

# Nickel - Ni

## Chemical properties of nickel - Health effects of nickel - Environmental effects of nickel

Atomic number	28
Atomic mass	58.71 g.mol <sup>-1</sup>
Electronegativity according to Pauling	1.8
Density	8.9 g.cm <sup>-3</sup> at 20°C
Melting point	1453 °C
Boiling point	2913 °C
Vanderwaals radius	0.124 nm
Ionic radius	0.069 nm (+2) ; 0.06 nm (+3)
Isotopes	10
Electronic shell	[ Ar ] 3d <sup>8</sup> 4s <sup>2</sup>
Energy of first ionisation	735 kJ.mol <sup>-1</sup>
Energy of second ionisation	1753 kJ.mol <sup>-1</sup>
Energy of third ionisation	3387 kJ.mol <sup>-1</sup>
Standard potential	- 0.25 V
Discovered by	Alex Constedt 1751



## Nickel

Nickel is silvery-white, hard, malleable, and ductile metal. It is of the iron group and it takes on a high polish. It is a fairly good conductor of heat and electricity. In its familiar compounds nickel is bivalent, although it assumes other valences. It also forms a number of complex compounds. Most nickel compounds are blue or green. Nickel dissolves slowly in dilute acids but, like iron, becomes passive when treated with nitric acid. Finely divided nickel adsorbs hydrogen.

### Applications

The major use of nickel is in the preparation of alloys. Nickel alloys are characterized by strength, ductility, and resistance to corrosion and heat. About 65 % of the nickel consumed in the Western World is used to make stainless steel, whose composition can vary but is typically iron with around 18% chromium and 8% nickel. 12 % of all the nickel consumed goes into super alloys. The remaining 23% of consumption is divided between alloy steels, rechargeable batteries, catalysts and other chemicals, coinage, foundry products, and plating.

Nickel is easy to work and can be drawn into wire. It resists corrosion even at high temperatures and for this reason it is used in gas turbines and rocket engines. Monel is an alloy of nickel and copper (e.g. 70% nickel, 30% copper with traces of iron, manganese and silicon), which is not only hard but can resist corrosion by sea water, so that it is ideal for propeller shaft in boats and desalination plants.

### Nickel in the environment

Most nickel on Earth is inaccessible because it is locked away in the planet's iron-nickel molten core, which is 10 % nickel. The total amount of nickel dissolved in the sea has been calculated to be around 8 billion tons. Organic matter has a strong ability to absorb the metal which is why coal and oil contain considerable amounts. The nickel content in soil can be as low as 0.2 ppm or as high as 450 ppm in some clay and loamy soils. The average is around 20 ppm. Nickel occurs in some beans where it is an essential component of some enzymes. Another relatively rich source of nickel is tea which has 7.6 mg/kg of dried leaves.

Nickel occurs combined with sulphur in millerite, with arsenic in the mineral niccolite, and with arsenic and sulphur in nickel glance. Most ores from which nickel is extracted are iron-nickel sulphides, such as pentlandite. The metal is mined in Russia, Australia, New Caledonia, Cuba, Canada and South Africa. Annual production exceeds 500.000 tons and easily workable reserves will last at least 150 years.

## Health effects of nickel

Nickel is a compound that occurs in the environment only at very low levels. Humans use nickel for many different applications. The most common application of nickel is the use as an ingredient of steel and other metal products. It can be found in common metal products such as jewelry.

Foodstuffs naturally contain small amounts of nickel. Chocolate and fats are known to contain severely high quantities. Nickel uptake will boost when people eat large quantities of vegetables from polluted soils. Plants are known to accumulate nickel and as a result the nickel uptake from vegetables will be eminent. Smokers have a higher nickel uptake through their lungs. Finally, nickel can be found in detergents.

Humans may be exposed to nickel by breathing air, drinking water, eating food or smoking cigarettes. Skin contact with nickel-contaminated soil or water may also result in nickel exposure. In small quantities nickel is essential, but when the uptake is too high it can be a danger to human health.