

wieland

Thin Strip Products Empowering Success



200 YEARS wieland
1820-2020



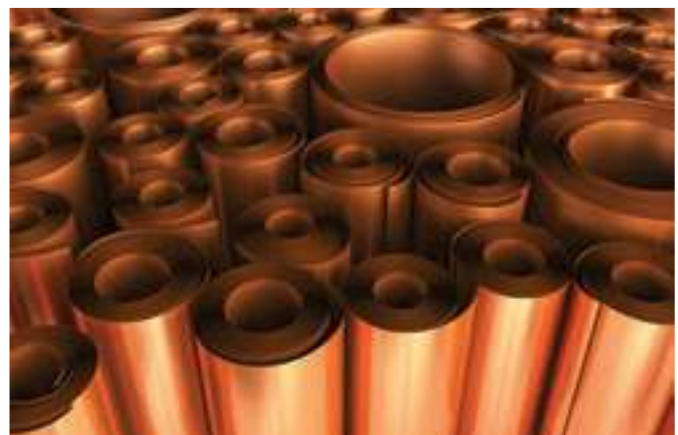
Wieland Group

We have 90 locations in 32 countries.
We are a global partner with regional roots.

Custom Reroller of light gauge stainless strip and ultra-thin copper alloy foil (10-140µm)

Products

- Thin gauge stainless steel & nickel alloys
- Thin gauge copper and copper alloys
- CopperBond treated foil



| Stainless Steel Alloys | | | | | | | |
|-------------------------|---------------------|---------------------|------------------------------|-------|-------|---------------------------|--|
| Current Alloys | Thicknesses | | Width | Specs | Cores | Quantities | Surface |
| | Tempered | Annealed | | | | | |
| Austenitic | 0.0254mm to 0.508mm | 0.0762mm to 0.508mm | 12.7mm to 940mm ¹ | AMS | 12" | 1150 kgs MoQ ² | 2B, Mist, Matte, Roll brush ³ Tension leveling available |
| Ferritic | | | | ASTM | 16" | | |
| Precipitation Hardening | | | | EN | 20" | | |

| Copper Alloys | | | | | | | | | | |
|--------------------------------------|---|------------------------------------|------------------|-------------------|-----------------|-------------------|---|---|---|--------------------------------|
| Current Alloys | Tempers | | Thicknesses | | Width | | Specs | Cores | Quantities | Surface |
| | Foil | Strip | Foil | Strip | Foil | Strip | | | | |
| Copper | Annealed (Grade 7) or As Rolled (Grade 5) | Tempered (½ Hard ¾ Hard Full Hard) | 0.010mm to 0.1mm | 0.11mm to 0.508mm | 12.7mm to 647mm | 12.7mm to 939.8mm | IPC 4562a 4 oz < (0.142mm) – Covers Mechanical Properties | 76.2mm or 152.4mm Fiber or Phenolic on AR & Steel on Annealed temper | MoQ from 250 kgs to 2000 kgs ² | Bare, anti-tarnish, Copperbond |
| High performance Alloys ⁴ | | | | | | | | | | |

¹Mill edge

²Grade pending

³Custom options available

⁴See following page for partial selection

We Find Answers to the Challenges of Tomorrow

Engineered Copper Foils Empowering the Future of 5G

The evolution of 5G will bring many advantages to our world of communication including greater speed for volumes of data, lower latency for increased velocity, and the ability for multi connectivity between devices from sensors to smart devices. A critical component to this evolution are engineered Rolled Copper foils. Rolled Copper foils' inherent properties increase the performance for 5G high frequency designs through customized microstructure,

surface finishes, and strength. These characteristics of Rolled Copper foils outperform the alternative to support megatrends such as miniaturization, electrification and connectivity.

Copper Foil Attributes

- Surface roughness of rolled foils can be up to 30% smoother in terms of Ra which reduces insertion loss
- Tensile strength properties of rolled alloy foil can exceed 700 MPa increasing fatigue life and supporting denser circuit boards
- Relative rigidity allows for an increase in transmission lines and reduces yield loss caused from creases

- Skew elimination possible using rolled foil panel versus ED foil on a woven glass panels
- Reduced loss tangent with high flex rolled foil over glass epoxy
- Miniaturization of compartments benefit from rolled flex foil in Antennas, Feedlines and Beamformers
- Ability to control grain structure and orientation with rolled foil improves fatigue performance and reduces signal loss

Prototypical Copper Alloys & Nominal properties

| Alloy | Elements | Tensile Strength (ksi) | Tensile Strength (Mpa) | Electrical Conductivity (IACS) | Softens at 200°C [†] | Softens at 300°C [†] |
|---|-----------------------------------|------------------------|------------------------|--------------------------------|-------------------------------|-------------------------------|
| K11 | 99.95% Cu | 50 | 344 | 100 | Yes | Yes |
| K32 | 99.9% Cu | 40-60 | 275-414 | 100 | Yes | Yes |
| K82 | 99.9% Cu 0.1% Zr | 50-80 | 344-551 | 85 | No | No |
| K65 | 97.4% Cu 2.4% Fe 0.12% Zn 0.03% P | 60-95 | 414-655 | 60 | No | No |
| K55 | 96.2% Cu 3% Ni 0.65% Si 0.15% Mg | 90-110 | 620-758 | 40 | No | No |
| Typical ED Copper Foil (for comparison) | | 45 | 310 | 95 | No | Yes |

Surface Treatments

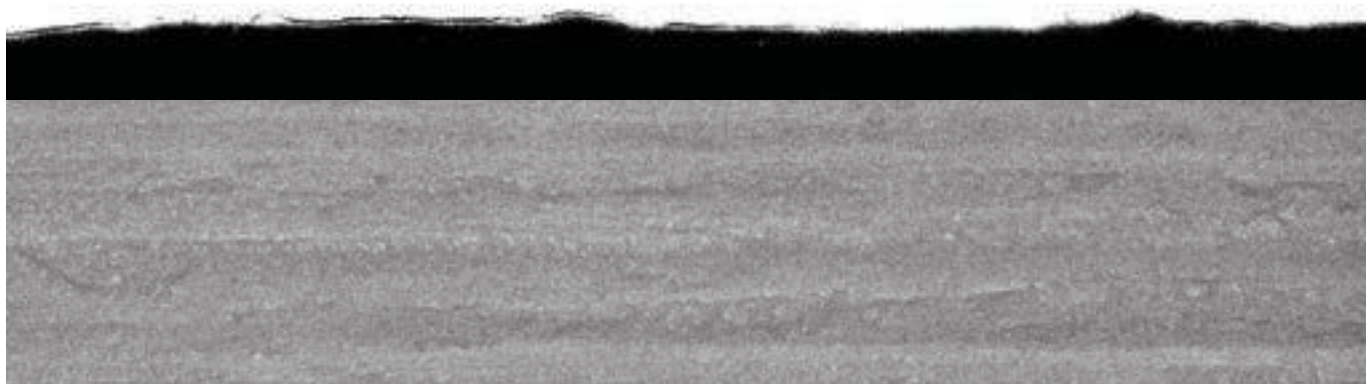
| Treatment | Description | Composition | Feature Height |
|-------------------|--------------------------|-------------|----------------|
| None | As-degreased surface | – | – |
| Anti-tarnish only | Tarnish film | Zn-Cr | – |
| Standard Pink | Electroplated Cu nodules | 100% Cu | Up to 2 µm |
| Low-profile | Smaller Cu nodules | 100% Cu | Up to 1 µm |
| High-profile | Larger Cu nodules | 100% Cu | Up to 4 µm |
| Very High-profile | Larger Cu nodules | 100% Cu | Up to 10 µm |

Nodule treatments can be applied to both sides of the foil, single or Doubletreat. Nodule treated foils have an anti-tarnish treatment applied to both sides.

[†]Time exposure of 60 mins

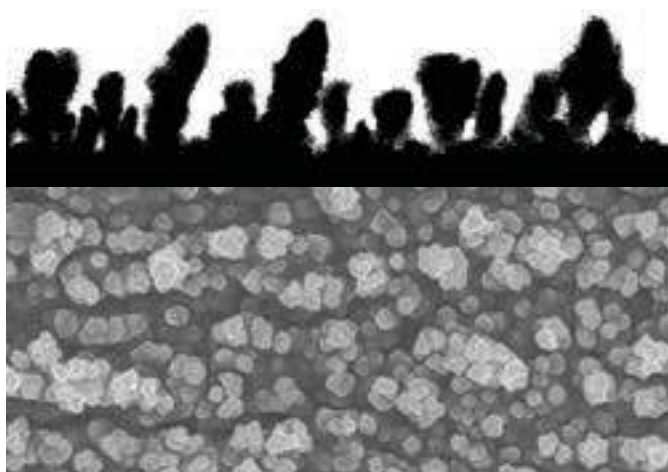
Rolled Foil Benefits

Untreated Foil



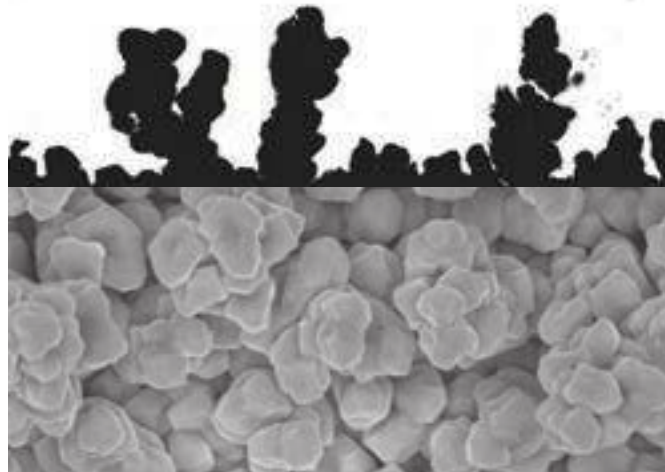
10,000x surface SEM and cross-section

Standard Pink Treatment



10,000x surface SEM and cross-section

High-Profile Treatment

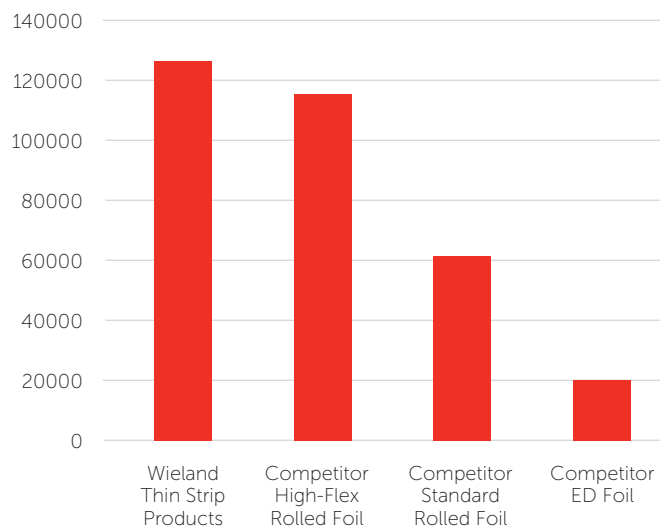


10,000x surface SEM and cross-section

Copperbond foil: Low Strain— high-flex superiority

The fatigue performance of our 1/2oz foil using a ductility flex test with a 6.35mm mandrel per IPC-TM 650 shows elevated performance when used in flex and flex to ridge PCB application.

With compartment miniaturization and demands for thinner capable foil we're positioned to support program demands.



Stainless Steel Alloy Guide

| Austenitic Stainless Steel | | | | | | | | | | | | | | Ferritic Stainless Steel | Martensitic Stainless | | PH Grade Steel | | | |
|--|-----------------------|----------------------------|----------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------------|-----------------------|-----------------------|-------------------------|-------------------------|-----------------------|---------|
| Alloy No. | 201 | 301L | 301Si | 301 | 301H | 302 | 304 | 304L ⁶ | 304H | 305 | 316 | 316L ⁶ | 321 ⁶ | 347 ⁶ | 409 | 430 | 410 | 420 | PH17-7 | |
| ASTM | A666 | A666 | | A666 | | A666 | A666 | A666 | A240 | A167 | A666 | A666 | A167 | A240 | A176 | A176 | A176 | A176 | A693 | |
| MIL Spec. No. | | | | | S5059 | S5059 | | S5059 | S4043 | | | | S5059 | S6721 | S6721 | | S25043 | | | |
| AMS Spec. No. | | 5517-5519 | 5517-5519 | 5517-5519 | 5517-5519 | 5516 | 5513 | 5511 | 5513 | 5514 | 5524 | 5507 | 5510 | 5512 | | 5503 | 5504 | 5506 | 5528 | |
| Ni min | 4.0 | 6.15 | 6.4 | 7.0 | 7.5 | 8.0 | 8.0 | 8.0 | 9.25 | 12.0 | 10.0 | 10.0 | 9.0 | 9.0 | .50 max | .75 max | .75 max | .50 max | 6.5 | |
| Cr min | 16 | 16 | 16 | 16 | 16 | 17 | 18 | 18 | 18 | 17 | 16 | 16 | 17 | 17 | | 16 | 11.5 | 12 | 16 | |
| Mo max | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.8 | 0.75 | 0.75 | 3.0 | 3.0 | 0.75 | 0.75 | | 0.50 | 0.50 | 0.50 | | |
| C max | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.08 | 0.03 | 0.08 | 0.12 | 0.08 | 0.03 | 0.08 | 0.08 | 0.08 | 0.12 | 0.15 | 0.4 | 0.09 | |
| Mn max | 7.5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |
| Si max | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | |
| N max | 0.25 | | | | | | 0.10 | 0.10 | 0.10 | | | 0.10 | | | | 0.08 | | | | |
| Physical Properties | | | | | | | | | | | | | | | | | | | | |
| Density (g/cm ³) | 7.8 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.7 | 7.7 | 7.7 | 7.7 | 7.8 | |
| Mod. of Elasticity (Gpa) | 197 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 193 | 200 | 200 | 200 | 200 | 203 | |
| Elec. Resistivity ¹ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.88x10 ⁻⁷ | 8.88x10 ⁻⁷ | 8.64x10 ⁻⁷ | 8.72x10 ⁻⁷ | 7.20x10 ⁻⁷ | 7.20x10 ⁻⁷ | 6.84x10 ⁻⁷ | 6.60x10 ⁻⁷ | 9.60x10 ⁻⁷ | |
| Therm. Conductivity ² | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.3 | 16.1 | 16.1 | 16.1 | 15.9 | — | 22.7 | 24.9 | 24.9 | 16.4 | |
| Coef. of Therm. Expansion ³ | 15.7 | 16.9 | 16.9 | 16.9 | 16.9 | 17.3 | 17.3 | 17.3 | 17.3 | 17.3 | 16.0 | 16.0 | 16.7 | 16.7 | 10.8 | 10.4 | 9.9 | 10.3 | 11.0 | |
| Cost Factor ⁴ | 0.87 | | | 0.95 | | 1 | 1 | 1.13 | | 1.39 | 1.56 | 1.68 | 1.35 | 1.62 | — | 0.73 | 0.76 | — | 2.18 | |
| Tensile Strength (Mpa) | | | | | | | | | | | | | | | | | | | | |
| Annealed | 689-930 | 965-1137 | 965-1137 | 758-930 | 689-896 | 517-758 | 620-999 | 620-723 | 620-723 | 551-689 | 551-689 | 551-689 | 551-723 | 551-999 | 379 Min | 448 Min | 448-655 | 689 Max | 1034 Max | |
| 1/8 Hard | 758-999 | | | 758-999 | 758-999 | 758-965 | 758-965 | 758-930 | 758-930 | 758-861 | 758-861 | 758-861 | | | | 655-758 | | | | |
| 1/4 Hard | 861-1034 | | | 861-1034 | 861-1034 | 861-1034 | 861-1034 | 861-1034 | 861-1034 | 861-1034 | 861-1034 | 861-1034 | | | | 758 Min | | | | |
| 1/2 Hard | 1034-1206 | | | 1034 - 1206 | 1034 - 1206 | 1034 - 1206 | 1034 - 1206 | | | | 1034 - 1206 | 1034 - 1206 | | | | | | | | |
| 3/4 Hard | 1026-1378 | | | 1026-1378 | 1026-1378 | 1026-1378 | 1026-1378 | | | | | | | | | | | | 1241 Min (3/4c) | |
| Full Hard | 1275 Min | 1275 Min | 1275 Min | 1275 Min | 1275 Min | 1275 Min | 1275 Min | | | | 1206 Min | 1206 Min | | | | | 1378 Min (HT) | 1654 Min (HT) | 1378 Min (cond c) | |
| Spring | 1378 - 1585 | 1378 Min | 1378 Min | 1378 - 1585 | | 1378 Min | 1378 Min | | | | | | | | | | | | | |
| SPL Spring | | 1861 Min Note ⁷ | 1861 Min Note ⁷ | | | | | | | | | | | | | | | | | |
| Yield Strength (Mpa) | | | | | | | | | | | | | | | | | | | | |
| Annealed | 275 Min | 275 Min | 275 Min | 241 Min | 241 Min | 241 Min | 241 Min | 206 Min | 241 Min | 206 Min | 206 Min | 206 Min | 206 Min | 206 Min | 206 Min | 206 Min | 241 Min | 206 Min | 206 Min | 275 Min |
| 1/8 Hard | 379 Min | | | 379 Min | 379 Min | 379 Min | 379 Min | 379 Min | 379 Min | 379 Min | 379 Min | 379 Min | | | | 413 Min | | | | |
| 1/4 Hard | 517 Min | | | 517 Min | 517 Min | 551 Min | 551 Min | 517 Min | 551 Min | 517 Min | 517 Min | 517 Min | | | | 689 Min | | | | |
| 1/2 Hard | 758 Min | | | 689 Min | 758 Min | 827 Min | 827 Min | | | | 758 Min | 758 Min | | | | | | | | |
| 3/4 Hard | 930 Min | | | 930 Min | 965 Min | 930 Min | 930 Min | | | | | | | | | | | | 896 Min (3/4c) | |
| Full Hard | 965 Min | 965 Min | 965 Min | 965 Min | 1034 Min | 999 Min | 999 Min | | | | 965 Min | 965 Min | | | | | 1172 Min (HT) | 1310 Min (HT) | 965 Min (CondC) | |
| Spring | 1103 Min | 1137 Min | 1137 Min | 1103 Min | | 1103 Min | 1103 Min | | | | | | | | | | | | | |
| SPL Spring | | Note ⁷ | Note ⁷ | | | | | | | | | | | | | | | | | |
| Elongation (% in 50.8mm) | | | | | | | | | | | | | | | | | | | | |
| Annealed | 40 Min | 25 Min | 25 Min | 40 Min | 40 Min | 45 Min | 45 Min | 40 Min | 45 Min | 45 Min | 40 Min | 40 Min | 40 Min | 40 Min | 20 Min | 20 Min | 20 Min | 15 Min | 20 Min | |
| 1/8 Hard | 30 Min | | | 35 Min | 35 Min | 35 Min | 35 Min | 35 Min | 35 Min | 25 Min | 30 Min | 30 Min | | | | 5 Min | | | | |
| 1/4 Hard | 25 Min | | | 25 Min | 25 Min | 15 Min | 15 Min | 15 Min | 15 Min | 10 Min | 10 Min | 10 Min | | | | 1 Min | | | | |
| 1/2 Hard | 15 Min | | | 15 Min | 15 Min | 5 Min | 5 Min | | | | 5 Min | 5 Min | | | | | | | | |
| 3/4 Hard | 7 Min | | | 10 Min | 8 Min | 3 Min | 3 Min | | | | | | | | | | | | 4 Min (3/4c) | |
| Full Hard | 3 Min | 5 Min | 5 Min | 8 Min | 5 Min | 3 Min | 1 Min | | | | 1 Min | 1 Min | | | | | 3 Min (HT) ⁵ | 3 Min (HT) ⁵ | 1 Min (CondC) | |
| Spring | 1 Min | 1 Min | 1 Min | 1 Min | | 1 Min | 1 Min | | | | | | | | | | | | | |
| SPL Spring | | Note ⁷ | Note ⁷ | | | | | | | | | | | | | | | | | |

Note: The above data and information is presented for design purposes and is not necessarily intended for use as purchasing specifications.

¹CIRCULAR MIL Ω/FT

²W / M °K @ 20°C

³PPM / °C from 20°C to 300°C (68°F to 572°F)

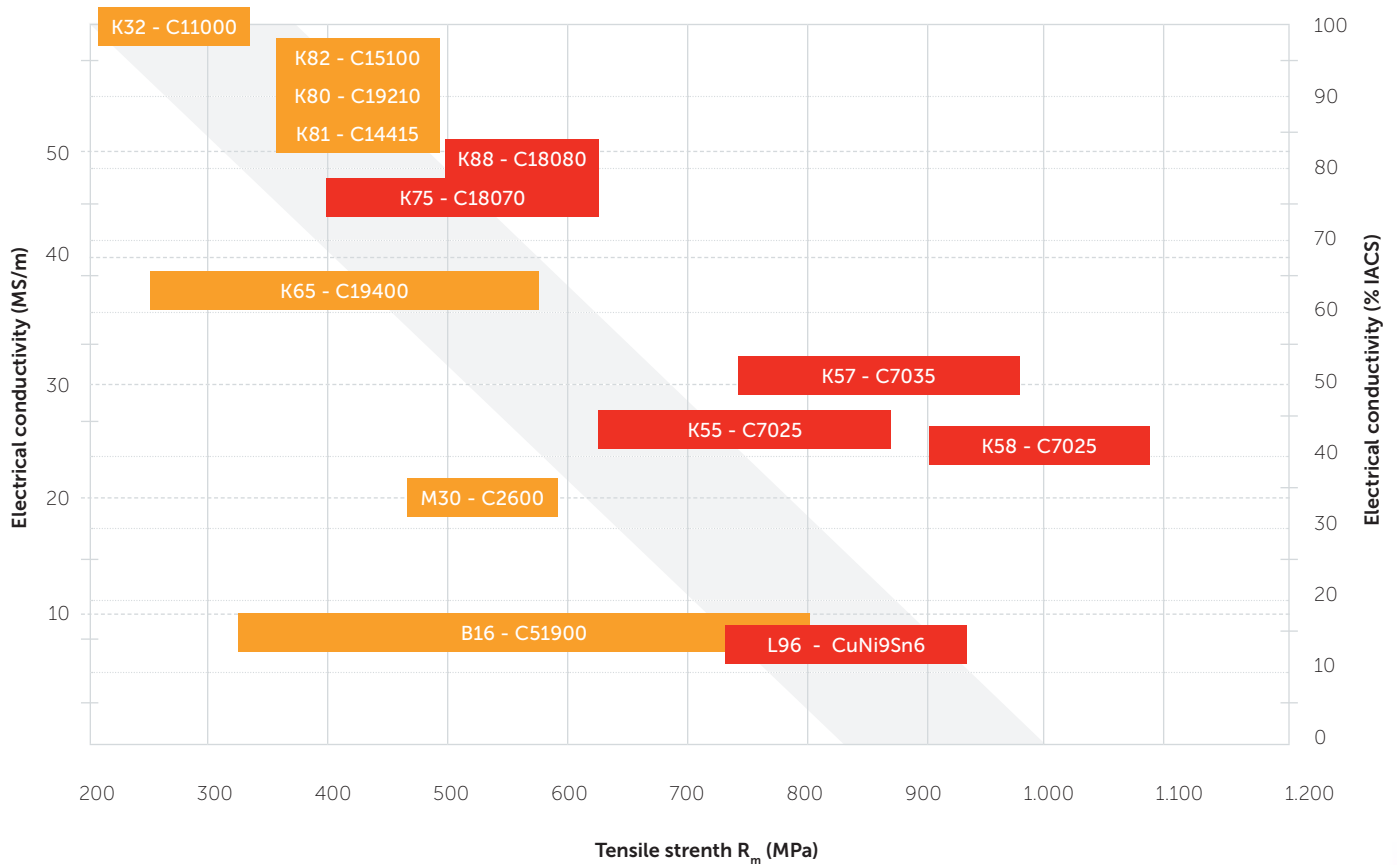
⁴Based On Alloy 304, Base Rice. No Extras for Gauge, Temper, Width, Quantity or Tolerance Included.

⁵Typical Heat Treated Properties Of Martensitic and PH Stainless Steels.

⁶Generally Sold In The Annealed Condition Only.

⁷Special Rolled Spring Properties Available For These Alloys.

Wieland Alloy Families



High Performance Alloys:
Solutions for your most
challenging applications

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