



STEP UP TO LONGER SERVICE LIFE AND LIGHTER EQUIPMENT

Changing from Hardox[®] 400 to Hardox[®] 450 will make your products more cost-effective. You get longer service life, lighter equipment and higher load capacity. Hardox[®] is a workshop-friendly material, making the upgrade a smooth process.

Mechanical properties	Hardox [®] 450	Hardox [®] 400
Hardness	425-475 HB	370-430 HB
Yield strength*	1200 MPa	1100 MPa
Tensile strength*	1400 MPa	1250 MPa
Elongation A5*	10%	10 %
Impact toughness at -40 °C*	50 J	45 J

Material	Thickness range	Maximum width
Hardox [®] 450 sheet	2-8 mm	1,65 m
Hardox [®] 450 plate	3,2-130 mm	3,35 m
Hardox [®] 400 sheet	2-8 mm	1,65 m
Hardox [®] 400 plate	4-130 mm	3,35 m

*Typical value for 20 mm plate thickness.

Upgrading benefits

50% LONGER WEAR LIFE

Hardox® 450 adds around 50 HB of hardness compared to Hardox® 400. Case studies show that the extra hardness can deliver up to 50% longer wear life, and even more in some applications. This naturally makes the dumper body or any other wear-affected equipment more cost-effective.

Examples of increased wear life by upgrading from Hardox® 400 to Hardox® 450 for different materials and sliding wear, according to Hardox® WearCalc™.

Basalt	Granite	Workshop steel scrap
30%	40%	30%

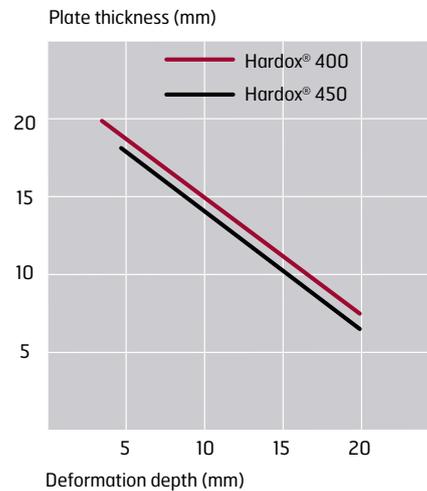
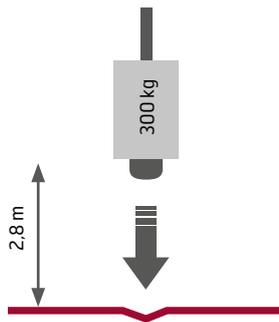
UP TO 15% LIGHTER

You can use thinner plates when designing with Hardox® 450 instead of Hardox® 400. Thinner plates mean lighter structures that can take more payload and increase your profitability. Weight reductions of up to 15% are possible. New design solutions naturally need to take buckling, deflection and fatigue strength into consideration.

Upgrading from Hardox® 400 to Hardox® 450 improves the dent resistance as shown in the figure. In this test, a 300 kg weight is dropped from 2,8 m onto a 600 x 600 mm test plate.

IMPROVED DENT RESISTANCE

Results from impact drop tests of Hardox® 400 and Hardox® 450.



Hardox® 450 in the workshop

WELDING

Hardox® 450 can be welded with all conventional arc welding methods for ordinary and high-strength steel. Use welding consumables with a yield strength of max. 500 MPa and a sufficiently low hydrogen content of max. 5ml/100 g of weld metal. The following consumables fulfill the hydrogen criteria:

- All solid wires applied at MAG (GMAW) and TIG welding
- MAG welding with flux cored wires (FCAW):
Rutile and basic types
- MAG welding with metal cored wires (MCAW):
Certain types
- SAW: Basic types of fluxes in combination with solid wires

Recommended preheating temperature using a heat input of 1.7 kJ/mm and a weld metal hydrogen content of maximum 5 ml/100 g of weld deposit, °C. For heat inputs between 1.0-1.6 kJ/mm, the min. preheat temperature is raised by 25°C in comparison to the values below. Please contact SSAB for min. preheat temperatures for heat inputs lower than 1.0 kJ/mm.

Single plate thickness (mm)	Hardox® 450 [°C]	Hardox® 400 [°C]
< 20	Room temperature	Room temperature
20-39,9	125	75
40-44,9	150	75
45-49,9	150	100
50-80	150	175
> 80	150	200

Welding materials with these properties reduce residual stress levels in the joint and its sensitivity to cold cracking. Preheating can be avoided by welding with austenitic stainless consumables according to type AWS 307 or AWS 309.

More detailed information regarding the hydrogen content of a certain brand can be attained from its manufacturer. In addition, SSAB provides examples of suitable welding consumables, please contact techsupport@ssab.com.

CUTTING

Oxy-fuel, plasma, laser and abrasive water jet (AWJ) are all suitable methods for cutting Hardox® wear plate.

Recommendations for oxy-fuel cutting of Hardox® 450.
Preheating requirement in °C.

Grade	Plate thickness	Minimum preheating temp. (°C)	Maximum preheating temp. (°C)
Hardox® 400	< 45 mm	No preheating	225
	45-59,9 mm	100	
	60-80 mm	150	
	> 80 mm	175	
Hardox® 450	< 40 mm	No preheating	225
	40-49,9 mm	100	
	50-69,9 mm	150	
	≥ 70 mm	175	

Recommended maximum cutting speed (mm/min) without preheating.

Max. plate thickness (mm)	< 40	40	45	50	60	70	80	> 80
Hardox® 450	No restr.	230	200	180	170	160	150	*
Hardox® 400	No restr.	No restr.	230	210	200	190	180	*

*Only preheating is applicable.

BENDING

Minimum recommended tool radius (R) and die opening width (W) when the bend line is perpendicular or parallel to the rolling direction.

	Thickness (t) (mm)		Transverse to rolling direction minimum R / t		Along rolling direction minimum R / t		Die opening width (w) minimum W / t	
	Hardox® 450	Hardox® 400	Hardox® 450	Hardox® 400	Hardox® 450	Hardox® 400	Hardox® 450	Hardox® 400
Hot rolled plate	t < 8	t < 8	3.0	2.5	3.5	3.0	12	12
	8 ≤ t < 20	8 ≤ t < 20	3.5	3.0	4.5	4.0	14	14
	t ≥ 20	20 ≤ t < 50	4.5	4.0	5.0	5.0	16	16
Hot rolled sheet	2.5 ≤ t < 4	2 ≤ t < 4	3.0	3.0	4.0	4.0	12	12
	4 ≤ t ≤ 8	4 ≤ t ≤ 8	3.0	3.0	3.5	3.5	12	12

To estimate the force needed during bending, all factors should be considered: Bending length, plate thickness, die width, tensile strength, and the changing moment arm during bending. The peak load is assumed to be reached at a bend opening angle of 120° with normal friction (no lubrication). Trial tests are always recommended.

$$P = \frac{b \cdot t^2 \cdot R_m}{(W - R_d - R_p) \cdot 9\,800}$$

P = Bend force, tons (metric)
t = Plate thickness, mm
W = Die width, mm
b = Bend length, mm
R_m = Tensile strength, MPa
R_d = Die entry radius, mm
R_p = Punch radius, mm

The SSAB Bending Formula® is verified by tests for 90° bends.

Since the tensile strength is higher for Hardox® 450, the required bending force is about 12% higher than for a Hardox® 400 plate of the same thickness. A Hardox® 450 plate can be 6% thinner than a Hardox® 400 plate

and bent with the same force. For example, the bending force for 19 mm Hardox® 450 is the same as for 20 mm Hardox® 400. The bending force for 5,5 mm Hardox® 450 is the same as for 6 mm Hardox® 400.

DRILLING

Drill	HSS-8% Co			Solid cemented carbide			Exchangeable drill head			Indexable inserts		
	Drill Ø mm	Hardox® 400	Hardox® 450	Drill Ø mm	Hardox® 400	Hardox® 450	Drill Ø mm	Hardox® 400	Hardox® 450	Drill Ø mm	Hardox® 400	Hardox® 450
Vc [m/min]		9	7		50-70	40-60		50-70	40-60		60-120	50-90
fn [mm/rev]		Min/max	Min/max		Min-max	Min-max		Min-max	Min-max		Min-max	Min-max
	5	0,06	0,05	3,0-5,0	0,03-0,06	0,03-0,05	7,5-12,0	0,08-0,12	0,07-0,11	12,0-20,0	0,04-0,10	0,04-0,10
	10	0,11	0,1	5,01-10,0	0,06-0,12	0,05-0,11	12,01-20,0	0,12-0,20	0,11-0,15	20,01-30,0	0,06-0,12	0,06-0,12
	15	0,16	0,15	10,01-15,0	0,12-0,16	0,11-0,15	20,01-25,0	0,20-0,25	0,15-0,20	30,01-44,0	0,06-0,14	0,06-0,14
	20	0,23	0,2	15,01-20,0	0,16-0,21	0,15-0,20	25,01-33,0	0,25-0,33	0,20-0,28	44,01-63,5	0,08-0,16	0,08-0,16

Use an as short drill as possible, when drilling with indexable inserts. The recommendations are for 2xØ.

SSAB is a Nordic and US-based steel company. SSAB offers value added products and services developed in close cooperation with its customers to create a stronger, lighter and more sustainable world. SSAB has employees in over 50 countries. SSAB has production facilities in Sweden, Finland and the US. SSAB is listed on Nasdaq Stockholm and has a secondary listing on Nasdaq Helsinki. www.ssab.com. Join us also on social media: Facebook, Instagram, LinkedIn, Twitter and YouTube.



CUSTOMER SUPPORT

For more information about the benefits of upgrading from Hardox® 400 to Hardox® 450, please contact your local SSAB sales representative. You will find contacts for all markets at www.ssab.com

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