



Type test report no. VR/R/VM/M 1E 001e

Temperature rise of contacts
tap selector and change-over selector

Product Approval
CTTP/Wag
10.02.2017

Type test for types:	Tap selectors of sizes "RC", "RD" and "RDE" without change-over selector, with reversing change-over selector or with coarse change-over selector, designed with 1, 2 or 3 current paths (connected in parallel) for use in combination with single phase, 2 phase or 3 phase diverter switches type VACUTAP® VR, VACUTAP® VM, OILTAP® R or OILTAP® M.
Test specification:	IEC 60214-1:2014, sub-clause 5.2.2: "Temperature rise of contacts".
Test sample:	OILTAP® R I 3003 – 72.5/RDE – 10 19 3W, S/N: 1525721.
Manufacturer:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.
Date of test:	Oktober 2014.
Place of test:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.
Tests performed:	<p>Measurement of temperature rise of contacts at a test current of 1.2 times the maximum rated through-current.</p> <p>The test was carried out on one single current path of the test sample with a test current of $1.2 \times 1300 \text{ A} = 1560 \text{ A}$.</p>
Test results:	<p>The requirements of IEC 60214-1:2014 were met.</p> <p>It was verified that contacts, which carry through-current continuously in service, did not exceed a temperature rise of 20 K when carrying 1.2 times the maximum rated through-current.</p>

This report contains 6 pages.

i. V. Dr. Thomas Strof
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Maschinenfabrik Reinhausen GmbH
- PRODUCT APPROVAL -

Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg, Germany
Phone +49 941 40 90-0
info@reinhausen.com
www.reinhausen.com

Managing Directors:
Dr. Nicolas Maier-Scheubeck
Michael Rohde

F01106:20

Chairman of Supervisory
Board: Hans-Jürgen Thaus
Commercial register
Regensburg HRB 3687
VAT reg. no.: DE133705195

Reinhausen Group

1. Test specification

The type tests were performed in accordance with IEC 60214-1:2014 "Tap-changers - Part 1: Performance requirements and test methods", sub-clause 5.2.2: "Temperature rise of contacts".

2. Data of test sample

On-load tap changer: OILTAP® R I 3003 – 72.5/RDE – 10 19 3W
 Serial no.: 1525721
 IBASE: 464099447
 Year of manufacture: 2014
 Part of test: Tap selector

3. Scope of application

Tap selectors of sizes "RC", "RD" and "RDE" are designed on the principle of a modular system, allowing a wide range of different variations, e.g. number of contacts, number of contact planes, number of parallel current paths (per phase) and type of change-over selector. Tap selectors of sizes "RC", "RD" and "RDE" are designed for use in combination with diverter switches type VACUTAP® VR, VACUTAP® VM, OILTAP® R or OILTAP® M.

The design of contacts that carry current continuously is identical for all tap selectors of sizes "RC", "RD" and "RDE" with reversing change-over selector, coarse change-over selector or without change-over selector.

Depending on the type of diverter switch the tap selector is combined with, tap selectors of sizes "RC", "RD" and "RDE" are available in following basic designs:

- Maximum rated through-current 1300 A with 1 single current path (per phase).
- Maximum rated through-current 2000 A with 2 current paths connected in parallel.
- Maximum rated through-current 3000 A with 3 current paths connected in parallel.
- Maximum rated through-current 2600 A with 2 current paths for applications with enforced current splitting.

Single current paths are designed for maximum rated through-current 1300 A. IEC 60214-2:2004, sub-clause 6.3.6 states, that current paths connected in parallel have a different current sharing caused by contact resistance variations. Therefore one of two current paths connected in parallel is loaded at most with 60 % of the through-current of the on-load tap-changer, i.e. one current path is loaded at most with $1.2 \times$ through-current of the on-load tap-changer divided by the number of current paths connected in parallel.

Table 1 shows, that single current paths of all available basic design variants are loaded at most with a through-current less or equal than the maximum rated through-current per current path 1300 A.

Number of (parallel) current paths	Enforced current splitting	Maximum rated through current	Maximum load per current path	Maximum rated through-current per current path
1	no	1300 A	1300 A	1300 A
2	no	2000 A	1200 A	
2	yes	2600 A	1300 A	
3	no	3000 A	1200 A	

Table 1: Maximum current load of basic design variants.

The type test was carried out on a single current path of OILTAP® R I 3003 – 72.5/RDE – 10 19 3W with a test current of $1.2 \times 1300 \text{ A} = 1560 \text{ A}$. Thus, all basic design variants listed in table 1 are covered by the performed test.

The temperature rise of contacts does not depend on the insulation levels of the tap selector, the tap selector size ("RC", "RD" or "RDE"), the type of change-over selector, the number of contacts and the type of diverter switch (VACUTAP® VR, VACUTAP® VM, OILTAP® R or OILTAP® M) the tap selector is combined with.

Therefore this type test report is valid for all tap selectors with following characteristics:

- Tap selector size: "RC", "RD" or "RDE"
- Change-over selector: without, reversing or coarse change-over selector
- Combined diverter switch: VACUTAP® VR, VACUTAP® VM, OILTAP® R or OILTAP® M
- Maximum rated through-current: 1300 A, 2000 A, 2400 A and 3000 A
- Number of phases: 1, 2 or 3
- Parallel current paths (per phase): 1, 2 or 3

4. Test arrangement

Schematic test circuit:	See figure 1.
Position and connection:	See figure 1.
Surrounding medium:	Transformer oil according to the requirements of IEC 60296.
Oil temperature:	approx. 21 °C.
Measurement:	By means of thermocouples (NiCr-Ni, type K), welded onto the contacts and reference points 25 mm below the contacts.
Measuring points:	See figures 2...9.
Condition of the test sample:	New, as manufactured.
Recording and evaluation:	Temperature measuring system.

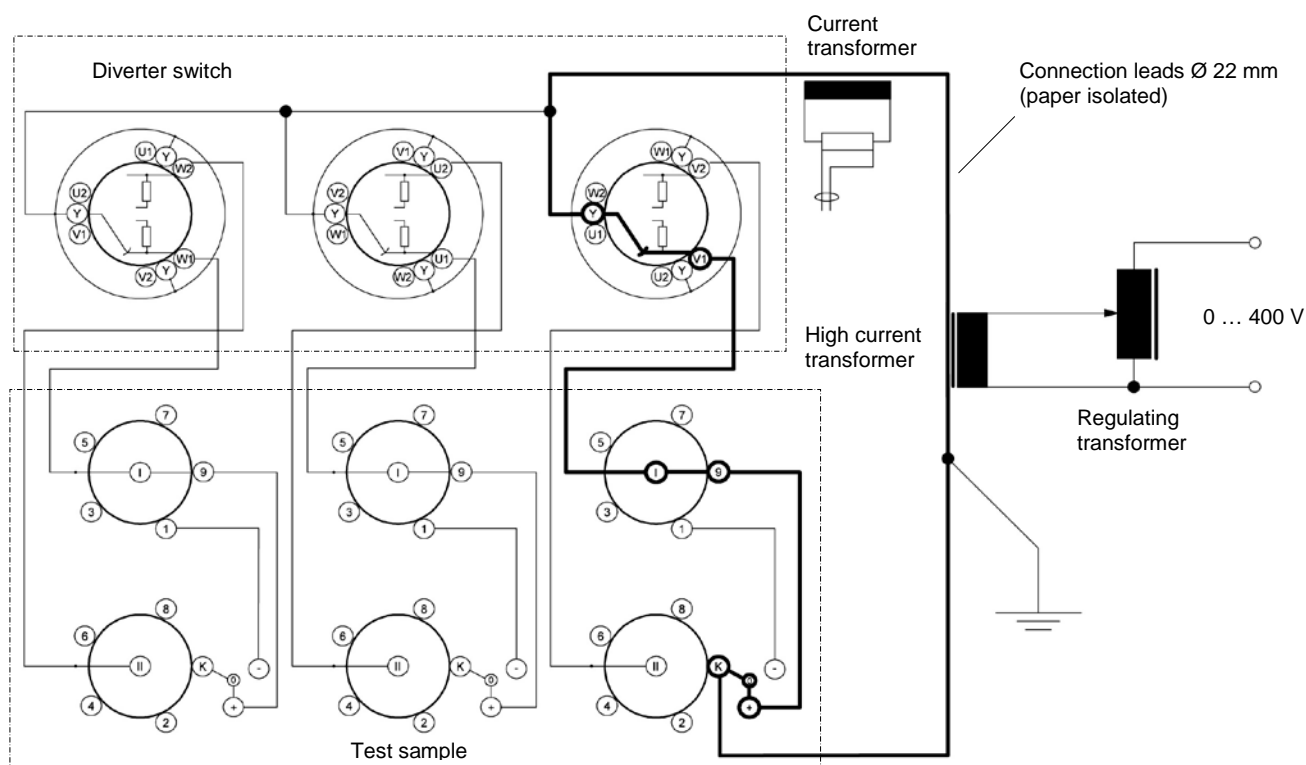


Figure 1: Schematic test circuit and connection of the test sample.

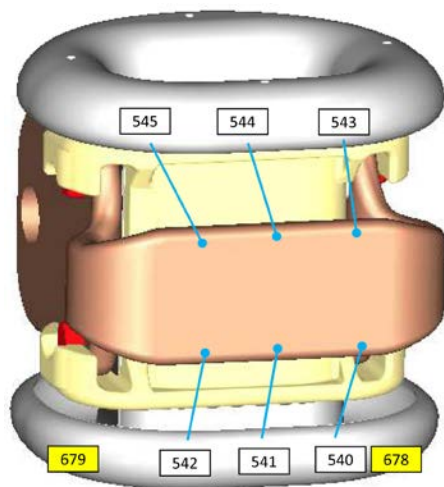


Figure 2: Tap selector - fixed contact

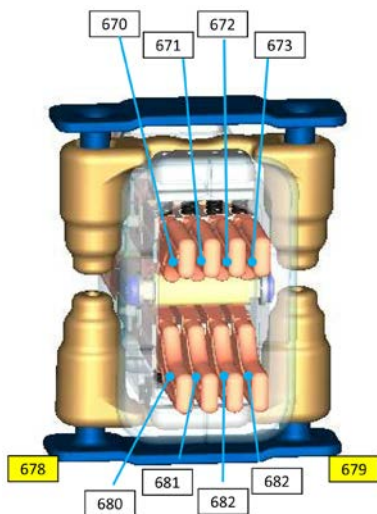


Figure 3: Tap selector - movable contact

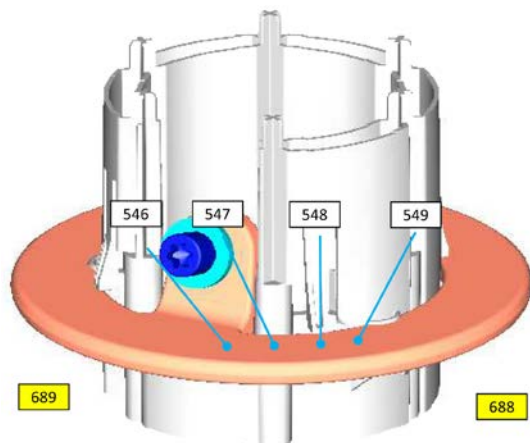


Figure 4: Tap selector - current ring

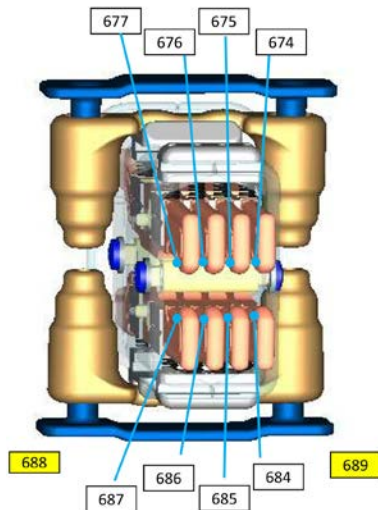


Figure 5: Tap selector - current ring movable contact

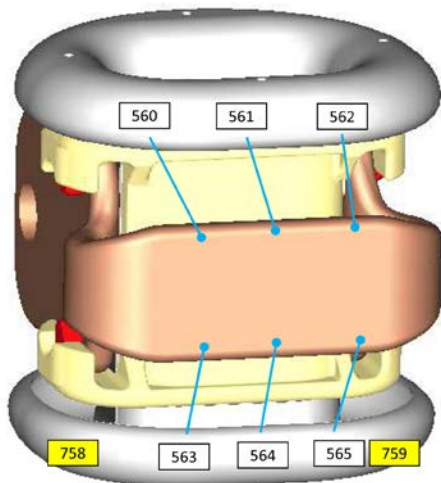


Figure 6: Change-over selector - fixed contact

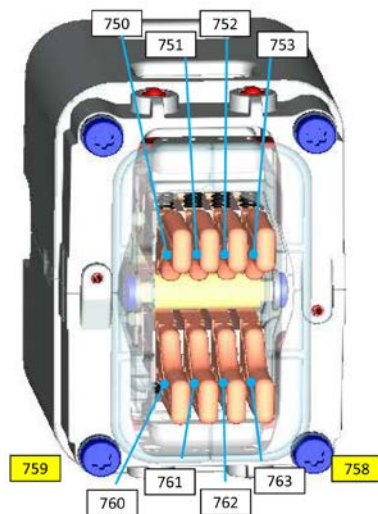


Figure 7: Change-over selector - movable contact

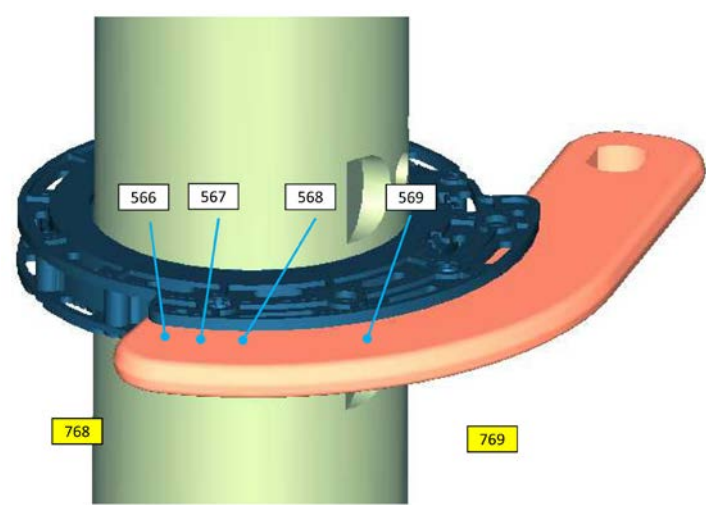


Figure 8: Change-over selector - current ring

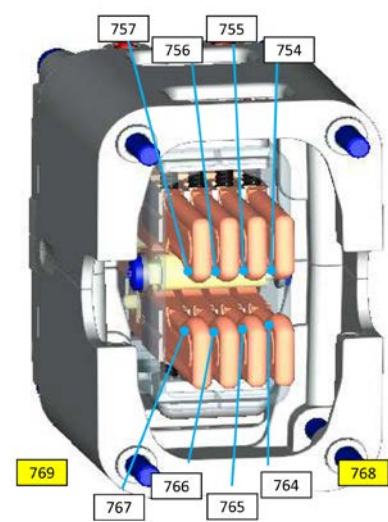


Figure 9: Change-over selector - current ring movable contact

5. Test performed

Test current: 1.2 x 1300 A = 1560 A.

Test duration: Measurement at steady temperature rise, i.e. the change of temperature was less than 1 K for more than one hour.

Tables 2 shows the determined temperature rise of contacts. The highest temperature rise is always indicated for parallel or equivalent contacts.

Designation of contacts	Measuring points (see figs. 2...9)	Steady temperature rise
Tap selector		
Fixed contact (upper side)	543...545	18.3 K
Fixed contact (lower side)	540...542	18.8 K
Movable contact (upper side)	670...673	14.1 K
Movable contact (lower side)	680...683	12.4 K
Oil below measuring points no. 540...545, 670...673, 680...683	678, 679	-
Current ring	546...549	15.8 K
Current ring movable contact (upper side)	674...677	13.9 K
Current ring movable contact (lower side)	684...687	11.7 K
Oil below measuring points no. 546...549, 674...677, 684...687	688, 689	-
Change-over selector		
Fixed contact (upper side)	560...562	18.2 K
Fixed contact (lower side)	563...565	18.9 K
Movable contact (upper side)	750...753	15.9 K
Movable contact (lower side)	760...763	13.9 K
Oil below measuring points no. 560...565, 750...753, 760...763	758, 759	-
Current ring	566...569	18.5 K
Current ring movable contact (upper side)	754...757	15.2 K
Current ring movable contact (lower side)	765...767	13.5 K
Oil below measuring points no. 566...569, 754...757, 765...767	768, 769	-

Table 2: Measured steady temperature rise of contacts.

6. Test results

The requirements according to IEC 60214-1:2014 "Tap-changers - Part 1: Performance requirements and test methods", sub-clause 5.2.2 "Temperature rise of contacts" were met.

It was verified that contacts, which carry through-current continuously in service, did not exceed a temperature rise of 20 K when carrying 1.2 times the maximum rated through-current.