thyssenkrupp rothe erde

rothe erde® rings

Seamless rolled rings
in the highest precision.

thyssenkrupp

thyssenkrupp rothe erde – Successful with seamless rolled rings.

Over 150 years of experience in steel forming and machining ensures that rothe erde® rings deliver outstanding performance. Our expertise in open-die and drop forging enabled us to apply the technology for seamless rolled rings (radial-axial rolling technology) perfectly from the outset and continuously improve it. By contrast with other methods such as production from heavy plate metal, this manufacturing process offers key economic and technical advantages.

In particular the tangential grain flow typical of rolled rings ensures homogeneous mechanical properties around the entire circumference of the ring. We stock the mostly required materials in various dimensions – including several aluminum alloys – in order to minimize the response time.

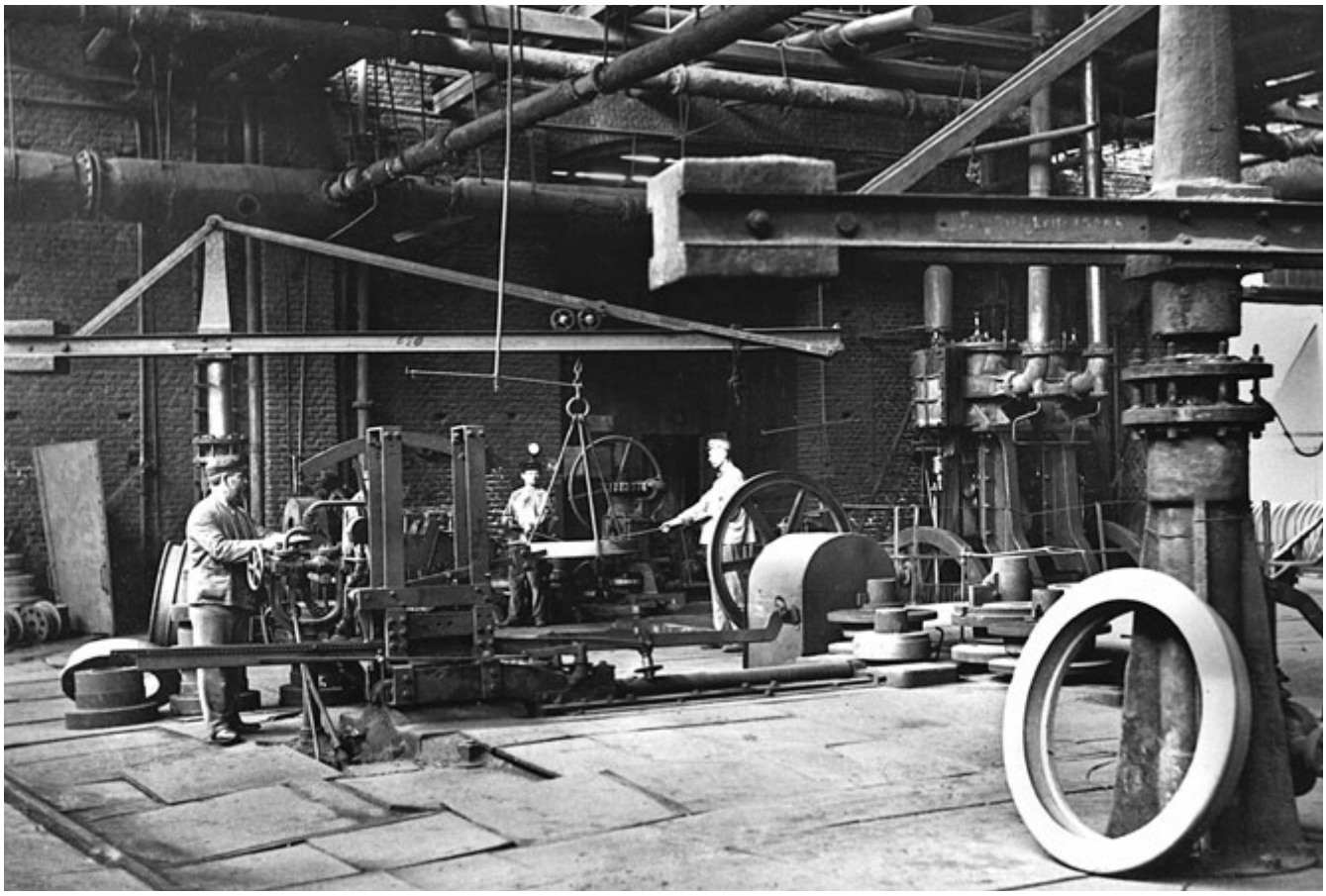
Material grades produced via ingot and continuous casting, electroslag remelting and forging enable us to meet a broad spectrum of customer requirements.

rothe erde® rings are available in a wide range of outside diameters from 300 to 8.000 mm.

In addition to their usage in slewing bearings, further applications for rothe erde® rings range from all types of industrial machinery, large gear units, vehicle construction and aerospace to wind turbines and tunnel boring machines. The in-house machining of our rings is the key to this diversity.

State-of-the-art testing facilities guarantee the high quality of our products

The experience which thyssenkrupp rothe erde has gained over many years enables us to meet all challenges of the markets of today and tomorrow.

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Sawing station

Flexibility

The basis for rationalized ring production

thyssenkrupp rothe erde holds all conventional materials in various dimensions and adequate quantities in stock. These materials include ingots and conti- nuous cast grades, preformed and ESR materials as well as non-ferrous metals, in particular standard aluminum alloys. It enables us to meet our customers' requests and stick to delivery deadlines.

Thanks to our worldwide network, we can quickly procure materials which are not usually held in stock. In many cases we are able to suggest alternative materials with identical application properties. Short throughput times are an important prerequisite for timely delivery. We achieve these by highly flexible order planning and production control.

Optimizing the ring dimensions in the early consultation phase further contributes to this flexibility.

The consequent adaptation of ring dimensions to the application purpose is further assisted by linked CAD and CNC programs. Depending on customer requirements, from the “simple” blank to the ready-to-install component. The very tight manufacturing tolerances can only be achieved by precise adherence to the specified weights when the ingot is cut to length. This is ensured by modern high-powered saws with integrated weighing systems.

Raw material ingots

Raw ingots being transported to the band saw

Productivity

A structured production system

Our rolling mills are among the most modern manufacturing plants of their type. They are equipped with CNC controls and cover outside diameters from 300 to 8.000 millimeters. They are the core elements of an electronically controlled, rationalized production flow with automatic loading, handling and conveying equipment.

Elaborate CNC ring rolling programs allow previously unattainable reproducibility in the manufacture of seamless rolled rings. The hydraulic presses integrated into the production flows are adapted to the capacities of the respective ring rolling mills. It is therefore possible to select the most suitable and economical production equipment for each ring type, size or quantity required. Preheating furnaces with high precision control and supervising systems allow the processing of each material at its material- specific temperature range. Besides, economical material usage is an important matter during the production process. Optimization during the forming stage contributes to assuring optimum material utilization while saving costs for the customer.

Due to their diversity, the applications of rolled rings require a large number of different cross sections and dimensions. Modern ring rolling technology provides the flexibility to meet such requirements. The limit values indicated are not always transferable to higher- alloyed materials with high deformation resistance. If the ring dimensions reach two limit values in combination, the rollability must be analyzed separately. It is possible to adjust the mechanical properties by appropriate heat treatment for the whole production range.

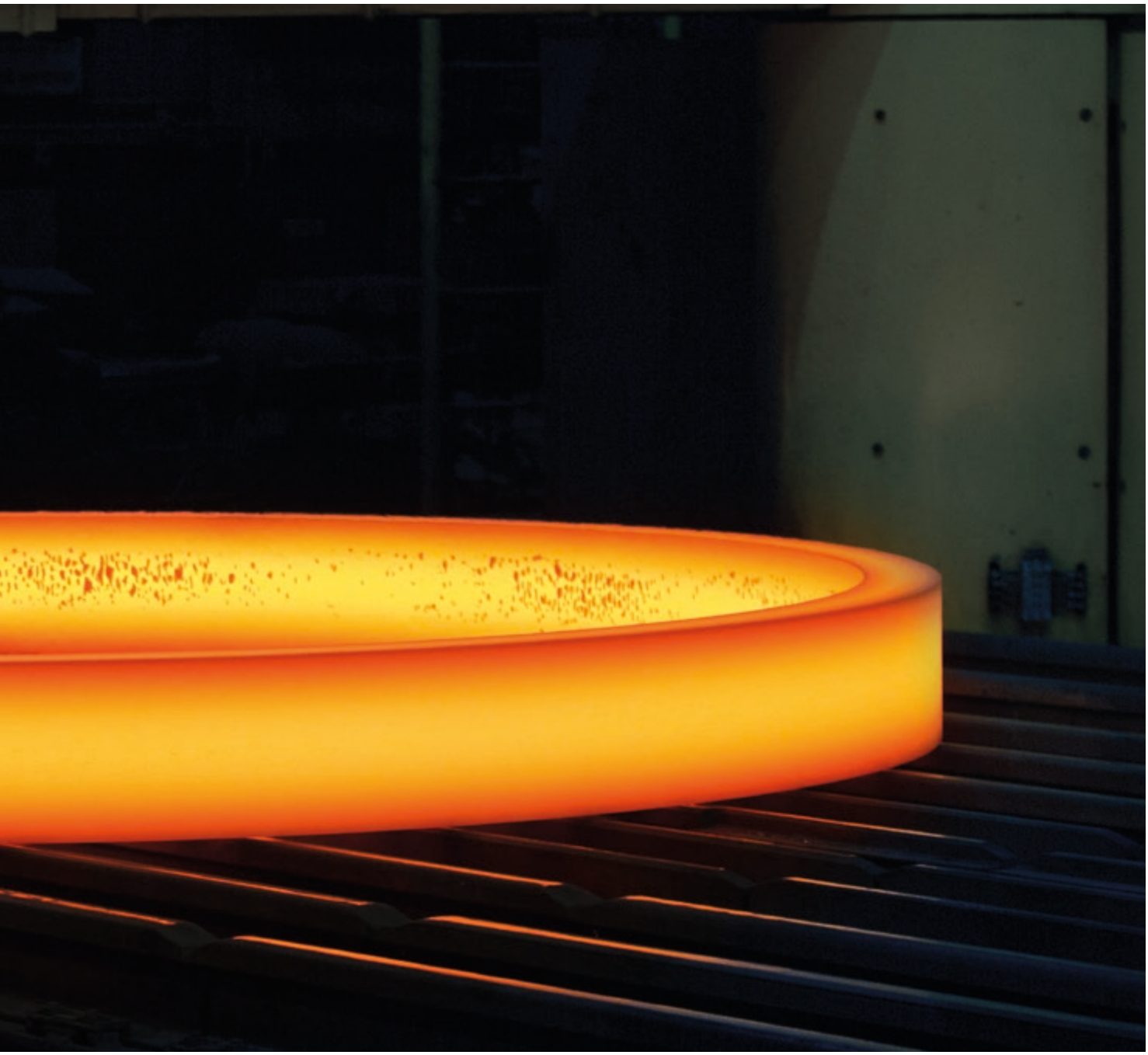
For further information or for assistance with your particular needs, please contact our sales department.

Individuality

Rolled rings on the cooling bed

Material-specific heat treatment and processing

The achievement of optimum processing and application properties in modern materials relies on material-specific heat treatment processes. In addition to know-how and experience, this requires most advanced technical equipment and procedures. This is the only way to allow a specific extraction of the material qualities demanded for the purpose. Besides the standard processes such as normalizing, annealing, soft annealing, etc., program controlled processes allow precise adherence to time-temperature specifications for special materials. The existing installations also meet the stringent requirements for aviation and space applications.



We not only supply rings “as-rolled” but on request we also carry out all kinds of machining in our highly capable mechanical production section, on request. This includes turning, drilling and especially gear cutting. Verified facilities are available for tip circle diameters from 300 to 10.000 mm: Internal gear cutting with straight teeth or external gear cutting with straight / angled teeth, and depending on the stresses that must be withstood, with inductive tooth flank or root hardening. Special procedures such as nitriding complete our program.

Universality

A single program for individual applications

A few examples of applications:

- Wind power plants
- High-power gears
- Mechanical engineering
- Offshore technology
- Rings and supporting rings for slewing bearings
- Turbines
- Generators
- Transformers
- Hydraulic motors
- Large valves
- Pipelines
- Textile machinery
- Tanks/pressure vessels
- Gear rings
- Aerospace and spaceflight
- Bulk-feed presses
- Steel mills

Quality

thyssenkrupp rothe erde management system

Through constant development, we are able to improve our business processes continuously. We perform regular reviews to ensure permanent effectiveness and continuous improvement of all sections. Next to customer demands, we are also able to comply with legal and governmental requirements.

The definition of quality, safety and environmental protection objectives ensures that resources are suitably used, measured and evaluated.

It is important to identify relevant requirements, avoid errors and strictly eliminate sources of error in all function areas during the processing of quotations and orders – from planning through to the shipment of products.

Sustainability is a core element of our company strategy: As part of a global industrial group, thyssenkrupp rothe erde develops innovative product solutions which not only secure long-term successes for our customers, but also make a positive contribution to global development. We are focusing on the future: our decisions are not only guided by economic considerations, but also by ecological and social concerns. Our integrated management system is certified according to the following standards:

- quality
  according to DIN EN ISO 9001
  according to DIN EN 9100
- environmental protection
  according to DIN EN ISO 14001
- energy management
  according to DIN EN ISO 50001
- occupational safety
  according to DIN EN ISO 45001

We offer products which are manufactured to the highest standards in terms of quality, occupational safety, ecological and economic aspects.

The spectrum of topics in the area of sustainability ranges from growth, compliance and human rights, to efficiency of resources. We use our engineering expertise to meet the worldwide demand for more goods and services in a better way.

Social responsibility

Environmental protection, health and safety at work

Our promise:	• promote sustainable development with man-oriented management and process control • enhance the sense of responsibility of serving society and environment protection with antipollution and continuous improvement • guide our behavior with relative laws and rules • put prevention first to avoid accidents
Our requirement:	• control of possible risks • prevent any kind of pollution • in compliance with the laws and rules
Our pursuit:	• create a safe, healthy and clean working environment • we are working on the development of new energy and will continue to make our contributions to society

Materials

International standards

Worldwide operations increasingly need to be adapted to international standards. Therefore, it is important to know to what extent identical analyses or application-identical material properties are meeting requirements. The following tables show various international standards applicable for unalloyed structural steels, quenched and tempered steels, high-alloyed steels and wrought aluminum alloys. Considering the multitude of formable materials, these lists cannot be comprehensive. Please contact the thyssenkrupp rothe erde sales department for more information.

Unalloyed structural steels

EN 10025	Great Britain	France	Italy	Sweden	Spain	USA	Japan	China
	BS	NF	UNI	SS/SIS	UNE	ASTM	JIS	GB
S 185	–	A 33	FE 320	1300-00	A 310-0	283 G. A		Q195
S 235 JR	40 B	–	–	1312-00	AE 235 B-FN	284 G. B	–	Q235B
S 235 J0	40 C/D	E 24-3/4	FE 360 C/D	–	AE 235 C/D	–	–	Q235C
S 235 J2	–	–	–	–	–	–	–	Q235D
S 275 JR	43 B	E 28-2	FE 430 B	1412-00	AE 275 B	–	–	Q275B
S 275 J0	43 C/D	E 28-3/4	FE 430 C/D	1414-00	AE 275 C/D	572 G. 42	SM 41 C	Q275C
S 275 J2	–	–	–	1414-01	–	–	–	Q275D
S 355 JR	50 B	E 36-2	FE 510 B	–	AE 355 B	–	–	Q355B
S 355 J0	50 C/D	E 36-3	FE 510 C/D	–	AE 355 C/D	440	SM 53 B/C	Q355C
S 355 J2	50 DD	E 36-4	–	–	–	–	–	Q355D
S355 NL								Q355NE
S 450 J0	50 B	–	–	–	–	–	–	–
E 295	–	A 50-2	FE 490	1550-00	A 490	572 G. 55	SS 50	–
E 335	55 C	A 60-2	FE 590	1650-00	A 590	572 G. 65	SM 58	–
E 360	–	A 70-2	FE 690	1655-00	A 690	–	–	–

Quenched and tempered steels

EN10083	Great Britain	France	Italy	Sweden	Spain	USA	Japan	China
	BS	NF	UNI	SS/SIS	UNE	ASTM	JIS	GB
C 22	050 A 20	–	–	–	–	1020	–	–
C 35	060 A 35	AF 55 C 35	–	1572	–	1035	–	35
C 45	080 M 46	AF 65 C 45	–	1672	–	1045	–	45
C 55	070 M 55	AF 70 C 55	–	1674	–	1055	–	55
C 60	080 A 62	–	–	–	–	1060	–	60
C 22 E/R	070 M 20	XC 18/u	C 25	–	Ck 25	–	S 22 C	–
C 35 E/R	080 M 36	XC 38 H1/u	C 35	–	Ck 35/1	–	S 35 C	–
C 45 E/R	080 M 46	XC 45 H1/u	C 45	–	Ck 45/1	–	S 45 C	–
C 55 E/R	070 M 55	XC 55 H1/u	C 55	–	Ck 55/1	–	S 55 C	–
C 60 E/R	070 M 60	–	C 60	–	–	–	S 58 C	–
28 Mn 6	150 Mn 28	38 C 2	–	2120	36 Mn 6	1330	SMn 1	30Mn2
38 Cr 2	120 M 36	38 C 2	–	–	–	–	SMn 2	–
46 Cr 2	605 M 36	42 C 2	–	–	–	–	SMn 3	–
34 Cr 4	530 M 32	32 C 2	–	–	–	5132	SCr 2	35Cr
37 Cr 4	530 M 36	38 C 4	–	–	38 Cr 4	5135	SCr 3	–
41 Cr 4	530 M 40	42 C 4	41 Cr 4	–	42 Cr 4	5140	SCr 4	40Cr
25 CrMo 4	708 M 25	25 CD 4	25 CrMo 4	2225	30 CrMo 4	4130	SCM 2	30CrMo
34 CrMo 4	708 M 32	34 CD 4	35 CrMo 4	2234	35 CrMo 4	4137	SCM 3	35CrMo
42 CrMo 4	708 M 40	42 CD 4	42 CrMo 4	2244	40 CrMo 4	4140	SNC M 4	42CrMo
34 CrNiMo 6	817 M 40	35 CD 6	30 NiCrMo 12	2541	40 NiCrMo 7	4340	SNC M 9	–
30 CrNiMo 8	823 M 30	30 NCD 8	–	2534	32 NiCrMo 16	–	SNC M 5	–
51 CrV 4	735 A 50	50 CV 4	50 CrV 4	–	–	6150	SUP 10	–

All spare parts can be ordered in old standards.

High-alloyed steels made in Germany

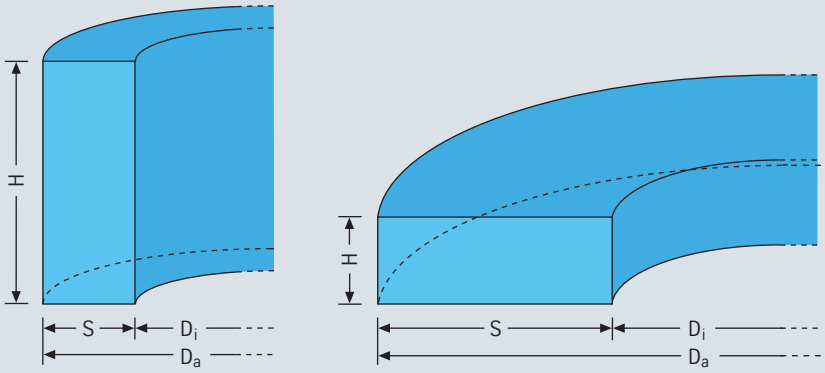
Steel grade SEW 400		ISO-standard	EURO-standard 88-86	Great Britain	France	Sweden	Spain	USA	Japan
Mat. No.	Short name 683/13			BS	NF	SS/SIS	UNE	ASTM	JIS
1.4000	X 6 Cr 13	1	X 6 Cr 13	403 S 17	Z 6 C 13	(2301)	3110	410 S	410 S
1.4002	X 6 CrAl 13	2	X 6 CrAl 13	405 S 17	Z 6 CA 13	–	3111	405	405
1.4006	X 10 Cr 13	3	X 10 Cr 13	(410 S 21)	(Z 12 C 13)	2302	(3401)	(410)	(410)
1.4104	X 12 CrMoS 17	9 a	X 14 CrMoS 17	–	Z 10 CF 17	2383	3117	–	430 F
1.4105	X 4 CrMoS 18	–	–	–	–	–	–	–	–
1.4510	X 6 CrTi 17	8 b	X 5 CrTi 17	–	Z 8 CT 17	2326	3114	439	430 LX
1.4512	X 6 CrTi 12	1 Ti	X 6 CrTi 12	409 S 19	Z 6 CT 12	–	–	409	409
1.4021	X 20 Cr 13	4	X 20 Cr 13	(420 S 29)	(Z 20 C 13)	2303	3402	(S 42010)	420 J 1
1.4024	X 15 Cr 13	3	X 15 Cr 13	(420 S 29)	(Z 12 C 13)	2302	(3401)	(410)	(410)
1.4028	X 30 Cr 13	5	X 30 Cr 13	420 S 45	(Z 30 C 13)	2304	3403	420 B	420 J 2
1.4031	X 38 Cr 13	–	X 40 Cr 13	–	(Z 40 C 14)	–	(3404)	420 X	420 J 2
1.4034	X 46 Cr 13	–	X 45 Cr 13	–	Z 40 C 13	–	3405	420 C	–
1.4057	X 20 CrNi 17 2	9 b	X 19 CrNi 17 2	431 S 29	Z 15 CN 16.02	2321	3427	431	431
1.4112	X 90 CrMoV 18	–	–	–	(Z 90 CDV 18)	–	–	(440 B)	440 B
1.4116	X 45 CrMoV 15	–	–	–	(Z 50 CD 13)	–	–	–	–
1.4120	X 20 CrMo 13	–	–	–	Z 20 CD 13	–	–	–	–
1.4122	X 35 CrMo 17	–	–	–	–	–	–	–	–
1.4125	X 105 CrMo 17	–	–	–	Z 100 CD 17	–	–	440 C	440 C
1.4418	X 4 CrNiMo 16 5	–	–	–	Z 5 CND 17.05	2387	–	–	–
1.4460	X 4 CrNiMoN 27 5 2	–	–	–	(Z 8 CND 26.05)	2324	–	329	(329 J 1)
1.4462	X 2 CrNiMoN 22 5 3	–	–	–	Z 2 CND 22.5 AZ	2377	–	S 31803	–
1.4301	X 5 CrNi 18 10	11	X 5 CrNi 18 10	304 S 15/16/31	Z 6 CN 18.09	2332	3504	304	304
1.4303	X 5 CrNi 18 12	13	X 5 CrNi 18 12	305 S 19	Z 4 CN 18.12	–	3513	(305)	305 J 1
1.4305	X 10 CrNiS 18 9	17	X 10 CrNiS 18 9	303 S 31	Z 10 CNF 18.09	2346	3508	303	303
1.4306	X 2 CrNi 19 11	10	X 2 CrNi 18 10	304 S 11	Z 2 CN 18.10	2352	3503	304 L	304 L
1.4311	X 2 CrNiN 18 10	10 N	X 2 CrNiN 18 10	(304 S 61)	Z 2 CN 18.10 AZ	2371	–	304 LN	304 LN
1.4541	X 6 CrNiTi 18 10	15	X 6 CrNiTi 18 10	321 S 31	Z 6 CNT 18.10	2337	3523	321	321
1.4550	X 6 CrNiNb 18 10	16	X 6 CrNiNb 18 10	347 S 31	Z 6 CNNb 18.10	2338	3524	347	347
1.4401	X 5 CrNiMo 17 12 2	20	X 5 CrNiMo 17 12 2	316 S 31	Z 6 CND 17.11	2347	3534	316	316
1.4404	X 2 CrNiMo 17 13 2	19	X 2 CrNiMo 17 13 2	316 S 11	Z 2 CND 17.12	2348	3533	316 L	316 L
1.4406	X 2 CrNiMoN 17 12 2	19 N	X 2 CrNiMoN 17 12 2	(316 S 61)	Z 2 CND 17.12 AZ	–	–	316 LN	316 LN
1.4429	X 2 CrNiMoN 17 13 3	19 a N	X 2 CrNiMoN 17 13 3	(316 S 63)	Z 2 CND 17.13 AZ	2375	3534	316 LN	316 LN
1.4435	X 2 CrNiMo 18 14 3	19 a	–	316 S 13	Z 2 CND 17.13	2353	3533	316 L	316 L
1.4436	X 5 CrNiMo 17 13 3	20 a	X 5 CrNiMo 17 13 3	316 S 33	Z 6 CND 17.12	2343	–	316	316
1.4438	X 2 CrNiMo 18 16 4	24	X 2 CrNiMo 18 16 4	317 S 12	Z 2 CND 19.15	2367	–	(317 L)	317 L
1.4439	X 2 CrNiMoN 17 13 5	–	X 2 CrNiMoN 17 13 5	–	–	–	–	–	–
1.4539	X 1 NiCrMoCu 25 20 5	A-4	–	–	Z 1 CNDU 25.20	2562	–	–	–
1.4571	X 6 CrNiMoTi 17 12 2	21	X 6 CrNiMoTi 17 12 2	320 S 31	Z 6 CNDT 17.12	2350	3535	316 Ti	–

DIN 17007	ISO	Int. Reg. Record (AA)	Great Britain	France	Italy	Sweden	Spain	Japan
			BS (old)	NF (old)	UNI	SS/SIS	UNE	JIS (old)
3.0515	AlMn 1	3103	N 3	–	3568	4054	L-3810	–
3.0517	AlMn 1 Cu	3003	–	A-M 1	7780	–	–	A 2 x 3
3.0526	–	3004	–	A-MG 1	6361	–	L-3820	–
3.3315	AlMg 1	(5005 A)	N 41	A-G 06	5764	4106	L-3350	A 2 x 8
3.3316	AlMg 1,5	(5050 B)	–	–	3573	–	L-3380	–
3.3535	AlMg 3	5754	–	A-G 3 M	3575	4133	L-3390	–
3.3345	–	5082	–	A-G 4,5	5420	–	–	–
3.3555	AlMg 5	5056 A	N 6	–	3576	4146	L-3320	A 2 x 2
3.3537	AlMg 3 Mn	5454	N 51	A-G 2,5 MC	7789	–	–	(A 2 x 9)
3.3545	AlMg 4 Mn	5086	–	A-G 4 MC	5452	–	L-3322	–
3.3547	AlMg 4,5 Mn	5083	N 8	A-G 4,5 MC	7790	4140	L-3321	A 2 x 7
3.3211	AlMg 1 SiCu	6061	H 20	A-GSUC	6170	–	L-3420	A 2 x 4
–	AlSi 1 MgMn	6082	H 30	A-SGM 07	3571	4212	L-3451	–
–	AlSi 1 Mg	6351	–	–	–	–	–	–
3.1305	AlCu 2 Mg	2117	3 L 86	A-U 2 G	3577	–	L-3180	A 3 x 3
3.1325	AlCu 4 MgSi	2017 A	–	A-U 4 G	3579	–	L-3120	A 3 x 2
3.1355	AlCu 4 Mg 1	2024	–	A-U 4 G 1	3583	–	L-3140	A 3 x 4
3.1255	AlCu 4 SiMg	2014	H 15	A-U 4 SG	3581	4338	L-3130	A 3 x 1
–	–	2001	–	A-U 6 MGT	–	–	–	–
3.4415	AlZn 1	7072	–	A-Z 1	–	–	L-3721	–
3.4335	AlZn 4,5 Mg 1	7020	H 17	A-Z 5 G	7791	4425	L-3741	7 N 01
–	–	7005	–	–	–	–	–	–
3.4345	–	7022	–	A-Z 4 GU	–	–	–	–
3.4365	AlZn 6 MgCu	7075	2 L 95	A-Z 5 GU	3735	–	L-3710	A 3 x 6
(3.4394)	–	7049 A	–	A-Z 8 GU	3737	–	–	–
–	–	2219	–	–	–	–	–	–
–	–	7010	–	–	–	–	–	–
3.4334	AlZn 5,5 MgCu	7175	–	–	–	–	–	–

Manufacturing range in medium-alloyed steels

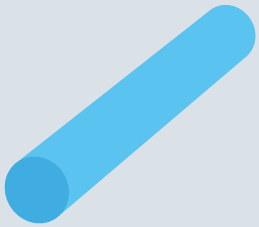
Geometrical forms from cylinder to disk shapes:

D_a max.: 8,000 mm
D_a min.: 300 mm
Height H: 20 - 800 mm
Wall thickness S min.: 20mm
Wall thickness S max.: 700 mm
Weight: 20 - 30,000 kg

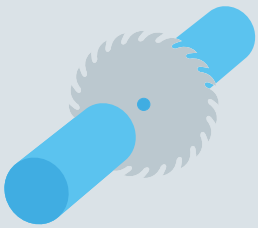


Production flow

Raw material

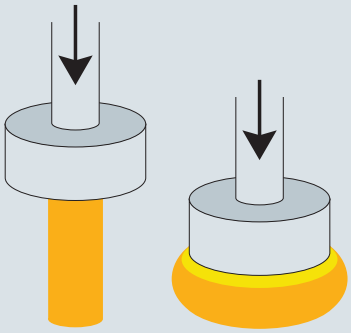


Sawing

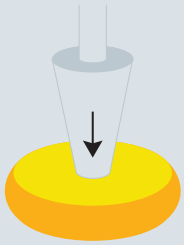


Heating

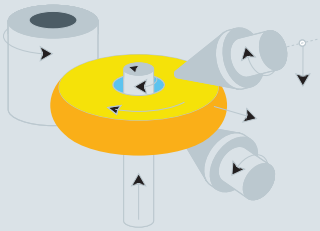
Upsetting



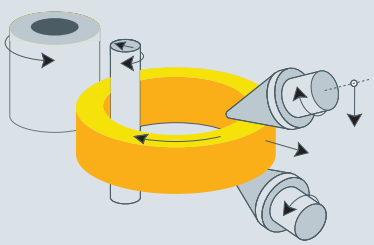
Punching



Rolling

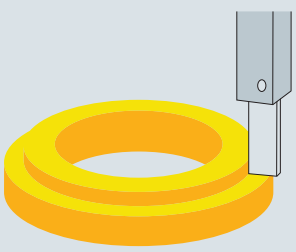


Rolling



Heat treatment

Mechanical machining



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