LR F2552 - Restricted

Test report

Electrical Tests on Klauke 110R12 KHD 150-12, 2069837 Cable Lug Mounted on 150 mm^2 Class 5 Copper Conductors with Novopress HP-series Crimping Tool

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TEST OBJECT
Klauke 110R12 KHD 150-12

TEST OBJECT RECEIVED
2010

TEST PROGRAM
Electrical tests according to IEC61238-1, Ed.2

TEST LOCATION
SINTEF Energy Research

DATE OF TEST
2011/ 2012

ABSTRACT

The cable lug Klauke 110R10 KHD 150-12, Code 22, according to DIN 46235, compressed with a dieless deep indent crimp, using a Novopress HP - Series crimping tool on a class 5 fine-stranded copper conductor has been tested according to the electric part of the IEC 61238-1 standard. The tested set of cable lugs passed all criteria of the test.

The test results relate only to the items tested

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1 Test object

The tested cable lug was a Klauke 110R10 KHD 150-12, Code 22, according to DIN 46235. It was compressed with a dieless deep indent crimp, using a Novopress HP - Series crimping tool. The cable lug is of class A. Figure 1 shows the cable lug after the test. Six specimens of this cable lug were used in the test. The crimping sequence was for cable lug specimens 1, 2 and 3 from the bolt and outwards, and for cable lug specimens 4, 5 and 6 vice versa.

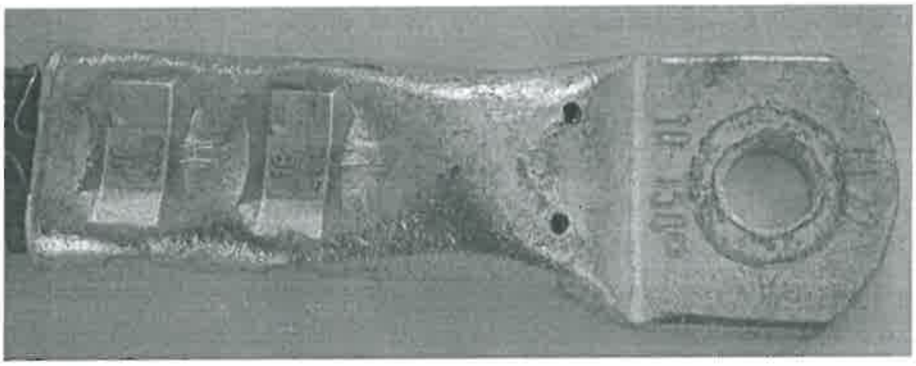

Figure 1: Tested cable lug.

2 INSTALLATION

2.1 Conductor used

The conductor used was a stripped, tin coated, fine-stranded, class 5 copper conductor. The nominal cross-section area was 150 mm^2. The cross-section of the copper bus bar bolted to the cable lugs was 5 mm x 30 mm.

2.2 Mounting procedure

The six specimens of the cable lug were mounted on the bare conductor. In the other end, the cable lugs were bolted to the bus bar. Two holes, a few millimetres deep and about 2 mm in diameter, were drilled in the middle of each cable lug. The holes were used to fasten (with small screws) one thermocouple and one voltage tap on each cable lug. Equalizer points for resistance measurements were soldered on the conductor.

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3 TEST PROCEDURES

3.1 Temperature cycling

The temperature on the reference conductor was cycled 1000 times between 35°C and about 120°C. The heating period was 53 minutes and the subsequent cool down time was about 37 minutes. The current in the test loop was generated by a constant voltage source (reg. No. B01-0597 and B01-0663). The current at the start of the heating period was 700 A, whereas the current at equilibrium was 654 A. No forced cooling was used.

Resistance measurements were made by passing a DC current of 50 A through the test circuit (from DC power supply with reg. No. B2-340).

Temperatures and voltage drops were recorded by a data logger (reg. No. G05-0172).

3.2 Short-circuit tests

After 200 heat cycles, six short-circuits were applied with currents and durations according to Table I.

Table I: Short circuit tests.

No.	I_{rms} (kA)	Time (s)
1	23.2	1.16
2	23.2	1.26
3	23.2	1.24
4	23.2	1.25
5	23.2	1.25
6	22.9	1.25

The short-circuit tests were performed in the same test rig. Four conductors arranged concentrically around the tested cable lugs were used for the return current.

4 RESULTS

4.1 Measured temperatures

The maximum temperatures for the cable lugs and for the reference conductor during cycling are given for certain cycles in Table II.

Table II: Maximum temperature (in °C) during cycling for the cable lugs and the reference conductor at different cycles.

Cycle	Cable lug 1	Cable lug 2	Cable lug 3	Cable lug 4	Cable lug 5	Cable lug 6	Reference conductor
1	115	105	109	109	101	98	118
200	121	115	112	115	104	101	122
250	105	105	113	109	100	98	117
325	110	107	117	112	104	100	121
400	111	106	119	113	104	100	119
475	113	107	111	110	101	100	118
550	112	105	109	111	101	100	119
625	111	105	108	108	100	100	120
700	113	106	113	109	100	100	118
775	115	109	120	115	106	102	120
850	113	108	119	112	104	101	121
925	110	102	110	106	99	97	117
1000	114	108	117	111	102	101	122

4.2 K-values

The k-values for the cable lugs are given in Table III and Figure 2.

Table III: k-values for the Cable lugs.

Cycle	Cable lug 1	Cable lug 2	Cable lug 3	Cable lug 4	Cable lug 5	Cable lug 6
0	0.87	0.65	0.60	0.65	0.68	0.67
200-	0.85	0.63	0.60	0.63	0.64	0.64
200+	0.95	0.72	0.72	0.75	0.75	0.75
250	0.90	0.66	0.66	0.68	0.69	0.69
325	0.89	0.66	0.66	0.68	0.68	0.70
400	0.90	0.66	0.66	0.67	0.68	0.70
475	0.90	0.65	0.66	0.68	0.68	0.70
550	0.88	0.65	0.65	0.67	0.67	0.69
625	0.89	0.65	0.65	0.67	0.67	0.69
700	0.88	0.65	0.65	0.67	0.67	0.69
775	0.88	0.65	0.65	0.67	0.67	0.69
850	0.89	0.65	0.65	0.67	0.67	0.69
925	0.89	0.65	0.65	0.67	0.67	0.69
1000	0.89	0.65	0.65	0.67	0.67	0.69

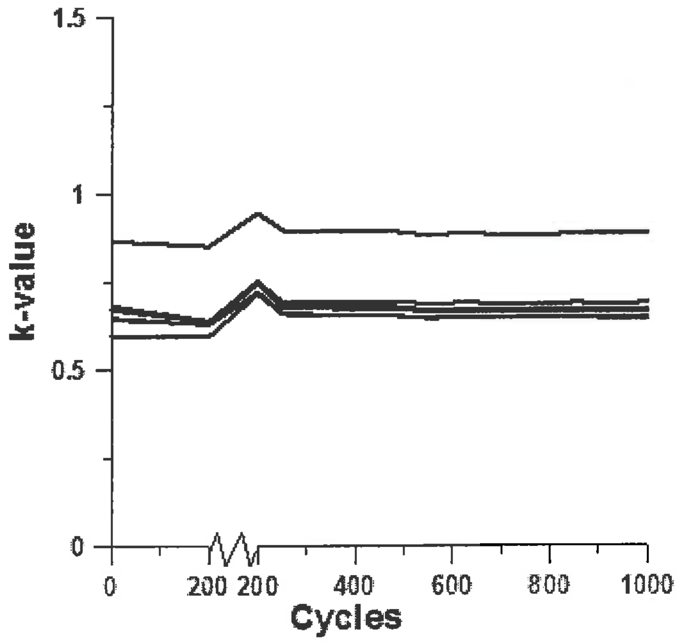

Figure 2: k-values as function of heat cycle for the six specimens.

4.3 IEC 61238-1 requirements

In Table IV the results of this test are compared to the requirements of the IEC 61238-1 standard.

Table IV: Obtained and maximum acceptable parameter values for the IEC 61238-1 standard.

Parameter	Designation	Result	Requirement
Initial scatter	δ	0.23	≤0.30
Mean scatter	β	0.21	≤0.30
Change in resistance factor	D	0.05	≤0.15
Resistance factor ratio	λ	1.19	≤2.0
Maximum temperature*	Θ_{max}	117 °C	≤122°C **

* Note that the cable lug temperature is influenced both by the tested cable lug-to-cable contact, and the cable lug-to-bus bar contact.
** Temperature of the reference conductor

The tested set of cable lugs passed all criteria of the electrical part of the IEC 61238-1 standard.

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