# Vibro-acoustic test procedure for tap changers (OLTP)

**Version 0** **Rev.0**

**December 17, 2009**

Cette version est une version préliminaire et temporaire pour **diffusion très limitée**.
Cette version fait référence au logiciel DIAC dont le développement est arrêté par Hydro-Québec.

Le logiciel OpenZen - Zensol (issu de nos logiciels existants CbaWin, GenWin, CbvWin, etc., copyright 1992 à 2009) remplacera DIAC totalement à court terme.

Il sera donc nécessaire de réviser et de corriger cette version, en supprimant notamment toutes les références à DIAC et en les remplaçant par les références équivalentes à OpenZen.

Merci de me contacter directement pour tout commentaire (bon ou mauvais), toute nouvelle idée, ainsi que toute suggestion d'amelioration de ce document ou du logiciel OpenZen et ces documents associés, dans le but ultime de l'obtention d'un logiciel et d'une documentation claire et pratique pour vous et tous nos utilisateurs. Tous vos retours d'information seront très appréciées.

Vous remerciant par avance pour votre collaboration,

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This version is a draft and temporary version for **limited distribution ONLY**.
This version refers to DIAC software whose development by Hydro-Québec is stopped.

The OpenZen – Zensol software (based on our existing softwares CbaWin, GenWin, CbvWin, etc., copyright 1992-2009) will completely replace DIAC in the short term.

This version needs to be reviewed and corrected by Tap-Changer specialists. Among other things, all references to DIAC software will be replaced by their equivalents in the OpenZen Software.

Text in red requires special attention and will be corrected.
If you want the original version of this text, please download the French document.

Please do not hesitate to contact me directly for any comment (good or bad), any new idea, or any suggestion regarding the improvement of this document or the improvement of the OpenZen software and any of its related documents, in order to ultimately obtain clear and useful documentations for you and all of our users. All of your feedbacks will be appreciated.

Thank you for your cooperation.

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# 1. Initial installation of probes

## 1.1. Installation of probe holder

### a) Choosing the location for measuring the noise

The acoustic measurement must be performed in normal service, and must choose an accessible location when the transformer is energized. The probe holder must be installed so that the measure could be made at all time respecting the distances of approach. In addition, the probe holder allows ensure that the measurement is always made at the same location.

In general, for "bolted to the main tank" OLTPs (e.g. ABB-UZ), the recommended position is inside the tank and for "internal" OLTPs (e.g. ABB-UC models and Reinhausen) the recommended position is located approximately 15 cm below the flange lid of the main tank.

The criteria for determining the proper location to install the probe holder are:

> Distances of approach: The probe holder must be mounted so that the measure could be made at any time respecting the distances of approach.
>
> Near the internal moving parts: The quality of the acoustic signature is affected by the distance of propagation of the wave to the probe. A rule of thumb therefore tells that the best location is nearest to the internal moving parts, if possible.
>
> Under the oil level: C Some compartments of tap changers include gas cushions in the upper part. For these models it must be ensure that the probe is located under the oil level to ensure a good transmission of part of the sound waves that propagate through the oil. This precaution does not apply to the compartment of switches of ABB-UC and Reinhausen types.
>
> Near structural elements: Tests have shown that is preferable to position acoustic probes near rigid structural elements (beam reinforcement flange) and to avoid the center of large plates. It recommends a distance approximately of 15 cm between the probe and the edges of the plate. Moreover, the probe should never be installed on a door compartment.

**Appendix I** presents the recommended positioning of probes according to the type of tap changer. There are exceptions where special configurations must be used due to the internal layout of the tap changer.

### b) Fixation of the probe holder

The vibro-acoustic probe (accelerometer) is installed only during the measurements. However, the probe holder is stuck in permanently on the wall of the transformer so as to maintain an identical position in each measure, and collect data consistent and comparable. The vibro-acoustic probe is screwed in the probe holder for time measurement.

The installation of the probe holder must be on a clean surface using a cleaning agent and lightly polished (Scotch Brite) to eliminate all wrinkles. It is not necessary to stick directly the probe holder in the metal of the tank. On the other hand, the paint or the finishing surface needs to offer a proper adherence (no rust, blister or roughness) – **Figure 1**.

**Figure 1** : Fixation of the probe holder.

*It is not necessary to polish the surface to the metal unless the paint is in poor condition. A degreasing and a light sandblast usually is enough for a good paint.*

The glue provided is of cyanoacrylate type. If necessary, equivalent products (Loc-Tite 401, Krazy Glue) can be used. For lower temperatures (-10 °C), this adhesive may have difficulty in crystallize. It should then choose a type of glue suitable or prepare the surfaces by heating.

## 1.2. Installation of the identifier of the supply of the OLTP

The installation of the current probe can usually be done directly one of the wires of supply of the motor of the OLTP, but occasionally one can use the main connector block. After the initial report, it is advisable to identify the wire used and mark it using a label for future tests.

On some models (e.g. GE and Ferranti), the motor is used as a brake and the choice of phase can strongly influence the shape of the signature at the end of operation. For these cases, we must place particular attention on choosing the right wire for the measure with the reference guides provided with the vibro-acoustics instrument.

# 2. Installation of the probes for the measurement

## 2.1. Installation of the accelerometer

The accelerometer used is a high performance instrument very reliable but on the other hand is expensive and fragile; a strong impact (e.g. fall) can damage it irreversibly. Its manipulation therefore requires certain precautions in all phases of the test so you don't damage it.

The small connection cable (Microdot) is also fragile and it is necessary to avoid leaving it connected to the probe during its handling and secure the largest cable firmly (BNC) to a fixed point on the tank.

On the other hand, the tightening of the accelerometer to the support plate should not be done with a tool to avoid damaging the threads. **A slight tightening by hand is sufficient** to apply the contact pressure required between the surface of the probe and the plate.

## 2.2. Using the pole for the installation of the accelerometer in height

On some models of OLTP, the probe holder must be installed in height and requires the use of an upward means. In order to facilitate the installation of the probe on the probe holder from the ground, a special pole was specially designed (**Figure 2**).


**The pole for the installation of probes can NOT be isolated.**

The pole is provided with a torque handle (**Figure 3**), a tightening torque of 0.55 Nm is recommended, while for release, the recommendation is 0.70 Nm.

**Figure 2 :** Pole designed for installation of the accelerometer in height.

**Figure 3** : Grip of the pole for adjusting the couple

### 2.3. Installation of the current clamp

The clamp must be completely closed around the wire (good contact between the two jaws of the ferrite, see **Figure 4**). A clamp badly closed will give a similar shape measurement but of reduced amplitude, therefore must pay attention to the current level measured. For reference, the amplitude is normally expected to exceed 1A.

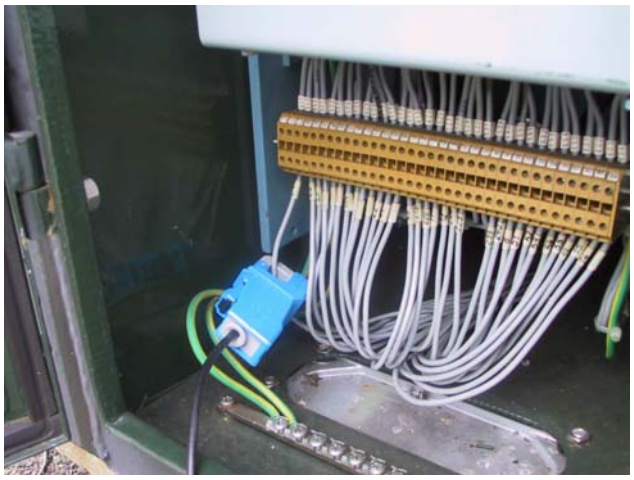

**Figure 4** : The clamp can be installed on a wire identified by the terminal block or near the motor as long as the wire is marked for subsequent measurements.

# Appendix I: Location of the acoustic probe

**Table 1:** Location of the probe according to the type of OLTP

| Manufacturers and model families | Type de tank | Probe location |
|---|---|---|
| ABB UCC<br>ABB UCB<br>ABB UCD<br>ABB UCG<br>ABB UCL<br>Reinhausen (All except RMV-II)<br>GE CLR100<br>AEG ARSD | Single cylinder<br>**(Figure I.1)** | An accelerometer in the center of the compartment and 15 cm below the flange of the lid. |
| | Multiple cylinders – single tank<br>**(Figure I.2)** | An accelerometer in the center of the compartment and 15 cm below the flange cover. |
| | Multiple Cylinders – separate tanks<br>**(Figure I.3)** | An accelerometer on each tank in the same manner as for a single cylinder. |
| ABB UZ<br>Reinhausen RMV-II | Single compartment<br>**(Figure I.4)** | An accelerometer in the bottom plate, in the center of the compartment and 15 cm from the connection flange to the main tank. |
| GE (All except CLR100)<br>Federal Pioneer<br>Ferranti Packard 25RT32 &<br>34 RT32 &<br>RT32 Reactive<br>Moloney<br>Westinghouse | Single compartment<br>**(Figure I.5)** | If the probe can be installed under the bottom plate, install the accelerometer on the right side wall at 15 cm from the flange to the main tank |
| ABB UTB<br>Federal Pioneer TC546<br>Ferranti Packard 69RT32 &<br>138RT32 | Multiple compartments (e.g. the switch and selector placed in separate tanks.<br>**(Figure I.6)** | An accelerometer on the tank of the selector at 15 cm from the flange to the main tank |

1. **Type of Tank: Single Cylinder**

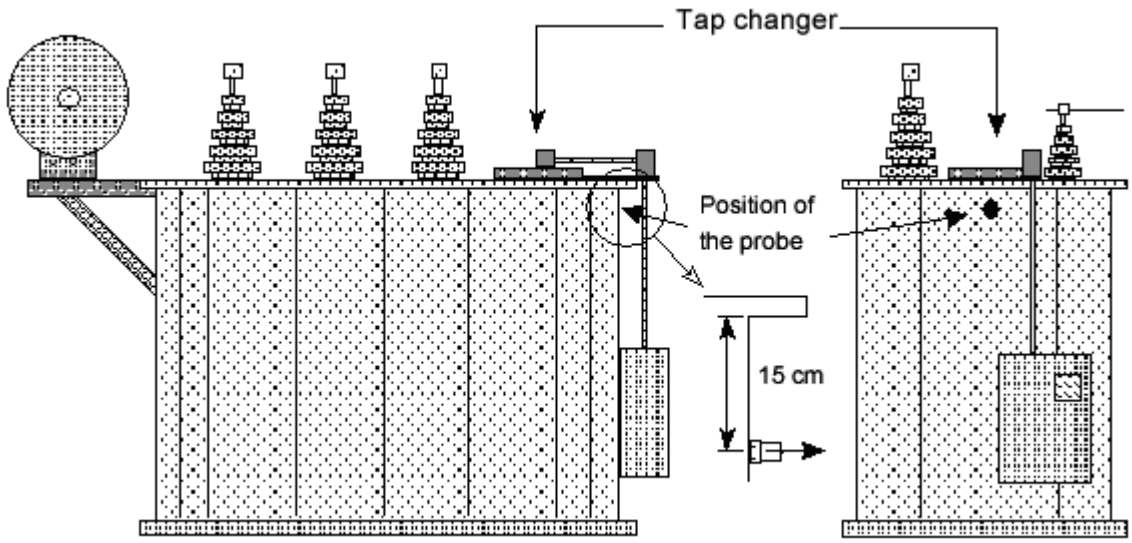


**Figure I.1:** Reinhausen and ABB UC OLTPs where the cylinder is within the main tank.

2. **Type of Tank: Multiple cylinders in a single tank**

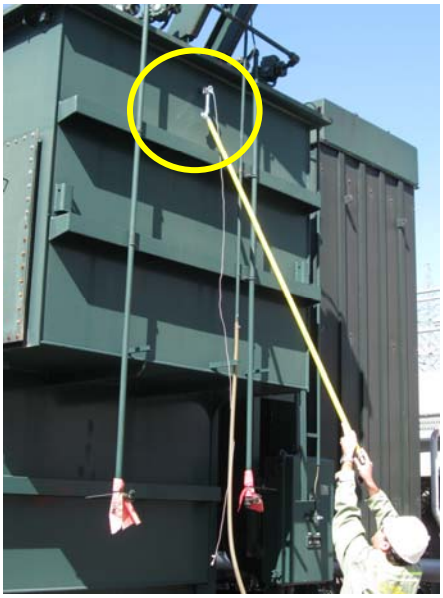

**Figure I.2:** Multiple cylinders in a single tank.

### 3. Type of Tank: Multiple cylinders in separate tanks


**Figure I.3:** ABB UCD with cylinders multiple in separated tanks

### 4. Type of Tank: Single Compartment (I)

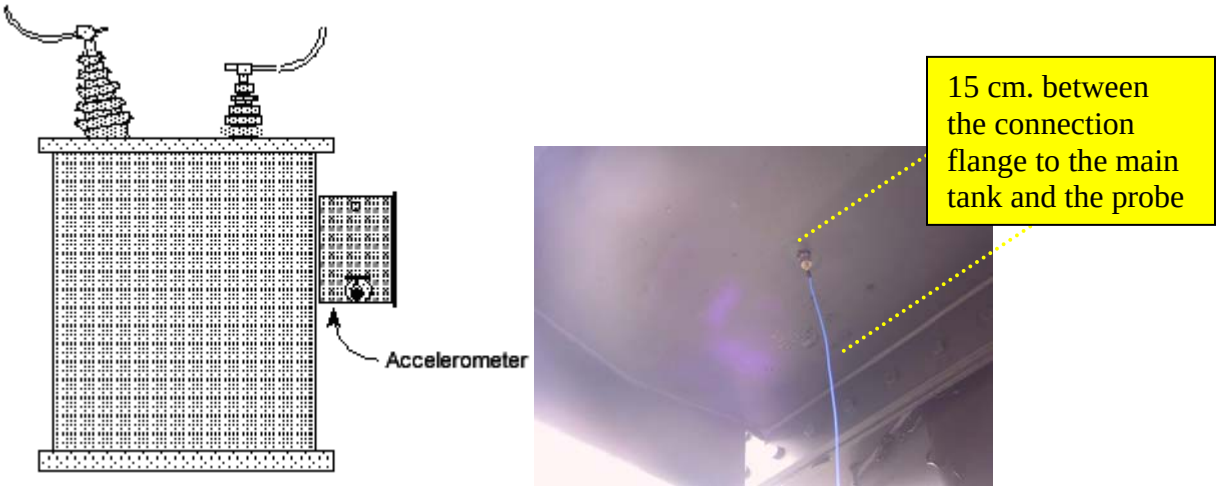


**Figure I.4:** ABB UZ with a single compartment

## 5. Type of Tank: Single Compartment (II)

**Figure I.5:** Westinghouse URS-H with a single compartment

## 6. Type of Tank: Multiple Compartments

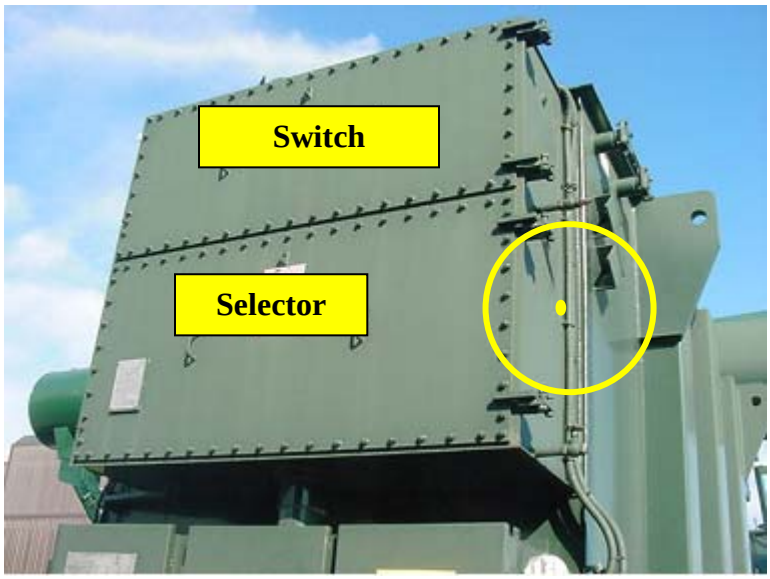


**Figure I.6:** Ferranti Packard (Model 69RT32) with 2 compartments

## 7. Special Configurations

Some configurations of OLTP are less common and a better knowledge of the internal parts can lead to a particular choice when all the principles outlined above are applied. The following example illustrates the position selected for a Ferranti-Packard Model RT32 of resistive-type.


**Figure I.7:** Internal setup of the OLTP conduit for a particular choice regarding the location of the probe.

The best location site is often guided by good knowledge of the internal parts of the OLTP. In this example, the position taken is not located near the flange of the main tank due to the **presence of an internal wall that divides the compartment between the mechanisms and the connections to the coil**. The measuring point shown corresponds approximately to the center of mechanism.