Contents of Work Package 2 - WP10 New Manufacturing Technologies and Materials

2-WP10: New Manufacturing Technologies and Materials

Coordinator of the WP

University of West Bohemia, responsible person: Ing. Pavel Žlábek, Ph.D.

Participants of the WP

Plasmametal, spol. s r. o. _Ing. Vojtěch Vlček

UWB – RTI _ Ing. Pavel Žlábek, Ph.D.

Main Goal of the WP

Design and optimization of thermal spray coating process for original parts and repair/maintenance. It should replace the currently using repair procedure by reducing the related costs of the maintenance and also with higher resistance to loading – increase maintenance interval of rail axles and finally reduce the costs for operator of railway vehicles.

Partial Goals for the Current Period

2-WP10-001 Thermal sprayed coating with defined sets of parameters to achieve higher resistance to various loading.

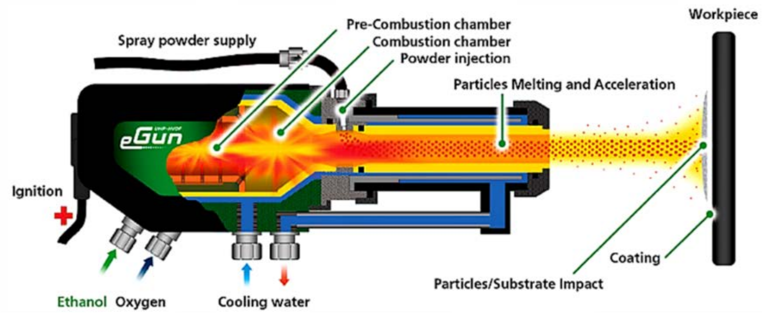
2-WP10-002 Technical report - Material properties of coating. Summarized and detailed description of material, morphological and other properties of the layer.

Activities in 2 - WP10 New Manufacturing Technologies and Materials

New Method of Thermal Spray Coating of Rail Axles - Development & Application

+

eGun™ Technology - Liquid Fuel (ethanol) HVOF Torch



Activities in 2 - WP10 New Manufacturing Technologies and Materials

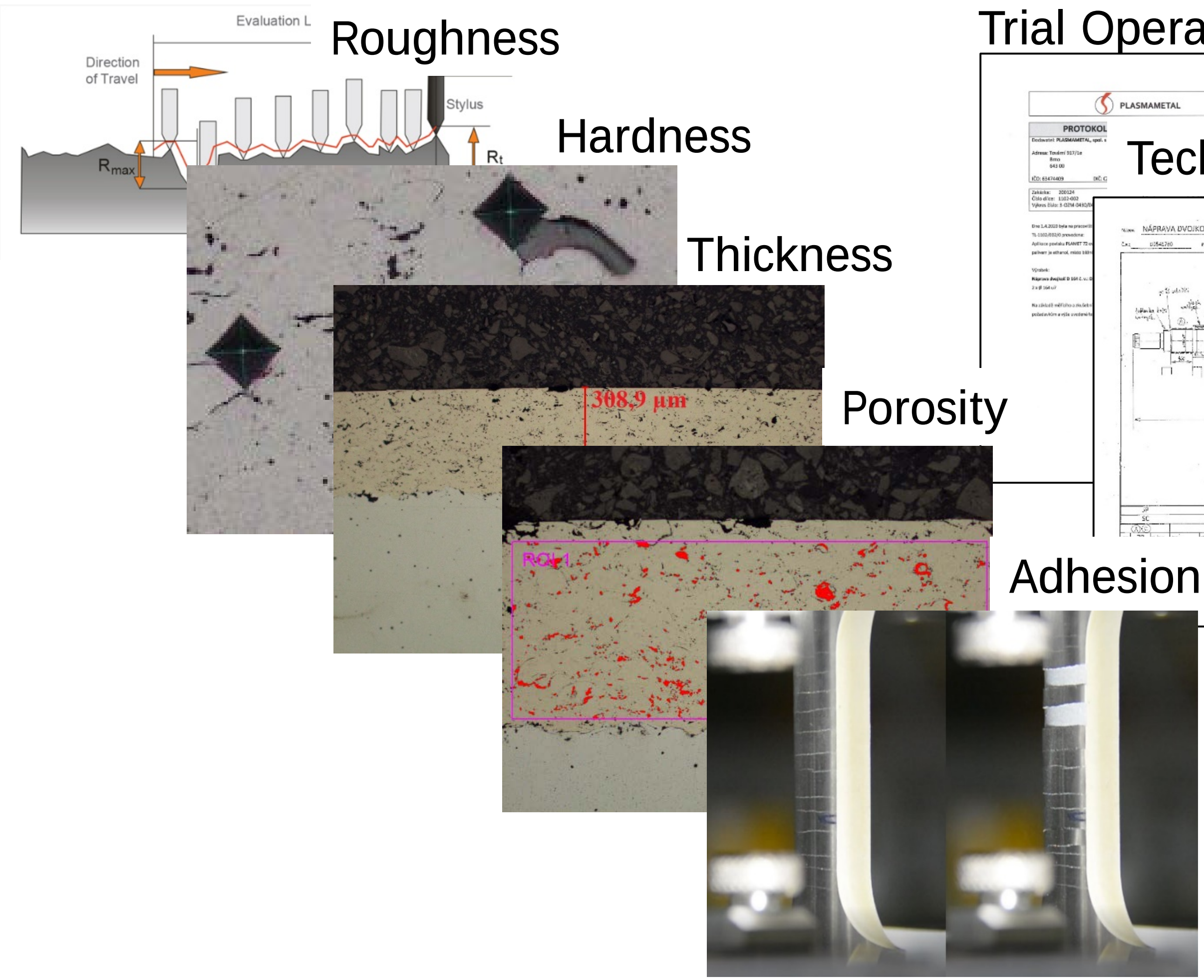
Roughness

Hardness

Thickness

Porosity

Adhesion



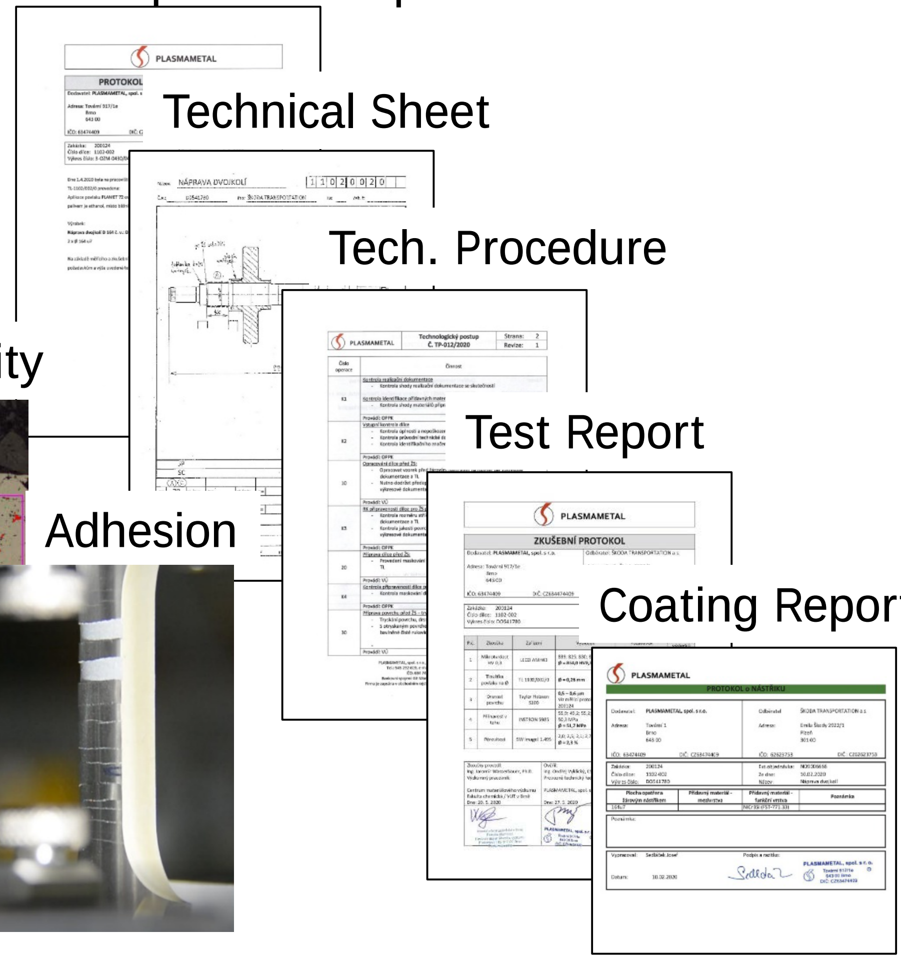
Trial Operation Report

Technical Sheet

Tech. Procedure

Test Report

Coating Report

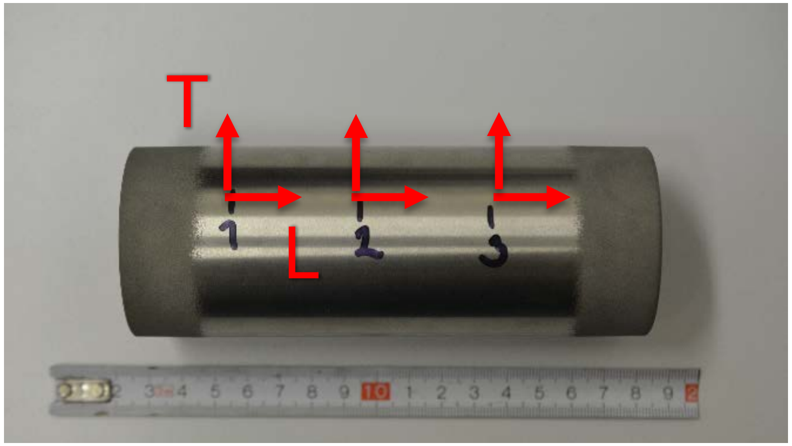


Activities in 2 - WP10 New Manufacturing Technologies and Materials

2-WP10-001 Thermal Sprayed Coating With Defined Sets of Parameters to Achieve Higher Resistance to Various Loading

Roughness Test

- contact method
- optical (non-contact) method
- longitudinal + transversal direction
- **requirement:** max Ra 0.8



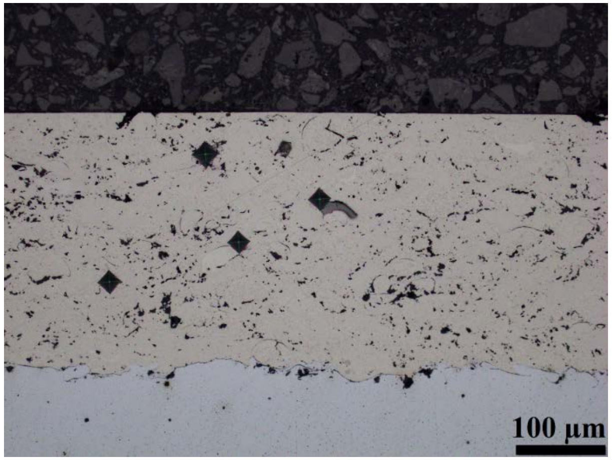
orientation	Ra [µm]	
	contact	non-contact
longitudinal	0.30	0.37±0.01
transversal	0.13±0.07	0.22±0.01

Activities in 2 - WP10 New Manufacturing Technologies and Materials

2-WP10-001 Thermal Sprayed Coating With Defined Sets of Parameters to Achieve Higher Resistance to Various Loading

Hardness Test

- HV0.3
- measured on transversal cross-section
- 5 samples, 4 indentations each
- 0.05 intervals surface → substrate
- **requirement:** min 750 HV0.3



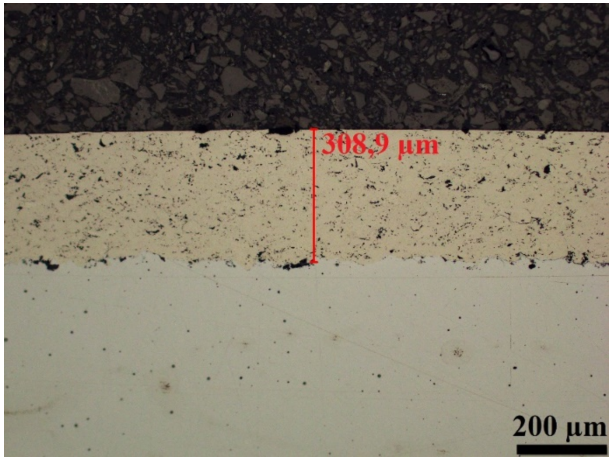
Depth [mm]	0.1	0.15	0.2	0.25
HV0.3	695±26	694±46	725±46	692±22

Activities in 2 - WP10 New Manufacturing Technologies and Materials

2-WP10-001 Thermal Sprayed Coating With Defined Sets of Parameters to Achieve Higher Resistance to Various Loading

Coating Thickness

- measured on transversal cross-section
- 5 samples x 3 measurements each
- image analysis at 100x magnification
- **requirement:** min 220 µm



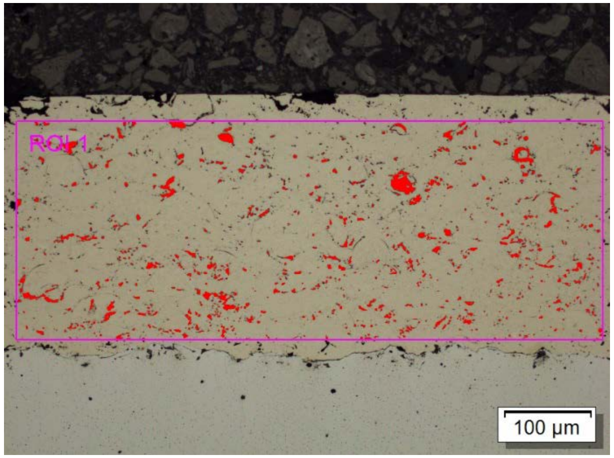
	Coating thickness [µm]
average	305±5
maximum	315
minimum	294

Activities in 2 - WP10 New Manufacturing Technologies and Materials

2-WP10-001 Thermal Sprayed Coating With Defined Sets of Parameters to Achieve Higher Resistance to Various Loading

Porosity

- measured on transversal cross-section
- 5 samples x 3 measurements each
- image analysis at 200x magnification
- **requirement:** max 3.5 %



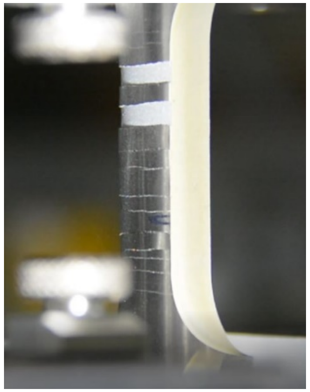
	Porosity [%]
average	2.8±0.5
maximum	4.0
minimum	1.9

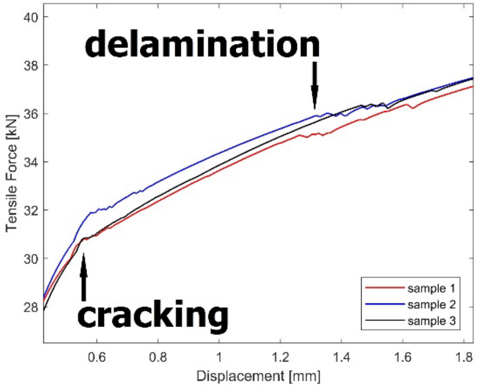
Activities in 2 - WP10 New Manufacturing Technologies and Materials

2-WP10-001 Thermal Sprayed Coating With Defined Sets of Parameters to Achieve Higher Resistance to Various Loading

Coating Adhesion

- tensile samples (ASTM C633 unsuitable)
- adhesion parameter: shear stress on the onset of delamination
- **requirement:** min 40 MPa (tensile adhesion ASTM C633)





	Shear stress [MPa]
delamination onset	73±1

Fulfillment of goals and deliverables of 2 - WP10 New Manufacturing Technologies and Materials

Current State of Deliverables, Milestones and Fulfillment of Goals

Development of the thermal sprayed coating with defined sets of parameters were performed with several iteration cycles in order to achieve higher resistance to chosen loading. The different material properties were measured on the samples. Several real parts - rail axle - with the final technology parameters of the thermal sprayed coating were produced and validate directly by the final user. The long term usage of the rail axle will shown more details about behaviour of the thermal sprayed coating.

List of Due Deliverables and Their Added Value

2-WP10-001 Thermal sprayed coating with defined sets of parameters to achieve higher resistance to various loading. This verified technology was done and the added value is in application of a new method of thermal spraying technology on functional surfaces of rail axles. The result will address the issue of innovative surface treatment with new technology HVOF - eGun, respectively optimization of material and technological parameters of NiCrBSi coatings.

2-WP10-002 Technical report - Material properties of coating. Is summarized and will in detail described a morphological and other properties of the layer.

Current Contribution of 2 - WP10 New Manufacturing Technologies and Materials

Assessment of the Contribution of Deliverables

Verified technology of the thermal sprayed coating will increase the time of usage rail axles. It will reduce the cost not only because the time-usage prolongation, but also due to substitution of the older repair technology – e.g. welding – with this new progressive technology of thermal sprayed coating. It will have impact also on increasing the fatigue life / the safety of the rail axle. There are several currently running research projects and commercial collaborations of applying thermal spray coating not only on the rail axles.

Acknowledgement

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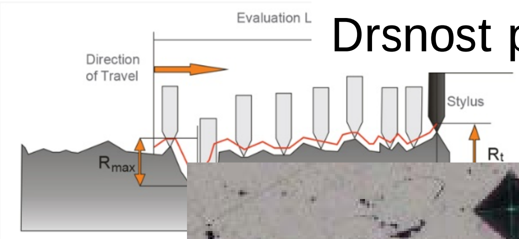
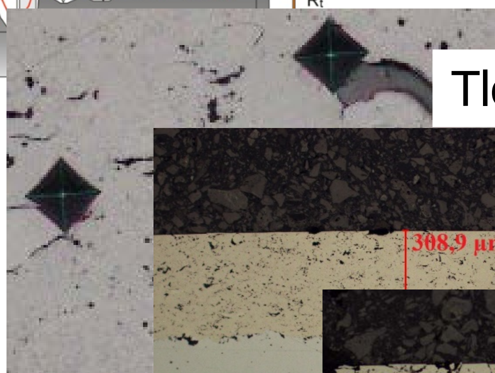
This support is gratefully acknowledged.

Výtah z prací 2019-2020 na 2 - WP10 Nové výrobní technologie a materiály - WBU – RTI _ Ing. Pavel Žlábek, Ph.D.

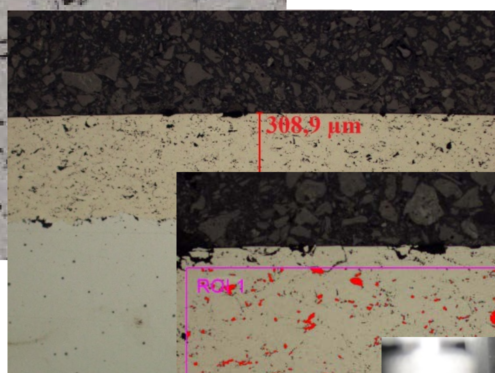
Drsnost povrchu



Tvrdost



Tloušťka vrstvy



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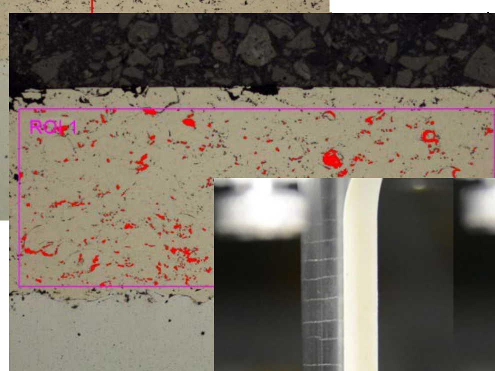
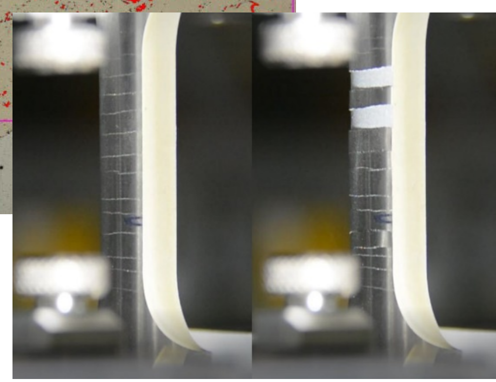


Přilnavost



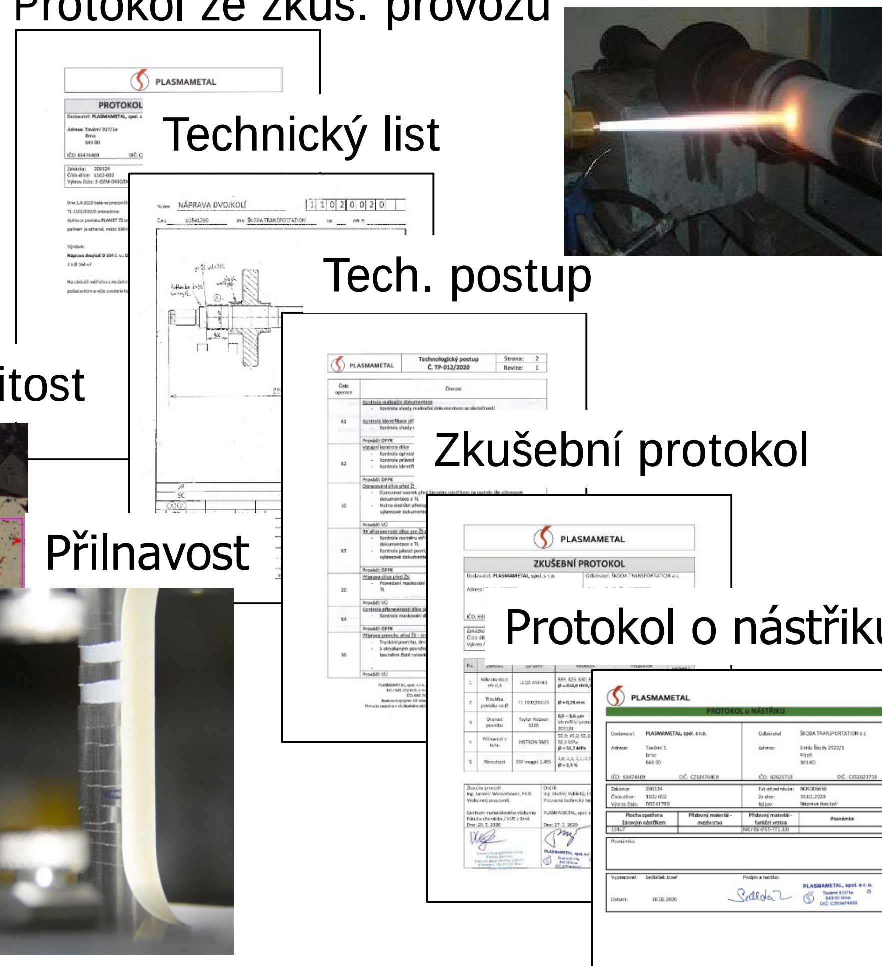
Protokol ze zkuš. provozu

Technický list

Tech. postup

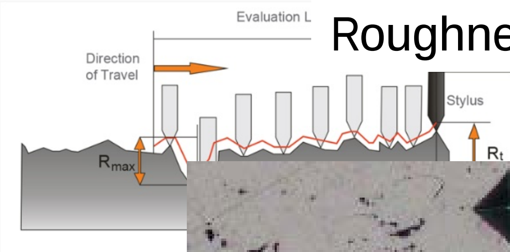
Zkušební protokol

Protokol o nástřiku

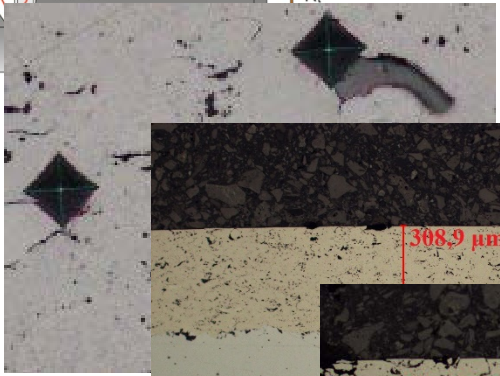


Results of 2 - WP10 New Manufacturing Technologies and Materials Achieved 2019-2020 - UWB – RTI _ Ing. Pavel Žlábek, Ph.D.

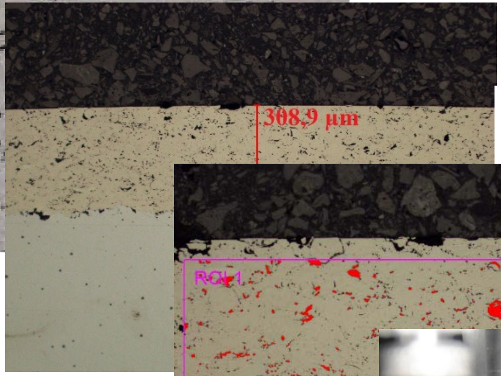
Roughness



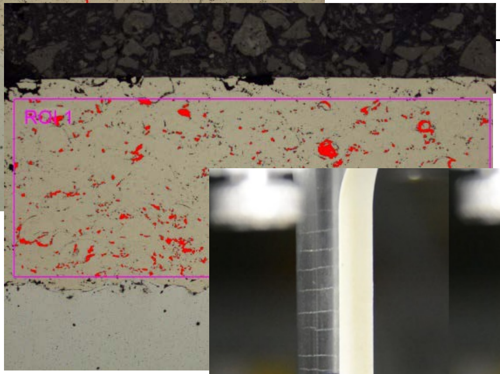
Hardness



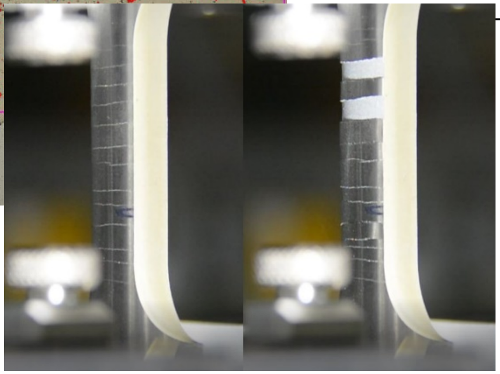
Thickness



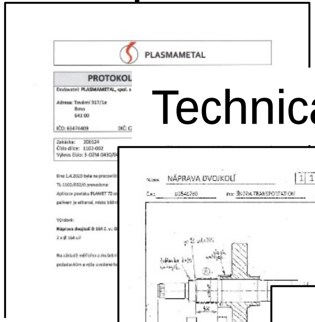
Porosity



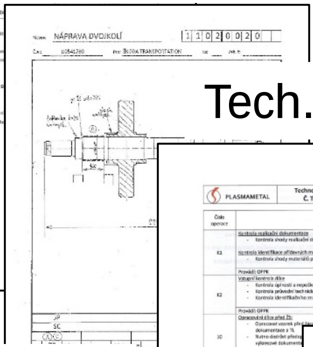
Adhesion



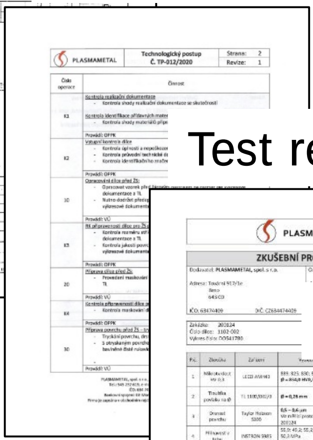
Trial operation report



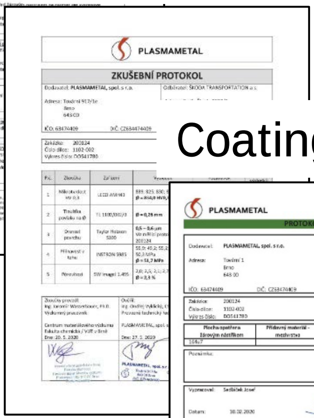
Technical sheet



Tech. procedure



Test report



Coating report