

Memo

To: To
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Subject: Comments on Functional Life Test

1 General view of the functional life test

The idea behind the functional life test is very good!

Criteria's and test conditions tricky to define.

The functional life test is very good to use in development activities, but very difficult to create a standard test of.

2 Uncertainties

There are several uncertainties that influence on the test results for the functional life test. Below are some of them listed.

- Statistical variations in contacts will influence
- Acceptance criteria not clear
 - Definition of start resistance
 - Stabilization criteria
- Oil quality influence
- Test set-up
- Wiping effect
- Risk for fire
- Acceleration of test and correlation with service experience not clarified.

2.1 Statistical variations.

The stability of contacts has statistical variations. In fig. 1 are the results from 5 different contact designs, with several pieces of each design. All the contacts were intended for the same purpose. The load on the contacts varied during the test time. All contacts were placed in the same tank in a similar way. The results of the test will give a very good indicator of the quality of the different designs.

If we look into the individual result of the worst contact modification 1 in fig 2, we can see that there is a large statistical variation. Some of the contacts behaved rather well while other didn't.

It should although be noted that a better contact design gives less variation in result.

Company Name

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			Registered Office

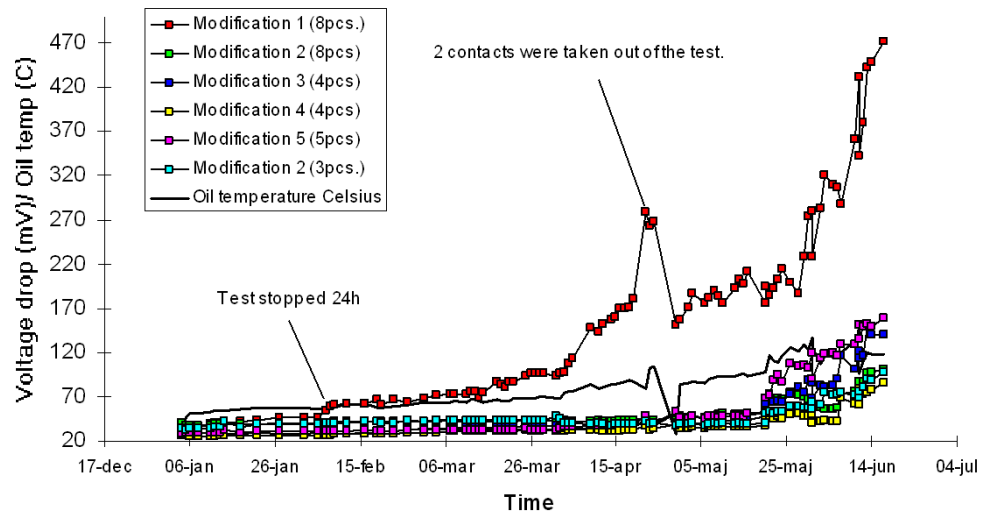


Fig. 1. Test results for the 5 different contact designs

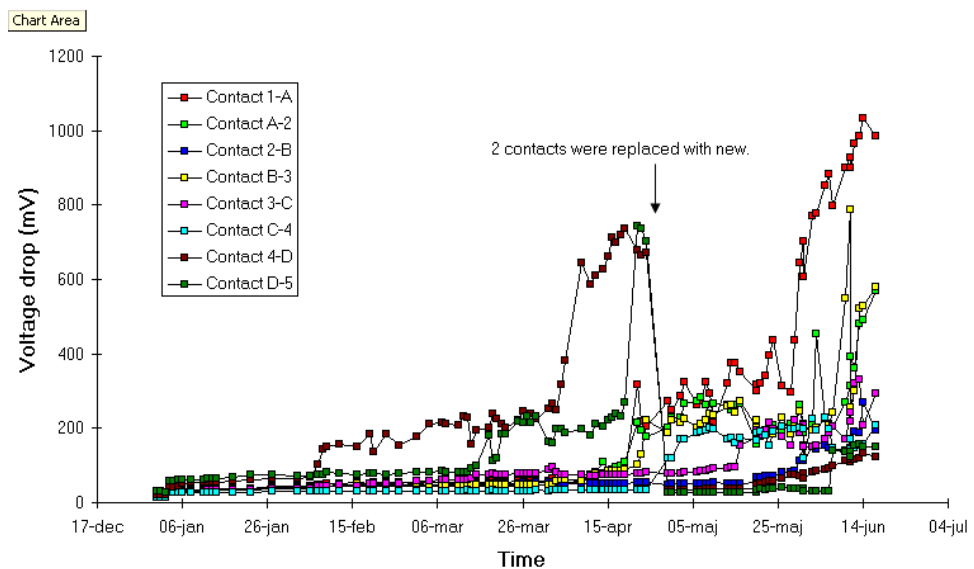


Fig. 2. Test result for the individual contacts of modification 1.

2.2 Acceptance criteria's

The acceptance criteria for the functional life test

A contact pair will have been deemed successful if the following criteria are met

1. Resistance change after the 30-day test is less than 25%.
2. Resistance change has stabilized and is not continuing to rise.

2.2.1 Start resistance

The resistance after 30 days (30years) shall not increase with more then 25%. The preparation of the contact before the test is the important.

Definition of start conditions for the contact

- Contacts maneuvered?
- Contact area cleaned?
- Contact been included in transformer drying process as vapor phase?



Fig. 3. Copper contact after several maneuvers against a silver contact.

In below fig. 4 the contacts have been prepared before the start of the test. The resistance has decrease for 4 of the contacts during the test. This test shows that that start condition of the contacts is important as also a too high start resistance will not influence so much on the rest of the test.

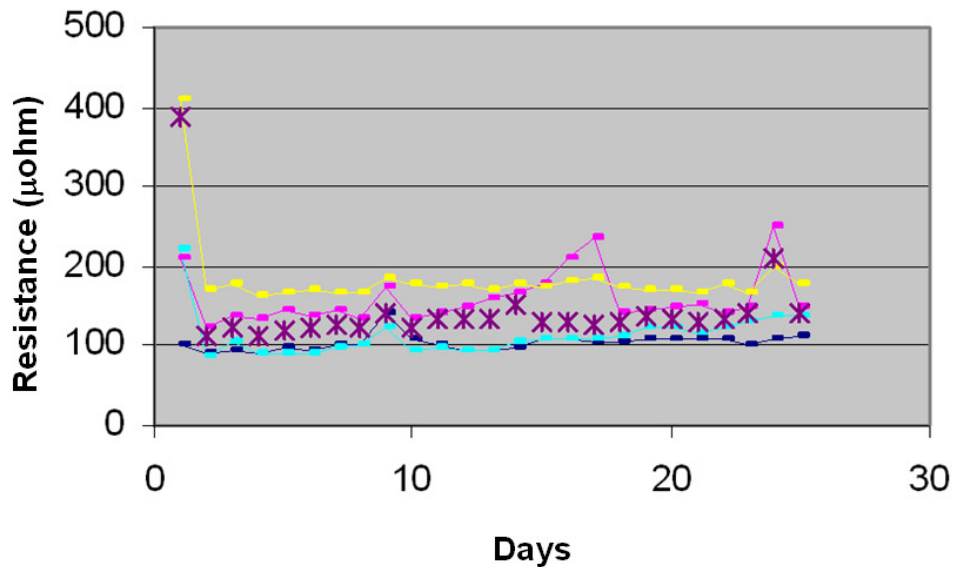


Fig. 4. Contacts with different preparation before the test

2.2.2 Stabilization criteria

Are these stable increases in fig 5 of concern if the contacts have not moved during the test time that should equal 30 years?

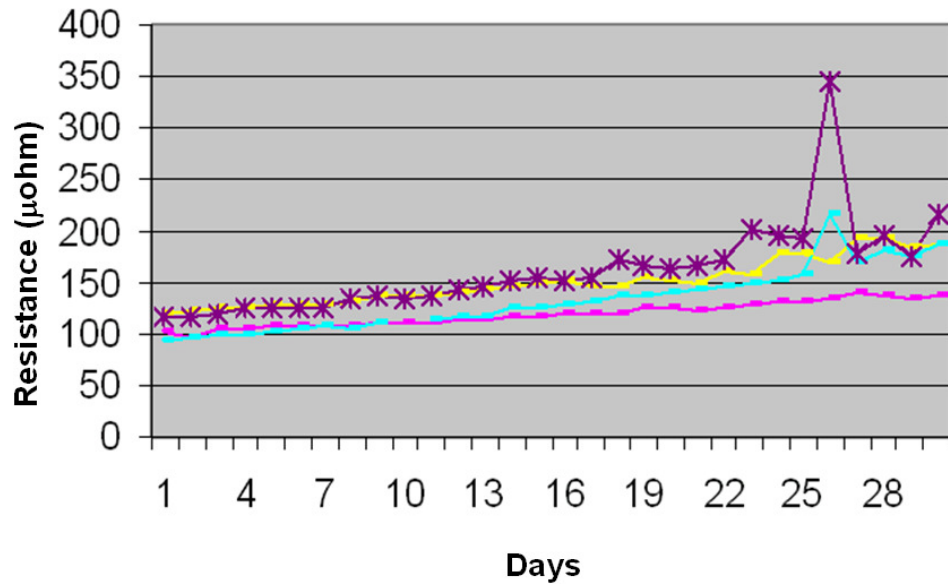


Fig. 5. Test when the resistance had a steady increase

- Should also contacts be rejected that has a low enough value (<25% increase) but are increasing?
- Contacts that include a large portion of bulk resistance will give a better result.
- In case of low resistance and high currents, when measuring voltage drop, the inductance will add to the result and give lower rise values.

2.3 Oil quality

The fluid that the contacts are placed in during the test will influence the test result.

- What kind of fluid (oil/ester) to use?
- Preparation of the fluid
 - Oxygen content (should it also be supplied during the test)
 - General gas content
 - Other oil related influences (inhibiter, ageing etc.)
- Can one contact test result be used for other fluids?



Fig. 6. Changes in oil appearance for 2 different oils after 22 days at 105°C



Fig. 7. Contacts stored in above oils for 22 days at 105°C

2.4 Test set-up

The test set-up can also influence on the test result.

- Fitting of the contacts the same as in the product
- Placement of the contacts on the same height in the test tank
- Oil circulation in the tank?

The contacts must be as in the same way as in the product, this to get the same thermal movement. The contacts should also be placed at the same height as probably forced oil circulation will influence on the test result.



Fig. 8. Placement of contacts in test tank and temperature gradient influence

2.5 Wiping effect

The wiping effect depends on

- Contact surface design
- Contact material
- Contact pressure

Not only the steady state design of the contact is important. The cleaning effect of the contact at a maneuver is also important. It is always recommended to maneuver the contacts at service stops.



Fig. 9. Wiping effect on contacts

2.6 Risk for fire

There is always a risk for fire with a test at 130 °C oil temperature and hot contacts. Incidents have already been reported.

2.7 Acceleration of test and correlation

Will the acceleration of the test and the performance give a correct correlation with service conditions? So far there are indications that contacts with good service experience also fulfils the tests and also the other way around.