



## Guided Wave Radar Level Transmitter (TDR)



measuring  
•  
monitoring  
•  
analysing

NGM



**HART**  
COMMUNICATION FOUNDATION

- For liquids and solids
- Independent of density, temperature, pressure, humidity and conductivity
- Measuring length: Max. 20 m
- Temperature range: -150 ... +250 °C
- Pressure range: -1 ... +40 bar
- Output: 4 ... 20 mA, switching output PNP

N2



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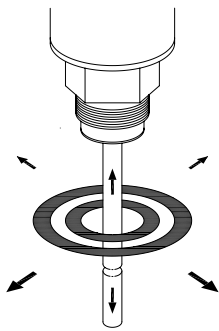
## Description

NGM uses TDR (Time Domain Reflectometry) technology, which is also known as Guide Microwave or Guided Wave Radar. This means that low-energy and high-frequency electromagnetic impulses, generated by the sensor's circuitry, are propagated along the probe which is immersed in the liquid or solid to be measured.

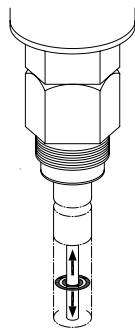
When these impulses hit the surface of the media, part of the impulse energy is reflected back up the probe to the circuitry which then calculates the level from the time difference between the impulses sent and the impulses reflected.

The sensor can output the analysed level as 4...20 mA analogue output, or it can convert the values into freely programmable switching output signal.

### Single rod probe



### Wire rope probe



## Application Area

The innovative TDR technology enables direct, precise and highly reliable continuous level measurement as well as point level detection in almost every liquid and light solids – independent of changing process conditions (such as density, conductivity, temperature, pressure or air humidity). The units can be mounted in small tanks, tall and narrow nozzles and it measures precisely even with difficult tank geometries or close to interfering structures. NGM is also especially suitable in bypass chambers and stilling wells. It has an exceptional performance in media with low dielectric constant (i.e. low reflectivity) such as oils and hydrocarbons.

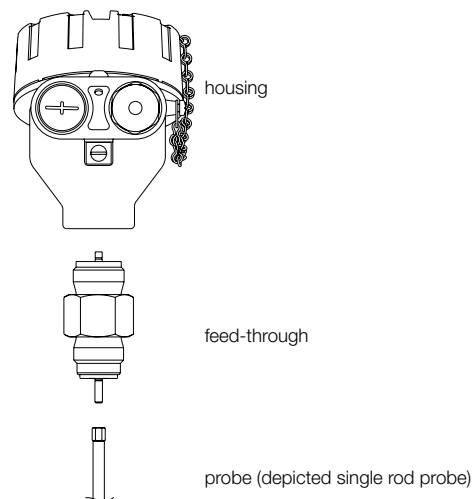
## Benefits

- Level measurement independent of pressure, temperature, humidity, conductivity
- Suitable for almost all media, liquids and light solids
- Fully modular probe design, i.e. the probe types are interchangeable without any special tools or welding
- Complete galvanic insulation of device electronics from its inputs/outputs and the tank potential (no problems with electrochemical corrosion protection)
- Highly robust measurement due to 4-wire design and innovative signal analysis and disturbance signal suppression

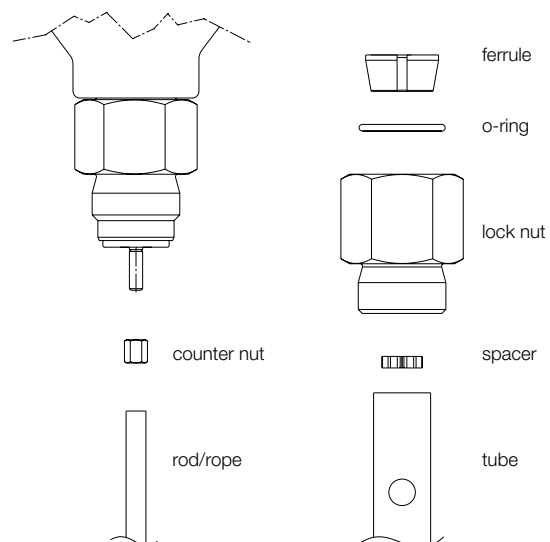
## Sensor Components

NGM consists of three major components: housing, feed-through, and probe. The only components that are exposed to the atmosphere inside the tank are probe and the part of the feed-through below the hexagon. The housing contains the sensor's electronics and input/output terminals and has no contact with the tank atmosphere. The so called feed-through is mounted into the bottom of the housing and serves two main purposes: its outer threaded metal bushing securely connects the sensor to the tank and its inner components guide the high frequency measurement signal from the electronics through the tank wall into the tank and back. The probe is mounted onto the bottom of the feed-through and gets immersed into the media inside the tank; the high-frequency measurement signal is propagated along the probe. NGM has a flexible modular concept. Any probe can be used with any housing since they are joined together by one universal feed-through.

### Sensor components



### Modular probe design



### Probe Types

To meet various application requirements, NGM has three different probe types: single rod probe, wire rope probe and coaxial probe.

#### Single rod (max. 3000 mm)

Single rod probe is suitable for a very wide range of applications, but the signal has a wider detection radius around the rod. Thus, they are more responsive for measurement signal disturbances which can be easily overcome by observing a few mounting considerations and making simple configuration adjustments to the sensor.

The single rod probe is recommended for installations in liquids and in bypass chambers and stilling wells, which basically act together with the rod as a big coaxial probe.

#### Wire rope (max. 20000 mm)

The wire rope probe model NGM-4 ... is recommended for installations in light solids and liquids, tall tanks and where limited headroom is available.

Wire rope probe is suitable for a very wide range of applications, but the signal has a wider detection radius around the rope, just like single rod probe. Thus, they are more responsive for measurement signal disturbances.

#### Coaxial (max. 6000 mm)

In the coaxial probe, the high-frequency measurement signal is completely contained within the outer tube. Thus, the coaxial probe is immune against any external conditions and interfering objects outside its tube which could otherwise cause disturbances of the measurement signal. This makes the coaxial probe the ideal solution for a hassle-free universal installation, ensuring reliable measurement under almost any application condition. The concentrated signal within the tube also makes the coaxial probe the ideal choice for measuring low reflectivity liquids (i.e. low dielectric constant) such as oils and hydrocarbons. The coaxial probe is recommended for the use with clean liquids only and cannot be used with solids, viscous, crystallizing, adhesive, coating, or sticky liquids; fibrous liquids, sludge, slurry, pulp; any liquids containing solid particles. Such liquids or solids in general might cause build-up, bridging or clogging inside the coaxial probe.

### Application Guide

Mounting type/probe type	Rod probe	Wire rope	Coaxial
Tall and narrow nozzles	*	*	+
Difficult tank or nozzle geometries	*	*	+
Close to internal tank structures or tank wall	*	*	+
Probe might move or touch internal tank structures or tank wall	*	*	+
Liquid spray may touch probe above the liquid surface	*	*	+
Non-stationary interference targets, e.g. agitator blades	*	*	+
Measurement readings at the very top or bottom of the tank	*	*	+
Non-metallic tanks	*	*	+
Bypass chambers and stilling wells	*	-	*
Limited head room for installation	*	+	*
Tall tanks	*	+	*
<b>Media Characteristics</b>			
Bulk solids	-	+	-
Measuring liquids with low dielectric constants	*	*	+
Viscous, crystallising, adhesive, coating or sticky liquids	+	+	-
Fibrous liquids, sludge, slurry, pulp	+	+	-
Liquids containing solid particles	+	+	-
Cleanability of probe important	+	+	-

+ = recommended    - = not recommended    \* = probably possible with configuration and/or mounting adjustments



## Guided Wave Radar Level Transmitter (TDR) Model NGM

### Technical Data

	Single rod	Wire rope	Coaxial
Probe diameter	6 mm	4 mm	17.2 mm
Max. load	Lateral: 6 Nm = 0.2 kg at 3 m	Tensile: 5 kN	Lateral: 100 Nm = 1.67 kg at 6 m
Probe length L	100 ... 3000 mm	1000 ... 20000 mm	100 ... 6000 mm (standard) 100 ... 1000 mm (high temperature)
Dielectric Constant ( $\epsilon_r$ )	> 1.8	> 1.8	> 1.4
Viscosity (cP)	< 5000	< 5000	< 500
Medium temperature, standard version	-40 ... +150 °C (without PTFE) -15 ... +100 °C (PTFE lining)	-40 ... +150 °C	-40 ... +130 °C (EPDM O-ring) -15 ... +150 °C (FKM O-ring)
High temperature version	-200 ... +250 °C (NBR O-ring) -150 ... +250 °C (FKM O-ring)	Not available	-200 ... +250 °C (NBR O-ring) -150 ... +250 °C (FKM O-ring)
Materials exposed to tank atmosphere	1.4571/316 Ti, PEEK (standard version) PTFE, O-ring (see order code), (PTFE lining) 1.4571/316 Ti, PEEK, PTFE, O-ring (see order code), (high temperature version) In all cases, in addition, a Klinger SIL® C-4400 gasket at connection thread, 2 mm thick	1.4404/316 L 1.4401/316, PEEK In addition, a Klinger SIL® C-4400 gasket at connection thread, 2 mm thick	1.4404/316 L, PEEK, O-ring (see order code), (standard version) 1.4404/316 L, PEEK, PTFE, O-ring (see order code), (high temperature version) In all cases, in addition, a Klinger SIL® C-4400 gasket at connection thread, 2 mm thick

Measuring principle: Guided Wave Radar (GWR)  
 Installation position: Vertical  
 Ambient temperature: -25 ... +80 °C  
 Storage temperature: -40 ... +85 °C  
 Max. pressure: -1 ... +40 bar  
 (except NGM-19:0 ... 4 bar)  
 Accuracy\*:  $\pm 3$  mm or 0.03 % of measured distance, whichever is greater  
 Repeatability\*: < 2 mm  
 Resolution\*: < 1 mm

\*Reference condition:  $\epsilon_r=80$ , water, tank  $\phi 1$  m, DN200 metal flange

Velocity of level change: < 1000 mm/s  
 Medium conductivity: No restrictions  
 Medium density: No restrictions  
 Process connection: Thread or flange, see ordering code

Interface  
 (e.g. oil on top of water): An oil layer of < 70 mm thickness on top of water is not detected by the sensor; in this case the sensor will detect only the water level at a slightly lower position than actual. From an oil layer thickness > 70 mm onwards, the sensor detects the total level, including the oil layer, according to specifications

### Materials

Housing: Aluminium alloy, epoxy coated, with safety chain and tin plated 1.4301/SS304 external earth screw  
 Option: Stainless steel 1.4401/SS316  
 O-ring: NGM Rod/Rope: None  
 NGM Coaxial: FKM or EPDM  
 NGM high temperature: NBR or FKM

### Weights

Housing incl. electronics: 720 g  
 Stainless steel housing incl. electronics: 1340 g  
 Connection  $\frac{3}{4}$  (Rod/rope): 220 g  
 Connection  $\frac{3}{4}$  (Coaxial): 350 g  
 1 m Rod probe: 230 g  
 1 m Rope probe: 66 g + 380 g ballast weight  
 1 m Coaxial probe: 540 g + 130 g (attachment kit)  
 Cooling extension for high temperature: 900 g

### Electrical data

Supply voltage:	12...30 V <sub>DC</sub> (reverse-polarity protected < 50 mA), 4-wire system
Output:	4...20 mA (programmable by HART® modem)
Total load:	< 500 Ω: HART® resistor approx. 250 Ω + load resistance approx. 250 Ω
Response time:	0.5 s [default], 2 s, 5 s (selectable)
Temperature drift:	< 0.2 mm/K change in ambient temperature
Switching output	
DC PNP (active):	NC [default] or NO (short-circuit protected)
Load current:	< 200 mA
Signal voltage HIGH:	Supply voltage - 2 V
Signal voltage LOW:	0 V...1 V
Response time:	< 100 ms
Current consumption:	< 50 mA at 24 V <sub>DC</sub> (no burden)
Start-up time:	< 6 s
Cable terminals:	Clamp terminal block for cable 0.5...2 mm <sup>2</sup>
Cable entry:	2 x M20 x 1.5
Protection:	IP68

### ATEX Certification

CE 0158 SEV 13 ATEX 0108 X

Ex II 1/2G Ex ia/d IIC T6 Ga/Gb

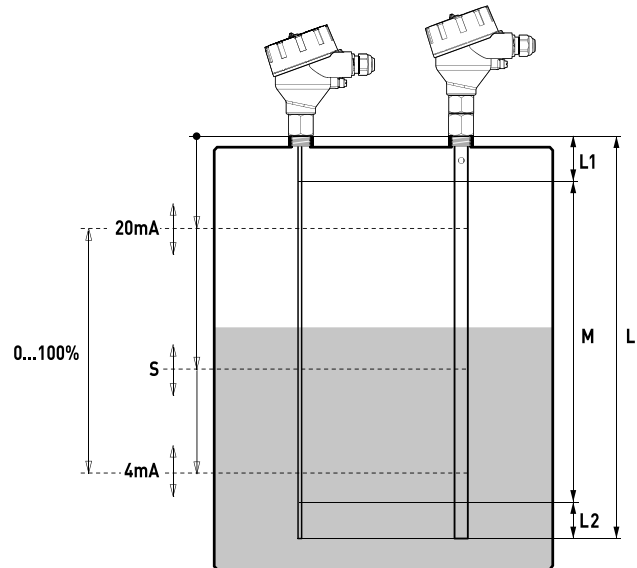
Ex II 1/2D Ex ia/tb IIIC T86°C IP68 Da/Db

Ex II 2G Ex ia d IIC T6 Gb

Ex II 2D Ex ia tb IIIC T86°C IP68 Db

### Measuring Range

The probe length [L] is not equal to the actual measuring range [M] of the sensor. TDR level sensors have small inactive areas at top [L1] and bottom [L2] of the probe. Those are due to the presence of unavoidable signal disturbances at both ends of the probe. In these inactive areas the measurements are nonlinear or have reduced accuracy. Therefore, it is not recommended to actually measure level within those inactive areas. Their length depends on the probe type and the reflectivity (i.e. dielectric constant) of the liquid/solid to be measured (see table below). The measuring range [M] of should be between the top and bottom inactive areas of the probe. The location of the switching point [S] of the switching output can also be freely positioned within the measuring range [M]. Fixed hysteresis or separate upper and lower thresholds can be defined for the switching output.



$\epsilon_r = 80$			
[mm]	Rod probe	Wire rope	Coax
L1 (top)	50	50	30
L2 (bottom)	10	10	10
$\epsilon_r = 2$			
L1 (top)	80	80	50
L2 (bottom)	50	50	50

Factory adjustment: L1 = 50 mm, L2 = 10 mm; S = 0.2 L from top, hysteresis = 3 mm, NC

### Mounting Considerations

Mounting type/ Probe type	Rod probe	Wire rope	Coaxial
Nozzle diameter	> 50 mm	> 50 mm	$\phi > 17.2$ mm
Nozzle height	< 300 mm	< 300 mm	no restrictions
Clearance to tank or other internal objects	> 100 mm	> 100 m	no restrictions
Clearance between probe end and tank bottom	> 2 mm	> 2 mm	no restrictions
Diameter of bypass chamber/ stilling well (only for liquids)	> 25 mm	> 25 mm	$\phi > 17.2$ mm*

\*There should be enough room around the probe for the liquid to flow in and out of the bypass chamber/stilling well

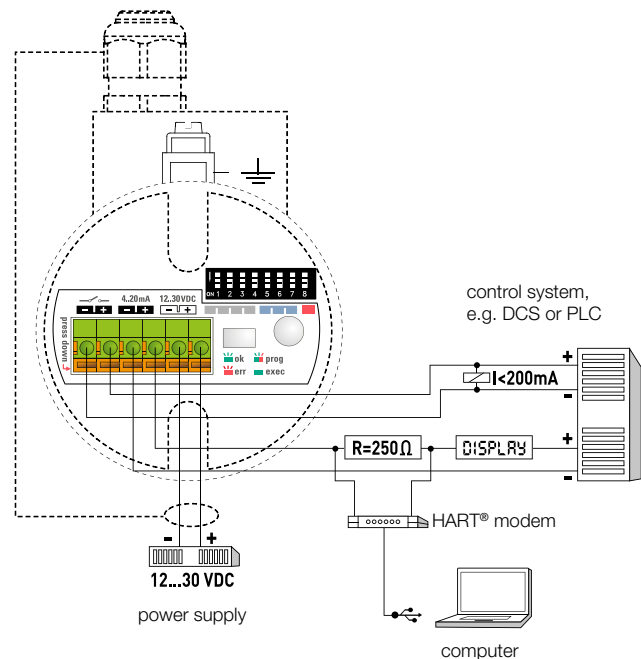


## Electrical Connection

NGM is a 4-wire system i.e. a set of 2 wires for the power supply and separate sets of 2 wires for each output. The electronic is galvanically completely insulated from its inputs/ outputs and the tank potential, thus avoiding any problems from electrochemical corrosion protection of the tank.

Basic configuration of the devices can be done directly on the device via a DIP switch, a single push button and visual feedback from an LED. For greater convenience, a simple EXCEL spread sheet is provided through which remote configuration and extensive diagnostics can be done. A standard HART® modem e.g. NGM-HART is required for communication between computer and sensor.

## Order Details HART® modem: NGM-HART



## Order Details (Example: NGM-1200 G5 A40)

Model	Material (Probe/O-ring)	Connection	Output	Option
NGM-1	Rod probe 200 = stainless steel, PEEK/without O-ring 900 <sup>5)</sup> = stainless steel, PEEK/FKM PTFE coating	G5 = G 3/4 male N5 = 3/4" NPT male F8 = DN 40/ PN 40 B1, 1.4404/316L flange EN1092-1 F9 = DN 50/ PN 40 B1, 1.4404/316L flange EN1092-1 FB = DN 80/ PN 40 B1, 1.4404/316L flange EN1092-1		00 = without B3 <sup>1)</sup> = mounted in bypass with DIN-flange DN10/PN40 B4 <sup>1)</sup> = mounted in bypass with DIN-flange DN15/PN40 B5 <sup>1)</sup> = mounted in bypass with DIN-flange DN20/PN40 B6 <sup>1)</sup> = mounted in bypass with DIN-flange DN25/PN40 BB <sup>1)</sup> = mounted in bypass with ANSI-flange 1/2" 300 lbs BC <sup>1)</sup> = mounted in bypass with ANSI-flange 3/4" 300 lbs BD <sup>1)</sup> = mounted in bypass with ANSI-flange 1" 300 lbs S1 <sup>2)</sup> = mount. in stilling well DIN-flange DN40/PN40 S2 <sup>2)</sup> = mount. in stilling well DIN-flange DN50/PN40 S3 <sup>2)</sup> = mount. in stilling well DIN-flange DN80/PN40 S4 <sup>2)</sup> = mount. in stilling well DIN-flange DN100/PN16 SA <sup>2)</sup> = mount. in stilling well 1 1/2" ASME B16.5 CL150 SB <sup>2)</sup> = mount. in stilling well 2" ASME B16.5 CL150 SC <sup>2)</sup> = mount. in stilling well 2 1/2" ASME B16.5 CL150 SD <sup>2)</sup> = mount. in stilling well 3" ASME B16.5 CL150 SE <sup>2)</sup> = mount. in stilling well 4" ASME B16.5 CL150 K0 <sup>3)</sup> = mounted in bypass with roller/ball display YY = special
NGM-8	Rod probe, high temperature 210 = stainless steel, PEEK/NBR 220 = stainless steel, PEEK/FKM	FC = DN 100/ PN16 B1, 1.4404/316L flange EN1092-1 A8 = 1 1/2" ASME B16.5 CL150, 1.4404/316L A9 = 2" ASME B16.5 CL150, 1.4404/316L AA = 2 1/2" ASME B16.5 CL150, 1.4404/316L AB = 3" ASME B16.5 CL150, 1.4404/316L	A4 = 4 ... 20 mA, PNP E4 <sup>4)</sup> = 4 ... 20 mA, PNP, ATEX-version	
NGM-2	Coaxial probe 230 = stainless steel, PEEK/EPDM 220 = stainless steel, PEEK/FKM			
NGM-9	Coaxial probe, high temperature 210 = stainless steel, PEEK/NBR 220 = stainless steel, PEEK/FKM			
NGM-4	Wire rope Ø 4 mm (liquids and light solids only) 200 = stainless steel, PEEK/without O-ring	AC = 4" ASME B16.5 CL150, 1.4404/316L XX = special (please specify in clear text)		

<sup>1)</sup> Bypass specification, see NBK-M3 data sheet. Please specify measuring length ML while ordering

<sup>2)</sup> Please specify probe length L and stilling well length (when different from standard, see drawing dimensions) in clear text while ordering

<sup>3)</sup> Bypass specification, see NBK data sheet. Max. possible measuring length ML=5500 mm. Not possible with NGM-2/-9/-4. Max. medium viscosity 500 cP

<sup>4)</sup> Not possible with NGM-19 ..., NGM-8... and NGM-9

<sup>5)</sup> Not possible for flange sizes <DN50/PN40 and <2 1/2" ASME CL150

**Note:** Please specify probe length L in clear text while ordering.

For options Bx and K0 measuring length/C-C length ML should be specified.

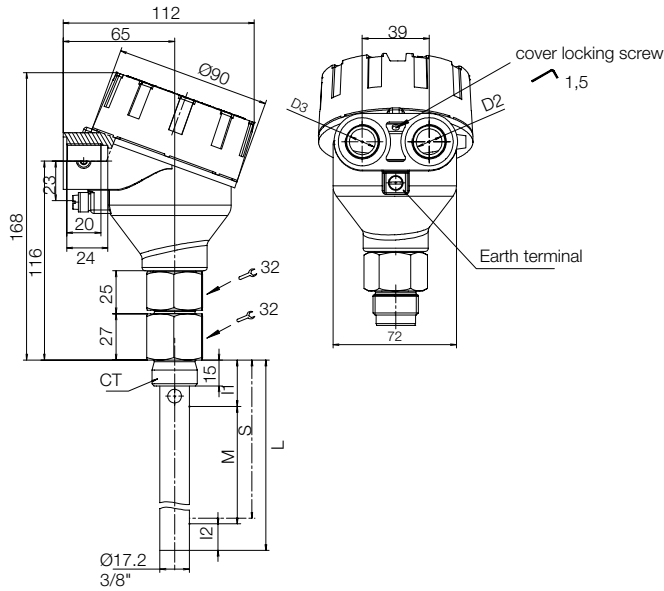




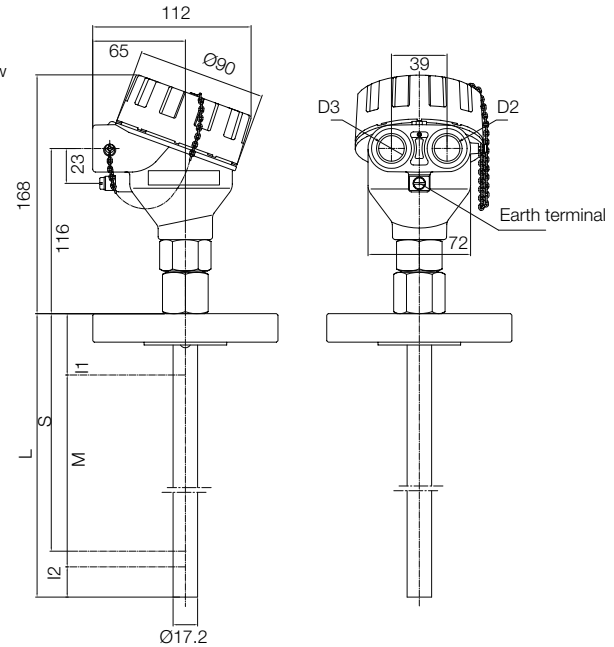
### NGM-22... with thread connection

Coaxial probe

Standard application temperature



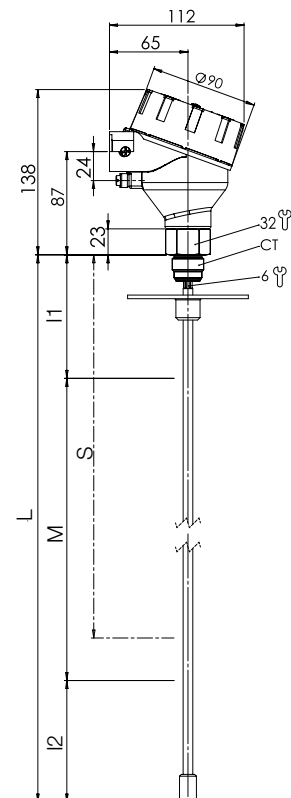
### NGM-22... with flange connection



### NGM-19... with flange connection

Single rod probe, PTFE coated

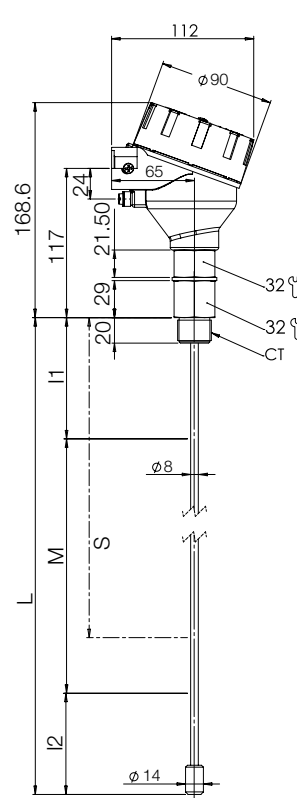
Flange disk



### NGM-19... with thread connection

Single rod probe, PTFE coated

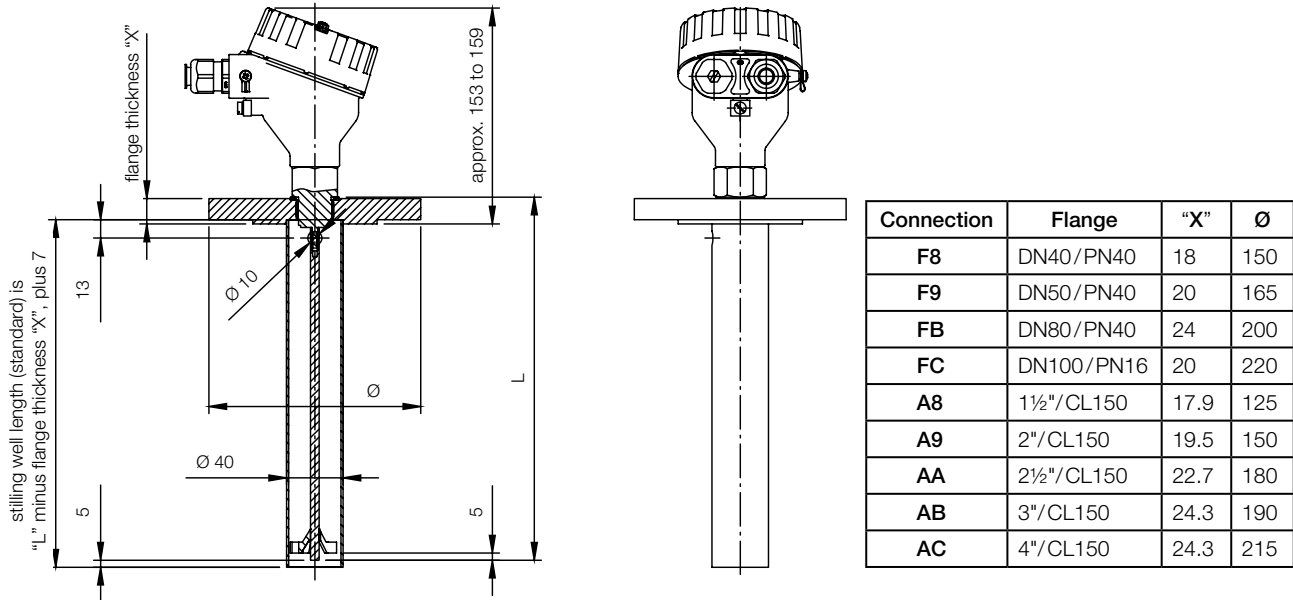
Connection thread







NGM with "Top Mounting in Stilling Well" option S



NGM assembled in a bypass tube with roller/ball display (redundant measurement) option K

