



Lunac 2+ duplex

The ultimate wear- and corrosion resistant piston rod and axle coating due to the unique combination of characteristics



WMV b.v.
The Netherlands
www.wmv.nl



Lunac 2+ duplex encompasses all essential characteristics to armour (offshore) hydraulic pistons and axles

The new semi-ceramic Lunac 2+ duplex coating (H_v 1200/2100) is partially a galvanic and partially a ceramic coating system that includes an intermediate layer of very dense modified nickel. The 70-100 µm hard Lunac 2+ top layer has been applied to various machine parts and tools for a longer period already because of its tough nature, friction reducing property, ultimate hardness, effective anti-galling property, smooth (seal friendly) surface and weld joint quality bond with steel or copper alloy substrates.

Lunac 2+ duplex successfully combines nearly incompatible characteristics

After a long period of additional research a delicately modified nickel sub layer added an unprecedented synergistic corrosion protection effect to the Lunac 2+ plating system in 2010. This breakthrough generated a coating that was principally able to combine the usually highly conflicting properties of ultimate hardness and good corrosion protection. Moreover, a striking sub-surface corrosion inhibition effect has been determined and the ability

to deal with even substantial plastic deformations. An affordable coating that as able to offer this combination of all mentioned characteristics was hardly available up to that moment.



Frequently applied full ceramic piston rod coatings to dredging equipment is often not sufficiently impact resistant. Apart from the outstanding corrosion protection, Lunac 2+ duplex proved to resist most stone chips even without any cracking

This new coating concept acquired the ultimate EPQ corrosion test approval in 2011, incorporated in the NBD 10300 (RWS) qualification. Since its introduction, the Lunac 2+ duplex coating is particularly applied to infrastructure systems, been operational under high loads and in various tough offshore applications. Almost none of the Lunac coated parts have been returned for repair and no Lunac 2+ duplex coated part has been claimed to show corrosion yet.

Ultimate hardness, supreme corrosion resistance and 100% coating bond were hard to unify for a long time

The Lunac 2+ duplex innovation:

Generally, hard galvanic coatings are rather affordable. The scratch and wear resistance is reasonable to good, but can hardly be compared with ceramic coatings. Although some hard galvanic coatings can offer sufficient corrosion protection as well, vulnerability, delamination and limited chloride/salt water resistance or pore problems are often recorded. Most HVOF ceramic coatings are notable for their effective anti-galling properties and high hardness as well as good corrosion resistance in the case of multilayer systems. However, these ceramic coatings frequently show serious bond and vulnerability problems, as well as causing increased seal-wear. Some hard coating systems based on welding or hard metal processes meet most requisites, but are generally regarded to be very expensive. For these reasons there continued to be a high demand for affordable hydraulic piston rod and axle coatings without major drawbacks. Lunac 2+ duplex is able to combine all these essential axle and piston rod armour properties in an as yet unprecedented manner. Moreover, Lunac 2+ duplex coatings can easily be repaired in the case of accidents.



Lunac 2+ duplex applied to bridge and lock door hinges offers wear and friction reduction as well as long lasting prevention of (galvanic) corrosion

All major Lunac 2+ duplex characteristics :

- 1. Superb (salt) water corrosion resistance if the substrate is free of defects; NBD10300 (Rijkswaterstaat 2010) EPQ corrosion testing, based on ASTM G59-97 (2003) / G61-86 (2003) and ISO 17475 standards. ASTM B117 salt spray testing > 3300 hours rating 10 and distinct sub-surface corrosion inhibition**

Lunac 2+ duplex plated piston rods or axles never returned because of spontaneous coating defects or corrosion spots

2. Lunac 2+ is highly resistant to adhesive and abrasive wear (Hv 1200/2100) and equals most full ceramic materials. Because Lunac 2+ is tough and harder than quartz sand, natural sand can hardly scratch Lunac 2+

3. Full bond with steel or copper alloy substrates (similar to a weld joint). Surfaces might partly be deformed (dented) and the Lunac 2+ coating could develop micro cracks beginning at 0.28% elongation, but Lunac coatings will never peel off

4. Lunac 2+ can deal with very high mechanical loads (shocks up to 600 MPa)

5. Generally, in most sliding systems that incorporate Lunac 2+, friction is reduced and galling or fretting are highly inhibited

6. The smooth pore-free Lunac 2+ surface does not cause the frequently observed increased 'seal on full ceramic' wear

7. The heat conductance of Lunac 2+ duplex is comparable

to steel, which means that Lunac 2+ (duplex) will discharge heat much better than full ceramic coatings.

8. The Lunac 2+ surface will tarnish in response to water contact and develop a thin (0.2 µm) brown/grey film. This layer will not disturb the functionality

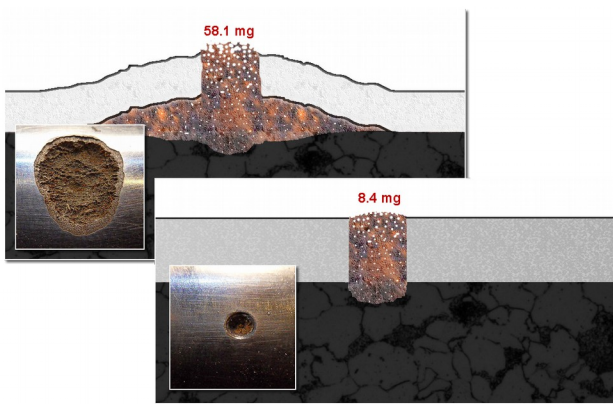
9. Locally damaged Lunac 2+ (duplex) coatings can be easily repaired (on location as well)



Lunac 2+ duplex applied to hydraulic piston rods, dealing with very hard (mechanical and corrosive) conditions after several years. All preceding coatings failed within 2 years at this spot. These piston rods clearly present the Lunac 2+ dark grey appearance that typically comes along with the Lunac 2+ surface under these harsh conditions.

Lunac 2+ duplex plated pistons and axles can deal with moderate stone chips and very high mechanical loads

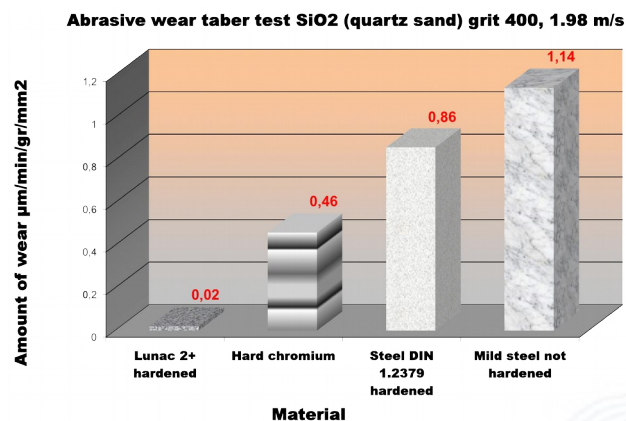
Subsurface corrosion highly limits the service time, particularly for piston rods due to the formation of sharp (lifted) edges. The unparalleled subsurface corrosion inhibition effect of Lunac 2+ duplex explains why this coating can even deal with some damage.



Corrosion behaviour after 8 days acidified salt water test in two 3.0 mm pre drilled holes. The first graphic pair shows the reaction of a duplex hard chromium coating and the second graphic pair the reaction of a Lunac 2+ duplex coating. The Lunac 2+ duplex coating reduces the total amount of corrosion (red numbers) and highly inhibits subsurface corrosion.

wear resistance as well as anti-galling and anti-fretting properties. The narrow tolerances combined with considerable dimensions, pollution, corrosive environment and vibrations require a coating that can deal with all these conditions simultaneously.

Typically, Lunac 2+ is explicitly resistant to the abrasive action of quartz sand. This characteristic explains the exceptional scratch and abrasive wear resistance in a sandy environment.



Lunac 2+ applied to hydro-electric power plant shafts offers corrosion protection and

Conditions for applying Lunac 2+ duplex successfully :

1 Almost any kind of steel softer than HRC 50 can be plated, but steel should be free of micro-defects. Certified steel with a high Charpy impact value is favourable

(examples: QT quality steel in the case of 42CrMo4 or J2 quality or higher in the case of S355)

2 The initial surface roughness must be less than $R_a = 0.10 \mu\text{m}$ / $R_z = 1.0 \mu\text{m}$ before the coating can be applied. Do not apply worn out abrasive belts or rolling to obtain this low initial surface roughness.

3 The Lunac 2+ duplex coating thickness is 0.12 mm (up to 0.15 mm, if necessary). Consequently, the product diameter must be reduced by 0.24 mm +/- 0.01 mm below the nominal final diameter, but by 0.21 +/- 0.01 mm if the surface roughness still needs to be reduced from $R_a = 0.9 \mu\text{m}$ (usually acquired by turning) to $R_a = 0.10 \mu\text{m}$

Common and hard fibre resins as well as most bronze versions guiding materials, can be applied. Harder (Shore-A 95 (PU)) seals are slightly preferred.

Plating capacity:

- Length: 3930 mm
- Ø: 780 mm
- weight: 3000 Kg

To complete the total product support, WMV also offers a comprehensive technical support (e.g. material research or bearing choice) thanks to the mechanical engineering specialisation and the material research department.

State of delivery and application details :

Copper alloys (and stainless steel to a lesser extent) in intensive contact with (salt) water and Lunac 2+ could slowly dissolve the Lunac 2+ coating locally.

After hardening at 310 °C the Lunac 2+ surface will be finish-ground with diamond to a surface roughness of round about $R_a = 0.15 \mu\text{m}$



Specialist in high performance alloy and ceramic precision plating

WMV b.v. Heliumstraat 1 7463 PL Rijssen
Netherlands Tel. +31 548 520681 www.wmv.nl