

6. Hollow Sections

Structural steel tubes that can be circular, hollow or rectangular, each with its own attributes, used for a wide range of construction and industrial applications.

6.1 Hot Finished

- 6.1.1 Circular Hollow Section (CHS)
- 6.1.2 Rectangular Hollow Section (RHS)
- 6.1.3 Square Hollow Section (SHS)

6.2 Cold Formed

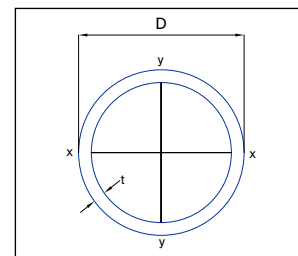
- 6.2.1 Circular Hollow Section (CHS)
- 6.2.2 Rectangular Hollow Section (RHS)
- 6.2.3 Square Hollow Section (SHS)

6.2 Cold Formed Hollow Section

Standard specifications

| Material | Yield strength | | Tensile strength | Min. Elongation | Min. Charpy V-notch. | Dimensions & Tolerances |
|-----------------|-------------------|-----------------------|-------------------|----------------------|----------------------|-------------------------|
| | N/mm ² | | N/mm ² | $L_0=5.65\sqrt{S_0}$ | | |
| EN 10219 | ≤16mm | >16 - ≤40mm | 3-40mm | | | EN10219 |
| S275J0H | 275 | 265 | 410-560 | 20% | 27J @ 0°C | |
| S275J2H | 275 | 265 | 410-560 | 20% | 27J @ -20°C | |
| S355J0H | 355 | 345 | 470-630 | 20% | 27J @ 0°C | |
| S355J2H | 355 | 345 | 470-630 | 20% | 27J @ -20°C | |
| S460MH | 460 | 440 | 530-720 | 17% | 40J @ -20°C | |

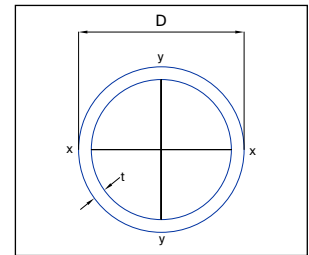
6.2.1 Cold Formed Circular Hollow Section (CHS)



| Designation | | Mass per Metre | Area of Section | Ratio For Local Buckling | Second Moment of Inertia | Radius of Gyration | Elastic Modulus | Plastic Modulus | Torsional Constants | | Surface Area per Metre |
|-------------|-----------|----------------|-----------------|--------------------------|--------------------------|--------------------|-----------------|-----------------|---------------------|-----------------|------------------------|
| Outside | Thickness | | | | | | | | J | C | |
| D | t | | A | D/t | I | r | Z | S | J | C | |
| mm | mm | kg/m | cm ² | | cm ⁴ | cm | cm ³ | cm ³ | cm ⁴ | cm ³ | m ² /m |
| 26.9 | 2.0 | 1.23 | 1.56 | 13.5 | 1.22 | 0.883 | 0.907 | 1.24 | 2.44 | 1.81 | 0.0845 |
| | 2.5 | 1.50 | 1.92 | 10.8 | 1.44 | 0.867 | 1.07 | 1.49 | 2.88 | 2.14 | 0.0845 |
| | 3.2 * | 1.87 | 2.38 | 8.41 | 1.70 | 0.846 | 1.27 | 1.81 | 3.41 | 2.53 | 0.0845 |
| 33.7 | 2.0 | 1.56 | 1.99 | 16.9 | 2.51 | 1.12 | 1.49 | 2.01 | 5.02 | 2.98 | 0.106 |
| | 2.5 | 1.92 | 2.45 | 13.5 | 3.00 | 1.11 | 1.78 | 2.44 | 6.00 | 3.56 | 0.106 |
| | 3.0 | 2.27 | 2.89 | 11.2 | 3.44 | 1.09 | 2.04 | 2.84 | 6.88 | 4.08 | 0.106 |
| | 3.2 * | 2.41 | 3.07 | 10.5 | 3.60 | 1.08 | 2.14 | 2.99 | 7.21 | 4.28 | 0.106 |
| | 4.0 * | 2.93 | 3.73 | 8.43 | 4.19 | 1.06 | 2.49 | 3.55 | 8.38 | 4.97 | 0.106 |
| 42.4 | 2.5 | 2.46 | 3.13 | 17.0 | 6.26 | 1.41 | 2.95 | 3.99 | 12.5 | 5.91 | 0.133 |
| | 3.0 | 2.91 | 3.71 | 14.1 | 7.25 | 1.40 | 3.42 | 4.67 | 14.5 | 6.84 | 0.133 |
| | 3.2 * | 3.09 | 3.94 | 13.3 | 7.62 | 1.39 | 3.59 | 4.93 | 15.2 | 7.19 | 0.133 |
| | 3.6 * | 3.44 | 4.39 | 11.8 | 8.33 | 1.38 | 3.93 | 5.44 | 16.7 | 7.86 | 0.133 |
| | 4.0 | 3.79 | 4.83 | 10.6 | 8.99 | 1.36 | 4.24 | 5.92 | 18.0 | 8.48 | 0.133 |
| 48.3 | 2.5 | 2.82 | 3.60 | 19.3 | 9.46 | 1.62 | 3.92 | 5.25 | 18.9 | 7.83 | 0.152 |
| | 3.0 | 3.35 | 4.27 | 16.1 | 11.0 | 1.61 | 4.55 | 6.17 | 22.0 | 9.11 | 0.152 |
| | 3.2 * | 3.56 | 4.53 | 15.1 | 11.6 | 1.60 | 4.80 | 6.52 | 23.2 | 9.59 | 0.152 |
| | 3.6 * | 3.97 | 5.06 | 13.4 | 12.7 | 1.59 | 5.26 | 7.21 | 25.4 | 10.5 | 0.152 |
| | 4.0 | 4.37 | 5.57 | 12.1 | 13.8 | 1.57 | 5.70 | 7.87 | 27.5 | 11.4 | 0.152 |
| 60.3 | 2.5 | 3.56 | 4.54 | 24.1 | 19.0 | 2.05 | 6.30 | 8.36 | 38.0 | 12.6 | 0.189 |
| | 3.0 | 4.24 | 5.40 | 20.1 | 22.2 | 2.03 | 7.37 | 9.86 | 44.4 | 14.7 | 0.189 |
| | 3.2 * | 4.51 | 5.74 | 18.8 | 23.5 | 2.02 | 7.78 | 10.4 | 46.9 | 15.6 | 0.189 |
| | 3.6 * | 5.03 | 6.41 | 16.8 | 25.9 | 2.01 | 8.58 | 11.6 | 51.7 | 17.2 | 0.189 |
| | 4.0 | 5.55 | 7.07 | 15.1 | 28.2 | 2.00 | 9.34 | 12.7 | 56.3 | 18.7 | 0.189 |
| 76.1 | 2.5 | 4.54 | 5.78 | 30.4 | 39.2 | 2.60 | 10.3 | 13.5 | 78.4 | 20.6 | 0.239 |
| | 3.0 | 5.41 | 6.89 | 25.4 | 46.1 | 2.59 | 12.1 | 16.0 | 92.2 | 24.2 | 0.239 |
| | 3.2 * | 5.75 | 7.33 | 23.8 | 48.8 | 2.58 | 12.8 | 17.0 | 97.6 | 25.6 | 0.239 |
| | 3.6 * | 6.44 | 8.20 | 21.1 | 54.0 | 2.57 | 14.2 | 18.9 | 108 | 28.4 | 0.239 |
| | 4.0 | 7.11 | 9.06 | 19.0 | 59.1 | 2.55 | 15.5 | 20.8 | 118 | 31.0 | 0.239 |
| 88.9 | 3.0 | 6.36 | 8.10 | 29.6 | 74.8 | 3.04 | 16.8 | 22.1 | 150 | 33.6 | 0.279 |
| | 3.2 * | 6.76 | 8.62 | 27.8 | 79.2 | 3.03 | 17.8 | 23.5 | 158 | 35.6 | 0.279 |
| | 4.0 | 8.38 | 10.7 | 22.2 | 96.3 | 3.00 | 21.7 | 28.9 | 193 | 43.3 | 0.279 |
| | 5.0 | 10.35 | 13.2 | 17.8 | 116 | 2.97 | 26.2 | 35.2 | 233 | 52.4 | 0.279 |
| 114.3 | 3.0 | 8.23 | 10.5 | 38.1 | 163 | 3.94 | 28.4 | 37.2 | 325 | 56.9 | 0.359 |
| | 3.2 * | 8.77 | 11.2 | 35.7 | 172 | 3.93 | 30.2 | 39.5 | 345 | 60.4 | 0.359 |
| | 3.6 * | 9.83 | 12.5 | 31.8 | 192 | 3.92 | 33.6 | 44.1 | 384 | 67.2 | 0.359 |
| | 5.0 | 13.48 | 17.2 | 22.9 | 257 | 3.87 | 45.0 | 59.8 | 514 | 89.9 | 0.359 |
| | 6.0 | 16.03 | 20.4 | 19.1 | 300 | 3.83 | 52.5 | 70.4 | 600 | 105 | 0.359 |
| | 6.3 | 16.78 | 21.4 | 18.1 | 313 | 3.82 | 54.7 | 73.6 | 625 | 109 | 0.359 |
| 139.7 | 5.0 | 16.61 | 21.2 | 27.9 | 481 | 4.77 | 68.8 | 90.8 | 961 | 138 | 0.439 |
| | 6.3 | 20.73 | 26.4 | 22.2 | 589 | 4.72 | 84.3 | 112 | 1177 | 169 | 0.439 |
| | 8.0 | 25.98 | 33.1 | 17.5 | 720 | 4.66 | 103 | 139 | 1441 | 206 | 0.439 |
| | 10.0 | 31.99 | 40.7 | 14.0 | 862 | 4.60 | 123 | 169 | 1724 | 247 | 0.439 |

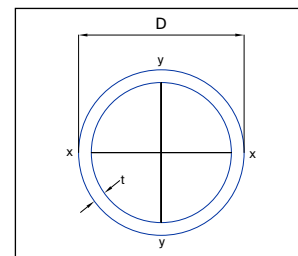
* Sizes not included in BS EN 10219 Part 2 (1997)

| | |
|---------------|---------------------|
| Dimensions | EN10219-2 |
| Specification | EN10219-1 |
| Size Range | OD 21.3mm to 1219mm |



| Designation | | Mass per Metre | Area of Section | Ratio For Local Buckling | Second Moment of Inertia | Radius of Gyration | Elastic Modulus | Plastic Modulus | Torsional Constants | | Surface Area per Metre |
|--------------|-----------|----------------|-----------------|--------------------------|--------------------------|--------------------|-----------------|-----------------|---------------------|-----------------|------------------------|
| Outside | Thickness | | | | | | | | J | C | |
| D | t | | A | D/t | I | r | Z | S | J | C | |
| mm | mm | kg/m | cm ² | | cm ⁴ | cm | cm ³ | cm ³ | cm ⁴ | cm ³ | m ² /m |
| 168.3 | 4.0 | 16.21 | 20.6 | 42.1 | 697 | 5.81 | 82.8 | 108 | 1394 | 166 | 0.529 |
| | 5.0 | 20.14 | 25.7 | 33.7 | 856 | 5.78 | 102 | 133 | 1712 | 203 | 0.529 |
| | 6.3 | 25.17 | 32.1 | 26.7 | 1053 | 5.73 | 125 | 165 | 2107 | 250 | 0.529 |
| | 8.0 | 31.63 | 40.3 | 21.0 | 1297 | 5.67 | 154 | 206 | 2595 | 308 | 0.529 |
| | 10.0 | 39.04 | 49.7 | 16.8 | 1564 | 5.61 | 186 | 251 | 3128 | 372 | 0.529 |
| | 12.5 * | 48.03 | 61.2 | 13.5 | 1868 | 5.53 | 222 | 304 | 3737 | 444 | 0.529 |
| 193.7 | 4.0 | 18.71 | 23.8 | 48.4 | 1073 | 6.71 | 111 | 144 | 2146 | 222 | 0.609 |
| | 4.5 * | 21.00 | 26.7 | 43.0 | 1198 | 6.69 | 124 | 161 | 2395 | 247 | 0.609 |
| | 5.0 | 23.27 | 29.6 | 38.7 | 1320 | 6.67 | 136 | 178 | 2640 | 273 | 0.609 |
| | 6.0 | 27.77 | 35.4 | 32.3 | 1560 | 6.64 | 161 | 211 | 3119 | 322 | 0.609 |
| | 6.3 | 29.12 | 37.1 | 30.7 | 1630 | 6.63 | 168 | 221 | 3260 | 337 | 0.609 |
| | 8.0 | 36.64 | 46.7 | 24.2 | 2016 | 6.57 | 208 | 276 | 4031 | 416 | 0.609 |
| | 10.0 | 45.30 | 57.7 | 19.4 | 2442 | 6.50 | 252 | 338 | 4883 | 504 | 0.609 |
| | 12.5 | 55.86 | 71.2 | 15.5 | 2934 | 6.42 | 303 | 411 | 5869 | 606 | 0.609 |
| 219.1 | 4.5 * | 23.82 | 30.3 | 48.7 | 1747 | 7.59 | 159 | 207 | 3494 | 319 | 0.688 |
| | 5.0 | 26.40 | 33.6 | 43.8 | 1928 | 7.57 | 176 | 229 | 3856 | 352 | 0.688 |
| | 6.0 | 31.53 | 40.2 | 36.5 | 2282 | 7.54 | 208 | 273 | 4564 | 417 | 0.688 |
| | 6.3 | 33.06 | 42.1 | 34.8 | 2386 | 7.53 | 218 | 285 | 4772 | 436 | 0.688 |
| | 8.0 | 41.65 | 53.1 | 27.4 | 2960 | 7.47 | 270 | 357 | 5919 | 540 | 0.688 |
| | 10.0 | 51.57 | 65.7 | 21.9 | 3598 | 7.40 | 328 | 438 | 7197 | 657 | 0.688 |
| | 12.0 | 61.29 | 78.1 | 18.3 | 4200 | 7.33 | 383 | 515 | 8400 | 767 | 0.688 |
| | 12.5 | 63.69 | 81.1 | 17.5 | 4345 | 7.32 | 397 | 534 | 8689 | 793 | 0.688 |
| | 16.0 * | 80.14 | 102 | 13.7 | 5297 | 7.20 | 483 | 661 | 10600 | 967 | 0.688 |
| 244.5 | 5.0 | 29.53 | 37.6 | 48.9 | 2699 | 8.47 | 221 | 287 | 5397 | 441 | 0.768 |
| | 6.0 | 35.29 | 45.0 | 40.8 | 3199 | 8.43 | 262 | 341 | 6397 | 523 | 0.768 |
| | 6.3 | 37.01 | 47.1 | 38.8 | 3346 | 8.42 | 274 | 358 | 6692 | 547 | 0.768 |
| | 8.0 | 46.66 | 59.4 | 30.6 | 4160 | 8.37 | 340 | 448 | 8321 | 681 | 0.768 |
| | 10.0 | 57.83 | 73.7 | 24.5 | 5073 | 8.30 | 415 | 550 | 10150 | 830 | 0.768 |
| | 12.0 | 68.81 | 87.7 | 20.4 | 5938 | 8.23 | 486 | 649 | 11880 | 972 | 0.768 |
| | 12.5 | 71.52 | 91.1 | 19.6 | 6147 | 8.21 | 503 | 673 | 12300 | 1006 | 0.768 |
| | 16.0 * | 90.16 | 115 | 15.3 | 7533 | 8.10 | 616 | 837 | 15070 | 1232 | 0.768 |
| 273 | 5.0 | 33.05 | 42.1 | 54.6 | 3781 | 9.48 | 277 | 359 | 7562 | 554 | 0.858 |
| | 6.0 | 39.51 | 50.3 | 45.5 | 4487 | 9.44 | 329 | 428 | 8974 | 657 | 0.858 |
| | 6.3 | 41.44 | 52.8 | 43.3 | 4696 | 9.43 | 344 | 448 | 9392 | 688 | 0.858 |
| | 8.0 | 52.28 | 66.6 | 34.1 | 5852 | 9.37 | 429 | 562 | 11700 | 857 | 0.858 |
| | 10.0 | 64.86 | 82.6 | 27.3 | 7154 | 9.31 | 524 | 692 | 14310 | 1048 | 0.858 |
| | 12.0 | 77.24 | 98.4 | 22.8 | 8396 | 9.24 | 615 | 818 | 16790 | 1230 | 0.858 |
| | 12.5 | 80.30 | 102 | 21.8 | 8697 | 9.22 | 637 | 849 | 17400 | 1274 | 0.858 |
| | 16.0 * | 101.41 | 129 | 17.1 | 10710 | 9.10 | 784 | 1058 | 21410 | 1569 | 0.858 |

6.2.1 Cold Formed Circular Hollow Section (CHS)



| Designation | | Mass per Metre | Area of Section | Ratio For Local Buckling | Second Moment of Inertia | Radius of Gyration | Elastic Modulus | Plastic Modulus | Torsional Constants | | Surface Area per Metre |
|--------------|-----------|----------------|-----------------|--------------------------|--------------------------|--------------------|-----------------|-----------------|---------------------|-----------------|------------------------|
| Outside | Thickness | | | | | | | | J | C | |
| D | t | | A | D/t | I | r | Z | S | J | C | |
| mm | mm | kg/m | cm ² | | cm ⁴ | cm | cm ³ | cm ³ | cm ⁴ | cm ³ | m ² /m |
| 323.9 | 5.0 | 39.32 | 50.1 | 64.8 | 6369 | 11.3 | 393 | 509 | 12740 | 787 | 1.02 |
| | 6.0 | 47.04 | 59.9 | 54.0 | 7572 | 11.2 | 468 | 606 | 15150 | 935 | 1.02 |
| | 6.3 | 49.34 | 62.9 | 51.4 | 7929 | 11.2 | 490 | 636 | 15860 | 979 | 1.02 |
| | 8.0 | 62.32 | 79.4 | 40.5 | 9910 | 11.2 | 612 | 799 | 19820 | 1224 | 1.02 |
| | 10.0 | 77.41 | 98.6 | 32.4 | 12160 | 11.1 | 751 | 986 | 24320 | 1501 | 1.02 |
| | 12.0 | 92.30 | 118 | 27.0 | 14320 | 11.0 | 884 | 1168 | 28640 | 1768 | 1.02 |
| | 12.5 | 95.99 | 122 | 25.9 | 14850 | 11.0 | 917 | 1213 | 29690 | 1833 | 1.02 |
| | 16.0 | * 121.49 | 155 | 20.2 | 18390 | 10.9 | 1136 | 1518 | 36780 | 2271 | 1.02 |
| 355.6 | 5.0 | 43.23 | 55.1 | 71.1 | 8464 | 12.4 | 476 | 615 | 16930 | 952 | 1.12 |
| | 6.0 | 51.73 | 65.9 | 59.3 | 10070 | 12.4 | 566 | 733 | 20140 | 1133 | 1.12 |
| | 6.3 | 54.27 | 69.1 | 56.4 | 10550 | 12.4 | 593 | 769 | 21090 | 1186 | 1.12 |
| | 8.0 | 68.58 | 87.4 | 44.5 | 13200 | 12.3 | 742 | 967 | 26400 | 1485 | 1.12 |
| | 10.0 | 85.23 | 109 | 35.6 | 16220 | 12.2 | 912 | 1195 | 32450 | 1825 | 1.12 |
| | 12.0 | 101.68 | 130 | 29.6 | 19140 | 12.2 | 1076 | 1417 | 38280 | 2153 | 1.12 |
| | 12.5 | 105.77 | 135 | 28.4 | 19850 | 12.1 | 1117 | 1472 | 39700 | 2233 | 1.12 |
| | 16.0 | 134.00 | 171 | 22.2 | 24660 | 12.0 | 1387 | 1847 | 49330 | 2774 | 1.12 |
| 406.4 | 6.0 | 59.25 | 75.5 | 67.7 | 15130 | 14.2 | 745 | 962 | 30260 | 1489 | 1.28 |
| | 6.3 | 62.16 | 79.2 | 64.5 | 15850 | 14.1 | 780 | 1009 | 31700 | 1560 | 1.28 |
| | 8.0 | 78.60 | 100 | 50.8 | 19870 | 14.1 | 978 | 1270 | 39750 | 1956 | 1.28 |
| | 10.0 | 97.76 | 125 | 40.6 | 24480 | 14.0 | 1205 | 1572 | 48950 | 2409 | 1.28 |
| | 12.0 | 116.72 | 149 | 33.9 | 28940 | 14.0 | 1424 | 1867 | 57870 | 2848 | 1.28 |
| | 12.5 | 121.43 | 155 | 32.5 | 30030 | 13.9 | 1478 | 1940 | 60060 | 2956 | 1.28 |
| | 16.0 | 154.05 | 196 | 25.4 | 37450 | 13.8 | 1843 | 2440 | 74900 | 3686 | 1.28 |
| 457 | 6.0 | 66.73 | 85.0 | 76.2 | 21620 | 15.9 | 946 | 1220 | 43240 | 1892 | 1.44 |
| | 6.3 | 70.02 | 89.2 | 72.5 | 22650 | 15.9 | 991 | 1280 | 45310 | 1983 | 1.44 |
| | 8.0 | 88.58 | 113 | 57.1 | 28450 | 15.9 | 1245 | 1613 | 56890 | 2490 | 1.44 |
| | 10.0 | 110.24 | 140 | 45.7 | 35090 | 15.8 | 1536 | 1998 | 70180 | 3071 | 1.44 |
| | 12.0 | 131.69 | 168 | 38.1 | 41560 | 15.7 | 1819 | 2377 | 83110 | 3637 | 1.44 |
| | 12.5 | 137.03 | 175 | 36.6 | 43150 | 15.7 | 1888 | 2470 | 86290 | 3776 | 1.44 |
| | 16.0 | 174.01 | 222 | 28.6 | 53960 | 15.6 | 2361 | 3113 | 107900 | 4723 | 1.44 |
| 508 | 6.0 | 74.28 | 94.6 | 84.7 | 29810 | 17.7 | 1174 | 1512 | 59620 | 2347 | 1.60 |
| | 6.3 | 77.95 | 99.3 | 80.6 | 31250 | 17.7 | 1230 | 1586 | 62490 | 2460 | 1.60 |
| | 8.0 | 98.65 | 126 | 63.5 | 39280 | 17.7 | 1546 | 2000 | 78560 | 3093 | 1.60 |
| | 10.0 | 122.81 | 156 | 50.8 | 48520 | 17.6 | 1910 | 2480 | 97040 | 3820 | 1.60 |
| | 12.0 | 146.79 | 187 | 42.3 | 57540 | 17.5 | 2265 | 2953 | 115100 | 4530 | 1.60 |
| | 12.5 | 152.75 | 195 | 40.6 | 59760 | 17.5 | 2353 | 3070 | 119500 | 4705 | 1.60 |
| | 16.0 | 194.14 | 247 | 31.8 | 74910 | 17.4 | 2949 | 3874 | 149800 | 5898 | 1.60 |

* Sizes not included in BS EN 10219 Part 2 (1997)