

Torque Tube Liquid Pneumatic Transmitters and Controllers Series 8000

Series 8000 pneumatic 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 a torque tube which, in turn, moves the pointer along the instruments scale.

This system is exceptionally accurate and friction-free as the torque tubes 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 compensation of the measured liquid. They can be also designed for the **interface or specific gravity service**.

They are available in different styles for external or internal mounting on tank and offer different possibilities both for the process connections position and for the construction materials.

The instrument case, provided with a segmental graduated scale, is dust and spray proof and fitted with two pressure gauges for the compressed air supply and output signal respectively. Case internal pressurization is possible on request.

Compressed air for the instrument supply must be filtered, oil-free and sufficiently dry; a pressure of 1.4 bar (20 psig) is required.

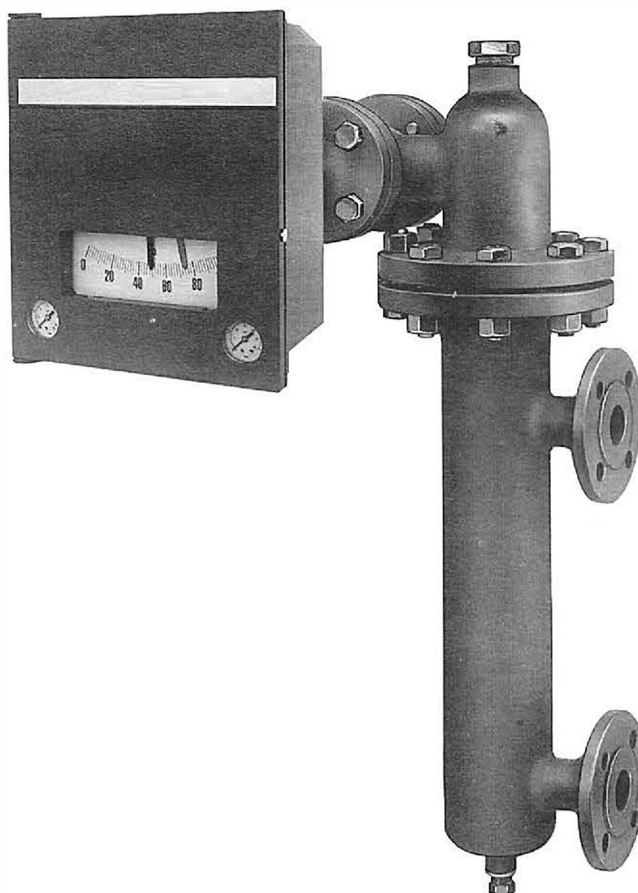


Fig. 1 - Liquid level instrument for external mounting.

DESIGN FEATURES

Mounting Style

Series 8000 pneumatic torque tube liquid level controllers and transmitters are available in different styles for external and internal mounting on tank.

Instruments for external mounting are provided with a displacer cage which is fastened outside the tank by means of two connections located at different points; hence the instruments may be removed from the tank without interrupting the process if two shut-off valves are installed.

Instrument for internal mounting are fastened at top or at side of the tank by means of a 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

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 PN40 or ANSI 300 rules.

Special executions are available for higher pressures according to ANSI 600-900 and 1500 lbs standards.

The temperature limits for the process fluid are: minimum -190°C and maximum 400°C; for temperature over 110°C and below -20°C the use of an extension between the instrument case and torque tube device is required; the employed materials will be in accordance with the design limits.

The maximum operating pressures for series 900 and 1500 lbs are determined by the specific gravity of the measured fluid.

The cage for **external mounting** instruments is normally provided with flanged connections DN40 (1.1/2") 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 connection flanges are available. The normally employed **materials** for **cages** and **heads** are:

Carbon steel for temperatures ranging from -20°C to 300°C and **AISI 316 stainless steel** for low or high temperatures and for corrosive fluids.

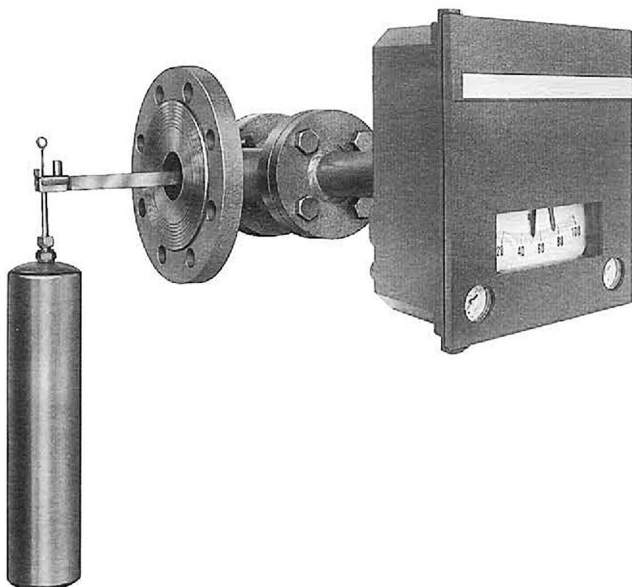


Fig. 2 - Liquid level instrument for side, internal mounting.

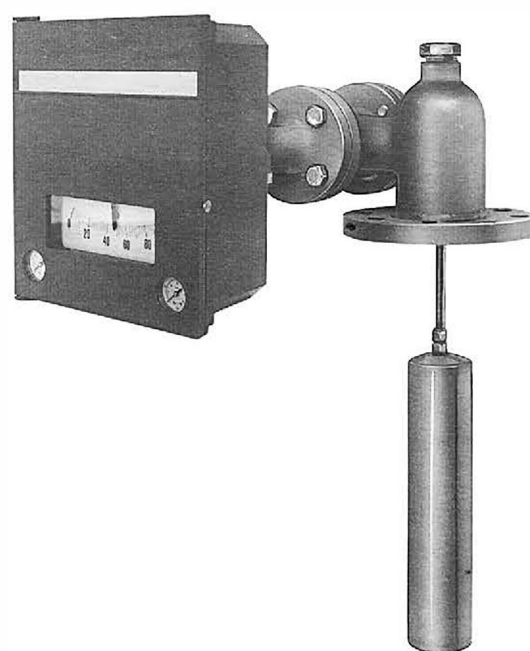


Fig. 3 - Liquid level instrument for top mounting on tank.

Torque tube

The torque tube assembly is normally fabricated in AISI 316 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.

Teflon linings is possible for corrosive service on request.

Displacer

Displacers used in series 8000 liquid level instruments are of cylindrical shape and normally of AISI 316 stainless steel; displacers made in special materials are used for applications with particular problems of corrosion.

Teflon lining is available.

Displacer length determines the measurement range (maximum level excursion which may be measured). 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)	

Displacer 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 the process requirement.



Fig. 4 - Displacer and torque tube unit.

Case arrangement

Series 8000 transmitters and controllers 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. In externally mounted instruments, the cage top may be swivelled thereby permitting turning of instrument case to the most convenient position for scale reading, independently of possibility to have the case located to the left or right of the connections to the tank.

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 the torque tube shaft end is connected to the pointer through a linkage system including an adjusting device.

This device permits adjustment of the pointer stroke in accordance with the specific gravity of the liquid. The instrument may be easily calibrated in the field.

The standard adjustment ranges for the specific gravity are:

0.5 to 1.1	0.8 to 1.3	1.2 to 1.7
------------	------------	------------

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.

SPECIFIC GRAVITY MEASUREMENT

Similarly to the interface level measurement, the displacer is fully submerged. Hence the buoyancy varies according to the specific gravity of the liquid and is independent from the level. Displacer dimensions are dependent on the desired range of the specific gravity.

TRANSMITTING INSTRUMENTS

They are designed to measure a liquid level or an interface level or a specific gravity indicating it on a segmental graduated scale; at the same time the measured variable is converted into a linear 0.2 to 1 bar or 3 to 15 psi pneumatic signal which is in turn transmitted to a receiver for remote indication, recording and/or an automatic control.

The case is identical to that of series 4000 instruments of which the same transducing elements are used.

These instruments find wide application in pneumatic transmitting systems for centralized measurement and control of processes.

A high capacity built in amplifying relay allows signal transmission, even over considerable distance, with minimum air consumption.

The transmitted signal is directly proportional to the measured value with remarkable accuracy, repeatability and sensitivity due to the feedback device of the transmitting unit.

The series 8000 pneumatic **transmitters** are available in the one single **type 8095**.

CONTROLLER INSTRUMENTS

They are designed to measure a liquid level or an interface level or a specific gravity indicating it on a segmental graduated scale; at the same time the measured variable is automatically controlled by means of a pneumatic control unit operating a control valve or any other pneumatic actuator.

The case is identical to that of series 4000 instruments of which the same amplifying and control elements are used.

Standard versions are equipped with a manually adjustable set point but also pneumatically or electrically adjustments of it are available for remote operation allowing the following facilities:

- manual remote set point adjustment by means of a manual loading station
- automatic set point adjustment from a master controller in cascade control loops
- automatic set point adjustment by a programme transmitter.

The control units are available in different versions for **proportional with manual reset (P)**, **proportional plus integral (PI)** and **proportional plus integral plus derivative (PID) control mode respectively**; for on-off service the controllers are provided with on-off control unit with non adjustable narrow differential gap.

Each control mode is easily adjustable by means of graduated dials. Also the action of the unit (direct or reverse) can be easily set in the field by means of the proportional band adjustment dial.

COMBINED TRANSMITTING AND CONTROLLING INSTRUMENTS

The transmitting plus controlling instruments represent a particular execution in the series 8000 instruments.

In the same case a transmitting unit and a controlling unit are housed and are operated by a single displacer.

As for the other instruments, the case is dust and spray proof and designed for external mounting; it is also fitted with two pressure gauges to display the transmitting signal (to the right) and the control signal (on left).

In these applications, compressed air supply pressure (20 psig) is indicated by the pressure gauge of the air filter regulator.

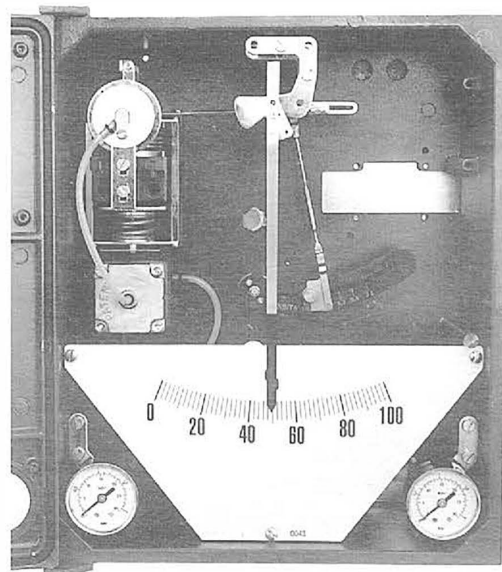
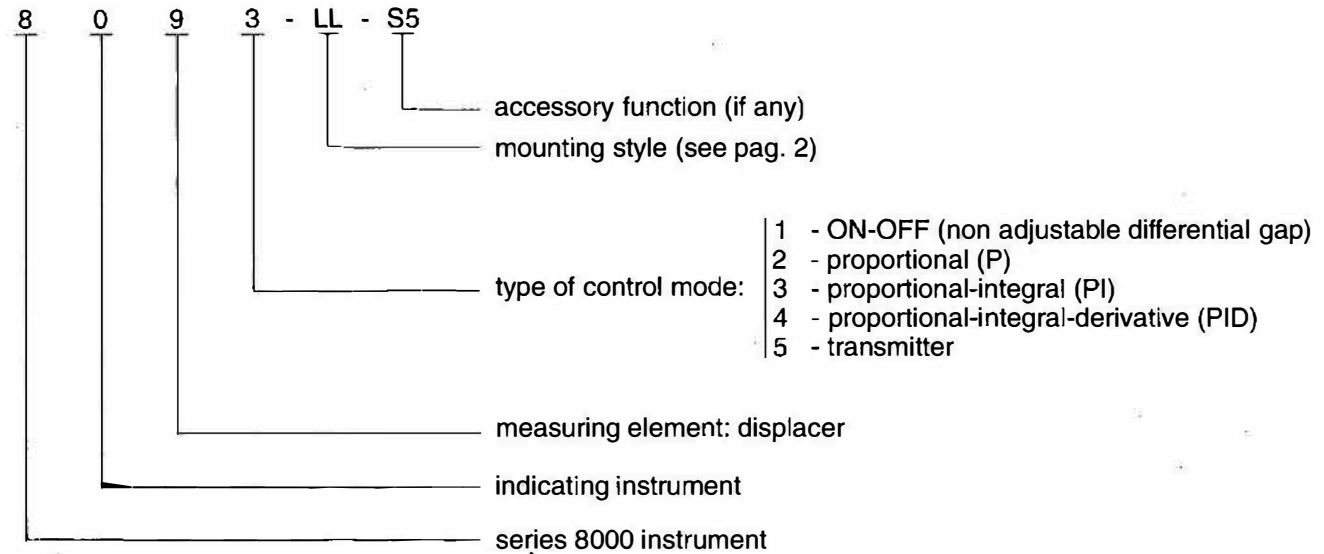


Fig. 5 - Inside view of transmitter case.

The type number, which identifies the general characteristics of the instrument, is composed by a number of four digits followed by an alphanumeric suffix. The meaning of digits and letters for an **instruments with one unit only** (controller or transmitter) is explained with an example:



The suffix, besides pointing out the mounting style, is used in order to complete or give complementary information about the instrument characteristics (i.e. S5 means that the instrument is fitted with a pneumatic adjustable set point); for the **instruments with combined functions** the suffix is also used to identify the control unit type and to point out the preference of a transmitting unit, for example:

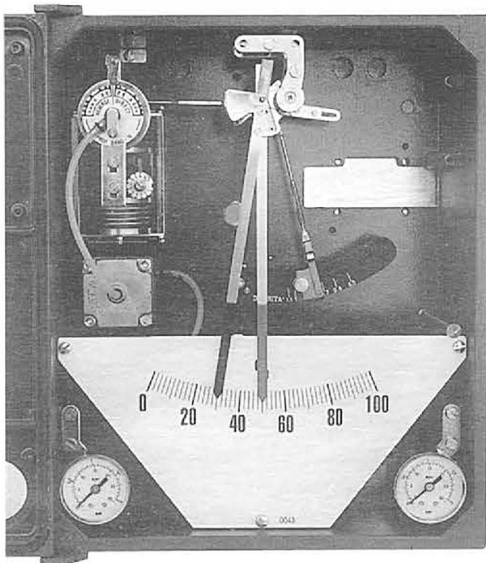
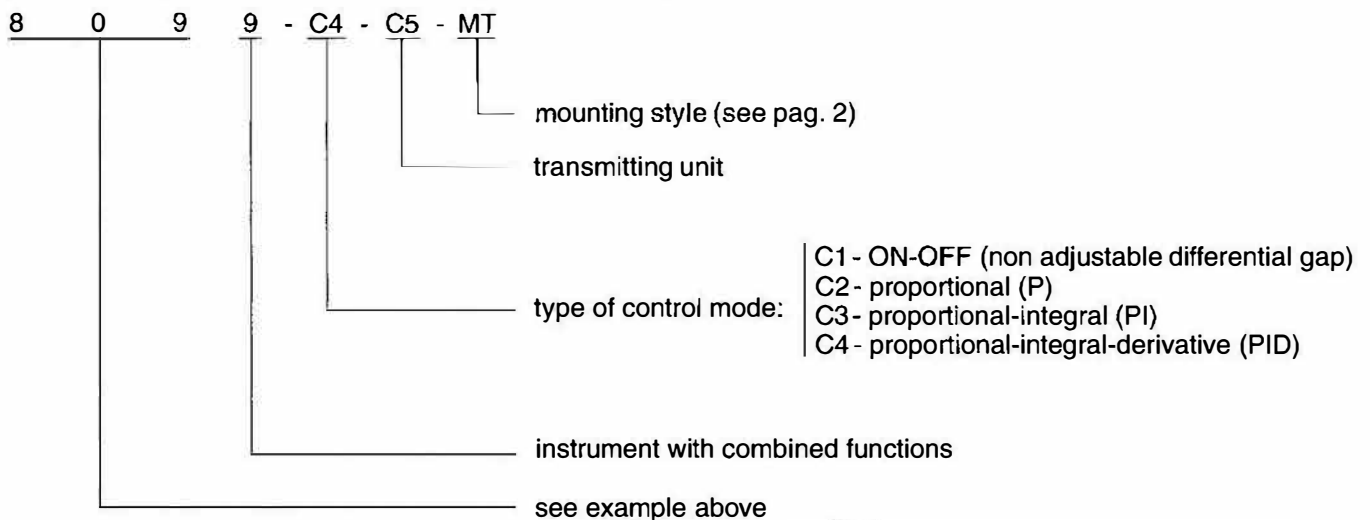


Fig. 6 - Inside view of controller case.

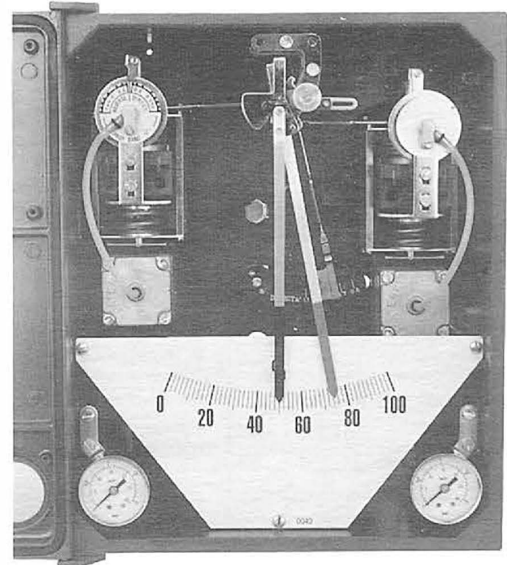
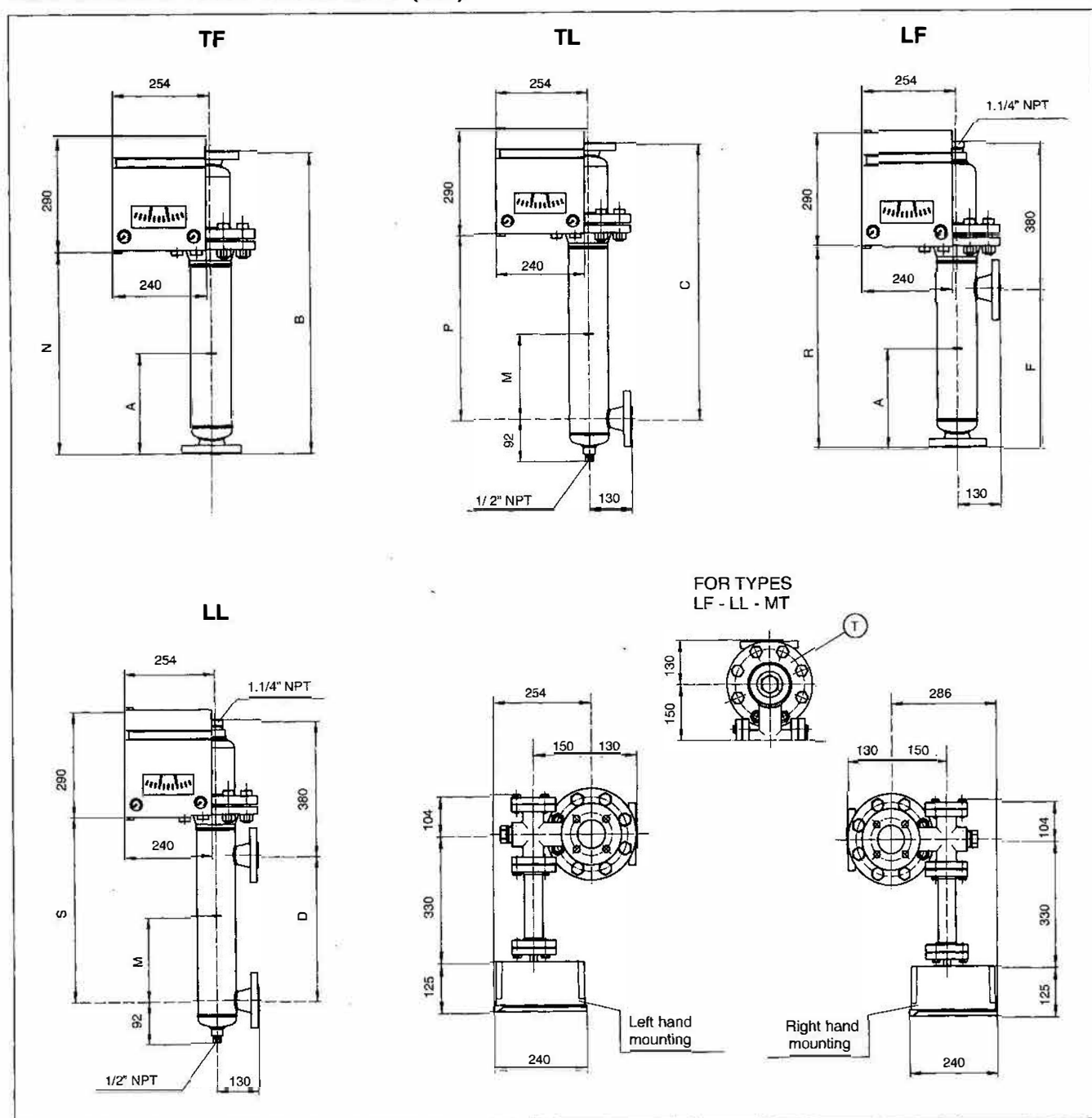


Fig. 7 - Inside view of transmitter-controller case.

GENERAL SPECIFICATIONS

Type of instruments	<ul style="list-style-type: none"> ● indicating pneumatic transmitter with direct measurement of the variable ● indicating pneumatic controller with direct measurement of the variable ● indicating transmitter and controller with direct measurement of the variable 			
Standard ranges of measurement in millimetres (or inches)	0 – 356 mm (14") 0 – 1219 mm (48") 0 – 2439 mm (96")	0 – 508 mm (20") 0 – 1524 mm (60") 0 – 2743 mm (108")	0 – 610 mm (24") 0 – 1829 mm (72") 0 – 3048 mm (120")	0 – 813 mm (32") 0 – 2134 mm (84")
Specific gravity adjustment ranges	0.5 to 1.1	0.8 to 1.3	1.2 to 1.7	
Scale	segmental 120 mm long			
Accuracy	1% of range span			
Sensitivity	0.2% of range span			
Repeatability	0.5% of range span			
Linearity	0.5% of range span			
Mode of transmission	direct with proportional action: output signal increases on increasing measured variable			
Action	<ul style="list-style-type: none"> ● direct action: control signal increases on increasing variable ● reverse action: control signal decreases on increasing variable action can be easily selected on the field			
Control modes	<ul style="list-style-type: none"> ● on-off with not adjustable differential gap ● proportional (P) with manual reset ● proportional-integral (PI) ● proportional-integral-derivative (PID) 			
Differential	1% of range span (for on-off not adjustable controllers)			
Proportional band	adjustable from 5% up to 200% of the scale span			
Integral action	adjustable from 0.1 to 20 repeats per minute			
Derivative action	adjustable from 0.02 to 20 minutes			
Output signal	0.2 to 1 bar or 3 to 15 psi for modulating control mode or transmission 0-1.4 bar or 0-20 psi for on-off control model			
Set point	<ul style="list-style-type: none"> ● manually adjustable on instruments by knob and index (standard) ● pneumatically adjustable from remote panel through a 0.2 to 1 bar or 3 to 15 psi signal (on request) ● electrically adjustable through a 0 to 10V or 4 to 20 mA or other signal (on request) 			
Air supply	compressed air at 20 psig \pm 1.5 psi (1.4 bar \pm 0.1 bar)			
Air consumption	0.2 Nm ³ /h (average for instruments with single unit)			
Air connections	1/4" NPT female			
Ambient temperature limits	maximum +65°C minimum –15°C			
Case	die cast aluminium, RAL 5010 epoxy coated spray and dust proof style with standard protection degree IP 54 or IP55 on request; connection for internal pressurization (optional)			
Mounting style	<ul style="list-style-type: none"> ● with displacer cage for external mounting ● without cage for internal mounting location of connections as specified at page 2			
Materials of cage and/or head	<ul style="list-style-type: none"> ● carbon steel ● AISI 316 stainless steel ● other special materials 			
Materials of displacer and torque tube	<ul style="list-style-type: none"> ● AISI 316 stainless steel ● Inconel or other special materials 			
Connecting flanges to process	According to UNI 2223-2229 PN 40 or ANSI 300 RF standards; tongues and grooves upon request; special executions ANSI 600, 900 and 1500 lbs			
Maximum pressure for process fluid	standard executions according to UNI PN40 or ANSI 300 lbs rating, higher ratings for special executions on request			
Temperature limits for process fluid	minimum –190°C for stainless steel and –20°C for C. steel maximum 400°C for special executions and for stainless steel and 300°C for C. steel.			

MOUNTING STYLE AND DIMENSIONS (mm)*



RANGES		A	B	C	D	F	M	N	P	R	S	displacer dia.
Inches	mm											
14"	356	258	626	556	356	426	178	377	307	538	468	76
20"	508	335	778	708	508	578	254	529	459	690	620	70
24"	610	385	880	810	610	680	305	627	561	792	722	60
32"	813	486,5	1083	1013	813	883	406.5	830	764	995	925	50
48"	1219	689,5	1489	1419	1219	1289	609.5	1236	1170	1401	1331	40
60"	1524	842	1794	1724	1524	1594	762	1541	1475	1706	1636	38
72"	1829	994,5	2099	2029	1829	1899	914.5	1846	1780	2011	1941	34
84"	2134	1147	2404	2334	2134	2204	1067	2151	2085	2316	2246	34
96"	2439	1299	2708	2638	2439	2508	1219	2455	2389	2620	2550	28
108"	2743	1451,5	3013	2943	2743	2813	1371.5	2760	2694	2925	2855	28
120"	3048	1604	3318	3248	3048	3118	1524	3065	2999	3230	3160	28

* Dimensions are referred to standard PN 40 executions with carbon steel or stainless steel bodies.

MOUNTING STYLE AND DIMENSIONS (mm)*

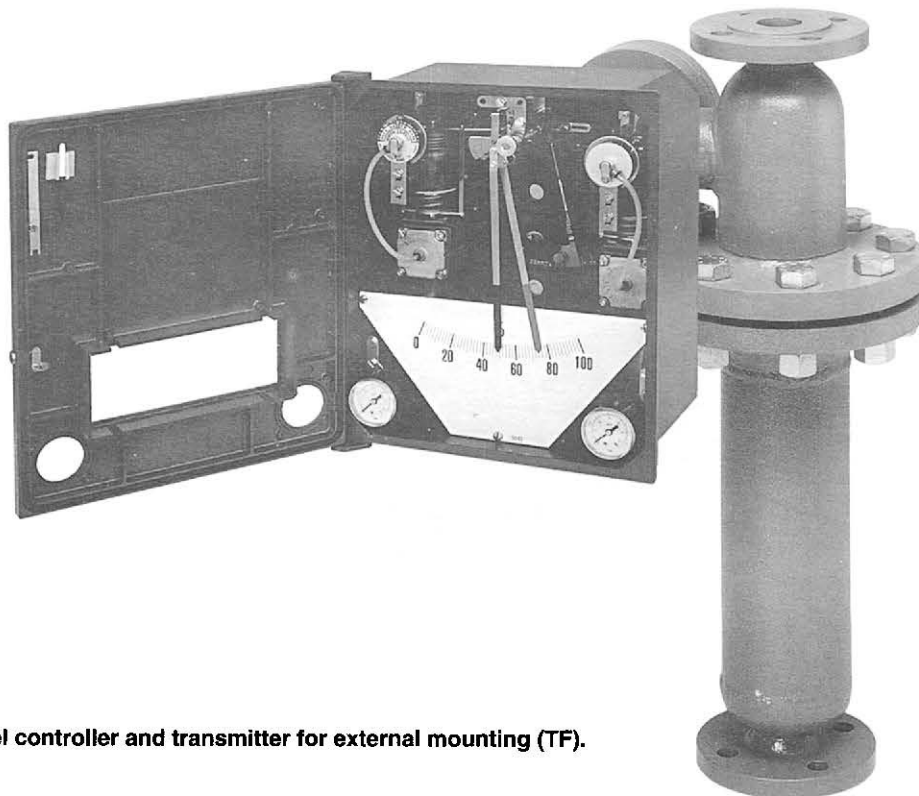
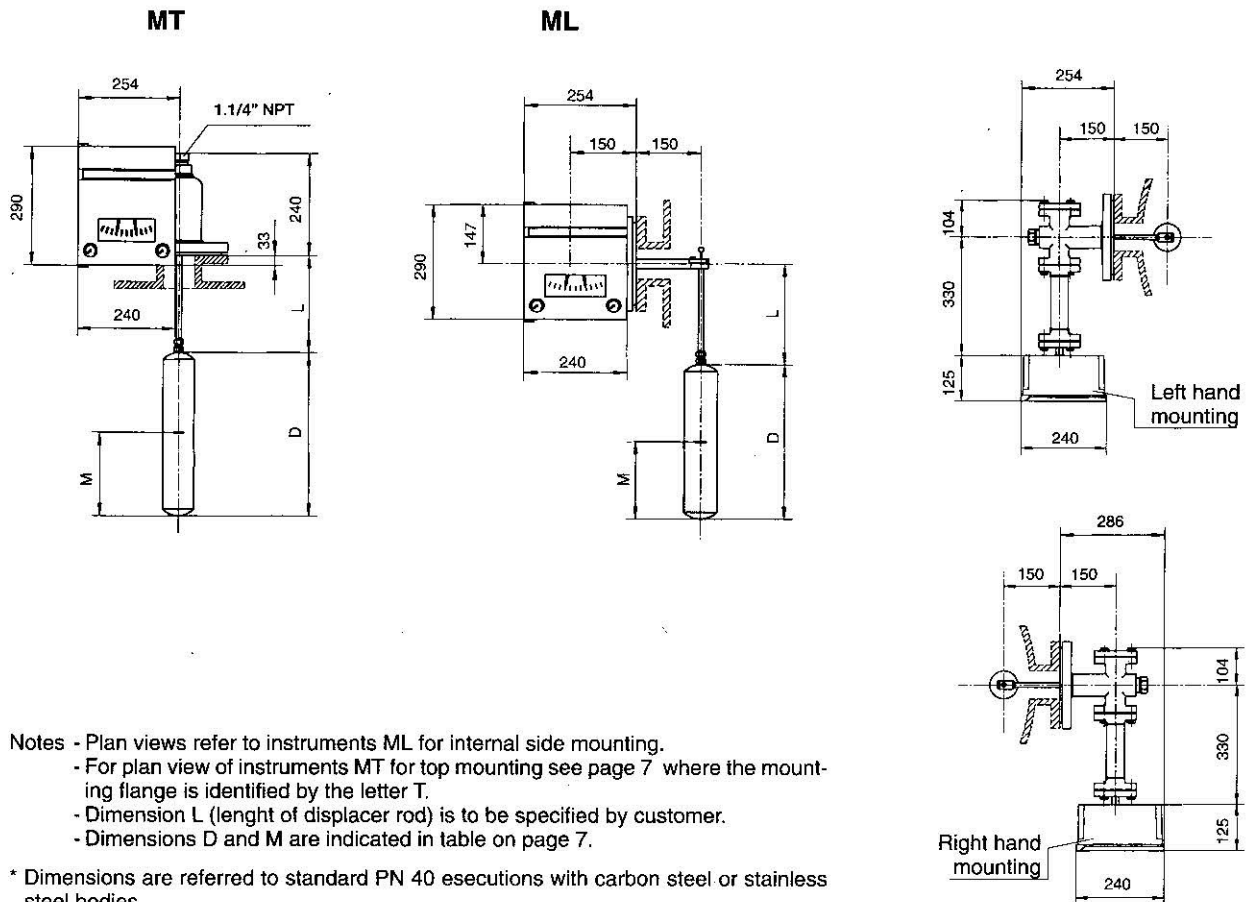


Fig. 8 - Liquid level controller and transmitter for external mounting (TF).