PPG HI-TEMP™ Heat-resistant Coatings

Essential criteria for choosing the right heat-resistant coating

When choosing, specifying, or using heat-resistant coatings, it is important to realize that not all coatings perform the same. There are many raw materials involved when formulating heat-resistant coatings, but the primary constituent is silicone resin. There are numerous silicone resins to choose from that are supplied by a range of raw material suppliers.

The silicone resin a coating manufacturer chooses will affect the finished coating in many ways:

- Heat resistance
- Dry time
- Hardness
- Color stability
- Thermal shock resistance
- Cure
- Compatibility with primers and other topcoats
- Cost
- Corrosion resistance
- Application characteristics
- VOC requirements

Key considerations affecting the quality of a heat-resistant coating

The characteristics and features of a heat-resistant coating are also affected by the blending of organic resins with silicone resins: acrylic, alkyd, etc. In formulating a color-stable, silicone, acrylic topcoat to 260°C (500°F), there are three important considerations:

1. Choice of silicone resin
2. Choice of acrylic resin
3. Ratio of silicone to acrylic

All three will greatly affect the above-mentioned characteristics of the final coating.

Saving money with the right heat-resistant coating

Choosing a quality heat-resistant coating will save you money and save you from associated problems when compared to other types of generic coatings: epoxy, urethane, zinc, and so on.

For example, the choice of a heat-resistant coating to paint a 91 meter (300-foot) stack that will run at 538°C (1000°F) should be based on the quality and expected high performance of the coating. If the coating does not perform well, repainting the stack is an expensive and time-consuming operation.

Important questions when choosing high-temperature resistant coatings

What is the maximum exterior metal temperature of the equipment that you wish to protect?
The maximum exterior metal temperature for each job must be determined in order to choose a coating that is able to withstand this temperature otherwise the coating will fail.

Is the equipment that needs to be protected insulated or not?
If the equipment is insulated, the coating you choose should be resistant to cyclic exposure from boiling water followed by dry, high temperatures. If you already have existing corrosion under insulation, you may need to choose a coating that also meets the following criteria:

- Ability to be applied directly to hot operating equipment
- High film-build capabilities ranging from 300 to 450 microns (12 to 18 mils) DFT

The high film-build is necessary to protect the peaks and valleys of pitted steel, which may have occurred as a result of the corrosion.

What are the thermal cyclic conditions of the equipment?

There are many generic materials rated for a particular heat resistance. However, they may not be able to withstand cyclic conditions. Be sure to choose a coating system that can withstand thermal cycling. All equipment – at one time or another – has to be started up or shut down.

Thermal shock
Thermal shock will occur due to events outside of the normal thermal cycling of the equipment. Even a piece of equipment that has a metal temperature of 371°C (700°F), which runs 24/7 and almost never shuts down, is exposed to thermal shock. For example, when it rains, the water hitting the 371°C (700°F) surface causes a shock to the coating system. The coating must be able to withstand this shock or it will fail.

What is the metal temperature during the application? Will the equipment be shut down (ambient) or in operation (hot)?

The metal temperature during application will dictate if you need a material that can be applied to ambient steel or if a heat-resistant coating that may be applied directly to hot operating equipment is required. There are protective coatings today that may be applied directly to hot steel having a metal temperature of up to 316°C (600°F).

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What type of steel are you coating?

The type of steel you want to protect will affect your choice of primers and topcoats. The two common types are carbon steel and stainless steel. It is important to know which will be coated. For example, coatings that will be used for the prevention of chloride-induced external stress corrosion cracking of insulated austenitic stainless steel should have the following characteristics:

- Resistance to boiling water
- Resistance to high temperatures
- Low level of leachable chlorides

Which heat-resistant primers should I choose for use in atmospheric exposure conditions?

Several parameters will indicate which primer to use, which include the following conditions:

- Heat resistance
- Environment/exposure
- Thermal cycling
- Dry time
- Cure
- Recoatability

Primer types to choose from are:

- Epoxy phenolic up to 149°C (300°F)
- Modified zinc silicone up to 316°C (600°F)
- Inorganic zinc up to 399°C (750°F)
- Zinc silicone up to 650°C (1200°F)
- Inert multipolymeric matrix, high-build primer up to 649°C (1200°F)

Of the above coatings, the inert multipolymeric matrix is the type of coating that offers the best protection against corrosion from atmospheric exposure. It is a high-build (250-300 microns/10-12 mils, up to 450 microns/18 mils for heavily corroded surfaces) heat-resistant primer that eliminates pinpoint rusting (notorious for thin-film primers) and offers superior corrosion resistance and barrier protection for the total temperature range.

Has the surface you are coating been previously painted? Is it in good condition? Is there much corrosion?

Determining the condition of the steel will affect whether you:

- Simply overcoat the equipment
- Spot prime and overcoat
- Remove all old coatings and corrosion, and apply the proper heat-resistant primer and topcoat.

What are your dry time parameters?

Some high-temperature primers and topcoats take a long time to dry. Others remain soft and/or tacky and never truly dry until exposed to heat. If your timetable is short, choose coatings that will enable you to complete the job in the time allotted. Coatings that will dry quickly and hard, will also aid in reducing any mechanical damage to the coating system during handling, packaging and shipment.

What are your cure capabilities?

Choosing a coating that does not require a 'complex post cure' will simplify the project and reduce cost. The best alternative is to choose a coating that does not require a heat cure.

What are the Federal, State and local VOC regulations requiring you to use heat-resistant coatings?

Check with your local and state agencies for the VOC regulations that apply to heat-resistant coatings.
The Federal regulation is 648 g/l (5.4 lb/gal) but many states now require a VOC content of 420 g/l (3.5 lb/gal) for heat-resistant coatings.

What are your color requirements for the project?

High temperatures can result in discoloration so, if aesthetics are crucial to the final appearance of the asset, it is important to choose the appropriate heat-resistant coating that will not discolor at the maximum temperature expected.

Matching the right coating to fit the project

As a final note, when choosing heat-resistant primers and topcoats, there are many factors that have to be considered in the decision-making process. All the above questions should help that process. Each project will have its own set of variables and parameters that may lead to a number of potential systems to choose from. Select the system that best fits your needs by using the information provided in this document.

For more detailed answers, or if you have other questions regarding heat-resistant protective coatings, please contact your PPG representative.

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