Tungsten Wire

T&D Materials manufactures and supplies premium pure tungsten and WK tungsten wire.

Tungsten Wire

Tungsten is the most widely used of the refractory metals. In wire form, it is essential for the production of lighting products such as wire filament, and other goods where its high temperature properties are of use. Among its properties are a melting point of 3410° C, a low coefficient of thermal expansion and low vapor pressure at elevated temperatures, along with good electrical and thermal conductivity.

Important applications of this metal wire are for the production of coiled incandescent lamp filaments, cathode and support structures for power tubes, heating elements for high temperature furnaces and evaporation sources in metallizing processes. Thicker wire sizes, straightened, finish-ground and cut into rod pieces are widely used for glass-to-metal seal lead parts in the lighting and electronic industries.

Tungsten Wire Types

T & D Materials produces two types of tungsten wire – Pure and WK (K-Al-Si doped).

**Pure tungsten wire** is produced in sizes above .020 inches in diameter. Typical usage is for re-straightening into rod products and for applications where there is a low alkali content requirement.

**WK tungsten wire** is wire which has been doped with trace amounts of potassium, causing the wire to exhibit an elongated interlocking grain structure with non-sag properties after recrystallization. WK wire is produced in sizes from less than .001 up to .250 inches in diameter and is used largely for lamp filament and wire filament applications.
Dimensions and Tolerances

Wire diameters are generally expressed in terms of inches or mils (thousandths of an inch). For thin wires from .001 inches up to .020 inches in diameter, the diameter of the wire is measured by weight per unit length. That is, the weight expressed in mg of a 200 mm length of wire.

The standard diameter tolerance is ±3% of the weight measurement. Closer tolerances are available, depending upon the application for the wire product.

To calculate diameter, the equation is:
\[ D \text{ (in mils)} = 0.71746 \times \sqrt{\frac{\text{mg weight}}{200 \text{ mm length}}} \]

For thicker wires from .020 inches up to .250 inches in diameter, the inch or mil measurements are used. The tolerances are expressed as a percentage of the diameter. Standard tolerance is ±1.5%.

Other Useful Equations:
- \[ \text{meters/kilogram} = \frac{102950}{(\text{diameter in mils})^2} \]
- \[ \text{mg/200 mm} = 1.9427 \times (\text{dia. in mils})^2 \]

Tensile Strength

Tensile strength for tungsten wire is usually expressed in grams per milligram weight of a 200 millimeter (or) g/mg/200mm. The normal range of values is from 40 to 110 grams. In general, as tensile strength increases, wire straightness decreases.

Straightness

Wire may be finished in the unstraightened or as drawn condition and is controlled to T & D’s internal standards. In addition, wire can be straightened via mechanical or heat treating processes. Typically, the measure of the straightness of a tungsten wire is obtained by cutting a ten inch long piece of wire and allowing it to lie on a flat clean surface. The maximum deviation from a straight line along its length is the quantitative measure of its straightness. In general, as the degree of straightness increases, tensile strength decreases.
**Out of Roundness**

Out of Roundness = (Maximum Diameter - Minimum Diameter / Maximum Diameter) x 100

**Splits**

Longitudinal cracks with a depth of more than 15% of the wire diameter are called splits. The wire is checked for splits with an eddy current split detector. The split level for a given length of wire is typically less than 5%.

**Quality and Finish**

Wire is free of scratches, kinks and distortions insofar as they are harmful to the intended end use of the product. Surface finish is supplied in the black, as drawn condition, where drawing lubricants and oxides are retained on the surface, or in the cleaned condition by firing in hydrogen or electrochemical etching.

**Spooling**

Wire is spooled on clean, defect free spools. For very large diameters, tungsten wire is self coiled. Spools are level filled without piling near flanges. The outer end of the wire is properly marked and attached securely to the spool or self coil.

<table>
<thead>
<tr>
<th>Typical Application</th>
<th>Description</th>
<th>Available Diameters</th>
<th>Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>Halogen Lamp Filaments</td>
<td>Black or Clean</td>
<td>0.001&quot;</td>
<td>0.010&quot;</td>
</tr>
<tr>
<td>General Lighting Service</td>
<td>Black</td>
<td>0.0008&quot;</td>
<td>0.005&quot;</td>
</tr>
<tr>
<td>(GLS) Incandescent /</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent</td>
<td>Clean</td>
<td>0.005&quot;</td>
<td>0.020&quot;</td>
</tr>
<tr>
<td>Electronic Grids and</td>
<td>Black or Clean</td>
<td>0.005&quot;</td>
<td>0.020&quot;</td>
</tr>
<tr>
<td>Filaments</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tensile Strength and Straightness
Because customer process and equipment are widely differentiated, T & D produces wire products to its own internal standards for tensile strength and straightness. These properties can be varied to meet specific customer needs and specifications.