



HERMITH
TITANIUM ADVANCED TECHNOLOGIES

NEW TECHNOLOGY from NEW TITANIUM PRODUCER

Oleg Mityashkin



Wire based Additive manufacturing



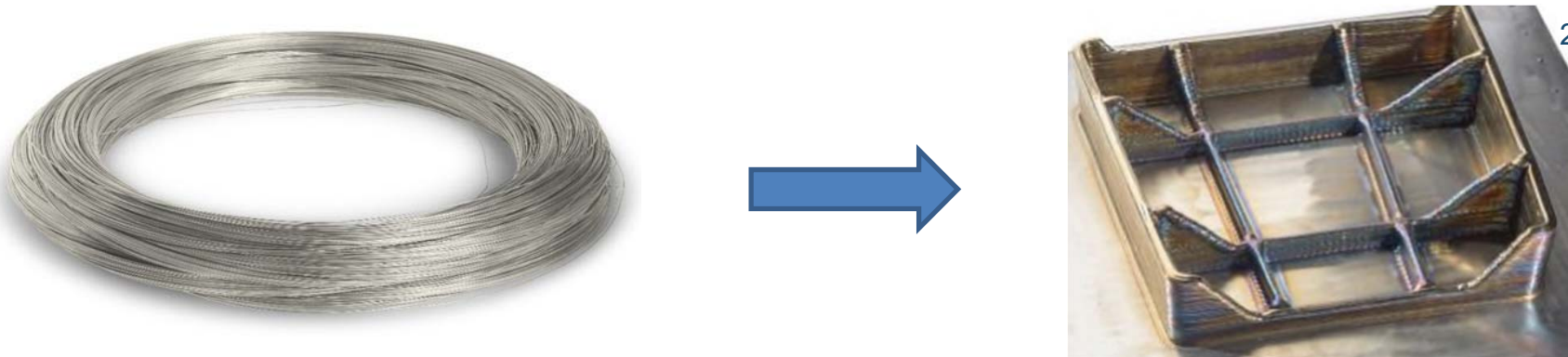
- AM is on the verge of widespread adoption for full-scale production purposes
- AM allows to decrease the “buy to fly” ratio down to 2.5 from around 10-12 of the standard production (large reduction in waste)^{1,2}
- Reduces the production time 10 times ^{1,2}
- AM market will be worth \$776.8 Million by 2020³

¹Norsk Titanium <https://www.norsktitanium.com>;

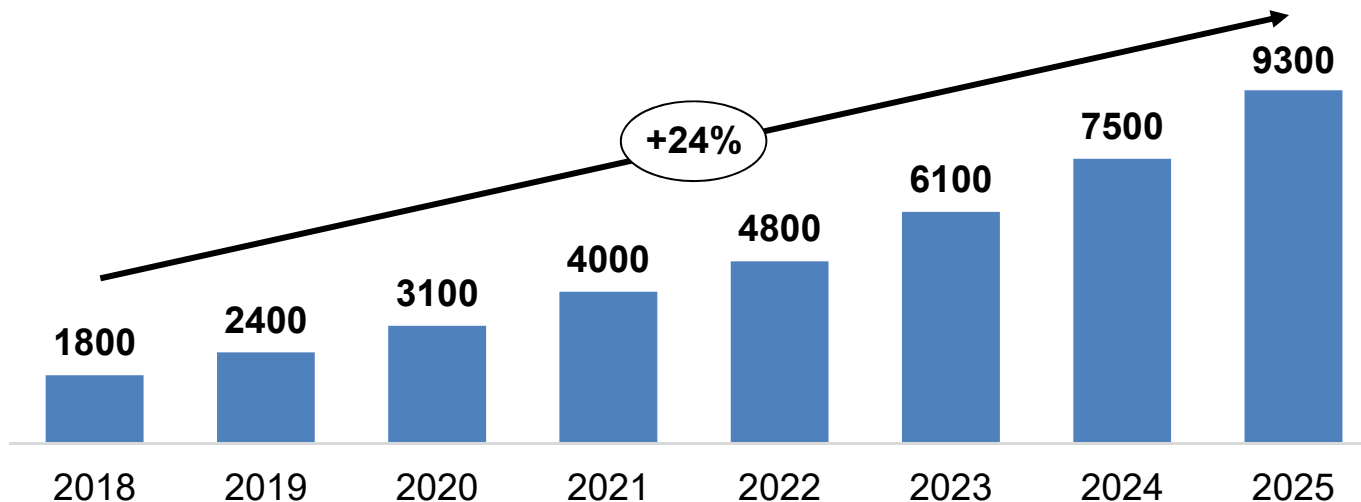
²Cranfield University www.waammat.com (picture taken)

³3D Printing Metal Market

Titanium wire for Additive Manufacturing



Forecast of the world Titanium Wire consumption, tons¹

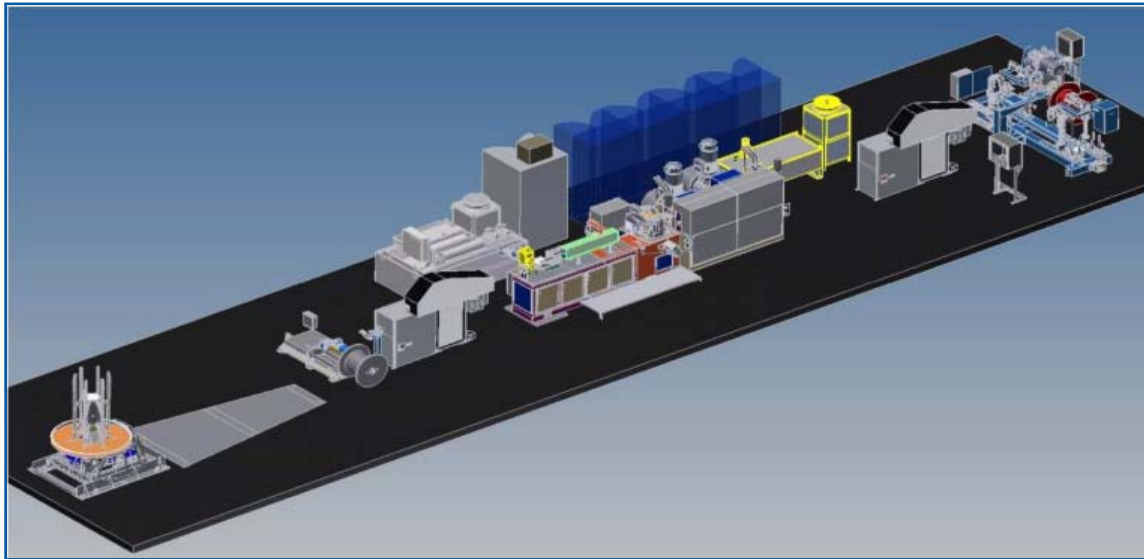


¹Forecast made by Hermith GmbH based on data from the largest consumers of the titanium additive wire

²Picture taken from <https://www.norsktitanium.com>

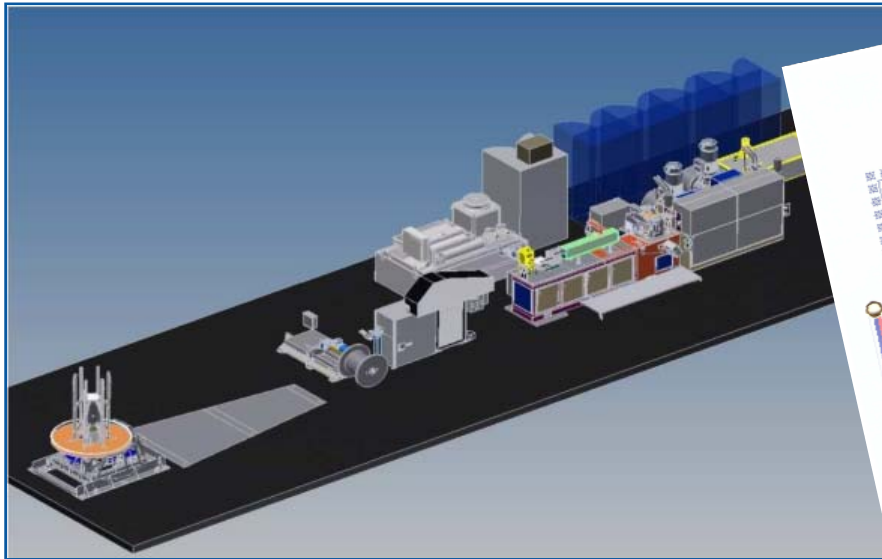
“Warm” wire drawing

- New technology was developed



“Warm” wire drawing

- New technology was developed



- Received 17 Patents

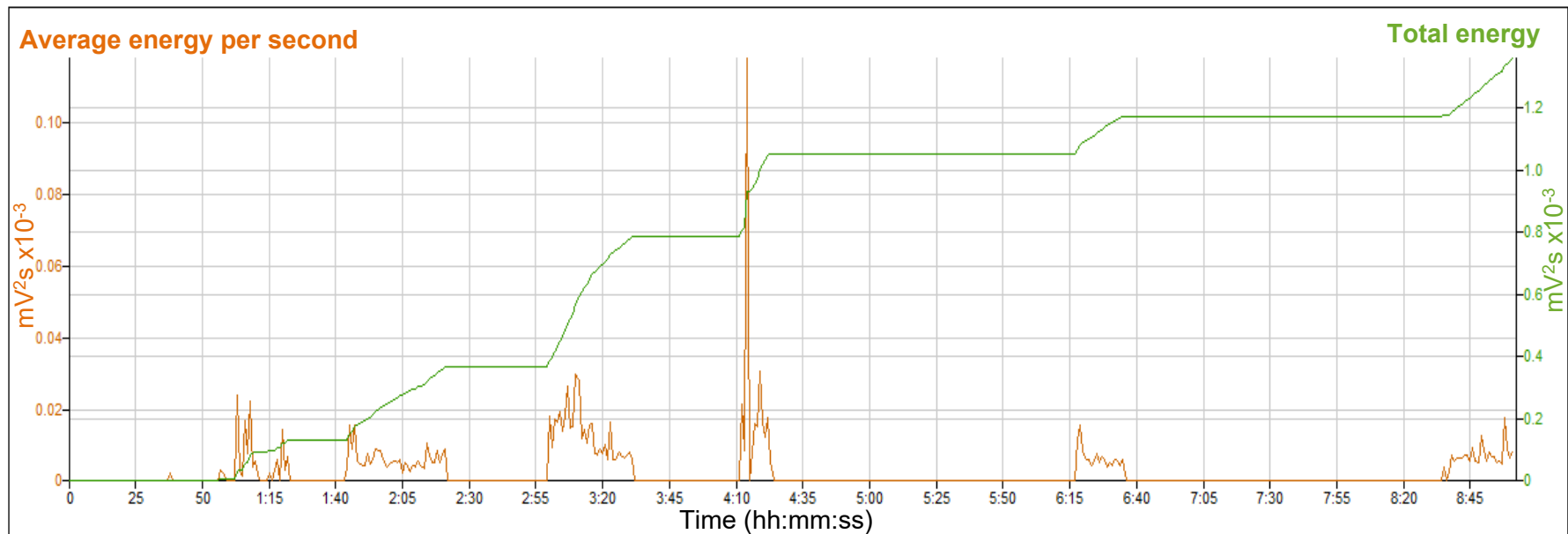


Technology process



- the wire is heated up during the drawing process
- the material is more ductile ➡ increase in the rate of the deformation
- do not need to anneal the wire between the stages
- strict control of the optimal temperature and speed is required
 - control with acoustic emission

Acoustic emission control



- Acoustic sensor is mounted in the area of the drawing die
- The deformation process of the wire is accompanied by the acoustic waves radiation
- The energy parameter of the waves allows to identify the process of microcracks forming
- Experimentally, the value of energy parameter was established, when the deformation occurred without the formation of microcracks
- Optimal temperature and speed were obtained

Comparison to the cold drawing

“Warm” drawing production time – up to 4 days for 1000 kg

Pass number	Operation	Input Diameter, mm	Output Diameter, mm	Speed, m/min	Length per 1 ton, m	Time to produce 1 t, hours
1	Drawing	7,5	5,8	60	8411	2,34
2	Drawing	5,8	4,5	60	13973	3,88
3	Drawing	4,5	3,5	60	23098	6,42
4	Drawing	3,5	2,7	60	38814	10,78
5	Drawing	2,7	2,1	60	64161	17,82
6	Drawing	2,1	1,7	60	97907	27,20
7	Peeling	1,7	1,6	120	110528	15,35
Total						83,8(3,5 days)

Comparison to the cold drawing

Cold drawing production time – up to 70 days for 1000 kg

Pass number	Operation	Input Diameter, mm	Output Diameter, mm	Speed, m/min	Length per 1 ton, m	Time to produce 1 t, hours
1	Drawing	7,5	7,04	60	5716	1,59
2	Annealing	7,04	7,04	10	5716	9,53
3	Drawing	7,04	6,60	60	6496	1,80
4	Annealing	6,60	6,60	10	6496	10,83
5	Drawing	6,60	6,19	60	7381	2,05
6	Annealing	6,19	6,19	10	7381	12,30
7	Drawing	6,19	5,81	60	8388	2,33
8	Annealing	5,81	5,81	10	8388	13,98
9	Drawing	5,81	5,45	60	9532	2,65
10	Annealing	5,45	5,45	10	9532	15,89
11	Drawing	5,45	5,11	60	10832	3,01
12	Annealing	5,11	5,11	10	10832	18,05
13	Drawing	5,11	4,79	60	12309	3,42
14	Annealing	4,79	4,79	10	12309	20,51
15	Drawing	4,79	4,50	60	13987	3,89
16	Annealing	4,50	4,50	10	13987	23,31
17	Drawing	4,50	4,22	60	15894	4,42
18	Annealing	4,22	4,22	10	15894	26,49
19	Drawing	4,22	3,96	60	18062	5,02
20	Annealing	3,96	3,96	10	18062	30,10
21	Drawing	3,96	3,71	60	20525	5,70
22	Annealing	3,71	3,71	10	20525	34,21
23	Drawing	3,71	3,48	60	23324	6,48
24	Annealing	3,48	3,48	10	23324	38,87

25	Drawing	3,48	3,27	60	26504	7,36
26	Annealing	3,27	3,27	10	26504	44,17
27	Drawing	3,27	3,07	60	30118	8,37
28	Annealing	3,07	3,07	10	30118	50,20
29	Drawing	3,07	2,88	60	34225	9,51
30	Annealing	2,88	2,88	10	34225	57,04
31	Drawing	2,88	2,70	60	38892	10,80
32	Annealing	2,70	2,70	10	38892	64,82
33	Drawing	2,70	2,53	60	44196	12,28
34	Annealing	2,53	2,53	10	44196	73,66
35	Drawing	2,53	2,37	60	50223	13,95
36	Annealing	2,37	2,37	10	50223	83,70
37	Drawing	2,37	2,23	60	57071	15,85
38	Annealing	2,23	2,23	10	57071	95,12
39	Drawing	2,23	2,09	60	64854	18,01
40	Annealing	2,09	2,09	10	64854	108,09
41	Drawing	2,09	1,96	60	73697	20,47
42	Annealing	1,96	1,96	10	73697	122,83
43	Drawing	1,96	1,84	60	83747	23,26
44	Annealing	1,84	1,84	10	83747	139,58
45	Drawing	1,84	1,72	60	95167	26,44
46	Annealing	1,72	1,72	10	95167	158,61
47	Drawing	1,72	1,60	60	110528	30,70
48	Annealing	1,60	1,60	10	110528	184,21
						Total 1675 (70 days)
						Drawing time 240 (10 days)

Advantages of the warm drawing

	COLD DEFORMATION	WARM DEFORMATION
Degree of deformation per one stage	low (10-15%)	high (35-45%)
The number of production stages	large (≥ 45)	reduced (≤ 8)
Heat treatments	after each stage	no
Energy consumption	high level	mid-level
Time of production	Long (up to 70 days for 1 ton)	Short (less than 4 days for 1 ton)
Production costs	High	Low

Ongoing projects

Ongoing projects

- Material Development for suspension Springs



- ✓ 2 new titanium alloys – HSA, HSA2

Ongoing projects

- Material Dev for suspens
- ✓ 2 new titan

IST INSTITUTE OF SPRING TECHNOLOGY LTD
Henry Street, Sheffield, S3 7EQ, United Kingdom
Tel: +44 (0)114 278 0771 Fax: +44 (0)114 252 7997
Email: ist@ist.org.uk Internet: www.ist.org.uk

TEST CERTIFICATE

CLIENT : HERMITH GMBH
Englmannstr. 2
81673
Munich
Germany

CONTACT : Johnathon Welst

CERTIFICATE NUMBER : 014887
IST JOB NO. : 017228Q
ORDER NO. : OP003840

SAMPLE IDENTITY : 2 off Long open-ended springs, manufactured from Hermith Spring Alloy 2 "HSA2" is an alpha-beta alloy with enhanced mechanical properties

ORDER RECEIVED DATE : 3rd November 2017

TEST COMPLETION DATE : 21st December 2017

TEST PROCEDURE : Fatigue test to client's requirements in conjunction with OI 26 issue 7. Load test to documented in-house methods OI 28 issue 10.

Page No 1 of 3

Fatigue testing 2 off compression springs identified as open-ended Long titanium springs

Each spring had pre-noted load requirements for fatigue testing. Each spring was load tested to its minimum and maximum working loads, and working lengths were found from the results. Springs were tested at ambient temperature and a test speed of 300 cycles per minute.

Spring No.	Cycles Completed	Broken	Unbroken	Length (mm) at Load (N)			
				4400		8000	
				Before	After	Before	After
1	500,000		X	308.82	307.58	235.00	232.12



Ongoing projects

HERMITH
TITANIUM ADVANCED TECHNOLOGIES

- Material Development for Sonotrodes



MS INDUSTRIE AG


EUROSONIC
ULTRASCHALL-TECHNOLOGIE

TELSONIC
ULTRASONICS

- ✓ 2 new titanium alloys – HSS, HSS2

Hermith GmbH

Our Past and Present



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Located in Munich, Germany, serving to the motorsport industry, predominantly F1 and F2



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Ongoing projects with Aerospace OEMs & tier suppliers
Stocking and distribution of 100+ tonnes per year of VSMPO materials



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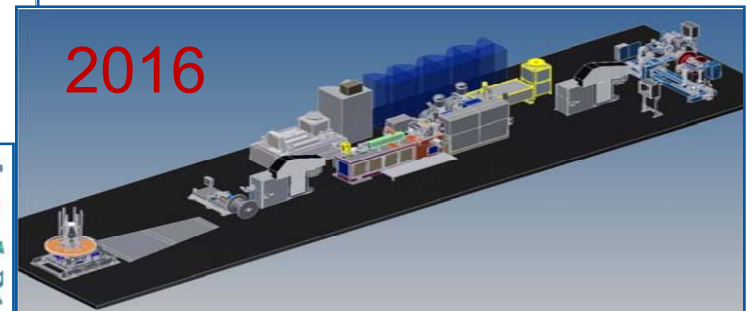
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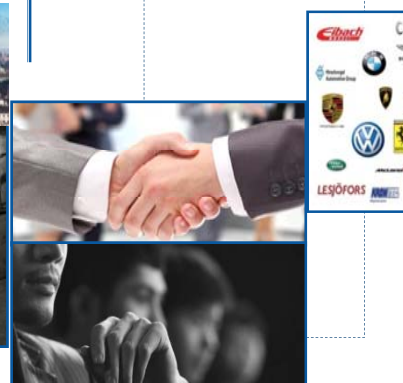
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ANNEX

to Certificate Registration No. 44 117 111040
EN 9100:2018 (technically equivalent to AS9100D and JIS Q 9100:2016 and in conformity with the requirements of ISO 9001:2015)

certification Structure: Campus

CERTIFI

Management system as per
EN 9100 : 2009
 (technically equivalent to AS9100C and JIS Q 9100:2015)

In accordance with TÜV NORD CERT procedures as per

Hermith GmbH
 Englmannstraße 2
 81673 München
 Germany

with the location Hermith GmbH Titanium Pro

applies a management system in line with the above

Manufacture, stock holding and distribution of ingots, bars, wires, sheets, stripes, plates and tubes in the entire range of titanium alloys

Issue date 2017-10-19
 Expiry date 2020-10-18
 (Following ISO 9001:2015 certification expires on 2019-09-14)

[Signature]
 Certification Body
 at TÜV NORD CERT GmbH

This certification was conducted in accordance with regular surveillance audits.

TÜV NORD CERT GmbH

Certificate Registration No.	Location	Scope
44 117 111040	Hermith GmbH Englmannstraße 2 81673 München Germany	Central function / Controlling address Manufacture, stock holding and distribution of ingots, billets, bars, wires, sheets, stripes, plates and tubes and machining of these products in the entire range of titanium alloys
44 117 111040-001	Hermith GmbH Titanium Production Campus Belova Street 7 427622 Glazov Russian Federation	Manufacture of ingots, billets, bars, wires, sheets, stripes, plates and tubes and machining of these products in the entire range of titanium alloys
44 117 111040-002	Hermith GmbH Titanium Production Campus Kirova Street 1 456203 Zlatoust Russian Federation	Manufacture of ingots, billets, bars, wires, sheets, stripes, plates and tubes and machining of these products in the entire range of titanium alloys

End of the List

[Signature]
 Certification Body
 at TÜV NORD CERT GmbH

Essen, 2019-03-05

45141 Essen www.tuev-nord-cert.com

DAkkS
Deutsche
Akreditierungsstelle
D-24120 Kiel

BDL

DAkkS/BDL within the IBCP-scheme.

2018

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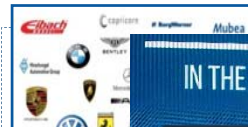
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2019-2022

Cooperation extension - increasing number of production Campuses and raw material suppliers



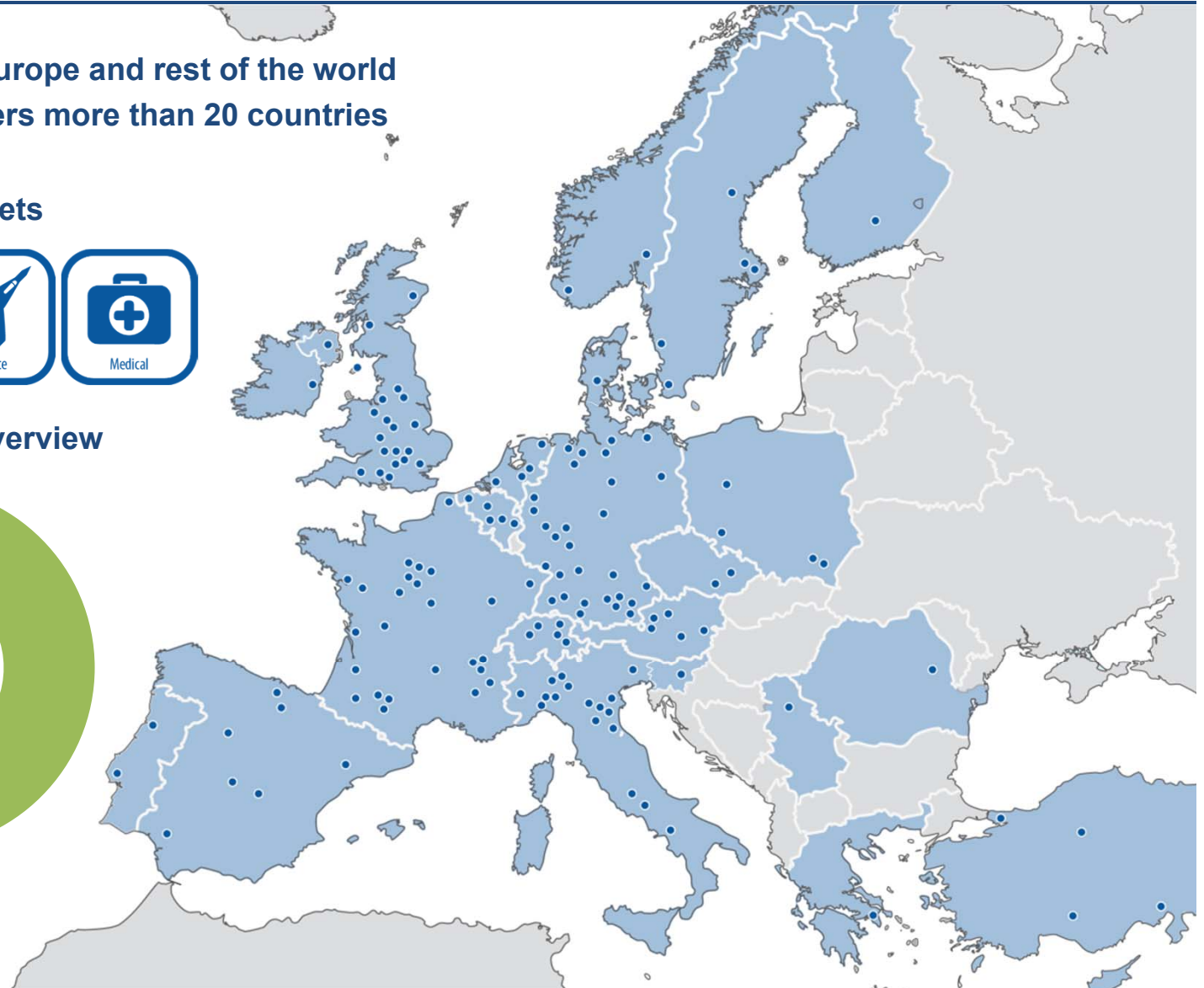
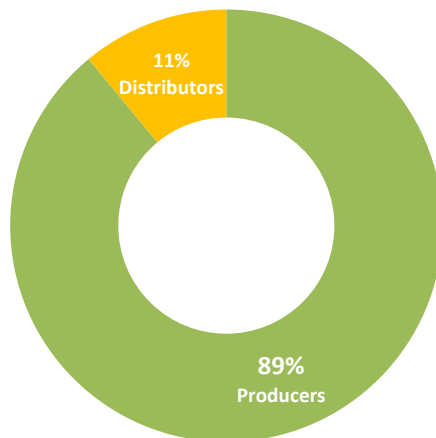
Our Customers

Over 2000 customers in Europe and rest of the world
Customer geography covers more than 20 countries

Our main markets



Our customers overview



Production Facilities of Hermith



- Organised and established Hermith production campuses on the basis of Joint Ventures with Russia based Ti producers
- All melting of ingots and production of the products done within the Hermith production facilities
- Hermith Production facilities certified under **EN9100**

Titanium ingots production

Raw materials for melting
are titanium sponge and
master-alloys

Pressed briquettes
Ø200...360 mm for furnace
electrodes



VAR ingots Ø360...450 mm
after double or triple melting



VAR ingots Ø280...360 mm
for mold casting



Titanium billets production

Hot forging machines



Hot rolled mills

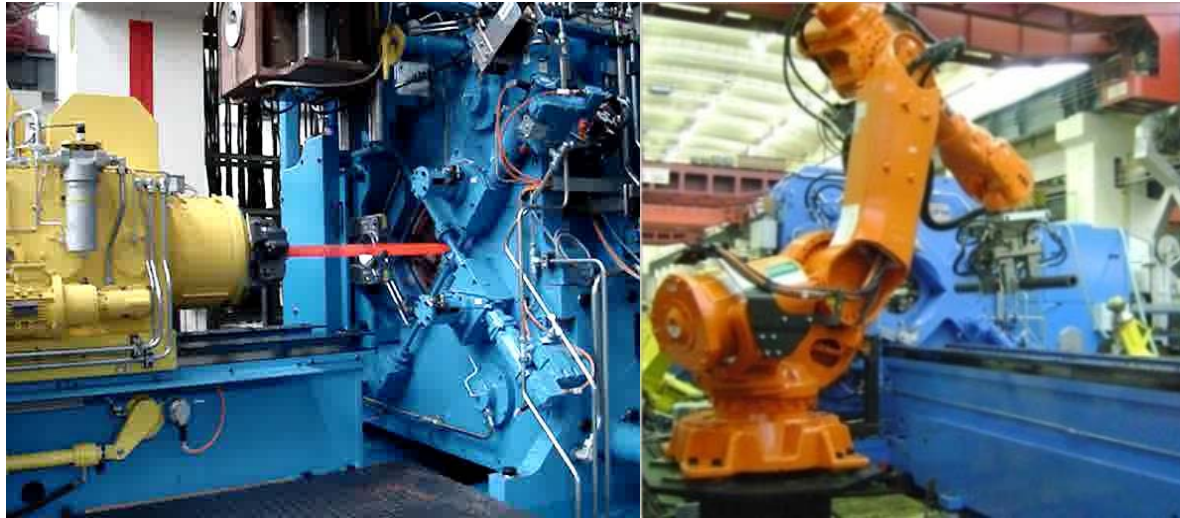


Hot extrusion and hot worked stage

The billets of bars and tubes are extruded at various equipment as horizontal and vertical presses.



Hot & cold forging. Heat treatment



Radial forging machines
Tubes Ø30...130 mm
Rods Ø23...130 mm

Horizontal and vertical
vacuum furnaces



Rolling and final operations

Rolling mills (Ø18 – 250 mm)

Cold pilgering mills (Ø6-120 mm)



Grinding (Ø6...150 mm)



Drawing Equipment



Gas shielded bypass annealing



Linear and
coil to coil drawing



Final quality control



Non-destructive ultrasonic and eddy current inspection of final rods and tubes



Gas Analyzer for infra-red absorption measurements. Definition range is from 0.001 to 2.0%.



Research equipment for digital investigation of metal structure.



Plasma mass spectrometer
Range is from $1 \cdot 10^{-5}$ to $1 \cdot 10^3$ weight %



X-ray Fluorescence Analyzer

Products

HERMITH
TITANIUM ADVANCED TECHNOLOGIES



Ingot



Plate



Bar



Tube



Wire

Alloys

Grade 2, 4, 5, 7, 9, 6242, 6246, 6Al 7Nb, 7Al4Mo, HSA, HSS, ПТ-1М, ПТ-7М, ПТ-3В, 3М, BT1-0, BT1-00, 2B, BT6, BT-6C, BT9, BT3-1, сп19, BT-16

Thank you for your attention

