

Not All Spandrel's Are Created Equal

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Keywords

1=Spandrel glass

2=Silicone

3=Elastomeric coatings

Abstract

Many coating or film type products can be used for spandrel glass production; frit, water based silicones, solvent based silicone, urethanes, tapes, and films. Each has been used and is accepted either by certain regions or globally for many years. Through adhesion, durability, and weatherability testing it has been shown that not all spandrel coatings are created equal. Careful attention must be taken in evaluation due to a lack of properties each may or may not exhibit. Each will have limitations that must be considered before specifying.

Overall, testing shows that water based coatings such as the silicone OPACI-COAT-300® show the best combination of properties and performance.

Introduction

The purpose of this article is to inform on what Spandrel is, how it is created and what the difference is between the many options for spandrel creation; environmental issues, structural strength

considerations, durability, fallout protection, and general weatherability.

One of the biggest questions we hear is; "what is a spandrel?" For sure you can't find the true meaning in any dictionary but it's a rather simple explanation. Spandrel for the construction industry is any substance that spans a distance while opacifying what is behind it. Spandrel area is the space between the floors on a commercial building that can be seen from the exterior of the building. This material could be anything from aluminum sheets to brick and most importantly to us; glass. Its main purpose is to; 1. create an opacifying face to the utilities area of the building (plumbing & electrical) and 2. to add an aesthetic quality to the overall exterior skin of the building. This is done by using glass with an opacifying coating behind it, meant to harmonize with the vision glass above and below or contrast in any innovative design an architect could create.

There are several ways to attain an opaque and colored spandrel glass; ceramic frit, water/solvent silicone, water/solvent urethanes, and tapes/films. Each is very different and requires information that must be shared to make an informed choice for a building design.

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The use of ceramic frit is one of the oldest methods by which to create spandrel glass. Basically, frit is an applied substance (roller coat, screen print) made of glass particles, inorganic pigments, and chemicals to aid in curing. After the pattern or solid coverage is applied to the glass, the glass must then be subjected to curing temperatures around 1,400° F to physically bind the coating into and fuse to the glass prior to the tempering process. The pigments used in this application must be able to withstand such temperature extremes and are inorganic.

The second standard for coating glass to be a spandrel is the use of water based silicone coatings such as OPACI-COAT-300®. Being a silicone the coating has a close kinship to the actual glass which is made of silicon and oxygen elements. This creates a natural tough bonding of the coating to the glass surface. This type of coating is cold applied and free from the tempering process, thus it can be sprayed, roller coated, or curtain coated after the tempering process. Ambient temperatures or up to 400° F oven temperatures can be used to cure the product. It is this much lower cure temperature that allows the use of organic pigments as well as specialty pigments that would otherwise burn away at 1,400° F.

Within this same class but at a much lesser level is the use of solvent silicone coatings, later in this article we will discover the property and application difference between the two yet the bonding chemistry to the glass is similar. The next application method to create a spandrel glass is by employing the use of tapes or films. Once these were used at a much higher rate than they are today,

application issues and durability in the spandrel cavity have shown to be a problem, hence the use has dramatically decreased.

Solvent and water based urethanes are popular in Europe for spandrel coatings and more recently starting to show acceptance in North America. These coatings although easy to apply issues have been raised with durability and weatherability in the spandrel cavity.

Environment

Environmental acceptance and education globally has created many issues among the various coating methods mentioned above. New laws on volatile organic compounds (VOC) emissions are being created to lower pollution levels. This has been met by each coating type by either creating water based versions or lowering VOC's to safe limits. Yet for solvent silicone coatings this is still an issue as they have not yet met this standard and are finding trouble in many regions globally, resulting in high permitting and disposal fees for glass processing plants and general applicators.

One of the longest standing environmental issues is with inorganic pigments; frit must use to attain certain hues of colors and luminosity. These are for example pigments such as lead, cadmium, chromium, cobalt, and bismuth. Great strides over the years have been made in reducing or eliminating these hazardous pigments yet the removal of one usually means the insertion of another that may still cause environmental harm. In this I am referring to the use of bismuth, a current issue in frit paints. This will result in a rejection of spandrel glass in "green" building design due to the

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coatings inherent hazardousness as well as lack of being certified as a clean fill possible product if the building were to be destroyed.

It must be added that there are several ceramic frit manufacturers, each having their own products that may or may not meet environmental legislation. The section above does generalize but does not mean to inform that all frits are hazardous.

For cold applied coatings such as water based OPACI-COAT-300®, this is not an issue. Many safe automotive grade pigments (for UV stability) are used to attain much great color ranges and brightness because high temperature withstanding elements such as bismuth are not used. The resin system in this coating is inert and non-hazardous, coupled with safe pigments; “green” buildings can offer certified spandrel for current design and post “clean fill” disposal options as well as infinite color options and opacity.

Adhesion Testing

Often one of the best tests for determining adhesion of spandrel coatings to glass is by employing a modified tensile adhesion test for structural sealant adhesion to glass; “ASTM C1135-90 *Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealant*”. This is a quantitative method for testing spandrel coatings adhesion to glass and a structural sealant.

In a recent test comparing water based OPACI-COAT-300® to a similar solvent based silicone spandrel, of all eleven samples tested, eight of the solvent silicone spandrel failed to yield results due

to massive failure. The test is comprised of running the coated glass through several conditions; 21 day ambient cure, 1 hour at 88° C heat exposure, 1 hour at -29° C cold exposure, seven day water immersion. The solvent spandrel failed in all but the seven day water soak test, of which the overall tensile strength to achieve failure was low. Water based OPACI-COAT-300® on the other hand shows high tensile strengths before failure and include proper failure points cohesively as opposed to at the glass or sealant interface. No other spandrel type of coatings was subjected to this test.

Another test for adhesion of coating to glass substrate is “ASTM C794-93 *Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants*”. The purpose of this test is to determine the strength and characteristic of the peel properties of cured-in-place elastomeric coatings on glass or elastomeric joint sealant. Again, OPACI-COAT-300® water based silicone was compared to another solvent based silicone spandrel. The samples are soaked in water and evaluated, OPACI-COAT-300® resulted in 400+ hours of soak time before adhesion loss or cohesive coating failure occurred. The comparison solvent silicone spandrel failed at the coating to glass interface prior to any water immersion time.

Durability Testing

Often coatings will be evaluated via the QUV Weatherometer accelerated weatherability testing machine. Again, the same two spandrel coatings were compared; OPACI-COAT-300® water based and a solvent based from another manufacturer. The tests resulted in OPACI-COAT-300® lasting over 10,000 hours before color fade, cohesion loss,

cracking or adhesion loss occurred. For the comparison solvent spandrel, at approximately 500 hours the following was observed: partial adhesion loss on both through glass and first surface exposure (especially where the coating was scribed to simulate a scratch due to glazing error), chalking and degradation of exposed coating.

Fallout Protection

For the commercial building industry the concept of fallout protection is extremely important. For Canada it is a standard that is part of every building, while in the US it only pertains to Federal Government buildings. Fallout protection is the ability of a spandrel material to hold the glass in the building in the event of a broken lite. The North American standard that pertains to this is; *GTA Specification #89-1-6(1991) Section 4.1 D.2 Fallout Resistance Test.*

For ceramic enamel (frit) and solvent urethanes to attain fallout resistance, a polyester backing must be applied to keep the glass together if breakage were to occur. It is still employed today with frit and adds to the overall cost and durability question as films have had issues with durability in the past. For now it is the only way frit will pass fallout protection testing. It would be obvious then that tapes and films for spandrel use will also pass fallout protection testing as they are the same or similar to the polyester backing for frit.

One of the major benefits of the water based OPACI-COAT-300® spandrel coating is that it's natural elastomeric nature adds fallout protection within the coating. No extra cost is created in this process.

Yet it must be stated that all silicone spandrels are not the same. As it has been shown in previous sections of this paper, the solvent silicone spandrels must be looked at closely. The difference falls in their chemistry as a silicone and how they are formulated. From the previous tests we showed that there is question regarding the durability and weatherability of solvent silicones, which would directly impact the fallout protection test criteria. In this test the spandrel glass and coating are subjected to temperature and humidity extreme cycling, then broken and subjected to positive and negative wind load simulations. It is very important for an architect or designer to understand that all parts of this test must be completed and passed for fallout certification to be placed on the product.

Conclusion

Many coating or film type products can be used for spandrel glass production; frit, water based silicones, solvent based silicone, urethanes, tapes, and films. Each has been used and is accepted either by certain regions or globally for many years. Through adherence, durability, and weatherability testing it has been shown that not all spandrel coatings are created equal. Careful attention must be taken in the evaluation of each coating type. Each will have limitations that must be considered before specifying.

Overall, testing shows that water based coatings such as the silicone OPACI-COAT-300® show the best combination of properties and performance.

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