

# Copper-Nickel Wire

| Alloy        | Diameter range<br>mm | Resistivity<br>$\Omega\text{mm}^2\text{m}^{-1}$ | Density<br>$\text{gcm}^{-3}$ |
|--------------|----------------------|-------------------------------------------------|------------------------------|
| CUPROTHAL 49 | 4.0-0.10             | 0.49                                            | 8.90                         |
| MANGANINA 43 | 8.0-0.10             | 0.43                                            | 8.40                         |
| CUPROTHAL 30 | 4.0-0.10             | 0.30                                            | 8.90                         |
| CUPROTHAL 15 | 4.0-0.10             | 0.15                                            | 8.90                         |
| CUPROTHAL 10 | 4.0-0.10             | 0.10                                            | 8.90                         |
| CUPROTHAL 05 | 4.0-0.10             | 0.05                                            | 8.90                         |

To obtain resistance at working temperature, multiply by the factor  $C_t$  in the following table:

| Alloy         | 20 °C | 100 °C | 200 °C | 300 °C | 400 °C | 500 °C | 600 °C |
|---------------|-------|--------|--------|--------|--------|--------|--------|
| CUPROTHAL 49  | 1.000 | 1.002  | 1.002  | 1.001  | 1.005  | 1.017  | 1.037  |
| MANGANINA 43* | -     | -      | -      | -      | -      | -      | -      |
| CUPROTHAL 30  | 1.000 | 1.020  | 1.030  | 1.040  | 1.060  | -      | -      |
| CUPROTHAL 15  | 1.000 | 1.035  | 1.070  | 1.110  | 1.150  | -      | -      |
| CUPROTHAL 10  | 1.000 | 1.060  | 1.110  | 1.190  | -      | -      | -      |
| CUPROTHAL 05  | 1.000 | 1.110  | 1.250  | 1.400  | -      | -      | -      |

\* The use of this alloy is limited to the range 15-35 °C.

Multiply the figures in the table with:

| Resistance<br>at 20 °C<br>$\Omega/\text{m}$ | $\text{cm}^2/\Omega$<br>at 20 °C | Weight<br>g/m |              |
|---------------------------------------------|----------------------------------|---------------|--------------|
| 1.0                                         | 1.0                              | 1.0           | CUPROTHAL 49 |
| 0.877                                       | 1.15                             | 0.94          | MANGANINA 43 |
| 0.612                                       | 1.63                             | 1.0           | CUPROTHAL 30 |
| 0.306                                       | 3.29                             | 1.0           | CUPROTHAL 15 |
| 0.204                                       | 4.93                             | 1.0           | CUPROTHAL 10 |
| 0.102                                       | 9.86                             | 1.0           | CUPROTHAL 05 |

| Dia-<br>meter<br>mm | Resistance<br>at 20 °C<br>$\Omega/\text{m}$ | $\text{cm}^2/\Omega$ <sup>1)</sup><br>at 20 °C | Weight<br>g/m | Surface<br>area<br>$\text{cm}^2/\text{m}$ | Cross<br>sectional<br>area<br>$\text{mm}^2$ |
|---------------------|---------------------------------------------|------------------------------------------------|---------------|-------------------------------------------|---------------------------------------------|
| 10                  | 0.0062                                      | 50355                                          | 699           | 314                                       | 78.5                                        |
| 9.5                 | 0.0069                                      | 43173                                          | 631           | 298                                       | 70.9                                        |
| 9.0                 | 0.0077                                      | 36709                                          | 566           | 283                                       | 63.6                                        |
| 8.25                | 0.0092                                      | 28275                                          | 476           | 259                                       | 53.5                                        |
| 8.0                 | 0.0097                                      | 25782                                          | 447           | 251                                       | 50.3                                        |
| 7.5                 | 0.0111                                      | 21244                                          | 393           | 236                                       | 44.2                                        |
| 7.35                | 0.0115                                      | 19994                                          | 378           | 231                                       | 42.4                                        |
| 7.0                 | 0.0127                                      | 17272                                          | 343           | 220                                       | 38.5                                        |
| 6.5                 | 0.0148                                      | 13829                                          | 295           | 204                                       | 33.2                                        |
| 6.0                 | 0.0173                                      | 10877                                          | 252           | 188                                       | 28.3                                        |
| 5.5                 | 0.0206                                      | 8378                                           | 211           | 173                                       | 23.8                                        |
| 5.0                 | 0.0250                                      | 6294                                           | 175           | 157                                       | 19.6                                        |
| 4.75                | 0.0277                                      | 5397                                           | 158           | 149                                       | 17.7                                        |
| 4.5                 | 0.0308                                      | 4589                                           | 142           | 141                                       | 15.9                                        |
| 4.25                | 0.0345                                      | 3866                                           | 126           | 134                                       | 14.2                                        |
| 4.0                 | 0.0390                                      | 3223                                           | 112           | 126                                       | 12.6                                        |
| 3.75                | 0.0444                                      | 2655                                           | 98.3          | 118                                       | 11.0                                        |
| 3.5                 | 0.0509                                      | 2159                                           | 85.6          | 110                                       | 9.62                                        |
| 3.25                | 0.0591                                      | 1729                                           | 73.8          | 102                                       | 8.30                                        |
| 3.0                 | 0.0693                                      | 1360                                           | 62.9          | 94.2                                      | 7.07                                        |
| 2.8                 | 0.0796                                      | 1105                                           | 54.8          | 88.0                                      | 6.16                                        |
| 2.6                 | 0.0923                                      | 885                                            | 47.3          | 81.7                                      | 5.31                                        |
| 2.5                 | 0.100                                       | 787                                            | 43.7          | 78.5                                      | 4.91                                        |
| 2.2                 | 0.129                                       | 536                                            | 33.8          | 69.1                                      | 3.80                                        |
| 2.0                 | 0.156                                       | 403                                            | 28.0          | 62.8                                      | 3.14                                        |
| 1.9                 | 0.173                                       | 345                                            | 25.2          | 59.7                                      | 2.84                                        |
| 1.8                 | 0.193                                       | 294                                            | 22.6          | 56.5                                      | 2.54                                        |

| Dia-<br>meter<br>mm | Resistance<br>at 20 °C<br>$\Omega/\text{m}$ | $\text{cm}^2/\Omega$ <sup>1)</sup><br>at 20 °C | Weight<br>g/m | Surface<br>area<br>$\text{cm}^2/\text{m}$ | Cross<br>sectional<br>area<br>$\text{mm}^2$ |
|---------------------|---------------------------------------------|------------------------------------------------|---------------|-------------------------------------------|---------------------------------------------|
| 1.7                 | 0.216                                       | 247                                            | 20.2          | 53.4                                      | 2.27                                        |
| 1.6                 | 0.244                                       | 206                                            | 17.9          | 50.3                                      | 2.01                                        |
| 1.5                 | 0.277                                       | 170                                            | 15.7          | 47.1                                      | 1.77                                        |
| 1.4                 | 0.318                                       | 138                                            | 13.7          | 44.0                                      | 1.54                                        |
| 1.3                 | 0.369                                       | 111                                            | 11.8          | 40.8                                      | 1.33                                        |
| 1.2                 | 0.433                                       | 87.0                                           | 10.1          | 37.7                                      | 1.13                                        |
| 1.1                 | 0.516                                       | 67.0                                           | 8.46          | 34.6                                      | 0.950                                       |
| 1.0                 | 0.624                                       | 50.4                                           | 6.99          | 31.4                                      | 0.785                                       |
| 0.95                | 0.691                                       | 43.2                                           | 6.31          | 29.8                                      | 0.709                                       |
| 0.90                | 0.770                                       | 36.7                                           | 5.66          | 28.3                                      | 0.636                                       |
| 0.85                | 0.864                                       | 30.9                                           | 5.05          | 26.7                                      | 0.567                                       |
| 0.80                | 0.975                                       | 25.8                                           | 4.47          | 25.1                                      | 0.503                                       |
| 0.75                | 1.11                                        | 21.2                                           | 3.93          | 23.6                                      | 0.442                                       |
| 0.70                | 1.27                                        | 17.3                                           | 3.43          | 22.0                                      | 0.385                                       |
| 0.65                | 1.48                                        | 13.8                                           | 2.95          | 20.4                                      | 0.332                                       |
| 0.60                | 1.73                                        | 10.9                                           | 2.52          | 18.8                                      | 0.283                                       |
| 0.55                | 2.06                                        | 8.38                                           | 2.11          | 17.3                                      | 0.238                                       |
| 0.50                | 2.50                                        | 6.29                                           | 1.75          | 15.7                                      | 0.196                                       |
| 0.475               | 2.77                                        | 5.40                                           | 1.58          | 14.9                                      | 0.177                                       |
| 0.45                | 3.08                                        | 4.59                                           | 1.42          | 14.1                                      | 0.159                                       |
| 0.425               | 3.45                                        | 3.87                                           | 1.26          | 13.4                                      | 0.142                                       |
| 0.40                | 3.90                                        | 3.22                                           | 1.12          | 12.6                                      | 0.126                                       |
| 0.375               | 4.44                                        | 2.66                                           | 0.983         | 11.8                                      |                                             |
| 0.35                | 5.09                                        | 2.16                                           | 0.856         | 11.0                                      |                                             |
| 0.32                | 6.09                                        | 1.65                                           | 0.716         | 10.1                                      |                                             |
| 0.30                | 6.93                                        | 1.36                                           | 0.629         | 9.42                                      |                                             |
| 0.28                | 7.96                                        | 1.11                                           | 0.548         | 8.80                                      |                                             |

<sup>1)</sup>  $\text{cm}^2/\Omega = I^2 \cdot C_t / p$  ( $I$  = Current,  $C_t$  = temperature factor,  $p$  = surface load  $\text{W}/\text{cm}^2$ )

(cont.)

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|--------------|-------------------|----------------------------------------------|---------------------------|
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| CUPROTHAL 15  | 1.000 | 1.035  | 1.070  | 1.110  | 1.150 | -      | -      |
| CUPROTHAL 10  | 1.000 | 1.060  | 1.110  | 1.190  | -     | -      | -      |
| CUPROTHAL 05  | 1.000 | 1.110  | 1.250  | 1.400  | -     | -      | -      |

\* The use of this alloy is limited to the range 15-35 °C.

Multiply the figures in the table with:

| Resistance at 20 °C |                               |            |              |
|---------------------|-------------------------------|------------|--------------|
| $\Omega/\text{m}$   | $\text{cm}^2/\Omega$ at 20 °C | Weight g/m |              |
| 1.0                 | 1.0                           | 1.0        | CUPROTHAL 49 |
| 0.877               | 1.15                          | 0.94       | MANGANINA 43 |
| 0.612               | 1.63                          | 1.0        | CUPROTHAL 30 |
| 0.306               | 3.29                          | 1.0        | CUPROTHAL 15 |
| 0.204               | 4.93                          | 1.0        | CUPROTHAL 10 |
| 0.102               | 9.86                          | 1.0        | CUPROTHAL 05 |

| Dia-meter mm | Resistance at 20 °C $\Omega/\text{m}$ | $\text{cm}^2/\Omega^{1)}$ at 20 °C | Weight g/m | Surface area $\text{cm}^2/\text{m}$ | Cross sectional area $\text{mm}^2$ |
|--------------|---------------------------------------|------------------------------------|------------|-------------------------------------|------------------------------------|
| 0.26         | 9.23                                  | 0.885                              | 0.473      | 8.17                                |                                    |
| 0.25         | 10.0                                  | 0.787                              | 0.437      | 7.85                                |                                    |
| 0.24         | 10.8                                  | 0.696                              | 0.403      | 7.54                                |                                    |
| 0.23         | 11.8                                  | 0.613                              | 0.370      | 7.23                                |                                    |
| 0.22         | 12.9                                  | 0.536                              | 0.338      | 6.91                                |                                    |
| 0.21         | 14.1                                  | 0.466                              | 0.308      | 6.60                                |                                    |
| 0.20         | 15.6                                  | 0.403                              | 0.280      | 6.28                                |                                    |

| Dia-meter mm | Resistance at 20 °C $\Omega/\text{m}$ | $\text{cm}^2/\Omega^{1)}$ at 20 °C | Weight g/m | Surface area $\text{cm}^2/\text{m}$ | Cross sectional area $\text{mm}^2$ |
|--------------|---------------------------------------|------------------------------------|------------|-------------------------------------|------------------------------------|
| 0.19         | 17.3                                  | 0.345                              | 0.252      | 5.97                                |                                    |
| 0.18         | 19.3                                  | 0.294                              | 0.226      | 5.65                                |                                    |
| 0.17         | 21.6                                  | 0.247                              | 0.202      | 5.34                                |                                    |
| 0.16         | 24.4                                  | 0.2063                             | 0.179      | 5.03                                |                                    |
| 0.15         | 27.7                                  | 0.1699                             | 0.157      | 4.71                                |                                    |
| 0.14         | 31.8                                  | 0.1382                             | 0.137      | 4.40                                |                                    |
| 0.13         | 36.9                                  | 0.1106                             | 0.118      | 4.08                                |                                    |

<sup>1)</sup>  $\text{cm}^2/\Omega = I^2 \cdot C_t / p$  ( $I$  = Current,  $C_t$  = temperature factor,  $p$  = surface load  $\text{W}/\text{cm}^2$ )