

Toolox[®] 33, 40, 44 and 46

Engineering and tool steel

Typical values

Toolox [®] 33 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		310	300	290	270	
Hardness (HRC)		~30	~29	~29	~26	
Yield strength $R_{p0.2}$ (MPa)		850	690	680	590	560
Tensile strength R_m (MPa)		970	900			
Elongation, A5, (%)		16	12			
Reduction of Area Z (%)		55				
Impact toughness, Charpy-V (J)	41	100	170	180	180	

Toolox [®] 40 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		400				
Hardness (HRC)		~40				
Yield strength $R_{p0.2}$ (MPa)		1150	1010	990	900	780
Tensile strength R_m (MPa)		1290	1170	1160	1060	900
Elongation, A5, (%)		14	14	14	15	16
Impact toughness, Charpy-V (J)	18	38				

Toolox [®] 44 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		435	440	415	380	345
Hardness (HRC)		~45	~44	~42	~38	~35
Yield strength $R_{p0.2}$ (MPa)		1300	1150	1040	980	825
Tensile strength R_m (MPa)		1405	1340	1270	1190	1010
Elongation, A5, (%)		13	10	12	14	19
Reduction of Area Z (%)		35				
Impact toughness, Charpy-V (J)	13	30	60	80	80	

Typical values

Toolox® 46 - Mechanical Properties	-20°C	+20°C	+300°C	+400°C	+500°C	+600°C
Hardness (HBV)		470	420	380	335	235
Hardness (HRC)		~47				
Yield strength RP0.2 (MPa)		1370	1170	1080	900	580
Tensile strength RM (MPa)		1575	1390	1290	1110	780
A5 (%)		10	12	15	17	28
Impact toughness Charpy V (J) (Thickness 10 mm)	10	14	17			
Impact toughness unnotched (J) (thickness 7.5 mm)		335				

Thermo Physical Properties	+20°C			+200°C			+400°C		
	Toolox® 33	Toolox® 44	Toolox® 46	Toolox® 33	Toolox® 44	Toolox® 46	Toolox® 33	Toolox® 44	Toolox® 46
Heat conductivity (W/m*K)	32	28	26	34	30	29	32	29	29
Thermal expansion coefficient (10 ⁻⁶ /K)	11.01	11.04	10.59	12.81	12.45	12.29	14.57	14.17	14.1

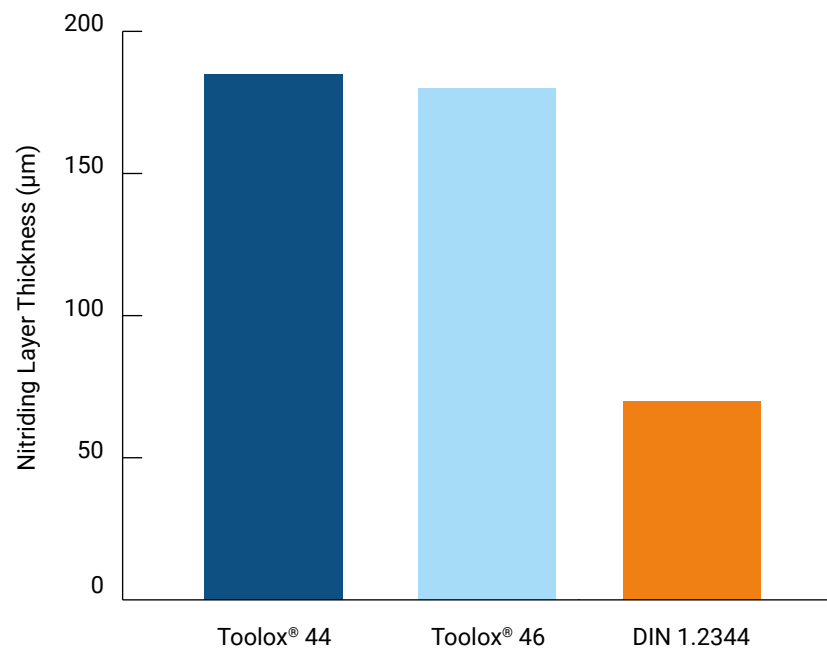
Inclusions			
	Toolox® 33	Toolox® 40	Toolox® 44
Inclusion size (equiv. diam.)	6 micron	6 micron	6 micron
Area fraction	0.015%	0.015%	0.015%
Aspect Ratio	1.2	1.2	1.2

Typical chemical composition	Toolox® 33	Toolox® 40	Toolox® 44	Toolox® 46
C	0.23%	0.28%	0.32%	0.34%
Si	1.1%	1.1%	0.9%	1.1%
Mn	0.8%	0.8%	0.8%	0.8%
P	Max 0.011%	Max 0.011%	Max 0.011%	Max 0.011%
S	Max 0.003%	Max 0.003%	Max 0.003%	Max 0.003%
Cr	Max 1.60%	Max 1.60%	Max 1.70%	Max 2.1%
Mo	Max 0.80%	Max 0.80%	Max 1.40%	Max 2.6%
V	Max 0.12%	Max 0.12%	Max 0.17%	Max 0.2%
Ni	Max 1.0%	Max 1.0%	Max 1.4%	Max 1.8%
CEIIW	0.65 (Max 0.69)	0.65 (Max 0.69)	0.96 (Max 1.00)	1.29 (Max 1.5)
CET	0.39 (Max 0.42)	0.39 (Max 0.42)	0.57 (Max 0.60)	0.74 (Max 0.8)

Surface hardening

Surface hardening such as nitriding, laser and PVD can be done with excellent results.

Nitriding Performance of Toolox® 44, Toolox® 46 and 1.2344



Process parameters

Nitriding Type:
Nitrocarburization

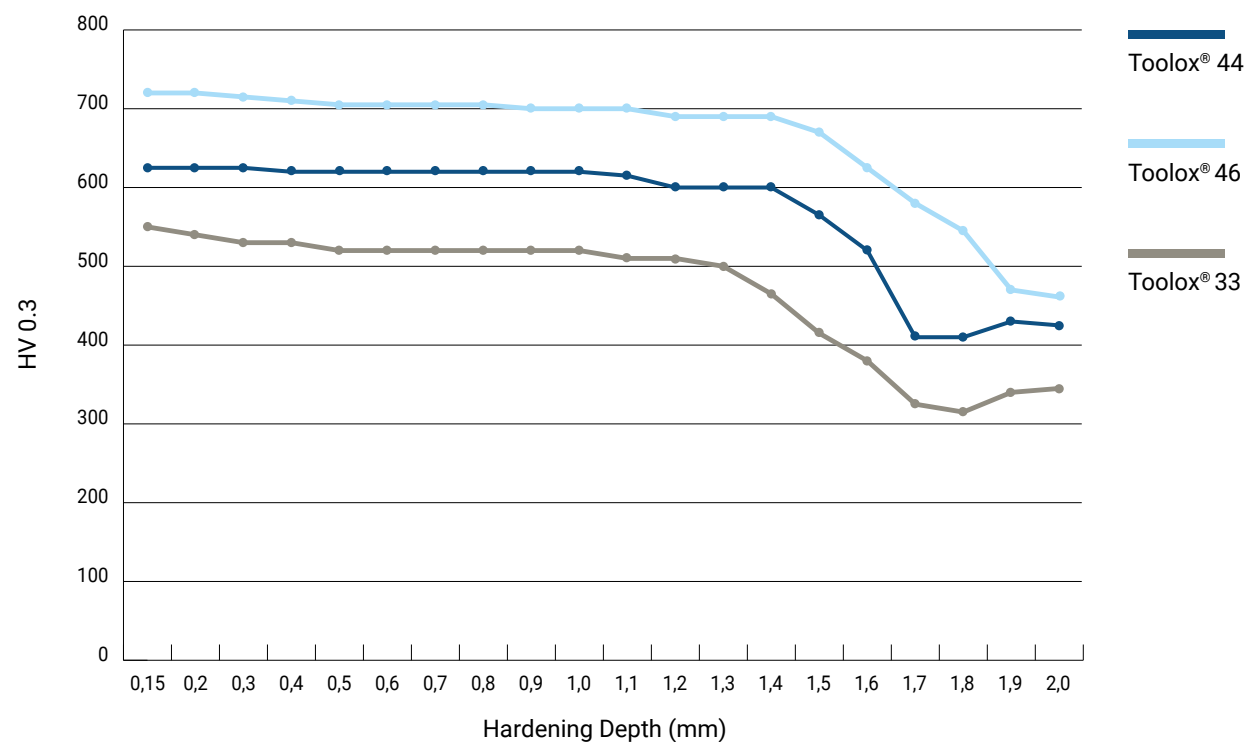
Process Temperature:
565 °C

Process Time:
4 hours (holding time)

Process Gases:
NH₃ and 5% CO₂
Pre Oxidation process
applied as well.

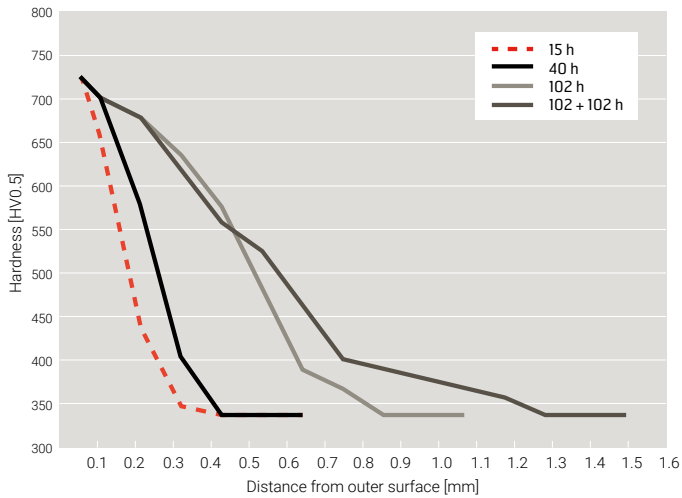
- **Toolox® 44**
Surface Hardness 950 HV
Core Hardness 435 HV
- **Toolox® 46**
Surface Hardness 900 HV
Core Hardness 440 HV
- **DIN 1.2344**
Surface Hardness 950 HV
Core Hardness 535 HV

Laser Hardening

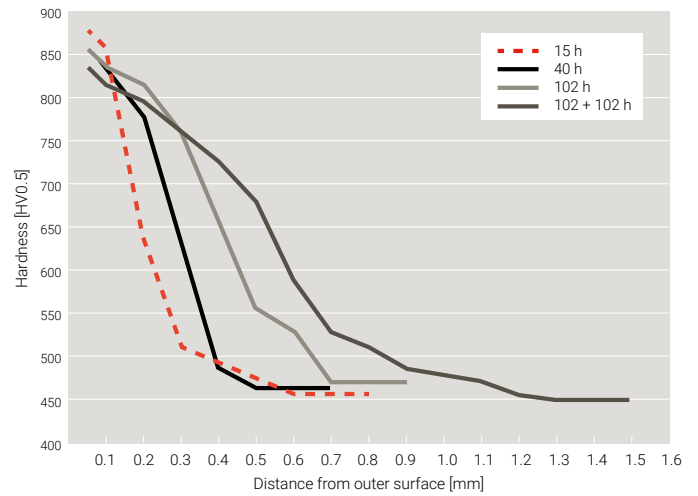


Surface technology

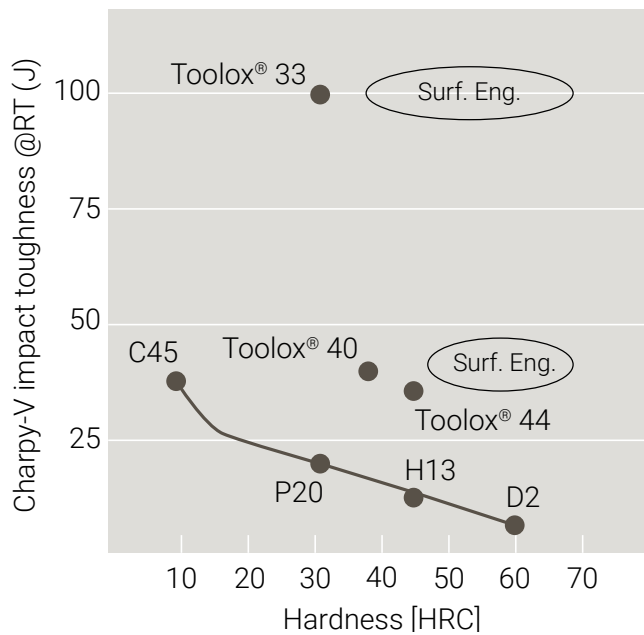
Gas nitriding of Toolox® 33



Gas nitriding of Toolox® 44



Hard and tough



Contact and more information

Contact your local sales representative to learn more, visit www.toolox.com or consult Tech Support at: help@ssab.com.

TOOLOX®
ENGINEERING & TOOL STEEL