

## TECHSUPPORT: #63

### Properties and Processing

#### Mechanical Properties

|                 | Hardness*<br>HBW | Toughness**<br>KV, - 40°C | Yield Strength**<br>Re | Tensile strength**<br>Rm | Carbon equivalent** |      | Thickness range<br>mm |
|-----------------|------------------|---------------------------|------------------------|--------------------------|---------------------|------|-----------------------|
|                 |                  |                           |                        |                          | CEV                 | CET  |                       |
| HARDOX HiTuf*** | 310 - 370        | 95 J                      | 950 MPa                | 980 MPa                  | 0,55                | 0,36 | 40 - 120              |
| HARDOX 400      | 370 - 430        | 45 J                      | 1000 MPa               | 1250 MPa                 | 0,37                | 0,27 | 3.2 - 130             |
| HARDOX 450      | 425 - 475        | 40 J                      | 1200 MPa               | 1400 MPa                 | 0,48                | 0,35 | 3.2 - 80              |
| HARDOX 500****  | 470 - 530        | 30 J                      | 1300 MPa               | 1550 MPa                 | 0,62                | 0,41 | 4.0 - 80              |
| HARDOX 550      | 525 - 575        | 30 J                      | 1400 MPa               | 1700 MPa                 | 0,72                | 0,48 | 10 - 50               |
| HARDOX 600      | 570 - 640        | 20 J                      | 1650 MPa               | 2000 MPa                 | 0,73                | 0,55 | 8.0 - 50              |

\* Guaranteed values. \*\* Typical values for 20 mm thick plates, except HARDOX HiTuf. \*\*\* Typical values are for the thickness range 40 - 70 mm.

\*\*\*\* Guaranteed hardness values are for the thickness range 4 - 32 mm. For thicknesses 32.1 - 80 mm is guaranteed 450 - 540 HBW.

#### Welding

Minimum recommended preheat and interpass temperatures for different single plate thicknesses (mm)

|   | 3     | 10 | 20    | 30    | 40    | 50    | 60    | 70    | 80 | 90    | 120   | 130 |
|---|-------|----|-------|-------|-------|-------|-------|-------|----|-------|-------|-----|
| HARDOX HiTuf                              |       |    |       |       |       | 100°C |       |       |    | 125°C |       |     |
| HARDOX 400                                |       |    |       | 75°C  |       | 100°C |       | 175°C |    |       | 200°C |     |
| HARDOX 450                                |       |    |       | 125°C |       |       | 150°C |       |    |       |       |     |
| HARDOX 500                                |       |    | 175°C |       |       | 200°C |       |       |    |       |       |     |
| HARDOX 550                                | 125°C |    | 175°C |       | 200°C |       |       |       |    |       |       |     |
| HARDOX 600                                | 150°C |    | 175°C |       |       |       |       |       |    |       |       |     |
| HARDOX 600<br>Stainless steel consumables |       |    |       | 100°C |       |       |       |       |    |       |       |     |

Room temperature (approx. 20°C)
  Outside the size range
  Only stainless steel consumables  
 Preheat and interpass temperature at least 100°C

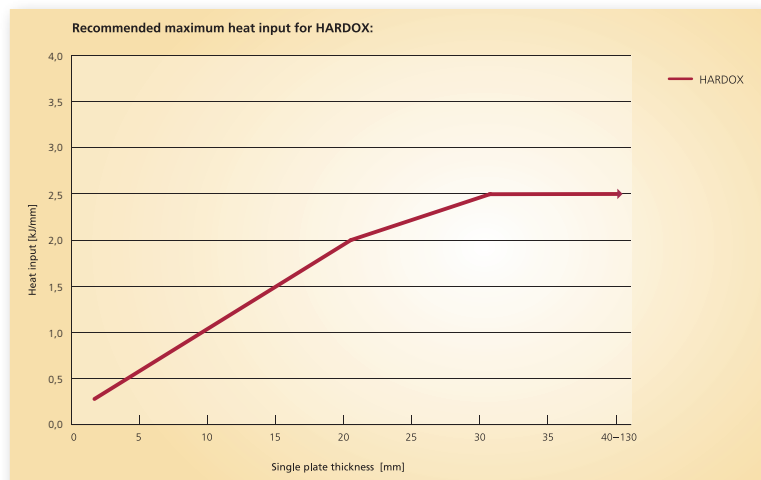
Note: The table is applicable to single plate thickness when welding with a heat input of 1.7 kJ/mm.

Further information on single plate thickness can be found in TechSupport #61 at [www.ssabox.com](http://www.ssabox.com).

#### Maximum recommended interpass temperature

|                |       |
|----------------|-------|
| HARDOX HiTuf** | 300°C |
| HARDOX 400     | 225°C |
| HARDOX 450     | 225°C |
| HARDOX 500     | 225°C |
| HARDOX 550     | 225°C |
| HARDOX 600     | 225°C |

\*\* Interpass temperatures of up to approx. 400°C can be used in certain cases for HARDOX HiTuf. In such cases, use WeldCalc.



# Cutting

Preheating of HARDOX prior to oxyfuel cutting.

Maximum cutting speed, mm/min, if no preheating is employed in oxy-fuel cutting

| Grade        | Plate thickness | Preheating temp. |
|--------------|-----------------|------------------|
| HARDOX HiTuf | ≥90 mm          | 100°C            |
| HARDOX 400   | 45–59,9 mm      | 100°C            |
|              | 60 – 80 mm      | 150°C            |
|              | >80 mm          | 175°C            |
| HARDOX 450   | 40– 49,9 mm     | 100°C            |
|              | 50 – 69,9 mm    | 150°C            |
|              | 70 - 80 mm      | 175°C            |
| HARDOX 500   | 30–49,9 mm      | 100°C            |
|              | 50 – 59,9 mm    | 150°C            |
|              | 60 – 80 mm      | 175°C            |
| HARDOX 550   | 20–50 mm        | 150°C            |
| HARDOX 600   | 12–29,9 mm      | 150°C            |
|              | 30–50 mm        | 175°C            |

| Plate thickness | HARDOX 400 | HARDOX 450 | HARDOX 500 | HARDOX 550 | HARDOX 600 |
|-----------------|------------|------------|------------|------------|------------|
| ≤ 12 mm         | x          | x          | x          | x          | x          |
| ≤ 15 mm         | x          | x          | x          | x          | 300        |
| ≤ 20 mm         | x          | x          | x          | x          | 200        |
| ≤ 25 mm         | x          | x          | 300        | 270        | 180        |
| ≤ 30 mm         | x          | x          | 250        | 230        | 150        |
| ≤ 35 mm         | x          | x          | 230        | 190        | 140        |
| ≤ 40 mm         | x          | 230        | 200        | 160        | 130        |
| ≤ 45 mm         | 230        | 200        | 170        | 140        | 120        |
| ≤ 50 mm         | 210        | 180        | 150        | 130        | 110        |
| ≤ 60 mm         | 200        | 170        | 140        | -          | -          |
| ≤ 70 mm         | 190        | 160        | 135        | -          | -          |
| ≤ 80 mm         | 180        | 150        | 130        | -          | -          |

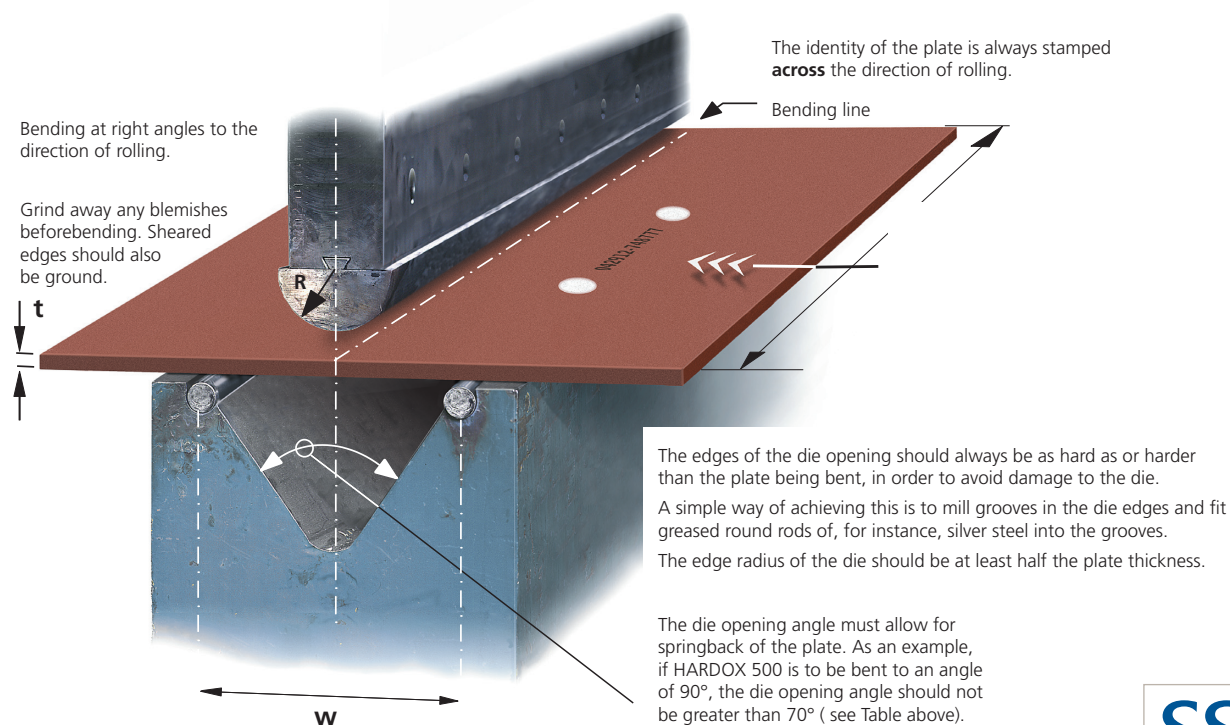
x = no restrictions

# Bending

Minimum recommended punch radius (R) and die opening width (W) for plate thickness (t) when the plate is being bent to 90° along the direction of rolling and at right angles to the direction of rolling – and also the corresponding springback.

|                       | Thickness [mm] | At right angles R/t | Along R/t | At right angles W/t | Along W/t | Springback [°] |
|-----------------------|----------------|---------------------|-----------|---------------------|-----------|----------------|
| S 355 acc to EN 10025 |                | 2,5                 | 3,0       | 7,5                 | 8,5       | 3-5            |
| HARDOX 400            | t < 8          | 2,5                 | 3,0       | 8,5                 | 10,0      | 9-13           |
|                       | 8 ≥ t < 20     | 3,0                 | 4,0       | 10,0                | 10,0      |                |
|                       | t ≥ 20         | 4,5                 | 5,0       | 12,0                | 12,0      |                |
| HARDOX 450            | t < 8          | 3,5                 | 4,0       | 10,0                | 10,0      | 11-18          |
|                       | 8 ≥ t < 20     | 4,0                 | 5,0       | 10,0                | 12,0      |                |
|                       | t ≥ 20         | 5,0                 | 6,0       | 12,0                | 14,0      |                |
| HARDOX 500            | t < 8          | 4,0                 | 5,0       | 10,0                | 12,0      | 12-20          |
|                       | 8 ≥ t < 20     | 5,0                 | 6,0       | 12,0                | 14,0      |                |
|                       | t ≥ 20         | 7,0                 | 8,0       | 16,0                | 18,0      |                |

Care should be taken during all bending – due to the high strength of the plate and the high bending force necessary. If the plate should crack, fragments of the material may fly off. During bending, the operator and other personnel must therefore not stand in front of the machine – they should move to the side.



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