WATERWORKS FITTINGS BY FUSION BONDED EPOXY – AS/NZS 4158

Ductile iron is a wonderful commodity found in a range of applications, including fittings used for waterworks. However, ductile iron fittings must be coated with Fusion Bonded Epoxy (FBE) to prevent corrosion. Frank Iapozzuto from PROVE Standards & Engineering explains the coating process.

Although cast iron dates back to the 5th Century, ductile iron is a relatively new ferrous metal, which was only created in the 1940s. The progression and refinement of ductile iron incorporates carbon as well as silicon and a few other elements that give it high-tensile strength and impact resistance. This improved performance characteristic (over its older cousin cast iron) makes it a perfect candidate for the construction of water main fittings. Ductile iron provides our industry with affordable, workable, and reliable solutions for above- and below-ground applications. While I might have convinced you how wonderful ductile iron may be, I have not yet spoken about its Achilles' heel – corrosion. Ductile iron suffers significantly from corrosion due to its higher carbon content, which exacerbates the effects of its exposure to humidity and oxygen. The solution to corrosion is, of course, the application of a robust and durable coating... but not just any old coating; I am talking about Fusion Bonded Epoxy (FBE).

FBE was invented in the early 1960s and has since become the only acceptable form of coating of ductile iron water main fittings. Our Australian Standards for fittings such as ductile iron pipe and fittings, gibaults, gate valves, non-return, etc, all reference the golden standard that is 'AS/NZS 4158'. AS/NZS 4158 has essentially two very important parts: Section 2 of AS/NZS 4158 is used to certify the manufacturer of the raw product. The manufacturers of the FBE product seek certification to Section 2 of AS/NZS 4158 in order to on-sell the coating system to FBE coating facilities. Certification to Section 3 of AS/NZS 4158 is what is used to verify that an FBE coating facility has the expertise to correctly apply the coating to a ductile iron product. Although this might sound simple for an FBE coating facility, FBE coating can be a tedious and difficult process to correctly apply.

A coating of Fusion Bonded Epoxy (FBE) is necessary to help prevent ductile iron fittings from corroding.

A BIT OF MAGIC

For those who have never witnessed a ductile iron fitting being FBE coated, it is a real bit of magic. FBE coating is not what you may think. My first impression was that there was a guy sporting a spray gun, a P3 respirator, gloves, and dragging behind a tin of wet paint. Quite the contrary. The coating product is dry fine powder, and in its blue form it looks like Smurf dust. The powder is placed into a fluidised bath. This fluidised bath uses air pressure to agitate the powder, which from a distance almost makes the powder look like it is on the boil. Instead, it is completely safe to touch. Now, you're probably asking, 'How does the raw powder get adhered to the ductile iron product?' The coating is applied by first heating the ductile iron fitting to a high temperature, and then lowering the fitting into the fluidised bath. The raw powder then melts and adheres to the heated ductile iron. The process sounds simple, but the engineers and operators of an FBE facility need to be very meticulous in getting the induction period just right. Overheating or underheating a ductile iron fitting prior it being submerged into the fluidised bath can result in poor coating thickness, lack of adhesion, 'holidays' (absence of coating), and insufficient curing.

Section 3 of AS/NZS 4158 is all about ensuring that the FBE facility has the capacity to tune and calibrate their equipment in such a way to accommodate the varying geometries and masses of ductile iron products. Smaller ductile fittings require less heat

than larger ductile fittings during the heating induction period. Overheating a sample will see gross differences in the coating thickness due to the effect of gravity during cooling. As the fitting is removed from the bath, the coating on the upper side of the fitting will recede, whereas the coating thickness on the lower section will thicken. On the other hand, if the ductile fitting is below the optimal temperature before being lowered into the fluidised bath, the coating may suffer from poor curing (like wet paint) and also inadequate coating thickness. However, as with all coating systems, preparation is paramount. Ductile fittings need to be prepared to ensure that the samples are free from oils or other foreign matter that may hinder the adhesion. Also, the casting and pre-preparation of the ductile iron is often roughened deliberately in order to improve the adhesion of the FBE coating to the ductile iron substrate.

TESTING PROCESS

Within our laboratory we are requested to test final production samples that need to comply with Section 3 of AS/NZS 4158. Testing includes:

- Minimum thickness requirements.
- Continuity – checking for the absence of pin holes.
- Adhesion – checking for adequate adhesion to the substrate of the ductile iron fitting.
- Foaming – at a microscopic level the coating is assessed for aeration.
- Degree of cure – coating is at least 95% cured.
- Hot water immersion – checking for changes in adhesion.

Now, what does this all mean? Essentially when you buy your next ductile fitting you might see a WaterMark logo, and somewhere below that logo you will see a standard number such as AS/NZS 2280, AS/NZS 2638 or AS 4998. All of these standards are product reference standards, but embedded in each of these standards lives a requirement for coating of ductile iron to AS/NZS 4158.

Not only does the product need to pass the dimensional and performance requirements of the standard, but the product also needs to demonstrate that the coating conforms to the application requirement of Section 3 of AS/NZS 4158. The coating requirements ensure the ductile iron is protected from corrosion to ensure longevity of the product for decades to come.

Should you have any questions about testing to AS/NZS 4158 please feel free to drop us a line.

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For more information please feel free to contact PROVE Standards & Engineering Pty Ltd at PROVeng.com.au

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