TYPE CODING

VALVE CONTROLLER (ND820) / LIMIT SWITCH (ND820/K00 OR ND820/I00)

1.	2.	3.	4.	5.		6.		7.	8.	9.
ND	8	2	2		/	S1	/	K	05	

1. sign	PRODUCT GROUP
ND	Valve controller

2. sign	SERIES CODE
8	

3. sign	INPUT SIGNAL RANGE
2	4-20 mA

4. sign	SPOOL VALVE	CONNECTIONS (S, C1, C2)
1	Ø 1 mm, double acting, only with EC actuators	1/4 NPT, G1/4 (S4)
2	Ø 2 mm, double acting	1/4 NPT
6	Ø 6 mm, double acting	1/4 NPT
11	Ø 1 mm, 3-way spool valve, single action, only with EJ actuators	1/4 NPT, G1/4 (S4)
21	Ø 2 mm, 3-way spool, single action	1/4 NPT
61	Ø 6 mm, 3-way spool, single action	1/4 NPT

5. sign	ACTION
	Double action, without sign. 4th sign should be 1, 2 or 6. In connection with B_CU4 to B_CU11, EC50 and RC12 actuators 4th sign must be 2. In connection with ECS and EC07 actuators 4th sign must be 1.
	Single action, without sign. 4th sign should be 21 or 61. In connection with B_JR, QP1, QP2, EJ07 and EJ10 actuators 4th sign should be 21. In connection with EJ05 4th sign must be 11. Not applicable with double acting actuators.
A	Single action, linear motion, applicable to Metso Automation D/R series diaphragm actuator. Not applicable to attachment face according to VDI/VDE 3845 (6th sign S1). 21A is for RA and DA. 61A is for RB, RC, RD, RE and DB, DC, DE. Also applicable to linear actuators acc. to IEC 60534-6-1 with own linkage acc. 4th sign 21 or 61 acc. to stroke volume for single action. Specify the stroke (20-60 mm or 60-100 mm).

6. sign	OPTIONS
	Standard, IP 65 enclosure, NEMA 4 and 4X. Built-in display and local keypad. PG 13,5 conduit entry. Without sign. Temperature range -20...+85 °C / -4...+185 °F. Load voltage max 13.5 VDC at 20 mA corresponding 675 Ω (max. voltage drop). Supply voltage ≤ 30 VDC.
C	Low temperature, -40 °C / -40 °F.
F	Valve controller without HART. Available with standard, X, XU, ZU and NU constructions.
X	ATEX II 1 G EEx ia IIC T5/T6 (EN 50014, EN 50020, EN 50284) or ATEX II 2 G EEx ia IIC T5/T6 (With option T9X.) and ATEX II 3 G EEx nL IIC T5/T6 (EN 50014, EN 50021) and Ex nL IIC T5/T6 (IEC 60079-15: 2001) and Ex N IIC T5/T6 (BS 6941: 1988) Temperature range T5: -20...+65 °C / -4...+149 °F, T6: +50 °C / +122 °F. Load voltage up to 13.5 VDC / 675 Ω / 20 mA. (Maximum voltage drop/supply voltage 30 VDC.)
XU	CSA Class 1, Div. 1 and 2 Groups A, B, C & D certification. 1/2 NPT conduit entry. Temperature range -20...+70 °C / -4...+158 °F. Load voltage max. 13.5 VDC / 675 Ω / 20 mA (max. voltage drop).
ZU	CSA Class 1, Div. 2 Groups A, B, C & D certification. 1/2 NPT conduit entry. Temperature range -20...+70 °C / -4...+158 °F. Load voltage max. 13.5 VDC / 675 Ω / 20 mA (max. voltage drop). No Zener Barriers needed.
NU	FM Class I, Division 2, Groups A, B, C and D certification. 1/2 NPT conduit entry Temperature range -20...+70 °C / -4...+158 °F. Load voltage max. 13.5 VDC / 675 Ω / 20 mA (max. voltage drop)

T	Position transmitter. Analog position feedback signal, output 4-20 mA, 2-wire (passive).
T1	Position transmitter. Analog position feedback signal, output 4-20 mA. Intrinsically safe construction CENELEC EEx ia IIC T5/T6 (passive). Available only with option X.
T2	Position transmitter. Analog position feedback signal, output 4-20 mA. Intrinsically safe construction CSA Class 1 Gr. A, B, C & D (passive) Available only with option XU or ZU.
T3	Position transmitter. Analog position feedback signal, output 4-20 mA. Intrinsically safe construction, FM Class I, Division 2, Groups A, B, C and D (passive). Available only with option NU.
T9	Top mounted position transmitter Camille Bauer K/NAX 3W2. Analog position feedback signal, output 4-20 mA. 2-wire connection (passive). IP 65 enclosure, NEMA 4 and 4X. PG 13.5 conduit entry. Not compatible with limit switch options I or K. Temperature range -25...+70 °C / -13...+158 °F.
T9X	Top mounted position transmitter Camille Bauer K/NAX 3W2. Intrinsically safe according to II 2 G EEx ia IIC T6. Analog position feedback signal, output 4-20 mA. 2-wire connection (passive). IP 65 enclosure, NEMA 4 and 4X. PG 13.5 conduit entry. Not compatible with limit switch options I or K. Temperature range -40...+60 °C / -40...+140 °F.
S1	Valve controller attachment face acc. to standard VDI/VDE 3845, equipped with an H-clip. When valve controllers are separate deliveries, VDI/VDE 3845 ear is supplied. Not applicable to linear actuators (5th sign A).
S4	Valve controller attachment face only for EC/EJ actuators without air tubings.
A	Pressure gauges, scale bar/psi/kPa, basic material brass, nickel plated, housing stainless steel, glycerine filled. Temperature range -40...+70 °C / -40...+158 °F.
P	Connection plug acc. to DIN 43650A / ISO 4400 (PG11). Not available with options X, XU, ZU, XT1, XUT2, ZUT2, NUT3 and accessories L, I and NJ.
Y	Special construction, to be specified.

7. sign	LIMIT SWITCH CODE
I	Inductive proximity switches, defined with 8th sign.
K	Micro switches, defined with 8th sign.

8. sign	LIMIT SWITCH TYPE
	Inductive proximity switches (I), 2 pcs.
01	P+F, NJ2-12GK-N, DC > 3 mA; < 1 mA. Intrinsically safe acc. to EEx ia IIC T6 (CENELEC EN 50014, EN 50020), 3-wire type. Option of valve controller shall always be X (6th sign). 9th sign always X. Temperature range -20...+65 °C / -4...+149 °F.
S6	Elm IFC 2002-ARKG/UP, DC; 150 mA, quiescent current < 0.6 mA, 2-wire. Not applicable to option X, XU, ZU, NU, P. Temperature range -20...+80 °C / -4...+176 °F.
	Micro switches (K), 2 pcs.
05	OMRON D2VW-5, standard. Not applicable to option X, XU, ZU, NU, P
06	OMRON D2VW-01, gold plated contacts, 24 V DC/AC, 100 mA. Not applicable to option X, XU, ZU, NU, P.

9. sign	OPTION OF LIMIT SWITCH
	Standard IP 65 enclosure. NEMA 4 and 4X, PG 13.5 conduit entry. Temperature range acc. to switch type. Without sign.
X	Intrinsically safe construction according to ATEX.
P	Connection plug according to DIN 43650A/ISO 4400 (PG11). Not available with options X, XU, ZU, NU and accessories L, N, T9, T9X.
Y	Special construction, to be specified.

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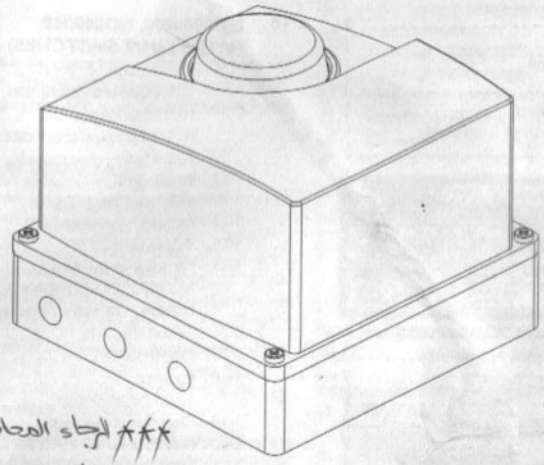


*** الرجاء المحافظه على هذا
.. manual ال
* خاص بالمهندس / وليد يونس
EPROT I.
thanks mohamed metwalli.

VALVE CONTROLLER

ND820 HART® Rev. 5.02

Installation, Maintenance and Operating Instructions
7 ND 70 en
Issue 2/03

metso automation

Table of Contents

READ THESE INSTRUCTIONS FIRST!

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

SAVE THESE INSTRUCTIONS!

1 INTRODUCTION

1.1 General

These instructions describe the digital Metso Automation ND820 valve position controller. The ND820 can be used with either cylinder or diaphragm type pneumatic actuators for rotary or linear valves.

1.2 Principle of operation

The ND820 is a 4-20 mA loop-powered microcontroller-based valve controller. A 3.84 mA input signal will allow enough energy to start communication via push buttons on the circuit board or HART. Either a 275 HART® hand-held terminal or a PC with a HART modem (Valve Manager™ program) can be connected to the terminal strip located in the ND820 itself or in the DCS (Distributed Control System). The maximum load voltage is 13.5 V at 20 mA.

Using push buttons or HART the configuration parameters can be set according to the actuator and valve in question. Then auto-calibration can be started via push buttons or HART. A three-digit display with text labels describes the operation.

In control service the microcontroller (µC) reads data from the input signal (mA), position sensor (α) and pressure sensor (p). A change in input signal will be detected by control algorithm inside the µC. The microcontroller will change the pilot current to one of the prestage (PR) coils. A prestage valve lowers the pilot pressure at the end of the spool valve (SV). The spool moves in the direction of low pressure to open the flow in to the top of the actuator cylinder and out from the other side of the piston. The increasing pressure difference over the piston moves the piston and rotates the feedback shaft. A position sensor (a) measures the rotation for the µC. Using a control algorithm the microcontroller adjusts the pilot current until a new position of the actuator proportional to the input signal (mA) is reached. In the steady state, the spool valve (SV) and prestage (PR) valves are closed.

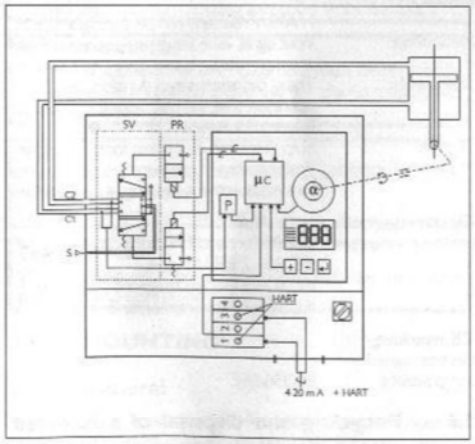


Fig. 1. Schematic diagram

1.3 Markings

The valve controller is equipped with an identification plate sticker (Fig. 2). Identification plate markings from top to bottom are:

- ☐ Type designation of the valve controller
- ☐ Revision number
- ☐ Enclosure class
- ☐ Input signal (voltage range)
- ☐ Input resistance
- ☐ Maximum supply voltage
- ☐ Supply pressure range
- ☐ Operational temperature
- ☐ Manufacturing series number
- ☐ CE mark

Fig. 2. Identification plate

Alternative markings on the optional plate (Fig. 3):

- ☐ Filter-regulator (-K)
  Operational temperature of regulator
- ☐ Conduit entries (-L, -I or -NJ)

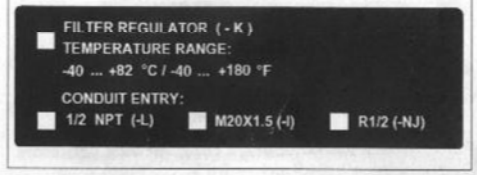


Fig. 3. Optional plate

1.4 Technical specifications

General

The ND820 valve controller is suitable for rotary and sliding stem valves.

Actuator connection	In accordance with VDI/VDE 3845 standard (S1) or as an option compatibility with other NE-series (S2). To replace an existing NE/NP positioner, specify existing valve assembly
Action:	Double or single acting
Turning angle:	min 60°, max 95°

Environmental influence

Operational temp.:	-20 - +85 °C (-4 - +185 °F)
option	-40 - +85 °C (-40 - +185 °F)
Influence of temperature on valve position	< 0.05 % / °C
Influence of vibration on valve position	< 1 % under 2g 5-150 Hz and 1g 150-300 Hz 0.5g 300-2000 Hz

Enclosure

Material:	Anodized aluminium alloy
Protection class:	IP65, NEMA 4 and 4X
Mechanical position indicator:	on cover
Pneumatics ports:	1/4 NPT (S4: G1/4)

ctrical connection:	Screw terminals internals for 2.5 mm^2 and 1 PG 13.5 conduit entry (1/2 NPT, M20x1.5 and R 1/2 as option, see optional plate)
eight:	2.1 kg (4.6 lbs)

eumatics

ply pressure:	2.5-8 bar (36-115 psi)
ect of supply essure:	< 0.2 %/10 kPa (0.14%/psi)
quality:	As defined by ISA S7.3 standard
pacity:	Max 30 Nm^3/h (18 scfm) at 4 bar (60 psi) supply
nsumption:	0.4 Nm^3/h (0.24 scfm) at 4 bar (60 psi) supply

ectronics

ply power:	Taken from the 4-20 mA input signal. No external power needed
nimum signal:	3.84 mA
rrent max:	100 mA
ad voltage:	up to 13.5 VDC at 20 mA / 675 Ω (max voltage drop)
ply voltage:	max 30 VDC
isically safe:	Terminals 1 and 3
ia IIC T6	U_i = 28 VDC I_i = 120 mA P_i = 1 W C_i = 16 nF L_i = 0 H
arity protection:	-30 VDC
ercurrent tection:	active over 25 mA

rformance with moderate constant load actuators

namic hysteresis + dead band:	< 0.8 %
tic hysteresis + dead band:	< 0.3 %
earity error:	< 2%

cal keypad functions

ibration:	Automatic / Manual
ntrol feedback	0.0-3.0 (d and b)
in configuration:	0.1-3.0 (gain)
de Selection:	Auto/Man/Off
nal, DIR:	- direct (default) - reverse
tation, ROT:	- clockwise (default) - counterclockwise
ad angle, A0:	according to valve (0 % default)
t-off-safety range, SAF:	2 % (default)
ve selection, Act:	- rot (rotary valve), default - lin (linear valve)

ctrical connections

ut signal:	4-20 mA, 2-wire. according to ANSI/ISA S50.1

provals

insically safe, le X	ATEX II 1 G EEx ia IIC T5/T6 (EN 50014, EN 50020, EN 50284). ATEX II 2 G EEx ia IIC T5/T6 (with option T9X). ATEX II 3 G EEx nL IIC T5/T6 (EN 50014, EN 50021). Ex nL IIC T5/T6 (IEC 60079-15: 2001). Ex N IIC T5/T6 (BS 6941: 1988).
Intrinsically safe, code XU	CSA Class I, Division 1 and 2, Groups A, B, C and D certification
Non-incendive code NU	FM Class I, Division 2, Groups A, B and D certification

Sensors

Position sensor linear range:	110 °
Actuator pressure sensor linear range:	7 bar (100 psi) (differential pressure)

Position transmitter

Output signal:	4-20 mA (galvanic isolation, 2500 VDC)
Supply voltage:	12-36 VDC, 2-wire 12-24 VDC, for intrinsically safe Power from external supply
Intrinsically safe: EEx ia IIC T6	Terminals 2 and 4 U_i = 24 VDC I_i = 120 mA P_i = 1 W C_i = 75 nF L_i = 0 H
Accuracy:	<2 %
Load resistance:	max 0-1200 Ω max 0-600 Ω, for intrinsically safe

User interfaces

Local:	3 keys + LCD display
HART:	Universal 275 HART hand-held terminal or PC with a HART modem (RS 232 or PCMCIA interface) and Valve Manager program. Connection points are on the screw terminal strip

Additional HART functions

Flow characterization:	Linear, equal percentage, custom
Split range:	4-12 mA, 12-20 mA, custom
Identification information:	HW/SW rev., serial numbers, actuator type etc.
Monitoring:	Input signal, valve travel setpoint, actual travel, actuator pressure and device temperature
Diagnostics:	Travel deviation, travel duration, load factor, operation time, valve/actuator travel counters, failure information
Testing:	Step response, hysteresis loop
Module calibration:	Position sensor, pressure sensor, temperature measurement, input signal measurement

Electromagnetic protection

Protection standards:	EN50081-1 and EN50082-2 IEC 801-2 ESD, level 4, IEC 801-3 Electro Magnetic Field, level 3 IEC 801-4 Fast Transients, level 4

CE marking

Electromagnetic compatibility:	89/336/EEC

1.5 Recycling and disposal of a rejected valve controller

Most valve controller parts can be recycled if sorted according to material. Most parts have material marking. A material list is supplied with the controller. In addition, separate recycling and disposal instructions are available from the manufacturer. A controller can also be returned to the manufacturer for recycling and disposal against a fee.

1.6 Safety precautions

CAUTION:
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:
Do not remove or dismantle a pressurized controller!
Removing or dismantling a pressurized prestage, spool valve or pressure sensor of an ND820 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:
During automatic or manual calibration the valve operates between open and closed positions. Make sure that the operation does not endanger people or processes!

Ex i WARNING:
Make sure that the complete installation and wiring is intrinsically safe before operating the device!

Ex i WARNING:
Do not remove the inner protective cover (46) within hazardous area!

Ex i WARNING:
Electrostatic charge hazard!
The pointer window is non-conductive. Clean with damp cloth only.

Ex i WARNING:
Spark hazard!
Protect the aluminium housing and cover from impacts.

Ex i WARNING:
For EEx ia applications, the equipment must be electrically connected via a certified Zener barrier placed outside the hazardous area!

NOTE:
Avoid earthing a welding machine in close proximity to an ND820 valve controller.
Damage to the equipment may result.

Ex i NOTE:
The mounting must be in accordance with the installation guidelines IEC-EN 60079-10.

2 MOUNTING

2.1 General

If the ND820 is supplied with valve and actuator the tubes are mounted and the ND820 adjusted in accordance with the customer's specificators. If the controller is ordered separately, the mounting parts for the assembly must be ordered at the same time.

Sample order: (B1CU13)-Z-ND826/S1.

The controller is equipped with both the Metso Automation mounting face, for connection according to VDI/VDE 3845 (S1). The mounting code for EC and EJ actuators is S4.

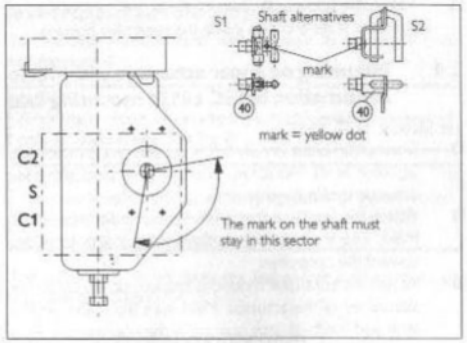


Fig. 4. Mounting on Metso Automation actuator with VDI/VDE mounting face

Shaft alternatives for the controller for Metso Automation actuators are shown in Figs. 4 and 5.

For mounting parts for Metso Automation actuators, see Sections 11.3-11.11.

2.2 Mounting on Metso Automation actuators with VDI/VDE mounting face (S1)

See Sections 11.3-11.5

- ☐ Run the actuator until the piston is in the top position (spring return actuators in the position determined by the spring).
- ☐ Set the direction arrow in the direction of the valve closure member and attach the draught piece (2) to the indicator cover in the position shown in Fig. 4. Secure the screw of the draught piece e.g. with Loctite and tighten it sufficiently.
- ☐ Attach the bracket (1) to the ND820.
- ☐ Attach the bracket (1) to the actuator. The shaft (40) of the ND820 must fit into the draught piece (2) shown in Fig. 5. See also drawings in Section 11.3.

Note the differences in installation between the B1C, B1J and B1JA actuators.

2.3 Mounting on EC and EJ actuators (S4)

See Sections 11.6-11.9

- ☐ Mount the O-rings (38) into the air connections in the bottom of the controller.
- ☐ Place the valve controller on top of the actuator so that the yellow mark is located in the position shown in Fig. 5. See also Fig. 16.

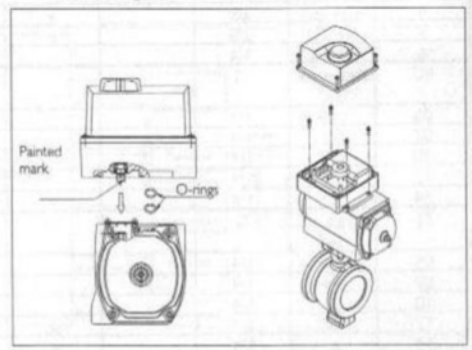


Fig. 5. Mounting on EC and EJ actuators

Fasten the screws (4). Two of the screws are located at the front edge and two inside the controller housing.

Mounting on linear actuators withMetso Automation or IEC 60534 mounting face

Sections 11.10, 11.11.

Connect an airset directly to the actuator and position the actuator at its mid-stroke position (see serial plate for actuator stroke length).

Attach the feedback arm on to the controller input shaft. Make sure the lettering on the feedback arm faces up, toward the controller.

Attach the controller mounting bracket loosely on to the slotted leg of the actuator. Make sure the marks on the shaft and feedback arm operate in the quadrant shown.

- ☐ Measure the distance from the centre of the feedback lever shaft to the slot on the feedback lever and mark this distance with a pencil or other marking instrument. Use the dimensions given in Sections 11.10 and 11.11.
- ☐ Mount the controller loosely onto the controller mounting bracket.
- ☐ Adjust the controller mounting bracket and the controller so that the controller is at 90° to the centre line of the actuator and the controller feedback lever is horizontal and at 90° to the centre line of the actuator.
- ☐ Tighten the controller mounting bracket screws.
- ☐ Adjust the controller on the controller mounting bracket so that the measured distance is maintained between the centre of the feedback lever shaft and the actuator pin (pre-measured mark on the feedback lever). Note the controller must still conform to the specifications in previous steps.

e 1. *Piping*

Actuator			Piping						
			Plastic/Cu/SS (")			Plastic/Cu/SS (mm)			Spool valve
B1C	Stroke vol. dm^3/in^3	NPT	1/4	3/8	1/2	6	10	12	
6	0.3/18	1/4	x			x			2
9	0.6/37	1/4	x			x			2
11	1.1/67	3/8	x			x			2
13	2.3/140	3/8		x			x		6
17	4.3/262	1/2		x			x		6
20	5.4/330			x			x		6
25	10.5/610	1/2		x	(x)		x	(x)	6
32	21/1282	3/4		x	(x)		x	(x)	6
40	43/2624	3/4		(x)	x			x	6
50	84/5126	1		(x)	x			x	6
502	195/11900	1			x			x	6
B1J B1JA	Stroke vol. dm^3/in^3	NPT	1/4	3/8	1/2	6/4	10/8	12/10	Spool valve
8	0.9/55	3/8	x			x			21
10	1.8/110			x			x		61
12	3.6/220	1/2		x			x		61
16	6.7/409			x			x		61
20	13/793	3/4		x	(x)		x	(x)	61
25	27/1648			x	(x)		x	(x)	61
32	53/3234	1		(x)	x			x	61
322	106/6468				x			x	61
QP	Stroke vol. dm^3/in^3	NPT	1/4	3/8	1/2	6/4	10/8	12/10	Spool valve
1	0.62/37	3/8	x			x			21
2	1.08/66	3/8	x			x			21
3	2.18/133	3/8		x			x		61
4	4.34/265	3/8		x			x		61
5	8.7/531	3/8		x			x		61
6	17.5/1068	3/4			x			x	61
EC	Stroke vol. dm^3	G							Spool valve
05	0.09	1/4	x			x			1
07	0.2	1/4	x			x			1
10	0.5	1/4	x			x			2
12	1.2	1/4	x			x			2
14	3.0	1/4		x			x		6
EJ	Stroke vol. dm^3	G							Spool valve
05	0.18	1/4	x			x			11
07	0.4	1/4	x			x			21
10	1	1/4	x			x			21
12	2.4	1/4		x			x		61
14	6	1/4		x			x		61

Table 2. Spring rates

Actuator type	Spring rate (bar/psi)
B1JK	3/43
B1JSTD	4.2/61
B1JV	5.5/80
QPB	3/43
QPC	4.3/62
QPD	5.6/81
Adjust regulator pressure to a level which is max 1 bar (14.5 psi) + spring rate. If spring rate is less than 3 bar (43 psi) then supply pressure 4 bar (58 psi) is recommended.	

- ☐ Tighten all the mounting bolts and then re-check that the controller complies with previous steps. Check that the actuator pin does not touch the controller case throughout the entire stroke of the actuator. If the actuator pin is too long it may be trimmed to length. (The pin must be trimmed on stroke of 1.125" or less.)
- ☐ Attach the spring on to the feedback arm as shown.
- ☐ Apply grease (Molykote or equivalent) to the contact surfaces of the actuator pin and the feedback lever to reduce wear.
- ☐ Increase and/or decrease air pressure to the actuator to stroke the actuator full stroke to check that nothing is binding and that the rotation of the feedback lever is 70° for a 1"-5" stroke and 60° for a ¾" stroke. See Sections 11.10 and 11.11.

2.5 Piping of supply air

CAUTION:
Do not exceed the permitted supply pressure of the ND820!

Table 1 provides the recommended tube sizes in accordance with actuator sizes. Tube sizes are the minimum values allowed. For supply air choose a tube one size bigger. Operating times can be tested by the Valve Manager program.

Connect the air supply to S (1/4 NPT or G1/4 with S4). Connect C1 and C2 (1/4 NPT) to the actuator, see Fig. 8.

When a ND820/S4 is connected direct to the EC or EJ actuator, connections C1 and C2 (G1/4) must be plugged, see 11.6, 11.7 and 11.9. A coupling plate (39) is required for EC05 actuators, see 11.7. EJ actuators require also plugging of the air connection, which is internally connected with C1.

When the EC actuator is connected for reverse action, Fig. 8 second section, external piping must be used, see 11.8. The air connections in the bottom of the controller must then be closed with threaded plugs (G1/8) and O-rings mounted in the grooves. EC05 actuators require a coupling plate with reverse action, see 11.7.

For the pipe threads liquid sealants, such as Loctite 577, are recommended.

NOTE:
A controller mounted on a spring actuator must be connected only as single-acting. See Fig. 8.

NOTE:
Too much sealant may cause faulty operation of the controller. Sealing tape is not recommended.
Ensure the cleaniness of the air piping.

The supply air must be clean, dry and oil-free instrument air, e.g. according to standard ISA S7.3-81.

2.6 Electrical connections

The ND820 is powered by a standard 4 - 20 mA current loop. HART is carried over the current loop too.

The input signal cable is led through a PG13,5 cable gland. Connect the conductors to the terminal strip according to Fig. 6.

Check the wire polarity before connection. The controller has 30 V polarity protection. EMC requirements require earthing of the input cable shield either at the DCS end or at the ND820 end, but never at both ends.

NOTE:
The ND820 equals a load of 675 Ω in the current loop.

NOTE:
Without earthing the valve position may vary in a strong magnetic field.

Connect the cables for the optional position transmitter according to Fig. 6. The position transmitter needs an external power supply. The ND820 and position transmitter circuits are galvanically isolated, and isolation voltage is 2500 VDC.

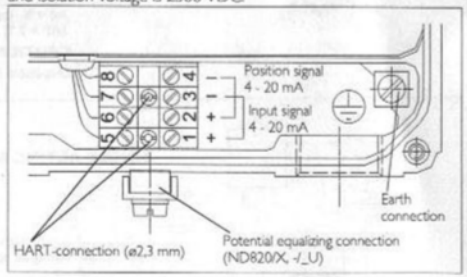


Fig. 6. Terminals

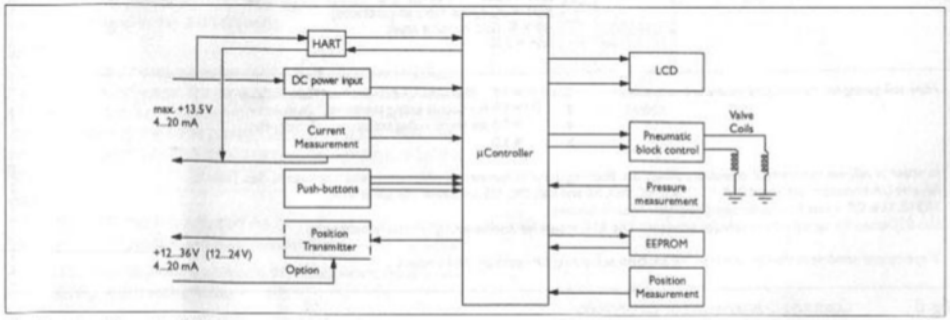
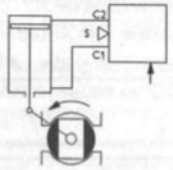


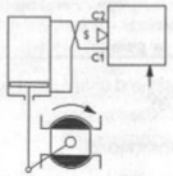
Fig. 7. Operation blocks



DOUBLE-ACTING ACTUATOR

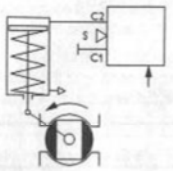
1. Increasing input signal to open valve.

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   A0 = % (acc. to valve type)
   SAF = 2 %
   NOTE: EC05 actuator requires a coupling plate



2. Increasing input signal to close valve.

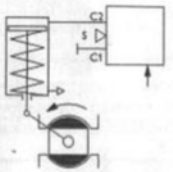
   Setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   A0 = % (acc. to valve type)
   SAF = 2 %
   NOTE: EC07...EC14 actuators require external piping
   EC05 actuator requires a coupling plate (reverse action)



SINGLE-ACTING ACTUATOR (SPRING TO CLOSE)

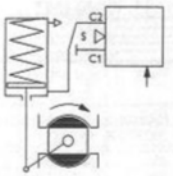
3. Increasing input signal to open valve.
   Spring to close valve.

   Default setting:
   DIR = OPE
   ROT = cC (close valve to clockwise)
   A0 = % (acc. to valve type)
   SAF = 2 %



4. Increasing input signal to close valve.
   Spring to open valve.

   Setting:
   DIR = CLO
   ROT = ccC (close valve to counterclockwise)
   A0 = % (acc. to valve type)
   SAF = 2 %
   CAUTION: Valve closes exceptionally counterclockwise.
   Unsuitable for Q-, R-, TS-, F- and L-series valves.



SINGLE-ACTING ACTUATOR (SPRING TO OPEN)

5. Increasing input signal to close valve.
   Spring to open valve.

   Default setting:
   DIR = CLO
   ROT = cC (close valve to clockwise)
   A0 = % (acc. to valve type)
   SAF = 2 %

fter self-tuning the default parameters are as follows:

Gain	= 1.0	(for enhanced control use Gain=1.2)
d	= 0.0	for double acting actuators (factory set)
d	= 1.0	for single acting actuators (factory set)
b	= 1.0	

order to achieve symmetrical operation, always use filter regulator in connection with spring return actuators. See Table 2.
A and DA actuators: use spool 21A. RB, RC, RD, RE and DB, DC, DE actuators: use spool 61A.
NOTE: Use QP values for diapharagm-pneumatic linear actuators.
se B1J values for spring-return cylinder actuators. Use B1C values for double-acting cylinder actuators

operational conditions change considerably, perform self-tuning for optimum performance.

8. *Operation directions and air connections*

3 USER INTERFACE

3.1 Keyboard and display

The keyboard and the display of the ND820 are shown in Fig. 9. Only applicable information is shown on the display in each mode. Operations and display are controlled by + , − and ↵ keys.

Four setting functions are available: MODE:, GAIN, DB or CALIB. Each of these names refers to the function to be adjusted or changed.

In **AUTO** or **MAN** mode the display indicates 0-100 % as the valve travel. In **OFF** mode the display shows two dashes (--) instead of digits. By pressing the ↵ key the display shows the input signal in mA within about 5 seconds. In other situations the display indicates the adjustable parameter value selected.

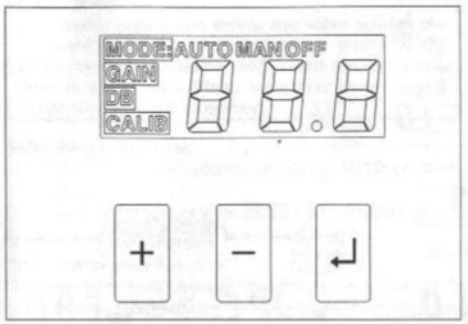


Fig. 9. LCD-display and keyboard

3.2 Keyboard functions

See keyboard operations (Fig. 11).

The keyboard setting state is initiated by pressing the + and − keys for 5 seconds. The blinking text item MODE: and one of the previously selected operation modes, **AUTO**, **MAN** or **OFF**, will be shown on the display. If you want to change the operation mode, press ↵ first. **AUTO**, **MAN** or **OFF** will start to blink showing that the mode-changing function is enabled. Choose the desired mode, **AUTO**, **MAN** or **OFF** with the + or − key. After the mode has been selected, press the ↵ key.

The MODE: function provides three alternative ND820 operation modes:

AUTO:
During **AUTO** mode the ND820 controls the valve position according to the incoming 4-20 mA signal. This mode is used during normal process control service. After signal failure the ND820 follows input signal in the **AUTO** mode.

MAN:
During this mode the valve position can be manually controlled from the keyboard + or − keys. The position of the manually driven valve is not saved in the non-volatile memory of the ND820, i.e. the valve does not return to the same position after signal failure. However, the valve can be driven back into position after signal failure by the + and − keys.

OFF:
When the **OFF** mode is activated the ND820 drives the valve to the 4 mA related position and does not respond to incoming signal.

Accept the selected mode by pressing the ↵ key which returns you automatically to the setting state.

Move to the next setting by pressing the + key. GAIN starts to flash. The positioner gain required for different size of actuators is set with the GAIN parameter. GAIN is set automatically by self-tuning procedure during **AUTO**/**MAN** calibration. Pressing the ↵ key allows you to change the gain value shown on the display with the + and − keys. Accept a changed value with ↵ key, which returns you automatically to the setting state.

DB includes positioner feedback parameters *d* and *b*. By pressing the ↵ key you can select one of the above parameters with the + and − keys. Confirm your choice with the ↵ key and change values with + and − keys. Confirm the value with ↵. Default values are listed in Fig. 8.

The next setting to move to with the + key is CALIB. By pressing the ↵ key you can start zero and travel range calibration and self-tuning. More detailed information about CALIB is given in Section 4.1.

Within different options you can move forward with the + key and with the − key backward.

In addition, there are six control valve related configuration parameters: *dir*, *rot*, *A0*, *SAF* and *Act*, which are explained in Section 4.3

You can return to the operation state from any setting by pressing + and − keys simultaneously for less than 1 second, repeating if necessary.

3.3 HART write protection

The ND820 is delivered from the factory with HART write protection **OFF** as the default setting. Reading and changing parameters is thus allowed. HART protection can be enabled with a switch (DIP1) located on the circuit board (Fig. 10). Changes which may influence the valve position cannot be made using the Valve Manager program when switch no. 1 (on the left-hand side of the switch block) is **ON**. For detailed information see the Valve Manager User's Guide.

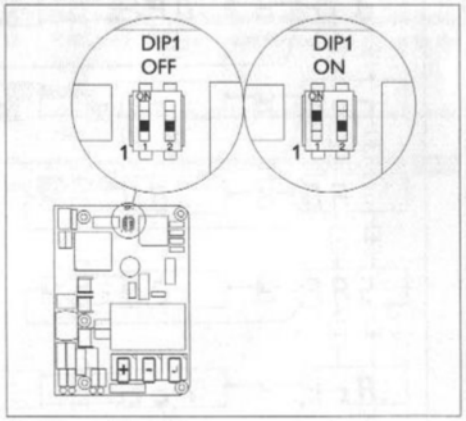
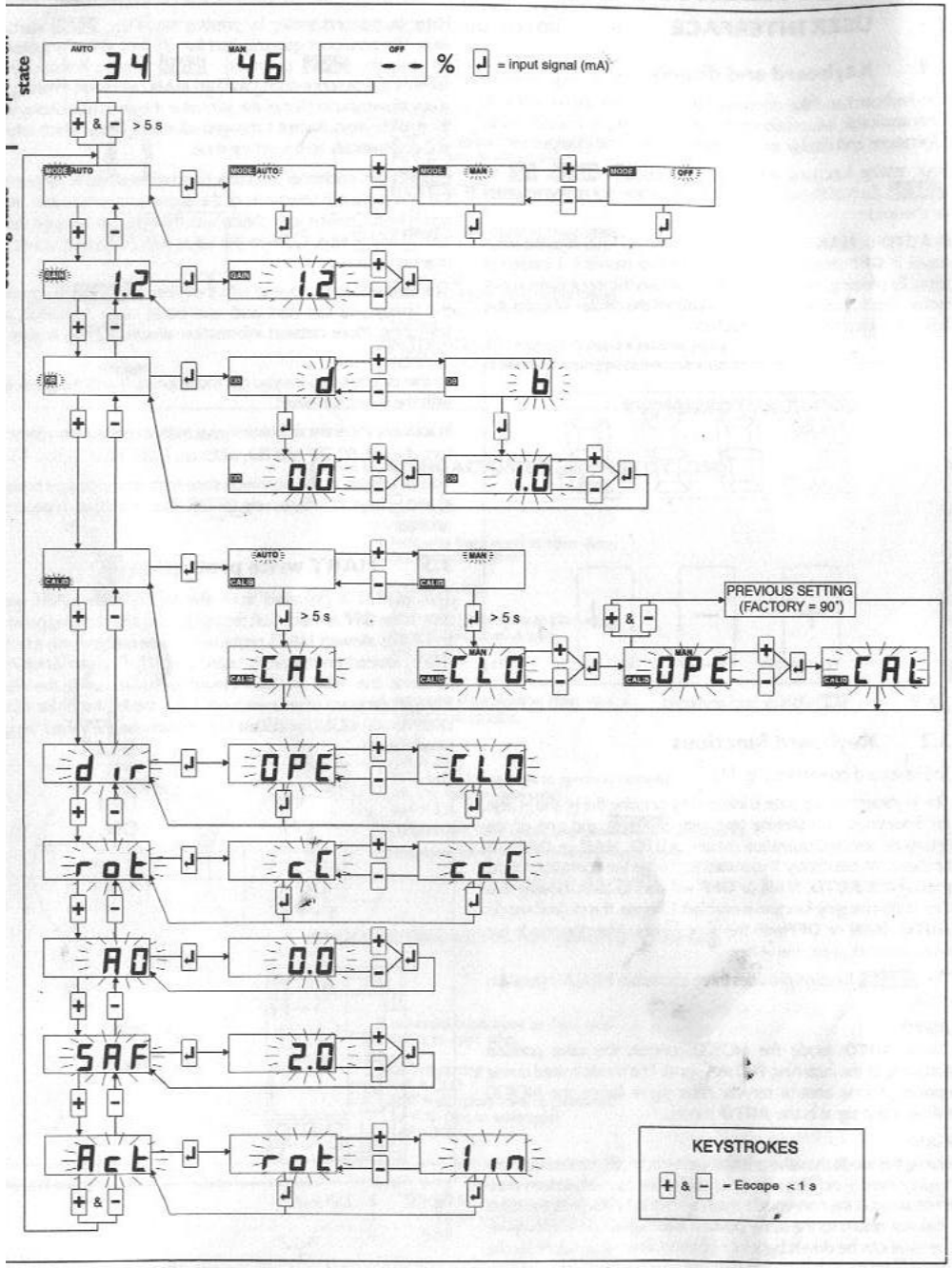


Fig. 10. DIP switch



11. *Keyboard operations*

4 CONFIGURATION

4.1 Zero and range

The ND820 position sensor operational range is factory adjusted to suit Metso Automation actuators. If the ND820 is to be fitted into another manufacturer's actuator, the sensor may need to be readjusted as explained in Section 5.4.

- ☐ Connect the air supply and input signal. Make sure that the voltage is max 13.5 VDC at 20 mA, measured from the + and - terminals.
- ☐ Select the **CALIB** function from the keyboard according to 3.2.
- ☐ Now you can select the **AUTO** or **MAN** calibration mode from the display by pressing the + or - key.

CAUTION:
Automatic calibration drives the valve against the mechanical open and closed travel limits of the valve-actuator assembly and a self-tuning procedure is performed. Make sure that these procedures can be safely executed.

Self-tuning procedure:

- ☐ This is performed automatically during **AUTO** or **MAN** calibration.
- ☐ As a result of self-tuning the **GAIN** is set = 1 and *b* is set = 1.
- ☐ *d* is originally factory set as explained in Fig. 8.

AUTO calibration function:

- ☐ For safety reasons the ↵ key needs to be pressed for 5 seconds to activate the **AUTO** calibration function. During calibration the display shows the text *CAL*. After calibration the ND820 returns automatically to the setting function.
- ☐ A self-tuning procedure is performed.
- ☐ At any time you may interrupt the calibration sequences by pressing the + and - keys simultaneously.
- ☐ After the **AUTO** calibration sequence is finished press the + and - keys simultaneously to get back to the operation state. If this sequence has ended and an error message *Err* appears on the display, see Chapter 7.

Now the ND820 will work with basic settings including 2 ± 0.5 % signal cutoff margins to secure full closing of the valve.

If you cannot drive the valve into a fully open position or if there is no mechanical limit stop, proceed as follows:

MAN calibration function:

- ☐ After selecting the **MAN** calibration function from the display press the ↵ key to activate the procedure.
- ☐ With the + or - keys drive the valve manually to the closed (0 %) position and then press the ↵ key.
- ☐ If you cannot drive the valve into the open position, you may skip this sequence by pressing the + and - keys simultaneously. Now the ND820 assumes that the maximum valve opening is the latest calibrated value. The factory setting is 90°.
- ☐ Drive the valve into the desired maximum opening position (100 %) with the + and - keys and press the ↵ key.
- ☐ A self-tuning procedure is performed.
- ☐ If an error message *Err* appears on the display, see Chapter 7.
- ☐ Press the + and - keys simultaneously to return to the operation state.

Now the valve controller will work with basic settings including 2 ± 0.5 % signal cutoff margins.

4.2 Position control

GAIN is the gain parameter, *d* is the actuator pressure feedback parameter and *b* is the valve velocity feedback parameter. The default values after self-tuning are given in Fig. 8. Values are defined for the control valve in question during self-tuning. However, because of the large range of pressure drop and temperature for the different processes, variations in supply air pressure and the great variety of valve constructions, actuator load may differ considerably from the default value. For this reason **GAIN**, *d* and *b* may have to be adjusted to ensure optimum control performance for special cases. Use the following guidelines to adjust **GAIN**, *d* and *b*.

- ☐ Check that *d* value is according to Fig. 8.
- ☐ Perform **AUTO** or **MAN** calibration.
- ☐ For enhanced control increase the **GAIN** to value 1.2
- ☐ If the valve is unstable, lower **GAIN** until the valve is stable at a constant input signal. If higher **GAIN** is needed, increase *d* to dampen instability with spring-return actuators.
- ☐ If the valve is slow, increase **GAIN**. If the valve is overshooting, decrease **GAIN**. Adjust **GAIN** for slight overshooting and then increase *b* to dampen it.
- ☐ If the deviation between input signal and actual valve position is high, increase **GAIN** to decrease deviation. However, avoid unstable operation.

GAIN setting:

- ☐ Select the **GAIN** function from the keyboard according to Section 3.2.
- ☐ Now the display should indicate the current parameter value. If you want to change it, press the ↵ key.
- ☐ Increase the parameter value by pressing the + key or decrease its value by pressing the - key.
- ☐ Press the ↵ key when the desired value appears on the display.
- ☐ Press the + and - keys simultaneously to return to the operation state.

DB setting:

- ☐ The **DB** parameters can be adjusted in the same manner. (See Fig. 11).

The ND820 stays in the selected operation mode during the **GAIN** and **DB** settings.

4.3 Control valve related settings

The basic factory settings of the ND820 assume a raising signal to open the valve and a clockwise closing direction for the position sensor. The signal cutoff safety margin is set to 2 ± 0.5 % to guarantee full closing of the valve against mechanical travel stops.

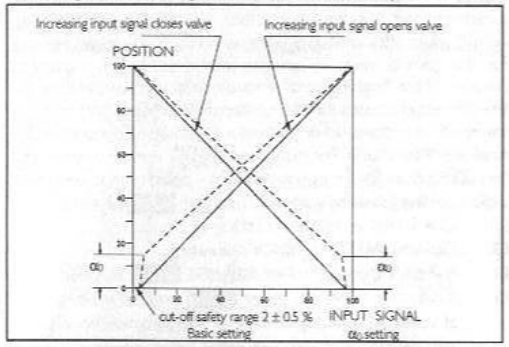


Fig. 12. Principle of setting

Following parameters are possible to change during setting state by pressing ⊞ or ⊟ keys until the parameter in question appears on the display.

Direction of signal (dir)

- ☐ When the letters dir appear on the display you may read the signal action direction by first pressing the ↵ key and then selecting either the DPE or CLO values by pressing the ⊞ and ⊟ keys. The value DPE 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. 8 and functions in Fig. 11.

Valve action (rot)

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

- ☐ Once rot is displayed press the ↵ key and the current parameter value will be shown on the display. Now you may select between two values by pressing the ⊞ or ⊟ key. The value cC means 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. See default values and tubing sizes in Fig. 8 and functions in Fig. 11.

α0 setting (dead angle, AD)

The α0 setting is made for Metso Automation segment and ball valves. This setting takes into account the "dead angle" α0 of the ball valves. The entire signal range is then used for effective valve opening 90° - α0 (Figure 13 and Table 3). Use 0 % as the "dead angle" for the valves not mentioned in Table 3.

- ☐ After selecting AD on the display, press the ↵ key and the parameter value currently selected appears as a percentage (%) on the display.
- ☐ Modify the parameter value by pressing ⊞ or ⊟ keys alternately until the desired value appears on the display.
- ☐ Press the ↵ key to finalize your selection and return to the setting state. See Fig. 11 for functions.

Table 3. Dead angle as percentage

Valve size		Valve series								
		MBV QMBV 1)	MBV QMBV 2)	D 3)	T5, QT5	QX-T5	T25, QT25	QX-T25	R, QR	E
mm	in	Dead angle as %								
25	1	14	-	-	25.5	19.5	-	-	15	25.5
40	1 ½	12	-	-	24.5	12.5	-	-	12	16.0
50	2	10	9	13.5	24.5	12.5	18.0	8.0	17	20.5
65	2 ½	9	-	-	-	-	-	-	13	-
80	3	10	8	12.0	18.0	8.0	16.5	8.5	9	8.5
100	4	10	8	12.0	16.5	8.5	16.0	9.0	8	7.0
125	5	12	-	-	-	-	12.0	6.5	8	-
150	6	10	8	11.5	16.0	9.0	13.5		8	13.5
200	8	9	7	8.5	12.0	6.5	9.5		7	
250	10	9	7	7.5	13.5		9.5		7	
300	12	8	6	6.5	9.5		7.5		6	
350	14		6	6.0	-				5	
400	16		5	5.5	9.5(14")				5	
450	18			6.0						
500	20			6.0	7.5(16")					
600	24			5.5						
650	26			7.0						
700	28			7.0						
750	30			6.0						
800	32			-						
900	36			5.5						

1) Seat supported 2) Trunnion 3) S/G seat

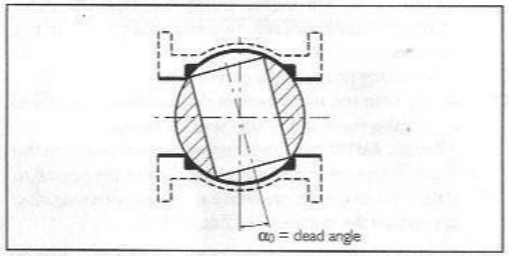


Fig. 13. Dead angle

Cut-off safety range (SAF)

- ☐ When SAF appears on the display, press the ↵ key and the current default value as a percentage (%) from the input range appears on the display. The Metso Automation' standard default value 2 % (2.0). Now modify this value to the desired number and press the ↵ key to return to the setting state. See Fig. 11 for functions.
- ☐ When all the control valve-related parameters are correctly set, return to operation state by pressing the ⊞ and ⊟ key simultaneously for a short time.

Rotary vs. linear valve selection (Rch)

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 at the Rch display.

- ☐ After selecting Rch on the display, press the ↵ key and select between two values rot and Lin using the ⊞ and ⊟ keys. The value rot indicates a rotary valve and Lin a linear valve.
- ☐ To conclude press the ↵ key when the desired value is shown on the display.

5 MAINTENANCE

The maintenance requirements of the ND820 valve controller depend on the service conditions, for instance, the quality of instrument air. In normal service conditions no regular maintenance is required.

The best reliability is achieved by following these instructions.

In the following text the numbers in parenthesis ( ) correspond to the part numbers on the expoded view in Chapter 11, unless otherwise stated.

The ND820 valve controller includes the following interchangeable modules: prestage (3), spool valve (4), circuit board (5), position sensor (6), and differential pressure sensor (7).

The modules are located underneath a protective cover (46) which is attached with M3-screws (48, 4 pcs.). If a module fails it must be changed. The module retrofit must be made in a clean, dry environment. After replacement apply thread-locking compound (for instance, Loctite 243) and tighten the screws firmly.

5.1 Prestage

NOTE:
The prestage must be handled very carefully. In particular the moving parts on both ends of the prestage should not be touched when the prestage is functioning and the protective cover is not in place.

Disassembly

- ☐ Unplug the prestage (3) wire connectors from the circuit board (5). Unscrew the M4 screws (92, 2 pcs.) and remove the prestage module.

Reassembly

- ☐ Place the O-rings (91) in the respective grooves and press the prestage into place. Make sure that the nozzles are properly guided on top of the O-rings. The screws guide the prestage body into the correct position.
- ☐ Push the prestage 2-pole wire connectors into the sockets on the circuit board. Make sure that the wires do not cross each other. The wire connectors can only be fitted in the correct way.
- ☐ Tighten the screws (92) evenly with a torque of approx. 0.8 Nm (0.6 ft.lb).
- ☐ Set the protective cover (46) carefully in place and tighten the screws (48).

5.2 Spool valve

Before removing the spool valve (4) the prestage (3) must be taken off. (See Section 5.1)

Disassembly

- ☐ Unscrew the M4 screws (99, 4 pcs.) and remove the spool valve assembly.

The spool valve can be cleaned by following **especially clean and careful procedures**. The seal (106), filter (105), restriction (104) and spring (100) are located at the ends of the spool valve (102, 103). The spool (97) can also be removed for cleaning.

NOTE:
Each spool valve body has an individual matching spool which cannot be replaced by any other spool. Never change the orientation of the spool or the location of the individual spool springs.

Reassembly

- ☐ Place a new gasket (98) in the location determined by the fitting screw holes. Fit the spool valve into its corresponding position on top of the seal and tighten the M4 screws (99) evenly.
- ☐ The O-rings must be mounted first in their grooves located in the spool valve unit. During mounting the O-rings must be compressed because the sealing is done radially. Make sure that the O-rings are evenly compressed and that they are fully inside the grooves. The O-rings must be in perfect condition; no defects are allowed. If a tool is used it must be blunt.
- ☐ Mount the prestage unit directly onto the spool valve unit. The ends of the nozzles will guide the prestage unit to the right location. The prestage unit must fit by pushing gently with no excessive force. Ensure that the spool valve unit and the prestage unit have an even surface connection before tightening the screws.

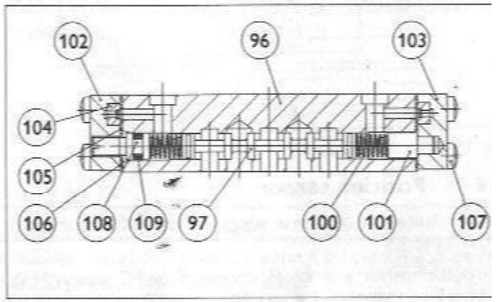


Fig. 14. Spool valve

5.3 Circuit board

Disassembly

- ☐ Loosen the M8 screw (66) and turn the position indicator (65) outwards from the feedback shaft.
- ☐ Unplug all wire connectors from the circuit board (5) and the signal wires from the terminal block (35).
- ☐ Remove the M3 screws (111, 5 pcs.).

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

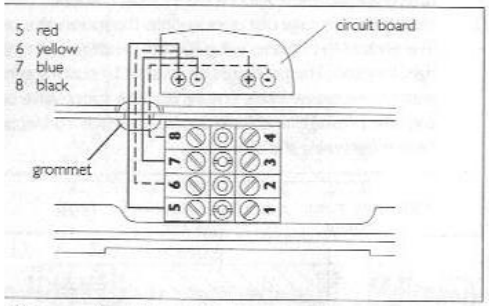
- ☐ Take hold of the sides of circuit board and lift it directly upwards and outwards. Handle the board carefully, touching only the sides.

Reassembly

- ☐ Remount the circuit board carefully. Do not let the feedback shaft touch the circuit board.
- ☐ Locate the pins of the pressure sensor on the matching connections on the board.
- ☐ Tighten the M3 screws (111) evenly.
- ☐ Push the rubber grommet into the slot located on the intermediate wall of the body and connect the wires to the terminal block as shown in Fig. 15. Plug the prestage wire connectors into the board making sure that the wires do not cross each other. Plug the position sensor (6) wire connector into the board.

Mount the protective cover (46).
Mount the position indicator (65) on the shaft and tighten the M8 screw (66) temporarily. The final locking of the position indicator occurs when the actuator is installed.

NOTE:
Changing a new circuit board requires updating the module parameters using HART communication. See the instructions provided with the new circuit board.



15. *Circuit board*

4 Position sensor

Before loosening the position sensor (6) first loosen the circuit board according to 5.3.

The position sensor assembly (6) consists of the MR-sensor (114), which is fixed to the housing, and the spiral (117), which is fixed to the main shaft.

Disassembly

- ☐ Loosen the M3 screws (116, 2 pcs.) and lift the sensor out of the housing.
- ☐ Remove the lock ring (119) from the shaft and open the hexagonal socket screw (118, 2 pcs.). Mark the top of the spiral before removing it. Slide the spiral out of the shaft.

Reassembly

- ☐ Mount the new sensor and spiral together as a pair. Slide the spiral back onto the shaft and replace the lock ring on the shaft. Turn the spiral and the shaft to the position shown in the Fig. 16, corresponding to a 45° valve opening. Tighten the M3 screws.
- ☐ Install a 0,1 mm (0.004 in) thick gauge strip between the sensor and the spiral. Press the sensor against the spiral, without using unnecessary force, and tighten the screws (116) evenly. Remove the strip.
- ☐ Mount the circuit board and the protective cover (46) as directed in 5.3.

NOTE:
Changing the new position sensor requires updating of the calibration values of the sensor using HART communication. See the instructions in the User's Manual for the ND820 HART master software (e.g. Valve Manager (v. 2.0 or later) or ND820 DD (= Device Description) for HART handheld (rev. 4 or later).

5.5 Pressure sensor

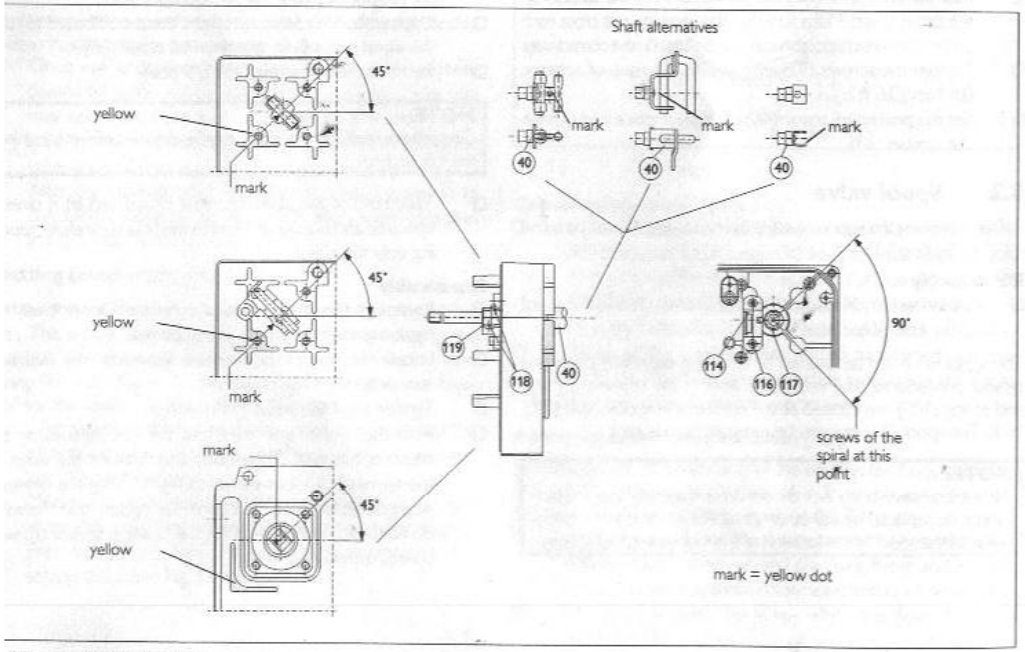
Before removing the pressure sensor (7) you must loosen the circuit board according to 5.3.

Disassembly

- ☐ Loosen the M3 screws (126, 2 pcs.) and lift out the pressure sensor (7) holding it from the both ends.

Reassembly

- ☐ Mount the O-rings (123, 2 pcs.) in their grooves in the housing. Push the pressure sensor back into place, guided by the O-rings. The final location is shown in Fig. 17. Tighten the M3 screws evenly.



16. *Position sensor*

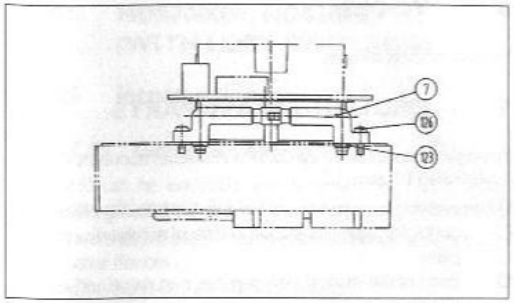


Fig. 17. Pressure sensor

- ☐ Replace the circuit board and the protective cover according to 5.3.

NOTE:
Changing the pressure sensor requires updating of the calibration values of the sensor using HART communication. See the instructions in the User's Manual for the ND820 HART master software (e.g. Valve Manager, ND820 DD for HART handheld).

6 ERROR MESSAGES

When the ND820 detects serious device failure (analogue inputs, analogue outputs or electronics) it enters fail-safe mode which drives the control valve into the 4 mA position. Fail-safe mode is indicated by the LCD as message *Exx*, where *xx* is a number between 1-99, or by the HART master software (e.g. Valve Manager). The error message is displayed until the cause of error is eliminated and the ND820 unit is cold-started, i.e. the input signal is momentarily disconnected

When the ND820 detects an error during travel calibration or self-tuning, the error message *Err* is displayed. It disappears when any key is pressed.

The ND820 stores error messages in its non-volatile memory, which saves the 20 most recent error codes. The memory can be read out with HART communication by using Valve Manager.

Table 4 lists the error messages shown on the LCD display and their explanations.

Table 4. Error messages shown on LCD display

Error message	Reason	Action
E21	Input signal measurement ADC low limit failure.	If error message occurs after cold-start within the input signal range of 4-20 mA, change circuit board and/or prestage.
E22	Input signal measurement ADC high limit failure.	If error message occurs after cold-start within the input signal range of 4-20 mA, change circuit board.
E41	Pneumatic prestage valve 1 (VA1) control failure.	Check wires and connectors or change circuit board. Resistance of the coil is approx. 100 Ω measured from the prestage connectors.
E44	Pneumatic prestage valve 2 (VA2) control failure.	Check wires and connectors or change circuit board. Resistance of the coil is approx. 100 Ω measured from the prestage connectors.
E51	Position feedback ADC low limit failure.	Check the mounting of controller; the mark on the shaft must stay in the right sector, see Fig. 4. Check wires, connector and position sensor rotation range or change circuit board. Rotate the position feedback shaft 10 degrees counterclockwise and cold-start the device.
E52	Position feedback ADC high limit failure.	Check the mounting of controller; the mark on the shaft must stay in the right sector, see Fig. 4. Check wires, connector and position sensor rotation range or change circuit board. Rotate the position feedback shaft 10 degrees clockwise and cold-start the device.
E61	Memory (EEPROM) failure.	Change circuit board.
E65	Memory (EEPROM) failure.	Change circuit board.
E81	Memory (RAM) failure.	Change circuit board.
E82	Memory (ROM) failure.	Change circuit board.
E91	Processor failure.	Change circuit board.
Err	Zero and travel calibration or self-tuning fails.	Check range of position sensor or mechanical limits of actuator. Check wires and connectors. Check leakage. Check that spool valve does not stick. Check that prestage is not defective.

ADC = analog/digital converter

TROUBLE SHOOTING

echanical/electrical defects

A change in the input signal does not affect the position of the actuator
- supply pressure too low
- spool valve sticks
- tubes between controller and actuator are incorrect, see Fig. 8
- actuator and/or valve jammed
- signal wires incorrectly connected, no value on display
- circuit board is defective
- calibration has not been carried out (**AUTO** or **MAN**)
- ND820 is either in **MAN** or **OFF** mode
- ND820 + cable load exceeds the maximum output load of the 4-20 mA analog output
- prestage is defective
- position sensor is defective

The actuator goes to the final position with a small change of input signal
- tubes between controller and actuator are incorrect, see Fig. 8
- the parameter settings *dir* and *rAt* are incorrectly selected. See Figs. 8 and 11

Inaccurate positioning
- spool valve dirty
- dirt in the permanent magnet air gap
- actuator too small
- supply pressure too low
- pressure sensor is defective
- *d* and *b* parameters in the **DB** mode do not comply with recommendations shown in Fig. 8
- **GAIN** parameter is too small, perform **AUTO** / **MAN** calibration acc. to Section 4.2

Overshooting or positioning too slow
- **GAIN** is too high or too low, see Fig. 8
- 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

Err is shown during calibration
- position sensor is out of range, see Section 5.4
- mechanical actuator travel exceeds position sensor linear travel, i.e. 110°. If it fails in fully closed position, turn the spiral (117) counterclockwise in 5° steps. If it fails in the fully open position, turn the spiral (117) clockwise in 5° steps.
- the parameter settings *dir* and *rAt* are incorrectly selected, see Section 4.3 and Fig. 8
- the actuator did not move or was stuck during calibration
- input signal is less than 4 mA
- ND820/actuator mounting is incorrect, see Figs. 4, 5, 16 and Sections 11.3-11.7
- spool valve sticks
- prestage is defective

ART trouble shooting is explained in the User's Guide of the ART master software (e.g. Valve Manager).

8 TOOLS

No special tools needed.

9 ORDERING SPARE PARTS

Spare parts are delivered as modules. Available modules are shown in Sections 11.1 and 11.2.

When ordering spare parts, always include the following information:
- controller type designation and serial number from the ID plate
- code of this manual, part number, part name and quantity required
- When ordering the circuit board, serial number of the position sensor

10 ND820/K00, ND820/I00 (WITH LIMIT SWITCHES)

10.1 Introduction

10.1.1 General description

ND820 can be equipped with limit switches. ND820/K00 has 2 microswitches and ND820/I00 2 inductive proximity switches.

Limit switches are used for electrical position indication of the valves and other devices.

The switching points can be chosen freely.

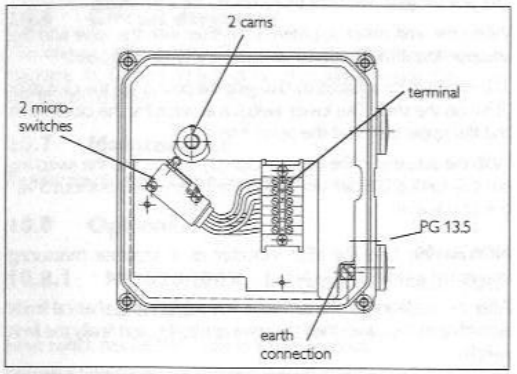


Fig. 18. ND820/K00 layout

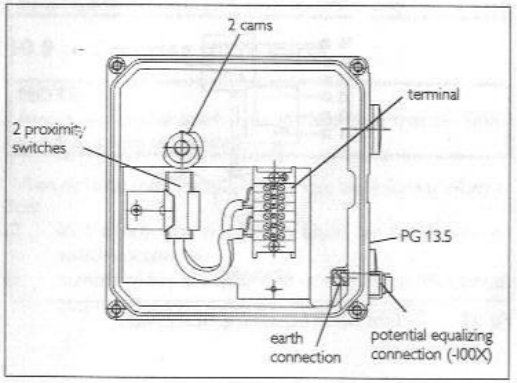


Fig. 19. ND820/I00 layout

10.1.2 Markings

The limit switch is provided with an identification plate sticker, see Fig. 20. Identification plate markings from top to bottom are:
- Type designation
- Electrical values
- Enclosure class
- Temperature range
- Conduit entry
- Serial number

The type designation is described in Chapter 13.

Fig. 20. Identification plate, ND800/K05

10.1.3 Technical specifications

10.1.3.1 ND820/K00

Microswitch type:	OMRON D2VW-5 OMRON D2VW-01 (gold plated contacts)	(05) (06)
	Protection class IP67	
Resistive load:	3A: 250 V AC 5A: 30 V DC 0.4A: 125 V DC	(05)
	100 mA: 30 V DC/125 V AC	(06)
Switch accuracy:	< 2°	
Number of switches:	2	
Protection class of cover:	IP65 (DIN 40050, IEC 529)	
Conduit entry:	PG 13.5 1/2 NPT = -L M20x1.5 = -I R 1/2 = -NJ	
Ambient temperature:	-20 - +80 °C (-4 - +176 °F)	
Weight:	Approx. 0.8 kg (1.8 lbs) (limit switches only)	
Materials:		
Body:	Aluminium alloy, epoxy-coated	
Internal parts:	Stainless steel and plastic	
Sealing:	Nitrile and neoprene rubber	

.3.2 ND820/I00

mity switch:	Inductive, diameter 8-14 mm (0.31-0.55 in) Sensing range 2 mm (0.08 in) Protection class IP67 P+F NJ2-12GK-N 01X ifm IFC2002-ARKG/UP 56 Other switch types on special order
ical values:	According to switch type
h accuracy:	< 1°
ber of switches:	2
ction class of housing:	IP65 (DIN 40050, IEC 529)
luit entry:	PG 13.5 NPT 1/2 = -L M20x1.5 = -I R 1/2 = -NJ
ent temperature:	According to switch type or -20 - +65 °C (-4 - +149 °F)
ht:	Approx. 0.8 kg (1.8 lbs) (limit switches only)
ials:	
:	Aluminium alloy, epoxy coated
al parts:	Polycarbonate
g:	Stainless steel and plastic Nitrile and neoprene rubber

.4 Safety precautions

UTION:
not exceed the limit switch performance limitations!
eeding the limitations marked on the limit switch may e damage to the limit switch, actuator and valve. Damage ersonal injury may result.

UTION:
serve caution with the live parts of the limit switch!
limit switches are fed with a voltage that, depending on system, may be lethal.
not touch any uncovered parts of the wires. Always onnect the wires before dismantling the limit switch.

Installing ND820/K00 or ND820/I00 on a valve controller

mit switch can be installed on an existing valve controller.

TE:
ot install a ND820/K00 limit switch on a ND820/X valve controller!

If the valve controller is already mounted on an actuator/valve assembly, operate the actuator into the closed or open position.
Remove the cover (2) and the pointer (65).
Turn the shaft (304) onto the shaft (40). Fasten the screw (305) using a locking agent such as Loctite. Unfasten the screws (331) in the cam discs (330).
Mount the housing (300) on the valve controller.
ND820/K00: Turn the cam discs (330) to avoid contact with the microswitches, if needed.

- ☐ Mount the pointer (65) on the shaft (304).
- ☐ Adjust the limit switch according to Section 10.4.

10.3 Electrical connections

Before connecting the power, make sure that the electrical specifications and the wiring meet the installation conditions. See the diagrams in Section 11.7. See also the information on the identification plate.
ND820/I00: Observe the functioning of the proximity switch; activated when the active face is either covered or free.

10.4 Adjustment

The pointer (65) 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 can be adjusted by changing the position of the cam discs (330) 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, find the switching point by turning the cam disc so that the switch changes about 5°-6° before the limit.

ND820/I00: 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 (65) so that the yellow line is parallel with the valve closure member.

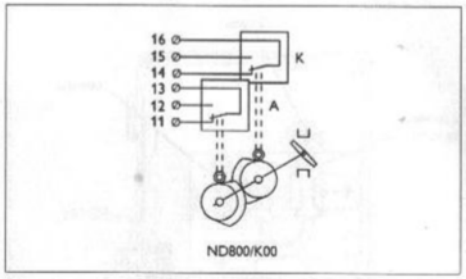


Fig. 21. Limit switch adjustment, ND820/K00

10.5 Removal of the limit switches ND820/K00 and ND820/I00 for accessing the valve controller

Before the protective cover (46) can be removed the limit switch must be detached.

- ☐ Remove the cover (2) and the pointer (65).
- ☐ Loosen the screws (302) and remove the housing (300).
- ☐ Detach the shaft (304) with cam discs (330).
- ☐ Proceed with the valve controller as applicable.

Re-install the limit switch according to Section 10.2 and check the adjustment according to Section 10.4.

10.6 Circuit diagrams

The internal circuitry of the limit switch is shown in the connection diagrams in Section 11.8 and on the sticker inside the cover (ND820/K00 only).

10.7 Maintenance

Regular maintenance of the limit switch is not necessary.

10.8 Options

10.8.1 ND820/I00X, intrinsically safe construction

Limit switch has DEMKO EEx ia IIC T6 approval.

NOTE:
The Ex classification requires the ND820/I00X limit switch to be used with the ND820/X valve controller only.

10.9 Ordering spare parts

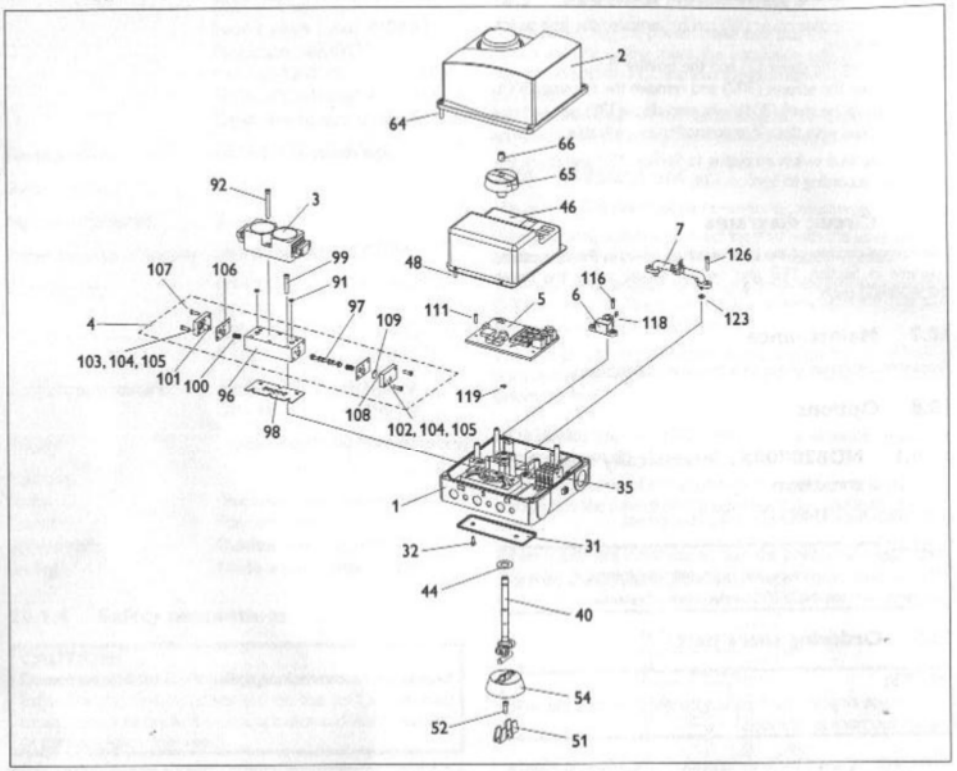
NOTE:
Always use original spare parts to make sure that the limit switch functions as intended.

When ordering spare parts, always include the following information:

- ☐ limit switch type designation (from the name plate or switch documents)
- ☐ number of the spare parts list or number of this manual, part number, part name and quantity required

11 DRAWINGS AND PARTS LISTS

11.1 Exploded view and parts list, ND820

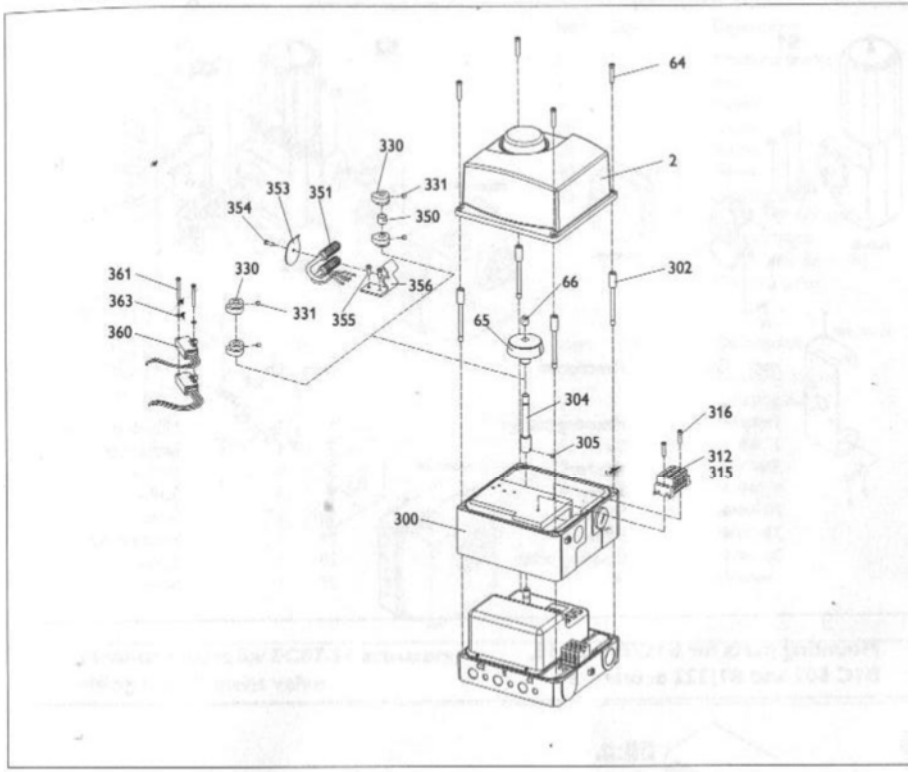


Item	Qty	Description	Recommended spare
1	1	Housing	
2	1	Cover	
3	1	Prestage unit *	
4	1	Spool valve assembly *	x
5	1	Circuit board	
6	1	Position sensor *	
7	1	Differential pressure sensor *	
31	1	Exhaust cover	
32	2	Screw	
35	4	Terminal block	
40	1	Shaft assembly	
44	1	Washer	
46	1	Protective cover	
48	4	Screw	
51	1	Ear	
52	1	Screw	
54	1	Couplings jacket	
64	4	Screw	
65	1	Pointer	
66	1	Screw	
91	2	O-ring	x
92	2	Screw	

Item	Qty	Description	Recommended spare
96	1	Spool valve body **	
97	1	Spool **	
98	1	Gasket	x
99	4	Screw	
100	2	Spring **	
101	1	Back stop **	
102	1	End piece I **	
103	1	End piece II **	
104	2	Restriction **	
105	2	Filter **	
106	2	Gasket **	
107	4	Screw **	
108	1	Adjustable back stop **	
109	1	O-ring **	
111	5	Screw	
116	2	Screw	
118	2	Screw	
119	1	Lock ring	
123	2	O-ring	
126	2	Screw	

*) delivered as a module
**) part of the spool valve assembly

11.2 Exploded view and parts list, ND820/K00 and ND820/I00



Item	Qty	Description	Recommended spare
2	1	Cover	
64	4	Screw	
65	1	Pointer	
66	1	Screw	
300	1	Housing	
302	4	Screw	
304	1	Shaft	
305	1	Screw	
312	6	Terminal block	
315	2	End stop	
316	2	Screw	
330	2	Cam disc	
331	2	Screw	
350	1	Bushing (I00)	
351	2	Inductive proximity sensor (I00)	
353	1	Washer (I00)	
354	1	Screw (I00)	
355	2	Screw (I00)	
356	1	Fastening plate (I00)	
360	2	Microswitch (K00)	
361	2	Screw (K00)	
363	2	Spring washer (K00)	