

Microvibration Dynamometer

Type 9236A1, 9236A2

-500 ... 500 N, Ceramic top plate

Piezoelectric multicomponent dynamometer for measuring the three orthogonal components of a force. The dynamometer has a ceramic top plate in order to reach the highest possible rigidity and consequently an extraordinary high natural frequency. Its high resolution enables the smallest dynamic changes in small forces to be measured.

- Wide measuring range
- For microvibration measurements
- Extremely rigid design
- Ceramic top plate
- Easy cleanable surface for use in clean rooms
- Calibrated in 6 components

Description

The high frequency dynamometer Type 9236A is especially designed for measurements in vacuum chambers or clean-rooms, and it is ideally suited for high natural frequencies and measurements of very low forces.

It consists of four 3-component force sensors fitted under high preload between a base plate and a ceramic top plate. Each sensor contains three pairs of quartz plates, one sensitive to pressure in the z direction and the other two responding to shear in the x and y directions respectively. The force components are measured practically without displacement.

The outputs of the four built-in force sensors are connected inside the dynamometer in a way to allow multicomponent measurements of forces and moments to be performed. The eight output signals are available at the 9-conductor flange socket. The four sensors are mounted ground-insulated. Therefore ground loop problems are largely eliminated.

Application examples

- Dynamic and quasistatic measurement of the three orthogonal components of a force
- Microvibration testing
- Cryo cooler testing
- Reaction wheel testing
- Clean room use



Type 9236A1



Type 9236A2

Technical data

(at Tref = 25 °C)

| | | | 9236A1 | 9236A2 |
|--|--|--------|-------------------------|-------------------------|
| Measuring range | F _x , F _y | N | ±500 | ±500 |
| Force application max. | F _z | | | |
| 200 mm (= a _{ZTot}) over the top plate | | | | |
| Overload | F _x , F _y , F _z | N | ±600 | ±600 |
| Calibrated range forces | F _x , F _y , F _z | N | 0 ... 200 | 0 ... 100 |
| (a _{ZTot} = 150 mm) | | | | |
| Calibrated range moments | M _x | N·m | 0 ... 30 | 0 ... 19,5 |
| (a _{ZTot} = 150 mm) | M _y | N·m | 0 ... -30 | 0 ... -19,5 |
| (a _y = 200 mm) | -M _z | N·m | 0 ... -30 | 0 ... -19,5 |
| (a _x = 200 mm) | M _z | N·m | 0 ... 30 | 0 ... 19,5 |
| Maximum static mass on dynamometer | | kg | ≤50 | ≤50 |
| Noise RMS (1 Hz ... 10 kHz) ¹ | F _x , F _y | N | ≈0,7 * 10 ⁻³ | ≈0,7 * 10 ⁻³ |
| | F _z | N | ≈1,5 * 10 ⁻³ | ≈1,5 * 10 ⁻³ |
| | M _x , M _y , M _z | N·m | ≈4,0 * 10 ⁻⁴ | ≈4,0 * 10 ⁻⁴ |
| Sensitivity | F _x , F _y | pC/N | -7,8 ±2,5 % | -7,8 ±2,5 % |
| | F _z | pC/N | -3,8 ±5 % | -3,8 ±5 % |
| Linearity incl. Hysteresis | F _x , F _y , F _z | %FSO | ≤±0,5 | ≤±0,5 |
| | M _x , M _y , M _z | %FSO | ±1 | ±1 |
| Cross talk | F _z → F _x , F _y | % | <±1 | <±1 |
| | F _x ↔ F _y | % | <±2 | <±2 |
| | F _x , F _y → F _z | % | <±3 | <±3 |
| | F → M | mN·m/N | ±15 | ±15 |
| | M → F | N/N·m | ±3 | ±3 |
| | M ↔ M | % | ±3 | ±3 |
| Isolation | | Ω | ≥10 ¹³ | ≥10 ¹³ |
| Ground insulation | | Ω | ≥10 ⁸ | ≥10 ⁸ |
| Operating and storage temperature range | | °C | 0 ... 60 | 0 ... 60 |
| Operating pressure | | bar | 0,01 ... 1,08 | 0,01 ... 1,08 |
| Weight | | kg | 31,5 | 72 |

¹ With charge amp Typ 5080A..., 100 pC range, no mass on dynamometer

Technical data (continuation)

| | | 9236A1 | 9236A2 |
|---|---------|--------------------|--------|
| Natural frequency | f_0 x | Hz | ≥2 600 |
| | f_0 y | Hz | ≥2 600 |
| | f_0 z | Hz | ≥4 500 |
| Natural frequency with static mass of 10 kg | f_0 x | Hz | ≥1 900 |
| | f_0 y | Hz | ≥1 900 |
| | f_0 z | Hz | ≥3 400 |
| Material of: | | A/2O3 - 99,7 % | |
| – Top plate | | 1.2316 (X36CrMo17) | |
| – Base plate | | | |

| | | 9236A1 | 9236A2 |
|------------------------------|----------|--------|--------|
| Preload (5 steps) | kN | 50 | 50 |
| Torque for fixation screw: | | | |
| – trough sensor 4xM12 (12.9) | N·m | 120 | 120 |
| – Parafin wax, white oil | | | |
| Torque for mounting screw | N·m | 20 | 20 |
| M8 on top plate | | | |
| Protection class | EN 60529 | IP41 | IP41 |

¹⁾ With charge amplifier Type 5080A... (AC – powered), 100 pC range, no mass on dynamometer

Dimensions Type 9236A1

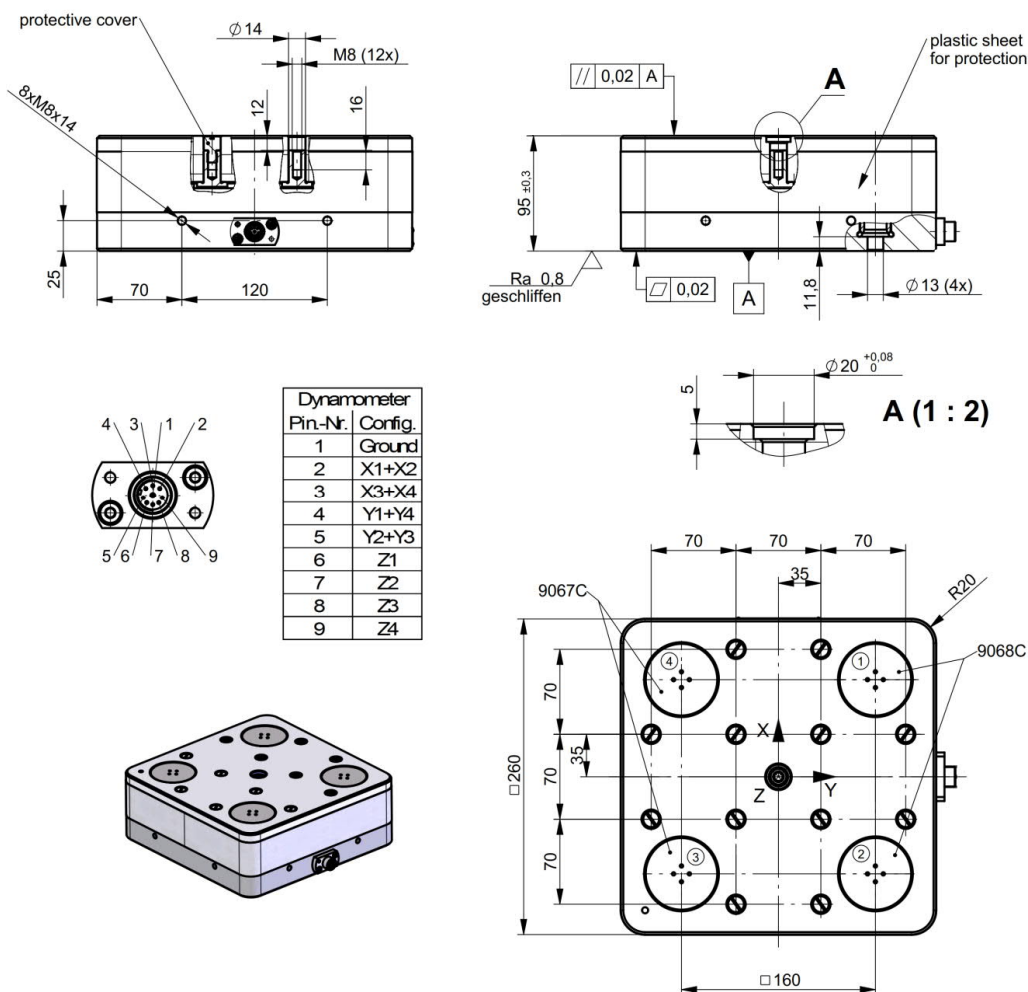


Fig. 1: Dimensions of Microvibration Dynamometer Type 9236A1

Mounting

For the best results, the dynamometer must be mounted with screws on a vibration isolated stone table, that is at least 10x heavier than the weight of the test setup. This allows to reach the highest resonant frequency of the measuring system. Uneven supporting surface may set up internal stresses, which will impose severe additional loads on the individual measuring elements and may also increase cross talk.

The supporting surfaces for the force-introducing parts must be face-ground to obtain good mechanical coupling to the cover plate.

The best results are reached in a silent room and a 5080A charge amplifier, which operates at an especially low noise level.

Dimensions Type 9236A2

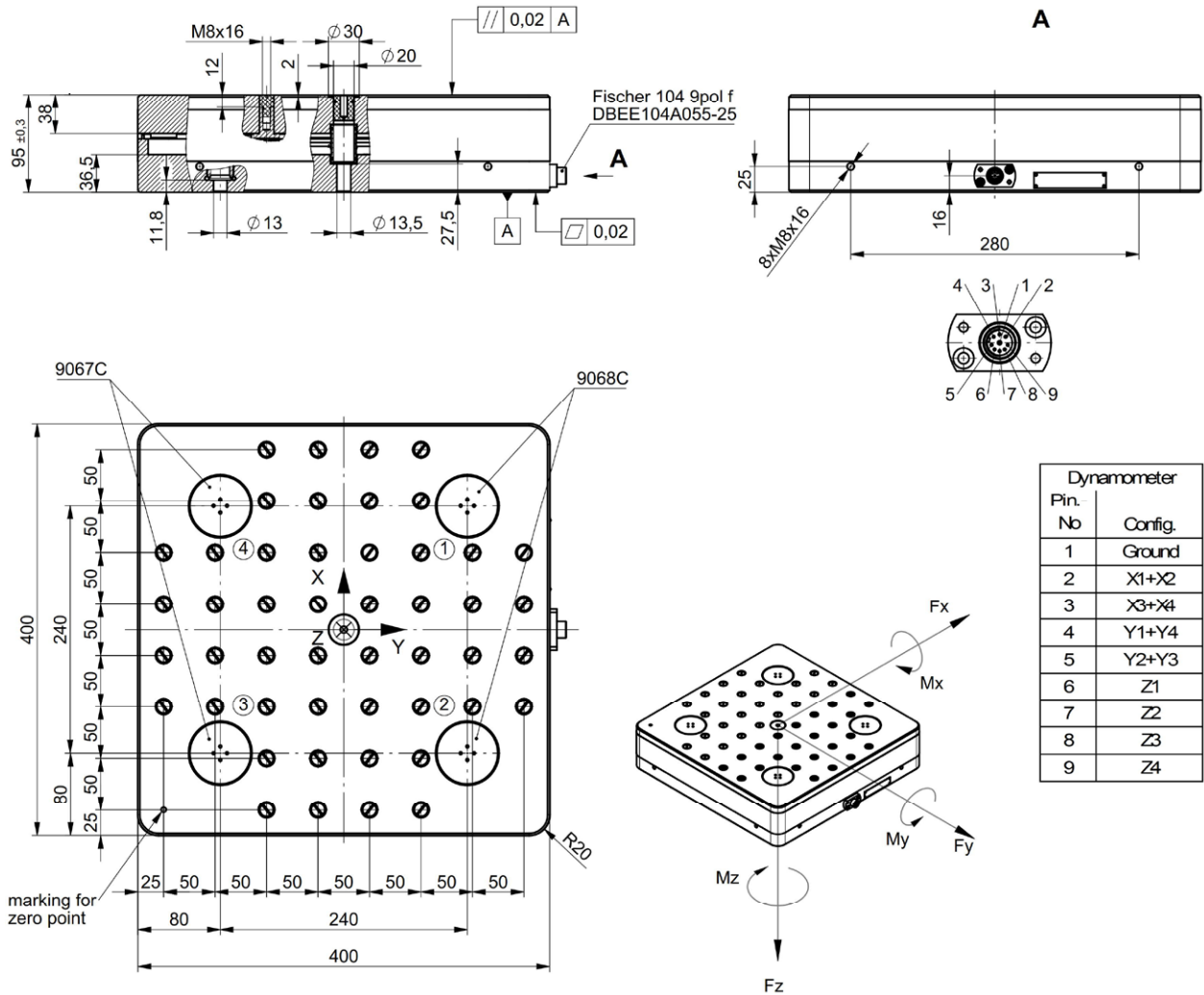


Fig. 2: Dimensions of Microvibration Dynamometer Type 9236A2

9236A_003-460e-10.19

3-component force measurement F_x, F_y, F_z

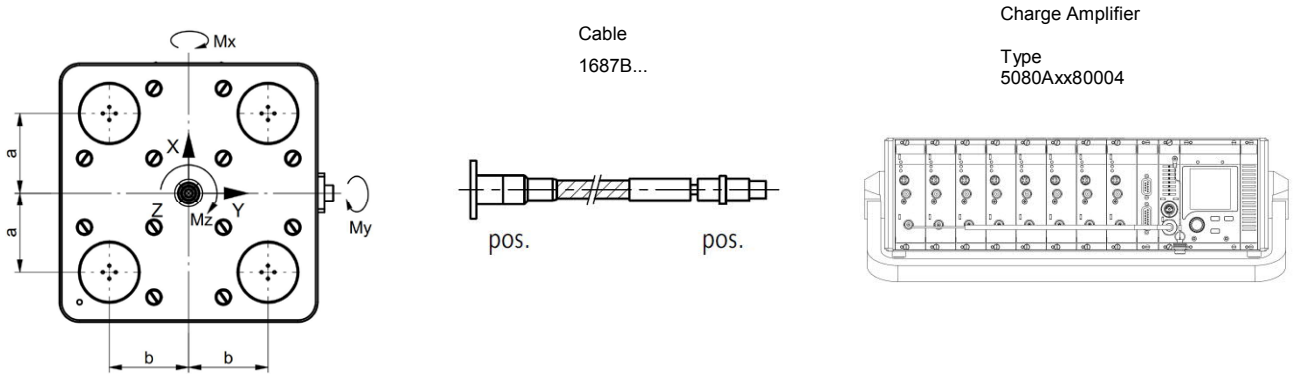


Fig. 2: Measuring system for 3-component measurement with multi-channel charge amplifier

6-component force-moment-measurement with 8-channel charge amplifier Type 5080A...

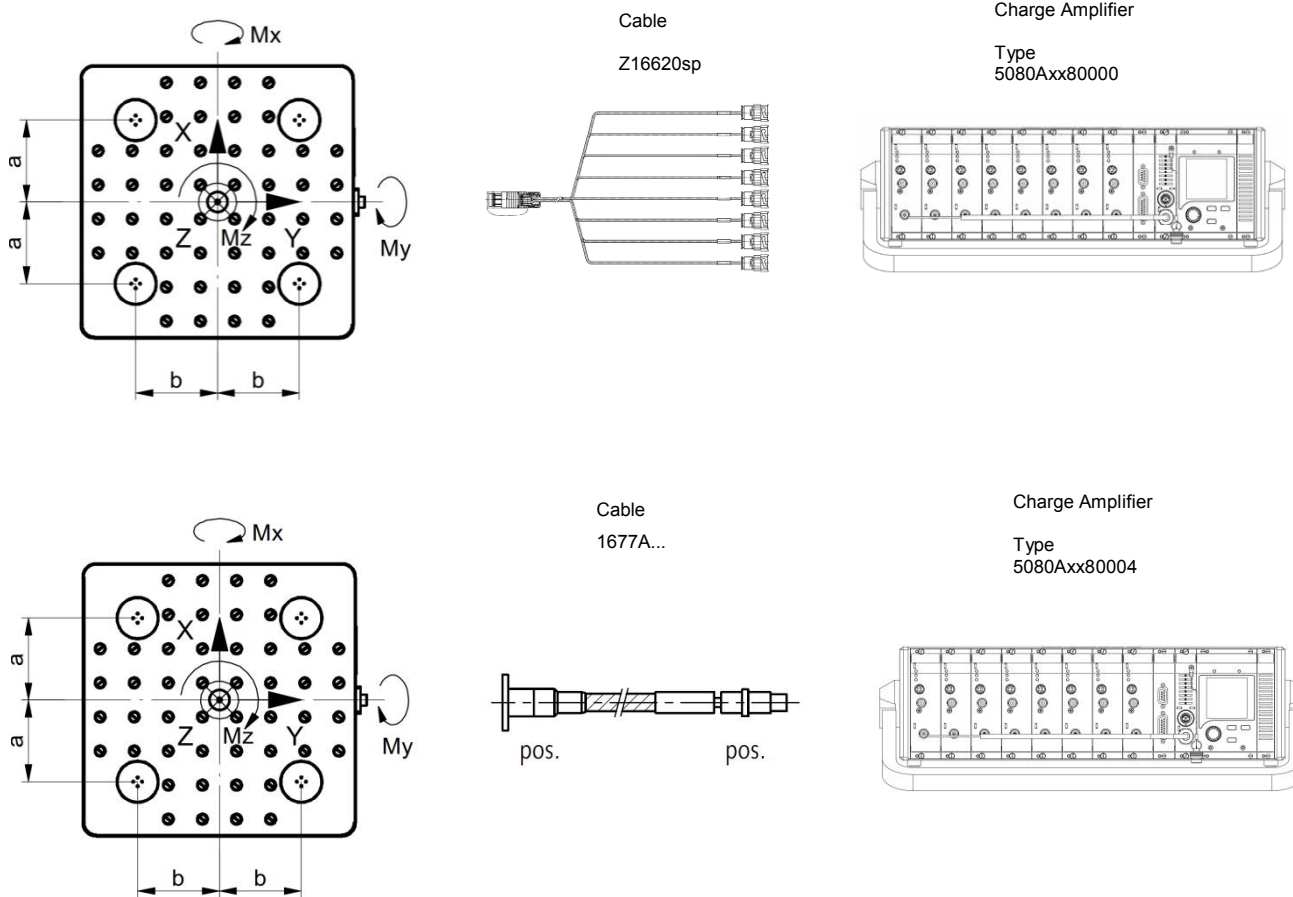


Fig. 3: Measuring system for 6-component measurement with multi-channel charge amplifier

9236A_003-460e-10.19

Cabling

| Output Signal | Cable | Cable Properties | Length [m] | | Temp. Range | IEC/EN 60529 | Connector Dynamometer | Connector Amplifier | IEC/EN 60529 | Channel | | | | | | | | | | | | | | | | |
|---------------------|------------------|------------------------------|------------|-----------------|-------------|-----------------|-----------------------|---------------------|--------------|-------------------|------------------------|---------------------|-------------------|------------------------|----------|----------|----------|----------|----------|----------|----------|----------|-------|--------|---|---|
| | | | min | max | | | | | | IP65 | IP65 | IP65 | IP67 | IP53 | IP20 | IP40 | IP40 | IP20 | IP20 | | | | | | | |
| sum 3 | Z15141sp | PFA | 1 | 20 | -5...70°C | plugged IP40 | 9-pole pos. | 3x BNC pos. | IP40 | 5030A | 5039A | 5073A... | 5074A... | 5877B... | 5015A... | 5018A... | 5080A... | 5165A... | 5167A... | KIDAQ | | | | | | |
| | 1683Asp | PFA with flexible steel hose | 2 | 20 | | | | | | IP65 | 9-pole pos. 90° | Fischer 9-pole pos. | IP65 | 1 | 1 | 1-4 | 1-4 | 1 | 1 | 1 | 1-8 | 1,4 | 4,8 | 4...52 | | |
| | 1687BQ01... | TPC black Ø3.6mm | 1 | 20 | | | | | | bolttable IP65 | Flange 9-pole pos. | | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1687BQ02... | PFA, steel braiding | 1 | 5 | | | | | | | | | bolttable IP67 | Flange 9-pole pos. | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1687B... | PFA with flexible steel hose | 2 | 20 | | | | | | bolttable IP67 | Flange 9-pole pos. | | | | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1689B... | PFA with flexible steel hose | 1 | 20 | | | | | | | | | bolttable IP67 | Flange 9-pole pos. 90° | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| separate 8 | Z16620sp | PFA | 1 | 20 | -5...70°C | plugged IP40 | 9-pole pos. | 8x BNC pos. | IP40 | 5030A | 5039A | | | | 5073A... | 5074A... | 5877B... | 5015A... | 5018A... | 5080A... | 5165A... | 5167A... | KIDAQ | | | |
| | 1685B... | TPC black Ø5.6mm | 1 | 20 | | | | | | plugged IP65 | 9-pole pos. | Fischer 9-pole pos. | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | 1686A... | TPC black Ø5.6mm | 1 | 20 | | | | | | | | | plugged IP65 | 9-pole pos. 90° | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1681B... | PFA with flexible steel hose | 1 | 20 | | | | | | bolttable IP65 | 9-pole pos. | | | | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1677AQ01.. | TPC black Ø5.6mm | 1 | 20 | | | | | | | | | bolttable IP65 | Flange 9-pole pos. | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1677AQ02.. | TPC, steel braiding | 1 | 20 | | | | | | bolttable IP67 | Flange 9-pole pos. | | | | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1677A... | PFA with flexible steel hose | 1 | 20 | | | | | | | | | bolttable IP67 | Flange 9-pole pos. | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1679A... | PFA with flexible steel hose | 2 | 20 | | | | | | bolttable IP67 | Flange 9-pole pos. 90° | | | | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| extension 3 8 | Z13705sp... | PFA | 1 | 20 | -5...70°C | plugged IP40 | 9-pole neg. | 3x BNC pos. | IP40 | | | | 5030A | 5039A | 5073A... | 5074A... | 5877B... | 5015A... | 5018A... | 5080A... | 5165A... | 5167A... | KIDAQ | | | |
| | 1688B... | TPC black Ø3.6mm | 1 | 20 | | | | | | plugged IP65 | 9-pole neg. | Fischer 9-pole pos. | IP65 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Z16634sp.. | PFA | 1 | 20 | | | | | | | | | plugged IP40 | 9-pole neg. | IP40 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | 1656Asp | PFA | 1 | 20 | | | | | | plugged IP40 | 9-pole neg. | | | | IP40 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 1678A... | TPC black Ø5.6mm | 1 | 25 | plugged IP65 | 9-pole neg. | IP65 | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |

Included Accessories

- 4 fixation screws M12x35
- 1 fixation screws M12x50 ²
- 4 eye bolt M 20x1,5
- 4 spacer
- 1 wrench adapter

Type/Mat. No.

- 65012818
- 65012841
- 55151639
- 55151642
- 9475

Ordering Code

- Microvibration dynamometer up to 500 N, cover plate 260x260 mm
- Microvibration dynamometer up to 500 N, cover plate 400x400 mm

Type/Mat. No.

- 9236A1
- 9236A2

² Type 9236A2 only