

The 2012 IAPMO Green Plumbing and Mechanical Code Supplement – An Overview

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Abstract

In February, 2010, IAPMO published the first green construction code in the United States, the *Green Plumbing and Mechanical Code Supplement (GPMCS)*. The second edition of the GPMCS was published in February of 2012. The GPMCS is designed to overlay with any baseline code or construction norm, not just IAPMO codes. It provide forward thinking localities with an enforceable code document, written in mandatory code language and format, that can be effectively utilized to raise the level of water and energy efficiency through the adoption of safe and proven technical provisions. This paper discusses the need to develop a green plumbing and mechanical code in the United States and how the GPMCS was developed with input from diverse stakeholder input. Various water efficiency provisions, hot water efficiency requirements that impact energy efficiency as well as water efficiency, alternate water source provisions that provide guidance towards the safe use of gray water and rain water will also be discussed.

Finally, the paper will show how IAPMO referenced research presented at past CIB W062 symposiums in developing provisions for this progressive code.

Keywords

IAPMO, Green Plumbing and Mechanical Code Supplement, Model Codes, Water Efficiency

1 Introduction

The International Association of Plumbing and Mechanical Officials (IAPMO) was founded in 1926 in Los Angeles, California. Formed from humble beginnings with a few dozen Los Angeles city plumbing inspectors for its total membership, IAPMO today is a true international organization with thousands of members. The first edition of the *Uniform Plumbing Code (UPC)* was published in 1945. Today, over half of the

world's population lives in an area that falls under the provisions of various IAPMO programs. From the very beginning, IAPMO's prime directive was to "promote the latest and most improved methods of sanitation" so as to protect the health and safety of the public. This prime directive remains unchanged as health and safety considerations remain paramount as our members continue to develop new provisions for our family of codes. Today, IAPMO publishes the following construction "model" Codes:

The Uniform Plumbing Code (UPC)
The Uniform Mechanical Code (UMC)
The Uniform Solar Energy Code (USEC)
The Uniform Swimming Pool, Spa, and Hot Tub Code (USPSHTC)

Over the years as IAPMO evolved, the UPC was always developed with a critical eye towards sustainability. With our historical roots based in the arid western portion of the United States, water efficiency was always a critical component of the code.

2 The Green Plumbing and Mechanical Code Supplement

In 2007, the IAPMO Board of Directors, noticing an increasing national focus on water and energy efficiency, called for a reduction in water and energy consumption in the Uniform Codes. In response, the IAPMO Green Technical Committee was formed as a mechanism to evaluate new technologies and identify opportunities to improve efficiency and make the Uniform Codes more sustainable.

Comprised of a diverse group of experts in Green plumbing and mechanical fields, the Green Technical Committee took on the task of developing a true green code for plumbing and mechanical provisions that can overlay with existing baseline model codes and provide an enforceable path for attaining higher efficiencies. In addition to the Green Technical committee, eight (8) focused task forces were created to address specific technical provisions. In total, over 85 industry leaders and experts, many representing some of the plumbing and mechanical industries most esteemed associations, worked together to develop the Green Plumbing and Mechanical Code Supplement (Figure 1).

Figure 1 – Supporting Organizations to the GPMCS



In February, 2010, the first edition of the GPMCS was published. It is designed to work in concert with established building rating systems, such as the United States Green Building Council's (USGBC) LEED™ program. Written in typical construction code format, the GPMCS provides forward thinking jurisdictions with the ability to easily adopt and enforce safe and proven green provisions that work towards improving water and energy efficiency over and above the base line provisions contained in the model codes. In addition, the GPMCS will effectively overlay with any model code, not just the Uniform codes published by IAPMO, and will yield water and energy efficiencies that are at least 20% more efficient than baseline code provisions.

All IAPMO codes are developed with two goals in mind. First, a true consensus process must be employed. IAPMO model codes are developed in accordance with the rigorous consensus requirements required to be classified as American National Standards and are accredited by the American National Standards Institute (ANSI). This ensures a transparent process and that no special interests can dominate the development of our codes. Secondly, all IAPMO codes are developed as “turnkey” documents such that they can be utilized without the need to purchase or reference other codes. The GPMCS addresses both residential and commercial plumbing and mechanical systems and covers all aspects of sustainability. Specific provisions contained in the GPMCS are detailed here:

3. Water Efficiency and Conservation (Chapter 4 of the GPMCS)

Coverage areas include: High efficiency plumbing fittings, fixtures and appliances, occupancy specific provision in restaurants and medical facilities, water softening equipment, sub-metering provisions and HVAC system water efficiency requirements.

The Table 1 below details some of the requirements contained in the GPMCS compared to the base line consumption requirements contained in the base line plumbing codes in the United States.

Table 1 Sample of GPMCS comparison to base-line codes

Water-using Fixture or Appliance	1980s Water Use	1990 Requirement	EPA Act 1992 Requirement	2009 Baseline Plumbing Code	2012 GPMCS	% Reduction in water use since 1980s
Residential Bathroom Lavatory Faucet	13+ Lpm	9.5 Lpm	8.3 Lpm	8.3 Lpm	5.7 Lpm	57%
Showerhead	13+ Lpm	13 Lpm	9.5 Lpm	9.5 Lpm	8.3 Lpm	43%
Toilet – Residential	18.9+ Lpf	13 Lpf	6 Lpf	6 Lpf	4.8 Lpf	74%
Toilet - Commercial	18.9+ Lpf	13 Lpf	6 Lpf	6 Lpf	6 Lpf	68%
Urinal	5.7 to 11.4+ Lpf	5.7 to 11.4 Lpf	3.8 Lpf	3.8 Lpf	1.9 Lpf	67%
Commercial Lavatory Faucet	13+ Lpm	9.5 Lpm	8.3 Lpm	1.9 Lpm	1.9 Lpm	86%

Food Service Pre-rinse Spray Valve	18.9+ Lpm	No requirement	6 Lpm (EPAct 2005)	No requirement	4.9 Lpm	74%
Residential Clothes Washer	193 Litres/load	No requirement	98.4 Litres/load (2012 standard)	No requirement	60.6 Litres/load	67%
Residential Dishwasher	53 Litres/cycle	No requirement	24.6 Litres/cycle (2012 standard)	No requirement	18.9 Litres/cycle (ASHRAE S191P)	64%

Note:

The GPMCS also requires that shower valves be of the anti-scald type and that the valve be tested with a showerhead flowing at 2.0 gpm.

The GPMCS allows the use of non-water consuming urinals, but due to performance and maintenance problems that have been experienced requires that a water distribution line be roughed in behind the urinal at a height that will accommodate the installation of a flushometer-valve, should removal of the non-water consuming urinals be necessary. Also, one (1) water-consuming fixture, such as a lavatory (bathroom) sink, water using urinal or toilet, be installed upstream of the non-water consuming urinal so as to facilitate drain line flow and rinsing.

For appliances, the GPMCS requires that clothes washer and dishwasher appliances be listed with and in compliance with the performance and consumption requirements detailed in the Energy Star™ program, an incentive labeling program that is managed by the US Department of Energy (DOE) (Go to <http://www.energystar.gov/> for additional details). For plumbing products, the US Environmental Protection Agency manages an incentive labeling program called WaterSense™ that works in a similar manner to the popular Energy Star™ program. WaterSense™ currently has specifications in effect for high efficiency tank type toilets, showerheads and bathroom faucets. The GPMCS likewise requires the use of WaterSense™ listed plumbing fixtures wherever applicable.

Progressive water metering provisions are contained in the GPMCS for larger commercial or multi-family buildings that allow for monitoring of the water used for lawn irrigation, make-up water to cooling towers and boilers, swimming pools, evaporative coolers and individual tenant spaces, under specific conditions. In addition, a means of providing data from the meters or submeters to the water consumer is required in order to provide a feedback mechanism allowing for corrective actions when warranted.

For HVAC systems, the GPMCS does not allow the installation of once-through cooling using potable water. In addition, progressive requirements for cooling towers and evaporative coolers are established.

4. Alternate Water Sources for Non-Potable Applications (Chapter 5 of the GPMCS)

Among the most important provisions contained in the GPMCS are those pertaining to the use of alternate water source systems, such as gray water systems, rainwater catchment systems and the safe use of municipally supplied reclaimed or “recycled” water. Manufacturers of gray water and rainwater systems often encountered code compliance problems that resulted in having their systems removed from installations due to a lack of comprehensive health and safety related installation guidance for code officials to reference. The GPMCS provides general requirements that pertain to all alternate water sources and goes on to provide specific provisions for each type of system individually. In this manner, code officials are now able to approve these systems with confidence, knowing exactly what they need to look for to ensure the safe use and adequate maintenance of these systems.

For all types of alternate water sources, except for small system used for irrigation only and isolated from the potable water system, the GPMCS requires cross-connection inspection and testing of all systems to ensure the isolation of the alternate water from the potable water system.

Gray water systems use untreated waste water from bathtubs, showers, lavatory (bathroom) sinks, clothes washers and laundry tubs. Water from toilets, urinals and kitchen sinks is classified as black water and cannot be used in conjunction with gray water systems. Untreated water can only be used for irrigation purposes and is not allowed for uses inside the building. The GPMCS requires that all gray water systems follow a detailed maintenance and inspection schedule that the plumbing inspector can review. Pipes containing gray water must be colored and identified in accordance with the applicable baseline plumbing code enforced in the area of installation.

The GPMCS allows for three (3) types of irrigation practices using gray water systems. See figures 2, 3 and 4.

Figure 2 - Subsurface Irrigation

- 2” minimum depth below grade
- Drip feeders
- Covered with mulch, rock or soil
- 115 micron filter required

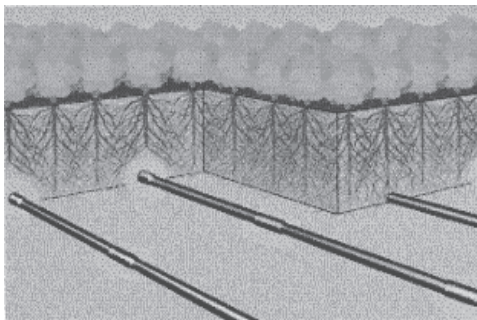


Figure 3 - Subsoil Irrigation

- Deep root irrigation only
- Gravel trench for pipe
- Minimum 10" soil depth
- Gray water disposal

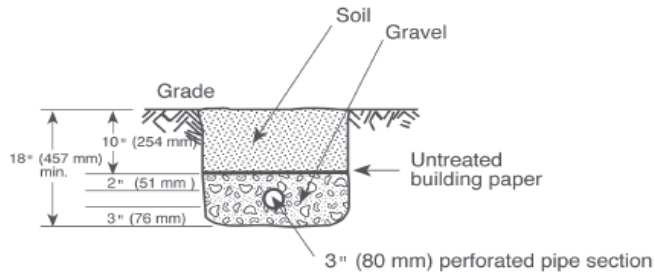
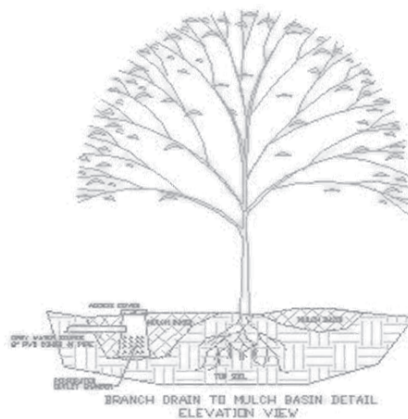


Figure 4 - Mulch Basin

- Trench or pit
- 10" minimum depth
- Minimum volume
- Filled with mulch
- Dwelling units only



The requirements for rainwater catchment systems in the GPMCS are based on a design standard developed by the American Rainwater Catchment System Association (ARCSA) and the American Society of Plumbing Engineers (ASPE). This design standard addresses the quality of the rainwater collection surfaces, storage tanks, debris removal devices, the configuration of the openings and access mechanisms in the storage tank and freeze protection.

The GPMCS requires that all rainwater catchment systems, except small residential systems used for irrigation purposes only, be designed by a person registered or licensed to perform plumbing design work.

Treated water from rainwater catchment systems is allowed to be used in commercial buildings for flushing toilets and urinals, trap priming, irrigation, water features (fountains or reflecting pools, for example) and cooling tower makeup water. An operations and maintenance manual is required to be supplied to the building owner and pipes containing water from rainwater catchments systems must be colored and identified in accordance with the baseline plumbing code.

Requirements for the use of water from rainwater catchment systems for potable water applications are contained in the appendix of the GPMCS. Potable rainwater systems must be designed by a person registered or licensed to perform plumbing design work, without exception. An operation and maintenance manual must be supplied to the building owner and available for review by the code official. Requirements for potable rainwater systems include detailed provisions addressing the quality of collection surfaces, storage tanks, debris removal devices, opening and access configuration and freeze protection. Minimum inspection and testing requirements of specific system components are detailed in the supplement.

Water quality testing for E. coli, total chloroform, heterotrophic bacteria is required annually. In addition, if more than 25 people consume water from the system in a 6 month period, a water test for cryptosporidium shall also be performed.

Requirements for the safe use of non-potable reclaimed water (also referred to as recycled water) provided by water utilities are also detailed in the GPMCS. Reclaimed water is wastewater (sewage) that has been treated to remove solids and certain impurities to achieve high quality standards, and then allowed to be used for toilet and urinal flushing and trap priming in addition to outdoor irrigation uses. Annual cross-connection inspection and testing is required and pipes containing reclaimed water must be colored (Figure 5) and identified in accordance with the base line plumbing code.

Figure 5 – Colored Pipe used for reclaimed water



5. Hot Water System Design (Chapter 6 of the GPMCS)

Energy is consumed in the conveyance of water from the source to the point of treatment, in the treatment process itself, in the distribution of water to the point of use, in the heating of water during use and in the wastewater treatment process. Of the energy consumed in the State of California, 19% is consumed in the movement, storage, treatment and heating of water. Water heating alone accounts for an average of 13% of the total energy consumed in US residential buildings. These values indicate the huge potential of achieving significant energy efficiencies through improved water efficiency measures, especially as they pertain to the efficient use of hot water. In addition, studies have shown that energy savings can be obtained at much lower costs through improving water efficiency, especially in retrofit projects, than by any other building system improvement.

The GPMCS contains comprehensive provisions addressing water heating system efficiency. The provisions establish a means of conserving both potable and non-potable water and energy associated with the generation and use of hot water in a building. Rather than create conflict with other well established construction standards, many of the energy related provisions contained in the GPMCS are extracted from ASHRAE 90.1 and 90.2. Chapter 6 contains numerous provisions pertaining to equipment efficiency, such as water heater efficiency, recirculation systems, service water heating controls, and swimming pool heaters and covers.

The GPMCS requires that the insulation on hot water piping, including return lines on hot water recirculation systems, be at a minimum equal to the nominal diameter of the pipe, up to 2 inches in diameter, and not less than 2 inches for larger diameter pipes. The insulation shall be continuous and have a K factor of ≤ 0.28 .

Residential recirculation systems are required to have pumps that do not run continuously and are activated only when a signal is received shortly before hot water is being desired at the fixture. This ensures minimum heat loss. Where water hardness exceeds 154 mg/L (9 grains per gallon), the GPMCS requires that the water supply line to the water heating equipment in one- and two-family dwellings be configured to allow for the installation of water softening equipment. This helps to control the build-up of calcium carbonate on heating elements that reduces water heater efficiency.

The GPMCS is the first construction code in the United States to limit the amount of water that is contained in the distribution pipes between the water source and the point of use fixture; a 32 oz (0.95 L) max between heat source and shower valve, kitchen sink or bathroom sink. If the volume is exceeded, the installer is required to incorporate a recirculation system in order to reduce hot water waste. Run outs to the point of use fixtures from the circulation loop are limited to 16 oz (0.48 L) max.

6. Additional provisions

In addition to the topical provisions detailed above, the GPMCS also contains extensive energy efficiency requirements in Chapter 7 for heating, ventilation and air conditioning

equipment based largely on the provisions contained in ASHRAE 90.1 and 90.2 for commercial and residential buildings, respectively. In Chapter 8, the GPMCS addresses indoor environmental issues such as pollutant control, moisture control, indoor air quality, whole-building ventilation and environmental comfort.

7. Continuous maintenance update process

Being a code overlay supplement, as opposed to a model code, has advantages. Updates and revisions to the GPMCS are not required to be issued on a three-year cycle in the same manner that model codes are in the United States. In fact, IAPMO can issue updates to the GPMCS as new requirements and provisions warrant. The nimble, continuous improvement process also allows IAPMO the ability to address emerging technologies and incorporate them into a green construction code in much less time, improving speed to market for manufacturers and reducing problems with code officials.

Revisions to the GPMCS can be submitted at any time by anyone, submittal forms are posted on the IAPMO website. The next update to the GPMCS is scheduled for 2012. The list of issues the Green Technical Committee will consider in their deliberations towards the next update is exhaustive. In addition to reviewing each chapter to identify where opportunities exist to raise the bar on specific provisions or to address emerging technologies, the GTC and the associated working groups will also apply their skills toward making progress on a number of longer term projects. There are two such projects that are of particular interest.

8. Past CIB-W062 research incorporated into the GPMCS

At the 36th CIB W062 Symposium held in Sydney, Australia, Dr. S. Cumming provided a paper titled *Outcomes from an industry and regulator research collaboration into reduced flows on building drainline systems in Australia*. The research focused on the use of non-water consuming urinals (also referred to as waterless urinals) and the drainline blockage problems that resulted as a result of the installation and use of those fixtures.

The study detailed the benefits of installing water consuming fixtures upstream of non-water consuming urinals in terms of eliminating or greatly reducing the frequency of clogging due to struvite build-up.

As a direct result of that research effort, Section 402.3.1 of the 2012 GPMCS requires that “Where non-water consuming urinals are installed, not less than one water supplied fixture rated at not less than 1 drainage fixture unit (DFU) shall be installed upstream on the same drain line to facilitate drain line flow and rinsing.

IAPMO stands ready to assist other countries with the development of green plumbing and mechanical provisions appropriate for their region and specific needs.

9. References

1. Outcomes from an industry and regulator research collaboration into reduced flows on building drainline systems in Australia – Dr. S. Cummings, CIB W062 36th International Symposium, Section G, Sustainable Construction

10. Presentation of Author

Peter (Pete) DeMarco is the Senior Director of Special Programs for IAPMO. His responsibilities include oversight of IAPMO's government relations department, water efficiency and green building initiatives, standards development activities, domestic and international plumbing programs, industry outreach programs and development of research projects relating to water efficiency.

