

Application Note

O-C Time Results Interpretation

This document explains importance of the Reclosing operation and how to interpret the results using the DV Power circuit breaker timing instrument - CAT.

Reclosing (O-C) operation simulates a breaker's fast closing after a short circuit trip to re-establish the current.

Experience shows that a great number of short circuits are temporary. It means they are caused by an event that disappears shortly after the breaker opens. A few examples are: short circuits caused by lightning, a bird, fallen trees or branches, etc.

The temporary faults create electrical arcs. Once the power feeding an arc is cut off, certain time amount needs to pass for the arc plasma to deionize before reconnecting power, or another trip may occur.

The purpose of the fast Reclose operation is to reduce the duration of a power interruption. It is important to reduce it (dead time) as much as possible but at the same time give enough time to clear the fault.

Statistics show that 300 ms duration between the contacts opening and the contacts closing is enough to achieve this goal.

Various standards for circuit breakers define timing parameters for the Reclosing operation. The major international standards are IEC[®] and ANSI[®]/IEEE[®]. One section of IEC 62271-100 "High-voltage alternating current circuit-breakers" standard describes the circuit-breaker-related timing definitions.

According to IEC 62271-100, the **Reclosing time** is the interval of time between the beginning of the opening time and the instant when the contacts touch in all poles during a reclosing cycle.

The Reclosing time is the time presenting sum of a delay (most often 300 ms) and the time of closing operation itself. The increase of Reclosing time most often means there could be a problem in the operating mechanism, if the stated time increase is present in the Close operation. If that is not the case, the problem is most likely in the control circuit of the circuit breaker or with the contacts of the protection relays or in the remote control unit that provides the voltage impulse to the operating coils.

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Operating the Instrument

To start, please make sure the breaker is in the closed position. Select **O-C Reclosing** operation in the **Select sequence** menu.

Following notification will appear:



Press and hold the "READY" button and then press START to start the test.

The CAT will initiate an OPEN command followed by CLOSE command after a 300 ms delay, as shown in the Figure 1.

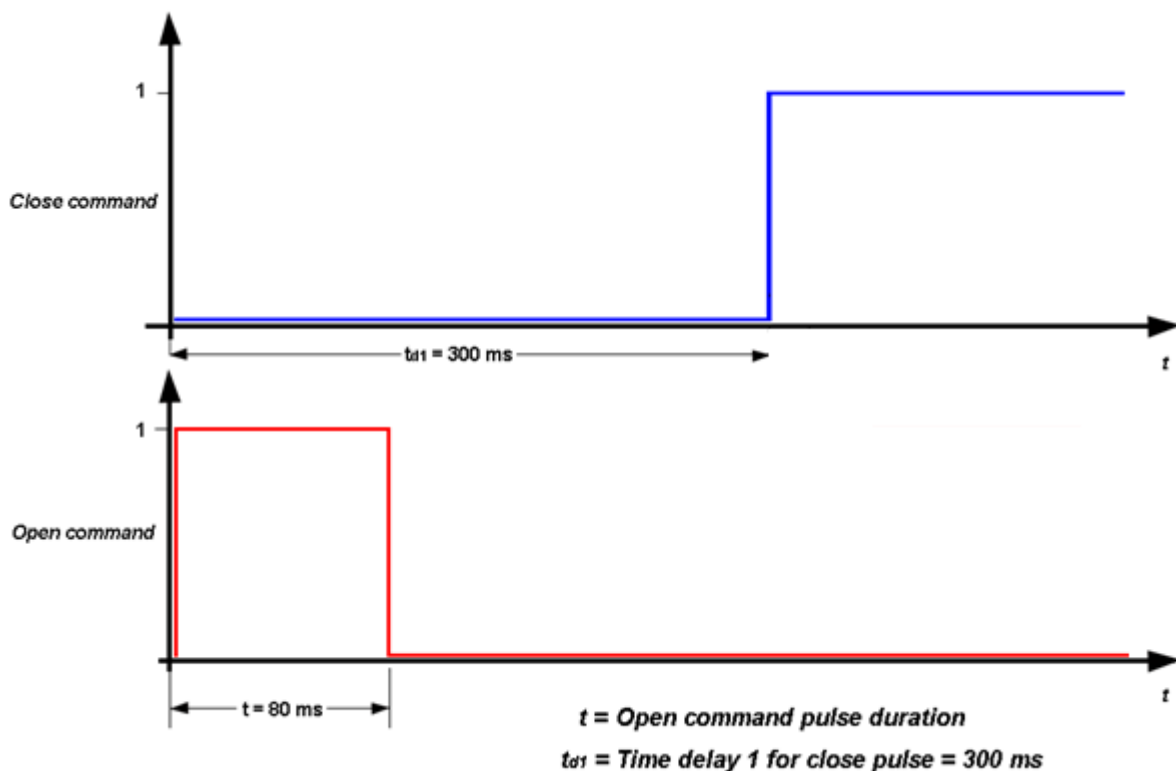
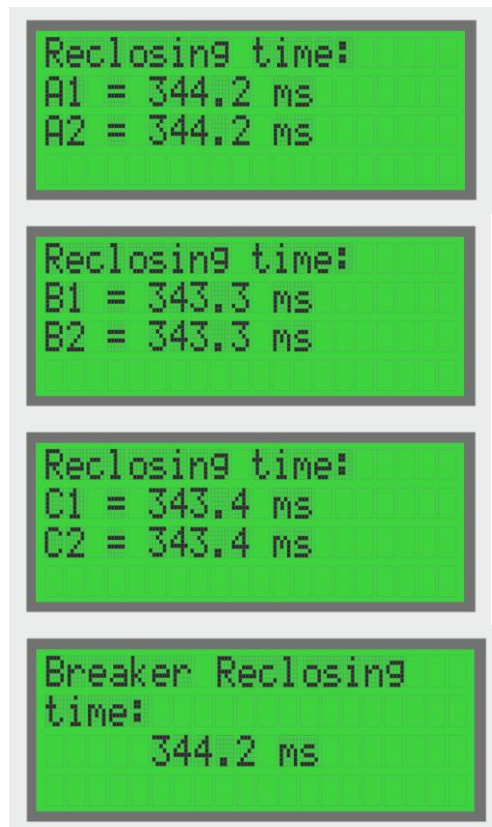


Figure 1: O-C Reclosing command pulse

Note: The Time delay t_{d1} parameter can be changed.

After processing data, the CAT will display the Reclosing test timing results.



A1 and **A2** are reclosing times of the main arcing contacts in the phase A (Figure 5).

B1 and **B2** are reclosing times of the main arcing contacts in the phase B (Figure 5).

C1 and **C2** are reclosing times of the main arcing contacts in the phase C (Figure 5).

Circuit breaker reclosing time is the interval of time between the beginning of the opening time and the instant when the contacts touch in all poles during a reclosing cycle. (Figure 5).

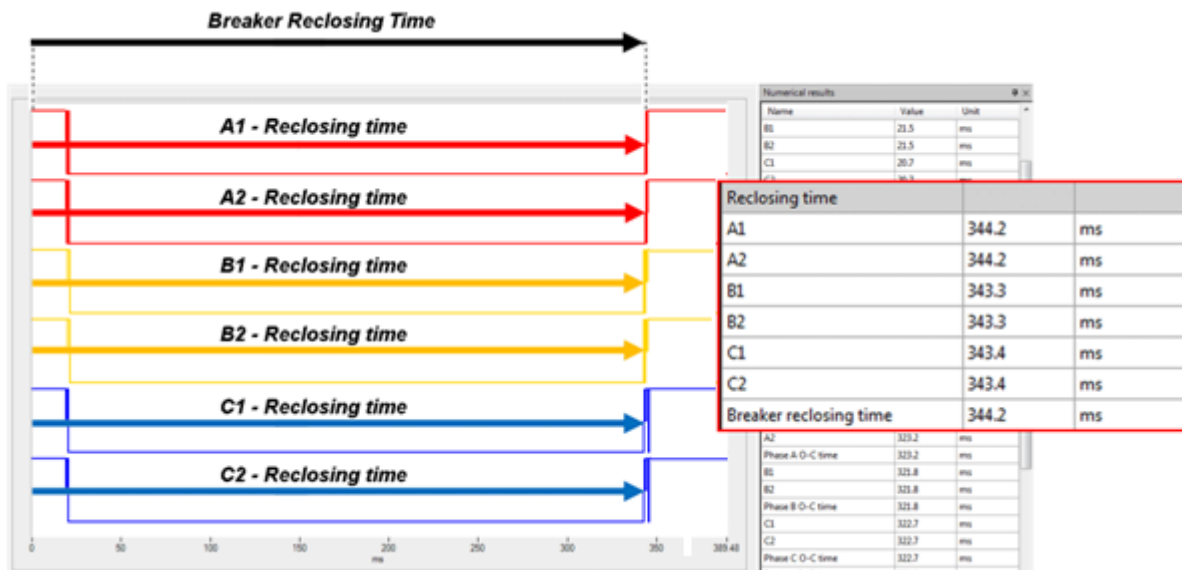


Figure 5. Reclosing time – graphical explanation

A1, A2 – Reclosing times of the main contacts in the phase A (red plot).

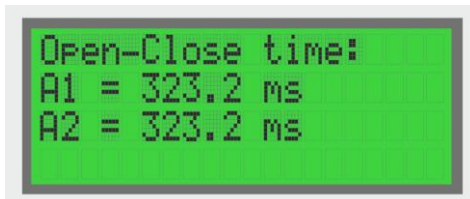
B1, B2 – Reclosing times of the main contacts in the phase B (yellow plot).

C1, C2 – Reclosing times of the main contacts in the phase C (blue plot).

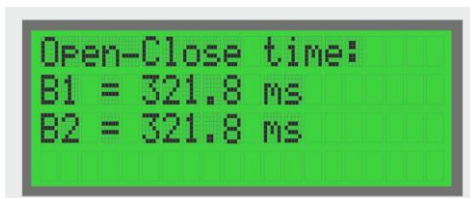
Figures above display the main contact state graph during Reclosing operation for phases A, B, C.

According to IEC 62271-100, **Open-Close time (during auto-reclosing)** is the interval of time between the instant when the arcing contacts have separated in all poles and the instant when the contacts touch in the first pole during a reclosing cycle.

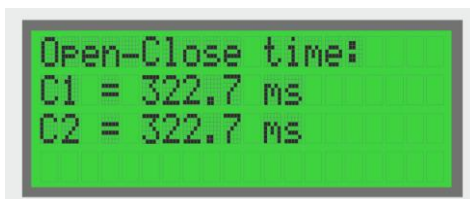
After displaying the Reclosing time, the CAT displays Open-Close (O-C) time per breaking points and per phases, as shown below.



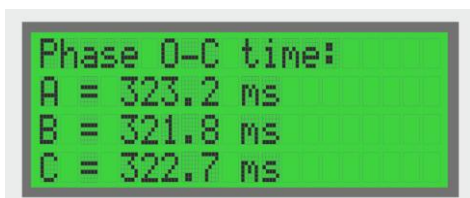
A1 and **A2** are open-close times of the main arcing contacts in the phase A (Figure 7).



B1 and **B2** are open-close times of the main arcing contacts in the phase B (Figure 7).



C1 and **C2** are open-close times of the main arcing contacts in the phase C (Figure 7).



A, **B** and **C** are open-close times of the main arcing contacts within the phases A, B and C.



Circuit breaker open-close time (during auto-reclosing) is the interval of time between the instant when the arcing contacts have separated in all poles and the instant when the contacts touch in the first pole during a reclosing cycle (Figure 7).

O-C time during the test simulates the dead time period during the fault. A dead time on the circuit breaker of at least 135 ms is normally required to clear the fault's ionized gases at voltage range 115 kV to 138 kV for circuit breakers without resistors across the interrupters.

The required dead time is greater for higher voltages or when selective pole tripping is used to clear only the faulted phases.

O-C time is higher than the specified delay between Open and Close operation. For example, for circuit breakers with delay 300 ms, O-C time needs to be higher than the stated value.

O-C time graphical and numerical display is shown in the Figure 7.

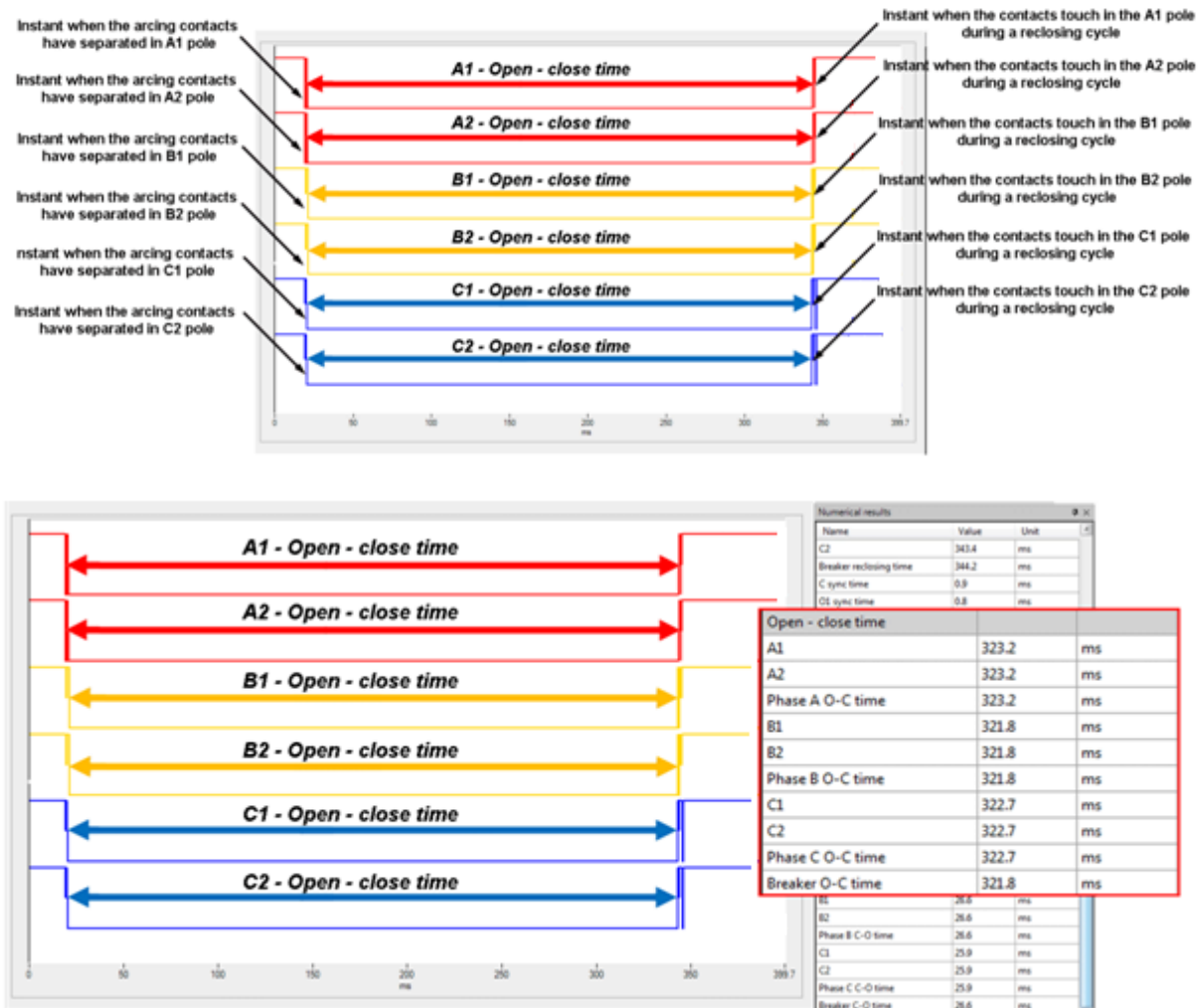


Figure 7. Open-close time – graphical explanation

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