

Operating Instructions for Du-Lites' 3-0 Process
Aldak 30, 3-0 Activator and 3-0 Black Oxide Salts for Blackening Stainless Steel,
Cast or Malleable Iron, Nickel Alloys, M1 & N14 Gas Ports, Winchester Post '64 Model 94 Receivers
and MIM (Metal injected molding) parts.
U-LITE'S 3-0 MEETS GOV. SPECIFICATION MIL-C-13924D, CLASS 4

Refer to page 7 for tank material and construction

1. Cleaning Tank: To remove oil, grease or buffing compounds from steel and ferrous alloys we recommend Du-Lite's #45 Cleaner, mixed at 12 oz./gal, heated to 150°-160°F, with a cleaning time of 5-15 minutes.

2. Warm Water Rinse Tank: Water should be heated to 150°F and overflowing slightly to keep rinse tank clean. Rinse parts for 30-45 seconds. Warm water does an excellent job of removing all cleaner residue from your work and preheats parts before next process. If this rinse is too hot, parts being removed will dry and cleaner residue in the rinse water will cause a cloudy stain to appear in the finish of your black oxidized parts. Cold water rinse is not recommended because it can cause white specks to form on your parts which will appear in the final finish.

3a.HCL and Aldak 30 Tank: To activate 400 Series stainless steel and cast iron prior to the 3-0 black oxide process. Hydrochloric acid is mixed at 50% water and 50% acid (20° Be, by volume) at room temperature, immersion time one to two minutes. Cold water rinse. Aldak 30 is mixed at 3½ lbs per gallon, when heated to 220-230°F solution should be boiling, immersion time 10-20 min. Stainless steel parts can sometimes be activated by using only HCL (muriatic acid), for best results we recommend using both HCL and Aldak 30 for activation.

3b.3-0 Activator Tank: To activate 300 Series stainless steel prior to the 3-0 black oxide process. 3-0 Activator is mixed at 3 lbs per gallon, heated to 180-200°F with an immersion time of 2-3 minutes. A slight change in surface color will indicate that activation is complete. Do not leave work immersed for too long in the hot acid activator - this can cause etching and make your parts difficult or impossible to blacken. Upon immersion in the hot acid activator, gas bubbles will begin to form on the surface of the work. This is an indication that the activator is working. If this "gassing" is not apparent immediately, the reaction can sometimes be started or accelerated by touching the rack or basket of work with a plain steel rod.

4.Cold Water Rinse Tank: Work is immersed in a cold water overflowing rinse to remove any remaining activator. Work should be transferred quickly from the activator bath into this rinse to prevent chemicals from drying on the surface of parts. We recommend running your water supply line to the bottom of the tank for better water circulation which flushes out old chemicals and results in a cleaner rinse.

5.3-0 Processing Tank: The 3-0 blackening bath is mixed using 4½ to 5 lbs of 3-0 salts per gallon. This solution is operated at a temperature of 240-245°F (for 300 Series stainless) or between 245-250°F (for 400 series stainless and all other metals). Immersion time is 10-20 minutes. Do not leave work in the 3-0 bath longer than is necessary. As soon as a good black color develops remove parts and go to step 6.

If the solution is boiling at the correct operating temperature, the chemicals required per gallon to produce the best results is correct.

Warning: 3-0 black oxide solution, heated to the correct operating temperature, but not boiling will not blacken your parts (solution must be boiling at the correct operating temperature to blacken your parts).

6.Cold Water Rinse Tank: Work is immersed in a cold water overflowing rinse to remove any remaining processing salts. Work should be transferred quickly from the black oxide bath into this rinse to prevent salts from drying on the surface of parts. We recommend running your water supply line to the bottom of the tank for better water circulation which flushes out old chemicals and results in a cleaner rinse.

7a.Hot Water Rinse Tank: For 300 series stainless, hot water rinse should be heated to 150°F. Rinse parts for 30 seconds to one minute. Dry parts. The process is complete after this step. Kwikseal can be applied for a shiny finish look if desired.

7b.Hot Water Rinse Tank: For 400 series stainless, hot water rinse should be heated to 150°F. Rinse parts for to one minute. Go on to Step 8.

8.Final Protective Coating: Kwikseal, Kwikseal A or Kwikseal D are recommended to seal the black oxide finish and enhance its corrosion resistance. Rinsed parts do not have to be dried off before entering the oil tank, water is displaced and forced to the bottom of the tank where it is easily drained off through a petcock valve.

WARNING - Some firearm receivers and trigger guards are made of aluminum and are black anodized. The 3-0 process contains sodium hydroxide (caustic soda) which will destroy parts made of aluminum and will pollute the black oxide solution. Aluminum parts that have been dissolved in the black oxide solution will coat the inside tank walls with aluminum; making it necessary to sandblast your tank before making up a new solution. You must discard and replace the polluted solution - it cannot be saved.

Tank Construction - 3-0 black oxide tanks can be constructed of stainless steel or plain steel. Soak cleaners and black oxide solutions are formulated from alkaline material (caustic soda) which will not harm equipment made these materials.

Heat Sources - There are three main heat sources for use with black oxide solutions. The heat source recommended by Du-Lite is LP (or Natural) Gas with burners placed beneath the processing tank. Tanks heated with gas burners can be kept clean by using Du-Lite's solution clarifiers. Electric heating elements can be used, but the heat distribution will not be as even and the solution movement will not be as vigorous. The third type is steam heating - plate coils can be used, but this type is not recommended.

Tank Construction (Aldak 30) - Aldak 30 tanks can be constructed of plain steel or stainless steel. If plain steel is used to construct the tank, the corners must be welded together with stainless steel rod. This tank can be heated with gas burners placed underneath the tank, stainless steel electric heating elements or stainless steel steam plate coils.

Tank Construction (3-0 Activator) - 3-0 Activator tanks must be constructed of steel with a sheet lead lining, Carpenter 20 or 316 stainless steel because 3-0 Activator is highly acidic and corrosive. This tank can be heated with quartz immersion heaters or gas burners placed underneath the tank.

Gas Controls - Small installations generally do not require special controls for gas burners. Larger installations incorporate pilot burners with Baso safety valves and automatic throttling gas controls for added safety.

Water Feed Systems - On small installations, water is added to the black oxide tank to replace water driven off as steam. If this is not done, the black oxide solution will overheat. Add small amounts of COLD OR ROOM TEMPERATURE water slowly and carefully while wearing gloves, protective clothing, goggles and face protection. As water is added to the hot bath it will spatter. For larger tanks, Du-Lite recommends an automatic Partlow Controller which will automatically add the proper amount of water required. **NEVER ADD HOT WATER TO A HOT BLACK OXIDE TANK - IT WILL ERUPT VIOLENTLY.**

NEVER ADD WATER TO A COLD BLACK OXIDE TANK BEFORE TURNING ON HEAT SOURCE. THE WATER WILL LAY ON TOP OF THE COLD SOLUTION. WHEN YOU HEAT THE TANK THE COLD WATER WILL MIX WITH THE HOT SOLUTION, CAUSING AN ERUPTION.

Hoist System - In small operations, parts being processed can be moved quickly and easily from one tank to another by hand. In large operations, for workloads which are heavy, Du-Lite recommends an overhead monorail and air operated hoist system for easy transportation from one tank to another.

Exhaust Equipment - Exhaust hoods should be installed over cleaning, activator and blackening tanks to remove fumes from the surface of these solutions. Hoods, piping and blower fans should be made of steel (not aluminum). The solution contains caustic soda which will destroy items not made of steel or plastic.

Water - Water used to make up the blackening solution or cleaners can be regular city water or well water. There is no need to use distilled or spring water. The only water that can pose a problem is water that contains high amounts of copper.

Bluing/Black Oxide - U.S. gun manufacturers all use black oxide to finish the outside of their firearms. A black oxide finish is also referred to as bluing. (Black passivation is black oxidizing of stainless steel.)

MIXING INSTRUCTIONS:

If a new PLAIN STEEL tank is being used, no special preparation is required. If an old tank is being used, it must be cleaned and rinsed well to remove any possible contaminants. When mixing a new solution, the first step is to determine the number of gallons your tank holds; then you can determine the amount of 3-0 Salts required to make the solution. Measure the processing tank, using the inside dimensions. The solution should be down three to six inches from the top of the tank to allow for expansion and boiling action. For square or rectangular tanks use the following formula:

Figure in Inches: Width x (Solution) Depth x Length ÷ 231 = Gallons

Example: For a tank measuring 6" x 9" x 40" with the solution down 3", calculate as follows: 6" x 6" x 40" = 1,440" ÷ 231 = 6.23 gallons

Once the tank capacity in gallons has been calculated, multiply that number by 5. To obtain the proper boiling temperature of a black oxide solution, 5 lbs of 3-0 Salts is required for each gallon. After determining the quantity of 3-0 Salts required, you are ready to mix the new solution.

MIXING SOLUTIONS: IMPORTANT! - When mixing a new solution, never start with HOT WATER (use cold or room temperature water only). When adding 3-0 Salts or any other chemical to water, add small amounts and stir constantly. 3-0 Salts can generate heat as it is being mixed with water. If this solution becomes too hot, it can erupt violently or cause a tank boil over! 3-0 Salts must be added slowly and mixed well to insure that it is completely dissolved into the solution.

To mix the new solution, fill the black oxide tank about one-third full with room temperature water. Slowly

add a small amount of 3-0 Salts to the tank while stirring constantly. The size of your tank will determine the increments of chemicals to be added at one time, i.e. a small gunsmith tank - 6x9x40" - with a capacity of 6 gallons requires 30 lbs of 3-0 Salts. This should be added to the tank in 4 lb increments while mixing constantly. For large industrial tanks, with a capacity of 100 gals or more, requiring 500 lbs or more of salts; add in 10 to 15 lb increments while mixing constantly.

After adding half of the amount of 3-0 Salts required, a sufficient amount of cold or room temperature water should be slowly added and mixed into the solution to bring the level in the tank up to about half the operating level. At this time turn on gas burners or electric heaters. Now you can alternately add water and 3-0 Salts slowly and carefully, mixing constantly until the desired operating level and required quantity of 3-0 Salts has been added. This procedure is not difficult and should be followed to avoid a boil over and to ensure the new solution is mixed properly.

BATH MAINTENANCE:

The 3-0 solution is maintained simply by making periodic additions of fresh salts and water to replace any material lost by "drag out" or consumption.

The bath must be boiling before adding fresh SALTS OR WATER to it. NEVER ADD CHEMICALS OR WATER TO A BLACK OXIDE BATH THAT IS NOT BOILING. The best time to add salts is at the end of the day. If you add chemicals during the day remove your work from the tank first. If you leave work in the tank the chemicals being added can settle on your work creating spots. Solution Life - Small black oxide tanks can only tolerate so many impurities. New solutions should be made up every six to nine months.

3-0 baths loss their effectiveness to blacken stainless steel parts faster then regular black oxide process for steel. Make up smaller baths so that you can discard them more often and easily. An indication of a played out bath is the inability to blacken and more and more smut is developed on parts processed through it.

Black Oxide Temperature - Since water boils at 212°F at sea level and the operating temperature of 3-0 Salts is 240-250°F, black oxide salts must be added to the bath to raise its boiling temperature. To understand how the amount of salts in a solution affects the boiling point, you must understand that adding salts to the solution makes it stronger and denser. Denser liquids have higher boiling points. Adding water to the solution lowers the density and, therefore, lowers the solution boiling point. When the boiling point is correct, the solution concentration is correct.

3-0 Salts has a recommended operating temperature of 240-250°F. The black oxide operating temperature is not controlled solely by the heat source, it is controlled by the combination of the heat source and the concentration of chemicals in the solution. Never try to obtain the proper operating temperature of a black oxide bath by adjusting the tank's heating system up or down. The heat source should be set for the day at a gentle rolling boil - then you can maintain the proper operating temperature with the additions of salts or water.

For example, if your solution is boiling at 235°F, you must add black oxide salts to your tank which will result in a denser solution and raise the boiling point. If your solution is boiling at 260°F, you must add room temperature water to the tank to create a thinner solution which will lower the boiling point.

Boiling Point - The boiling point of a black oxide bath is indicated by a slight eruption in one corner or along the sidewall of the tank. This slight eruption along with the proper operating temperature indicates that blackening is occurring. A black oxide tank can be heated to the proper operating temperature but without this boiling action - blackening will not occur.

STARTING A COLD BLACK OXIDE TANK - Before turning on the heat source, always mix the

solution thoroughly to insure that there aren't any hardened or crusted-over salts in the tank. Check your temperature probes to make sure that crystallized salts have not built up around them. Once the salts have been thoroughly mixed back into solution, turn the heat source on, and mix every ten to 15 minutes while heating to operating temperature. If the bath does not boil at the proper temperature: add water (if solution boils above recommended operating temperature) or salts (if solution boils below recommended operating temperature). Failure to thoroughly mix crusted salts will result in an eruption and boil over!

OPERATING TIPS:

Redness Caused by Silicone - Cast metal parts, such as, rifle and shotgun receivers, slides, frames, triggers and hammers which turn red in one to 14 days after black oxidizing contain too much silicone in the casting metal itself. The silicone content should not exceed 0.5%. Silicone is added to the casting metal at the foundry for easier pouring and to produce parts with greater detail. Parts with this condition are successfully processed by using Du-Lite's 3-0 Process.

After processing cast metal parts and powdered metal parts with the 3-0 process, parts should be treated with Du-Lite's SD Compound or NECCO #2 to eliminate the possibility of salt bleed out. Refer to Du-Lite's SD Compound operating instructions for further details.

Stainless Steel - To tell the difference between 300 and 400 series stainless steel, use a magnet. The majority of all gun parts are made of 400 series stainless; 400 series has a slight magnetic pull, 300 series has no magnetic pull and regular steel has a heavy magnetic pull.

Guns assembled with both series of stainless cannot be blackened successfully. Because the two types of stainless require two different activators, it is impossible to activate one without rendering the other series of stainless inactive, to the point where it will not blacken.

Racking Parts - Never lay parts in the bottom of the black oxide tank. This will cause stains in the finished work. Parts must be suspended in the middle of the solution by small wire baskets, racks or steel mechanics wire threaded through the gun barrels and fastened off in a circle to be used as your handle. This will enable you to transfer the parts from one tank to another without touching the parts with your gloves.

Thermometer - One of the most important pieces of equipment needed to run black oxide properly is an accurate thermometer. You should verify the accuracy of your thermometer every three months. Place the stem of the thermometer in boiling water and note the reading. At sea level the boiling temperature of water is 212°F. To calibrate a Du-Lite thermometer, place a wrench on the nut that is located under the face of the thermometer and turn the thermometer to 212°F. If your thermometer cannot be adjusted in this manner, note the difference in the reading and adjust for the difference when taking the temperature of your bath.

High Altitude Temperature - Du-Lite's operating temperature is based on water boiling at 212°F at sea level. At higher elevations where water can boil at 209°F or lower, you must adjust your temperature accordingly. This 3 degree temperature difference must be taken off the operating temperature, i.e. at sea level 240-250°F at a higher elevation 237-247°F.

Immersion Time - Normal blackening time is 15-30 minutes. Extended immersion time in the blackening bath can develop smut on the outside of your finished parts. Black oxide is a staining process into the metal and not a surface coating buildup.

Competitor's Chemicals - Do not add 3-0 Salts to our competitor's black oxide solution. Use of the last of their chemicals, discard the bath and thoroughly rinse the tank before making up your new solution with 3-0

Salts.

Rust, Scale and Heat Discoloration on Welded Areas - Parts must be cleaned before applying black oxide over these areas. Glass bead blasting is an excellent method to clean these parts. Hydrochloric acid can also be used but for only a short time - 1-2½ minutes because hardened parts cleaned with an acid can become hydrogen embrittled. Parts with hydrogen embrittlement can break easily and lose their heat treating temper.

Stripping Black Oxide - To strip old black oxide finishes from parts, use 50% water and 50% hydrochloric acid (20°Be) at room temperature for ten seconds. If your parts are immersed in the acid mixture too long they will etch and your new black oxide finish will look dull.

OPERATING PROBLEMS:

Barreled Receivers - can pose a problem for black oxidizing. Sometimes manufacturers install stainless steel gun barrels to regular steel receivers. Activate both the barrel and receiver with Aldak 30 for 10-15 minutes and rinse in overflowing cold water, now activate the stainless steel barrel only in 50% water and 50% HCL acid at room temperature for 1-2 minutes. Next, place the whole gun in the acid solution for 10 seconds, remove and quickly rinse both barrel and receiver in overflowing cold water. This procedure is necessary to blend in the finish of the two different metals. Now you are ready to blacken the whole assembly in the 3-0 process. For best results, if possible, remove the barrel from the receiver and activate the different metals with the appropriate activator followed by the 3-0 process.

Regular Steel - Can be blackened in the 3-0 process but must be activated with hydrochloric acid, 50/50 with water at room temperature for one minute. Parts will be dull in appearance because of this acid treatment.

Sludge - A slight build up of iron sludge in the bottom of the tank is normal when the bath has been in operation for a length of time. Remove the sludge at the end of the day - shut off the heat source, after the boiling action stops, the sludge will settle to the bottom. You can now remove it with a hoe or similar implement or scoop. Du-Lite sells solution clarifiers which are designed to capture and contain this sludge for easy removal.

Scum - It is a normal condition to have brown scum form and float on top of your boiling black oxide solution. This material is purged out of the metal being processed. You should scoop this scum from the bath a couple of times a day and discard it. When placing parts in the black oxide bath or removing them, do not let your parts come into contact with the scum at the top of the tank, as it can stain your finished work. Small amounts of scum can be pushed to one side with a piece of steel while wearing gloves.

Brown Foaming - A black oxide tank with a chocolate milk shake appearance on the surface is an indication that your heat source is too high. Foaming can appear all over the top of the tank or crawling up the side walls and overflowing - turn down your heat source to correct this problem.

Smut - This is a black powder material that rubs off your finished work. Smut is a normal occurrence for any black oxide process for stainless steel. Parts activated with hydrochloric acid produce smut. The longer the activation the more smut is produced. As the 3-0 process bath ages, it will develop more and more smut. To eliminate this problem, after blackening and cold water rinse, smut can be wiped off with a rag or tumble parts in corn cob and oil.

When blackening stainless steel, your first try will give you the best color and the least amount of smut on your work. Any second or third tries of blackening these parts will result in poorer and poorer finishes.

Bath Contamination - Racks, baskets, wire, etc. used in handling work during processing should be steel or stainless steel. Never use copper or brass wire. Processing baskets should not be assembled by brazing, because the copper content in the brazed areas will cause contamination of the black oxide solution. Water

supply lines near the top of the black oxide tank should be made of iron - never copper - corroding copper pipe flakes can pollute the bath. Other metals that can contaminate the bath are: aluminum gun receivers, tin, cadmium, zinc or galvanized steels.

Blotchy Finish - A blotchy finish can be caused by poor cleaning, uneven buffing, old black oxide finish remaining, or two or more different metals have been used to make up the part.

Pollution - Du-Lite's processes are highly alkaline and corrosive in nature. If the solution must be disposed of, or rinse water waste treated, request Du-Lite's Neutralization and Disposal Information.

Safety Equipment Required - When operating Du-Lite's black oxide solution the operator must wear a long sleeve cotton shirt, rubber gloves, boots, long pants, apron, goggles or face shield. Black oxide is an industrial process, do not use it around children. After processing work, lock up the work area.

Burns from Solution - Black oxide solutions are highly alkaline and can cause severe burns to unprotected skin. Wash affected areas thoroughly with water and neutralize the alkaline chemicals on your skin with white vinegar.

Tank Construction:

1. Soak Cleaner Tank - Should be constructed of steel or stainless steel.
2. Warm Water Rinse Tank - Should be constructed of steel or stainless steel.
3. Aldak 30 Tank - Should be constructed of steel or stainless steel.
4. Hydrochloric Acid Tank - Should be constructed of plastic (polypropylene).
5. 3-0 Activator Tank - Should be constructed of Carpenter 20, 316 stainless steel or lead lined steel tank.
6. 3-0 Processing Tank - Should be constructed of steel or stainless steel.

IMPORTANT! Material Safety Data Sheets are available for all Du-Lite products. All operating personnel should read and understand these sheets.

THE PRODUCTS MENTIONED IN THESE INSTRUCTIONS ARE FOR INDUSTRIAL USE ONLY

03/25/13

**A QUICK HISTORY OF THE POST '64
WINCHESTER MODEL 94 RECEIVER**

During the early 1960's, the Winchester Model 94 was redesigned to accommodate a more economical method of production. The re-engineered receivers were machined from a graphitic steel casting. This new material would not accept the normal Du-Lite Oxiblak bluing process, used by Winchester since 1940, without discoloration. The color could vary from copper to plum red, depending upon the individual piece. The chart below shows dates and serial numbers for the three different blackening processes used by Winchester on these receivers between 1964 and 1981.

Mfg. Date	Serial Numbers	Blackening Process
1964-1968	2,700,000 - 3,185,691	Du-Lite 3-0 Process
1968-1972	3,185,692 - 3,806,499	Black Chrome Plate
1972-1981	3,806,500 - 5,024,957	Win Blue/Oxiblak

(Win Blued receivers were iron plated and blackened with Du-Lite's Oxiblak.)

When refinishing receivers which have been iron or black chrome plated, the gunsmith, when buffing these receivers, often removes the thin iron or chrome plated coating exposing the raw castings. Normal

blackening processes cannot be used on these receivers.

In 1981, with the purchase of Winchester by USRACO, receivers were switched over to 4144 steel and the angle ejection port design was used. These receivers will polish and reblue normally.

DU-LITE'S PROCESS FOR BLACKENING POST '64 RECEIVERS

Du-Lite has developed a process that will blacken these receivers. Once blackened, these receivers will not turn red or discolor.

THE BLACK OXIDE PROCESS WINCHESTER POST '64 MODEL 94 RECEIVER

1. Du-Lite #45 Cleaner, (12 oz/gal.) 150°-160° temp. for 10 min.
2. Warm water rinse - 150° temp.
3. 50/50 HCL acid (muriatic acid) w/water, room temp. for 2-3 min.
4. Cold water rinse.
5. Aldak #30, (3-4 lbs/gal.), 220°-230° temp. for 20 min.
6. Cold water rinse.
7. Du-Lite 3-0 Bath (4½-5 lbs/gal), 240°-250° temp. for 20-30 min.
8. Cold water rinse.
9. Du-Lite Kwikseal or Kwikseal A, straight, room temp., 1 min.

This chemical process can also be used to blacken M-1 Garand & M-14 gas ports, cast or malleable iron, nickel alloy gun receivers and MIM (Metal Injected Molding) parts.