Working to Keep Building Water Systems Safe and Efficient – The Vital Role of the Plumbing Industry

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The way water is used in homes and non-residential buildings today has changed drastically over the course of the past three decades. In residences, every type of plumbing fixture and household appliance that consumes water has been rethought and redesigned to use only a fraction of the water consumed in the 1980s, while still providing excellent consumer satisfaction and functionality. In commercial and institutional buildings, manufacturing processes and industrial equipment, especially water consuming commercial food service equipment used in restaurants, have also been redesigned to be more efficient. Around the globe, manufacturers, engineers, trades people, water utilities, architects and all levels of government have rallied around the cause of increased water efficiency. According to a U.S. Department of the Interior U.S. Geological Survey report, public water withdrawals in 2015 were 7% lower than in 2010 and those savings are directly attributed to urban water efficiency measures. And, despite the correlation to an increase in Legionella outbreaks over the same time frame, we have no choice but to continue to strive to be an increasingly water efficient society.

**Water consumption by water-using plumbing products and appliances – 1980s to 2017**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Residential Bathroom Lavatory Faucet</td>
<td>3.5+ gpm</td>
<td>2.5 gpm</td>
<td>2.2 gpm</td>
<td>2.2 gpm</td>
<td>1.2 gpm</td>
<td>66%</td>
</tr>
<tr>
<td>Showerhead</td>
<td>3.5+ gpm</td>
<td>3.5 gpm</td>
<td>2.5 gpm</td>
<td>2.5 gpm</td>
<td>2.0 gpm</td>
<td>43%</td>
</tr>
<tr>
<td>Toilet – Residential</td>
<td>5.0+ gpf</td>
<td>3.5 gpf</td>
<td>1.6 gpf</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
<td>74%</td>
</tr>
<tr>
<td>Toilet - Commercial</td>
<td>5.0+ gpf</td>
<td>3.5 gpf</td>
<td>1.6 gpf</td>
<td>1.6 gpf</td>
<td>1.28 gpf</td>
<td>74%</td>
</tr>
<tr>
<td>Urinal</td>
<td>1.5 to 3.0+ gpf</td>
<td>1.5 to 3.0 gpf</td>
<td>1.0 gpf</td>
<td>1.0 gpf</td>
<td>0.125 gpf</td>
<td>92%</td>
</tr>
<tr>
<td>Commercial Lavatory Faucet</td>
<td>3.5+ gpm</td>
<td>2.5 gpm</td>
<td>2.2 gpm</td>
<td>0.5 gpm</td>
<td>0.5 gpm</td>
<td>86%</td>
</tr>
<tr>
<td>Food Service Pre-Rinse Spray Valve</td>
<td>5.0+ gpm</td>
<td>No requirement</td>
<td>1.6 gpm (EPAct 2005)</td>
<td>No requirement</td>
<td>1.3 gpm</td>
<td>74%</td>
</tr>
<tr>
<td>Residential Clothes Washer</td>
<td>51 gallons/load</td>
<td>No requirement</td>
<td>26 gallons/load (2012 standard)</td>
<td>No requirement</td>
<td>13 gallons/load (Energy Star)</td>
<td>75%</td>
</tr>
<tr>
<td>Residential Dishwasher</td>
<td>14 gallons/cycle</td>
<td>No requirement</td>
<td>6.5 gallons/cycle (2012 standard)</td>
<td>No requirement</td>
<td>3.5 gallons/cycle (Energy Star)</td>
<td>75%</td>
</tr>
</tbody>
</table>

Being increasingly efficient with our finite and shrinking water resources is a necessity if we are to meet the needs of a growing global population, especially in the many urban areas of the world that have profound water-related challenges. Sao Paulo, Brazil, narrowly missed running out of water in 2015 and Cape Town, South Africa, is working hard to avoid a “Day Zero” scenario —where a major metropolitan city runs out of water and the taps run dry. BBC News recently issued a report detailing the 11 major cities that are most likely to run out of water, Miami among them. It’s a certainty that stresses on water resources will only increase as we
move forward in time. Thus, turning back the clock on water efficiency and increasing water flows in buildings as a possible measure to help keep our water systems safe from Legionella and other dangerous pathogens simply isn’t an option.

Rather, all segments of the water related industries, in concert with government and academia, need to focus collective efforts on developing thoughtful research programs, new technologies, effective standards, and treatment methodologies leading to the codification of water system design and maintenance provisions that work to keep our water systems safe while taking lower water flows into account. Much will be discussed at the Legionella 2018 Conference pertaining to a better understanding on how to best mitigate legionellosis outbreaks from a water distribution and treatment perspective. This paper, in line with the session on Plumbing System Design that I am moderating at the conference, focuses on the quotient that the plumbing industry is already providing and will continue to work on toward these collective efforts. Much has already been done, and a great deal of continuing work is underway.

As will be presented, research organized and supported by the International Association of Plumbing and Mechanical Officials (IAPMO), the American Society of Plumbing Engineers (ASPE), and the Water Quality Association – Research Foundation (WQA-RF), working with Professor Steven Buchberger’s team at the University of Cincinnati, has resulted in the development of a new alternative to Hunter’s Curve when estimating water supply demand for residential buildings. This work also resulted in a new “Water Demand Calculator” that better estimates pipe sizing based on current residential use patterns.

The significance of this work cannot be overstated, as it represents the first practical application of an improved, statistically based pipe-sizing method since the 1940s that does not result in excessive over design and oversizing of water pipes. The method is applicable for both single- and multi-family dwellings. A complimentary, easy-to-use Water Demand Calculator (WDC) estimates the supply demand for the whole building, as well as cold and hot water branches and risers for indoor water use based on today’s plumbing fixtures and appliances and usage patterns. Research on this new approach for pipe-sizing continues so that it can applied for non-residential buildings, as well; however, a coordinated effort amongst researchers to better understand how water is being used in various non-residential building types is needed to move forward with this work.

In early 2017, Purdue University was awarded a US$2.5 million grant from the U.S. EPA to lead a group of researchers in a three-year project to bring together existing and experimental data on building plumbing into a risk assessment tool that can guide new water use and safety regulations. Working with researchers at Michigan State and San Jose State Universities, the program is focused on a better understanding of how lower water flows and reduced usage impacts water quality in premise plumbing systems. Work is well underway on this multifaceted program, including the monitoring of water usage and water quality in several buildings.

As Christop Lohr’s presentation details, plumbing manufacturers are developing new water system technologies, some designed primarily for installation in health care facilities, that monitor water use, temperature and residual disinfectant levels such that treatments can be applied instantly when conditions become favorable for the amplification of legionella or other pathogens. In addition, new plumbing fittings and installation techniques that work to reduce stagnation, especially in seldom used sections of plumbing systems, are also gaining wide acceptance. Plumbing engineers, in addition to specifying and installing these new technologies, are designing building water systems around the current body of knowledge to
eliminate problematic features, such as “dead legs,” vii and eliminating materials that are known to support biofilm growth.

The plumbing industry is also working to provide accurate and practical information to the public and to the building trades pertaining to Legionella. Plumbing Manufacturers International’s (PMI) safeplumbing.org website viii has excellent information on Legionella, how water systems can become contaminated, and information on how water systems can be best maintained and tested to keep them free from contamination. The American Society of Sanitary Engineers (ASSE) recently published a certification standard ix that details best practices for keeping building occupants and plumbers, pipefitters, sprinkler fitters, HVAC technicians and demolition workers safe from contracting Legionella when working on existing water and other industrial systems that have the potential to harbor dangerous pathogens.

On the policy front, the plumbing industry is united in calling for a temporary moratorium on further regulatory based water flow reductions on indoor, water consuming consumer products, plumbing fixtures and appliances until research can be conducted on the unintended consequences of water efficiency. Our nation has done such a great job at becoming more water efficient over the past three decades and there is little to be gained by trying to shave additional tenths of a gallon off already efficient products while risking further declines in water quality.

While much has been accomplished, much more work needs to be done to keep building occupants safe from the increasing threat of waterborne pathogens. Addressing the risks from Legionella while also taking the realities of water scarcity and dwindling safe water supplies into account will be a daunting challenge. As a result, the plumbing industry acknowledges its profound responsibility and the vital role it plays in addressing these complex problems.

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ii The Drainline Transport of Solid Waste in Buildings, Plumbing Efficiency Research Coalition Report - J. Koeller, P. DeMarco (updated)
iii BBC News Report, The 11 Cities Most Likely to Run Out of Water – Like Cape Town, 11 February, 2018
iv For information on Hunter Curve, See US Department of Congress, Report BMS65
https://www.gpo.gov/fdsys/pkg/GOVPUB-C13-a13c5a2020dd0a7b1df8b91b165745ca/pdf/GOVPUB-C13-a13c5a2020dd0a7b1df8b91b165745ca.pdf
v See http://www.iapmo.org/WEStand/Pages/default.aspx for detailed information on the revised pipe sizing method, its implications and the Water Demand Calculator
vi See http://www.purdue.edu/newsroom/releases/2017/Q1/project-focuses-on-reducing-pathogen-threat-in-low-flow-water-systems.html for additional information on the EPA funded research at Purdue University
vii A “dead leg” is a portion of a plumbing system that is stagnant or has rare flow of water in the pipes (an emergency eye wash station, for example)
viii See PMI’s Safe Plumbing Website https://www.safeplumbing.org/health-safety/legionella-and-water-supply-systems
ix See ASSE/ IAPMO/ANSI Series 12000 – Health and Safety of Construction and Maintenance Personnel Certification Standard
http://www.asse-plumbing.org/12000.html