ARC SUPPRESSION TECHNOLOGIES

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Contact Life

Unsuppressed vs. Suppressed Arcing

Lab Note #105 — rev A

ABSTRACT

Electric current arcing causes significant degradation of the contacts in electromechanical relays and contactors. This contact degradation drastically limits the overall life of a relay or contactor to a range of perhaps 10,000 to 100,000 operations … a level far below the mechanical life of the same device, which can be in excess of 20 million operations. Product designers, technicians and engineers are all trained to believe that a snubber connected across the contacts of a relay will reduce or eliminate the arcing. Snubbers do not measure up to the claim of being arc suppressors.

PROBLEM

Product designers, technicians and engineers are all trained to accept specifications when selecting electromechanical relays and contactors. None of these specifications, however, indicate the impact of electrical arcing on contact life expectancy.

TESTS

Operate a Tyco T90 open-frame relay switching a resistive load at 240Vac, 5kW, 1 second cycle time, 50% duty cycle, under three separate test conditions:

I. With no suppression element
II. With a typical RC Snubber (ITW QuenchArc, 0.1μF+200Ω) connected across the relay contacts
III. With a NOsparc MMXac™ arc suppressor connected across the relay contacts

The QuenchArc was selected as representative of RC snubbers.

The relays were run at the above duty cycle up to 100,000 cycles (or failure, if that came first).

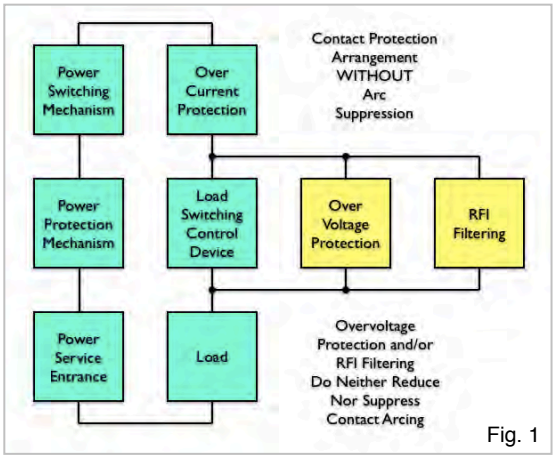

Fig. 1

Fig 1. is a diagram of a typical contact protection arrangement without arc suppression. Fig 2. is a diagram of a typical contact protection arrangement with arc suppression. The box labeled "Load Switching Control Device" in both Fig. 1 and Fig. 2 represents a process control relay whose arc is being measured.

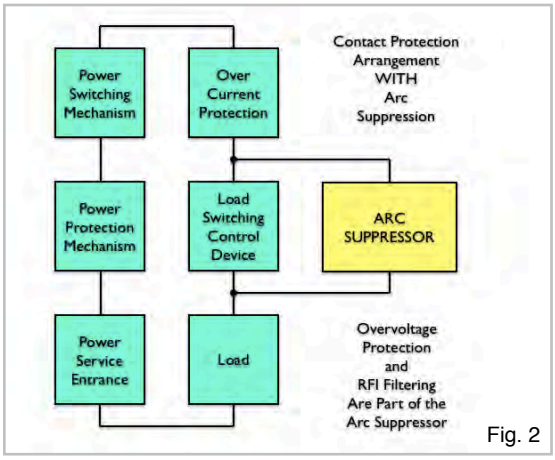

Fig. 2

The relay contacts move from open to closed and back in four distinct states shown in Fig. 3:

1. **CLOSED**
2. **BREAK** (transition state from closed to open)
3. **OPEN**
4. **MAKE** (transition state with "bounce" from open to closed state)

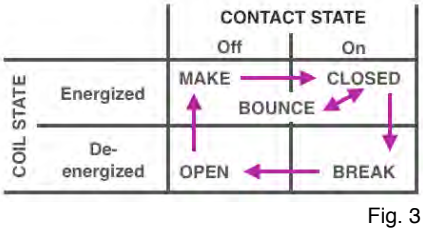

Fig. 3

There are two distinct arcs during the MAKE state: the first is the initial dielectric breakdown (Make Arc), followed by one or more Bounce arcs until the contacts come to rest in the CLOSED state. The most damaging arc occurs during the contact BREAK state, as it is akin to the process of arc welding. We refer to this arc as the "break arc" and the test specifically measures this arc under the three test conditions.

WARNING: Tests use high electrical power, therefore only qualified personnel should attempt to recreate them.

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RESULTS

Results are shown in pictures taken of each relay's contacts upon conclusion of the test.
(Note: The results are best seen when this document is either printed in color or viewed online at: www.ArcSuppressionTechnologies.com/Labnotes.aspx.)

Test I

Fig. 4 shows side and face views of contacts from a relay operated without any arc suppression element. This relay completed 88,265 cycles.

Test II

Fig. 5 shows side and face views of contacts from a relay operated with a typical RC snubber across the contacts. This relay completed 100,000 cycles.

Test III

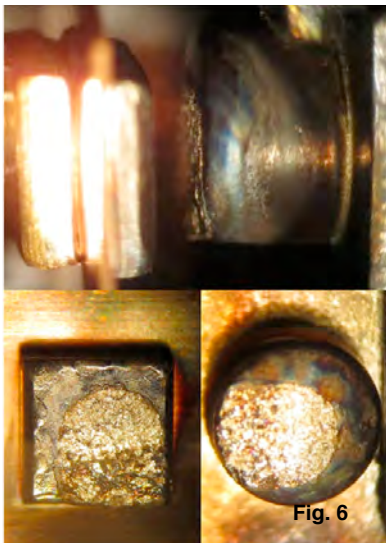

Fig. 6 shows side and face views of contacts from a relay operated with a NOsparc arc suppressor across the contacts. This relay completed 100,000 cycles.

DISCUSSION

Contacts from a relay operating under manufacturer's rated operating specifications show visibly significant damage from electrical arcing when operated without suppression. In fact, the unsuppressed relay's contacts welded shut at 88,265 cycles, and could not complete the desired 100,000 cycles. The physical contact damage along with the coating of carbon and other matter make the contacts nearly unrecognizable.

Likewise, a relay operated with an RC snubber across the contacts show a similar level of damage to the one operated without suppression. This relay completed 100,000 cycles, however, the contacts appear to be both as damaged and carbon covered as those in a relay operated without any suppression. The nearly identical damage is indicative of the RC snubber's ASF ≈ 1.

In contrast, contacts from a relay operated with an arc suppressor show visibly and significantly less damage than those operated either without suppression or with an RC snubber. This relay completed 100,000 cycles, yet the contacts show significantly less damage. Even the striations on the metal surface of the contact spring are still perfectly visible. The lack of obvious damage is indicative of the arc suppressor's ASF ≈ 1250.

Unused Contacts

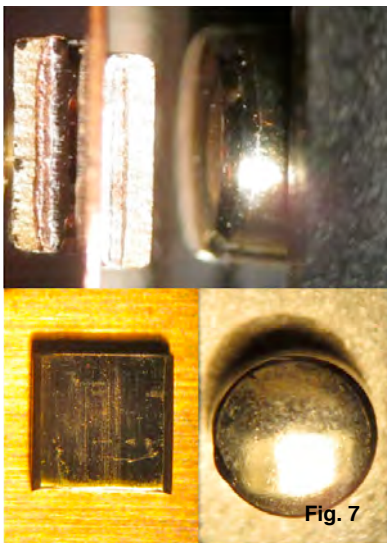

Fig. 7 shows side and face views of contacts from an unused relay, for comparison with Figs 4, 5 and 6.

CONCLUSION

Relays operating to their rated specifications do in fact suffer visible and significant damage from the effects of electric current arcing.

Contrary to what product designers, technicians and engineers are taught, snubbers make no visible difference in the level of destruction caused to the contacts by electrical arcing.

Only an arc suppressor can visibly limit the destruction caused by electrical arcing to contacts of electromechanical relays operating to rated specifications.

Note: This lab note is related to Lab Note #103 "Snubbers—Are They Arc Suppressors?" which may be found online at: www.ArcSuppressionTechnologies.com/LabNotes.aspx.

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