Testing Current Interruption Fuses, Breakers, & Contactors

NH Research, Inc.

Fuses and other current interruption devices are normally tested to application-specific standards such as IEC 60127, UL 248, and SAE J1284. One item common in all standards is the need to accurately measure the *Clearing Time* (*Fig. 1*) when the unit-under-test is subjected to an overload current that exceeds its rating. To accurately measure this time requires precise current control along with sufficiently fast current and voltage rise times in the sub-mS range. Below are three (3) different testing approaches along with considerations for each.

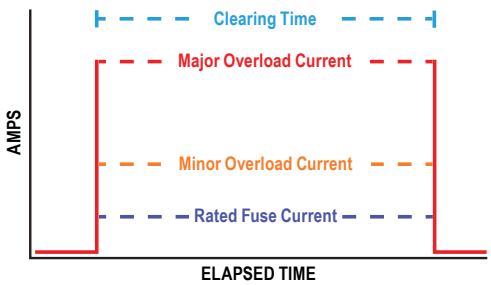

Figure 1 - Ideal fast & stable current rise-time

Testing Approach #1: Battery With DC Load & Charger

Batteries are often chosen to test fuses because of their fast voltage and current rise times. In a perfect test environment, this allows accurate testing to IEC, UL, and SAE standards but because batteries are sensitive to external changes over time, the following considerations should be looked at before going this route:

- Safety: Shock hazard & potential for battery failure/leak
- Test time: Preparing (recharging) batteries
- External equipment: Required to accurately measure current, recharge, & provide constant current (*Fig. 2*)
- Accuracy: Current is affected by batteries age, charge level, & temp

Figure 2 - Require extra equipment & safety considerations

Testing Approach #2: DC Power Supplies

DC Power supplies are another common approach for testing fuses because of their consistent voltage and current sourcing. For minor overload testing where rise times are not as crucial (*Fig. 3*), this approach is often acceptable but attention should be given to the following points:

- Output response: Slow rise times limit major overload testing
- IEC, UL, & SAE: Can't accurately test to all standards because of slow rise times
- External equipment: Needed to accurately measure current and voltage

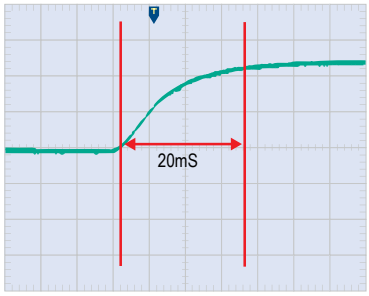

Figure 3 - Slow rise time of typical DC supply

■ = Expected fuse clearing time.

Testing Approach #3: NH Research, Inc.'s 9200

The 9200 allows proper and repeatable fuse testing and measurement to IEC, UL, and SAE standards. It combines the positive testing characteristics of batteries and DC power supplies (*Fig. 4*) while providing the additional benefits:

- Safe: No chemical or battery risks
- Fast: Fully programmable & quick microsecond rise times
- External Equipment: No additional equipment for set or measurement
- Built-in: 1.2 Mega-sample/second waveform digitizer

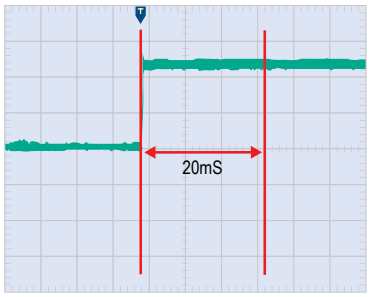

Figure 4 - Sub-millisecond rise time of 9200

■ = Expected fuse clearing time.

The NH Research, Inc. Advantage

Precise High-Speed Current With Built-in Measurements

The 9200 is a fully integrated system with high-accuracy/high-speed current control and a built-in measurement system that dramatically simplifies the test setup. No additional test equipment is required providing a single point of control and measurement using NHR's fully-documented LabVIEW & IVI drivers. To demonstrate the ability to test to IEC, UL, and SAE standards, a fuse was directly connected to the output terminals of the 9200. Using the supplied LabVIEW drivers, the 9200 was programmed to 200A with safety voltage set to 20V and instructed capture the resulting voltage and current waveforms (*Fig. 5*).

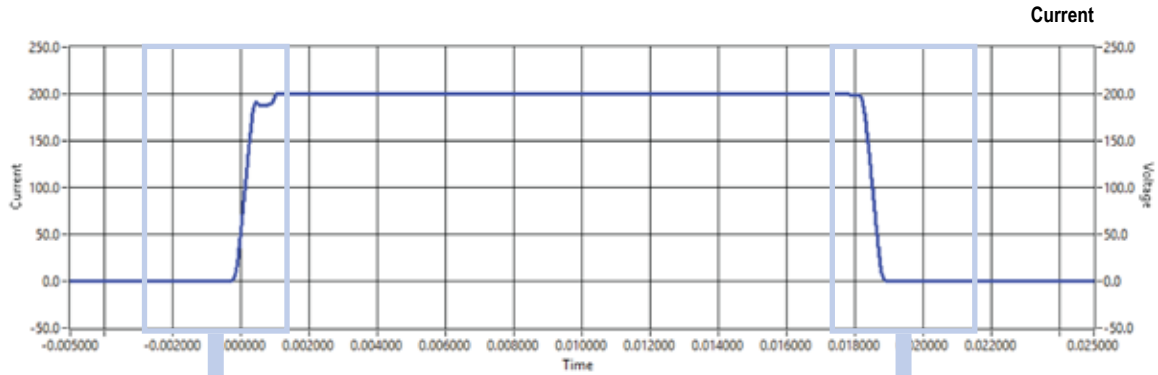

Figure 5 - Major Overload Test – Fuse Opens in 19mS

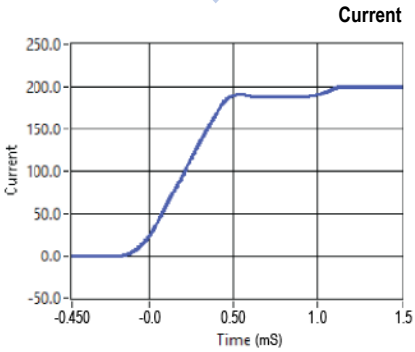

Figure 6 - Fast Current Rise Time

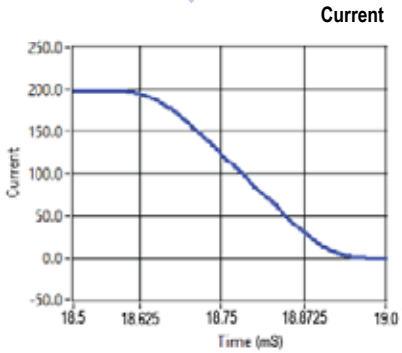

Figure 7 - Fast Current Fall Measurement

Major Overload Testing

In a major overload, the fuse will open very quickly (19mS as demonstrated in above). To maintain accurate Clearing Time calculations, the current must rise to the desired value at least 10X faster than the maximum allotted time. Above (*Figure 6 & 7*), the current rise and fall time was demonstrated to be sub-mS meeting the high speed IEC, UL, and SAE requirement.

Minor Overload Testing

The 9200 precisely regulates current to within 0.2% of the requested current indefinitely, allowing the fuse to eventually open many seconds, minutes, or even hours after the overload starts. To capture the event, the 9200 provides a single request, time-stamped group of measurements including voltage, current, power, and more.

Contact NH Research, Inc. for more information and to discuss your application testing needs.

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