

## Hoc P. ELECTRIC ARC

An electric arc is an [electrical breakdown](#) of a gas which produces an ongoing [plasma discharge](#), resulting from a current flowing through normally [nonconductive](#) media such as [air](#). A synonym is arc discharge. An arc discharge is characterized by a lower voltage than a [glow discharge](#), and relies on [thermionic emission](#) of electrons from the electrodes supporting the arc. The phenomenon was first described by [Vasily V. Petrov](#), a Russian scientist who discovered it in 1802. An archaic term is voltaic arc as used in the phrase "voltaic arc lamp".

The various shapes of electric arc are [emergent properties](#) of nonlinear patterns of [current](#) and [electric field](#). The arc occurs in the gas-filled space between two conductive [electrodes](#) (often made of [tungsten](#) or [carbon](#)) and it results in a very high [temperature](#), capable of [melting](#) or [vaporizing](#) most materials. An electric arc is a continuous discharge, while a similar electric [spark](#) discharge is momentary. An electric arc may occur either in [Direct current](#) circuits or in [alternating current](#) circuits. In the latter case, the arc may re-strike on each half cycle of the current. An electric arc differs from a [glow discharge](#) in that the current density is quite high, and the voltage drop within the arc is low; at the [cathode](#) the current density may be as high as one [megaampere](#) per square centimeter.

An electric arc has a non-linear relationship between current and voltage. Once the arc is established (either by progression from a glow discharge or by momentarily touching the electrodes then separating them), increased current results in a lower voltage between the arc terminals. This [negative resistance](#) effect requires that some positive form of [impedance](#) to be placed in the circuit, if it is desired to maintain a stable arc. This property is the reason uncontrolled electrical arcs in apparatus become so destructive, since once initiated an arc will draw more and more current from a fixed-voltage supply until the apparatus is destroyed.

Industrially, electric arcs are used for [welding](#), [plasma cutting](#), for [electrical discharge machining](#), as an [arc lamp](#) in [movie projectors](#) and [followspots](#) in [stage lighting](#). [Electric arc furnaces](#) are used to produce [steel](#) and other substances. [Calcium carbide](#) is made in this way as it requires a large amount of energy to promote an [endothermic reaction](#) (at temperatures of 2500 °C).

Low-pressure electric arcs are used for lighting, e.g., [fluorescent tubes](#), mercury and sodium [street lamps](#), and camera flash lamps.

Formation of an intense electric arc, similar to a small-scale [arc flash](#), is the foundation of [exploding-bridgewire detonators](#).

Electric arcs have been studied for [electric propulsion](#) of spacecraft.