Certificato No. LRC 180457
ISO 9001

7E.300-E
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Torque Tube TB300
Digital Transmitters

Description

Series TB300 torque tube liquid level instruments utilize the buoyancy exerted on a displacer when immersed in a liquid. The buoyancy on the displacer is proportional to the liquid level and operates on an elastic torque tube which, transforming the applied force in a rotary movement, operates the magnet and consequently the electronic transmitter.
This system is exceptionally accurate and friction free as the torque tube acts also as sealing device towards the pressure of the process fluid whose level is being measured.
The instruments are provided with a system for the specific gravity calibration of the measured liquid. They can be also designed for the interface measurement of different liquids or for density measurements.
They are available in different styles for external or internal mounting on tank and offer different possibilities both for the process connection position and for the construction materials.

Application

The instrument is intended to be used as an accessory equipment in pressure with a service function for level control. Therefore, it is not intended as a safety device. The transmitter is suitable with both group 1 and 2 fluids.

Mounting Style

- **Instruments for external mounting** are provided with a displacer cage which is fastened outside the tank by means of connections as indicated below; hence the instruments may be removed from the tank without interrupting the process if two shut-off valves are installed.
- **Instruments for internal mounting** are fastened on top or at side of the tank by means of an appropriate mounting flange.

Mounting style is identified by the following suffixes:

- **TF -** displacer with external cage and top and bottom connections
- **LL -** displacer with external cage and side and side connections
- **TL -** displacer with external cage and top and side connections
- **LF -** displacer with external cage and side and bottom connections
- **MT -** internal displacer for top mounting
- **ML -** internal displacer for side mounting

Fig. 1 - Liquid level instrument for external mounting

Rating, connections and materials

Instrument bodies normally in contact with measured fluid or under pressure are, in the standard execution, designed and rated according to UNI PN 40 or ANSI 300 rules.
Special execution are available on request for higher pressures according to ANSI 600 standards.
The temperature limits for the process fluid are: minimum -190°C and maximum 400°C; for temperatures exceeding 150°C the use of an extension between the instrument case and the torque tube device is required. The employed materials will be in accordance with the design limits.
The displacer cage for the **external mounting** instruments is normally provided with flanged tank connections DN40 (1½" size) rated according to UNI 2223-2229 PN40 or ANSI 300 RF. Two inches size connections and / or tongues and grooves connecting flanges are available on request.
Instruments for **internal mounting** at top or at side of the tank, have a head with a DN100 (4") connecting flange sized according to UNI 2223-2229 PN40 or ANSI 300 RF. Tongues and grooves connecting flanges are available on request.

The normally employed **materials** for **cages** and **heads** are:

- **Carbon steel** for temperatures ranging from -20°C to 300°C.
- **AISI 316L** stainless steel for lower or higher temperatures and in any case for corrosive fluids.
- **Special alloyed steel** where required.

Fig. 2 - Liquid level instrument for top mounting on tank

Fig. 3 - Liquid level instrument for internal mounting

Local regulations may restrict the use of this product to below the conditions quoted.
In the interest of development and improvement of the product, we reserve the right to change the specification.

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Torque tube

The torque tube assembly is normally fabricated in AISI 316L stainless steel and its design is such that it ensures perfect torsional elasticity with no hysteresis thereby achieving instantaneous and accurate response to the torque produced by the buoyancy exerted on the float.
The stainless steel keeps its own characteristics of elasticity also at the lowest temperatures. Inconel torque tube are used for temperatures of the measured fluid exceeding 250°C or for peculiar problems of corrosion.
PTFE linings is possible for corrosive service on request.

Torque measurement

The TB300 transmitter has the peculiar feature to measure the rotary movement of the torque tube by means of an innovating system without contact: the magnetic Hall effect sensor. This sensor, by eliminating the use of all mechanical components connecting the measuring unit and the electronic transmitter, consequently eliminates all negative effects originated by vibrations, temperature, mechanical deterioration and deposits.

Fig. 4 - Hall sensor assembly

Density measurement

As for the measurement of the interface level, the displacer is completely immersed and its buoyancy exerted on the float varies with the specific gravity of the liquid and independently from the level.
The dimensions of the displacer depend on the measuring range of the density.

Displacer

Displacers used in TB300 series transmitters are of cylindrical shape and normally of AISI 316L stainless steel; displacers made in special materials are used for applications with particular problems of corrosion.
PTFE lining is available.
Displacer length determines the measuring range (maximum level excursion which may be measured). Its diameter depends on the measuring range and on the specific gravity of the liquid.
The upper part of the displacer rod is provided with a friction free ball joint for quick connection to the torque arm. In the instruments for internal mounting the length of the rod is designed according to the process requirement.

Standard displacer lengths are as follows:	
14" (356 mm)	72" (1829 mm)*
20" (508 mm)	84" (2134 mm)
24" (610 mm)	96" (2439 mm)
32" (813 mm)	108" (2743 mm)
48" (1219 mm)	120" (3048 mm)
60" (1524 mm)	

* maximum length for side mounting, left and right mounting.

Case arrangement

Series TB300 level transmitters are normally supplied with instrument case left hand mounted to the displacer vertical axis (standard execution) or right hand mounted on request.
Thanks to the special design of these instruments, case position may be reversed without being necessary to replace parts.

Specific gravity compensation adjustment

As the buoyancy exerted on the displacer varies with the liquid specific gravity, in order to ensure that the liquid level travel from bottom to top of the displacer exactly corresponds to the pointer movement through the full scale of the instrument, a compensation has to be carried through the calibration of the electronic circuit by means of the magnetic tool or of the communication protocol.

Interface measurement

Interface is defined as the boundary surface between two immiscible liquids with different specific gravities; for instance as found in a tank containing water and petrol. The interface occurs in an intermediate zone of the displacer which must function completely submerged.
The buoyancy which determines the measurement, depends not only upon the interface level, but also on the difference in specific gravities of the liquids. Consequently special displacer and special torque tube, if necessary, will have to be provided.

Fig. 5 - Displacer and torque tube unit

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Technical Specifications

Hazardous Area certifications
ATEX for explosion proof Eex d IIC T6 - II 2G
ATEX for intrinsic safety Eex ia IIC T6 - II 2G

Case
Die-cast aluminium coated with epoxy paint
Enclosure rating IP 67 / Nema 4X

Electrical connections
½" NPT

Temperature
Ambient:	-40 - 85°C (-40 - 185°F)
Storage:	-40 - 90°C (-40 - 194°F)
Digital display:	-40 - 85°C without damage

Display
4½ numerical and 5 alphanumeric digits LCD indicator

Humidity
0 - 100% relative humidity

Damping
Adjustable

Position sensing
Magnetic sensor with Hall effect

Resolution
≤ 0.1% full scale

Repeatability
≤ 0.1% full scale

Hysteresis
≤ 0.1% full scale

Vibrations influence
± 0.3% / g of the range

Electromagnetic interface effect
Designed to comply with IEC 801 / 61326 and European Standards EN50081 and EN500082

Models and Protocols

TB301 4-20 mA + HART®

TB301 is suitable with two-wire systems using 4-20 mA signal. The superimposed digital communication is HART®.
The configuration of all parameters and the external calibration can be done by using portable units such as a Palm PDA or a PC equipped with HART® interface. A basic configuration can be done through a local adjustment by means of the magnetic tool.

TB302 Foundation™ Fieldbus

Communication protocol: Foundation™ Fieldbus
Digital communication: transmission at 31.25 Kbits/sec according to the protocol requirements
Power supply: 9 to 32 Vdc supplied by the bus. Stand-by current absorption: 12 mA
Function blocks: up to 20 preset and dynamically applicable

TB303 Profibus PA

Communication protocol: Profibus PA
Digital communication: transmission at 31.25 Kbits/sec according to the protocol requirements
Power supply: 9 to 32 Vdc supplied by the bus. Stand-by current absorption: 12 mA
Function blocks: Physical, Transducer, Display and Output

Ordering code

TB 30	Torque tube transmitter

Code	Output signal / Communication
1	4 - 20 mA + Hart
2	Foundation Fieldbus
3	Profibus PA

Code	Type of measurement
L	Level
I	Interface
D	Density

Code	Head
F	Fixed position
O	Adjustable position

Code	Mounting
TF	Displacer with external cage and top and bottom connections
LL	Displacer with external cage and side and side connections
TL	Displacer with external cage and top and side connections
LF	Displacer with external cage and side and bottom connections
MT	Internal displacer for top mounting
ML	Internal displacer for side mounting

Code	Displacer lenght / Density
14	356 mm
20	508 mm
24	610 mm
32	813 mm
48	1219 mm
60	1524 mm
72	1829 mm (max for ML mounting)
84	2134 mm
96	2439 mm
108	2743 mm
120	3048 mm
11	Density
13	Density
17	Density
99	Special / Interface

Code	Flanges / Connections
A	DN 40 PN 40
B	1½ ANSI 300
C	1½ ANSI 600
Z	On request

Code	Material → Body
AC	Carbon Steel (STD)
SL	AISI 316 L (STD)
SP	Special

Code	Material → Displacer
2	AISI 316 L
3	Other special

Code	Material → Torque Tube
A	AISI 316 (L)
I	INCONEL
S	Special

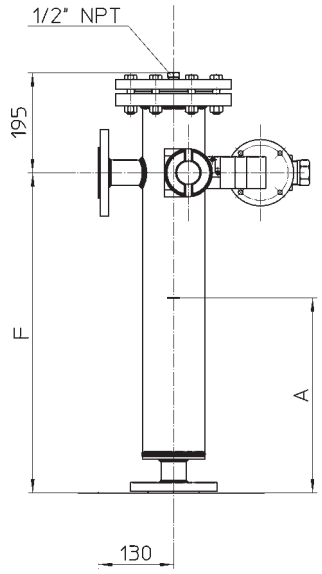
Code	Material → Electronic Case
00	Paint coated Aluminium (STD)
H1	AISI 316

Code	Options (Case / Materials)
I2	Explosion proof ATEX certification
I4	Intrinsically safe ATEX certification
I3	Canadian Standards Certification (C.S.A.)
I1	Factory Mutual Certification (FM)
J1	Tag plate AISI 316
HT	Cooling extension for fluid temperature > 180°C
HP	Special application for high pressure > ANSI 300 PN 40
DS	Special drain (on request)
SS	Special vent (on request)

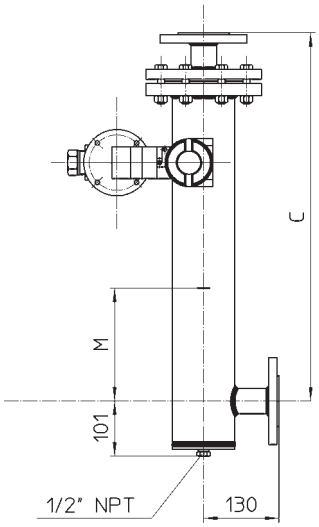
Mounting and Dimensions (mm) for Fixed position version (F)

Ranges Inches	mm	A	B	C	D	F	M	Ø Displacer
14"	356	279	733	620	356	469	178	76
20"	508	355	885	772	508	621	254	70
24"	610	406	987	874	610	723	305	60
32"	813	507.5	1190	1077	813	926	406.5	50
48"	1219	710.5	1596	1483	1219	1332	609.5	40
60"	1524	863	1901	1788	1524	1637	762	38
72"	1829	1015.5	2206	2093	1829*	1942	914.5	34
84"	2134	1168	2511	2398	2134	2247	1067	28
96"	2439	1320	2816	2703	2439	2552	1219	28
108"	2743	1472.5	3120	3007	2743	2856	1371.5	28
120"	3048	1625	3425	3312	3048	3161	1524	28

* maximum length for side mounting, left and right mounting.



LF



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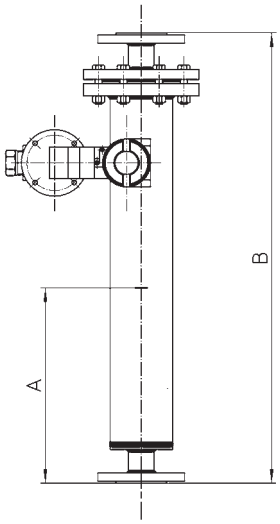

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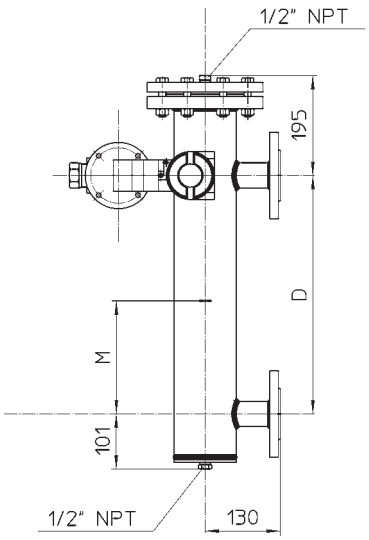

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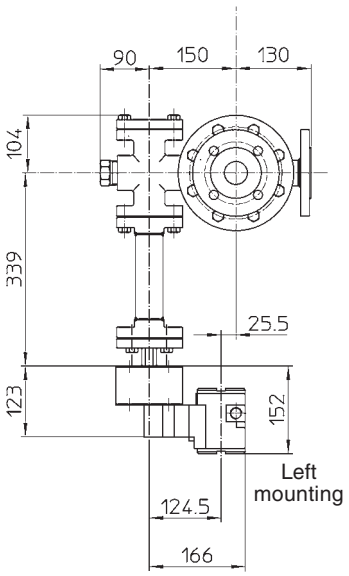
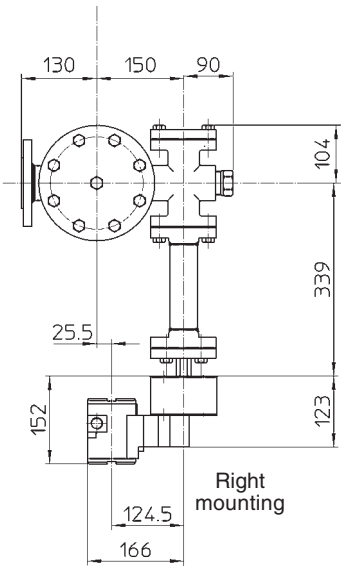
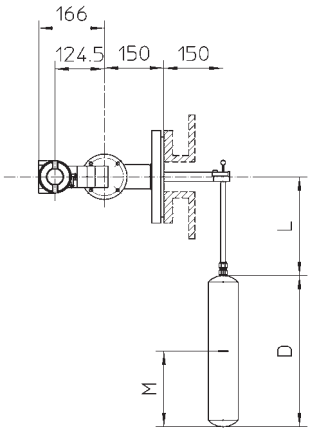




Mounting and Dimensions (mm) for Adjustable position version (O)

Ranges Inches	mm	A	B	C	D	F	M	Ø Displacer
14"	356	258	626	556	356	426	178	76
20"	508	335	778	708	508	578	254	70
24"	610	385	880	810	610	680	305	60
32"	813	486.5	1083	1013	813	883	406.5	50
48"	1219	689.5	1489	1419	1219	1289	609.5	40
60"	1524	842	1794	1724	1524	1594	762	38
72"	1829	994.5	2099	2029	1829*	1899	914.5	34
84"	2134	1147	2404	2334	2134	2204	1067	34
96"	2439	1299	2708	2638	2439	2508	1219	28
108"	2743	1451.5	3013	2943	2743	2813	1371.5	28
120"	3048	1604	3318	3248	3048	3118	1524	28

* maximum length for side mounting, left and right mounting.



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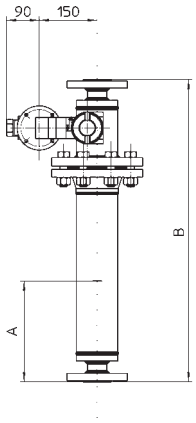

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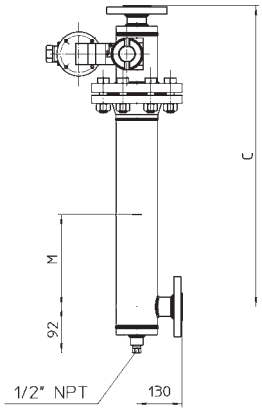

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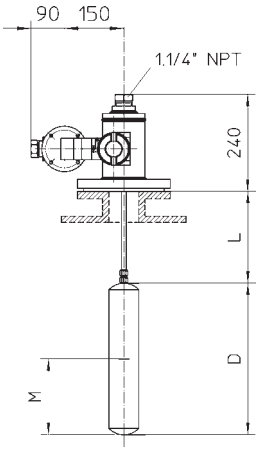
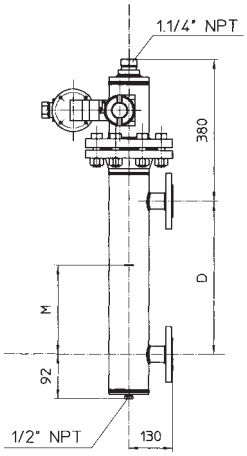


MT



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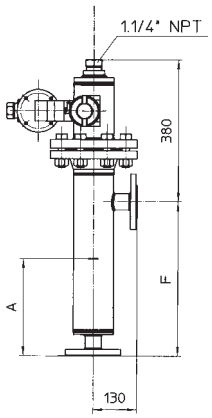

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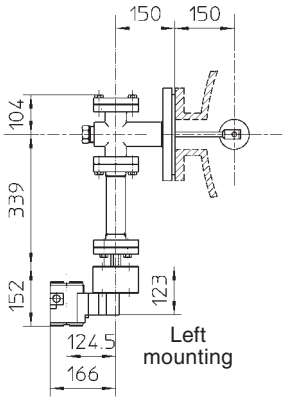

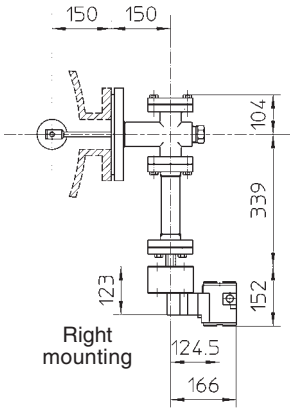

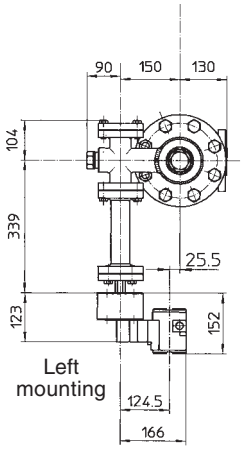

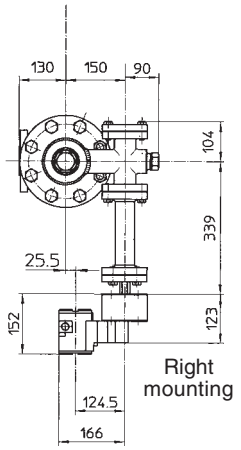

Specification Form

Type of fluid to be measured

Operation Pressure

Min.: **Max.:**

Operation Temperature

Min.: **Max.:**

Mounting Style

Right ☐ **Left** ☐

Area Classification

Explosion Proof ☐ **Intrinsically Safe** ☐ **Not classified** ☐ **Other:**

Communication Protocol and Control System

4÷20 mA + HART ☐	Foundation Fieldbus ☐	Profibus PA ☐
System:	System:	System:

Special Application Sketch and Notes

Sketch	Other Notes