HÄRTHA
GROUP
SURFACE TECHNOLOGIES

Our customers inspire us.

They take on the great upheavals and challenges of our time. They actively work on future-oriented and sustainable technologies.

Whether in outer space or upon the stormy sea, under high pressure or at high speed: The components of our customers must stand up to the most extreme situations. We feel right at home wherever optimum properties are essential and every micrometre and microgram counts. As a companion and trailblazer for our customers.

We develop and perfect state-of-the-art heat treatment and coating processes that lend the crucial additional durability and resistance to precision components.
For us the highest quality standards also mean the highest environmental standards.

It is our firm belief that sustainability and economic success can go hand in hand. The environmentally friendly and resource-saving production processes we employ make us pioneers in our industry. A path that we follow out of conviction – for our customer, for our planet and for future generations.

WE IMPROVE WHAT MATTERS.

"PERFECTED
SURFACE TECHNOLOGY
FOR PRECISION COMPONENTS."

DEPENDABLE WHEN THE NEAREST WORKSHOP IS 20,000 KM AWAY.

PERFECTED HEAT TREATMENT AND COATING.

Making the state of the art our standard – this claim makes us one of the leading providers of heat treatment processes and coating solutions in Europe.

For our processes, we rely on cutting-edge technologies such as plasma nitriding, vacuum hardening, low pressure carburising and inductive hardening. We attach primary importance to reproducible quality. We know: Every component that leaves our furnaces must hold up in critical situations.

This is why we tailor each process individually to the needs of our customers. Our team of experts advises you on the treatment process from start to finish. Together we choose the process that fits your requirements best.

Our processes at a glance:

→ **Nitriding**
Oxidising, gas nitriding, salt bath nitriding, nitrocarburising, nitrocarburising with post-oxidation (NIOX and ALDOX), plasma nitriding

→ **Hardening & tempering**
Bainitising, quenching and tempering, tempering, salt bath hardening, bright hardening, vacuum hardening

→ **Edge layer hardening**
Inductive hardening, carbonitriding, edge layer hardening, case hardening, low pressure carburising (LPC), Laser hardening

→ **Annealing**
Soft annealing, stress-free annealing, precipitation hardening, normal annealing, solution annealing, intermediate annealing

→ **Coating**
PVD coating, DLC coating, phosphating, anodising, chemical nickel plating, burnishing, galvanic zinc plating

→ **Additional services**
Straightening of steel, deep cryogenic treatment, magnetic powder crack testing, blast cleaning, material analysis, hardness testing, metallography

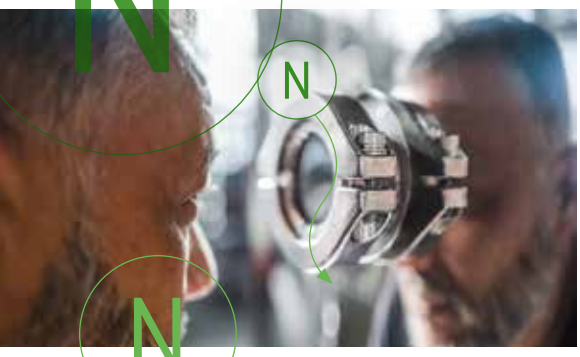
More details about our processes are also available here:

NITRIDING

Nitriding is one of our core competencies. As a thermochemical process, the purpose of nitriding is to specifically improve the surface hardness of steel – a crucial property for minimising wear and extending the service life of components.

Our teams of experts use various nitriding processes, all of which are distinguished by their minimum warping.

Components can therefore be almost completely processed before the hardening process. This ensures high heat resistance of up to 600 °C. Nitriding offers wide application possibilities: While almost any steel can be nitrided, alloy steels are particularly suitable. Our teams of experts are always at your side to support you.



Advantages:

- Improved surface hardness
- Reduced wear
- High corrosion resistance combined with a low friction coefficient
- Heat-resistant up to 600 °C
- Partial hardening possible

1,020° C

HARDENING AND TEMPERING

Hardening and tempering are processes that we have perfected at HÄRTHA.

They can optimise the mechanical properties of steel. By hardening we increase the hardness and tensile strength of the steel through controlled heating and rapid cooling. However, this also leads to increased material brittleness, and so the process is followed by tempering. Controlled heating and slow cooling during tempering reduce brittleness, while achieving an excellent balance between hardness, toughness and strength.

Because we understand the importance of this delicate balance, at HÄRTHA we adapt each procedure individually to ensure the optimum properties for your specific requirements.

Advantages:

- → Improved hardness, tensile strength and wear resistance
- → Increased toughness through tempering
- → Processes customised to individual needs
- → Perfectly reproducible results

600° C

EDGE LAYER HARDENING

Edge layer hardening, also known as surface hardening, is a process that we at HÄRTHA use with great care and precision, in order to increase the quality and durability of your components.

Through targeted austenitising of the edge layer, i.e. a transformation of the microstructure by heating and quenching, we increase the hardness of the surface, while preserving the toughness of the component's core. Ideal for applications calling for high wear resistance and durability, this process can be applied to a wide variety of steel types.

Case hardening or carbonitriding requires that austenitising is preceded by a carbonising step using carbon or carbon and nitrogen. Tempering after edge layer hardening allows the component to be optimised for its particular use.

Our team of experts guarantees a fast and high-quality implementation of your order, using state-of-the-art systems.

Advantages:

- → Increased durability and fatigue strength
- → Improved vibration resistance of the component surface
- → Enhanced rigidity and resilience of the working surfaces
- → Greater precision and improved surface quality
- → Suitable for a large number of steels and applications

ANNEALING

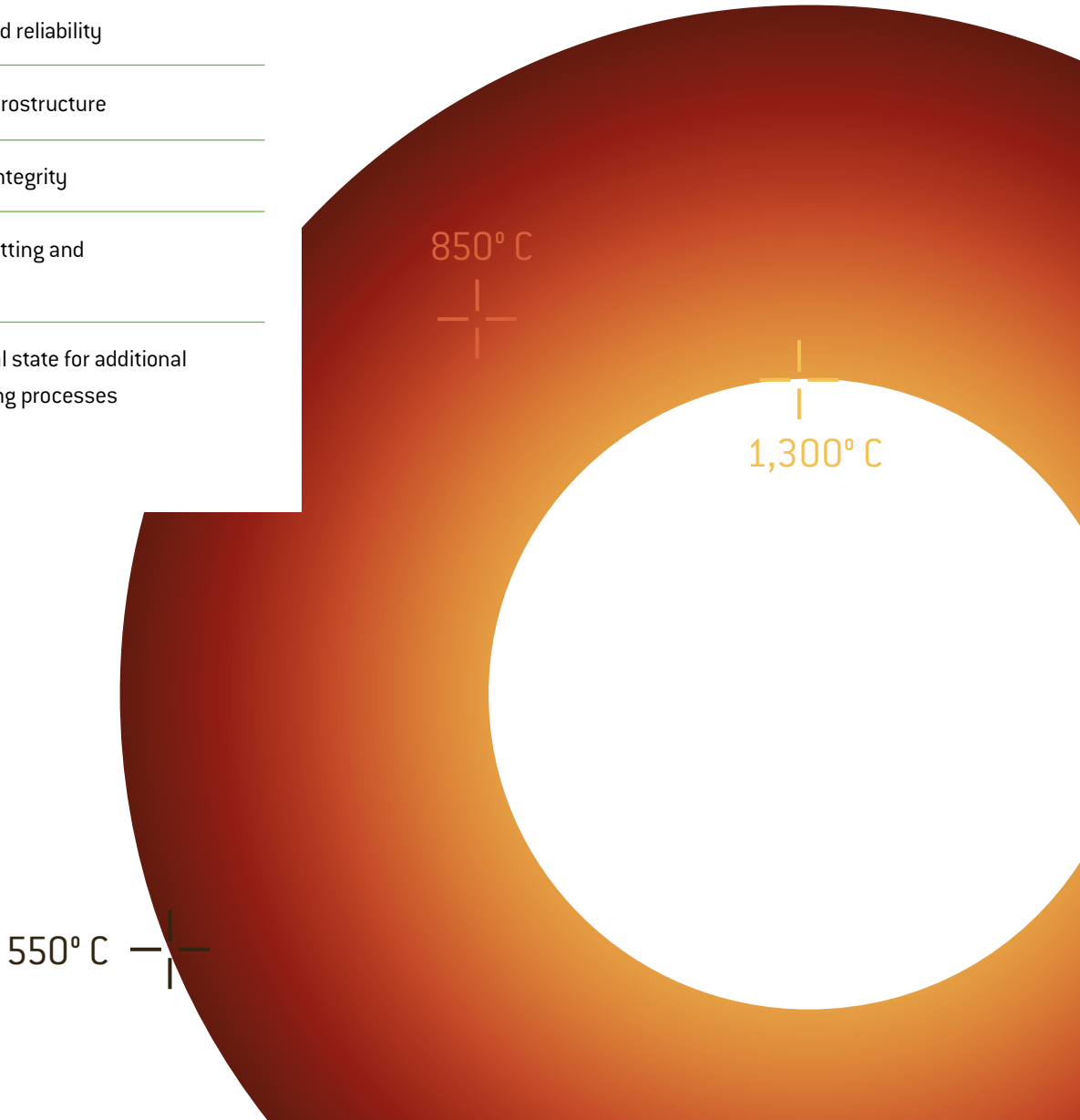
A heat treatment process that reduces the degree of hardness in metals, while increasing their flexibility and reducing their internal stresses, annealing constitutes a key technique in our range of services at HÄRTHA.

By subjecting the component to heating up, heating through and cooling, we change its material properties in order to perfectly prepare the microstructure, e.g. for cold forming.

Whether individual parts or entire series, our modern systems at different locations enable us to complete even short-term orders on time. Our many years of experience are your guarantee for maximum quality in every annealing process.

Advantages:

- → Increased durability and reliability
- → Optimisation of the microstructure
- → Improved component integrity
- → Ideal preparation for cutting and non-cutting machining
- → Restoration of the initial state for additional treatments or machining processes



COATING

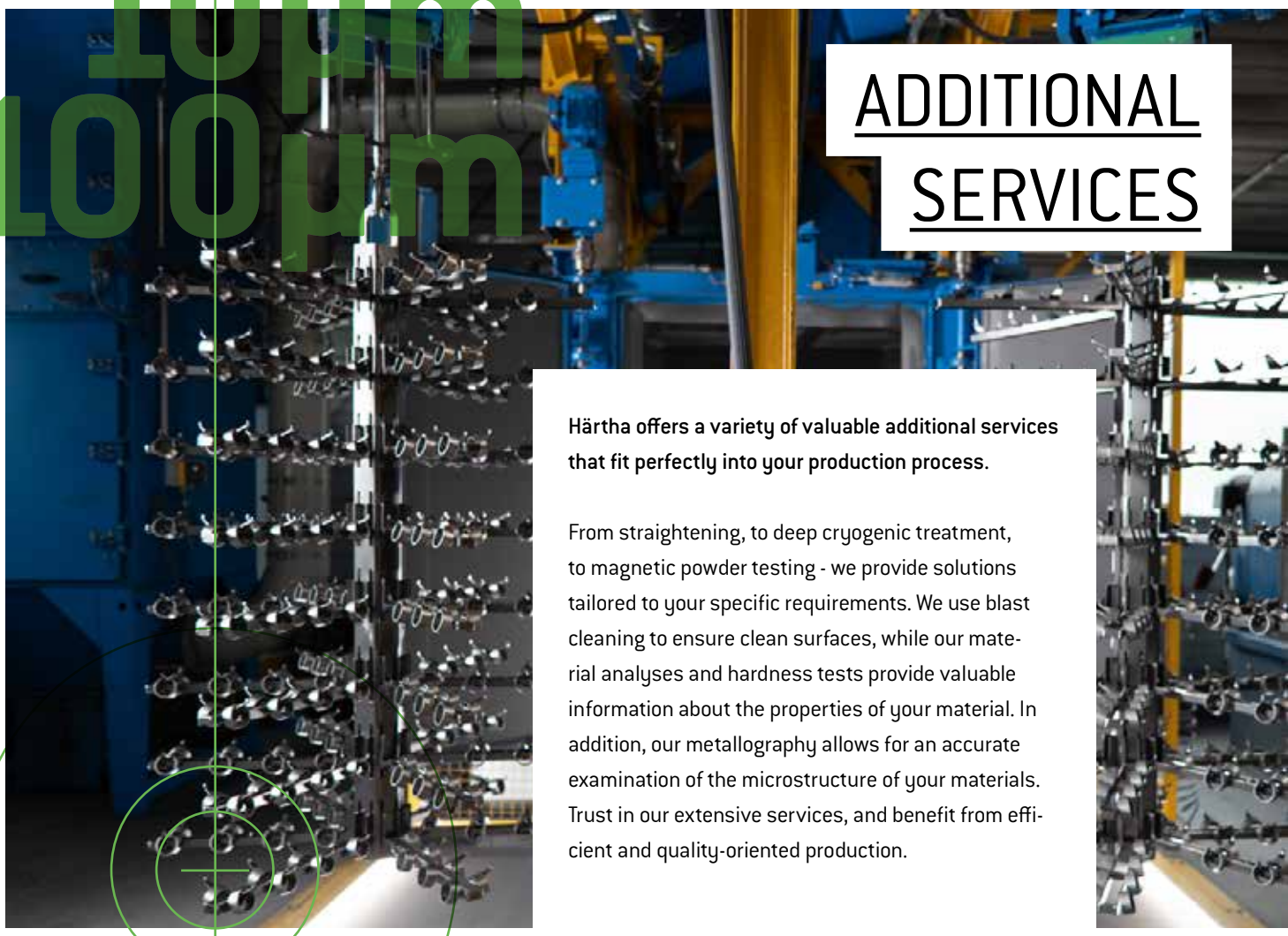
The coating of components, especially by means of the PVD process, is one of our specialities at HÄRTHA. PVD, short for Physical Vapour Deposition, is a process in which the coating material is evaporated and then applied to the workpiece.

This process serves to protect the surface and improve its decorative and functional properties. Our PVD coatings are distinguished by their brilliant colour quality.

Our well-founded know-how and state-of-the-art technologies allow us to guarantee you the highest quality and timely execution of your orders. Whether you need PVD or PaCVD coatings, you can trust us as your reliable partner.

Advantages:

- → Great dimensional stability
- → Improved wear resistance and hardness
- → Lower friction thanks to smooth surfaces
- → Versatile layer structure (mono-layer, multi-layer)
- → Visual refinement of the components



ADDITIONAL SERVICES

Härtha offers a variety of valuable additional services that fit perfectly into your production process.

From straightening, to deep cryogenic treatment, to magnetic powder testing - we provide solutions tailored to your specific requirements. We use blast cleaning to ensure clean surfaces, while our material analyses and hardness tests provide valuable information about the properties of your material. In addition, our metallography allows for an accurate examination of the microstructure of your materials. Trust in our extensive services, and benefit from efficient and quality-oriented production.

More details about our additional services are also available here:

Our additional services at a glance:

- → Rectification of steel
- → Deep cryogenic treatment
- → Magnetic powder crack test
- → Blast cleaning
- → Material analysis
- → Hardness test
- → Metallography

WE CANNOT EASE YOUR DEADLINE PRESSURE. BUT WE CAN BOOST THE LOAD CAPACITY OF YOUR CRANE.

HOLISTIC APPROACH TO QUALITY MANAGEMENT

Quality is not a random product, but the result of a clear-cut attitude. Thinking in quality terms is an integral part of our corporate culture.

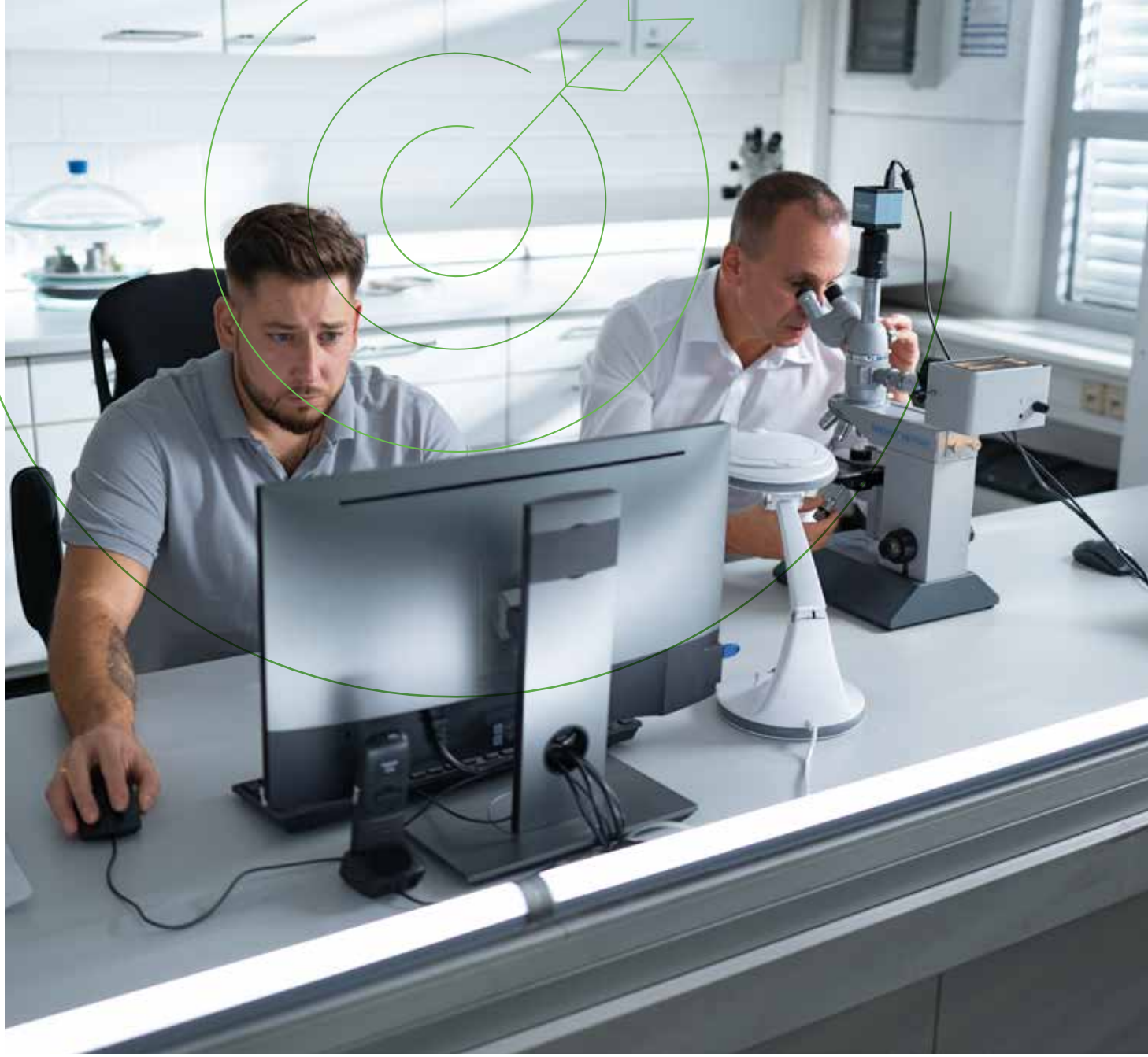
To us, this translates to regarding every single team member as an indispensable part of quality assurance. Everyone at HÄRTHA constantly strives to achieve the best outcome throughout the entire process.

We are convinced that consistently superior quality is impossible without the interaction of different types of expertise as well as individual commitment.

This attitude pays off: We regularly pass the toughest customer audits and meet the strictest international standards for quality, energy and environmental management.

In our state-of-the-art laboratories we apply all current testing methods. These testing methods are largely non-destructive. Not only is our forward-looking commitment to quality, the environment, energy, and process reliability commendable – it has also been confirmed with certificates and seals of approval.

"TO US, QUALITY IS AN ATTITUDE. AN ATTITUDE DEEPLY INGRAINED IN EVERYONE AT HÄRTHA."



Our certificates at a glance:

CERTIFIED ISO 9001 CERTIFIED

CERTIFIED CQI-9 CERTIFIED

CERTIFIED IATF 16949 CERTIFIED

CERTIFIED EN 9100 CERTIFIED

CERTIFIED Nadcap CERTIFIED

CERTIFIED ISO 14001 CERTIFIED

CERTIFIED ISO 50001 CERTIFIED

CERTIFIED CDP CERTIFIED

CERTIFIED SBTi CERTIFIED

SERVICE ON LEVEL TERMS.

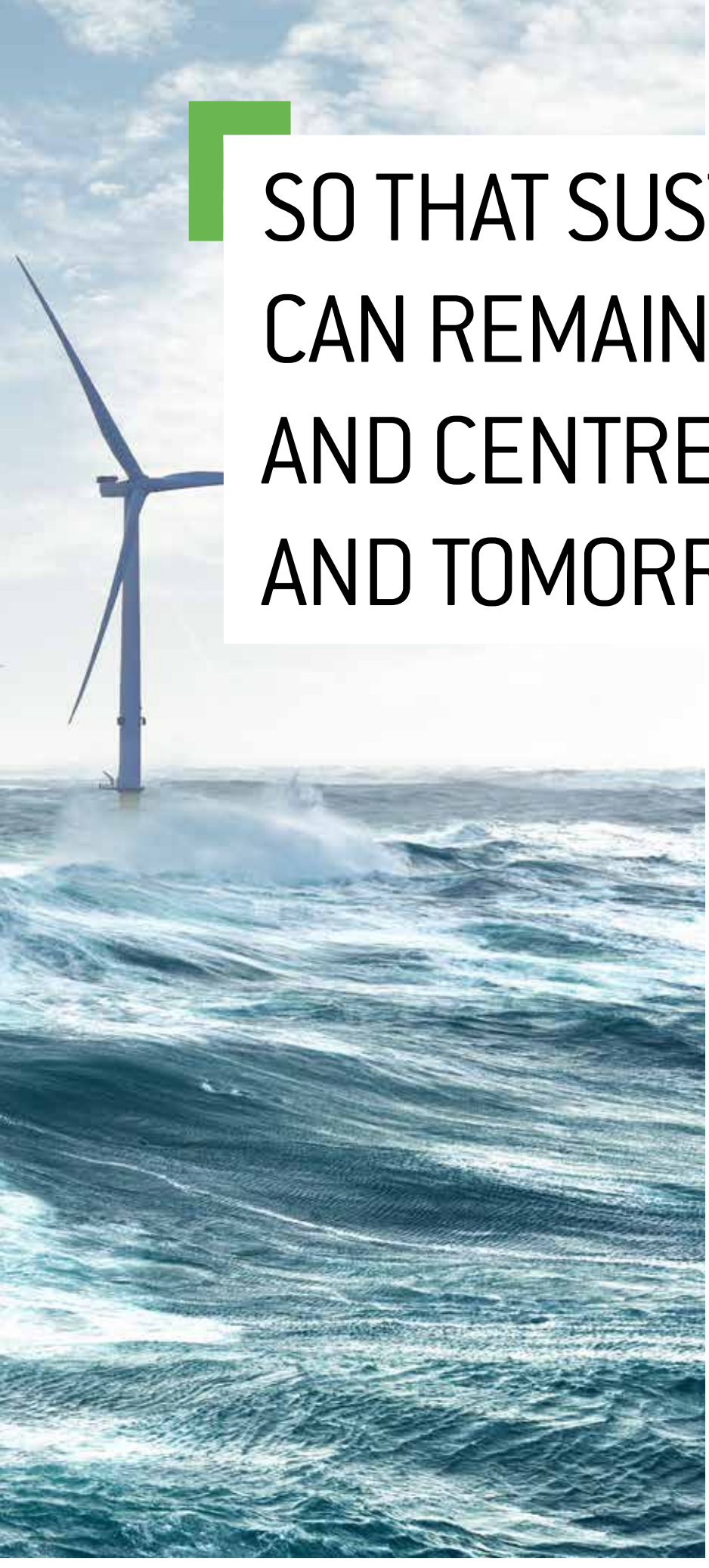
We interpret service as a promise that we give to our customers. A promise that you as a customer are not just looked after, but also understood.

To this end, we are happy to walk in the customer's shoes and we try to recognise your individua requirements and wishes, to fulfil them in the best way possible.

We support you with your project from start to finish. We understand that our customers are often under time pressure, and so we offer you flexibility and reliability and, if necessary, undertake the safe transport of your components from us to your location.

Equally important to us is the training and further education of our customers. We offer training and further education to promote a deeper understanding of our processes and procedures. We are happy to share our comprehensive process knowledge along with our long years of experience.

Because our goal is to build a lasting and trusting working relationship, rather than meeting your expectations just once.



SO THAT SUSTAINABILITY CAN REMAIN FRONT AND CENTRE - TODAY AND TOMORROW.

Aldenhoven location

SUSTAINABILITY – COMMMITTED TO FUTURE GENERATIONS.

For us sustainability is not just a buzzword – it is the core of our business. By increasing the durability and efficiency of components, our refinements save valuable resources.

We lead by setting a good example. We are firmly convinced that: Decisions are never based solely on financial considerations. This is why all our considerations always include ecological and societal aspects as well.

We have now switched to renewable energies for our electricity consumption. Our own photovoltaic installations make a major contribution to this effort.

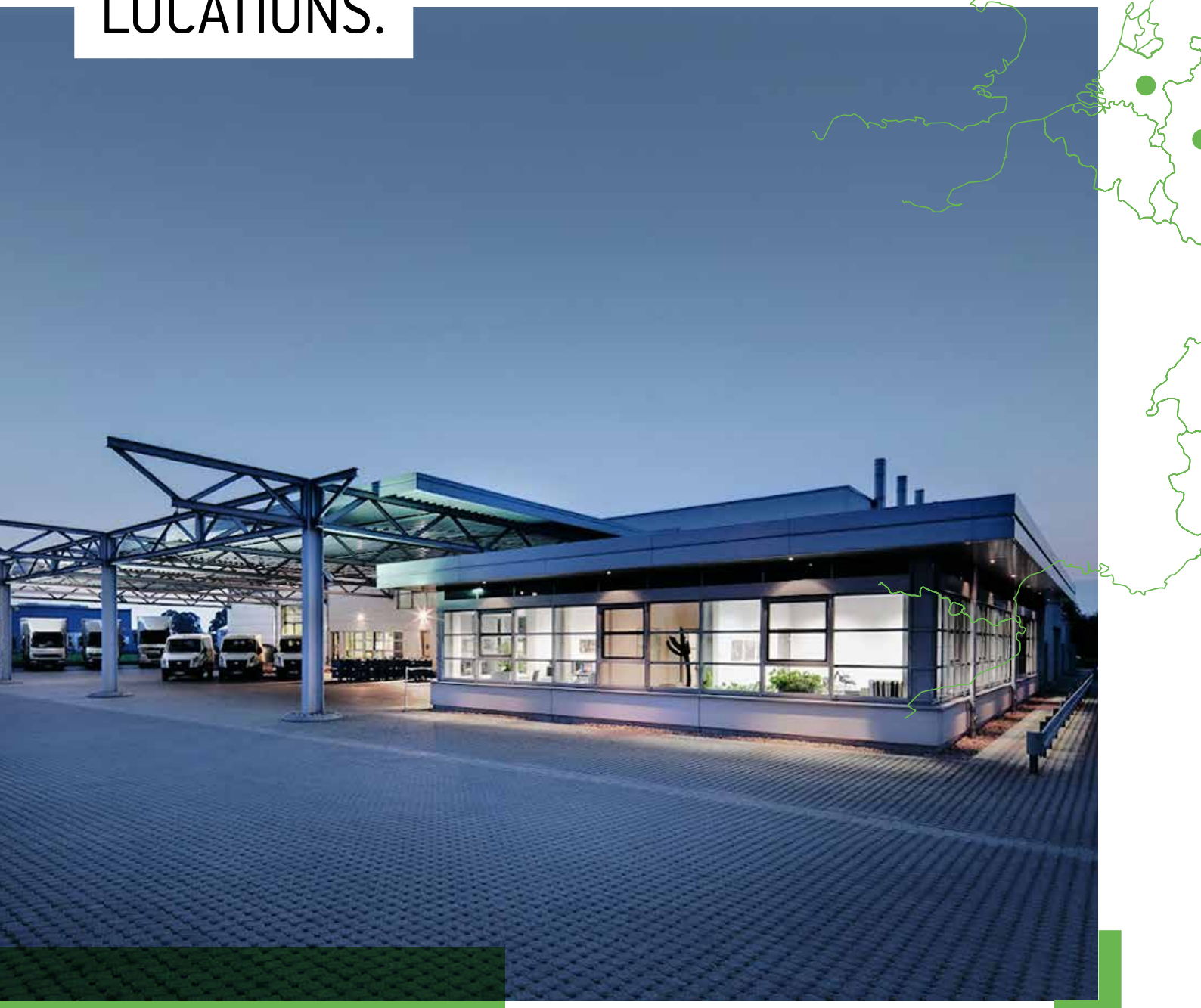
We invest in state-of-the-art and highly energy-efficient plant technology, and implement digital measurement concepts to further optimise our use of resources. We are proud to be part of the global Science Based Targets Initiative (SBTI) and actively advocate for CO2-neutral corporate management.

We follow this path with great conviction.
We promise future generations to walk this path with unwavering determination.

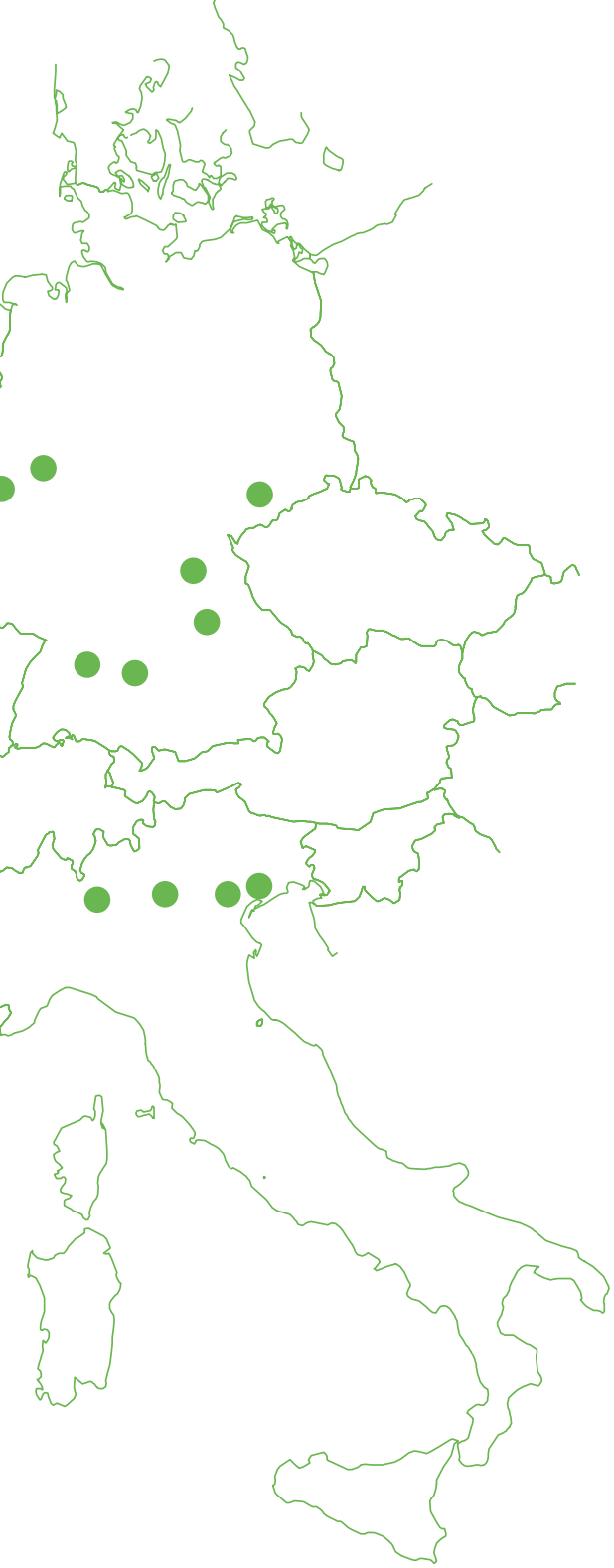
"WE MAKE SUSTAINABILITY POSSIBLE."

THIS IS WHERE WE PERFECT YOUR PRODUCT. VISIT US.

OUR LOCATIONS.



More details about our locations are also available here:



Deutschland

HÄRTHA – ALDENHOVEN GmbH
Industriestraße 30
52457 Aldenhoven
aldenhoven@haertha.de
+49 2464 58060

HÄRTHA – Weißenburg GmbH, Werk Cadolzburg
Gewerbestraße 11
90556 Cadolzburg
weissenburg@haertha.de
+49 9141 85890

Härterei Aribert Conrad GmbH
Heckenkamp 26 – 30
58640 Iserlohn
info@haerterei-conrad.de
+49 2371 97800

Donau-Härterei GmbH
Böttgerstraße 11
89231 Neu-Ulm
info@donau-haerterei.de
+49 731 97828-0

FORTE Wärmebehandlung GmbH
Auer Straße 9
09366 Stollberg
post@forte-gmbh.de
+49 37296 92680

HÄNDLE Härterei GmbH
Rittweg 45
72070 Tübingen
tuebingen@haertha.de
+49 7071 97020

HÄRTHA – Weißenburg GmbH, Hauptsitz
Dettenheimer Straße 28
91781 Weißenburg
weissenburg@haertha.de
+49 9141 85890

Konzernzentrale

HÄRTHA GROUP GmbH
Joseph-von-Fraunhofer-Straße 3a
52477 Alsdorf
info@haertha.de
+49 2404 922230

Niederlande

SABO BOXTEL BV
Staarten 9
5281 PK Boxtel
info@saboboxtel.nl
+31 411 673031

Italien

HAERTHA – VERDELLO S.R.L., Werk Verona
Via Cesare Beccaria 15
37036 San Martino Buon Albergo (VR)
verona@haertha.de
+39 045 8923093

HAERTHA COATING S.R.L.
Via Cesare Beccaria 15
37036 San Martino Buon Albergo (VR)
coating-verona@haertha.de
+39 045 8923093

VACUUM S.P.A.
Via M. Pagano 10
20090 Trezzano sul Naviglio (MI)
vacuum@pec.vacuum.it
+39 02 9443451

HAERTHA – VERDELLO S.R.L., Hauptsitz
Via dell`Artigianato 2
24049 Verdello (BG)
verdello@haertha.de
+39 035 4829789

Overview of the most common steels and the achievable surface hardness

MATERIAL	VACUUM HARDENING	QUENCHING AND TEMPERING	BRIGHT HARDENING	GAS NITRIDING	PLASMA NITRIDING	NITRO-CARBURISING	CASE HARDENING	CARBO-NITRIDING	STRESS-FREE ANNEALING	SOLUTION ANNEALING
1.0503			35-55 HRC	400–500 HV 1	400–450 HV 1	400–500 HV 1		58–62 HRC	X	
1.2162				600–750 HV 1	600–750 HV 1	650–750 HV 1	58–62 HRC		X	
1.2312	48–50 HRC			650–800 HV 1	650–800 HV 1	650–800 HV 1			X	
1.2343	50–54 HRC			900–1200 HV 1	900–1200 HV 1	900–1200 HV 1			X	
1.2344	50–55 HRC			900–1200 HV 1	900–1200 HV 1	900–1200 HV 1			X	
1.2365	50–52 HRC			750–900 HV 1	750–900 HV 1	900–1200 HV 1			X	
1.2367	54–56 HRC			900–1000 HV 1	900–1000 HV 1	900–1200 HV 1			X	
1.2379	58–63 HRC			1000–1200 HV 1	1000–1200 HV 1				X	
1.2714	56–58 HRC			600–700 HV 1	600–700 HV 1	600–700 HV 1			X	
1.2767	52–56 HRC			600–700 HV 0	600–700 HV 1				X	
1.2842			60–64 HRC	550–680 HV 1	550–680 HV 1				X	
1.4021	48–50 HRC				900–1200 HV 1				X	
1.4035	46–48 HRC				900–1200 HV 1				X	
1.4112	54–56 HRC				900–1200 HV 1				X	
1.4122	48–50 HRC				900–1200 HV 1				X	
1.4301					900–1200 HV 1					X
1.4305					900–1200 HV 1					X
1.7131				600–750 HV 1	600–750 HV 1	600–750 HV 1	58–62 HRC		X	
1.7139				600–750 HV 1	600–750 HV 1	600–750 HV 1	58–62 HRC		X	
1.7225		27–44 HRC	45–60 HRC	600–750 HV 1	600–750 HV 1	600–750 HV 1			X	
1.7227		27–44 HRC	45–60 HRC	600–750 HV 1	600–750 HV 1	600–750 HV 1			X	
1.8519		27–44 HRC	45–58 HRC	850–950 HV 1	850–950 HV 1	850–950 HV 1			X	
1.8550				850–950 HV 1	850–950 HV 1	850–950 HV 1			X	
E 355 (St–52)				250–450 HV 1	250–450 HV 1	300–500 HV 1		50–60 HRC	X	
S 235				250–450 HV 1	250–450 HV 1	300–500 HV 1		50–60 HRC	X	

TECHNICAL SPECIFICATIONS

Achievable hardness penetration depths by inductive hardening

Quenched and tempered steels

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.0501	51–57 HRC	max. 4 mm
1.0726	50–55 HRC	max. 4 mm
1.1181	51–57 HRC	max. 4 mm
1.1183	51–57 HRC	max. 4 mm
1.0503	56–61 HRC	max. 4 mm
1.0727	55–60 HRC	max. 4 mm
1.1191	56–61 HRC	max. 4 mm
1.1193	56–61 HRC	max. 4 mm
1.1213	58–63 HRC	max. 4 mm
1.0728	58–62 HRC	max. 2 mm
1.221	59–64 HRC	max. 2 mm
1.1249	60–64 HRC	max. 2 mm
1.6971	60–64 HRC	max. 2 mm
1.5067	52–57 HRC	max. 4 mm
1.5038	53–58 HRC	max. 4 mm
1.5122	55–58 HRC	max. 6 mm
1.5120	54–59 HRC	max. 6 mm
1.5121	54–59 HRC	max. 6 mm
1.5141	58–63 HRC	max. 6 mm

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.7005	56–61 HRC	max. 6 mm
1.7033	51–56 HRC	max. 6 mm
1.7034	53–58 HRC	max. 6 mm
1.7043	53–58 HRC	max. 6 mm
1.7035	54–59 HRC	max. 6 mm
1.7045	54–59 HRC	max. 6 mm
1.7220	52–57 HRC	max. 6 mm
1.7223	54–59 HRC	max. 6 mm
1.7225	54–59 HRC	max. 6 mm
1.7238	57–62 HRC	max. 6 mm
1.7228	57–62 HRC	max. 6 mm
1.8159	57–62 HRC	above 6 mm
1.8161	59–64 HRC	above 6 mm
1.6580	50–55 HRC	above 6 mm
1.6582	51–56 HRC	above 6 mm
1.6511	52–57 HRC	above 6 mm
1.0601	56–62 HRC	max. 3 mm
1.1167	50–55 HRC	max. 4 mm
1.1157	53–58 HRC	max. 4 mm

Stainless steels

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.2082	48–52 HRC	max. 6 mm
1.2083	54–58 HRC	max. 6 mm
1.4112	54–58 HRC	above 6 mm
1.4535	54–58 HRC	above 6 mm
1.4125	55–60 HRC	max. 6 mm

Ball bearing steel

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.3505	61–65 HRC	max. 6 mm

Tool steels

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.2344	55–60 HRC	max. 6 mm
1.2327	60–65 HRC	above 6 mm
1.2067	60–65 HRC	max. 4 mm

Valve steels

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
1.4718	55–60 HRC	max. 2 mm
14,747	51–55 HRC	max. 2 mm

Cast materials

MATERIAL	SURFACE HARDNESS	MAXIMUM DEPTH
0.6025	46–52 HRC	max. 2 mm
0.7060	52–58 HRC	max. 2 mm
0.7070	55–62 HRC	max. 2 mm
1.0443	50–57 HRC	max. 3 mm
1.0553	55–60 HRC	max. 3 mm

Achievable hardness penetration depths of edge layer hardening processes

MATERIAL	GAS NITRIDING	PLASMA NITRIDING	NITROCARBURISING	CASE HARDENING	CARBONITRIDING
1.0503	0.2– 0.5 mm	0.2– 0.4 mm	0.2– 0.3 mm		max. 1.0 mm
1.2162	0.2– 0.6 mm	0.2– 0.5 mm	0.2– 0.3 mm	max. 1.6 mm	
1.2312	0.2– 0.5 mm	0.2– 0.4 mm	0.2– 0.3 mm		
1.2343	0.1– 0.25 mm	0.1– 0.25 mm	0.15– 0.2 mm		
1.2344	0.1– 0.25 mm	0.1– 0.25 mm	0.15– 0.2 mm		
1.2365	0.1– 0.25 mm	0.1– 0.25 mm	0.15– 0.2 mm		
1.2367	0.1– 0.25 mm	0.1– 0.25 mm	0.15– 0.2 mm		
1.2379	0.1– 0.25 mm	0.1– 0.25 mm			
1.2714	0.2– 0.5 mm	0.2– 0.4 mm			
1.2767	0.2– 0.5 mm	0.2– 0.4 mm			
1.2842	0.2– 0.5 mm	0.2– 0.4 mm			
1.4021		0.10– 0.20 mm			
1.4035		0.10– 0.20 mm			
1.4112		0.05– 0.15 mm			
1.4122		0.05– 0.15 mm			
1.4301		0.05– 0.15 mm			
1.4305		0.05– 0.15 mm			
1.7131	0.2– 0.6 mm	0.2– 0.5 mm	0.25– 0.35 mm	max. 1.6 mm	
1.7139	0.2– 0.6 mm	0.2– 0.5 mm	0.25– 0.35 mm	max. 1.6 mm	
1.7225	0.2– 0.45 mm	0.2– 4 mm	0.25– 0.35 mm		
1.7227	0.2– 0.45 mm	0.2– 4 mm	0.25– 0.35 mm		
1.8519	0.2– 0.4 mm	0.2– 0.4 mm	0.2– 0.3 mm		
1.8550	0.2– 0.5 mm	0.2– 0.4 mm	0.2– 0.3 mm		
E 355 (St-52)	0.2– 0.6 mm	0.1– 0.5 mm	0.2– 0.5 mm		max. 0.8 mm
S 235	0.2– 0.6 mm	0.1– 0.5 mm	0.2– 0.5 mm		max. 0.8 mm

Achievable nitriding hardness depths of nitriding processes

MATERIAL	GAS NITRIDING	PLASMA NITRIDING	NITROCARBURISING
1.0503	5–15 µm	5–15 µm	10–20 µm
1.2162	2–10 µm	2–10 µm	5–15 µm
1.2312	2–10 µm	2–10 µm	5–15 µm
1.2343	1–10 µm	0–5 µm	2–10 µm
1.2344	1–10 µm	0–5 µm	2–10 µm
1.2365	1–10 µm	0–5 µm	2–10 µm
1.2379	0–2 µm	0–2 µm	
1.2714	2–10 µm	2–10 µm	
1.2767	2–10 µm	2–10 µm	
1.2842	2–10 µm	2–10 µm	
1.4021		0 µm	
1.4035		0 µm	
1.4112		0 µm	
1.4122		0 µm	
1.4301		0 µm	
1.4305		0 µm	
1.7131	2–10 µm	2–10 µm	5–15 µm
1.7139	2–10 µm	2–10 µm	5–15 µm
1.7225	2–10 µm	2–10 µm	5–15 µm
1.7227	2–10 µm	2–10 µm	5–15 µm
1.8519	2–10 µm	2–10 µm	5–15 µm
1.8550	2–10 µm	2–10 µm	5–15 µm
E 355 (St-52)	4–10 µm	4–10 µm	5–15 µm
S 235	4–10 µm	4–10 µm	5–15 µm

Hardness conversion tables for non-alloy, low-alloy steels and cast steel as per DIN EN ISO 18265-A.1

TENSILE STRENGTH MPA	VICKERS HARDNESS HV 10	BRINELL HARDNESS HB	ROCKWELL HARDNESS HRB	HRF	HRC	HRA	HRD	HR15N	HR30N	HR45N
255	80	76								
270	85	80.7	41							
285	90	85.5	48	82.6						
305	95	90.2	52							
320	100	95	56.2	87						
335	105	99.8								
350	110	105	62.3	90.5						
370	115	109								
385	120	114	66.7	93.6						
400	125	119								
415	130	124	71.2	96.4						
430	135	128								
450	140	133	75	99						
465	145	138								
480	150	143	78.7	101.4						
495	155	147								
510	160	152	81.7	103.6						
530	165	156								
545	170	162	85	105.5						
560	175	166								
575	180	171	87.1	107.2						
595	185	176								
610	190	181	89.5	108.7						
625	195	185								
640	200	190	91.5	110.1						
660	205	195	92.5							
675	210	199	93.5	111.3						
690	215	204	94							
705	220	209	95	112.4						
720	225	214	96							
740	230	219	96.7	113.4						
755	235	223								
770	240	228	98.1	114.3	20.3	60.7	40.3	69.6	41.7	19.9
785	245	233			21.3	61.2	41.1	70.1	42.5	21.1
800	250	238	99.5	115.1	22.2	61.6	41.7	70.6	43.4	22.2
820	255	242	(101)		23.1	62	42.2	71.1	44.2	23.2
835	260	247			24	62.4	43.1	71.6	45	24.3
850	265	252	(102)		24.8	62.7	43.7	72.1	45.7	25.2
865	270	257			25.6	63.1	44.3	72.6	46.4	26.2
880	275	261	(104)		26.4	63.5	44.9	73	47.2	27.1
900	280	266			27.1	63.8	45.3	73.4	47.8	27.9
915	285	271	(105)		27.8	64.2	46	73.8	48.4	28.7
930	290	276			28.5	64.5	46.5	74.2	49	29.5
950	295	280			29.2	64.8	47.1	74.6	49.7	30.4
965	300	285			29.8	65.2	47.5	74.9	50.2	31.1
995	310	295			31	65.8	48.4	75.6	51.3	32.5
1 030	320	304			32.2	66.4	49.4	76.2	52.3	33.9
1 060	330	314			33.3	67	50.2	76.8	53.6	35.2

TENSILE STRENGTH MPA	VICKERS HARDNESS HV 10	BRINELL HARDNESS HB	HRC	HRA	HRD	HR15N	HR30N	HR45N
1 095	340	323	34.4	67.6	51.1	77.4	54.4	36.5
1 125	350	333	35.5	68.1	51.9	78	55.4	37.8
1 155	360	342	36.6	68.7	52.8	78.6	56.4	39.1
1 190	370	352	37.7	69.2	53.6	79.2	57.4	40.4
1 220	380	361	38.8	69.8	54.4	79.8	58.4	41.7
1 255	390	371	39.8	70.3	55.3	80.3	59.3	42.9
1 290	400	380	40.8	70.8	56	80.8	60.2	44.1
1 320	410	390	41.8	71.4	56.8	81.4	61.1	45.3
1 350	420	399	42.7	71.8	57.5	81.8	61.9	46.4
1 385	430	409	43.6	72.3	58.2	82.3	62.7	47.4
1 420	440	418	44.5	72.8	58.8	82.8	63.5	48.4
1 455	450	428	45.3	73.3	59.4	83.2	64.3	49.4
1 485	460	437	46.1	73.6	60.1	83.6	64.9	50.4
1 520	470	447	46.9	74.1	60.7	83.9	65.7	51.3
1 555	480	456	47.7	74.5	61.3	84.3	66.4	52.2
1 595	490	466	48.4	74.9	61.6	84.7	67.1	53.1
1 630	500	475	49.1	75.3	62.2	85	67.7	53.9
1 665	510	485	49.8	75.7	62.9	85.4	68.3	54.7
1 700	520	494	50.5	76.1	63.5	85.7	69	55.6
1 740	530	504	51.1	76.4	63.9	86	69.5	56.2
1 775	540	513	51.7	76.7	64.4	86.3	70	57
1 810	550	523	52.3	77	64.8	86.6	70.5	57.8
1 845	560	532	53	77.4	65.4	86.9	71.2	58.6
1 880	570	542	53.6	77.8	65.8	87.2	71.7	59.3
1 920	580	551	54.1	78	66.2	87.5	72.1	59.9
1 955	590	561	54.7	78.4	66.7	87.8	72.7	60.5
1 995	600	570	55.2	78.6	67	88	73.2	61.2
2 030	610	580	55.7	78.9	67.5	88.2	73.7	61.7
2 070	620	589	56.3	79.2	67.9	88.5	74.2	62.4
2 105	630	599	56.8	79.5	68.3	88.8	74.6	63
2 145	640	608	57.3	79.8	68.7	89	75.1	63.5
2 180	650	618	57.8	80	69	89.2	75.5	64.1
	660		58.3	80.3	69.4	89.5	75.9	64.7
	670		58.8	80.6	69.8	89.7	76.4	65.3
	680		59.2	80.8	70.1	89.8	76.8	65.7
	690		59.7	81.1	70.5	90.1	77.2	66.2
	700		60.1	81.3	70.8	90.3	77.6	66.7
	720		61	81.8	71.5	90.7	78.4	67.7
	740		61.8	82.2	72.1	91	79.1	68.6
	760		62.5	82.6	72.6	91.2	79.7	69.4
	780		63.3	83	73.3	91.5	80.4	70.2
	800		64	83.4	73.8	91.8	81.1	71
	820		64.7	83.8	74.3	92.1	81.7	71.8
	840		65.3	84.1	74.8	92.3	82.2	72.2
	860		65.9	84.4	75.3	92.5	82.7	73.1
	880		66.4	84.7	75.7	92.7	83.1	73.6
	900		67	85	76.1	92.9	83.6	74.2
	920		67.5	85.3	76.5	93	84	74.8
	940		68	85.6	76.9	93.2	84.4	75.4

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Contact

→ **HÄRTHA GROUP GmbH**
Joseph-von-Fraunhofer-Straße 3a
52477 Alsdorf

info@haertha.de
+49 2404 922230

www.haertha.de

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