

NELFLOW[®], A VALVE AS A FLOWMETER



NELFLOW by Neles Controls brings added functionality for the control valve, which can also be used to measure the flow rate. The NELFLOW concept is based on the measurement of the pressure difference over the valve and the measurement of actual travel of the valve. Based on the flow coefficient C_v , which depends on the actual valve and travel, and standardized valve sizing equations the flow can be calculated if pressure difference is known. NELFLOW utilizes today's latest digital technology: its core is the digital valve controller ND800, which in addition to valve positioner and valve diagnostics can now also act as a flow transmitter.

Improved process performance

Because valves are already installed for process control, process optimization and performance can be further improved by using NELFLOW control valves to measure the flow rate.

More accurate material balances

NELFLOW is especially suited to measuring and gathering material balances in demanding applications such as water and steam systems, refining and screening processes.

Economy

NELFLOW provides a particularly cost effective solution in large pipeline sizes.

FEATURES

All in one

- digital positioner
- control valve diagnostics
- flow measurement

Wide applicability

- valve compatible with many different fluids
- wide control range = wide measurement range
- wide range of nominal sizes
- wide range of pressure classes and valve materials
- if the flow can be controlled by a valve and the pressure difference can be measured then the flow is measurable

Reliable and robust flow measurement

- the flow rate based on pressure differential measurement is immune to different variables like electrical conductivity, air content of fluid, fibres, solid particles

Ease of retrofitting

- simply change the positioner and use the pressure information from the pipeline
- possibility for flow measurement without pipeline modifications
- applies to existing valves

Quick response time

- pressure changes are detected almost instantly, this allows quicker tuning for control loop

For difficult fluids

- turbulent flow and blending downstream of the closure member prevents any build-up of particles on the inner walls of the valve

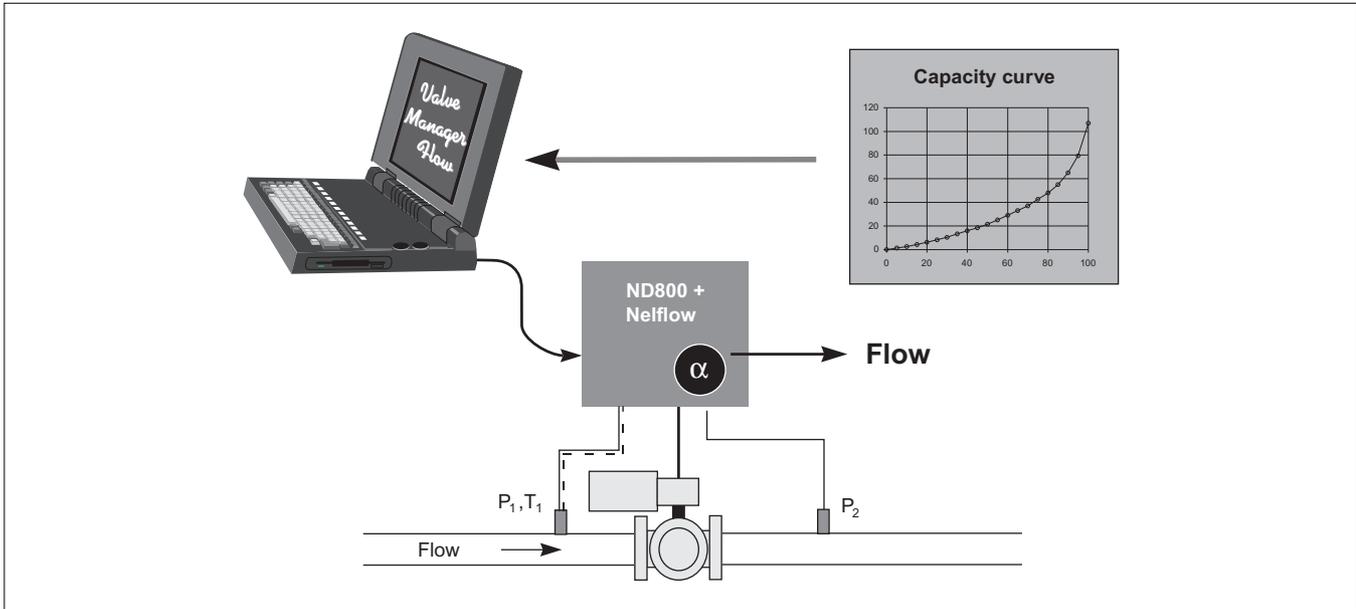
Cost effective solution

- initial cost is low especially in large sizes
- low installation costs because valve will be installed anyway
- low operational costs, use of existing valve pressure difference
- maintenance costs are the valve maintenance costs

Applications

- clean liquids and gases
- pulp and paper industry: fiber suspensions, reject flows, slurries, liquors
- steam and condensates

PRINCIPLE OF OPERATION



NELFLOW's core components are a control valve, pressure transmitters and the ND800 digital valve controller modified for NELFLOW applications. In addition to ND800 the digital valve controller (see also bulletin 7 ND 20) NELFLOW valve controller includes its own circuit board for the flow transmitter and a connection terminal for pressure and temperature signals. ND800 is a 4-20 mA loop-powered microprocessor-based valve controller. The flow transmitter is also a 4-20 mA loop-powered device which takes the power from flow output circuit. Configuration of the flow transmitter is carried out with the Valve Manager for Nelflow software utilising HART.

Flow measurement is based on the measurement of the pressure differential over the valve, with gases or steam flows

also the temperature can be measured. When actual valve travel and flow coefficient C_v is known the flow can be calculated with standardized control valve sizing equations (standard IEC 60534-2). The pressure differential is obtained by measuring actual upstream and downstream pressures with pressure transmitters or by using a differential pressure transmitter. If both or one of the pressures is known to be a constant, e.g. constant level of tank, it is possible to set the constant value with the configuration program as well as the temperature. The travel is measured by a position sensor in the ND800 valve controller and valve C_v -values are saved in the memory of the flow transmitter circuit board, the calculated flow is transmitted as a 4-20 mA output.

TECHNICAL SPECIFICATIONS

General

The NELFLOW concept applies to rotary and globe valves with pneumatic actuators.

Environmental influence

Operational temperature: $-40...+85^{\circ}\text{C}$ / $-40^{\circ}...+185^{\circ}\text{F}$
 Effect of temperature on flow value: $< 0.1\%/^{\circ}\text{C}$, valve gain < 2 , effect of temperature to pressure measurement $< 0.05\%/^{\circ}\text{C}$
 Effect of vibration on flow value: $< 1\%$, 2g, 5-100 Hz

Enclosure

Material: Epoxy painted anodized aluminium alloy
 Protection class: IP65
 Electrical connection: Screw terminals 0,25 - 2,5 mm² and 4 pieces of PG13.5 conduit entries (as options 1/2 NPT, M20x1.5 and R1/2)
 Weight: 2.8 kg

NELFLOW's electronics

Valve controller:

Supply power: taken from the 4...20 mA control signal
 Minimum signal: 3.8 mA
 Load voltage: up to 13.2 VDC/20 mA (corresponding 660 Ω , maximum load voltage)
 Supply voltage: max. 30 VDC
 Polarity protection: -30 VDC
 Over current protection: active > 25 mA

Flow transmitter:

Supply power: taken from the 4...20 mA 2-wire output signal.
 Load voltage: up to 14 VDC/20 mA (corresponding 700 Ω , maximum load voltage)
 Supply voltage: 14-30 VDC
 External load: 0-800 Ω
 Polarity protection: -30 VDC
 Isolated from valve controller's control signal

Connections to pressure and temperature measurements:

Each transmitter requires its own power supply

Measurement range: 4-20 mA
 Voltage: max. 30 VDC
 Polarity protection: -30 VDC
 Load: 7V/20 mA (350 Ω)
 Isolated from other connections

Connection options for pressure transmitters (connection diagrams shown in Installation, Maintenance and Operating instructions):

1. supply voltage to pressure transmitters through terminal block of Nelflow (default connection in installation ready unit)
2. supply voltage to pressure transmitters

Performance

Repeatability of flow measurement: $< \pm 0.5\%$
 Flow measurement error: $< \pm 2.5\%$ of reading for factory-calibrated unit, when velocity for liquids ≥ 0.5 m/s / 1.64 fps

Transmitters

Pressure transmitters for valve inlet/outlet:
 type: diaphragm, 2-wire transmitter WIKA 891.13.520

material: stainless steel 1.4571, ANSI 316
 pressure range: 0...6 bar / 0...90 psi
 temperature range: 0°...100°C / 32...+212°F for medium, -20°...+80°C / -4...+178°F for environment

electrical connections: 4...20 mA output, supply voltage 10...30 VDC ($R_x = 350 \Omega$)

connection: G1/2"
 mounting: either to Nelflow's transmitter flanges or in the piping by using weld-on adaptor

other pressure transmitters: by using weld-on adaptor in the piping, requirement is 4...20 mA output, error $< \pm 0.5\%$ F.S.

Temperature transmitter to valve inlet:
 by using weld-on adaptor in the piping, requirement is 4...20 mA output

Transmitter flanges:

In measurement alternative 1 (installation ready unit) pressures are measured in immediate vicinity of the valve by using transmitter flanges for transmitter mounting.

material: AISI 316
 flange sealing: PTFE
 flange facing: raised face (Ra 10-12.5), corresponds DIN 2526, form C
 flange thickness: 33 mm / 1.3"
 nominal sizes: DN25-DN250 / 1" - 10"
 pipe flanges: see applicable bulletins, R-series segment valve 3 R 20 or Finetrol rotary control valve 5 FT 20.

Face-to-face dimensions of the installation ready unit:

Dimensions in mm									
DN	25	40	50	65	80	100	150	200	250
Series R1 wafer	118	128	143	168	168	183	228	268	308
Series R11 wafer	170	182	192	213	233	262	297	311	365

Dimensions in inch									
Size	1	1.5	2	2.5	3	4	6	8	10
Series R1 wafer	4.65	5.04	5.63	6.61	6.61	7.20	8.98	10.55	12.13
Series R11 wafer	6.69	7.17	7.56	8.39	9.17	10.31	11.69	12.24	14.37

User interface**valve controller:**

local HART 3 push buttons + LCD display
 Valve Manager software

flow transmitter:

HART Valve Manager for Nelflow software including configuration and parameter settings, monitoring of pressures and flow, and flowmeter calibration.

Configuration

Installation ready Nelflow unit with valve and actuator is supplied as valve type, size and transmitters ready configured, the user must configure only the medium.

If only Nelflow valve controller is supplied the user takes care of all configuration.

Electromagnetic compatibility

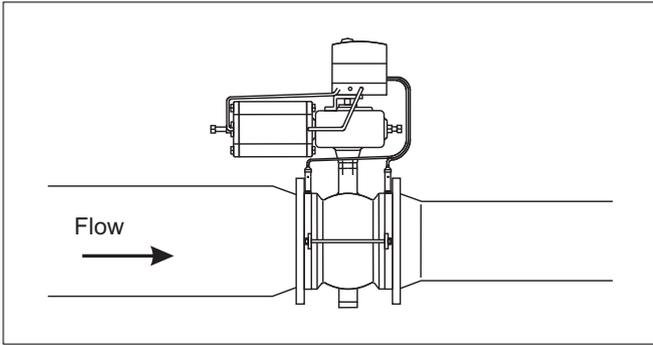
EN 50081-1 and EN 50082-2, CSA pending

CE-marking

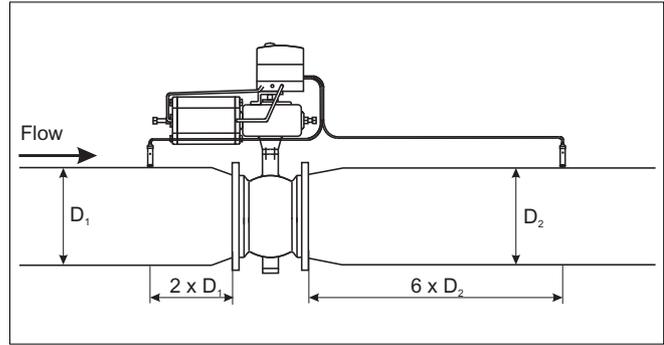
Electromagnetic compatibility:
 89/336/EEC

MEASUREMENT ALTERNATIVES:

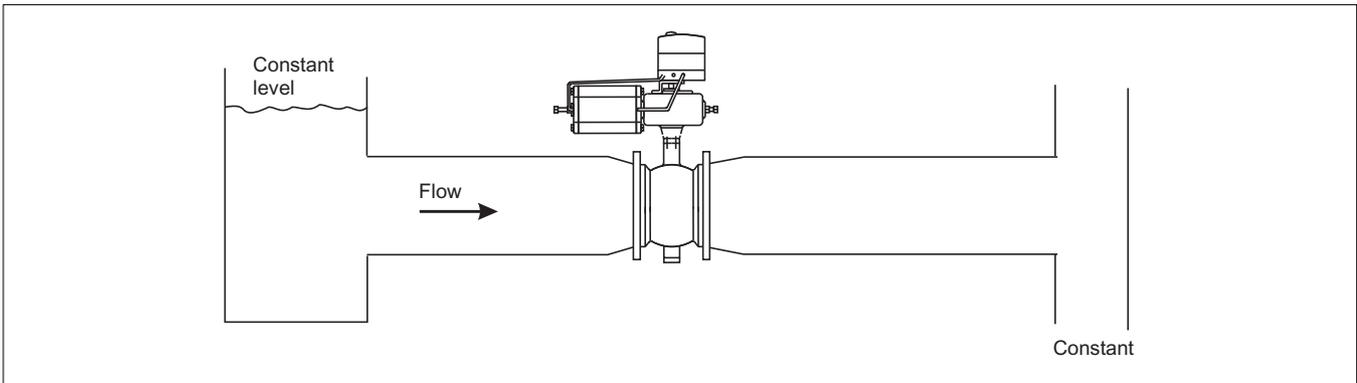
Flow value by NELFLOW is based on pressure differential over the valve and actual valve travel. Pressure differential can be measured by pressure transmitters or pressure differential transmitters with following alternatives:



1. Pressure differential is measured with pressure transmitter flanges mounted in immediate vicinity of valve. In this case installation ready NELFLOW unit can be supplied as calibrated at Neles Controls factory. Applicable for wafer R-series or wafer Finetrol.



2. Pressure differential is measured from the pipeline according to distances specified in standard IEC 60534-2-3, which enables the use of valve C_V -values from technical bulletins. If other distances are used the effect on flow coefficient can be taken into account by the configuration program. It is not recommended to measure downstream pressure closer to valve than specified in standard. Applicable for all Neles Controls valves.



3. If either or both of pressures can be assumed to be constant, it is possible to configure a constant value by using Valve Manager for Nelflow program. Flow can be then calcu-

lated without pressure measurement. Applicable for all Neles Controls valves.

TYPE CODING

NOTE: SPECIFY VALVE AND ACTUATOR ACCORDING TO APPLICABLE TECHNICAL BULLETIN

VALVE CONTROLLER FOR NELFLOW, NDQ800

1.	2.	3.	4.	5.	*)	6.	7.
NDQ	8	2	2	-	/	S1	KL

*) Slash shall always be marked in places shown above.

1. sign	PRODUCT GROUP	
NDQ	Valve controller with flow measurement including position transmitter	
2. sign	SERIES CODE	
8		
3. sign	INPUT SIGNAL RANGE	
2	4-20 mA	
4. sign	SPOOL VALVE	PNEUMATIC CONNECTIONS
2	ø 2 mm, double action.	1/4 NPT
6	ø 6 mm, double action.	1/4 NPT
21	ø 2 mm, 3-way spool valve, single action.	1/4 NPT
61	ø 6 mm, 3-way spool valve, single action.	1/4 NPT
5. sign	ACTION	
A	Double action, without sign. Specify 4. sign 2 or 6. In connection with B_C6 and B_C9 4. sign must be 2.	
	Single action, without sign. Specify 4. sign 21 or 61. In connection with B_J8, QP1 and QP2 actuators 4. sign must be 21. Not applicable with double acting actuators.	
	Single action, linear motion, applicable to Neles Controls D/R-series diaphragm actuator. 4. sign must be 21 or 61. 21A is for RA and DA. 61A is for RB, RC, RD, RE and DB, DC, DE. Also applicable to linear actuators according to IEC 60534-6-1 with own linkage set. Specify 4. sign 21 or 61 according to stroke volume for single action. Specify the stroke (20-60 mm or 60-100 mm).	
6. sign	OPTIONS	
	If several options below are needed to the same valve controller, the codes shall be marked in presented order from top. Temperature range for various options shall be considered carefully.	
	Standard , IP 65 enclosure, NEMA 4 and 4X. Built-in display and local keypad. PG 13.5 conduit entry, 4 pieces. Temperature range -20°C... +85°C / -4°F... +185°F. Valve controller: Load voltage: up to 13.2 VDC at 20 mA corresponding 660 Ω (maximum voltage drop). Supply voltage ≤ 30 VDC. Flow transmitter: output signal: 4-20 mA (optical isolation) supply voltage: 14-30 VDC external load resistance: 0 - 800 Ω Position transmitter: output signal: 4-20 mA (galvanic isolation) supply voltage: 12-36 VDC external load resistance: 0 - 1200 Ω	
C	Low temperature construction, lowest operational temperature -40°C/-40°F	
S1	Valve controller attachment face according to 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 (5. sign A).	
A	Pressure gauges, scale bar/psi/kPa, basic material brass, nickel plated housing stainless steel, glycerine filled. Temperature range -40°C... +70°C / -40°F... +158°F	
Y	Special construction, to be specified.	
7. sign	EXTERNAL CONNECTION PARTS FOR VALVE CONTROLLER	
K	Filter regulator for supply air, type BELLOFRAM 51FR. Pressure gauge, scale bar/psi/kPa, basic material brass, nickel plated, housing stainless steel glycerine filled. Filter size 5 µm. Will be specified in the option sticker. Temperature range -18°C... +52°C / 0°F... +125°F. Filter regulator with higher capacity needed for actuators BC40 and BJ32!	
L	PG13.5 / 1/2 NPT conduit entry nipple, 4 pieces. Will be specified in the option sticker.	
I	PG13.5 / M20x1.5 conduit entry nipple, 4 pieces. Will be specified in the option sticker.	
NJ	PG13.5 / R1/2 (PF1/2) conduit entry nipple, 4 pieces. Will be specified in the option sticker.	

NELFLOW ACCESSORIES

1.	2.	3.
P6	F80	C1

1. sign	PRESSURE TRANSMITTERS
P6	2-wire pressure transmitters, model WIKA 891.13.520. Includes two separate transmitters (upstream and downstream). Pressure range of medium 0...6 bar / 0...87 psi, temperature range of medium 0°C... +100°C/+32°F...212°F. Ambient temperature -20°C... +80°C / -4°F ...+176°F. 4...20 mA output, supply voltage 10...30 VDC. Connection G 1/2", mounting either in pressure measurement flanges or directly into the pipeline with weld-on adaptors.
Y	Special transmitters, to be specified.
2. sign	PRESSURE TRANSMITTER CONNECTIONS
F25... F250	Pressure measurement flanges, mounted upstream and downstream of flangeless valve, not applicable for butterfly valves. Applicable for pressure transmitter WIKA with G1/2" connection. End connection style: ANSI B16.5, raised face, stock finished (Ra 10 - 12.5), meets DIN 2526 form C. Applicable flange sizes: DN 25, 40, 50, 65, 80, 100, 150, 200, 250 mm. Flange thickness 33 mm. Flange material: AISI 316. Nuts and studs: stainless steel. Gaskets: PTFE.
W	Weld-on adaptors (sockets) for pressure transmitter connection into the pipeline. G1/2 connection. Material stainless steel 1.4571
Y	Special construction, to be specified.
3. sign	CALIBRATION
	No calibration without sign.
C1	Nelflow valve flow transmitter calibration in Neles Controls flow loop. Available for sizes DN 25 - DN 400.
Y	Special calibration, to be specified.

VALVE MANAGER

1.	2.	3.	4.	5.	6.
HART	16	M	N	N	N

1. sign	PRODUCT GROUP
HART	SOFTWARE UTILISING HART PROTOCOL FOR COMMUNICATION WITH ND800 VALVE CONTROLLER
2. sign	VALVE MANAGER SOFTWARE
15	Valve Manager™ for nelflow - software and modem with RS-232 interface for PC
16	Configuration software for Nelflow, no diagnostics, monitoring or testing. Not needed if 2.sign is 15.
3. sign	MODEMS
N	No modem
M	Modem Kit: RS-232 Modem + Cable + User's Guide. Note: 2. sign 11 and 15 includes always one Modem Kit, 3.sign M is used to order additional modems.
4. sign	CONVERTERS
N	No converter
5. sign	MULTIPLEXERS
N	No Multiplexer
6. sign	OTHER SOFTWARE
N	No other software

Subject to change without prior notice.

INTERNATIONAL MANUFACTURING AND SALES LOCATIONS

UNITED STATES: Shrewsbury, Massachusetts. MEXICO: Chihuahua. BRAZIL: São José dos Campos.
FINLAND: Helsinki. FRANCE: Wittenheim. PEOPLE'S REPUBLIC OF CHINA: Shanghai.

Our products are available through Neles Controls sales offices in Australia, Austria, Belgium, Canada, Chile, Denmark, England, Germany, Indonesia, Italy, Japan, The Netherlands, Norway, Portugal, Russia, Saudi Arabia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, United Arab Emirates, Venezuela, as well as through a world-wide network of representatives.



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