SHIPBUILDING STEEL PRODUCTS HANDBOOK

DIMENSIONS – WEIGHT – GRADE – REGULATIONS

Bulbflats

Shipbuilding Plates

Merchant Bars

Shotblasting and Painting

In-house Tests

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BAGLIETTO

Throughout Three Centuries

BAGLIETTO

BAGLIETTO is one of the leading suppliers of steel and aluminum to the Shipbuilding and Ship Repair Industry worldwide, with an experience of more than 100 years in the field.

BAGLIETTO manage about 40.000 ton of material in various shapes, grades and types for marine, off-shore and naval applications.

Stock availability, quick delivery, competence and a complete package of services offered to Customers, such as blasting and painting, nesting, cutting, forming, bending and in-house tests, are the strong points that led to the success of BAGLIETTO, who nowadays has gained an excellent reputation as reliable international Steel and Aluminum Stockholding and Trading Company.

Laboratory for mechanical tests
and chemical analysis

LABORATORY FOR CHEMICAL ANALYSIS AND MECHANICAL TEST

The laboratory is approved by the following Classification Societies:

- **ABS** - American Bureau Veritas
- **BV** - Bureau Veritas
- **DNV/GL** – Det Norske Veritas and Germanischer Lloyd
- **LRS** - Lloyd's Register of Shipping
- **RINA** - Registro Italiano navale

Also, possibility to carry out testing for the following Classification Societies:

- **RMRS** - Russian Maritime Register of Shipping
- **NK** - Nippon Kaiji Kyokai
- **IRS** – Indian Register of Shipping
- **CRS** - Croatian Register of Shipping

STEEL FOR SHIP BUILDING

Yield strength R_{eH} minimum, [N/mm²]	R.I.Na.	Lloyds Register of Shipping	Det Norske Veritas	Germanischer Lloyd	Bureau Veritas	American Bureau of Shipping	Russian Register
Normal strength steel							
235	A	A	A	A	A	A	A
	B	B	B	B	B	B	B
	D	D	D	D	D	D	D
	E	E	E	E	E	E	E
Hight strength steel							
265		A 27 S		NV A 27 S			
		D 27 S		NV D 27 S			
		E 27 S		NV E 27 S			
315	AH 32	AH 32	NV A 32	A 32	AH32	AH 32	A32
	DH 32	DH 32	NV 32	D 32	DH 32	DH 32	D 32
	EH 32	EH 32	NV E 32	E 32	EH 32	EH 32	E 32
355	AH 36	AH 36	NV A 36	A 36	AH 36	AH 36	A 36
	DH 36	DH 36	NV D 36	D 36	DH 36	DH 36	D 36
	EH 36	EH 36	NV E 36	E 36	EH 36	EH 36	E 36
390	A 40	A 40	NVA 40	A 40			
	D 40	D 40	NVD 40	D 40			
	E 40	E 40	NVE 40	E 40			

STRUCTURAL STEEL

UNI-EN	EN	EN	DIN	NF	BS	UNE	UNI	NBN	ASTM	JIS
10025-95	**10025-95**	**10025:1990**	**17100-80**	**A35-501-81**	**4360-79**	**36080**	**7070-82**	**A21-01/76**		**G3101-87**
S185	1.0035	Fe 310-0	ST 33	A 33		A 310-0	Fe 320	A 320	–	–
S235JR	1.0037	Fe 360 B	St 37-2	E 24-2			Fe 360 B	AE 235-B	–	–
S235JRG1	1.0036	Fe 360 BFU	USt37-2			AE235B-FU		–	–	
S235JRG2	1.0038	Fe 360 BFN	RSt 37-2		40 B	AE235B-FN			–	–
S235J0	1.0114	Fe 360 C	St 37-3 U	E 24-3	40 C	AE 235 C	Fe 360-C	AE 235-C	A 36-70a	SS 400
S235J2G3	1.0116	Fe 360 D1	St 37-3 N	E 24-4	40 D	AE 235 D	Fe 360 D	AE 235-D	–	–
S235J2G4	1.0117	Fe 360 D2	-		43 B		Fe 430 B	AE 255-B	–	–
S275JR	1.0044	Fe 430 B	St 44-2	E 28-2	43 C	AE 275 B	Fe 430 C	AE 255-C	A 529-70a	–
S275J0	1.0143	Fe 430 C	St 44-3 U	E 28-3	43 D	AE 275 C	Fe 430 D	AE 255-D	–	
S275J2G3	1.0144	Fe 430 D1	St 44-3 N	E 28-4	50 B			–	–	
S275J2G4	1.0145	Fe 430 D2	_		50 C	AE 275 D	Fe 510 B	AE 355-B	–	–
S355JR	1.0045	Fe 510 B	–	E 36-2	50 D	AE 355 B	Fe 510 C	AE 355-C	A 440-70a	–
S355J0	1.0553	Fe 510 C	St 52-3 U	E 36-3	50 DD	AE 355 C	Fe 510 D	AE 355-D	A 441-70a	–
	1.057	Fe 510 D1	St 52-3 N			AE 355 D		AE 355-DD	–	SS 540
S355J2G4	1.0577	Fe 510 D2	–						–	–
S355K2G3	1.0595	Fe 510 DD1	–	E 36-4					–	–
S355K2G4	1.0596	Fe 510 DD2	–						–	–
E295	1.005	Fe 490-2	St 50-2	A 50-2		A 490	Fe 490	A 490-2 gr. 70	A 306-64 and 75	SS 490
E355	1.006	Fe 590-2	St 60-2			A 590	Fe 590	A 590-2 gr 80	A 306-64	–
E360	1.007	Fe 690-2	St 70-2	A 70-2		A 690	Fe 690	A 690-2	–	–

CHEMICAL COMPOSITION AND MECHANICAL CHARACTERISTICS

In this section we describe mechanical tests and chemical analysis for the material used in the shipbuilding field according to Unified Requirement IACS (International Association of Classification Societies) UR W11 (Rev.6 May 2004).

Chemical composition

Chemical composition and deoxidation practice for normal strength steels

Grade	A	B	D	E
Deoxidation Practice	For t ≤ 50 mm Any method except rimmed steel (1) For t > 50 mm Killed	For t ≤ 50 mm Any method except rimmed For t > 50 mm Killed	For t ≤ 25mm killed For t > 25 mm Killed and fine grain treated fine grain treated	Killed and fine grain treated
Chemical Carbon Composition % (ladle samples) (4) (7) (8)	plus of the manganese content is not to exceed 0,40%			
C max.	0,21 (2)	0,21	0,21	0,18
Mn min.	2,5 x C	0,80 (3)	0,6	0,7
Si max.	0,5	0,35	0,35	0,35
P max.	0,035	0,035	0,035	0,035
S max.	0,035	0,035	0,035	0,035
Al (acid soluble) min.	–	–	0,015 (5) (6)	0,015 (6)

t = thickness

Notes:

1. Grade A sections up to a thickness of 12.5 mm may be accepted in rimmed steel subject to the special approval of the Classification Society.
2. Max. 0.23% for sections.
3. When Grade B steel is impact tested the minimum manganese content may be reduced to 0.60%.
4. When any grade of steel is supplied in the thermo-mechanically rolled condition variations in the specified chemical composition may be allowed or required by the Classification Society.
5. For Grade D steel over 25 mm thick.
6. For Grade D steel over 25 mm thick and Grade E steel the total aluminium content may be determined instead of acid soluble content. In such cases the total aluminium content is to be not less than 0.020%. A maximum aluminium content may also be specified by the Classification Society. Other suitable grain refining elements may be used subject to the special approval of the Classification Society.
7. The Classification Society may limit the amount of residual elements which may have an adverse effect on the working and use of the steel, e.g. copper and tin.
8. Where additions of any other element have been made as part of the steelmaking practice, the content is to be indicated.

CHEMICAL COMPOSITION AND DEOXIDATION PRACTICE FOR HIGHER STRENGTH STEELS

Grade (1)	A32 D32 E32 F32 A36 D36 E36 F36 A40 D40 E40 F40
Deoxidation Practice	*killed and finegrain treated*
Chemical Composition % (5) (7) (ladle samples)	
C max.	0.18 / 0.16
Mn	0.90 - 1.60 (2) / 0.90-1.60
Si max.	0.50 / 0.50
P max.	0.035 / 0.025
S max.	0.035 / 0.025
Al (acid soluble) min.	0.015 (3) (4) / 0.015 (3) (4)
Nb	0.02 - 0.05 (4)total: / 0.02-0.05(4)) total:
V	0.05 - 0.10 (4)) 0.12 / 0.05-0.10(4)) 0.12
Ti max.	0.02) max. / 0.02) max.
Cu max.	0.35 / 0.35
Cr max.	0.20 / 0.20
Ni max.	0.40 / 0,08
Mo max.	0.08 / 0.08
N max.	- / 0.009 (0.012 if Al is present)
Carbon Equivalent (6)	

Notes:

1. The letter "H" may be added either in front or behind the grade mark e.g. HA 32 or AH 32.
2. Up to a thickness of 12.5 mm the minimum manganese content may be reduced to 0.70%.
3. The total aluminium content may be determined instead of the acid soluble content. In such cases the total aluminium content is to be not less than 0.020%.
4. The steel is to contain aluminium, niobium, vanadium or other suitable grain refining elements, either singly or in any combination. When used singly the steel is to contain the specified minimum content of the grain refining element. When used in combination, the specified minimum content of a fine graining element is not applicable.
5. When any grade of higher strength steel is supplied in the thermo-mechanically rolled condition variations in the specified chemical composition may be allowed or required by the Classification Society.
6. When required, the carbon equivalent value is to be calculated from the ladle analysis using the following formula.

$$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \ (\%)$$

This formula is applicable only to steels which are basically of the carbon-manganese type and gives a general indication of the weldability of the steel.

7. Where additions of any other element have been made as part of steelmaking practice, the content is to be indicated.

For Thermo-Mechanical Rolling, TM (**Thermo-Mechanical Controlled Processing, TMCP**) steels the following special requirements apply:

(i) The carbon equivalent value is to be calculated from the ladle analysis using the following formula and to comply with the requirements of Table 3;

$$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \ (\%)$$

(ii) The following formula (cold cracking susceptibility) may be used for evaluating weldability instead of the carbon equivalent at the discretion of the Classification Society;

$$Ceq = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B\%$$

In such cases the cold cracking susceptibility value required may be specified by the Classification Society.

CARBON EQUIVALENT FOR HIGHER STRENGTH STEELS UP TO 100MM IN THICKNESS PRODUCED BY TM.

Grade	Carbon Equivalent, max. (%) (1)	
	t < 50	50 < t < 100
A32, D32, E32, F32	0.36	0.38
A36, D36, E36, F36	0.38	0.40
A40, D40, E40, F40	0.40	0.42

t: thickness (mm)

Notes:

1. It is a matter for the manufacturer and shipbuilder to mutually agree in individual cases as to whether they wish to specify a more stringent carbon equivalent.

Mechanical Properties

For tensile test either the upper yield stress (ReH) or where ReH cannot be determined, the 0.2 percent proof stress (Rp 0.2) is to be determined and the material is considered to comply with the requirements if either value meets or exceeds the specified minimum value for yield strength (Re). The results obtained from tensile tests are to comply with the appropriate requirements following tables.

Mechanical properties for normal strength steels

Grade	Yield Strength ReH (N/mm2) min	Tensile Strength Rm (N/mm2)	Elongation ($5.65\sqrt{S_O}$) A5 (%)	Impact Test					
				Test Temp. °C	Average Impact Energy (J) min					
					t ≤ 50		50 <t ≤ 70		70 <t ≤ 100	
					Long (3)	Trans (3)	Long (3)	Trans (3)	Long (3)	Trans (3)
A	235	400/500 (1)	22 (2)	+20	–	–	34(5)	24(5)	41(5)	27(5)
B				0	27 (4)	20 (4)	34	24	41	27
D				-20	27	20	34	24	41	27
E				-40	27	20	34	24	41	27

t: thickness (mm)

Notes:

1. For all thicknesses of Grade A sections the upper limit for the specified tensile strength range may be exceeded at the discretion of the Classification Society.
2. For full thickness flat tensile test specimens with a width of 25 mm and a gauge length of 200mm the elongation is to comply with the following minimum values :

Thickness mm	>5 ≤ 5	> 10 ≤ 15	> 15 ≤ 20	> 20 ≤ 25	> 25 ≤ 30	> 30 ≤ 40	> 40 ≤ 50
Elongation %	14	16	17	18	19	20	21	22

3. See NOTE i)
4. Charpy V-notch impact tests are generally not required for Grade B steel with thickness of 25 mm or less.
5. Impact tests for Grade A over 50 mm thick are not required when the material is produced using fine grain practice and furnished normalised. TM rolling may be accepted without impact testing at the discretion of the Society.

MECHANICAL PROPERTIES FOR HIGHER STRENGTH STEELS

Grade	Yield Strength ReH (N/mm2) min	Tensile Strength Rm (N/mm2)	Elongation ($5.65\cdot\sqrt{S_O}$) A5 (%)	Impact Test						
				Test Temp. °C	Average Impact Energy (J) min					
					t ≤ 50		50 <t ≤ 70		70 <t ≤ 100	
					Long (3)	Trans (3)	Long (3)	Trans (3)	Long (3)	Trans (3)
A32 D32 E32 F32	315	440/570	22 (1)	0	31(3)	22(3)	38	26	46	31
				-20	31	22	38	26	46	31
				-40	31	22	38	26	46	31
				-60	31	22	38	26	46	31
A36 D36 E36 F36	355	490/630	21 (1)	0	34(3)	24(3)	41	27	50	34
				-20	34	24	41	27	50	34
				-40	34	24	41	27	50	34
				-60	34	24	41	27	50	34
A40 D40 E40 F40	390	510/660	20 (1)	0	39	26	46	31	55	37
				-20	39	26	46	31	55	37
				-40	39	26	46	31	55	37
				-60	39	26	46	31	55	37

t: thickness (mm)

NOTES:

1. For full thickness flat tensile test specimens with a width of 25mm and a gauge length of 200 mm the elongation is to comply with the following minimum values:

Thickness mm	Grade	≤ 5	> 5 ≤ 10	> 10 ≤ 15	> 15 ≤ 20	> 20 ≤ 25	> 25 ≤ 30	> 30 ≤ 40	> 40 ≤ 50
Elongation %	A32, D32, E32 & F32	14	16	17	18	19	20	21	22
	A36, D36, E36 & F36	13	15	16	17	18	19	20	21
	A40, D40, E40 & F40	12	14	15	16	17	18	19	20

2. See paragraph W11.6.3.

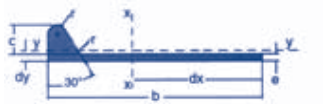
3. For Grades A32 and A36 steels a relaxation in the number of impact tests for acceptance purposes may be permitted by special agreement with the Classification Society provided that satisfactory results are obtained from occasional check tests.

i. Minimum average energy values are specified for Charpy V-notch impact test specimens taken in either the longitudinal or transverse directions (see W11.12.2). Generally only longitudinal test specimens need to be prepared and tested except for special applications where transverse test specimens may be required by the purchaser or the Classification Society. Transverse test results are to be guaranteed by the supplier.

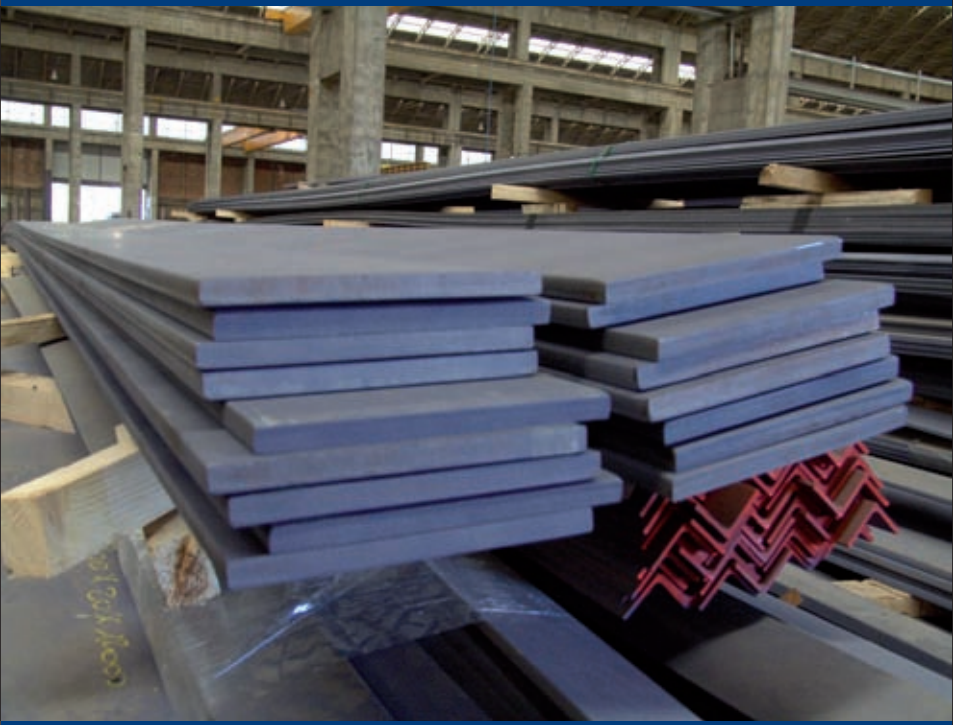
STEEL PLATES

Weight m² per kg	Thickness mm	Weight m² per kg	Thickness mm
32	4	**256**	32
36	4.5	**264**	33
40	5	**272**	34
44	5,5	**280**	35
48	6	**288**	36
52	6,5	**296**	37
56	7	**304**	38
60	7.5	**312**	39
64	8	**320**	40
68	8,5	**328**	41
72	9	**336**	42
76	9,5	**344**	43
80	10	**352**	44
84	10,5	**360**	45
88	11	**368**	46
92	11.5	**376**	47
96	12	**384**	48
100	12,5	**392**	49
104	13	**400**	50
108	13,5	**440**	55
112	14	**480**	60
116	14,5	**520**	65
120	15	**560**	70
124	15.5	**600**	75
128	16	**640**	80
136	17	**680**	85
144	18	**720**	90
152	19	**760**	95
160	20	**800**	100
168	21	**880**	110
176	22	**960**	120
184	23	**1040**	130
192	24	**1120**	140
200	25	**1200**	150
208	26	**1280**	160
216	27	**1360**	170
224	28	**1440**	180
232	29	**1520**	190
240	30	**1600**	200
248	31	**256**	32

BULB FLATS ROLLED



Width	Thickness	Weight	Height	Radius	Area		Inertia	Modulus
b	e	w	c	r	A	dx	Ix	Wx
mm	mm	Kg/m	mm	mm	cm^2	cm	cm^4	cm^3
60	**4**	**2,81**	13	3,5	3,58	3,82	12,2	3,2
	5	**3,28**	13	3,5	4,18	3,70	14,4	3,89
	6	**3,75**	13	3,5	4,78	3,62	16,4	4,55
80	**5**	**4,24**	14	4	5,4	4,89	33,8	6,91
	6	**4,87**	14	4	6,2	4,78	39,0	8,15
	7	**5,55**	14	4	7,0	4,69	43,3	9,24
100	**5**	**5,28**	15,5	4,5	6,72	6,14	66,4	10,4
	6	**6,08**	15,5	4,5	7,74	5,98	76,1	12,7
	7	**6,86**	15,5	4,5	8,74	5,87	85,5	14,5
	8	**7,65**	15,5	4,5	9,74	5,78	94,3	16,3
120	**6**	**7,31**	17	5	9,31	7,20	133	18,5
	7	**8,25**	17	5	10,5	7,07	148	20,9
	8	**9,19**	17	5	11,7	6,96	164	23,6
140	**7**	**9,74**	19	5,5	12,4	8,31	241	29
	8	**10,83**	19	5,5	13,8	8,18	266	32,5
	9	**11,92**	19	5,5	15,2	8,07	291	36
	10	**13,03**	19	5,5	16,6	7,92	316	39,9
160	**7**	**11,4**	22	6	14,6	9,66	373	38,6
	8	**12,7**	22	6	16,2	9,49	411	43,3
	9	**14,0**	22	6	17,8	9,36	448	47,9
	10	**15,3**	22	6	19,4	9,30	485	52,3
180	**8**	**14,8**	25	7	18,9	10,90	609	55,9
	9	**16,2**	25	7	20,7	10,70	663	61,8
	10	**17,6**	25	7	22,5	10,60	717	67,8
	11	**19,0**	25	7	24,3	10,50	770	73,5
200	**9**	**18,5**	28	8	23,6	12,10	941	77,7
	10	**20,1**	28	8	25,6	11,90	1020	85
	11	**21,7**	28	8	27,6	11,80	1090	92,3
	11,5	**22,5**	28	8	28,6	11,70	1126	96,2
	12	**23,4**	28	8	29,6	11,70	1160	99,6
220	**10**	**22,8**	31	9	29,0	13,40	1400	105
	11	**24,5**	31	9	31,2	13,20	1500	113
	11,5	**25,4**	31	9	32,3	13,10	1550	118,3
	12	**26,2**	31	9	33,4	13,00	1530	122
240	**10**	**25,4**	34	10	32,4	14,70	1860	126
	11	**27,4**	34	10	34,9	14,60	2000	137
	12	**29,3**	34	10	37,3	14,40	2130	148
260	**10**	**28,3**	37	11	36,1	16,20	2430	153
	11	**30,3**	37	11	38,7	16,00	2610	162
	12	**32,4**	37	11	41,3	15,80	2770	175
280	**11**	**33,5**	40	12	42,6	17,40	3330	191
	12	**35,7**	40	12	45,6	17,20	3550	206
	13	**37,9**	40	12	48,3	17,00	3760	221
300	**11**	**36,7**	43	13	46,7	18,90	4190	222
	12	**39**	43	13	49,7	18,70	4460	239
	13	**41,5**	43	13	52,8	18,50	4720	256
320	**12**	**42,5**	46	14	54,2	20,10	5530	274
	13	**45,0**	46	14	57,4	19,90	5850	294
	14	**47,5**	46	14	60,7	19,70	6170	313
340	**12**	**46,1**	49	15	58,8	21,50	6760	313
	13	**48,8**	49	15	62,2	21,30	7160	335
	14	**51,5**	49	15	65,5	21,10	7540	357
	15	**54,2**	49	15	68,9	20,90	7920	379
370	**13**	**54,6**	53,5	16,5	69,9	23,50	9470	402
	14	**57,5**	53,5	16,5	73,3	23,20	9980	428
	15	**60,5**	53,5	16,5	77,0	23,00	10490	455
400	**14**	**63,9**	58	18	81,4	25,50	12930	507
	15	**67,0**	58	18	85,4	25,20	13580	537
	16	**70,2**	58	18	89,4	25,00	14220	568
430	**15**	**73,9**	62,5	19,5	94,1	27,40	17260	628
	17	**80,6**	62,5	19,5	103,0	26,90	18860	700



FLAT BARS

Width b [mm]
Weight per m in kg

Thickness a [mm]

	20	25	30	35	40	50	60	70	80
5	0,785	0,981	1,178	1,374	1,570	1,963	2,355	2,748	3,140
6	0,942	1,178	1,413	1,649	1,884	2,355	2,826	3,297	3,768
7	1,099	1,374	1,649	1,923	2,198	2,748	3,297	3,847	4,396
8	1,256	1,570	1,884	2,198	2,512	3,140	3,768	4,396	5,024
9	1,413	1,766	2,120	2,473	2,826	3,533	4,239	4,946	5,652
10	1,570	1,963	2,355	2,748	3,140	3,925	4,710	5,495	6,280
11	1,727	2,159	2,591	3,022	3,454	4,318	5,181	6,045	6,908
12	1,884	2,355	2,826	3,297	3,768	4,710	5,652	6,594	7,536
13	2,041	2,551	3,062	3,572	4,082	5,103	6,123	7,144	8,164
14	2,198	2,748	3,297	3,847	4,396	5,495	6,594	7,693	8,792
15	2,355	2,944	3,533	4,121	4,710	5,888	7,065	8,243	9,420
16	2,512	3,140	3,768	4,396	5,024	6,280	7,536	8,792	10,048
17	2,669	3,336	4,004	4,671	5,338	6,673	8,007	9,342	10,676
18	2,826	3,533	4,239	4,946	5,652	7,065	8,478	9,891	11,304
19		3,729	4,475	5,220	5,966	7,458	8,949	10,441	11,932
20		3,925	4,710	5,495	6,280	7,850	9,420	10,990	12,560
21			4,946	5,770	6,594	8,243	9,891	11,540	13,188
22			5,181	6,045	6,908	8,635	10,362	12,089	13,816
23			5,417	6,319	7,222	9,028	10,833	12,639	14,444
24			5,652	6,594	7,536	9,420	11,304	13,188	15,072
25			5,888	6,869	7,850	9,813	11,775	13,738	15,700
26				7,144	8,164	10,205	12,246	14,287	16,328
27				7,418	8,478	10,598	12,717	14,837	16,956
28				7,693	8,792	10,990	13,188	15,386	17,584
29				7,968	9,106	11,383	13,659	15,936	18,212
30				8,243	9,420	11,775	14,130	16,485	18,840
31					9,734	12,168	14,601	17,035	19,468
32					10,048	12,560	15,072	17,584	20,096
33					10,362	12,953	15,543	18,134	20,724
34					10,676	13,345	16,014	18,683	21,352
35					10,990	13,738	16,485	19,233	21,980
36						14,130	16,956	19,782	22,608
37						14,523	17,427	20,332	23,236
38						14,915	17,898	20,881	23,864
39						15,308	18,369	21,431	24,492
40						15,700	18,840	21,980	25,120
45							21,195	24,728	28,260
50							23,550	27,475	31,400
55								30,223	34,540
60								32,970	37,680
65									40,820
70									43,960

FLAT BARS

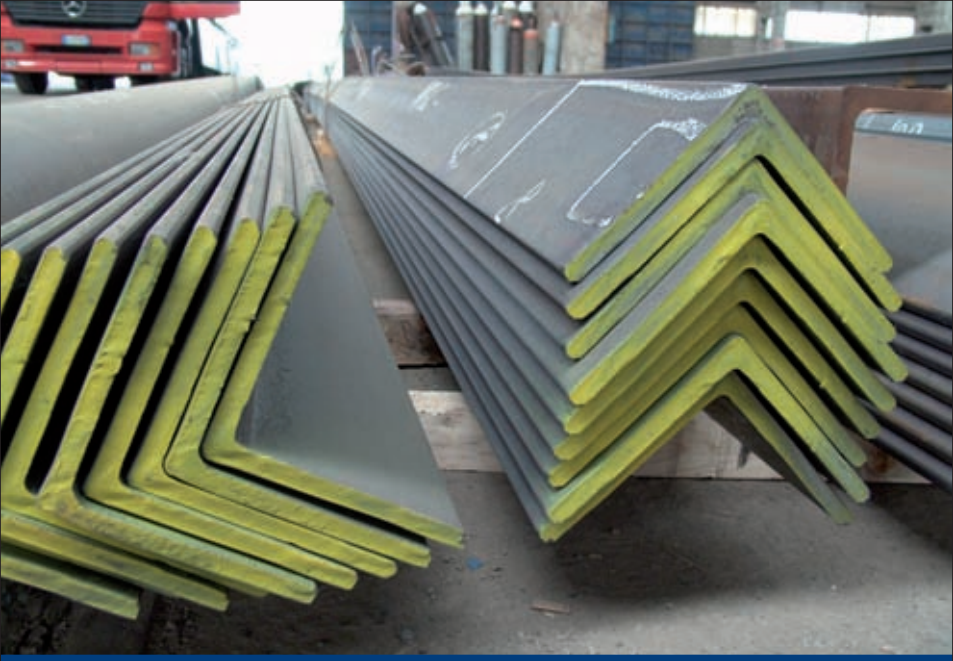
Width b [mm]
Weight per m in kg

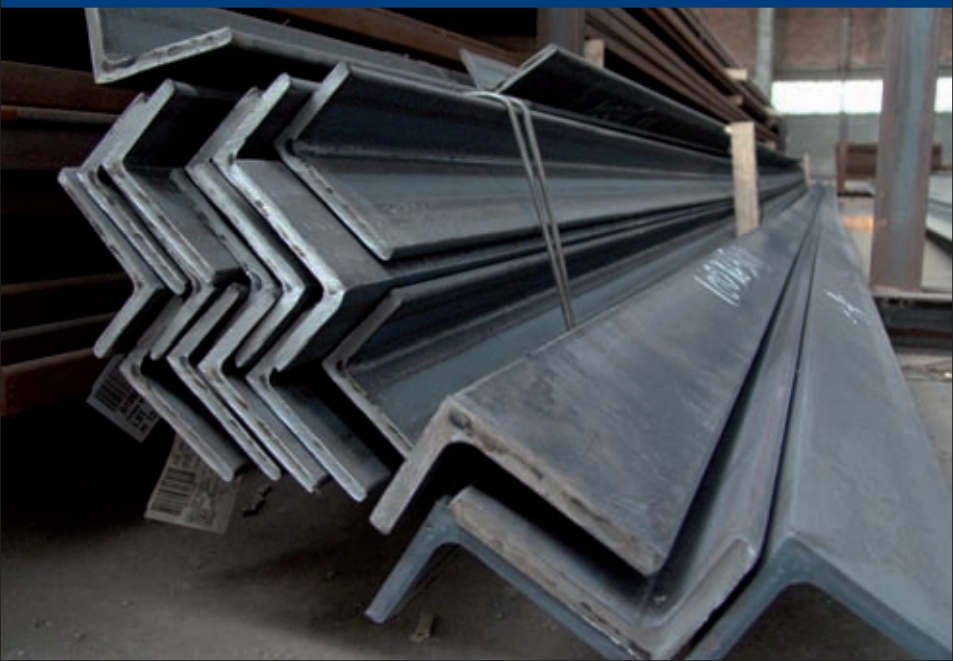
Thickness a [mm]	90	100	110	120	130	140	150
5	3,533	3,925	4,318	4,710	5,103	5,495	5,888
6	4,239	4,710	5,181	5,652	6,123	6,594	7,065
7	4,946	5,495	6,045	6,594	7,144	7,693	8,243
8	5,652	6,280	6,908	7,536	8,164	8,792	9,420
9	6,359	7,065	7,772	8,478	9,185	9,891	10,598
10	7,065	7,850	8,635	9,420	10,205	10,990	11,775
11	7,772	8,635	9,499	10,362	11,226	12,089	12,953
12	8,478	9,420	10,362	11,304	12,246	13,188	14,130
13	9,185	10,205	11,226	12,246	13,267	14,287	15,308
14	9,891	10,990	12,089	13,188	14,287	15,386	16,485
15	10,598	11,775	12,953	14,130	15,308	16,485	17,663
16	11,304	12,560	13,816	15,072	16,328	17,584	18,840
17	12,011	13,345	14,680	16,014	17,349	18,683	20,018
18	12,717	14,130	15,543	16,956	18,369	19,782	21,195
19	13,424	14,915	16,407	17,898	19,390	20,881	22,373
20	14,130	15,700	17,270	18,840	20,410	21,980	23,550
21	14,837	16,485	18,134	19,782	21,431	23,079	24,728
22	15,543	17,270	18,997	20,724	22,451	24,178	25,905
23	16,250	18,055	19,861	21,666	23,472	25,277	27,083
24	16,956	18,840	20,724	22,608	24,492	26,376	28,260
25	17,663	19,625	21,588	23,550	25,513	27,475	29,438
26	18,369	20,410	22,451	24,492	26,533	28,574	30,615
27	19,076	21,195	23,315	25,434	27,554	29,673	31,793
28	19,782	21,980	24,178	26,376	28,574	30,772	32,970
29	20,489	22,765	25,042	27,318	29,595	31,871	34,148
30	21,195	23,550	25,905	28,260	30,615	32,970	35,325
31	21,902	24,335	26,769	29,202	31,636	34,069	36,503
32	22,608	25,120	27,632	30,144	32,656	35,168	37,680
33	23,315	25,905	28,496	31,086	33,677	36,267	38,858
34	24,021	26,690	29,359	32,028	34,697	37,366	40,035
35	24,728	27,475	30,223	32,970	35,718	38,465	41,213
36	25,434	28,260	31,086	33,912	36,738	39,564	42,390
37	26,141	29,045	31,950	34,854	37,759	40,663	43,568
38	26,847	29,830	32,813	35,796	38,779	41,762	44,745
39	27,554	30,615	33,677	36,738	39,800	42,861	45,923
40	28,260	31,400	34,540	37,680	40,820	43,960	47,100
45	31,793	35,325	38,858	42,390	45,923	49,455	52,988
50	35,325	39,250	43,175	47,100	51,025	54,950	58,875
55	38,858	43,175	47,493	51,810	56,128	60,445	64,763
60	42,390	47,100	51,810	56,520	61,230	65,940	70,650
65	45,923	51,025	56,128	61,230	66,333	71,435	76,538
70	49,455	54,950	60,445	65,940	71,435	76,930	82,425

WIDE FLAT BARS

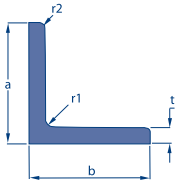
Width b [mm]
Weight per m in kg

Thickness a [mm]	160	170	180	200	220	250	300	350	400	450	500
5	6,280	6,673	7,065	7,850	8,635	9,813	11,775	13,738	15,700	17,663	19,625
6	7,536	8,007	8,478	9,420	10,362	11,775	14,130	16,485	18,840	21,195	23,550
7	8,792	9,342	9,891	10,990	12,089	13,738	16,485	19,233	21,980	24,728	27,475
8	10,048	10,676	11,304	12,560	13,816	15,700	18,840	21,980	25,120	28,260	31,400
9	11,304	12,011	12,717	14,130	15,543	17,663	21,195	24,728	28,260	31,793	35,325
10	12,560	13,345	14,130	15,700	17,270	19,625	23,550	27,475	31,400	35,325	39,250
12	15,072	16,014	16,956	18,840	20,724	23,550	28,260	32,970	37,680	42,390	47,100
14	17,584	18,683	19,782	21,980	24,178	27,475	32,970	38,465	43,960	49,455	54,950
16	20,096	21,352	22,608	25,120	27,632	31,400	37,680	43,960	50,240	56,520	62,800
18	22,608	24,021	25,434	28,260	31,086	35,325	42,390	49,455	56,520	63,585	70,650
20	25,120	26,690	28,260	31,400	34,540	39,250	47,100	54,950	62,800	70,650	78,500
22	27,632	29,359	31,086	34,540	37,994	43,175	51,810	60,445	69,080	77,715	86,350
25	31,400	33,363	35,325	39,250	43,175	49,063	58,875	68,688	78,500	88,313	98,125
27	33,912	36,032	38,151	42,390	46,629	52,988	63,585	74,183	84,780	95,378	105,975
30	37,680	40,035	42,390	47,100	51,810	58,875	70,650	82,425	94,200	105,975	117,750
35	43,960	46,708	49,455	54,950	60,445	68,688	82,425	96,163	109,900	123,638	137,375
40	50,240	53,380	56,520	62,800	69,080	78,500	94,200	109,900	125,600	141,300	157,000
45	56,520	60,053	63,585	70,650	77,715	88,313	105,975	123,638	141,300	158,963	176,625
50	62,800	66,725	70,650	78,500	86,350	98,125	117,750	137,375	157,000	176,625	196,250
55	69,080	73,398	77,715	86,350	94,985	107,938	129,525	151,113	172,700	194,288	215,875
60	75,360	80,070	84,780	94,200	103,620	117,750	141,300	164,850	188,400	211,950	235,500
65	81,640	86,743	91,845	102,050	112,255	127,563	153,075	178,588	204,100	229,613	255,125
70	87,920	93,415	98,910	109,900	120,890	137,375	164,850	192,325	219,800	247,275	274,750
75	94,200	100,088	105,975	117,750	129,525	147,188	176,625	206,063	235,500	264,938	294,375
80	100,480	106,760	113,040	125,600	138,160	157,000	188,400	219,800	251,200	282,600	314,000
85	106,760	113,433	120,105	133,450	146,795	166,813	200,175	233,538	266,900	300,263	333,625
90	113,040	120,105	127,170	141,300	155,430	176,625	211,950	247,275	282,600	317,925	353,250
95	119,320	126,778	134,235	149,150	164,065	186,438	223,725	261,013	298,300	335,588	372,875
100	125,600	133,450	141,300	157,000	172,700	196,250	235,500	274,750	314,000	353,250	392,500



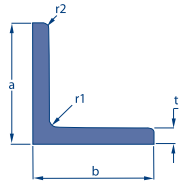


EQUAL ANGLES



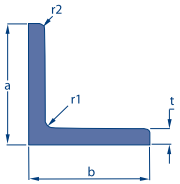
height a x width b [mm]		Weight per m in kg Thickness t [mm]										
a	b	3	4	5	6	7	8	9	10	11	12	13
15	15	0,64	0,83									
20	20	0,88	1,14									
25	25	1,12	1,46	1,78								
30	30	1,36	1,78	2,18	2,56							
35	35	1,60	2,09	2,57	3,04							
40	40	1,84	2,42	2,97	3,52							
45	45	2,09	2,74	3,38	4,00	4,60						
50	50	2,33	3,06	3,77	4,47	5,15	5,82					
55	55		3,38	4,18	4,95	5,77	6,46					
60	60		3,70	4,57	5,42	6,31	7,09	7,90	8,69			
65	65			4,97	5,91	6,83		8,62				
70	70			5,37	6,38	7,38	8,36	9,34	10,03	11,20		
75	75			5,87	6,87	7,94	9,03	9,96	11,10		13,10	
80	80			6,17	7,34	8,49	9,63	10,67	11,90		14,00	
90	90				8,30	9,61	10,8	12,20	13,40	14,70	15,90	17,10
100	100			7,90	9,20	10,7	12,20	13,50	15,00		17,80	
110	110				10,2	11,80	13,50	15,00	16,60		19,70	
120	120				11,14		14,80	16,50	18,20	19,90	21,60	23,30
130	130						16,00		19,80	21,80	23,60	25,50
140	140								21,70	23,70	25,60	27,50
150	150								23,00		27,30	29,40
160	160											
180	180											
200	200											
250	250											

EQUAL ANGLES



height a x width b [mm]		Weight per m in kg Thickness t [mm]											
a	b	14	15	16	17	18	19	20	22	24	25	26	28
15	15												
20	20												
25	25												
30	30												
35	35												
40	40												
45	45												
50	50												
55	55												
60	60												
65	65												
70	70												
75	75												
80	80												
90	90		19,05										
100	100	20,60	21,90	23,20									
110	110	22,80											
120	120	25,00	26,60			31,50							
130	130	27,20		30,90									
140	140		31,40	33,30	35,30								
150	150	31,60	33,80	35,90		40,1	44,21						
160	160		36,20		40,70		45,10						
180	180	38,40	41,00	43,50		48,60		53,70	58,6				
200	200	42,90	45,80	48,50		54,30		59,90	65,6	71,1		76,6	82,0
250	250					67,30					93,6		104,0

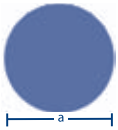
UNEQUAL ANGLES



height a x width b [mm]		Weight per m in kg Thickness t [mm]											
a	b	4	5	6	7	8	9	10	11	12	14	15	16	18
30	20	1,46	1,78											
35	20	1,62	1,98											
40	20	1,77	2,17											
40	25	1,93	2,37											
45	30	2,24	2,76	3,27										
50	30		2,96	3,51										
60	30		3,37	3,99	4,59									
60	40		3,76	4,46	5,14									
70	50		4,53	5,48	6,23									
75	50		4,75	5,65	6,53	7,42	8,23							
80	40			5,41	6,25	7,07		8,72						
80	60			6,37	7,36	8,34		10,31						
90	60			6,82		8,96								
100	50			6,85	7,93	8,99		11,10						
100	65				8,77	9,94	11,10		13,4					
100	75				9,32	10,5	11,80	13,00	14,3					
110	75					11,2		13,7	15,18					
120	60					10,91		13,4		15,9				
120	80					12,20		15,0		17,8	20,5			
130	65					11,80		14,6		17,3				
130	90							16,6		19,7				
150	75						15,4	17,00	18,6	20,2		24,8		
150	90							18,2		21,6	24,2			
150	100					15,3		19,00		22,6	26,10		30,4	
160	80							18,2		21,6	25,0			
180	90							20,6		24,5	28,3			
200	90						20,0	22,1	24,3	26,4		32,5		
200	100							23,00		27,3	31,6	33,7	35,9	
200	150							26,9		32,0		39,6		47,1
250	90							26,1		31,1	36,0		40,9	


60

ROUNDS



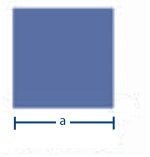
a	A	P
mm	cm2	kg/m
5	0,20	0,15
6	0,28	0,22
7	0,38	0,30
8	0,50	0,39
9	0,64	0,50
10	0,79	0,62
11	0,95	0,75
12	1,13	0,89
13	1,33	1,04
14	1,54	1,21
15	1,77	1,39
16	2,01	1,58
17	2,27	1,78
18	2,54	2,00
19	2,84	2,23
20	3,14	2,47
21	3,46	2,72
22	3,80	2,98
23	4,15	3,26
24	4,52	3,55
25	4,91	3,85
26	5,31	4,17
27	5,73	4,49
28	6,16	4,83
29	6,61	5,19
30	7,07	5,55
31	7,55	5,92
32	8,04	6,31
33	8,55	6,71
34	9,08	7,13
35	9,62	7,55
36	10,18	7,99
37	10,75	8,44
38	11,34	8,90
39	11,95	9,38
40	12,57	9,86
41	13,20	10,36
42	13,85	10,88
43	14,52	11,40
44	15,21	11,94
45	15,90	12,48
45	15,90	12,48
46	16,62	13,05
47	17,35	13,62
48	18,10	14,21
49	18,86	14,80
50	19,63	15,41

a	A	P
mm	cm2	kg/m
51	20,43	16,04
52	21,24	16,67
57	25,52	20,03
58	26,42	20,74
59	27,34	21,46
60	28,27	22,20
62	30,19	23,70
63	31,17	24,47
65	33,18	26,05
68	36,32	28,51
70	38,48	30,21
72	40,72	31,96
73	41,85	32,86
75	44,18	34,68
78	47,78	37,51
80	50,27	39,46
82	52,81	41,46
83	54,11	42,47
85	56,75	44,54
88	60,82	47,74
90	63,62	49,94
92	66,48	52,18
93	67,93	53,32
95	70,88	55,64
98	75,43	59,21
100	78,54	61,65
105	86,59	67,97
110	95,03	74,60
115	103,87	81,54
120	113,10	88,78
125	122,72	96,33
130	132,73	104,19
135	143,14	112,36
140	153,94	120,84
145	165,13	129,63
150	176,71	138,72
155	188,69	148,12
160	201,06	157,83
165	213,82	167,85
170	226,98	178,18
175	240,53	188,81
180	254,47	199,76
185	268,80	211,01
190	283,53	222,57
195	298,65	234,44
200	314,16	246,62
205	330,06	259,10

HALF ROUNDS

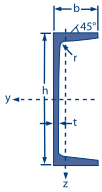
a	A	P
mm	cm2	kg/m
60	14,14	11,10
76	22,68	17,81
100	39,27	30,83

SQUARES



a	A	P	a	A	P	a	A	P
mm	cm2	kg/m	mm	cm2	kg/m	mm	cm2	kg/m
5	0,25	0,20	42	17,64	13,85	155	240,25	188,60
6	0,36	0,28	44	19,36	15,20	160	256,00	200,96
7	0,49	0,38	45	20,25	15,90	165	272,25	213,72
8	0,64	0,50	48	23,04	18,09	170	289,00	226,87
9	0,81	0,64	50	25,00	19,63	175	306,25	240,41
10	1,00	0,79	52	27,04	21,23	180	324,00	254,34
11	1,21	0,95	53	28,09	22,05	185	342,25	268,67
12	1,44	1,13	55	30,25	23,75	190	361,00	283,39
13	1,69	1,33	58	33,64	26,41	195	380,25	298,50
14	1,96	1,54	60	36,00	28,26	200	400,00	314,00
15	2,25	1,77	62	38,44	30,18	205	420,25	329,90
16	2,56	2,01	63	39,69	31,16	210	441,00	346,19
17	2,89	2,27	65	42,25	33,17	215	462,25	362,87
18	3,24	2,54	68	46,24	36,30	220	484,00	379,94
19	3,61	2,83	70	49,00	38,47	225	506,25	397,41
20	4,00	3,14	72	51,84	40,69	230	529,00	415,27
21	4,41	3,46	73	53,29	41,83	235	552,25	433,52
22	4,84	3,80	75	56,25	44,16	240	576,00	452,16
23	5,29	4,15	78	60,84	47,76	245	600,25	471,20
24	5,76	4,52	80	64,00	50,24	250	625,00	490,63
25	6,25	4,91	82	67,24	52,78	255	650,25	510,45
26	6,76	5,31	83	68,89	54,08	260	676,00	530,66
27	7,29	5,72	85	72,25	56,72	265	702,25	551,27
28	7,84	6,15	88	77,44	60,79	270	729,00	572,27
29	8,41	6,60	90	81,00	63,59	275	756,25	593,66
30	9,00	7,07	92	84,64	66,44	280	784,00	615,44
31	9,61	7,54	93	86,49	67,89	285	812,25	637,62
32	10,24	8,04	95	90,25	70,85	290	841,00	660,19
33	10,89	8,55	98	96,04	75,39	295	870,25	683,15
34	11,56	9,07	100	100,00	78,50	300	900,00	706,50
35	12,25	9,62	105	110,25	86,55	305	930,25	730,25
36	12,96	10,17	110	121,00	94,99	310	961,00	754,39
37	13,69	10,75	115	132,25	103,82	315	992,25	778,92
38	14,44	11,34	120	144,00	113,04	320	1024,00	803,84
39	15,21	11,94	125	156,25	122,66	325	1056,25	829,16
40	16,00	12,56	130	169,00	132,67	330	1089,00	854,87

UPN BEAMS

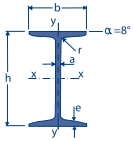


SECTION	Weight	DIMENSION				SECTION		Static value related to axes y-y z-z*				
	kg/m	h	b	t	r	A	Iy	Wy	py	Iz	Wz	pz
		mm	mm	mm	mm	cm²	cm⁴	cm³	cm	cm⁴	cm³	cm
30	4,27	30	33	5	7	5,44	6,39	4,26	1,08	5,1	2,6	0,968
40	4,88	40	35	5	7	6,21	14,1	7,07	1,51	6,68	3,08	1,04
50	5,59	50	38	5	7	7,12	26,5	10,06	1,93	9,1	3,74	1,13
65	7,09	65	42	5,5	7,5	9,03	57,5	17,7	2,52	14	5,05	1,25
80	8,65	80	45	6	8	11	106	26,5	3,1	19,4	6,35	1,33
100	10,6	100	50	6	8,5	13,5	205	41,1	3,91	29,1	8,45	1,47
120	13,3	120	55	7	9	17	364	60,7	4,63	43,1	11,1	1,59
140	16	140	60	7	10	20,4	605	86,4	5,45	62,5	14,7	1,75
160	18,9	160	65	7,5	10,5	24	925	116	6,21	85,1	18,2	1,88
180	22	180	70	8	11	28	1,354	150	6,96	114	22,4	2,01
200	25,3	200	75	8,5	11,5	32,2	1,911	191	7,71	148	26,9	2,14
220	29,4	220	80	9	12,5	37,4	2,691	245	8,48	196	33,5	2,29
240	33,2	240	85	9,5	13	42,3	3,599	300	9,22	247	39,5	4,42
260	37,9	260	90	10	14	48,3	4,824	371	10	317	47,8	2,56
280	41,9	280	95	10	15	53,4	6,276	448	10,8	398	57,2	2,73
300	46,1	300	100	10	16	58,8	8,028	535	11,7	493	67,6	2,9

* I_z moments of inertia about the "I" axis of centroid;

i_z radius of gyration $\left[i_z = \sqrt{\frac{I_z}{A}} \right]$

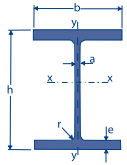
W_z stretch modulus $\left[W_z = \frac{I_z}{h/2} \right]$



ROLLED BEAMS IPN

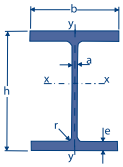
SECTION	WEIGHT	DIMENSION				Section		Static value related to axes x-x y-y				
	Kg/m	h	b	a	e	A	Ix	Wx	px	Iy	Wy	py
		mm	mm	mm	mm	cm²	cm⁴	cm³	cm	cm³	cm³	cm
80	5,90	80	42	3,9	5,9	7,57	77,7	19,4	3,20	6,28	3	0,91
100	8,34	100	50	4,5	6,8	10,6	170,0	34,1	4,00	12,1	4,88	1,07
120	11,10	120	58	5,1	7,7	14,2	327,0	54,5	4,80	21,4	7,41	1,23
140	14,30	140	66	5,7	8,6	18,2	572,0	81,8	5,60	35,1	10,7	1,39
160	17,90	160	74	6,3	9,5	22,8	934,0	117,0	6,40	54,6	14,8	1,55
180	21,90	180	82	6,9	10,4	27,9	1444,0	161,0	7,20	81,2	19,8	1,71
200	26,20	200	90	7,5	11,3	33,4	2138,0	214,0	8,00	117	26,0	1,87
220	31,00	220	98	8,1	12,2	39,5	3055,0	278,0	8,70	162	33,1	2,03
240	36,20	240	106	8,7	13,1	46,1	4230,0	363,0	9,50	220	41,7	2,1
260	41,90	260	113	9,4	14,1	53,3	5735,0	441,0	10,40	287	51,0	2,32
280	47,90	280	119	10,1	15,2	61	7576,0	541,0	11,10	363	61,2	2,44
300	54,20	300	125	10,8	16,2	69	9785,0	652,0	11,90	450	72,2	2,55
320	61,00	320	131	11,5	17,3	77,7	12480,0	781,0	12,70	554	84,7	2,67
340	68,0	340	137	12,2	18,3	86,7	15670,0	922,0	13,44	674	98,4	2,80
360	76,10	360	143	13	19,6	97	19580,0	1087,0	14,20	818	114	2,9
380	84,0	380	149	13,7	20,5	107	24010,0	1260	15,0	975	131	3,02
400	92,60	400	155	14,4	21,6	118	29210,0	1461,0	15,70	975	149	3,13
450	115,00	450	170	16,2	24,3	147,0	45790,0	2040,0	17,65	1730	203	3,43
500	141,00	500	185	18,0	27,0	180	68650,0	2746,0	19,53	2480	268	3,72
550	166,00	550	200	19,0	30,0	212	98950,0	3598,0	21,60	3490	349	4,02

ROLLED BEAMS HE



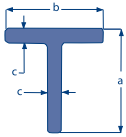
SECTION	WEIGHT	DIMENSION					Section	Static value related to axes x-x y-y					
	Kg/m	h mm	b mm	a mm	e mm	r mm	A cm²	Ix cm⁴	Wx cm³	px cm	Iy cm⁴	Wy cm³	py cm
HE 100 A	16,70	96	100	5	8	12	21,20	349	73,0	4,06	134,0	27,0	2,51
HE 100 B	20,40	100	100	6	10	12	26,00	450	90,0	4,16	167,0	33,0	2,53
HE 100 M	41,80	120	106	12	20	12	53,20	1143	190,0	4,63	399,0	75,0	2,74
HE 120 A	19,90	114	120	5	8	12	25,30	606	106,0	4,89	231,0	38,0	3,02
HE 120 B	26,70	120	120	6,5	11	12	34,00	864	144,0	5,04	318,0	53,0	3,08
HE 120 M	52,10	140	126	12,5	21	12	66,40	2018	288,0	5,51	708,0	112,0	3,25
HE 140 A	24,70	133	140	5,5	8,5	12	31,40	1033	155,0	5,73	389,0	56,0	3,52
HE 140 B	33,70	140	140	7	12	12	43,00	1509	216,0	5,93	550,0	78,0	3,58
HE 140 M	63,20	160	146	13	22	12	80,60	3291	411,0	6,39	1144,0	157,0	3,77
HE 160 A	30,40	152	160	6	9	15	38,80	1673	220,0	6,57	616,0	77,0	3,98
HE 160 B	42,60	160	160	8	13	15	54,30	2492	311,0	6,78	889,0	111,0	4,05
HE 160 M	76,20	180	166	14	23	15	97,10	5098	566,0	7,25	1759,0	212,0	4,26
HE 180 A	35,50	171	180	6	9,5	15	45,30	2510	294,0	7,45	925,0	103,0	4,52
HE 180 B	51,20	180	180	8,5	14	15	65,30	3831	426,0	7,66	1368,0	151,0	4,57
HE 180 M	88,90	200	186	14,5	24	15	113,0	7483	748,0	8,13	2580,0	277,0	4,77
HE 200 A	42,30	190	200	6,5	10	18	53,80	3692	389,0	8,28	1336,0	134,0	4,98
HE 200 B	61,30	200	200	9	15	18	78,10	5696	570,0	8,54	2003,0	200,0	5,07
HE 200 M	103,00	220	206	15	25	18	131,3	10642	967,0	9,00	3651,0	354,0	5,27
HE 220 A	50,50	210	220	7	11	18	64,30	5410	515,0	9,17	1955,0	178,0	5,51
HE 220 B	71,50	220	220	9,5	16	18	91,00	8091	736,0	9,43	2843,0	258,0	5,59
HE 220 M	117,00	240	226	15,5	26	18	149,4	14605	1220,0	9,89	5012,0	444,0	5,79
HE 240 A	60,30	230	240	7,5	12	21	76,80	7763	675,0	10,10	2769,0	231,0	6,00
HE 240 B	83,20	240	240	10	17	21	106,0	11259	938,0	10,30	3923,0	327,0	6,08
HE 240 M	157,00	270	248	18	32	21	199,6	24289	1800,0	11,00	8153,0	657,0	6,39
HE 260 A	68,20	250	260	7,5	12,5	24	86,80	10455	836,0	11,00	3668,0	282,0	6,50
HE 260 B	93,00	260	260	10	17,5	24	118,4	14919	1156,0	11,20	5135,0	395,0	6,58
HE 260 M	172,00	290	268	18	32,5	24	219,6	31307	2160,0	11,90	10449,0	780,0	6,90
HE 280 A	76,40	270	280	8	13	24	97,30	13673	1010,0	11,90	4763,0	340,0	7,00
HE 280 B	103,00	280	280	10,5	18	24	131,4	19270	1380,0	12,10	6595,0	471,0	7,09
HE 280 M	189,00	310	288	18,5	33	24	240,2	39547	2550,0	12,80	13163,0	914,0	7,40
HE 300 A	88,30	290	300	8,5	14	27	112,5	18263	1200,0	12,70	6310,0	421,0	7,49
HE 300 B	117,00	300	300	11	19	27	149,1	25166	1680,0	13,00	8563,0	571,0	7,58
HE 300 M	245,00	260	260	10	17,5	24	312,0	68135	3800,0	14,80	19709,0	1280,0	7,95
HE 320 A	97,60	290	268	18	32,5	24	124,0	22930	1479,0	13,60	6985,0	466,0	7,49
HE 320 B	127,00	320	300	11,5	20,5	27	161,0	30820	1926,0	13,80	9239,0	616,0	7,57
HE 320 M	245,00	359	309	21	40	27	312,0	68135	3800,0	14,80	19709,0	1280,0	7,95
HE 340 A	105,00	330	300	9,5	16,5	27	133,0	27690	1678,0	14,40	7436,0	496,0	7,46
HE 340 B	134,00	340	300	12	21,5	27	171,0	36660	2156,0	14,60	9690,0	646,0	7,53
HE 340 M	248,00	377	309	21	40	27	315,8	76372	4050,0	15,60	19711,0	1280,0	7,90
HE 360 A	112,00	350	300	10	17,5	27	143,0	33090	1891,0	15,20	7887,0	526,0	7,43
HE 360 B	142,00	360	300	12,5	22,5	27	181,0	43190	2400,0	15,50	10140,0	676,0	7,49
HE 360 M	250,00	395	308	21	40	27	318,8	84867	4300,0	16,30	19522,0	1270,0	7,83
HE 400 A	125,00	390	300	11	19	27	159,0	45070	2311,0	16,80	8564,0	571,0	7,34
HE 400 B	155,00	400	300	13,5	24	27	198,0	57680	2884,0	17,10	10820,0	721,0	7,40
HE 400 M	256,00	432	307	21	40	27	325,8	104119	4820,0	17,90	19335,0	1260,0	7,40
HE 450 A	140,00	440	300	11,5	21	27	178,0	63722	2900,0	18,90	9465,0	631,0	7,29
HE 450 B	171,00	450	300	14	26	27	218,0	79887	3550,0	19,10	11721,0	781,0	7,33
HE 500 A	155,00	490	300	12	23	27	197,5	86975	3550,0	21,00	10367,0	691,0	7,24
HE 500 B	187,00	500	300	14,5	28,0	27	238,6	107176	4290,0	21,00	12624,0	842,0	7,27

ROLLED BEAMS IPE



SECTION	WEIGHT	DIMENSION					Section	Static value related to axes x-x y-y					
	Kg/m	h mm	b mm	a mm	e mm	r mm	A cm²	Ix cm⁴	Wx cm³	px cm	Iy cm⁴	Wy cm³	py cm
IPE 80	6,00	80	46	3,8	5,2	5	7,64	80,1	20	3,24	8,49	3,69	1,05
IPE 100	8,10	100	55	4,1	5,7	7	10,3	171	34,2	4,07	15,9	5,78	1,24
IPE 120	10,40	120	64	4,4	6,3	7	13,2	318	53	4,9	27,7	8,66	1,45
IPE 140	12,90	140	73	4,7	6,9	7	16,4	541	77,3	5,74	44,9	12,30	1,65
IPE 160	15,80	160	82	5	7,4	9	20,1	869	109	6,58	68,3	16,66	1,84
IPE 180	18,80	180	91	5,3	8	9	23,9	1317	146	7,42	101	22,20	2,05
IPE 200	22,40	200	100	5,6	8,5	12	28,5	1943	194	8,26	142	28,40	2,24
IPE 220	26,20	220	110	5,9	9,2	12	33,4	2772	252	9,11	205	37,27	2,48
IPE 240	30,70	240	120	6,2	9,8	15	39,1	3892	324	9,97	284	47,33	2,69
IPE 270	36,10	270	135	6,6	10,2	15	45,9	5790	429	11,2	420	62,22	3,02
IPE 300	42,20	300	150	7,1	10,7	15	53,8	8356	557	12,5	604	80,53	3,35
IPEM 300	154,20	300	175	25	40	13	196,4	26221	1748	11,5	3601	411,54	18,30
IPE 330	49,10	330	160	7,5	11,5	18	62,6	11770	713	13,7	788	98,50	3,55
IPE 360	57,10	360	170	8	12,7	18	72,7	16270	904	15	1043	122,71	3,79
IPE 400	66,30	400	180	8,6	13,5	21	84,5	23130	1160	16,5	1318	146,44	3,95
IPE 450	77,60	450	190	9,4	14,6	21	98,8	33740	1500	18,5	1676	176,42	4,12
IPE 500	90,70	500	200	10,2	16	21	116	48200	1930	20,4	2142	214,20	4,31
IPE 550	106,00	550	210	11,1	17,2	24	134	67120	2440	22,3	2668	254,10	4,45
IPE 600	122,00	600	220	12	19	24	156	92080	3069	24,3	3387	307,90	4,66

T-BARS*



			Weight per m in kg Thickness c [mm]												
height a x width b [mm]	A	B	4,0	4,5	5,0	5,5	6,0	6,5	7,0	8,0	9,0	10,0	11,0	13,0	15,0
	20	**20**	1,13												
	25	**25**		1,61											
	30	**30**			2,16										
	35	**35**				2,78									
	40	**40**					3,49								
	45	**45**						4,26							
	50	**50**							5,11						
	60	**60**							6,23	7,03					
	70	**70**								8,32	9,26				
	80	**80**									10,70	11,78			
	90	**90**										13,40			
	100	**100**											16,40		
	120	**120**												23,20	
	140	**140**													31,30

*The indicated value refer to T round edges profiles

TOLERANCE

In the tables under mentioned, we indicate the kind of tolerance for each product:
Plate tolerance

Nominal Thickness [mm]	Class A		Class b		Class c		Class d		≥ 600 < 2000	≥ 2000 < 2500	≥ 2500 < 3000	≥ 3000 <3500	≥ 3500 <4000	≥ 4000
	-	+	-	+	-	+	-	+						
≥3 < 5	-0,4	0,8	-0,3	0,9	0	1,2	-0,6	0,6	0,8	0,9	0,9	-	-	-
≥ 5 < 8	-0,4	1,1	-0,3	1,2	0	1,5	-0,75	0,75	0,9	0,9	1	1	-	-
≥8 < 15	-0,5	1,2	-0,3	1,4	0	1,7	-0,85	0,85	0,9	1	1	1,1	1,1	1,2
≥15 < 25	-0,6	1,3	-0,3	1,6	0	1,9	-0,95	-0,95	1	1,1	1,2	1,2	1,3	1,4
≥25 < 40	-0,8	1,4	-0,3	1,9	0	2,2	-1,1	-1,1	1,1	1,2	1,2	1,3	1,3	1,4
≥40 < 80	-1	1,8	-0,3	2,5	0	2,8	-1,4	-1,4	1,2	1,3	1,4	1,4	1,5	1,6
≥80 < 150	-1	2,2	-0,3	2,9	0	3,2	-1,6	-1,6	1,3	1,4	1,5	1,5	1,6	1,7
≥150 ≤ 250	-1,2	2,4	-0,3	3,3	0	3,6	-1,8	-1,8	1,4	1,5	1,6	1,6	1,7	-

Class A Negative tolerances according to nominal thickness
Class B Fixed negative tolerances of 0,3 mm

Class C All positive tolerances according to nominal thickness
Class D Symmetrical tolerances according to nominal thickness

Width

Nominal width [mm]	Tolerance	
	-	+
≥ 600 < 2000	0	+20
≥ 2000 > 3000	0	+25
≥ 3000	0	+30

Length

Nominal length	Tolerance	
	-	+
< 4000	0	+20
≥ 4000 < 6000	0	+30
≥ 6000 < 8000	0	+40
≥ 8000 < 10000	0	+50
≥ 10000 <15000	0	+75
≥ 15000 ≤ 20000	0	+100

Flatness

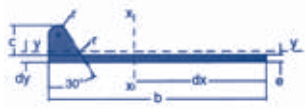
Nominal thickness [mm]	Class L		Class H	
	Lenght [mm]			
	1000	2000	1000	2000
≥ 3 < 5	9	14	12	17
≥ 5 < 8	8	12	11	15
≥ 8 < 15	7	11	10	14
≥ 15 < 25	7	10	10	13
≥ 25 < 40	6	9	9	12
≥ 40 < 250	5	8	8	11

Class L steel having a minimum yield strength (ReH)≤ 460 N/mm²
Class H steel having a minimum yield strength (ReH) between 460 N/mm² and 700 N/mm²
(all types of Hardened Steel and Hardened & Tempered Steel)

TOLERANCE

ELEMENTS	TOLERANCES

Bulb flats — UNI EU 67 - 79



Normal size b >	Normal size b ≤	Normal size e ≥	Normal size e ≤	Tolerance b	Tolerance e
	120	5	8	± 1,5	+ 0,7 - 0,3
120	180	7	11	± 2,0	+ 1,0 - 0,3

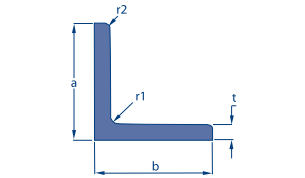
Bulb flats — UNI EU 58

b Normal size	b Tolerance	a Normal size	a Tolerance
20 ≤ b ≤ 35 40 ≤ b ≤ 70	± 0,75 ± 1	a ≤ 20	± 0,5
80 ≤ b ≤ 100	± 1,5	20 < a ≤ 40	± 1
100 < b ≤ 125 b > 125	± 2 ± 2,5	a > 40	± 1,5

Universal flats — UNI EU 91 - NF / EU 91 - DIN 59200

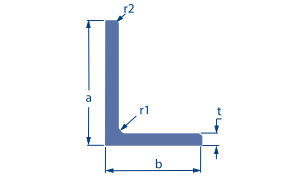
b Tolerance	a Normal size	a Tolerance
± 2% of b	4 ≤ a < 10	- 0,4 / +0,6
	10 ≤ a < 20	- 0,4 / +0,8
	20 ≤ a < 25	- 0,5 / +0,9
	25 ≤ a < 30	- 0,6 / +1,0
	30 ≤ a < 40	- 0,7 / +1,1
	40 ≤ a < 50	- 0,9 / +1,1

Equal angles — UNI EN 10256-2 - UNI EN 56



a Normal size	a Tolerance	t Normal size	t Tolerance
a ≤ 50	± 1,0	t ≤ 5	± 0,5
50 < a ≤ 100	± 2,0	5 < t≤10	± 0,75
100 < a ≤ 150	± 3,0	10 < t ≤ 15	± 1,0

Unequal angles — UNI EN 10256-2 - UNI EU 57

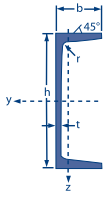


a Normal size	a&b Tolerance	t Normal size	t Tolerance
a ≤ 50	± 1,0	t ≤ 5	± 0,5
50 < a ≤ 100	± 2,0	5 < t ≤ 10	± 0,75
100 < a ≤ 150	± 3,0		
150 < a ≤ 200	± 4,0	10 < t ≤ 15	± 1,0

TOLERANCE

ELEMENTS	TOLERANCES

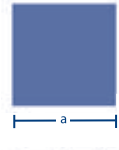
UPN



UNI EN 10056/2 - UNI EU 57

a		a&b	
Normal size	Tolerance	Normal size	Tolerance
a ≤ 50	± 1,0	c ≤ 5	± 0,5
50 < a ≤ 100	± 2,0	5 < c ≤ 10	± 0,75
100 < a ≤ 150	± 3,0		
150 < a ≤ 200	± 4,0	10 < c ≤ 15	± 1,0

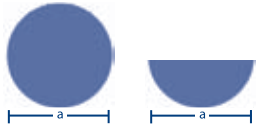
SQUARES



EU 59-78

a		r	
Normal size	Tolerance	Normal size	Tolerance
5,5 < a ≤ 15	± 0,4	8≤a≤12	r ≤ 1
15 < a ≤ 25	± 0,5	12 < a ≤ 20	r ≤ 1,5
		20 < a ≤ 30	r ≤ 2
25 < a ≤ 35	± 0,6	30 < a ≤ 50	r ≤ 2,5

ROUNDS & HALF ROUNDS



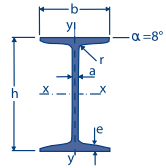
UNI EU 60

a	
Normal size	Tolerance
8 ≤ a ≤ 15	± 0,4
15 < a ≤ 25	± 0,5
25 < a ≤ 3	± 0,6

TOLERANCE

IPN

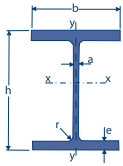
EN 10024



h		b		a		e	
N,S	> T	N,S	T	N,S	T	N,S	T≤
≤ 200	± 2≤	75	± 1,5	< 7	+ 0,5 - 1,0	≤ 7	+ 1,5 - 0,5
200 ÷ 400	± 3	75 ÷ 100	± 2			7 ÷ 10	+ 2 -1
> 400	± 4	100 ÷ 125	± 2,5	7 ÷ 10	+ 0,7 - 1,5	10 ÷ 20	+ 2,5 - 1,5
		> 125	± 3	> 10 + 1	- 2	> 20	+ 2,5 -2,0

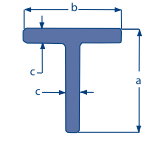
HE & IPE

EN 10034



h		b		a		e	
N,S	T	N,S	T	N,S	T	N,S	T
≤ 180	+ 3,0 - 2,0	≤ 110	+ 4,0 - 1,0	< 7	± 7,0	< 6,5	+ 1,5 - 0,5
180 ÷ 400	+ 4 - 2	110 ÷ 210	+ 4 - 2	7 ÷ 10	± 1,0	6,5 ÷ 10	+ 2 - 1
						10 ÷ 20	+ 2,5 - 1,5
400 ÷ 700	+ 5 - 3	210 ÷ 325	+ 4 - 4	10 ÷ 20	± 1,5	20÷30	+ 2,5 -2
				20 ÷ 40	± 2,0	30 ÷ 40	± 2,5
> 700	+ 5 - 5	> 325	+ 6 - 5	40 ÷ 60	± 2,5	40 ÷ 60	± 3
				> 60	± 3,0	> 60	± 4

T-profiles



a or b		a or b		c	
N,S	T	N,S	T	N,S	T
20 ÷ 50		± 1		± 0,5	
60 ÷ 100		± 1,5		± 0,75	

Remarks

Not all listed materials are available on the market and sometimes it's difficult to procure flat bars having "non commercial" thickness values but they can be obtained off plates by plasma cutting, provided their section is not smaller than 150 x 10 mm.

Lengths of commercial flatbars are up to 16000 mm while profiles are available from 6000 up to 12000 mm.

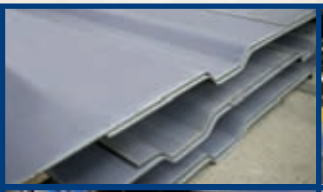
Commercial size plates of 2500 x 12000 mm or 3000 x 12000 mm and thickness from 5 up to 40 mm are usually available.

Plates with thickness from 3 up to 12 mm, width of 1500 and 2000 mm of any length not exceeding 16000 mm, can be obtained off coils.

Values printed in this handbook are to be considered theoretical.
G. Baglietto Naval Steel do not undertake responsibility for possible errors but values interpretation is let to handbook users.

YOUR HULL IN KIT FORM

Plasma Cutting – Steel Preparation – Bending Profiles
Forming Plates – Corrugated Plates – Welded Beams-
Sub-Assemblies and Steel Blocks

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