



**TOOLOX**<sup>®</sup>  
ENGINEERING & TOOL STEEL

# TOOLOX FOR HOT WORK

WEBINAR  
OCTOBER 4, 2022

SSAB

# ***NOW PRESENTING***

**TOOLOX<sup>®</sup>**  
ENGINEERING & TOOL STEEL



**Håkan Engström**

Product Manager Toolox<sup>®</sup>

Sales manager Spain, Portugal, Mexico

[hakan.engstrom@ssab.com](mailto:hakan.engstrom@ssab.com)

[www.toolox.com](http://www.toolox.com)

**SSAB**



**SSAB**



**STRENX™**  
PERFORMANCE STEEL

The high-strength, high-performance steel



**HARDOX®**  
WEAR PLATE

The renowned hard and tough steel for aggressive environments



**DOCOL®**  
THE AUTOMOTIVE STEEL

Safety for automotive



**TOOLOX®**  
ENGINEERING & TOOL STEEL

The premium engineering and tool steel



**ARMOX®**  
PROTECTION PLATE

Hardest steel for maximum protection



**GREENCOAT®**  
COLORFUL STEEL

For harsh weather and greener living



SSAB  
DOMEX / BORON  
FORM / WEATHERING  
LASER® PLUS

Optimized families



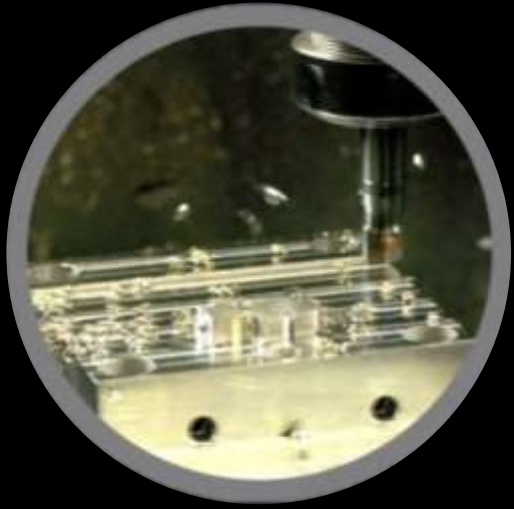
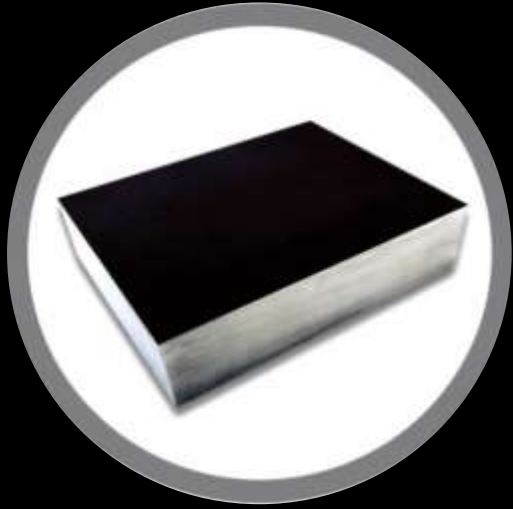
## What is HYBRIT?

In 2016, SSAB, LKAB (Europe's largest iron ore producer) and Vattenfall (one of Europe's largest energy companies) joined forces to create HYBRIT – an initiative that endeavors to revolutionize steelmaking. Using HYBRIT technology, SSAB aims to replace coking coal, traditionally needed for ore-based steelmaking, with fossil-free electricity and hydrogen. The result will be the world's first fossil-free steelmaking technology, with virtually no carbon footprint. Our goal is to reduce Sweden's CO2 emissions by 10% and Finland's by 7%.

[READ MORE](#)



**HYBRIT**  
▶▶ FOSIL-FREE STEEL



## **Commercial heat treatment company**

**“our energy costs only for running the operation  
increased 40 % in 6 months”**



# RISK OF HEAT TREATMENT



				SSAB EMEA AB, SE-613 80 OXELÖSUND, Sweden A01							
Inspection certificate EN 10 204 - 3.1	A02	Issuing department Quality inspection	A05	Purchaser order no SC 93 527 - 232	A07	Our order no 10056586-190	A08	Invoice no	A19	Certificate no and date 17220868 2018-04-10	A03



Purchaser A11 46172  SSAB Oxelösund AB C/O Bvba Thor Shipping & Transport Quay 117-123, Vrieskaaiport 2030 Antwerpen Belgium	Product Tool steel		B01	Marking (Stamping) Manufacturer, MATERIAL ID			B06	Customer marks			B15	
	Quantity	B08	Dimensions [mm]		B09-B11		Weight [kg]	B12	Deliv. Cond.	B04	Internal code	B16
	1		T 66	W 2115	L 5040		5662		Q		20794	
Consignee				A06	Standard/rules			B02				
SSAB Oxelösund AB C/O Bvba Thor Shipping & Transport Quay 117-123, Vrieskaaiport 2030 Antwerpen Belgium					OX Steel grade TOOLOX 44							
MATERIAL ID											B07	
085782-231717												

Chemical composition										C71-C92	Carbon equivalent etc	C93-C99			
Heat no	C	Si	Mn	P	S	Cr	Ni	Mo	V	Ti	Cu	Al	Nb	B	N
085782	.32	1.08	.78	.007	.001	1.32	.05	.778	.138	.013	.02	.013	.016	.002	.005

Testtype	C04	Millcode	C00	Specimen position	C01	Direction	C02	Treatment	B05	Specimen type	C10	Temp [degr C]	C03	Test results			
Impact test (1/4 T)		427234		Tail end		Longitudinal		Delivery condition		Charpy-V 10x10		20		C42 E [J] 26	C42 E [J] 26	C42 E [J] 29	C43 Ave [J] 27
Hardness test (HBW)		427247		Tail end				Delivery condition						C32 Ave 456			
Tensile Test		427250		Tail end		Longitudinal		Delivery condition		Round				C11 Rp0.2 [MPa] 1310	C12 Rm [MPa] 1472	C13 A5 [%] 13	

Ultrasonic testing: Satisfactory results according to:

TOOLSTEEL

	This certificate is produced with EDP and valid without signature	Z02	It is hereby certified that the material described above complies with the requirements of the order.	Z01		A04
	Quality Inspection Department/ A Backlund / S Koekkoek					A22

# PLATES & BARS



**Toolox<sup>®</sup> 33/SM100 - 300 HB**  
**Toolox<sup>®</sup> 44/SM140 - 45 HRC**  
**(TS 46)**

6 – 170 mm



**Toolox<sup>®</sup> 44**  
**(TS 46)**

Ø21 – 405 mm



TOOLOX FORGED BLOCKS - Up to 320 mm thickness

# Toolox® – the premium engineering and tool steel

Many production environments today face pressure to produce better and faster in order to stay competitive. Toolox® rises to these challenges by providing a modern engineering and tool steel of unmatched hardness and toughness.

[PRODUCT PROGRAM](#)[CONTACT SALES](#)[CHAT](#)**SSAB**

Country  ▼

[VIEW DISTRIBUTOR LIST](#)

TOOLOX®  
Engineering & Toolox





## **Baris Yildirim**

Technical Development Manager  
(TDM) of Toolox<sup>®</sup>

Mobile: +46 70 280 74 56

[baris.yildirim@ssab.com](mailto:baris.yildirim@ssab.com)

# Hot Work Applications

- ▶ High Pressure Die Casting (Aluminium, Zink, Brass)
- ▶ Hot Forging
- ▶ Extrusion

# What We Need?

- ▶ Heat Checking Resistance
- ▶ Hot Wear Resistance
- ▶ Toughness



Toolox<sup>®</sup> 33  
300 HB

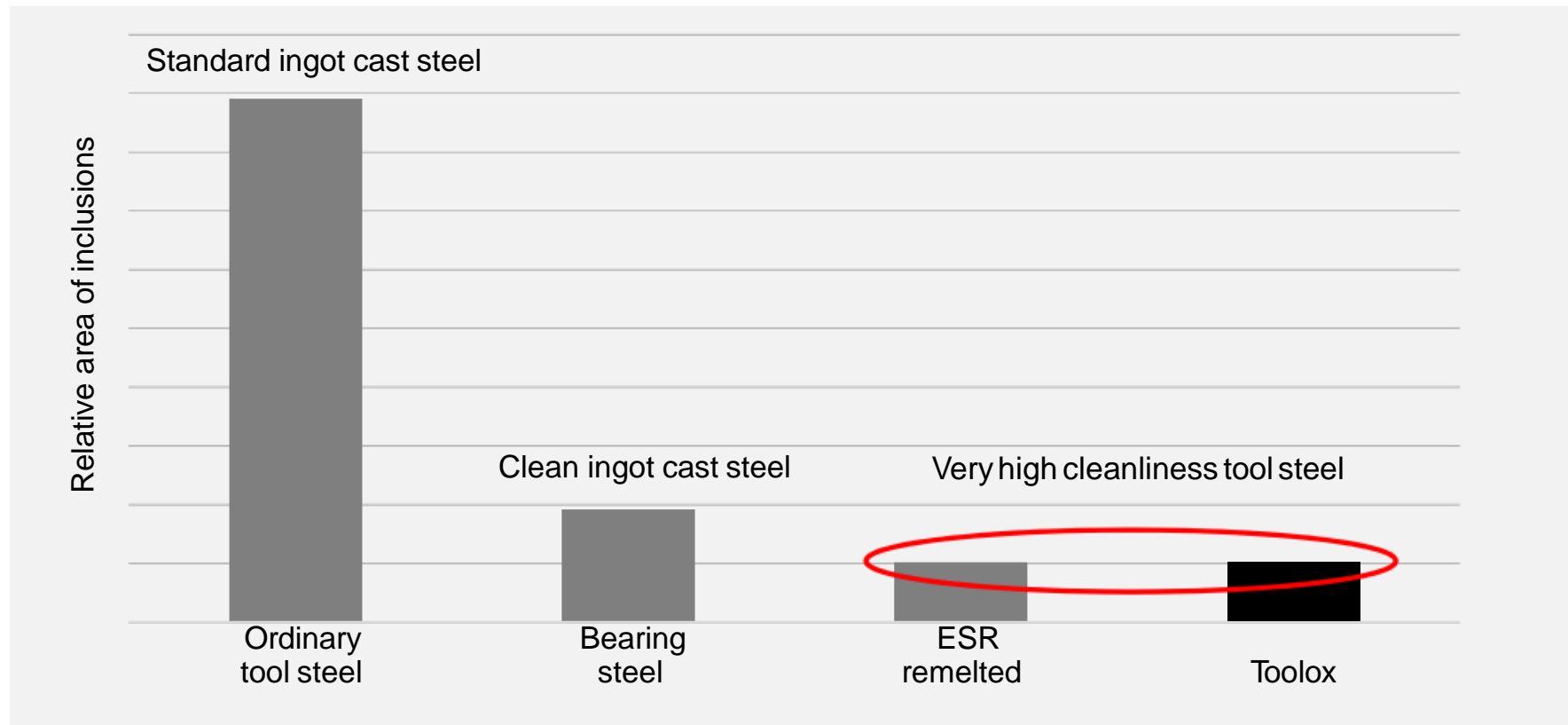
Toolox<sup>®</sup> 44  
45 HRc

TS46

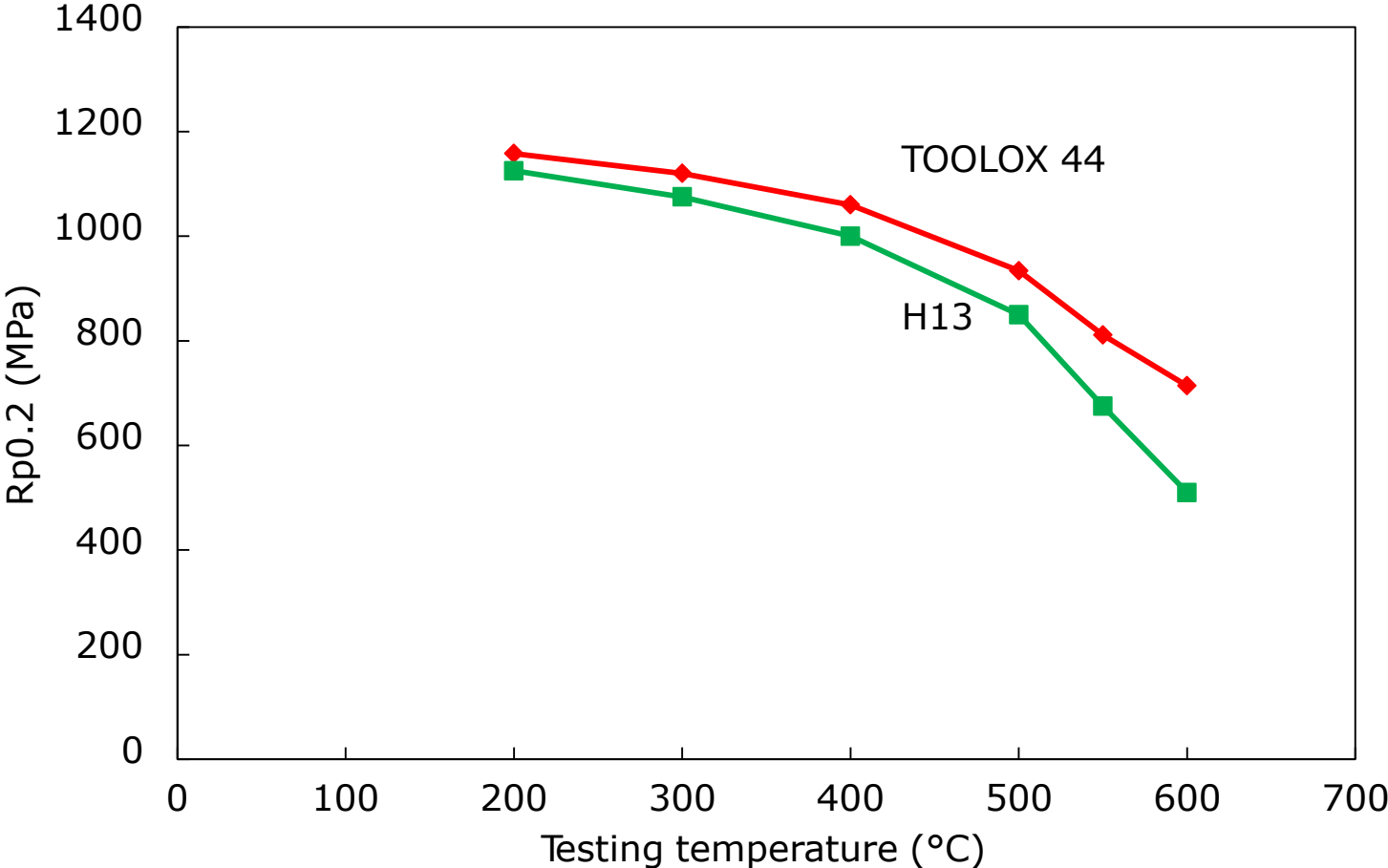
+

Nitriding • PVD • Laser hardening • Induction hardening

## SSAB cleanliness vs Tool & Engineering steel

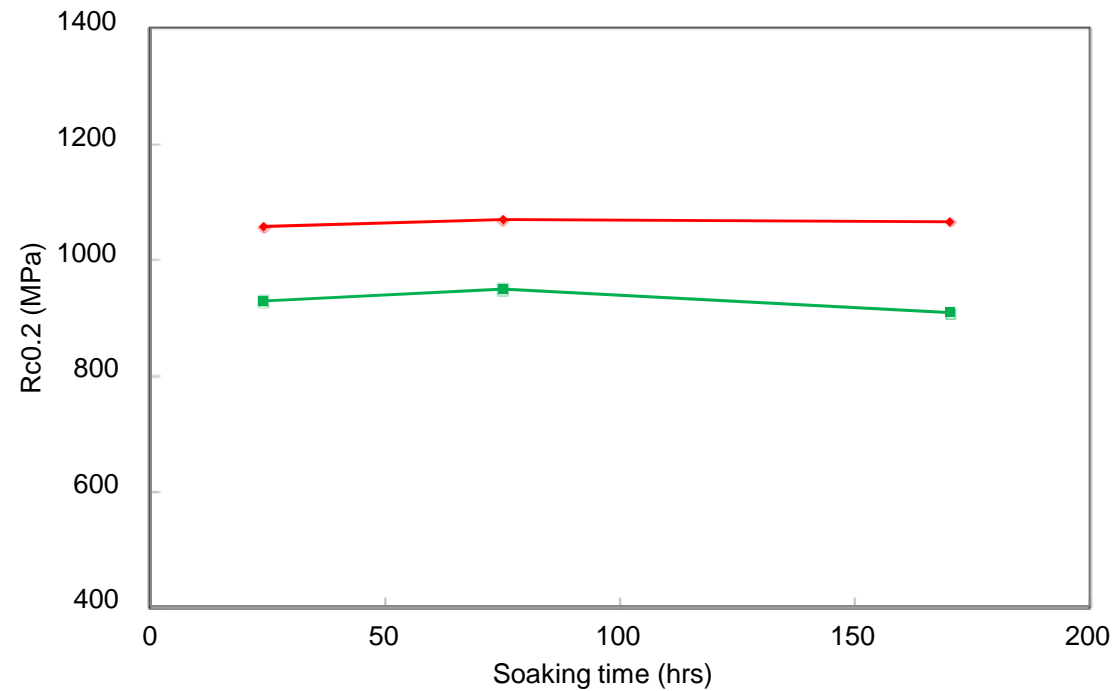


# Yield properties



# Yield properties

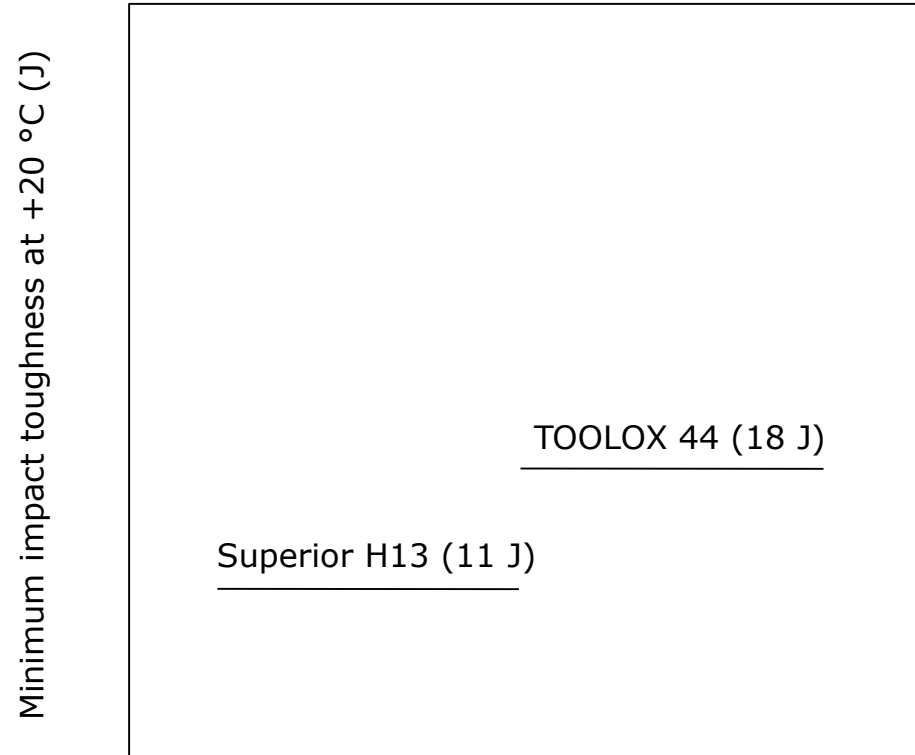
TOOLOX 44 maintains a high yield strength even after extensive temperature testing

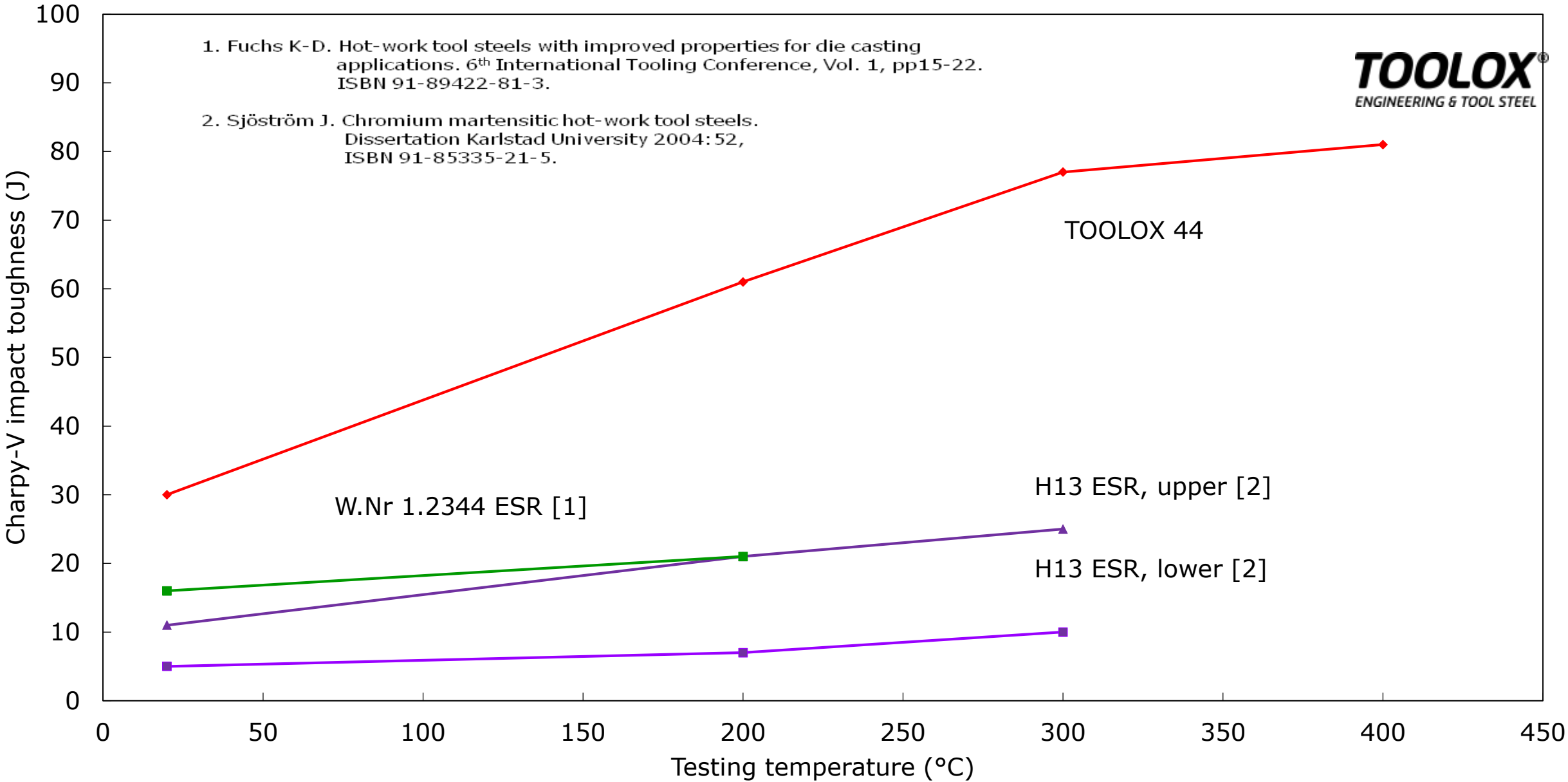


# Toughness

## NADCA #207-2006

Impact toughness requirements on H13 in aluminium die-casting





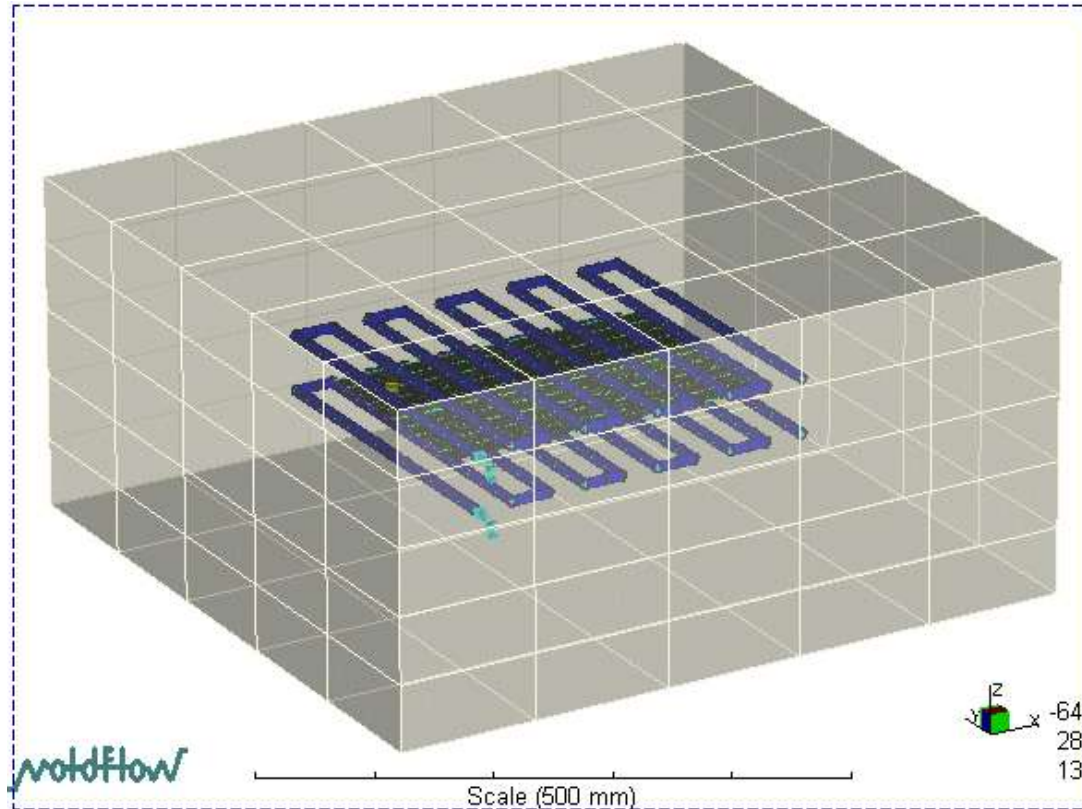
1. Fuchs K-D. Hot-work tool steels with improved properties for die casting applications. 6<sup>th</sup> International Tooling Conference, Vol. 1, pp15-22. ISBN 91-89422-81-3.

2. Sjöström J. Chromium martensitic hot-work tool steels. Dissertation Karlstad University 2004:52, ISBN 91-85335-21-5.

**TOOLOX**<sup>®</sup>  
ENGINEERING & TOOL STEEL

**SSAB**

# Thermal conductivity



Higher mould thermal conductivity will shorten the cooling time.

The analysis shows that a reduction in cycle time due to the increased thermal conductivity of TOOLOX 44 gives 3-5 % shorter cooling time when compared to W.Nr 1.2344 (Q&T to 45 HRC)

Grade	Hardening method	Temp. (C°)	Soaking time (hrs)	Surface hardness (HV <sub>1</sub> )	Hardening depth (mm)
Toolox® 33	Nitro-carburizing in salt bath	580	1.75	790	0.18
	Nitro-carburizing in salt bath	580	1.5	800	0.19
	Gas Nitro-carburizing	580	4	780	0.27
	Gas nitriding	520	12	760	0.23
	Gas nitriding	520	30	720	0.64
	Plasma nitriding	540	8	780	0.55
	Plasma nitriding	540	12	800	0.44
	Plasma nitriding	540	30	810	0.51
Toolox® 44	Nitro-carburizing in salt bath	580	1.5	820	0.18
	Gas Nitro-carburizing	580	4	840	0.27
	Gas nitriding	520	12	750	0.19
	Gas nitriding	520	30	660	0.55
	Plasma nitriding	540	8	840	0.31
	Plasma nitriding	540	12	880	0.28
	Plasma nitriding	540	30	760	0.41



DIE CASTING

# DIE CASTING DIES

## Requirements of die casting dies

Properties	Toolox <sup>®</sup> 44
Heat Checking resistance	As good as H13
Toughness/Crack resistance	Very good
EDM/WEDM Capability	Very good
Weldability	Very good
Thermal Conductivity	Slightly better than H13
Machinability	Good vs H13 (@45HRc)
Nitriding/Oxidation/PVD capability	Very good
Heat treatment risks	No risk



Suitable for cores, cavities, sliding cores, shot sleeves and plungers

## ***NITRIDING AND OXIDATION***

Nitriding very suitable, thanks to high toughness of Toolox

If there is thin cross sections (2-3 mm wall thickness) on the die nitriding doesn't work because of brittle structure. In that case oxidation on every ~15.000 shots could be better solution against sticking problem.

Periodic stress relieving treatment also very important for long service life.

## **DIE CASTING CASE-I**

**TOOLOX<sup>®</sup>**  
ENGINEERING & TOOL STEEL



**Die Material : Toolox<sup>®</sup> 44 + Nitriding.**

**Weight of Aluminium: 8 (part)+5(runners)=13kgs**

**Press: 1200 tons**

**Cycle Time: 94 sec.**

**Current Service Life: 15.000 shots without any failure**



**SSAB**

***BUILDING TRUST***



Toolox<sup>®</sup> 44 + Nitriding

120x700x700 mm

36 cavities

~ 500K shots

Hot wear

**10 x Pieces produced!**

FORGING

# FORGING DIES

## Requirements of forging dies

Properties	Toolox <sup>®</sup> 44
Heat Checking resistance	As good as H13
Toughness/Crack resistance	Higher than H13
EDM/WEDM Capability	Very good
Weldability	Very good
Thermal Conductivity	Slightly better than H13
Machinability	Better than 1.2714Q&T and H13 @45HRc
Nitriding capability	Very good
Heat treatment risks	No risk



”We changed from H13 heat treated to 52-54 HRc to nitrided Toolox<sup>®</sup> 44. Life time increased from 9000 to 21000 pieces.  
Die production cost was kept same”

*Hand tool producer*

---

They introduced Toolox<sup>®</sup> 44 as standard for their forging dies



Toolox® 44		W.Nr 1.2714	W.Nr 1.2344 (H13)
Hardness	410-475 HBW	36 – 42 HRc	(heat treated 45-50 HRc)
Toughness guarantee	Min 11 J @ RT (for Forged block and round bars) Min 18 J @RT (for rolled plates)	None	None
C	0.31	0.55	0.40
Cr	1.35	1.10	5.20
Ni	0.70	1.50	-
Mo	0.80	0.50	1.40
V	0.145	0.10	0.90
P (max)	0.010	0.030	0.030
CE	0.97	1.12	1.96

# FORGING CASE-I



Material	Hardness	Die Life	Failure Mechanism
1.2714	42 HRc	2.000 pcs	Hot wear
1.2344	46-47 HRc	4.500 pcs	Hot wear / Crack
Toolox 44	44 HRc	6.000 pcs	Hot wear /No crack

# FORGING CASE II-III



Chain for tracked vehicle.



Material	Hardness	Die Life	Failure Mechanism
1.2365/1.2367	48-50 HRc	x	Hot wear
Toolox 44 120x260x460 mm	45 HRc	15% higher	Hot wear

Material	Hardness	Die Life	Failure Mechanism
1.2344	47-48 HRc	1.700-2.000 pcs	Hot wear
Toolox 44 Dia260x140mm	45 HRc	1.000 pcs	Hot wear
Toolox44	45 HRc + Nitriding	5.000 pcs	No wear

# FORGING CASE-IV

**Press Type :** Screw Type  
**Work Piece Material:** AISI 1040  
**Tool Size :** 120x120x100 mm (Insert size). It is in 1.2714Q&T Holder as shrink fit



Toolox44



1.2367

Material	Hardness	Service Life	Failure
1.2367	50 HRc	1.200 pcs	Cracking
Toolox44	45 HRc	2.500 pcs	Hot wear

# ALUMINIUM EXTRUSION

# EXTRUSION DIES

## Requirements of extrusion dies

Properties	Toolox <sup>®</sup> 44
Heat Checking resistance	As good as H13 EFS
Toughness/Crack resistance	Higher than H13/H11 ESR
EDM/WEDM Capability	Very good
Nitriding capability	Very good
Heat treatment and its risk	No risk
Surface quality	Better than H13/H11 EFS



# EXTRUSION CASE-I



Dia 220 x 40 mm



Aluminium Alloy	6063
Billet Temperature	555°C
Toolox 44 Die Life	21 tons
1.2344 Die Life	16 tons

(All dies are nitrided condition)

***TOOLOX***<sup>®</sup>

***ENGINEERING & TOOL STEEL***