

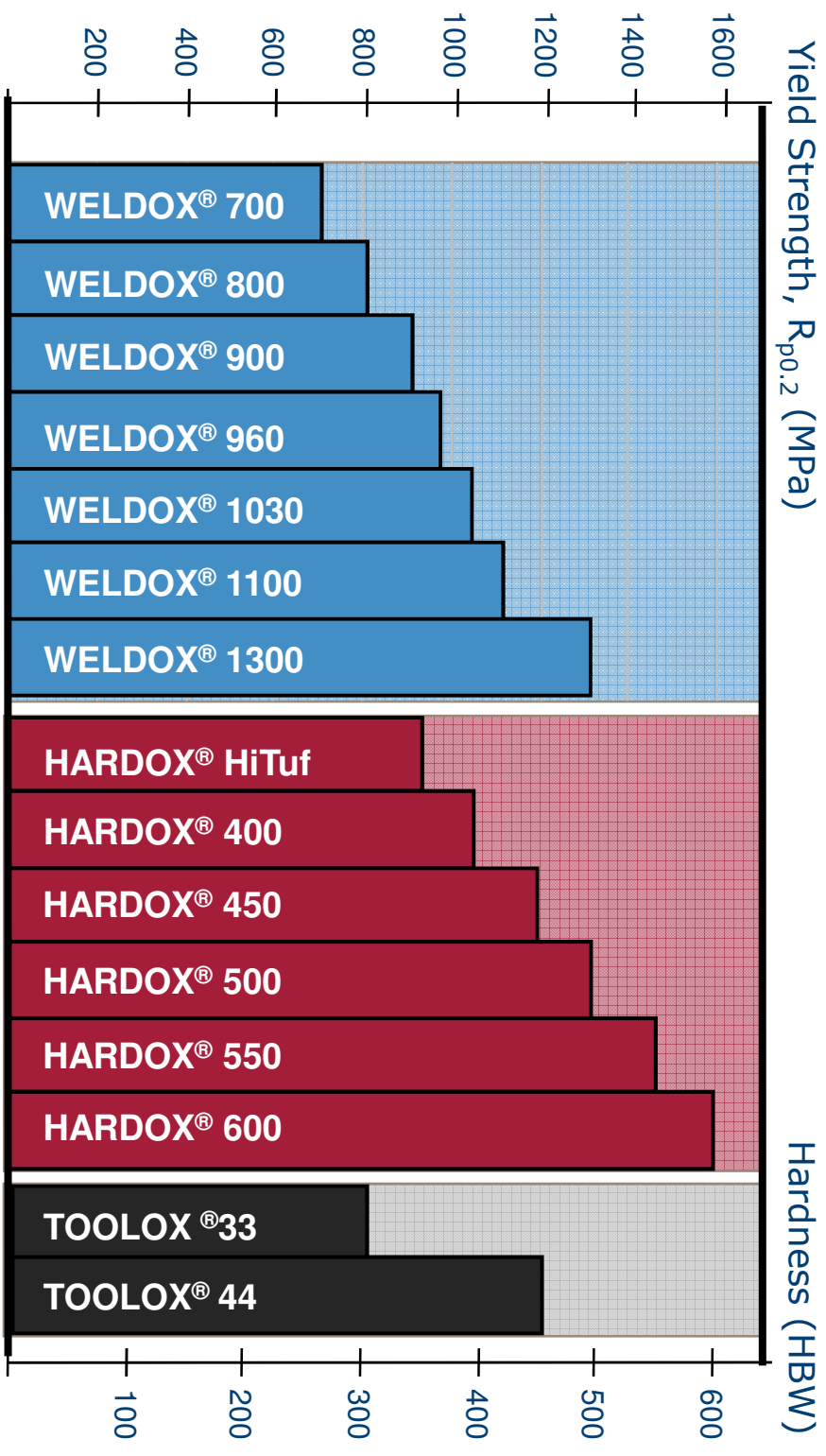
TOOLOX[®]

PREHARDENED TOOL STEEL

TOOLOX in die-casting applications

Per Hansson

SSAB Plate





WELDOX[®]
HIGH STRENGTH STEEL



HARDOX[®]
WEAR PLATE

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).

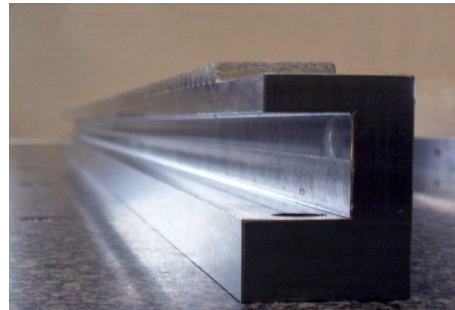
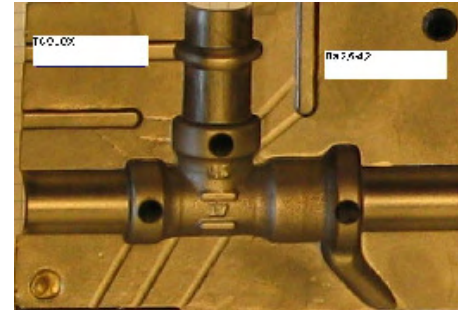
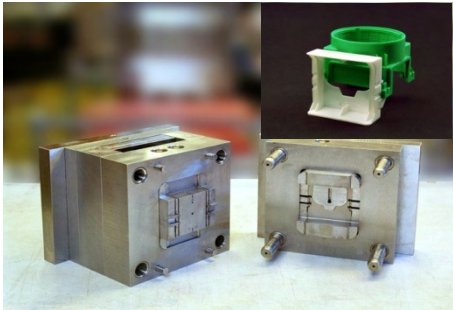
For direct use...

- ▶ 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

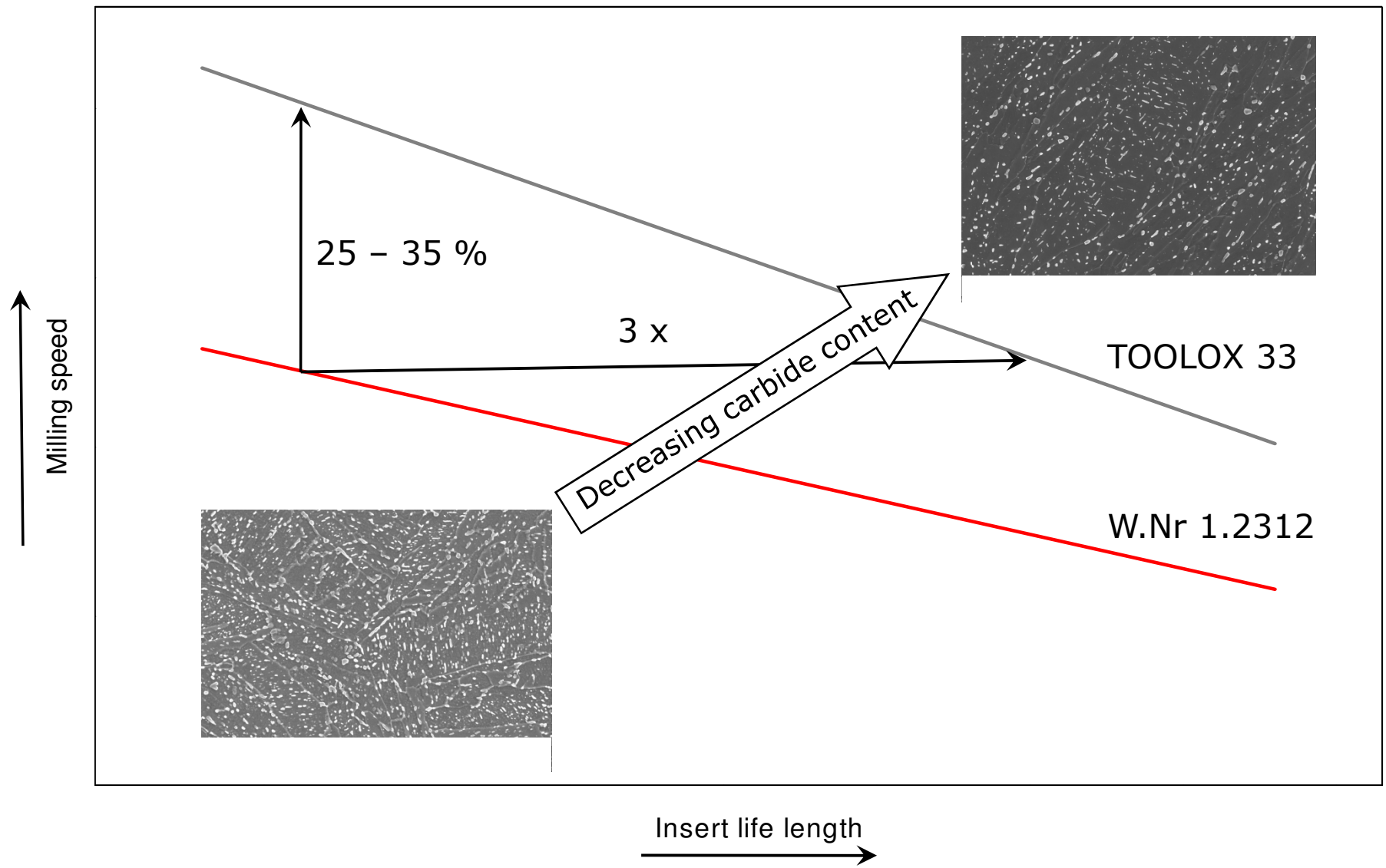
TOOLOX 44

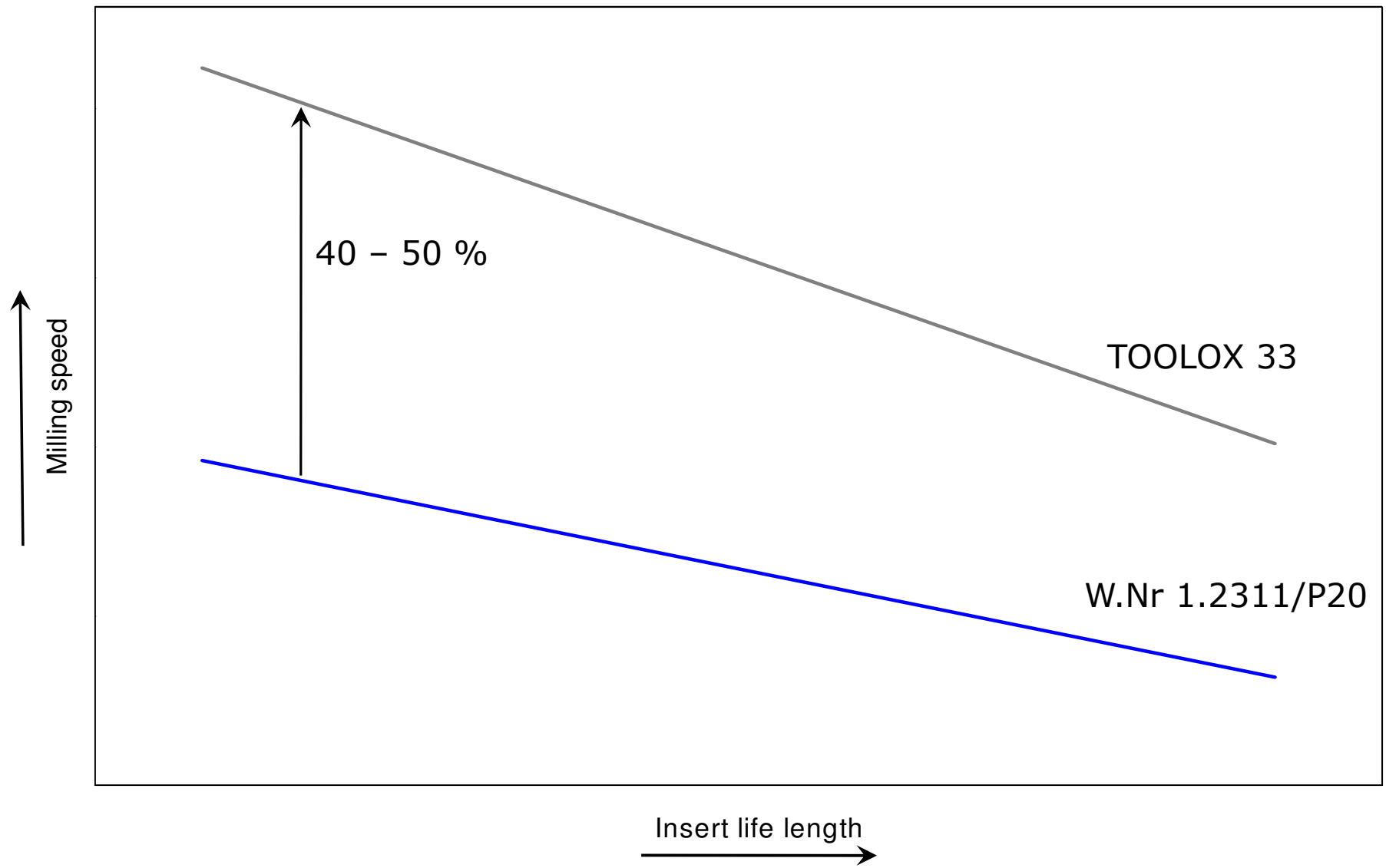
- ▶ W.Nr 1.2343 = H11
- ▶ W.Nr 1.2344 = H13
- ▶ W.Nr 1.2767

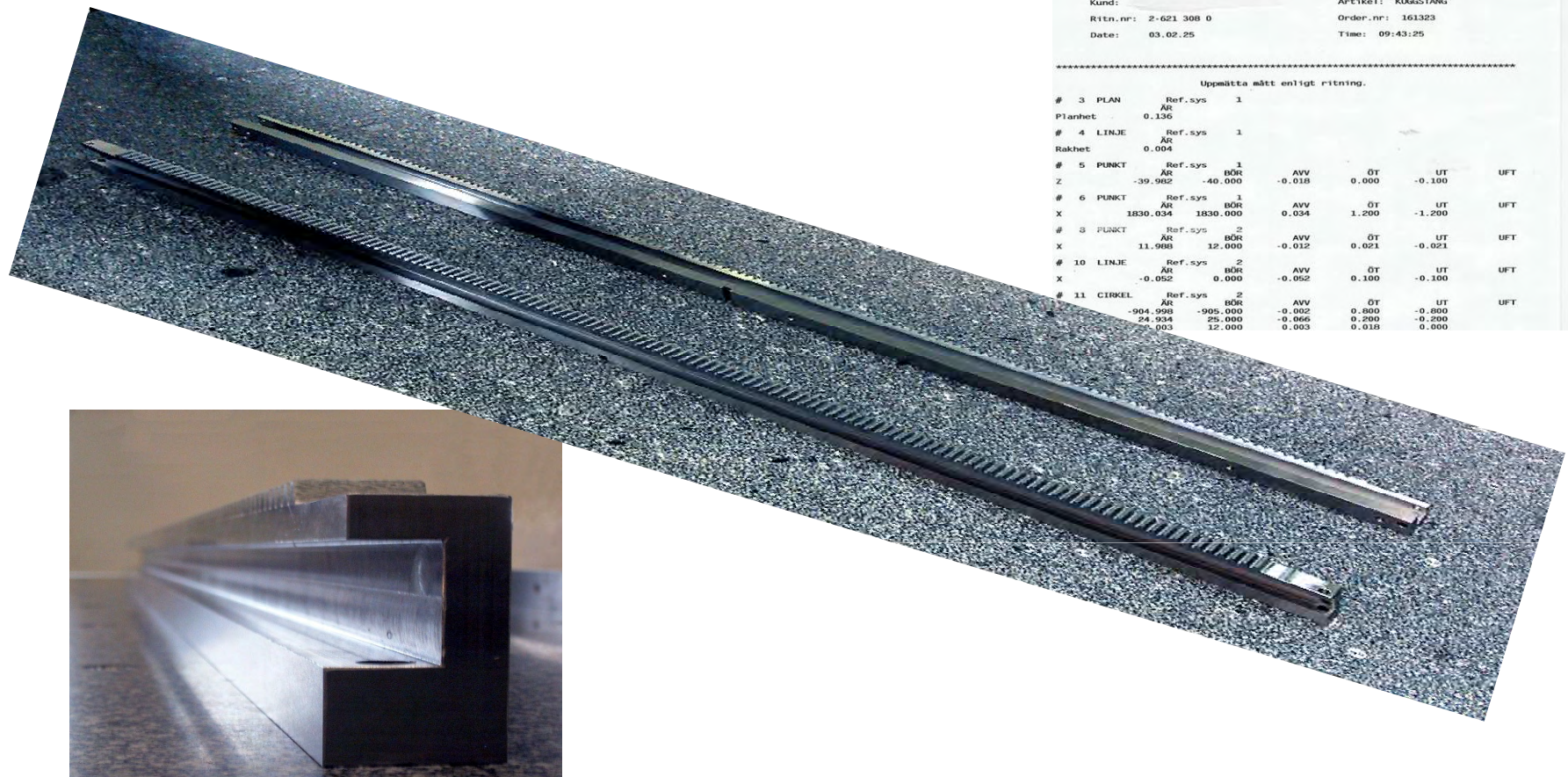
- ▶ W.Nr 1.2363
- ▶ W.Nr 1.2379 = D2
- ▶ W.Nr 1.2358

	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 _{IIV}	0.61-0.73	1.01-1.27	0.90-0.94	1.80-2.13

Machining, dimensional stability, mould
manufacturing time...

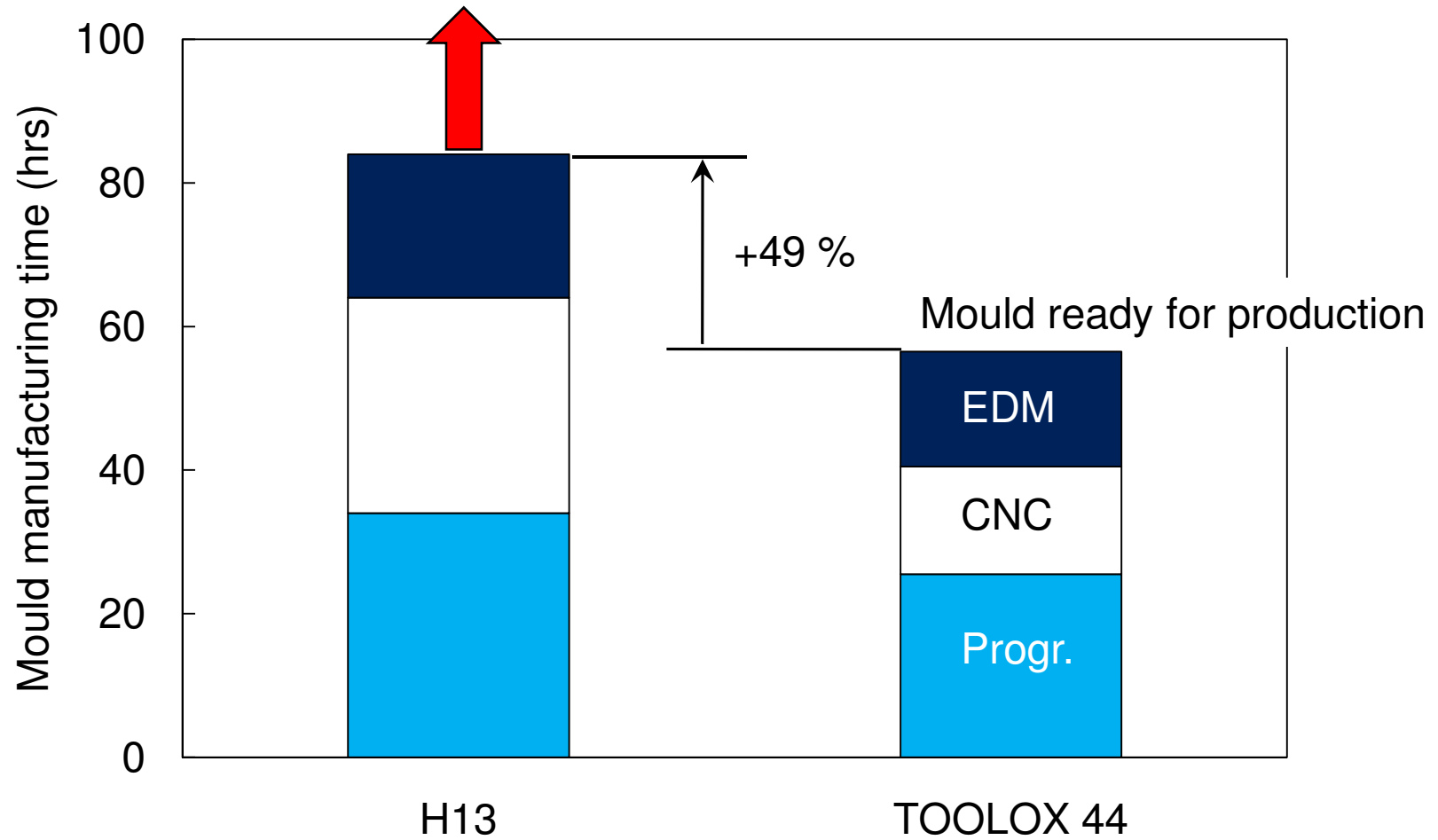




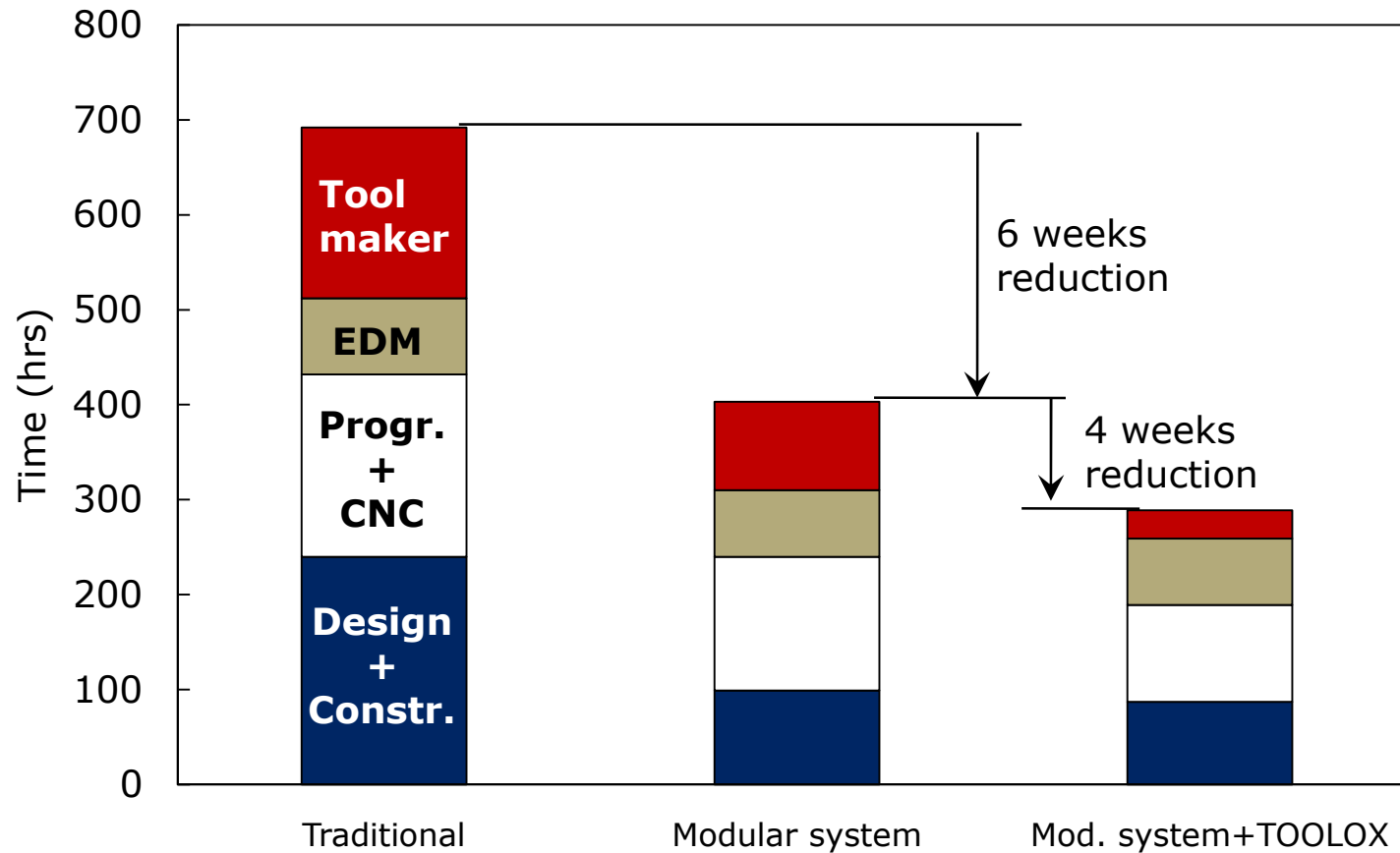


Tommy Peterson, Stena Stål. "To start with flat instead of round material saved a lot of production time. The gear-racks were absolutely straight; 0.004 mm sidewise deflection and 0.136 mm longitudinal deflection on 1.8 m measuring length!"

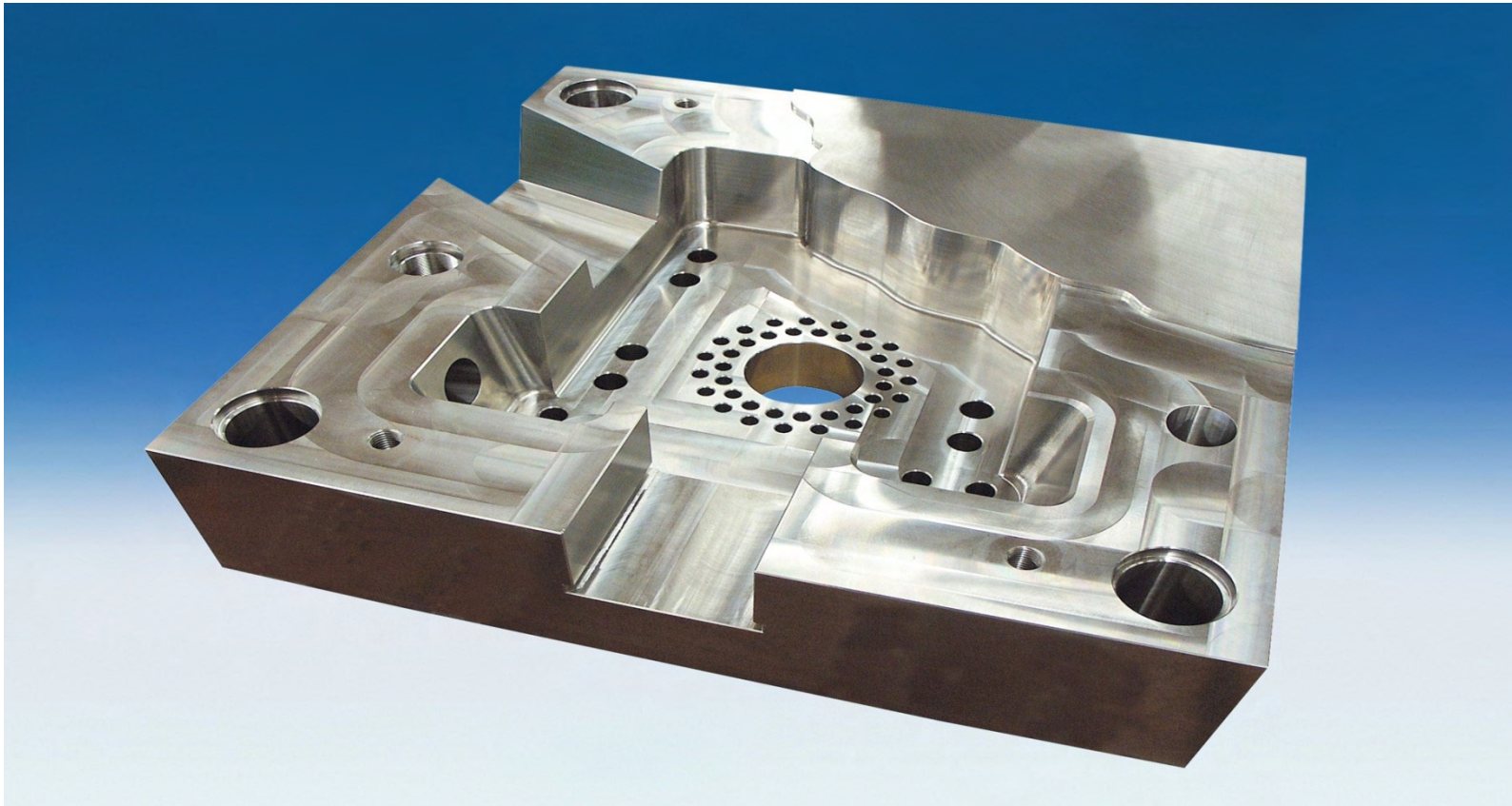
Heat treatment time to be added?



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



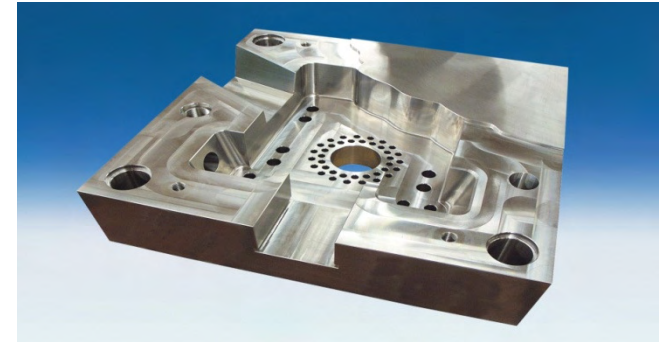
A cost comparison has been made when manufacturing the component shown below...



	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:

$$1411 - (\text{steel price difference}) = ?? \text{ €}$$



To conclude...

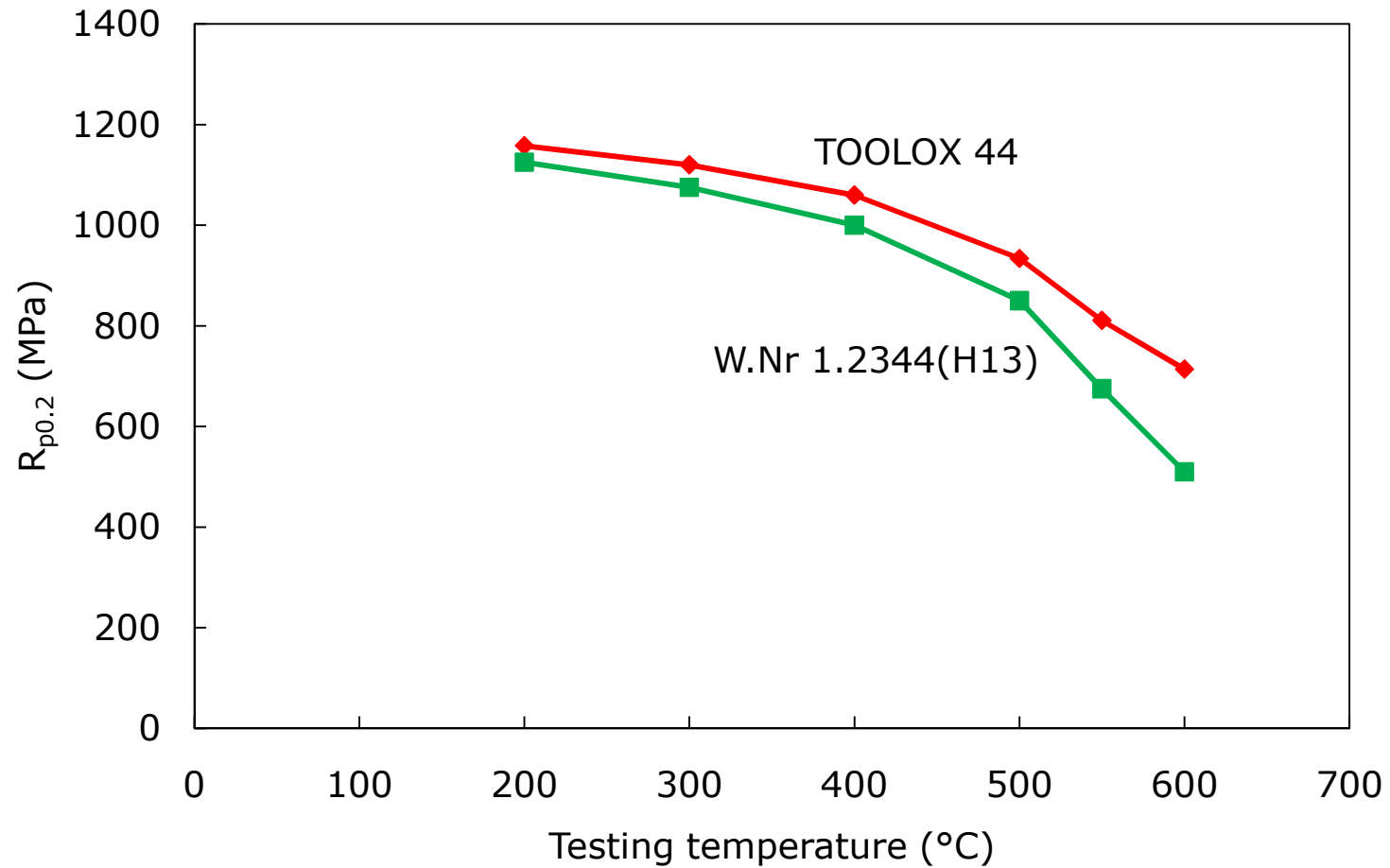
- ▶ Better flatness/thickness tolerances means lower material volume to be milled off, and also lower material weight to be bought!
- ▶ Faster machining possible!
- ▶ Machining in only one (1) set-up!
- ▶ No need for heat treatment!
- ▶ Shorter grinding time!

TOOLOX in die-casting

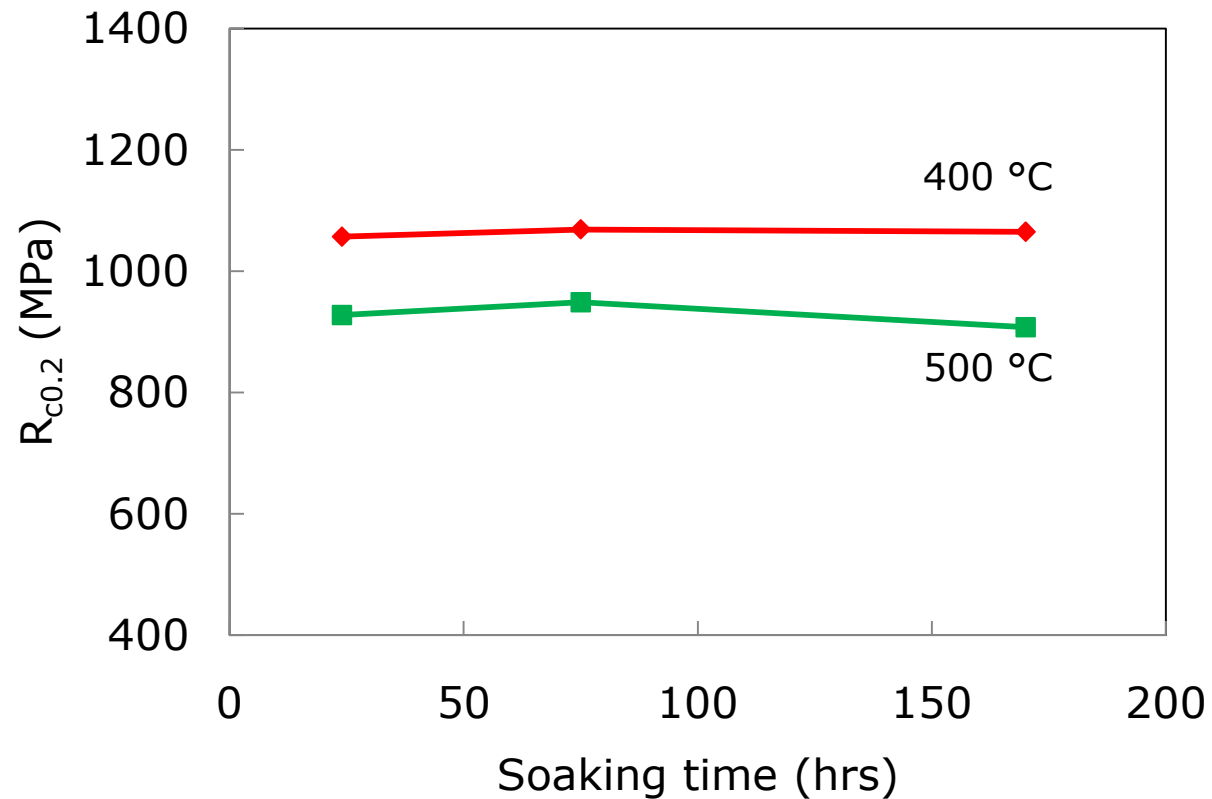
Properties at elevated temperatures

- ▶ Compressive yield strength.
- ▶ Compressive yield strength after 170 hrs soaking at 400 and 500 °C resp.
- ▶ Charpy-V impact toughness.
- ▶ Thermal fatigue (aluminium die-casting simulation).

Yield strength

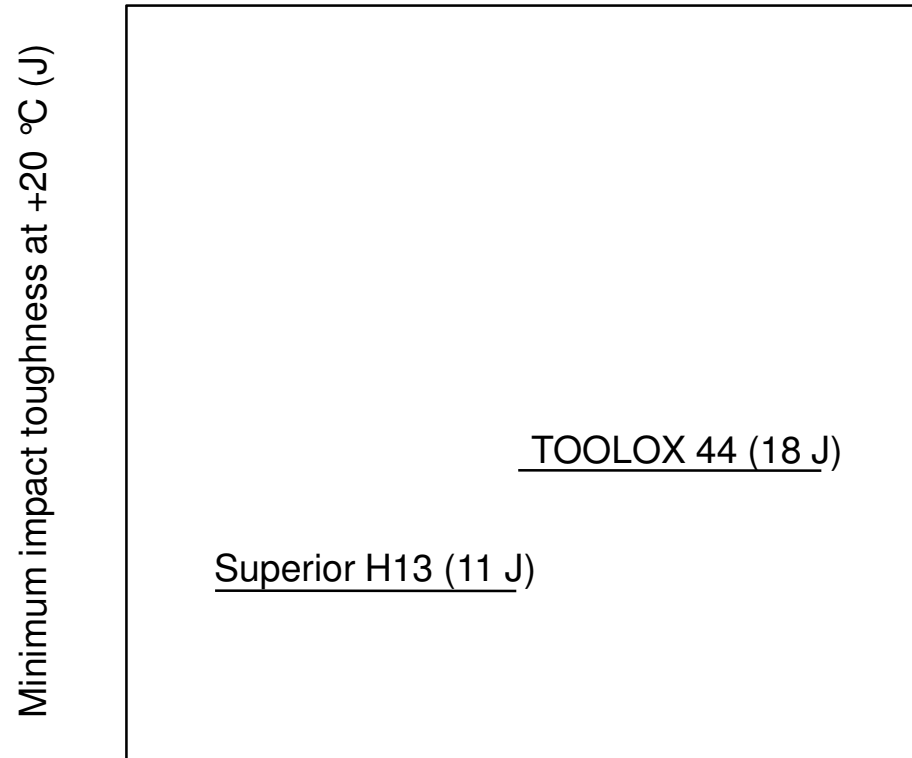


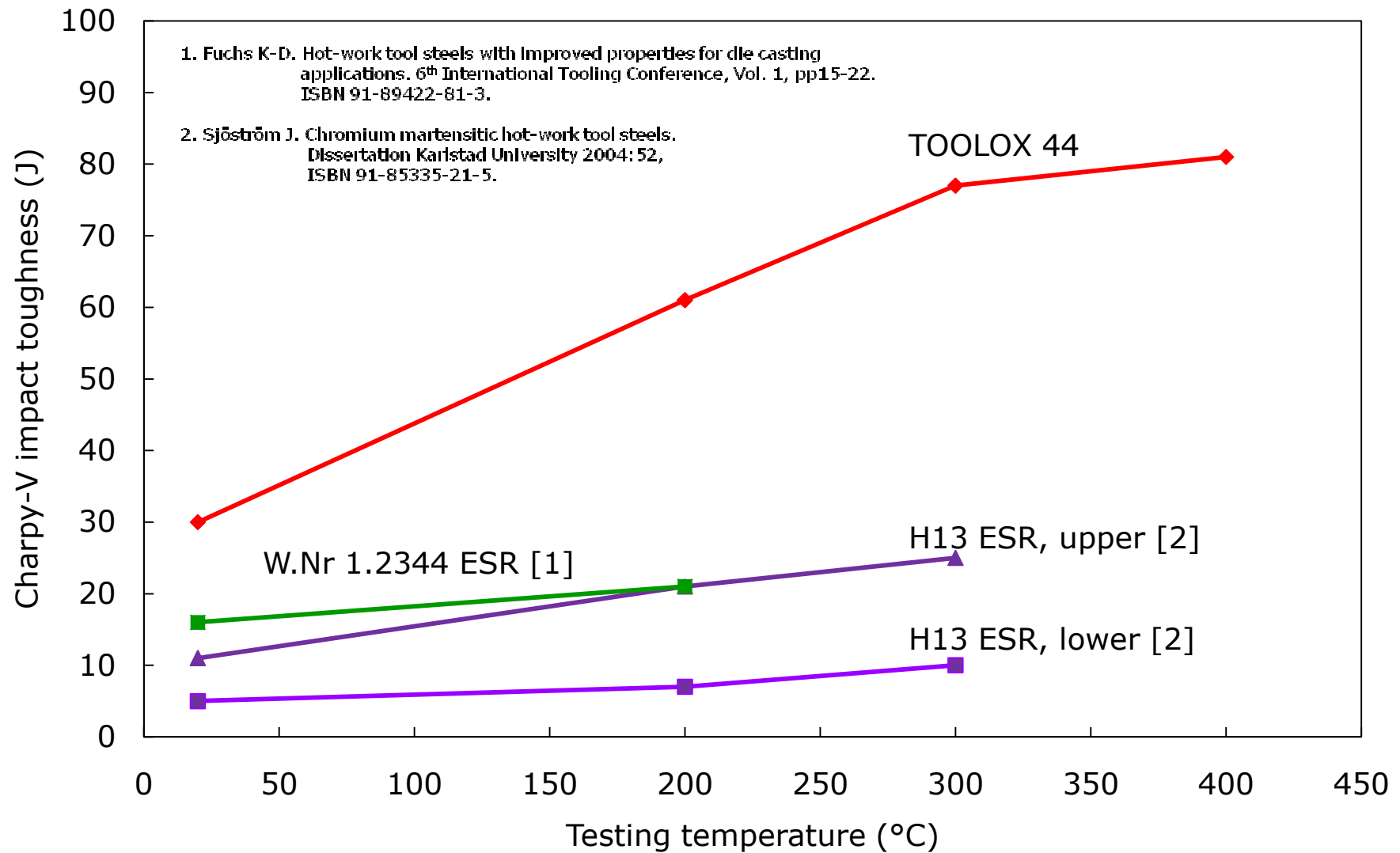
TOOLOX 44 maintains a high yield strength even after extensive temperature testing



NADCA #207-2006

Impact toughness requirements on H13 in aluminium die-casting





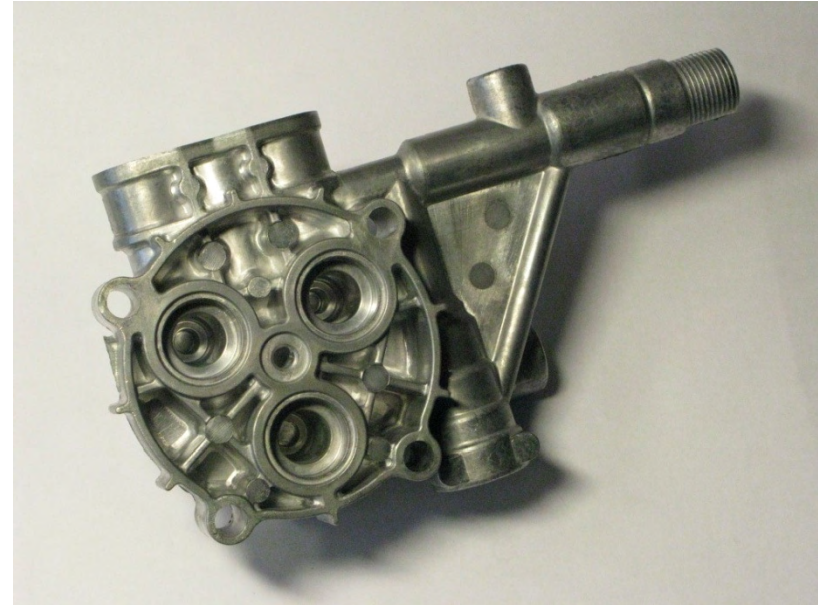
Thermal fatigue

- ▶ Simulation of aluminium die casting, $T_{\text{peak}} = 710 \text{ }^{\circ}\text{C}$.
- ▶ No difference when compared with H13/W.Nr 1.2344 heat treated to 45 HRC, i.e no cracks could be detected!

TOOLOX 44 in aluminium die-casting

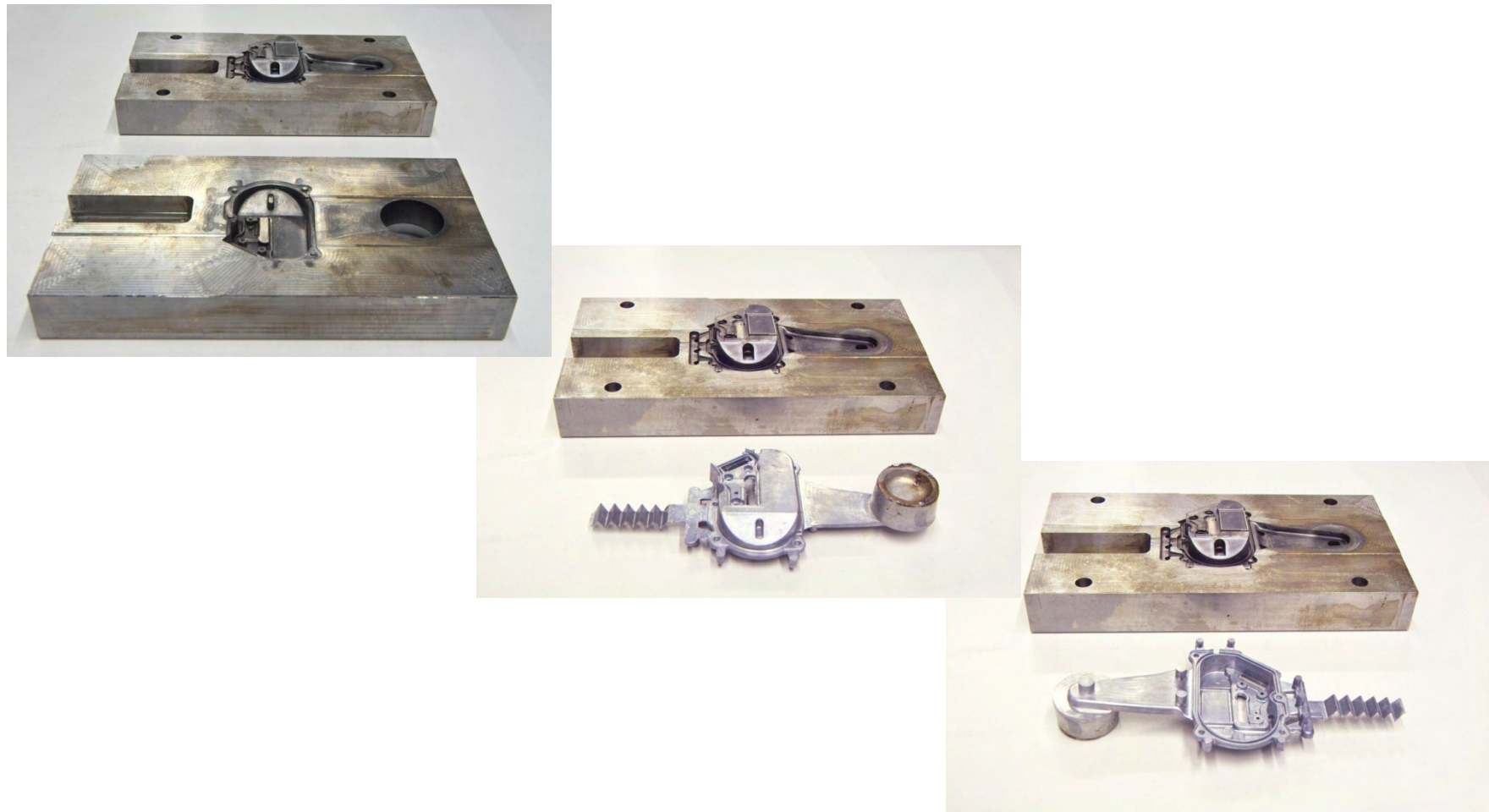


Un-coated die

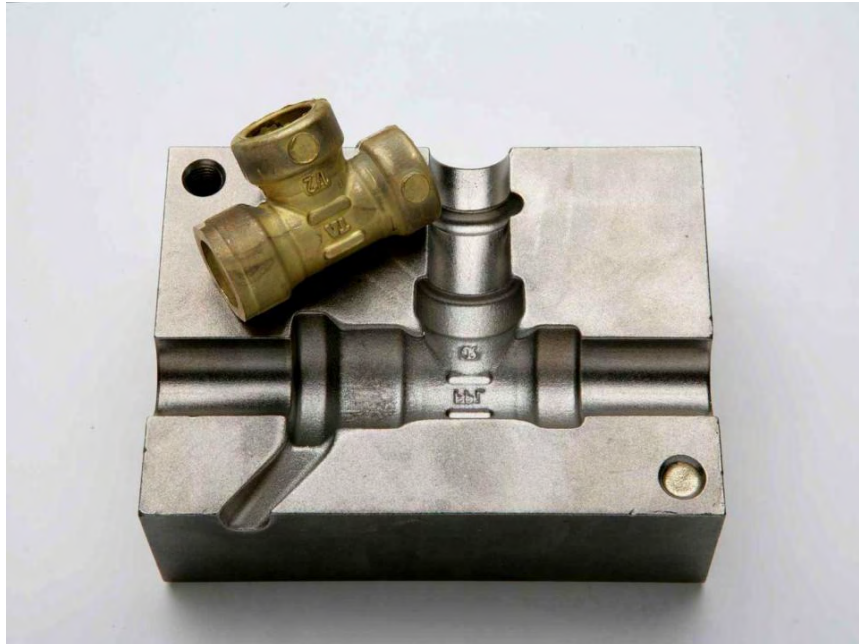


(CrN)PVD-coated die due to chemical attack from the melt. The die produced 80,000 components

TOOLOX 44 in aluminium die-casting



TOOLOX 44 in brass die-casting



Two dies were run simultaneously, one made of QRO 90 and the other of TOOLOX 44. Both dies fulfilled the required service life, i.e. 45,000 shots.

Thank you for your attention!