

Hardened tool steel for plastic molds and machine parts. Excellent for polishing and etching, processing 20-25% faster than 1.2312. Originally developed as a plastic mold steel, Toolox® 33 has gained popularity in tool and machinery construction due to its toughness, minimal distortion, ease of machining, and high strength.

Toolox® 33 is also used for slide guides and wear plates with a nitrided surface. For precision components, its unique dimensional stability and size consistency are appreciated, even when the application does not strictly require hardening. Toolox® 33 is surprisingly easy to machine without the addition of sulfur, which could compromise its excellent toughness.

As a result, Toolox® 33 completely replaces 1.2312, surpassing or at least matching it in virtually all technical properties. Nitriding treatment or PVD coating is easily achievable, and further heat treatment is unnecessary and not recommended. If higher hardness or strength is required, we recommend Toolox® 44.

As an 'Approved Dealer,' Gebr. Recknagel is the authorized sales partner for the Swedish manufacturer SSAB in Germany.

Color coding:

Grey (Toolox® 33)



| | |
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TOOLOX® 33



PräziPlan® - Precision flat steel (according to DIN 59350)

Specifications:

Hardened to approximately 860-1,010 MPa, hardness 275-325 HB, Thickness ground with Ra = 6 µm, width finely machined, Decarburization-free machining on all sides

Tolerances:

width: +0.2 / -0 mm
thickness: +0.2 / -0 mm
length: +40.0 / -0 mm



length: 1,000 mm price per piece

| | | thickness [mm] | | | | | | | | | | | | | | | | | |
|------------|-------|----------------|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | | 4.2 | 5.2 | 6.2 | 8.2 | 10.4 | 12.4 | 15.4 | 16.4 | 20.4 | 25.4 | 30.4 | 32.4 | 40.4 | 50.4 | 60.4 | 70.4 | 80.4 | 100.4 |
| width [mm] | 20.3 | 15 | 17 | 19 | 20 | 22 | 25 | 26 | | | | | | | | | | | |
| | 25.3 | 17 | 18 | 20 | 22 | 24 | 27 | 31 | 33 | 35 | | | | | | | | | |
| | 30.3 | 18 | 20 | 22 | 24 | 26 | 29 | 33 | 36 | 40 | 52 | | | | | | | | |
| | 32.3 | | | 23 | 25 | 28 | 31 | 36 | 39 | 43 | 58 | | | | | | | | |
| | 40.3 | 21 | 23 | 25 | 28 | 31 | 35 | 39 | 43 | 48 | 61 | 68 | | | | | | | |
| | 50.3 | 24 | 27 | 29 | 31 | 36 | 39 | 46 | 51 | 56 | 65 | 76 | 80 | 92 | | | | | |
| | 60.3 | 27 | 29 | 31 | 36 | 39 | 46 | 51 | 58 | 66 | 69 | 82 | 87 | 96 | 115 | | | | |
| | 63.3 | 28 | 30 | 35 | 39 | 42 | 48 | 55 | 59 | 71 | 76 | 89 | 89 | 99 | 119 | | | | |
| | 70.3 | 30 | 33 | 36 | 41 | 47 | 52 | 61 | 63 | 73 | 83 | 94 | 101 | 105 | 128 | 146 | | | |
| | 80.3 | 32 | 37 | 40 | 47 | 52 | 57 | 69 | 73 | 78 | 90 | 104 | 109 | 118 | 159 | 175 | 204 | | |
| | 100.3 | 36 | 42 | 48 | 54 | 58 | 65 | 81 | 86 | 95 | 107 | 123 | 131 | 155 | 180 | 208 | 219 | 257 | |
| | 120.3 | | | | | | | 96 | | 114 | 131 | 155 | 165 | 179 | 201 | 212 | 243 | 324 | |
| | 125.3 | | | 60 | 66 | 73 | 84 | 103 | 107 | 123 | 148 | 158 | 169 | 182 | 205 | 215 | 246 | 326 | |
| | 150.3 | | | 66 | 72 | 81 | 93 | 112 | 121 | 138 | 160 | 183 | 191 | 221 | 251 | 297 | 342 | 409 | 527 |
| | 200.3 | | | 86 | 101 | 119 | 140 | 167 | 190 | 193 | 217 | 246 | 263 | 305 | 365 | 428 | 490 | 526 | 594 |
| 220.3 | | | | | 128 | 150 | 181 | 205 | 216 | 239 | 274 | 297 | 324 | 389 | 472 | 527 | 582 | 655 | |
| 250.3 | | | | | 136 | 159 | 195 | 219 | 238 | 261 | 301 | 331 | 342 | 413 | 516 | 563 | 638 | | |
| 300.3 | | | | | 163 | 183 | 228 | 234 | 269 | 297 | 342 | 367 | 391 | 475 | 553 | 620 | 678 | | |
| 400.3 | | | | | 234 | 268 | 326 | 345 | 359 | 407 | 454 | 504 | 521 | 626 | 730 | | | | |
| 500.3 | | | | | 292 | 334 | 407 | 431 | 449 | 495 | 569 | 626 | 647 | 740 | 917 | | | | |

square, length 1,000 mm price per piece

| | 10.4 | 12.4 | 15.4 | 16.4 | 20.4 | 25.4 | 30.4 | 32.4 | 40.4 | 50.4 | 60.4 | 70.4 | 80.4 | 100.4 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| | 22 | 24 | 31 | 33 | 37 | 47 | 68 | 70 | 82 | 110 | 136 | 159 | 225 | 324 |

We provide custom versions quickly and affordably!

EcoPlan® 150 / 400 / 800 Precision flat steel
(according to DIN 59350) in cost-effective short lengths

Specifications:

Hardened to approximately 860-1,010 MPa, hardness 275-325 HB, Precision machining without decarburization on all sides, including length

Tolerances:

width: +0.2 / -0 mm
thickness: +0.2 / -0 mm
length: +0.4 / -0 mm

length: 400.3 mm

price per piece

| 400 | | thickness [mm] | | | | | | | | | | | |
|------------|-------|----------------|------|------|------|------|------|------|------|------|------|------|-------|
| | | 8.4 | 10.4 | 12.4 | 15.4 | 20.4 | 25.4 | 30.4 | 40.4 | 50.4 | 60.4 | 80.4 | 100.4 |
| width [mm] | 20.3 | 14 | 15 | 16 | 18 | 19 | | | | | | | |
| | 25.3 | 15 | 15 | 17 | 20 | 21 | 23 | | | | | | |
| | 30.3 | 16 | 16 | 18 | 21 | 22 | 23 | 30 | | | | | |
| | 40.3 | 17 | 17 | 20 | 24 | 25 | 27 | 30 | 38 | | | | |
| | 50.3 | 18 | 19 | 22 | 27 | 28 | 29 | 34 | 44 | 50 | | | |
| | 60.3 | 20 | 21 | 24 | 30 | 32 | 34 | 38 | 48 | 55 | 69 | | |
| | 80.3 | 23 | 23 | 29 | 36 | 38 | 40 | 46 | 58 | 71 | 84 | 96 | |
| | 100.3 | 26 | 26 | 34 | 43 | 45 | 48 | 55 | 71 | 78 | 101 | 112 | 145 |
| | 120.3 | 30 | 34 | 42 | 49 | 53 | 58 | 69 | 80 | 92 | 115 | 144 | 167 |
| | 150.3 | 32 | 36 | 41 | 58 | 60 | 72 | 82 | 99 | 112 | 138 | 171 | 199 |
| | 200.3 | 45 | 53 | 63 | 75 | 74 | 92 | 110 | 137 | 157 | 179 | 216 | 254 |
| | 250.3 | 86 | 61 | 71 | 89 | 97 | 117 | 135 | 153 | 185 | 215 | 262 | 308 |
| | 300.3 | 98 | 73 | 82 | 105 | 117 | 133 | 153 | 175 | 213 | 251 | 305 | 362 |
| 400.3 | 120 | 105 | 120 | 135 | 143 | 179 | 204 | 234 | 281 | 334 | 398 | 471 | |

Toolox 33

length: 150.3 mm

price per piece

| 150 | | thickness [mm] | | | | | | | | |
|------------|-------|----------------|------|------|------|------|------|------|------|------|
| | | 8.4 | 10.4 | 12.4 | 15.4 | 20.4 | 25.4 | 30.4 | 40.4 | 50.4 |
| width [mm] | 20.3 | 7 | 7 | 8 | 9 | 10 | | | | |
| | 25.3 | 7 | 7 | 8 | 9 | 11 | 11 | | | |
| | 30.3 | 8 | 8 | 9 | 10 | 11 | 13 | 17 | | |
| | 40.3 | 9 | 9 | 10 | 11 | 12 | 15 | 16 | 20 | |
| | 50.3 | 9 | 9 | 11 | 13 | 14 | 16 | 19 | 23 | 27 |
| | 60.3 | 9 | 9 | 11 | 15 | 16 | 17 | 20 | 26 | 28 |
| | 80.3 | 12 | 13 | 14 | 17 | 18 | 22 | 26 | 29 | 39 |
| | 100.3 | 13 | 14 | 16 | 20 | 21 | 24 | 29 | 35 | 43 |
| | 120.3 | 17 | 19 | 22 | 23 | 24 | 32 | 38 | 44 | 50 |
| | 150.3 | 18 | 20 | 23 | 29 | 30 | 31 | 36 | 45 | 53 |

length: 800.3 mm

price per piece

| 800 | | thickness [mm] | | | | | | | | | | |
|------------|-------|----------------|------|------|------|------|------|------|------|------|------|------|
| | | 8.4 | 10.4 | 12.4 | 15.4 | 20.4 | 25.4 | 30.4 | 40.4 | 50.4 | 60.4 | 80.4 |
| width [mm] | 80.3 | 45 | 47 | 56 | 60 | 72 | 76 | 85 | 110 | 125 | 138 | 175 |
| | 100.3 | 54 | 54 | 65 | 69 | 83 | 89 | 99 | 128 | 145 | 162 | 207 |
| | 120.3 | 56 | 63 | 73 | 76 | 91 | 104 | 124 | 144 | 168 | 184 | 259 |
| | 150.3 | 58 | 64 | 79 | 89 | 110 | 128 | 146 | 175 | 198 | 237 | 327 |
| | 200.3 | 80 | 95 | 112 | 133 | 154 | 173 | 196 | 244 | 292 | 342 | 420 |
| | 250.3 | 156 | 108 | 127 | 156 | 190 | 208 | 240 | 268 | 330 | 412 | 506 |
| | 300.3 | 175 | 130 | 146 | 182 | 215 | 237 | 273 | 318 | 380 | 442 | 542 |
| | 400.3 | 212 | 187 | 214 | 236 | 282 | 325 | 363 | 412 | 500 | 584 | 764 |
| | 500.3 | 196 | 233 | 258 | 279 | 335 | 395 | 455 | 522 | 592 | 733 | 937 |
| | 600.3 | 285 | 285 | 297 | 322 | 389 | 460 | 545 | 648 | 763 | 891 | 1109 |

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TOOLOX® 33

VarioPlan®
Precision-milled semi-finished products in customizable dimensions

- Flexible in width, thickness, and length
- Sawed or milled edges
- Optional bevels and/or corner radii
- Manufacturing in 2 to 3 days
- Easy calculation

Use our online calculation tool on the WebShop: www.varioplan.de

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ENGINEERING & TOOL STEEL

The screenshot displays the VarioPlan web application interface. At the top, there are navigation tabs for 'WebShop', 'Produkte', 'Zuschlagskoeff.', 'Lieferzeiten', 'Umsatzkoeff.', and 'Downloads'. The main content area is titled 'VarioPlan gefräster Flachstahl Toolox 33'. It includes sections for 'Toleranzen' (Tolerances), 'Auf Wunsch mit gefrästen Kanten lieferbar' (Optional with milled edges), 'Minimalabmessung' (Minimum dimensions), and 'Maximalabmessung' (Maximum dimensions). A 'Kalkulation' (Calculation) section shows the selected dimensions: 'Ihr gewählter VarioPlan (Dicke + Kanten gefräst)' with a width of 113.3 mm, thickness of 11.7 mm, and length of 252.3 mm, priced at 72.40 €/Stück. Below this, there are input fields for defining chamfers (Fasen) and radii (Radien) for the top, side, and bottom edges. A 'Schematische Darstellung von Fase, Radien und Einzug' (Schematic representation of chamfer, radii, and chamfer) section shows a 3D model of the plate with these features highlighted and labeled A, B, C, and D. The interface is clean and professional, with a sidebar on the right containing navigation options like 'VarioPlan', 'Sonder-Produkt', 'Material', and 'Stahlexikon'.

Toolox 33

Raw material

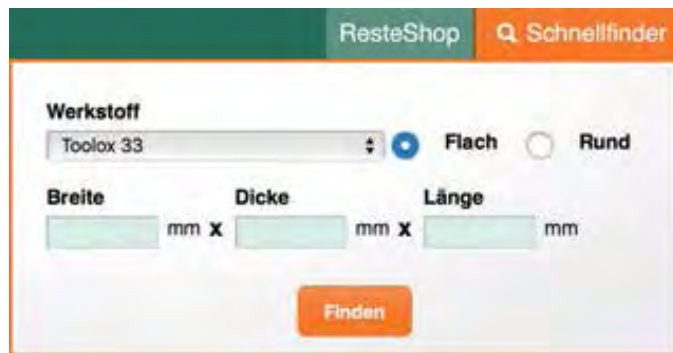
Plates and cuttings thereof, hardened to 275-325 HB,
plate surface blasted and primed

| thickness [mm] | | | | | | | | | | | | | | |
|----------------|----|-----|----|------|----|------|-----|-----|------|------|-----|------|----|--|
| 6 | 8 | 9.2 | 10 | 11.6 | 12 | 13.6 | 14 | 16 | 16.7 | 17.6 | 18 | 20 | 22 | |
| 25 | 27 | 28 | 30 | 32.5 | 35 | 40 | 43 | 50 | 53 | 55 | 60 | 63.5 | 65 | |
| 70 | 74 | 75 | 80 | 84 | 90 | 100 | 104 | 105 | 110 | 120 | 125 | 130 | | |



Select cost-effective raw materials online, including cut-to-size options
www.ResteShop.de

Fast, clear, and transparent:
Offcut shop and Quick finder at www.stahlnetz.de



Offcut shop

- All materials
- With cutting service
- Available from stock
- Competitive special prices for remnants
- While supplies last

Quick finder

- All products in comparison
- Your custom parts calculated and ready
- Easy selection of the optimal solution

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TOOLOX® 33



Material data sheet

Toolox® 33 is a hardened and tempered tool steel designed for minimal residual stresses. As a result, this material exhibits excellent dimensional stability during machining. Toolox® 33 combines very good machining properties with a hardness of 300 HBW. This tool steel is specifically intended for use in plastic molds and is excellent for polishing and texturing.

Other applications include rubber molds, bending tools, wear parts, and structural components in mechanical engineering.

Toolox® 33 replaces materials 1.2311 / 1.2312 / 1.2738 / 1.7225.

| | |
|---|--|
| hardness (guaranteed value) | HBW 275–325 (approximately 26–32.5 HRC) |
| impact toughness (guaranteed value) | testing temperature 20°C impact toughness Charpy-V in transverse direction ≤ 130mm mind. 35 J |
| tensile strength (converted value) | tensile strength approximately 860–1010 MPa |
| ultrasonic testing (guaranteed value) | according to EN 10 160 (sheets) or EN 10 228-3 (forged parts) and additional requirements in accordance with SSAB V6. |
| etching properties (warranty obligation) | Toolox® 33 meets the requirements of NADCA 207–2006. |
| dimensions | Toolox® 33 is supplied in sheet thicknesses of 6-130mm. |
| delivery condition | Hardened and tempered at a minimum of 590°C. |
| heat treatment | Nitriding or coating is possible at temperatures below 590°C. Toolox® 33 is not intended for further heat treatment. If this material is subjected to heat treatment above 590°C after delivery, the properties are no longer guaranteed. |
| testing | Testing according to EN 10 025 and EN ISO 6506-1. Hardness tested on a milled surface 0.5 - 2mm below the sheet surface. |
| tolerances | Sheet: According to EN 10 029 and SSAB AccuRollTech™. Round steel: EN 10 060. |
| welding | Please refer to page 73 for further details. |
| products | Precision flat steel (standard and custom dimensions), EcoPlan®, P-plates, VarioPlan®, and raw material cuttings. Machine parts and guide rails customized to your specifications and drawings. |



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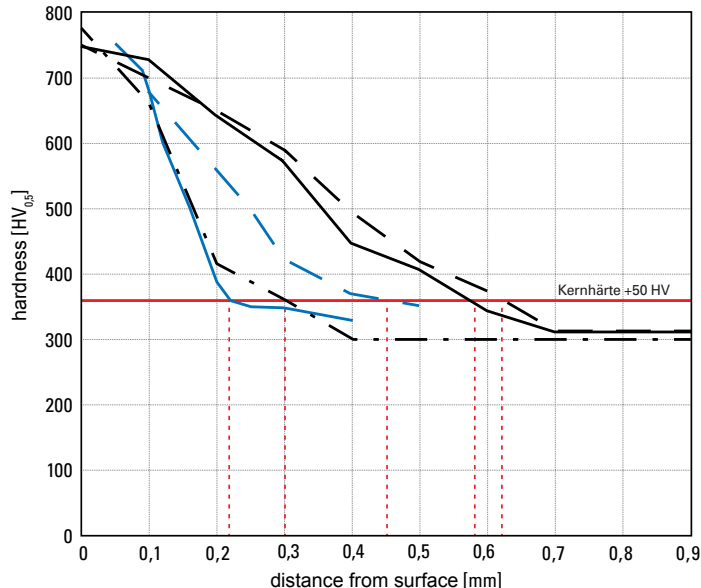


Metallurgical information

| | C | Si | Mn | P | S | Cr | Mo | V | Ni |
|------|------|-----|-----|------|-------|-----|-----|------|-----|
| max. | 0.24 | 1.1 | 0.8 | 0.01 | 0.003 | 1.2 | 0.3 | 0.11 | 1.0 |
| min. | 0.22 | 0.6 | | | | 1.0 | | 0.10 | |

Hardness profile

Determination of the nitriding depth NHD according to DIN 50190-3 at core hardness +50 HV



— gas nitriding in ammonia gas stream, 36 h, 510°C: NHD=0.58 mm
 --- gas nitriding in ammonia gas stream, 84 h, 510°C: NHD=0.62 mm
 - · - gas nitrocarburizing, 5 h, 580°C: NHD=0.30 mm
 — plasma nitriding, short-time: NHD=0.22 mm, VS=7 μm
 - - - plasma nitriding, long-time: NHD=0.45 mm, VS=7 μm

Inclusion content (typical values)

inclusion rating (equivalent diameter) 6 μm
 surface area 0.015 %
 length-width-ratio 1.2

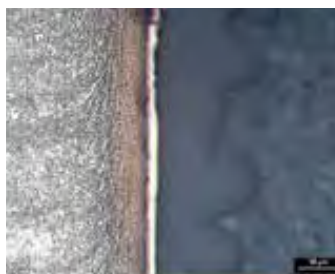
physical properties (typical values)

thermal expansion coefficient [10⁻⁶ /K]
 bei +20 - 200°C: 13,1

thermal conductivity

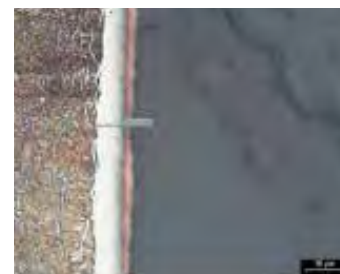
| | |
|-------------------|-----------|
| +20°C | 35.0 W/mK |
| +200 ° | 35.0 W/mK |
| +400 ³ | 30.0 W/mK |
| C | |

short time



diffusion zone, no bonding layer

long time



diffusion zone, bonding layer with 36 μm

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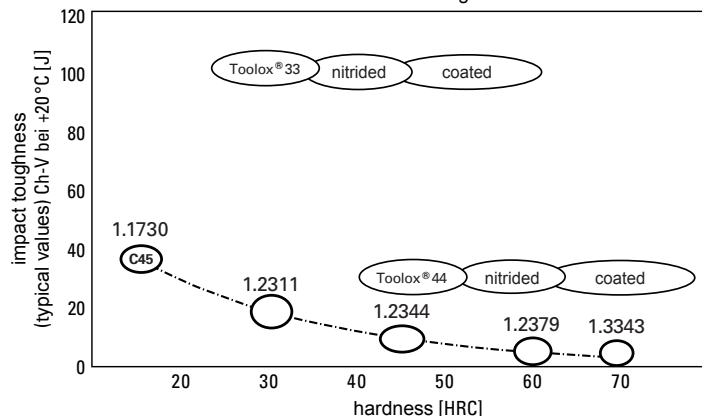
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TOOLOX® 33

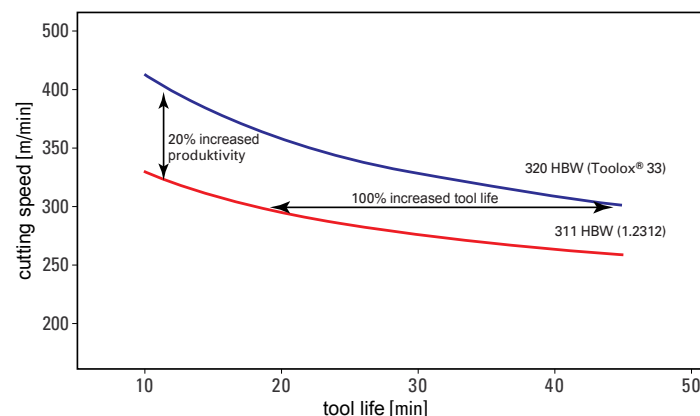
TOOLOX®
 ENGINEERING & TOOL STEEL

surface engineering

hard and tough



tool life in face milling



Mechanical properties (typical values)

| | guaranteed hardness [HBW] | guaranteed impact toughness Min [J] | typical impact toughness [J]* | yield strenght typical R _{p0,2} [MPa]* | tensile strenght typical R _m [MPa]* | elongation at break typical A ₅ [%]* | compression yield strength typical MPa* | thickness [mm] |
|---------|---------------------------|-------------------------------------|-------------------------------|---|--|---|---|----------------|
| -40 °C | | | 27 | | | | | 6-130 |
| -20 °C | | | 45 | | | | | |
| +20 °C | 275-325 | 35 | 100 | 850 | 980 | 16 | 800 | |
| +200 °C | | | 170 | 800 | 900 | 12 | 750 | |
| +300 °C | | | 180 | | | | 700 | |
| +400 °C | | | 180 | | | | 590 | |
| +500 °C | | | | | | | 560 | |

Toolox is tested for hardness and impact toughness at room temperature. All other values provided are derived from supplementary tests and are for informational purposes only, and are not guaranteed.

* Reference values for information purposes only.

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machining Toolox®

All major tool manufacturers are well-prepared for machining Toolox®. It is recommended to seek advice on suitable tools and cutting values. These recommendations should be followed meticulously to achieve optimal results and productive performance. It is crucial to avoid reducing the feed due to a misunderstood sense of caution. Good chip formation leads to success, and Toolox will reward you with extended tool life and faster machining.

Toolox 33
Toolox 44

Drilling

Drilling with HSS (High-Speed Steel) tools is reserved for less stable machines and low production quantities. HSS-Co (High-Speed Steel with Cobalt) tools with the cutting values provided below have proven to be effective. Ensure a continuous machine feed and maintain sharp tools. A sharpened cross edge would be advantageous to ensure optimal chip formation.

Drilling with solid carbide (VHM) tools is productive and efficient. In this case, it is advisable to use internal coolant with a higher concentration. Ensure that you drill with a continuous feed (not lower than the tool manufacturer's recommendation).

| | Toolox® 33 | Toolox® 44 |
|--------------------------|--------------------------------|-------------------|
| cutting speed: v [m/min] | ~ 15 | ~ 7 |
| diameter [mm] | feed: f [mm/U] / turns [1/min] | |
| 5 | 0.10/950 | 0.05/445 |
| 10 | 0.10/475 | 0.09/220 |
| 15 | 0.16/325 | 0.15/150 |
| 20 | 0.23/235 | 0.20/110 |
| 25 | 0.30/195 | 0.25/90 |
| 30 | 0.35/165 | 0.30/75 |
| * 35 | 0.40/136 | 0.35/63 |
| * 40 | 0.45/119 | 0.40/55 |

| | Toolox® 33 | | Toolox® 44 | |
|--------------------------|-------------------|-----------|-------------------|-----------|
| cutting speed: v [m/min] | 65–90 | | 40–65 | |
| diameter [mm] | feed [mm/U] | | | |
| | min.–max. | std value | min.–max. | std value |
| 3.0–5.0 | 0.08–0.15 | 0.10 | 0.06–0.11 | 0.07 |
| 5.01–10.0 | 0.09–0.16 | 0.12 | 0.08–0.13 | 0.10 |
| 10.01–15.0 | 0.16–0.22 | 0.18 | 0.12–0.18 | 0.15 |
| 15.01–20.0 | 0.22–0.28 | 0.25 | 0.16–0.20 | 0.18 |

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TOOLOX® 33 / TOOLOX® 44

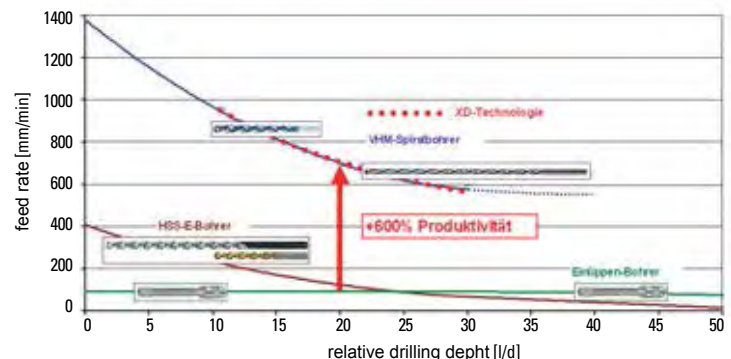
Carbide replaceable inserts or brazed cutting edges are used for medium diameters. Refer to the table for cutting values

| | Toolox® 33 | Toolox® 44 | | |
|--------------------------|-------------------|-------------------|-----------|-----------|
| cutting speed: v [m/min] | 50–80 | 40–60 | | |
| diameter [mm] | feed [mm/U] | | | |
| | min.–max. | std value | min.–max. | std value |
| 7.5–12.0 | 0.10–0.16 | 0.13 | 0.08–0.14 | 0.11 |
| 12.01–20.0 | 0.15–0.23 | 0.20 | 0.12–0.20 | 0.15 |
| 20.01–25.0 | 0.18–0.27 | 0.22 | 0.14–0.22 | 0.17 |
| 25.01–30.0 | 0.20–0.30 | 0.24 | 0.16–0.25 | 0.19 |

Extra-long bores up to over 50 x D can also be produced very productively on machining centers with internal coolant supply (IKZ) when using solid carbide drills with a special geometry. Typical cutting values are provided in the table below.

| material | hardness | diameter d [mm] | depth l [mm] | rel depth l/d | cutting data | | | cooling emulsion |
|-------------------|----------|--------------------|-----------------|------------------|------------------------|--------|-------------------------|------------------|
| | | | | | v _C [m/min] | f [mm] | v _f [mm/min] | |
| Toolox® 33 | 300 HB | 5 | 10 | 20 | 50 | 0.15 | 477 | IK, p=20 bar |
| Toolox® 44 | 45 HRc | 5 | 100 | 20 | 36 | 0.15 | 344 | IK, p=20 bar |

Werkangaben Titex



Toolox 33
Toolox 44

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Toolox 33
Toolox 44

Deep drilling in Toolox® presents a special challenge, which the renowned manufacturer Botek has managed and economically solved with a special cutting edge geometry. The single-lip solid drilling tools, Type 110, with special geometry for diameters up to 12.0mm, as well as single-lip deep drilling tools, Type 01, with interchangeable cutting inserts and guide rails in special design from a diameter of 12.0mm, have proven to be excellent solutions.

| | drilling-Ø | 3 | 4 | 5 | 6 | 7-8 | 9-10 | 11-12 | >12 |
|-------------------|------------------------------|--------|-------|--------|--------|-------|-------|-------|-------|
| Toolox® 33 | cutting speed [m/min] | 50 | 50 | 50 | 50 | 40-50 | 40-50 | 40-50 | 40-50 |
| | feed [mm/U] | 0.005 | 0.01 | 0.015 | 0.0175 | 0.02 | 0.03 | 0.04 | 0.1 |
| | coolant pressure [bar] | 100 | 100 | 100 | 90 | 80 | 70 | 60 | 40 |
| | pilot drilling distance [mm] | 40 | 40 | 50 | 60 | 60 | 70 | 70 | 70 |
| | pilot drilling feed [mm/U] | 0.0025 | 0.005 | 0.0075 | 0.009 | 0.01 | 0.015 | 0.02 | 0.05 |

factory specs. Botek

achievable service life with oil: approx. 10 - 12 meters at optimized process conditions

For further information, please contact Botek (www.botek.de) and feel free to reference us.

| | drilling-Ø | 3 | 4 | 5 | 6 | 7 | 8 | 9-10 | 11-12 | >12 |
|-------------------|------------------------------|--------|-------|-------|--------|--------|--------|-------|-------|-------|
| Toolox® 44 | cutting speed [m/min] | 50 | 50 | 50 | 50 | 40-50 | 40-50 | 40-50 | 40-50 | 40-50 |
| | feed [mm/U] | 0.005 | 0.01 | 0.012 | 0.015 | 0.015 | 0.0175 | 0.02 | 0.03 | 0.07 |
| | coolant pressure [bar] | 100 | 100 | 100 | 90 | 90 | 80 | 70 | 60 | 40 |
| | pilot drilling distance [mm] | 40 | 40 | 50 | 50 | 60 | 60 | 70 | 70 | 70 |
| | pilot drilling feed [mm/U] | 0.0025 | 0.005 | 0.006 | 0.0075 | 0.0075 | 0.009 | 0.01 | 0.015 | 0.035 |

factory specs. Botek

achievable service life with oil: approx. 2 - 3 meters at optimized process conditions

WebShop:
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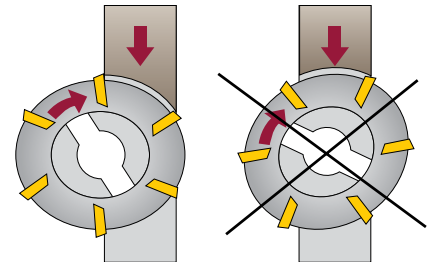
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TOOLOX® 33 / TOOLOX® 44

Milling:

Due to extremely low residual stresses, Toolox is particularly resistant to deformation when machined with optimal parameters and when unnecessary heat is not introduced into the workpiece. Long tool life is achieved through clever milling strategies, stable clamping, and always maintaining an adequate chip thickness. Toolox has a unique microstructure that facilitates machining despite its high hardness. Carbides are very hard and wear-resistant microstructural components. Their microscopically fine, spherical shape within the Toolox structure prevents the cutting edge damage typically observed in other tool steels. A sufficiently high tooth feed ensures the removal of carbides along with the chips, while too low a feed would result in intensive abrasive wear on the edge. Sharp cutting edges with positive geometry are optimal for Toolox. Select tools designed for processing high-strength steels. Tools intended for hard machining (up to 60 HRC) are unsuitable, as their cutting edges typically have negative rake angles.



Toolox 33
Toolox 44

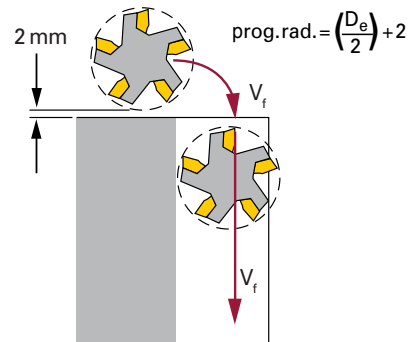
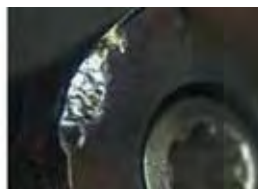
Introduction into the cutting process using the 'roll-in' method



Entry using the 'roll-in' method; wear after 800 machining passes



Straight entry into the workpiece; wear after 390 machining passes.



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Milling

Interrupted cuts are milled more effectively with round inserts. Particularly high productivity is achieved with HPC (High-Performance Cutting) tools. Also, corner milling heads are suitable for Toolox.

Recommendation for 45° cutters.

| | Toolox® 33 | | Toolox® 44 | |
|--------------------------------|------------|------------|------------|------------|
| cutting speed: v [m/min] | 180–220 | | 120–160 | |
| feed: f _z [mm/Zahn] | min.–max. | std values | min.–max. | std values |
| insert grade P30 | 0.15–0.35 | 0.25 | 0.15–0.35 | 0.25 |

Recommendation for face milling cutters with round inserts

| | Toolox® 33 | | Toolox® 44 | |
|--------------------------------|------------|------------|------------|------------|
| cutting speed: v [m/min] | 180–220 | | 140–180 | |
| feed: f _z [mm/Zahn] | min.–max. | std values | min.–max. | std values |
| insert grade P30 | 0.10–0.25 | 0.15 | 0.10–0.25 | 0.15 |

Recommendation for end mills / corner milling heads

| | Toolox® 33 | | Toolox® 44 | |
|--------------------------------|------------|------------|------------|------------|
| cutting speed: v [m/min] | 180–220 | | 120–160 | |
| feed: f _z [mm/Zahn] | min.–max. | std values | min.–max. | std values |
| insert grade P30 | 0.12–0.25 | 0.17 | 0.12–0.25 | 0.17 |

Cutting parameters for HPC (High-Performance Cutting) copy and face milling cutters

| material group | material designation | strength N/mm ² | copy milling | | | | | | | | plunge and circular milling | | | | | | | |
|----------------|----------------------------|----------------------------|-----------------------------|------------------------|-------|-----|-----------------------------|------------------------|-------|-----|-----------------------------|------------------------|-------|-----------------------------|------------------------|-----|-------|-----|
| | | | dry machining | | | | wet machining | | | | dry machining | | | wet machining | | | | |
| | | | cutting material 1st choice | V _c [m/min] | | | cutting material 1st choice | V _c [m/min] | | | cutting material 1st choice | V _c [m/min] | | cutting material 1st choice | V _c [m/min] | | | |
| | | | | min | start | max | | min | start | max | | min | Start | | max | min | Start | max |
| 8.2 | Toolox® 33 tool steels | 900–1100 | F25M | 120 | 140 | 160 | F25M | 110 | 130 | 150 | F25M | 80 | 90 | 100 | F25M | 70 | 85 | 100 |
| 10.0 | Toolox® 44 hardened steels | 41–47 HRC | F15M | 120 | 160 | 200 | – | – | – | – | F15M | 80 | 105 | 130 | – | – | – | – |

Werksangaben Hoffmann

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slot- /endmilling

In slot milling, a depth of cut (ap) of 0.5 x D has proven to be effective, with sufficient chip space available. Shaft milling, including trochoidal milling, is very productive with ap along the full cutting length and ae of approximately 0.1 x D. Dry milling with compressed air cooling for chip removal avoids thermal shock and overload due to retracted chips.

thread

Both Toolox materials can be machined with **machine taps**. Experienced fitters drill the core hole slightly larger. Cutting paste, cutting oil, or a richer emulsion have proven to be particularly effective.

Thread milling is a productive method for high manufacturing reliability, even with very small diameters, especially where thread cutting is difficult.

Counterboring and countersinking can be easily done on machining centers using insert tools. For less stable machines, countersinks with pilot pins have proven to be effective.

| | Toolox® 33 | Toolox® 44 |
|----------------------|------------------------|------------|
| cutting speed v [mm] | 7–10 | 3–5 |
| size | rational speed [1/min] | |
| M5 | 445–635 | 190–320 |
| M6 | 370–530 | 160–265 |
| M8 | 270–400 | 120–200 |
| M10 | 220–320 | 95–160 |
| M12 | 185–265 | 80–130 |
| M16 | 140–200 | 60–100 |
| M20 | 110–160 | 45–80 |

| | Toolox® 33 | Toolox® 44 |
|--------------------------------|------------|------------|
| cutting speed v [mm]: | 80–110 | 50–70 |
| feed: f _z [mm/Zahn] | 0.03–0.06 | 0.02–0.05 |

| | Toolox® 33 | Toolox® 44 |
|----------------------|------------------------|------------|
| cutting speed v [mm] | 0.10–0.20 | 0.10–0.20 |
| diameter [mm] | rational speed [1/min] | |
| 19 | 670–1340 | 335–840 |
| 24 | 530–1060 | 265–665 |
| 34 | 375–750 | 185–470 |
| 42 | 300–600 | 150–380 |
| 57 | 225–440 | 110–280 |

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Polishing Toolox®



1. Fine grinding with a coarse abrasive (e.g., grain size 120). All traces of processing or eroding are completely ground away. Preferably, the flat side of the abrasive should be used. Vary the grinding direction in an X-pattern to achieve an absolutely flat surface, make your work more efficient, and save time at the same time.
2. Fine grinding as in step 1, but with a finer grain size such as 320. All remaining traces after the previous grinding are completely removed.
3. Coarse polishing with diamond paste on a piece of brass. Grain size 45µm. This coarse polishing is carried out until all remaining traces and scratches from the previous step (step 2) are completely eliminated.

4. Proceed as in step 3, but use 15µm diamond paste until all traces remaining from step 3 have disappeared.
5. In this step, follow the procedure as in step 4, but use 7µm diamond paste. This step is also continued until all traces remaining from step 4 are removed.
6. Polish with 7µm diamond paste on a fiber or plastic element. Continue until the last remaining irregularities from step 5 are eliminated.
7. Now, follow the procedure as in step 6, but use 3µm diamond paste instead of 7µm paste. Continue until the last nuances of irregularities remaining from step 6 are removed. (We use the word "nuance" here because the surface is already so flat and fine that there are virtually no visible scratches to the naked eye.)
8. Polish with 3µm diamond paste on a piece of felt until all nuances remaining from the previous step are removed.
9. As a final step, polish with 3µm diamond paste and cotton. This is a manual process and is where the final shine is achieved. Continue until the entire surface has a uniform gloss.

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TOOLOX® 33 / TOOLOX® 44



Welding Toolox:

Toolox can be welded well while following the guidelines below. The carbon equivalent for Toolox 33 CEIIV is 0.62–0.71 / CET 0.4–0.44, and for Toolox 44 CEIIV is 0.92–0.96 / CET 0.55–0.57.

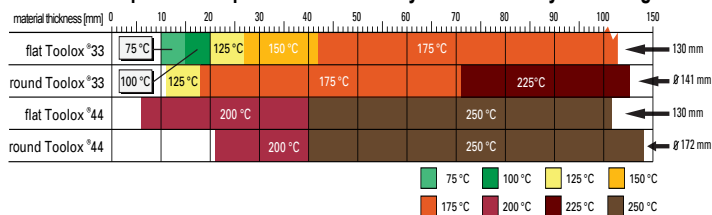
is 5 ml/100g of weld material. To achieve optimal texture quality, welding should be performed using the TIG process with a filler wire of the same chemical composition as the base material. The simplest method is to cut a rod from a leftover piece of the base material.

Austenitic welding fillers such as AWS 307 or AWS 309 are suitable for welding without preheating. This results in a strength of approximately Rp0.2 = 500 MPa in the weld. Non-alloyed or low-alloy welding fillers provide strengths of up to Rp0.2 = 930 MPa and good toughness. For the selection of welding fillers, refer to page 84.

1. Preheat both sides of the weld joint, approximately 100–150mm on each side. The preheating temperature should be reached at the center of the plate. Maintain the preheating temperature throughout the entire welding process, especially during tack welding..

3. Weld with a heat input that results in a t8/5 value between 10 and 20 seconds.
4. During welding, an interpass temperature of no more than:
 - 170°C for Toolox 33**
 - 225°C for Toolox 44**
 should be reached before proceeding to the next pass.

The minimum preheat temperature for non-alloyed and low-alloyed welding fillers



2. Use electrodes that are as soft as possible or stainless. The electrodes must be dry. The maximum allowable hydrogen content

5. Conduct a post-weld heat treatment in the area approximately 100–150mm on each side of the weld joint. The soaking time should be 5 minutes per millimeter of plate thickness or at least 60 minutes. Typically, a soaking time of 2 hours is sufficient. The start of the soaking time is when the temperature is reached throughout the entire tempering volume.

* If only low requirements for dimensional stability are necessary, the post-weld heat treatment should be conducted at a temperature of 150–200°C.

* If high requirements for dimensional stability are needed, and the influence of the weld on the texture formation result should be minimized, the post-weld heat treatment should be conducted at a temperature of 560–580°C.

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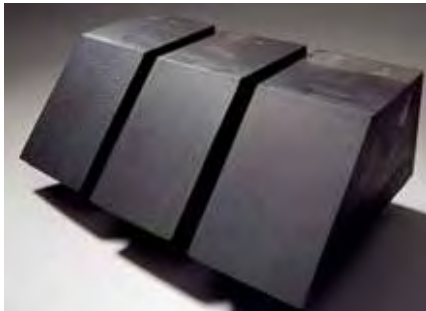


application examples

Toolox 33
Toolox 44



Toolox was originally developed as a plastic mold steel; however, it soon proved to be exceptionally well suited for a variety of other applications.



Plastic molds made from Toolox are wear-resistant, and the fine microstructure of Toolox allows for easy polishing and photo etching. Furthermore, Toolox is highly workable due to its microstructure with spherical carbides. It is not necessary to add sulfur, which would compromise toughness and polishability.

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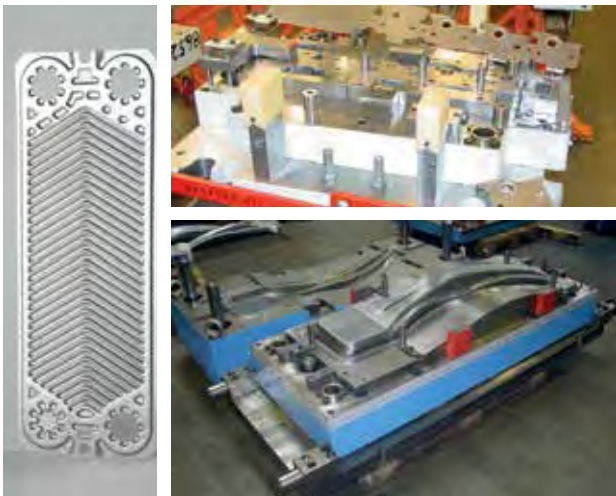


Stamping and bending tools, as well as forming tools, benefit from the high base hardness of Toolox 44. With a hardness of approximately 45 HRC, Toolox is particularly resistant to pressure and wear as a bending tool. Its high toughness allows for fracture-free stress, even in unfavorable constructions. Additionally, Toolox is used in pressure plates and slide guides. Machine blades made from Toolox cut high-strength sheets in steel mills.

Hydroforming tools require high strength, toughness, and workability. This is where Toolox 44 fully leverages its advantages.



Toolox 33
Toolox 44



The high tempering temperature allows for a wide range of heat applications. Slide and mold components in **aluminum die-casting tools** are made from Toolox 44. Even under the harshest conditions, such as when removing furnace slag in steel mills or aluminum smelting, Toolox outlasts conventional wear steels. The excellent weldability is of particular importance in these applications.



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Toolox
33

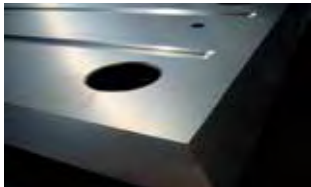
Toolox
44

High-strength and wear-resistant machine components of all kinds are made from Toolox when the highest precision is required.

The extremely low inherent stresses of the material are ensured by the high tempering temperature of at least 590°C, which acts like a stress-relief annealing process. In our processes, Toolox is exclusively cold-processed, and we do not encounter thermal stresses or hardness losses from oxy-fuel or plasma cutting. The effortless maintenance of dimensional tolerances is why many manufacturers rely on Toolox.

The high hardness already provides excellent wear resistance without the need for additional heat treatment. This is beneficial for **fixtures** that can be directly manufactured from raw material and immediately used without heat treatment.

The highest demands for long-term precision are achieved by **nitriding the surface**. Toolox does not lose core hardness during the nitriding process but gains increased abrasion resistance and corrosion resistance.



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