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Power Contact Cleaning & Restoration

By Means of a Metallic Plasma Pressure-Wash!

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The Destructive T-Arcs of the Wet Power Contact Cycle (Wet PCC)

The term "cleaning arc" has been used by engineers, designers, and technicians for many decades in spite of the name having neither a broadly accepted nor even a consistent definition. Similarly, the terms "***short-arc***" and "***long arc***" (ref. 1) have more accepted definitions, however, their respective measurement and discrete differentiation has only been possible with the development of Electronic Power Contact Arc Suppression (**EPCAS**).

EPCAS clarifies the difference in the two distinct plasma phases that comprise the highly-destructive **T-Arcs** that occur in the **Wet PCC** (fig. I [a], ref. 2); specifically, and in order:

(1) a several *microsecond* (**µs**), beneficial *metallic plasma phase*, which is the "short-arc" (ref. 1, fig. I [b])

(2) a several *millisecond* (**ms**), highly-destructive *gaseous plasma phase*, which is the "long-arc" (ref. 1, fig. I [b])

Using **EPCAS** allows the former to exist on its own as a **T-Arclet** (ref. 3), creating what we believe may be appropriately referred to as the "cleaning arc."

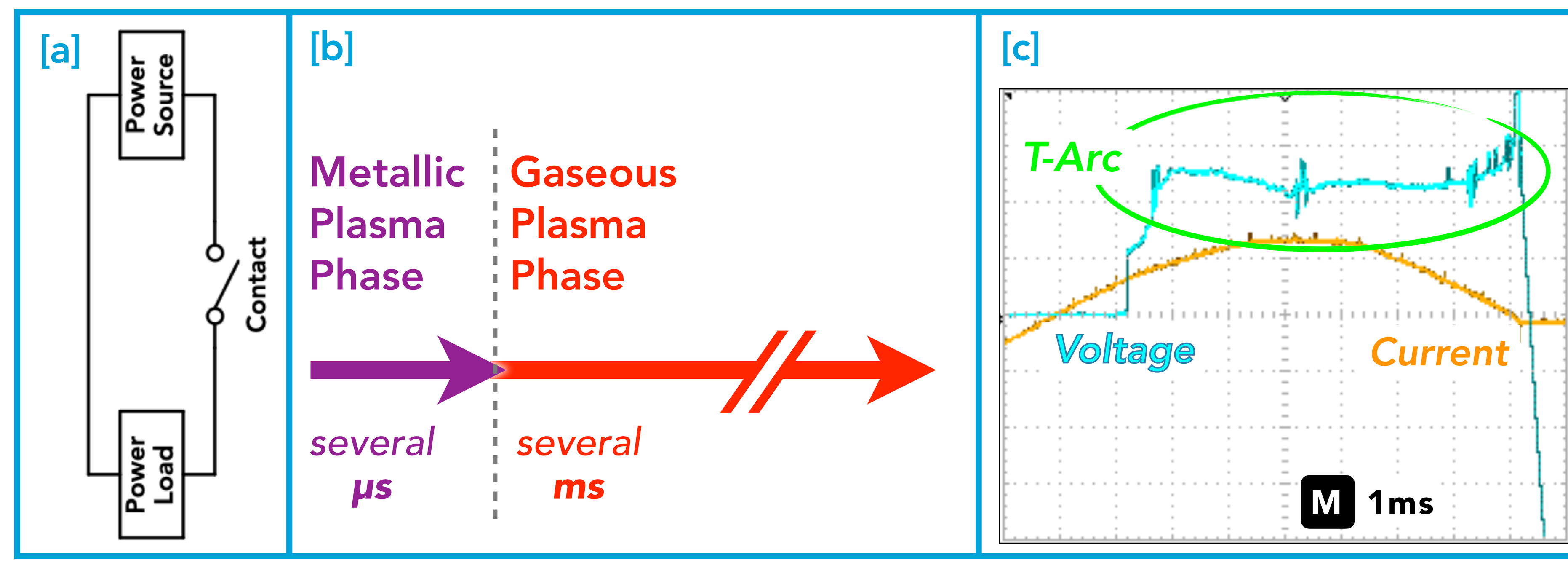

Figure I: [a] Wet PCC wiring diagram; [b] T-Arc Phases and Durations (not to scale); [c] 7ms T-Arc

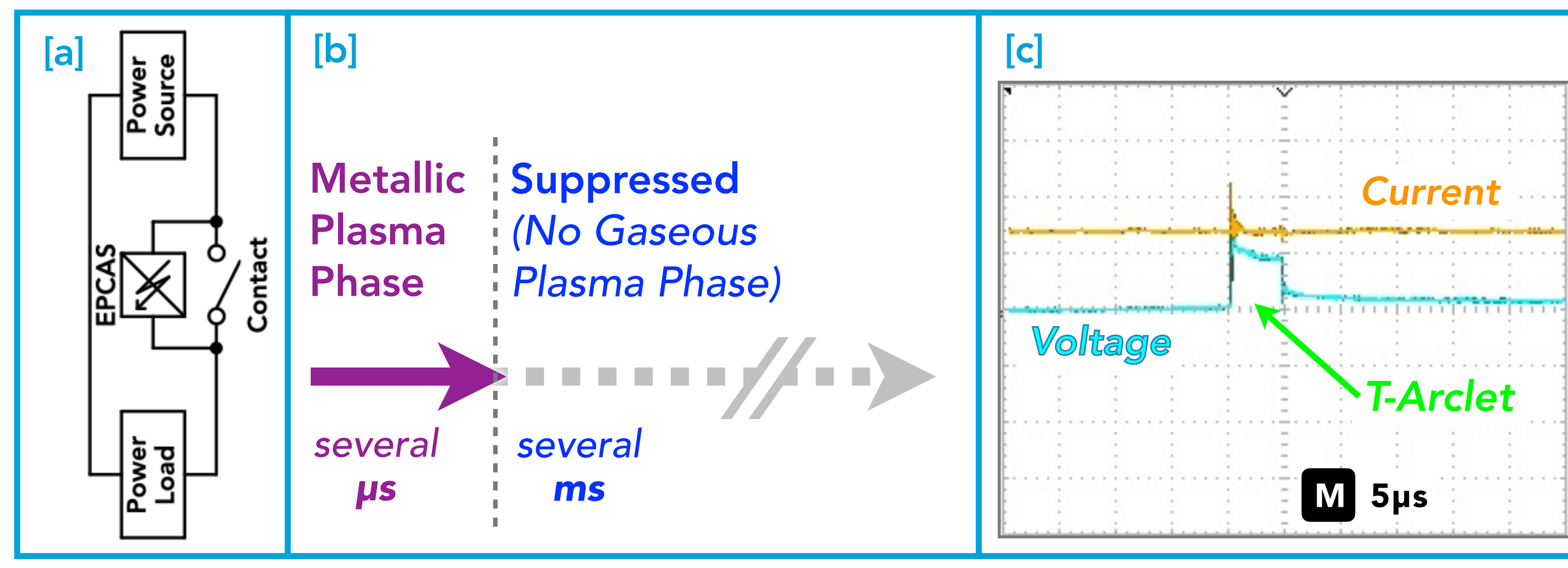

Figure II: [a] EPCAS wiring diagram; [b]: T-Arclet and No Gaseous Phase (not to scale); [c] 5µs T-Arclet

The Beneficial T-Arclets of the EPCAS Cycle

Without **EPCAS**, every time a contact bounces or breaks, the metallic plasma phase cleans its power contact electrode surfaces. However, the evidence of this cleaning is subsequently destroyed during the gaseous plasma phase.

EPCAS (fig. II [a], ref. 3) suppresses the destructive gaseous plasma phase, leaving the benefits of the metallic phase (fig. II [b]) intact. The **T-Arclet** acts as a "***Metallic Plasma Pressure-Wash***" which cleans the contact during BREAKS and bounces. This scrubbing also facilitates a "smithing" of the electrode surfaces via the hammer-like impacts during contact MAKE-bounces. Together, the "pressure-washing" and "smithing" yield clean, metallic electrode surfaces that provide ongoing like-new performance (fig. IV [b]).

Figure III: Failed Contacts from Wet PCC after Restoration by EPCAS Cycles

EPCAS Enabled Cleaning and Restoration

Classic methods of "Arc suppression," provide neither contact cleaning nor electrode surface restoration, resulting in failed contacts (fig. IV [a]). **EPCAS** allows the metallic plasma phase **T-Arclet** to burn in a controlled manner between the electrodes for a few microseconds, cleaning the contact.

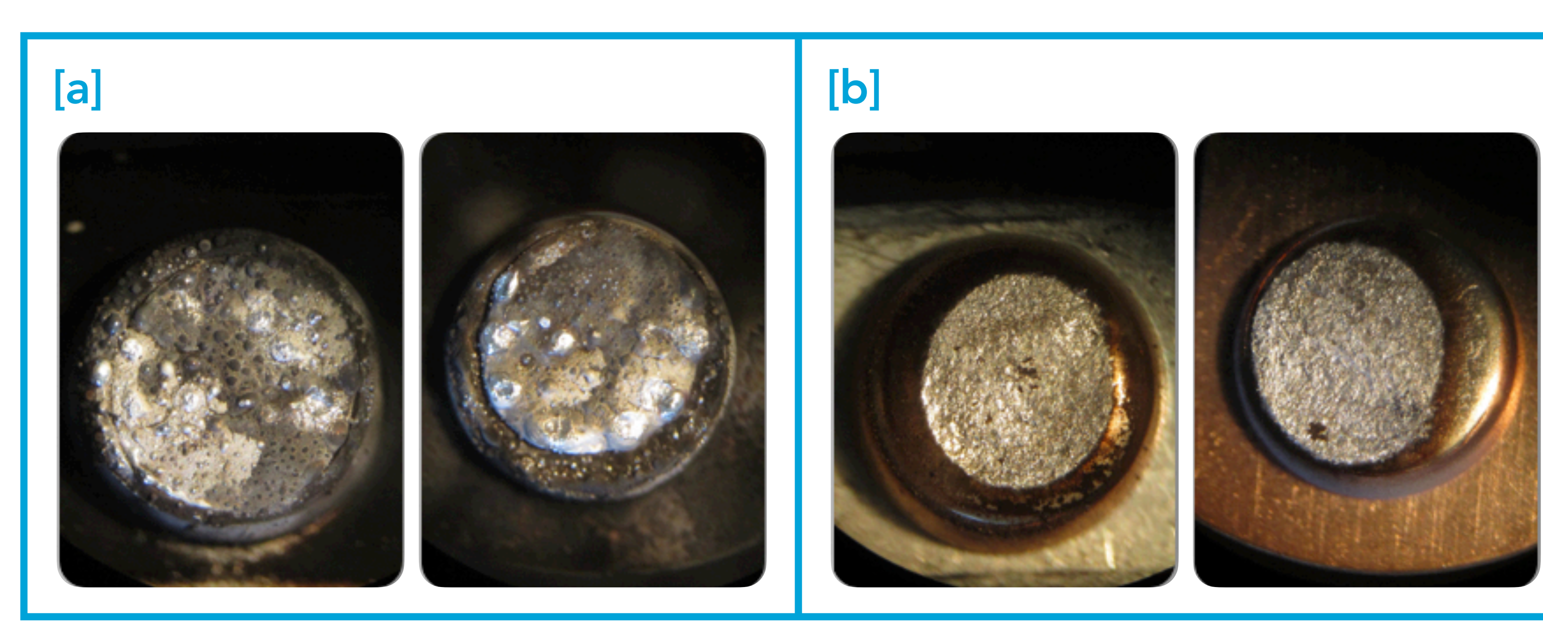

Figure IV: [a] Wet PCC, Failed Contacts, Less Than 100K Cycles; [b]: EPCAS Cycle, Clean Contacts, More Than 1 Million Cycles

While not a recommended use of **EPCAS**, the cleaning power of the **T-Arclet** may also be demonstrated by its restorative capability. The example (fig. III) shows how 3,000 **Wet PCC** operations yields arc-caused destruction of the contact electrode surface, degrading contact life. After 1,000 **EPCAS Cycles**, reconditioned metal electrode surface is visible, and even more so after 2,000 cycles. After 10,000 **EPCAS Cycles** there is a significant area of restored metal visible on electrode surface, allowing for "near new" contact performance.

A **T-Arclet** is required to unseal protective films and to remove insulating coatings from power contact electrode surfaces. For each subsequent cycle, the **T-Arclet** remains an in-situ, real-time, energy-controlled, while-in-use, cleaning arc mechanism. *The constantly cleaned electrode surfaces of **EPCAS** protected contacts yield increased reliability, safety, and healthy operation **throughout the mechanical life** of a power relay or contactor* (fig. IV [b]).

In conclusion, the heretofore mythical "cleaning arc" can now be identified as the "short arc" … or more accurately, the **T-Arclet.**

References:
1. M.Atalla, Mechanisms of the initiation of the short Arc, 1954
2. R.Henke and R.P.Thorbus, "The Wet Power Contact Cycle," 2021
3. R.Henke and R.P.Thorbus, "The EPCAS Cycle," 2021