3540 Series
Tension & Compression Force Transducers

Operating Manual

1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

Table of Contents

1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

1 Safety note

1.1 Use for intended purpose

NOSHOK 3540 Series Tension & Compression Force Transducers are intended for the measurement of static and dynamic tension or compression force. These devices have been constructed and tested in accordance with the safety regulations for electronic measuring equipment. Any other usage is deemed to be **incorrect**. The transducers can only be guaranteed to operate correctly and safely if the information in the operating instructions is complied with. The legal and safety regulations that apply to the respective application must also be observed during use (e.g. VDE 0100). This also applies to the use of accessories.
The transducer is not intended to be used a safety element. The correct and safe operation of this transducer depends on correct transportation and proper storage, installation and assembly and careful operation and maintenance.

1.2 General dangers if the safety instructions are not followed

Force transducers made by NOSHOK are manufactured in accordance with the latest state of technology and are safe during operation. However, the transducers can be the source of residual danger if they are used or operated improperly.
Any person who is entrusted to install, start up, maintain or repair a force transducer must have read and understood the operating instructions, particularly the technical safety instructions.

1.3 Residual dangers

The performance and scope of delivery of the transducer only cover a sub-area of force measuring technology. The technical safety aspects of force measuring technology must also be planned and implemented by the system planner / equipper / operator in such a way that residual dangers are minimised. The existing regulations must be complied with. Residual dangers associated with force measuring technology must be pointed out.

The following symbols are used in these operating instructions:

Danger

Note

1.4 Ban on unauthorized changes and modifications

The transducer must not be modified from a structural or technical safety point of view or opened without the express permission of NOSHOK. Any modifications cancel our liability for any resulting damage.

1.5 Qualified staff

These transducers must only be used by qualified staff in accordance with the technical data in connection with the safety requirements and regulations mentioned in the following. The legal and safety requirements for the respective application must also be observed.
This also applies to the use of accessories.
Qualified staff are persons who are familiar with the installation, assembly, start-up and operation of the product and have the qualifications to carry out their work.

1.6 Operating location conditions

The transducers must be protected from mechanical and electrical damage.

1.7 Maintenance

The force transducers in the 3540 Series are maintenance-free. During welding work the transducer must be bypassed with a copper wire (min. 50 mm^2) so that welding current does not flow through the transducer and weld the force introduction points.

1.8 Accident prevention

Although the specified nominal force in the destruction range is a multiple of the measuring range limit, the relevant accident prevention regulations of the employer's liability insurance association must be taken into consideration.

2 Scope of delivery

Tension & compression force transducer, 2x lock nuts, operating manual

3 Deployment areas and usage instructions

The transducers are intended for measuring static and dynamic tension and / or compression force. Because of their extremely small dimensions, the transducers can also be used in situations where little space is available. The force transducers are suitable for harsh environmental conditions and tough operational demands. They are maintenance free and can also be installed in locations that are difficult to access. The wide range of output signals allows NOSHOK force transducers to be adapted to many difference usage conditions.
As precision measuring devices, the transducers must be handled with care during transportation and assembly. Shocks (e.g. colliding with a hard surface) can also cause unexpected overloading during measuring operation, causing permanent damage.

The limits for the permitted mechanical, thermal and electrical loads are listed in the "technical data". These must be complied with.

4 Design and method of operation

4.1 Measuring element

Innovative transducer manufacturing methods using the DMS principle have recently been developed. Etched wire strain gauges are not used in this case. The entire Wheatstone bridge with the necessary equalisation resistances and temperature compensation is realised using a thin-film method on a metallic, pot-shaped body. This thin-film sensor is then welded into in an appropriately shaped measuring spring with the aid of a laser welding method. The force is introduced into the force transducer via two threaded ends. The thin-film sensor and the optional electronics are sealed against moisture and dust.

4.2 Measuring procedure and output signal

The force acting in the measuring direction causes the measuring spring to become elastically deformed and therefore also the welded-in thin-film cell. This deformation generates a resistance change in the individual bridge resistors. If the measuring bridge is now supplied with a feed voltage, a measuring signal that is proportional to the force occurs at the bridge output. This signal can either be output directly (c=2 mV/V) or supplied as a standardised 4-20mA or 0-10V output signal with the aid of integrated amplifiers.

5 Deployment location conditions

5.1 Ambient temperature

The temperature range of -20°C to +80°C that is specified in the data sheet applies with regard to deployment. The specified error limits are not guaranteed outside this temperature range.
Temperature gradients in the force transducer must be avoided if possible. One-sided or local heating of the force transducer can cause large measuring errors.

The temperature errors specified in the data sheet always relate to the entire measuring device up to the plug or the end of the cable (including the integrated amplifier).

5.2 Moisture and corrosion protection

Tropical climates and condensation are not a problem because the transducers comply with protection class IP 67 in accordance with EN 60529:1991+A1:2000 / IEC 529.
The entire measuring spring is made from stainless steel. The amplifier casing with plug connection is made from aluminium. The design of the accessory cable also complies with protection class IP 67.

5.3 Deposits

Dust, dirt and other object must not be allowed to form deposits in such a way that they create a force short-circuit to the measuring spring, which would falsify the measuring signal.

6 Mechanical installation conditions of tension / compression force transducers

6.1 Precautions to take during assembly

- Force measuring equipment is extremely sensitive and must be handled carefully.
- Attention must be paid to the installation position and therefore the load direction when the force transducers are being installed.
- Torsional moments, off-centre loads and lateral loads cause measuring errors and can permanently damage the transducers.
- Care must therefore be taken to keep the transducer free of lateral loads and torsion during assembly (e.g. when tightening the lock nuts).
- Overloading must be prevented at all times.
- The output signal (2mV/V, 4...20mA, 0...10V) is noted on the name plate (Fig. 3). The connection assignments are also noted on the name plate and can also be found in the section entitled “Electrical connection”. The polarity must be correct at all times.

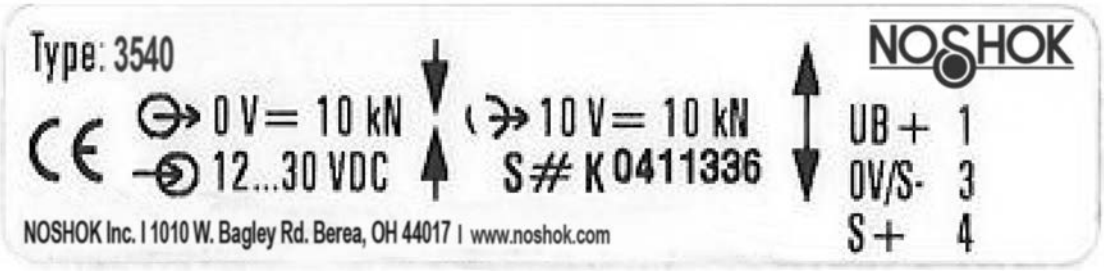


Fig. 3 Name plate

Type	Model
⊖→	Signal
−⊖	Power suply
S#	Product no.
UB+	Pin assignment – power supply +
0V/S-	Pin assignment – power supply - / signal -
S+	Pin assignment – signal +
↕	Tension
↓↑	Compression

6.2 General installation guidelines

- The loads acting upon the force transducer must be as exact as possible in the load direction.
- Torsion and lateral force must be avoided.
- Tension and/or compression force is introduced via two axial threaded pins in the above-mentioned model series. The supplied lock nuts must not come into contact with the deformation body. In order to avoid interfering force, NOSHOK recommends the use of articulated heads (see chapter 9.1).

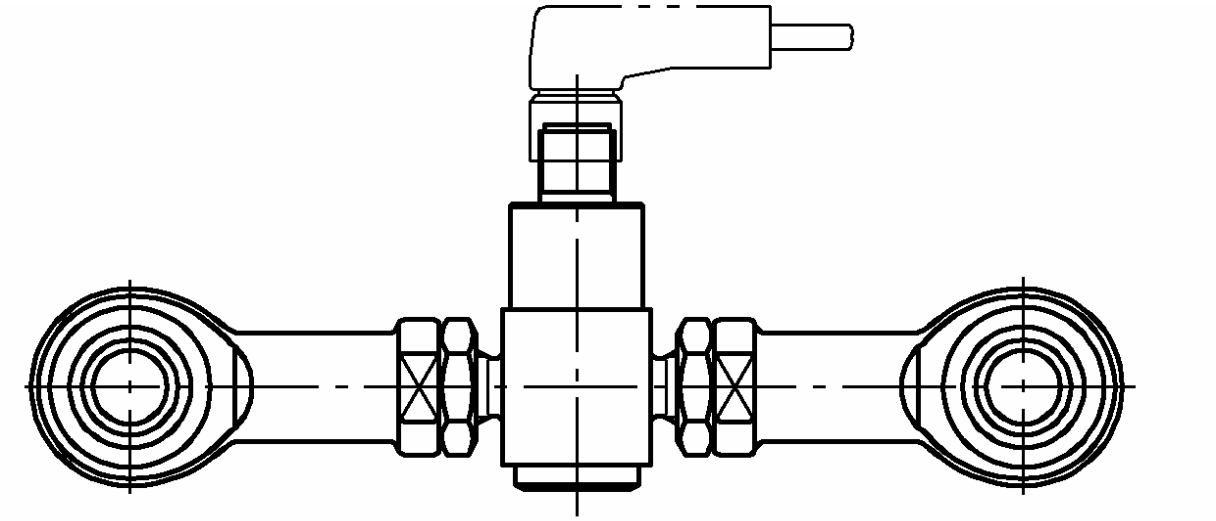


Fig. 4 Installation situation of a tension & compression force transducer

7 Electrical connection

Electrical and magnetic fields often generate interfering voltage in the measuring circuit. This interference essentially emanates from high voltage current running parallel to the measuring lines, but can also be caused by contactors or electric motors operating in the vicinity. Interfering voltage can also be introduced galvanically. This particularly occurs in cases where the measuring chain is earthed at various points that do not have the same potential.

To avoid the coupling in of interference, please note the following:

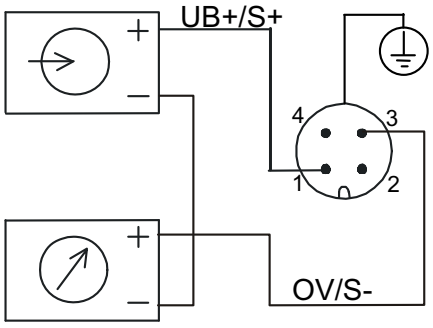
- Always use shielded, low-capacity measuring cables (all NOSHOK cables meet these requirements, see chapter 9.2).
- Do not route the measuring cable parallel to high-voltage current and control cables.

1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

- Avoid leakage fields from transformers, motors and contactors.
- The transducer, the amplifier and the display unit must not have multiple earths. Attach all equipment to the same protective conductor.

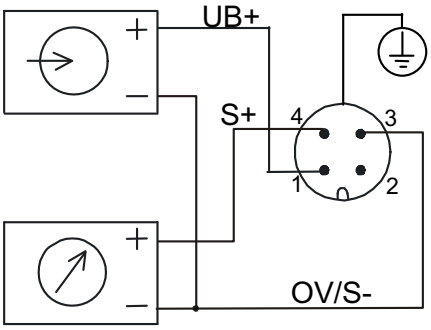
The plug or cable connection assignments can be found on the name plate. Unless otherwise agreed, the following assignments are used as standard.

Round connector
M12x1, 4-pin



940E01

Round connector
M12x1, 4-pin



940E04

	mV/V Output (4 – wire)	4...20 mA (2 – wire)	0...10 VDC (3 – wire)	Colour coding cable
Power supply: UB+	1	1	1	brown
Power supply: 0V/UB-/S-	3	3	3	blue
Signal: S+	4	-	4	black
Signal: S–	2	-	-	white
Shield ⏚	Housing	Housing	Housing	Shield ⏚

The cable shield is connected to the earth of the transducer. The shield of the accessory cables is connected to the knurled nut and therefore the transducer earth.
The earth cables can be extended or shortened without problems. Only shielded and low-capacity cables must be used for extending. The shield must also be properly connected.

8 Technical data

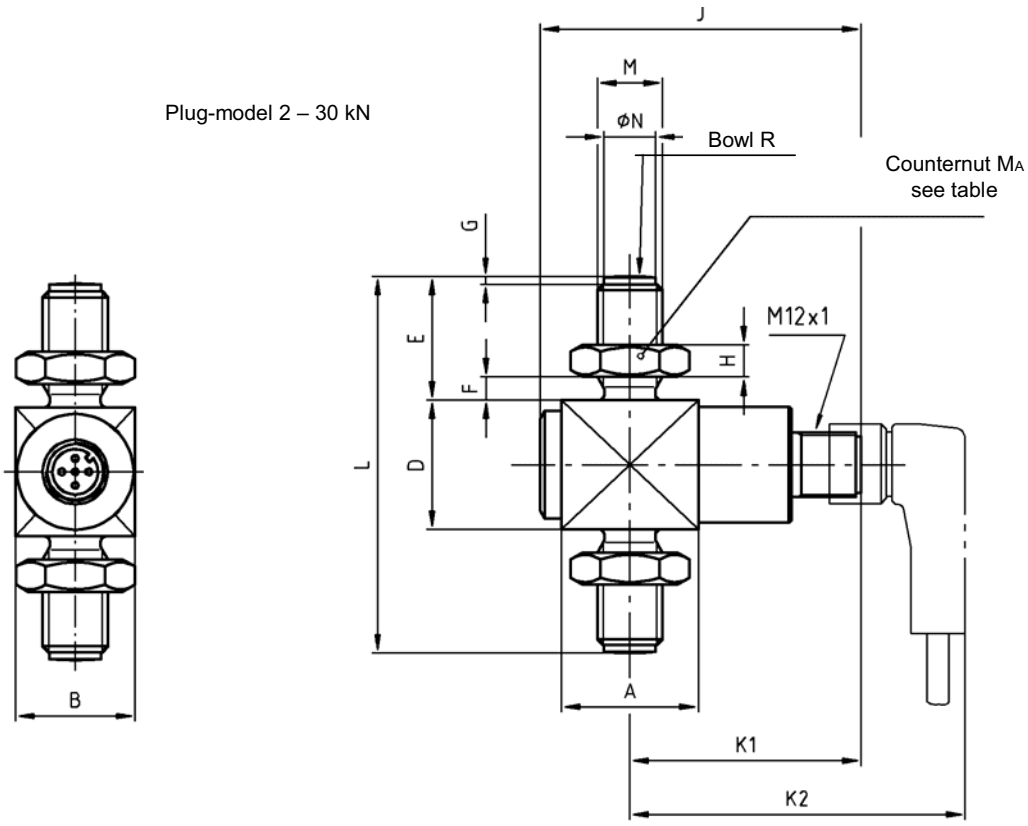
Model series	**3540**
Nominal force Fnom	1/ 2 / 3 / 5 / 10 / 20 / 30 / 50 / 100 / 200 / 300 / 500 kN
Force limit	150 % F_{nom}
Breaking limit	> 300 % F_{nom}
Permissible fluctuation	+/ - 50 % F_{nom} acc. to DIN 50100 *
Output signal (Output signal range: C_n)	4 … 20mA 2-wire technology; 0 ... 10 V 3-wire technology; 2 mV/V 4-wire technology (R Bridge ≈ 6500 Ω)
Comb. error	< 0.2 % C_n
Relative backlash width (Hysteresis)	< 0.1 % C_n
Creeping, 30 min. at F_{nom}	0.1 % C_n
Nominal temperature range	-20 °C … 80 °C
Storage temperature	-40 °C … 100 °C
Temperature influence - Meas.range - Null signal	0.2 % F_{nom} /10K 0.2 % F_{nom} /10K
Vibration resistance	20g, 100h, 50...150Hz acc. to IEC68-2-6 Fc
Protection class	IP 67 acc. to EN 60 529 / IEC 529
Electrical connection	Round connector M12x1, 4-pin or cable output
Auxiliary power	10 ... 30 VDC (4 ... ≤ 20 mA 12 ... 30 VDC (0 ... 10 V) 2 ... 10 VDC (mV/V)
Power consumption	Current output: 4 … 20 mA: Signal current Voltage output: < 10mA
Burden	≤ (UB–6V)/0.024 A for 4...20 mA output
Adjusting time	≤ 1 ms (within 10 % to 90 % F_{nom})
Interfering emission	acc. to EN 61326
Interference immunity	acc. to EN 61326
Electrical protection class	Reverse polarity, overvoltage and short circuit protection

Measuring element made from stainless steel

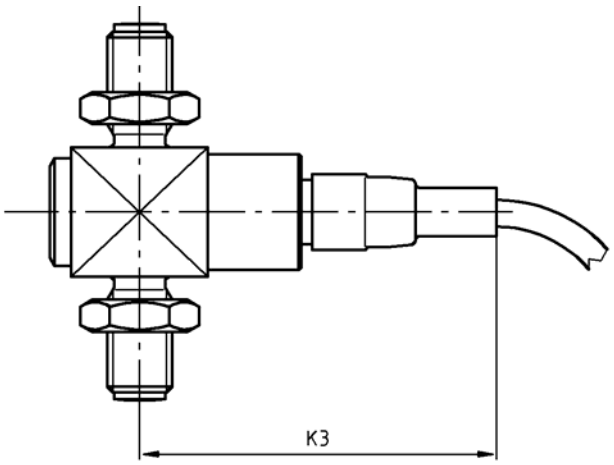
***** i.e. use next load level for higher load

1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

Plug-model 2 – 30 kN

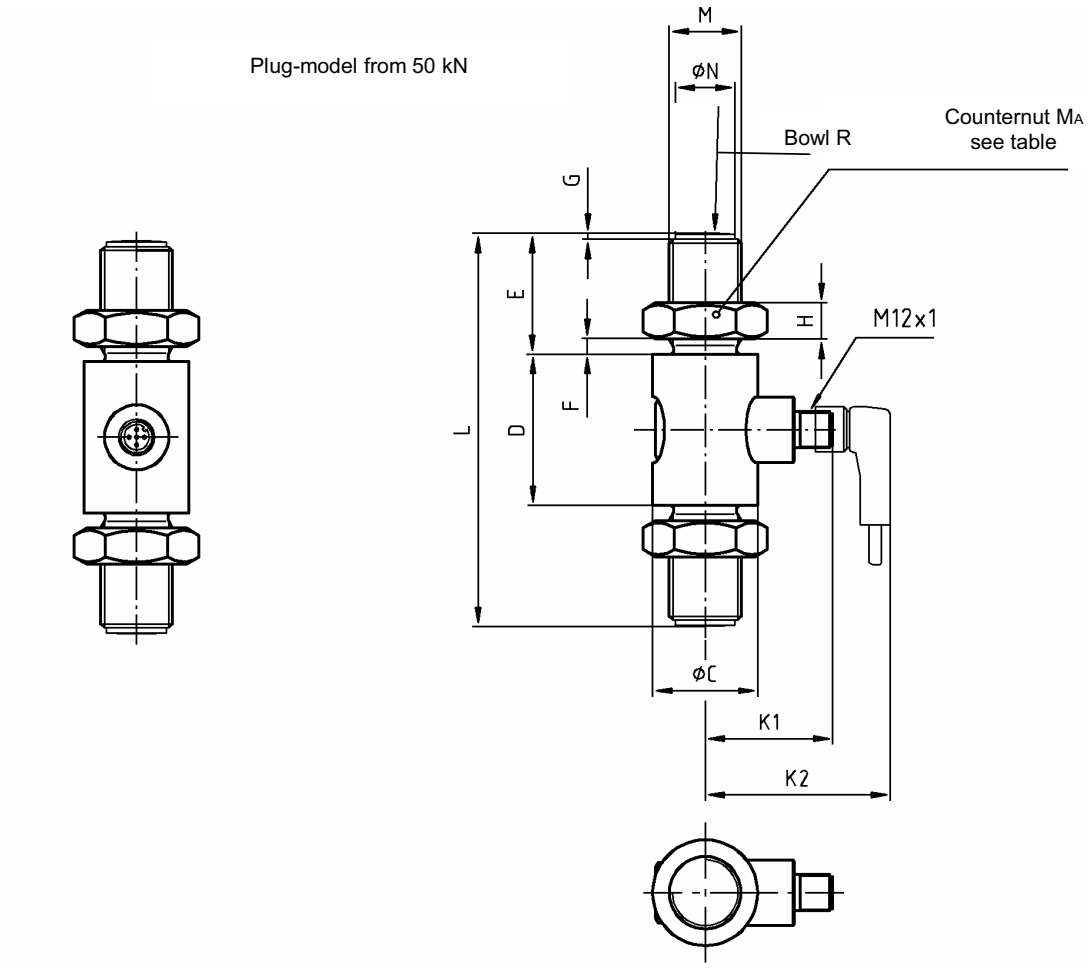


Model with fix cable connexion
2 – 30 kN

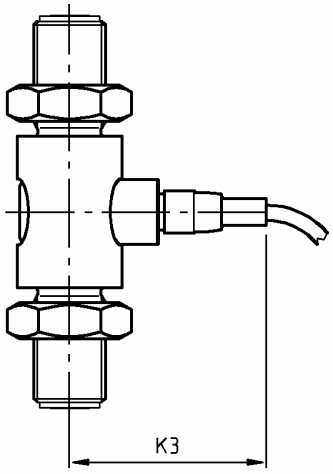


Nom. force	A	B	D	E	F	G	H	J	K1	K2	K3	L	M	ØN-0,1	Bowl R	MA (Nm)
1,2,3 kN	25,2	22	24	23	4,3	1,5	6	59	43	62	66	70	M12	9,5	60	60
5 kN	25,2	22	24	23	4,3	1,5	6	59	43	62	66	70	M12	9,5	60	60
10 kN	25,2	22	31	23	4,3	1,5	6	59	43	62	66	77	M12	9,5	80	60
20 kN	25,2	26	33	34	3,8	2	10	59	43	62	66	101	M20x1,5	17	100	300
30 kN	27,5	27,5	40	34	3,8	2	10	61,5	44	63	67	108	M20x1,5	17	120	300

Plug-model from 50 kN



Model with fix cable connexion
from 50 kN



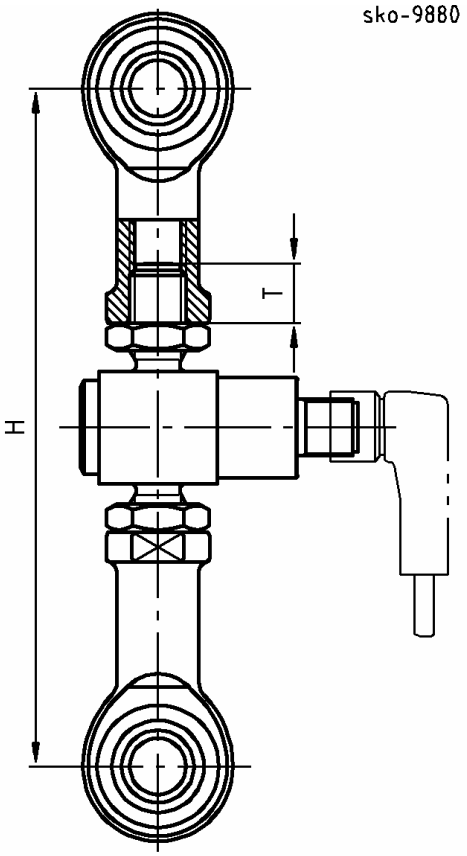
Nom. force	ØC	D	E	F	G	H	K1	K2	K3	L	M	ØN-0,1	Bowl R	MA (Nm)
50 kN	35	50	40	5	2	12	43	62	66	130	M24x2	20	150	500
100 kN	54	54	68	10	3	19,5	44	64	68	190	M39x3	34	200	2500
200 kN	67	67	82	12	3	22,5	45	65	69	231	M45x3	42	250	4000
300 kN	73	73	98	14	3	28	49	69	73	269	M56x4	50	300	6000
500 kN	94	94	113	17	3	32	59	79	83	320	M64x4	58	400	9000

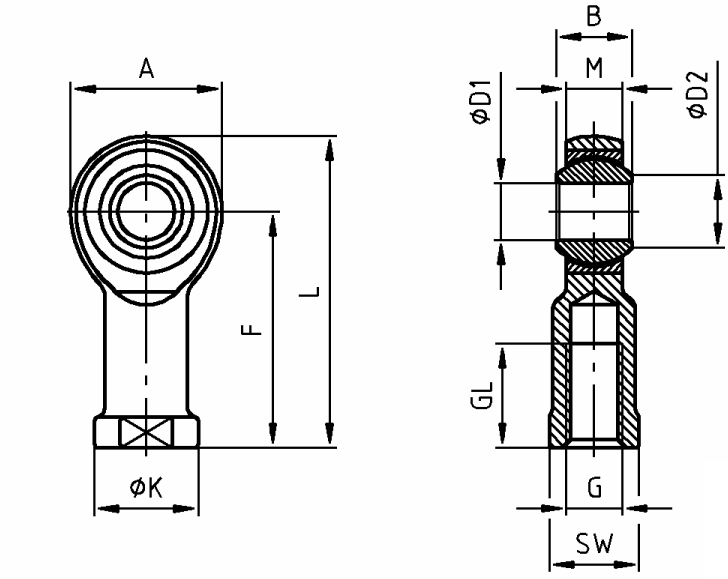
1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

9 Accessories

9.1 Built-in elements: articulated heads

Nom. force	H	T min. srew in depth
2 kN	148±3	9,5
5 kN	148±3	9,5
10 kN	155±3	9,5
20 kN	219±4	16
30 kN	226±4	16
50 kN	276±4	19,5
100 kN	405±7	31
200 kN	466±13	36
300 kN	568±11	45
500 kN	665±13	51

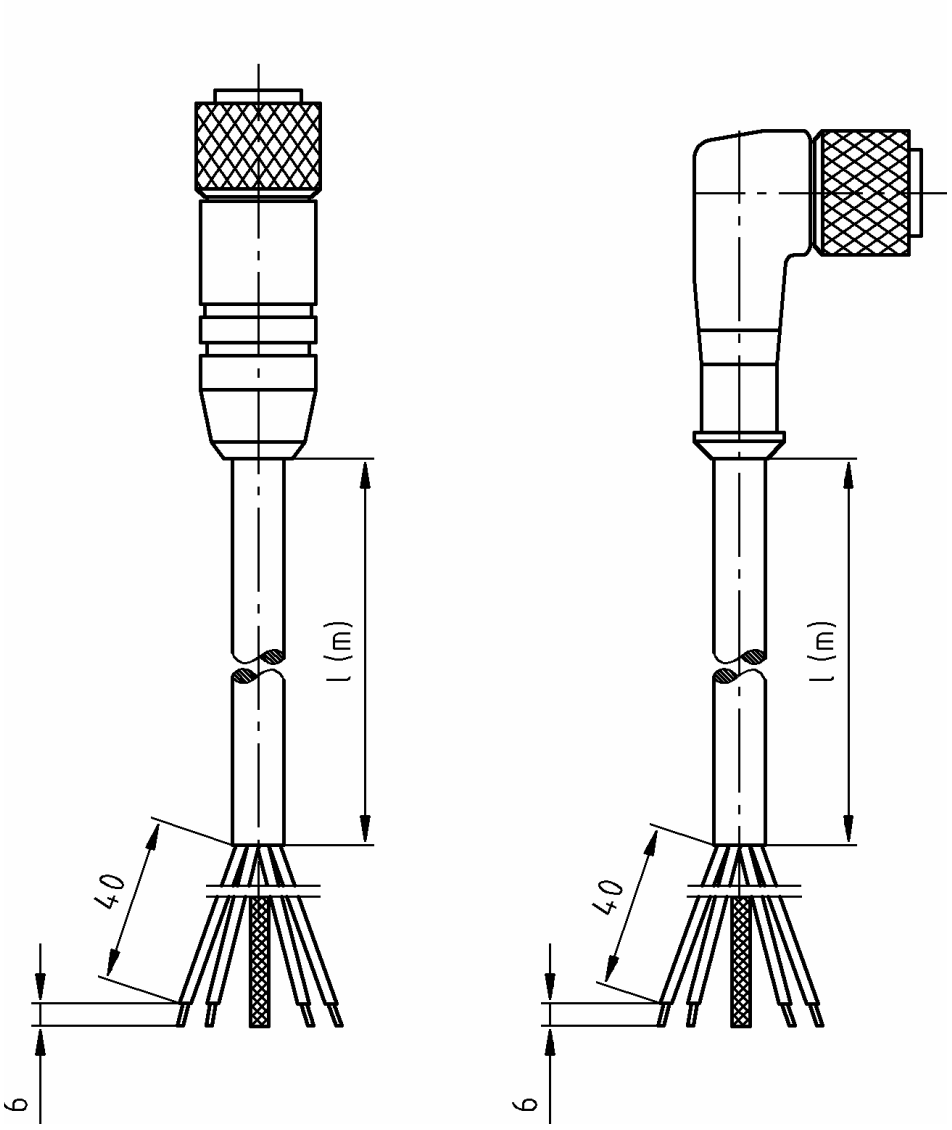




Swivel heads acc. DIN ISO 12240-4,
∅D1= 12 to 25 dimension column K
∅D2= 40 to 80 dimension column E

Nom. force in kN	Weight in kg	A	B	ØD1	ØD2	F	G	GL	ØK	L	M	SW
0…10	0,115	32	16	12 H7	15,4	50	M12	22	22	66	12	19
20…30	0,415	50	25	20 H7	24,3	77	M20x1,5	34	34	102	18	32
50	0,750	60	31	25 H7	29,6	94	M24x2	42	42	124	22	36
100	2	92	28	40-0.012	45	142	M39x3	65	65	188	23	55
200	3,5	112	35	50-0.012	56	160	M45x3	68	75	216	30	65
300	8,6	160	49	70-0.015	77,9	200	M56x4	80	98	280	42	85
500	12	180	55	80-0.015	89,4	230	M64x4	85	110	320	47	100

9.2 Accessory cables



Cable socket, M12x1 plug	2m	5m	10m	Variant
4-pin with cable	▪	▪	▪	straight
	▪	▪	▪	offset

1010 West Bagley Road, Berea, Ohio 44017 I P 440.243.0888 I F 440.243.3472 I www.noshok.com

10 NOTES:

NOSHOK

CORPORATE HEADQUARTERS
1010 West Bagley Road, Berea, Ohio 44017
P 440.243.0888 F 440.243.3472
E-mail : noshok@noshok.com
Web : www.noshok.com