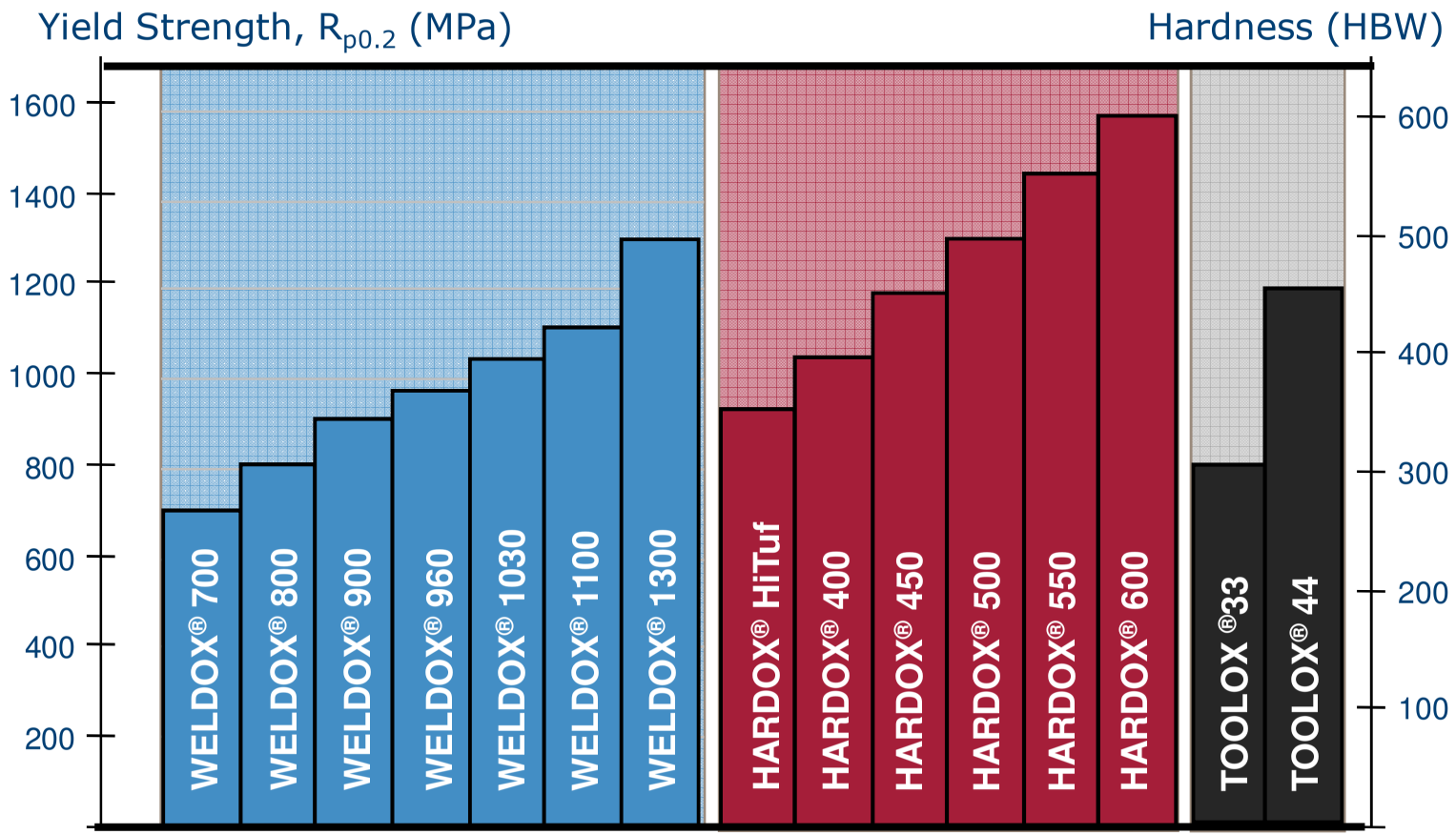
TOOLOX®

PREHARDENED TOOL STEEL

TOOLOX in plastic moulding applications

Per Hansson
SSAB Plate

SSAB


Yield Strength, $R_{p0.2}$ (MPa)
Hardness (HBW)
1600
1400
1200
1000
800
600
400
200
600
500
400
300
200
100
WELDOX® 700
WELDOX® 800
WELDOX® 900
WELDOX® 960
WELDOX® 1030
WELDOX® 1100
WELDOX® 1300
HARDOX® HiTuf
HARDOX® 400
HARDOX® 450
HARDOX® 500
HARDOX® 550
HARDOX® 600
TOOLOX® 33
TOOLOX® 44

WELDOX®
HIGH STRENGTH STEEL

HARDOX®
WEAR PLATE

SSAB

What is TOOLOX?

- Quenched and tempered tool and machine steel having ESR-properties.
- Designed to be machined, dimensional stable when machining.
- Extremely well suited for surface engineering (Nitriding/PVD-coating).

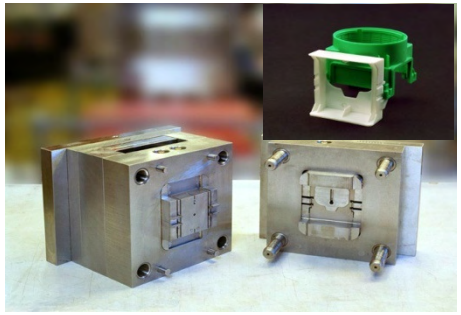
For direct use…

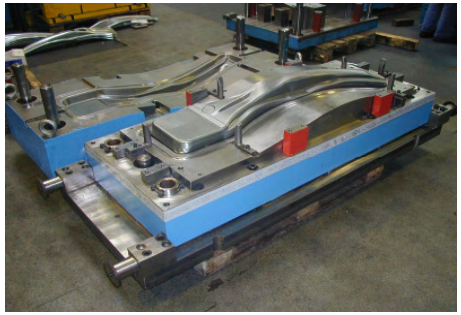
- Hardness and impact toughness,
  guaranteed and measured on all delivered plates.
- Tensile properties,
  measured on all delivered plates, the values are reported for guidance only.
- Homogeneity,
  guaranteed and ultrasonic inspected on all delivered plates.
- Milling properties,
  are guaranteed on all delivered plates.
- All plates are delivered with an EN 10 204 3.1 inspection certificate!

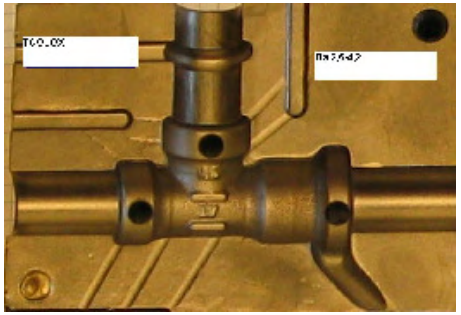
Benefits…

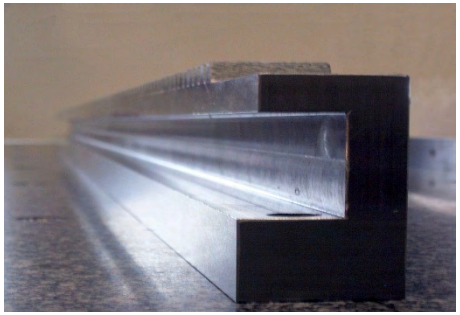
- Faster mould/die manufacturing.
- Known mechanical properties of the mould/die.

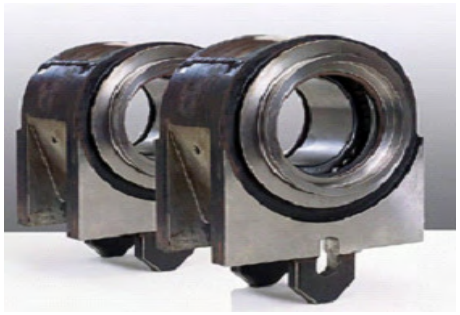
Application areas…











Tool steel substitution…

TOOLOX 33

- W.Nr 1.2311 = P20
- W.Nr 1.2312 = P20+S
- W.Nr 1.2738 = P20+Ni

- W.Nr 1.2363
- W.Nr 1.2379 = D2

- 42CrMo4
- C45-C60

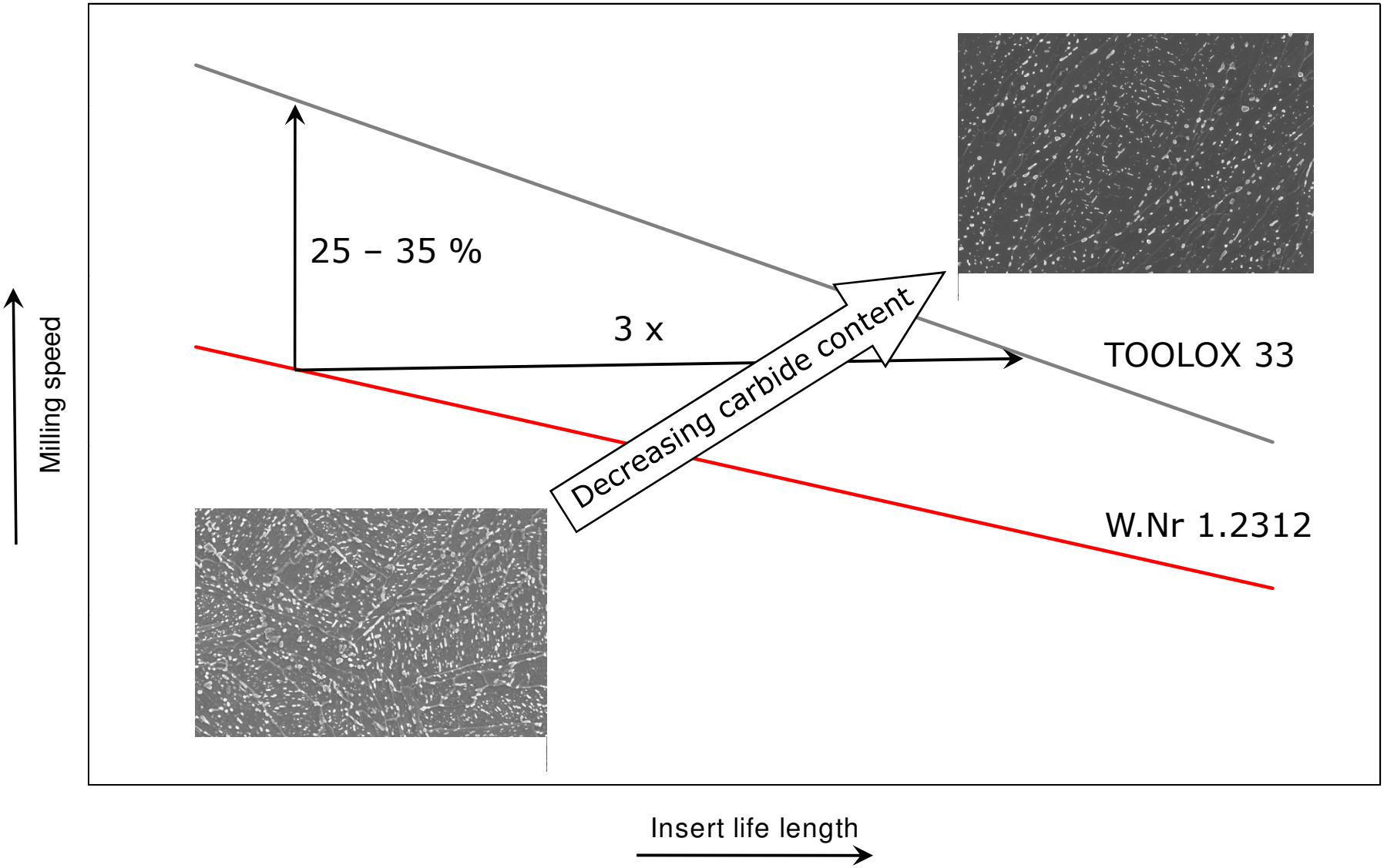
TOOLOX 44

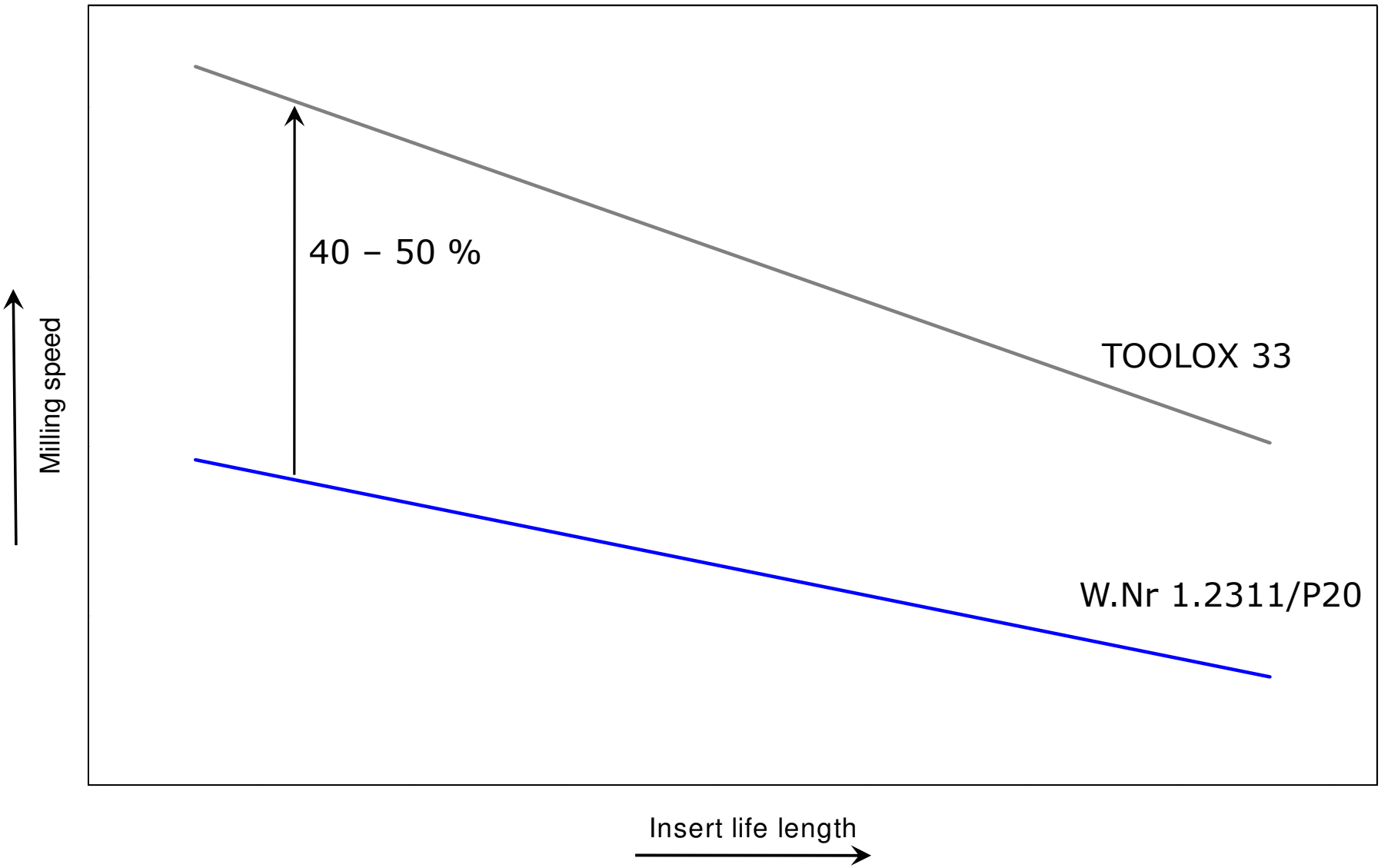
- W.Nr 1.2343 = H11
- W.Nr 1.2344 = H13
- W.Nr 1.2767

- W.Nr 1.2363
- W.Nr 1.2379 = D2
- W.Nr 1.2358

	TOOLOX 33	W.Nr 1.2738 (P20+Ni)	TOOLOX 44	W.Nr 1.2344 (H13)
Hardness	280-330 HBW	280-325 HBW	410-475 HBW	None
Toughness	Min 27 J @ RT	None	Min 18 J @ RT	None
ESR-prop.	Yes	No	Yes	Optional
C	0.21-0.26	0.35-0.45	0.30-0.34	0.37-0.43
Si	1.0-1.2	0.20-0.40	1.0-1.2	0.90-1.20
Mn	0.7-0.9	1.30-1.60	0.7-0.9	0.30-0.50
P	Max 0.010	Max 0.035	Max 0.010	Max 0.030
S	Max 0.003	Max 0.035	Max 0.003	Max 0.030
Cr	1.0-1.3	1.80-2.10	1.3-1.4	4.80-5.50
Ni	-	0.90-1.20	-	-
Mo	0.15-0.40	0.15-0.25	0.75-0.85	1.20-1.50
V	0.09-0.12	-	0.13-0.15	0.90-1.10
CE_{IIW}	0.61-0.73	1.01-1.27	0.90-0.94	1.80-2.13

Machining, dimensional stability, mould manufacturing time…


Milling speed
25 – 35 %
3 x
Decreasing carbide content
TOOLOX 33
W.Nr 1.2312
Insert life length

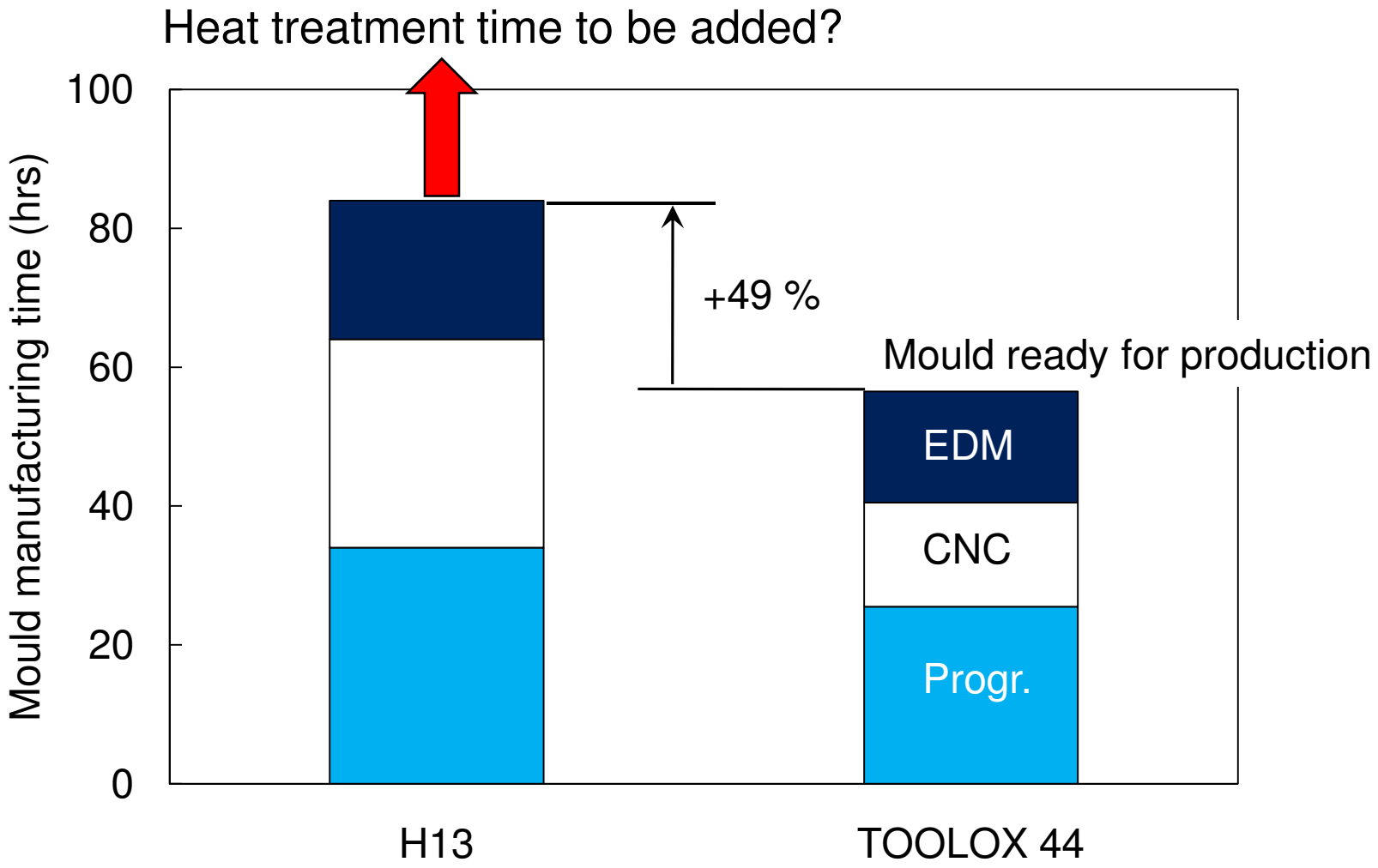

40 – 50 %
TOOLOX 33
W.Nr 1.2311/P20
Milling speed
Insert life length

NYBRO STÅLPRODUKTER AB — Kontrollavdelningen
Kund: — Artikel: KUGGSTÅNG
Ritn.nr: 2-621 308 0 — Order.nr: 161323
Date: 03.02.25 — Time: 09:43:25

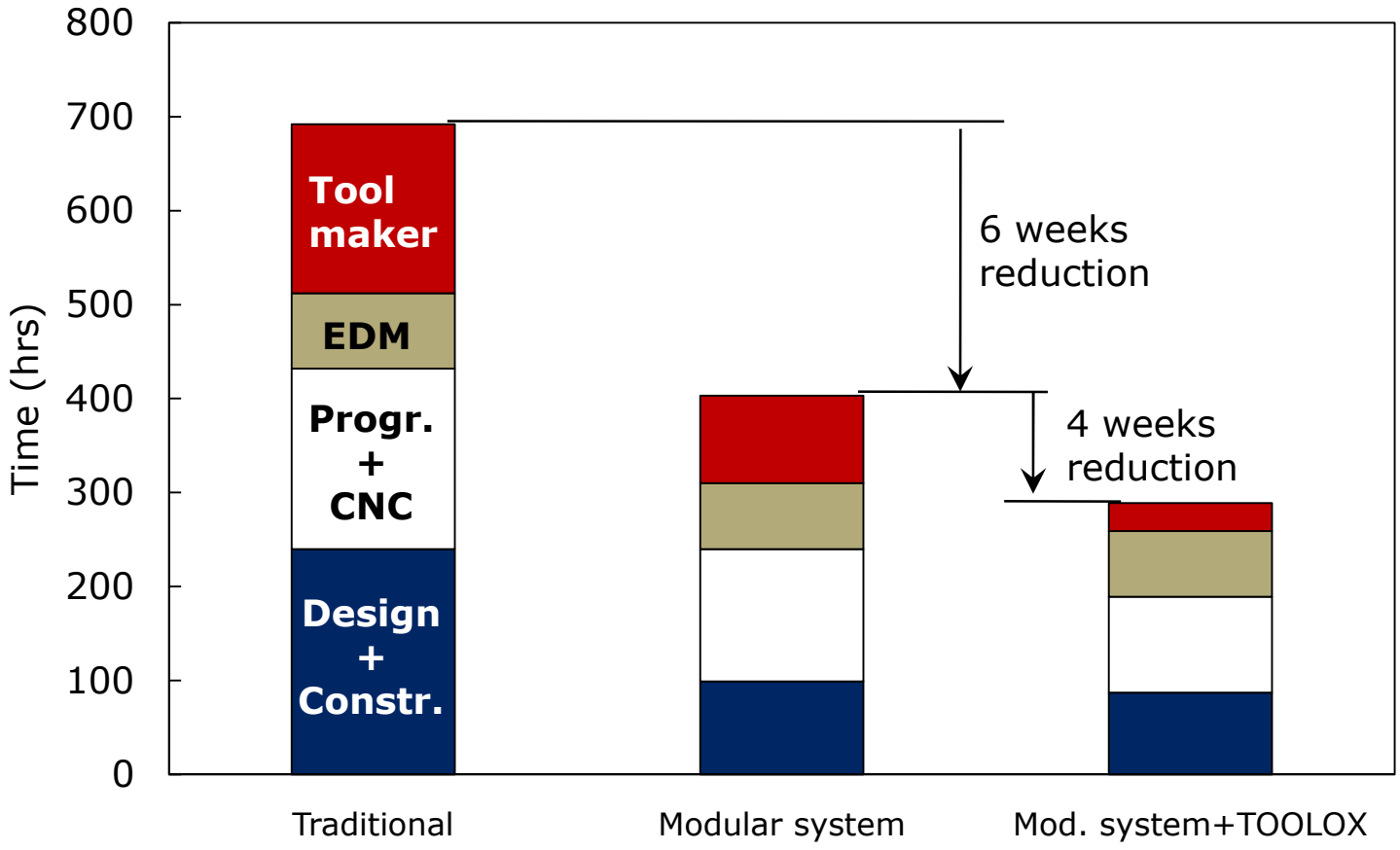
Uppmätta mått enligt ritning.

# 3	PLAN	Ref.sys	1				
		ÄR					
Planhet		0.136					
# 4	LINJE	Ref.sys	1				
		ÄR					
Rakhet		0.004					
# 5	PUNKT	Ref.sys	1				
		ÄR	BÖR	AVV	ÖT	UT	UFT
Z		-39.982	-40.000	-0.018	0.000	-0.100	
# 6	PUNKT	Ref.sys	1				
		ÄR	BÖR	AVV	ÖT	UT	UFT
X		1830.034	1830.000	0.034	1.200	-1.200	
# 8	PUNKT	Ref.sys	2				
		ÄR	BÖR	AVV	ÖT	UT	UFT
X		11.988	12.000	-0.012	0.021	-0.021	
# 10	LINJE	Ref.sys	2				
		ÄR	BÖR	AVV	ÖT	UT	UFT
X		-0.052	0.000	-0.052	0.100	-0.100	
# 11	CIRKEL	Ref.sys	2				
		ÄR	BÖR	AVV	ÖT	UT	UFT
		-904.998	-905.000	-0.002	0.800	-0.800	
		24.934	25.000	-0.066	0.200	-0.200	
		.003	12.000	0.003	0.018	0.000	

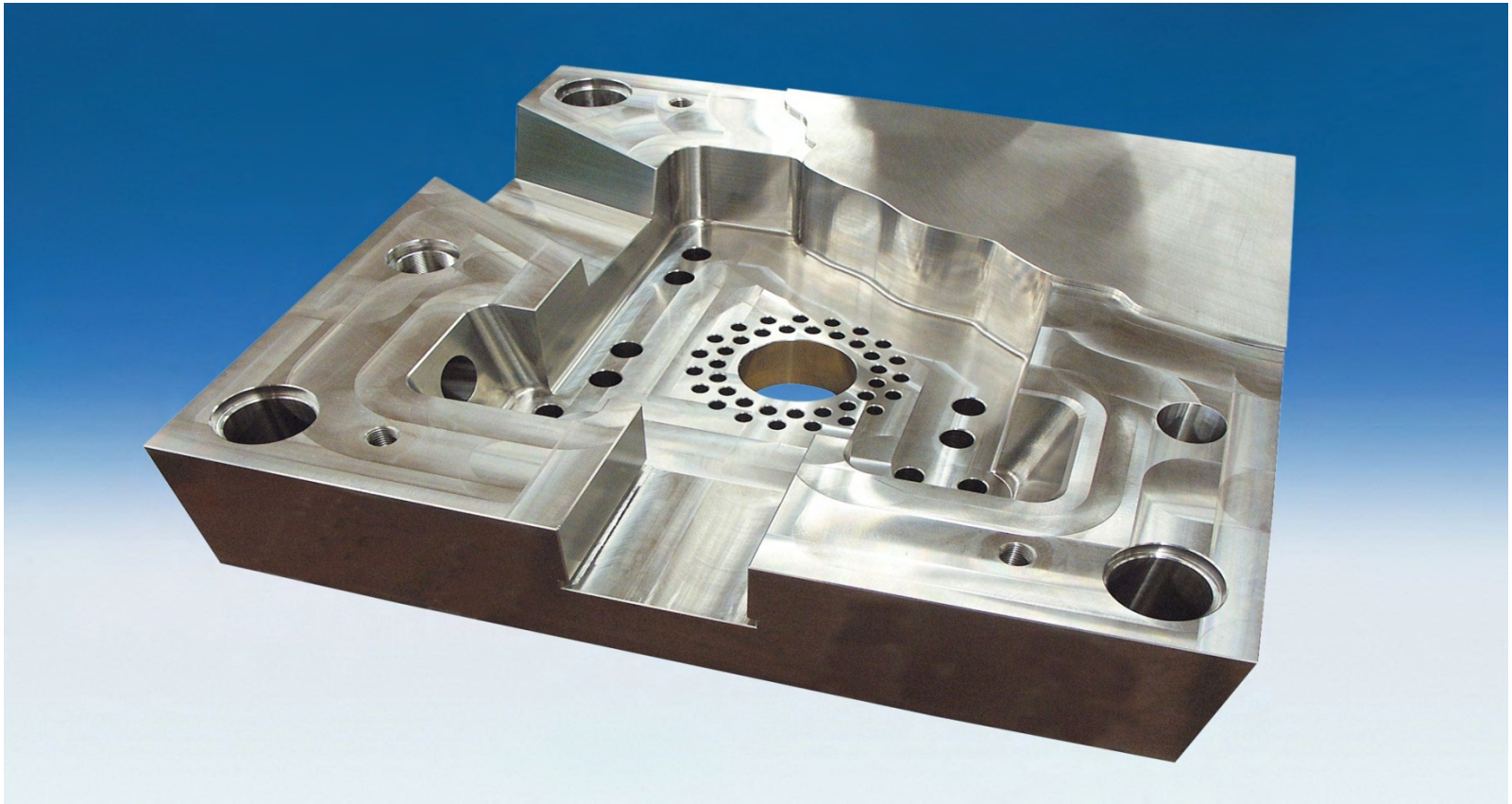
Tommy Peterson, Stena Stål. ”To start with flat instead of round material saved a lot of production time. The gear-racks were absolutely straight; 0.004 mm sidewise deflection and 0.136 mm longitudinal deflection on 1.8 m measuring length!”


Heat treatment time to be added?
Mould manufacturing time (hrs)
100
80
60
40
20
0
+49 %
Mould ready for production
EDM
CNC
Progr.
H13
TOOLOX 44

Improved tool design and use of TOOLOX has reduced mould cost by ~58 % and manufacturing time by ~60 %



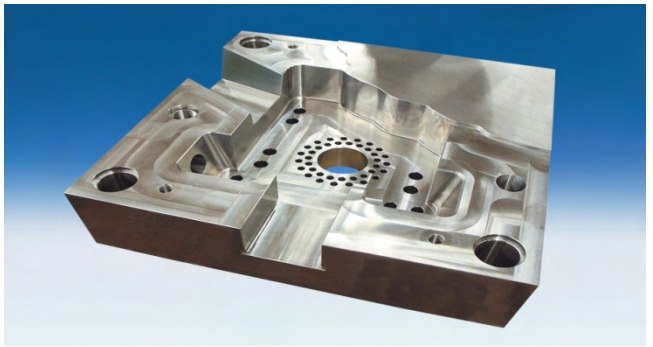
A cost comparison has been made when manufacturing the component shown below…



	W.Nr 1.2312 (P20+S)	TOOLOX 33
Steel cost	?	?
Milling/drilling	4960 €	3930 €
Stress-relieving	191 €	----
Grinding	260 €	70 €

When making the component you save:

1411 - (steel price difference) = ?? €



To conclude…

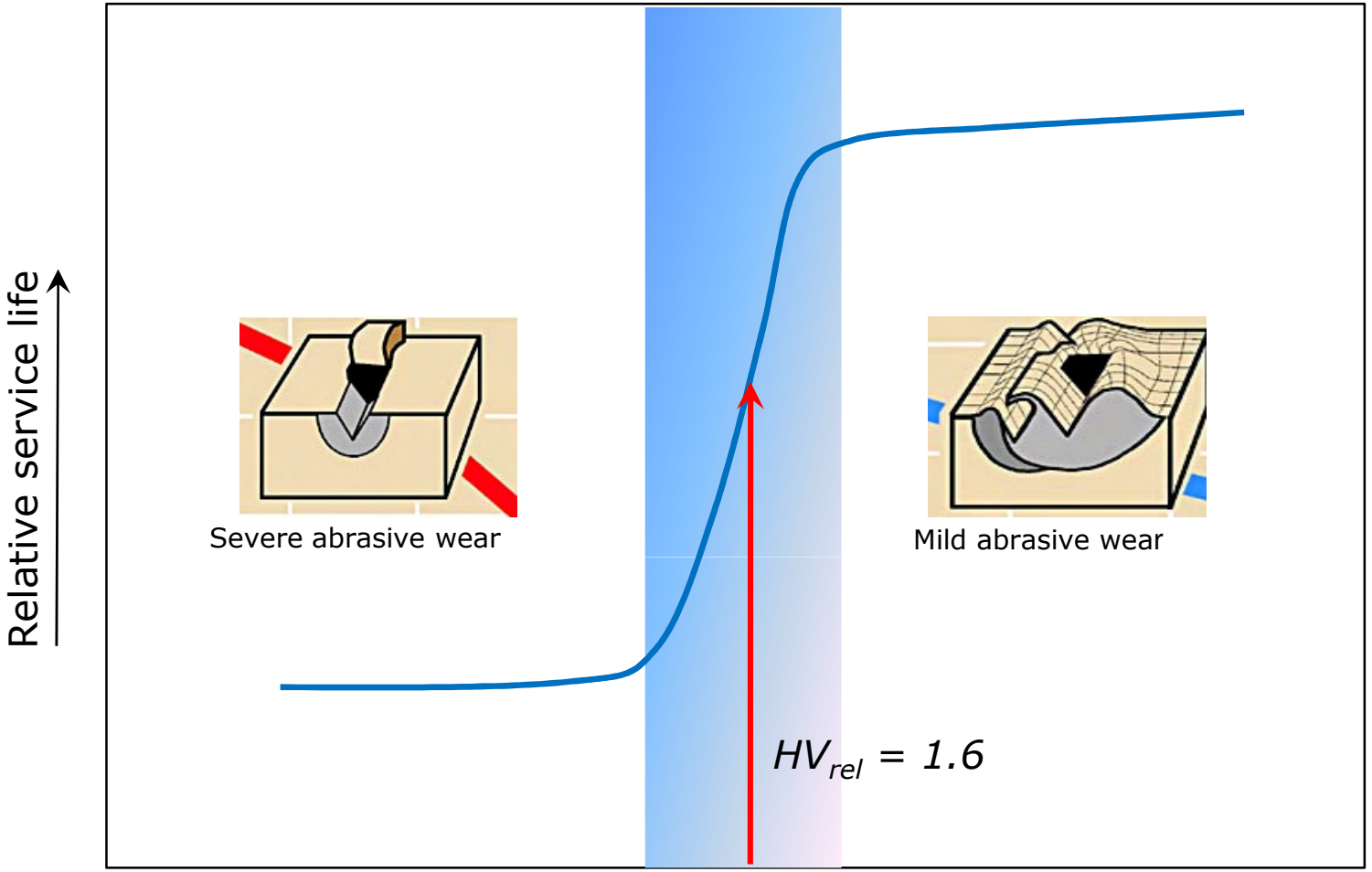
- Better flatness/thickness tolerances means lower material volume to be milled off, and also lower material weight to be bought!
- Faster machining possible!
- Machining in only one (1) set-up!
- No need for heat treatment!
- Shorter grinding time!

TOOLOX in mould bases…

Advantages…

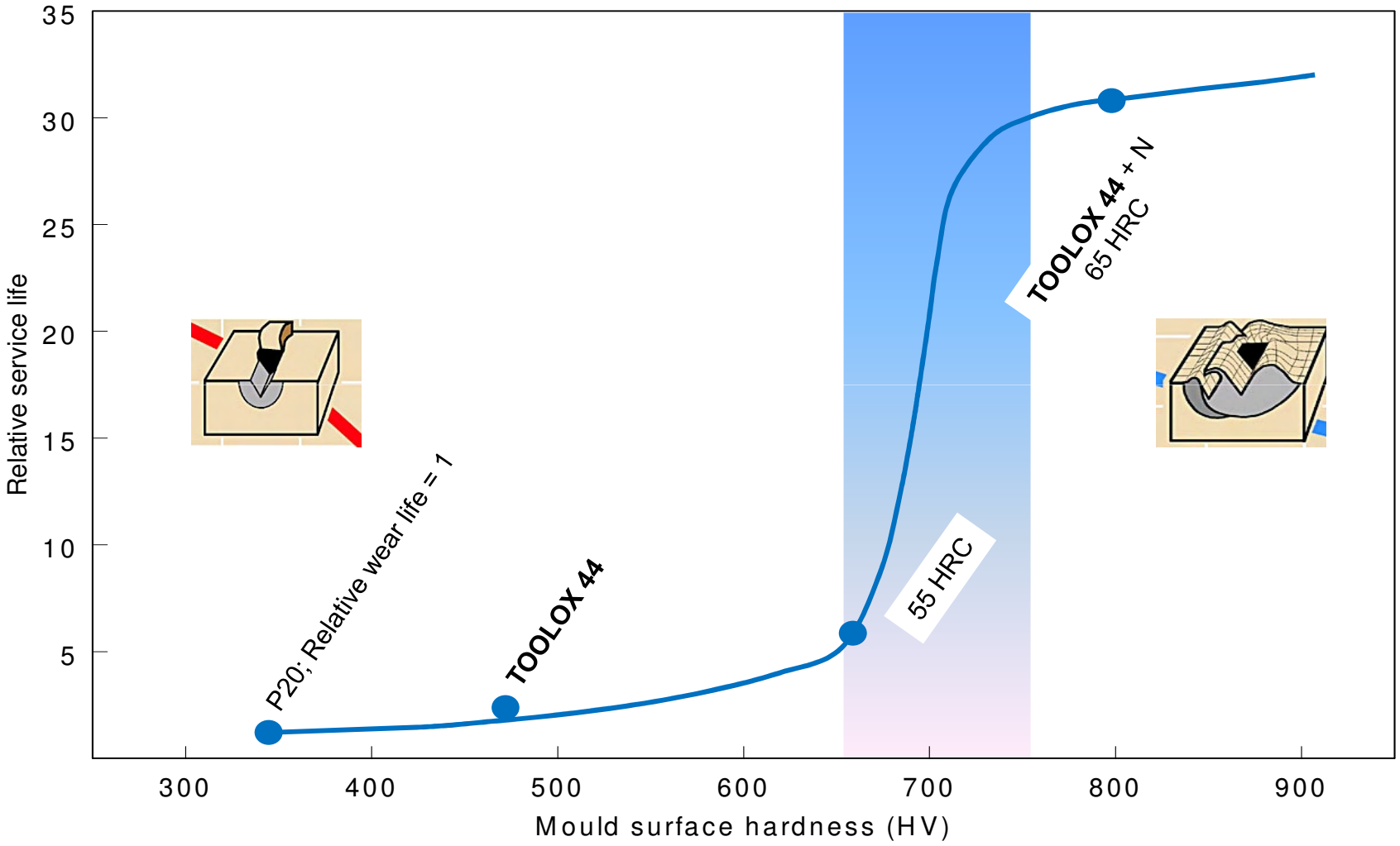
- Better flatness of TOOLOX means less extra plate thickness necessary, i.e. less machining time and cost.
- Tighter thickness tolerance of TOOLOX means less extra material to mill off.
- Faster manufacturing when using TOOLOX thanks to its superior machining properties.

TOOLOX in plastic moulding…



$(HV_{rel} = HV_{abrasive\ medium} / HV_{mould\ surface})$

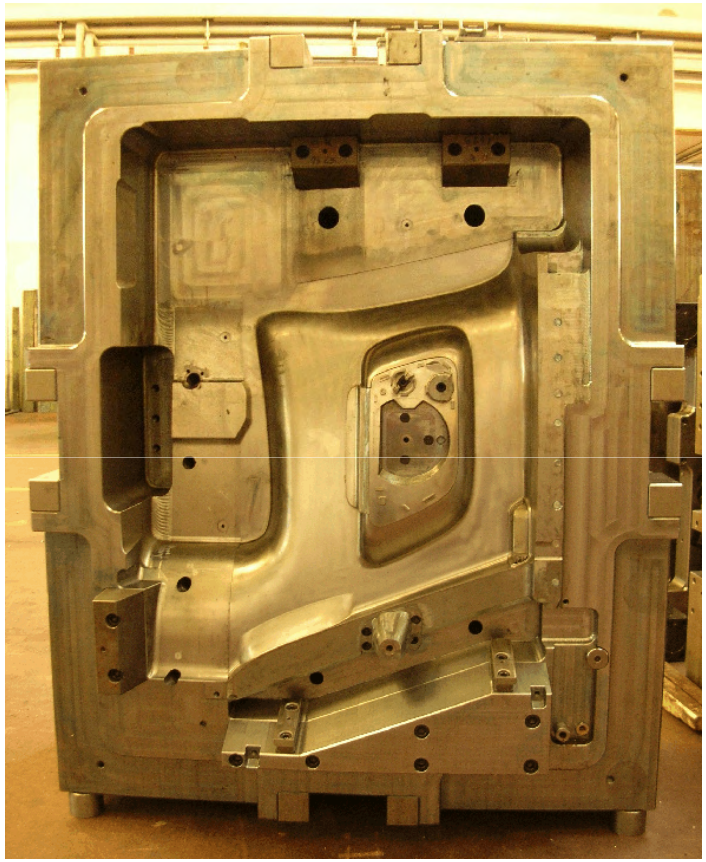
Mould worn by glass fibre reinforced nylon



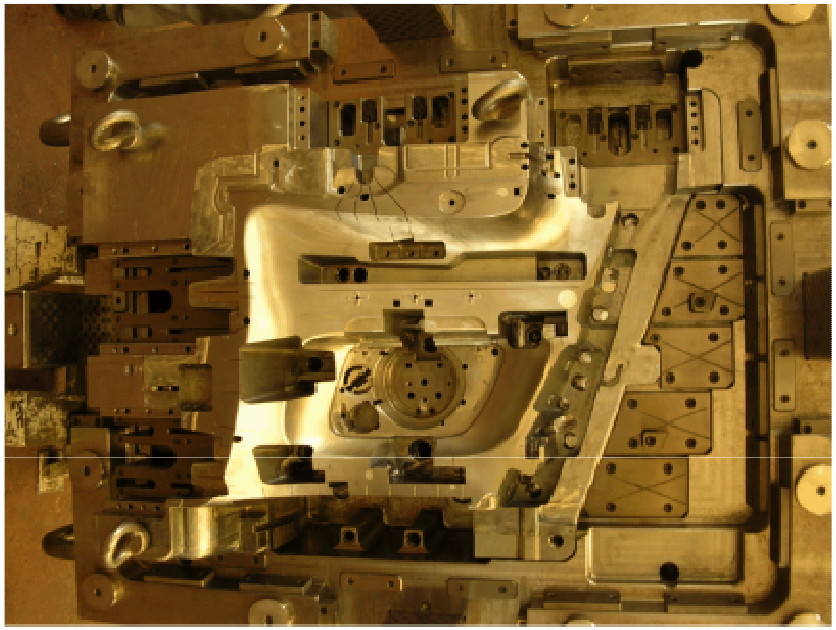
The actual component

Nitrided TOOLOX 44 was used in a mould producing glass-fibre reinforced nylon components. The demand of mould service life was production of 50,000 components. Due to the aggressive wear of the glass-fibre, nitriding of the mould surface was chosen pertaining to establish a less aggressive wear system. The mould manufacturing was quicker due to using a Q&T tool steel. TOOLOX 44 was chosen instead of a regular tool steel which requires heat treatment and secondary machining to produce a high precision mould.

TOOLOX 44 in a mould for automotive



W.Nr 1.2738 HH due to the large thickness (400 mm)



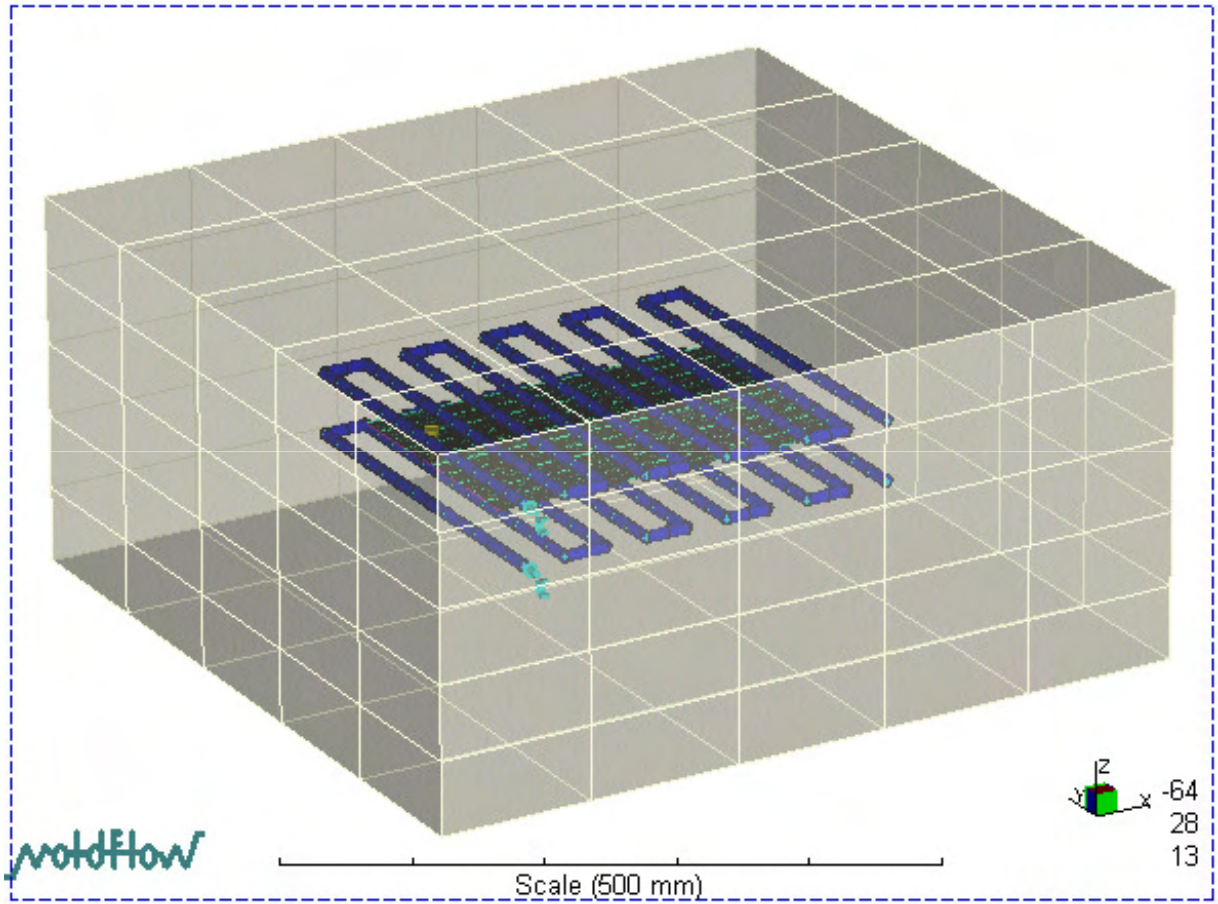
All inserts are made in TOOLOX 44

TOOLOX 44 for doorhandles

W.Nr 1.2343/H11 Q&T was the earlier choice.

TOOLOX 44 is now the choice to shorten mould manufacturing time.

Thermal conductivity



Thermal conductivity

- Higher mould thermal conductivity will shorten the cooling time.
- The simulation explains how a reduction in cycle time is possible with TOOLOX 44 due to its increased thermal conductivity. TOOLOX 44 can achieve a 3-5 % reduction in the cooling time when compared with W.Nr 1.2344 [H13] (Q&T to 45 HRC).

Which grade to choose in moulding?

Plastic	Choose
PP	TOOLOX 33
PA6 (nylon)	TOOLOX 44
PA66	TOOLOX 44 + Nitriding
PC	TOOLOX 44 + Nitriding
ABS	TOOLOX 44
PMMA (Styrene)	TOOLOX 33 + Nitriding, or TOOLOX 44
PCPBT	TOOLOX 44 + Nitriding
With filler (glass-fibre)	TOOLOX 44 + Nitriding

Thank you for your attention!