

**HOTTINGER BALDWIN MESSTECHNIK**  
**HBM Mess- und Systemtechnik GmbH**



**Electrical  
measurement  
of mechanical  
quantities**

## ***Mounting Instructions***

**Force transducer**  
**C2**

**B 20.C2.10 e**



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## Safety instructions

### Use in accordance with the regulations

Force transducers of the C2 type are designed for force measurements in test rigs/presses/test devices/testing machines. 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 C2 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:  **DANGER**

*Meaning:* **Highest level of danger**

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

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:* **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 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 document).

## **Prohibition of own 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.

## **Qualified personnel**

These transducers are only to be installed by qualified personnel strictly in accordance with the specifications 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 C2 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

- C2 force transducer
- C2 Operating Manual

### Accessories (not included in the scope of supply)

- EPO3/EPO3R thrust piece mounting accessory
  - for 500N...10kN: Order no. 1-EPO3/200KG
  - 20kN, 50kN: Order no. 1-EPO3R/5t
  - 100kN, 200kN: Order no. 1-EPO3R/20t
  - 500kN: Order no. 1-EPO3/50t

### Options

- Operating temperature range extended to 120 °C
- Degree of protection IP68

## **2 Application notes**

Force transducers of the C2 type series are suitable for the measurement of compressive forces. They provide extremely accurate measurements of static and dynamic forces and must therefore be handled carefully. You must be particularly vigilant when transporting and installing the devices. If the transducers are dropped or jolted, permanent damage could be caused. The limits for the permissible mechanical, thermal and electrical stresses are stated in the Specifications. Be sure to allow for them when planning the measuring setup, when installing and lastly, when operating.

## **3 Structure and mode of operation**

### **3.1 Measuring body**

The measuring element is a measuring spring made from stainless steel, to which strain gauges (S/G) are applied. The measuring element is simultaneously the top part of the transducer housing. The strain gauges are arranged so that four of them are extended and the other four are upset when a force acts on the transducer. Correction and compensation resistors are placed in the transducer circuit in order to remove unwanted influences on the zero signal and sensitivity.

### **3.2 Disturbance variables and their compensation**

Torsion, bending and transverse load are disturbance variables and are therefore to be avoided. If necessary they can be remedied with HBM mounting accessories (section 5.3 ). In addition to this, the C2 has independent lateral force compensation, which reduces the effects of transverse forces to a minimum (See Specifications).

The effects of temperature on the zero signal and on the sensitivity are compensated.

Changes in the ambient pressure act as additive/subtractive forces.

## 4 Conditions on site

### 4.1 Ambient temperature

To achieve optimal measurement results the nominal temperature range must be maintained. Constant but slowly changing temperatures are best. Measurement errors caused by temperature arise if one side is heated (for example, radiant heat) or cooled. A radiation shield and all-round heat insulation bring about marked improvements. They must not form a force shunt.

### 4.2 Moisture

Extreme humidity or a tropical climate should be avoided, if outside the classified limit values (degree of protection IP67 under DIN EN 60529).



#### NOTE

Moisture must not be allowed to penetrate the free end of the connection cable.

### 4.3 Air pressure

Changes in air pressure affect the force transducer in the same way as a change in force. The ambient pressure should be 0 – 5 bar. Please note that pressure variance will displace the zero point:

Nominal load	500N	1kN	2kN	5kN	10kN	20kN	50kN	100kN	200 kN
max. zero drift [%/10 mbar]	0.065	0.032	0.016	0.006	0.003	0.006	0.003	0.002	0.001

### 4.4 Chemical effects

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).

## 5 Mechanical installation

### 5.1 Important measures for installation

- Treat the transducer gently
- Do not overload the transducer.
- During or immediately after installation, the transducer should be bridged by a stranded copper wire 50mm<sup>2</sup> (highly flexible signal ground cable EEK from the HBM line). The cable is screwed on both above and below the transducer. This prevents welding currents from flowing through 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 measurement direction in which forces act on the transducer must be as precise as possible.

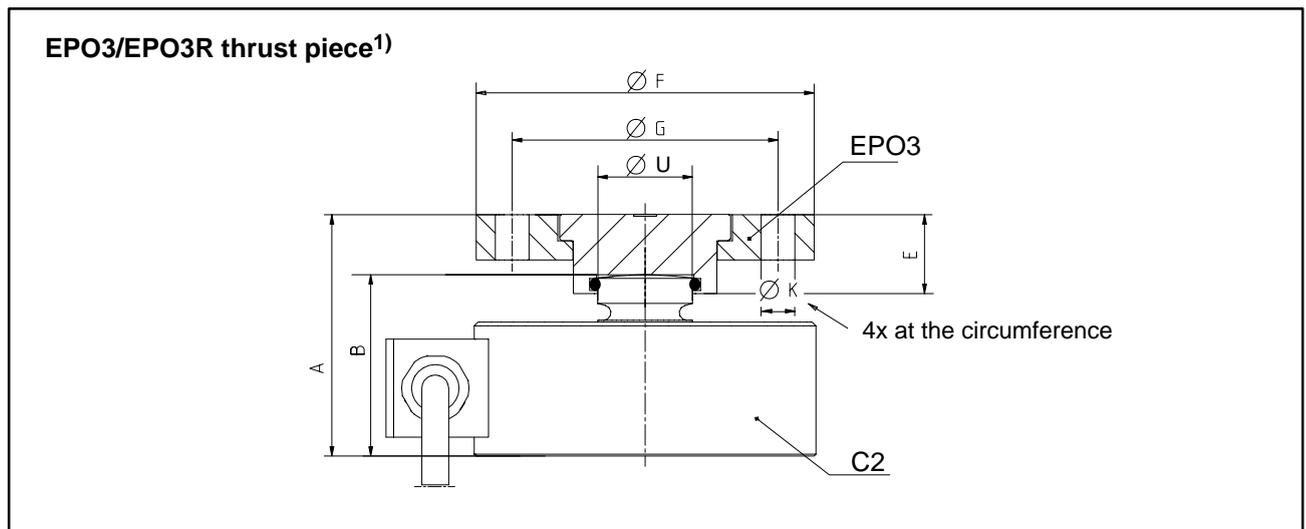


#### **WARNING**

**Torsion and bending moments, eccentric loading and transverse forces result in measurement errors and if limit values are exceeded, could destroy the transducer.**

HBM supplies the EPO3 thrust piece as a mounting accessory for transducers of the C2 type series. This mounting accessory stops torsion and bending moments and prevents transverse or oblique loads being introduced into the transducers.

## 5.3 Mounting accessories



Nominal force	A	B	E	ØF	ØG	ØU	ØK	Weight [kg]
500N...10kN	46	30	21	89	70	13	9	0.65
20kN , 50kN	64	48	21	89	70	25	9	0.65
100kN, 200kN	80	60	27.5	110	90	32	13	1.10
500 kN	130	90	50	147	130	44	17	2.80

1) Thrust pieces EPO3R and EPO3/200kG are made from stainless steel.

## 6 Electrical connection

The 3m long transducer connection cable has colour-coded free wire ends. The cable shielding is connected in accordance with the Greenline concept. This means that the measurement system is surrounded by a Faraday cage. Electromagnetic interference will not affect the measurement system.

Connectors to CE standard are to be fitted at the free end of the transducer. **The shielding is here to be laid over the whole area.**

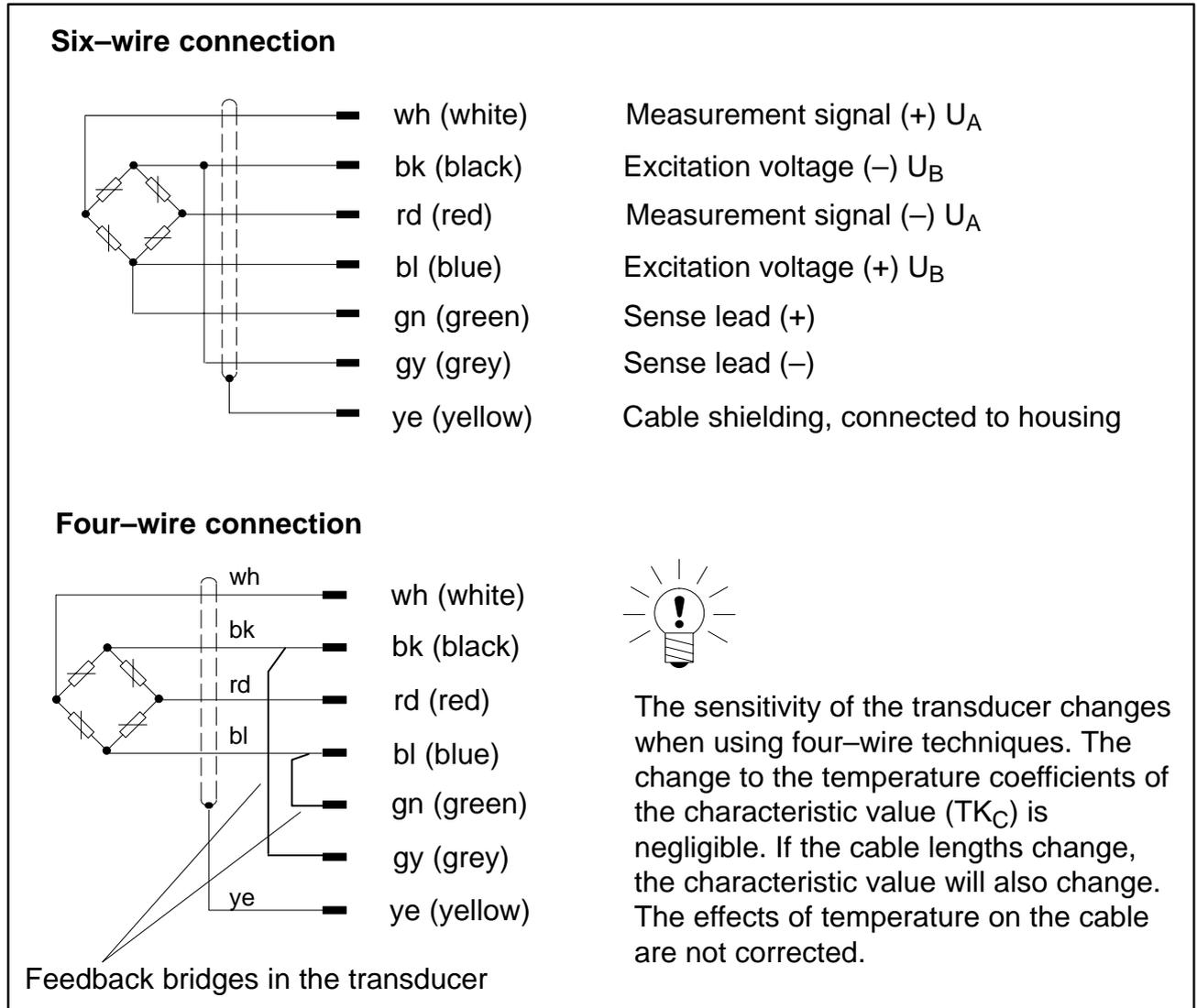
If a different connection technique is used then good EMC shielding is to be provided in the wiring loom, the shielding again being laid over the full area (see also HBM Greenline Information, document G36.35.0).

### 6.1 Instructions for cabling

- Always use shielded, low-capacity measurement cable 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 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.
- Connection diagram, earthing concept (Greenline)

## 6.2 Wiring pin assignment

If the transducer is connected according to the following connection diagram then when the transducer has compressive loading the output voltage at the measuring amplifier is positive.



**Fig. 6.1** C2 pin assignment; cable lengths 6m

## 7 Specifications

Type			C2									
Nominal force	$F_{nom}$	kN	0.5	1	2	5	10	20	50	100	200	500
Accuracy class			0.2	0.1								
Nominal sensitivity	$C_{nom}$	mV/V	2									
Rel. sensitivity deviation pressure	$d_c$	%	< $\pm 0.2$									
Rel. deviation from zero	$d_{ao}$	%	< 1									
Hysteresis (0.2 $F_{nom}$ to $F_{nom}$ )	$u$	%	< 0.2	< 0.15								
Linearity deviation	$d_{lin}$	%	< 0.2	< 0.1								
Temperature effect on the sensitivity, per 10K by reference to sensitivity	$TK_C$	%	0.1									
Temperature effect on the zero point, per 10K by reference to sensitivity	$TK_0$	%	0.05									
Effect of eccentricity per mm	$d_e$	%	$\pm 0.3$	$\pm 0.3$	$\pm 0.2$	$\pm 0.1$				$\pm 0.2$		
Rel. creep over 30min	$d_{crF+E}$	%	< $\pm 0.06$									
Input resistance	$R_e$	$\Omega$	> 340									
Output resistance	$R_a$	$\Omega$	300...400									
Isolation resistance	$R_{Is}$	G $\Omega$	> $2 \times 10^9$									
Reference excitation voltage	$U_{ref}$	V	5									
Operating range of the excitation voltage	$B_{U,G}$	V	0.5...12									
Nominal temperature range	$B_{t,nom}$	$^{\circ}C$	-10 to +70									
Operating temperature range	$B_{t,G}$	$^{\circ}C$	-30 to +85 (120) <sup>2)</sup>									
Storage temperature range	$B_{t,S}$	$^{\circ}C$	-50 to +85									
Reference temperature	$t_{ref}$	$^{\circ}C$	+23									
Max. operational force	( $F_G$ )	%	130				150					
Limit force	( $F_L$ )	%	130				150					
Breaking force	( $F_B$ )	%	> 300									
Static lateral limit force <sup>1)</sup>	( $F_Q$ )	%	50									

1) by reference to a force introduction point on the load introduction point

2) 120 $^{\circ}C$  version option

## Specifications continued

Type			C2									
Nominal force	$F_{nom}$	kN	0.5	1	2	5	10	20	50	100	200	500
Nominal displacement	$S_{nom}$	mm	< 0.1					< 0.06				< 0.1
Fundamental resonance frequency	$F_G$	kHz	4.4	8.7	9.7	18.5	19.3	13	14	13	14	10.5
Weight		kg	0.4					1.8	1.8	3	3	8.6
Rel. permissible vibrational stress	$F_{rb}$	%	100									
Degree of protection to DIN EN 60529			IP67 (IP68) <sup>3)</sup>									
Cable length, six-wire connection		m	3					6		12		

3) IP68 version option

Additional specifications for final tolerances:

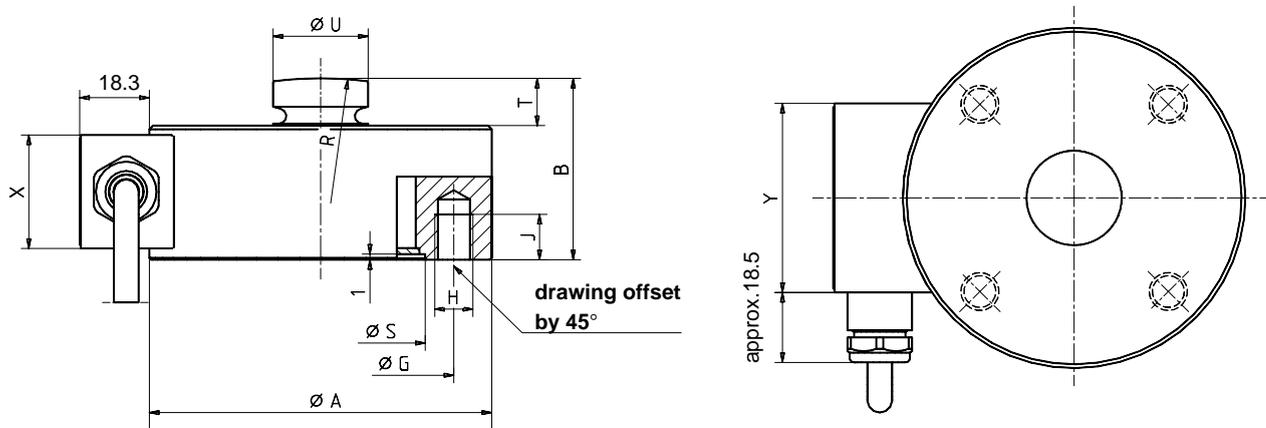
- The relative range of inversion is by reference to the final value and is given at 50% of the nominal load:

500N: < 4 $\mu$ m/m

1kN–500kN: < 3 $\mu$ m/m

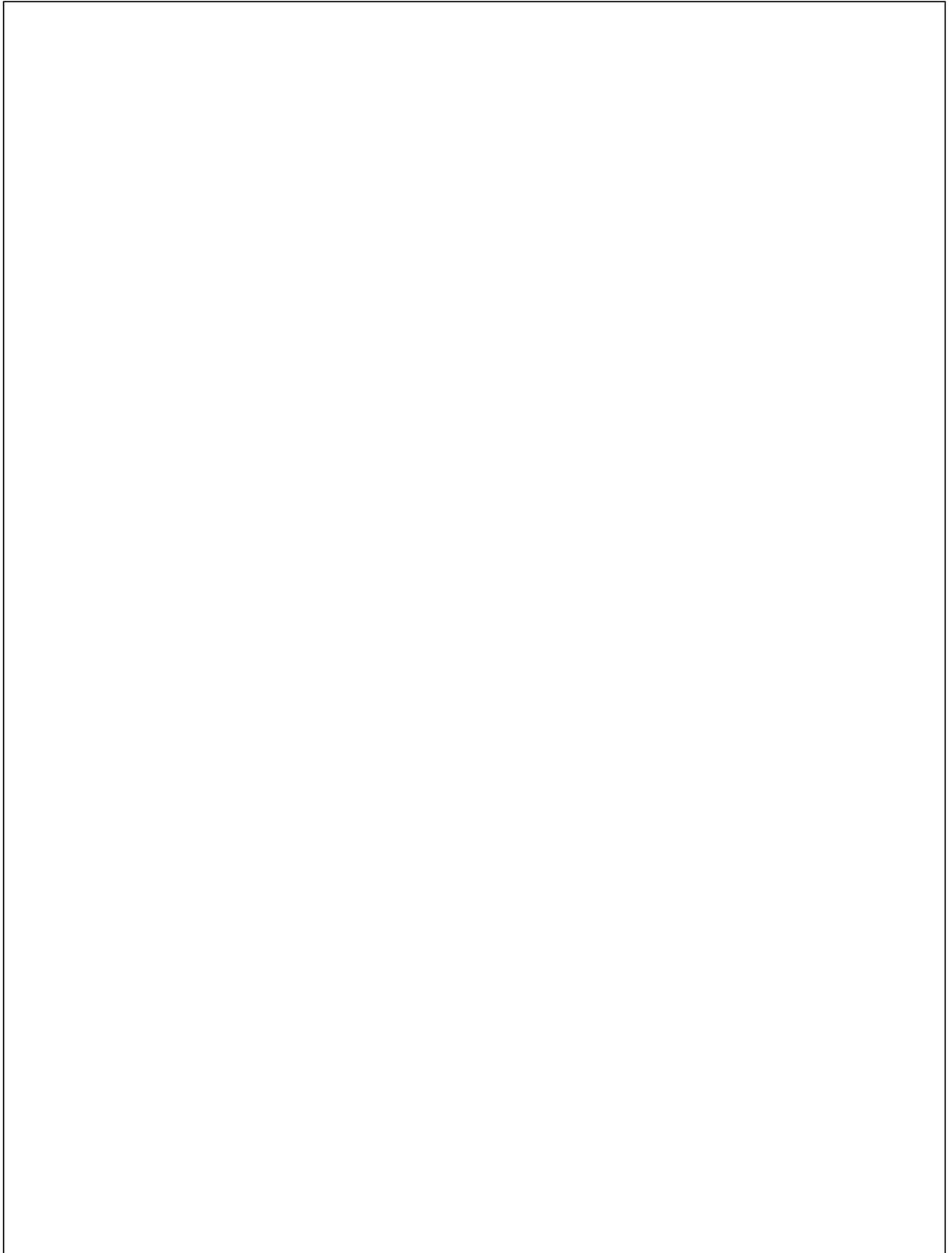
## 8 Dimensions

**C2** (nominal forces 500N...500kN)



Nominal force	ØA <sub>0.2</sub>	B	ØG	H	J	R	ØSH <sup>8</sup>	T	ØU	X	Y
500N...10kN	50	30	42	4xM5	7	60	34	7	13	20	35
20kN, 50kN	90	48	70	4xM10	12	100	55	12.5	25	30	50
100kN, 200kN	115	60	90	4xM12	16	160	68	12.5	32	30	50
500 kN	155	90	125	4xM16	20	300	97	15.5	44	30	50

## 9 Declaration of conformity









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IM-D 07.99 – POD