

INTRODUCTION OF INGPULS MEDICAL

From Ingpuls to Ingpuls Medical

Company overview



Ingpuls Headquarter in Bochum

Ingpuls & Ingpuls Medical cover 50,000 sqr ft total production space

Ingpuls Medical site, located on Ingpuls campus

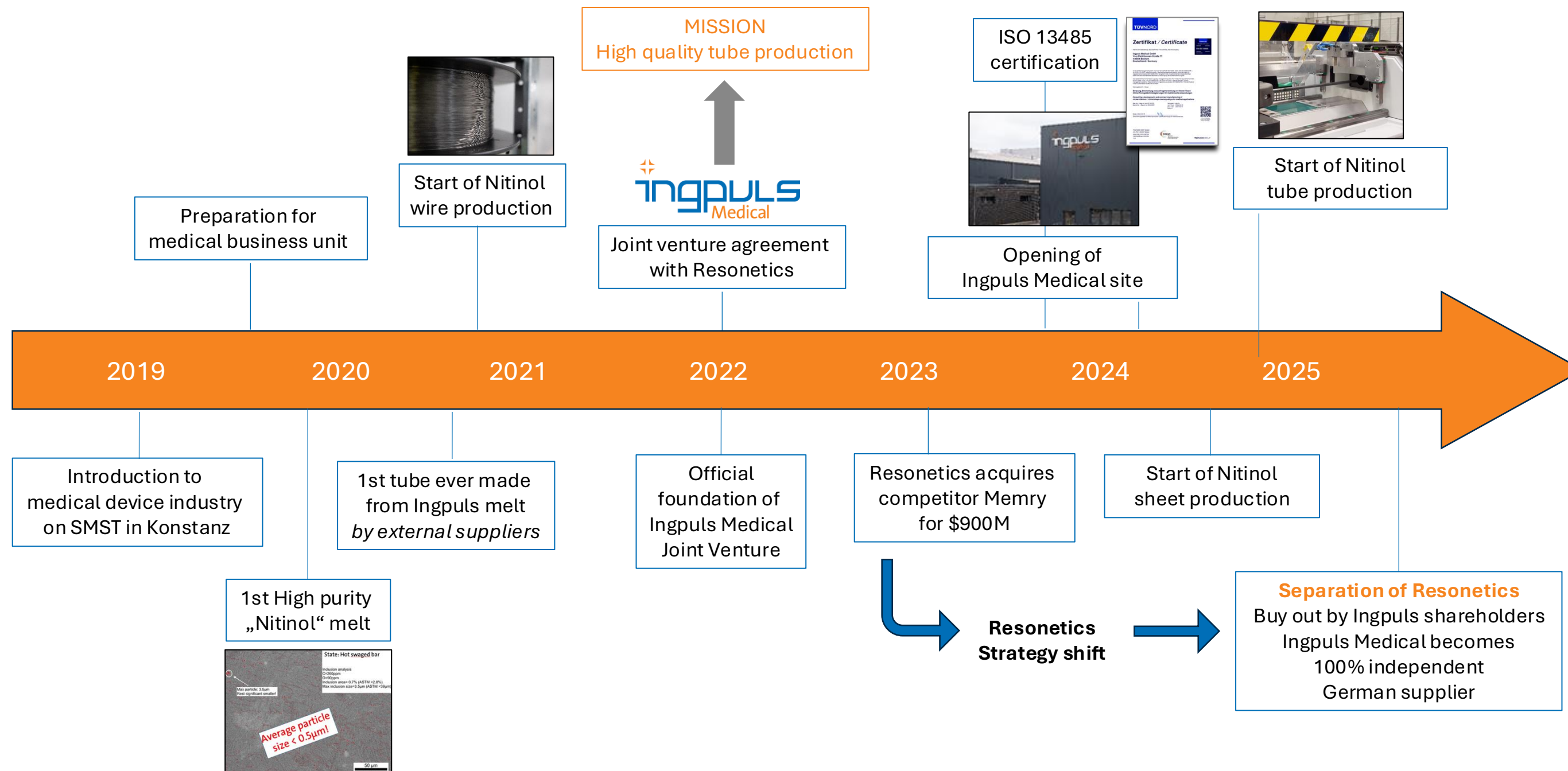
Ingpuls Medical is the vertical arm of Ingpuls, build to serve the Medical device industry best.



Ingpuls Medical



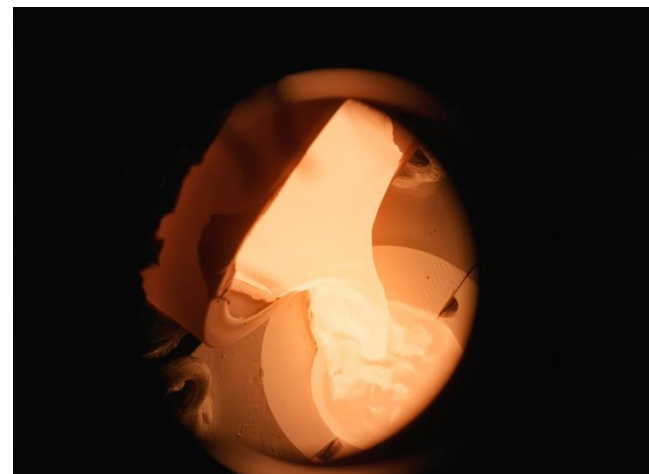
How it started and how things changed...



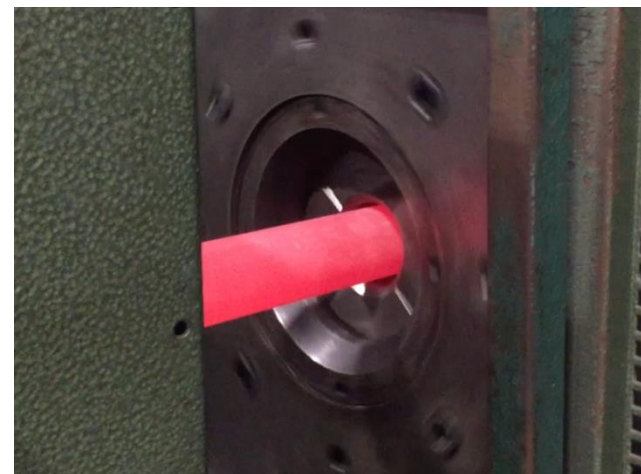
Know-how & Capabilities

Fully integrated production from melting to final inspection

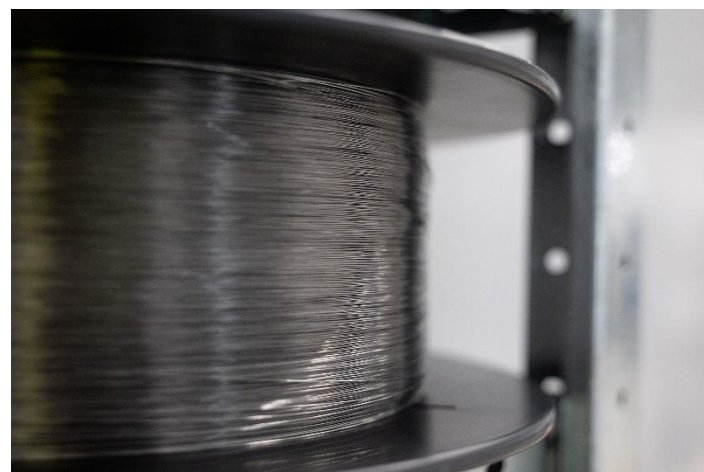
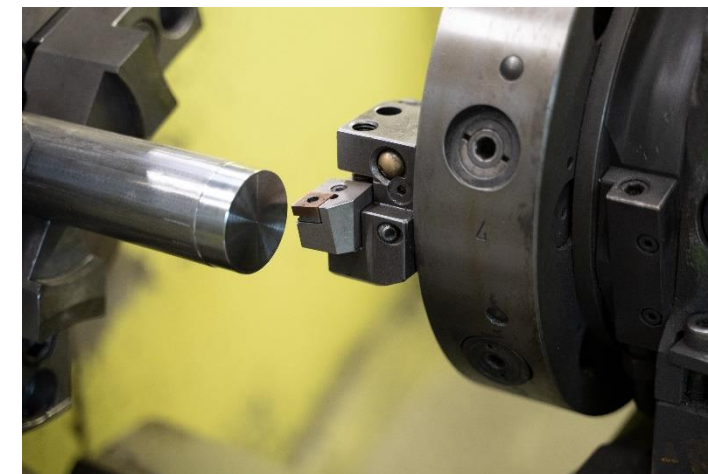
High Performance Vacuum Induction Melting



Hot Swaging



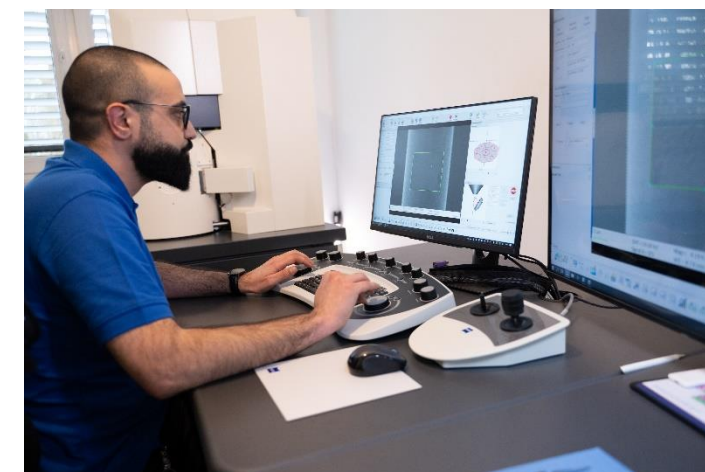
CNC Machining



Wire & Tube Drawing



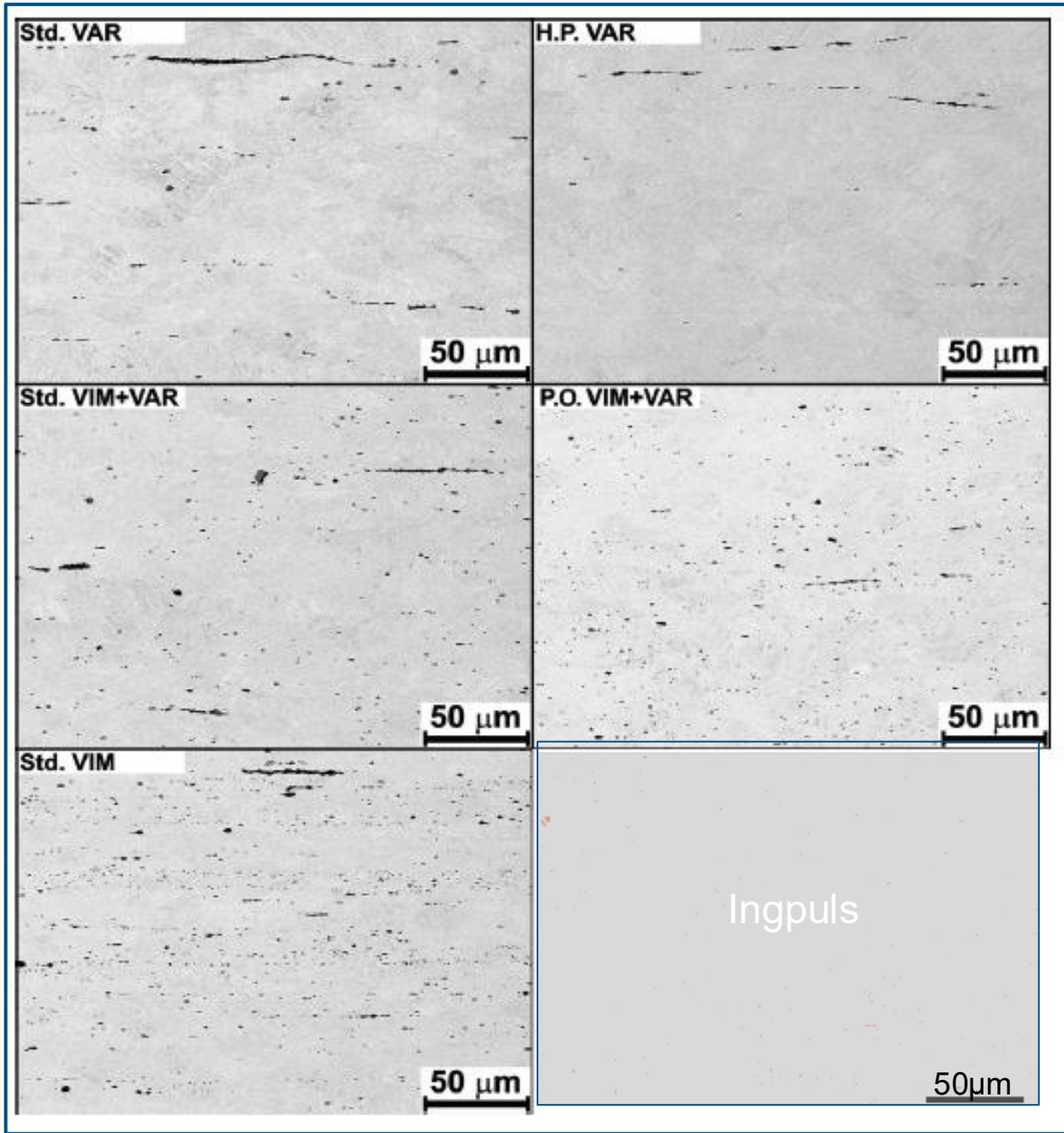
Heat Treatment



Professional Inspection

Advanced Microcleanliness by best in class Metallurgy

Benchmark of microcleanliness



From: A statistical approach to understand the role of inclusions on the fatigue resistance of superelastic Nitinol wire and tubing.

Ingpuls Medical Microcleanliness

Inclusion area: <1%
Max inclusion size: <5μm

Premium SMA raw material



SMA wires
Premium SMA tubes
SMA powder

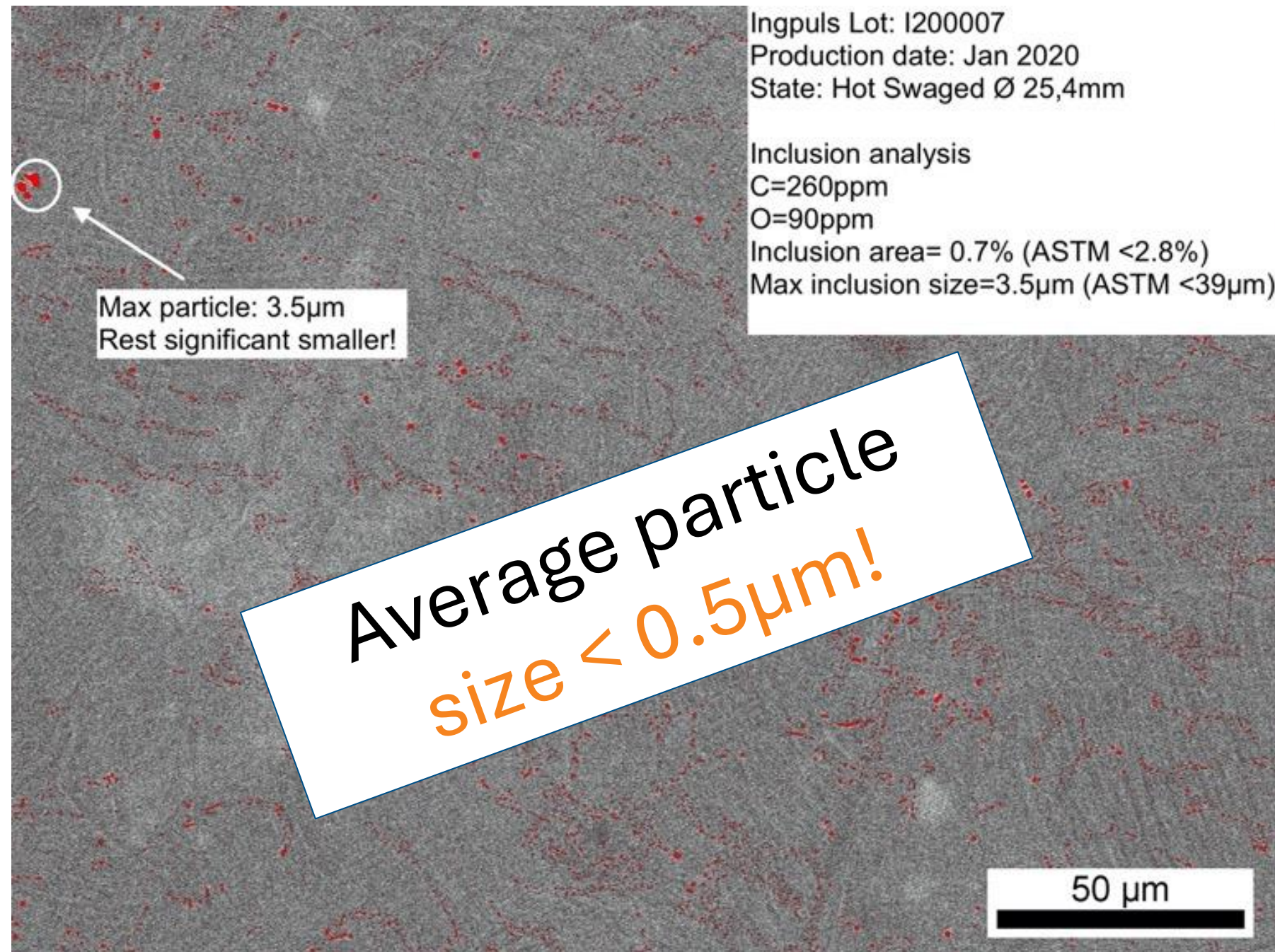


Delivery systems
Premium Stents
Additive products



Advanced Microcleanliness by best in Class Metallurgy

State: Hot swaged bar



High Purity Nitinol by Ingpus Medical

Portfolio 2026



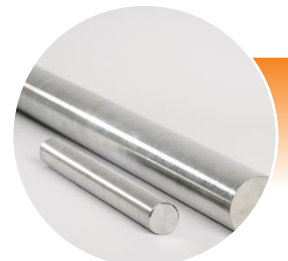
Electrodes & Powder

- Electrodes with customized compositions
- Powder for additive manufacturing



Sheets

- Hot rolled sheets with thickness of 1-3mm



Bars

- Hot swaged bars Ø 6-20mm



Tubes & Hollows

- Hollows for tube drawing OD 10-18mm with common OD/ID ratios
- Tubes of OD 0.2-10mm, starting in Q1/26



Wires

- Endo-, Stent- and Guidewires Ø 0.025 – 1.2mm

Supplier qualification Reasons for and how to...

Why companies add or switch a Nitinol supplier

Customer survey / complaints...



Our customers reported about several reasons to us why they want to add us or to switch to us as a Nitinol supplier:

- My supplier became my competitor (Supply chain)
- Extended lead times (Performance)
- Price increase (Cost)
- Weak support or communication / intransparency (Performance)
- No US supplier allowed (Supply chain)
- Bad or inconsistent quality (Performance)
- My supplier denied to continue deliveries (Supply chain)
- European supplier needed (Supply Chain)

We conclude, cost is not the main reason. Strategic stability and consistent delivery performance seem to be the main criteria to choose a Nitinol supplier.

How to add or switch a supplier in detail

Smart approach



In step 1 our customer usually requires “the same material” as before to avoid any adjustments of his downstream processing parameters. Only when the material has been accepted and supply has been granted, the customer is open to innovate in step 2 to improve product performances.

Ingpuls Medical is a contract manufacturer for Nitinol products.

Melting, conversion and all processing steps are covered in-house to allow for highspeed R&D projects.

Therefore, we can support our customer in supplier qualification process with professional Nitinol experts and our in-house state of the art lab and quality equipment.

5 step approach in detail:

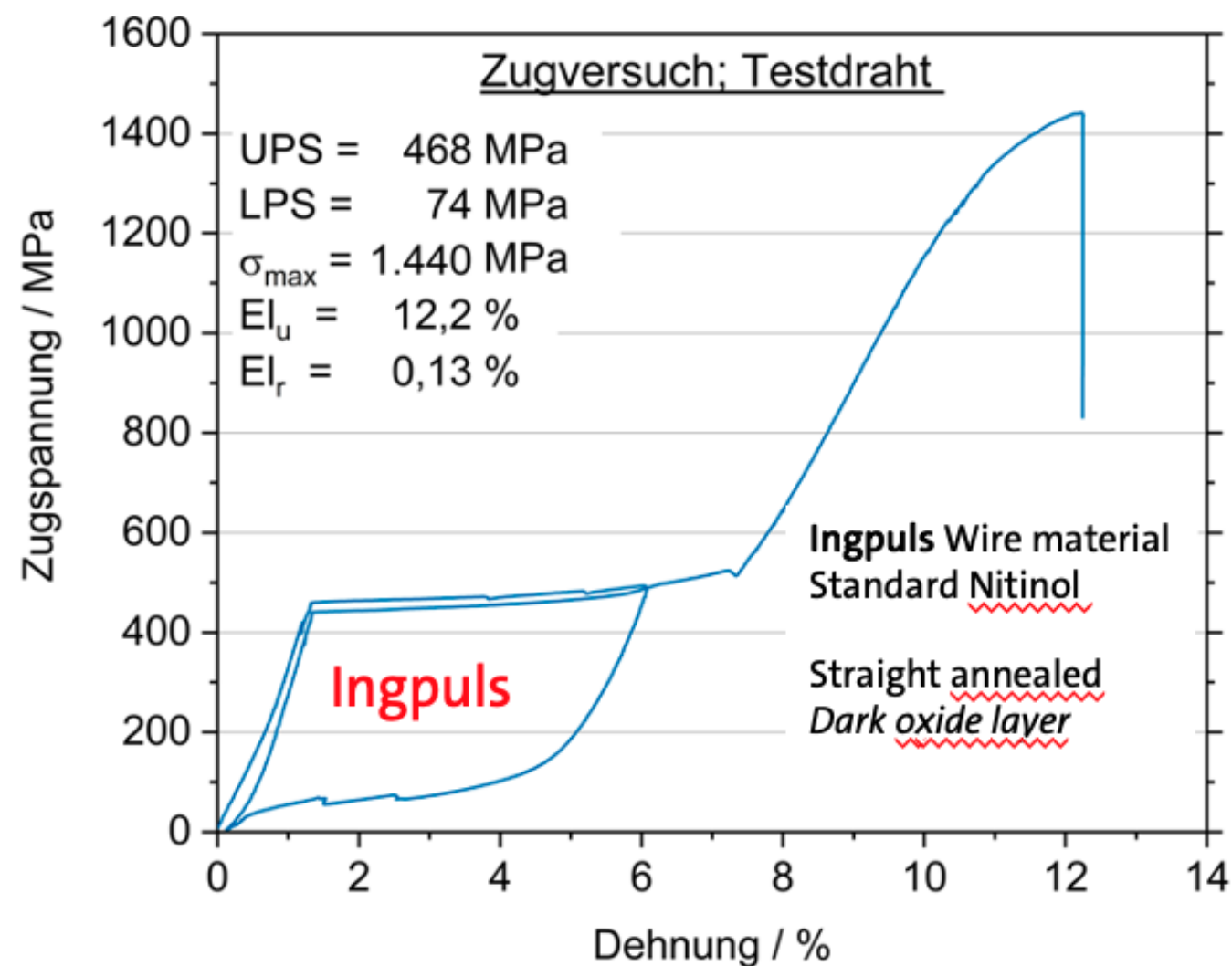
- Data analysis (datasheets, lifetime testing results, etc. → Customer provides his documentation to IPM)
- Benchmark of current product (Customer provides samples to IPM for materials characterization)
- Testing of sample material (Basic material characterization and report by IPM to customer)
- Start of sample production to „clone“ competitor material
- Delivery of sample material for internal customer qualification



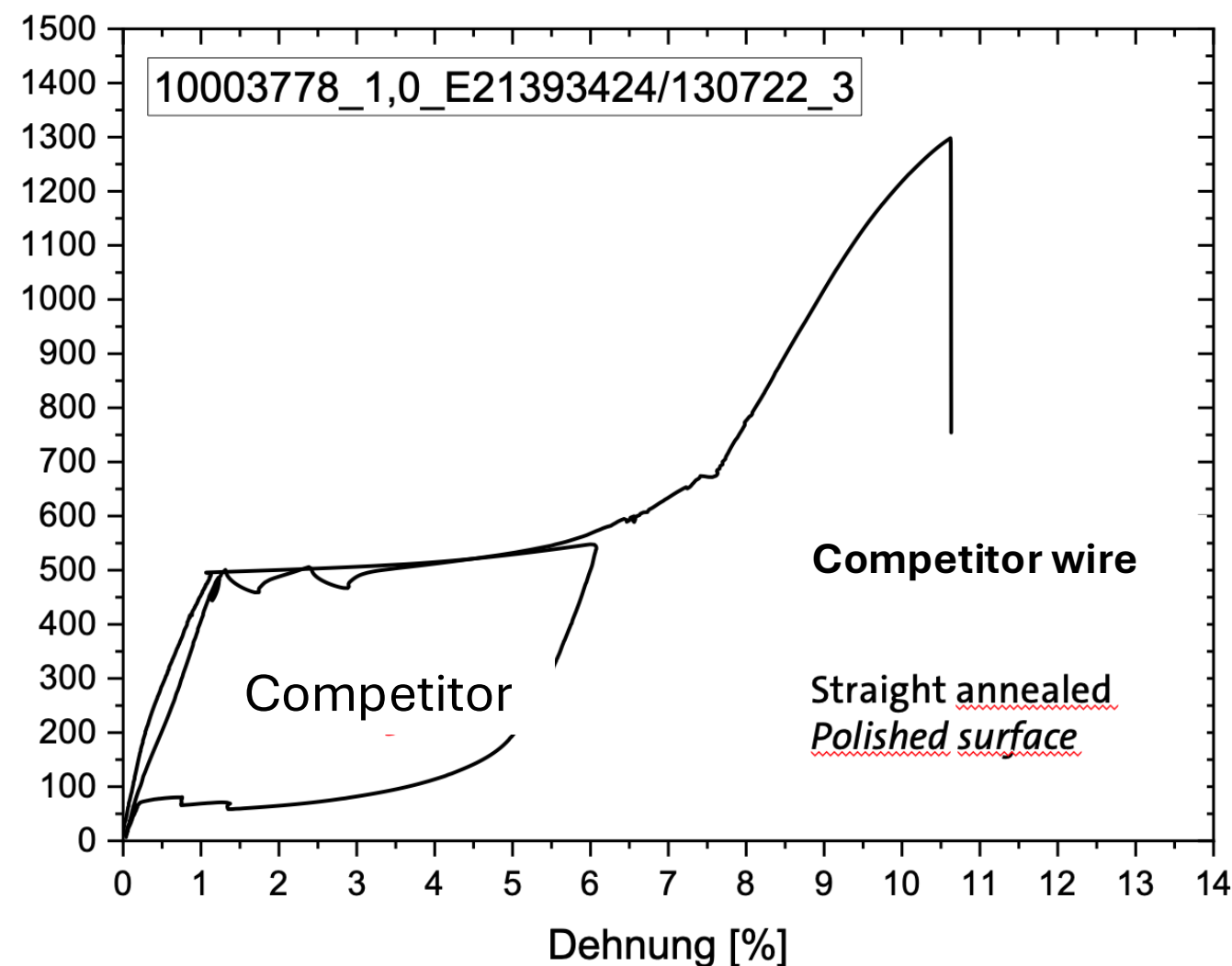
Example: Nitinol wire Ø 1.0mm

How to proof that materials are comparable in a quantitative manner

Ingpuls Medical alternative



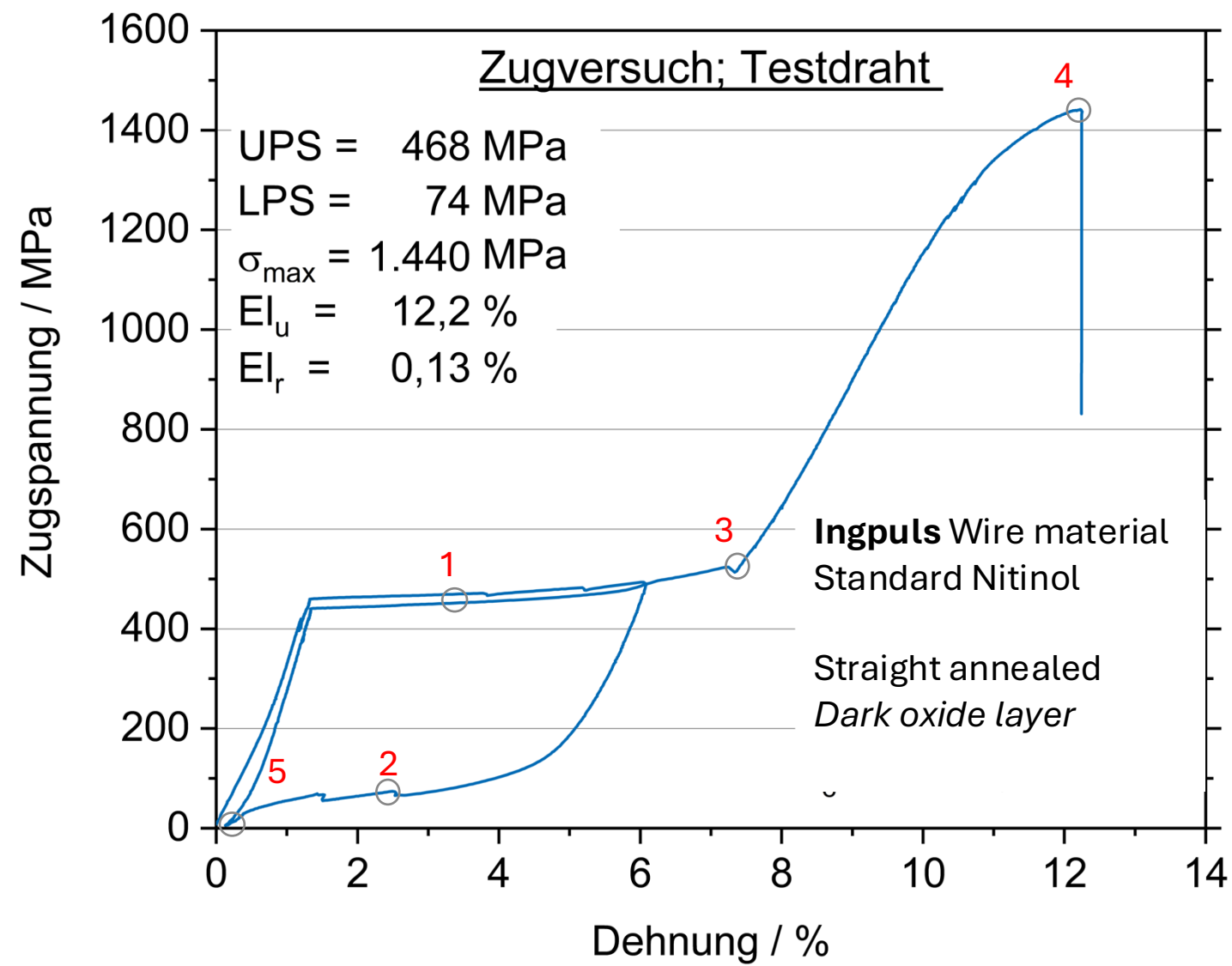
Material in use



Both measurements are made internally in Ingpuls Medical lab under same testing conditions

One by one comparison of parameters

Scientific characterization of stress-strain behavior of superelastic wire



Characteristic data for comparison
(see red numbers in left figure)

1. Upper plateau stress @3%
2. Lower plateau stress @2.5%
3. End of plateau strain
4. Ultimate tensile strength and strain
5. Residual strain after unloading

One by one comparison of 1.0mm Nitinol wire



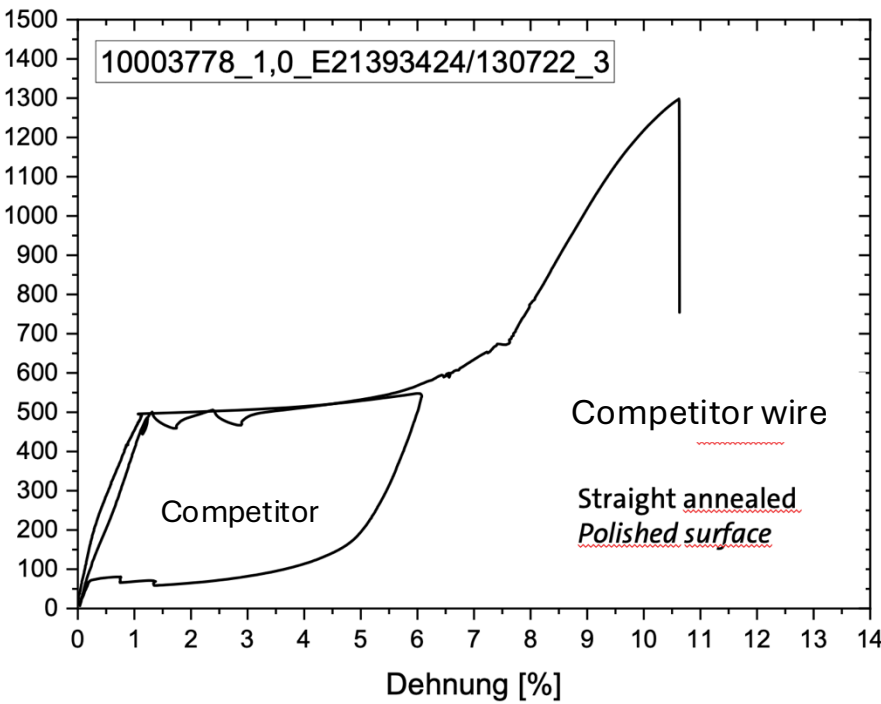
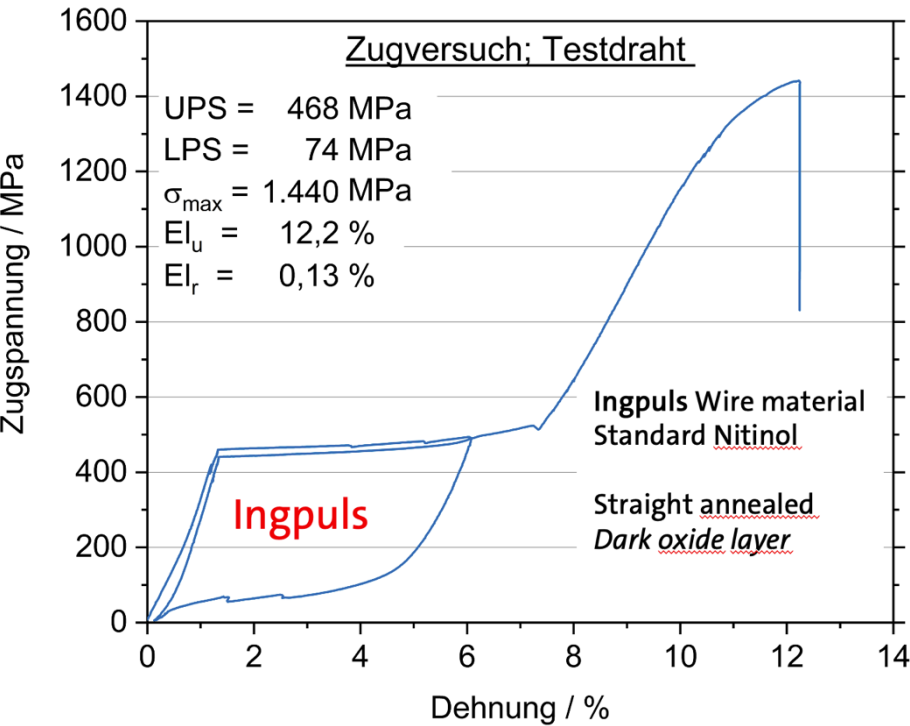
Wires of both suppliers, Ingpuls Medical and Competitor are very comparable

Characteristic data for comparison

- 1. Upper plateau stress @3%
- 2. Lower plateau stress @2.5%
- 3. End of plateau strain
- 4. Ultimate tensile strength and strain
- 5. Residual strain after unloading

Criteria	Ingpuls Medical	Competitor
UPS at 3%	468 MPa	500 MPa
LPS at 2.5%	74 MPa	80 MPa
End of plateau strain	7.5 %	7.7 %
Ultimate stress / strain	1.440 MPa / 12.2 %	1.310 MPa / 10.7%
Res. Strain	0.13%	0.05%

Data are comparable in a narrow tolerance
Both materials are in accordance with ASTM 2063-18





Melt consistency
Why it matters and how to prove

Melt consistency is a critical topic



It matters even more the bigger the melt size is

If material properties differ significantly from melt to melt, consistent properties on product level can not be guaranteed. But **long-term reliable delivery performance** is essential for products in the medical device industry. After successful qualification, an awarded supplier usually can not be changed for high-cost reason of re-qualification.

Ingpuls Medical is a contract manufacturer for Nitinol products.
High precision VIM melting is key of success.

We melt smaller ingots than other suppliers, but with lower cycle times and higher level of consistency. Since 2016 Ingpuls melt consistency has been demonstrated year by year in millions of products. Ingpuls components impresses with extremely small deviations. Not only from melt to melt, but over almost one decade of reliable delivery in automotive industry without any re-calls or any complaints. Beside medical device industry, parts of Ingpuls nowadays can be found in critical applications like nuclear power plant safety valves, satellites, or even as *retired* actuator on the moon surface.

To proof consistency, you need to demonstrate same level of quality, independent of melting variables.

Statistical evaluation
of microcleaning
Period pending

Intermediate statistical evaluation of microcleanliness



How it started and how things changed...

Test procedure:

- Evaluation according to **ASTM F 2063-18**
- Sample quantity = 50 melts

4 year Evaluation period:

- Jan 2020 - June 2024

Melting conditions:

- Randomly selected melts from the production cycle
- VIM Melting performed by different workers, furnaces, crucibles and productions shifts

Statistical evaluation of microcleanliness

How it started and how things changed...

Test results:

For n=50 melts	Percentage of area [%]	Maximum particle size [μm]
Minimum	0.165	1.310
Maximum	1.881	5.700
Median	0.493	2.520
Mean Value	0.594 ✓	2.675 ✓
Standard Deviation	0.349	0.932
ASTM 2063-18 threshold value	< 2.800	< 39.0

Conclusion

In this study the IPM melts show consistently very low max. inclusions sizes, while the fraction area is comparable to competitor material. This is in accordance with our understanding of the melt technology.

Statistical evaluation of microcleanliness

How it started and how things changed...

Result of carbon analysis of a Nitinol melt campaign in March 2025 underlines :

Ingot-Nr.	C-content in ppm
I240635	229
I240636	211
I240639	221
I240640	233
I240641	233
I240642	225
I240643	210
I240644	189

Average = 219ppm $\pm$ 14ppm

Conclusion

Due to the common use of graphite crucibles, carbon is the element of concern in Nitinol material melted by VIM technology. The presented content levels are very low and demonstrate reliable quality.

Our renewed mission statement



The Ingpuls Medical Mission

To serve our customers best by

- Providing an excellent and competent support
- Providing the **best** SMA **material** in the world
- Becoming the **technology driver** for innovations
- Achieving the best **delivery performance**

Ingpuls Medical

The European supplier
for high quality Nitinol





Thank you for your Attention.

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