



**BRONZE**  
**3444**  
non-ferrous alloys  
Copper Alloys

Material No.	DIN Abbreviation	AFNOR	AISI/SAE/ASTM	ISO	Euro Standard EN	Others
2.1016	CuSn4Pb4Zn4 (former MSnBz 4 Pb)	CuSn4Pb4Zn4		CuSn4Pb4 Zn4	CW456 K	UNS C54400 JIS C5441

Distinctive feature & main attribute: a free cutting bronze alloy with excellently self-lubricating and high mechanical properties and ease of machining, giving a combination of high strength, ductility and good corrosion resistance in numerous environments.

Use & application range: this quality is most suitable for the production of electronic components such as plug-in connectors for its fine contact properties, prongs for its good wastage properties, medical devices, components for watches, marine engineering etc. but not for medical use.

REFERENCE ANALYSIS %	Cu	Pb	Zn	Sn
	<b>88.00</b>	<b>4.00</b>	<b>4.00</b>	<b>4.00</b>

<b>EXECUTION DELIVERY FORM STANDARD SIZES AVAILABILITY</b>	<ul style="list-style-type: none"> <li>• Execution in 3 m round or square &amp; hexagonal bars</li> <li>• Standard size in stock: see <a href="#">Programme range</a></li> <li>• Other sizes on request</li> </ul>
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<b>TOLERANCES</b>	<ul style="list-style-type: none"> <li>• Pointed &amp; chamfered; ISO <b>h9</b></li> <li>• Tighter tolerances in ground execution on short terms of delivery are available</li> </ul>
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<b>PHYSICAL &amp; ELECTRICAL PROPERTIES</b>	<ul style="list-style-type: none"> <li>• Colour: bronze</li> <li>• Density (<math>\rho</math>) at 20 °C: 8.90</li> <li>• Point of fusion (°C): 930</li> <li>• Specific thermal properties (J kg<sup>-1</sup>K<sup>-1</sup>): 380</li> <li>• Linear coefficient of thermal expansion m/m °C between 20 – 100 °C: 17.3x10<sup>-6</sup></li> <li>• Modulus of elasticity (E) at 20 °C MPa: 105000</li> <li>• Thermal conductivity (<math>\lambda</math>) (W m/m<sup>2</sup>°C) at 20 °C: 67</li> <li>• Electrical conductivity (<math>\sigma</math>) (% IACS): 17</li> <li>• Electrical resistivity (R) (<math>\mu\Omega</math> – cm): 10</li> <li>• Magnetic properties: excellent, non-magnetic at any temperature</li> </ul>
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<b>MECHANICAL PROPERTIES</b>				
<b>At delivery status:</b>	in annealed condition (only for coils)	½ hard	Ø ≤ 8 4/4 hard	Ø > 8 4/4 hard
<b>Tensile strength <math>R_m</math> (MPa)</b>	≤ 400	350 – 500	≥ 600	≥ 500
<b>Yield strength <math>R_e 0.2</math> (MPa)</b>	≥ 100	250 – 350	≥ 450	≥ 400
<b>Ductile yield <math>A (\epsilon)</math> (%)</b>	≥ 35	≥ 5	≤ 5	≤ 10
<b>Vickers hardness (HV)</b>	≤ 90	120 – 150	≥ 160	≥ 160

<b>HEAT TREATMENT</b>	<ul style="list-style-type: none"> <li>Annealing: 475 – 675 °C</li> <li>Stress relief annealing: 200 – 250 °C</li> </ul>
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<b>PROCESSING PARAMETER</b>		Chip class 1				
<b>TURNING</b>	<b>TOOLS</b>	V: Rough machining E: Finishing machining	Cutting speed m/min	Feed mm/ revolution	Clearance angle	Cutting angle
	High speed steel	V	90 – 210	0.1 – 0.5	0	6
		E	90 – 210	0.005 – 0.3		
	Cemented carbide	V	120 – 240	0.2 – 0.7	0	4 – 6
E		200 – 40	0.08 – 0.3			
<b>DRILLING</b>	<b>TOOLS</b>	Cutting speed m/min	Feed mm/ revolution	Nose angle	Relief angle	Helix angle
	High speed steel	40 – 100	0.03 – 0.2	118	12 – 15	20 – 30
<b>CUTTING OFF</b>	<b>TOOLS</b>	Cutting speed m/min	Feed mm/revolution	Nose angle	Relief angle	
	High speed steel	90 – 210	0.1 – 0.6	0	5 – 10	
<b>MILLING</b>	<b>TOOLS</b>	Cutting speed m/min	Feed mm/sprocket	Radial cutting angle	Cone angle	
	High speed steel	90 – 210	0.08 – 0.45	0 – 10	10 – 15	
	Cemented carbide	200 – 300	0.05 – 0.25			

<b>DEFORMATION</b>	<ul style="list-style-type: none"> <li>Cold: good</li> <li>Hot: not recommendable</li> </ul>
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<b>CONNECTIVITY</b>	<ul style="list-style-type: none"> <li>• Soft soldering:</li> <li>• Hard soldering:</li> <li>• Welding:</li> </ul>	<p>good not recommendable not recommendable</p>
<b>SURFACE FINISH</b>	Polishing is possible but delicate. Debris of electrolytic particles may occur when improperly handled.	
<b>CUTTING RATES</b>	$v_c \sim 100 - 130 \text{ m/min}$ , value depending on the lubrication oil, cutting tools and shape of parts.	