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Multicomponent Dynamometer

Type 9257B

–5 ... 10 kN, top plate 100x170 mm

Quartz three-component dynamometer for measuring 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 to be measured.

- Universal applicable
- For cutting force measurements
- Stable and reliable

Description

The dynamometer consists of four three-component force sensors fitted under high preload between a baseplate and a 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.

The dynamometer is rustproof and protected against penetration of splashwater and cooling agents. Together with the connecting cable Type 1687B5/1689B5 and Type 1677A5/1679A5 it corresponds to the protection class IP67.

A special thermal isolation coating is integrated in the top plate which renders the dynamometer largely insensitive to temperature influences.

Application examples

- Dynamic and quasistatic measurement of the three orthogonal components of a force
- Measuring cutting force when turning, milling, grinding etc. In conjunction with the calibrated partial ranges the high sensitivity and low threshold allow exact measurements on small tools and when grinding.
- Measurements on scale models in wind channels

Technical data

Range	F_x, F_y, F_z	kN	–5 ... 5 [1]
F_z for F_x and $F_y \leq 0{,}5\ F_z$	F_z	kN	–5 ... 10 [2]
Calibrated partial range 1	F_x, F_y	N	0 ... 500
	F_z	N	0 ... 1 000
Calibrated partial range 2	F_x, F_y	N	0 ... 50
	F_z	N	0 ... 100
Overload	F_x, F_y, F_z	kN	–7,5/7,5
F_z for F_x and $F_y \leq 0{,}5\ F_z$	F_z	kN	–7,5/15
Threshold		N	<0,01
Sensitivity	F_x, F_y	pC/N	≈–7,5
	F_z	pC/N	≈–3,7
Linearity, all ranges		%FSO	≤±1
Hysteresis, all ranges		%FSO	≤0,5
Cross talk		%	≤±2
Rigidity	c_x, c_y	kN/µm	>1
	c_z	kN/µm	>2
Natural frequency	f_n(x, y, z)	kHz	≈3,5 [4]
Natural frequency	f_n(x, y)	kHz	≈2,3 [4]
(mounted on flanges)	f_n(z)	kHz	≈3,5 [4]
Operating temperature range		°C	0 ... 70
Capacitance	F_x, F_y, F_z	pF	≈220
Insulation resistance (20 °C)		Ω	$>10^{13}$
Ground insulation		Ω	$>10^{8}$
Protection class EN60529		–	IP67 [3]
Weight		kg	7,3
Clamping area	mm	100x170	
Connection		Fischer flange, 9 pol. neg.	

[1] Application of force inside and max. 25 mm above top plate area
[2] Range for turning, application of force at point A
[3] With connecting cable Types 1687B5, 1689B5, 1677A5, 1679A5
[4] Without tool holder Type 9403

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Dimensions milling, grinding

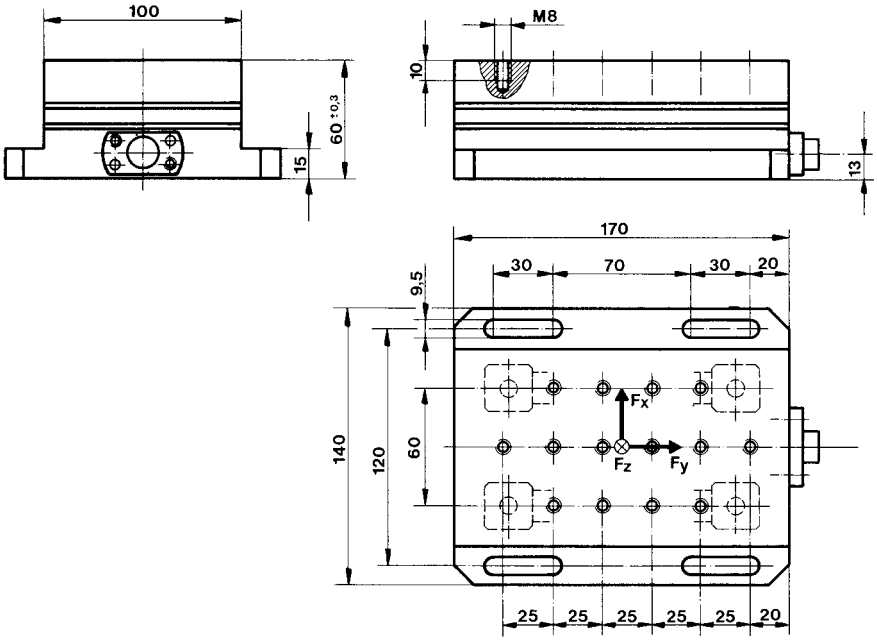
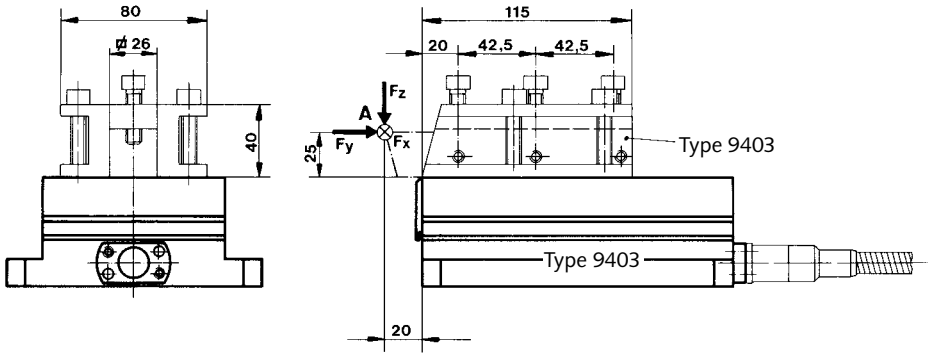


Fig. 1: Dimensions dynamometer Type 9257B

Dimensions turning



Mounting

The dynamometer may be mounted with screws or claws on any clean, face-ground supporting surface, such as the table of a machining tool for example. 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.

For mounting the force-introducing components, such as lathe tools and workpieces, fourteen M8x1,25 mm blind tap 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 26x26 mm shank cross section, the tool holder Type 9403 may be used.
This holder is not included in the standard accessories and must therefore be ordered separately.

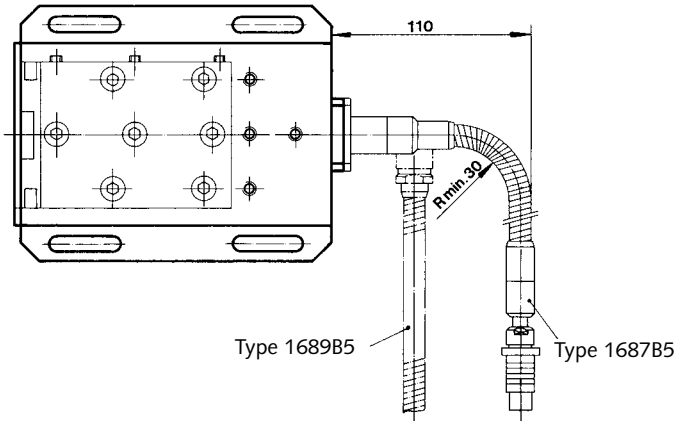


Fig. 2: Dimensions dynamometer Type 9257B with mounted tool holder Type 9403

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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.

3-component force measurement F_x, F_y, F_z

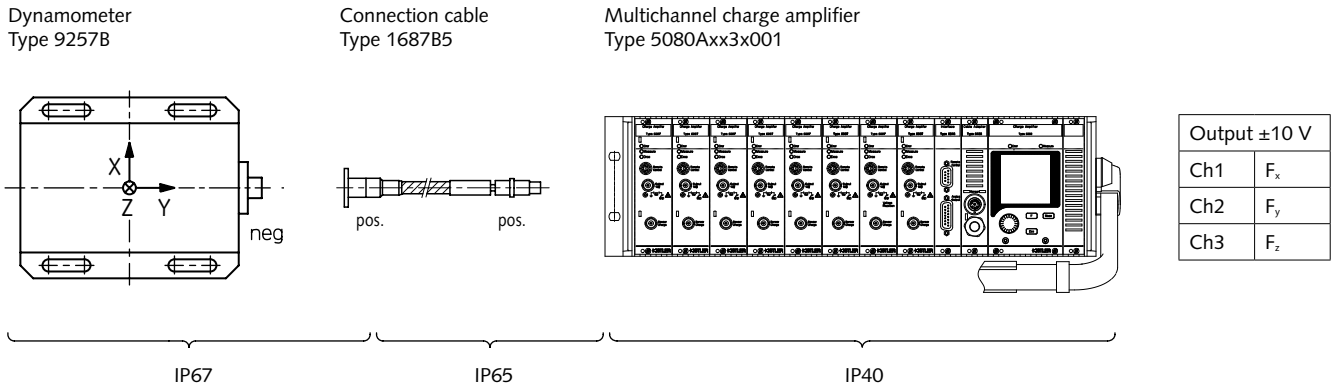

Fig. 3: Measuring system for 3-component measurement with multichannel charge amplifier

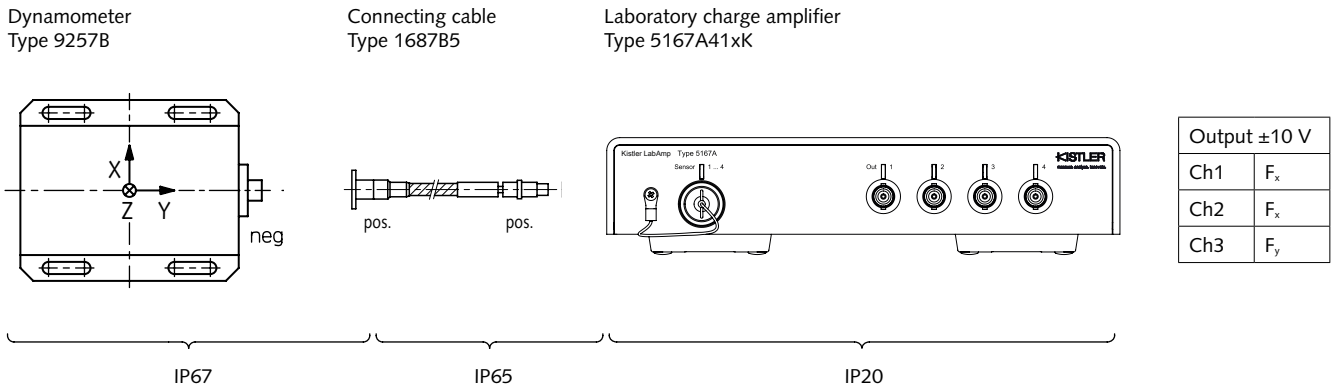

Fig. 4: Measuring system for 3-component measurement with laboratory charge amplifier

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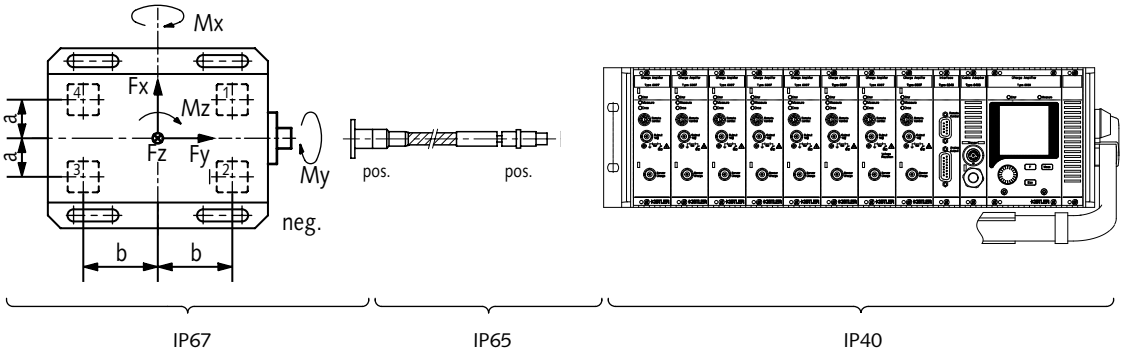
6-component force measurement F_x, F_y, F_z, M_x, M_y, M_z

Dynamometer
Type 9257B

Connection cable
Type 1677A5

Multichannel charge amplifier
Type 5080Axx8x004



Output ±10 V	
Ch1	F_{x1+2}
Ch2	F_{x3+4}
Ch3	F_{y1+4}
Ch4	F_{y2+3}
Ch5	F_{z1}
Ch6	F_{z2}
Ch7	F_{z3}
Ch8	F_{z4}

Degree of protection EN60529

Fig. 5: Measuring system for 6-component measurement with multichannel charge amplifier

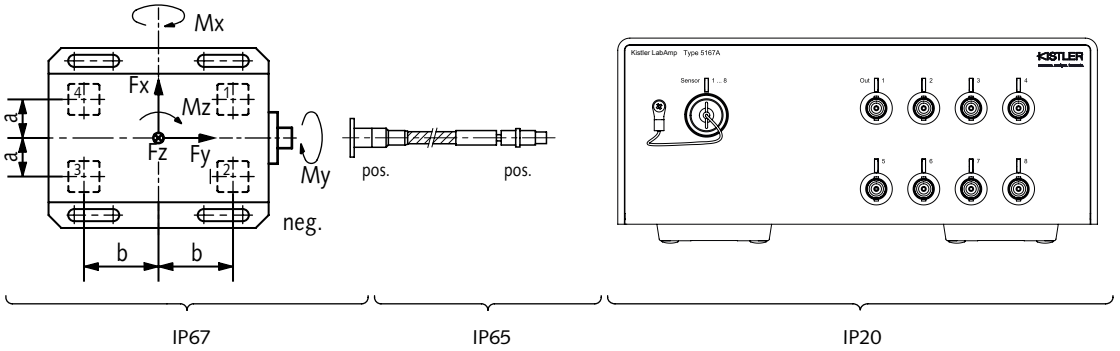
Value a,b for Type 9257B:

a mm	b mm
30	57,5

Dynamometer
Type 9257B

Connection cable
Type 1677A5

Laboratory charge amplifier
Type 5167A81xK



Output ±10 V	
Ch1	F_{x1+2}
Ch2	F_{x3+4}
Ch3	F_{y1+4}
Ch4	F_{y2+3}
Ch5	F_{z1}
Ch6	F_{z2}
Ch7	F_{z3}
Ch8	F_{z4}

Degree of protection EN60529

Fig. 6: Measuring system for 6-component measurement with laboratory charge amplifier

Value a,b for Type 9257B:

a mm	b mm
30	57,5

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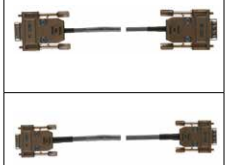
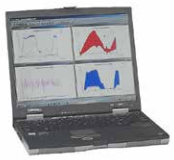
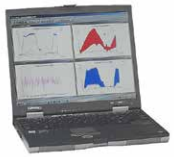
Typical measuring chain with DAQ system Type 5697A1

					
Dynamometer	Connection cable, high impedance	Charge amplifier	Connecting cable	DAQ system	Notebook (from customer side) with DynoWare
Type 9257B	Type 16xx	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 9257B	Type 16xx	Type 5167A…	

Ordering Code	**Type/Art. No.**
• Multicomponent dynamometer up to 10 kN, cover plate 100x170 mm	**9257B**

Optional accessories	**Type/Art. No.**
• Tool holder	**9403**
• Waterproof protective cap for cable connection	**1431A1**

For 3-component force measurement F_x, F_y, F_z

• Connecting cable, 3 wire, with flexible metal sheath (L = 5 m)	**1687B5**
• Connecting cable, 3 wire, steel braided, flexibel (L = 5 m)	**1687BQ02**
• Extension cable, 3 wire, high insulation (L = 5 m)	**1688B5**
• Connecting cable, 3 wire, with flexible metal sheath and angle connector (L = 5 m)	**1689B5**

For 6-component force and moment measurement F_x, F_y, F_z / M_x, M_y, 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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