ARC SUPPRESSION TECHNOLOGIES
7900 INTERNATIONAL DR STE 300, BLOOMINGTON, MN 55425
www.ArcSuppressionTechnologies.com

EFFECTIVE ARC SUPPRESSION FOR "STEALTH"

Our Armed Forces Require It … But They Don't Get It

By Reinhold Henke and Robert P. Thorbus

ARC SUPPRESSION: WHAT MIL-STDs SPECIFY vs. WHAT IS DELIVERED

Every time a power contact turns on or off, the resulting arcs[1] generate and transmit electromagnetic pulses (EMPs). This exposes armed forces operations to anyone "listening" electronically. Our armed forces have known this since Marconi — yet MIL-STDs requiring arc suppression have been considered "fulfilled" based on component selection (fig. 1) [2,3,4] … rather than formally verifying whether this "arc suppression" is effective.

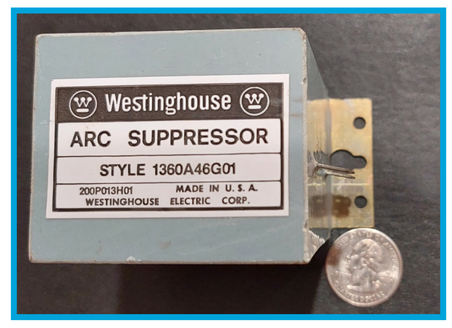

***Fig. 1:** "Snubber" Labeled as an "Arc Suppressor"*
- by Reinhold Henke

Every Arcing Power Contact is an Electromagnetic Pulse Transmitter

Wireless communication was born from an electric arc discharge. Marconi's earliest transmitters, in the mid-1890s, generated their signal by establishing an arc discharge in a spark gap; his 1901 transatlantic transmission proved an arc-generated pulse could be detected across thousands of miles of ocean.[5,6]

Every power contact — in a relay, contactor, switch, or breaker — is functionally the same as Marconi's spark gap, sending a broadband RF signal every time it arcs. Detecting this is like "radar in reverse": i.e., instead of a "radar reflection", the target transmits its own position, speed, and heading.

So MIL-STDs Mandate Arc Suppression — for Good Reason

MIL-STDs for electromechanical equipment have long required "arc suppression" (table I) for exactly this reason: without arc suppression, contact arcs broadcast their positions, speeds, and headings to anyone electronically listening.

MIL-STD-461 – electromagnetic interference (EMI) & electromagnetic compatibility (EMC)
MIL-STD-464 – system-level EMC requirements
MIL-STD-469 – radar electromagnetic compatibility
MIL-STD-704 – aircraft electrical systems requirements for AC and DC power
MIL-STD-810 – environmental engineering
MIL-STD-1275 – electrical power characteristics of DC systems in military vehicles
MIL-STD-1399 – shipboard electrical power systems on naval vessels
MIL-STD-1472 – human engineering design criteria for military systems
MIL-STD-1541 – electromagnetic compatibility requirements for space systems
MIL-STD-1553 – multiplex data bus standard for military avionics
MIL-STD-1556 – multiplex data bus standards beyond avionics (MIL-STD-1553)
MIL-STD-1576 – electromagnetic interference (EMI) in aircraft equipment
MIL-STD-1630 – fiber optic performance and reliability requirements
MIL-STD-1686 – electrostatic discharge (ESD) control
MIL-STD-1760 – electrical interface between aircraft and externally carried stores
MIL-STD-1916 – design of highly reliable electronic systems
MIL-STD-2169 – high-altitude electromagnetic pulse (HEMP) environment

***Table I:** Partial list of MIL-STDs containing arc suppression requirements.*

The Gap: Compliant on Paper, Unverified in Fact

No MIL-STD defines a minimum value for arc suppression efficacy, so there has never been a number to fail. Components installed today typically achieve a Contact Arc Suppression Factor (CASF) [7] (fig. 2) of only 1 to 2 — barely distinguishable from no arc suppression. By contrast, independent lab testing of state-of-the-art electronic arc suppression has demonstrated CASF values of 1,000 or higher — a 30 dB improvement or more.[8,9]

MIL-STDs ask for "arc suppression," but delivered equipment has never been validated by defined metrics that would catch the difference.

Contact Arc Suppression Factor
(CASF)

$$CASF = W_{(arc)} / W_{(arclet)}$$

Where:
$W_{(arc)}$ *= Unsuppressed Arc Energy*
$W_{(arclet)}$ *= Suppressed Arc Energy*

***Fig. 2:** Contact Arc Suppression Factor (CASF) Figure of Merit. [7]*

Why This Is an ELINT / TEMPEST / STEALTH Problem

- A contact's electromagnetic pulse broadband RF is detectable well beyond line-of-sight — in principle, worldwide.[5]
- Unsuppressed arcing is a standing security risk for any platform: e.g., vehicles, vessels, aircraft, drones, weapons systems, fixed installations.
- An arcing contact is not TEMPEST compliant — it is an effective, unintentional RF emitter operating outside the framework meant to prevent this very type of intelligence leakage.
- The vulnerability cuts both ways: it exposes friendly platforms to detection and targeting, and the same physics applies to an adversary's unsuppressed equipment.

Three Problems, Three Fixes

1. Not getting what is asked for: equipment is accepted as "arc suppressed" without demonstrating it. Fix: demand documented compliance.
2. MIL-STDs prescribe solutions instead of outcomes: standards name specific components rather than requiring arc suppression efficacy. Fix: specify the outcome — effectively suppress the arc.
3. No verification exists: no MIL-STD measurement confirms arc suppression efficacy. Fix: verify and certify using the Arc Suppression Factor before acceptance.

A Thought Experiment

Offer a commander the choice of two otherwise identical vehicles: one with arc suppression independently certified to a measured CASF; the other satisfying a MIL-STD checklist, never tested. Every experienced operator chooses the certified platform — because the difference is whether the platform can be electronically tracked, targeted, and/or eliminated.

Effective electronic arc suppression works like a fire-suppression system: it extinguishes arcing within microseconds rather than milliseconds — 1000X faster.

The Bottom Line

The arc suppression requirement is not in question: our armed forces have understood since the birth of radio that an unsuppressed arc gives away position, speed, and heading. What is missing is verification — a quantitative standard confirming that fielded equipment actually achieves effective arc suppression. Closing that gap is the single highest-leverage step available to protect the signal security of installed defense equipment.

> *"Anyone with an AM radio can listen to arcing power contacts. Contact arc suppression prevents enemies or competitors from detecting and tracking your equipment. Contact arc detection allows you to track and target enemy and competitor equipment."*

Looking further ahead, we foresee that a purpose-built, application-specific system — filter-band receivers connected to antenna arrays — could eventually be developed to triangulate a target's position, speed, and heading. Realizing that capability would require dedicated engineering and R&D — not an adaptation of existing equipment — along with specific tests that do not exist today.

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