

| Désignation | NiBe2 | DIN | EN Nr. | UNS (ASTM) | AISI | LMSA |
|-------------|-------|-----|--------|------------|------|------|
| | | - | - | N03360 | - | A800 |

Chemical composition

| Ni* | Be | Ti | Cu | Fe | Si |
|---------|-------------|-------------|--------|--------|--------|
| Balance | 1.85 - 2.05 | 0.40 - 0.60 | ≤ 0.25 | ≤ 0.20 | ≤ 0.20 |

Values (Weight %). In order to achieve maximum homogeneity and consistent quality, the actual manufacturing tolerances are tighter and more precisely than the composition indicated.
*Nickel plus additions > 99.5%

Main technical properties and features

The alloy 360, nickel-beryllium combines unique high mechanical and physical performances properties. The advantages include among others, a high ultimate tensile strength up to more than approximately 2000 N/mm², an excellent formability as well as a very high resistance to thermal stress relaxation up to temperatures exceeding 300 °C. This alloy is recommended in all applications requiring particularly high spring properties at high temperatures. We find applications for the alloy 360, in the connector industry at temperatures of use which can reach 300°C and sometimes 350 °C, where all the copper alloys cannot be used at a higher temperature than 200 °C. Due to its excellent resistance to temperature fluctuations, this alloy is also used for the production of components that are subjected to elevated temperatures for short intervals (up to 380 °C). This alloy also maintains good spring properties in these conditions. The fatigue strength is excellent; it can reach more than 700 N/mm² for 10⁶ (reverse bending R=-1), which is more than two times higher than that of CuBe2, alloy 25.

The precipitation hardening of the alloy 360, is possible. During this treatment an increase of density appears (approximately 0.5 %), which involves a dimensional shrinking of the material of about 0.2 %. A decrease of the cold formability is induced by such a heat treatment, contrary to the mechanical resistance, which can rise from 300 to 500 N/mm², according to the temper and heat treatment condition.

The surface preparation of the NiBe2 remains simple, by mechanical or chemical processes.

Typical uses

Electronic components exposed to high temperatures and requiring good spring properties. Manufacture of thermostats, bellows, burn-in connectors and sockets, casings, diaphragms and membranes, etc.

Typical manufacturing range

| | | Thickness (mm) | Width (mm) | Length (mm) |
|------------------------|--------------------------------|----------------|--------------|-------------|
| Rolled products | Strip in coils ^[1] | 0.010 - 2.000 | 1.5 - 200.0 | - |
| | Strip as sheets ^[1] | 0.010 - 1.500 | 10.0 - 200.0 | 100 - 3000 |

^[1] Not all our production possibilities are presented here. Other dimensions or product forms available upon request. Some combinations of thicknesses and widths are not possible.

Mechanical properties of strips

| Temper | | Heat Treatment | R _{p0.2} (N/mm ²) | R _m (N/mm ²) | A _{50mm} (%) | Hardness HV | R/t (90°) G / B ^[1] |
|--------|---------------|----------------|---|--|--------------------------|----------------|-----------------------------------|
| A | Soft annealed | - | 270 - 490 | 650 - 900 | > 30 | 100 - 200 | 0 / 0 |
| ¼ H | ¼ hard | - | 440 - 860 | 750 - 1040 | > 15 | 150 - 295 | 0 / 0 |
| ½ H | ½ hard | - | 790 - 1180 | 900 - 1210 | > 4 | 180 - 385 | 1.2 / 1.2 |
| H | hard | - | 1030 - 1310 | 1030 - 1310 | > 1 | 220 - 490 | 2.0 / 2.0 |

| Mill-hardened tempers | | Heat Treatment | R _{p0.2} (N/mm ²) | R _m (N/mm ²) | A _{50mm} (%) | Hardness HV | R/t (90°) G / B ^[1] |
|-----------------------|------|---|---|--|--------------------------|----------------|-----------------------------------|
| | MH2 | Mill-hardened tempers. No further heat treatment is required. | 680 - 870 | 1060 - 1240 | > 14 | - | 0 / 0 |
| | MH4 | | 820 - 1070 | 1240 - 1420 | > 12 | - | 0.5 / 0.5 |
| | MH6 | | 1030 - 1210 | 1370 - 1550 | > 10 | - | 1.0 / 1.2 |
| | MH8 | | 1170 - 1420 | 1510 - 1690 | > 9 | - | 1.2 / 1.6 |
| | MH10 | | 1370 - 1550 | 1650 - 1860 | > 8 | - | 1.5 / 2.2 |
| | MH12 | | 1510 - 1700 | 1790 - 2000 | > 8 | - | 2.0 / 3.0 |

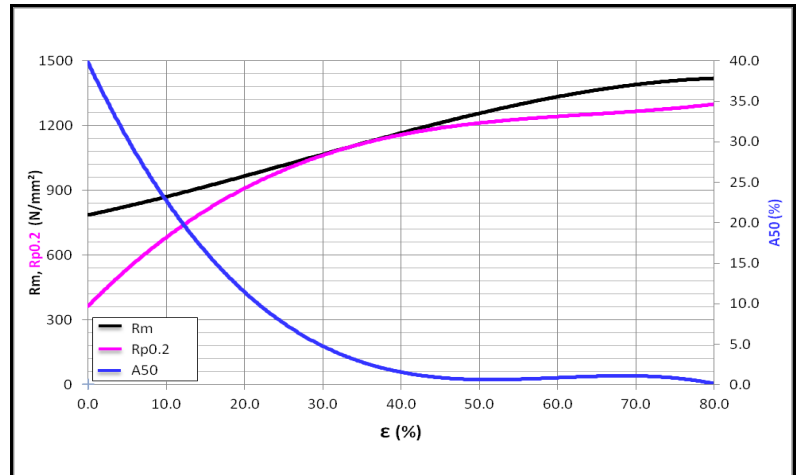
[1] Minimum bend radius at 90°. R = radius, t = strip thickness, G = "Good way", perpendicular to rolling direction and B = "Bad way", parallel to rolling direction.

After age hardening (by the customer)

| Temper | | Heat Treatment | R _{p0.2} (N/mm ²) | R _m (N/mm ²) | A _{50mm} (%) | Hardness HV |
|--------|-----------------|----------------|---|--|--------------------------|----------------|
| A | Annealed + aged | 3h at 500°C | > 1030 | > 1480 | > 12 | > 340 |
| ¼ H | ¼ hard + aged | 3h at 500°C | 1400 - 1520 | 1650 - 1850 | 10 - 3 | 500 - 600 |
| ½ H | ½ hard + aged | 2h at 500°C | 1450 - 1550 | 1700 - 1800 | 10 - 3 | 500 - 570 |
| H | Hard + aged | 2h at 500°C | > 1590 | > 1860 | > 8 | > 440 |

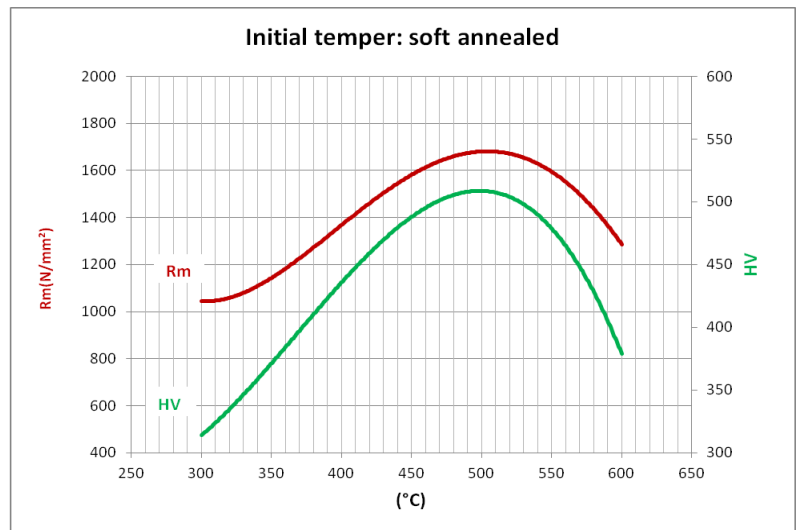
[2] The age hardening is achieved by a simple heat treatment of 1.5h to 3h at a typical temperature of 500°C. In order to obtain specific mechanical properties, the heat treatment can be made apart from these conditions. A protective atmosphere is not required but is recommended for a clean and shiny surface.

Strain-hardening curve.
 R_m , $R_{p0.2}$ (N/mm²) and A_{50} (%).



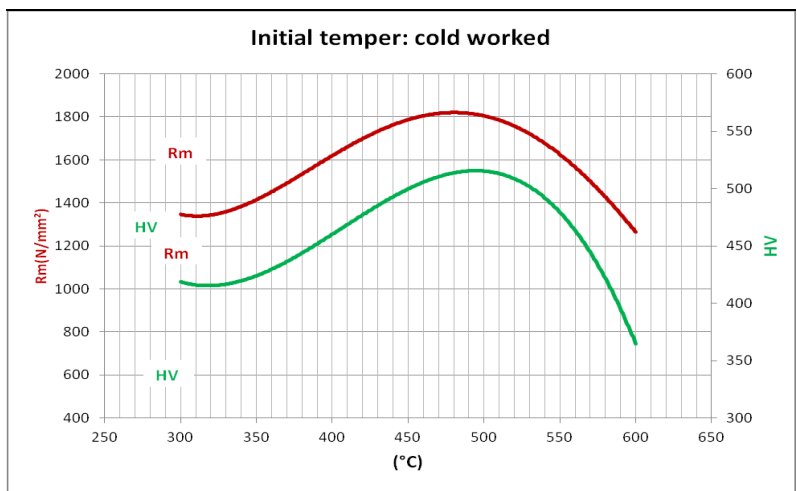
Evolution of HV and R_m of alloy 360, NiBe2
 as function of temperature (3 hours).

Initial temper: soft annealed.



Evolution of HV and R_m of alloy 360, NiBe2
 according to the processing temperature (3
 hours).

Initial temper: cold worked



Physical properties

| | | |
|--|-----------------------|---------------------------|
| Modulus of elasticity | kN/mm ² | 195, 210 ^[1] |
| Poisson ratio | | 0.30 |
| Density | g/cm ³ | 8.25, 8.36 ^[1] |
| Melting point / Melting range | °C | 1195 - 1325 |
| Linear dilatation coefficient (20-300°C) | 10 ⁻⁶ / °C | 14.5 |
| Thermal conductivity at 20°C | W/m °K | 48 |
| Electrical resistivity | μΩcm | 43, 28.7 ^[1] |
| Electrical conductivity | MS/m | 2, 4 ^[1] |
| Electrical conductivity | % IACS | 4, 6 ^[1] |
| Magnetic properties | | Ferromagnetic |

^[1] Values before and after hardening, respectively.

Tolerances (strip and foil)

| Thickness | Thickness (mm) | | EN Standard | | Lamineries MATTHEY | | |
|-----------------|---|-------|--------------------|-----------------|--------------------|----------------|--------------|
| | ≥ | < | 10140 Precision | 10258 Precision | LMSA Standard | LMSA Precision | LMSA Extreme |
| | - | 0.025 | - | - | - | - | ± 0.001 |
| | 0.025 | 0.050 | - | - | ± 0.003 | ± 0.002 | ± 0.0015 |
| | 0.050 | 0.065 | - | ± 0.003 | ± 0.003 | ± 0.0025 | ± 0.002 |
| | 0.065 | 0.100 | - | ± 0.004 | ± 0.004 | ± 0.0035 | ± 0.003 |
| | 0.100 | 0.125 | ± 0.005 | ± 0.006 | ± 0.005 | ± 0.004 | ± 0.003 |
| | 0.125 | 0.150 | ± 0.005 | ± 0.006 | ± 0.005 | ± 0.005 | ± 0.004 |
| | 0.150 | 0.250 | ± 0.010 | ± 0.008 | ± 0.008 | ± 0.006 | ± 0.004 |
| | 0.250 | 0.300 | ± 0.010 | ± 0.009 | ± 0.009 | ± 0.007 | ± 0.005 |
| | 0.300 | 0.400 | ± 0.010 | ± 0.010 | ± 0.010 | ± 0.007 | ± 0.005 |
| | 0.400 | 0.500 | ± 0.015 | ± 0.012 | ± 0.012 | ± 0.008 | ± 0.006 |
| | 0.500 | 0.600 | ± 0.015 | ± 0.014 | ± 0.014 | ± 0.010 | ± 0.007 |
| | 0.600 | 0.800 | ± 0.015 | ± 0.015 | ± 0.015 | ± 0.010 | ± 0.007 |
| | 0.800 | 1.000 | ± 0.015 | ± 0.018 | ± 0.018 | ± 0.012 | ± 0.009 |
| | 1.000 | 1.200 | ± 0.020 | ± 0.020 | ± 0.020 | ± 0.015 | ± 0.012 |
| | 1.200 | 1.250 | ± 0.020 | ± 0.020 | ± 0.020 | ± 0.015 | ± 0.012 |
| | 1.250 | 1.500 | ± 0.020 | ± 0.020 | ± 0.020 | ± 0.015 | ± 0.014 |
| Width | Our width tolerances "Standard" is +0.2, -0.0 (or ± 0.1 mm upon request). They are available for slit widths < 125 mm and thicknesses < 1.00 mm. Special tolerances upon request. | | | | | | |
| Camber | Width (mm) | | Camber max. (mm/m) | | | | |
| | > | ≤ | LMSA Standard | | LMSA Extreme | | |
| | | | ≤ 0.5 mm | > 0.5 mm | ≤ 0.5 mm | > 0.5 mm | |
| | 3 | 6 | 12 | - | 6 | - | |
| | 6 | 10 | 8 | 10 | 4 | 5 | |
| | 10 | 20 | 4 | 6 | 2 | 3 | |
| | 20 | 250 | 2 | 3 | 1 | 1.5 | |
| Surface | Special surface qualities upon request | | | | | | |
| Flatness | Special requirement on the longitudinal or transversal flatness upon request | | | | | | |

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