

Ultra-Blak™ 400

Black Oxide Finish for Steel

Ultra-Blak 400 is an alkaline salt and oxidizing agent mixture containing penetrants, catalysts, activators, rectifiers and wetters which, when dissolved in water and heated, will produce a black oxide (Fe_3O_4 - magnetite) finish on steel. The oxide finish is normally topcoated and sealed with one of **EPI's E-Tec** brand of rust preventive oils, waxes or clear lacquers to enhance the depth of black and impart corrosion resistance to the finish.

The **Ultra-Blak 400** solution is maintained at a temperature of 285°F to blacken a wide range of carbon steels, alloy steels and hardened tool steels. It will not blacken stainless steel, which is blackened with **EPI's Ultra-Blak 407**. It will blacken cast iron. However, **Ultra-Blak 404** is recommended if only cast iron is to be blackened.

ADVANTAGES of and use of **Ultra-Blak 400** and its finishes.

1. **Ultra-Blak 400** is used at a low concentration of only 5 3/4 lbs. per gallon of water which means a lower make up cost and much lower maintenance costs with reduced drag-out.
2. The lower viscosity of the wetted solution further reduces drag-out by 20% to 30%.
3. The thinner and wetter solution wets down passive steel surfaces resulting in a more uniform black finish.
4. The solution is rectified to tolerate contamination with copper, colloidal red iron, oxides, zinc, etc. which reduces maintenance
5. The **Ultra-Blak 400** finish meets military specification **MIL-DTL-13924E Class 1** as well as Aerospace Material Specification **AMS 2485L**.
6. **Ultra-Blak 400** produces an economical black chemical conversion finish with added corrosion protection.
7. **Ultra-Blak 400** produces essentially no dimensional change - only 5 millionths of an inch. Items such as gauges, cams, bolts, precision machined surfaces or other close-tolerance parts, which cannot tolerate a build up of a plated or painted finish, can be finished with **Ultra-Blak 400**.
8. The black oxide finish has good wear resistance and excellent adhesion and will not flake, chip or peel.
9. The black finish reduces light glare on moving tools and machine parts. Thus, safety is improved and eye fatigue is reduced. A black finish also improves the performance of many optical surfaces for the same reason.

10. The porous oxide film has the ability to absorb the final **E-Tec** sealant or rust preventive, hence keeping the sealant in intimate contact with the steel surface longer than if the preventive were applied directly to the bare metal.
11. Has a very low production cost on small parts since the process lends itself to bulk handling.
12. The anti galling surface achieved through blackening allows the outer lubricating layer to be sacrificed during contact and abrasion; therefore, it is excellent for break-in.
13. The pleasing decorative black finish enhances the salability of many steel objects.

BLACKENING PROCEDURES

1. Clean and degrease in a hot 160°F - 180°F solution of an **EPI** alkaline soak cleaner such as **E-Kleen SR 196 low** caustic up to 210°F (float oil), liquid **E-Kleen SR 102** (float oil) or liquid **E-Kleen SR 102-E** (emulsify oil).
2. Rinse in a bottom-fed overflowing cold water rinse tank.
3. Optional acid salt pickle in an **E-Pik 211** solution at room temperature or 50% Hydrochloric Acid.
4. Rinse in a bottom-fed overflowing cold water rinse tank.
5. Blacken parts in a boiling **Ultra-Blak 400** solution at 5 3/4 lbs. of salts per gallon at 285°F - 290°F. Immersion times of 5 to 20 minutes depending upon the mass of the parts, type of steel and condition of the surfaces. Ideally, the temperature of the solutions should not drop below the boiling point for more than a few minutes, even with the heaviest loads. Loads should be approximately one pound of work to one gallon of blackening solution including the weight of the baskets, barrels and racks. One pound per gallon is preferred and loads should not exceed 2 pounds per gallon. A rolling boil must be obtained before work is introduced and then maintained. Operating the solution at temperatures approaching 300°F or higher will cause the build-up of red iron oxide, which can cause a red smut or an off-color on the surfaces of the blackened parts.
6. Rinse in bottom-fed overflowing cold water rinse tank. Transfer time from the **Ultra-Blak 400** solution to the rinse water should be as short as possible to avoid the development of a red tint off-color on the metal surface. Removing heavy parts from the rinse before they have cooled completely may also produce a red tint to the finish. On an automatic machine, if the transfer time cannot be reduced enough, then a fine mild water spray rinse should be applied while the parts are being transferred. If parts flash dry during transfer, the dried salts, which are very corrosive, will cause a splotching discoloration. A spray rinse during transfer will also eliminate flash drying.
7. Seal the finish by immersing the parts while still wet from the preceding rinse in a water displacing solution of **E-Tec 501** for an oily finish, **E-Tec 505** for a soft, dry film or **E-Tec 520** for a hard, clear, dry film.

OPERATING TIPS

The concentration of salts in the solutions is maintained by the boiling point of the solution. The **Ultra-Blak 400** salts are mainly lost from the solution by drag out and must be replenished by additions of replenishment salts. Frequent additions of small amounts of salts will produce more uniform results than large amounts added less frequently. Water will be lost only by evaporation.

If the boiling point drops below 285°F, salts are slowly added until the boiling point reaches 285°F. If the boiling point exceeds 290°F water is added slowly and safely until the boiling point is reduced and the heat is lowered to provide a gently rolling boil.

Salts are added only to raise the level of the tank or raise the boiling point. If the solution level falls below the desired working level, water is slowly added until the solution level reaches the desired point, then the salts are slowly added to produce the desired boiling point.

RECTIFICATION

Occasionally a red oxide can develop on top of the black oxide finish due to an excess of red iron oxide or copper in the bath. If skimming the surface of the bath does not solve the problem, then **Ultra-Blak Rectifier** solution must be added. Excess iron oxide usually occurs when parts are dropped in the bath or finely divided iron is on the surface of the steel parts from polishing and buffing operations. **Ultra-Blak Rectifier** is added at 1/2 to 1 fluid ounce per gallon of **Ultra-Blak 400** solution. Add slowly to avoid spattering and eruptions.

SAFETY PRECAUTIONS

When salts are added to a cold or hot solution they should be added slowly by sprinkling them over the entire surface while stirring the solution. Large shovelfuls or buckets of salts should never be just dumped in mass into the solution as this could cause a violent eruption of the hot solution.

Although the temperature of the solution can be maintained by manually adding water, an automatic indicating temperature controller is recommended for the safe addition of water. The only reason for the boiling point to rise is due to the evaporation of water. The automatic temperature controller will replenish the water as needed on a continuous basis to maintain the correct boiling point and concentration. It will also guard against the undesirable and detrimental overheating of the solution.

Water should only be added automatically to the solution when it is boiling so that the fresh water is rapidly and thoroughly dispersed throughout the solution from the boiling action. If water is added to the solution when it is not boiling, the water will lie on the surface of the solution and can be suddenly drawn in mass below the surface upon the first boiling action and this could cause a violent eruption of the solution. Stirring the solution is satisfactory if water is added manually when the solution is not boiling.

The bath should be periodically desludged to remove accumulation of sodium carbonate, iron oxide and soils at the bottom of the tank. In addition, the surface of the solution should be periodically skimmed with a dust pan-type tool to remove hydrated iron oxide from the surface.

Sludge must not be allowed to build up on the bottom of underfired gas heated tanks because this could lead to a violent eruption of the solution due to a sudden overheating from the insulating effect of the sludge. The sludge could also become overheated and suddenly crack, allowing water to penetrate below the sludge causing the sudden formation of steam and the violent eruption of the solution. When heat is applied to a cold **Ultra-Blak 400** solution, the solution must be stirred until the operating temperature is reached to avoid overheating and the violent eruption of the solution.

The sludge in an **Ultra-Blak 400** solution will consist mainly of Soda Ash (Sodium Carbonate - Na_2CO_3), with inclusions of Iron Oxide (Fe_2O_3) and Sodium Hydroxide (NaOH). The Soda Ash is produced from the reaction of the Sodium Hydroxide and Carbon Dioxide in the water and air. The Soda Ash is not soluble in the solution, thus producing the major part of the sludge. The white, crusty accumulation on the tank walls above the solution level is also predominately Soda Ash. It will not go back into solution and should be scraped off, caught in a pan and disposed of properly.

EQUIPMENT

The **Ultra-Blak 400** tank must be constructed of mild steel. The cleaning and rinse tanks may also be of mild steel. The acidic **E-Pik 211** solution should be contained in plastic or rubber (Koroseal) lined steel tanks.

The **E-Kleen** solution, **E-Pik** solutions and the **Ultra-Blak 400** solutions must be ventilated. Galvanized steel should not be used for the duct work.

Gas heating units are preferred for producing the most rapid heat up and maintenance of the solution temperature--with rapid recovery when a load is introduced into the solution. The gas pipe burner units should be mounted evenly along the bottom of the insulated tank with the flue gases allowed to rise evenly around all four sides of the tank encased in an insulated steel housing with a one-inch air space between the insulation and tank walls. The flue gases exit through one or two openings at the rear of the tank.

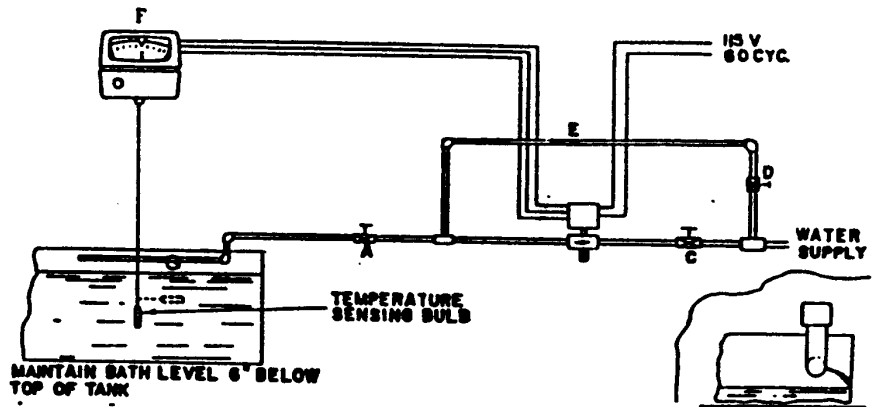
The bottom of underfired gas heated tanks should be 1/4 inch thick for tanks up to 30 x 30 x 40 inches, 3/8 inch thick for up to 48 x 48 x 60-inch tanks. A 1/2-inch tank bottom should be used for larger sizes.

A single 6-inch outlet for hot flue gases is recommended for tanks up to 40 inches wide. With tanks wider than 50-60 inches, two (2) 6-inch outlets at each end should be used. A damper should be provided on the flue pipe outlets.

An automatic butterfly valve should be provided to the gas supply to throttle back gas to burners when tank is idling with no work, but will supply gas when work is introduced and temperature drops. Gas heat should never be turned off completely between loads. Gas fired pipe burner assemblies should be sized to provide a minimum heat up time of two hours from room temperature to 285°F. This will require 1,260 BTU per gallon of **Ultra-Blak 400** solution and will provide for heat losses and provide sufficient recovery when parts are introduced into the solution.

Electric immersion heaters may be used and 0.317 KW will be required per gallon of **Ultra-Blak 400** solution for a two hour heat up time. Care should be taken to avoid scorching the solution with electric heaters by providing enough heaters to evenly heat the solution. A mechanical stirrer should be used during heat up to avoid scorching which will produce a loose red oxide on the parts.

An automatic indicating temperature control should be used to control a 1/4-inch electric motor operated water inlet valve as diagrammed.



- A. 1/2-inch needle valve.
- B. 1/2-inch motor operated water valve.
- C&D. 1/2-inch globe valves.
- E. By pass.
- F. Automatic indicating temperature controller--range 100°F to 350°F stainless steel bulb and capillary.
- G. Capped 1/2-inch water inlet pipe with 1/8 inch or 3/16-inch holes--2 inches apart--drilled longitudinally along the pipe and angled to direct water against the inside of the back wall so that water runs down back wall into solution. Pipe must be at least 4 inches above the solution level.

Water must not be allowed to enter tank unless solution is boiling or is being stirred. At shut down time, the electricity to the motor operated water inlet valve can only be shut off when the valve is in the closed position to avoid the introduction of water when tank is not in operation. Do not turn on power to the water valve until solution is boiling or being stirred. The main supply valve to the system should also be shut off when tank is not in operation.

Bi-metallic corrosion which can cause a red cast on parts must be avoided with **Ultra-Blak 400** solutions by not having common steel alloys in contact with stainless steel. A galvanic cell will be set up between the metals. Therefore, if dip baskets, hooks, or rotating barrels must be constructed of stainless steel because an acid pickle is used, they must be insulated from the mild steel **Ultra-Blak 400** tank with rubber or wood.

MAKE UP OF NEW SOLUTIONS

1. Clean tank of all debris, rust or loose scale to avoid off color reddish parts when parts are first processed.
2. Fill tank half full with cold water. Do not turn on heat.
3. With the exhaust system turned on, add the **Ultra-Blak 400** salts to the cold water while stirring to dissolve the chemicals. Heat will be generated and solution temperature may reach 180°F. Do not add all of the salts at once as this could cause a violent eruption.
4. When all the salts have been added and dissolved, add cold water to bring the solution level to within 2 inches of the final desired level.
5. Turn on the heat and stir as the temperature rises. Do not have the power turned on to the motor operated water inlet valve.
6. When the solution reaches a boil, the motor operated valve may be turned on. If the boiling temperature exceeds 290°F water may be added slowly to lower the temperature. If the boiling temperature is less than 285°, additional **Ultra-Blak 400** salts can be added slowly to raise the boiling point or the solution may be allowed to boil to evaporate water and raise the boiling point. Adding salts, adding water or evaporating water is used to make the final adjustment of the solution to the desired operating level where it is then maintained.
7. The heat may be turned on when the solution reaches a boil. A gently rolling boil is then maintained while blackening parts.

CAUTION

This material contains caustic soda - causes severe burns.

Do not get in eyes, on skin or on clothing. Avoid breathing dusts or solution mists. Do not take internally. When handling powder or working near the **Ultra-Blak 400** solution, a full-face shield or goggles must be worn along with protective rubber gloves, rubber apron and rubber boots.

In case of contact with powdered **Ultra-Blak 400** material or **Ultra-Blak** solution immediately flush skin or eyes with plenty of water for at least fifteen minutes. For contact with eyes, immediately call a physician.

Do not introduce zinc or aluminum objects into the **Ultra-Blak 400** solutions as this will cause a violent reaction and eruption of the solution.

Avoid contact with all acids, aluminum, tin, lead, zinc and their alloys.

Do not mix **Ultra-Blak 400** or its solutions with other chemicals or solutions.

Do not work with **Ultra-Blak 400** without first reading and understanding the **SAFETY DATA SHEET** furnished by **EPI**.

PACKAGING

125 pound and 500-pound non-returnable containers.

IMPORTANT NOTICE! For Industrial Use Only

The following is made in lieu of all warranties, expressed or implied, including the implied warranties of merchantability and fitness for purpose: seller's and manufacturer's only obligation shall be to replace such quantity of the product as proved to be defective. Before using, user shall determine the suitability of the product for its intended use, and user assumes all risk and liability whatsoever in connection therewith. **Neither seller nor manufacturer shall be liable either in tort or in contract for any loss or damage, direct, incidental or consequential, arising out of the use or the inability to use the product.**

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