

NSF Standard 61 Annex G

Coating Testing Rationale

For a Coating to be considered the water contact surface, acting as a barrier to a substrate material containing lead in plumbing fittings, proof of durability is a necessary prerequisite.

Durability can be proven in several ways:

1. Demonstration of field returns as old as expected life of the product – evidence of adequate coating thickness remaining.
2. Conduct accelerated testing through:
 - a. Pumping challenge water(s) deliberately aggressive to the coating chemistry at a flow rate that represents nominal product usage flow rate at 150% of the total flow quantity that would pass through the product during its useful life.
 - b. Subject the coated product to a heat/quench test or thermo-cycling to evaluate the adhesion of the coating to the substrate.
 - c. If the coated parts are moving components of a product, subject the product to its normal life cycle standard testing protocol, and

With respect to accelerated durability testing, we have chosen five test water chemistries that Mike Schock, a well recognized water corrosion chemistry expert (currently of the US EPA Cincinnati Labs, formerly of Illinois Water Survey), picked as generally representative of the variations of waters available from utilities. Since any coating, either metallic or organic, will be more vulnerable to corrosion attack by one or more of these water chemistries, that is how they shall be selected.

In the case of faucets and plumbing fittings of ½ inch nominal size or less, a 2.5 gpm flow rate would be appropriate, as faucet and showerhead outlets are restricted to that limit. For ¾ inch nominal size, a maximum of 5 gpm would be appropriate, although a good argument could be made for 2.5 gpm. A ¾ line is usually one which is trunk that serves several branches. It is not too often that more than one outlet is used simultaneously. A ¾ inch line is used not so much to serve multiple outlets operating simultaneously, but to minimize the pressure drop between the water meter or water heater and the outlet.

According to the AWWA Research Foundation report, “Residential End Uses of Water,” the per capita usage of faucets (kitchen and Lavatory) is 10 gallons per day. For the average 3 person home, this would be 900 gallons per month. According to the National Association of Home Builders study, “Study of Life Expectancy of Home Components,” the expected life of is 20+ years. We have reviewed the data source at NAHB to more concretely determine what 20+ means – **(Seeking answer from NAHB)** . If the durability test were run at 2.5 gpm with just one of the Challenge waters for 4 weeks, the total flow passing through the product would be 108,000 gallons, or the equivalent of 10

years of life. Therefore, a 12 week test would simulate 30 years. It is reasonable to expect some safety factor from this test, wherein the coating thickness following the test can be used to project an expected life. That life should be some factor beyond the expected life of the product. In this case, an understanding of the NAHB study should clarify the expected life information.

Adhesion testing of any coating is also necessary, as a “catastrophic” or large surface area adhesion failure of the coating would suddenly expose a significant area of the lead containing substrate. In the case of metallic plating (either electroplate or chemical deposition), adhesion is primarily an issue of the cleanliness of the substrate, such that chemical bonding can occur. A simple adhesion test that has been effective on metallic plated coatings is to heat the part and quench it in ambient room temperature water. For organic coatings, which are often more flexible, a program of thermo-cycling is more appropriate.

The Task Group has also raised the issue of abrasion of components by sand or other particles in the water flowing and of mechanical wear of coated working components, such as valve parts. In faucets, we have seen very little evidence of sand particle abrasion of waterways; however, a test could be devised to introduce some particles into the water stream. This would also create a severe test of the pumping and other test apparatus equipment. Again, we have not seen evidence of particle erosion in faucets. In examining old products that have been returned from field installation after many years, chemical corrosion of corrosion/erosion (wire draw) is not at all uncommon. With respect to mechanical wear, this can and does occur. In thinking through this scenario, what happens is that the load bearing contact surfaces, between a threaded valve stem and body threads, for instance, is that the rather small load bearing areas can wear down through the coating, exposing a limited amount of leaded substrate. To a degree, the worn surface area can gradually expand as the substrate areas themselves wear down to increase the contact area. However, this phenomenon only exposes substrate surfaces in a very gradual manner, and likely does not pose much threat to human exposure to lead.

The Task Group will need to have continued discussion on these issues.