HARDOX®
WEAR PLATE

HARDOX® HITEMP

CAN TAKE THE HEAT

Internal presentation

May 2019

WHY HARDOX® HITEMP

Elevated working temperatures

Workshop friendly

HARDOX®
WEAR PLATE

SSAB HOT WEAR OFFER

GRADE	THICKNESS RANGE (MM)	HARDNESS (HBW)	IMPACT TOUGHNESS (TYPICAL)	CEV (TYPICAL)
TOOLOX® 33	6 – 165	275-325	100 J/20 °C	0.66
HARDOX® HITEMP	4.7 – 51.0	375-425	60 J/-40 °C	0.59
TOOLOX® 44	6 – 165	410-475	30 J/20 °C	0.96

HARDOX® HITEMP CAN TAKE THE HEAT

- Nominal hardness 400 HBW ± 25 HB
- Impact toughness CVL 60 J @ -40°C
- Maximum CET (CEV): 0.47 (0.70)
- Typical CET (CEV): 0.40 (0.59)
- Thickness: 4.7-51 mm
- High resistance to hydrogen cracking
- Suitable to use in wear applications below 500 °C
- Form stable

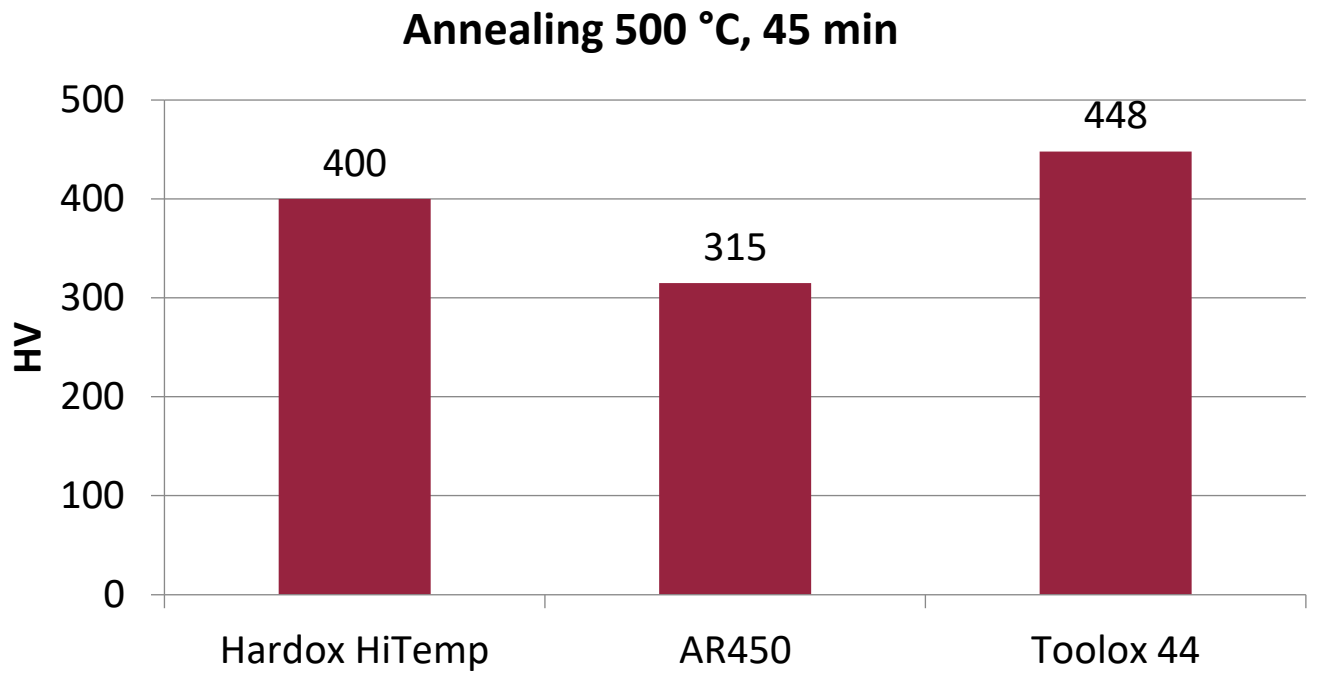
HARDOX®
WEAR PLATE

PEFORMANCE AND BENEFITS OF HARDOX® HITEMP

SSAB

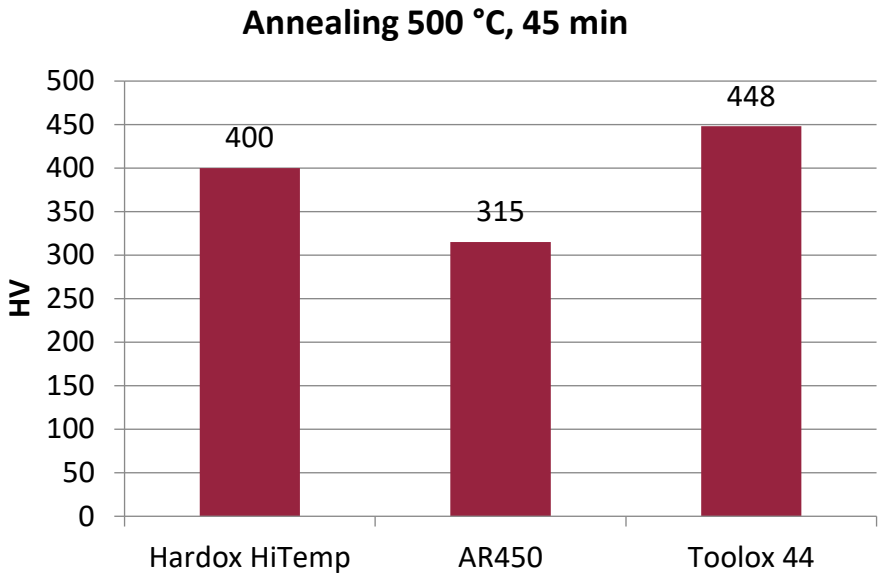
HIGH TEMPERATURE RESISTANCE - HARDNESS

- In many environments the temperatures are cyclic
- Conventional wear resistant steels are sensitive to elevated temperature, which means that hardness will be lost when temperature exceeds 200 °C
- When the plate is cooled down from the increased temperature the hardness will be lower than the As-delivered hardness
- Hardox® HiTemp will not loose hardness when exposed to temperature up to 500 °C

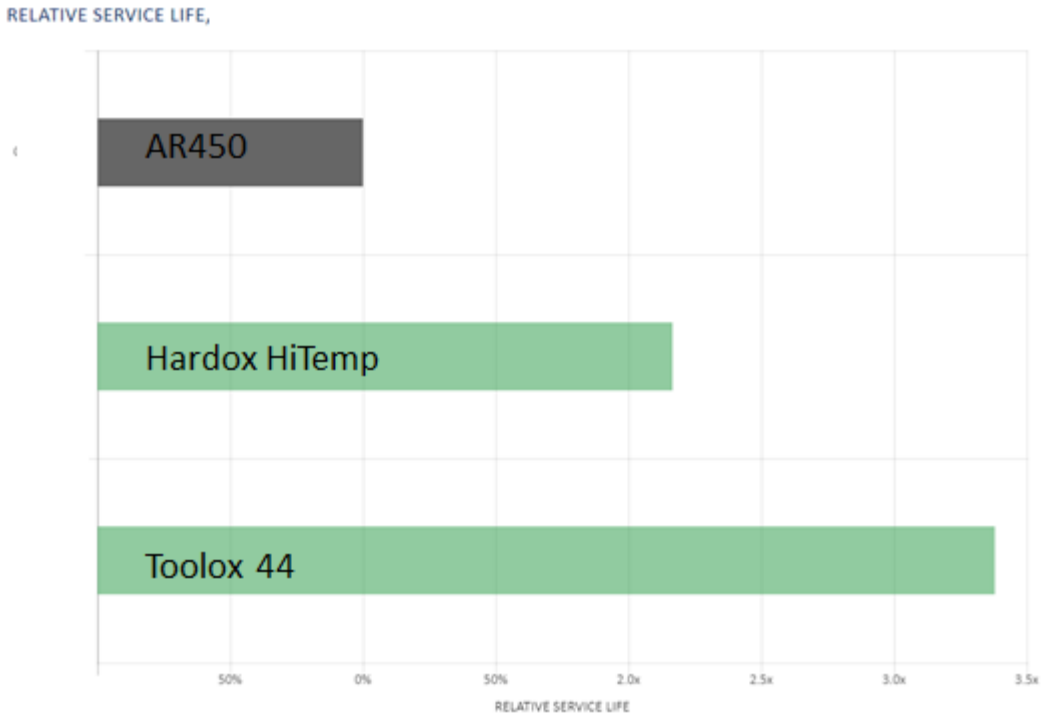


Hardness measurements at room temperature. The materials have been exposed to 500 °C for 45 minutes and then cooled down

HIGH TEMPERATURE WEAR RESISTANCE AND WEAR LIFE



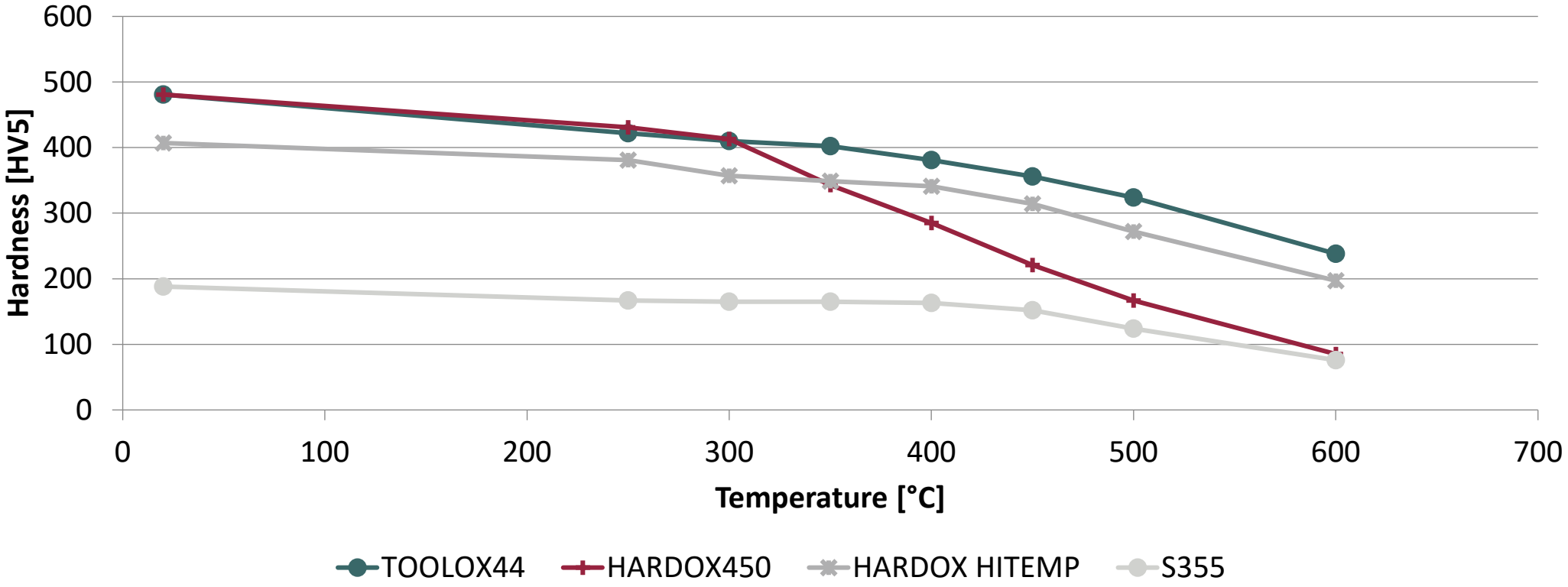
Sliding wear – Blast furnace slag



- At first exposure to heat the hardness will be according to the As-Delivered
- When the plates cools down, the hardness for the conventional AR 450 will be lower than the hardness for Hardox® HiTemp that will retain its original hardness
- According to WearCalc Hardox® HiTemp will outperform the AR 450 material at both high temperature but also at room temperature
- The graph shows that Hardox® HiTemp will have double service life compared to the conventional AR 450 steel when the abrasive material is at room temperature

PERFORMANCE OF HARDOX® HITEMP AT CONSTANT TEMPERATURE

- Measurement of Hardness at elevated temperature
- These values can be used if temperature is constant



EXAMPLE OF A PRACTICAL CASE WITH CYCLIC TEMPERATURES

A bucket is loading hot material with a temperature of 500 °C

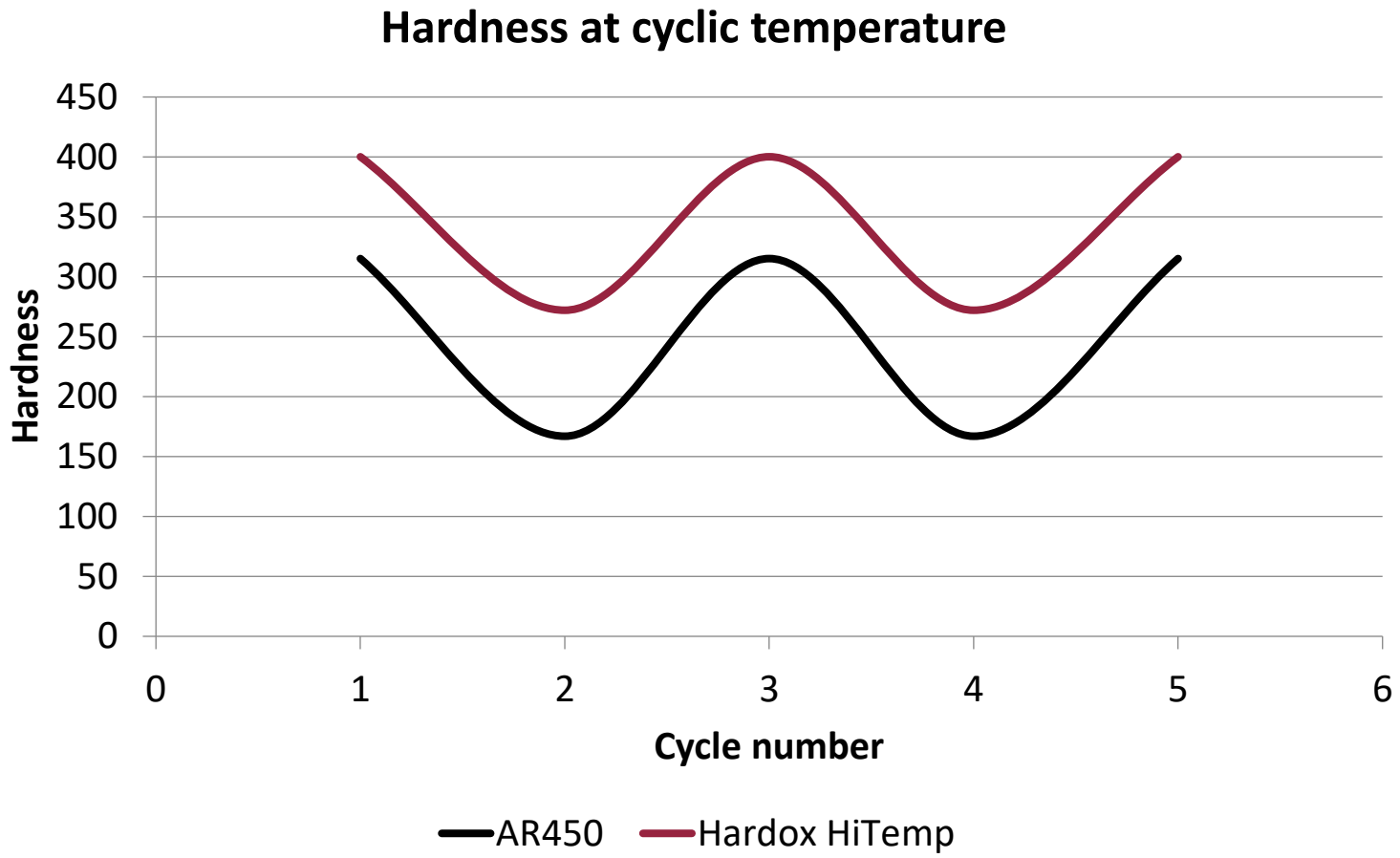
Cycle 1: The bucket is cold (below 200 °C)

Cycle 2: The bucket is hot (above 500 °C)

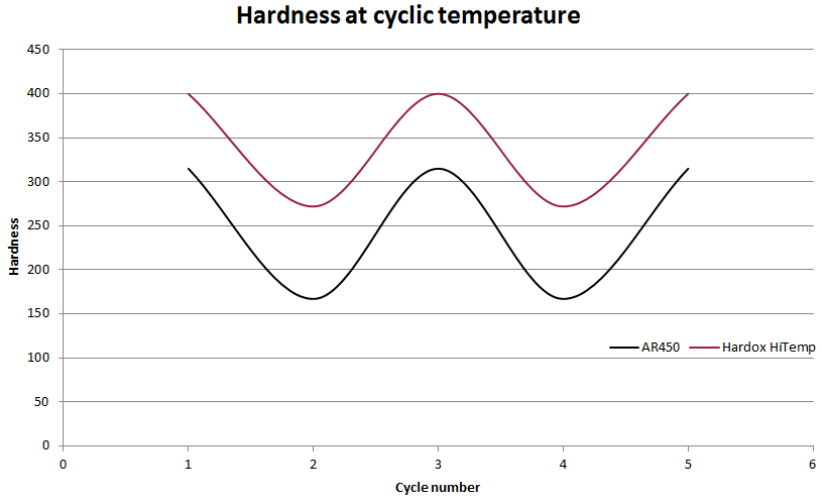
Cycle 3:The bucket is cold (below 200 °C)

Cycle 4: The bucket is hot (above 500 °C)

Cycle 5: The bucket is cold (below 200 °C)



EXAMPLE OF A PRACTICAL CASE WITH CYCLIC TEMPERATURES



A bucket is loading hot material with a temperature of 500 °C

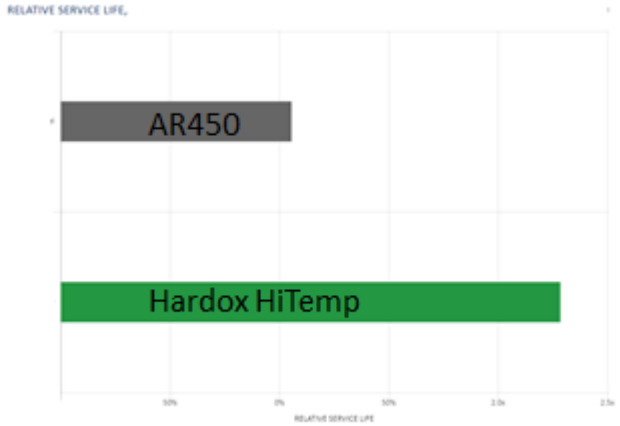
Cycle 1: The bucket is cold (below 200 °C)

Cycle 2: The bucket is hot (above 500 °C)

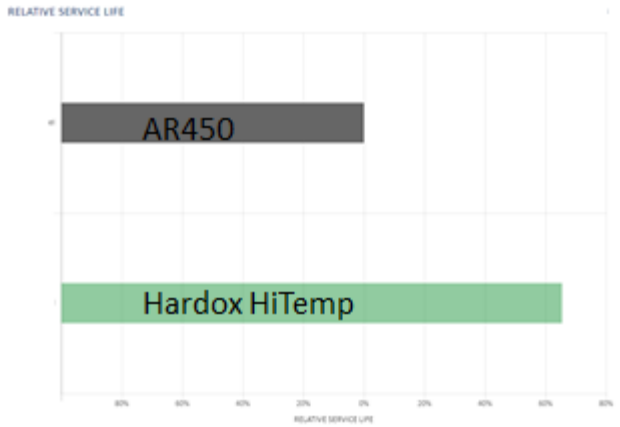
Cycle 3:The bucket is cold (below 200 °C)

Cycle 4: The bucket is hot (above 500 °C)

Cycle 5: The bucket is cold (below 200 °C)



Hardox® HiTemp performs 2.1X better than AR450 when the temperature is 200 °C or less

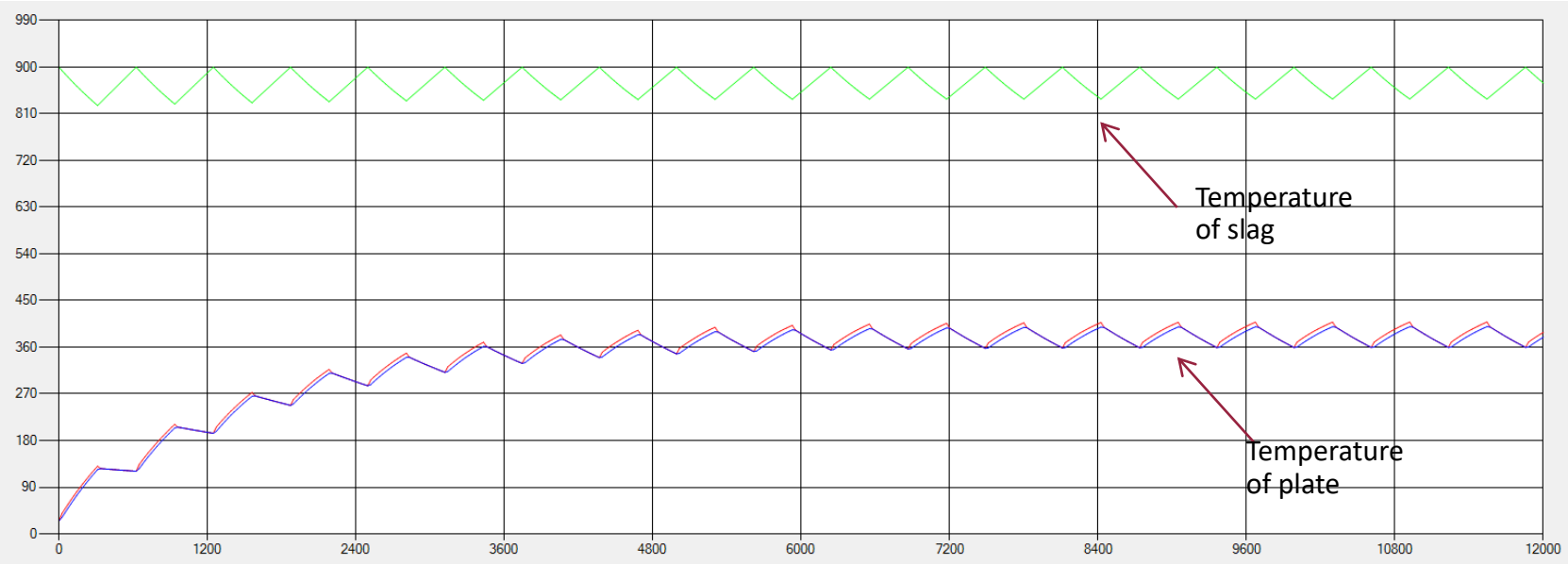


Hardox® HiTemp performs 60% better than AR450 when the temperature is 500 °C

HOW HOT DOES THE PLATE GET?

HARDOX® WEAR PLATE

- It's the temperature of the plate that is important
- Transferring heat into a plate takes time…
- Exposure time, working cycle in hot environment and abrasive material will control how hot the steel gets



PRACTICAL EXAMPLE

- A dumper is loading hot slag with the temperature 900 °C
- It takes 5 minutes from loading to unloading
- Even though the slag is 900 °C the plate temperature will only reach 400 °C*

*calculated with SSAB software HeatCalc

SSAB

WHERE TO LOOK FOR BUSINESS

►Hot working environments (300-500°C), either caused by transportation of hot material or frictional heating.

►Applications involved in the following:

- Asphalt plants — *Lifter plats inside drier, drier drum etc.*
- Cement plants — *Clinker cooler plates, liner plates at exit of kiln, outlet from heating station etc.*
- Steel plants — *Slag buckets/tippers, briquettes/pellets production, blast furnace etc.*
- Coke plants — *Sliding shoe, quenching wagon, cooling bed, furnaces inlet scrapers etc.*
- Power plants — *Liners plates in transportation systems, ash handling, chain conveyers etc.*
- Foundries — *Scrapers, screeners, liner plates etc.*
- Crushers — *Liner plates inside crusher, gypsum hammers, clinker crusher hammer*

►How hot does it get?

- Exposure time, working cycle in hot environment and abrasive material will control how hot the steel gets.
- Example coke plant wear shoe
  - The furnace is 1050°C but the steel only reach 500°C due to the low exposure time (50s)

DESIGNING IN HIGH TEMPERATURES

Allow the plate to expand

Rule of thumb 1 mm/1 m, 100 °C

Temperature expansion

Elevated working temperatures will cause the steel to expand

Example with 5000x2000 [mm] plate

20°C → 300°C	+ 18 mm expansion	**+ 0,7%**
20°C → 500°C	+ 31 mm expansion	**+ 1,2%**

Design recommendations

Be careful where you place bolts and/or welds since the plate will find a way to expand. The design should allow the plate to move to a certain degree in order to avoid cracks in welds and buckling of the plate

Liner plates in coke plant cooling bed

Free-moving design

REFERENCE CASES

Poland - Slag bucket

France - Slag bucket

France – Foundry screener

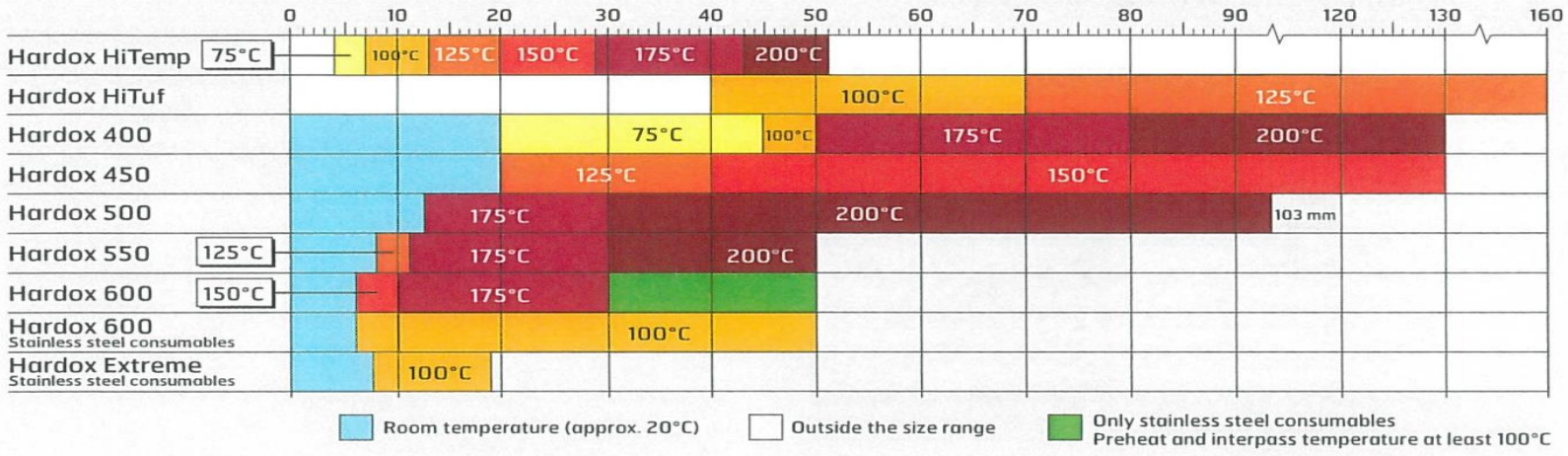
HARDOX® HITEMP IN THE WORK SHOP

PREHEATING WELDING

HARDOX®
WEAR PLATE

Table 5a: Recommended preheating temperatures. The single plate thickness in millimeters is shown on the x-axis.

Minimum recommended preheat and interpass temperatures for different single plate thicknesses (mm)



CUTTING - OXYFUEL

HARDOX® WEAR PLATE

No need for preheating

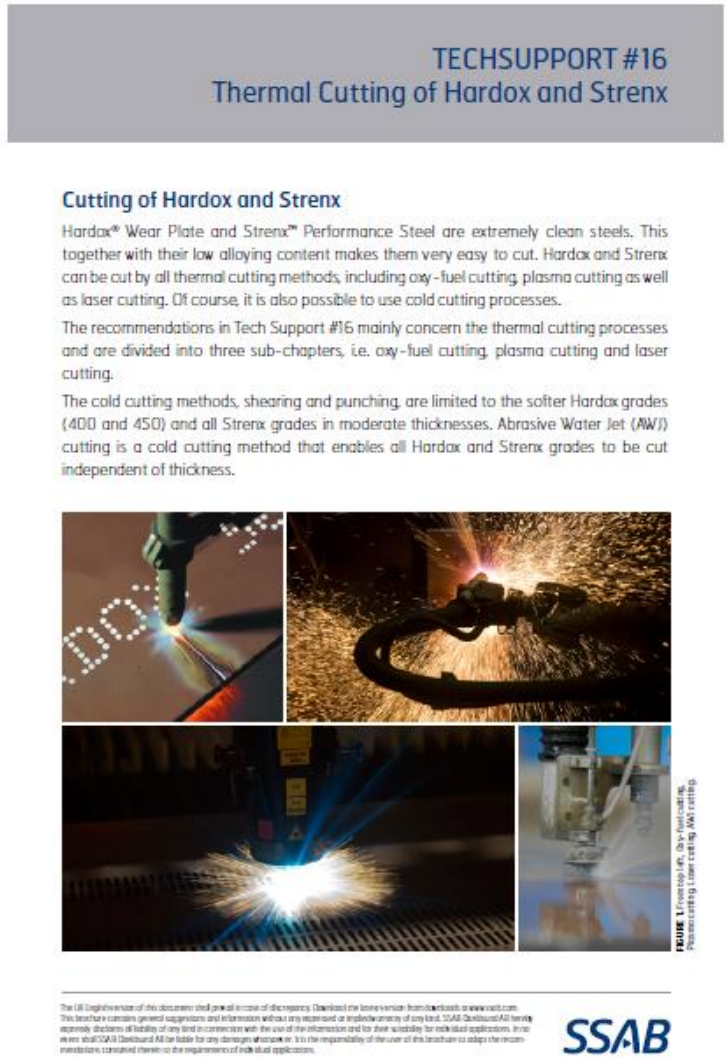
Support regarding cutting in Hardox® can be found at ssab.com under downloads

https://www.ssab.com/download-center?dcFilter=cutting&dcSearch=

Grade	Plate thickness	Minimum preheating temp. (°C)	Maximum preheating temp. (°C)
Hardox HiTemp	5 – 51 mm	No preheating	500
Hardox HiTuf	< 90 mm ≥ 90 mm	No preheating 100	300
Hardox 400	< 45 mm 45 – 59.9 mm 60 – 80 mm > 80 mm	No preheating 100 150 175	225
Hardox 450	< 40 mm 40 – 49.9 mm 50 – 69.9 mm ≥ 70 mm	No preheating 100 150 175	225
Hardox 500	< 25 mm 25 – 49.9 mm 50 – 59.9 mm ≥ 60 mm	No preheating 100 150 175	225
Hardox 550	< 20 mm 20 – 51 mm > 51 mm	No preheating 150 170	200
Hardox 600	< 12 mm 12 – 65 mm	No preheating 175	180
Hardox Extreme*	8 – 19 mm	100	100

TABLE 2. Preheat temperatures for oxy-fuel cutting of the Hardox grades.

*SSAB recommends AWJ cutting. If only oxy-fuel cutting is available follow the recommendations in table 2.



TECHSUPPORT #16
Thermal Cutting of Hardox and Strenx

Cutting of Hardox and Strenx

Hardox® Wear Plate and Strenx™ Performance Steel are extremely clean steels. This together with their low alloying content makes them very easy to cut. Hardox and Strenx can be cut by all thermal cutting methods, including oxy-fuel cutting, plasma cutting as well as laser cutting. Of course, it is also possible to use cold cutting processes.

The recommendations in Tech Support #16 mainly concern the thermal cutting processes and are divided into three sub-chapters, i.e. oxy-fuel cutting, plasma cutting and laser cutting.

The cold cutting methods, shearing and punching, are limited to the softer Hardox grades (400 and 450) and all Strenx grades in moderate thicknesses. Abrasive Water Jet (AWJ) cutting is a cold cutting method that enables all Hardox and Strenx grades to be cut independent of thickness.

SSAB

BENDING

HARDOX® WEAR PLATE

Class	Grade	Nominal Thickness (mm)	Punch Radius Minimum R/t [1]	
			Bending Direction ⊥ [2]	Bending Direction ∥ [2]
A	Hardox® 400 sheet	2 ≤ t < 4	3.0	4.0
		4 ≤ t < 8	3.0	3.5
B	Hardox® 450 sheet	2 ≤ t < 4	3.0	4.0
		4 ≤ t < 8	3.0	3.5
C	Hardox®450 CR sheet Hardox® 500 sheet	0.7 ≤ t < 3	4.0[3]	4.0[3]
		3 ≤ t < 6.5	3.5	4.0
D	Hardox® 400 plate	t < 8	2.5	3.0
		8 ≤ t < 15	3.0	4.0
		15 ≤ t < 20	3.0	4.0
		20 ≤ t < 50	4.0	5.0
E	Hardox® 450 plate Hardox® 500 Tuf plate Hardox® HiTemp plate	t < 8	3.0	3.5
		8 ≤ t < 15	3.5	4.5
		15 ≤ t < 20	3.5	4.5
		t ≥ 20	4.5	5.0
F	Hardox® 500 plate	t < 8	3.5	4.5
		8 ≤ t < 15	4.0	4.5
		15 ≤ t < 20	4.5	5.0
		t ≥ 20	5.5	6.0

[1] R/t stands for punch radius (R) divided by thickness (t).
[2] The rolling direction
[3] Bending guarantees for Cold Rolled (CR) products are based on fixed die edges and normal friction.

DRILLING RECOMMENDATIONS FOR UNSTABLE MACHINE CONDITIONS

HARDOX® WEAR PLATE

Steel grade	Cutting speed (Vc), m/min	Drill diameter, (Dc), mm					
		Feed per revolution, (fn) mm/rev					
		Ø 5 mm	Ø 10 mm	Ø 15 mm	Ø 20 mm	Ø 25 mm	Ø 30 mm
Hardox HiTuf	≈ 12	0,07	0,10	0,16	0,23	0,29	0,35
Hardox HiTemp	≈ 9	0,06	0,11	0,16	0,23	0,29	0,35
Hardox 400	≈ 9	0,06	0,11	0,16	0,23	0,29	0,35
Hardox 450	≈ 7	0,05	0,10	0,15	0,20	0,25	0,30
Hardox 500	≈ 5	0,04	0,08	0,12	0,16	0,20	0,24
Hardox 500 Tuf	≈ 5	0,04	0,08	0,12	0,16	0,20	0,24

HSS Drill

Suitable up to 500 HBW

DRILLING RECOMMENDATIONS FOR STABLE MACHINE CONDITIONS

HARDOX® WEAR PLATE

- Solid cemented carbid drill
- Indexable insert drills
- Drills with exchangable drill heads

DILLS WITH EXCHANGEABLE DRILL HEADS

For stable machine conditions and with internal coolant.

Steel grade	Cutting speed (Vc), m/min	Drill diameter, (Dc), mm Feed per revolution, (fn) mm/rev			
		Ø 7,5 – 12,0 mm	Ø 12,01 – 20,0 mm	Ø 20,01 – 25,0 mm	Ø 25,01 – 33,0 mm
Hardox HiTuf	60 – 80	0,08 – 0,13	0,13 – 0,22	0,22 – 0,27	0,27 – 0,36
Hardox HiTemp	50 – 70	0,08 – 0,12	0,12 – 0,20	0,20 – 0,25	0,25 – 0,33
Hardox 400	50 – 70	0,08 – 0,12	0,12 – 0,20	0,20 – 0,25	0,25 – 0,33
Hardox 450	40 – 60	0,07 – 0,11	0,11 – 0,15	0,15 – 0,20	0,20 – 0,28
Hardox 500	35 – 50	0,06 – 0,10	0,10 – 0,14	0,14 – 0,18	0,18 – 0,24
Hardox 500 Tuf	35 – 50	0,06 – 0,10	0,10 – 0,14	0,14 – 0,18	0,18 – 0,24
Hardox 550	30 – 40	0,05 – 0,08	0,08 – 0,12	0,12 – 0,16	0,16 – 0,22
Hardox 600	25 – 35	0,04 – 0,07	0,07 – 0,11	0,11 – 0,14	0,14 – 0,18

INDEXABLE INSERT DRILL

For stable machine conditions and with internal coolant.
Important: Use as short drill as possible. The recommendations are for 2xØ.

Steel grade	Cutting speed (Vc), m/min	Drill diameter, (Dc), mm Feed per revolution, (fn) mm/rev			
		Ø 12,0 – 20,0 mm	Ø 20,01 – 30,0 mm	Ø 30,01 – 44,0 mm	Ø 44,01 – 63,5 mm
Hardox HiTuf	70 – 130	0,04 – 0,10	0,06 – 0,12	0,06 – 0,14	0,08 – 0,16
Hardox HiTemp	60 – 120	0,04 – 0,10	0,06 – 0,12	0,06 – 0,14	0,08 – 0,16
Hardox 400	60 – 120	0,04 – 0,10	0,06 – 0,12	0,06 – 0,14	0,08 – 0,16
Hardox 450	50 – 90	0,04 – 0,10	0,06 – 0,12	0,06 – 0,14	0,08 – 0,16
Hardox 500	40 – 70	0,04 – 0,08	0,04 – 0,10	0,06 – 0,12	0,08 – 0,14
Hardox 500 Tuf	40 – 70	0,04 – 0,08	0,04 – 0,10	0,06 – 0,12	0,08 – 0,14
Hardox 550	35 – 55	0,04 – 0,08	0,04 – 0,10	0,06 – 0,12	0,08 – 0,14
Hardox 600	30 – 50	0,04 – 0,06	0,04 – 0,08	0,06 – 0,10	0,06 – 0,12

- The cutting data for indexable drill has been formulated in co-operation with Sandvik Coromant.
- Not suitable for Hardox Extreme.

SOLID CEMENTED CARBIDE DRILL

For stable machine conditions and with internal coolant,
This is the only type of drill suitable for drilling Hardox Extreme.

Steel grade	Cutting speed (Vc), m/min	Drill diameter, (Dc), mm Feed per revolution, (fn) mm/rev			
		Ø 3,0 – 5,0 mm	Ø 5,01 – 10,0 mm	Ø 10,01 – 15,0 mm	Ø 15,01 – 20,0 mm
Hardox HiTuf	60 – 80	0,03 – 0,06	0,06 – 0,12	0,12 – 0,17	0,17 – 0,22
Hardox HiTemp	50 – 70	0,03 – 0,06	0,06 – 0,12	0,12 – 0,16	0,16 – 0,21
Hardox 400	50 – 70	0,03 – 0,06	0,06 – 0,12	0,12 – 0,16	0,16 – 0,21
Hardox 450	40 – 60	0,03 – 0,05	0,05 – 0,11	0,11 – 0,15	0,15 – 0,20
Hardox 500	35 – 50	0,03 – 0,05	0,05 – 0,10	0,10 – 0,14	0,14 – 0,18
Hardox 500 Tuf	35 – 50	0,03 – 0,05	0,05 – 0,10	0,10 – 0,14	0,14 – 0,18
Hardox 550	30 – 40	0,03 – 0,05	0,05 – 0,09	0,09 – 0,13	0,13 – 0,17
Hardox 600	25 – 35	0,02 – 0,04	0,04 – 0,08	0,08 – 0,13	0,13 – 0,16
Hardox Extreme	18 – 25	0,02 – 0,04	0,04 – 0,08	0,08 – 0,12	0,12 – 0,15

- Drilling 7x Dc, reduce the feed rate -20%
- Drilling with external coolant, reduce the spindle speed and feed rate -20%

COUNTERSINKING/BORING

HARDOX® WEAR PLATE

Reduce the cutting data with about **30% for countersinking**.

Steel grade	Cutting speed (Vc), m/min	Counterbore diameter, (Dc), mm			
		Feed per revolution, (fn) mm/rev			
		Ø 18,0 – 26,0 mm	Ø 26,0 – 38,0 mm	Ø 38,0 – 47,0 mm	Ø 47,0 – 60,0 mm
Hardox HiTuf	30 – 80	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox HiTemp	25 – 70	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 400	25 – 70	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 450	20 – 50	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 500	15 – 45	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 500 Tuf	15 – 45	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 550	12 – 40	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox 600	10 – 35	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20	0,10 – 0,20
Hardox Extreme	5 – 15*	0,05 – 0,15	0,05 – 0,15	0,05 – 0,15	0,05 – 0,15

Counterboring is not suitable for Hardox Extreme.

Counterbore

Countersink

TAPPING RECOMMENDATIONS

Steel grade	Cutting speed (Vc), m/min	Size from - to
Hardox HiTuf	6 – 10	M6 – M30
Hardox HiTemp	4 – 8	M6 – M30
Hardox 400	4 – 8	M6 – M30
Hardox 450	1 – 5	M6 – M30
Hardox 500	1 – 3	M8 – M30
Hardox 500 Tuf	1 – 3	M8 – M30

Calculation of spindle speed

$$n = \frac{Vc * 1000}{\pi * Dc}$$

n = Spindle speed (rpm)
Vc = Cutting speed (m/min)
Dc = Tool diameter (Ø mm)
π = 3,142

THREAD MILLING RECOMMENDATIONS

HARDOX®
WEAR PLATE

Steel grade	Cutting speed (Vc), m/min	Feed per tooth (fz), mm/tooth
Hardox HiTuf	70 – 100	0,03 – 0,06
Hardox HiTemp	60 – 80	0,02 – 0,05
Hardox 400	60 – 80	0,02 – 0,05
Hardox 450	50 – 70	0,02 – 0,05
Hardox 500	40 – 60	0,02 – 0,05
Hardox 500 Tuf	40 – 60	0,02 – 0,05
Hardox 550	35 – 55	0,02 – 0,04
Hardox 600	30 – 40	0,01 – 0,03
Hardox Extreme	25 – 35	0,01 – 0,03

MILLING RECOMMENDATIONS

Face milling with a 45° setting angle

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t	
		min	max
		Insert grade P30	Insert grade P30
Hardox HiTuf	140 – 180	0,10	0,25
Hardox HiTemp	120 – 160	0,10	0,25
Hardox 400	120 – 160	0,10	0,25
Hardox 450	110 – 150	0,10	0,25
Hardox 500	100 – 140	0,10	0,25
Hardox 500 Tuf	100 – 140	0,10	0,25
Hardox 550	70 – 90	0,10	0,20
Hardox 600	50 – 70	0,10	0,20
Hardox Extreme	30 – 50	0,10	0,20

Face milling round inserts

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t	
		min	max
		Insert grade P30	Insert grade P30
Hardox HiTuf	140 – 180	0,10	0,25
Hardox HiTemp	120 – 160	0,10	0,25
Hardox 400	120 – 160	0,10	0,25
Hardox 450	110 – 150	0,10	0,25
Hardox 500	100 – 140	0,10	0,25
Hardox 500 Tuf	100 – 140	0,10	0,25
Hardox 550	70 – 90	0,10	0,25
Hardox 600	50 – 70	0,10	0,20
Hardox Extreme	30 – 50	0,10	0,20

MILLING RECOMMENDATIONS

HARDOX® WEAR PLATE

Shoulder milling with a 90° setting angle

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t	
		min	max
		Insert grade P30	Insert grade P30
Hardox HiTuf	140 – 180	0,12	0,25
Hardox HiTemp	120 – 160	0,12	0,25
Hardox 400	120 – 160	0,12	0,25
Hardox 450	110 – 150	0,12	0,25
Hardox 500	100 – 140	0,12	0,25
Hardox 500 Tuf	100 – 140	0,12	0,25
Hardox 550	70 – 90	0,10	0,20
Hardox 600	50 – 70	0,10	0,20
Hardox Extreme	30 – 50	0,10	0,20

High feed milling with Coromil 210, 10° setting angle

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t			
		Min Insert grade P30	Max Insert grade P30	Min Insert grade P30	Max Insert grade P30
		Insert size 09	Insert size 09	Insert size 14	Insert size 14
Hardox HiTuf	140 – 180	0,4	2,0	0,5	3,0
Hardox HiTemp	120 – 160	0,4	2,0	0,5	3,0
Hardox 400	120 – 160	0,4	2,0	0,5	3,0
Hardox 450	110 – 150	0,4	2,0	0,5	3,0
Hardox 500	90 – 130	0,4	2,0	0,5	3,0
Hardox 500 Tuf	90 – 130	0,4	2,0	0,5	3,0
Hardox 550	70 – 90	0,4	2,0	0,5	3,0
Hardox 600	50 – 70	0,4	2,0	0,5	3,0
Hardox Extreme	35 – 50	0,4	2,0	0,5	3,0

• The fz and pitch/rev are recommendations for Coromill 210 from Sandvik Coromant.

MILLING RECOMMENDATIONS

HARDOX® WEAR PLATE

End milling for solid cemented carbide tools

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t		
		Min – Max	Min – Max	Min- Max
		Ø Diameter 3,0 – 6,0	Ø Diameter 8,0 – 12,0	Ø Diameter 14,0 – 20,0
Hardox HiTuf	80 – 105	0,01 – 0,03	0,04 – 0,07	0,07 – 0,10
Hardox HiTemp	75 – 100	0,01 – 0,03	0,03 – 0,06	0,06 – 0,09
Hardox 400	75 – 100	0,01 – 0,03	0,03 – 0,06	0,06 – 0,09
Hardox 450	70 – 95	0,01 – 0,03	0,03 – 0,06	0,06 – 0,08
Hardox 500	45 – 70	0,01 – 0,025	0,03 – 0,05	0,05 – 0,07
Hardox 500 Tuf	45 – 70	0,01 – 0,025	0,03 – 0,05	0,05 – 0,07
Hardox 550	40 – 65	0,01 – 0,02	0,03 – 0,045	0,05 – 0,065
Hardox 600	30 – 40	0,005 – 0,015	0,02 – 0,03	0,03 – 0,04
Hardox Extreme	20 – 30	0,005 – 0,01	0,015 – 0,025	0,025 – 0,035

Shoulder milling

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t		
		Min – Max	Min – Max	Min- Max
		Ø Diameter 3,0 – 6,0	Ø Diameter 8,0 – 12,0	Ø Diameter 14,0 – 20,0
Hardox HiTuf	190 – 220	0,02 – 0,05	0,06 – 0,10	0,10 – 0,13
Hardox HiTemp	180 – 210	0,02 – 0,04	0,06 – 0,09	0,10 – 0,13
Hardox 400	180 – 210	0,02 – 0,04	0,06 – 0,09	0,10 – 0,13
Hardox 450	160 – 190	0,02 – 0,04	0,06 – 0,09	0,10 – 0,12
Hardox 500	120 – 150	0,015 – 0,35	0,05 – 0,07	0,08 – 0,10
Hardox 500 Tuf	120 – 150	0,015 – 0,35	0,05 – 0,07	0,08 – 0,10
Hardox 550	80 – 110	0,01 – 0,035	0,045 – 0,07	0,08 – 0,10
Hardox 600	70 – 100	0,01 – 0,035	0,04 – 0,07	0,08 – 0,10
Hardox Extreme	60 – 90	0,01 – 0,03	0,04 – 0,06	0,06 – 0,08

MILLING RECOMMENDATIONS

HARDOX® WEAR PLATE

Shoulder milling with a 90° setting angle

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t	
		min	max
		Insert grade P30	Insert grade P30
Hardox HiTuf	140 – 180	0,12	0,25
Hardox HiTemp	120 – 160	0,12	0,25
Hardox 400	120 – 160	0,12	0,25
Hardox 450	110 – 150	0,12	0,25
Hardox 500	100 – 140	0,12	0,25
Hardox 500 Tuf	100 – 140	0,12	0,25
Hardox 550	70 – 90	0,10	0,20
Hardox 600	50 – 70	0,10	0,20
Hardox Extreme	30 – 50	0,10	0,20

High feed milling with Coromil 210, 10° setting angle

Steel grade	Cutting speed (Vc), m/min	Feed per tooth, (fz) mm/t			
		Min Insert grade P30	Max Insert grade P30	Min Insert grade P30	Max Insert grade P30
		Insert size 09	Insert size 09	Insert size 14	Insert size 14
Hardox HiTuf	140 – 180	0,4	2,0	0,5	3,0
Hardox HiTemp	120 – 160	0,4	2,0	0,5	3,0
Hardox 400	120 – 160	0,4	2,0	0,5	3,0
Hardox 450	110 – 150	0,4	2,0	0,5	3,0
Hardox 500	90 – 130	0,4	2,0	0,5	3,0
Hardox 500 Tuf	90 – 130	0,4	2,0	0,5	3,0
Hardox 550	70 – 90	0,4	2,0	0,5	3,0
Hardox 600	50 – 70	0,4	2,0	0,5	3,0
Hardox Extreme	35 – 50	0,4	2,0	0,5	3,0

• The fz and pitch/rev are recommendations for Coromill 210 from Sandvik Coromant.