

## Product Data Sheet

### TriplexPro-210 Advanced Plasma Spray Gun

**The Oerlikon Metco TriplexPro™-210 Plasma Spray Gun offers the ultimate in overall performance at power levels up to 90 kW.**

The advanced design features of the TriplexPro-210, unavailable on any other thermal spray gun, set new standards of effectiveness, efficiency, economics and environmentally friendly design.

#### Effective

TriplexPro-210 produces the widest range of high quality, air plasma coatings in the industry. The unique construction provides performance not achievable with standard plasma guns. The small overall size with right angle hose and cable attachments provides flexibility in terms of the component configurations that can be coated, including internal bores. A variety of spray velocities and plume shapes can be achieved with the selection of available nozzles.

#### Efficient

TriplexPro-210 saves powder, saves energy and saves time. Efficient heat transfer to the plasma gas and a constant energy state provide the ideal conditions for every powder particle in the plasma stream, improving deposit efficiencies and application rates.

#### Economical

A smart investment, TriplexPro-210 has the lowest cost per operating hour of any plasma spray gun in the industry. TriplexPro-210 has been validated to maintain constant performance for 200 hours at 62 kW with no service intervention, and can be run continuously for up to 16 shifts with little to no process drift or degradation of coating quality. Consumable parts are quickly exchanged at designated service intervals, and maintenance is easily performed in house, by the customer.

#### Environmentally Friendly

Operation of the TriplexPro-210 reduces the use of strategic resources, waste and noise pollution. High throughput efficiency significantly reduces the amount of overspray waste produced, and high thermal efficiency lowers overall power consumption. For many applications, excellent coatings are produced using argon-only parameters, eliminating the need for scarce helium gas. With all of this plus the elimination of thoriated tungsten gun components, TriplexPro-210 is the "green gun" of the 21<sup>st</sup> century.

#### What's New?

The TriplexPro-210 offers outstanding new features, that make it the easiest, most reliable TriplexPro gun ever:

#### Simplified consumable parts:

- Quicker, easier gun maintenance
- Significantly reduces the potential of mis-assembly

#### Keyed and numbered electrode power connectors:

- Simplifies data-logging and quality management

#### Helium-free\* operation:

- Reduce spray process costs using low helium or helium-free parameters using only Ar, Ar/N<sub>2</sub> or Ar/H<sub>2</sub>

#### More robust design:

- Stands up to the harsh thermal spray environment even better than previous TriplexPro guns, ensuring long spray runs will be trouble-free

\* Development of low helium or helium-free parameters are the responsibility of the customer or can be contracted through Oerlikon Metco Coating Solution Centers.



TriplexPro-210 Advanced Plasma Spray Gun

## 1 General Description

The TriplexPro-210 is a universal, all-purpose plasma gun that incorporates three essential design elements:

- Cascaded arc chamber
- Divided arc current
- Standard, exchangeable nozzles

Together, these features make the TriplexPro-210 the most versatile gun on the market today.

### 1.1 Cascaded Arc Control

Oerlikon Metco, who pioneered the cascaded approach to control and stabilization of arc voltage, has refined and enhanced this fundamental technology in the design of the TriplexPro-210. The key benefits of a cascaded arc design are:

- Higher voltage, lower amperage operation
- A magnitude of reduction in voltage oscillation
- The influence of gas flow and type on the arc behavior is eliminated

The cascade fixes the length of the electric arc and provides the arc with a starting path over a series of electrically neutral rings (neutrodes) within the arc chamber. Once the gun is ignited, only the common front anode (nozzle) is electrically connected to the power supply.

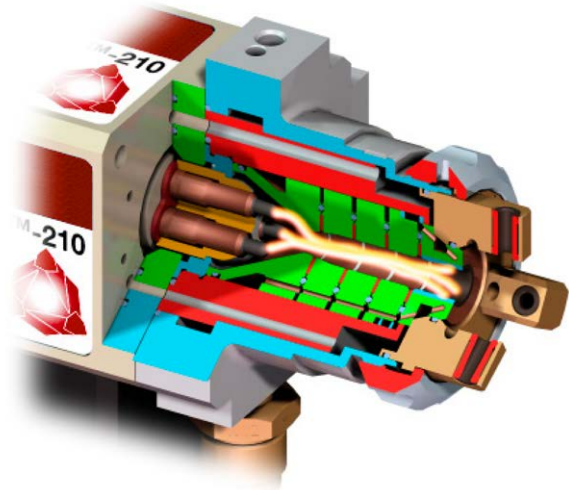
The fixed arc length has the advantage of stabilizing the plasma plume, eliminating the very high amplitude power oscillations in the three to five kHz range inherent in plasma guns without arc stabilization. This effect is often overlooked as modern plasma controllers display filtered readings of the actual power and voltage signals from the gun. Thus, for plasma guns without arc stabilization, a plasma parameter that is displayed as 65 V may actually oscillate as much as 20 to 85 V using a secondary gas of nitrogen or hydrogen. As the amplitude and frequency of the oscillation is directly linked to the heating and flight path of each powder particle, the stable plume produced by the TriplexPro-210 significantly increases deposit efficiency and coating quality consistency.

### 1.2 Divided Arc Current

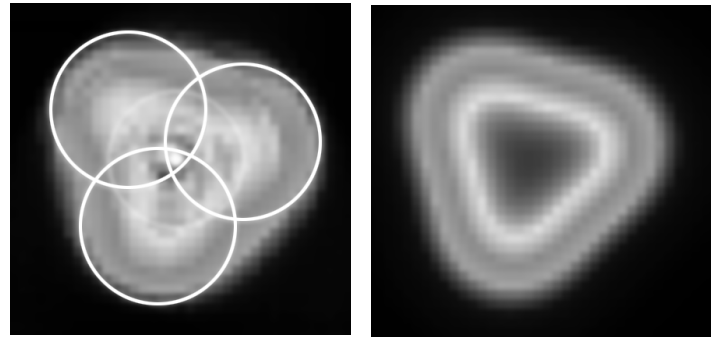
The TriplexPro-210 divides the total gun current equally between three electrodes. This improves gun component life and coating processing rates through:

- Uniform heating of the plasma gas
- Less erosion of the anode at arc attachment points
- Defines the location of arc attachments

Three arcs operating at a higher overall voltage has the advantage of stable gun operation over time. For example,



TriplexPro-210 Cascaded Arc Design



These reconstructed emissivity distributions show the ideal plasma geometry inherent with the TriplexPro-210. Left: Plasma jet cross-section. Right: Analytic model of 3 gaussian profiles.

a 200-hour endurance test of the TriplexPro-210 at 62 kW, with coating samples of chrome oxide periodically sprayed and evaluated, produced the following results:

- Voltage remained within  $\pm 1$  V of set point
- Individual electrode weight loss was less than 0.06 g (0.0021 oz)
- All coating samples demonstrated highly consistent coating quality and microstructure.

The three-arc arrangement is a key performance element of the TriplexPro-210. Studies of conventional plasma gun nozzles often show that the arc creates a wear pattern on one side of the anode bore. The relationship of the arc attachment relative to the radial position of the injector has, in some cases, a large effect on overall gun performance. The three arcs of the TriplexPro-210 have a magnetic repulsion separation of 120 degrees, which generate a symmetrical plume with defined zones of preferred powder injection.

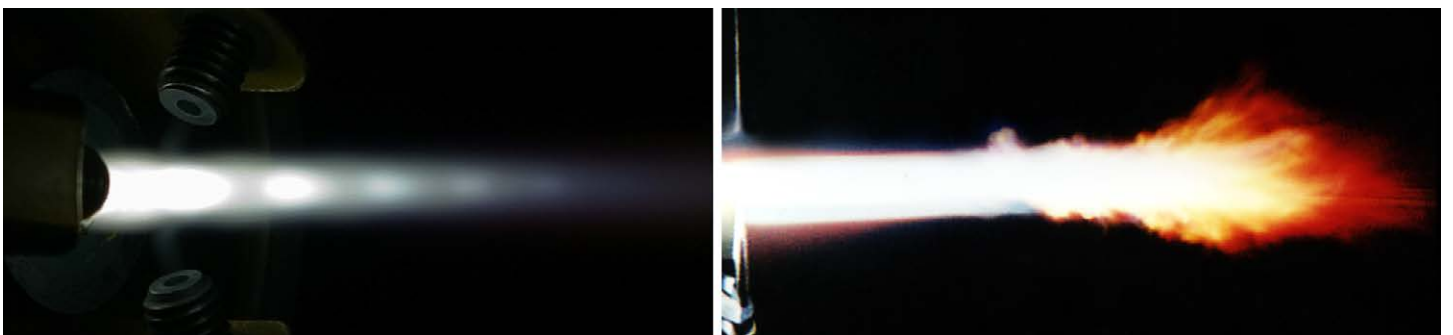
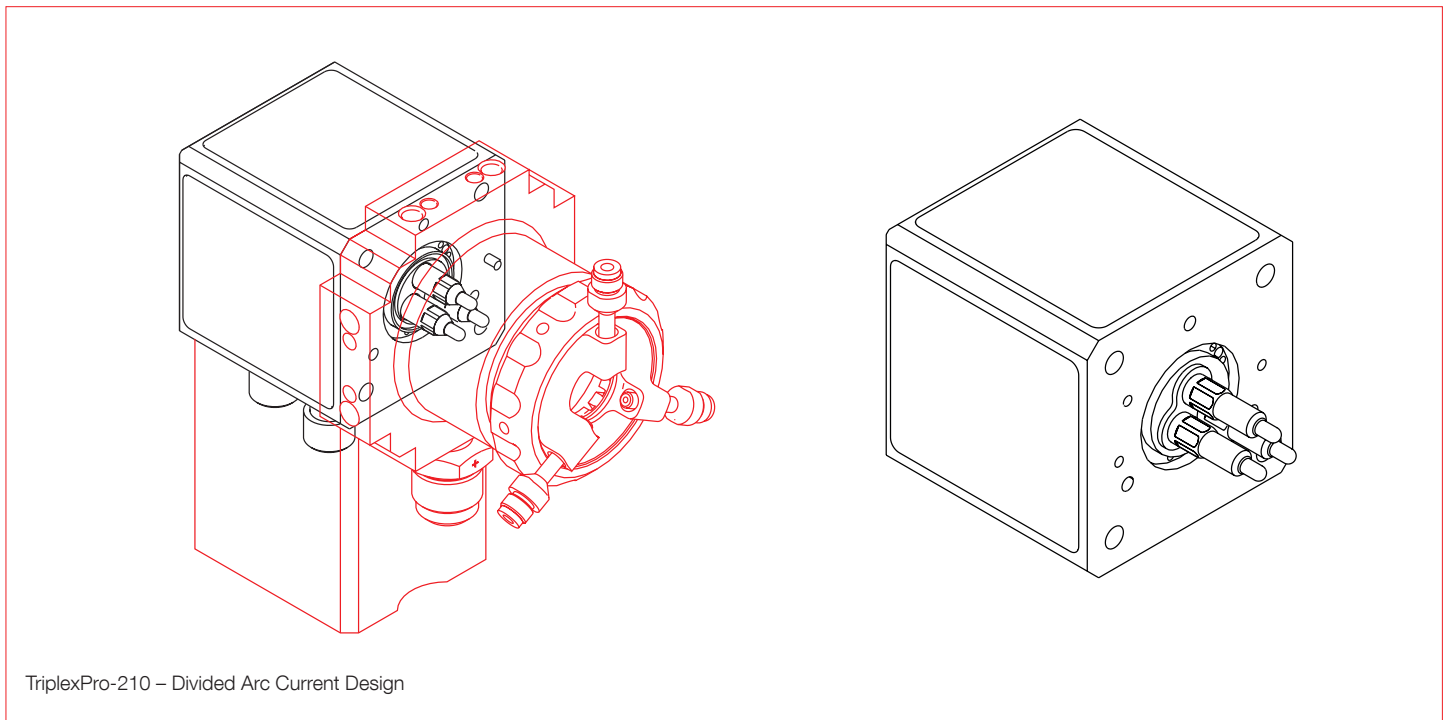
### 1.3 Configurable for Application Flexibility

The following nozzles, injectors and injector rings are available for the TriplexPro-210 which maximizes its usable range (std = standard, supplied with the gun; opt = optionally available):

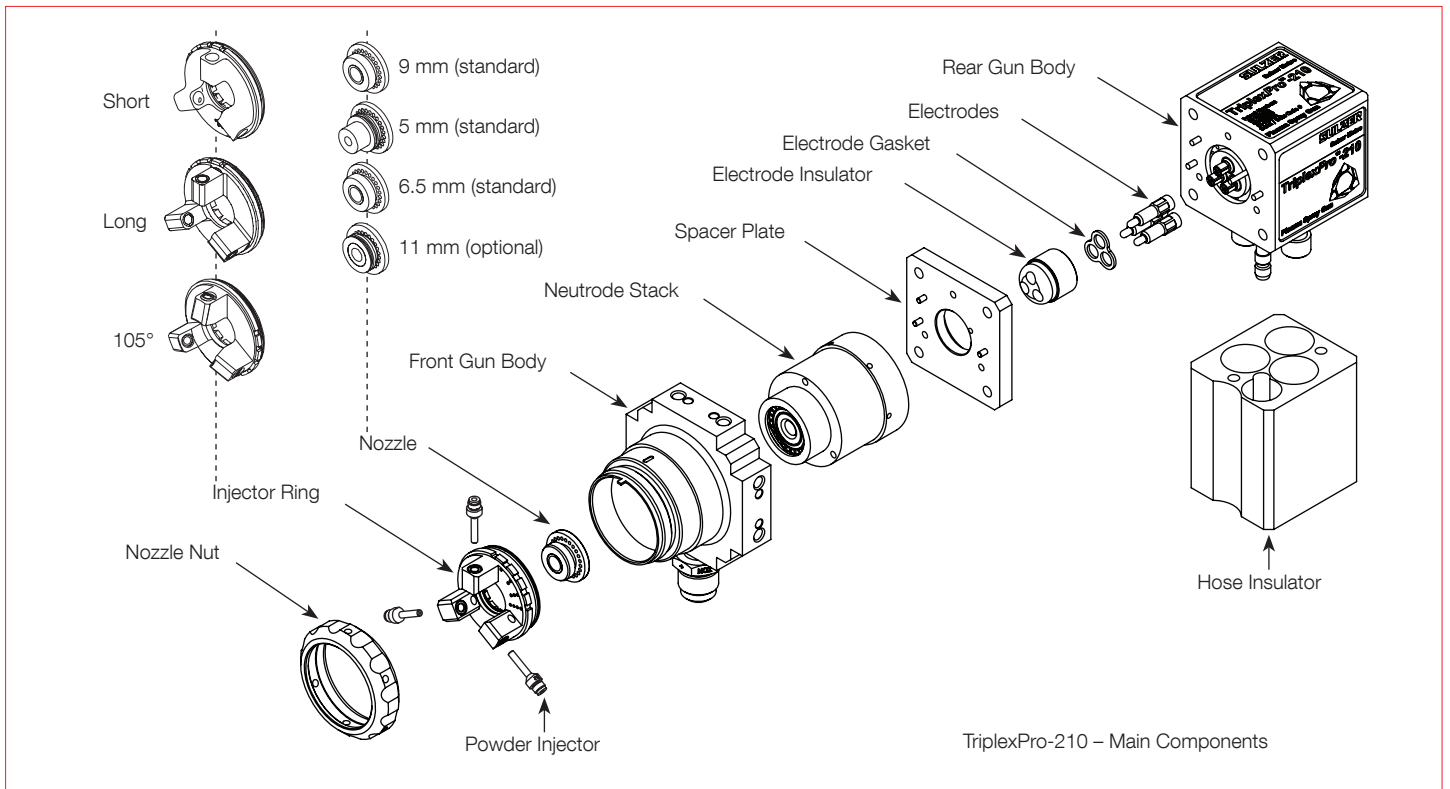
Item		Description / Application
Nozzle 9 mm	Std	Select alloys, ceramics, abrasives
Nozzle 6.5 mm	Std	Alloys, select ceramics (high velocity)
Nozzle 5 mm	Std	Carbides (high velocity)
Nozzle 11 mm	Opt	Zirconia, select TBCs (high enthalpy)
Injector rings	Std	105° long, 90° long and 90° short
Powder injectors	Std	2.0 mm and 1.8 mm
Powder injectors	Opt	1.5 mm
Powder injectors - long life	Opt	2.0 mm, 1.8 mm or 1.5 mm

Each nozzle is designed for a specific function and is easily exchanged within minutes. Oerlikon Metco has leveraged the design freedom that results from the unique arc control

design of the gun to offer nozzles that cover the normal meters associated with plasma spray as well as extend the range of the gun into new, unique operational ranges.



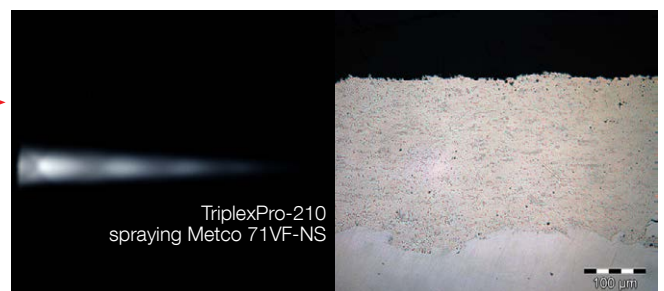
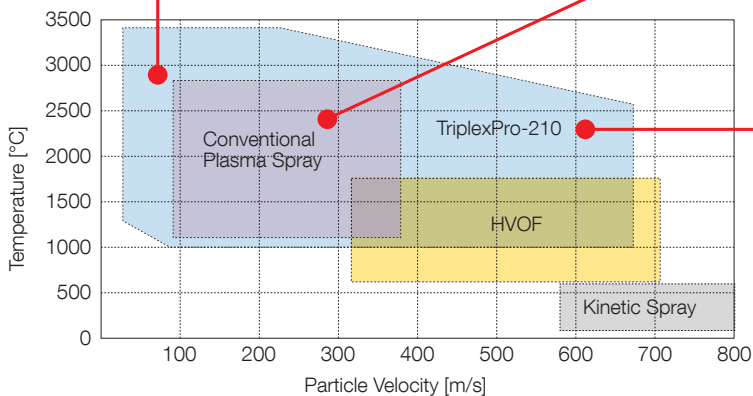
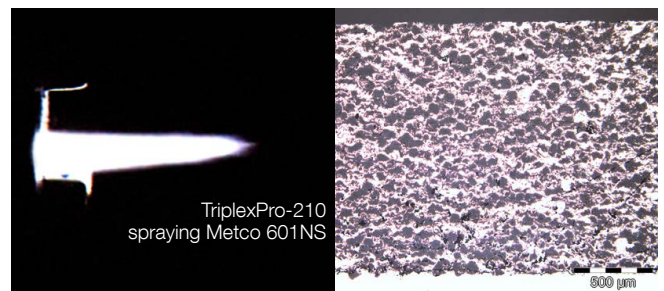
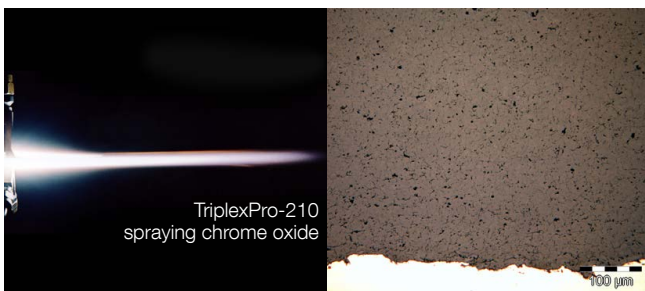
The unprecedented operational scope of TriplexPro-210 expands the range of plasma spray applications



## 2 Features and Benefits

### 2.1 Effectiveness

- Designed for universal application use
- Produces the widest range of quality air plasma coatings possible
- Enhanced flexibility with included standard nozzles
- Plasma arc is stable over a wide range of gas flows, gas mixtures and pressures
- Small size permits coating of many part configurations, including some internal bores



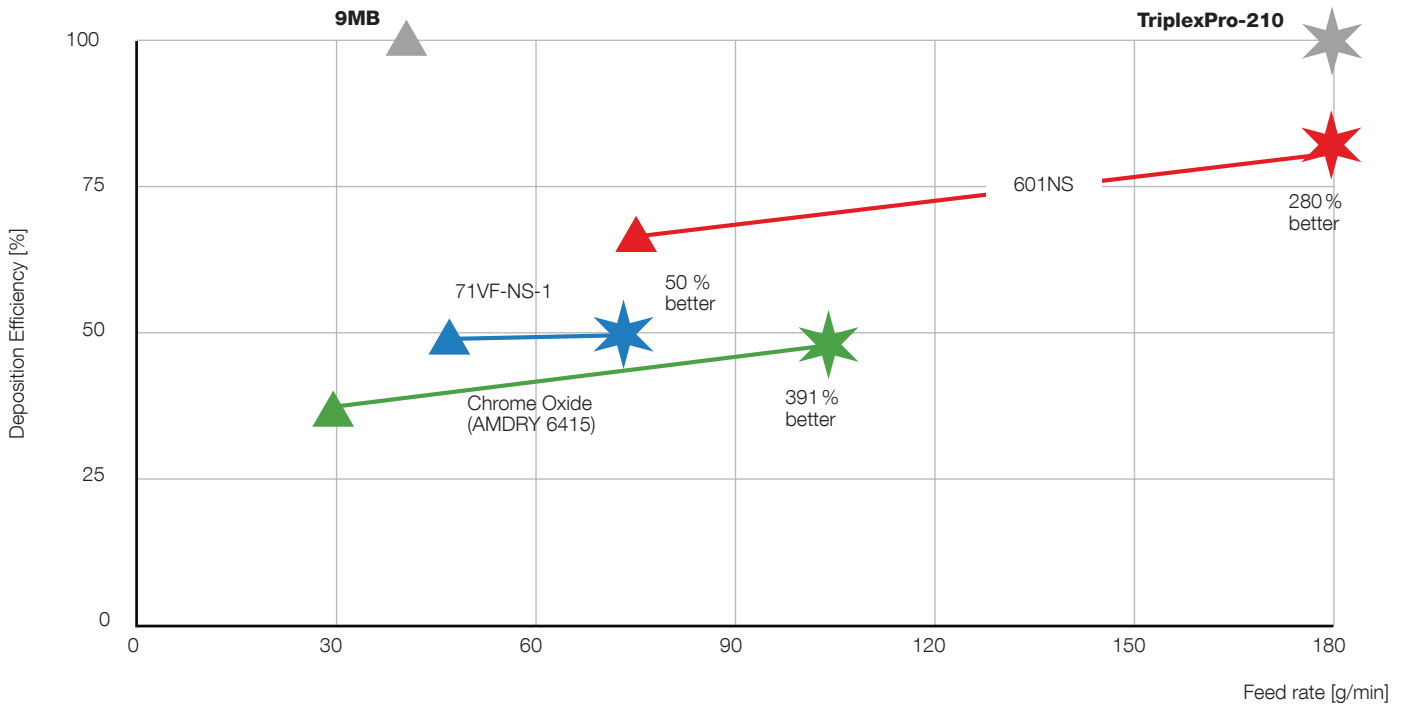
TriplexPro-210's Wide Application Range



## 2.2 Efficiency

- High throughput saves powder, energy and time
- Power divided over three individual arcs for more efficient heat transfer into the plasma plume
- Arcs are maintained at a fixed length for constant voltage and unprecedented stability
- Constant energy provides the ideal plasma state for all powder particles, improving deposit efficiency and application rates

- Highly reproducible, TriplexPro-210 achieves the desired process window again and again
- Redesigned to improve thermal management and robustness
- Keyed and numbered power connectors simplifies data logging and quality management

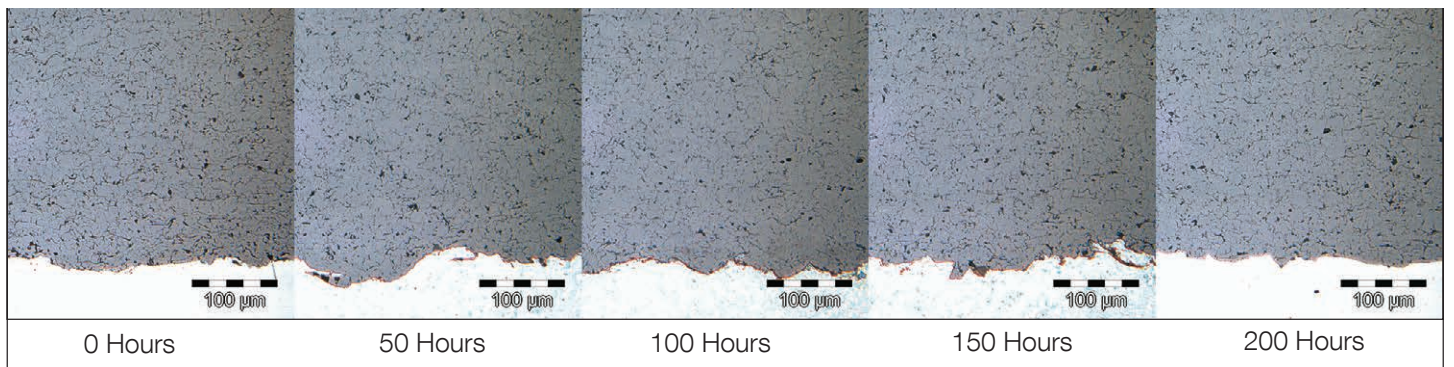


Throughput comparison (feed rate vs DE) between TriplexPro-210 and 9MB

## 2.3 Economy

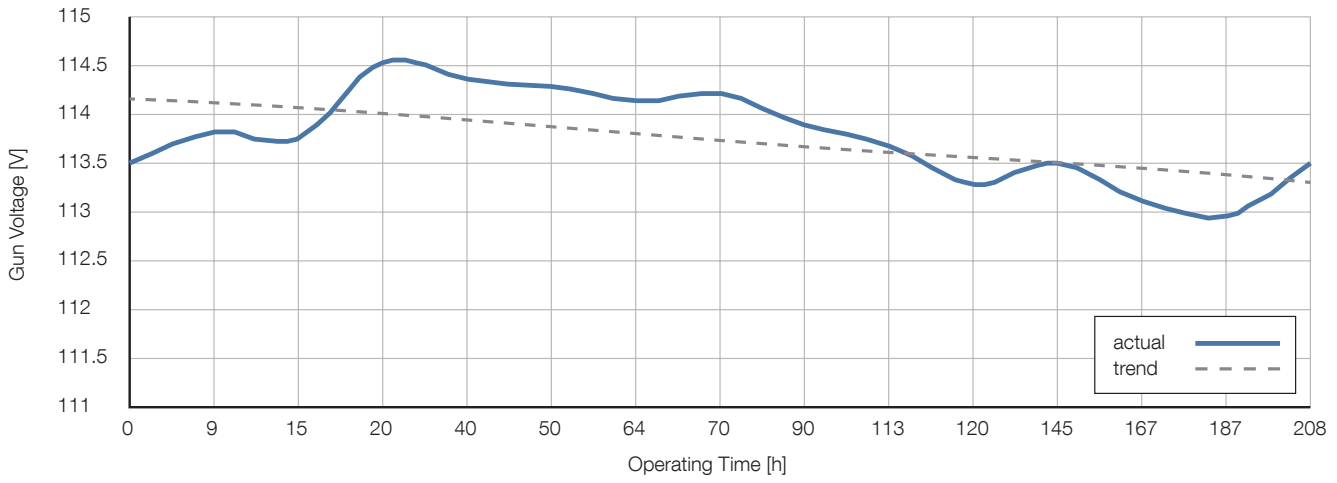
- Maintains constant performance over long periods with high coating consistency and no maintenance
- Runs continuously for up to 16 spray shifts without maintenance

- Redesigned to significantly simplify maintenance, when required, reducing time and cost
- Quick exchange of gun consumables at designated service intervals, easily done in-house



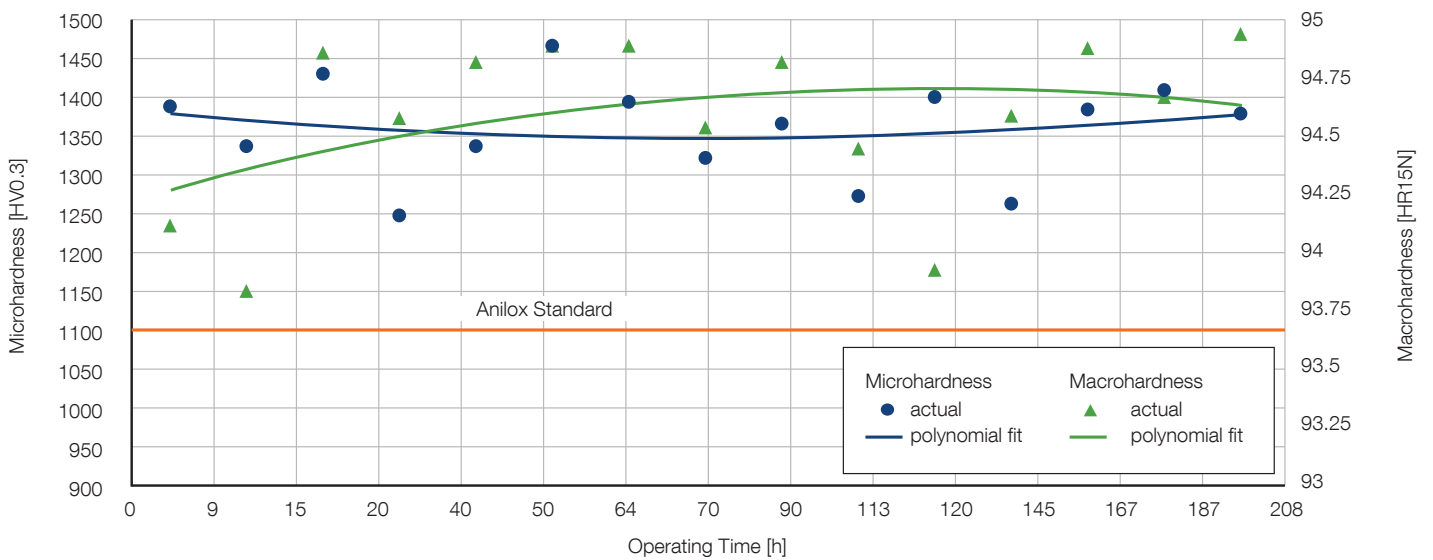
TriplexPro-210 provides consistent coating results over long periods with no maintenance required, as seen from this 200 hour endurance test of chrome oxide sprayed at 62 kW. (AMDRY 6420 with gun stopped and started before each test sample for a total of 62 ignitions).

### Change in Gun Voltage Over Time



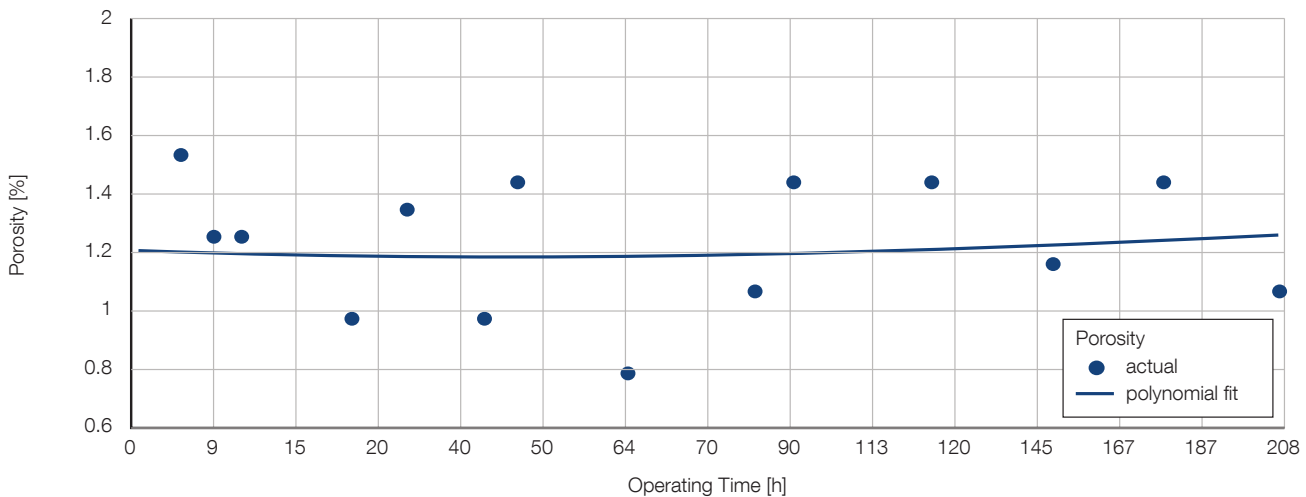
### Microhardness and Macrohardness Over Time

(Chrome Oxide at 110 mm stand-off distance)



### Porosity Change Over Time

(Chrome Oxide at 110 mm stand-off distance)



## 2.4 Environmentally Friendly

- High thermal efficiency reduces power consumption
- High throughput significantly reduces overspray waste
- Excellent coatings can be produced with argon-only parameters, reducing the need to use expensive helium gas
- Quiet operation with reduced noise using the standard nozzles. In the high energy configuration to spray carbide materials, noise is lower than HVOF spray guns producing comparable coatings.
- No thoriated tungsten components, eliminates a waste disposal issue

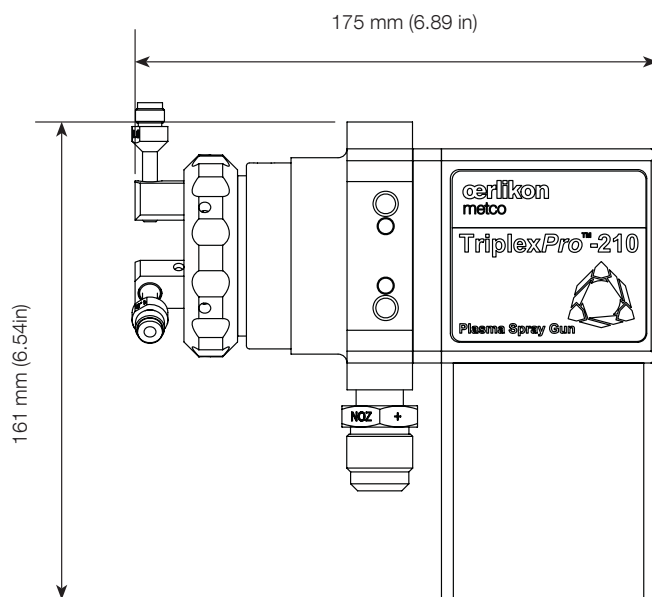
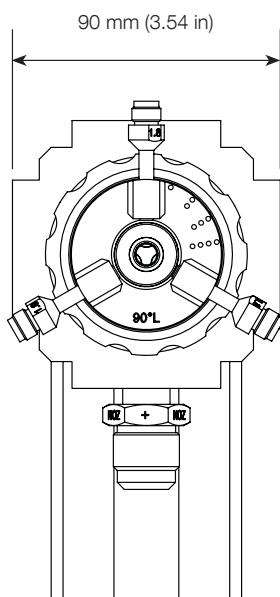
## 3 Accessories and Options

Oerlikon Metco offers a choice of hoses and cables in different lengths, powder injectors of various bore sizes and nozzles to be used with specific spray powders and to achieve a wide variety of plume enthalpies. For a complete list of optional parts and spare parts, please refer to the parts list section of the instruction manual.

Customers can choose from Oerlikon Metco's extensive portfolio of thermal spray materials suitable for the plasma spray process. These include a variety of ceramics, alloys, superalloys, blends and self-fluxing materials to meet a wide range of surfacing needs.

## 4 Technical Data

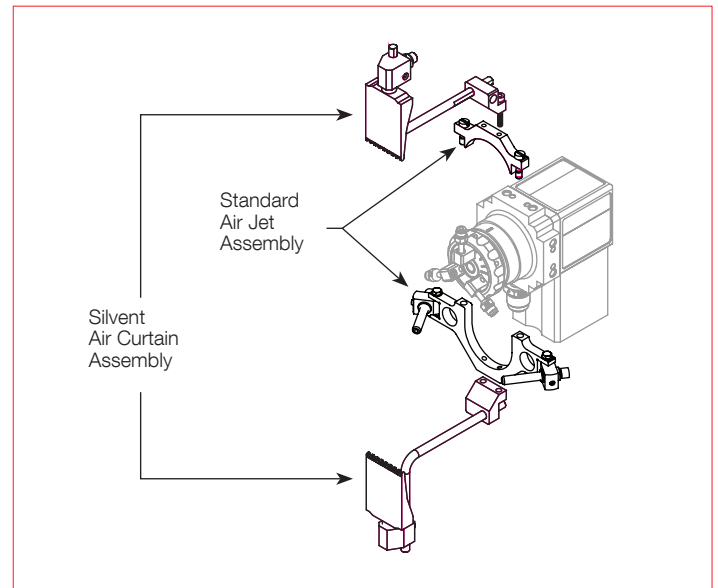
### 4.1 Dimensions



### 3.1 Air Jets

Two types of air jets are available as options:

- **Standard Air Jet Assembly:** Designed to cool the substrate during the coating process
- **Silvent Air Curtain Assembly:** Attaches to the Standard Air Jet Assembly to aid in the removal of overspray dust and reduce the potential of unmelted particles in the coating



## 4.2 Specifications

### Power Rating

Maximum power – 100 % duty cycle	
Standard operation	65 kW
High velocity operation <sup>a, b</sup>	90 kW
Maximum voltage	
Standard operation	132 V
High velocity operation <sup>b</sup>	200 V

### Powder Feed

Number of powder ports	3
Number of radial detents	5
Radial angles	0°, 20°, 40°, 60°, 80°

### Gas Quality

Argon – Ar	
Minimum requirements	99.95 %
European standard	99.998 %
Helium – He	
Minimum requirements	99.995 %
European standard	99.998 %
Nitrogen – N <sub>2</sub>	
Minimum requirements	99.7 %
European standard	99.996 %

### Cooling Water Requirements

Inlet temperature	max.	18 °C	65 °F
Inlet pressure		13.8 to 17 bar	200 to 250 psi
Flow	min.	18 l/min	4.75 gal/min
Total hardness		0.5 Grade F	
		0.35 Grade E	
		0.28 Grade D	
Conductivity	max.	5 µS	
Dissolved oxygen	max.	10 ppm	

### Weight

Without cooling jets, hoses and cables	2.6 kg	5.7 lb
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### Compatibility

Controllers <sup>c</sup>	MultiCoat™, UniCoat™
Powder feeder	9MP-CL-20, Single/Twin 120-A, Single 220-A
Power supply	TriStar™ IPS-500/200

<sup>a</sup> This value is at 450 A and 200 V

<sup>b</sup> Life of consumable components is reduced using high velocity parameters

<sup>c</sup> Equipped with 200 NLPM Argon, 200 NLPM Helium and 50 NLPM Nitrogen capability. Existing MultiCoat and UniCoat systems can be field upgraded.

TriplexPro-210 is protected under U.S. Patents 5225652, 5406046, 7030336 and 7759599 with additional patents pending.