NCBFO
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Ottawa, Ontario

Control Valve Technology
What Cx Agents Should Know
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Learning Objectives

Pressure Independent Valves and the Energy Valve

- What is a pressure independent valve and why do we need it

- Reading valve position, Flow, BTU's, coil water inlet and outlet temperature

- On board Cx report

6 Way Pressure Independent Valves

- What is a 6 way valve and where is it used

- Verify max flow settings for heating and cooling

- Measure flow

- Cycle valve

Butterfly Valves
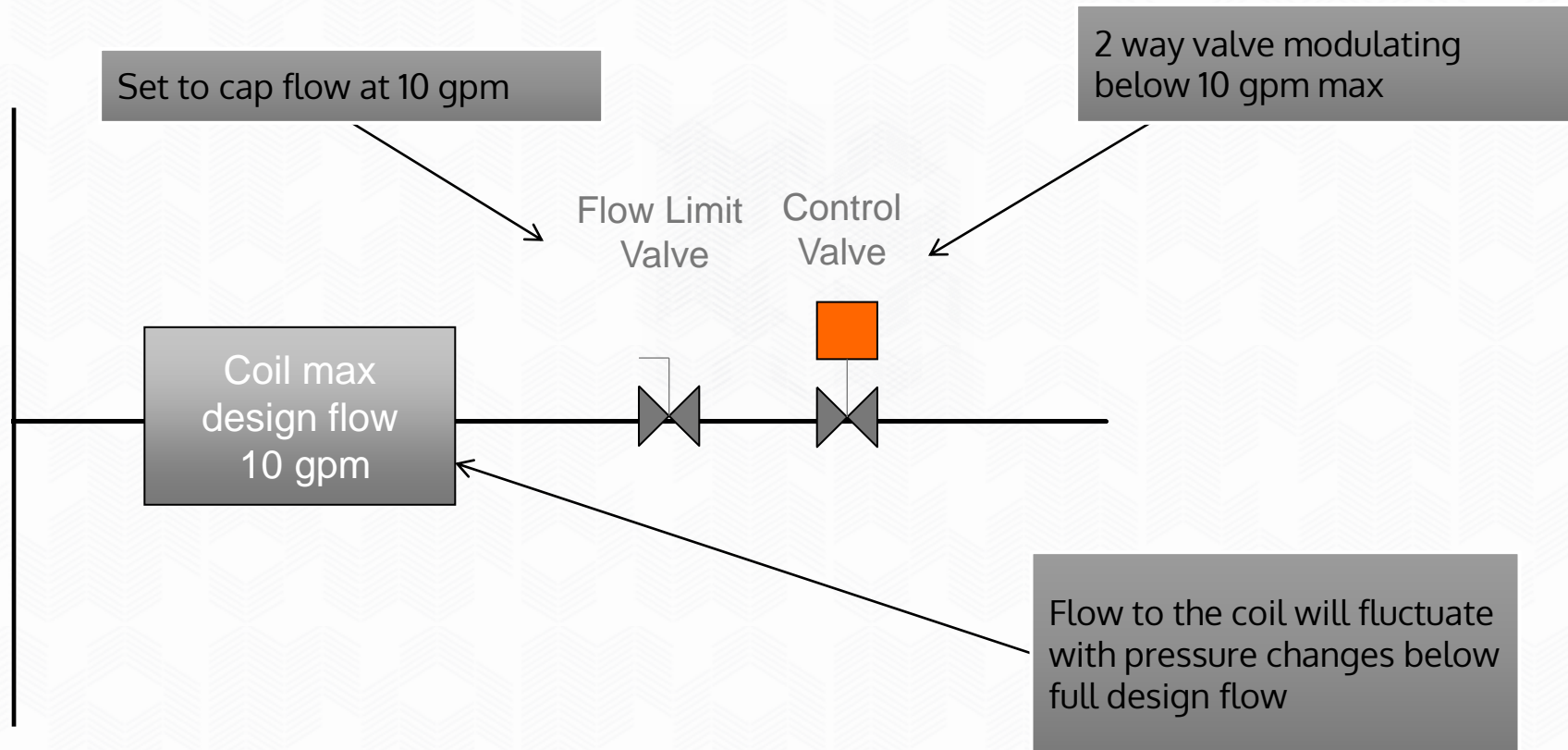
- The BFV has become a lot more transparent

- Verify valve position, run time, auxiliary switch setting

Thermal (BTU) Meter

- On board commissioning and report generation

What is a Pressure Independent Valve

A control valve that is dynamically pressure independent through the full range of control. Control Valve and balancing in one unit.

Set to cap flow at 10 gpm

2 way valve modulating below 10 gpm max

Flow Limit Valve

Control Valve

Coil max design flow 10 gpm

Flow to the coil will fluctuate with pressure changes below full design flow

3

CONTROL VALVE OVERFLOW

$$Cv = \frac{GPM}{\sqrt{\Delta P}}$$

At Design

$$Cv = \frac{100GPM}{\sqrt{4}}$$

$$Cv = 50$$

During Operation

$$Cv = \frac{100GPM}{\sqrt{10}}$$

$$Cv = 32$$

If the pressure drop changes the flow changes

CONTROL VALVE OVERFLOW

Only 6 PSI Increase

$$GPM = Cv * \sqrt{4}$$
$$= 50 * 2$$
$$= 100GPM$$

$$GPM = Cv * \sqrt{10}$$
$$= 50 * 3.162$$
$$= 158GPM$$

58% Increase In Flow

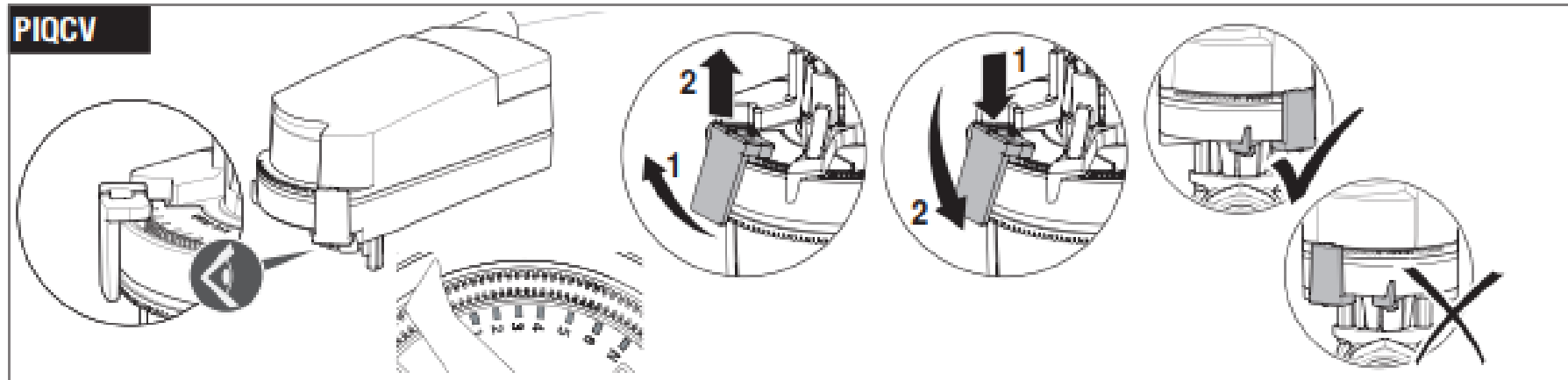If the pressure drop changes the flow changes

Flow Verification

Pressure ports

5 psi minimum

Balancing at full load only !!!!

Flow Verification

Valve Model 1/2"	Clip Position for Flow Adjustment (GPM)																			
	1	1+	2-	2	2+	3-	3	3+	4-	4	4+	5-	5	5+	6-	6	6+	N-	N	No Clip
Z2050QPT-B			0.1					0.2			0.3		0.4		0.5		0.6	0.7	0.8	0.9
Z2050QPT-D	0.2			0.3			0.4	0.5		0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.0
Z2050QPT-F				0.6		0.7	0.8	0.9	1.0	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.3	3.6	4.3
Valve Model 3/4"																				
Z2075QPT-G			1.6	1.8	2.1	2.4	2.7	3.0	3.3	3.7	4.0	4.4	4.9	5.3	5.8	6.3	6.7	7.2	7.7	9.0
Runtime	30	33	35	37	39	41	43	45	47	49	51	53	55	58	60	62	64	66	68	75

Flow Verification

Flow Verification

Flow Verification

PIQCV

Valve Model 1/2"	Clip Position for Flow Adjustment (GPM)																			
	1	1+	2-	2	2+	3-	3	3+	4-	4	4+	5-	5	5+	6-	6	6+	N-	N	No Clip
Z2050QPT-B	■	■	0.1	■	■	■	■	0.2	■	■	0.3	■	0.4	■	0.5	■	0.6	0.7	0.8	0.9
Z2050QPT-D	0.2	■	0.3	■	■	■	0.4	■	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.5	1.6	1.8	2.0
Z2050QPT-F	■	■	■	0.6	■	0.7	0.8	0.9	1.0	1.3	1.5	1.7	1.9	2.2	2.5	2.8	3.1	3.3	3.6	4.3
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Runtime	30	33	35	37	39	41	43	45	47	49	51	53	55	58	60	62	64	66	68	75

Flow Verification

Electronic PI, Flow Readings

Ultrasonic Flow Meter
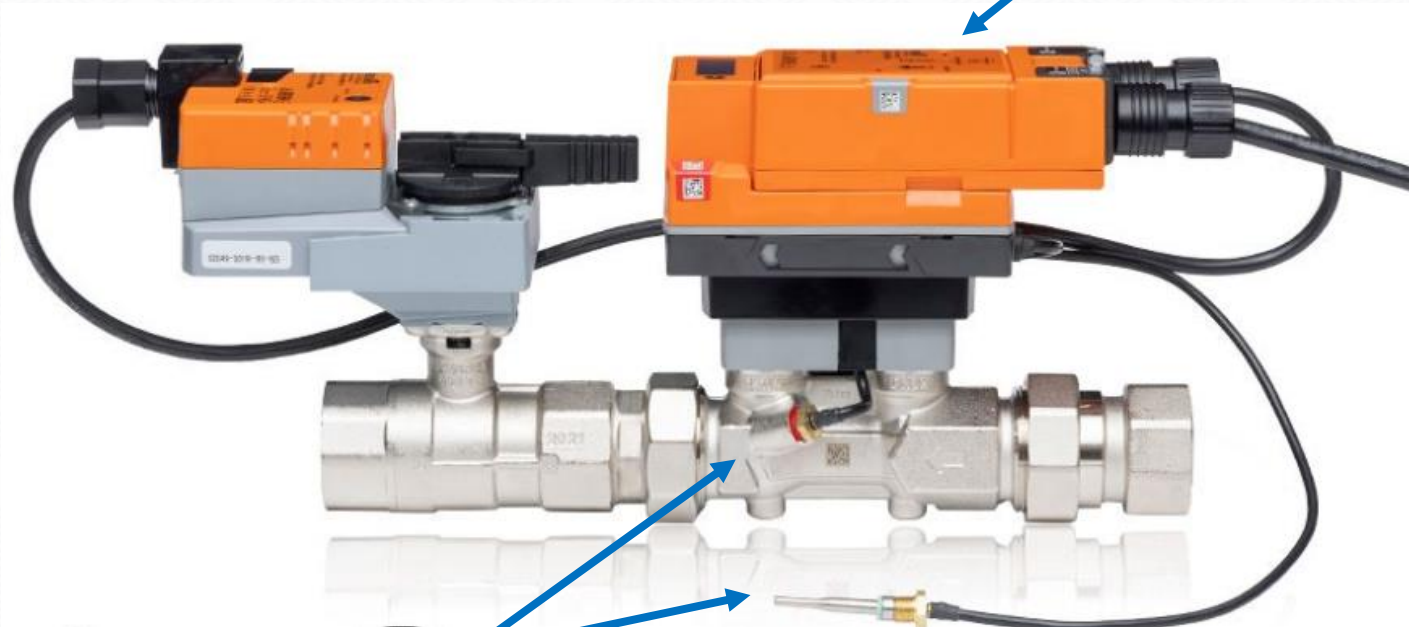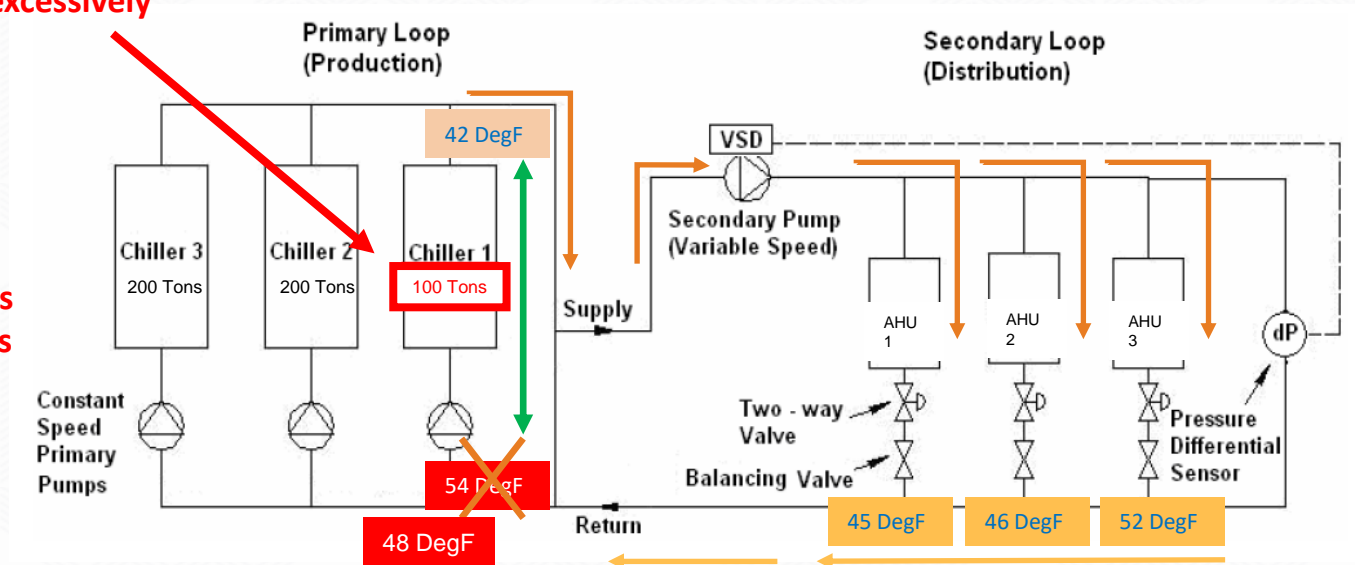
Tonnage drops by 50% and second chiller is needed to make up loss. The problem gets worse with increase in load until all chillers are operating excessively
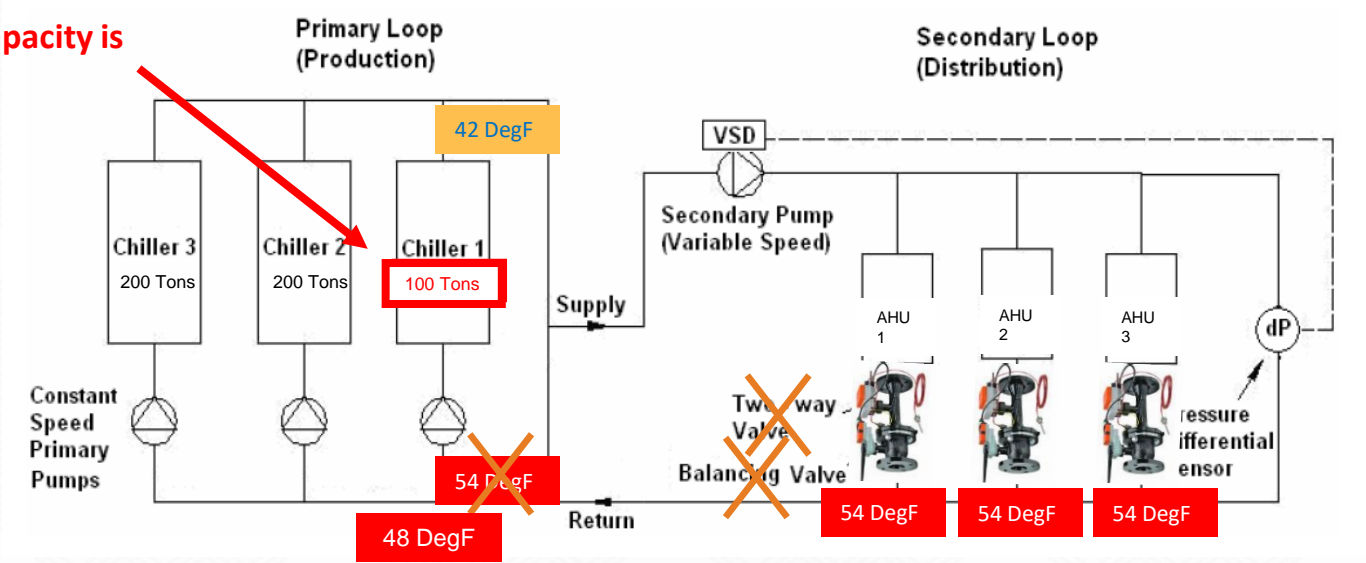
Primary/Secondary Loop
3 Chillers and 3 AHU's

Delta T of chiller drops to 6 degrees

Primary Loop
(Production)

Secondary Loop
(Distribution)

42 DegF

VSD

Chiller 3
200 Tons

Chiller 2
200 Tons

Chiller 1
100 Tons

Secondary Pump
(Variable Speed)

Supply

AHU 1

AHU 2

AHU 3

dP

Constant
Speed
Primary
Pumps

Two - way
Valve

Pressure
Differential
Sensor

54 DegF

Balancing Valve

45 DegF

46 DegF

52 DegF

48 DegF

Return

Delta T design is 12 degrees, therefore a return water temperature of 54 deg F will provide rated chiller tonnage, but pressures are always different at each AHU causing higher flows than expected, and colder return water.

The Solution

Chiller capacity is restored

Primary Loop (Production)

Secondary Loop (Distribution)

42 DegF

Chiller 3 — 200 Tons
Chiller 2 — 200 Tons
Chiller 1 — 100 Tons

Constant Speed Primary Pumps

Supply

54 DegF
48 DegF

Return

VSD

Secondary Pump (Variable Speed)

AHU 1
AHU 2
AHU 3

Two way Valve
Balancing Valve

Pressure Differential Sensor

dP

54 DegF   54 DegF   54 DegF

Install Energy Valves

Return water Temperature and Delta T is restored

Remove 2 way valves and open balancing valves fully

On Board Commissioning

Commissioning / Status Report Belimo Energy Valve

Device Mp Serial Number	22142-30002-022-168
Protocol creation date/time	20.01.2022 / 15:03
Project Name	Project Name
Address	33 Turner Road, 06810 Danbury
Installation Location	Second Floor Outside Employee Lounge
Device Name	Energy Valve
Device Type	EV125+AKRX-E

Application Settings

Valve Type	2way
Nominal Pipe Size	1 1/4"	DN32
Nominal Flow	28.50 gpm
Media	Propylene Glycol
Glycol Concentration	28.31 %
Maximum Flow	28.50 gpm
Maximum Power	1300.00 kBTU/h
Control Mode	Position control
Setpoint Source	Analog
Control Signal Range (Y3)	2-10V
Invert Control Signal Range (Y3)	inverted
Analog Feedback (U5)	Relative flow
Analog Feedback Range	2-10V

IP Settings

MAC Address	50:2d:f4:0f:e1:f1
IP Host Address	10.200.8.191
IP Mode	Static
Network Mask	255.255.255.0
Gateway	10.200.8.2
Broadcast Address	10.200.8.255

Communication Settings

Bus Protocol	BACnet IP

BACnet IP Settings

Port	47808
Device Setting	Simple device

Device Object Settings

Instance ID	3043
Device Name	Energy Valve
BACnet Location	Device Location
System Status	Operational
Protocol Version	1
Protocol Revision	14

Version Information

BSP Version	13.9.0
CSP Version	4.21.1
Application Model	EV4
Application Version	1.0.4

Live Values

Forced Control	None
Valve Position	99.33 %
Actuator Sync Position	Sync at 0%
Flow	9.22 gpm
External Temperature Sensor (T1)	73.18 °F
Integrated Temperature Sensor (T2)	72.33 °F
Heating Energy	1006.32 kBTU
Cooling Energy	11549.75 kBTU
Total Volume	1425.16 m3
Delta T Manager Status	not selected

Delta T Manager

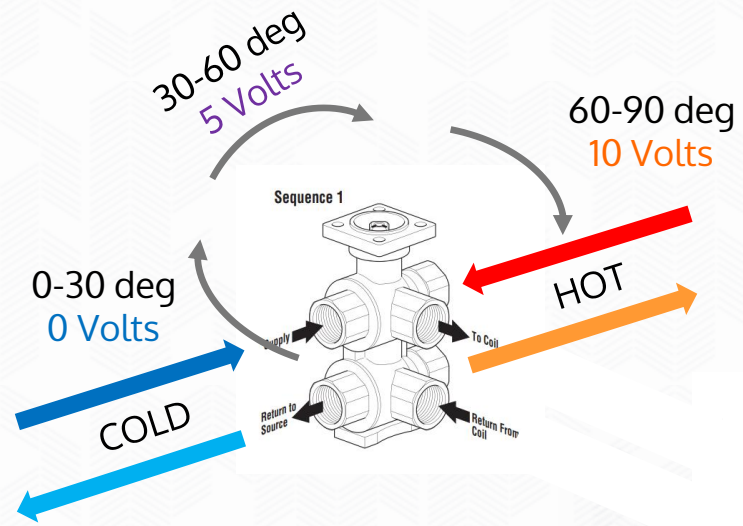|	
dT Limiting Function	Off
dT Limiting Value	9.99 °F

Health State

Health State	OK

6 Way Valve

- ½, ¾ , and 1.0 inch

- Different Cv options for heating and cooling

  Replace 4, 2 way valves with one 6 way

  Only one controls point required

30-60 deg
5 Volts

60-90 deg
10 Volts

0-30 deg
0 Volts

Sequence 1

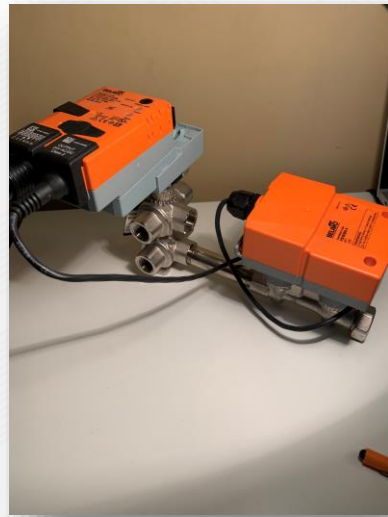Supply
To Coil
Return to Source
Return From Coil

HOT

COLD

1 valve instead of 4

1 BAS connection instead of 4

Estimated cost savings $1800 per FCU or Chilled Beam ½ inch

Collecting Information Using NFC

Set Up Using Near Field Communication
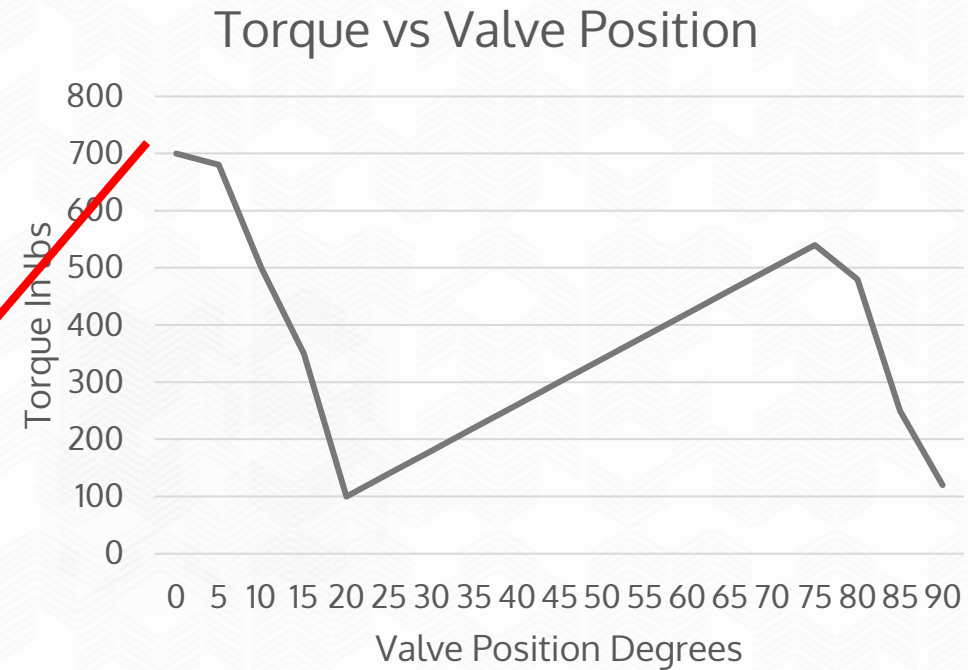
Set Up Using Near Field Communication

Butterfly Valve

Torque Sensing for Tight Shut Off

Break Away Torque

Torque vs Valve Position

Torque In lbs

Valve Position Degrees

Torque Sensing for Tight Shut Off

- Auto Set up

- Self Adjusting Valve Seating Senses Break Torque

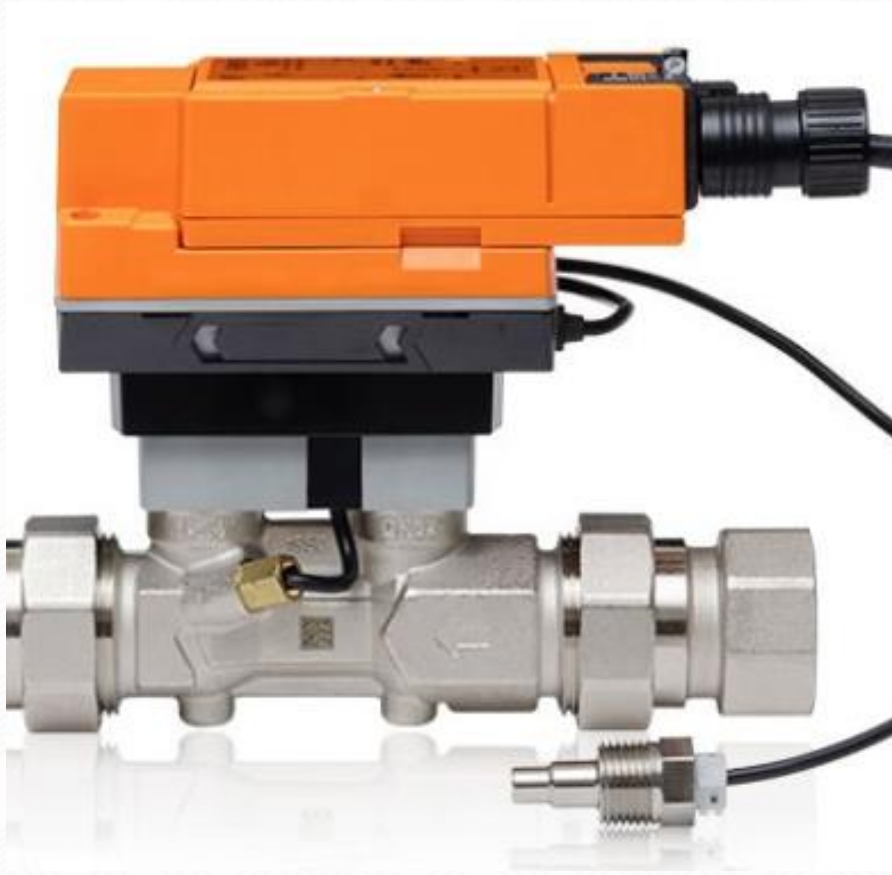- As seat wears, torque is applied for tight shut off, not valve position.

Commissioning BFV's

Values & Settings	Factory Setting	Manual	Power On (NFC)	Power Off (NFC)	Power On (ZTH)
Running time setting [30-120 s]	35 s	-	RW	RW	RW
Max angle of rotation	100%	-	RW	RW	RW
Actuator Position [0-100%]	-	Position Indicator	R	-	R
Setting for auxiliary switch s2 [0-90°]	85%	Hand crank	-	-	-
Display of input signal voltage (Power supply)	-	-	R	-	-
Valve Setting [Regular, 8", 10", 12"]	Type specific	-	RW	RW	-
Override Control (Force Position)	-	Hand crank	RW	-	RW
Location String	-	-	RW	RW	-
Control [Floating Point, On/Off, 0.5 - 10V, 2 - 10V, 4 - 20 mA]	2..10V	-	RW	RW	RW
Feedback Mode [2 - 10V, 0.5 - 10V, inverted]	2..10V	-	RW	RW	RW
Feedback Mode [DC variable]	-	-	-	-	RW
Control Signal [DC variable]	-	-	-	-	RW
Control Signal Fail Position [None, On/Off]	None	-	RW	RW	-
Hybrid Mode - Setpoint [MP-Bus, Analog]	Bus	-	RW	RW	-
Bus Setting [MP-Bus, BACnet]	MP, PP	-	RW	RW	-
Power Off Position [0 - 100%]	0%		RW	RW	RW
Power Fail Delay [0 - 10 s]	2 s		RW	RW	RW

[R=reading; W=writing]

Thermal Energy Meter

- **On Board Commissioning**

- **NFC**

- **Glycol Compensation**

Commissioning / Status Report Thermal Energy Meter

Configuration Date / Time	21.01.2022 / 13:09 UTC
Project Name	Project Name
Address	
Zip Code	
City Name	
Device Name	Thermal Energy Meter
Serial Number	22141-40003-034-087
Installation Location	Belimo Canada
Device Type	

Application Settings

DN Size	1/2"	DN 15
qp	1.5 m3/h
Medium	Water
Glycol Concentration	0 %
Feedback Signal	Power
Feedback Signal Range	0...10 V

IP Settings

MAC Address	50:2d:f4:1d:84:53
IP Address	192.168.0.10
IP Configuration	Static/Zeroconf
Network Mask	255.255.255.0
Gateway	0.0.0.0
Broadcast Address	192.168.0.255

Communication Settings

Bus Protocol	BACnet MS/TP

BACnet MSTP Settings

Baud Rate	38400
BACnet/Modbus Address	1
Terminating Resistor	false

Device Object Settings

Instance ID	1
BACnet Device Name	Thermal Energy Meter
BACnet FW Revision	14.10.0001

Live Values

Volumetric Flow	0 m3/h
External Temperature Sensor (T1)	20.87 °C
Integrated Temperature Sensor (T2)	21.51 °C
Heating Energy	0 J
Cooling Energy	0 J
Total Volume	0 m3

Health State

Collective Error Status	Error

Product Information

Operating System Version	13.9.0
Core Software Version	4.21.1
Model Name	TEM4
Model Version	1.0.4

Lots of data easily accessed

- ZTH
- NFC (Near Field Communication)
- Commissioning Reports

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