



# Tungsten

## Description

Wolfram, also called tungsten, is a chemical element with atomic number  $Z = 74$  which is located in the group VI B of the periodic table of elements. It is a rare metal in the Earth's crust, listed at being number 57 in abundance. It is found as oxides and salts in certain minerals. The word 'wolfram' comes from the German words 'wolf' and 'rahm', which translates as 'Wolf drool' in reference to the superstitions of the medieval Saxon miners who believed that the devil appeared in wolf form and lived deep in the Cassiterite mines, corroding the mineral with its drool. The word 'tungsten' comes from the Swedish words 'tung' translated as heavy and 'sten', stone.

It is never found as a free metal naturally, but as its salts are combined with other elements, mainly as Scheelite ( $\text{CaWO}_4$ ) and wolframite ( $(\text{Fe}, \text{Mn}) \text{WO}_4$ ), which are the most important minerals. There are other minor minerals such as Cuproscheelite ( $\text{CuWO}_4$ ), Ferberite ( $\text{FeWO}_4$ ), Hübnerite ( $\text{MnWO}_4$ ) and Stölgite ( $\text{PbWO}_4$ ). These minerals are extracted and used to produce about 35,000 tons per year of tungsten concentrates. China produces more than 75% of this total and most of the remaining production comes from: Austria, Bolivia, Portugal and Russia.

To obtain tungsten from its ores, they are melted with soda ash to obtain sodium tungstate,  $\text{Na}_2\text{WO}_4$ . Soluble sodium tungstate is then extracted with hot water and treated with hydrochloric acid to obtain tungstic acid,  $\text{H}_2\text{WO}_4$ . This compound, once washed and dried, forms the Tungsten oxide  $\text{WO}_3$ , which is reduced with hydrogen or carbon in an electric furnace. The obtained fine powder is reheated in moulds in atmospheric hydrogen, and pressed into bars which are wound and hammered at high temperatures to make them compact and ductile. It is also possible to obtain tungsten by reduction with hydrogen  $\text{WF}_6$ .

## Properties

Physical Properties		Electronic Properties	
Name	Tungsten	Valence	2, 3, 4, 5, 6
Atomic Number	74	Electro negativity	2.36
Symbol	W	Covalent Radius	1.46
Atomic Weight	183.85	Ionic Radius	0.64
Density (g/ml)	19.3	Atomic Radius	1.39
Boiling Point °C	5555	Atomic Structure	$[\text{Xe}]4f^{14}5d^46s^2$
Melting Point °C	3422	Ionization Potential (eV)	7.86

It is steel-gray coloured, very hard and dense; it has the highest melting point of all other metals and the highest boiling point of all known elements. From a chemical point of view, tungsten is relatively inert. It is not easily etched by common acids, alkalis, or aqua regia. It reacts with a mixture of nitric and hydrofluoric acids. Oxidizing fused salts such as sodium nitrite easily etche break it down. Chlorine, bromine, iodine, carbon dioxide, carbon monoxide and gaseous sulphur only react with tungsten at high temperatures. Carbon, boron, silicon and nitrogen also form various compounds with it at elevated temperatures. It does not react with hydrogen.

Tungsten is neither classified as a hazardous substance by EU legislation nor as a hazardous good for transportation.

## Uses

- Manufacturing special steels.
- Manufacturing tungsten carbide for machinery.
- TIG welding electrodes.
- Filament bulbs and electric heaters.
- Manufacturing luminaries.

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