SILVER-BEARING TOUGH-PITCH COPPER

(Low Silver)

Cu-LSTP

Common name: Silver Copper

A high-conductivity oxygen-bearing copper containing silver either naturally or as an added alloying element. The material has greater resistance to softening and creep than unalloyed high-conductivity copper at moderately elevated temperatures.

COMPOSITION (weight %)

Cu (+ Ag)	99.90 min.
Ag	0.02–0.12

1 SOME TYPICAL USES

Electrical

Windings, including hollow conductors for large generators and other heavy-duty rotating machines; commutator segments; busbars; contacts and switches; induction coils; integrated circuit lead frames.

Mechanical

Strip for automobile radiators and other heat exchangers; photogravure printing plates.

2 PHYSICAL PROPERTIES

	Metric Units	English Units
2.1 Density at 20 °C *68 °F*	8.9 g/cm³	0.321 lb/in³
2.2 Melting point	1 082 [a] °C	1 980 [a] °F
2.3 Coefficient of thermal expansion (linear) at:		
– 183 °C *– 297 °F*	0.000 009 5 per °C	0.000 005 28 per °F
– 191 to 16 °C *– 312 to 61 °F*	0.000 014 1 „ „	0.000 007 83 „ „
20 to 100 °C *68 to 212 °F*	0.000 016 8 „ „	0.000 009 33 „ „
20 to 300 °C *68 to 572 °F*	0.000 017 7 „ „	0.000 009 83 „ „
2.4 Specific heat (thermal capacity) at:		
– 150 °C *– 238 °F*	0.069 cal/g °C	0.069 Btu/lb °F
– 50 °C *– 58 °F*	0.087 „	0.087 „
20 °C *68 °F*	0.092 „	0.092 „
100 °C *212 °F*	0.094 „	0.094 „
200 °C *392 °F*	0.097 „	0.097 „
2.5 Thermal conductivity at:		
– 200 °C *– 328 °F*	1.37 cal cm/cm² s °C	330 Btu ft/ft² h °F
– 183 °C *– 297 °F*	1.13 „	270 „
– 100 °C *– 148 °F*	1.04 „	252 „
20 °C *68 °F*	0.94 „	227 „
100 °C *212 °F*	0.92 „	223 „
200 °C *392 °F*	0.91 „	220 „
300 °C *572 °F*	0.90 „	217 „
2.6 Electrical conductivity (volume) at:		
– 200 °C *– 328 °F* (annealed) [b]	460 [a] m/ohm mm²	800 [a] % IACS
– 100 °C *– 148 °F* („) [b]	110 [a] „	190 [a] „ „
20 °C *68 °F* („)	57.4–58.6 „	99–101 „ „
100 °C *212 °F* („) [b]	44 „	76 „ „
200 °C *392 °F* („) [b]	34 „	58 „ „
20 °C *68 °F* (fully cold worked) [b]	56.3 „	97 „ „

continued overleaf

INDEX NUMBERS RELATE TO LITERATURE REFERENCES (see page 10); INDEX LETTERS RELATE TO FOOTNOTES AT END OF TABLE

Prepared by
CONSEIL INTERNATIONAL POUR LE DEVELOPPEMENT DU CUIVRE (CIDEC)
8, rue du Marché - GENEVE

DATA SHEET No. B 2
Cu-LSTP
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PHYSICAL PROPERTIES (continued)	Metric Units	English Units
2.7 Electrical resistivity (volume) at:		
− 200 °C *− 328 °F* (annealed) [b]	0.002 2 [a] ohm mm²/m 0.22 [a] microhm cm	1.3 [a] ohms (circ mil/ft) 0.085 [a] microhm in
− 100 °C *− 148 °F* („) [b]	0.009 1 [a] ohm mm²/m 0.91 [a] microhm cm	5.5 [a] ohms (circ mil/ft) 0.36 [a] microhm in
20 °C *68 °F* („)	0.017 4–0.017 1 ohm mm²/m 1.74–1.71 microhm cm	10.5–10.3 ohms (circ mil/ft) 0.686–0.672 microhm in
100 °C *212 °F* („) [b]	0.022 7 ohm mm²/m 2.27 microhm cm	13.6 ohms (circ mil/ft) 0.89 microhm in
200 °C *392 °F* („) [b]	0.029 5 ohm mm²/m 2.95 microhm cm	17.7 ohms (circ mil/ft) 1.16 microhm in
20 °C *68 °F* (fully cold worked) [b]	0.017 8 ohm mm²/m 1.78 microhm cm	10.7 ohms (circ mil/ft) 0.700 microhm in
2.8 Temperature coefficient of electrical resistance at: [c]		
20 °C *68 °F* (annealed) applicable over range from − 100 to 200 °C *− 148 to 392 °F*	0.003 93 per °C (100% IACS)	0.002 18 per °F (100% IACS)
20 °C *68 °F* (fully cold worked) applicable over range from 0 to 100 °C *32 to 212 °F*	0.003 81 „ „ (97% IACS)	0.002 12 „ „ (97% IACS)
2.9 Modulus of elasticity (tension) at 20 °C *68 °F:*		
annealed	12 000 kg/mm²	17 000 000 lb/in²
cold worked	12 000–13 500 „	17 000 000–19 000 000 „
2.10 Modulus of rigidity (torsion) at 20 °C *68 °F:*		
annealed	4 500 kg/mm²	6 400 000 lb/in²
cold worked	4 500 – 5 000 „	6 400 000 – 7 000 000 „

(a) Approximate value.

(b) Based on annealed copper having a conductivity of 100% IACS (58.00 m/ohm mm²) at 20 °C *(68 °F)*.

(c) —The temperature coefficients of resistance given can be used for calculating resistances within the temperature range shown, but these relate only to calculations based on a reference temperature of 20 °C *(68 °F)*. If it is more convenient to base calculations upon some other reference temperature, different temperature coefficients of resistance must be applied; for example, in the case of annealed copper (100% IACS), the temperature coefficient of resistance at 20 °C *(68 °F)* is 0.003 93 per °C *(0.002 18 per °F)* whereas at 0 °C *(32 °F)* the value is 0.004 265 per °C *(0.002 37 per °F)*.

—The change in resistance of annealed copper with temperature is essentially linear over a very wide range of temperature. Thus, although a range of only 0 to 100 °C *(32 to 212 °F)* is usually quoted for the temperature coefficient at 20 °C *(68 °F)*, the same coefficient may be used for calculations within the wider range of −100 to 200 °C *(−148 to 392 °F)* without introducing an error greater than 1%.

—Comparatively little information is available on the resistance/temperature relationship for cold-worked copper and there is, therefore, less justification for extending the range for its coefficient beyond 0 to 100 °C *(32 to 212 °F)*.

—The temperature coefficient of resistance of copper can be assumed to be directly proportional to the conductivity value. Thus, for copper of 101% IACS conductivity, the coefficient can be deduced by adding 1% to the value relating to copper of 100% IACS conductivity, i.e. the temperature coefficient corresponding to 101% IACS conductivity can be taken to be 0.003 97 per °C *(0.002 20 per °F)*. However, as the use of this modified coefficient changes the calculated value of resistance at 100 °C *(212 °F)* by less than 0.5%, adjustment of the temperature coefficient to take account of minor variations in conductivity is rarely considered to be worth while.

N.B.: The values shown in Section 2, which have been appropriately rounded in view of the composition range involved, are based partially on selected literature references and also upon values for Cu-ETP (electrolytic 'tough-pitch' copper).

3 FABRICATION PROPERTIES

The information given in this table is for general guidance only, since many factors influence fabrication techniques. The values shown are approximate only, since those used in practice are dependent upon form and size of metal, equipment available, techniques adopted and properties required in the material.

	Metric Units	English Units
3.1 Casting temperature range [(a)]	1 120–1 200 °C	2 050–2 190 °F
3.2 Annealing temperature range [(b)]	350– 650 °C	660–1 200 °F
Stress relieving temperature range [(b)]	225– 275 °C	440– 530 °F
3.3 Hot working temperature range [(b)]	750– 950 °C	1 400–1 750 °F
3.4 Hot formability [(b)]	Good	
3.5 Cold formability	Excellent	
3.6 Cold reduction between anneals	90 % max.	
3.7 Machinability:	See General Data Sheet No. 2	
Machinability rating (free-cutting brass = 100)	20	
3.8 Joining methods [(b)]:	See General Data Sheet No. 3.2	
Soldering	Excellent	
Brazing	Good	
Oxy-acetylene welding	Not recommended	
Carbon-arc welding	Fair	
Gas-shielded arc welding	Fair	
Coated metal-arc welding	Not recommended	
Resistance welding: spot and seam	Not recommended	
butt	Good	

(a) Optimum casting temperature range 1 120–1 150 °C (*2 050–2 100 °F*).
(b) Embrittlement will occur if this material is heated in atmospheres containing an excess of hydrogen.

4 NATIONAL SPECIFICATIONS FOR MANUFACTURED FORMS

Country	Designation of Standards	Designation of Material in Standards	Specification for Chemical Composition [(a)]	Plate Sheet Strip	Rod	Wire	Tube	Sections / Shapes	Forgings
Australia . .	SAA	—	—	—	—	—	—	—	—
Belgium . .	NBN	Cu Ag	—	266.02	266.02	266.02	—	266.02	—
Canada . .	CSA	Cu-STP 114	—	HC.4.1	—	—	—	—	—
Chile . .	INDITECNOR	CuAg $\overline{TP}$	245 n.68	—	—	—	—	—	—
France . .	NF	—	—	—	—	—	—	—	—
Germany . .	DIN	E-CuAg (2.1202)	17 666	40 500, Bl.1	40 500, Bl.3	40 500, Bl.4	—	—	—
Italy . . .	UNI	Cu-STP	5649	—	—	—	—	—	—
Netherlands .	N or NEN [(b)]	—	—	—	—	—	—	—	—
South Africa .	SABS	—	—	—	—	—	—	—	—
Spain . .	UNE	—	—	—	—	—	—	—	—
Sweden . .	SIS	14 50 30	—	—	—	—	—	—	—
Switzerland .	VSM	Cu-LSTP	10826	11852	11852	11852	—	11852	—
United Kingdom	BS	—	—	—	—	—	—	—	—
United States [(c)]	ASTM	Nos. 113, 114 115, 116 or STP	—	B48 B124 B133 B152 B187 B272	B49 B124 B133 B152 B187	B1 B2 B3 B33 B47 B48	B188	B124 B133 B187	—

(a) Applicable when the chemical composition is not given in the specifications for wrought forms.
(b) Older specifications bear prefix N; for new specifications the NEN prefix is used.
(c) In the United States bar and flat wire are covered under the Plate-Sheet-Strip column.

5 MECHANICAL PROPERTIES

5.1 Mechanical properties at room temperature

Tensile properties	see tables 5.1.1/2/3
Hardness	„ „ 5.1.1/2/3
Shear strength	„ „ 5.1.1/2/3
Modulus of elasticity (tension)	see 2.9
Modulus of rigidity (torsion)	„ 2.10

5.2 Mechanical properties at low temperature

Tensile properties	no data traced
Impact properties	„ „ „

5.3 Mechanical properties at elevated temperature

Short-time tensile properties	see table 5.3.1
Creep properties	see tables 5.3.2.1/2

5.4 Fatigue properties

Fatigue strength at room temperature	see table 5.4.1

5.1 MECHANICAL PROPERTIES AT ROOM TEMPERATURE [a]

5.1.1 Typical Tensile Properties and Hardness Values - Metric Units

The values shown represent reasonable approximations for general engineering use, taking account of variations in composition and manufacturing procedures. For design purposes, national specifications should be consulted.
For a given temper, individual elongation values may show some variation above or below the typical values indicated.

Form	Temper	Tensile Strength kg/mm²	Proof Stress 0.2 % offset kg/mm²	Elongation %	Elongation gauge length	Hardness Brinell	Hardness Vickers	Shear Strength kg/mm²	Typical Size Related to Properties Shown [b]
Plate Sheet Strip	Annealed	22	5	48	$5.65\sqrt{S_o}$	45	50	16	—
	Hot Rolled [c]	23	8	40	$5.65\sqrt{S_o}$	55	60	16	—
	Typical Cold Worked Tempers	27	18	25	$5.65\sqrt{S_o}$	75	80	18	0.2 - 10 mm thick
		32	27	12	$5.65\sqrt{S_o}$	90	100	19	0.2 - 6 mm thick
		38	34	6	$5.65\sqrt{S_o}$	105	115	20	0.2 - 1.5 mm thick
Rod	Annealed	22	5	45	$5.65\sqrt{S_o}$	45	50	16	—
	Typical Cold Worked Tempers	28	19	20	$5.65\sqrt{S_o}$	75	80	18	6–40 mm diam. or equivalent area
		34	28	10	$5.65\sqrt{S_o}$	95	105	19	6–20 mm diam. or equivalent area
Wire	Annealed	23	—	37	200 mm	—	—	16	over 3 mm diam.
		24	—	35	200 mm	—	—	16	1–3 mm diam.
		26	—	28	200 mm	—	—	17	0.5–1 mm diam.
		—	—	26	200 mm	—	—	—	0.2–0.5 mm diam.
	Typical Cold Drawn Tempers	38	—	—	—	—	—	20	over 6 mm diam.
		42	—	—	—	—	—	22	3–6 mm diam.
		45	—	—	—	—	—	23	up to 3 mm diam.
Tube	Annealed	24	6	45	$5.65\sqrt{S_o}$	45	50	16	—
	Typical Cold Drawn Tempers	27	18	30	$5.65\sqrt{S_o}$	75	80	18	10–200 mm O.D. up to 10 mm wall
		32	27	15	$5.65\sqrt{S_o}$	90	100	19	10–100 mm O.D. up to 6 mm wall
		35	30	8	$5.65\sqrt{S_o}$	100	110	20	10– 50 mm O.D. up to 2 mm wall
		38	35	6	$5.65\sqrt{S_o}$	105	115	20	up to 25 mm O.D. up to 1 mm wall
Sections / Shapes	Hot Worked [c]	24	8	35	$5.65\sqrt{S_o}$	50	55	16	—
	Typical Cold Worked Tempers [c]	27	18	20	$5.65\sqrt{S_o}$	75	80	18	—
		32	27	10	$5.65\sqrt{S_o}$	90	100	19	—

(a) It will be noted that tables 5.1.1, 5.1.2 and 5.1.3, giving typical tensile properties and hardness values in Metric, English and American units respectively, are not directly comparable. This is because the properties quoted reflect to some extent the metalworking techniques and specification practices of the countries concerned.

(b) It is possible to obtain sizes outside the ranges given in this column, but information on their mechanical properties should be obtained from the metal manufacturers.

(c) The mechanical properties will be largely dependent upon the size and cross-sectional area or complexity of the product.

5.1.2 Typical Tensile Properties and Hardness Values - English Units

The values shown represent reasonable approximations for general engineering use, taking account of variations in composition and manufacturing procedures. For design purposes, national specifications should be consulted.

For a given temper, individual elongation values may show some variation above or below the typical values indicated.

Form	Temper	Tensile Strength ton/in²	Proof Stress 0.1 % offset ton/in²	Elongation %	Elongation gauge length	Vickers Hardness	Shear Strength ton/in²	Typical Size Related to Properties Shown (a)
Plate Sheet Strip	Annealed	14	3	50	2 in.	50	10	—
	Hot Rolled (b)	15	6	45	2 in.	65	10	—
	Typical Cold Worked Tempers	16	9	45	2 in.	75	11	0.006–0.5 in. thick
		17	14	30	2 in.	85	11	0.006–0.25 in. thick
		23	20	10	2 in.	110	13	0.006–0.1 in. thick
Rod	Annealed	14	3	50	$5.65\sqrt{S_o}$	50	10	—
	Typical Cold Worked Tempers	17	13	30	$5.65\sqrt{S_o}$	85	11	0.25–1 in. diam. or equivalent area
		20	16	17	$5.65\sqrt{S_o}$	105	12	"
Wire	Annealed	14	—	35	10 in.	—	10	over 0.05 in. diam.
		15	—	30	10 in.	—	10	over 0.036 up to 0.05 in. diam.
		16	—	25	10 in.	—	11	over 0.02 up to 0.036 in. diam.
		—	—	20	10 in.	—	—	over 0.005 up to 0.02 in. diam.
	Typical Cold Drawn Tempers	26	—	—	—	—	14	over 0.104 in. diam.
		29	—	—	—	—	15	over 0.064 up to 0.104 in. diam.
		30	—	—	—	—	15	up to 0.064 in. diam.
Tube	Annealed	15	5	50	2 in.	50	10	—
	Typical Cold Drawn Tempers	17	10	45	2 in.	80	11	4–8 in. O.D. up to 0.5 in. wall
		20	17	20	2 in.	100	12	"
		18	12	30	2 in.	85	12	0.5–4 in. O.D. up to 0.2 in. wall
		24	21	10	2 in.	110	13	"
Sections (extruded)	Typical Cold Drawn Tempers (b)	16	11	27	$5.65\sqrt{S_o}$	80	10	—
		20	16	15	$5.65\sqrt{S_o}$	105	12	—

(a) It is possible to obtain sizes outside the ranges given in this column, but information on their mechanical properties should be obtained from the metal manufacturers.

(b) The mechanical properties will be largely dependent upon the size and cross-sectional area or complexity of the product.

5.1.3 Typical Tensile Properties and Hardness Values - American Units

The values shown represent reasonable approximations for general engineering use, taking account of variations in composition and manufacturing procedures. For design purposes, national specifications should be consulted.
For a given temper, individual elongation values may show some variation above or below the typical values indicated.

Form	Temper [(a)]	Tensile Strength psi	Yield Strength 0.5 % extension under load psi	Elongation		Rockwell Hardness			Shear Strength psi	Typical Size Related to Properties Shown [(b)]
				%	gauge length	F	B	30 T		
Flat Products (Plate, Sheet, Strip, Bar and Flat Wire)	As Hot Rolled	34 000	10 000	45	2 in.	45	—	—	23 000	0.040 in. thick
	Annealed	32 000	10 000	45	2 in.	40	—	—	22 000	0.040 in. thick
	Cold Worked									
	Light Cold Rolled	36 000	28 000	30	2 in.	60	10	25	25 000	0.040 in. thick
	Half Hard	42 000	36 000	14	2 in.	84	40	50	26 000	"
	Hard	50 000	45 000	6	2 in.	90	50	57	28 000	"
	Spring	55 000	50 000	4	2 in.	94	60	63	29 000	"
	Extra Spring	57 000	53 000	4	2 in.	95	62	64	29 000	"
	Light Cold Rolled	36 000	28 000	40	2 in.	60	10	—	25 000	0.250 in. thick
	Hard	50 000	45 000	12	2 in.	90	50	—	28 000	"
	Hard	45 000	40 000	20	2 in.	85	45	—	26 000	1.0 in. thick
Rod	As Hot Rolled	32 000	10 000	55	2 in.	40	—	—	22 000	1.0 in. diam.
	Soft	32 000	10 000	55	2 in.	40	—	—	22 000	1.0 in. diam.
	Cold Worked									
	Hard	48 000	44 000	16	2 in.	87	47	—	27 000	1.0 in. diam.
Wire	Annealed - Soft	40 000	—	17	10 in.	—	—	—	—	0.008–0.020 in. diam.
		38 000	—	23	10 in.	—	—	—	—	0.021–0.039 in. diam.
		35 000	—	27	10 in.	—	—	—	—	0.040–0.118 in. diam.
		35 000	—	33	10 in.	—	—	—	—	over 0.118 in. diam.
	Cold Worked									
	Medium Hard Drawn	56 000	—	1	60 in.	—	—	—	—	0.008–0.039 in. diam.
	Hard Drawn	67 000	—	1	60 in.	—	—	—	—	"
	Medium Hard Drawn	54 000	—	1.5	60 in.	—	—	—	—	0.040–0.118 in. diam.
	Hard Drawn	65 000	—	1	60 in.	—	—	—	—	"
	Medium Hard Drawn	49 000	—	2.5	10 in.	—	—	—	—	over 0.118 in. diam.
	Hard Drawn	57 000	—	2	10 in.	—	—	—	—	"
Tube	Annealed	32 000	10 000	45	2 in.	40	—	—	22 000	1.0 in. O.D. × 0.065 in. wall
	Cold Worked									
	Light Drawn	40 000	32 000	25	2 in.	77	35	45	26 000	1.0 in. O.D. × 0.065 in. wall
	Drawn	42 000	35 000	17	2 in.	85	—	—	27 000	"
	Hard Drawn	55 000	50 000	8	2 in.	95	60	63	29 000	"
Shapes	As Hot Rolled	32 000	10 000	50	2 in.	40	—	—	22 000	0.50 in. thick
	Annealed - Soft	32 000	10 000	50	2 in.	40	—	—	22 000	0.50 in. thick
	Cold Worked									
	Hard	40 000	32 000	30	2 in.	—	35	—	26 000	0.50 in. thick
Forgings	As Forged [(c)]	33 000	11 000	45	2 in.	37	—	—	23 000	—

(a) The tempers listed are those referred to in ASTM and other American Standards.

(b) It is possible to obtain sizes different from those given in this column, but information on their mechanical properties should be obtained from the metal manufacturers.

(c) The mechanical properties will be largely dependent upon the size and cross-sectional area or complexity of the product.

5.2 MECHANICAL PROPERTIES AT LOW TEMPERATURE

5.2.1 Tensile Properties - Impact Properties

At the date of publication of this sheet, no data relating to this material have been traced.

5.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE

5.3.1 Short-Time Tensile Properties

Form	Temper	Testing Temperature		Tensile Strength			Proof Stress			Elongation % on 2 in.
		°C	°F	kg/mm²	ton/in²	psi	0.2 % offset kg/mm²	0.1 % offset ton/in²	Yield Strength 0.5 % ext. under load psi	
Sheet (1) 2 mm 0.08 in.	Annealed (grain size 0.030 mm)	20	68	23	**14.7**	33 000	—	**3.1**	—	**53**
		100	212	21	**13.4**	30 000	—	**3.0**	—	**49**
		200	392	18.5	**11.8**	26 500	—	**2.9**	—	**47**
		300	572	16.5	**10.5**	23 500	—	**2.9**	—	**45**
		400	752	15	**9.5**	21 500	—	**2.4**	—	**44**
		500	932	11	**6.9**	15 500	—	**2.1**	—	**42**
Strip (2)	Cold Worked (a)	20	68	35	22.5	**50 000**	33.0 (b)	—	—	**8.5**
		288	550	24.5	15.5	**35 000**	19.7 (b)	—	—	**12.1**
Rod (3) 3.2 mm diam. 0.125 in. diam.	Cold Worked 84 %	24	75	41.5	26.5	**59 300**	—	—	**54 100**	**8.5**
		149	300	—	—	—	—	—	**47 000**	—

(a) Quoted as 'cold rolled to RB 61' hardness, in original document, but amount of cold work not defined.
(b) This value was originally reported in psi; in this table it is given in kg/mm² to 3 significant figures.
N.B.: Original values are printed in **bold type**; other values are converted.

5.3.2 Creep Properties

5.3.2.1 Original Creep Data

Form	Temper	Testing Temperature °C	Testing Temperature °F	Stress kg/mm²	Stress ton/in²	Stress psi	Duration 1 000 h	Total Extension % (a)	Intercept %	Min. Creep Rate % per 1 000 h
Strip (4) 2.5 mm 0.1 in.	Annealed (grain size 0.030 mm)	130	266	14	8.5	20 000	2.40	15.8	14.7	1.05
		175	347	9.5 14	6 8.5	14 000 20 000	2.60 2.40	7.0 27.4	6.7 23.2	0.35 1.85
		225	437	4 9.5	2.5 6	6 000 14 000	3.00 2.50	0.9 10.6	0.6 8.0	0.02 1.1
	Cold Worked 10 %	130	266	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	4.75 9.80 7.20	0.09 0.17 0.325	0.08 0.145 0.29	0.000 4 0.002 4 0.007
		175	347	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	4.85 12.90 4.90	0.13 0.28 0.565	0.11 0.22 0.43	0.006 5 0.008 2 0.03
		225	437	5.5 9.5	3.5 6	8 000 14 000	8.90 12.90	0.26 0.865	0.175 0.34	0.009 8 0.037
	Cold Worked 25 %	130	266	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	4.75 10.20 7.20	0.08 0.18 0.26	0.075 0.16 0.24	0.002 0.004 0.005
		175	347	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	4.90 12.90 10.30	0.16 0.25 0.43	0.14 0.18 0.33	0.003 0.005 0.011
		225	437	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	8.90 11.50 9.87	0.21 0.56 1.7 (b)	0.14 0.38 0.43	0.006 4 0.017 0.105
	Cold Worked 50 %	130	266	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	4.55 11.40 7.25	0.09 0.20 0.29	0.08 0.185 0.265	0.001 5 0.001 5 0.004
		175	347	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	6.90 12.90 3.70	0.135 0.285 0.39	0.115 0.25 0.315	0.004 0.006 0.021
		225	437	5.5 9.5 14	3.5 6 8.5	8 000 14 000 20 000	8.90 12.90 3.00	0.26 0.795 0.825	0.15 0.335 0.525	0.011 0.029 0.10
Strip (2)	Cold Worked (c)	288	550	21 17.5 15 10.5	13 11 9.5 6.5	30 000 25 000 22 000 15 000	0.001 05 (b) 0.020 (b) 0.040 (b) 0.170 (b)	— — — —	— — — —	— — — —
Rod (3) 3.2 mm diam. 0.125 in. diam.	Cold Worked 84 %	149	300	6.5 10.5 14 17.5 21 28	4 6.5 8.5 11 13 17.5	9 900 15 000 19 950 24 950 30 000 40 000	7.25 7.25 7.08 7.08 6.00 6.00	0.079 9 0.112 0.181 0.224 0.305 0.870	0.016 9 0.013 8 0.043 6 0.051 5 0.089 8 0.268	<0.000 1 0.000 3 0.001 0.001 6 0.002 9 0.055

continued overleaf

5.3.2.1 Original Creep Data (continued)

Form	Temper	Testing Temperature		Stress			Duration 1 000 h	Total Extension % [a]	Intercept %	Min. Creep Rate % per 1 000 h
		°C	°F	kg/mm²	ton/in²	psi				
Square Wire [5] **6.5 mm 0.257 in.**	Cold Worked 5 %	300	572	5	3	**7 500**	**1.440** [d]	**0.345**	—	**6.3** [f]
				8.5	5.5	**12 500**	**1.440** [d]	**0.755**	—	**19.2** [f]
				5	3	**7 500**	**1.240** [d]	**0.35**	—	**4.7** [g]
				7	4	**10 000**	**1.275** [d]	**0.48**	—	**7.8** [g]
				5	3	**7 500** [e]	**1.410** [d]	**0.43**	—	**5.4** [g]
				7	4	**10 000** [e]	**1.340** [d]	**0.45**	—	**7.8** [g]
				5	3	**7 500**	**1.400** [d]	**0.40**	—	**5.7** [g]
				7	4	**10 000**	**1.250** [d]	**0.465**	—	**9.6** [g]
				5	3	**7 500** [e]	**1.200** [d]	**0.39**	—	**6.0** [g]
				7	4	**10 000** [e]	**1.340** [d]	**0.625**	—	**10.2** [g]
	Cold Worked 20 %	300	572	5	3	**7 500**	**1.395** [d]	**0.420**	—	**10.0** [f]
				8.5	5.5	**12 500**	**1.415** [d]	**0.870**	—	**24.6** [f]
				12	7.5	**17 500**	**0.315** [d]	**1.060**	—	— [f]
				8.5	5.5	**12 500**	**1.440** [d]	**1.075**	—	**30.0** [g]
	Cold Worked 30 %	300	572	5	3	**7 500**	**1.370** [d]	**0.370**	—	**9.4** [f]
				8.5	5.5	**12 500**	**1.380** [d]	**0.940**	—	**22.0** [f]
	Cold Worked 40 %	300	572	5	3	**7 500**	**1.400** [d]	**0.405**	—	**12.5** [f]
				8.5	5.5	**12 500**	**1.400** [d]	**0.970**	—	**27.2** [f]
				8.5	5.5	**12 500**	**1.340** [d]	**1.050**	—	**31.0** [g]

(a) Total extension = Initial extension + Total Creep = Initial extension + Intercept + (Minimum creep rate × Duration).
(b) Rupture test. (c) Quoted as 'cold rolled to RB 61' hardness in original document, but amount of cold work not defined.
(d) Duration in 1 000 minutes. (e) Compression test. (f) Creep tests performed on material containing 0.063% Ag. (g) Creep tests performed on material containing 0.072% Ag.
N.B.: Original values are printed in **bold type**; other values are calculated.

5.3.2.2 Stress for Designated Creep Rate

Form	Temper	Testing Temperature		Stress for Designated Creep Rate								
				0.001 % per 1 000 h			0.01 % per 1 000 h			0.1 % per 1 000 h		
		°C	°F	kg/mm²	ton/in²	psi	kg/mm²	ton/in²	psi	kg/mm²	ton/in²	psi
Rod [3] **3.2 mm diam. 0.125 in. diam.**	Cold Worked 84 %	149	300	15	9.5	**22 000**	25	16	**36 000**	28.5	18	**41 000**

N.B.: Original values are printed in **bold type**; other values are converted.

5.4 FATIGUE PROPERTIES

5.4.1 Fatigue Strength at Room Temperature

At the date of publication of this sheet, no data relating to this material have been traced.

REFERENCES

MECHANICAL PROPERTIES (SECTION 5)

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Printed in England by Impress (Worcester) Ltd.