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Facts & Myths of Arc Suppression

Bringing Clarity to Address the Uncertainty and Confusion

By Reinhold Henke and Robert P. Thorbus

Commonly Heard Phrases and Common Statements of Belief

The electromechanical industry is rife with myths about contact arcing and electronic power contact arc suppression. Consider the following myths that are commonly accepted and often repeated … in spite of being incorrect:

Myth: *"An arc is a surge!"*

Fact: An arc is a natural continuation of load current via the arc's plasma between electrodes.

Myth: *"Zero-crossing methods suppress arcing!"*

Fact: Contact sticking and release has unpredictable duration fluctuations of many milliseconds that makes predicting the current zero-crossing impossible.

Myth: *"A transient suppressor across the contact suppresses arcing!"*

Fact: A transient suppressor across the contact may suppress some F-Arcs but cannot suppress any T-Arcs.

Myth: *"A flyback diode across the coil suppresses arcing!"*

Fact: A flyback diode across the coil may suppress some F-Arcs but cannot suppress any T-Arcs.

Myth: "Inductance is required for arcs!"

Fact: The T-Arc initiates <u>without</u> inductance in the loop. The F-Arc <u>requires</u> a high voltage.

Myth: *"A transient suppressor across the coil suppresses arcing!"*

Fact: A transient suppressor across the coil may suppress some F-Arcs but cannot sup-press any T-Arcs.

The Reality of Arc Suppression

The vast majority of arc suppression myths may be ascribed to a lack of understanding of arcing and arc initiation mechanisms. For instance, most "classic, ineffective across-the-contact arc suppression methods" are derived from transient suppression methods. Prior to our research, there also been little if any practical knowledge of the importance of the differences between Field-Emissions-Initiated-Arcs (**F-Arcs**) and Thermionic-Emissions-Initiated-Arcs (**T-Arcs**) (fig. I).

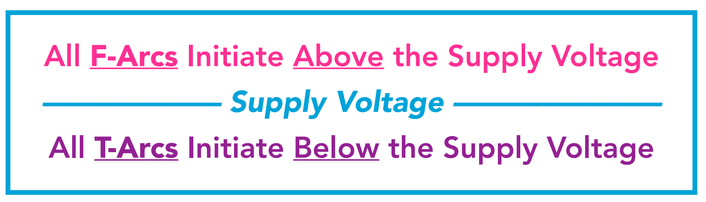


Figure I: *F-Arc and T-Arc initiation voltages within a single, typical power contact cycle.*

In addition, we understand that "arc suppression" does not mean "arc elimination," as some tiny arcs ("arclets") yield beneficial micro-welds. These micro-welds, which are created by "little" MAKE-bounce-T-Arcs (fig. II), are a desired, healthy, and important power contact feature because they ensure vibration-resistant, low ohmic, and non-permanent electrode connections.

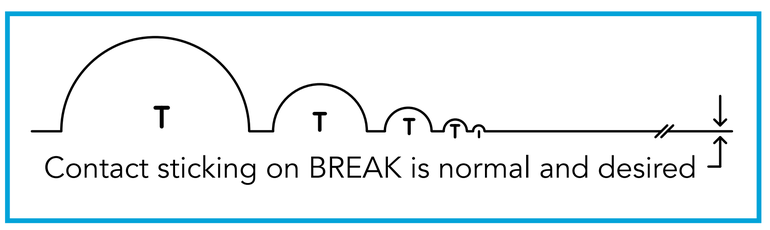


Figure II: *Beneficial, temporary micro-welds result from a series of "little" MAKE-bounce-T-Arcs.*

The Reality of Commonly Accepted Arc Suppression Myths

Classic, yet ineffective across-the-contact arc suppression methods all yield negative outcomes for contact protection. This is due to their inability to address the respective T-Arcs and F-Arcs caused by specific loads (table I).

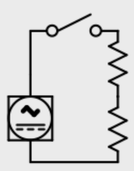
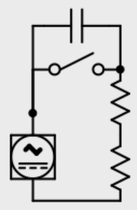
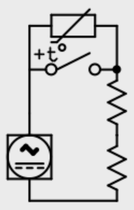
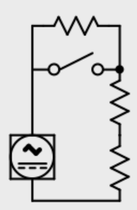
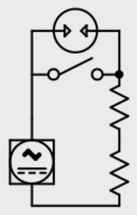
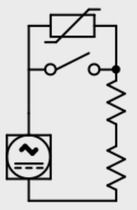
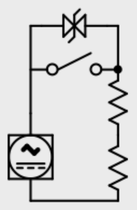
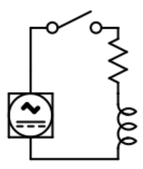
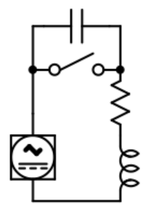
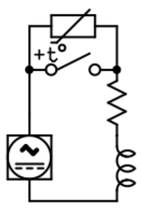
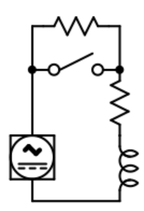
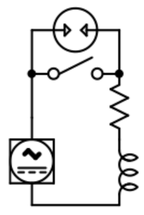
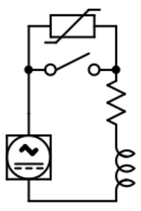
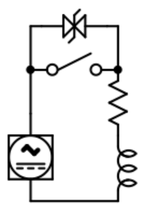
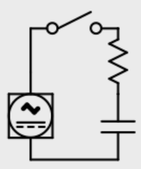
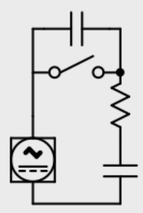
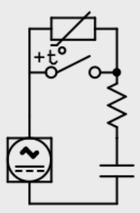
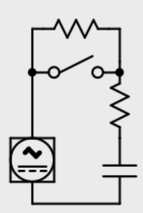
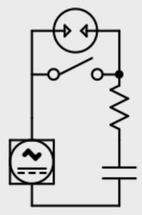
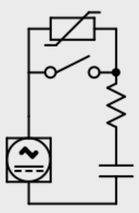
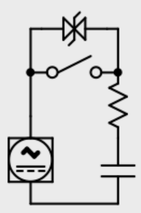
There is NO Contact Protection Here!	Noteworthy Observations	Arcing Contact	"Classic, Ineffective-Across-The-Contact, Arc Suppression Methods"					
			Spot Welder Capacitor	Over Current Limiters PTC	Over Current Limiters Resistor	Over Voltage Limiters GDT	Over Voltage Limiters MOV	Over Voltage Limiters TVS
"Resistive" Loads e.g.: Resistors Heaters Lamps	**During Make:** One Short F-Arc + Bounce T-Arcs **During Break:** One Big T-Arc + Tiny F-Arcs							
"Inductive" Loads e.g.: Motors Solenoids Transformers	**During Make:** One Short F-Arc + Bounce T-Arcs **During Break:** One Big T-Arc + Long F-Arcs							
"Capacitive" Loads e.g.: Capacitors Cap Banks Power Supplies	**During Make:** One Short F-Arc + Bounce T-Arcs **During Break:** One T-Arc and No F-Arcs							
	ATTENTION Contact erosion, faults, and failures		**DANGER** Creates permanent contact welds		**CAUTION** No power disconnect; parts get hot! Still arcing with lower energy arcs		**BE ADVISED** No T-Arc suppression at all! F-Arc suppression only for transients that exceed the over voltage limit.	

Table I: *Description of the respective inadequacies of classic arc suppression methods by load type.*

References:
1. R. Henke and R.P. Thorbus, "Arcs vs. Sparks," Arc Suppression Technologies publication, November 2020
2. C.C. Bates, "Contact Protection for Electromagnetic Relays," Electromechanical Design Magazine, August 1966