



Optimal Maintenance & Repair Welding Solutions for Tunnel Boring

August 2018

Agenda

Wear processes

Tunnel Construction

Cutter Head M&R Consumables

Conveying Screws & chains

Tunnel Boring Machine drill bits brazing

Project References



Industry Segments

Best products for demanding industries: Maintenance & Repair

Steel



Cement



Sugar



Agriculture



Mining



Railway



Tool construction

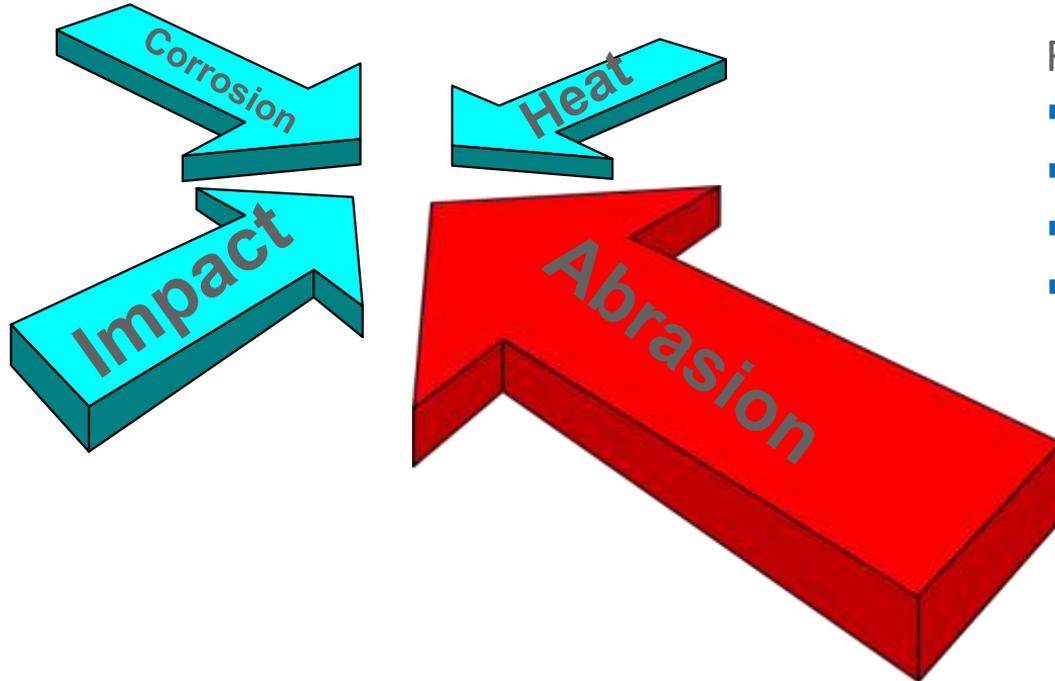


Hydropower



Wear processes in a Tunnel Boring

Amongst the most aggressive environments in terms of wear



Reasons for wear:

- High temperatures
- Thermal stresses
- 24/7h of operation
- Handling of hard raw materials

Tunnel Construction in general

- ❖ Artificial passage through or under a mountain, body of water or other hindrance
- ❖ Thoroughfares for rail vehicles, motor vehicles and pedestrians
- ❖ Profiles: rectangular, mouth, circular, cylindrical
- ❖ Minimum clearance diameter – 1 meter for disposal and supply tunnels
- ❖ no mining tunnels taken into account
- ❖ Start: end of the 19th / beginning of the 20th century

Cutter Head M&R Consumables



- ❖ UTP S DUR 600 or UTP AF Robotic 600 are used for cladding the cutter head (red part)
- ❖ The knife (blue part) is cemented carbide itself, don't need to clad.

Cutter Head M&R Consumables

SMAW

- Easy handling
- Perfect for small repairs

UTP DUR 600
UTP DUR 650 Kb

GMAW - Solid wire

- Good deposition rate

UTP A DUR 600
UTP A DUR 650

FCAW Folded & Seamless

- High deposition rate
- Wide welding parameter range
- Large alloy choice

UTP AF Robotic 600
SK 258TiC-O

Cutter Head M&R Consumables

Applications – UTP AF ROBOTIC 600



UTP AF ROBOTIC 600

gas-shielded metal-cored wire

Classifications				
DIN 8555		EN 14700		
MSG 6-GF-60-GP		T Fe 8		
Characteristics and field of use				
UTP AF ROBOTIC 600 is a seamless, chromium-alloyed, metal-cored wire for wear resistant hardfacing applications on parts subject to a combination of pressure, impact and abrasion wear. Very good weldability in comparison to solid wires, good resistance to abrasion, minimized slag formation with easy slag removal.				
Thanks to its constant wire feed and excellent weldability, this wire is especially suited for automated welding.				
Application field: Cutting tools, esp. cutting edges of presses in ceramic tiles production, jaw crushers, baffle plates				
Typical analysis in %				
C	Mn	Si	Cr	
0.45	0.4	3.0	9.0	
Typical mechanical properties				
Hardness as welded: 57 - 62 HRC				
Welding positions				
		Current type: DC (+)	Shielding gas: Ar/CO ₂ (EN ISO 14175: M21) Flow rate: 14 - 20 l/min	
Recommended welding parameters				
Diameter [mm]	Spools	Weight [kg]	Amperage [A]	Voltage [V]
1.2	B300	16	120-300	20-32
1.6	B300	16	180-420	22-34
Other diameters on request				

No moisture pick up due to seamless flux cored wire for application in the tunnel

All-rounder hardfacing alloy:

- Good impact resistance
- Good abrasion resistance

Hard & tough:

- Crack-free weld overlay using proper welding procedure

Typical hardness:

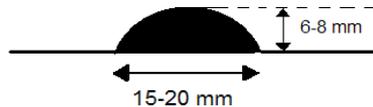
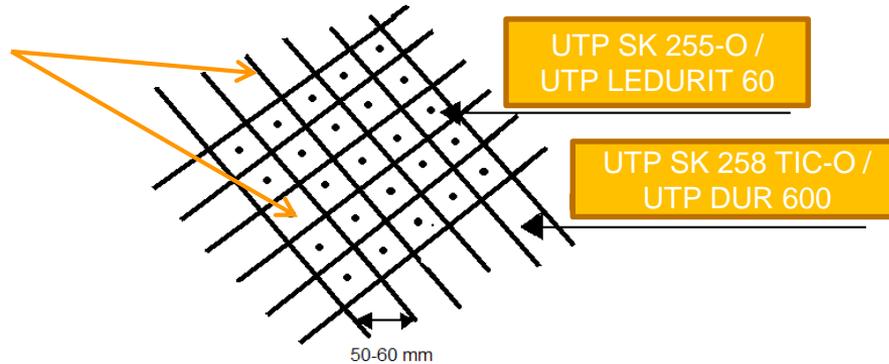
- 58 HRC

Cost effective solution!

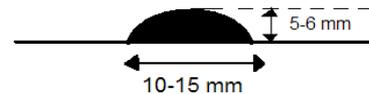


Cutter Head - Weld seam design

UTP AF ROBOTIC 600
can be used for both the
applications.



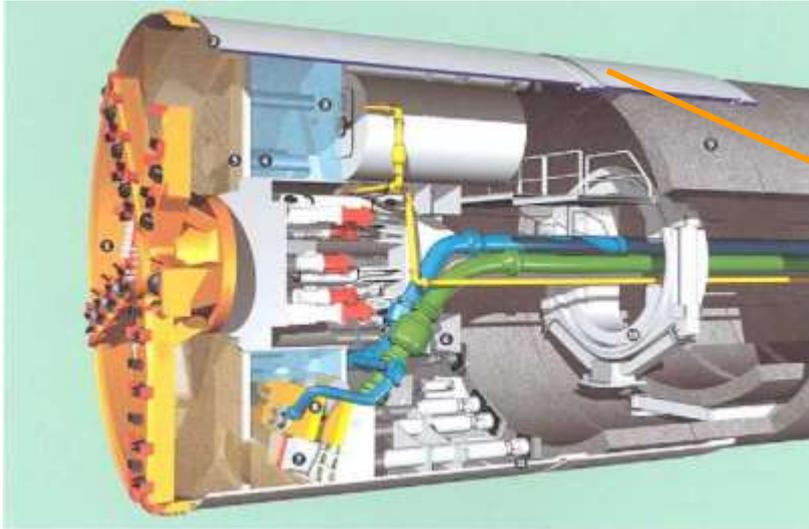
UTP SK 255-O – 2.4mm
UTP LEDURIT 60 – 5.00mm



UTP SK 258 TIC-O – 2.4mm
UTP DUR 600 – 5.00mm



Welding on the boring shield



With seamless FCAW wire UTP AF ROBOTIC 600 or UTP SK 258 TiC-O

Conveying Screws & chains with SK 900 Ni RTC-G

For extreme abrasion solicitations combined with wet corrosion

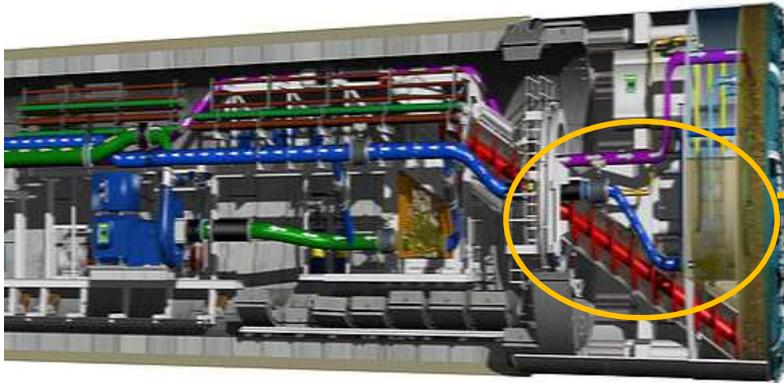
- 1) More tungsten carbides in first layer.
- 2) Better resistance against abrasion by mineral particles.
- 3) Better thermal stability of the carbides
- 4) Better weld metal wettability



Shaft & wings



Wing edges



Wheel of a tunneling boring machine train



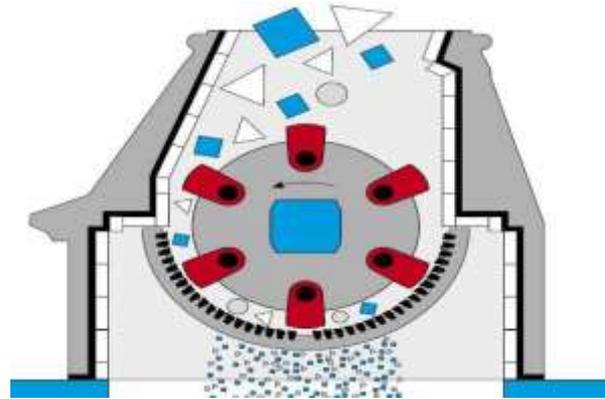
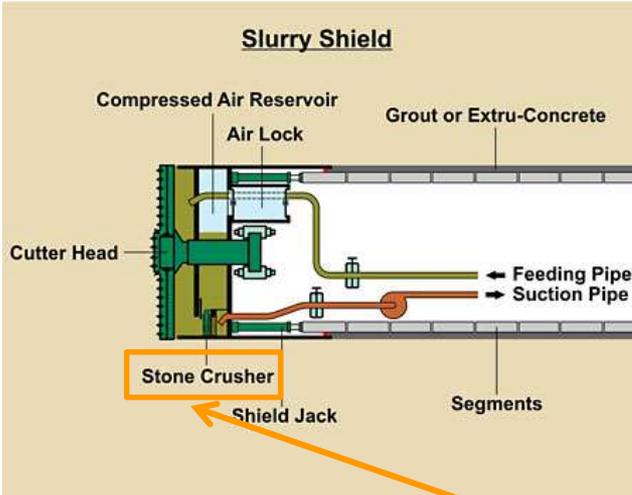
Wheel of a tunneling transport system
welded with **Bohler A7-FD**

Source: Gotthardtunnel / CH Herrenknecht TBM

Welded by a service company

Year of completion 2016
the longest railway tunnel in the world (57 km)

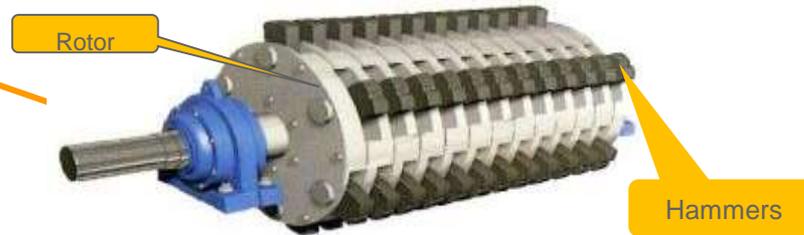
Stone Crusher- Hammer & Rotor Refurbishment



Hammer and Rotor
Refurbishment –

FCAW Seamless wire –
UTP AF ROBOTIC 600

SMAW Electrodes –
UTP S DUR 600



Hard and Silica stone grinder's rolls



SK ABRAMAX-O/G

Wear resistant coatings – Suction Pipes



Internal pipe welding in the TBM is becoming the preferred wear resistant coatings above traditional Ceramic or Basalt, as in the past.

Pipe diameters ranging from 150 to 500 NB with layer thickness 4-20 mm .

Welding consumables:

Lobster bends: SK A43-O (UTP S LEDURIT 65)

Straight sections: SK 867-O (UTP S LEDURIT 61)



Refurbishment of grinding components is more cost effective that replacing with new components



Crushing & Benefication Equipment



Slurry Pump



Scrubber



Screen

Crusher & Beneficiation refurbishment consumables



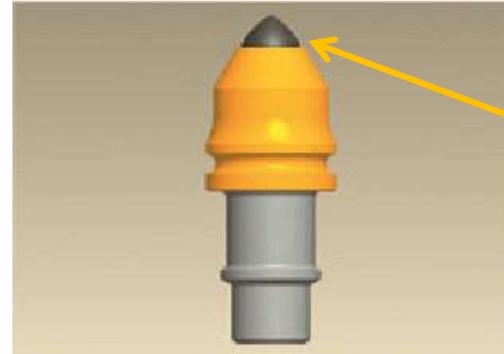
Application	Problem	Recommendation
Crusher Body	Crack/ Liner plate Joining	UTP S 65 AP/ UTP S 63/ UTP S 613 Kb
Scrubber Inlet feed Pipe	Wear	UTP SK C 866-O / UTP SK C A 43-O UTP S Ledurit 61 Abrasodur 43
Slurry Pump Casing/Impellers	Wear	UTP S Ledurit 61 Abrasodur 43

Tunnel Boring Machine drill bits brazing



Hardened EN24 material
body 50-52 HRC

8% Cobalt containing
carbide tip



**49% Silver Brazing
Alloys –**
Rod - A324,
Foil - A324F
& A324 Powder

Reference - Metro Athens Herrenknecht Tunnel Boring Shell



- ❖ Project name: ATTIKO METRO
- ❖ Project sponsor : AEGEK A.G.
- ❖ Project data:
 - Lenght 19.3 km
 - Height 9.5 m
 - Width 9.5 m
- ❖ Completion time 3 YEARS
- ❖ Built around in 1980 with

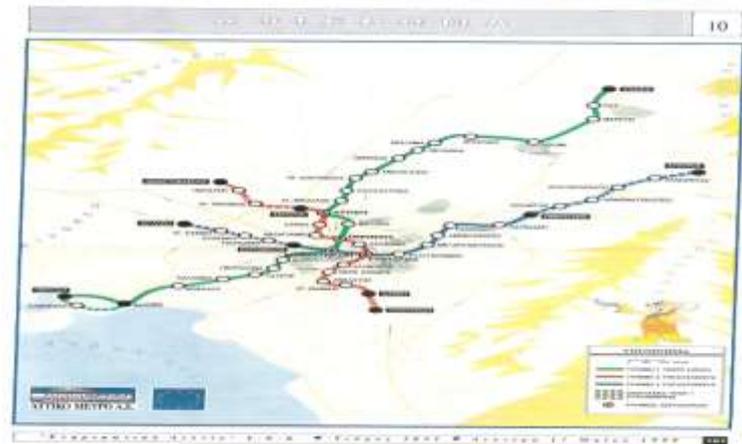
Reference - Metro Athens Herrenknecht Specification of the boring machine



- ❖ LENGTH 150 m
- ❖ DIAMETER 9,495 m
- ❖ OUTPUT 4,000 KW
- ❖ WEIGHT 840 tons
- ❖ DAILY CAPACITY 14m - 26m

At every planned underground station stop Metro Athens

- ❖ UTP SK 258 TIC-O 400 kg / UTP LEDURIT 60 – 2500 Kg
- ❖ UTP SK 255-O 250 kg / UTP DUR 600 - 4000 Kg
- ❖ Days ~ 4-6
- ❖ Welders 5 - 8
- ❖ Working hours 24 h



Reference TBM fabricator (Pictures Tunnel Lyon-Turin)

Le projet de nouvelle ligne ferroviaire Lyon-Turin



Between Saint Jean de Maurienne (France) – Suze (Italy) 0

- 26 Billion euros
- 2 tunnel of 57 Km each one
- Transit of 1 million truck per year via railway (truck placed on trains)

Beginning of project : 2014

Estimated end date : 2030



Welding material for one TBM:

Böhler HL 51 T-MC - 30 Tons

Application : joining of TBM (Tunnel Boring Machine)

Length : 135 m / diameter 12 m

Thickness : 50 ~ 80 mm

Reference TBM fabricator (Pictures Tunnel Lyon-Turin)



Why Böhler HL 51 T-MC :

- ❖ Improve the welding behavior against competitor metal cored wire
- ❖ **No moisture pick up** of Tubular Fluxes cored wire for application **in the tunnel**
- ❖ Softer arc
- ❖ Better impact toughness
- ❖ Better feedability with long liner (5 meters and more from machine to torch)

Tunneling Head



Customer – mts PERFORATOR GmbH Germany

Customer was encountering frequent intervention for cutter head maintenance due to presence of abrasive soils.

Severe wear was observed on excavation tools and on the backside of the cutter head which had to plough through accumulated spoil at the bottom of the excavation chamber.

Product used: **UTP 7502**

Base metal: Tool steel

Hardness: Carbide approx. 2500Hv

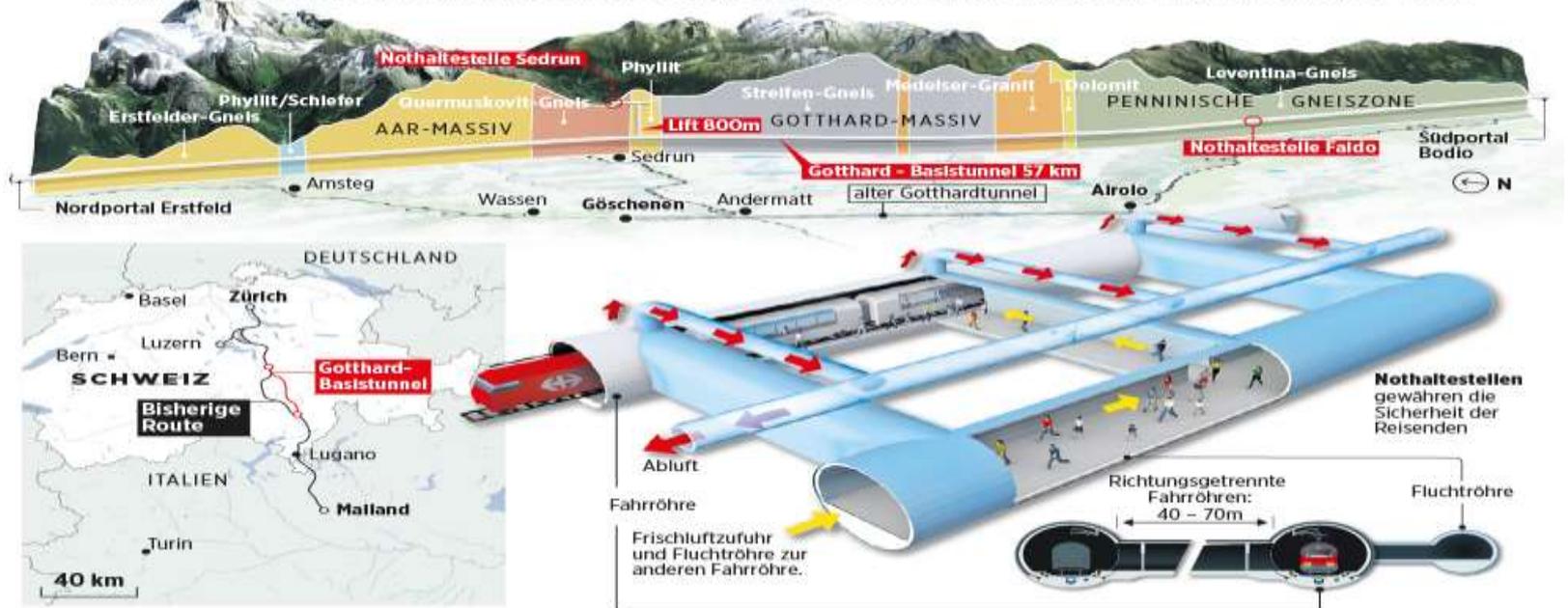
Working temperature: 900°C

The weld deposit of UTP 7502 consist of very hard tungsten carbides, imbedded in a corrosion resistant matrix.

Reference- Longest Railway Tunnel in the world (57 km)

Jahrhundert-Bauwerk Gotthard-Tunnel

Nach 17 Jahren Bauzeit führen am 1.6.2016 die ersten Züge durch die 57 Kilometer lange Verbindung durch das Alpen-Massiv



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For Service in Australia



Avweld Australasia Pty Ltd are a large scale specialty hardfacing company based in Melbourne. Avweld are Gold Distributors & Applicators for UTP Maintenance / Bohler Welding by Voestalpine.

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Thank you!

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