

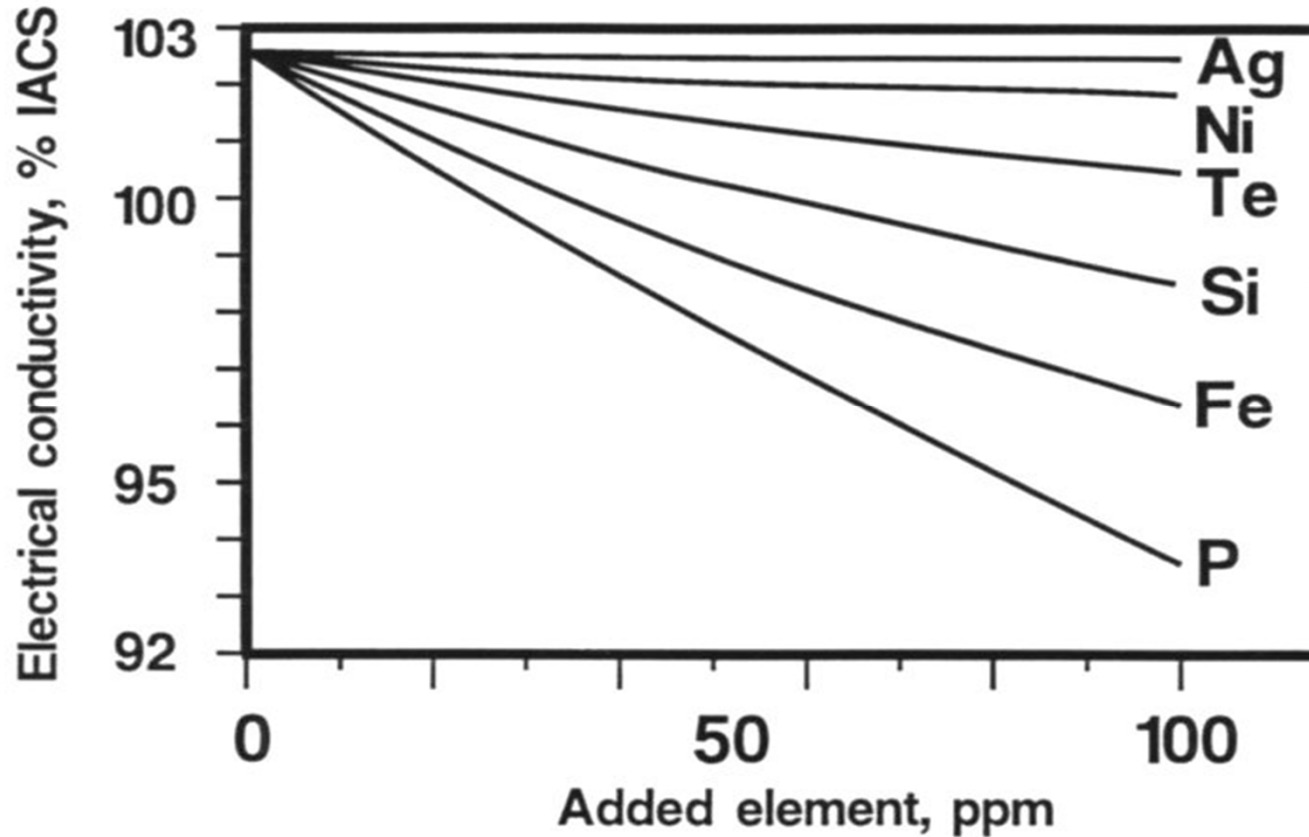
COPPER PRODUCTS / ELECTRICAL PROPERTIES:

- Electrical conductivity - %IACS value is very easy to use
- % IACS = Internal Annealed Copper Standard
- Cu – OF / CW008A min. 100 %IACS (OF-OK / Luvata Pori Oy)
- Electrical Conductivity 100 %IACS = 58 MS/m
- Mass resistivity 0,1533 ohm x g / m² ("Copper 100 %IACS")
- Volume resistivity 0,01724 ohm x mm² / m ("Copper 100 %IACS")

The % IACS values are calculated as percentages of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission. Copper having a volume resistivity 0,017 24 micro-ohm x m at 20 deg C, is defined as corresponding to a conductivity of 100 %.

COPPER PRODUCTS / ELECTRICAL PROPERTIES:

Effect of additives on electrical conductivity (%IACS) of copper



COPPER PRODUCTS / ELECTRICAL PROPERTIES:

- Current carrying capacity: A very approximate method is to assume current density of 2 A / mm² (CDA Publication No. 22)
- Current carrying capacity tables (CDA, ABB / ASEA, Strömberg, ...)
- Standard cases / special cases:

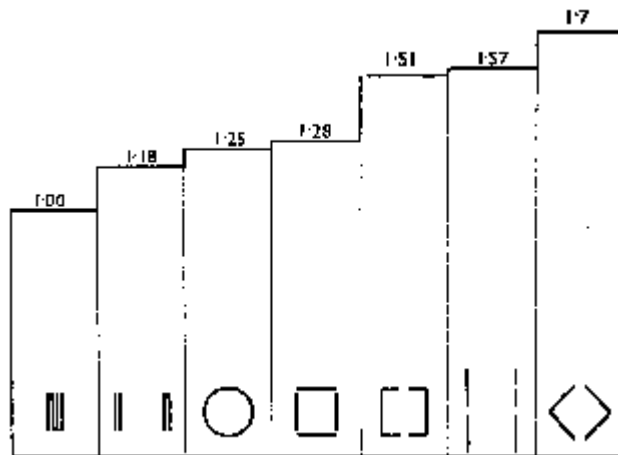


Figure 11 Comparative a.c. ratings of various conductor arrangements each having a cross sectional area of 10,000 mm² of HC copper

COPPER PRODUCTS / ELECTRICAL PROPERTIES:

a mm	b mm	area mm ²	Approx DC res 20 °C μΩ/m	weight kg/m	Approx DC rating A	Approx AC rating A
20	5	100	172,4	0,893	275	275
20	10	200	86,2	1,786	440	430
25	5	125	137,9	1,116	345	345
25	10	250	69,0	2,233	545	535
30	5	150	114,9	1,340	385	380
30	10	300	57,5	2,679	590	570
40	5	200	86,2	1,786	490	480
40	10	400	43,1	3,572	750	715
50	10	500	34,5	4,465	910	850
60	10	600	28,7	5,358	1100	985
80	10	800	21,6	7,144	1390	1240
100	10	1000	17,2	8,930	1700	1490
120	10	1200	14,4	10,716	2160	1740
160	10	1600	10,8	14,288	2865	2220
200	10	2000	8,6	17,860	3510	2700

Table 1. Approximate DC and AC rating for CuOF bus bars

COPPER PRODUCTS / ELECTRICAL PROPERTIES:

When number of conductors are used in parallel, the total current capacity is less than the rating for single bars times the number of bars used. This is due to obstruction to convection and radiation losses from the inner conductors. The approximate DC rating can be obtained using the multiplying factor from table 2.

Table 2. Multiplying factor for number of bus bars in parallel

No of laminations	Multiplying factor
2	1,8
3	2,5
4	3,2
5	3,9
6	4,4
8	5,5
10	6,5

COPPER PRODUCTS / ELECTRICAL PROPERTIES:

Table 2. Physical and Mechanical Properties of Copper and Aluminium (1350)

Property	Copper	Aluminium(1350)	Units
Electrical conductivity (annealed)	100	61	%IACS
Electrical resistivity (annealed)	1.72	2.83	$\mu\Omega\text{cm}$
Thermal conductivity at 20 °C	397	230	W/mK
Coefficient of expansion	17×10^{-6}	23×10^{-6}	/°C
Tensile strength (annealed)	200-250	50-60	N/mm ²
Tensile strength (half-hard)	260-300	85-100	N/mm ²
0.2% proof strength (annealed)	50-55	20-30	N/mm ²
0.2% proof strength (half-hard)	170-200	60-65	N/mm ²
Elastic modulus	116-130	70	N/mm ²
Fatigue Strength (annealed)	62	35	N/mm ²
Fatigue Strength (half hard)	117	50	N/mm ²
Specific heat	385	900	J/kgK
Density	8.91	2.70	g/cm ³
Melting Point	1083	660	°C

Table 3 Electrical properties (at 20 °C)

Designation		Material condition		Volume resistivity	Mass resistivity ^a	Conductivity	
Material				$\frac{\Omega \times \text{mm}^2}{\text{m}}$	$\frac{\Omega \times \text{g}}{\text{m}^2}$	MS/m	% IACS ^b
Symbol	Number			max.	max.	min.	min.
Cu-ETP	CW004A	D		0,017 86	0,158 8	56,0	96,6
Cu-FRHC	CW005A	H035	R200	0,017 24	0,153 3	58,0	100,0
Cu-OF	CW008A						
CuAg0,04	CW011A	H065	R250	0,017 54	0,155 9	57,0	98,3
CuAg0,07	CW012A	H065	R230				
CuAg0,10	CW013A	H085	R300				
CuAg0,04(OF)	CW017A	H085	R280				
CuAg0,07(OF)	CW018A	H075	R260	0,017 86	0,158 8	56,0	96,6
CuAg0,10(OF)	CW019A						
Cu-PHC	CW020A	H100	R350				
CuAg0,04P CuAg0,07P CuAg0,10P Cu-HCP	CW014A CW015A CW016A CW021A	D		0,018 18	0,161 6	55,0	94,8
		H035	R200	0,017 54	0,155 9	57,0	98,3
		H065	R230	0,017 86	0,158 8	56,0	96,6
		H085	R300				
		H085	R280				
		H075	R260	0,018 18	0,161 6	55,0	94,8
H100	R350						

NOTE 1 The % IACS values are calculated as percentages of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission. Copper having a volume resistivity 0,017 24 $\mu \Omega \times \text{m}$ at 20 °C, is defined as corresponding to a conductivity of 100 %.

NOTE 2 1 MS/m is equivalent to 1 $\text{m}/(\Omega \times \text{mm}^2)$.

^a Calculated with a density of copper 8,89 g/cm^3 .

^b IACS: International Annealed Copper Standard.