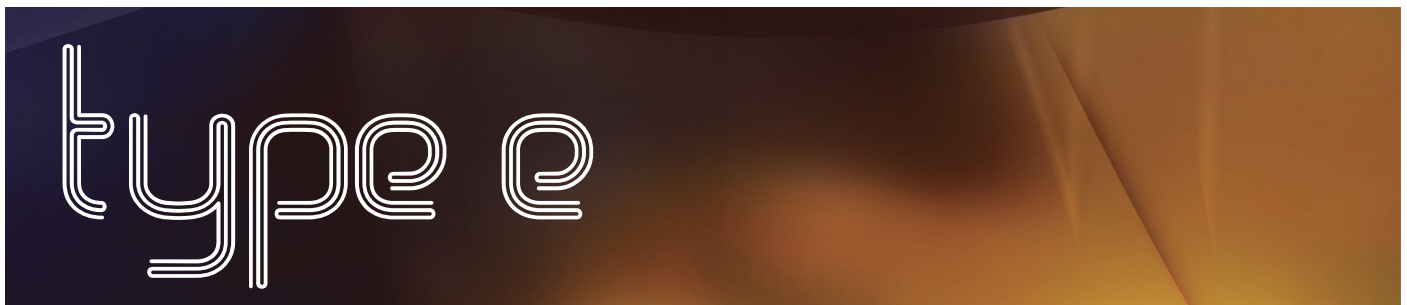


Thermocouple Alloys



This thermocouple has the highest EMF output per degree of all the referenced thermocouples. This characteristic allows type E to be used in applications requiring high EMF output and superior resistance to oxidation in the operating range from 150°C to 870°C. It is sometimes used in thermal-generators (thermopiles). Arranged in series, a thermopile permits measuring accurately very small temperature differences.

Aperam Alloys Rescal has developed special thermopile application elements (see chapter “thermopile applications” below).

1. Chemical composition and mechanical properties

| Alloy | Chemical composition | | | Melting point. °C | Resistivity | Density g/cm ³ | Temp. coef. of resistance (x10 ⁻⁶ /°C) | Linear expansion (coef. x10 ⁻⁶ /°C) | Thermal Conductivity (W m ⁻¹ °C ⁻¹ at 20°C) |
|--------|----------------------|----|----------------|-------------------|-------------|---------------------------|---|--|---|
| | Ni | Cu | Others | | | | | | |
| EP (+) | 90 | 10 | + | 1430 | 100 | 8.72 | 300 | 17 | 19.20 |
| EN (-) | 44 | - | Fe+-Bal Cu-Mn+ | 1210 | 49 | 8.90 | 60 | 14 | 21.20 |

Resistivity: micro ohm-cm at 20°C - Temperature coefficient by °C from 20 up to 100°.

2. Maximum operating temperatures

Please note that the data below are given as indicative values.

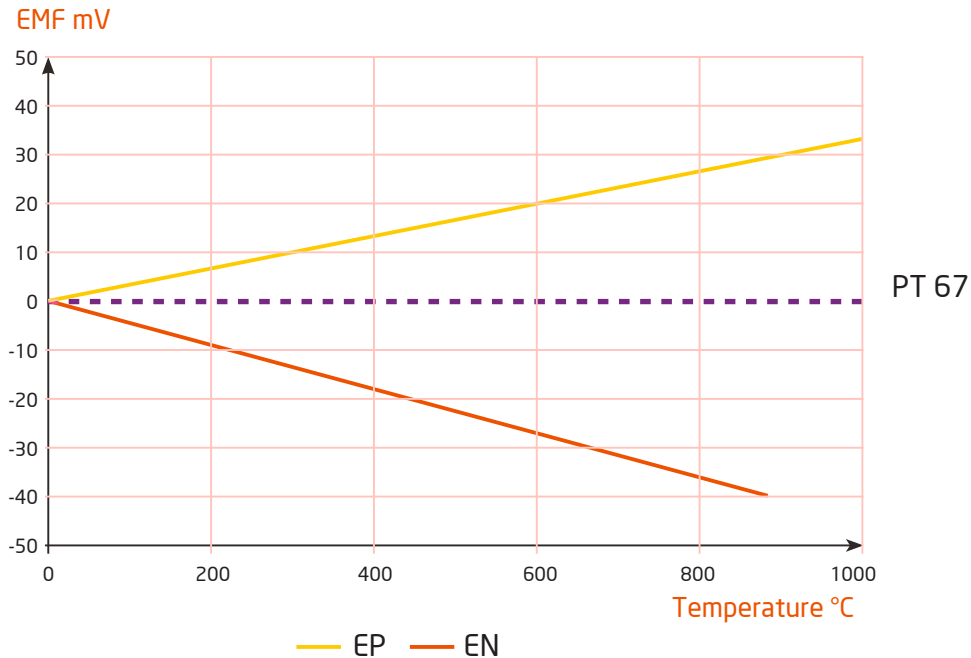
As per norm ASTM

| Thermocouple | Dia 3.26 mm | Dia 1.63 mm | Dia 0.81 mm | Dia 0.51 mm | Dia 0.25 mm |
|--------------|-------------|-------------|-------------|-------------|-------------|
| EP - EN | 870 °C | 650°C | 540°C | 430°C | 370°C |

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3. EP and EN vs Platinum

Nominal EMF for type E thermocouple vs Pt 67



* For extension cables EMF values: please refer to thermocouple graphics until 200°C

4. Couple EP/EN EMF reference table (mV)

| °C | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|-----|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 0 | 0.591 | 1.192 | 1.801 | 2.42 | 3.048 | 3.685 | 4.33 | 4.985 | 5.648 | 6.319 |
| 100 | 6.319 | 6.998 | 7.685 | 8.379 | 9.081 | 9.789 | 10.504 | 11.224 | 11.951 | 12.684 | 13.421 |
| 200 | 13.421 | 14.164 | 14.9121 | 15.664 | 16.42 | 17.181 | 17.945 | 18.713 | 19.484 | 20.257 | 21.036 |
| 300 | 21.036 | 21.817 | 22.6001 | 23.386 | 24.174 | 24.964 | 25.757 | 26.552 | 27.348 | 28.146 | 28.946 |
| 400 | 28.946 | 29.747 | 30.55 | 31.354 | 32.159 | 32.965 | 33.772 | 34.579 | 35.388 | 36.196 | 37.005 |
| 500 | 37.005 | 37.815 | 38.624 | 39.434 | 40.244 | 41.053 | 41.862 | 42.671 | 43.479 | 44.286 | 45.093 |
| 600 | 45.093 | 45.9 | 46.705 | 47.51 | 48.313 | 49.116 | 49.917 | 50.718 | 51.517 | 52.315 | 53.112 |
| 700 | 53.112 | 53.908 | 54.703 | 55.497 | 56.289 | 57.08 | 57.87 | 58.659 | 59.446 | 60.232 | 61.017 |
| 800 | 61.017 | 61.801 | 62.583 | 63.364 | 64.144 | 64.922 | 65.698 | 66.473 | 67.246 | 68.017 | 68.787 |
| 900 | 68.787 | 69.554 | 70.319 | 71.083 | 71.844 | 72.603 | 73.36 | 74.115 | 74.869 | 75.621 | 76.373 |

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5. Conversion tables

EP wire

| B&S or AWG | | | | | SWG | | | | | Metric | | | |
|------------|--------|-------|---------------|--------------|-----|--------|-------|---------------|--------------|-------------|--------|---------------|--------------|
| B&S or AWG | Dia mm | Ohm/m | Length m / kg | Weight g / m | SWG | Dia mm | Ohm/m | Length m / kg | Weight g / m | Diameter mm | Ohm/m | Length m / kg | Weight g / m |
| - | - | - | - | - | - | - | - | - | - | 4 | 0.0561 | 9.12 | 72.3 |
| 8 | 3.251 | 0.085 | 13.8 | 72.4 | 10 | 3.251 | 0.085 | 13.8 | 72.4 | 3.26 | 0.085 | 13.8 | 72.3 |
| 10 | 2.591 | 0.133 | 21.7 | 45.9 | 13 | 2.337 | 0.164 | 26.7 | 37.4 | 3 | 0.0998 | 16.2 | 61.6 |
| 11 | 2.311 | 0.168 | 27.3 | 36.5 | 14 | 2.032 | 0.817 | 35.3 | 28.3 | 2.5 | 0.144 | 23.3 | 42.8 |
| 12 | 2.057 | 0.212 | 24.5 | 28.9 | 15 | 1.829 | 0.269 | 43.6 | 22.9 | 2.05 | 0.213 | 34.7 | 28.8 |
| 13 | 1.829 | 0.269 | 43.6 | 22.9 | 16 | 1.626 | 0.34 | 55.2 | 18.1 | 1.8 | 0.277 | 45.1 | 22.2 |
| 14 | 1.626 | 0.34 | 55.2 | 18.1 | 18 | 1.219 | 0.605 | 98.2 | 10.2 | 1.63 | 0.338 | 54.9 | 18.2 |
| 16 | 1.295 | 0.536 | 87 | 11.5 | 19 | 1.016 | 0.871 | 141.4 | 7.07 | 1.29 | 0.54 | 87.7 | 11.4 |
| 20 | 0.813 | 1.359 | 220.9 | 4.52 | 21 | 0.813 | 1.359 | 220.9 | 4.52 | 0.81 | 1.37 | 222.5 | 4.49 |
| 24 | 0.311 | 3.442 | 559.1 | 1.78 | 25 | 0.508 | 3.483 | 565.8 | 1.77 | 0.5 | 3.595 | 584 | 1.71 |
| 28 | 0.32 | 8.778 | 1426 | 0.7 | 30 | 0.315 | 9.059 | 1471 | 0.679 | 0.3 | 9.987 | 1622 | 0.62 |
| 32 | 0.203 | 21.81 | 35430 | 0.282 | 35 | 0.213 | 19.8 | 3218 | 0.311 | 0.2 | 22.47 | 3650 | 0.27 |

EN wire

| B&S or AWG | | | | | SWG | | | | | Metric | | | |
|------------|--------|--------|---------------|--------------|-----|--------|-------|---------------|--------------|-------------|--------|---------------|--------------|
| B&S or AWG | Dia mm | Ohm/m | Length m / kg | Weight g / m | SWG | Dia mm | Ohm/m | Length m / kg | Weight g / m | Diameter mm | Ohm/m | Length m / kg | Weight g / m |
| - | - | - | - | - | - | - | - | - | - | 4 | 0.039 | 8.94 | 112 |
| 8 | 3.251 | 0.059 | 13.5 | 73.9 | 10 | 3.251 | 0.059 | 13.5 | 73.9 | 3.26 | 0.059 | 13.5 | 73.9 |
| 10 | 2.591 | 0.0929 | 21.3 | 46.9 | 13 | 2.337 | 0.114 | 26.2 | 38.2 | 3 | 0.0693 | 15.9 | 62.9 |
| 11 | 2.311 | 0.116 | 26.8 | 37.3 | 14 | 2.032 | 0.151 | 34.6 | 28.8 | 2.5 | 0.0998 | 22.9 | 43.7 |
| 12 | 2.057 | 0.147 | 33.8 | 29.6 | 15 | 1.829 | 0.186 | 42.7 | 23.4 | 2.05 | 0.148 | 34 | 29.3 |
| 13 | 1.829 | 0.186 | 42.7 | 23.4 | 16 | 1.626 | 0.236 | 54.1 | 18.5 | 1.8 | 0.193 | 44.1 | 22.6 |
| 14 | 1.626 | 0.236 | 54.1 | 18.5 | 18 | 1.219 | 0.419 | 96.2 | 10.4 | 1.63 | 0.235 | 53.2 | 18.6 |
| 16 | 1.295 | 0.372 | 85.3 | 11.7 | 19 | 1.016 | 0.604 | 138.6 | 7.21 | 1.29 | 0.375 | 85.9 | 11.6 |
| 20 | 0.813 | 0.943 | 216.4 | 4.62 | 21 | 0.813 | 0.943 | 216.4 | 4.62 | 0.81 | 0.951 | 218 | 4.58 |
| 24 | 0.311 | 2.389 | 548 | 2.89 | 25 | 0.508 | 2.417 | 554 | 1.8 | 0.5 | 5.092 | 572 | 1.75 |
| 28 | 0.32 | 6.092 | 1397 | 0.715 | 30 | 0.315 | 6.287 | 1441 | 0.693 | 0.3 | 6.932 | 1589 | 0.629 |
| 32 | 0.203 | 15.14 | 3471 | 0.288 | 35 | 0.213 | 13.75 | 3153 | 0.317 | 0.2 | 15.59 | 3576 | 0.279 |

Any intermediate diameter non above listed can be supplied upon request.

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