ArcelorMittal

BIMETALS
DEFLECTION AND CURVATURE

Further information regarding our range of bimetals and their properties :

1. Chemical composition
2. Temperature dependence of deflection
3. Temperature dependence of resistivity
4. Calculation of bimetal parts

1. CHEMICAL COMPOSITION

PASSIVE COMPONENT / **ACTIVE COMPONENT**	**LINEARITY RANGE**	
	-20℃ to +200℃	-20℃ to +380℃
	INVAR ® (Fe Ni36)	**N 42** (Fe Ni42)
B 72 M (Mn Cu18 Ni10)	108 SP 140 SP + nickel = 60 SP – 40 SP + copper = 20 SP – 15 SP – 11 SP – 8 SP – 5 SP	
B 6 M (Fe Ni20 Mn6)	AS + nickel = AS 55 – AS 35 – AS 25 + copper = AS 11 - AS 6	BS + copper = BS 9
NC 4 (Fe Ni22 Cr3)	R 80 + nickel = R 40 – R 25 + copper = R 16 – R 11 – R8 – R 6 – R 4	

R 15	Active component Ni	Passive component INVAR ®

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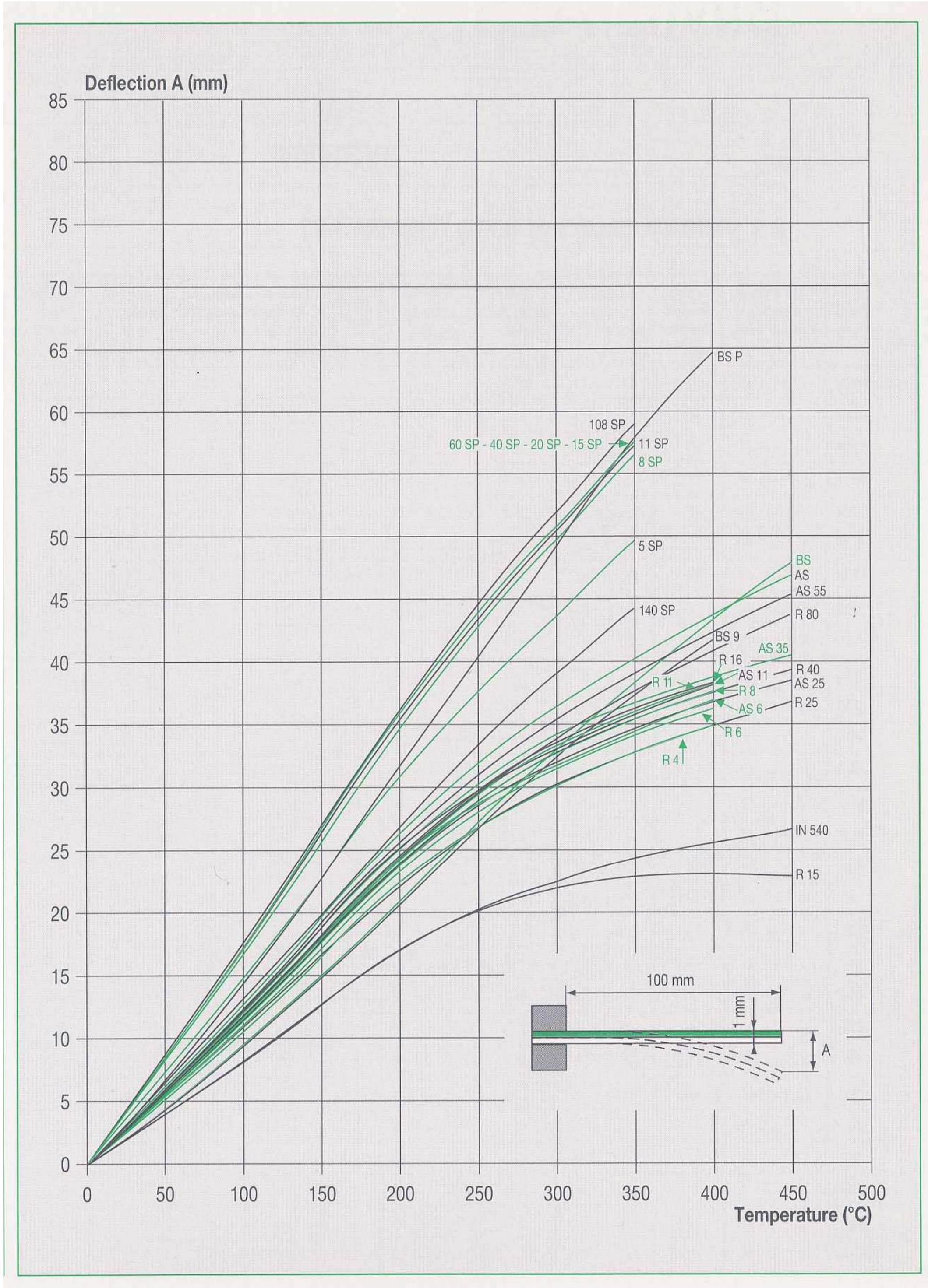
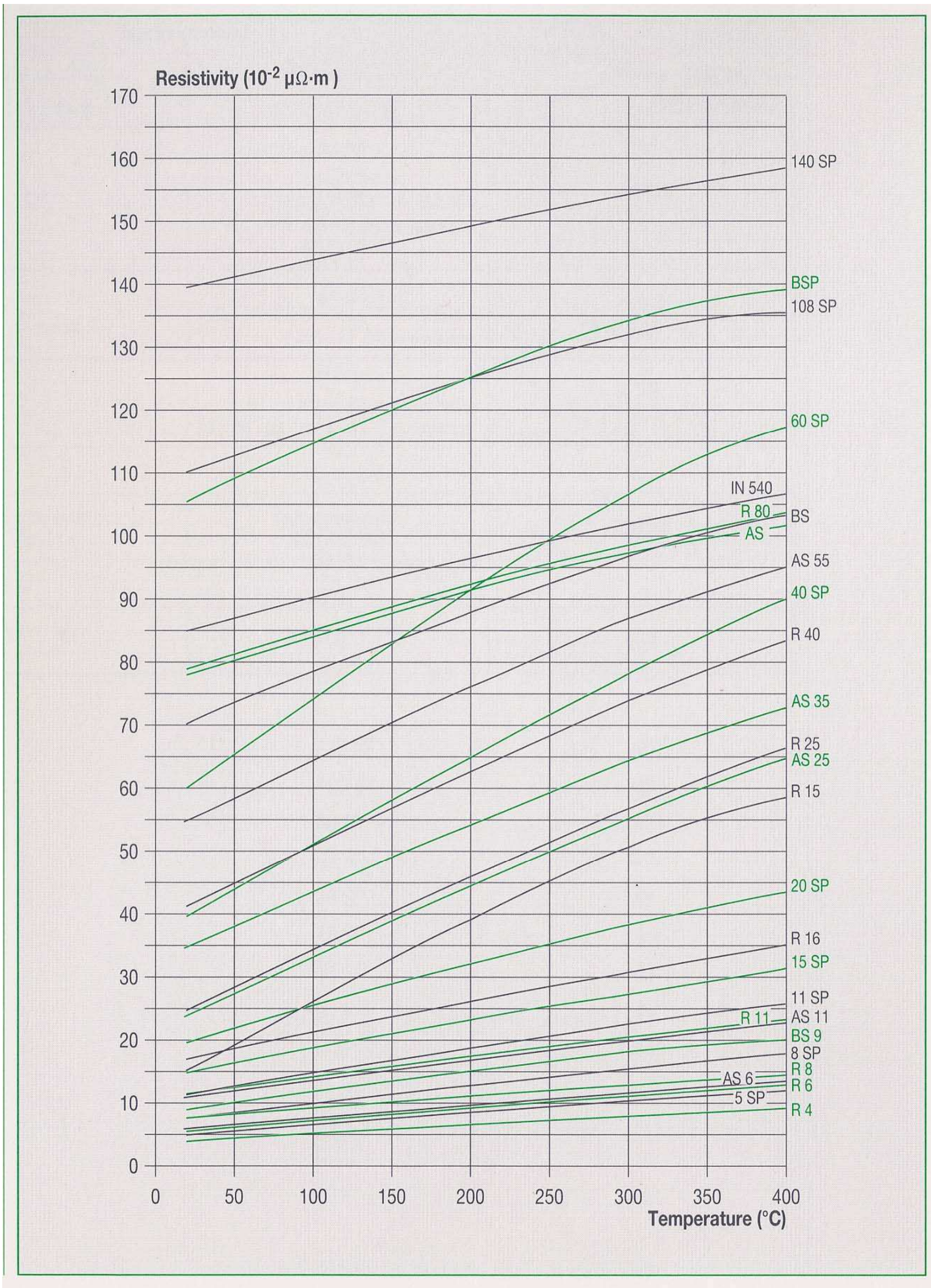
2. TEMPERATURE DEPENDENCE OF DEFLECTION



3- TEMPERATURE DEPENDENCE OF RESISTIVITY



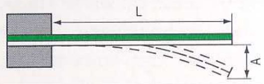
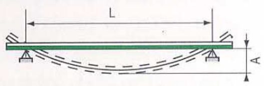
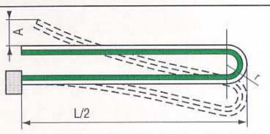
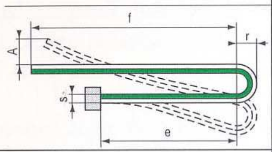
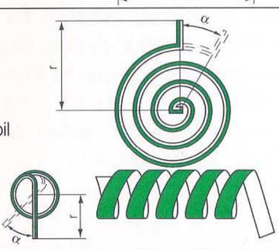
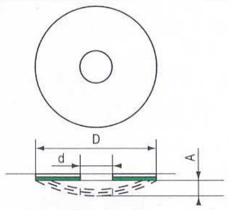
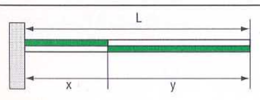
4- CALCULATION OF BIMETAL PARTS

A

FORMULAS

SYMBOLS USED

A : Deflection (mm)
α : Angle of rotation (degrees)
P : Force (N)
ΔT : Temperature difference (K)
L : Useful length (mm)
B : Width (mm)
s : Thickness (mm)
D : External diameter (mm)
d : Internal diameter (mm)
k : Specific curvature (K^{-1})
a : Specific deflection (K^{-1})
σ : Stress (N/mm^2)
E : Young's modulus (N/mm^2)
n : number of discs in the opposite direction
m : number of discs in the same direction

Element forms		Deflection (without obstruction)	Force (for mechanical deflection)	Force (for suppressed deflection)	Permissible load
Cantilever strip		$A = \frac{a L^2}{s} \cdot \Delta T$	$P = \frac{E B s^3}{4 L^3} \cdot A$	$P = \frac{a E B s^2}{4 L} \cdot \Delta T$	$P_{max} \leq \frac{\sigma_{perm} B s^2}{6 L}$
Simply-supported beam		$A = \frac{a L^2}{4 s} \cdot \Delta T$	$P = \frac{4 E B s^3}{L^3} \cdot A$	$P = \frac{a E B s^2}{L} \cdot \Delta T$	$P_{max} \leq \frac{\sigma_{perm} B s^2}{1.5 L}$
If r << L		$A = \frac{a L^2}{2 s} \cdot \Delta T$	$P = \frac{E B s^3}{L^3} \cdot A$	$P = \frac{a E B s^2}{2 L} \cdot \Delta T$	if (e-f) > (f+r): $P_{max} \leq \frac{\sigma_{perm} B s^2}{6 (e-f)}$
U-Shape element		$A = \frac{a}{s} (f^2 - e^2 + 4 r^2 + 2 e f + 2 \pi r f) \cdot \Delta T$			if (e-f) < (f+r): $P_{max} \leq \frac{\sigma_{perm} B s^2}{6 (f+r)}$
Spiral or helical coil		$\alpha = \frac{360 a L}{\pi s} \cdot \Delta T$	$P = \frac{\pi E B s^3}{2.16.10^3 L r} \cdot \alpha$	$P = \frac{a E B s^2}{6 r} \cdot \Delta T$	$P_{max} \leq \frac{\sigma_{perm} B s^2}{6 r}$
Creep type disc		$A = n \cdot \frac{a (D^2 - d^2)}{4.5 s} \cdot \Delta T$	$P = \frac{m 4 E s^3}{n (D^2 - d^2)} \cdot A$	$A = m \cdot a E s^2 \Delta T$	$P_{max} \leq m \cdot \frac{2 \sigma_{perm} s^2}{3}$
Reverse cantilever		$A = \frac{a (y^2 - 2xy - x^2)}{s} \cdot \Delta T$	$P = \frac{E B s^2}{4 L^3} \cdot A$	$P = \frac{a E B s^2 (y^2 - 2xy - x^2)}{4 L^3} \cdot \Delta T$	