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Solutions Flash

Reduce processing cost and time using TriplexPro-210 to apply abradable coatings

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Today's situation

Thermal sprayed abradable coatings have long been considered an effective method to achieve clearance control in turbine engines, and in particular, aircraft turbine engines, offering the following advantages:

- A friable structure that does not cause excessive wear on rubbing components within the clearance control system or particulate damage to components downstream.
- Coating thickness that can be tailored to suit the application and can be machined to dimension using single point tools.
- A variety of available coating chemistries suitable for different operating conditions.
- Relatively simple application, with the ability to be removed and reapplied as needed at overhaul.

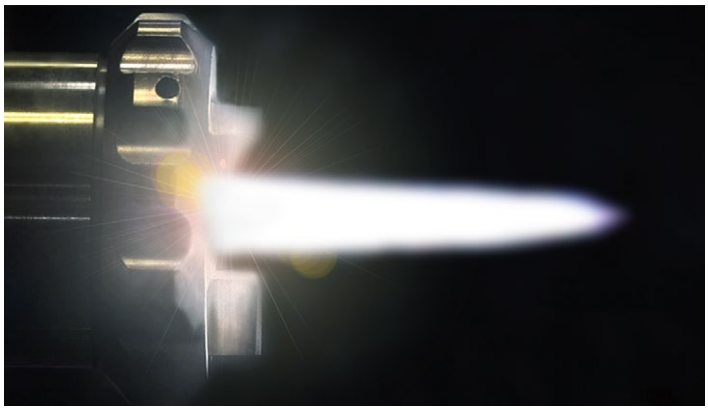
The matrix materials used for abradable materials are, in general, relatively inexpensive; however, the additives used to induce friability and other abradable properties are more costly rare earths or plastics. Furthermore, many of the parts coated with abradable materials are large, such as compressor casings and fan casings, and the coatings are applied quite thick. Using conventional spray guns, the spray rate can be improved, thereby reducing processing time, but at the expense of deposit efficiency. Even at optimum spray rates, the deposit efficiency that can be achieved using conventional spray guns and still achieve the desired coating structure is limited by the efficiency of these guns.

The Oerlikon Metco solution

A plasma spray system incorporating the Oerlikon Metco TriplexPro™-210 gun addresses the need for improved deposit efficiency for abradable coatings as well as faster application rates. Abradable coatings applied using TriplexPro-210 have optimal hardness and porosity and exhibit closely packed, homogeneous structures.

TriplexPro-210 is also economical when it comes to the consumption of spray process consumables, such as gas, gun parts that wear, and electricity. The bond coat and the top coat materials of the abradable coating system are sprayed using the same gun hardware, so changeover from one material to another is also fast and efficient.

Extremely stable, the TriplexPro-210 is capable of spraying for more than 200 hours without process drift and without the need to change gun wear parts.



The Oerlikon Metco TriplexPro-210 plasma spray gun with high enthalpy flame.

Solution description and validation

TriplexPro-210 saves time and reduces cost

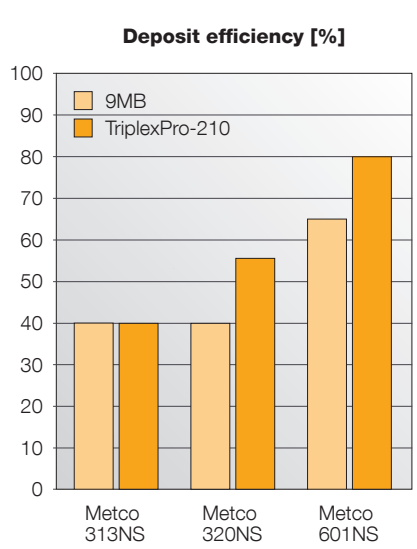
The Oerlikon Metco TriplexPro-210 Plasma Spray Gun can spray standard abradable materials with greater deposit efficiency and at higher spray rates, reducing both the cost of materials and processing time. This can result in a very significant savings to turbine engine component manufacturers and overhaul facilities.

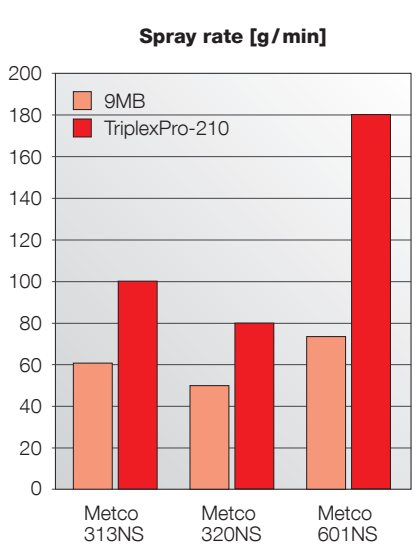
Deposit efficiency and spray rates

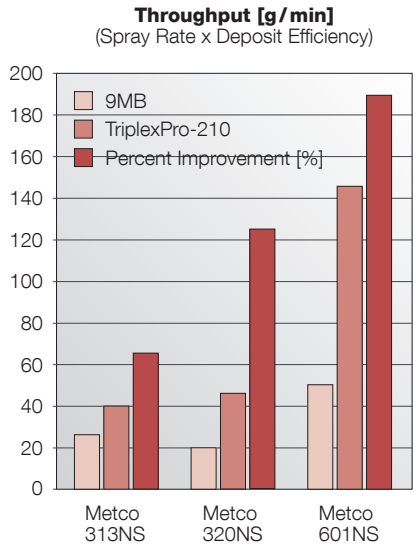
Abradable coating materials sprayed using TriplexPro-210 exhibit substantially higher deposit efficiencies compared to the same materials applied using the Oerlikon Metco 9MB plasma spray gun.

Of equal importance is that TriplexPro-210 can maintain these higher deposit efficiencies and the quality of the coating at feed rates that are as much as three times higher than the Oerlikon Metco 9MB gun.

A more complete picture emerges through an evaluation of coating throughput improvement (spray rate vs. deposit Efficiency), yet the power levels for TriplexPro-210 are comparable to other plasma guns.







TriplexPro-210 parameters	Metco 313NS		Metco 320NS		Metco 601NS	
Primary flow – Ar	90 NLPM	205.5 SCFH	76 NLPM	173.5 SCFH	160 NLPM	365 SCFH
Secondary flow – N_2	–	–	–	–	2 NLPM	4.5 SCFH
Current	350 A		250 A		330 A	
Power (approx.)	34 kW		22 kW		42 kW	

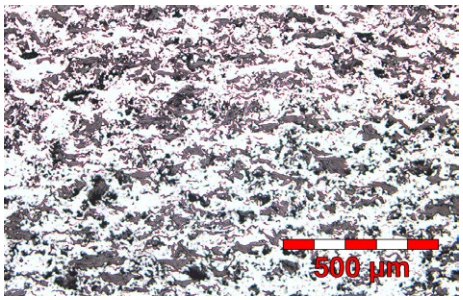
- Deposit efficiency and throughput data reported as mean values. Small variations (± 3.5 %) should be expected.
- Parameters may vary as a result of differences in system setup, material and quality/specification requirements.
- Metco 313NS and Metco 320NS results not optimized for total throughput. Additional optimization may produce even better results.

Additional processing considerations

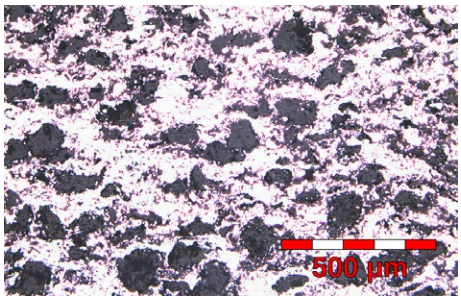
- With TriplexPro-210, many spray parameters can be achieved using only argon for the process gas. In some instances, small amounts of nitrogen can be used to increase overall energy. There is no need for complex ternary gas parameters and the infrastructure to support them.
- Bond coats are usually applied using the same gun configuration as the top coat, so material changeover from bond coat to top coat can be automated.
- The TriplexPro-210 maintains the spray process window with stable output for long periods without gun component wear. The cost of gun components are approximately US $2.00 per hour.
- The TriplexPro-210 achieves the process window again and again, without the need to adjust parameters.
- Validation testing has proven that the TriplexPro-210 can spray Metco 601NS for more than 200 hours with no change in coating quality or microstructure.

Coating quality

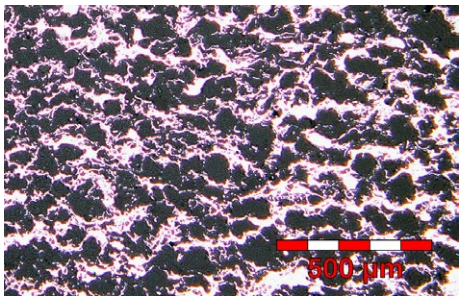
The coatings produced by the TriplexPro-210 plasma spray gun easily meet specifications. It can achieve the parameter window repeatedly and maintains it over long spray runs, even with numerous gun starts and stops.



Metco 313NS
Macrohardness (R15Y): 65 – 75
Fugitive Phase + Porosity: 45 – 50



Metco 320NS
Macrohardness (R15Y): 56 – 62
Fugitive Phase + Porosity: 51 – 57

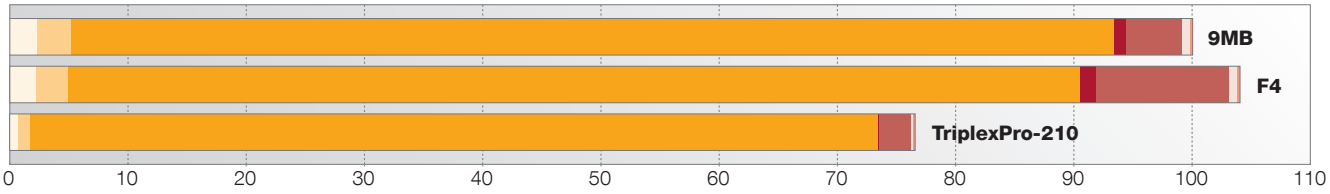


Metco 601NS
Macrohardness (R15Y): 62.5 – 70.5
Fugitive Phase + Porosity: 54.5 – 57

Processing costs

Total cost to use the TriplexPro-210 spray Metco 601NS indicates an overall savings of 24 % compared to the Metco 9MB series guns and a 27 % savings compared to the Metco F4 series guns.

Comparative coating costs for Metco 601NS



Capital cost	(10 year amortized depreciation)
Operator	(Grade 7 per U.S. Dept. of Commerce)
Coating material	(Standard pricing)
Spare parts	(Average hourly rate)
Utilities	(U.S. Dept. of Commerce national averages)
Maintenance	(Grade 11 per U.S. Dept. of Commerce)
Facilities	(U.S. Dept. of Commerce national averages)

Notes:
- Based on cost to apply 1 kg of material using standard parameters and normalized against the Metco 9MB plasma spray gun.
- Calculations based on fully utilized, single-shift operation.
- Costs will vary according to the Customer's location and system configuration.

Customer benefits

Effective

- Produce high quality abradable coating systems that meet or exceed OEM requirements for coating structure, hardness, porosity and abradability.
- Highly stable process ensures coating requirements are met with little or no process drift during long spray campaigns.
- Simplified infrastructure requirements and coating development resulting from single (argon only) or binary (argon with nitrogen bleed) process gas parameters.

Efficient

- Significantly increase production throughput with higher deposit efficiencies and/or spray rates.
- Quick changeover from bond coat to top coat using the same gun configuration.
- Highly stable process with no parameter adjustment required from part to part or day to day for more than 200 hours of spray time.

Economical

- Save material costs with higher deposit efficiencies.
- Save production time with higher spray rates, throughput values and a stable process that does not require constant adjustment.
- Inexpensive gun consumable cost, estimated at only US $2.00 per hour.
- Economical power and gas consumption.
- Save on spray run qualification costs resulting from higher process reproducibility.

Environmental benefits

- Reduce waste with higher deposition efficiency parameters.
- Low gun decibel level reduces shop noise levels.
- No thoriated tungsten components used, reducing a hazardous waste disposal issue.

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