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Transducers installation examples

INTRODUCTION

One of the main difficulties in measuring the displacement on a circuit breaker is the position of the transducer and the attachment of the mechanical base on the breaker.

For more theoretical information on displacement tests and their interpretation, a thorough explanation may be found in the Sharing Knowledge section.

CHOOSING A TRANSDUCER

In the selection of a transducer, the mechanism's action gives a good idea of what type of transducer to choose.

If it is solely linear, as it is in the case of bulk oil breakers, or purely rotary, in the case of HPL breakers, the choice is simple.

It is sometimes possible that both types of transducers may be used, as in the case of a GL212 breaker, as shown in example 2.

In the case of the linear transducer, there is one simple rule to remember, which is to always place the transducer parallel to the breaker's mechanism, or it could be damaged.

Finally, the length of the linear transducer used will depend on the total travel of the circuit breaker.

For rotary transducers, the following table will give the equivalent lengths, in millimeters, in relation to the number of turns.

Transducer	ZRT-01 Single turn	ZRT-03 3 turns	ZRT-05 5 turns	ZRT-10 10 turns
Total travel in millimeters	± 157 mm	± 471 mm	± 785 mm	± 1570 mm

NEED AND INTEREST TO MEASURE DISPLACEMENT

One question that is frequently asked is: is it necessary to measure the displacement on my breakers?

It is not always necessary to measure the displacement. It is important to check the circuit breaker's factory manual to see if the manufacturer recommends it. The manufacturer will supply information on total travel, overtravel, displacement speed, instantaneous velocity at a given point, etc., that will be expected from your breakers. The CBA-32P Circuit Breaker Analyzer will automatically calculate these values (see examples below).

By attaching a transducer to the contacts shows how they behave during the breaker's movement. This information, combined with the mechanical design of the breaker, gives us valuable information on the breaker's mechanical state, which is not always revealed in timing tests, as shown in the examples below.

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EXAMPLE OF A SHIELDED BREAKER

In this example, performed on a shielded breaker, three displacement transducers have been mounted, one on each phase (DpA for phase A, DpB for phase B and DpC for phase C).

Even if the contact closing time does not show any problem (the contacts are perfectly synchronized), the displacement graph shows that phase A's travel (DpA) is not completed, which can be verified by the calculation of the total travel, which is 112 mm instead of 180 mm.

Moreover, the piston begins its movement 30 to 35 milliseconds after the main piston. The normal delay is 20 milliseconds.

EXAMPLE OF A DEAD TANK BREAKER

The contacts are perfectly synchronized in this example too, but the displacement curve indicates an anomalous bounce (in the left-hand graph).

The problem was due to a defective dashpot. After it was replaced, the situation returned to normal, as shown in the right-hand graph.

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INSTALLING THE DISPLACEMENT KIT ON THE BREAKER

There are several types of kits available: the most used are the linear kits and the rotary kits.

These kits, even if they are called “universal”, sometimes need a few minor adaptations, as you can see in the examples below. These adaptations show the great variety of circuit breakers and mechanisms.

However, as you will see in the examples below, you will notice that there are overall resemblances between the mechanisms of certain breakers, which allow the use of the supplied kits with minimal adaptation.

Some customers which have their own machine and welding shop also develop their own mechanical bases, as shown among the photos.

MOUNTING EXAMPLES FOR MECHANICAL BASES AND THEIR TRANSDUCERS

We have gathered several mounting examples here, taken from our own test experiences over the years, in many locations around the world. These tests were all performed using the CBA-32P Circuit Breaker Analyzer and the CBA Win software.

We hope that you will find these photos useful and that they will inspire you when you make your tests.

We take this opportunity to thank our customers, who gave us permission to take these photos and to show them to you, so that everyone can benefit from their experience.

The examples shown below do not represent all possible cases. The displacement kits may be used for other types of breakers with either minimal adaptation or none at all.

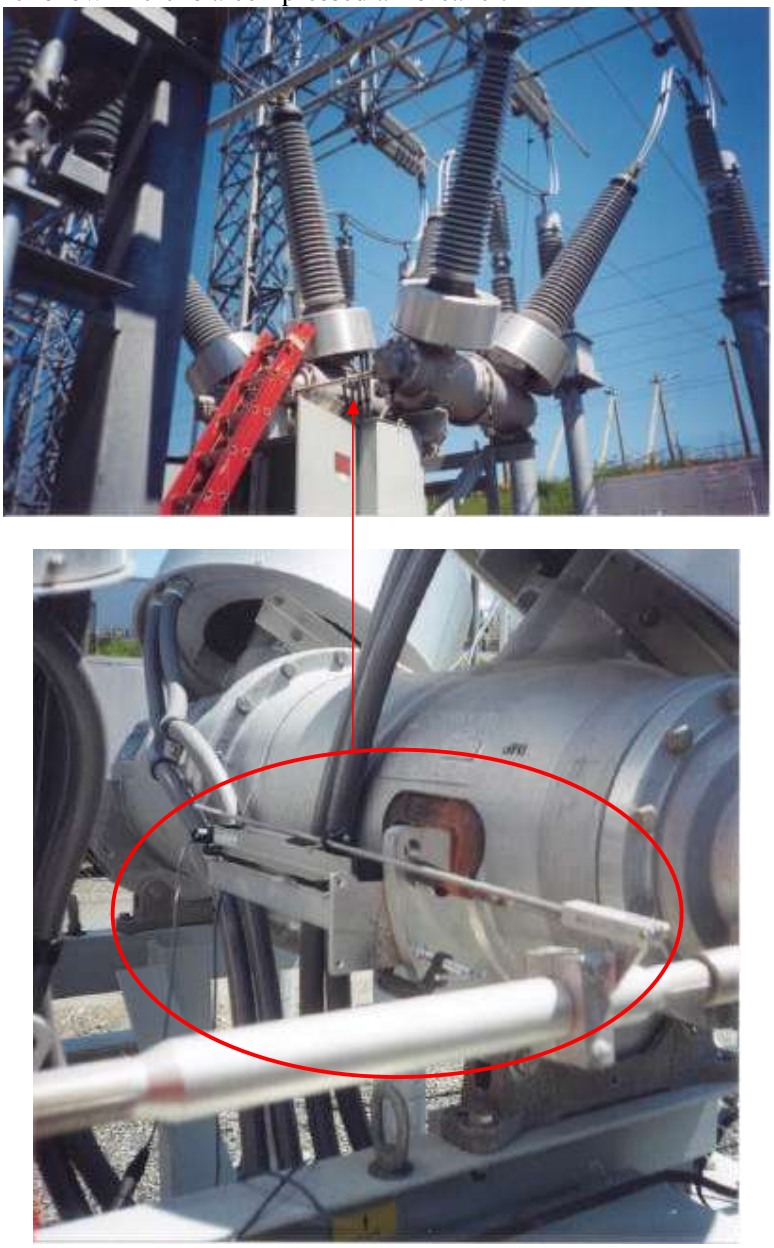
We wish to emphasize that all the rods used to connect the transducer to the mechanisms of the breakers shown in these examples were supplied by the customer.

Practical examples

EXAMPLE 1 : ABB BREAKER
EXAMPLE 2 : AREVA GL BREAKER
EXAMPLE 3 : SPRING TYPE BREAKER
EXAMPLE 4 : T-TYPE BREAKER
EXAMPLE 5 : GE BREAKER
EXAMPLE 6 : BULK OIL BREAKER
EXAMPLE 7 : HPL BREAKER
EXAMPLE 8 : HPL T-TYPE BREAKER (BLG mechanism)
EXAMPLE 9 : GFX BREAKER
EXAMPLE 10 : GL T-TYPE BREAKER
EXAMPLE 11 : ABB BREAKER
EXAMPLE 12 : MAGNE BLAST BREAKER
EXAMPLE 13 : MOUNTING EXAMPLE WITH A MAGNETIC BASE
EXAMPLE 14 : HGF DEAD TANK BREAKER BY AREVA
EXAMPLE 15 : ABB HPL 245 BREAKER; INTERRUPTOR HPL 245 DE ABB – (KIT – ZMS)
EXAMPLE 16 : WESTINGHOUSE DB BREAKER – (KIT – ZMS)
EXAMPLE 17 : DEAD TANK MITSUBISHI BREAKER – (KIT – ZLR)

EXAMPLE 1 : ABB breaker (tests performed in British Columbia, Canada)

The ABB breaker shown here is a compressed air breaker.



The kit used is a KIT-ZLB linear kit with a ZLT-300 linear transducer. This breaker's mechanism makes only a small rotation of less than one-quarter turn. In order to use the linear transducer, the customer supplied the linkage assembly shown here, along with the base kit supplied by Zensol.

Linkage assembly used with the kit.

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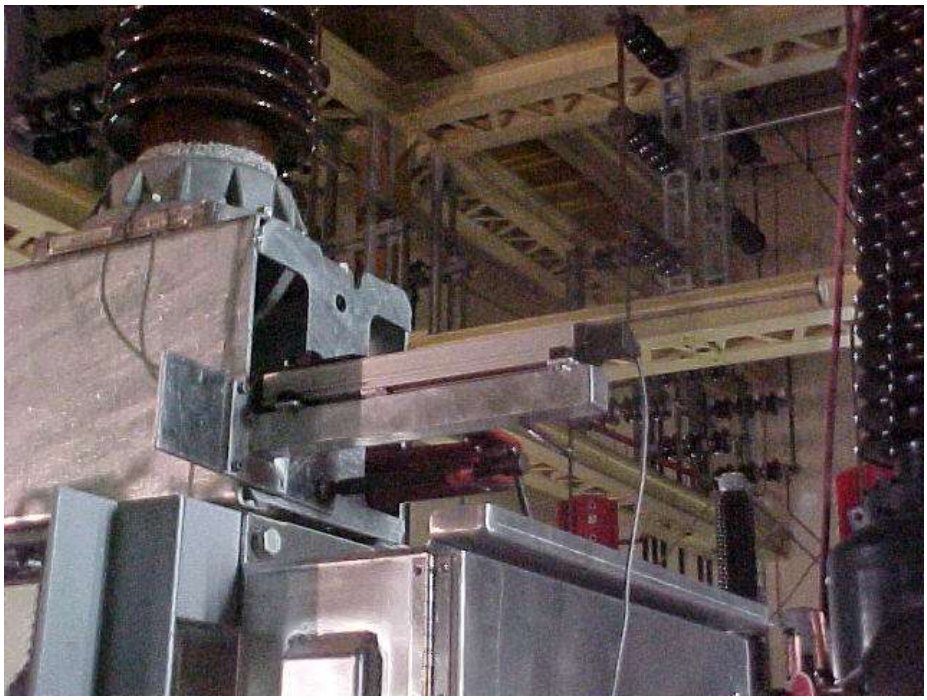
EXAMPLE 2 : AREVA GL Breaker (tests performed in Québec, Canada)

The GL212 breaker is manufactured by AREVA (formerly Alstom). The motion of this breaker can be checked at both ends of the breaker with different displacement kits.

Close-up view of the mechanism

As shown below, the KIT-ZLB linear kit was directly installed with a ZLT-225 linear transducer without any particular adapation.



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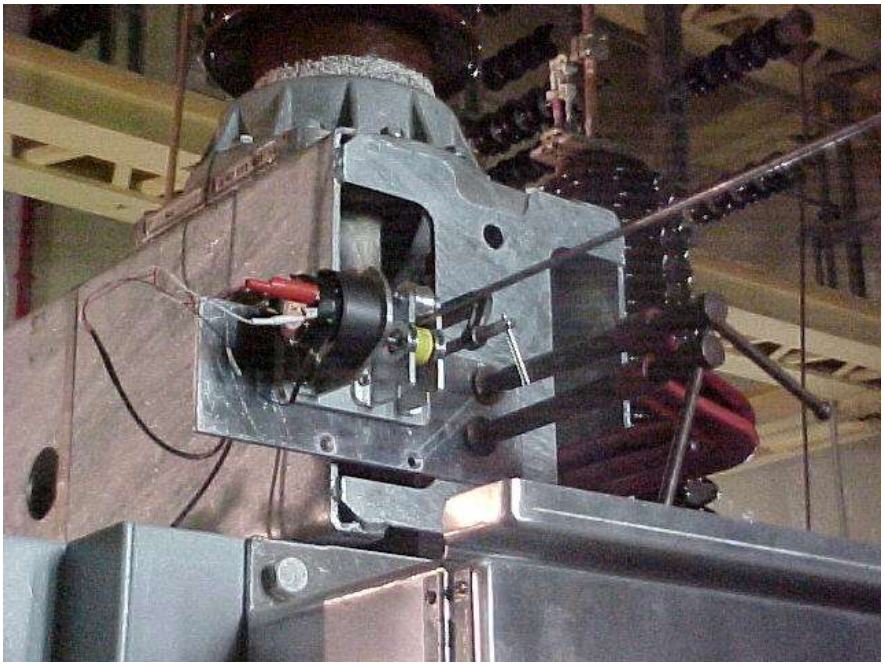
Here is the same breaker with a KIT-ZLR linear-to-rotary converter (Hydro-Québec licence) in place, along with a ZRT-10 ten-turn rotary transducer (note: ZRT-3 three-turn transducer could also have been used here). The mechanical base used here was an older model. To see the new model, please see our accessories section.



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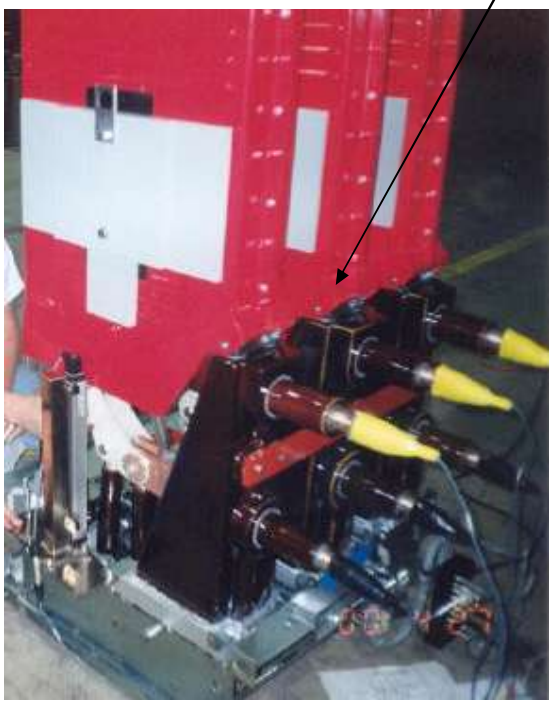
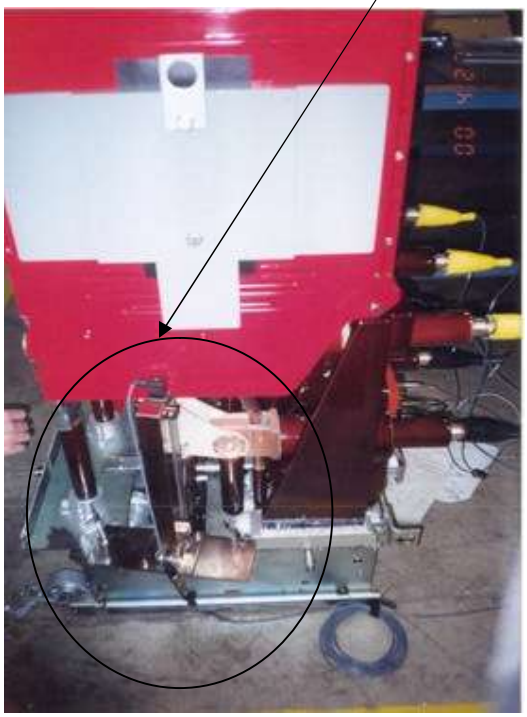
EXAMPLE 3 : SPRING-TYPE BREAKER (tests performed in Texas, USA)

The breaker shown here is one widely used by industrial customers, such as aluminum factories, mines, pulp and paper mills, etc. The three phases are visible here. The KIT-ZLB linear displacement kit and its transducer have been mounted on the side of the breaker without any special adaptation.





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EXAMPLE 4 : T-TYPE BREAKER (tests performed in Mexico City, Mexico and Guatemala City, Guatemala)

The circuit breakers shown here are 6-contact units (2 contacts per phase), commonly called T-type breakers.
The transducer used is a KIT-ZLB linear kit with a ZLT-225 transducer. The transducer is mounted at the bottom of the breaker, as shown in the photos below.

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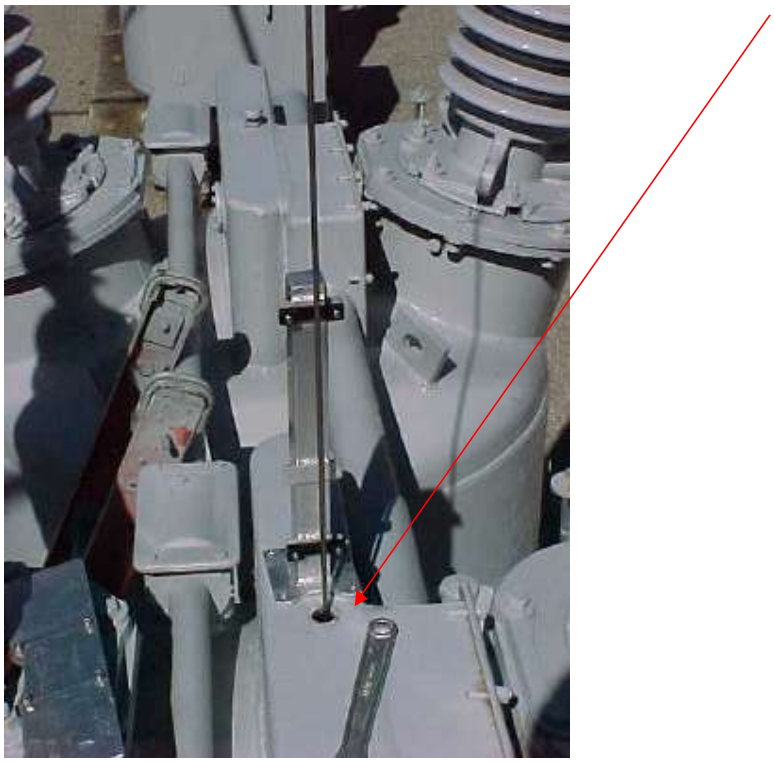
EXAMPLE 5 : GE BREAKER (tests performed in Alabama, USA)

The breaker shown here is a 3-contact unit, one contact per phase.

For the displacement measurement, this breaker has a place for this purpose, where a rod can be inserted and screwed to the mobile part of the contact, as shown in the photo below:



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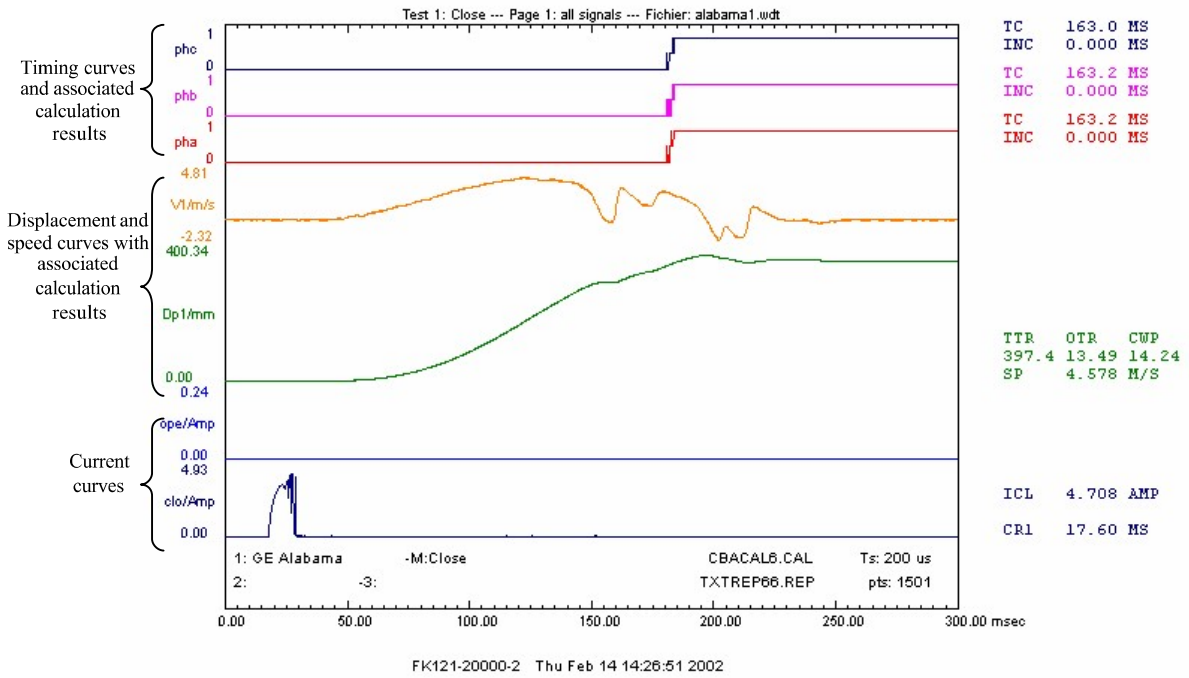
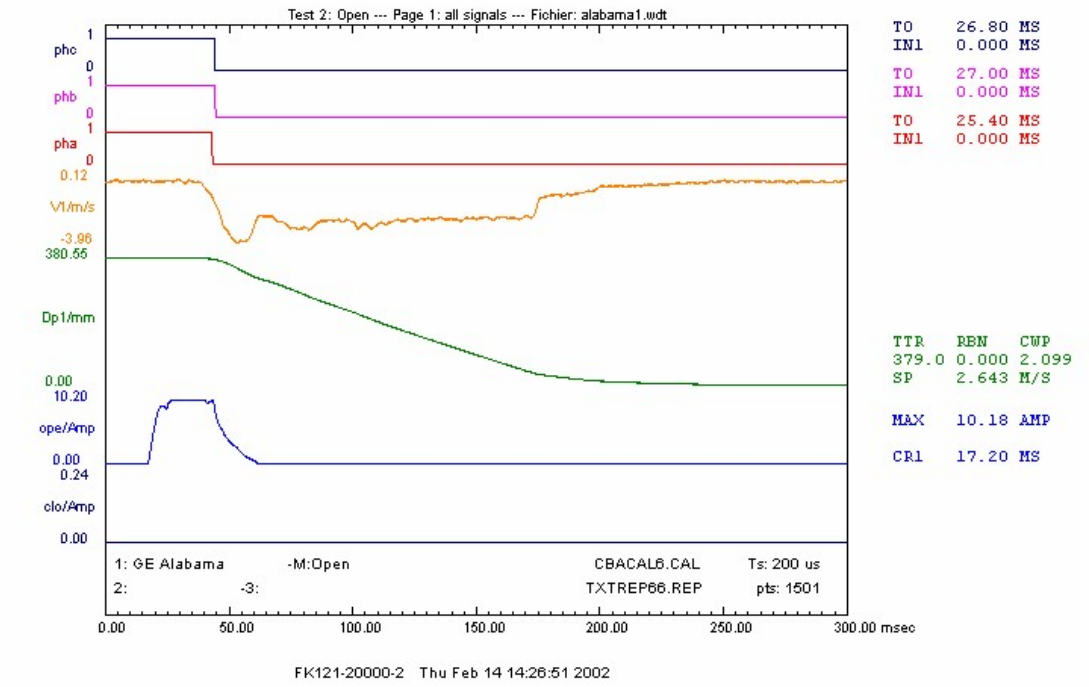
The KIT-ZLB linear kit used with a ZLT-600 transducer.

Test results on Close operation using CBA WIN software

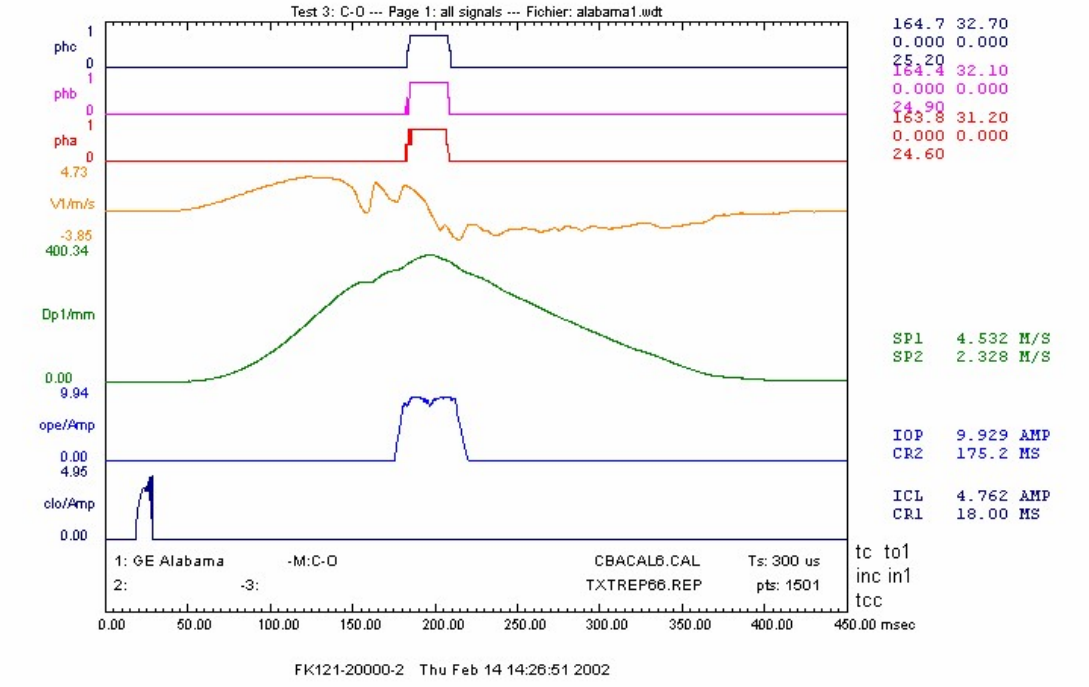


In these test results, in addition to the usual curves we can see the instantaneous velocity curve, drawn in orange on the graph.

Test results on Open operation using CBA WIN software



Test results on Close-Open operation using CBA WIN software

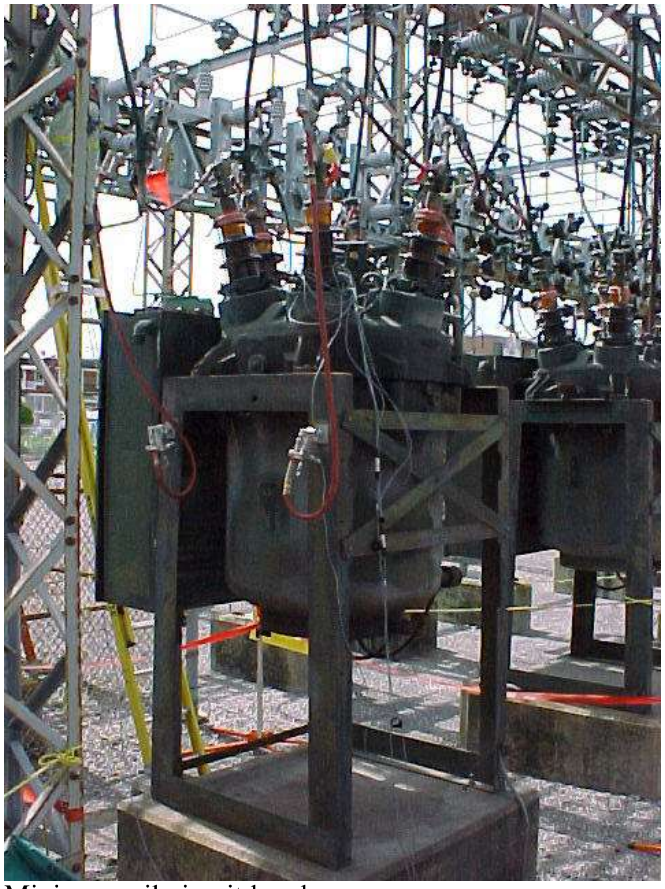


EXAMPLE 6 : BULK OIL BREAKER (tests performed in Québec, Canada)

Oil breakers are among the oldest types of circuit breakers on the market. Many are in service for over 50 years. Their reliability and simple operation account for their endurance. They are available in various sizes and voltage ratings.

The KIT-ZLB linear kit is usually used for this type of circuit breaker, along with a ZLT-600 linear transducer, since the total travel of this type of breaker is among the longest of all.

However, ZRT rotary transducers may also be used in combination with our KIT-ZLR linear-to-rotary motion converter. In the case of the rotary transducer, either the ZRT-03 or ZRT-05 transducers should be adequate for this purpose.



Minimum oil circuit breaker

Here, you will also find photographs of the inside of these breakers and their mechanisms.

Bulk oil breaker

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With a KIT-ZLB linear kit and a ZLT-600 linear transducer.

With a our KIT-ZLR linear-to-rotary motion converter and a ZRT-05 rotary transducer.

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EXAMPLE 7 : HPL BREAKER (tests performed in Québec, Canada)

The HPL breaker is manufactured by ABB, and exist in several models with different mechanisms.

In the mechanism shown below, it is obvious that a rotary-type transducer is required. The transducer must be attached to the rotating part of the mechanism. Each phase of the breaker has such a mechanism. So, 3 KIT-HPL rotary kits are necessary to measure the displacement of each phase.

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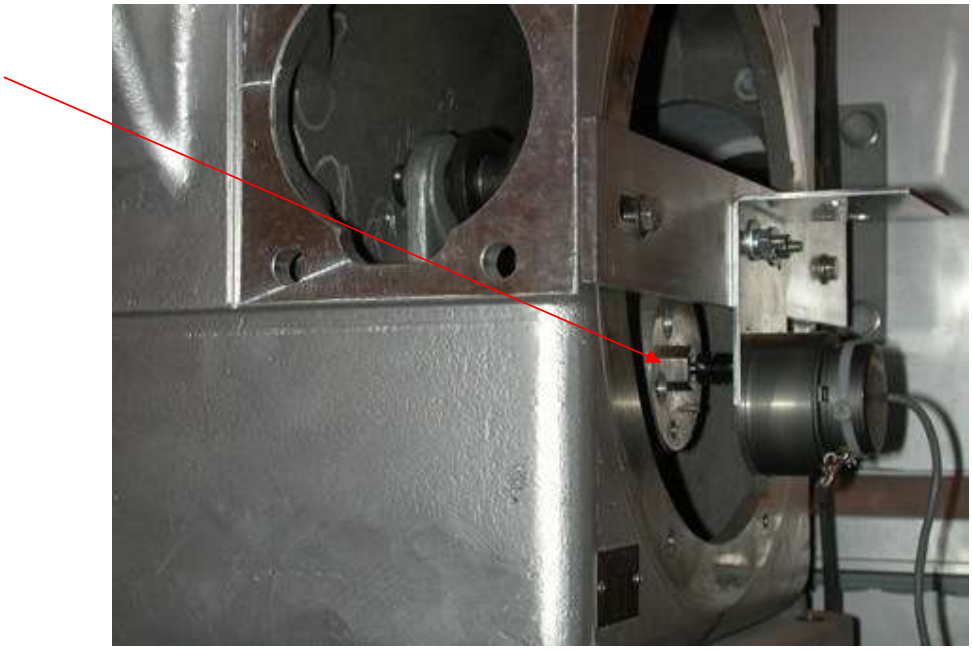
Here is an example of a mechanical base for a rotary transducer. As seen in the following photos, this base has unused holes and angles that can be used in other types of breakers.

Face-on view

Side view



The bolt, as well as the coupler that connects the transducer to the breaker's mechanism, are supplied with the KIT-HPL.

EXAMPLE 8 : T-TYPE HPL BREAKER (BLG MECHANISM) (tests performed in Québec, Canada)

The HPL breaker shown here is completely different from the one in the preceding example.

The photo below shows the mechanism in the lower part of the HPL breaker. Three KIT-HPL rotary kits are required to measure all three phases of the breaker.

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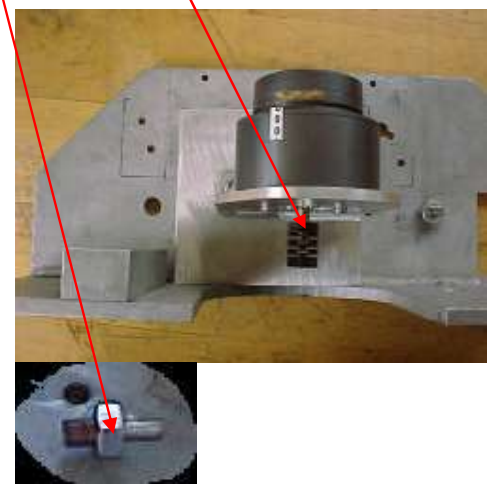
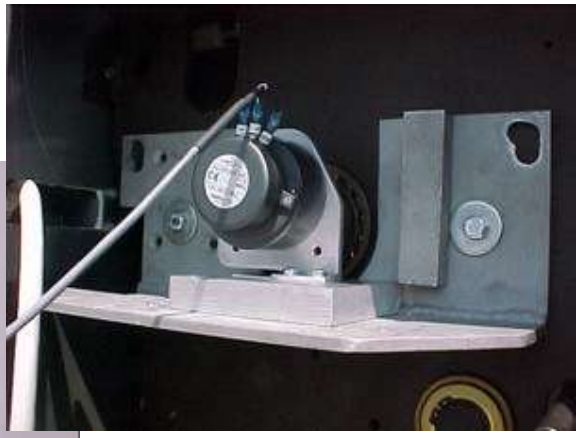
Ci-dessous les photos de l'embase utilisé pour se positionner. (note : l'embase actuelle a été remplacée par l'embase simplifiée présentée dans l'exemple 7).

In these photos, we can more clearly see the bolt and the coupler mentioned in example 7.



The kit as mounted on the breaker :



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EXAMPLE 9 : GFX BREAKER (tests performed in Québec, Canada)

The GFX breaker is manufactured by AREVA. It is a cold-weather version of the FX-type breaker. Hydro-Québec has developed its own mechanical base for this breaker.

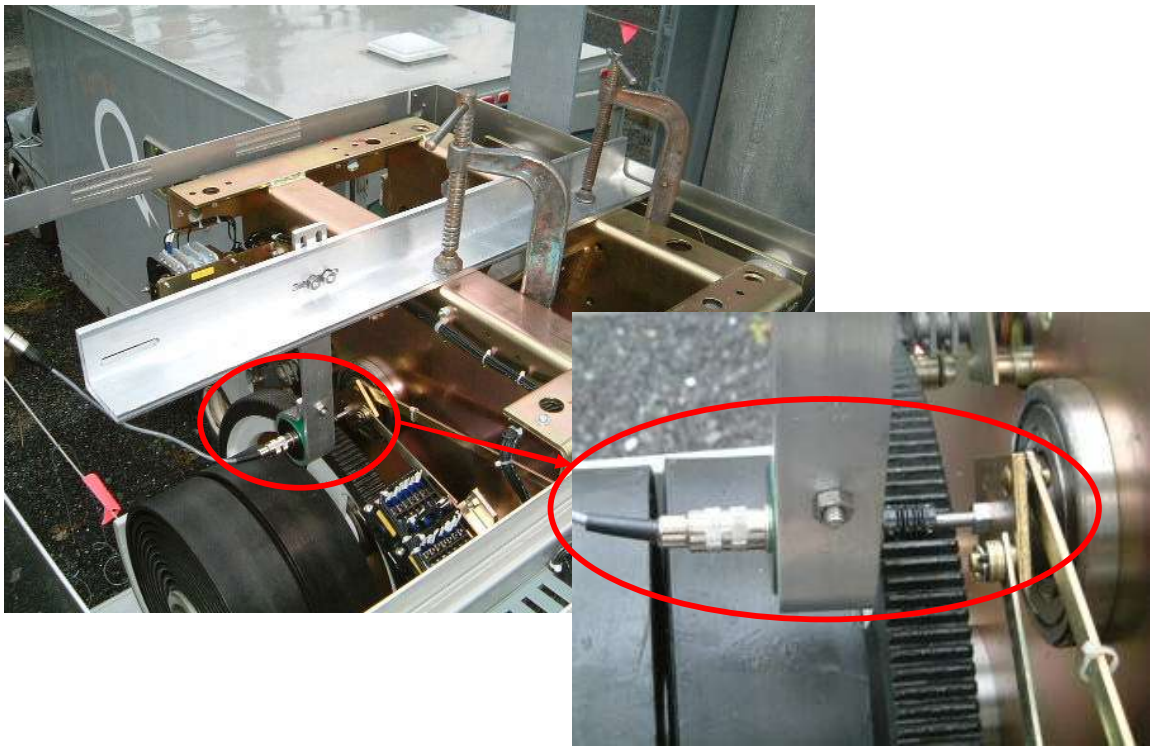
The measurement displacement done here is part of dynamic contact resistance measurements of the breaker's main contacts, using the KIT Z-DRM-2 along with the CBA-32P circuit breaker analyzer, in order to detect defects in the breaker's contacts without having to open each one of them.

Once again, the ZLT linear transducer is used with a mechanical base and a coupler specially made for this breaker by Hydro-Québec.

Since each phase has its own mechanism, each requiring its own kit, three kits are required in total.

EXEMPLE 10 : TYPE-T GL BREAKER (tests performed in Québec, Canada)

Here is another type of GL breaker: it will only work with ZRT rotary transducers. The mechanical base (one per phase) shown below was specifically developed by Hydro-Québec for this type of circuit breaker. The bolt and the coupler required to link the transducer to the breaker can be seen here. Three kits are required, one for each phase.



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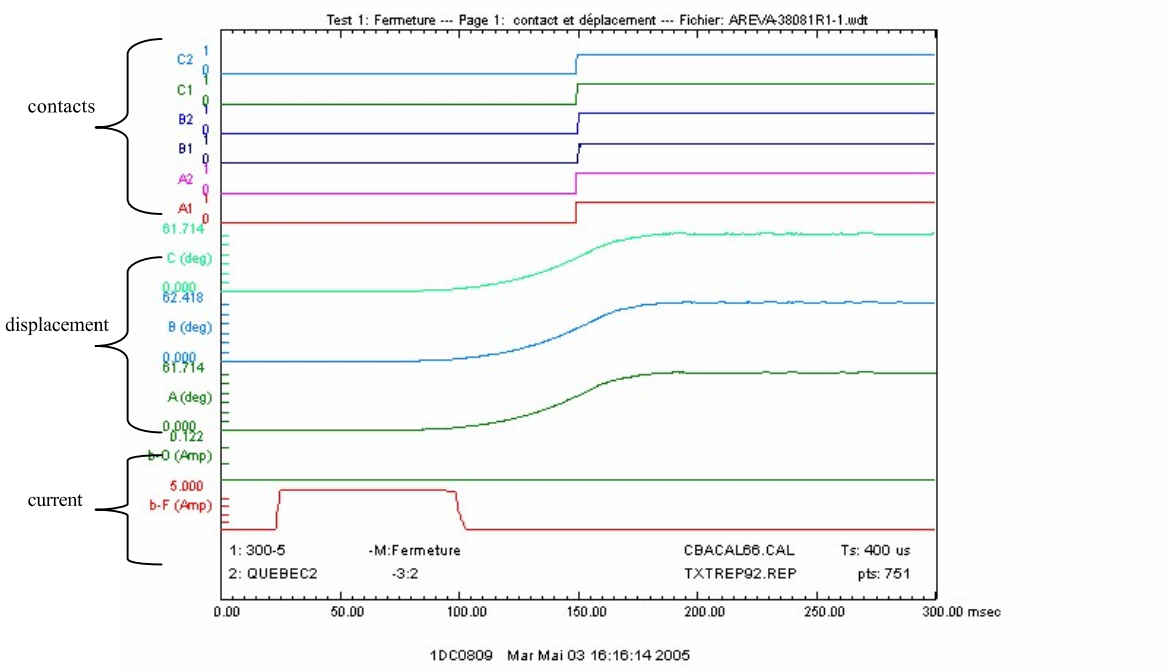
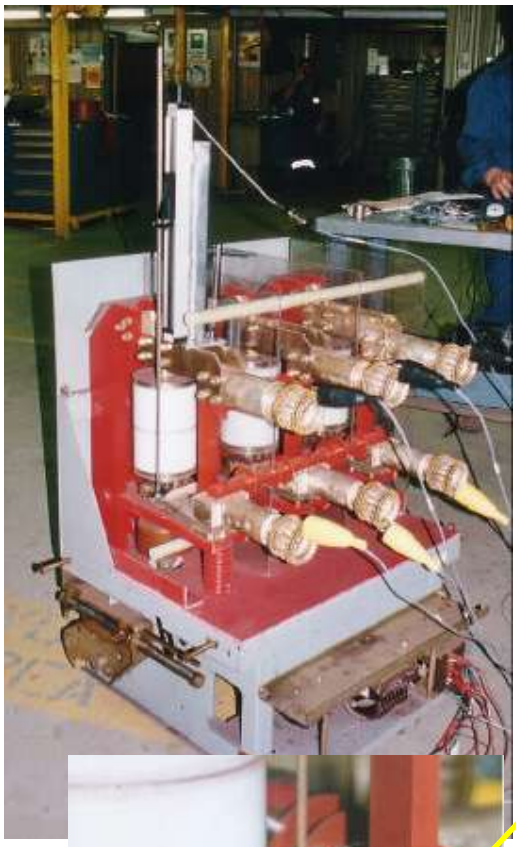
Typical test results from a Close operation on a GL breaker as shown above:

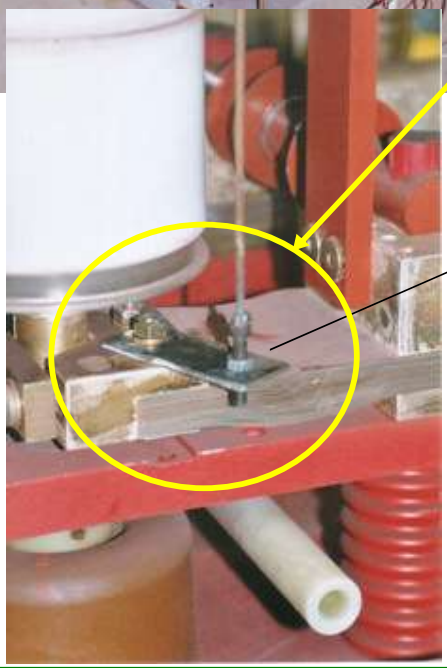
This GL215 has two contacts per phase, for a total of six contacts, and one mechanism per phase, giving three displacement curves. Everything is clearly shown on the graph below:



EXAMPLE 11 : ABB BREAKERS (tests performed in Labrador, Canada)

The breakers shown here are widely used by industrial customers such as aluminum factories, mines, paper mills, etc. The three phases are visible. The transducer was installed on top of the breaker with a minor adaptation, as shown in the following photos.





The displacement of this breaker is very small (less than ½ inch).
The rod was attached to the breaker with a simple steel plate.

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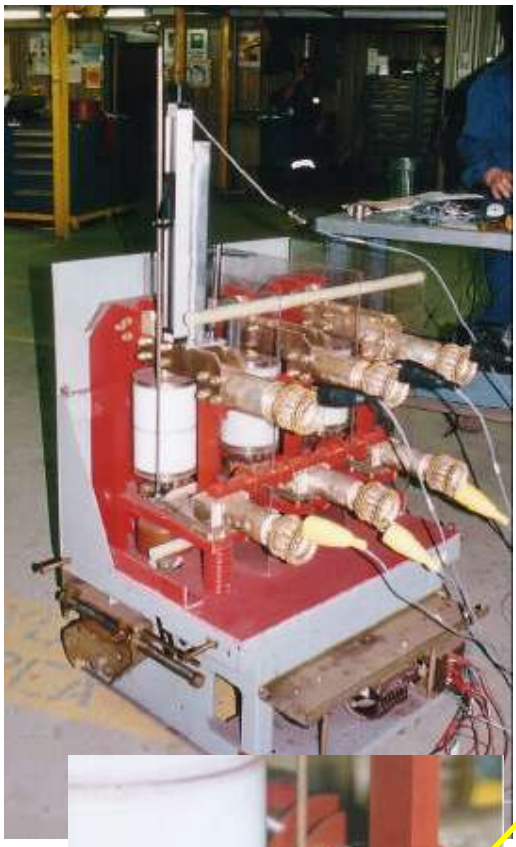
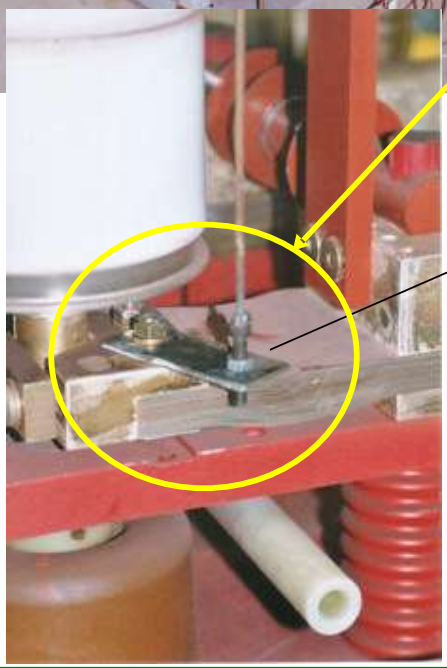
EXAMPLE 12 : MAGNA BLAST BREAKERS (tests performed in Labrador, Canada)

The breakers shown here are widely used by industrial customers such as aluminum factories, mines, paper mills, etc. The three phases are visible. The transducer was installed on top of the breaker with a minor adaptation, as shown in the following photos.





The displacement of this breaker is very small (less than ½ inch).
The rod was attached to the breaker with a simple steel plate.

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EXAMPLE 13 : MOUNTING EXAMPLE WITH A MAGNETIC BASE (tests performed in Québec, Canada)

This base is ideal for small distribution-type or low-voltage breakers.

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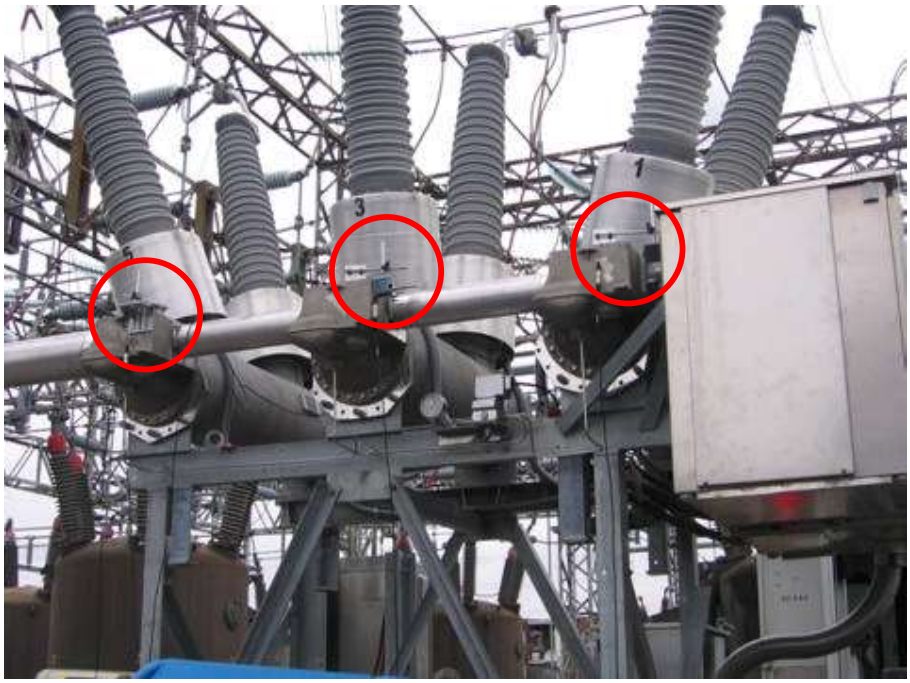
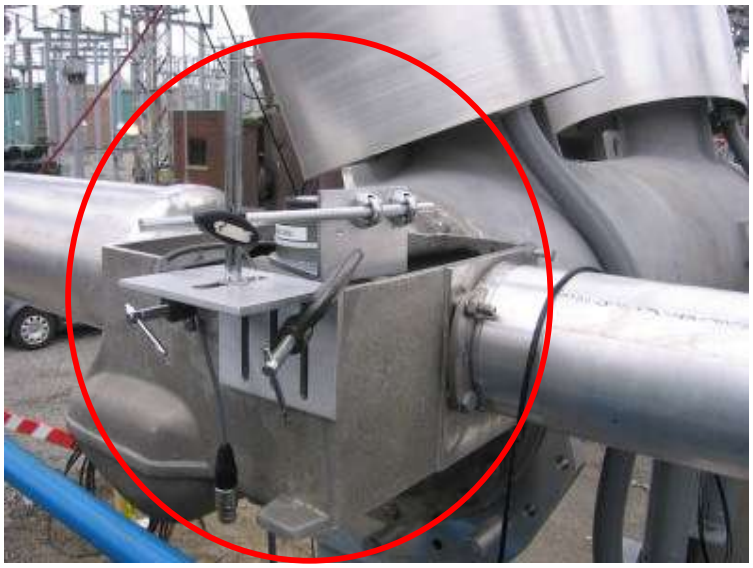
EXAMPLE 14: HGF DEAD TANK BREAKER BY AREVA (QUÉBEC, CANADA)

This breaker is a new type by AREVA. It required the use of three ZRT rotary transducers. The mecha nical base (one per phase) shown below is a combination of our KIT-HPL and some clamps. Also, Hydro-Québec has fabricated a special coupling for this breaker, which will be left in place on the breaker for future tests. Three kits are required, one for each phase.27





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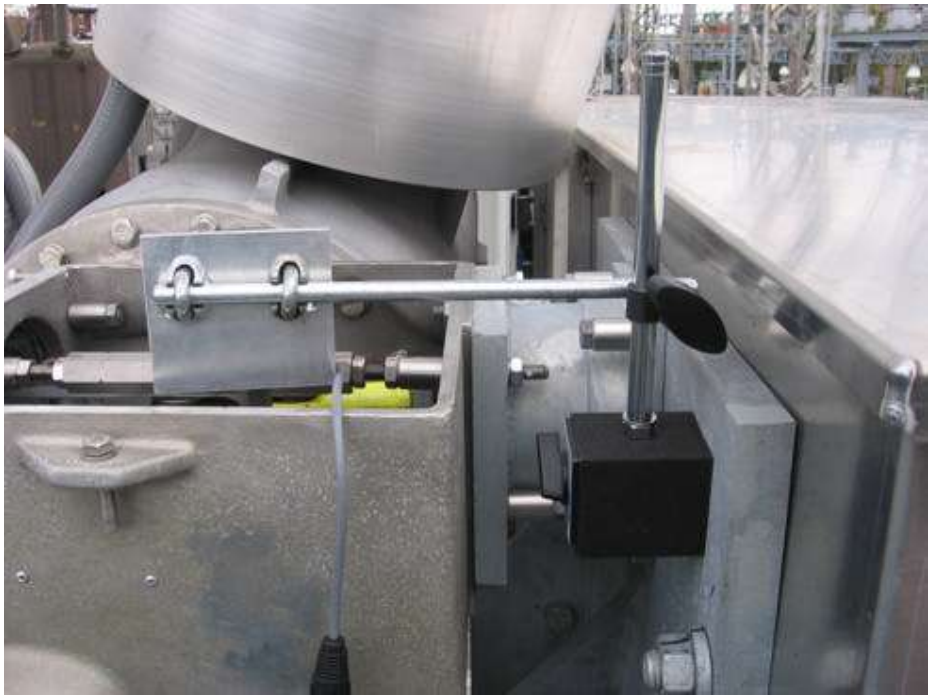

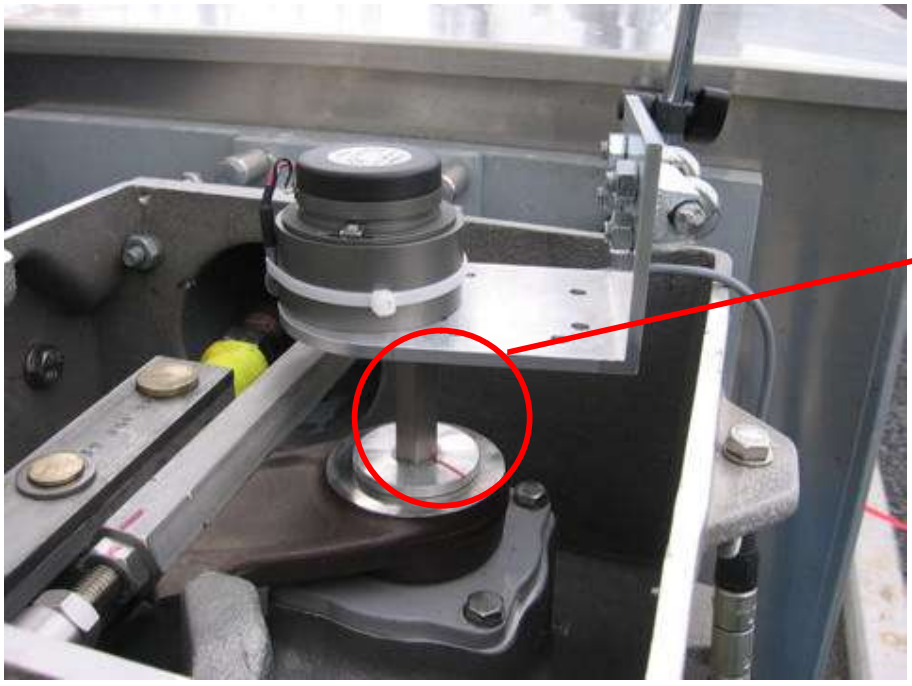

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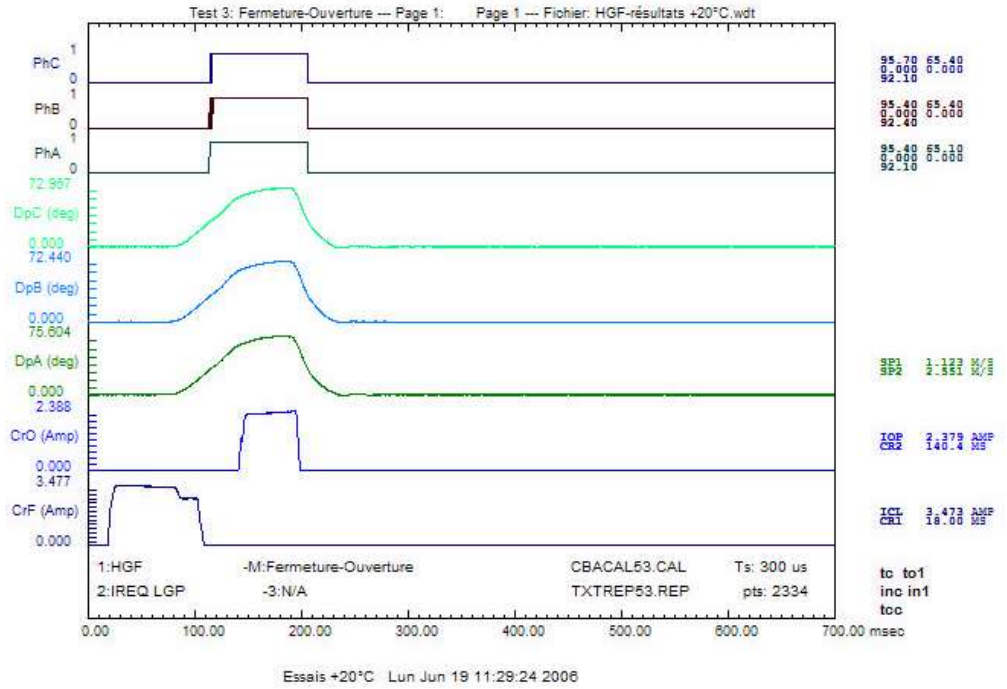
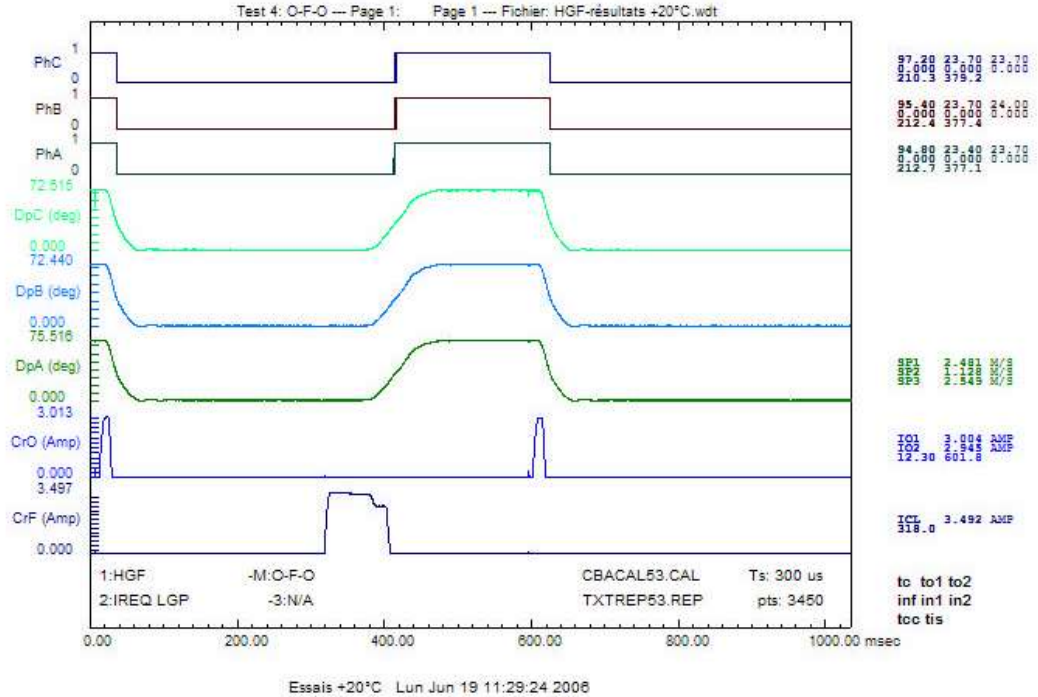
Results obtained on Close-Open operation with the CBA WIN software.



Results obtained on Open-Close-Open operation with the CBA WIN software.



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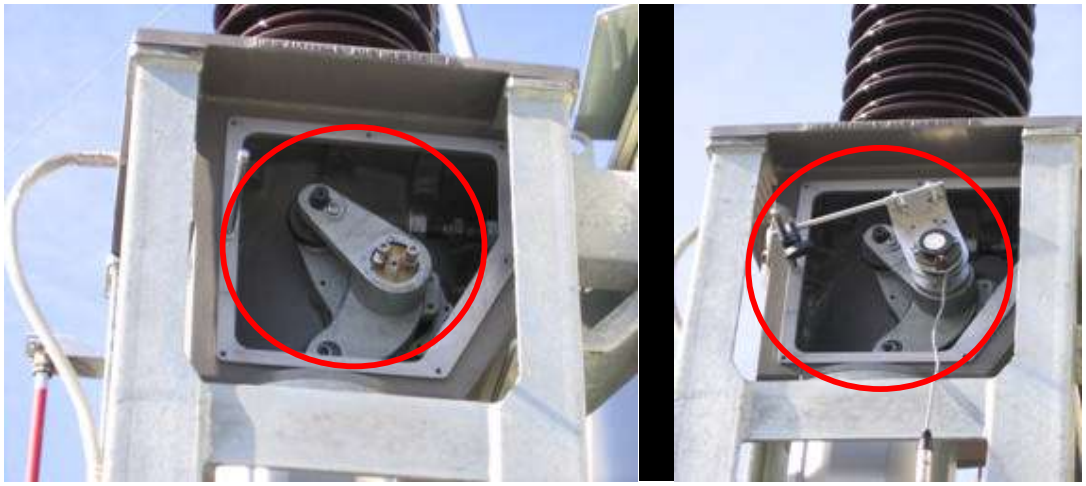
EXAMPLE 15: HPL 245 BREAKER FROM ABB (QUÉBEC, CANADA)

On this SF6 breaker from ABB, during the displacement measures, two parametres are verified : the contact's displacement and the damper's closing displacement. Two rotary transducers per phase are then needed : 1 for the contact and 1 for the damper. The mechanical base of the damper uses a combination of our ZMS magnetic base with our HPL-KIT base. The two bases implies the use of a blot specificly created for this test and a coupling piece.

General view of the breaker

Moving parts of the breaker



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Damping part of the breaker (It is found behind the metal box)

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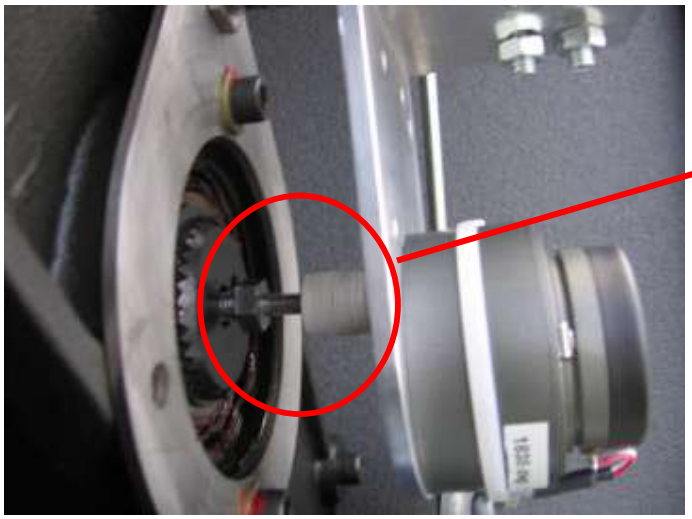
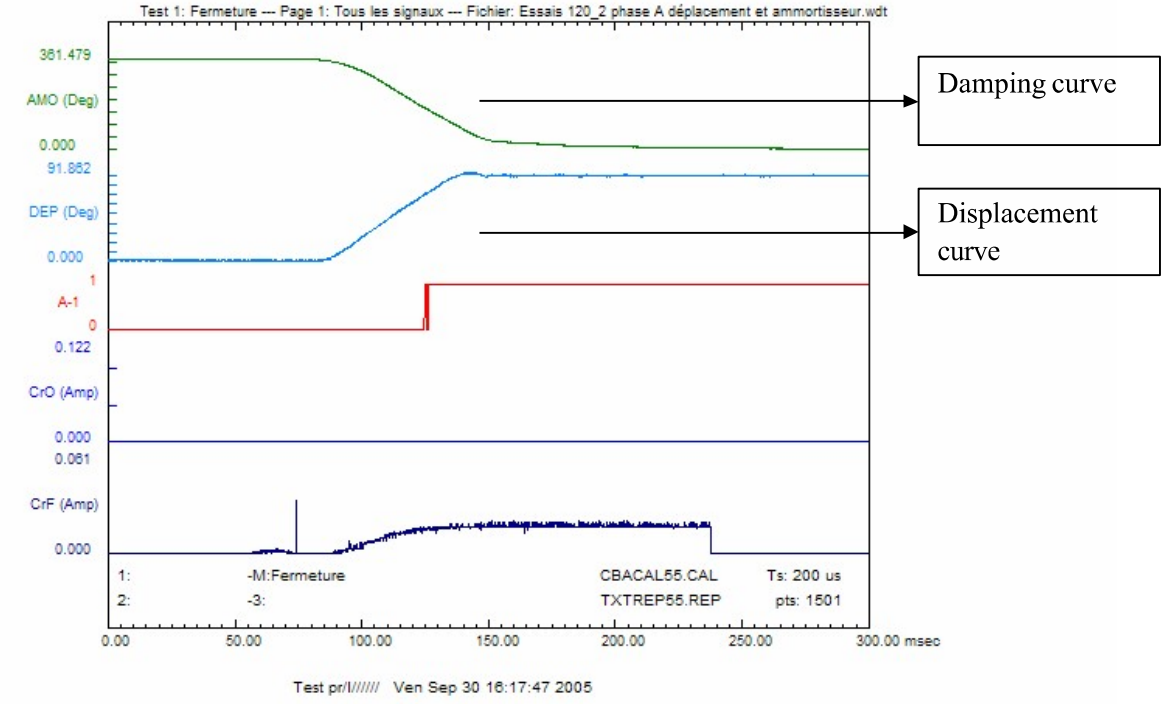
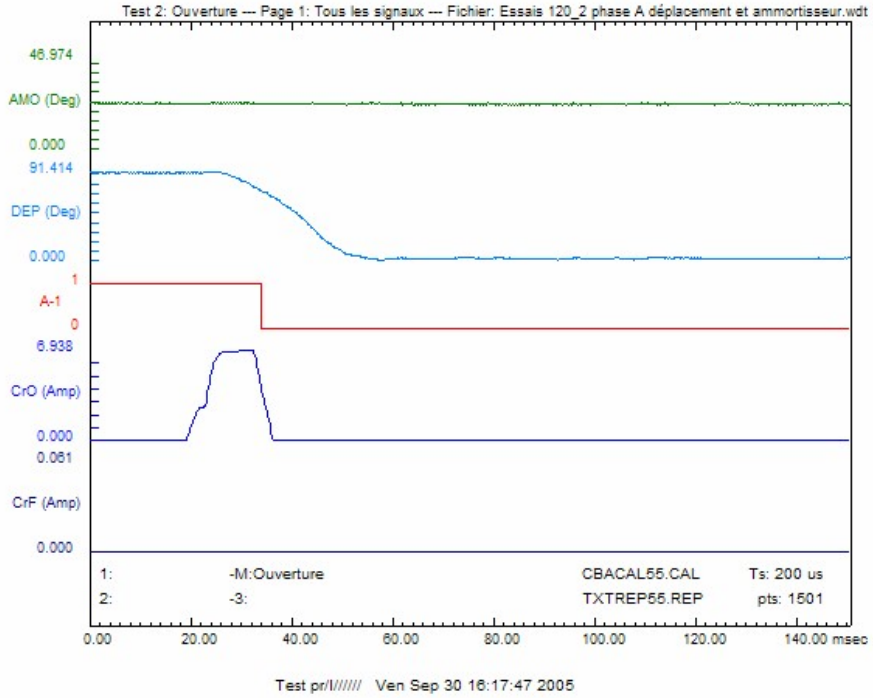


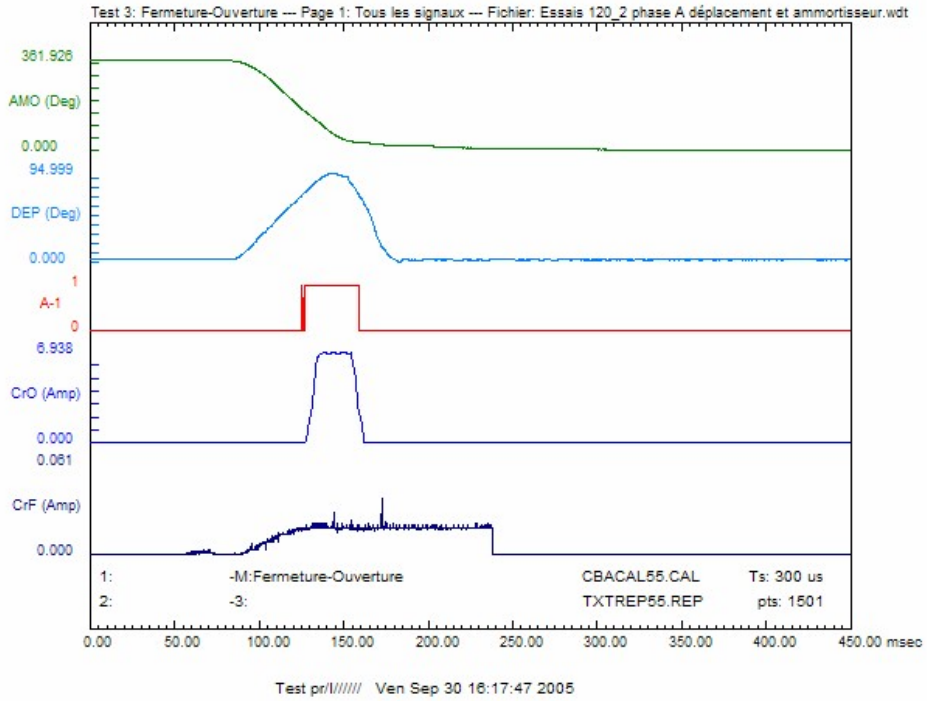
Results from a CLOSE with the software CBA WIN



Results from an OPEN with the software CBA WIN



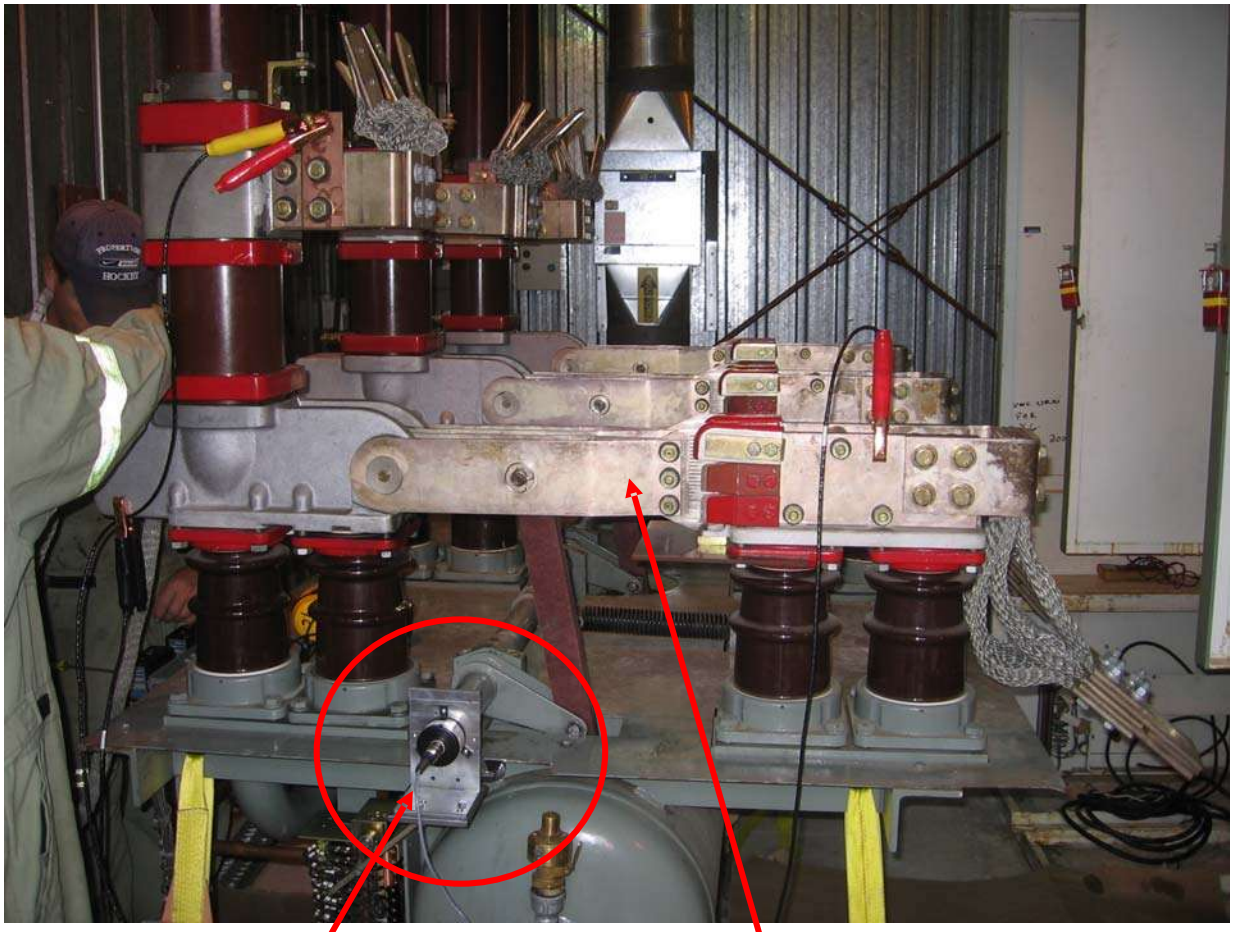
Results from a CLOSE-OPEN with the software CBA WIN



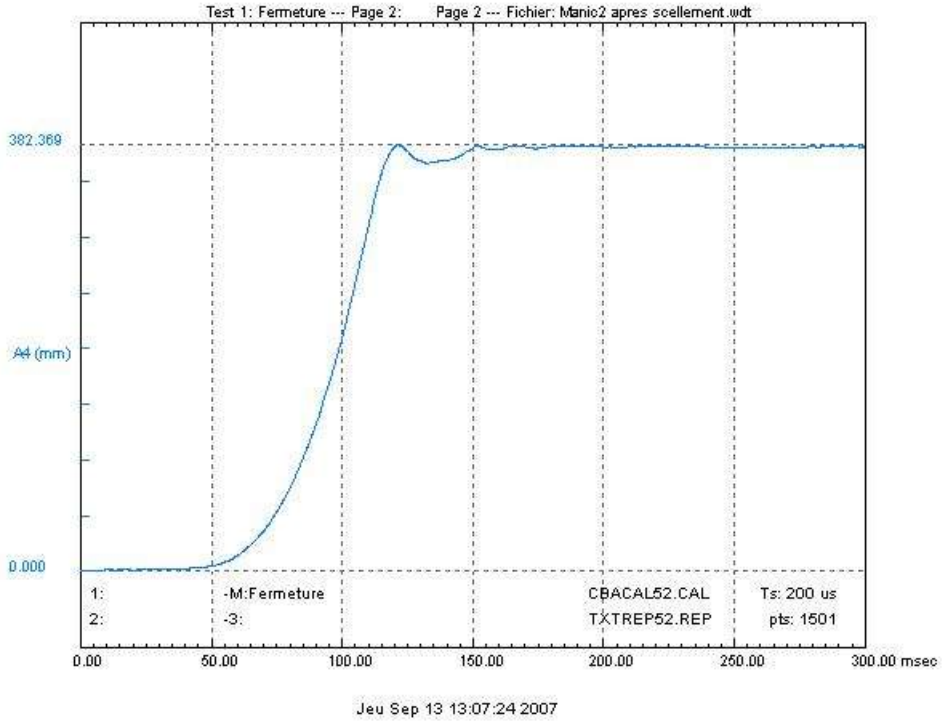
EXAMPLE 16: DB BREAKER FROM WESTIGHOUSE (QUEBEC, CAADA)

Measuring the travel of the blade can be critical on DB breakers. If the blades are not well aligned or move too fast, it can result in breaker damages which can be costly to repair.

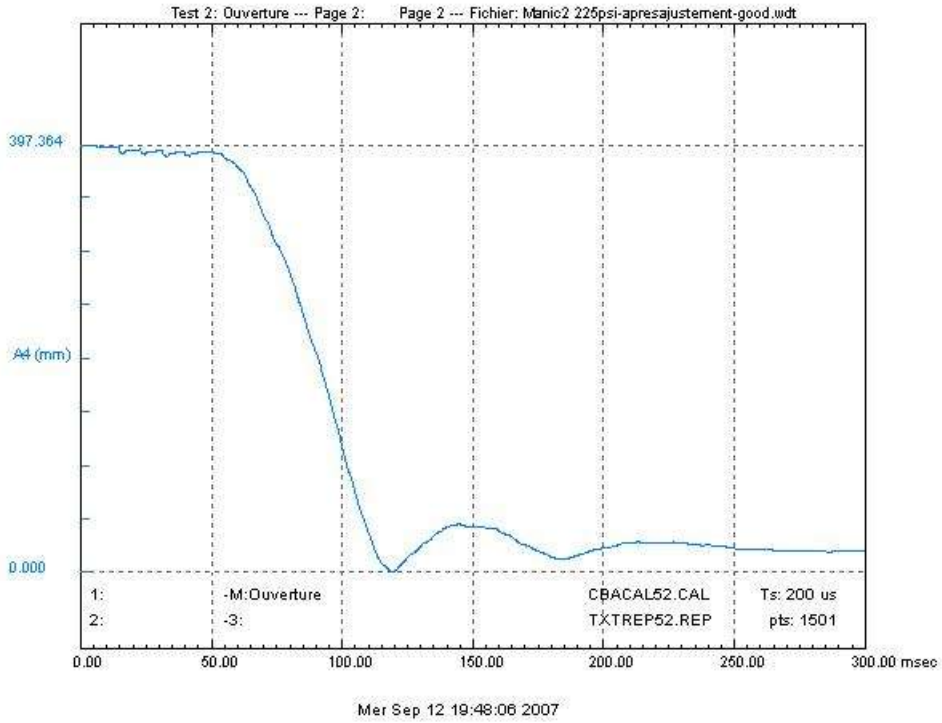
On this air blast breaker, the travel measured is represented by the movement of the blades. Our rotary transducer ZRT must be positioned directly aligned with the breaker rotary axis as shown below.



Here is the measured travel curve at the close operation.



Here is the measured travel curve at the open operation.



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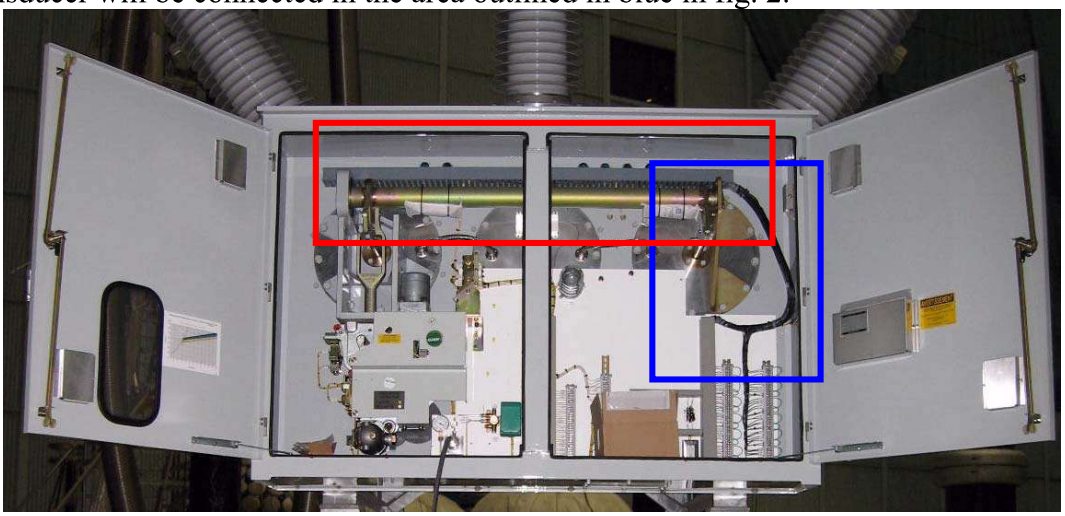
EXAMPLE 17: SFMT DEAD TANK BREAKER BY MITSUBISHI (TEST PERFORMED IN QUÉBEC, CANADA)

(**Fig 1**) Circuit breaker

This 3 contact dead tank breaker manufactured by Mitsubishi has one contact per phase. The travel mechanism of this breaker is common to all three phases (see red rectangle in fig.2). Only one single transducer is required to measure the breaker travel. This transducer will be connected in the area outlined in blue in fig. 2.



(**Fig 2**) Mechanism

Measurement of the travel and velocity is part of the regular maintenance required by the

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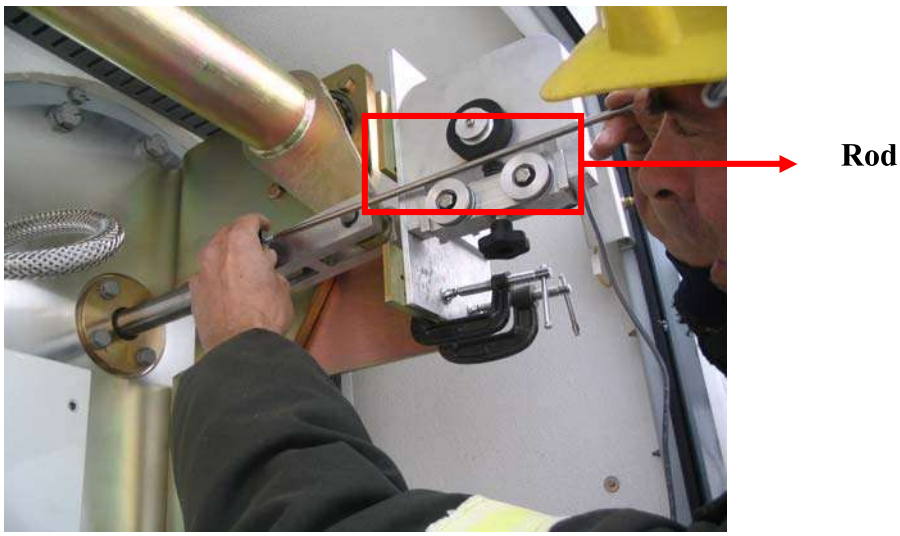
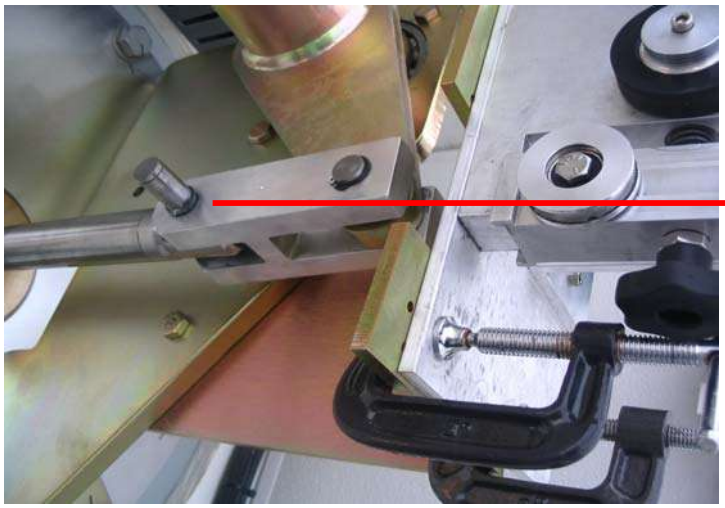
manufacturer on this breaker.
The contacts move in a linear motion. For this, we can use either a **rotary transducer** or an **optical encoder** connected to our linear to rotary converter **KIT-ZLR** used in conjunction with the **bracket** supplied by the manufacturer (shown in fig. 3).

(**Fig 3**) Bracket

To this **bracket** we connect our KIT-ZLR. A rod directly attached to the breaker mechanism will be connected to the three wheels of our KIT-ZLR.



(**Fig 4**) Rod



(**Fig 5**) Coupling piece

(**Fig 5 Bis**) Coupling piece

As for all breakers with linear movement, we are going to connect a **rod** to the breaker mechanism fig 4 thanks to the **coupling piece** shown in fig 5bis

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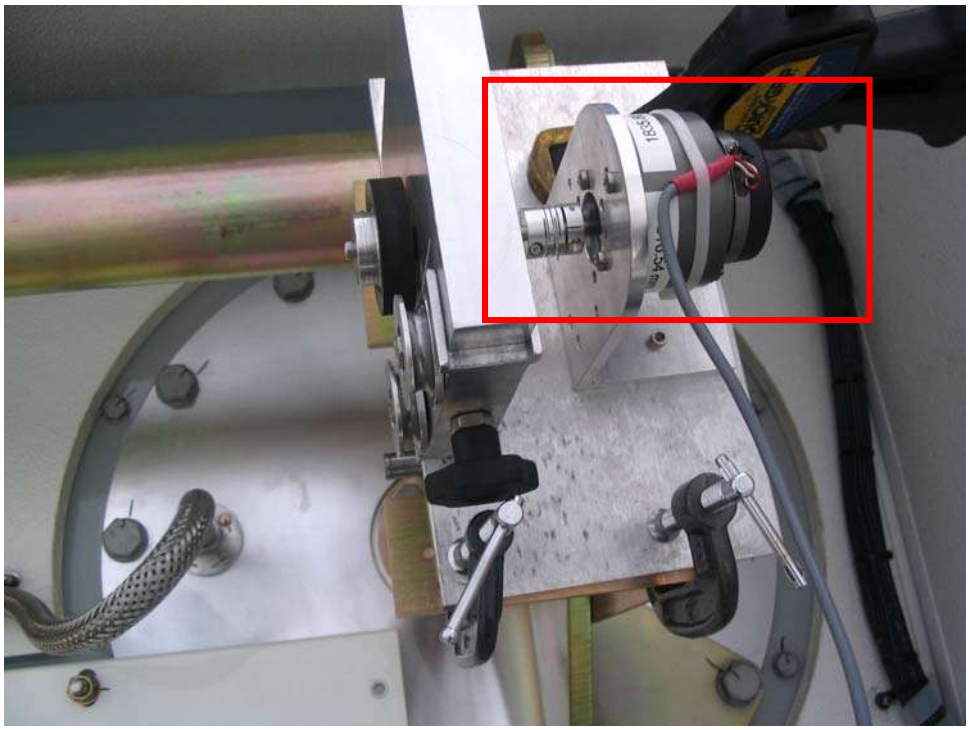
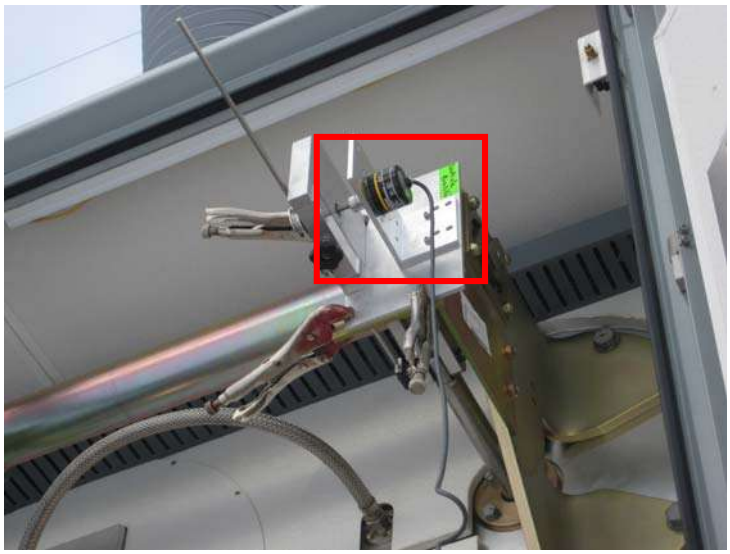
Final mounting

with **rotary transducer**….



(fig 6)

…with **Optical Encoder**



(Fig 6 bis)

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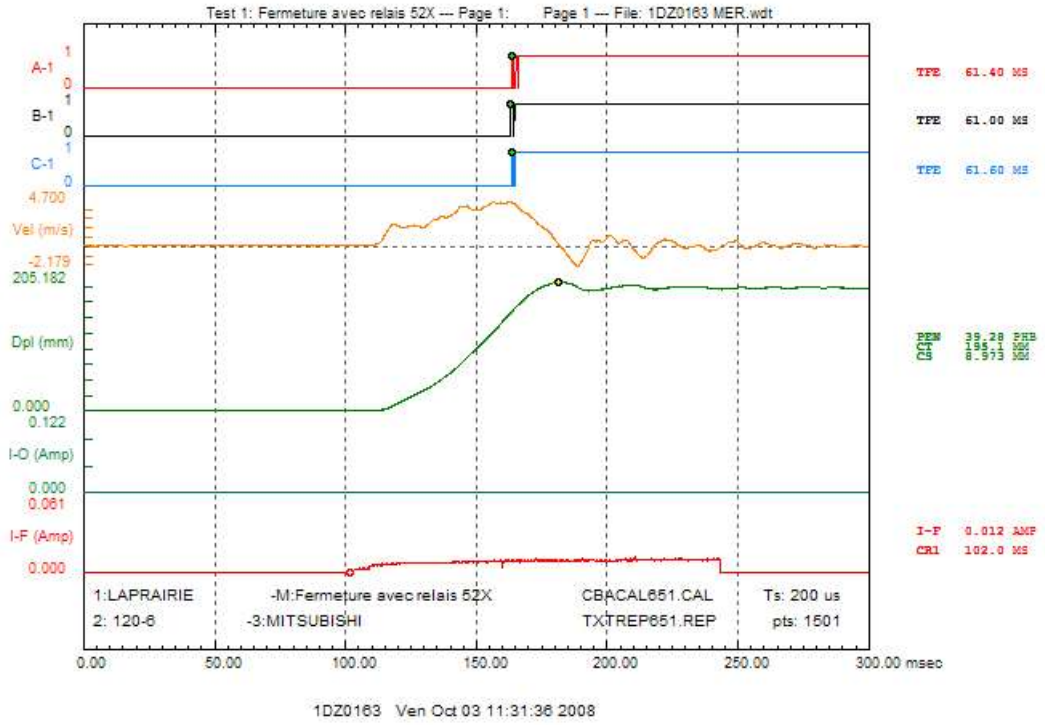
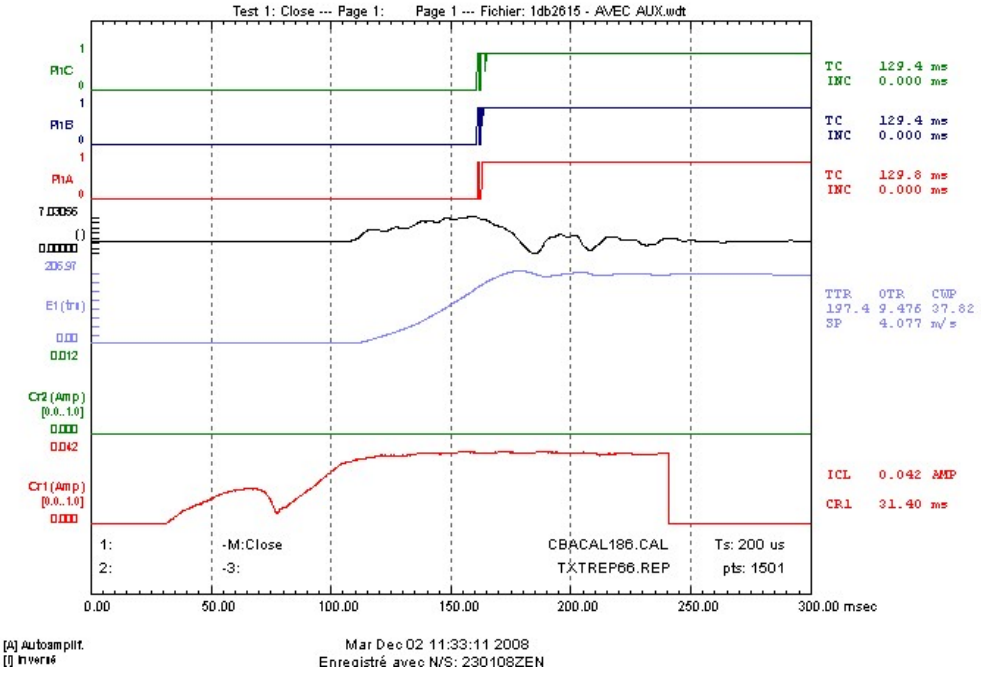
Results obtained on Close operation with the CBA WIN software.

Below you will see two examples of the Close test done with the two types of transducers. As you can see, the travel curves are almost identical.

With Rotary transducer



With Optical encoder



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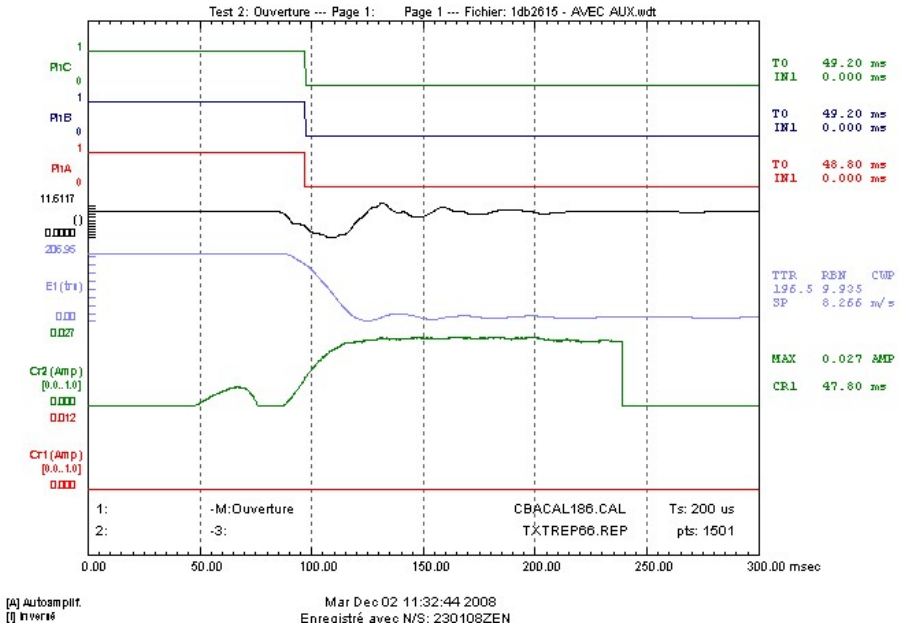
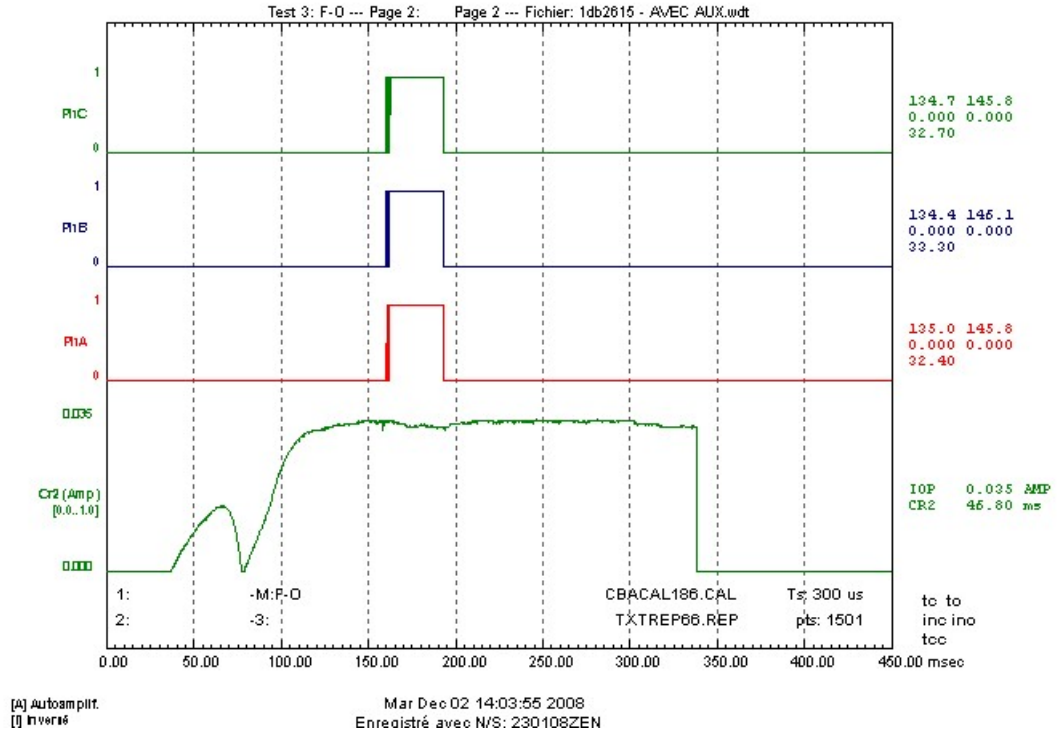
Results obtained on Open operation with the CBA WIN software.

With optical encoder



Results obtained on Close-Open operation with the CBA WIN software.

With optical encoder



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