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.

**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

**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.
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°C / -40°...+185°F
- **Effect of temperature on flow value:** $<0.1\%/\degree$C, valve gain $<2$, effect of temperature to pressure measurement $<0.05\%/\degree$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: < ± 0.5%
Flow measurement error: < ± 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: 0º...100ºC / 32…+212°F for medium, -20º...+80ºC / -4…+178°F for environment
electrical connections: 4...20 mA output, supply voltage 10...30 VDC (Rₓ = 350 Ω)
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 < ±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:

<table>
<thead>
<tr>
<th>DN</th>
<th>25</th>
<th>40</th>
<th>50</th>
<th>65</th>
<th>80</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
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<tbody>
<tr>
<td>Series R1 wafer</td>
<td>118</td>
<td>128</td>
<td>143</td>
<td>168</td>
<td>168</td>
<td>183</td>
<td>228</td>
<td>268</td>
<td>308</td>
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<tr>
<td>Series R11 wafer</td>
<td>170</td>
<td>182</td>
<td>192</td>
<td>213</td>
<td>233</td>
<td>262</td>
<td>297</td>
<td>311</td>
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<tr>
<th>Size</th>
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<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series R1 wafer</td>
<td>4.65</td>
<td>5.04</td>
<td>5.63</td>
<td>6.61</td>
<td>6.61</td>
<td>7.20</td>
<td>8.98</td>
<td>10.55</td>
<td>12.13</td>
</tr>
</tbody>
</table>

User interface
valve controller: 3 push buttons + LCD display
HART Valve Manager software
flow transmitter: 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 calculated without pressure measurement. Applicable for all Neles Controls valves.
### TYPE CODING

#### VALVE CONTROLLER FOR NELFLOW, NDQ800

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
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<th>5.</th>
<th>6.</th>
<th>7.</th>
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</thead>
<tbody>
<tr>
<td>NDQ</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>/</td>
<td>S1</td>
</tr>
<tr>
<td>KL</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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

#### NELFLOW ACCESSORIES

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>P6</td>
<td>F80</td>
<td>C1</td>
</tr>
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</table>

#### 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.

#### EXTERNAL CONNECTION PARTS FOR VALVE CONTROLLER

<table>
<thead>
<tr>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
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<tbody>
<tr>
<td>HART</td>
<td>16</td>
<td>M</td>
<td>N</td>
<td>N</td>
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</tbody>
</table>

#### PRODUCT GROUP

**HART** SOFTWARE UTILISING HART PROTOCOL FOR COMMUNICATION WITH ND800 VALVE CONTROLLER

#### VALVE MANAGER

<table>
<thead>
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<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Valve Manager® for nelflow - software and modem with RS-232 interface for PC.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>16</td>
<td>Configuration software for Nelflow, no diagnostics, monitoring or controlling. Not needed if 2.sign is 15.</td>
<td></td>
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</tr>
</tbody>
</table>

#### MODEMS

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<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>No modem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Modem Kit: RS-232 Modern + Cable + User's Guide. Note: 2. sign 11 and 15 includes always one Modem Kit, 3.sign M is used to order additional Modems.</td>
<td></td>
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</tbody>
</table>

#### CONVERTERS

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<tbody>
<tr>
<td>N</td>
<td>No converter</td>
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#### MULTIPLEXERS

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<th>6.</th>
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</thead>
<tbody>
<tr>
<td>N</td>
<td>No Multiplexer</td>
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#### OTHER SOFTWARE

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<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>No other software</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
INTERNATIONAL MANUFACTURING AND SALES LOCATIONS

UNITED STATES: Shrewsbury, Massachusetts. MEXICO: Chihuahua. BRAZIL: São José dos Campos.

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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