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|--|-----------------------------|--|--|--|--|
| Brand Name | ISA® 13¹⁾ | | | | |
| Material Code | 2.1356 | | | | |
| Abbreviation | CuMn3 | | | | |
| Chemical Composition (mass components) in %. Average values of alloy components | | | | | |
| Cu Rem. | Mn 3 | | | | |

Features and Application Notes

ISA® 13 is known for low resistivity and a relatively low temperature coefficient, as well as its relatively high corrosion resistance. It is used for low-value resistors and for heating wires and mats in heating cords and in heating cables. The maximum working temperature in air is +200 °C. ISA® 13 can also be used as welding wire, e. g. for building-up welding in copper-plated steel-tanks, as well as for tube-weldings.

Form of Delivery

ISA® 13 is supplied in the form of round wires in the range 0.05 to 8.00 mm Ø in bare or enamelled condition, flat wires, stranded wires and ribbons.

Electrical Resistance in Annealed Condition

| Temperature coefficient of electrical resistance between +20 °C and +105 °C 10 ⁻⁶ /K | Electrical resistivity in: µΩ x cm (first line) and Ω/CMF (second line) Reference Values | | | | | |
|---|---|-------------|-------------|---------|---------|---------|
| | +20 °C tolerance ±10 % | +100 °C | +200 °C | +300 °C | +400 °C | +500 °C |
| +280 to +380 | 12.5 | 12.9 | 13.3 | | | |
| | 75 | 75 | 80 | | | |

Physical Characteristics (Reference Values)

| Density at +20 °C | | Melting point °C | Specific heat at +20 °C J/g K | Wärmeleitfähigkeit bei +20 °C W/m K | Average linear thermal expansion coefficient between +20 °C and | | Thermal EMF against copper at +20 °C µV/K |
|-------------------|-------------|---------------------|-------------------------------------|--|--|--------------|--|
| g/cm ³ | lb/cub in | | | | +100 °C | +400 °C | |
| 8.80 | 0.32 | +1,050 | 0.39 | 84.00 | 15.50 | 18.00 | +1.00 |

Strength Properties at +20 °C in Annealed Condition

| Tensile Strength ²⁾ MPa | Elongation (L ₀ = 100 mm) % at nominal diameter in mm | | | | | |
|---------------------------------------|--|------------------|-----------------|----------------|-------------|--|
| psi | 0.020 to 0.063 | > 0.063 to 0.125 | > 0.125 to 0.50 | > 0.50 to 1.00 | > 1.00 | |
| 290 | ≈ 8 | ≈ 15 | ≈ 20 | ≥ 20 | ≥ 25 | |

Notes on Treatment // ISA® 13 can be worked easily. This alloy can be soldered and brazed without difficulty. All known welding methods can be used.

1) ISA® 13 is a registered trademark of Isabellenhütte Heusler GmbH & Co. KG.

2) This value applies to wires of 2.0 mm diameter. For thinner wires the minimum values will substantially increase, depending on the dimensions.

| Nominal Diameter mm | Cross Section mm ² | Weight per 1.000 m g | DC Resistance Referred to Length at +20 °C Ω/m | | | |
|------------------------|----------------------------------|----------------------------|---|-----------|---------------|---------------|
| | | | Nominal Value | Tolerance | Minimum Value | Maximum Value |
| 0.050 | 0.001963 | 17.30 | 63.7 | ±8 % | 58.6 | 68.8 |
| 0.056 | 0.002463 | 21.70 | 50.8 | | 46.7 | 54.8 |
| 0.060 | 0.002827 | 24.90 | 44.2 | | 40.7 | 47.7 |
| 0.063 | 0.003117 | 27.40 | 40.1 | | 36.9 | 43.3 |
| 0.070 | 0.003848 | 33.90 | 32.5 | | 29.9 | 35.1 |
| 0.071 | 0.003959 | 34.80 | 31.6 | | 29.1 | 34.1 |
| 0.080 | 0.005027 | 44.20 | 24.9 | | 22.9 | 26.9 |
| 0.090 | 0.006362 | 56.00 | 19.6 | | 18.1 | 21.2 |
| 0.100 | 0.007854 | 69.10 | 15.9 | | 14.6 | 17.2 |
| 0.110 | 0.009503 | 83.60 | 13.2 | | 12.2 | 14.1 |
| 0.112 | 0.009852 | 86.70 | 12.7 | 11.8 | 13.6 | |
| 0.120 | 0.01131 | 99.50 | 11.1 | 10.3 | 11.8 | |
| 0.125 | 0.01227 | 108.00 | 10.2 | 9.47 | 10.9 | |
| 0.130 | 0.01327 | 117.00 | 9.42 | 8.76 | 10.1 | |
| 0.140 | 0.01539 | 135.00 | 8.12 | 7.55 | 8.69 | |
| 0.150 | 0.01767 | 156.00 | 7.07 | 6.58 | 7.57 | |
| 0.160 | 0.02011 | 177.00 | 6.22 | 5.78 | 6.65 | |
| 0.180 | 0.02545 | 224.00 | 4.91 | 4.57 | 5.26 | |
| 0.200 | 0.03142 | 276.00 | 3.98 | 3.74 | 4.22 | |
| 0.220 | 0.03801 | 335.00 | 3.29 | 3.09 | 3.49 | |
| 0.224 | 0.03941 | 347.00 | 3.17 | 2.98 | 3.36 | |
| 0.250 | 0.04909 | 432.00 | 2.55 | 2.39 | 2.70 | |
| 0.280 | 0.06158 | 542.00 | 2.03 | 1.91 | 2.15 | |
| 0.300 | 0.07069 | 622.00 | 1.77 | 1.66 | 1.87 | |
| 0.315 | 0.07793 | 686.00 | 1.60 | 1.52 | 1.68 | |
| 0.350 | 0.09621 | 847.00 | 1.30 | 1.23 | 1.36 | |
| 0.355 | 0.09898 | 871.00 | 1.26 | 1.20 | 1.33 | |
| 0.400 | 0.1257 | 1,110.00 | 0.995 | 0.945 | 1.04 | |
| 0.450 | 0.1590 | 1,400.00 | 0.786 | 0.747 | 0.825 | |
| 0.500 | 0.1963 | 1,730.00 | 0.637 | 0.605 | 0.668 | |

| Nominal Diameter mm | Cross Section mm ² | Weight per 1.000 m g | DC Resistance Referred to Length at +20 °C Ω/m | | | |
|------------------------|----------------------------------|----------------------------|---|-----------|---------------|---------------|
| | | | Nominal Value | Tolerance | Minimum Value | Maximum Value |
| 0.550 | 0.2376 | 2,090.00 | 0.526 | | 0.505 | 0.547 |
| 0.560 | 0.2463 | 2,170.00 | 0.508 | | 0.487 | 0.528 |
| 0.600 | 0.2827 | 2,490.00 | 0.442 | | 0.424 | 0.460 |
| 0.630 | 0.3117 | 2,740.00 | 0.401 | | 0.385 | 0.417 |
| 0.650 | 0.3318 | 2,920.00 | 0.377 | | 0.362 | 0.392 |
| 0.700 | 0.3848 | 3,390.00 | 0.325 | | 0.312 | 0.338 |
| 0.710 | 0.3959 | 3,480.00 | 0.316 | | 0.303 | 0.328 |
| 0.800 | 0.5027 | 4,420.00 | 0.249 | | 0.239 | 0.259 |
| 0.900 | 0.6362 | 5,600.00 | 0.196 | | 0.189 | 0.204 |
| 1.000 | 0.7854 | 6,910.00 | 0.159 | | 0.153 | 0.166 |
| 1.120 | 0.9852 | 8,670.00 | 0.127 | | 0.122 | 0.132 |
| 1.200 | 1.131 | 9,950.00 | 0.111 | | 0.106 | 0.115 |
| 1.250 | 1.227 | 10,800.00 | 0.102 | | 0.0978 | 0.106 |
| 1.400 | 1.539 | 13,550.00 | 0.0812 | | 0.0780 | 0.0844 |
| 1.500 | 1.767 | 15,550.00 | 0.0707 | | 0.0679 | 0.0736 |
| 1.600 | 2.011 | 17,690.00 | 0.0622 | | 0.0597 | 0.0647 |
| 1.800 | 2.545 | 22,390.00 | 0.0491 | | 0.0472 | 0.0511 |
| 2.000 | 3.142 | 27,650.00 | 0.0398 | ±4 % | 0.0382 | 0.0414 |
| 2.200 | 3.801 | 33,450.00 | 0.0329 | | 0.0316 | 0.0342 |
| 2.240 | 3.941 | 34,680.00 | 0.0317 | | 0.0305 | 0.0330 |
| 2.500 | 4.909 | 43,200.00 | 0.0255 | | 0.0244 | 0.0265 |
| 2.800 | 6.158 | 54,190.00 | 0.0203 | | 0.0195 | 0.0211 |
| 3.000 | 7.069 | 62,200.00 | 0.0177 | | 0.0170 | 0.0184 |
| 3.150 | 7.793 | 68,580.00 | 0.0160 | | 0.0154 | 0.0167 |
| 3.200 | 8.042 | 70,770.00 | 0.0155 | | 0.0149 | 0.0162 |
| 3.500 | 9.621 | 84,670.00 | 0.0130 | | 0.0125 | 0.0135 |
| 3.550 | 9.898 | 87,100.00 | 0.0126 | | 0.0121 | 0.0131 |
| 4.000 | 12.57 | 110,580.00 | 0.00995 | | 0.00955 | 0.0103 |
| 4.500 | 15.90 | 139,960.00 | 0.00786 | | 0.00755 | 0.00817 |
| 5.000 | 19.63 | 172,790.00 | 0.00637 | | 0.00611 | 0.00662 |
| 5.500 | 23.76 | 209,070.00 | 0.00526 | | 0.00505 | 0.00547 |
| 5.600 | 24.63 | 216,750.00 | 0.00508 | | 0.00487 | 0.00528 |
| 6.000 | 28.27 | 248,810.00 | 0.00442 | | 0.00424 | 0.00460 |
| 6.300 | 31.17 | 274,320.00 | 0.00401 | | 0.00385 | 0.00417 |
| 8.000 | 50.27 | 442,340.00 | 0.00249 | | 0.00239 | 0.00259 |