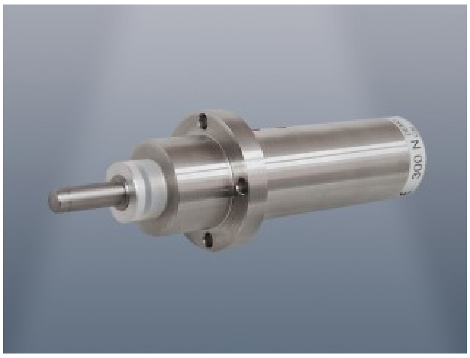
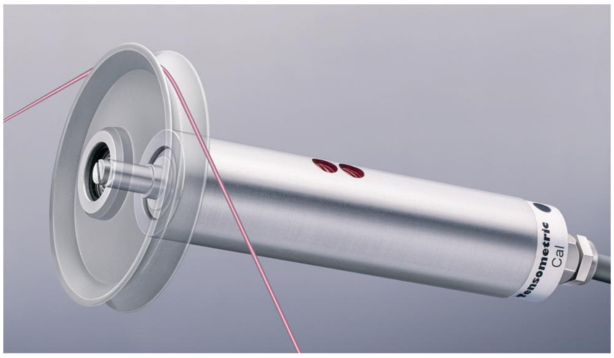
Date 01/2024
Instruction Manual

1 - Tensile roller force - transducer with integrated measuring amplifier





Area of validity

These operating instructions are valid for the following articles:
1 -Tensile roller force - transducer with integrated measuring amplifier

Series: LC-1390, M-1391-(C), M-1392, M-1300-20, M-1494-T....

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1 Safety instructions

Any person entrusted with the commissioning or operation of this device,
must have read and understood the operating instructions and in particular the safety instructions.

To ensure safe operation, the device may only be used in accordance with the information in
operating instructions. When using, there are also those for the
the legal and safety regulations required in the respective application.
This also applies to the use of accessories.

1.1 Intended use

The force transducers are used to convert forces into electrical signals.
Any other use is considered improper.

These devices must not be used as the sole means of preventing dangerous conditions on machines and plants.
Machines and systems must be designed in such a way that faulty conditions cannot occur to a dangerous situation for the operating personnel.
In particular, it must be ensured that incorrect inputs, a malfunction or a failure do not lead to a danger for man and machine.

1.2 Qualified personnel

The tensile force transducers may only be used by qualified personnel, exclusively in accordance with the
technical data.
Qualified personnel are persons who are familiar with the installation, assembly, commissioning and operation of electronic measuring and have the qualifications corresponding to their activity.

1.3 Residual dangers

The tensile force transducers correspond to the state of the art and are safe to operate.
Residual dangers can arise from the device if it is used and operated improperly by untrained personnel.

1.4 EC conformity

The force transducers comply with:

EN 61000-6-3
EN 61000-6-2

The commissioning of the transducer is forbidden until the integration into the end product fulfils the requirements of the current.
EC Machinery Directive and the Employer's Liability Insurance Association are fulfilled.

1.5 ElektroG (Electrical and Electronic Equipment Act)

According to the ElektroG of March 16, 2005, Annex I, the transducer belongs to category 9 "Monitoring and control devices" and is a B2B product.
The exemption rule according to §10 paragraph (2) is claimed. According to this the
user to dispose of the device properly at the end of its useful life in accordance with the ElektroG.
This regulation applies to devices that were placed on the market for the first time after August 13, 2005.
These devices have a serial number from Tensometric greater than 25 08 00.

2 Description

A tensile force measuring system can be easily set up with a Tensometric radial force transducer.

For tensile force measurement on running material, a ball bearing mounted roller is mounted on the bearing axle. This roller is then positioned in the machine so that it deflects the material to be measured at a defined angle. Angles of wrap of the material to be measured around the roller of 3° to 180° are possible.
The radial force on the bearing axis resulting from the deflection is measured by the transducer.
It is proportional to the tensile force in the material to be measured.

The wrapping of the material to be measured around the centre roller (the measuring roller),
a resultant force is generated which acts radially on the measuring roller.

This force is transmitted via the axis and generates a defined deformation of a spring body.
Strain gauges are used to convert the deformation into an electrical signal.

Due to the known wrap angle, the resulting force,
the tensile force in the material to be measured.

1-roll transducers are designed for stationary installation in the material line to be measured.
The transducer is installed at the intended measuring location and connected to an evaluation unit.
The evaluation unit can be, for example, a digital display or the analog input of a PLC.
For its function, the sensor requires the supply voltage specified on the type of plate.

After calibration, the sensor is ready for use.

The output signal of the transducer is proportional to the measured radial force.

2.1 WARNING!

Tensometric transducers are precise measuring elements suitable for laboratory and production.
Nevertheless, they should be handled with great care.

The movement of the bearing axis from ' 0 ' to ' full load ' is only a few tenths of a millimetre.

**Therefore, uncontrolled strong thumb pressure on the bearing axis,
especially an transducers with low nominal loads, can destroy the measuring system.**

3 Commissioning:

Check the operating voltage of the power supply unit.
It must correspond to the voltage specification on the type of plate of the measuring sensor.
To measure the voltage, use a voltmeter with a sufficient measuring range.

Switch off the power supply unit.

Connect the transducer to the power supply unit.

Connect a voltmeter to the voltage output of the transducer.

Switch on the operating voltage.
The voltmeter at the signal output displays measured values.
Slight loads on the measuring roller influence the output signal.

After calibration, the sensor is ready for use.

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4 Installation

The sensor is designed for stationary installation in the material line to be measured.

4.1 Mounting position: The sensor can be operated in horizontal or vertical position; the mounting position is arbitrary.

4.2 Mounting: The transducer must be attached to a mounting bracket for operation.
The mounting must be able to absorb the forces that occur during a measurement and the forces that may occur in the event of overloading by the material to be measured.
For transducers with an M25x1.5 screw thread on the sleeve, the mounting is done in a 25 mm hole. The locking is done by means of 2 nuts SW32 and the wrench flat SW19 on the housing.

4.3 Material guidance: The measuring direction in which the transducer has its greatest sensitivity (its nominal load) is marked with red dots. It should point in the direction of the resulting force.
Deviations from this direction increase the measuring range of the transducer.

4.4 Running direction: The running direction of the material can be from right to left,
as well as from left to right, via a measuring roller mounted on the bearing axis.

4.5 Angle of wrap: The wrap angle that the material to be measured takes around the measuring roller, also determines the measuring range of the transducer.
Wrap angles from 3° to 180° are possible.
It can vary depending on the thickness of the material to be measured.
This also changes the resulting force that acts on the measuring roller and thus on the measuring system installed in the transducer.
During a measurement, the wrap angle around the measuring roller have to be kept constant.

5 Installation instructions

Although the device has a high level of protection against electromagnetic interference,
the installation and cable routing must be carried out properly,
so that electromagnetic interference immunity is ensured in all cases.

Observe the following installation instructions.
They guarantee a high level of protection against electromagnetic interference.

1. The transducer must be mounted on a grounded support.

2. Use shielded cable. The connecting wires should be as short as possible.
The shield of the attached cable is connected to the transducer housing.

3. Never lay signal and control line together with main line, motor supply line, supply line from cylinder coils, rectifiers, etc... The lines should be laid in conductive, grounded cable ducts. This applies in particular to long cable runs, or if the lines are exposed to strong radio waves from broadcast transmitters.

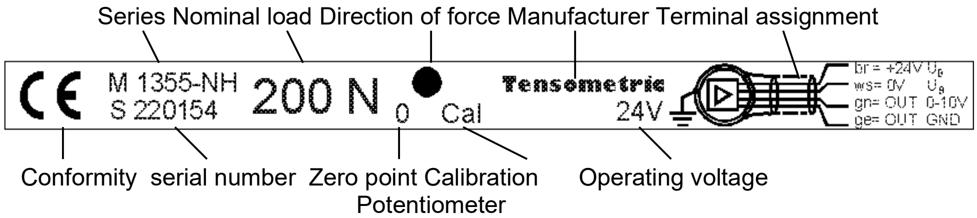
4. Mount the transducer and route signal line inside control cabinets as far as possible from contactors, control relays, transformers, and other sources of interference.

5. For very strong electromagnetic interference in the range > 90 Mhz, external filtering can be applied. This can be achieved by installing ferrite sleeves. The sleeves should be installed as close as possible to the unit.
The following parts are recommended for suppressing electromagnetic interference:
Ferrite sleeve with an inner diameter of 4.5 - 5.5 mm, length min. 20mm.

6. Long cables are more susceptible to electromagnetic interference than short ones.
Therefore, keep the lines as short as possible.

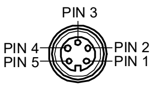
7 Avoid switching inductive loads or ensure sufficient interference suppression.

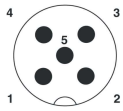
Type example shield:

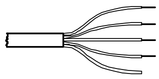


6 Electrical connections

Operating voltage 5 V, 12 V, or 24 V:
View of connector plug M16x1 and M12 A-coded Male connection cable.





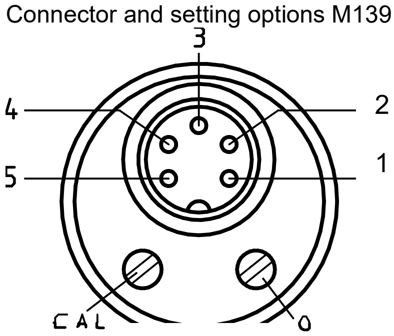


In brackets the colors for a M12 connector

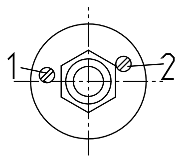
PIN 1 = brown (brown) =	+ operating voltage
PIN 3 = white (blue) =	- operating voltage
PIN 4 = green (black)=	output signal 0-10V corresponding to 0-100% of the nominal load
PIN 2 = yellow (white) =	GND output signal
PIN 5 = grey (grey) =	option: output signal 4-20mA max. load 500Ω
Shield (not) =	is connected to the housing

Shield and housing must be connected to ground potential.

Connector and setting options M1391-C, M1300-20….



CAL (1) = Calibration (gain setting)
0 (2) = Offset (zero-point setting)



7 Setting options on the transducer

Settings by means of screwdriver.
To operate the "CAL" and "0" potentiometers, insert a screwdriver through the labelled holes in the slots of the potentiometers. (Position of "CAL" and "0" see appendix)

7.1 "CAL" potentiometer measuring signal gain. It is used to adjust the gain of the integreted measuring amplifier. By setting the gain, the transducer can be calibrated.

Adjustment by screwdriver:
Clockwise rotation increases the gain.
Turning counterclockwise decreases the amplification.

7.2 "0" potentiometer Zero-point adjustment. It can be used, for example, to tare the measuring roller weight.
Adjustment by screwdriver:
Clockwise rotation increases the electrical zero point.
Counterclockwise rotation decreases the electrical zero point.

8 Calibration

During calibration of the transducer, the force applied to the bearing axis,
is brought into a defined relationship to the output signal or to the numerically correct measured value display.

There are two different calibration methods.

- Calibration to exact tensile force measurement
- Calibration to exact radial force measurement

The transducer is factory calibrated for exact radial force measurement.

8.1 Description: Calibration for exact tensile force measurement

When calibrating for exact tensile force measurement, the calibration is performed with the wrap angle and the material that is to be measured subsequently (cable, wire, foil, etc.).
The transducer is calibrated in its real measuring location under conditions similar to operating conditions.

The following calibration method is preferable:

- in case of small wrap angles (< 60°) of the material to be measured around the measuring roller.
- if the wrap angle of the material to be measured around the measuring roller is not precisely known.
- for tensile force measurements on thick materials.
- if the direction of the resulting force does not correspond to the measuring direction of the transducer.

A sufficient length of the material to be measured is inserted into the measuring roller during calibration in such a way,
as it corresponds to the material course at the measuring point.
Then the material to be measured is loaded with a known tensile force and the output signal is adjusted.
The load can be applied by weight stones.

8.2 Description: Calibration to exact radial force measurement

When calibrating for exact radial force measurement, the calibration is carried out with weights,
which are hung directly on the bearing axis.
In most cases, this calibration method is easier to carry out than the calibration for exact tensile force measurement.
The prerequisite for this method is the exact knowledge of the wrap angle
of the material to be measured around the measuring roller, in the later place of use.

8.3 Calibration principle:

To calibrate the transducer, a tension measuring instrument,
with a sufficient measuring range is connected to the voltage output of the transducer.

At least two force measuring conditions must be simulated during calibration.

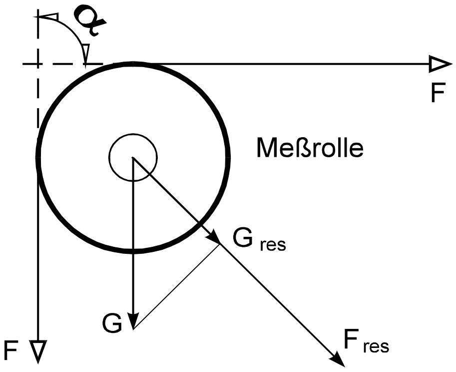
1. No measuring force is present on the measuring roller of the transducer.
   In this state, the output signal of the transducer is set to 0 V with potentiometer 2, marked " 0 ".

2. A known force is applied to the measuring roller.
   This force can be generated by weight stones.
   which are either attached to the material to be measured (calibration to exact tensile force measurement), or directly to the bearing axis (calibration to exact radial force measurement).

   In this condition, the output signal corresponding to the force at from Tensometric measuring amplifier.
   is set with the potentiometer "CAL".

8.4 Calculation of the output signal:

To calculate the output signal of the transducer, the wrap angle of the material to be measured around the measuring roller and the nominal load of the transducer have to be known.



= wrap angle
F = tensile force of the material to be measured
Fres = measured resultant tensile force
G = weight force of the measuring roller
Gres = proportion of the measuring roller weight force in the direction of action of the transducer

Calculation of the resulting force:
Fres = 2 * F * sin (/2)

Fres can also be taken from the enclosed table.

Output signal = Fres / nominal load of the transducer * 10V

Example for a transducer with voltage output signal 0-10V:

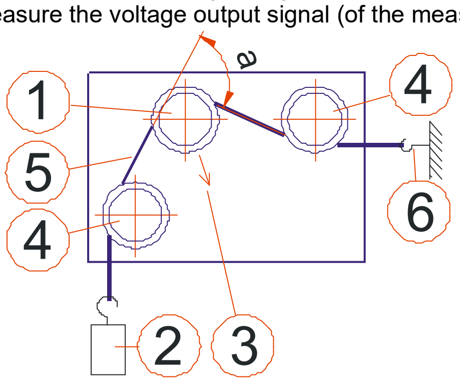
Tensile force in the material to be measured, generated by weight stones = 150N
Wrap angle around the measuring roller = 30°.
Nominal load of the radial force transducer = 100N

Resulting force Fres = 2 * 150N * sin 15° = 77,65N
Output signal Ua = 77.65N / 100N * 10V = 7.765V

If required, the output signal can now also be set to 7.5V with the "CAL" potentiometer on the transducer. Thus, the output signal at a tensile force of 200 N = 10V

8.5 Calibration procedure: Calibration to exact tensile force measurement

The transducer is installed in its measuring location (in the machine).
The measuring direction of the transducer is aligned in the direction of the resulting force, which is generated by the wrap around the measuring roller.
The measuring roller is mounted on the bearing axis of the transducer.
Switch on the operating voltage for the transducer.
Measure the voltage output signal (of the measuring amplifier) with a voltmeter.



1 = Measuring roller on transducer
2 = Weight
3 = Direction of the resulting force
4 = guide rollers
5 = material to be measured
6 = mounting for material to be measured
a = wrap angle

Calibration procedure:

1. The measuring roller of the transducer is unloaded.
Using a screwdriver, actuate the potentiometer zero-point setting "0" (4mA).
In the connected voltmeter, set output signal 0V or display "000". (4.00mA)

2. The measuring roller (1) of the transducer is loaded with a known force.
A length of the material (5) subsequently must be placed to be measured,
in the guide rollers (4) (of the machine), and measuring roller (1) (of the transducer).

   Create a known tensile force by attaching weights to the material to be measured.
The known tensile force should be approx. 80 % of the nominal load of the transducer.
Measure the output signal with a tension meter.
It must correspond to the output voltage corresponding to the tensile force.

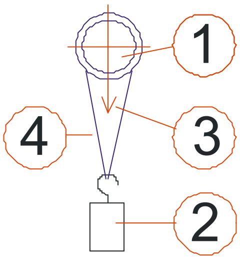
   If the measured output signal does not correspond to the generated tensile force, the correct voltage of the output signal must be set with the potentiometer measuring signal amplification "CAL".

3. Relieve the load on the measuring roller of the transducer.

The connected tension measuring instrument shows 0V (4mA) again. The tensile force transducer is now ready for operation.
If there are deviations from 0V, repeat points 1 to 3 of calibration procedure 8.5.
Note: If the tensile force to be measured does not reach 80% of the measuring range, it is also possible to calibrate with forces that are in the range of the expected tensile force.
The output signal must be converted accordingly.

8.6 Calibration procedure: Calibration for exact radial force measurement

The transducer is installed in a stable holder.
The measuring direction of the transducer points downwards.
The measuring roller is mounted.
Switch on the operating voltage for the transducer.
Measure the voltage of the voltage output signal with a voltmeter**.**



1 = Measuring roller on transducer
2 = Weight
3 = Direction of the resulting force
4 = Guide rollers

1. The measuring roller of the transducer is unloaded:
Using a screwdriver, actuate the potentiometer zero-point setting "0".
Set output signal 0V (4mA) or display "000". (4.00)

2. The measuring roller of the transducer is loaded with a known force.
Create a known tensile force by attaching weights, to the measuring roller.
The known tensile force should be 80% of the nominal load of the transducer.
Using a voltmeter, measure the voltage of the output signal.
100% of the nominal load of the transducer, corresponds to an output signal of 10V. (20mA)
If the output signal does not correspond to the generated radial force, the calculated voltage of the output signal must be adjusted with the potentiometer measuring signal amplification "CAL".

3. Relieve the load on the transducer.

If the connected voltmeter shows 0V (4mA) again, the transducer is ready for operation.
If there are deviations from 0V (4mA), repeat points 1 to 3 of calibration procedure 8.6.

8.7 Zero-point adjustment after final installation

If the transducer has to be turned to its final position for mounting, a zero-point deviation will occur.
This deviation can be eliminated by a new zero-point adjustment with potentiometer "0".
The calibration does not have to be repeated.

8.8 Calibration time interval

Tensometric transducers have a high long-term stability, so that a calibration check every 6 months is sufficient when used as intended.

Overloads that exceed the specified overload protection can influence the subsequent measured values. If such an overload has occurred, a permanent zero-point shift appears in the simplest case, just as with a change in position of the transducer.

If the zero-point shift is unacceptable in its amount, calibration must also be carried out before a time interval has elapsed.

9 Maintenance

From Tensometric Transducers are maintenance-free.
The ball bearings in the rollers must be checked for smooth running. Defective ball bearings must be replaced.
The running surfaces of the guide and measuring rollers must be checked for wear and damage.
Damaged rollers must be replaced. The connection cable must be checked for damage.

9.1 Removal and installation of the track roller

Special care must be taken when removing and installing the measuring roller.
The measuring roller is directly connected to the measuring system via the bearing axle.
The measuring system is protected against excessive radial forces, as they occur during tensile force measurement.

However, there is **no** overload protection against excessive axial forces.

To remove a track roller, depending on the version, the circlip or the fastening screw must be from the end face of the bearing shaft, depending on the design.
If the measuring roller cannot be pulled off the bearing shaft by hand, a puller must be used.
Axial forces greater than the nominal load of the installed radial force transducer must be avoided when pulling and pushing ball bearings onto the bearing axle.

If a track roller has been pushed onto the bearing axle, it must be fixed with the circlip or the fixing screw, depending on the design.

10 Deflection angle to force

Example:
The maximum tensile force to be measured is 300N, the wrap angle around the measuring roller is 65°. according to. Table the resulting force is 107.46% = 322.38N

Umschl. Grad	Resultierende %	Umschl. Grad	Resultierende %	Umschl. Grad	Resultierende %	Umschl. Grad	Resultierende %
1	1,745	**45**	76,537	**90**	141,421	**135**	184,776
2	3,490	**46**	78,146	**91**	142,650	**136**	185,437
3	5,235	**47**	79,750	**92**	143,868	**137**	186,084
4	6,980	**48**	81,347	**93**	145,075	**138**	186,716
5	8,724	**49**	82,939	**94**	146,271	**139**	187,334
6	10,467	**50**	84,524	**95**	147,455	**140**	187,939
7	12,210	**51**	86,102	**96**	148,629	**141**	188,528
8	13,951	**52**	87,674	**97**	149,791	**142**	189,104
9	15,692	**53**	89,240	**98**	150,942	**143**	189,665
10	17,431	**54**	90,798	**99**	152,081	**144**	190,211
11	19,169	**55**	92,350	**100**	153,209	**145**	190,743
12	20,906	**56**	93,894	**101**	154,325	**146**	191,261
13	22,641	**57**	95,432	**102**	155,429	**147**	191,764
14	24,374	**58**	96,962	**103**	156,522	**148**	192,252
15	26,105	**59**	98,485	**104**	157,602	**149**	192,726
16	27,835	**60**	100,000	**105**	158,671	**150**	193,185
17	29,562	**61**	101,508	**106**	159,727	**151**	193,630
18	31,287	**62**	103,008	**107**	160,771	**152**	194,059
19	33,010	**63**	104,500	**108**	161,803	**153**	194,474
20	34,730	**64**	105,984	**109**	162,823	**154**	194,874
21	36,447	**65**	107,460	**110**	163,830	**155**	195,259
22	38,162	**66**	108,928	**111**	164,825	**156**	195,630
23	39,874	**67**	110,387	**112**	165,808	**157**	195,985
24	41,582	**68**	111,839	**113**	166,777	**158**	196,325
25	43,288	**69**	113,281	**114**	167,734	**159**	196,651
26	44,990	**70**	114,715	**115**	168,678	**160**	196,962
27	46,689	**71**	116,141	**116**	169,610	**161**	197,257
28	48,384	**72**	117,557	**117**	170,528	**162**	197,538
29	50,076	**73**	118,965	**118**	171,433	**163**	197,803
30	51,764	**74**	120,363	**119**	172,326	**164**	198,054
31	53,448	**75**	121,752	**120**	173,205	**165**	198,289
32	55,127	**76**	123,132	**121**	174,071	**166**	198,509
33	56,803	**77**	124,503	**122**	174,924	**167**	198,714
34	58,474	**78**	125,864	**123**	175,763	**168**	198,904
35	60,141	**79**	127,216	**124**	176,590	**169**	199,079
36	61,803	**80**	128,558	**125**	177,402	**170**	199,239
37	63,461	**81**	129,890	**126**	178,201	**171**	199,383
38	65,114	**82**	131,212	**127**	178,987	**172**	199,513
39	66,761	**83**	132,524	**128**	179,759	**173**	199,627
40	68,404	**84**	133,826	**129**	180,517	**174**	199,726
41	70,041	**85**	135,118	**130**	181,262	**175**	199,810
42	71,674	**86**	136,400	**131**	181,992	**176**	199,878
43	73,300	**87**	137,671	**132**	182,709	**177**	199,931
44	74,921	**88**	138,932	**133**	183,412	**178**	199,970
		89	140,182	**134**	184,101	**179**	199,992
						180	200,000