durostat®

Hot-rolled cut sheets

CUT SHEETS

durostat 400/450/500

Data sheet • May 2017

Wear-resistant sheets made from hot-rolled steel strip

durostat 400, durostat 450 and durostat 500 typically achieve surface hardness values of roughly 400, 450 and 500 HB. The steel is optimally suited to applications with high mechanical stress and high levels of abrasion, such as those in loading and conveying machinery, dredgers, crushing plants, screening equipment, chutes and truck cab structures. Their high level of hardness is adjusted by means of direct quenching after hot rolling. State-of-the-art alloying technology with low carbon content guarantees excellent welding properties. Sheets made of durostat 400, durostat 450 and durostat 500 are well suited to cold forming in spite of their high strength. In order to maintain their hardness, durostat 400, durostat 450 and durostat 500 may not be heated to more than 200 °C.

Convincing advantages:

- High wear resistance, low abrasion
- Longer service life and maintenance intervals
- Light-weight applications resulting from higher strength

voestalpine Steel Division
www.voestalpine.com/steel

voestalpine
ONE STEP AHEAD.

Chemical composition

Ladle analysis in weight percent and carbon equivalent

durostat®	C max.	Si max.	Mn max.	P max.	S max.	Al min.	Cr max.	Mo max.	Ti max.	B max.	CEV max.	CET max.
400	0.15	0.60	2.30	0.025	0.010	0.020	0.50	0.20	0.050	0.005	0.59	0.38
450	0.20	0.60	2.30	0.025	0.010	0.020	0.50	0.20	0.050	0.005	0.62	0.42
500	0.24	0.60	2.30	0.025	0.010	0.020	0.50	0.20	0.050	0.005	0.66	0.46

CEV = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15

CET = C + (Mn+Mo)/10 + (Cr+Cu)/20 +Ni/40

Mechanical properties: Surface hardness/tensile strength

durostat®	Hardness [HB]	Typical values			
		Hardness [HB]	Yield strength $R_{p0.2}$ [MPa]	Tensile strength R_m [MPa]	Total elongation A_5 [%]
400	360 - 440	400	1150	1350	10
450	410 - 490	450	1250	1450	9
500	460 - 540	500	upon request	upon request	upon request

Mechanical properties: Notch impact energy/bending radii

durostat®	Typical values: Notch impact energy [1] Av [Joule]		Bending radius Ri min. [2] [3]	
			Location of bending edge in direction of rolling	
	Test temperature -20 °C	Test temperature -40 °C	Transverse	Longitudinal
400	60	40	3 x sheet thickness	4 x sheet thickness
450	50	30	4 x sheet thickness	5 x sheet thickness
500	upon request	upon request	4 x sheet thickness	5 x sheet thickness

[1] Typical values (ISO-V, longitudinal), full samples (10 x 10 mm)

[2] Smallest permissible inside radius at 90° edging, Ri min.

[3] It must be taken into consideration that the quality of the cut edge has a strong influence on the achievable bending radii.

Example dimensions

Maximum width per thickness

durostat®	Thickness [mm]					
	2.5	3.0	3.5	4.0	5.0	6.0
400	1250	1520	1570	1620	1620	1620
450	1250	1520	1570	1620	1620	1620
500	-	upon request	upon request	1500	1500	1500

Thickness < 4 mm: Supplied as cut sheet with cut edge

Thickness ≥ 4 mm: Supplied as cut sheet with mill edge

Maximum sheet length: 12 m (18 m at extra charge)

Further dimensions upon request

TECHNICAL RECOMMENDATIONS FOR WELDING

As a result of their chemical composition, sheets made of durostat 400, durostat 450 and durostat 500 exhibit good welding characteristics in all commonly used fusion welding techniques. The heat-affected zone of the welded joints is characterized by both the occurrence of temper softening and a lack of hardness increase as compared to the direct quenched base material.

Temper softening

The extent of temper softening is directly dependent on the cooling time ($t_{8/5}$). The effects of temper softening on the strength properties across the weld are dependent on the relative width of the soft zone (ratio of soft zone width to sheet thickness) and the strength properties of the weld metal.

No hardness increase

Maximum hardness in the heat-affected zone (HAZ) does not exceed the hardness of the base material because of the purely martensitic microstructure. The hardness depends exclusively on carbon content. The carbon equivalent therefore only has an effect on transformation behavior and a decrease in maximum hardness as the $t_{8/5}$ time increases.

Preheating not necessary

Preheating is generally not required up to a sheet thickness of 6 mm.

This applies under the following conditions:

- Use of welding consumables that lead to a very low hydrogen content in the weld metal (HD < 5 ml/100 g weld metal). Compliance with the manufacturer's instructions on storage and re-drying is mandatory.
- Sheets must be kept clean, dry and free from coatings, rust and scale in the area of the joint.

In cases of deviation, an estimation of the preheating temperature is recommended based on EN 1011-2, C.3, Method B, or SEW 088. Depending on atmospheric conditions (temperature below dew point, condensation of humidity), edge drying is recommended immediately before welding at a temperature of at least 80 °C.

Manual metal arc welding (111) and gas-shielded metal arc welding (MAG, 135)

The strength properties across the weld are influenced among other factors by the strength characteristics of the selected welding consumable.

Welding consumables

Strength value of the welding consumable or pure weld metal [1]	Manual metal arc welding (111)	Gas-shielded metal arc welding (MAG, 135)
Rm ≥ 500 MPa	AWS A5.1: E7018-1H4R EN ISO 2560-A: E 42 5 B 4 2 H5 (e.g. BÖHLER FOX EV 50)	AWS A5.18: ER70S-6 EN ISO 14341-A: G 42 4 M21 3Si1 (e.g. BÖHLER EMK 6)
Rm ≥ 530 MPa	AWS A5.5: E8018-C3H4R EN ISO 2560-A: E 46 6 1Ni B 4 2 H5 (e.g. BÖHLER FOX EV 60)	AWS A5.18: ER70S-6 EN ISO 14341-A: G 46 4 M21 4Si1 (e.g. BÖHLER EMK 8)
Rm ≥ 690 MPa	AWS A5.5: E10018-GH4R EN ISO 18275-A: E 62 6 Mn2NiCrMo B 4 2 H5 (e.g. BÖHLER FOX EV 75)	WS A5.28: ER100S-G EN ISO 16834-A: G 69 6 M21 Mn4Ni1,5CrMo (e.g. UNION NiMoCr)
Rm ≥ 760 MPa	AWS A5.5: E11018-GH4R EN ISO 18275-A: E 69 6 Mn2NiCrMo B 4 2 H5 (e.g. BÖHLER FOX EV 85)	AWS A5.28: ER110S-G EN ISO 16834-A: G 79 5 M21 Mn4Ni1,5CrMo (e.g. UNION X 85)
Rm ≥ 830 MPa	-	AWS A5.28: ER120S-G EN ISO 16834-A: G 89 6 M21 Mn4Ni2CrMo (e.g. UNION X 90) AWS A5.28: ER120S-G EN ISO 16834-A: G 89 5 M21 Mn4Ni2,5CrMo (e.g. UNION X 96)

[1] Minimum tensile strength Rm in untreated, as-welded condition

Should the respective structure require that welding seams feature the same level of wear resistance as the base material, the cover pass can be carried out using wear-resistant welding consumables.

Wear-resistant welding consumables

Hardness value of the welding consumable or pure weld metal [1]	Manual metal arc welding (111)	Gas-shielded metal arc welding (MAG, 135)
Hardness 370 HB	EN 14700: E Fe 1 (e.g. UTP DUR 350)	-
Hardness 450 HB	-	EN 14700: SZ Fe 2 (e.g. UTP A DUR 350)
Hardness 56–58 HRC	EN 14700: E Fe 8 (e.g. UTP DUR 600)	EN 14700: S Fe 8 (e.g. UTP A DUR 600)

[1] Typical hardness in HB or HRC in untreated, as-welded condition

durostat®

Laser welding (521, 522, 523) and laser hybrid welding

As compared to manual metal arc welding and gas-shielded metal arc welding, a lower tendency toward temper softening in the heat-affected zone and higher strength in the weld metal are the result of concentrated energy input and the associated increased cooling rate.

Please find further information and downloadable files at the following link:
www.voestalpine.com/Produktinformationsportal

voestalpine Steel Division
voestalpine-Straße 3
4020 Linz, Austria
T. +43/50304/15-8018
produktmanagement@voestalpine.com
www.voestalpine.com/steel

voestalpine
ONE STEP AHEAD.