

TYPE APPROVAL VIBRATION TEST  
OF LØGSTRUP TYPE TESTED PANEL  
ACC. TO IEC 439-1, (BS5486  
VDE 0660), FORM 4, 660 V

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Test IEC 68-2-6

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1. IDENTIFICATION

Project No. : 3677 A 20

Subject : Type approval vibration test of Løgstrup  
TTP, FORM 4, 660 V

Client : A/S Løgstrup Steel  
Sundtoldvej 8 P  
3000 Helsingør  
Denmark

References : Mr. John Olsen  
Mr. Birger Jørgensen

EC test engineer : Kim A. Schmidt

Test period : 89.04.14 - 89.04.20

2.        GENERAL

This report describes the results from a type approval vibration test of a 660 V Type-Tested Panel, Form 4 manufactured by A/S Løgstrup Steel.

The test specification is based on the type approval vibration test specification from Det Norske Veritas and Lloyd's Register of Shipping.

The test was partly attended by:

Mr. A. Fjeldheim	Det Norske Veritas
Mr. J. Olsen	A/S Løgstrup Steel
Mr. B. Jørgensen	A/S Løgstrup Steel

3. TEST SPECIMEN

As received from Client 89.04.13 :

One Type-Tested Panel, Sag 5.12-3, Form 4 mounted with:

- \* Explosion-sections for unit-, cable- and busbar sections
- \* Unit-section, 3 modules wide
- \* Busbar vertical : 2#12x12 cu, L1-L2-L3-N (main busbars)  
Busbar vertical : 2#6x6 cu, L1-N (control busbars)  
Busbar vertical : 2#12x12 cu, earth  
Busbar horizontal : 2#12x12 cu, L1-L2-L3-N (main busbars)  
Busbar horizontal : 2#12x12 cu, earth  
Busbar connection, horizontal/vertical
- \* Cable section, 2 modules wide
- \* Lexan cover-plates
- \* Segregation- and coverplates in alu-zink and painted alu-zink
- \* Complete Bridge-unit with inlet
- \* Complete MCCB-unit with inlet and outlet
- \* Complete MCC Draw-out unit with power and control in- and outlet
- \* Units with mounting plate in alu-zink and painted alu-zink
- \* The entire program of lock's

The test specimen is shown on FIG. 1 in APPENDIX 1 together with the axis designation.

There were no electrical connection etc. to the test specimen during the testing.

#### 4. TEST SPECIFICATION

The test specification is based on the type approval vibration test requirements from Det Norske Veritas and Lloyd's Register of Shipping.

The exposures includes resonance search and endurance vibration as follows:

##### Resonance search:

Performed with sinusoidal vibration according to IEC 68-2-6, Test Fc with the following test data:

Frequency range	:	2 - 100 Hz
Vibration level	:	2 - 8 Hz : $\pm 50$ mm/s 8 - 13.2 Hz : $\pm 1.0$ mm 13.2 - 100 Hz : $\pm 0.7$ g
Sweep rate	:	1 octave per minut
No. of axes	:	3 mutually perpendicular

The resonance search is performed with stroboscopic light with slow-motion facility and with accelerometer measurements of the vibration response curves on major resonant parts of the test specimen.

##### Endurance vibration:

Performed with random vibration according to IEC 68-2-36, Test Fdb with the following test data:

Frequency range	:	3 - 200 Hz
Total rms level	:	0,70 g
Acceleration Spectral Density	:	3 - 100 Hz : $0,0033$ g <sup>2</sup> /Hz 100 - 200 Hz : - 6 dB/octave
No. of axes	:	3 mutually perpendicular
Duration per axis	:	2 hours

The choice of random vibration as endurance vibration was done in agreement with the present surveyor from Det Norske Veritas, as the complex nature of the test specimens means that a very large number of different resonances occurs.

The endurance vibration specification is according to the type approval random vibration requirements from Det Norske Veritas for Class A Equipment, except that frequencies below 3 Hz have been cut-off with a 100 dB/octave slope instead of the specified

6 dB/octave slope. It is the vibration test equipment that gives this limitation and it was judged to have no practical meaning for the test specimen, as no amplification or resonances below 10 Hz were found.

## 5. EXPOSURES AND RESULTS

### 5.1 General

The test was performed in several tempi:

Initial resonance search

Modification of mounting principle/fixture

Resonance search

Modification of test specimen

Resonance search and endurance vibration

These are described detailed below.

### 5.2 Initial resonance search

The initial resonance search was performed 89.04.14 with the original test specimen. The panel was lying on the backside without the backplates on a horizontal fixture of 1.7 x 1.1 metres. The vertical parts of the frame of the panel was screwed to the fixture at five points in each side and at one point in the the middle.

The initial resonance search was only performed in the X- and Y-axis, as the resonance search showed that the fixture and the mounting principle not was sufficiently rigid.

### 5.3 Modification of mounting principle/fixture

According to the results from the initial resonance search, it was decided to improve the fixture and make a mounting situation more like the one encountered during normal use of the test specimen.

The improvements were performed 89.04.17 by personel from the client.

The improvements covered the following point:

- \* A rigid, steel frame made of U-profiles with the shape of a rectangular with a diagonally cross was welded together. This frame was then screwed on the backside of the frame of the panel at all four edges and at a point in the middle.
- \* A rigid diagonally cross was screwed on the bottom frame of the panel.

The U-profile frame was then attached to the 1.7 x 1.1 metres horizontal fixture.



These improvements should mean that the normal mounting situation, where the panel is bolted both to the floor and a wall, is simulated better than during the initial resonance search.

#### 5.4 Resonance search

The resonance search was performed 89.04.18 with the original test specimen lying on the modified fixture.

As the complex nature of the test specimen means that chattering and rattling occur at many frequencies, it was decided to perform the vibration response measurements with a 100 Hz low-pass filter on the accelerometer preamplifier.

The complex nature of the test specimen does also give a very large number of resonances of different parts of the test specimen. It was therefore decided to concentrate the vibration response measurement on the more important part of the test specimen, i.e. the busbars and the parts around the busbars.

The results from the vibration response measurement are presented on FIG. 1 - 8 in APPENDIX 2 as acceleration versus frequency. Some of the curves are reference curves (the acceleration level at the mounting points for the test specimen). The amplification factors can be found from the other curves by dividing the measured acceleration level with the reference curve.

The following curves are presented in APPENDIX 2:

CURVE	AXIS	REMARK
1	Y	Reference curve
2	Y	Measured on the middle of the vertical busbar
3	Y	Measured on the fuseholder support
4	Z	Reference curve
5	Z	Measured on the outlets from the fuseholder
6	X	Reference curve
7	X	Measured on the lower part of the vertical busbar
8	X	Measured on the middle of the vertical busbar

As the resonances concerning the busbar (curve 2, 7 and 8) were judged to be too powerful, it was decided to modify the design of the test specimen.

#### 5.5 Modification of test specimen

The mounting situation for the vertical busbars was improved by adding two BSR 9 profiles, one on each side of the supports for the busbars. This means that the mounting situation for the vertical busbars is more rigid than it is, when it is only the plates that the supports are mounted in. The modification was performed 89.04.19 by personnel from the client.

#### 5.6 Resonance search and endurance vibration

The resonance search and the endurance vibration were performed 89.04.19 - 89.04.20 with the modified test specimen lying on the modified fixture.

The vibration response measurements were performed with a 100 Hz low-pass filter on the accelerometer preamplifier.

The vibration response measurements were concentrated to the more important part of the test specimen, i.e. the busbars and the parts around the busbars.

The endurance vibration was performed immediately after the resonance search in each axis. The random endurance vibration were performed by means of 3 control accelerometers and extremal level control. An example of a recorded random vibration level is given in APPENDIX 3.

The results from the vibration response measurement are presented on FIG. 9 - 13 in APPENDIX 2 as acceleration versus frequency. Some of the curves are reference curves (the acceleration level at the mounting points for the test specimen). The amplification factors can be found from the other curves by dividing the measured acceleration level with the reference curve.

The following curves are presented in APPENDIX 2:

CURVE	AXIS	REMARK
9	X	Reference curve
10	X	Measured on the middle of the vertical busbar
11	X	Measured on the lower part of the vertical busbar
12	Y	Reference curve
13	Y	Measured on the middle of the vertical busbar

The resonances in the Z-axis were not changed due to the modification.

The amplification factors of the busbars were reduced to a acceptable (ref. Surveyor from Det Norske Veritas) low level, when comparing the modified and the original test specimen.

The actual sequence followed during the resonance search and the endurance vibration were as follows:

DATE	AXIS	EXPOSURE
89.04.19	X	Resonance search
89.04.19	X	Endurance vibration (2 hours)
89.04.19	Y	Resonance search
89.04.19	Y	Endurance vibration (2 hours)
89.04.20	Z	Endurance vibration (2 hours)

The test was thus performed as specified without any remarks.

## 5.7 Visual inspection

A visual inspection was performed 89.04.20 by ElektronikCentralen in order to detect any possible deterioration etc. caused by the vibration test.

The visual inspection gave the following remarks:

Wear powder and wear marks observed in the following places:

Around 4 locks (2 x 90 deg. slot, finger lock and snap lock)

Rubber seal for door on draw-out unit

Guide rails for draw-out unit

There were no new wear marks on the contact points in the draw-out unit (it was the same wear marks as observed before the vibration test, i.e. the wear marks arising from normal use).

There were no sign of wear, movements etc. on or around the busbars and the supports for the busbars.

6. SUMMARY

The 660 V type-Tested Panel, Form 4 manufactured by A/S Løgstrup Steel has been subjected to a vibration test based on the type approval vibration test specifications from Det Norske Veritas and Lloyd's Register of Shipping.

The exposures included resonance search and endurance vibration.

After modifications of the mounting principle/fixture and modifications of the test specimen, the test was performed as specified.

The vibration test results and the visual inspection showed that the test specimen was unaffected by the test, except that wear powder and wear marks were observed after the exposures.