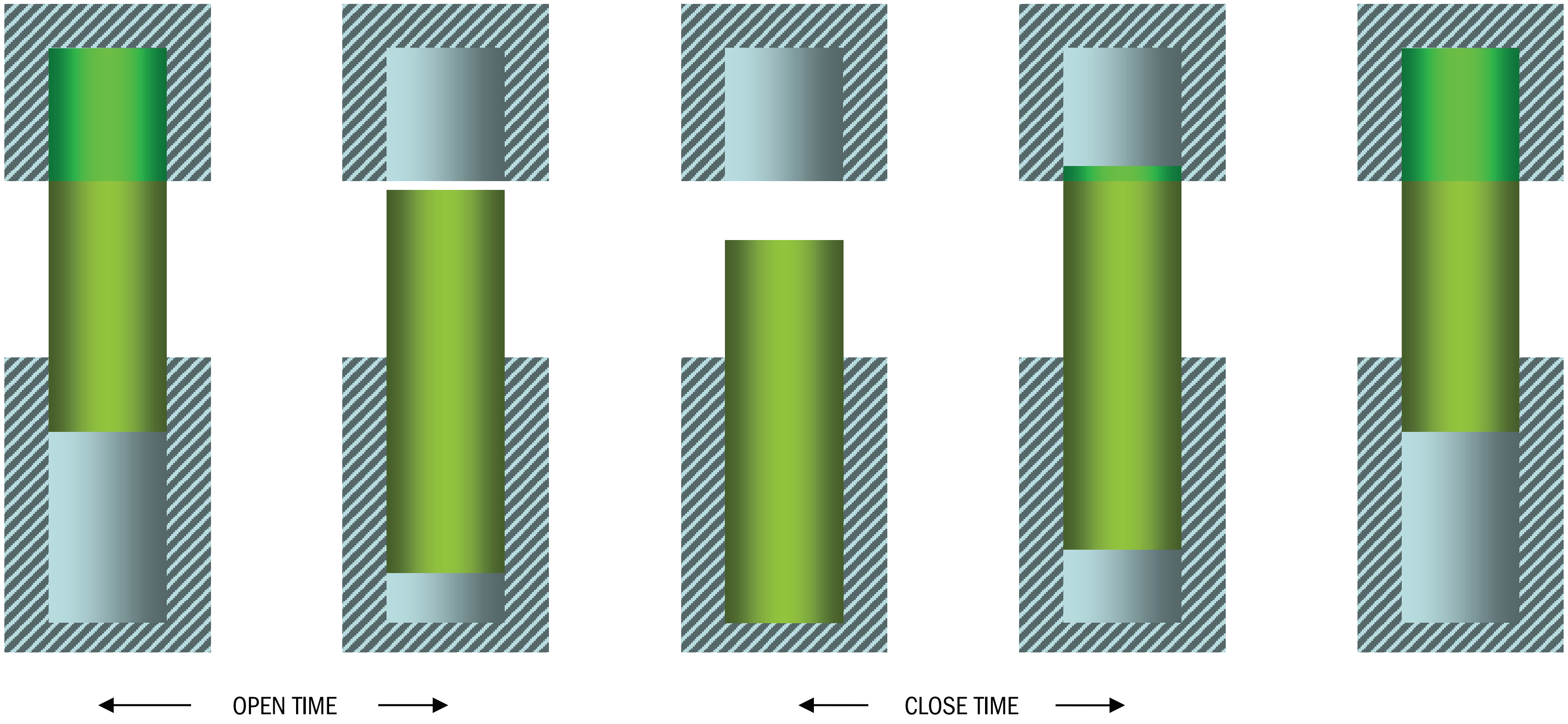
PME-500-TR Applications Note:

Analysis of circuit breaker operation time measurements

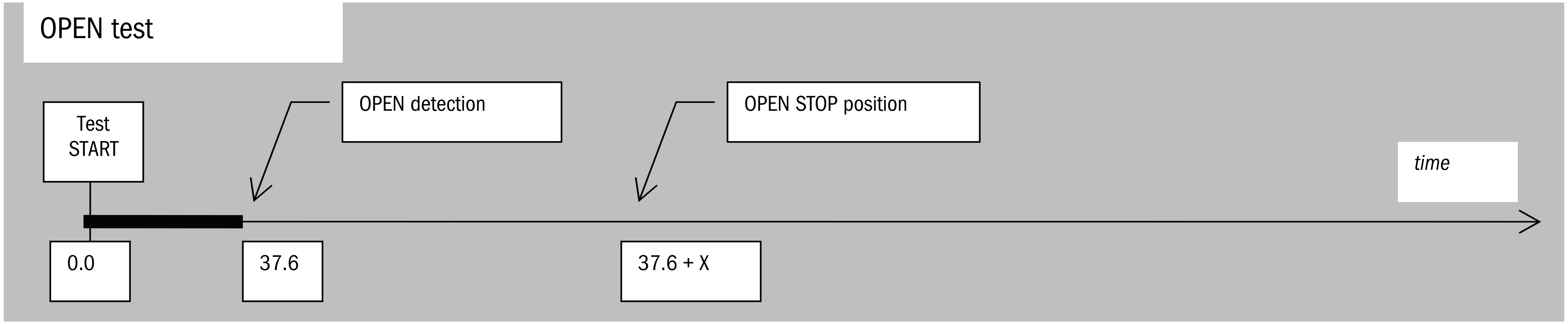
Close and Open times may differ when measured with a single-operation test from the partial times resulting from a combined sequence. The main (although not the only influencing factor) reason is the actual starting position of the circuit breaker's poles when the timer starts.

The following is a very simplified explanation why individual Close and Open times should not be calculated from a test sequence, but from a single-operation test. We will examine the time results from two separated OPEN and CLOSE commands, as opposed to those resulting from an OPEN-CLOSE sequence. The *sequential* effect can be neutralized if a sufficiently long *wait* interval is inserted between the two consecutive commands.



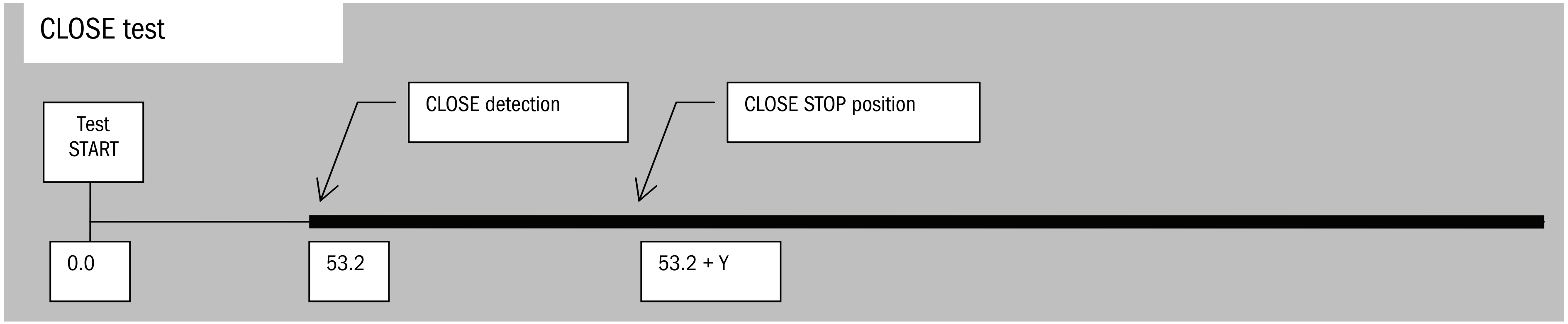
1. OPEN

The pole departs from steady CLOSED position. 37.6 ms later, it looses contact with the fixed counterpart and continues moving until the mechanical limit (OPEN STOP position) is reached. This time (“X”) cannot be measured with the normal timing test.



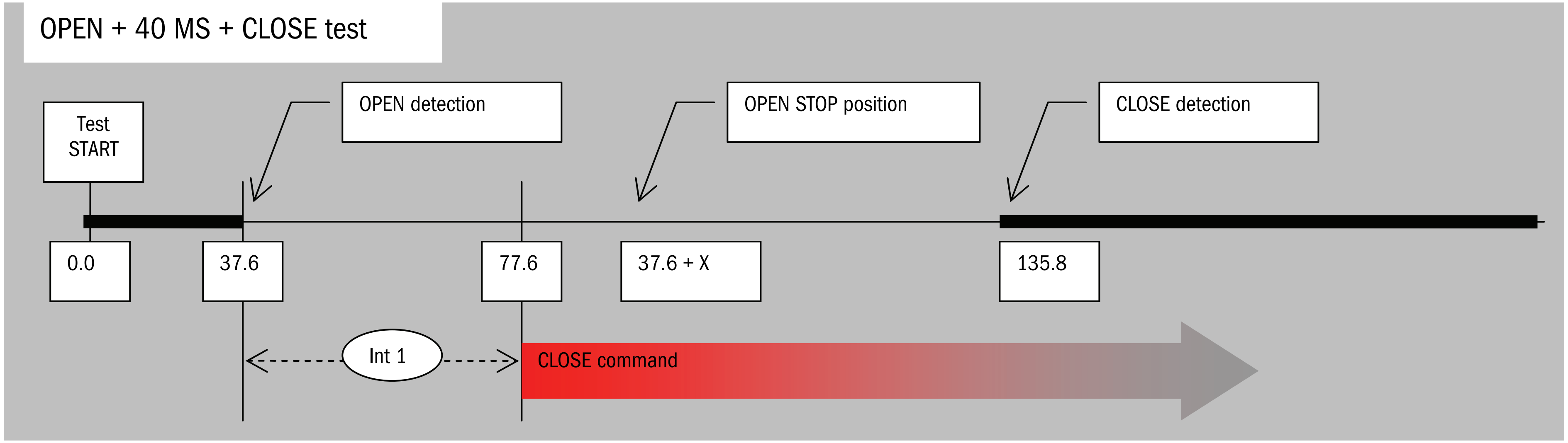
2. CLOSE

The pole departs from steady OPEN position. 53.2 ms later, it reaches the fixed counterpart and continues moving until the mechanical limit (CLOSE STOP position) is reached. This time (“Y”) cannot be measured with the normal timing test.



3. OPEN + 40 MS + CLOSE

The pole departs from steady CLOSED position. 37.6 ms later, it looses contact with the fixed counterpart and continues moving until the mechanical limit (OPEN STOP position) is reached.



40 ms (Int 1) after the OPEN state is detected, the PME-500-TR issues the subsequent CLOSE command. However, the pole has not reached its OPEN STOP position yet. After reaching there, it will start moving back towards the fixed counterpart to complete the CLOSE command.

Therefore, if Int 1 is smaller than X (or if no Interval is used at all),

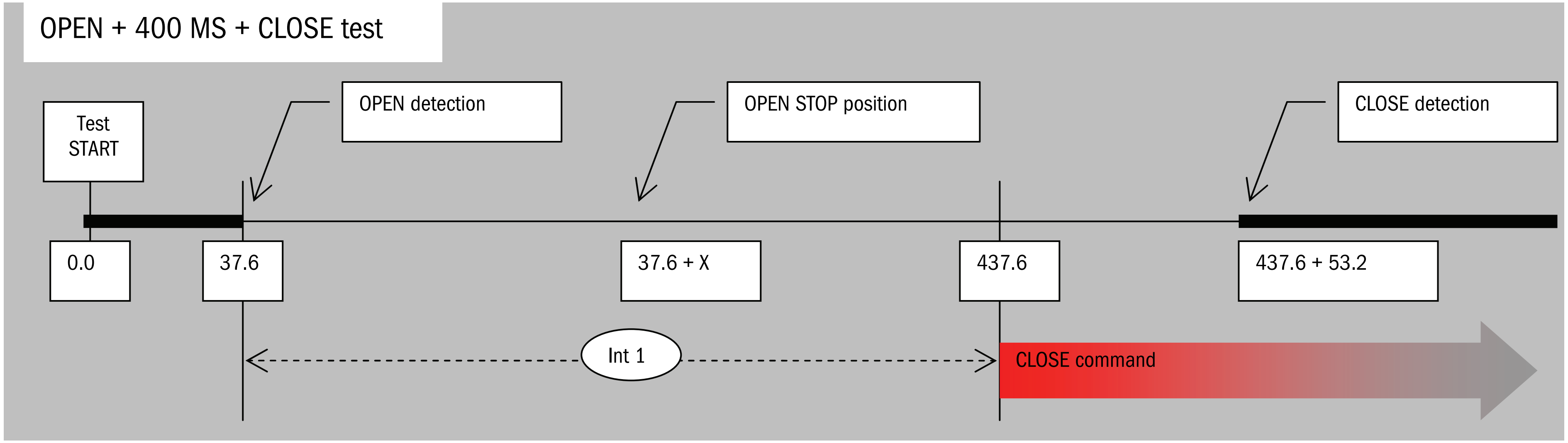
CLOSE time = CLOSE detection – OPEN detection – X

= 135.8 – 37.6 - X

= 98.2 – X

(which is an unknown value)

4. OPEN + 400 MS + CLOSE



400 ms after the OPEN state is detected, the PME-500-TR issues the subsequent CLOSE command. By that time, the pole is steadily placed and waiting at its OPEN STOP position (as it was for the simple CLOSE test), so it will only need to move towards the fixed counterpart to complete the CLOSE command. The unknown “X” time has been entirely absorbed by the longer 400-ms Int 1, so it will no longer influence our calculations.

Therefore, if Int 1 is long enough (a CLOSE+OPEN should be fine), then

CLOSE time = CLOSE detection – OPEN detection – 400

= 437.6 + 53.2 – 37.6 – 400

= 53.2

(which equals exactly the value for a simple CLOSE operation)

The same can be concluded for a CLOSE – OPEN test.

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