

# NiL35® HYDRAULIC CYLINDER COATING



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**Cat® roof supports have to operate in very severe underground applications where high resistance to wear and corrosion is of key importance. Due to the superior corrosion resistance against seawater, strong acids and even caustic chloride solutions, Caterpillar uses the NiL35® coating for the surface treatment of hydraulic cylinders in underground mining operations.**

## **Wear Protection and Corrosion Resistance**

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NiL35® – developed from MTV Metallveredlung — is a combination of the two coatings Bronze and MProtect with high wear protection and superior corrosion resistance. The electrolytically deposition of the NiL35® layers results in a metallic, atomic connection with excellent adhesion to the base material, performing just like a composite material. Even coatings of large components and parts with complex geometry as well as internal coatings are possible in a cost efficient way. Hence, the NiL35® system offers a technically as well as financially excellent alternative to cost intensive processes such as spray coatings or claddings, which so far have been used under difficult environmental conditions and in aggressive atmosphere.

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# NiL35<sup>®</sup> Hydraulic Cylinder Coating

## Properties

NiL35<sup>®</sup> layers are corrosion resistant against sea water, strong acids and caustic chloride solutions and therefore very suitable for e.g. armatures and hydraulic cylinders in offshore and underground mining applications.

Thus NiL35<sup>®</sup> is the first electroplated coating, which passed the tightened sea water resistance test according to ASTM G48-C in a hydrochloric acid + ferric chloride solution at 40°C over 72 hours without any pitting corrosion.

- ▶ Adhesion Strength:  $\geq 100$  N/mm<sup>2</sup> (on Fe)
- ▶ Hardness:  $\sim 800$  HV0.1
- ▶ Coefficient of Friction:  $\sim 0.18$  (lubricated on Bz)
- ▶ Kesternich Test:  $\geq 7$  cycles (RP 10)\*
- ▶ AASS Resistance:  $\geq 2.000$  hours (RP 10)\*

NiL35<sup>®</sup> is plated with approximately 60  $\mu\text{m}$ . Here the Bronze barrier layer should have about 40  $\mu\text{m}$  and the MProtect top coat approximately 20  $\mu\text{m}$ . If repair work is required, it will be realized by a thicker Bronze layer.

## Corrosion Resistance

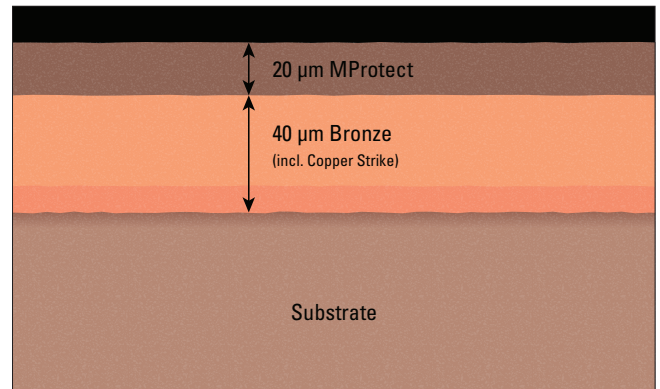
The NiL35<sup>®</sup> system provides highest tarnish and superior corrosion resistance against sea water as well as caustic iron-III-chloride solutions. Also strong acids as sulfuric acid, hydrochloric acid, nitric acid and phosphoric do not show any attack on NiL35<sup>®</sup> layers.

On steel panels deposited NiL35<sup>®</sup> layers in electrochemical tests in iron-III-chloride solutions show a free corrosion potential of 600 mVH. Potential dynamic polarization attempts in the same electrolyte with 40°C NiL35<sup>®</sup> layers form passive areas up to 400 mVH. The redox potential of the iron-III-chloride solution lies at 945 mVH.

- ▶ **Acetic Acid Salt Spray Testing**  
(according to DIN ISO 9227 AASS) 60  $\mu\text{m}$ :  
 $\geq 2,000$  hours (discontinued without corrosion)\*
- ▶ **Neutral Salt Spray Test**  
(according to DIN EN ISO 9227 NSS) 60  $\mu\text{m}$ :  
After 0.14% Elongation (10 x 380 bar):  $\geq 1,000$  hours  
(discontinued without corrosion)\*
- ▶ **Kesternich Test** (according to DIN 50018 KFW 2.0 S) 60  $\mu\text{m}$ :  
After the above Test with the same parts:  $\geq 7$  cycles  
(discontinued without corrosion)\*
- ▶ **Sea Water Resistance** (according to ASTM G48-C in hydrochloric acid + ferric chloride) 60  $\mu\text{m}$ :  
After the above Test with the same parts:  $\geq 72$  hours at 40°C (without any pitting corrosion)



Cat<sup>®</sup> roof support with NiL35 coated hydraulic cylinders



Cross section of a 60  $\mu\text{m}$  NiL35 coating

\* Rating of the test pieces (according to DIN EN ISO 10289):  
Degree of protection RP 10 (no failure visible)

## Wear Resistance

The NiL35<sup>®</sup> coating passed numerous investigations and tests performed by leading hydraulics manufacturers and users, including tests with up to 250,000 strokes as well as with additional fill and up to 8.827 tons of cross load. During these tests, no noise developments or stick-slip-effects with standard gaskets and piston rings occurred.

- ▶ Taber-Abrasion Test (CS10-Roller, 10 N Load, 10,000 Cycles):  
 $\leq 12$  mg Abrasion / 1,000 Cycles

## Temperature Resistance

NiL35<sup>®</sup> layers display no cracks even after 15 cycles of an alternating temperature test (-40 to 80°C). In this test, a tube plated with MProtect was alternately kept at -40°C for 23 hours and 80°C preheated climate chamber for 1 hours.

For more complete information on Cat products, dealer services, and industry solutions, visit us on the web at [mining.cat.com](http://mining.cat.com) and [www.cat.com](http://www.cat.com)