MILWAUKEE VALVE

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Selecting The Correct Valve Material – Bronze vs. Brass

For residential and small commercial water systems, there are two basic body materials available in copper alloy valves, namely brass and bronze. Taking that broad statement as a starting point, there are subordinate issues regarding 'which brass', 'which bronze', 'what are the materials in the rest of the valve', or 'on what service will the valve be applied', as well as others. This paper will try to lay out the basic issues and provide some common-sense guidance to engineers, plumbing contractors, and property owners faced with these choices when laying out or modifying a plumbing system.

A few givens are in order before we get into the main question – 1) that you are dealing with a long-standing reputable valve company with a real manufacturing presence in the United States; 2) that the prospective supplier(s) adhere to core product standards and specifications such as those promulgated by MSS (Manufacturer's Standardization Society), ASME (American Society of Mechanical Engineers), ASTM (American Society for Testing and Materials) and others, as well as special performance standards such as those developed by Underwriter's Laboratories (UL), Canadian Standards Association (CSA), National Sanitation Foundation (NSF), and others. Over these fundamentals, high quality valve suppliers follow a widely accepted general quality management system such as ISO 9000 to act as an umbrella over the entire supply process, from understanding and acceptance of the customer requirements and order, to the final supply of the correct item to fill those requirements, and everything in between. Those who specify and use valve products need to know that there are less reputable suppliers in the marketplace who offer low cost product for sale that looks great on the table, but doesn't stack up to the required standards. There are even companies who advertise and mark their products as compliant when they are not. Will these suppliers be there for you once the purchase order is filled if you have issues? Users are reminded that the main certifying agencies (UL, CGA, FM) can verify which manufacturers and what products are actually certified, and users can generally access the certification data on the web.

To the main question of bronze vs. brass: for many years, the majority of small valves used in residential and light commercial plumbing projects were made from 'bronze', or 'valve bronze' alloys. The most commonly used, in decreasing order of corrosion resistance and cost, are: ASTM B61 (3-5% zinc), ASTM B62 (4-6% zinc), and ASTM B584, Alloy C84400 (7-10% zinc). Gate, globe and check valves made to MSS SP-80

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require the primary body material to be either ASTM B61 or B62. Having said that, there are gate, globe and check valves available in the marketplace that don't comply with SP-80, and therefore might be made of a high zinc bearing brass or some other alloy not specified or controlled in SP-80. Users of gate, globe and check valves are reminded to look for compliance to MSS SP-80 as the first measure of reliability and corrosion resistance.

The MSS ball valve standard, SP-110, covers many types of materials. When it comes to copper alloy, it is not specific about which should be used. As a result, copper alloy SP-110 ball valves can be made from a yellow brass with a high percentage of zinc (in the range of 35 to 45 per cent), or a more noble bonze, with zinc running anywhere from 3 to 10 per cent.

The situation, therefore, is this: a plumbing contractor or system designer has the option to specify and use a brass product or a more expensive bronze product. When the decision is made purely on a cost basis, the procurement obviously is going to swing to brass (which is what has happened across the marketplace at an incredible rate, over the last 5 years especially). BUT – while it is true that in many cases the brass product will give good service and perform nearly as well as the bronze product, it is equally true that in some cases, the brass item may degrade quickly in service, and cause a host of problems and additional costs for the property owner. The challenge, then, is to understand under what conditions the brass valve may not work well, and in situations where you might get a little close to the edge, specify and install the bronze valve up front to eliminate the problems before they happen.

What kind of 'problems' are we talking about? In a word – 'dezincification'. This term describes a corrosion mechanism whereby zinc preferentially corrodes or dissolves out of a copper alloy, leaving the remaining substrate like Swiss cheese, with holes where the zinc used to reside. Clearly, that's not a good situation in a device meant to contain fluid at pressure. Dezincification can result in early valve failure, including flooding damage, as well as damage to the rest of the plumbing system by introduction of corrosion by-products, which can choke narrow flow passages, and otherwise create havoc.

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There are companies circulating documents that say when zinc content is above 15%, you are at risk for dezincification, and when it is below that number, you are not. This is not the most accurate way to present the situation. The fact is that dezincification can occur for ANY zinc bearing copper alloy, depending on the circumstances, and when it happens, it can be destructive to the parts even when the starting concentration of zinc is low. It may be more accurate to say that in most cases, for expected potable water systems in the contiguous US, when zinc content of the body is below 15% and there are no other exacerbating factors present, that risk of dezincification may be small. Even when this is true, it may be better to err on the side of caution and if there is a single or multiple exacerbating factors present for dezincification, then the user might be wise to specify a bronze valve to mitigate that risk, as the overall project cost does not increase much, even though the cost per valve might triple in some cases when moving from brass to bronze.

What about the situation where the body material is bronze, but the end piece or internal trim materials are made from brass? From the corrosion engineering perspective, the body is the most vulnerable part, since it is directly coupled to the piping, which may or may not set up an undesirable galvanic couple. It carries the piping loads – (and stress generally exacerbates corrosion), and finally it has the largest wetted surface (generally), so when the body is bronze, the greatest risk of dezincification is immediately reduced.

Valve manufacturers with years of experience in all the product types report that very few valves with bronze bodies ever fail in dezincification, even when the tailpieces (in the case of ball valves), or internal trim materials (such as stems, balls, packing glands, etc.) are made from brass or plated brass.

The characteristics of the fluid passing through the valve have a lot to do with whether dezincification will occur, and if so, at what rate. Very pure water makes a poor electrolyte, and as a result, dezincification is uncommon on ultra-pure water. Moving up the scale from ultra-pure, water with high TDS (total dissolved solids) or salt content, up to and including salt water, is increasingly electrolytic, and dezincification is more likely to occur in applications where the water is heavily softened, or the water otherwise carries a high amount of salt. If electrical current is present in the piping system, it can set up or exacerbate dezincification. This can happen accidentally, for example when piping is run alongside electrical wiring, there can be impressed current, or when DC grounds are brought right to the copper piping and there are stray direct leak currents from the grounded equipment.

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Anecdotally, there are at least a few areas of the country where the water seems to be inherently corrosive, and valves are more prone to dezincification. Some of these areas are listed below:

- St. Louis, MO
- Some areas of the Carolinas
- Some areas in Texas and Oklahoma

Some valve manufacturers report that any town or city that draws water from the Colorado River system can see this problem, unless the water is otherwise treated to mitigate the risk. As mentioned previously, other than a general propensity in a geographical area for this to occur, the real culprit is water that has electrolytic properties, i.e. carries higher levels of salt, and consequently, water that is heavily softened can be destructive, even if the geographical area is not otherwise well known for the problem.

Another application that can create problems with dezincification is buried service, where the wet dirt and mud surrounding the valve and attached piping becomes an enveloping electrolyte, promoting dezincification from the outside in.

The key thing to remember is that dezincification is not always predictable, but when it does happen, it can be a real problem. If there is any opportunity for dezincification in an application you are evaluating or designing today, be sure to look at using bronze valves instead of brass – the small additional expense will be well worth the savings in problems, irritation and downstream costs.