ASSAB PM 30 SuperClean

Uddeholm Vanadis 30 SuperClean

ASSAB
SuperClean

ASSAB

ASSAB	UDDEHOLM	REFERENCE STANDARD		
		AISI	WNr.	JIS
ASSAB DF-2	ARNE	O1	(1.2510)	(SKS 3)
ASSAB DF-3		O1	(1.2510)	(SKS 3)
ASSAB XW-5	SVERKER 3	D6 (D3)	(1.2436)	(SKD 2)
ASSAB XW-10	RIGOR	A2	1.2363	SKD 12
ASSAB XW-41	SVERKER 21	D2	1.2379	SKD 11
ASSAB XW-42		D2	1.2379	SKD 11
CARMO	CARMO		1.2358	
CALMAX	CALMAX		1.2358	
CALDIE	CALDIE			
ASSAB 88	SLEIPNER			
ASSAB PM 23 SUPERCLEAN	VANADIS 23 SUPERCLEAN	(M3:2)	1.3395	SKH 53
ASSAB PM 30 SUPERCLEAN	VANADIS 30 SUPERCLEAN	(M3:2 + Co)	1.3294	SKH 40
ASSAB PM 60 SUPERCLEAN	VANADIS 60 SUPERCLEAN		1.3292	
VANADIS 4 EXTRA SUPERCLEAN	VANADIS 4 EXTRA SUPERCLEAN			
VANADIS 6 SUPERCLEAN	VANADIS 6 SUPERCLEAN			
VANADIS 10 SUPERCLEAN	VANADIS 10 SUPERCLEAN			
VANCRON 40 SUPERCLEAN	VANCRON 40 SUPERCLEAN			
ELMAX SUPERCLEAN	ELMAX SUPERCLEAN			
ASSAB 618		P20 Mod.	1.2738	
ASSAB 618 HH		P20 Mod.	1.2738	
ASSAB 618 T		P20 Mod.	1.2738 Mod.	
ASSAB 718 SUPREME	IMPAX SUPREME	P20 Mod.	1.2738	
ASSAB 718 HH	IMPAX HH	P20 Mod.	1.2738	
NIMAX	NIMAX			
MIRRAX 40	MIRRAX 40	420 Mod.		
VIDAR 1 ESR	VIDAR 1 ESR	H11	1.2343	SKD 6
UNIMAX	UNIMAX			
CORRAX	CORRAX			
ASSAB 2083		420	1.2083	SUS 420J2
STAVAX ESR	STAVAX ESR	420 Mod.	1.2083 ESR	SUS 420J2
MIRRAX ESR	MIRRAX ESR	420 Mod.		
POLMAX	POLMAX			
RAMAX HH	RAMAX HH	420 F Mod.		
ROYALLOY	ROYALLOY			
PRODAX				
ASSAB PT18				
ASSAB MMXL				
ASSAB MM40				
ALVAR 14	ALVAR 14		1.2714	SKT 4
ASSAB 2714			1.2714	SKT 4
ASSAB 8407 2M	ORVAR 2M	H13	1.2344	SKD 61
ASSAB 8407 SUPREME	ORVAR SUPREME	H13 Premium	1.2344 ESR	SKD 61
DIEVAR	DIEVAR			
HOTVAR	HOTVAR			
QRO 90 SUPREME	QRO 90 SUPREME			
ASSAB 705		4340	1.6582	SNCM8
ASSAB 709		4140	1.7225	SCM4
ASSAB 760		1050	1.1730	S50C

Edition 140101

General

ASSAB PM 30 SuperClean is a high alloyed powder metallurgical (PM) high speed steel characterised by:

- High wear resistance
- High compressive strength at high hardness
- Good through-hardening properties
- Good toughness
- Good dimensional stability during heat treatment
- Good grindability and machinability
- Very good temper resistance

Typical analysis %	C 1.28	Cr 4.2	Mo 5.0	W 6.4	V 3.1	Co 8.5
Standard specification	AISI (M3:2 + Co), WNr. 1.3294, SKH 40					
Delivery condition	Soft annealed to max. 300 HB Drawn, max. 320 HB					
Colour code	Dark Green					

Applications

ASSAB PM 30 SuperClean is a cobalt alloyed high performance PM high speed steel. The cobalt addition of approx. 8.5% has a positive influence on the hot strength/hardness, temper resistance and modulus of elasticity. The presence of cobalt has little influence on wear resistance. As cobalt does not form carbides, the wear resistance of ASSAB PM 30 SuperClean is more or less the same as for steels with the same base analysis but without cobalt (e.g., ASSAB PM 23 SuperClean). On the other hand, its presence reduces the toughness and hardenability somewhat but increases compressive strength and high temperature properties.

PROPERTIES PROFILE FOR COLD WORK APPLICATIONS

- The combination of high wear resistance and unusually good compressive strength can be put to use in tooling for heavy forming operations.
- In some cold work operations, the active surface (e.g., cutting edge or forming surface) of a tool can reach temperatures in excess of 200°C. Such conditions can be found in tooling running on high speed presses. Also, development of high temperatures in the tooling can be expected in heavy forming operations.

Properties

PHYSICAL PROPERTIES

Temperature	20°C	400°C	600°C
Density[1] kg/m^3	8 040	7 935	7 880
Modulus of elasticity[2] MPa	240 000	214 000	192 000
Thermal conductivity[2] W/m °C	22	26	25
Specific heat[2] J/kg °C	420	510	600

[1] Soft annealed condition
[2] Hardened and tempered condition

COEFFICIENT OF THERMAL EXPANSION IN DIFFERENT TEMPERATURE INTERVALS

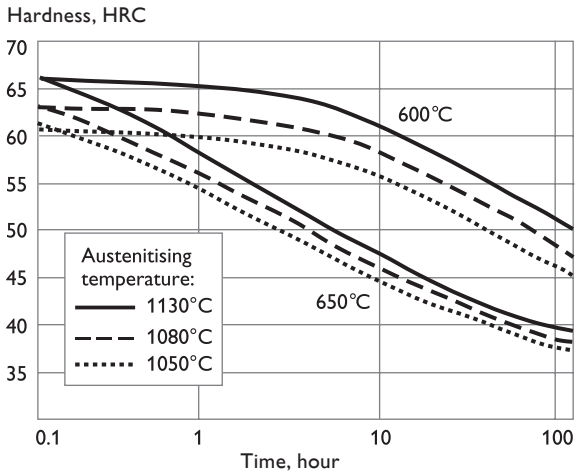
Hardened and tempered condition.

Temperature range	Coefficient (°C^{-1})
20 - 100°C	10.1 x 10^{-6}
20 - 200°C	10.3 x 10^{-6}
20 - 300°C	10.6 x 10^{-6}
20 - 400°C	11.0 x 10^{-6}
20 - 500°C	11.2 x 10^{-6}
20 - 550°C	11.3 x 10^{-6}

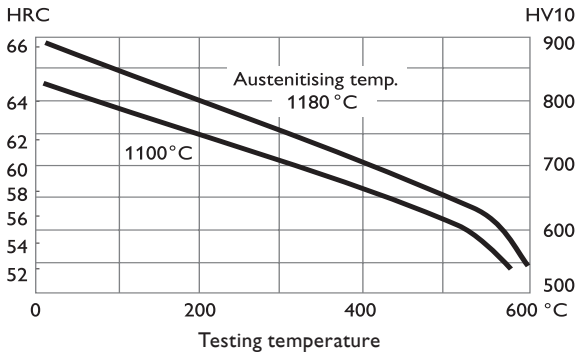
HIGH TEMPERATURE PROPERTIES

Hardness as a function of holding time at different working temperatures

Austenitising temperature: 1050 - 1130°C
Tempering: 3 x 1 h at 560°C



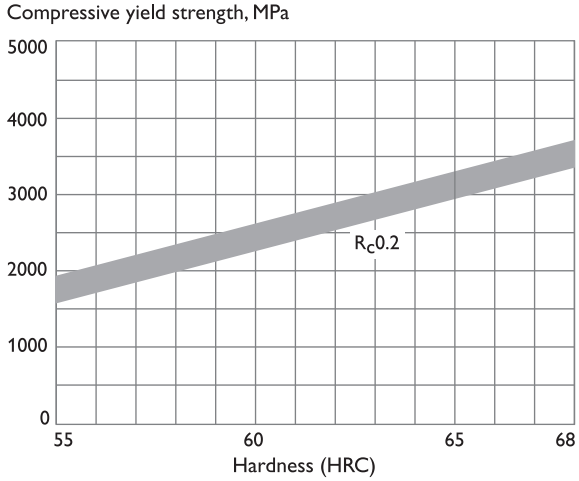
Hot hardness



COMPRESSIVE YIELD STRENGTH

Specimen: Hourglass shaped with 10mm Ø waist

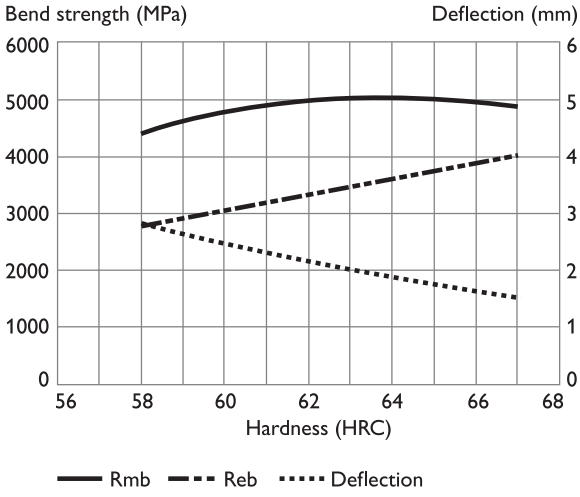
Approximate compressive yield strength versus hardness at room temperature



BENDING STRENGTH

Four-point bend testing.

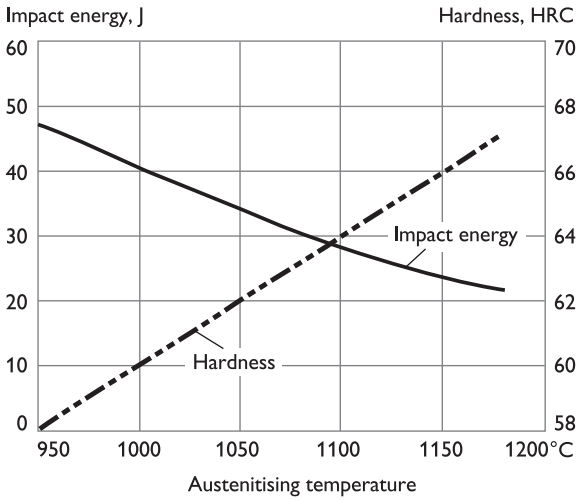
Original dimension: 6 mm Ø
Specimen size: 5 mm Ø
Tempering: 3 x 1 h at 560°C



IMPACT STRENGTH

Approximate room temperature impact strength at different hardness levels.

Original dimensions: 9 x 12 mm
Specimen size: 7 x 10 x 55 mm
Specimen type: Unnotched
Tempering: 3 x 1 h at 560°C



Heat treatment

SOFT ANNEALING

Protect the steel and heat through to 850 - 900°C. Cool in the furnace at 10°C/h to 700°C, then freely in air.

STRESS RELIEVING

After rough machining, the tool should be heated through to 600 - 700°C, holding time 2 hours. Cool slowly to 500°C, then freely in air.

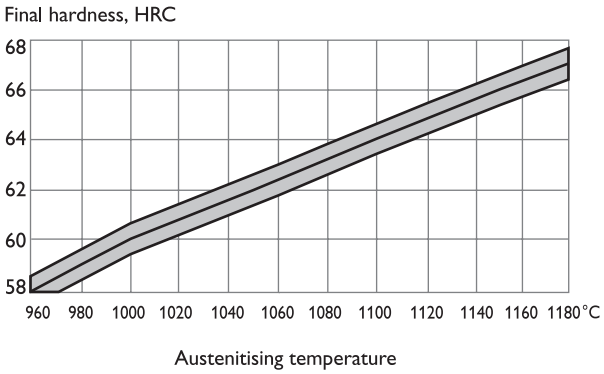
HARDENING

Preheating temperature: 450 - 500°C and 850 - 900°C

Austenitising temperature: 1050 - 1180°C, according to the desired final hardness, see diagram below

The tool should be protected against decarburisation and oxidation during hardening.

Hardness after tempering 3 times for 1 hour at 560°C

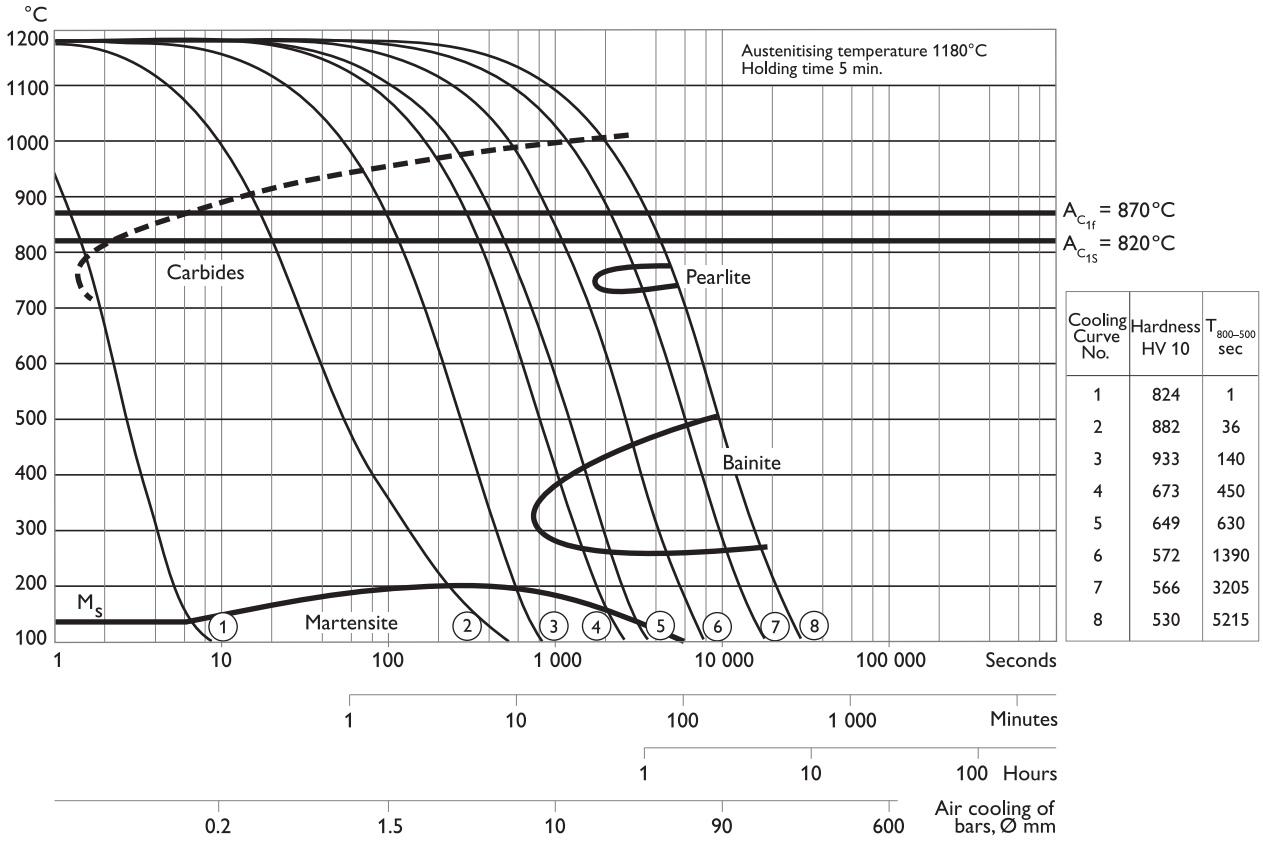


Hardness obtained after hardening at different austenitising temperatures and tempering 3 times for 1 hour at 560°C

Hardness HRC	Austenitising temp. °C
60	1000
62	1050
64	1100
66	1150
67	1180

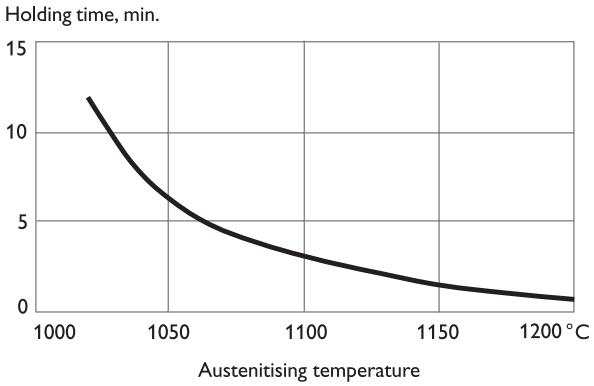
CCT graph

Austenitising temperature 1180°C. Holding time 5 minutes.



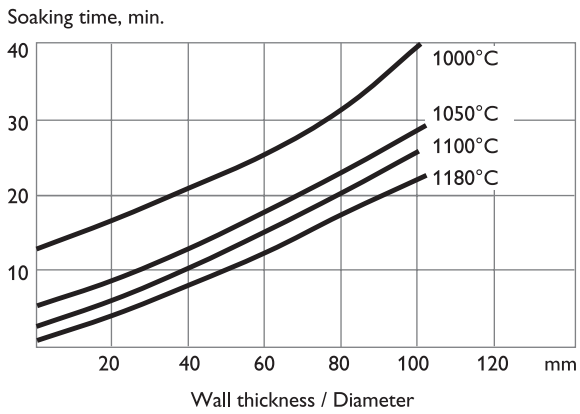
Cooling Curve No.	Hardness HV 10	$T_{800-500}$ sec
1	824	1
2	882	36
3	933	140
4	673	450
5	649	630
6	572	1390
7	566	3205
8	530	5215

Recommended holding time, vacuum, fluidised bed or atmosphere furnace



Holding time = Time at austenitising temperature after the tool is fully heated through. A holding time that is less than the recommendation mentioned above, will result in loss of hardness.

Total soaking time in a salt bath after preheating in two stages at 450°C and 850°C



QUENCHING MEDIA

- Vacuum furnace with high speed gas at sufficient overpressure (≥2 bar)
- Martempering bath at approx. 540°C
- Forced air / gas

Note 1: Quenching should be continued until the temperature of the tool reaches approx. 50°C. The tool should then be tempered immediately.

Note 2: For applications where maximum toughness is required, use a martempering bath or a furnace with sufficient overpressure.

TEMPERING

Tempering should always be carried out at 560°C irrespective of the austenitising temperature. Temper three times for at least 1 hour each at full temperature. The tool should be cooled to room temperature between the tempers. The retained austenite content will be less than 1% after this tempering cycle.

DIMENSIONAL CHANGES

Dimensional changes after hardening and tempering.

Heat treatment: Austenitising between 1050 - 1140°C and tempering 3 x 1 h at 560°C

Specimen size: 80 x 80 x 80 mm and 100 x 100 x 25 mm

Dimensional changes: Growth in length, width and thickness: +0.03% to +0.13%

Machining recommendations

The cutting data below are to be considered as guiding values and as starting points for developing your own best practice.

Condition: Soft annealed condition ~300 HB

TURNING

Cutting data parameters	Turning with carbide		Turning with HSS†
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min	80 - 110	110 - 140	10 - 15
Feed (f) mm/r	0.2 - 0.4	0.05 - 0.2	0.05 - 0.3
Depth of cut (a_p) mm	2 - 4	0.5 - 2	0.5 - 3
Carbide designation ISO	K20 P10 - P20 Coated carbide* or cermet*	K15, P10 Coated carbide* or cermet*	–

† *High speed steel*
* *Use a CVD coating*

DRILLING

High speed steel twist drill

Drill diameter mm	Cutting speed (v_c) m/min	Feed (f) mm/r
≤ 5	8 - 10*	0.05 - 0.15
5 - 10	8 - 10*	0.15 - 0.20
10 - 15	8 - 10*	0.20 - 0.25
15 - 20	8 - 10*	0.25 - 0.35

* *For coated HSS drill, v_c = 14 - 16 m/min*

Carbide drill

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (v_c) m/min	100 - 130	50 - 70	25 - 35
Feed (f) mm/r	0.05 - 0.15[2]	0.10 - 0.25[3]	0.15 - 0.25[4]

[1] *Drill with replaceable or brazed carbide tip*
[2] *Feed rate for drill diameter 20 - 40 mm*
[3] *Feed rate for drill diameter 5 - 20 mm*
[4] *Feed rate for drill diameter 10 - 20 mm*

MILLING

Face and square shoulder milling

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min	40 - 80	80 - 110
Feed (f_z) mm/tooth	0.2 - 0.4	0.1 - 0.2
Depth of cut (a_p) mm	2 - 4	≤ 2
Carbide designation ISO	K20 - P20 Coated carbide*	K15 - P15 Coated carbide* or cermet*

* *Use a CVD coating*

End milling

Cutting data parameters	Type of end mill		
	Solid carbide	Carbide indexable insert	High speed steel[1]
Cutting speed (v_c) m/min	35 - 45	70 - 90	12 - 16
Feed (f_z) mm/tooth	0.01 - 0.2[2]	0.06 - 0.2[2]	0.01 - 0.3[2]
Carbide designation ISO	–	K15, P10 - P20 Coated carbide[3] or cermet[3]	–

[1] *A coated HSS end mill*
[2] *Depending on radial depth of cut and cutter diameter*
[3] *Use a CVD coating*

GRINDING

Wheel recommendation

Type of grinding	Soft annealed condition	Hardened condition
Face grinding straight wheel	A 46 HV	B151 R50 B3[1] A 46 HV[2]
Face grinding segments	A 36 GV	A 46 GV
Cylindrical grinding	A 60 KV	B151 R50 B3[1] A 60 KV[2]
Internal grinding	A 60 JV	B151 R75 B3[1] A 60 IV
Profile grinding	A 100 JV	B126 R100 B6[1] A 120 JV[2]

[1] *If possible, use CBN wheels for this application*
[2] *Preferably a wheel type containing sintered Al_2O_3 (seeded gel)*

Surface treatment

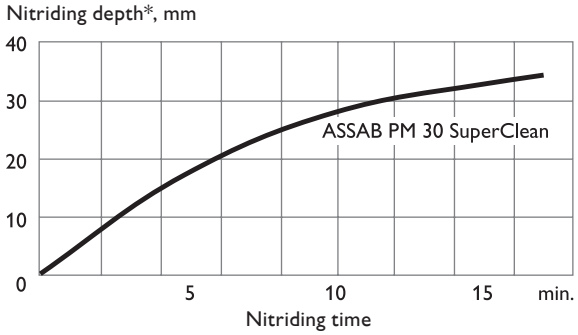
Some cold work tools are given a surface treatment in order to reduce friction and increase tool wear resistance. The most commonly used treatments are nitriding and surface coating with wear-resistant layers produced via PVD and CVD.

ASSAB PM 30 SuperClean has been found to be particularly suitable for titanium carbide and titanium nitride coatings. The uniform carbide distribution in ASSAB PM 30 SuperClean facilitates bonding of the coating and reduces the spread of dimensional changes resulting from hardening. This, together with its high strength and toughness, makes ASSAB PM 30 SuperClean an ideal substrate for PVD and CVD coatings.

NITRIDING

A brief immersion in a special salt bath to produce a nitrided diffusion zone of 2 - 20 µm is recommended. This reduces the friction on the nitrided surface of punches and has various other advantages.

Depth of nitriding as a function of nitriding time during nitrocarburising at 570°C



* *Nitriding depth is the distance from the surface where the hardness is 50 HV higher than the matrix hardness*

PVD

Physical vapour deposition, PVD, is a method of applying a wear-resistant coating at temperatures between 200 - 500°C. As ASSAB PM 30 SuperClean is high temperature tempered at 560°C, there is no danger of dimensional changes during PVD coating.

CVD

Chemical vapour deposition, CVD, is used for applying wear-resistant surface coatings at a temperature of around 1000°C. It is recommended that the tools should be separately hardened and tempered in a vacuum furnace after surface treatment.

Electrical discharge machining

If EDM is performed in the hardened and tempered condition, the EDM'd surface is covered with a resolidified layer (white layer) and a rehardened and untempered layer, both of which are very brittle and hence detrimental to the tool performance.

When a profile is produced by EDM, it is recommended to finish with "fine-sparking", i.e., low current, high frequency. For optimal performance, the EDM'd surface should be ground/polished to remove the white layer completely. The tool should then be retempered at approx. 535°C.

Further information

For further information, i.e., steel selection, heat treatment, application and availability, please contact our ASSAB office nearest to you.

Relative comparison of ASSAB cold work tool steels

MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS

ASSAB grade	Hardness/ Resistance to plastic deformation	Machinability	Grindability	Dimension stability	Resistance to		Fatigue cracking resistance	
					Abrasive wear	Adhesive wear	Ductility/ resistance to chipping	Toughness/ gross cracking
ASSAB DF-3								
CALMAX								
CALDIE (ESR)								
ASSAB XW-10								
ASSAB 88								
ASSAB XW-42								
ASSAB XW-5								
VANADIS 4 EXTRA								
VANADIS 10								
VANCRON 40								
ASSAB PM 23								
ASSAB PM 30								
ASSAB PM 60								
AISI M2								

REGIONAL HEAD OFFICE

SINGAPORE
ASSAB Pacific Pte Ltd
Tel : +65 6534 5600
Fax : +65 6534 0655
info@assab.com
www.assab.com

CHINA

Beijing
ASSAB Tooling (Beijing) Co., Ltd.
Tel : +86 10 6786 5588
Fax : +86 10 6786 2988
info.beijing@assab.com

Changchun*
ASSAB Tooling (Beijing) Co., Ltd., Dalian Branch
Tel : +86 431 8897 8922
Fax : +86 431 8897 8922
info.changchun@assab.com

Changzhou*
ASSAB Tooling Technology (Shanghai) Co., Ltd. - Changzhou Branch
Tel : +86 519 8188 0008
Fax : +86 519 8510 2820
info.changzhou@assab.com

Chongqing
ASSAB Tooling Technology (Chongqing) Co., Ltd.
Tel : +86 23 6745 5698
Fax : +86 23 6745 5699
info.chongqing@assab.com

Dalian
ASSAB Tooling (Beijing) Co., Ltd., Dalian Branch
Tel : +86 411 8761 8080
Fax : +86 411 8761 9595
info.dalian@assab.com

Dongguan
ASSAB Tooling (Dong Guan) Co., Ltd.
Tel : +86 769 2289 7888
Fax : +86 769 2289 9312
info.dongguan@assab.com

Guangzhou*
ASSAB Tooling (Dong Guan) Co., Ltd., Guangzhou Branch
Tel : +86 020 3482 8891
Fax : +86 020 3482 5329
info.guangzhou@assab.com

Hong Kong*
ASSAB Steels (HK) Ltd.
Tel : +852 2487 1991
Fax : +852 2489 0938
info.hongkong@assab.com

Hunan*
ASSAB Tooling (Dong Guan) Co., Ltd., Hunan Branch
Tel : +86 731 8452 3986
Fax : +86 731 8452 3986
info.hunan@assab.com

Ningbo
ASSAB Tooling Technology (Ningbo) Co., Ltd.
Tel : +86 574 8680 7188
Fax : +86 574 8680 7166
info.ningbo@assab.com

Qingdao
ASSAB Tooling (Qingdao) Co., Ltd.
Tel : +86 532 8752 9999
Fax : +86 532 8752 9588
info.qingdao@assab.com

Shanghai
ASSAB Tooling Technology (Shanghai) Co., Ltd.
Tel : +86 21 2416 9688
Fax : +86 21 5442 4244
info.shanghai@assab.com

Suzhou*
ASSAB Tooling Technology (Shanghai) Co., Ltd. - Suzhou Branch
Tel : +86 512 6900 0161
Fax : +86 512 6252 9227
info.suzhou@assab.com

Tianjin*
ASSAB Tooling (Beijing) Co., Ltd., Tianjin Branch
Tel : +86 22 2370 7808
Fax : +86 22 2370 7806
info.tianjin@assab.com

Wuhan
ASSAB Tooling Technology (Shanghai) Co., Ltd., Wuhan Branch
Tel : +86 27 6930 0156
Fax : +86 27 6934 6326
info.wuhan@assab.com

Xiamen
ASSAB Tooling (Xiamen) Co., Ltd.
Tel : +86 592 562 4678
Fax : +86 592 568 3703
info.xiamen@assab.com

Xi'an*
ASSAB Tooling (Beijing) Co., Ltd., Xi'an Branch
Tel : +86 29 8525 5139
Fax : +86 29 8526 2080
info.xian@assab.com

Yantai*
ASSAB Tooling (Qingdao) Co., Ltd.
Tel : +86 535 693 4100
Fax : +86 535 693 4200
info.yantai@assab.com

INDONESIA

Jakarta - Head Office
PT. ASSAB Steels Indonesia
Tel : +62 21 461 1314
Fax : +62 21 461 1306/
+62 21 461 1309
info.jakarta@assab.com

Bandung*
PT. ASSAB Steels Indonesia
Tel : +62 22 5234 017
Fax : +62 22 5234 020
info.bandung@assab.com

Cikarang*
PT. ASSAB Steels Indonesia
Tel : +62 21 461 1314
Fax : +62 21 461 1306/
+62 21 461 1309
info.cikarang@assab.com

Medan*
PT. ASSAB Steels Indonesia
Tel : +62 61 8477 935
Fax : +62 61 8477 936
info.medan@assab.com

Semarang*
PT. ASSAB Steels Indonesia
Tel : +62 24 7071 2574/
+62 24 7658 4803
Fax : +62 24 674 7145
info.semarang@assab.com

Surabaya
PT. ASSAB Steels Indonesia
Tel : +62 31 849 9606
Fax : +62 31 843 2040
info.surabaya@assab.com

Tangerang*
PT. ASSAB Steels Indonesia
Tel : +62 21 5316 0795
Fax : +62 21 5316 0794
info.tangerang@assab.com

JAPAN

Tokyo - Head Office*
Bohler-Uddeholm KK
Tel : +81 3 5226 3771
Fax : +81 3 5226 6110
info@bohler-uddeholm.jp

Fukuroi
Bohler-Uddeholm KK
Tel : +81 538 43 9240
Fax : +81 538 43 9244
info@bohler-uddeholm.jp

Nagoya*
Bohler-Uddeholm KK
Tel : +81 52 979 5081
Fax : +81 52 933 6461
info@bohler-uddeholm.jp

Osaka*
Bohler-Uddeholm KK
Tel : +81 6 6307 7621
Fax : +81 6 6307 7627
info@bohler-uddeholm.jp

KOREA

Incheon - Head Office
ASSAB Steels (Korea) Co., Ltd.
Tel : +82 32 821 4300
Fax : +82 32 821 3311
info.korea@assab.com

Busan
ASSAB Steels (Korea) Co., Ltd.
Tel : +82 51 831 3315
Fax : +82 51 831 3319
info.korea@assab.com

Daegu
ASSAB Steels (Korea) Co., Ltd.
Tel : +82 53 384 3315
Fax : +82 53 384 3317
info.korea@assab.com

MALAYSIA

Kuala Lumpur - Head Office
ASSAB Steels (Malaysia) Sdn. Bhd.
Tel : +60 3 6189 0022
Fax : +60 3 6189 0044/55
info.kualalumpur@assab.com

Northern Branch
ASSAB Steels (Malaysia) Sdn. Bhd.
Tel : +60 4 507 2020
Fax : +60 4 507 6323
info.penang@assab.com

Southern Branch
ASSAB Steels (Malaysia) Sdn. Bhd.
Tel : +60 7 598 0011
Fax : +60 7 599 4890
info.johor@assab.com

PHILIPPINES

Laguna
ASSAB Pacific Pte Ltd - Philippine Branch
Tel : +63 49 539 0441 to 0442
Fax : +63 49 539 1075
info.philippines@assab.com

SINGAPORE

ASSAB Steels Singapore (Pte) Ltd
Tel : +65 6862 2200
Fax : +65 6862 0162
info.singapore@assab.com

TAIWAN

Taipei - Head Office
ASSAB Steels Taiwan Co., Ltd.
Tel : +886 2 2299 2849
Fax : +886 2 2299 0147
info.taipei@assab.com

Kaoshiung
ASSAB Steels Taiwan Co., Ltd.
Tel : +886 7 624 6600
Fax : +886 7 624 0012
info.kaoshiung@assab.com

Nantou
ASSAB Steels Taiwan Co., Ltd.
Tel : +886 49 225 1702
Fax : +886 49 225 3173
info.nantou@assab.com

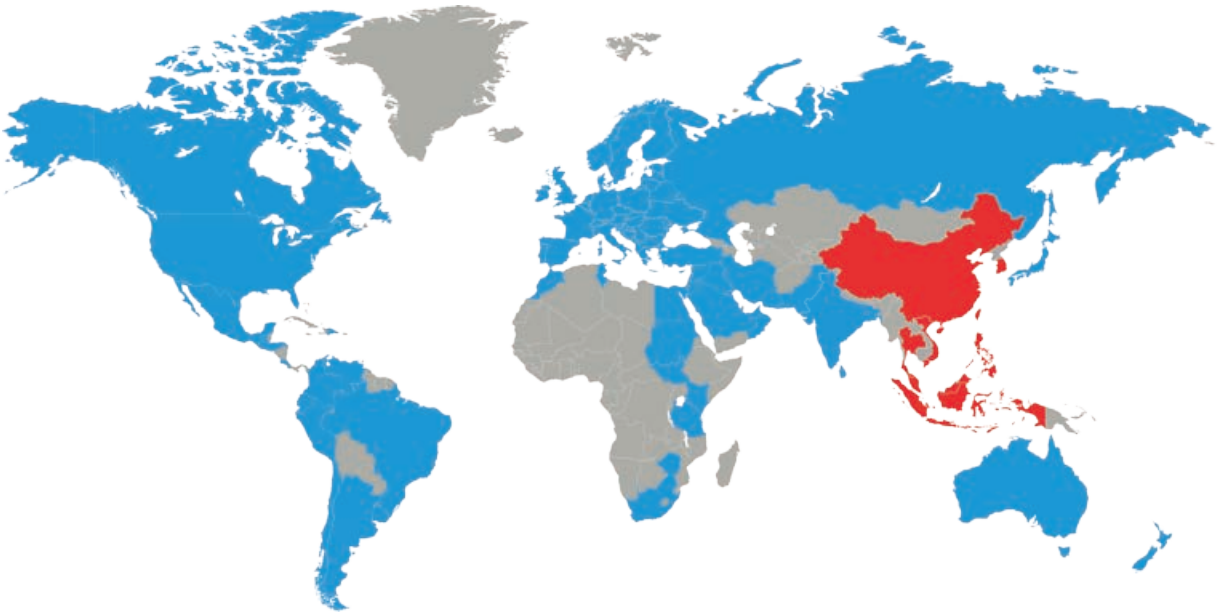
THAILAND

ASSAB Steels (Thailand) Ltd
Tel : +66 2 757 5017
Fax : +66 2 385 5943
info.thailand@assab.com

VIETNAM

ASSAB Steels (Vietnam) Co. Ltd
Tel : +84 61 8899 099
Fax : +84 61 8899 191
info.vietnam@assab.com

* Sales office



Choosing the right steel is of vital importance. ASSAB engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the best treatment for each application. ASSAB not only supplies steel products with superior quality, we offer the state-of-the-art machining, heat treatment and surface treatment services to enhance steel properties to meet your requirement in the shortest lead time. Using holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

ASSAB and Uddeholm are present on every continent. This ensures you that high-quality tool steels and local support are available wherever you are. Together, we secure our position as the world's leading supplier of tooling materials.

For more information, please visit www.assab.com

UDDEHOLM

ASSAB