



CPC ENGINEERING SPECIFICATION	
SECTION SOP	Doc. No. CES-26-150
ISSUE "A"	REV "0"
DATE: 17-06-2023	Page 1 of 4

## METAL BLACKENING PROCEDURE

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0	Initial Issue	17.06.2023	PK	USR	JG	Released



CPC ENGINEERING SPECIFICATION	
SECTION SOP	Doc. No. CES-26-150
ISSUE "A"	REV "0"
DATE: 17-06-2023	Page 2 of 4

## APPLICATION OF METAL BLACKENING

### **1.0 SCOPE**

- 1.0 Metal blackening, also known as chemical blackening or steel blackening, is one of several surface treatments refers to the process of chemically altering the surface of metal objects to create a black oxide layer. As well as improving general durability and corrosion resistance.

### **2.0 ACCEPTANCE CRITERIA**

- 2.1 The plating vendor is responsible for compliance with this technical data sheet. Manager QC is responsible for compliance of this specification through regular audits at the vendor.
- 2.2 Metal blackening produced in accordance with this Specification shall be in the range The thickness of a cold blackening coating on steel for max 15 micron. The thickness of a hot black coating on steel, depending on the temperature of the bath. The weight and thickness of the applied Blackening will vary and will be dependent upon the alloy content of the steel.
- 2.3 Surface Appearance: The Metal Blackening shall be even and continuous over the entire surface of the part.
  - 2.3.1 Unless otherwise specified on the drawing or router, the entire surface of the part shall be Metal Blackening. After process, the part shall be examined by the QAD personnel to verify that all surfaces are coated, including holes and cavities.
  - 2.3.2 Mid acidic Solution is sometimes used to improve the uniformity of the blackening process, especially for smooth surfaces
  - 2.3.3 Any blackening surfaces which have rusty spots following completion of the process shall be reprocessed through the entire blackening system.
  - 2.3.4 Residue forming a roughened or crinkled surface shall be cause for reprocessing.
  - 2.3.5 Smut, blotchiness, or loose blackening on the surface shall be cause for reprocessing.
  - 2.3.6 Parts that have been re-machined, butted, or sanded shall be reprocessed.

CPC ENGINEERING SPECIFICATION	
SECTION SOP	Doc. No. CES-26-150
ISSUE "A"	REV "0"
DATE: 17-06-2023	Page 3 of 4

### 3.0 BLACKENING QUALIFICATIONS

**3.1** Cold and hot blackening processes both create a conversion layer of iron oxide on the surface of the metal, but they differ in their characteristics and qualification methods. Here's a breakdown:

#### 3.2 Blackening Depth (Microns):

The thickness of a cold blackening coating on steel is 0.000030 inches, or about one micron. The thickness of a hot black coating on steel can range from 0.4 to 2.4 microns, depending on the temperature of the bath:

- 3.2.1** Process Variability: Both hot and cold blackening are influenced by multiple factors like solution concentration, immersion time, and surface preparation. These factors can cause variations in blackening depth even within the same process.
- 3.2.2** Focus on Functionality: Black oxide coatings are primarily used for corrosion resistance and aesthetics, not for precise dimensional control. Therefore, depth isn't a major qualification point.

#### 3.3 Blackening Qualifications:

- 3.3.1** Visual Inspection: The primary qualification method for both hot and cold blackening is visual inspection. The finish should be a uniform, deep black color, free of blemishes, spots, or unevenness.
- 3.3.2** Weight Gain: A secondary qualification method is weight gain measurement. The black oxide layer adds a small amount of weight to the metal. Manufacturers may specify an acceptable weight gain range for a given surface area.
- 3.3.3** Corrosion Resistance Tests: Depending on the application, the black oxide layer may need to pass specific corrosion resistance tests like salt spray testing. These tests ensure the black oxide coating provides adequate protection against corrosion.

Table summarizing the key differences:

Feature	Cold Blackening	Hot Blackening
<b>Process Temperature</b>	Room Temperature	140°F - 300°F (60°C - 150°C)
<b>Blackening Depth</b>	Not precisely measured	Not precisely measured
<b>Qualification Methods</b>	Visual Inspection, Weight Gain (optional), Corrosion Resistance Tests (optional)	Visual Inspection, Weight Gain (optional), Corrosion Resistance Tests (optional)
<b>Advantages</b>	Simpler process, No special equipment needed	Faster process, Denser black oxide layer
<b>Disadvantages</b>	Lighter black color, Less control over depth	Requires special heating equipment, can be more hazardous

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<b>SECTION SOP</b>	<b>Doc. No. CES-26-150</b>
<b>ISSUE "A"</b>	<b>REV "0"</b>
<b>DATE: 17-06-2023</b>	<b>Page 4 of 4</b>

## **4.0 BLACKENING PARAMETERS**

### **4.1 Solution Concentration:**

- 4.1.1** Cold blackening solutions are typically sold as concentrates that need to be diluted with water. The dilution ratio significantly impacts the blackening process.
- 4.1.2** Higher concentration (less dilution): Leads to a darker black finish but can be more aggressive and potentially uneven.
- 4.1.3** Lower concentration (more dilution): Produces a lighter black finish but offers better control and is less likely to cause unevenness.

### **4.2 Solution Temperature:**

- 4.2.1** While called "cold" blackening, some solutions may benefit from slightly elevated temperatures (around room temperature, 68°F - 86°F). This can enhance the reaction rate but strictly follow the manufacturer's recommendations to avoid unintended effects.

### **4.3 Immersion Time:**

- 4.3.1** The immersion time in the blackening solution directly affects the depth and darkness of the finish. Longer immersion times result in a deeper black. However, exceeding the recommended time can lead to unevenness or a rougher finish.

### **4.4 Metal Surface Preparation:**

- 4.4.1** The quality of the surface preparation significantly impacts the uniformity and adherence of the black oxide layer.
- 4.4.2** Ensure thorough degreasing and cleaning to remove contaminants.
- 4.4.3** Consider light sanding or grit blasting for a more adherent finish, especially on smooth surfaces.

### **4.5 Additional Considerations:**

- 4.5.1** Metal Composition: While cold blackening works well on carbon steel, the effectiveness can vary with other types of steel or metals. Check the manufacturer's recommendations for compatibility.
- 4.5.2** Agitation: Gentle agitation of the solution during immersion can promote a more even blackening process.