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Technical Information Proservo NMS5

Intelligent Tank Gauge with High Accuracy Performance Liquid Level, I/F, Density & Density Profile Application



Application

Proservo NMS5 of intelligent tank gauges is designed for high accuracy liquid level measurement in storage and process applications.
It fulfills the exact demands of tank inventory management, loss control, total cost saving and safe operation.

Typical areas of application include:

- Oil (fuels), LPG/LNG, Chemicals, Water / chemical interface measurement Alcohols

Tank mounted intelligence makes the NMS5 ideal for single or multi-task installation, converting a wide range of measurement functions including:

- Liquid level, Interface level, Spot density, Density profile, Tank bottom, Water Drop

Features and benefits

- SIL2 Certified
- Measures liquid to an accuracy of +/- 0.7 mm
- Measures two clear interface levels and specific gravity of up to three liquid phases
- Profiling of liquid density throughout the tank (Tank profile) and upper layer (I/F profile)
- Latest microtechnology keeps the design simple, lightweight and compact
- Wetted parts are completely separated from the electronic circuit
- Tank top mounting with 3” flange weighing only 12kg (aluminum version)
- Wide range of output signals including V1, RS 485, WM550, M/S, Enraf BPM and HART protocol
- Material and pressure rating of the wetted parts can be selected according to the application.
- Suitable for atmospheric and high pressure applications up to 2.45MPa/24.5bar
- Maintenance prediction of the instrument
- Direct connection of spot or average temperature probes
- Easy to program using the E+H matrix system
- Robust IP67/NEMA 4X housing
- Selectable English, Japanese or Chinese display
- Proactive safety diagnostics output to display and System Operators (patent pending)

Endress+Hauser
People for Process Automation

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Notes on safety conventions and symbols

Symbols for Safety Conventions

Symbol	Meaning
 A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
 A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
 A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
 A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for Certain Types of Information

Symbol	Meaning
 A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
 A0011183	**Recommendation** Indicates procedures, processes or actions that are recommended.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.

Function and system design

System design

NMS5 is an intelligent tank gauge for measuring liquid levels with high precision, and employing the latest microprocessor technology. In addition to gauging level, NMS5 can measure the interfaces between up to three liquids, density, and tank bottom. To enable accurate volume calculation or simple indication, NMS5 will accept input from either an average temperature probe NMT 53x series (via twisted pair cables, HART protocol) or spot temperature element (via 3 wire Pt. 100 RTD signal). Once installed, all calibration and operating functions can be done via the user friendly Matrix program and touch sensitive keypad. Tank side monitoring and liquid measurement operation can be performed by the Promonitor NRF560.

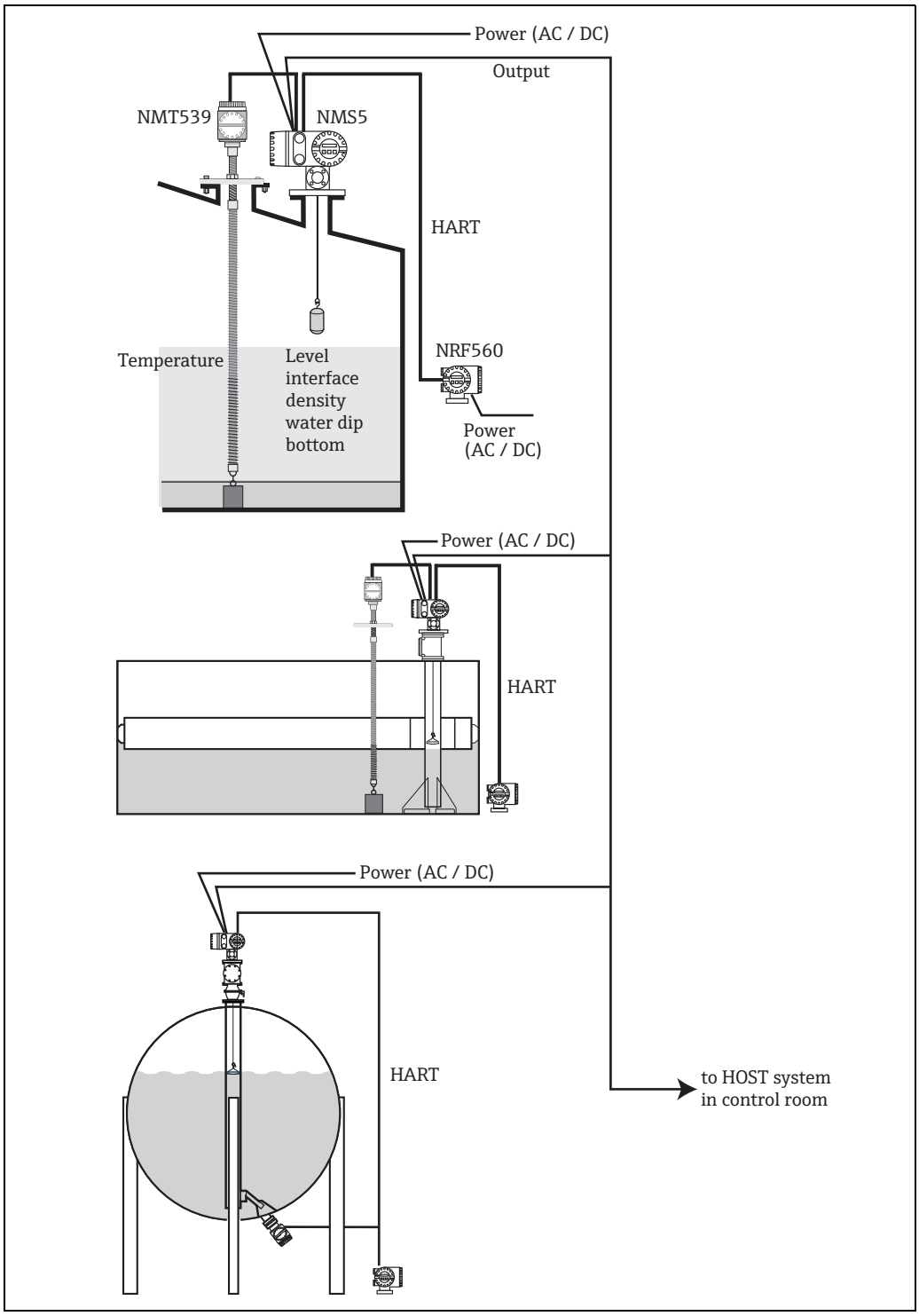


Figure 1: Measuring system

System configuration

- From single tank level measurement to the largest oil refinery applications, NMS5 can be an integral part of tank farm management solutions. A wide variety of data output protocols are available for seamless integration into many commonly used systems.
- A primary example is Endress+Hauser's revolutionary Tankvision., A scalable concept, offering local tank management for up to 225 tanks via Modbus, V1 or Whessomatic 550 protocols. Accumulated data is available to DCS and other plant management systems via a Host Link.
- Output protocols
  - Modbus, RS485 or current loop
  - V1 serial pulse
  - Whessomatic 550
  - local HART
  - Mark/Space
  - Enraf BPM

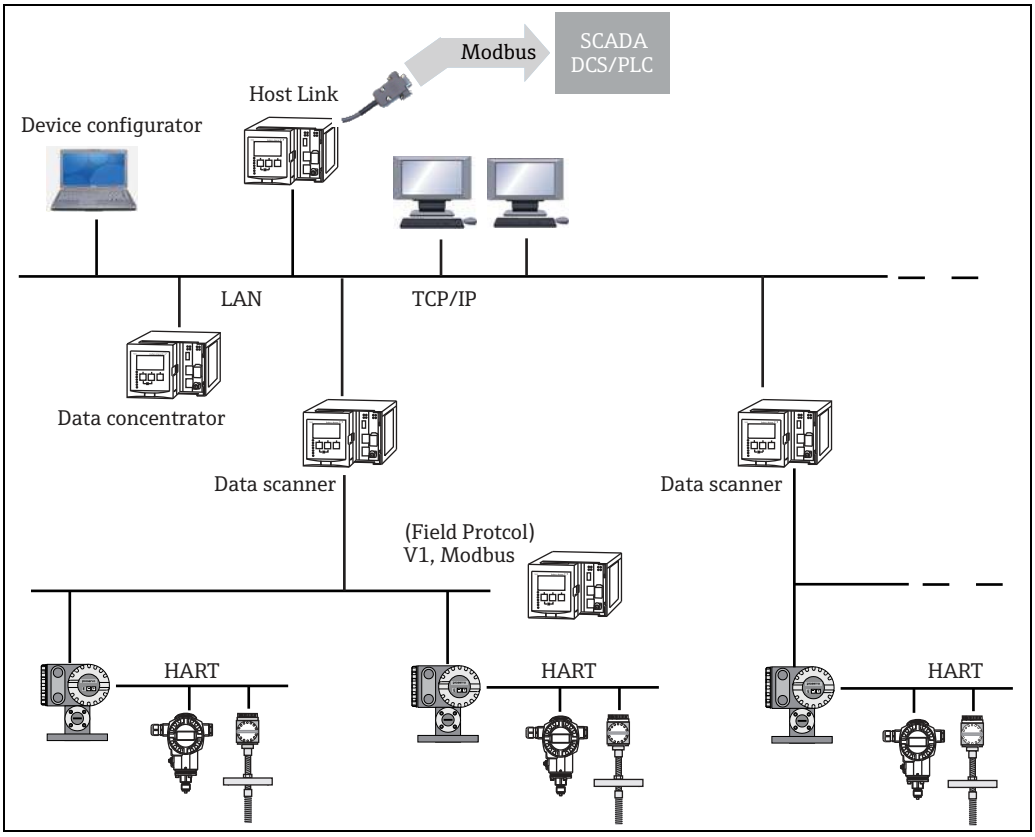


Figure 2: NMS5 system configuration serial pulse output

Major application

The number of measuring functions and output options as well as the lightweight compact design enables NMS5 to be installed in a wide range of applications at minimal cost.

Petroleum industry
From oil production to storage at an oil depot, there exists an extensive need to measure and manage a wide variety of products. Remote tank gauging and an inventory management system combined into NMS5 and a receiving computer is an ideal way to measure and manage tank contents.

Chemical industry
A wide choice of products are available in the wetted parts construction manufacturing industry, to ensure chemical compatibility and long life.

Power plant
Oil levels are a major applications where precise measurement is required to ensure safe operation.

Operating principle

A small displacer is accurately positioned in a liquid medium using a servo motor. The displacer is then suspended on a measuring wire which is wound onto a finely grooved drum housing. NMS5 counts the rotation of the wire drum and calculates the traveling distance of the wire and then obtain the liquid level change.The drum is driven via coupling magnets which are completely separated by the drum housing. Outer magnets are connected to the wire drum whilst inner magnets are connected to the drive motor. As the inner magnets turn, their magnetic attraction causes the outer magnets to turn, as well, causing the entire drum assembly to turn. The weight of the displacer on the wire creates torque on the outer magnets generating change of magnetic flux. These changes generated in the drum assembly are detected by a unique electromagnetic transducer on the inner magnets. The drive motor is actuated to balance the voltage generated by variations of magnetic flux to equal the reference voltage defined by operating commands.When the displacer is lowered and touches a liquid, the weight of the displacer is reduced by liquid buoyancy force. As a result, torque in the magnetic coupling changes, which is measured by 5 sets of Hall sensors, (patented) chips which are temperature compensated. A signal, indicating the position of the displacer, is sent to the motor control circuit. As the liquid levels rise and fall, the displacer position is adjusted by the drive motor. The rotation of the wire drum is precisely evaluated to determine level value.

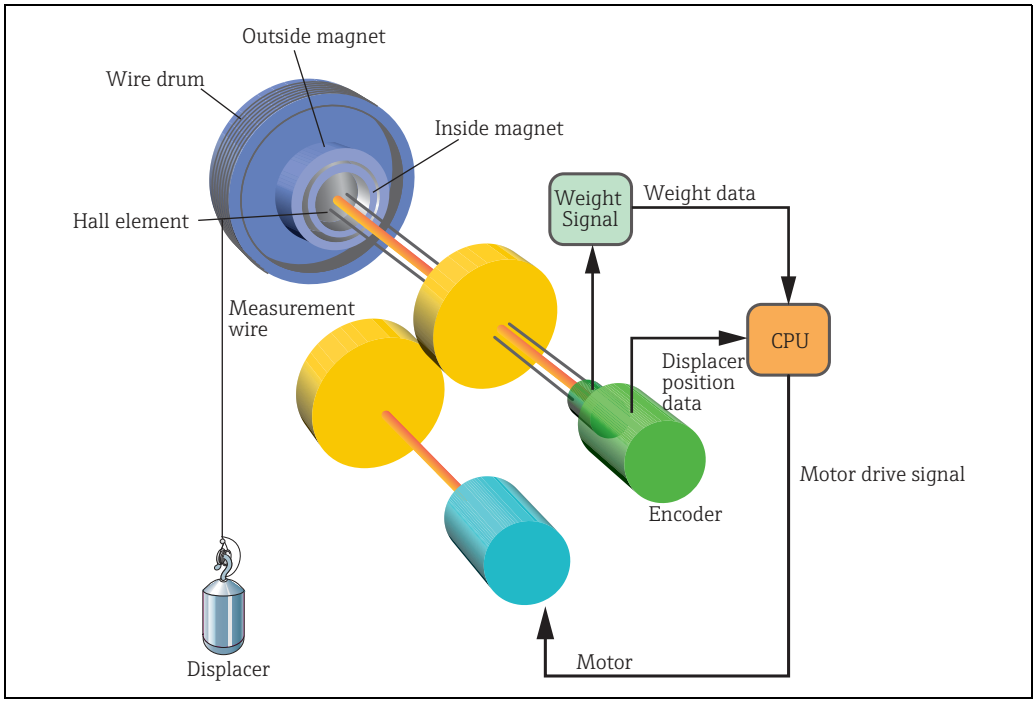


Figure 3: Direct torque detection

Typical tank installation

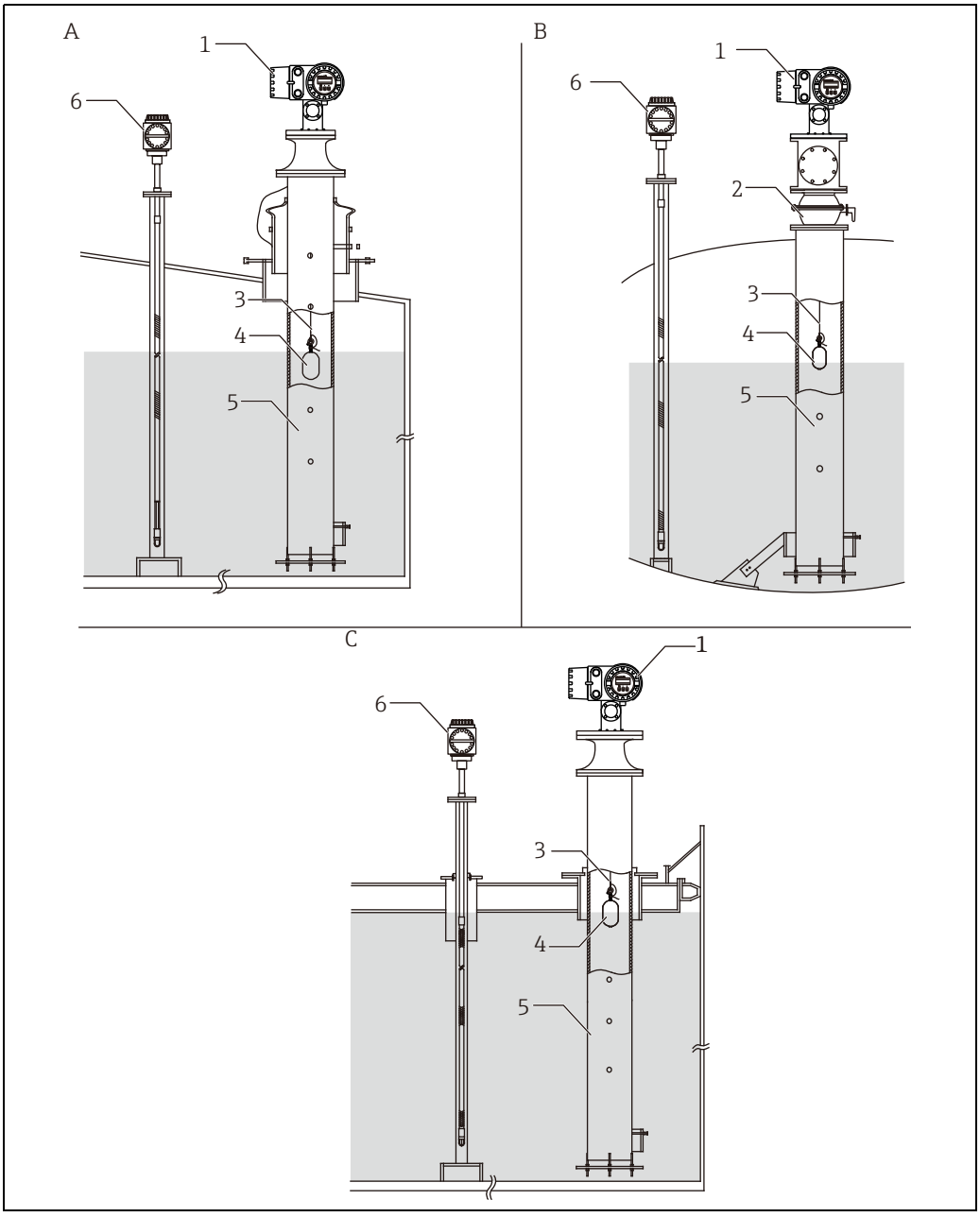


Figure 4: Typical tank

A *Fixed roof tank*
B *High pressure tank*
C *Floating roof tank with stilling well*
1 *NMS5*
2 *Ball valve*
3 *Measuring wire*
4 *Displacer*
5 *Stilling well*
6 *Prothermo NMT539*

Measurement terminology

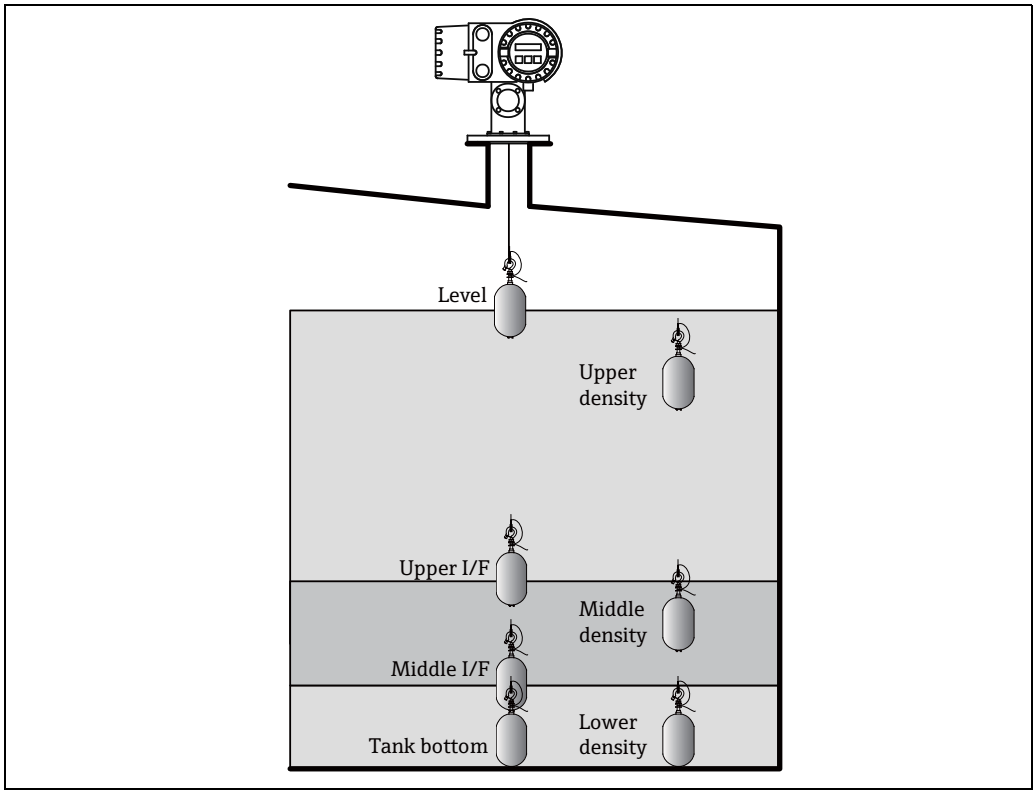


Figure 5: NMS5 with standard level, I/F x 2, tank bottom and spot density x 3 measurement

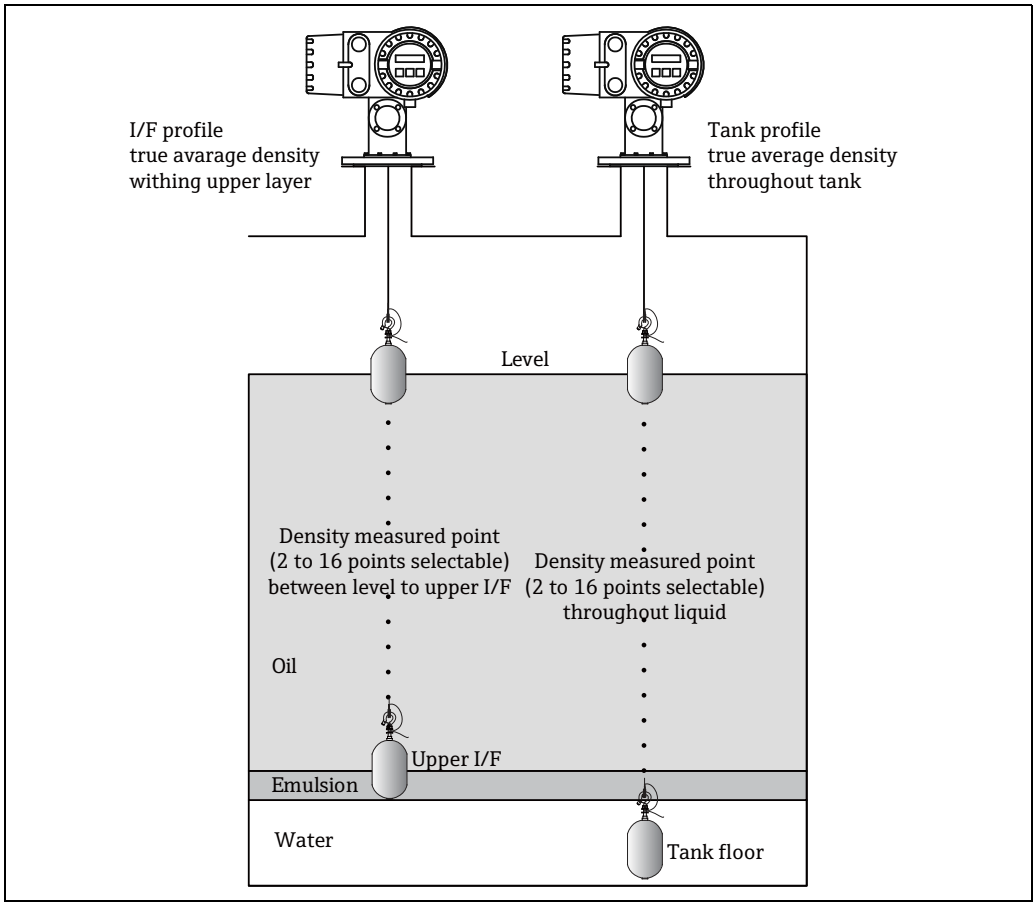


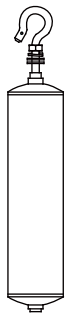
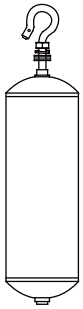
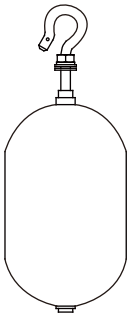
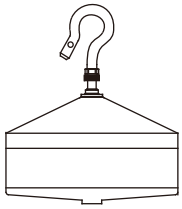
Figure 6: Density profile measurement "I/F (Interface) Profile" (Left) "Tank Profile" measurement range (Right)

Application selection

Displacer selection guide

A wide variety of displacers are available to meet your applications. Proper displacer selection ensures optimal performance and longevity. The following guidelines will assist you in selecting the ideal displacer for your application.

Displacer types

30mm	40mm	50mm	70mm	110mm
SUS316/PTFE	SUS316/PTFE	SUS316/PTFE Alloy C	SUS316	SUS316
				
(Standard materials available)				

Recommended displacer by application

Application	Surface	Interface	Density
Viscous	50mm PTFE	Not Recommended	Not Recommended
Crude	50mm 316 50mm PTFE	50mm 316 50mm PTFE	50mm 316 50mm PTFE
Black oil	50mm 316	50mm 316	50mm 316
White oil	50mm 316	50mm 316	50mm 316
Liquefied gases, LPG/LNG	70mm 316	70mm 316	50mm 316
Aggressive	50mm Alloy C 50mm PTFE	50mm Alloy C 50mm PTFE	50mm Alloy C 50mm PTFE
Custody transfer	70mm 316 110mm 316	N/A	N/A

NOTICE

The above table is for 80A (3") mounting flange or larger.

Point to confirm

Application:
What will be the primary measurement function in your application? Most applications can be generalized into three classifications: level data, density data, or both. NMS5 is primarily a highly accurate level measurement gauging instrument, with the added ability to measure density. Level is derived by determining fluid surface level, interface level(s) between different liquids, as well as finding tank floor or datum plate. Density served from single-point (called “spot” measurements), as well as profile measurements of all liquid(s) in a tank.

Surface level:
In general, larger diameter displacers have better accuracy under similar conditions.

Interface level(s):
Cylindrical-shaped displacers, with rounded top and bottom, reduce resistance while moving through liquid(s). Thus, providing smoother movement and faster interface measurements, compared to flat-based displacers, particularly in density profile measurements that span the full tank height.

⚠ CAUTION

Note that in order for a displacer to travel down through liquid(s), displacer density (its weight divided by its volume) must be higher than liquid(s) density.

Tank-bottom/datum plate level:
(same as for Interface Levels)

Density:
Since the density is the calculated result of two of more measurements, a displacer with higher volume will usually yield the most accurate density measurement. In most cases we recommend our 50mm diameter displacer for density measurement.

Level and density:
When an application calls for equal importance placed on measuring both level and density, the 50mm diameter, cylindrical displacer will give the best all-around performance.

Custody transfer

What is the requirement for Custody Transfer approval?

- The 70mm, conical, 316 displacer is the choice for requirements per NMi
- The 110mm, conical 316 displacer is the choice for requirements per PTB

Material compatibility

What are the liquid(s) characteristics of your application? Displacers are available in three different standard materials. Material compatibility should be confirmed to ensure safe operation and optimal NMS5 performance.

316:
Stainless steel is a highly versatile industrial material and provides good compatibility with a wide range of chemicals, including most white and black oils.

Alloy C:
This high-performance material is harder than 316, and provides excellent resistance to many of harshest corrosive chemical applications.

PTFE:
One of the most well-known and versatile polymer materials, this high-performance material has one of the lowest friction coefficients. It provides excellent performance in viscous/sticky liquids, and also has excellent chemical resistance to a wide range of corrosives

Process connection size

The process connection defines the tank process entry, and may affect displacer size. The standard NMS5 process connections start at 3”/DN80 and fit most tank gauging applications. Accordingly, most applications can be covered with one of the 50mm or 70mm displacer options. Smaller diameter displacers are available when the process connection is smaller.

⚠ CAUTION

Note that, when the 110mm diameter custody transfer approval (PTB) displacer is selected, a separate calibration and maintenance chamber is recommended between the NMS5 and tank process connection.

Input and output

Input for local devices

Signal	Multi drop local HART protocol max. 4 devices
Power supply	DC 24V
Additional units	NMT 53x average temperature sensor NRF 560 field data processor Other - compatible HART devices Spot temperature Pt 100 Ohm ISO standard three wire connection

By setting the HART retry number, it is possible to change the HART communication error detection time of connected NMT53x to suit application needs (approximately from 40 seconds to 34 minutes).

Output parameters based on communication protocol

	V1(new)	V1 (old)	MODBUS	HART	WM550	ENRAF	M/S
Level	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Temperature (Product)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vapor temperature	Yes	-	Yes	Yes	Yes	-	-
Upper I/F (Water Level) *1	Yes	-	Yes	Yes	Yes	Yes	-
Middle I/F	Yes	-	Yes	Yes	-	-	-
Upper density *2	Yes	-	Yes	Yes	Yes	-	-
Middle densuty*3	Yes	-	Yes	Yes		-	-
Lower density*4	Yes	-	Yes	Yes		-	-
Average density *5	Yes	-	Yes	-	Yes	-	-
1-16 points individual density *6	Yes	-	Yes	-	-	-	-
Multi-element temperature	Yes	-	Yes	Yes	Yes	--	-
HART device input (Device 1)	Yes	-	Yes	Yes	Yes	-	-
HART device input (Device 2)	Yes	-	Yes	Yes	Yes	-	-
Alarm data	Yes	Yes	Yes	Yes	Yes	Yes	-
Protocol documentation	-	-	KA0002N	-	KA001N	-	-

CAUTION

*1. Upper I/F output value can be either selected from the Proservo's own displacer measurement or Water Bottom measured value via the Prothermo NMT 539.

*2. A single point density measurement within the upper layer liquid in the tank. The measurement position is configured to 150mm below the liquid surface at default.

*3. A single point density measurement within the middle layer liquid in the tank. The measurement position is configured to 150mm below the upper interface level at default.

*4. A single point density measurement within the lower layer liquid in the tank. The measurement position is configured to 150mm below the middle interface at default

*5. The value of this "Average Density" is based on the calculation after performing the Density Profile operation at NMS5.

*6. All of the selected number of density measured value from 1 to 16 points can be transmitted.

RS485 Modbus

Module name	Commdule RS 485 communication module (until 2008), COM - 5 (from 2009)
No. of unit	Maximum 10 instruments per loop
Baud rate	600/1,200/ 2,400/ 4,800/ 9,600/ 19,200 bit/s, selectable
Parity	Odd, Even, None, selectable
Cable	Two wire twisted cable with screening (DGND is connected to the ground cable)
Topology	Serial bus, electrically isolated, tree structure
Transmission distance	Maximum 1,200 m including limbs or branches (negligible with branches under 3 m)
Instrument address	Accessed via touch control
Isolation	Bus inputs are electrically isolated from the other electronics

Bidirectional serial pulse (V1 protocol)

Module name	COM - 1
No. of units	Maximum 10 instruments per loop
Baud rate	3,300 BPS
Cable	Two wire (twisted pair) unscreened cable
Topology	Serial bus, tree structure
Transmission distance	Maximum 6,000 m
Instrument address	Accessed via touch control
Isolation	Serial communication circuit isolated from other circuits

HART protocol

Module name	Commdule HART (from 2009), COM - 6 (from 2009)
No. of units	Maximum 15 instruments per loop
Baud rate	1,200 BPS
Cable	Two wire, twisted pair screened cable Minimum core ϕ 0.15 (24AWG)
Transmission distance	Maximum 1,200 m
Instrument address	Accessed via touch control or HART master device
Isolation	Bus input are electrically isolated from the other electronics

Whessoematic 550

Module name	WM550 communication module
No. of units	15 instruments per loop (connected to RTU)
Baud rate	1,200 / 2,400 bit/s
Cable	Two wire, twisted cable with screening
Topology	20 mA current loop
Transmission distance	Depending on specifications (ask your E+H engineer)
Instrument address	Setting by DIP switches on communication board
Isolation	Current loop circuit isolated from other circuits

Mark/Space

Module name	Mark/Space communication module
No. of units	Depending on specification (ask to your E+H engineer)
Baud rate	1,200 / 2,400 / 4,800 / 9,600 / 19,200 bit/s
Cable	Four wire
Topology	Serial bus, tree structure
Transmission distance	Depending on specifications (ask your E+H engineer)
Instrument address	Setting by DIP switches on communication board
Isolation	Serial pulse isolated from other circuits

Enraf Bi Phase Mark (BPM)

Module name	COM - 3
No. of units	Maximum 10 instruments per loop
Baud rate	1,200, 2,400 bit/s, selectable
Cable	Two wire, twisted cable with screening
Topology	Serial bus, electrically isolated, tree structure
Transmission distance	Maximum 10 km
Instrument address	Accessed via touch control
Isolation	Serial communication circuit isolated from other circuits

Analog output

Module name	I/O - 5
Output	4 to 20 mA, active
On alarm	Switchable Max. 22mA, Min. 2mA or hold last measured value
Electrical isolation	Analogue output isolated from other circuits
Maximum load	500 ohm
Conversion Accuracy	+/-0.3%

Relay

<table>
<tr><td>Module name</td><td colspan="3">I/O - 3</td></tr>
<tr><td>Alarm output, Standard
(Order Code position 050= 1,2,3 or 5)</td><td colspan="3">4 relays with potential-free change-over contacts, freely assignable to measured value</td></tr>
<tr><td>Hysteresis, Alarm output</td><td colspan="3">Switch points and switching hysteresis freely adjustable, residual current fail-safe mode: minimum or maximum, selectable</td></tr>
<tr><td rowspan="6">Operation output logic</td><td></td><td colspan="2">Relay Condition</td></tr>
<tr><td>Initial Configuration
(Normal Status)</td><td>Open</td><td>Closed</td></tr>
<tr><td>On alarm</td><td>Closed</td><td>Open</td></tr>
<tr><td>On device error</td><td>Closed</td><td>Open</td></tr>
<tr><td>On abnormal power supply
(5% lower than, higher than specified power supply</td><td>Custody Transfer Closed</td><td>Custody Transfer Open</td></tr>
<tr><td>Power outage</td><td colspan="2">Hold last condition</td></tr>
<tr><td>Switching capacity, Alarm output</td><td colspan="3">▪ Max. 250VAC, 2A/62.5W
▪ Max. 220VDC, 2A/60W
▪ FM/CSA: 30VAC, 2A/42VDC, 2A, 60W
▪ TIIS: 250VAC, 1.5A/30VDC, 9W</td></tr>
</table>

Module name	I/O - 3 TUV OSP	
Alarm output, Overspill prevention (Order code position 050 = 4)	2 relays with potential- free changeover contacts, assignable to Level	
Hysteresis, Alarm output	Switch points and switching hysteresis freely adjustable, residual current fail-safe mode: minimum or maximum, selectable	
Operation output logic		Relay condition
	Initial configuration (Normal status)	Closed
	On alarm	Open
	On device error	Open
	On abnormal power supply (5% lower than, higher than specified power supply	Open
	Power outage	Open
Switching capacity	▪ Umax. 200VDC/200VppAC ▪ Imax. 0.5AC, DC or peak AC ▪ Pmax. 15W	

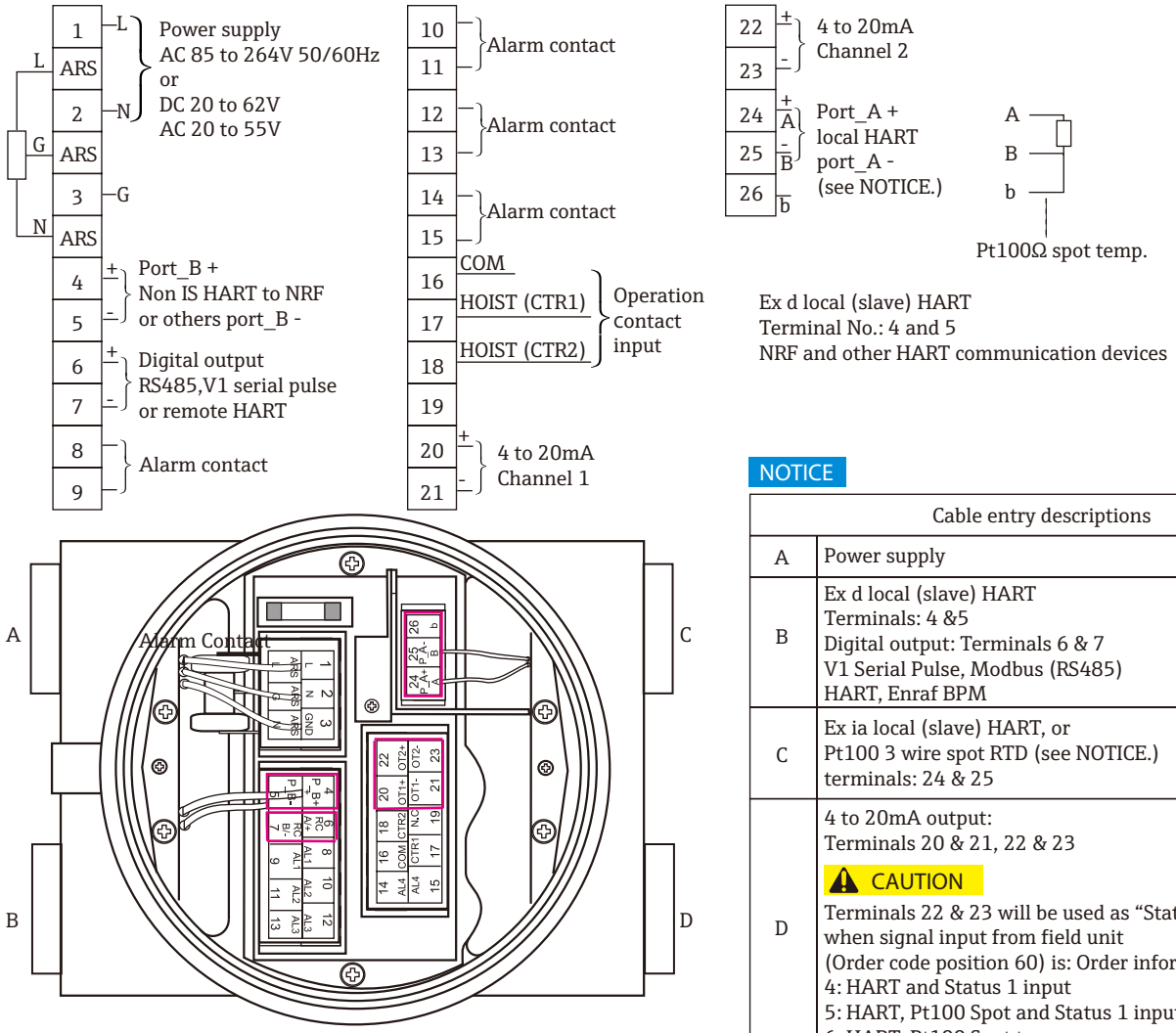
NOTICE

When selecting Output2: "4: 2 x relay SPST, TUV with overspill prevention" at order code 50, relay type is specified as only normal closed.

Operation input	2 photocouplers, for external input from controller (tumbler switch, DCS, etc.)		
Operation output logic	Gauge Status	CTR1	CTR2
	Level	0 (OFF)	0 (OFF)
	UP	1 (ON)	0 (OFF)
	STOP	0 (OFF)	1 (ON)
	Interface Level	1 (ON)	1 (ON)
Input voltage	15VDC, active circuit (supplied by NMS5)		
Input current	Approximately 5mA		

Auxiliary energy (Wiring for primary output)

V1 Serial Pulse, Modbus RS 485, HART Enraf BPM



NOTICE

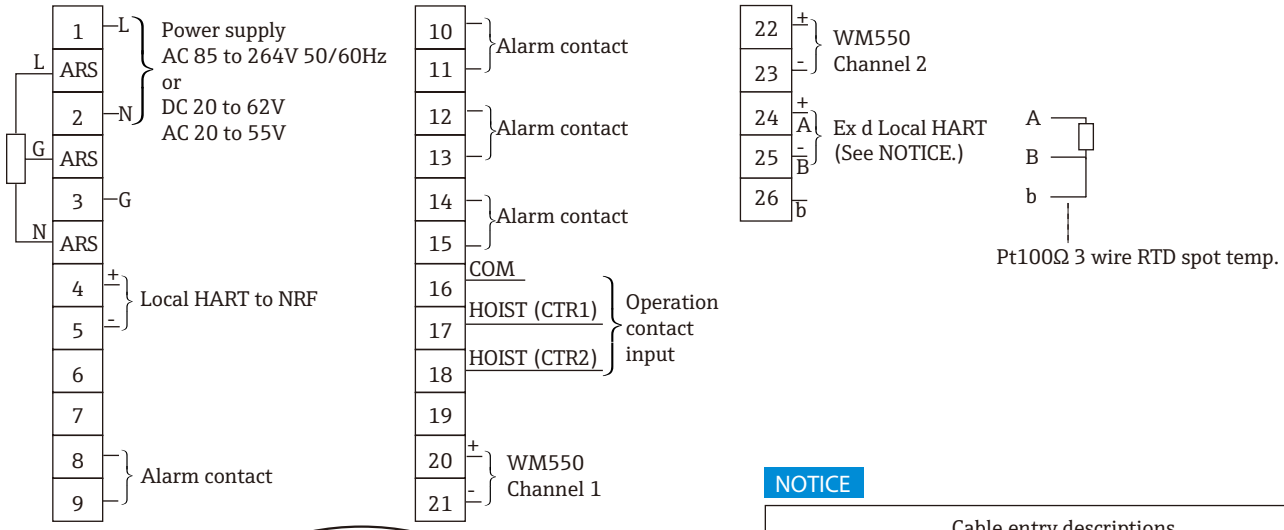
Cable entry descriptions	
A	Power supply
B	Ex d local (slave) HART Terminals: 4 &5 Digital output: Terminals 6 & 7 V1 Serial Pulse, Modbus (RS485) HART, Enraf BPM
C	Ex ia local (slave) HART, or Pt100 3 wire spot RTD (see NOTICE.) terminals: 24 & 25
D	4 to 20mA output: Terminals 20 & 21, 22 & 23 ⚠ CAUTION Terminals 22 & 23 will be used as “Status 1 Input” when signal input from field unit (Order code position 60) is: Order information: 060 4: HART and Status 1 input 5: HART, Pt100 Spot and Status 1 input 6: HART, Pt100 Spot temp., Operation contact, and Status 1 input

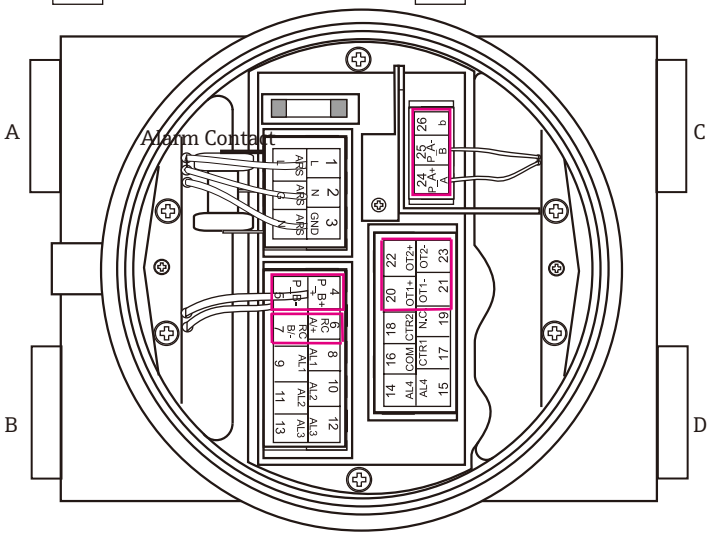
NOTICE

- Terminal connection for Whessoe Matic 550 (WM550) and Mark Space, refer to the next few pages.
- Terminals 4 & 5 and 24 & 25 for HART devices are inter - connected on Explosion proof (Ex d) certified version.
- Terminals 24 & 25 (and 24, 25 & 26 for spot temp.) will be intrinsically safe (i.s.) device connection only when intrinsically safe certified version is selected.

Figure 7: Wiring sample 1

Whessoematic 550





NOTICE

Cable entry descriptions	
A	Power supply
B	Ex d local (slave) HART terminals: 4 &5
C	Ex d local (slave) HART, or Pt100 3 wire spot RTD (see NOTICE.) terminals: 24 & 25
D	Whessoe Matic (WM)output: terminals 20 & 21, 22 & 23 WM550 is the current loop redundant data transmission protocol. Since these 4 terminals are occupied by WM550 terminal connection, 4 to 20mA output and status 1 input function are no longer available.

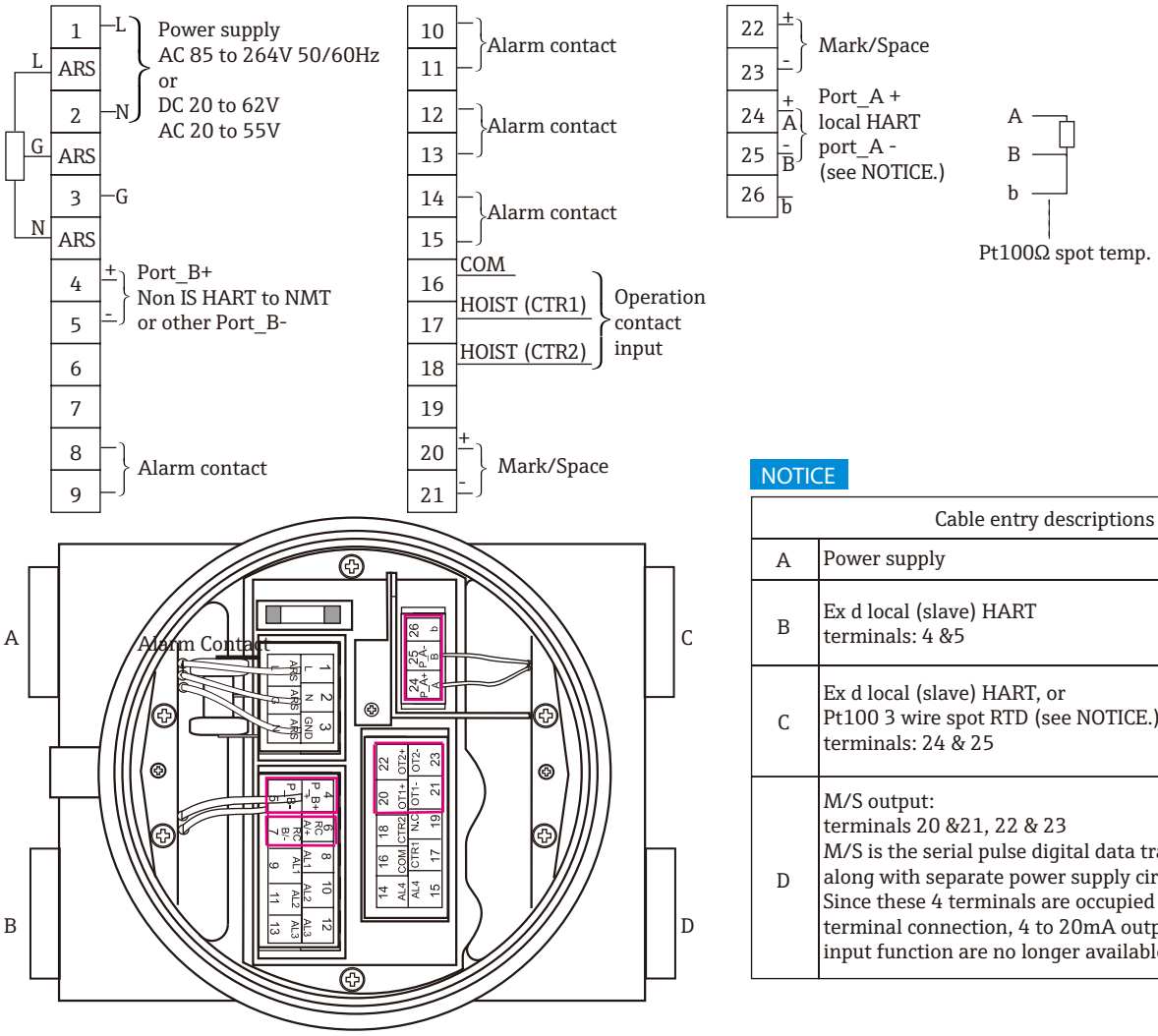
Normally the combination of WM550 and analog 4 to 20mA is prohibited.
Contact Endress+Hauser representatives if needed.

NOTICE

- Terminals 4 & 5 and 24 & 25 for HART devices are inter - connected on Explosion proof (Ex d) certified version.
- Terminals 24 & 25 (and 24, 25 & 26 for spot temp.) will be intrinsically safe (i.s.) device connection only when intrinsically safe certified version is selected.

Figure 8: Wiring sample 2

Mark/Space



Cable entry descriptions	
A	Power supply
B	Ex d local (slave) HART terminals: 4 &5
C	Ex d local (slave) HART, or Pt100 3 wire spot RTD (see NOTICE.) terminals: 24 & 25
D	M/S output: terminals 20 &21, 22 & 23 M/S is the serial pulse digital data transmission along with separate power supply circuit. Since these 4 terminals are occupied by M/S terminal connection, 4 to 20mA output and status 1 input function are no longer available.

Normally the combination of M/S and analog 4 to 20mA is prohibited.
Contact Endress+Hauser representatives if needed.

NOTICE

- Terminals 4 & 5 and 24 & 25 for HART devices are inter - connected on Explosion proof (Ex d) certified version.
- Terminals 24 & 25 (and 24, 25 & 26 for spot temp.) will be intrinsically safe (i.s.) device connection only when intrinsically safe certified version is selected.

Figure 9: Wiring sample 3

Cable entry	Thread: G1/2, 3/4 NPT1/2,3/4 M20, 25 *TIIS: G only, CSA: NPT only
Overvoltage protection	NMS5 has internal surge arrester which complies with EN/IEC 61000-4-5 (Line to Line 1.0kV, Line to ground 2.0kV) Connect the metallic housing of the NMS5 to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.
Supply voltage	High voltage type: 85 to 264 VAC, 50/60 Hz Low voltage type: 20 to 62 VDC / 20 to 55 VAC 50/60Hz ⚠ WARNING Allowable voltage supply is specifically stated depending on each Ex approval. Refer to the designated certification
Power consumption	Maximum 50 VA/50W
Safe electrical isolation	Between power supply and signal output, CPU, RS 485, relay and other electronics

Performance characteristics

Maximum measured error

Level	± 0.7mm (± 0.027 inch)*1
Interface	± 2.7 mm (± 0.106 inch)*2
Density	± 0.005 g/cm³ (g/ml)*3
Sensitivity	± 0.1 mm (± 0.004 inch)

*1 : Under reference conditions
*2 : Difference of product densities 100kg/m³ (g/ml)(6.25 lb)/ft³
*3 : (optional) when calibrated and equipped for density measurement

Compensation

Displacer
Automatic compensation of displacer weight

Tank wall
Compensation of depression and distortion

Sensitivity

+/- 0.1 mm (0.004 in)

Resolution

+/- 0.1 mm (0.004 in)

Motion delay

0 to 9.9 seconds (configurable in 100 milliseconds steps)

Operating conditions: communications

Modbus (RS485 output)

Modbus is connected to Tankvision or other Modbus (RS485) receiver.

Termination resistors
The terminal voltage for the device located at the furthest position from the receiver needs to be set with an NM5 that is connected on same line. The setting can be made using the mechanical dip switch on the communication board.

Bus address
Each device has an individual bus address and can be set via touch control.

Bus cabling
The bus cabling is galvanically isolated from the device or interface adapter. Standard communication cable (CPEV or KEPV) can be used for the data transmission.

Bus topology
When planning a system, attention should be paid to possible segmentation of the bus according to individual plant sections. Suitable topologies are:

- Tree of total length 1200 m

Sakura V1 Serial Pulse output

The bus is connected to Tankvision or other Endress+Hauser V1- type receiver. The interface or receiver must be configured accordingly.

Termination resistors
It is not necessary to set any termination resistors.

Bus address
Each device has an individual bus address and can be set via touch control.

Bus cabling
The bus cabling is galvanically isolated from the device or interface. Standard communication cable (CPEV or KEPV) can be used.

Bus topology
The suitable topologies for the serial pulse output are:
Serial max. 6000m (Sakura V1)
Set the V1 so that total extension is within the range of 6000 m per one loop for bus topology.

Enraf Bi Phase Mark output

The bus is connected to an Enraf I/F CIU or RTU8 to transmit measured value to upper host system as Entis (Enraf TG program) or Fuels Manager. These interface must be configured accordingly.

Termination resistors
It is not necessary to set any termination resistors for serial pulse output.

Bus address
Each device has an individual bus address and can be set via touch control.

Bus cabling
The bus cabling is galvanically isolated from the device or interface adapter. Standard communication cable (CPEV or KEPV) can be used for the data transmission.

Bus topology
The suitable topologies for Enraf BPM serial pulse output are:
Serial max. resistance: 400 ohm at 3 bus loops or less (10 transmitters per 1bus loop)
Serial max. capacitance: 1 micro F or less

Data transmission & operation
NMS5 is capable to transmit following sensory data as well as gauge operation command via Enraf BPM serial pulse output.

- Data: level, temperature, operation status
- Gauge command: STOP, UP, LEVEL, I/F

HART output

The bus is connected to a HART master. The HART master must be configured accordingly.

Termination resistors
It is not necessary to set any termination resistors for serial pulse output.

Bus address
Each device has an individual bus address. This is defined by host system or HART handy terminal.

Bus cabling
The bus cabling is galvanically isolated from the device and the PC plug-in board or the interface adapter. The screening must be grounded and have electrical continuity throughout. EMC tests indicate the best result when the grounding at both ends and each transmitter is established. If there is a potential difference in between the grounds, measurement must be taken to equalize whilst observing a relevant hazardous area.

Bus topology
The suitable topologies are:
Serial max. 1000 m
Set HART output so that total extension is within the range of 1000m per one loop for bus topology.

Whessoematic 550 (WM550) output

The bus is normally connected to Whessoe 1098, RTU 8 or other upper host system via dual channel (can be single) WM550 current loop.

Termination resistors
It is not necessary to set any termination resistors for serial pulse output.

Bus address
Each device on a signal loop has an individual bus address. This is defined within the transmitter by mechanical dip switch on communication board.

Bus cabling
The bus cabling is galvanically isolated from the device and the PC plug-in board or the interface adapter. BS5308 or equivalent 1.5sq.mm screened twisted pairs are recommended for bus cabling.

Bus topology
The suitable topologies for the WM550 current output are depending on number of transmitter and cable quality on the loop. Recommended number of transmitter on single loop shall be15 units or less to achieve the maximum performance.

Varec Mark Space (M/S) output

The bus is normally connected to Interface Unit (IFU), Data acquisition Processor (DAP), RTU 8 or other upper host system via 4 wire M/S serial bus link.

Termination resistors
It is not necessary to set any termination resistors for serial pulse output.

Bus address
Each device on a signal loop has an individual bus address. This is defined within the transmitter by mechanical dip switch on com board.

Bus cabling
The bus cabling is galvanically isolated from the device and the PC plug-in board or the interface adapter. The total length of field wiring shall be determined by calculation of maximum resistance within the system and required operation current. Once the total length is determined, distance has to be reduced by half because of current flow in both B+ & B- leads.

Bus topology
The suitable topologies for the M/S serial pulse output are depending on number of transmitter & cable quality on the loop.

Operating conditions: environment

Ambient temperature	-20 to +60°C (-4 to 140°F) -40 to +60°C (-40 to 140°F) ATEX approval cold temperature version
Storage temperature	-40 to +60°C (-40 to 140°F)
Liquid temperature	-200 to +200°C (-328 to +392°F)
Degree of protection	IP 67, NEMA4x with closed housing and cable glands
Electromagnetic compatibility (EMC)	Electromagnetic compatibility meets with EN 61326-1.

Operating condition: process

Process pressure

	Aluminum Drum Housing	Stainless Drum Housing
0 to 19.8kPa (Low Pressure)	NMS5-1	NMS5-2
0 to 588kPa (Medium Pressure)	NMS5-4	NMS5-5
0 to 2.45MPa (High Pressure)		NMS5-6
Maximum process pressure of JIS 10k/ASME Cl. 150/DIN PN10/JPI 150lbs: 0.98MPa		

Measuring range

Level

28m	Standard Option
36m	Standard Option
47m	Standard Option
Longer ranges available upon request. Contact Endress+Hauser representatives.	

Density
0.430 to 2.000 g/cm^3 (g/ml)

Mechanical construction

Design and dimensions

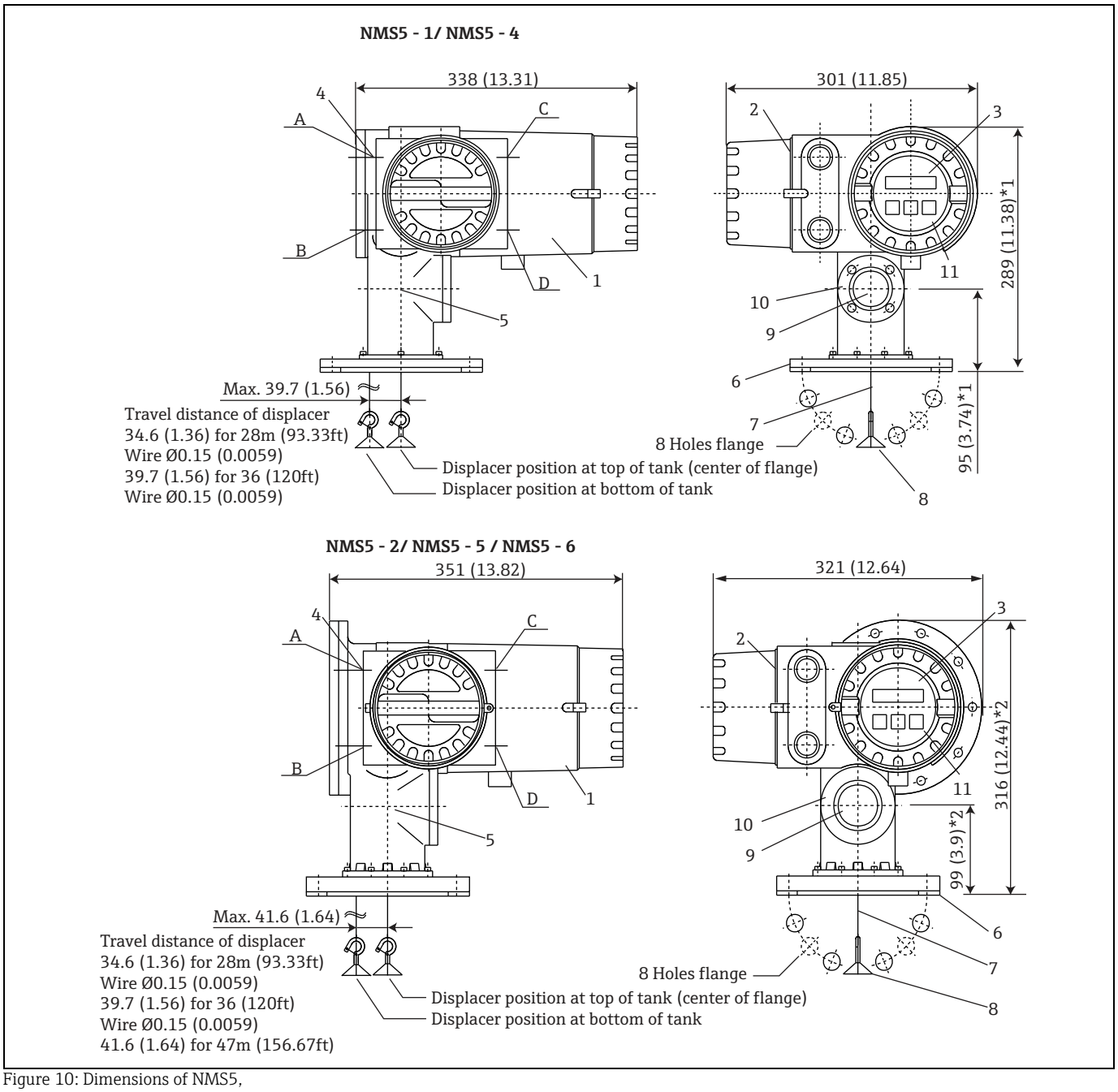


Figure 10: Dimensions of NMS5,
unit of measurement: mm (in)

1	Electrical compartment	7	Measuring wire
2	Terminal box	8	Displacer
3	Display (LCD)	9	Calibration window
4	Cable entry (A, B, C, D)	10	Window cover
5	Wire drum housing	11	Touch control
6	Flange		

NOTICE

*1: In case of 18mm (Flange thickness) at JIS10K80ARF
*2: In case of 20mm (Flange thickness) at JIS20K80ARF

Housing materials of construction

Electrical compartment: aluminum casting
Drum chamber for NMS 5-1/5-4: aluminum casting
Drum chamber for NMS 5-2/5-5/5-6: stainless steel 316 casting

Weight

NMS 5-1/5-4: 12 kg
NMS 5-2/5-5/5-6: 27 kg

Flange type

ASME, JIS, DIN 3" and 6" (standard) or equivalent. Refer to order code for full selection.
Flange for NMS5-1/5-4: aluminum
Flange for NMS5-2/5-5/5-6: stainless steel 304

Measuring wire

Material (Standard)

- Stainless steel 316L, 0.15 mm (standard)
- Alloy C. ϕ0.2 mm (max. 22m range)
- PFA coated SUS316, 0.4 mm (max. 16m range)

⚠ CAUTION

When liquid level in a tank becomes turbulent condition, use a stilling well pipe or a guide wire for installation.

Displacer

- Diameter: 50 mm (Standard), 30 to 110mm (option)
- Material (Standard): Stainless steel 316
- Material (optional): Alloy C, PTFE
- Traveling speed: 0 to 2500 mm /min to maximum

Feature: 070	Measuring range/material/ diameter of wire	Horizontal movement distance (mm/m) on drum wire
C	0-28m; SUS316L, 0.15mm	1.24
H	0-16m; PFA>SUS316, 0.4mm	1.34
K	0-16m; Alloy C, 0.2mm	1.57
L	0-36m; SUS316L, 0.15mm	1.10
M	0-22m; Alloy C, 0.2mm	1.57
N	0-47m; SUS316L, 0.15mm	0.88

Cable entry

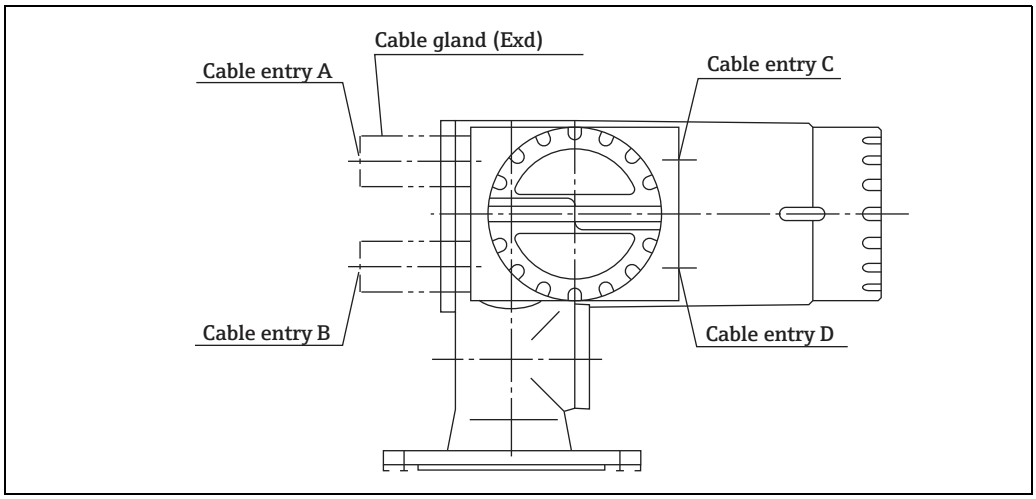


Figure 11: Cable entries

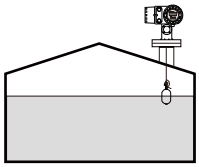
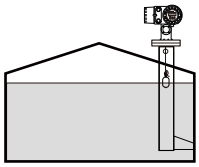
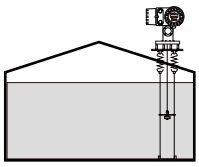
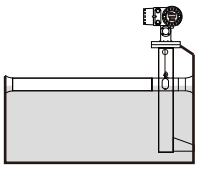
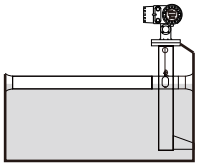
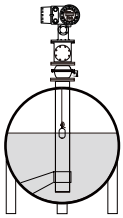
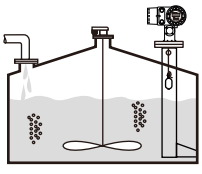
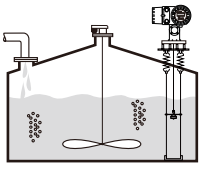
⚠ WARNING

When ordering TIIS Ex d specification, cable glands are attached with NMS5. Ensure to use the cable glands.

Installation

Type of tanks

Depending on the type of tank and application, different installation procedures are recommended for NMS5.

Type of tanks	Without guide system	With stilling well	With guide wires
fixed roof tank	✓✓ 	✓✓ 	✓✓ 
Floating roof tank	✗	✓✓ 	✗
Covered floating roof tank	✗	✓✓ 	✗
Pressurized or bullet tank	✗	✓✓ 	✗
Tank with agitator or heavy turbulence	✗	✓✓ 	✓✓ 

- A stilling well is required in a floating roof tank and a covered floating roof tank.
- Guide wires cannot be installed in a floating roof tank. When the measuring wire is exposed to free space, it may break due to an external shock.
- Installing guide wires is not allowed in pressurized tanks because the wires would prevent closing the valve for replacing the wire, wire drum, or displacer. NMS5 installation position is important for applications without the guide wire system in order to prevent the measuring wire from being broken (refer to Alignment of NMS5 for details).
- Installing guide wires is not allowed in pressurized tanks because the wires would prevent closing the valve for replacing the wire, wire drum, or displacer. NMS5 installation position is important for applications without the guide wire system in order to prevent the measuring wire from being broken.

Mounting without guide system

NMS5 is mounted on a nozzle of the tank roof without a guide system. Sufficient clearance inside the nozzle is necessary to allow the displacer to move without hitting the inner walls.

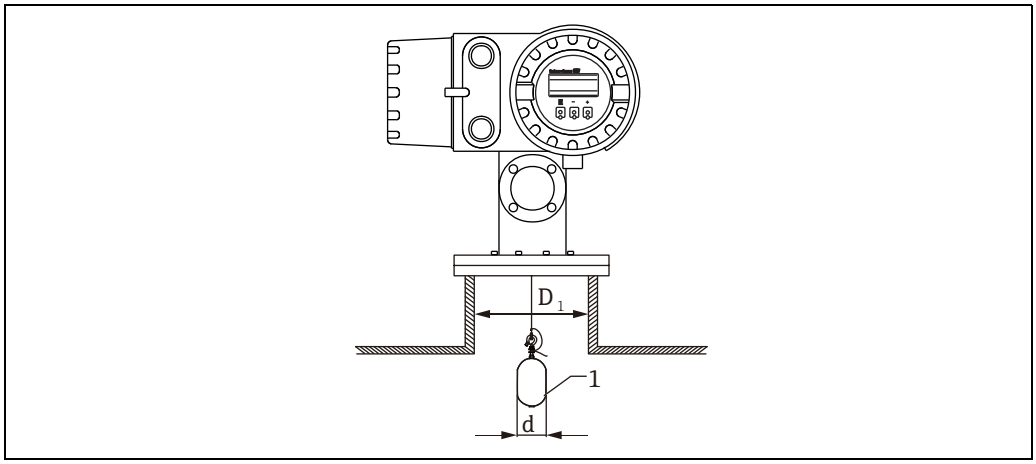


Figure 12: Mounting without guide system

D_1 *Inner Diameter of the tank nozzle*
d *Diameter of the displacer*

Mounting with stilling well

The stilling well diameter that is required to protect the measuring wire without disturbing its operation varies depending on the tank height. The stilling well could either be of constant diameter, or narrower at its upper part and wider at its lower part. The following figure shows two examples of the latter case, namely a concentric stilling well and an asymmetric stilling well.

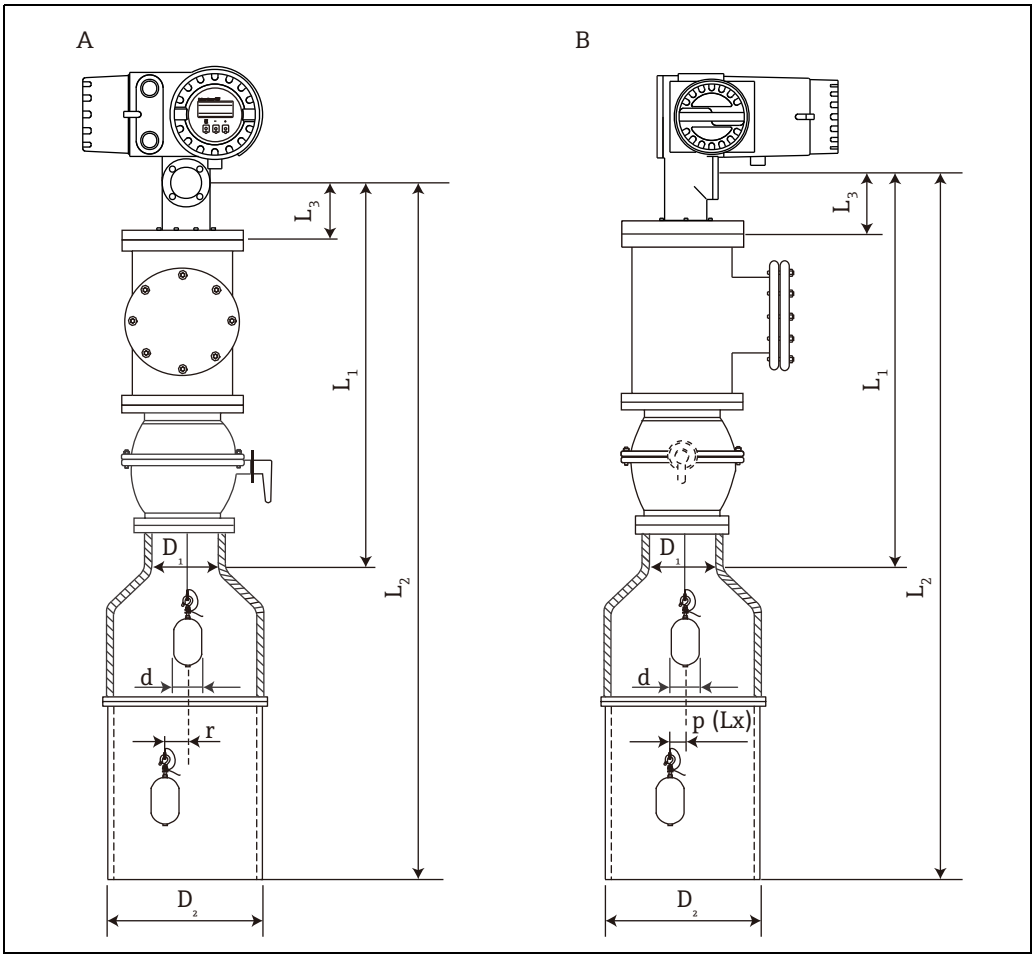


Figure 13: Mounting with connection pipe

A *Front view*
B *Side view*
L1 *Length from the center of the calibration window to the upper part of the stilling well*
L2 *Length from the center of the calibration window to the bottom of the stilling well*
L3 *Length from the center of the calibration window to the bottom of the flange*
D1 *Diameter of upper part of stilling well*
D2 *Diameter of stilling well*
d *Diameter of displacer*
p(Lx) *Longitudinal wire position from the center of the flange*
r *Radial direction offset*

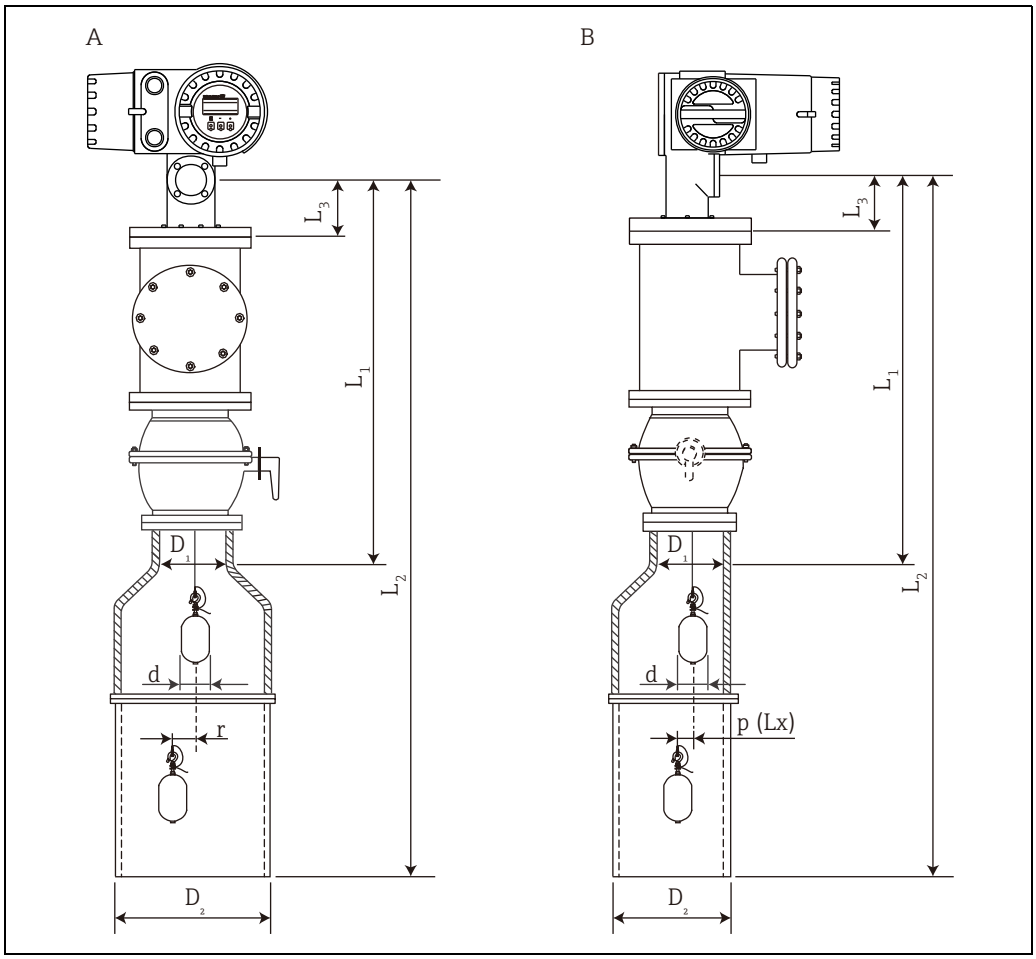


Figure 14: Mounting with asymmetric stilling well

A *Front view*
B *Side view*
L1 *Length from the center of the calibration window to the upper part of the stilling well*
L2 *Length from the center of the calibration window to the bottom of the stilling well*
L3 *Length from the center of the calibration window to the bottom of the flange*
D1 *Diameter of upper part of stilling well*
D2 *Diameter of stilling well*
d *Diameter of displacer*
p(Lx) *Longitudinal wire position from the center of the flange*
r *Radial direction offset*

- L3: length from center of the calibration window to the bottom of the flange (77 mm (3.03 in) + flange thickness). For JIS 10K 150A RF, the dimension is 77mm (3.03 in) and the flange thickness is 22 mm (0.87 in).
- When using an asymmetric stilling well, take into account the lateral shift of the displacer and follow the NMS5 mounting direction as shown in the figure.
- To calculate the required stilling well diameters, the formula below should be used. The following tables contain the necessary parameters in order to calculate the dimensions of the stilling well. Be sure to have appropriate dimensions of the stilling well according to each dimension in the table.
- The radial direction offset is required for only the 47 m (154.2 ft) wire drum. For all other drums, the offset is 0 mm/in.

Symbol	Description
P (Lx)	Longitudinal wire position from the center of the flange
r	Radial direction offset
s	Safety factor recommended; 5.0mm (0.20 in)

Feature: 070	Descriptions	r
N	0-47m: SUS316L, 0.15mm	6 mm (0.24 in)

The following graph shows the lateral shift of the displacer depending on the measured distance for the different wire drums.

Feature: 110	Descriptions	d
B	Conical 50mm, PTFE	50mm (1.97 in)
D	Cylindrical 50mm, SUS316	50mm (1.97 in)
K	Cylindrical 40mm, SUS316	40 mm (1.57 in)
N	Cylindrical 30mm, SUS316	30 mm (1.18 in)
R	Conical 70mm, SUS316	70 mm (2.76 in)
S	Conical 110mm, SUS316	110 mm (4.33 in)
T	Cylindrical 50mm, AlloyC	50mm (1.97 in)
U	Cylindrical 50mm, PTFE	50mm (1.97 in)
V	Cylindrical 40mm, PTFE	40 mm (1.57 in)
W	Cylindrical 30mm, PTFE	30 mm (1.18 in)

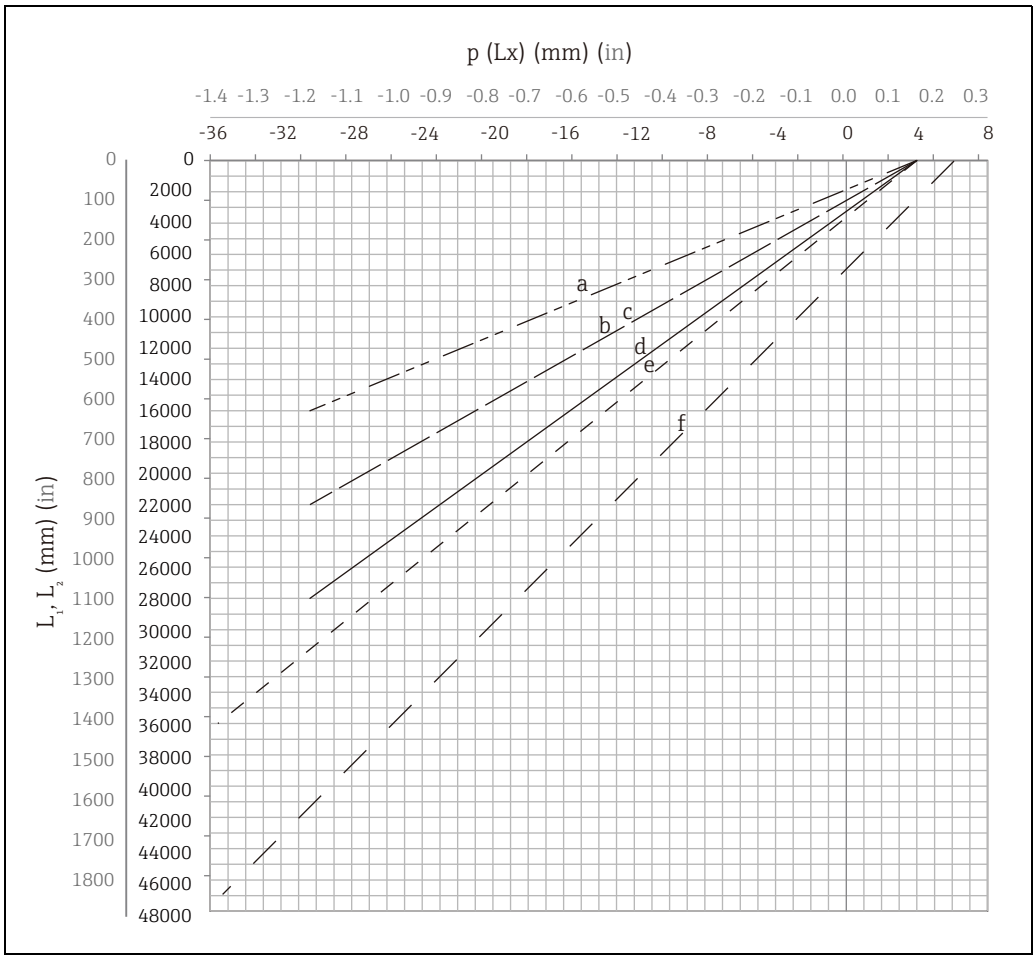


Figure 15: Lateral shift of displacer according to measurement range

a *0-16m: PFA>SUS316, 0.4mm*
b 0-16m: Alloy C, 0.2mm
c 0-22m: Alloy C, 0.2mm
d 0-28m: SUS316L, 0.15mm
e 0-36m: SUS316L, 0.15mm
f 0-47m: SUS316L, 0.15mm

Upper diameter of stilling well

The dimension of D_1 has to be the largest value of the dimensions D_{1a}, D_{1b},D_{1c}, and D_{1d} according to the following formula.

D_1 Dimension (Example)	D_{1x} dimension		Description	Formula
	Example	Symbol		
>68.1 mm (2.68 in)	68.1mm (2.68in)	D_{1a}	D_1 dimension when the displacer is in $L_1 = 0$	= 2 x (|p (0)| + d/2 + s)
	65.6mm (2.58in)	D_{1b}	D_1 dimension when the displacer is in L_1 length	= 2 x (|p (L_1)| + d/2 + s)
	51.2mm (2.02in)	D_{1c}	D_1 dimension when the displacer is in L_2 length	= 2 x (|p (L_2)| + s)
	N/A	D_{1d}	D_1 dimension when the radial direction offset is considered. This calculation is used only with the 47 m (156.67 ft) wire drum (N in Feature 70)	= 2 x (d/2 + r + s)

Example: L_1 = 1 000 mm, L_2 = 20 000 mm, d = 50 mm, s = 5.0, 28 m drum

Lower diameter of stilling well
The dimension of D_2 has to be the larger value of the dimensions D_1 and D_{2b}. See the graph above.

Concentric pipe

D_1 Dimension (Example)	D_{1x} dimension		Description	Formula
	Example	Symbol		
>101.2 mm (3.98 in)	68.1mm (2.68in)	D_1	Calculated D_1 Value	N/A
	101.2mm(3.98in)	D_{2b}	D_2 dimension when the displacer is in L_2 length	= 2 x (| p (L_2) | + d/2 + s)

Example: L_2 = 20 000 mm, d = 50 mm, s = 5.0, 28 m drum

Asymmetric pipe

D_1 Dimension (Example)	D_{1x} dimension		Description	Formula
	Example	Symbol		
>84.7 mm (3.33 in)	68.1mm (2.68in)	D_1	Calculated D_1 Value	N/A
	84.7mm(3.33in)	D_{2b}	D_2 dimension that the displacer can pass through (Nth groove)	= | p (L_2) | + d/2 + s + D_1/2

Example: L_2 = 20 000 mm, d = 50 mm, s = 5.0, 28 m drum

Recommendations for mounting stilling well

Follow the recommendations for mounting NMS5 with stilling well:

- Keep the pipe connection welds smooth.
- When drilling holes into the pipe, keep the interior surface of the holes clear of metal chips and burrs.
- Coat or paint the interior surface of the pipe to prevent corrosion.
- Keep the pipe as vertical as possible. Check using a plumb bob.
- Install the asymmetric pipe under the valve and fit the centers of the NMS5 and the valve.
- Set the center of the lower part of the asymmetric pipe in the direction of the lateral motion.
- Observe the recommendations as per API MPMS chapter 3.1B.
- Confirm grounding between NMS5 and the tank nozzle.

Mounting with guide wires It is also possible to guide the displacer by a guide wire to prevent swinging.

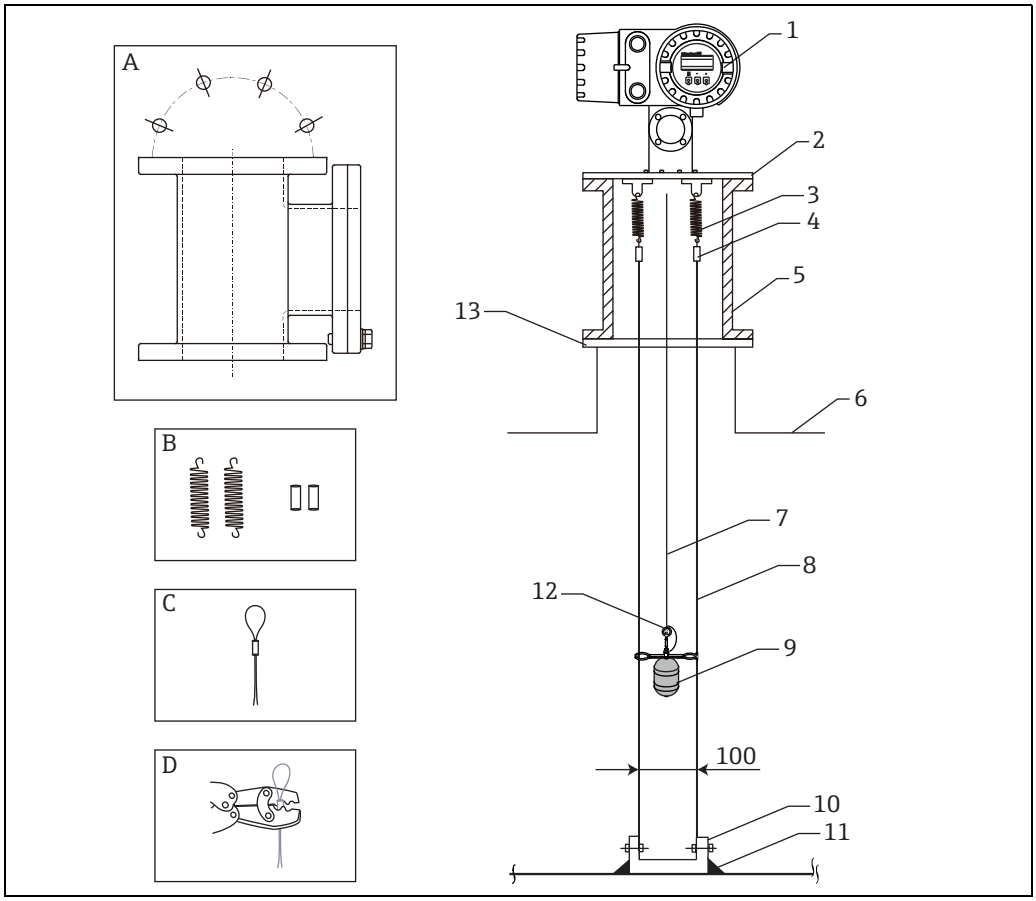


Figure 16: Mounting with guide wire, unit of measurement: mm (in)

No.	Description
A	Calibration chamber
B	Spring and sleeve
C	Guide wire sleeve
D	Crimp tool
1	NMS5
2	Reducer plate (for low pressure: 6mm (0.236 in)) Reduce flange (material is selectable from SS400 an SUS304.)
3	Spring, SUS304
4	Sleeve, SUS316
5	Calibration chamber for maintenance NHC4HP for high pressure, SCS13 equivalent to SUS304 NHC4LP for low pressure, SCS13 equivalent to SUS304
6	Tank
7	Measuring wire
8	Guide wire, SUS316
9	Displacer
10	Anchor hook plate, SUS304
11	Welding point
12	Ring, SUS316
13	Flange

Human interface

Operating concept

NMS5 is furnished with a four line illuminated liquid crystal display. With the E+H matrix driven operation, configuration is simple. Using only three keys, all parameters can be selected and modified. For example:

- Operation - level; interface; spot & profile density, water dip, & tank bottom
- Current output
- Relay output
- Maintenance prediction
- Calibration, etc.

The display can be configured to be displayed in English, Japanese or Chinese. Measurement unit & decimal point can be also configured within NMS matrix.

Operational security
The programming information can be protected by software access codes that disable all programmable parameters or by a hardware switch to prevent changes from remote transmission or the touch control keypad. A self-diagnosis function checks for any operational failures.

Display (LCD)

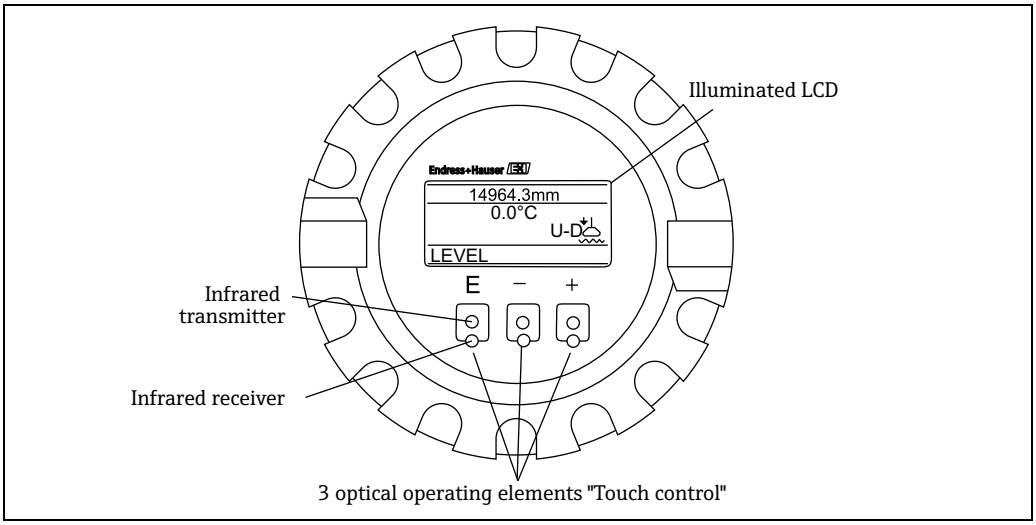


Figure 17: Display (LCD)

Four line 16-digit illuminated display English, Japanese, Chinese selectable

Programming

Three optical keys (touch control) for selection of matrix functions.

Memo function

Memo of maintenance information.

Advanced maintenance

Maintenance prediction	NMS 5 will provide advance warning of required maintenance such as replacement of worn wire etc. The operating life-span of electrical and mechanical parts of the NMS 5 are factory set within the instruments memory. This information is checked involving with the built-in clock and compared and registered in the instrument.
Maintenance	The maintenance record can be accessed via the matrix and will provide information of alarm data (e.g. date, time, alarm type). A memo function allows the user or an E+H Service Engineer to enter maintenance data manually.
Proactive safety	Proactive safety diagnostic function warns of mechanical failure, and outputs maximum level value, e.g. 99999 to local display and Fieldbus.

Certificates and approval

CE mark	By attaching the CE mark, Endress+Hauser confirms that the instruments pass the required tests.
Ex approvals	TIIS Ex d IIB T4 FM XP Cl. I Div. 1 Gr. C-D FM XP-AIS Cl. I Div.1 Gr. C-D CSA Cl. I Div. 1 Gr. C-D CSA Ex d[ia] Cl. I Div. 1 Gr. C-D ATEX II 1/2G Ex d IIB T6...T3 ATEX II 1/2G Ex d IIC T6...T3 ATEX II 1/2G Ex d IIB T6...T3, -40°C ATEX II 1/2G Ex d (ia) IIB T6...T3 ATEX II 1/2G Ex d (ia) IIB T6...T3, -40°C IEC Ex d ia IIB T6...T3 Ga/Gb IEC Ex d IIB T6...T3 Ga/Gb IEC Ex d IIC T6...T3 Ga/Gb IEC Ex d ia IIB T6...T3 Ga/Gb, -40°C IEC Ex d IIB T6...T3 Ga/Gb, -40°C NEPSI Ex d ia IIB T6...T3 NEPSI Ex d IIB T6...T3 NEPSI Ex d IIC T6...T3 NEPSI Ex d ia IIB T6...T3, -40°C NEPSI Ex d IIB T6...T3, -40°C
Custody transfer approvals	PTB: Germany NMi: Netherlands
Overspill prevention	TÜV: Germany
SIL2	TÜV: Germany
External standards and guidelines	EMC-Directive 89/336/EC PE-Directive 97/23/EC EN 10204-3.1B OIML-R85/1998 OIML-R85/2008 SIL IEC61508 ISO 9001:2008

Order information

NMS5

010	**Drum Housing Pressure Rating; Material:**	
	1	0··· 200mbar/20kPa/2.9psi; Alu
	2	0··· 200mbar/20kPa/2.9psi; stainless ste>
	4	0··· 5.88bar/588kPa/85.28psi; Alu
	5	0··· 5.88bar/588kPa/85.28psi; stainless steel
	6	0··· 24.5bar/2.45MPa/355.34psi; stainless steel
	9	Special version, TSP-no. to be spec.

020	**Approval:**	
	0	Weather proof, IP 67 NEMA 4X
	1	TIIS Ex d IIB T4
	5	FM XP Cl. I Div. 1 Gr. C-D
	N	FM XP-AIS Cl. I Div.1 Gr. C-D
	6	CSA Cl. I Div. 1 Gr. C-D
	O	CSA Ex d|ia| Cl. I Div. 1 Gr. C-D
	G	ATEX II 1/2G Ex d IIB T6...T3
	Q	ATEX II 1/2G Ex d IIC T6...T3
	S	ATEX II 1/2G Ex d IIB T6...T3, -40°C
	J	ATEX II 1/2G Ex d (ia) IIB T6...T3
	U	ATEX II 1/2G Ex d (ia) IIB T6...T3, -40°C
	A	IEC Ex d ia IIB T6...T3 Ga/Gb
	B	IEC Ex d IIB T6...T3 Ga/Gb
	C	IEC Ex d IIC T6...T3 Ga/Gb
	D	IEC Ex d ia IIB T6...T3 Ga/Gb, -40°C
	E	IEC Ex d IIB T6...T3 Ga/Gb, -40°C
	T	NEPSI Ex d ia IIB T6...T3
	V	NEPSI Ex d IIB T6...T3
	W	NEPSI Ex d IIC T6...T3
	X	NEPSI Ex d ia IIB T6...T3, -40°C
	4	NEPSI Ex d IIB T6...T3, -40°C
	9	Special version, TSP-no. to be spec.

030	**Application:**	
	A	Liquid Level
	B	PTB (<1mm) type approval, liquid level
	C	NMi (<1mm) type approval, liquid level
	D	Multi measurement, liquid level, I/F level, bottom, density
	E	PTB (<1mm) type approval, liquid level, I/F level, bottom, density
	F	NMi (<1mm) type approval, liquid level, I/F level, bottom, density
	G	Density profile multi measurement, liquid level, I/F level, bottom, density
	H	PTB (<1mm)type approval, density profile, liquid level, I/F level, bottom, density
	J	NMi (<1mm) type approval, density profile, liquid level, I/F level, bottom, density
	Y	Special version, TSP-no. to be spec.

040	**Output 1:**	
	F	Not selected
	A	2-way 2-wire (V1 protocol)
	J	2-way 2-wire (MDP protocol)
	B	2-way 2-wire (BBB protocol)
	C	2-way 2-wire (MIC, RS232C protocol)
	D	2-way 2-wire (MIC protocol)
	G	HART active
	H	HART passive
	L	Whessmatic 550, overvoltage protection
	M	Mark Space
	N	Enraf BPM
	P	Modbus RS 485
	Y	Special version, TSP-no. to be spec.

NMS5-	**Product designation (Continued on next page)**

050	Output 2:
0	Not selected
1	4 x relay SPST
2	2 x 4-20mA
3	4 x relay SPST, 2 x 4 - 20mA
4	2 x relay SPST, Overspill prevention TÜV
5	4 x relay SPST, 1 x 4 - 20mA
9	Special version, TSP-no. to be spec.

060	Input:
0	HART (NMT5xx, NRF560, pressure transmitter)
1	1 x spot temperature Pt100, HART (NRF560, pressure transmitter)
2	2 x operation contact, HART (NMT5xx, NRF560, pressure transmitter)
3	1 x spot temperature Pt100, 2 x operation contact, HART (NMT5xx, NRF560, pressure transmitter)
4	1 x status, HART (NMT5xx, NRF560, pressure transmitter)
5	1 x spot temperature Pt100, 1 x status, HART (NMT5xx, NRF560, pressure transmitter)
6	1 x spot temperature Pt100, 1 x status, 2 x operation contact, HART (NMT5xx, NRF560, pressure transmitter)
9	Special version, TSP-no. to be spec.

070	Measuring Range; wire:
C	0 - 28m; SUS316L, 0.15mm
L	0 - 36m; SUS316L, 0.15mm
N	0 - 47m; SUS316L, 0.15mm
H	0 - 16m; PFA>SUS316, 0.4mm
K	0 - 16m; Alloy C, 0.2mm
M	0 - 22m; Alloy C, 0.2mm
Y	Special version, TSP-no. to be spec.

080	Cable Entry:
E	4 x thread G1/2
F	4 x thread G3/4
G	4 x thread NPT1/2
H	4 x thread NPT3/4
L	4 x thread M20
M	4 x thread M25
Y	Special version, TSP-no. to be spec.

090	Process Connection:
A	10K 80A RF, flange JIS B2220
C	10K 80A FF, flange JIS B2220
U	10K 150A RF, flange JIS B2220
E	20K 80A RF, flange JIS B2220
G	NPS 3" Cl.150 RF, flange ASME B16.5
J	NPS 3" Cl.300 RF, flange ASME B16.5
W	NPS 4" Cl.300 RF, flange ASME B16.5
T	NPS 6" Cl.150 RF, flange ASME B16.5
L	DN80 PN10 B1, flange EN1092-1 (DIN2527 B)
N	DN80 PN25 B1, flange EN1092-1 (DIN2527 B)
Q	80A 150lbs RF, flange JPI 7S-15
S	80A 300lbs RF (apply for NMS5-6), flange JPI 7S-15
Y	Special version, TSP-no. to be spec.

100	Power supply:
3	85 - 264 VAC, 50/60 Hz
4	20 - 62 VDC, 20 - 55 VAC, 50/60 Hz
Y	Special version, TSP-no. to be spec.

NMS5-	Product designation (Continued on next page)

110	**Displacer:**	
	N	Cylindrical 30 mm, SUS316
	K	Cylindrical 40 mm, SUS316
	D	Cylindrical 50 mm, SUS316
	W	Cylindrical 30 mm, PTFE
	V	Cylindrical 40 mm, PTFE
	U	Cylindrical 50 mm, PTFE
	T	Cylindrical 50 mm, Alloy C
	B	Conical 50 mm, PTFE
	R	Conical 70 mm, SUS316
	S	Conical 110 mm, SUS316
	Y	Special version, TSP-no. to be spec.

120	**O-ring; chamber finishing:**	
	0	NBR; not selected
	1	Silicon rubber; not selected
	5	Silicone rubber; FEP coated
	3	PTFE (wire drum FKM); not selected
	4	PTFE (Wire drum FKM); FEP coated
	6	CR; not selected
	2	FKM; not selected
	7	FKM; FEP coated
	8	FFKM; not selected
	A	FFKM; FEP coated
	9	Special version, TSP-no. to be spec.

130	**Options:**	
	A	not selected
	C	Rc3/8 cleaning nozzle
	D	Rc3/8 gas purging nozzle
	E	Guide wire installation
	G	Relief valve
	H	Relief valve, pressure gauge
	J	Sunshade
	L	Rc3/8 gas purging nozzle, sunshade
	M	Rc3/8 cleaning nozzle, sunshade
	N	Rc3/8 gas purging nozzle, guide wire installation
	P	Rc3/8 cleaning nozzle, guide wire installation
	Q	Guide wire installation, sunshade
	R	Relief valve, guide wire installation
	S	Relief valve, pressure gauge, guide wire installation
	T	Relief valve, sunshade
	U	Relief valve, pressure gauge, sunshade
	Y	Special version, TSP-no. to be spec.

NMS5-	**Complete product designation**

Accessories

Calibration chamber

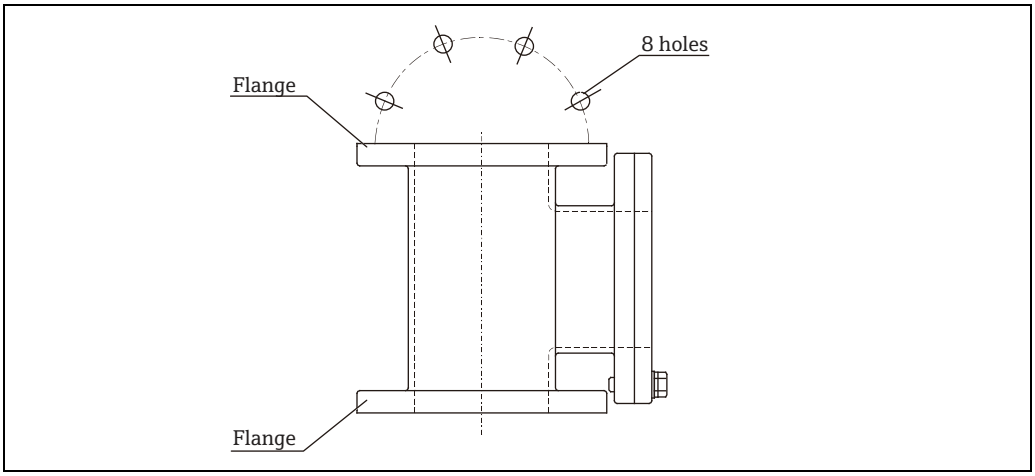


Figure 18: Calibration chamber, unit of measurement: mm (in)

Calibration chamber is recommended for use with tank level gauges in order to allow maintenance (removing displacers), while tank is in service.
Standard chamber is 6" flange, with bolts and packing for NMS connection.

NOTICE

The dimensions differ depending on material, flange size. Contact Endress+Hauser for details.

NHC4HP (High pressure version)

010	**Process Connection:**	
	A	10K 150A RF, flange JIS B2220
	C	10K 150A FF, flange JIS B2220
	E	20K 150A RF, flange JIS B2220
	G	NPS 6" Cl.150 RF, flange ASME B16.5
	J	NPS 6" Cl.300 RF, flange ASME B16.5
	L	DIN 150 PN10 B1, flange EN1092-1(DIN2527 B)
	N	DIN 150 PN25 B1, flange EN1092-1(DIN2527 B)
	Q	150A 150lbs RF, flange JPI 7S-15
	S	150A 300lbs RF, flange JPI 7S-15
	Y	Special version, TSP-no. to be spec.
020	**Pipe Material; Flange Material:**	
	2	STPG370; SS400
	3	SUS304TP; SUS304
	9	Special version, TSP-no. to be spec.
030	**Bolts, Packing:**	
	0	not used
	1	SUS304, Valker #6502
	9	Special version, TSP-no. to be spec.
040	**Pressure Gauge, Relief Valve:**	
	1	Selected
	9	Special version, TSP-no. to be spec.
NHC4HP-		Complete product designation

NHC4LP (Low pressure version)

010	**Process Connection:**	
	A	10K 150A RF, flange JIS B2220
	C	10K 150A FF, flange JIS B2220
	G	NPS 6" Cl.150 RF, flange ASME B16.5
	L	DN150 PN10 B1, flange EN1092-1(DIN2527 B)
	Q	150A 150lbs RF, flange JPI 7S-15
	Y	Special version, TSP-no. to be spec.

020	**Pipe Material; Flange Material:**	
	1	AC4A ; AC4A
	3	SUS304TP ; SUS304
	9	Special version, TSP-no. to be spec.

030	**Bolts, Packing:**	
	0	not used
	1	SUS304, Valker #6502
	9	Special version, TSP-no. to be spec.

NHC4LP-	Complete product designation

Power + control switch

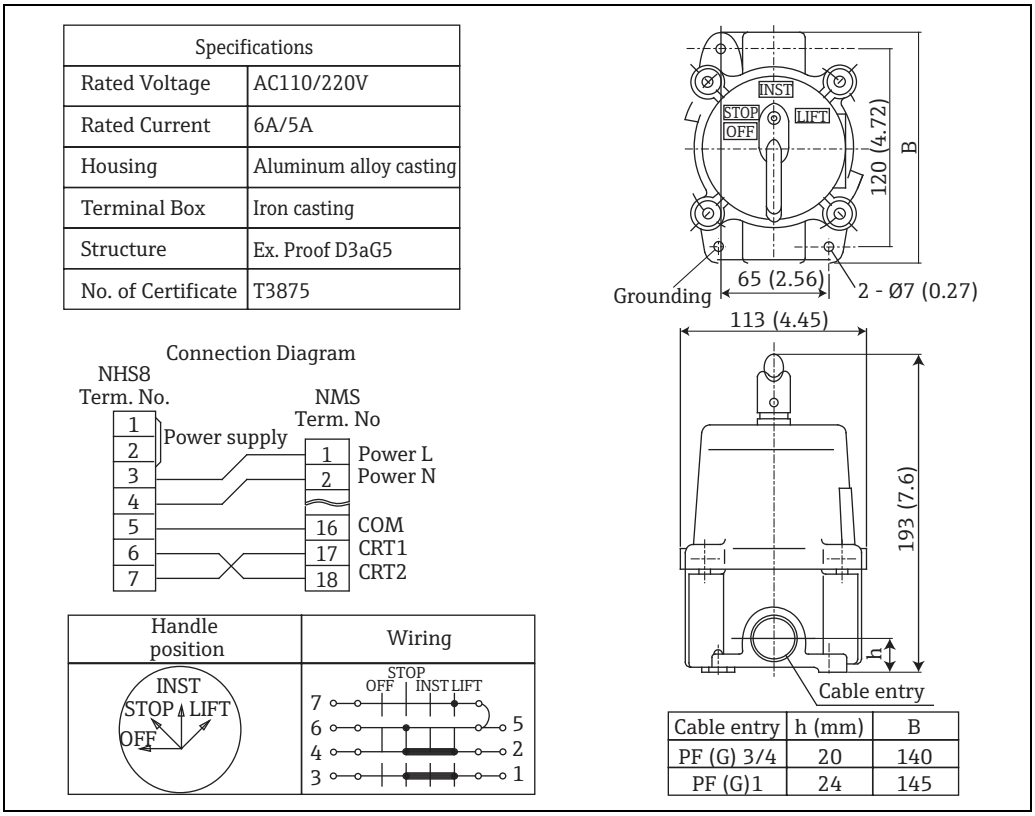


Figure 19: Power and control switch, unit of measurement: mm (in)

Power & Control Switches are used for field mounted tank gauges. This provides additional gauge operation contact switching in order to control gauge's operation, such as hoisting up displacer.

NHS8

010	**Approval:**		
	1		Weather proof IP67
	2		Flame proof (TIIS d3aG5)
020		**Cable entry:**	
		0	2 x thread G3/4
		1	2 x thread G1
		2	2 x thread NPT3/4
		3	2 x thread NPT1
		9	Special version, TSP-no. to be spec.
NHS8-			Complete product designation

Ball valve

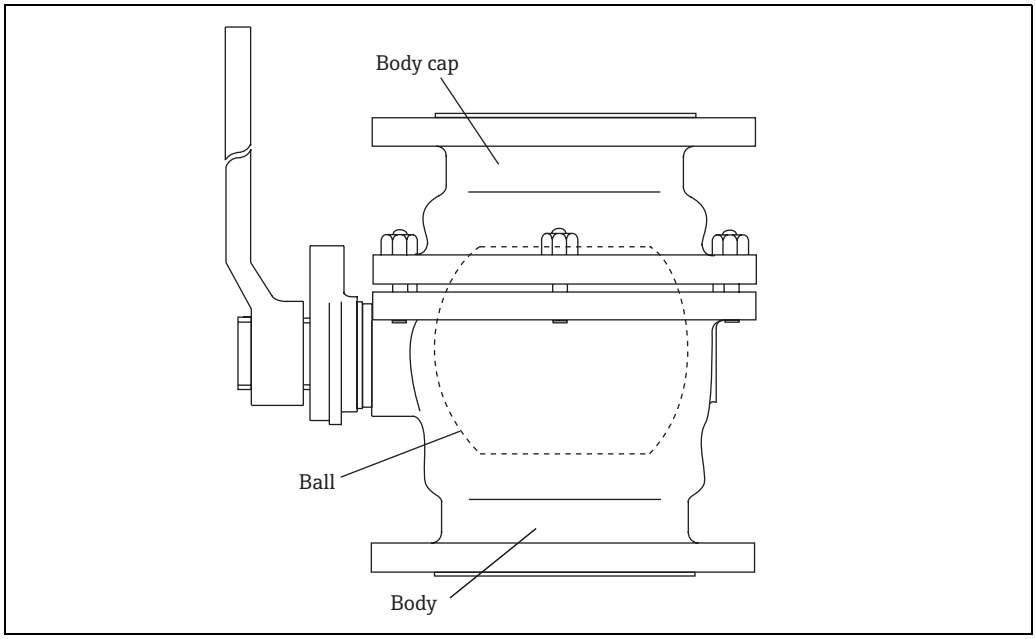


Figure 20: Parts name of ball valve

Ball valves are recommended for use with tank level gauges in order to allow such maintenance as removing displacers, while tank is in service.
Standard ball valve with ASME flanges. Ball material is SS304, seat material is PTFE.

NOTICE

The dimensions vary depending on material, flange size. Contact Endress+Hauser for details.

NHV4A (ASME flanges)

Standard ball valve with ASME flanges. Ball material is SS304, seat material is PTFE.

010	**Process Connection; Body:**	
	C31	NPS 3" Cl.150 RF; steel casting flange ASME B16.5
	C33	NPS 3" Cl.300 RF; steel casting flange ASME B16.5
	C61	NPS 6" Cl.150 RF; steel casting flange ASME B16.5
	C63	NPS 6" Cl.300 RF; steel casting flange ASME B16.5
	S31	NPS 3" Cl.150 RF; SUS304 flange ASME B16.5
	S33	NPS 3" Cl.300 RF; SUS304 flange ASME B16.5
	S61	NPS 6" Cl.150 RF; SUS304 flange ASME B16.5
	S63	NPS 6" Cl.300 RF; SUS304 flange ASME B16.5
	Y99	Special version, TSP-no. to be spec.

020		**Ball Type:**	
		A	Full bore
		B	Reduced bore
		Y	Special version, TSP-no. to be spec.

NHV4A-				Complete product designation

NHV4J (JIS flanges)
For body in mild steel and in SS304, ball material is SS304, ball material is SS304. For body in SS316, ball material is SS316. Seal material is PTFE.

10	**Process Connection; Body:**		
	C11		10K 80A RF; Steel flange JIS B2220
	C12		10K 150A RF; Steel flange JIS B2220
	C21		20K 80A RF; Steel flange JIS B2220
	C22		20K 150A RF; Steel flange JIS B2220
	S11		10K 80A RF; SUS316 flange JIS B2220
	S12		10K 150A RF; SUS316 flange JIS B2220
	S21		20K 80A RF; SUS316 flange JIS B2220
	S22		20K 150A RF;SUS316 flange JIS B2220
	H11		10K 80A RF; SUS304 flange JIS B2220
	H12		10K 150A RF; SUS304 flange JIS B2220
	H21		20K 80A RF; SUS304 flange JIS B2220
	H22		20K 150A RF;SUS304 flange JIS B2220
	Y99		Special version, TSP-no. to be spec.
20		**Ball Type:**	
		A	Full bore
		B	Reduced bore
		Y	special version, TSP-no. to be spec.
NHV4J-			Complete product designation

Reducing flange

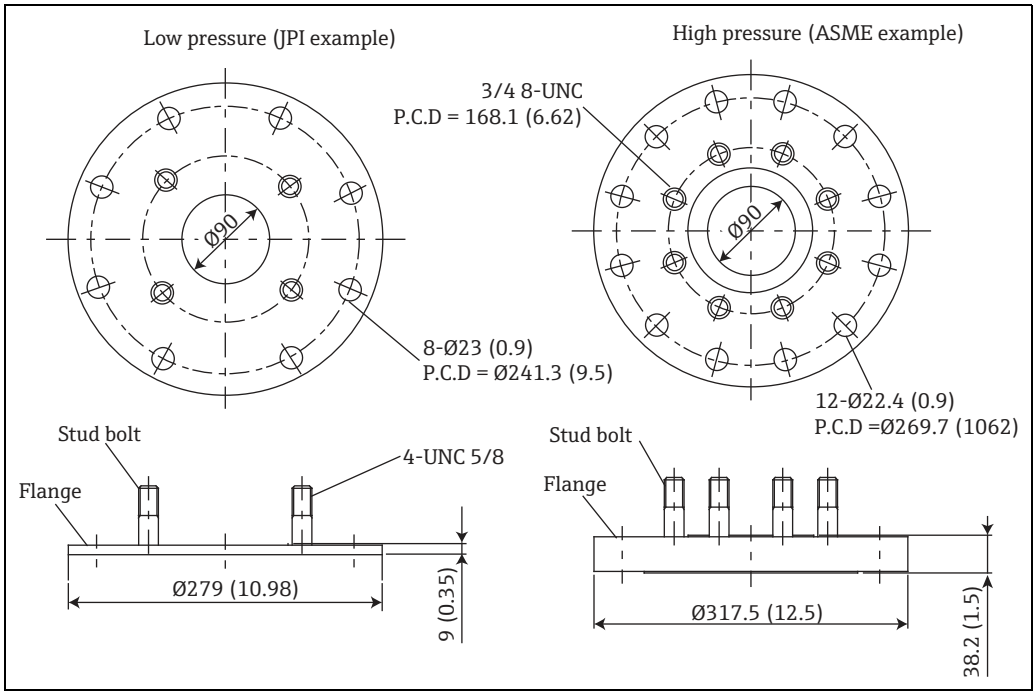


Figure 21: Reducing flange, unit of measurement: mm (in)

Use reducing flange when NMS5 connection 80A(30")and mounting nozzle is 150A(6").

NHF4

10	**Process Connection; Body:**	
	A	10K 150A RF, flange JIS B2220
	C	10K 150A FF, flange JIS B2220
	E	20K 150A RF, flange JIS B2220
	G	NPS 6" Cl.150 RF, flange ASME B16.5
	J	NPS 6" Cl.300 RF, flange ASME B16.5
	L	DIN 150 PN10 B1, flange EN1092 (DIN2527 B)
	N	DIN 150 PN25 B1, flange EN1092 (DIN2527 B)
	Q	150A 150lbs RF, flange JPI 7S-15
	S	150A 300lbs RF, flange JPI 7S-15F
	Y	Special version, TSP-no. to be spec.
20	**Flange Material:**	
	0	SS400
	1	SUS304
	9	Special version, TSP-no. to be spec.
NHF4-		Complete product designation

NOTICE

NHF4 is not required if NMS5 is ordered with "Order Information; Guide Wire Installation (130-E)". When NHF4 is ordered as NMS5-xxxxxxxxxxxxE with Guide Wire Installation, all the required mounting equipment is included.

Supplementary documentation

Technical information	**TI00042G** Prothermo NMT 539 **TI00462G** Promonitor NRF 560
Operating manual	**BA00401G** Proservo NMS5
Compact instructions	**KA001N** Whessoemtric 550 **KA002N** RS485 Modbus
Safety instructions	**XA00578G** Proservo NMS5 - ATEX **XA00582G** Proservo NMS5 - IECEx **XA10257G** Proservo NMS5 - NEPSI **EX421-439** Proservo NMS5 - FM **EX540-742** Proservo NMS5 - CSA
Functional safety manual	**SD00337G** Proservo NMS5 - (4-20mA Output, Overspill prevention relay)

Appendix

Stainless steel conversion table

The stainless steel material used in products of Endress + Hauser Yamanashi normally have expressions according to Japanese industrial standards, such as JIS. Each country or region may have different expressions place to place.
The following conversion table contains the expression of equivalent stainless steel material based on the chemical composition and mechanical properties.

County	Standard	Expressions			
Japan	JIS	SUS304	SUS304L	SUS316	SUS316L
Germany	DIN 17006	X5 CrNi 18 10 X5 CrNi 18 12	X2 CrNi 18 11	X5 CrNiMo 17 12 2 / 1713 3	X2 CrNiMo 17 13 2
	W.N. 17007	1.4301 1.4303	1.4306	1.4401 / 1.4436	1.4404
France	AFNOR	Z 6 CN 18-09	Z 2CN 18-10	Z 6 CND 17-11 / 17 12	Z2 CND 17-12
Italy	UNI	X5 CrNi 1810	X2 CrNi 1911	X5 CrNiMo 1712 / 1713	X2 CrNiMo 1712
U.K.	BSI	304S15 / 304S16	304S11	316S31 / 316S33	316S11
U.S.A.	AISI	304	304 L	316	316L
U.E.	EURONORM	X6 CrNi 1810	X3 CrNi 1810	X6 CrNiMo 17 12 2 / 17 13 3	X3 CrNiMo 17 12 2
Spain	UNE	X6 CrNi 19-10	X2 CrNi 19-10	X6 CrNiMo 17-12-03	X2 CrNiMo 17-12-03
Russia	GOST	08KH18N10 06KH18N11	03KH18N11	–	03KH17N14M2
-	ISO	11	10	20	19
-	ASME	S30400	S30403	S31600	S31603

NOTICE

Since each standard carries its own mechanical and scientific definition, some expressions on the list above may not have a straight conversion from the Japanese standard. Consult a local authority or legislature to ensure proper comparison of the applied standard prior to determining specifications.

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