HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH

HBM
spectris group

Mounting instructions

Force transducer

S2/S9

B 20.S2S9.20 e

Contents **Page**

Safety instructions

Use in accordance with the regulations

Force transducers in the S2/S9 series are intended for force measurements in test benches, test rigs and testing devices. Use for any additional purpose shall be deemed to be **not** in accordance with the regulations.

In the interests of safety, the transducer should only be operated as described in the Mounting Instructions. It is also essential to observe the appropriate legal and safety regulations for the application concerned during use. The same applies to the use of accessories.

The transducer is not a safety element within the meaning of its use as intended. Proper and safe operation of this transducer requires proper transportation, correct storage, assembly and mounting and careful operation and maintenance.

General dangers due to non-observance of the safety instructions

The S2/S9 force transducer corresponds to the state of the art and is fail-safe.

The transducers can give rise to residual dangers if they are inappropriately installed and operated by untrained personnel.

Everyone involved with the installation, commissioning, maintenance or repair of a force transducer must have read and understood the Mounting Instructions and in particular the technical safety instructions.

Residual dangers

The scope of supply and performance of the transducer covers only a small area of force measurement technique. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of force measurement technique in such a way as to minimise residual dangers. Prevailing regulations must be complied with at all times. There must be reference to the residual dangers connected with force measurement technique.

In these mounting instructions residual dangers are pointed out using the following symbols:

Symbol:  **WARNING**

Meaning: **Possibly dangerous situation**

Warns of a **potentially** dangerous situation in which failure to comply with safety requirements **can** lead to death or serious physical injury.

Symbol:  **ATTENTION**

Meaning: **Dangerous situation**

Warns of a potentially dangerous situation in which failure to comply with safety requirements **could** lead to damage to property, slight or moderate physical injury.

Symbol:  **NOTE**

Refers to the fact that important information is being given about the product or its use.

Symbol: CE

Meaning: CE mark

The CE mark indicates a guarantee from the manufacturer that the product meets the requirements of the relevant EC directives (see Declaration of conformity at the end of this Operating Manual).

Conversions and modifications

The transducer must not be modified from the design or safety engineering point of view except with our express agreement. The force introduction parts must not be dismantled or removed. Any modification shall exclude all liability on our part for any damage resulting therefrom. An exception to this rule is fitting and removing the knuckle eyes as described in Chapter 5.

Qualified personnel

This instrument is only to be installed by qualified personnel strictly in accordance with the technical data and with the safety rules and regulations which follow. It is also essential to observe the appropriate legal and safety regulations for the application concerned. The same applies to the use of accessories.

Qualified personnel means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function.

Conditions on site

Protect the transducer from damp and weather influences such as rain, snow, etc.

Maintenance

The S2/S9 force transducer is maintenance free.

Accident prevention

Although the specified nominal force in the destructive range is several times the full scale value, the relevant accident prevention regulations from the trade associations must be taken into consideration.

1 Scope of supply

- 1 S2 or S9 force transducer
- 1 S2/S9 Operating Manual

Accessories (not included in the scope of supply):

• Knuckle eye ZGUW	S2 for 20N – 1kN	Order no. 1–U1/200kg/ZGW
	S9 for 2 – 10kN	Order no. 1–U2A/1T/ZGUW
	S9 for 20 – 50kN	Order no. 1–U2A/5T/ZGUW

2 Application notes

Force transducers in the S2/S9 Series are suitable for measuring tensile and compressive forces. They provide extremely accurate measurements of static and dynamic forces and must therefore be handled carefully. You must take particular care when transporting and installing the devices. Transducers can be permanently damaged if jolted or dropped.

The perfect seal (sealant) intended to protect sensitive strain gauge applications must be maintained under all conditions.

The sealant must not be damaged.

The permissible limits for mechanical, thermal and electrical stresses are stated in the Specifications. Please take these points into account whenever planning measurement arrangements and when installing or operating the equipment.

3 Structure and mode of operation

3.1 Measuring element

The measuring device is a flexible aluminium/steel bar to which strain gauges (SGs) are applied. The SGs are arranged so that four of them are stretched and the other four are compressed when a force is applied to the transducer.

3.2 Strain gauge cover

To protect the strain gauges, S2/S9 force transducers are sealed with a plastic compound at appropriate points. This seal must be protected from mechanical damage.

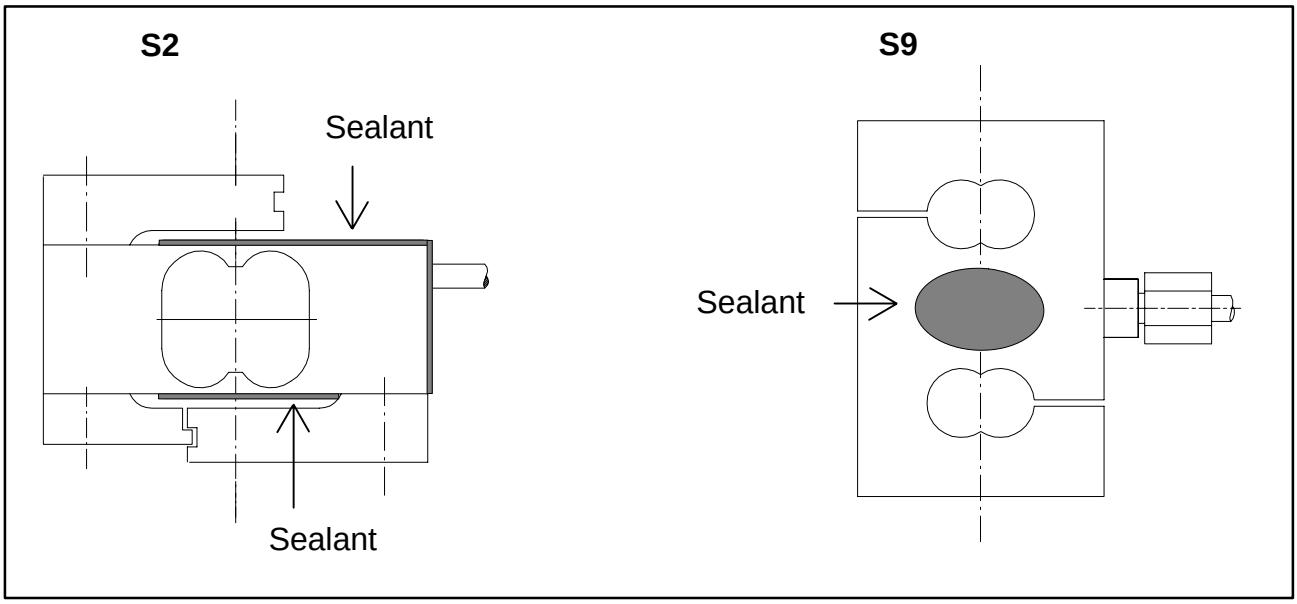


Fig. 3.1: Strain gauge protection

4 Conditions on site

4.1 Ambient temperature

The effects of temperature on the zero signal and sensitivity are compensated. For optimum measurement results, keep to the nominal temperature range. Measurement errors due to temperature may occur if there is uneven warming (e.g. by radiant heat) or cooling. Whilst a radiation shield and all-round heat insulation provide noticeable improvements, they should not be permitted to create any kind of force leakage.

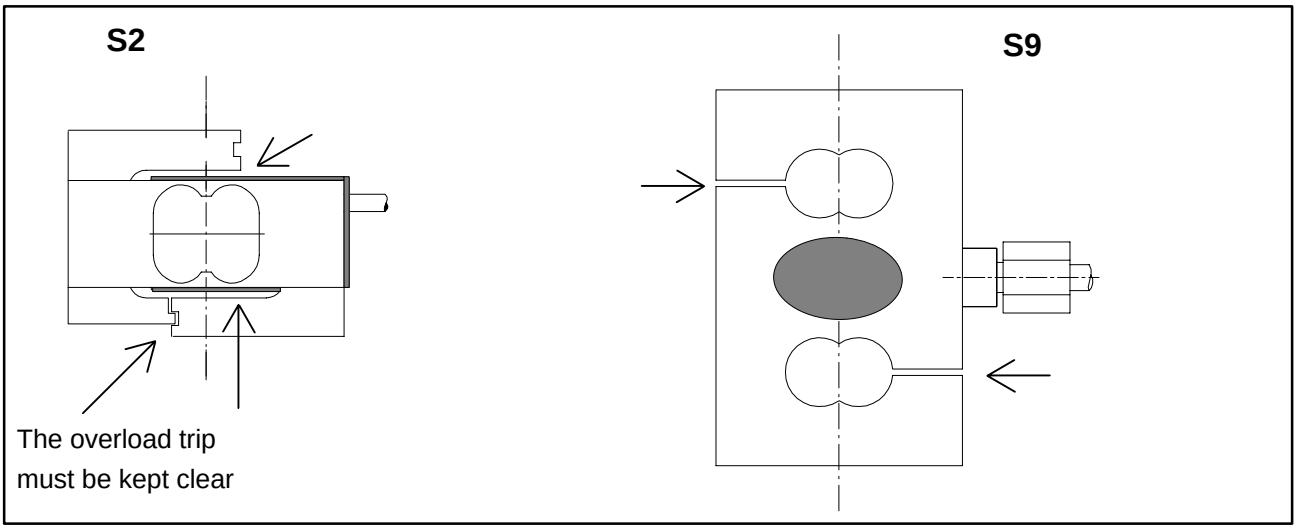
4.2 Moisture

Extremes of humidity or tropical conditions are to be avoided where outside the specified limit values (degree of protection IP65 to DIN EN 60529).

4.3 Contamination

Dust, dirt and other foreign bodies should not be allowed to accumulate to such an extent that part of the measuring force can be diverted onto the housing and falsify the measured value (force leakage).

NOTE:
The gap under the force introduction parts must not become clogged with foreign bodies.



5 Mechanical installation

5.1 Important measures for installation

- Treat the transducer gently
- Do not overload the transducer.

WARNING

If there is a risk of breakage through overload on the transducer and thus a risk to persons, additional safety measures are to be taken.

5.2 General installation guidelines

Forces to be measured must as far as possible act on the transducer precisely in the direction of measurement. Torsion and bending moments, eccentric loading and transverse forces may result in measurement errors and if the limit values are exceeded could destroy the transducer.

HBM supplies knuckle eyes for series S2/S9 transducers as mounting accessories. Knuckle eyes are suitable for use in the event of quasi-static loading (stress reversal $\leq$10Hz). When there is dynamic loading at a higher frequency, flexible tension bars should be used.
Knuckle eyes prevent torsional moments from being introduced into the transducer. If two knuckle eyes are used, these have the further effect of excluding bending moments, as well as lateral and oblique loadings.

NOTE:

The cable-mounting side of the transducer should always be connected directly to the rigid force outlet sections customer-side.

When doing so, make sure as far as possible that the position of the cable causes no force leakage (for instance due to its weight or stiffness).

5.3 Installation for tensile loading/compressive loading

Screw the transducer by its flange or base directly to an available part of the structure (such as a profile, cover or plate). This method enables the transducer to measure axial forces in both the tensile **and** compressive direction. Alternating loads can also be covered with very little effort. Make sure the transducer is installed without any axial play. For dynamic and sustained loading, use lock nuts to pre-tension the upper and lower threaded connectors to a value exceeding the maximum load.

5.3.1 Installation using two knuckle eyes

If the transducer is going to be subjected to tensile loading, it can be installed using knuckle eyes.

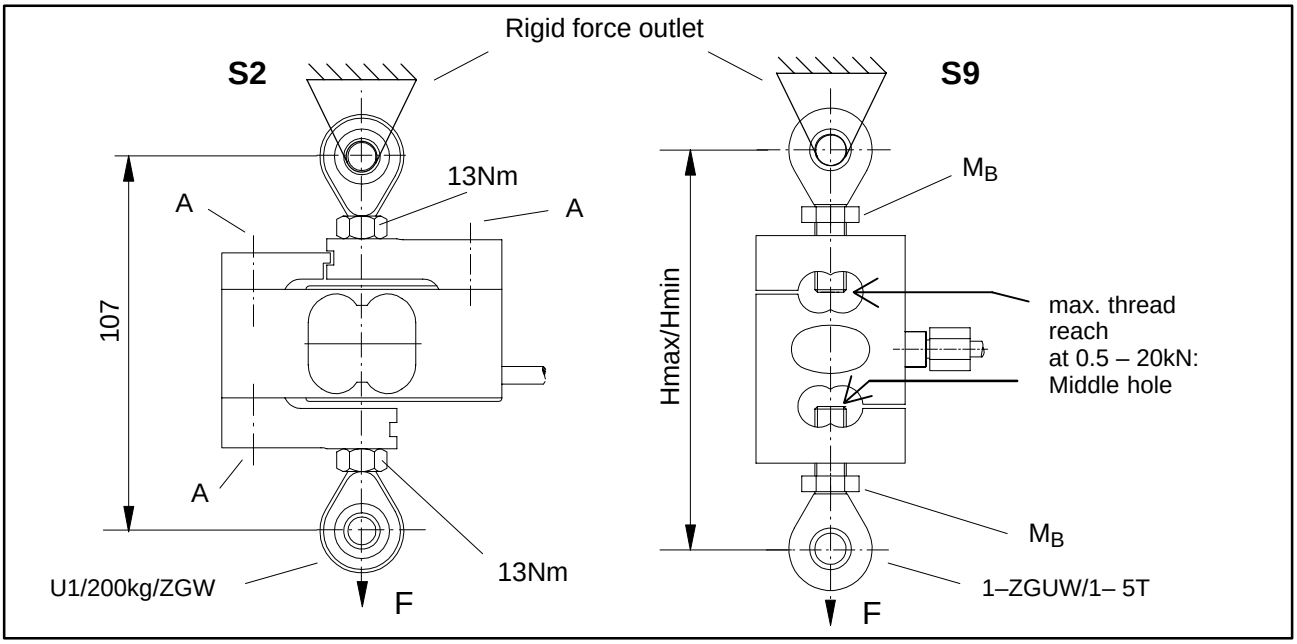


Fig. 5.1: Installation for tensile loading

ATTENTION

Do not loosen the screws labelled “A”. The transducer could be damaged beyond repair.

S9:

Nominal force (N)	H_{max} (mm)	H_{min} (mm)	Starting torque M_B (Nm)
2	172	153	60
5	172	153	60
10	172	153	60
20	220	206	300
50	260	256	500

Screwing in the knuckle eye:

- Turn the lock nut back as far as the eye
- Screw the knuckle eye into the transducer
- Unscrew the knuckle eye one or two turns and align
- Load eye to nominal load
- Tighten the lock nut

ATTENTION
When tightening the lock nut, the torque must on no account be transmitted through the transducer.

5.3.2 Installation using one knuckle eye

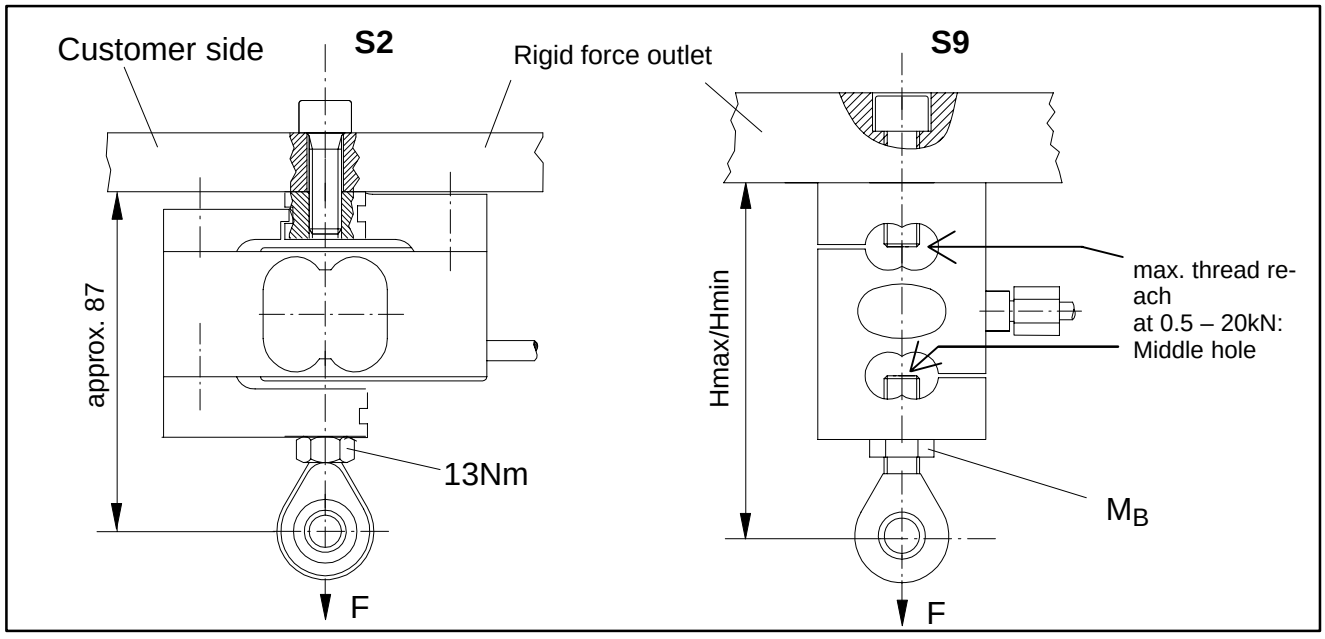


Fig. 5.2: Installation for compressive and tensile loading

ATTENTION
The cable-mounting side of the transducer should always be connected directly to the rigid force outlet sections customer-side. When doing so, make sure as far as possible that the position of the cable causes no force leakage (for instance due to its weight or stiffness).

S9:

Nominal force (N)	H_{max} (mm)	H_{min} (mm)	Starting torque M_B (Nm)
2	130	120	60
5	130	120	60
10	130	120	60
20	160	153	300
50	180	178	500

Screwing in the knuckle eye:

- Turn the lock nut back as far as the eye
- Screw the knuckle eye into the transducer
- Unscrew the knuckle eye one or two turns and align
- Load eye to nominal load
- Tighten the lock nut

ATTENTION

When tightening the lock nut, the torque must on no account be transmitted through the transducer.

6 Electrical connection

The transducers are supplied with a 3m (S2) or 6 m (S9) length of unterminated cable.

ATTENTION

The balancing resistors must not be cut off the end of the cable (sensitivity would alter).

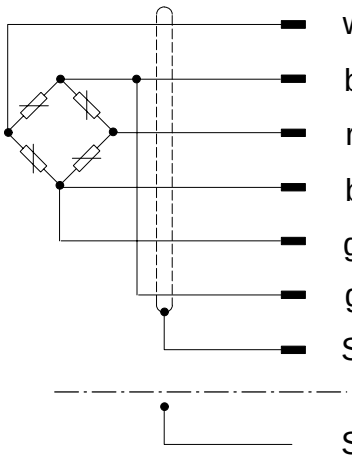
The cable shielding is connected in accordance with the Greenline concept. Under this scheme, the measurement system is enclosed in a Faraday cage; then electromagnetic interference does not affect the measurement system.

Transducers with unterminated cables must be fitted with connectors to CE standard. In this event the shielding must be laid evenly over the whole area. If a different connection technique is used then good EMC shielding is to be provided in the wiring loom, the shielding again being laid over the full area (see also HBM Greenline Information, document G36.35.0).

6.1 Notes on cabling

- Always use shielded, low-capacitance measurement cable supplied by HBM.
- Do not lay measurement cable parallel to high-voltage power lines or control circuits. If this is not possible (e.g. in cable shafts) protect the measurement cable, e.g. with armoured steel tube and maintain a minimum distance of 50 cm from the other cables. High-voltage power lines and control circuits should be twisted (15 turns per metre).
- Avoid stray fields from transformers, motors and contactors.
- Do not earth transducer, amplifier and display device more than once. All the devices in the measurement chain are to be connected to the same earthed conductor.
- Link the connection cable shielding to the transducer housing.

Six-wire connection



wh (white)	Measurement signal (+) U_A
bk (black)	Excitation voltage (–) U_B
rd (red)	Measurement signal (–) U_A
bu (blue)	Excitation voltage (+) U_B
gn (green)	Sensor circuit (+)
gy (grey) / or (orange)[1)]	Sensor circuit (–)
Shielding[2)]	Cable shielding, connected to housing
Shielding[3)]	

Four-wire connection

If you connect the transducer to an amplifier using four-wire connection, you must connect the sensor circuit to the appropriate bridge excitation circuit:

Connect sensor circuit (–) (grey / orange[1)]) to excitation voltage (–) (black)
and
sensor circuit (+) (green) to excitation voltage (+) (blue)

The sensitivity of the transducer changes when operating in four-wire connection. The change in the thermal coefficient of sensitivity (TK_C) is negligibly small. Changing the cable length changes the sensitivity. There is no correction for the effects of temperature on the cable.

1) for transducer S2
2) for S2: shielding only (without soldered yellow stranded wire)
3) for S9: yellow stranded wire soldered to shielding

Fig. 6.1: S2/S9 pin assignment

7 Specifications (VDI/VDE2638)

7.1 Specifications S2

Type			**S2**					
Nominal force	F_{nom}	N	20	50	100	200	500	1000
Accuracy class			0.05					
Nominal sensitivity	C_{nom}	mV/V	2					
Relative sensitivity deviation compressive force	d_c	%	$< \pm 0.25$					
Relative tensile/compressive sensitivity difference	d_{zd}	%	$< \pm 0.1$					
Relative deviation from zero	$d_{s.o}$	%	<8	<6	<5			
Relative range of inversion ($0.2F_{nom}$ to F_{nom})	u	%	<0.05					
Linearity deviation	d_{lin}	%	<0.05					
Effect of temperature on sensitivity/10K by reference to sensitivity	TK_c	%	<0.05					
Effect of temperature on zero signal/10K by reference to sensitivity	TK_0	%	<0.05					
Effect of eccentricity at 1mm	d_E	%	$< \pm 0.1$					
Effect of transverse forces Transverse force 10% F_{nom}[1)]	d_Q	%	$< \pm 0.1$					
Creep over 30 min	d_{crf+E}	%	$< \pm 0.05$					
Input resistance	R_e	Ω	>345					
Output resistance	R_a	Ω	300 – 500					
Isolation resistance	R_{is}	Ω	$>2x\ 10^9$					
Reference excitation voltage	U_{ref}	V	5					
Operating range of the excitation voltage	$B_{U.GT}$	V	0.5 to 12					
Nominal temperature range	$B_{t.nom}$	°C	+10 to +70					
Operating temperature range	$B_{t.G}$	°C	–10 to +70					
Storage temperature range	$B_{t.S}$	°C	–30 to +85					
Reference temperature	t_{ref}	°C	+23					
Maximum operating force	(F_G)	%	120	150				
Limit force	(F_L)	%	200					
Breaking force	(F_B)	%	>300					

1) by reference to a force introduction point on the force-introduction surface

Limit torque	(M_d)	Nm	0.6	1.5	3	6	15	15
Static lateral limit force[1)]	(F_Q)	%	50	100				50
Nominal displacement	S_{nom}	mm	<0.4					
Fundamental resonance frequency	f_G	kHz	0.29	0.49	0.76	1.09	1.81	2.45
Relative permissible vibrational stress	F_{rb}	%	±70					
Weight		kg	approx. 0.4					
Degree of protection to DIN EN 60529			IP65					
Materials: Measuring body Sealant (strain gauge cover) Screwed cable gland Cable sheath			Aluminium Silicone rubber Stainless steel / Perbunan seal PVC					
Cable length, six-wire connection		m	3					

1) by reference to a force introduction point on the force-introduction surface

7.2 Specifications S9

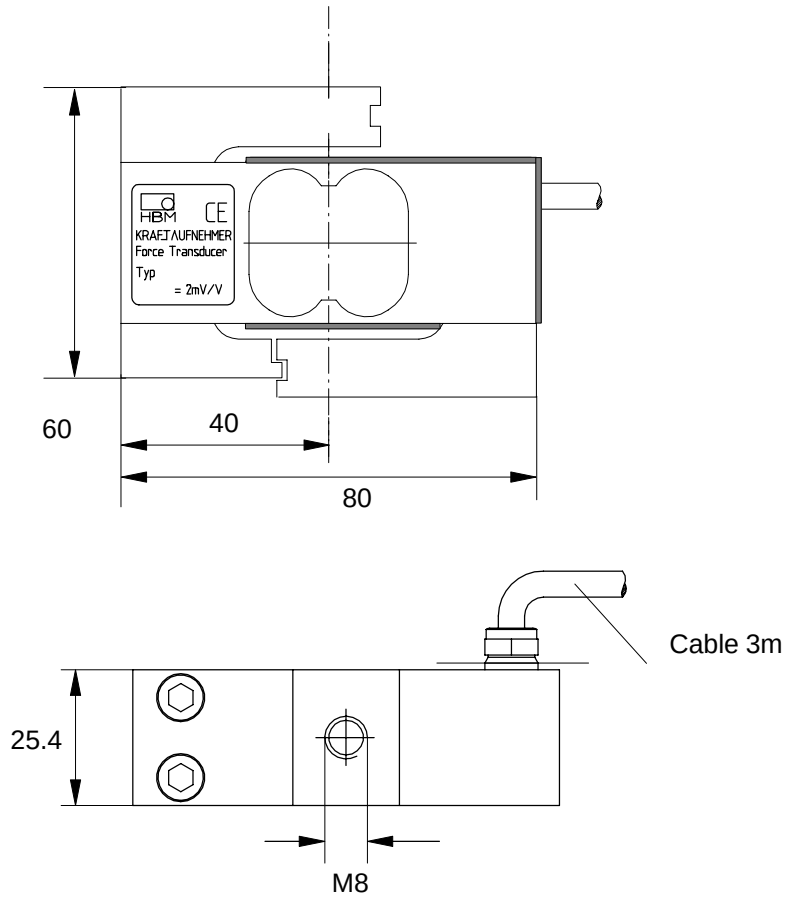
Type			**S9**				
Nominal force	F_{nom}	kN	2	5	10	20	50
Accuracy class			0.05				
Nominal sensitivity	C_{nom}	mV/V	2				
Relative sensitivity deviation compressive force	d_c	%	<0.25				
Relative tensile/compressive sensitivity difference	d_{zd}	%	$< \pm 0.1$				
Relative deviation from zero	$d_{s.o}$	%	<5				
Relative range of inversion ($0.2F_{nom}$ to F_{nom})	u	%	0.1				
Linearity deviation	d_{lin}	%	0.05				
Effect of temperature on sensitivity/10K by reference to sensitivity	TK_c	%	0.05				
Effect of temperature on zero signal/10K by reference to sensitivity	TK_0	%	0.05				
Effect of transverse forces Transverse force 10% F_{nom}[1)]	d_Q	%	± 1				
Creep over 30 min	d_{crf+E}	%	$< \pm 0.05$				
Input resistance	R_e	Ω	350...500				
Output resistance	R_a	Ω	350...500				
Isolation resistance	R_{is}	Ω	>1				
Reference excitation voltage	U_{ref}	V	5				
Operating range of the excitation voltage	$B_{U.GT}$	V	0.5 to 12				
Nominal temperature range	$B_{t.nom}$	°C	–10 to +70				
Operating temperature range	$B_{t.G}$	°C	–30 to +85				
Storage temperature range	$B_{t.S}$	°C	–30 to +85				
Reference temperature	t_{ref}	°C	$+22 \pm 1$				
Maximum operating force	(F_G)	%	150				
Limit force	(F_L)	%	150				
Breaking force	(F_B)	%	>300				>250
Limit torque	(M_d)	Nm	6	15	30	60	150
Static lateral limit force[1)]	(F_Q)	%	10				

1) by reference to a force introduction point on the force-introduction surface

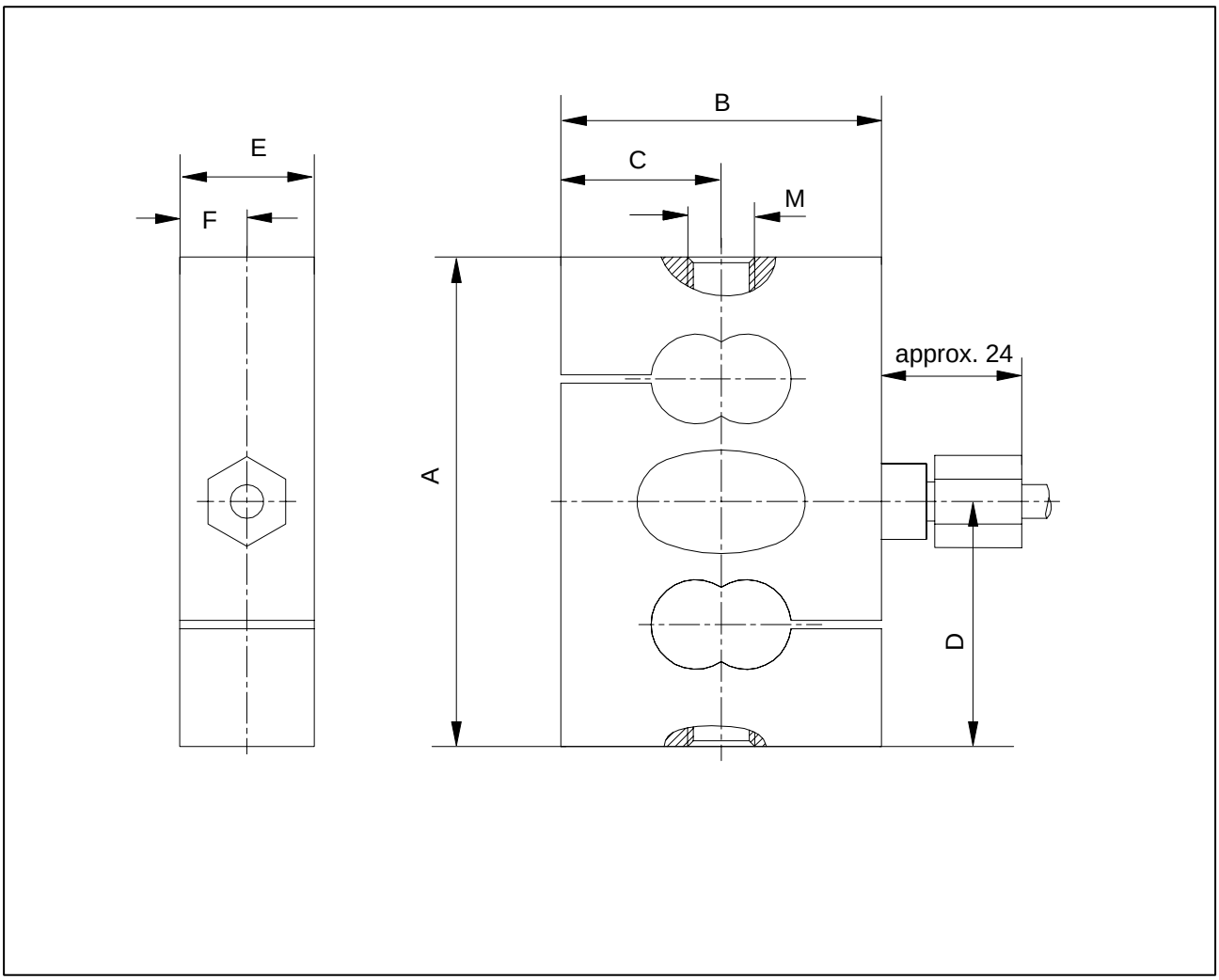
Nominal displacement	S_{nom}	mm	<0.4				<0.5
Fundamental resonance frequency	f_G	kHz	1.6	2.2	2.7	2.4	2.6
Relative permissible vibrational stress	F_{rb}	%	70				
Weight		kg	0.77			1.6	1.8
Degree of protection to DIN EN 60529			IP65				
Materials:							
Measuring body			stainless steel				
Sealant (strain gauge cover)			Polyurethane				
Screwed cable gland			Stainless steel / Perbunan seal				
Cable sheath			Polyurethane				
Cable length, six-wire connection		m	6				

8 Dimensions

8.1 Dimensions S2



8.2 Dimensions S9

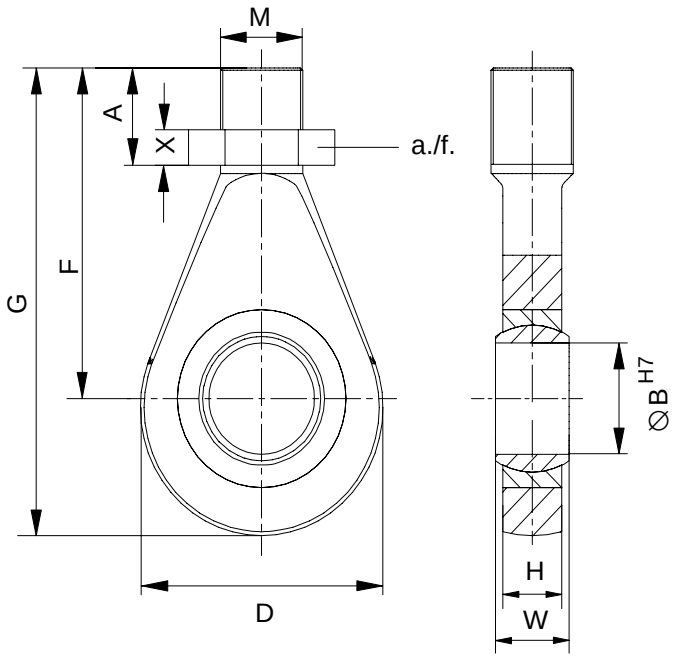


Dimensions in mm:

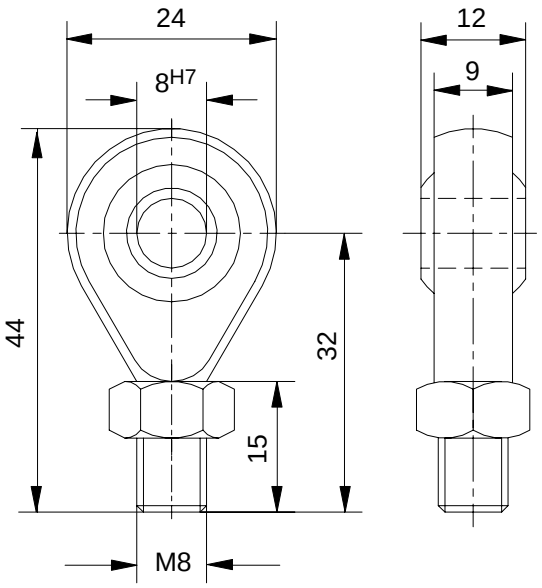
Nominal force (N)	A	B	C	D	E	F	M
2–10	8.3	57.2	28.6	43.7	24	12	M12
20	100	69.8	34.9	50	30.2	15.1	M24x2
50	100	76.2	38.1	50	36.6	18.3	M24x2

Mounting accessories

Knuckle eye ZGUW for **S9**



Knuckle eye U1/200kg/ZGW for **S2**



Weight: 50g

Material: tempering steel, galvanised; rolled steel and PTFE/bronze fabric foil

Knuckle eye ZGUW for S9

Nominal force (kN)	Weight [kg]	A	∅B H7	D	F	G	H	M	X	W	a./f.
0.5...10	0.1	33.5	12	32	54.5	70.5	12	M12	7	16	19
20..50	0.4	57.5	25	60	94.5	124.5	22	M24x2	10	31	36

9 Declaration of conformity

HOTTINGER
BALDWIN
MESSTECHNIK

HBM MESS- UND SYSTEMTECHNIK GMBH
Im Tiefen See 45 - D-64293 Darmstadt
Tel. ++49/6151/803-0, Fax. ++49/6151/894896

Konformitätserklärung ***Declaration of Conformity*** ***Déclaration de Conformité***

Document: *101/01.1998*

Wir,

We,

Nous,

Hottinger Baldwin Messtechnik GmbH, Darmstadt

erklären in alleiniger Verantwortung, daß das Produkt

declare under our sole responsibility that the product

déclarons sous notre seule responsabilité que le produit

Kraftaufnehmer der Typenreihe S9 (auf der Basis RSC-Wägezelle)

auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokument(en) übereinstimmt (siehe Seite 2) gemäß den Bestimmungen der Richtlinie(n)

to which this declaration relates is in conformity with the following standard(s) or other normative document(s) (see page 2) following the provisions of Directive(s)

auquel se réfère cette déclaration est conforme à la (aux) norme(s) ou autre(s) document(s) normatif(s) (voir page 2) conformément aux dispositions de(s) Directive(s)

89/336/EWG - Richtlinie des Rates vom 3. Mai 1989 zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit, geändert durch 91/263/EWG, 92/31/EWG und 93/68/EWG

Die Absicherung aller produktspezifischen Qualitätsmerkmale erfolgt auf Basis eines von der DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) seit 1986 zertifizierten Qualitätsmanagementsystems nach DIN ISO 9001 (Reg.Nr. DQS-10001).
Die Überprüfung der sicherheitsrelevanten Merkmale (Elektromagnetische Verträglichkeit, Sicherheit elektrischer Betriebsmittel) führt ein von der DATech erstmals 1991 akkreditiertes Prüflaboratorium (Reg.Nr. DAT-P-006 und DAT-P-012) unabhängig im Hause HBM durch.

All product-related features are secured by a quality system in accordance with DIN ISO 9001, certified by DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) since 1986 (Reg. No. DQS-10001). The safety-relevant features (electromagnetic compatibility, safety of electrical apparatus) are verified at HBM by an independent testing laboratory which has been accredited by DATech in 1991 for the first time (Reg. Nos. DAT-P-006 and DAT-P-012).

Chez HBM, la détermination de tous les critères de qualité relatifs à un produit spécifique est faite sur la base d´un protocole DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) certifiant, depuis 1986, notre système d´assurance qualité selon DIN ISO 9001 (Reg.Nr. DQS-10001).
De même, tous les critères de protection électrique et de compatibilité électromagnétique sont certifiés par un laboratoire d´essais indépendant et accrédité depuis 1991 (Reg.Nr. DAT-P-006 et DAT-P-012).

Darmstadt, 12.01.1998

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	Document: ***101/01.1998***	

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.
Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

This declaration certifies conformity with the Directives listed above, but is no asseveration of characteristics.
Safety directions of the delivered product documentation have to be followed.

Cette déclaration atteste la conformité avec les directives citées mais n´assure pas un certain charactère.
S.v.p. observez les indications de sécurité de la documentation du produit ajoutée.

Folgende Normen werden zum Nachweis der Übereinstimmung mit den Vorschriften der Richtlinie(n) eingehalten:

The following standards are fulfilled as proof of conformity with the provisions of the Directive(s):

Pour la démonstration de la conformité aux disposition de(s) Directive(s) le produit satisfait les normes:

EN 50082-2 : 1995 ***Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit;*** Teil 2: Industriebereich; Deutsche Fassung

HOTTINGER BALDWIN MESSTECHNIK

HBM MESS- UND SYSTEMTECHNIK GMBH
Im Tiefen See 45 - D-64293 Darmstadt
Tel. ++49/6151/803-0, Fax. ++49/6151/894896

Konformitätserklärung *Declaration of Conformity* *Déclaration de Conformité*

Document: ***103/01.1998***

Wir,

We,

Nous,

HBM Mess- und Systemtechnik GmbH, Darmstadt

erklären in alleiniger Verantwortung, daß das Produkt

declare under our sole responsibility that the product

déclarons sous notre seule responsabilité que le produit

Kraftaufnehmer der Typenreihe S2

auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder normativen Dokument(en) übereinstimmt (siehe Seite 2) gemäß den Bestimmungen der Richtlinie(n)

to which this declaration relates is in conformity with the following standard(s) or other normative document(s) (see page 2) following the provisions of Directive(s)

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Die Überprüfung der sicherheitsrelevanten Merkmale (Elektromagnetische Verträglichkeit, Sicherheit elektrischer Betriebsmittel) führt ein von der DATech erstmals 1991 akkreditiertes Prüflaboratorium (Reg.Nr. DAT-P-006 und DAT-P-012) unabhängig im Hause HBM durch.

All product-related features are secured by a quality system in accordance with DIN ISO 9001, certified by DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) since 1986 (Reg. No. DQS-10001). The safety-relevant features (electromagnetic compatibility, safety of electrical apparatus) are verified at HBM by an independent testing laboratory which has been accredited by DATech in 1991 for the first time (Reg. Nos. DAT-P-006 and DAT-P-012).

Chez HBM, la détermination de tous les critères de qualité relatifs à un produit spécifique est faite sur la base d´un protocole DQS (Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagementsystemen) certifiant, depuis 1986, notre système d´assurance qualité selon DIN ISO 9001 (Reg.Nr. DQS-10001).
De même, tous les critères de protection électrique et de compatibilité électromagnétique sont certifiés par un laboratoire d´essais indépendant et accrédité depuis 1991 (Reg.Nr. DAT-P-006 et DAT-P-012).

Darmstadt, 15.01.1998

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Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.
Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.

This declaration certifies conformity with the Directives listed above, but is no asseveration of characteristics.
Safety directions of the delivered product documentation have to be followed.

Cette déclaration atteste la conformité avec les directives citées mais n´assure pas un certain charactère.
S.v.p. observez les indications de sécurité de la documentation du produit ajoutée.

Folgende Normen werden zum Nachweis der Übereinstimmung mit den Vorschriften der Richtlinie(n) eingehalten:

The following standards are fulfilled as proof of conformity with the provisions of the Directive(s):

Pour la démonstration de la conformité aux disposition de(s) Directive(s) le produit satisfait les normes:

EN 50082-2 : 1995 ***Elektromagnetische Verträglichkeit (EMV); Fachgrundnorm Störfestigkeit;*** Teil 2: Industriebereich; Deutsche Fassung

HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH
Postfach 10 01 51, 64201 Darmstadt
Im Tiefen See 45, 64293 Darmstadt
Tel.: 0 61 51/ 8 03-0; Fax: 0 61 51/ 89 48 96;
e–mail: TSC @hottinger–baldwin.com
www.hbm.de

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