



## Type test report no. VRD/VRF/R 1D 001e

### Temperature rise of contacts of tap selector and change-over selector

Test department  
26.04.2006

#### Type test for tap selector and change-over selector type:

Tap selector, reversing change-over selector and coarse change-over selector of sizes "C", "D" and "DE" for on-load tap-changer types OILTAP® R and VACUTAP® VRD/VRF with:

- single-, two- or three-phase tap-changer with one current path per phase and maximum rated through-current up to 1300 A,
- single-phase tap-changer with 2 parallel current paths and maximum rated through-current up to 2100 A without enforced current splitting,
- single-phase tap-changer with 2 parallel current paths and maximum rated through-current up to 2600 A with enforced current splitting,
- single-phase tap-changer with 3 parallel current paths and maximum rated through-current of 3000 A without enforced current splitting.

#### Test specification:

IEC 60214-1:2003, sub-clause 5.2.1: "Temperature rise of contacts".

#### Test sample:

Tap selector with reversing change-over selector type  
R I 3003 - /D - 16 31 1W, Serial no. 150247.

#### Manufacturer:

Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.

#### Date of test:

February 2003.

#### Place of test:

Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.

#### Tests performed:

Measurement of temperature rise of contacts with test currents of:

- 1.2 x 1300 A = 1560 A with 1 current path per phase,
- 1.2 x 2100 A = 2520 A with 2 parallel current paths per phase,
- 1.2 x 3000 A = 3600 A with 3 parallel current paths per phase.

#### Test results:

The requirements of IEC 60214-1:2003 were met, i.e.:  
All steady temperature rises of contacts were below the maximum admissible value of 20 K.

This report contains 5 sheets.

MASCHINENFABRIK REINHAUSEN GMBH  
- TEST DEPARTMENT -

## 1. Test specification

The type test was performed in accordance with IEC 60214-1:2003 "Tap-changers - Part 1: Performance requirements and test methods", sub-clause 5.2.1 "Temperature rise of contacts".

## 2. Data of test samples

Test sample: Tap selector with reversing change-over selector  
R I 3003 - /D - 16 31 1W

Serial no.: 150247

Year of manufacture: 2003

Maximum rated through-currents with arrangement of tap-selector and change-over selector for:

- single-, 2- or 3-phase with one current path per phase: 1300 A,
- single-phase with 2 parallel current paths without enforced current splitting: 2100 A,
- single-phase with 2 parallel current paths with enforced current splitting: 2600 A,
- single-phase with 3 parallel current paths without enforced current splitting: 3000 A.

## 3. Scope of application

The test sample has three parallel current paths per phase and each current path is designed for a maximum rated through-current of 1300 A. The design of all parts that carry current continuously does not depend on the number of parallel current paths per phase. Therefore the test sample is representative for tap selectors and change-over selectors with one current path per phase, with 2 parallel current paths per phase and with 3 parallel current paths per phase.

The design of the reversing change-over contacts and the coarse change-over selector contacts is the same. Therefore this test is valid for applications without change-over selector, with reversing change-over selector and with coarse change-over selector.

The design of all parts that carry current continuously is the same for selector sizes "C", "D" and "DE". Therefore this test is applicable to all selectors of sizes "C", "D" and "DE" with 10..18 tap selector contacts. The temperature rise of tap selector contacts and change-over selector contacts does not depend on:

- insulation level,
- number of tap selector contacts (up to 18 with and without change-over selector),
- number of phases,
- type of diverter switch (OILTAP® R, VACUTAP® VRD/VRF) the tap selector is combined with.

Therefore this type test is valid for all on-load tap-changers VACUTAP® VRD/VRF and OILTAP® R with selector sizes "C", "D" and "DE".

## 4. Test arrangement

Surrounding medium: Transformer oil Shell Diala D.

Measurement: By means of copper-constantan thermocouples soldered onto the contacts and 25 mm below the contacts. Measuring points see figure 1. Each current path in case of parallel current paths was measured similar to fig. 1.

Position and connection of test sample: Reversing change-over selector at position "-", tap selector at position "K", connection between tap selector contact "K" and change-over selector contact "0" as in service. Test circuit connected with Cu-lead 500 mm<sup>2</sup> to change-over selector contact "-" and end of connection lead from tap selector plane "2..K" to diverter switch.

Condition of the test samples: New, as manufactured. Vapour-phase drying before the test in acc. to the operating instruction of the on-load tap-changer "R". Switched several times under no-load condition.

## 5. Tests performed

For all tap selector and change-over selector types within the application range (see clause 3) the steady temperature rise, caused by a test current of  $1.2 \times$  maximum rated through-current, was measured, i.e. the change of the temperature rise was less than 1 K over an hour. Table 1 summarizes the performed tests.

Type of tap selector and change-over selector	maximum rated through-current	Test current
single-, two- or three-phase tap selector and change-over selector with one current path per phase	1300 A	$1.2 \times 1300 \text{ A} = 1560 \text{ A}$
single-phase tap selector and change-over selector with 2 parallel current paths with enforced current splitting <sup>1)</sup>	2600 A	
single-phase tap selector and change-over selector with 2 parallel current paths without enforced current splitting	2100 A	$1.2 \times 2100 \text{ A} = 2520 \text{ A}$
single-phase tap selector and change-over selector with 3 parallel current paths without enforced current splitting	3000 A	$1.2 \times 3000 \text{ A} = 3600 \text{ A}$

Table 1: Summary of the performed tests.

<sup>1)</sup>: This type is designed with two parallel current paths and a maximum rated through-current up to 2600 A with enforced current splitting by two parallel windings. Therefore the test of one current path with maximum rated through-current of 1300 A is valid.

## 6. Test results

Tables 2..4 summarize the temperature rise of contacts for the tap selector and the change-over selector. The highest temperature rise is always indicated for equivalent measuring points.

All steady temperature rises of contacts were below the admissible value of 20 K according to IEC 60214-1:2003, sub-clause 5.2.1 "Temperature rise of contacts".

Designation of contacts		Measuring points (see fig. 1)	Steady temperature rise at test current 1560 A
Tap selector	Stationary contact	21	16 K
	Moveable contacts	13..20	12 K
	Oil below contacts	22	36°C
	Moveable contacts current ring	4..11	11 K
	Stationary contact current ring	3	9 K
	Oil below contacts	12	36°C
Change-over selector	Stationary contact	45	10 K
	Moveable contacts	37..44	11 K
	Oil below contacts	46	37°C
	Moveable contacts current ring	28..35	12 K
	Stationary contact current ring	27	11 K
	Oil below contacts	36	36°C

Table 2: Test with one current path

Designation of contacts		Measuring points (see fig. 1)	Steady temperature rise at test current 2520 A
Tap selector	Stationary contact	21	12 K
	Moveable contacts	13..20	10 K
	Oil below contacts	22	30°C
	Moveable contacts current ring	4..11	11 K
	Stationary contact current ring	3	8 K
	Oil below contacts	12	27°C
Change- over selector	Stationary contact	45	9 K
	Moveable contacts	37..44	10 K
	Oil below contacts	46	30°C
	Moveable contacts current ring	28..35	9 K
	Stationary contact current ring	27	9 K
	Oil below contacts	36	30°C

Table 3: Test with 2 parallel current paths; values are maximum values of both current paths

Designation of contacts		Measuring points (see fig. 1)	Steady temperature rise at test current 3600 A
Tap selector	Stationary contact	21	14 K
	Moveable contacts	13..20	12 K
	Oil below contacts	22	33°C
	Moveable contacts current ring	4..11	12 K
	Stationary contact current ring	3	9 K
	Oil below contacts	12	32°C
Change- over selector	Stationary contact	45	10 K
	Moveable contacts	37..44	11 K
	Oil below contacts	46	36°C
	Moveable contacts current ring	28..35	10 K
	Stationary contact current ring	27	9 K
	Oil below contacts	36	36°C

Table 4: Test with 3 parallel current paths; values are maximum values of 3 current paths

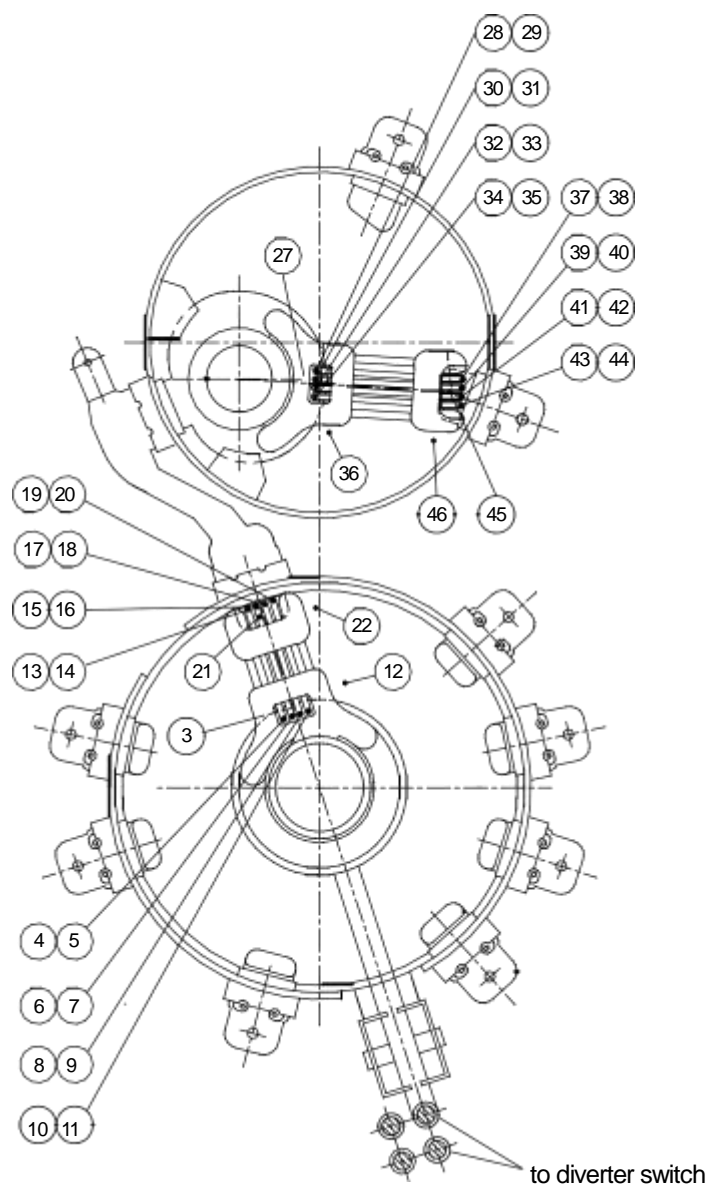


Figure 1: Measuring points at tap selector and change-over selector.  
Each current path in case of parallel current paths was measured similar to fig. 1.