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Elements in Steel

A to Z in Steel.

Below we list the elements in steel and explain their individual roles and qualities.

Aluminium (Al)	Aluminium is added to steel as a deoxidizer. Added to control grain size aluminium can control austenite grain growth in reheated steels.
Boron (B)	Boron is an alloying element added to steel to aid heat treatment through enhancement hardenability. Sometimes added to austenitic stainless steel grades to improve its high temperature strength.
Carbon (C)	Carbon is the most important element in the majority of steel, affecting hardness and strength by heat treatment. The ductility and weldability decreases with increasing carbon content.
Cobalt (Co)	Cobalt can be used up to 10% content in some high speed steels. It becomes radioactive when exposed to nuclear radiation therefore for radioactive applications it must not be present in steel.
Copper (Cu)	Copper can be present in stainless steels for precipitation hardening properties. Used in "weathering" steels.
Chromium (Cr)	Chromium is added to steel to increase corrosion and oxidation resistance. It also increases hardenability and combined with high carbon improves wear and abrasion resistance.
Iron (Fe)	Iron is the base metal in steel, combining with other alloying elements to form all steel types. It is relatively soft and weak in its pure form.
Lead (Pb)	Lead is added to improve machineability.
Manganese (Mn)	Manganese contributes to strength and hardness with variable carbon content. It is an austenite forming element in some steels and has a significant effect on hardenability.
Molybdenum (Mo)	Molybdenum is added to nickel chrome alloy steels to improve strength and hardness and also in chromium nickel austenitic steels it improves corrosion resistance. Molybdenum is used in some high speed steel grades.
Nickel (Ni)	Nickel is an important element which increases hardenability, tensile and impact values of steels.

	Added to high chromium stainless steels in amounts of over 8% it produces austenitic structures which gives high temperature strengths and resistance to oxidation and corrosion.
Niobium (Nb)	Niobium stabilises carbon in the same way as titanium and strengthens steels for high temperature service.
Nitrogen (N)	Nitrogen is added to stainless steel to improve the austenitic stability with increased yield strength.
Phosphorous (P)	Phosphorous is normally controlled to low levels but higher phosphorous can be used to improve machineability.
Selenium (Se)	Selenium is added to steel to improve machineability.
Silicon (Si)	Silicon is a principal deoxidiser in steel, used in silicon manganese, corrosion and heat resisting steels.
Sulphur (S)	Sulphur is often added to improve machineability, but does decrease ductility and notch impact toughness.
Tantalum (Ta)	Tantalum is a refractory metal which is highly corrosion resistant. It is part of the refractory metals group, which are widely used as minor components in alloys and precipitation hardening stainless steels.
Titanium (Ti)	Titanium is commonly added to steel for carbide stabilization, combining with carbon to form titanium carbides.
Tungsten (W)	Tungsten is a major element in high speed and some tool steels. In the heat treated condition it retains hardness at elevated temperatures and is particularly useful for cutting tools.
Vanadium (V)	Vanadium helps improve fatigue stress and wear resistance when used with other alloying elements.
Zirconium (Zr)	Zirconium can be added to high strength low alloy steels, affecting inclusion improvement, giving toughness and ductility in bending modes.