HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH

Mounting Instructions

Force transducer

U3

B 20.U3.20 en

Contents **Page**

Safety instructions

Use in accordance with the regulations

Force transducers in the U3 range are designed for force measurements on test benches/in press–fit devices/test devices/pressing. 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 U3 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: **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: **Possibly 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 signals a guarantee by the manufacturer that his product meets the requirements of the relevant EC directives (see Declaration of conformity at the end of this Mounting Instructions).

Conversions and modifications

The transducer must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom. Mounting and removing the adapter in accordance with Chapter 5 excluded.

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 U3 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 U3 force transducer
- 1 U3 Operating Manual

Accessories (not included in the scope of supply):

- 'complete adapter' for knuckle eye mounting

  0.5–10kN: Adapter with four M5x12 and four M5x16 screws
  Order no. 2–9289.1956

  20kN: Adapter with four M10x25 and four M10x30 screws
  Order no. 2–9289.1957

  50kN: Adapter with eight M10x25 and eight M10x30 screws
  Order no. 2–9289.1958

  100kN: Adapter with eight M10x25 and eight M10x30 screws each
  Property class 12.9. galvanized Order no. 2–9289.2280

- Knuckle eye ZGUW for 0.5–10kN Order no. 1–U2A/1t/ZGUW
  20 kN Order no. 1–U2A/2t/ZGUW
  50 kN Order no. 1–U2A/5t/ZGUW
  100kN Order no. 1–Z4/100kN/ZGUW

2 Application information

Force transducers of the U3 type series are suitable for measuring tensile and compressive forces. They measure static and dynamic forces extremely accurately and therefore require careful handling. You must take particular care when transporting and installing the devices. If you knock or drop the transducers, this could permanently damage them.

The housing provides an elaborate seal to protect the sensitive strain gauge applications and it is essential that this is preserved. You must be particularly careful with the base of the housing, as this is extremely thin.

The limits for the permissible mechanical thermal and electrical stresses are stated in the Specifications. It is essential that these are taken into consideration in planning the measuring set–up, during installation and finally, during operation.

3 Structure and mode of operation

3.1 Measuring element

The measuring element is a measuring spring made from stainless steel, to which strain gauges (S/G) are applied. The S/Gs are arranged so that four of them can be strained and the other four compressed when the transducer reacts to a force.

3.2 Housing

The housing with the integrated measuring spring is completed underneath by an attached base. This base is extremely thin and must not be loaded centrally (see Page 11). It should be protected against mechanical damage.

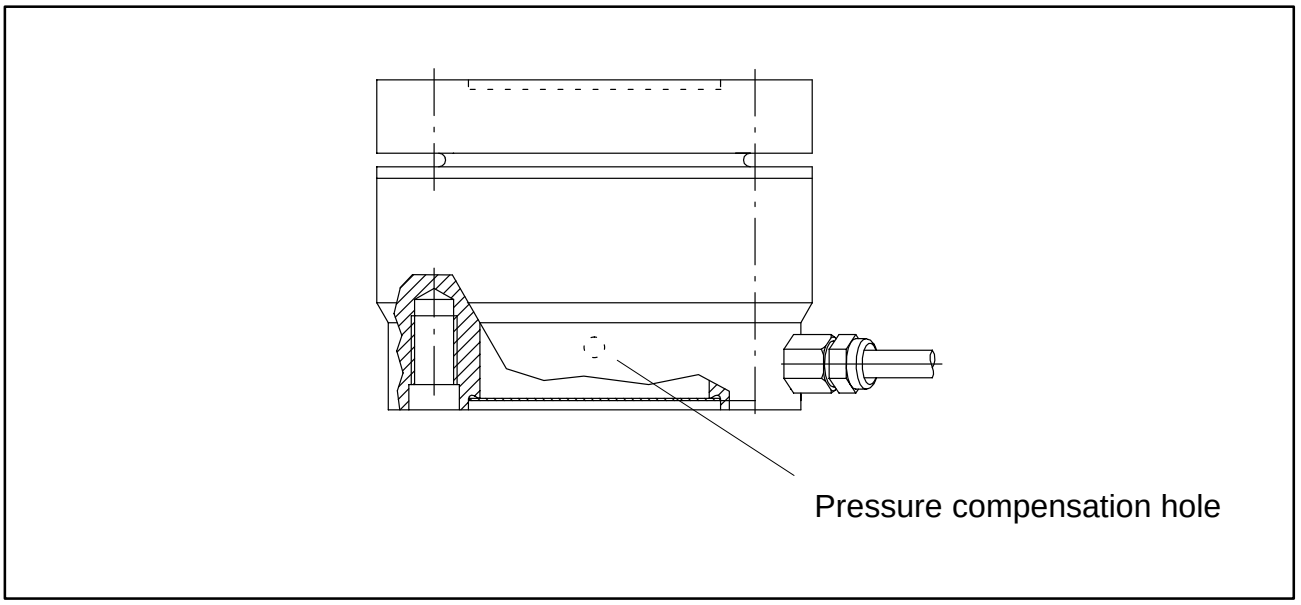


Fig. 3.1 Position of housing base

4 Conditions on site

4.1 Ambient temperature

The effects of temperature on the zero signal and on the sensitivity are compensated. To achieve optimal measurement results the nominal temperature range must be maintained. Temperature–induced measurement errors are caused by heating (e.g. radiant heat) or cooling on one side. A radiation barrier and all–round thermal insulation will produce a marked improvement, but should not form a force shunt.

4.2 Moisture

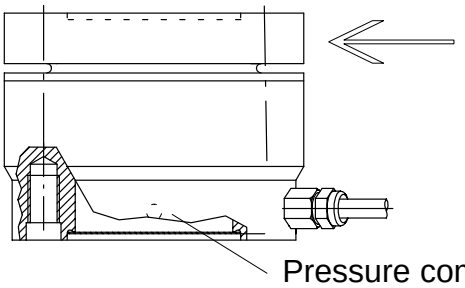
Extreme humidity or a tropical climate should be avoided if this means that the classified limit values are exceeded (degree of protection IP65 under DIN EN 60529).

NOTE:
Moisture must not be allowed to penetrate the free end of the connection cable or get into the pressure compensation hole.

4.3 Deposits

Dust, dirt and other foreign bodies must not be allowed to accumulate such that they divert part of the measured force onto the housing and so falsify the measured value (force shunt).

NOTE:
Foreign bodies must not be allowed to clog the gap beneath the flange surface.



5 Mechanical installation

5.1 Important measures for installation

- Treat the transducer gently.
- Do not overload the transducer.
- Either during installation or immediately afterwards, the transducer should be bridged by a 50mm^2 stranded copper wire (highly flexible signal ground cable EEK from the HBM line). The cable is attached by screws both above and below the transducer. This prevents welding current flowing over the transducer and welding the force introduction point.

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

The direction of measurement in which the forces work should be as much towards the transducer as possible. 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.

The transducer can take up 100% (80% at 50kN, 50% at 100kN) of its nominal force as transverse force by reference to a force introduction point on the force–introduction surface (see diagram Fig. 5.1), without losing its mechanical competence.

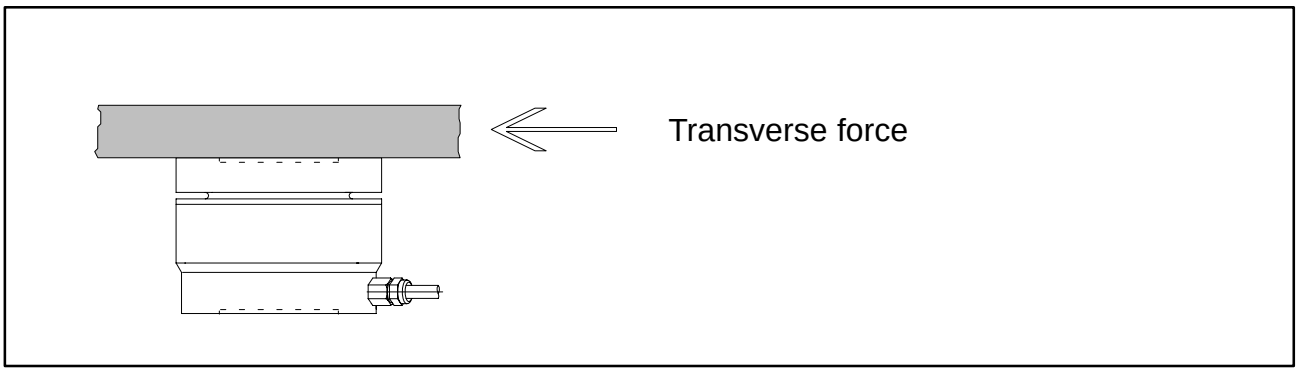


Fig. 5.1 Transverse force introduction

NOTE:
In the case of transducers of nominal forces 20kN, 50kN and 100kN, the base area is not flat.

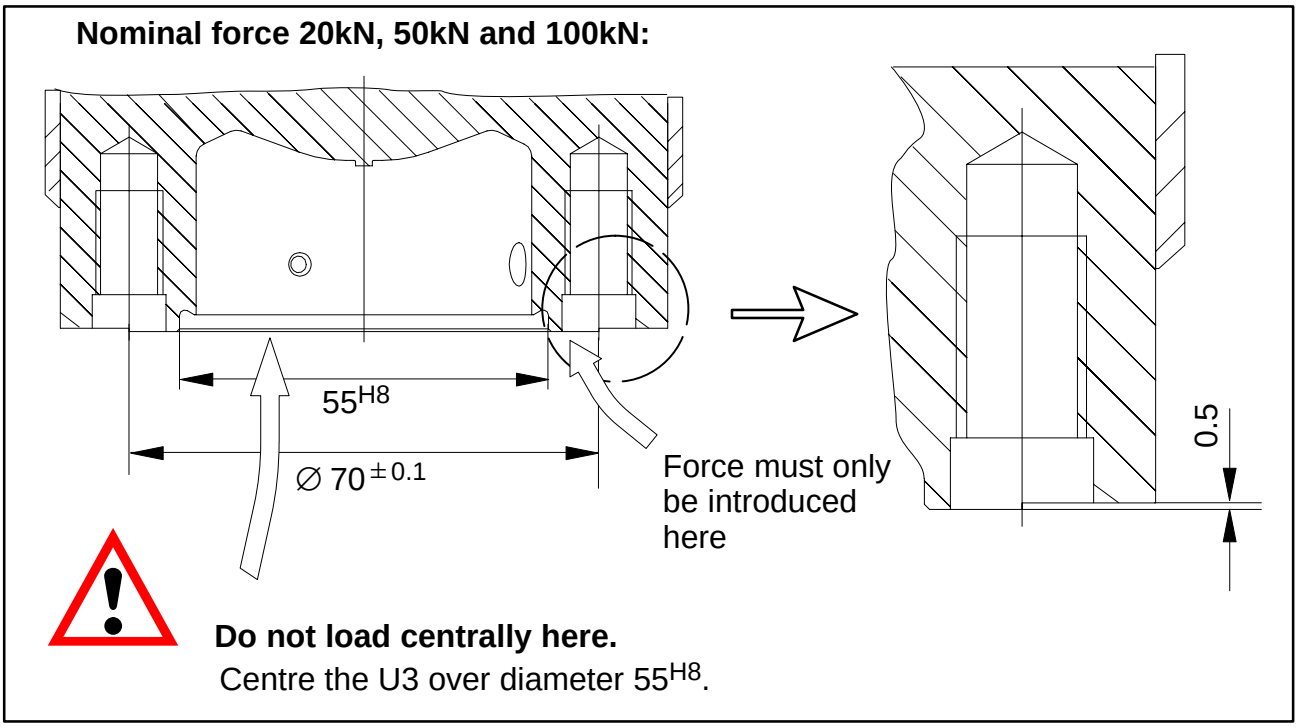


Fig. 5.2 Base of the U3

5.3 Installation for tensile loading/compressive loading

5.3.1 Installation without adapter

The transducer is screwed directly (by flange or base) on to an existing structural element (e.g. profile, cover, plate). This type of installation enables the transducers to measure axial forces in the tensile force **and** compressive force directions. Alternating loads can also be recorded perfectly. The transducer must be installed without axial play for this. For dynamic sustained loading, the top and bottom threaded connectors must be prestressed by lock nuts to above the maximum load.

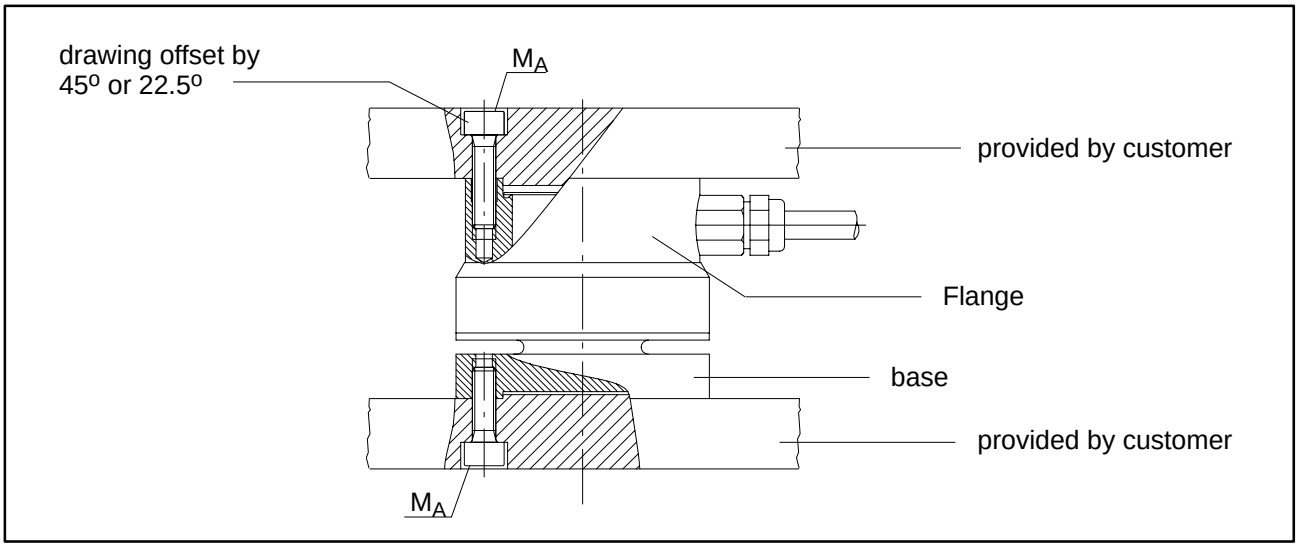


Fig. 5.3 Installation for compressive loading

Nominal force (kN)	Starting torque M_A (Nm)	Thread[1)]
0.5 – 10	5	4 x M5
20	40	4 x M10
50	40	8 x M10
100	94	8 x M10[2)]

1) Take note of the thread depth (see Dimensions, Page 18)
2) 12.9 DIN912 galvanized

HBM supplies knuckle eyes as mounting accessories for transducers of the U3 type series. Knuckle eyes are suitable for use during quasi–static loading (10Hz alternating loads). In the case of dynamic loading at a higher frequency, you should use flexible tension bars. Knuckle eyes prevent the introduction of torsional moments and when 2 knuckle eyes are used, stop bending moments and transverse and angular loading being introduced in the transducers.

5.3.2 Installation with adapter and knuckle eye

If the transducer is to be tensile force loaded, it can be mounted with an adapter (HBM accessory) and a knuckle eye. There is a centre hole (34^{H8}mm or 55^{H8}mm, effective depth approx. 1mm) on both sides of the transducer.

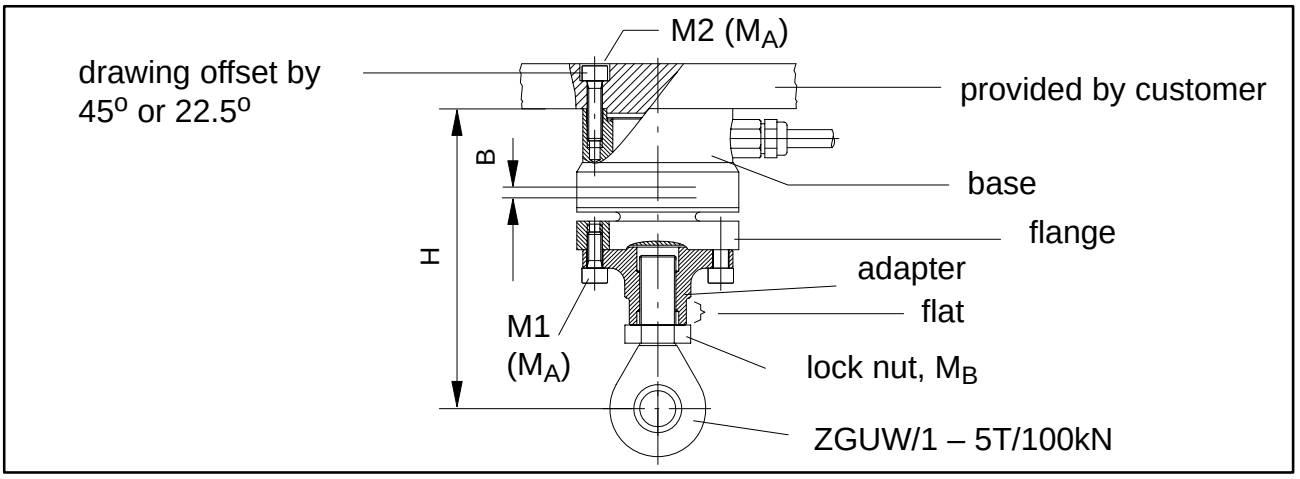


Fig. 5.4 Installation for tensile loading

Nominal force (kN)	H_{Max} (mm)	B_{MIN} (mm)	Starting torque M_A (Nm)	Starting torque M_B (Nm)	Screws for adapter mounting	
					M1	M2
0.5 – 10	108	7	5	60	M5x12	M5
20	170	18	40	300	M10x25	M10
50	180	24	40	500	M10x25	M10
100	187	24	94	1000	M10x25	M10

Attaching the knuckle eye:

- Screw the correct adapter (dependent on nominal force!) to the U3 (please note screw length, screw quality A2–70, at 100kN. 12.9 DIN912, galvanized)
- Turn the lock nut back as far as the eye
- Screw the knuckle eye into the adapter as far as the stop

ATTENTION
Do not apply force to the transducer flange.

- Unscrew knuckle eye 1 to 2 turns and align
- Load eye with nominal load
- Tighten lock nut (M_B, lock using the flat of the adapter)

ATTENTION
When locking with the lock nut, under no circumstances let the torque be transmitted through the transducer.

5.3.3 Installation with two knuckle eyes

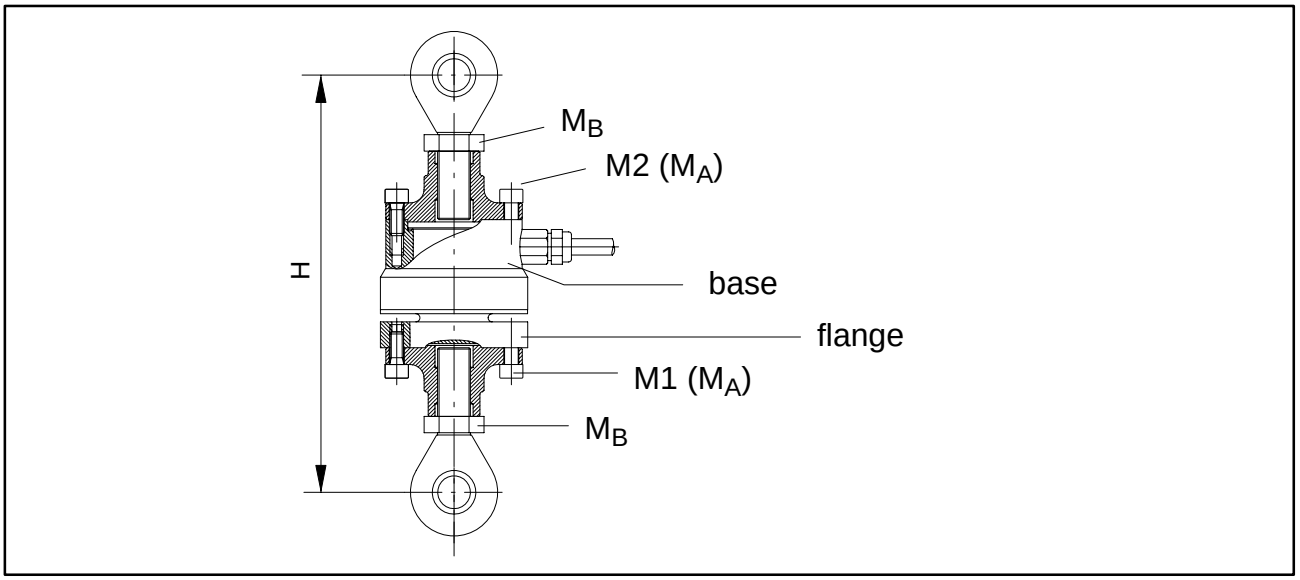


Fig. 5.5 Installation for tensile loading with two knuckle eyes

Nominal force (kN)	H(mm)	Starting torque M_A (Nm)	Starting torque M_B (Nm)	Screws for adapter mounting	
				M1	M2
0.5 – 10	153	5	60	M5x12	M5x16
20	232	40	300	M10x25	M10x30
50	256	40	500	M10x25	M10x30
100	300	94	1000	M10x25	M10x30

Attaching the knuckle eye:

- Screw the correct adapter (dependent on nominal force!) to the U3 (please note screw length)
- Turn the lock nut back as far as the eye
- Screw the knuckle eye into the adapter as far as the stop

ATTENTION
Do not apply force to the transducer flange.

- Unscrew knuckle eye 1 to 2 turns and align
- Load eye with nominal load
- Tighten lock nut (M_B, lock using the flat of the adapter)

ATTENTION
When locking with the lock nut, under no circumstances let the torque be transmitted through the transducer.

6 Electrical connection

The transducers come complete with a 3m long cable with free ends. The cable shielding is connected in accordance with the Greenline concept. This means that the measurement system is surrounded by a Faraday cage and is not affected by electromagnetic interference.

Connectors to CE standard are to be fitted at the free cable end of the transducer. The shielding is here to be laid 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 Instructions for cabling

- Always use shielded, low–capacity measurement cable, available from HBM.
- Do not lay measurement cable parallel to high–voltage power lines or control circuits. If this is not possible (e.g. in cable ducts) 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 lines should be twisted (15 turns per metre).
- Avoid stray fields of transformers, motors and contactors.
- Do not earth transducer, amplifier and display device more than once. All the devices in the measuring chain are to be connected to the same earthed conductor.
- The screen of the connection cable is connected to the transducer housing.

Connecting to terminals:

1. You can get to the screen through a slit in the cable sheath (see Fig. 6.1).
2. Lay the screen flat on the housing frame.

Attaching to a connector:

Lay the cable shield flat on the connector housing.

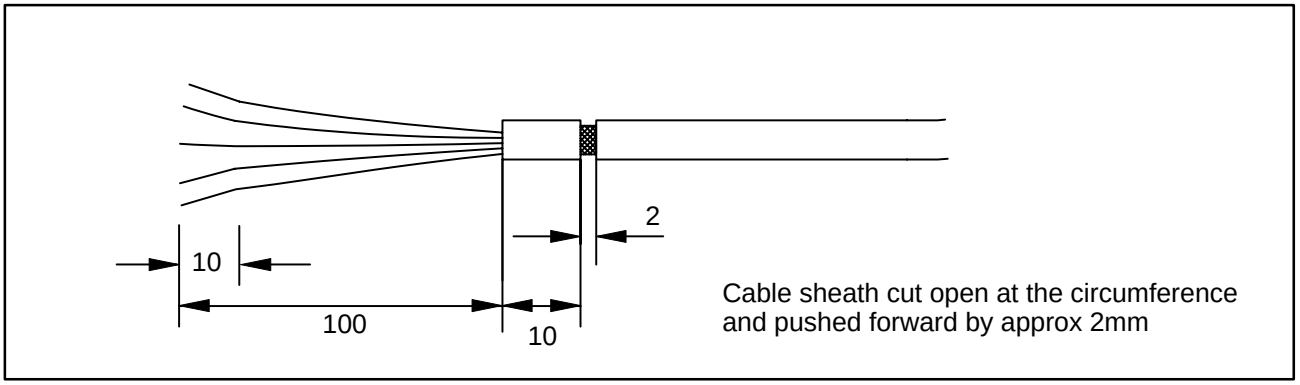


Fig. 6.1: Slit cable sheath

Six–wire connection

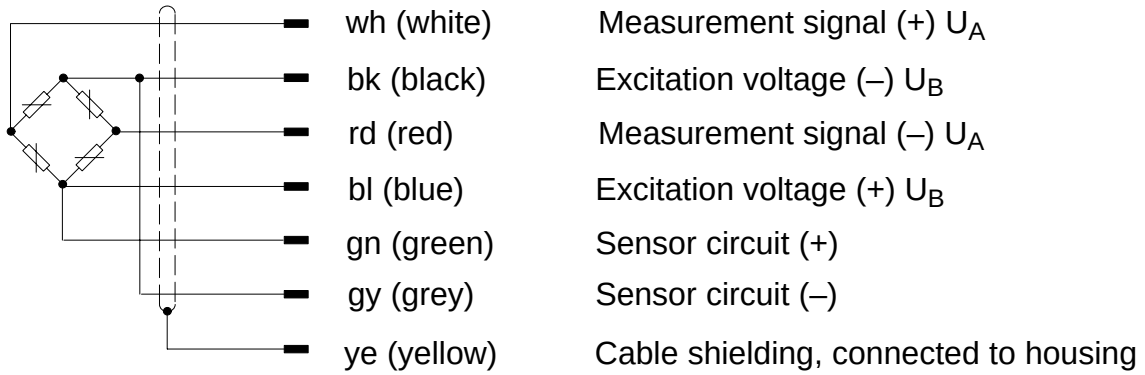


Fig. 6.2: Pin assignment for the U3

7 Specifications (VDI/VDE2638)

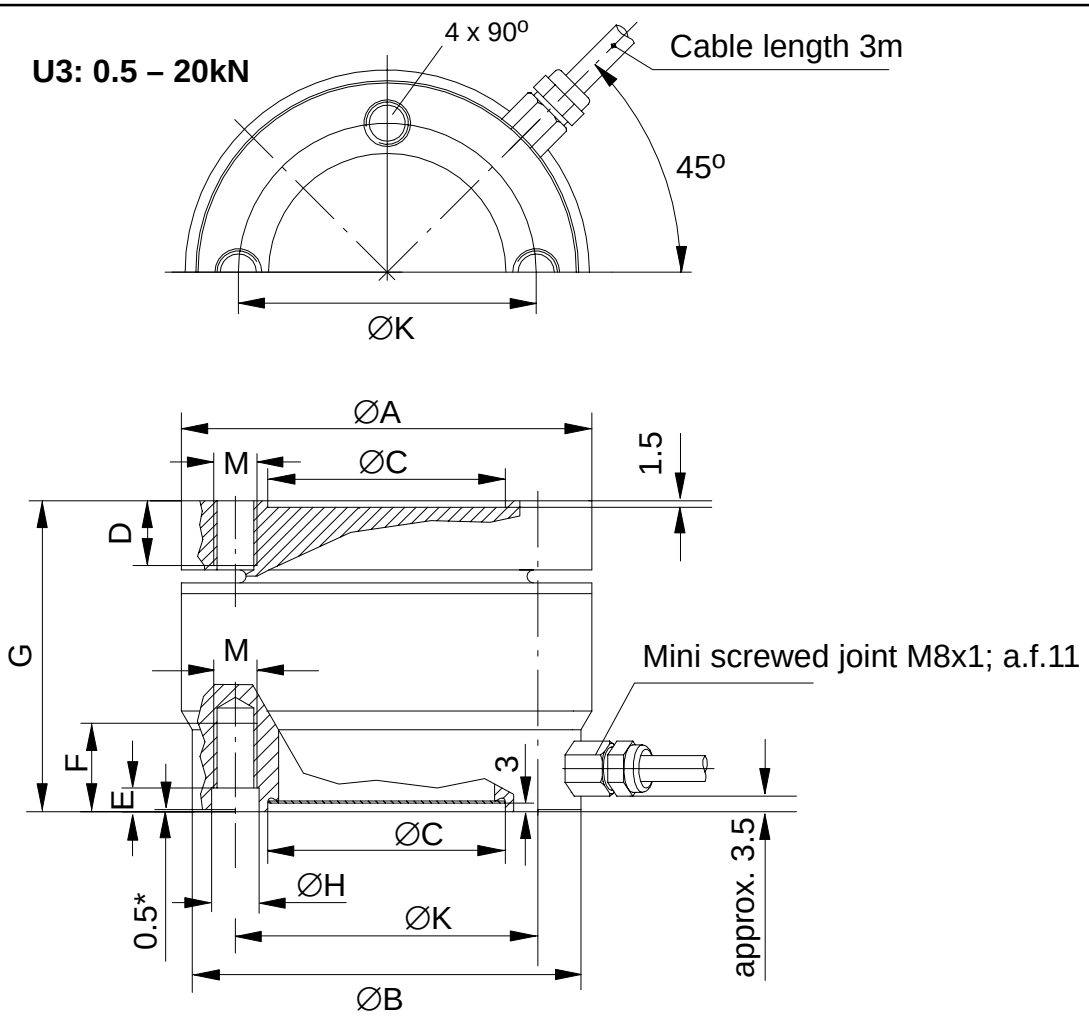
Type			**U3**							
Nominal force	**F_{nom}**	**kN**	**0.5**	**1**	**2**	**5**	**10**	**20**	**50**	**100**
Accuracy class			0.2							
Nominal sensitivity	C_{nom}	mV/V	2							
Relative sensitivity deviation compressive force	d_c	%	$< \pm 0.2$							
Relative tensile/compressive force sensitivity difference	d_{zd}	%	< 2	< 1						
Relative zero signal deviation	$d_{s.o}$	%	< 1							
Hysteresis ($0.2F_{nom}$ to F_{nom})	u	%	< 0.2							
Linearity deviation compressive force	d_{lin}	%	< 0.2							
Linearity deviation tensile force	d_{lin}	%	< 0.3	< 0.2						
Effect of temperature on sensitivity/10K by reference to sensit.	TK_c	%	< 0.2	< 0.1						
Effect of temperature on zero signal/10K by reference to sensitivity	TK_0	%	< 0.1							
Effect of eccentricity at 1mm	d_E	%	$< \pm 0.1$							
Effect of transverse forces Transverse force 10% F_{nom}[1)]	d_Q	%	$< \pm 0.1$							$< \pm 0.2$
Creep over 30 min	d_{crf+E}	%	$< \pm 0.1$							
Input resistance	R_e	Ω	> 345							
Output resistance	R_a	Ω	300–400							
Isolation resistance	R_{is}	Ω	$> 2 \times 10^9$							
Reference excitation voltage	U_{ref}	V	5							
Operating range of the excit. volt.	$B_{U.GT}$	V	0.5 bis 12							
Nominal temperature range	$B_{t.nom}$	°C	–10 bis +70							
Operating temperature range	$B_{t.G}$	°C	–30 bis +85							
Storage temperature range	$B_{t.S}$	°C	–50 bis +85							
Reference temperature	t_{ref}	°C	+23							
Maximum operating force	(F_G)	%	130	150						130
Limit force	(F_L)	%	130	150						130
Breaking force	(F_B)	%	> 300							250
Static lateral limit force[1)]	(F_Q)	%	100						80	50
Permissible eccentricity	e_G	mm	25					40	32	20
Nominal displacement	S_{nom}	mm	< 0.08					< 0.1		
Fundamental resonance frequency	f_G	kHz	1.3	2.1	3.1	5.2	7.1	3.7	5.7	7.25
Rel. permissible vibrational stress	F_{rb}	%	100	160						
Weight		kg	app. 0.6					app. 2.5		
Degree of protection to DIN EN60529			IP65							
Cable length, six–wire connection		m	3							

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

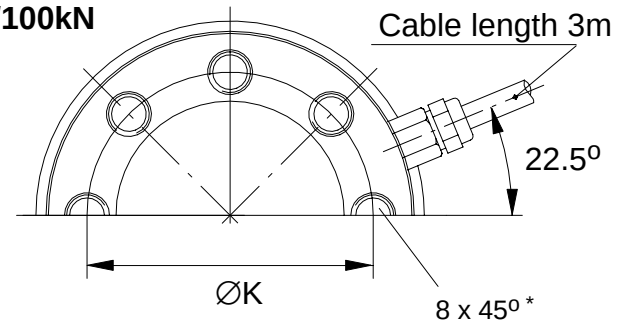
HBM 11.12.2000

8 Dimensions

U3: 0.5 – 20kN



U3:50kN/100kN



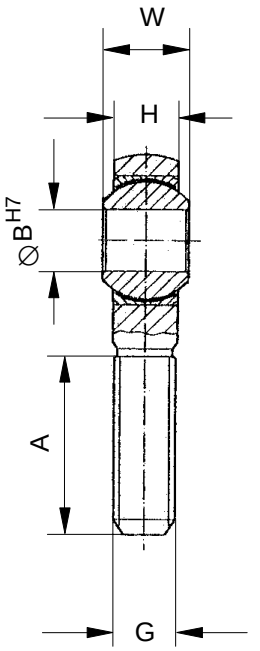
* only at 20, 50kN and 100kN

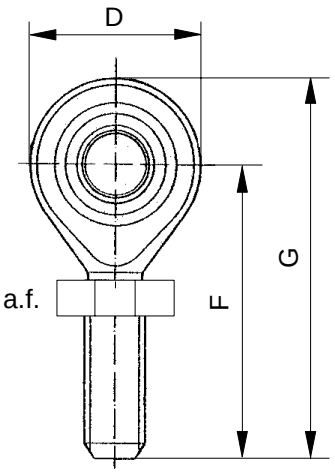
Nominal force	∅A	∅$B_{-0.02}$	∅C^{H8}	D	E	F	G	∅H	∅$K^{\pm 0.1}$	M
U3/0.5–10kN	54	50	34	8.5	5	13	47	5.5	42	M5
U3/20kN	95	90	55	15	5.5	20.5	72	11	70	M10
U3/50kN										
U3/100kN										

HBM 11.12.2000

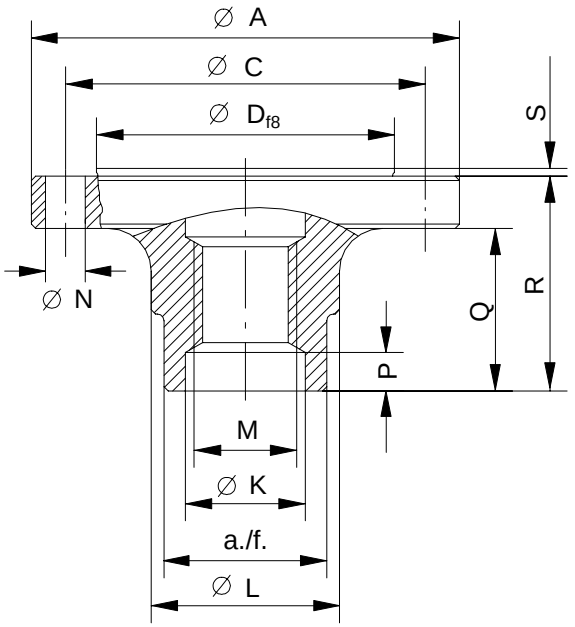
Mounting accessories

Knuckle eye ZGUW





Adapter



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

Knuckle eye

Nominal force (kN)	A	∅B H7	D	F	G	H	M	X	W	a./f.	Weight (kg)
0,5...10	33.5	12	32	54.5	70.5	12	M12	7	16	19	0.1
20	47	20	50	79.8	104.8	18	M20x1.5	9	25	30	0.4
50	57	25	60	94.5	124.5	22	M24x2	10	31	36	0.6
100	66	30 H7	70	110	145	25	M30x2	24	37	46	1.1

Adapter

Nominal force (kN)	∅A	∅C	∅D f8	M	∅K	∅L	∅N	P	Q	R	S	a./f.	Weight 1) (kg)
0.5...10	50	42	34	M12	14	22	4x5.5	4.5	19	25.1	0.9	19	0.15
20	90	70	55	M20x1.5	22	34	4x11	4.5	15	40.1	0.9	30	1.3
50	90	70	55	M24x2	26	42	8x11	6	20	45.1	0.9	36	1.45
100	90	70	55	M30x2	26	42	8x11	6	20	45.1	0.9	41	1.45

1) including screws

9 Declaration of conformity

HOTTINGER BALDWIN MESSTECHNIK

HOTTINGER BALDWIN MESSTECHNIK 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: ***097/07.1997***

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 U3

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, 04.07.1997

QV1051A1.03

Seite 2 zu | Page 2 of | Page 2 du

Document: ***097/07.1997***

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

QV1051A1.03

HBM 11.12.2000

HOTTINGER BALDWIN MESSTECHNIK
HBM Mess- und Systemtechnik GmbH
Postfach 10 01 51, D-64201 Darmstadt
Im Tiefen See 45, D-64293 Darmstadt
Tel.: +49/ 61 51/ 8 03-0; Fax: +49/ 61 51/ 89 48 96; *www.hbm.com*
e–mail: info@hbm.com

IM–C 12.00–POD