

QS3 & Henning Sensor Suite



Acceleration Measurement in all 3-axes



***Design for
modern elevator
Diagnosis***

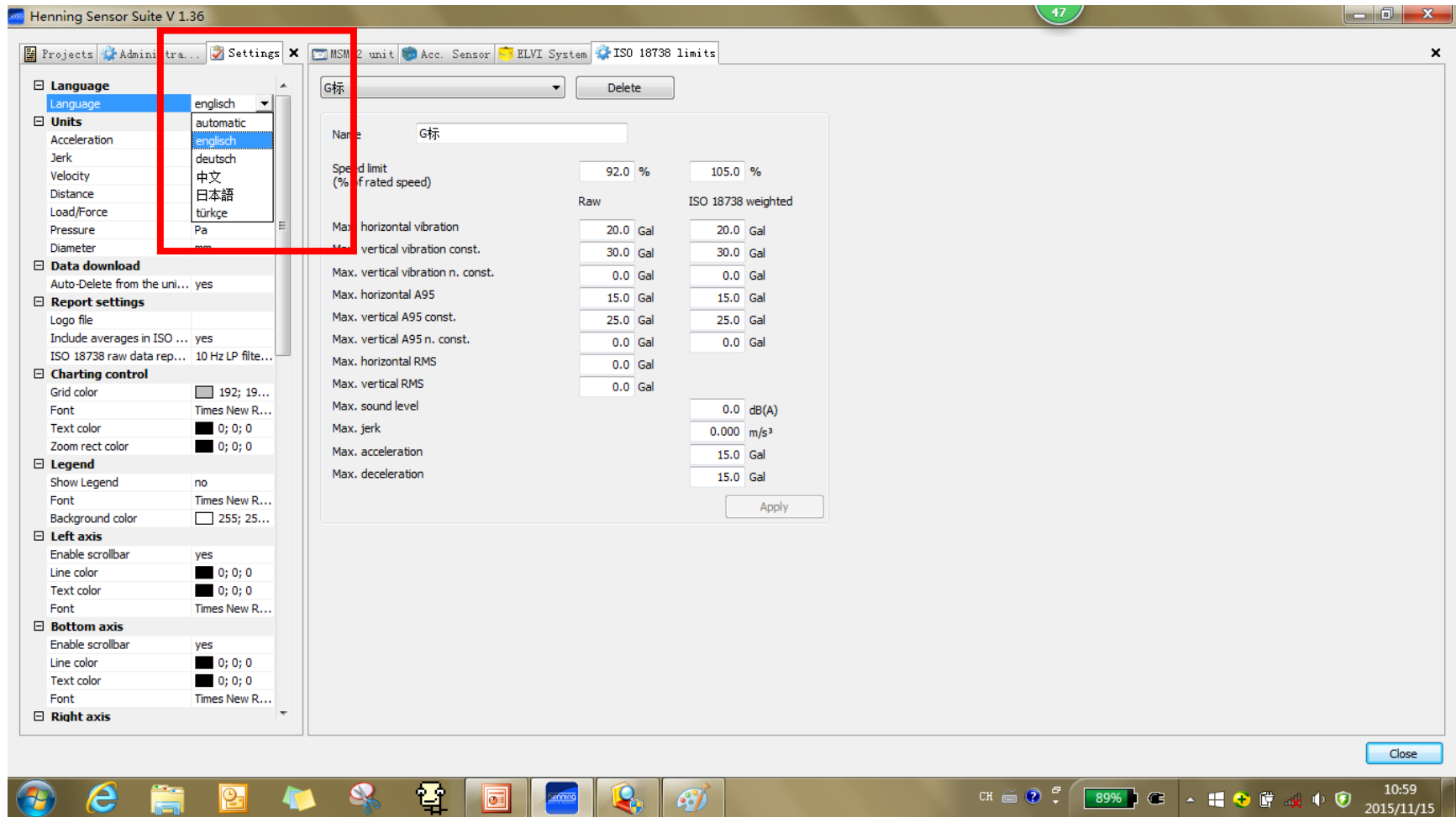
- „No” time limit for measurement within 8G memory disk
- Simultaneous representation and data evaluation, via USB connection with laptop
- Built-in Bluetooth module
- remote control APP for Android device
- Built-in Li-ion battery pack, easy maintenance
- reload with mobile power-bank possible
- Built-in wireless Qi charging module

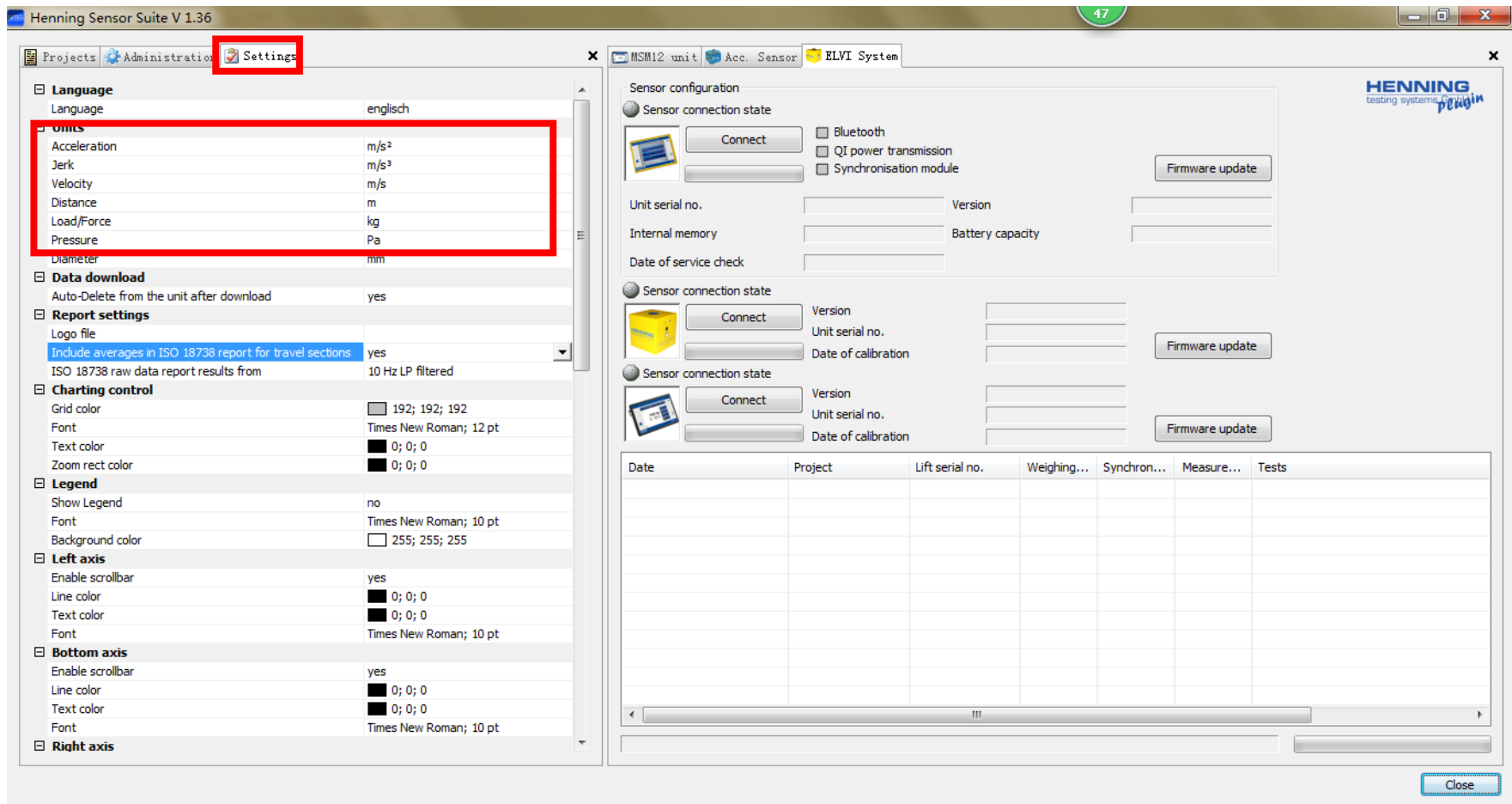
Download the latest setup file from Henning web-site and install the software. The installation will recognize your OS language automatically (available for English, German, Chinese, Japanese and Turkish at the moment) and apply it to software. The user can also select a language later on.

Double-click  to start the software.

HENNING Suite can be use for the data collection, evaluation of following HENNING products:

- acceleration sensor (type: QS3)
- sound level meter (type: AZ8922)
- mobile rope load sensor (type: MSM12)
- Elevator testing device ELVI





The screenshot displays the 'Henning Sensor Suite V 1.36' application window. The 'Settings' tab is active, showing various configuration options. A red box highlights the 'Data download' and 'Report settings' sections. A red arrow points from the 'Data download' section to a modal dialog box that is open, showing the same settings. The dialog box has a 'Close' button at the bottom right.

Settings Tab:

- Language:** englisch
- Units:**
 - Acceleration: m/s²
 - Jerk: m/s³
 - Velocity: m/s
 - Distance: m
 - Load/Force: kg
 - Pressure: Pa
 - Diameter: mm
- Data download:**
 - Auto-Delete from the unit after download: yes
 - Report settings: yes
 - Logo file: no
- Charting control:**
 - ISO 18738 raw data report results from: 10 Hz LP filtered
 - Grid color: 192; 192; 192
 - Font: Times New Roman; 12 pt
 - Text color: 0; 0; 0
 - Zoom rect color: 0; 0; 0
- Legend:**
 - Show Legend: no
 - Font: Times New Roman; 10 pt
 - Background color: 255; 255; 255
- Left axis:**
 - Enable scrollbar: yes
 - Line color: 0; 0; 0
 - Text color: 0; 0; 0
 - Font: Times New Roman; 10 pt
- Bottom axis:**
 - Enable scrollbar: yes
 - Line color: 0; 0; 0
 - Text color: 0; 0; 0
 - Font: Times New Roman; 10 pt
- Right axis:**

Modal Dialog Box:

- Data download:**
 - Auto-Delete from the unit after download: yes
- Report settings:**
 - Logo file: no

Data Plots:

- Distance [m]:** Max: 6.93, 3.315 m
- ISO X [m/s²]:** Max Pk/Pk: 0.012 A95: 0.010 0-Pk: 0.008
- ISO Z [m/s²]:** -0.150

System Tray: 19:50, 2015/11/17

The screenshot displays the 'Henning Sensor Suite V 1.36' application window. The interface is divided into several sections:

- Left Panel (Settings):** Contains tabs for 'Projects', 'Administration', and 'Settings'. Under 'Settings', there are sections for 'Language' (set to 'englisch'), 'Units' (Acceleration: m/s², Jerk: m/s³, Velocity: m/s, Distance: m, Load/Force: kg, Pressure: Pa, Diameter: mm), 'Data download' (Auto-Delete: yes), 'Report settings' (Logo file: empty), 'Charting control' (Grid color: 10 Hz LP filtered), 'Legend' (Show Legend: no, Font: Times New Roman, 10 pt, Background color: 255; 255; 255), 'Left axis' (Enable scrollbar: yes, Line color: 0; 0; 0, Text color: 0; 0; 0, Font: Times New Roman, 10 pt), and 'Bottom axis' (Enable scrollbar: yes, Line color: 0; 0; 0, Text color: 0; 0; 0, Font: Times New Roman, 10 pt).
- Right Panel (Data and Settings):**
 - Travel section:** Shows a '1/6' indicator and buttons for 'Additional Sensors', 'Distance', 'Velocity', 'Acceleration', 'Jerk', 'RMS (x, y, z)', 'Frequency analysis', 'Acceleration vector', 'Acceleration (Raw)', 'ISO 18738 weighted', and 'ISO 18738 raw data'. A red arrow points from the 'Charting control' dropdown in the left panel to the 'ISO 18738 raw data' button.
 - Distance [m] Plot:** Shows a line graph with a peak labeled 'Max: 6.93' and a specific point labeled '3.315 m'.
 - ISO X [m/s²] Plot:** Shows a line graph with a peak labeled 'Max Pk/Pk: 0.012 A95: 0.010 0-Pk: 0.008'.
 - Report settings:** A sub-window showing 'Logo file' (empty), 'Include averages in ISO 18738 report for travel...' (yes), 'ISO 18738 raw data report results from' (10 Hz LP filtered), and 'Charting control' (Grid color: 10 Hz LP filtered).
 - ISO Z [m/s²] Plot:** Shows a line graph with a peak labeled 'Max: -0.150'.

The bottom of the window shows a Windows taskbar with various icons and a system clock indicating 20:33 on 2015/11/17.

Henning Sensor Suite V 1.36

Projects Administration **Settings**

Language
Language: englisch

Units
Acceleration: m/s²
Jerk: m/s³
Velocity: m/s
Distance: m
Load/Force: kg
Pressure: Pa

Report settings
Logo file: [dropdown]
Include averages in ISO 18738 report for travel sections: yes
ISO 18738 raw data report results from: 10 Hz LP filtered

Charting control
Grid color: 192; 192; 192
Font: Times New Roman; 12 pt
Text color:
Zoom rect color:
Legend:
Show Legend:
Font:
Background color:

Left axis
Enable scrollbar: yes
Line color: 0; 0; 0
Text color: 0; 0; 0
Font: Times New Roman; 10 pt

Bottom axis
Enable scrollbar: yes
Line color: 0; 0; 0
Text color: 0; 0; 0
Font: Times New Roman; 10 pt

Right axis

Sensor configuration
Sensor connection state:
Bluetooth
Qi power transmission
Synchronisation module
Firmware update
Unit serial no.:
Version:
Internal memory:
Battery capacity:

Include averages in ISO 18738 report for travel sections

Get the average values for all travel sections in one measurements in the end of a report

Close

Henning Sensor Suite V 1.36

Projects Administration Settings MSM12 unit Acc. Sensor ELVI System ISO 18738 limits

ISO 18738 limits

My Sensors

G标

Delete

Name: G标

Speed limit (% of rated speed): 92.0 % 105.0 %

Raw	ISO 18738 weighted
Max. horizontal vibration: 20.0 Gal	20.0 Gal
Max. vertical vibration const.: 30.0 Gal	30.0 Gal
Max. vertical vibration n. const.: 0.0 Gal	0.0 Gal
Max. horizontal A95: 15.0 Gal	15.0 Gal
Max. vertical A95 const.: 25.0 Gal	25.0 Gal
0.0 Gal	0.0 Gal
0.0 Gal	0.0 Gal
0.0 Gal	0.0 Gal

0.0 dB(A)
0.000 m/s³
15.0 Gal
15.0 Gal

Apply

Close

In "Administration" the user can define limit sets for the ISO 18738 values

Choose an entry from the pull down list

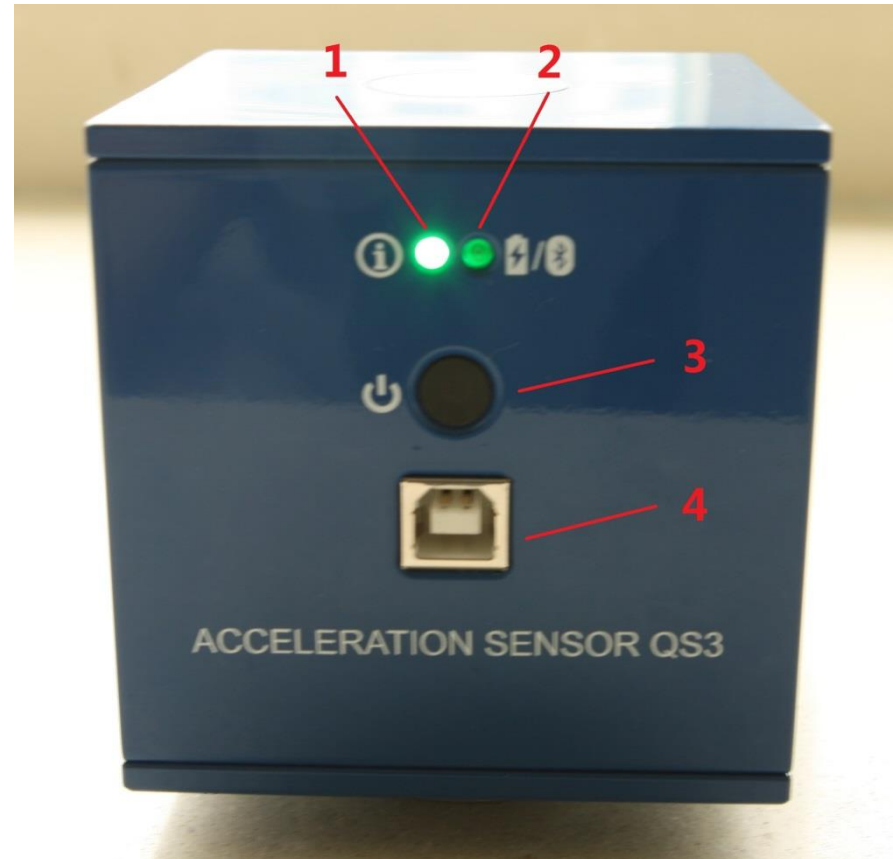
Save with "Apply"

1. Status Anzeige

- Blinking green slowly: Idle
- Fast green blinking : Initialisation
- Steady green: Measurement is running
- Blinking red slowly: Batteries down
- Fast red blinking: Internal memory full

2. Bluetooth and Charging

- Blue: BT transmission
- Steady red: Batteries are loaded



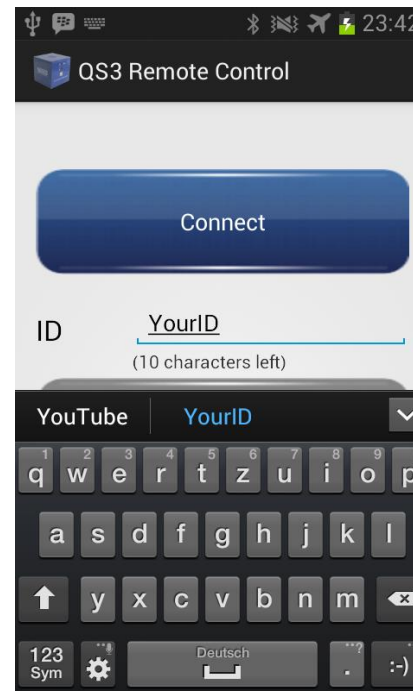
Stand-Alone:

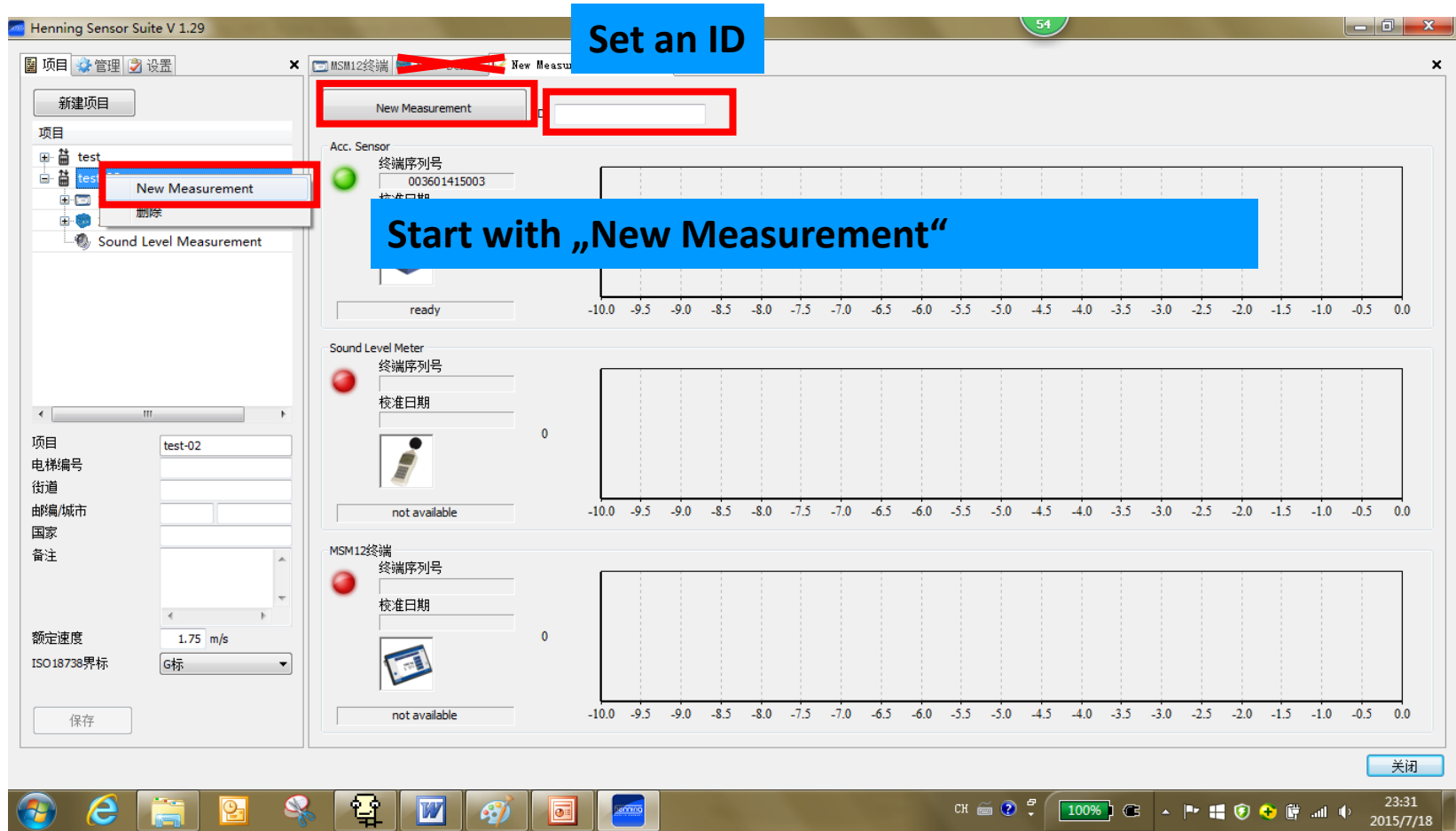


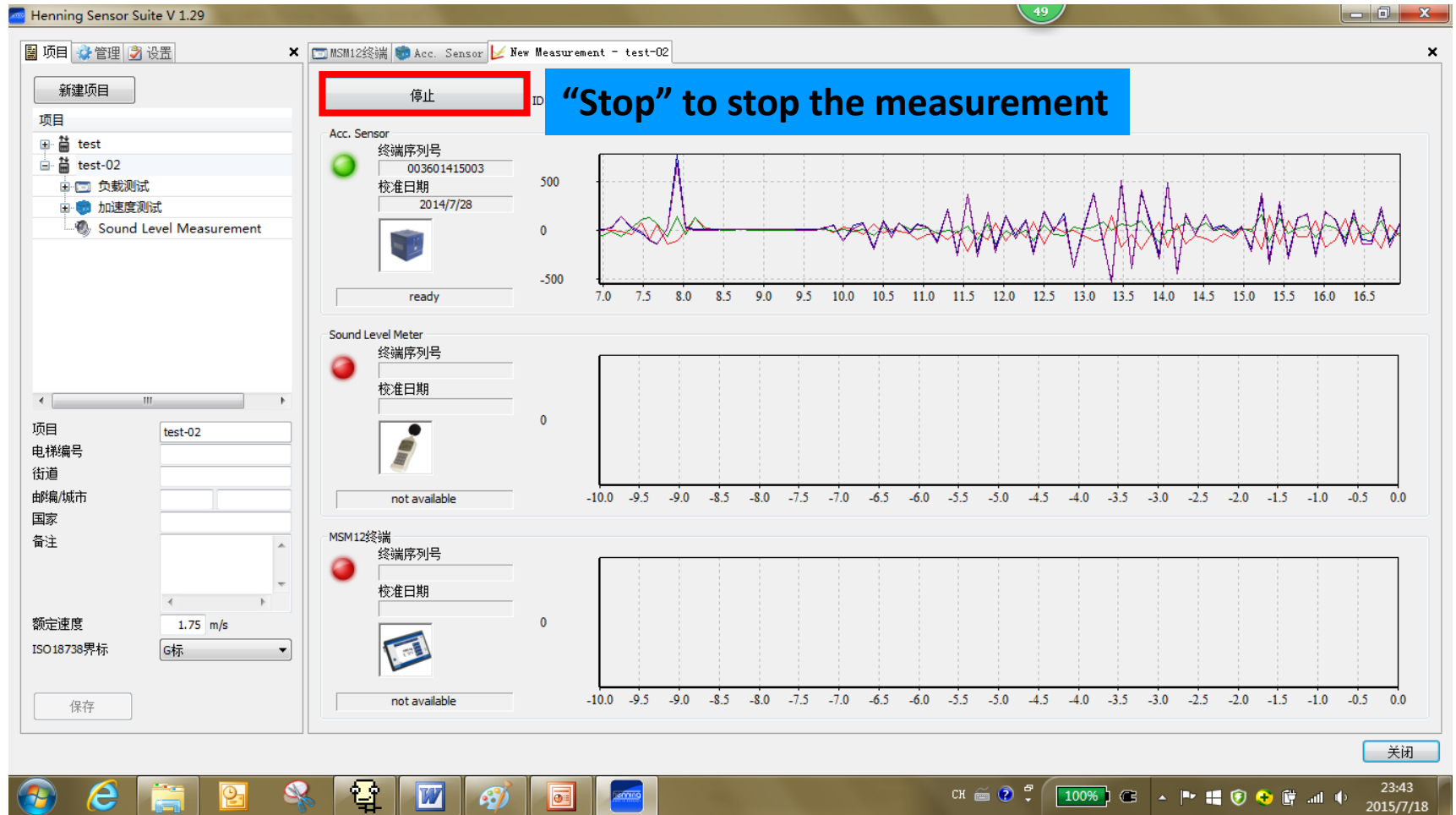
- 1. Start the sensor:**
Push the black button once
=> LED starts blinking green
- 2. Start the measurement**
Push the black button again
=> green LED stays on
- 3. Stop the measurement**
Push the black button again
=> LED starts blinking green
- 4. Download and Evaluation via PC**



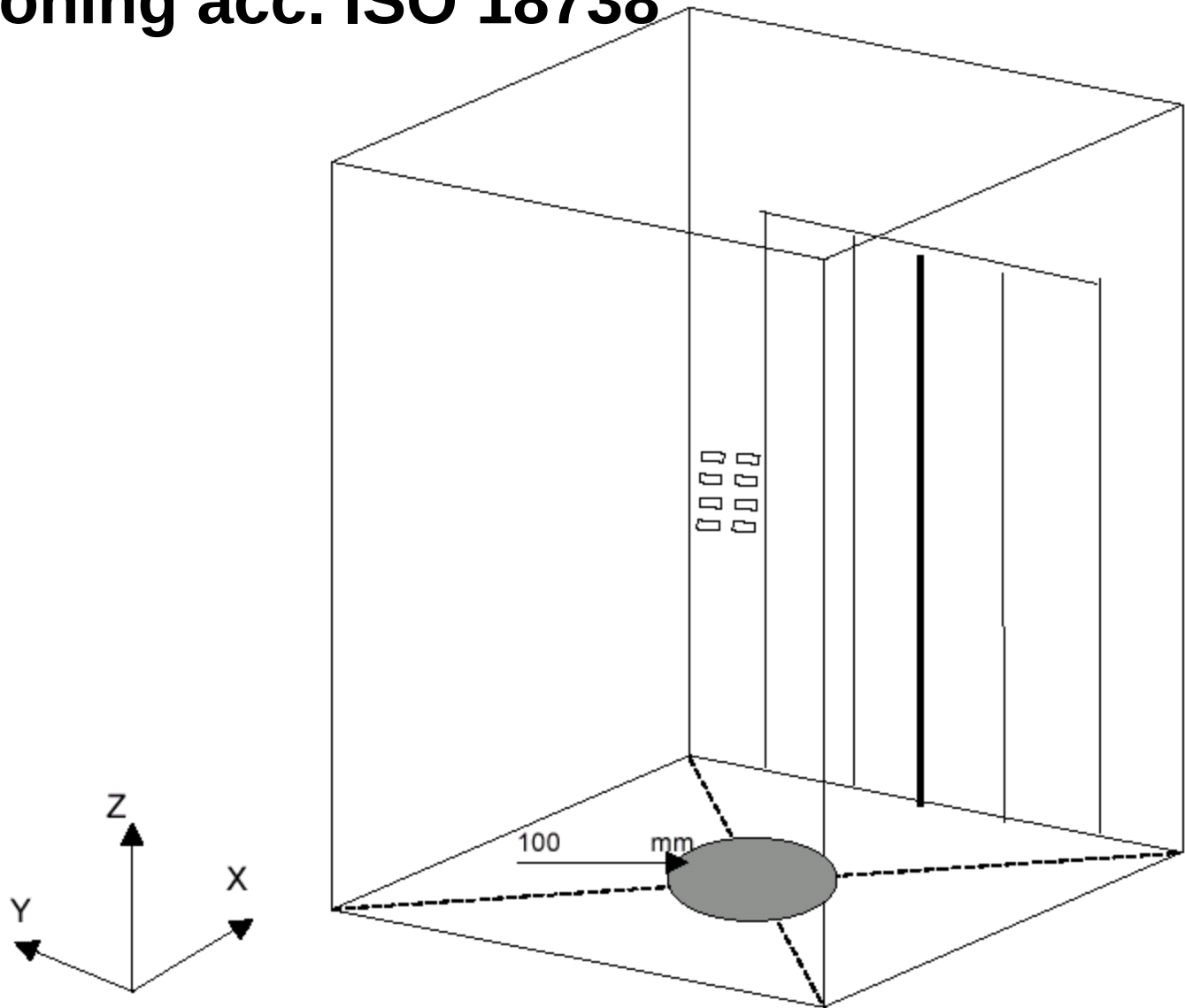
Control the QS3 via an Android phone by Bluetooth







Positioning acc. ISO 18738



[illegible]

Henning Sensor Suite V 1.29

项目 管理 设置

新建项目

项目

- test
- test-02
- 2015/7/18

项目: test-02

电梯编号:

街道:

邮编/城市:

国家:

备注:

额定速度: 1.75 m/s

ISO 18738 界标: G标

保存

MSM12终端 Acc. Sensor

传感器连接情况

断开连接 固件升级

传感器设置

终端序列号: 003601415003 版本: V 1.06

校准日期: 2014/7/28

内部存储: 8.00 GB

电池容量: 4.50 Ah

☒ X轴 ±2 g, 1000 Hz

☒ Y轴 ±2 g, 1000 Hz

☒ Z轴 ±2 g, 1000 Hz

☒ 第二Z轴 ±20 g, 6000 Hz

☒ 蓝牙

☒ Qi-无线充电

☐ 同步模块

解锁附加功能

日期	时间	ID编号	类型	信息
2015/7/18				
☒ 2015/7/18	13:47:08	00000056	加速度测试	Acc. Sensor S/N 1415003, 校准日期 2014/7/28

选择群组

关闭

22:04 2015/7/18

Henning Sensor Suite V 1.29

项目 管理 设置

新建项目

项目

- test
- test-02
 - 负载测试
 - 加速度测试
 - 2015/7/18 13:47:08 ID: 00000056
 - Sound Level Measurement

项目: test-02

电梯编号:

街道:

邮编/城市:

国家:

备注:

额定速度: 1.75 m/s

ISO 18738 界标: G标

保存

MSM12终端 Acc. Sensor

传感器连接情况

断开连接 固件升级

传感器设置

终端序列号: 003601415003 版本: V 1.06

校准日期: 2014/7/28 ☒ 蓝牙

内部存储: 8.00 GB ☒ Qi-无线充电

电池容量: 4.50 Ah ☐ 同步模块

☒ X轴 ±2 g, 1000 Hz

☒ Y轴 ±2 g, 1000 Hz

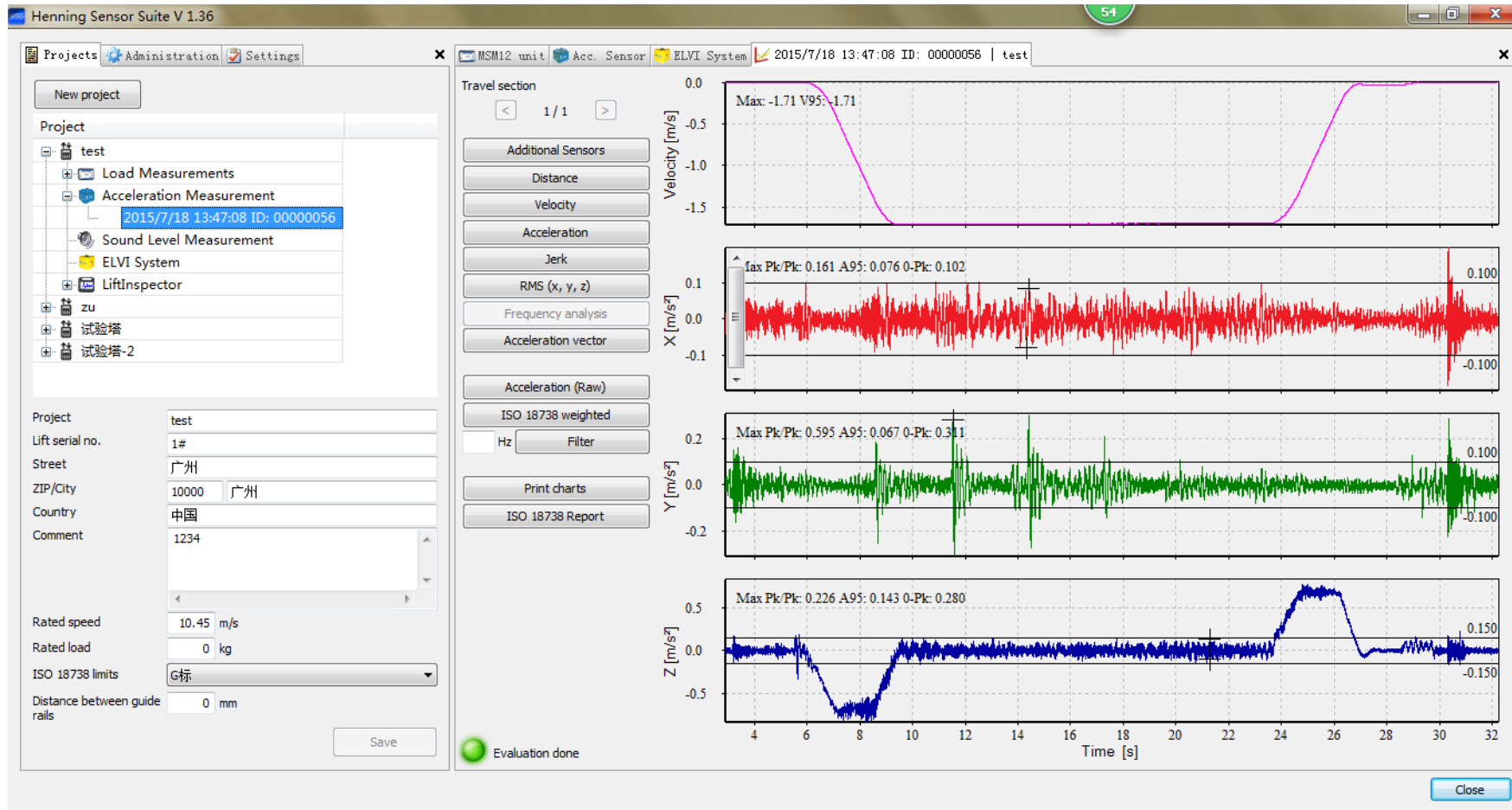
☒ Z轴 ±2 g, 1000 Hz

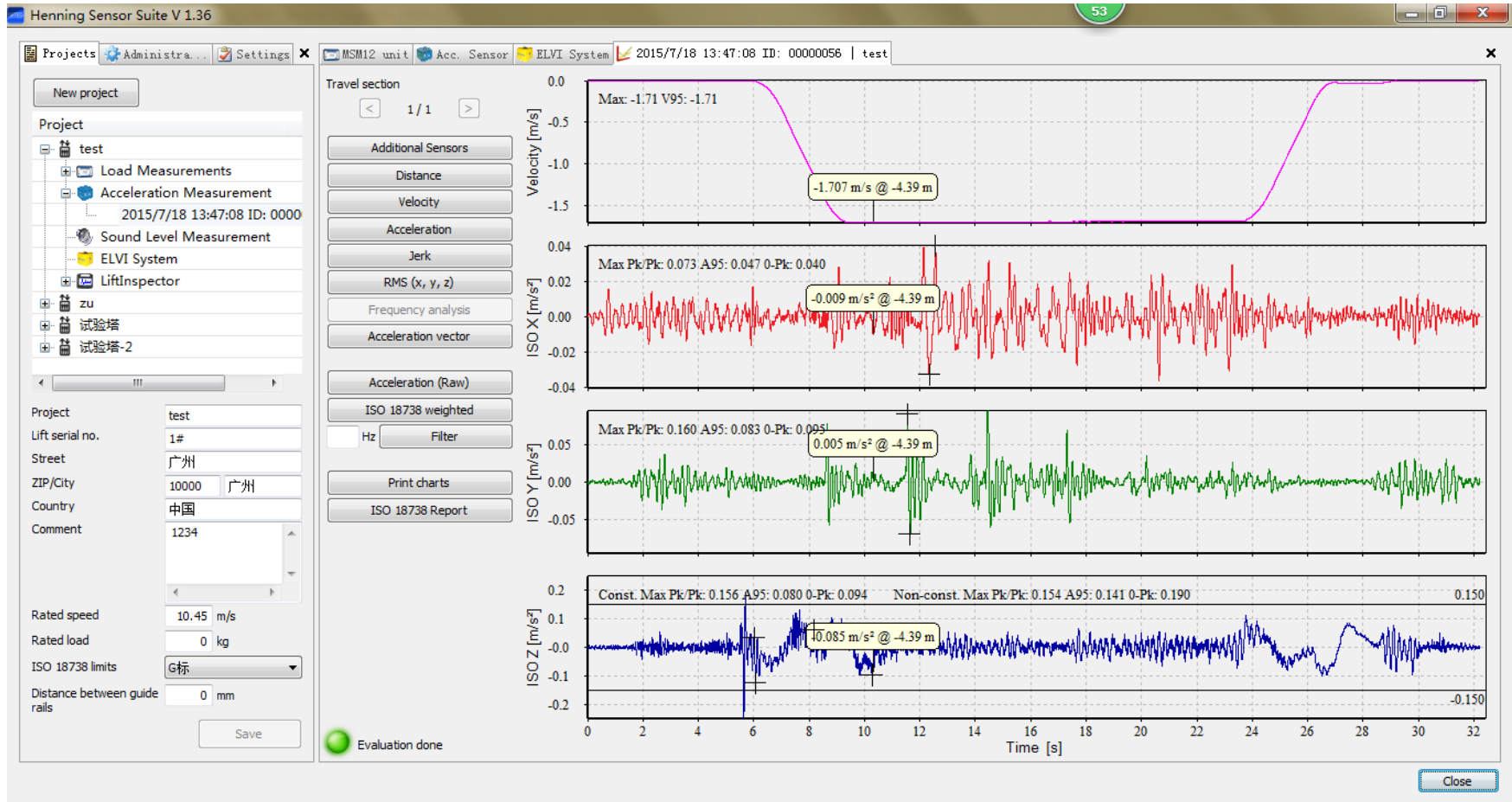
☒ 第二Z轴 ±20 g, 6000 Hz

解锁附加功能

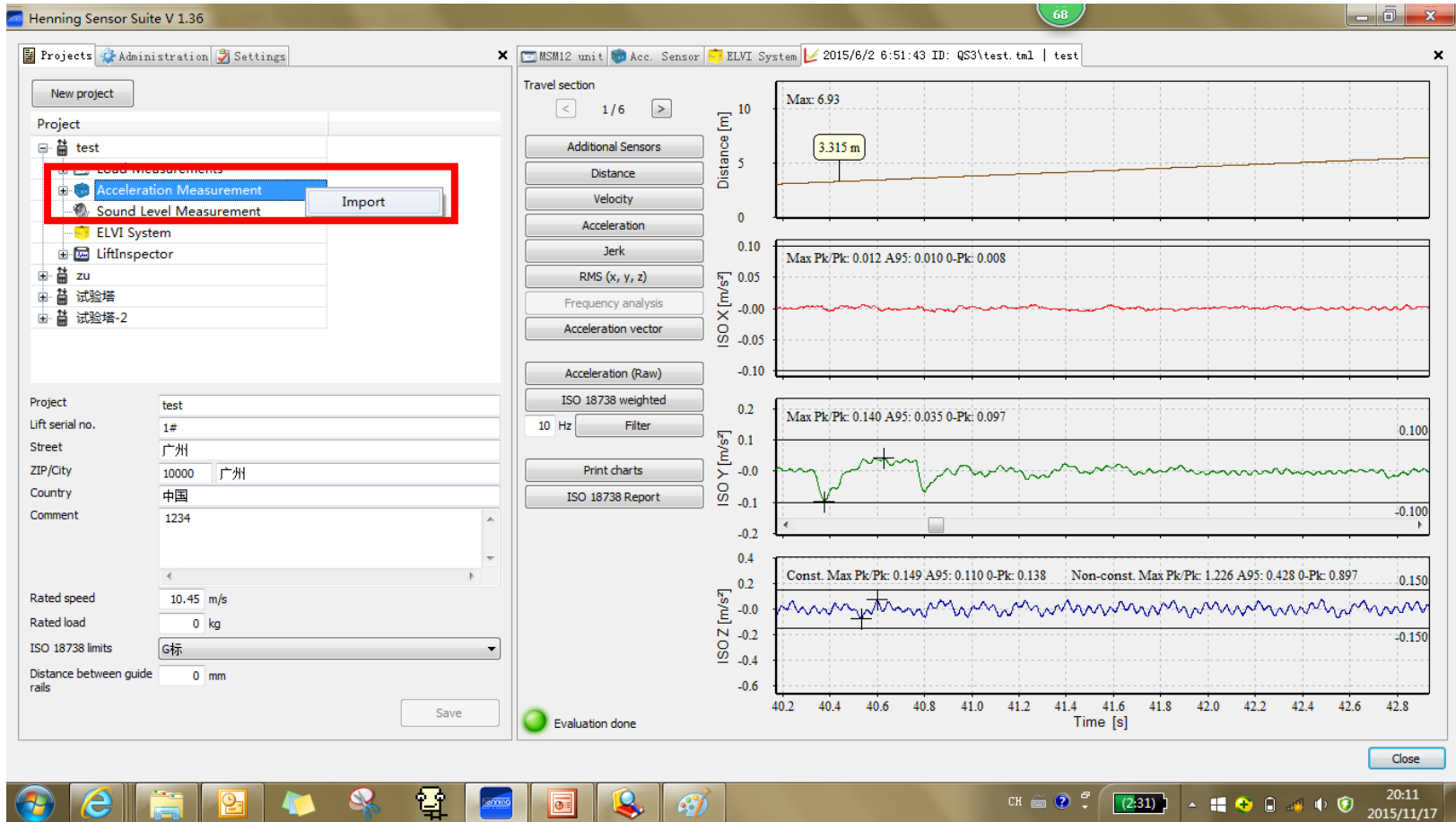
日期	时间	ID编号	类型	信息

关闭



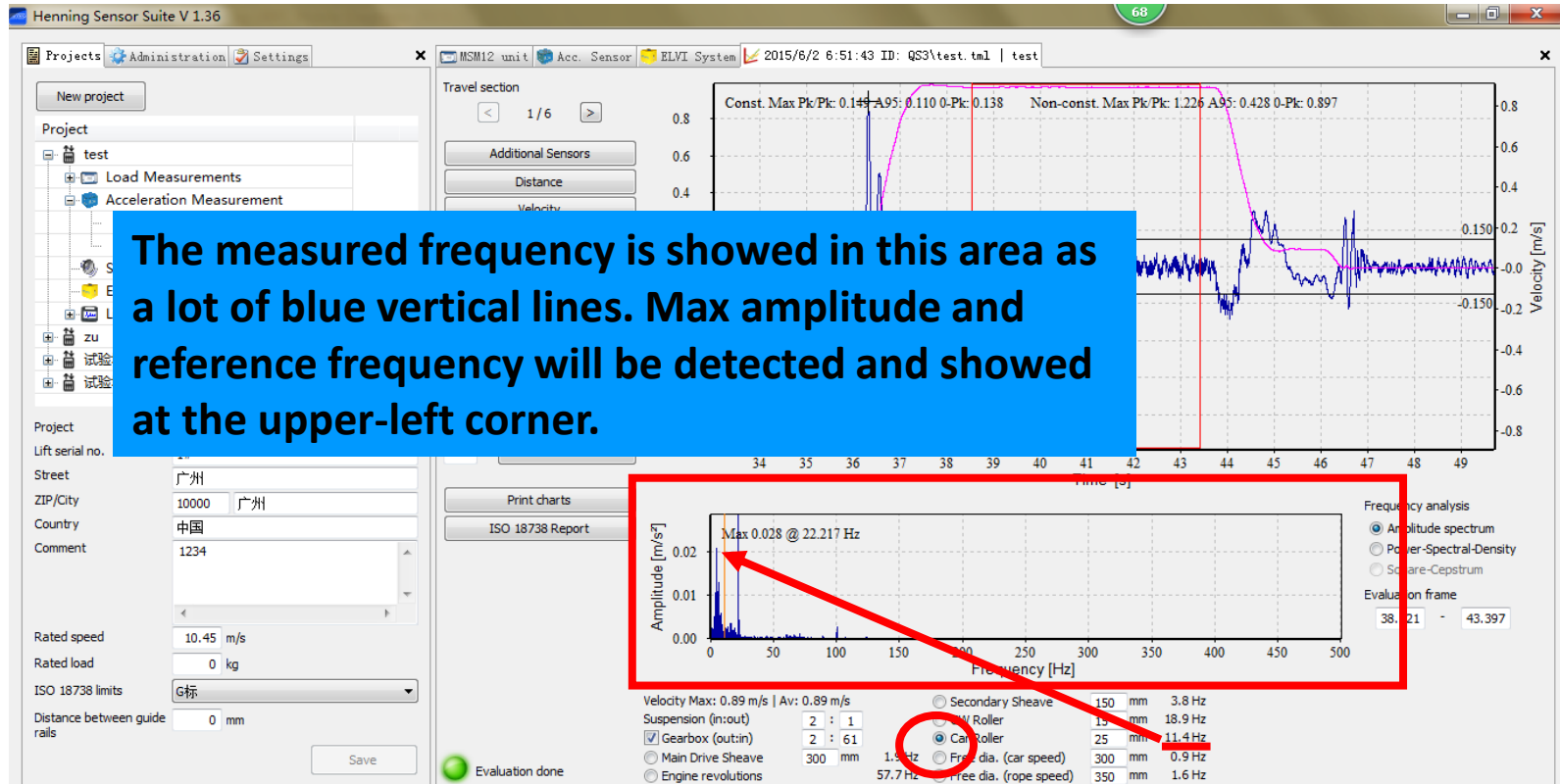


Undo zoom: Zoom from bottom right corner to upper left corner
mouse gestures



Delete Measurements and projects

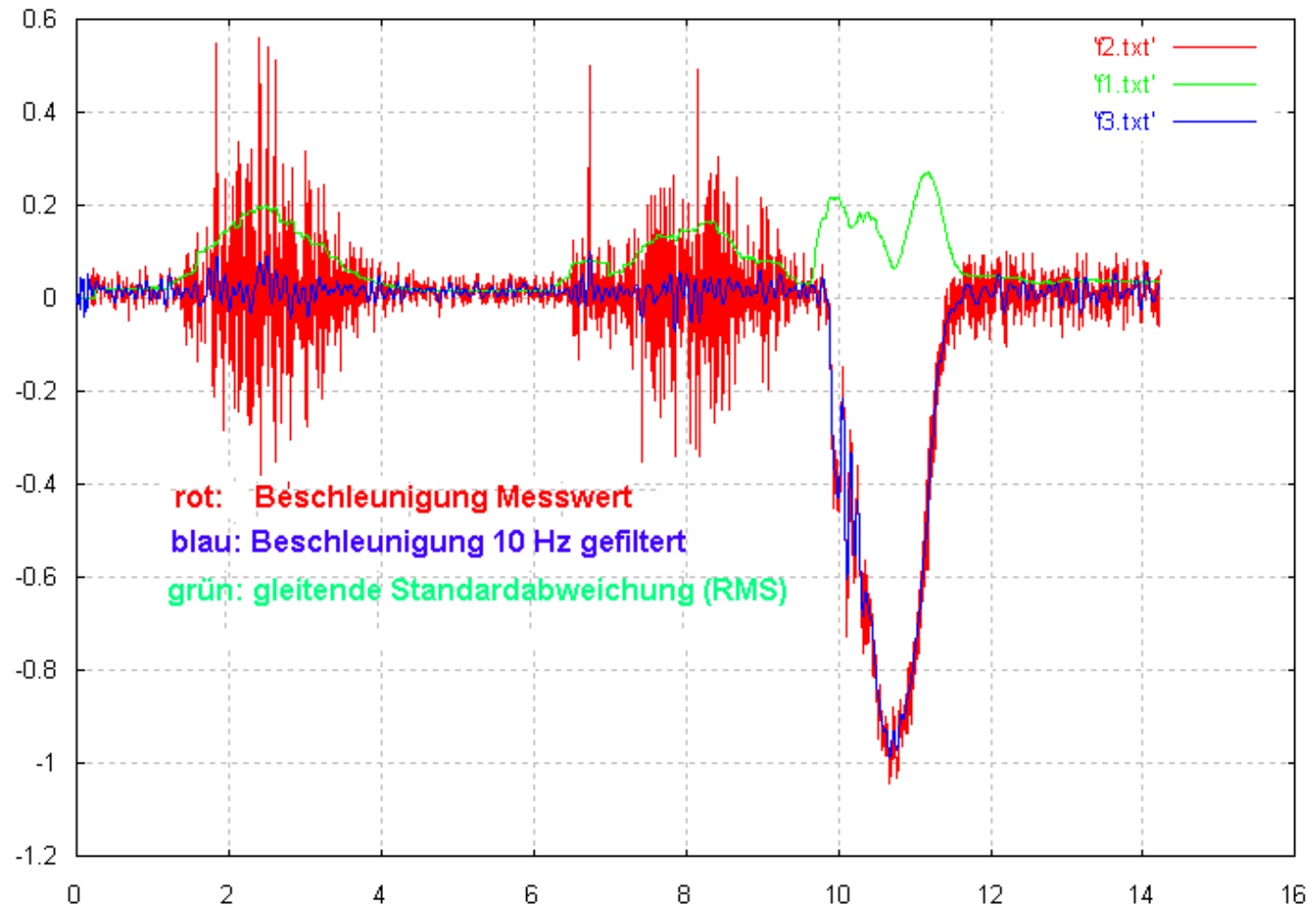
The screenshot displays the Henning Sensor Suite V 1.36 software interface. The left sidebar shows a project tree with a red box highlighting the '2015/6/2 6:51:43 ID: QS3\test.tml' entry, with 'Open', 'Delete', and 'Export' options visible. The main window shows a 'Travel section' with various sensor data plots over time (40.2 to 42.8 s). The plots include Distance [m] (Max: 6.93, 3.315 m), ISO X [m/s²] (Max Pk/Pk: 0.012 A95: 0.010 0-Pk: 0.008), ISO Y [m/s²] (Max Pk/Pk: 0.140 A95: 0.035 0-Pk: 0.097), and ISO Z [m/s²] (Const. Max Pk/Pk: 0.149 A95: 0.110 0-Pk: 0.138; Non-const. Max Pk/Pk: 1.226 A95: 0.428 0-Pk: 0.897). The bottom status bar indicates 'Evaluation done' and 'Close'.



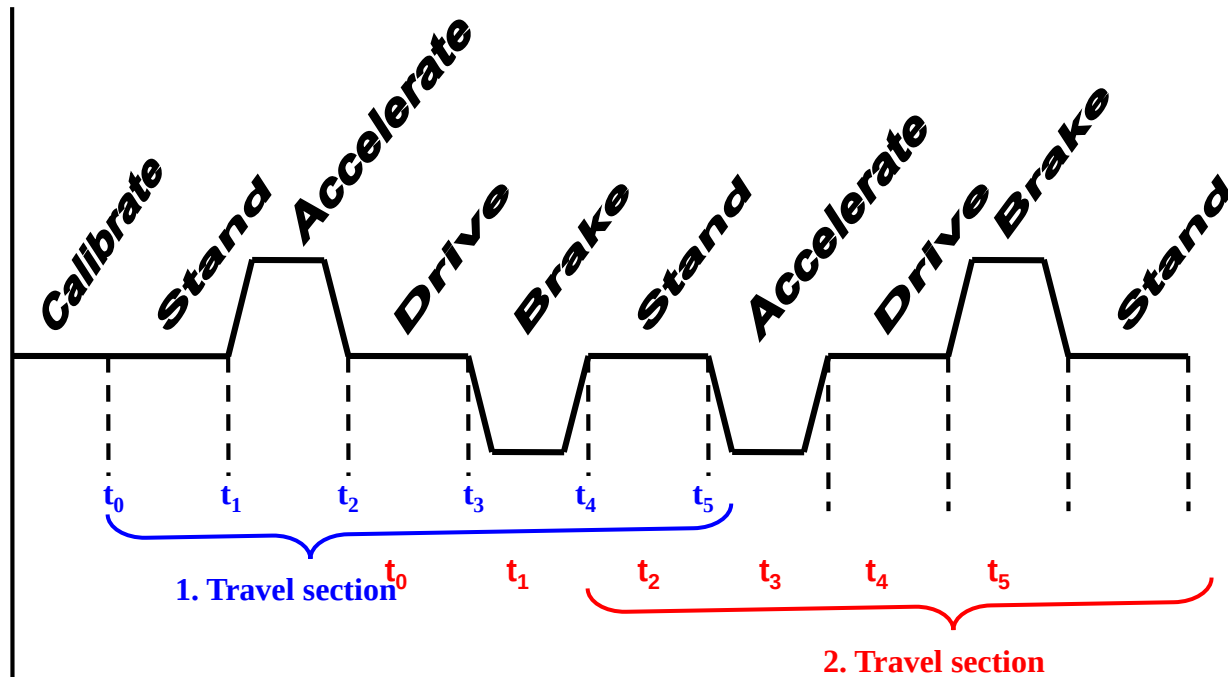
Choose a sheave, its natural frequency will be mark on the area of measured frequency as a orange vertical line. If this orange line is overlap with one of blue line, it means the chosen sheave leads this vibration. Try to find out which sheave leads the max amplitude. It is the principal source of vibration during the constant drive.

- **How does the analysis recognize the travel situations?**
- **How are the performance data determined?**
- **How is the ride quality determined?**
- **How are the parameters calculated?**

Based on the threshold values and not causal filters
the travel situation is recognized



Based on the threshold values and not causal filters the travel situation is recognized



Calculation of acceleration and path

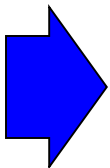
Measurement: acceleration in z-direction [m/s^2]

Integration

Calculates: Velocity [m/s]

Integration

Calculates: Path [m]

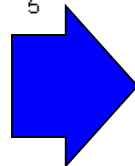
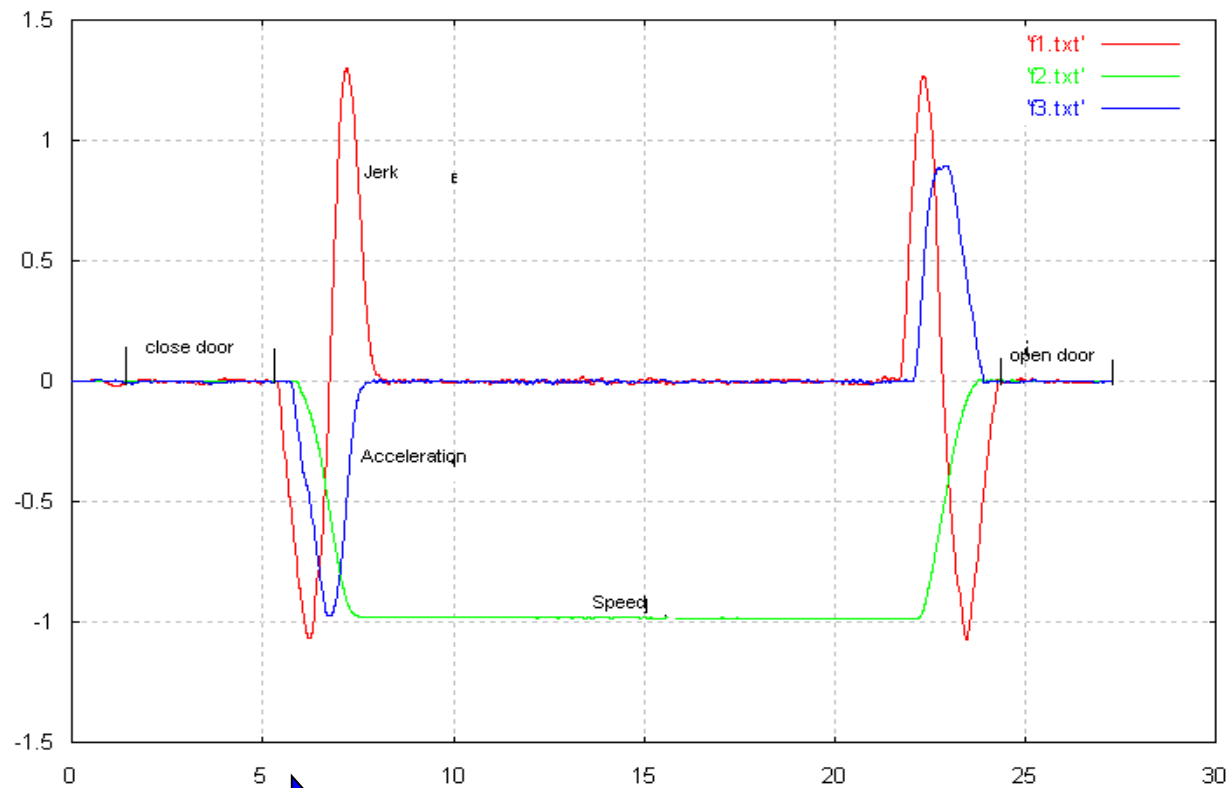


Parameters: max. acceleration, max. velocity

Measurement: acceleration in z-direction [m/s²]

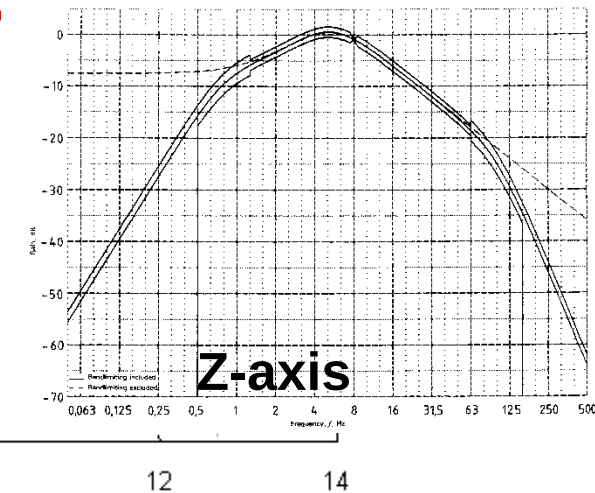
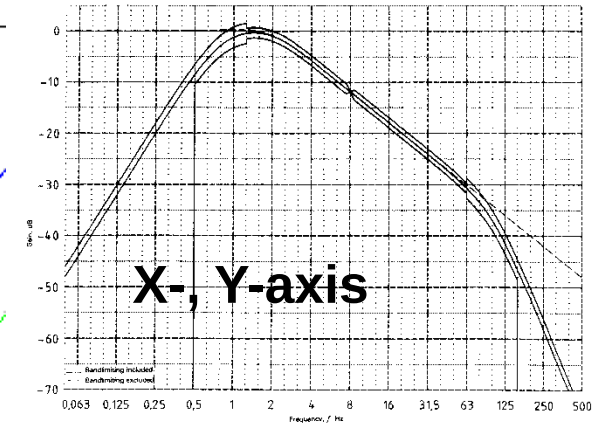
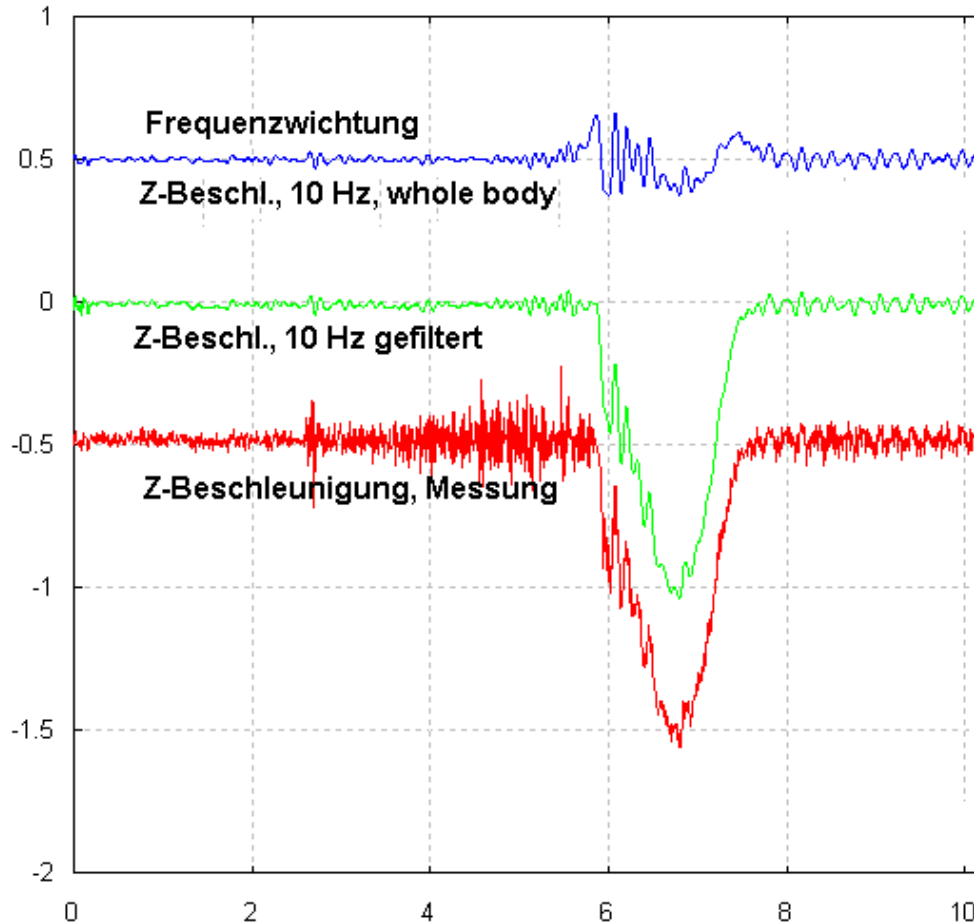
Differentiation

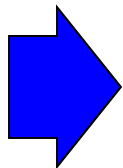
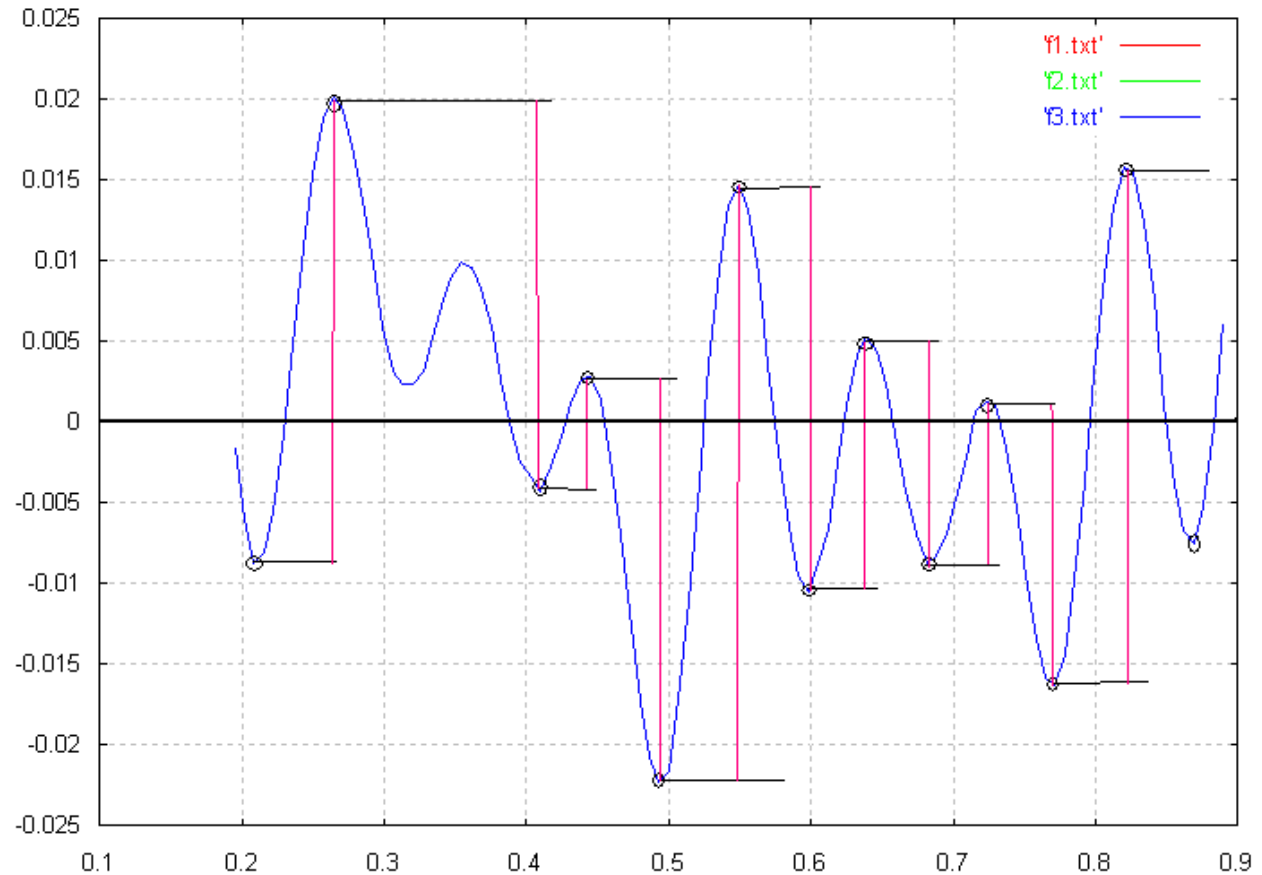
Calculates: Jerk [m/s³]



Parameter: max. jerk

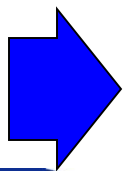
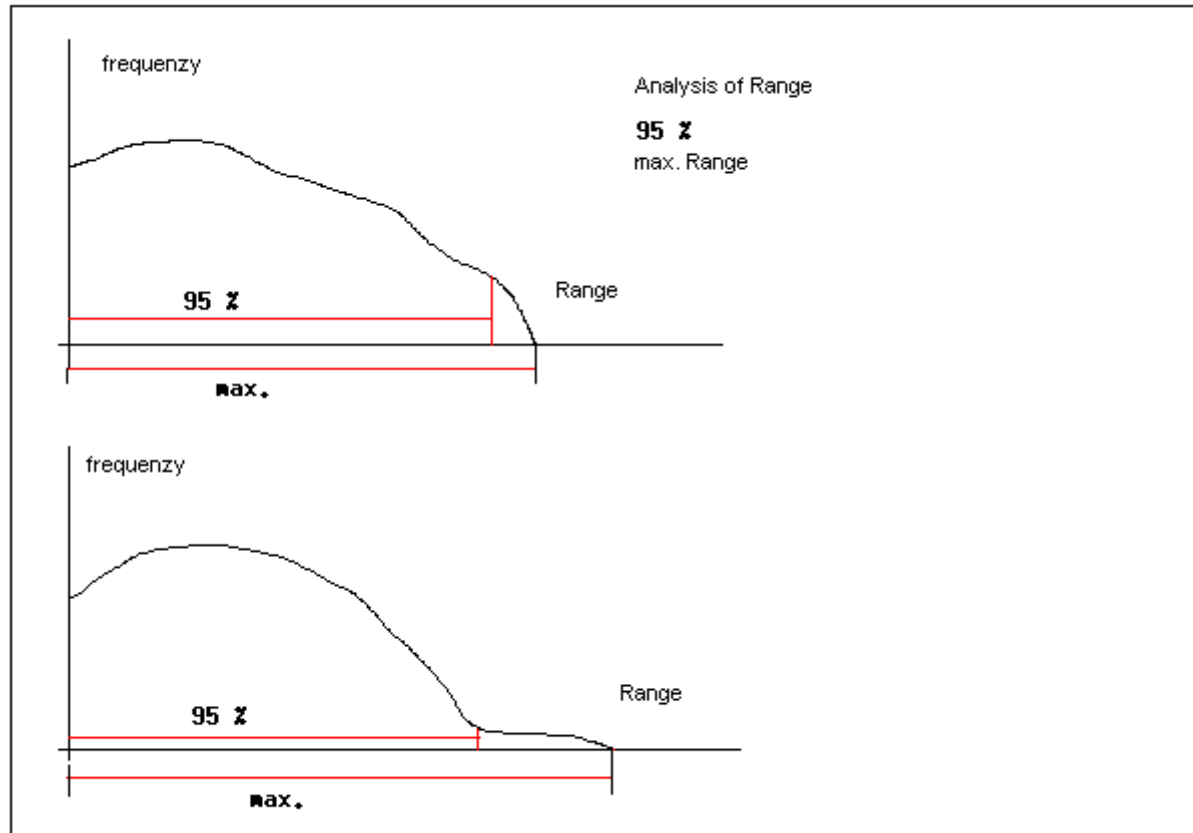
Vibration analysis (evaluation acc. to ISO 8041)





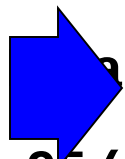
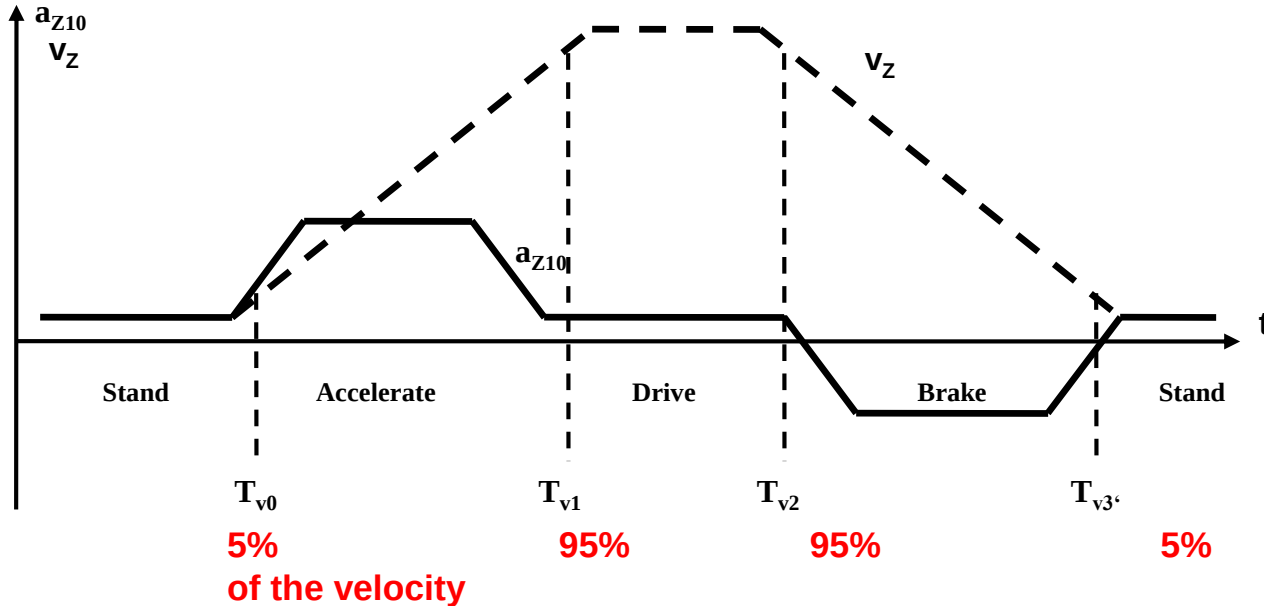
Parameters: Peak to Peak

Zero to Peak



Parameter: 95 % value

95 % of all values are below this limit



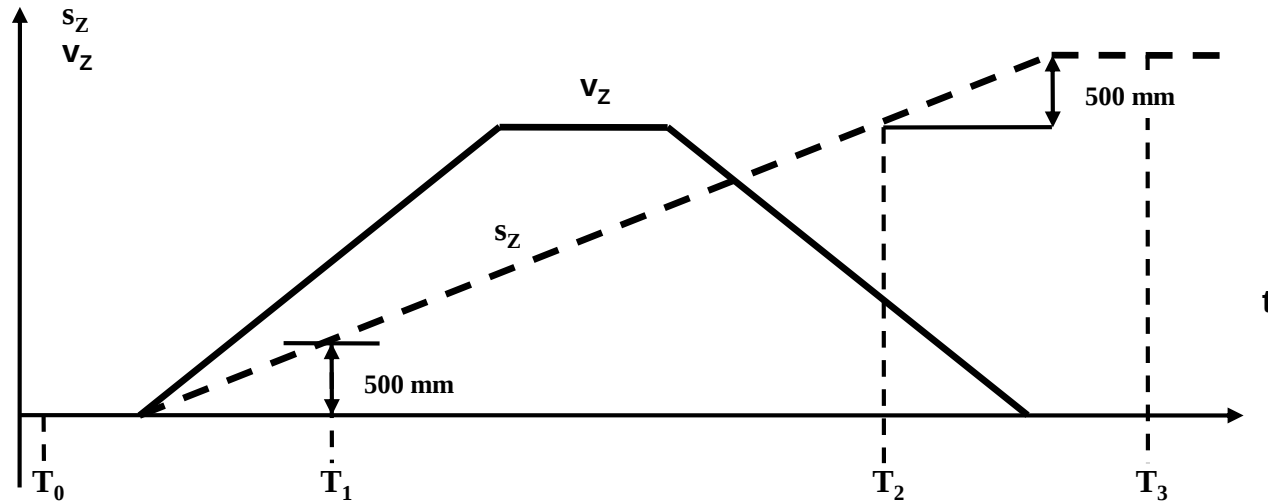
Parameters:

a_{95} (acceleration):

between T_{v0} and T_{v1}

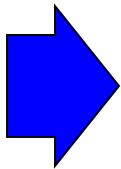
a_{95} (braking):

between T_{v2} and T_{v3}



- T_0 : 0.5 sec before closing the door
- T_1 : 500 mm after travel start
- T_2 : 500 mm before travel end
- T_3 : 0.5 sec after opening the door

Parameters:

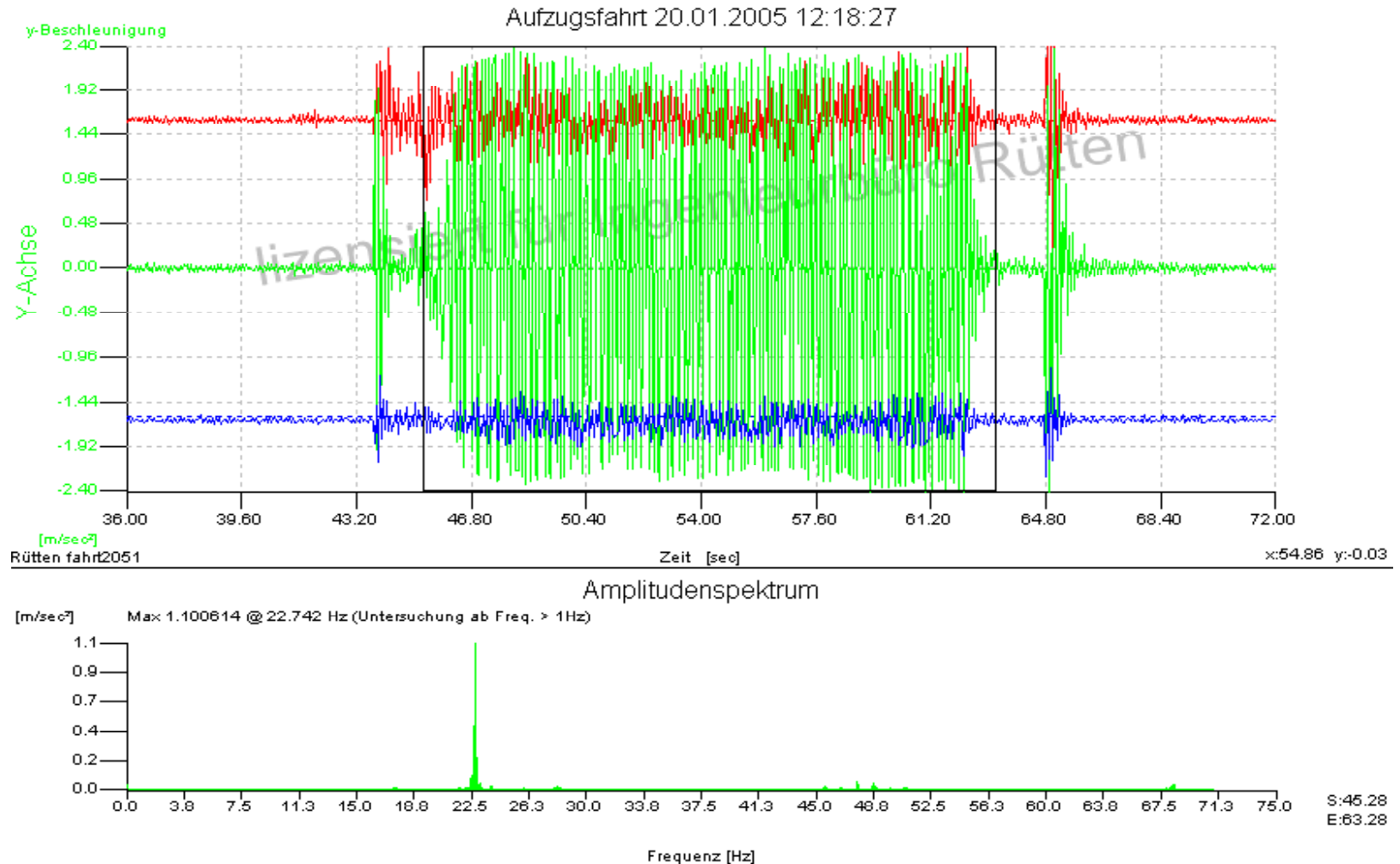


a_{zmax} : maximum acceleration between T_0 and T_1

a_{zmin} : maximum deceleration between T_2 and T_3

- **Trouble shooting**
- **Control problems**
- **Mechanical drive problems**

Measurement directly on the drive unit



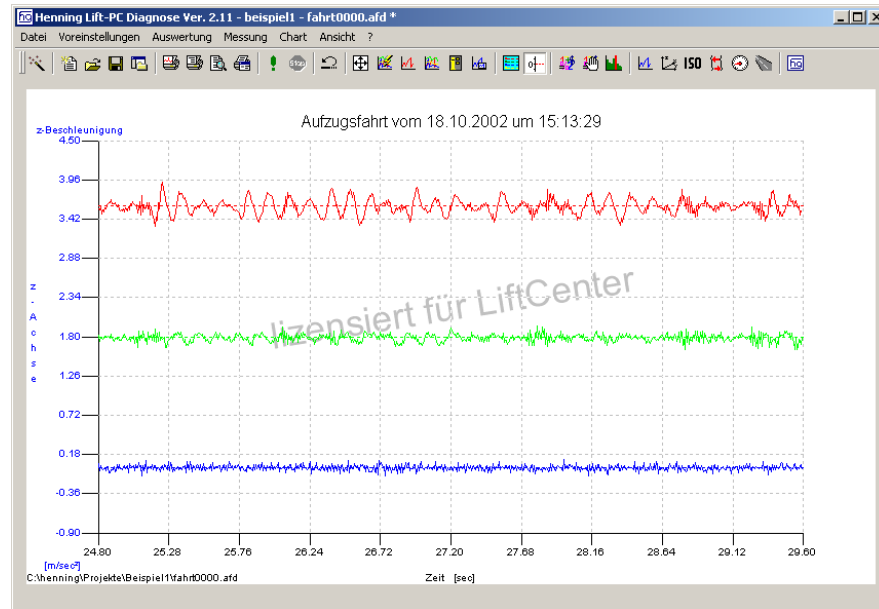
**High acceleration level only in Y-direction
=> Unbalance in the engine**

Starting situation:

- High-quality elevator plant
- Very unquiet running
- The measurements shall specify the defect source in more detail: Drive or car mechanics?

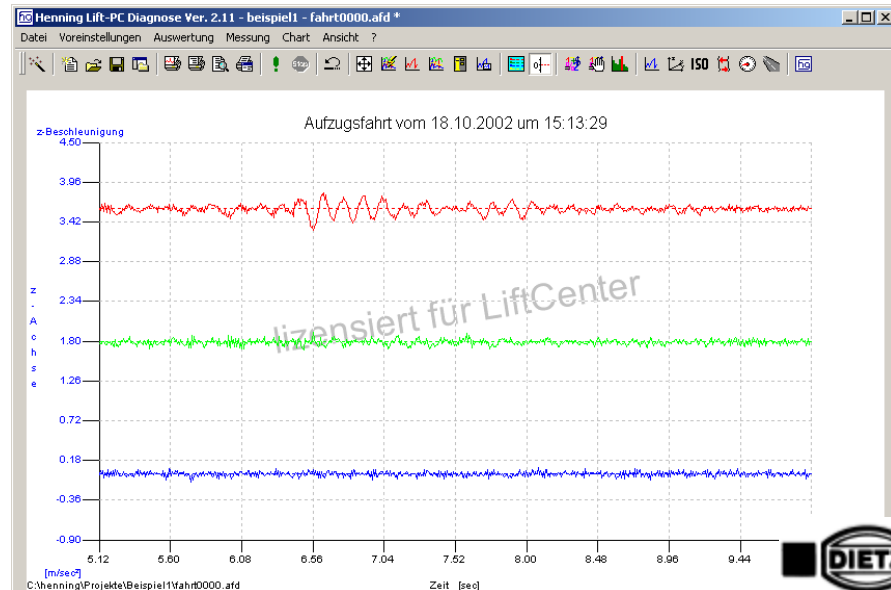
**Travel
upward**

**Accelerations
in the car**



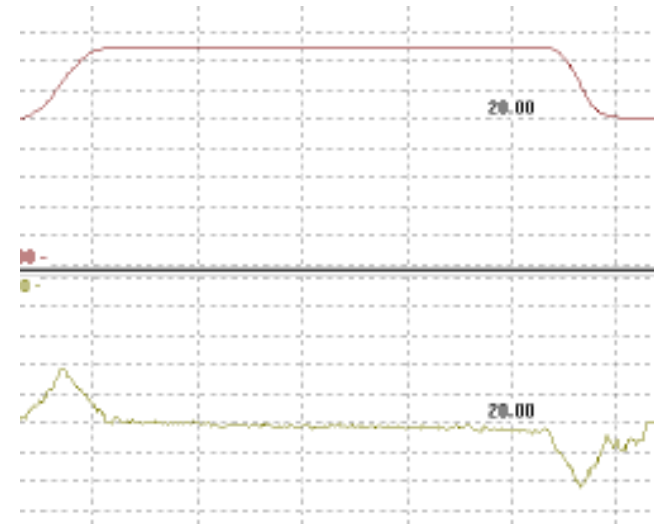
**Travel
downward**

**Accelerations
in the car**



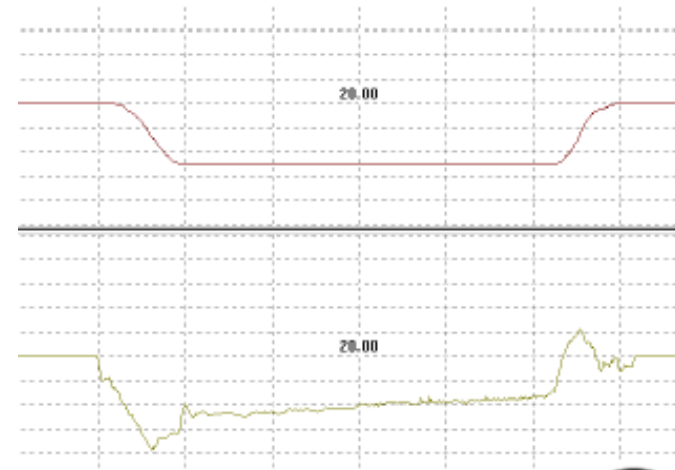
Travel upward

Rotational speed
and torque
at the winch



Travel downward

Rotational speed
and torque
at the winch



⇒ The cause cannot be the drive, as the acceleration curves in the Z-direction do not show the strong peaks, this is also confirmed by the rotational speed curves

Die Schienen wurde offensichtlich aus zwei sehr unterschiedlichen Chargen montiert



Vorhandene Schienenstöße am Gegengewicht waren nicht ordnungsgemäß verschliffen

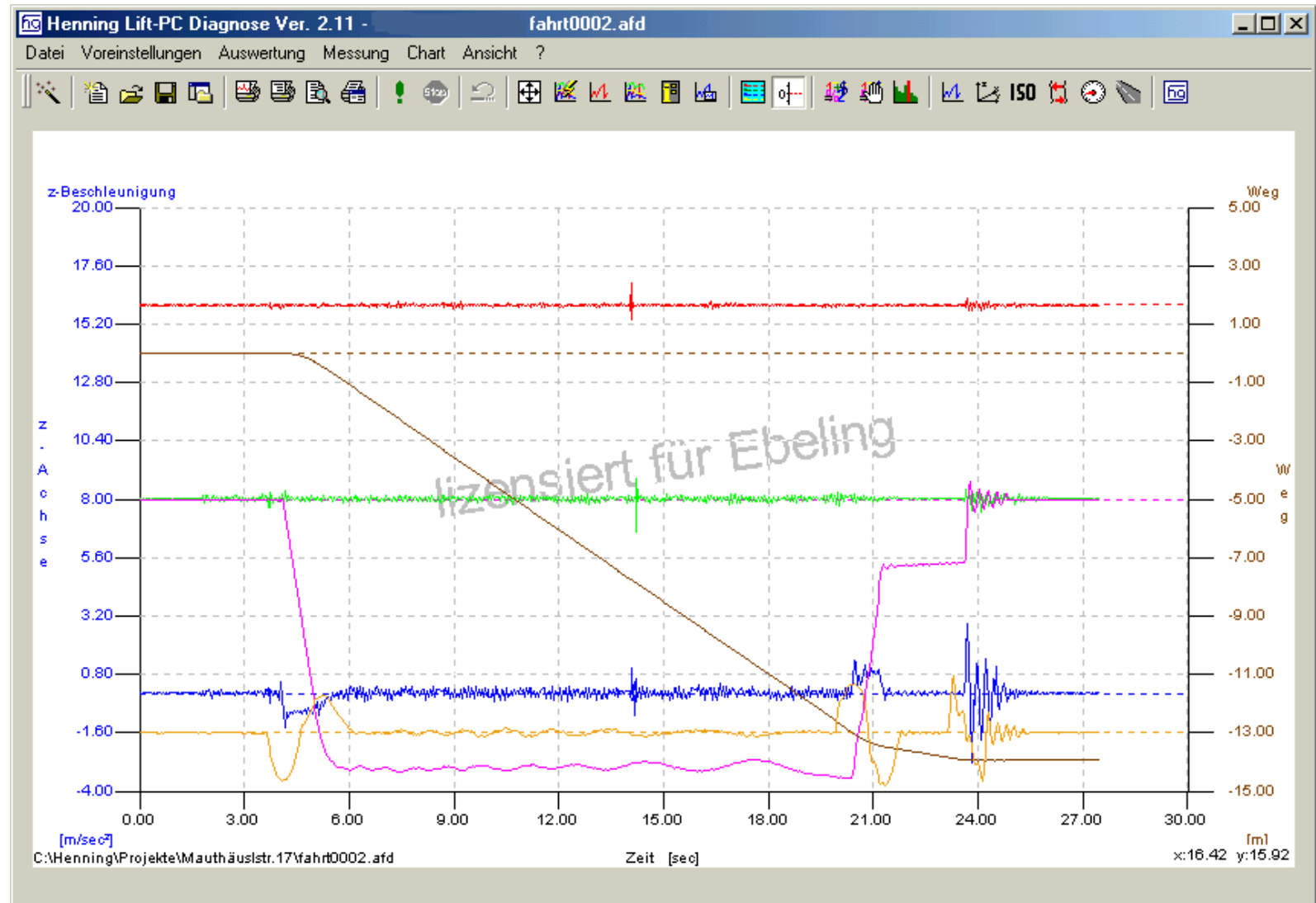


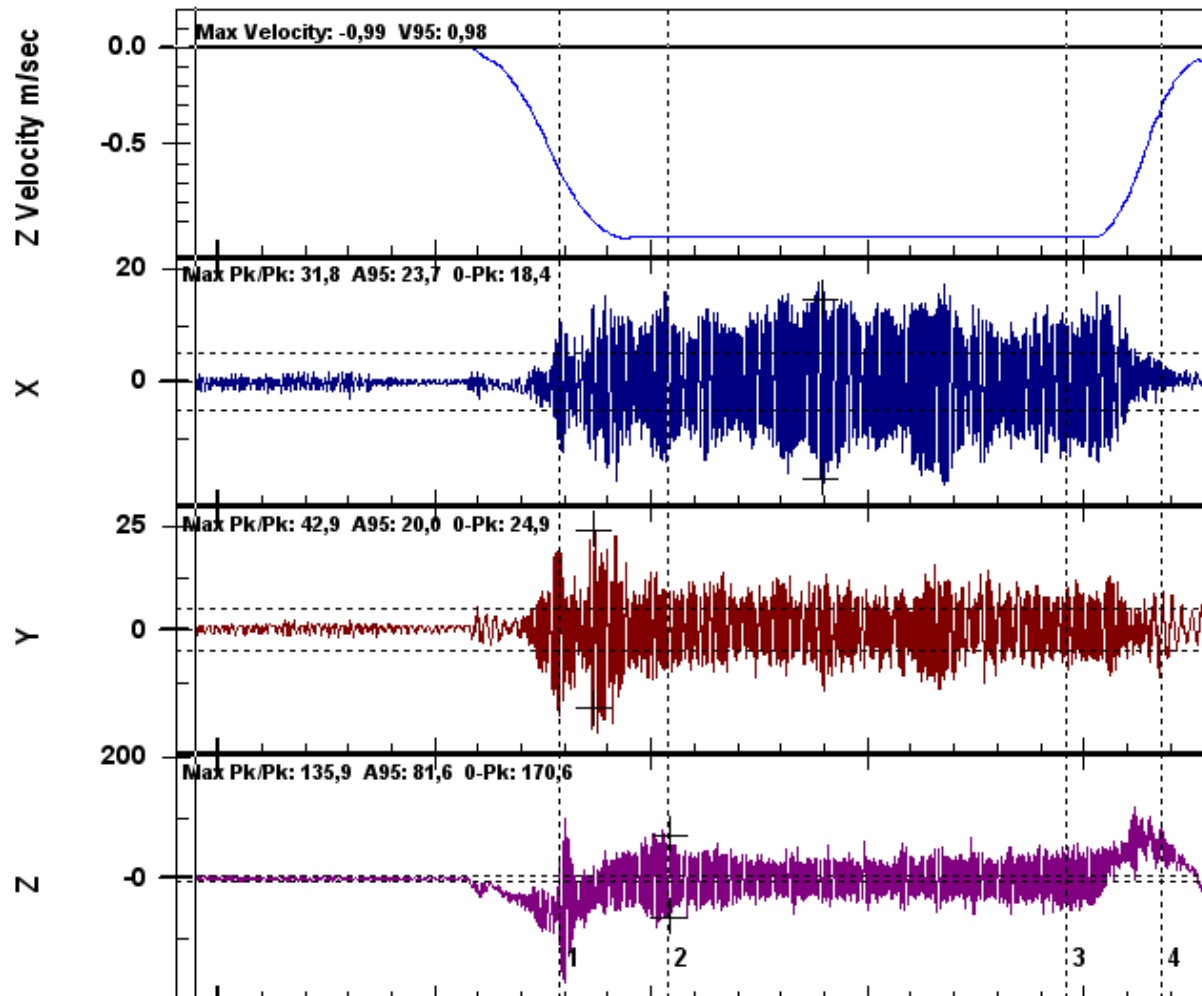
Quetschung der Mittel-Rolle durch fehlerhaftes Stichmaß (starker Lagerschaden)



Starker Verschleiß des starr montierten 3-Rollen-Sets (Abrieb an der Mittel-Rolle)

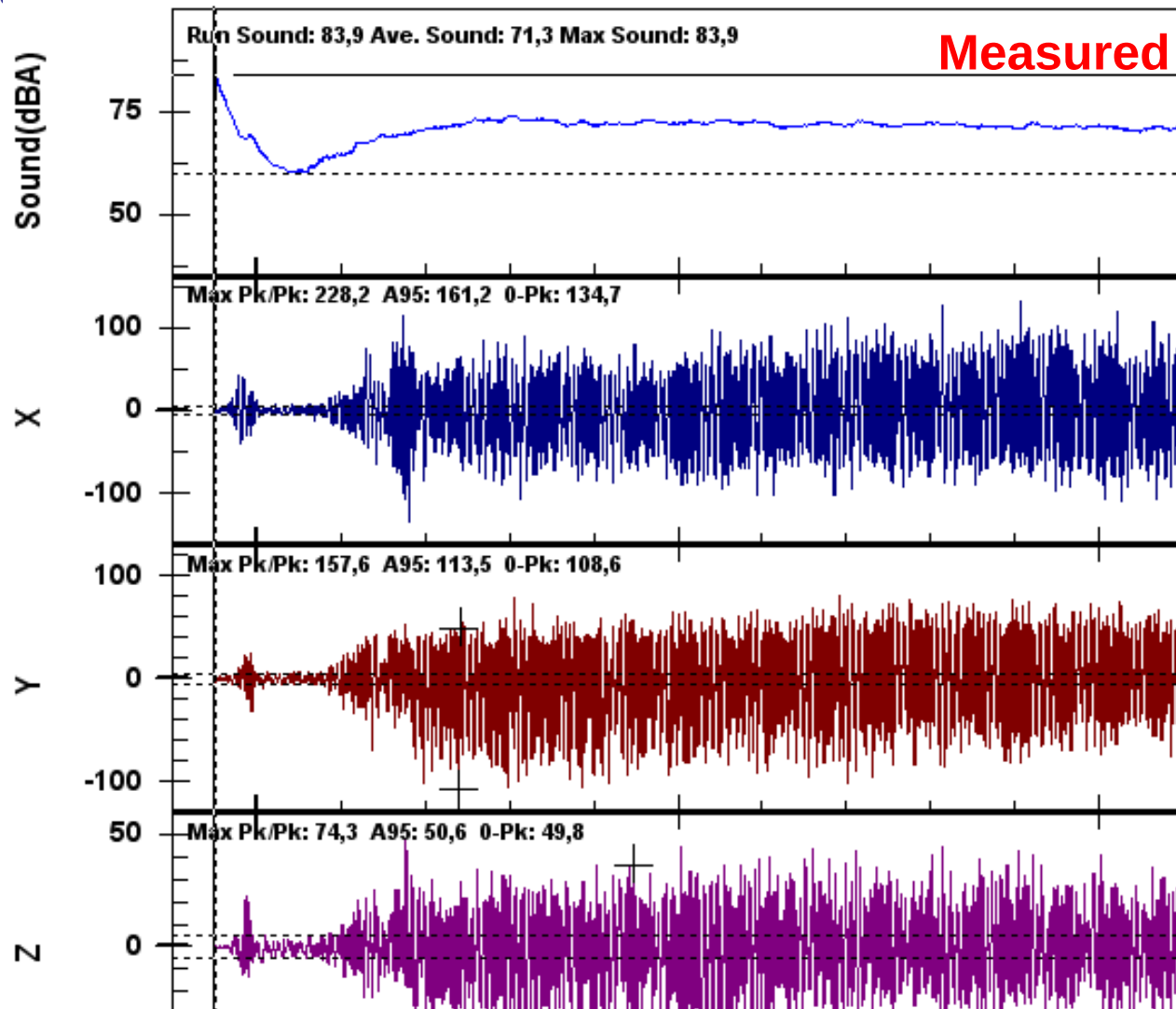






Found: High noise development (car)

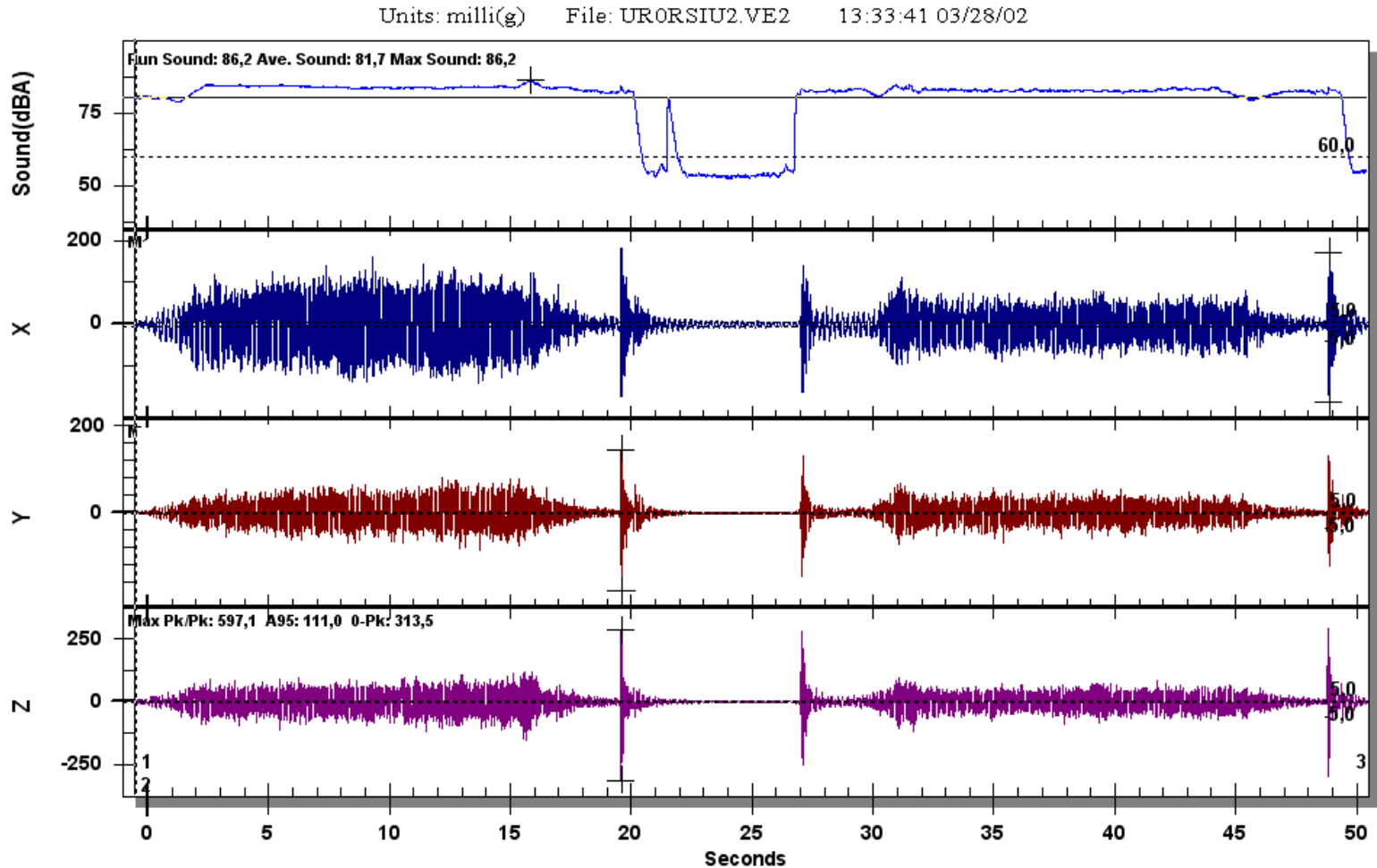
Measured: Excessively high accelerations in all directions



High level in all room directions

=> Misalignment motor/gearbox

Measured at the winch



High level only in X
=> Unbalance in the motor

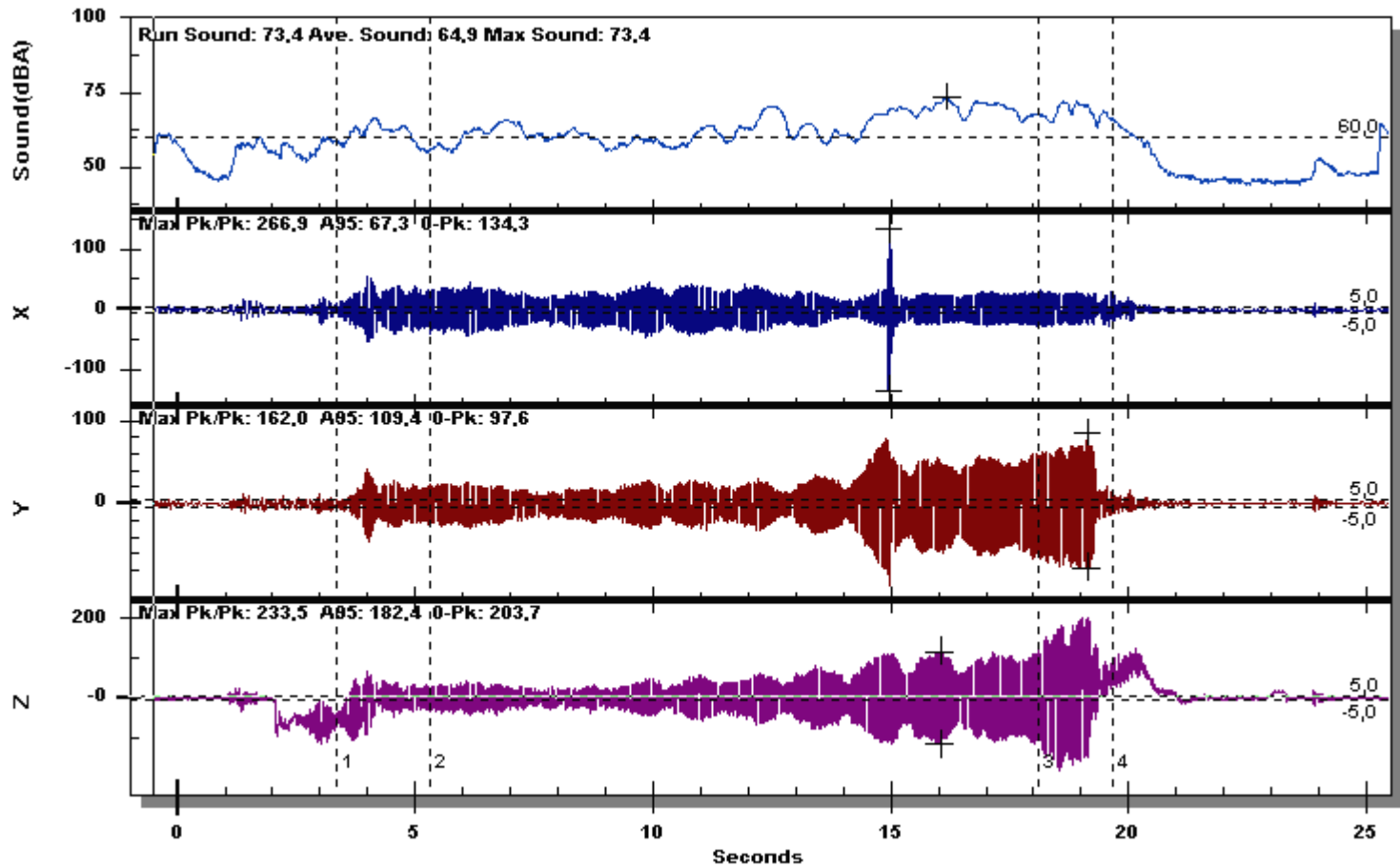
Starting situation:

- **High noise development and vibrations in the car**
- **Several plants of the same type show the same behaviour**
- **By visual control guides and rails have been excluded to be the cause**
- **Frequency converter by variation of the I- and P-share, adoption of the motor flow etc. excluded**
- **Suggestion: The drive transmits vibrations by the ropes into the car**

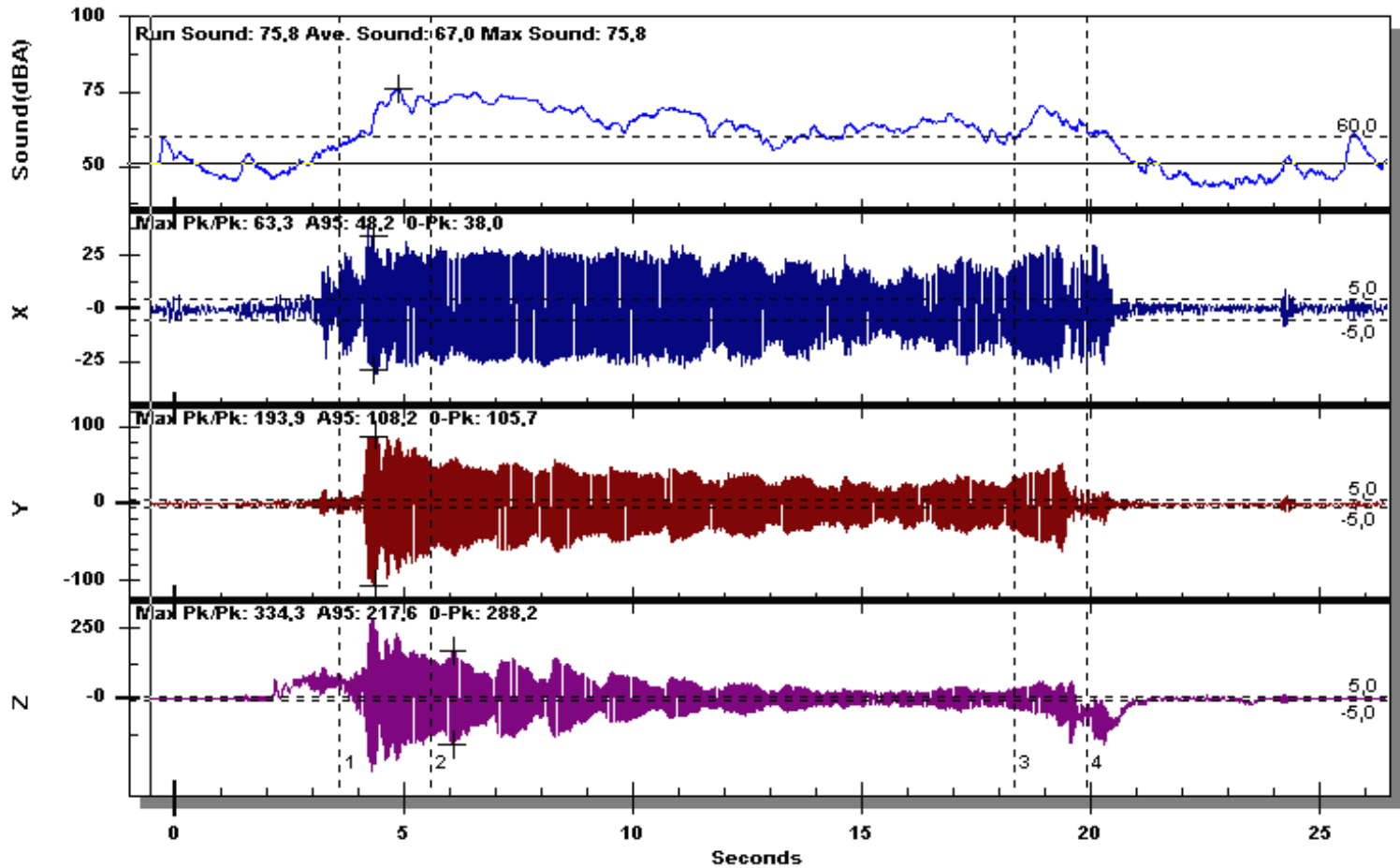
Procedure:

- **Measurement empty car down**
- **Measurement empty car up**
- **Measurement gear unit empty down**
- **Measurement gear unit empty up**
- **Frequency analysis**

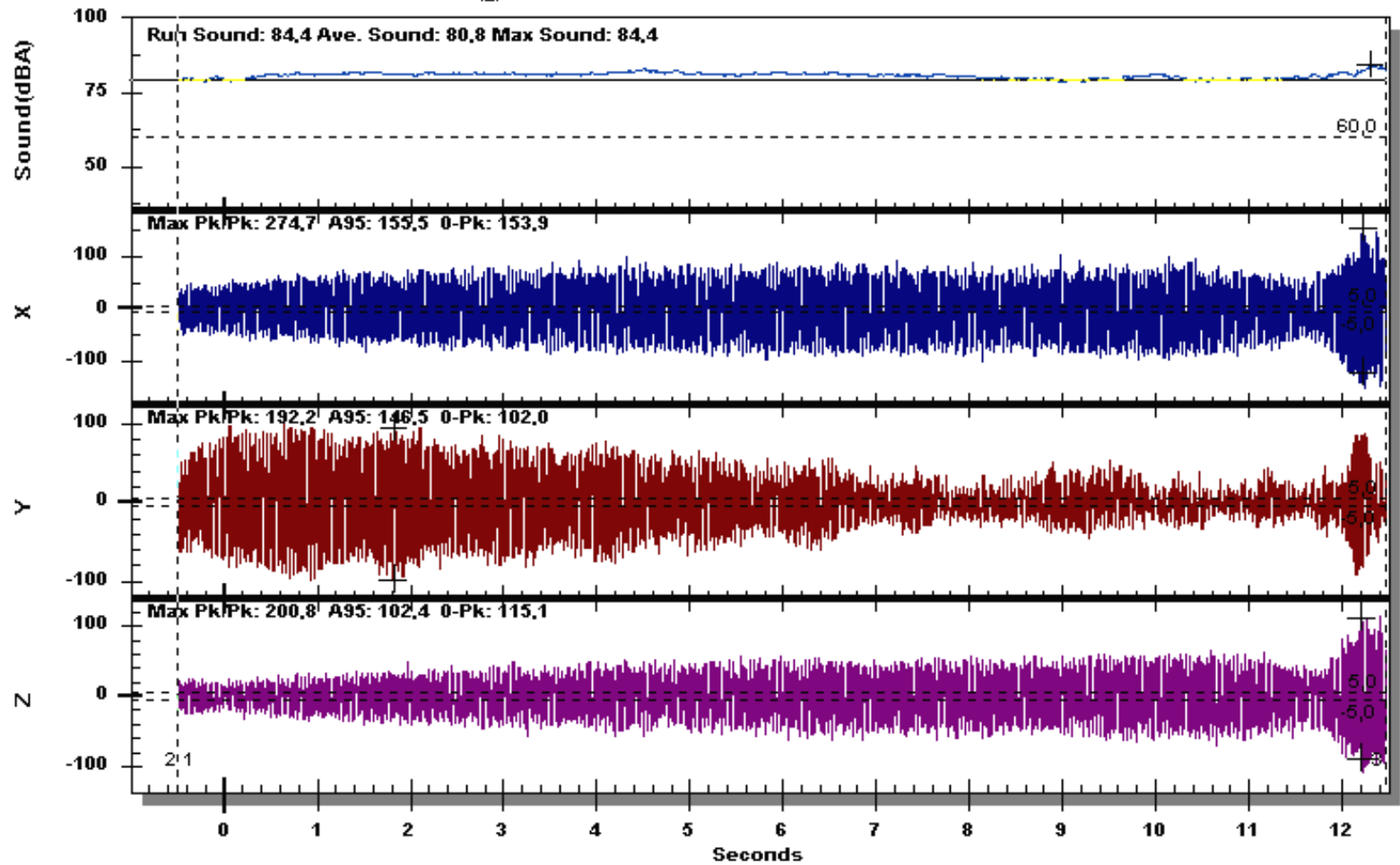
Car empty down



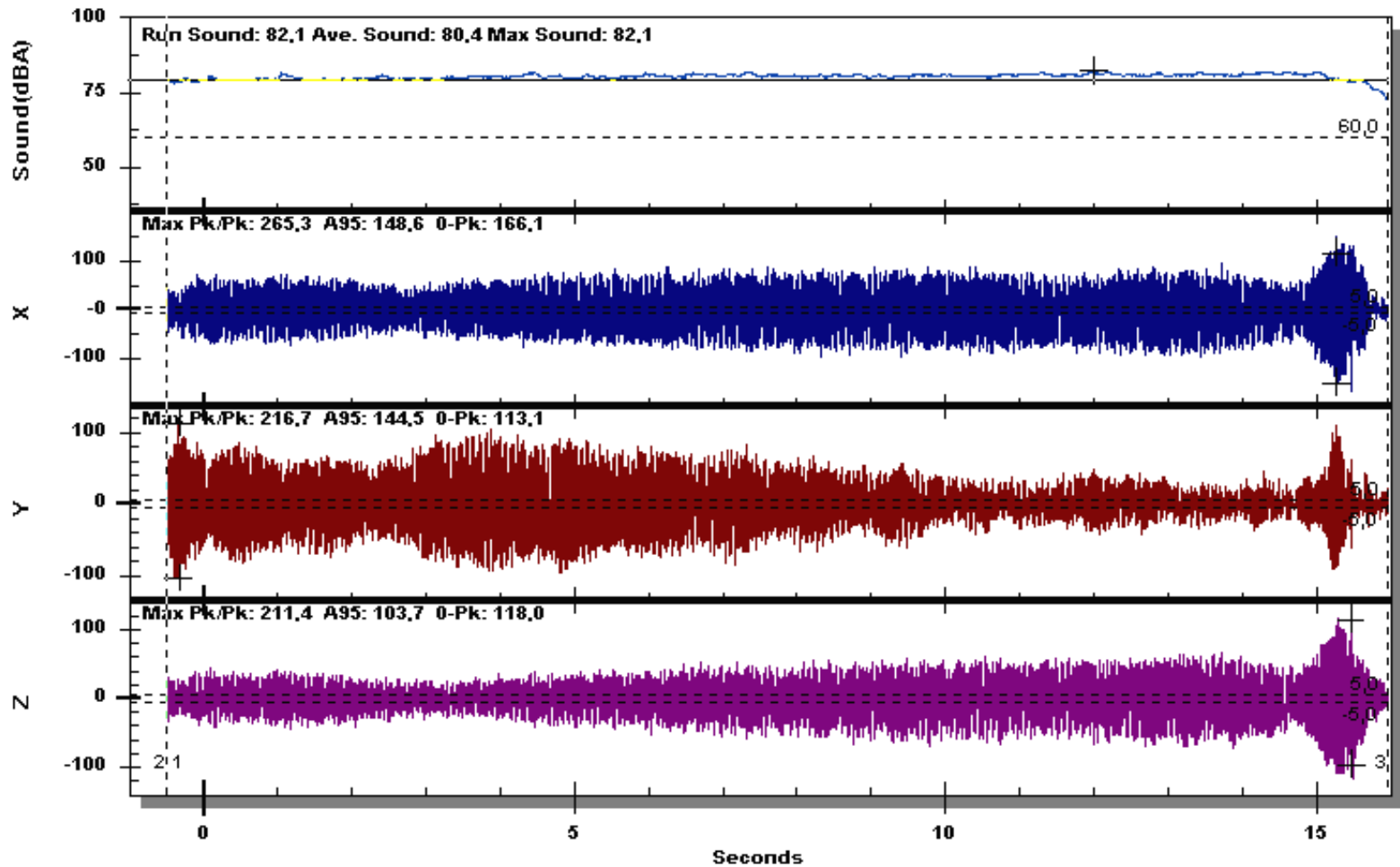
Car empty up



Gear unit empty down

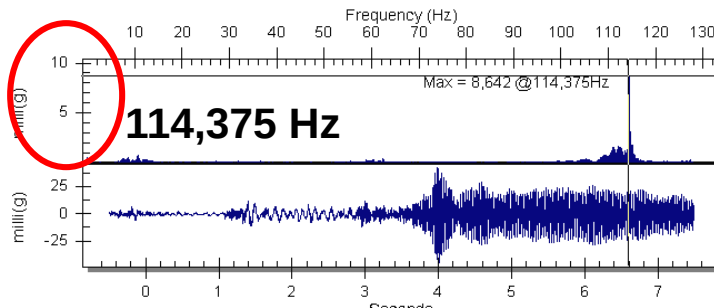


Gear unit empty up

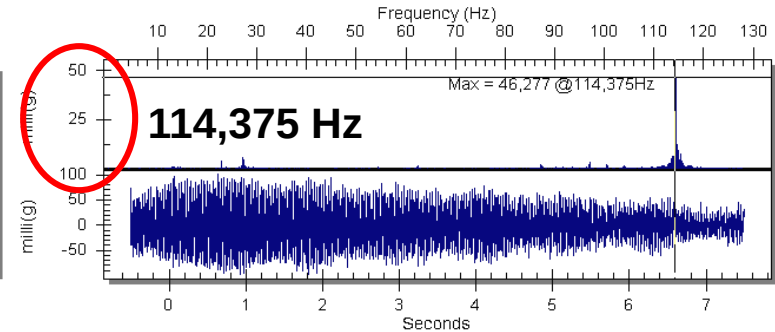


Frequency analysis of the Y channel (Same sensor room orientation)

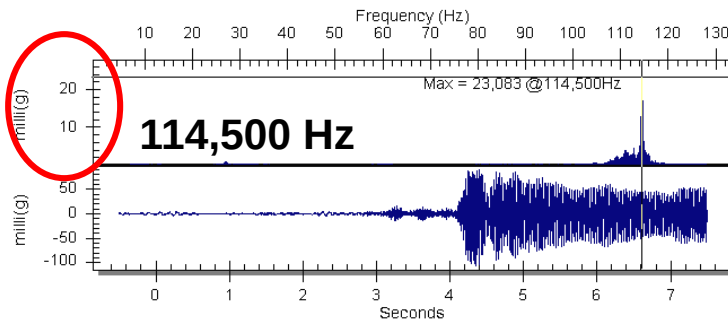
Car empty down



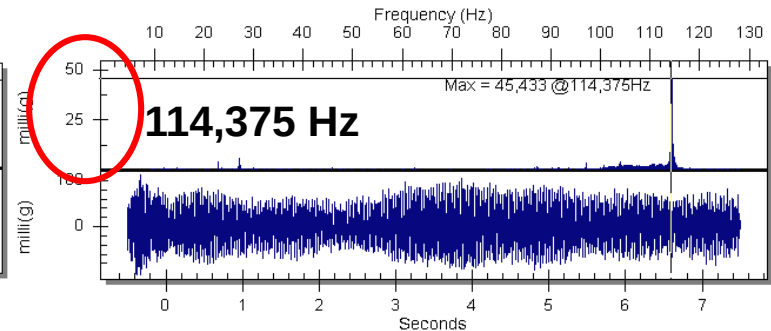
Gear unit empty down



Car empty up



Gear unit empty up



=> The vibration results from the drive

Measured: Frequency in Y-direction **114.375 Hz**

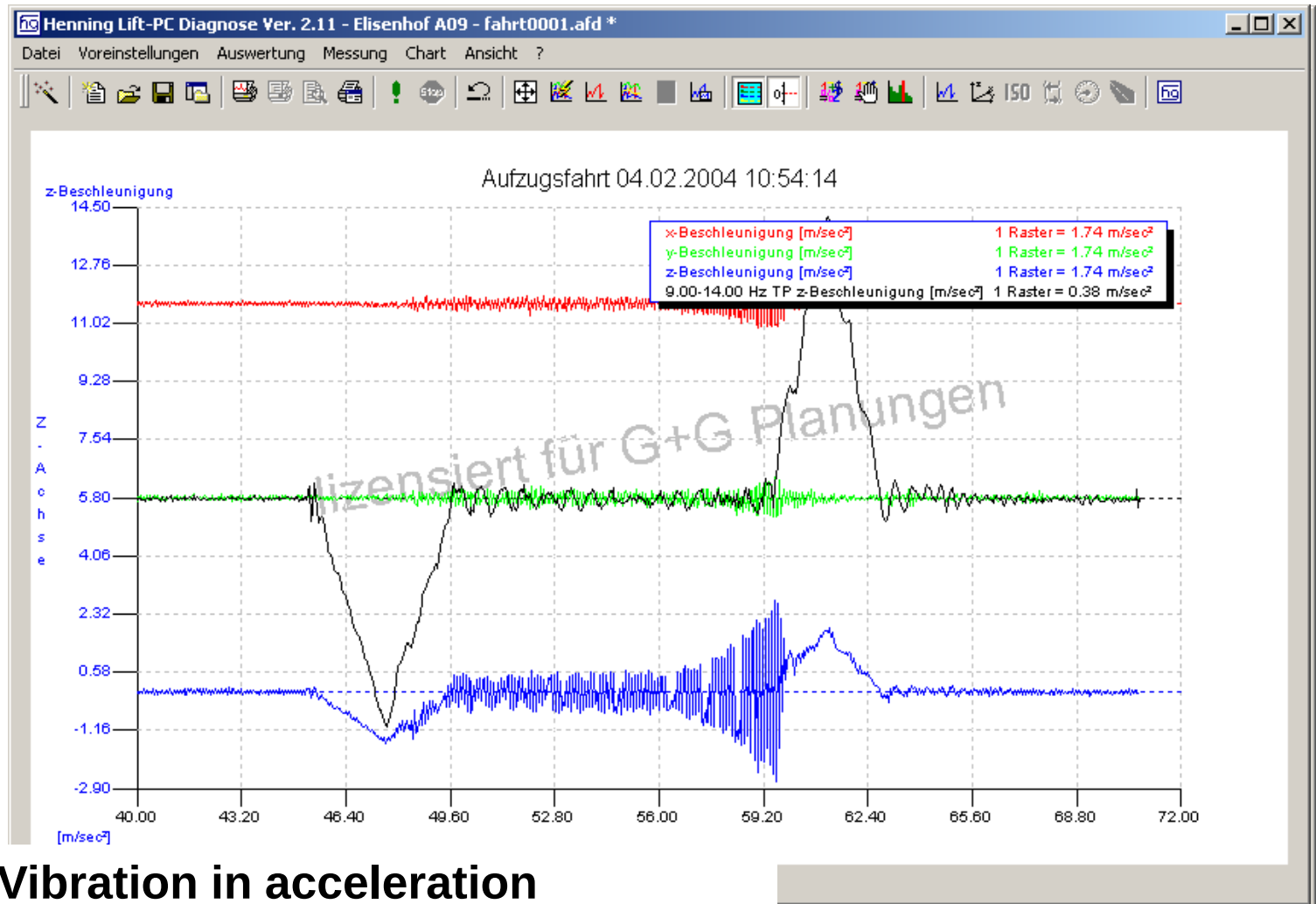
Measured: Motor speed 1372.5 1/min

Motor speed 1 372.5 1/min = **22.875 1/sec (Hz)**

$$\frac{114.375 \text{ Hz}}{22.875 \text{ Hz}} = \text{Factor 5}$$

The gear unit has a 5-start worm

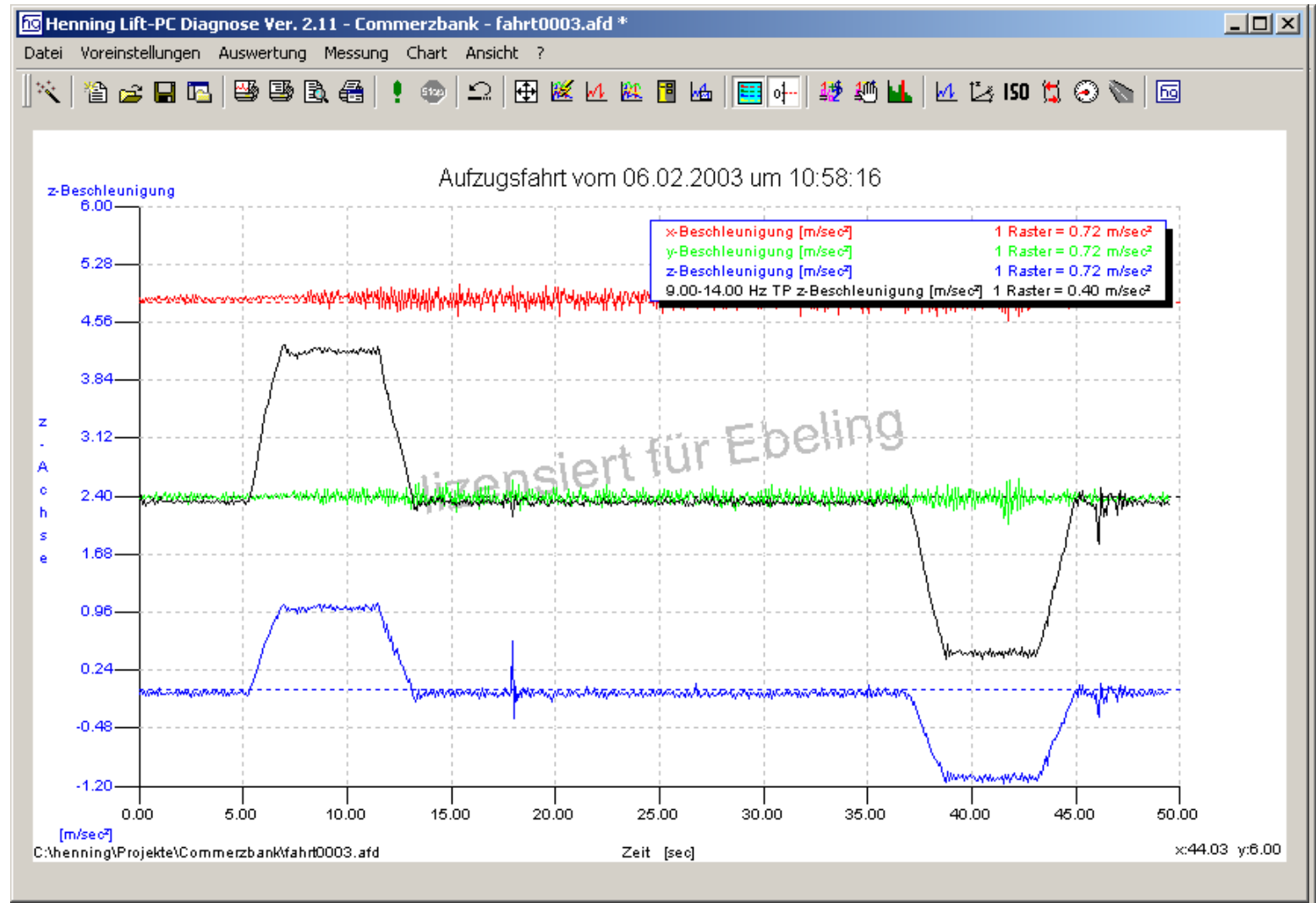
=> Too big geometric tolerance of the worm



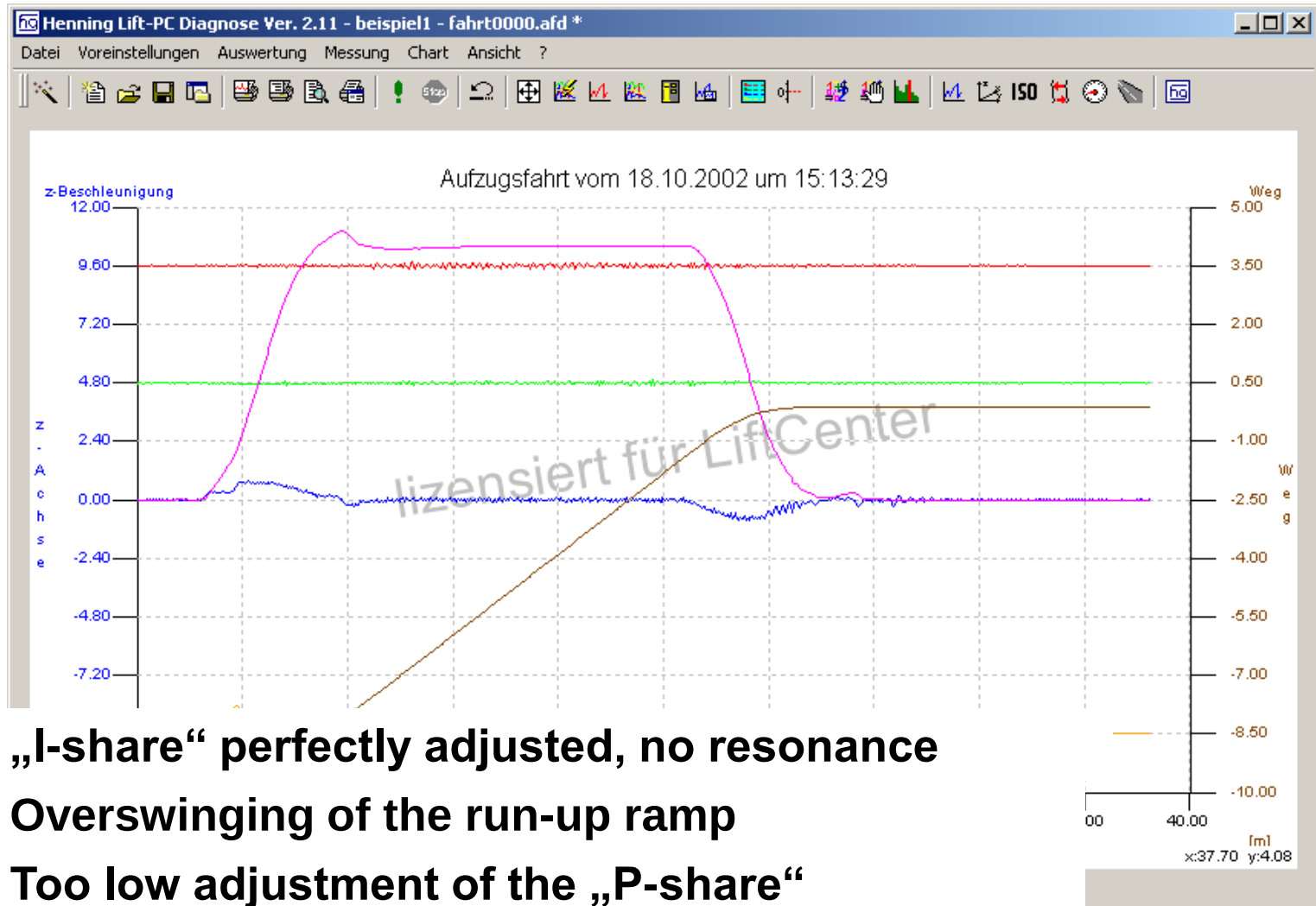
Vibration in acceleration

Resonance between motor control loop and car

=> Too hard adjustment of the „I share“



Softer adjustment of the “I share“



„I-share“ perfectly adjusted, no resonance

Overswinging of the run-up ramp

Too low adjustment of the „P-share“

**With high loading the „P-share“ can no longer
„guide“ the controller**

Discussion