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NMIM
NATIONAL METROLOGY INSTITUTE OF MALAYSIA

AKTA SISTEM PENGUKURAN KEBANGSAAN 2007
(AKTA 675)

No. Kelulusan: ASPK-0048-23

PERAKUAN KELULUSAN REKA BENTUK PADA ALAT-ALAT PENGUKUR

Perihalan	:	Alat Mengukur Suhu untuk Tangki Simpanan
Pembuat	:	Endress + Hauser Yamanashi Co. Ltd. Mitsukunugi Sakaigawa-cho 862-1 4060846 Fuefuki-shi Yamanashi, Japan
Jenama	:	Endress + Hauser
Model	:	Prothermo NMT81
Tahun pembuatan	:	2023
Penentuan teknikal	:	Lihat Spesifikasi Teknikal ASPK-0048-23
Catatan	:	Lihat nota

Adalah diperakukan bahawa alat mengukur suhu untuk tangki simpanan di atas telah diluluskan sebagai sesuai bagi kegunaan penguatkuasaan undang-undang tertakluk kepada syarat yang berikut:

Sebarang pengubahsuaian alat di atas wajib dimaklumkan kepada Penyimpan Timbang dan Sukat dan ianya tertakluk kepada kelulusan seterusnya.

Tarikh: 23/11/2023

Dr. OSMAN ZAKARIA (Nov 23, 2023 11:25 GMT+8)

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Ketua Metrologist
Institut Metrologi Kebangsaan Malaysia (NMIM)

Nota:

1. Perakuan ini berkaitan dengan kesesuaian alat di atas bagi kegunaan penguatkuasaan undang-undang sahaja berkenaan ciri-ciri metrologinya. Ia tidak boleh dijadikan atau membayangkan apa-apa jaminan mengenai keselamatannya dalam penggunaan bagi penguatkuasaan undang-undang atau selainnya.

2. Kelulusan ini adalah sah bagi tempoh 10 tahun dari tarikh kelulusan perakuan ini.

NATIONAL METROLOGY INSTITUTE OF MALAYSIA

ASPK-0048-23

Lampiran 1

TECHNICAL SPECIFICATION

DESCRIPTION	:	Temperature Measuring Device for Storage Tank
MANUFACTURER	:	Endress + Hauser Yamanashi Co. Ltd. Mitsukunugi Sakaigawa-cho 862-1 4060846 Fuefuki-shi Yamanashi, Japan
APPLICANT	:	Endress + Hauser (Tenaga) Sdn. Bhd. 4th Floor, Lot 10 Jalan Astaka U8/84, Seksyen U8 40150 Shah Alam, Selangor
MODEL	:	Prothermo NMT81

1.0 Essential Parts

1.1 Structure

The Prothermo NMT81 is a flexible metal corrugated tube with a permanently attached transmitter and a PT100 point sensor. Additionally, an independent display is available as an alternative (Figure 1).

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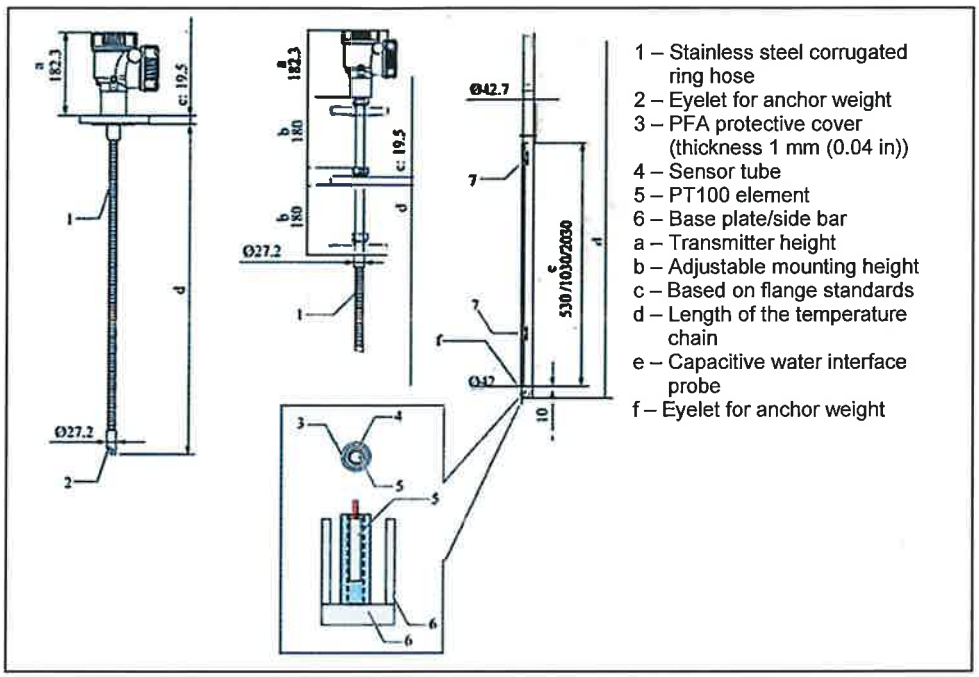


Figure 1 : Prothermo NMT81 in various configurations (from left): with welded flange, with adjustable flange, with water layer measurement

The data is transmitted to the tank gauge via a hart bus, which must have the requisite attributes to communicate with the NMT81(Figure 2 and Figure 3):

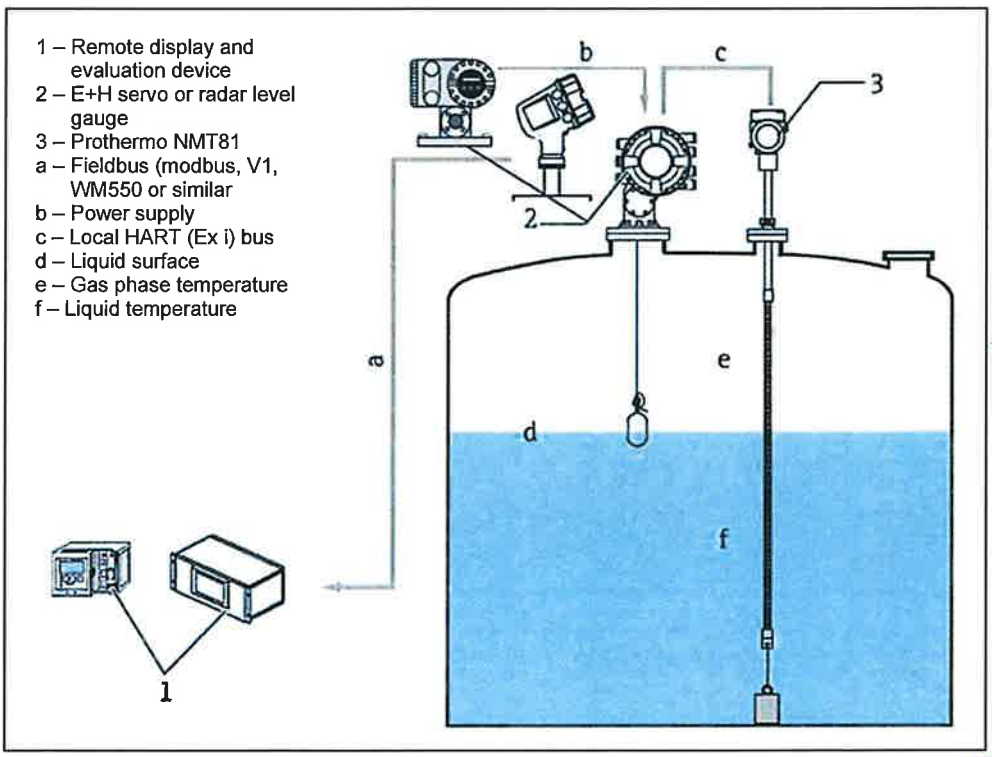


Figure 2 : Example of level gauge mounted on the tank roof

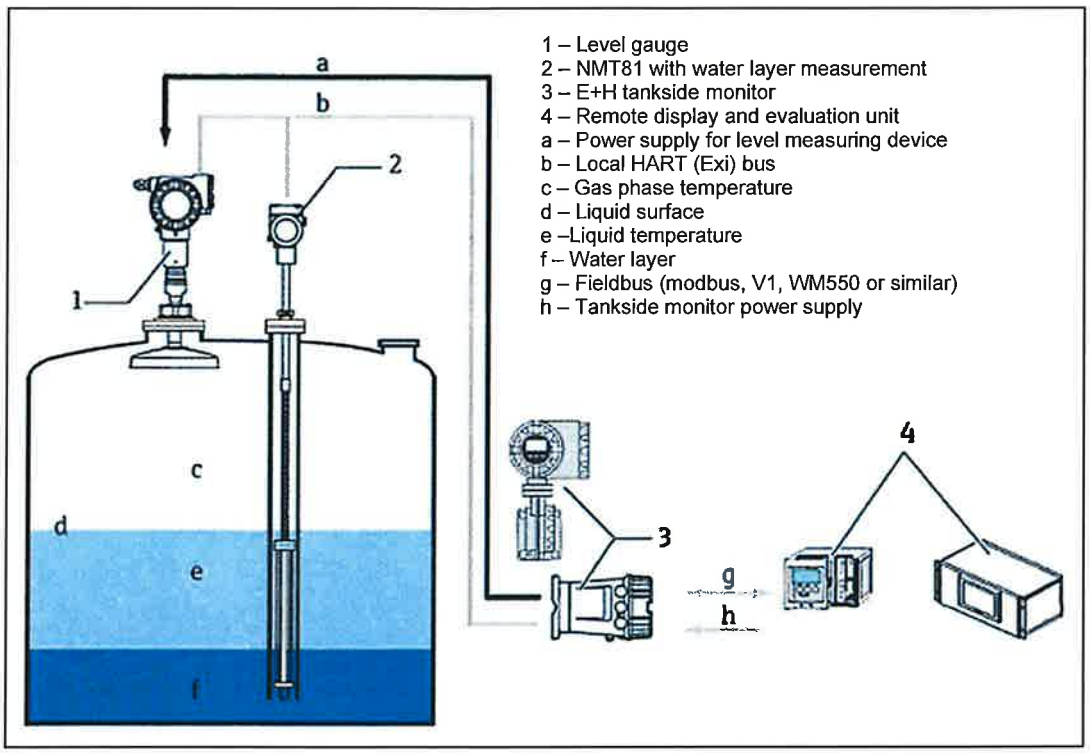


Figure 3 : Example of the connection of NMT81 with water layer measurement to a tank side monitor

1.2 Transducer

The temperature sensor comprises of a maximum of 24 measuring resistors with the PT100 characteristic, in classes 1/10 DIN class B or class A, housed in a flexible protective tube. Six measuring resistors from each connection are combined in a connector block before being routed to the transmitter in a four-wire arrangement. One line is routed in conjunction with these (Figure 4).

The first measuring resistor is positioned at the temperature sensor's lowest point. It is installed approximately 100 mm from the temperature sensor's base. As a standard for calculating average values, the location of the temperature transducer's lowest temperature element is set to 500 mm above the level zero reference.

The additional measurement resistors are either installed at predetermined locations along the chain or are distributed equally (maximum 3000 mm) throughout the length of the temperature sensor. The temperature sensor has a 99 m maximum length. Using up to four plug-in connections, the temperature transducer is linked to the transmitter.

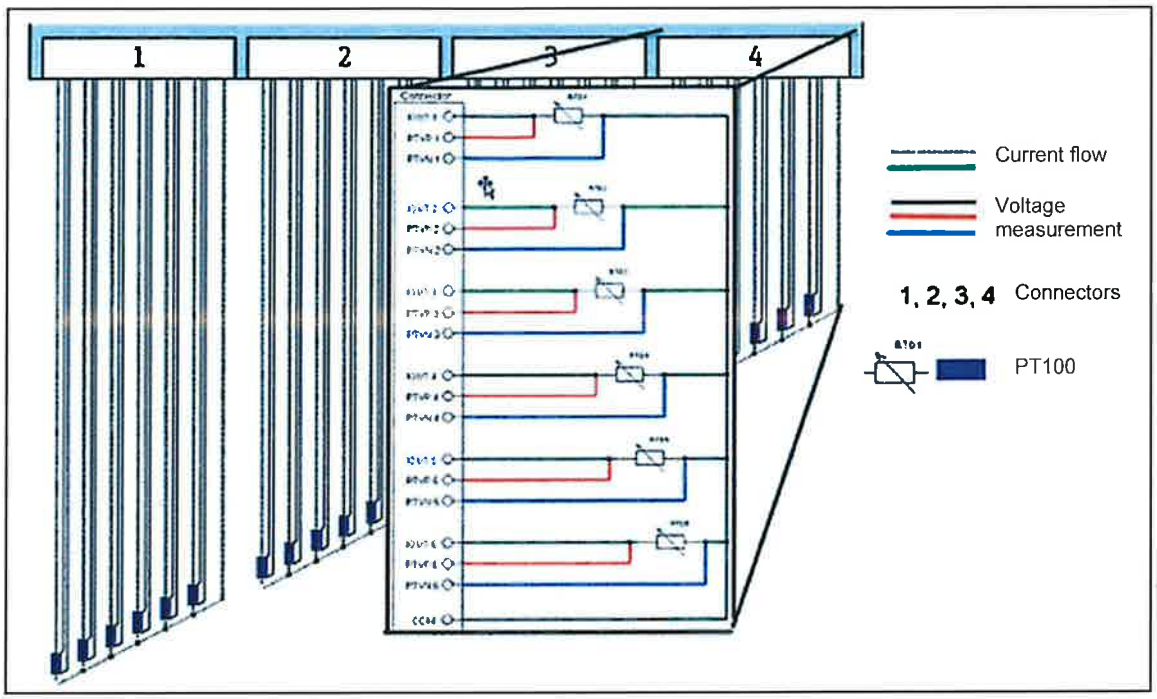


Figure 4 : Connection overview and details of the temperature measurement chain

The PT100 sensors can also be built in pairs in the temperature measurement chain, with up to 12 PT100 sensor pairs at roughly the same height. Each member of the pair is spread across various connectors (Figure 5). In this variation, the calculation of the average value makes equal use of the temperature correctors of both elements. In the event that one element fails, the remaining element is given double weighting. An error message is displayed, and the entire pair of components can be removed from the average calculation if the difference is greater than the given value.

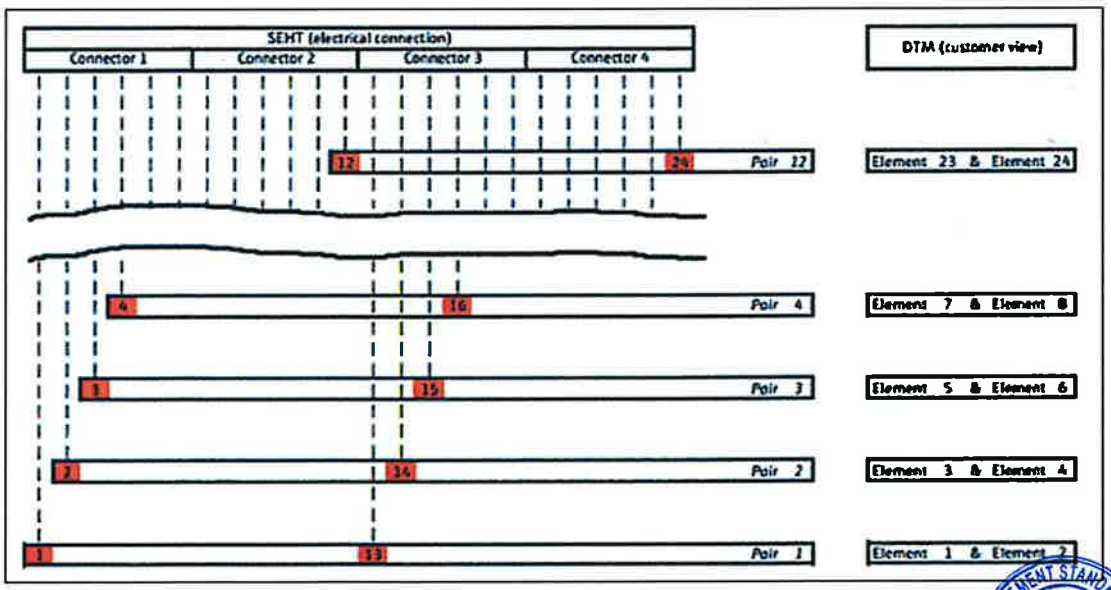


Figure 5 : Connection overview of the variation with redundant sensors

1.3 Measurement Value Processing

The measurement value processing comprises of hardware and software components as follow:

1.3.1 Hardware

The transmitter is equipped with a processor unit, a power supply, connections for a filter unit, and an optional C/F converter for measuring the water bottom (Figure 6). Figure 7 depicts the physical construction of the transmitter head. The resistance measurement measuring circuit and the formula for determining the single PT100 are shown in Figure 8.

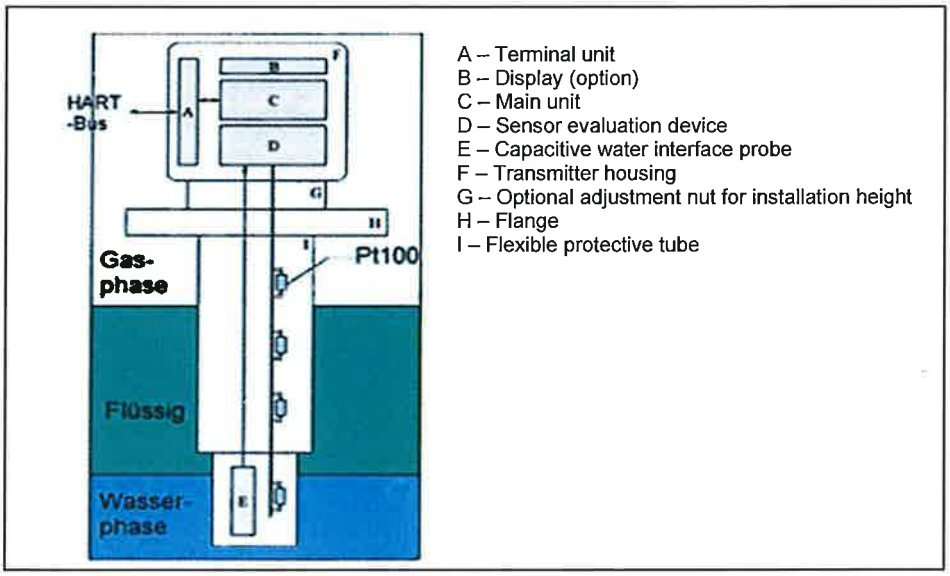


Figure 6 : Basic structure of NMT81

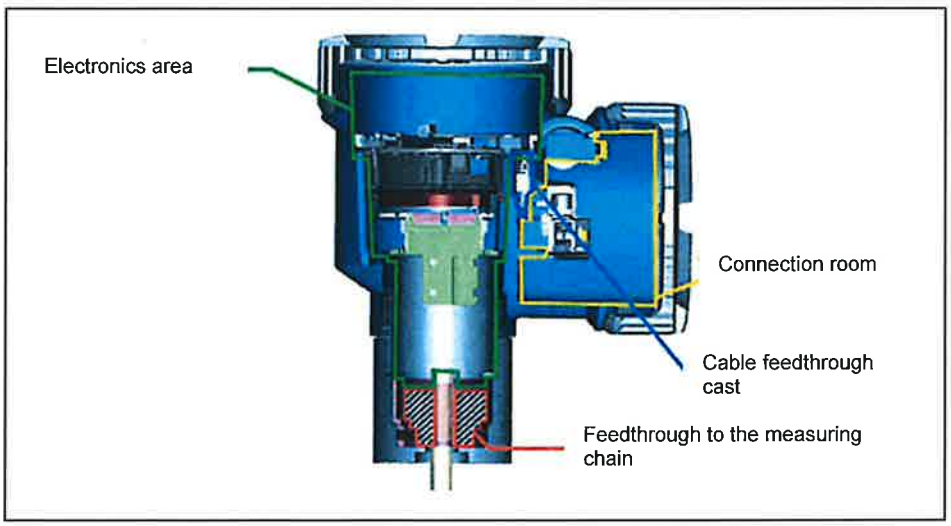
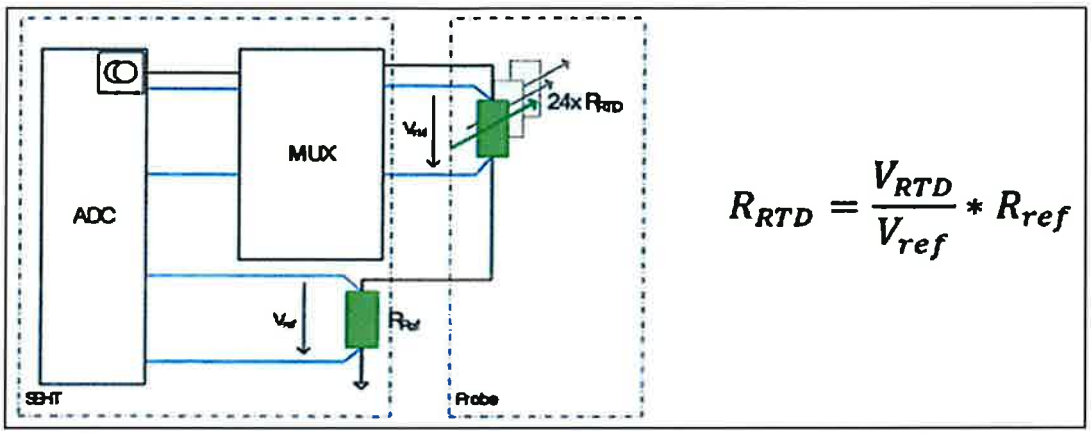


Figure 7 : Mechanical construction of the measuring head



$$R_{RTD} = \frac{V_{RTD}}{V_{ref}} * R_{ref}$$

Figure 8 : Principle measurement set-up and formula for calculating the measured resistance (Analog Digital Converter – ADC, MUX multiplexer)

1.3.2 Software

The built-in software processes the measured values in the most important modules as follows:

i) Element temperatures

- Measurement of the line-compensated resistance
- Conversion of the single-element resistance into the single-element temperature
- Calibrating the element temperature
- Adding the configured temperature offset to each individual temperature
- Providing the element temperatures as output
- Output of the resistance value and the temperature for the selected element
- Output of the reference resistors

ii) Average temperature

- Selection of the elements to be used for the average temperature calculation depending on the level supplied by the connected level meter
- Weighting of the element temperatures
- Calculation of average temperatures
- Output of the average temperatures for the specified filling heights

iii) System self-check

- Checking the programme memory (minimum every 15 minutes)
- Checking the configuration memory (< 10 seconds)

By comparing the checksums of the present memory contents and the programmed software version, the program memory is verified (Table 1). Depending on the program version, it is fixed. When the calibration interlock is activated, the configuration's checksum is calculated and fixed.

Table 1 : Software version and checksum

Software Version	Checksum
1.01.00	0xdc3573e3

1.4 Display of the Measured Values

The measured value is displayed in the connected Endress + Hauser level measuring device (radar, Proservo or tank idemonitor).

2.0 Technical Data

2.1 Nominal Operating Conditions and Environmental Conditions Characteristics

i)	Measuring range	:	-50 °C to +120 °C.
ii)	Minimum immersion depth	:	500 mm.
iii)	Settling time	:	< 30 minutes (water).
iv)	Ambient temperature range	:	-40 °C to +70 °C.

2.2 Calibration Error Limits

i)	Error limits for the measuring range	:	0.5 °C.
ii)	Error limits for the temperature transducer	:	0.3 °C.
iii)	Error limits for the electronic display device	:	0.2 °C.

3.0 Reference

Reference should be made to the following documents for additional information on this temperature measuring device for storage tank:

i) Physikalisch-Technische Bundesanstalt Type Examination Certificate No. DE-22-M-PTB-0048.

ii) PTB-A 14.7 (Temperature Measuring Devices in Tank Installations – Tank Thermometers).

4.0 Conditions for Approval

i) Validity of the approval is 10 years. The approval applies only to temperature measuring device for storage tank, design, composition, construction and performance of which are identical to that described in the material submitted, and that are typified by samples submitted for evaluation for approval.

5.0 Identification

Figure 9 : Photo of Prothermo NMT81.
Figure 10 : Mechanical seals of Prothermo NMT81.
Figure 11 : Electronic seals of Prothermo NMT81.

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Figure 9 : Photo of Prothermo NMT81

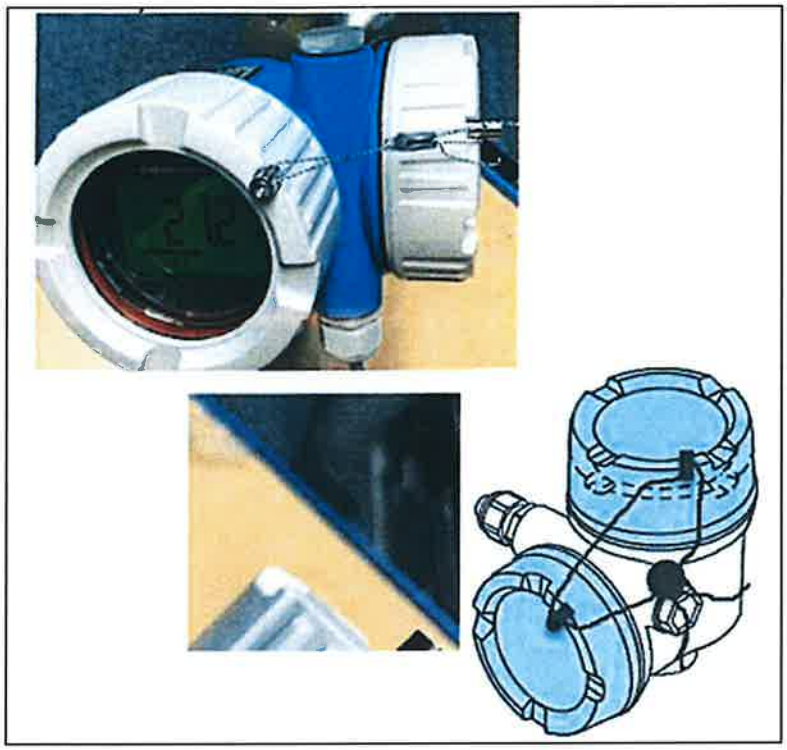

Figure 10 : Mechanical seals of Prothermo NMT81

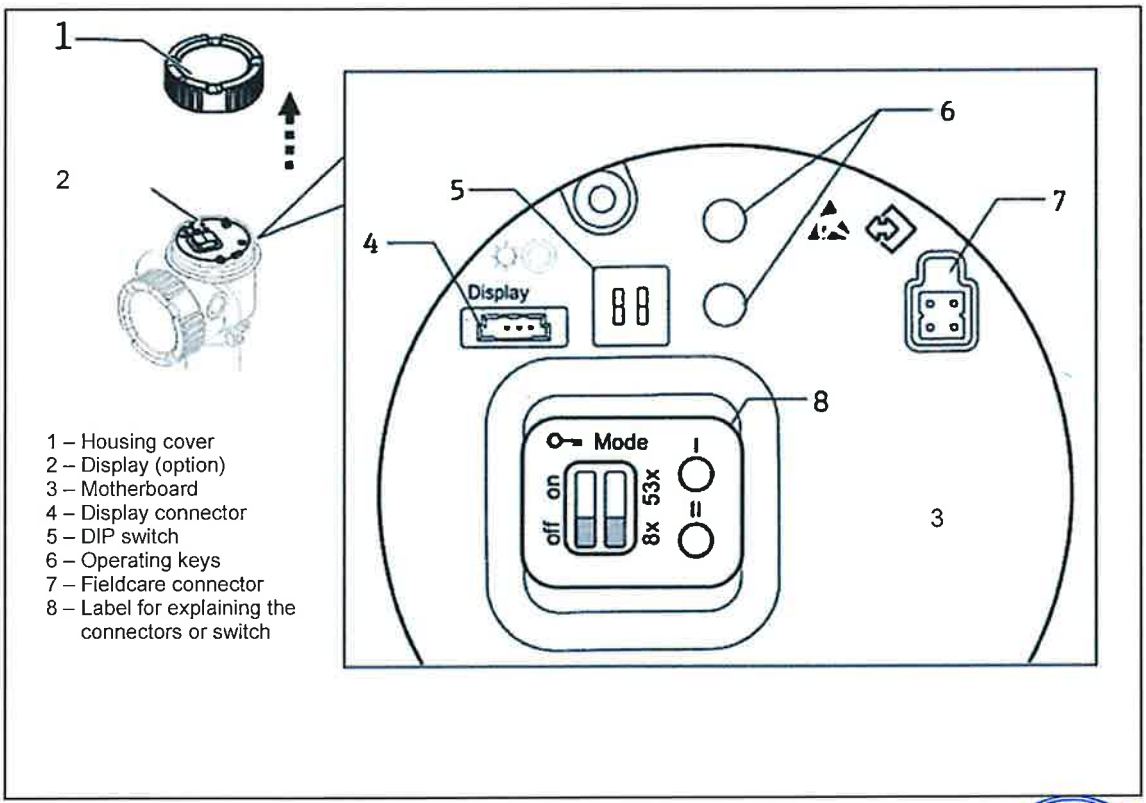

Figure 11 : Electronic seals of Prothermo NMT81