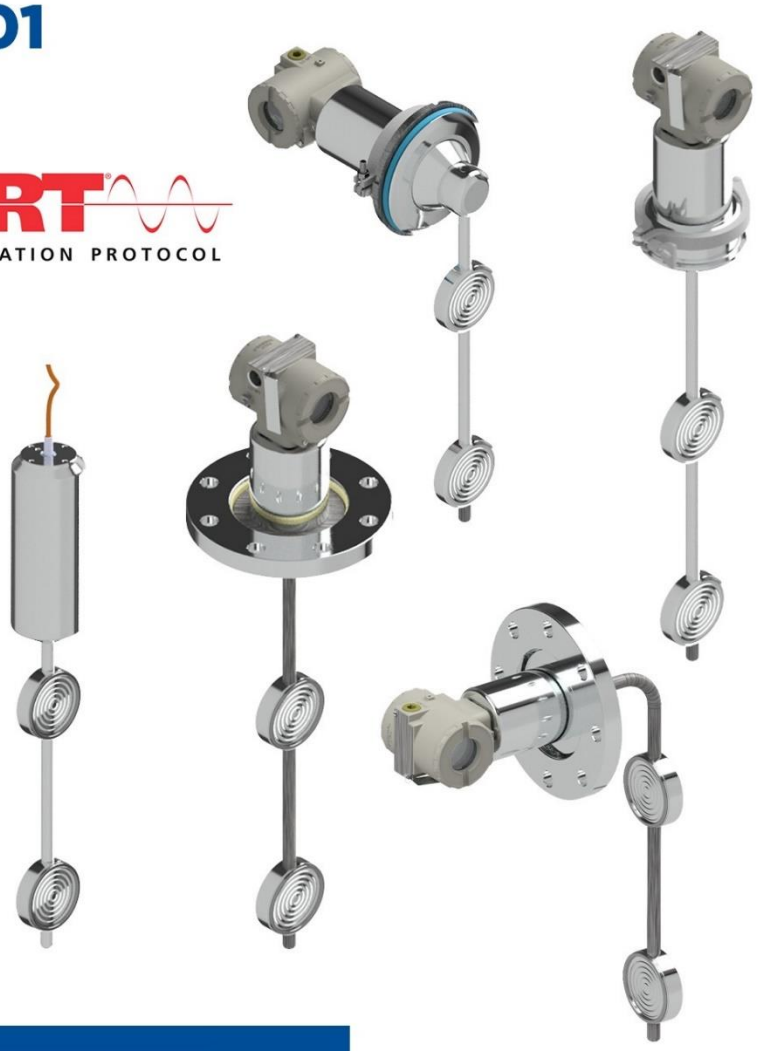
MANUAL

INSTRUCTIONS | OPERATION | MAINTENANCE

DENSITY/CONCENTRATION TRANSMITTER

DT301

HART® COMMUNICATION PROTOCOL



DEC 24 / VERSION 3

smar

Technology Company

DT301

Density/Concentration Transmitter

HART COMMUNICATION PROTOCOL

Consult our subsidiary

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INTRODUCTION

The **DT301** Intelligent Concentration/Density Transmitter is a device designed for the continuous online measurement of liquid concentration/density, directly in industrial process.

The **DT301** consists of a capacitive type differential pressure transmitter coupled to a pair of pressure repeaters immersed in the process. The repeaters are connected to the external capacitive sensor through capillary tubes. A temperature sensor located between the two pressure repeaters automatically compensates temperature variations in the process

Special techniques in the production and assembly repeaters and temperature sensor ensure that small variations in the process temperature are quickly informed to the transmitter, which calculates the fluid density process accurately through dedicated software.

Depending on the industrial process, density can be expressed in Density, Relative Density, Brix degree, Baumé degree, Plato degree, % of Solids, Concentration, etc.

Designed for process control applications, this 2-wire transmitter generates a 4-20 mA signal proportional to the concentration/density. Digital communication for remote calibration and monitoring is also provided (HART Protocol).

The digital technology used in the **DT301** allows the choice of several types of transfer functions, an easy interface between the field and the control room and some characteristics that reduce the installation, operation, and the maintenance costs considerably.

ATTENTION

Get the best results of the **DT301** by carefully reading these instructions.
This product is protected by US patent numbers: **6,234,019; D439,855** and **5,827,963.**

NOTE
This manual is compatible with version 3.XX, where 3 indicates software version and XX software release. The indication 3.XX means that this manual is compatible with any release of software version 3.

Waiver of responsibility

The contents of this manual abides by the hardware and software used on the current equipment version. Eventually there may occur divergencies between this manual and the equipment. The information from this document are periodically reviewed and the necessary or identified corrections will be included in the following editions. Suggestions for their improvement are welcome.

Warning

For more objectivity and clarity, this manual does not contain all the detailed information on the product and, in addition, it does not cover every possible mounting, operation or maintenance cases.

Before installing and utilizing the equipment, check if the model of the acquired equipment complies with the technical requirements for the application. This checking is the user's responsibility.

If the user needs more information, or on the event of specific problems not specified or treated in this manual, the information should be sought from Smar. Furthermore, the user recognizes that the contents of this manual by no means modify past or present agreements, confirmation or judicial relationship, in whole or in part.

All of Smar's obligation result from the purchasing agreement signed between the parties, which includes the complete and sole valid warranty term. Contractual clauses related to the warranty are not limited nor extended by virtue of the technical information contained in this manual.

Only qualified personnel are allowed to participate in the activities of mounting, electrical connection, startup and maintenance of the equipment. Qualified personnel are understood to be the persons familiar with the mounting, electrical connection, startup and operation of the equipment or other similar apparatus that are technically fit for their work. Smar provides specific training to instruct and qualify such professionals. However, each country must comply with the local safety procedures, legal provisions and regulations for the mounting and operation of electrical installations, as well as with the laws and regulations on classified areas, such as intrinsic safety, explosion proof, increased safety and instrumented safety systems, among others.

The user is responsible for the incorrect or inadequate handling of equipments run with pneumatic or hydraulic pressure or, still, subject to corrosive, aggressive or combustible products, since their utilization may cause severe bodily harm and/or material damages.

The field equipment referred to in this manual, when acquired for classified or hazardous areas, has its certification void when having its parts replaced or interchanged without functional and approval tests by Smar or any of Smar authorized dealers, which are the competent companies for certifying that the equipment in its entirety meets the applicable standards and regulations. The same is true when converting the equipment of a communication protocol to another. In this case, it is necessary sending the equipment to Smar or any of its authorized dealer. Moreover, the certificates are different and the user is responsible for their correct use.

Always respect the instructions provided in the Manual. Smar is not responsible for any losses and/or damages resulting from the inadequate use of its equipments. It is the user's responsibility to know and apply the safety practices in his country.

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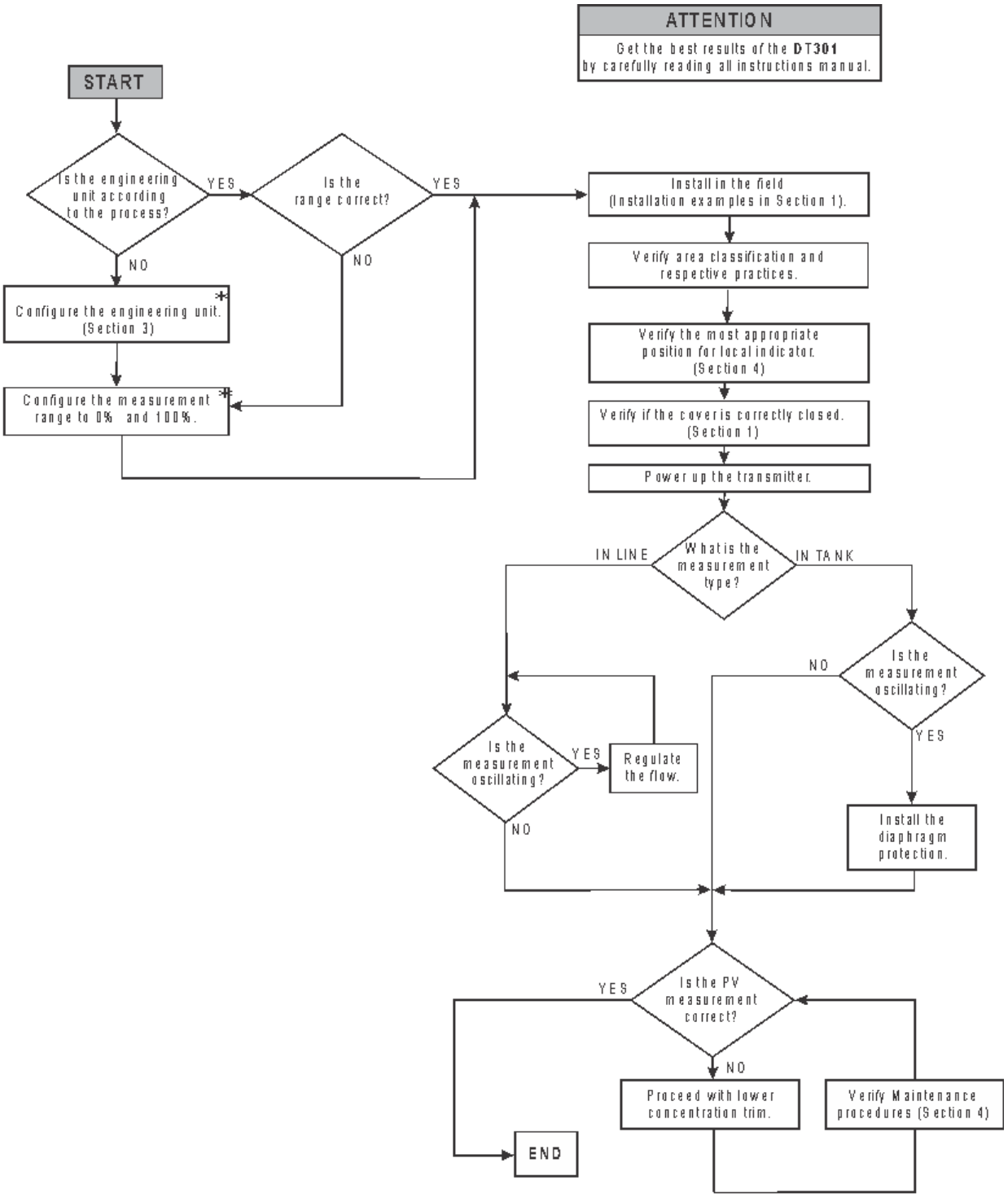
Installation Flowchart



* More information in Section 3 from DT301 Operation, Maintenance and Instructions Manual.
** Tip: The Brix of water is 0 (zero)/ or H_2O density = 998.2@20°C.

Section 1

INSTALLATION

General

The overall accuracy of density/concentration measurement depends on several variables. Although the transmitter has an outstanding performance, proper installation is essential to maximize its performance.

Among all factors, which may affect transmitter accuracy, environmental conditions are the most difficult to control. There are, however, ways of reducing the effects of temperature, humidity and vibration.

The capacitive sensor of the **DT301**, that is located external to the process, is protected of external sources of heat by an enclosure with internal thermal insulation. Nevertheless, the transmitter should be installed protected from the sun.

Humidity is fatal to electronic circuits. In areas subjected to high relative humidity, the O-rings for the electronic housing covers must be correctly placed and the covers must be completely closed by tighten them manually until you feel the o-rings being compressed. See how to close suitably on item – electrical connections. Do not use tools to close the covers. Removal of the electronics cover in the field should be reduced to the minimum necessary, since each time it is removed; the circuits are exposed to the humidity.

The electronic circuit is protected by a humidity proof coating, but frequent exposures to humidity may affect the protection provided. It is also important to keep the covers tightened in place. Every time they are removed, the threads are exposed to corrosion, since painting cannot protect these parts. Code-approved sealing methods should be employed on conduit entering the transmitter. The unused outlet connection should be plugged accordingly.

Although the transmitter is virtually insensitive to vibration, installation close to pumps, turbines or other vibrating equipment should be avoided. If inevitable, install the transmitter at a solid base and use flexible tube which does not transmit the vibration.

Recommendations for use of DT301

The process fluid should always cover the two diaphragms.

The maximum process fluid velocity over the two repeater diaphragms must be 0.3m/s. This information is according to fluids which viscosity is close to that water. For fluids where the viscosity is very different to that water viscosity should be analyzed. This limitation is due to the losing of load between the diaphragms.

The temperature range of the process fluid must be between -20°C and 150°C.

For applications in corrosive fluids, compatible materials should be chosen. The materials of the parts that are not in direct contact with the process but can be subject to the corrosive atmosphere or drops of the process, should also be observed.

A possible leak of the fill fluid (less than 5 ml), due to a hole in the diaphragm can contaminate the process. In case that is not allowed, choose a fill fluid compatible with the process.

DT301 Concentration / Density Transmitters Models

DT301I - Industrial model, for general purpose.

DT301S - Sanitary model for food, pharmaceutical industry and other applications where sanitary connections are required.

DT30XM – Immersion model, for applications where above models or larger tanks are not possible and allow the probe to be submerged.

The industrial model uses connection flanges in compliance with ASME B16.5 or DIN 2526 Standards.

The sanitary model uses Tri-Clamp connection to allow a quick and easy connection and disconnection from the process. Wetted surface finish is 32RA as standard. These models meet 3A

recommendations that is the most widely accepted sanitary standard in the food, drug, and beverage industry.

Assembly

Both models (**DT301I** and **DT301S)** have two mounting types: top mounting (straight type) and side mounting (curved type).

For DT301M only straight type configuration is possible.

The Figures 1.1 to 1.4 show the dimensions of the **DT301** straight and curved type for industrial and sanitary models. The DT301M dimensions are in the figures 1.5 and 1.6. The dimensions are in millimeters (inches).

The installation can be done in open or pressurized tanks or through a sampling device, external to the process.

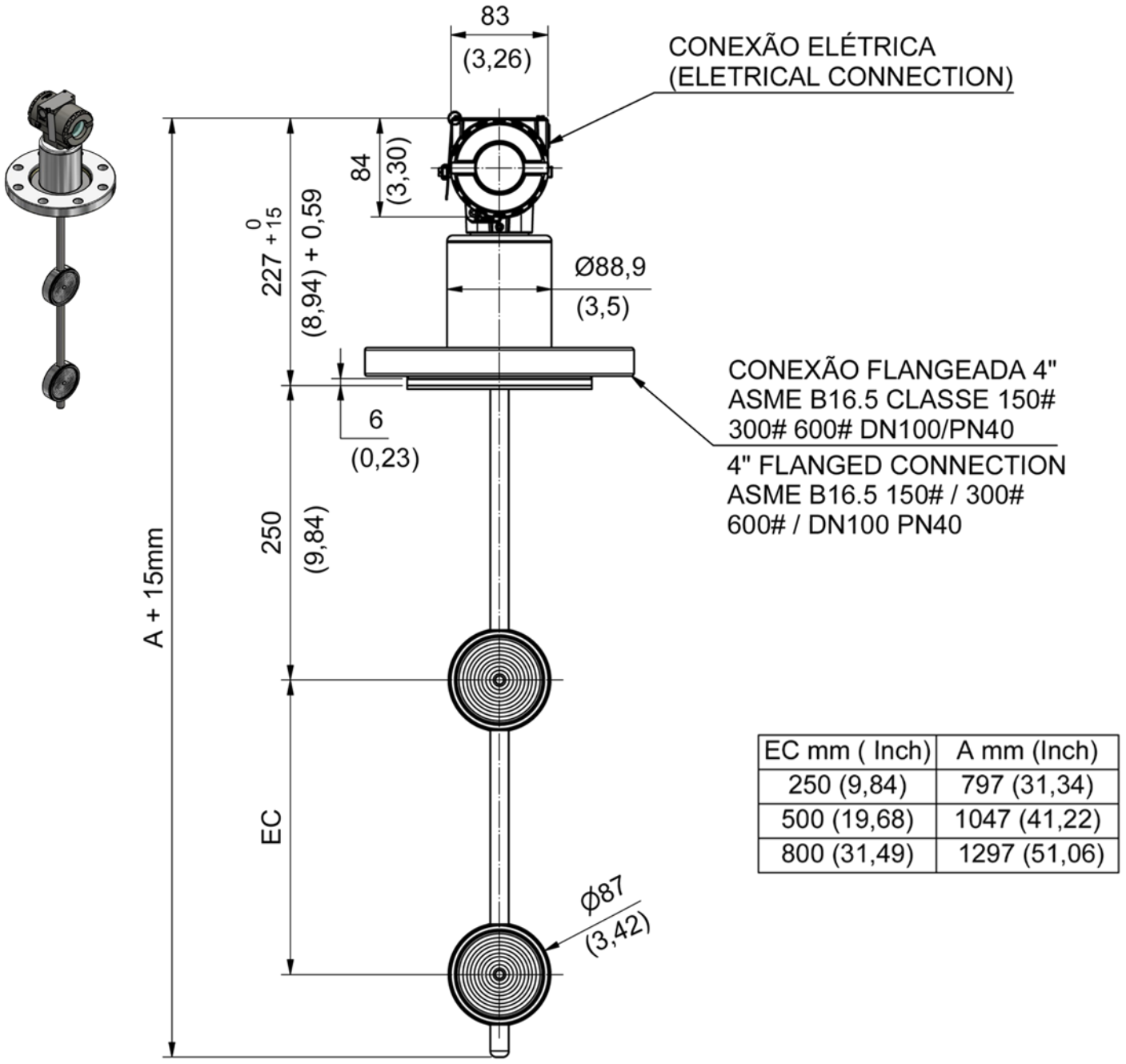
The Figures 1.7 up to 1.21 show some mounting examples. The dimensions are in millimeters.

Choose a place for installation that facilitates the access for the measuring point and that be free from mechanical shocks.

Use a valve in the process connection before the DT301. This simplifies the calibration and maintenance of the equipment.

IMPORTANT
For device, installed in areas not covered by CEPEL, it must be demands strictly followed respective certificate.

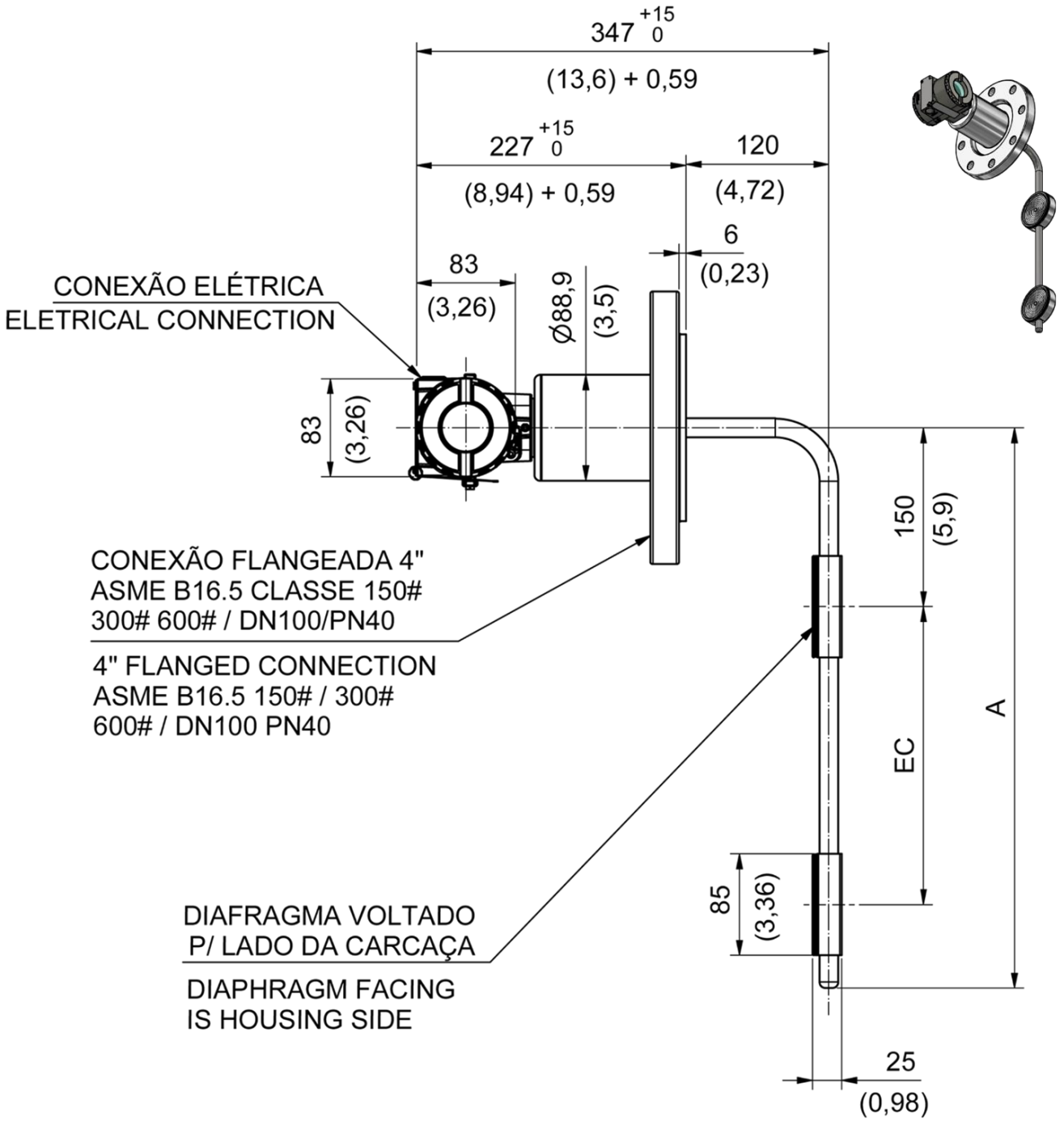
A - Industrial Model – Straight Type



EC mm (Inch)	A mm (Inch)
250 (9,84)	797 (31,34)
500 (19,68)	1047 (41,22)
800 (31,49)	1297 (51,06)

Figure 1.1 – DT301 Dimensional

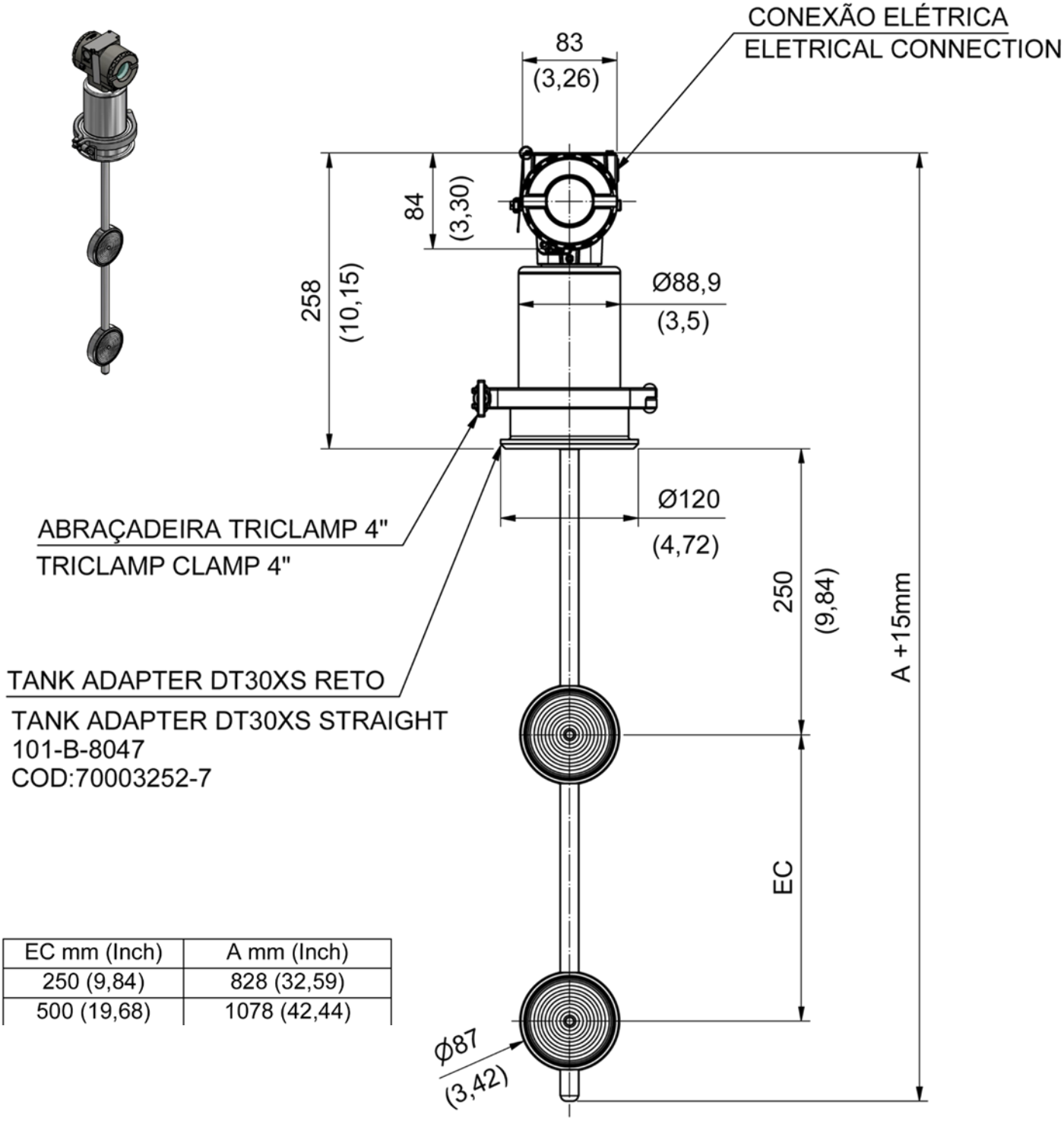
B – Industrial Model – Curved Type



EC mm (Inch)	A mm (Inch)
250 (9,84)	470 (18,5)
500 (19,68)	720 (28,34)
800 (31,49)	970 (38,19)

Figure 1.2 – DT301 Dimensional

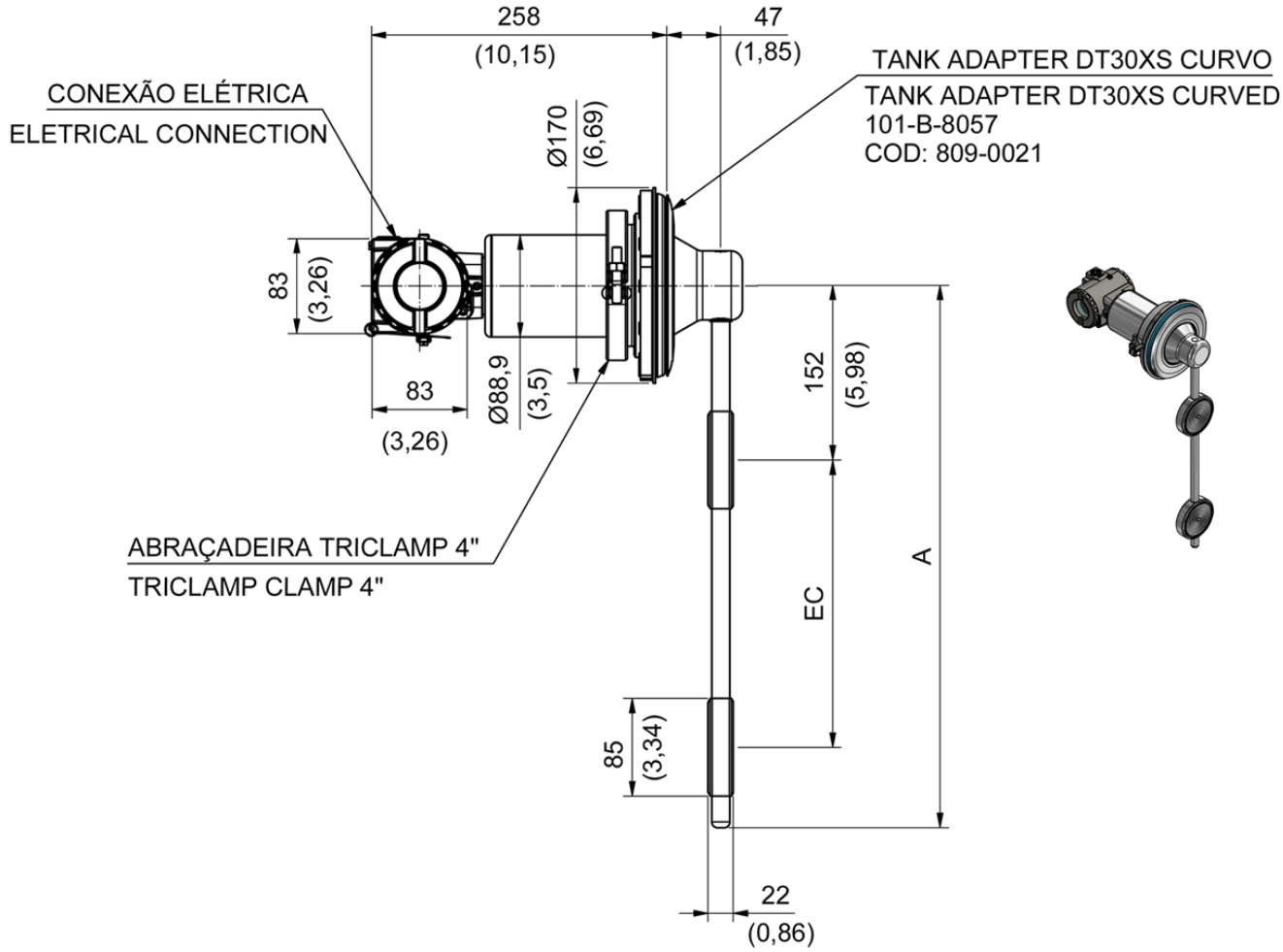
C – Sanitary Model – Straight Type



EC mm (Inch)	A mm (Inch)
250 (9,84)	828 (32,59)
500 (19,68)	1078 (42,44)

Figure 1.3 – DT301 Dimensional

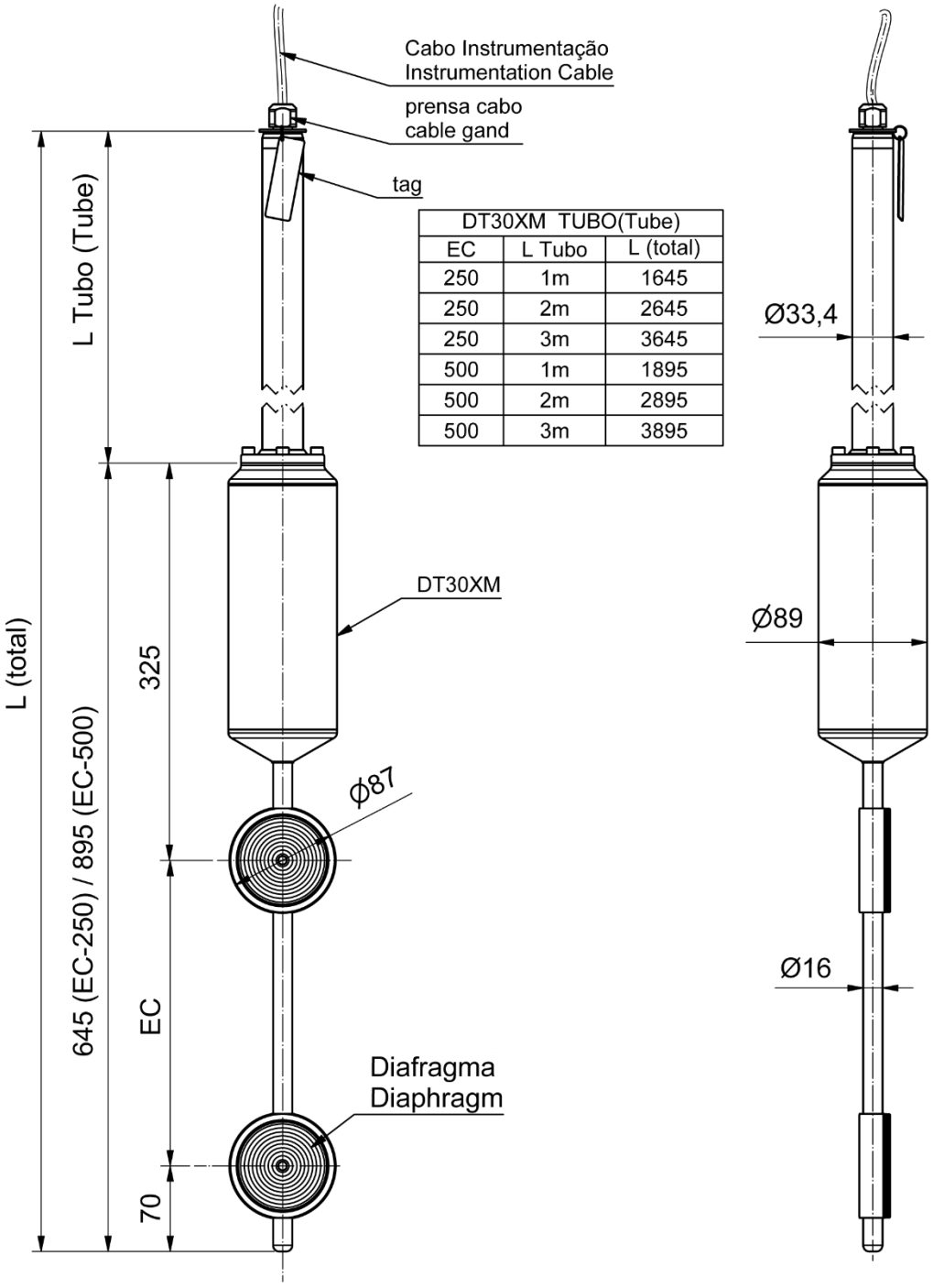
D – Sanitary Model – Curved Type



EC mm (Inch)	A mm (Inch)
250 (9,84)	472 (18,58)
500 (19,68)	722 (28,42)

Figure 1.4 – DT301 Dimensional

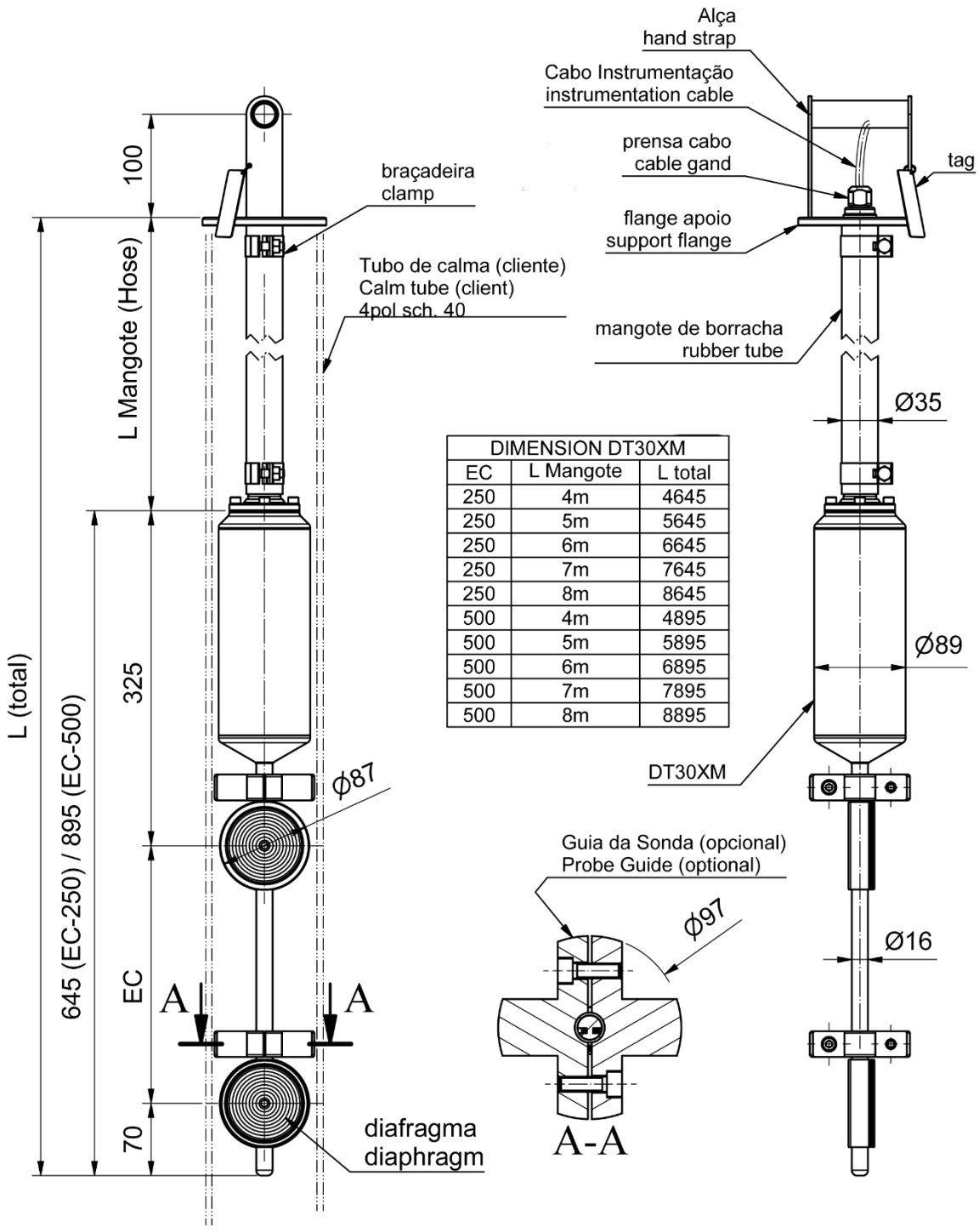
E – DT30XM Model (Stainless Steel Tubular Rod)



DT30XM TUBO(Tube)		
EC	L Tubo	L (total)
250	1m	1645
250	2m	2645
250	3m	3645
500	1m	1895
500	2m	2895
500	3m	3895

Figure 1.5 – DT301M Dimensional

F – DT30XM Model (Hose Rod)



DIMENSION DT30XM		
EC	L Mangote	L total
250	4m	4645
250	5m	5645
250	6m	6645
250	7m	7645
250	8m	8645
500	4m	4895
500	5m	5895
500	6m	6895
500	7m	7895
500	8m	8895

Figure 1.6 – DT30XM Dimensional

A – Typical Installation for Standpipe Tank

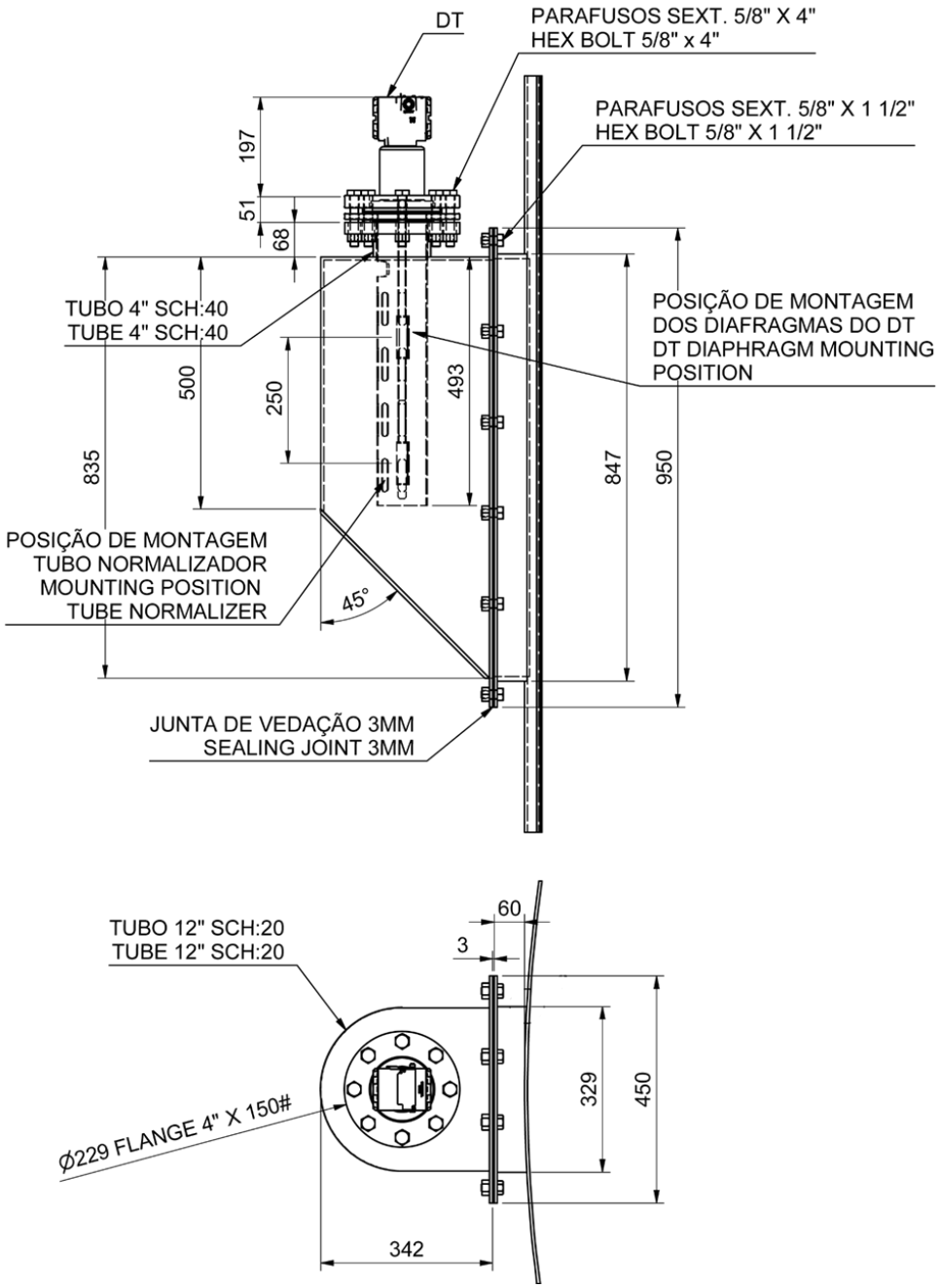


Figure 1.7 – Typical Installation for DT301

B – Typical Installation for 6¨ Up Flow Tank with Normalizer Tube

MAXIMUM FLOW =15m^3/H

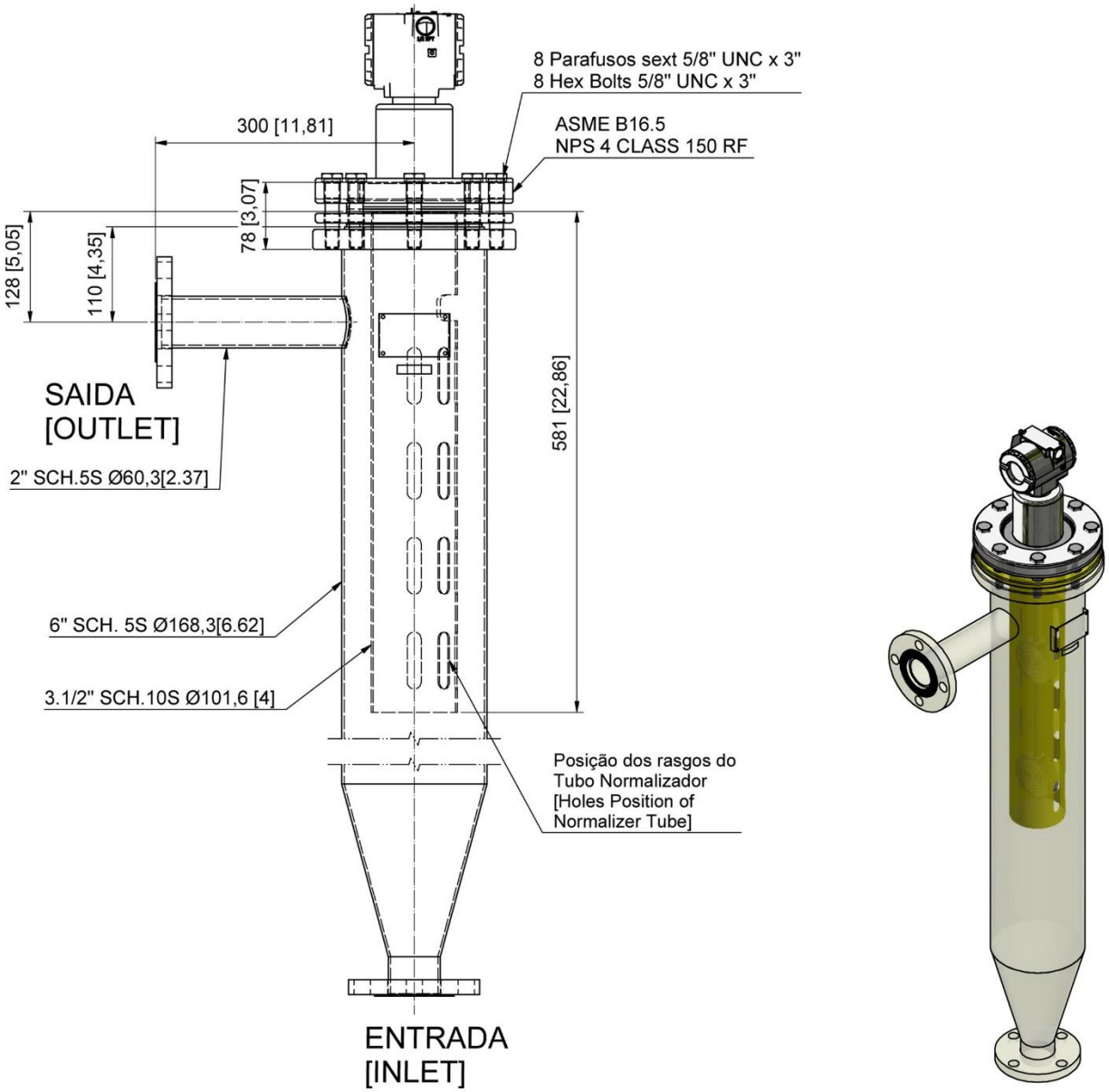


Figure 1.8 – Typical Installation for DT301

C – Typical Installation for Up Flow Tank of Overflow With Normalizer Tube

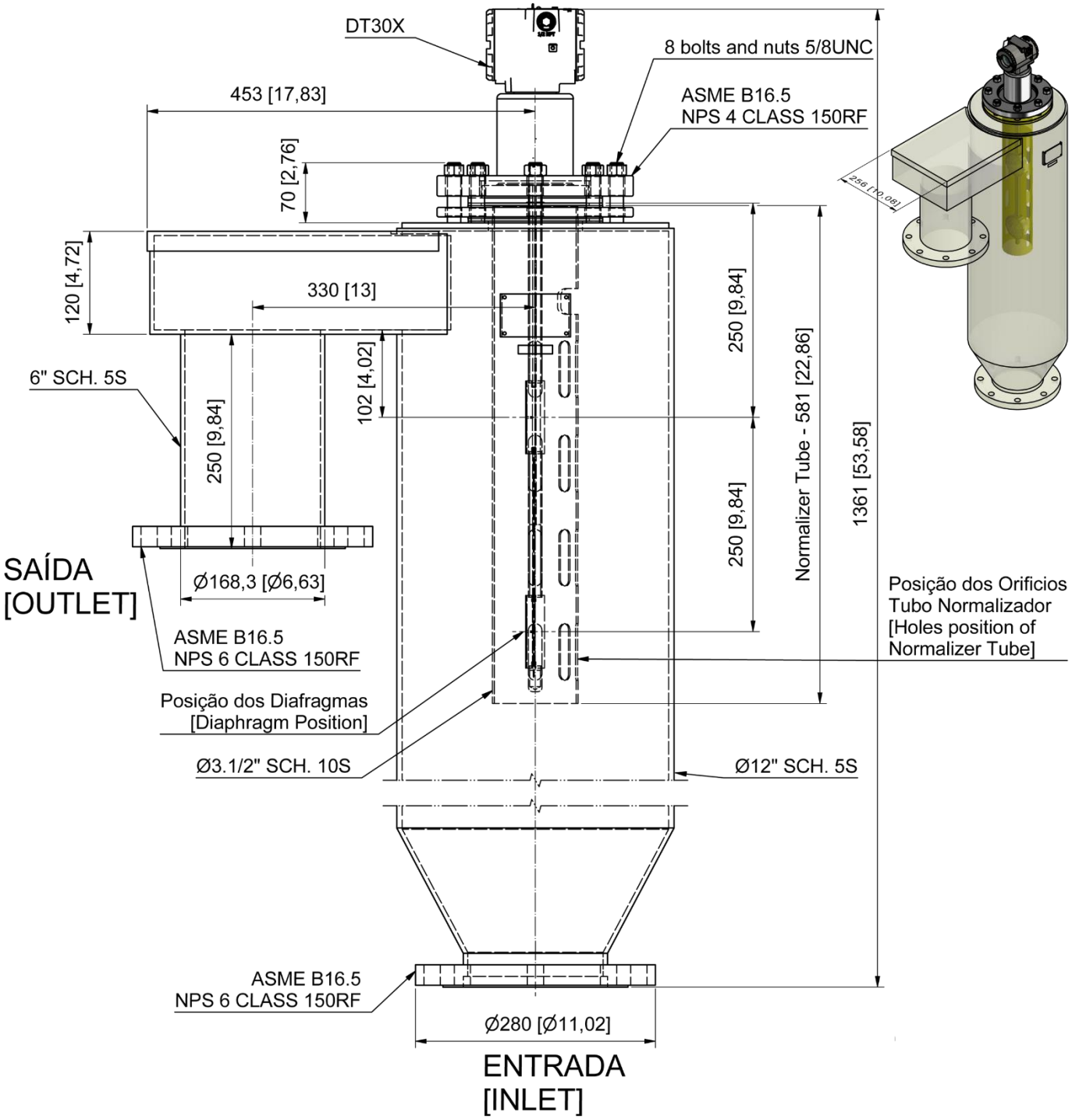


Figure 1.9 – Typical Installation for DT301

D – Typical Installation for 6 Up flow Tank – Sanitary Model

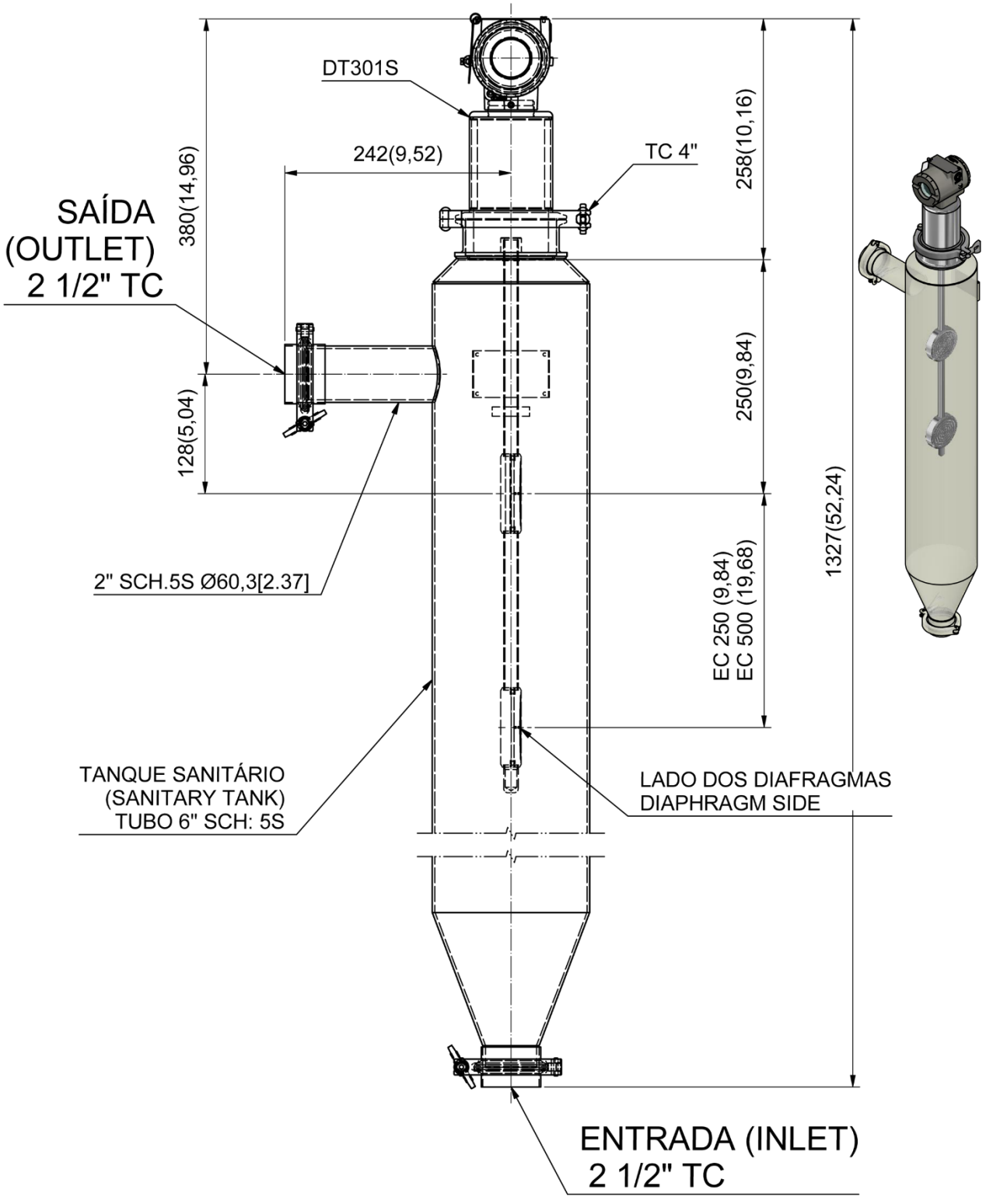


Figure 1.10 – Typical Installation for DT301 (D)

E – Typical Installation for 6¨ Up Flow Tank

MAXIMUM FLOW =15m³/H

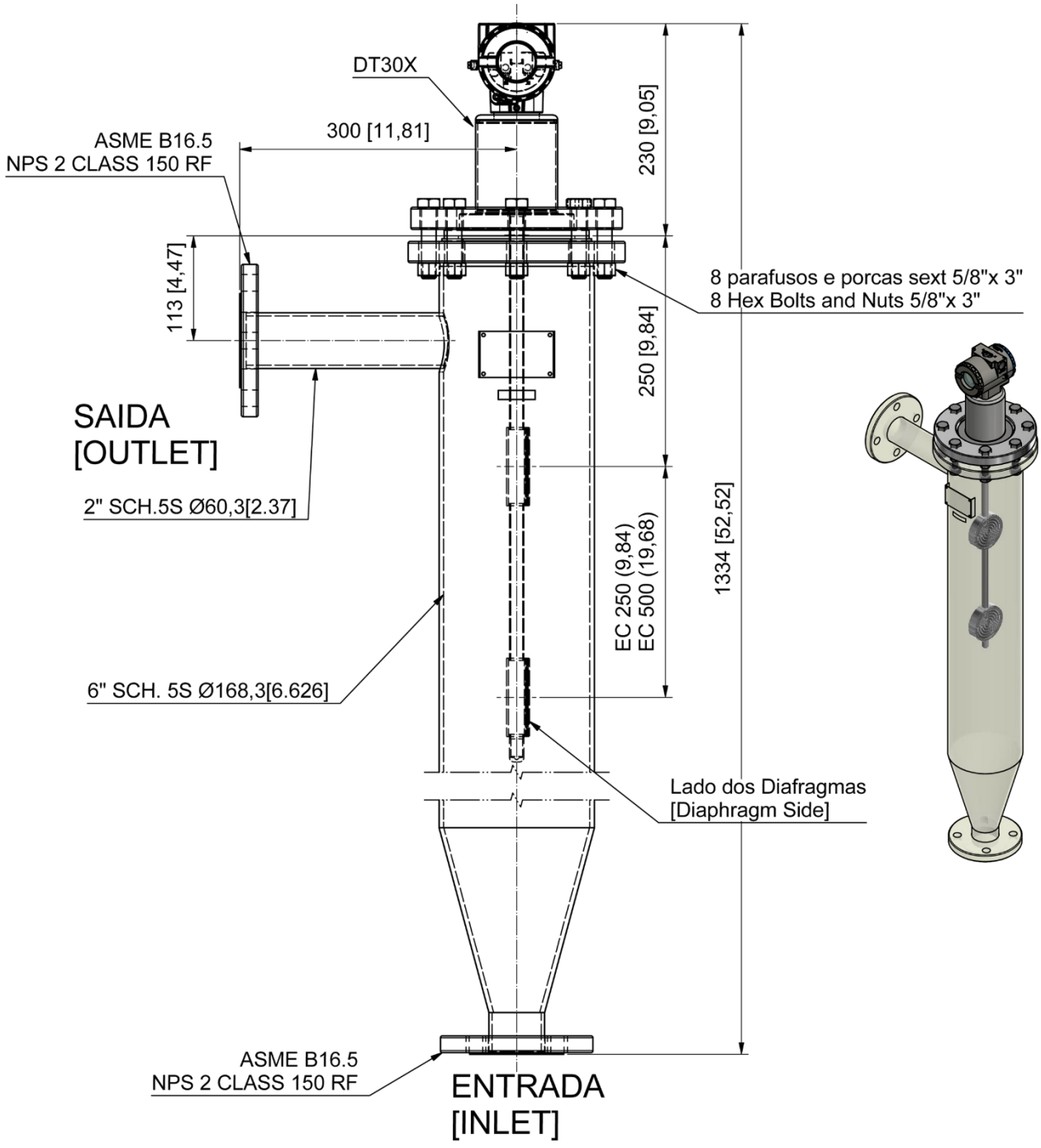


Figure 1.11 – Typical Installation for DT301

F – Typical Installation for 8¨ Up Flow Tank

MAXIMUM FLOW =27m^3/H

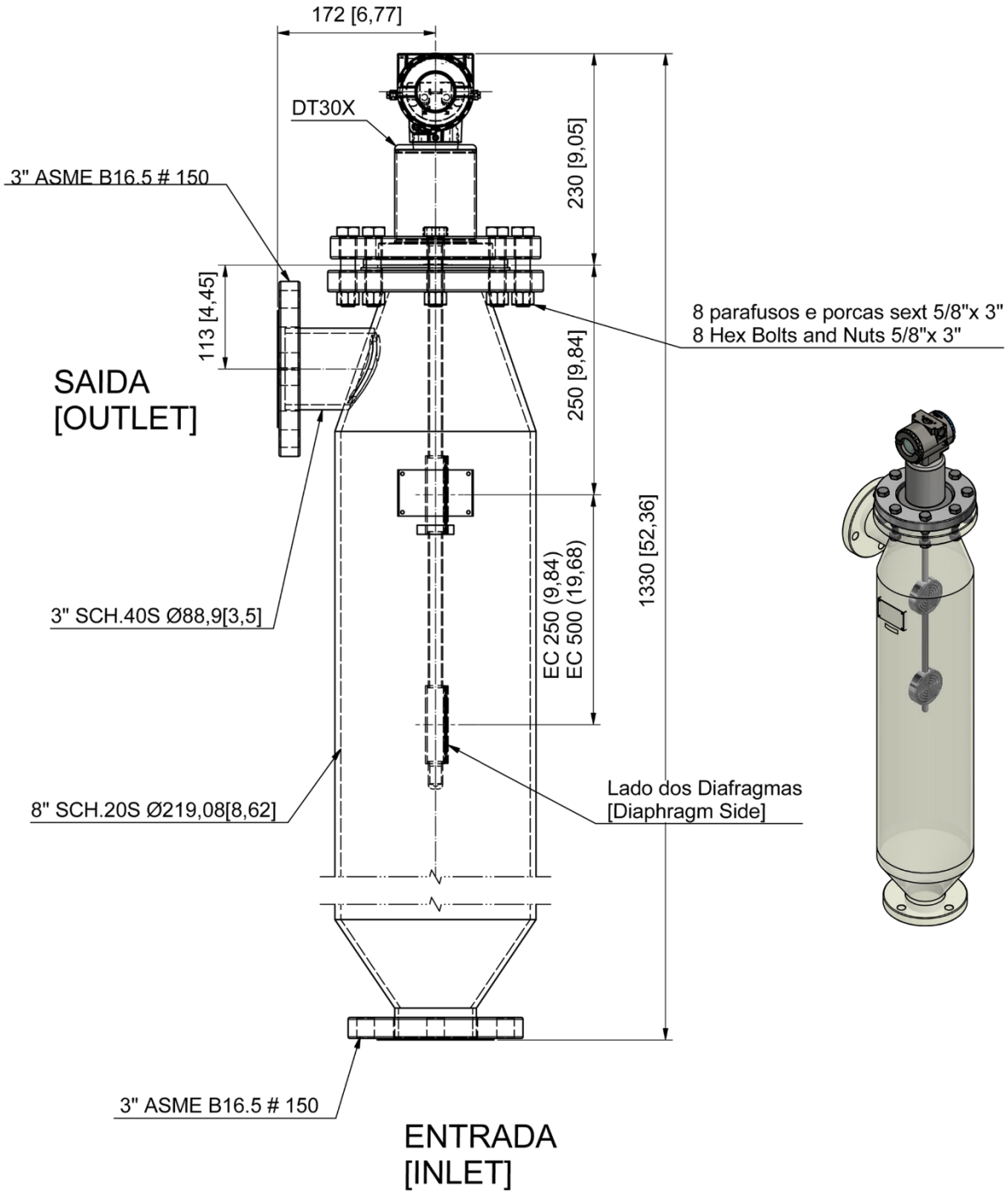


Figure 1.12 – Typical Installation for DT301

G - Typical Installation for 8¨ Up Flow Rubberized Tank

MAXIMUM FLOW =27m³/H

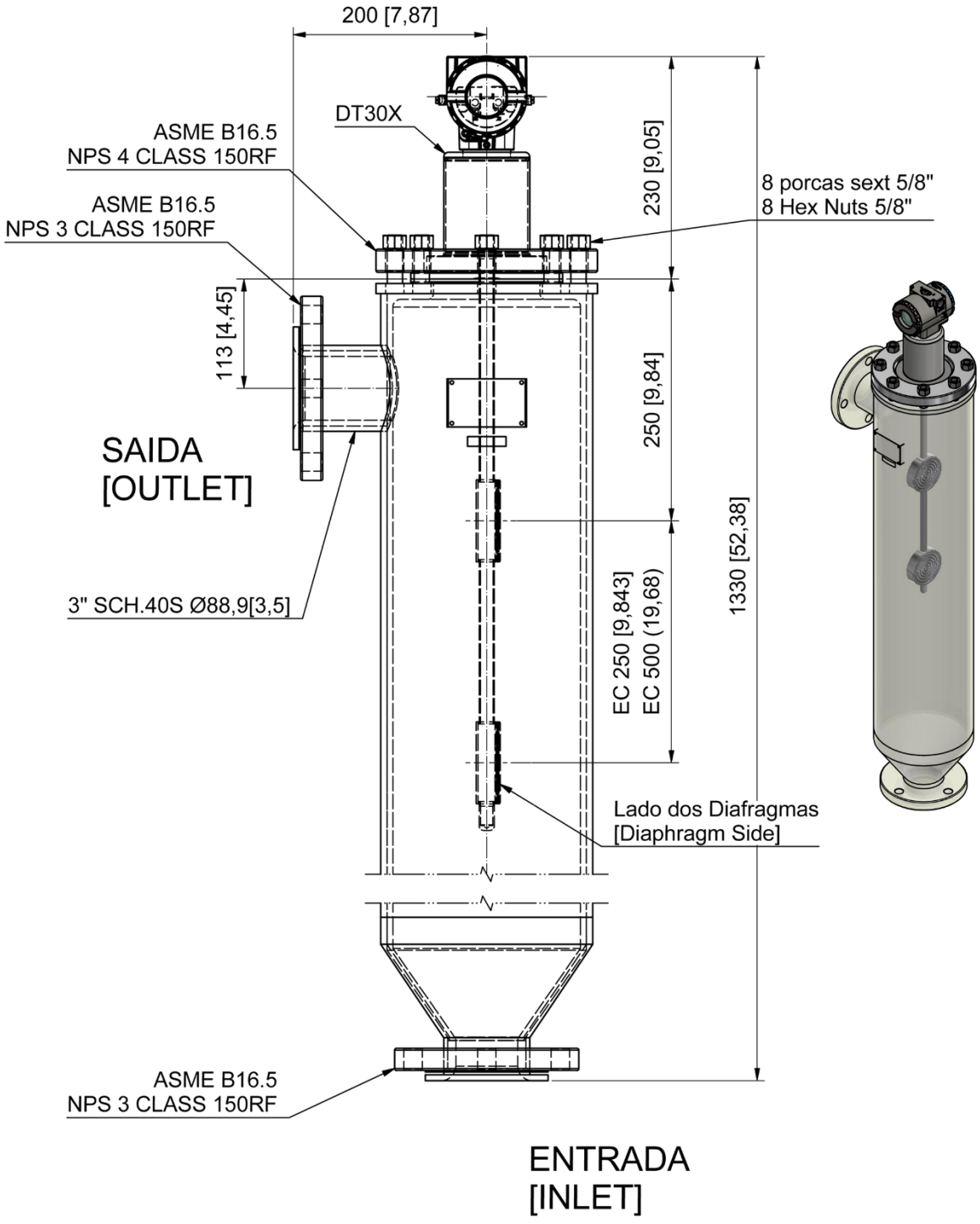


Figure 1.13 – Typical Installation for DT301

H - Typical Installation for 12¨ Up Flow Tank of Overflow

MAXIMUM FLOW = 65m³/H

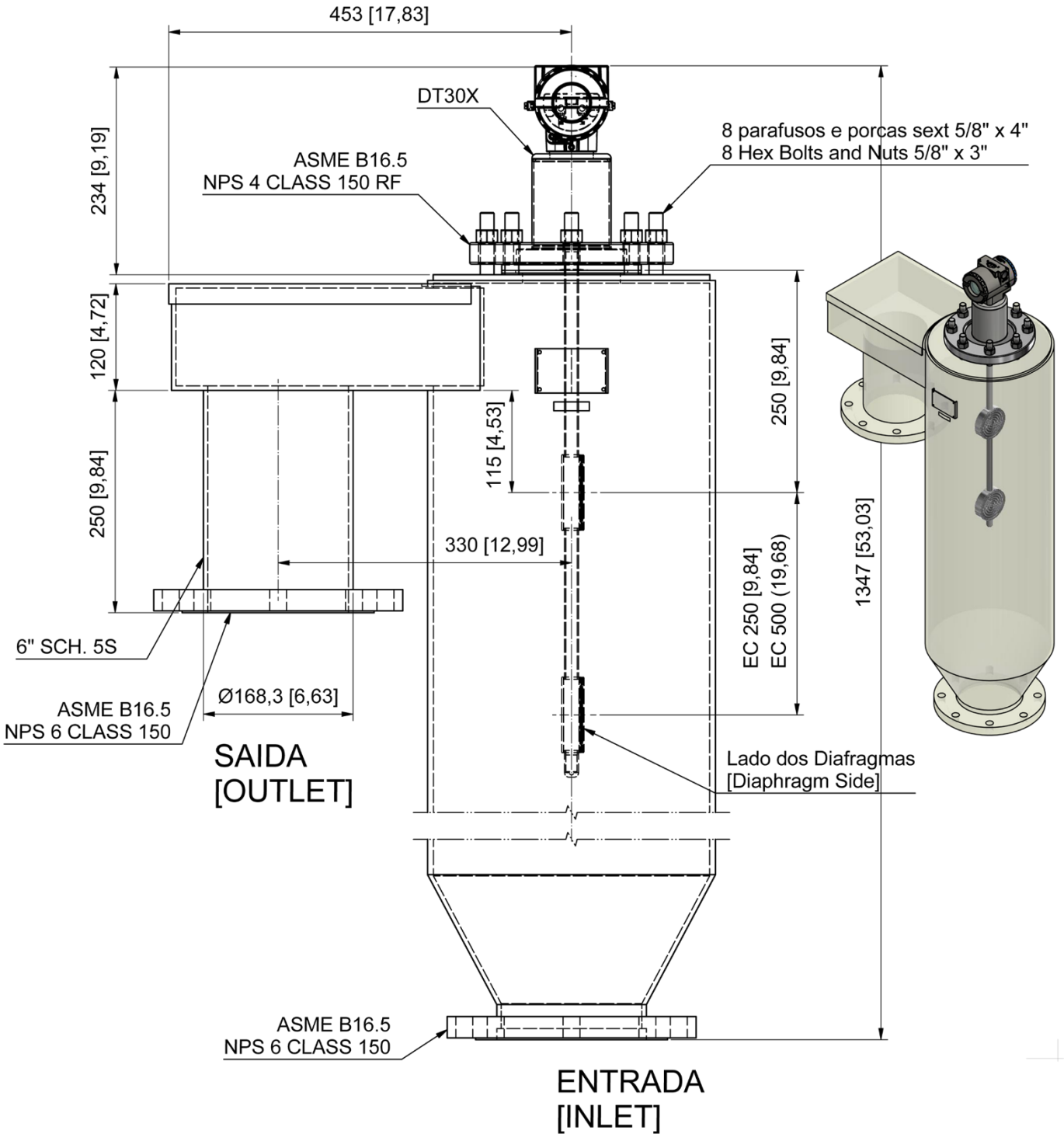


Figure 1.14 – Typical Installation for DT301

I - Typical Installation for 12¨ Up Flow Rubberized Split Tank

MAXIMUM FLOW = 65m³/H

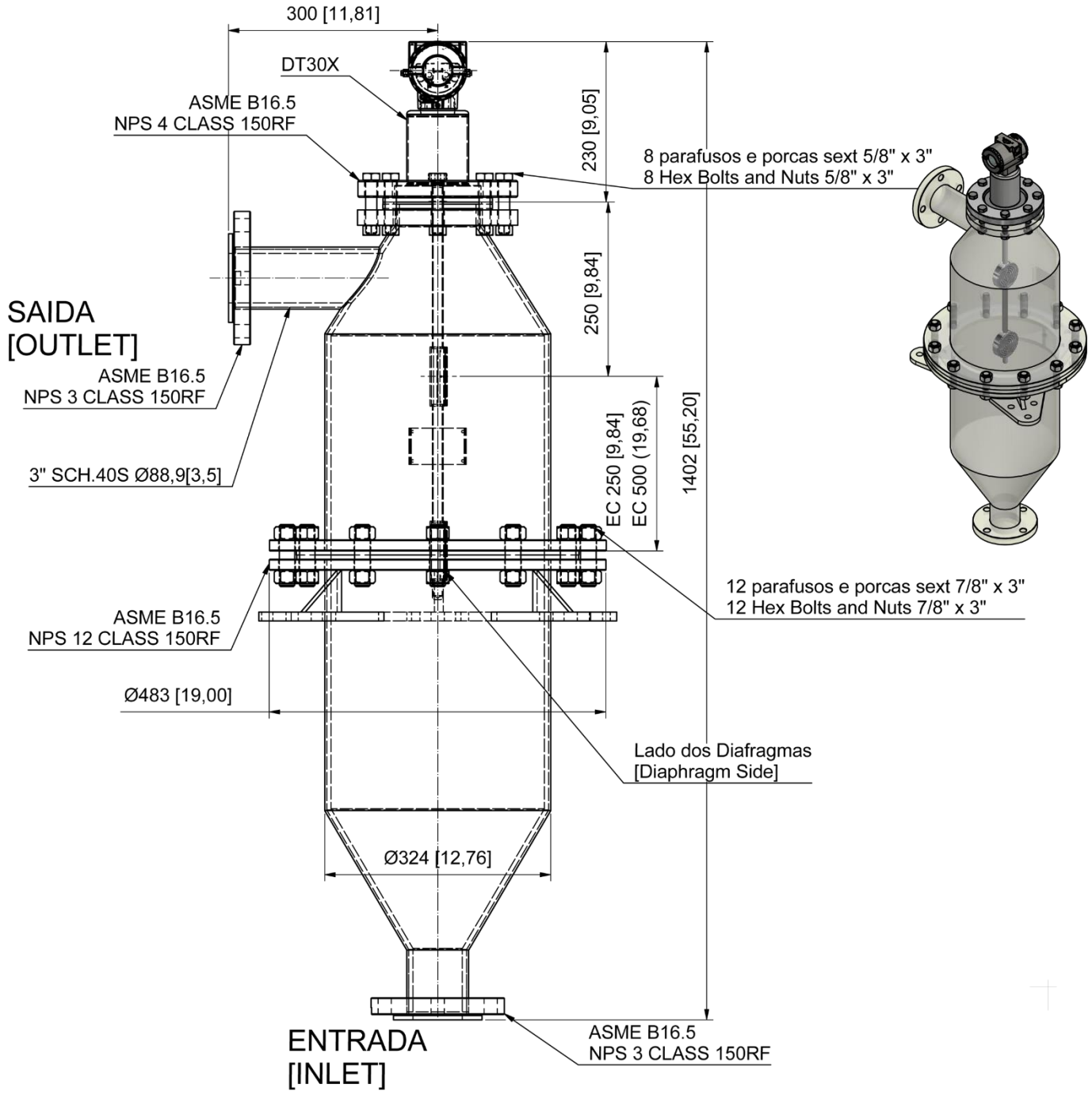


Figure 1.15 – Typical Installation for DT301

J - Typical Installation in Tank (Industrial Model)

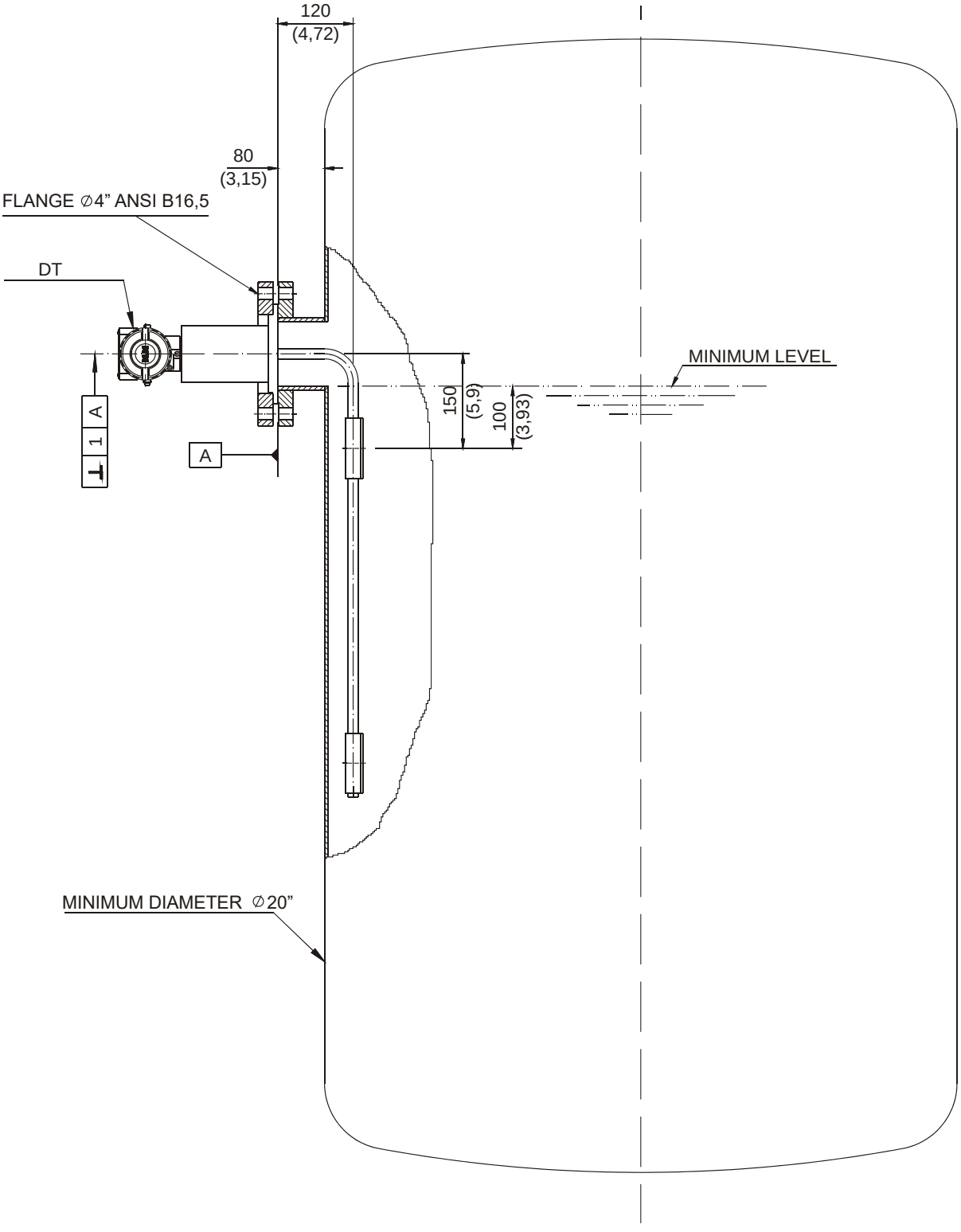


Figure 1.16 – Typical Installation for DT301

K - Typical Installation in Tank (Sanitary Model)

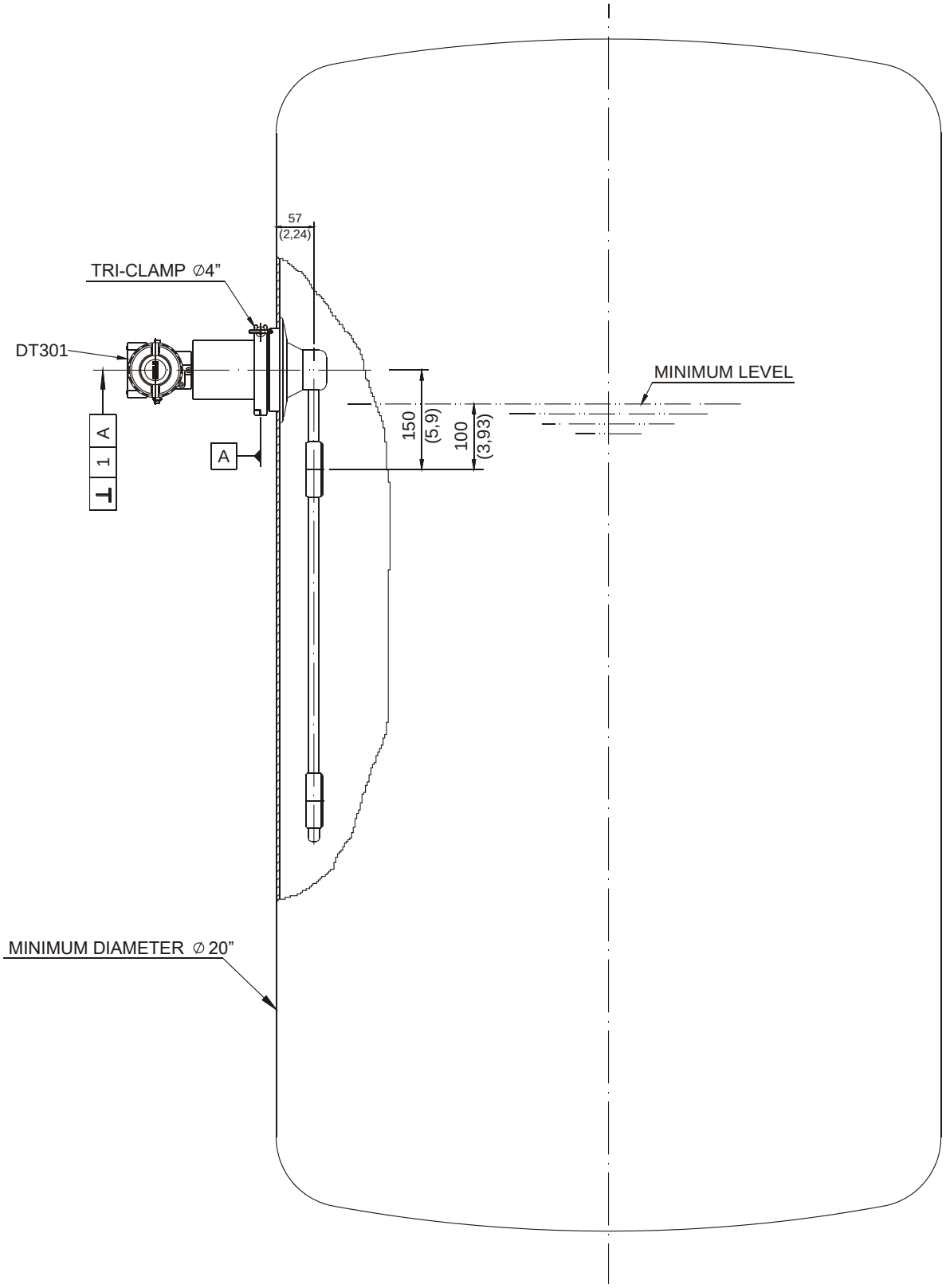


Figure 1.17 – Typical Installation for DT301

L - Typical Installation in Tank with Diaphragm Protection (Industrial Model)

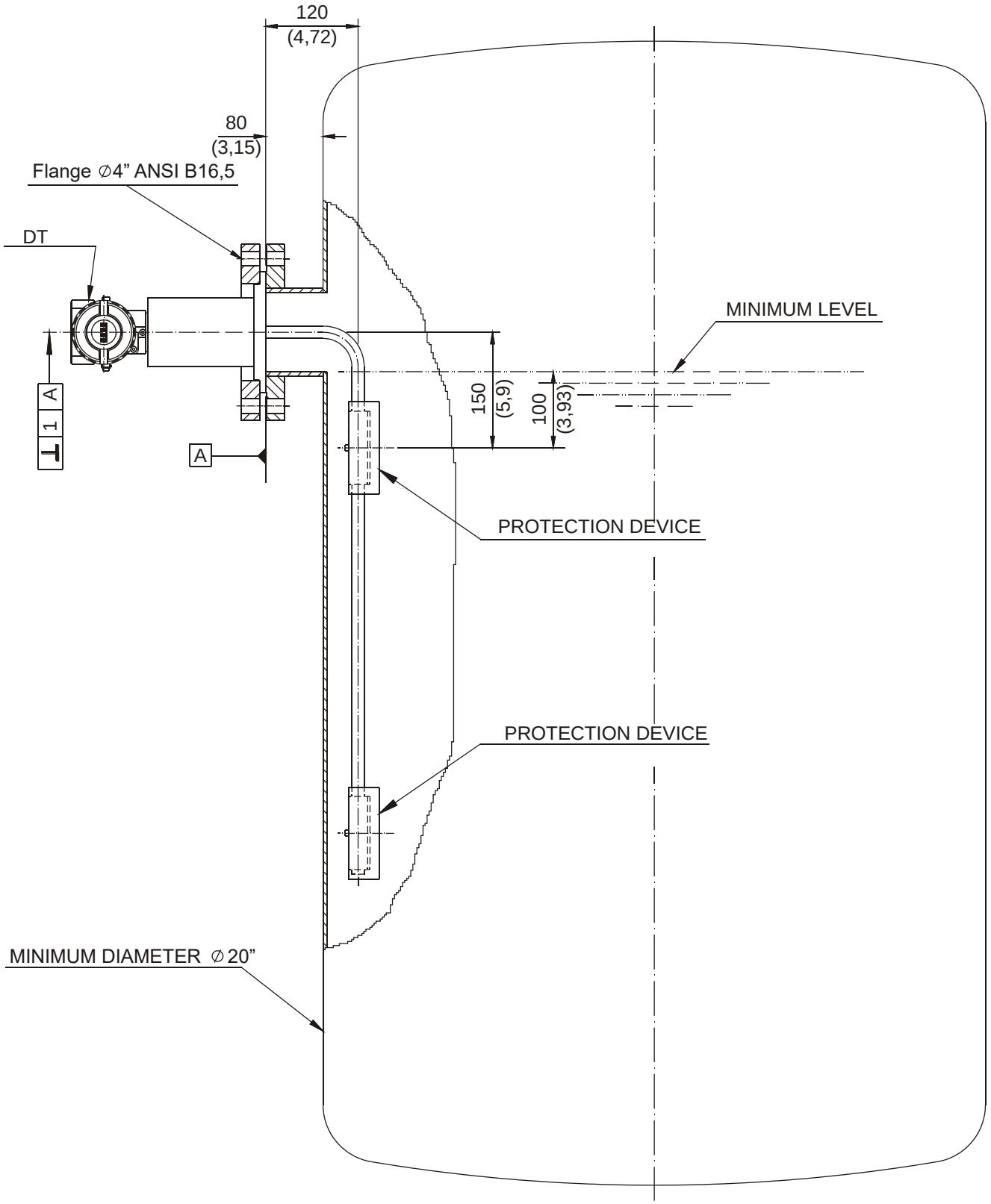


Figure 1.18 – Typical Installation for DT301

M - Typical Installation for Low Flow Tank with Bubble Breaker (Industrial Model)

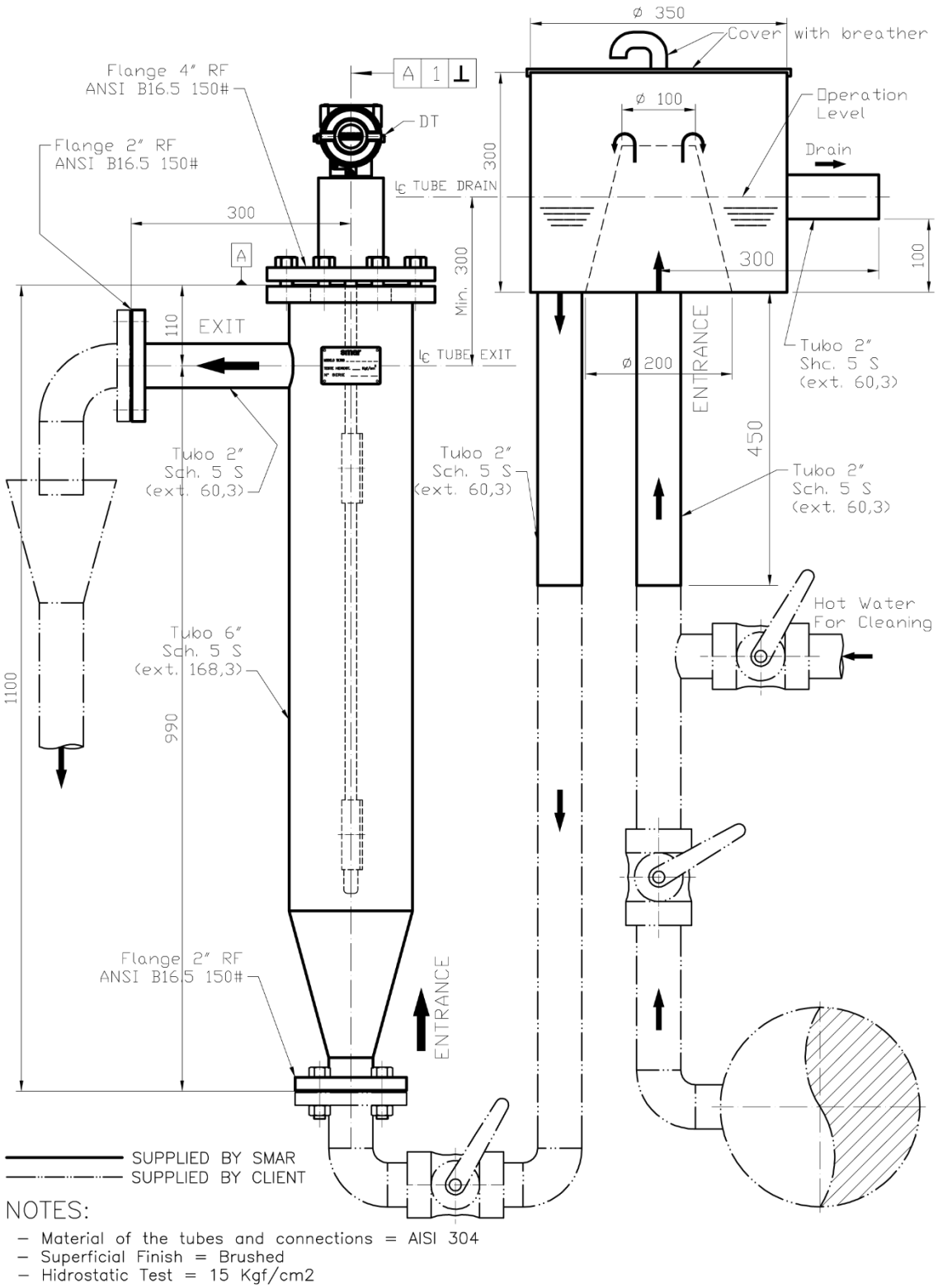


Figure 1.19 – Typical Installation for DT301

N - Typical Installation in Tank for Level Interface (Industrial Model)

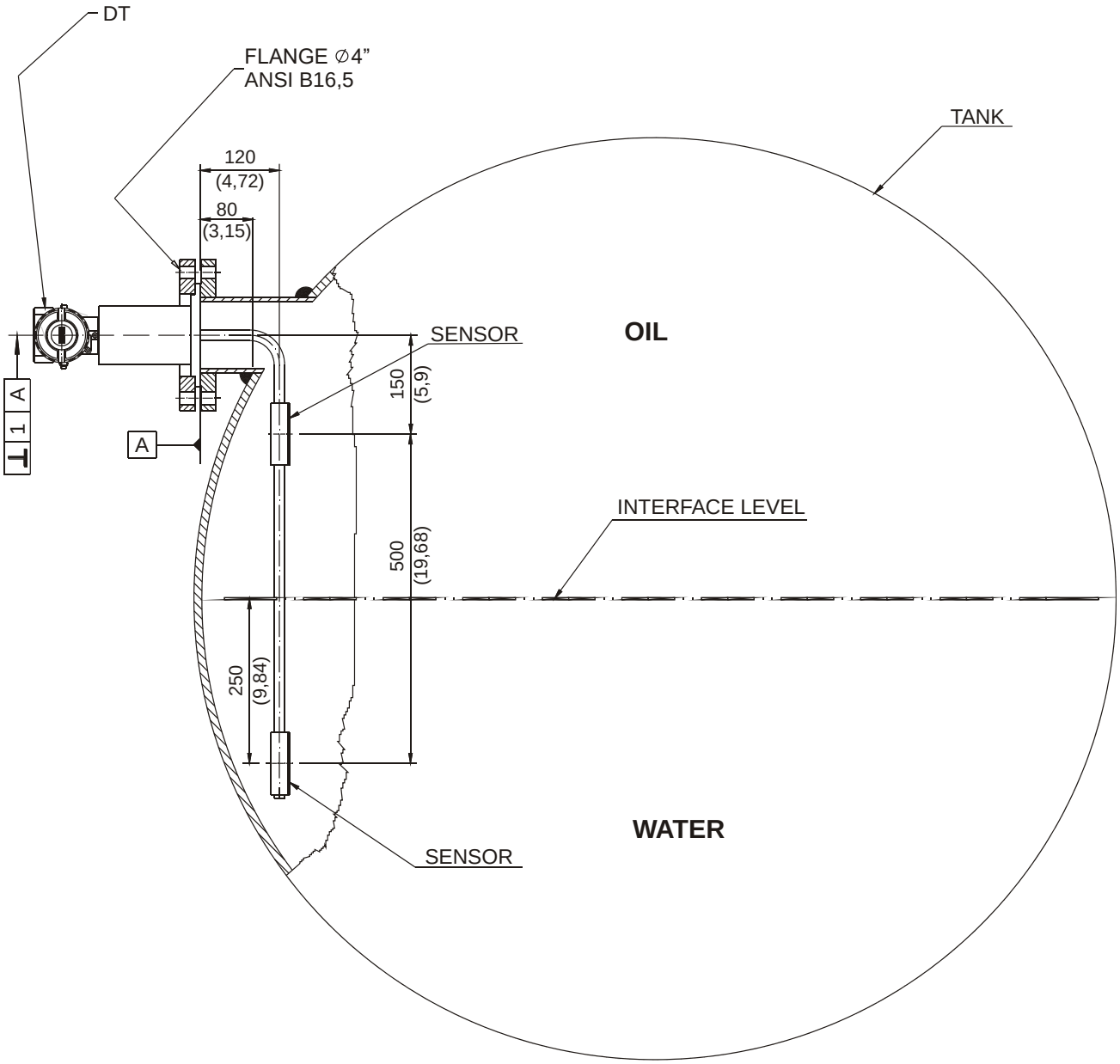


Figure 1.20 – Typical Installation for DT301

O - Typical Installation in Tank for Level Interface Stand Pipe (Industrial Model)

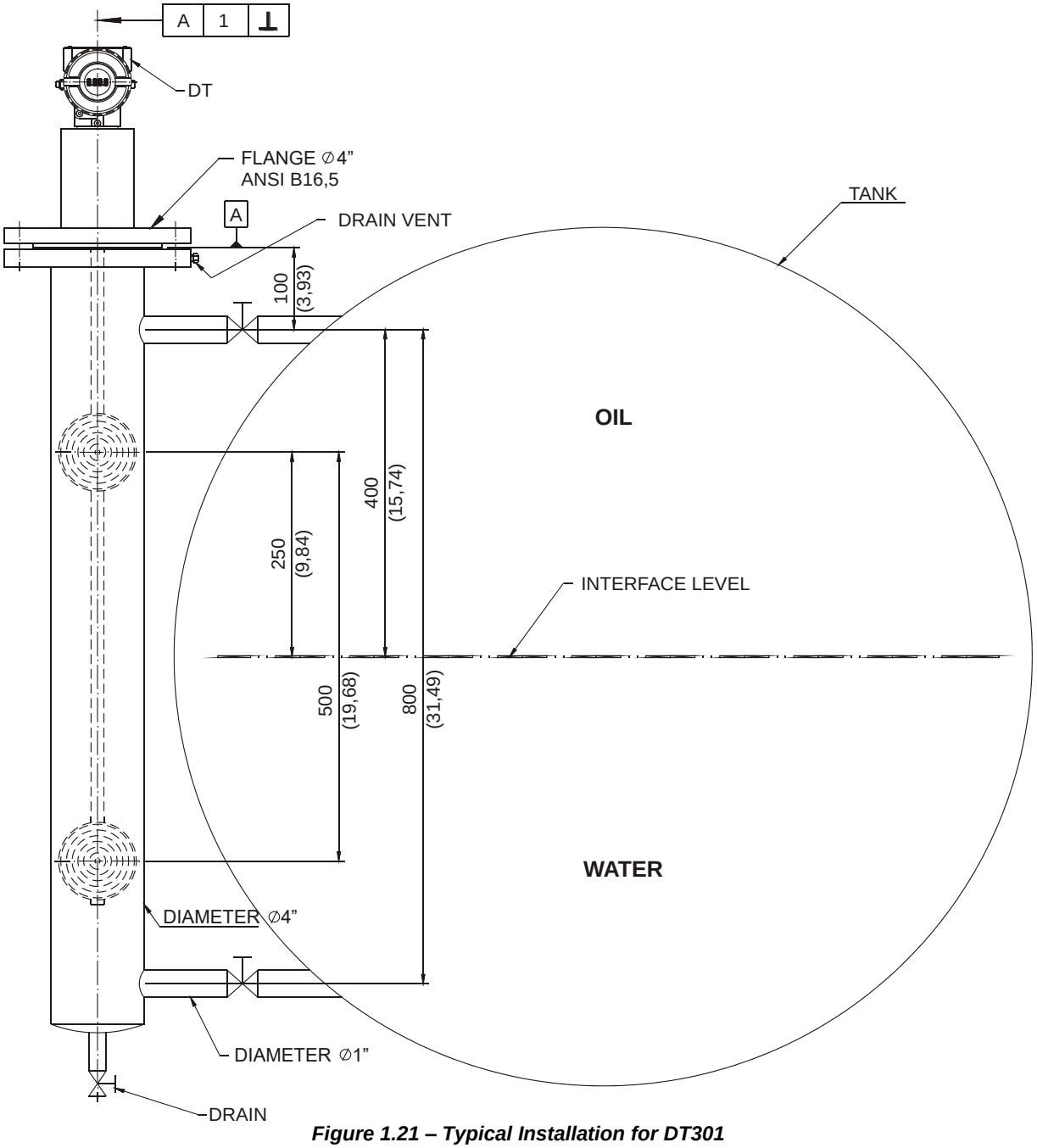


Figure 1.21 – Typical Installation for DT301

Electronic Housing Rotation

The electronic housing can be rotated to adjust the digital display on a better position. To rotate it, loose the housing rotation set screw, see next figure.

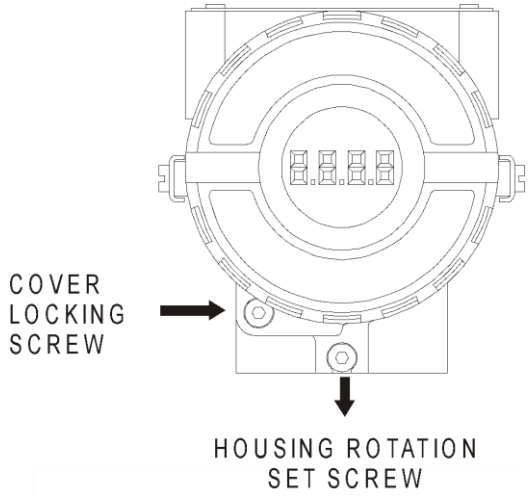


Figure 1.22 – Housing Rotation Set Screw

The digital display can also be rotated. See section 4, figure 4.2.

Electric Wiring

Reach the terminal block by removing the electrical connection cover. The cover locking screw (next figure) locks this cover. To release the cover, rotate the locking screw clockwise.

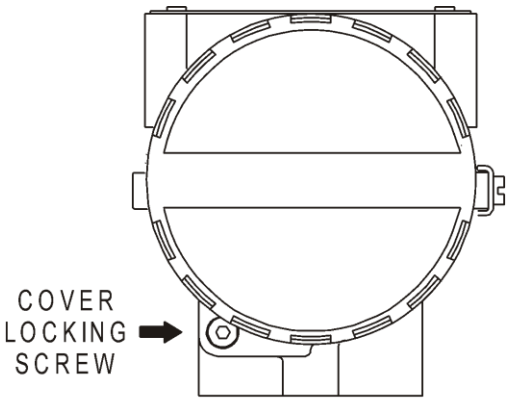


Figure 1.23 – Cover Locking Screw

The terminal block has screws on which fork or ring type terminals can be fastened. See next figure.

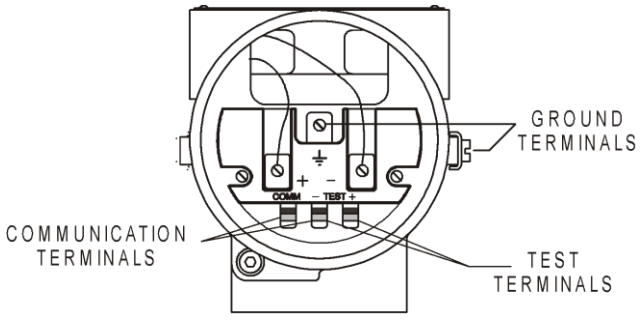


Figure 1.24 – Terminal Block

For convenience, there are three ground terminals: one inside the cover and two external located close to the conduit entries.

Test and Communication terminals allow, respectively, to measure the current in the 4 - 20 mA loop, without opening the circuit, and also to communicate with the transmitter. The “Test Terminals” must be used to measure the current. The “COMM” terminal must be used for HART communication. See the next figure.

Use of twisted pair (22 AWG or greater than) cables is recommended.

Avoid routing signal wiring close to power cables or switching equipment. Plug and seal the unused outlet connection accordingly.

The **DT301** has protection against reverse polarity.

Connection of the **DT301** should be done as in Figure 1.26.

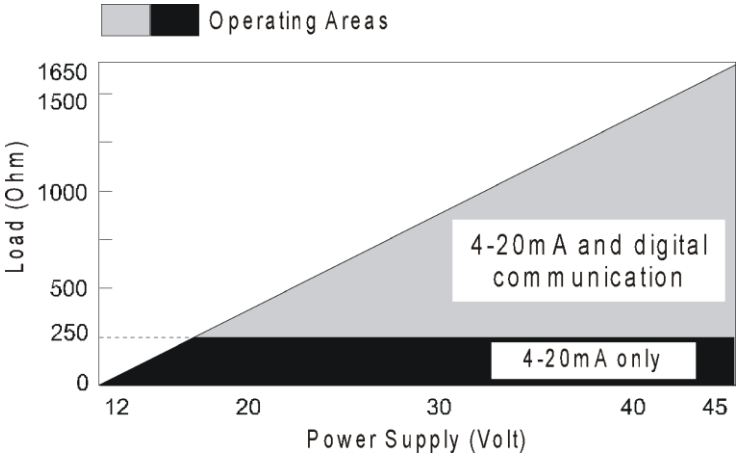


Figure 1.25 – Load Curve

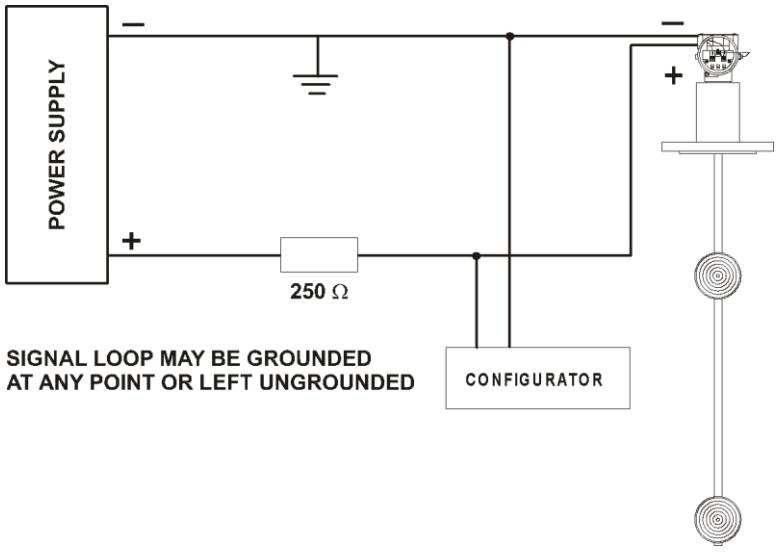


Figure 1.26 – DT301 Connection Diagram

Multidrop Operation

Multidrop connection is formed by several transmitters connected in parallel to a single communication transmission line. Communication between the host and the transmitters is done digitally with the transmitters analog output deactivated.

The communication with the transmitters and the Hart (Configurator, SDCD, Data Acquisition System or PC) can be done with a HI311 Smar interface Bell 202 Modem using HART Protocol. Each transmitter is identified by a unique address from 1 to 15.

The **DT301** is factory set to address 0, which means a non-multidrop operation mode, allowing the transmitter to communicative with the Hand-Held Terminal, superimposing the communication on the 4-20 mA signal. To operate in multidrop mode, the transmitter address must be changed to a number from 1 to 15. This change deactivates the 4-20 mA analog output sending it to 4mA.

NOTE
The current output will be set at 4 mA as soon as the transmitter address is changed from zero (0) to another one in the multidrop range (1 to 15).

To operate in multidrop mode, it is necessary to verify which transmitters are connected on the same line.

The connection of the **DT301** in a multidrop mode should be made according to figure 1.27.

ATTENTION
For proper operation, the Smar's configurator requires a minimum load of 250 Ohms between it and the power supply. See figure 1.25.

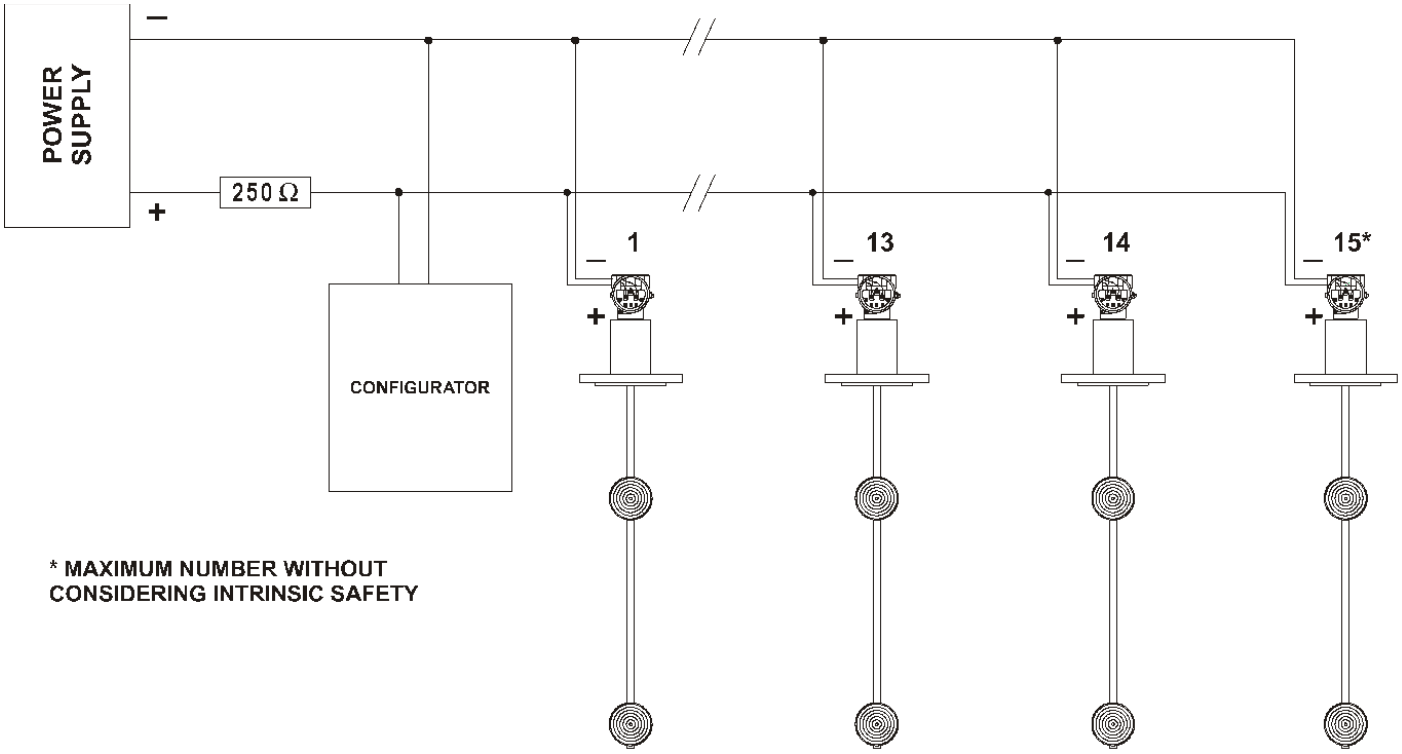


Figure 1.27 – DT301 Diagram for Multidrop Connection

Installation in Hazardous Areas

Consult the Appendix A for Hazardous Location Approvals.

Section 2

OPERATION

The pressure sensor used by the **DT301** Smart Concentration/ Density Transmitter is a capacitive cell, the same type used by the LD301 Smart Pressure Transmitter. This sensor is connected to a probe to perform the measures through of the pressure differential reading. The figure 2.1 schematizes the sensor used by the **DT301**.

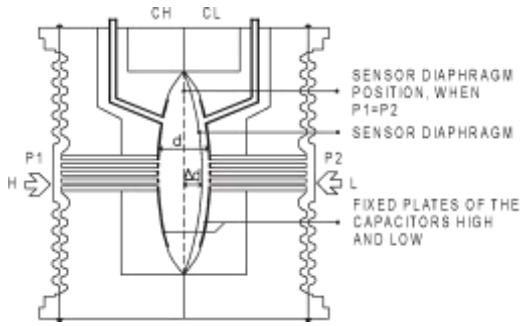


Figure 2.1 – Capacitive Cell

Functional Description – Sensor

Where,

P_1 and P_2 are the pressures applied in cameras H and L.

CH = capacitance between the fixed plate on P1 side and the sensing diaphragm.

CL = capacitance between the fixed plate on the P2 side and the sensing diaphragm.

d = distance between CH and CL fixed plates.

Δd = sensing diaphragm's deflection due to the differential pressure ΔP = P1 - P2.

The capacitance of a capacitor with flat, and parallel plates may be expressed as a function of plate area (A) and distance (d) between the plates:

$$C = \frac{\in A}{d}$$

Where,

ε = dielectric constant of the medium between the capacitor's plates.

If *CH* and *CL* be considered the capacity of flat and parallel plates with identical areas, then:

$$CH = \frac{\in .A}{(d/2) + \Delta d} \qquad CL = \frac{\in .A}{(d/2) - \Delta d}$$ and

However, if the differential pressure (ΔP) applied to the capacitive cell not deflect the sensing diaphragm beyond d/4, it is possible to assume ⊗P as proportional to ⊗d, that is:

ΔP 〈 Δd

By developing the expression (CL - CH)/ (CL + CH), it follows that:

$$\frac{CL - CH}{CL + CH} = \frac{2\Delta d}{d}$$

As the distance (d) between the fixed plates CH and CL is constant, is possible to conclude that the expression (CL - CH) / (CL + CH) is proportional to Δd and, therefore, to the differential pressure to

be measured.

Thus it is possible to conclude that the capacitive cell is a pressure sensor formed by two capacitors whose capacitances vary according to the differential pressure applied.

Functional Description - Hardware

The transmitter blocks Diagram, as it shows the Figure 2.2, it describes the circuit used by the **DT301** functionally.

Probe
The probe is the transmitter part that is directly in contact with the process.

Pressure Repeaters
It transfers to the capacitive sensor the differential pressure detected in the process.

Temperature Sensor
It captures the process fluid temperature.

Sensor Board
It implements the transducer that converts the sensor signal to a measure that can be treated by CPU.

Oscillator
It generates a proportional frequency to the capacitive generated by sensor.

Signal Isolator
It performs the isolation of signals between the sensor and CPU. The Control signals from the CPU are transferred through optocouples, and the signal from the oscillator is transferred through transformers.

EEPROM Memory
It is a non-volatile memory and it contains the specific information of the sensor, such as, construction materials, calibration, production, and customer's data.

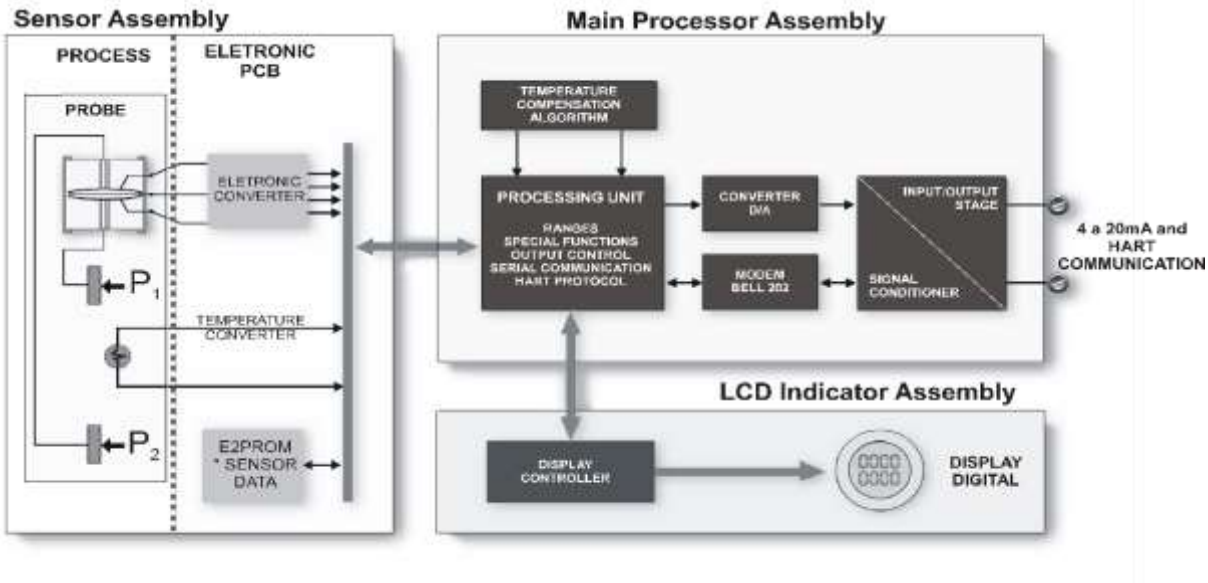


Figure 2.2 – DT301 Hardware Block Diagram

Main Board

(CPU) Central Processing Unit and PROM
The (CPU) Central Processing Unit is the intelligent part of the transmitter responsible for the management and operation of the circuits, signal treatment and performs the communication digital with other devices. For temporary data storage, CPU uses the memory position of its internal RAM. The data stored in this RAM are those that can be destroyed in the case of energy lack. The data that request its retention, CPU stores them in its external FRAM.
The program is stored in a flash internal memory.

D/A Converter
It converts the digital data from the CPU to an analog signal with 14-bits resolution.

Output
It controls the current in the line. This current control generates a proportional current to the value of the variable reading. The work range of the transmitter defines the values for the currents 4 and 20 mA. The control current of the **DT301** transmitter meets the specifications of the NAMUR NE-43 standard.

Modem
The function of this circuit is to become possible the change of information between the Smar configurator and the **DT301** transmitter, through HART protocol. The communication signal is symmetrical and it doesn't affect the level DC in the output of 4-20mA.

Power Supply
The transmitter gets the energy of the communication line for its own operation (two wires transmitter). The minimum operating voltage of the transmitter is 12 Vdc, measured at its terminal block.

Display Controller
It controls the lit of the liquid crystal Display segments according to the correspondent data sent by the CPU. The user has the option of selecting the variable shown in the display, through digital communication.

Functional Description - Software

The figure 2.3 shows the software functional diagram of the **DT301** transmitter.

Digital Filter
The digital filter is a lowpass filter with an adjustable time constant Damping. It is used to smooth noisy signals. The Damping value is the time required for the output reaching 63.2% for a step input of 100%.

Factory Characterization
It calculates the real pressure through capacitance and sensor temperature readings, considering the data of factory calibration stored in EEPROM of the sensor. This module has as output the values of differential pressure and temperature.

Specific Weight Calculation
It calculates the specific weight of the solution, considering its physicochemical properties.

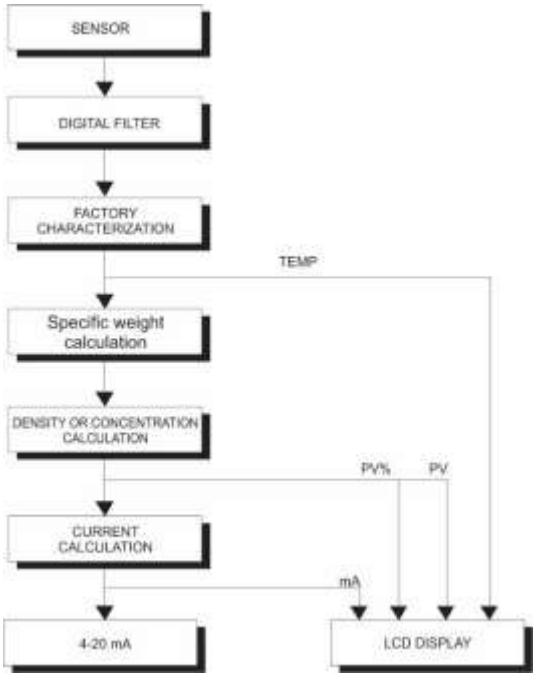


Figure 2.3 – DT301 Software Block Diagram

Density or Concentration Calculation

After obtaining the specific weight value, the density or concentration can be determined easily. At this point, the value of the PV main variable is obtained, both in percentage and in engineering units.
At this point, the value of the main variable PV is obtained, both in percentage and in engineering units

Current Calculation
It makes the correlation of PV with the current values in mA, according to the configured working range.

Display

The indicator, constituted by the liquid crystal display, can show one or two variables in according to the user's selection. When it is shown two variables, the indicator will alternate between both with an interval of approximately 3 seconds.

Beyond the numeric and alphanumeric fields, the display shows some alphanumeric icons to indicate the transmitter states. The figure 2.4 shows the segment configuration used by **DT301** transmitter.

Monitoring
The **DT301** transmitter is continually in the monitoring mode. In this mode, the indication at the display alternates between the primary and secondary variable, according to the user's configuration. The indicator has the capacity to show the value, the engineering unit and the variable type, simultaneously with most of the state indications. See in the figure 2.4 a sample of a **DT301** standard indication.

The display is capable also to show messages and errors (See the table 2.1).

Figure 2.4 – Typical Monitoring Mode Display Showing PV, in this case 25.0 BRIX

DISPLAY	DESCRIPTION
INIT	The **DT301** is in initializing after power on.
FAIL	Fails in the transmitter. See Section 4 – Maintenance.
SAT	Primary or secondary Variable out of the range operation. See Section 4 - Maintenance.

Table 2.1 - Display Errors and Messages

CONFIGURATION

The **DT301** Intelligent Density Transmitter is a digital instrument with the most up-to-date features a measurement device can possibly have. Its digital communication protocol (HART→) enables the instrument to be connected to a computer in order to be configured in a very simple and complete way. Such computers connected to the transmitters are called HOST computers. They can either be Primary or Secondary Masters. Therefore, even the HART→ being a master-slave protocol, it is possible to work with up to two masters in a bus. The Primary HOST plays the supervisory role and the Secondary HOST plays the Configurator role.

The transmitters may be connected in a point-to-point or multidrop type network. In a point-to-point connection, the equipment must be in its "0" address so that the output current may be modulated in 4 to 20 mA, as per the measurement. In a multidrop network, if the devices are recognized by their addresses, the transmitters shall be configured with a network address between "1" and "15. In this case, the transmitter's output current is kept constant, with a consumption of 4 mA each. If the devices are recognized by their tag, the transmitter's addresses may be "0" while, their output current is still being controlled, even in a multidrop configuration.

In the case of the **DT301**, which can be configured a transmitter; the HART→ addressing is used as follows:

Transmitter Mode - The "0" address causes the **DT301** to control its output current and addresses "1" up to "15" place the **DT301** in the multidrop mode without current control.

The **DT301** Intelligent Density Transmitter includes a very encompassing set of HART→ Command functions that make it possible to access the functionality of what has been implemented. Such commands comply with the HART→ protocol specifications, and are grouped as Overall Commands, Common Practice Controls Commands and Specific Commands.

Smar has developed the DEVCOMDROID (Android DDL Interpreter) software, which can be used with the HI331 (Bluetooth Interface) to configure the HART→ equipment. However, the old PALM with HPC301, which is obsolete, continues to run normally.
They provide easy configuration and monitoring of field devices, capability to analyze data and to modify the action of these devices. The operation characteristics and use of each one of the configuration tool are stated on their respective manuals.

Figure 3.1 – DEVCOMDROID Configurator

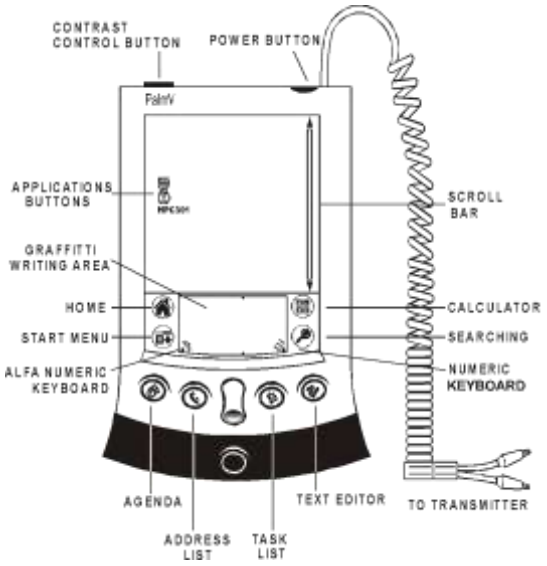


Figure 3.2 – Palm Configurator

Configuration Resources

Using HART® configurator, the **DT301** firmware allows the following configuration features to be accessed:

- ✔ Transmitter identification and manufacturing data
- ✔ Primary variable trim – density
- ✔ Primary variable trim – current
- ✔ Transmitter adjustment to the working range
- ✔ Engineering unit selection
- ✔ Linearization table
- ✔ Device configuration
- ✔ Equipment maintenance

Manufacturing Data and Identification

The following information about the **DT301** manufacturing and identification data is available:

TAG - 8-character alphanumeric field for transmitter identification.

DESCRIPTOR - 16-character alphanumeric field for additional identification of the transmitter. May be used to identify a service or location.

DATE - The date may be used to identify a relevant date as the last calibration, the next calibration or the installation. The date is presented in the form of bytes where DD = [1,..31], MM = [1..12], AA = [0..255], where the effective year is calculated by [Year = 1900 + AA].

MESSAGE - 32-character alphanumeric field for any other information, such as the name of the person who made the last calibration, some special care to be taken, or if a ladder is needed for accessing.

FLANGE TYPE - Ø 4” x 150 #ANSI B16.5 RF, Ø 4” x 300 #ANSI B16.5 RF, Ø 4” x 600 #ANSI B16.5 RF, DN 100 PN25/40, DIN2526-Forma D, 03 " Tri Clamp, Special.

FLANGE MATERIAL - 316L SST, Hastelloy C276, Special.

O-RING MATERIAL - Buna-N, Viton, Teflon and Special.

LOCAL INDICATOR - Installed or None.

REMOTE SEAL TYPE - Straight Type, Side Type.

REMOTE SEAL FLUID - DC200/20 Silicone Oil, DC704 Silicone Oil, Glycerin / Water, Sylthern 800, Propylene Glycol (NEOBEE M20).

REMOTE SEAL DIAPHRAGM - 316L SST, Hastelloy C276, Special.

SENSOR FLUID* - DC200/20 Silicone Oil, DC704 Silicone Oil, Glycerin / Water, Sylthern 800, Propylene Glycol (NEOBEE M20).

SENSOR ISOLATING DIAPHRAGM* - 316 SST, Hastelloy C, Monel, Tantalum and Special.

SENSOR TYPE* - It shows the sensor type.

SENSOR RANGE* - It shows the sensor range in engineering units chosen by user. See Configuration Unit.

NOTE
Items marked with asterisk cannot be changed. They come directly the sensor memory.

Trim of the Primary Variable – Density

Density, defined as a primary variable, is determined from the sensor reading through a conversion method. Such method uses parameters obtained during the manufacturing process. They depend on the electric and mechanical characteristics of the sensor, and on the temperature variation to which the sensor is submitted. These parameters are recorded in the sensor's EEPROM memory. When the sensor is connected to the transmitter, such information is made available to the transmitter's main board which relates the sensor signal and the measured density.

Sometimes, the measure shown on the transmitter's display is different from the user's standard. This may be due to several reasons, among which the following can be mentioned:

- The transmitter mounting position.
- The user's standard differs from the factory standard.
- Sensor's original characteristics shifted by overpressure, over temperature or other special conditions of use.

The concentration trim is the method used in order to adjust the measurement as related to the density/concentration of the process, as per the user's standard. The most common discrepancy found in transmitters is usually due to zero displacement. This may be corrected through the lower concentration trim.

Concentration Trim

This trim is done with the DT301 installed in the process fluid. Catch a sample of the process fluid and determine the density or concentration in laboratory. Enter the trim menu to adjust the lower concentration, informing the value read in laboratory or another standard.

Self Calibration Trim (Only for Adjust 250mm and 500mm Models)

Self calibration trim calibrates the transmitter considering as reference the air and water densities.

DT301 Self Calibration

First Step – Air Self calibration
Place the **DT301** in work position (vertical) and facing the air, wait approximately **5** minutes for stabilization, choose **Kg/m³** as measurement unit. Enter the **TRIM** menu, choose the option **AIR** self-calibration trim and click on **SEND**, when the indicated error is between ±0.4 Kg/m³**,** press OK.

Second Step – Water Self calibration
After air calibration, place the **DT301** in work position (vertical) and in water, immersing both diaphragms, wait approximately **5** minutes for stabilization and change the measurement unit to **Brix**. Enter the **TRIM** menu, choose the option **WATER** self-calibration trim and click **SEND**, when the indicated error is between ±0.1 Brix, press OK.

Figure 3.3 – Air Self Calibration

Figure 3.4 – Water Self Calibration

Following these steps, the **DT301** will be calibrated. In case there is a difference between the **DT301** and the standard used as reference, adjust the concentration in the process.

IMPORTANT:
Whin using 800mm distance between diafragms DT, the use ot self calibration will generate adjustment erros.

Temperature Trim

There might be differences between the Smar temperature standards and your temperature plant Standard. In this case, the Temperature Trim adjustment shall be done to correct this difference in the Temperature Trim menu.

Primary Variable Current Trim

When the microprocessor generates a 0% output signal, the Digital to Analog converter and associated electronics are supposed to deliver a 4 mA output. If the signal is 100%, the output should be 20 mA.

There might be differences between the Smar current standards and your current plant Standard. In this case, the Current Trim adjustment shall be done with a precision ammeter as measurement reference. Two Current Trim types are available:

- ✔ **4 mA TRIM:** this is used to adjust the output current value corresponding to **0%** of the measurement;
- ✔ **20 mA TRIM:** this is used to adjust the output current value corresponding to **100%** of the measurement;

The Current Trim shall be carried out as per the following procedure:

- ✔ Connect the transmitter to the precision ammeter;
- ✔ Select one of the Trim types;
- ✔ Wait a while for the current to stabilize and inform the transmitter the current reading in the precision ammeter.

NOTE
The transmitter has a resolution that allows the control of microampere currents. Therefore, when informing the current read to the transmitter, it is recommended that data input consider values up to tenths of microamperes.

Configuring the Transmitter to Working Range

This function affects, directly, the 4-20 mA output of the transmitter. It is used to define the working range of the transmitter and, in this document; this process is defined as transmitter calibration. The transmitter **DT301** has two calibration resources:

OUTPUT CURRENT CALIBRATION: The output current shall be calibrated so that lower concentration value represents 4 mA and the upper concentration value represents 20 mA;

MEASUREMENT CALIBRATION: The **DT301** is manufactured and calibrated in accordance with the customer's request. During the installation, some changes can occur on the device and an adjustment on the measurement can be necessary. If the required adjustment is only for the measurement engineering units, refer to the measurement item described below. If the adjustment requires changes in measurement values, perform calibration with reference.

DAMPING: The damping item in calibration menu enables damping factor adjustment of the engineering unit (PV) reading filter, performed by software. The damping is a digital filter which time constant can be adjusted between 0 and 32 seconds. The transmitter has intrinsic mechanical damping of 0.2 seconds.

MEASUREMENT

This function of configuration menu allows to select the transference function type that the transmitter will perform. There are several functions related with the measurement of density and concentration, and there is a special function which allows to check the 4 to 20 mA current generated by the transmitter. The following transference functions have been implemented:

- **Density**

The transference functions related to the density measurement correspond to the measurement of absolute density measurement, which takes into consideration the chemical properties of the solution and the physical properties of the medium, and to the relative density measurement, based on water density. Therefore, it is possible to perform measurements in the following units: kg/m^3, g/cm^3, SGU@ 20ºC, SGU@ 4ºC.

- **Concentration**

Such measurements inform the composition of a solution in comparison with several worldwide accepted units, such as: Baumé Degree, Plato Degree, Brix Degree and INPM Degree.

- **Constant Output**

This measurement allows the user to check the consistency of the input current generation values between 3.9 and 21 mA. This is also extremely important characteristic while performing the Loop Testing during the Startup of an Industrial plant.

DISPLAY

This option allows to configure up to two variables to be shown on the transmitter display. If the option is for only one variable, repeat the same variable as the second variable or, alternatively, none shall be chosen as the option for the second variable.

Engineering Unit Selection

The user can also choose the measured type:

- Density in g/cm³;
- Density in Kg/m³;
- Relative Density @ 20°C;
- Relative Density @ 4°C;
- Density in lb/ft³ ;
- Density in t/m³;
- Baume;
- Brix;
- Plato;
- INPM;
- GL;
- Solid Percent;
- API.
- Solid %

Solid Percent (% sol)
The concentration/ density transmitter DT301 offers resources with the objective of relating Baume degree to solid percent.

The general equation to determine the solid percent is:

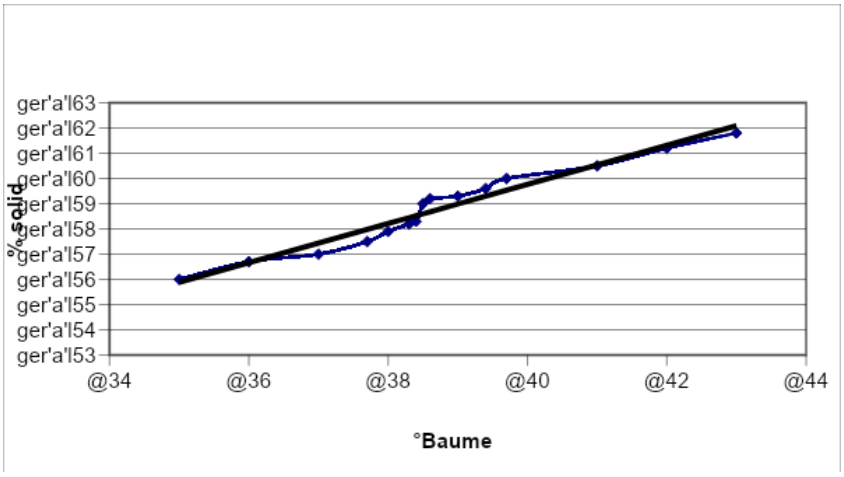
$$\%sol = a_0 + a_1\ bme^1 + a_2\ bme^2 + a_3\ bme^3 + a_4 bme^4 + a_5\ bme^5$$

The table and the graph below indicate the application of the **DT301** polynomial that relates Baume degree to solid percent, generating the polynomial:

$y = 0.004768x^4 - 0.760813x^3 + 45.407284x^2 - 1200.648795x + 11919.089787.$

NOTE
You can use the DT301 previously adjusted to obtain the measurement points and enter them into the calculation. The more points there are, the better the result. The minimum number of points to use is 6.

	X	
1	Bme	%SOL.
2	35	56
3	36	56,7
4	37	57
5	37,7	57,5
6	38	57,9
7	38,3	58,2
8	38,4	58,3
9	38,5	59
10	38,6	59,2
11	39	59,3
12	39,4	59,6
13	39,7	60
14	41	60,5
15	42	61,2
16	43	61,8



POLYNOMIAL REGRESSION

Concentration Percentage (% conc)
For applications that demand other relation among measures, the polynomial used is:

$$f(a,d,t) = a_0 + a_1 d + a_2 d^2 + a_3 d^3 + a\, d^4 + a_5 d^5 + a_6 d\, t + a_7 d^2 t + a_8 d^3 t + a_9 d\, t^2 + a_{10} d\, t^3 + a_{11} d^2 t^2 + a_{12} d^3 t^3 + a_{13} t + a_{14} t^2 + a_{15} t^3 + a_{16} t^4 + a_{17} t^5$$

This function is applied to a higher number of applications. It relates three measurements: density, temperature and concentration.

As the digital display used in **DT301** is of 4 ½ digits, the maximum indicated value would be 19999. When selecting the unit, make sure that in your application the value will not exceed 19999.

Equipment Configuration

The **DT301** enables the configuration of not only its operational services, but of instrument itself. This group includes services related to: input filter, burnout, addressing, display indication and passwords.

✔ **INPUT FILTER** - The input filter, also referenced to as damping, is a first class digital filter implemented by the firmware, where the time constant may be adjusted between 0 and 32 seconds. The transmitter's mechanical damping is 0.2 seconds;

✔ **BURNOUT** - The output current will remain fixed within the valves off. Lower Burnout or Upper Burnout, when a sensor fail occurs.

The user does not choose the upper and lower burnout current limits. These limits are previously determined in accordance with the transmitter version. The lower current limit is 3.9 mA and the latest versions comply with the specifications of standard NAMUR NE-43, that is, 3.6 mA. In what respects to the upper limit, all versions use the same limit: 21 mA. The selection of lower burnout and upper burnout is done through mode switching mechanism.

✔ **MONITORING -** This function allows the remote monitoring of one of the transmitter variables in the configurator display. To activate it, select “monit” in the main menu.

✔ **ADDRESSING** - The **DT301** includes a variable to define the equipment address in a HART® network. Addresses may go from value "0" to "15"; addresses from "1" to "15" are specific addresses for multidrop connections. This means that, in a multidrop configuration, the **DT301** will display the message MDROP for addresses "1" to "15";

NOTE
The output current will be increased to 4 mA as the **DT301** address is changed to another value than "0".

✔ **DISPLAY INDICATION** - the **DT301** digital display has three distinct fields: an information field with icons indicating the active configuration status, a 4 ½ digit numeric field for values indication, and a 5 digit alphanumeric field for units and status information.

The **DT301** can work with up to two display configurations to be alternately displayed at 2 second intervals. Parameters that may be selected for visualization are those listed on Table 3.1, below.

PV (%)	Process variable in percentage.
PV	Process variable in engineering units.
OUT (%)	Output in percentage.
OUT (mA)	Output in milliamperes.
TEMP	Process temperature.
S/INDIC	Used to cancel the second indication.

Table 3.1 - Variables for Indication in Display

✔ **PASSWORDS** - this service allows the user to modify the operation passwords used in the **DT301**. Each password defines the access for a priority level (1 to 3); such configuration is stored in the **DT301** FRAM. Password level 3 is hierarchically higher than the level 2 password, which is

higher than the level 1 password.

Equipment Maintenance

Here are grouped maintenance services related with the collection of information required for equipment maintenance. The following services are available: Order Code, Serial Number, Operation Counter and Backup/Restore.

✔ **ORDER CODE** - The Order Code is the one used for purchasing the equipment, in accordance with the User specification. There are 22 characters available in the **DT301** to define this code.

Example:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
D	T	3	0	1	I	1	I	S	0	0	7	5	1	0							

Industrial Model (I):
Range: 0 to 3000 kg/m³ (1);
Diaphragm of 316L SS (I);
Silicone Oil Fill Fluid DC 200/20 (S);
Without Local Indicator (0);
Electric Connection 1/2 - 14NPT (0);
Type of Assembly - Straight (7);
Connection to the Process 4” ASME B16.5 (5);
Pressure Class 150# (1)
Flange Face RF (0)

✔ **SERIAL NUMBER** - Three serial numbers are stored:

Circuit Number - This number is unique for all main circuit boards and cannot be changed.

Sensor Number – It is the serial number of the sensor connected to the **DT301** and cannot be changed. This number is read from the sensor every time a new sensor is inserted in the main board.

Transmitter Number - the number that is written at the identification plate of each transmitter.

NOTE
The transmitter number must be changed whenever the main board is changed to avoid communication problems.

✔ **OPERATION COUNTER** - Whenever any configuration increments its operation counter. The monitored items are:

LRV/URV: when any type of calibration is done;
Function: when any change in the transference function is done, e.g., linear, square root or table;
Trim_4mA: when the current trim is done at 4mA;
Trim_20mA: when the current trim is done at 20mA;
Trim_Zero/Lower: when density trim is done at Zero or Lower Density;
Trim Upper Density: when the trim is done at Upper Density;
Characterization: when any change is done in any point of the density characterization table in trim mode;
Multidrop: when any change is done in the communication mode, for example, multidrop or single transmitter.

✔ **BACKUP/RESTORE -** When the sensor or main circuit is changed, it is necessary, immediately after the assembly, to transfer the data of the new sensor to the main board or the old sensor data for the new main board.

Most of the parameters are automatically transferred. The calibration parameters, however, remain safe in the main board, so that the working range cannot be accidentally modified. When the replaced part is the sensor, it becomes necessary to transfer calibration data from the main board to the sensor and vice-versa if the replaced part is the main board.
Backup operation saves the contents of the main board in the sensor memory and the restore function performs the reverse operation.

Section 4

MAINTENANCE PROCEDURES

General

Smar **DT301** Intelligent Density/Concentration Transmitters are extensively tested and inspected before delivery to the end user. Nevertheless, during their design and development, consideration was given to the possibility of repairs by the end user, if necessary.

As main characteristics how much to the maintenance easiness it can be detached its modularity and its reduced number of electronic board.

In general, it is recommended that end users do not try to repair printed circuit boards. Spare circuit boards may be ordered from Smar whenever necessary.

The **DT301** concentration/density transmitter has been designed to operate for many years without malfunctions. In case the process application requires periodic cleaning of the repeater diaphragms, the flanges may be easily removed and reinstalled.

If the transmitter eventually requires maintenance, it may not be done in the field. In this case, the possibly damaged sensor should be returned to Smar for evaluation and, if necessary, repair. Refer to the item "Returning Materials" on this Section.

Diagnostic with Configurator

If any problem be noticed relating to the transmitter output, investigation may be carried out by the configurator, as long as power is supplied and communication and the processing unit are operating normally (see table 4.1).

The configurator should be connected to the transmitter according to the wiring diagram shown on Section 1.

Error Messages

When communicating using the configurator the user will be informed about any problem found by the transmitter self-diagnostics.

The error messages always are alternate with the information shown in the first line of Smar configurator display. The table 4.1 lists the error messages. For more details on the corrective action, see referred table.

ERROR MESSAGES	POTENTIAL SOURCE OF PROBLEM
PARITY ERROR **OVERRUN ERROR** **CHECK SUM ERROR** **FRAMING ERROR**	● The line resistance is not according to load curve. ● Excessive noise or ripple. ● Low level signal. ● Interface damaged. ● Power supply or configurator without battery.
NO RESPONSE	● Transmitter line resistance is not according to load curve. ● Transmitter not powered. ● Interface not connected or damaged. ● Transmitter configured in multidrop mode being accessed by ON LINE SINGLE UNIT. ● Transmitter reversibly powered (polarity is reversed). ● Interface damaged. ● Power supply or configurator without battery.
BUSY LINE	● Other device using the line.
CMD NOT IMPLEMENTED	● Software version not compatible between configurator and transmitter. ● Configurator is trying to perform a **DT301** specific command in a transmitter from another manufacturer.
XMTR MALFUNCTION	● Sensor disconnected. ● Sensor failure.

COLD START	● Start-up or reset due to power supplies failure.
OUTPUT FIXED	● Output in constant mode. ● Transmitter in multidrop mode.
OUTPUT SATURATED	● Pressure out of calibrated span or in fail-safe (Output current in 3.90 or 21.00 mA).
SV OUT OF LIMITS	● Temperature out of operating limits. ● Temperature sensor damaged.
PV OUT OF LIMITS	● Pressure out of operation limits. ● Sensor damaged or sensor module not connected. ● Transmitter with wrong configuration.
LOWER RANGE VALUE TOO HIGH	● The 4 mA point out of range limits.
LOWER RANGE VALUE TOO LOW	● The 4 mA point < (lower range limit).
UPPER RANGE VALUE TOO HIGH	● The 20 mA point > (upper range limit).
UPPER RANGE VALUE TOO LOW	● The 20 mA point < (lower range limit + minimum span).
UPPER & LOWER RANGE VALUES OUT OF LIMITS	● Both the 4 and 20 mA points were outside the sensor's range limit.
SPAN TOO SMALL	● The difference, between the 4 and 20 mA points, is less than the minimum span) allowed by the transmitter.
APPLIED PROCESS TOO HIGH	● The pressure applied on the sensor > (upper range limit).
APPLIED TOO LOW	● The pressure applied on the sensor < (lower range limit).
EXCESS CORRECTION	● The trim value applied exceeds the factory set value by more than 20% ●
PASSED PARAMETER TOO LARGE	● Parameter above operating limits.
PASSED PARAMETER TOO SMALL	● Parameter below operating limits.
CONTROL LOOP SHOULD BE IN MANUAL	● This message appears whenever the possibility exists that the operation will affect the 4-20 mA output signal. Thus, the transmitter must be disconnected from any control loop.
CONTROL LOOP MAY BE RETURNED TO AUTO	● After the operation is completed, it is recommended to return the control to automatic, ,i.e. connected to the control loop.

Table 4.1 - Diagnostic Error and Potential Source

Diagnostic without Configurator

Symptom*: NO LINE CURRENT*

Probable Source of Trouble:

Transmitter Connections
- Check wiring polarity and continuity.
- Check for short circuit or ground loops.
- Check if the power supply connector is connected to main board.

Power Supply
- Check power supply output. The voltage must be between 12 and 45 Vdc at transmitter terminals.

Electronic Circuit Failure
- Check the main board for defect by replacing it with a spare one.

Symptom*: NO COMMUNICATION*

Probable Source of Trouble:

Terminal Connections
- Check terminal interface connections.
- Check if the interface is connected to the transmitter connection wires or to the terminals [COMM] and [-].
- Check if the interface HART Protocol.

Transmitter Connections
- Check if connections are according to wiring diagram.

- Check line resistance; it must be equal to or greater than 250 Ohm between the transmitter and the power supply.

Power Supply
- Check output of power supply. The voltage at the **DT301** terminals must be between 12 and 45 V, and ripple less than 500 mV.

Electronic Circuit Failure
- Locate the failure by alternately replacing the transmitter circuit and the interface with spare parts.

Transmitter Address
- In ON LINE MDROP item check if the address is "0."

Symptom: *CURRENT OF 21.0 mA or 3.9 mA*

Probable Source of Trouble:

Pressure Tap (Piping)
- Check the pressure connection.
- Check if bypass valves are closed.
- Check if pressure applied is not over upper limit of transmitter's range.

Sensor to Main Circuit Connection
- Check connection (male and female connectors).

Symptom*: INCORRECT OUTPUT*

Probable Source of Trouble:

Transmitter Connections
- Check power supply voltage.
- Check for intermittent short circuits, open circuits and grounding problems.

Process Fluid Oscillation
- Adjust damping

Pressure Tap
- Check the integrity of the circuit by replacing it with a spare one.

Calibration
- Check the transmitter calibration.

NOTE
A 3.6 or 21.mA current indicates that the transmitter is in BURNOUT. Use the configurator to investigate the source of problem.

Procedure to change the DT301 Main Board

Please contact Smar Techsupport for instructions. They are different, depending on version.

Disassemble Procedure

WARNING
Do not disassemble with power on.

Figures 4.3 and 4.4 show transmitter's exploded view and will help you to understand the text below. The numbers between parentheses are relating to the enumeration of the items of the related drawing.

Probe Set (11A, 11B, 1A or 1B)

To have access to the probe for cleaning, it is necessary to remove it from the process.

Cleaning should be done carefully to avoid damaging diaphragms. Use of a soft cloth and a nonacid solution is recommended.

To remove the sensor from the electronic housing, the electrical connections (in the field terminal side) and the main board connector must be disconnected.

Loosen screw **(5)** and carefully remove the electronic housing from the sensor, only after removing main Board, you can rotate, probe removing.

IMPORTANT
Never twist probe flat cable connection.

WARNING
To avoid damage do not rotate the electronic housing more than 270º starting from the fully threaded without disconnecting the electronic circuit from the sensor and from the power supply. See Figure 4.1.

Figure 4.1 – Safe Housing Rotation

Electronic Circuit

To remove the circuit board, loosen the two screws that fasten the board.

WARNING
The board has CMOS components, which may be damaged by electrostatic discharges. Observe correct procedures for handling CMOS components. It is also recommended to store the circuit boards in electrostatic-proof cases.

Pull the main board out of the housing and disconnect the power supply and the sensor connectors.

Assemble Procedure

WARNING
Do not assemble with power on.

Probe Set (11A, 11B, 1A or 1B)

The bolts, nuts, flanges, and other parts should be inspected for corrosion or other eventual damage. Damaged parts should be replaced.

The fitting of the probe must be done with the main board out of the electronic housing. Mount the probe to the housing turning clockwise until it stops. Then turn it counterclockwise until it faces the protective cover **(1)** parallel to the process flange. Tighten the screw **(5)** to lock the housing to the sensor. Only install the main board after that.

Display

Plug sensor connector and power supply connector to main board.

Attach the display to the main board. Observe the four possible mounting positions (Figure 4.2). The Smar mark indicates up position.

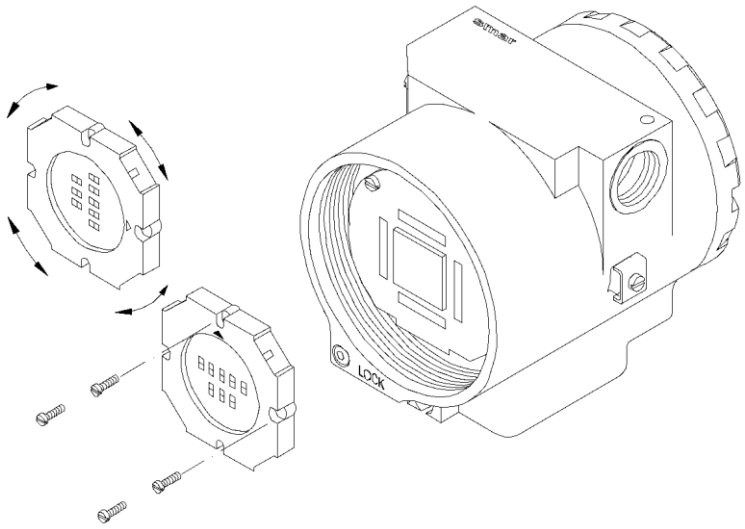


Figure 4.2 – Four Possible Positions of the Display

Fasten the main board and display with their screw **(3)**. After tightening the protective cover **(1)**, mounting procedure is complete. The transmitter is ready to be energized and tested.

Interchangeability

To obtain an accurate and better temperature compensation response, the data of the sensor should be transferred to the EEPROM of the main board. This is done automatically when the transmitter is powered.

In this operation, then main circuit reads the sensor serial number. If it is different from the number stored in the main board, the circuit considers that the sensor has been changed and it will search in the new sensor memory its characteristics:

- Temperature compensation coefficients.
- Sensor's trim data, including characterization curve;
- Sensor characteristics: type, range, diaphragm material and fill fluid.

The other information is stored in the main circuit memory and is not affected by sensor change.

Data transfer from the sensor to the main circuit can also be performed by function

MAINT/BACKUP/READ FROM SENSOR.

In the case of change of the main board, the sensor information, as described above are up-to-date. Even so, the transmitter information as upper value, lower value, damping and output unit must be reconfigured.

Returning Materials

Should it become necessary to return the transmitter and/or configurator to **SMAR**, simply contact our office, informing the defective instrument serial number, and return it to our factory.

To speed up analysis and solution of the problem, the defective item should be returned with the Service Request Form (SRF – Appendix B) properly filled with a description of the failure observed and with as much details as possible. Other information concerning to the instrument operation, such as service and process conditions, is also helpful.

Instruments returned or to be revised outside the warranty term should be accompanied by a purchase order or a quote request.

Isolation Test on Equipment Housing

1. Power off the equipment in the field, remove its back cover and disconnect all field cables from the transmitter terminal block, isolating them safely.

2. It is not necessary to remove the main board and display.

3. Jumper (connect) the power terminals (positive and negative) with the cable coming from the Megohmmeter (megger).

4. Configure the megohmmeter for 500 Vdc scale and check the isolation between the housing and the cable that short-circuits all the terminals.

ATTENTION
 Never test with a voltage greater than 500 Vdc.

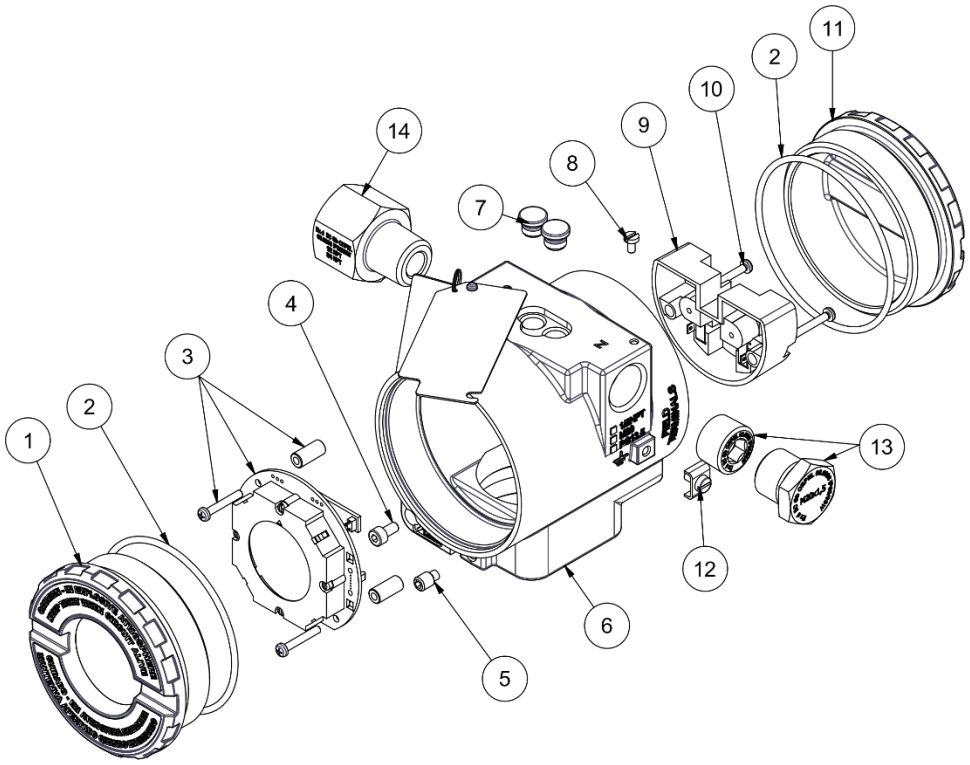
5. The value obtained must be greater than or equal to 2GΩ and the voltage application time must be at least 1 second and at most 5 seconds.

6. If the value obtained by the megohmmeter is below 2GΩ, the possibility of moisture entering the electrical connection compartment must be analyzed.

7. It is possible to loosen the two screws that secure the terminal block to the housing and carry out a superficial cleaning and dry the surface well. Afterwards, the isolation can be tested again.

8. If the isolation test still shows that the isolation has been compromised, the housing must be replaced and sent to Nova Smar S.A. for analysis and retrieval.

IMPORTANT
a) For equipment certified Exd and Exi (Explosion Proof and Intrinsically Safe) the standards advise not to carry out repairs in the field of the housing electronic components, only at Nova Smar S.A.
b) In normal use, the housing components must not cause failures that affect its isolation. For this reason, it is important to verify whether there are traces of water entering the housing and, if so, an assessment of the electrical installations and the sealing rings of the covers must be carried out. Nova Smar S.A. has a team ready to support the assessment of facilities, if necessary.



The letters x, after the codes, indicate continuation. See complete code in the manual.

14	1	¾ NPT AISI316 BR-EXD ADAPTER	
13	1	PG 13.5 AISI 316 BR-EXD EXTERNAL HEXAGON PLUG	
13	1	M20x1.5 AISI 316 BR-EXD EXTERNAL HEXAGON PLUG	
13	1	1/2 NPT AISI 304 BR-EXD INTERNAL HEXAGON PLUG	
13	1	1/2 NPT AC BICROM BR-EXD INTERNAL HEXAGON PLUG	
13	1	1/2 NPT AISI 304 INTERNAL HEXAGON PLUG (NO EXD)	
13	1	1/2 NPT AC BICROM INTERNAL HEXAGON PLUG (NO EXD)	
12	1	EXTERNAL GROUND SCREW	
11	1	COVER WITHOUT WINDOW	
10	1	TERMINAL BLOCK FIXING SCREW	
9	1	TERMINAL BLOCK	
8	1	IDENTIFICATION PLATE FIXING SCREW	
7	2	LOCAL ADJUSTMENT PROTECTION CAP (Z and S)	
6	1	HOUSING	
5	1	SENSOR LOCKING SCREW	
4	2	COVER LOCKING SCREW	
3	1	MAIN BOARD	
2	1	COVER O-RING	
1	1	COVER WITH WINDOW	
Item	Qt	Description	Code

NOTE ITEM 3
Access www.smar.com.br/en/support. In General support, look for Compatibility Note and refer to the document.

CODE	Description
400-1314	Housing; DT301

Option	Communication Protocol
H	HART & 4-20 mA
R	HART & 4-20 mA +

Option	Electrical Connection
0	½ NPT
A	M20 x 1.5
B	PG 13.5

Option	Material
H0	Aluminum (IP/TYPE)
H1	SST (IP/TYPE)
H2	Aluminum for Saline Atmosphere (IP W/TYPE X)
H4	Copper Free Aluminum (IP W/TYPE X)

Option	Painting
P0	Grey Munsell N6.5
P8	Without Painting
P9	Blue Safety Epoxy Base – Electrostatic Painting

400-1314	H	0	H0	P0	Typical Model Number

CODE	Description
400-1307	Cover

Option	Type
0	Without Window
1	With Window

Option	Material
H0	Aluminum (IP/TYPE)
H1	SST (IP/TYPE)

Option	Painting
P0	Grey Munsell N6.5
P8	Without Painting
P9	Blue Safety Epoxy Base – Electrostatic Painting

400-1307	1	H0-	P0	Typical Model Number

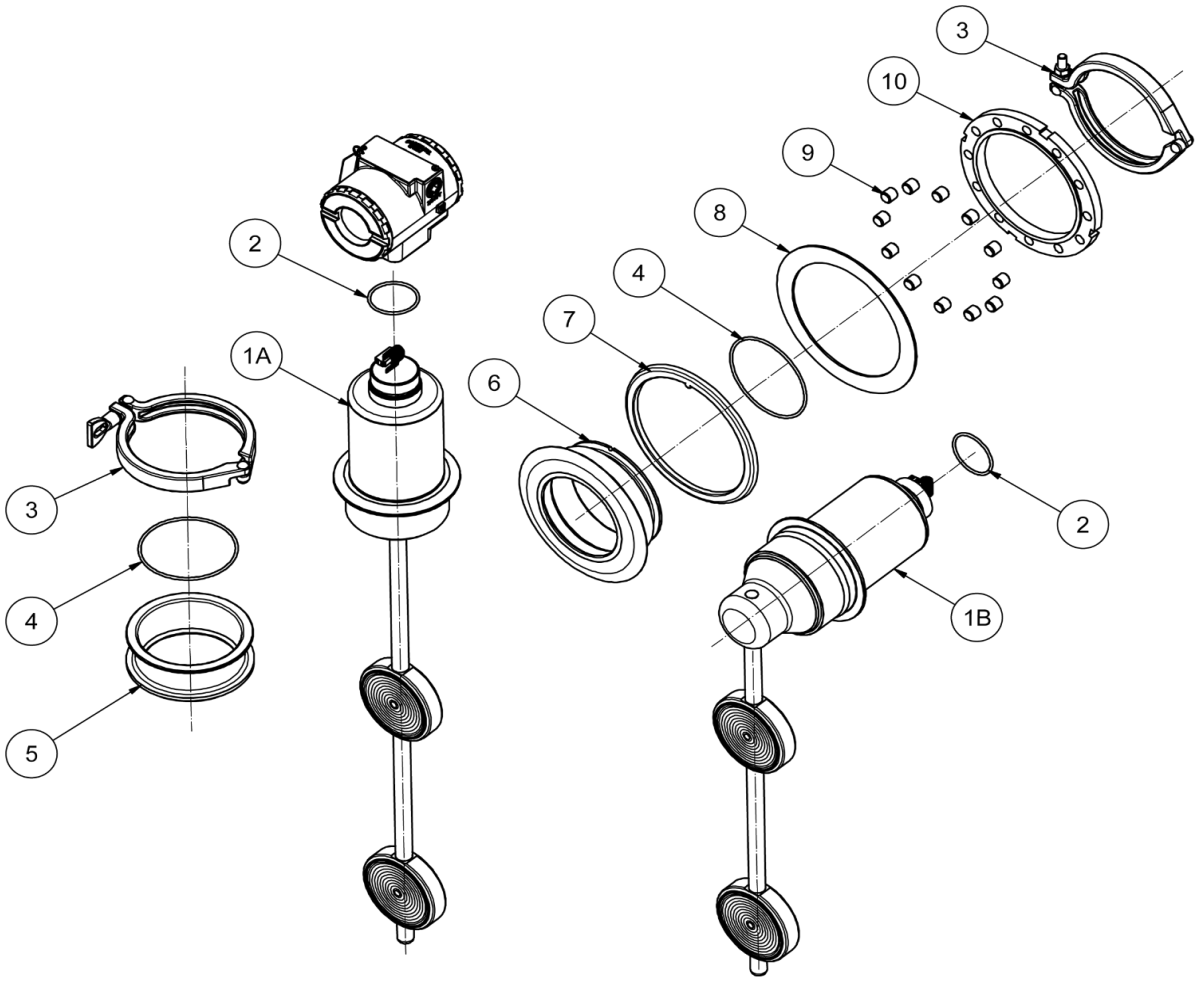


Figure 4.4 - DT301 - Exploded View (Sanitary Model)

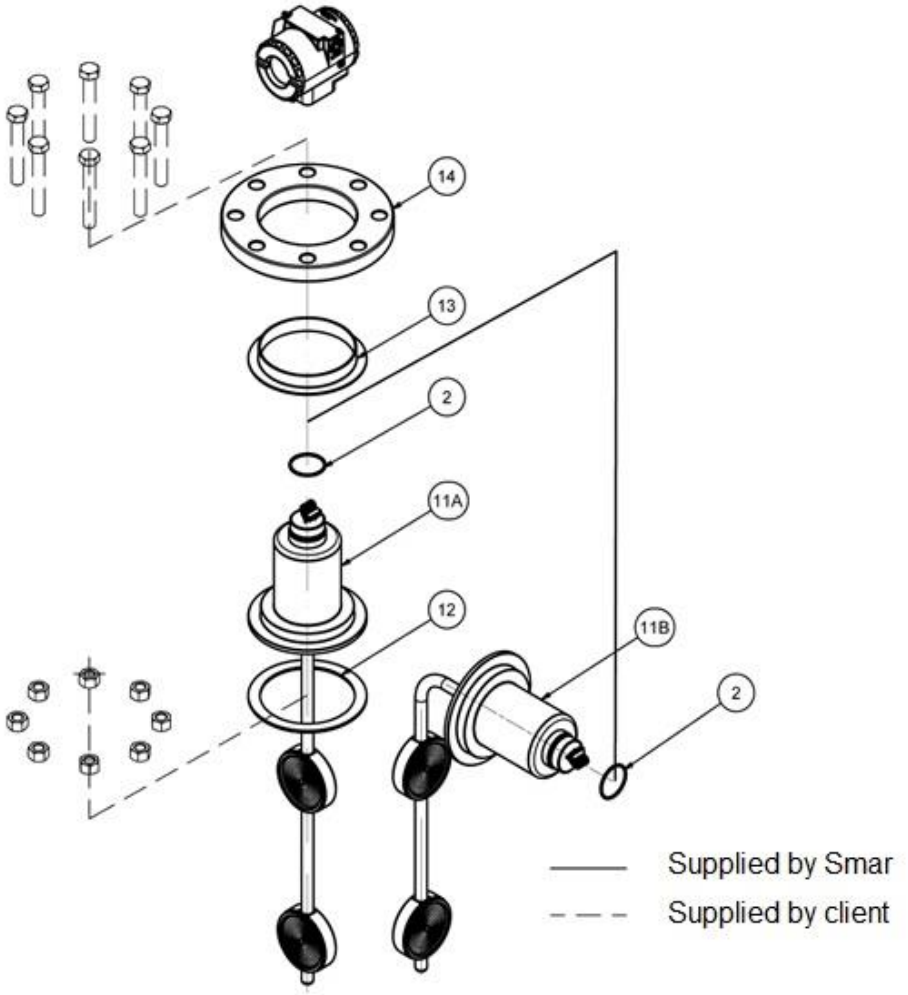


Figure 4.4 - DT301 - Exploded View (Industrial Model)

SPARE PARTS LIST			
DESCRIPTION OF PARTS	**POSITION**	**CODE**	**CATEGORY (NOTE 1)**
O-RINGS (NOTE 4)			
Neck, Buna-N	2	204-0113	B
Process connection, Buna-N (**Sanitary Model**)	4	400-0236	B
Process connection, Viton (**Sanitary Model**)	4	400-0813	B
Process connection, Teflon (**Sanitary Model**)	4	400-0814	B
PROCESS CONECTION – INDUSTRIAL MODEL			
Flange 4” – 150# ANSI B-16.5, 316L SST	14	400-0237	
Flange 4” – 300# ANSI B-16.5, 316L SST	14	400-0238	
Flange 4” – 600# ANSI B-16.5, 316L SST	14	400-0239	
Flange DN 100, PN 25 / 40, DIN 2526 – Form D, 316L SST	14	400-0240	
Teflon gasket	12	400-0720	
Teflon Insulation joint	13	400-0863	
PROCESS CONNECTION - SANITARY MODEL			
Tank Adapter for Straight Model – 316L SST	5	400-0241	
Tri-Clamp 4”, AISI316L SST (Clamp 304/ Nut 316L)	3	400-0242	
Tank Adapter for Curved Model – 316L SST	6	400-0721	
Silicon O Ring	7	400-0722	
Protection Flange	8	400-0723	
Tightening Flange	10	400-0724	
Tightening Flange Screw	9	400-0725	
PROBE			
Industrial Probe	11A or 11B	**(NOTE 5)**	B
Sanitary Probe	1A or 1B	**(NOTE 5)**	B

Table 4.2 - Spare Parts List

NOTE 1: For category A, it is recommended to keep in stock one set for every 25 pieces installed, and for category B, one set for every 50 pieces installed.
NOTE 2: Includes terminal block, bolts, and identification plate without certification.
NOTE 3: The main board of **DT301** and probe are items.
NOTE 4: O-rings and backup are packaged with 12 units.
NOTE 5: To specify sensors, use the following tables.

400-0243-S	Sanitary Model Probe

CLASS	RANGE
1	0 to 3 g/cm^3 (1)
2	0 to 10 g/cm^3

CLASS	Diaphragm Material / Probe
I	316L SST / SST
U	Hastelloy C276 / 316L SST

COD.	Fill Fluid
N	Propylene Glycol – Neobee

COD.	Mounting
1	Straight
2	Curved

400-0243-S	-	1	I	-	S	1

Typical Model

Note 1: Values referring to the 250 mm probe between centers. For a 500 mm probe, range 1 ranges from 0 to 2 g/cm3.

400-0243-I	Industrial Model Probe

CLASS	Range
1	0 to 3 g/cm^3 (1)
2	0 to 10 g/cm^3 (2)

CLASS.	Diaphragm Material / Probe
H	Hastelloy C276 / Hastelloy C276
I	316L SST / 316L SST
L	A.I 316L C/REV. HALLAR / A.I 316L C/REV. HALLAR
U	Hastelloy C276 / 316L SST
Z	Others - Specify

CLASS.	Fill Fluid
N	Propylene Glycol – Neobee Max 200
S	DC 200/20 - Silicone Oil

CLASS	Mounting
1	Straight
2	Curved

400-0243-I	-	1	H	-	S	1

Typical Model

Note 1: Values referring to the 250 mm probe between centers. For a 500 mm probe, range 1 ranges from 0 to 2 g/cm3 and 800 mm probe, varies from 0 to 1.8 g/cm3.
Note 2: Values referring to probes of 250 and 500 mm between centers. For 800 mm probe, range 2 ranges from 0 to 7 g/cm3.

Section 5

TECHNICAL CHARACTERISTICS

Filling Fluids

The filling fluid should be selected considering its physical properties for pressure, temperature limits and chemical compatibility with the process fluid. The latter is an important consideration in thermal expansion case the filling fluid contacts the process fluid due to a leakage.

The table 5.1 presents the filling fluids, which are available for the **DT301**, with some their physical properties and applications.

FILLING FLUID	VISCOSITY (cSt) at 25ºC	DENSITY (g/cm³) at 25ºC	THERMAL EXPANSION COEFFICIENT (1/ºC)	APPLICATIONS
Silicone DC 200 / 20	20	0.95	0.00107	General purpose – Standard
Neobee M20 (Food Grade)	9.8	0.90	0.001	Food and beverage, and pharmaceutical areas

Table 5.1 – Properties of Filling Fluids

Functional Specifications

Output Signal
Two-wire, 4-20 mA with superimposed digital communication. (HART® Protocol)

Power Supply
12 to 45 Vdc

Indicator
Optional 4½ - digit numerical and 5-character alphanumerical LCD indicator.

Hazardous Area Certifications
Refer to Appendix A.

Zero and Span Adjustment
Non-interactive, via digital communication.

Temperature Limits
Ambient: -40 to 85º C (-40 to 185º F)
Process: -20 to 150º C (-4 to 302º F)
Storage: -40 to 100º C (-40 to 212º F)
Digital Display: -10 to 60º C (14 to 140º F)

Failure Alarm
In case of sensor or circuit failure, the self-diagnostics drives the output to 3.6 or 21.0 mA, according to the user's choice.

Turn-on Time
Approximately 5.0 seconds.

Volumetric Displacement
Less than 0.15 cm^3 (0.01 in^3)

Static Pressure Limit
70 kgf/cm^2 (7 MPa) (1015 PSI)

Humidity Limits
0 to 100% RH

Damping Adjustment
0 to 32 seconds in addition to intrinsic sensor response time (0.2 s) (Via Digital Communication).

Configuration
Through digital communication using HART® Protocol.

Performance Specifications

Reference conditions: span starting at zero, temperature 25ºC (77ºF), atmospheric pressure, power supply of 24 Vdc, silicone oil filling fluid, isolating diaphragms in 316 L SS and digital trim equal to lower and upper range values.

RANGE	ACCURACY (1)	AMBIENT TEMPERATURE EFFECT	STABILITY (For 3 Months)	ZERO (2) STATIC PRESSURE (per 1 kgf/cm^2)
1	±0.0004 g/cm^3 (±0.1 ^{0}Bx)	0.003 kg/m^3	0.021 kg/m^3	0.001 kg/m^3
2	±0.0007 g/cm^3	0.013 kg/m^3	0.083 kg/m^3	0.004 kg/m^3

(1) Linearity, hysteresis, and repeatability effects are included.
(2) This systematic error can be eliminated by calibrating at the operating static pressure.

Power Supply Effect
±0.005% of calibrated span per volt.

Electro-Magnetic Interference Effect
Designed to comply with IEC 61326-1:2006, IEC 61326-2-3:2006, IEC 61000-6-4:2006 and IEC 61000-6-2:2005.

Physical Specifications

Electrical Connection
½ -14 NPT, PG 13.5 or M20 x 1.5.

Process Connection
Industrial model: AISI316L Stainless Steel Flange, in accordance with ASME B16.5 or EN1092-1 (Former DIN2526).
Sanitary model: AISI316L Stainless Steel Triclamp (Clamp 304/ Nut 316L).

Wetted Parts
Isolating diaphragms: 316L SST or Hastelloy C276.
Probe material: 316L SST, Hastelloy C276 or 316L SST with plated PFA / HALLAR.
O-ring for sanitary model: Buna-N, Viton™ or Teflon™

Non-wetted Parts
Electronic Housing: injected aluminum with electrostatic painting or 316 SST (NEMA 4X, IP67).
Cover o-rings: Buna-N.
Fill fluid: Silicone (DC200/20), or Neobee M20.
Identification plate: 316 SST.

Mounting
Side or top mounting.

Weight
Sanitary model: 9 kg (20 lb)
Industrial model: 12 kg (26.5 lb).

Ordering Code

MODEL DT301S	SANITARY CONCENTRATION/DENSITY TRANSMITTER

CODE	Range			
1	0	to	3 kg/cm^3	**Note**: These measurement ranges are provided for our standard Density Transmitter, 250 mm of distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500 and 800mm, please see table 1 page 5.4.
2	0	to	10 kg/cm^3	

CODE	Diaphragm/ Probe Material
I	316L SST/ 316L SST
U	Hastelloy C276 / 316L SST

CODE	Fill Fluid
N	Neobee - M20 Propylene Glycol
S	DC 200/20 - Silicone Oil

CODE	Local Indicator
0	Without Indicator
1	With Digital Indicator

CODE	Electrical Connection
0	½ - 14 NPT **(4)**
1	½ - 14 NPT x ¾ NPT (AI 316) – With Adapter **(5)**
2	½ - 14 NPT x ¾ BSP (AI 316) – With Adapter **(6)**
3	½ - 14 NPT x ½ BSP (AI 316) – With Adapter **(6)**
A	M20 X1.5 **(4)**
B	PG 13.5 DIN **(6)**
Z	Others - Specify

CODE	Mounting
1	Top – distance between centers 500 mm
2	Side – distance between centers 500 mm
3	Top – distance between centers 250 mm
4	Side – distance between centers 250 mm

CODE	Process Connection
J	Tri-clamp – 4”
K	SMS thread diameter 89 RD120-4

CODE	O-Rings Material
B	Buna-N
V	Viton
T	Teflon

CODE	Tank Adapter
0	Without Tank Adapter (Supplied by Customer)
2	Curved DT30XS with adapter for D>4M T tank
3	Curved DT30XS with adapter for 1.2M T < D < 3.8M T tank
4	Curved DT30XS with adapter for 0.5M T < D < 1M T tank
5	Straight DT30XS with adapter (welded)

CODE	Tri-Clamp
0	Without Tri-clamp
1	With Tri-clamp in 304 SST

CODE	Continues Next Page

DT301S	1	I	N	1	0	2	J	B	1	1	*

Typical Model Number

* Leave it blank for no optional items.

MODEL DT301S	SANITARY CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)

CODE	Identification Plate
I1	FM: XP, IS, NI, DI
I4	ATEX (EX-I, EX-D) GAS
I5	INMETRO (EX-D, EX-I) GAS
I6	Without Certification
I7	ATEX (EX I) MINING
IO	INMETRO (DUST)

CODE	Housing Material (1) (2)
H0	Aluminum (IP/Type)
H1	316 SST (IP/Type)
H2	Aluminum for Saline Atmosphere **(3)** (IPW/TypeX)
H3	316 SST for Saline Atmosphere **(3)** (IPW/TypeX)
H4	Copper Free Aluminum **(3)** (IPW/TypeX)

CODE	Special – See notes
Z0	Not Applicable
ZZ	See notes

CODE	Tag Plate
J0	With Tag
J1	Blank

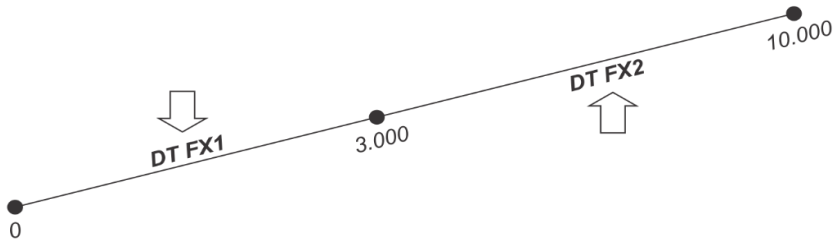
CODE	Display Unit
Y0	Percentage
Y2	1: Density/Concentration (Eng. Unit)
YU	User's Specification

CODE	Painting
P0	Gray Munsell N 6,5
P2	Blue Safety – Atmospheric Zone - Petrobras N1021
P3	Black Polyester
P8	Without Painting
P9	Blue Safety Epoxy – Electrostatic Painting

CODE	Manufacturing Standard
S0	SMAR

DT301S	I6	H0	Z0	J0	Y0	P0	S0

Typical Model Number



Notes

(1) IPX8 tested in 10 meters of water column for 24 hours.
(2) Ingress Protection:

Product	CEPEL	NEMKO / EXAM	FM	CSA	NEPSI
DT30X	IP66/68/W	IP66/68/W	Type 4X/6	Type 4X	IP67

(3) IPW / TypeX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
(4) Certification Ex-d for FM/ ATEX / IECEx / INMETRO.
(5) Certification Ex-d for INMETRO.
(6) Options not certified for Explosive Atmosphere.

Table 1

Dimensions between diaphragms (centers) mm	Limit Values	
	Measuring range fx1	Measuring range fx2
(mm)	(kg/m3)	(kg/m3)
250	0 - 3000	0 - 10000
500	0 - 2000	0 - 10000

MODEL DT301I	INDUSTRIAL CONCENTRATION/DENSITY TRANSMITTER

CODE	Range			
1	0	to	3 kg/cm^3	**Note**: These measurement ranges are provided for our standard Density Transmitter, 250 mm of distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500 and 800mm, please see table 1 page 5.7.
2	0	to	10 kg/cm^3	

CODE	Diaphragm Material / Probe
H	Hastelloy C276 / Hastelloy C276
I	SST / SST
L	316L SST with HALAR coating / 316L SST with HALAR coating
U	Hastelloy C276 / 316L SST
Z	Others - Specify

CODE	Fill Fluid
N	Neobee - M20 Propylene Glycol – Food Grade
S	DC 200/20 - Silicone Oil

CODE	Local Indicator
0	Without Indicator
1	With Digital Indicator

CODE	Electrical Connection
0	½ - 14 NPT **(4)**
1	½ - 14 NPT x ¾ NPT (AI 316) – With Adapter **(5)**
2	½ - 14 NPT x ¾ BSP (AI 316) – With Adapter **(6)**
3	½ - 14 NPT x ½ BSP (AI 316) – With Adapter **(6)**
A	M20 X1.5 **(4)**
B	PG 13.5 DIN **(6)**
Z	Others - Specify

CODE	Mounting
1	Top - Between Centre of the Sensors 500 mm
2	Side - Between Centre of the Sensors 500 mm
3	Top - Between Centre of the Sensors 800 mm
4	Side - Between Centre of the Sensors 800 mm
5	Top - Between Centre of the Sensors 250 mm
6	Side - Between Centre of the Sensors 250 mm
7	Top - Between Centre of the Sensors 250 mm with normalizer tube
Z	Special - See notes

CODE	Process Connection
5	4" ASME B 16.5
A	DN 100 EN 1092-1
Z	Others – Specify

CODE	Pressure Class
1	150#
2	300#
3	600#
C	PN 25/40
Z	Others - Specify

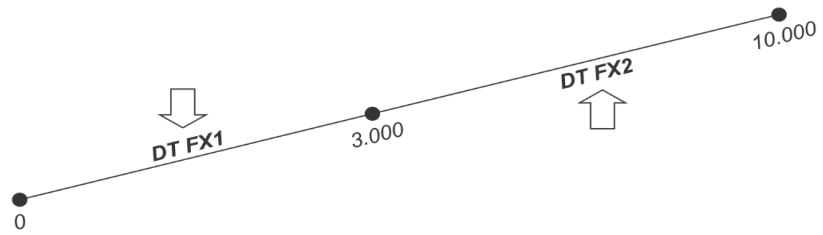
CODE	Flange Face
0	**RF**
2	**RTJ**

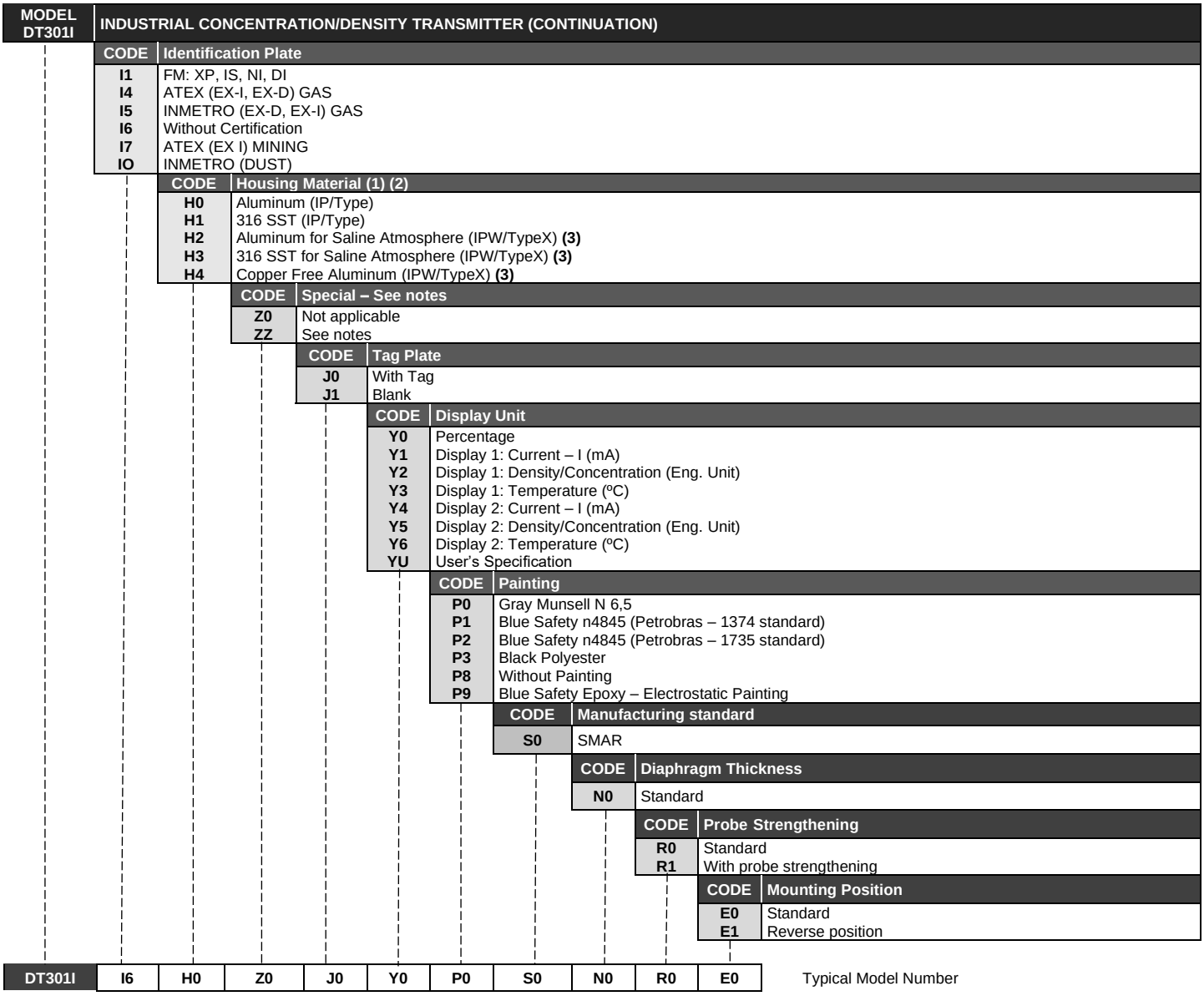
CODE	Continues Next Page

DT301I	1	I	S	1	0	1	5	1	0	*

Typical Model Number

* Leave it blank for no optional items.





MODEL DT301I	INDUSTRIAL CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)

CODE	Identification Plate
I1	FM: XP, IS, NI, DI
I4	ATEX (EX-I, EX-D) GAS
I5	INMETRO (EX-D, EX-I) GAS
I6	Without Certification
I7	ATEX (EX I) MINING
IO	INMETRO (DUST)

CODE	Housing Material (1) (2)
H0	Aluminum (IP/Type)
H1	316 SST (IP/Type)
H2	Aluminum for Saline Atmosphere (IPW/TypeX) **(3)**
H3	316 SST for Saline Atmosphere (IPW/TypeX) **(3)**
H4	Copper Free Aluminum (IPW/TypeX) **(3)**

CODE	Special – See notes
Z0	Not applicable
ZZ	See notes

CODE	Tag Plate
J0	With Tag
J1	Blank

CODE	Display Unit
Y0	Percentage
Y1	Display 1: Current – I (mA)
Y2	Display 1: Density/Concentration (Eng. Unit)
Y3	Display 1: Temperature (ºC)
Y4	Display 2: Current – I (mA)
Y5	Display 2: Density/Concentration (Eng. Unit)
Y6	Display 2: Temperature (ºC)
YU	User's Specification

CODE	Painting
P0	Gray Munsell N 6,5
P1	Blue Safety n4845 (Petrobras – 1374 standard)
P2	Blue Safety n4845 (Petrobras – 1735 standard)
P3	Black Polyester
P8	Without Painting
P9	Blue Safety Epoxy – Electrostatic Painting

CODE	Manufacturing standard
S0	SMAR

CODE	Diaphragm Thickness
N0	Standard

CODE	Probe Strengthening
R0	Standard
R1	With probe strengthening

CODE	Mounting Position
E0	Standard
E1	Reverse position

DT301I	I6	H0	Z0	J0	Y0	P0	S0	N0	R0	E0

Typical Model Number

Optional Items

Diaphragm Thickness	**N0** - Standard
	N1 – 0.1 mm
Strengthening of the Probe	**R1** – with strengthening of the probe
Mounting Position	**E1** – reverse position

Notes

(1) IPX8 tested in 10 meters of water column for 24 hours.
(2) Ingress Protection:

Product	CEPEL	NEMKO / EXAM	FM	CSA	NEPSI
DT30X	IP66/68/W	IP66/68/W	Type 4X/6	Type 4X	IP67

(3) IPW / TypeX tested for 200 hours according to NBR 8094 / ASTM B 117 standard.
(4) Certification Ex-d for FM/ ATEX / IECEx / INMETRO.
(5) Certification Ex-d for INMETRO.
(6) Options not certified for Explosive Atmosphere.

Table 1

Dimensions between diaphragms (centers) mm	Limit Values	
	Measuring range fx1	Measuring range fx2
(mm)	(kg/m3)	(kg/m3)
250	0 - 3000	0 - 10000
500	0 - 2000	0 - 10000
800	unavailable	350 - 7000

MODEL DT301M	SUBMERSIBLE CONCENTRATION/DENSITY TRANSMITTER

CODE	Range
1	0 to 3 kg/cm^3
2	0 to 10 kg/cm^3

Note: These measurement ranges are provided for our standard Density Transmitter, 250 mm of distance between diaphragms (centers) on the probe and are valid for straight and curved devices. For instruments with distance between centers of 500 mm, please see table 1 next page.

CODE	Diaphragm Material
H	Hastelloy C276

CODE	Probe Material
I	316L SST

CODE	Distance Between Centers
1	250 mm
2	500 mm

CODE	Fill Fluid
S	Silicone Oil DC 200/20

CODE	Normalizer Tube
0	Without Tube
1	With 304 SST Tube

CODE	Rod Type
1	316 SST Tubular Rod
2	Flanged Hose

CODE	Rod Length
1	1m
2	2m
3	3m
4	4m
5	5m
6	6m
7	7m
8	8m

CODE	Power Supply Cable Length
1	10m
2	15m

CODE	Continues Next Page

DT301M	1	H	I	1	S	0	1	1	1	*

Typical Model Number

* Leave it blank for no optional items.

MODEL DT301M	SUBMERSIBLE CONCENTRATION/DENSITY TRANSMITTER (CONTINUATION)

CODE	Identification Plate
I6	Without Certification

CODE	Tag Plate
J0	With Tag
J1	Blank
J2	According notes

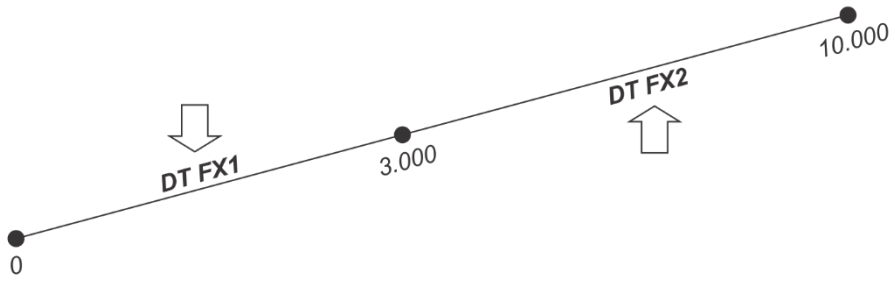
CODE	Centralizer
1	Standard
2	With Centralizer

CODE	Probe Strengthening
R0	Standard

DT301M	I6	J0	1	R0

Typical Model Number

Table 1		
Dimensions between diaphragms (centers) mm	Limit Values	
	Measuring range fx1	Measuring range fx2
(mm)	(kg/m3)	(kg/m3)
250	0 - 3000	0 - 10000
500	0 - 2000	0 - 10000



Appendix A

CERTIFICATIONS INFORMATION

European Directive Information

Consult www.Smar.com for the EC declarations of conformity and certificates.

Authorized representative/importer located within the Community:
Smar Europe BV De Oude Wereld 116 2408 TM Alphen aan den Rijn Netherlands

ATEX Directive 2014/34//EU - "Equipment for explosive atmospheres"
The EC-Type Examination Certificate is released by DNV Product Assurance AS (NB 2460) and DEKRA Testing and Certification GmbH (NB 0158).
Designated certification body that monitors manufacturing and released QAN (Quality Assurance Notification) is UL International Demko AS (NB 0539).

LVD Directive 2014/35/EU – "Low Voltage"
According the LVD directive Annex II, electrical equipment for use in an explosive atmosphere is outside the scope of this directive.
According to IEC standard: IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements.

PED Directive 2014/68/EU - "Pressure Equipment"
This product is in compliance with Article 4 paragraph 3 of the Pressure Equipment Directive 2014/68/EU and was designed and manufactured in accordance with the sound engineering practice. This equipment cannot bear the CE marking related to PED compliance. However, the product bears the CE marking to indicate compliance with other applicable European Community Directives.

ROHS Directive 2011/65/EU - "Restriction of the use of certain hazardous substances in electrical and electronic equipment"
For the evaluation of the products the following standards were consulted: EN IEC 63000.

EMC Directive 2014/30/EU - "Electromagnetic Compatibility"
For products evaluation, the standard IEC 61326-1 were consulted and to comply with the EMC directive the installation must follow these special conditions:
Use shielded, twisted-pair cable for powering the instrument and signal wiring.
Keep the shield insulated at the instrument side, connecting the other one to the ground.

Hazardous locations general information

Ex Standards:
IEC 60079-0 General Requirements
IEC 60079-1 Flameproof Enclosures "d"
IEC 60079-7 Increased Safe "e"
IEC 60079-11 Intrinsic Safety "i"
IEC 60079-18 Encapsulation "m"
IEC 60079-26 Equipment with Separation Elements or combined Levels of Protection
IEC 60079-31 Equipment dust ignition protection by enclosure "t"
IEC 60529 Classification of degrees of protection provided by enclosures (IP Code)
IEC 60079-10 Classification of Hazardous Areas
IEC 60079-14 Electrical installation design, selection and erection
IEC 60079-17 Electrical Installations, Inspections and Maintenance
IEC 60079-19 Equipment repair, overhaul and reclamation
ISO/IEC 80079-34 Application of quality systems for equipment manufacture

Warning:
Explosions could result in death or serious injury, besides financial damage.
Installation of this instrument in hazardous areas must be in accordance with the local standards and type of protection. Before proceedings with installation make sure that the certificate parameters are in accordance with the classified hazardous area.

Maintenance and Repair
The instrument modification or replaced parts supplied by any other supplier than authorized representative of Smar is prohibited and will void the Certification.

Marking Label
The instrument is marked with type of protection options. The certification is valid only when the type of protection is indicated by the user. Once a particular type of protection is installed, do not reinstall it using any other type of protection.

Intrinsic Safety / Non Incendive application
In hazardous areas with intrinsic safety or or non-incendive requirements, the circuit entity parameters and applicable installation procedures must be observed.
The instrument must be connected to a proper intrinsic safety barrier. Check the intrinsically safe parameters involving the barrier and equipment including the cable and connections. Associated apparatus ground bus shall be insulated from panels and mounting enclosures. Shield is optional, when using shielded cable, be sure to insulate the end not grounded.
Cable capacitance and inductance plus Ci and Li must be smaller than Co and Lo of the Associated Apparatus.
It is recommended do not remove the housing covers when powered on.

Explosionproof / Flameproof application
Only use Explosionproof/Flameproof certified Plugs, Adapters and Cable glands.
The electrical connections entries must be connected using a conduit with sealed unit or closed using metal cable gland or metal blanking plug with at least IP66.
Do not remove the housing covers when powered on.

Enclosure
The electronic housing and sensor threads installed in hazardous areas must have a minimum of 6 fully engaged threads.
The covers must be tightened with at least 8 turns, to avoid the penetration of humidity or corrosive gases, and until it touches the housing. Then, tighten more 1/3 turn (120º) to guarantee the sealing.
Lock the housing and covers using the locking screw.
The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction.
Care must be taken during installation and use to prevent impact or friction.

Degree of Protection of enclosure (IP)
IPx8: Second numeral meaning continuous immersion in water under special condition defined as 10m for a period of 24 hours (Ref: IEC60529).
IPW/ TypeX: Supplementary letter W or X meaning special condition defined as saline environment tested in saturated solution of NaCl 5% w/w at 35ºC for a period of 200 hours (Ref: NEMA 250/ IEC60529).
For enclosure with IP/IPW/TypeX applications, all NPT threads must apply a proper water-proof sealant (a non-hardening silicone group sealant is recommended).

Hazardous Locations Approvals

FM Approvals
FM20US0149X
XP Class I Division 1, Groups A, B, C, D
DIP Class II, III Division 1, Groups E, F, G
IS Class I, II, III Division 1, Groups A, B, C, D, E, F G
NI Class I, Division 2, Groups A, B, C, D
T4A; Ta = -25°C < Ta < 60°C; Type 4, 4X, 6

Electrical parameters: 30Vdc
Entity Parameters/Nonincendive Field Wiring Parameters:
Supply terminals: Vmax = 30 V dc, Imax = 110 mA, Ci = 5nf, Li = 0
Overpressure Limits: 1015 psi (report 3011728)

Special conditions for safe use:
The enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken during installation and use to prevent impact or friction.

Drawing 102A-0607, 102A-1200, 102A-1323

DNV
Explosion Proof (Nemko 03ATEX1375X)
II 2G Ex d IIC T6 Gb
Ambient Temperature: -20 ºC to +60 ºC
Options: IP66/68W or IP66/68

Special conditions for safe use:
Repairs of the flameproof joints must be made in compliance with the structural specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 1 and 2 of EN/IEC 60079-1.

The Essential Health and Safety Requirements are assured by compliance with:
EN 60079-0:2012 General Requirements
EN 60079-1:2007 Flameproof Enclosures “d”

Drawing 102A-1386, 102A-1480

DEKRA
Intrinsic Safety (DMT 01 ATEX E 151)
I M1 Ex ia I Ma
II 1/2 G Ex ia IIC T4/T5/T6, EPL Ga/Gb

Supply and signal circuit designed for the connection to an intrinsically safe 4-20 mA current loop:
Ui = 28 Vdc, Ii = 93 mA, Ci ≤ 5 nF, Li = Neg
Ambient Temperature: -40ºC ≤ Ta ≤ +85ºC

Maximum Permissible power:

Max. Ambient temperature Ta	Temperature Class	Power Pi
85°C	T4 and Group I	700mW
75°C	T4 and Group I	760mW
44°C	T5	760mW
50ºC	T5	700mW
55ºC	T5	650mW
60ºC	T5	575mW
65ºC	T5	500mW
70ºC	T5	425mW
40ºC	T6	575mW

The Essential Health and Safety Requirements are assured by compliance with:
EN 60079-0:2012 + A11:2013 General Requirements
EN 60079-11:2012 Intrinsic Safety “i”
EN 60079-26:2007 Equipment with equipment protection level (EPL) Ga

Drawing 102A-1386, 102A-1480, 102A-1267, 102A-1481

INMETRO NCC
Segurança Intrínseca (NCC 24.0147X)
Ex ia IIC T5 Ga
Ex ia IIIC T_{200} 100 ºC Da
Ui = 30 V Ii = 93 mA Pi = 0,7 W Ci = 5,0 nF Li = desp
Tamb: -20 °C a +50 °C
IP66/68 ou IP66W/68W

Prova de Explosão (NCC 24.0148)
Ex db IIC T6 Ga/Gb
Ex tb IIIC T85 ºC Da/Db
Tamb: -20 °C a +40 °C
IP66/68 ou IP66W/68W

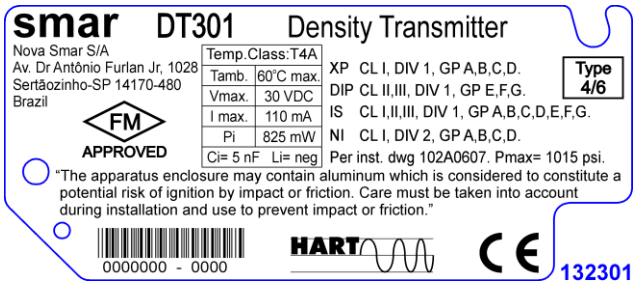
Observações:
O número do certificado é finalizado pela letra "X" para indicar que para a versão do Transmissor de densidade, intrinsecamente seguro, modelo DT301 equipado com invólucro fabricado em liga de alumínio, somente pode ser instalado em localização que exigem o “EPL Ga”, se durante a instalação for excluído o risco de ocorrer impacto ou fricção entre o invólucro e peças de ferro/aço.
O produto adicionalmente marcado com a letra suplementar "W" indica que o equipamento foi ensaiado em uma solução saturada a 5% de NaCl p/p, à 35 °C, pelo tempo de 200 h e foi aprovado para uso em atmosferas salinas, condicionado à utilização de acessórios de instalação no mesmo material do equipamento e de bujões de aço inoxidável ASTM-A240, para fechamento das entradas roscadas não utilizadas.
Os planos de pintura P1 são permitidos apenas para equipamento fornecido com plaqueta de identificação com marcação para grupo de gás IIB.
O grau de proteção IP68 só é garantido se nas entradas roscadas de ½” NPT for utilizado vedante não endurecível à base de silicone.
O segundo numeral oito indica que o equipamento foi ensaiado para uma condição de submersão de dez metros por vinte e quatro horas. O acessório deve ser instalado em equipamentos com grau de proteção equivalente.
É responsabilidade do fabricante assegurar que todos os transformadores da placa analógica tenham sido submetidos com sucesso aos ensaios de rotina de 1500 V durante um minuto.
Este certificado é válido apenas para os produtos dos modelos avaliados. Qualquer modificação nos projetos, bem como a utilização de componentes ou materiais diferentes daqueles definidos pela documentação descritiva dos produtos, sem a prévia autorização, invalidará este certificado.
As atividades de instalação, inspeção, manutenção, reparo, revisão e recuperação dos equipamentos são de responsabilidade dos usuários e devem ser executadas de acordo com os requisitos das normas técnicas vigentes e com as recomendações do fabricante.

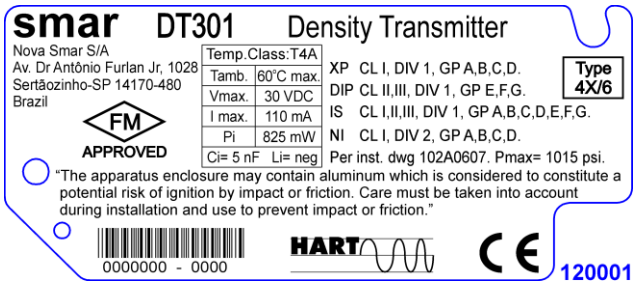
Normas Aplicáveis:
ABNT NBR IEC 60079-0:2020 Atmosferas explosivas - Parte 0: Equipamentos – Requisitos gerais
ABNT NBR IEC 60079-1:2016 Atmosferas explosivas - Parte 1: Proteção de equipamento por invólucro à prova de explosão “d”
ABNT NBR IEC 60079-11:2013 Atmosferas explosivas - Parte 11: Proteção de equipamento por segurança intrínseca "i"
ABNT NBR IEC 60079-26:2022 Atmosferas explosivas - Parte 26: Equipamentos com elementos de separação ou níveis de proteção combinados
ABNT NBR IEC 60079-31:2022 Atmosferas explosivas - Parte 31: Proteção de equipamentos contra ignição de poeira por invólucros “t”
ABNT NBR IEC 60529:2017 Graus de proteção providos por invólucros (Código IP)

Desenhos102A1358, 102A1198, 102A1994, 102A1993, 102A2077

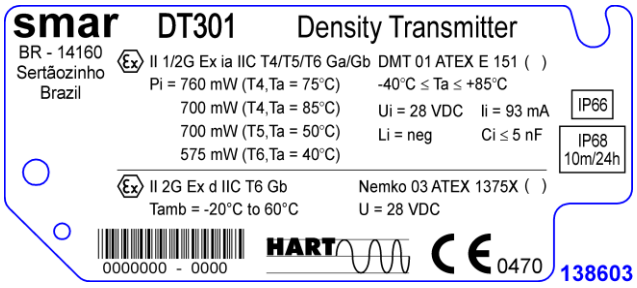
Identification Plate

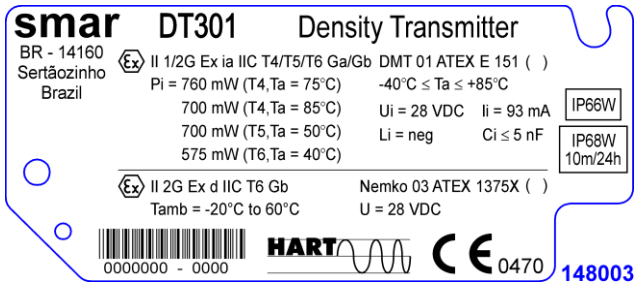
FM Approvals

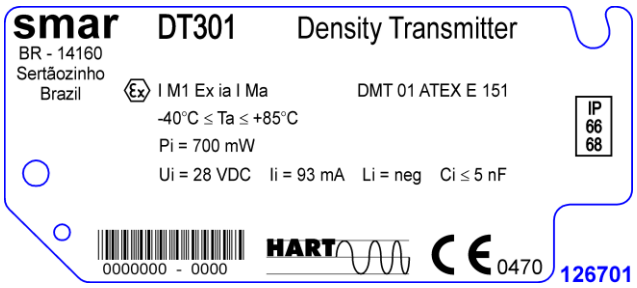


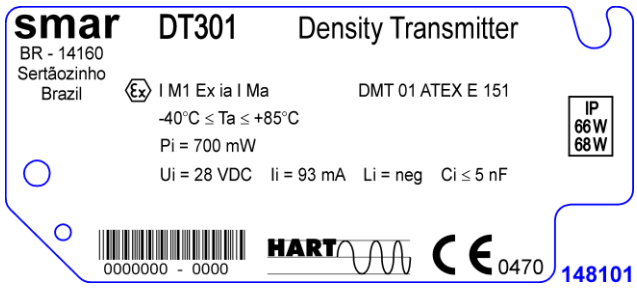


ATEX / IECEx

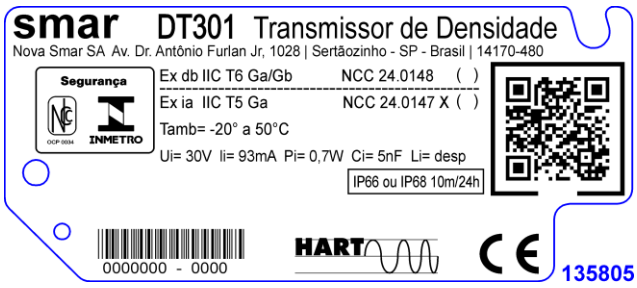


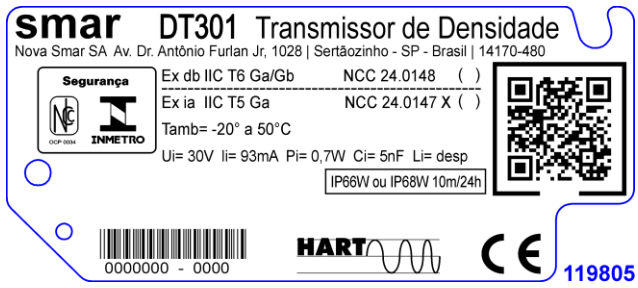


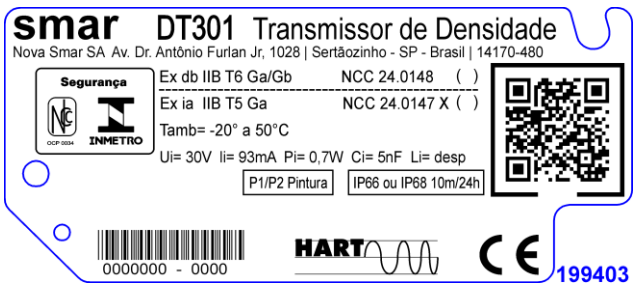


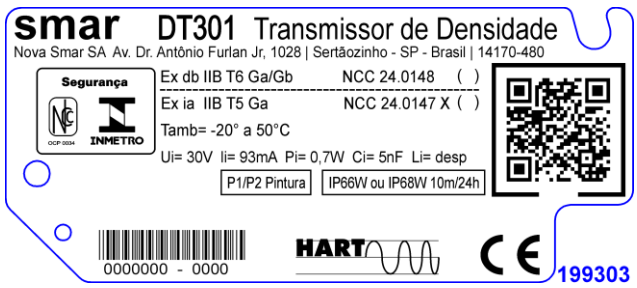


INMETRO NCC



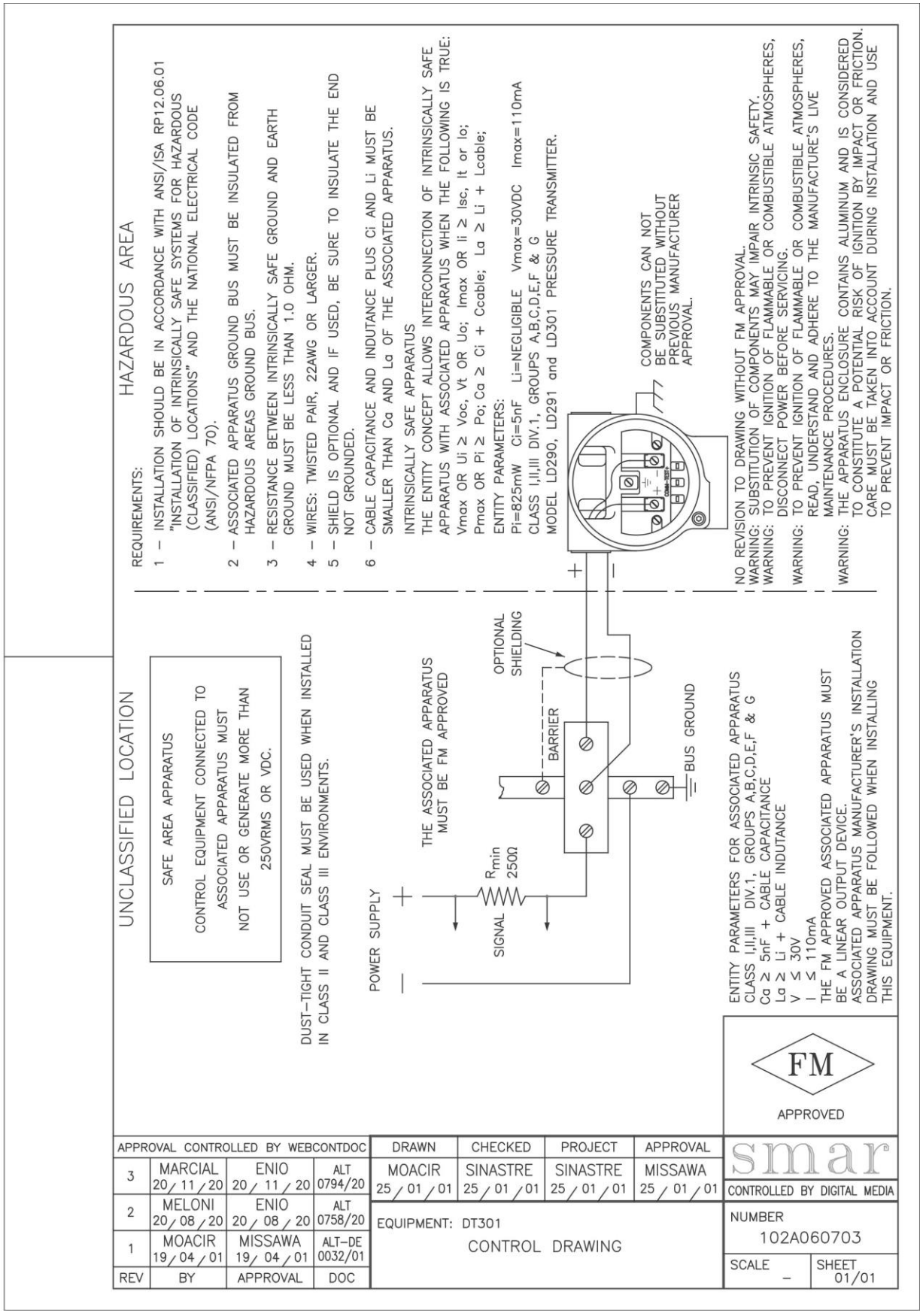







smar DT301 Transmissor de Densidade
Nova Smar SA Av. Dr. Antônio Furlan Jr, 1028 | Sertãozinho - SP - Brasil | 14170-480
Segurança
INMETRO
Ex tb IIIC T85°C Db NCC 24.0148 ( )
Ex ia IIIC T200100°C Da NCC 24.0147 X ( )
Tamb= -20° a 50°C
Ui= 30V Ii= 93mA Pi= 0,7W Ci= 5nF Li= desp
IP66 ou IP68 10m/24h
0000000 - 0000
HART
207704

FM Approvals



Appendix B

smar	**SRF – Service Request Form Density Transmitters**	**Proposal No.:**

Company:	**Unit:**	**Invoice:**

COMMERCIAL CONTACT	**TECHNICAL CONTACT**
Full Name:	**Full Name:**
Function:	**Function:**
Phone: **Extension:**	**Phone:** **Extension:**
Fax:	**Fax:**
Email:	**Email:**

EQUIPMENT DATA

Model:	**Serial Number:**	**Sensor Number:**
Technology: ( ) HART® ( ) FOUNDATION™ fieldbus ( ) PROFIBUS PA		**Firmware Version:**

PROCESS DATA

Process Fluid:

Calibration Range		**Ambient Temperature (ºF)**		**Process Temperature (ºF)**		**Process Pressure**	
Min.:	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**
Static Pressure		**Vacuum**		**Density**		**Concentration**	
Min.:	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**	**Min.:**	**Max.:**

Normal Operation Time:	**Failure Date:**

FAILURE DESCRIPTION

Please, describe the failure. Can the error be reproduced? Is it repetitive?

OBSERVATIONS

SUBMITTER INFORMATION

Company:

Contact: Title: Section:

Phone: Extension: E-mail:

Date: Signature:

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on https://www.smar.com.br/en/support**.**