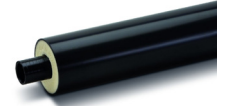


Hydraulic piping calculation



The following table shows the properties of the main secondary fluids as well as the maximum recommended cooling capacity for the different hydraulic pipe diameters.

| Fluid | Nominal diameter | Inches | DN | | | | | | | | | | | | | | | | |
|---|------------------|--------|------|------|------|------|------|------|--------|--------|--------|------|--------|------|--------|-------|-------|-------|--|
| | | | 3/8" | 1/2" | 5/8" | 3/4" | 7/8" | 1" | 1 1/8" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 3 1/2" | 4" | 5" | 6" | |
| Copper (DIN 1057) | | | 15.0 | 18.0 | | 22.0 | | 28.0 | | 35.0 | 42.0 | 54.0 | 64.0 | 76.0 | 88.9 | 108.0 | 133.0 | 159.0 | |
| Galvanised steel (DIN EN 10255) | | | 17.2 | 21.3 | | 26.9 | | 33.7 | | 42.4 | 48.3 | 60.3 | | 76.1 | 88.9 | 114.3 | 139.7 | 168.3 | |
| Carbon steel / Stainless steel (DIN EN 10220/10216) | | Dext. | 17.2 | 21.3 | | 26.9 | | 33.7 | | 42.4 | 48.3 | 60.3 | | 76.1 | 88.9 | 114.3 | 139.7 | 168.3 | |
| PEX, PB, 10 bar, SDR 9 | | | | 20.0 | | 25.0 | | 32.0 | | 40.0 | 50.0 | 63.0 | 75.0 | 90.0 | 110.0 | 125.0 | 160.0 | 200.0 | |
| PE, PB class 2, 10 bar, SDR 11 | | | 16.0 | 20.0 | 22.0 | 25.0 | 28.0 | 32.0 | | 40.0 | 50.0 | 63.0 | 75.0 | 90.0 | | | | | |
| ABS, PP-R, 10 bar, SDR 17 | | | | | | 25.0 | | | | 32.0 | 40.0 | 50.0 | 63.0 | 75.0 | 90.0 | 110.0 | 140.0 | 160.0 | |

| Fluid | % | Fluid temp. (°C) | Frozen temp (°C) | Density (kg/m³) | Specific heat (kJ/kg·K) | Viscosity (mPa·s) | Duct W/mK | Max. recommended cooling capacity(kW) | | | | | | | | | | | | | | | | |
|---------------------------|------|------------------|------------------|-----------------|-------------------------|-------------------|-----------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| | | | | | | | | (calculated for a temperature difference of 5 K and a pressure drop of 400 Pa/m) | | | | | | | | | | | | | | | | |
| Water | | 7 | 0 | 1000 | 4.21 | 1.4 | 0.58 | 1.4 | 2.6 | 3.5 | 4.7 | 6.9 | 8.7 | 12 | 17 | 29 | 57 | 93 | 153 | 236 | 396 | 666 | 967 | |
| Ethanol | 30 % | -10 | -17 | 975 | 3.65 | 12.7 | 0.45 | 0.4 | 0.9 | 1.4 | 2.2 | 3.8 | 4.9 | 6.8 | 10 | 17 | 35 | 58 | 96 | 150 | 254 | 450 | 747 | |
| Propylene glycol | 15 % | 5 | -4 | 1015 | 4.04 | 2.9 | 0.51 | 1.2 | 2.2 | 3.0 | 4.1 | 6.0 | 7.5 | 10 | 15 | 26 | 50 | 82 | 135 | 210 | 353 | 619 | 943 | |
| Propylene glycol | 25 % | 0 | -9 | 1026 | 3.91 | 5.6 | 0.46 | 1.0 | 1.8 | 2.6 | 3.5 | 5.1 | 6.5 | 8.9 | 13 | 22 | 44 | 73 | 120 | 187 | 315 | 555 | 915 | |
| Propylene glycol | 30 % | -5 | -13 | 1033 | 3.84 | 9.1 | 0.44 | 0.6 | 1.4 | 2.2 | 3.0 | 4.5 | 5.7 | 7.9 | 12 | 20 | 40 | 66 | 110 | 171 | 290 | 512 | 847 | |
| Propylene glycol | 35 % | -10 | -17 | 1040 | 3.76 | 16 | 0.43 | 0.3 | 0.8 | 1.3 | 2.0 | 3.4 | 4.8 | 6.9 | 10 | 18 | 36 | 59 | 98 | 154 | 263 | 466 | 773 | |
| Propylene glycol | 40 % | -15 | -22 | 1047 | 3.68 | 28 | 0.41 | | 0.4 | 0.7 | 1.1 | 1.9 | 2.6 | 4.1 | 7 | 15 | 31 | 52 | 86 | 136 | 233 | 416 | 694 | |
| Propylene glycol | 45 % | -20 | -27 | 1055 | 3.59 | 54 | 0.40 | | | 0.4 | 0.5 | 1.0 | 1.3 | 2.1 | 3.6 | 7.9 | 21 | 43 | 74 | 117 | 202 | 363 | 610 | |
| Propylene glycol | 50 % | -25 | -32 | 1062 | 3.51 | 110 | 0.38 | | | | 0.5 | 0.6 | 1 | 1.7 | 3.8 | 10 | 22 | 45 | 86 | 169 | 307 | 520 | | |
| Propylene glycol | 55 % | -30 | -39 | 1070 | 3.41 | 239 | 0.37 | | | | | 0.8 | 1.7 | 4.7 | 9.7 | 20 | 39 | 85 | 196 | 412 | | | | |
| Propylene glycol | 60 % | -40 | -46 | 1079 | 3.30 | 969 | 0.37 | | | | | | | | | 2.3 | 4.9 | 9.4 | 20 | 47 | 99 | | | |
| Hot propylene glycol | 50 % | 20 | -32 | 1038 | 3.63 | 6.1 | 0.38 | 0.9 | 1.7 | 2.3 | 3.2 | 4.7 | 5.9 | 8.2 | 12 | 20 | 41 | 67 | 111 | 172 | 291 | 512 | 845 | |
| Ethylene glycol | 10 % | 5 | -3 | 1018 | 4.02 | 2.1 | 0.54 | 1.3 | 2.3 | 3.2 | 4.3 | 6.3 | 7.9 | 11 | 16 | 27 | 52 | 86 | 141 | 218 | 366 | 640 | 940 | |
| Ethylene glycol | 20 % | 0 | -8 | 1036 | 3.82 | 3.4 | 0.50 | 1.1 | 2.0 | 2.8 | 3.8 | 5.6 | 7.0 | 9.6 | 14 | 24 | 47 | 77 | 127 | 197 | 331 | 581 | 910 | |
| Ethylene glycol | 30 % | -5 | -15 | 1056 | 3.62 | 5.8 | 0.47 | 0.9 | 1.7 | 2.4 | 3.2 | 4.8 | 6.1 | 8.3 | 12 | 21 | 41 | 68 | 112 | 175 | 296 | 520 | 858 | |
| Ethylene glycol | 35 % | -10 | -19 | 1066 | 3.51 | 8.6 | 0.45 | 0.6 | 1.4 | 2.1 | 2.9 | 4.3 | 5.4 | 7.5 | 11 | 19 | 38 | 62 | 103 | 161 | 273 | 481 | 795 | |
| Ethylene glycol | 40 % | -15 | -23 | 1077 | 3.39 | 13 | 0.44 | 0.4 | 0.9 | 1.4 | 2.2 | 3.8 | 4.8 | 6.6 | 9.7 | 17 | 34 | 56 | 94 | 147 | 249 | 441 | 731 | |
| Ethylene glycol | 45 % | -20 | -28 | 1088 | 3.27 | 21 | 0.43 | | 0.6 | 0.9 | 1.4 | 2.4 | 3.3 | 5.2 | 8.4 | 15 | 30 | 50 | 84 | 132 | 225 | 399 | 663 | |
| Ethylene glycol | 50 % | -25 | -34 | 1100 | 3.15 | 34 | 0.42 | | | 0.5 | 0.8 | 1.4 | 2.0 | 3.1 | 5.3 | 12 | 26 | 44 | 74 | 116 | 199 | 356 | 595 | |
| Ethylene glycol | 55 % | -30 | -40 | 1112 | 3.01 | 57 | 0.41 | | | | 0.5 | 0.8 | 1.1 | 1.8 | 3 | 6.7 | 18 | 37 | 63 | 101 | 174 | 312 | 524 | |
| Alkali | 18 % | -10 | -28 | 942 | 4.25 | 2.7 | 0.44 | 1.2 | 2.2 | 3.1 | 4.1 | 6.1 | 7.6 | 10 | 15 | 26 | 51 | 83 | 137 | 213 | 358 | 627 | 919 | |
| Alkali | 21 % | -20 | -37 | 939 | 4.27 | 4.3 | 0.41 | 1.1 | 2.0 | 2.8 | 3.8 | 5.6 | 7.0 | 10 | 14 | 24 | 48 | 78 | 129 | 201 | 339 | 596 | 921 | |
| Alkali | 25 % | -30 | -45 | 933 | 4.30 | 7.4 | 0.37 | 0.8 | 1.7 | 2.5 | 3.4 | 5.0 | 6.3 | 9 | 13 | 22 | 44 | 72 | 120 | 187 | 316 | 557 | 921 | |
| Calcium chloride | 15 % | 0 | -11 | 1086 | 4.04 | 2.4 | 0.55 | 1.3 | 2.3 | 3.3 | 4.4 | 6.4 | 8.1 | 11 | 16 | 27 | 54 | 88 | 144 | 223 | 375 | 657 | 1009 | |
| Calcium chloride | 20 % | -5 | -17 | 1117 | 3.99 | 3.5 | 0.54 | 1.2 | 2.2 | 3.0 | 4.1 | 6.0 | 7.6 | 10 | 15 | 26 | 51 | 83 | 137 | 213 | 359 | 630 | 1024 | |
| Calcium chloride | 25 % | -20 | -29 | 1143 | 3.96 | 9.9 | 0.51 | 0.6 | 1.5 | 2.4 | 3.3 | 4.9 | 6.2 | 8.5 | 12 | 22 | 43 | 71 | 118 | 185 | 313 | 553 | 916 | |
| Calcium chloride | 30 % | -30 | -55 | 1278 | 3.93 | 25 | 0.48 | 0.3 | 0.6 | 1.0 | 1.6 | 2.8 | 3.8 | 6.1 | 10 | 19 | 38 | 64 | 107 | 168 | 286 | 509 | 848 | |
| Sodium chloride | 10 % | 0 | -7 | 1078 | 4.12 | 2.0 | 0.60 | 1.4 | 2.5 | 3.4 | 4.6 | 6.7 | 8.4 | 11 | 17 | 28 | 56 | 91 | 149 | 231 | 388 | 679 | 1021 | |
| Sodium chloride | 15 % | -5 | -12 | 1120 | 4.08 | 2.6 | 0.59 | 1.3 | 2.4 | 3.3 | 4.4 | 6.5 | 8.2 | 11 | 16 | 28 | 54 | 89 | 147 | 227 | 382 | 669 | 1051 | |
| Sodium chloride | 20 % | -10 | -17 | 1161 | 4.05 | 4.1 | 0.56 | 1.2 | 2.2 | 3.1 | 4.1 | 6.1 | 7.7 | 10 | 15 | 26 | 52 | 85 | 139 | 217 | 365 | 641 | 1056 | |
| Lithium chloride | 10 % | -5 | -12 | 1056 | 3.60 | 3.0 | 0.59 | 1.1 | 2.0 | 2.7 | 3.7 | 5.4 | 6.8 | 9.3 | 13 | 23 | 45 | 75 | 122 | 190 | 320 | 561 | 873 | |
| Lithium chloride | 15 % | -15 | -25 | 1082 | 3.35 | 6.0 | 0.56 | 0.8 | 1.6 | 2.2 | 3.0 | 4.5 | 5.6 | 7.8 | 11 | 19 | 39 | 64 | 105 | 163 | 276 | 486 | 802 | |
| Potassium formate | | | | | | | | | | | | | | | | | | | | | | | | |
| Freezium | 25 % | -5 | -15 | 1155 | 3.12 | 2.7 | 0.51 | 1.0 | 1.8 | 2.6 | 3.4 | 5.0 | 6.3 | 8.7 | 12 | 21 | 42 | 69 | 113 | 176 | 295 | 517 | 827 | |
| Hycool20, Freezium | 30 % | -10 | -20 | 1206 | 2.93 | 3.8 | 0.50 | 0.9 | 1.7 | 2.3 | 3.1 | 4.6 | 5.7 | 7.9 | 11 | 20 | 39 | 63 | 104 | 162 | 272 | 478 | 787 | |
| Hycool30, Freezium | 35 % | -25 | -30 | 1269 | 2.73 | 7.1 | 0.45 | 0.7 | 1.4 | 1.9 | 2.6 | 3.9 | 4.9 | 6.7 | 9.7 | 17 | 33 | 55 | 91 | 142 | 240 | 423 | 698 | |
| Tyfoxit F15 | 25 % | -5 | -15 | 1232 | 3.17 | 3.6 | 0.52 | 1.0 | 1.8 | 2.5 | 3.4 | 5.0 | 6.4 | 8.7 | 13 | 22 | 43 | 70 | 115 | 178 | 300 | 527 | 867 | |
| Tyfoxit F40 | 40 % | -25 | -40 | 1354 | 2.65 | 11 | 0.44 | 0.5 | 1.0 | 1.7 | 2.4 | 3.5 | 4.5 | 6.2 | 9 | 16 | 31 | 52 | 86 | 134 | 228 | 402 | 665 | |
| Potassium acetate | | | | | | | | | | | | | | | | | | | | | | | | |
| Tyfoxit | 60 % | -10 | -20 | 1162 | 3.20 | 6.4 | 0.48 | 0.8 | 1.6 | 2.2 | 3.0 | 4.4 | 5.6 | 7.6 | 11 | 19 | 38 | 63 | 103 | 161 | 272 | 479 | 790 | |
| Tyfoxit | 70 % | -25 | -31 | 1193 | 3.10 | 17 | 0.45 | 0.3 | 0.7 | 1.1 | 1.7 | 3.0 | 4.1 | 6 | 8.9 | 16 | 31 | 52 | 87 | 136 | 231 | 410 | 681 | |
| Tyfoxit | 80 % | -35 | -40 | 1222 | 3.00 | 44 | 0.43 | | 0.3 | 0.4 | 0.7 | 1.1 | 1.6 | 2.5 | 4.4 | 9.4 | 25 | 42 | 70 | 112 | 192 | 344 | 576 | |
| Potassium acetate-formate | | | | | | | | | | | | | | | | | | | | | | | | |
| Temper -10 | | 0 | -10 | 1090 | 3.54 | 2.8 | 0.51 | 1.1 | 2.0 | 2.8 | 3.7 | 5.5 | 6.9 | 9.4 | 14 | 23 | 46 | 75 | 124 | 192 | 323 | 566 | 887 | |
| Temper -15 | | -5 | -15 | 1120 | 3.39 | 3.8 | 0.49 | 1.0 | 1.8 | 2.5 | 3.4 | 5.0 | 6.4 | 9.4 | 13 | 22 | 43 | 70 | 115 | 180 | 302 | 530 | 873 | |
| Temper -20 | | -10 | -20 | 1149 | 3.23 | 5.1 | 0.47 | 0.9 | 1.7 | 2.3 | 3.1 | 4.6 | 5.8 | 8 | 12 | 20 | 39 | 65 | 107 | 167 | 281 | 494 | 814 | |
| Temper -30 | | -20 | -30 | 1190 | 3.00 | 10 | 0.44 | 0.5 | 1.1 | 1.8 | 2.5 | 3.8 | 4.8 | 6.6 | 9.6 | 17 | 33 | 55 | 92 | 143 | 242 | 428 | 708 | |
| Temper -40 | | -30 | -40 | 1225 | 2.88 | 24 | 0.41 | | 0.5 | 0.8 | 1.2 | 2.0 | 2.8 | 4.4 | 7.6 | 14 | 28 | 46 | 77 | 121 | 206 | 367 | 611 | |
| Temper -55 | | -45 | -55 | 1267 | 2.62 | 58 | 0.38 | | | 0.3 | 0.4 | 0.8 | 1.1 | 1.7 | 2.9 | 6.5 | 18 | 35 | 59 | 94 | 162 | 292 | 490 | |
| Temper -60 | | -50 | -60 | 1288 | 2.59 | 108 | 0.38 | | | | 0.4 | 0.6 | 0.9 | 1.6 | 3.5 | 9.5 | 20 | 41 | 79 | 141 | 256 | 434 | | |
| Betaine (Thermera AC) | | -5 | -15 | 1075 | 3.12 | 8 | | | | | | | | | | | | | | | | | | |