

A BRIEF GUIDE TO HIGH TEMPERATURE COATINGS

Read Online:

<https://resources.forrestpaint.com/a-brief-guide-to-high-temp-coatings>



Selecting Coatings for High Temperature Applications (200 °F - 1200 °F / 93 °C - 649 °C)

This article provides an overview of high temperature coating technologies available for operating temperatures from 200 °F - 1200 °F / 93 °C - 649 °C.

High temperature coatings play a crucial role in safeguarding substrates from corrosion while operating at high temperatures. High heat rated components preserve coating integrity during extended operation while special additives provide resistance to environmental factors such as cold shock during operation, moisture, and UV exposure.

Use this quick reference guide for high temperature coatings to understand characteristics, applications, and key considerations for selection. [Contact Forrest Technical Coatings](#), a leading global supplier of high temperature coatings, for technical consult on high temperature product selection.

How do high temperature coatings differ from conventional coatings?

High temperature coatings are protective barriers formulated with components rated for high heat resistance.

A high temperature coating will:

- Withstand long-term exposure to high operating temperatures with no visual or microscopic failures;
- Maintain film integrity to prevent substrate contact with moisture and other environmental elements;
- Contain colorfast pigments not affected by heat;
- Adhere to substrates without flaking or pitting;
- Perform at the temperature for which it is rated.

High Temperature Coating: Before and After Extended Burning



Appearance before and after burning is virtually the same. Slight variations in color and gloss is due to burning off of organic components and crosslinking siloxane bonds during the curing process.

In contrast, when a conventional coating is exposed to high temperatures, it may:

- Contain components and pigments that begin to breakdown when exposed to high temperatures as low as 200 °F / 93 °C;
- Develop visible evidence of damage following exposure to high temperatures including color fading, gloss loss, and peeling;
- Develop insidious and non-visible damage from high temperature exposure known as micropitting;
- Microscopic pitting allows moisture to penetrate the coating film and cause corrosion;
- Visible signs such as corrosion spots or flaking may eventually appear or corrosion may take hold underneath the coating without evidence of the surface.

Conventional Coating Used in A High Temperature Environment



Corrosion spots are inevitable when a conventional coating is used in a high temperature operating environment.

Reference Chart for High Temperature vs. Conventional Coatings Characteristics:

CHEMISTRY COMPARISON

Differences in characteristics and performance (in applications exceeding 200 °F)

HIGH TEMPERATURE	VS	CONVENTIONAL COATINGS
Formulation for up to 1200 °F	⊙	Organics Breakdown at 200 °F
Siloxane Bond (Si-O bond)	⊙	Carbon-Carbon Bond
Colorfast Pigments	⊙	Pigment Change at 200 °F
Maintain Film Integrity	⊙	Microscopic or Visual Failure
Protects Substrate from Moisture	⊙	Compromised Film is Permeable

How do high temperature coatings maintain film integrity and prevent corrosion?

Silicone resins and robust pigments used in high temperature coatings remain stable even under extreme heat exposure. The coatings create a polymer casing around metal components to prevent direct contact between the substrate and moisture and other environmental elements.

The carbon-carbon bond found in most organic resin structures used in typical industrial paints is not strong enough to withstand heat exposure. The silicone resins used in high temperature paints are based on a silicone-oxygen bond (also known as siloxane bond or Si-O bond) that is about 25% stronger than the carbon-carbon bond. The siloxane bond forms a cross-linked structure during curing and ensures outstanding heat resistance, chemical resistance, and light degradation resistance. These factors increase the durability of the coating film and effectively prevent corrosion.

How do high temperature liquid and powder coatings differ in application and performance?

High temperature coatings are available in both **High Temperature Liquid** and **High Temperature Powder** formulations. Liquid coatings are typically solvent-based and provided in bulk for sprayer application with aerosol touch-up availability as well. Powder coatings are a solvent-free and environmentally-friendly option applied electrostatically and requiring specialized equipment.

In terms of performance, liquid high temperature coatings generally perform better in terms of flexibility, higher coverage due to thinner coats, and higher maximum temperature resistance. Powder coatings offer advantages in durability, hardness, and corrosion resistance.

RELATIVE ADVANTAGES OF LIQUID VS. POWDER COATINGS

For High Temperature Formulations



What are the temperature and performance limitations of high temperature coatings?

High temperature coatings are inherently high hardness and brittleness that can lead to failure. They are susceptible to integrity failure due to impact or sudden temperature fluctuations. Handling the product carefully during the curing process minimizes undesired fractures.

Chemists assess the performance characteristics of high temperature coatings using a range of adhesion tests, flexibility tests, durability and hardness tests, and, if necessary for the intended application, a quench test where the heated coating is rapidly cooled in cool or cold water. These tests provide accurate information to customers regarding the coating's performance in their specific application. The collaboration between specifying engineers or manufacturers and coatings chemists is crucial in selecting a product that strikes the right balance of performance characteristics for the intended end use.

High temperature coatings have a temperature maximum of around 1200 °F / 649 °C because metal substrates themselves begin to warp or degrade at these temperatures. Warped substrates compromise coating adherence. Stainless steel or ceramic coatings become the preferred option above these temperatures.

What specialty high temperature products are available for specific application or performance needs?

As a specialty high temperature coatings manufacturer, FORREST helps customers choose a coating to fit their particular temperature, application, and performance needs. **Contact FORREST for technical consultation on choosing a coating.**

Some specialty options available in high temperature coatings systems include:

- **Bake enamels:** Single-component, robust coating systems that reach full properties by the time the oven bake is complete. Provide long-term durability and corrosion resistance with excellent pre-thermal and post-thermal performance for outdoor working machines.
- **Ambient Cure:** Because heat is not necessary to reach full cure, ambient cured high temperature coatings are the most recent technological jump in low-cost and environmentally friendly high temp coatings.
- **Air Dry Products:** Allow for a streamlined manufacturing process, yielding parts that may be handled, assembled, and shipped without baking, though they will not reach full durability until they experience their service temperatures for a sufficient time.
- **High Solids:** Comply with stricter environmental standards and thicker coverage.
- **Rapid Cure:** Shorten production wait time.
- **Powder Coatings:** Require heat to flow, gel, and cure and are VOC-free.
- **Zinc-rich:** Provide sacrificial zinc that delays overall corrosion progression. Often used in difficult to repaint applications.

Regardless of specific characteristics, high temperature coatings tend to have excellent exterior durability and light fastness and provide a range of aesthetic options.

What industries and applications use high temperature coatings?

High temperature coatings are often used in the following applications. Each industry requires a special high temperature coating that fits their specific application and performance needs.

- Hearth and heating appliances;
- Barbeques, grills, and smokers;
- Mufflers and exhaust systems for automotive and working machines;
- Industrial processes that include high temperature equipment;
- Aerospace propulsion systems;
- Incinerators, gas turbines, industrial furnaces, and industrial silencers;
- Any installed or moving equipment that reaches temperatures above 200 °F / 93 °C is a prime candidate for a high temperature coating;
- High temperature coatings protect equipment in these applications from corrosion and are resistant to fading, peeling, and unseen corrosion.



Manufacturers of consumer products such as wood and gas stoves may use baking enamels cured during production. A fully-cured high temperature coating is more durable and easier to transport and install.



High temperature coatings for barbeques and smokers are rated for exterior exposure (UV resistant, corrosion resistant, rapid heating/cooling stable) and resist breaking down when exposed to animal fats and frequent cleaning.

What should be considered when choosing a high temperature coating?

High temperature coatings are available in standard and custom formulations and are uniquely suited to specific temperature ranges, performance needs, and application methods.

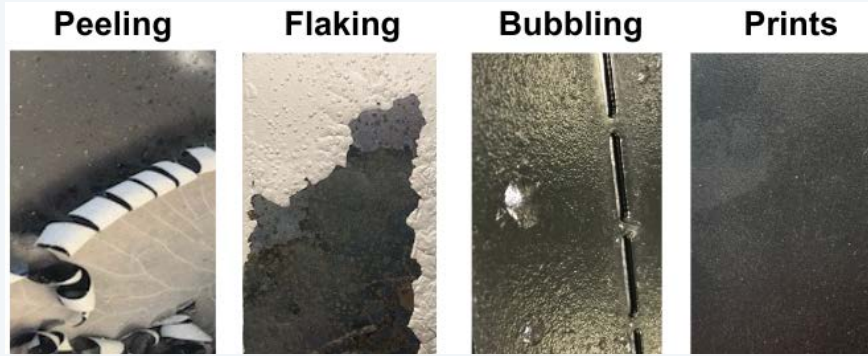
Consult with a high temperature coatings manufacturer like FORREST Technical Coatings to select the correct coating for the application.

Information to aid coating selection:

- **The peak and continuous operating temperature of the equipment:**
Use a laser thermometer to collect several temperature readings during all phases of operation and on different parts of the machine.
- **The substrate to be used:**
Coatings are designed to perform on specific substrates. Be aware that a substrate change may necessitate a high temperature coating adjustment. Substrates with low-organic profiles (such as cold-rolled steel) may have better adhesion than substrates with higher organic content (see example). Your coatings provider will test the coating they recommend for your temperature range and performance needs on the substrate selected for your equipment.
- **Specialized performance characteristics:**
What are the needs for efficient production and end performance of your coating? Some manufacturers require rapid cure or ambient cure properties to aid production, transport, and end-user satisfaction. Other applications may require superior durability, chemical resistance, or other specialized properties.
- **Application method and any environmental or human-safety requirements:**
Your coatings team will help you select a coating that works with local regulations and can be sprayed with your equipment. Coatings must be applied to the recommended wet film thickness (as provided by the manufacturer).
- **Pretreatment and handling:**
Select a pretreatment method that will be chemically compatible with the high temperature coating selected for your application. Errors in handling can lead to adhesion problems.

Technical sales and chemists work with customers to select appropriate coatings and work through testing with the customer. Your coatings team will work with you to collect the necessary information for selecting an appropriate coating. You will also work through a testing product to make sure the coating works for your application.

Common Coating Adhesion Failures to Avoid



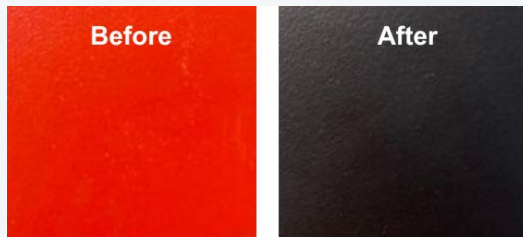
Peeling
Cause:
Use of a
non-high
temperature
primer

Flaking
Cause:
Not minding the
recommended
wet film
thickness

Bubbling
Cause:
Inadequate
surface
preparation

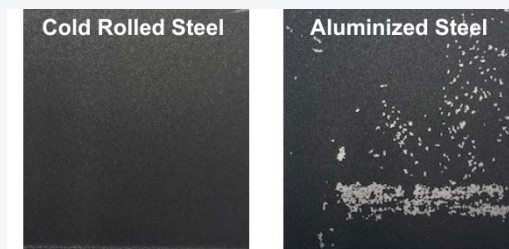
Prints
Cause:
Handling with
dirty hands or
gloves.

Discoloration: When a Non-High Temp Coating is Exposed to Extended High Temperature



This standard shop coat primer with an acrylic topcoat was exposed to 450 °F / 232 °C for 4 hours. The non-high temperature red pigments in the paint broke down due to the heat exposure.

Select a Coating Tested for the Substrate



The same coating was applied to two different substrates and heated to 650 °F / 343 °C for an extended duration. Note the poor adherence on the aluminized steel. Always use a coating that has been tested for the intended substrate.

Consult with a high temperature coatings manufacturer like FORREST Technical Coatings to choose a product and learn to apply it for optimal results.

FORREST Technical Coatings is a global supplier of high temperature coatings known for the brands Stove Bright® High Temperature Paint and INFERNEX® Extreme Temperature Coatings. FORREST is based in Eugene, Oregon and serves manufacturers and consumers worldwide with high quality high temperature paint and powder coatings. Visit www.forrestpaint.com for more information or write to us at info@forrestpaint.com.

World Headquarters
1011 McKinley Street
Eugene, Oregon USA
Phone: 800-537-7201
Email: info@forrestpaint.com

Spokane Service Center
3808 North Sullivan Road
Bldg N-17
Spokane Valley, Washington
Phone: 509-924-3785

Seattle Service Center
1741 South Central Ave
Kent, Washington USA
Phone: 253-854-6372

Portland Service Center
3335 NW St. Helens Rd
Portland, Oregon USA
Phone: 503-228-0207

 **FORREST**
Technical Coatings
forrestpaint.com