Engineered Solutions™ for Point-of-Use Emergency Shower Water Tempering

By Casey Hayes

Most significant changes in life encounter a certain degree of inertia before movement can be measured. So it has been with ANSI's 2004 update of the Z358.1 Standard governing emergency showers and eyewashes. The update provided a much greater degree of clarity around the issue of providing tepid water through emergency shower and eyewashes. Prior to that time, while tepid water was mandated, the specific definition of "tepid" was left up to the interpretation of specifiers. Because exposure to sustained water temperatures below 60ºF could easily lead to hypothermia and temperatures above 100ºF could damage sensitive tissue (eyes for example), conventional wisdom pointed to those temperatures as the boundaries. And, in fact, when the 2004 revision clarified the range, those numbers were made official.

As the old saying goes, "Be careful what you ask for… you may get it!" The 2004 Z358.1 revision provided a clear tepid water temperature range … now what? How does one achieve compliance and maintain it with the myriad of operational challenges typically encountered? Heating cool input water or cooling warm water seems, at first blush, to be a relatively simple matter … isn't it? The answer is "yes" if it's that simple. But, like most things, the devil is in the details! How much hot or cold water will be needed? Sizing the system is an immediate challenge, driving performance, as well as initial and ongoing operating costs. Maintaining a constant temperature range requires a closed loop recirculation system; no simple task in most industrial plants. Specifiers quickly realize that seasonal, process-related and other variables can dramatically impact performance. How about fluctuations in input water pressures and temperatures? You must have built-in compensation. How about responding to a partial or complete failure of the hot water source, if you're heating water in the loop? You must have redundancies like a full-flow cold water by-pass system to ensure against starvation... since an adequate flow of cold water is better than none at all!

How does one know what "state-of-the-art" looks like, if you only occasionally design such a system? The answer is to team up with an equipment manufacturer who can design and build cost-effective point-of-use systems tailored to your specific needs.

Haws Engineered Solutions™

The Haws Corporation has collaborated in over 700 custom projects, where clients have taken advantage of our Engineered Solutions™ capabilities. Over time, this broad experience base created a valuable resource within Haws Corporation of staff that possess not only industry knowledge, but a solid understanding of the client-side of the equation. Recognizing this knowledge growth and wishing to nurture even greater expertise, Haws Corporation spun off the Engineered Solutions Division late last year. We continue to have the full backing and resources of the industry leader in emergency equipment at our disposal. Additionally, we now have the entrepreneurial freedom to further pursue development of the ultimate best response products on the market, in collaboration with individual users. The resulting products provide a "plug-and-play" package - in either open skid or enclosed booth configuration - that can be literally dropped into the appropriate location or locations anywhere within the plant. After the collaborative design/build phase, the end user simply provides power and water hook-ups. Point-of-use tempering units can be configured to include showers or not, as well as feeding tempered water to adjacent existing showers. *Photo #1* depicts open and enclosed versions of these custom solutions.

Photo #1-Matched and balanced tempered water systems can be either skid mounted or contained in an Enclosed Emergency Environments (E3) booth.

In most large plant operations, the sheer size of the recirculation loop required makes central heating and/or cooling impractical. That's where point-of-use tempering comes into play. Each skid or enclosed tempering platform can feed water to a number of nearby showers/eyewashes. It is the perfect solution to the daunting task of tempering all safety equipment in the facility. Let's consider the hot and cold system requirements of tempering:

Warming Cold Inlet Water Temperatures

The most prevalent need for tempering is an application where inlet water temperatures are below the 60ºF threshold. As stated earlier, even in areas where the water temperatures are thought to be moderate, sustained running (for 15 minutes at 20 gpm) will often result in lowering temperatures through the shower use cycle, approaching source water temperature. And, that source water temperature is very often below the minimum 60ºF.

As a general rule, tempered water blending systems designed to warm inlet water consist of three major components: a hot water storage tank, a heater and a blending valve. A fourth component, a booster pump, is sometimes specified where water pressure might be too low to run multiple pieces of emergency equipment at a combined peak demand.

Importantly, the specific requirements that the showers or eyewashes impose on the system need to be taken into account when sizing the componentry for the tempered water system. This is an important point. By considering the tempering componentry and the demands of the showers and eyewashes within the system the specifier can build a complete, matched system. An ANSI-compliant shower may not actually be compliant if the upstream tempering components are sized improperly. That's because ANSI compliance is sought and granted based on specific pressure and flow ranges.

When your objective is to warm cold inlet water, the heart of the tempered water delivery system is the mixing valve, such as the Haws Model TWBS.SH. *(See Photo #2)* It ensures that the emergency equipment safely receives water at the required temperature, by monitoring output temperatures and adjusting cold and warm input streams accordingly. Emergency equipment manufacturers are in the best position to design appropriate mixing valves, since we understand the equipment and the specific flow rate requirements. Knowing what flows and potential peak demands are expected is critical in properly designing a good system. For example, consider a facility that has several pieces of emergency equipment and needs tepid water delivered to all of them. First, you must determine how many of those devices may be required to run concurrently, as the mixing valve must be capable of handling the highest demand of multiple uses, as well as the lower demand associated with a single eyewash. Determining flow requirements will not only help the emergency equipment manufacturer to properly size the mixing valve, it will also allow them to determine the size of the required hot water source.

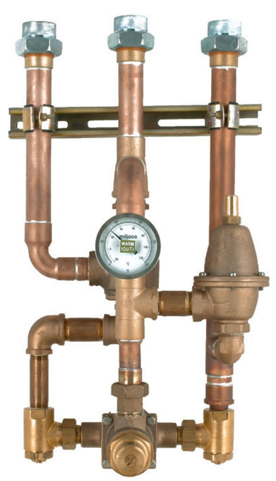
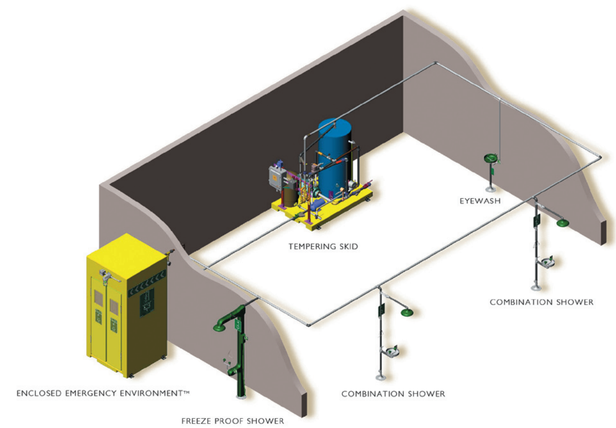


Photo #2 - A premium Tempered Water Blending System valve is actually a series of valves that provide all of the redundancies and by-pass capabilities to assure smooth operation in virtually any circumstance.

Once the mixing valve capacity is calculated, you will need to know the associated pressure drop at the high demand. The most common oversights are underestimating the pressure required to drive the emergency equipment after it has passed through the mixing valve and the flowing pressure available. The mixing valve can have a rather large pressure drop as the flow requirement can be 30 gpm and higher. Also, emergency equipment is designed so that it will produce the required flow patterns at a minimum pressure of 30psi. Adding this minimum pressure requirement to the pressure drop of the valve and the associated piping, you can determine what supply pressure is required. You might find that there is insufficient pressure at the facility to run the system. If this is the case, you will have to either add a booster pump to the supply, or limit the number of showers and/or eyewashes on the system. Other options are to look at increasing the pipe size one or two sizes so that the friction losses are less.



Now that you have the essential data to size the system, you will need to ask the emergency equipment manufacturer about the safety redundancies of their valve. This is very important. You need to ensure that the mixing valve can offer a full flow bypass of cold water. In the event there is a loss of hot water at the valve, or the cold-water inlet at the valve becomes restricted, it is essential that there is a means to offer a full flow of cold water to the equipment. If you are considering a mixing valve stated to have an internal cold water bypass, you will need to ask if this bypass can handle the maximum flow of the system design. If the bypass is less, there is a good possibility that an eyewash, for example, will not flow water if it is needed concurrently with a shower, as the shower will take as much as it can receive. The offered mixing valve must also have a positive means of hot water shut off in the event of a cold-water failure. If there is a sudden loss of pressure on the cold side, the mixing valve must shut off completely and not allow any hot water to pass. You do not want a valve to pass only hot water, as there may be enough flow to operate an eyewash. As mentioned earlier, temperatures in excess of 100°F have been determined to be harmful to the eyes. These safety redundancies are essential in the safe operation of the mixing valve, and should be *external* to the main mixing valve so that their performance is not jeopardized by the performance of the mixing valve itself.

Cooling Hot Inlet Water Temperatures

Now, let's discuss emergency equipment outlet water temperatures that exceed the 100°F maximum, thereby requiring cooling facilities. Consider, for example, an emergency drench shower/eyewash combination application in a petrochemical refinery in the Middle East. Radiant and ambient temperatures in many areas within a warm climate refinery often drive standing water temperatures up well above 120°F. The dynamics of heat transfer will raise the standing water temperature at the emergency equipment to dangerous levels approaching the maximum ambient/radiant temperature. When actuated, the emergency equipment would deliver very hot water to the injury victim exacerbating the injury, creating more physical harm or causing the victim to recoil from the flow and cease the drench or irrigation protocol.

If you've ever washed your car on a hot summer day, you've probably witnessed a similar phenomenon. As you soap the car, the automatic sprayer on the hose is off, with a length of hose exposed to direct sunlight. When it's time to rinse off the soap, you grab the hose and squeeze the handle, immediately spraying out substantially warmer water than usual. The hot spray lasts until all of the water contained in the portion of the hose exposed to direct sunlight has been discharged. Now, consider what would happen if a large portion of the water supply immediately needed in an emergency was exposed to that much sustained heat… and, that water was fed into an eyewash or drench shower. It would make for a challenging – and dangerous – 15-minute drench or irrigation cycle! That's what the high side limit of the range established by ANSI Z358.1-2004 is designed to control.

With respect to cooling high ambient temperature water to bring it within the guidelines, the most popular approach is to size a chiller to handle the maximum anticipated load. *Photo #3* shows an actual Haws Engineered Solutions™ installation ready for shipment to that not-so-hypothetical Middle East plant.

Photo #3 - Large Enclosed Emergency Environment for use in lowering source water temperatures.

A variety of different products are available, based on the volume of water required at peak demand and the footprint of the recirculation loop specified. As is also the case with warming technologies, all components must be matched to assure the availability of proper peak flow rates and temperatures. Emergency equipment manufacturers are in the best position to assist with system design as they know their equipment flow rates, peak demands and other associated requirements.

Just as progress has given us full-function emergency equipment and, later on, tepid water requirements, it has now also given us a clearly defined minimum and maximum range of acceptable outlet temperatures. Designing and managing an emergency equipment system that is capable of delivering sustained use volumes of properly tempered water should be a step-by-step process. It's a matter of identifying your risks, sizing your total system for peak flow use and factoring in local water conditions (pressure and temperature), as well as seasonal and process-related variations. Only then is it possible to specify and match your overall need to a tailored system, capable of delivering emergency equipment water temperatures that are within the required range.

For more information on the tempering systems visit www.hawsco.com.

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