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## **Black Oxide - Exploring the Effect of Base Metal on Coating Appearance**

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Black oxide is a chemical conversion coating. The iron on the surface of the base metal is converted to black iron oxide ( $\text{Fe}_3\text{O}_4$ ) also known as magnetite. The alloy, heat treatment and the condition of the surface will impact the resultant black oxide coating.

### **Alloys**

- The higher alloyed the steel is, the more difficult it can be to blacken
- High Speed Tool Steels often need higher temperature in the blackening bath and/or longer immersion times (sometimes as long as 90 minutes)
- Alloys containing high amounts of silicon (greater than 0.5%) often will produce a mahogany color rather than black
- Stainless steels require a different blackening chemistry, lower bath temperatures and an acid activation step prior to blackening



### **Heat Treatment**

- Scale must be removed in an acid or by mechanical means prior to blackening
- The amount and type of scale can vary based on heat treatment. Optimum pretreatment process is established on a part by part basis
- Parts that have been induction hardened can exhibit different depths of black

on the same part

## Surface Condition

- Oily surfaces can result in a non-uniform black oxide
- Machined areas can give a different depth of black than unworked areas
- Highly polished parts can result in a blue/black appearance while unpolished areas produce a deeper black
- Phosphated parts that were not stripped prior to heat treat can have a red tint to the surface when blackened
- Powdered metal can turn red if copper impregnated
- Powdered metal can bleed out white carbonate if not properly treated after blackening
- Laser cut steel requires a hydrochloric acid pickle to remove the oxide from the cut edges prior to blackening
- Rust should be removed in an acid pickle, alkaline deruster or by mechanical blasting

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**For more information, including a Problem Solving Guide, visit our [Black Oxide Library](#) on our website or use the quick links here.**

- [Black Oxide Control Systems](#)
- [Waste Treatment of Black Oxide Baths](#)
- [Problem Solving Guide for Black Oxide](#)
- [General Conditions For Operating Heatbath Black Oxide Solutions](#)
- [Why Black Oxide?](#)

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## Desludging

It is important to remove carbonates and colloidal iron from the black oxide bath on a regular basis. High colloidal iron can result in a brown rub-off on the surface of the black oxide. High carbonates can make the black oxide bath sluggish. Watch this [video](#) for instructions on how to properly desludge a black oxide bath.



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## PENTRATE ULTRA®

[Pentrate Ultra](#) is Heatbath's premier product used to produce the deepest black oxide on

steel. Offers the fastest, most efficient blackening with improved appearance and excellent abrasion resistance. Incorporated rectifier system controls nonferrous metal contamination. Available in both powder and liquid form. Coatings produced meet the requirements of MIL-DTL-13924, Class 1 and AMS 2485.



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For more information on Black Oxide please [Contact Us](#). Visit our website for a complete list of [Black Oxide](#) products.

For Heatbath Products  
Contact DuBois Chemicals  
at (413) 452-2000

