

1 General Information

Title: ETI fuses testing

Order N°: P1-2017-03-06

Report N°: LAE-R-370_17

Product(s): Fuses (6 pack of 6 fuses, plus one additional fuse)

Project(s): /

Manufacturer(s): ETI Elektroelement d.d.
Obrezija 5
1411 Izlake

Applicant(s): RC eNeM d.o.o.
Podvine 36
1410 Zagorje ob Savi
Podružnica: Keramični materiali in varovalke
Obrezija 5
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Owner: RC eNeM d.o.o.
Podvine 36
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Standard(s) / specification(s): JBP | Test Specification (Battery Pack and Subcomponents) and instructions by customer

Summary: Fuses are tested according to specifications

Remarks: /

Issue Date: May 12, 2017

Project File: /

Report File: LAE-R-370_17 ETI varovalke.pdf

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Reviewed by
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Picture 1: Fuses (6 packets)

2 Performed tests and results

2.1 Performed tests

Each pack of fuses was tested by just one test. Example: Pack 1 was tested just according to the damp heat test 2. Pack 4. is tested just according to the warm storage test.

Nr.	Test	Operating hours
1.	Damp Heat Test 2	288
2.	Temperature Cycle Test	280
3.	Thermal Shock Test	1536
4.	Warm Storage Test	48
5.	Cold Storage Test	48
6.	Salt Spray Test	72

Table 1: Performed tests and tests durations

Fuses were tested according to the JBP Test Specification (Battery Pack and Subcomponents) and were tested in non operating mode.

2.2 Results

2.2.1 Damp heat test 2



Picture 2: Fuses at the end of damp heat test 2

Test nr. 1	Damp heat test 2
Standard:	JBP Test Specification (Battery Pack and Subcomponents, page 33 / 129)
Number and duration of cycles	12 x 24 h (complete duration 288 h)
Relative humidity	93+/-2 %
Upper temperature	$T_0=80\text{ }^{\circ}\text{C}$
Lower temperature	$T_U=-40\text{ }^{\circ}\text{C}$
Used chamber	Vötsch - VC 4034
Visual inspection	Screws are rusted

Table 2: Damp heat test 2

2.2.2 Temperature cycle test



Picture 3: Fuses at the end of temperature cycle test

Test nr. 2	Temperature cycle test
Standard:	JBP Test Specification (Battery Pack and Subcomponents, page 35 / 129)
Number and duration of cycles	35 x 8 h (complete duration 280 h)
Relative humidity	80+/-5 % (for T < 0 °C unspecified)
Upper temperature	T _O =80 °C
Lower temperature	T _U = -40 °C
Used chamber	Vötsch - VC 4034
Visual inspection	No changes

Table 3: Temperature cycle test

2.2.3 Thermal shock test



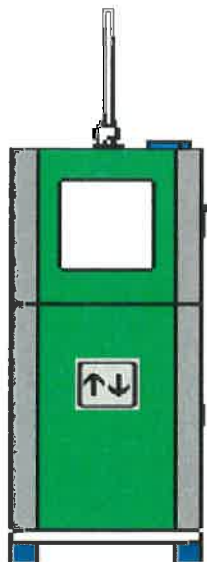
Picture 4: Fuses at the beginning of thermal shock test



Picture 5: Fuses at the end of thermal shock test

Test nr. 3	Thermal shock test
Standard:	Specifications and instructions by customer
Number and duration of cycles	768 x 2 h (complete duration 1536 h) Hot chamber: 1h Cold chamber: 1 h
Relative humidity	/
Upper temperature	T _O =80 °C
Lower temperature	T _U = -40 °C
Used chamber	CTS GmbH – TSS 70/350/S
Visual inspection	No changes

Table 4: Thermal shock test



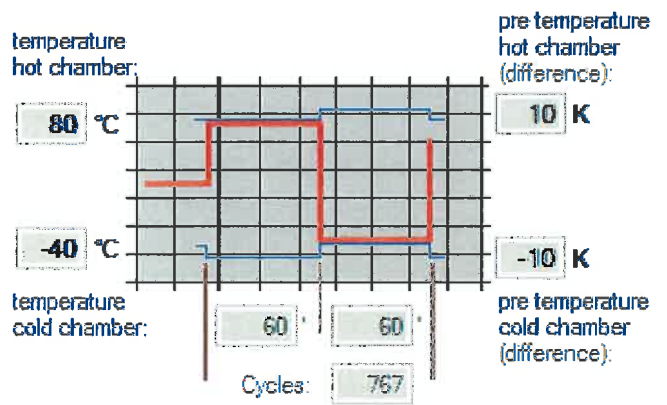
temperature
mob. cradle
C: -39.9 °C

Act. values:

- rem. time hot: 60 min
- temp hot: 90.2 °C
- cycle counter: 1 x
- temp cold: -39.9 °C
- rem. time cold: 46 min

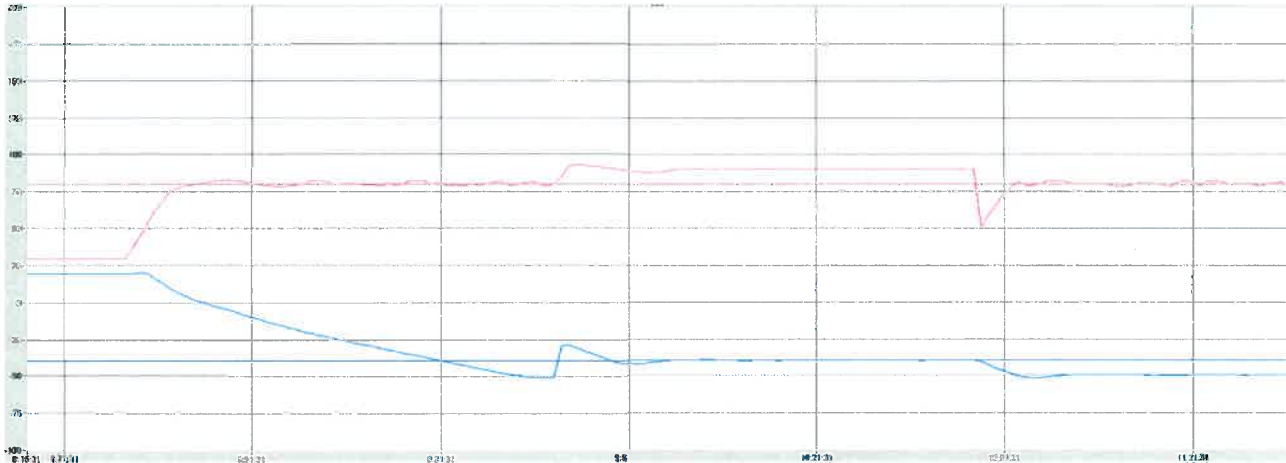
Program data:

Name: No.:



temperature hot chamber: 80 °C
 temperature cold chamber: -40 °C
 pre temperature hot chamber (difference): 10 K
 pre temperature cold chamber (difference): -10 K
 Cycles: 767

Picture 6: Thermal shock cycle



Picture 7: Example of one cycle

08:31:03	01	Digital channel: Temp hot: set to '1'
08:31:03	01	Digital channel: Temp cold set to '1'
08:31:03	01	Digital channel: door lock set to '1'
09:39:43	01	Digital channel: Lift up set to '0'
09:39:43	01	Digital channel: Lift down set to '1'
10:46:53	01	Digital channel: Lift up set to '1'
10:46:53	01	Digital channel: Lift down set to '0'
11:48:18	01	Test unit stopped in manual mode
11:48:23	01	Digital channel: Temp hot: set to '0'
11:48:23	01	Digital channel: Temp cold set to '0'
11:48:23	01	Digital channel: door lock set to '0'

Picture 8: Thermal shock chamber operation for one cycle (for cycle shown on Picture 7)

2.2.4 Warm storage test



Picture 9: Fuses at the end of warm storage test

Test nr. 4	Warm storage test
Standard:	Specifications and instructions by customer
Duration and temperature	48 h at $T_0=80\text{ °C}$
Used chamber	Vötsch VMT 07/35
Visual inspection	No changes

Table 5: Warm storage test

2.2.5 Cold storage test



Picture 10: Fuses at the end of cold storage test

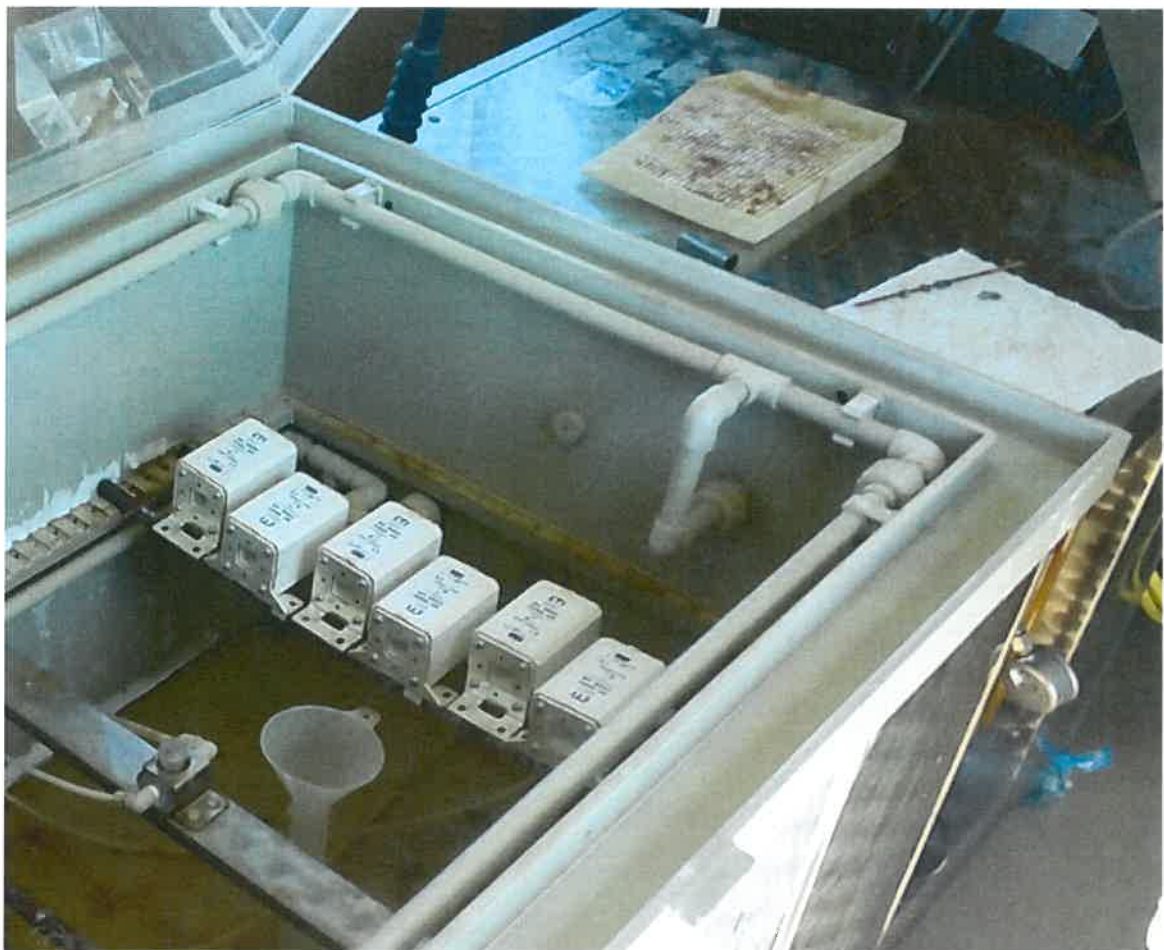
Test nr. 5	Cold storage test
Standard:	Specifications and instructions by customer
Duration and temperature	48 h at $T_{\min} = -50\text{ °C}$
Used chamber	Feutron KPK 800
Visual inspection	No changes

Table 6: Cold storage test

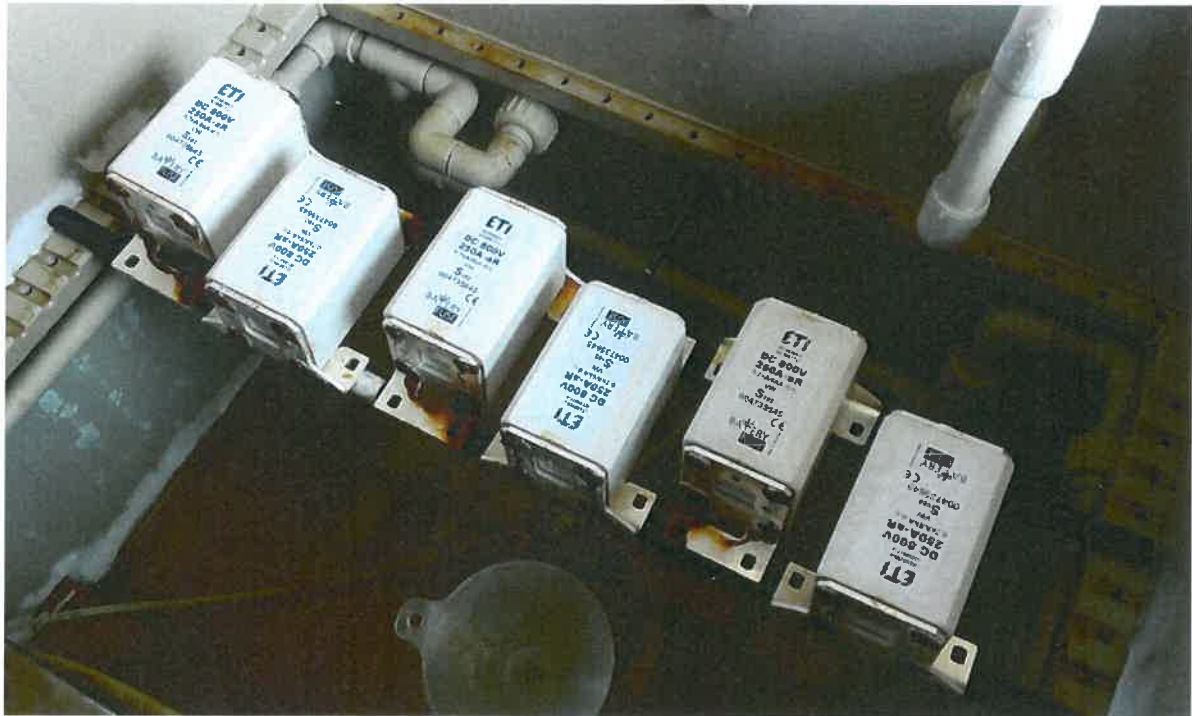
2.2.6 Salt spray test



Picture 11: Fuses at the beginning of salt spray test



Picture 12: Fuses at the beginning of salt spray test



Picture 13: Fuses at the end of salt spray test



Picture 14: Fuses at the end of salt spray test

Test nr. 6	Salt spray test
Standard:	Specifications and instructions by customer
Duration, temperature and salt	72 h at T= 35 °C and 5 % salt solution
Used chamber	Advest Kohler HK500
Visual inspection	Screws are hard rusted

Table 7: Salt spray test

3 Conclusions

Fuses (specimens) were tested according to specifications.

The visual inspection reveal rusted screws at fuses tested by damp and hard rusted screws at fuses tested by salt spray test.

The visual inspection did not reveal any fracture of structural parts. Functionality of fuses is not in scope of this testing.

Fuses (specimens) were returned to the customer.