



# **CORRAX**

**UDDEHOLM CORRAX**

	 <small>a voestalpine company</small>	REFERENCE STANDARD		
		AISI	Wnr.	JIS
ASSAB DF-3	ARNE	O1	1.2510	SKS 3
ASSAB XW-10	RIGOR	A2	1.2363	SKD 12
ASSAB XW-42	SVERKER 21	D2	1.2379	(SKD 11)
CALMAX / CARMO	CALMAX / CARMO		1.2358	
VIKING	VIKING / CHIPPER		(1.2631)	
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 8 SUPERCLEAN	VANADIS 8 SUPERCLEAN			
VANCRON SUPERCLEAN	VANCRON SUPERCLEAN			
ELMAX SUPERCLEAN	ELMAX SUPERCLEAN			
VANAX SUPERCLEAN	VANAX SUPERCLEAN			
ASSAB 518		P20	1.2311	
ASSAB 618 T		(P20)	(1.2738)	
ASSAB 618 / 618 HH		(P20)	1.2738	
ASSAB 718 SUPREME / 718 HH	IMPAX SUPREME / IMPAX HH	(P20)	1.2738	
NIMAX / NIMAX ESR	NIMAX / NIMAX ESR			
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)	(1.2083)	(SUS 420J2)
MIRRAX ESR	MIRRAX ESR	(420)		
MIRRAX 40	MIRRAX 40	(420)		
TYRAX ESR	TYRAX ESR			
POLMAX	POLMAX	(420)	(1.2083)	(SUS 420J2)
ROYALLOY	ROYALLOY	(420 F)		
COOLMOULD	COOLMOULD			
ASSAB 2714			1.2714	SKT 4
ASSAB 2344		H13	1.2344	SKD 61
ASSAB 8407 2M	ORVAR 2M	H13	1.2344	SKD 61
ASSAB 8407 SUPREME	ORVAR SUPREME	H13 Premium	1.2344	SKD 61
DIEVAR	DIEVAR			
QRO 90 SUPREME	QRO 90 SUPREME			
FORMVAR	FORMVAR			

( ) - modified grade

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Edition 20210505

## **CORRAX**

Corrax stainless mould steel has a unique set of properties that makes it the ultimate choice in a large number of demanding applications. Its superior resistance to corrosion combined with a hardness of up to 50 HRC makes it perfectly suited for moulds making:

- medical parts
- parts made of corrosive plastics, i.e. PVC
- parts made of rubber as well as for moulds running in clean room environment

The mould user can count on two major advantages: The outstanding stainless properties of Corrax cut maintenance costs dramatically. Constant cycle time can be kept during very long runs of production. The mould maker benefits greatly by the very simple heat treatment needed to get hardnesses from 32 to 50 HRC.

## GENERAL

Compared with conventional corrosion-resistant tool steel, Corrax has the following advantages:

- Flexible hardness, 34–50 HRC, achieved by an ageing treatment in the temperature range 425–600°C
- Extremely good dimensional stability during ageing.
- High uniformity of properties also for large dimensions
- Very good weldability, no preheating necessary
- No hard “white” layer after EDM
- Corrosion resistance superior to that of AISI 420 and WNr. 1.2083

Typical analysis %	C 0.03	Si 0.3	Mn 0.3	Cr 12.0	Ni 9.2	Mo 1.4	Al 1.6
Delivery condition	Solution treated to ~34 HRC						

## APPLICATIONS

- Injection moulds for
  - corrosive plastics
  - rubber
  - medical and food industry
- Extrusion dies
- Plastic processing
  - screws
- Engineering parts



Production of PVC tubes or fittings places very high demands on the corrosion resistance of the mould. Corrax is a suitable mould steel for this application.

## PROPERTIES

### PHYSICAL DATA

Aged to approx. 46 HRC.

Temperature	20 °C	200 °C	400 °C
Density kg/m <sup>3</sup>	7 770	-	-
Modulus of elasticity MPa	200 000	190 000	170 000
Coefficient of thermal expansion per °C from 20 °C	-	11.7 × 10 <sup>-6</sup>	12.3 × 10 <sup>-6</sup>
Thermal conductivity W/m°C	-	18	21

### MECHANICAL DATA

Tensile strength at room temperature

	Solution treated ~34 HRC	Aged to ~ 40 HRC	Aged to ~ 46 HRC	Aged to ~ 50 HRC
Yield strength Rp0.2 N/mm <sup>2</sup>	700	1 000	1 400	1 600
Tensile strength, Rm N/mm <sup>2</sup>	1 100	1 200	1 500	1 700
Elongation A5 %	15	15	11	10

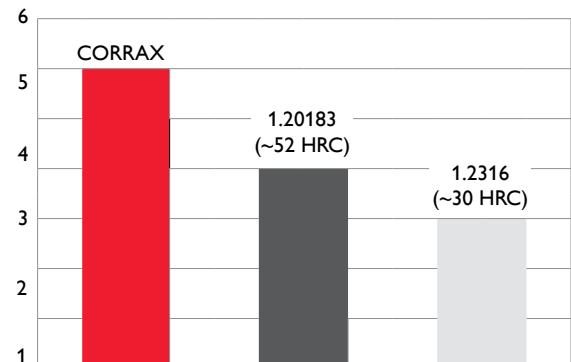
Compressive strength at room temperature

	Solution treated ~34 HRC	Aged to ~ 40 HRC	Aged to ~ 46 HRC	Aged to ~ 50 HRC
Rc0.2 N/mm <sup>2</sup>	900	1 300	1 600	1 800

### CORROSION RESISTANCE

Corrax has a very good corrosion resistance, better than the corrosion resistant standard grades used for plastic moulding. The corrosion resistance is the same in all heat treated conditions (except after nitriding).

Corrosion resistance



Corrax will withstand attacks from most corrosive plastics and diluted acids.

A mould made of Corrax will also have good resistance to humid working and storage conditions. Corrax also shows better resistance to stress corrosion cracking than standard hardenable corrosion resistant steel grades.

## HEAT TREATMENT

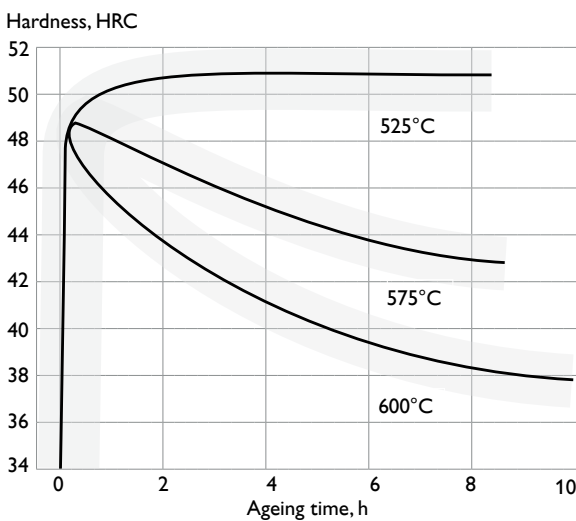
Corrax is delivered in solution treated condition and can be used in the as delivered condition. When, however, the steel is to be heat treated to a higher hardness, the following instructions may be helpful.

### STRESS RELIEVING

Stress relieving can not be performed as for other steel grades since an increase in temperature results in a higher hardness because of ageing effect.

### AGEING

Corrax can be used in as-delivered condition. Higher hardness is obtained by ageing. Suitable ageing parameters can be obtained from the figure below. Ageing time means the time at the ageing temperature after the tool is fully heated through.



When the ageing time is reached, cool the tool in air to room temperature. Ageing at high temperature gives a better toughness compared with ageing to the same hardness at a lower temperature.

### AGEING RECOMMENDATION

Ageing temperature / time	Hardness, HRC
525 °C/ 4 h*	49 - 52
575 °C/ 4 h	44 - 47
600 °C/ 4 h	40 - 43

\* Ageing 49–52 HRC is only recommended when toughness is not important.

If Corrax is used at temperatures higher than 200°C the solution treated condition (delivery condition) is not recommended because ageing can occur during use.

### SOLUTION TREATMENT

It is possible to solution treat Corrax, if aged, in order to get back to the delivery condition. Solution treatment should be done at 850°C, holding time 30 minutes. Cool in air.

### DIMENSIONAL CHANGE

Ageing results in a small and uniform decrease in volume. The following shrinkage can be expected during ageing.

Ageing temperature / time	Dimensional change%		
	Longitudinal direction	Transversal direction	Short transversal direction
525 °C/ 4 h ~50 HRC	-0.07	-0.07	-0.07
575 °C/ 4 h ~46 HRC	-0.09	-0.09	-0.09
600 °C/ 4 h ~40 HRC	-0.14	-0.14	-0.14

## MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guiding values, which must be adapted to existing local conditions.

The recommendations in following tables are valid for Corrax in solution treated condition approx. 34 HRC.

### TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel Fine turning
	Rough turning	Fine turning	
Cutting speed ( $v_c$ ), m/min	110 – 160	160 - 210	13 - 18
Feed (f) mm/rev	0.2 – 0.4	0.05 – 0.2	0.05 - 0.2
Depth of cut ( $a_p$ ), mm	2 - 4	0.5 – 2	0.5 – 3
Carbide designation ISO	P20 – P40 Coated carbide	P10 Coated carbide or cermet	-

## MILLING

### FACE AND SQUARE SHOULDER MILLING

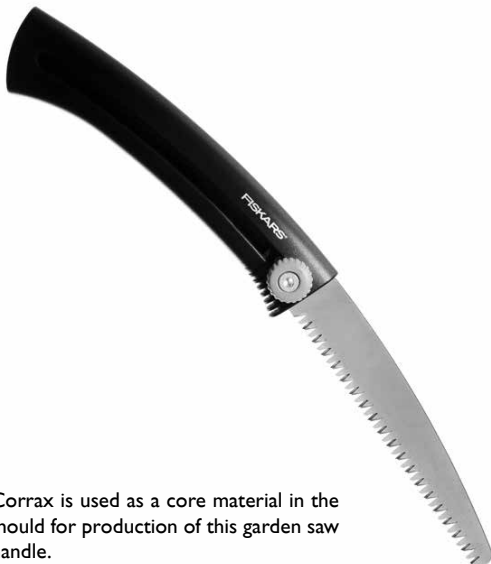
Cutting data parameter	Milling with carbide	
	Rough milling	Fine milling
Cutting speed ( $V_c$ ) m/min	70 – 90	90 – 110
Feed (f) mm/tooth	0.2 – 0.4	0.1 – 0.2
Depth of cut ( $a_p$ ) mm	2 – 5	< 2
Carbide designation ISO	P20 - P40 Coated carbide	P10 - P20 Coated carbide or cermet

### END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed ( $v_c$ ) m/min	60 – 100	70 – 110	20 – 25 <sup>1)</sup>
Feed ( $f_z$ ) mm/tooth	0.006 – 0.20 <sup>2)</sup>	0.06 – 0.20 <sup>2)</sup>	0.01 – 0.35 <sup>2)</sup>
Depth of cut ( $a_p$ ) mm	-	P20 - 30	-

<sup>1)</sup> For coated high speed steel end mill  $V_c = 35 - 45$  m/min

<sup>2)</sup> Depending on radial depth of cut and cutter diameter



Corrax is used as a core material in the mould for production of this garden saw handle.

## DRILLING

### HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Cutting speed ( $v_c$ ) m/min	Feed (f) mm/r
≤ 5	13 - 15 *	0.05 – 0.10
5 – 10	13 - 15 *	0.10 – 0.20
10 – 15	13 - 15 *	0.20 – 0.25
15 – 20	13 - 15 *	0.25 – 0.30

\* The same cutting speed when using coated HSS drill  
 $V_c = 13 - 15$  m/min

### CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip <sup>1)</sup>
Cutting speed ( $v_c$ ), m/min	180 – 200	100 – 130	50 – 70
Feed ( $f_z$ ) mm/tooth	0.05 – 0.15 <sup>2)</sup>	0.10 – 0.25 <sup>2)</sup>	0.15 – 0.40 <sup>2)</sup>

<sup>1)</sup> Drill with replaceable or brazed carbide tip

<sup>2)</sup> Depending on drill diameter

## GRINDING

A general grinding wheel recommendation is given below. More information can be found in the publication "Grinding of tool steel".

Type of grinding	Delivery condition and aged condition
Face grinding straight wheel	A 46 GV
Face grinding segments	A 36 FV
Cylindrical grinding	A 60 JV
Internal grinding	A 60 IV
Profile grinding	A 120 JV

When good surface finish is required a SiC-wheel could be an alternative.

## PHOTO-ETCHING

Corrax has a very good corrosion resistance and a special process is thus required for chemical photo-etching. Fine patterns with shallow depths <0.04 mm are readily achievable.

## ELECTRICAL DISCHARGE MACHINING — EDM

Corrax can be EDM'd in the same way as ordinary tool steels. The “white layer” will, however, not be as hard and is therefore more easily removed.

## WELDING

Preheating is not necessary. When welding on Corrax in delivery condition, intermittent welding is recommended.

In order to obtain an even hardness, it is necessary to carry out a heat treatment after welding. The temperature and time are determined by the required hardness and the filler material. Corrax TIG-Weld is recommended to be used as filler material.

## FURTHER INFORMATION

Please contact your local ASSAB office for further information on the selection, heat treatment, application and availability of ASSAB tool steel.

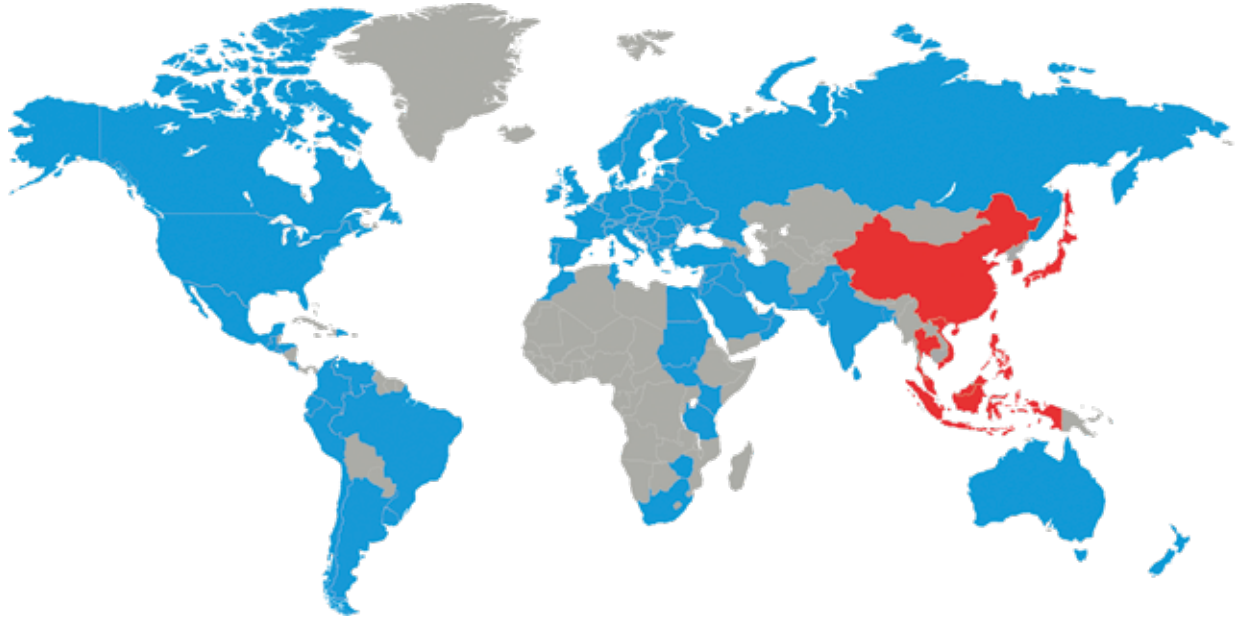
### RELATIVE COMPARISON OF THE RESISTANCE TO FAILURE MECHANISMS AND CRITICAL MOULD STEEL PROPERTIES

ASSAB Grade	Wear resistance	Toughness	Compressive strength	Corrosion resistance	Machinability <sup>^</sup>	Polishability	Weldability	Nitridability	Photo-etchability
ASSAB 618 T	□	□	□	□	□	□	□	□	□
ASSAB 618 HH	□	□	□	□	□	□	□	□	□
ASSAB 718 HH	□	□	□	□	□	□	□	□	□
Nimax	□	□	□	□	□	□	□	□	□
Mirrax 40	□	□	□	□	□	□	□	□	□*
Corrax	□	□	□	□	□	□	□	□	□*
Vidar 1 ESR	□	□	□	□	□	□	□	□	□
ASSAB 8407 Supreme	□	□	□	□	□	□	□	□	□
Stavax ESR	□	□	□	□	□	□	□	□	□*
Mirrax ESR	□	□	□	□	□	□	□	□	□*
Polmax	□	□	□	□	□	□	□	□	□*
Unimax	□	□	□	□	□	□	□	□	□
ASSAB XW-10	□	□	□	□	□	□	□	□	□
Elmax <sup>+</sup>	□	□	□	□	□	□	□	□	□*
Vanadis 4 Extra <sup>+</sup>	□	□	□	□	□	□	□	□	□
ASSAB PM 23 <sup>+</sup>	□	□	□	□	□	□	□	□	□
RoyAlloy	□	□	□	□	□	□	□	□	□

<sup>+</sup> ASSAB SuperClean PM tool steel

\* Special process required

<sup>^</sup> Tested in delivery condition



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 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 a 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 steel 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](http://www.assab.com)

