VERZINKSHOP STAINLESS STEEL BLACK OXIDE MANUAL

Important: Read the manual all the way through before you begin.

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WHAT IS STAINLESS STEEL COLD CHEMICAL BLACKENING

Cold black oxidation of stainless steel is a conversion process at room temperature that forms a dark grey-black iridescent layer on stainless steel, via immersion or manual application (brush/sponge).

The finishing is usually done in 1–5 minutes. The product can also be used for updating existing black stainless steel surfaces.

Stainless steel is naturally passive due to a chromium oxide layer. For a lasting and consistent black conversion layer, this passive surface must first be activated, after which the stainless steel can be blackened immediately.

Galvanizing Shop Black Stainless Steel Oxide is suitable for a variety of stainless steel parts and is ideally suited for architectural surfaces such as furniture and panels and meets the Living Building Challenge Red List.

STAINLESS STEEL TYPES (COMPOSITION & CORROSION PROTECTION)

If the chromium is more than ±10.5%, a very thin, adhesive chromium oxide layer (Cr_2O_3) is formed. Nickel stabilizes the austenitic structure and improves overall corrosion resistance. Molybdenum mainly increases the resistance to pitting/crevice corrosion in chlorides. Nitrogen strengthens and helps against pitting.

- 304 (A2, austenitic) – approx. 18% Cr, 8% Ni. Good general corrosion protection in indoor/light outdoor environments. Passive layer stable. Activation: normal.
- 316 (A4, austenitic) – approx. 16–18% Cr, 10–14% Ni, 2–3% Mo. Better against chloride pitting/crevice corrosion than 304 (swimming pools, coastal). Passive layer very robust. Activation: stronger/longer.
- 430 (ferritic) – approx. 16–18% Cr, ~0% Ni (magnetic). Medium corrosion protection; more sensitive to chlorides than 304/316. Activation: relatively easy.
- 410/420 (martensitic) – approx. 11.5–14% Cr, higher C (magnetic, hardenable). Lowest corrosion protection within the stainless steel family; may show oxide more quickly. Activation: simple; protection is more desirable afterwards.
- Duplex 2205 (duplex) – approx. 21–23% Cr, 4.5–6.5% Ni, ~3% Mo, +N. Very good resistance to chloride pitting and stress corrosion cracking; high strength. Passive layer very robust. Activation: usually more aggressive.

- 17-4PH / AISI 630 (precipitation hardening) – approx. 15–17% Cr, 3–5% Ni, +Cu, Nb/Cb. Good general corrosion protection (usually <316 in chlorides). Activation: medium.

The higher alloyed/more robust the passive layer (316, duplex), the more careful or aggressive the activation must be for consistent black conversion. All stainless steel types can be blackened after correct activation.

EQUIPMENT REQUIRED

- Black-stainless-steel-oxide bath: use tanks/baskets/racks made of PP, PE or PVC or rubber/plastic-lined steel. Do not use stainless steel as tank/basket material for this bath.
- Dipping baskets/racks: PP/PE/PVC or plastic-coated.
- Rotating/perforated drums: PP/PE.

OTHER BATHS AND EQUIPMENT

- Alkaline cleaner: tank made of mild steel or stainless steel; immersion heaters mild steel.
- Derusting agent: tank made of stainless steel or PP/rubber-lined. Immersion heaters quartz or stainless steel.
- Sinks & sealer: mild steel, stainless steel or plastics.

Extraction & heaters: for hot alkaline cleaners and acids; ductwork made of mild steel, stainless steel or plastic.

CLEANING / DEGREASING

Use an alkaline degreaser.

An alkaline degreaser is a water-based, all-round cleaner (high pH) that effectively removes oil, grease, coolants and tensiles, polishing paste and similar contamination. This type of cleaner is recommended as a standard step before metal surface treatments such as black oxidation.

Examples (practically available):St. Marc, Blue Wonder Degreaser, Dasty DegreaserProfessional: Kärcher RM 31, Zep Industrial Purple Degreaser

Use: Light the degreaser as shown on the product label, apply generously, leave on briefly, brush/wipe if necessary, and then rinse thoroughly with clean water.

RUST REMOVAL

Stainless steel, especially from the 400 series, can get rust spots where the passive chromium oxide layer is too damaged (e.g. by chloride contamination, iron introduction or oxide layer). Remove rust and dirt completely to keep the bath clean and get an even result.

Suitable methods:

- Mechanical
  - sanding, Scotch-Brite, fibre disc, glass bead blasting.
  - Do not use carbon steel brushes or tools.

- Chemical
  - Galvanizing Shop Metal Activator (for light rust/fly rust).
  - Hydrochloric acid (HCl): 30% HCl 1:1 or 1:2 with water), immerse several times until rust is removed – Use in a controlled manner to prevent pitting corrosion. Then rinse very well.

After any chemical: rinse thoroughly. If necessary, neutralize briefly in sodium bicarbonate dissolved in water – then rinse well again.

ACTIVATION OF STAINLESS STEEL

Stainless steel is naturally covered with a thin chromium oxide layer that protects the metal. This passive layer blocks the conversion reaction by the Black Stainless Steel Oxide product. This passive layer must first be removed, mechanically or chemically, = activation of stainless steel.

Please note that the passive layer will immediately start reforming as soon as the surface is exposed to air. Therefore, work wet-on-wet: do not let it dry between activating, rinsing and the Black Stainless Steel Oxide bath.

MECHANICAL ACTIVATION

- sanding, Scotch-Brite, fibre disc, blasting (no ferrous product)
- Then degrease, rinse and without drying in the Black Stainless Steel Oxide bath.

CHEMICAL ACTIVATION

- Galvanizing Shop Metal Activator: 5 minutes is often sufficient for light/passive layers (suitable for stainless steel from the 400 series).
- Hydrochloric acid (HCl): 30% HCl 1:1 or 1:2 diluted with water: immerse for about 2 to 5 minutes. Rinse very well immediately.
    - Start with 30–60 seconds (light/passive surface 400 series).
    - Start with 1–2 min (heavy/passive 300 series).

IMMEDIATE FOLLOW-UP STEPS AFTER ACTIVATION

1. Rinse very well (preferably with demi/DI water).
2. Neutralize if necessary (water + sodium bicarbonate) - Rinse well again.
3. Without drying in the Black Stainless Steel Oxide bath.

Signs of insufficient activation: gray/iridescent, blotchy, poor adhesion, layer that wipes off = activate again or activate a little longer/stronger (if your mixing ratio is okay).

Signs of over-etching: dull/rough spots, beginning of pits = shorter or milder activation.

EXTRA ACTIVATION WITH STEEL

With stainless steel, the process can start slowly after correct activation due to the very passive chromium oxide layer (little "free iron"). The reaction starts via galvanic displacement: copper ions reduce on reactive iron and then form the dark layer with selenium.

If you have this problem, you can solve it by putting the stainless steel in direct contact with a piece of ordinary steel at the start. For example, by holding a piece of steel wire in the liquid against the object, a galvanic reaction occurs: the steel dissolves very slightly, allowing copper to precipitate on the stainless steel. Once the first piece of the film is formed, the reaction usually continues over the entire surface, even without further contact.

- When to apply: highly passive/polished stainless steel alloys; if no discoloration occurs within ±10–30 s after activation.
- Execution: use clean, bare steel hooks or wires; ensure metal-to-metal contact in a non-visible area; Break contact as soon as colouring begins.

Note: use only a minimal amount of steel and keep the bath clean.

PASSIVATION OF STAINLESS STEEL

Passivation is the (re)shaping of the chromium oxide layer that gives stainless steel its corrosion resistance. After activation or mechanical cleaning, this layer begins to recover as soon as the metal comes into contact with oxygen. Within a few hours, a functional layer grows back and is usually fully developed within 1 to 2 days. This natural process can, if desired, be accelerated with an acid dip.

CITRIC ACID:

- Composition: 50–100 g citric acid powder per litre of demi/DI water (5–10%).
- Temperature/time: 25–50 °C, 10–30 min.
- Application: Suitable for most stainless steel types (304/316, 430/410, etc.).
- Rinse: Rinse thoroughly with clean water, preferably demi/DI, and dry.

NITRIC ACID:

- Composition: 200–250 ml of concentrated nitric acid (HNO_3) per liter of solution (20–25%).
- Temperature/time: 20–50 °C, 10–30 min.
- Application: Effective and fast; pay attention to good ventilation and strict PPE safety.
- Rinse: Rinse thoroughly with clean water, preferably demi/DI, and dry.

IMPORTANT SAFETY AND PRACTICAL POINT:

- Always add acid to water (never the other way around).
- Use plastic/glass/lined tubs (no stainless steel process trays).
- A short baking soda (sodium bicarbonate) post-neutralization is not mandatory but can help to eliminate acid residue and prevents oxidation - always rinse well afterwards.

PROTECTING THE CONVERSION COATING

Stainless steel is naturally corrosion-resistant due to a passive chromium oxide skin. After activation and black oxidation, this passive skin grows back on its own (usually within a few hours to 1–2 days), which again protects the substrate against corrosion. A sealer is therefore not mandatory but recommended to make the object water-repellent and to prevent stains from, for example, fingerprints.

- Galvanizer shop DeepSeal Metal Sealer for an oily finish that dries dust-dry.
- Galvanizing Acrylic Sealer on acrylic base for a shiny thin hard finish. Suitable for indoors.
- Possibly another sealer of your choice, such as lacquer, wax or oil.

INTERIM RINSING

Thorough rinsing between each step is crucial—especially after activating with hydrochloric acid or an etching agent, and after blackening. Residues of acid or black oxide liquid can cause stains or rust when drying and contaminate sealer and process baths.

It is best to rinse objects in an overflowing tank fed from below. Immersion in containers with clean water is also possible, as long as the water is not too polluted.

- Rinse generously with cold, clean water after cleaning, activating, blackening and before sealing. Preferably flush flowing/overflowing.
- Optional neutralizing step: add a small amount of sodium bicarbonate (baking soda) to the last rinsing water to neutralize any remaining acid; Then rinse again with clean water.
- Do not allow parts to dry after activation. Keep them wet and proceed immediately to the next steps to prevent passivation of the stainless steel surface.

Never rinse objects under the tap and prevent the rinse water from ending up directly in the sewer system.

NEUTRALIZING ACID

Acid from the etching agent or the black oxide liquid can cause corrosion if it is not completely washed away. As an additional step before sealing, you can dissolve 1–2 tablespoons of sodium bicarbonate (baking soda) in 2 litres of water and briefly immerse the workpiece in it to neutralise any remaining acid. Then rinse the object very well with clean water and apply the sealer.

PREPARING THE BLACK OXIDE BATH

Before a production bath is created, well-prepared stainless steel test pieces (cleaned and activated) must first be tested. A different ratio is required for each type of stainless steel and desired finish. Vary dilution and immersion time to determine the desired dark gray-black hue and uniformity.

Starting point mixing ratio:

- Stainless steel 300 series: 1 part concentrate + 1 part water (1:1).
- Stainless steel 400 series: 1 part concentrate + 2 parts water (1:2) or 1 part + 3 parts water (1:3).
- Surfaces that are difficult to blacken: undiluted concentrate.

Dipping time: typically 1–5 minutes.

Important during testing:

- Immediately after activation: rinse and (without drying) immerse in the Black Stainless Steel Oxide bath.
- Does the surface react slowly or unevenly? Additional activation and/or creating galvanic contact with bare steel during blackening (e.g. steel hooks/racks or some bare steel wires in the plastic immersion basket).
- Maintain a constant solution temperature (approx. 18–24 °C) for reproducible results.
- Apply light agitation/movement to break up air bubbles and obtain an even layer.

Creation & maintenance:

- Dilute the concentrate with water according to the desired mixing ratio.
- For process stability, regularly add small amounts of concentrate to keep the strength of the bath above 85%; Use the required immersion time as a practical indication of the strength of the bath. If it increases, then when dosing.
- Circulation/filtration (±50 µm polypropylene filter) keeps the liquid clean and extends the life of the bath.

CHEMICAL BLACKENING - DIPPING

Clean and activate stainless steel first. After activation, do not let the stainless steel dry: go wet-on-wet to the black oxide bath.

Depending on shape, weight and production requirements, parts are placed in plastic immersion baskets or hung on plastic-coated racks or hooks. For large numbers of small parts, rotating, perforated plastic drums (1–2 revolutions per minute) are recommended. When using baskets or racks, the parts should be moved when inserting into each solution and rinse to remove air bubbles and achieve even contact with the solution throughout.

If you work with an immersion basket, shake or move the parts several times during immersion to prevent "nesting" of air bubbles and ensure an even finish.

1. Cleaning – Use an alkaline cleaner or, for example, alcohol or acetone for light soiling. Do not use oil-based degreaser.
2. Rinse – Min. 30 s in clean (preferably running/overflowing) water.
3. Activate:
    a. 300 series: in a 50% hydrochloric acid solution
    1 part 30% hydrochloric acid + 1 part water - approx. 2–5 minutes at room temp.
    b. 400-series: Galvanizing shop Metal Activator according to manual
    1 part 30% hydrochloric acid + 1 part water - approx. 1-3 minutes at room temp.
    c. Alternative/additional: mechanical (sanding/Scotch-Brite/blasting).
4. Rinsing – Rinse very well to remove the etching agent.
5. Blacks – Immerse in the Black Stainless Steel Oxide liquid according to the tested mixing ratio. Time approx. 2–5 min.
6. Rinse – Rinse very well – possibly a short baking soda dip to neutralize acid residues; Then rinse well again.
7. Sealing (optional) – Apply an optional sealer for extra protection and darker appearance.
8. Drying – Shaking off excess sealer; not with compressed air; If necessary, be careful with a heat gun.

CHEMICAL BLACKENING - APPLY BY HAND

For local work, repairs or large flat stainless steel surfaces with pad/brush.
Apply after cleansing and activation; work wet-on-wet.

1. Clean – Degrease thoroughly with an alkaline cleaner, alcohol or acetone. *No* oil-based degreaser.
2. Rinse – At least 30 seconds with clean water.
3. Activate:
    a. 300 series: in a 50% hydrochloric acid solution
    1 part 30% hydrochloric acid + 1 part water - approx. 2–5 minutes at room temp.
    b. 400-series: Galvanizing shop Metal Activator according to manual
    1 part 30% hydrochloric acid + 1 part water - approx. 1-3 minutes at room temp.
    c. Alternative/additional: mechanical (sanding/Scotch-Brite/blasting).
4. Rinse – Rinse very well.
5. Prepare Swab-on solution – Use undiluted. If a slower reaction is desired: 1 part black stainless steel oxide + 2–4 parts water (1:2–1:4).
6. Apply – Apply generously with cotton swab, sponge or brush and rub in for 1–3 minutes. Always add fresh solution as soon as the reaction slows down.
7. Rinsing – Rinse thoroughly to remove residue of the blackening agent. If necessary, treat with sodium bicarbonate (baking soda) dissolved in water to neutralize the remaining acid – then rinse well.
8. Drying – Remove the loose, non-stick black oxide haze with a soft cloth. Dry with cloth or carefully with a heat gun. *Do not* use compressed air – this can cause stains.
9. Repeat (if darker desired) – Repeat steps 6–8 until the desired dark gray-black shade is achieved.
10. Sealing – For extra protection and color deepening.

APPLICATION ON RUSTY STEEL

Although this product has been developed for stainless steel, it can also be used to color rusty steel (beams, plates, ornaments) dark gray-black as a patina/finish. This is a swab-on, non-rinse application: you don't rinse between steps. The black layer on ordinary steel is cosmetic; A sealer is necessary for corrosion protection.

Necessary

- Black Stainless Steel Oxide Undiluted
- Fibre sanding pad such as Scotch-Brite
- Brush/sponge or cloth to apply
- Clean, slightly damp cloths/paper to wipe and dry cloths to rub
- PPE and good ventilation

Step-by-step plan

1. Prepare – Remove loose rust and dirt (wire brush/scraper).
2. Degrease.
3. Application – Apply product generously undiluted (brush/sponge/cloth).
4. Soak in & scrub – While the surface is wet with liquid: scrub with a fiber sanding pad to loosen rust and promote reaction.
5. Wipe – Wipe the surface with a slightly damp cloth to remove loosened rust/exhausted reaction products.
6. Apply – Apply again undiluted; Leave on briefly until it is evenly dark.
7. Wipe & dry – Wipe again damp and then wipe dry with a clean cloth.
8. Apply Sealer – Finish with two layers of sealer.
    a. Galvanizing shop DeepSeal for an oil-based sealer.
    b. Suitable lacquer for the desired application (indoors or outdoors) until the desired gloss is achieved. Allow layers to dry in between according to the paint instructions.
    c. Other finish of preference such as a wax, powder coating, wd-40

Tips

Work in small sections for an even result.

Repeat steps 5–6 locally if the color is still too light.

Irregular spots usually indicate insufficient wiping/cleaning or not properly degreased.

TECHNICAL CHARACTERISTICS

Product	Galvanizing shop Black Stainless Steel Oxide
Works on	Stainless steel - not for ordinary steel/iron.
Application	Immerse or by hand (swab-on).
Dilute – dip	• 300 series: 1:1 (1 part concentrate + 1 part water). • 400 Series: 1:2–1:3. Difficult surfaces: undiluted.
Dilute – swab-on	Undiluted; for slower response 1:2–1:4.
Dip/contact time	Immersion: 1–5 min typical. Swab-on: 1–3 min per cycle light rub; Repeat for darker.
Surface (coverage)	depending on stainless steel type, preparation and method (4 to 8 m2 per liter of concentrate)
Activate	• 300 series: in a 50% hydrochloric acid solution 1 part 30% hydrochloric acid + 1 part water - approx. 2–5 minutes. • 400-series: Galvanizing Shop Metal Activator according to manual 1 part 30% hydrochloric acid + 1 part water - approx. 1-3 minutes. • Alternative/additional: mechanical (sanding/Scotch-Brite/blasting).
Galvanic start	During blackening, brief direct contact with bare steel.
Sealer	Optional; deepens color and improves abrasion resistance.
Temperature	Room temperature (approx. 18–24 °C).
Agitation	Mechanical or light movement.
Filtration	Recommended: ±50 µm polypropylene filter; keeps bath clean and extends life. In small baths, it is possible to let by-products settle and then pour over the clean liquid.
Tanks/baskets/racks	No stainless steel tanks/racks; use PP/PE/PVC or rubber/plastic-lined; Plastic-coated hooks.
Dry	No compressed air; If necessary, be careful with a heat gun.

Shelf life	Solution: several months in closed packaging. Process bath at dosing/maintenance at start-up. Refill or refresh in case of delayed reaction.

PROBLEMS AND SOLUTIONS

It is very important that acids from any etching bath, or from the black oxide agent itself, are properly rinsed away. If acids remain, the metal will react to this during sealing or later and brown rust will occur.

Baking soda can be added to the final rinsing water, after the black oxide process and before the sealer, to neutralize residual acids. Then rinse the object well.

It is also important to make sure that, during sealing, the chosen sealer expels all the water and no moisture remains on the black oxide coating. Immerse the object in the sealer several times to expel the water.

Problem	Cause	Solution
No or slow response; Remains gray	Activation insufficient or uneven. Re-passivation by drying between steps. Concentration too low. Process temperature too low.	Reactivate and instantly blacken out. Increase the mixing ratio or test undiluted.18–24 °C.
Spotty / non-uniform finish	Residual dirt/oil or fingerprints. Water breaks during rinsing. Uneven activation. Air bubbles / "nesting".	Remove layer and degrease thoroughly. Water breakage test; better rinse. Equalize activation. Light agitation; repositioning parts.
Bluish or iridescent glow	Passive zones not etched away. Activation too short or too mild.	Intensify or prolong activation. Then blacks again.
Coating rubs off / powdery	Solution too weak or immersion time too long. Activation insufficient. Bath polluted.	Increase concentration; time. Reactivate and blacks. Filter bath (~50 µm) or refresh.
Dark stripes / contact marks	Air bubbles on the surface. Poor suspension/pressure points. Local galvanic spots in the event of metal-to-metal contact.	Breaking air bubbles; light movement. Change or isolate suspension points. Limit contact with steel once reaction is underway.
Local response does not start	Stainless steel too inert at start; no initial galvanic stimulus.	Create brief contact with bare steel at the start (steel hook/rack or steel wire); then minimize contact.

Problem	Cause	Solution
Rust spots after drying	Residues of acid or blackening agent remained. Hard rinse water. Sealer does not expel water.	Additional coils; short baking soda dip and rinse. Final rinse with demi/DI water. Choose a sealer that displaces water well.
White spots / limescale traces	Minerals from hard water.	(Final) rinse with demi/distilled water. Drain and dry well.
Pits after activation	Hydrochloric acid applied too strongly or too long. Chloride contamination.	Strictly limit activation (±30–60 s). Rinse very well or use alternative activator.
Rapid discoloration / fingerprints	Residual water, oil or blackening agent on surface. Soiled gloves.	Better rinsing and cleaning. Rub off residues before sealing. Use clean (nitrile) gloves.
Reaction stops early	Bath exhausted or dirty. Ion strength too low.	Replenish or (partially) refresh the bath. Filtering/circulating. Monitor immersion time; Dose as soon as it increases.
Color too light after ±5 min	Concentration too low for this stainless steel. Activation insufficient.	Increase the mixing ratio (e.g. 1:3 → 1:2 → 1:1 → undiluted) and test again. Check/extend activation.
Shade on welded or heated areas	Heat discoloration/oxide scale not removed.	Remove heat tint completely (mechanical or staining). Re-cleanse, activate and blacken.
Excessive wear of the layer	Too strong or too long treatment. Pre-treatment insufficient.	Correcting concentration/time. Improve cleansing/activation; blacks again.
Sealer: residual oil / shine spots	Too much sealer. Do not drain/shake off properly.	Apply thinner. Shake off excess sealer; Remove excess with cloth.

WARNING!

The Black Oxide solutions are slightly acidic. Avoid contact with eyes, skin and clothing. Wear eye protection (goggles, goggles, or face shield), protective rubber gloves, and aprons when preparing solutions and while working with the solutions. Do not mix the Black Oxide concentrate or solutions with cyanide or alkaline

materials, or other chemicals. The Black Oxide solutions are toxic when used internally.

Do not work with the Black Oxide solutions or other Galvanizing Shop products without first reading and understanding the SAFETY INFORMATION.

The safety data sheet can be found on the product page or can be requested from Verzinkshop.nl by e-mail: info@verzinkshop.nl

Do you have any questions? Contact us via:

Mail: info@verzinkshop.nl

Whatsapp or call: +31 6 28090022

WWW.VERZINKSHOP.NL

SAFETY

ALWAYS wear a dust mask, respirator, gloves, and apron when necessary.

ALWAYS treat any chemical as if it could kill you.

ALWAYS label buckets and storage containers with a permanent marker so that you and others know what's inside.

NEVER pour water into acid; it can heat up and explode. ALWAYS pour acid into water.

NEVER leave electroplating pools or other systems that use power unattended. These products may cause a short circuit and cause a fire.

NEVER come into direct contact with chemicals. They can cause serious burns or other damage and are very dangerous substances if not treated with respect.

NEVER THINK you can get away without taking safety precautions! That is not possible!

NEVER leave the lids off the tanks when not in use. They WILL fall over!

Always work safely and ensure good protection and ventilation.

The safety data sheet can be found on the product page or can be requested from Verzinkshop.nl by e-mail: info@verzinkshop.nl

DISCLAIMER

Did you find an error or something unclear in the manual? Please let us know via info@verzinkshop.nl

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