Intelligent valve controller

Neles™ ND7000H
Neles™ ND9000H, ND9000F, ND9000P
Rev. 4.0

Installation, maintenance and
operating instructions

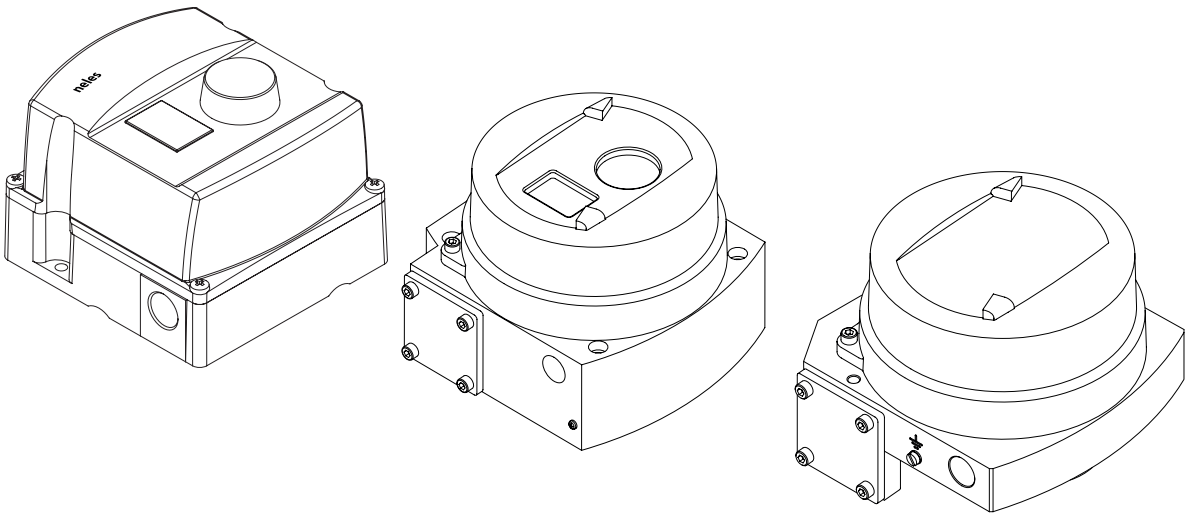


Table of contents

READ THESE INSTRUCTIONS FIRST!

These instructions provide information about safe handling and operation of the valve.

If you require additional assistance, please contact the manufacturer or manufacturer's representative.

SAVE THESE INSTRUCTIONS!

Addresses and phone numbers are printed on the back cover.

1. PRODUCT FAMILY SUMMARY

1.1 ND9000™

Key features

- Benchmark control performance on rotary and linear valves
- Reliable and robust design
- Ease of use
- Language selection: English, German and French
- Local / remote operation
- Expandable architecture
- Advanced device diagnostics including
- Self-diagnostics
  - Online diagnostics
  - Performance diagnostics
  - Communication diagnostics
  - Extended off-line tests
  - Performance view
  - Online Valve Signature

Options

- Interchangeable communication options:
  - HART 6 or 7 (H)
  - FOUNDATION fieldbus (F)
  - Profibus PA (P)
- Limit switches
- Position transmitter (in HART only)
- Stainless steel housing
- Exhaust adapter
- Remote mounting
- Cold version (up to -53 °C)

Total cost of ownership

- Low energy and air consumption
- Future proof design allows further options at a reduced cost
- Optimised spares program. Reduced number of spares
- Retro-fit to existing installations (Valmet or 3rd party)

Minimised process variability

- Linearisation of the valve flow characteristics
- Excellent dynamic and static control performance
- High-speed of response
- Accurate internal measurements

Easy installation and configuration

- Same unit for linear and rotary valves, double and single-acting actuators
- Simple calibration and configuration
  - using Local User Interface (H, F, P)
  - using DTM or EDD in a remote location (H, F)
  - see 375/475 menu structure from annex 1
  - using Profibus configurator like Simatic PDM (P) or DTM
- Low power design enables installation to all common control systems
- Ability to attach options to electronics and mechanics later
- Possibility to mount also on valves that are in process with 1-point calibration feature

Open solution

Valmet is committed to delivering products that freely interface with software and hardware from a variety of manufacturers; and the ND9000 is no exception. This open architecture allows the ND9000 to be integrated with other field devices to give an unprecedented level of controllability.

- FDT based and DD/eEDD multi-vendor support configuration files from download page: www.valmet.com/ND9000

ND9000 in fieldbus networks

- Approved interoperability
  - Host interoperability ensured
  - FOUNDATION fieldbus ITK version 6.1.2 certified
  - Profibus PA profile version 3.0 PNO certified
- Easy to upgrade; can be done by replacing the HART communication board to fieldbus communication board
- Excellent maintainability with firmware download feature
- Advanced communication diagnostics
- Digital communication via the fieldbus includes not only the set point, but also the position feedback signal from the position sensor. No special supplementary modules for analog or digital position feedback are needed when using the fieldbus valve controller.
- Back up LAS functionality available in FOUNDATION fieldbus enviroment
- Input selector and output splitter blocks available in FOUNDATION fieldbus devices allowing advanced distributed control
- Multipurpose functionality
  - Standard function blocks enables the freedom to use ND9000 intelligent valve controller either in continuous or on-offcontrol applications
  - Open and close information directly available via the fieldbus
  - Open and close detection is based on either position measurement (soft limit switch) or mechanical limit switch information

Product reliability

- Designed to operate in harsh environmental conditions
  - Rugged modular design
  - Excellent temperature characteristics
  - Vibration and impact tolerant
  - IP66 enclosure
  - Protected against humidity
- Maintenance free operation
  - Resistant to dirty air
  - Wear resistant and sealed components
  - Contactless position measurement

Predictive maintenance

- Easy access to collected data with FDT based DTM
  - Unique Online Valve Signature to detect valve friction even more accurately.
  - Performance view with report, which gives guidelines for recommended actions.
  - Logical trend and histogram collection
  - Information collected on service conditions
  - Extensive set of off-line tests with accurate key figure calculations
  - Fast notifications using on-line alarms
  - Condition monitoring tool available
  - Real time monitoring of valve control parameters

1.2 ND7000™

Key features

- Benchmark control performance on rotary and linear valves
- Reliable and robust design
- Ease of use
- Language selection: English, German and French
- Local / remote operation
- Expandable architecture
- Basic diagnostics including
  - Self-diagnostics
  - Online diagnostics
  - Extended off-line tests

Total cost of ownership

- Low energy and air consumption
- Retro-fit to existing installations (Valmet or 3rd party)

Minimised process variability

- Linearisation of the valve flow characteristics
- Excellent dynamic and static control performance
- High-speed of response
- Accurate internal measurements

Easy installation and configuration

- Same unit for linear and rotary valves, double and single-acting actuators
- Simple calibration and configuration
  - using Local User Interface (H)
  - using DTM or EDD in a remote location (H, F)
  - see 375/475 menu structure from annex 1
- Low power design enables installation to all common control systems
- Possibility to mount also on valves that are in process with 1-point calibration feature

Open solution

Valmet is committed to delivering products that freely interface with software and hardware from a variety of manufacturers; and the ND7000 is no exception. This open architecture allows the ND7000 to be integrated with other field devices to give an unprecedented level of controllability.

- FDT based multi-vendor support configuration
  ND9000 DTM download page:
  www.valmet.com/ND9000

Product reliability

- Designed to operate in harsh environmental conditions
  - Rugged modular design
  - Excellent temperature characteristics
  - Vibration and impact tolerant
  - IP66 enclosure
  - Protected against humidity
- Maintenance free operation
  - Resistant to dirty air
  - Wear resistant and sealed components
  - Contactless position measurement

2. ND9000 AND ND7000 INTELLIGENT VALVE CONTROLLER WITH DIFFERENT COMMUNICATION PROTOCOLS

2.1 General

This manual incorporates Installation, Maintenance and Operation Instructions for the Neles ND9000 and ND7000 intelligent valve controller. The ND9000 and ND7000 may be used with either cylinder or diaphragm type pneumatic actuators for rotary or linear valves.

NOTE:

The selection and use of the valve controller in a specific application requires close consideration of detailed aspects. Due to the nature of the product, this manual cannot cover all the likely situations that may occur when installing, using or servicing the valve controller.

If you are uncertain about the use of the controller or its suitability for your intended use, please contact Valmet for more information.

2.2 Technical description

ND9000H and ND7000H

The ND9000H and ND7000H are a 4–20 mA loop-powered microcontroller-based intelligent valve controllers. The devices operate even at 3.6 mA input signal and communicates via HART.

ND9000F

The ND9000F is a fieldbus powered microcontroller-based intelligent valve controller.

ND9000P

The ND9000P is a fieldbus powered microcontroller-based intelligent valve controller.

All versions

All devices contain a Local User Interface enabling local configuration.

Independently from the communication protocol, the valve position is controlled by the powerful 32-bit microcontroller. The measurements include:

- Input signal
- Valve position with contactless sensor
- Actuator pressures, 2 independent measurements
- Supply pressure
- Spool valve position
- Device temperature

Advanced self-diagnostics guarantees that all measurements operate correctly. Failure of one measurement does not cause the valve to fail if the input signal and position measurements are operating correctly. After connections of electric signal and pneumatic supply the micro controller (µC) reads the input signal, position sensor (α), pressure sensors (Ps, P1, P2) and spool position sensor (SPS). A difference between input signal and position sensor (α) measurement is detected by the control algorithm inside the µC. The µC calculates a new value for prestage (PR) coil current based on the information from the input signal and from the sensors. Changed current to the PR changes the pilot pressure to the spool valve. Reduced pilot pressure moves the spool and the actuator pressures change accordingly. The spool opens the flow to the driving side of the double diaphragm actuator and opens the flow out from the other side of the actuator. The increasing pressure will move the diaphragm piston. The actuator and feedback shaft rotate clockwise. The position sensor (α) measures the rotation for the µC. The µC using control algorithm modulates the PR-current from the steady state value until a new position of the actuator according to the input signal is reached.

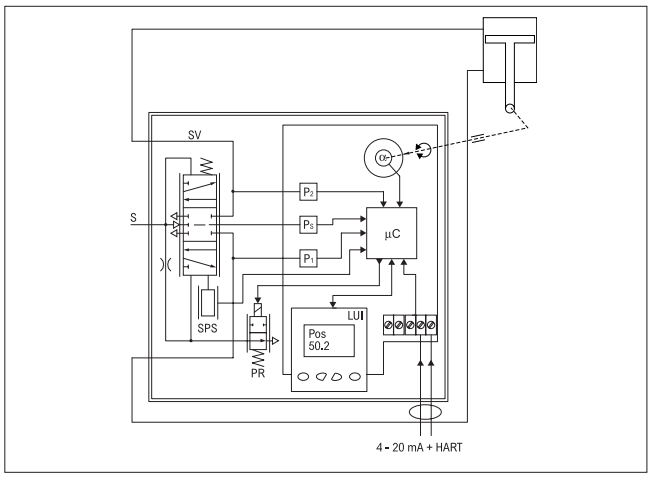


Fig. 1. The principle of operation

2.3 Markings

The valve controller is equipped with an identification plate (Fig. 2).

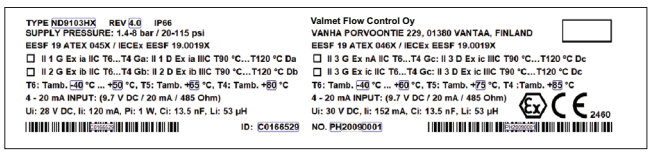


Fig. 2. Example of the identification plate

Identification plate markings include:

- Type designation of the valve controller
- Revision number
- Enclosure class
- Input signal (voltage range)
- Input resistance
- Maximum supply voltage
- Operational temperature
- Supply pressure range
- Contact details of the manufacturer
- CE mark
- Manufacturing serial number TTYYWWNNNN*)

*) Manufacturing serial number explained:

TT= device and factory sign

YY= year of manufacturing

WW = week of manufacturing

NNNN = consecutive number

Example: PH13011234 = controller, year 2013, week 1, consecutive number 1234.

Note, that in ND9200 and ND9300 models there may have two identification plates if there is double approval (type ND92_XE1 or ND93_XE1).

When device is installed to Ed i or Ex d area, remove identification plate which is not valid.

If device is installed to Ex d area, it can't be installed to Ex i area even that identification plate would be changed.

See Chapter 15 for all ID plates.

2.4 Technical specifications

ND9000 AND ND7000 INTELLIGENT VALVE CONTROLLER

General

Either loop powered (ND9000H and ND7000H) or

bus powered (ND9000F and ND9000P),

no external power supply required.

Suitable for rotary and sliding-stem valves.

Actuator connections in accordance with VDI/VDE 3845 and IEC 60534-6 standards.

Action:	Double or single acting
Travel range:	Linear; 10–120 mm with standard IEC parts.
	Larger strokes possible with suitable kits
	Rotary; 45–95°.
	Measurement range 110° with freely rotating feedback shaft.

Environmental Influence

Standard temperature range:	-40° to +85 °C / -40° to +185 °F
Low temperature option:	-53° to +85 °C / -64° to +185 °F

Influence of temperature on valve position:

< 0.5 % / 10 °C

Influence of vibration on valve position:

Standard for vibration testing	IEC 60068-2-6
	< 1 % under 2g 5–150 Hz,
	1g 150–300 Hz, 0.5g 300–2000 Hz

Enclosure

ND9100 and ND7100

Material:	Anodised aluminium alloy and polymer composite
Protection class:	IP66, NEMA 4X
Pneumatic ports:	G 1/4

Electrical connections (incl. junction box): max. 0.25–2.5 mm2 (solid or flexible conductors) Torque value for the tightening of screws (incl. junction box): 0.6-0.8 Nm

Cable gland thread:	M20 x 1.5 / 1/2 NPT (U)
Weight:	1.8 kg / 4.0 lb

with extension housing (limit switches) plus 0.8 kg / 1.8 lb

Mechanical and digital position indicator visible through the main cover

ND9200 and ND7200

Material:	Anodised aluminium alloy and tempered glass
Protection class:	IP66, NEMA 4X
Pneumatic ports:	1/4 NPT

Electrical connections (incl. junction box): max. 0.25–2.5 mm2 (solid or flexible conductors) Torque value for the tightening of screws (incl. junction box): 0.6-0.8 Nm

Cable gland thread:	M20 x 1.5, except 1/2 NPT (E2)
Weight:	3.4 kg / 7.5 lb

with extension housing (limit switches) plus 1.0 kg / 2.2 lb

Mechanical and digital position indicator visible through the main cover (not applicable to ND9200_E2)

ND9300 and ND9400

Material: (ND9300)	Full stainless steel enclosure
	Stainless steel housing and polymer composite cover (ND9400)
Protection class:	IP66, NEMA 4X
Pneumatic ports:	1/4 NPT

Electrical connections (incl. junction box): max. 0.25–2.5 mm2 (solid or flexible conductors) Torque value for the tightening of screws (incl. junction box): 0.6-0.8 Nm

Cable gland thread:	M20 x 1.5 / 1/2 NPT (U and E2)
Weight:	5.6 kg / 12.4 lbs (ND9400)
	8.6 kg / 19.0 lbs (ND9300)

with extension housing (limit switches) plus 3.0 kg / 6.6 lb

Pneumatics

Supply pressure:	1.4–8 bar / 20–115 psi

Effect of supply pressure on valve position:

< 0.1 % at 10 % difference in inlet pressure

Air quality:	According to ISO 8573-1:2001
	Solid particles: Class 6
	Humidity: Class 1
	(dew point 10 °C / 18 °F below minimum temperature is recommended)
	Oil class: 3 (or <1 ppm)
Supply media:	Air, nitrogen

Capacity with 4 bar / 60 psi supply:

	5.5 Nm3/h / 3.3 scfm (spool valve 2)
	12 Nm3/h / 7.1 scfm (spool valve 3)
	38 Nm3/h / 22.4 scfm (spool valve 6)

Consumption with 4 bar / 60 psi supply

in steady state position:	< 0.6 Nm3/h / 0.35 scfm (spool valves 2 & 3)
	< 1.0 Nm3/h / 0.6 scfm (spool valve 6)

Electronics

ND9000H and ND7000H

Supply power:	Loop powered, 4–20 mA
Minimum signal:	3.6 mA
Current max :	120 mA
Load voltage:	up to 9.7 V DC / 20 mA
	(corresponding 485 Ω)
Voltage:	max 30 V DC
Polarity protection:	-30 V DC

Over current protection:

active over 35 mA

ND9000F and ND9000P

Power supply:	Taken from bus
Bus voltage: protection	9–32 V DC, reverse polarity

Quiescent Current

Draw:	16 mA
Max basic current:	17.2 mA
Fault current (FDE):	3.9 mA

FOUNDATION fieldbus function block execution times

ND9000F

AO	20 ms
AI	20 ms
PID	20 ms
DO	20 ms
DI	15 ms
IS	15 ms
OS	15ms

Performance with moderate constant-load actuators

Values at 20 °C / 68 °F and without any additional instruments, such as boosters or quick exhaust valves etc.

Dead band:	≤ 0.1 %
Hysteresis:	< 0.5 %

Local user interface functions

- Local control of the valve
- Monitoring of valve position, input signal, temperature, supply and actuator pressure difference
- Guided start-up function
- LUI may be locked remotely to prevent unauthorised access
- Calibration: Automatic/Manual/Linearization
- 1-point calibration
- Control configuration: aggressive, fast, optimum, stable, maximum stability
- Mode selection: Automatic/Manual
- Rotation: valve rotation clockwise or counterclockwise to close
- Dead angle
- Low cut-off, cut-off safety range (default 2 %)
- Positioner fail action, open/close
- Signal direction: Direct/reverse acting
- Actuator type, double/single acting
- HART version: HART 6 or HART 7
- Valve type, rotary/linear IEC/nelesCV Globe/FLI
- Language selection: English, German and French

Electromagnetic protection

	Electromagnetic compatibility acc. to
	Emission: EN 61000-6-4:2018
	Immunity: EN 61000-6-2 (2016)
Safety	
	IEC 61508 compliant up to and including SIL 2 by TUV
CE marking	
	EMC 2014/30/EU

Approvals

Table 1. Approvals and electrical values, HART

Certificate	Approval	Electrical values
ATEX		
ND_X EESF 19 ATEX 045X EESF 19 ATEX 046X EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-15:2010 EN 60079-31:2014	II 1G Ex ia IIC T6…T4 Ga II 2G Ex ib IIC T6…T4 Gb II 3G Ex ic IIC T6…T4 Gc II 1D Ex ia IIIC T90 °C…T120 °C Da II 2D Ex ib IIIC T90 °C…T120 °C Db II 3D Ex ic IIIC T90 °C…T120 °C Dc II 2D Ex ta IIIC T90 °C…T120 °C Da II 2D Ex tb IIIC T90 °C…T120 °C Db II 3D Ex tc IIIC T90 °C…T120 °C Dc II 3D Ex nA IIC T6…T4 Gc	ia / ib devices: Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH. c devices: Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH.
ND_E1 SIRA 11 ATEX 1006X EN 60079-0:2012 EN 60079-1:2007 EN 60079-31:2009	II 2 G Ex d IIC T6...T4 Gb II 2 D Ex tb IIIC T80 °C...T105 °C Db IP66	Input: Ui ≤ 30 V Output: Ui ≤ 30 V, Pmax = device limits itself.
IECEx		
ND_X IECEx EESF 19.0019X IEC 60079-0:2017 Edition:7.0 IEC 60079-11:2011 Edition:6.0 IEC 60079-15:2010 Edition:4 IEC 60079-31:2013 Edition:2	Ex ia IIC T6…T4 Ga Ex ib IIC T6…T4 Gb Ex ic IIC T6…T4 Gc Ex ia IIIC T90 °C…T120 °C Da Ex ib IIIC T90 °C…T120 °C Db Ex ic IIIC T90 °C…T120 °C Dc Ex ta IIIC T90 °C…T120 °C Da Ex tb IIIC T90 °C…T120 °C Db Ex tc IIIC T90 °C…T120 °C Dc Ex nA IIC T6…T4 Gc	ia / ib devices: Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH. ic devices: Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH. nA devices: Input: Ui ≤ 30 V, Ii ≤ 152 mA Output: Ui ≤ 30 V, Ii ≤ 152 mA
ND_E1 IECEx SIR 11.0001X IEC 60079-0:2011 Edition:6.0 IEC 60079-1:2007-04 Edition:6 IEC 60079-31:2008 Edition:1	Ex d IIC T6...T4 Gb Ex tb IIIC T80 °C...T105 °C Db IP66	Input: Ui ≤ 30 V Output: Ui ≤ 30 V, Pmax = device limits itself.
INMETRO		
ND_Z NCC 12.0793 X NCC 12.0794 X ABNT NBR IEC 60079-0:2013 Versão corrigida em 2016 ABNT NBR IEC 60079-11:2013 Versão corrigida em 2017 ABNT NBR IEC 60079-31:2014	Ex ia IIC T6...T4 Ga / Ex ia IIIC T90 °C...T120 °C Da / Ex ta IIIC T90°C...T120°C Da Ex ib IIC T6...T4 Gb / Ex ib IIIC T90 °C...T120 °C Db / Ex tb IIIC T90°C...T120°C Db Ex ia IIC T6...T4 Ga / Ex ib IIC T6...T4 Gb	Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13,5 nF, Li ≤ 53 µH Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13,5 nF, Li ≤ 53 µH.
ABNT NBR IEC 60079-0:2013 Versão corrigida em 2016 ABNT NBR IEC 60079-11:2013 Versão corrigida em 2017 ABNT NBR IEC 60079-15:2012 ABNT NBR IEC 60079-31:2014	Ex nA IIC T6...T4 Gc	Input: Ui ≤ 30 V, Ii ≤ 152 mA Output: Ui ≤ 30 V, Ii ≤ 152 mA
	Ex ic IIC T6...T4 Gc Ex ic IIC T90 °C...T120 °C Dc Ex tc IIIC T90 °C...T120 °C Dc	Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13,5 nF, Li ≤ 53 µH. Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13,5 nF, Li ≤ 53 µH.
ND_E5 NCC 12.0795 X ABNT NBR IEC 60079-0:2013 ABNT NBR IEC 60079-1:2016 ABNT NBR IEC 60079-31:2014	Ex db IIC T6...T4 Gb Ex tb IIIC T80 °C... T105 °C Db IP66	Input: Ui ≤ 30 V Output: Ui ≤ 30 V, Pmax = device limits itself.

Certificate	Approval	Electrical values
ATEX		
cCSAus		
ND_U Certificate: 1552597 Project: 80059145 CSA C22.2 No. 0-M91 CSA C22.2 No. 94-M91 CSA C22.2 No. 142-M1987 CSA C22.2 No. 213-M1987 CSA C22.2 No. 60079-0:11 CSA C22.2 No. 60079-11:2014 CSA C22.2 No. 60079-15:12 CSA C22.2 No. 60529:05 ANSI/ISA 60079-0: 2009 ANSI/ISA 60079-11: 2012 ANSI/ISA 60079-15: 2012 FM 3600 November 1998 FM 3610 October 1999 FM 3611 October 1999 FM 3810-2005 ANSI/NEMA 250:1991 ANSI/IEC 60529:2004	Class I, Division 1, Groups A, B, C, and D; T4/T5/T6 Ex ia IIC T4/T5/T6 Ga Class I, Zone 0 AEx ia IIC T4/T5/T6 Ga	Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH.
	Class I, Division 2, Groups A, B, C, and D; T4/T5/T6 Ex nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga Class I, Zone 2 AEx nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga	Input: Ui ≤ 30 V. Output: Ui ≤ 30 V.
ND_E2 Certificate: 1980091 Project: 70017722 CSA Std C22.2 No.25-1966 CSA Std C22.2 No.30-10 CAN/CSA-C22.2 No.94-M91 C22.2 No. 142-M1987 CAN/CSA C22.2 61010-1-04 CAN/CSA-C22.2 No 60079-0-07 CAN/CSA-C22.2 No 60079-1-11 CAN/ CSA C22.2 No 60079-31-12 CAN/CSA-C22.2 No. 60529-05 FM 3600 (1998) FM 3615 (2006) FM 3810 (2005) ANSI/ NEMA 250-1991 ISA 60079-0-07 ISA 60079-1-07 ISA 60079-31-2009 ANSI/IEC 60529:2004	Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E,F,G; Class III; T4…T6, Enclosure type 4X Ex d IIC T4…T6 AEx d IIC T4…T6 Ex tb IIIC T100 °C IP66 AEx tb IIIC T100 °C IP66	Ui ≤ 32 V
Japanese Ex-d Certification:		
ND_E4 CML 19JPN1284X	Ex d IIC T6 Gb Ex tb IIIC T80°C Db	Input: Ui ≤ 30 V Output: Ui ≤ 30 V, Pmax = device limits itself.

Table 2. Approvals and electrical values, FOUNDATION fieldbus and Profibus PA

Certificate	Approval	Electrical values
ATEX		
ND_X EESF 19 ATEX 045X EESF 19 ATEX 046X EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-15:2010 EN 60079-31:2014	II 1G Ex ia IIC T6…T4 Ga II 2G Ex ib IIC T6…T4 Gb II 3G Ex ic IIC T6…T4 Gc II 1D Ex ia IIIC T90 °C…T120 °C Da II 2D Ex ib IIIC T90 °C…T120 °C Db II 3D Ex ic IIIC T90 °C…T120 °C Dc II 2D Ex ta IIIC T90 °C…T120 °C Da II 2D Ex tb IIIC T90 °C…T120 °C Db II 3D Ex tc IIIC T90 °C…T120 °C Dc II 3D Ex nA IIC T6…T4 Gc	ia / ib devices: Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO field device ic devices: Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO Ex ic field device nA devices: Ui ≤ 24 V
ND_E1 SIRA 11 ATEX 1006X EN 60079-0:2012 EN 60079-1:2007 EN 60079-31:2009	II 2 G Ex d IIC T6...T4 Gb II 2 D Ex tb IIIC T80 °C...T105 °C Db IP66	Ui ≤ 32 V
IECEx		
ND_X IECEx EESF 19.0019X IEC 60079-0:2017 Edition:7.0 IEC 60079-11:2011 Edition:6.0 IEC 60079-15:2010 Edition:4 IEC 60079-31:2013 Edition:2	Ex ia IIC T6…T4 Ga Ex ib IIC T6…T4 Gb Ex ic IIC T6…T4 Gc Ex ia IIIC T90 °C…T120 °C Da Ex ib IIIC T90 °C…T120 °C Db Ex ic IIIC T90 °C…T120 °C Dc Ex ta IIIC T90 °C…T120 °C Da Ex tb IIIC T90 °C…T120 °C Db Ex tc IIIC T90 °C…T120 °C Dc Ex nA IIC T6…T4 Gc	ia / ib devices: Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO field device ic devices: Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO Ex ic field device nA devices: Ui ≤ 24 V
ND_E1 IECEx SIR 11.0001X IEC 60079-0:2011 Edition:6.0 IEC 60079-1:2007-04 Edition:6 IEC 60079-31:2008 Edition:1	Ex d IIC T6...T4 Gb Ex tb IIIC T80 °C...T105 °C Db IP66	Ui ≤ 32 V
INMETRO		
ND_Z NCC 12.0793 X NCC 12.0794 X ABNT NBR IEC 60079-0:2013 Versão corrigida em 2016 ABNT NBR IEC 60079-11:2013 Versão corrigida em 2017 ABNT NBR IEC 60079-31:2014	Ex ia IIC T6...T4 Ga / Ex ia IIIC T90 °C...T120 °C Da / Ex ta IIIC T90°C...T120°C Da Ex ib IIC T6...T4 Gb / Ex ib IIIC T90 °C...T120 °C Db / Ex tb IIIC T90°C...T120°C Db Modelos ND7400, SD7400, ND9400 e SD9400: Ex ia IIC T6...T4 Ga / Ex ib IIC T6...T4 Gb	Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO field device
ABNT NBR IEC 60079-0:2013 Versão corrigida em 2016 ABNT NBR IEC 60079-11:2013 Versão corrigida em 2017 ABNT NBR IEC 60079-15:2012 ABNT NBR IEC 60079-31:2014	Ex nA IIC T6...T4 Gc	Ui ≤ 24 V
	Ex ic IIC T6...T4 Gc Ex ic IIIC T90 °C...T120 °C Dc Ex tc IIIC T90 °C...T120 °C Dc	Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO Ex ic field device
ND_E5 NCC 12.0795 X ABNT NBR IEC 60079-0:2013 Versão corrigida em 2016 ABNT NBR IEC 60079-1:2016 ABNT NBR IEC 60079-31:2014	Ex db IIC T6...T4 Gb Ex tb IIIC T80 °C... T105 °C Db IP66	Ui ≤ 32 V

Certificate	Approval	Electrical values
ATEX		
cCSAus		
ND_U Certificate: 1552597 Project: 80059145 CSA C22.2 No. 0-M91 CSA C22.2 No. 94-M91 CSA C22.2 No. 142-M1987 CSA C22.2 No. 213-M1987 CSA C22.2 No. 60079-0:11 CSA C22.2 No. 60079-11:2014 CSA C22.2 No. 60079-15:12 CSA C22.2 No. 60529:05 ANSI/ISA 60079-0: 2009 ANSI/ISA 60079-11: 2012 ANSI/ISA 60079-15: 2012 FM 3600 November 1998 FM 3610 October 1999 FM 3611 October 1999 FM 3810-2005 ANSI/NEMA 250:1991 ANSI/IEC 60529:2004	Class I, Division 1, Groups A, B, C, and D; T4/T5/T6 Ex ia IIC T4/T5/T6 Ga Class I, Zone 0 AEx ia IIC T4/T5/T6 Ga	Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO field device
	Class I, Division 2, Groups A, B, C, and D; T4/T5/T6 Ex ic IIC T4/T5/T6 Gc Class I, Zone 2 AEx ic IIC T4/T5/T6 Gc	Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Comply with the requirements for FISCO Model Ex ic field device
ND_E2 Certificate: 1980091 Project: 70017722 CSA Std C22.2 No.25-1966 CSA Std C22.2 No.30-10 CAN/CSA-C22.2 No.94-M91 C22.2 No. 142-M1987 CAN/CSA C22.2 61010-1-04 CAN/CSA-C22.2 No 60079-0-07 CAN/CSA-C22.2 No 60079-1-11 CAN/ CSA C22.2 No 60079-31-12 CAN/CSA-C22.2 No. 60529-05 FM 3600 (1998) FM 3615 (2006) FM 3810 (2005) ANSI/ NEMA 250-1991 ISA 60079-0-07 ISA 60079-1-07 ISA 60079-31-2009 ANSI/IEC 60529:2004	Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E, F, G; Class III; T4…T6, Enclosure type 4X Ex d IIC T4…T6 AEx d IIC T4…T6 Ex tb IIIC T100 °C IP66 AEx tb IIIC T100 °C IP66	Ui ≤ 32 V
Japanese Ex-d Certification:		
ND_E4 CML 19JPN1284X	Ex d IIC T6 Gb Ex tb IIIC T80°C Db	Input: Ui ≤ 30 V Output: Ui ≤ 30 V, Pmax = device limits itself.

Optional parts

ND9000H and ND7000H

Position transmitter

Output signal:	4–20 mA (galvanic isolation; 600 V DC)
Supply voltage:	12–30 V
Resolution:	16 bit / 0.244 µA
Linearity:	< 0.05 % FS
Temperature effect:	< 0.35 % FS
External load:	max 0–780 Ω max 0–690 Ω for intrinsically safe

ND9000/H, ND9000/F, ND9000/P,

ND9000F/B06, ND9000P/B06

Proximity sensors and micro switches, 2 pieces

(with extension module)

Code D33	SST Sensor Dual Module: **Obsolete**
Code D44	Namur Sensor Dual Module: **Obsolete**
Code I02	P+F NJ2-12GK-SN
Code I09	P+F NCB2-12GM35-N0
Code I32	Omron E2E-X2Y1
Code I41	P+F NJ4-12GK-SN
Code I45	P+F NJ3-18GK-S1N
Code I56	IFC 2002-ARKG/UP
Code K05	Omron D2VW-5
Code K06	Omron D2VW-01
Code B06	Omron D2VW-01 (ND9100F/P, ND9200F/P and ND9300F/P only)

2.5 Recycling and disposal

Most valve controller parts can be recycled if sorted according to material.

Most parts have material marking. A material list is supplied with the valve controller. In addition, separate recycling and disposal instructions are available from the manufacturer.

A valve controller may also be returned to the manufacturer for recycling and disposal. There will be a charge for this.

2.6 Safety precautions

NOTE (ND9000, ND7000):

Avoid earthing a welding machine in close proximity to an ND valve controller.

Damage to the equipment may result.

CAUTION (ND9000, ND7000):

Do not exceed the permitted values!

Exceeding the permitted values marked on the valve controller may cause damage to the controller and to equipment attached to the controller and could lead to uncontrolled pressure release in the worst case. Damage to the equipment and personal injury may result.

CAUTION (ND9000, ND7000):

Do not remove or dismantle a pressurized controller!

Removing or dismantling a pressurized prestage or spool valve of an ND leads to uncontrolled pressure release. Always shut off the supply air and release the pressure from the pipelines and equipment before removing or dismantling the controller. Otherwise personal injury and damage to equipment may result.

WARNING (ND9000, ND7000):

During automatic or manual calibration the valve operates between open and closed positions. Make sure that the operation does not endanger people or processes!

WARNING (ND9000, ND7000):

Do not operate the device with electronics cover (39) removed!

Electromagnetic immunity is reduced, valve may stroke. Explosion protection may be impaired.

Ex d WARNING (ND9200, ND7200, ND9300):

Do not open the device when energized!

Explosion protection is lost.

ELECTRICAL SAFETY WARNING (ND9200, ND7200, ND9300):

Use fuses for limit switch installations with

50 V AC / 75 V DC or higher.

Ex WARNING (ND9100, ND7100):

Electrostatic charge hazard!

The cover is non-conductive. Clean with a damp cloth only!

Spark hazard!

Protect the aluminium housing from impacts and friction!

Ex WARNING (ND9100, ND9200, ND9300 and ND7100):

For use in the presence of combustible dust.

Ignition protection relies on the enclosure. Protect the cover of the valve controller from impacts. When temperature is higher than 70 °C / 158 °F the temperature rating of the cable shall be higher than the ambient temperature.

Ex WARNING (ND9200, ND7200, ND9300):

The locking screw (part 107) of the cover is essential to explosion protection.

The cover has to be locked in place for Ex d protection. The screw grounds the cover to the housing.

Intrinsic Safety (Ex i) WARNING (ND9100, ND9200, ND9300 and ND7100):

Ensure that the complete installation and wiring is intrinsically safe before operating the device!

The equipment must be connected via a certified Zener barrier placed outside the hazardous area.

Ex WARNING (ND9200, ND7200):

Electrostatic charge hazard!

The windows and identification plate are non-conductive. Clean with a damp cloth only!

Ex WARNING (ND9100, ND7100):

For use in the presence of combustible dust.

Device shall not be subjected to a prolific charge generating mechanism.

Ex WARNING (ND9000, ND7000):
Accumulation of dust shall be avoided!

Ex d WARNING (ND9200, ND7200, ND9300):
Use a cable gland and blind plug with suitable Ex d certification.

For ambient temperature over 70 °C / 158 °F use a heat resistant cable and cable gland suitable for at least 90 °C / 194 °F.

Ex n WARNING (ND9100, ND9200, ND9300 and ND7100):
At an ambient temperature ≥ +70 °C / 158 °F, the temperature rating of selected connection cable shall be in accordance with the maximum ambient temperature range.

Selected cable gland shall not invalidate the type of protection.

Ex i WARNING (ND9100, ND9200, ND9300 and ND7100):
At an ambient temperature ≥ +70 °C / 158 °F, the temperature rating of selected connection cable shall be in accordance with the maximum ambient temperature range.

Ex NOTE:
Follow the standards EN/IEC 60079-14 when installing the equipment and and EN/IEC 60079-25 when connecting Ex i interfaces.

NOTE: (Class I, Division 2):
This equipment is suitable for installation in Class I, Division 2, Groups A, B, C, D hazardous locations or nonhazardous locations only.

WARNING: Explosion Hazard (Class I, Div 2):
Substitution of components may impair suitability for Class I, Division 2.

NOTE: (Class I, Division 2):
Wiring to or from this device, which enters or leaves the system enclosure, must utilize wiring methods suitable for Class I, Division 2 Hazardous Locations, as appropriate for the installation.

WARNING: Explosion Hazard:
Do not connect or disconnect this equipment unless power has been removed or the area is known to be nonhazardous

3. TRANSPORTATION, RECEPTION AND STORAGE

The valve controller is a sophisticated instrument, handle it with care.

- Check the controller for any damage that may have occurred during transportation.
- Store the uninstalled controller preferably indoors, keep it away from rain and dust.
- Do not unpack the device until installing it.
- Do not drop or knock the controller.
- Keep the flow ports and cable glands plugged until installing.
- Follow instructions elsewhere in this manual.

4. MOUNTING

4.1 General

NOTE:

The enclosure of ND9000 and ND7000 intelligent valve controller meets the IP66 protection class according to EN 60529 in any position when the cable entry is plugged according to IP66.

Based on good mounting practice, the recommended mounting position is electrical connections placed downwards. This recommendation is shown in our mounting position coding for control valves.

If these requirements are not fulfilled, and the cable gland is leaking and the leakage is damaging valve controller or other electrical instrumentation, our warranty is not valid.

NOTE:

Make sure the mounting of the device and the valve assembly is suitable for the weight of the assembly.

If the ND is supplied with valve and actuator, the tubes are mounted and the ND adjusted in accordance with the customer's specifications. If the controller is ordered separately, the mounting parts for the assembly must be ordered at the same time.

Sample order: (B1CU13)-Z-ND9_06HN

Shaft coupling alternatives for the controller for Neles actuators are shown in Fig. 4.

4.2 For mounting parts for Neles actuators, see 12.5–12.8. Mounting on Neles actuators with VDI/VDE mounting face

See figures in Section 12.5–12.7.

ND9100, ND9400, ND7100

- Mount the H-shaped coupling (47) to the shaft. Apply the thread-locking compound to the screw (48) and tighten firmly.
- Remove all protective plastic plugs from the pneumatic connections (5 pcs.). Mount the metal plugs (54) with sealant to the unused controller connections at the bottom of the controller.
- BJ and other single acting actuators: mount a metal plug (53) with sealant to the C1 connection.
- Set the direction arrow of the actuator in the direction of the valve closure member and attach the ear (2) to the indicator cover in the position shown in Section 12.5–12.7. Secure the screw of the ear using e.g. Loctite and tighten firmly.
- Attach the bracket (1) to the ND.
- Attach the bracket (1) to the actuator. The shaft coupling of the ND must fit into the ear (2) so that the pointer of the shaft washer (16) is located in the position shown in Fig. 3.

ND9200, ND7200, ND9300

- Make sure the mounting bracket is suitable for the weight of the controller. See detailed weight information in Section 2.4.
- **ND9300:** Extra mounting holes exist in the housing for additional support. See dimension drawings for ND9300 in Chapter 13. The use of this extra support is mandatory in addition to the standard face.

- **ND9300**: Due to the extra weight of stainless steel version and/or possible heavy vibration, make sure there are proper supports in the pipeline to hold the weight of the valve assembly.
- Mount the H-shaped coupling (47) to the shaft. Apply the thread-locking compound to the screw (48) and tighten firmly.
- Remove the protective plastic plugs from pneumatic connections C2, S and C1. Leave the metal plugs (54) in the unused connections at the bottom of the controller.
- **BJ and other single acting actuators**: install a metal plug (53) with sealant to the C1 connection.
- Set the direction arrow of the actuator in the direction of the valve closure member and attach the ear (2) to the indicator cover in the position shown in Section 12.5–12.7. Secure the screw of the ear using e.g. Loctite and tighten firmly.
- Attach the bracket (1) to the controller.
- Attach the bracket (1) to the actuator. The shaft coupling of the controller must fit into the ear (2) so that the pointer is located in the position shown in Fig. 3.

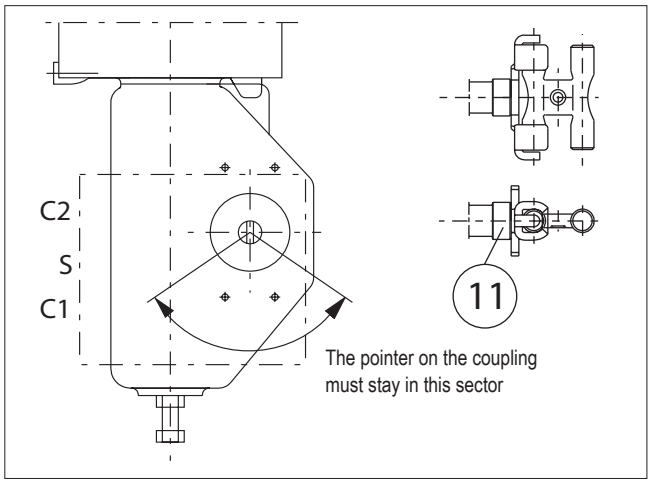


Fig. 3. Mounting on Neles actuator with VDI/VDE mounting face

4.3 Mounting on Neles VC and VD actuators or linear actuators with IEC 60534 mounting face

See figure in Section 12.8.

ND9100, ND9400, ND7100

- Attach the feedback arm with spacer to the valve controller shaft. Note the position of the mark on the shaft as in 12.8. Apply thread locking compound to the screws and tighten firmly. Attach the spring to the feedback arm as shown in Section 12.8.
- Mount the valve controller mounting bracket loosely to the yoke of the actuator.
- Remove all plastic plugs from all actuator connections. Mount the metal plugs (54) with sealant to the unused controller connections at the bottom of the controller.
- Mount the valve controller loosely to the mounting bracket guiding the pin on the actuator stem to the slot of the feedback arm.
- Align the bracket and the valve controller with the actuator stem and adjust their position so that the feedback arm is approximately at a 90° angle to the actuator stem (in the mid-stroke position).
- Tighten the valve controller mounting bracket screws.
- Adjust the distance of the valve controller to the pin on the actuator stem so that the pin stays in the lever slot at full stroke. Ensure also that the maximum angle of the lever does not exceed 45° in either direction. Maximum allowed travel of the lever is shown in Section 12.10. Best control performance is achieved when the feedback lever utilises the maximum allowed angle (±45° from horizontal position). The whole range should be at least 45°.
- Make sure that the valve controller is in right angle and tighten all the mounting bolts.
- Ensure that the valve controller complies with previous steps. Check that the actuator pin does not touch the valve controller case throughout the entire stroke of the actuator. If the actuator pin is too long it may be cut to size.
- Apply grease (Molykote or equivalent) to the contact surfaces of the actuator pin and the feedback arm to reduce wear.

ND9200, ND7200, ND9300

- Make sure the mounting bracket is suitable for the weight of the controller. See detailed weight information in Section 2.4.
- ND9300: Extra mounting holes exist in the housing for additional support. See dimension drawings for ND9300 in Chapter 13. The use of this extra support is mandatory in addition to the standard face.
- ND9300: Due to the extra weight of stainless steel version and/or possible heavy vibration, make sure there are proper supports in the pipeline to hold the weight of the valve assembly.
- Attach the feedback arm with spacer to the valve controller shaft. Note the position of the pointer on the shaft as in 12.8. Apply thread locking compound to the screws and tighten firmly. Attach the spring to the feedback arm as shown in Section 12.8.
- Mount the valve controller mounting bracket loosely to the yoke of the actuator.
- Remove the protective plastic plugs from pneumatic connections C2, S and C1. Leave the metal plugs (54) in the unused connections at the bottom of the controller. Single acting actuators: install a metal plug (53) with sealant to the C1 connection.
- Mount the valve controller loosely to the mounting bracket guiding the pin on the actuator stem to the slot of the feedback arm.
- Align the bracket and the valve controller with the actuator stem and adjust their position so that the feedback arm is approximately at a 90° angle to the actuator stem (in the mid-stroke position).
- Tighten the valve controller mounting bracket screws.
- Adjust the distance of the valve controller to the pin on the actuator stem so that the pin stays in the lever slot at full stroke. Ensure also that the maximum angle of the lever does not exceed 45° in either direction. Maximum allowed travel of the lever is shown in Section 12.8. Best control performance is achieved when the feedback lever utilises the maximum allowed angle (±45° from horizontal position). The whole range should be at least 45°.
- Make sure that the valve controller is in right angle and tighten all the mounting bolts.
- Ensure that the valve controller complies with previous steps. Check that the actuator pin does not touch the valve controller case throughout the entire stroke of the actuator. If the actuator pin is too long it may be cut to size.
- Apply grease (Molykote or equivalent) to the contact surfaces of the actuator pin and the feedback arm to reduce wear.

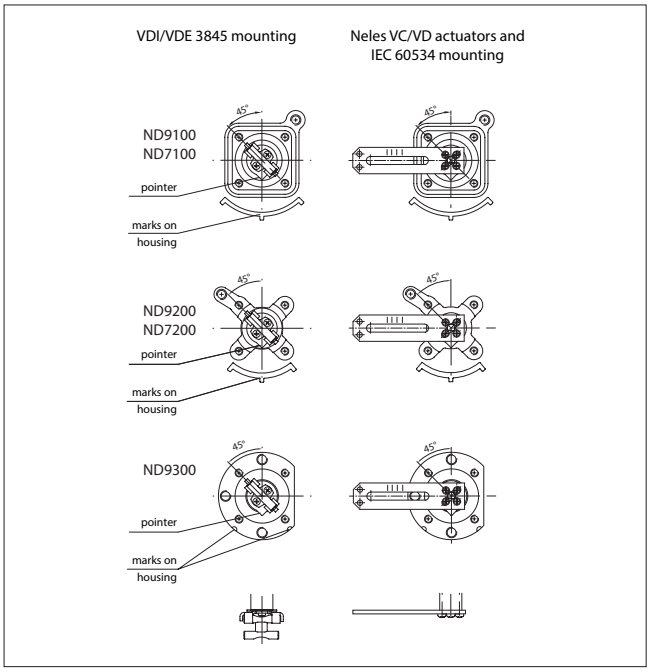


Fig. 4. Shaft coupling alternatives

4.4 Piping

CAUTION:

Do not exceed the permitted supply pressure (8 bar / 115 psi) of the ND9000 and ND7000!

Table 4 provides the recommended tube sizes in accordance with actuator sizes. Tube sizes are the minimum values allowed. Operating times may be tested by the offline tests in DTM / EDD.

- Connect the air supply to S.
- Connect C1 and C2 to the actuator, see Fig. 5 and 6.

Air connections are as follows

ND9100, ND7100: G 1/4

ND9200, ND9300, ND9400, ND7200, : 1/4 NPT

Liquid sealants, such as Loctite 577 are recommended for the pipe threads.

NOTE:

A valve controller mounted on a spring actuator must be connected only as single-acting. See Fig. 5 and 6.

NOTE:

An excess of sealant may result in faulty operation of the controller when accessed to pneumatic components.

Sealing tape is not recommended.

Ensure that the air piping is clean.

When pneumatic connector is removed, clean threads carefully from dry sealant particles before mounting connector back.

The air supply must be clean, dry and oil-free instrument air, see Section 2.4.

Table 3. Spring rates

Actuator type	Spring rate (bar/psi)
B1JK	3 / 43
B1J	4.2 / 61
B1JV	5.5 / 80
QPB	3 / 43
QPC	4.3 / 62
QPD	5.6 / 81
Adjust regulator pressure to a level that is max 1 bar (14.5 psi) + spring rate.	

Table 4. Piping and stroke times

Actuator				ND_2_ Supply 1/4" NPT Actuator 1/4" NPT			ND_3_ Supply 1/4" NPT Actuator 1/4" NPT			ND_6_ Supply 1/2" NPT Actuator 1/2" NPT		
B1C	Stroke volume dm^3 / in^3		NPT	Piping	Open (s)	Close (s)	Piping	Open (s)	Close (s)	Piping	Open (s)	Close (s)
6	0.3	18	1/4	6 mm or 1/4"	1.6*	1.6*	6 mm or 1/4"	1.0*	1.0*	–	–	–
9	0.6	37	1/4	–	–	–	6 mm or 1/4"	2.0	2.0	–	–	–
11	1.1	67	3/8	–	–	–	10 mm or 3/8" [6 mm or 1/4" (x)]	4.1	4.1	–	–	–
13	2.3	140	3/8	–	–	–	10 mm or 3/8"	–	–	–	–	–
17	4.3	262	1/2	–	–	–	–	–	–	10 mm or 3/8"	3.6	3.6
20	5.4	330	1/2	–	–	–	–	–	–	10 mm or 3/8"	5.0	5.0
25	10.5	610	1/2	–	–	–	–	–	–	10 mm or 3/8"	9.5	9.5
32	21	1282	3/4	–	–	–	–	–	–	10 mm or 3/8"	18.0	18.0
40	43	2624	3/4	–	–	–	–	–	–	10 mm or 3/8"	35.0	35.0
50	84	5126	1	–	–	–	–	–	–	10 mm or 3/8"	67.0	67.0
60	121	7380	1	–	–	–	–	–	–	10 mm or 3/8"	–	–
75	189	11500	1	–	–	–	–	–	–	10 mm or 3/8"	–	–
502	195	11900	1	–	–	–	–	–	–	10 mm or 3/8"	130.0	130.0
602	282	17200	1	–	–	–	–	–	–	10 mm or 3/8"	–	–
752	441	26900	1	–	–	–	–	–	–	10 mm or 3/8"	–	–
B1J B1JA	Stroke volume dm^3 / in^3		NPT	Piping	Air (s)	Spring (s)	Piping	Air (s)	Spring (s)	Piping	Air (s)	Spring (s)
10	1.8	110	3/8	–	–	–	10 mm or 3/8"			–	–	–
6	0.47	28.7	3/8	10 mm or 3/8" [6 mm or 1/4" (x)]	–	–	10 mm or 3/8" [6 mm or 1/4" (x)]	–	–	–	–	–
8	0.9	55	3/8	10 mm or 3/8" [6 mm or 1/4" (x)]	–	–	10 mm or 3/8" [6 mm or 1/4" (x)]	–	–	–	–	–
12	3.6	220	1/2	–	–	–	–	–	–	10 mm or 3/8"	3.0	5.2
16	6.7	409	1/2	–	–	–	–	–	–	10 mm or 3/8"	5.8	7.7
20	13	793	3/4	–	–	–	–	–	–	10 mm or 3/8"	9.0	14.0
25	27	2048	3/4	–	–	–	–	–	–	10 mm or 3/8"	19.0	25.0
32	53	3234	1	–	–	–	–	–	–	10 mm or 3/8"	36.0	50.0
322	106	6468	1	–	–	–	–	–	–	10 mm or 3/8"	70.0	100.0
QP	Stroke volume dm^3 / in^3		NPT	Piping	Air (s)	Spring (s)	Piping	Air (s)	Spring (s)	Piping	Air (s)	Spring (s)
1C	0.62	37	3/8	10 mm or 3/8" [6 mm or 1/4" (x)]	–*	–*	10 mm or 3/8" [6 mm or 1/4" (x)]	1.2*	2.1*	–	–	–
2C	1.08	66	3/8	–	–	–	10 mm or 3/8"	2.4	3.0	–	–	–
3C	2.18	133	3/8	–	–	–	10 mm or 3/8"	4.8	5.2	–	–	–
4C	4.34	265	3/8	–	–	–	–	–	–	10 mm or 3/8"	3.2	3.7
5C	8.7	531	3/8	–	–	–	–	–	–	10 mm or 3/8"	7.5	11.0
6C	17.5	1068	3/4	–	–	–	–	–	–	10 mm or 3/8"	12.0	20.0

Air supply piping 10 mm or 3/8" for all actuators.

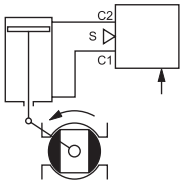
Pipe sizes are nominal, i.e. approximately outer diameter. Inner diameter is typically 2 mm smaller.
x = Standard pipe size used in Neles control valves.
(x) = Minimum pipe size (if smaller than standard).
*) Spool size 2 is preferred for accurate control and standard for Neles control valves.
Spool size 3 can be used if fast full stroke times are required.
Stroking times have been measured without valve.
Tests have been done with supply pressure of 5 bar.

Table 5. VD & VC stroking time table

Act'r Series	Stroke length	Controller Series	Stroking time (Sec.)		Act'r Series	Stroke length	Controller Series	Stroking time (Sec.)		Act'r Series	Stroke length	Controller Series	Stroking time (Sec.)	
			Load	Vent				Load	Vent				Load	Vent
VD_25	20mm	NDX	3	3	VD_25	20mm	ND9202	5	7		60mm		6	7
							ND9203	4	5	VC_30	80mm	ND9206	8	8
VD_29	20mm	NDX	3	3	VD_29	20mm	ND9203	5	7		100mm		10	10
	40mm		3	4		40mm		8	10		80mm		8	10
VD_37	20mm	NDX	3	3.5	VD_37	20mm	ND9203	9	11	VC_40	100mm	ND9206	10	11
	40mm		3.5	4		40mm		11	16		120mm		11	12
	50mm		4	5		50mm	ND9206	7	8		100mm		13	13
VD_48	20mm	NDX	3	4	VD_48	20mm	ND9203 ND9206	16	19	VC_50	120mm	ND9206	15	14
	40mm		3.5	5		40mm		9	11		140mm		17	16
	50mm		4	6		50mm		10	12	VC_60	120mm	ND9206	18	16
	60mm		5	6.5		60mm		11	13		140mm		21	19
	70mm		6	7.5		70mm		12	14		180mm		25	21
VD_55	20mm	NDX	3	6	VD_55	20mm	ND9206	9	11	VC_70	140mm	ND9206	20	19
	40mm		4	7		40mm		12	15		180mm		24	22
	50mm		5	8		50mm		14	17		240mm		28	27
	60mm		6	9		60mm		16	19	VC_80	180mm	ND9206	31	30
	70mm		7	10		70mm		18	21		240mm		35	31
	80mm		8	11		80mm		20	23		280mm		39	34

Note:
- Mounted with ND9 / NDX smart positioners and B72G-2AS-980 AFR only.
- VD model / spring range : VDR / 0.8 ~ 2.6 bar
- Stroking time accuracy: ± 10 %
- Supply pressure for VD_25/29/37 is 3.2 bar and VD_48&55 is 3.5 bar.
- VC model air supply pressue : 6.0 barg

DOUBLE-ACTING ACTUATOR



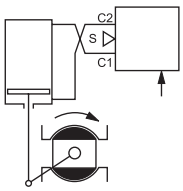
1. Increasing input signal to open valve (shown)

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   ATYP = 2-A
   PFA = CLO
   A0, CUTL and VTYP according to valve type

2. Increasing input signal to close valve **(not recommended)**

   Default setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   ATYP = 2-A
   PFA = CLO
   A0, CUTL and VTYP according to valve type

DOUBLE-ACTING ACTUATOR, REVERSED PIPING



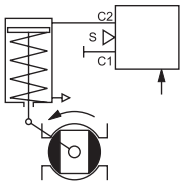
3. Increasing input signal to open valve **(not recommended)**

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   ATYP = 2-A
   PFA = OPE
   A0, CUTL and VTYP according to valve type

4. Increasing input signal to close valve (shown)

   Default setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   ATYP = 2-A
   PFA = OPE
   A0, CUTL and VTYP according to valve type

SINGLE-ACTING ACTUATOR, SPRING TO CLOSE



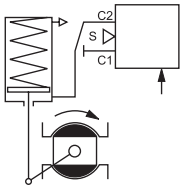
5. Increasing input signal to open valve (shown)

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   ATYP = 1-A
   PFA = CLO (must be in the spring direction)
   A0, CUTL and VTYP according to valve type

6. Increasing input signal to close valve **(not recommended)**

   Default setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   ATYP = 1-A
   PFA = CLO (must be in the spring direction)
   A0, CUTL and VTYP according to valve type

SINGLE-ACTING ACTUATOR, SPRING TO OPEN



7. Increasing input signal to close valve (shown)

   Default setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   ATYP = 1-A
   PFA = OPE (must be in the spring direction)
   A0, CUTL and VTYP according to valve type

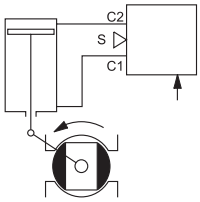
8. Increasing input signal to open valve **(not recommended)**

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   ATYP = 1-A
   PFA = OPE (must be in the spring direction)
   A0, CUTL and VTYP according to valve type

Fig. 5. Operation directions and air connections, ND9000H and ND7000H

DOUBLE-ACTING ACTUATOR

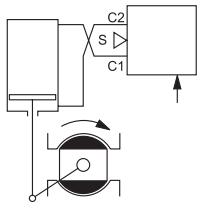
1. Self closing



Default setting:
ROT = cC (close valve to clockwise)
ATYP = 2-A
PFA = CLO
A0, CUTL and VTYP according to valve type

DOUBLE-ACTING ACTUATOR, REVERSED PIPING

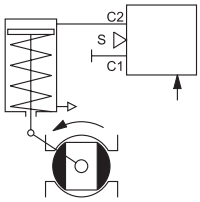
2. Self opening



Default setting:
ROT = cC (close valve to clockwise)
ATYP = 2-A
PFA = OPE
A0, CUTL and VTYP according to valve type

SINGLE-ACTING ACTUATOR, SPRING TO CLOSE

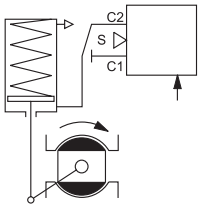
3. Self closing



Default setting:
ROT = cC (close valve to clockwise)
ATYP = 1-A
PFA = CLO (must be in the spring direction)
A0, CUTL and VTYP according to valve type

SINGLE-ACTING ACTUATOR, SPRING TO OPEN

4. Self opening



Default setting:
ROT = cC (close valve to clockwise)
ATYP = 1-A
PFA = OPE (must be in the spring direction)
A0, CUTL and VTYP according to valve type

Fig. 6. Operation directions and air connections, ND9000F and ND9000P

4.5 Electrical connections

ND9000H, ND7000H

The ND9000H and ND7000H is powered by a standard 4–20 mA current loop that also functions as a carrier to the HART communication.

The input signal cable is led through a

- M20 x 1.5 cable gland, or
- 1/2 NPT cable gland (U, E2)

Connect the conductors to the terminal strip as shown in Fig. 7. It is recommended that the earthing of the input cable shield be carried out from the DCS end only.

The position transmitter is connected to 2-pole terminal PT as shown in Fig. 7. The position transmitter needs an external power supply. The ND9000H / ND7000H and the position transmitter circuits are galvanically isolated and withstand a 600 V AC voltage.

NOTE:

The ND9000H and ND700H equal a load of 485 Ω in the current loop.

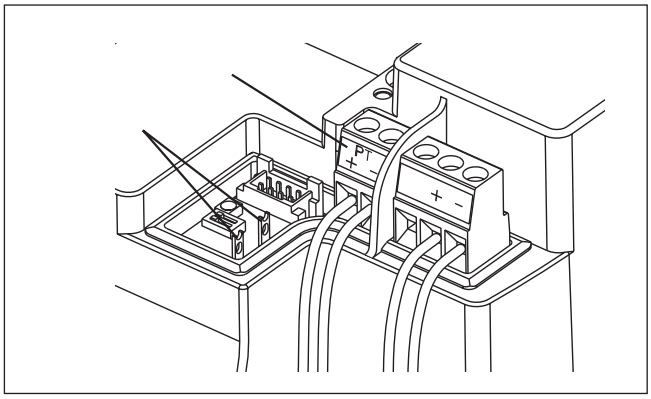


Fig. 7. Terminals, ND9000H and ND7000H

ND9000F, ND9000P

The ND9000F is powered by FOUNDATION fieldbus (IEC 61158-2).

The ND9000P is powered by Profibus PA (IEC 61158-2).

The same bus cable is used also for the fieldbus communication.

The bus cable is led through a

- M20 x 1.5 cable gland, or
- 1/2 NPT cable gland (U, E2)

Connect the conductors to the terminal strip as shown in Fig. 8.

Reverse polarity protection permits connection of the bus cables in any order.

The cable shield can be grounded by connecting the shield to the earth connection screw. The shield can be left unconnected by using the empty terminal.

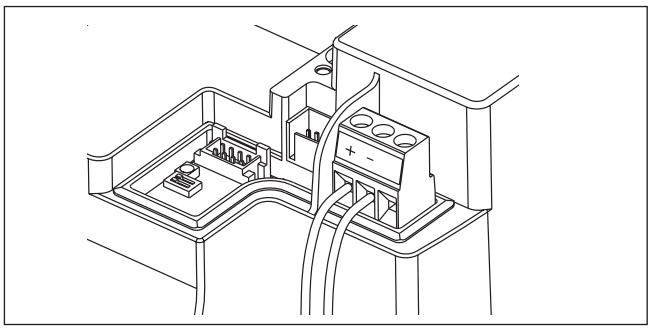


Fig. 8. Terminals, ND9000F and ND9000P

Please note following before mounting the cover of the valve controller:

- Attach the LUI (223) cabling to the sticker on the reverse side of the LUI.
  Check that the cabling does not get squeezed by the electronics cover (39) or the device cover (100).
- Check using a feeler gauge that the clearance between the position indicator (109) and the electronics cover is 1 mm.

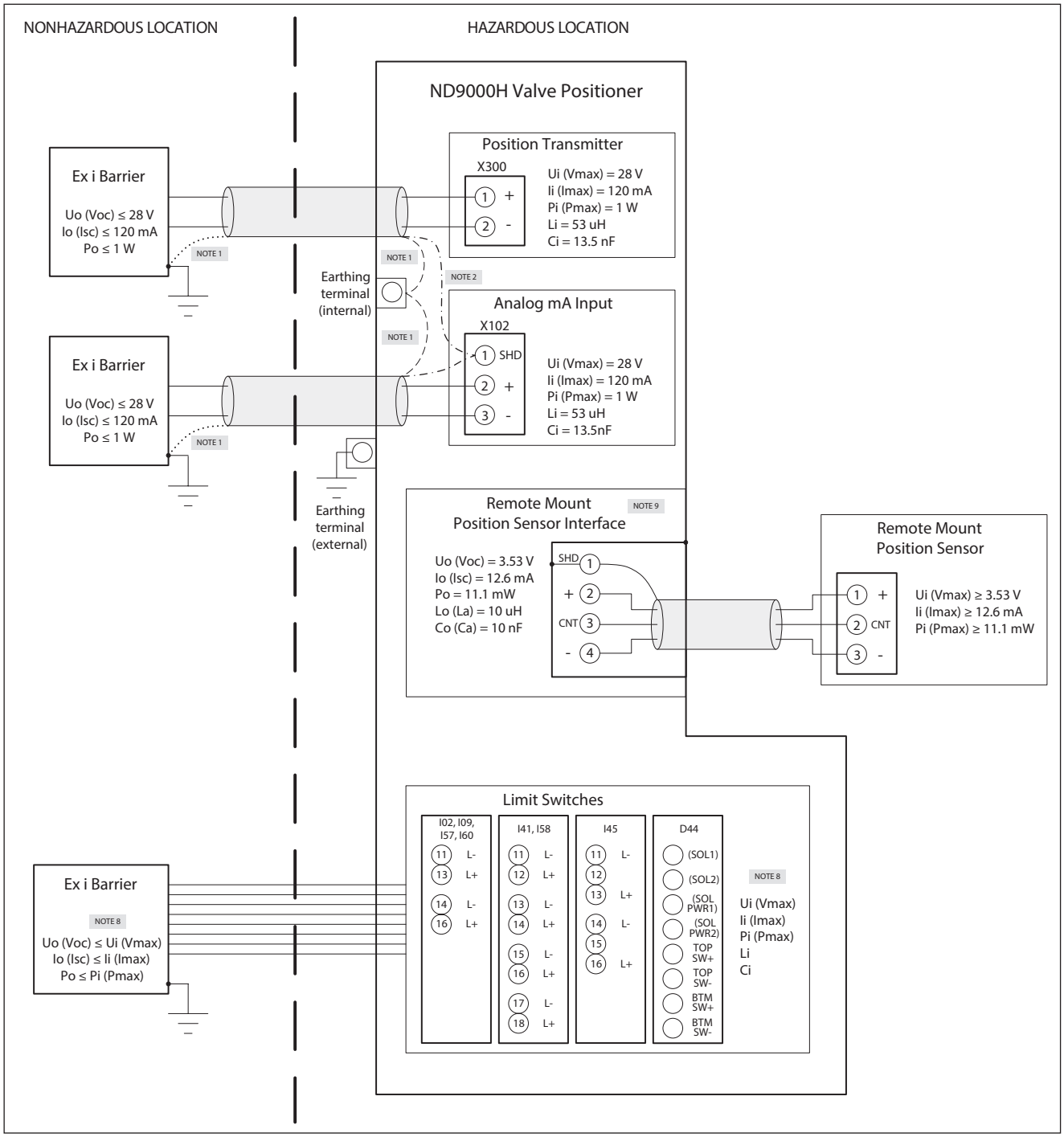


Fig. 9. Control wiring, ND9000H and ND7000H, Ex i

Notes

1. By default, the screen of the cable is connected to earth either at the barrier (dotted line) or at the earthing terminal inside ND9000H enclosure (dash line). If the screen is connected to earth at both ends of the cable, the potential equalization of the system shall conform to requirements of IEC 60079-14:2013 Clause 16.2.3.
2. X102 terminal 1 (SHD) does not have any electrical connection. If wanted, cable screens can be connected to this terminal for floating termination of screen at ND9000H end (dash-dot line). Shrink tubes are recommended to avoid short circuits.
3. For installation in accordance with this figure, the intrinsically safe barrier must be certified by an accredited agency.
4. The following conditions must be satisfied:

   Uo (Voc) <= Ui (Vmax) Co (Ca) >= Ci + Ccable
   Io (Isc) <= Ii (Imax) Lo (La) >= Li + Lcable
   Po <= Pi (Pmax)
5. Maximum non-hazardous area voltage must not exceed 250 V.
6. Canadian installations should be in accordance with Canadian Electrical Code, Part I. U.S. installations should be in accordance with Article 504 in the National Electrical Code, ANSI/NFPA 70.
7. See user manual for installation conditions.
8. See documents F41446 and F41476 for the approved switches and their entity parameters.
9. Remote Mount (option -R) is only available for ND91_ (standard enclosure) variants.

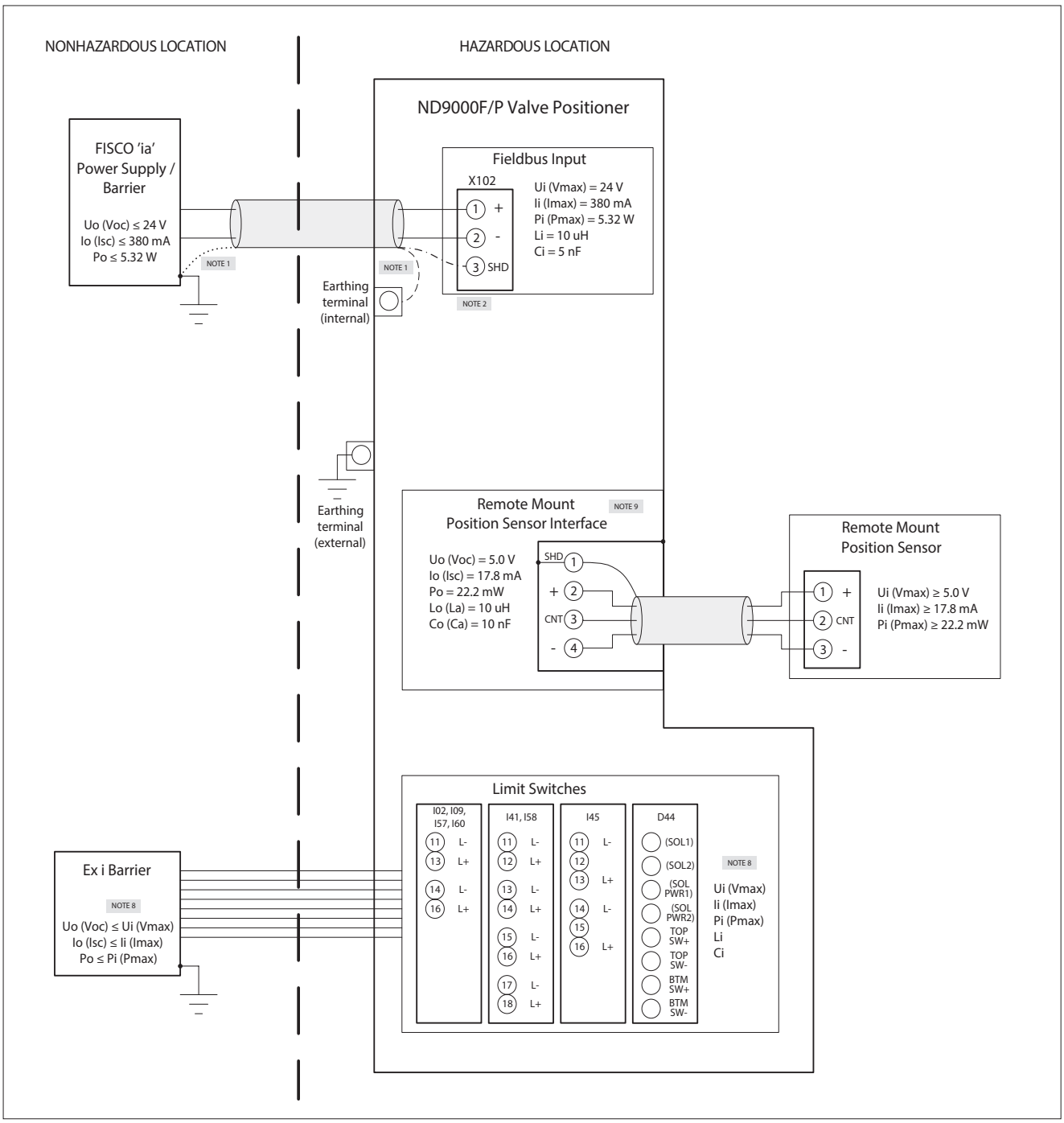


Fig. 10. Control wiring, ND9000F/P, Ex 'ia' for Zone 0 / Division 1

Notes

1. By default, the screen of the cable is connected to earth either at the barrier (dotted line) or at the earthing terminal inside ND9000F/P enclosure (dash line). If the screen is connected to earth at both ends of the cable, the potential equalization of the system shall conform to requirements of IEC 60079-14:2013 Clause 16.2.3.
2. X102 terminal 3 (SHD) does not have any electrical connection. If wanted, cable screen can be connected to this terminal for floating termination of screen at ND9000F/P end (dash-dot line). Shrink tube is recommended to avoid short circuits.
3. For installation in accordance with this figure, the intrinsically safe barrier must be certified by an accredited agency.
4. The following conditions must be satisfied:

   Uo (Voc) <= Ui (Vmax) Co (Ca) >= Ci + Ccable
   Io (Isc) <= Ii (Imax) Lo (La) >= Li + Lcable
   Po <= Pi (Pmax)
5. Maximum non-hazardous area voltage must not exceed 250 V.
6. Canadian installations should be in accordance with Canadian Electrical Code, Part I. U.S. installations should be in accordance with Article 504 in the National Electrical Code, ANSI/NFPA 70.
7. See user manual for installation conditions.
8. See documents F41446 and F41476 for the approved switches and their entity parameters.
9. Remote Mount (option -R) is only available for ND91_ (standard enclosure) variants.

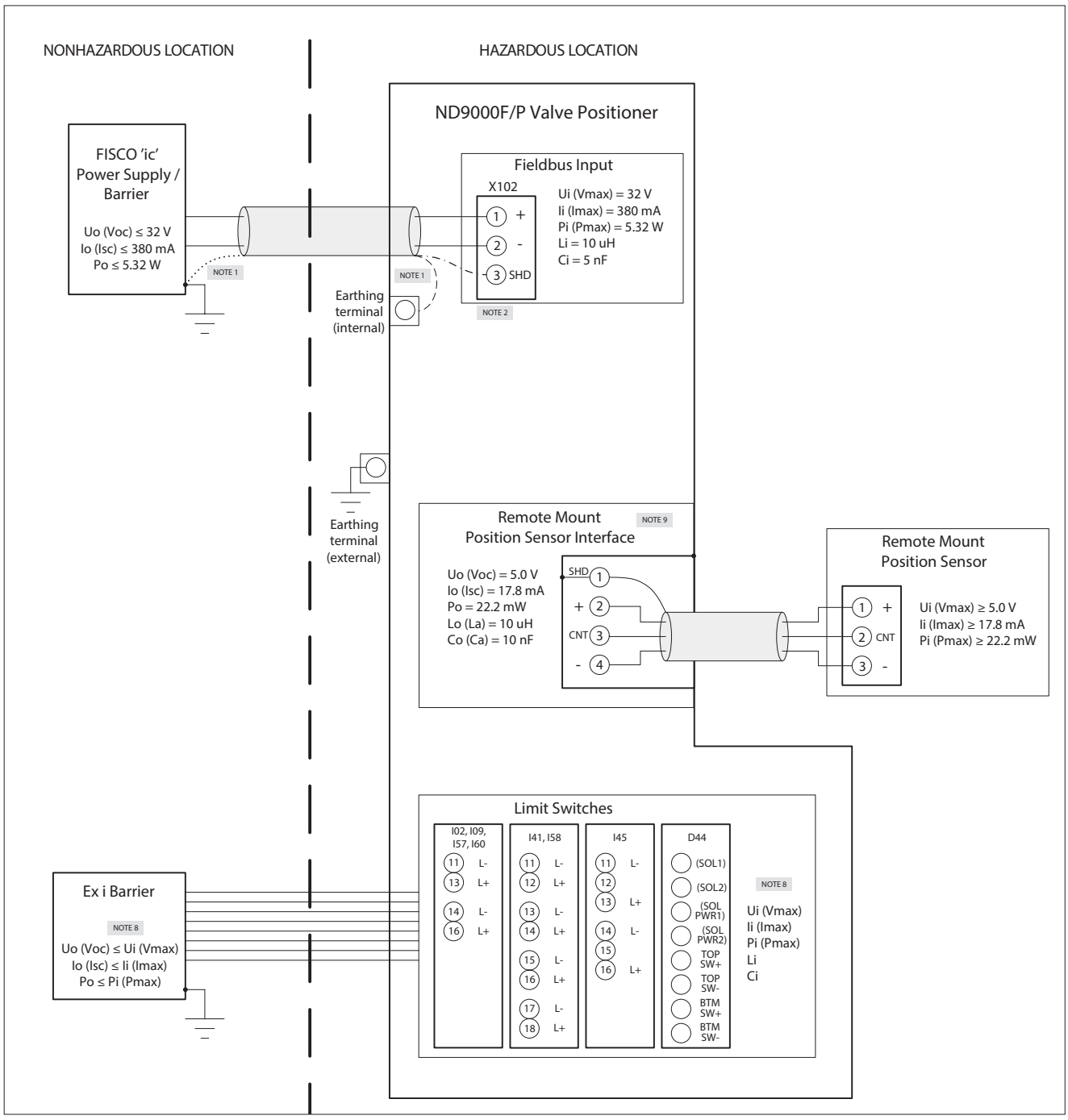


Fig. 11. Control wiring, ND9000F/P, Ex 'ic' for Zone 2 / Division 2

Notes

1. By default, the screen of the cable is connected to earth either at the barrier (dotted line) or at the earthing terminal inside ND9000F/P enclosure (dash line). If the screen is connected to earth at both ends of the cable, the potential equalization of the system shall conform to requirements of IEC 60079-14:2013 Clause 16.2.3.
2. X102 terminal 3 (SHD) does not have any electrical connection. If wanted, cable screen can be connected to this terminal for floating termination of screen at ND9000F/P end (dash-dot line). Shrink tube is recommended to avoid short circuits.
3. For installation in accordance with this figure, the intrinsically safe barrier must be certified by an accredited agency.
4. The following conditions must be satisfied:

   Uo (Voc) <= Ui (Vmax) — Co (Ca) >= Ci + Ccable
   Io (Isc) <= Ii (Imax) — Lo (La) >= Li + Lcable
   Po <= Pi (Pmax)
5. Maximum non-hazardous area voltage must not exceed 250 V.
6. Canadian installations should be in accordance with Canadian Electrical Code, Part I. U.S. installations should be in accordance with Article 504 in the National Electrical Code, ANSI/NFPA 70.
7. See user manual for installation conditions.
8. See documents F41446 and F41476 for the approved switches and their entity parameters.
9. Remote Mount (option -R) is only available for ND91_ (standard enclosure) variants.

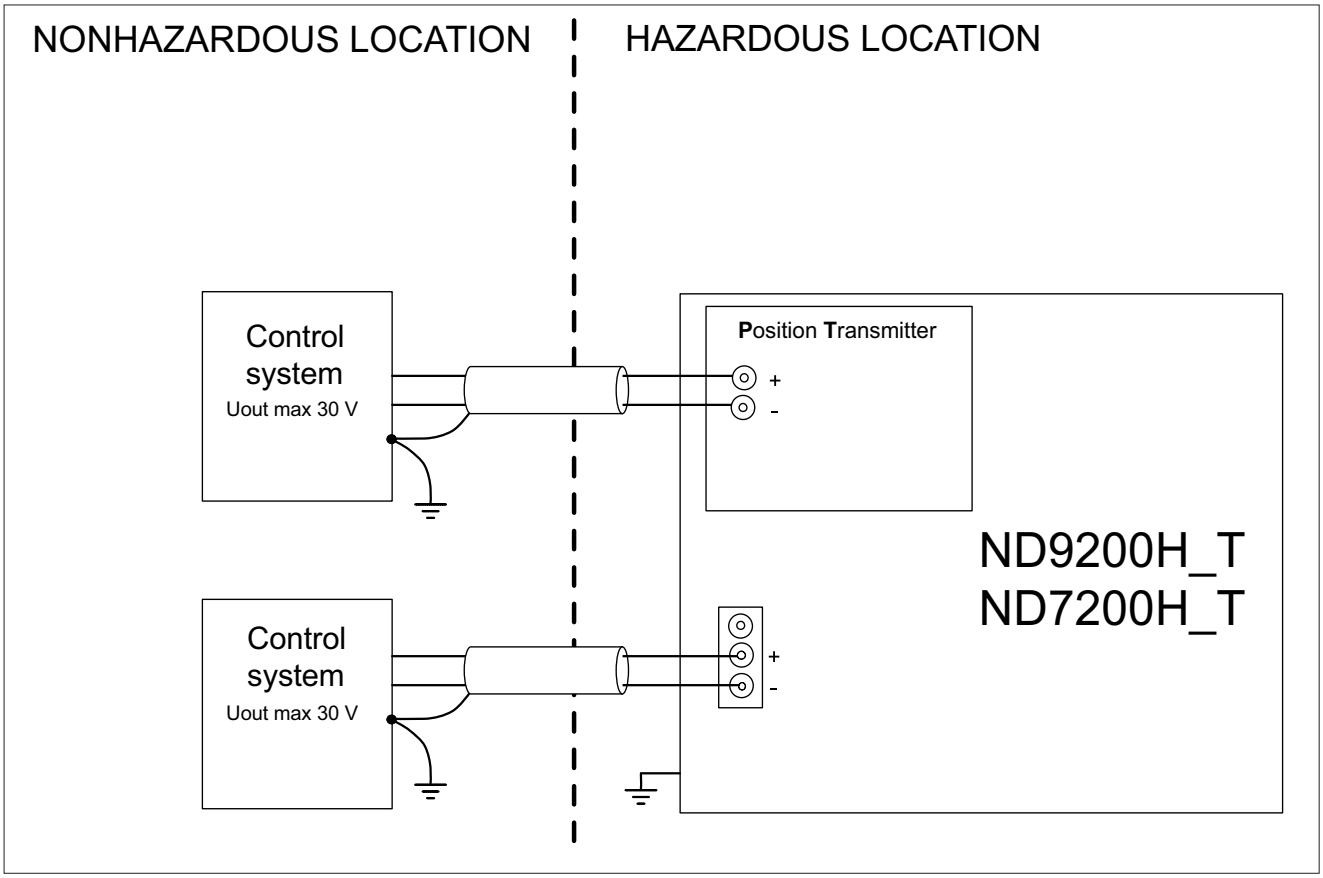


Fig. 12. Control wiring, ND9000 and ND7000, Ex d

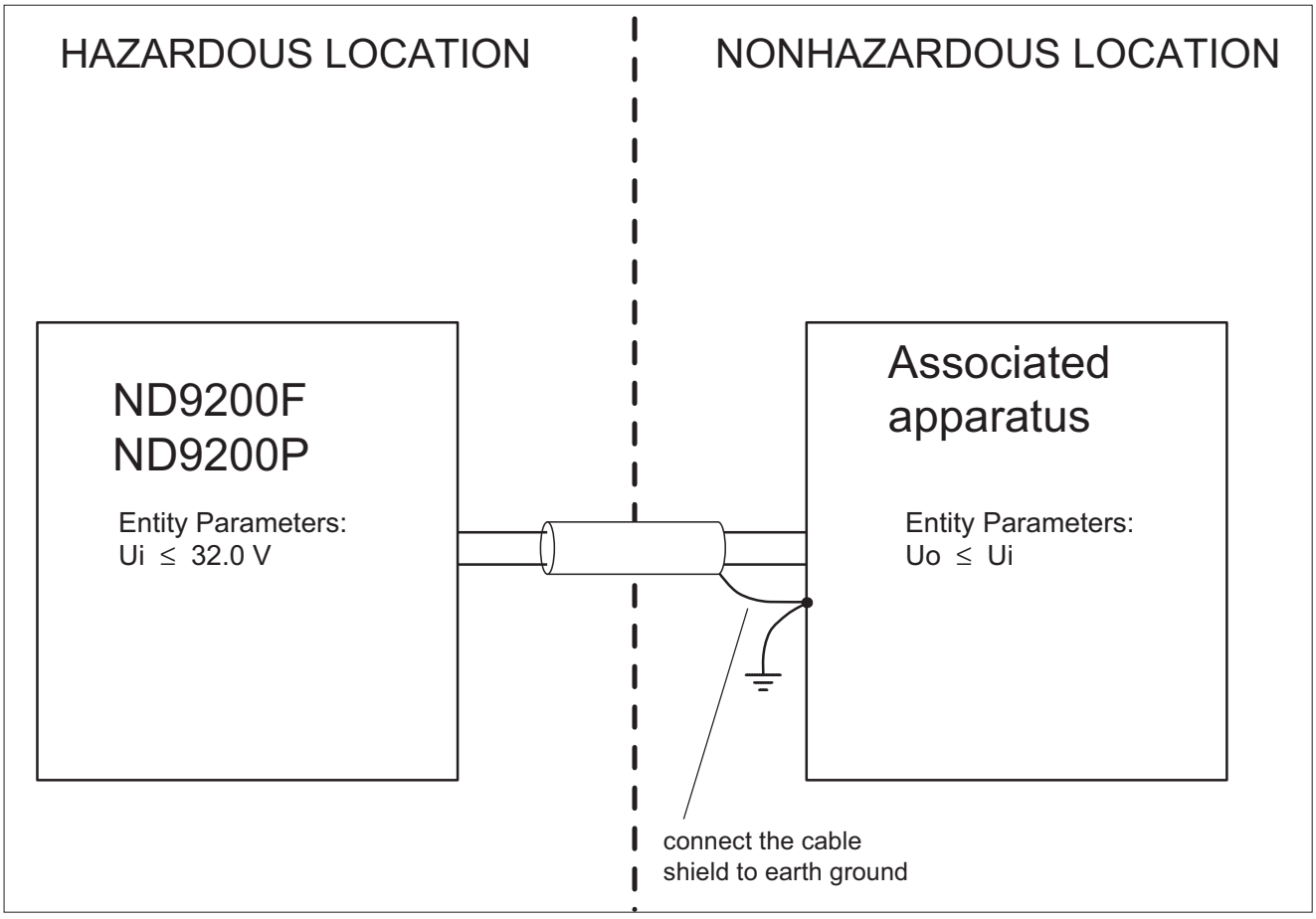


Fig. 13. Control wiring, ND9000F and ND9000P, Ex d

Remote mounting

ND9100H,ND9100F, ND9100P, ND7100H

For applications if there is e.g. heavy vibrations, environment temperature is very high or access is difficult, there is available remote position measurement option. In this kind of applications position sensor is attached to actuator and ND9000 can be installed further away. Pneumatic piping between ND9000 and actuator is done as explained in chapter 4.6 and wiring between position sensor and ND9000 according to Fig. 13.

There are three different cable lengths available between ND9000 and remote position sensor: 1.2m, 3m and 30m.

If position sensor is remote mounted to linear actuator, there are some parameters which have to be defined as following:

- valve acting type (VTYP) have to be defined as rotary
- valve rotation direction (ROT) have to be defined as Clockwise to Close (CC)

Remote position sensor for rotary actuators is available also with limit switch.

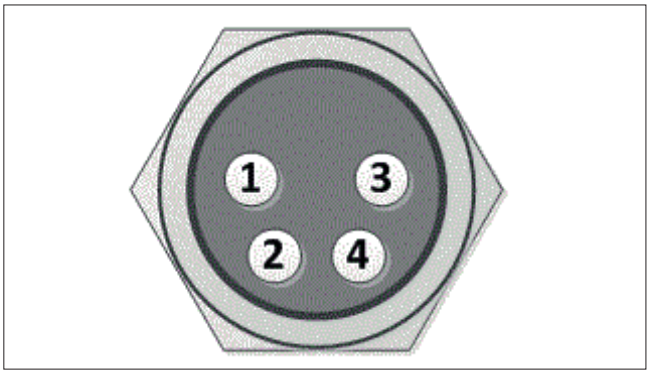


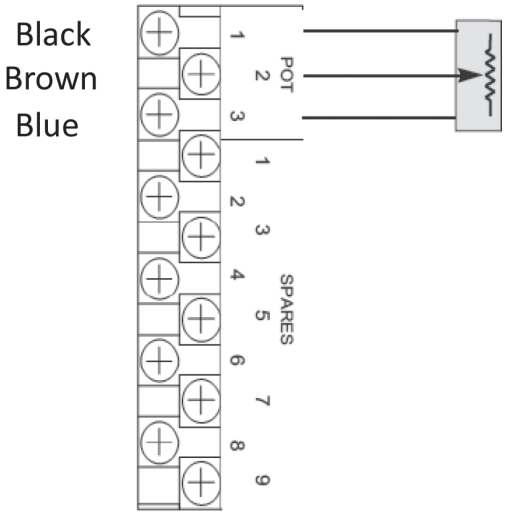
Fig. 14. Pin assignment in female connector view (connector in device)

Pin assignement

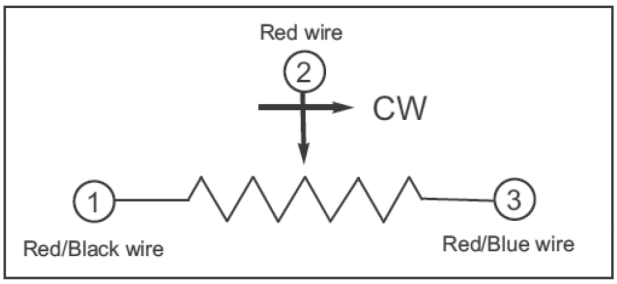
Pin#	Function
1	Cable Shield Ground (Ground)
2	Potentiometer Plus (Blue)
3	Potentiometer Center (Brown)
4	Potentiometer Minus (Black)

Quartz position sensor connections and calibration

Wiring diagram

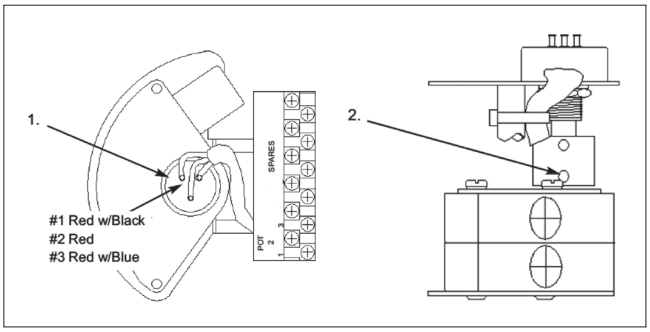


Electrical schematic



Potentiometer Calibration

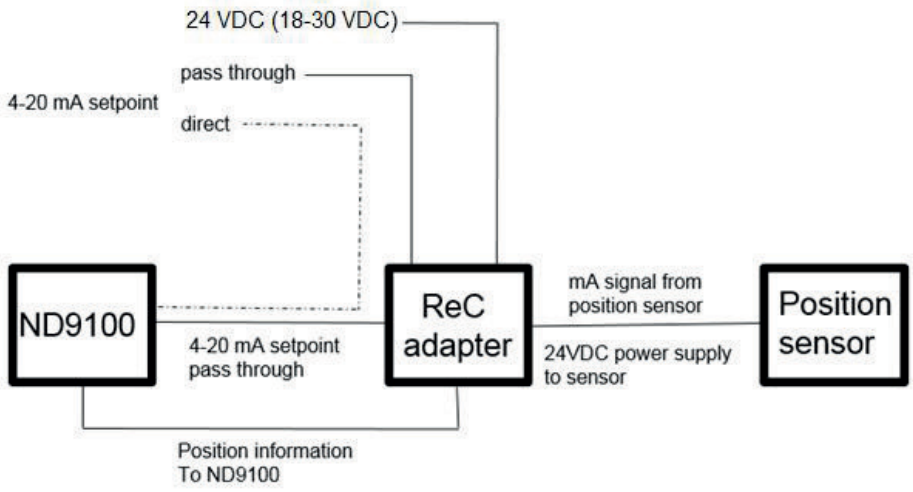
1. Operate the actuator to the desired “zero” position. Connect an ohm meter across the terminals POT 1 & POT 2 to measure the potentiometer output.
2. Loosen the bottom set screw and rotate the coupling until the ohm meter reads approximately 5k Ohms (assuming a 10K Ohm potentiometer). Retighten the set screw and verify the ohm meter still reads approximately 5k Ohms.
3. Operate the actuator to the desired “100 %” position (assuming 90 degree rotation) and verify the ohm meter reads (2.7K Ohms or 7.7K Ohms +/- 10 %, depending on rotation direction).
4. Remove all test equipment.
5. Connect the position sensor cable to the terminal strip as shown in the above wiring diagram.
6. Connect the connector end of the position sensor cable to the ND9000 female connector shown in ffigure on the right.



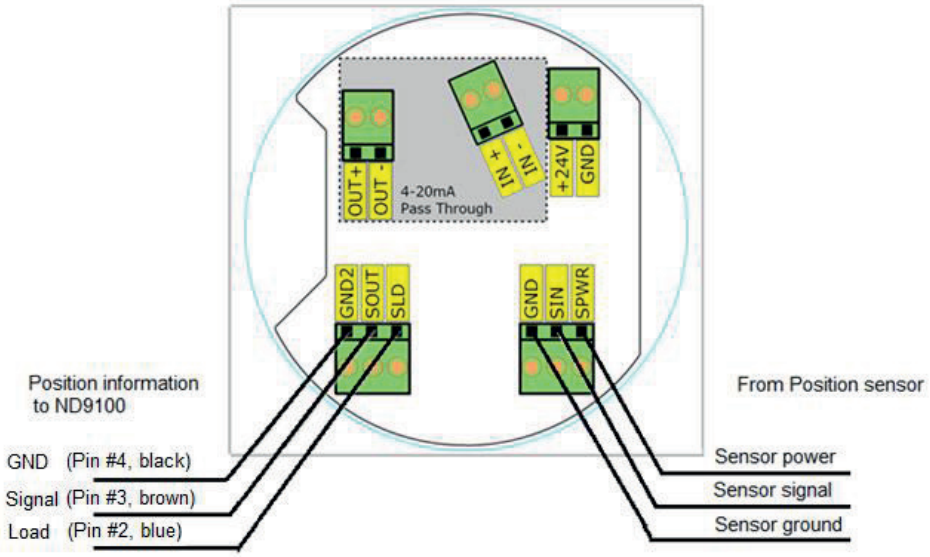
Remote mounting by using Neles ReC

If there is 4-20mA output from the position sensor, that can't be connected directly to ND9100R. This kind of cases there have to be ReC adapter which converts position signal suitable for ND9100 like shown in schematic picture

Connection terminals in Rec adapter:



Connection terminals in Rec adapter



NOTES:

1. Cut the ND9 cable (RC01, RC02 or RC03) and the Position sensor cable to optimal length for your application. Then connect the individual wires as shown in connection diagram.
2. Connect positioner control (4…20mA) signal directly to ND or alternatively to Pass through terminals IN+/IN-, and Neles ND9 control input cable to OUT+/OUT-.
   4-20mA Pass Through connectors positive (+) terminals are internally shorted, and negative (-) terminals are internally shorted.
3. Connector with "+24V" and "GND" shall be supplied from external 24V (nominal 24 VDC, range is 18-30 VDC) voltage supply. This supply is powering the converter and the external position sensor.
4. Use proper cable cland or blind plug for each cable entry.

5. LOCAL USER INTERFACE (LUI)

The local user interface may be used to monitor the device behaviour as well as configuring and commissioning the controller during installation and normal operation. The local user interface consists of 2 row LCD and 4 button keypad interface. There are also custom graphical characters for special conditions.

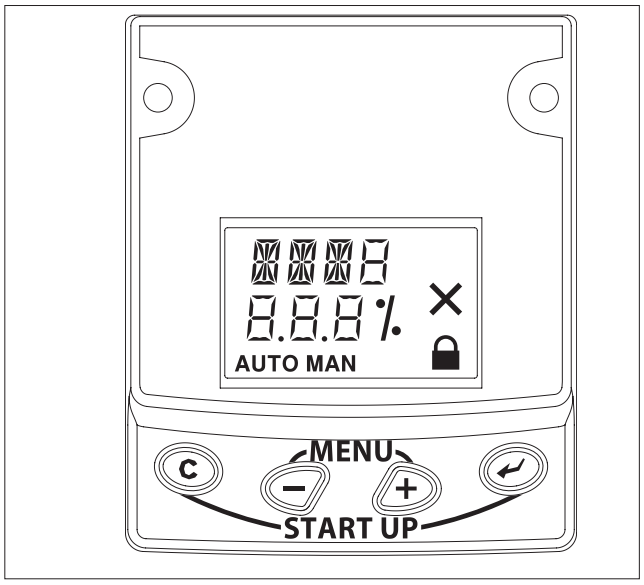


Fig. 15. Local user interface (LUI)

5.1 Measurement monitoring

When the device is powered, it enters the measurement monitoring view. The following measurements may be viewed from the display. The Table 6 identify the default unit and also optional unit of the measurement.

Table 6. Default / optional units of measurements

Measurement	Default unit	Optional unit
valve position	Percentage (of full scale)	Angle, where 0 % refers to 0 deg.
target position	Percentage (of full scale)	none
current loop set-point (ND9000H, ND7000H)	mA	Percentage (of full scale)
setpoint (ND9000F, P)	Percentage (of full scale)	
actuator pressure difference	bar	psi
supply pressure	bar	psi
device temperature	degree Celsius	degree Fahrenheit

If the unit selection is altered from the frame application software to US units, the pressure default unit will automatically be changed to psi and temperature unit to Fahrenheit.

The active unit may be changed by pressing the ↵ key constantly. The display shows the current unit selection on the top row of the display. You may change the selection by pressing + or − key while keeping the ↵ key pressed down. When the buttons are released the current selection will be activated.

If the device has been idle for 1 hour, and there is no user activity on the local user interface, the measurements will start scrolling on the display. This enables the user to view all the measurements through the window of the main cover.

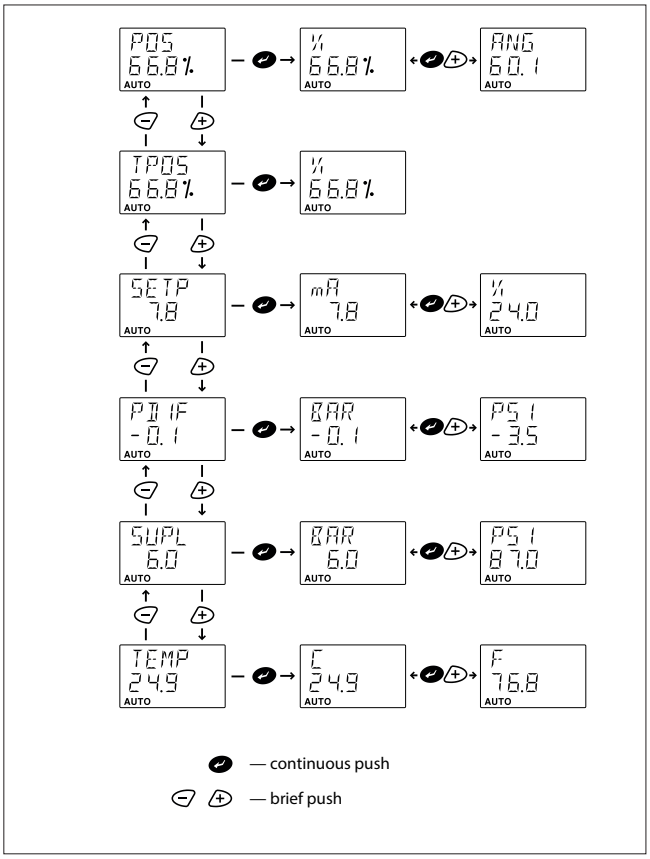


Fig. 16. Measurement unit change, ND9000H and ND7000H

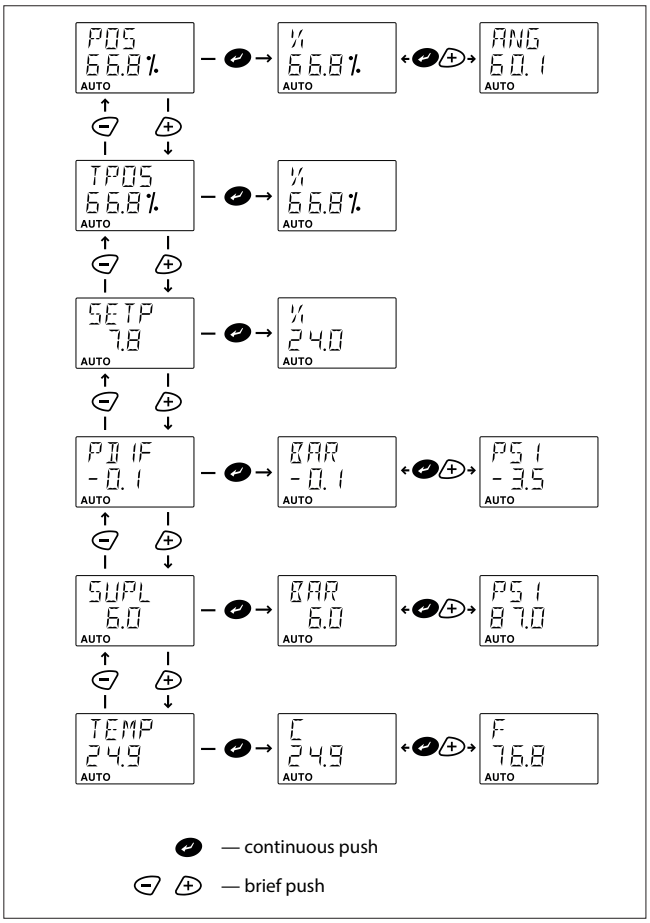


Fig. 17. Measurement unit change, ND9000F and ND9000P

5.2 Guided start-up

Guided startup offers a fast view of the most critical parameters of the ND controller, actuator and valve configuration. After verifying the parameters the valve travel calibration is recommended.
The guided start-up is entered by pressing the © and ↵ keys simultaneously.

The configuration parameters are listed in following order, see explanation from 5.5:

Valve type	VTYP
Actuator type	ATYP
Positioner fail action	PFA
Valve rotation direction	ROT
Valve dead angle	A0
PA address	ADR (ND9000P only)

If you modify any of the parameters you will also need to calibrate the device. See 5.6 for detailed description.

NOTE:

You may cancel any action by pressing the = button.

Cancelling of operation returns user interface view one level up in menu hierarchy.

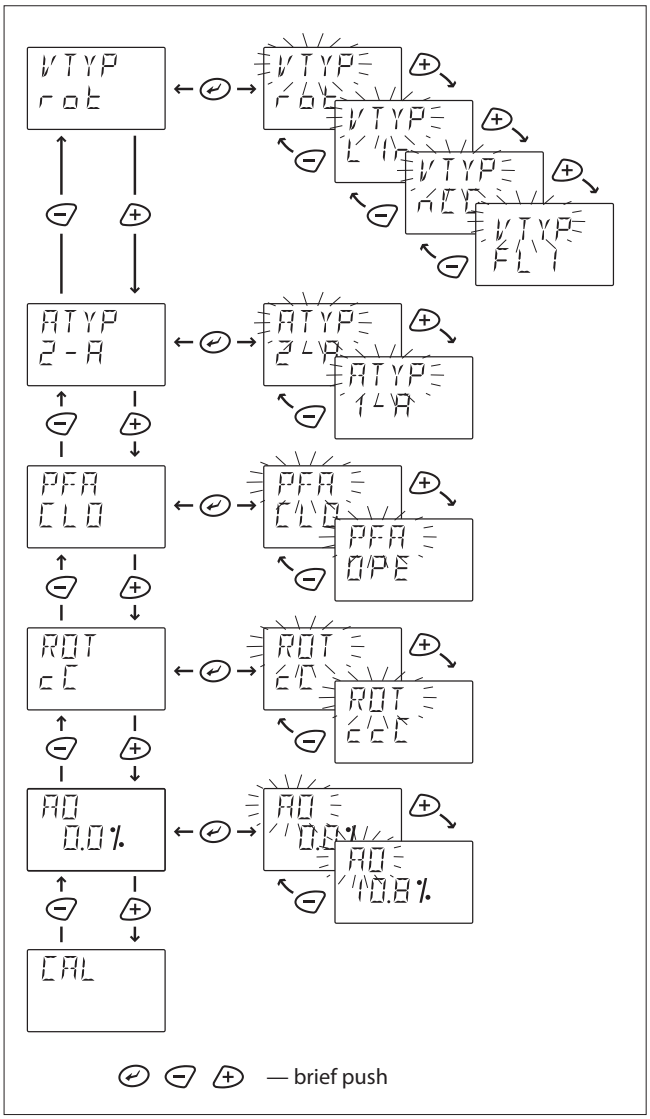


Fig. 18. Guided start-up, ND9000H, ND7000H and ND9000F

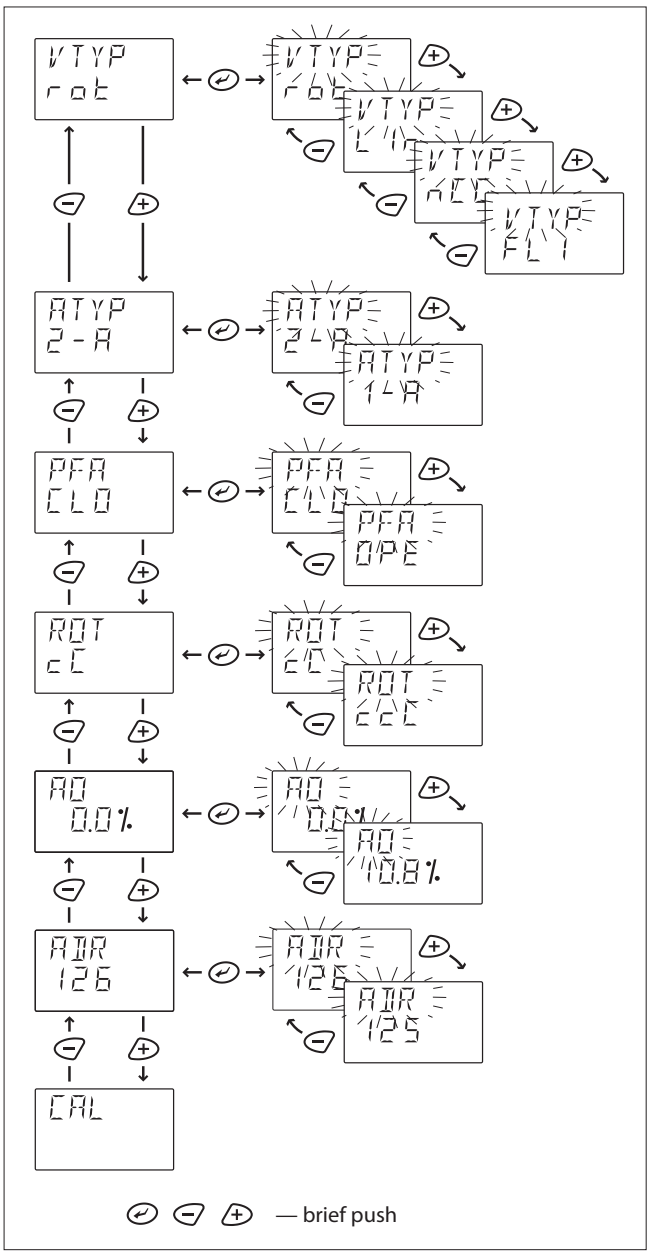


Fig. 19. Guided start-up, ND9000P

5.3 Configuration menu

The local user interface is organised in a menu structure. To enter the menus press ⊕ and ⊖ keys simultaneously in the measurement monitoring view panel. To move to the next or previous selection by pressing ⊕ or ⊖ key accordingly.

5.4 Mode menu

If the user wants to change the valve operating mode, press the ↵ key at the MODE selection. The MODE will start to flash and by pressing ⊕ or ⊖ key you may alter the operation mode selection. User accepts the current selection by pressing the ↵ key.

There are two options for the operating mode.

AUTO

During the auto mode, the controller controls the valve position according to the incoming setpoint signal from the 4–20 mA signal source or from the bus.

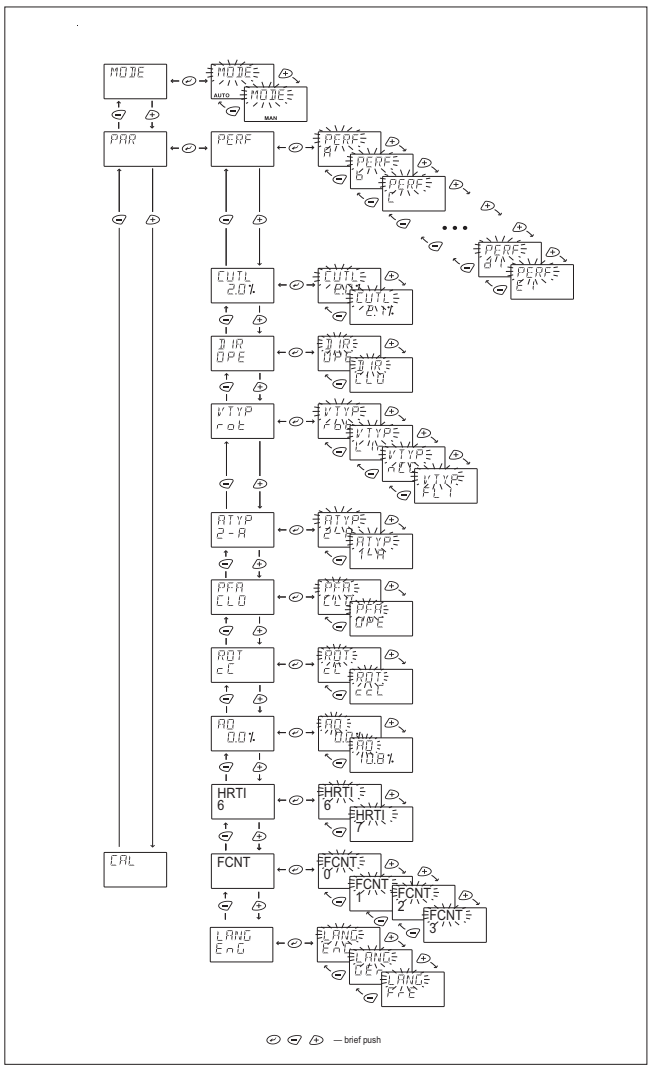


Fig. 20. Configuration, ND9000H and ND7000H

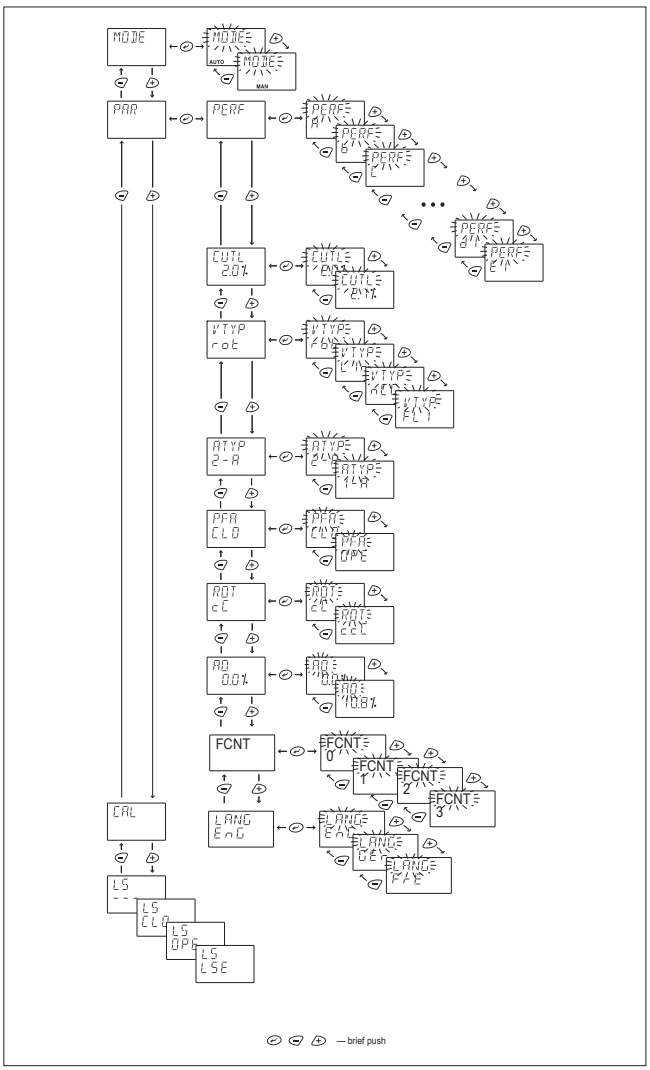


Fig. 21. Configuration, ND9000F

MAN

During this mode the valve position may be controlled manually by using the keypad and pressing the ⊕ or ⊖ key. The position of the manually driven valve is not saved in the memory of the controller, i.e. the valve will not return to the same position after signal failure. However, the valve may be driven back into position after signal failure by using ⊕ and ⊖ keys. The manual control starts from the current position of the valve after the MAN-mode is activated. In order to change the manual setpoint return to the measurement monitoring view and go to target position measurement. Press the ↵ key shortly to activate the target position editing, text TPOS starts to blink and now you are able to edit the setpoint by pressing ⊕ or ⊖ key. The setpoint changes in 0.1 % increments/ decrements in spite of the selected unit and the valve starts to move immediately. A continuous push changes the setpoint faster. In order to view other measurements, press the ↵ or ⓒ key and select a measurement. Repeat the previous steps if you would like to alter the setpoint value again.

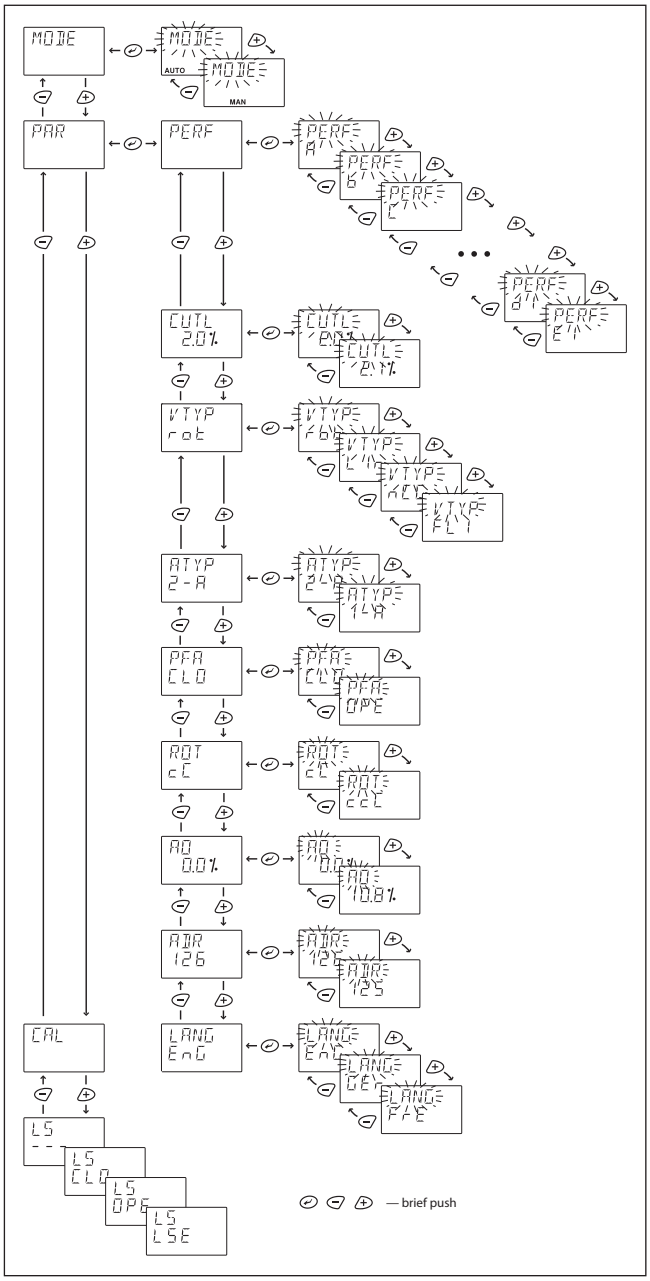


Fig. 22. Configuration, ND9000P

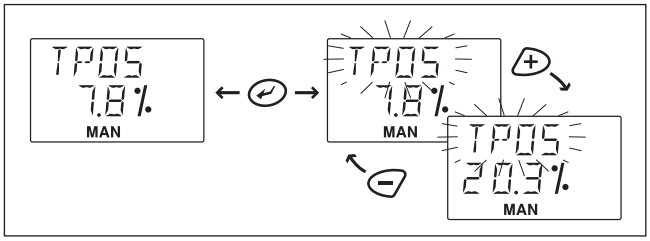


Fig. 23. Setpoint change in MAN mode

5.5 Configuration parameters

When PAR is on the display you may enter the configuration menu by pressing the ↵ key. In this menu the most important configuration and signal modification parameters are viewable. You may view the current value and edit them by pressing the ↵ key at the relevant parameter. The name of the parameter will appear on the upper row of the display and the current value is on the lower row.

Performance level, PERF

If you want to change the tuning of the valve position control, the PERF selection is available. The default factory value is C.

Once PERF is displayed press the ↵ key to enter the edit state and PERF starts to blink.

Select between five values by pressing the ⊕ or ⊖ key

Table 7. Performance level

Selection	Meaning	Description
A	Aggressive	Immediate response to signal changes, overshoots
b	Fast	Fast response to signal changes, small overshooting
C	Optimum	Very small overshoot with minimum step response time
d	Stable	No overshooting, slow response to input signal changes
E	Maximum stability	No overshooting, deadband may increase, slow but stable behaviour
For use with volume boosters and/or very fast actuators, additional performance levels A1 to D1 can be used. Characteristics of these extended levels are the same as those in the table above. However, with performance level settings A1 to D1, adaptive properties of the ND control algorithm are disabled.		

- After the desired value is displayed, press the ↵ key to conclude the operation.

Low cut-off, CUTL

Low cut-off safety range CUTL ensures the valve closing against mechanical travel stops. The factory default value is 2 %.

- Once CUTL is displayed press the ↵ key to enter the edit state and the CUTL will start to blink. The currently selected value appears as a percentage (%) on the display
- Modify the parameter value by pressing ⊕ or ⊖ keys alternately until the desired value appears on the display.
- After the desired value is displayed, press the ↵ key to conclude the operation.

Signal direction, DIR

ND9000H, ND7000H

The opening and closing direction of the valve with raising current loop signal is defined by signal direction parameter DIR.

- When DIR is displayed press the ↵ key to enter the edit state and DIR starts to blink.
- Select either the OPE or CLO values by pressing the ⊕ and ⊖ keys. The value OPE signifies the raising signal 4–20 mA to open the valve and CLO means the raising signal to close the valve.
- To conclude, press the ↵ key when the desired value is shown on the display.

See default values in Fig. 5 and 6.

Valve type, VTYP

To compensate for nonlinearity of the position feedback caused by the actuator linkage mechanism of a linear control valve, the appropriate selection must be made on the VTYP display.

- After selecting VTYP on the display, press the ⊙ key to enter the edit state and the VTYP starts to blink.
- Select between four values rot, LIn, nCG or FLI using the ⊕ and ⊖ keys. The value rot indicates a rotary valve and LIn a linear valve. Use nCG only for nelesCV Globe valves to accommodate special linkage geometry. Use FLI only for linear valves when linkage geometry is needed to be corrected by valve controller.
- To conclude press the ⊙ key when the desired value is shown on the display.

NOTE:
Perform valve calibration always when VTYP has been changed.

Actuator type, ATYP

In order to optimise the control performance the device needs to be informed about the actuator type.

- After selecting ATYP on the display, press the ⊙ key to enter the edit state and ATYP starts to blink.
- Select between two values 2-A or 1-A using the ⊕ and ⊖ keys. The value 2-A indicates a double acting actuator and 1-A a single acting actuator.
- To conclude press the ⊙ key when the desired value is shown on the display.

NOTE:
Perform valve calibration always when ATYP has been changed.

Positioner fail action, PFA

Positioner fail action will take place in case of signal failure or when the controller software discovers a fatal device failure. For single acting actuators set value in the spring direction. For double acting actuators see Fig. 7 and 8 for correct settings.

- Once PFA is displayed, press the ⊙ key to enter the edit state and the PFA will start blinking.
- You may select between two values by pressing the ⊕ or ⊖ key. The CLO value indicates that the valve ought to be closed in fail action situations. The OPE value indicates the valve to be opened in fail action situations.
- After the desired value is displayed, press the ⊙ key to conclude the operation.

NOTE:
Perform valve calibration always when controller fail action parameter has been changed.

Valve rotation direction, ROT

The application-specific parameter ROT defines the relationship between position sensor rotation and valve action.

Once ROT is displayed press the ⊙ key to enter the edit state and ROT starts to blink.

Now you may select between two values by pressing the ⊕ or ⊖ key. The value cC indicates clockwise rotation for closing the valve and ccC means counterclockwise to close.

After the desired value is displayed, press the ⊙ key to conclude the operation.

NOTE:
Perform valve calibration always when ROT has been changed.

Valve dead angle, a0

The α_0 setting is made for Neles segment and ball valves. This setting takes into account the “dead angle” α_0 of the ball valves. The entire signal range is then used for effective valve opening 90° - α_0. Use 0 % as the “dead angle” for the valves not mentioned in Table 8.

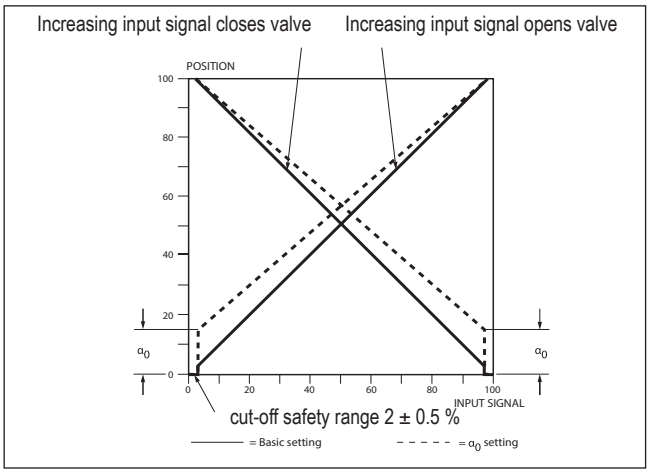


Fig. 24. Principle of setting, ND9000H and ND7000H

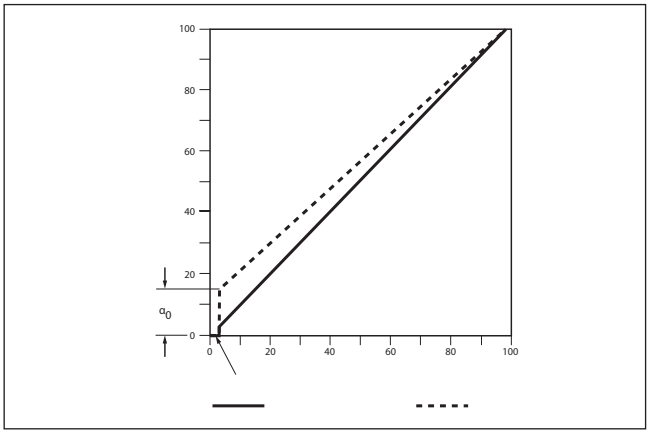


Fig. 25. Principle of setting, ND9000F and ND9000P

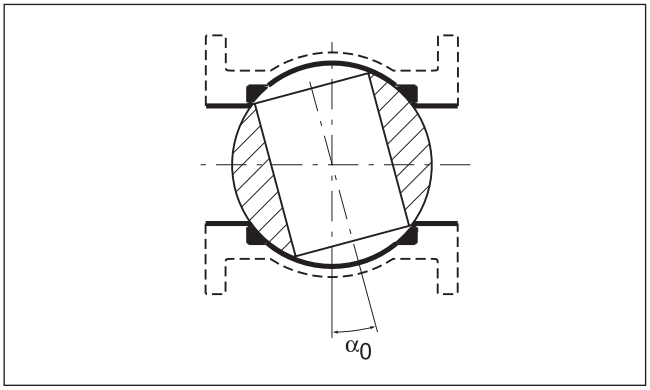


Fig. 26. Dead angle

Table 8. Dead angle in percentage

SIZE		Valve series																ZX	
DN	IN	Q-D1 Q-D2 QLM-D1 QLM-D2 Q-	XMBV Q-XG Q-XM	T5 Q-T5 QA-T5	T25 Q-T25	9000	XMBV XG XM	7000 5300 5150 4000	XMBVR	E	Q2G	Q2GH	Q2GT5 Q2GHT5	RE RA Segment valves			FL	Trim	Dead Angle [%]
		Dead angle, %																	
15	1/2							8,1						Seat				L001	18,6
20	3/4							8,3						S&A	1S	T2		L003	
25	1			20,6		17,8	14	11,7		17,78				15,8	14,2	26,8		L011	
25/1	1/1												C005	11,4		17,9	11	L025	
25/2	1/2												C015	11,4		17,9	11	L060	16,7
25/3	1/3												C05	11,4		17,9	9,8	E043	
25/4	---												C15	11,4		17,9		B020	
32	1 1/4							12,2										B050	
40	1 1/2			20,6		17,8	12	9,4		9,4				13,2	10,3	20,7		L030	
50	2	18,9	12	20,6	20,6	17,8	12	8,3		8,3	17,8	17,78		18,6	12,7	23,4		L070	
60	2 1/2													14	11,8	18,7		B130	
80	3	15,6	9,6	15	15	14,4	9,6	9,4	8,1	9,4	14,2	14,22	23,33	9,9	8,7	15,7		E022	17,3
100	4	15,6	9,1	15	13,9	14,4	9,1	10,6	8,9	10,6	13,3	14,22	22,22	9	7,8	15,7		E011	9,9
125	5																	L180	
150	6	12,2	10,8	13,9	11,1	12,2	10,8	11,1	12,11	10,6	14,1	14,11	20,22	7,8	6,	13,6		E460	
200	8	10	9,3	11,1		10	9,3	10,8	11,56		11,8	14,11	15,78	6,9	6,6	12,7		L550	9,2
250	12	8,9	8,1	11,1	11,1	8,9	8,1	8,3			10,4	11,89	17,78	6,8	6	10,8		L350	10,4
300	12	8,9	7	11,1	11,1	8,9	7	8,9			8,9	10	13,22	6,2	5,6	10		B130	
350	14	7,8	6,8	11,1		8,9	6,8	7,8			8,9	8,9	10,44	5,8	6,	9,6		B280	
400	16	7,8	6,4	11,1		8,9	6,4	7,8			8,4	8,9	10,44	5,7	4,9	9,1		L700	
450	18	8,9						8,9			8,9	8,9						L1150	
500	20	6,7						6,7			8,9	8,9		4,9	4,9	7,9		E540	
600	24	6,7									8,9	8,9			6,6			E800	
700	28	7,8									8,9	8,9			7			E320	
750	30	6,7									8,9	8,9						B280	
800	32	6,7									8,9	8,9						B520	
900	36	5,6									8,9	8,9						E260	14,2
																		L120	
																		L310	
																		E090	
																		L150	14,8
																		E115	

- After selecting AO on the display, press the ↵ key to enter the edit state and AO starts to blink. The value currently selected appears as a percentage (%) on the display.
- Modify the parameter value by pressing + or - keys alternately until the desired value appears on the display.
- Press the ↵ key to make your selection and return to the setting state.

Profibus slave address setting

ND9000P only

- You can modify the Profibus slave address by pressing + and - keys. Range is 0-126, default value is 126.
- Press the ↵ key to make your selection and return to the setting state.

Low cut-off, low limit, high cut-off, high limit

ND supports signal cut-off and limiting in both ends of the operating range. The configuration parameters are; low cut-off, low limit, high cut-off and high limit.

- If the input signal is smaller than low cut-off, the valve will be fully closed.
- If the input signal is smaller than low limit, the valve stays in the low limit.
- If the input signal is greater than high cut-off, the valve will be fully opened.
- If the input signal is greater than high limit, the valve stays in the high limit.

The cut-off overrides the limit as follows:

- If the low cut-off > low limit, the low limit is not active.
- If the low cut-off < low limit, both low cut-off and limit are active.
- If the low cut-off is set to zero, the low cut-off is not active.
- If the high cut-off < high limit, the high limit is not active.
- If the high cut-off > high limit, both high cut-off and limit are active.
- If the high cut-off is set to 100 %, the high cut-off is not active.

Only the low cut-off is adjustable using the LUI. Low limit, high cut-off and high limit are configurable via frame application software.

HART version, HRTI

- Select if device is used as HART 6 or HART 7 device by using the + and - keys.
- To conclude press the [enter] key when the desired value is shown on the display.
- As default device is HART 6 device.
- Device needs to be rebooted after change

FCNT Simulation control mode, FCNT

Parameter FCNT (Failure Control) in Params-menu controls positioner behavior in case of failure of position measurement. Options 1,2 and 3 can be used only with single acting actuators.

Following parameter options are available:

0 no action (default parameter), failure will lead to normal fail safe action,
1 pressure control, stay in place, cut-offs enabled
2 pressure control, stay in place, cut-offs disabled
3 simulated position measurement using cylinder pressure value

With option 0, if there is position sensor failure, device will go to fail safe mode.

With options 1 and 2 (should be used only with ND9100R), valve is held in position if position sensor failure is detected (if setpoint remains unchanged). If setpoint is changed, valve will move to position corresponding setpoint. If there is position feedback option in the device (T in the type code), feedback signal will go to 3.5 mA if there is position sensor failure.

With option 3, when position sensor failure or position sensor out of range, an event simulation_control_mode is added to the event log and status emergency_control_warning is activated.

When position sensor failure is cleared, normal control mode is re-stored and warning status cleared. If the position transmitter is in use, position transmitter output is determined by the simulated position approximation.

Language selection, LANG

- Select between three languages EnG, GEr or FrE using the ⊕ and ⊖ keys.
- To conclude press the ↵ key when the desired value is shown on the display.

5.6 Valve travel calibration

During the calibration the ND controller searches for optimum internal control parameters for the valve position control. Also it defines open and close ends. After the calibration sequence is finished, press the ⓒ key to get back to the measurement view. You may interrupt the calibration sequences at any time by pressing the ⓒ key, then device returns to basic measurement display. Calibration parameters will not be changed if calibration is cancelled or failed. If calibration fails, LUI and DTM event log shows error message. See Chapter 7 for more information. The calibration will not alter the PERF parameter.

Select CAL from the menu by using ⊕ or ⊖ keys and press the ↵ key. Define the calibration type AUTO, MAN, IPT CAL, LCAL 3P or LCAL 9P, see Fig. 27. In case of LCAL 3P and LCAL 9P, see more information from 5.6 Linearization.

When CAL menu from the LUI is opened again, the last started travel calibration will be shown first on the list.

NOTE:

If AUTO CAL, MAN CAL, LCAL 3P or LCAL 9P is selected, the valve controller must be in AUTO mode. 1-point calibration may run in both AUTO and MAN mode.

WARNING:

Automatic calibration drives the valve against the mechanical open and closed travel limits of the valve-actuator assembly. Make sure that these procedures can be safely executed.

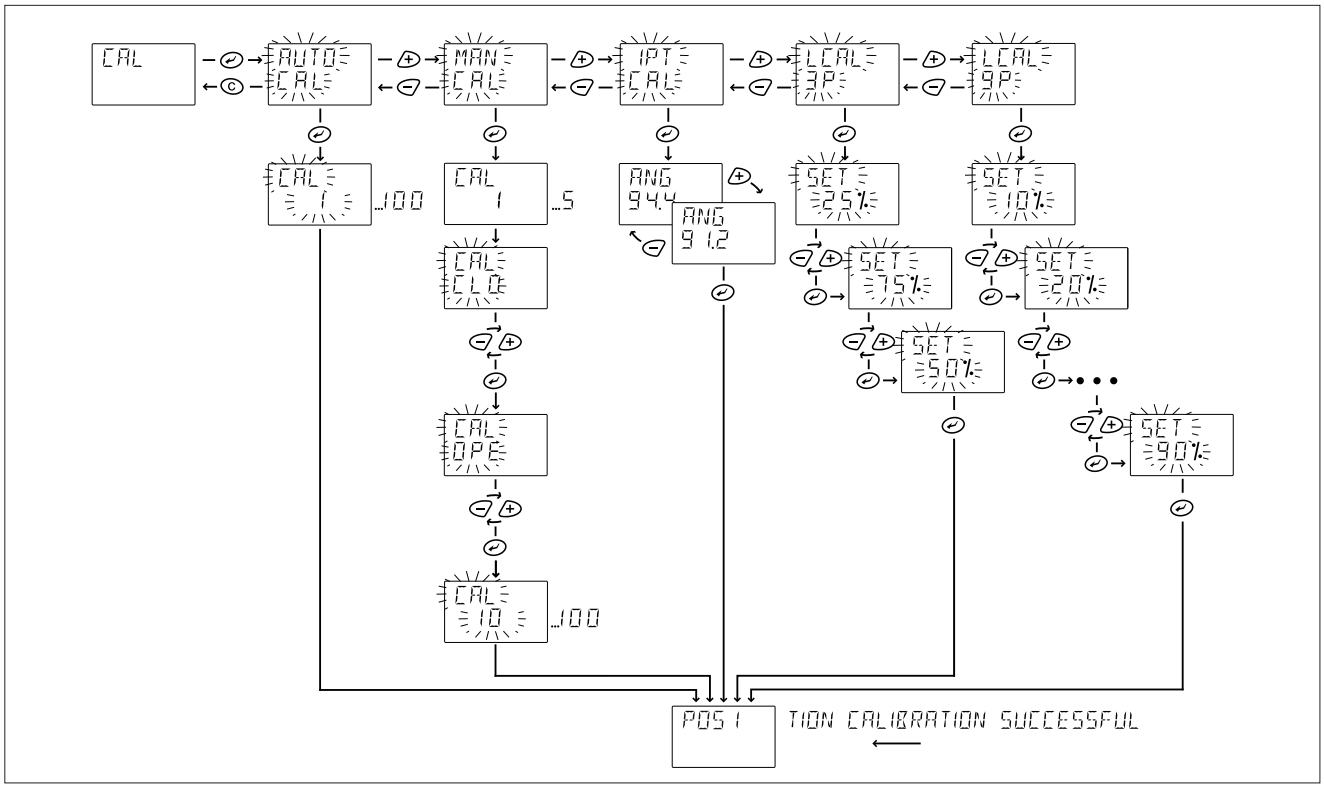


Fig. 27. Calibration selection

AUTO calibration function

During the calibration process the display will show blinking CAL and numbers run from 1 to 100 to show calibration progress. After calibration the display shows scrolling POSITION CALIBRATION SUCCESSFUL text and device returns to basic measurement display after one hour. Press the ⓒ key to get back to the basic measurement view immediately.

If you cannot drive the valve into a fully open position or if there is no mechanical limit stop, a manual calibration is required.

If AUTO CAL option is not available in the menu, please check Section 5.6 MAN calibration function

MAN calibration function

After selecting the MAN calibration function from the menu press the ↵ key to activate the procedure. First there will be short valve speed identification. Then user is asked to drive valve manually into open or close end (depends on installation), the display shows CAL OPE or CAL CLO. With the ⊕ or ⊖ keys drive the valve manually to the open (100 %) or closed (0 %) position and then press the ↵ key.

After defining first end position, user is asked to drive valve to another end position. Display shows CAL OPE or CAL CLO (depends on installation). With the ⊕ or ⊖ keys drive the valve manually to the open (100 %) or closed (0 %) position and then press the ↵ key.

The display shows blinking CAL and numbers continue to run from 10 to 100 to show the calibration progress. After calibration the display shows scrolling POSITION CALIBRATION SUCCESSFUL text and device returns to basic measurement display after one hour. Press the ⓒ key to get back to the basic measurement view immediately.

If the last performed calibration has been **MAN**, and valve type is selected as Lin or FLI, it is not possible to run **AUTO** calibration. AUTO CAL is disabled from the calibration menu.

Only way to get AUTO CAL back to the calibration menu is to select valve type as rot again, then there are all calibration options available again.

1-Point calibration

1-point calibration is useful in cases in which the valve controller needs to be changed but it is not possible to run the normal calibration and the valve is not allowed to change position (the valve is active, for example). **This procedure does not ensure the best possible control performance, and it is always recommended to run either AUTO or MAN calibration, as soon as possible.** The primary way to calibrate valve position is to use either **AUTO** or **MAN** calibration.

Before starting 1-point calibration, read the warnings and notes below and check that the valve is mechanically locked. Before starting 1-point calibration, adjust the TPOS value in the MAN mode (see Section 5.4.2) to correspond with the physical position of the valve.

Once the 1-point calibration is started, the first view shows ANG above and NN.N below (see Fig. 27). NN.N presents the maximum turning angle (in degrees) that the valve can perform.

To change the value:

Press ⊙, NN.N begins blink

Press ⊕ and ⊖ keys to change the value

After the correct valve operation angle is set, press ⊙ key.

After calibration the ND9000 and ND7000 scrolls POSITION CALIBRATION SUCCESSFUL text. You may interrupt the calibration sequences at any time by pressing the ⓒ key.

After the calibration sequence is finished, press the ⓒ key twice to get back to the measurement view.

Please refer to Chapter 7 if this sequence has failed and an error message is displayed.

The valve can now be unlocked.

WARNING:

Supply pressure can be connected to the valve controller only after 1-point calibration is successfully completed. If supply pressure is connected to the valve controller before successful 1-point calibration, the valve may move and cause danger.

NOTE:

If an incorrect valve operation angle is given to the valve controller during 1-point calibration, valve operation will be incorrect. In this case, you must perform 1-point calibration again with correct valve operation angle value.

NOTE:

If the valve position is not stable (due to heavy vibration etc) during 1-point calibration, the calibration will not end successfully. Check that the valve position is fully stable during this operation.

Linearization

Linearization FLI can be used for linear valves when linkage geometry is needed to be corrected by valve controller.

Linearization can be done with 3 points (and end points) or with 9 points (and end points).

3-point linearization will be done in positions 25 %, 50 % and 75 %.

9-point linearization will be done in positions 10 %, 20 %, 30 %, 40 %, 50 %, 60 %, 70 %, 80 % and 90 %.

NOTE:

There have to be external position measurement in linear valve that you can compare actual position and given position.

Before linearization:

- Perform the Valve travel calibration (auto or manual).
- Before 3-point or 9-point linearization is visible on the display. Valve type VTYP has to be set as Fixed Linear FLI.

Linearization:

- Select 3-point LCAL 3P or 9-point LCAL 9P linearization from CAL by pressing the ⊙ key.
- The display shows SET 10 % or SET 25 % depending on which is selected: 3-point or 9-point calibration.
- Drive valve position manually with the ⊕ and ⊖ keys to 10 % or 25 %.
- When required position is reached (according to position measured by external measurement) press the ⊙ key.
- The display starts to blink next position (50 % or 20 %). When last point have confirmed, the LUI displays that calibration is successful and returns to basic measurement display.
- User can terminate linearization any time by pressing the = key. Linearization is cancelled and device returns to basic measurement display. No changes to linearization are made and corresponding message is shown to user.

If linearization fails, a message about the reason will be shown on the LUI display and also in event log that can be read with DTM. If linearization is not successfully completed, there will be no changes in linearization.

LS status

ND9000F and ND9000P only

LS shows the status of limit switches:

---	No LS active
CLO	LS “Closed” active
OPE	LS “Open” active
LSE	LS Error, both switches activated at the same time

5.7 Special displays

User interface locked

In order to prevent unauthorised access, the Local User Interface may be locked. In this mode measurements may be viewed but configurations and calibrations are prohibited. You may lock and unlock the device only via HART (ND9000H, ND7000H) or dip switch (ND9000F, ND9000P), see Fig. 32 and 33. When the Local User Interface is locked the lock symbol will be activated on the display.

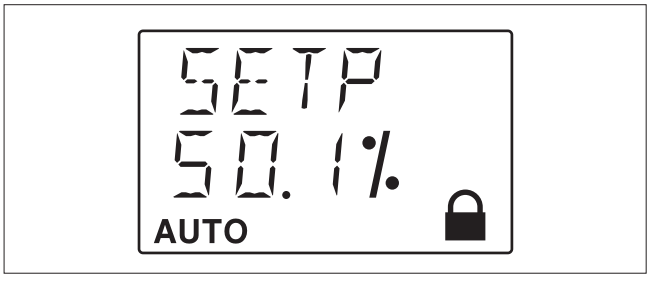


Fig. 28. LUI locked

Online-alarm active

If an online alarm has been detected the solid & symbol is activated. This symbol will disappear after the recovery from online alarm. You may view the reason for the alarm by viewing the latest event while pushing the ⓒ and ⊖ keys simultaneously or by using frame application software where all events may be viewed.

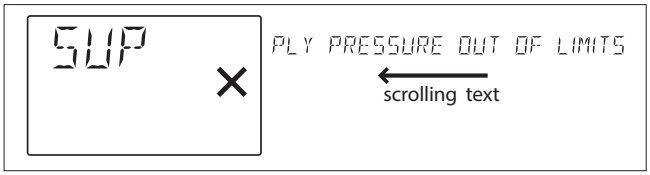


Fig. 29. Example of online alarm message

Viewing of latest event

You may view the latest event by pressing the © and ⮌ keys simultaneously in the measurement monitoring view. The message is scrolled on the top row of the display twice. You may stop the scrolling by pressing the ⮌ key. By pressing the © key, the message will disappear.

For the list of events see Chapter 7.

Fail-safe active

When the ND detects serious device failure (setpoint, valve position and control signals) it enters fail-safe mode, which drives the control valve into the position defined in the parameter controller fail action (PFA). Fail-safe mode is indicated by the display as seen in Fig. 30. The error message is displayed until the cause of error is eliminated and the ND unit is restarted, i.e. the power is momentarily disconnected.

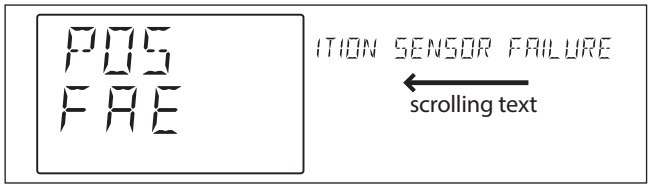


Fig. 30. Example of failsafe display

Reduced performance

When the ND detects spool valve measurement failure, it enters reduced performance mode. This is indicated by the blinking & in the display, see Fig. 31.

In reduced performance mode valve control can not be optimized. To correct the problem replace the spool valve assembly and perform auto calibration.

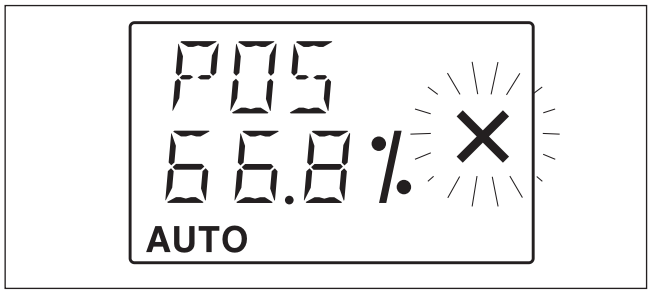


Fig. 31. Reduced performance display

5.8 Write protection

HART write protection, ND9000H and ND7000H

The ND9000H and ND7000H are delivered from the factory with the default set as HART write protection OFF. Reading and changing parameters is allowed. HART protection may be enabled with a switch (DIP1) located on the communication circuit board under the Local User Interface module. Changes that may influence the valve position cannot be made using the frame application software or HART hand held when switch no. 1 (on the left-hand side of the switch block) is ON, Fig. 32.

Write protection, ND9000F, ND9000P

The ND9000F/ND9000P is delivered from the factory with HW write protection OFF as the default setting. Reading and changing parameters is thus allowed.

Write protection can be enabled with the switch (DIP1) located on the circuit board, Fig. 32.

The simulation can be enabled with the switch (DIP2) located on the circuit board, Fig. 33.

Write protection protects all write access to all writeable parameters of the device. Changing the parameters from the LUI or fieldbus configurator is thus not allowed.

The simulation switch is OFF as the default setting. A0 block simulation is thus disabled. The simulation can be enabled with the switch (DIP2) located on the circuit board, Fig. 33.

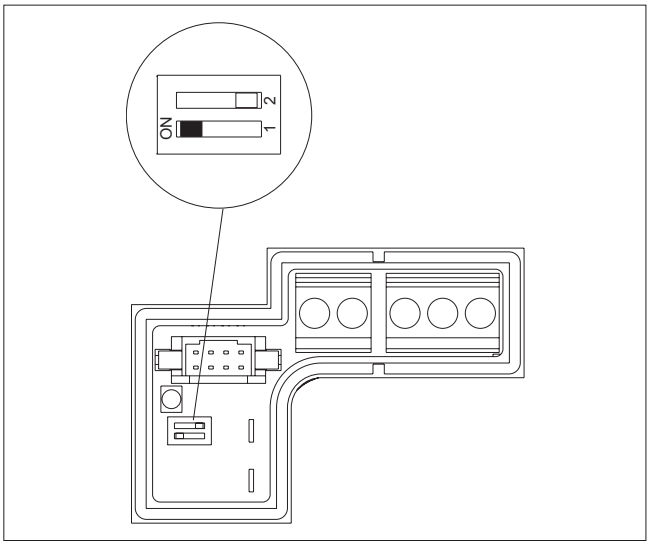


Fig. 32. HART write protection, ND9000H and ND7000H

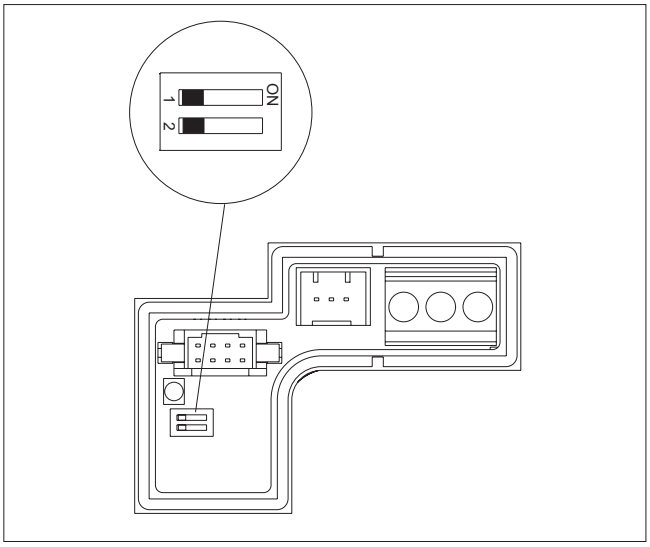


Fig. 33. Write protection, ND9000F and ND9000P

6. MAINTENANCE

Ex d WARNING (ND9200, ND7200, ND9300):
Service of the cylindrical flameproof joints is not allowed.
This includes the diaphragm cover (part 171), flame arrester plunger (part 200), their mating surfaces in the housing (part 2) and the shaft assembly fixed in the housing.

The maintenance requirements of the ND valve controller depend on the service conditions, for instance, the quality of instrument air. Under normal service conditions there is no requirement for regular maintenance.

When maintaining the ND ensure that the supply air is shut off and pressure is released. In the following text the numbers in brackets ( ) correspond to the part numbers in the exploded view as shown in Chapter 12, unless otherwise stated.

The ND valve controller includes the following interchangeable modules: prestage unit (120), spool valve (193), communication circuit board with optional position transmitter (215).

In ND9100 and ND7100 the modules are located below the covers (39) and (43). In ND9200, ND7200 and ND9300 the spool valve is located on the bottom side of the device while the other modules are located below the covers (100) and (39). In the event of failure the whole module must be changed. The module retrofit must be assembled in a clean, dry environment. In reassembly apply a thread-locking compound (for instance, Loctite 243) and tighten the screws firmly.

6.1 Prestage

NOTE:
The prestage must be handled carefully. In particular the moving parts of the prestage should not be touched when the inner cover (39) is not in place.

Removal

ND9100, ND9400 and ND7100

- Open the prestage cover (43) attached with M4 screw (44). Unplug the prestage wire connector on the spool sensor board. Unscrew the M4 screws (139, 2 pcs.) and lift up the prestage module. Remove the O-ring (140).

ND9200, ND7200, ND9300

- Loosen the M8 stop screw (110) in the position indicator (109) and turn the position indicator from the shaft (11). Remove the inner cover (39) attached with M3 screws (42, 3 pcs).
- Unplug the prestage wire connector from the spool sensor board (182). Unscrew the M4 screws (139, 2 pcs.) and lift up the prestage module. Remove the O-ring (140).

Installation

ND9100, ND9400 and ND7100

- Place a new O-ring (140) into the groove on the spool valve and press the prestage into place. Make sure the nozzle is guided into the O-ring properly. The screws guide the prestage body into the correct position. Tighten the screws (139) evenly.
- Push the prestage 2-pole wire connector into the socket on the spool sensor board. The wire connector may only be fitted in the correct position. Replace the prestage cover (43) and tighten the M4 screw (44).

ND9200, ND7200, ND9300

- Place a new O-ring (140) into the groove in the housing and press the prestage into place. Make sure the nozzle is guided into the O-ring properly. The screws guide the prestage body into the correct position. Tighten the screws (139) evenly.
- Push the prestage 2-pole wire connector into the socket on the spool sensor board. The wire connector can only be fitted in the correct position. Replace the inner cover (39) and tighten the M3 screws.

6.2 Spool valve

Removal

NOTE:
Each spool valve body has an individual corresponding spool which cannot be replaced by any other spool. Never alter the orientation of the spool. The orientation of the spool is marked on the device, see Fig. 34 and 35.

ND9100, ND9400 and ND7100

- Before removing the spool valve assembly (193) the prestage (120) must be removed. See 6.1.
- Unscrew the M4 screws (47, 3 pcs.), M3 screws (48, 2 pcs.) and M3 screw (49). Remove the spool valve assembly.
- The spool valve may be cleaned if special attention is paid to a clean environment and proper procedure. After unscrewing the M4 screws (47, 3 pcs.) the spool valve may be lifted from the fixture. Hold the ends of the body with your fingers to avoid dropping the spool from the body. Clean the spool and the bore of the body with care. Do not leave any fibres from cleaning materials in the bore or on the spool. Do not scratch the mating surfaces of the spool and body. The restrictor is located under the spool valve in the fixture. It may be cleaned when the spool valve is removed.

ND9200, ND7200, ND9300

- For spool valve removal it is usually necessary to unmount the valve controller from the actuator.
- Working from the bottom side of the valve controller, unscrew the M4 screws (47, 3 pcs.). Remove the spool valve cover (61) and the spool valve (193) with gasket (174). Hold the ends of the body with your fingers to avoid dropping the spool from the body.
- Spool valve removal is only possible in the spring-forced failsafe position of the spool. In the case of a stuck spool it might be necessary to remove the secondary diaphragm cover (167), the spool spring (166) with its disc (164) and the secondary diaphragm (162) with its plate. After the removal of these parts it is possible to use a punch to force the spool to the failsafe position.
- The spool valve may be cleaned if special attention is paid to a clean environment and proper procedure.
- Clean the spool and the bore of the body with care. Do not leave any fibres from cleaning materials in the bore or on the spool. Do not scratch the mating surfaces of the spool and body.

Installation

NOTE:
If the maintenance operations have been done for the spool valve assembly, the device must always be calibrated.

ND9100, ND7100

- Ensure that the gasket (174) is properly located in the groove on the bottom of the spool valve assembly. Mount the spool valve assembly on to the housing and tighten the M3 and M4 screws evenly. Ensure the O-ring (140) slots inside the groove fully. Mount the prestage unit directly on the spool valve unit as in 6.1.

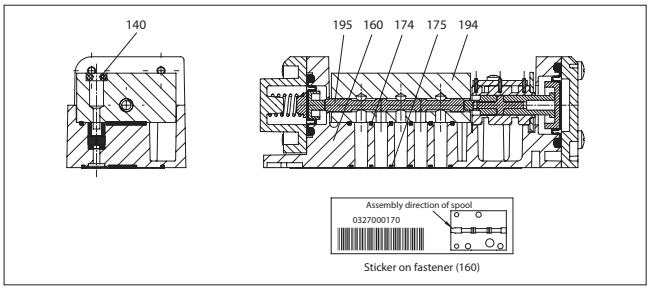


Fig. 34. Spool valve assembly, ND9100 and ND7100

ND9200, ND7200, ND9300

- Ensure that the gaskets (174) and (63) are properly located in their grooves on the bottom of the housing. Mount the spool valve and the spool valve cover (61) to the housing, and tighten M4 screws evenly.

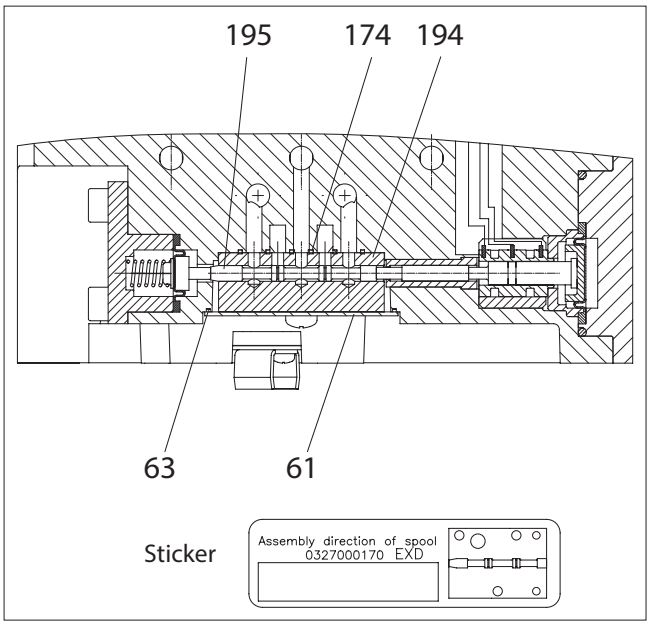


Fig. 35. Spool valve assembly, ND9200, ND7200 and ND9300

6.3 Flame arrestor assembly

ND9200, ND7200, ND9300

The flame arrestor and the restrictor are fit into the same plug which is located under the diaphragm cover (171). This assembly can not be disassembled and should be replaced if clogged.

- To remove the flame arrestor assembly, unscrew the screws (173, 4 pcs.) and remove the diaphragm cover (171) with its O-ring. Turn a M3 screw into the threaded hole of the flame arrestor assembly to extract it from the housing. Installation is the reversal of removal. Place the O-rings carefully.

6.4 Diaphragms

ND9200, ND7200, ND9300

The diaphragms (169, 162) may be replaced by removing the respective covers (171, 167). The unit should be unmounted from the actuator and the side to be worked on turned upwards in order to avoid loss of small parts. When replacing the secondary diaphragm (162), the spool spring (166) with its guide (164) has to be removed first. When reassembling, pay special attention to the installation of the diaphragms and O-rings.

6.5 Communication board

Removal

NOTE:

Ground yourself on the body of the device before touching the circuit board.

NOTE:

Do not remove the Valve Controller Board (210)!

Removing the board will void the warranty.

ND9100, ND7100

- Loosen the M8 grub screw (110) off the position indicator (109) and turn the position indicator from the shaft. Remove the cover of the prestage (43). Remove the electronics cover (39) attached with M3 screws (42, 4 pcs.).
- Remove the M3 screws (217, 4 pcs.). Hold the sides of the circuit board and lift it directly upwards and outwards. Handle the board carefully, touching only the sides.

ND9200, ND7200, ND9300

- Loosen the M8 stop screw (110) in the position indicator (109) and turn the position indicator from the shaft (11). Remove the inner cover (39) attached with M3 screws (42, 3 pcs.).

Remove the M3 screws (217, 4 pcs.). Hold the sides of the circuit board and lift it directly upwards and outwards. Handle the board carefully, touching only the sides.

Installation

Ex WARNING:

Grounding of the circuit board is essential to explosion protection.

The board is grounded to the housing by the mounting screw next to the terminal blocks.

ND9100, ND7100

- Mount the new communication circuit board carefully.
- Locate the pins with the matching connector on the board. Tighten the M3 screws (217) evenly.
- Install the electronics cover (39)s and the cover of the prestage (43).
- Mount the position indicator (109) on the shaft and tighten the M8 screw (110) temporarily. The final orientation and locking of the position indicator should be done after installation of the valve controller to the actuator.

ND9200, ND7200, ND9300

- Mount the new communication circuit board carefully.
- Locate the pins with the matching connector on the board. Tighten the M3 screws (217) evenly.
- Install the inner cover (39).
- Mount the position indicator (109) on the shaft and tighten the M8 stop screw (110) temporarily. The final orientation and locking of the position indicator should be done after installation of the valve controller to the actuator.

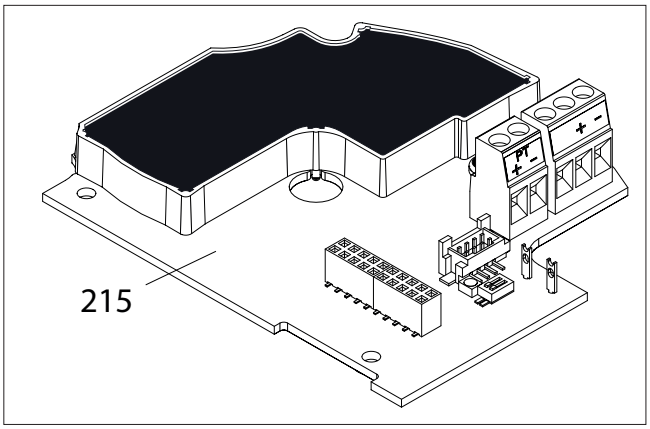


Fig. 36. Communication board, ND9000H and ND7000H

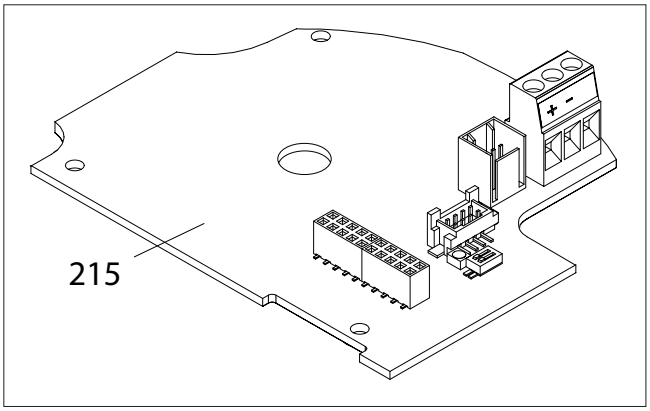


Fig. 37. Communication board, ND9000F and ND9000P

7. ERROR MESSAGES

7.1 Failsafe errors

Display message	Description
POSITION SENSOR FAILURE	Position sensor measurement failed. Change the ND device to a new one.
SETPOINT SENSOR FAILURE (HART version only)	mA measurement failed. Change the ND device to a new one.
PRESTAGE SHORTCUT ERROR	Shortcut in the prestage unit.
FAE nnn	Fatal malfunction in the device. nnn is a number between 001– 004. Change the ND device to a new one.

7.2 Alarms

Display message	Description
DEVIATION ALARM	Valve deviation out of limits.
STICTION LOW ALARM	Stiction has exceeded the low limit (ND9000 only).
STICTION HIGH ALARM	Stiction has exceeded the high limit (ND9000 only).
LOAD FOR OPENING LOW ALARM	Load for opening has exceeded the low limit (ND9000 only).
LOAD FOR OPENING HIGH ALARM	Load for opening has exceeded the high limit (ND9000 only).
SPOOL VALVE PROBLEM	Spool valve problem in the controller. Check the spool valve unit and replace if necessary.
PNEUMATICS PROBLEM	Inconsistent actuator pressures. Check pneumatic connections and actuator leakage.
FRICTION PROBLEM	Valve is not moving correctly. Check load factor.

7.3 Errors

Display message	Description
PRESTAGE CUT ERROR	Prestage wire is cut or connector is loose.
PRESSURE SENSOR 1 FAILURE	Actuator pressure sensor has failed. The device performance level is reduced if device is used as D/A actuator. This will not effect to control performance for single acting actuator. Change the ND device to a new one during next maintenance activity.
PRESSURE SENSOR 2 FAILURE	Actuator pressure sensor has failed. The device performance level is reduced. Change the ND device to a new one during next maintenance activity.
PRESSURE SENSOR 3 FAILURE	Supply pressure sensor has failed. This does not affect the performance level.
SPOOL VALVE SENSOR FAILURE	Spool valve sensor failed. Check the sensor connections. The device performance level is reduced. For ND9100 and ND7100 change spool valve assembly (193) during next maintenance activity. For ND9200/ ND7200/ND9300 replace device to a new one during next maintenance activity.
TEMPERATURE SENSOR FAILURE	Temperature measurement failed. The accuracy of the measurements is reduced. Change the ND device to a new one during next maintenance activity.
STATISTICS DATABASE ERROR	Failed to store statistics. New measurements will be lost.
EVENT DATABASE ERROR	Failed to store events. The new events will be lost.
POSITION CALIBRATION FAILED	Travel calibration failed. Check the configuration parameters and controller mounting. Check that the controller shaft is correctly aligned.
POSITION CHANGE TOO SMALL	Given samples in Linearization are closer than 5 % to each other, i.e. there's not enough change between two consequent samples.
LINEARIZATION FAILED	3P/9P linearisation failed.
FACTORY SETTINGS RESTORE FAIL	Factory settings restoring failed.
TOO SMALL VALVE MOVEMENT	Position sensor range failed during calibration. Valve controller shaft failed to rotate minimum 45 degrees. Check the configuration parameters and controller mounting. Check that the controller shaft is correctly aligned.
POSITIONER SHAFT MOVEMENT OUT OF RANGE	Pointer out of mark on housing, see Figure 6.
CALIBRATION TIMEOUT	Calibration timeout occurred. Check configuration and installation.
CALIBRATION START FAILED	The calibration starting conditions are not met. Check the supply pressure.
TOO SMALL SPOOL VALVE MOVEMENT	Spool sensor range failed during position calibration. Check the configuration parameters. Check the prestage and spool valve unit.
POOR VALVE PACKAGE CONTROLLABILITY	Position calibration takes too long time due to weak controllability.
CHECK ASSEMBLY RELATED PARAMETERS	Check assembly and assembly related parameters and start calibration again.
CALIBRATION FAIL - SUPPLY PRESSURE OUT OF RANGE	Supply pressure out of range during position calibration.
CALIBRATION FAIL - SENSOR FAILURE	Sensor failure (valve position/spool position) is detected during position calibration.
CALIBRATION FAIL - POSITION OUT OF RANGE	Valve position out of range is detected during position calibration.

7.4 Warnings

Display message	Description
TOTAL OPERATION TIME WARNING	Operating time exceeded limit.
VALVE FULL STROKES WARNING	Valve stroke counter limit reached.
VALVE REVERSALS WARNING	Valve reversals counter limit reached.
ACTUATOR FULL STROKES WARNING	Actuator stroke counter limit reached.
ACTUATOR REVERSALS WARNING	Actuator reversals counter limit reached.
SPOOL FULL STROKES WARNING	Spool stroke counter limit reached.
SPOOL REVERSALS WARNING	Spool reversals counter limit reached.
STEADY STATE DEVIATION WARNING	Warning that steady state deviation has increased.
DYNAMIC STATE DEVIATION WARNING	Warning that dynamic state deviation has increased (ND9000 only).
STICTION LOW WARNING	Warning that stiction has exceeded the low limit (ND9000 only).
STICTION HIGH WARNING	Warning that stiction has exceeded the high limit (ND9000 only).
LOAD FOR OPENING TOO LOW	Warning that load for opening has exceeded the low limit (ND9000 only).
LOAD FOR OPENING TOO HIGH	Warning that load for opening has exceeded the high limit (ND9000 only).
SUPPLY PRESSURE OUT OF LIMITS	Supply pressure has exceeded the specified operating conditions.
TEMPERATURE OUT OF LIMITS	Temperature has exceeded the specified operating conditions.
HUNTING DETECTION WARNING	Valve hunting detected. Change performance level to less aggressive to stabilize valve. Check that the spool valve capacity is suitable for the actuator.
REDUCED PERFORMANCE ACTIVATED	Valve controller performance is reduced due to defective spool valve sensor or defective pressure sensor.
TOO LOW SUPPLY PRESS FOR 1-ACT ACTUATOR	Too low supply pressure level for 1-acting actuator.
VALVE REVERSALS TREND WARNING	Warning that valve reversals per day has exceeded the limit.
SETPOINT REVERSALS TREND WARNING	Warning that setpoint reversals per day has exceeded the limit.
VALVE TRAVEL TREND WARNING	Warning that valve travel per day has exceeded the limit.
VALVE REVERSALS WH STABLE SETP WARNING	Warning that valve reversals while setpoint is stable, per day, has exceeded the limit

7.5 Notifications

Display message	Description
POSITION CALIBRATION SUCCESSFUL	Position calibration successfully performed.
LINEARIZATION SUCCESSFUL	3P/9P linearisation successfully performed.
TEST CANCELLED	Off-line test has been cancelled.
TEST DONE	Off-line test has been successfully performed.
TEST FAILED	Off-line test failed. Repeat the test sequence.
CALIBRATION CANCELLED	Calibration has been cancelled.
FACTORY DEFAULTS ACTIVATED	Factory settings activated. Device have to be configured and calibrated.
PT NOT ACTIVATED	(Only with position transmitter option). The position transmitter is not energized.
1PT CAL FAILED	1-point calibration failed. Check the mounting of the valve controller. Verify input parameter (range) value. Check rotation parameter (ROT).
REDUCED PERFORMANCE DEACTIVATED	Spool valve measurement and normal valve control is recovered.

8. TROUBLE SHOOTING

Mechanical/electrical defects

1. A change in the valve position setpoint will not affect the position of the actuator

- Supply pressure too low
- Spool valve sticks
- Incorrect configuration parameters
- Actuator and/or valve jammed
- Signal wires incorrectly connected, no value on display
- Circuit boards are defective
- Calibration has not been carried out
- Device is in manual mode
- Prestage is defective
- Device is in fail-safe mode
- Spool mounted backwards into spool valve

2. The actuator goes to the end position with a small change of input signal

- Tubes between controller and actuator are incorrect, see Fig. 5 and 6
- The parameter settings PFA and ROT are incorrectly selected

3. Inaccurate positioning

- Spool valve dirty
- Too high actuator load
- Supply pressure too low
- Spool or pressure sensors are defective
- Actuator leakage

4. Overshooting or positioning too slow

- Change PERF value
- Spool valve dirty
- Supply air tube too small or supply air filter dirty
- Valve sticks
- Check leakages in tubes between controller and actuator
- Check leakages in mechanical stop screws

5. Error during valve travel calibration

- Valve controller is in MAN mode
- Check the coupling alignment with the pointer, see Fig. 4.
- The parameter settings PFA and ROT are incorrectly selected
- The actuator or valve did not move or was stuck during calibration
- Supply pressure too low
- Spool valve dirty

9. ND9000 WITH LIMIT SWITCHES

9.1 Introduction

General description

ND9000 can be equipped with limit switches. Limit switches are used for electrical position indication of the valves and other devices. The switching points may be chosen freely.

ND9100

ND9100_/D__ and ND9100_/I__ have two inductive proximity switches, ND9100_/K0_ has two microswitches.

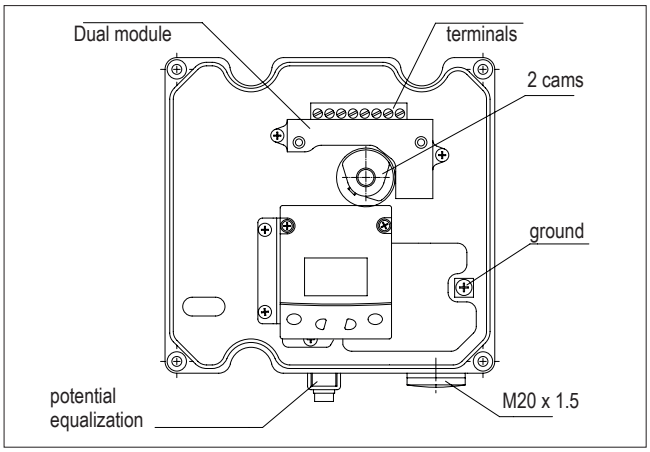


Fig. 38. ND9100_/D__ layout

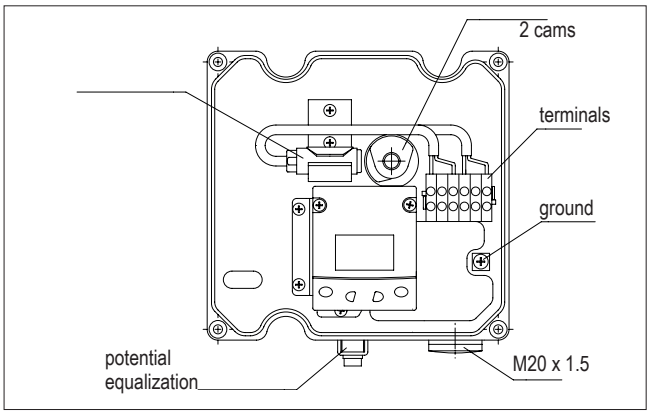


Fig. 39. ND9100_/I__ layout

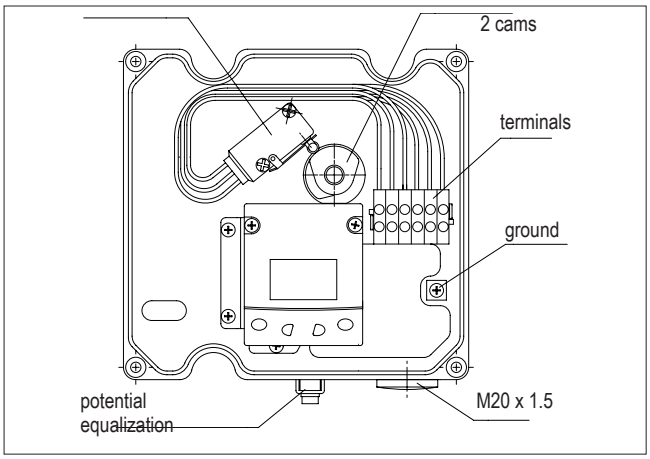


Fig. 40. ND9100_/K0_ layout

ND9100F/B06 and ND9100P/B06

ND9100F/B06 and ND9100P/B06 have two bus powered mechanical micro switches which are connected to the FBI circuit board. Thus the limit information is available directly on the bus through the DI function blocks.

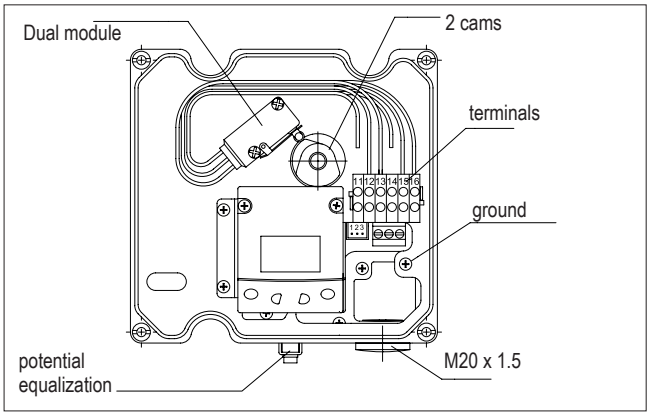


Fig. 41. ND9100F/B06 and ND9100P/B06 layout

ND9200

ND9200_/D__ and ND9200_/I__ have two inductive proximity switches, ND9200_/K0_ has two microswitches.

ND9200F/B06 and ND9200P/B06

ND9200F/B06 and ND9200P/B06 have two bus powered mechanical micro switches.

ND9300

ND9300_/I__ have two inductive proximity switches, ND9300_/K0_ has two microswitches.

ND9300F/B06 and ND9300P/B06

ND9300F/B06 and ND9300P/B06 have two bus powered mechanical micro switches.

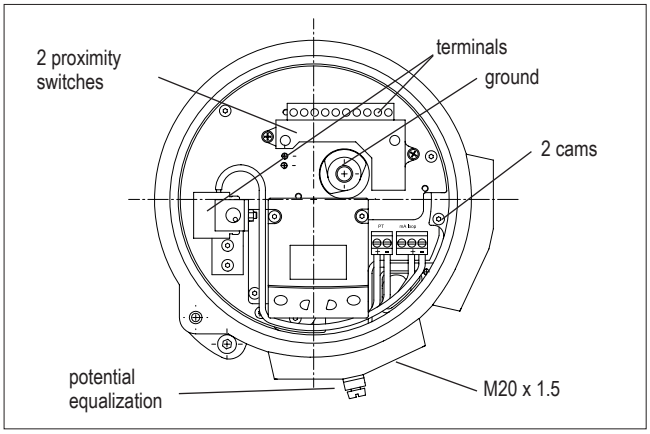


Fig. 42. ND92/93_/D__ layout

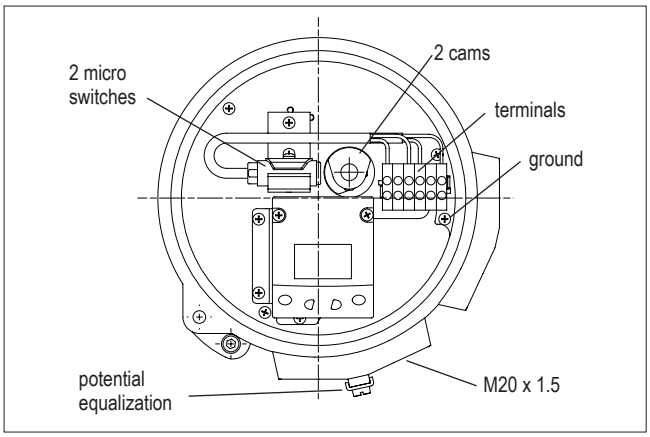


Fig. 43. ND92/93_H/I__, ND92/93_F/I__ and ND92/93_P/I__ layout

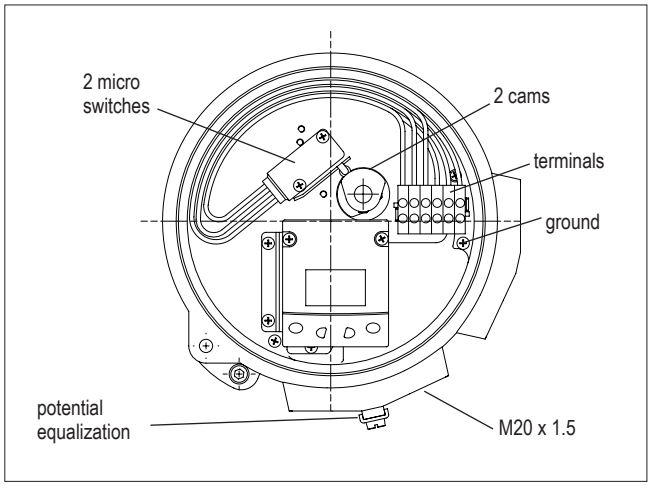


Fig. 44. ND92/93_H/K0_, ND92/93_F/K0_ and ND92/93_P/K0_ layo

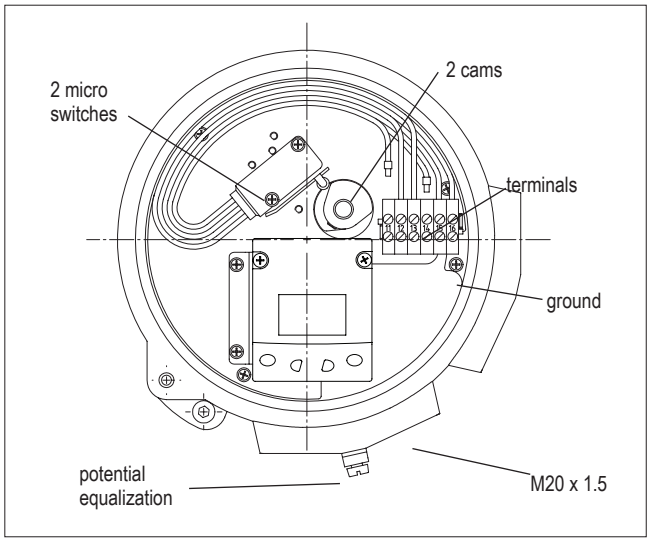


Fig. 45. ND92/93_F/B06 and ND92/93_P/B06 layout

Markings

The limit switch is provided with an identification plate, see Fig. 46 and 47. Identification plate markings include:

- Type designation
- Electrical values
- Enclosure class
- Temperature range
- Conduit entry
- Serial number
- Manufacturing serial number

The type designation is described in Chapter 15.

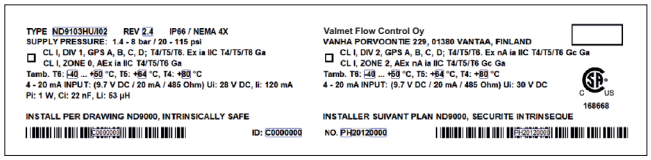


Fig. 46. Example of the identification plate, ND9100

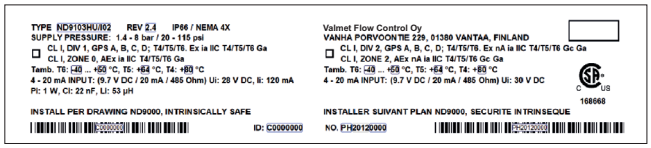


Fig. 47. Example of the identification plate, ND9200

Technical specifications

ND9000_/D__

Proximity switch:	Inductive, Dual Module	
	2 sensors,	
	Normally Open	(33)
	Normally Closed	(44)
Electrical values:		
SST Dual Module	(33)	
Indications:	Target on sensor = LED on	
	Target off sensor = LED off	
Operating voltage:	8–125 V DC; 24–125 V AC	
Maximum voltage drop:	6.5 V / 10 mA	
	7.0 V / 100 mA	
Current ratings:		
Max inrush	2.0 A / 125 V DC / V AC	
Max continuous	0.3 A / 125 V DC / V AC	
Minimum on current	2.0 mA	
Leakage current	<0.15 mA with DC voltage	
	<0.25 mA with AC voltage	
Namur Dual Module	(44)	
Indications:	Target on sensor = LED off	
	Target off sensor = LED on	
Operating voltage:	6–29 V DC	
Current ratings:	Target on (LED off) <1.0 mA	
	Target off (LED on) >3.0 mA	

Must use intrinsically safe repeater barrier.

Namur sensors conform to DIN 19234 standard.

Number of switches:	2
SIL:	Usable up to SIL3 acc. to IEC61508

ND9000_/I__

Proximity switch type:	Inductive	
	P+F NJ2-12GK-SN	(I02)
	P+F NCB2-12GM35-N0	(I09)
	OMRON E2E-X2Y1	(I32)
	P+F NJ4-12GK-SN	(I41)
	P+F NJ3-18GK-S1N	(I45)
	IFM IFC2002-ARKG/UP	(I56)
Electrical values:	According to switch type, check connection diagram from Section 12.11	
Number of switches:	2	
Protection class of housing:	IP66 (DIN 40050, IEC 60529)	
Conduit entry:	M20 x 1.5	
	(ND9100U and	
	ND9200E2, ND9300E2: 1/2 NPT)	
SIL:	Usable up to SIL3 acc. to	
	IEC61508	(02, 45)
	Usable up to SIL2 acc. to IEC61508	(09)

ND9000_/K0_

Microswitch type: OMRON D2VW-5 (K05)
OMRON D2VW-01 (K06)
(gold-plated contacts, contact form is SPDT)
Protection class IP67

Resistive load: 3A: 250 V AC (K05)
5A: 30 V DC
0.4 A: 125 V DC
100 mA: 30 V DC/125 V AC (K06)

Switch accuracy: < 2°

Number of switches: 2

Protection class of housing:
IP66 (DIN 40050, IEC 60529)

Conduit entry: M20 x 1.5 (ND9100U and ND9200E2, ND9300E2: 1/2 NPT)

ND9000F/B06, ND9000P/B06

Microswitch type: OMRON D2VW-01 (B06)
(gold-plated contacts, contact form is SPDT)
Protection class IP67

Resistive load: 100 mA: 30 V DC/125 V AC

Switch accuracy: < 2°

Number of switches: 2

Protection class of housing:
IP66 (DIN 40050, IEC 60529)

Conduit entry: M20 x 1.5 (ND9100U and ND9200E2, ND9300E2: 1/2 NPT)

Electric data and ambient temperatures

Table 9.

Limit switch code	Switch type	Electrical data	Max. Number of switches
2-wire, DC voltage proximity switches:			
I02	P+F NJ2-12GK-SN	Ui: 16 V, Ii: 52 mA	2
I09	P+F NCB2-12GM35-N0	Ui: 16 V, Ii: 52 mA	2
I56	IFM IFC2002-ARKG/UP	U: 10-36 V DC, Imax: 150 mA	2
I41	P+F NJ4-12GK-SN	Ui: 16 V, Ii: 52 mA	4
3-wire, DC voltage proximity switches:			
I45	P+F NJ3-18GK-S1N	Ui: 16 V DC, Ii: 52 mA	2
2-wire, AC voltage proximity switches:			
I32	OMRON E2E-X2Y1	U: 24-240 V AC, Imax: 200 mA	2
Dual module type proximity switches::			
D33	SST Dual Module, NO	2 A - 8-125 V DC, 24-125 V AC	1
D44	Namur Dual Module	3 mA; 1 mA, 6-29 V DC	1
DC/AC voltage micro switches:			
K05	OMRON D2VW-5	3 A - 250 V AC, 0.4 A - 125 V DC, 5 A - 30 V DC	2
K06	OMRON D2VW-01	100 mA - 30 V DC / 125 V AC	2
B06	OMRON D2VW-01	BUS POWERED, NO EXTERNAL POWER NEEDED	2

Table 10.

ND9000	Ambient temperature ranges (Ta) filled according to type		
	T6 T80 °C	T5 T95 °C	T4 T105 °C
NDabcdE1e NDabcdE1e/I02 NDabcdE1e/I04 NDabcdE1e/K05 NDabcdE1e/K06 NDabcdE1e/B06 NDabcdE1e/I32 NDabcdE1e/R35 NdabcdE1e/I41	-40 ... +60 °C	-40 ...+75 °C	-40 ... +85 °C
NDabcdE1e/D33 NDabcdE1e/D44	-40... +60 °C	-40° to +75 °C	-40° to +82 °C
NDabcdE1e/R01	-40° to +60 °C	-40° to +75 °C	-25° to +80 °C
NDabcdE1e/I59	-40° to +60 °C	-40° to +60 °C	-40° to +60 °C
NDabcdE1e/I09 NDabcdE1e/I45 NDabcdE1e/I57 NDabcdE1e/I58	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
NDabcdE1e/I56	-25° to +60 °C	-25° to +75 °C	-25° to +80 °C
NDabcdE1e/I11 NDabcdE1e/I21 NDabcdE1e/I34 NDabcdE1e/I60	-25° to +60 °C	-25° to +70 °C	-25° to +70 °C
NDabcdE1Ce**	-53° to +60 °C	-53° to +75 °C	-53° to +85 °C
NDabcdE1Ce/I59**	-53° to +60 °C	-53° to +60 °C	-53° to +60 °C
NDabcdE1Ce/I41**	-50° to +60 °C	-50° to +75 °C	-50° to +85 °C
Not allowed with external junction box (J, -40 °C)			

Table 11. Ambient temperatures, ND9_X

Variant type	II 1 G Ex ia IIC T6...T4 Ga; II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb; II 2 D Ex tb IIIC T90 °C Db		
	Ambient temperature ranges		
	T6	T5	T4
ND91_X_	-40° to +50 °C	-40° to +65 °C	-40° to +80 °C
ND91_X/I02	-40° to +50 °C	-40° to +64 °C	-40° to +80 °C
ND91_X/I09	-25° to +50 °C	-25° to +65 °C	-25° to +80 °C
ND91_X/I45	-25° to +50 °C	-25° to +64 °C	-25° to +80 °C

Table 12. Ambient temperatures, ND9_X

Variant type	II 1 G Ex ia IIC T6...T4 Ga; II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb; II 2 D Ex tb IIIC T90 °C Db		
	Ambient temperature ranges		
	T6	T5	T4
ND91_X	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND91_X/I02	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND91_X/I09	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
ND91_X/I45	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C

Table 13. Ambient temperatures, ND9_N

Variant type	Ambien temperature ranges
ND_N_ ND_N_/I02 ND_N_/K05 ND_N_/K06 ND_N_/B06 ND_N_/I32	-40° to +85 °C
ND_N_/D33 ND_N_/D44	-40° to +82 °C
ND_N_/I45	-25° to +85 °C
ND_N_/I56	-25° to +80 °C
ND_NC_ (*	-53° to +85 °C
ND_NC_/I41 (*	-50° to +85 °C
Note *) Not allowed with external junction box (J, -40 °C)	

Table 14. Ambient temperatures, ND9_U

Variant type	IS Class I, Division 1, Groups A, B, C, D, T4...T6 IS Class I, Zone 0, AEx ia, IIC T4...T6		
	Ambient temperature ranges		
	T6	T5	T4
ND9_U_	-40° to +50 °C	-40° to +65 °C	-40° to +80 °C
ND9_U/D44 ND9_U/I02 ND9_U/I09 ND9_U/I45	Pending		

Table 15. Ambient temperatures, ND9_U

Variant type	NI Class I, Division 2, Groups A, B, C, D, T4...T6 NI Class I, Zone 2, Ex nA IIC T4...T6		
	Ambient temperature ranges		
	T6	T5	T4
ND9_U_	-40° to +50 °C	-40° to +65 °C	-40° to +80 °C
ND9_U/D44 ND9_U/I02 ND9_U/I09 ND9_U/I45	Pending		

Table 16. Ambient temperatures, ND9_E2 (ND9_E4, only T6)

Variant type	Ex d IIC T4...T6, AEx d IIC T4...T6 Ex tb IIIC T100 °C IP66, AEx tb IIIC T100 °C IP66		
	Ambient temperature ranges		
	T6	T5	T4
ND9_E2	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND9_E2/I02	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND9_E2/I09	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
ND9_E2/I32	-25° to +60 °C	-25° to +70 °C	-25° to +70 °C
ND9_E2/D33	-40° to +60 °C	-40° to +75 °C	-40° to +82 °C
ND9_E2/D44	-40° to +60 °C	-40° to +75 °C	-40° to +82 °C
ND9_E2/I45	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
ND9_E2/K05	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND9_E2/IK06	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND9_E2/B06	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C

Table 17. Ambient temperatures, ND9_Z Inmetro

Variant type	Ex ia IIC T4/T5/T6 Ga Ex ia IIC T4/T5/T6 Gb		
	Ambient temperature ranges		
	T6	T5	T4
ND91_Z	-40° to +50 °C	-40° to +65 °C	-40° to +80 °C
ND91_Z/I02	-40° to +50 °C	-40° to +64 °C	-40° to +80 °C
ND91_Z/I09	-25° to +50 °C	-25° to +65 °C	-25° to +80 °C
ND91_Z/I45	-25° to +50 °C	-25° to +64 °C	-25° to +80 °C

Table 18. Ambient temperatures, ND9_Z Inmetro

Variant type	Ex nA IIC T4/T5/T6 Gc Ex ic IIC T4/T5/T6 Gc		
	Ambient temperature ranges		
	T6	T5	T4
ND91_Z_	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND91_Z/I02	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND91_Z/I09	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
ND91_Z/I45	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C

Table 19. Ambient temperatures, ND9_Z Inmetro

Variant type	Ex d IIC T4/T5/T6 Gb Ex tb IIIC T100 °C Db IP66		
	Ambient temperature ranges		
	T6	T5	T4
ND9_E1_ ND9_E1/I02 ND9_E1/K05 ND9_E1/K06 ND9_E1/B06	-40° to +60 °C	-40° to +75 °C	-40° to +85 °C
ND9_E1/D33 ND9_E1/D44	-40° to +60 °C	-40° to +75 °C	-40° to +82 °C
ND9_E1/I09 ND9...E1/I45	-25° to +60 °C	-25° to +75 °C	-25° to +85 °C
ND9_E1/I56	-25° to +60 °C	-25° to +75 °C	-25° to +80 °C
ND9_E1/I32	-25° to +60 °C	-25° to +70 °C	-25° to +70 °C

9.2 Position transmitter (T01) calibration instructions

The position transmitter (T01) needs to be calibrated according to the valve operation direction; clockwise (CW) to open or counter clockwise (CCW) to open. The calibration is carried out once ND9000 is connected to the actuator and the valve is in closed position (when using rising signal to open configuration). For correct calibration of the position transmitter follow these instructions:

- Loosen the potentiometer set screw located on the potentiometer outer surface and disconnect the potentiometer cable plug from the transmitter board terminal pins.
- Adjust the potentiometer unit to correct angle by rotating the inner section of the potentiometer (smaller diameter cylindrical part on top side of the potentiometer unit). The correct angle depends on the valve operation orientation; CCW or CW to open (see Fig. 48). The centerline mark on the potentiometer side helps aligning the potentiometer for initial position. Make sure that the valve and axis stay stationary in closed position when adjusting the potentiometer orientation.
- For closed position the resistance value of the potentiometer should be adjusted between 400- 600 ohms. Measure the resistance by connecting an ohm meter to terminal connector at potentiometer cable. For CW to open applications measure the resistance between the yellow and red leads, for CCW to open applications measure the resistance between green and red leads.
- Once you have the potentiometer inner section aligned to correct resistance value, tighten the potentiometer set screw to connect the potentiometer firmly to the valve controller axis. Verify that the resistance values stays between 400-600 ohms after the tightening.
- The potentiometer cable can now be connected back to the transmitter board terminal pins. The positioning of the terminal plug is done according to valve operation orientation (see Fig. 49). The plug must always be aligned to one end or the other of the five pin terminal on the transmitter board.
- Connect DC power to the correct positive and negative terminals in the terminal strip (see chapter 12.9 for wiring details).
- Make sure the valve is stationary in closed position and adjust the zero trimpot to give 4 mA output.
- Operate the valve to desired open position.
- Make sure the valve is stationery in open position and adjust the span trimpot to give 20 mA output. The zero and span adjustments are non-interactive.

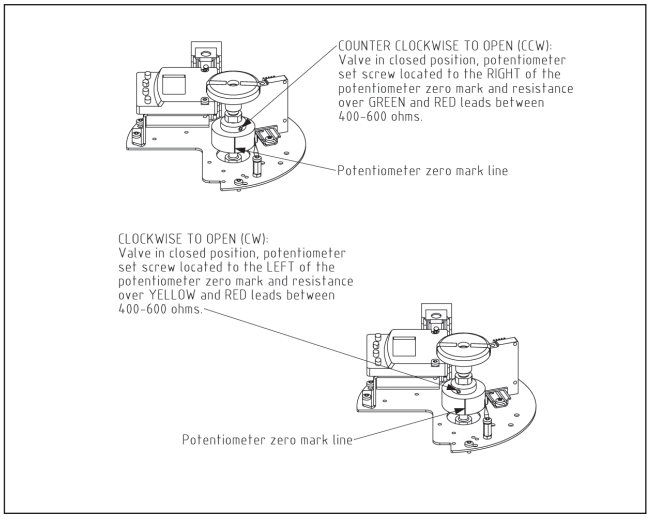


Fig. 48. Potentiometer operation.

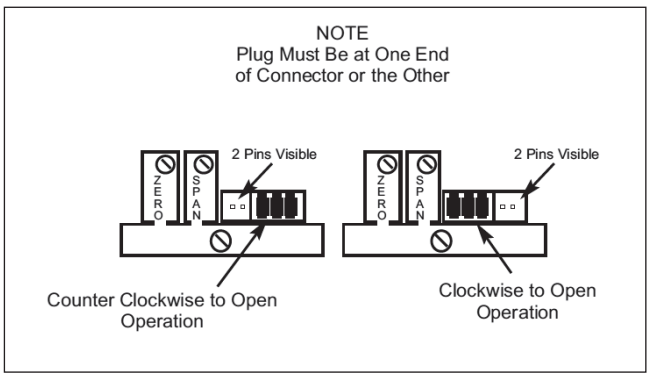


Fig. 49. Plug setting for transmitter operation.

9.3 Installation on a valve controller

The limit switch may be installed on an existing valve controller.

ND9100

- If the valve controller is already mounted on an actuator/ valve assembly, operate the actuator into the closed or open position.
- Remove the cover (100), the pointer (109), the LUI (223), the prestage cover (43) and electronics cover (39).
- Turn the shaft (311) onto the shaft (11). Fasten the screw (312) using a locking agent such as Loctite. Unfasten the screws (314) in the cam discs (313).
- Mount the electronics cover (39) and the housing (300) on the valve controller.
- ND9100/K00: Turn the cam discs (313) to avoid contact with the micro switches, if required.
- Mount the LUI (223) on the bed (306).
- Mount the pointer (109) on the shaft (311). Adjust the limit switch according to 9.5.

ND9200, ND9300

- If the valve controller is already mounted on an actuator/ valve assembly, operate the actuator into the closed or open position.
- Remove the cover (100), the pointer (109), the LUI (223) and electronics cover (39).
- Turn the shaft (311) onto the shaft (11). Fasten the screw (312) using a locking agent such as Loctite.
- Mount the electronics cover (39) and the limit switch housing (300) on the valve controller. Lock the housing in place with screw (326). Install the base plate (324) with the limit switches and connector block into the limit switch housing. Fasten the base plate with screws (325), 3 pcs.
- Install the cam discs (313) and bushings (346) to the shaft.
- Mount the LUI (223) on the holder (306).
- Replace the plastic plugs with metal ones in conduit entries which will not be used.
- Mount the pointer (109) on the shaft (311). Adjust the limit switch according to 9.5.

9.4 Electrical connections

Before connecting the power, make sure that the electrical specifications and the wiring meet the installation conditions. See the diagrams in 12.9 Refer to the information on the identification plate.

ND9000/D__ and ND9000/I__: Observe the functioning of the proximity switch; activated when the active face is either covered or free.

9.5 Adjustment

The pointer (109) need not be removed for adjustment.

When the limit switch is ordered together with the valve and the actuator, the valve controller switches are factory-adjusted. The limits may be adjusted by altering the position of the cam discs (313) on the shaft.

The lower switch is activated at the closed limit and the upper switch at the open limit.

- With the actuator in the open or closed position, locate the switching point by turning the cam disc so that the switch state changes approx. 5°–6° before the limit.

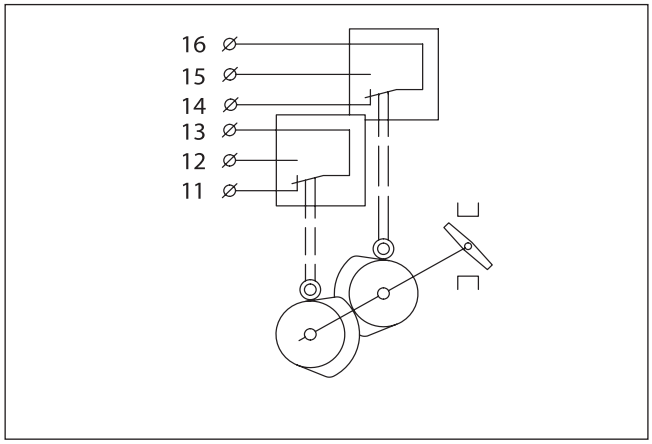


Fig. 50. Limit switch adjustment, 2 switches

- ND9000/D__ and ND9000/I__: Use the LED indicator or a separate measuring instrument as an aid.
- After re-installation of the actuator, first adjust its mechanical limits according to the valve, then the valve controller, and finally the limit switch.
- When adjustment is completed, turn the pointer (109) so that the yellow line is parallel with the valve closure member.

9.6 Removal of the limit switches for accessing the valve controller

ND9100

- Remove the cover (100) and the pointer (109).
- Detach the cam discs (313).
- Remove the LUI cabling from the circuit board.
- Loosen the screws (303) and remove the housing (300).
- Remove the electronics cover (39).
- Proceed with the valve controller as applicable.
- Re-install the limit switch according to 9.3 and check the adjustment according to 9.5.

ND9200, ND9300

- Remove the cover (100) and the pointer (109).
- Loosen the screws (314) in the cam disks (313) and remove the cam disks and spacers (346) from the shaft.
- Remove the LUI cabling from the circuit board. Disconnect and remove all cabling which enters the limit switch housing (300).
- Remove screws (325), 3 pcs. and lift out the limit switch base plate (324) complete with switches, LUI and connector block.
- Open screw (326) and turn the limit switch housing (300) from the positioner housing.
- Remove the electronics cover (39).
- Proceed with the valve controller as applicable.
- Re-install the limit switch according to 9.3 and check the adjustment according to 9.5.

Ex WARNING:

The locking screw of the limit switch housing (Part 326) is essential to explosion protection.

The limit switch housing has to be locked in place for Ex d protection. The screw grounds the limit switch housing to the housing of the valve controller.

9.7 Circuit diagrams

The internal circuitry of the limit switch is shown in the connection diagrams in 12.9 and inside the cover (not ND9100H/I__).

9.8 Maintenance

Regular maintenance of the limit switch is not necessary.

10. TOOLS

Following tools are needed for the product installation and service:

- Flat screwdriver
  - 0.4 x 2.5 x 80 mm
  - 1.2 x 6.5 x 150 mm
- Torx screwdriver
  - T10
  - T15
  - T20
- Phillips screwdriver
  - PH1 x 60 mm
- Allen key
  - 2 mm
  - 4 mm
  - 5 mm

Other tools are depended on actuator where ND installed.

11. ORDERING SPARE PARTS

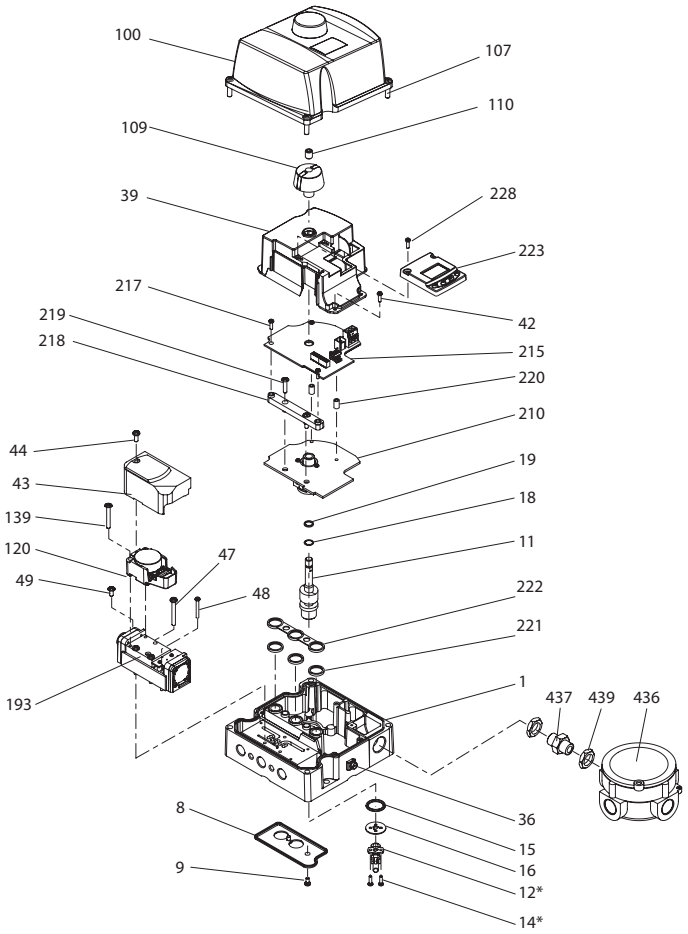
Spare parts are delivered as modules. The modules available are indicated in 12.1 and 12.3.

When ordering spare parts, always include the following information:

- Valve controller type designation and serial number from the ID plate
- The code of this manual, the part number, the part name and quantity required

12. DRAWINGS AND PARTS LISTS

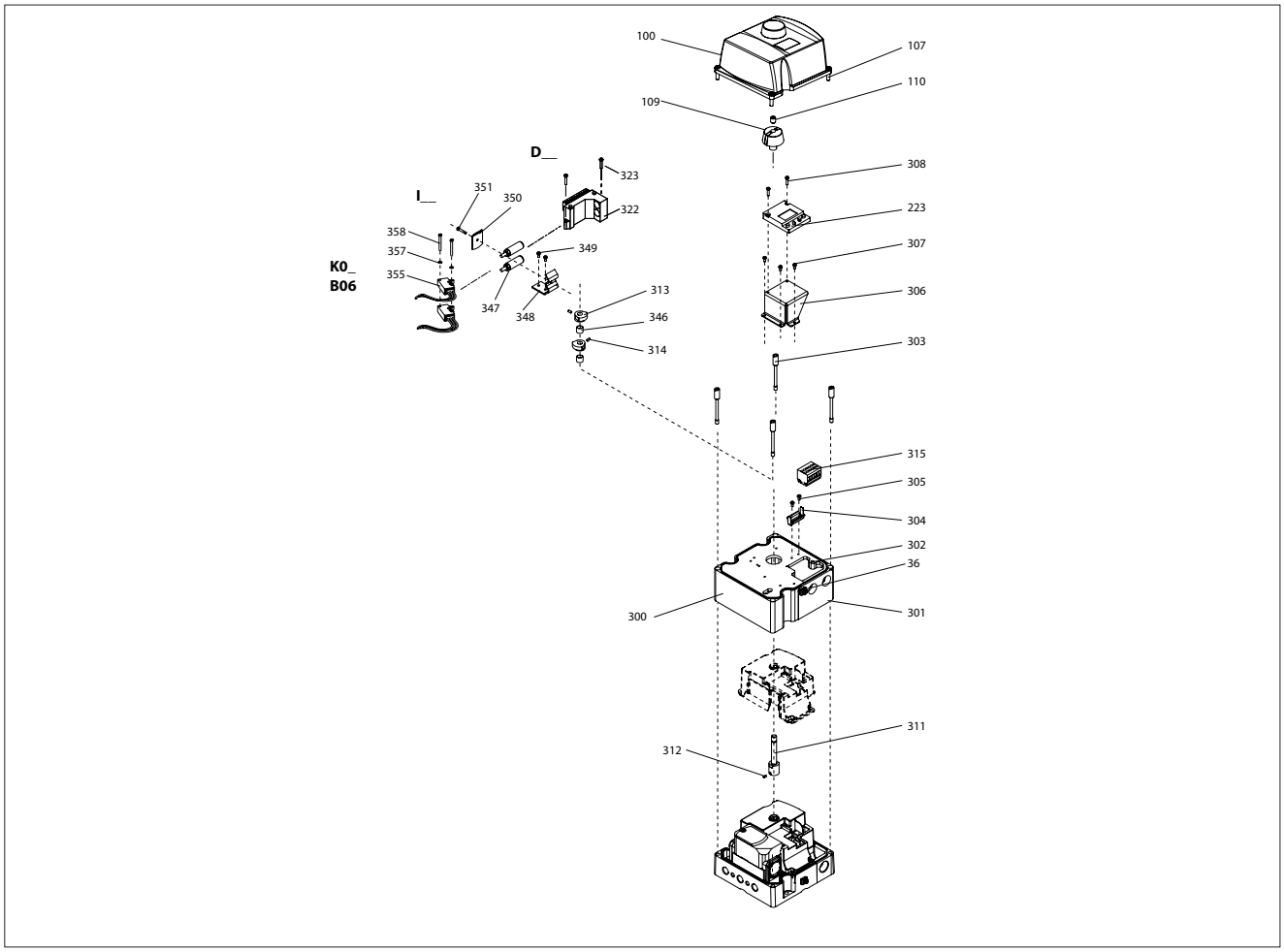
12.1 Exploded view ND9100, ND9400, ND7100



Item	Qty	Description	Spare part modules
1	1	Housing	
8	1	Exhaust cover	
9	2	Screw	
11	1	Shaft	
15	1	O-ring	
16	1	Washer	
18	1	Wave spring	
19	1	Bushing	
36	1	Grounding screw	
39	1	Electronics cover	
42	4	Screw	
43	1	Prestage cover	
44	1	Screw	
47	3	Screw	
48	2	Screw	
49	1	Screw	
100	1	Cover	ND91_ = H035118, ND71_ = H099717, includes item 107
107	4	Screw	
109	1	Pointer	
110	1	Grub screw	
120	1	Prestage unit	H039292, includes item 139
139	2	Screw	
193x	1	Spool valve assembly	ND9102 = H060178, ND9103 = H039293, ND9106 = H039294, kits include items 47, 48, 49
210	1	Valve Controller board	
215**	1	Communication board	ND9_H = H039296, ND9_HT = H041368, ND9_F = H142599, ND9_P = H133927
217	4	Screw	
218	1	Support	
219	2	Screw	
220	2	Threaded spacer	
221	3	O-ring	
222	1	Isolation part	
223	1	Local user interface (LUI)	H039295, includes item 228
228	2	Screw	
436	1	Connection box	Not available with ND7000
437	1	Nipple	
439	2	Nut	

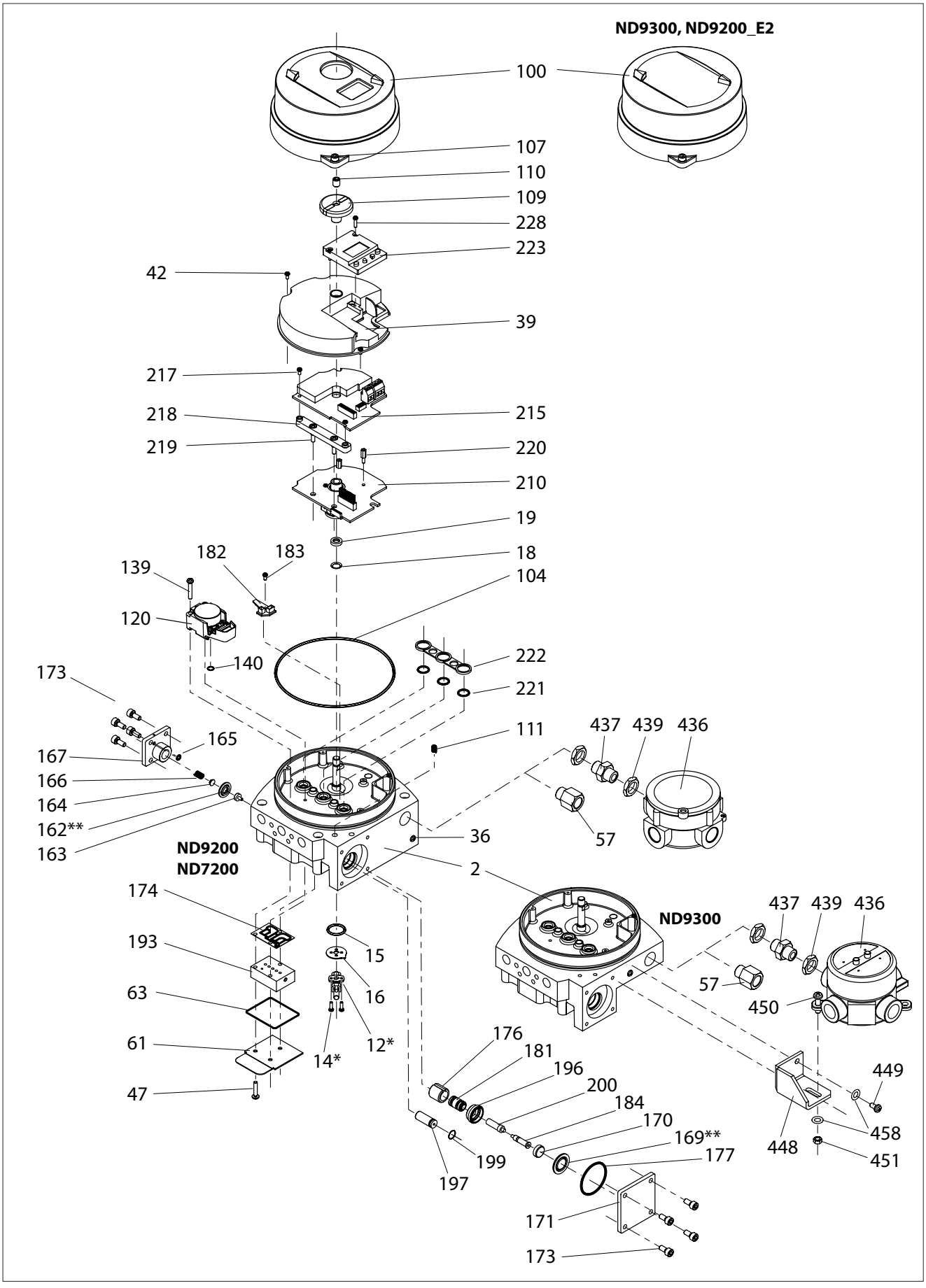
*) Mounting parts: coupling (12), screws (14)
**) PH number from the ID plate is required
x) Spool valve assembly includes the spool valve with the fastener. Separate ID code for fastener is H077294. This contains also all gaskets and diaphragms.

12.2 Exploded view ND9100_/D__, ND9100_/I__, ND9100_/K0_ and ND9100_/B06



Item	Qty	Description
36	1	Grounding screw
100	1	Cover
107	4	Screw
109	1	Pointer
110	1	Screw
223	1	Local user interface (LUI)
300	1	Housing
301	1	Gasket
302	1	Screw
303	4	Screw
304	1	Bracket
305	2	Screw
306	1	Bed of Local User Interface (LUI)
307	3	Screw
308	2	Screw
311	1	Shaft
312	2	Screw
313	2	Cam disc
314	2	Screw
315	6	Terminal block
322	1	Proximity switch (D__)
323	2	Screw
346	1 or 2	Bushing (I__)
347	2	Inductive proximity sensor (I__)
348	1	Fastening plate
349	2	Screw
350	1	Washer
351	1	Screw
355	2	Microswitch (K0_, B06)
357	2	Spring washer (K0_, B06)
358	2	Screw (K0_, B06)

12.3 Exploded view ND9200, ND9300, ND7200



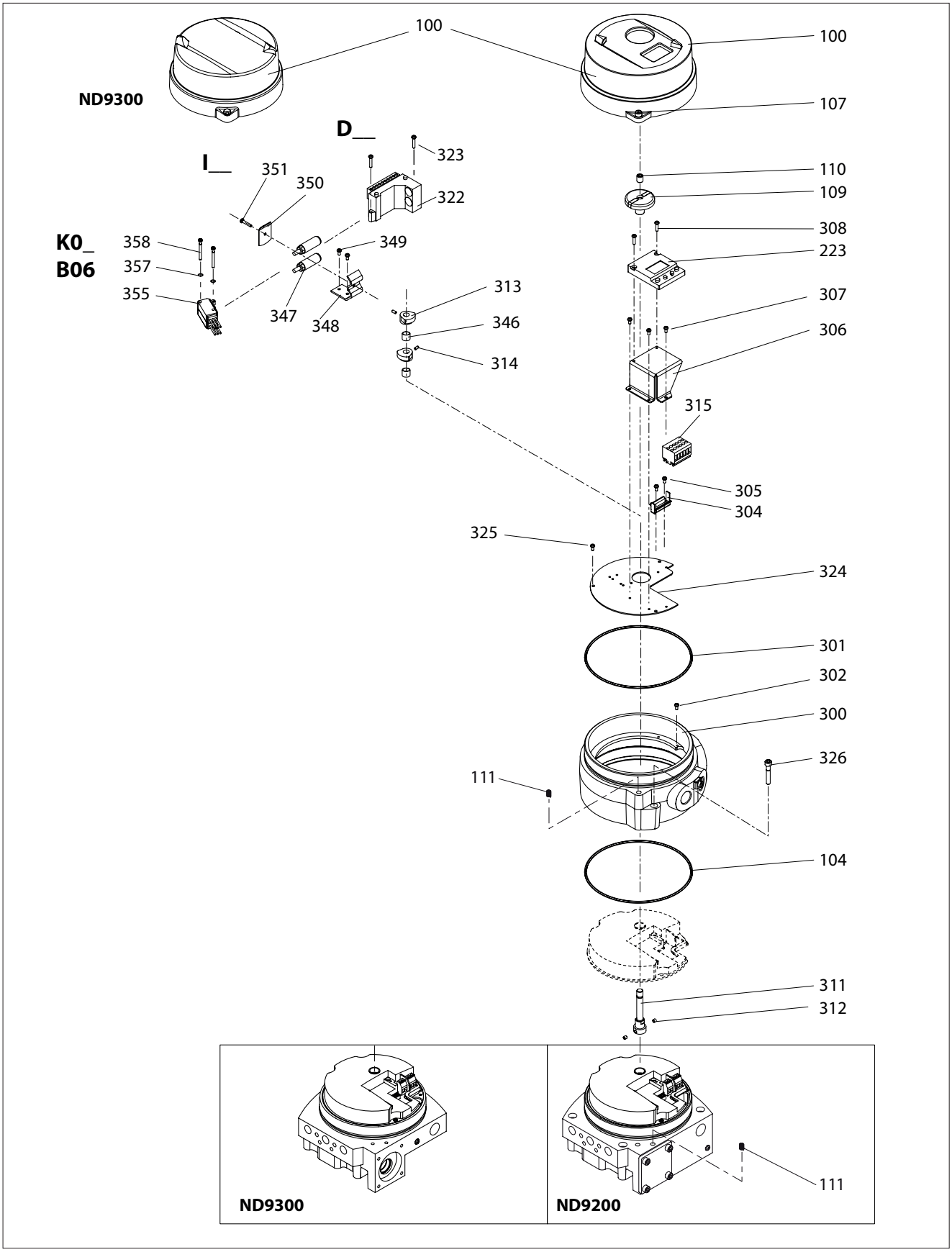
Item	Qty	Description	Spare part modules
2	1	Housing	
15	1	O-ring	
16	1	Washer	
18	1	Wave spring	
19	1	Bushing	
36	1	Grounding screw	
39	1	Inner cover	
42	3	Screw	
47	3	Screw	
57	1	Conduit entry adapter	
61	1	Spool valve cover	
63	1	Gasket	
100	1	Cover	ND92_E1 = H087634, ND92_E2 = H087617, ND9300 = H087628 ND72_E1 = H087634, ND72_E2 = H087617
104	1	O-ring	
107	1	Screw	
109	1	Pointer	
110	1	Stop screw	
111	1	Spring	
120	1	Prestage unit	H039292, also includes items 139 and 140
139	2	Screw	
140	1	O-ring	
162**	1	Supply pressure diaphragm	ND92 = H048584, ND93 = H078592, ND72 = H048584
163	1	Diaphragm plate	
164**	1	Spring guide	
165**	1	O-ring	
166	1	Spring	
167	1	Diaphgram cover	
169**	1	Pilot pressure diaphgram	
170	1	Diaphragm plate	
171	1	Diaphragm cover	
173	8	Screw	
174	1	Gasket	
176	1	Bushing	
177**	1	O-ring	
181	1	Sleeve	
182	1	Spool sensor board	
183	1	Screw	
184	1	Plunger	
193	1	Spool valve	ND9202 = H060179, ND9203 = H048586, ND9206 = H048587, ND9302 = H076999, ND9303 = H077000, ND9306 = H077001 ND7202 = H060179, ND7203 = H048586, ND7206 = H048587, also includes item 63
196	1	Bushing	
197	1	Restriction assembly	
199	1	O-ring	
200	1	Flame arrester	H080913
210	1	Valve controller board	
215***	1	Communication board	ND9_H = H039296, ND9_HT = H041368, ND9_F = H142599, ND9_P = H133927
217	4	Screw	
218	1	Support	
219	2	Screw	
220	2	Threaded spacer	
221	3	O-ring	
222	1	Isolation part	
223	1	Local user interface (LUI)	H039295, includes item 228
228	2	Screw	
436	1	Connection box	Not available with ND7000
437	1	Nipple	
439	2	Nut	
448	1	Bracket	
449	2	Screw	
450	1	Screw	
451	1	Hexagon nut	
458	1	Washer	

*) Mounting parts: coupling (12), screws (14)

**) Diaphgram set includes additional ** marked parts

***) PH number from the ID plate is required

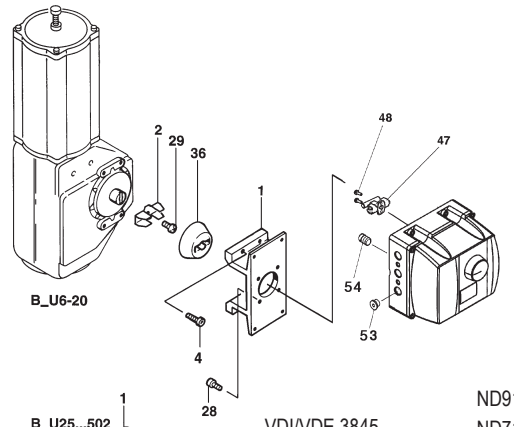
12.4 Exploded view ND9200_/D__, ND9200_/I__, ND9200_/K0_, ND9200_/B06, ND9300_/D__, ND9300_/I__, ND9300_/K0_, ND9300_/B06

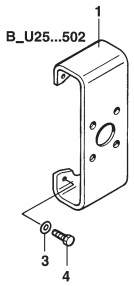


Item	Qty	Description
100	1	Cover
104	1	O-ring
107	1	Screw
109	1	Pointer
110	1	Stop screw
111	2	Spring (ND9200)
223	1	Local user interface (LUI)
300	1	Housing
301	1	O-ring
302	1	Screw
304	1	Bracket
305	2	Screw
306	1	Bracket
307	3	Screw
308	2	Screw
311	1	Extension shaft
312	2	Screw
313	2 or 4	Cam disc
314	2 or 4	Screw
315	1	Terminal block
322	1	Proximity switch
323	2	Screw
324	1	Base plate
325	2	Screw
326	1	Screw
346	1 or 2	Bushing
347	2	Proximity switch
348	1	Fixing plate
349	2	Screw
350	1	Washer
351	1	Screw
355	2 or 4	Microswitch
357	2	Spring washer
358	2	Screw

12.5 Mounting parts for B1C/B1J 6-20 actuators

ND9100, ND7100

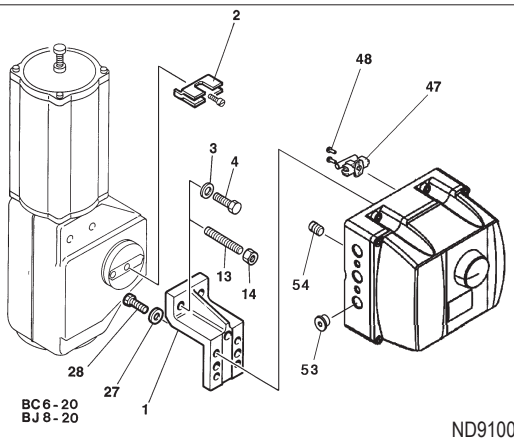




VDI/VDE 3845
attachment face

ND9100
ND7100

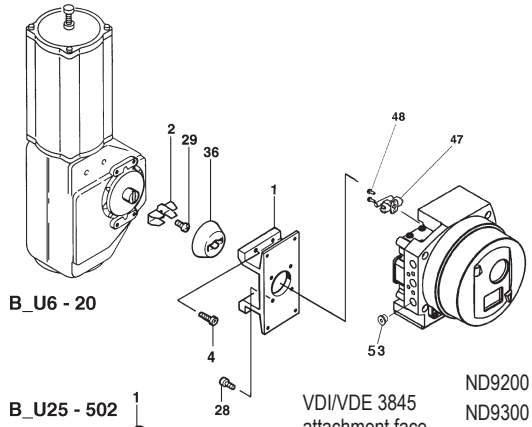
Item	Qty	Description
1	1	Mounting bracket
2	1	Ear
3	4	Washer
4	4	Screw
28	4	Screw
29	1	Screw
36	1	Couplings jacket
47	1	Coupler socket
48	2	Screw
53	1	Plug (BJ actuators only)
54	2	Plug

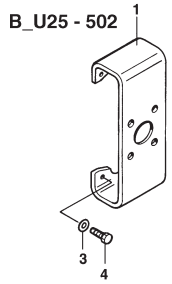


ND9100
ND7100

Neles
attachment face

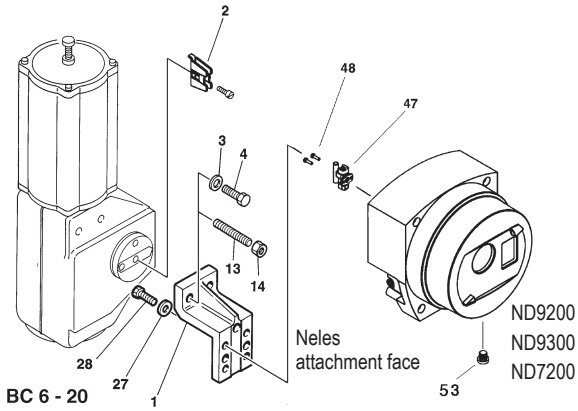
Item	Qty	Description
1	1	Mounting bracket
2	1	Draught piece
3	4	Washer
4	4	Screw
13	2	Screw
14	2	Hexagon nut
28	4	Screw
29	1	Screw
47	1	Coupler socket
48	2	Screw
53	1	Plug (BJ actuators only)
54	2	Plug





VDI/VDE 3845
attachment face

ND9200
ND9300
ND7200



Neles
attachment face

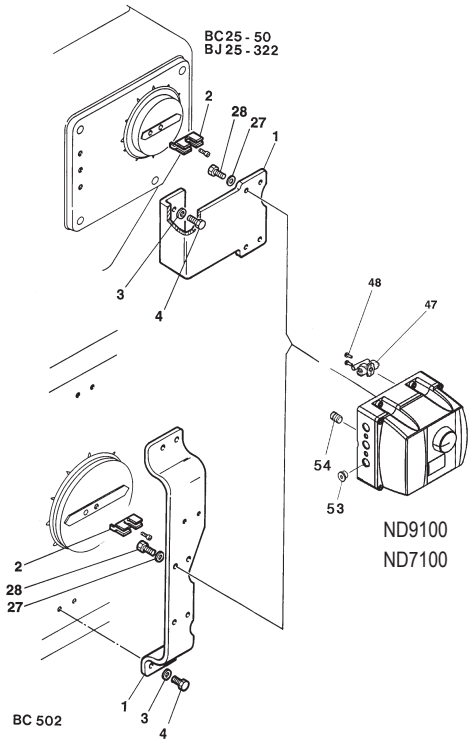
ND9200
ND9300
ND7200

Item	Qty	Description
1	1	Mounting bracket
2	1	Draught piece
3	4	Washer
4	4	Screw
13	2	Screw
14	2	Hexagon nut
28	4	Screw
29	1	Screw
47	1	Coupler socket
48	2	Screw
53	1	Plug (BJ actuators only)

Note: See 12.7 for old series B actuators

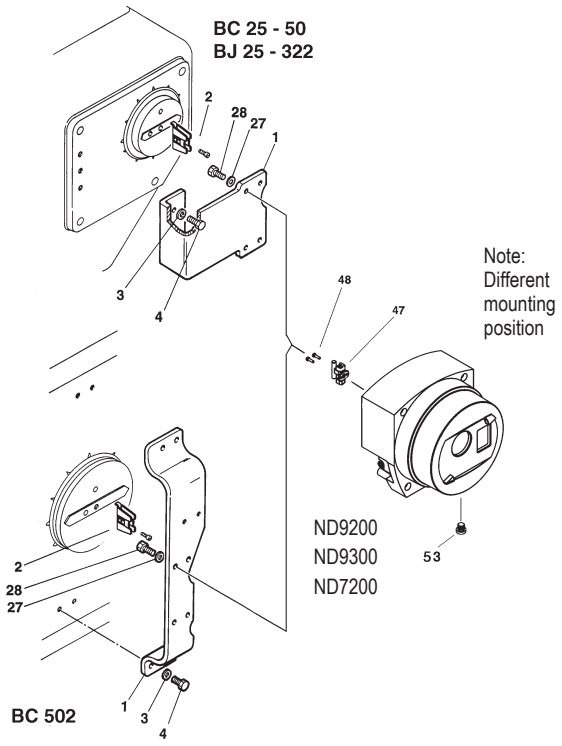
12.6 Mounting parts for B1C/B1J 25-50, B1C 502 and B1J322 actuators

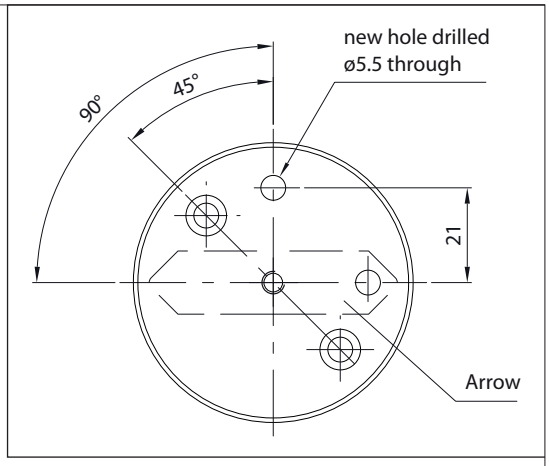
ND9100, ND7100



Item	Qty	Description
1	1	Mounting bracket
2	1	Draught piece
3	4	Washer
4	4	Screw
27	4	Washer
28	4	Screw
47	1	Coupler socket
48	2	Screw
53	1	Plug (BJ actuators only)
54	2	Plug

ND9200, ND9300, ND7200

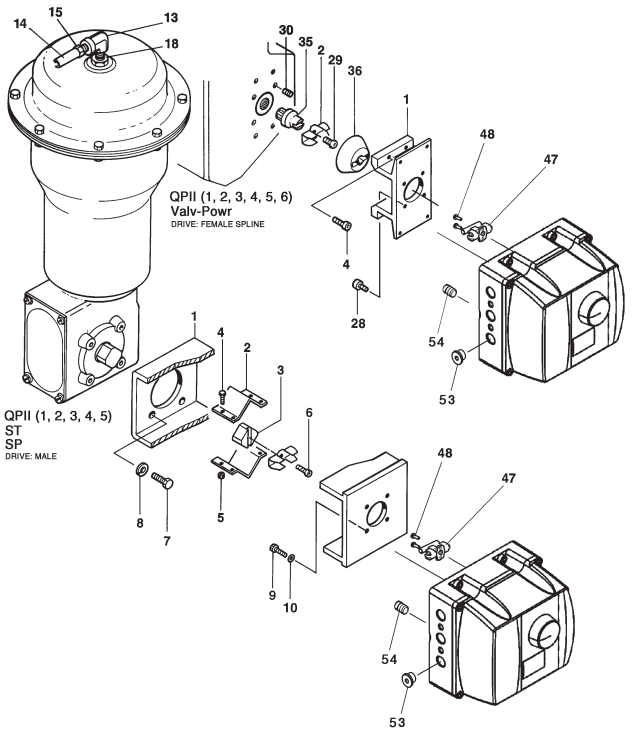




Item	Qty	Description
1	1	Mounting bracket
2	1	Draught piece
3	4	Washer
4	4	Screw
27	4	Washer
28	4	Screw
47	1	Coupler socket
48	2	Screw
53	1	Plug (BJ actuators only)

12.7 Mounting parts for Quadra-Powr® actuators

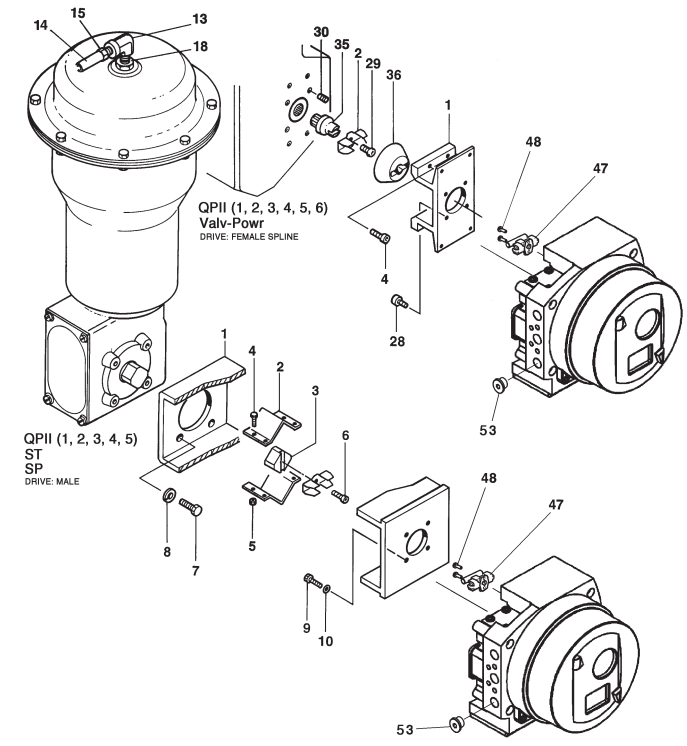
ND9100, ND7100



Item	Qty	Description
1	1	Mounting bracket
2	1	Ear
4	4	Screw
28	4	Screw
29	1	Screw
30	4	Screw
35	1	Adapter plug (QP II 1/S- 6/S only)
35	1	Adapter plate (QP II 2B/K thr. 6_/K)
36	1	Couplings jacket
47	1	Coupler socket
48	2	Screw
53	1	Plug
54	2	Plug

Item	Qty	Description
1	1	Mounting bracket
2	2	Coupling half
3	1	Adapter
4	4	Screw
5	4	Hex nut
6	1	Screw
7	4	Screw
8	4	Washer
9	4	Screw
10	4	Washer
47	1	Coupler socket
48	2	Screw
53	1	Plug
54	2	Plug

ND9200, ND9300, ND7200

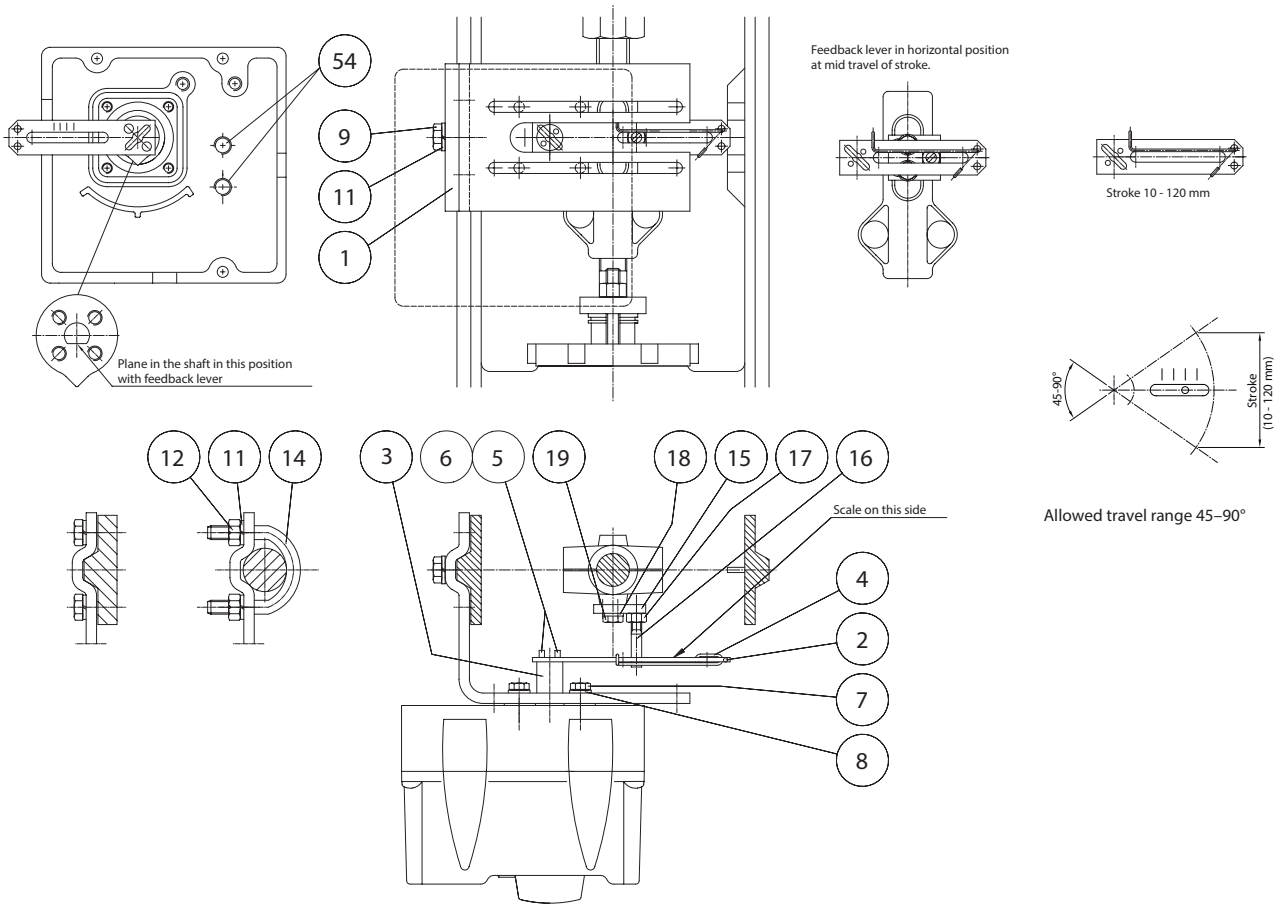


Item	Qty	Description
1	1	Mounting bracket
2	1	Ear
4	4	Screw
28	4	Screw
29	1	Screw
30	4	Screw
35	1	Adapter plug (QP II 1/S- 6/S only)
35	1	Adapter plate (QP II 2B/K thr. 6_/K)
36	1	Couplings jacket
47	1	Coupler socket
48	2	Screw
53	1	Plug

Item	Qty	Description
1	1	Mounting bracket
2	2	Coupling half
3	1	Adapter
4	4	Screw
5	4	Hex nut
6	1	Screw
7	4	Screw
8	4	Washer
9	4	Screw
10	4	Washer
47	1	Coupler socket
48	2	Screw

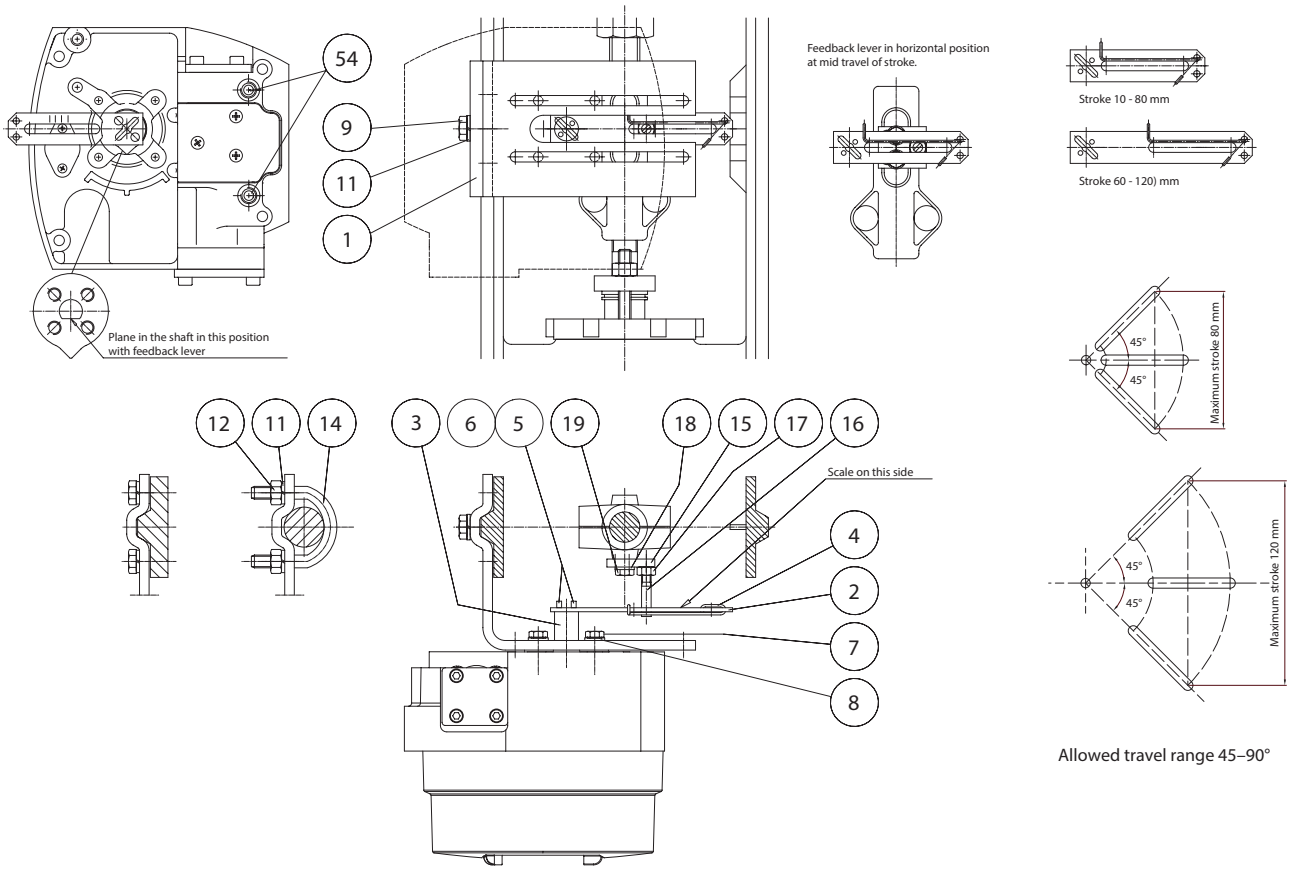
12.8 Mounting on Neles VC and VD actuators or linear actuators with IEC 60534 mounting face.

ND9100, ND7100



Item	Qty	Description
1	1	Bracket
2	1	Feedback lever
3	1	Filling piece
4	1	Clearance remove spring
5	4	Cross rec head screw
6	4	Washer
7	4	Hexagon screw
8	4	Washer
9	4	Hexagon screw
11	4	Spring washer
12	2	Hexagon nut
14	2	Clamp
15	1	Fixing plate
16	1	Special screw
17	1	Hexagon nut
18	2	Washer
19	2	Hexagon screw
54	2	Plug

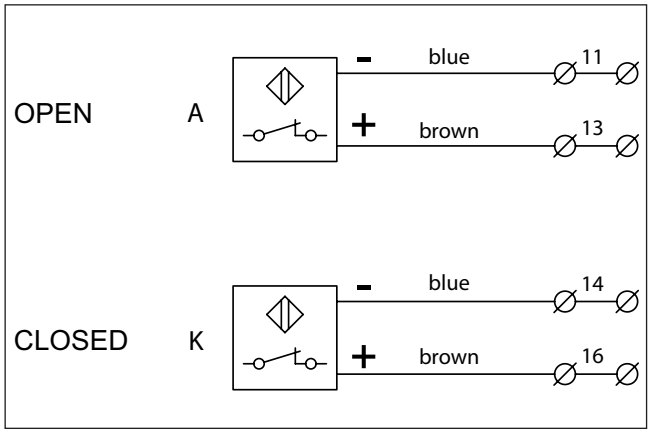
ND9200, ND9300, ND7200



Item	Qty	Description
1	1	Bracket
2	1	Feedback lever
3	1	Filling piece
4	1	Clearance remove spring
5	4	Cross rec head screw
6	4	Washer
7	4	Hexagon screw
8	4	Washer
9	4	Hexagon screw
11	4	Spring washer
12	2	Hexagon nut
14	2	Clamp
15	1	Fixing plate
16	1	Special screw
17	1	Hexagon nut
18	2	Washer
19	2	Hexagon screw
54	2	Plug

12.9 Connection diagrams

ND9000/I02, I09



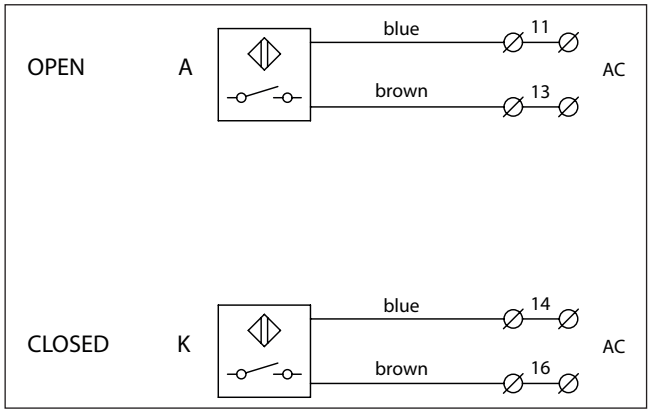
Factory adjustment

Active faces of proximity switches are covered when actuator is in intermediate position.

Active face A (upper switch) becomes free at open limit of travel and face K (lower switch) at closed limit.

Function can be inverted on site by re-adjusting the cam discs.

ND9000/I32



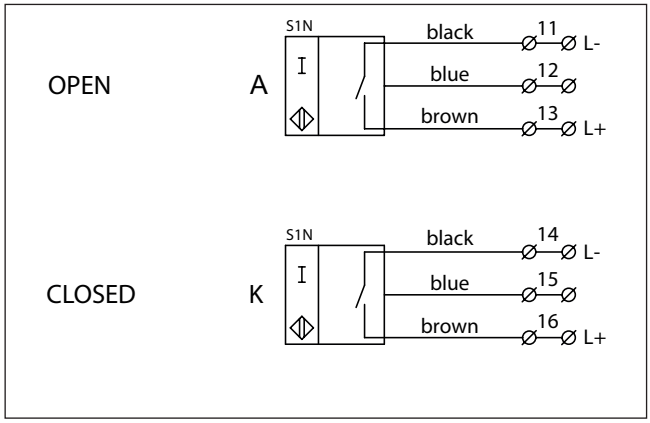
Factory adjustment

Active faces of proximity switches are free when actuator is in intermediate position.

Active face A (upper switch) becomes covered at open limit of travel and face K (lower switch) at closed limit.

Function can be inverted on site by re-adjusting the cam discs.

ND9000/I45



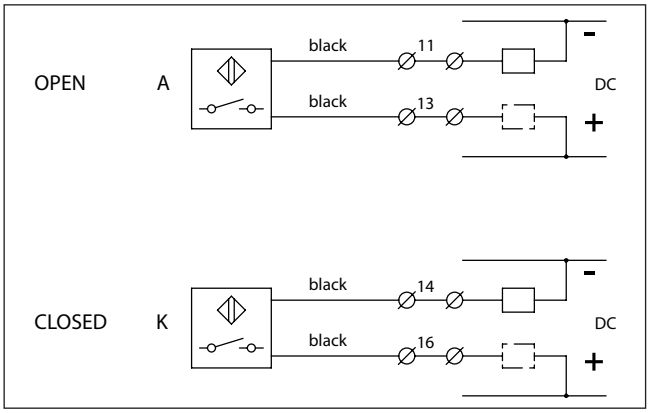
Factory adjustment

Active faces of proximity switches are covered when actuator is in intermediate position.

Active face A (upper switch) becomes free at open limit of travel and face K (lower switch) at closed limit.

Function can be inverted on site by re-adjusting the cam discs.

ND9000/I45



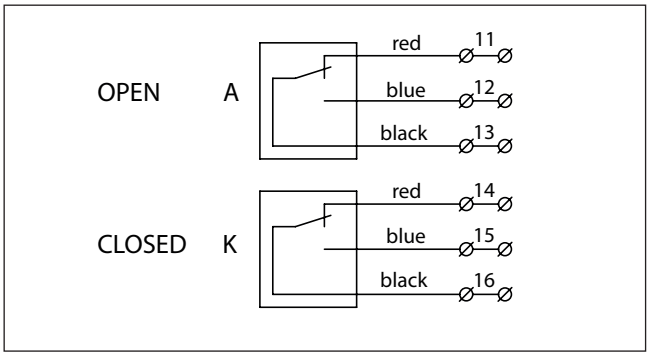
Factory adjustment

Active faces of proximity switches are free when actuator is in intermediate position.

Active face A (upper switch) becomes covered at open limit of travel and face K (lower switch) at closed limit.

Function can be inverted on site by re-adjusting the cam discs.

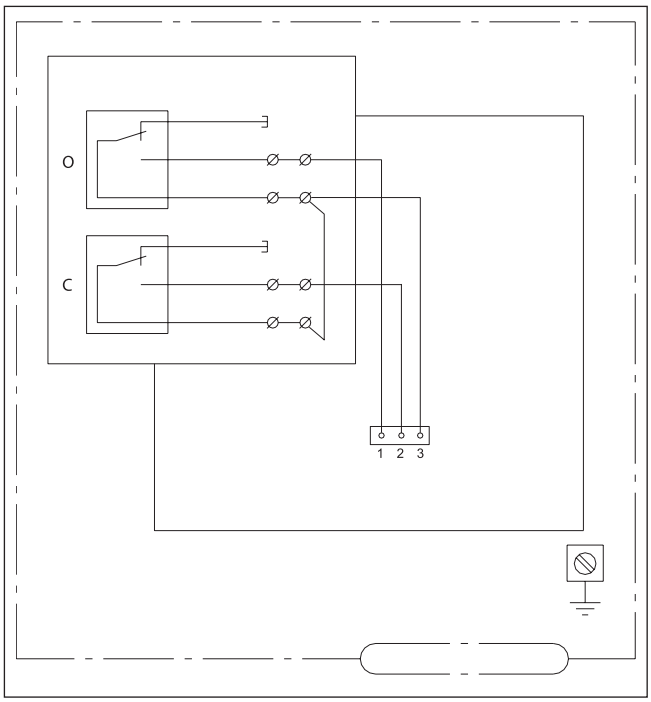
Connections: Load can be connected to + or -.**ND9000/K_**



Connection diagram shows limit switch when actuator is in intermediate position.

Switch A (upper) is activated at the open limit of the travel and switch K (lower) at the closed limit.

ND9000F/B06, ND9000P/B06



Bus powered switches, no external connections.

Microswitch

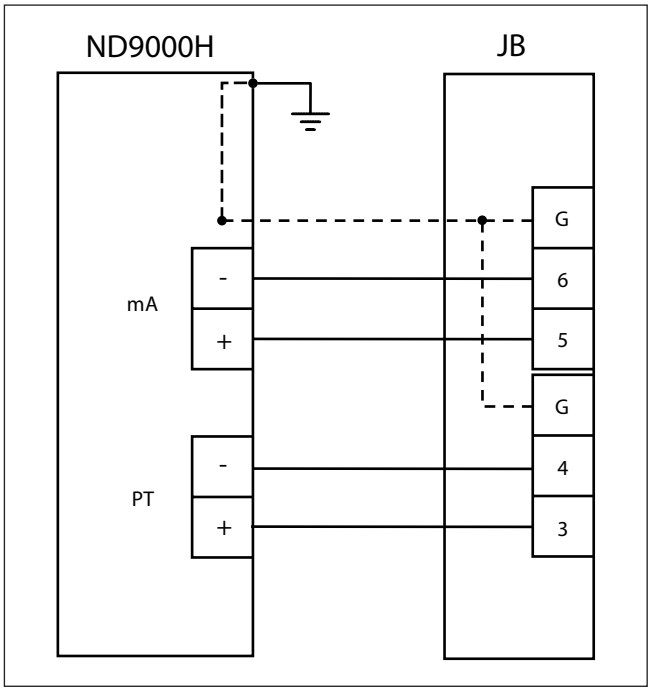
OMRON D2VW-01

Gold plated contacts

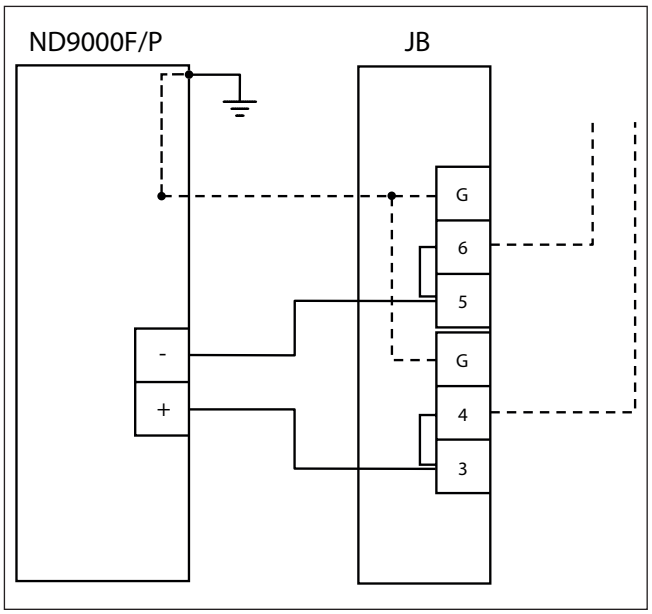
Bus Powered, no external power needed.

Temperature range: -40° to +85 °C / -40° to +185 °F.

ND9000H_J



ND9000F_J, ND9000P_J



NOTE (ND9000, ND7000):

Junction box conduit entries are M20x1.5, suitable cable glands shall be used.

NOTE (ND9000, ND7000):

When External Junction box is used, the external thread types other than metric or metric to NPT converter are not permitted as an option for cable glands in field wiring installations in the junction box. Therefore the user shall ensure than no such cable glands are installed in the enclosure entries.

NOTE (ND9000, ND7000):

All unused terminals in the junction box shall be tightened.

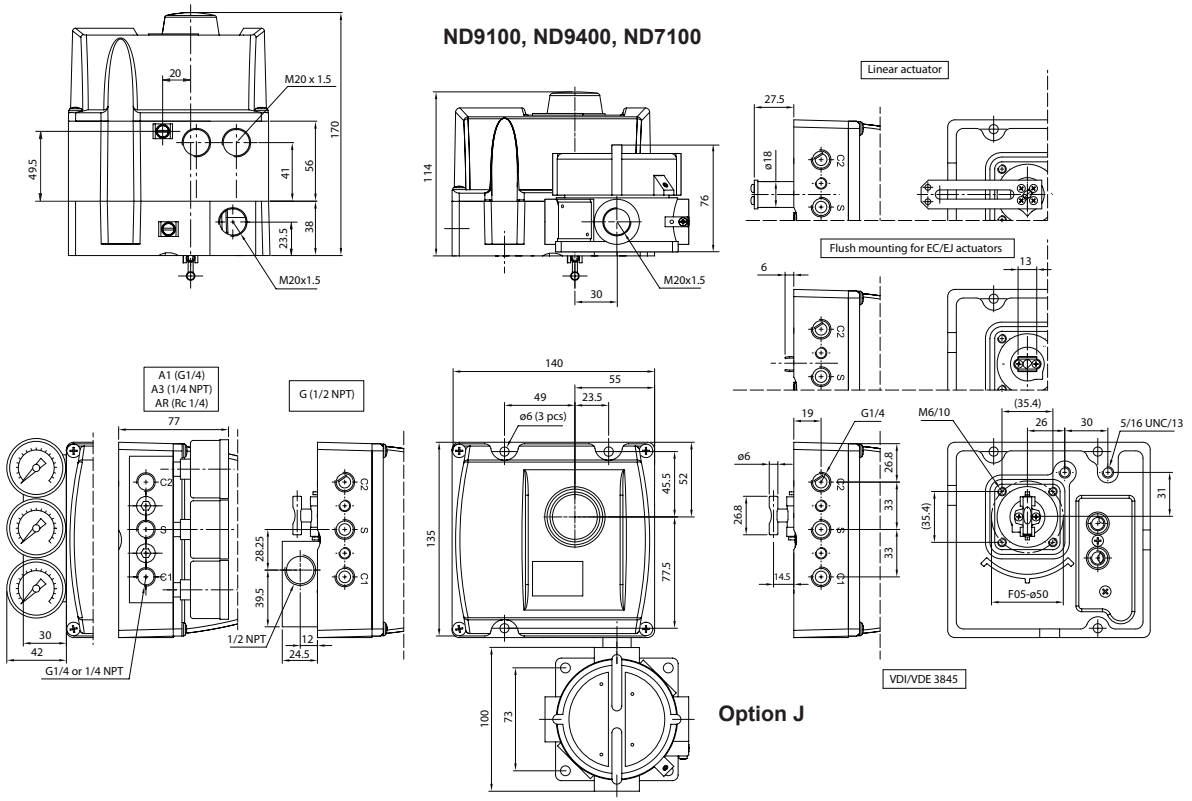
NOTE (ND9000, ND7000):

The maximum temperature at the cable entry and branching point is 80.9°C at a maximum ambient temperature of 80°C. This shall be considered for determining the cable or cable entries during installation.

13. DIMENSIONS

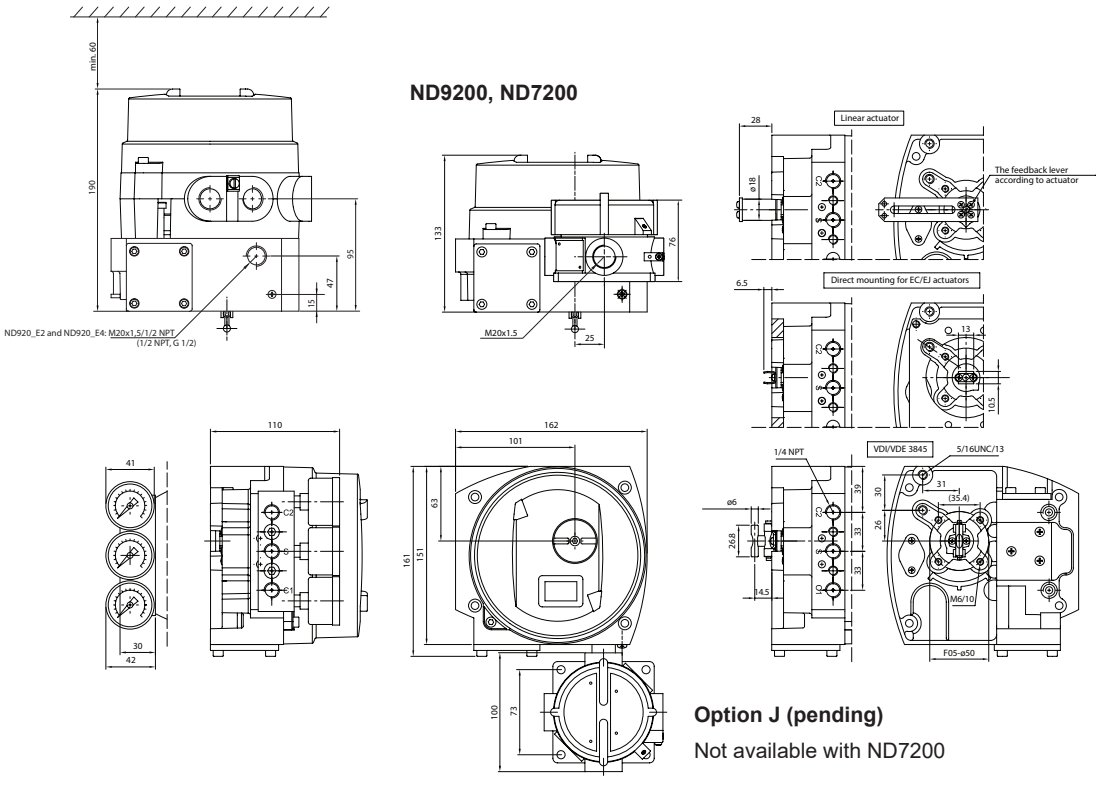
ND9100, ND9400, ND7100

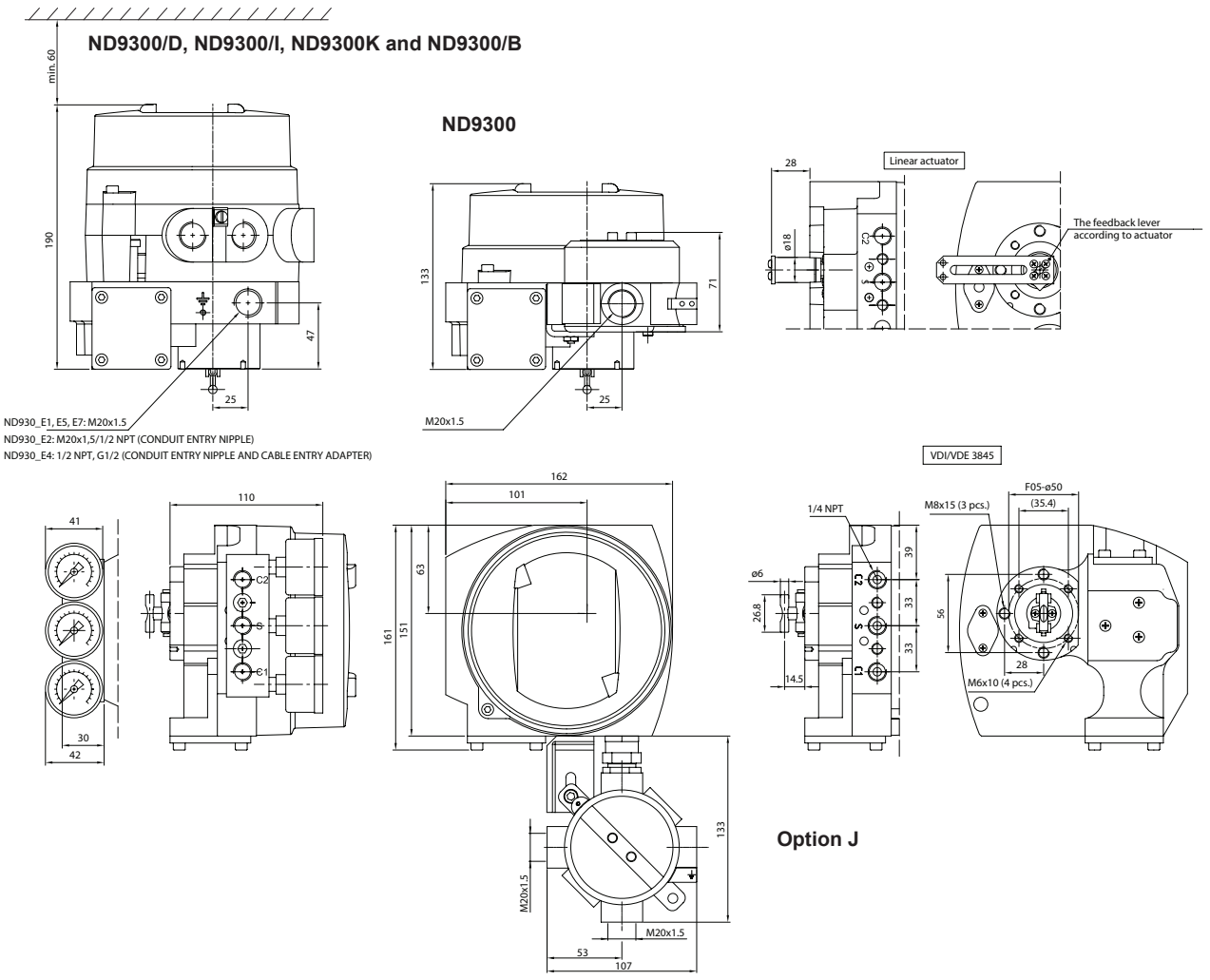
ND9100/D, ND9100/I, ND9100K and ND9100/B



ND9100, ND9400, ND7100

ND9200/D, ND9200/I, ND9200K and ND9200/B




ND9300/D, ND9300/I, ND9300K and ND9300/B
min. 60
190
47
25
ND930_E1, E5, E7: M20x1.5
ND930_E2: M20x1,5/1/2 NPT (CONDUIT ENTRY NIPPLE)
ND930_E4: 1/2 NPT, G1/2 (CONDUIT ENTRY NIPPLE AND CABLE ENTRY ADAPTER)
ND9300
133
71
25
M20x1.5
28
Linear actuator
ø18
C2
S
C1
The feedback lever
according to actuator
41
110
C2
S
C1
30
42
162
101
63
161
151
M20x1.5
133
53
107
VDI/VDE 3845
1/4 NPT
ø6
26.8
14.5
39
33
33
M8x15 (3 pcs.)
F05-ø50
(35.4)
56
28
M6x10 (4 pcs.)
Option J

14. EU DECLARATION OF CONFORMITY

EU DECLARATION OF CONFORMITY

Manufacturer:
Valmet Flow Control Oy
01301 Vantaa
Finland

Product: **Intelligent Valve Controller Neles™ ND9000™ and ND7000 series**

Approvals:

Type	Approval	EC Type examination Certificate
ND9...PA(Profibus PA) ND9...F (Foundation Fieldbus)	EMC 2014/30/EU EN 61000-6-4:2018 EN 61000-6-2 (2016)	SGS Fimko 278969-1
ND9…HNT (Hart) ND7...HNT (Hart)	EMC 2014/30/EU EN 61000-6-4:2018 EN 61000-6-2 (2016)	SGS Fimko 276525-2
ND910.HX ND910.FX ND910.PX ND920.HX ND920.FX ND920.PX ND930.HX ND930.FX ND930.PX ND710.HX	ATEX II 1 G Ex ia IIC T6...T4 Ga ATEX II 1 D Ex ta IIIC T90 °C Da ATEX II 1 D Ex ia IIIC T90...T120 °C Da ATEX II 2 G Ex ib IIC T6...T4 Gb ATEX II 2 D Ex tb IIIC T90 °C Db ATEX II 2 D Ex ib IIIC T90...T120 °C Db	EESF 19 ATEX 045X EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-31:2014
	ATEX II 3 G Ex nA IIC T6...T4 Gc ATEX II 3 D Ex tc IIIC T90 °C Dc ATEX II 3 D Ex ic IIIC T90 °C...T120 °C Dc ATEX II 3 G Ex ic IIC T6...T4 Gb ATEX II 3 D Ex tc IIIC T90 °C Dc ATEX II 3 D Ex ic IIIC T90 °C...T120 °C Dc	EESF 19 ATEX 046X EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-31:2014 EN 60079-15:2010
ND920...E1, ND930...E1 ND720...E1 ND920...E7, ND930...E7 ND720...E7	ATEX II 2 G Ex d IIC T6...T4 Gb ATEX II 2 D Ex tb IIIC T80 °C...T105 °C Db IP66	SIRA 11 ATEX 1006X EN 60079-0:2012 EN 60079-1:2007 EN 60079-31:2009

As the products within our sole responsibility of design and manufacture may be used as parts or components in machinery and are not alone performing functions as described in Article 6(2) in the Machinery Directive (2006/42/EC), we declare that our product(s) to which this Declaration of Conformity relates must NOT be put into service until the relevant machinery into which it is to be incorporated has been declared in conformity with the provisions of the Machinery Directive.

The product above is manufactured in compliance with the applicable European directives and technical specifications/standards.

Protection from e.g. static electricity caused by the process or connected equipment must be considered by the user (EN 60079-14§6).

The product do not possess any residual risk according to hazard analyses made under the applicable directives providing that the procedures stated by the Installation, Operation and Maintenance manual are followed and the product is used under conditions mentioned in the technical specifications.

Applicable directives:

EMC 2014/30/EU	Electrical
ATEX 2014/34/EU	Approved and Ex marked types

Approved bodies for EC Type Examination Certificate:
CSA (Notified body number 2813)
CSA Group Netherlands B.V.
Utrechtseweg 310,
6812 AR, Arnhem,
Netherlands

EESF (Notified body number 0537)
Eurofins Expert Services Oy
Kivimiehentie 4
FI-02150 Espoo
Finland

Approved bodies for Quality Assurance:

ISO 9001:2015	DNV-GL	73538-2010-AQ-FIN-FINAS
ATEX 2014/34/EU Annex IV	Presafe 2460	Presafe 18 ATEX 91983Q

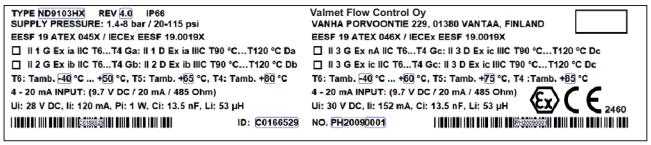
Det Norske Veritas AS (Presafe notified body number 2460)
Veritasveien 1
1322 Høvik, Oslo
Norway

Vantaa 10th March 2022

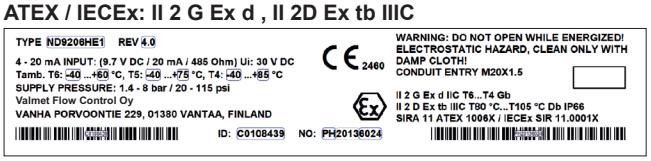
Janne Jussila, Quality Manager
Authorized person of the manufacturer within the European Community

15. ID PLATES

ATEX / IECEx: **II 1 G Ex ia, II 1 D Ex ta**
II 2 G Ex ib, II 2 D Ex tb
II 3 G Ex nA, II 3 D Ex tc
II 3 G Ex ic, II 3 D Ex tc



ATEX / IECEx: II 2 G Ex d , II 2D Ex tb IIIC



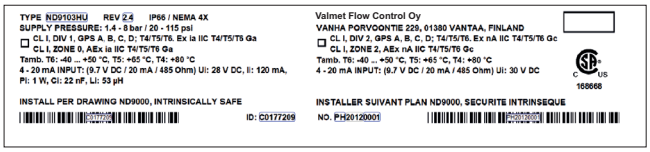
cCSAus: Explosion proof

TYPE NDa2cHE2def REV 2.3

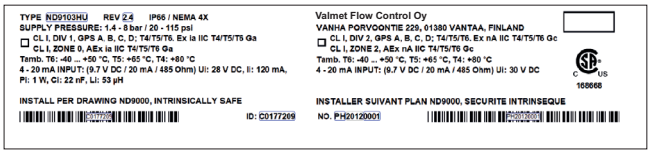
4 - 20 mA INPUT: (9.5 V DC / 20 mA / 475 Ohm) U: 30 V DC
Tamb. T6: -40 ... +60 °C, T5: -40 ... +75 °C, T4: -40 ... +85 °C
SUPPLY PRESSURE: 1.4 - 8 bar / 20 - 115 psi
CLASS I, DIV 1, GRP B, C, D; CLASS II, DIV 1, GRP E, F, G;
CLASS III; T4...T6, ENCLOSURE TYPE 4X;
Ex d IIC T4…T6, CLASS I, ZONE 1 AEx d IIC T4...T6;
Ex tb IIIC T100°C IP66, ZONE 21 AEx tb IIIC T100°C IP66
CSA 08.1980091
WARNING: A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE ENCLOSURE
ATTENTION: UN SCELLEMENT DOIT ÊTRE INSTALLÉ À MOINS DE 50 mm DU BOÎTIER
WARNING: DO NOT OPEN WHEN ENERGIZED
ATTENTION: NE PAS OUVRIR SOUS TENSION
ID: C00012345 NO: PH20190001

VALMET FLOW CONTROL OY
VANHA PORVOONTIE 229, 01380 VANTAA, FINLAND

cCSAus: Intrinsically safe



cCSAus: Non incendive



16. TYPE CODING

INTELLIGENT VALVE CONTROLLER ND9000 / LIMIT SWITCH (ND9000/D__, ND9000/I__, ND9000/K0_ or ND9000/B06)									
1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**		**8.**	**9.**
ND	9	2	03	H	E1	T	/	K05	

1.	**PRODUCT GROUP**
ND	Intelligent Valve Controller.

2.	**SERIES CODE**
9	Series 9000 Intelligent valve controller with universal shaft and attachment face according to standard VDI/VDE 3845.

3	**ENCLOSURE** **All models are IP66 / NEMA 4X enclosure**
1	Standard enclosure.
2	Flameproof (Ex d) enclosure.
3	Stainless steel flameproof (Ex d) enclosure.
4	Stainless steel housing, polymer composite cover

4.	**SPOOL VALVE**	**PNEUMATIC CONNECTIONS (S, C1, C2)**	
02	Low capacity. Stroke volume of actuator < 1 dm^3.	G 1/4 1/4 NPT	(ND91 series), (ND92,ND93 and ND94 series).
03	Medium capacity. Stroke volume of actuator 1–3 dm^3.	G 1/4 1/4 NPT	(ND91 series), (ND92,ND93 and ND94 series).
06	High capacity. Stroke volume of actuator > 3 dm^3.	G 1/4 1/4 NPT	(ND91 series), (ND92,ND93 and ND94 series).

5.	**COMMUNICATION / INPUT SIGNAL RANGE**
H	4-20 mA, HART communication. Will be delivered as HART 6, can be changed to HART 7 from LUI. Supply voltage 30 V DC. Load voltage: up to 9.7 V DC at 20 mA corresponding to 485 Ω (maximum voltage drop).
F	FOUNDATION Fieldbus, physical layer according to IEC 61158-2
P	Profibus PA, physical layer according to IEC 61158-2.

6.	**APPROVALS FOR HAZARDOUS AREAS**
N	No approvals for hazardous areas. M20 x 1.5 conduit entry. Temperature range range -40 ... +85 °C / -40 ... +185°F. Not applicable to 3. sign “2”.
N7	**No approvals for hazardous areas.** Like N, but this is with Russian language machine plate. Check details of marking from N

6.	**APPROVALS FOR HAZARDOUS AREAS**
X	**ATEX and IECEx certifications:** II 1 G Ex ia IIC T6...T4 Ga II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb II 2 D Ex tb IIIC T90 °C Db ND9_HX: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH. ND9_FX and ND9_PX: FISCO model Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Temperature range: T4: -40 – +80 °C / -40 – +176 °F; T5: < +65 °C / < +149 °F; T6: < +50 °C / < +122 °F. II 3 G Ex nA IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc ND9_HX: Ui ≤ 30 V, Ii ≤ 152 mA, ND9_FX and ND9_PX: Ui ≤ 24 V Temperature range: T4: -40 – +85°C / -40 – +185°F; T5: < +75 °C / < +167 °F; T6: < +60 °C / < +140°F. II 3 G Ex ic IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc ND9_HX: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH. ND9_FX, ND9_PX: FISCO model Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH, Temperature range: T4: -40 – +85 °C / -40 – +185 °F; T5: < +75 °C / +167 °F; T6: < +60 °C / +140 °F. M20x1.5 conduit entry Available without limit switches or with ATEX / IECEx certified inductive limit switches With limit switch temperature range marking is updated according switch type. NOTE: Dust approval: II 1 D Ex ta IIIC T90 °C Da II 2 D Ex tb IIIC T90 °C Db II 3 D Ex tc IIIC T90 °C Dc not applicable to 3. sign “4”.
X7	**TR CU (Russian) certification:** 0Ex ia IIC T6...T4 Ga X / Ex ia IIIC T95 °C...T125 °C Da X 0Ex ia IIC T6...T4 Ga X / Ex ta IIIC T95 °C...T125 °C Da X 1Ex ib IIC T6...T4 Gb X/ Ex ib IIIC T95 °C...T125 °C Db X 1Ex ib IIC T6...T4 Gb X/ Ex tb IIIC T95 °C...T125 °C Db X 2Ex nA IIC T6...T4 Gc X / Ex ic IIC T95 °C...T125 °C Dc X 2Ex nA IIC T6...T4 Gc X / Ex tc IIIC T95 °C...T125 °C Dc X 2Ex ic IIC T6...T4 Gc X/ Ex ic IIIC T95 °C...T125 °C Dc X 2Ex ic IIC T6...T4 Gc X/ Ex tc IIIC T95 °C...T125 °C Dc X Temperature range: Ta according to separate table (see certificate). Available without limit switches or with certified inductive limit switches.
X8	**CCC (Chinese) certification:** Ex ia IIC T4...T6 Ga Ex ib IIC T4...T6 Gb Ex ic IIC T4...T6 Gc T4: -40°C to +80°C; T5: -40°C to +65°C; T6: -40°C to +50°C

6.	APPROVALS FOR HAZARDOUS AREAS
U	**cCSAus certifications:** IS Class I, Division 1, Groups A, B, C and D; T4/T5/T6 Ex ia IIC T4/T5/T6 Ga IS Class I, Zone 0, AEx ia, IIC T4/T5/T6 Ga ND91_HU and ND93_HU: Class I, Division 2, Groups A, B, C, and D; T4/T5/T6 Ex nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga Class I, Zone 2 AEx nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C. Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH ND91_FU and ND93_FU: Class I, Division 2, Groups A, B, C, and D; T4/T5/T6 Ex ic IIC T4/T5/T6 Gc Class I, Zone 2 AEx ic IIC T4/T5/T6 Gc Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C. Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH No Zener Barrier needed. 1/2 NPT conduit entry. With limit switch temperature range is updated according to switch type.
Z	**INMETRO certifications:** Ex ia IIC T4/T5/T6 Ga Ex ia IIC T4/T5/T6 Gb ND91_HZ and ND93_HZ: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH. ND91_FZ and ND91_PZ, ND93_FZ and ND93_PXZ: FISCO Field Device Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Temperature range: T4: -40 to +80 °C / -40 to +176 °F; T5: < +65 °C / < +149 °F; T6: < +50 °C / < +122 °F. Ex nA IIC T4/T5/T6 Gc ND91_HZ and ND93_HZ: Ui ≤ 30 V, Ii ≤ 152 mA, ND91_FZ and ND91_PZ, ND93_FZ and ND93_PZ: Ui ≤ 24 V Temperature range: T4: -40 to +85 °C / -40 to +185 °F; T5: < +75 °C / +167 °F; T6: < +60 °C / +140 °F. Ex ic IIC T4/T5/T6 Gc ND91_HZ and ND93_HZ: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH. ND91_FZ and ND91_PZ, ND93_FZ and ND93_PZ: FISCO Field Device Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH. Temperature range: T4: -40 to +85 °C / -40 to +185 °F; T5: < +75 °C / +167 °F; T6: < +60 °C / +140 °F. Not applicable to 3. sign “2” or “4”. M20 x 1.5 conduit entry. With limit switch Temperature range marking is updated according switch type.
E1	**ATEX and IECEx certifications:** Ex d IIC T6...T4 Gb Ex tb IIIC T80 °C...T105 °C Db Temperature range: T4: -40 – +85 °C / -40 – +185°F; T5: < +75 °C / < +167 °F; T6: < +60 °C / < +140 °F. Not applicable to 3. sign “1” or “4”. M20 x 1.5 conduit entry ND92_HE1, ND93_HE1: Ui ≤ 30 V ND92_FE1, ND92_PE1, ND93_FE1 and ND93_PE1: Ui ≤32 V
E2	**cCSAus certification:** Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E,F,G; Class III; T4…T6, Enclosure type 4X Ex d IIC T4…T6 AEx d IIC T4…T6 Ex tb IIIC T100 °C IP66 AEx tb IIIC T100 °C IP66 Temperature range: T4: -40 – +85 °C / -40 – +185 °F; T5: < +75 °C / < +167 °F; T6: < +60 °C / < +140 °F. Not applicable to 3. sign “1” or “4”. 1/2 NPT conduit entry. ND92_HE2, ND93_HE2: Ui ≤ 30 V. ND92_FE2, ND92_PE2, ND93_FE2 and ND93_PE2: Ui ≤ 32 V

6.	APPROVALS FOR HAZARDOUS AREAS
E4	**TIIS (JIS) certifications:** Ex d II C T6 Temperature range: T6; -20 – +60 °C / -4 – +140 °F Applicable only to 3. sign “2” Applicable only to 5. sign “H” Not available with any limit switches (8. sign I or K) Delivered always with TIIS (JIS) approved cable gland and conduit entry nipple (accessory CG42 or CG41), see type code from Accessories for Positioners item 10: **CG42:** G 1/2 Conduit entry and Cable entry adapter **CG41:** 1/2 NPT Conduit entry and Cable entry adapter ND92_HE4: Ui ≤ 30 V
E5	**INMETRO certification:** Ex d IIC T4/T5/T6 Gb Ex tb IIIC T100 °C Db IP66 Temperature range: T4: -40 to +85 °C / -40 to +185 °F; T5: < +75 °C / < +167 °F; T6: < +60 °C / < +140 °F. Not applicable to 3. sign “1” or “4”. M20 x 1.5 conduit entry. ND92_HE5, ND93_HE5: Ui ≤ 30 V. ND92_FE5, ND92_PE5, ND93_FE5, ND93_PE5: Ui ≤ 32 V.
E7	**TR CU (Russian) certification:** 1Ex d IIC T6...T4 Gb X / Ex tb IIIC T80°C...T105°C Db X Temperature range: Ta according to separate table (see certificate). Available with or without limit switches.
E8	**CCC (Chinese) certification:** Ex d IIC T4~T6 Gb Ex tD A21 IP66 T80°C/T95°C/T105°C Available with or without limit switches.

7.	OPTIONS OF VALVE CONTROLLER
T	ND9_H_T only: Internal 2-wire (passive) position transmitter. Analog position feedback signal, output 4-20 mA, supply voltage 12 - 30 V DC,external load resistance 0 – 780 Ω. ND91_HXT, ND91_HZT, ND92_HXT, ND93_HXT, , ND93_HZT, ND94_HXT: II 1 G Ex ia IIC T6...T4 Ga II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb II 2 D Ex tb IIIC T90 °C Db Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–690 Ω. ND91_HXT, ND91_HZT, ND92_HXT, ND93_HXT, ND93_HZ, T, ND94_HXT: II 3 G Ex nA IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc Ui ≤ 30 V, Ii ≤ 152 mA II 3 G Ex ic IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH. external load resistance 0 - 780 Ω. ND91_HUT, ND92_HUT, ND94_HUT and ND93_HUT: Class I, Division 1, Groups A, B, C, and D; T4/T5/T6 Ex ia IIC T4/T5/T6 Ga Class I, Zone 0 AEx ia IIC T4/T5/T6 Ga Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–690 Ω. Class I, Division 2, Groups A, B, C, and D; T4/T5/T6 Ex nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga Class I, Zone 2 AEx nA IIC T4/T5/T6 Gc or Ex nA ia IIC T4/T5/T6 Gc Ga Ui ≤ 30 V, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–780 Ω ND92_HE1T, ND92_HE2T, ND92_HE4T, ND92_HE5T, ND93_HE1T, ND93_HE5T: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω.
P	For partial stroke test (PST). Separate button to start PST test available from accessory type code. IQI option

7.	OPTIONS OF VALVE CONTROLLER
R	Remote mounting Applicable only to 3. sign “1” Requires always external position measurement. For rotary actuator see accessories type code. Output values for: HART Uo(Voc) = 3.53V, Io(Isc) = 12.6mA, Po = 11.1 mW, Co(Ca) = 10nF, Lo(La) = 10µH. Not applicable to any internal limit switches. Not applicable to 6. sign “X” if 5. sign is F or P.
G	Exhaust adapter. ND9100: 1x 1/2 NPT thread, ND9200 and ND9300: 2x 1/2 NPT thread.
C	Arctic temperature option. Temperature range -53 – +85 °C / -64 – +185 °F Applicable to 3. sign “2” or “3” Applicable to 6. sign “X”, “X7”, “X8”, “E1, “E2”, “E7”, “E8” and “U” Not applicable to 7. sign J (External junction box) Note, Limit switch may limit the temperature range
J	ND9000_H series:: External junction box for all 4-20 mA wirings, including position transmitter, if applicable. Junction box is connected to the enclosure, 2 pcs. M20 x 1.5 conduit entry. ND91000_F and ND91000_P series: External junction box for wiring, including option for parallel connection of external surge protector. Junction box is connected to the enclosure, 2 pcs. M20 x 1.5 conduit entry. Applicable to 6. sign “N”, “X”, “X7”, “X8”, “Z”.”E1”, “E2”, “E7” or “E8”.
Y	Special construction.
Brand code or customer/project identifier. V01-V10 is reserved for branded models. V11-V99 is reserved for customer/project identifies.	
V01	Branded model for Flowrox.
V02	Branded model for SMC
V04	Branded model for TK Nucera
V11	Neste Oyj specific settings
V51	Wuhan Nai Na Si Valve and Control C Ltd
V61	Wuxi Canfu control equipment Co., Ltd
V63	Beijing Sanju group (OEM)
L1	Extension housing with additional conduit entries, 2 pcs M20x1.5. Not applicable to sign 3. “4”, sign 6. “E2” or limit switches (8. sign)
Y	Special construction which doesn’t effect to Ex issues, need to be specified.

8.	LIMIT SWITCH TYPE
	Inductive proximity switches, 2 pcs. IP 66/ NEMA 4X enclosure. M20x1.5 conduit entry (2 pcs). Option E2: 1/2 NPT conduit entry (2 pcs). Limit switches applicable only with ND9100, ND9200 and ND9300
~~D33~~	Obsolete Select R01 option instead.
~~D44~~	Obsolete Select replacement from other NAMUR switch options, e.g. I02.
I02	P+F; NJ2-12GK-SN, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NC. Temperature range: -40...+85°C / -40...+185°F Intrinsically safe according to ATEX II and IECEx. II 1 G Ex ia IIC T6. Ui < 16 V, Ii < 25 mA, Pi < 64 mW, Ci < 50 nF, Li < 150 µH, Temperature range: T4: -40° – +80°C / -40° – +176°F; T5: < +64°C / < +147°F; T6: < +50°C / < +122°F. II 2 G Ex ia IIC T6. Ui < 16 V, Ii < 52 mA, Pi < 169 mW, Ci =50 nF, Li = 150 µH, Temperature range: T4: -40° – +80°C / -40° – +176°F; T5: < +64°C / < +147°F; T6: < +50°C / < +122°F. Not applicable to 6. sign ”E4” Usable up to SIL3 acc. to IEC61508. NOTE: In safety-related applications the sensor must be operated with a qualified fail safe interface, such as P+F KFD2-SH-EX1

8.	LIMIT SWITCH TYPE
I09	P+F; NCB2-12GM35-N0, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NC. Temperature range: -25...+85°C / -13...+185°F Usable up to SIL2 acc. to IEC1508. Intrinsically safe according to ATEX and IECEx II 1 G Ex ia IIC T6. Ui < 16 V, Ii < 25 mA, Pi < 64 mW, Ci =90 nF, Li = 100 µH, Temperature range: T4: -25° – +80°C / -13° – +176°F; T5: < +65°C / < +147°F; T6: < +50°C / < +122°F. II 2 G Ex ia IIC T6. Ui < 16 V, Ii < 52 mA, Pi < 169 mW, Ci =90 nF, Li = 100 µH, Temperature range: T4: -25° – +80°C / -13° – +176°F; T5: < +65°C / < +147°F; T6: < +50°C / < +122°F. Not applicable to 6. sign ”E4”.
I32	Omron E2E-X2Y1, 2-wire type; AC; <100 mA; 24–240 V AC. Temperature range: -40° to +85 °C / -40° to +185 °F. Applicable to 6. sign “N”. Temperature range: -25° to +75 °C / -13° to +167 °F. Applicable to 6. sign “E1”, “E2”, “E5” and “E8”
I41	P+F, NJ4-12GK-SN, 2-wire, DC; > 3 mA; < 1 mA, NAMUR NC Temperature range -50 ... +85 °C /-58 ... 185 °F) Intrinsically safe according to ATEX II 1 G Ex ia IIC T6. Ui < 16 V, Ii < 25 mA, Pi < 64 mW, Ci =70 nF, Li = 150 µH, Temperature range: T4: -50° – +80°C / -58° – +176°F; T5: < +75°C / < +167°F; T6: < +60°C / < +140°F. II 2 G Ex ia IIC T6. Ui < 16 V, Ii < 52 mA, Pi < 169 mW, Ci =70 nF, Li = 150 µH, Temperature range: T4: -50° – +80°C / -58° – +176°F; T5: < +75°C / < +167°F; T6: < +60°C / < +140°F. Applicable to 6. sign ””N”, “X”, “X7”, “X8”,”U” “E1”,”E2”, “E7” or “E8”.
I45	P+F, NJ3-18GK-S1N, 3-wire, DC; > 3 mA; < 1 mA, NAMUR NO. Temperature range: -25...+85°C / -13...+185°F Intrinsically safe according to ATEX and IECEx II 1 G Ex ia IIC T6. Ui < 16 V, Ii < 25 mA, Pi < 64 mW, Ci =70 nF, Li = 200 µH, Temperature range: T4: -25° – +80°C / -13° – +176°F; T5: < +64°C / < +147°F; T6: < +50°C / < +122°F. II 2 G Ex ia IIC T6. Ui < 16 V, Ii < 52 mA, Pi < 169 mW, Ci =70 nF, Li = 200 µH, Temperature range: T4: -25° – +80°C / -13° – +176°F; T5: < +64°C / < +147°F; T6: < +50°C / < +122°F. Not applicable to 6. sign ”E4”. Usable up to SIL3 acc. to IEC61508. NOTE: In safety-related applications the sensor must be operated with a qualified fail safe interface, such as P+F KFD2-SH-EX1.
I56	ifm IFC2002-ARKG/UP, 2-wire type, DC; 150 mA, 10 - 36 V DC, leakage current < 0.6 mA. Temperature range -20 ... +80°C / -4 ... +176°F. Not applicable to 6. sign “X”, “X7”, “X8” “Z”, “U”, “E2” and “E4”.
K05	Omron D2VW-5, 3 A - 250 V AC, 0.4 A - 125 V DC, 5 A - 30 V DC. Temperature range: -40° to +85 °C / -40° to +185 °F. Not applicable to 6. sign “X”, “X7”, “Z”, “U” and “E4”.
	Mechanical micro switches, 2 pcs. IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.). Option E2: 1/2 NPT conduit entry (2 pcs.). Limit switches applicable only with ND9100, ND9200 and ND9300
K06	Omron D2VW-01, gold plated contacts, 100 mA - 30 V DC / 125 V AC. Temperature range: -40° to +85 °C / -40° to +185 °F. Not applicable to 6. sign “X”, “X7”, “Z”, “U” and “E4”.
	Bus powered mechanical micro switches, 2 pcs. Applicable to ND9000F and ND9000P only. IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.). Option E2: 1/2 NPT conduit entry (2 pcs.).
B06	Omron D2VW-01, gold plated contacts; Bus Powered, no external power needed. Temperature range: -40° to +85 °C / -40° to +185 °F. Not applicable to 5. sign “H”. Not applicable to 6. sign “E4”.
Reed or leverless type proximity switches, 2 pcs.	
R01	Valmet; Maxx-Guard G, Reed, SPDT, 300 mA, 24 VDC; 200 mA, 125 VAC Temperature range -40...+80°C / -40...+176 °F. Usable up to SIL 3 acc. to IEC61508. Applicable to 6. sign ””N”, “N7”, “E1”, “E2”, “E5”, “E7” and “E8” Mechanical micro switches, 2 pcs. IP 66/ NEMA 4X enclosure. M20x1.5 conduit entry (2 pcs). Option E2: 1/2 NPT conduit entry (2 pcs). Limit switches applicable only with ND9100, ND9200 and ND9300

8.	LIMIT SWITCH TYPE
K05	OMRON D2VW-5; 3 A – 250 V AC, 0.4 A – 125 V DC, 5 A – 30 V DC. Temperature range -40 ... +85°C / -40 ... +185°F. Not applicable to 6. sign “X”, “X7”, “X8”,”Z”, “U” and “E4”.
K06	OMRON D2VW-01; gold plated contacts, 100 mA - 30 V DC / 125 V AC. Temperature range -40 ... +85°C / -40 ... +185°F. Not applicable to 6. sign “X”, “X7”, “X8” , “Z”, “U” and “E4”.
Bus powered mechanical micro switches, 2 pcs. Applicable with ND9000F and ND9000P only. IP 66/ NEMA 4X enclosure. M20x1.5 conduit entry (2 pcs). Option E2: 1/2 NPT conduit entry (2 pcs).	
B06	OMRON D2VW-01, gold plated contacts; Bus Powered, no external power needed. Temperature range -40 ... +85°C / -40 ... +185°F. Not applicable to 5. sign “H”. Not applicable to 6. sign “E4”.
Position transmitters	
T01	SIL certified 2-wire (passive) position transmitter. Usable up to SIL2 acc. to IEC61508. Analog position feedback signal, output 4-20 mA, supply voltage 12 - 30 VDC, external load resistance 0 – 700 Ω. Potentiometer Contelec GL60, transmitter electronics Valmet. Temperature range -40 to +85 °C / -40 to +185 °F. Applicable with sign 3. “2” and “3” Not applicable to 6. sign “U”, or “E2”. Not available with limit switches.

9.	OPTIONS OF LIMIT SWITCH
Y	Special construction, to be specified.

INTELLIGENT VALVE CONTROLLER ND7000									
1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	***)**	**8.**	**9.**
ND	7	1	03	H	X	T	/	I02	

1.	**PRODUCT GROUP**
ND	Digital Valve Controller

2.	**SERIES CODE**
7	Series 7000 digital valve controller with universal shaft and attachment face according to standard VDI/VDE 3845. Relevant shaft adapter included in mounting kits. When valve positioners are separate deliveries, shaft adapter kit is supplied.

3.	**ENCLOSURE**
1	Standard IP66 / NEMA 4X enclosure
2	Flameproof (Ex d) IP66 / NEMA 4X enclosure.

4	**SPOOL VALVE**	**PNEUMATIC CONNECTIONS (S, C1, C2)**
02	Low capacity. Stroke volume of actuator < 1 dm^3.	G 1/4 (ND7100), 1/4 NPT (ND7200).
03	Medium capacity. Stroke volume of actuator 1–3 dm^3.	G 1/4 (ND7100), 1/4 NPT (ND7200).
06	High capacity. Stroke volume of actuator > 3 dm^3.	G 1/4 (ND7100), 1/4 NPT (ND7200).

5.	**COMMUNICATION / INPUT SIGNAL RANGE**
H	4–20 mA, HART communication. Supply voltage 30 V DC. Load voltage: up to 9.7 V DC at 20 mA corresponding to 485 Ω (maximum voltage drop).

6.	**APPROVALS FOR HAZARDOUS AREAS**
N	No approvals for hazardous areas. M20 x1.5 conduit entry. Temperature range -40° to +85 °C.
N7	No approvals for hazardous areas. Like N, but this is with Russian language machine plate. Check details of marking from N
X	**ATEX and IECEx certifications:** II 1 G Ex ia IIC T6...T4 Ga II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb II 2 D Ex tb IIIC T90 °C Db II 1 D Ex ia IIIC T90 °C...T120 °C Da II 2 D Ex ib IIIC T90 °C...T120 °C Db Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C. II 3 G Ex nA IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc II 3 G Ex ic IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc II 3 D Ex ic IIIC T90 °C...T120 °C Dc Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C. M20 x 1.5 conduit entry.
X7	**TR CU (Russian) certification:** 0Ex ia IIC T6...T4 Ga X / Ex ia IIIC T95 °C...T125 °C Da X 0Ex ia IIC T6...T4 Ga X / Ex ta IIIC T95 °C...T125 °C Da X 1Ex ib IIC T6...T4 Gb X/ Ex ib IIIC T95 °C...T125 °C Db X 1Ex ib IIC T6...T4 Gb X/ Ex tb IIIC T95 °C...T125 °C Db X 2Ex nA IIC T6...T4 Gc X / Ex ic IIIC T95 °C...T125 °C Dc X 2Ex nA IIC T6...T4 Gc X / Ex tc IIIC T95 °C...T125 °C Dc X 2Ex ic IIC T6...T4 Gc X/ Ex ic IIIC T95 °C...T125 °C Dc X 2Ex ic IIC T6...T4 Gc X/ Ex tc IIIC T95 °C...T125 °C Dc X Temperature range: Ta according to separate table (see certificate). Available without limit switches or with certified inductive limit switches.
X8	**CCC (Chinese) certification:** Pending for approval
Z	**INMETRO certifications:** Ex ia IIC T4/T5/T6 Ga Ex ia IIC T4/T5/T6 Gb Ex nA IIC T4/T5/T6 Gc Ex ic IIC T4/T5/T6 Gc M20 x 1.5 conduit entry.

6.	**APPROVALS FOR HAZARDOUS AREAS**
E1	**ATEX and IECEx certifications:** II 2 G Ex d IIC T6...T4 Gb II 2 D Ex tb IIIC T80 °C...T105 °C Db IP66 Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C. Not applicable to 3. sign “1”. M20 x 1.5 conduit entry.
E4	**Japanese Ex-d Certification:** II 2 G Ex d IICT6 Gb II 2 D Ex tb IICT80°C Db Temperature range: T6: < +60 °C. Not applicable to 3. sign “1” or “4”. Delivered always with IECEx approved cable gland and conduit entry nipple (accessory CG43 or CG44), please select correct type from Accessories for Positioners item 10: CG43: 1/2 NPT Conduit entry and Cable entry adapter. CG44: G 1/2 Conduit entry and Cable entry adapter.
E5	**INMETRO certifications (pending):** Ex d IIC T4/T5/T6 Gb Ex tb IIIC T100 °C Db IP66 Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C. Not applicable to 3. sign “1” M20 x 1.5 conduit entry.
E7	**TR CU (Russian) certification:** 1Ex d IIC T6...T4 Gb X / Ex tb IIIC T80°C...T105°C Db X Temperature range: Ta according to separate table (see certificate). Available with or without limit switches.
E8	**CCC (Chinese) certification:** Pending for approval

7.	**OPTIONS OF VALVE CONTROLLER**
T	Internal 2-wire (passive) position transmitter. Analog position feedback signal, output 4–20 mA, supply voltage 12–30 V DC, external load resistance 0–780 Ω. ND7_HXT, ND7_HZT: II 1 G Ex ia IIC T6...T4 Ga II 1 D Ex ta IIIC T90 °C Da II 2 G Ex ib IIC T6...T4 Gb II 2 D Ex tb IIIC T90 °C Db Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 13.5 nF, Li ≤ 53 µH, external load resistance 0–690 Ω. ND7_HXT, ND7_HZT: II 3 G Ex nA IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc Ui ≤ 30 V, Ii ≤ 152 mA II 3 G Ex ic IIC T6...T4 Gc II 3 D Ex tc IIIC T90 °C Dc Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 13.5 nF, Li ≤ 53 µH, external load resistance 0–780 Ω.
R	Remote mounting Applicable only to 3. sign “1” Requires always external position measurement. For rotary actuator see accessories type code. Output values for: HART Uo(Voc) = 3.53V, Io(Isc) = 12.6mA, Po = 11.1 mW, Co(Ca) = 10nF, Lo(La) = 10µH. FOUNDATION fieldbus and Profibus Uo(Voc) = 5.0V, Io(Isc) = 17.8mA, Po = 22.2mW, Co(Ca) = 10nF, Lo(La) = 10µH.
C	Arctic temperature option. Temperature range -53° to +85 °C / -64° to +185 °F Applicable to 3. sign “2 and 3” Applicable to 6. sign “X”,”X7”, “E1 and “E7” Not applicable to 7. sign J (External junction box) Note, Limit switch may limit the temperature range

8.	LIMIT SWITCS TYPE
	Inductive proximity switches, 2 pcs. IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.). Option E2: 1/2 NPT conduit entry (2 pcs.).
I02	P+F; NJ2-12GK-SN, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NC. Temperature range: -40 °C to +85 °C / -40 °F to +185 °F. Not applicable to 6. sign “E4”. Usable up to SIL3 acc. to IEC61508 NOTE: In safety-related applications the sensor must be operated with a qualified fail safe interface, such as P+F KFD2-SH-EX1.
I41	P+F, NJ4-12GK-SN, 2-wire, DC; > 3 mA; < 1 mA, NAMUR NC Temperature range -50° to +85 °C /-58° to 185 °F) Applicable to 6. sign “N”, “N7”, “X”, “X7”, “U”, “E1”, “E2” or “E7”. Note that device may limit temperature range.
	Mechanical micro switches, 2 pcs. IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.). Option E2: 1/2 NPT conduit entry (2 pcs.). Temperature range: -40° to +85 °C / -40° to +185 °F.
K05	Omron D2VW-5, 3 A - 250 V AC, 0.4 A - 125 V DC, 5 A - 30 V DC. Temperature range: -40° to +85 °C / -40° to +185 °F. Not applicable to 6. sign “X”, “X7”, “Z”, “U” and “E4”.

ADDITIONAL ACCESSORIES

FILTER REGULATOR	
KS	Filter regulator for supply air. Filter size 5 µm. Pressure gauge, scale bar/psi/kPa and kg/cm^2, basic material brass, nickel plated, housing stainless steel, glycerine filled. Temperature range -40° to +82 °C / -40° to +180 °F. KS option includes a thread nipple 1/4”NPT to 1/4”NPT between filter regulator and positioner which is suitable with ND7200 positioner options A3 and A5 (1/4NPT AIR CONNECTION). Supply air connector in the filter regulator is female 1/4”.
K1S	Filter regulator for supply air. Filter size 5 µm. Pressure gauge, scale bar/psi/kPa and kg/cm^2, basic material brass, nickel plated, housing stainless steel, glycerine filled. Temperature range -40° to +82 °C / -40° to +180 °F. K1S option includes a thread nipple 1/4”NPT to G1/4” between filter regulator and positioner which is suitable with ND9100 and ND9400 positioner and with option A1 (G1/4 AIR CONNECTION). Supply air connector in the filter regulator is female 1/4”.
K2	Stainless steel (AISI 316) filter regulator for supply air. Filter size 5 µm. Pressure gauge, scale bar/psi/kpa/kg/cm^2 ,silicone oil, AISI 316, Temperature range -40° to +80 °C / -40° to +176 °F.

CONDUIT ENTRY NIPPLES	
CE07	1/2 NPT conduit entry nipples M20x1,5 / 1/2 NPT (ND9100 and ND9400)
CE08	R1/2 (PF1/2) conduit entry nipples M20x1,5 / R1/2 (ND9100 and ND9400)
CE09	1/2 NPT conduit entry nipples Brass M20x1,5 / 1/2 NPT, Exd approved (ND9200)
CE19	1/2 NPT conduit entry nipples Stainless Steel M20x1.5 / 1/2 NPT, Exd approved (ND 9300)

CABLE GLANDS	
	Not to be used together with conduit entry nipples (CE_) or connection plugs (P_).
CG5	M20x1.5 grey/plastic, IP66
CG6	M20x1.5 blue/plastic, IP66, Ex e
CG43	Conduit entry and cable entry adapter for ND9200, ND7200 and ND9300 M20 (M) x 1/2NPT (F) SS316 ExdIIC ExdbIIC Gb, IP66
CG44	Conduit entry and cable entry adapter for ND9200, ND7200 and ND9300 M20 (M) x G1/2 (F) SS316 ExdIIC ExdbIIC Gb, IP66

PRESSURE GAUGES AND CONNECTION BLOCKS	
A1	Pressure gauges, scale bar/psi/kPa and kg/cm^2, basic material brass, nickel plated, housing stainless steel, oil filled. Temperature range -40° to +85 °C / -40° to +185 °F. Pneumatic connection block, material AlMgSi1, anodized grey. Connections G1/4 (S, C1, C2).
A1B	As A1 but includes two pressure gauges with connections G1/4 (S, C2). Use with in single acting use only.
A3	Pressure gauges, scale bar/psi/kPa and kg/cm2, basic material brass, nickel plated, housing stainless steel, oil filled. Temperature range -40° to +85 °C / -40° to +185 °F. Pneumatic connection block, material AlMgSi1, anodized grey. Connections 1/4 NPT (S, C1, C2), converts also ND91_ connections to 1/4 NPT.
A3B	As A3 but two pressure gauges with connections 1/4 NPT (S, C2). Converts also ND91_ connections to 1/4 NPT.Use with in single acting use only.
A5	Pneumatic connection block, converts ND91_ connections to 1/4 NPT. Material AlMgSi1, anodized grey. Connections 1/4 NPT (S, C1, C2). Only for ND9100.
A6	Pressure gauges with connections G1/4. Material AISI 316.
A7	Pressure gauges with connections 1/4 NPT. Material AISI 316.
A10	Pressure gauges with connections 1/4 NPT for ND9300 or ND9400 AISI 316, pressure gauges for severe off-shore use, safety glass window.
D3	Non oil filled, dry pressure gauges, scale bar/psi/kPa and kg/cm2, basic material brass, nickel plated, housing stainless steel. Temperature range -40° to +85 °C / -40° to +185 °F. Pneumatic connection block, material AlMgSi1, anodized grey. Connections 1/4 NPT (S, C1, C2), converts also ND91_ connections to1/4 NPT.
D3B	As D3 but two pressure gauges with connections 1/4 NPT (S, C2). Converts also ND91_ connections to 1/4 NPT.Use with in single acting use only.

CONNECTION PLUGS	
	Not to be used together with conduit entry nipples (CE_) or cableglands (CG_).
P1H	ND9000H (HART): Connection plug according to M20x1.5 / DIN 43650A (ISO 4400). Not applicable with 5.sign “F” and “P”.
P4H	Valve controller and limit switch with connection plugs (1 + 1 pc) ND9000 (HART): M20x1.5 / DIN 43650A (ISO 4400). ND9000/K00 or 2 wire ND9100/I00. Not applicable with 5.sign “F” and “P”.
P2F	ND9000F and ND9000F/B06 (FOUNDATION fieldbus): Connection plug male eurofast, Turck FSV49, M20x1.5 / M12. Not applicable with 5.sign “H” and “P”.
P3F	ND9000F and ND9000F/B06 (FOUNDATION fieldbus): Connection plug male minifast, Turck RSFV49, M20x1.5 / 7/8”. Not applicable with 5.sign “H” and “P”.
P2P	ND9000P and ND9000P/B06 (Profibus PA): Connection plug male, Weidmuller 842593, M20x1.5 / M12. Not applicable with 5.sign “H” and “F”.
P3P	ND9000P and ND9000P/B06 (Profibus PA): Connection plug male minifast, Turck RSFV48, M20x1.5 / 7/8”. Not applicable with 5.sign “H” and “F”.

DRIVER SETS	
	Driver sets including the needed parts when assembling ND9000 on rotary actuators with VDI/VDE 3845 attachment face or Neles standard mounting faces. Select the correct driver set according to the actuator and the pneumatic connections of valve controller or gauge block when applicable. Note! Earlier the DS04 was delivered with bareshaft positioners as default. This practice is no longer valid, the needed driver set must be ordered as an accessory.
DS01	Driver set for ND9100 on actuators with VDI/VDE3845 attachment face. Set includes the G1/4 plug for single acting actuators. The driver set should also be applied with all ND7/9 with gauge blocks A1, A1B, A2 or A6.
DS02	Driver set for ND92/93/94 on actuators with VDI/VDE 3845 attachment face. Set includes the 1/4NPT plug for single acting actuators. The driver set should also be applied with all ND with gauge blocks A3, A3B, A5, A7 or A10.
DS04	General driver set for ND91/92/94/93 on actuators with VDI/VDE 3845 and Neles standard attachment face (e.g. when replacing NE/NP7 or ND800 with S2 shaft). Earlier default driver set. Includes 1/4NPT and G1/4 plugs when used with single acting actuators.

3RD PARTY MOUNTING SETS	
	Mounting sets between the ND9000 generation valve controllers and linear actuators, including bracket and ball joint based feedback system. Note! Sets are including the 1/4" pneumatic plugs needed when used with single acting actuators.
MS01	Mounting set for linear actuators, attachment face according to IEC 60534-6, stroke length 10-55 mm. (H116240)
MS02	Mounting set for linear actuators, attachment face according to IEC 60534-6, stroke length 55-120 mm. (H120404)
MS03	Mounting set for Masoneilan 87/88 actuators, sizes 6...23. Stroke length 12-64 mm. (H120809)

Remote mounting accessories		
	ID code	**Descpition**
RR01	C0217108	ND remote mount rotary sensor QNCOK05HDM
RR02	C0215954	ND remote mount rotary sensor QNCAK05HDM
RC01	H144183	Cable assembly remote mount sensor cable 1.2 m, straight connector
RC02	H126145	Cable assembly remote mount sensor cable 3.0 m, angle connector
RC03	H127093	Cable assembly remote mount sensor cable 30 m, angle connector

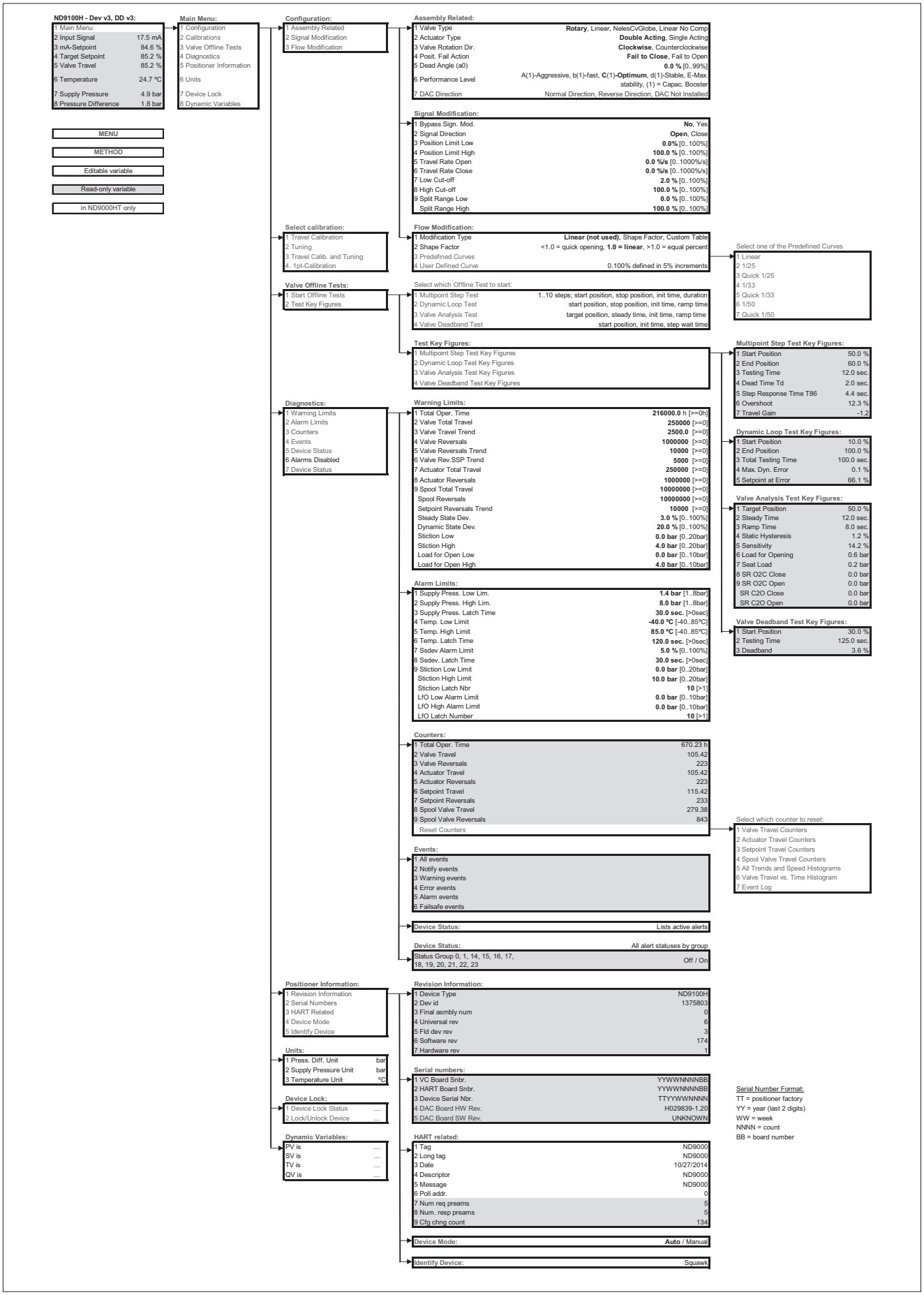


Fig. 51. ND9000H 0303 Menu Tree

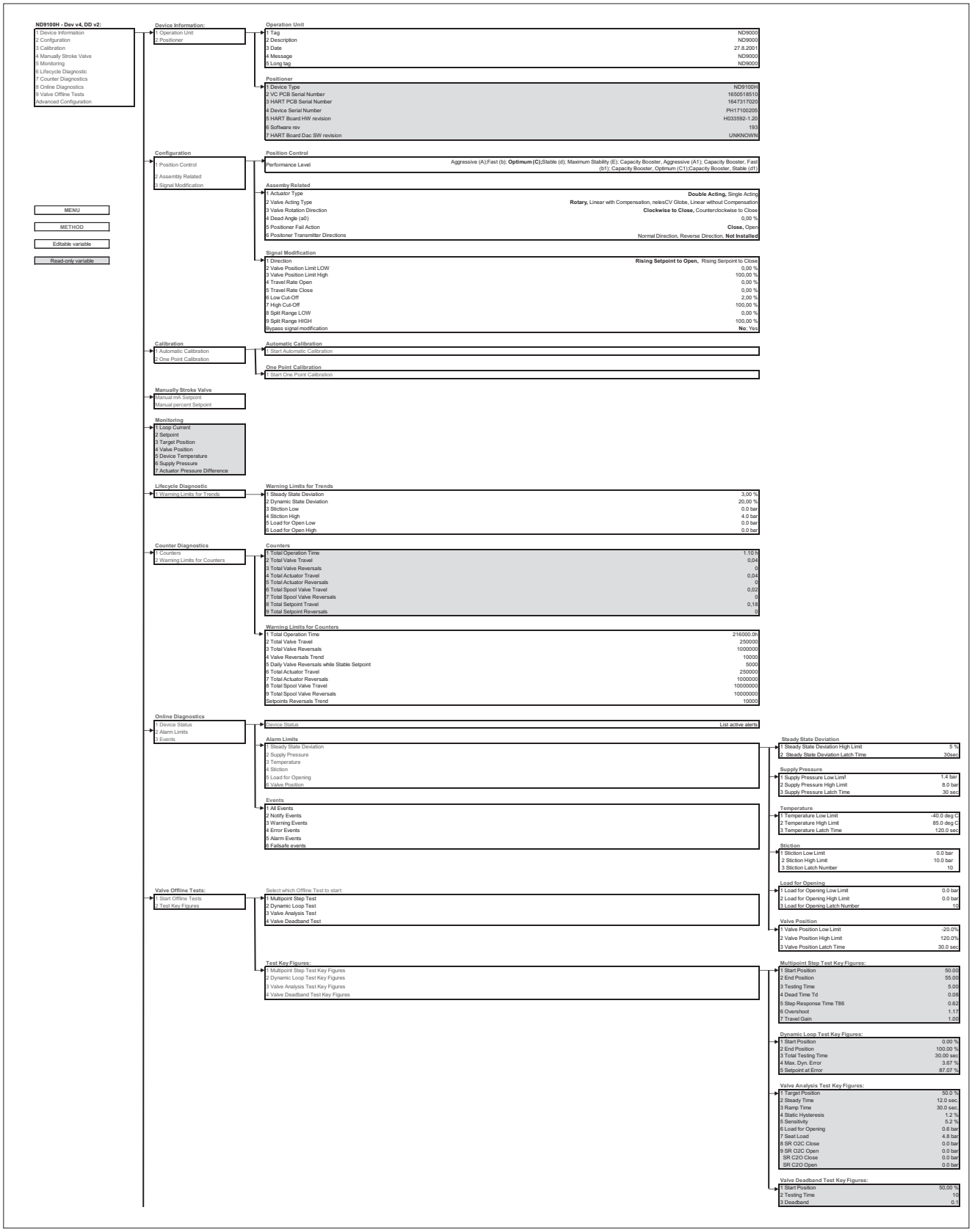


Fig. 52. ND9000H 0402 Menu Tree

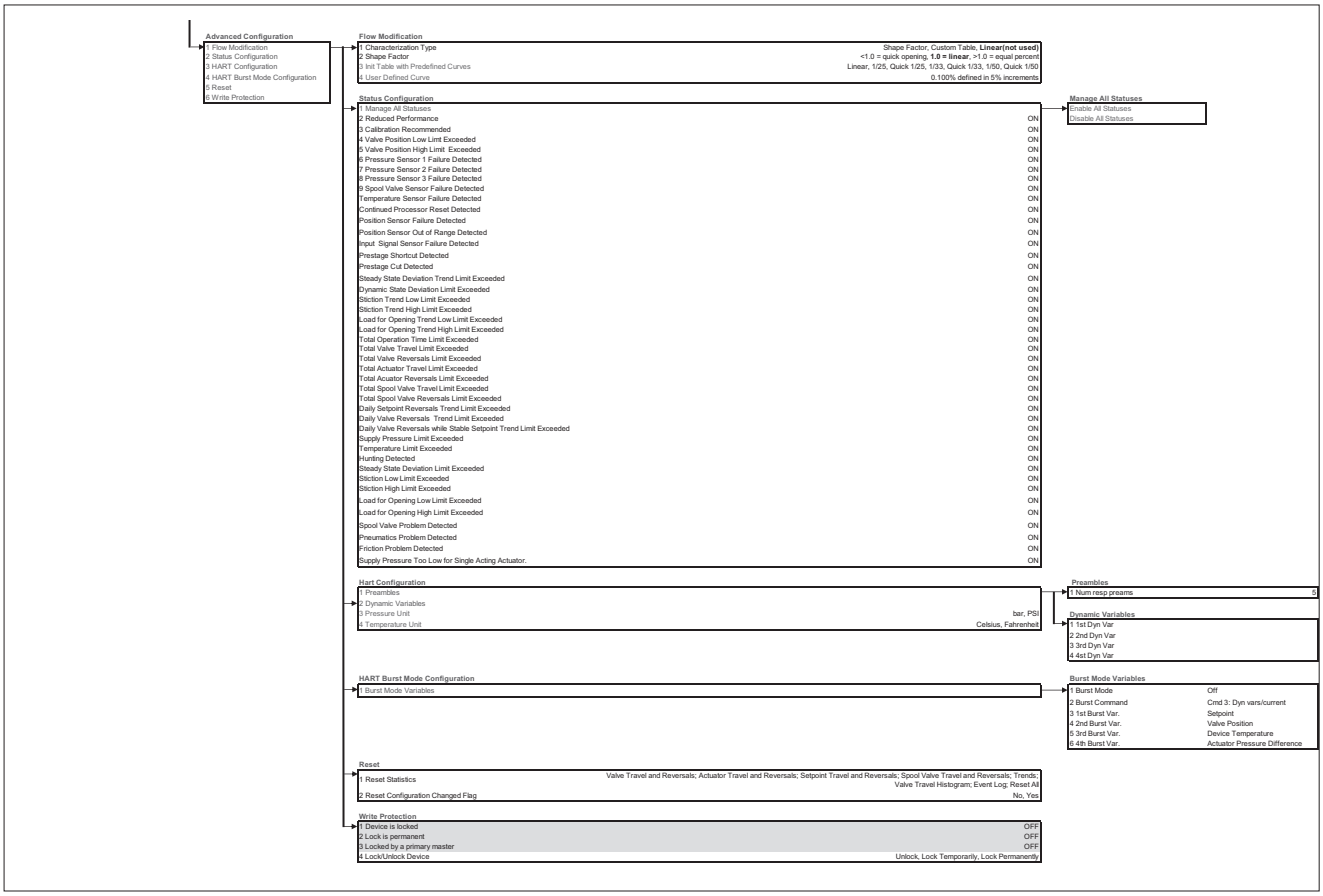


Fig. 53. ND9000H 0402 Menu Tree

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