# NTS Europe



## TCG NEBS COMPLIANCE TEST REPORT FOR:

## Product: Outdoor Model 42U700x700

## PART: 23
## EARTHQUAKE, OFFICE VIBRATION, AND TRANSPORTATION VIBRATION

**Section 4.4, GR-63-CORE**
**Telcordia Technologies GR-63, Issue 4, April 2012**

**Date: Sep 26, 2018Sep 25, 2018**

**Report: N16D0001**

**Approved By:________________________________Date: Sep 25, 2018Sep 26, 2018**

**Deniz Ezgi, NTS Program Manager**

# TABLE OF CONTENTS



# LIST OF TABLES



# LIST OF FIGURES

## TEST RESULTS SUMMARY

The Outdoor Model 42U700x700 was tested acc. to the requirements of GR 63 CORE, Issue 4, 2012

The Outdoor Model 42U700x700 complies with all applicable requirements and objectives.

## Column Heading Definitions for Summary of Test Results Table

The following Summary of Test Results table contains these columns of information:

- **Section** column gives the Section numbers from GR-63-CORE.
- **Section Name** column gives the Section name from GR-63-CORE.
- **Criteria** column gives the local number of the requirement (e.g., R3-1) from GR-63-CORE and the absolute number of the requirement (e.g., [2]).
- **Results** column gives the results of the evaluation (Compliant, Non-compliant, etc.).
  - **Compliant:** The Equipment Under Test (Outdoor Model 42U700x700) met the requirements of the corresponding criteria.
  - **Non-compliant:** The Outdoor Model 42U700x700 did not meet the requirements of the corresponding criteria.
  - **NA:** The criteria were Not Applicable to the Outdoor Model 42U700x700.
  - **ENR:** An Evaluation, to these criteria, was Not Requested by the customer.
  - For additional details, go to the page listed in this report.
- **Page** column gives the page number, in this report, for the corresponding criteria.

**Table 23-1 Earthquake, Office- and Transportation-Vibration Summary of Test Results**

| Section | Section Name | Criteria | Results | Comments | Page |
|---|---|---|---|---|---|
| **4.4** | **Earthquake, Office Vibration, and Transportation Vibration** | - | - | | - |
| 4.4.1 | Earthquake Environment and Criteria | - | - | | - |
| 4.4.1.2 | Physical Performance Criteria | R4-65 [110] | Compliant | | 6 |
| | | R4-66 [111] | Compliant | | 6 |
| | | R4-67 [112] | Compliant | | 6 |
| | | O4-68 [113] | Compliant | | 6 |
| 4.4.1.3 | Functional Performance | R4-69 [114] | NA | | 6 |
| | | O4-70 [115] | NA | | 6 |
| 4.4.2 | Framework and Anchor Criteria | O4-71 [116] | ENR | | 26 |
| | | R4-72 [117] | Compliant | | 26 |
| | | O4-73 [118] | NA | No static pull test performed | 26 |
| | | R4-74 [119] | NA | Concrete expansion anchors were not part of the test-setup | 26 |
| | | O4-75 [120] | NA | | 26 |
| | | O4-76 [121] | NA | | 26 |
| 4.4.3 | Wall-Mounted Equipment Anchor Criterion | O4-76 [211] | NA | EUT is no wall mounted equipment | 27 |
| | | R4-78 [175] | NA | | 27 |
| 4.4.4 | Office Vibration Environment and Criteria | - | - | | - |
| | Physical Performance Criteria | R4-79 [122] | ENR | | |
| | Functional Performance Criteria | R4-80 [123] | ENR | | |
| 4.4.5 | Transportation Vibration Criteria | - | - | | - |
| 4.4.5.1 | Transportation Environment | R4-98 [124] | ENR | | |

## OVERVIEW

### Project Objective

Testing was performed to determine if the Outdoor Model 42U700x700 meets the requirements for Section 4.4, *Earthquake, Office Vibration, and Transportation Vibration*, of Telcordia Technologies GR-63-CORE, Issue 4, April 2012.

The Equipment Configuration, Operating Conditions and Pass/Fail Criteria are described in the Executive Summary, which is part of this documentation.

# EARTHQUAKE ENVIRONMENT AND CRITERIA (4.4.1)

## Physical Performance Criteria (4.4.1.2)

## Criteria:

During this test, only the equipment shelf's physical performance is considered. Permanent structural or mechanical damage of the framework or its fastening hardware would not constitute a failure, but may invalidate the test.

Permanent structural damage is defined as deformation of any load-bearing element of the equipment being tested, or any connection failure. Typical examples of permanent structural damage are bent or buckled uprights, deformed bases, cracks, and failed anchors or fastening hardware.

Mechanical damage is defined as any dislocation or separation of components. Examples of mechanical damage are disengaged cards and modules, and opened (ajar) doors, drawers, or covers.

**R4-65 [110]** All equipment shall be constructed to sustain the waveform testing of Section 5.4.1, "Earthquake Test Methods," without permanent structural or mechanical damage.

*During frame-level testing, the physical performance of the equipment shelves, framework, and fastening hardware are considered. Permanent structural or mechanical damage of any of these elements constitutes a test failure. During shelf- level and wall-mounted testing, only the equipment shelf's physical performance is considered. (Permanent structural or mechanical damage of the framework or its fastening hardware would not constitute a failure, but may invalidate the test.) Hardware replacement during the earthquake testing is not permitted. Tightening of anchors or fasteners that can be performed without interrupting service is acceptable and is the only permissible repair.*

**R4-66 [111]** Frame-level equipment shall be constructed so that during the waveform testing of Section 5.4.1, the maximum single-amplitude deflection at the top of the framework, relative to the base, does not exceed 75 mm *(3 in)*.

**R4-67 [112]** Frame-level equipment shall have a natural mechanical frequency greater than 2.0 Hz as determined by the swept sine survey of Section 5.4.1

**O4-68 [113]** Frame-level equipment should have a natural mechanical frequency greater than 6.0 Hz as determined by the swept sine survey of Section 5.4.1

## Functional Performance (4.4.1.3)

## Criteria:

The criterion for assessing functionality depends on the service provided by the equipment being tested. The criteria are determined by applying appropriate Telcordia generic requirements or, if none exist, by reviewing the supplier's or purchaser's own performance specifications.

**R4-69 [114]** All equipment shall be constructed to meet applicable functionality requirements **immediately before and after** each axis of waveform testing of Section 5.4.1. The equipment shall sustain operation without replacement of components, manual rebooting, or human intervention.

**O4-70 [115]** All equipment should be constructed to meet applicable functionality requirements continuously during waveform testing of Section 5.4.1. These functionality criteria shall demonstrate that the equipment has sustained operation without loss of service during the testing.

## Test Method

### Frame-Level

The frame-level configuration shall be used for network equipment supplied with a framework.

1. Mount the equipment to its supporting framework.
2. Mount the equipment frame to the shaker table similar to how it will be installed in service. This may include using a concrete slab and anchors to simulate equipment installed on concrete building floors. In all cases use recommended fastener size, quantities, torque values, hold-down plates, shims, isolation devices, etc. Where concrete expansion anchors are normally used to fasten the framework base to the building floor, the mounting to the shaker table may be substituted by welded studs, bolts, or cap-screws of equal quantities and diameter as the concrete expansion anchors.
3. The equipment shall be fastened to the shaker table (or concrete slab) using typical anchor locations. If the framework base allows for a variety of anchor locations, locate one fastener in the inner most location.
4. Record the torque value of each anchor or fastener.
5. Frames intended to support overhead cable shall be loaded with a weight of 23 kg (50.0 lb) on top of the framework. Less weight may be used if it can be demonstrated that the above value is excessive. Where less weight is used, the computations for such weight shall be provided as part of the test plan.

*Frame-Level Instrumentation Configuration*

1. Locate the accelerometers so they record the acceleration of the shaker table, acceleration at the top of the framework, and acceleration at the mid-height level.
2. Install anchor load measurement equipment to record the peak anchor loads if the concrete slab and concrete expansion anchors are omitted from the framelevel test. It can be assumed that the inner-most anchor position is the worstcase and will have the highest load.
3. Install deflection measurement equipment to measure the deflection at the top of the framework relative to its base.

## Test Location

The following evaluation was performed by Mr. Tanz on May 30, 2018 at

SGS Germany GmbH
Hofmannstraße 50
81379 München
Germany

## Test Sequence

1. Perform a swept sine survey with an acceleration amplitude of 0.2 g from 1 to 50 Hz at a sweep rate of 1.0 octave per minute. (Higher sweep rates are permitted to reduce equipment stress.)
2. Verify equipment functionality and physical condition.
3. Subject the equipment to the VERTEQII waveform. Verify the TRS meets or exceeds the RRS in the frequency range from 1.0 to 50 Hz. If the TRS is below the RRS at any point, use the last drive signal and table acceleration to update the transfer function. Apply it to the Telcordia waveform to generate a new drive signal, and retest the equipment. Repeat this step as necessary.
   The TRS should not exceed the RRS by more than 30% in the frequency range of 1 to 7 Hz. A test may be invalid if an equipment failure occurs when the TRS exceeds the RRS by more than 30% in this frequency range.
4. Record the displacement and acceleration data during the shaking.
5. Thoroughly inspect the equipment and note all changes to its physical condition.
6. Record any reductions in anchor or fastener torques.
7. Reverify equipment functionality.

The test severity corresponds to Zone 4, the time history signal applied was Verteq II.
The rack itself was fixed with screws (M12) to an aluminum plate of 40mm thickness.

Definition of axes:
x : horizontally side to side
y : horizontally front to back
z : vertical

## Deviations from prescribed Test Sequence

## Resonance Search

The resonance search was performed on an electrodynamic shaker. Due to its performance, the following deviations from GR 63 CORE occurred:

1. Start of sine sweep was 1,25 Hz (instead of 1 Hz)
2. Amplitude was 0,13 g (instead of 0,2 g)
3. 3 axes; 1 sweep cycle per axis

| Frequency Range (Hz) | Acceleration | Sweep Rate (oct. / min) |
|---|---|---|
| 1,25 – 50 * | 0,13 g | 1 |

**Resonance Search**

Fig. 23-1 Resonance search: x-axis (horizontal)

Fig. 23-2 Resonance search: y-axis (horizontal)

Fig. 23-3 Resonance search: z-axis (vertical)

Fig. 23-4 EUT with dummy weights

Fig. 23-5 Measuring point MP2 at middle of EUT

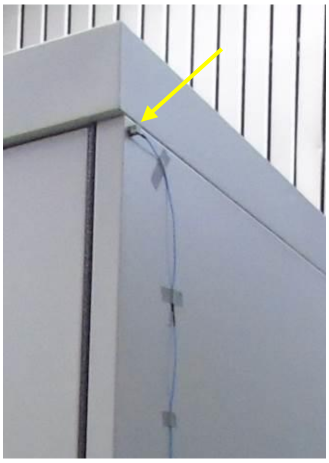


Fig. 23-6 Measuring point MP1 at top of EUT

## Waveform Testing

The waveform testing was performed on a MTS seismic table. The entire built-up is shown in Fig. 23-7 … .Fig. 23-9.
For z-axis test, a vertically oriented piston underneath the table is used.
For the z-axis test, no LVDT is applied.

All earthquake tests are documented by video.

Fig. 23-10 to Fig. 23-13 show the applied accelerometers (one at the table and two at the rack's top and middle respectively).

Fig. 23-7 Entire built-up for waveform testing (x-axis)

Fig. 23-8 Entire built-up for waveform testing (y-axis)

Fig. 23-9 Entire built-up for waveform testing (z-axis)

Fig. 23-10 LVDT measuring system

Fig. 23-11 Measuring point at table

Fig. 23-12 Measuring point at middle of EUT

Fig. 23-13 Measuring point at top of EUT

## <u>Test Results</u>

### Resonance Search

The resonance search was performed in three axes with the following results (figs. 23-14 to 23-19):

lowest natural gross frequency for excitation in x-direction: 8,3 Hz
lowest natural gross frequency for excitation in y-direction: 9,5 Hz
lowest natural gross frequency for excitation in z-direction: no results in the examined frequency range

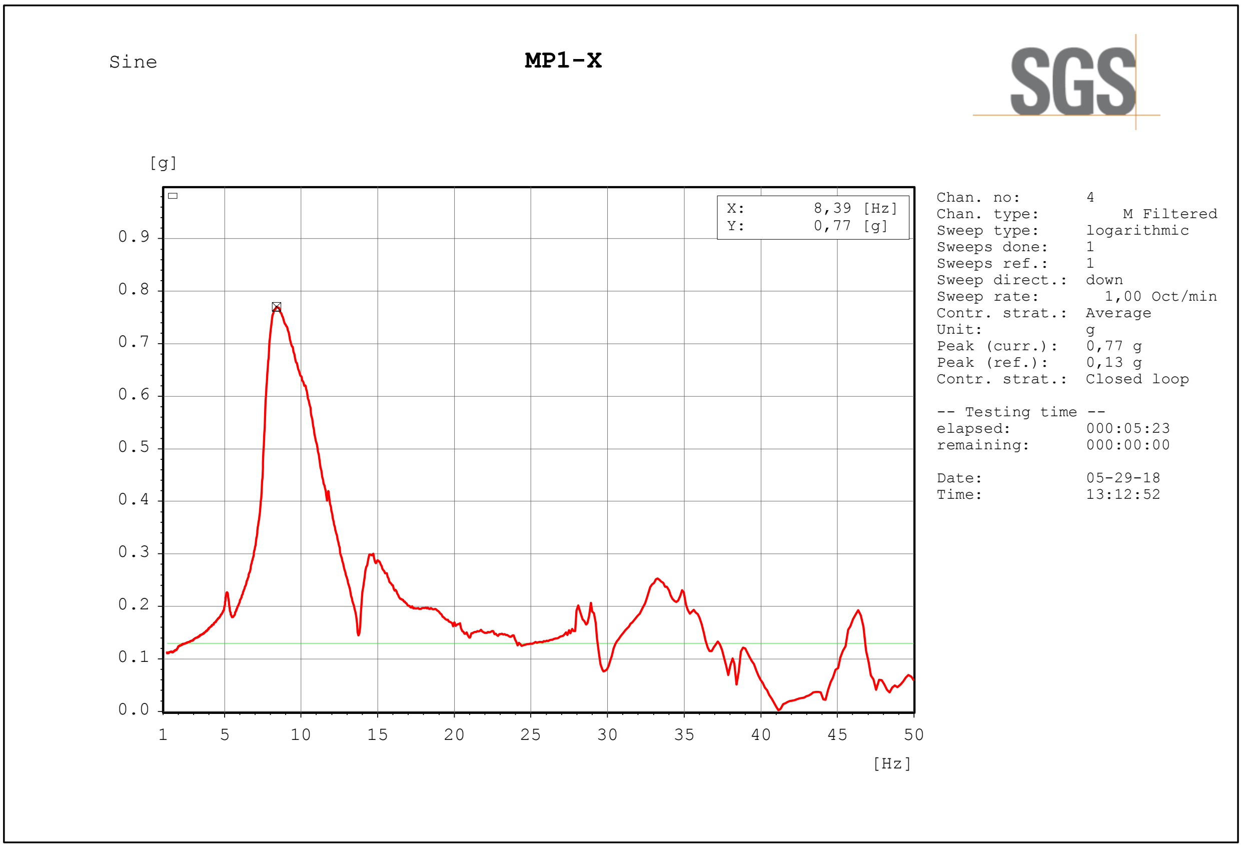



Fig. 23-14 Resonance search: excitation in x-dir.; top of the rack

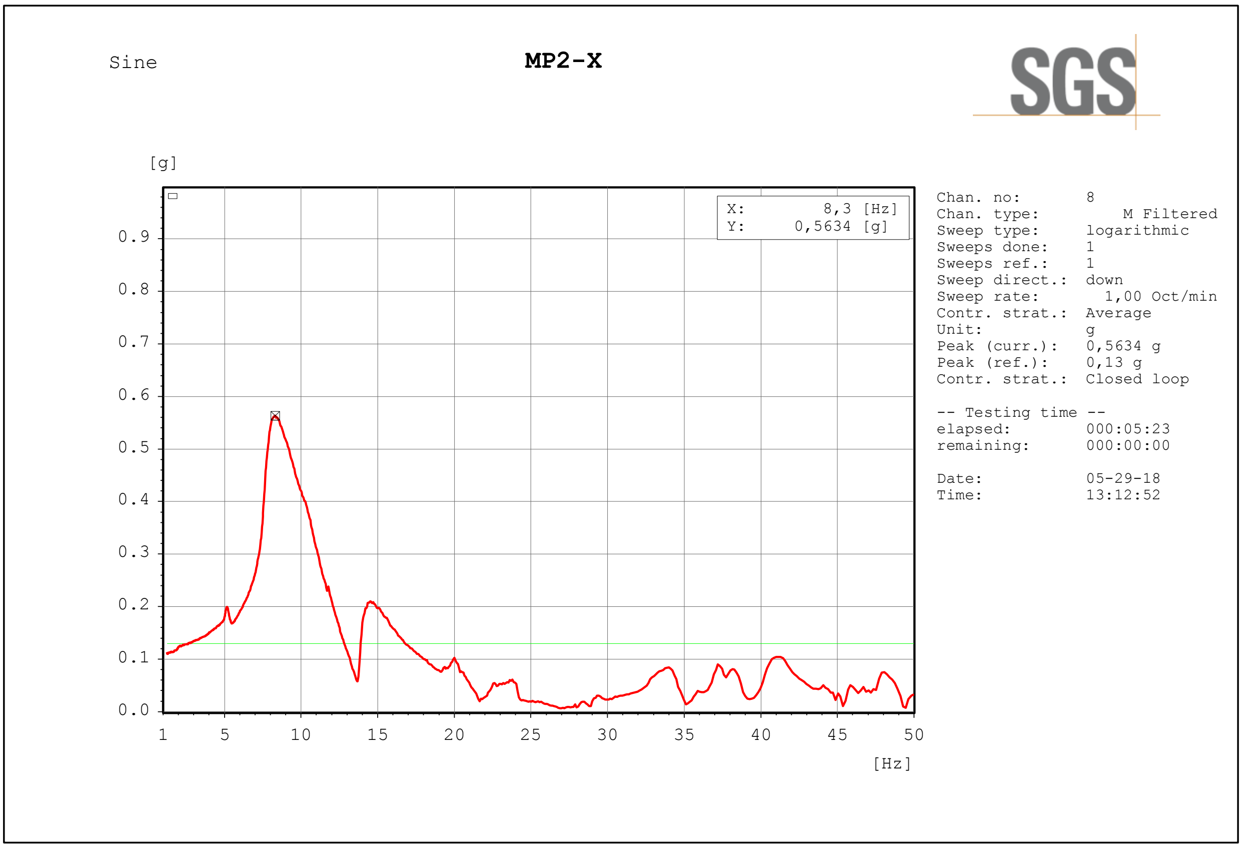



Fig. 23-15 Resonance search: excitation in x-dir.; middle of the rack

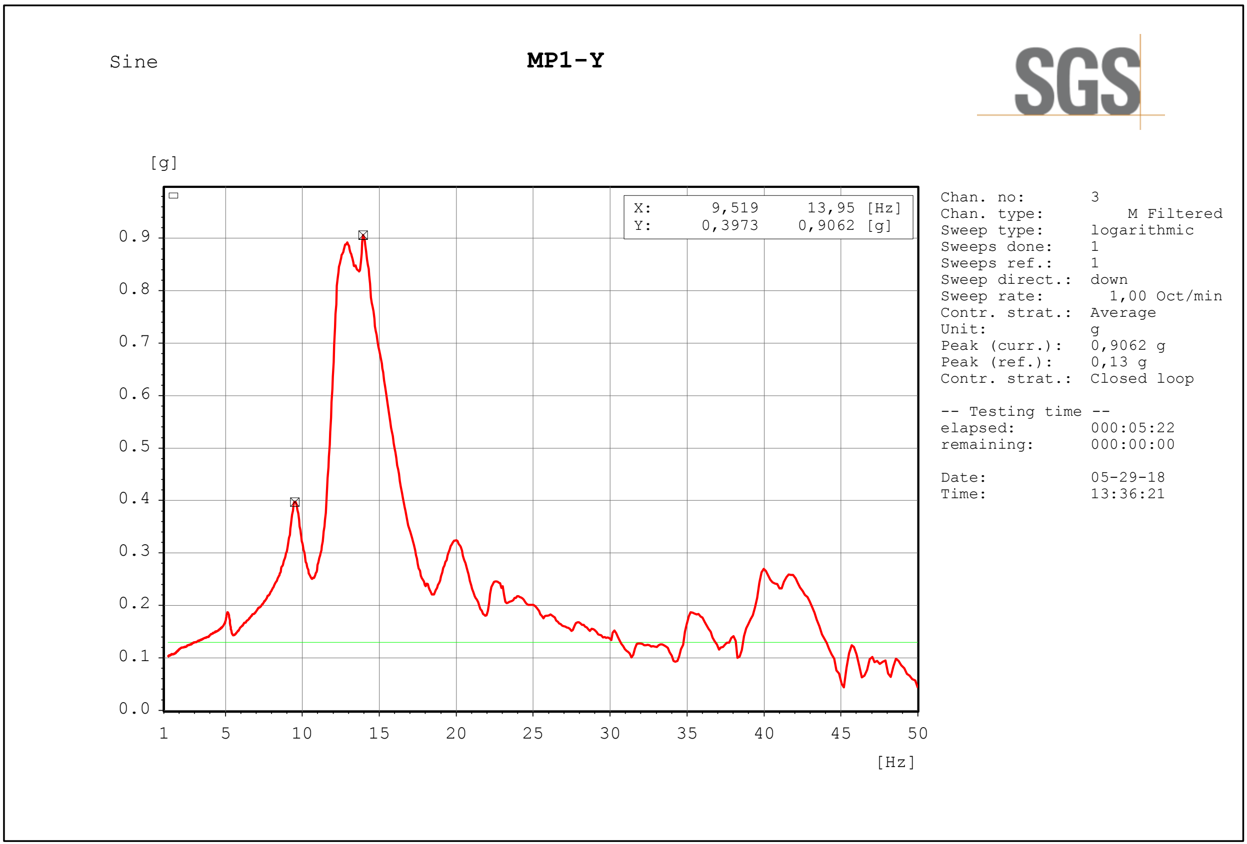



Fig. 23-16 Resonance search: excitation in y-dir.; top of the rack

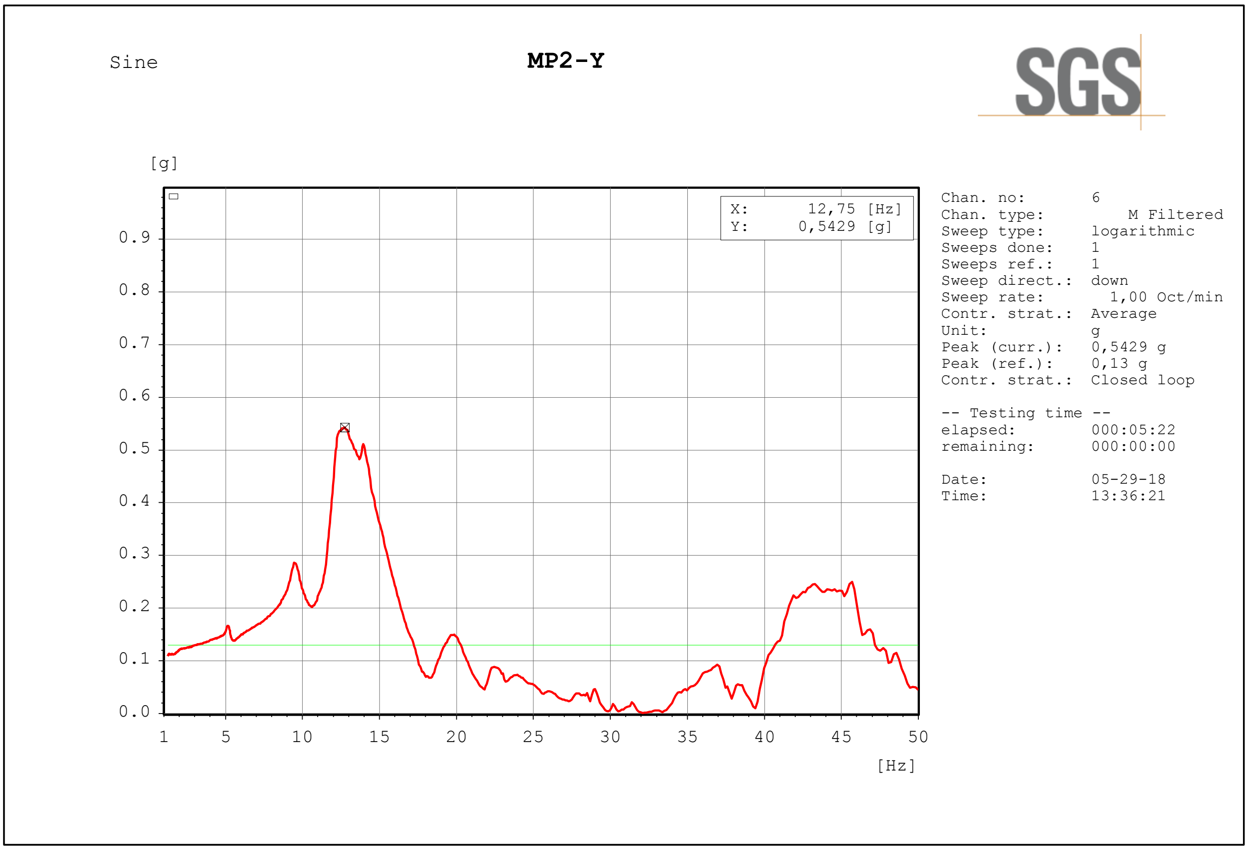



Fig. 23-17 Resonance search: excitation in y-dir.; middle of the rack

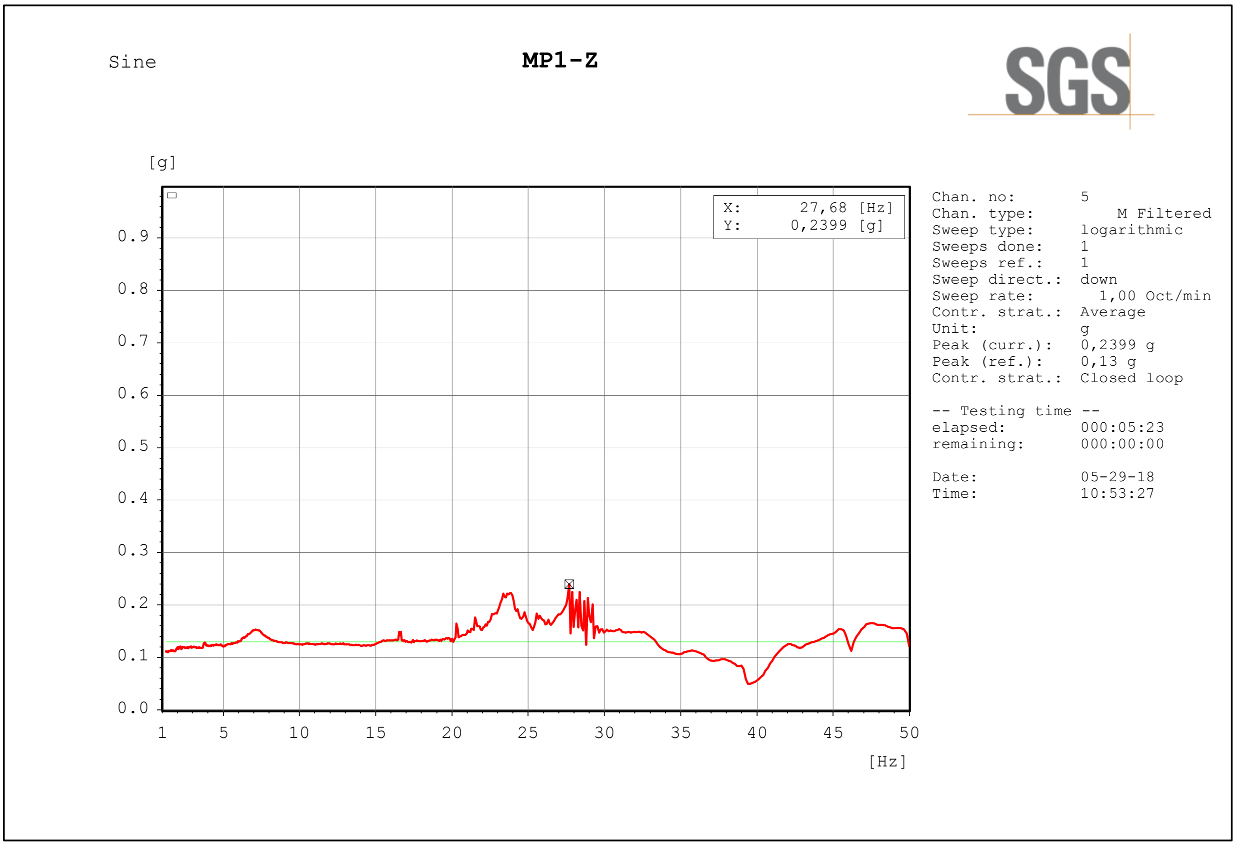



Fig. 23-18 Resonance search: excitation in z-dir.; top of the rack

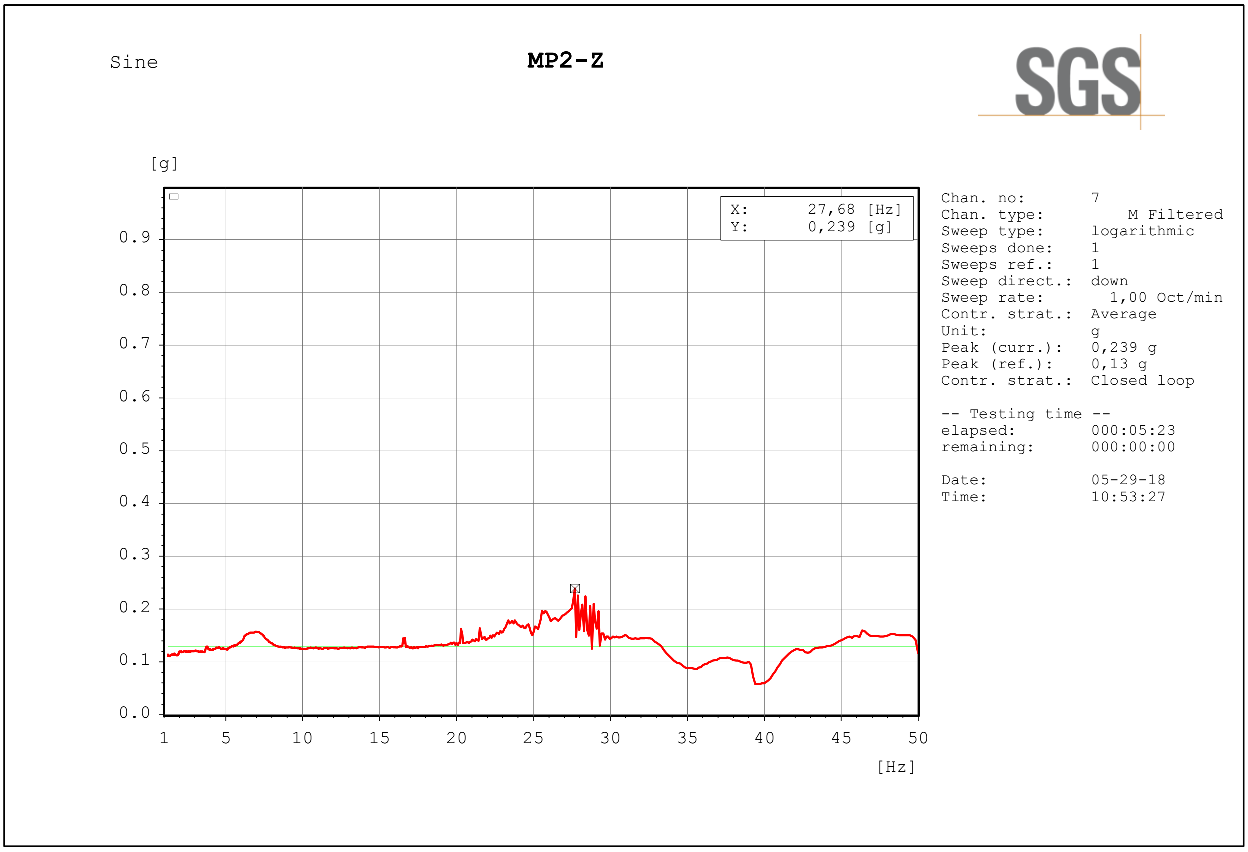



Fig. 23-19 Resonance search: excitation in z-dir.; middle of the rack

**Waveform Testing**

**<u>Excitation in direction of x-axis</u>**

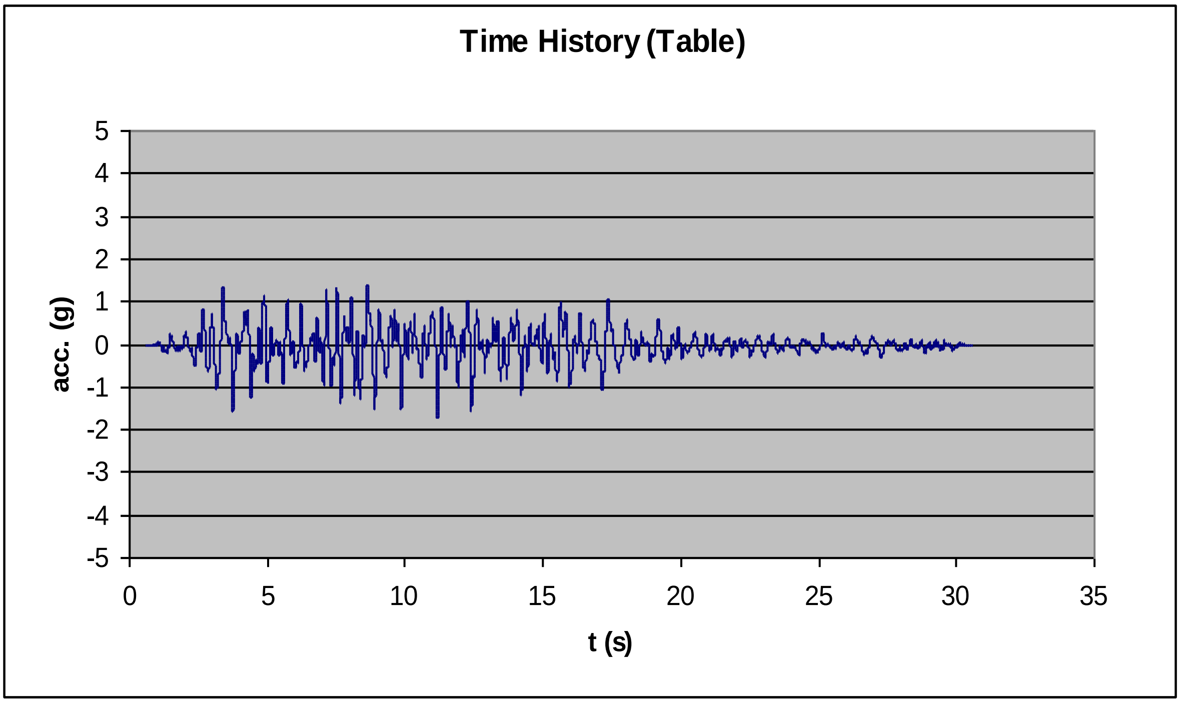



Fig. 23-20 Time history signal at the table X-axis

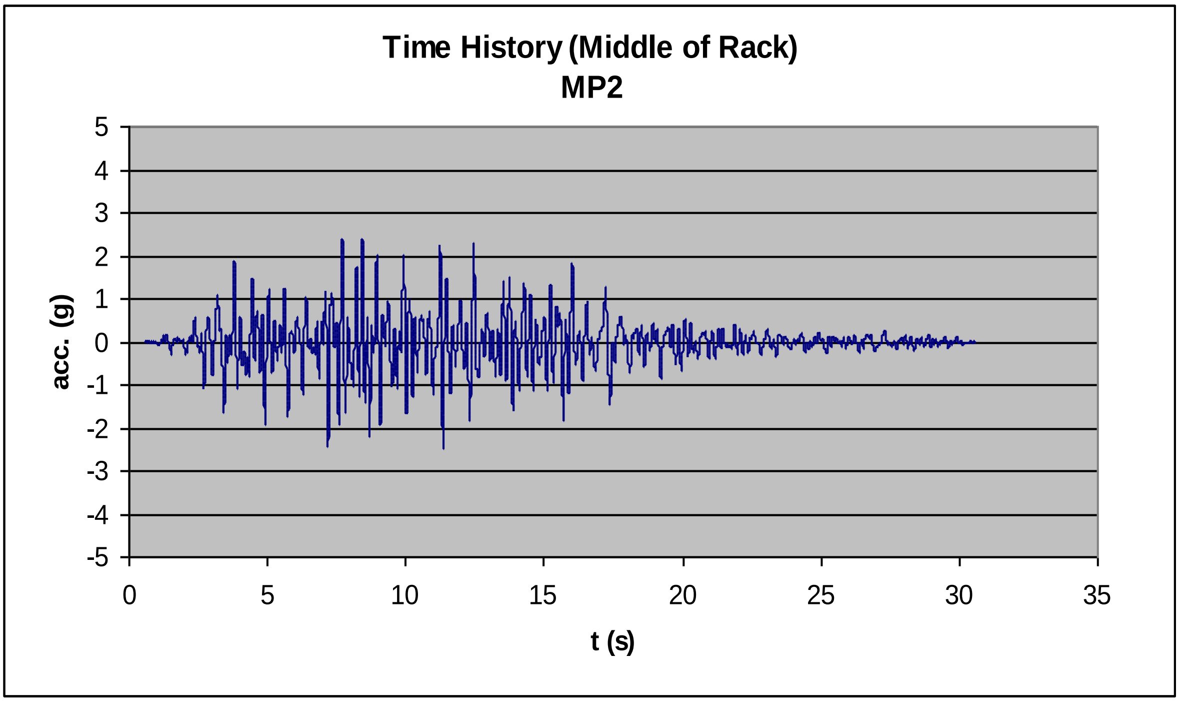



Fig. 23-21 Time history signal at the middle of the rack X-axis

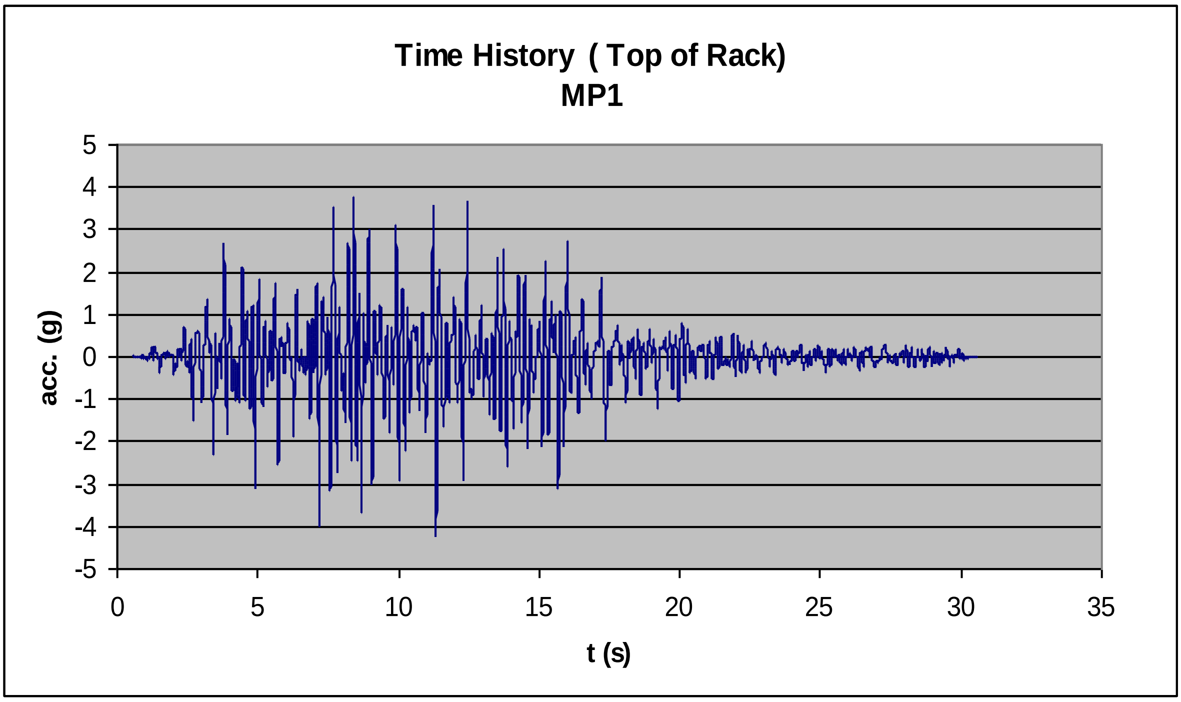



Fig. 23-22 Time history signal at the top of the rack X-axis

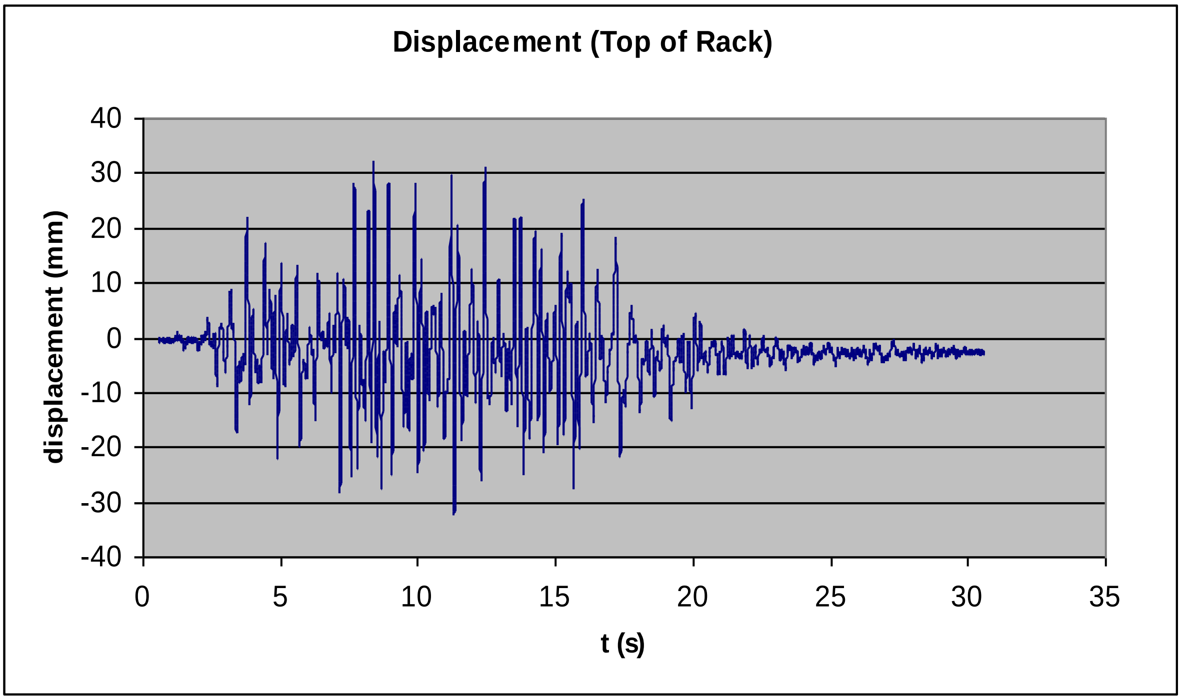



Fig. 23-23 Displacement at the top of the rack X-axis

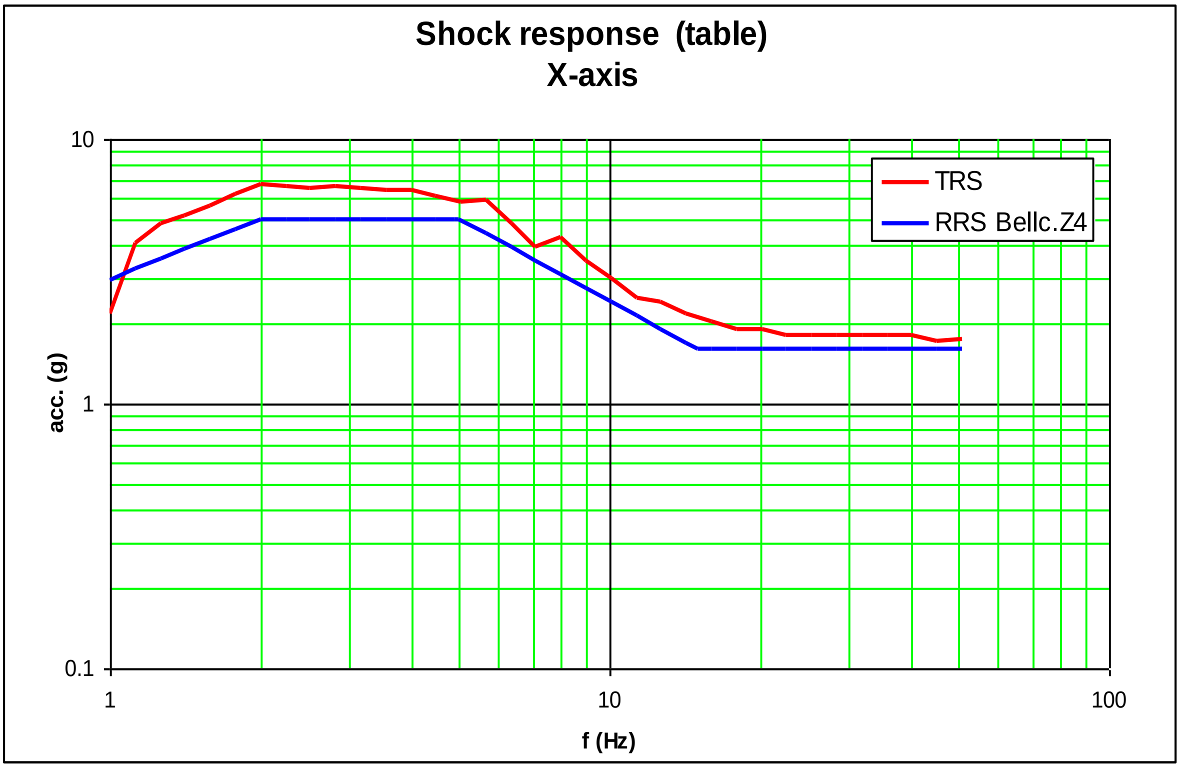



Fig. 23-24 RRS and TRS at the table X-axis

**Excitation in direction of y-axis**

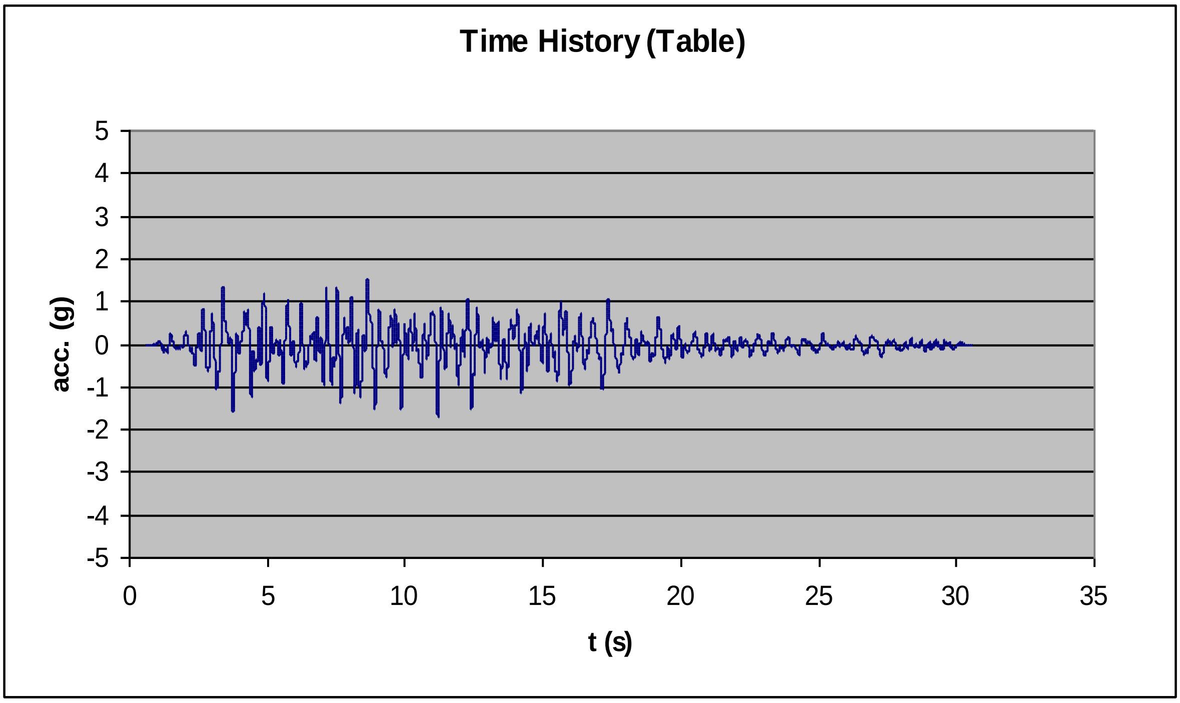



Fig. 23-25 Time history signal at the table Y-axis

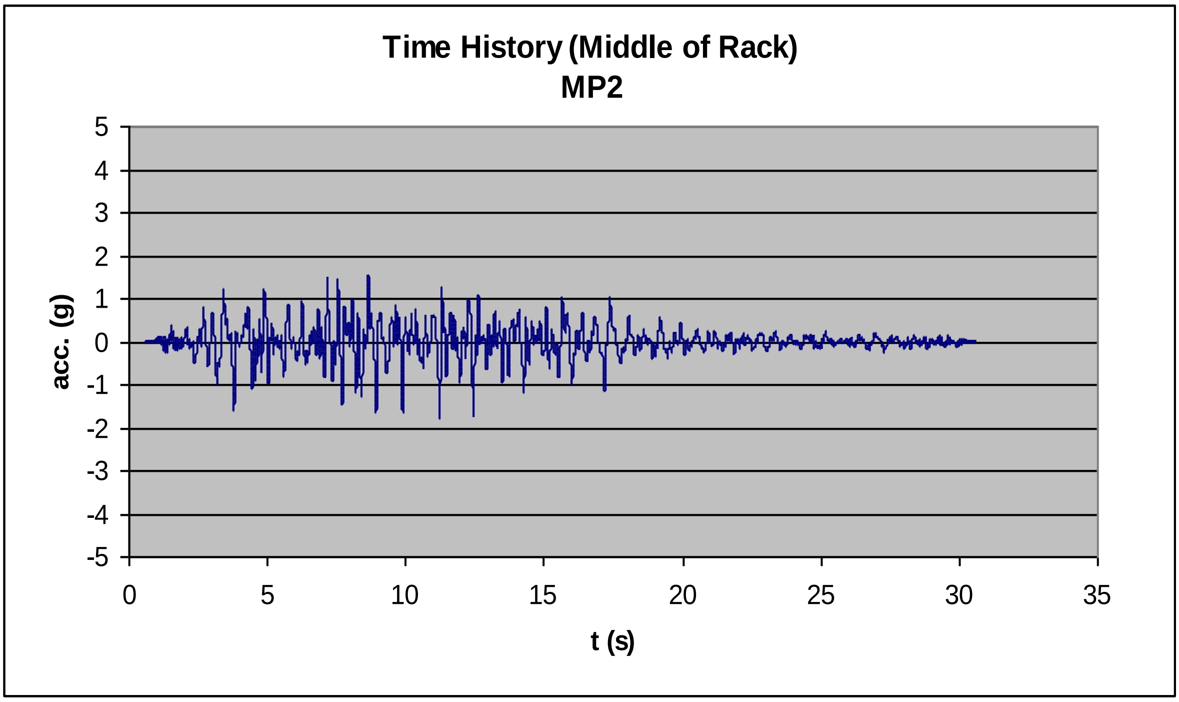



Fig. 23-26 Time history signal at the middle of the rack Y-axis

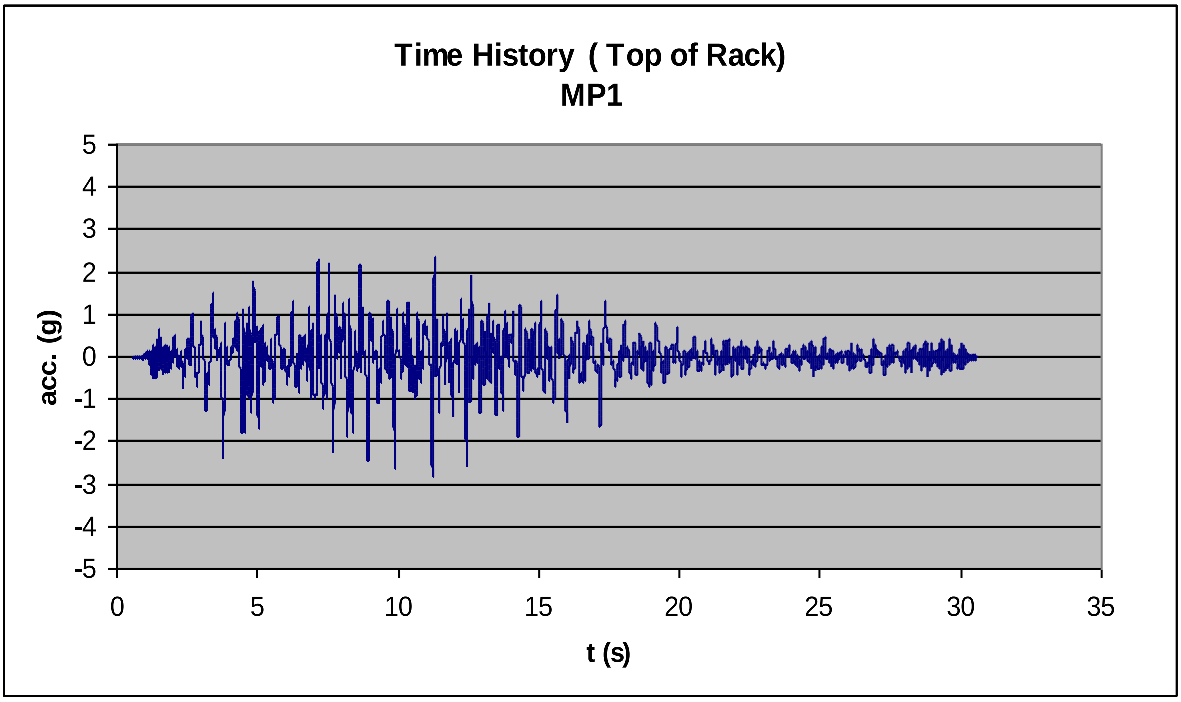



Fig. 23-27 Time history signal at the top of the rack Y-axis

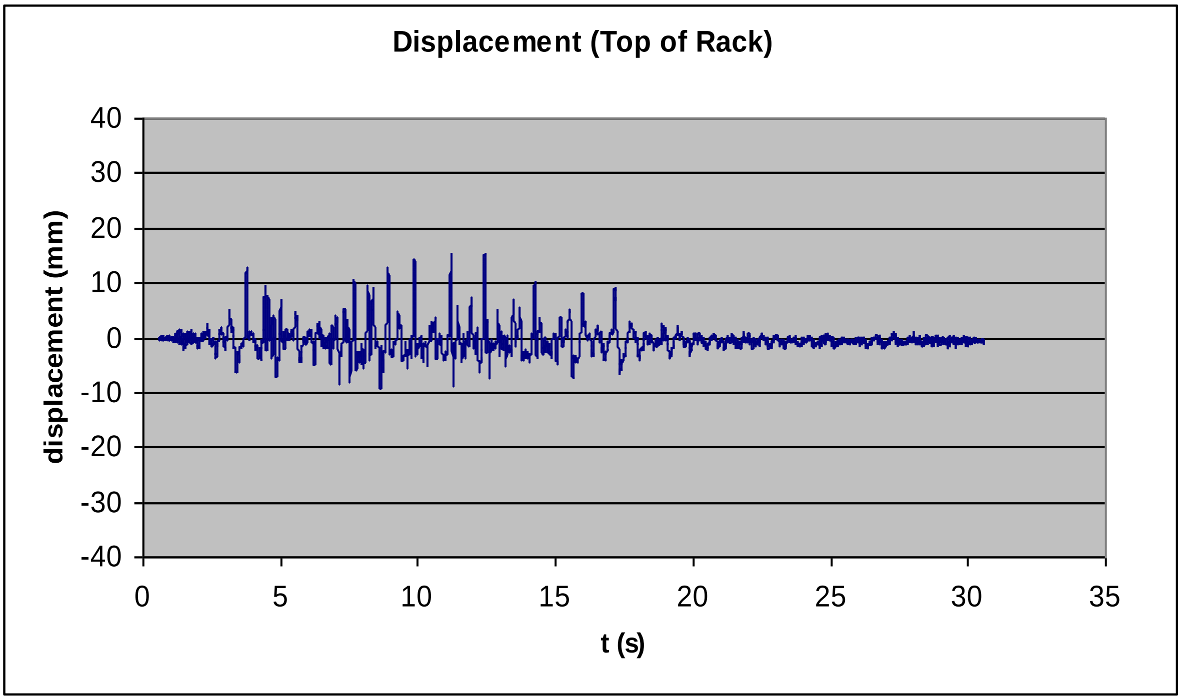



Fig. 23-28 Displacement at top of the rack Y-axis

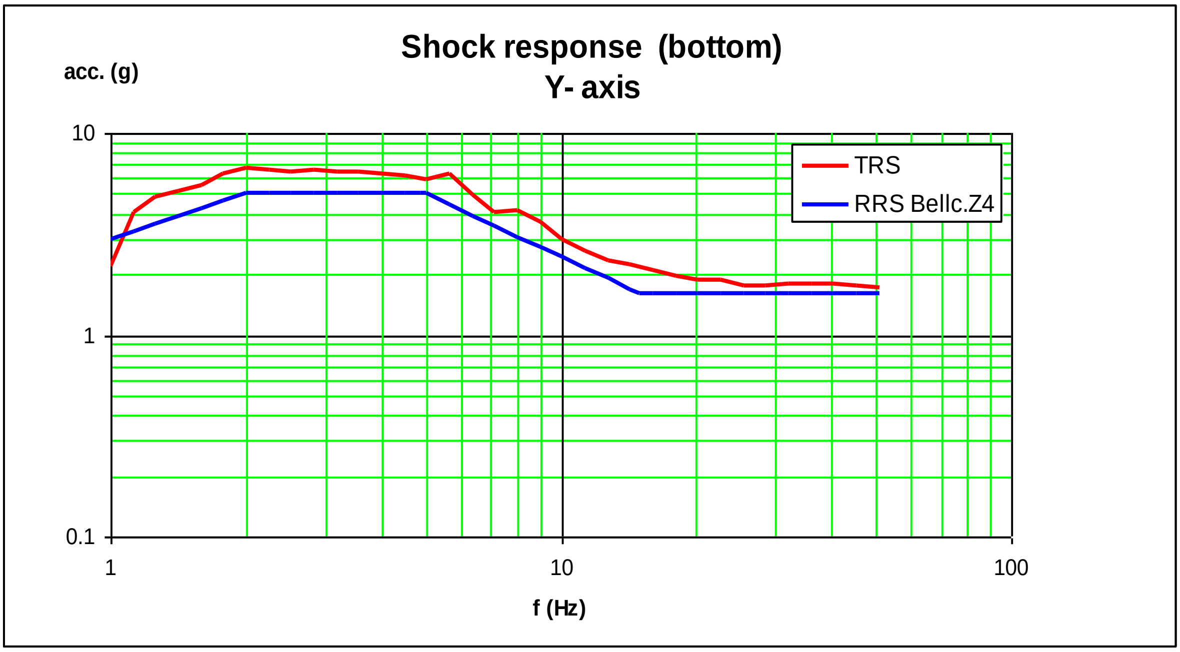



Fig. 23-29 RRS and TRS at the table Y-axis

**Excitation in direction of z-axis**

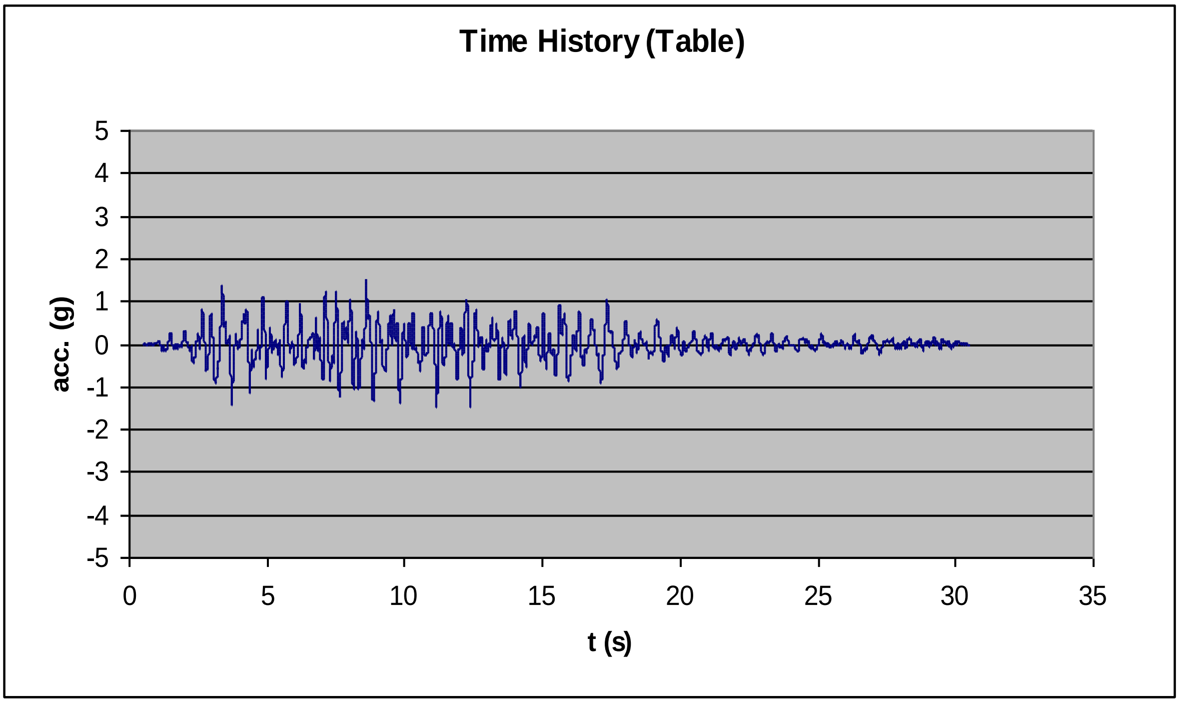



Fig. 23-30 Time history signal at the table Z-axis

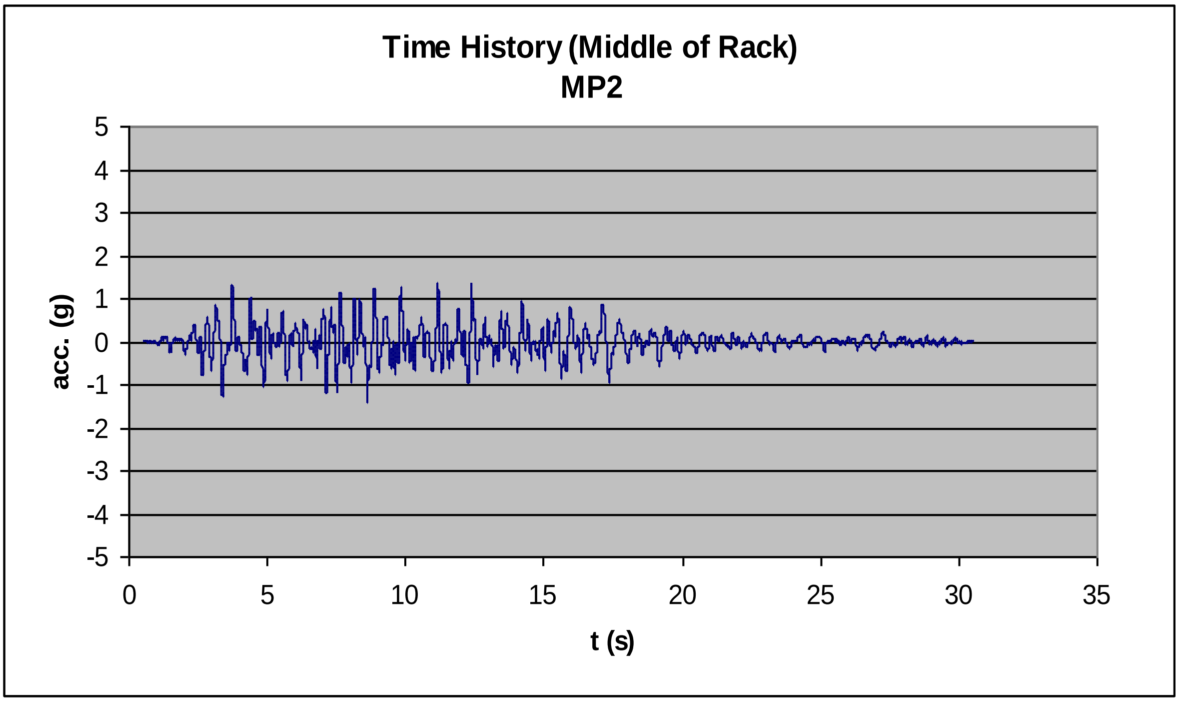



Fig. 23-31 Time history signal at the middle of the rack Z-axis

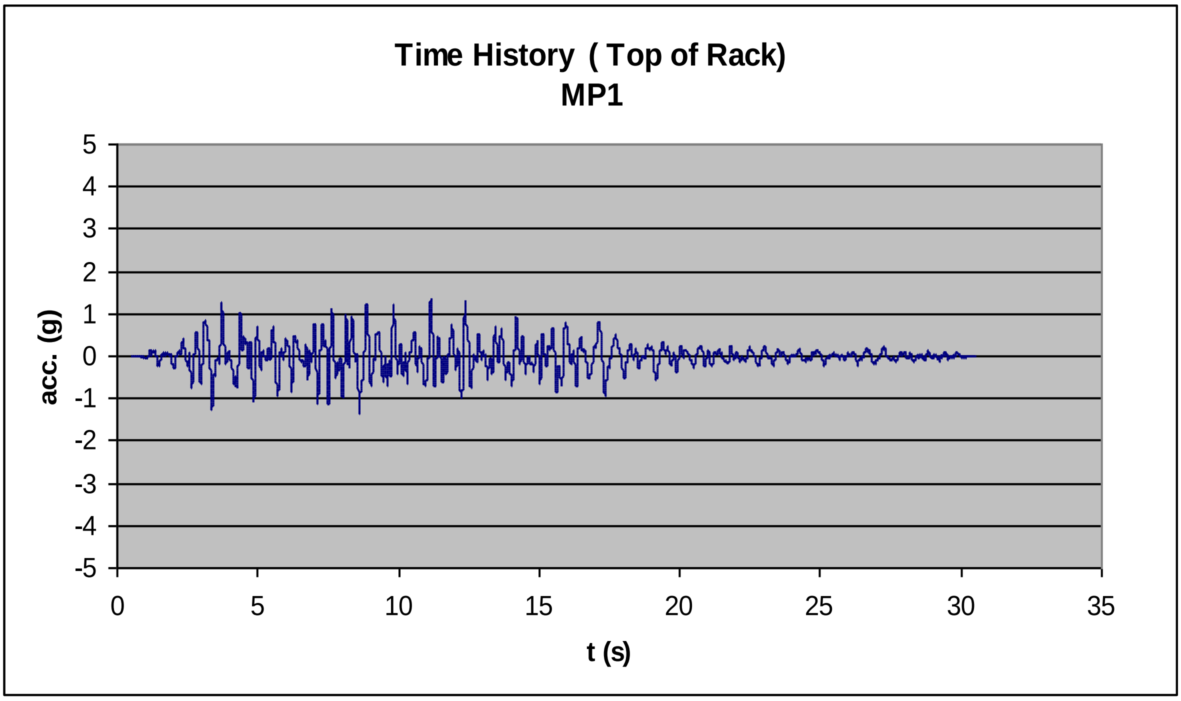



Fig. 23-32 Time history signal at the top of the rack Z-axis

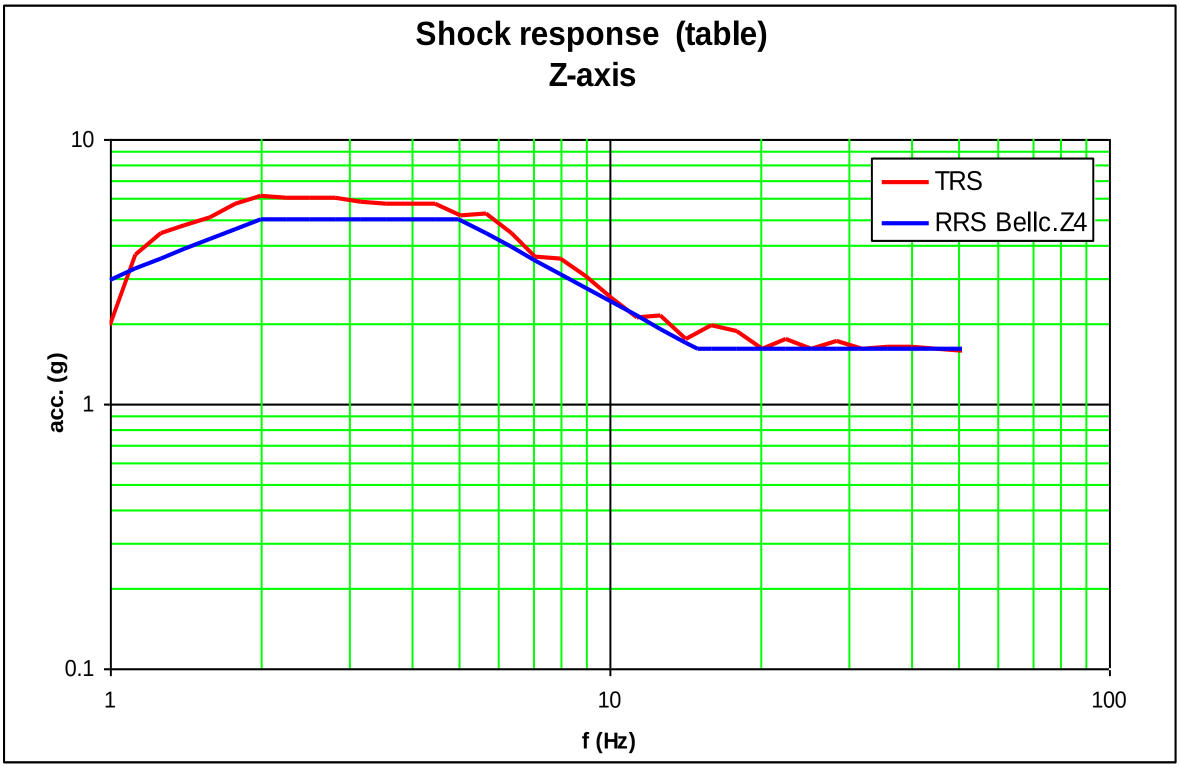



Fig. 23-33 RRS and TRS at the table Z-axis

For Z-axis test no displacement data was recorded.

After waveform testing, no mechanical or structural damages were detected.

The maximum displacement at top of the rack was 33 mm.

The Outdoor Model 42U700x700 is **compliant** with **R4-65 [110], R4-66 [111], R4-67 [112], O4-68 [113].**

## Test Equipment Used

**Table 23-2 Earthquake Environment List of Test Equipment**

**Electro-dynamic Shaker 80 A**

| ID. No. | Equipment | Manufacturer | Status | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| S1419 | 80A Vibration Exciter VIB9000 | RMS | cnn | | |
| S5452 | Vib Control V2.12.25 | m+p | cnn | | |
| S5560 | Vibration Control and Analysis system | VXI Technology | cal | Mar 28, 2018 | Mar 2019 |
| S6267 | Lenovo Think Centre Tower PC (VIB9000) | Lenovo | ind | | |
| S6184 | Accelerometer | PCB | cal | Mar 23, 2017 | Mar 2019 |
| S6185 | Accelerometer | PCB | cal | Jan 17, 2017 | Jan 2019 |
| S6440 | Accelerometer | PCB | cal | Nov 17, 2017 | Nov 2019 |
| S6448 | Accelerometer | PCB | cal | Jan 11, 2018 | Jan 2020 |

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

**Seismic Test System 86 A**

| ID. No. | Equipment | Manufacturer | Status | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| S0353 | Earthquake Test System | MTS | cnn | | |
| S0896 | Control System for Earthquake | | cnn | | |
| S5317 | Accelerometer | Sensotec | cal | Jul 25, 2017 | Jul 2019 |
| S5453 | Software Version 3.3A | MTS | cnn | | |
| S5482 | Power Supply | TET Electronic | ind | | |
| S5544 | Position Transducer | National Oilwell | ind | | |
| S5841 | 3 CH DC Signal Conditioner | PCB | cal | Jul 19, 2016 | Jul 2018 |
| S5398 | Accelerometer | Endevco | cal | Aug 02, 2017 | Aug 2019 |
| S5844 | Accelerometer | Sensotec | cal | Jul 31, 2017 | Jul 2019 |

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, man = Maintenance

## FRAMEWORK AND ANCHOR CRITERIA (4.4.2)

## Criteria:

The following criteria apply to all framework and concrete expansion anchors used in network facilities. They are intended to ensure minimum limits for structural performance in earthquake environments are met.

**O4-71 [116]** Framework should be of welded construction.

**R4-72 [117]** Framework shall be constructed for base mounting to the floor without auxiliary support or bracing from the building walls or ceilings.

**O4-73 [118]** For framework used in earthquake risk zones, the static pull testing procedures of Section 5.4.1.4, should be followed, meeting these objectives:

- The maximum single amplitude deflection at the top of the framework should not exceed 75 mm.
- The top of the framework should return to its original position, within 6 mm when the load is removed.
- The framework should sustain no permanent structural damage during static framework testing.

**R4-74 [119]** Concrete expansion anchors used to base mount framework to the floor shall meet the following requirements:

- • Maximum embedment depth of 90 mm (3.5 in)
- • Maximum bolt diameter of 13 mm (0.5 in).

**O4-75 [120]** It is an objective that concrete expansion anchors used to base mount the framework to the floor should be suitable for earthquake (dynamic) applications, as specified by the manufacturer.

**NOTE***: Typical concrete anchors are not designed for dynamic loads, such as earthquakes. The above criterion specifies that the selected anchors should be designed to meet the dynamic loads specified in this document.*

**O4-76 [121]** It is an objective that concrete expansion anchors should use steel construction to minimize creep.

*Concrete expansion anchors used for frame-level waveform testing must conform to the physical performance requirements of Section 4.4.1, "Earthquake Environment and Criteria." If substitute fasteners are used in place of concrete expansion anchors during frame-level testing, the peak increase in fastener load above its preload as calculated or measured during the tests should not exceed the safe working load specified for the concrete expansion anchors by the manufacturer in 3000 psi concrete.*

## Test Location

The following evaluation was performed by Mr. Tanz on May 30, 2018 at

SGS Germany GmbH
Hofmannstraße 50
81379 München
Germany

## Test Method

No test performed.

## WALL-MOUNTED EQUIPMENT ANCHOR CRITERION (4.4.3)

## Criteria:

**O4-77 [211]** It is an objective that framework used for securing wall-mounted equipment should be of welded construction.

**R4-78 [175]** Fastening systems used for wall-mounted equipment shall withstand a force of 3 times the weight of the equipment applied to the equipment in any direction.

Wall-mounted equipment listed to the latest edition of **ANSI / UL 60950-1:2005**, *Standard for Safety of Information Technology Equipment,* conform to this requirement.

## Test Location

The following evaluation was performed by Mr. Tanz on May 30, 2018 at

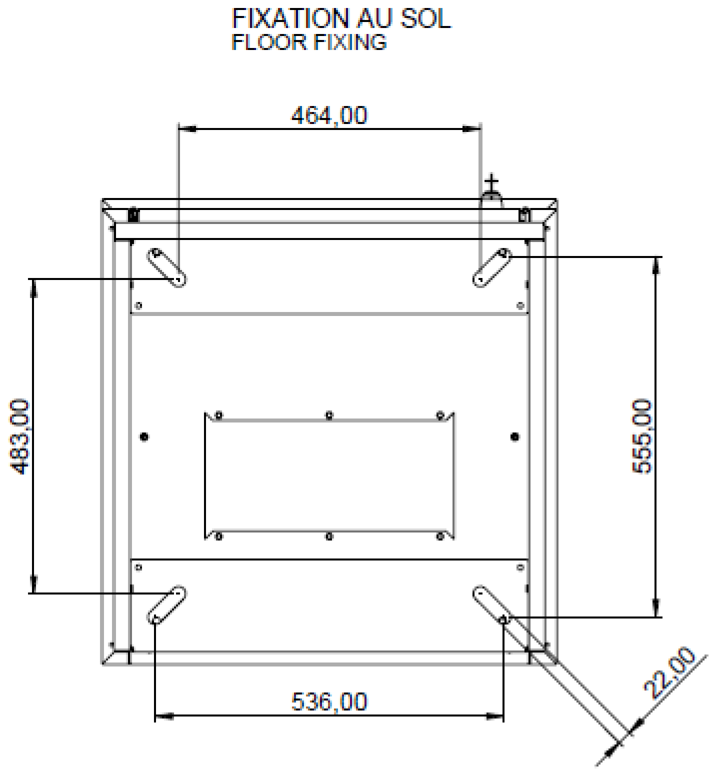
SGS Germany GmbH
Hofmannstraße 50
81379 München
Germany

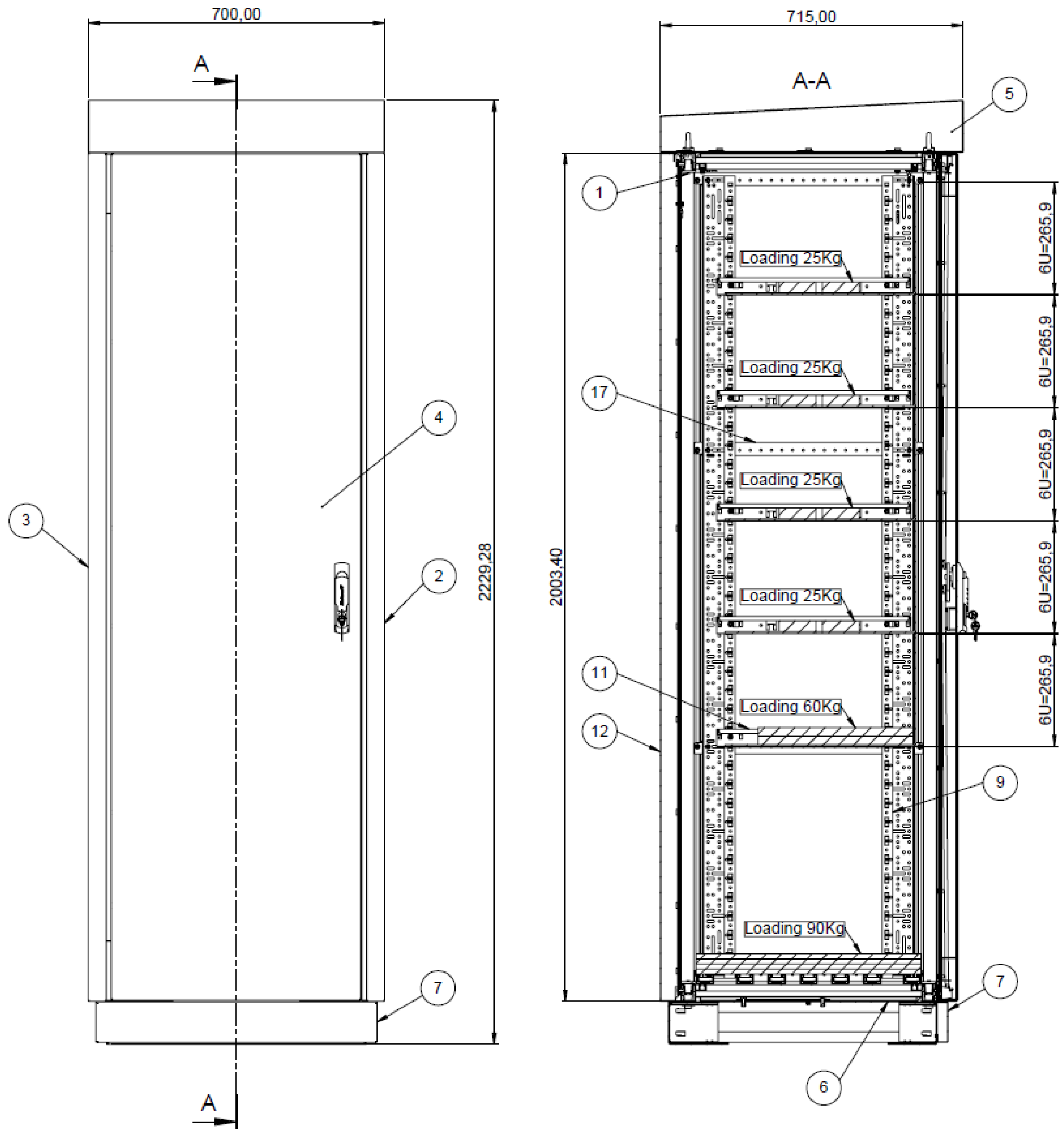
## Test Method

No test performed.

As the Outdoor Model 42U700x700 is a no wall mounted equipment, the requirement **R4-95 [175]** is **not applicable (NA).**

# APPENDIX A : EUT Description

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12
9
Loading 90Kg
7
6