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

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

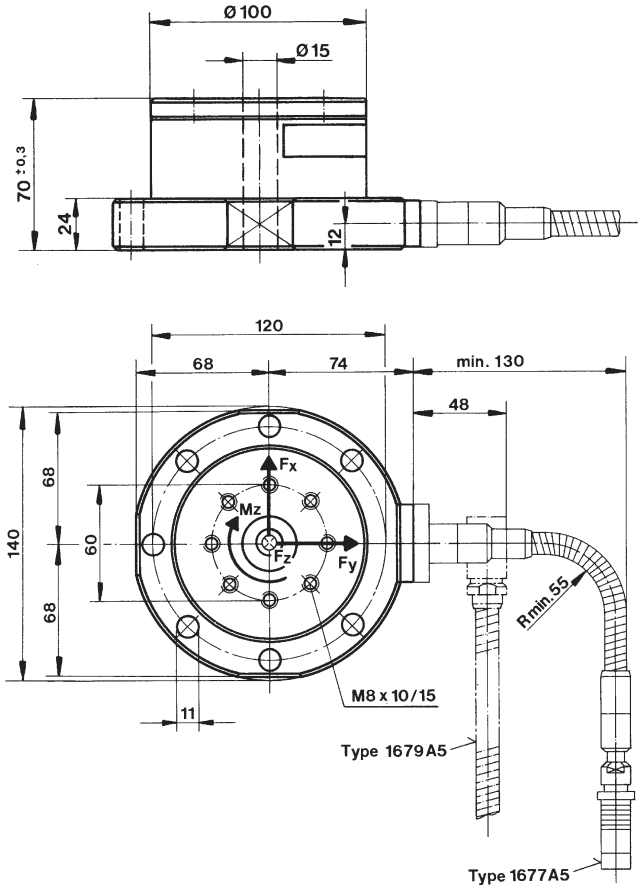

Fig. 1: Dimensions Dynamometer Type 9272

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	$F_x \leftrightarrow F_y$	%	≤±5
	$F_z \rightarrow F_{x,y}$	%	≤±2
	$F_{x,y} \rightarrow F_z$	%	≤±5
Natural frequency	f_n (x,y)	kHz	≈1,5
(mounted on flanges) with tool holder	f_n (z)	kHz	≈4

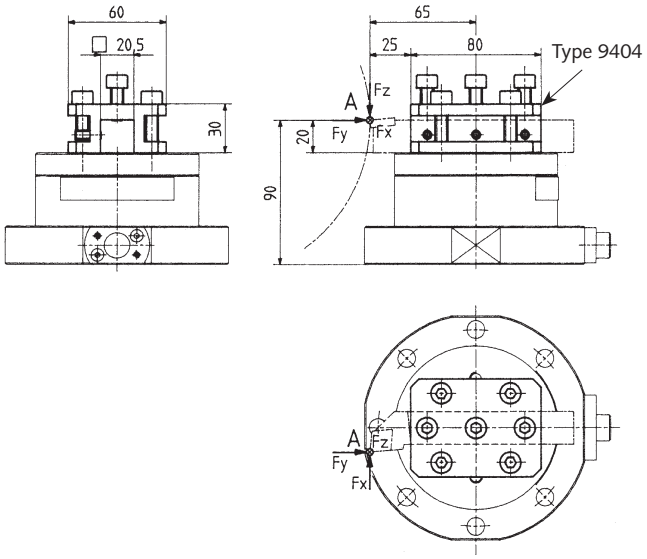

Fig. 2: Dimensions Dynamometer Type 9272 with mounted tool holder Type 9404

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4-Component Force-Torque Measurement M_z, F_z, F_y, F_x with 4-Channel Charge Amplifier

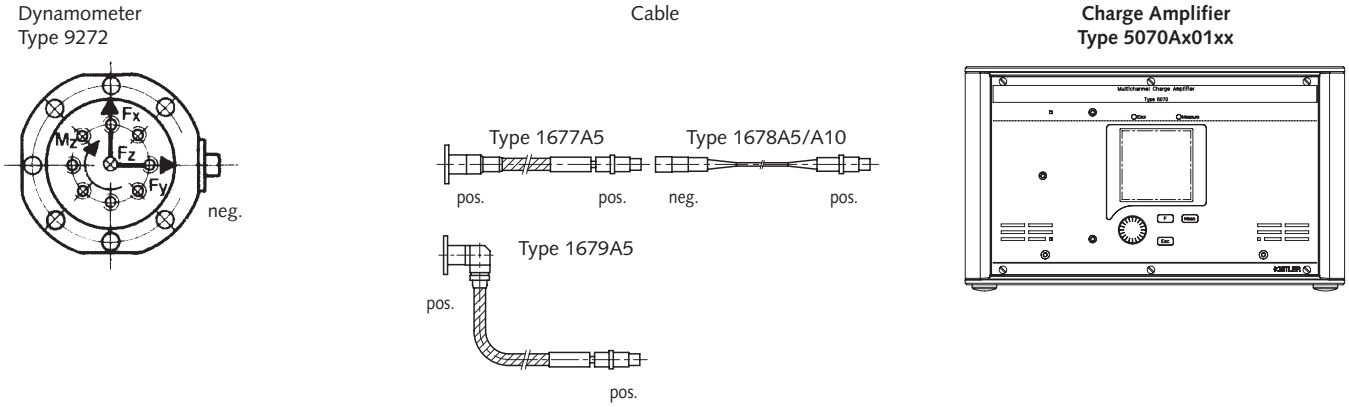

Fig. 3: Example of a measuring system with dynamometer Type 9272

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.

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.

Signal Conditioning

In addition to the dynamometer, a four-component measuring system needs a multi-core high-insulation connecting cable and four charge amplifier channels.

These convert the charge signals from the dynamometer into output voltages. The output voltage is proportional to the forces and moments occurring.

The multichannel charge amplifier Type 5070A… is ideal for this purpose. For details, see the data sheet 5070A_000-485.

Data Acquisition and Evaluation

Kistler DynoWare is an easy to use universal software and is ideal for multi-component force measurement with dynamometers. For details, see the data sheet 2825A_000-371.

Optional Accessories	Type
• Connecting cable (8 leads)	1677A5
	1679A5
• Extension cable (8 leads)	1678A5
	1678A10
• Tool holder	9404

Ordering Key	Type
• 4-Component Dynamometer for Cutting Force Measurement in Drilling	9272

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