



The Eiffel Tower, as photographed from the Champ de Mars in Paris, France on June 1, 2009. Photo by Benh Lieu Song, Wikimedia Commons.

Protecting the Eiffel Tower from the Onset of Corrosion

The World-Renowned Structure Is Painted for the 19th Time

KATHY RIGGS LARSEN, STAFF WRITER

In addition to marking the 120th anniversary of the inauguration of the Eiffel Tower in Paris, France, this is the year that the world-renowned “Iron Lady” is being repainted for the 19th time since its initial construction in 1889. Although more than a century has elapsed since the first coating on the tower, the current painting crew will employ the same methods used over 100 years ago to sand, clean, spot treat for corrosion, and apply a coat of modern day, urethane alkyd-based paint. All the work is done manually by 25 painters who climb on girder beams, at altitudes of up to 300 m, to reach every inch of the tower’s 250,000 m² of surface area with their handheld scrapers and paint brushes—no sandblasting or spray painting allowed.

The Eiffel Tower, owned by the city of Paris and currently operated by the Société d’Exploitation de la Tour Eiffel (SETE), has been painted every seven years since 1899. The 19th repainting campaign started in March 2009 and is expected to take 15 to 18 months to complete, with unfavorable weather conditions such as rain and cold temperatures factored in. The entire tower is being coated with a topcoat in the same color that has been used to repaint the tower since 1968—three variations of the bronze color known as “Eiffel Tower Brown.” The tower is painted not just one

shade; three shades are used. The lightest shade is used at the top of the tower and the shades become progressively darker toward the tower’s base. This is done to ensure that the tower is perceived to be a uniform color as it stands against the Parisian sky. Although the color remains the same, lead-based pigments used in the past were replaced in 2002 with a zinc phosphate agent, which is resistant to factors contributing to corrosion, such as bird droppings and urban air pollution.

According to SETE, an estimated 15 tons of coating is lost between paintings due to erosion, and each new coat of paint



The 19th repainting of the Eiffel Tower is being done manually by 25 painters who climb on girder beams at altitudes of up to 300 m. Photo courtesy of Jotun.



The same methods employed over 100 years ago are used today to sand, clean, spot treat for corrosion, and apply a coat of modern day, urethane alkyd-based paint. Painters wear security harnesses attached to the girder beams as they climb along the structure to coat all metal surfaces. Photo by C. Bamale, courtesy of SETE.

provides an opportunity to inspect the structure and replace corroded metallic parts if needed. At the start of this painting campaign, an initial assessment of the tower's entire surface identified the most corroded zones, which comprised about 5% of the total surface. These areas were treated with two coats of an anti-corrosion primer, and the rest of the structure was industrially steam cleaned before the topcoat was applied.

Starting at the top of the tower and working down to the ground level, a crew from painting contractor Stelma (Athens, Greece) will use 1,000 scrapers, 5,000 sanding disks, 1,500 brushes, and 1,000 pairs of gloves to apply a total of 60 tons (~50,000 L) of Mammut RQ.[†] Supplied by Jotun (Sandefjord, Norway), this coating is a high-performance, high-build, single-pack, urethane alkyd-based system that includes the touch-up primer used on the tower's corroded zones and the topcoat applied to the entire metal structure. This coating system is designed

for the marine and protective market and normally applied with airless spray, explains Geir Slettingdalen, senior chemist with the Jotun coatings laboratory in Sandefjord. "For this reason, we use a clay to give the paint rheological properties. If this system is applied with a brush you will have brush marks, so it was very important that we made a new brush- and roller-quality version," he explains. The new coating system was formulated with a combination of two binders, the original one and a new thixotropic alkyd designed for roller-quality properties. Micaceous iron oxide (MIO) was added to give the paint very good corrosion and weatherability resistance properties.

This corrosion-inhibiting product is a low-gloss formula that is specially formulated for quick application with a brush and designed to protect structural steel and iron work, says Jean-Francois Ferrer, general manager, Jotun France SAS. The brush-applied coating thickness is ~80 μm , he adds.

Although the painting crew is accustomed to working on tall buildings and metal structures, safety is an important aspect of the painting operation. Scaffolding is not used. Painters wear security

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harnesses attached to the girder beams as they climb along the structure to coat all metal surfaces. Security cords allow freedom of movement while keeping the workers secured to the tower. Tools, including paint brushes, are worn on a waist or wrist belt. Buckets of paint are hooked onto the tower's metal braces. Protection netting, coated with a polymer film that renders it drip-free, is installed around the work area to catch falling objects or paint chips. For the current repainting job, 50 km of security cord and 5 acres (20,235 m²) of protection netting will be used.

Corrosion experts conduct regular inspections, especially in areas that are difficult to access, as well as oversee the quality of the paint job. The budget for the 19th repainting, Ferrer says, is ~€4.5 million (~\$6.6 million⁽¹⁾).

A History of Corrosion Protection

This ongoing commitment to protect the tower from corrosion first began with the tower's design, as its creator, Gustave Eiffel, was mindful of the debilitating effects that could be caused by corrosion.

In his book, *La Tour de 300 Mètres (The 300 Meter Tower)*,¹ Eiffel noted that the first consideration for construction was that every single part be accessible so that each time the tower is inspected for rust, it can be treated. He considered the fight against the onset of corrosion to be of the utmost importance, and all sheet iron used for the tower's construction was conserved in enclosed hangars during the fabrication stage and rigorously sanded when needed. All exterior parts were laminated, even those that would no longer be exposed after assembly. That way, the iron was not exposed to rain until after assembly.

"We will most likely never realize the full importance of painting the Tower, that it is the essential element in the conservation of metal works and the more meticulous the paint job, the longer the Tower shall endure," Eiffel said.

[†] Trade name.

⁽¹⁾ Exchange rate: 1 EUR = 1.479 USD on September 22, 2009.



Shown is the newly constructed Eiffel Tower as it appeared during the Paris Universal Exhibition of 1889. Photo available from the U.S. Library of Congress Prints and Photographs Division.

The very first coat of paint, a reddish-brown color named “Venice Red,” was applied in the workshop before the tower was assembled. The second and third coats applied were linseed oil, and a reddish-brown glazed fourth coat was applied in May 1889 around the time the tower was first opened to the public. The fourth coat alone cost 60,000 French gold francs and was guaranteed for one year. Several years later, in 1892, the tower’s previous coating was washed and a new coat of paint was applied. This coat cost 57,000 French gold francs and was guaranteed, with maintenance, for five years.

The decision to paint the Iron Lady every seven years was made when the tower was repainted a different color, ocher yellow, in 1899. The tower’s color changed two more times before 1968, when the present day brown color was selected.

Today, painting still performs an essential role in conserving this historic monument, which initially was built to last 20 years. With every repainting campaign, there is an opportunity to draw from previous experiences to improve painting methods and work conditions and to utilize the latest advances in coatings and related technology. Since 1988,

climbers with video cameras have been monitoring the condition of the coating in areas that are difficult to access. During this repainting campaign, new sanding techniques are being tested, and improved paints with low volatile organic compound (VOC) content are being tried in test zones.

The Eiffel Tower, built for the Universal Exhibition of 1889, is constructed of 7,300 tons of metal—mainly puddle iron, a type of wrought iron used for construction in the nineteenth century that contains a slight increase in carbon content, as compared to wrought iron, which provides it with a higher tensile strength.² The tower, which took just over two years to construct, includes more than 18,000 metal parts and 2.5 million rivets, and was assembled by 132 workers on site. Construction cost was ~7.8 million French gold francs. When built, the Eiffel Tower was the tallest building in the world, standing at 312 m with 1,665 steps. Today, the overall height of the tower, including the antennae, is 324 m.

During painting, the Eiffel Tower remains open to visitors. For more information about the monument, visit www.eiffel-tower.com.

References

- 1 G. Eiffel, *La Tour de 300 Mètres* (Paris, France: Lemerancier Publications, 1900).
- 2 “Puddle Iron,” Wikipedia, The Free Encyclopedia, http://en.wikipedia.org/wiki/Puddle_iron, (September 21, 2009).

Bibliography

“All You Need to Know about the Eiffel Tower.” Société d’Exploitation de la Tour Eiffel. http://www.tour-eiffel.fr/teiffel/uk/documentation/pdf/about_the%20Eiffel_Tower.pdf?id=4_11. September 21, 2009.

“The Eiffel Tower Gets Beautified.” Société d’Exploitation de la Tour Eiffel. http://www.tour-eiffel.fr/teiffel/uk/actualites/page/doc/how_the_eiffel_tower_gets_beautified.pdf. September 21, 2009. **MP**