

| Alloy Designation |                   |
|-------------------|-------------------|
| EN                | Cu-DLP<br>(SW-Cu) |
| DIN CEN/TS 13388  | CW 023 A          |
| JIS               | -                 |
| UNS               | C12000            |

**Copper Rolled Products**



We produce a vast assortment of copper rolled products with highest purity in various chemical compositions, sizes and formats, all suited to many types of final processing.

| Chemical Composition   |                |   |
|------------------------|----------------|---|
| Weight percentage in % |                |   |
| Cu                     | ≥ 99.90        | % |
| P                      | 0.005 .. 0.012 | % |

**Characteristics**

Cu-DLP is a phosphorus-deoxidized copper with a limited, medium amount of residual Phosphorus. It has a good electrical conductivity and excellent welding and soldering properties. It can be formed excellent, either hot or cold.

This alloy is in accordance with RoHS 2002/96/CE for electric & electronic equipments and 2002/53/CE for automotive industry

**Main Applications**

**Electrical**  
Cable Strip, Busbars (Welded or Brazed), Tubular Bus, Leadframes for power semiconductors,

**Industrial**  
Tubing, LP Gas Service, Conductors, Resistance Welding Equipment, Welded Tube, Medical Gas- Oxygen

**Other**  
Applications Requiring Welding or Brazing, Apparatus industry

| Physical Properties                          |   |       |                     |
|--|---|-------|---------------------|
| Typical values in annealed temper at 20 °C   |   |       |                     |
| Density                                      |   | 8.9   | g/cm <sup>3</sup>   |
| Thermal expansion coefficient                | -191 .. 16 °C                               | 14.1  | 10 <sup>-6</sup> /K |
|  | 20 .. 300 °C                                | 17.3  | 10 <sup>-6</sup> /K |
| Specific heat capacity                       |   | 0.386 | J/(g·K)             |
| Thermal conductivity                         |   | 375   | W/(m·K)             |
| Electrical conductivity                      | (1 MS/m = 1 m/(Ω mm <sup>2</sup> ))         | 55    | MS/m                |
| Electrical conductivity                      | (IACS)                                      | 95    | %                   |
| Thermal coefficient of electrical resistance | (0 .. 200 °C)                               | 3.6   | 10 <sup>-3</sup> /K |
| Modulus of elasticity                        | (1 GPa = 1 kN/mm <sup>2</sup> ) cold formed | 130   | GPa                 |
|  | annealed                                    | 118   | GPa                 |

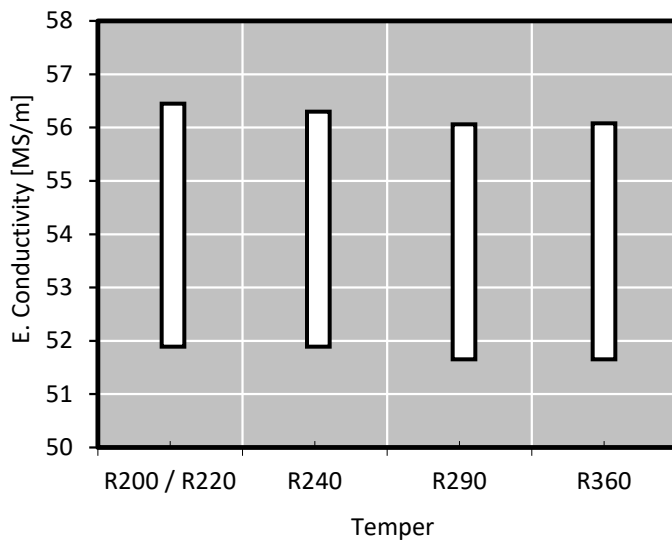


#### Mechanical Properties (EN 1652)

| Temper |          | Tensile Strength | Yield Strength    | Elongation Minimum | Hardness  |
|--------|----------|------------------|-------------------|--------------------|-----------|
|        |          | R <sub>m</sub>   | R <sub>p0.2</sub> | A <sub>50mm</sub>  | HV *      |
|        |          | MPa              | MPa               | %                  | HV        |
| R200   | annealed | 200 .. 250       | ≤ 100*            | (≥ 2,5 mm) 42      | 40 .. 65  |
| R220   | annealed | 220 .. 260       | < 140*            | 33                 | 40 .. 65  |
| R240   |          | 240 .. 300       | ≥ 180             | 8                  | 65 .. 95  |
| R290   |          | 290 .. 360       | ≥ 250             | 4                  | 90 .. 110 |
| R360   |          | ≥ 360            | ≥ 320             | 2                  | ≥ 110     |

\* only for information

#### Electrical Conductivity



Electrical conductivity is strongly influenced by chemical composition. A high level of cold deformation and small grain size decrease the electrical conductivity moderately. Minimum conductivity level can be specified.

#### Fabrication Properties\*

|  |               |
|--|---------------|
| Cold Forming Properties                | Excellent     |
| Hot Forming Properties at 750 .. 950°C | Good          |
| Machinability (Rating 20)              | Less suitable |
| Electroplating Properties              | Excellent     |
| Hot Tinning Properties                 | Excellent     |
| Soft soldering, Brazing                | Excellent     |
| Resistance Welding                     | Less suitable |
| Gas Shielded Arc Welding               | Excellent     |
| Laser Welding                          | Fair          |
| Soft Annealing                         | 250 .. 650°C  |
| Stress Relieving Annealing             | 150 .. 200°C  |

#### Corrosion Resistance\*

Resistant to:

Atmospheric corrosion: formation of the a greenish protective patina due to the formation of copper basic salts (such sulphates, chlorides in marine environment, nitrates and carbonates). Cu-DLP has a good resistance in in natural and industrial atmosphere.

Industrial and drinking water, aqueous and alkaline solutions (not oxidizing), pure water vapour (steam), non oxidizing acids (without oxygen in solution) and salts, neutral saline solutions.

Practically resistant against stress corrosion cracking

Not resistant to:

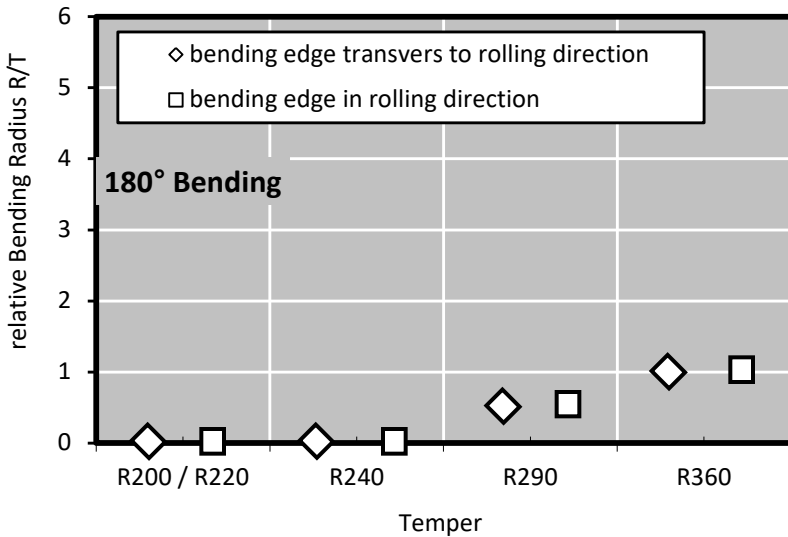
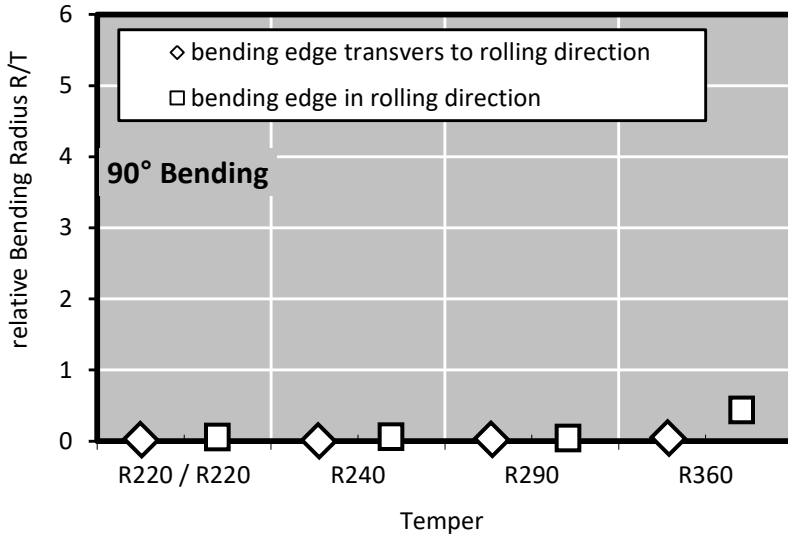
Oxidising acids, solutions containing cyanides, ammonia or halogens, hydrous ammonia and halogenated gases, hydrogen sulfide, seawater especially with high flow rates.

\* For more details call our technical service

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**Bending Properties** Thickness: ≤ 0.5 mm

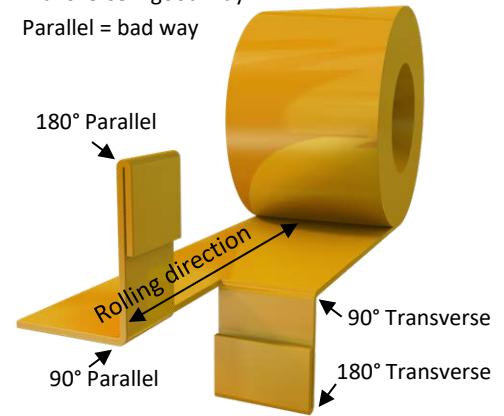


Bending test according to EN ISO 7438 is done with 10 mm wide samples. Smaller samples in general – as well as lower thickness – allow a lower bending radius without cracks. If needed we supply bending optimized temper classes that far exceed standard quality.

Please take care when comparing with ASTM E 290 results, there the bend definition direction is contradictory.

**Bending Definition**

Transverse = good way  
Parallel = bad way



**Minimum Bending Radius Calculation**

To find out the minimum possible bending radius take the R/T value from the list.

Example: R/T = 0.5 and thickness 0.3 mm

$$\text{Minimum radius} = (R/T) \times \text{thickness} \\ = 0.5 \times 0.3 \text{ mm} = 0.15 \text{ mm}$$

**Bending Properties\***

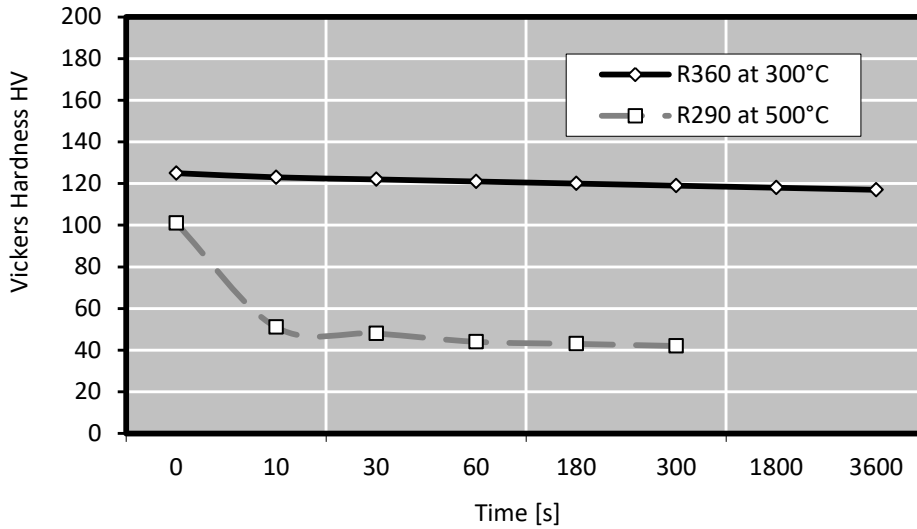
| Temper | Thickness Range | Bending 90° |          | Bending 180° |          |
|--------|-----------------|-------------|----------|--------------|----------|
|        |                 | Trans-vers  | Parallel | Trans-vers   | Parallel |
|        | mm              | R/T         | R/T      | R/T          | R/T      |
| R200   | ≤ 0.5           | 0           | 0        | 0            | 0        |
| R220   | ≤ 0.5           | 0           | 0        | 0            | 0        |
| R240   | ≤ 0.5           | 0           | 0        | 0            | 0        |
| R290   | ≤ 0.5           | 0           | 0        | 0.5          | 0.5      |
| R360   | ≤ 0.5           | 0           | 0.5      | 1            | 1        |

\* Measured at sample width 10 mm according to EN 1654

Possible bending radius = (R/T) x thickness



**Softening Resistance**



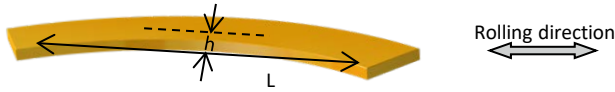
After short time heat treatment Vickers Hardness is measured. The diagram shows typical values.

**Bend Fatigue (at room temperature)**

The fatigue strength gives an indication about the resistance to variations in applied tension. It is measured under symmetrical alternating load. The maximum bending load for  $10^7$  load cycles without crack is measured. Dependent on the temper class it is approximately 1/3 of the tensile strength  $R_m$ .



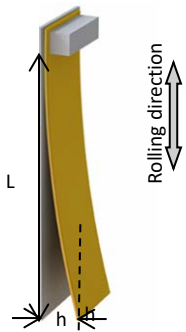
#### Camber



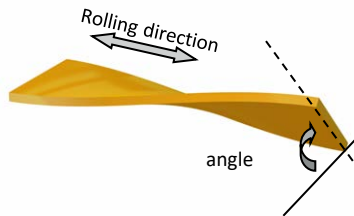
#### Evenness



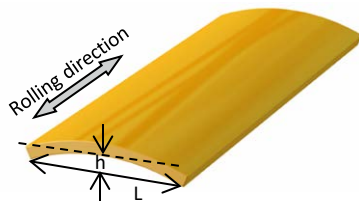
#### Coil set



#### Twist



#### Transverse Flatness



#### Evenness Tolerance

| Thickness Range [mm] | Width Range [mm] |          |           |
|----------------------|------------------|----------|-----------|
|                      | 7 .. 20          | 21 .. 50 | 51 .. 100 |
| 0.10 .. 0.50         | +0.10            | +0.20    | +0.30     |
| 0.50 .. 1.00         | +0.15            | +0.25    | +0.35     |

#### Width Tolerance Standard / Precision

| Thickness Range [mm] | Width Range [mm] |             |             |             |             |              | * Only R200 and R220 |
|----------------------|------------------|-------------|-------------|-------------|-------------|--------------|----------------------|
|                      | 10 .. 50         | 51 .. 100   | 101 .. 200  | 201 .. 350  | 351 .. 700  | 700 .. 1.250 |                      |
| 0.10 .. 1.00         | +0.2 / +0.1      | +0.3 / +0.2 | +0.4 / +0.3 | +0.6 / +0.4 | +1.0 / +0.5 | -            |                      |
| 0.20 .. 1.00         | +0.2 / +0.1      | +0.3 / +0.2 | +0.4 / +0.3 | +0.6 / +0.4 | +1.0 / +0.5 | +2.0         |                      |
| 1.01 .. 2.00         | +0.3 / +0.2      | +0.4 / +0.2 | +0.5 / +0.4 | +1.0 / +0.6 | +1.5 / +0.7 | +2.0         |                      |
| 2.01 .. 3.00         | +0.5 / +0.3      | +0.6 / +0.3 | +0.7 / +0.5 | +1.2 / +0.7 | +2.0 / +0.9 | +3.0         |                      |
| 3.01 .. 6.00         | +2.0 / -         | +2.3 / -    | +2.5 / -    | +3.0 / -    | +4.0 / -    | +6.0         |                      |

#### Customized Tolerances

Our products are produced in accordance with relevant norms EN 1652 / EN 1654. Customer specific tolerances for Thickness, Width, Camber, Transverse Flatness, Evenness, Twist and Coil set can be defined. We will be happy to meet your demands. EN 1652 defines only camber.

#### Thickness Tolerance

| Thickness Range [mm] | EN 1652 ≤350 mm [mm] | KME Standard [mm] | KME Precision [mm] |
|----------------------|----------------------|-------------------|--------------------|
| 0.10 .. 0.20         | ± 0.018              | ± 0.005           | ± 0.004            |
| 0.21 .. 0.30         | ± 0.022              | ± 0.007           | ± 0.005            |
| 0.31 .. 0.40         | ± 0.025              | ± 0.015           | ± 0.006            |
| 0.41 .. 0.50         | ± 0.030              | ± 0.015           | ± 0.008            |
| 0.51 .. 0.60         | ± 0.040              | ± 0.017           | ± 0.010            |
| 0.61 .. 0.70         | ± 0.040              | ± 0.020           | ± 0.010            |
| 0.71 .. 0.85         | ± 0.040              | ± 0.022           | ± 0.012            |
| 0.86 .. 1.30         | ± 0.050              | ± 0.025           | ± 0.015            |
| 1.31 .. 2.00         | ± 0.060              | ± 0.030           | ± 0.020            |
| 2.01 .. 3.00         | ± 0.070              | ± 0.045           | ± 0.025            |
| 3.00 .. 4.00         | ± 0.100              | ± 0.050           | ± 0.025            |
| 4.00 .. 6.00         | ± 0.120              | ± 0.060           | ± 0.030            |

#### Roughness

| Ra [μm]      | Thickness [mm] |
|--------------|----------------|
| 0.13 .. 0.18 | 0.1 .. 2.0     |
| 0.20 .. 0.30 | 0.1 .. 2.0     |
| 0.35 .. 0.46 | 0.1 .. 2.0     |
| On request   | > 2.0          |



| Formats  | Dimension*                     |   |                 |    |
|--|--------------------------------|---|-----------------|----|
|    | Coil                           | Strip thickness (other thicknesses on request)                  | ≥ 0.1 .. 6.00   | mm |
|  |                                | Strip width   | ≥ 3 .. 1,250    | mm |
|  |                                | Outside diameter  | ≤ 1,400         | mm |
|  |                                | Weight (Standard)   | ≤ 8,400         | kg |
|  |                                | Weight (Deep-Drawing Quality)                                   | ≤ 8,000         | kg |
|  |                                | Weight per mm   | ≤ 12.0          | kg |
|    | Traverse wound strip           | Thickness   | ≥ 0.2 .. ≤ 1.50 | mm |
|  |                                | Width   | ≥ 8 .. ≤ 60.0   | mm |
|  |                                | Weight  | 300 .. 1,500    | kg |
|  |                                | Drums: wood, plastic, metal, flangeless                         |                 |    |
|    | <b>TECSTRIP®</b><br>_multicoil | Thickness   | 0.18 .. 0.80    | mm |
|  |                                | Width   | 15 .. 50        | mm |
|  |                                | Inner diameter 300 mm for thickness                             | 0.15 .. 0.80    | mm |
|  |                                | Inner diameter 400 mm for thickness                             | 0.41 .. 0.80    | mm |
|  |                                | Maximum weight  | 5,000           | kg |
|  |                                | Outer diameter maximum  | 1,600           | mm |
|   | Sheet<br>≤ 6.35 mm             | Thickness   | 0.3 .. 6.35     | mm |
|  |                                | Width   | 50 .. 1,250     | mm |
|  |                                | Length  | 200 .. 6,500    | mm |
|  |                                | Weight  | 2,800 .. 8,000  | kg |
|  |                                | Sheets in standard dimensions<br>e.g. 1,000 x 2,000 mm on stock |                 |    |
|  | Sheet<br>> 6.35 mm             | Thickness   | 6.35 .. 9.50    | mm |
|  |                                | Width   | 50 .. 2,450     | mm |
|  |                                | Length  | 200 .. 7,500    | mm |
|  |                                | Weight  | ≤ 10,000        | kg |
|  |                                | Sheets in standard dimensions<br>e.g. 1,000 x 2,000 mm          |                 |    |
|  | Plate                          | Thickness   | 9.5 .. 150      | mm |
|  |                                | Width   | ≤ 4,500         | mm |
|  |                                | Length  | ≤ 15,000        | mm |
|  |                                | Weight  | ≤ 8,000         | kg |
|  | Disc                           | Thickness   | 0.3 .. 150      | mm |
|  |                                | Diameter  | 20 .. 3,100     | mm |
|  |                                | Weight  | ≤ 10,000        | kg |

\* Some combinations might not be possible



| Surface coatings & Special Treatments * |  | Dimension  |                    |
|---|--|--|--------------------|
|   | Hot-Dip tinned and<br>STOL®28M Tin-Silver  | Width  | ≤ 330 mm           |
|   | STOL®13 Thermic Sn   | Thickness  | ≤ 1.5 mm           |
|   |  | Tin Layer Thickness  | 0.4 .. 20 μm       |
|   | Different thickness per side possible  | R360 on request  |                    |
|   | Electroplating   | Width  | ≤ 400 mm           |
|   |  | Thickness  | ≤ 2.5 mm           |
|   | Tin, Silver, Gold,<br>Cu-Flash, Ni-Flash,<br>Selective plating                   | Other coatings on request  |                    |
|   | Profiled strips<br>STOL®Multigauge   | Width  | 15 .. 90 mm        |
|   |  | Thickness  | 0.23 .. 1 mm       |
|   |  | Other width on request   |                    |
|   | Deburred and rounded edges   | Width  | ≥ 200 .. 1,250* mm |
|   | (e.g. for Transformer Strips)  | Thickness  | 0.3 .. 2.0* mm     |
|   |  | * 0.3 - 2.0 mm Width ≤ 700 mm and<br>0.4 - 2.0 mm Width ≥ 700 mm     |                    |
|   | Precision Strip  | Fully Integrated Fast Fourier Transformation (FFT) Analysis per coil |                    |
|   | With low periodic thickness variation for e.g. High Frequency Cable Applications |  |                    |
|   | Surface with extra low residual carbon content possible.                         |  |                    |
|   | Protection with oil or adhesive foil on request                                  |  |                    |

\* Further details you find at [www.kme.com](http://www.kme.com)

#### Standards for copper and copper alloys

|          |   |
|----------|---|
| EN 1652  | Plate, sheet, strip and circles for general purposes  |
| EN 1654  | Strip for springs and connectors                      |
| EN 1758  | Strip for lead frames                                 |
| EN 13148 | Hot-dip tinned strip                                  |
| EN 13599 | Copper plate, sheet and strip for electrical purposes |
| EN 14436 | Electrolytically tinned strip                         |