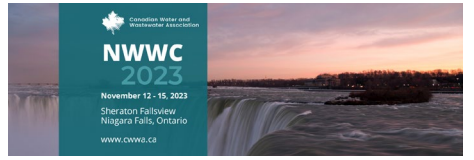
Modern Magnetic Flowmeters

Much more than flow rate and totals

Dean Rudd
Industry Manager

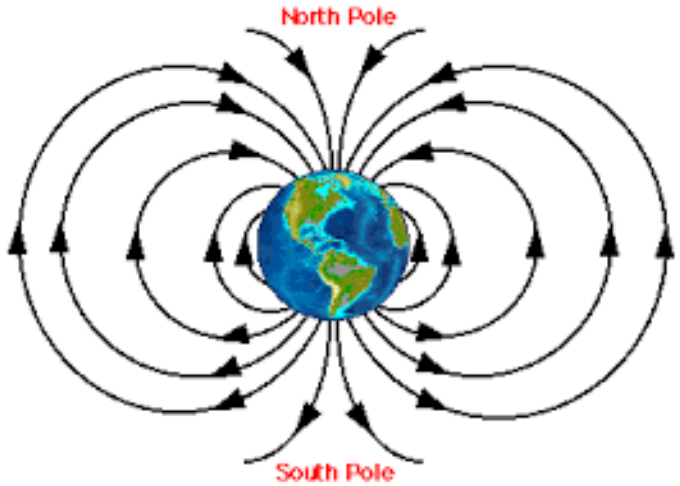
Endress+Hauser
People for Process Automation



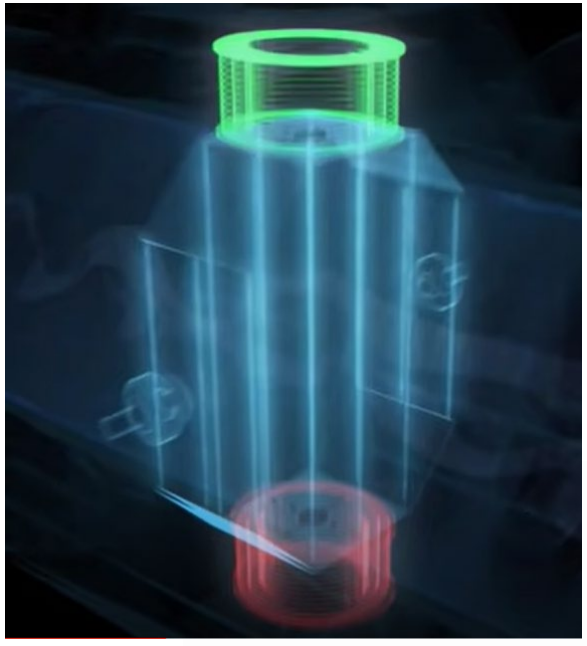
Modern Magnetic Flowmeters

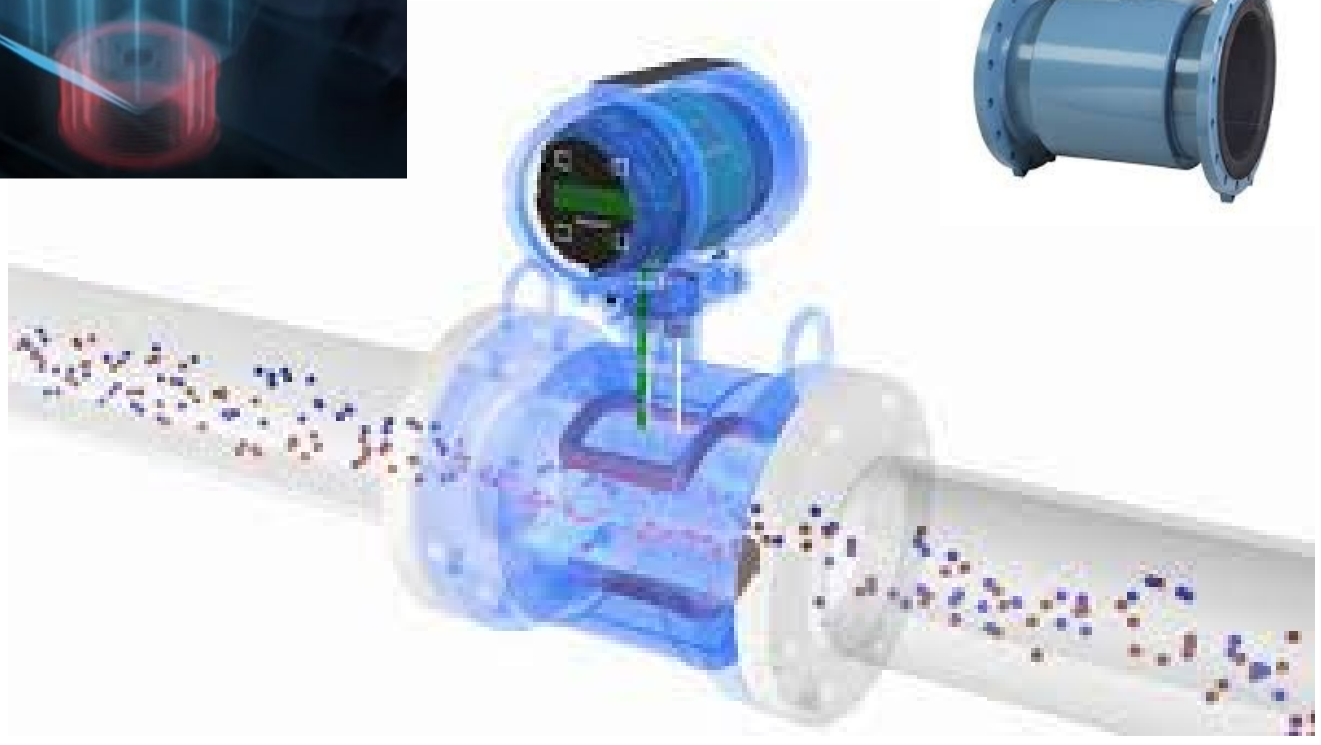
Much more than flow rate and totals

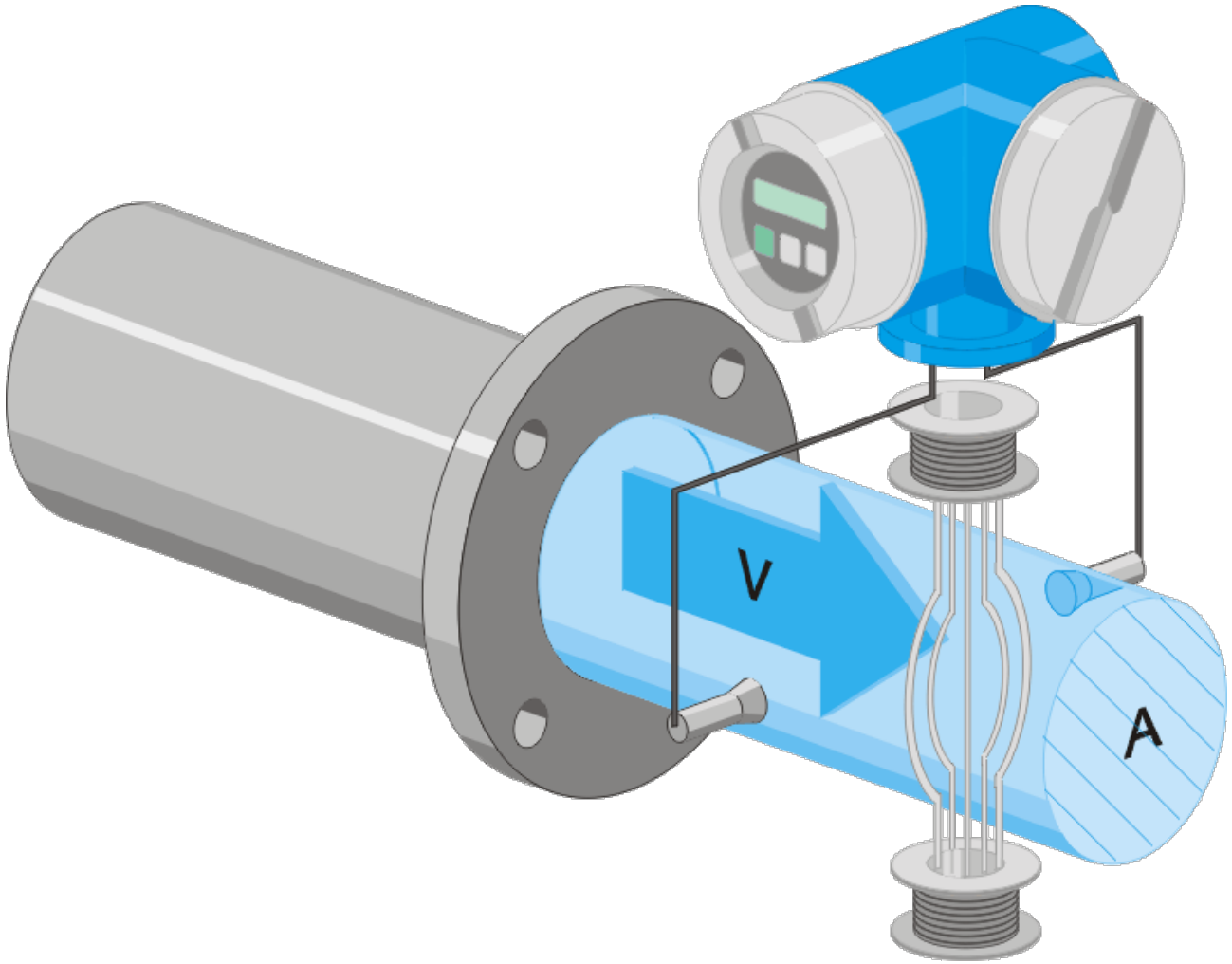
Michael Faraday, 1831 electrical induction in magnetic field



100 years later Priest Father
Bonaventura Thurlemann
First magnetic flowmeter







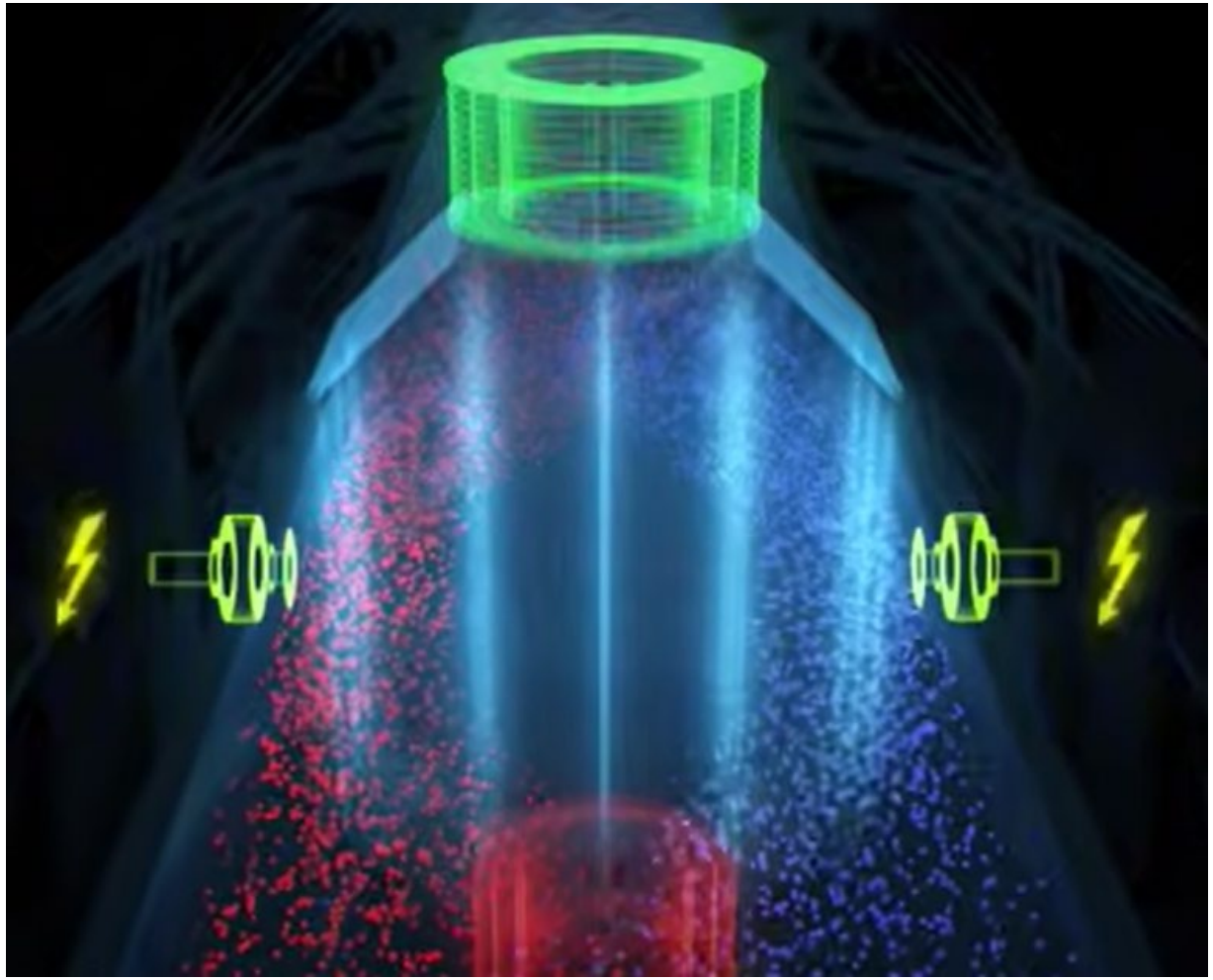
$$U_{flow} \sim v$$

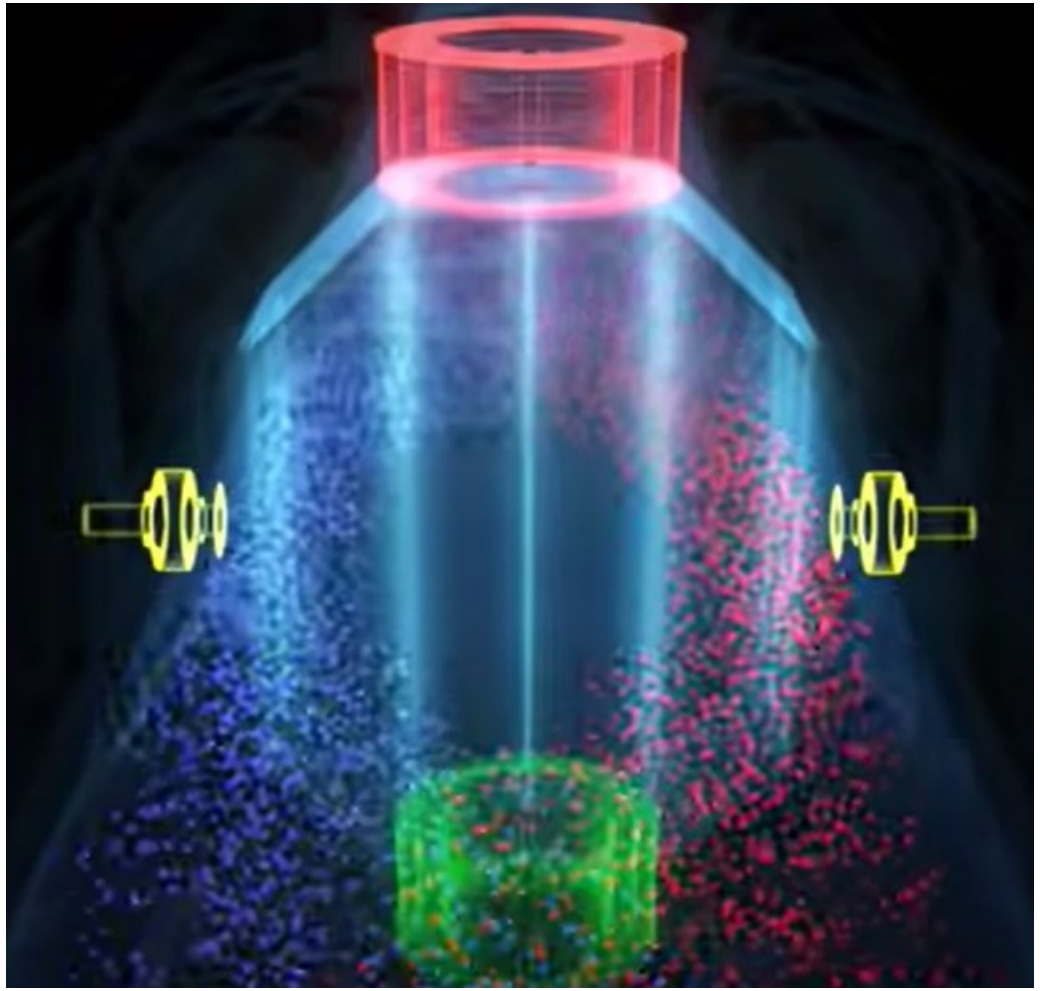
$$Q = v \bullet A$$

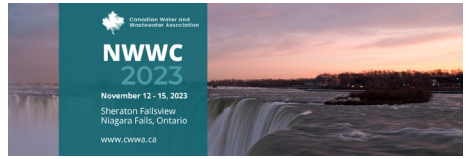
U_{flow} = induced voltage

v = flow velocity

Q = volume flow







Webservers

Simple, Easy, Menu driven the way we deal with computers every day

- No special software
- No pushing buttons
- No weird codes
- No more manuals
- Set-up wizards

1

Remote connections

Standard protocols
No need to remove covers
No wires

- WLAN
- Bluetooth
- Employee Safety
- Smartphones
- Tablets

2

Advanced Diagnostics

The meters are always testing themselves like all modern technology

- Standard error messages
- On board verifications
- Condition Monitoring

3

Easier installation

New designs eliminate the needs for traditional pipe runs

- Lap-joint flanges
- Zero upstream - downstream pipe diameters
- Battery power

4

Additional Information

Direct digital connections and data

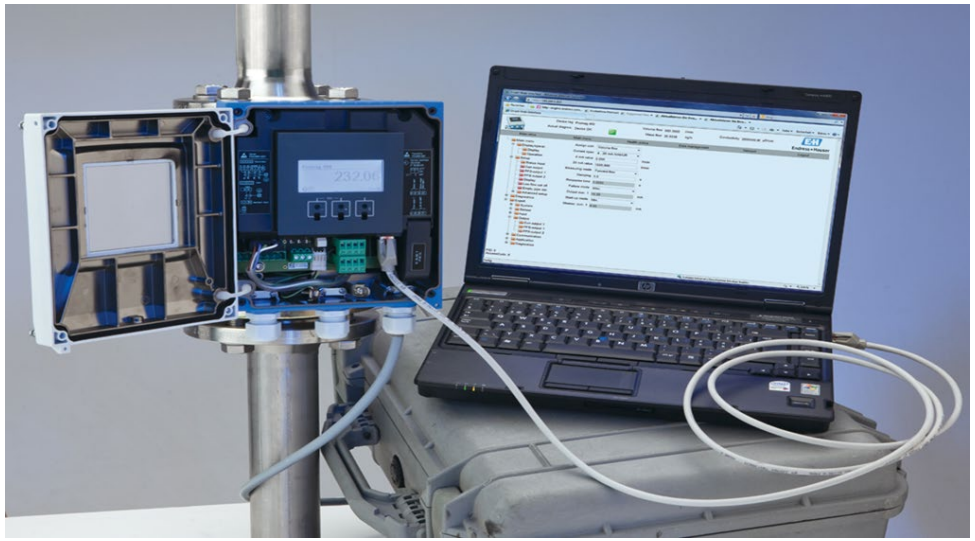
- Conductivity
- Ethernet Proptocols
- Floating point measurements

5

Webservers

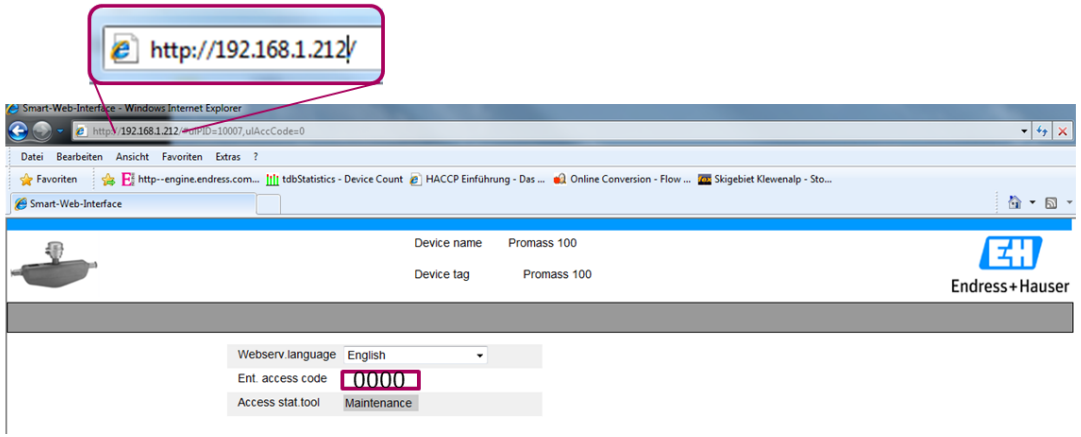
Simple, Easy, Menu driven the way we deal with computers every day

- No special software
- No pushing buttons
- No weird codes
- No more manuals
- Set-up wizards



If the IP address is correctly configured, then you are able to connect to the device via webserver.

1. Browse to the following address: http://192.168.1.212
2. Log in access code: 0000



Smart-Web-Interface

192.168.1.212/#ulPID=8,ulAccCode=330177772

Search

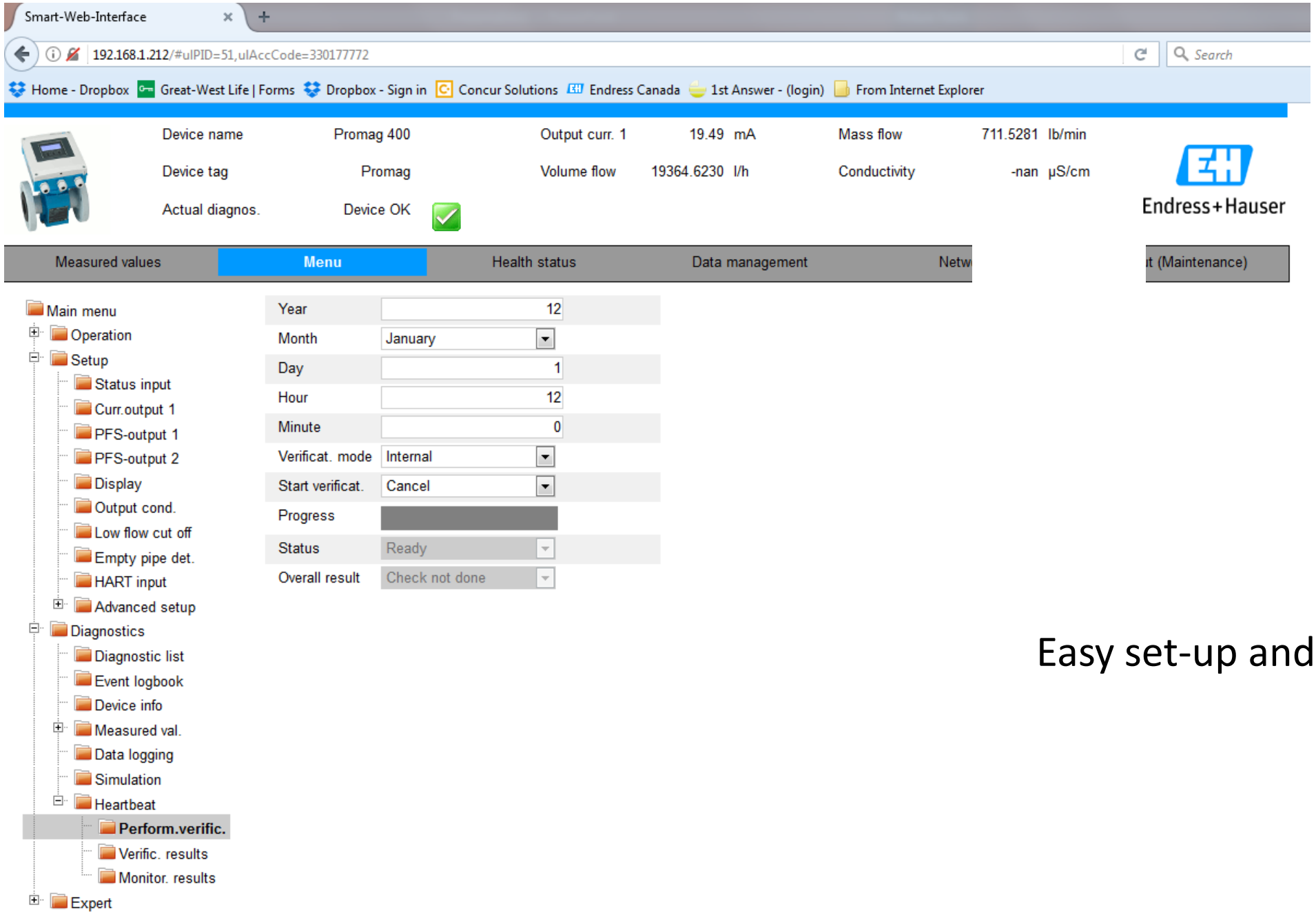
Home - Dropbox | Great-West Life | Forms | Dropbox - Sign in | Concur Solutions | Endress Canada | 1st Answer - (login) | From Internet Explorer

Device name	Promag 400	Output curr. 1	19.50	mA	Mass flow	711.7761	lb/min
Device tag	Promag	Volume flow	19371.3730	l/h	Conductivity	-nan	µS/cm
Actual diagnos.	Device OK						

Measured values | Menu | Health status | Data management | Network

Measured values

Volume flow	19371.3809	l/h
Mass flow	711.7764	lb/min
Totalizer val.1	3907366.7500	gal (us)
Tot. overflow 1	0	
Totalizer val.2	3907366.7500	gal (us)
Tot. overflow 2	0	
Totalizer val.3	3907366.7500	gal (us)
Tot. overflow 3	0	



Easy set-up and configuration

Smart-Web-Interface

192.168.1.212/#ulPID=2,ulAccCode=330177772

Search

Home - Dropbox | Great-West Life | Forms | Dropbox - Sign in | Concur Solutions | Endress Canada | 1st Answer - (login) | From Internet Explorer

Device name	Promag 400	Output curr. 1	19.49 mA	Mass flow	711.3006 lb/min
Device tag	Promag	Volume flow	19358.4629 l/h	Conductivity	-nan µS/cm
Actual diagnos.	Device OK				

Measured values | Menu | **Health status** | Data management | Network | Logout (Maintenance)

Health status

- Diagnostics 1: OK
- Diagnostics 2: OK
- Diagnostics 3: OK
- Diagnostics 4: OK
- Diagnostics 5: OK

Remote connections

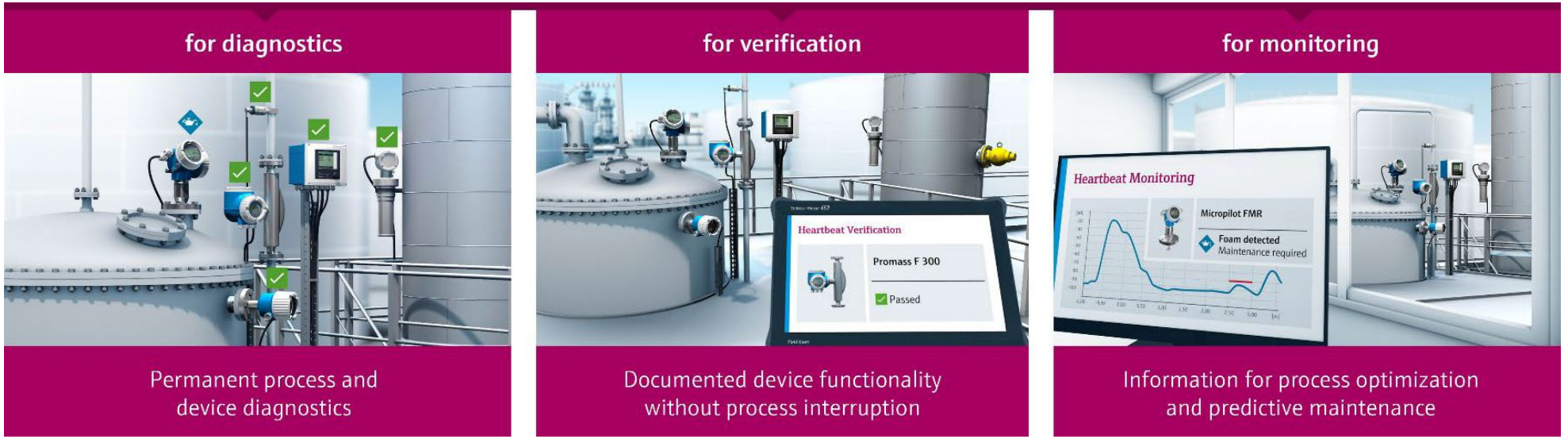
Standard protocols
No need to remove covers
No wires

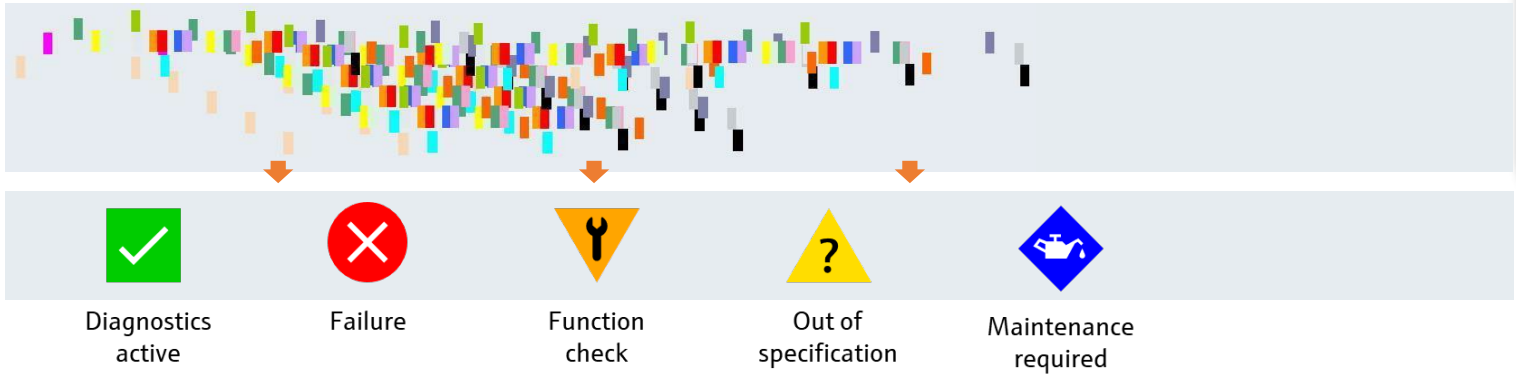
- WLAN
- Bluetooth
- Employee Safety
- Smartphones
- Tablets

Advanced Diagnostics

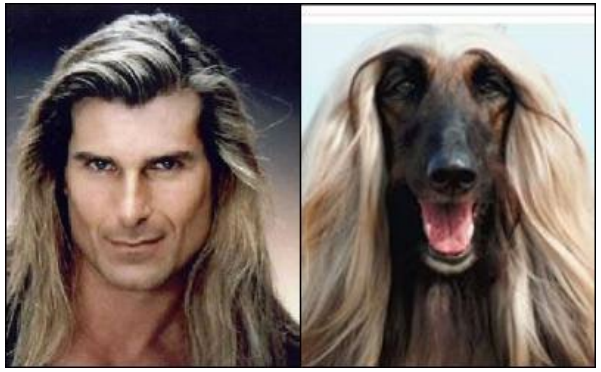
The meters are always testing themselves like all modern technology

- Standard error messages
- On board verifications
- Condition Monitoring





Calibration is the comparison of the process variable measurement of the instrument under test to a known traceable standard. Calibration determines the uncertainty (or error) between the two. .



Flow calibration rigs

Verification is the assessment of functional performance of the instrument by verifying its internal parameters with specialized tooling and processes ensuring full traceability.

- External
- Up to 60 minutes
- Test coverage
  90% or better

- Internal
- 1 to 10 minutes
- Total diagnostic coverage
  94-98%

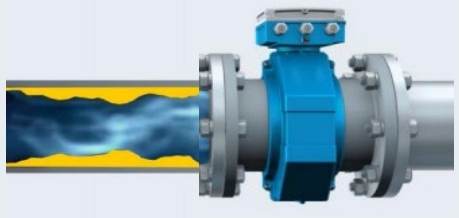
Sensor	☑	**Passed**
Inlet pickup coil	☑	Passed
Outlet pickup coil	☑	Passed
Measuring tube temperature sensor	☑	Passed
Carrier tube temperature sensor	☑	Passed
Pickup coil symmetry	☑	Passed
Frequency lateral mode	☑	Passed
Frequency torsion mode	☑	Passed
Sensor integrity	☑	**Passed**
Sensor electronic module	☑	**Passed**
Zero point tracking	☑	Passed
Reference clock	☑	Passed
Reference temperature	☑	Passed
I/O module	☑	**Passed**

- **Completed within seconds, no process interruption**
- **Can be performed locally or remotely**
- **Allows to identify where a problem occurs**
- **Accepted for compliance**

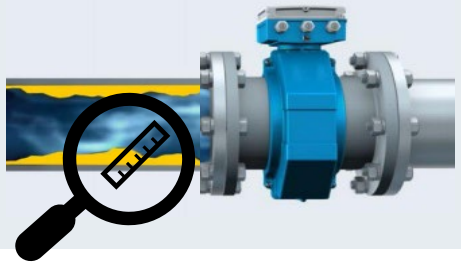
– Taking the pulse of your measurement

1. Device is clean

2. Build-up develops



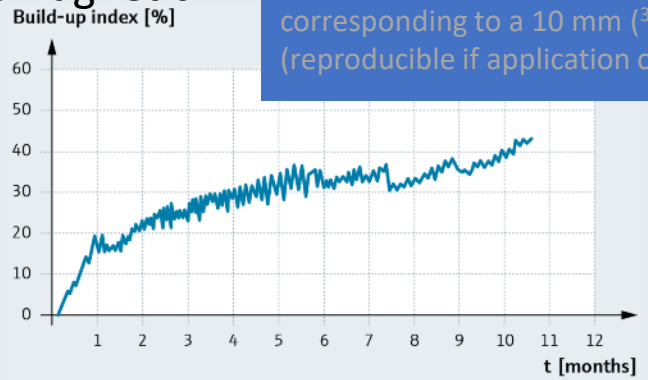
3. Check build-up thickness regularly



4. Write down the values

Build-up – Flow – Electromagnetic

Month	Build-up thickness	Build-up index
Month 2	3 mm	20%
Month 4	5 mm	30%
Month 6	7 mm	37%
Month 11	10 mm	42%



After 11 months the build-up index was 42%, corresponding to a 10 mm ($^3/_8$ in) thick layer (reproducible if application conditions are stable)

5. Clean the device

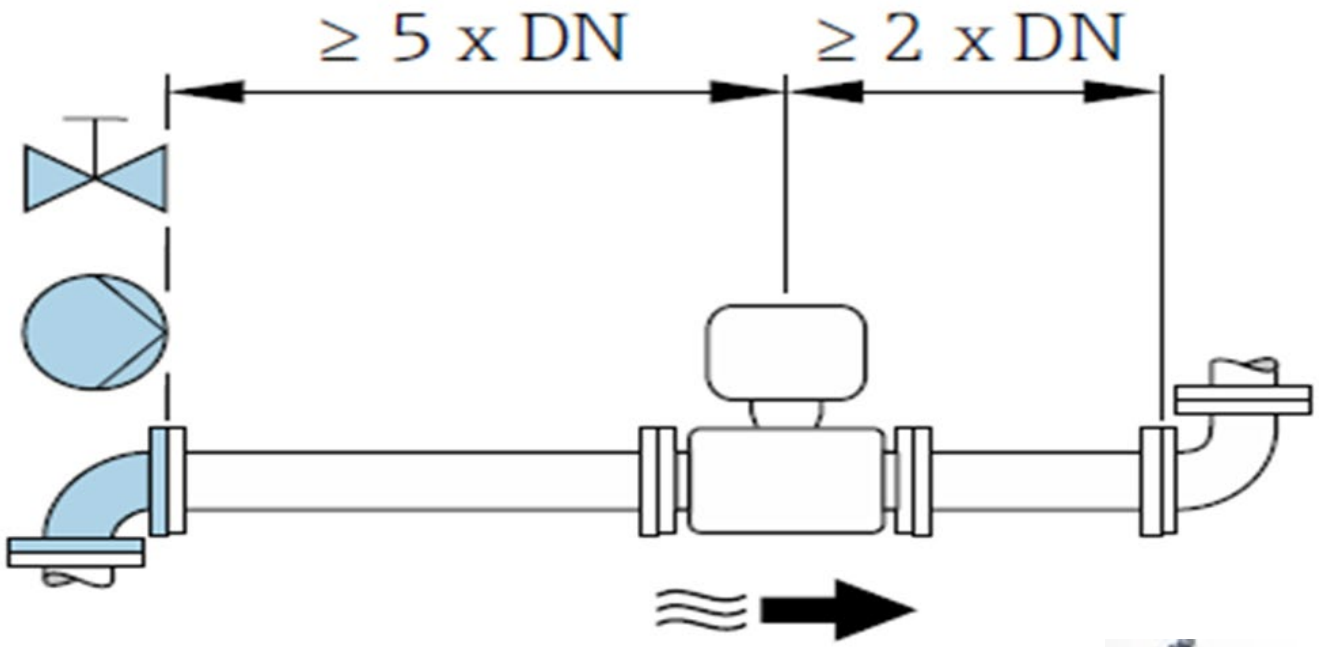
When the build-up is removed, the build-up index returns to its low initial value

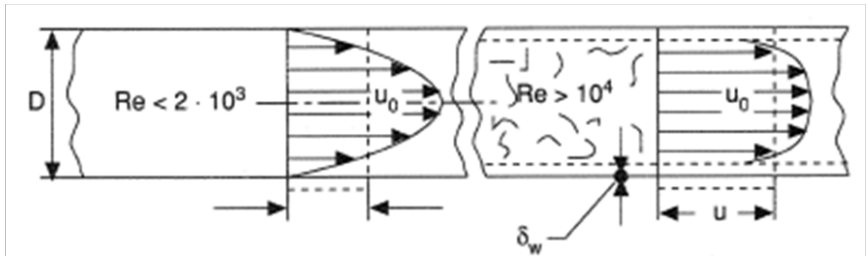
The build-up index correlates to the build-up thickness, but needs to be determined per application

Easier installation

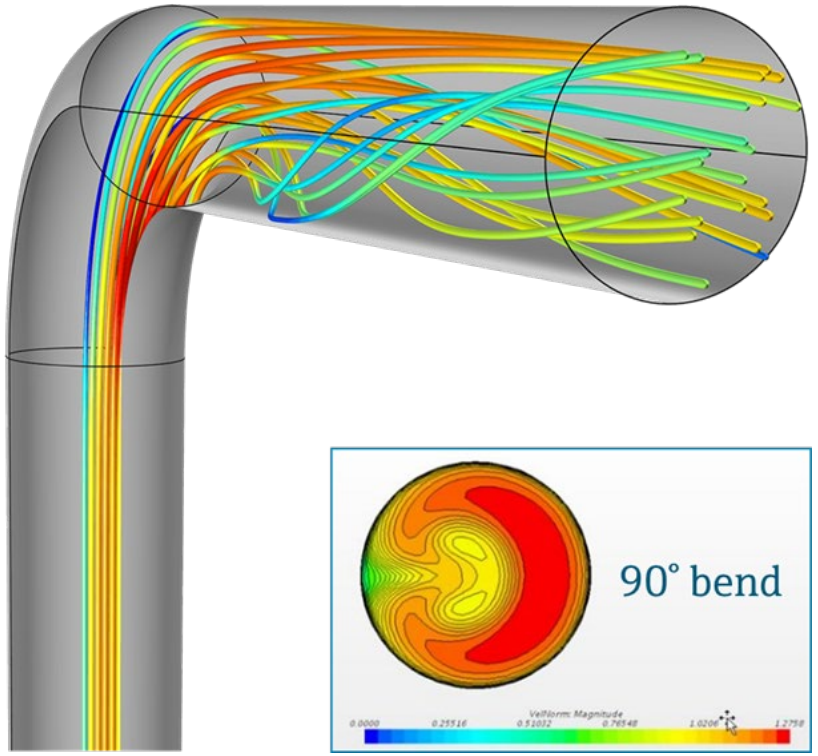
New designs eliminate the needs for traditional pipe runs

- Lap-joint flanges
- Zero upstream - downstream pipe diameters



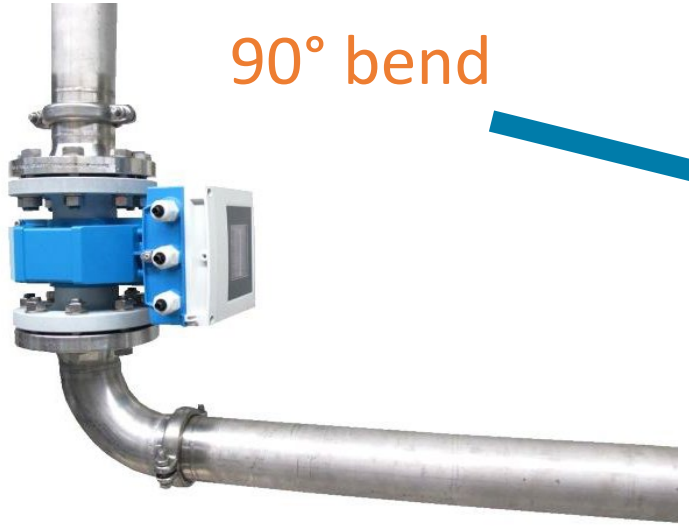


Big Mags Create a real problem

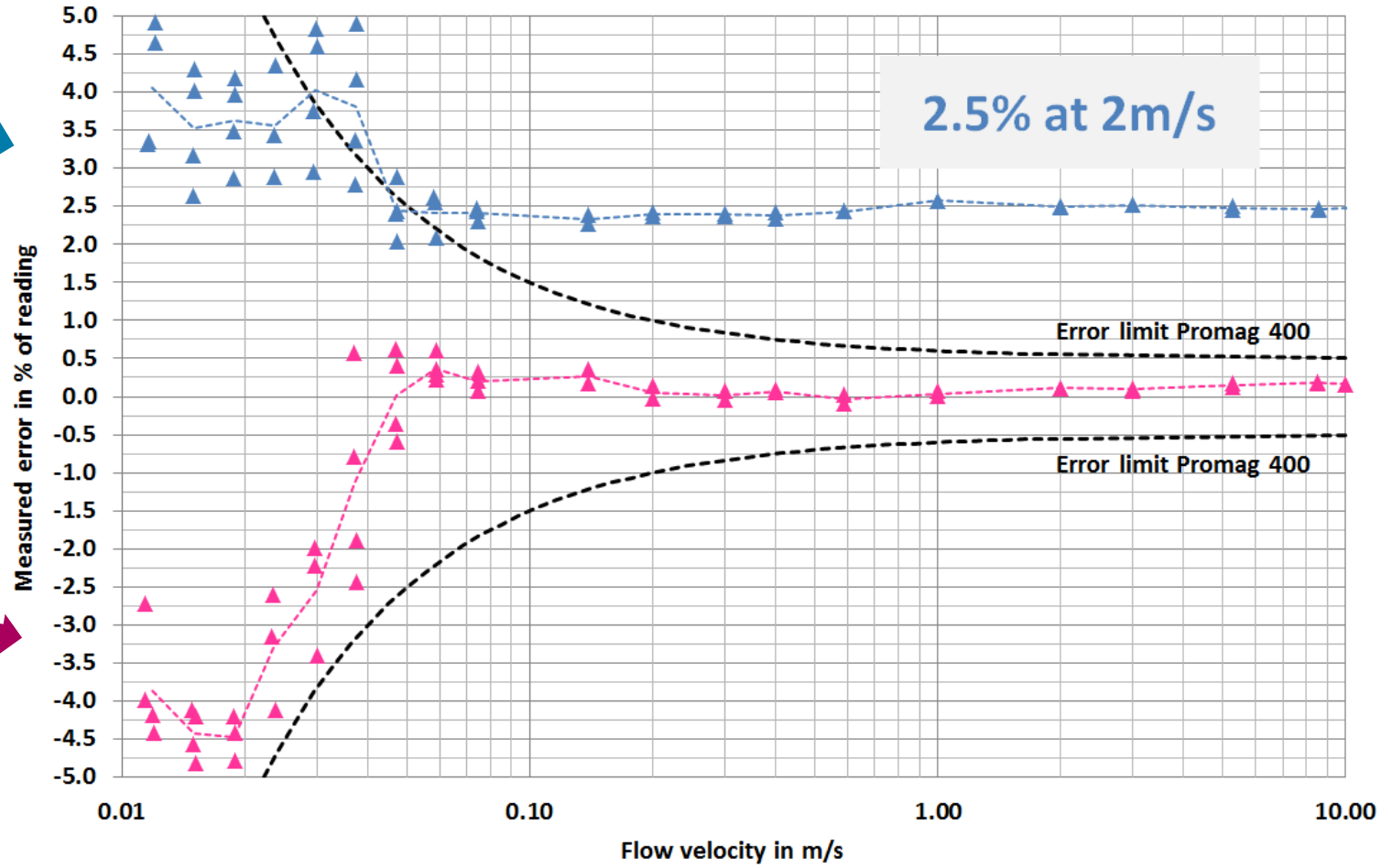


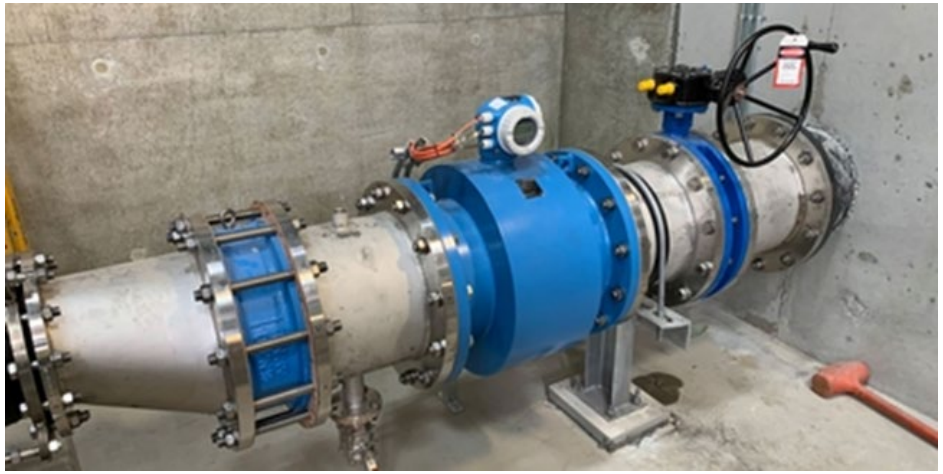
Flow Profile Changes

90° bend

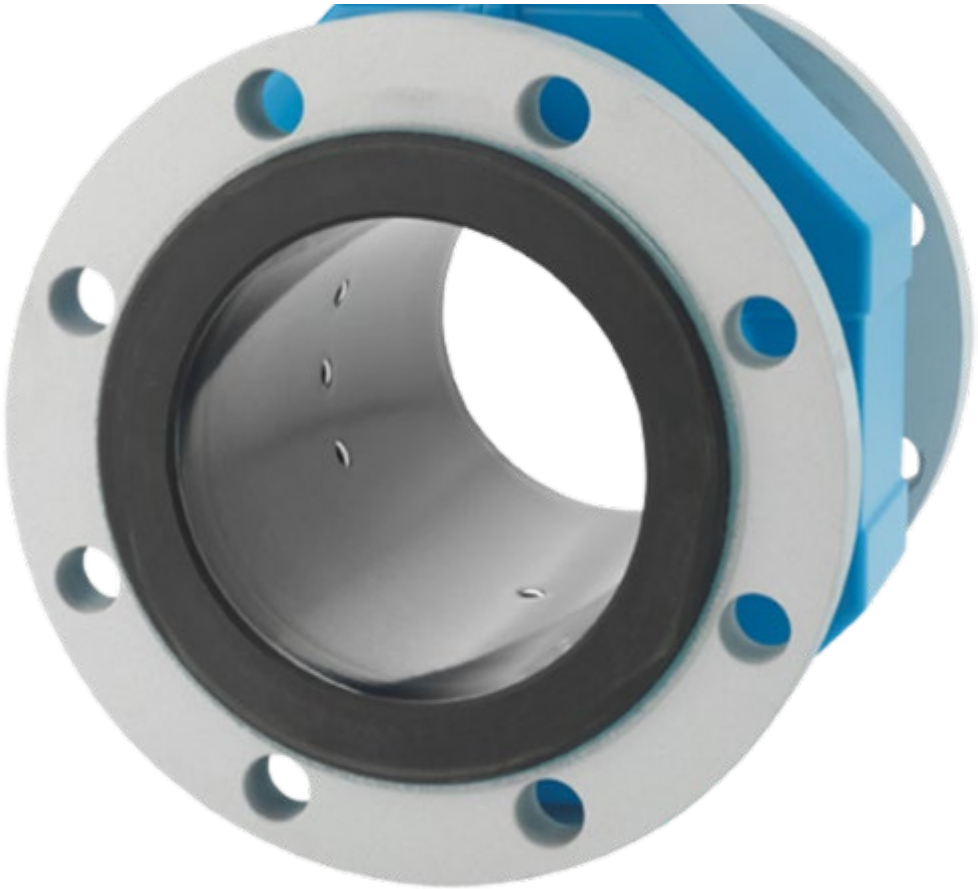


40 × DN


2.5% at 2m/s
Error limit Promag 400
Error limit Promag 400
Measured error in % of reading
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
0.01
0.10
1.00
10.00
Flow velocity in m/s



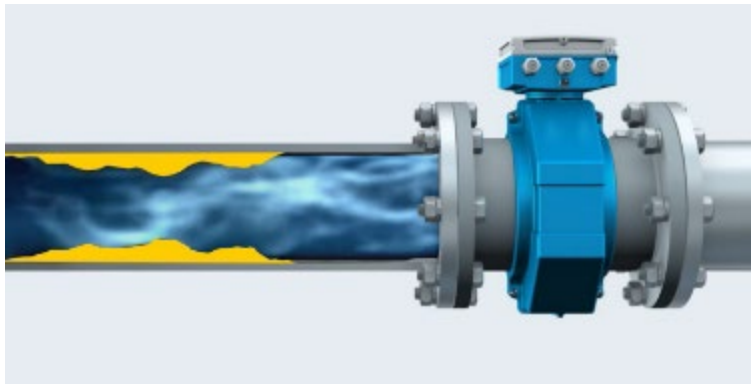
- **Zero upstream - downstream pipe diameters**



Reduce bore, leading edge, pressure drop, erosion potential

Smooth Sailing

No Problems

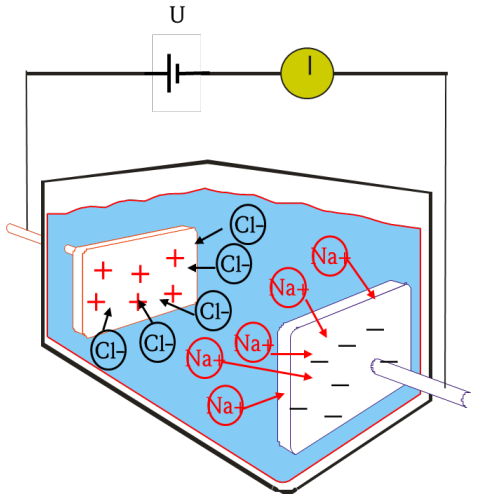


Additional Information

Direct digital connections and data

- Conductivity
- Ethernet Protocols
- Floating point measurements

(no grounding rings)



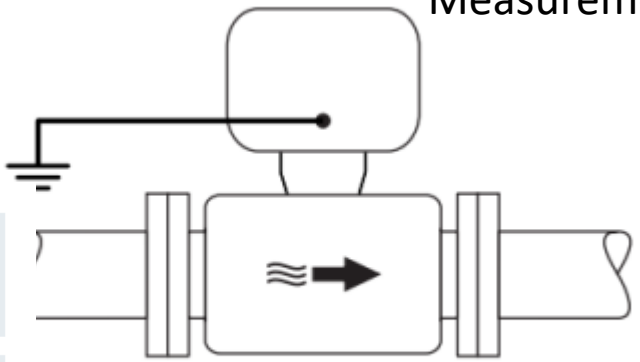
Conductivity

Battery, direct to the cloud (cellular)

EtherNet/IP™

PROFINET

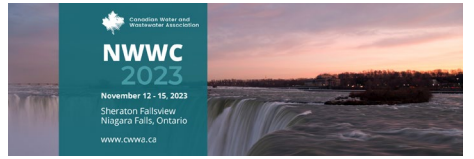
Floating point Measurement



→ No connection between PE and medium via reference electrode

✓ Electrochemical corrosion of the reference electrode is prevented (minimization of equalizing currents).

$PE = P_P \neq P_M$



Webservers

Simple, Easy, Menu driven the way we deal with computers every day

- No special software
- No pushing buttons
- No weird codes
- No more manuals
- Set-up wizards

1

Remote connections

Standard protocols
No need to remove covers
No wires

- WLAN
- Bluetooth
- Employee Safety
- Smartphones
- Tablets

2

Advanced Diagnostics

The meters are always testing themselves like all modern technology

- Standard error messages
- On board verifications
- Condition Monitoring

3

Easier installation

New designs eliminate the needs for traditional pipe runs

- Lap-joint flanges
- Zero upstream - downstream pipe diameters
- Battery power

4

Additional Information

Direct digital connections and data

- Conductivity
- Ethernet Proptocols
- Floating point measurements

5

Modern Magnetic Flowmeters

Much more than flow rate and totals

Dean Rudd
Industry Manager

Endress+Hauser
People for Process Automation