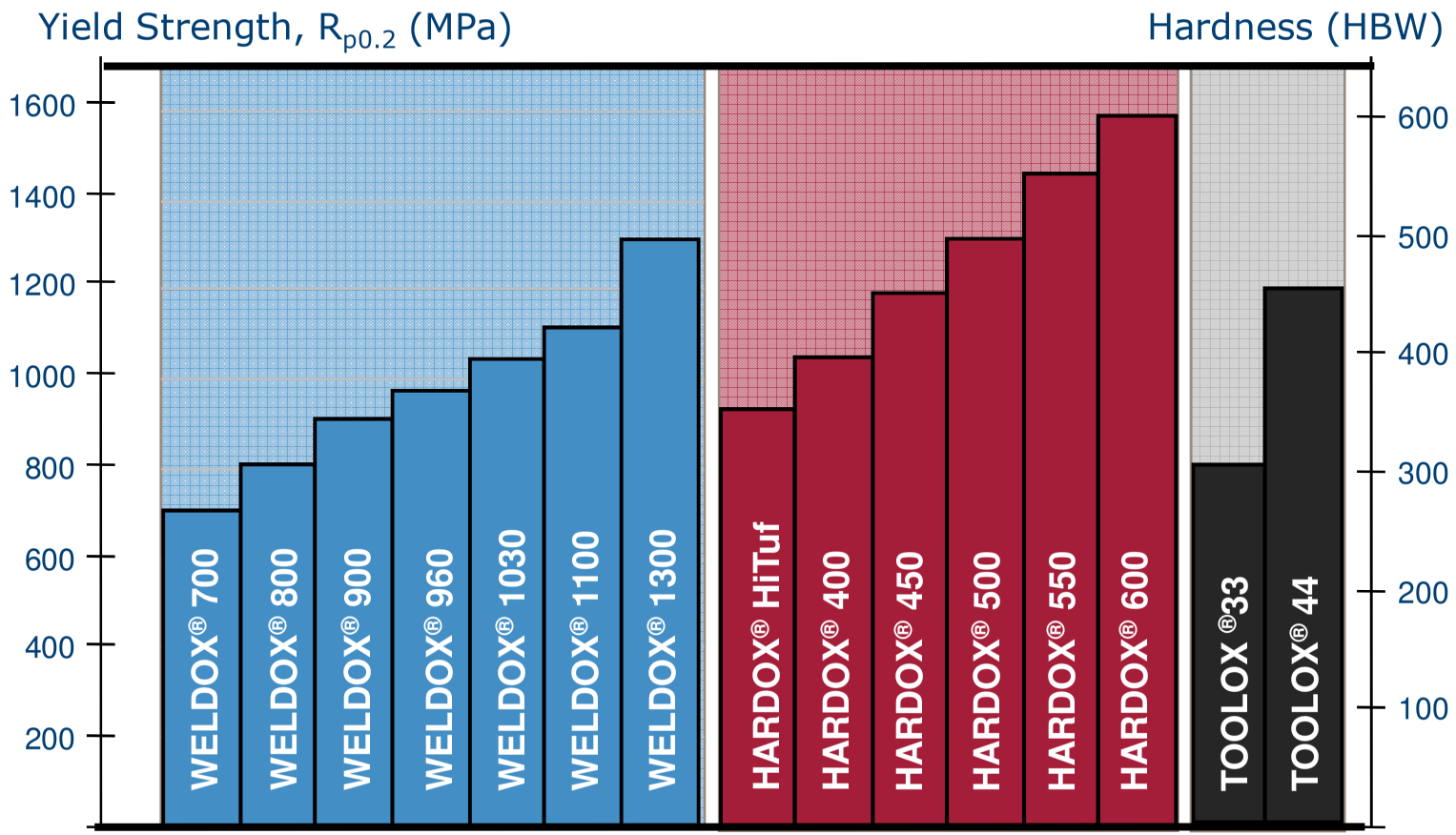
# TOOLOX®

PREHARDENED TOOL STEEL

## TOOLOX in cold-forming 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).

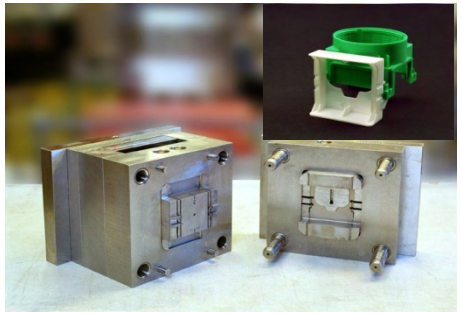
# For direct use…

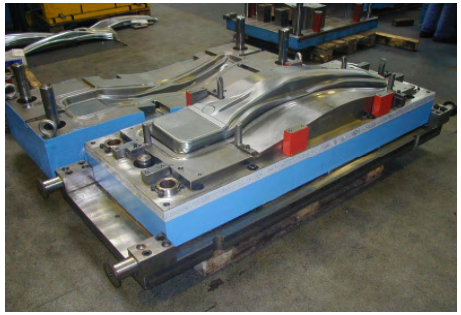
- Hardness and impact toughness,
  *guaranteed and measured on all delivered plates.*
- Tensile properties,
  *measured on all delivered plates, the values are reported for guidance only.*
- Homogeneity,
  *guaranteed and ultrasonic inspected on all delivered plates.*
- Milling properties,
  *are guaranteed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

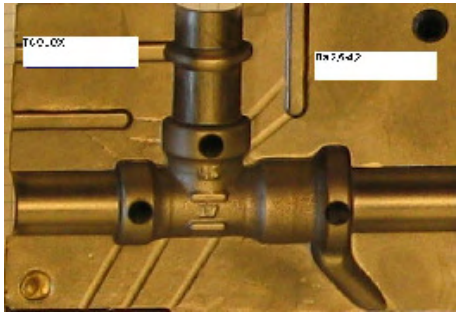
# Benefits…

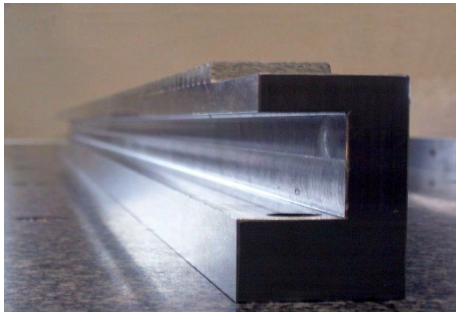
- Faster mould/die manufacturing.
- Known mechanical properties of the mould/die.

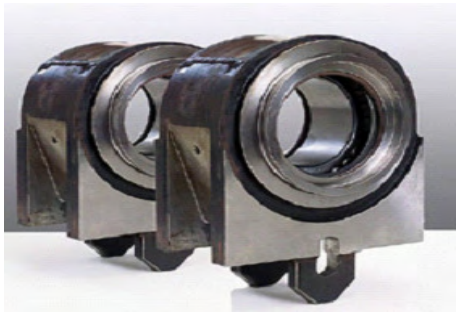
# Application areas…











# 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

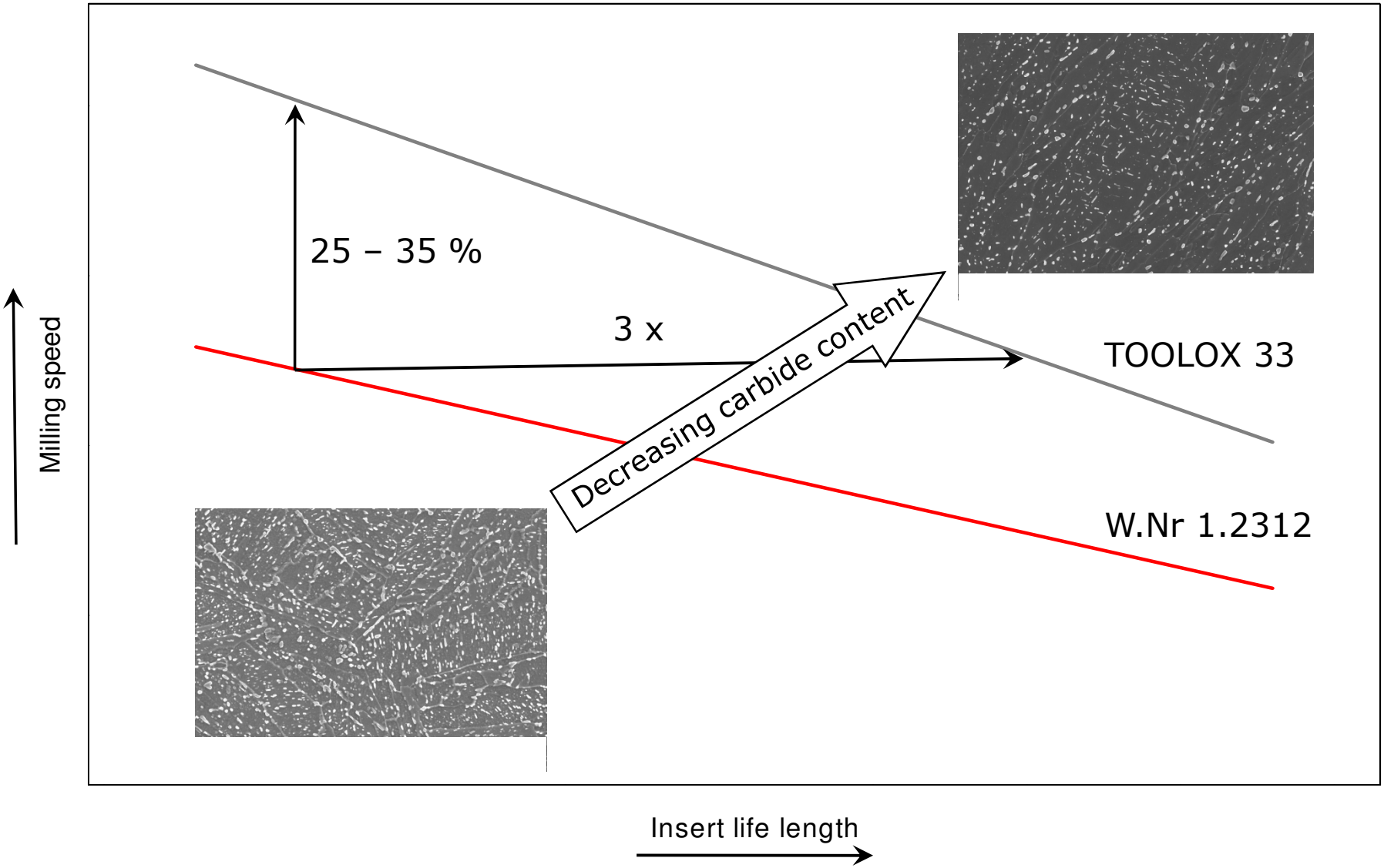
**TOOLOX 44**

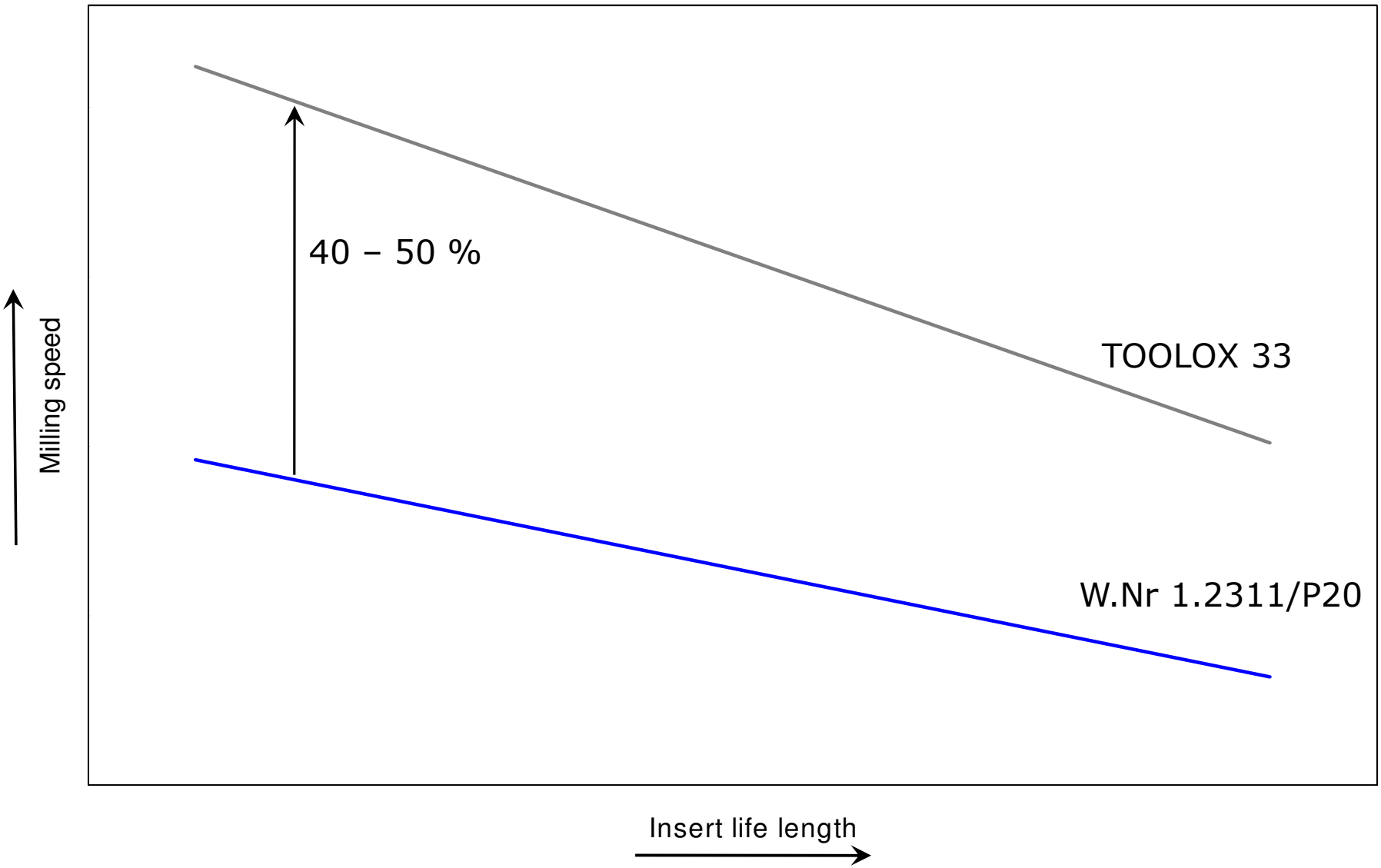
- W.Nr 1.2343 = H11
- W.Nr 1.2344 = H13
- W.Nr 1.2767

- 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

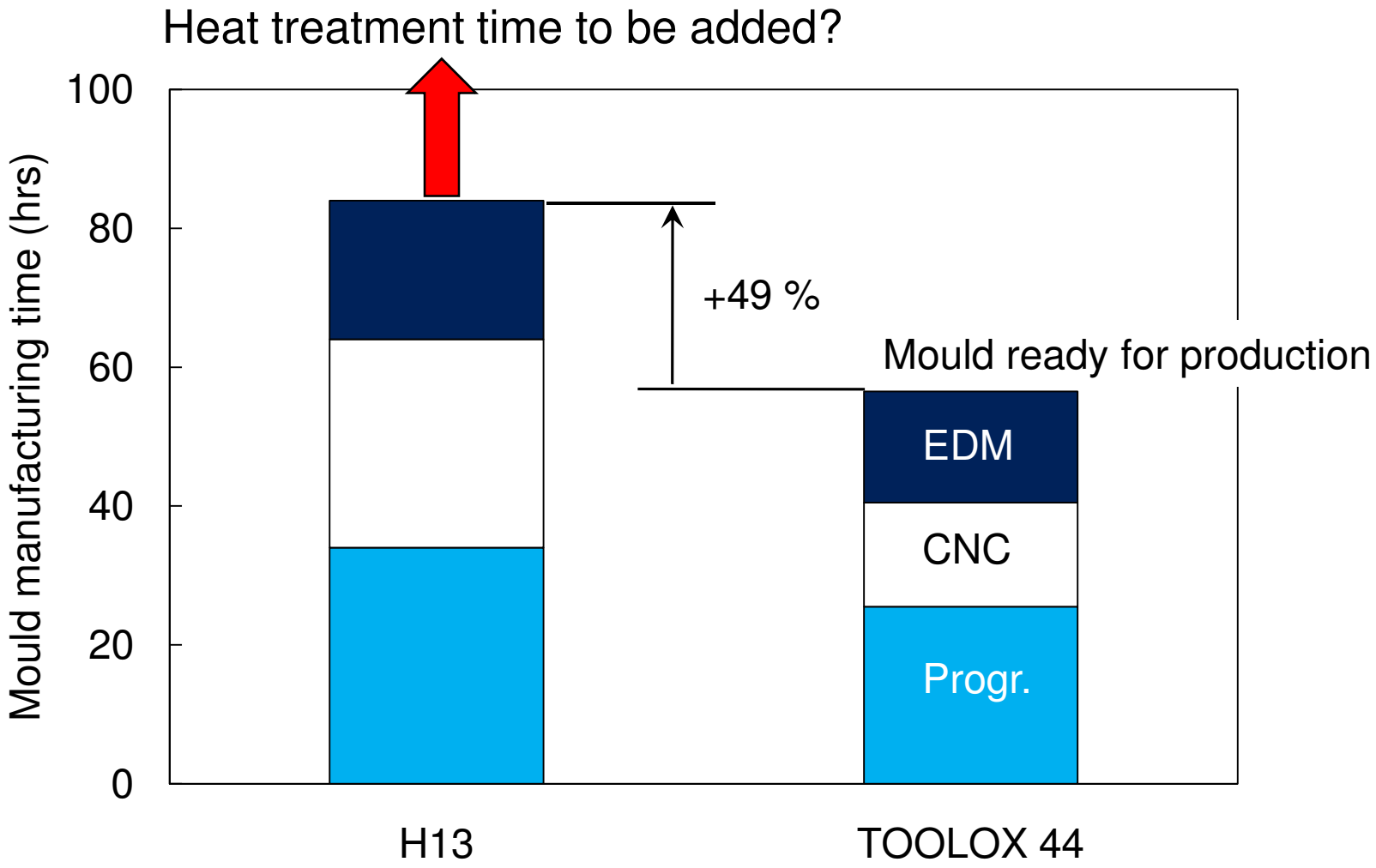
NYBRO STÅLPRODUKTER AB — Kontrollavdelningen
Kund: — Artikel: KUGGSTÅNG
Ritn.nr: 2-621 308 0 — Order.nr: 161323
Date: 03.02.25 — Time: 09:43:25

Uppmätta mått enligt ritning.

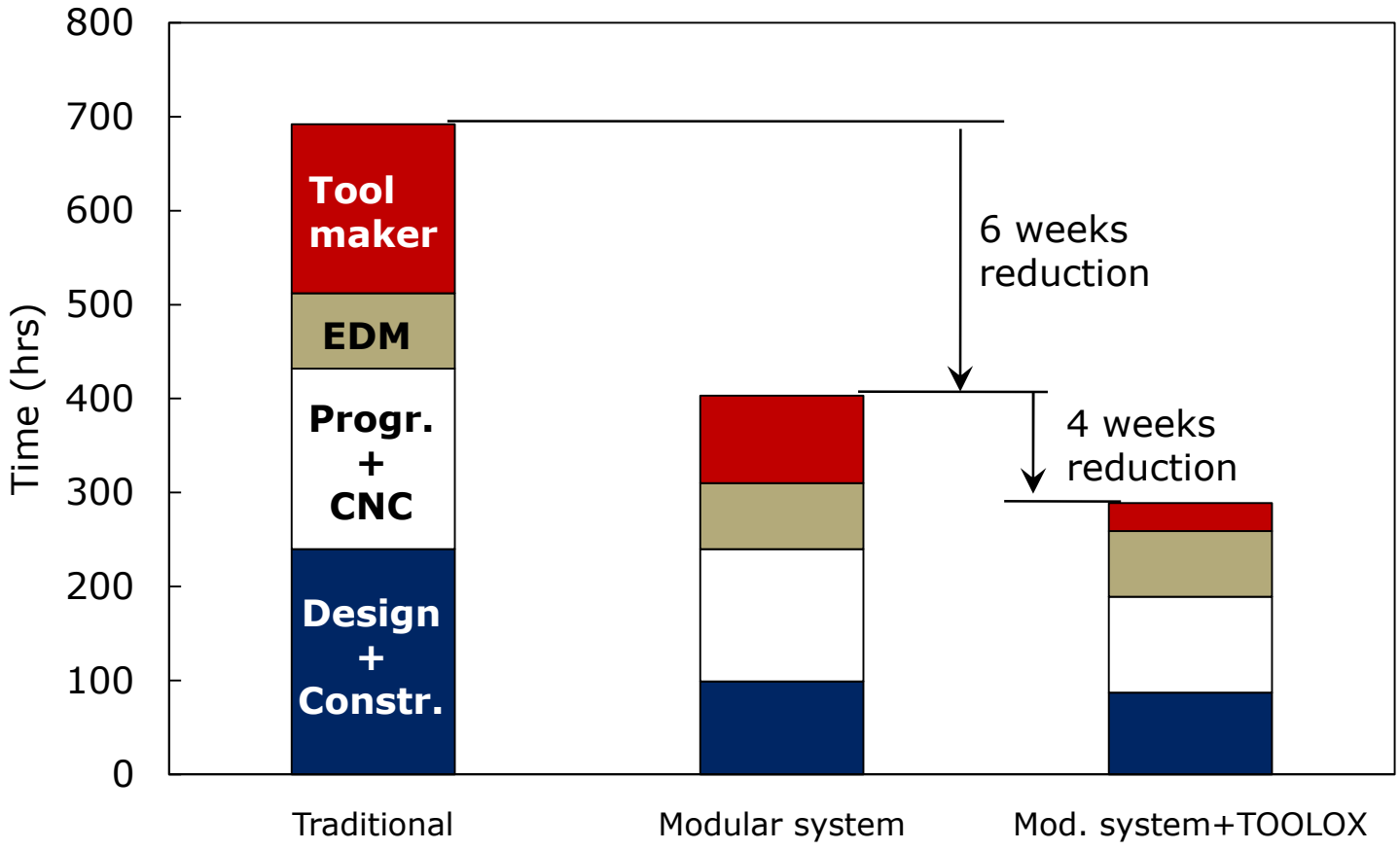
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| # 3 | PLAN | Ref.sys | 1 | | | | |
| | | ÄR | | | | | |
| Planhet | | 0.136 | | | | | |
| # 4 | LINJE | Ref.sys | 1 | | | | |
| | | ÄR | | | | | |
| Rakhet | | 0.004 | | | | | |
| # 5 | PUNKT | Ref.sys | 1 | | | | |
| | | ÄR | BÖR | AVV | ÖT | UT | 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 | |



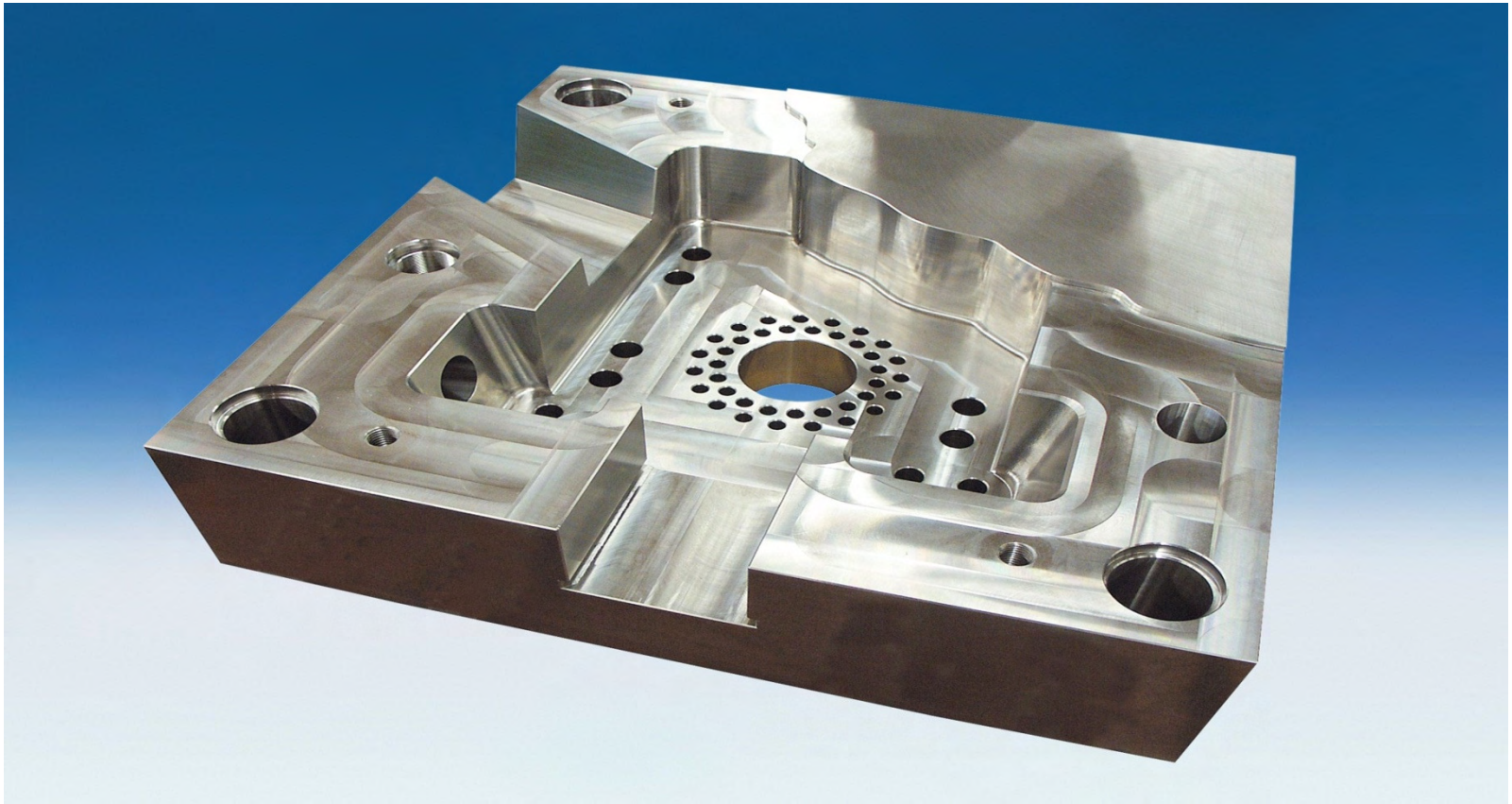
**Tommy Peterson, Stena Stål.** ”To start with flat instead of round material saved a lot of production time. The gear-racks were absolutely straight; 0.004 mm sidewise deflection and 0.136 mm longitudinal deflection on 1.8 m measuring length!”


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 %



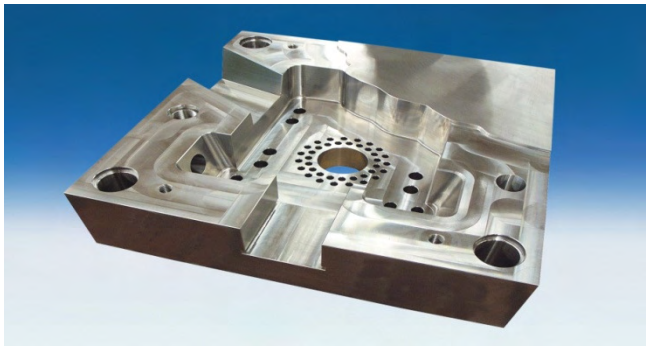
# A cost comparison has been made when manufacturing the component shown below…



| | 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) = ?? €



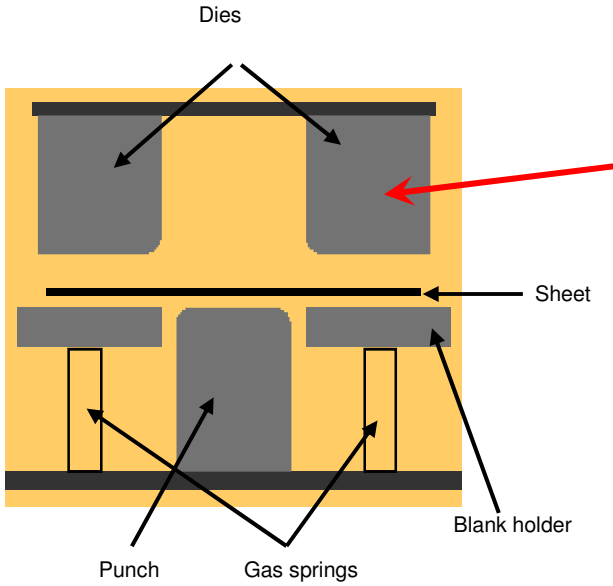
# To conclude…

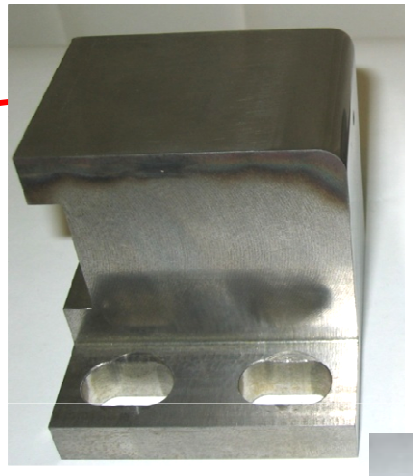
- Better flatness/thickness tolerances means lower material volume to be milled off, and also lower material weight to be bought!
- Faster machining possible!
- Machining in only one (1) set-up!
- No need for heat treatment!
- Shorter grinding time!

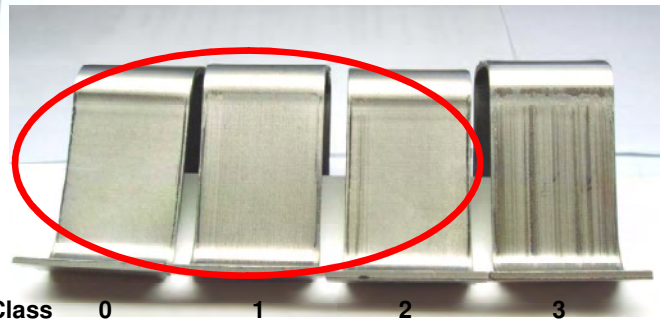
# TOOLOX in cold forming

(Sheet forming, punching, blanking, cutting…)

# Adhesive wear test



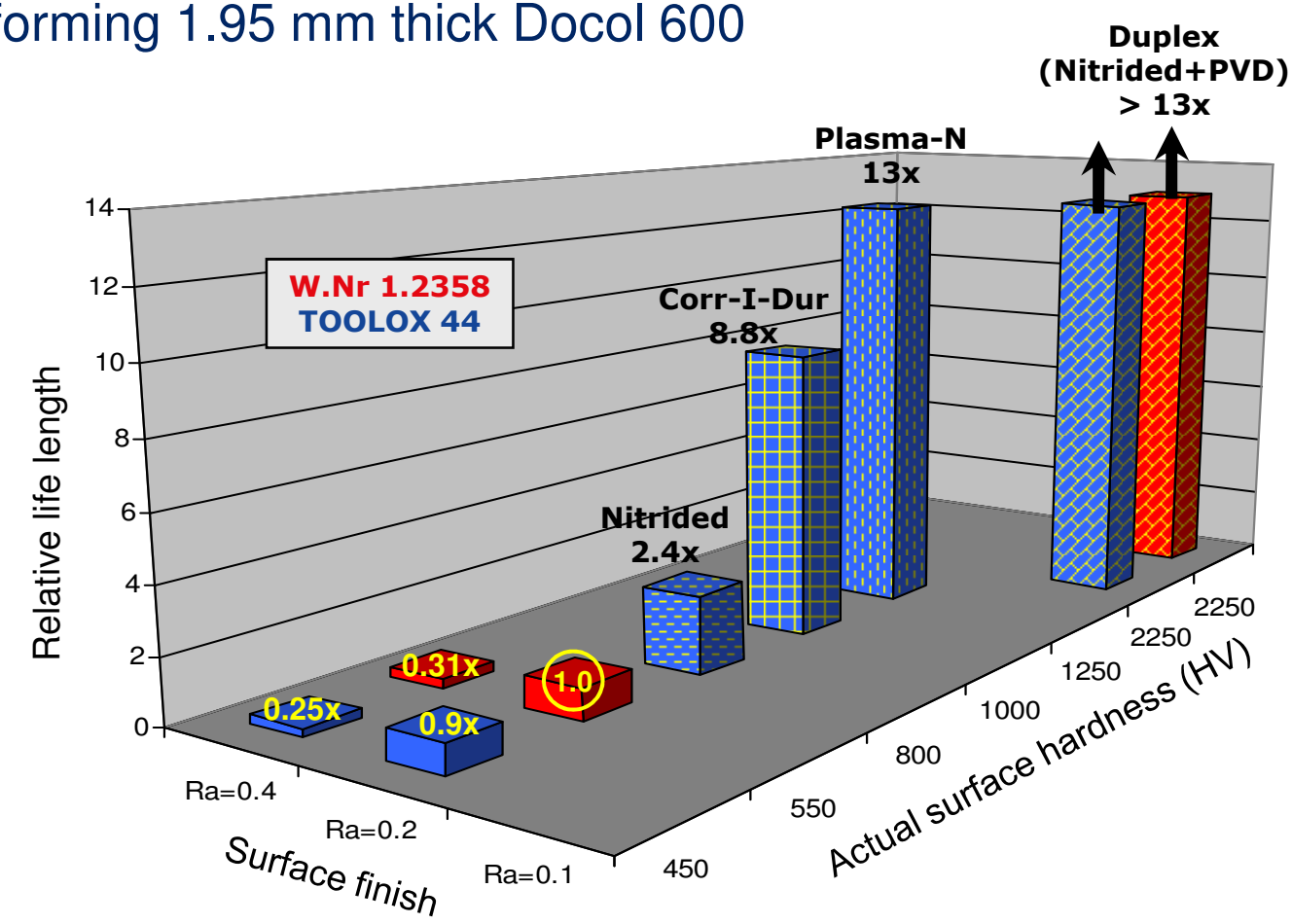





| Class | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| | Good part Not for outer panels | Incipient scratches/ galling | | Scratches cover the entire part: interruption of the test run |

# Test of different surfaces

## When forming 1.95 mm thick Docol 600



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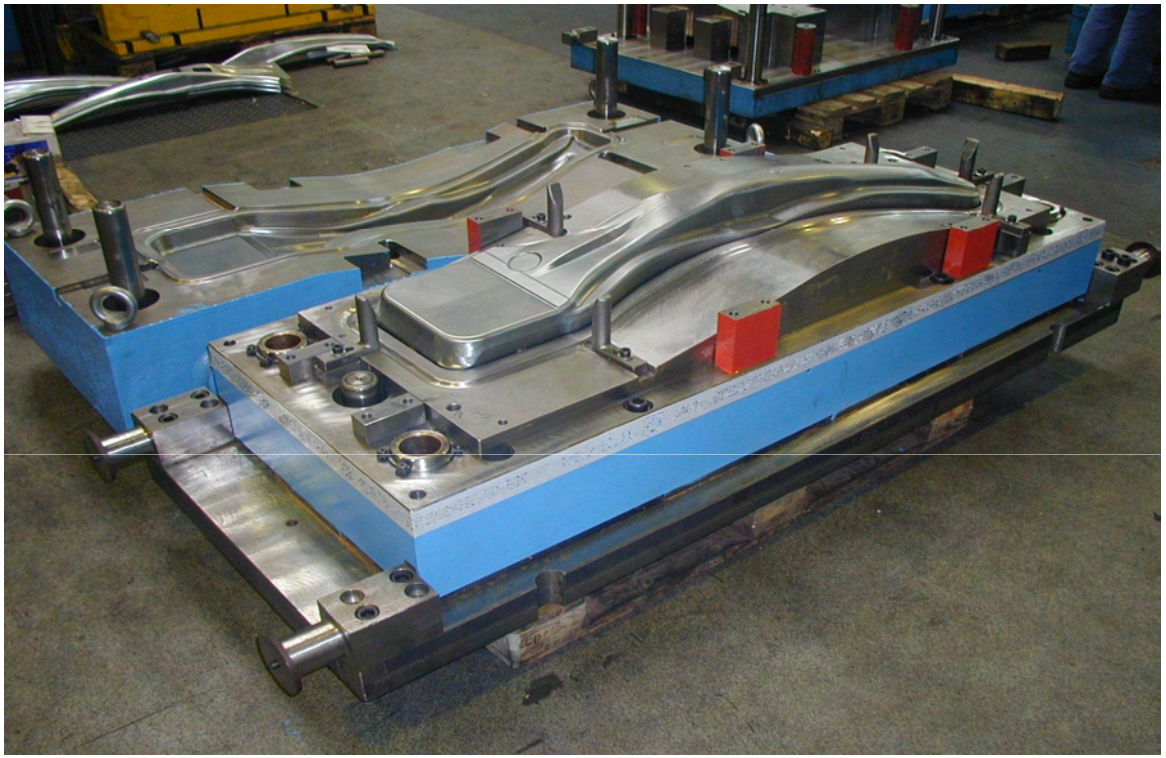
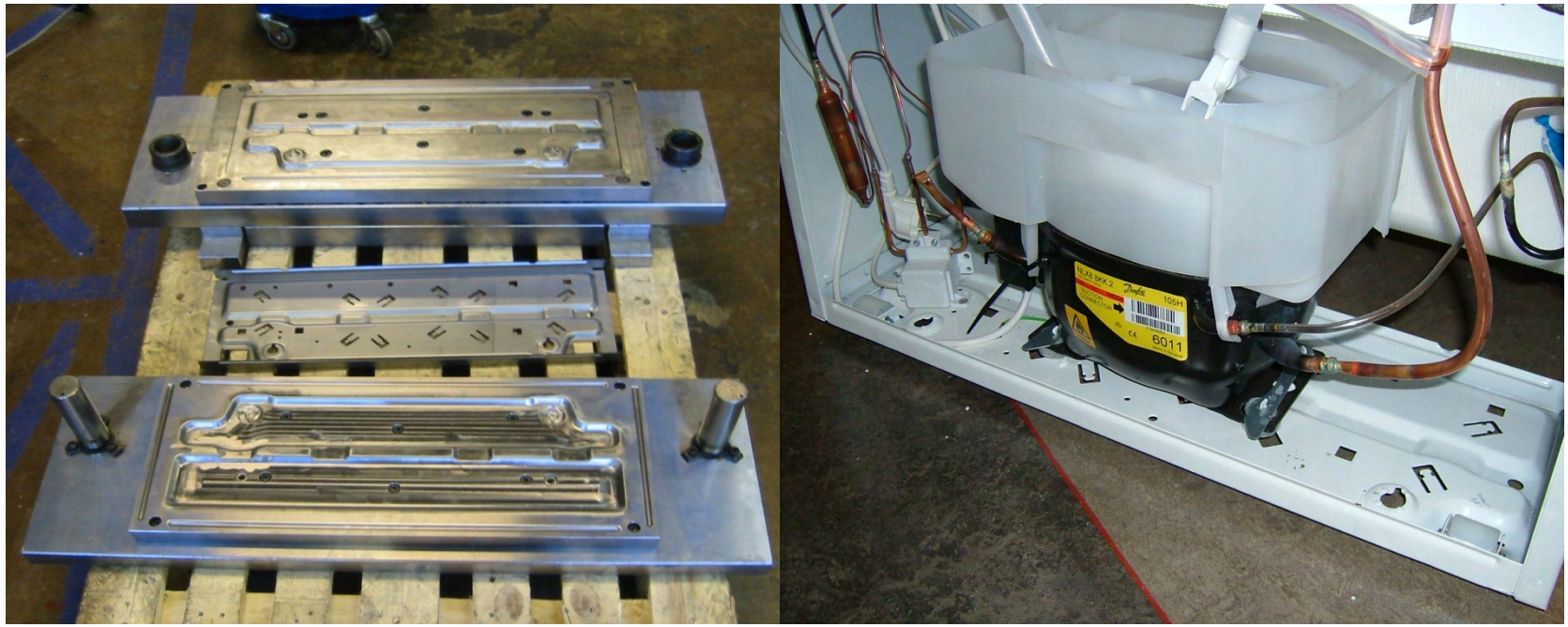
# TOOLOX 33 in a B-pillar press tool



**TOOLOX 33** has substituted W.Nr 1.2379/D2 (58/60 HRC) in a press tool forming 1.8 mm DP 600. Tool manufacturing time was reduced by two weeks due to elimination of the heat treatment process. The tool is designed for production of 80,000 components. The daily production is 80 pillars.

# TOOLOX 44 in a progressive die

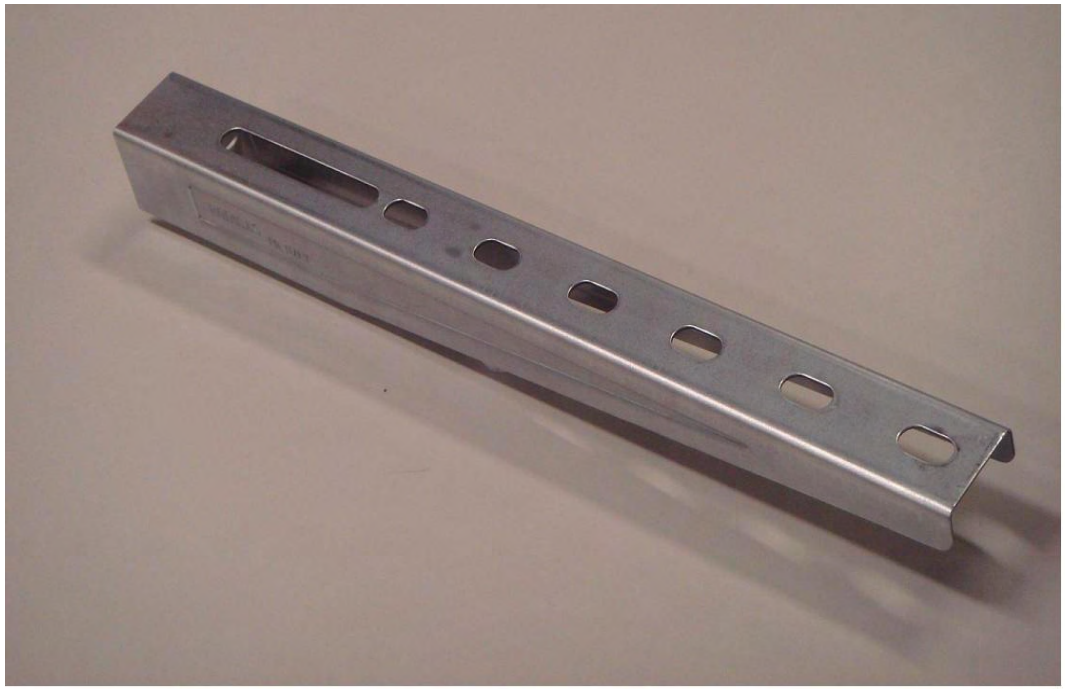


**TOOLOX 44** has substituted W.Nr 1.2363 (60 HRC) in a progressive die set forming 1 mm DP 400. From 2003 until February 2007 has the unit produced more than 1.6 million components, without any visible wear of the die set.

# TOOLOX 44 in a stamping die

**TOOLOX 44** has substituted W.Nr 1.2379/D2 (58/60 HRC) in a stamping die forming 1.8 mm P13 (Italian grade). In as delivered condition, 45 HRC, the die produced 65,000 components between Nov. 2006 and Jan. 2007. Thereafter was it nitrided (58/60 HRC) and another 127,000 components were produced. The normal service life of a 2379(D2)-die is 50-75 % of the TOOLOX-die. Production speed is 44 strokes/minute.

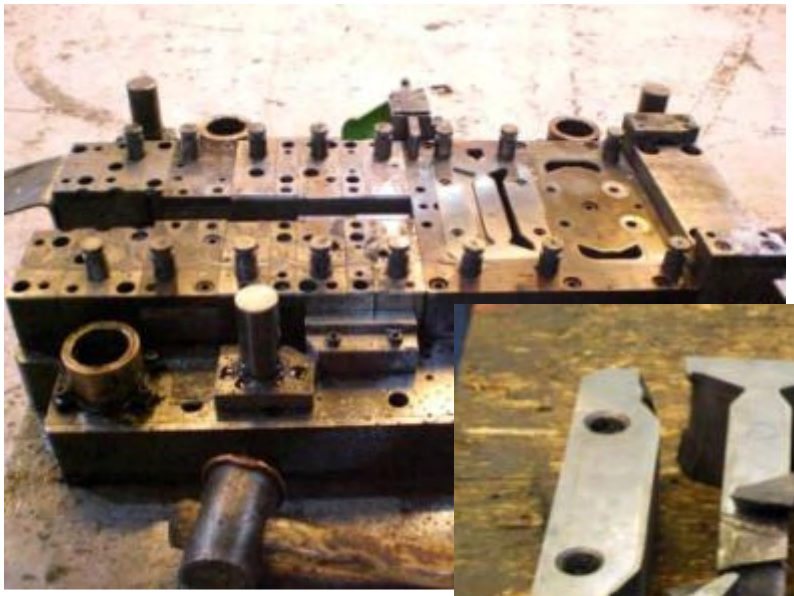
# TOOLOX 44 in forming of galvanized sheet

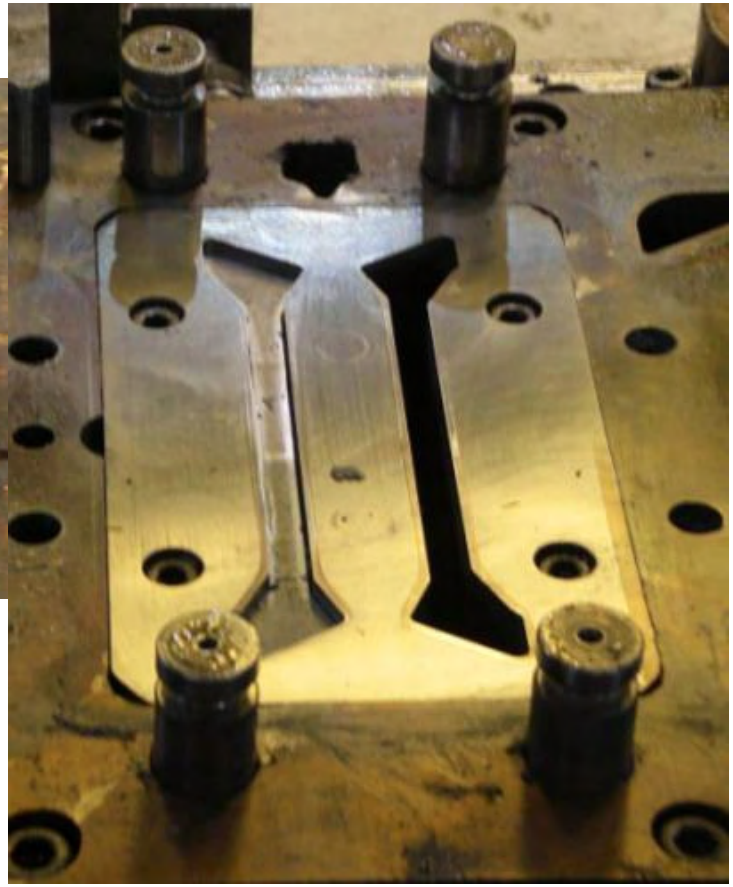


**TOOLOX 44** has substituted W.Nr 1.2379/D2 (58/60 HRC) in forming, cutting and trimming 2 mm thick galvanized mild steel. The TOOLOX-die is reported to last twice as long as W.Nr 1.2379(D2)-material before requiring any maintenance.

# TOOLOX 44, nitrided

Blanking of 3.8 mm 270 MPa sheet





D2 = W.Nr 1.2379

**Result;**

-D2 58-60 HRC; 10,000 blanks
-D2 54-56 HRC; 10,000 blanks
-DC53 (8% Cr steel); 15,000 blanks
-TOOLOX 44, nitrided; >254,000 blanks,
and still in operation...



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# TOOLOX 44 in automotive sheet cutting

| | Sheet thickness (mm) | Surface eng. of knife | Number of cuts | Result |
|---|---|---|---|---|
| Docol 600DP | 1.2 | No | 38,000 | Failed |
| Docol 600DL | 2.0 | No | 24,000 | Failed |
| Docol 600DP | 2.0 | Nitrided | 50,000 | OK |
| Docol 1000DP | 2.0 | Nitrided | 50,000 | OK |

In the test, the cutting edge has to shear 50,000 pieces to fulfil the manufacturers requirements.

# TOOLOX 44 in heavy plate shear blades

Nitrided TOOLOX 44 in cutting of:

- Q&T plate in thicknesses up to 35 mm having $R_m$ up to ~1150 MPa. 8,000 cuts on each edge!

- As-rolled plate in thicknesses up to 25 mm having $R_m$ up to ~950 MPa.

W.Nr 1.2767 was previously used in the knives.

Thank you for your attention!