SHARING KNOWLEDGE

Troubleshooting Examples

RELATED PRODUCTS: **CBA-32P CBV**

By definition, a circuit breaker timing test is the process of measuring the mechanical operating times with the goal of verifying, analyzing and validating the proper function of the circuit breaker.

The importance of timing tests is particularly critical in maintaining the reliability of the transport and distribution network, and also in the safety of the personnel employed to maintain and operate the network protection apparatus.

Using test execution and analysis tools, such as the CBA-32P, by Zensol, which is driven by the CBA Win© software, and with the experience acquired in the field, it is possible to determine, with remarkable accuracy, the nature of the problems that affect circuit breaker performance even before disassembling the apparatus.

However, timing tests are not limited to tests conducted after the circuit breaker fails (corrective maintenance). In the preventive maintenance strategy, the breaker is subject to

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Consequences of circuit breaker misoperation

The potential for damage that a circuit breaker – essentially a protective device – can inflict on a network if its operation is not within specifications are not to be neglected. The economic repercussions can be just as severe: cost of repairs, cost of the failure, interruption of service to customers, etc.

If the operation time during a Trip is too long, the short-circuit current being interrupted will persist for much longer, and could damage transformation, transmission and distribution installations. The reduction of the interrupting time can also bring the added benefit of increasing the transportable power because the stable power limit increases in inverse proportion with the tripping time. Also, the contacts themselves are subject to the arc for longer periods, which reduces their useful lifespan.

Also, all contacts must be synchronized, within a certain tolerance limit. In three-phase systems, not only must the contacts in a single pole operate simultaneously, but all poles must also operate at the same time.

If the contacts in one pole do not operate synchronously, then the slowest contact to close and the quickest to open will absorb the greater part of the load, which will cause the premature wear of the contacts in question.

The difference between phases (poles) could generate voltage spikes because of the very nature of the transportation system, long transmission lines with extremities whose state cannot always be predicted: open-ended, loaded, capacitive or inductive load, etc. These factors may cause huge voltage spikes that could potentially damage the network and its equipment.

Inoperative insertion resistors will cause premature wear on the main contacts, since they will be subjected to the strongest breaking currents, with the accompanying arc that will be so

of the problem by visualizing the mechanical process of the operation, in perspective with the data of the timing test.

The same is true of the experienced mechanic who can determine, at a glance, the source of the mechanical problem in a car. He knows not only automobile mechanics as a general subject, but he knows the peculiarities of the model that is brought to him.

One also needs precise timing test data, such as those produced by CBA Win after a timing test conducted with Zensol's CBA-32P.

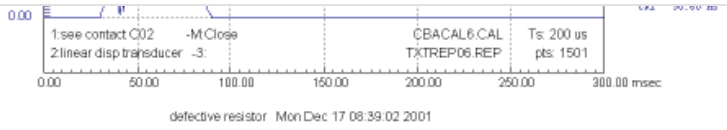
The following examples, showing the curves generated by the faulty apparatus, followed by the analysis, the description of the actions and corrections applied, and the curves generated by the repaired equipment, illustrate how the principles previously explained can be applied in a real-world situation.

Conclusion	

The role played by the high voltage circuit breaker has always been one of the most determining factors of high voltage network reliability. Its main role is to protect the network and installed electric equipment from destructive short-circuit current surges. A high voltage circuit breaker can stay in the closed position for years but is still expected to interrupt a powerful short-circuit current of many thousands of amperes in a fraction of a second. The nature of its operation places it among the most unpredictable equipment on the electric network.

PK – Inoperative resistor	

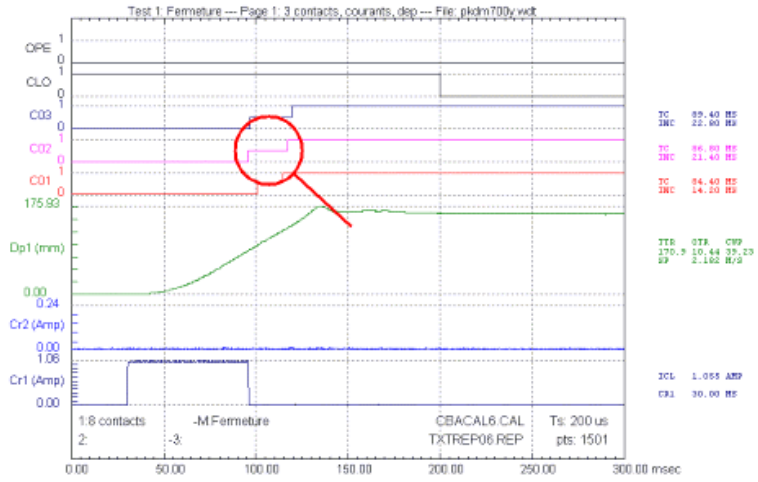
The insertion resistor does not work. The spring on the moving contact is broken and blocks the piston.



defective resistor Mon Dec 17 08:39:02 2001

PK – Correction

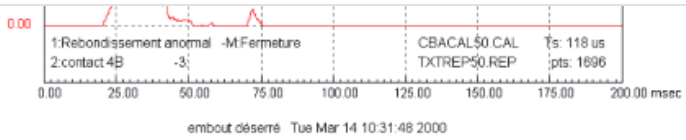
Disassembly of the auxiliary moving contact, observe the damage (broken spring), replacement of the spring and reassembly. A timing test shows the return of the resistor's trace on the second phase (C02).



Ressort remplacé Mer Dec 12 09:18:57 2001

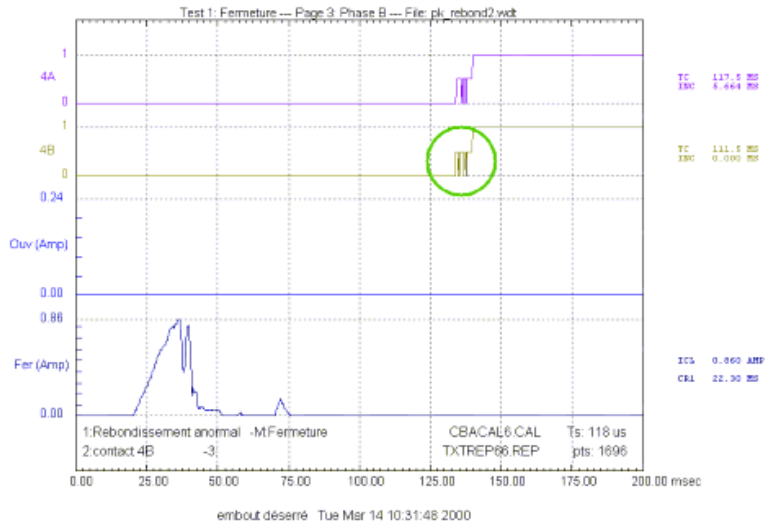
PK – Rebounds

Abnormal rebounds on an auxiliary (resistive) contact. The head on the semi-mobile contact is loose.



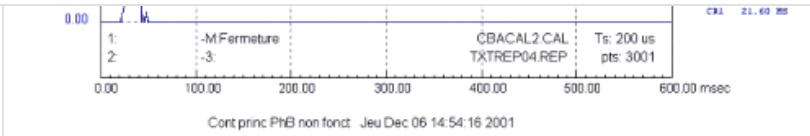
PK – Correction

Disassembly of the auxiliary moving contact, observe the problem (loose head). Tighten the head and immobilize with Loctite and punching, followed by reassembly. A timing test shows the disappearance of the unusual rebounding on the resistive trace.



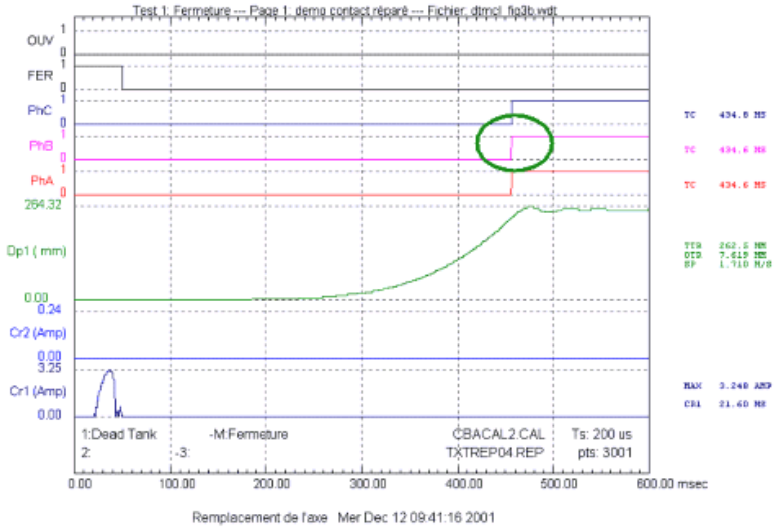
Dead Tank – Missing main contact

Case of an inoperative main contact on one phase (PhB), showing an open circuit on a Close operation.



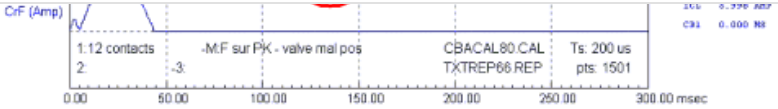
Dead Tank – Correction

Disassembly of the internal parts of the defective phase. Observe the damage, a shaft connecting the actuating rod to the moving contact had fallen, causing the contact piston to separate from the actuating rod. Replace the shaft and reassemble. A timing test shows the reappearance of the main contact on the second phase.



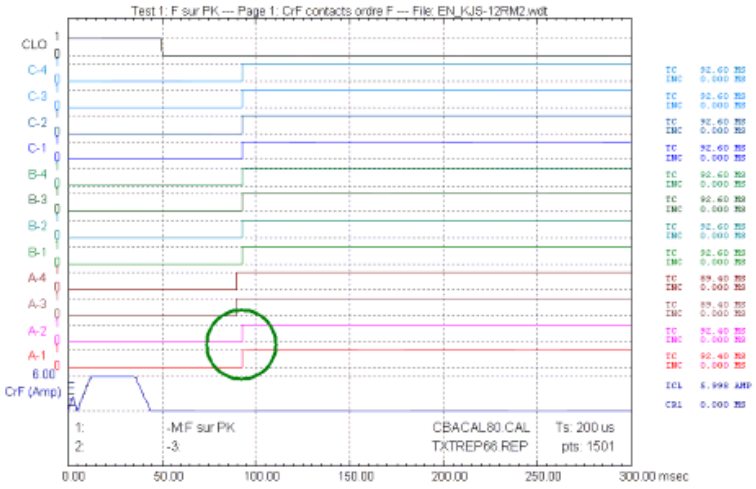
PK – Valve in wrong position

The close control valve on the breaker is in the wrong position. The result is that the closing times on the two chambers connected to this valve are longer than the others.



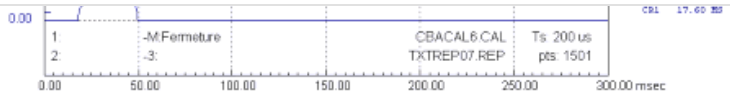
PK – Correction

Disassembly of the close control valve. Observe that the body of the valve had been installed at a 90° angle relative to the normal position of the valve body, which caused a delay in the admission of compressed air, producing the observed delays on the signals of contacts A-1 and A-2. Replace the valve in the correct position. A timing test shows that contacts A-1 and A-2 now close within the expected times.



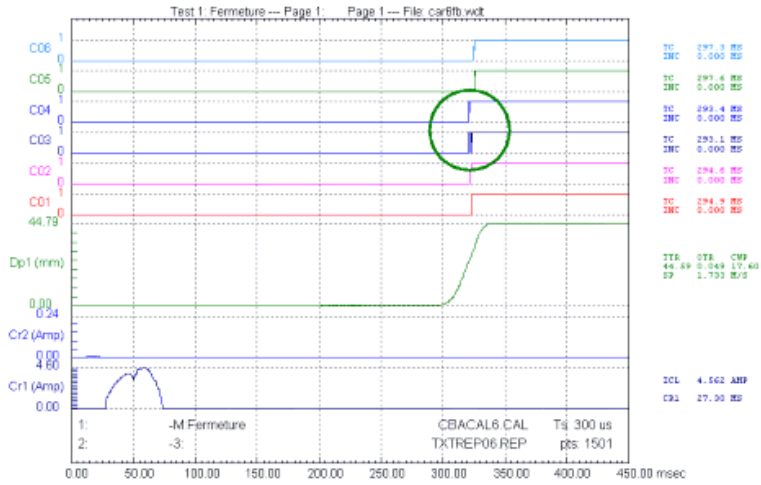
SF6 breaker with hydraulic commands – adjustment screw incorrectly set

An adjustment screw on the breaker is incorrectly set, creating a 25 millisecond difference on one phase. This problem may produce similar results to those produced by an incorrectly positioned control valve.



SF6 breaker with hydraulic commands – Adjustment screw – Correction

The adjustment screw was set to obtain similar closing times on all phases and contacts. A timing test shows that the closing time on contacts C03 and C04 are now comparable to those on the other contacts.

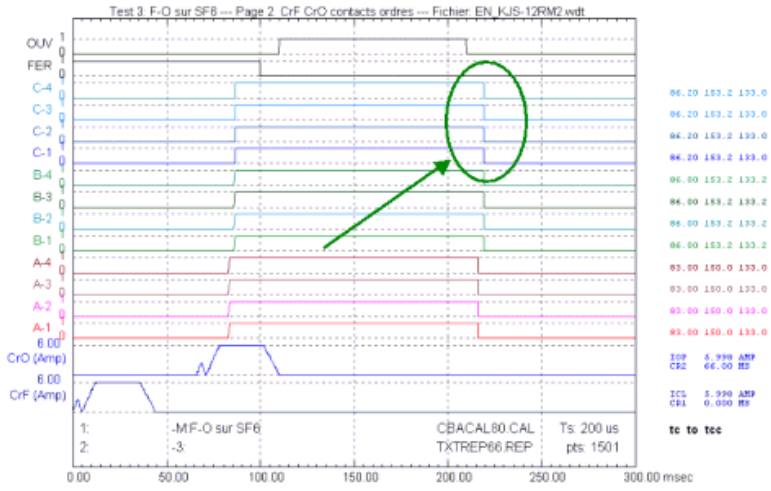


SF6 breaker with hydraulic actuator – short-circuit time

Adjustment of the short-circuit time for a SF6 breaker with hydraulic actuator. Circuit breakers with hydraulic actuators are usually equipped with a signal piston with drives the signaling contacts. These contacts control the minimum short-circuit time of the circuit breaker (trip-free). This example shows all three phases following a Close-Open operation. It may be seen that

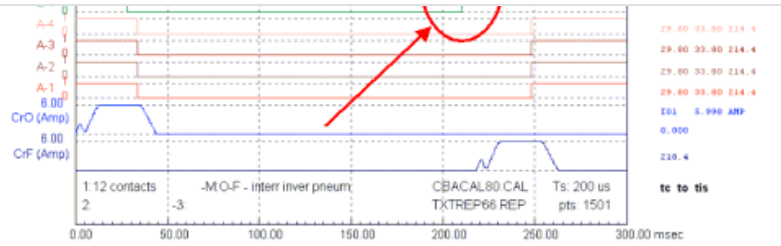
SF6 breaker – Correction of short-circuit time

Adjust the admission restriction of the hydraulic command in order to obtain synchronous operation of all phases.



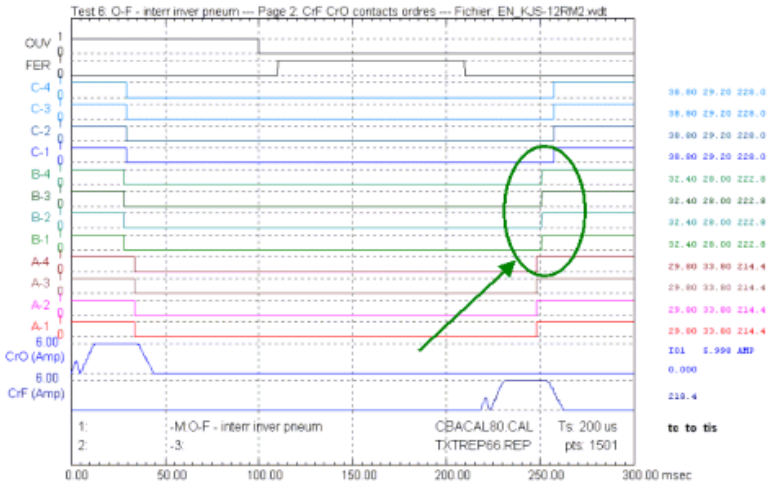
Pneumatic breaker, isolation time

Air-driven breakers are usually equipped with a pneumatic inverter switch on each phase. The main function of this switch is to prevent the close operation for approximately 250 milliseconds after a trip, so the dielectric medium has time to properly regenerate. The following example shows all three phases after an Open-Close operation (the close order is



Pneumatic breaker – Correction

Adjust the restriction on the inverter switch in order to obtain comparable times between all phases.



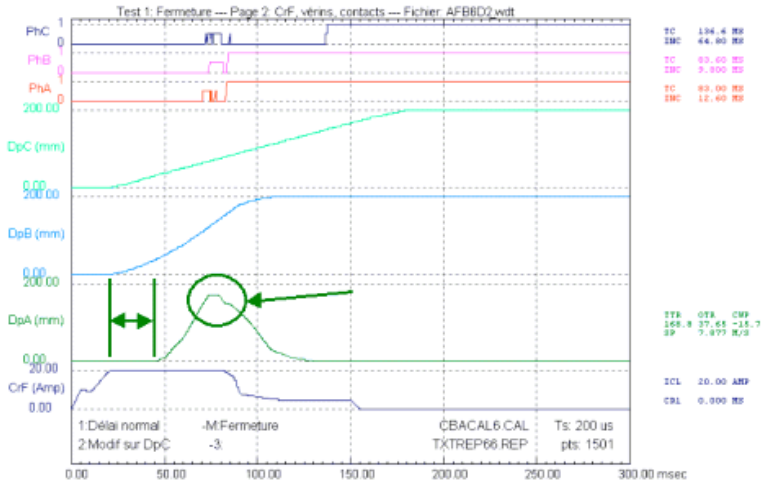
Shielded breaker

Two problems are noted on this breaker. First, the engagement piston doesn't attain its full travel (180 mm). Second, the piston begins moving 30 to 35 milliseconds after the main pistons. The normal delay is about 20 milliseconds.

Vérin enclencheur défect

Shielded breaker – Correction

To correct the delay problem, the diameter of the appropriate diaphragm orifice is increased by 0.020 inches. The premature reopening of the resistor is due to the main contact closing later. The curve shows that there is also a problem with the upper piston (DpC) of the main contact on Phase C. This piston was overhauled prior to the timing test.



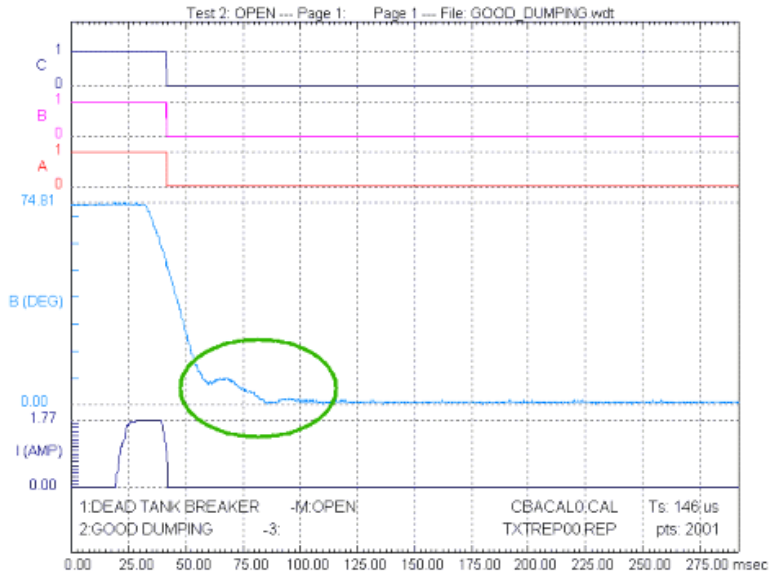
Vérin enclencheur réparé

Dead Tank – Bad damping

The following timing diagram shows a hard rebound at the bottom of the displacement curve, during a Trip operation on a Dead Tank type circuit breaker. This suggests a lack of damping at the end of travel. Excess energy is poorly absorbed and damage may already have occurred.

Dead Tank – Correction

After examining the internal components, it is observed that damage has indeed occurred on the main rod of the moving contact. The source of the problem is a defective dashpot. After repair, the timing test shows correct damping at the bottom of the travel curve.



2. The distribution network

At the output of the generating stations, transforming stations step up the production-level voltage to the high voltage

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