SWEBOR WEAR PLATES™

REFLECTING THE MINDSET OF PEOPLE WHO MAKE IT

DATASHEET

MATERIAL

The Swebor Wear plates™ family is both hard and tough, yet easily formable and weldable.

Wear plates from Swebor have a unique chemical composition designed for the best abrasion resistance. Combined with the optimum rolling, careful heat treatment and processing Swebor Wear plates™ possess unique combination of hardness, toughness and workability. Low carbon equivalent guarantee good weldability.

Grades of Swebor Wear plates™ are: **Swebor 400, Swebor 450, Swebor 500, Swebor 550 and Swebor 600.**

APPLICATION

Swebor Wear plates™ are designed for use in construction, mining, agricultural machinery and other equipment.

CHEMICAL COMPOSITION (max content in wt.%)

GRADE	C	Si	MN	P	S	Cr	B
SWEBOR 400	0,18	0,25	1,20	0,020	0,010	0,20	0,006
SWEBOR 450	0,24	0,25	1,00	0,020	0,010	0,20	0,006
SWEBOR 500	0,27	0,30	1,20	0,020	0,010	0,30	0,006
SWEBOR 550	0,32	0,80	0,60	0,015	0,003	0,80	0,006
SWEBOR 600	0,40	0,80	0,60	0,015	0,003	0,80	0,006

*The steel is grain-refined

All values are in max. wt. %

Other alloying elements may be added.
For more info contact Swebor.

DELIVERY CONDITION

Quenched

HARDNESS

The hardness is measured according to DIN EN ISO 6506-1. The measurement takes place 1 mm underneath the plate surface.

HBW HARDNESS

SWEBOR 400	SWEBOR 450	SWEBOR 500	SWEBOR 550	SWEBOR 600
400	450	500	550	600

Hardnesses ± 10%

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MECHANICAL PROPERTIES AND CARBON EQUIVALENT (TYPICAL VALUES)

GRADE	THICKNESS (mm)	YIELD STRENGTH $Rp_{0,2}$ (N/mm2)	R_m (N/mm2)	ELONGATION A5%	IMPACT STRENGTH KV -20C	CEV** %	CEV*** %
SWEBOR 400	2,5 - 12	1050	1250	10,0	25	0,42	0,43
SWEBOR 450	2,5 - 12	1200	1500	8,0	20	0,45	0,46
SWEBOR 500	2,5 - 12	1250	1600	6,0	20	0,52	0,53
SWEBOR 550	2,5 - 12	1400	1800	10,0	22*	0,85	0,86
SWEBOR 600	2,5 - 12	1550	2100	8,5	13*	0,93	0,94

*KV impact strength at -40C

**CEV according to IIW:
CEV= C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15

***CEV according to AWS:
CEV= C+(Mn+Si)/6+(Cr+Mo+V)/5+(Ni+Cu)/15

DIMENSION RANGE

THICKNESS (mm)	WIDTH (mm)	LENGTH (mm)
2,50 - 2,74 ± 0,17	1300 - 0/+20	8000 - 0+5
2,75 - 2,99 ± 0,17	1400 - 0/+20	8000 - 0+5
3,00 - 5,99 ± 0,20	1525 - 0/+20	8000 - 0+5
6,00 - 9,99 ± 0,25	1525 - 0/+20	6100 - 0+5
10,00 - 12,00 ± 0,30	1525 - 0/+20	6100 - 0+5

CERTIFICATES	Can be delivered with analysis certificate and hardness certificate upon agreement
WEIGHT	The weight can be calculated using a density of 8 g/cm3
SURFACE TYPES	Heat-treated and brushed mill finish. VCI treatment can be obtained upon agreement.
FLATNESS	Maximum permissible deviation from flatness 6 mm/m. For special flatness demand please contact us

WELDING

Swebor 400, 450 and 500 can be easily welded. Plates must be clean and dry. Commonly used filler metals for quenched steels are Esab 48.00 and OK autrod 12.51. If high strength is required for filler metal OK 75.75 or Ok Autrod 13.10/13.12 are suitable. Equivalent filler metals from other suppliers can also be used. Always use low-hydrogen welding consumables.

For Swebor 550 and 600 we recommend MIG/MAG welding. For welding of Swebor 550 and 600 Swebor Stal recommends austenitic consumables (recommendation AWS307 - ER 307 - EN 1600: E 18 8 Mn R 12 - DIN 8556 : E 18 8 Mn R 26 - AWS A-5.4: E 307-17 - EN ISO 3581-A: E 18 8 Mn R 12 - W.Nr.: 1.4370).
Both grades shall be preheated to temperature not more than 100°C. Preheating is applied for hydrogen content control (expulsion of moisture).

Interpass temperature for Swebor 550 and 600 should not exceed 150°C. Backstep welding principle should be used for proper interpass temperatures. Recommended gas mixture is 2 - 2,5%CO2 + Ar or 2 - 2,5 Ar + 1%02 + Ar.

WELDING HYGIENE

A good welding hygiene is to be considered: Pollutants such as water, oil, dust, paint and rust shall at the most be removed.

INFLUENCE OF ALLOYING ELEMENTS

For being hardened steel Swebor steels has a relatively low alloying content with a good weldability as a result. Generally a higher alloying content require higher preheating and a higher heat input.

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HYDROGEN CRACKING

Hydrogen cracking is a phenomena where hydrogen gas is formed in the material crating so high pressure in the ¨bubbles¨ that they ¨explode¨ and the material crating so high pressure in the ¨bubbles that they ¨explode¨¨¨ and the material crack/fractures. Hydrogen cracking comes from:

1. Hydrogen in the weld/material
2. Stresses in the weld/material

The hydrogen content shall be maximum 3 ml / 100 g of weld. Hydrogen content must be limited with proper preheating and proper use of consumables.

HOW TO AVOID HYDROGEN CRACKING

1. Minimize the hydrogen content in the weld by:

Use the right preheat and heat input.
Use welding consumables with low hydrogen content (make sure they also are dry). In case of moisture and/or wet welding consumables material must be dried before use according to best practice from welding consumables producer or workshop experience (recommendation is baking at 350°C for 2 hours). Vacuum packed electrodes can be used without baking but the package must be used in 8 hours after opening.

Keep impurities such as moist, snow, ice, water, oil, grease and paint of the welding area. Material must be cleaned using chemical and/or mechanical cleaning. Mechanical cleaning with brushing, grinding, sand or shot blasting is preffered followed by degreasing with suitable solvent and clean cloth.

2. Minimise the stress in the weld joint:

Do not use welding consumables of a higher strength than necessary - undermatching is recommended. Arrange the weld sequence so the residual stresses are minimized - backstep welding is recommended. Set the gap between the welded parts to a maximum of 3mm.

PREHEAT TEMPERATURES FOR SWEBOR STEELS

For Swebor 400, 450 and 500 when the combined sheet thickness exceeds 30 mm preheating is needed. Approx. 100°C is the advisable temperature for preheating.
For Swebor 550 and 600 for all sheet thicknesses recommended preheating temperature is 60 - 80°C.

These values are valid for unalloyed and low alloyed welding consumables. There are two general rules to consider during preheating:

1. The thickest plate determine the preheat temperature
2. When welding plates of different alloying content the highest alloyed/requiring the highest prehat value determine the preheat temperature.

Recommended minimal temperature of the plate before welding should be at least 15°C. When using austenitic welding consumables temperature of steel plate shall not be lower than room temperature.

HEAT INPUT Q = U I

To weld Swebor steels the Heat input shall be between 0,6 and 3 kJ/mm for Swebor of weld. To calculate the right heat input the formula below shall be used. As all welding environments and equipment are individually different the calculation must be verified by trials in your facility with your equipment.

$$Q = k \cdot U \cdot I/v \cdot 1000 \text{ [kJ/mm]}$$

Q	Heat input [kJ/mm]	**Thermal efficiency k [/] values:**
U	Voltage [V]	MMA 0,8
I	Current [A]	MAG (all types] 0,8
v	Welding speed [mm/min]	SAW 1,0
k	Thermal efficiency [/]	TIG 0,6

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FREE BENDING

Swebor 400, 450, 500, 550 and 600 can be cold formed - bended due to its precise chosen chemical composition and heat treatment. This combination guarantees suitable hardness and good ductility of material.

BENDING PROCEDURE

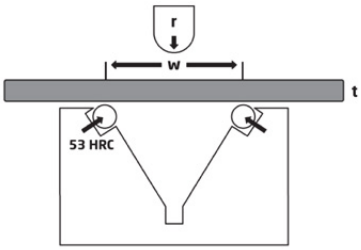
1. Preparation of parts
2. Plate edges should be ground smooth, and for thick plates and high hardness grades, the plate edges should be rounded prior to cold forming - bending.
3. Ensure that there are no obvious defects (striated grinding lines for example)
4. Preliminary trials on prototypes
5. Bending with slow fall the first pieces
6. Pinching to be used very carefully
7. Dye penetrant test in the area in extension at east for the first pieces
8. Minimal recommended temperature: 15°C (60°F)

It is important that the capacity of the machine is suitable, bending press manufacturers provide information on bending loads in relation to V-block opening, plate thickness and steel strength.

The use of smaller former radius is not recommended for bending. The correct punch radius, along with the die width, is the most important parameter when bending. The die edges must be clean and undamaged.

Spring back increases with increased die width, while punch force is reduced. Make sure that the opening angle of the die allows for over-bending without bottoming out, to compensate for spring back. An increased die opening width can in many cases lower the strain level in the bend. Also, make sure that there is enough room for the chosen punch together with the workpiece, in the die, during bending, without deforming the die.

FREE BENDING	<90 radius of curvature of the press / plate thickness R/t
CLEAR OPENING	width / plate thickness W/t
BENDING TO SINGLE V GROOVE	90 W/t
BENDING SPEED	Slow bending speed is recommended
BENDING STEP	Bending in one step is recommended
BENDING TYPE	Swebor Wear plates™ can be bottomed or free bended



GRADE	SWEBOR 400	SWEBOR 450	SWEBOR 500			SWEBOR 550	SWEBOR 600
THICKNESS mm		FREE BENDING		CLEAR OPENING	BENDING TO SINGLE V GROOVE		
2,5	2,0	2,5	2,5	9	15		
3,0	2,0	2,5	2,5	9	15		
4,0	2,5	3,0	3,0	9	15	FOR SWEBOR 550 BENDING CONTACT US	FOR SWEBOR 600 BENDING CONTACT US
5,0	3,0	3,5	3,5	9	15		
6,0	3,5	4,0	4,0	9	15		
10,0	4,0	5,0	5,0	9	15		
12,0	4,5	6,0	6,0	10	15		

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SAWING

Sawing values valid for Swebor 400, Swebor 450 and Swebor 500. For sawing of Swebor 550 and Swebor 600 contact us.

CUTTING LENGTH	100	200	300
CUTTING SPEED	60	50	40

MECHANICAL CUTTING

Mechanical cutting values valid for Swebor 400, Swebor 450 and Swebor 500. For sawing of Swebor 550 and Swebor 600 contact us.

THICKNESS mm	CUTTING CLEARANCE mm	CAMBER DEGREES α○	BEVEL ANGLE λ○	SHEAR FORCE kN/m
2,5 - 3	0,30 - 0,40	0 -	0 - 1	<100
4	0,35 - 0,50	0 - 1	0 - 2	150
5	0,40 - 0,60	2 - 3	0 - 3	200
6	0,50 - 0,70	3 - 4	0 - 3	250
8	0,65 - 1,30	3 - 5	0 - 5	300 - 400
10	0,80 - 1,80	4 - 6	0 - 5	400
12	1,00 - 2,20	4 - 6	0 - 5	500

DRILLING, TURNING AND MILLING

Drilling turning and milling values valid for Swebor 400, Swebor 450 and Swebor 500. For sawing of Swebor 550 and Swebor 600 contact us. Swebor Wear plates™ can but drilled with rapid steel or HSS - hard metal drills.

CUTTING SPEED	ROTATION SPEED r/min (drill d<5mm)	FEED mm/r	ROTATION SPEED r/min (drill d<10mm)	FEED mm/r	ROTATION SPEED r/min (drill d<5mm)	FEED mm/r	ROTATION SPEED r/min (drill d<5mm)	FEED mm/r
High speed drill ~10 m/s	500	0,07	300	0,10	200	0,15	150	0,20
High speed drill ~100 m/s	1040	0,10	830	0,15	700	0,16	600	0,17

OTHER CUTTING METHODS

GRADE	SWEBOR 400	SWEBOR 450	SWEBOR 500	SWEBOR 550	SWEBOR 600
Autogenous	Slow cutting speeds up to max 700 mm/min with maximum gap of 5mm and dimension tolerance of ±2mm. Highest heat affected zone from 4 to 10mm				**NOT RECOMMENDED**
Plasma	Highest cutting speeds up to max 6000 mm/min with maximum gap of 4mm and dimension tolerance of ±1mm. Medium heat affected zone from 2 to 5mm For lower values of HAZ submerged cutting is possible				**NOT RECOMMENDED**
Laser	High cutting speeds up to max 2300 mm/min with maximum gap of 1mm and narrow dimension tolerance of ± 0.2mm. Small heat affected zone of 0,2 to 2mm.				
Abrasive water jet	Slow cutting speeds up to max 200 mm/min with max gap of 3mm and narrow dimension tolerance of ± 0.2mm with no heat affected zone.				

NOTE: All values may vary on the type of machine / cutting consumables (for ex. nozzles) and/or parameters.

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