



**SAUROC**

**TripleHard<sup>®</sup>**

**NEXT-GENERATION TRIVALENT  
HARD CHROME TECHNOLOGY**



# NEXT-GEN HYDRAULIC PERFORMANCE

For over a decade, Savroc has developed advanced trivalent chromium coatings to meet the growing demand for safer and more sustainable surface technologies. TripleHard® is the latest result of this development — a high-performance trivalent hard chrome coating for hydraulic cylinder rods in demanding industrial environments.

Combining hardness, wear resistance and corrosion protection with a smooth, uniform surface, TripleHard® delivers the proven durability of hard chrome without the environmental and safety concerns of hexavalent chromium.

## Built for the toughest environments

Hydraulic systems operate in extreme conditions — heat, moisture, pressure fluctuations and continuous mechanical stress. TripleHard® has been developed to protect cylinder rods in exactly these environments. The coating forms a dense, metallic surface layer that resists wear, corrosion and microcracking even under repeated load cycles and abrasive exposure.

The coating's structure and hardness remain stable across wide temperature variations, ensuring consistent operation from forestry and mining machines to marine and industrial hydraulics. The result is reliable protection and reduced maintenance downtime, even in long-term outdoor or high-humidity service.

## Sustainable surface technology

Savroc's long-term goal is to make this trivalent technology the industrial standard for hydraulic rod coatings — matching or surpassing hard-chrome performance while advancing a more sustainable future for heavy equipment manufacturing.

TripleHard® is entirely free from hexavalent chromium and fully compliant with REACH and current environmental directives. Beyond compliance, it enables substitution of a known carcinogenic process with a safer, proven alternative — exactly what regulators expect when viable options exist.

Conventional hard chrome imposes heavy EHS burdens: toxic-mist control, exposure monitoring, hazardous-waste handling and permitting. TripleHard's trivalent nickel-chrome system reduces worker exposure, simplifies ventilation and waste management, and de-risks audits — without compromising on-rod performance.

## Consistent quality, proven results

Savroc's production follows standardized quality procedures designed for industrial scalability. Every coating batch is inspected for hardness, thickness uniformity, adhesion and corrosion resistance according to ISO 9227, ISO 4287 and ASTM G65 test methods.

These systematic controls ensure repeatable performance from pilot-scale to full production lines. The coating has been validated in continuous hydraulic operation, confirming stable friction behavior, long seal life and excellent resistance to surface pitting and rust formation. Partners can rely on consistent surface quality and predictable performance through the entire lifecycle of the component.

## Engineered precision in every layer

TripleHard® combines the well-known hardness and mirror-like finish of traditional hard chrome with the uniformity and control of a modern trivalent chromium process. The coating is applied using optimized plating parameters that balance current density, temperature and bath chemistry to achieve a dense, fine-grained microstructure.

Each layer is deposited and finished under tightly monitored conditions to ensure excellent adhesion to the base steel, low surface roughness and a defect-free coating. The process allows precise control of coating thickness and guarantees that every rod can be polished and fitted with seals exactly like conventional hard chrome components.

# TRIPLEHARD



## Trivalent Hard Chrome Coating for Hydraulic Cylinder Rods

TripleHard® coating is designed for use on standard carbon steel grades commonly used in hydraulic cylinder rods, including 20MnV6 and Ck45. These materials provide an ideal combination of strength, toughness and machinability, while the trivalent nickel-chrome coating ensures excellent surface properties and long-term corrosion resistance.

The coating process is compatible with standard manufacturing and finishing operations, including grinding, polishing and seal fitting, without modification to existing production equipment.

## Component dimensions

TripleHard® coated rods are available within the following dimensional range:

Diameter range	10 - 150 mm
Maximum length	2.5 m
Maximum component weight	1000 kg

Range will soon be extended to larger dimensions.

## Corrosion testing (NSS - ISO 9227)

TripleHard® coatings have been tested in Neutral Salt Spray (NSS) conditions at 35 °C according to ISO 9227 and evaluated per ISO 10289. All samples maintained full protection (rating 10) throughout the test durations listed below.

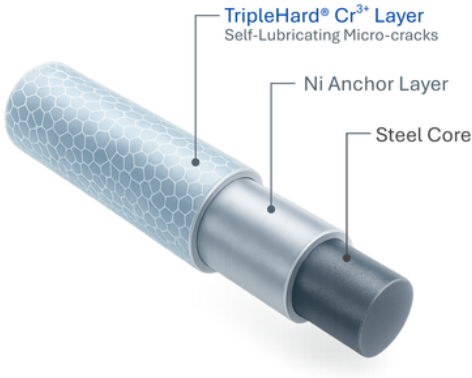
Test duration	Environment	Result	Evaluation
200 h	NSS (ISO 9227)	No base metal corrosion	Rating 10
500 h	NSS (ISO 9227)	No base metal corrosion	Rating 10
1000 h	NSS (ISO 9227)	No base metal corrosion	Rating 10

## Performance summary

Test condition	Coating thickness	Surface hardness (HV <sub>0.05</sub> )	Surface roughness (Ra)
200 h NSS - TripleHard®	30 µm	900 - 1300 HV	< 0.2 µm
500 h NSS - TripleHard®	40 µm	900 - 1300 HV	< 0.2 µm
1000 h NSS - TripleHard®	50 µm	900 - 1300 HV	< 0.2 µm

## Coating composition

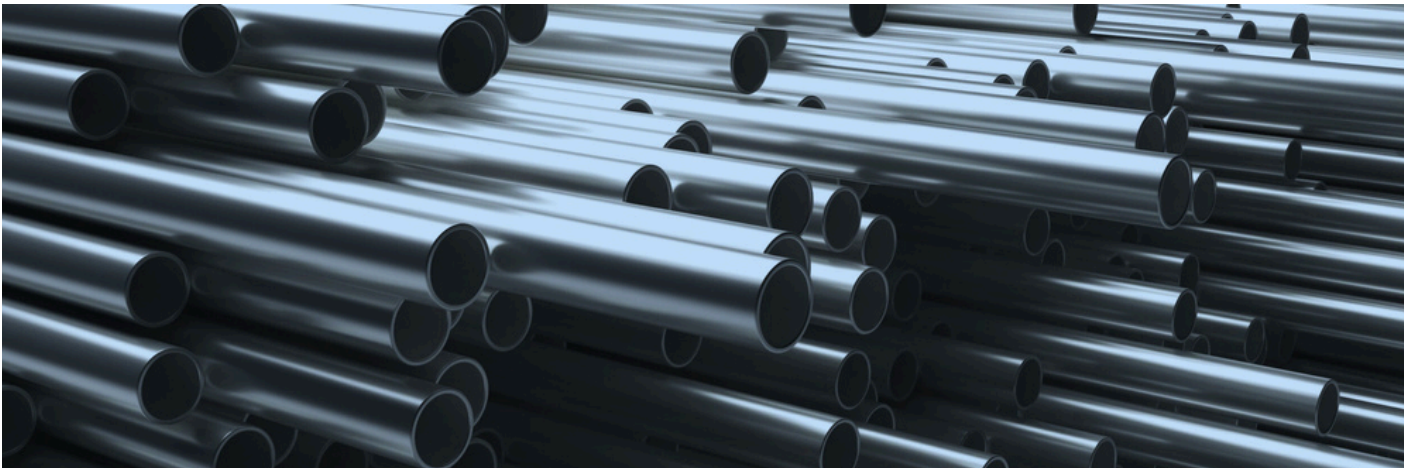
TripleHard® surface consists of a dual-layer system combining nickel and trivalent chromium. The nickel underlayer enhances corrosion protection and adhesion, while trivalent chromium top layer provides surface hardness, wear resistance and the bright metallic appearance expected from high-quality hydraulic rods.



## Weldability

TripleHard® coated components are compatible with friction welding and MIG/MAG welding.

Both 20MnV6 and Ck45 base materials weld cleanly, and the nickel-chrome coating causes no issues with adhesion or joint strength. Tests confirm stable, defect-free welds without coating detachment or heat-related damage.





# DURABILITY IN MINING ENVIRONMENTS

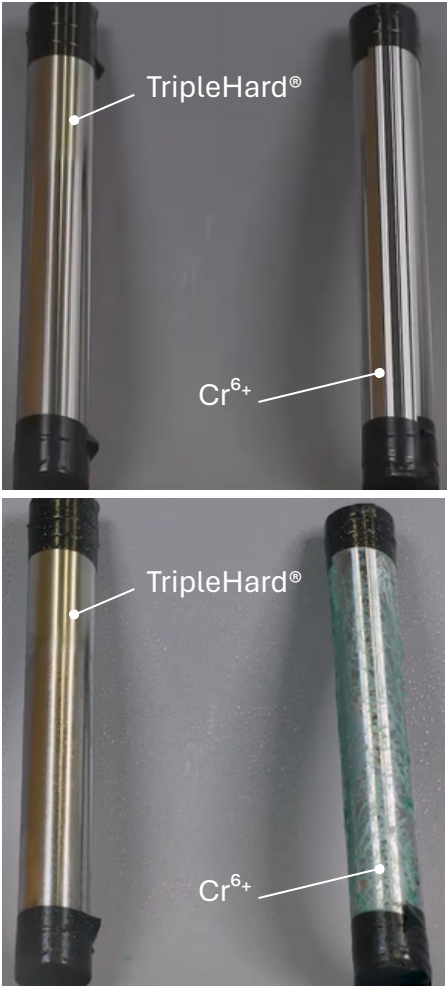
Hydraulic components in mining applications face some of the harshest operating conditions imaginable — extreme pressure, abrasive dust, high humidity, and exposure to acidic process water. To validate the real-world performance of TripleHard®, the coating has been extensively in both laboratory and field conditions, including direct exposure to actual mine water with pH below 1.

## Mine Water Corrosion test

In a 72-hour droplet corrosion test performed by Hydroline, TripleHard® and conventional hexavalent hard chrome coatings were subjected side-by-side to genuine mine water containing sodium chloride, magnesium chloride and sulfuric acid.

Parameter	TripleHard® (Ni-Fe-C Alloy + Cr <sup>3+</sup> )	Conventional Hard Chrome (Cr <sup>6+</sup> )
Test duration	72 h (continuous droplet exposure)	72 h (continuous droplet exposure)
Water composition	pH < 1, NaCl, MgCl <sub>2</sub> , H <sub>2</sub> SO <sub>4</sub>	pH < 1, NaCl, MgCl <sub>2</sub> , H <sub>2</sub> SO <sub>4</sub>
Visible corrosion	None observed	Extensive corrosion and pitting
Surface condition after test	Intact, no discoloration or degradation	Severely degraded, surface flaking
Functional status	Fully operational	Unusable

After the test, Cr<sup>6+</sup> coated rod was completely degraded and unusable, while the TripleHard® sample showed no visible corrosion or surface damage. This exceptional acid resistance is achieved through the alloyed nickel-iron-carbon matrix of the coating, which provides strong protection against low-pH corrosion — far beyond what traditional hard chrome can withstand.



## Australian case study

Field comparisons further confirm these results: according to Australian case study, TripleHard® delivered ~94% lower CO<sub>2</sub> emissions, a 17× longer operational lifetime, and ~20,000 € in cost savings per cylinder per year compared to conventional Cr<sup>6+</sup> coatings.

Together, these results demonstrate that TripleHard® not only outperforms traditional hard chrome in durability but also sets a new benchmark for sustainable surface technology in heavy mining environments.

[Read more](#)

## Repairability

TripleHard® coated rods can be fully re-polished, stripped and re-coated without affecting base material dimensions or mechanical properties. Even after exposure to highly acidic mine environments, the coating adheres firmly and can be renewed to its original specification.

This capability enables complete component refurbishment — reducing downtime, waste and total cost of ownership, while extending the functional life of hydraulic systems.



# PROVEN PERFORMANCE. READY TO DEPLOY.

TripleHard® is a trivalent Ni+Cr coating that pairs hard-chrome-class performance with modern EHS compliance. Built for hydraulic cylinder rods in demanding conditions.

## Spec highlights

- **Base materials:** Carbon steel grades
- **Dimensions:** Ø 10–150 mm, length 2.5 m, max 1000 kg
- **Coating:** Nickel underlayer + Cr(III) top layer
- **Hardness:** 900–1300 HV
- **Surface roughness:** < 0.2 µm
- **Corrosion (NSS):** 200 h / 500 h / 1000 h → Rating 10
- **Repairability:** strip + re-coat; full refurbishment

## Test methods & compliance

**ISO 9227** (NSS)

**ISO 10289** (evaluation)

**ISO 4287** (Ra)

Cr(VI)-free & **REACH-compliant**

Supports EU substitution expectations

**Improves EHS:** Lower exposure, simpler ventilation & waste handling, reduced audit risk

**Request trial rods · Book a corrosion/wear evaluation · Get detailed test reports**

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