Downstream Pressure Control
General Information

Intellisys™
ADAPTIVE PRESSURE CONTROL COMPONENTS

New Products

Intellisys Next Generation IQ+ Controller

Responding to emerging industry requirements, Nor-Cal now has a fully RoHS compliant and DeviceNet certified adaptive pressure controller called the IQ+. It is similar in function and appearance to the earlier line of IQ-controllers, but features a much advanced pressure control algorithm for improved control during difficult conditions. The IQ+ on-board controller can be used with any throttle valve and it offers a popular fail safe battery backup option and add-on gauge power.

Capacitance Diaphragm Gauges

Nor-Cal proudly announces the availability of ultra stable ceramic sensor gauges featuring digital circuitry, one push button zero and a convenient service port. The gauges exhibit second-to-none short and long term stability, shorter warm-up times and excellent recovery from atmospheric bursts.

Intellisys - The Fastest, Most Precise Pressure Control System

Nor-Cal Products offers unequalled performance with the Intellisys downstream pressure control products, providing measurable process benefits through higher resolution, speed and reliability. These benefits are the direct result of two core functions embedded in all Intellisys control systems.

First, a unique patented closed-loop motor control technology, which is a combination of electronics hardware and software, resides in every Intellisys controller. This allows Intellisys control valves to be operated at high rates of speed and with extremely fine positional resolution, while using standard off-the-shelf stepper motors.

Second, capitalizing on the high motor speed and fine resolution is an adaptive pressure control algorithm that yields near flawless pressure control performance over a wide range of system conditions without the need to "tune" or "learn" PID parameters.

Adding to the pressure control system benefits is a host of valve functions and features aimed at optimizing control performance and reliability. These include the selection of direct driven valves that eliminate the use of costly and unreliable gear heads or belt drives. Furthermore, none of the Intellisys control valves rely on mechanical or optical switches to determine the valve stroke end-points. Instead, bulletproof hard stops that are sensed by the closed-loop motor position feedback signals serve as the open and closed indicators. Last, all Intellisys control valves, regardless of type, have been designed with controllability and conductance in mind. Optimally designed throttle plates and actuation mechanisms therefore provide an essential contribution to the overall behavior and performance of the downstream pressure control system.

Products

Every complete downstream pressure control system design incorporates three components including a throttle valve, valve controller and pressure (vacuum) gauge. Nor-Cal Products has products available in all of these categories.

The selection of throttle valves includes families of butterfly, pendulum, and gate valves. The choice of valve depends on the intended application, but each is available in a wide range of sizes and flange types with many optional functions and features, and all of them feature the closed-loop motor control capability that results in high speed and ultra-fine resolution. In addition, Nor-Cal offers the Universal Valve Drive (UVD) – a motor drive product that can be tailored to fit most other manufacturers' valves. Doing so can greatly improve pressure control performance characteristics of existing valves at a reduced cost.

Adaptive pressure controllers are available for each type of valve or valve drive, and generally come in two styles. The stand-alone buried box controllers are ideal for applications where expanded communications or user interfaces are desired. For installations where installation space is of concern, the on-valve IQ-series controllers may be a preferred choice. Regardless of type, all Intellisys controllers are powered by Digital Signal Processors (DSP) and have many available host communications interfaces such as RS-232, RS-485, DeviceNet, and Analog/TTL.

Nor-Cal capacitance diaphragm gauges (CDG) feature an utlra-stable ceramic diaphragm and advanced digital circuitry in all unheated and heated models. The gauges are available in all common ranges and can be supplied with most popular pipe fittings and connector types.

Intellisys Technology

Many users want to know more about the underlying closed-loop control technology that forms the backbone of Intellisys control systems. Whereas the finer details of this technology are, for obvious reasons, closely guarded, Nor-Cal is still happy to provide educational material for the sake of eliminating some of the "mystique" surrounding the technology or simply satisfying anyone's curious mind. To this end, the following page contains excerpts from a feature article that was written for and published by Semiconductor International magazine. Also, please visit us on the web at **www.n-c.com** or give our Intellisys technical support staff a call at **800-824-4166.**

Increase Vacuum Processing Throughput and Yield Using Advanced Downstream Pressure Control Methods

Vacuum process tool throughput and yield rates can be significantly affected by the performance level of chamber pressure control. Faster step transitions and more precise pressure control are often desired or needed to enhance tool productivity or increase production yields.

The Intellisys technology revolves around a new method of operating a variety of stepper motor driven downstream control valves (such as butterfly, poppet, gate and pendulum). In essence, it combines closed loop stepper motor control with an advanced pressure control algorithm allowing such valves to be controlled in ways never before possible. As a result of the exceptionally fast valve actuation and ultra-high position resolution, throughput increases up to 15% coupled with significant yield improvements and 100-fold scrap reduction have been realized saving vacuum processors millions of dollars per year.

Throttle Valves & Control Systems

One common method of controlling pressure in vacuum chambers is downstream pressure control. Downstream pressure control generally works well over a wide range of conditions, but its effectiveness can be challenged by "external" factors such as the sudden changing of inlet gas flowrates or the turning on or off of plasma events. Furthermore, certain flow-and pressure combinations can force the throttle valve to operate in a position at or beyond the limit of its intended control range. In such instances neither accurate nor repeatable pressure control may be feasible. Alternatively, pressure control may be feasible but not in a fast and efficient manner. As a result semiconductor wafer yield and throughput suffer.

Existing Technology - At present, throttle valves are available from a host of manufacturers and tool OEMs. As different as the various valves may be, almost all possess one common characteristic – that they are driven by stepper motors. Conventional motor drive technology involves sequencing the stepper motor through a prescribed combination of motor winding currents designed to guide the motor to move in a given direction using the desired number of steps. Referring to Table 1, we can see a typical sequence for a bipolar full step moving sequence.

From any given position (step), the motor can be moved to an adjacent position by changing the current going to the four respective drive phases (A, A', B and B'). Knowledge about the actual position is in these cases done by incrementing a step-or pulse-counter. This is referred to as open-loop motor control. Unfortunately, the speed and resultant position accuracy with which conventional open-loop stepping can be done is negatively influenced by non-linear effects from the valve and the motor drive assembly. Examples of such effects include inertia, friction, and backlash. As a result (and in comparison to what it could be) open-loop motor operation and positioning is by design sluggish.

Table 1: Bipolar Full Step Phase Sequencing

STEP	A	A'	B	B'
1	+	-	-	+
2	-	+	-	+
3	-	+	+	-
4	+	-	+	-
1	+	-	-	+

Improved Method - Motor control performance can be greatly improved by employing some means of true position feedback. By accurately tracking position, the user is no longer forced to be as conservative with respect to the acceleration or speed used in operating the motor. In addition to using the position feedback signal to determine the actual position, a position error term (target position less observed position) can easily be calculated, monitored and used to alter the amount of current delivered to the motor so as to overcome variations in external inertia and friction. This is what is referred to as closed-loop motor control, and it enables the motor to be driven to its full torque-speed potential. Since the knowledge of position can only be as accurate and timely as is the means by which the true position is obtained, it is important to use a feedback sensor with a high enough resolution and accuracy. It is also imperative to synchronize the reading of position with the commanded position, lest the position error term cannot be accurately calculated. It is because of the challenges associated with the achievable resolution and synchronization that Nor-Cal Products' Intellisys line of valves and controllers employ the back EMF generated by the motor itself as a means of determining its position.

Effects on Pressure Control

The enhancements in the motor and valve drive technology as have been discussed up to this point would have little importance if they could not be tied to quantifiable improvements in pressure control. A live test was designed and conducted in order to illustrate and quantify any possible benefits of using higher speed and higher position resolution valve drive technology, such as in the case with a direct drive butterfly valve using back EMF position sensing. A multi-step wafer recipe was executed in a 35 liter chamber outfitted with throttling valve in the downstream position.

The Benefits of Speed – As can be seen in Figure 1 the first notable event occurs in the pressure transition step in which the pressure set-point is suddenly increased. As each of the three controllers drives their respective valves completely closed, the chamber pressure rises accordingly. The Intellisys valve closes completely in 0.125 seconds, as compared to 1.7 and 2.0 seconds of System 1 and 2, respectively. The result is an immediate onset of pressure rise allowing the set point to be reached that much faster.

Further contributing to the slower time to set point is System 2's gradual ramp toward set-point. The valve's relatively low speed necessitates a slow approach to set-point, lest significant pressure over-shooting would occur.

The Benefits of Resolution – Ultrafine step resolution, such as that which can be achieved through back EMF position sensing, can play a very important role in the ability to control pressure at all. This benefit is especially noticeable in large valves that are also sealing valves – such as throttling gate and pendulum valves.

Figure 2 shows a comparison between two ISO-200 sealing throttling pendulum valves. In this diagram, the Intellisys system uses back EMF as the position sensing mechanism. System 3 uses standard open-loop type motor control. As is illustrated by the chart, almost indistinguishable moves by the Intellisys valve plate result in smooth pressure control at 1000 mTorr. In contrast, a significant amount of "hunting" is evidenced by the System 3 valve, which in this case translates in to 50 to 60 mTorr pressure swings. When occurring in critical processes or at sensitive times within a process, pressure swings such as these can have a dramatic and detrimental effect on the uniformity and yield of the wafer.

It has been shown how open-loop motor control differs from closed-loop motor control, and specifically how back EMF can be used to provide an unparalleled method for motor position feedback. Because of the high precision and resolution of such feedback mechanisms, ordinary stepper motors can be employed in ways not possible by conventional means. The advancements in motor control capabilities were then substantiated by demonstrating how cluster tool throughput and wafer yield can positively be impacted by the resultant improvements in pressure control.

Figure 1: Pressure Transition Using 100 mm Butterfly Valves

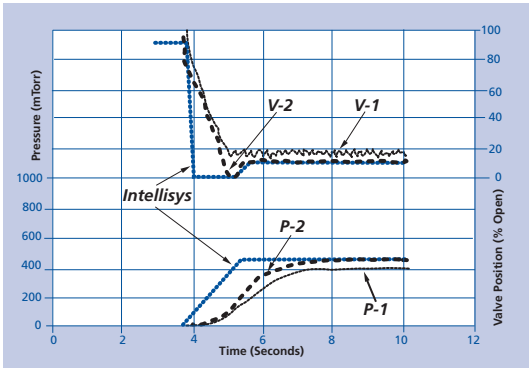
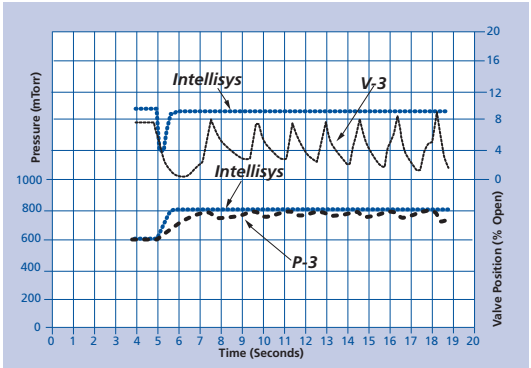


Figure 2: Pressure Control Stability Using 200 mm Pendulum Valve

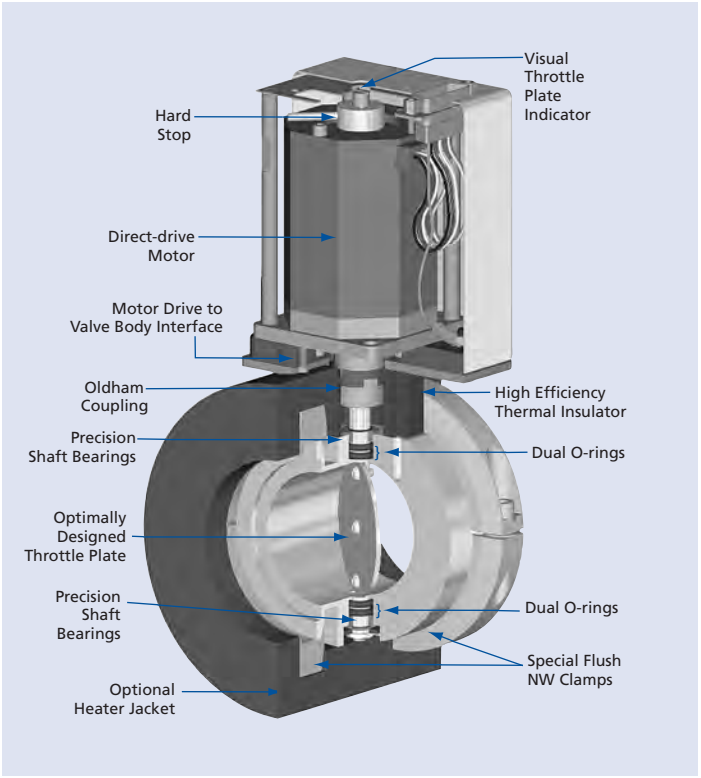


Downstream Pressure Control
Throttling Butterfly Valves

High actuation speed and ultra-fine position resolution

The Intellisys throttling butterfly valves (TBV) are available in a wide range of sizes and flange types and come standard with compact and low cost direct drives. More powerful geared drives are available as an option. Both styles use long time proven and reliable off-the-shelf stepper motors that deliver smooth operation, high actuation speed and ultra-fine position resolution. Intellisys TBVs are non-sealing and are therefore not suitable as isolation valves.

When combined with an Intellisys controller, the fast response Nor-Cal TBVs enable vacuum systems to reach process pressures sooner, reducing cycle time and increasing throughput. Furthermore, the high precision valve movement assures pressure control accuracy at 0.25% of set point, and often well within. Available controllers for TBVs include the buried box APC-family and, in most cases, the on-valve IQ and IQ+ series.



Features and Benefits

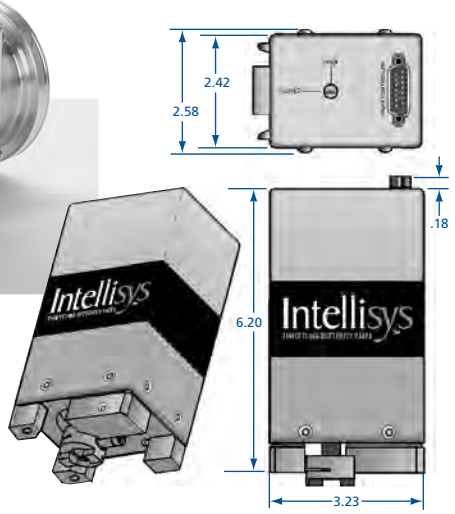
- Higher system throughput
- Optimally designed throttle plate for improved controllability
- Smallest footprint available
- Direct drive motor for more compact and reliable design
- Fully serviceable valve motor subassembly
- 316 stainless steel and Viton seals on all wetted parts. Other seal materials are available.
- High open conductance
- Low closed conductance

Universal Valve Drive (UVD)

Universal Valve Drives (UVD) can be used to retrofit and upgrade other manufacturers' valves, including butterfly, vane, flapper and other ¼- or ½-turn valve types. The resulting performance often comes close of that of a standard Intellisys system but at a fraction of the cost. Drive-to-valve adapters for most manufacturers have already been designed, and others can be easily made upon request. The UVD is currently only available with a geared drive.

UVD90-G— *Specific Mating Valve Details*

Please call with mating valve information such as: manufacturer, shaft diameter, adapter configuration, etc.



All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Downstream Pressure Control
Throttling Butterfly Valves

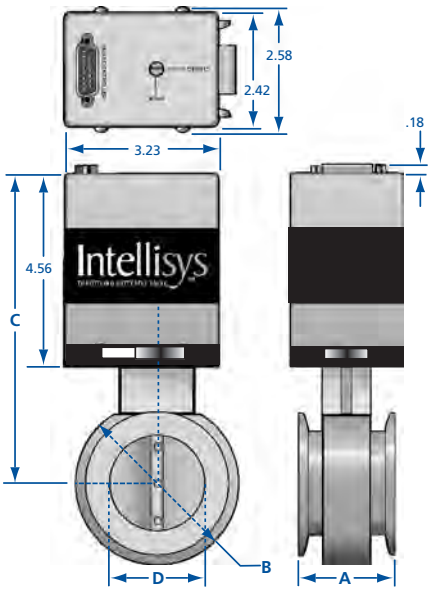
Direct Drive Throttling Butterfly Valves

MODEL NUMBER	NOMINAL ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBV-D-100-NW-25	1	NW-25	2.25 (57.2)	2.75 (69.9)	6.68 (170)	6.99 (178)	5.5 (2.5)
TBV-D-150-NW-40	1.5	NW-40	2.25 (57.2)	2.75 (69.9)	6.68 (170)	1.39 (35.3)	5.3 (2.4)
TBV-D-200-NW-50	2	NW-50	2.00 (50.8)	3.36 (85.3)	6.99 (178)	1.98 (50.3)	5.5 (2.5)
TBV-D-250-ISO-63	2.5	ISO-63	1.00 (25.4)	5.12 (130)	7.44 (189)	2.44 (62.0)	7.5 (3.4)
TBV-D-300-ISO-80	3	ISO-80	1.00 (25.4)	5.71 (145)	7.76 (197)	2.94 (74.7)	8.8 (4.0)
TBV-D-400-ISO-100	4	ISO-100	1.00 (25.4)	6.50 (165)	8.19 (208)	3.85 (97.8)	9.5 (4.3)

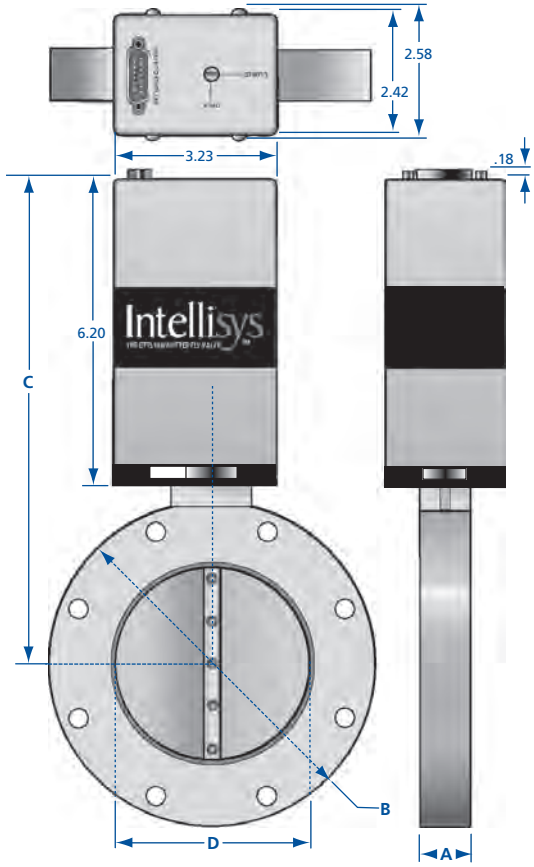
Gear Drive Throttling Butterfly Valves

MODEL NUMBER	NOMINAL ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBV-G-600-ISO-160	6	ISO-160	1.62 (41.1)	8.90 (226)	10.5 (267)	5.67 (149)	21.8 (9.9)
TBV-G-800-ISO-200	8	ISO-200	1.62 (41.1)	11.2 (285)	12.5 (316)	7.87 (200)	28.5 (12.9)
TBV-G-1000-ISO-250	10	ISO-250	1.62 (41.1)	13.2 (335)	13.5 (342)	9.88 (251)	38.0 (17.3)

Direct Drive



Gear Drive



Seal Material Options

SEAL MATERIAL	CODE
Viton	Default (no code)
Kalrez 4079	-K79
Kalrez 8085	-K85
Kalrez 8575	-K75
Kalrez 9100	-K91
Chemraz E38	-C38
Dupra 192	-D19
Perlast G74P	-PP7

Example: TBV-G-600-ISO-160-K75
Gear drive TBV with 6 inch bore, ISO 160 flanges and Kalrez 8575 O-rings.

SPECIFICATIONS

General

Compatible Controllers:
Direct drive: 200-series
Geared drive: 100-seres buried box
Valve position: Visual indicator

Construction

Wetted materials: 316 stainless steel, seal material *(see below)*
Seals: Viton standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Motor power input: Supplied by APC controller.
Differential pressure: 15 psi maximum across the valve plate
Forced heating capabilities: Valves may be heated up to 200°C with optional external heaters, provided seal and coupling material is specified to handle such temperatures.
Process gas temperature capabilities: For process gas temperatures in excess of 100°C, please consult with Nor-Cal Intellisys technical support for proper selection of seal materials and other design considerations.
Ambient operating conditions: 0 - 60°C @ 0 - 95% humidity
Leak rate: 1×10^{-9} atm·scc/sec He

Inherent performance

Maximum speed: Open to closed in 125 msec *(direct)*, 250 msec *(geared)*
Control resolution: 3.2 arc second *(direct)*, 0.2 arc second *(geared)*
Maximum torque: 280 in-oz *(direct)*, 2100 in-oz *(geared)*

Pressure Control Performance
(when used with an Intellisys controller)

Accuracy: The greater of 5 mV or 0.25% of reading
Repeatability: Within 2.5 mV or 0.12% of reading
Control range: 0.5% - 100% of the vacuum gauge range

Reliability
(99% confidence level, in clean environment)

O-ring cycle life: 5 million open- close cycles
MTBF: >50,000 hrs. continuous operation

Approvals

CE *(EMC and machinery directives)*

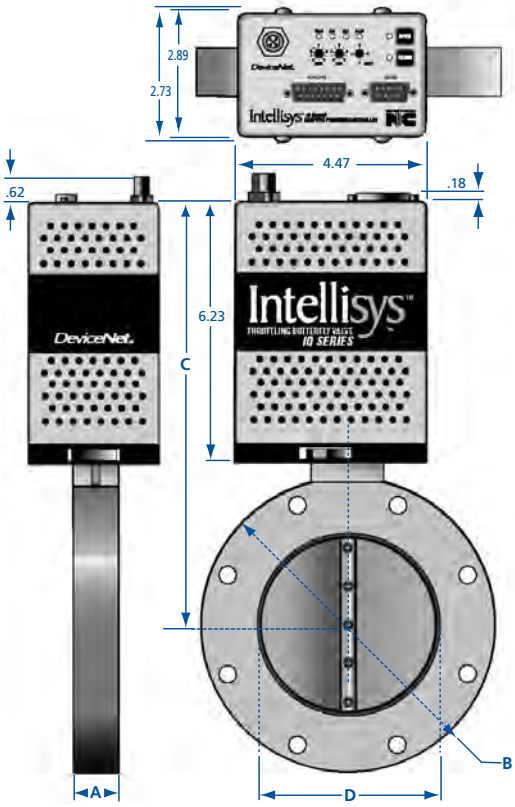
All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

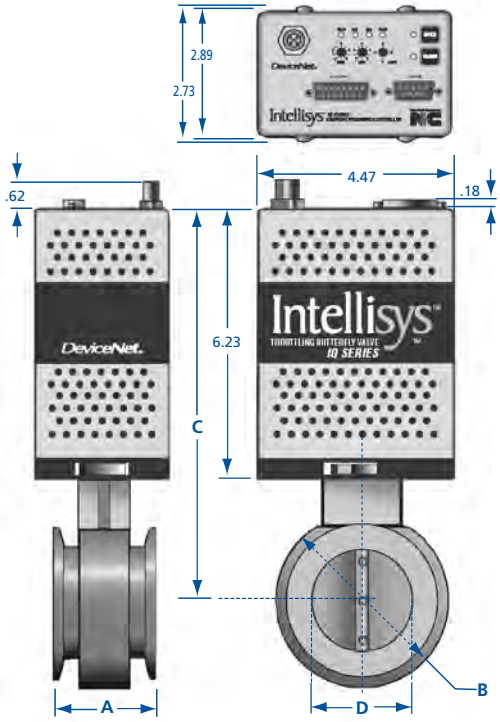
Downstream Pressure Control
Throttling Butterfly Valves

IQ Throttling Butterfly Valves

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBV-IQA-100-NW-25	1	NW-25	2.25 (57.2)	2.75 (69.9)	8.34 (212)	0.87 (212)	5.5 (2.5)
TBV-IQA-150-NW-40	1.5	NW-40	2.25 (57.2)	2.75 (69.9)	8.34 (212)	1.39 (35.3)	5.3 (2.4)
TBV-IQA-200-NW-50	2	NW-50	2.00 (50.8)	3.36 (85.3)	8.65 (220)	1.98 (50.3)	5.5 (2.5)
TBV-IQA-250-ISO-63	2.5	ISO-63	1.00 (25.4)	5.12 (130)	9.10 (231)	2.44 (62.0)	7.5 (3.4)
TBV-IQA-300-ISO-80	3	ISO-80	1.00 (25.4)	5.71 (145)	9.42 (239)	2.94 (74.7)	8.8 (4.0)
TBV-IQA-400-ISO-100	4	ISO-100	1.00 (25.4)	6.50 (165)	9.85 (250)	3.85 (97.8)	9.5 (4.3)
TBV-IQA-600-ISO-160	6	ISO-160	1.62 (41.1)	8.90 (226)	10.4 (264)	5.87 (149)	21.8 (9.9)
TBV-IQA-800-ISO-200	8	ISO-200	1.62 (41.1)	11.2 (284.5)	12.4 (314)	7.87 (200)	28.5 (12.9)
TBV-IQA-1000-ISO-250	10	ISO-250	1.62 (41.1)	13.2 (335.0)	13.3 (338)	9.88 (251)	38.0 (17.3)

Note: *IQA can be replaced with IQD, IQD2, IQE, and IQR*





SPECIFICATIONS

General

Controller Options:
IQA: Analog / TTL / RS232 interface
IQD: DeviceNet / RS232 interface
IQD2: DeviceNet / RS232 interface, no power via DN connector
IQE: Ethernet / RS232 interface
IQR: RS485 interface

Value position: Visual indicator

Construction

Wetted materials: 316 stainless steel, seal material *(see below)*

Seals: Viton standard. Kalrez, Chemraz, Perlast and other materials available on request *(see below)*

Operation

Power input: +24 VDC

Differential pressure: 15 psi maximum across valve plate

Forced heating capabilities: Valves may be heated up to 150°C with optional external heaters.

Process gas temperature capabilities: For process gas temperatures in excess of 100°C, please consult with Nor-Cal Intellisys technical support for proper design considerations.

Ambient operating conditions: 0 - 60°C @ 0 - 95% humidity

Leak rate: 1×10^{-9} atm·scc/sec He

Inherent performance

Open to close speed: 125 msec

Control resolution: 3.2 arc second

Maximum torque: 1 in - 4 in : 280 in-oz

Maximum torque: 6 in - 10 in :700 in-oz

Pressure control performance

Accuracy: The greater of 5mV or 0.25% of reading

Repeatability: Within 2.5mV or 0.12% of reading Control range: 0.5% - 100% of the vacuum gauge range

Reliability *(99% confidence level, in clean environment)*

O-ring cycle life: 5 million open-close cycles

MTBF: >50,000 hours continuous operation

Approvals

CE *(EMC and machinery directives)*

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Seal Material Options

SEAL MATERIAL	CODE
Viton	Default (no code)
Kalrez 4079	-K79
Kalrez 8085	-K85
Kalrez 8575	-K75
Kalrez 9100	-K91
Chemraz E38	-C38
Dupra 192	-D19
Perlast G74P	-PP7

Example: TBV-IQD-400-ISO-100-C38
IQD TBV with 4 inch bore, ISO 100 flanges and Chemraz E38 O-rings.

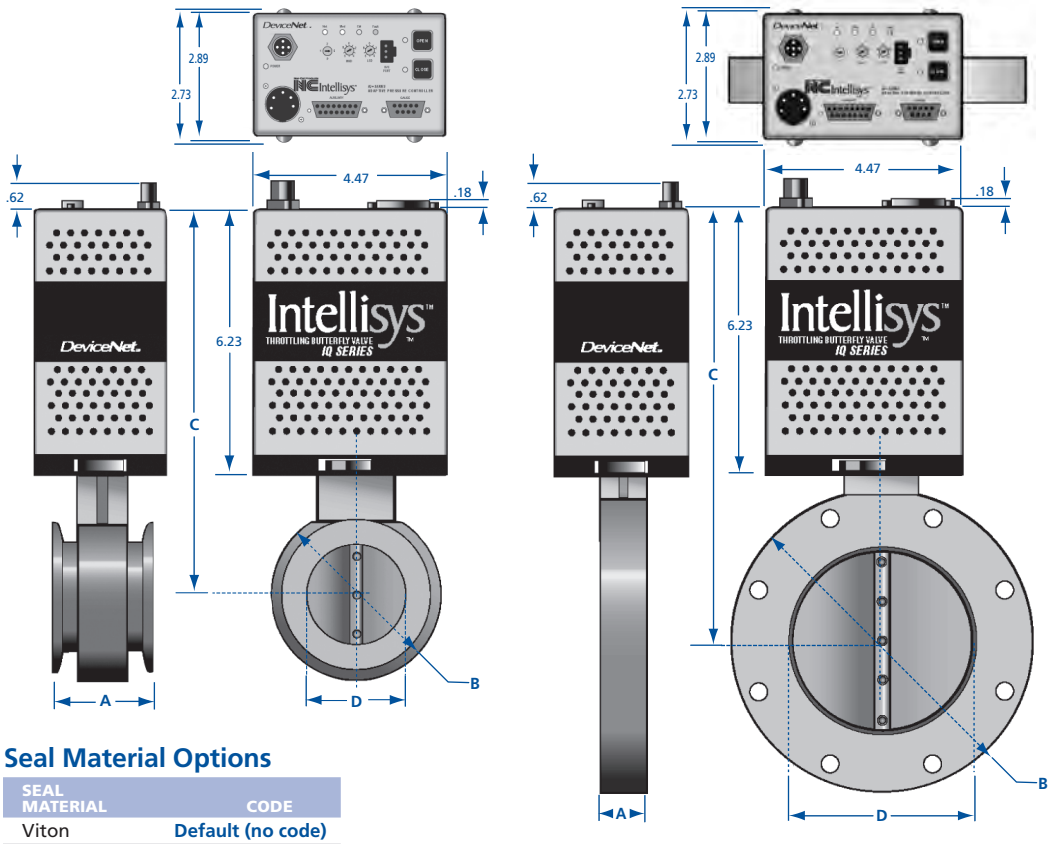
IQ+ Throttling Butterfly Valves

Nor-Cal's new IQ+ controller is available on the complete line of regular and sealing Throttling Butterfly Valves (TBV and TBVS) turning what is very good performance into best-in-class process control. The IQ+ controller is an on-valve integral control & drive unit that is fully RoHS compliant with 100% lead-free circuit board content. User interfaces include an ODVA certified DeviceNet protocol and physical layer, as well as standard RS-232 communications. Gauge power capabilities have been upgraded to a full 1500 mA at +/- 15 VDC in order to power two heated CDG's directly from the IQ+ unit. In addition, a battery backup feature is available that can be used to bring the valve to a fail-closed or fail-open safe position in the event of system power loss. Last, the IQ+ adaptive pressure control algorithm has been significantly improved to better deal with difficult control situations, in particular at conditions that typically occur at low pressures and low flows.

For larger system pressure control requiring multiple pumps and forelines, such as on flat panel, industrial coating or photovoltaic tools, it is easily possible to gang up to ten valves together. Multi-valve Master/Slave system control like this is facilitated via the Nor-Cal-Net intervalve communications system. One IQ+ operated valve serves as the master with communications to the host tool, gauge input and has direct command over the control position of the remaining slave valves. The IQ+ controlled butterfly valves are the right answer to any new or challenging pressure control application.

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBV-QPD-NW-25	1	NW-25	2.25 (57.2)	2.75 (69.9)	8.34 (212)	0.87 (212)	5.5 (2.5)
TBV-QPD-NW-40	1.5	NW-40	2.25 (57.2)	2.75 (69.9)	8.34 (212)	1.39 (35.3)	5.3 (2.4)
TBV-QPD-NW-50	2	NW-50	2.00 (50.8)	3.36 (85.3)	8.65 (220)	1.98 (50.3)	5.5 (2.5)
TBV-QPD-ISO-63	2.5	ISO-63	1.00 (25.4)	5.12 (130)	9.10 (231)	2.44 (62.0)	7.5 (3.4)
TBV-QPD-ISO-80	3	ISO-80	1.00 (25.4)	5.71 (145)	9.42 (239)	2.94 (74.7)	8.8 (4.0)
TBV-QPD-ISO-100	4	ISO-100	1.00 (25.4)	6.50 (165)	9.85 (250)	3.85 (97.8)	9.5 (4.3)
TBV-QPD-ISO-160	6	ISO-160	1.62 (41.1)	8.90 (226)	10.4 (264)	5.87 (149)	21.8 (9.9)
TBV-QPD-ISO-200	8	ISO-200	1.62 (41.1)	11.2 (284.5)	12.4 (314)	7.87 (200)	28.5 (12.9)
TBV-QPD-ISO-250	10	ISO-250	1.62 (41.1)	13.2 (335.0)	13.3 (338)	9.88 (251)	38.0 (17.3)

Note: *QPD can be replaced with QPDB, QPDG and QPDBG*



Seal Material Options

SEAL MATERIAL	CODE
Viton	Default (no code)
Kalrez 4079	-K79
Kalrez 8085	-K85
Kalrez 8575	-K75
Kalrez 9100	-K91
Chemraz E38	-C38
Dupra 192	-D19
Perlast G74P	-PP7

Example: TBV-QPDBG-400-ISO-100-C38
IQ+ TBV with DeviceNet, battery backup, guage power, 4 inch bore, ISO 100 flanges and Chemraz E38 O-rings.

SPECIFICATIONS

General

Controller Options:
QPD: DeviceNet/RS232 interface
QPDB: DeviceNet/RS232 interface, with battery back-up
QPDG: DeviceNet/RS232 interface, with gauge power
QPDBG: DeviceNet/RS232 interface, with battery back-up and gauge power
Contact the factory for other interfaces such as Analog, TTL, RS-485 and Ethernet.
Valve position: Visual indicator

Construction

Wetted materials: 316 stainless steel, seal material *(see below)*
Seals: Viton standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Power input: +24 VDC
Differential pressure: 15 psi maximum across the valve plate
Forced heating capabilities: Valves may be heated up to 150°C with optional external heaters.
Process gas temperature capabilities: For process gas temperatures in excess of 100°C, please consult with Nor-Cal Intellisys technical support for proper selection of seal materials and other design considerations.
Ambient operating conditions: 0 - 60°C @ 0 - 95% humidity
Leak rate: 1×10^{-9} atm·scc/sec He

Inherent performance

Open to close speed: 125 msec
Control resolution: 0.4 arc second
Maximum torque:
1"–4": 280 in-oz
6"–10": 700 in-oz

Pressure Control Performance
(when used with an Intellisys controller)

Algorithm: Improved for better stability and faster transitions
Accuracy: The greater of 5 mV or 0.25% of reading
Repeatability: Within 2.5mV or 0.12% of reading
Control range: 0.5% - 100% of the vacuum gauge range

Reliability
(99% confidence level, in clean environment)

O-ring cycle life: 5 million open- close cycles
MTBF: >50,000 hrs. continuous

Approvals

RoHS compliant
ODVA certified DeviceNet
CE *(EMC and machinery directives)*

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Downstream Pressure Control
Throttling Butterfly Valves

Sealing Throttling Butterfly Valves

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBVS-G-100-NW-25	1	NW-25	2.00 (50.8)	2.11 (53.6)	8.32 (211)	0.98 (24.9)	6.5 (3.0)
TBVS-G-150-NW-40	1.5	NW-40	2.25 (57.2)	2.73 (69.3)	8.32 (211)	1.27 (32.3)	5.8 (2.9)
TBVS-G-200-NW-50	2	NW-50	2.25 (57.2)	3.35 (85.1)	8.63 (219)	1.85 (47.0)	6.5 (3.0)

IQ Sealing Throttling Butterfly Valves

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBVS-IQA-100-NW-25	1	NW-25	2.00 (50.8)	2.11 (53.6)	8.34 (212)	0.98 (24.9)	6.5 (3.0)
TBVS-IQA-150-NW-40	1.5	NW-40	2.25 (57.2)	2.73 (69.3)	8.34 (212)	1.27 (32.3)	5.8 (2.9)
TBVS-IQA-200-NW-50	2	NW-50	2.25 (57.2)	3.35 (85.1)	8.65 (220)	1.85 (47.0)	6.5 (3.0)

Note: *IQA can be replaced with IQD, IQD2, IQE, and IQR*

SPECIFICATIONS

General

Controller Options:
IQA: Analog / TTL / RS232 interface
IQD: DeviceNet / RS232 interface
IQD2: DeviceNet / RS232 interface, no power via DN connector
IQE: Ethernet / RS232 interface
IQR: RS485 interface
Value position: Visual indicator

Construction

Wetted materials: 304 stainless steel, seal material *(see below)*
Seals: Viton standard. Kalrez, Chemraz, Perlast and other materials available on request *(see below)*

Operation

Power input:
Non-IQ: Supplied by APC controller
IQ: +24 VDC
Differential pressure: 15 psi maximum across valve plate
Forced heating capabilities: Valves may be heated up to 150°C with optional external heaters.
Process gas temperature capabilities: For process gas temperatures in excess of 100°C, please consult with Nor-Cal Intellisys technical support for proper selection of seal materials and other design considerations.
Ambient operating conditions: 0 - 60°C @ 0 - 95% humidity
Leak rate:
Shaft: 1×10^{-9} atm·scc/sec He
Plate: 1×10^{-6} atm·scc/sec He

Inherent performance

Maximum speed: Open to closed in 300 msec
Control resolution: 3.2 arc second
Maximum torque: 700 in-oz

Pressure control performance
(when used with an Intellisys controller)

Accuracy: The greater of 5mV or 0.12% of reading
Repeatability: Within 2.5mV or 0.12% of reading
Control range: 0.5% - 100% of the vacuum gauge range

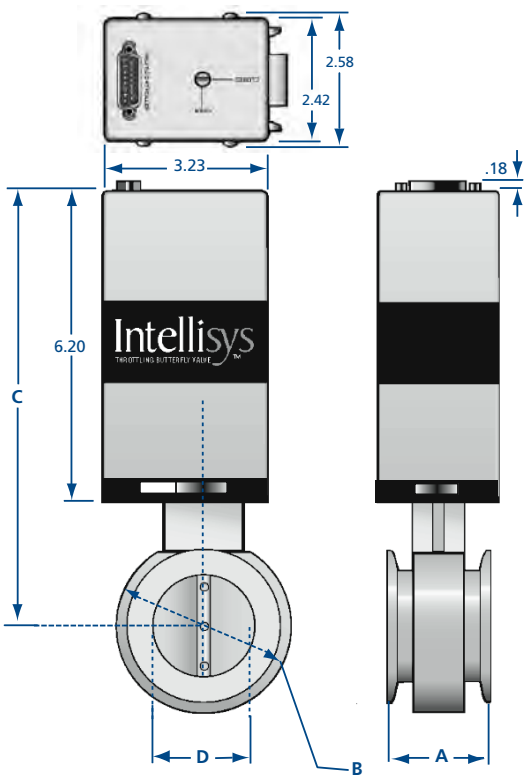
Reliability *(99% confidence level, in clean environment)*

O-ring cycle life (shaft): 5 million open-close cycles
O-ring cycle life (plate): Process dependent
MTBF: >50,000 hours continuous operation *(excluding plate O-ring)*

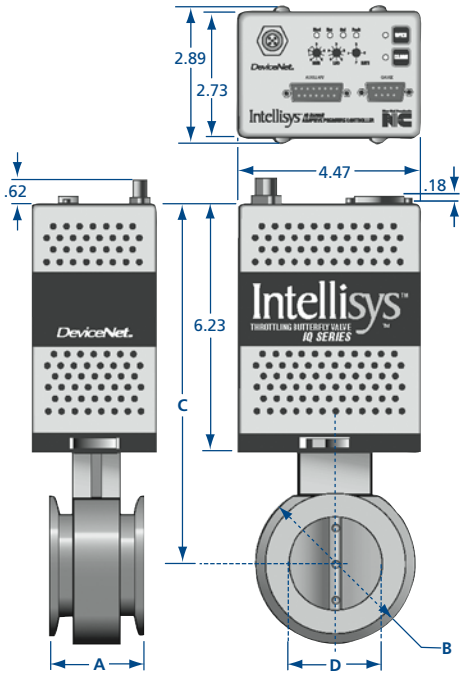
Approvals

CE *(EMC and machinery directives)*

Sealing TBV



IQ Sealing TBV



Replacement O-ring Kits

NOMINAL ID	MODEL NO.
1	BFV-100-95
1.5	BFV-150-95
2	BFV-200-95

Seal Material Options

SEAL MATERIAL	CODE
Viton	Default (no code)
Kalrez 4079	-K79
Kalrez 8085	-K85
Kalrez 8575	-K75
Kalrez 9100	-K91
Chemraz E38	-C38
Dupra 192	-D19
Perlast G74P	-PP7

Example: TBVS-G-150-NW-40-PP7
Sealing butterfly valve with 1.5 inch bore, NW-40 flanges and Perlast G74P O-ring.

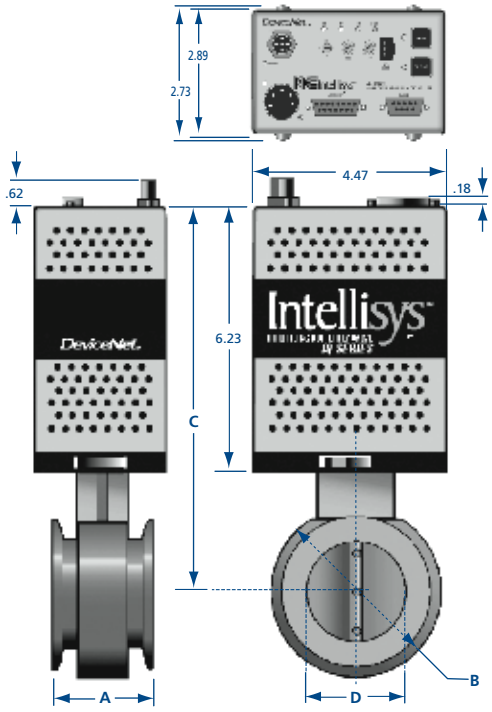
IQ+ Sealing Butterfly Valves

Nor-Cal's new IQ+ controller is available on the complete line of regular and sealing Throttling Butterfly Valves (TBV and TBVS) turning what is very good performance into best-in-class process control. The IQ+ controller is an on-valve integral control & drive unit that is fully RoHS compliant with 100% lead-free circuit board content. User interfaces include an ODVA certified DeviceNet protocol and physical layer, as well as standard RS-232 communications. Gauge power capabilities have been upgraded to a full 1500 mA at +/- 15 VDC in order to power two heated CDG's directly from the IQ+ unit. In addition, a battery backup feature is available that can be used to bring the valve to a fail-closed or fail-open safe position in the event of system power loss. Last, the IQ+ adaptive pressure control algorithm has been significantly improved to better deal with difficult control situations, in particular at conditions that typically occur at low pressures and low flows.

For larger system pressure control requiring multiple pumps and forelines, such as on flat panel, industrial coating or photovoltaic tools, it is easily possible to gang up to ten valves together. Multi-valve Master/Slave system control like this is facilitated via the Nor-Cal-Net intervalve communications system. One IQ+ operated valve serves as the master with communications to the host tool, gauge input and has direct command over the control position of the remaining slave valves. The IQ+ controlled butterfly valves are the right answer to any new or challenging pressure control application.

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBVS-QPD-NW-25	1	NW-25	2.00 (50.8)	2.11 (53.6)	8.34 (212)	0.98 (24.9)	6.5 (3.0)
TBVS-QPD-NW-40	1.5	NW-40	2.25 (57.2)	2.73 (69.3)	8.34 (212)	1.27 (32.3)	5.8 (2.9)
TBVS-QPD-NW-50	2	NW-50	2.25 (57.2)	3.35 (85.1)	8.65 (220)	1.85 (47.0)	6.5 (3.0)

Note: *QPD can be replaced with QPDB, QPDG and QPDBG*



Seal Material Options

SEAL MATERIAL	CODE
Viton	Default (no code)
Kalrez 4079	-K79
Kalrez 8085	-K85
Kalrez 8575	-K75
Kalrez 9100	-K91
Chemraz E38	-C38
Dupra 192	-D19
Perlast G74P	-PP7

Example: TBVS-QPD-NW-50-K75
IQ+ sealing butterfly valve with 2 inch bore, NW-50 flanges and Kalrez 8575 O-ring.

Replacement O-ring Kits

NOMINAL ID	MODEL NO.
1	BFV-100-95
1.5	BFV-150-95
2	BFV-200-95

SPECIFICATIONS

General

Controller Options:
QPD: DeviceNet/RS232 interface
QPDB: DeviceNet/RS232 interface, with battery back-up
QPDG: DeviceNet/RS232 interface, with gauge power
QPDBG: DeviceNet/RS232 interface, with battery back-up and gauge power
Contact the factory for other interfaces such as Analog, TTL, RS-485 and Ethernet.
Valve position: Visual indicator

Construction

Wetted materials: 304 stainless steel, seal material *(see below)*
Seals: Viton standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Power input: +24 VDC
Differential pressure: 15 psi maximum across the valve plate
Forced heating capabilities: Valves may be heated up to 150°C with optional external heaters.
Process gas temperature capabilities: For process gas temperatures in excess of 100°C, please consult with Nor-Cal Intellisys technical support for proper selection of seal materials and other design considerations.
Ambient operating conditions: 0 - 60°C @ 0 - 95% humidity
Leak rate:
Shaft: 1×10^{-9} atm·scc/sec He
Plate: 1×10^{-6} atm·scc/sec He

Inherent performance

Open to close speed: 300 msec
Control resolution: 0.4 arc second
Maximum torque: 700 in-oz

Pressure Control Performance
(when used with an Intellisys controller)

Algorithm: Improved for better stability and faster transitions
Accuracy: The greater of 5 mV or 0.25% of reading
Repeatability: Within 2.5mV or 0.12% of reading
Control range: 0.5% - 100% of the vacuum gauge range

Reliability
(99% confidence level, in clean environment)

O-ring cycle life (shaft): 5 million cycles
O-ring cycle life (plate): Process dependent
MTBF: >50,000 hrs. continuous *(excludiing plate O-ring)*

Approvals

RoHS compliant
ODVA certified DeviceNet
CE *(EMC and machinery directives)*

All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Downstream Pressure Control
Throttle Valve Heaters

Throttle Valve Heaters

Many semiconductor processes are carried out in vacuum chambers with internal temperatures of several hundred degrees Celsius. Process by-products exit the chamber in vapor phase, but sublimate in the foreline and vacuum pump exhaust when gas temperatures drop sufficiently for them to form solids. The resultant buildup can increase wafer defects from particle backstreaming, reduce throughput of vacuum lines, impede the function of throttle valves and isolation valves, damage some dry pumps and reduce the efficiency of the scrubber. This buildup can be reduced or eliminated by heating vacuum lines and associated components from the chamber to the scrubber, or by using a combination of heaters and foreline traps, which collect the by-products preventing them from continuing downstream.

Heater jackets with a UL recognized electronic thermostat for fixed set-point applications is available for temperatures up to 150°C. For fully adjustable temperature set-points up to 200 °C, a UR/CE certified heater with a Type K thermocouple and PID controller can provide precise temperature control. Standard heaters cover the entire valve body, and in the case of butterfly valves also the mating flanges. As such, heaters for NW-flanged TBV's are provided with special aluminum clamps.

Standard ½" insulation add-on heaters are available for all Throttling Butterfly and SoftShut Gate Valves. These can be purchased and installed separately provided that the valve is fitted with the proper high temperature seals and other thermally compatible components. Heaters for Throttling Pendulum Valves are integral to the valve, and must be ordered together. Field retrofit of a heater on to a TPV is not possible. Special heater solutions or higher temperature control for all valves may be available. Call for details.

Heater Jacket Part Number and Ordering Information

Please use the following part numbering tree to specify the heater jacket to fit your throttling butterfly or SoftShut valve. **Note:** All part number combinations may not be valid or available. Contact Nor-Cal Products for the latest pricing, availability and other options.

Control Type	–	Valve Type	–	Valve Size	–	Temp. / Voltage

Control Type

CONTROL TYPE	CODE
PID control*	HC
Electronic thermostat	HTE

** Requires separate PID controller. (See controllers Section 6.)*

Valve Type

VALVE TYPE	CODE
Throttling butterfly	TBV
Sealing throttling butterfly	TBVS
Throttling SoftShut - ISO	TSSI
Throttling SoftShut - CF	TSSC

Valve Size

VALVE SIZE	CODE
1.00*	100
1.50*	150
2.00*	200
2.50	250
3.00	300
4.00	400
6.00	600
8.00	800
10.00	1000

** Includes two special NW clamps*

Temperature/Voltage

TEMPERATURE & VOLTAGE	CODE
HC type, 120 VAC	201
HC Type, 208 VAC	202
HTE type, 90°C, 120 VAC	091
HTE type, 90°C, 208 VAC	092
HTE type, 120°C, 120 VAC	121
HTE type, 120°C, 208 VAC	122
HTE type, 150°C, 120 VAC	151
HTE type, 150°C, 208 VAC	152

Example 1: **HC-TBV-250-201** PID controlled jacket for 2.5 inch ID TBV. 120 VAC.
Example 2: **HTE-TSSC-600-122** Electronic thermostat controlled jacket for 6 inch ID, CF flanged TSS. 120 °C and 208 VAC operation.