COMPARISON REPORT

October 2024

PURPOSE OF THIS DOCUMENT

Presentation of the work done to compare the original Rokide Gun and its new version, the Rokide 2.

The comparison of these two flame spray guns has been made on several aspects:

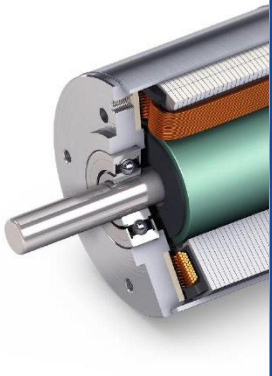
1. Capabilities of the equipment
2. Visual aspect of the flame
3. Profile of the tip of the rod
4. Speed and temperature of the particles
5. Coating specifications
6. Conclusion

1. Capabilities of the equipment

a. Material feeding

The material feeding speed is a key factor as it dictates the quantity of material supplied to the combustion chamber. However, even more crucial than speed is the stability of this process. Fluctuations in speed during spraying can lead to inconsistent coating, negatively affecting the quality of the coating, including its porosity, hardness and deposit efficiency. To address this, we have placed special emphasis on selecting the most appropriate components for feeding the material in the Rokide 2 gun.

We opted for a **high-quality brushless motor** equipped with integrated Hall sensors. These sensors generate six different combinations of switching impulses per electrical turn, which are counted to determine rotation speed. With its optimized magnetic circuit, the motor provides high power in a compact design, allowing the new Rokide 2 to be lighter **by ~60%**.



Rotor delivers good dynamics and large torques

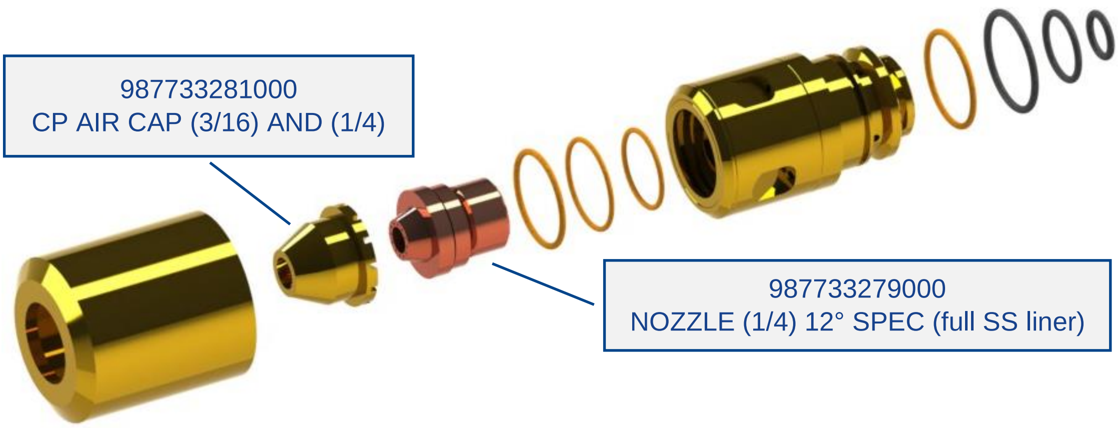
Stator with an iron winding for high power at a low cogging torque

Steel housing and flange to ensure good heat dissipation and mechanical stability

However, even the best brushless motor needs a **high-performance servo controller** to function optimally. In line with this, we selected a servo controller with dynamic control capabilities, ensuring exceptional performance. This closed-loop controller continuously compares the actual speed (via Hall sensors) with the desired set point and dynamically adjusts speed in the event of deviations (such as increased friction in the gas nozzle). This ensures the material feed speed remains stable throughout the process.

b. Air cap & gas nozzles

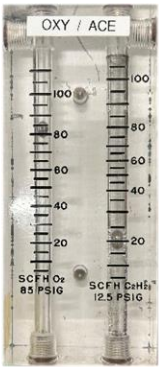
The nozzle design plays a crucial role in maintaining consistent melting conditions within the combustion chamber during the spraying process. Both Rokide spray gun models feature identical air cap and gas nozzles, ensuring uniformity in performance.



Exploded view of the Rokide 2 nozzles

c. Gas control panel

The flame's power and characteristics, particularly its temperature and stoichiometry, are crucial factors determining the equipment's ability to melt a specific amount of material within a given timeframe. To precisely measure the input gases, we installed mass flow meters upstream of the Rokide gun setup. This allowed us to accurately quantify the oxygen, acetylene and compressed air supplied to the Rokide gun during the spraying process. Below you will find the Rokide's spray parameters along with their conversion into actual flow rates:

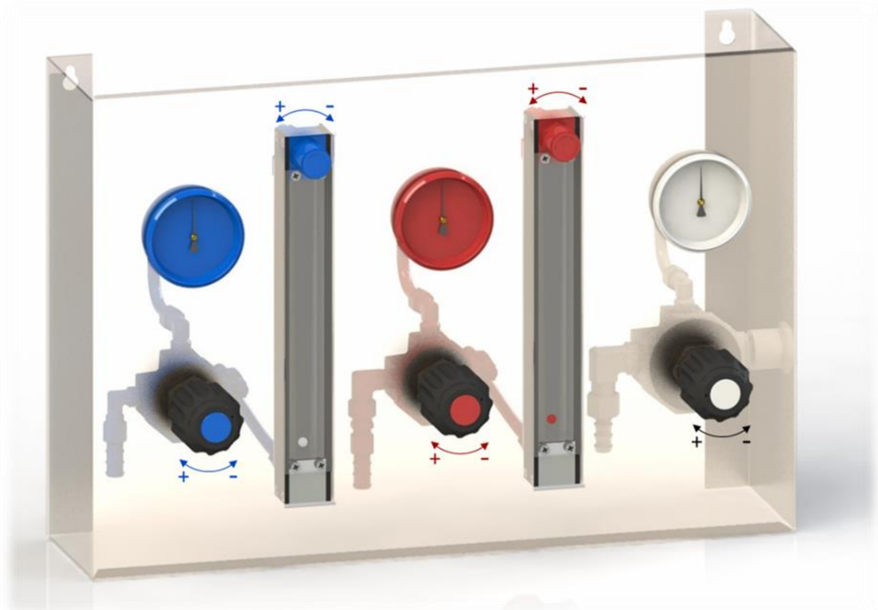


	ROKIDE	Mass flow meters measurement
Oxygen	Pressure = 90 psi (6.2 bars) Ball height = 90	138 scfh (65 nl/min)
Acetylene	Pressure = 15 psi (1 bar) Ball height = 60	50 scfh (24 nl/min)
Air	Pressure = 80 psi (5,5 bars)	1218 scfh (575 nl/min)

Then we defined the spray parameters on the new Rokide 2 with its gas control panel:

	Flow to reach	ROKIDE 2 spray parameters
Oxygen	138 scfh (65 nl/min)	Pressure = 94 psi (6.5 bars) Ball height = 61 mm
Acetylene	50 scfh (24 nl/min)	Pressure = 15 psi (1 bar) Ball height = 82 mm
Air	1218 scfh (575 nl/min)	Pressure = 80 psi (5,5 bars)

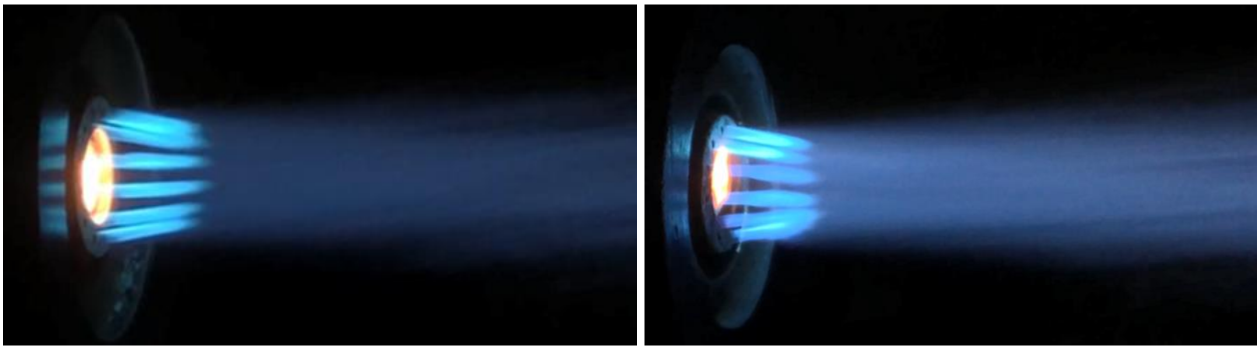
The newly designed gas control panel enhances spray parameter management by allowing independent adjust of pressure and flow. This improvement is achieved through the integration of adjustment knobs at the outlet of each ball flowmeter, replacing the simpler traditional ball flowmeters. As a result, operators can fine-tune the spray parameters with greater precision and ease.



Rokide 2 gas control panel

2. Visual aspect of the flame

To further validate the spray parameters, particularly flow and stoichiometry, we implemented a visual flame analysis. The flame's length, color, and profile provide valuable insights into its state (neutral, carburizing or oxidizing). To facilitate the assessment, we developed a custom nozzle configuration that exposes the core flames typically hidden by the air cap nozzle. Additionally, we suspended the compressed air supply to observe the undisturbed ore flames emerging from the gas nozzle. This visual inspection serves as an additional criterion for verifying the accuracy of our spray parameter measurements.



Rokide 2 (left) & Rokide (right) core flames (with special nozzle set)

Rokide flame

Rokide 2 flame

ROKIDE 2 SAINT-GOBAIN

Rokide flame

Rokide 2 flame

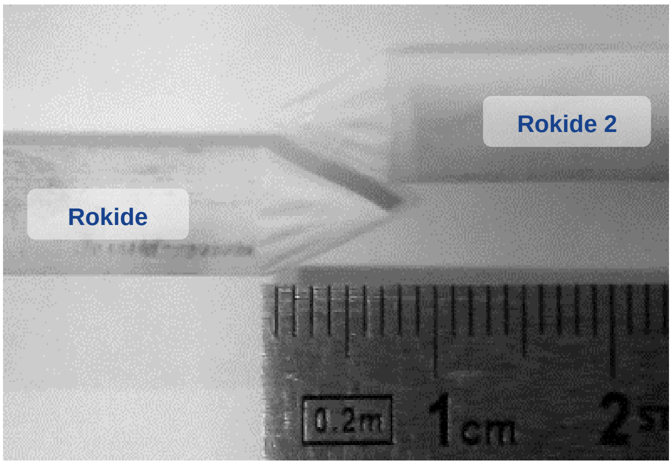
Color, length (core flame and complete flame) and type of flame are the same with the previously defined spray parameters.

ROKIDE 2 spray parameters

Oxygen	Pressure = 94 psi (6.5 bars) Ball height = 61 mm
Acetylene	Pressure = 15 psi (1 bar) Ball height = 82 mm
Air	Pressure = 80 psi (5,5 bars)

3. Profile of the tip of the rod

The post-spray profile of the rod tip serves as another indicator for verifying consistent spraying conditions. This analysis is particularly useful when maintaining a constant flame power, characteristics, and material feed rate. As illustrated in the image on the right, the uniform angle and length of the rod tip confirm the consistency of the spray conditions between the Rokide and Rokide 2.

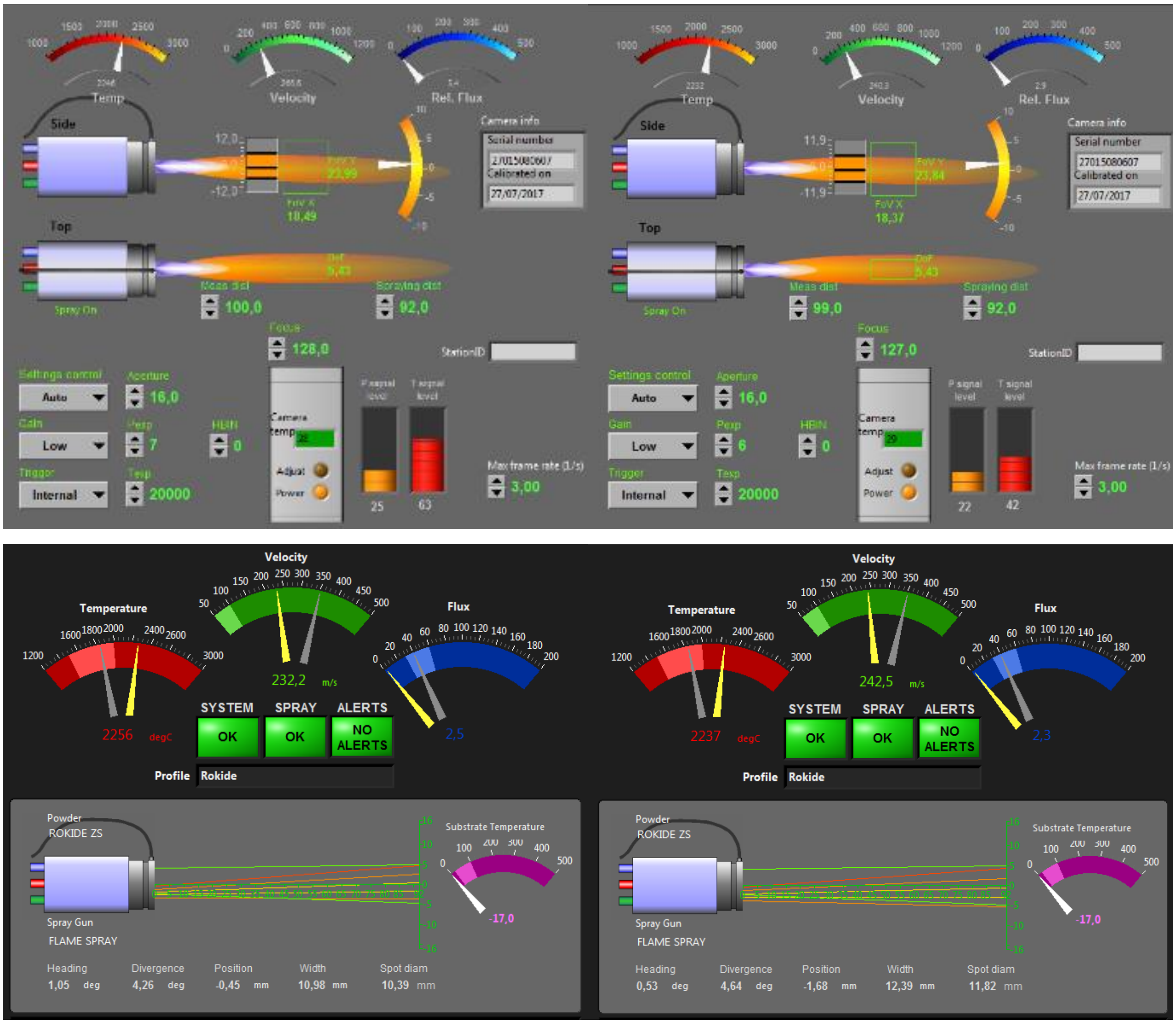


Additionally, the conical tip of the rod exhibits distinct “grooves”. These markings are formed by the core flames and provide visual evidence of the spray process’s uniformity.

4. Speed and temperature of the particles

We utilized SprayWatch technology to compare the two guns during the spraying process, focusing on particle velocity and temperature. These parameters are crucial indicators when aiming to ensure consistent coating specifications. By acquiring and analyzing this data, we were able to evaluate the performance consistency between the two guns, providing another layer of quality assurance in our coating process.

Rokide **Rokide 2**

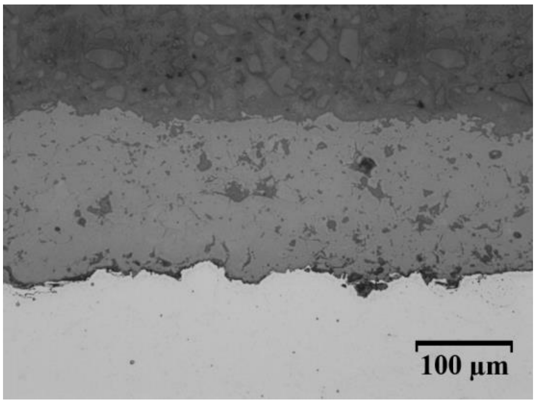


With Rokide EZ rod at 4 In/min (10 cm/min)	**ROKIDE**	**ROKIDE 2**
Average speed of particles	761 f/sec (232 m/s)	793 f/sec (242 m/s)
Average temperature of particles	4092°F (2256°C)	4058°F (2237°C)

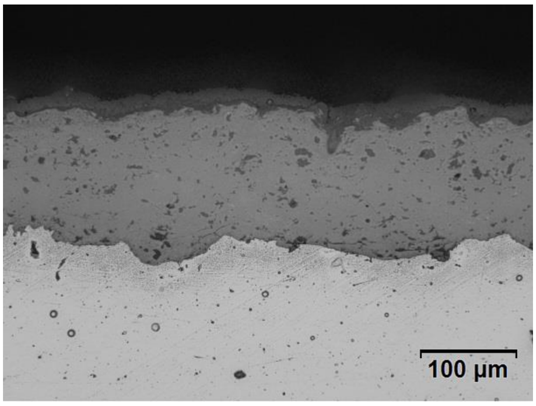
This comparison of the guns demonstrates similar results regarding particle velocity and temperature.

5. Coating specifications

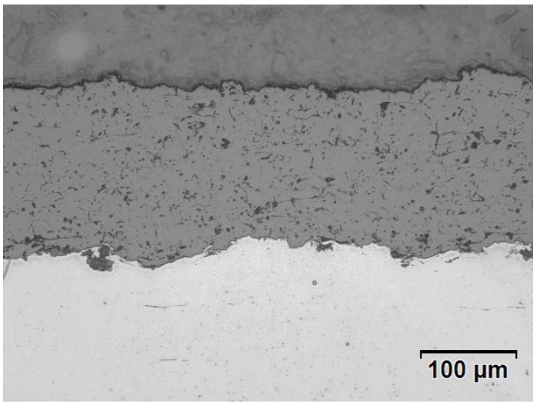
To finalize this comparison between the two guns, the coating cross sections, microhardness, deposit efficiency, porosity, and roughness can be found below:



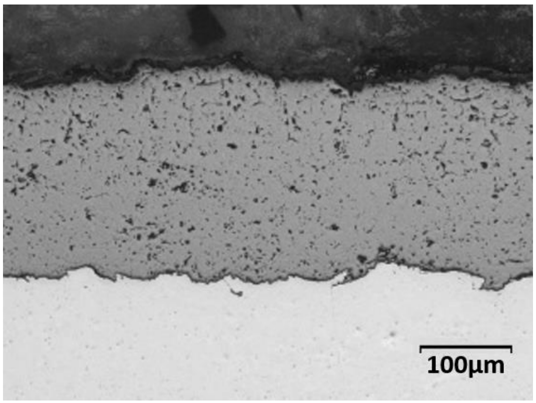
EZ rod - Rokide



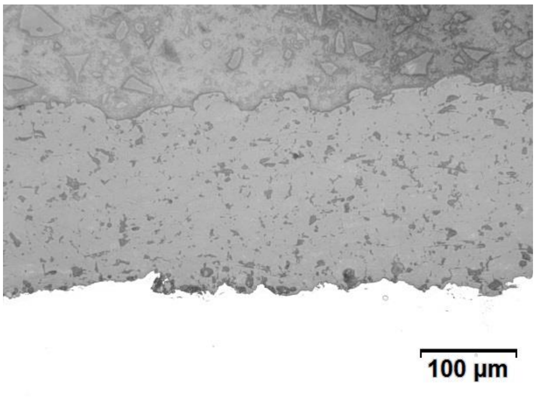
EZ rod Rokide 2



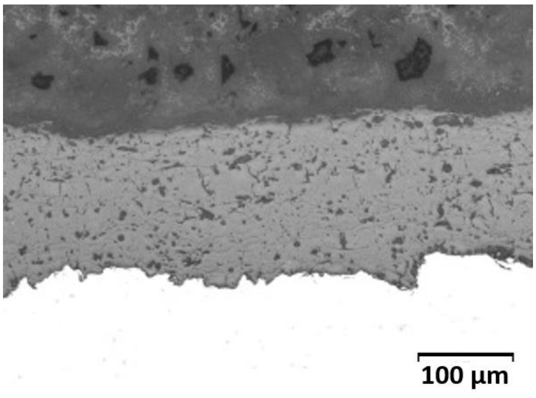
C rod - Rokide



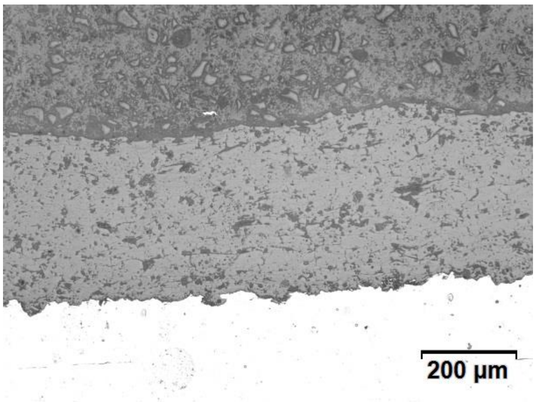
C rod – Rokide 2



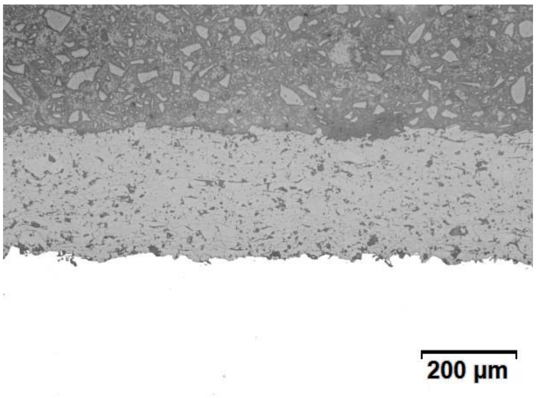
HPA rod - Rokide



HPA rod – Rokide 2



A rod - Rokide



A rod – Rokide 2

	Microhardness *(HV 500g) - (HV 300g)*	Porosity	Deposit efficiency	Ra
EZ Rod - Rokide	473	8,72%	57,85%	8,962
EZ Rod - Rokide 2	484	8,73%	60,41%	8,931
C Rod - Rokide	860,6 *	6,67%	50,23%	3,5422
C Rod - Rokide 2	859,8*	6,55%	54,02%	3,7824
HPA Rod - Rokide	695	9,26%	70,16%	6,9754
HPA Rod - Rokide 2	753	9,38%	75,26%	7,5904
A Rod - Rokide	763	9,84%	78,18%	7,5982
A Rod - Rokide 2	814	9,99%	77,05%	6,9176

6. CONCLUSION

Based on the analysis presented in this report, the Rokide 2 is capable of delivering the same high-quality coating as the previous Rokide gun. The performance of Rokide 2 matches that of its predecessor.

Below is a summary of the key advantages of the Rokide 2 compared to the previous model:

- Brushless motor + servo controller which give a constant material speed and improved lifetime = **more reliable**.
- Gas control panel design allow the set of the pressure and the flow with higher accuracy and repeatability = better control of the spray parameters for the operator.
- **~60% lighter**, compact design and more ergonomic = easier to manipulate for operators
- Enables spraying of Rokide Rods, Wires and Flexicord materials simply by switching the nozzle configuration = open the field of possibilities of coatings