

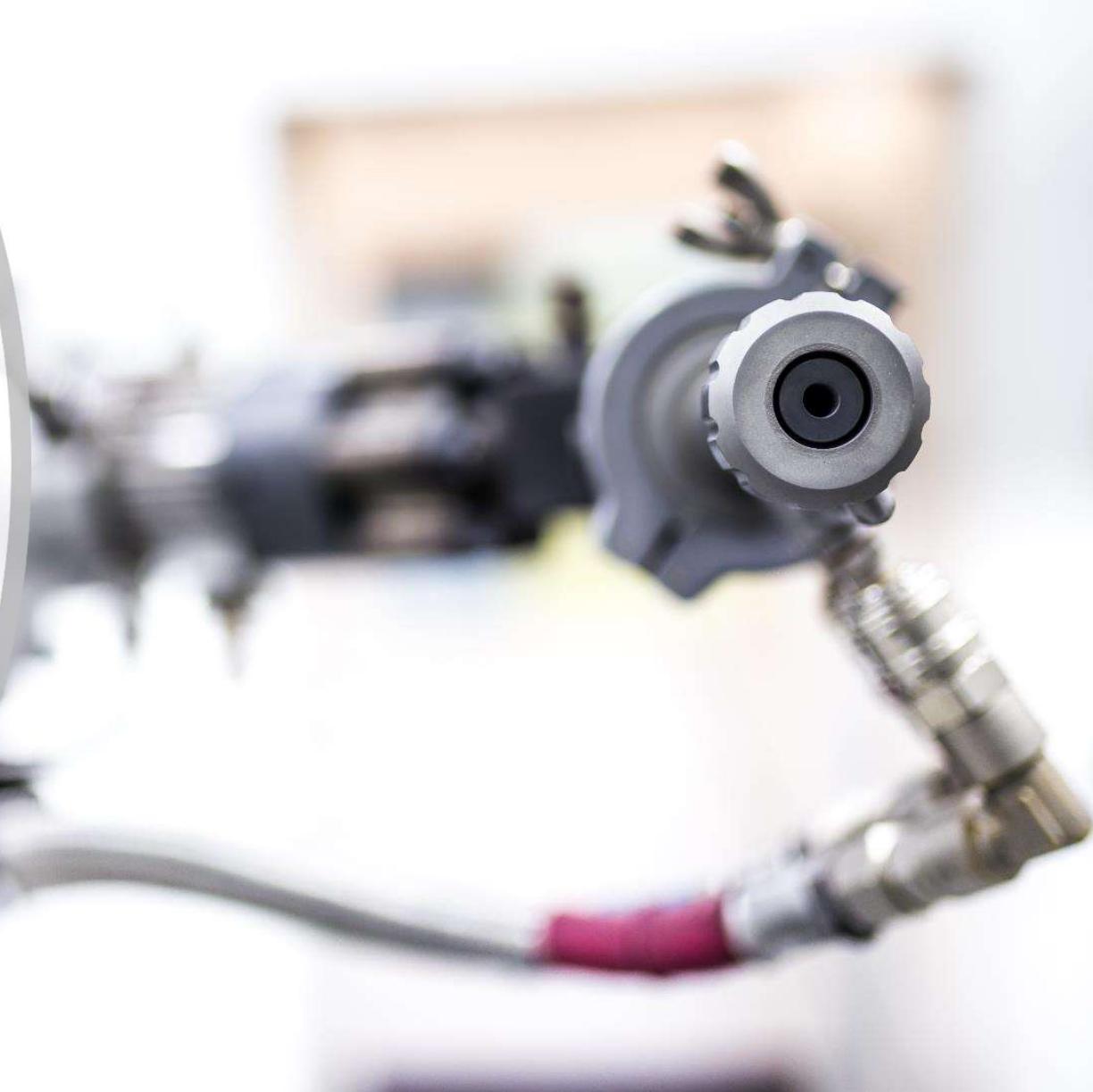


We. Spray. Future.

Global technology leader for industrial cold spray

Niobium alloy C-103 for high-performance space applications – using Cold Spray Additive Manufacturing (CSAM)

Cold Spray Club Meeting, Barcelona
26.04.2024, Markus Brotsack





Agenda

- Company Introduction
- Latest developments for high-pressure cold spray equipment
- CSAM C-103 test part
- Properties of C-103 test part

Global technology leader for industrial cold spray

impact

OUR IMPACT ON COLD SPRAY

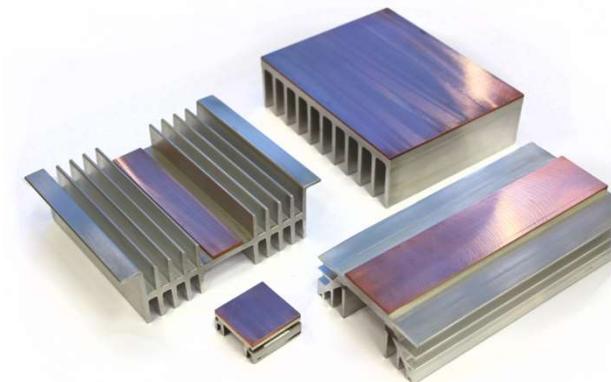
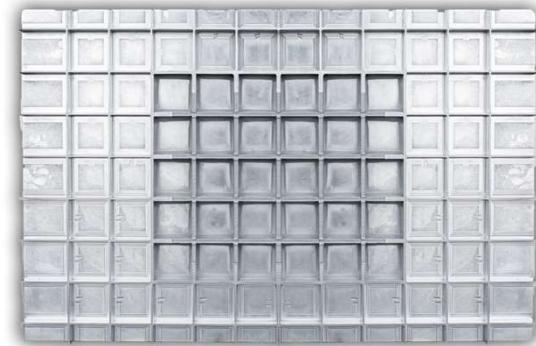
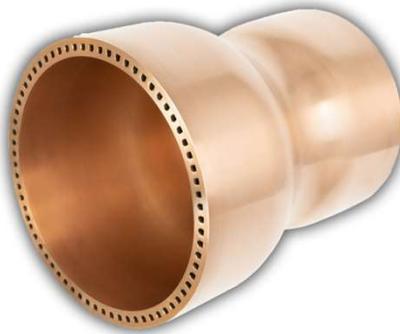
- Date of Foundation: April 12, 2010
- >20 years of experience in Cold Spray Technology
- Global technology leader in High Pressure Cold Spray Equipment for industrial applications



Global technology leader for industrial cold spray

OUR IMPACT ON COLD SPRAY

- In-House development and manufacturing
- Cold Spray R&D Center
- >100 Impact Systems installed worldwide
- 45 employees at headquarter in Germany



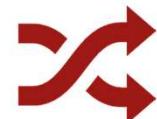
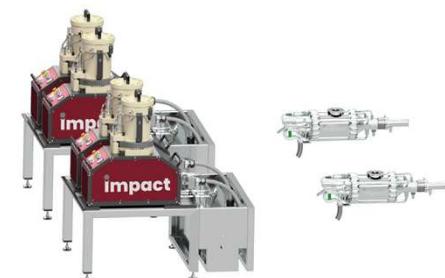


New Generation Impact Spray System EvoCSII

impact

Ready for industry and 24/7 operation

- A wide range of system configurations possible
 - Operation of 2 guns in parallel
 - Up to 4 powder feeders
- Various interfaces for integration in production lines and higher level controls
- Monitoring of more than 150 process parameters and system data
 - Closed loop process control
 - Preventive maintenance
 - Machine learning



2 Spray Guns



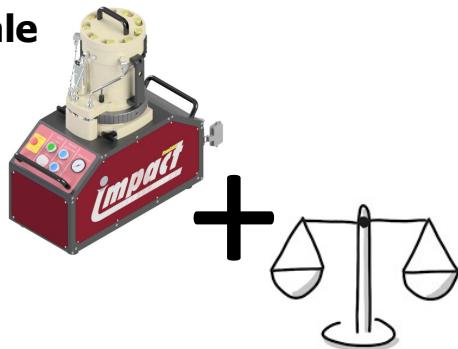
for parallel operation

4 Powder Feeders
for parallel operation



Upcoming system hardware

Powder feeder with integrated scale



- Powder feeding according to weight/minute
- Permanent monitoring of the feed rate
- Recording of all powder related data possible

Impact Gun 8/12

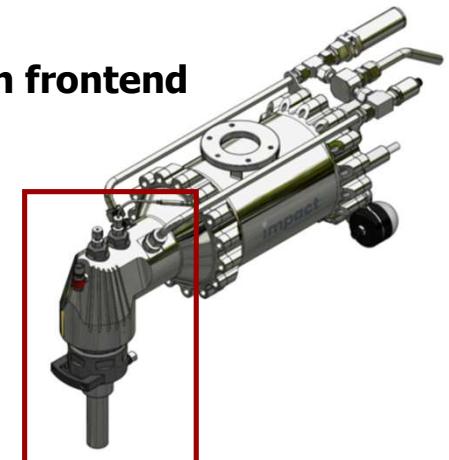


80 bar

1200 °C

- Process gas pressure up to 80 bar
- Process gas temperature up to 1200 °C
- Max. parameter combinations 80 bar / 1000°C or 60 bar / 1200°C

New gun frontend



- Central injection of the powder to the pre-chamber
- Water cooled powder injector
- Water cooled pre-chamber
- Water cooled nozzle

Trusting cooperations – our customers and partners





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C-103 alloy parameter screening

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- Test of three different powders from two different suppliers with different PSD
- Optimise:
 - Temperatur
 - Pressure
 - Feed rate
- Samples 1.1.1 to 1.6.1 show the results for different parameter sets



C-103 alloy parameter screening

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C-103 alloy test part with flange

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C-103 alloy test part with flange

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Test part on mandrel tube with flange
on one end

Size:

Diameter: ~ 140 mm
Length: ~ 125 mm
Thickness: ~ 2 mm
(as sprayed)

Flange:

Length: ~4 mm
Thickness: ~8 mm



C-103 alloy test part with flange - machined

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C-103 alloy test part properties



Cold Spray corner stone data:

- Deposition Efficiency (DE): 92,4%
- Powder feed rate: 4,83 kg/h → 80 g/min
- Deposition Rate (DR): 4,46 kg/h → 74,3 g/min
- Hardness Vickers: ~235 HV 0,3

C-103 alloy test part – cross cuts

impact



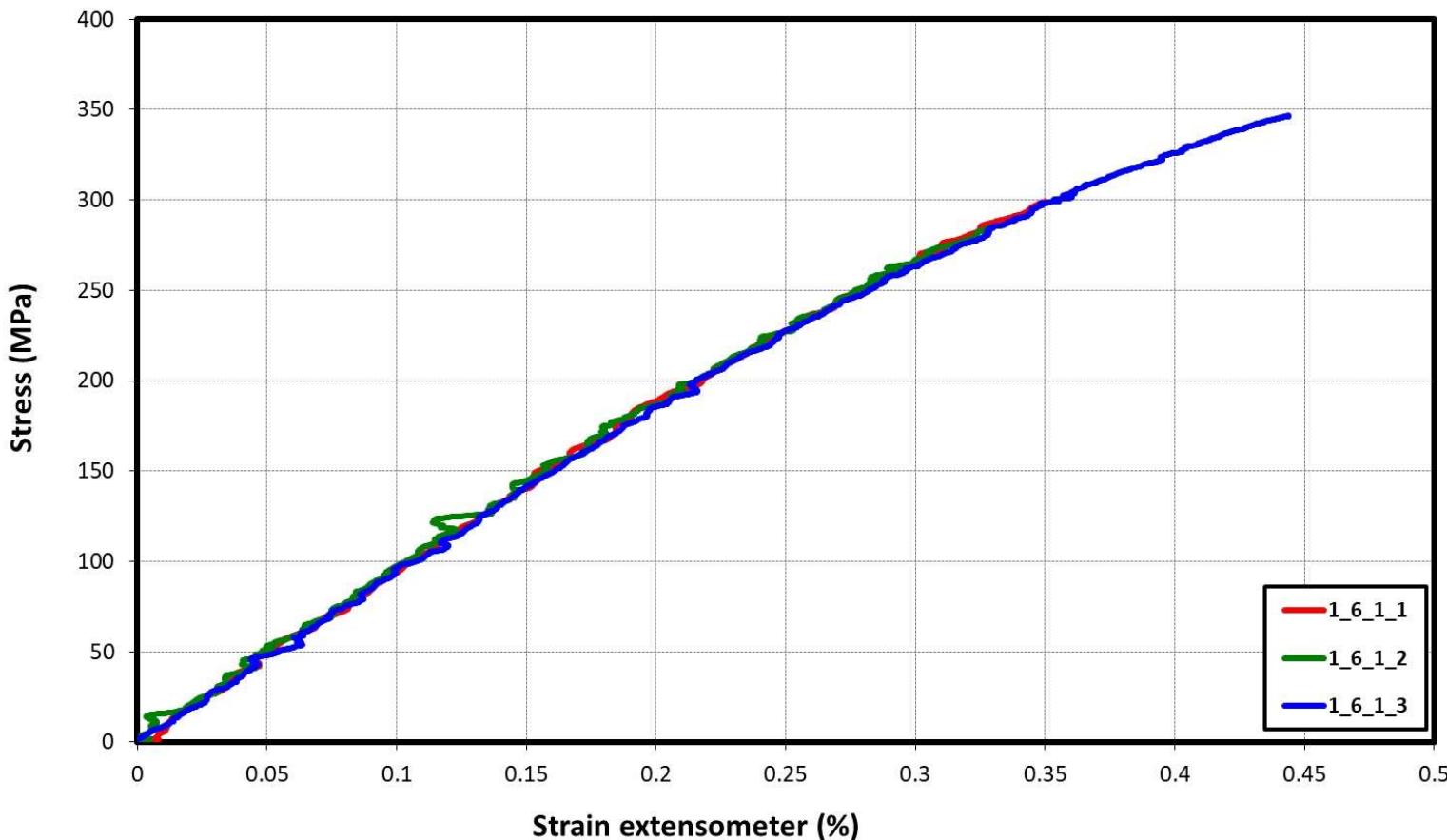
C-103 coating on Al substrate

Cross cuts on witness parts



C-103 alloy test part: stress – strain curve

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Ductility: ~0.45%

Stress: ~345 MPa

C-103 alloy test part – tensile specimen

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NOTE:

Tensile specimens had a very rough surface after milling (?) → therefore the weak results

→ We'll prepare new tensile specimens and characterise the tensile properties in as deposited and after heat treatment state



Specimen	Temp. °C	a ₀ mm	b ₀ mm	b _u mm	R _{p0,2} MPa	R _m MPa	A ₀ %	A %	Z %
1_6_1_1	23	2.44	3.01	3.01	-	299	0.03	0.03	-
1_6_1_2	23	2.44	3.01	3.01	-	285	0.03	0.03	-
1_6_1_3	23	2.10	3.01	3.01	-	347	0.07	0.07	-

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Join us.