

Laser cladding als alternatief voor verchromen van hydraulische zuigerstangen

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Roy Orbon

Large Projects – Boxtel



- Tot juni 2022: Bosch Rexroth
- Sinds juni 2022: Van Halteren Technologies
- Voortzetting van alle Large Projects activiteiten, incl. Engineering, Productie en Services.
- Hydraulische cilinders, meetsystemen, leidingwerk, power packs, installatie & ingebruikname, project management, service.
- Hydraulische cilinders en EHA/EMA.

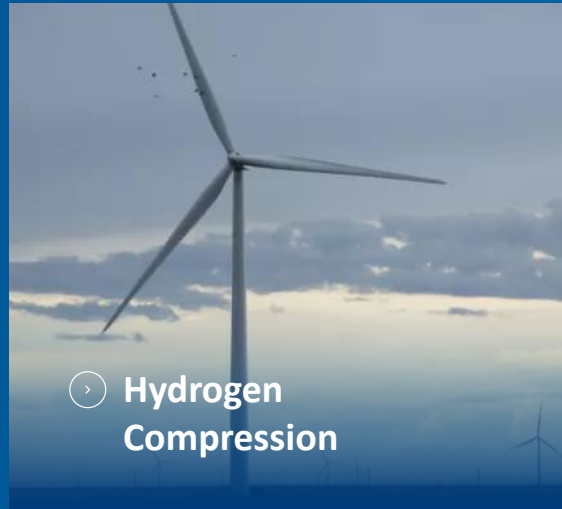
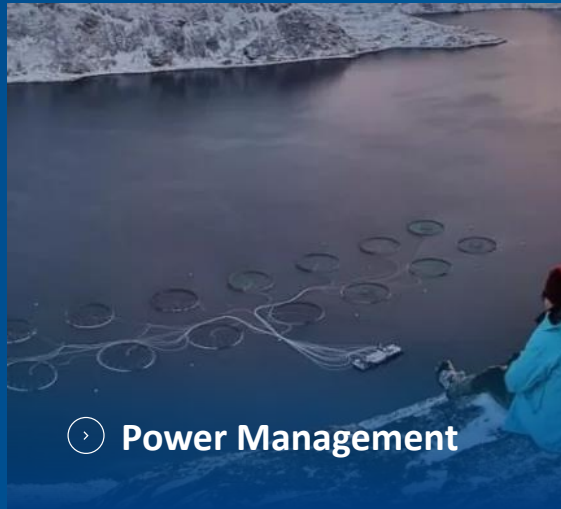
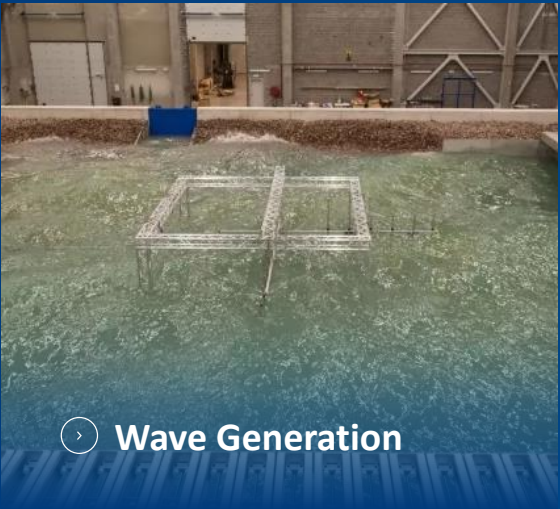


LHC Productie Boxtel

Large Hydraulic Cylinders

- Boring: 200 – 1.500mm
- Slag: 27m
- ETO
- Seriegrootte: ~2st.
- Service
- Build-to-Print
- Jobbing

Markets



Rod Surface Technology



Application

- Civil vs Offshore vs Industry
- Environment
- Corrosion | Chemicals
- Wear | Impact
- Frequency

Tribology

- Surface structure
- Hydraulic fluid
- Seal technology

Coating technology

- Production technology
- Coating material

VHT bekijkt alle aspecten hiervan bij de vrijgave van een nieuwe coating

Eigenschap	Hard-Chroom	HVOF	Laser Cladding
Prijs	++++	+	+
Corrosie	+	+++	++++
Mechanisch	+	++	++
Tribologie	++	+++	++
Hechting	++	+	++++
Milieu	----	--	-

Hard-Chroom – Proces

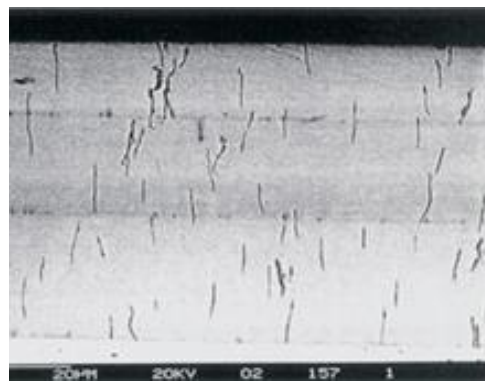
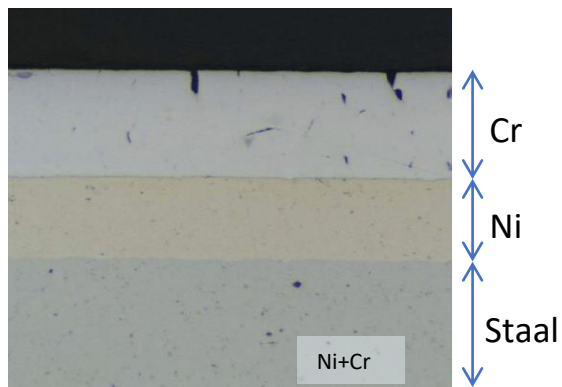
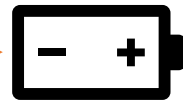
Elektrolyse proces:

- Cr-metaal depositie



Cr⁶⁺

- Wordt gebruikt in het proces
 - Zit niet in het eindproduct
 - Lozingsnormen aangescherpt
 - EU: REACH (Sept. 2017)
- EXIT Cr!
- Alternatief??

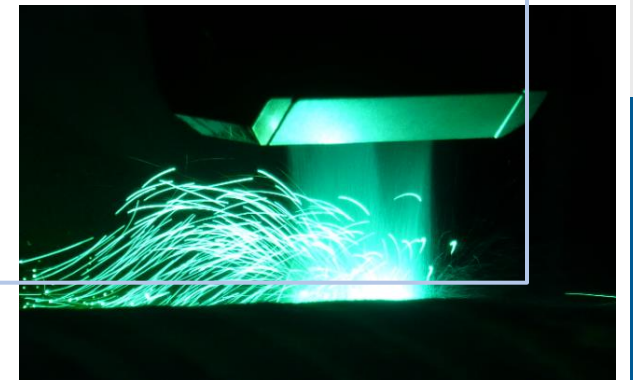


Uitgangspunten

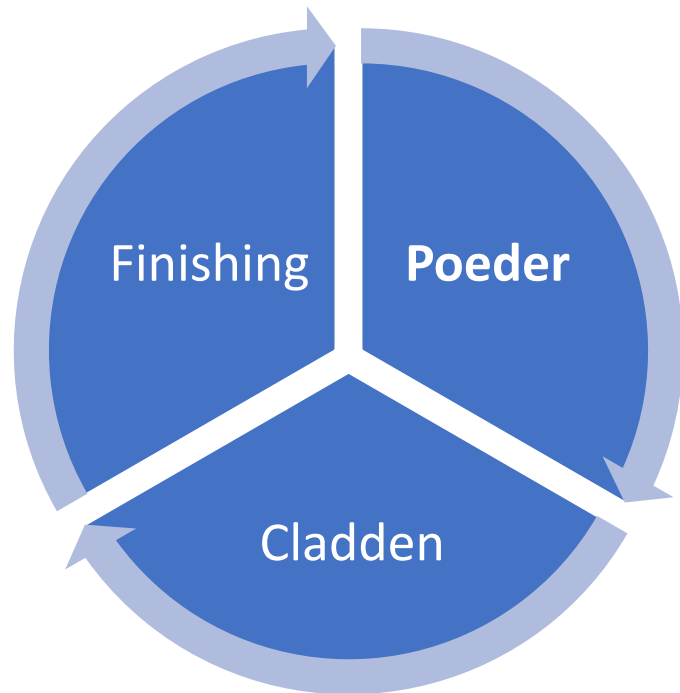
- Concurrerend t.o.v. (Ni+)Cr:
 - Corrosie / Slijtage
- Toekomstbestendig
- Alle gangbare substraten
- Duidelijke verbetering van milieu-impact
- Aanbrengen met laser cladding

Equipment

- 20kW diode laser
- Rechthoekige spot
- D: 60 – 900mm
- L: 300 – 30.000mm

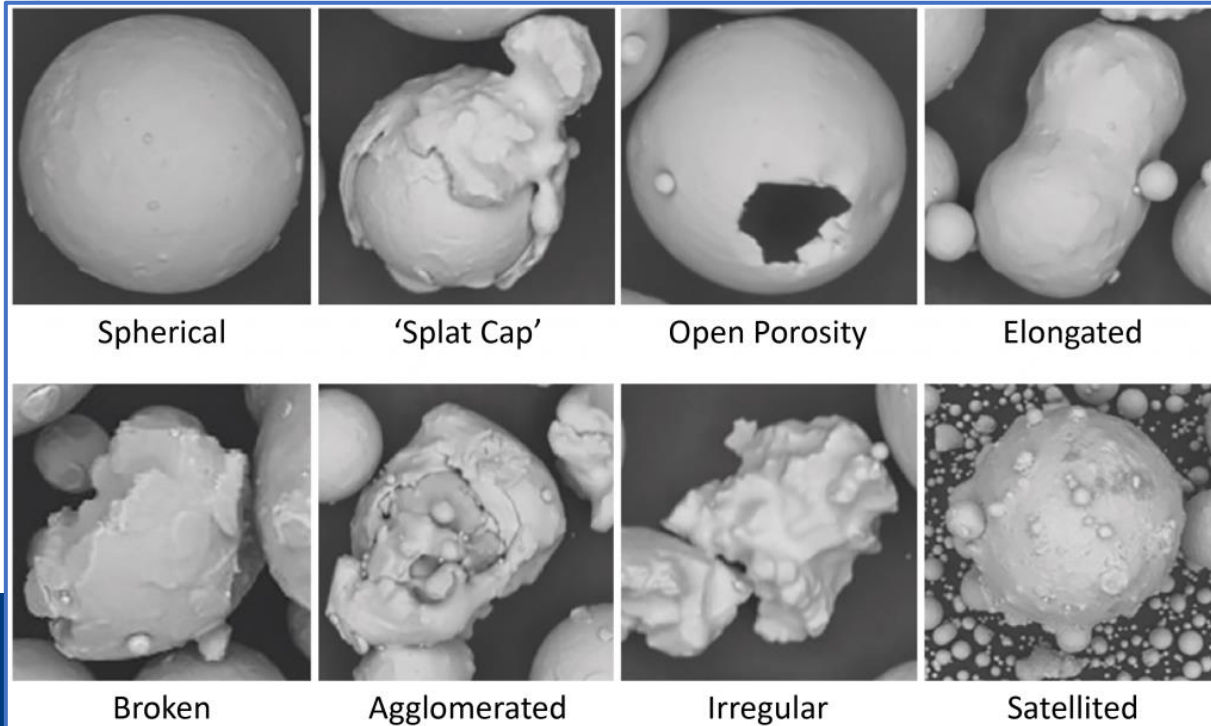


Laser Cladden



Poeder

- Prijs:
 - EUR/kg: Fe < Ni < Co
 - Laagdikte < : Prijs <
 - Ondergrens: nabewerkingen en productierisico's
- Relatie met cladden en finishen
 - Voorverwarmen?
 - Buffer-laag?

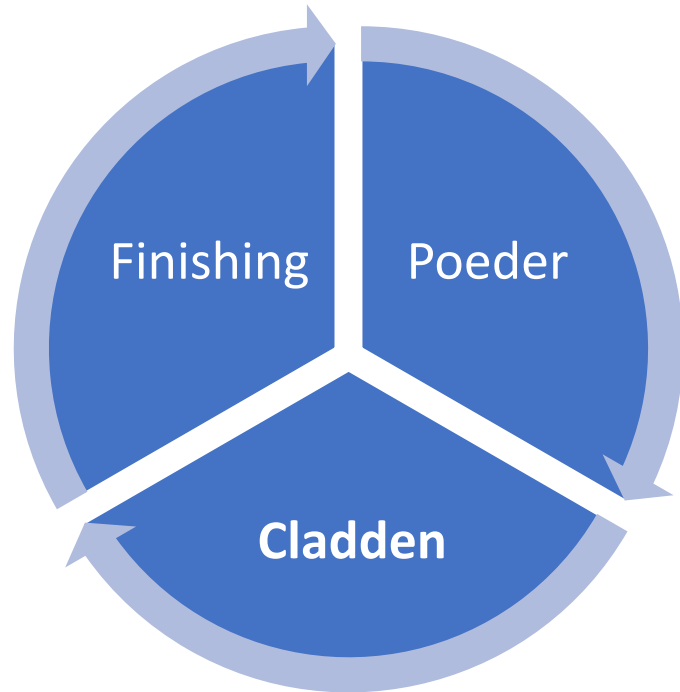


Poederkeuze

- Chemie:
 - PREn: $\%Cr + 3.3(\%Mo + 0.5\%W) + 16\%N$
 - Alleen vrije Cr!
 - Vergelijk alleen binnen zelfde RVS-soort
 - Hardheid <-> Brosheid
 - Afhankelijk afkoelsnelheid / overlap
 - Lasbaarheid
 - Zuiverheid
- Deeltjesgrootte
- Vorm:
 - Vloeigedrag

Ontwikkeling van VHT LC BASE

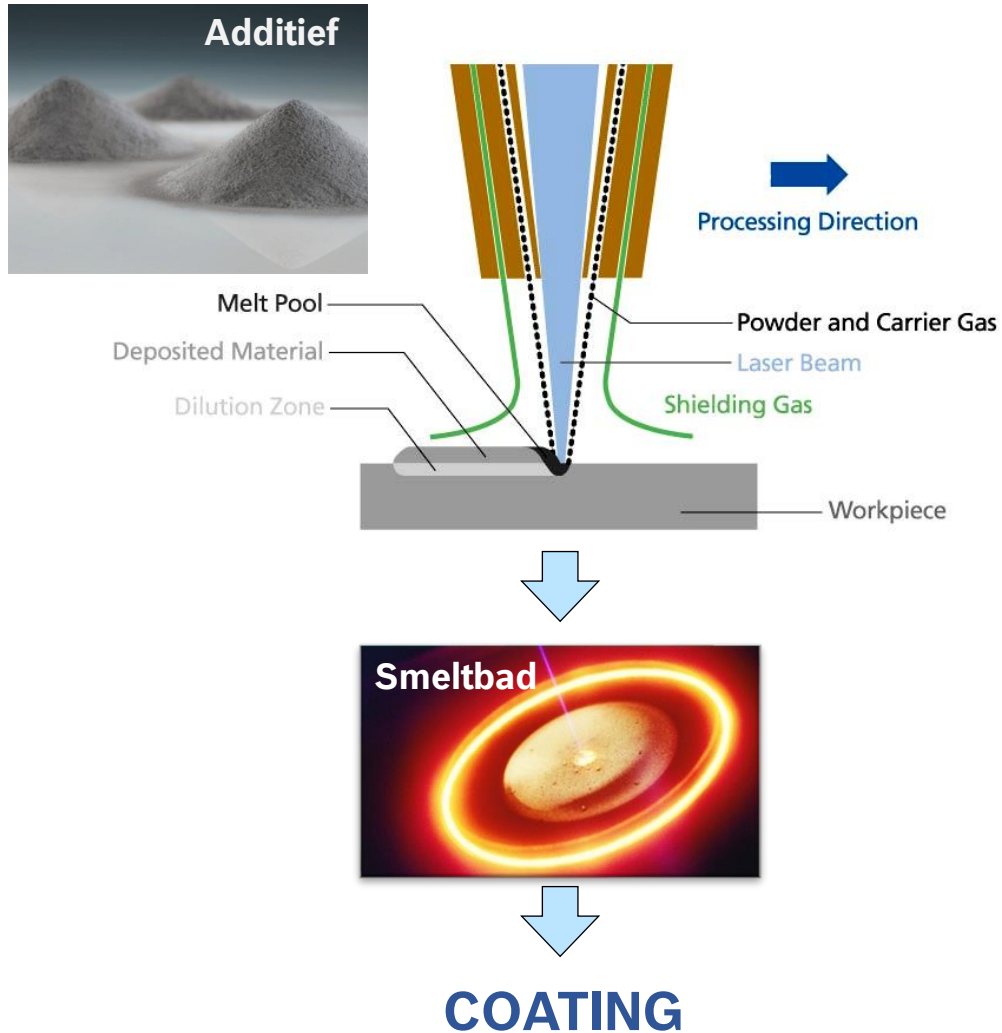
Laser Cladden



Cladden

- Lassnelheid
- Laservermogen
- Spoed
- Spotgrootte

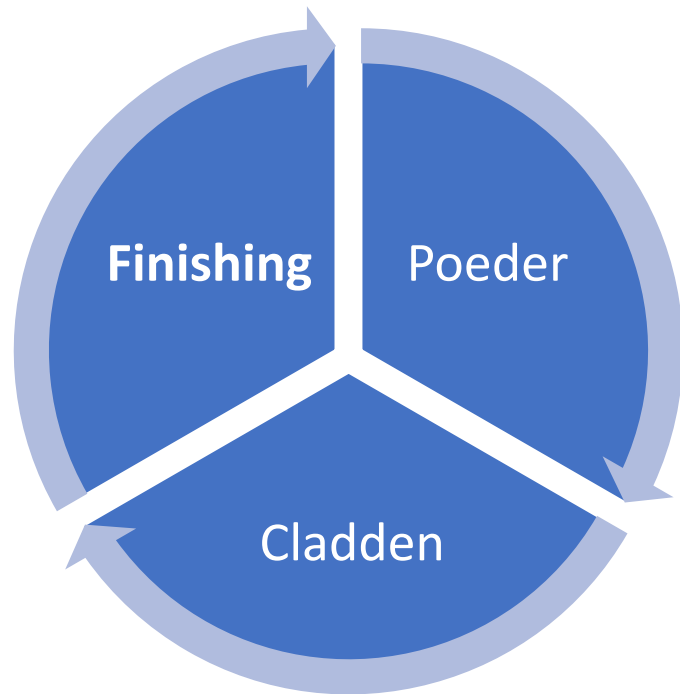
Ontwikkeling van VHT ENDUROQ 1



Procesparameters

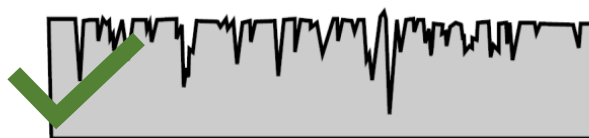
- Laservermogen
- Spotgrootte
- Lassnelheid
- Spoed
- Overlap
- Rupsvorm
- Voorverwarmen
- Poederhoeveelheid

Prijsopbouw Laser Cladden



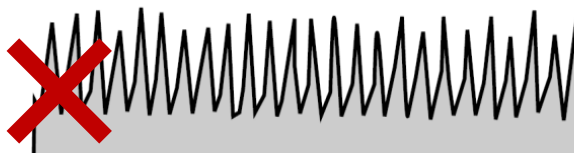
Finishing

- Afnamesnelheid
- Hoonstenen
- Hoonafloop



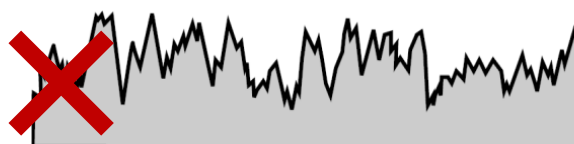
Honed and polished surface

$R_a = 2,4 \mu\text{m}$
 $R_{\text{max}} = 10,2 \mu\text{m}$
 $R_z = 5,2 \mu\text{m}$



Turned surface

$R_a = 2,5 \mu\text{m}$
 $R_{\text{max}} = 10,2 \mu\text{m}$
 $R_z = 9,5 \mu\text{m}$



Ground surface

$R_a = 2,4 \mu\text{m}$
 $R_{\text{max}} = 10,4 \mu\text{m}$
 $R_z = 7,3 \mu\text{m}$

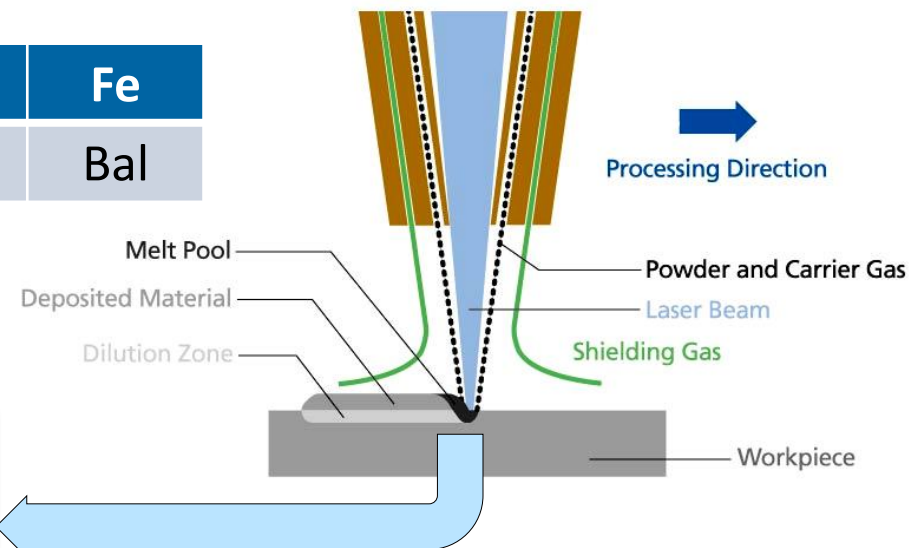
Finishing

- Geometrie
- Ruwheidsprofiel <-> Tribologie



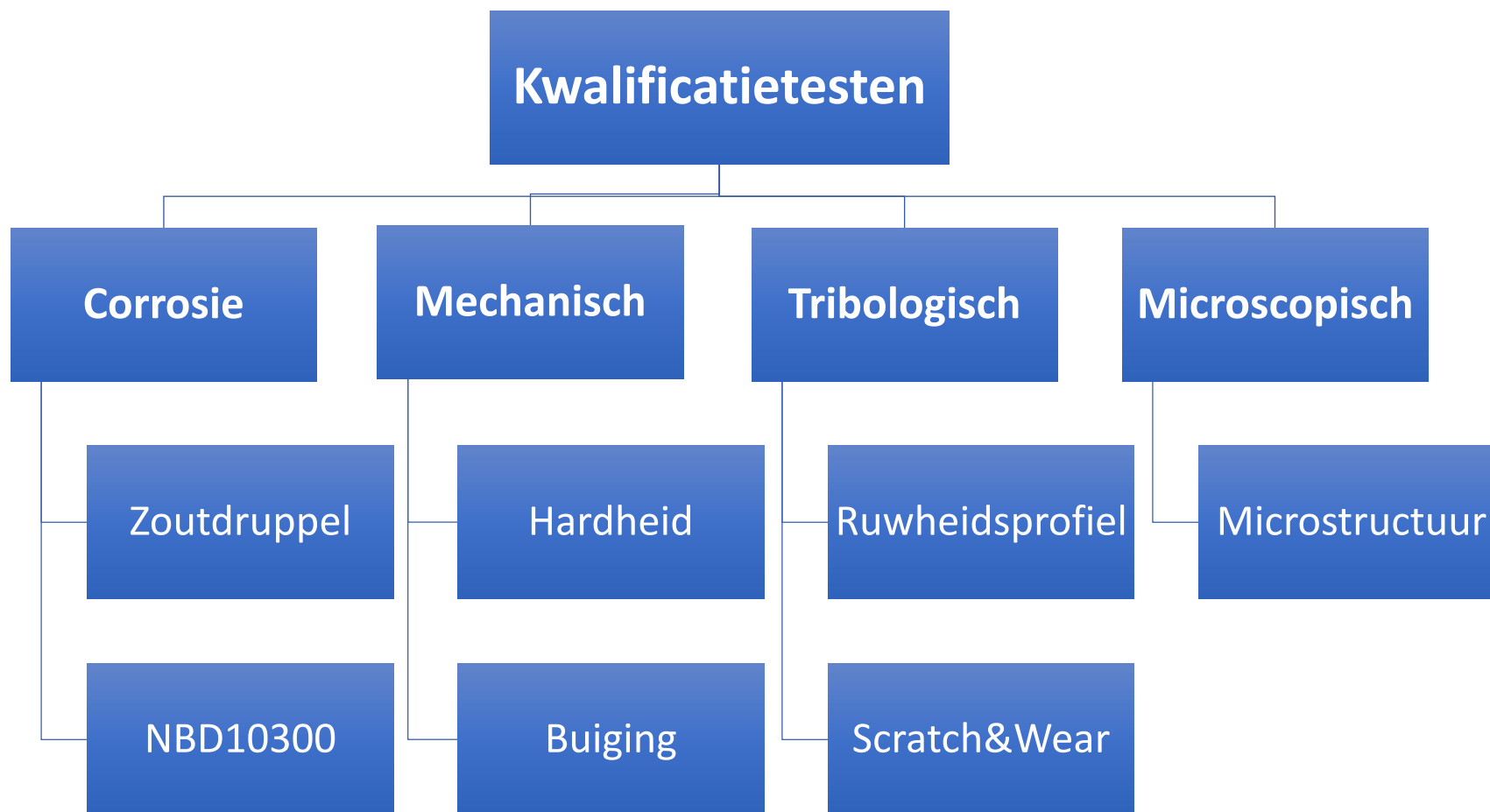
Laser Cladding – VHT ENDUROQ 1

m%	C	Cr	Ni	Mo	Si	Fe
ENDUROQ 1	0.15	18	2	1	1	Bal



ENDUROQ 1

Testen van stangbekleding





Testing and Qualification

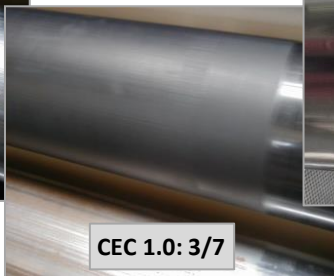
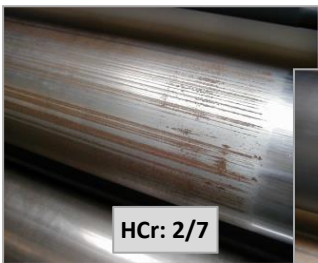
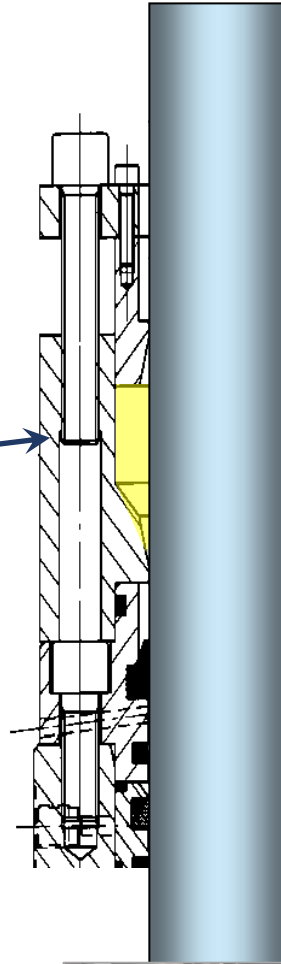
Scratch & Wear Test

Combined corrosion and extreme wear test:

1. Sharp sand 50 km
2. Sharp sand pre-stressed
3. SiC grit 50 km
4. SiC grit pre-stressed
5. Al₂O₃ blasting grit 50 km
6. Al₂O₃ blasting grit pre-stressed
7. As step 5 100 km

In 3.5% saltwater solution

Criterion: Sealing failure resulting in oil leakage



VHT Rod Coating Overview & Characteristics (indicative)

Coating	Ni / Cr	Enduroq 2000	Enduroq 2200	Enduroq 1	Enduroq 3	Test Method
Material	Cr on Ni	NiCr based	NiCr based	Stainless steel	Co based	-
Application Process	Galvanic	HVOF	HVOF	Laser Cladding	Laser Cladding	-
Surface Hardness	~ 1,000 HV0.1	~ 650 HV5	~ 650 HV5	~ 650 HV5	~ 320 HV5	ISO 6507
Wear Resistance	2 of 7	7 of 7	7 of 7	7 of 7	5 of 7	S&W test
Layer Thickness	~ 60 / 40 µm	~ 250 µm	~ 440 µm	~ 400 µm	~ 700 µm	-
Max. coating stress	n/a	400 MPa	400 MPa	550 MPa	550 MPa	3-pt bending
Impact Strength	14 J	10 J	8 J	>15 J	>15 J	ASTM D2794-9
Corrosion Resistance	<1,100 h	~ 15,000 h	~ 60,000 h	> 4,200 h	> 80,000 h	DNV-C1 (SDCT)
Corrosion Resistance	n/a	No Pass	Pass	Pass	Pass	RWS NBD10300
CIMSmart Capability	No	Yes	Yes	No	Yes	-
Corrosivity Category*	C1 - C3	C1-C3	C3-C5	C1-C4	C3-CX	-

*: Besides the direct corrosion and chemical by the direct environment, the Effective Corrosivity Category is heavily influenced by secondary influences, e.g., extension time, movement frequency, hydraulic medium. The final choice of piston rod coating should always be made with all these in mind.



Bedankt voor uw aandacht