TUNGSRAM™

Innovation is our heritage
EST. 1896

Advanced Materials

Tungsram has a 120-year long track record and unique assets and capabilities

Over 120 years of reliable operations

1896

World-class innovation heritage

General lighting
Automotive lighting
Components

5100+
manufacturing employees in Hungary

Export to **107** countries globally

5 plants for traditional lighting technologies

20 sales offices globally

Ceramics, metal, glass and tooling facilities

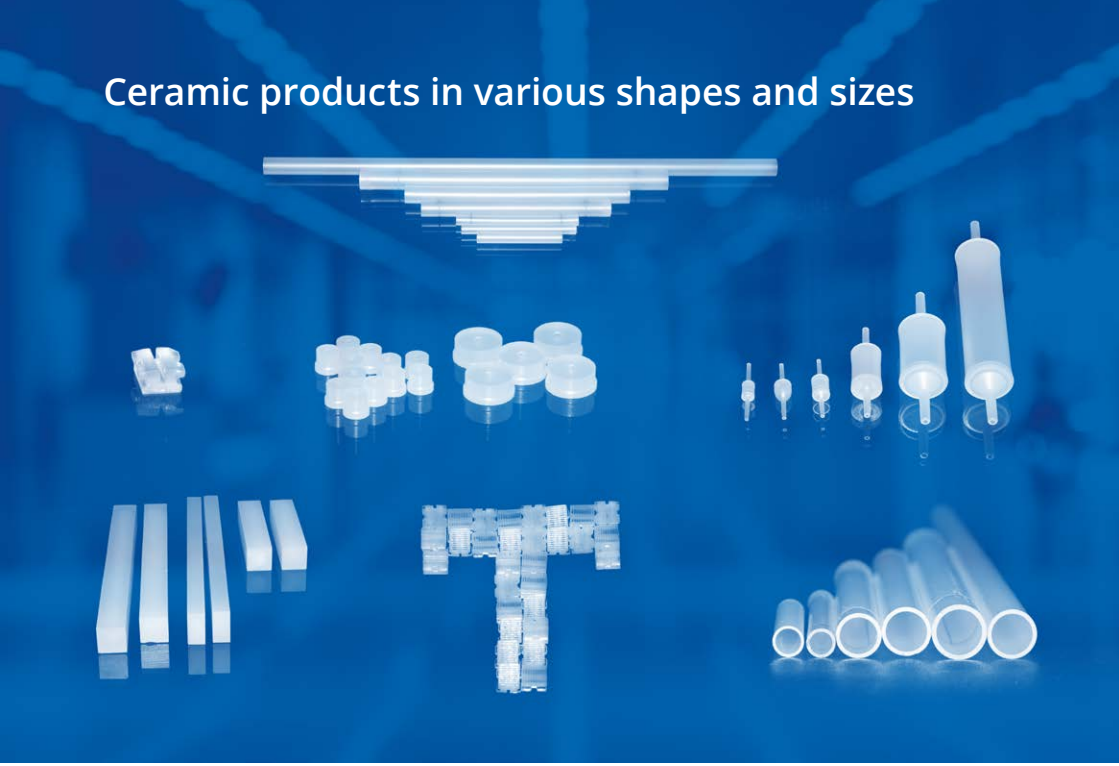
Engineering talent

Did you know?

The brand name **Tungsram** is an abbreviation of the English **tungs**ten and its Hungarian/German counterpart wolf**ram**. Established in 1896, our company has 100+ years of experience developing and producing tungsten materials and products. Aladár Pácz invented and patented (in 1917) the "non-sag" tungsten, which laid the foundation for mass production and **utilization of tungsten coils and cathodes** in the lighting and other industries for the following 50+ years. From 1905, Sándor Just & Ferenc Harmann – both Tungsram employees – experimented with thoriated tungsten and developed the **helix and double helix incandescent coils.** Pál Túry, Tivadar Millner and Imre Tarján invented the sodium-silica-potassium-aluminium doped tungsten which had the purity of 99.5% after annealing. Nowadays called the **"GK"-type Tungsten,** it was patented in 1928. The properties of this material exceeded those of the original and made **Hungarian tungsten wire and coil manufacturing world-class.**

Tungram was the 3rd in the world to launch the development and manufacturing of electron tubes in 1917. In 1932, the company was the first to build a screen-grid Tetrode, the AS4104 and continued developing vacuum/electron tubes and magnetrons for the following decades.

Hence our slogan: Innovation is our heritage.



Advantages of Al_2O_3 Ceramics

- Capable of withstanding very high temperature: 1600°C + (3000°F+)
- Very good resistance against acids and alkalis
- High hardness: 82 (HR – 45N)
- Very low thermal expansion coefficient: 7,2 a (µm/m°K)
- Very low electric conductivity

Possible utilization of Ceramics

- Prostheses, dental implants, braces
- Laboratory instrument tubes and sample holders
- Thermometry sensors
- Furnace liner tubes
- High voltage insulators
- Sealing rings

Ceramic products in various shapes and sizes

- Powder mixing
- Drying
- Pressing
- Injection molding
- Cutting
- Pre- and final sintering
- Grinding

Current capabilities

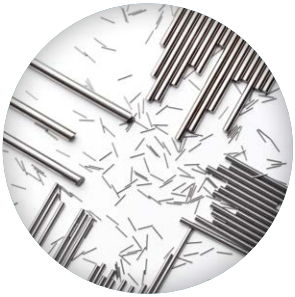
Tungsram has the capability to measure and control each production phase throughout the whole production process which guarantees high-quality components.

The company has world-class sintering capability in H_2 gas (and other gases) at high temperatures. **This sintering technology is rare among manufacturers in the EU** (in translucent ceramic production). Our doping capabilities and experience maximizes the potential of our products according to the customer's request. We use high purity 99.99% aluminum oxide to produce our ceramic parts. Tungsram has molding tool and molding insert design and manufacturing capabilities that enable us to make a high diversity of products. To ensure surface quality, we use Zyglo Fluorescent Penetrant Inspection to filter out cracks and discontinuities.

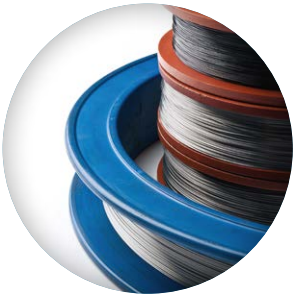
Furthermore, Tungsram has electric conductor printing capability on its ceramic parts.

Coils, cathodes & wires for every purpose

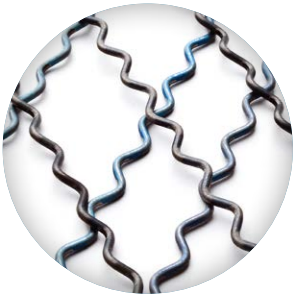
Tungsten rods



Tungsten electrodes



Tungsten heavy wire



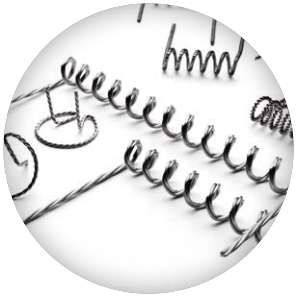
Tungsten heating elements

Tungsten fine wire

Advantages of Tungsten

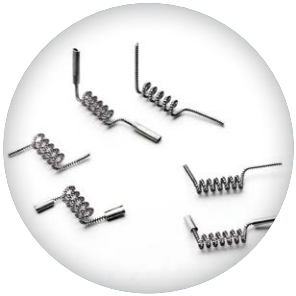
- Tungsten has the **highest melting temperature** of all metals: **3370°C** (6100°F)
- Tungsten has the **highest tensile strength** amongst any non-alloyed metals: **2965 MPa** (430000 psi)*
- Tungsten has the **lowest thermal expansion** coefficient amongst every metal: **4,5 a** (µm/m°K)

Coils, cathodes & wires for every purpose



Heating coils & ion sources

Halogen



Automotive

Specialty & studio

HID & CMH cathodes

Lead-in wires

Possible utilizations of Tungsten

- **The material's tensile properties & the general robustness** are highly capable of providing high mechanical strength at very low diameter range, allowing practical utilization at miniature and microscopic levels.
- **The density of Tungsten** makes it visible, therefore traceable under X-ray and ultra-sound.
- **The resistance to heat and relatively good conductivity** allows the material and its alloys to be utilized as circuits for microelectronics.
- **The thermionic emitting & heat resistance capabilities** of Tungsten makes it fit to be utilized as an electron source for X-ray or CT machines.

Tungsten production capabilities from raw material

Current capabilities

Tungsram has the **Tungsten wire production capability from powder metallurgy** to the **finest possible sizes.** We have the capacity to produce **80+ tons of Tungsten rods/year.** We have the experience of producing **Re-alloyed Tungsten wire** at **various Re%. The company developed and built the fine-wire production machines and processes in-house.** Wire cleaning capabilities meets the highest industry standards. Our currently produced lowest wire size is: **0.008 mm (0.000315 inch)** We have **100% process control** from powder metallurgy to the packaging, which allows **full traceability throughout the production process.** Currently we are producing **650+ different coil SKUs and 1000+ different wire SKUs annually.**

* Measured at 21°C (70°F) on a 0.7112 mm (0.028") drawn Tungsten wire.
Source: "DMIC Report 191: The engineering properties of tungsten and tungsten alloys - F.F. Schmidt& H.R. Ogden"

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