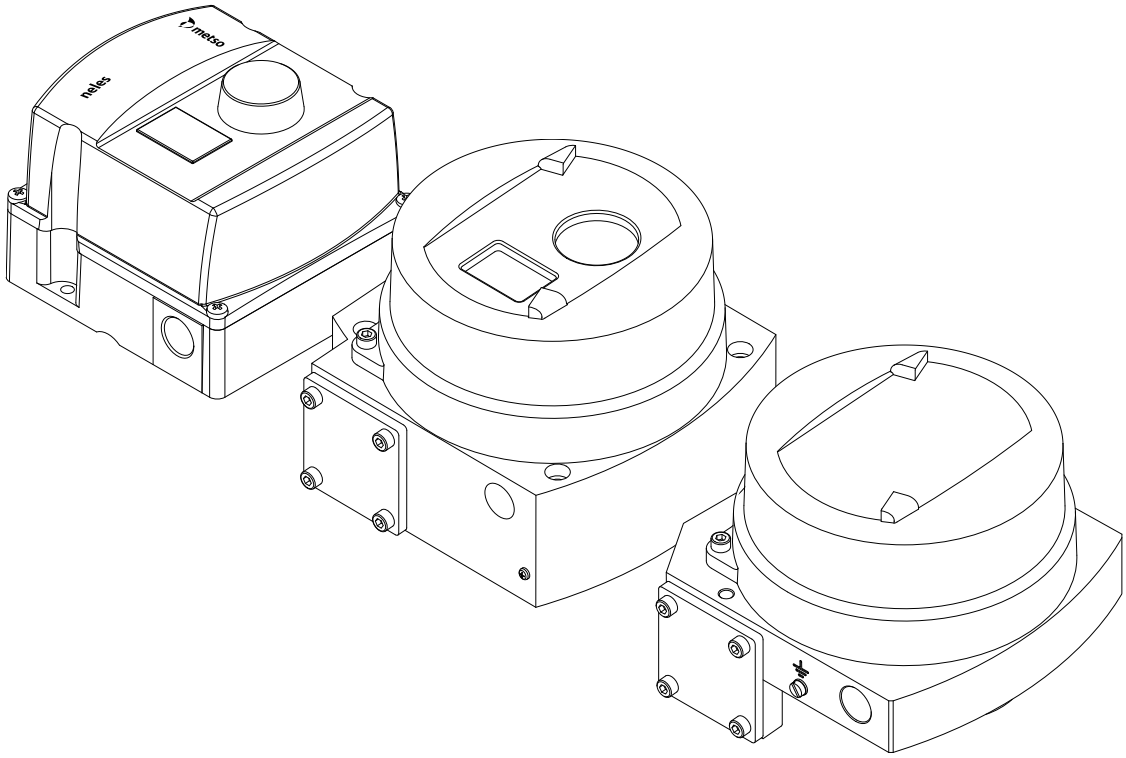
neles

# INTELLIGENT VALVE CONTROLLER

## ND7000H
## ND9000H, ND9000F, ND9000P
## Rev. 2.4

Installation, Maintenance and Operating Instructions




metso
Expect results

7 ND90 71 en • 7/2013

## Table of Contents



**READ THESE INSTRUCTIONS FIRST!**
These instructions provide information about the safe handling and operation of the intelligent valve controller.
If you require additional assistance, please contact the manufacturer or manufacturer's representative. Addresses and phone numbers are printed on the back cover.
See also www.metso.com/valves for the latest documentation.
**SAVE THESE INSTRUCTIONS!**

# 1 PRODUCT FAMILY SUMMARY

## 1.1 ND9000

### 1.1.1 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
  - ❑ Dynamic Diagnostics Diamond

### 1.1.2 Options

- ❑ Interchangeable communication options:
  - ❑ HART (H)
  - ❑ FOUNDATION fieldbus (F)
  - ❑ Profibus PA (P)
- ❑ Limit switches
- ❑ Position transmitter (in HART only)
- ❑ Special corrosion resistant finish
- ❑ Exhaust adapter

### 1.1.3 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 (Neles or 3rd party)

### 1.1.4 Minimised process variability

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

### 1.1.5 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 FieldCare software in a remote location (H, F)
  - ❑ using Profibus configurator, such as Fieldcare or Simatic PDM (P)
- ❑ 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

### 1.1.6 Open solution

Metso 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.metso.com/valves

### 1.1.7 ND9000 in fieldbus networks

- ❑ Approved interoperability
  - ❑ Host interoperability ensured
  - ❑ FOUNDATION fieldbus ITK version 5.0.1 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-off control 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

### 1.1.8 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

### 1.1.9 Predictive maintenance

- ❑ Easy access to collected data with FieldCare software
  - ❑ Ingenious Valve Diamond to visualise control valve performance and diagnostics
  - ❑ 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

### 1.2.1 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

### 1.2.2 Total cost of ownership

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

### 1.2.3 Minimised process variability

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

### 1.2.4 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 FieldCare software in a remote location (H)
- ❑ 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

### 1.2.5 Open solution

Metso 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.metso.com/valves

### 1.2.6 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 Metso 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 Metso's Automation business 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.

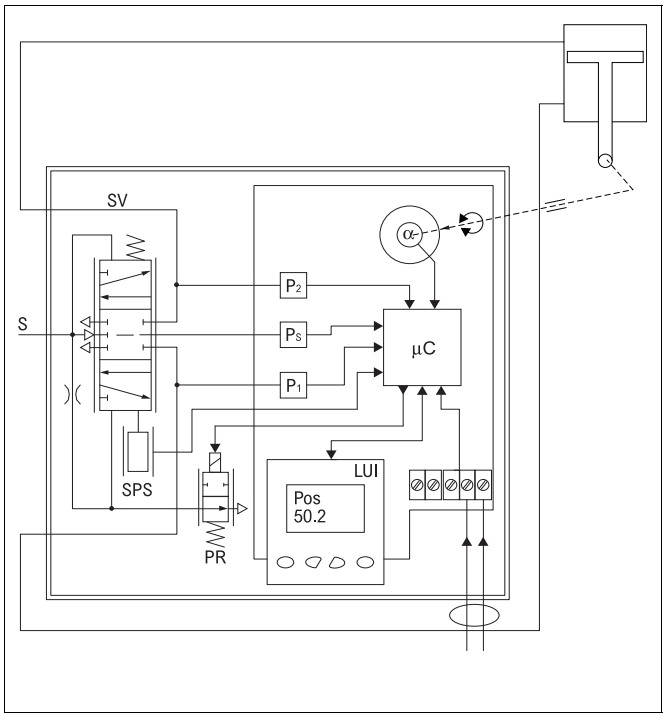



*Fig. 1 The principle of operation*

## 2.3 Markings

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

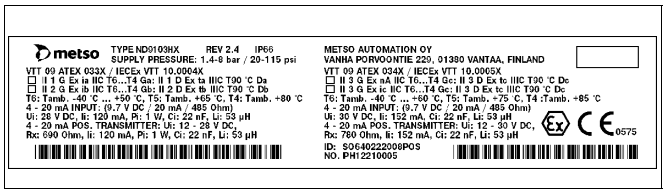



*Fig. 2 Example of the identification plate*

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.

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.

Flush mounting on nelesCV™ control valves (not ND9300).

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

**Environmental Influence**

Standard temperature range:
-40° to +85 °C / -40° to +185 °F

Influence of temperature on valve position:
< 0.5 % / 10 °C

Influence of vibration on valve position:
< 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 connection: max 2.5 $mm^2$

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 connection: max. 2.5 $mm^2$

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**

Material: Full stainless steel enclosure

Protection class: IP66, NEMA 4X

Pneumatic ports: 1/4 NPT

Electrical connection: max. 2.5 $mm^2$

Cable gland thread: M20 x 1.5 / 1/2 NPT (U and E2)

Weight: 8.6 kg / 19.0 lb
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 5
(3–5 µm filtration is recommended)
Humidity: Class 1
(dew point 10 °C / 18 °F below minimum temperature is recommended)
Oil class: 3 (or <1 ppm)

Capacity with 4 bar / 60 psi supply:
5.5 $Nm^3/h$ / 3.3 scfm (spool valve 2)
12 $Nm^3/h$ / 7.1 scfm (spool valve 3)
38 $Nm^3/h$ / 22.4 scfm (spool valve 6)

Consumption with 4 bar / 60 psi supply
in steady state position:
< 0.6 $Nm^3/h$ / 0.35 scfm (spool valves 2 & 3)
< 1.0 $Nm^3/h$ / 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: 9–32 V DC, reverse polarity protection

Max basic current: 17.2 mA

Fault current (FDE): 3.9 mA

**FOUNDATION fieldbus function block execution times**
**ND9000F**

| | |
|---|---|
| AO | 20 ms |
| PID | 25 ms |
| DO | 15 ms |
| DI | 15 ms |
| IS | 15 ms |
| OS | 20 ms |

**Performance with moderate constant-load actuators EC05-EC10 in ambient temperature**

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

Dead band acc. to IEC 61514:
≤ 0.1 %

Hysteresis acc. to IEC 61514:
< 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
- ❑ Valve type, rotary/linear IEC/nelesCV Globe/FLI
- ❑ Language selection: English, German and French

**Electromagnetic protection**

Electromagnetic compatibility
Emission acc. to EN 61000-6-4 (2007)
and FCC 47 CFR PART 15,
SUBPART B, CLASS B (1994)
Immunity acc. to EN 61000-6-2 (2005)

**CE marking**

89/336/EEC
Electromagnetic compatibility

94/9/EC
ATEX (when applicable)

## Approvals

*Table 1 Approvals and electrical values, HART*

| Certificate | Approval | Electrical values |
|---|---|---|
| **ATEX** | | |
| **ND_X**<br>VTT 09 ATEX 033X<br>VTT 09 ATEX 034X<br><br>EN 60079-0: 2012<br>EN 60079-11: 2012<br>EN 60079-26: 2007<br>EN 60079-31: 2009 | II 1G Ex ia IIC T6...T4 Ga<br>II 1D Ex ta IIIC T90 °C Da<br>II 2 G Ex ib IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T90 °C Db | Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH.<br>Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH,<br>external load resistance 0–690 Ω |
| EN 60079-0: 2012<br>EN 60079-11: 2012<br>EN 60079-15: 2010<br>EN 60079-31: 2009 | II 3 G Ex nA IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc | Input: Ui ≤ 30 V, Ii ≤ 152 mA<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA |
| | II 3 G Ex ic IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc | Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH.<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF,<br>Li ≤ 53 µH, external load resistance 0–780 Ω |
| **ND_E1**<br>SIRA 11 ATEX 1006X<br><br>EN 60079-0:2012<br>EN 60079-1:2007<br>EN 60079-31:2009 | II 2 G Ex d IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T80 °C...T105 °C Db | Input: Ui ≤ 30 V<br>Output: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω |
| **IECEx** | | |
| **ND_X**<br>IECEx VTT 10.0004X<br>IECEx VTT 10.0005X<br><br>IEC 60079-0: 2007/2011<br>IEC 60079-11: 2011<br>IEC 60079-26: 2006<br>IEC 60079-31: 2008 | Ex ia IIC T6...T4 Ga<br>Ex ta IIIC T90 °C Da<br>Ex ib IIC T6...T4 Gb<br>Ex tb IIIC T90 °C Db | Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH<br>Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH,<br>external load resistance 0–690 Ω |
| IEC 60079-0: 2007/2011<br>IEC 60079-11: 2011<br>IEC 60079-15: 2010,<br>IEC 60079-31: 2008 | Ex nA IIC T6...T4 Gc<br>Ex tc IIIC T90 °C Dc | Input: Ui ≤ 30 V, Ii ≤ 152 mA<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA |
| | Ex ic IIC T6...T4 Gc<br>Ex tc IIIC T90 °C Dc | Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF,<br>Li ≤ 53 µH, external load resistance 0–780 Ω |
| **ND_E1**<br>IECEx SIR 11.0001X<br><br>IEC 60079-0:2011<br>IEC 60079-1:2007<br>IEC 60079-31:2008 | Ex d IIC T6...T4 Gb<br>Ex tb IIIC T80 °C...T105 °C Db | Input: Ui ≤ 30 V<br>Output: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω |
| **INMETRO** | | |
| **ND_Z**<br>NCC 12.0793 X<br>NCC 12.0794 X<br><br>ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-11:2009<br>ABNT NBR IEC 60079-26:2008 (2009)<br>ABNT NBR IEC 60079-27:2010 | Ex ia IIC T4/T5/T6 Ga<br>Ex ia IIC T4/T5/T6 Gb | Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH<br>Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH,<br>external load resistance 0–690 Ω. |
| ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-11:2009<br>IEC 60079-15:2010<br>ABNT NBR IEC 60079-27:2010<br>ABNT NBR IEC 60529:2009 | Ex nA IIC T4/T5/T6 Gc | Input: Ui ≤ 30 V, Ii ≤ 152 mA<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA |
| | Ex ic IIC T4/T5/T6 Gc | Input: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH.<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH,<br>external load resistance 0–780 Ω. |
| **ND_E5**<br>NCC 12.0795 X<br><br>ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-1:2009 (2011)<br>ABNT NBR IEC 60079-31:2011<br>ABNT NBR IEC 60529:2009 | Ex d IIC T4/T5/T6 Gb<br>Ex tb IIIC T100 °C Db IP66 | Input: Ui ≤ 30 V<br>Output: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω |
| **cCSAus** | | |
| **ND_U**<br>Pending | IS Class I, Division 1, Groups A, B, C, D, T4...T6<br>IS Class I, Zone 0, AEx ia, IIC T4...T6 | Input: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH<br>Output: Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH,<br>external load resistance 0–690 Ω. |
| | NI Class I, Division 2, Groups A, B, C, D, T4...T6<br>NI Class I, Zone 2, Ex nA IIC T4...T6. | Input: Ui ≤ 30 V, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH<br>Output: Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF,<br>Li ≤ 53 µH, external load resistance 0–780 Ω. |
| **ND_E2**<br>1980091 | Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E,F,G; Class III; T4…T6, Enclosure type 4X<br>Ex d IIC T4…T6<br>AEx d IIC T4…T6<br>Ex tb IIIC T100 °C IP66<br>AEx tb IIIC T100 °C IP66 | Input: Ui ≤ 30 V<br>Output: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω |
| **TIIS (JIS)** | | |
| **ND_E4** | Ex d II C T6 | Input: Ui ≤ 30 V<br>Output: Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω. |

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

| Certificate | Approval | Electrical values |
|---|---|---|
| **ATEX** | | |
| **ND_X**<br>VTT 09 ATEX 033X<br>VTT 09 ATEX 034X<br><br>EN 60079-0: 2012<br>EN 60079-11: 2012<br>EN 60079-26: 2007<br>EN 60079-31: 2009 | II 1G Ex ia IIC T6...T4 Ga<br>II 1D Ex ta IIIC T90 °C Da<br>II 2 G Ex ib IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T90 °C Db | Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| EN 60079-0: 2012<br>EN 60079-11: 2012<br>EN 60079-15: 2010<br>EN 60079-31: 2009 | II 3 G Ex nA IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc | Ui ≤ 24 V |
| | II 3 G Ex ic IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc | Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| **ND_E1**<br>SIRA 11 ATEX 1006X<br><br>EN 60079-0:2012<br>EN 60079-1:2007<br>EN 60079-31:2009 | II 2 G Ex d IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T80 °C...T105 °C Db | Ui ≤ 32 V |
| **IECEx** | | |
| **ND_X**<br>IECEx VTT 10.0004X<br>IECEx VTT 10.0005X<br><br>IEC 60079-0: 2007/2011<br>IEC 60079-11: 2011<br>IEC 60079-26: 2006<br>IEC 60079-31: 2008 | Ex ia IIC T6...T4 Ga<br>Ex ta IIIC T90 °C Da<br>Ex ib IIC T6...T4 Gb<br>Ex tb IIIC T90 °C Db | Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| IEC 60079-0: 2007/2011<br>IEC 60079-11: 2011<br>IEC 60079-15: 2010,<br>IEC 60079-31: 2008 | Ex nA IIC T6...T4 Gc<br>Ex tc IIIC T90 °C Dc | Ui ≤ 24 V |
| | Ex ic IIC T6...T4 Gc<br>Ex tc IIIC T90 °C Dc | Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| **ND_E1**<br>IECEx SIR 11.0001X<br><br>IEC 60079-0:2011<br>IEC 60079-1:2007<br>IEC 60079-31:2008 | Ex d IIC T6...T4 Gb<br>Ex tb IIIC T80 °C...T105 °C Db | Ui ≤ 32 V |
| **INMETRO** | | |
| **ND_Z**<br>NCC 12.0793 X<br>NCC 12.0794 X<br><br>ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-11:2009<br>ABNT NBR IEC 60079-26:2008 (2009)<br>ABNT NBR IEC 60079-27:2010 | Ex ia IIC T4/T5/T6 Ga<br>Ex ia IIC T4/T5/T6 Gb | Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-11:2009<br>IEC 60079-15:2010<br>ABNT NBR IEC 60079-27:2010<br>ABNT NBR IEC 60529:2009 | Ex nA IIC T4/T5/T6 Gc | Ui ≤ 24 V |
| | Ex ic IIC T4/T5/T6 Gc | Ui ≤ 32 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH.<br>Comply with the requirements for FISCO field device |
| **ND_E5**<br>NCC 12.0795 X<br><br>ABNT NBR IEC 60079-0:2008 (2011)<br>ABNT NBR IEC 60079-1:2009 (2011)<br>ABNT NBR IEC 60079-31:2011<br>ABNT NBR IEC 60529:2009 | Ex d IIC T4/T5/T6 Gb<br>Ex tb IIIC T100 °C Db IP66 | Ui ≤ 32 V |
| **cCSAus** | | |
| **ND_U**<br>Pending | IS Class I, Division 1, Groups A, B, C, D, T4...T6<br>IS Class I, Zone 0, AEx ia, IIC T4...T6 | Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH |
| | NI Class I, Division 2, Groups A, B, C, D, T4...T6.<br>NI Class I, Zone 2, Ex nA IIC T4...T6. | Ui ≤ 24 V, Ii ≤ 380 mA, Pi ≤ 5.32 W, Ci ≤ 5 nF, Li ≤ 10 µH |
| **ND_E2**<br>1980091 | Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E, F, G; Class III; T4…T6, Enclosure type 4X<br>Ex d IIC T4…T6<br>AEx d IIC T4…T6<br>Ex tb IIIC T100 °C IP66<br>AEx tb IIIC T100 °C IP66 | Ui ≤ 32 V |

**Optional parts**

**ND9100H, ND9300H, ND7100H and ND7200H 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<br>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 |
| Code D44 | Namur Sensor Dual Module |
| Code I02 | P+F NJ2-12GK-SN |
| Code I09 | P+F NCB2-12GM35-N0 |
| Code I32 | Omron E2E-X2Y1 |
| 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, ND7100, ND9300):**
**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, ND7100, ND9300):**
**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, ND7100, ND9300):**
**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, ND7100, ND9300):**
**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.

# 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

The controller is equipped with the Metso flush mounting face (not ND9300), the old Neles mounting face and for connection according to VDI/VDE 3845.

Shaft coupling alternatives for the controller for Metso actuators are shown in Fig. 6.

For mounting parts for Metso actuators, see 12.5–12.10.

## 4.2 Mounting on EC and EJ actuators

See figure in Section 12.5.

**ND9100, ND7100**

- ❑ Mount the U-shaped coupling (47) to the shaft. Apply thread-locking compound to the screws (48) and tighten firmly.
- ❑ Remove all protective plastic plugs (5 pcs.) from all pneumatic connections. Mount the metal plugs (53) to the unused controller connections with sealant.
  For EJ (single acting, spring to close) and EJA (single acting, spring to open) actuators, mount a metal plug (54) with sealant to the C1 connection at the bottom of the controller.
- ❑ Mount the O-rings (38, 2 pcs.) into the air connections in the bottom of the controller.
- ❑ Mount the O-ring (49) into the square groove in the bottom of the controller.
- ❑ Place the valve controller on top of the actuator so that the pointer of the shaft washer (16) is located in the position shown in Fig. 3.
- ❑ Fasten the screws (4).

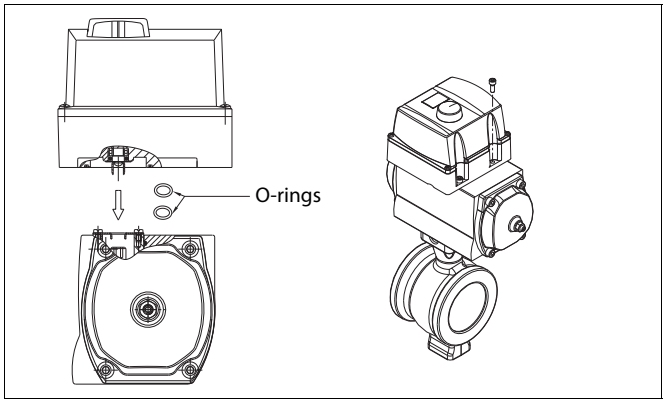



*Fig. 3 Mounting on EC and EJ actuators, ND9100 and ND7100*

**ND9200, ND7200**

- ❑ Mount the U-shaped coupling (47) to the shaft. Apply thread-locking compound to the screws (48) and tighten firmly.
- ❑ Remove the protective plastic plugs from pneumatic connections C2, S and C1. Mount the metal plugs (53) to the unused controller connections with sealant.
  For EC (double acting) actuators, remove the metal plugs (54, 2 pcs) from the connections at the bottom of the controller.
  For EJ (single acting, spring to close) and EJA (single acting, spring to open) actuators, leave the metal plug (54) in the C1 connection at the bottom of the controller and remove the metal plug from the C2 connection at the bottom.
- ❑ Mount the O-rings (38, 4 pcs.) into the air connections in the bottom of the controller and the mounting plate (64).
- ❑ Install the mounting plate (64) on the actuator as shown in 12.5.
- ❑ Place the valve controller on top of the actuator so that the pointer is located in the position shown in Fig. 4.
- ❑ Fasten the screws (4).

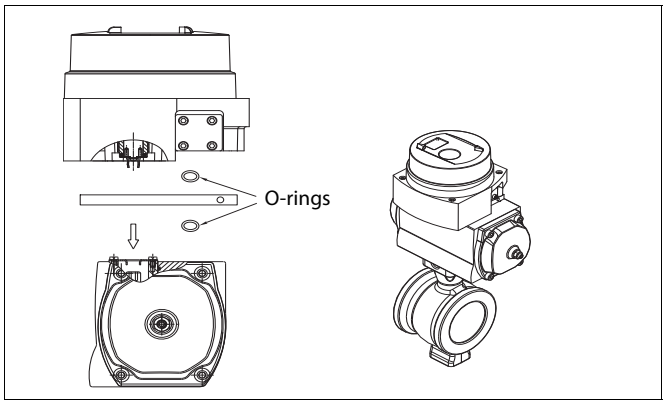



*Fig. 4 Mounting on EC and EJ actuators, ND9200 and ND7200*

## 4.3 Mounting on Metso actuators with VDI/VDE mounting face

See figures in Section 12.6–12.7.

**ND9100, 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 12.6-12.7. 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. 5.

**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 12.6-12.7. 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. 5.

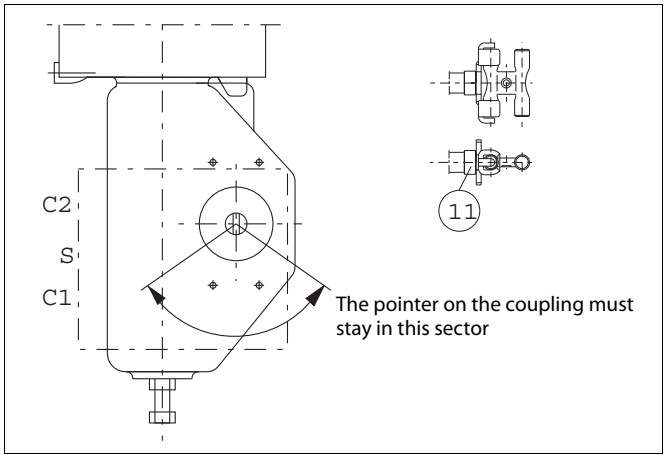



*Fig. 5 Mounting on Metso actuator with VDI/VDE mounting face*

## 4.4 Mounting on linear actuator of nelesCV Globe

See figure in Section 12.9

**ND9100, ND7100**

- ❑ Attach the J-shaped feedback lever (47) to the valve controller shaft. Apply the thread-locking compound to the screws and tighten firmly.
- ❑ Remove all plastic plugs from all actuator connections (5 pcs.). Mount the metal plugs (53) to the unused controller connections with sealant.
- ❑ Mount the metal plug (54) with sealant to the connection C1 at the bottom of the controller and mount the O-rings (38, 2 pcs.) to the connections.
- ❑ Attach the mounting plate (39) to the valve controller with screws (28).
- ❑ Mount the the conical plug (16) to the lever and select the position on the scale according to the valve stroke.
- ❑ Install the O-ring (31) to the actuator. Place the conical plug into the frame on the stem and tighten the screws (4).

**ND9200, ND7200**

- ❑ Make sure the mounting bracket is suitable for the weight of the controller. See detailed weight information in Section 2.4.
- ❑ Attach the J-shaped feedback lever (47) to the valve controller shaft. Apply the thread-locking compound to the screws and tighten firmly.
- ❑ Remove the protective plastic plugs from pneumatic connections C2, S and C1. Mount the metal plugs (53) to the unused controller connections with sealant.
- ❑ Leave metal plug (54) in the connection C1 at the bottom of the controller. Remove the metal plug (54) from the C2 connection at the bottom. Mount the O-rings (38, 2 pcs.) to the connections.
- ❑ Attach the mounting plate (64) to the valve controller with screws (65).
- ❑ Mount the O-rings (38, 2 pcs.) and attach the mounting plate (39) to the valve controller with screws (28).
- ❑ Mount the conical plug (16) to the lever and select the position on the scale according to the valve stroke.
- ❑ Install the O-ring (31) to the actuator. Place the conical plug into the frame on the stem and tighten the screws (4).

## 4.5 Mounting on linear actuator with IEC 60534 mounting face

See figure in Section 12.10

**ND9100, ND7100**

- ❑ Attach the feedback arm with spacer to the valve controller shaft. Note the position of the mark on the shaft as in 12.10. Apply thread locking compound to the screws and tighten firmly. Attach the spring to the feedback arm as shown in Section 12.10.
- ❑ Mount the valve controller mounting bracket loosely to the yoke of the actuator.
- ❑ Remove all plastic plugs from all actuator connections (5 pcs.). 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 12.10. Apply thread locking compound to the screws and tighten firmly. Attach the spring to the feedback arm as shown in Section 12.10.
- ❑ 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 12.10. 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.

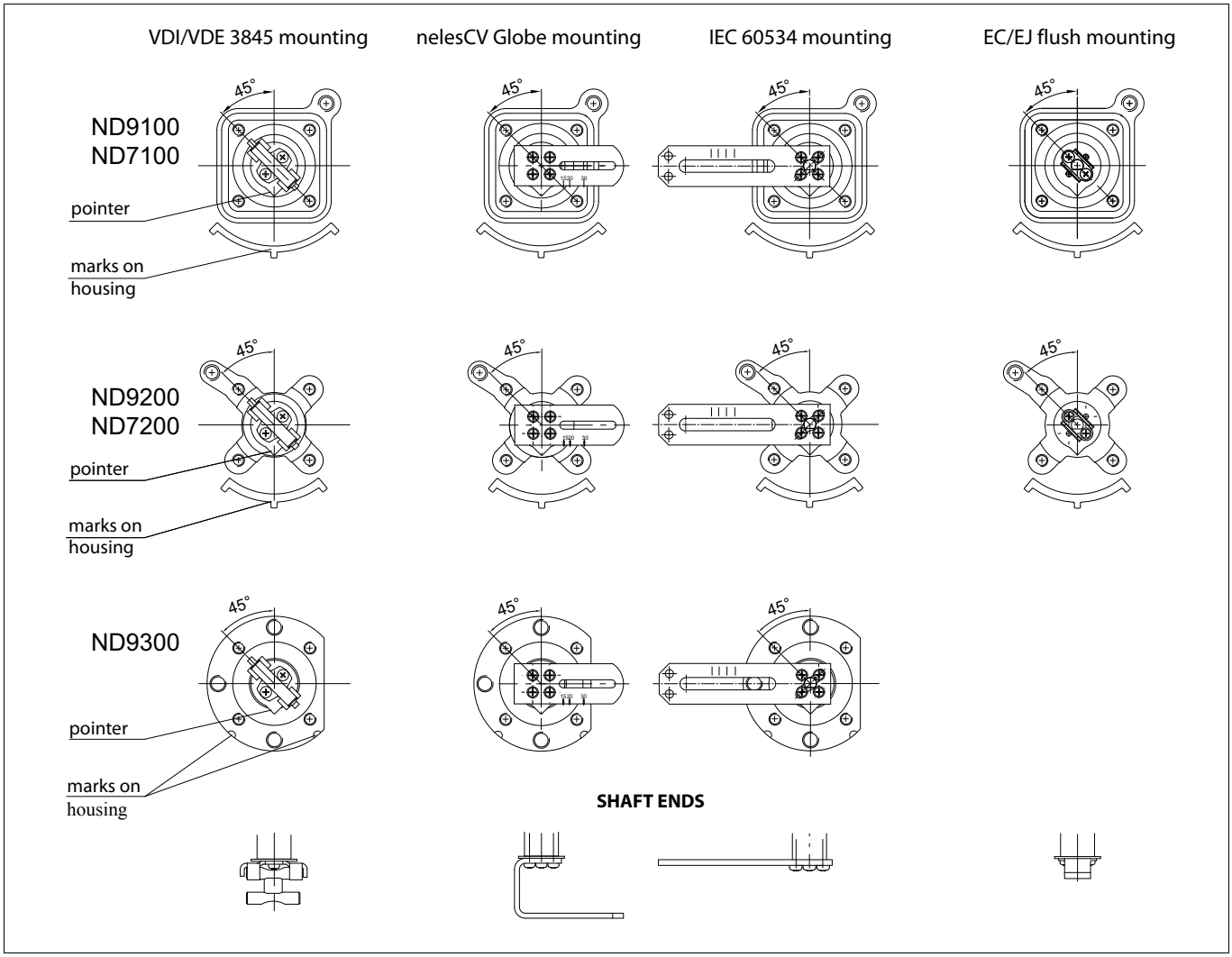



*Fig. 6 Shaft coupling alternatives*

## 4.6 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 FieldCare software.

- ❑ Connect the air supply to S.
- ❑ Connect C1 and C2 to the actuator, see Fig. 7 and 8.
- ❑ If ND9000 or ND7000 is connected direct to the EC or EJ actuator, connections C1 and C2 must be plugged, see 12.7.

Air connections are as follows
ND9100, ND7100: G 1/4
ND9200, ND7200, ND9300: 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. 7 and 8.

**NOTE:**
An excess of sealant may result in faulty operation of the controller.
Sealing tape is not recommended.
Ensure that the air piping is clean.

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 |
| EJK | 3 / 43 |
| EJ | 4 / 57 |
| EJV | 5 / 72 |
| Adjust regulator pressure to a level that is max 1 bar (14.5 psi) + spring rate. | |

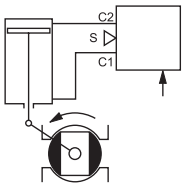
*Table 4 Piping and stroke times*

| 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)** |
| **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)] | – | – | – | – | – |
| **10** | 1.8 | 110 | 3/8 | – | – | – | 10 mm or 3/8" | | | – | – | – |
| **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.

DOUBLE-ACTING ACTUATOR



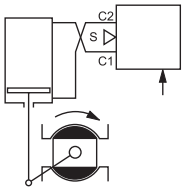

1. Increasing input signal to open valve (shown)

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



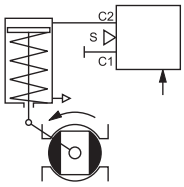

3. Increasing input signal to open valve **(not recommended)**

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



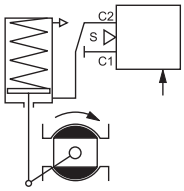

5. Increasing input signal to open valve (shown)

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

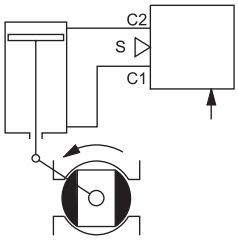
8. Increasing input signal to open valve **(not recommended)**

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. 7 Operation directions and air connections, ND9000H and ND7000H*

DOUBLE-ACTING ACTUATOR

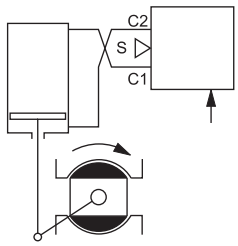
1. Self closing




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

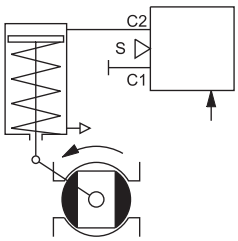
2. Self opening




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

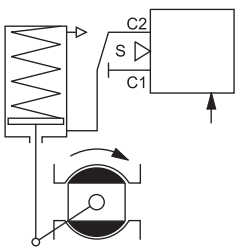
3. Self closing




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. 8 Operation directions and air connections, ND9000F and ND9000P*

## 4.7 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. 9. 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. 9. 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.

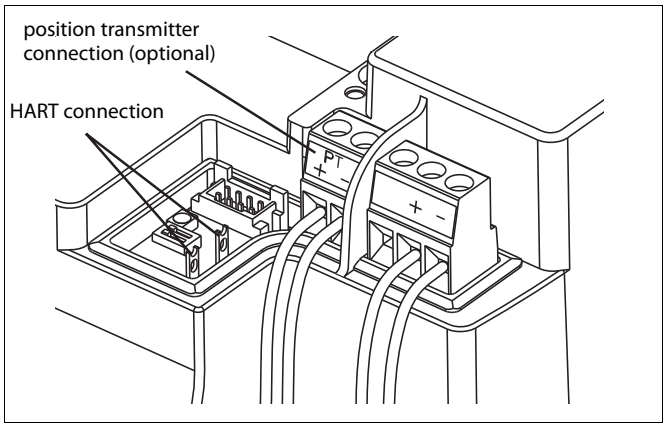



*Fig. 9 Terminals, ND9000H and ND7000H*

**ND9000F, ND9000P**

The ND9200F is powered by FOUNDATION fieldbus (IEC 61158-2).

The ND9200P 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. 10.

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.

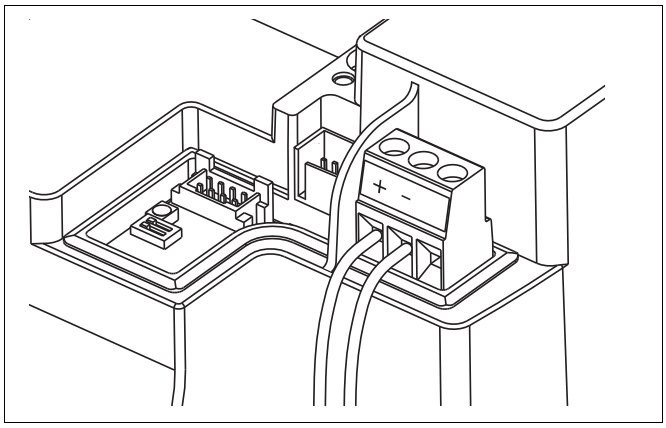



*Fig. 10 Terminals, ND9000F and ND9000P*

**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.

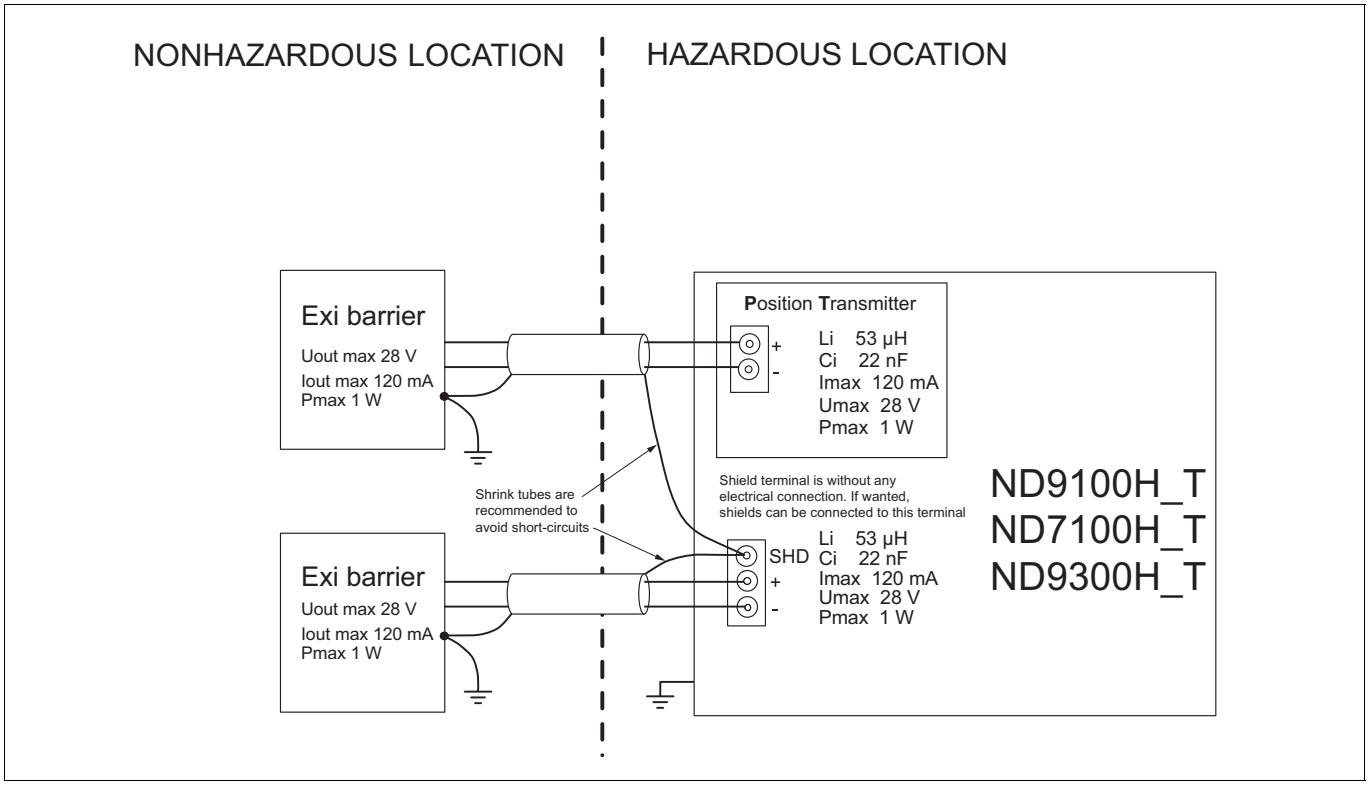



*Fig. 11 Control wiring, ND9100H / ND7100H / ND9300H, Ex i*

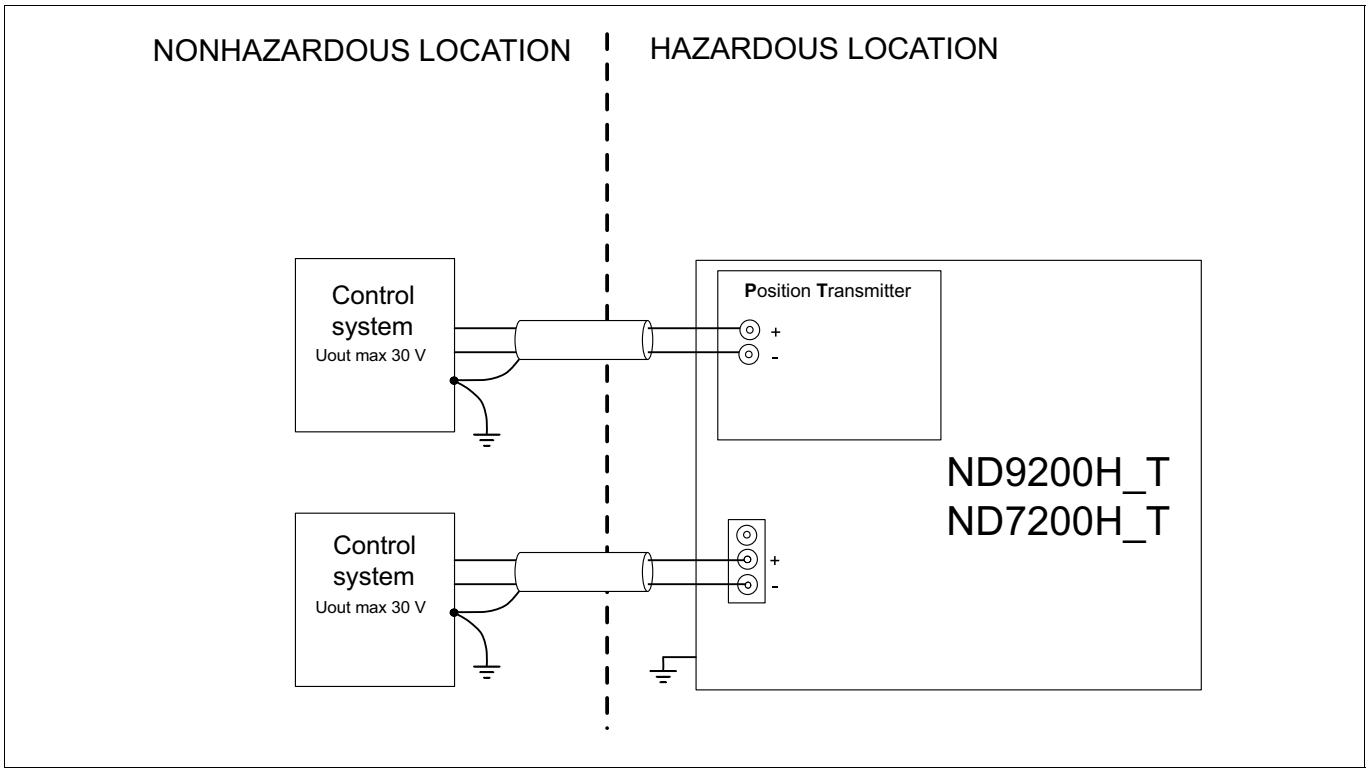



*Fig. 12 Control wiring, ND9200H / ND7200H / ND9300H, Ex d*

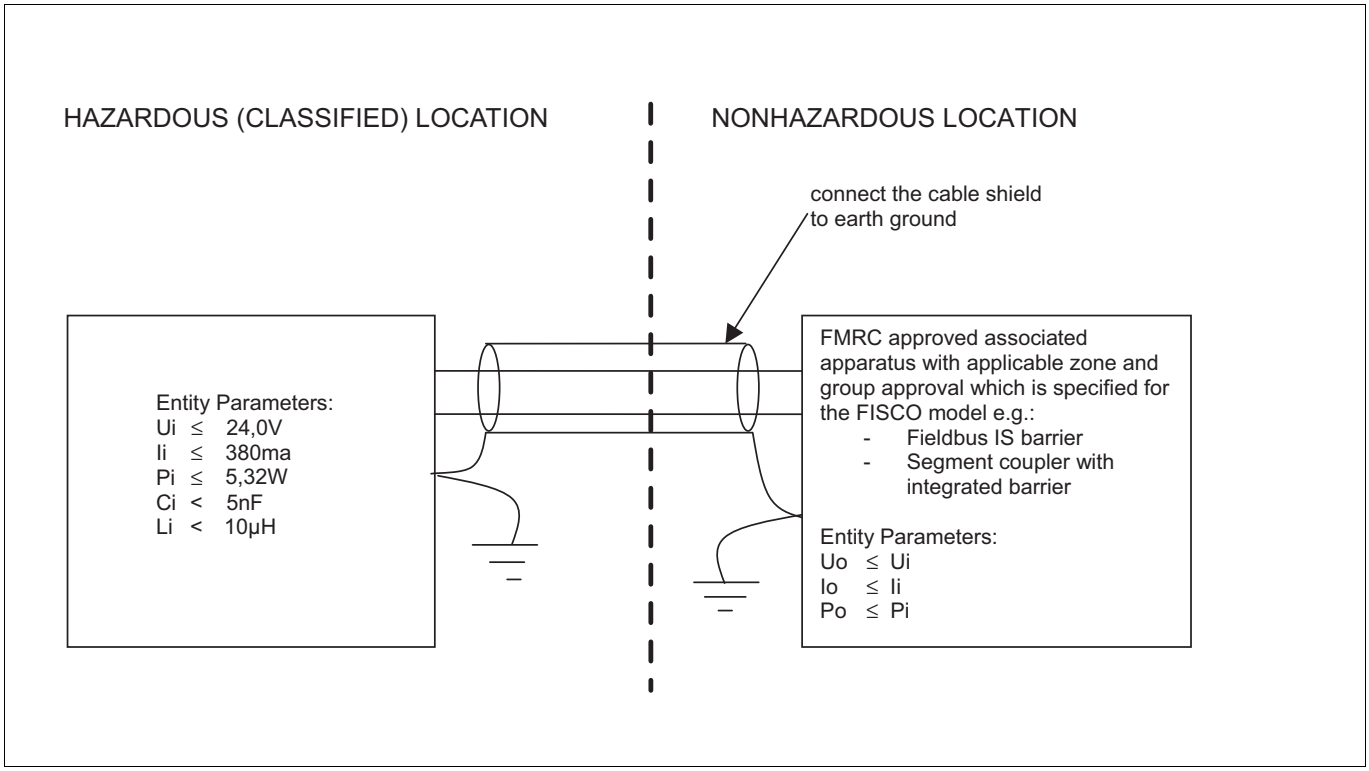



*Fig. 13 Control wiring, ND9100F, ND9100P, ND9300F, ND9300P, Ex i*

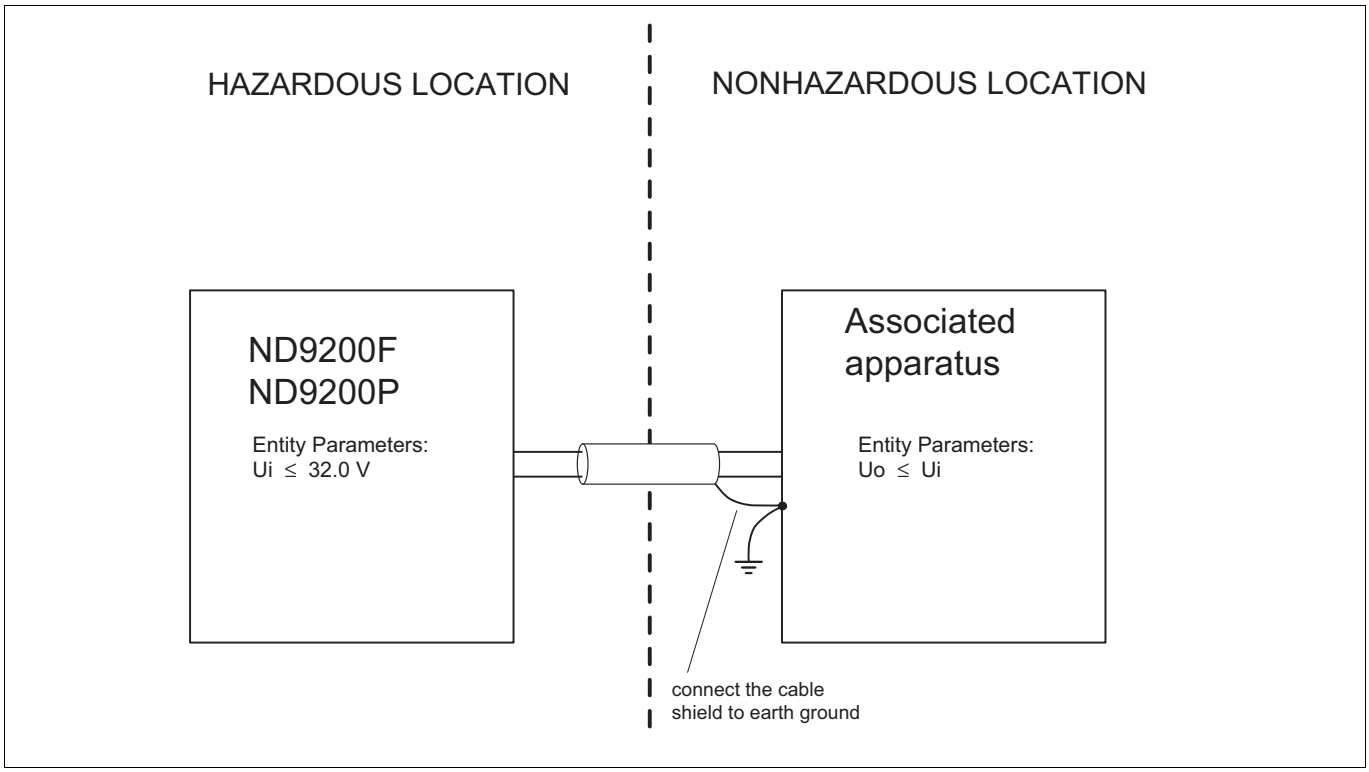



*Fig. 14 Control wiring, ND9200F / ND9200P / ND9300F / ND9300P, Ex d*

# 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.

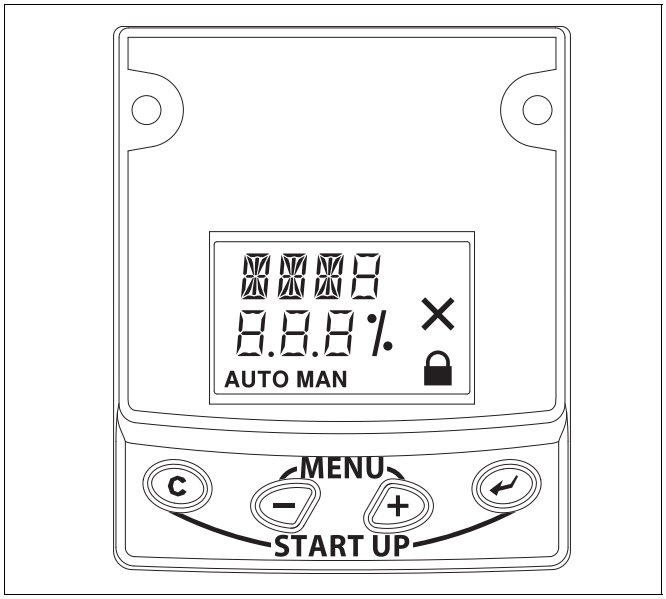



*Fig. 15 Local user interface (LUI)*

## 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 5 identify the default unit and also optional unit of the measurement.

*Table 5 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 FieldCare 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.

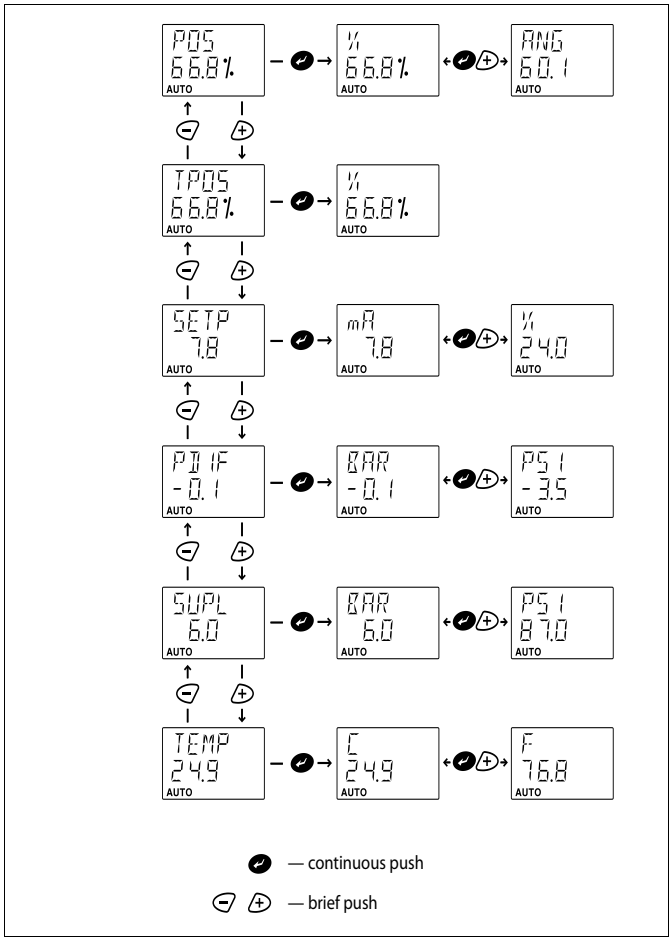



*Fig. 16 Measurement unit change, ND9000H and ND7000H*

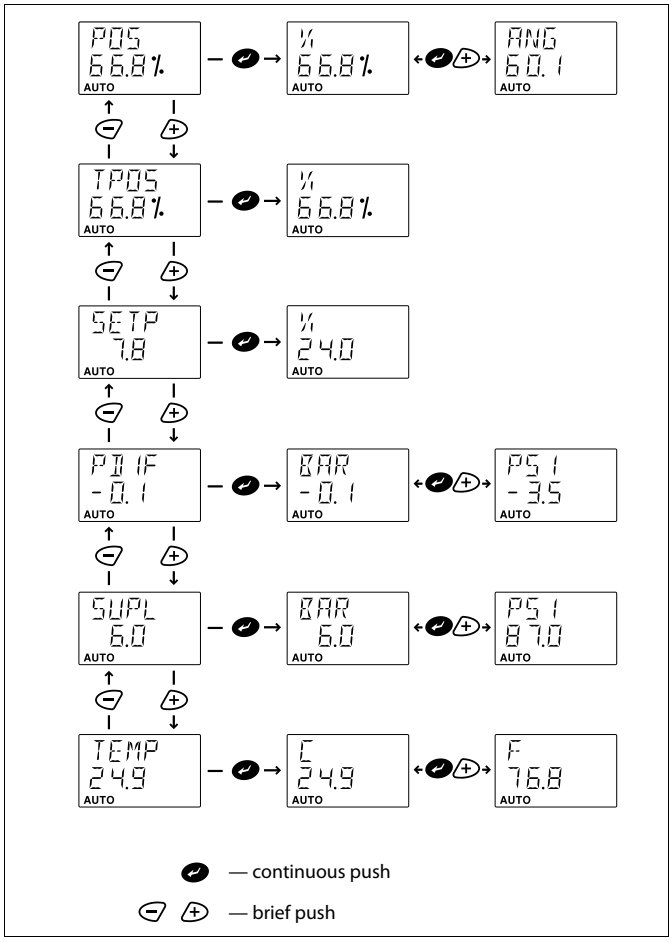



*Fig. 17 Measurement unit change, ND9000F and ND9000P*

## 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.

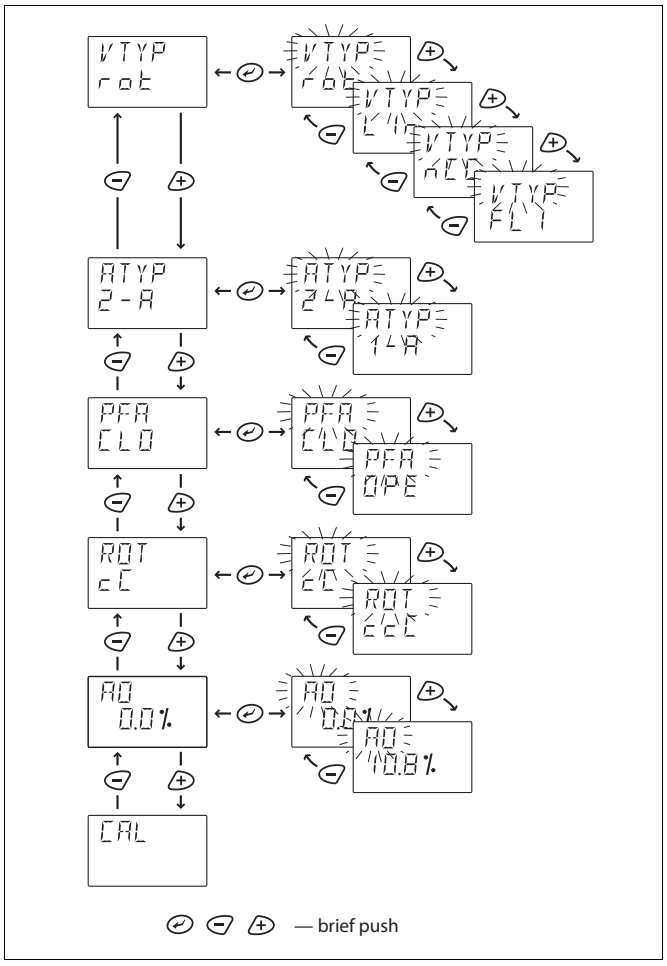



*Fig. 18 Guided start-up, ND9000H, ND7000H and ND9000F*

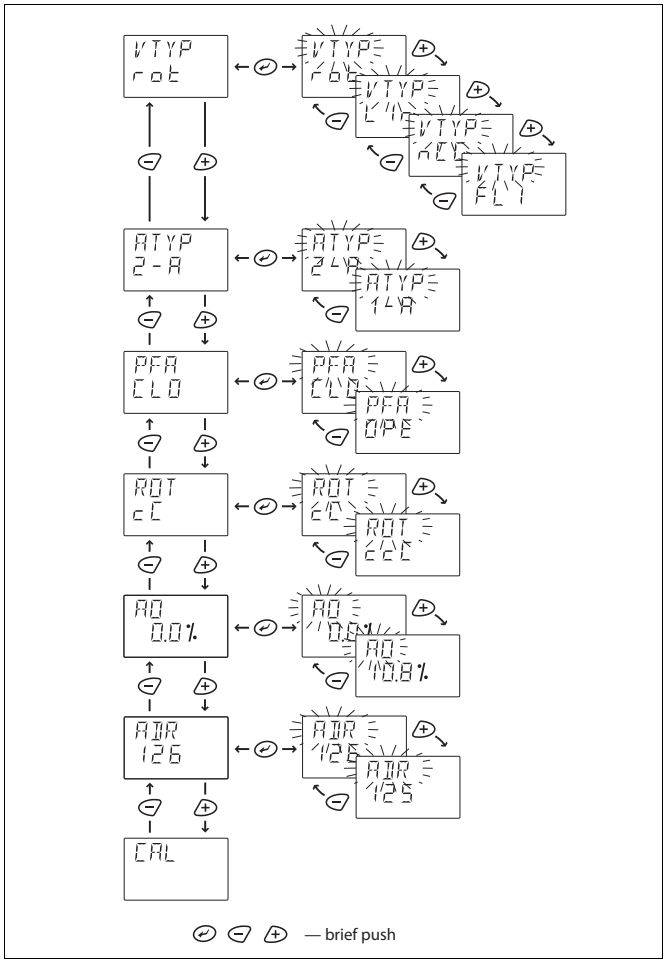



*Fig. 19 Guided start-up, ND9000P*

## 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.

### 5.4.1 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.

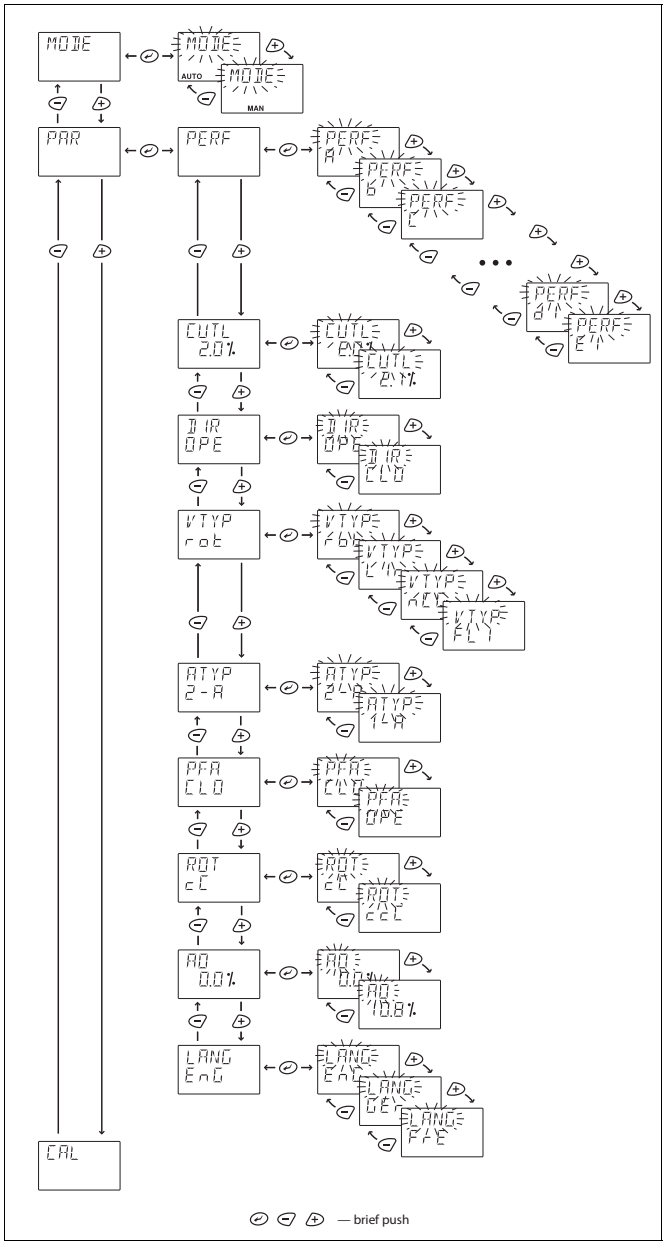



*Fig. 20 Configuration, ND9000H and ND7000H*

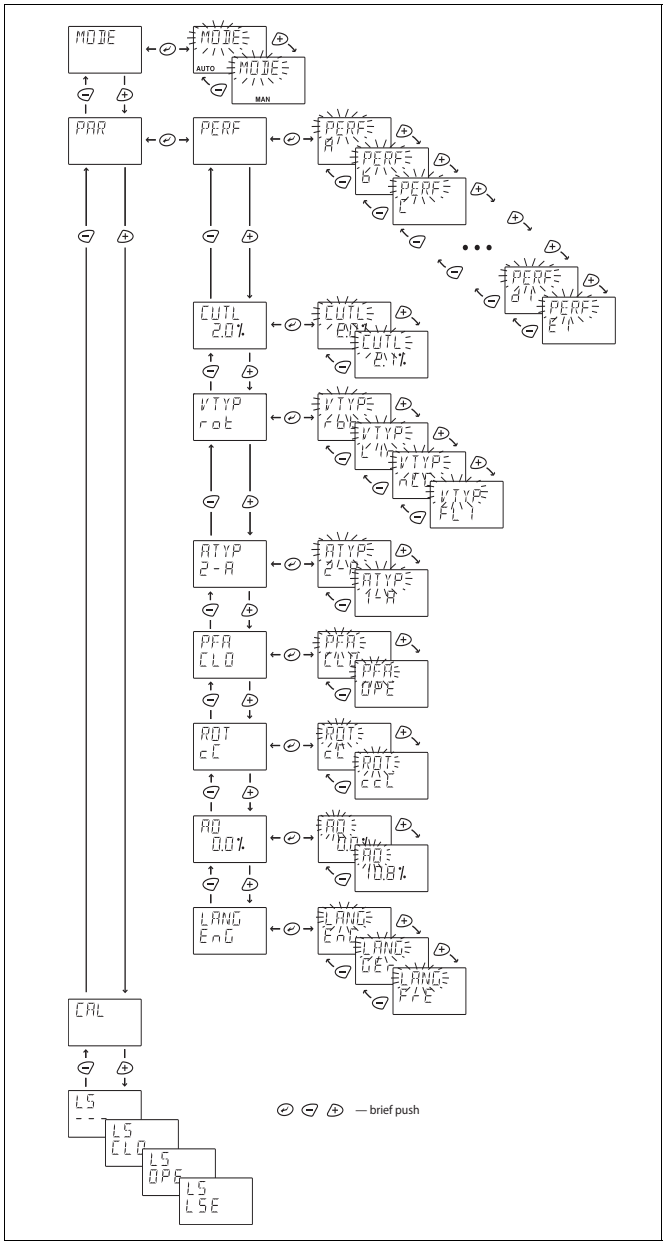



*Fig. 21 Configuration, ND9000F*

### 5.4.2 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.

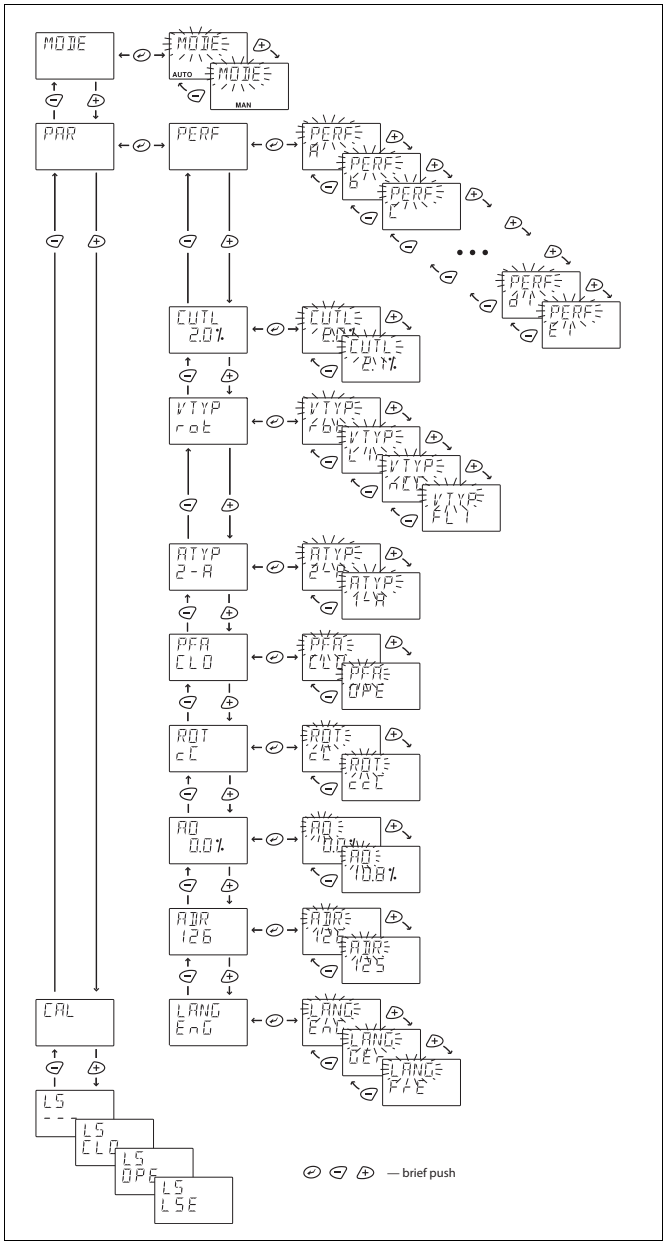



*Fig. 22 Configuration, ND9000P*

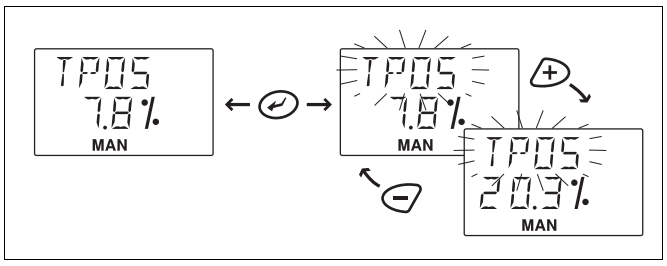



*Fig. 23 Setpoint change in MAN mode*

## 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.

### 5.5.1 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 6 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.

### 5.5.2 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.

### 5.5.3 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. 7 and 8.

### 5.5.4 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.

### 5.5.5 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.

### 5.5.6 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.

### 5.5.7 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.

### 5.5.8 Valve dead angle, AD

The $\alpha_0$ setting is made for Metso segment and ball valves. This setting takes into account the "dead angle" $\alpha_0$ of the ball valves. The entire signal range is then used for effective valve opening 90° - $\alpha_0$. Use 0 % as the "dead angle" for the valves not mentioned in Table 7.

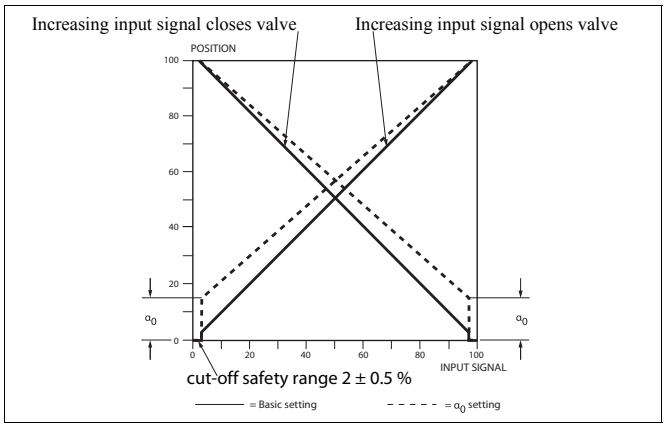



*Fig. 24 Principle of setting, ND9000H and ND7000H*

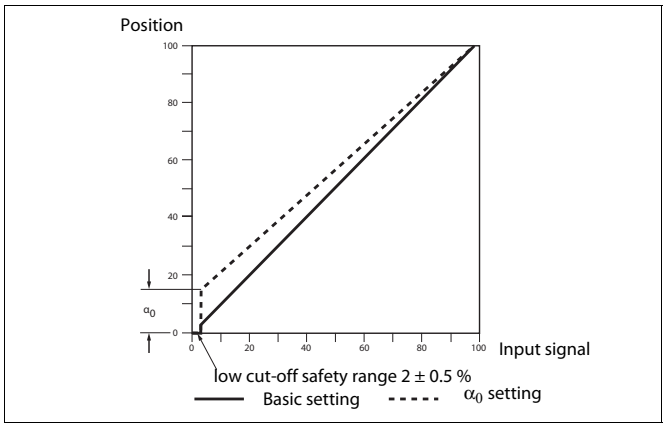



*Fig. 25 Principle of setting, ND9000F and ND9000P*

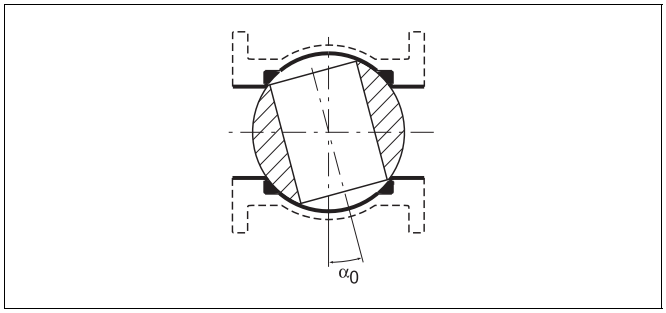



*Fig. 26 Dead angle*

- ❑ After selecting AD on the display, press the ⏎ key to enter the edit state and AD starts to blink. The value currently selected appears as a percentage (%) on the display.

*Table 7 Dead angle in percentage*

| Valve size | | Valve series | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MBV QMBV 1) | MBV QMBV 2) | D, P, C | T5, QT5 | QX-T5 | T25, QT25 | QX-T25 | R, QR | E | R-SOFT 3) | FL 4) | ZX |
| mm | in | Dead angle, % | | | | | | | | | | | |
| 15 | 1/2 | | | | | | | | | | | | 15 |
| 20 | 3/4 | | | | | | | | | | | | 15 |
| 25 | 1 | 14 | - | - | 25.5 | 19.5 | - | - | 15 | 25.5 | 27 | | 12.5 |
| 25/1 | 1/1 | | | | | | | | | | | 11 | |
| 25/2 | 1/2 | | | | | | | | | | | 11 | |
| 25/3 | 1/3 | | | | | | | | | | | 10 | |
| 40 | 1 1/2 | 12 | - | - | 24.5 | 12.5 | - | - | 12 | 16 | 21 | | 12.5 |
| 50 | 2 | 10 | 9 | 13.5 | 24.5 | 12.5 | 18 | 8 | 17 | 20.5 | 23 | | 12.5 |
| 65 | 2 1/2 | 9 | - | - | - | - | - | - | 13 | - | 18 | | |
| 80 | 3 | 10 | 8 | 12 | 18 | 8 | 16.5 | 8.5 | 9 | 8.5 | 15.5 | | |
| 100 | 4 | 10 | 8 | 12 | 16.5 | 8.5 | 16 | 9 | 8 | 7 | 14.5 | | |
| 125 | 5 | 12 | - | - | - | - | 12 | 6.5 | 8 | - | | | |
| 150 | 6 | 10 | 8 | 11.5 | 16 | 9 | 13.5 | | 8 | 13.5 | 13 | | |
| 200 | 8 | 9 | 7 | 8.5 | 12 | 6.5 | 9.5 | | 7 | | 11.5 | | |
| 250 | 10 | 9 | 7 | 7.5 | 13.5 | | 9.5 | | 7 | | 10.5 | | |
| 300 | 12 | 8 | 6 | 6.5 | 9.5 | | 7.5 | | 6 | | 9.5 | | |
| 350 | 14 | | 6 | 6 | - | | | | 5 | | 9.5 | | |
| 400 | 16 | | 5 | 5.5 | 9.5 (14") | | | | 5 | | 9.5 | | |
| 450 | 18 | | | 6 | 7.5 (16") | | | | | | | | |
| 500 | 20 | | | 6 | | | | | 4.5 | | | | |
| 600 | 24 | | | 5.5 | | | | | | | | | |
| 650 | 26 | | | 7 | | | | | | | | | |
| 700 | 28 | | | 7 | | | | | | | | | |
| 750 | 30 | | | 6 | | | | | | | | | |
| 800 | 32 | | | - | | | | | | | | | |
| 900 | 36 | | | 5.5 | | | | | | | | | |
| 1) Seat supported 2) Trunnion 3) Soft seated R-valve 4) Low Cv Finetrol | | | | | | | | | | | | | |

- ❑ 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.

### 5.5.9 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.

### 5.5.10 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 FieldCare software.

### 5.5.11 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 5.6.4.

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.**

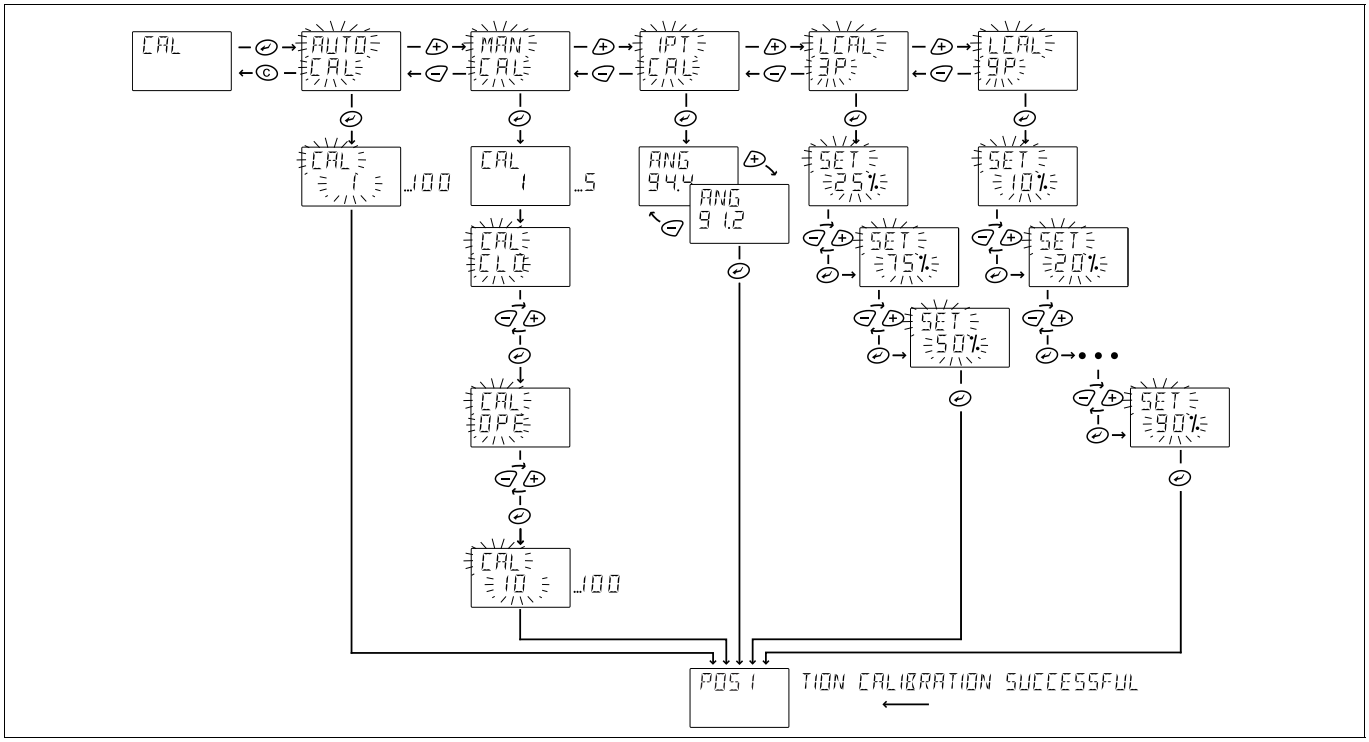



*Fig. 27 Calibration selection*

### 5.6.1 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 5.6.2

### 5.6.2 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.

### 5.6.3 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 RNG 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.

### 5.6.4 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.

### 5.6.5 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

### 5.7.1 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.

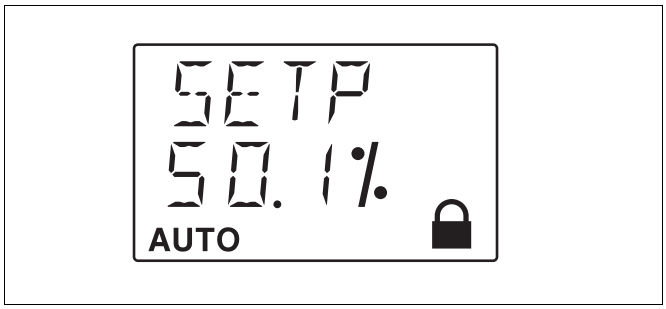



*Fig. 28 LUI locked*

### 5.7.2 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 FieldCare software where all events may be viewed.

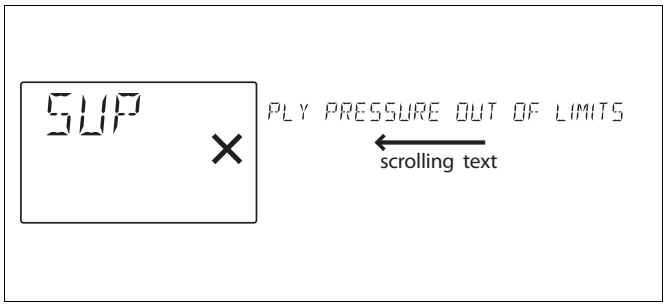



*Fig. 29 Example of online alarm message*

### 5.7.3 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.

### 5.7.4 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.

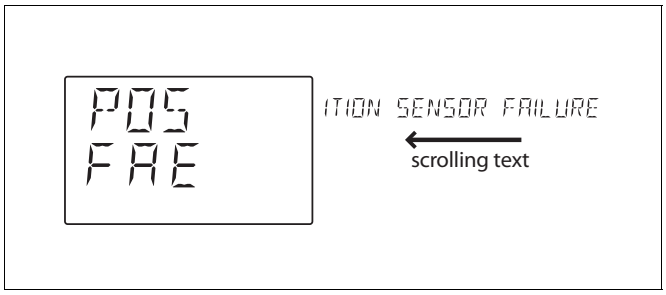



*Fig. 30 Example of failsafe display*

### 5.7.5 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.

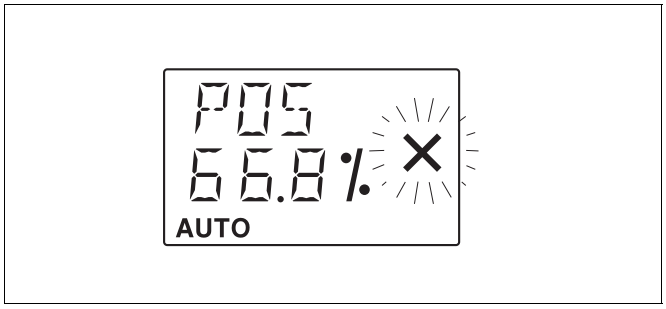



*Fig. 31 Reduced performance display*

## 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 FieldCare 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. 33.

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.

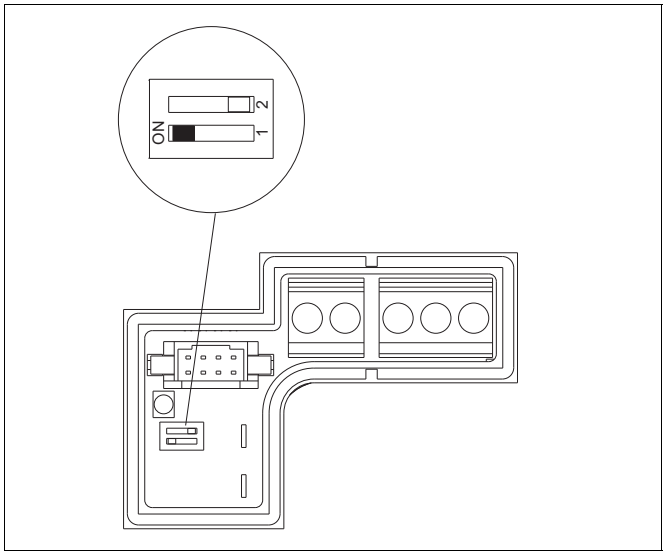



*Fig. 32 HART write protection, ND9000H and ND7000H*

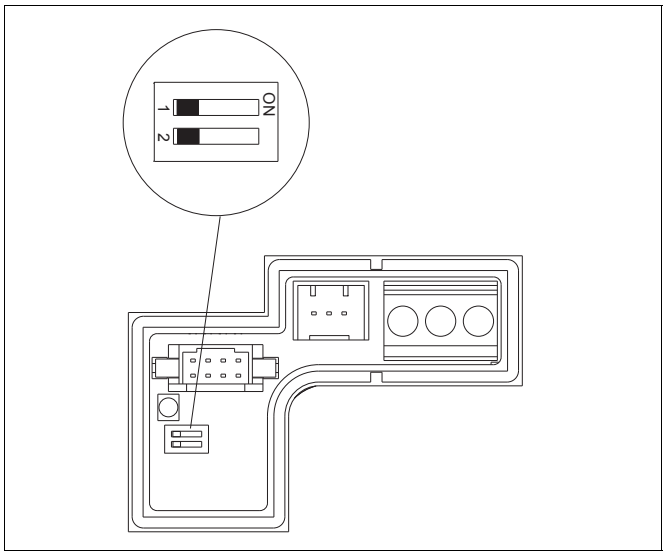



*Fig. 33 Write protection, ND9000F and ND9000P*

# 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.

### 6.1.1 Removal

**ND9100, 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).

### 6.1.2 Installation

**ND9100, 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

### 6.2.1 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, 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.

### 6.2.2 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.

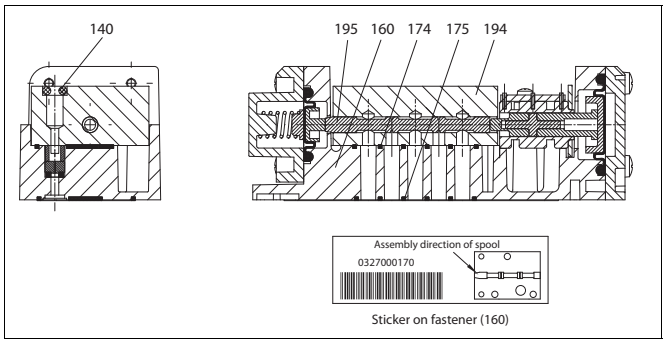



*Fig. 34 Spool valve assembly, ND9100 and ND7100*

**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.

## 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.

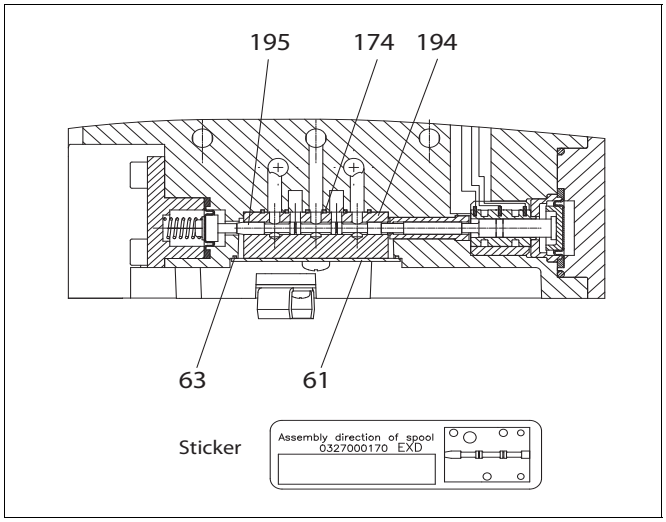



*Fig. 35 Spool valve assembly, ND9200, ND7200 and ND9300*

## 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

### 6.5.1 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.

### 6.5.2 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.

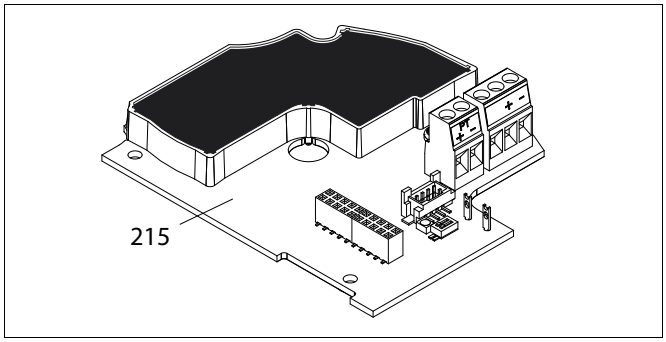



*Fig. 36 Communication board, ND9000H and ND7000H*

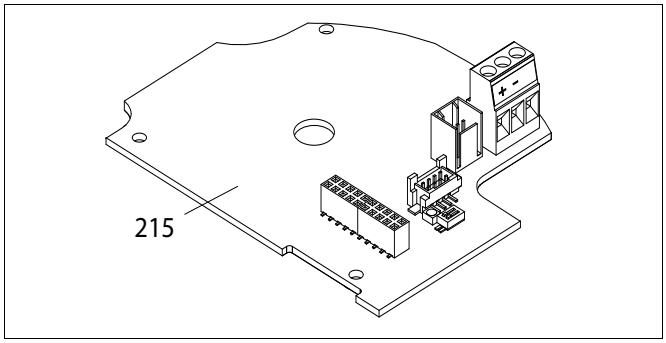



*Fig. 37 Communication board, ND9000F and ND9000P*

# 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).<br>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. 7 and 8
- ❑ 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. 6.
- ❑ 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

### 9.1.1 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.

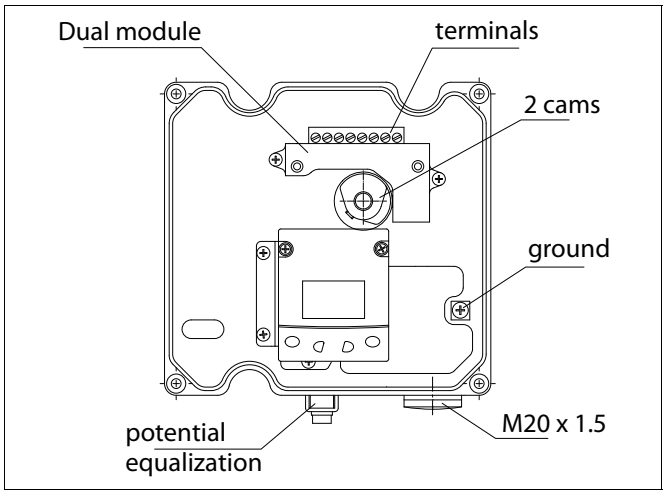



*Fig. 38 ND9100_/D__ layout*

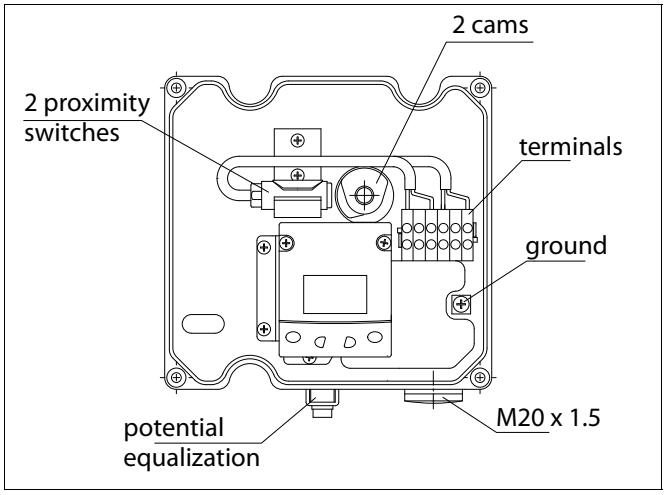



*Fig. 39 ND9100_/I__ layout*

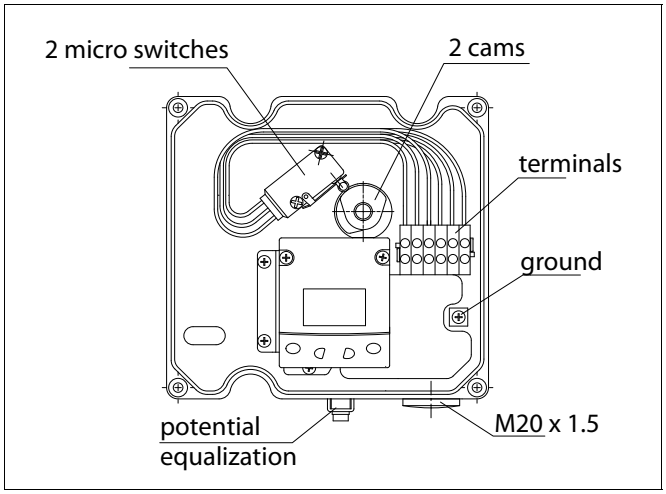



*Fig. 40 ND9100_/K0_ layout*

**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.

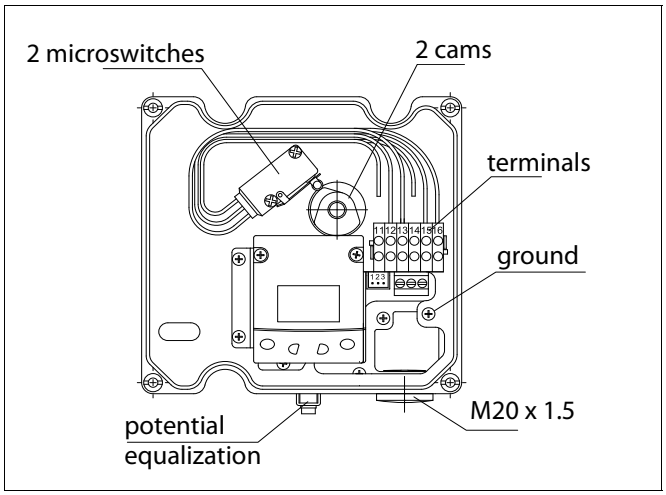



*Fig. 41 ND9100F/B06 and ND9100P/B06 layout*

**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_/D__ and 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.

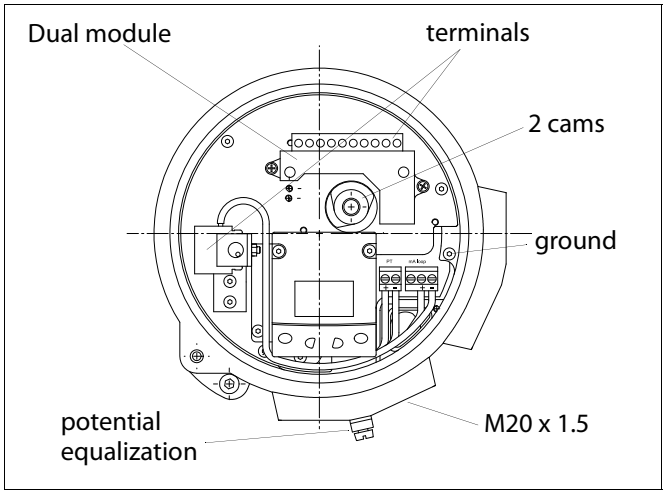



*Fig. 42 ND92/93_/D__ layout*

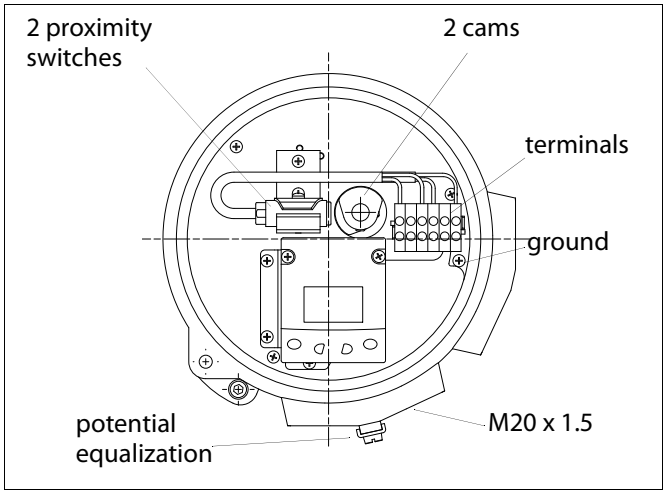



*Fig. 43 ND92/93_H/I__, ND92/93_F/I__ and ND92/93_P/I__ layout*

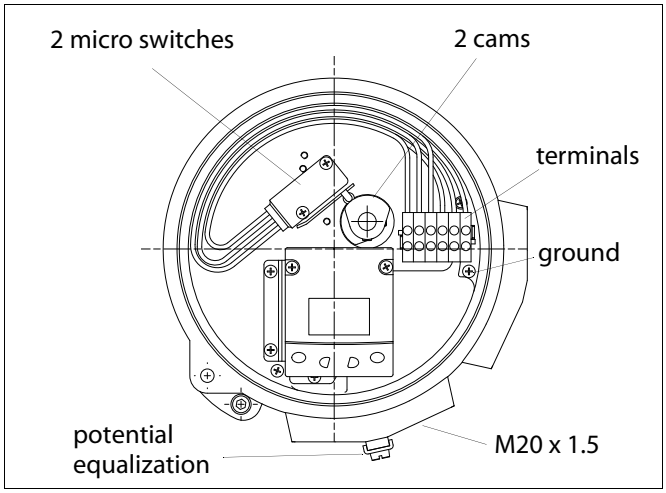



*Fig. 44 ND92/93_H/K0_, ND92/93_F/K0_ and ND92/93_P/K0_ layout*

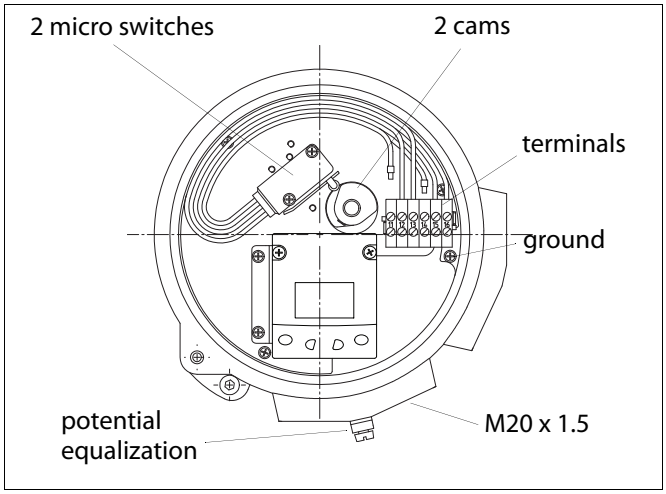



*Fig. 45 ND92/93_F/B06 and ND92/93_P/B06 layout*

## 9.1.2 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.

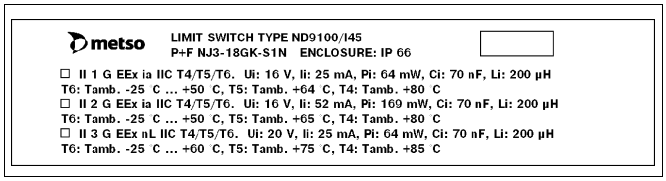



*Fig. 46 Example of the identification plate, ND9100*


*Fig. 47 Example of the identification plate, ND9200*

## 9.1.3 Technical specifications

### 9.1.3.1 ND9000_/D__

| | | |
|---|---|---|
| Proximity switch: | Inductive, Dual Module<br>2 sensors,<br>Normally Open<br>Normally Closed | <br><br>(33)<br>(44) |
| Electrical values: | | |
| SST Dual Module | | (33) |
| Indications: | Target on sensor = LED on<br>Target off sensor = LED off | |
| Operating voltage: | 8–125 V DC; 24–125 V AC | |
| Maximum voltage drop: | 6.5 V / 10 mA<br>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<br><0.25 mA with AC voltage | |
| Namur Dual Module | | (44) |
| Indications: | Target on sensor = LED off<br>Target off sensor = LED on | |
| Operating voltage: | 6–29 V DC | |
| Current ratings: | Target on (LED off) <1.0 mA<br>Target off (LED on) >3.0 mA | |

Must use intrinsically safe repeater barrier.

Namur sensors conform to DIN 19234 standard.

Number of switches: 2

### 9.1.3.2 ND9000_/I__

Proximity switch type: Inductive, diameter 8–14 mm (0.31–0.55 in)
Sensing range 2 mm (0.08 in)
Protection class IP67
P+F NJ2-12GK-SN (I02)
P+F NCB2-12GM35-N0 (I09)
Omron E2E-X2Y1 (I32)
P+F NJ3-18GK-S1N (I45)
ifm IFC2002-ARKG/UP (I56)
Other switch types on special order

Electrical values: According to switch type, check connection diagram from Section 12.11

Switch accuracy: < 1°

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)

Materials:
Body: Aluminium alloy, epoxy coated
Internal parts: Stainless steel and polymer
Sealing: Nitrile and neoprene rubber

### 9.1.3.3 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)

Materials:
Body: Aluminium alloy, epoxy-coated
Internal parts: Stainless steel and polymer
Sealing: Nitrile and neoprene rubber

### 9.1.3.4 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)

Materials:
Body: Aluminium alloy, epoxy-coated
Internal parts: Stainless steel and polymer
Sealing: Nitrile and neoprene rubber

## 9.1.4 Electric data and ambient temperatures

*Table 8 Electric data*

| Limit switch code | Electric data | No. of switches | Ambient Range |
|---|---|---|---|
| **Inductive proximity switches** | | | |
| D33 | 2 A - 8-125 V DC, 24-125 V AC | 1 | See tables 9...18 |
| D44 | 3 mA; 1 mA, 6-29 V DC | 1 | |
| I02 | Ui: 16 V, Ii: 52 mA, Pi: 169 mW | 2 | |
| I09 | Ui: 16 V, Ii: 52 mA, Pi: 169 mW | 2 | |
| I32 | 24-240 V AC, < 200 mA | 2 | |
| I45 | Ui: 16 V DC, Ii: 52 mA, Pi: 169 mW | 2 | |
| I56 | 10-36 V DC, < 150 mA | 2 | |
| **Mechanical micro switches** | | | |
| K05 | 3 A - 250 V AC, 0.4 A - 125 V DC, 5 A - 30 V DC | 2 | See tables 9, 12, 15 & 18 |
| K06 | 100 mA - 30 V DC / 125 V AC | 2 | |
| **Bus powered mechanical micro switches** | | | |
| B06 | 100 mA - 30 V DC / 125 V AC | 2 | See tables 9, 12, 15 & 18 |

*Table 9 Ambient temperatures, ND9_E1*

| Variant type | II 2 G Ex d IIC T6...T4 Gb; II 2 D Ex tb IIIC T80 °C...T105 °C Db | | |
|---|---|---|---|
| | Ambient temperature ranges | | |
| | T6 | T5 | T4 |
| ND9_E1_<br>ND9_E1/I02<br>ND9_E1/K05<br>ND9_E1/K06<br>ND9_E1/B06 | -40 °C … +60 °C | -40 °C … +75 °C | -40 °C … +85 °C |
| ND9_E1/D33<br>ND9_E1/D44 | -40 °C … +60 °C | -40 °C … +75 °C | -40 °C … +82 °C |
| ND9_E1/I09<br>ND9_E1/I45 | -25 °C ... +50 °C | -25…+60 °C | -25…+60 °C |
| ND9_E1/I56 | -25 °C … +60 °C | -25 °C … +75 °C | -25 °C … +80 °C |
| ND9_E1/I32 | -25 °C … +60 °C | -25 °C … +70 °C | -25 °C … +70 °C |

*Table 10 Ambient temperatures, ND91_X*

| Variant type | II 1 G Ex ia IIC T6...T4 Ga; II 1 D Ex ta IIIC T90 °C Da<br>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 °C ... +50 °C | -40 °C ... +65 °C | -40 °C ... +80 °C |
| ND91_X/I02 | -40 °C ... +50 °C | -40 °C ... +64 °C | -40 °C ... +80 °C |
| ND91_X/I09 | -25 °C ... +50 °C | -25 °C ... +65 °C | -25 °C ... +80 °C |
| ND91_X/I45 | -25 °C ... +50 °C | -25 °C ... +64 °C | -25 °C ... +80 °C |

*Table 11 Ambient temperatures, ND91_X*

| Variant type | II 3 G Ex nA IIC T6...T4 Gc; II 3 D Ex tc IIIC T90 °C Dc<br>II 3 G Ex ic IIC T6...T4 Gc; II 3 D Ex tc IIIC T90 °C Dc | | |
|---|---|---|---|
| | **Ambient temperature ranges** | | |
| | **T6** | **T5** | **T4** |
| ND91_X | -40 °C ... +60 °C | -40 °C ... +75 °C | -40 °C ... +85 °C |
| ND91_X/I02 | -40 °C ... +60 °C | -40 °C ... +75 °C | -40 °C ... +85 °C |
| ND91_X/I09 | -25 °C ... +60 °C | -25 °C ... +75 °C | -25 °C ... +85 °C |
| ND91_X/I45 | -25 °C ... +60 °C | -25 °C ... +75 °C | -25 °C ... +85 °C |

*Table 12 Ambient temperatures, ND9_N*

| Variant type | Ambient temperature ranges |
|---|---|
| ND9_N_ | -40 °C… +85 °C |
| ND9_N/D33 | -40 °C… +82 °C |
| ND9_N/D44 | -40 °C… +82 °C |
| ND9_N/I02 | -40 °C… +85 °C |
| ND9_N/I09 | -25 °C… +85 °C |
| ND9_N/I32 | -40 °C… +85 °C |
| ND9_N/I45 | -25 °C… +85 °C |
| ND9_N/I56 | -20 °C… +85 °C |
| ND9_N/K05 | -40 °C… +85 °C |
| ND9_N/K06 | -40 °C… +85 °C |
| ND9_N/B06 | -40 °C… +85 °C |

*Table 13 Ambient temperatures, ND9_U*

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

*Table 14 Ambient temperatures, ND9_U*

| Variant type | NI Class I, Division 2, Groups A, B, C, D, T4...T6<br>NI Class I, Zone 2, Ex nA IIC T4...T6 | | |
|---|---|---|---|
| | **Ambient temperature ranges** | | |
| | **T6** | **T5** | **T4** |
| ND9_U_ | -40 °C… +55 °C | -40 °C… +70 °C | -40 °C… +85 °C |
| ND9_U/D44<br>ND9_U/I02<br>ND9_U/I09<br>ND9_U/I45 | Pending | | |

*Table 15 Ambient temperatures, ND9_E2*

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

*Table 16 Ambient temperatures, ND9_Z Inmetro*

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

*Table 17 Ambient temperatures, ND9_Z Inmetro*

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

*Table 18 Ambient temperatures, ND9_Z Inmetro*

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

## 9.2 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 9.4.

**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 9.4.

## 9.3 Electrical connections

Before connecting the power, make sure that the electrical specifications and the wiring meet the installation conditions. See the diagrams in 12.11. 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.

## 9.4 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.

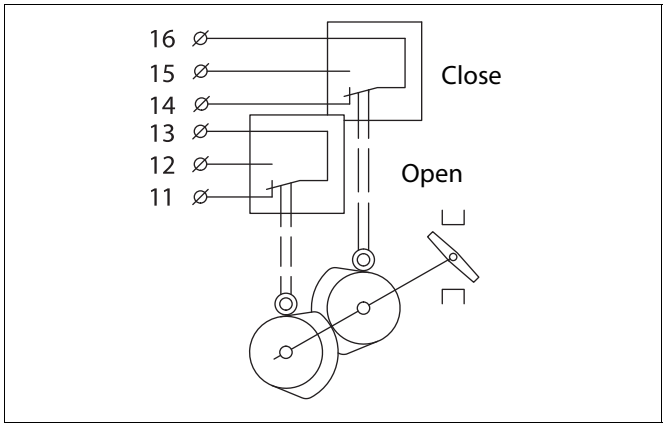



*Fig. 48 Limit switch adjustment, 2 switches*

- ❑ **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.

## 9.5 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 9.2 and check the adjustment according to 9.4.

**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 9.2 and check the adjustment according to 9.4.

**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.

## 9.6 Circuit diagrams

The internal circuitry of the limit switch is shown in the connection diagrams in 12.11 and inside the cover (not ND9100H/I__).

## 9.7 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

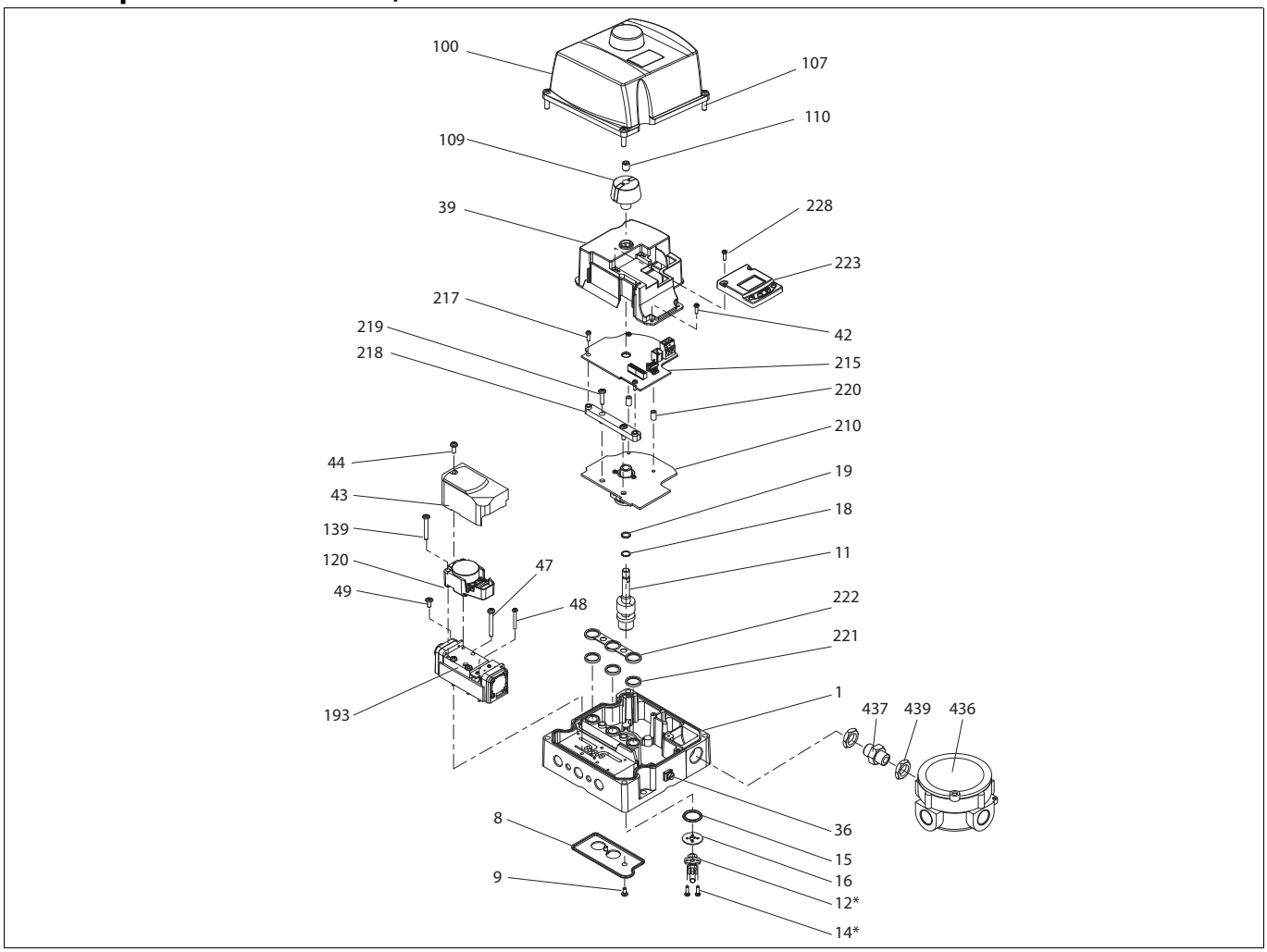
Spare parts are delivered as modules. The modules available are indicated in 12.1 and 12.3.

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

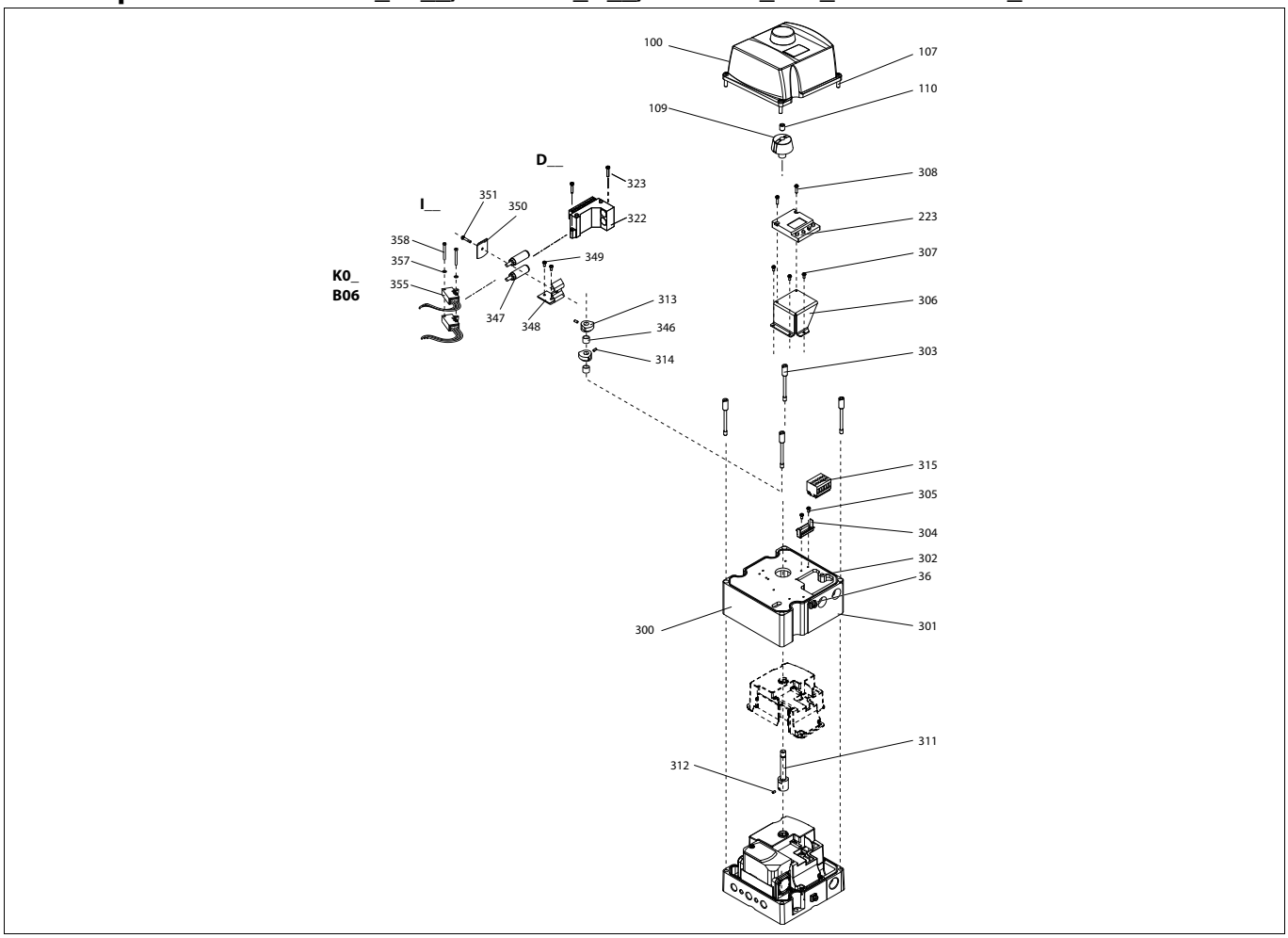
## 12.1 Exploded view ND9100, ND7100




| 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 | |
| 193[x] | 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 = H033594, ND9_P = H033595 |
| 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 | |

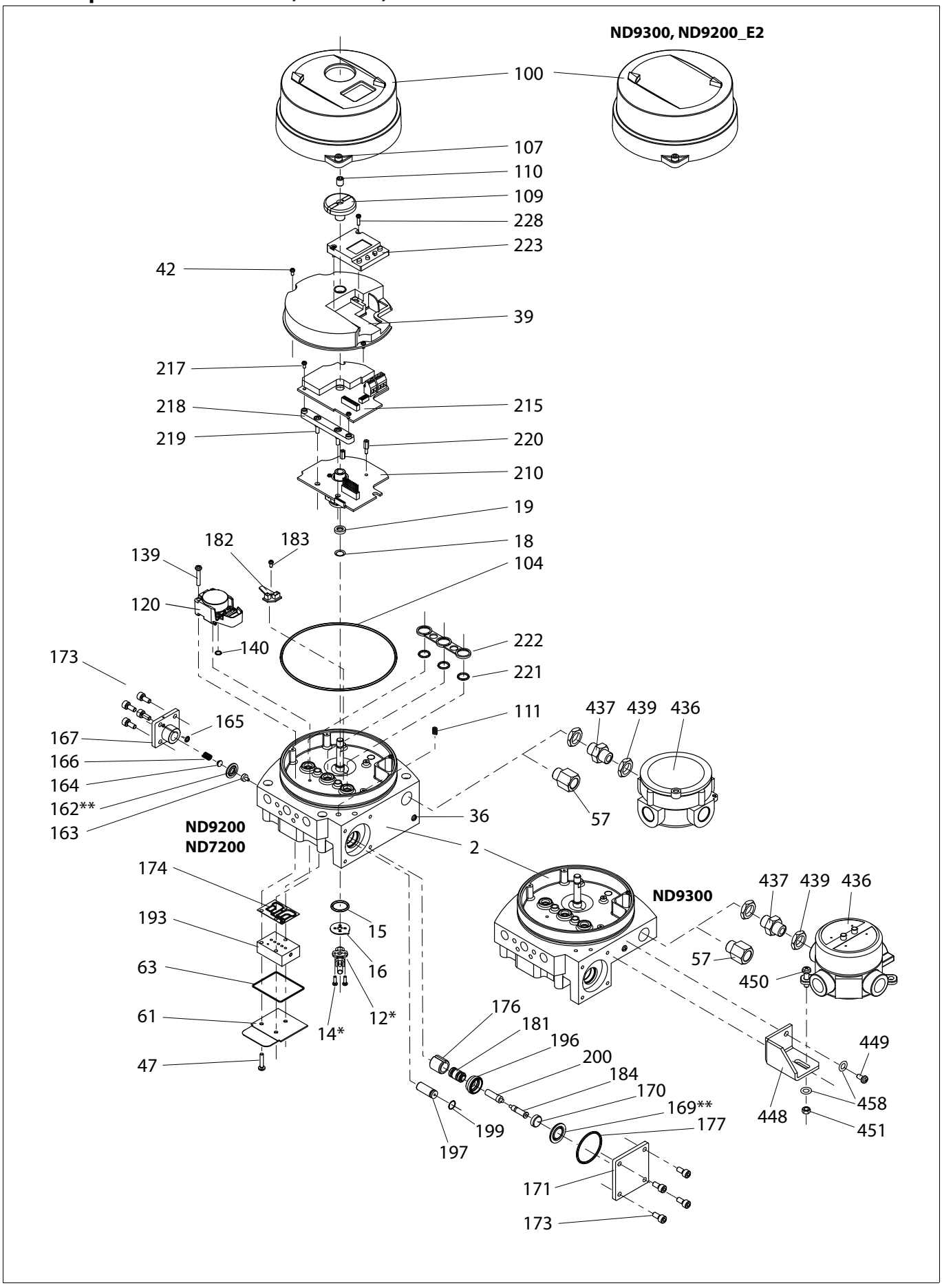
*) Mounting parts: coupling (12), screws (14)
**) PH number from the ID plate is required
x) Spool valve assembly includes the spool valve with the fastener. Separate ID code for fastener is H077294. This contains also all gaskets and diaphragms.

## 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) |

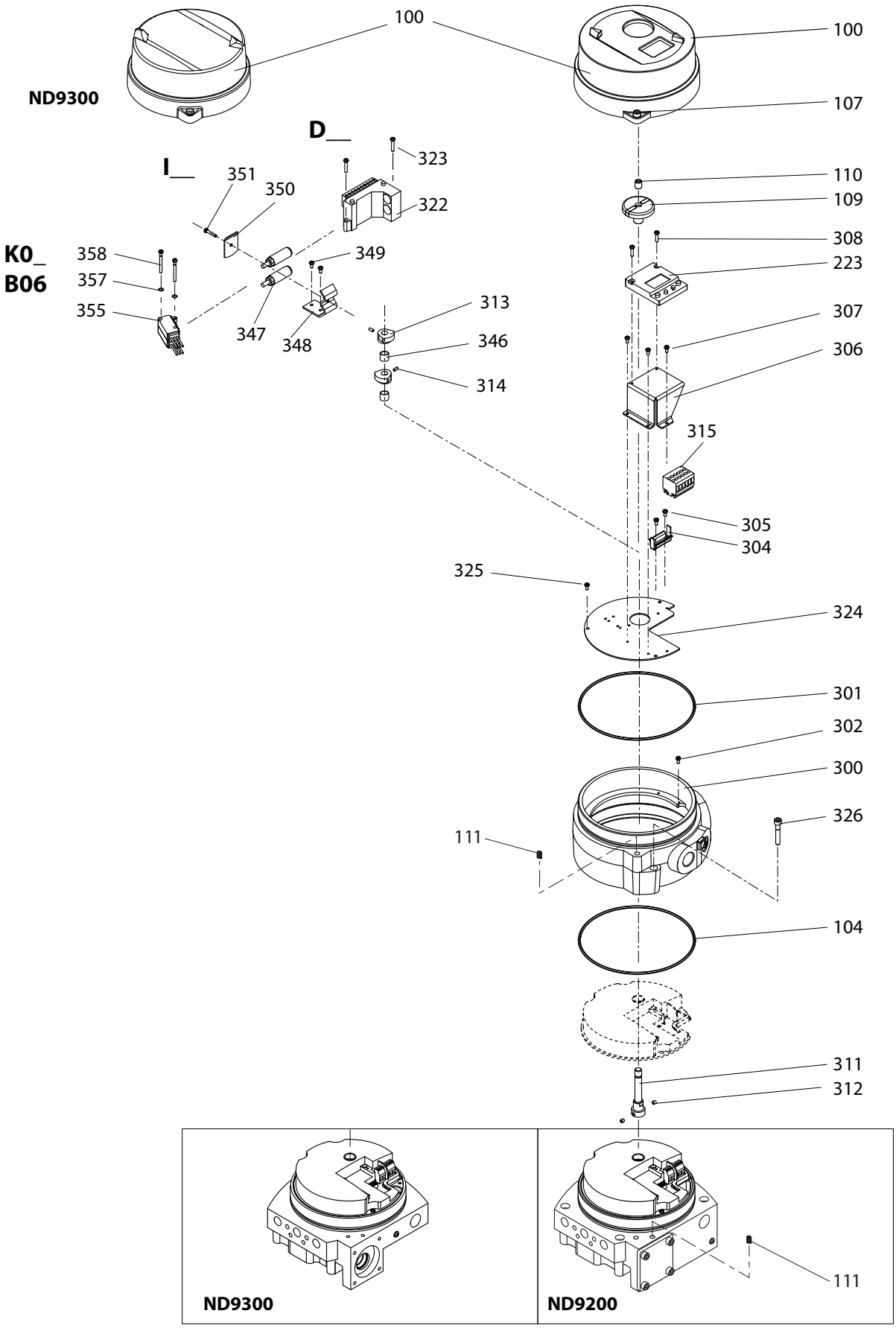
## 12.3 Exploded view ND9200, ND9300, ND7200



| 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<br>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,<br>ND9303 = H077000, ND9306 = H077001<br>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 = H033594, ND9_P = H033595 |
| 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_

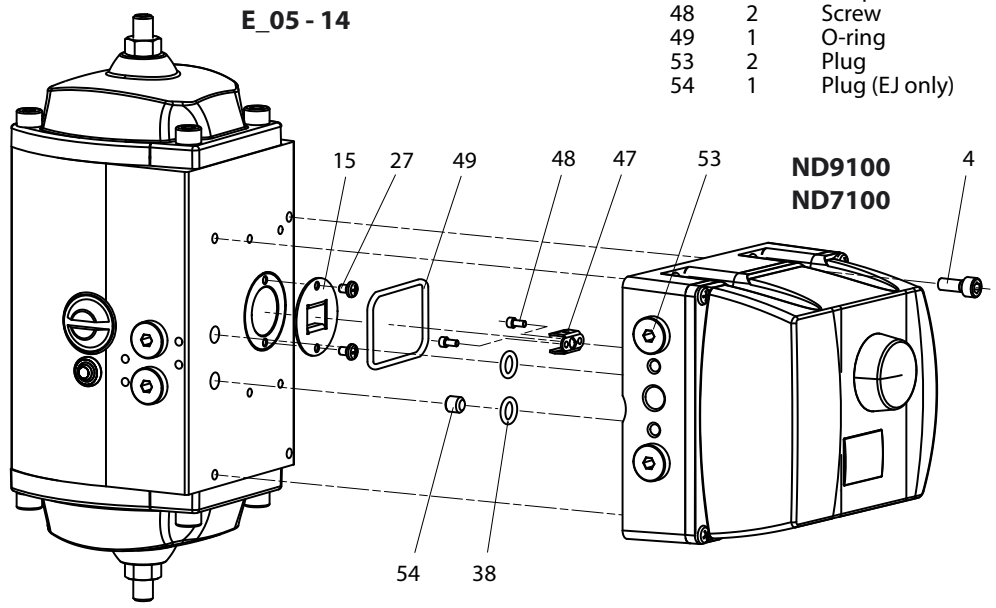


| Item | Qty | Description |
|---|---|---|
| 100 | 1 | Cover |
| 104 | 1 | O-ring |
| 107 | 1 | Screw |
| 109 | 1 | Pointer |
| 110 | 1 | Stop screw |
| 111 | 2 | Spring (ND9200) |
| 223 | 1 | Local user interface (LUI) |
| 300 | 1 | Housing |
| 301 | 1 | O-ring |
| 302 | 1 | Screw |
| 304 | 1 | Bracket |
| 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 EC05-14/EJ05-14 actuators, rising signal opens valve

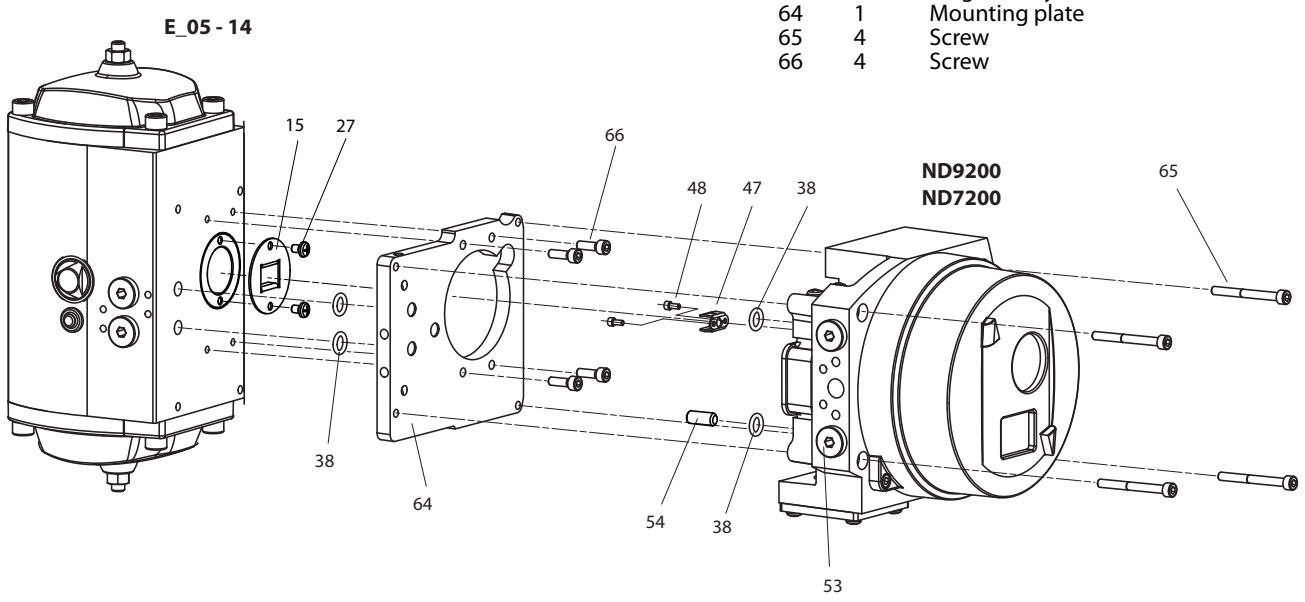
### ND9100, ND7100

| Item | Qty | Description |
|---|---|---|
| 4 | 3 | Screw |
| 15 | 1 | Coupling |
| 27 | 2 | Screw |
| 38 | 2 | O-ring |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 49 | 1 | O-ring |
| 53 | 2 | Plug |
| 54 | 1 | Plug (EJ only) |



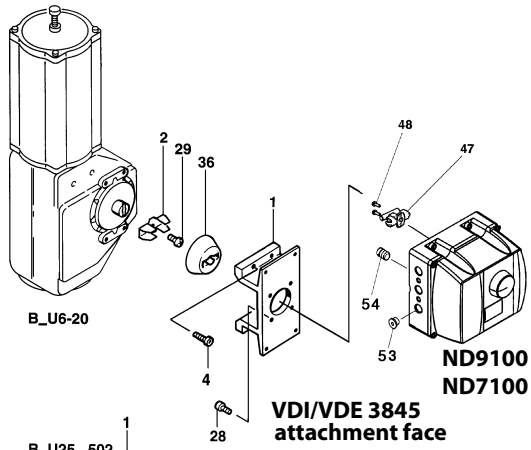

### ND9200, ND7200

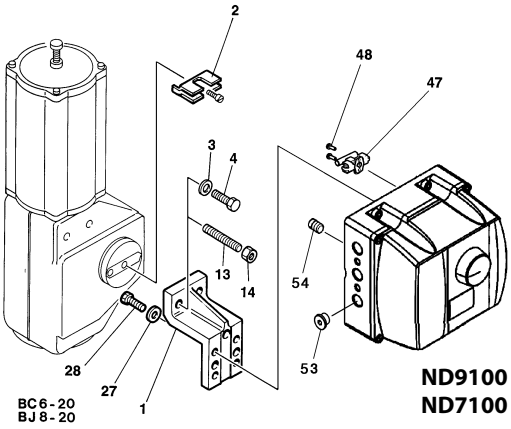
| Item | Qty | Description |
|---|---|---|
| 15 | 1 | Coupling |
| 27 | 2 | Screw |
| 38 | 4 | O-ring |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 53 | 2 | Plug |
| 54 | 1 | Plug (EJ only) |
| 64 | 1 | Mounting plate |
| 65 | 4 | Screw |
| 66 | 4 | Screw |

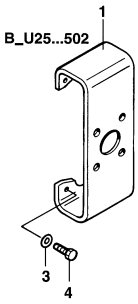


## 12.6 Mounting parts for B1C/B1J 6-20 actuators

### ND9100, ND7100



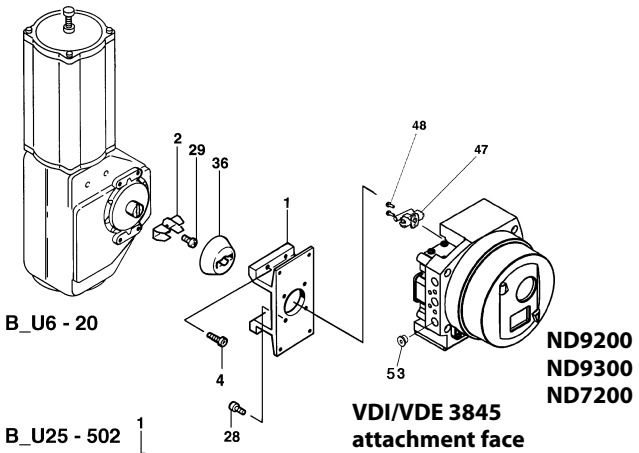



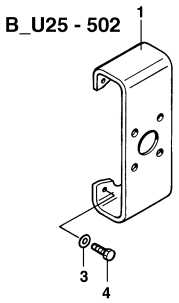




| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Mounting bracket |
| 2 | 1 | Ear |
| 3 | 4 | Washer |
| 4 | 4 | Screw |
| 28 | 4 | Screw |
| 29 | 1 | Screw |
| 36 | 1 | Couplings jacket |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 53 | 1 | Plug (BJ actuators only) |
| 54 | 2 | Plug |

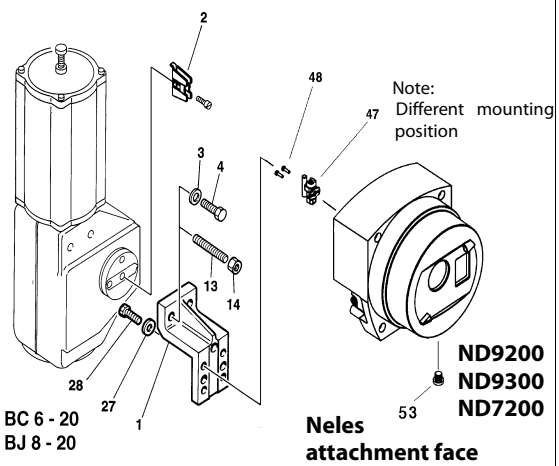
| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Mounting bracket |
| 2 | 1 | Draught piece |
| 3 | 4 | Washer |
| 4 | 4 | Screw |
| 13 | 2 | Screw |
| 14 | 2 | Hexagon nut |
| 28 | 4 | Screw |
| 29 | 1 | Screw |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 53 | 1 | Plug (BJ actuators only) |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

### ND9200, ND9300, ND7200




| 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) |

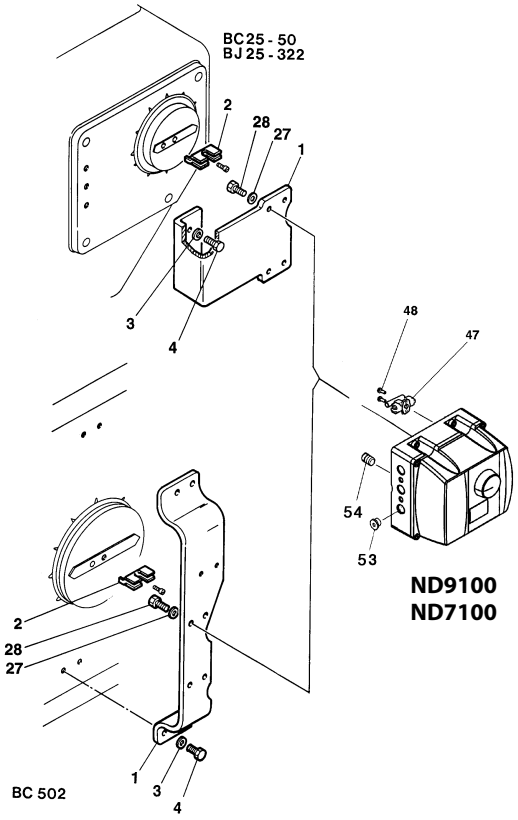



| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Mounting bracket |
| 2 | 1 | Draught piece |
| 3 | 4 | Washer |
| 4 | 4 | Screw |
| 13 | 2 | Screw |
| 14 | 2 | Hexagon nut |
| 28 | 4 | Screw |
| 29 | 1 | Screw |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 53 | 1 | Plug (BJ actuators only) |

**Note: See 12.7 for old series B actuators**

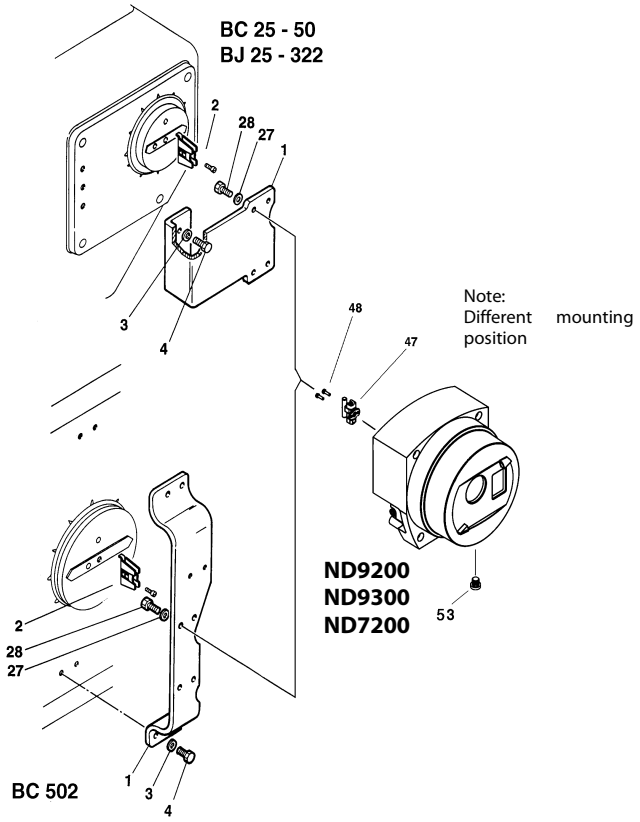
## 12.7 Mounting parts for B1C/B1J 25-50, B1C 502 and B1J322 actuators

### ND9100, ND7100

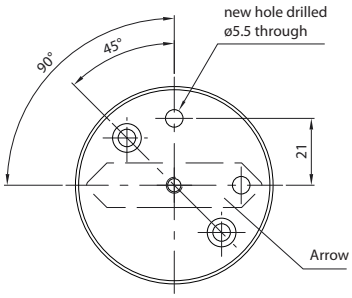



| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Mounting bracket |
| 2 | 1 | Draught piece |
| 3 | 4 | Washer |
| 4 | 4 | Screw |
| 27 | 4 | Washer |
| 28 | 4 | Screw |
| 47 | 1 | Coupler socket |
| 48 | 2 | Screw |
| 53 | 1 | Plug (BJ actuators only) |
| 54 | 2 | Plug |

### ND9200, ND9300, ND7200



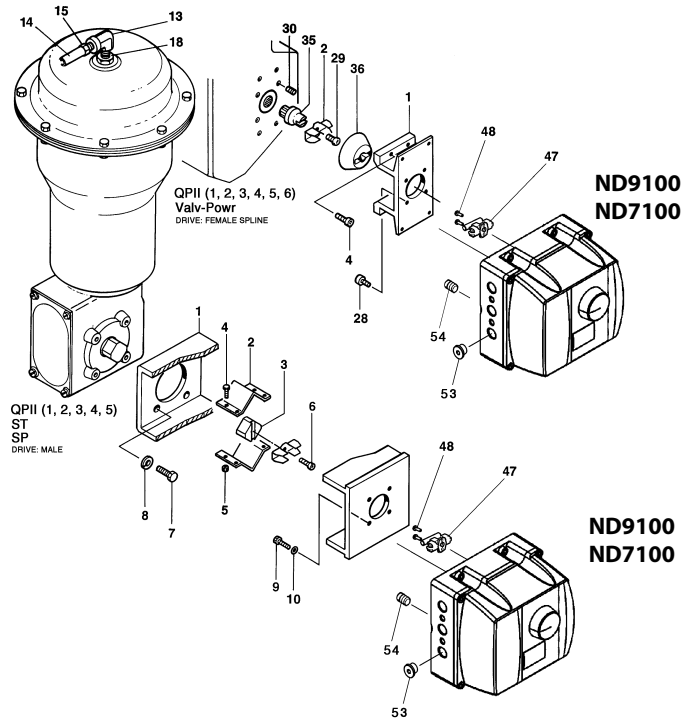

**Note: Old series B actuators**




| 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) |

## 12.8 Mounting parts for Quadra-Powr® actuators

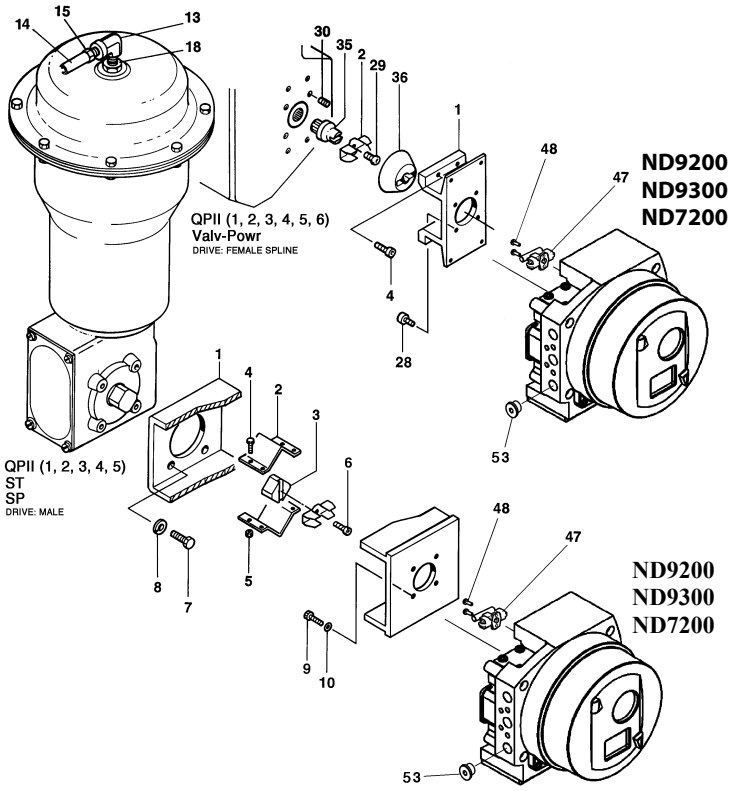
### ND9100, ND7100




| 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

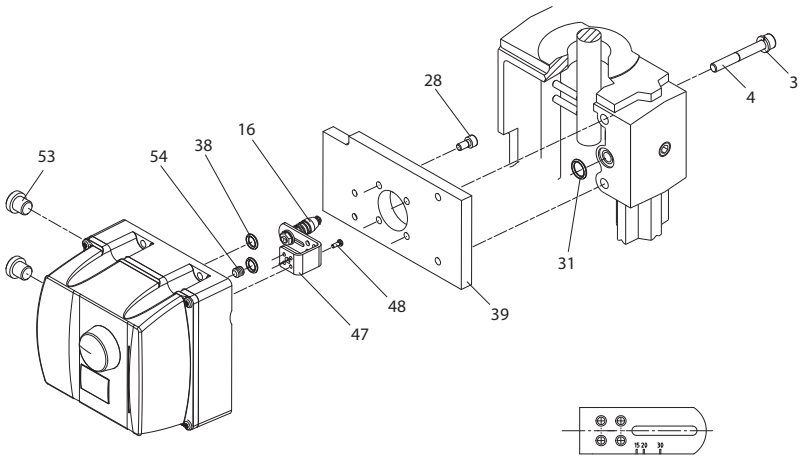



| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Mounting bracket |
| 2 | 1 | Ear |
| 4 | 4 | Screw |
| 28 | 4 | Screw |
| 29 | 1 | Screw |
| 30 | 4 | Screw |
| 35 | 1 | Adapter plug (QP II 1/S- 6/S only) |
| 35 | 1 | Adapter plate (QP II 2B/K thr. 6_/K) |
| 36 | 1 | Couplings jacket |
| 47 | 1 |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

## 12.9 Mounting parts for linear actuators of nelesCV Globe

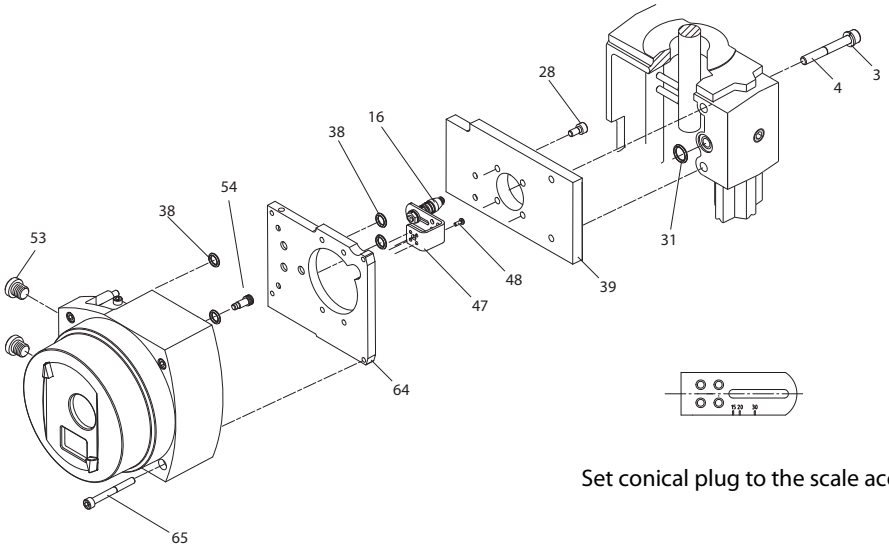
### ND9100, ND7100




Set conical plug to the scale according to the stroke

| Item | Qty | Description |
|---|---|---|
| 3 | 2 | Washer |
| 4 | 2 | Screw |
| 16 | 1 | Conical plug |
| 28 | 4 | Screw |
| 31 | 1 | O-ring |
| 38 | 2 | O-ring |
| 39 | 1 | Mounting plate |
| 47 | 1 | Feedback lever |
| 48 | 4 | Screw |
| 53 | 2 | Plug |
| 54 | 1 | Plug |

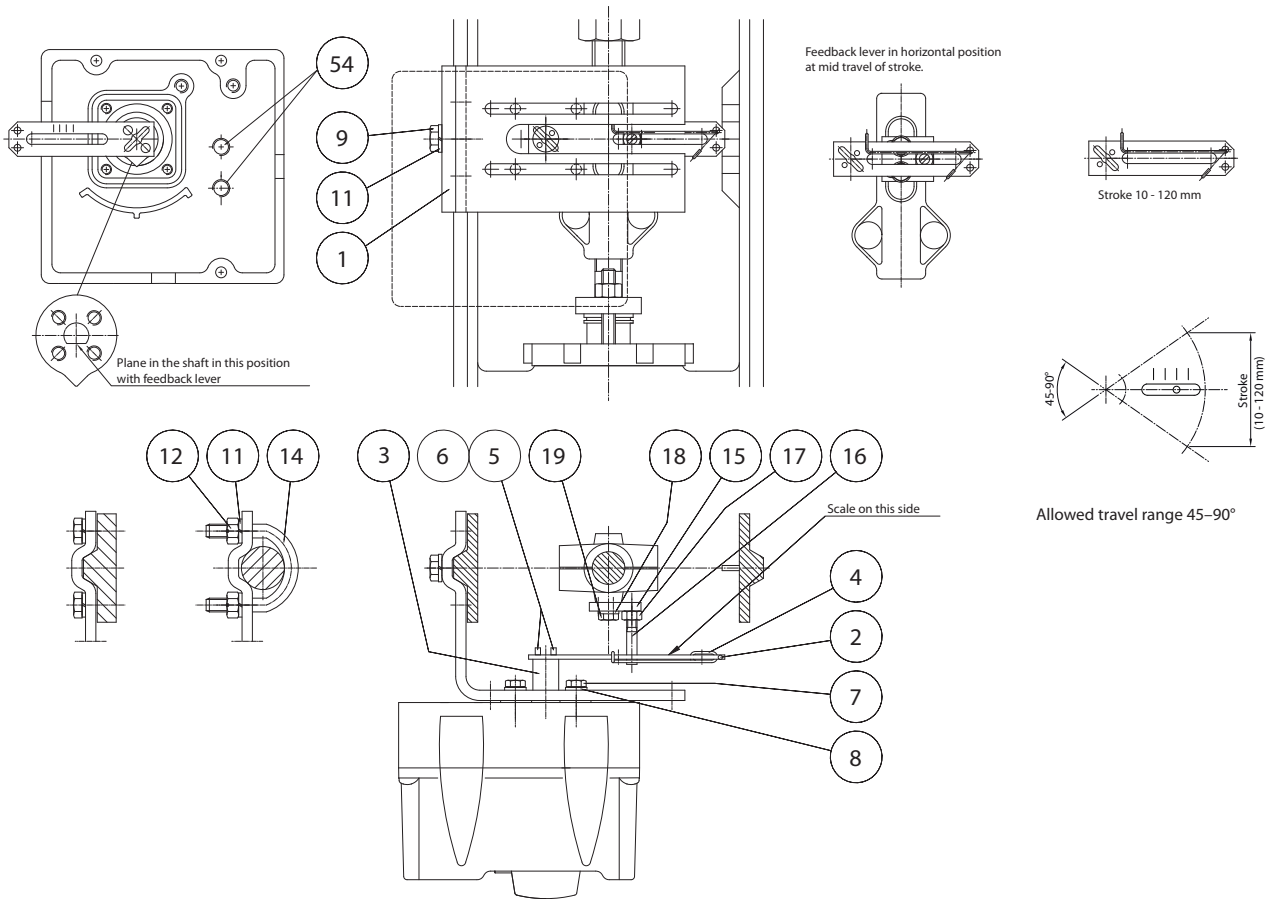
### ND9200, ND7200




Set conical plug to the scale according to the stroke

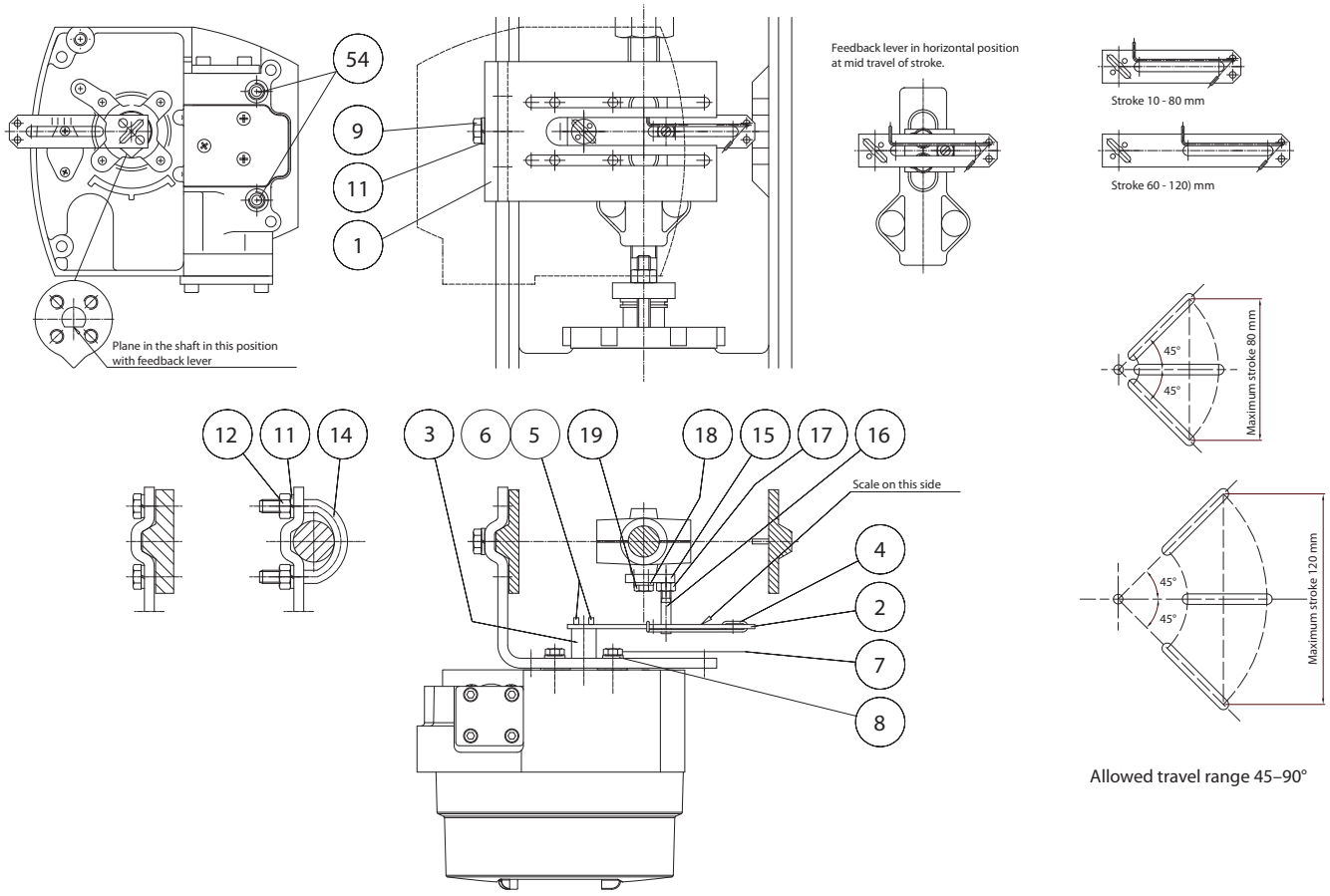
| Item | Qty | Description |
|---|---|---|
| 3 | 2 | Washer |
| 4 | 2 | Screw |
| 16 | 1 | Conical plug |
| 28 | 4 | Screw |
| 31 | 1 | O-ring |
| 38 | 2 | O-ring |
| 39 | 1 | Mounting plate |
| 47 | 1 | Feedback lever |
| 48 | 4 | Screw |
| 53 | 2 | Plug |
| 54 | 1 | Plug |
| 64 | 1 | Mounting plate |
| 65 | 4 | Screw |

## 12.10 Mounting parts for linear actuators, IEC 60534
## 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

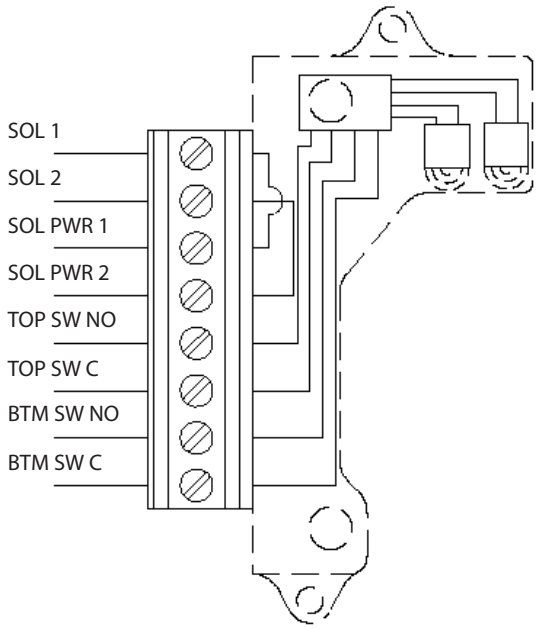



| Item | Qty | Description |
|---|---|---|
| 1 | 1 | Bracket |
| 2 | 1 | Feedback lever |
| 3 | 1 | Filling piece |
| 4 | 1 | Clearance remove spring |
| 5 | 4 | Cross rec head screw |
| 6 | 4 | Washer |
| 7 | 4 | Hexagon screw |
| 8 | 4 | Washer |
| 9 | 4 | Hexagon screw |
| 11 | 4 | Spring washer |
| 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 |

## 12.11 Connection diagrams

See Section 9.1.3 for additional limit switch data.

### ND9000/D33

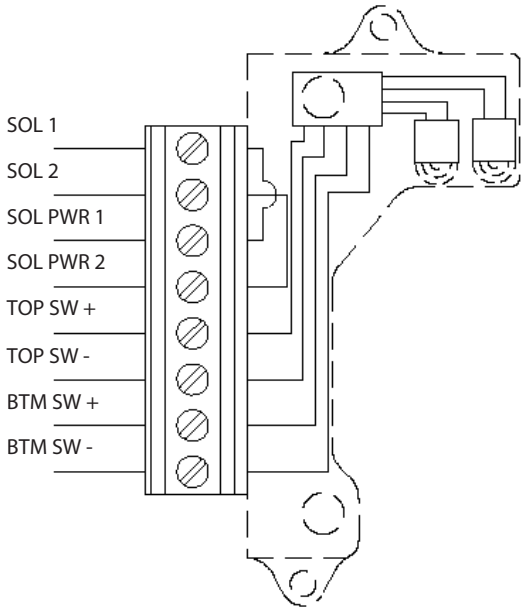



Connections SOL1, SOL2, SOL PWR1 and SOL PWR2 are not used.

TOP SW NO: Positive connection for top switch
TOP SW C: Negative connection for top switch
BTM SW NO: Positive connection for bottom switch
BTM SW C: Negative connection for bottom switch

See Section 9.1.3.1 for electrical ratings.

### ND9000/D44

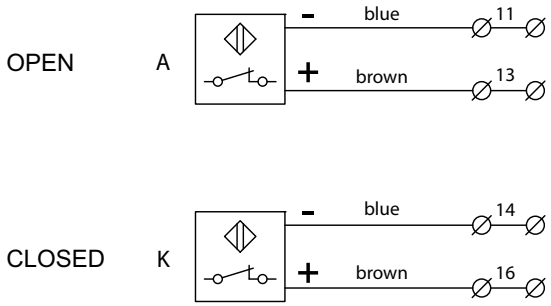



Connections SOL1, SOL2, SOL PWR1 and SOLP WR2 are not used.

TOP SW +: Positive connection for top switch
TOP SW -: Negative connection for top switch
BTM SW +: Positive connection for bottom switch
BTM SW -: Negative connection for bottom switch

See Section 9.1.3.1 for electrical ratings.

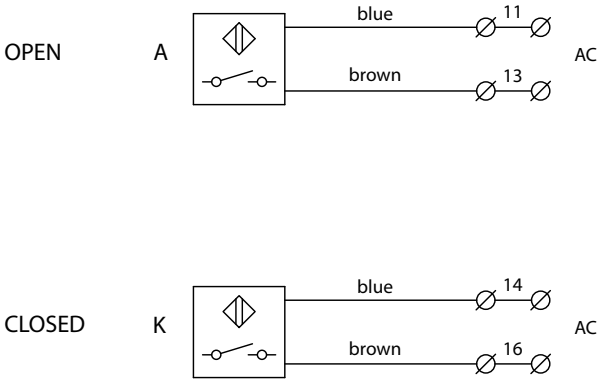
## ND9000/I02, I09




**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.

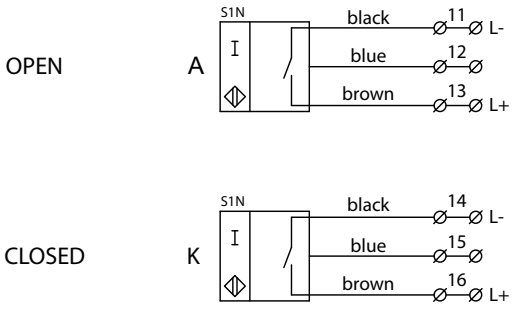
## ND9000/I32




**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.

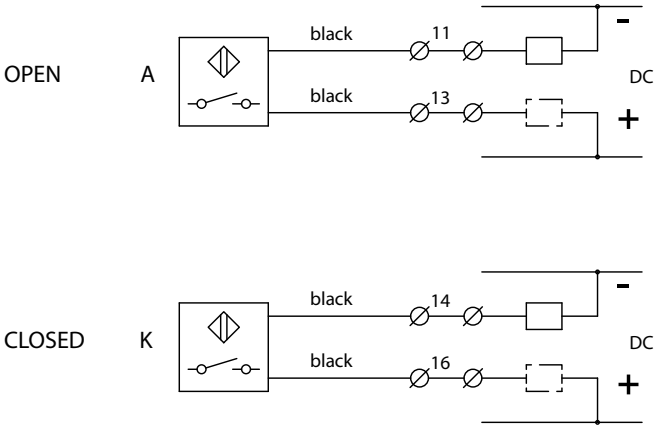
## ND9000/I45




**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/I56

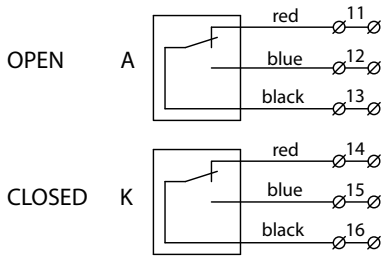



**Factory adjustment**

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.

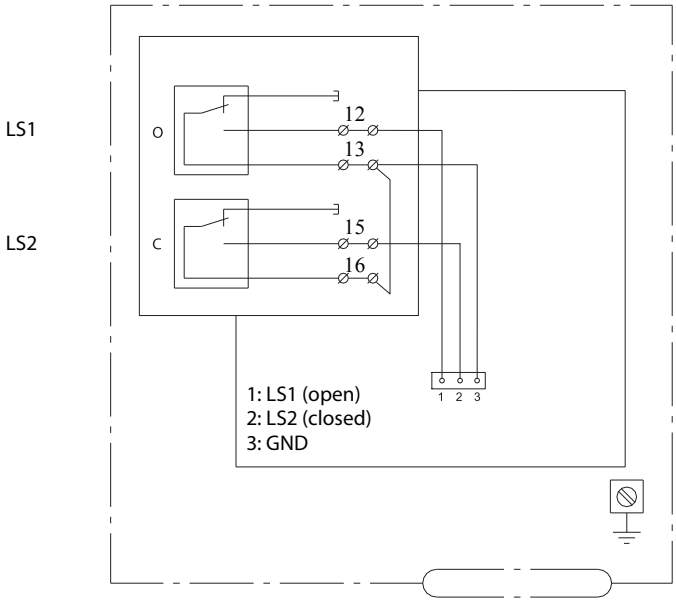
Connections: Load can be connected to + or -.

## 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

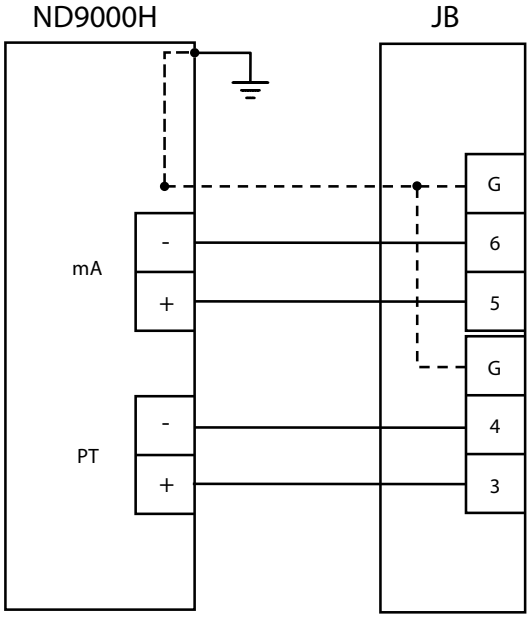



Bus powered switches, no external connections.

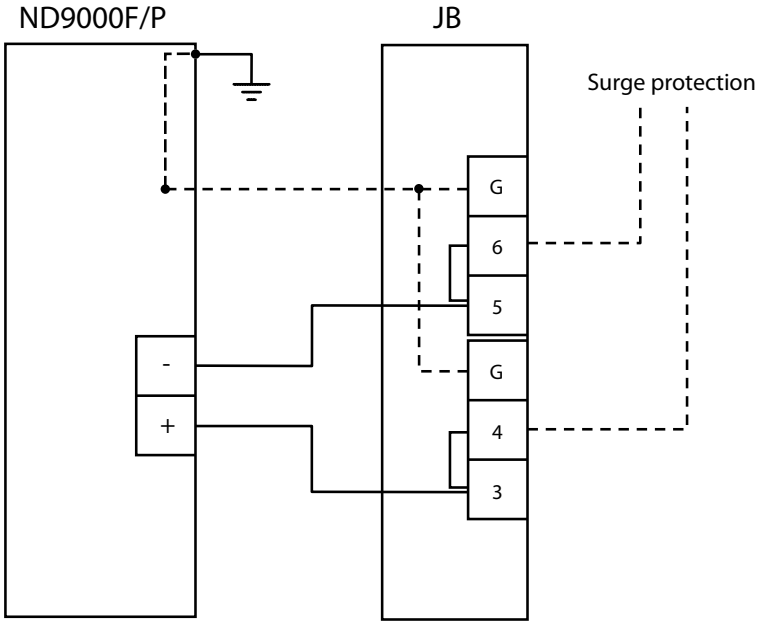
**Microswitch**

OMRON D2VW-01
Gold plated contacts
Bus Powered, no external power needed.
Temperature range: -40° to +85 °C / -40° to +185 °F.

**ND9000H_J**



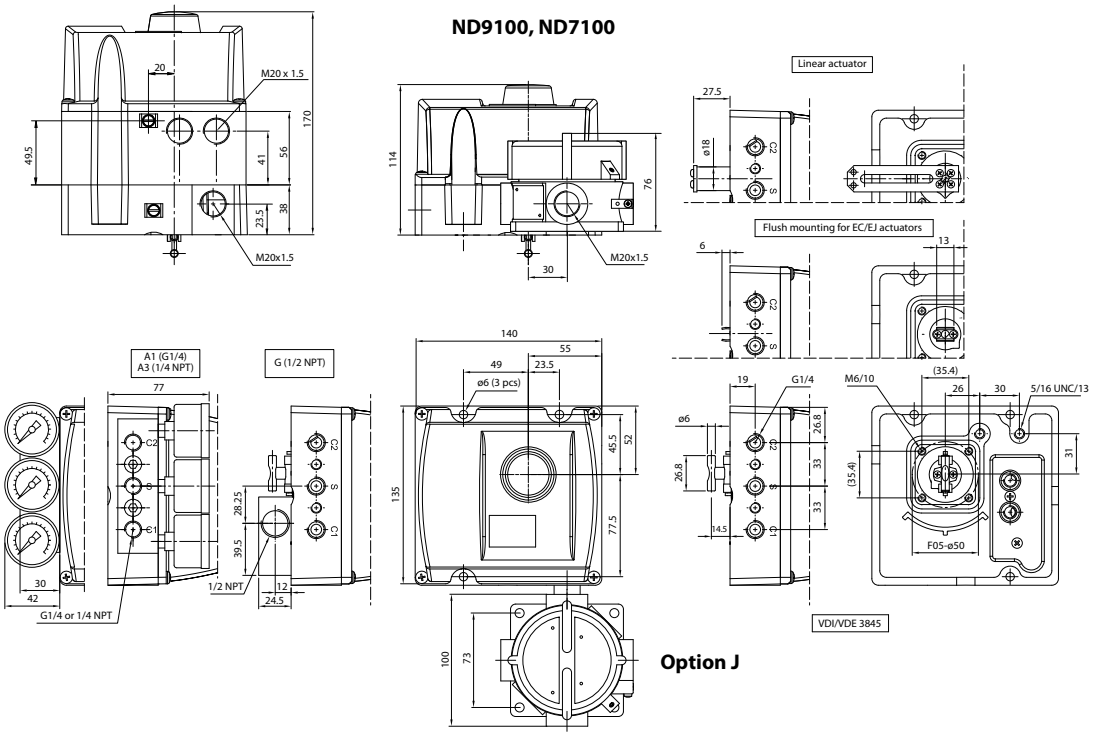

**ND9000F_J, ND9000P_J**



# 13 DIMENSIONS

## ND9100, ND7100

### ND9100/D, ND9100/I, ND9100/K and ND9100/B



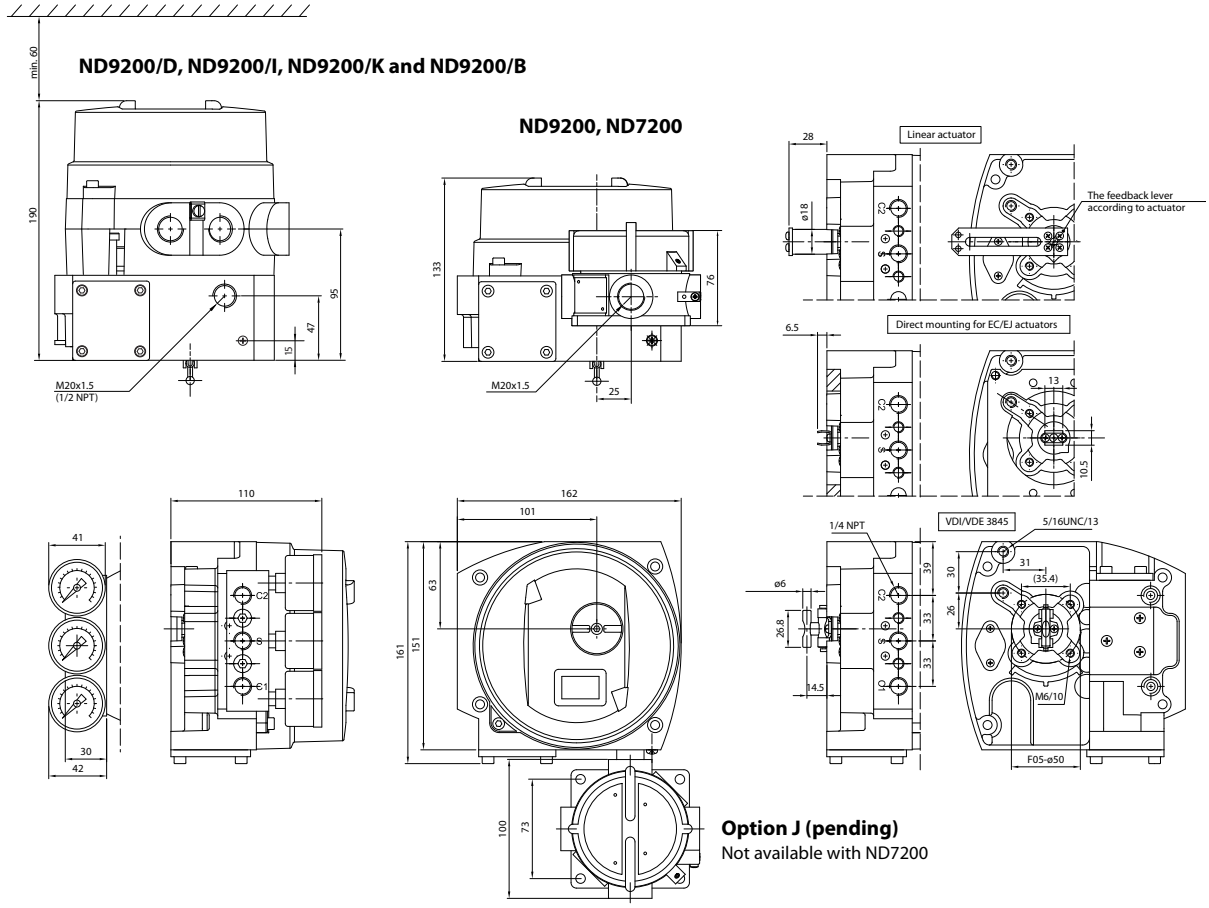

### ND9100, ND7100




**Option J**

## ND9200, ND7200

### ND9200/D, ND9200/I, ND9200/K and ND9200/B

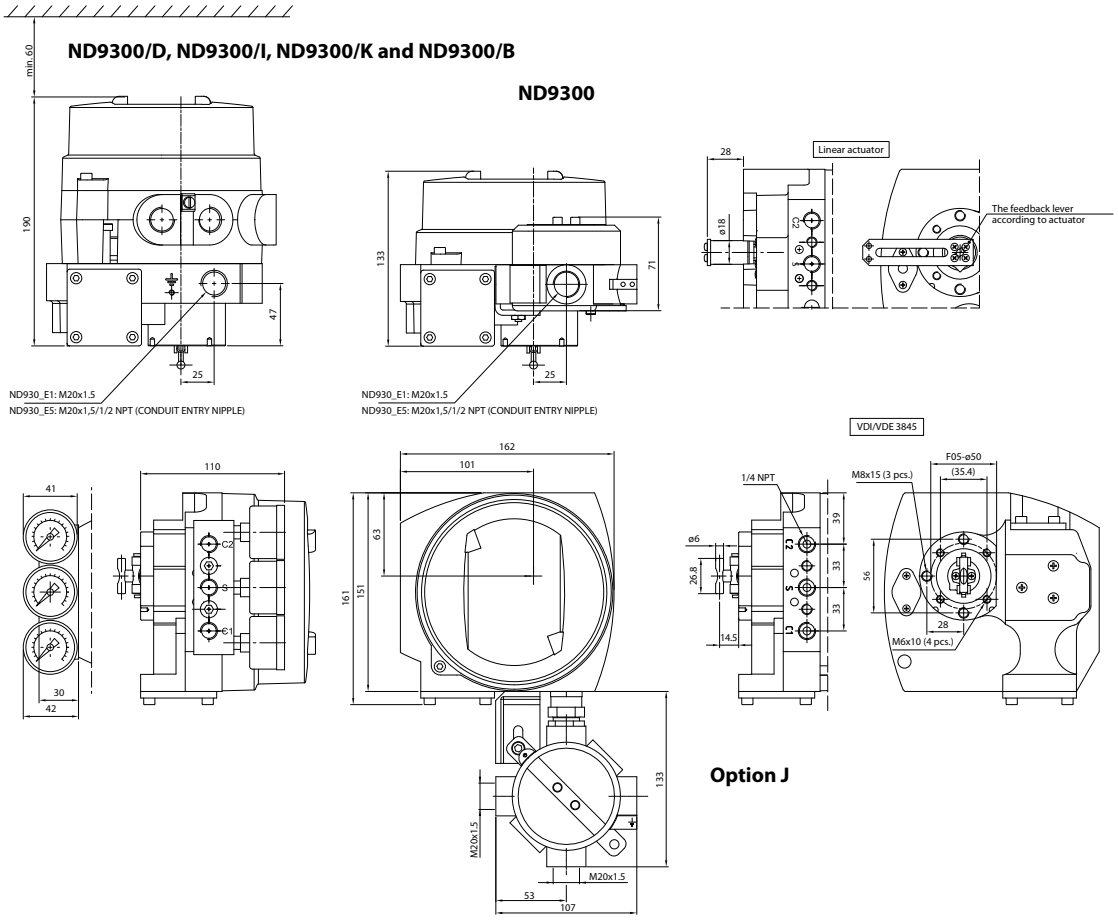



### ND9200, ND7200




**Option J (pending)**
Not available with ND7200

## ND9300


ND9300/D, ND9300/I, ND9300/K and ND9300/B
ND9300
min. 60
190
47
25
ND930_E1: M20x1.5
ND930_E5: M20x1,5/1/2 NPT (CONDUIT ENTRY NIPPLE)
133
71
25
ND930_E1: M20x1.5
ND930_E5: M20x1,5/1/2 NPT (CONDUIT ENTRY NIPPLE)
Linear actuator
28
ø18
C2
S
C1
The feedback lever
according to actuator
41
30
42
110
C2
S
C1
162
101
63
161
151
133
M20x1.5
M20x1.5
53
107
VDI/VDE 3845
1/4 NPT
ø6
26.8
14.5
39
33
33
C2
S
C1
F05-ø50
(35.4)
M8x15 (3 pcs.)
56
28
M6x10 (4 pcs.)
Option J

# 14 EC DECLARATION OF CONFORMITY

## EC DECLARATION OF CONFORMITY

Manufacturer:
Metso Automation Oy
01301 Vantaa
Finland

Product: **Intelligent Valve Controller Neles ND 9000- and ND 7000-series**

Approvals:

| Type | Approval | EC Type examination Certificate |
|---|---|---|
| ND9…PA (Profibus PA) | (EMC 2004/108/EC) EN61000-6-2(2001) | NEMKO 101425 & NEMKO 1052749 |
| ND9…F (Foundation Fieldbus) | (EMC 2004/108/EC) EN61000-6-2(2001) | (Same HW as ND9...PA) |
| ND9…HNT (Hart)<br>ND7...HNT (Hart) | (EMC 2004/108/EC) EN61000-6-4(2007)<br>EN61000-6-2(2005), FCC 47 CFR Part 15 subpart B, Class B (2002) | NEMKO 188949 & NEMKO 194947 |
| ND910.HX, X1, X2, X3<br>ND910.FX, X1, X2, X3<br>ND910.PX, X1, X2, X3<br>ND930.HX, X1, X2, X3<br>ND930.FX, X1, X2, X3<br>ND930.PX, X1, X2, X3<br>ND710.HX | ATEX II 1 G Ex ia IIC T6...T4 Ga<br>ATEX II 1 D Ex ta IIIC T90 °C Da | VTT 09ATEX 033X<br>EN 60079-0: 2012,<br>EN 60079-11: 2012,<br>EN 60079-26: 2007,<br>EN 60079-31:2009 |
| | ATEX II 2 G Ex ib IIC T6...T4 Gb<br>ATEX II 2 D Ex tb IIIC T90 °C Db | |
| | ATEX II 3 G Ex nA IIC T6...T4 Gc<br>ATEX II 3 D Ex tc IIIC T90 °C Dc | VTT 09ATEX 034X<br>EN 60079-0: 2012,<br>EN 60079-11: 2012,<br>EN 60079-15: 2010,<br>EN 60079-31:2009 |
| | ATEX II 3 G Ex ic IIC T6...T4 Gb<br>ATEX II 3 D Ex tc IIIC T90 °C Dc | |
| ND920...E1, ND930...E1<br>ND720...E1 | ATEX II 2 G Ex d IIC T6...T4 Gb<br>ATEX II 2 D Ex tb IIIC T80 °C...T105 °C Db | SIRA 11 ATEX 1006X<br>EN 60079-0:2012, EN 60079-1:2007<br>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 2004/108/EC | Electrical |
| ATEX 94/9/EC | Approved and Ex marked types |

**ATEX Notified Bodies for EC Type Examination Certificate:**
**SIRA** (Notified body number 0518)
Sira Certification Service
Rake Lane, Eccleston, Chester, CH4 9JN
England

**VTT** (Notified body number 0537)
VTT, Expert Services
Otakaari 7B, Espoo
P.O.Box 1000, FI-02044 VTT
Finland

**ATEX Notified Body for Quality Assurance:**

| | |
|---|---|
| ISO 9001:2008 | Certificate No: 73538-2010-AQ-FIN-FINAS |
| ATEX 94/9/EC Annex IV | Certificate No: DNV-2006-OSL-ATEX-0260Q |

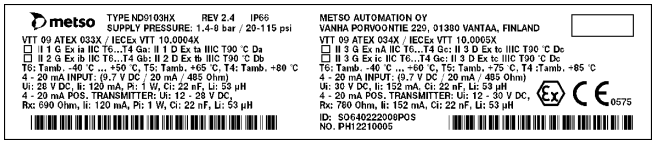
**Det Norske Veritas AS** (Notified body number 0575)
Veritasveien 1
1322 Høvik, Oslo
Norway

Vantaa 5th June 2013

Ralf Liljestrand, Quality Manager
Authorized person of the manufacturer within the European Community

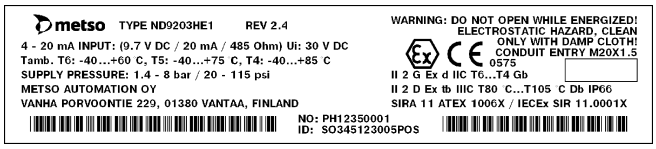
# 15 ID PLATES

## 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

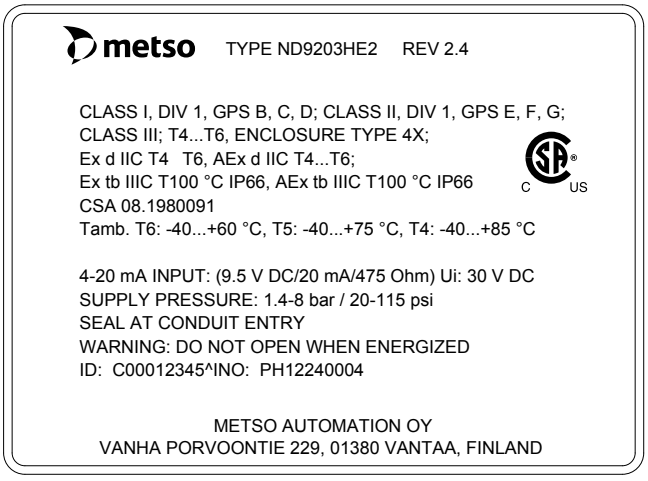




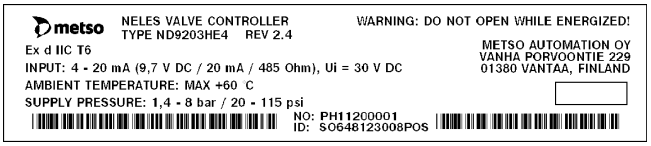
## ATEX / IECEx: II 2 G Ex d , II 2D Ex tb IIIC



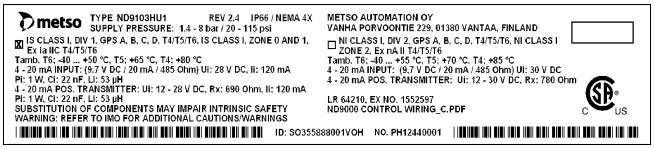

## cCSAus: Explosion proof



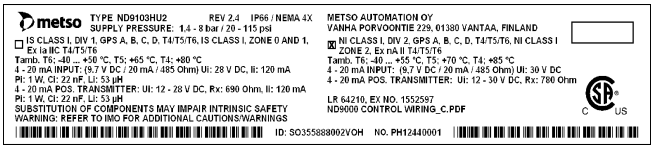

## TIIS (JIS): Ex d




## 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 valve controller with universal shaft and attachment face according to standard VDI/VDE 3845.<br>Relevant shaft adapter included in mounting kits. When valve controllers are separate deliveries, shaft adapter kit is supplied. |

| **3.** | **ENCLOSURE** |
|---|---|
| **1** | Standard IP66 / NEMA 4X enclosure. |
| **2** | Flameproof (Ex d) IP66 / NEMA 4X enclosure. |
| **3** | Stainless steel 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 (ND9100 series),<br>1/4 NPT (ND9200/ND9300 series). |
| **03** | Medium capacity. Stroke volume of actuator 1–3 $dm^3$. | G 1/4 (ND9100 series),<br>1/4 NPT (ND9200/ND9300 series). |
| **06** | High capacity. Stroke volume of actuator > 3 $dm^3$. | G 1/4 (ND9100 series),<br>1/4 NPT (ND9200/ND9300 series). |

| **5.** | **COMMUNICATION / INPUT SIGNAL RANGE** |
|---|---|
| **H** | 4–20 mA, HART communication.<br>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.<br>Temperature range -40° to +85 °C.<br>Not applicable to 3. sign "20". |
| **X**<br>**(X1)**<br>**(X2)**<br>**(X3)** | **ATEX and IECEx certifications:**<br>II 1 G Ex ia IIC T6...T4 Ga  II 2 G Ex ib IIC T6...T4 Gb<br>II 1 D Ex ta IIIC T90 °C Da  II 2 D Ex tb IIIC T90 °C Db<br>Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C.<br><br>II 3 G Ex nA IIC T6...T4 Gc  II 3 D Ex tc IIIC T90 °C Dc<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C .<br><br>II 3 G Ex ic IIC T6...T4 Gc  II 3 D Ex tc IIIC T90 °C Dc<br>Ex ic IIC T6...T4<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C.<br><br>Not applicable to 3. sign "20".<br>Available without limit switches or with ATEX or IECEx certified inductive limit switches.<br>M20 x 1.5 conduit entry.<br>With limit switch temperature range is updated according to switch type. |
| **U**<br>**(U1)**<br>**(U2)** | **cCSAus certifications (pending):**<br>IS Class I, Division 1, Groups A, B, C, D, T4...T6<br>IS Class I, Zone 0, AEx ia, IIC T4...T6<br>Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C.<br><br>NI Class I, Division 2, Groups A, B, C, D, T4...T6.<br>NI Class I, Zone 2, Ex nA IIC T4...T6.<br>Temperature range: T4: -40° to +85 °C; T5: < +70 °C ; T6: < +55 °C.<br>No Zener Barrier needed.<br>Not applicable to 3. sign "20".<br>1/2 NPT conduit entry.<br>With limit switch temperature range is updated according to switch type. |

| **6.** | **APPROVALS FOR HAZARDOUS AREAS** |
|---|---|
| **Z** | **INMETRO certifications:**<br>Ex ia IIC T4/T5/T6 Ga  Ex ia IIC T4/T5/T6<br>Ex ia IIC T4/T5/T6 Gb<br>Temperature range: T4: -40° to +80 °C; T5: < +65 °C; T6: < +50 °C.<br><br>Ex nA IIC T4/T5/T6 Gc<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C.<br><br>Ex ic IIC T4/T5/T6 Gc  Ex ic IIC T4/T5/T6<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C.<br><br>Not applicable to 3. sign "20".<br>Available without limit switches or with IECEx certified inductive limit switches.<br>M20 x 1.5 conduit entry.<br>With limit switch temperature range is updated according to switch type. |
| **E1** | **ATEX and IECEx certifications:**<br>II 2 G Ex d IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T80 °C...T105 °C Db<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C ; T6: < +60 °C.<br>Not applicable to 3. sign "10".<br>M20 x 1.5 conduit entry<br>**ND92_HE1, ND93_HE1:**<br>Ui ≤ 30 V.<br>**ND92_FE1, ND92_PE1, ND93_FE1 and ND93_PE1:**<br>Ui ≤ 32 V. |
| **E2** | **cCSAus certification:**<br>Class I, Div 1, Groups B, C, D; Class II, Div 1, Groups E, F, G; Class III; T4…T6, Enclosure type 4X<br>Ex d IIC T4…T6<br>AEx d IIC T4…T6<br>Ex tb IIIC T100 °C IP66<br>AEx tb IIIC T100 °C IP66<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C ; T6: < +60 °C.<br>Not applicable to 3. sign "10"<br>Not applicable with limit switch 8. sign "I56".<br>1/2 NPT conduit entry. |
| **E4** | **TIIS (JIS) certifications:**<br>Ex d II C T6<br>Temperature range: T6; -20° to +60 °C.<br>Applicable only to 3. sign "20".<br>Applicable only to 5. sign "H".<br>Not available with any limit switches (8. sign "I" or "K").<br>G 1/2 or 1/2 NPT conduit entry.<br>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:<br>**CG42:** G 1/2 Conduit entry and Cable entry adapter.<br>**CG41:** 1/2 NPT Conduit entry and Cable entry adapter. |
| **E5** | **INMETRO certification:**<br>Ex d IIC T4/T5/T6 Gb<br>Ex tb IIIC T100 °C Db IP66<br>Temperature range: T4: -40° to +85 °C; T5: < +75 °C; T6: < +60 °C.<br>Not applicable to 3. sign "10".<br>M20 x 1.5 conduit entry. |

| 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.<br><br>**ND91_HXT, ND93_HXT, ND91_HZT, ND93_HZT:**<br>II 1 G Ex ia IIC T6...T4 Ga<br>II 1 D Ex ta IIIC T90 °C Da<br>II 2 G Ex ib IIC T6...T4 Gb<br>II 2 D Ex tb IIIC T90 °C Db<br>Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–690 Ω.<br><br>**ND91_HXT, ND93_HXT, ND91_HZT, ND93_HZT:**<br>II 3 G Ex nA IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc<br>Ui ≤ 30 V, Ii ≤ 152 mA<br><br>II 3 G Ex ic IIC T6...T4 Gc<br>II 3 D Ex tc IIIC T90 °C Dc<br>Ui ≤ 30 V, Ii ≤ 152 mA, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–780 Ω.<br><br>**ND91_HU1T and ND93_HU1T:**<br>Ui ≤ 28 V, Ii ≤ 120 mA, Pi ≤ 1 W, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–690 Ω.<br>**ND91_HU2T and ND93_HU2T:**<br>Ui ≤ 30 V, Pmax = device limits itself, Ci ≤ 22 nF, Li ≤ 53 µH, external load resistance 0–780 Ω.<br>**ND92_HE1T, ND92_HE2T, ND92_HE4T, ND92_HE5T, ND93_HE1T, ND93_HE5T:**<br>Ui ≤ 30 V, Pmax = device limits itself, external load resistance 0–780 Ω.<br><br>Applicable to 5. sign "H". |
| **J** | **ND91_H and ND93_H:**<br>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.<br><br>**ND91_F, ND93_F, ND91_P and ND93_P:**<br>External junction box for wirings, including option for parallel connection of external surge protector.<br>Junction box is connected to the enclosure,<br>2 pcs. M20 x 1.5 conduit entry.<br><br>Applicable to 6. sign "N", "X", "Z". "E1" pending. |
| **G** | Exhaust adapter. ND9100: 1x 1/2 NPT thread, ND9200 and ND9300: 2 x 1/2 NPT thread. |
| **Y** | Special construction. |

| 8. | LIMIT SWITCH TYPE |
|---|---|
| | **Inductive proximity switches,** 2 pcs.<br>IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.).<br>Option E2: 1/2 NPT conduit entry (2 pcs.). |
| **D33** | Metso; SST Sensor Dual Module, NO, 8–125 V DC / 24–125 V AC<br>Temperature range -40° to +82 °C / -40° to +179 °F.<br>Applicable to 6. sign "N", "E1", "E2" and "E5". |
| **D44** | Metso; Namur Sensor Dual Module, 6–29 V DC, > 3 mA; < 1 mA.<br>Temperature range -40° to +82 °C / -40° to +179 °F.<br>Applicable to 6. sign "N", "U", "E1", "E2" and "E5". |
| **I02** | P+F; NJ2-12GK-SN, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NC.<br>Temperature range: -40° to +85 °C / -40° to +185 °F.<br>Not applicable to 6. sign "E4". |
| **I09** | P+F; NCB2-12GM35-N0, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NC<br>Temperature range: -25° to +85 °C / -13° to +185 °F.<br>Not applicable to 6. sign "E4". |
| **I32** | Omron E2E-X2Y1, 2-wire type; AC; <100 mA; 24–240 V AC.<br>Temperature range: -40° to +85 °C / -40° to +185 °F.<br>Applicable to 6. sign "N".<br><br>Temperature range: -25° to +75 °C / -13° to +167 °F.<br>Applicable to 6. sign "E1", "E2 and "E5". |
| **I45** | P+F; NJ3-18GK-S1N, 2-wire type, DC; > 3 mA; < 1 mA, NAMUR NO.<br>Temperature range: -25° to +85 °C / -13° to +185 °F.<br>Not applicable to 6. sign "E4". |
| **I56** | ifm; IFC2002-ARKG/UP, 2-wire type, DC; 150 mA, 10–36 V DC, leakage current < 0.6 mA.<br>Temperature range: -20° to +85 °C / -4° to +185 °F.<br>Not applicable to 6. sign "X", "Z", "U", "E2" and "E4". |
| | **Mechanical micro switches,** 2 pcs.<br>IP66 / NEMA 4X enclosure.<br>M20 x 1.5 conduit entry (2 pcs.).<br>Option E2: 1/2 NPT conduit entry (2 pcs.). |
| **K05** | Omron D2VW-5, 3 A - 250 V AC, 0.4 A - 125 V DC, 5 A - 30 V DC.<br>Temperature range: -40° to +85 °C / -40° to +185 °F.<br>Not applicable to 6. sign "X", "Z", "U" and "E4". |
| **K06** | Omron D2VW-01, gold plated contacts, 100 mA - 30 V DC / 125 V AC.<br>Temperature range: -40° to +85 °C / -40° to +185 °F.<br>Not applicable to 6. sign "X", "Z", "U" and "E4". |
| | **Bus powered mechanical micro switches,** 2 pcs.<br>Applicable to ND9000F and ND9000P only.<br>IP66 / NEMA 4X enclosure. M20 x 1.5 conduit entry (2 pcs.).<br>Option E2: 1/2 NPT conduit entry (2 pcs.). |
| **B06** | Omron D2VW-01, gold plated contacts; Bus Powered, no external power needed.<br>Temperature range: -40° to +85 °C / -40° to +185 °F.<br>Not applicable to 5. sign "H".<br>Not applicable to 6. sign "U" and "E4". |

| 9. | OPTIONS OF LIMIT SWITCH |
|---|---|
| **Y** | Special construction. |