range that would not adequately address either hazard. The proposed code change was unanimously voted down at the model plumbing code hearings. The maximum temperature of 120 F has been established by numerous code & standard industry committees for decades based on the Moritz & Henriques burn studies as the maximum safe temperature to minimize scald injuries in showers, bathtubs and combination bathtub/showers.

**Table 1 – Scalding Temperatures**

<b><u>Temp. F</u></b>	<b><u>Temp. C</u></b>	<b><u>Time to Receive Burn injury for Adult Males</u></b>
120	40	More than 5 minutes
130	54	20 seconds
140	60	3 seconds
150	66	1.5 seconds

*Source: Whirlpool Water Heaters: Installation, Use & Care Guide. 2004*

### **What are Legionella Bacteria Growth Temperatures?**

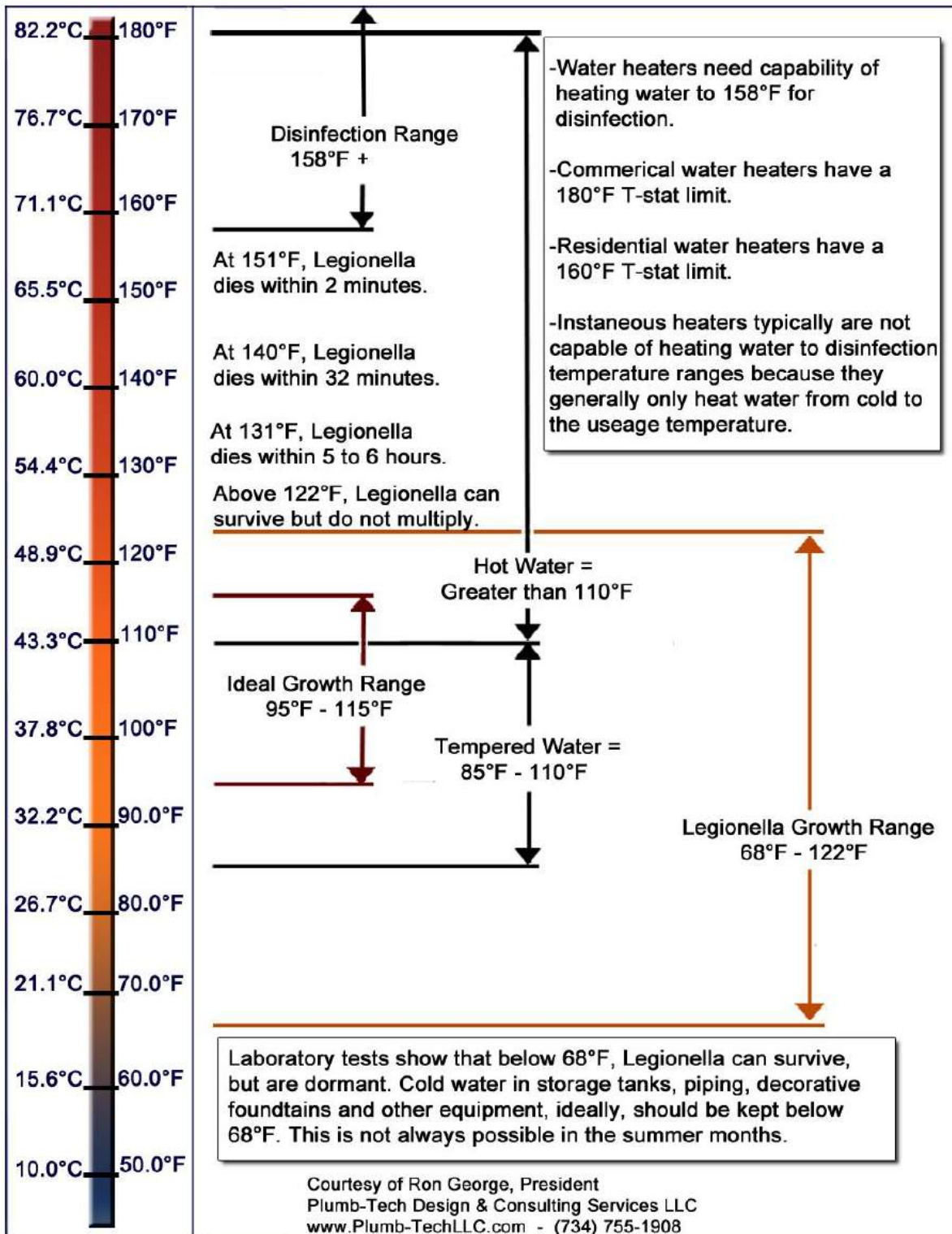


Figure 1 – Legionella Bacteria Growth Temperatures

### **Chemical Treatment for Control of Legionella Bacteria.**

One method of controlling Legionella bacteria in both cold water distribution systems and hot water distribution systems is by adding supplemental disinfectants to the water in order to maintain water treatment disinfectant chemical residuals at a level that is effective at controlling Legionella bacteria. The most common water treatment chemicals are Chlorine, Sodium Hypochlorite, Chlorine Dioxide, Monochloramines, Copper/Silver Ionization, Ozone and UV. If a facility is going to add these chemicals to treat the water on site, they may need to register as a water treatment provider with the local jurisdiction. The levels of water treatment chemicals added to the water should be controlled to assure the water treatment chemical residuals do not harm the piping system. Many chlorine based chemicals can be very corrosive to piping systems if the chemical residuals are too high.

### **What are some Emergency Disinfection Methods for Hot Water systems that are Contaminated with Legionella Bacteria?**

Emergency disinfection methods are typically used when a plumbing system tests positive for Legionella bacteria or if a case of Legionella has been attributed to someone who was in or around the building and resulting tests of the plumbing system are positive.

### **Flushing**

Flushing is simply flowing lots of water through all parts of the plumbing system to assure any stagnant areas of the plumbing system have been adequately flushed with fresh, treated water from the municipal water supply. It is important to verify that the municipal water supply has an adequate water treatment residual to control legionella bacteria growth. Testing of the source water supply may be necessary as part of a building water management plan designed to control Legionella and other organisms that may grow and colonize in a building water distribution piping system.

### **High-Temperature Heat & Flush**

High temperature heat and flush is often done to kill legionella and other bacterial organism growth in the hot water distribution and circulation system. This method is often done improperly, and some plumbing systems are incapable of performing a heat and flush disinfection. If high temperature heat and flush is to be used, the minimum temperature of 158 F is required thermally disinfect the entire plumbing system. The temperature loss in the system needs to be accounted for and this is not always done by novice maintenance personnel or inexperienced remediation professionals. Many failed thermal disinfections occur where the facility operators simply set the water heater thermostat to the disinfection temperature and do not take into account the temperature drop in the system.

There are new system components on the market that make it practically impossible to thermally disinfect the hot water distribution system because of temperature actuated

balancing valves on the hot water return piping and other thermal limiting or mixing devices in the hot water distribution system.

In a hotel facility that I investigated, that had a prior Legionella problem the building maintenance personnel decided to disinfect their system with hot water at 150 F. Figure 1 shows with the water set at 150 F, the Legionella bacteria should be killed in just over 2 minutes. However, looking at the hot water return temperature in this large facility, there was a 37-degree temperature drop during peak usage hours and a 42 degree temperature drop during off-peak hours. (The hot water distribution and recirculation system was poorly designed) This created a condition where the hot water was leaving the water heater at 150 F and returning at 108 F during off-peak hours when the heat and flush operation was performed. The HW system was only capable of heating to 160 f because of the heating water heat exchanger. The system was incapable of heating the water in the entire system to a disinfecting temperature because of poor system design. When the temperature was dropped back down to the normal system operating temperature of 122 F, the return temperature would fluctuate between 80 – 85F based on the usage in the building. If 158 degrees F is required in all parts of the plumbing system, and the hot water circulation system is designed for a 20 degree temperature drop from the water heater outlet to the hot water return after the circulating pump, then the water heater outlet temperature should be 178 F. There are other ways to make sure a proper heat and flush can be performed for a building with somewhat lower water heating capabilities. Looking at the chart, Legionella begins to die at 131 F but it takes 5 to 6 hours at 131 F. So if the hot water return temperature is maintained for more than 6 hours and slightly above 131 f the hot water main circuit should be disinfected, however, the branches and dead legs will not be disinfected. A complete survey of the piping in the building should be performed to identify all branches and dead legs and water would need to be flowed from each branch for a period of time sufficient to kill the bacteria in the biofilm. Remember bacteria buried in a biofilm may be insulated from the water temperature flowing in the piping, so additional time flowing at a given temperature would be required to assure killing bacteria buried deep in biofilm and the underlying scale and calcium build-up on the pipe walls.

The flow rate through each branch should be for at least 25% more time than shown in the chart in Figure 1, in order to effectively kill bacteria within the scale and biofilm.

For example:

Water flowing from a fixture at 140 F requires about 32 minutes to provide a kill of all Legionella bacteria in laboratory test samples. Adding 50% to the 32 minutes means the water would need to flow for about 48 minutes at 140 F (140 degrees = 32 minutes from Figure 1 x 1.5 = 48 minutes).

**Large Scale Flushing Test Example 140 F:** If a large institutional facility has 1,200 fixtures and each fixture needs to flow water for 48 minutes at 140 F, and the amount of water flowed from each fixture was limited to 1 gpm each, and if 20 fixtures were flowed at the same time, the water heating equipment would need the capability of flowing 20 gallons per minute for 48 minutes without having the temperature drop off. It could take

approximately 1 hour and two people to work continuously for 20 gallons per minute for 60 hours continuously in order to flow hot water from every fixture in the building. That is equivalent to a week and a half for two maintenance workers. The scope can be very large and lend itself to cutting corners.

**Large Scale Flushing Test Example 140 F:** Water flowing from a fixture at 151 F requires about 2 minutes to provide a kill of all Legionella bacteria in laboratory test samples. The minimum flow time from each fixture for thermal disinfection is discussed in various standards and minimum required thermal flushing of fixture branches can be as much as 15 minutes. Using the method above, with 151 Degree water flowing from the fixture outlet and adding 50% to the 2 minute kill time in figure 1, means the water would need to flow for about 3 minutes at a minimum of 151degrees F. (151 degrees = 2 minutes from Figure 1 x 1.5 = 3 minutes).

### **Hyper-Chlorination**

Hyper-chlorination is also known as chemical shock is the use of chemical disinfectants, such as chlorine or chlorine dioxide for a relatively brief period, for example, 1 hour to 24 hours at concentrations above maximum levels permitted for potable water. The objective of hyper-chlorination or chemical shock is remediation of hot and cold potable water systems colonized by Legionella. Typically, the chemical disinfectant is introduced upstream of the area to be treated and is distributed throughout the building potable water system, with sequential flushing of the disinfectant through every fixture for several minutes. Because chemical shock utilizes chemical concentrations above the maximum levels permitted for potable water, adequate precautions should be taken to prevent use of the water during the chemical shock period and to protect occupants that may be exposed to water with high chemical concentrations. You should notify the occupants of the building prior to implementation of the chemical shock process. Some building use patterns may allow chemical shock treatment to be scheduled when occupancy is low.

Corrosion and other damage can occur to plumbing system components and piping with increases in disinfectant concentration, time, temperature and the frequency with which chemical shock or hyperchlorination is performed.

Component manufacturers often provide the maximum chemical concentrations to which their products can be exposed. Treatment with higher concentrations may cause damage and invalidate manufacturers' warranties. High chemical concentrations and durations can damage the plumbing system and with increased oxidation or corrosion of the plumbing system, it can make future efforts to treat Legionella colonization more difficult.

### **Hot Water System Design to Control Legionella Bacteria Growth and Scalding.**

The proper way to design a domestic hot water system to control Legionella and Scalding in that order would be to store the hot water about 140 F to 150 F to be at a temperature that will kill Legionella bacteria or pasteurize the water in the storage tank and distribution piping system. Then the proper design would use a digital mixing valve that will deliver hot water to the distribution system at 134 F plus or minus 1 degree and record the temperatures continuously. The circulating pump size/flow rate and hot water system insulation thickness should be designed with the recirculation piping limiting the flow velocity to a maximum of 3 feet per second at a 10-degree temperature drop in the circulated loop so that the hot water return temperature is at or above 124 F. The reason for a minimum of 124 F hot water return temperature is because in the new ASHRAE 188 standard Legionellosis: Control of Legionella in building water systems suggests a hot water distribution temperature no less than 122F. If you look at Figure 1, Legionella bacteria stops growing about 122 F. A safety factor should be applied to assure the temperatures do not drop into the growth temperature range below 122 F. With 124 F selected as the minimum hot water return temperature, the 124 F hot water return water returns after the circulating pump where there should be a temperature gauge to monitor the lowest temperature in the hot water distribution and circulation system. The hot water return pipe should then split and go to the cold water inlet of the mixing valve and the cold water inlet of the water heater. The 124 F hot water return water mixes with 140 F hot water from the water heater in the digital mixing valve where it constantly monitors and records the system temperatures to deliver 134 F hot water to the distribution system. This is a relatively close temperature margin and some types of thermostatic mixing valves would have trouble mixing when hot water return temperatures get close to the delivery temperature. This is where digital mixing valves perform very good.

### **Recent Discussions Related to Hot Water System Temperature Controls**

During several recent industry meetings dealing with control of organisms like Legionella bacteria in building water systems, many people seemed to have misunderstandings about how plumbing systems work. I heard comments from people saying you need to set the water heater thermostat to 158 F degrees and flow water from all the fixtures for a 20-minute period to disinfect the hot water system. It is important to note, If you need 158 F for disinfection, the water temperature setting at the water heater must be approximately the same number of degrees higher than 158 as the hw return temperature is below the hot water distribution temperature.

I have also heard comments that said, “the code official or health department requires that we set our water heater at 110 F or 120 F to prevent scalding”. I pointed out that in most cases the plumbing code does not specifically address hot water storage or distribution temperature. And in a few isolated cases health departments make mistakes and mandate language that creates a health and safety hazard because most health officials do not understand how plumbing systems work, there are some that

have mandated low temperatures to try and protect people from scalding, by mandating storage temperatures in the Legionella bacteria growth temperature range. If they would have simply stated the maximum temperature flowing from a shower is 110F, the limit stop on the shower valve could be set to limit the hot water temperature to 110F. Instead, they apparently tried to address buildings where there are old non-code tub/shower valves and they mandated low storage temperatures instead of mandating updating the shower valves to code compliant shower valves with maximum temperature limit stop adjustments that are set to 110 F.

Another guy said my code requires me to store and deliver hot water at 120 F so the return temperature is always going to be between 100 – 110 F. I then explained to him that there is no place in the plumbing code that addresses a maximum temperature in the storage or distribution system. (except for a requirement for combined heating and domestic hot water systems to have a mixing valve set to a maximum of 140 F) The guy then started to mention sections in the plumbing code and health code requirements that address maximum temperature of the water required in the hot water storage tank and piping. He was pointing to the section on showers & bathtubs. I then pointed out to him that section 4 of the model codes is fixture and fitting requirements and addresses maximum hot water delivery temperatures from the fixture and it does not address storage or distribution temperatures.

During my 40-year career, I have witnessed many domestic hot water systems that were designed, installed, or maintained poorly. As part of my forensic investigation work I have investigated many scald incidents, legionnaires disease outbreaks, and poorly performing or failing plumbing systems.

### **Energy Conservation**

There is no justification for energy or water conservation programs that allow inadequate system performance and contribute to health & safety effects that kill hundreds of people every year.

In Australia, a Hospital Engineer said a green program may have increased bacteria risk

The electrician at Queensland Hospital told the News agencies that a State Government energy efficiency program may have increased the risk of Legionella bacteria living in the water supplies of homes and businesses across Queensland, Australia.

The Welsley hospital has had its hot water temperatures limited to 45 degrees Celsius, (113 F) in line with Queensland regulations designed to prevent patients from scalding themselves. The Brisbane electrician who worked for the State Government's now defunct Climate Smart Program says anyone who used that service would have had their hot water system temperatures reduced to 50C (122 F) to save energy.

He says electricians warned the Government at the time that lowering the temperature would encourage harmful bacteria growth, but the warning was ignored.

"Part of the direction given was to turn down all the hot water systems all over Queensland down to 50 degrees (122 F)," the man, who did not want to be named, said.

"Anybody that had the Climate Smart service had the temperature of their hot water system reduced from 65 to 70 C (149 – 158 F) down to 50 C. (122 F)"

This was an example where an energy conservation program was potentially deadly. I believe energy and water conservation should take a back seat to health and safety.

### **Water Conservation**

We seem to be in a water conservation limbo contest with competing green design standards and water & energy conservation programs trying to squeeze every drop of water down to an undetermined minimum flow in order to gain points for a plaque to hang on the wall in a building and save a few drops of water. How low can they go? Water conservation is causing lower flows in water utility mains and building water distribution piping. These lower flows cause water to take longer to arrive at the end of the system. Current ultra-low-flow fixture flow rates are about 20% of the overall water flow rates prior to the Energy Policy act of 1992. This causes significantly lower flows where in the past it would take days for water from the treatment plant to reach the ends of the distribution system, not it takes weeks for water to reach the ends of the distribution system. This allows water treatment chemicals to dissipate to undetectable levels well before reaching the end of the water distribution system and then there are no water treatment chemical residuals to fight-off bacteria and organisms growing in the biofilm of our water distribution pipes.

Recently Drexel University and Purdue University were awarded EPA grant money to study and report on the effects of water conservation programs on water quality.

In addition to water quality issues, water conservation is also causing drain line transport issues with lower and lower flow rates, out drain pipes look like rivers during a drought. There is not enough water in the river to float the boats. At a recent industry meeting where water conservation activists made a proposal to further reduce the flow rates for various fixtures, I made a plea to stop the madness of percentage flow reduction every code cycle to save water. Saving water will mean nothing if the water we save goes to nut farmers in the desert who are extracting millions of gallons of water every day to water trees on new farms in the desert and they are exempt from water conservation rules. What we need to also do is pay for research to determine what are the minimum sustainable flow rates for various pipe sizes. We have issues with drain line transport of solids, high tensile strength toilet paper, baby wipes, adult wipes, feminine products, etc. We need to fund more research through the Plumbing Efficiency Research Coalition (PERC) to know what are the sustainable minimums.

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**Andrew Cahill — Membership**

## Membership Report

Our summer days are winding down and we are on the cusp of the 2018-2019 ASPE calendar year. The Baltimore board of directors conducted our meetings in June and have a fun and informative slate planned for the months ahead. We are excited to welcome Chris Imhoff and Steve Hudson to the board, who will be serving as the Education Chair and Historian respectively.

While we will maintain some constants in 2018-2019 – meeting location, holiday party and golf outing, we hope to implement some new traditions as well – AYP & WOA events and an active engineers week. Of course 2018 is a convention year, which will find some of us in Atlanta as well.

Our chapter added several new members this summer:

- James Cruz
- George Gruner, P.E., Mueller Associates, Inc.
- Gregory Jung
- Ronald Rice Jr., Mid Atlantic Rep South
- Madison Stine

Please join me in welcoming them to the Baltimore chapter. We look forward to seeing them at our meetings this year.

Let me know if I can be of assistance to anyone interested in joining ASPE. You can direct them to <https://www.aspe.org/join> or email me at [andrew.cahill@uponor.com](mailto:andrew.cahill@uponor.com).

Did you know that engineering firms may offer reimbursement to employees for affiliation with professional organizations such as ASPE? In fact, participation with local chapters is often encouraged and provides significant benefits. In addition to the ability to attain CEUs from monthly educational seminars and networking opportunities with other industry professionals, members are provided with a volume of the Plumbing Engineering Design Handbook for each year of participation – a key resource in completing CPD testing. Have a conversation with your firm’s principal about your options for joining ASPE.





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# 2018-2019 ASPE Baltimore Chapter Meeting Schedule

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Date: **September 26, 2018**  
Speaker: Craig Boyce—Kemper AIP Metals  
Topic: Legionella, ASHRAE 188, and Minimizing Risk

Date: **October 24, 2018**  
Speaker: WSSC  
Topic: WSSC 2016 Code Update

Date: **November 28, 2018**  
Speaker: Otto Sales  
Topic: Rainwater Harvesting for Potable Reuse

Date: **December 12, 2018**  
Event: Holiday Party  
Location: [Mustang Alley's](#)

Date: **January 23, 2019**  
Speaker: STH  
Topic: Fire Protection Design

Date: **February 27, 2019**  
Speaker: Sherman Engineering Company  
Topic: Lab Specialty Gas Sources and Distribution

Date: **March 27, 2019**  
Speaker: Highland Tank  
Topic: Grease Interceptor Design

Date: **April 24, 2019**  
Speaker: Ultra Pure Water Systems  
Topic: Evoqua

Date: **April 26, 2019**  
Event: Golf Outing  
Location: [The Timbers at Troy](#)

Date: **May 22, 2019**  
Speaker: EJ Dwyer  
Topic: Digital Mixing Valves

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## Monthly Sponsorship Opportunities

The Baltimore Chapter of ASPE continues to have successful meetings and is looking to continue improving throughout the year.

The Chapter has the following sponsorship opportunities for each month:

**Tabletop Presentations:** \$100 to provide a tabletop presentation of equipment or material relative to the plumbing profession. The tabletops will be set up from the beginning to the end of the monthly meeting and provides the opportunity to provide a brief (under 5 minutes) presentation.

Please make checks payable to the Baltimore Chapter of ASPE.

Contact Jeff Edwards or Kathy Dwyer if interested  
[jedwards@muellerassoc.com](mailto:jedwards@muellerassoc.com)  
[kdwyer@ejdwyer.com](mailto:kdwyer@ejdwyer.com)

