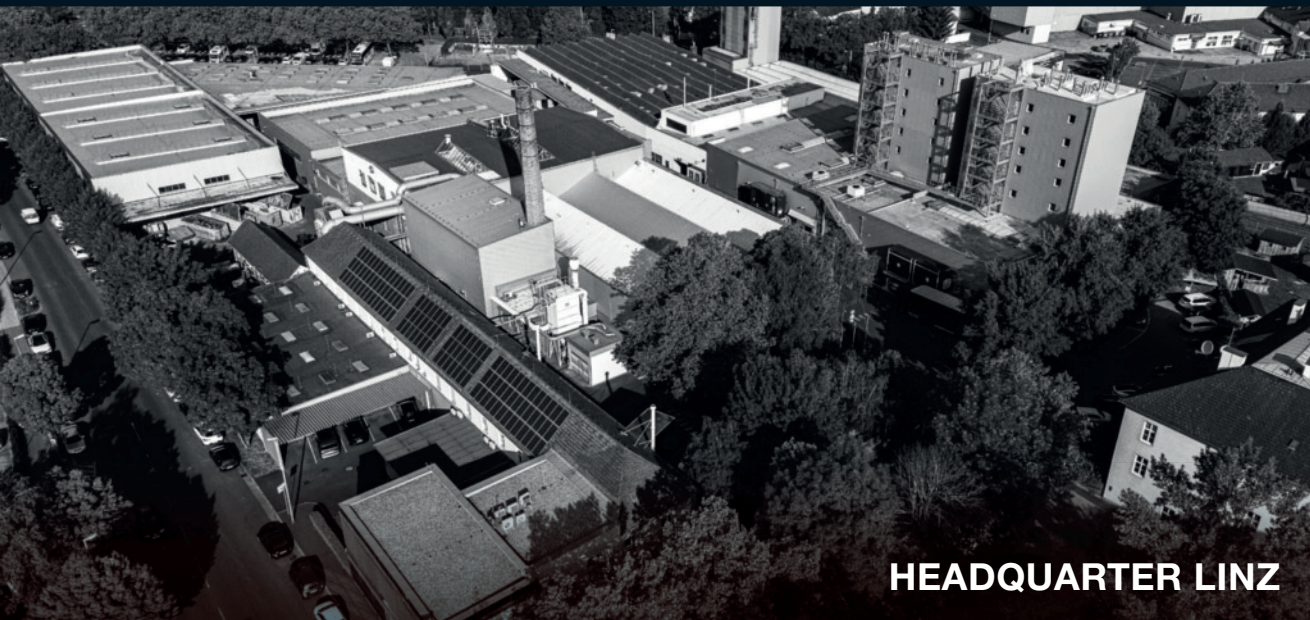


E - M O B I L I T Y

H  W



HEADQUARTER LINZ



E-MOBILITY CENTER GARSTEN



EXTRUSION CENTER LEONDING

H I G H P E R F O R M A N C E W I R E S

HPW Metallwerk GmbH, founded in 1946 as Gebauer & Griller Metallwerk and headquartered in Linz, is a renowned supplier of flat copper and aluminum wires, playing a decisive role in the global energy transition. The company produces approximately 20.000 tons of flat wire annually, primarily serving the electromobility and wind energy sectors. Additionally, HPW operates its own melting plant in Linz, where it manufactures nickel-based alloys. In response to the growing demand, particularly in electromobility, HPW continues to expand its operations. The company runs three production sites in Austria, located in Linz, Garsten, and Leonding, and is currently planning the establishment of a new facility in the United States. HPW is certified according to ISO 9001, ISO 14001 and IATF 16949, ensuring the highest quality standards in the automotive industry.

State-of-the-art electric motors for EV's, PHEV's and HEV's require new and sophisticated solutions – especially in the field of stator windings and insulation materials. HPW – as a specialist for flat insulated aluminum and copper winding wires over decades – developed different solutions suitable for various applications, voltage levels and other special requirements.

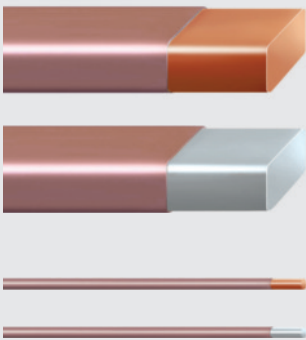
Starting from bare copper or aluminum rod, we cover the entire manufacturing process including surface preparation and cleaning, rolling, drawing and insulating. Our enamel insulated wires with improved properties significantly reduce typical failure rates in the industry. For high voltage applications we offer extruded insulation systems out of high performance polymers such as PEEK defining a new industry standard and targeting specific requirements of our customers.






In particular, the increasing system voltage levels (up to 1000 volts and higher) and the resulting operating temperatures in the electric motor lead to ever higher thermal loads. HPW’s high level of innovation is demonstrated by several patented, exclusive manufacturing processes using high-performance polymers such as PEEK. These extrusion processes make it possible to apply polymer-based insulation systems with firm adhesion directly to the conductor surface. A loadable temperature range of up to 260° Celsius, the flexibility in the bending process and the better electrical insulation properties (dielectric strength) of the material clearly surpass those of conventional insulation system.

**Extruded PEEK
insulated Flat & Round Wires**

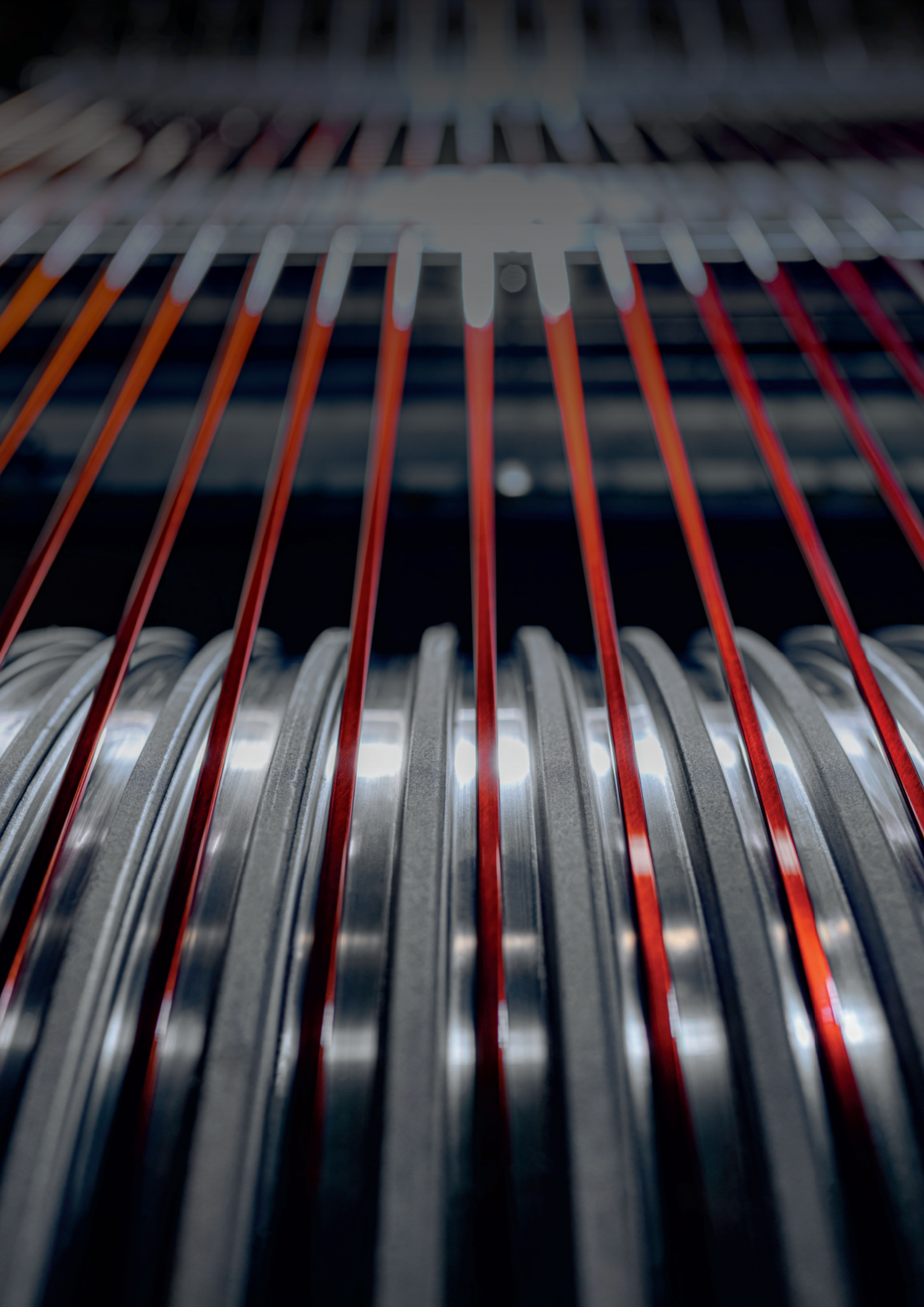
- Smooth, even surface
- Excellent adhesion on copper and aluminum surface without any further bonding layer
- High flexibility of insulation material
- Very good aging and PD resistance



MICRO SECTION

-  Cu | round | 1.00 | 85µm
-  Cu | 4.90 x 1.90 | 150µm
-  Cu | hollow conductor | 3.90 x 2.50 | 180µm

Surface	even, closed
Temperature class	240-260
Possible Coating Thickness	max. 300µm
Flexibility in Coating Thickness	++
Minimum Bending Diameter	1x bare wire width/thickness
Electr. Properties	++
Aging Resistance	++
Corona Resistance	+++
Possible Wire Shape	Flat & Round



HPW is the European market leader with the largest installed capacity for enamel insulated flat wires. With worldwide state-of-the-art machines as well as stable production and monitoring processes for enameled flat wires, HPW supplies leading OEM's and Tier 1 suppliers. HPW thus ensures security of supply in a dynamically growing industry.

HPW's particularly low-defect and multi-layer insulated flat wires increase the efficiency and thus the effectiveness of electric drive trains. PAI enamel insulated flat wires are typically used in systems lower than 600V. Increasing demand on electric motors require particularly good use of the available installation space, which is why winding wires with rectangular cross-sections are increasingly being used instead of insulated round wires.

Enameled Flat Wires

- Smooth, even surface
- Excellent adhesion on copper and aluminum surface
- Extremely low failure rate (< 1 fault / 1000m)
- Failure marking upon customers request



MICRO SECTION



Cu | 4.44 x 2.03 | 150µm



Cu | 4.50 x 1.00 | 120µm



Cu | 4.20 x 1.83 | 80µm

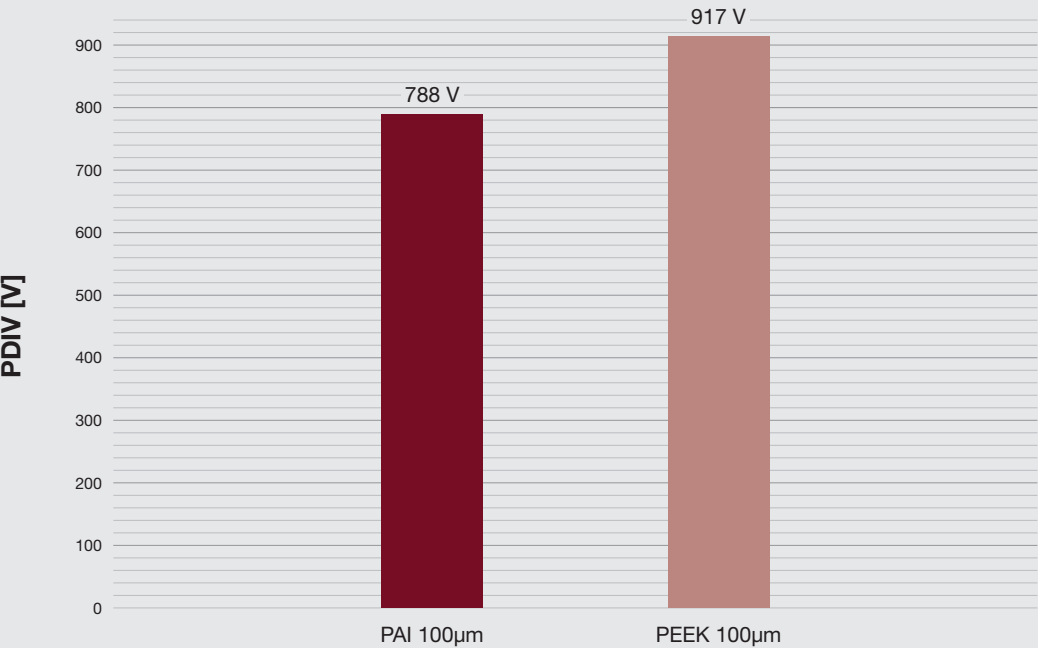


Cu | 6.055 x 1.555 | 80µm

Surface	even, closed
Temperature class	200
Possible Coating Thickness	max. 150µm
Flexibility in Coating Thickness	+
Minimum Bending Diameter	2x bare wire width/thickness
Electr. Properties	+
Aging Resistance	~
Corona Resistance	-
Possible Wire Shape	only Flat

Comparison PEEK vs. PAI-Enamel Insulation

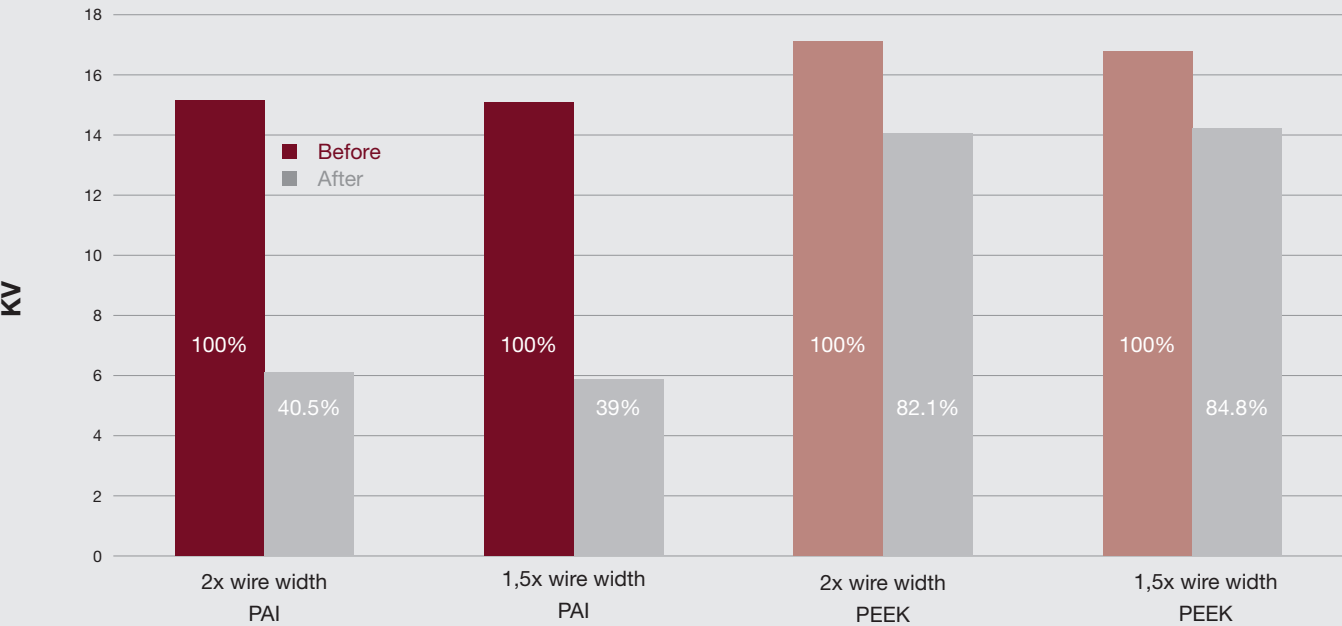
Partial Discharge Inception Voltage



Voltage Increase of 20V per second
Frequency: 50Hz

Break Down Voltage after Thermal Shock

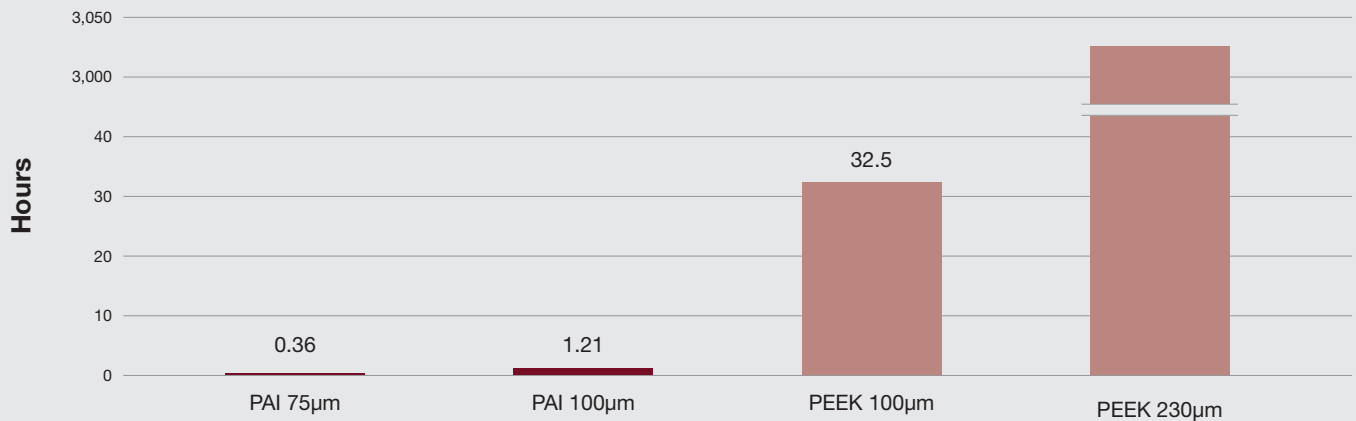
No. of samples failed	0	6	0	5	0	0	0	0
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Samples exposure: from -40°C to 200°C, 1 hour, 200 cycles
BDV measured in electrolytic solution, BDV of < 1kV considered as failure

Comparison PEEK vs. PAI-Enamel Insulation

Lifetime Test – Corona Resistance Test

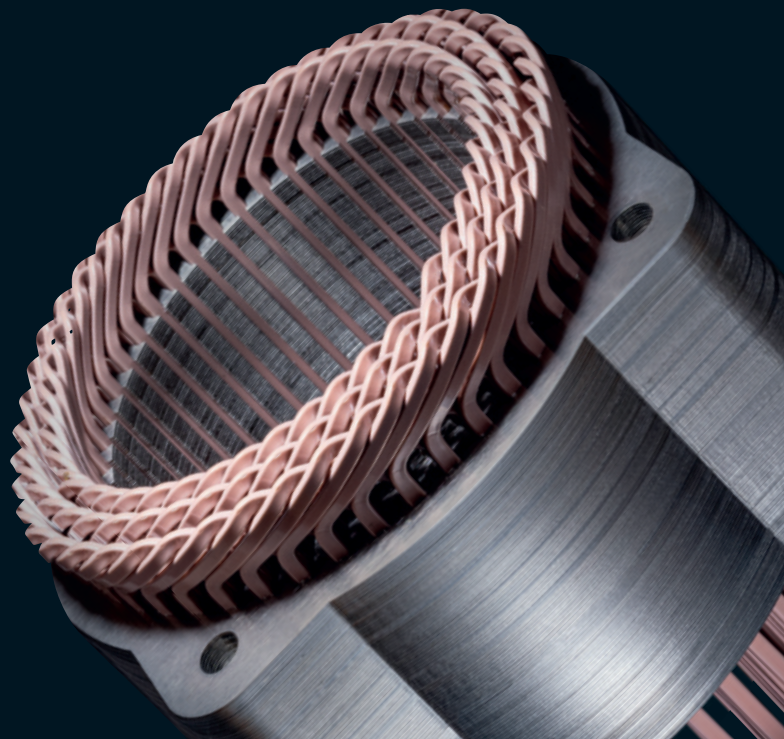


**No electric failure on 230μm PEEK insulated wire samples.
The test was terminated after 3000 hours.**

10 twisted pairs of wire samples, tested before and after aging
180°C, 16 Hz +/-800V (1500V peak)
Corona Resistance determined as time to failure

CONCLUSION

- Superior thermal behavior according to temperature cycle test offers longer lifetime: suitable for > 800V and commercial vehicle applications.
- Thermoplastic PEEK insulation allows compact motor design due to narrow bending radii.
- HPW PEEK monolayer eliminates degradation of enamel bonding layer (no brittle enamel layer between conductor and PEEK insulation).
- PEEK insulation shows superior performance at PDIV testing and better resistance against PD effects compared to PAI-enamel insulated wires.





HPW manufactures customer-specific dimensions up to a cross section of 400 mm² in a fully automated process that covers the entire value chain from the primary metal out of aluminum or copper to the finished, insulated flat conductor. These busbars fulfill the increasing demand of tightest bending radii and they withstand electrical and mechanical stress caused during bending operation and in the final application. Typical requirements in the industry such as weight reduction, bending radii and temperature resistance of the insulation (“Thermal Runaway”) are addressed by developing new materials together with leading customers as well as in international research projects.

**Insulated BUSBAR
Conductor**

Insulation material PA12 and PEEK

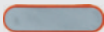
Excellent adhesion on copper and aluminum conductor surface

No bonding layer between conductor and insulation

Customer specified marking possible



MICRO SECTION



Al | 24.00 x 5.6 | 600µm



Cu | 19.00 x 4.00 | 500µm

Surface	even, closed
Width of conductor	max. 50 mm
Thickness of conductor	max. 8 mm
Insulation increase	0.25 – 1 mm
Tensile strength (Cu)	200 – 270 N/mm ²
Tensile strength (Al)	60 – 95 N/mm ²
Elongation (Cu)	≥ 32%
Elongation (Al)	≥ 25%
Springback angle (Cu)	≤ 6.0°
Springback angle (Al)	≤ 6.0°
Color	RAL 2003 – RAL 2008

www.hpwires.com

