

4-Component Dynamometer

Type 9272

For cutting force measurement in drilling

Four-component dynamometer for measuring a torque M_z and the three orthogonal components of a force.

The dynamometer has a great rigidity and consequently a high natural frequency. Its high resolution enables the smallest dynamic changes in large forces and torques to be measured.

- Compact and robust multicomponent force measuring instrument
- Suitable for cutting force measurements when drilling
- Universal use

Description

The dynamometer consists of a four component sensor fitted under high preload between a base plate and a top plate.

The four components are measured practically without displacement.

It must be taken into account that combined and eccentric loads may reduce the measuring ranges.

The sensor is mounted ground-isolated. Therefore ground loop problems are largely eliminated.

The dynamometer is rustproof and protected against penetration of splash water and cooling agents.

Together with the connecting cable Type 1677A5/1679A5 it corresponds to the protection class IP 67.

Application examples

- Measuring feed force, deflective force and moment when drilling, threadcutting etc.
- Cutting force measurements while milling and grinding
- Cutting force measurements while turning
- Testing torque wrenches
- Testing springs (torsion)
- Measurements on small thrust bearings, friction clutches etc.
- Measuring starting torques on fractional horsepower and stepping motors
- Ergonomic measurements



Technical data

| | | | | |
|----------------------------|------------|--------|-------------------------|-----|
| Measuring range | F_x, F_y | kN | -5 ... 5 ¹⁾ | |
| | F_z | kN | -5 ... 20 ²⁾ | |
| | M_z | N·m | -200 ... 200 | |
| Calibrated measuring range | 100 % | | | |
| | F_x, F_y | kN | 0 ... 5 | |
| | F_z | kN | 0 ... 20 | |
| 10 % | M_z | N·m | 0 ... 200 | |
| | 0 ... -200 | | | |
| | F_x, F_y | kN | 0 ... 0,5 | |
| Overload | F_z | kN | 0 ... 2 | |
| | M_z | N·m | 0 ... 20 | |
| | 0 ... -20 | | | |
| Max. bending moment | F_x, F_y | kN | -6/6 | |
| | F_z | kN | -6/24 | |
| | M_z | N·m | -240/240 | |
| Threshold | M_x, M_y | N·m | -400 ... 400 | |
| | F_x, F_y | N | <0,01 | |
| | F_z | N | <0,02 | |
| Sensitivity | M_z | mN·m | <0,2 | |
| | F_x, F_y | pC/N | ≈-7,8 | |
| | F_z | pC/N | ≈-3,5 | |
| Linearity, all ranges | M_z | pC/N·m | ≈-160 | |
| | | | % FSO | ≤±1 |
| | | | % FSO | ≤1 |

| | | | |
|--|---------------------------|----------------|----------------|
| Crosstalk | $F_x \leftrightarrow F_y$ | % | $\leq \pm 2$ |
| | $F_z \rightarrow F_{x,y}$ | % | $\leq \pm 1$ |
| | $F_{x,y} \rightarrow F_z$ | % | $\leq \pm 2$ |
| | $F_z \rightarrow M_z$ | mN·m/N | $\leq \pm 0,2$ |
| | $M_z \rightarrow F_z$ | N/N·m | $\leq \pm 1$ |
| | $F_{x,y} \rightarrow M_z$ | mN·m/N | $\leq \pm 0,7$ |
| | $M_z \rightarrow F_{x,y}$ | N/N·m | $\leq \pm 0,5$ |
| Rigidity | c_x, c_y | kN/ μ m | $\approx 0,4$ |
| | c_z | kN/ μ m | ≈ 2 |
| | cM_z | N·m/ μ rad | $\approx 0,7$ |
| Natural frequency (mounted on rigid base) | $f_n(x,y)$ | kHz | $\approx 3,1$ |
| | $f_n(z)$ | kHz | $\approx 6,3$ |
| | $f_n(M_z)$ | kHz | $\approx 4,2$ |

| | | |
|--|----------------------------|--------------------|
| Operating temperature range | °C | 0 ... 70 |
| Temperature coefficient of sensitivity | %/°C | -0,02 |
| Capacitance | F_x, F_y, F_z | pF 185 |
| | M_z | pF 420 |
| Insulation resistance (20 °C) | Ω | $> 10^{13}$ |
| Ground isolated | Ω | $> 10^8$ |
| Connector | Fischer flange 9-pole neg. | |
| Degree of protection EN60529 | – | IP67 ³⁾ |
| Weight | kg | 4,2 |

- ¹⁾ Force application point inside and max. 25 mm above top plate area
- ²⁾ Force application point max. 20 mm from center
- ³⁾ With connecting cable Types 1677A5, 1679A5

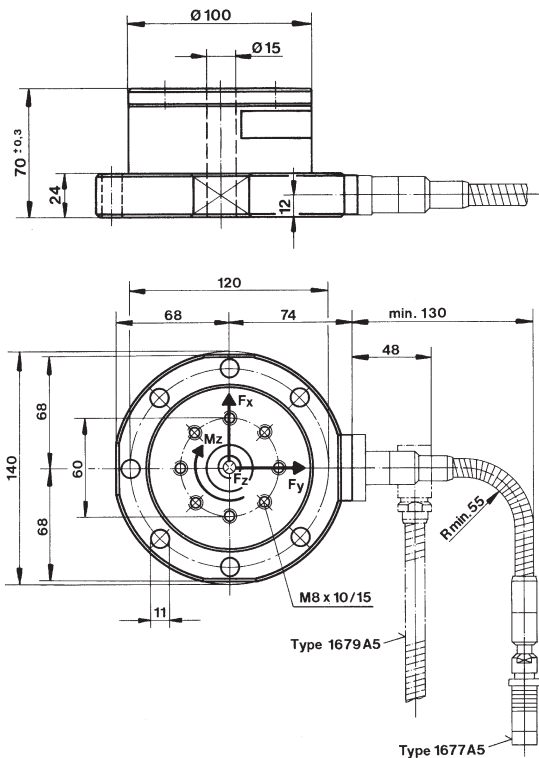


Fig. 1: Dimensions Dynamometer Type 9272

Mounting

The dynamometer may be mounted with screws or claws on any clean, face-ground supporting surface, such as the table of a machine tool for example. Uneven supporting surface may set up internal stresses, which will impose severe additional loads on the sensor and may also increase crosstalk.

For mounting the force-introducing components, such as lathe tools and workpieces, eight M8 mm threaded holes in the cover plate are available. The supporting surfaces for the force-introducing parts must be face-ground to obtain good mechanical coupling to the cover plate.

Technical Data

Dynamometer Type 9272 with Mounted Tool Holder Type 9404
for turning; force acting onto point A

| | | | |
|---|---------------------------|-----|---------------|
| Range | F_x, F_y | kN | -2 ... 2 |
| | F_z | kN | 0 ... 4 |
| Crosstalk | $F_x \leftrightarrow F_y$ | % | $\leq \pm 5$ |
| | $F_z \rightarrow F_{x,y}$ | % | $\leq \pm 2$ |
| | $F_{x,y} \rightarrow F_z$ | % | $\leq \pm 5$ |
| Natural frequency (mounted on flanges) with tool holder | $f_n(x,y)$ | kHz | $\approx 1,5$ |
| | $f_n(z)$ | kHz | ≈ 4 |

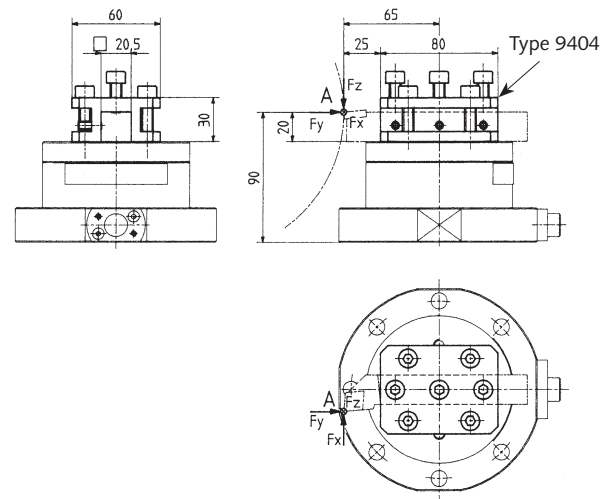


Fig. 2: Dimensions Dynamometer Type 9272 with mounted tool holder Type 9404

For satisfactory mounting of lathe tools up to 20x20 mm shank cross section, the tool holder Type 9404 may be used. This holder is not included in the standard accessories and must therefore be ordered separately.

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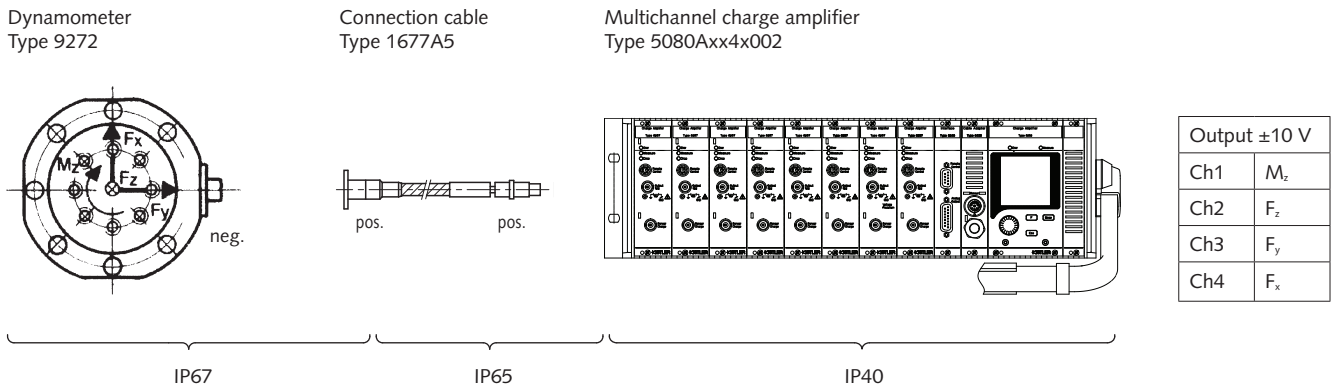
Processing the measurement signals

Charge amplifier channels are also needed to build a complete measuring system (e.g. Type 5080A...). These convert the measurement signal into an electrical voltage. The measured value is exactly proportional to the force acting.

Data acquisition and analysis

Kistler offers with the Type 5697A1 DAQ system an universal and easy to operate package, consisting of a hardware for the data acquisition and the DynoWare software. For details see data sheet 5697A_000-745.

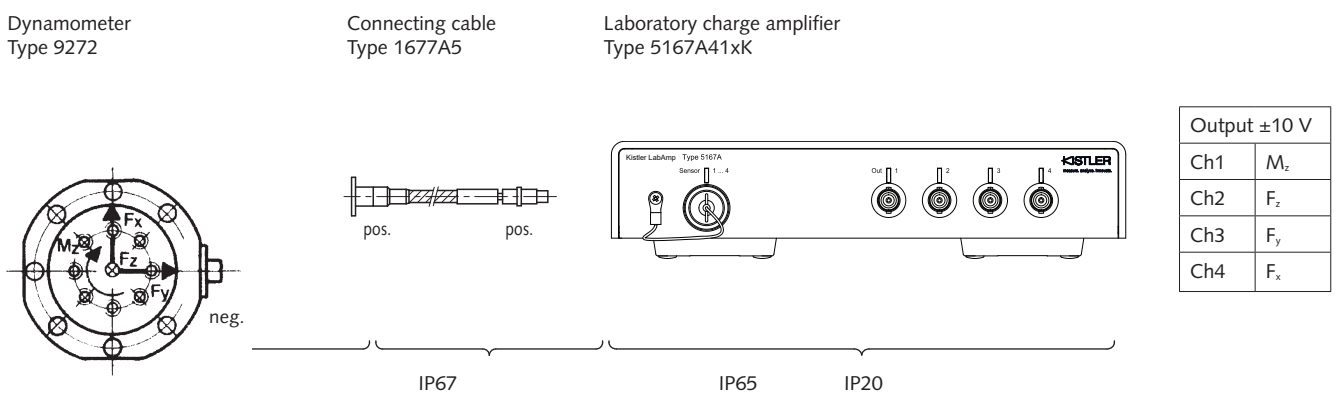
Measuring system for 4-component measurement M_z , F_x , F_y , F_z



Degree of protection EN60529

Fig. 3: Measuring system for 4-component measurement with multichannel charge amplifier

Measuring system for 4-component measurement M_z , F_x , F_y , F_z




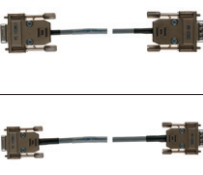

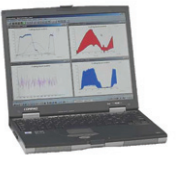


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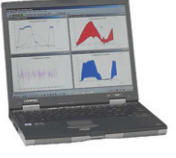
Fig. 4: Measuring system for 4-component measurement with laboratory charge amplifier

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Typical measuring chain with DAQ system Type 5697A1

| | | | | | |
|---|---|---|--|---|---|
|  |  |  |  |  |  |
| Dynamometer | Connection cable, high impedance | Charge amplifier | Connecting cable | DAQ system | Notebook (from customer side) with DynoWare |
| Type 9272 | Type 1677A | Type 5080A | Type 1700A111A2 Type 1200A27 | Type 5697A1 | |

Typical measuring chain with LabAmp system Type 5167A...

| | | | | |
|---|---|--|--|---|
|  |  |  | |  |
| Dynamometer | Connection cable, high impedance | Charge amplifier with integrated DAQ | | Notebook (from customer side) with DynoWare |
| Type 9272 | Type 1677A | Type 5167A... | | |

Ordering code

- 4-component dynamometer for cutting force measurement in drilling

Type/Art. No.
9272

Optional accessories
• Tool holder

Type/Art. No.
9404

For 4-component force and moment measurement

$F_x, F_y, F_z / M_z$

- Connecting cable, 8 wire, with flexible metal sheath (L = 5 m) **1677A5**
- Connecting cable, 8 wire, with steel braided, flexibel (L = 5 m) **1677AQ02**
- Extension cable, 8 wire, high insulation (L = 5 m) **1678A5**
- Connecting cable, 8 wire, with flexible metal sheath and angle connector (L = 5 m) **1679A5**

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