

Mechanical properties, hot-rolled condition

Wall thickness mm	Yield strength R_{eH} min MPa	Tensile strength R_m min MPa	Elongation A_5 min %	Hardness ca HB
≤ 25	500	670	17	225
> 25	470	640	17	220
E470	470	640	17	220

Tolerances, hot-rolled

Outer diameter, OD tolerance mm	Wall tolerance mm
≤ 80	± 0,4 mm
> 80	± 0,5 % av YD
Level 2	± 0,5 % av YD
Execution Normal	± (5 % + 0,1 mm) (min ± 0,7 mm)
E470	
≤ 30 mm	± 12,5 %
> 30 mm	± 10 %

Tolerances, cold worked*

Outer diameter, OD tolerance mm	Wall thickness mm	Wall tolerance mm
< 60	≤ 6	± 0,20 mm
≥ 60	> 6 - < 8	± 0,25 mm
	≥ 8	± 0,30 mm
		± 0,35 mm
		± 0,40 mm

* Stress relieved

Straightness The maximum deviation from the straight line is 1 mm on a gauge length of 1,000 mm.

Ovality The ovality may amount to maximum 65 % of the total OD-tolerance.

Finish turned size Guaranteed finished turned size is valid up to a part length of max 3 x OD. For sizes with E470 tolerances the finished turned size is guaranteed up to a part length of max 600 mm.

Steel grades

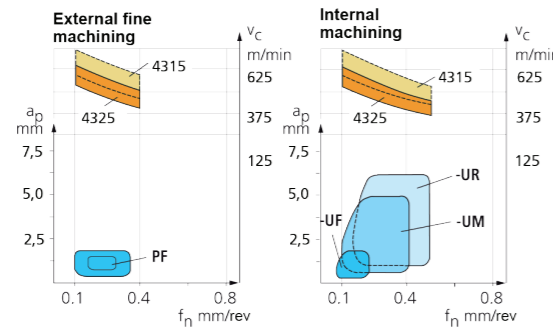
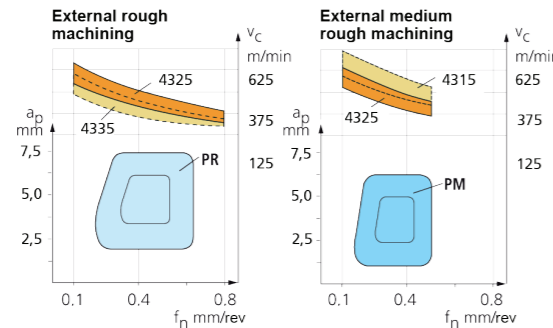
Valid steel grades	Replaced steel grades				
	Ovako	EN 10294	SS	DIN	AFNOR
280	E 470	2142	20MnV6	20MV6	

Chemical composition

	C %	Si %	Mn %	P %	S %	Cr %	Ni %
min	0.16	0.30	1.45				
max	0.20	0.40	1.60	0.025	0.040	0.30	0.20

Machining recommendations for hollow bar inserts Ovako 280/Sandvik Coromant P-Line

In the bottom part of the chipbreaking diagrams the innermost area indicates the limits for good chip forming. The cutting speed recommendations at the top of the diagrams shows the cutting speed interval where a 15 minutes tool life can be reached, i. e. recommended cutting speeds. The marked area shows two partially overlapping insert grades.



Definitions

a_p = cutting depth, mm
 f_n = feed, mm/rev
 v_c = cutting speed, m/min
 4315 etc = Coromant grade
 PR, PM, PF = Coromant insert geometry

The diagrams are based on tests performed by Sandvik Coromant and Ovako on the Ovako 280 hollow bar with Coromant inserts of the given grades and geometries.

Rough turning

Cutting tool: CNMG 120412-PM, GC 4025
 Wear out time: 15 minutes
 Wear out criterium: V_{bmax} 0.40 mm
 Nose radius: 1.2 mm
 Holder: PCLNL 2525 M12
 Cutting fluid: Oemeta S33 V24 5 %

Cutting depth, mm	Cutting speed, m/min and power, kW			
	1	2	3	4
0.25	480/5.3	400/8.8		
0.32	450/5.9	370/9.7	370/14.6	
0.40	420/6.5	340/10.4	310/14.3	295/18.1
0.50	380/6.8	290/10.4	260/14.0	260/18.7

Conversion factors

Tool P15: x 1.1
 Tool P35: x 0.85
 Forged or milled surface: x 0.7–0.9

Intermittent machining: x 0.8–0.9
 Internal turning: x 0.8
 Unstable conditions: x 0.7–0.9
 Turning in E 470: x 0.7 (SS 2142)

Fine turning

Cutting tool: CNMG 120404-PF CNMG 120408-PF GC 4015
 Wear out time: 15 minutes
 Wear out criterium: V_{bmax} 0,30 mm
 Holder: PCLNL 2525 M12
 Cutting fluid: Oemeta S33 V24 5 %
 Cutting depth: 1,0 mm

Surface roughness, R_a μ m	0.8	1.2	1.8	2.0
	Feed, mm/rev and cutting speed, m/min			
0.4	0.13/550	0.15/520	0.18/490	0.21/460
0.8	0.18/540	0.20/508	0.25/475	0.32/455

Conversion factors

Tool P10: x 1.1
 Tool P25: x 0.85
 Forged or milled surface: x 0.7–0.9

Intermittent machining: x 0.8–0.9
 Internal turning: x 0.8
 Unstable conditions: x 0.7–0.9
 Turning in E 470: x 0.7 (SS 2142)

Heat treatment

Ovako 280 tube is well suited for most commonly applied heat treatment processes. If properly executed, the result of the heat treatment will be very consistent, with small and predictable dimensional changes.

Normalizing: 900–920°C. Cooling in air.
 Stress relieving: 550–600°C. Soaking time 1–2 hours. Cool with the furnace or in air.
 Quenching and tempering: 900–920°C. Quench in water and temper at around 500°C for 1 hour.
 Case hardening: Carburizing at 850–950°C. Quenching from 780–830°C in oil or step bath. Tempering at 50–200°C for 1 hour
 Normal surface hardness: 58–63 HRC.
 Nitriding: 500–520°C. Surface hardness around 650 HV. Also suitable for ion nitriding.

Mechanical properties after heat treatment

Condition/wall thickness mm	Yield strength R_{eH} min MPa	Tensile strength R_m min, MPa	Elongation A_5 min %	Hardness ca HB	Impact strength KV min at -40°C, J
Normalized					
≤ 15	430	600	25	190	27
15–25	400	580	25	220	27
> 25	380	560	25	220	27
Q/T					
- 30	600	700	18	260	27
> 30	570	670	16	225	27

Welding

Ovako 280T has good welding properties and can be welded with all conventional welding methods. The low carbon equivalent means that 280T can be welded without preheating up to fairly large dimensions.

- For the best results welding should be continuous, and the weld should be slowly cooled in ambient air conditions.
- If the welding is performed in a damp environment or if the temperature is below 5°C the preheating temperature should be increased by 25°C.
- To minimize the effects of a mixed zone, the chemical composition of the filler metal should be similar to that of the base material.
- Hydrogen content should not exceed 5 ml/100 g weld metal.
- Post-heating directly after welding also assists the removal of hydrogen. It should be performed at 200°C, directly after welding, holding for 5 min/mm material thickness, for at least one hour.

Recommended working temperatures for welding with ferritic consumables

Combined wall thickness, mm							
10	20	30	40	50	60	70	80
20°C	75°C	100°C	125°C	150°C			

The recommended preheating temperatures are based upon a heat input around 1.7 kJ/mm and that the hydrogen content does not exceed 5 ml/100 g weld metal.

Typical filler metals

	ESAB	AWS	EN
MMA	OK 48.08	SFA/AWS A5.5 E8018-G	EN 499 E 46 5 1Ni B 32 HS
MIG/MAG	OK Autrod 12.64	SFA/AWS A5.18 ER70S-6	EN 440 G4Si1
SMAW	OK Tubrod 14.05	SFA/AWS A5.28 E70C-G	EN 758 T 42 4 Z M M 2 H10

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OVAKO 280
STOCK SIZES AND
TECHNICAL DATA

OVAKO

Stock sizes

Type	Nom. delivery size				Guaranteed finished size, mm				
	OD mm	wall mm	ID mm	Weight kg/m	outer chucking OD	inner chucking ID	outer chucking OD	inner chucking ID	
3020	30.7	6.10	18.5	3.70	30.0	20.0	29.20	19.20	CW
3525	35.7	6.10	23.5	4.47	35.0	25.0	34.20	24.20	CW
4020	40.7	11.15	18.4	8.15	40.0	20.0	39.10	19.10	CW
4030	40.7	6.10	28.5	5.22	40.0	30.0	39.20	29.20	CW
4525	45.7	11.15	23.4	9.53	45.0	25.0	44.10	24.10	CW
4530	45.7	8.65	28.4	7.92	45.0	30.0	44.10	29.20	CW
4535	45.7	6.10	33.5	5.97	45.0	35.0	44.20	34.20	CW
5025	50.7	13.65	23.4	12.51	50.0	25.0	49.10	24.10	CW
5030	50.7	11.15	28.4	10.90	50.0	30.0	49.10	29.10	CW
5035	51.4	9.55	32.3	9.86	50.0	35.0	48.80	34.00	HR
5040	51.4	7.05	37.3	7.73	50.0	40.0	48.80	39.00	CW
5530	56.4	14.7	27.0	15.12	55.0	30.0	53.50	28.70	HR
5535	56.4	12.1	32.3	13.18	55.0	35.0	53.80	34.00	HR
5540	56.4	9.6	37.3	11.03	55.0	40.0	53.80	39.00	HR
5545	56.4	7.1	42.3	8.58	55.0	45.0	53.80	44.00	HR
6030	61.4	17.3	26.8	18.82	60.0	30.0	58.30	28.50	HR
6035	61.4	14.7	32.0	16.93	60.0	35.0	58.50	33.70	HR
6040	61.4	12.1	37.3	14.67	60.0	40.0	58.80	39.00	HR
6045	61.4	9.6	42.3	12.21	60.0	45.0	58.80	44.00	HR
6234	63.6	16.3	31.1	18.98	62.2	34.2	60.60	32.80	HR
6241	63.6	12.3	39.1	15.51	62.2	41.8	61.00	40.80	HR
6251	63.6	7.4	48.9	10.20	62.2	51.6	61.00	50.60	HR
6535	66.4	17.4	31.7	20.99	65.0	35.0	63.30	33.40	HR
6540	66.4	14.7	37.0	18.74	65.0	40.0	63.50	38.70	HR
6545	66.4	12.1	42.3	16.15	65.0	45.0	63.80	44.00	HR
6550	66.4	9.6	47.3	13.39	65.0	50.0	63.80	49.00	HR
7035	71.4	20.0	31.5	25.31	70.0	35.0	68.00	33.20	HR
7040	71.4	17.4	36.7	23.13	70.0	40.0	68.30	38.40	HR
7045	71.4	14.7	42.0	20.56	70.0	45.0	68.50	43.70	HR
7050	71.4	12.1	47.2	17.70	70.0	50.0	68.80	48.90	HR
7055	71.4	9.6	52.3	14.57	70.0	55.0	68.80	54.00	HR
7038	71.6	18.3	35.0	24.05	70.2	38.4	68.40	36.70	HR
7047	71.6	13.8	44.0	19.67	70.2	46.9	68.80	45.70	HR
7057	71.6	8.4	54.8	13.09	70.2	57.6	69.00	56.50	HR
7540	76.4	20.0	36.4	27.82	75.0	40.0	73.00	38.10	HR
7545	76.4	17.4	41.7	25.27	75.0	45.0	73.30	43.40	HR
7550	76.4	14.7	47.0	22.37	75.0	50.0	73.50	48.70	HR
7555	76.4	12.1	52.2	19.19	75.0	55.0	73.80	53.90	HR
7560	76.4	9.6	57.2	15.81	75.0	60.0	73.80	58.90	HR

Type	Nom. delivery size				Guaranteed finished size, mm				
	OD mm	wall mm	ID mm	Weight kg/m	outer chucking OD	inner chucking ID	outer chucking OD	inner chucking ID	
8040	81.5	22.7	36.1	32.92	80.0	40.0	77.80	37.80	HR
8045	81.5	20.1	41.4	30.38	80.0	45.0	78.10	43.10	HR
8050	81.5	17.4	46.7	27.51	80.0	50.0	78.40	48.40	HR
8055	81.5	14.8	51.9	24.34	80.0	55.0	78.60	53.60	HR
8060	81.5	12.2	57.2	20.78	80.0	60.0	78.90	58.90	HR
8065	81.5	9.7	62.2	17.10	80.0	65.0	78.90	63.90	HR
8447	85.7	20.9	44.0	33.35	84.2	47.7	82.20	45.70	HR
8452	85.7	18.4	48.9	30.54	84.2	52.4	82.50	50.60	HR
8545	86.5	22.7	41.1	35.72	85.0	45.0	82.80	42.80	HR
8550	86.5	20.1	46.4	32.86	85.0	50.0	83.10	48.10	HR
8555	86.5	17.5	51.6	29.72	85.0	55.0	83.40	53.30	HR
8560	86.5	14.8	56.9	26.17	85.0	60.0	83.60	58.60	HR
8565	86.5	12.2	62.2	22.28	85.0	65.0	83.90	63.90	HR
8570	86.5	9.7	67.2	18.29	85.0	70.0	83.90	68.90	HR
9050	91.5	22.7	46.1	38.52	90.0	50.0	87.80	47.80	HR
8952	90.7	20.9	49.0	35.92	89.2	52.7	87.20	50.70	HR
9055	91.5	20.1	51.3	35.39	90.0	55.0	88.10	53.00	HR
9060	91.5	17.5	56.6	31.87	90.0	60.0	88.40	58.30	HR
9065	91.5	14.8	61.9	27.99	90.0	65.0	88.60	63.60	HR
9070	91.5	12.2	67.1	23.86	90.0	70.0	88.90	68.80	HR
9075	91.5	9.7	72.2	19.48	90.0	75.0	88.90	73.90	HR
9550	96.6	25.4	45.8	44.60	95.0	50.0	92.60	47.60	HR
9555	96.6	22.8	51.0	41.50	95.0	55.0	92.90	52.80	HR
9560	96.6	20.2	56.3	37.99	95.0	60.0	93.20	58.10	HR
9565	96.6	17.5	61.6	34.14	95.0	65.0	93.40	63.40	HR
9570	96.6	14.9	66.8	30.02	95.0	70.0	93.70	68.60	HR
9575	96.6	12.3	72.1	25.48	95.0	75.0	94.00	73.90	HR
9580	96.6	9.8	77.1	20.88	95.0	80.0	94.00	78.90	HR
10050	101.6	28.1	45.5	50.88	100.0	50.0	97.40	47.30	HR
10055	101.6	25.4	50.8	47.73	100.0	55.0	97.60	52.60	HR
10060	101.6	22.8	56.0	44.31	100.0	60.0	97.90	57.80	HR
10065	101.6	20.2	61.3	40.48	100.0	65.0	98.10	63.10	HR
10070	101.6	17.6	66.5	36.38	100.0	70.0	98.40	68.30	HR
10075	101.6	14.9	71.8	31.86	100.0	75.0	98.70	73.60	HR
10080	101.6	12.3	77.1	26.99	100.0	80.0	98.90	78.90	HR
10085	101.6	9.8	82.1	22.09	100.0	85.0	99.00	83.90	HR
10555	106.7	21.8	50.5	54.47	105.0	55.0	102.40	52.30	HR
10560	106.7	25.9	54.9	51.61	105.0	60.0	102.70	56.70	HR
10565	106.7	22.9	61.0	47.25	105.0	65.0	103.00	62.80	HR
10570	106.7	20.2	66.3	43.09	105.0	70.0	103.20	68.10	HR
10575	106.7	17.6	71.5	38.67	105.0	75.0	103.50	73.30	HR
10580	106.7	15.0	76.8	33.83	105.0	80.0	103.70	78.60	HR
10585	106.7	12.4	82.0	28.74	105.0	85.0	104.00	86.80	HR
10590	106.7	9.8	87.1	23.42	105.0	90.0	104.00	88.90	HR

Type	Nom. delivery size				Guaranteed finished size, mm				
	OD mm	wall mm	ID mm	Weight kg/m	outer chucking OD	inner chucking ID	outer chucking OD	inner chucking ID	
11060	111.7	28.2	55.4	58.00	110.0	60.0	107.40	57.20	HR
11065	111.7	25.5	60.7	54.21	110.0	65.0	107.70	62.50	HR
11166	112.7	25.4	61.9	54.69	111.0	66.2	108.70	63.70	HR
11070	111.7	22.9	66.0	50.07	110.0	70.0	107.90	67.80	HR
11075	111.7	20.3	71.2	45.67	110.0	75.0	108.20	73.00	HR
11080	111.7	17.6	76.5	40.84	110.0	80.0	108.45	78.30	HR
11085	111.7	15.0	81.8	35.67	110.0	85.0	108.70	83.60	HR
11090	111.7	12.4	87.0	30.26	110.0	90.0	109.00	88.80	HR
11095	111.7	9.8	92.1	24.63	110.0	95.0	109.00	94.00	HR
11560	116.7	30.8	55.1	65.25	115.0	60.0	112.10	56.90	HR
11565	116.7	28.2	60.4	61.47	115.0	65.0	112.40	62.20	HR
11570	116.7	25.5	65.7	57.35	115.0	70.0	112.60	67.50	HR
11575	116.7	22.9	70.9	52.97	115.0	75.0	112.90	72.70	HR
11580	116.7	20.3	76.2	48.17	115.0	80.0	113.20	78.00	HR
11585	116.7	17.6	81.5	43.01	115.0	85.0	113.40	83.30	HR
11590	116.7	15.0	86.7	37.62	115.0	90.0	113.70	88.50	HR
11595	116.7	12.4	92.0	31.78	115.0	95.0	113.90	93.90	HR
11766	118.8	28.5	61.9	63.39	117.0	66.5	114.40	63.70	HR
11774	118.8	24.5	69.9	56.89	117.0	74.1	114.80	71.70	HR
11782	118.8	20.0	78.9	48.63	117.0	82.7	115.30	80.70	HR
12065	121.8	30.9	60.1	69.20	120.0	65.0	117.20	61.90	HR
12070	121.8	28.2	65.4	65.09	120.0	70.0	117.40	67.20	HR
12075	121.8	25.6	70.6	60.73	120.0	75.0	117.70	72.40	HR
12080	121.8	23.0	75.9	55.95	120.0	80.0	118.00	77.70	HR
12085	121.8	20.3	81.2	50.81	120.0	85.0	118.20	83.00	HR
12090	121.8	17.7	86.4	45.44	120.0	90.0	118.50	88.20	HR
12095	121.8	15.1	91.7	39.62	120.0	95.0	118.70	93.60	HR
120100	121.8	12.4	97.0	33.45	120.0	100.0	119.00	98.90	HR
12570	126.8	30.9	65.1	73.00	125.0	70.0	122.20	66.90	HR
12575	126.8	28.2	70.4	68.57	125.0	75.0	122.40	72.20	HR
12580	126.8	25.6	75.6	63.89	125.0	80.0	122.70	77.40	HR
12585	126.8	23.0	80.9	58.78	125.0	85.0	123.00	82.70	HR
12590	126.8	20.4	86.1	53.42	125.0	90.0	123.20	88.00	HR
12595	126.8	17.7	91.4	47.62	125.0	95.0	123.50	93.30	HR
125100	126.8	15.1	9						