KISTLER
measure. analyze. innovate.

Tie Bar Extension Measuring Chain

Type 9827A...

for Clamped or Screwed Installation in Injection Molding Machines

Tie bar extension measuring chain consisting of a quartz longitudinal measuring pin with integrated cable and a miniature charge amplifier.

- Measurement of tensile and compressive forces
- Installation in holes ø11/12/16/20 mm with a clamping sleeve
- Screwed installation for holes D13 and D16

Description

Tie bar extension measuring chains are adjusted to the proper applications by Kistler. Depending on measuring chain and application, the sensitivity is 0,7 ... 1,2 V/100 με resp. 7 ... 12 mV/με. The measuring chain ist available on a clamped longitudinal version and screwed longitudinal version. The screw version is recommended for the measurement of large extensions.

The nominal output voltage is 5 V. Measurements in the overload range (up to 6 V) can be implemented without restrictions.

The extension due to the clamping force in the tie bar causes a change of the preload in the sensor. The sensor yields a piezoelectric charge proportional to the preload variation. The electric charge is converted into a proportional output voltage in the charge amplifier. The sensor must be preloaded until it yields a charge of –40 000 pC.

The operating load corresponds to max. 20 % of the load due to preloading, whereby on principle the longitudinal measuring pin can be loaded by tensile or compressive forces.

Application

Measurement in One Tie Bar

The measurement of the tie bar extension in one tie bar of an injection molding machine or press can be used to monitor or control the damping force.

Measurement in Four Tie Bars

When measuring the extension in all four tie bars the precise clamping force can be evaluated from the sum of the four individual forces. This arrangement allows for a precise adjustment of the injection molding machine or press.

The force measurement for ensuring mold safety is only possible and relevant if the measurement is made in all four tie bars.

The tie bar load can be adapted for asymmetric molds. Moreover, all tie bars can be monitored in regard of overload (tie bar rupture).

Technical Data

Measuring range (typical)[1]	με	±500
Overload	με	±1 000
Sensivity (typical)[2]	mV/με	±10
Linearity	% FSO	<±2
Threshold	με	0,1
Operating temperature range	°C	–20 ... 85
Output Voltage	V	±5
Input Voltage (Overload)[3]	V	<±6
Power supply	V DC	10 ... 36
Charge yield during preloading of the sensor	pC	–40 000

[1] Sensor installed under preload, yielding a charge of –40 000 pC

[2] The exact values of the uniform sensitivity and their tolerances are given in the table on page 2 and 3

[3] The nominal output voltage is 5 V. Measurements in the overload range (up to 6 V) can be implemented without restrictions

9827A_000-175e-09.09

KISTLER
measure. analyze. innovate.

Measuring Chain with Clamped Measuring Pin

Data and Dimensions

Type	Uniform sensitivity	Diameter	Length			Spanner Size AF	
		øD	L1	L2	L3	SW1	SW2
	mV/με	mm	mm	mm	min./max. m		
9827A1291	–11,8 ±5 %	20	31	44	0,18/1,5 [1]	11	8
9827A1392	–7,3 ±5 %	16	31	44	0,18/1,5 [1]	11	8
9827A2491	–10,9 ±5 %	12	22,5	39	0,18/1,5 [1]	7	–
9827A2591	–11,7 ±5 %	11	22,5	39	0,18/1,5 [1]	7	–

[1] The length of the measuring chain L3 can be chosen with respect to mounting.
It should be ordered exceeding the length of the mounting bore by about 0,1 ... 0,2 m.

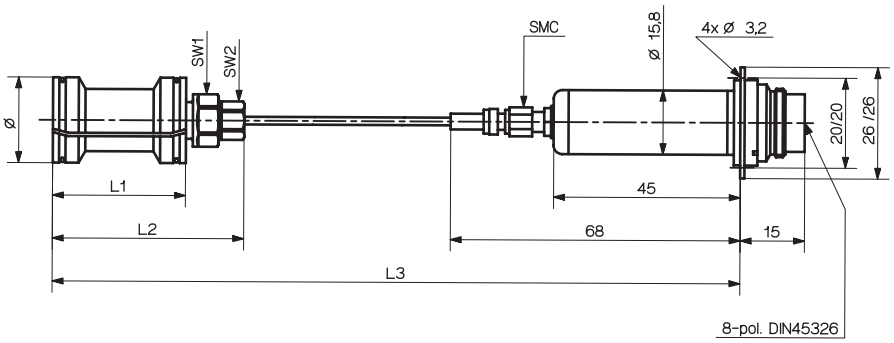

Fig. 1: Measuring chain with clamped measuring pin

Mounting Bores

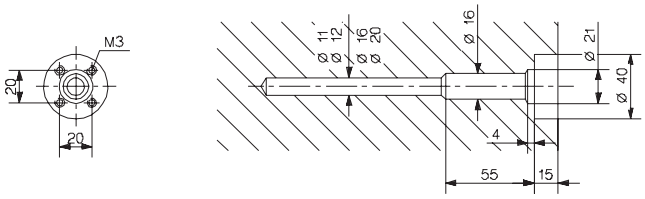

Fig. 2: Mounting bore for clamped installation

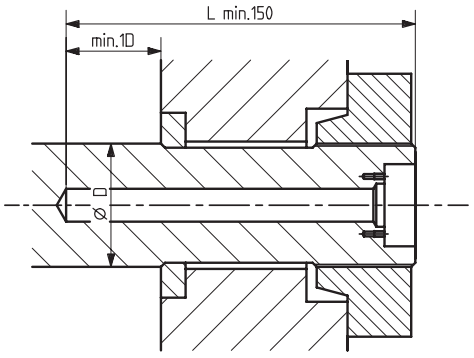

Fig. 3: Clamped showing tie bar shoulder installation

Mounting

The longitudinal measuring pin is clamped through tightening by means of an expansion anchor in the bottom of the bore. The high clamping force secures the pin for all operating loads.

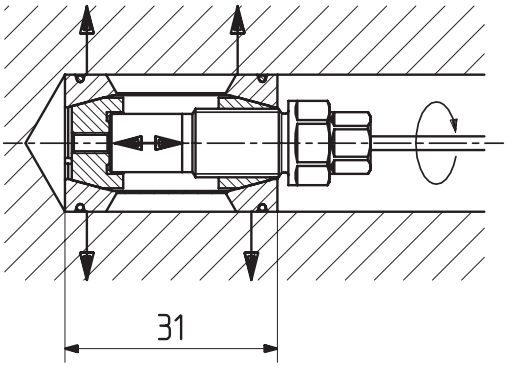

Fig. 4: Operating principle of clamped installation

KISTLER
measure. analyze. innovate.

Measuring Chain with Screwed in Pin

Data and Dimensions

Type	Uniform sensitivity mV/με	Diameter øD mm	Length L1	L2	L3 min./max. m	Spanner Size AF SW1 mm	SW2 mm
9827A1192	–10,2 ±5 %	13	–	–	0,18/1,5 [1]	11	8
9827A1192	–9,2 ±5 %	16	–	–	0,18/1,5 [1]	11	8

[1] The length of the measuring chain L3 can be chosen with respect to mounting.
It should be ordered exceeding the length of the mounting bore by about 0,1 ... 0,2 m.

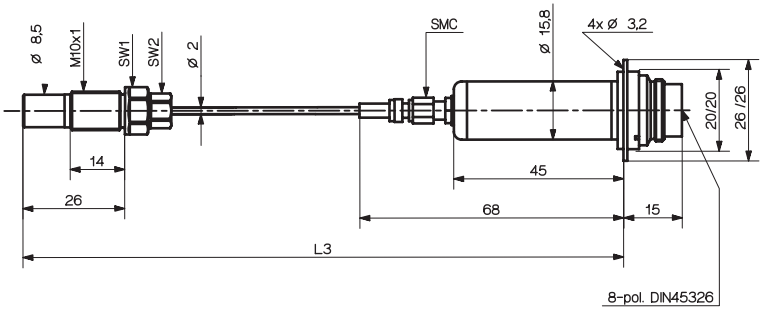

Fig. 5: Measuring chain for screwed measuring pin

Mounting Bores

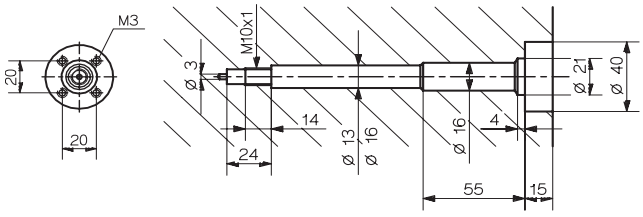

Fig. 6: Mounting bore for screwed measuring pin

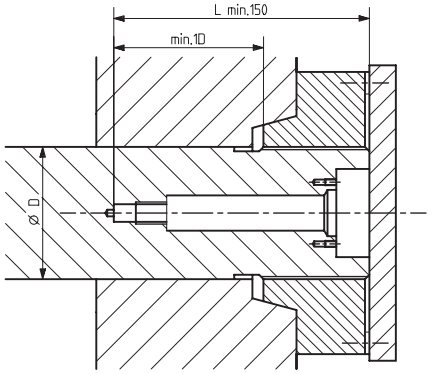

Fig. 7: Screwed without shoulder

Mounting

The longitudinal measuring pin is screwed in the bore.

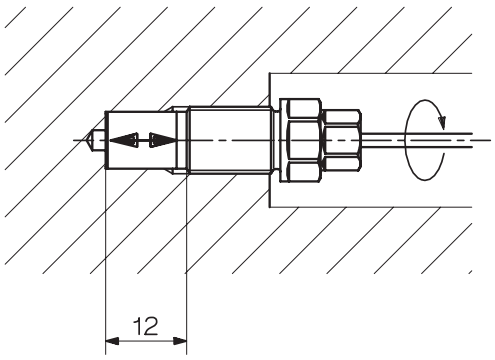

Fig. 8: Operating principle of screwed installation

9827A_000-175e-09.09

KISTLER
measure. analyze. innovate.

Charge Amplifier

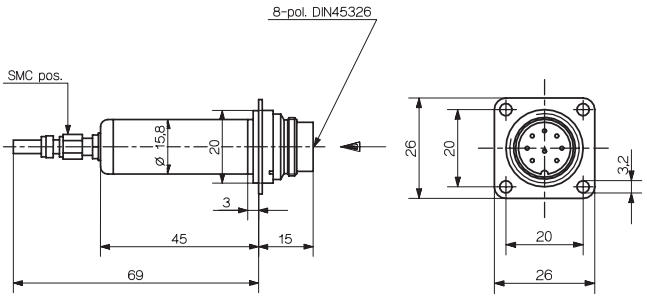

Fig. 9: Charge amplifier dimensions
art. no. 7.690.020 and 7.690.021

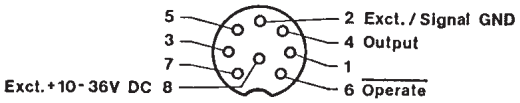

Fig. 10: Pin allocation — coupling socket

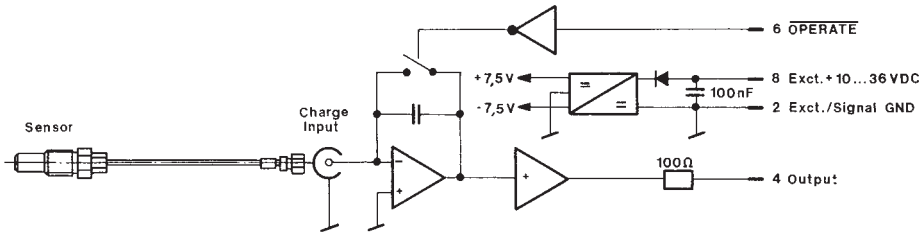

Fig. 11: Charge amplifier circuit

Installation of the Measuring Chain

Clamped Installation

Introduce sensor into the bore by means of the corresponding spanner, then position it.

Preload with:

- Preload tester Type 5991
  Preload to –40 000 pC
  Connect amplifier and install it in the tie bar.

Screwed Installation

- Grind bore base with end finishing tool Type 1300A27 and insert sensor into the bore with corresponding spanner.

Preload with:

- Preload tester Type 5991
  Preload to –40 000 pC
  Connect amplifier and install it in the tie bar.

Calculating the Tie Bar Loading

Conversion of the extension sensitivity (mV/με) in force sensitivity (kN/V) with given tie bar size:

$$F = \sigma \cdot A \qquad \sigma = e \cdot E \qquad A = \frac{\pi \cdot d^2}{4} \qquad \varepsilon = \frac{U}{S_e}$$

$$F = \frac{U \cdot E \cdot \pi \cdot d^2}{4 \cdot S_e}$$

Example

S_e = 7,3 mV/με (Type 1392)
d = 150 mm
E = $2 \cdot 10^5$ N/mm² (Stahl)
V = 460 mV

$$F\,[N] = \frac{460 \cdot 2 \cdot 10^5 \cdot \pi \cdot 150^2}{4 \cdot 7{,}3} = 2\,227\,000\ N = 2\,23\ MN$$

S_e	[mV/[με]	Sensor sensivity
U	[mV]	Output signal of measuring chain
e	[με]	Strain in tie bar
d	[mm]	Tie bar diameter
E	[N/mm²]	Modulus at elasticity of the tie bar material
σ	[N/mm²]	Mechanical stress in the tie bar
F	[N]	Tensile force in tie bar
1	[με]	1 microstrain = 10^{-6} m/m

KISTLER
measure. analyze. innovate.

Included Accessories	Art. No. / Type
• Cylinder screw	6.120.004
• Spring washer	6.230.051
• Amplifier by measuring chains Type 9827A1291, 9827A1392, 9827A2491, 9827A2591	7.690.020
• Amplifier by measuring chains Type 9827A1192	7.690.021

Optional Accessories	Type
• Spanner key SW7 (L_{min} = 0,1 m/L_{max} = 0,8 m)	1369sp100 ... 800
• Spanner key SW8 (L_{min} = 0,4 m/L_{max} = 1,0 m)	1389sp400 ... 1 000
• Spanner key SW11 (L_{min} = 0,1 m/L_{max} = 0,8 m)	1387sp100 ... 800
• Reamer	1300A27
• Preload tester	5991
• Cable for preloader tester	1965A
• 8-pin connector	1500A57
• Extension cable (L_{min} = 0,09 m/L_{max} = 3 m)	Z16636sp

Ordering Key

Type 9827A ☐

ø20 mm bore with clamped measuring pin	**1291**
ø16 mm bore with clamped measuring pin	**1392**
ø12 mm bore with clamped measuring pin	**2491**
ø11 mm bore with clamped measuring pin	**2591**
ø13 or ø16 mm bore with screwed measuring pin	**1192**

9827A_000-175e-09.09