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TECHNICAL DATA

KOOL-BLAK 225

Mid Temperature Black Oxide Finish for Steel

KOOL-BLAK 225 is a highly concentrated solution of **EPi's** oxidizing salt formulation, patent pending, containing a blend of activators, rectifiers, catalysts, penetrants and wetters. The **KOOL-BLAK 225** finish meets military specification **MIL-DTL-13924D Class 1** as well as Aerospace Material Specification **AMS 2485L**.

The **KOOL-BLAK 225** solution is operated at a temperature of 220-255°F to blacken a wide range of carbon steels, alloy steels and hardened tool steels. It will not blacken stainless steels. Passes the oxalic acid test and produces no smut like other processes. Eliminate boiling caustic fumes, provide safer work environment and save energy costs ($$).

BATH MAKE-UP

A new bath is started by filling the tank with **KOOL-BLAK 225** solution, as received, to within six inches from the top or with **KOOL-BLAK 225 OX** 38% by volume and **KOOL-BLAK 225 Na** 62% by volume. Heat is applied to bring solution to 220-255°F. If **KOOL-BLAK 225** solution is added manually, care should be taken to avoid too rapid an addition which could lead to spattering or an eruption on the surface. Allow the **KOOL-BLAK 225** solution to slowly run down along a corner of the tank. If **KOOL-BLAK 225** is added to the tank with a pump, it should be added above the surface, against the tank wall, through a pipe in a shielded corner. If the working temperature of the solution climbs above 240°F, water must be added to replenish evaporated water and reduce the temperature. Care must be taken when adding water at high temperatures greater than 240°F to avoid spattering and eruptions. If water is added manually, allow the water to run through a pipe down a corner of the tank. The corner should be covered with a mild steel shield extending diagonally across the corner from one side to the other side with the water inlet pipe passing through the shield and ending above the solution level and directed against the corner of the tank. **DO NOT INTRODUCE WATER BELOW THE SURFACE OF THE SOLUTION.**

It is recommended that an automatic indicating temperature controller and motor operated water inlet valve be used to safely control the additions of water. The automatic controller will replenish evaporated water as needed to maintain the correct temperature and concentration. It will also protect against the undesirable and detrimental over-heating of the solution. Automating the water additions will relieve the operator of the responsibility for maintaining the temperature and ensures consistent, uniform, high-quality black finishes. **EPi** can supply the automated temperature controller and water inlet valve with the preferred drilled piping to introduce the water along the rear wall of the tank above the solution level. Consult **EPi** for advice prior to installing a water inlet to a tank.

FINISHING PROCEDURE

Pieces to be blackened may be processed in mild steel baskets, tumbling barrels or hung on racks or hooks, depending upon the shape and weight and production requirements.

1. Thoroughly clean and degrease pieces with **EPi's** Non-Silicated **E-Kleen SR 102** (floats oil) or **102-E** (emulsifies oil) hot 150-180°F alkaline soak cleaners. A typical cleaning time is five to ten minutes. Non-silicated cleaners are a must when using **KOOL-BLAK**; silica is a contaminant.
2. Rinse in bottom-fed, overflowing cold water rinse.
3. Hydrochloric Acid 50% by volume ***(Do NOT use inhibited acid, the parts will turn brown or not blacken)*** or **E-Pik 215**, 2#/gallon for 5-10 minutes.
4. Rinse in bottom-fed, overflowing cold water rinse.
5. Immerse in **KOOL-BLAK 225** solution (at 220-255°F) until a uniform, deep black color is developed. Immersion time will be from 15 to 45 minutes, depending upon the mass of parts and type of steel alloy and condition of the surface.
6. Rinse in bottom-fed, overflowing cold water rinse.
7. Seal the finish by immersing for one minute in **EPi's E-Tec 501** water displacing oil for an oily finish; **E-Tec 510** water soluble oil for a soft, dry film; or **E-LAQ 525** for a hard, dry film.

Kool Blak 225 Refinishing Procedure

If, after processing there is a need to remove the finish and re blacken the parts, the following procedure should be used:

1. Clean/Degrease to fully remove the oil using an **E-Kleen SR** product per technical bulletin for 5-10 minutes.

2. Cold Water Rinse for 30-60 seconds. Inspect for water breaks and if there are water breaks and/or beading go back to step 1.

3. Strip the Black finish in 50% HCl (uninhibited) until the black disappears in 30-120 seconds.

4. Cold Water Rinse for 30-60 seconds.

5. Immerse into the **Kool Blak 225** for 20-30 minutes.

Complete process with rinsing followed by rust preventive.

OPERATING TIPS

Problems will rarely arise with a properly maintained and controlled **KOOL-BLAK 225** solution. Most problems can be traced to insufficient cleaning of the work or an incorrect temperature. Other tips would include:

1. A calibrated digital or Teflon coated thermometer (NO GLASS, accuracy of ± 1%) should be kept on hand to check the accuracy of the automatic temperature controller.

2. Frequent small additions of **KOOL-BLAK 225** will produce more uniform results than large amounts added less frequently.
3. Ideally, the temperature of the solution should not drop below 220-255°F when work is introduced. Sufficient heat should be maintained to ensure that the solution does not drop below 220-255°F for more than a few minutes, even with the heaviest loads. Maximum loads should not exceed one pound of work per one-half gallon of solution. Optimum loads would be approximately one pound of work to one gallon of solution, including the weight of barrels, baskets and racks.
4. Electric immersion heaters should use a stainless electric lighting mixer in the tank to produce faster blackening.
5. Silica at 2000-2200 ppm will slow down the blackening reaction and more silica can completely stop the blackening reaction.
6. 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 **KOOL-BLAK 225** 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 a **KOOL-BLAK 225** 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.)
7. A thorough final rinse after blackening will minimize contamination of the sealant solutions.

Bath, Analysis, Maintenance & Replenishment Options (any of these methods will work)

1. Titrate for **KOOL-BLAK 225 OX** and **KOOL-BLAK 225 Na**
2. Titrate for **KOOL-BLAK 225 Concentrate**
3. Dropping bottle method for **KOOL-BLAK 225 Concentrate**

TITRATION PROCEDURE FOR KOOL-BLAK 225 OX AND KOOL-BLAK 225 NA

1. Procedure for **KOOL-BLAK 225 OX**
    a. Pipette 2ml of bath sample into a 100ml volumetric flask and dilute to the mark with DI water
    b. Pipette 50ml of the solution prepared in step 1 into a 250ml Erlenmeyer Flask and add 50ml of DI water.
    c. Add 10ml of 5N sulfuric acid.

d. Titrate with 0.2N potassium permanganate to a pink endpoint that remains for at least 30 seconds.
e. Calculation: ml of 0.2N potassium permanganate X 2.755 = % **of KOOL-BLAK 225 OX**

2. Procedure for **KOOL-BLAK 225 Na**
   a. Pipette 1ml of bath sample into a 250ml Erlenmeyer flask
   b. Add 10-15ml of DI water
   c. Add 8-10 drops of Phenolphthalein indicator. Solution will turn to a pink color.
   d. Titrate with 1.0N hydrochloric acid to a colorless endpoint.

Calculation: ml of 1.0N hydrochloric acid X 4.755 = % of **KOOL-BLAK 225 Na**

Titration Example for KOOL-BLAK 225 Na and OX – Tank Size 100 gallons

A new bath has 62% by volume **KOOL-BLAK 225 Na** and 38% by volume **KOOL-BLAK 225 OX**. Titration result of **KOOL-BLAK 225 Na** 58% and **KOOL-BLAK 225 OX** 34% by volume.

KOOL-BLAK 225 Na addition = .62 - .58 x tank size (100 gallons) = 4 gallons
KOOL-BLAK 225 OX addition = .38 - .34 x tank size (100 gallons) = 4 gallons

TITRATION PROCEDURE FOR KOOL-BLAK 225 CONCENTRATE

1. Procedure for **KOOL-BLAK 225 Concentrate**
   a. Pipette 1ml of bath sample into a 250ml Erlenmeyer flask
   b. Add 10-15ml of DI water
   c. Add 8-10 drops of Phenolphthalein indicator. Solution will turn to a pink color.
   d. Titrate with 1.0N hydrochloric acid to a colorless endpoint.

Calculation: ml of 1.0N hydrochloric acid X 7.669 = % of **KOOL-BLAK 225 Concentrate**

Titration Example for KOOL-BLAK 225 Concentration – Tank Size 100 gallons

After the titration for **KOOL-BLAK 225 Concentrate** has been performed the results show that the level is 95%. To adjust for the consumed **KOOL-BLAK 225,** 5 gallons of the concentrate should be added to the bath. Note, if tank is full and the add cannot be made, when water evaporates, instead of adding water add **KOOL-BLAK 225**.

DROPPING BOTTLE METHOD

1. Take a sample of **KOOL-BLAK 225** working solution and cool down.
2. Transfer 1.0 ml of **KOOL-BLAK 225** working solution to an Erlenmeyer flask and dilute with 50 ml of DI water.

3. Add 8 to 10 drops Phenolphthalein Indicator to the sample solution in the flask.
4. Using the 4 oz dropping bottle containing 6.0N Hydrochloric Acid, add drops to the sample solution in the Erlenmeyer flask with constant swirling until the solution turns clear.

Concentration of **KOOL-BLAK 225** (% by volume) = (Drops of 6.0N HCL) x 1.58

If you are using **KOOL-BLAK 225** only, you may replenish the solution with more **KOOL-BLAK 225**. When the blackening reaction slows down as you drag out the **KOOL-BLAK 225** chemistry, add back 3-5% by volume of **KOOL-BLAK 225**. For best results, titrate or use dropping bottle method for quick results (less accurate results).

Dropping Bottle Example – Tank Size 100 gallons

You perform dropping bottle test discovering that you are low 7% by volume. Add 7 gallons of **KOOL-BLAK 225**. Note, if tank is full and add cannot be made, when water evaporates, instead of adding water add **KOOL-BLAK 225**.

EQUIPMENT

The **KOOL-BLAK 225** tank must be constructed of mild steel. The cleaning and rinse tanks may also be of mild steel. The acidic hydrochloric acid and the acidic **E-Pik 215** solutions should be contained in plastic or rubber (Koroseal) lined steel tanks. **NOTE:** Lab testing in Pyrex/glass beakers can affect the blackening reactions.

The **E-Kleen** solution, **E-Pik** solutions and the **KOOL-BLAK 225** 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 under fired 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 225°F. This will require 1,260 BTU per gallon of **KOOL-BLAK 225** solution and will provide for heat losses and provide sufficient recovery when parts are introduced into the solution.

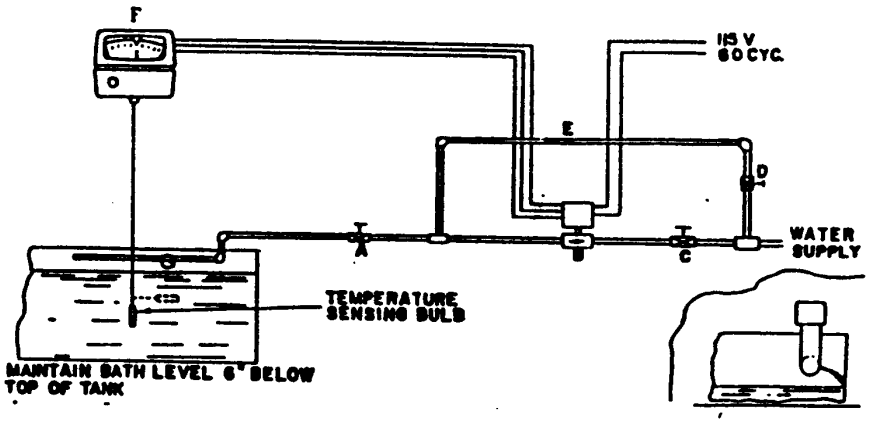
Electric, de-rated immersion heaters may be used, and below is recommended KW/gallon of **KOOL-BLAK 225**. Care should be taken to avoid scorching the solution with electric heaters by providing enough heaters to evenly heat the solution. A mechanical stirrer should be used during heat up to avoid scorching which will produce a loose red oxide on the parts.

Approximate heat up times:

One hour heat up - 0.733 KW/gallon
Two hour heat up - 0.466 KW/gallon
Three hour heat up - 0.378 KW/gallon

- Dimensions of tank will determine final wattage/gallon

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 **KOOL-BLAK 225** 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 **KOOL-BLAK 225** tank with rubber or wood.

Notice: Before using this material, the **MATERIAL SAFETY DATA SHEET** for **KOOL-BLAK 225** or **KOOL-BLAK Na** and **KOOL-BLAK OX** furnished by **EPi** must be read and the specific instructions and precautions followed to assure correct use and personal safety.

CAUTION-THIS MATERIAL CONTAINS CAUSTIC SODA. CAUSES SEVERE BURNS.

Avoid contact with eyes, skin and clothing. Do not take internally. When handling the solution and working near the bath, wear goggles or face shield, rubber gloves and rubber apron. While preparing solutions and making additions, take care to avoid violent spattering.

In case of contact, immediately flush skin or eyes with plenty of water for at least fifteen minutes. For eyes, call a physician.

Avoid contact of **KOOL-BLAK 225** solutions with acidic materials.

DO NOT MIX KOOL-BLAK 225 solutions with any other chemicals or solutions.

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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