Downstream Pressure Control

Section Four

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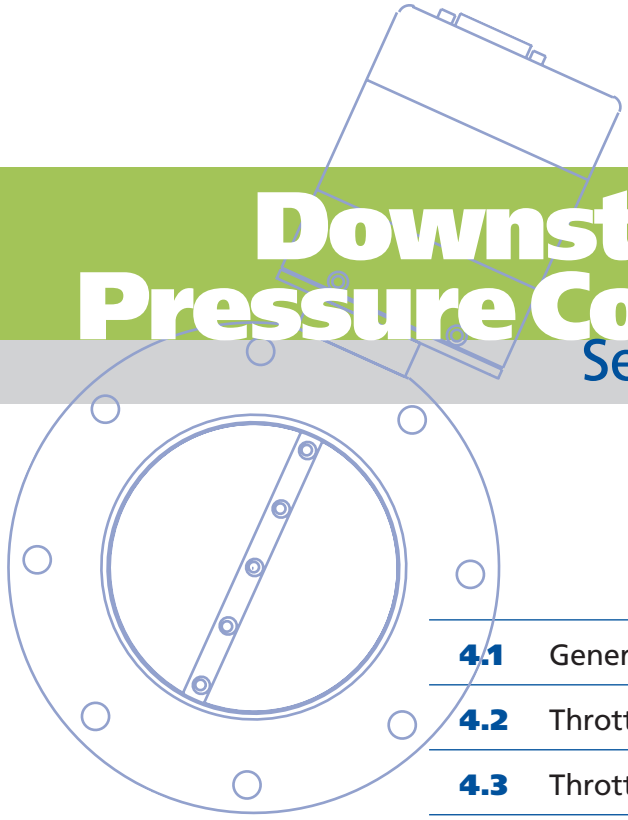

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Downstream Pressure Control
General Information

Intellisys™
ADAPTIVE PRESSURE CONTROL COMPONENTS

The Fastest, Most Precise Pressure Control System

Nor-Cal Products offers unequalled performance with 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-, gear- and ball-screw driven valves that do not rely on notoriously unreliable 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 vacuum gauge. Nor-Cal Products has products available in all of these categories.

The selection of throttling products includes families of butterfly and pendulum valves, as well as a number of special drives used to operate other types of fluid control devices.. 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.

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, Ethernet, and Analog/TTL.

Nor-Cal Products 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.

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 to drive the larger valves, or even smaller ones when used in aggressive processes. All TBV styles use long time proven and reliable off-the-shelf stepper motors that deliver smooth operation, high actuation speed and ultra-fine position resolution. Different series and configurations exist to allow for operation in all types of downstream pressure control applications including those using very low flow combined with high control pressures. Intellisys TBVs are non-sealing and are unsuitable as isolation valves.

When combined with an Intellisys controller, the fast response Nor-Cal Products 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 the on-valve IQ and IQ+ series.

Features and Benefits

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

Intellisys Technology

Many users want to know more about the underlying closed-loop control technology that forms the backbone of Intellisys control systems. A detailed paper describing the technology at hand can be found at **www.n-c.com/GainControl** or by scanning this QR-code.

Alternatively, give our Intellisys technical support staff a call at **800-824-4166**.

Downstream Pressure Control
Throttling Butterfly Valves

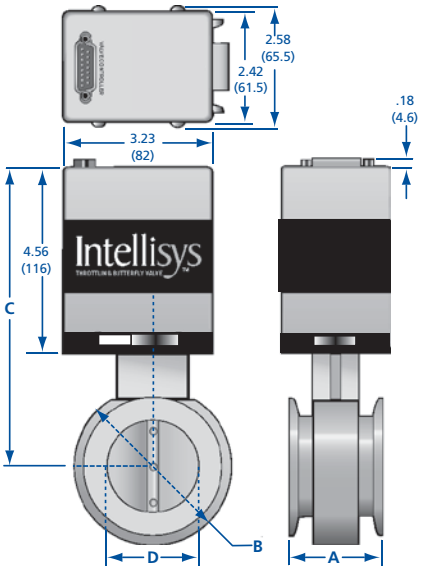
Direct Drive Throttling Butterfly Valves

MODEL NUMBER	NOMINAL ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBVP-D-NW-25	DN 25	NW	2.25 (57.1)	2.75 (69.8)	6.68 (169)	0.87 (22.1)	5.50 (2.5)
TBVP-D-NW-40	DN 40	NW	2.25 (57.1)	2.75 (69.8)	6.68 (169)	1.39 (35.3)	5.30 (2.4)
TBVP-D-NW-50	DN 50	NW	2.00 (50.8)	3.36 (85.3)	6.99 (177)	1.98 (50.3)	5.50 (2.5)
TBVP-D-ISO-63	DN 63	ISO-F	1.00 (25.4)	5.12 (130)	7.44 (189)	2.44 (62.0)	7.50 (3.4)
TBVP-D-ISO-80	DN 80	ISO-F	1.00 (25.4)	5.71 (145)	7.76 (197)	2.94 (74.7)	8.80 (4.0)
TBVP-D-ISO-100	DN 100	ISO-F	1.00 (25.4)	6.50 (165)	8.19 (208)	3.85 (97.8)	9.50 (4.3)

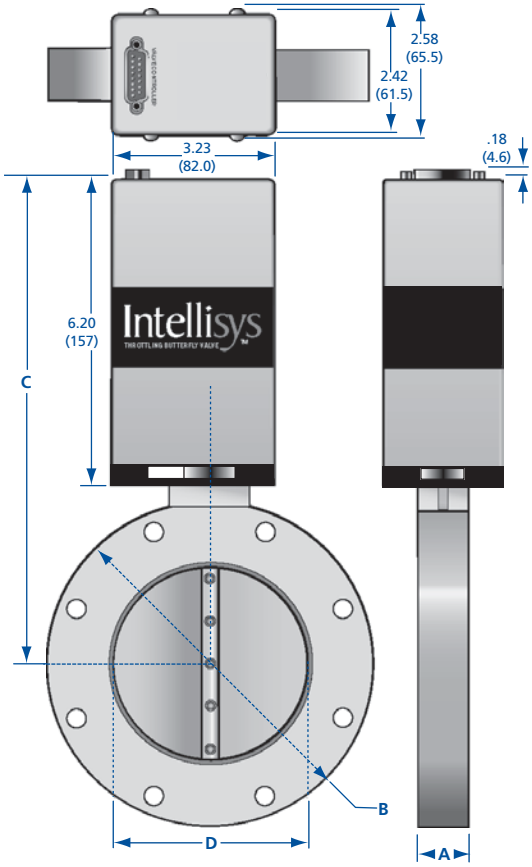
Gear Drive Throttling Butterfly Valves

MODEL NUMBER	NOMINAL ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBVP-G-ISO-160	DN 150	ISO-F	1.62 (41.1)	8.90 (226)	10.5 (266)	5.67 (144)	21.8 (9.9)
TBVP-G-ISO-200	DN 200	ISO-F	1.62 (41.1)	11.2 (284)	12.5 (317)	7.87 (199)	28.5 (12.9)
TBVP-G-ISO-250	DN 250	ISO-F	1.62 (41.1)	13.2 (335)	13.5 (342)	9.88 (250)	38.0 (17.3)

Direct Drive



Gear Drive



Seal Material Options

SEAL MATERIAL	CODE
FKM	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: TBVP-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: FKM standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Motor power input: Supplied by BQC controller.
Differential pressure: 1.1 bar 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 Products 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} mbar·liter/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

Nor-Cal Products 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.

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: FKM standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Power input: +24 VDC
Differential pressure: 1.1 bar 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 x 10^{-9} mbar·liter/sec He

Inherent performance

Open to close speed: 125 msec
Control resolution: 0.4 arc second
Maximum torque: DN-25 to DN-100 : 280 in-oz
DN-160 to DN-320 :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

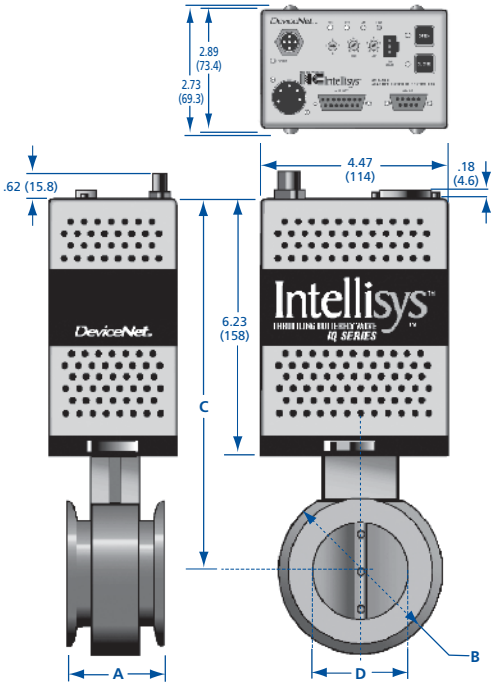
Approvals

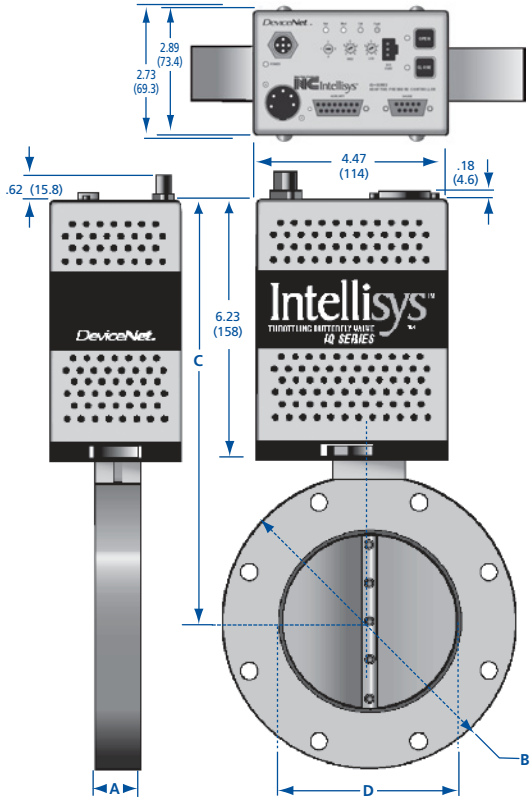
RoHS compliant
ODVA certified DeviceNet
CE *(EMC and machinery directives)*

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

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBV-QPD-NW-25	DN 25	NW	2.25 (57.1)	2.75 (69.8)	8.34 (211)	0.87 (22.1)	5.50 (2.5)
TBV-QPD-NW-40	DN 40	NW	2.25 (57.1)	2.75 (69.8)	8.34 (211)	1.39 (35.3)	5.30 (2.4)
TBV-QPD-NW-50	DN 50	NW	2.00 (50.8)	3.36 (85.3)	8.65 (219)	1.98 (50.3)	5.50 (2.5)
TBV-QPD-ISO-63	DN 63	ISO-F	1.00 (25.4)	5.12 (130)	9.10 (231)	2.44 (62.0)	7.50 (3.4)
TBV-QPD-ISO-80	DN 80	ISO-F	1.00 (25.4)	5.71 (145)	9.42 (239)	2.94 (74.7)	8.80 (4.0)
TBV-QPD-ISO-100	DN 100	ISO-F	1.00 (25.4)	6.50 (165)	9.85 (250)	3.85 (97.8)	9.50 (4.3)
TBV-QPD-ISO-160	DN 150	ISO-F	1.62 (41.1)	8.90 (226)	10.4 (264)	5.87 (149)	21.8 (9.9)
TBV-QPD-ISO-200	DN 200	ISO-F	1.62 (41.1)	11.2 (284)	12.4 (315)	7.87 (199)	28.5 (12.9)
TBV-QPD-ISO-250	DN 250	ISO-F	1.62 (41.1)	13.2 (335)	13.3 (337)	9.88 (250)	38.0 (17.3)
TBV-QPD-ISO-320	DN 300	ISO-F	1.62 (41.1)	16.7 (424)	15.4 (389)	12.3 (312)	51.0 (23.2)

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





Seal Material Options

SEAL MATERIAL	CODE
FKM	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.

Downstream Pressure Control
Throttling Butterfly Valves

NEW Performance Engineered
IQ+ Throttling Butterfly Valves with J-Lock Seal Technology

The dynamic range, or controllable conductance, of these valves spans from 0.01 liter/sec at closed for the 40mm size up to 600 liter/sec using the 100mm size valve in the full open position. When combined with the Intellisys™ on-board IQ+ controller, the J-Lock TBV valves can be used to control chamber pressures up to 1 bar and beyond, even with very low gas flow rates. Some users combine the valve controls with a differential pressure gauge, which enables precise pressure control either just above or just below atmospheric pressure.

The ultra-fine motor resolution of the IQ+ controller enables extremely precise valve plate movement resulting in very smooth and stable system pressures. The precision of the micro-stepping drive also enables the J-Lock TBV to be used as a soft-start or soft-pump valve whereby the chamber evacuation rate can be controlled to a constant value (ex. 1 mbar/sec decay). Simply issue the rate value command to the controller and run it in evacuation pressure control mode.

Process by-product mitigation is accomplished by heating the valve body, either by use of heater jackets or integral cartridge heaters. The J-Lock TBV valve can be baked out to 120°C as long as precautions are taken to ensure the IQ+ controller does not exceed 45°C. Higher temperature options are available but require consultation with Nor-Cal Products' technical team.

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	WEIGHT
TBJ-QP-NW-40	DN 40	NW-40	2.3 (58.4)	3.0 (76.2)	8.5 (215.9)	1.2 (30.5)	7.8 lbs. (3.5)
TBJ-QPA-NW-40	DN 40	NW-40	2.3 (58.4)	3.0 (76.2)	8.5 (215.9)	1.2 (30.5)	7.8 lbs. (3.5)
TBJ-QPD-NW-40	DN 40	NW-40	2.3 (58.4)	3.0 (76.2)	8.5 (215.9)	1.2 (30.5)	7.8 lbs. (3.5)

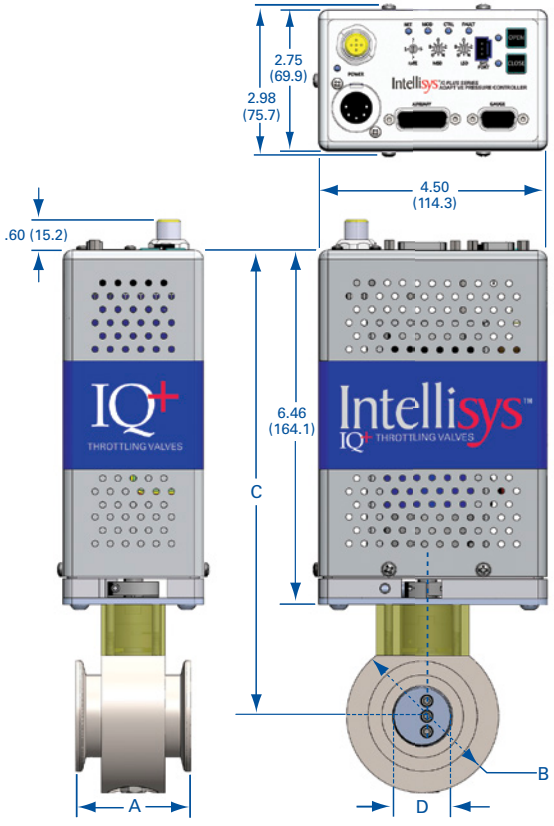
More sizes and flange types available. Call for information.

Features

- Patented design combines near foreline sealing with downstream pressure control
- Achieve high pressure control with minimal gas flow
- Avoid load lock condensation or particle generation by regulating evacuation rates
- Highest system throughput and fastest actuation speed
- Ultra-fine position resolution
- Reduced maintenance downtime
- CE marked / fully REACH and RoHS compliant
- Available in stainless steel with NW 40 flanges

Seal Material Options

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



SPECIFICATIONS

General

Controller Types:
QP: RS232 interface
QPA: Analog TTL/RS232 interface
QPD: DeviceNet/RS232 interface
Contact the factory for other interfaces such as, RS-485 and Ethernet

Controller Options:
B: Battery back-up
G: Gauge power
Example: **TBJ-QPDBG-NW-40:** DeviceNet/RS232 interface, with battery back-up and gauge power

Construction

Body, Support Plate and Shaft: 316 stainless steel
J-Lock Seal Plate: PTFE (GL20)
Shaft Seals: FKM standard. Kalrez, Chemraz, Perlast and other materials available on request.

Operation

Power input: +24 VDC
Differential pressure:
1.1 bar maximum across the valve plate
Forced heating capabilities:
Valves may be heated up to 120°C with optional external heaters.
Process gas temperature capabilities:
For process gas temperatures in excess of 100°C, please consult with Nor-Cal Products Intellisys technical support for proper selection of seal materials and other design considerations.
Ambient operating conditions:
0 - 60°C @ 0 - 95% humidity

Inherent performance

Open to close speed: 625 msec
Control resolution: 0.1 arc second
Maximum torque:
DN-40 to DN-100: 1900 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 2.5 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
J-Lock Seal life: 1 million open-close cycles

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 back-streaming, 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 inch (12.7mm) insulation add-on heaters are available for all Throttling Butterfly 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 onto 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 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

Valve Size

VALVE SIZE	CODE
1.00*	100
0.50*	150
2.00*	200
2.50	250
3.00	300
4.00	400
6.00	600
8.00	800
10.0	1000
12.0	1200

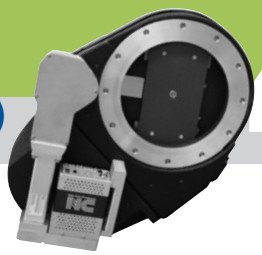
* *Includes two special NW clamps*

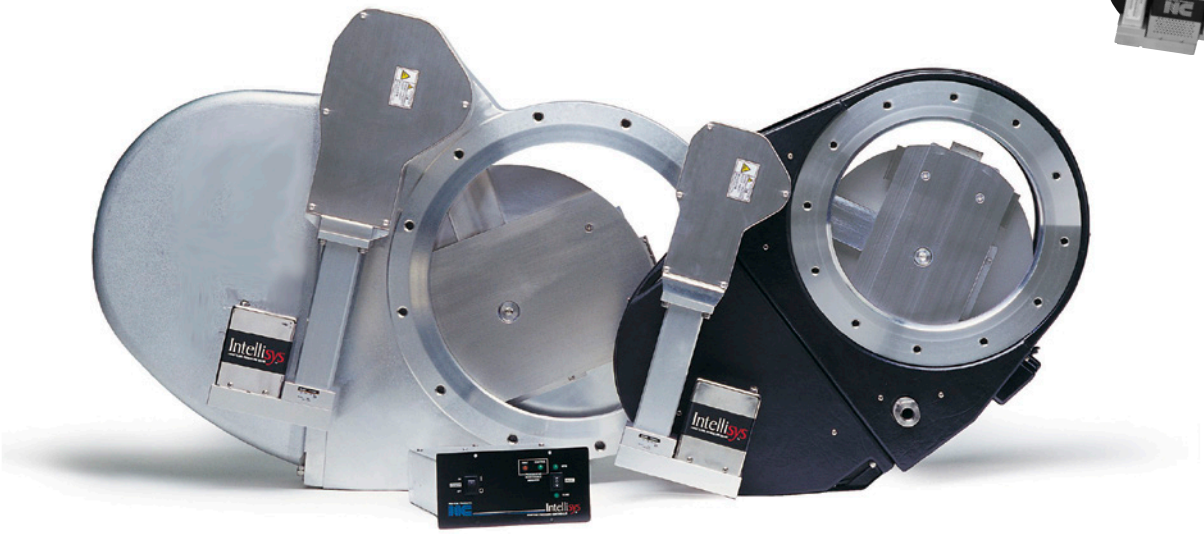
Temperature/Voltage

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.

Downstream Pressure Control
Throttling Pendulum Valves (TPV)





Unmatched Pressure Control Performance and Low Particle Generation

Nor-Cal Products' line of Intellisys pendulum valves provides equipment manufacturers with unmatched pressure control performance and low particle generation. Other pendulum valves use one actuation method to move the gate and another method to seal, creating an "out of control" area near the closed position. To compensate for this, system designers often add secondary bypass lines with costly throttling butterfly valves for high pressure, high flow regimes, such as NF_3 cleans. Intellisys pendulum valves utilize the same exclusive closed loop motor technology as other Nor-Cal Products control valves, but also feature a patented Penduroll actuator mechanism to move the sealing gate rapidly across the valve bore and transition to the axial direction. The result is precise pressure control over the entire valve stroke, most notably near the closed position. The Intellisys control system is the only choice for demanding 300mm Etch and CVD applications which require fast, accurate pressure control across the entire range of critical process flows and chamber pressures.

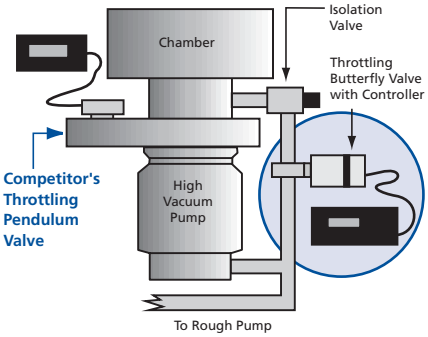
The Intellisys closed loop motor control monitors and controls the exact position of the valve's gate mechanism. When combined with an Intellisys adaptive pressure controller, the pendulum valves provide up to 160 million steps of positional resolution to position the gate exactly where it needs to be to control pressure or to seal. In addition, the Nor-Cal Products control system's speed of actuation is unequaled in providing optimal transient response, pressure set-point stability and overall process improvement. The APC's adaptive algorithm outperforms "learn modes" by optimizing phase and gain settings in real time during varying chamber pressure and flow conditions.

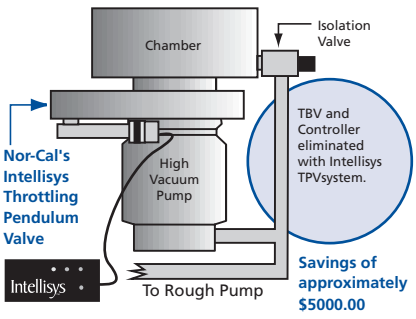
In-situ serviceability of the valve is made possible through the incorporation of a removable bonnet cover. The entire gate assembly and sealing O-ring can be accessed without removing the valve from the system, making regular inspections, cleanings and O-ring replacements quick and easy.

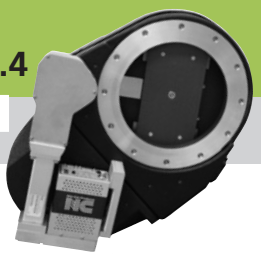
Nor-Cal Products also offers pneumatically actuated isolation pendulum valves that contain the same patented Penduroll mechanism that is found in the throttling valves. For more information about these valves, please refer to the Isolation Valves section of this catalog.

Features and Benefits

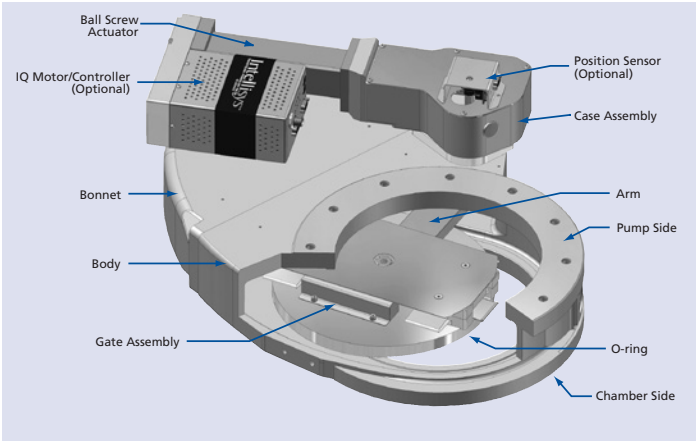
- Space saving, low cost design
- Low particle generation
- High reliability
- Easy maintenance, split body allows O-ring replacement without removing valve from system
- Body can be heated up to 150°C with optional heater jackets
- Available in ISO and JIS flange styles







Downstream Pressure Control
Throttling Pendulum Valves



TPV Part Number and Ordering Information

Please use the following part numbering tree to add the appropriate options for a TPV to fit your application.
Note: All part number combinations may not be valid. Contact Nor-Cal Products for the latest pricing, availability and other options.

Valve Model Number	–	Heater Option	–	Seal Material	–	Other Options

Heater Options

HEATER OPTIONS	OPERATION	CODE
None		*Leave blank*
90°C thermostat	120 VAC	**HT091**
120°C thermostat	120 VAC	**HT121**
150°C thermostat	120 VAC	**HT151**
90°C thermostat	208 VAC	**HT092**
120°C thermostat	208 VAC	**HT122**
150°C thermostat	208 VAC	**HT152**

Seal Material Options

SEAL MATERIAL	CODE
FKM	*Leave blank*
Kalrez 4079	**-K79**
Kalrez 8085	**-K85**
Kalrez 8575	**-K75**
Kalrez 9100	**-K91**
Chemraz E38	**-C38**
Dupra 192	**-D19**
Perlast G74P	**-PP7**

Other Options

OTHER OPTIONS	CODE
Motor actuator position R* (default)	*Leave blank*
Motor actuator position T*	**T**
Pump-out port (NW-16 size on DN160 and DN200 NW-40 size on DN250, DN320 and DN35	**U**
Open / closed position indicators (Optical with indicating LEDs)	**W**
Mirror image body configuration	**Z**
*See dimension diagram on facing page	

Example 1: **TPV-800-ISO-200-MB-HT122-K79-T**
TPV with 8 inch ISO flanges, bright dipped aluminum, heated to 120°C with thermostat control, 208 VAC operation, Kalrez 4079 compound O-ring material and motor actuator in T position

Example 2: **TPV-QPDB-ISO-250-C38**
IQ+ TPV with DeviceNet and battery backup, 10 inch ISO flanges and E38 Chemraz O-ring material.

Body Materials Available

Standard TPV bodies are cast aluminum that have been either bright dipped or hard anodized. Some sizes are machined and either bright dipped or hard anodized. The model number denotes the body material and surface treament used for each size.

Note: Some sizes are not available in both machined and cast bodies.

BODY MATERIAL	CODE
Cast bright dipped aluminum	*Default*
Cast Type III hard anodize	**HA**
Machined bright dipped aluminum	**MB**
Machined Type III hard anodize	**HM**

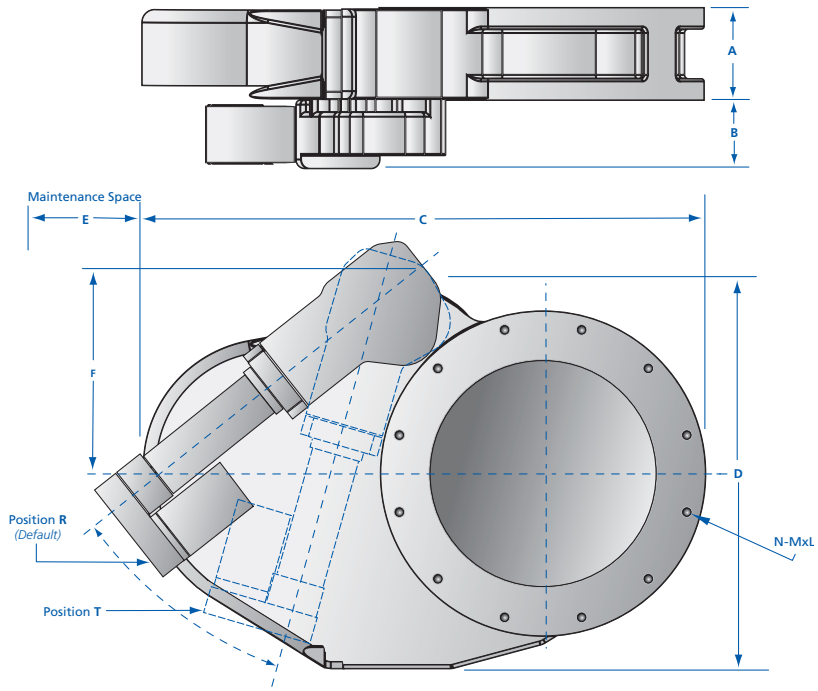
All dimensions are in inches (mm) & weights are in pounds (kg), unless otherwise noted.

Downstream Pressure Control
Throttling Pendulum Valves

Throttling Pendulum Valves

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	E	F	N	M	L	WEIGHT
TPVP-ISO-160-MB	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPVP-ISO-160-HM	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40 .0 (18.0)
TPVP-ISO-200-MB	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49.0 (22.2)
TPVP-ISO-200-HM	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49.0 (22.2)
TPVP-ISO-250	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62.0 (28.1)
TPVP-ISO-250-HA	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62.0 (28.1)
TPVP-ISO-320	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPVP-ISO-320-HA	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPVP-JFF-150-MB	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPVP-JFF-150-HM	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPVP-JFF-200-MB	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPVP-JFF-200-HM	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPVP-JFF-250	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPVP-JFF-250-HA	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPVP-JFF-300	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123.0 (55.8)
TPVP-JFF-300-HA	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123.0 (55.8)
TPVP-JFF-350	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143.0 (64.9)
TPVP-JFF-350-HA	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143.0 (64.9)

Note: ***N***=*Number bolt holes* ***M***=*Thread bolt diameter* ***L***=*Thread depth*



SPECIFICATIONS

General

Compatible controllers: 800-series APC buried box controllers

Construction

Wetted materials
Body: Cast aluminum A356.0 *(machined billet aluminum 6061-T6 in 8" size)*
Valve plate: Aluminum 6061-T6
Other parts: A6061, A7075, SS304, SS316, Inconel X-750 and FKM
Seals: FKM standard. Kalrez, Chemraz, Perlast and other materials available
Body and plate surface treatment: Bare aluminum standard, hard Type III anodizing optional

Operation

Motor power input: Supplied by BQC controller. Refer to APC section.
Differential pressure:
With valve fully sealed: 1.1 bar maximum across the valve plate
While opening the valve
27 mbar (DN160 and DN200)
32 mbar (DN250)
39 mbar (DN320 & DN350)
Operating pressure: 3.8×10^{-8} to 1 bar
Heating or bakeout capabilities:
Body: 150°C maximum with optional heater kits
Actuator: 60°C maximum
Ambient operating conditions:
0 - 60°C @ 0 - 95% humidity, noncondensing
Leak rate: 1×10^{-9} mbar·liter/sec He with FKM seals across seat and to atmosphere *(1×10^{-6} mbar·liter/sec He for hard anodized body or gate)*
Derated with some perfluoro-elastomers

Inherent performance

Maximum speed: Open to closed in 2 to 5 seconds, depending on size
Control resolution: 16 to 40 million steps, open to closed, depending on size

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: 1 million cycles open to control closed. 200K cycles open to fully closed.
MTBF: >10,000 hrs. continuous operation

Approvals

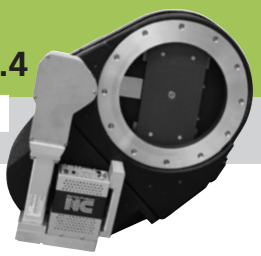
CE *(EMC and machinery directives)*

Options

Body & seal material, drive & heater *(see options page this section)*

JIS Flange O-Rings

SIZE	O-RINGS
150	OR-JIS-150
200	OR-JIS-200
250	OR-JIS-250
320	OR-JIS-320
350	OR-JIS-350



Downstream Pressure Control
Throttling Pendulum Valves

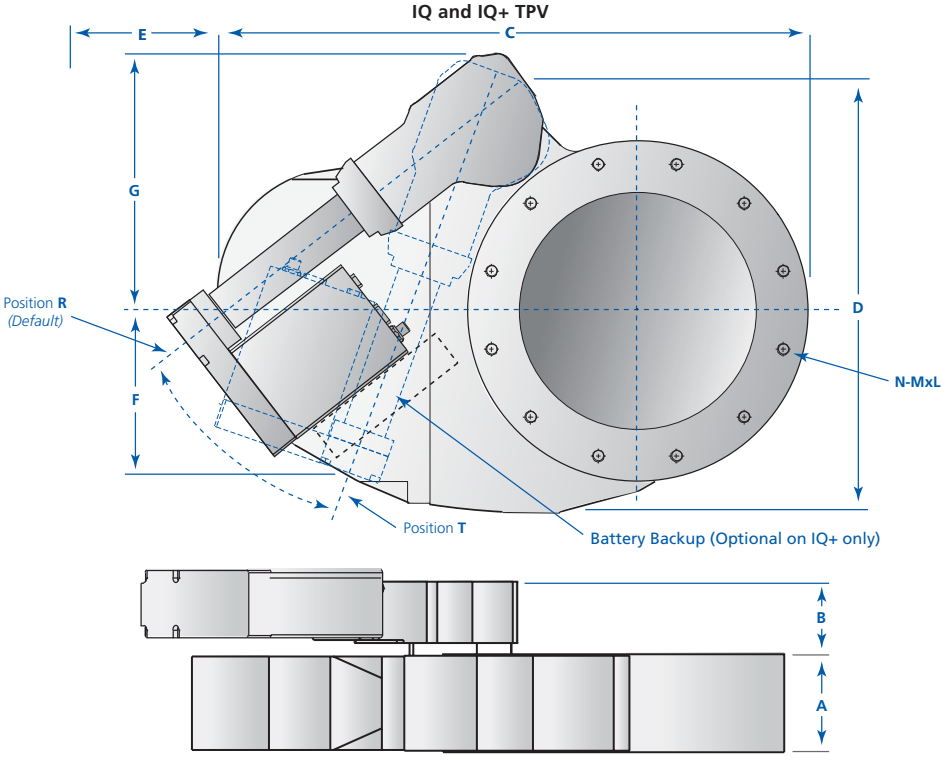
IQ Throttling Pendulum Valves

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	E	F	N	M	L	WEIGHT
TPV-IQA-600-ISO-160-MB	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-IQA-600-ISO-160-HM	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40 .0 (18.0)
TPV-IQA-800-ISO-200-MB	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49.0 (22.2)
TPV-IQA-800-ISO-200-HM	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49.0 (22.2)
TPV-IQA-1000-ISO-250	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62 .0 (28.1)
TPV-IQA-1000-ISO-250-HA	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62 .0 (28.1)
TPV-IQA-1200-ISO-320	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-IQA-1200-ISO-320-HA	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-IQA-600-JIS-150-MB	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40 .0 (18.0)
TPV-IQA-600-JIS-150-HM	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-IQA-800-JIS-200-MB	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPV-IQA-800-JIS-200-HM	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPV-IQA-1000-JIS-250	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPV-IQA-1000-JIS-250-HA	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPV-IQA-1200-JIS-300	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-IQA-1200-JIS-300-HA	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-IQA-1400-JIS-350	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143 (64.9)
TPV-IQA-1400-JIS-350-HA	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143 (64.9)

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

***N**=Number bolt holes **M**=Thread bolt diameter **L**=Thread depth*

IQ and IQ+ TPV



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

Construction

Wetted materials:
Body: Cast aluminum A356.0 *(machined billet aluminum 6061-T6 in 8" size)*
Valve plate: Aluminum 6061-T6
Other parts: A6061, A7075, SS304, SS316, Inconel X-750 and FKM
Seals: FKM standard. Kalrez, Chemraz, Perlast and other materials available
Body and plate surface treatment: Bare aluminum standard, hard Type III anodizing optional

Operation

IQ controller power input: +24 VDC,+/- 10%
Differential pressure:
With valve fully sealed: 1.1 bar maximum across the valve plate
While opening the valve:
27 mbar (DN160 & DN200);
32 mbar (DN250);
29 mbar (DN320 & DN350)
Operating pressure: 3.8×10^{-8} to 1 bar
Heating or bakeout capabilities:
Body: 150°C maximum with optional heater kits
Actuator: 60°C maximum
Ambient operating conditions:
0 - 45°C @ 0 - 95% humidity, non-condensing
Leak rate: 1×10^{-9} mbar·liter sec^{-1} He FKM seals across seat and to atmosphere (1×10^{-6} *mbar·liter sec^{-1} He for hard anodized body or gate).* Derated with some perfluoro-elastomers.

Inherent performance

Maximum speed: Open to closed in 2 to 5 seconds, depending on size
Control resolution: 16 to 40 million steps, open to closed, depending on size

Pressure control performance
(when used with an Intellisys controller)

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:
1 million cycles open to control closed.
200K cycles open to fully closed.
MTBF: >10,000 hrs. continuous operation

Approvals

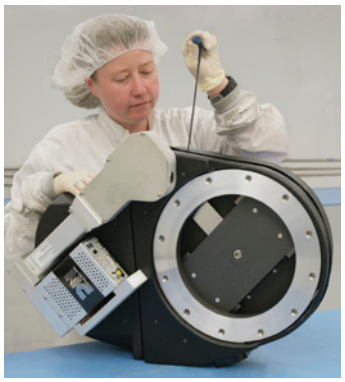
CE *(EMC and machinery directives)*

Options Body and seal material, drive and heater (see options page this section)

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

IQ+ Throttling Pendulum Valves

Nor-Cal Products IQ+ controller is available on the complete line of Throttling Pendulum Valves (TPV) turning what is very good performance into best-in-class process control. The IQ+ controller is an on-valve integral control and 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 back-up 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 pendulum valves are the right answer to any new or challenging pressure control application.

MODEL NUMBER	NOM. ID	FLANGE TYPE	A	B	C	D	E	F	N	M	L	WEIGHT
TPV-QPD-ISO-160-MB	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-QPD-ISO-160-HM	DN 160	ISO-F	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-QPD-ISO-200-MB	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49.0 (22.2)
TPV-QPD-ISO-200-HM	DN 200	ISO-F	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	12	M10	(10.0)	49 .0 (22.2)
TPV-QPD-ISO-250	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62.0 (28.1)
TPV-QPD-ISO-250-HA	DN 250	ISO-F	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M10	(10.0)	62.0 (28.1)
TPV-QPD-ISO-320	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-QPD-ISO-320-HA	DN 320	ISO-F	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-QPD-JFF-150-MB	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-QPD-JFF-150-HM	DN 150	JIS	3.15 (80.0)	3.78 (96.0)	15.9 (403)	12.2 (310)	5.31 (135)	8.50 (216)	8	M10	(10.0)	40.0 (18.0)
TPV-QPD-JFF-200-MB	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPV-QPD-JFF-200-HM	DN 200	JIS	3.46 (87.9)	3.78 (96.0)	19.9 (506)	14.4 (266)	6.50 (165)	9.29 (236)	8	M12	(12.0)	49.0 (22.2)
TPV-QPD-JFF-250	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPV-QPD-JFF-250-HA	DN 250	JIS	3.94 (100)	3.78 (96.0)	23.8 (605)	16.6 (422)	8.46 (215)	9.49 (241)	12	M12	(12.0)	62.0 (28.1)
TPV-QPD-JFF-300	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-QPD-JFF-300-HA	DN 300	JIS	4.72 (120)	4.06 (103)	30.2 (767)	22.0 (559)	10.6 (269)	12.8 (325)	12	M12	(18.0)	123 (55.8)
TPV-QPD-JFF-350	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143 (64.9)
TPV-QPD-JFF-350-HA	DN 350	JIS	4.92 (125)	4.06 (103)	32.3 (820)	22.0 (559)	12.2 (310)	12.8 (325)	12	M12	(18.0)	143 (64.9)

NOTE: *QPD can be replaced with QPDB, QPDG and QPDBG* ***N****=Number bolt holes* ***M****=Thread bolt diameter* ***L****=Thread depth*

JIS Flange O-Rings

SIZE	O-RINGS
150	OR-JIS-150
200	OR-JIS-200
250	OR-JIS-250
300	OR-JIS-300
350	OR-JIS-350

SPECIFICATIONS

General

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

Construction

Wetted materials
Body: Cast aluminum A356.0 *(machined billet aluminum 6061-T6 in 8 inch size)*
Valve plate: Aluminum 6061-T6
Other parts: A6061, A7075, SS304, SS316, Inconel X-750 and FKM
Seals: FKM standard. Kalrez, Chemraz, Perlast and other materials available
Body and plate surface treatment: Bare aluminum standard, hard Type III anodizing optional

Operation

Power input: +24 VDC
Differential pressure:
With valve fully sealed: 1.1 bar maximum across the valve plate
While opening the valve:
27 mbar (DN160 and DN200)
32 mbar (DN250)
39 mbar (DN320 & DN350)
Operating pressure: 3.8×10^{-8} to 1 bar
Heating or bakeout capabilities:
Body: 150°C maximum with optional heater kits
Actuator: 60°C maximum
Ambient operating conditions:
0 - 45°C @ 0 - 95% humidity, non-condensing
Leak rate: 1×10^{-9} mbar·liter/sec He with FKM seals across seat and to atmosphere *(1×10^{-6} mbar·liter/sec He for hard anodized body or gate)*
Derated with some perfluoro-elastomers

Inherent performance

Maximum speed: Open to closed in 2 to 5 seconds, depending on size
Control resolution: 64 to 160 million steps, open to closed, depending on size

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: 1 million cycles open to control closed. 200K cycles open to fully closed.
MTBF: >10,000 hrs. continuous operation

Approvals

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

Options

Body & seal material, drive & heater
(see options page this section)

Downstream Pressure Control
Adaptive Pressure Controllers

Advanced Control System Performance

The Intellisys Adaptive Pressure Controller (APC) provides advanced control system performance by combining closed loop motor control with adaptive pressure control. PCs are available in two basic configurations – the buried box style and the new on-valve IQ-series. The patented closed loop motor control technology, found at the core of the Intellisys controller technology, results in 250 times greater motor positional resolution at 10-20 times the speed compared to other existing technologies. The adaptive pressure control algorithm eliminates pressure over and undershoots as well as ringing during process step transitions.

APC controllers are available for all of Nor-Cal Products Intellisys control valves and drives, and can be supplied with auto-ranging AC, or low voltage DC power supplies. Depending on the model and intended valve operation, users can choose from additional optional features such as battery back-up, local and remote displays and a range of communication modes including Analog/TTL, RS-232 and RS-485 serial, as well as DeviceNet.

SPECIFICATIONS

General

Construction material
Chassis:5052-aluminum
Power input: +24 VDC +/-10%, 100W max *(600W nonminal)* power input
Battery back-up: Optional
Ambient operating conditions:
0 - 45°C @ 0 - 95% humidity, non-condensing

System interface

Serial communication: RS-232 or RS-485 on DB-15 female connector
Analog/TTL communication:
Four (4) analog I/O and seven (7) TTL I/O on DB-25 female connector
DeviceNet communication:
Micro-style 5-pin male connector
Analog setpoint input:
0-10 or 0-5 VDC linearly proportional to pressure or valve position
Pressure output: 0-10 VDC analog output proportional to pressure, one for each vacuum gauge attached
Valve position output: 0-10 VDC or 0-5 VDC analog output proportional to valve position

Device interface

Gauge connection: Differential analog signal input with ±15 VDC power output to one or two gauges
Valve connection: DB-15 female connector provides power and transmits position information required to operate the high performance valve

User Interface

Switches: Valve open & close, and mutli-position rotary switches for communications settings
Indicating LEDs:
Power, Fault, Control, Valve open and closed, DeviceNet: Mod and Net

Pressure Control Performance

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)
MTBF: >50,000 hours continuous operation

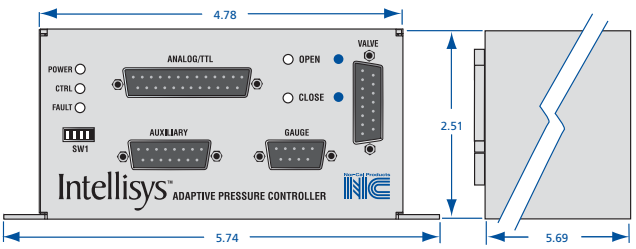
Approvals

CE *(EMC and Low Voltage Directives)*
NRTL *(United States)*
SCC *(Canada)*
EU Directives *(Europe)*

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

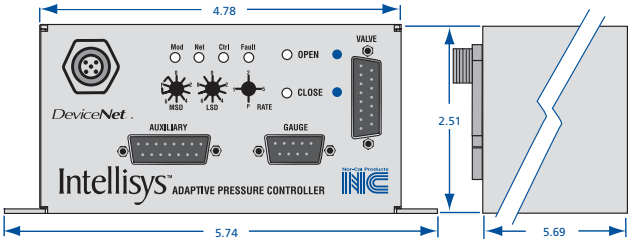
Low Voltage Controllers

MODEL NUMBER	FOR USE WITH	BATTERY BACK-UP	WEIGHT
BQC-100L-A	Geared Butterfly Valves (TBVP-G-xxx)	NO	1.6 (0.7)
BQC-100L-AB	Geared Butterfly Valves (TBVP-G-xxx)	YES	2.5 (1.1)
BQC-200L-A	Direct Drive Butterfly Valves (TBVP-D-xxx)	NO	1.6 (0.7)
BQC-200L-AB	Direct Drive Butterfly Valves (TBVP-D-xxx)	YES	2.5 (1.1)
BQC-800L-A	Pendulum Valves (TPVP-xxx)	NO	1.6 (0.7)
BQC-800L-AB	Pendulum Valves (TPVP-xxx)	YES	2.5 (1.1)



Low Voltage Controllers with DeviceNet

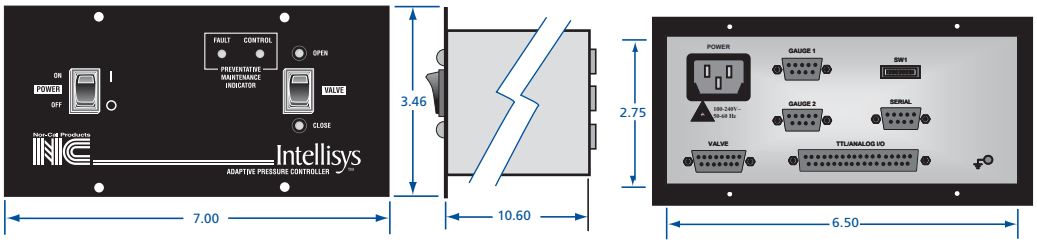
MODEL NUMBER	FOR USE WITH	BATTERY BACK-UP	WEIGHT
BQC-100L-D	Geared Butterfly Valves (TBVP-G-xxx)	NO	1.6 (0.7)
BQC-100L-DB	Geared Butterfly Valves (TBVP-G-xxx)	YES	2.5 (1.1)
BQC-200L-D	Direct Drive Butterfly Valves (TBVP-D-xxx)	NO	1.6 (0.7)
BQC-200L-DB	Direct Drive Butterfly Valves (TBVP-D-xxx)	YES	2.5 (1.1)
BQC-800L-D	Pendulum Valves (TPVP-xxx)	NO	1.6 (0.7)
BQC-800L-DB	Pendulum Valves (TPVP-xxx)	YES	2.5 (1.1)



Downstream Pressure Control
Adaptive Pressure Controllers

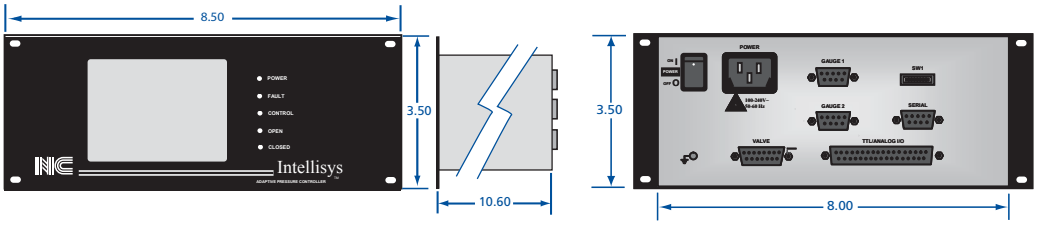
A/C Adaptive Pressure Controllers

MODEL NUMBER	FOR USE WITH	BATTERY BACK-UP	WEIGHT
APC-100-A	Geared Butterfly Valves (TBV-G-xxx)	NO	3.5 (1.6)
APC-200-A	Direct Drive Butterfly Valves (TBV-D-xxx)	NO	3.5 (1.6)
APC-800-A	Pendulum Valves (TPV-xxx)	NO	3.5 (1.6)



A/C Adaptive Pressure Controllers with Touch Screen

MODEL NUMBER	FOR USE WITH	BATTERY BACK-UP	WEIGHT
APC-150-A	Geared Butterfly Valves (TBV-G-xxx)	NO	4.2 (1.9)
APC-250-A	Direct Drive Butterfly Valves (TBV-D-xxx)	NO	4.2 (1.9)
APC-850-A	Pendulum Valves (TPV-xxx)	NO	4.2 (1.9)



SPECIFICATIONS

General

Construction material
Chassis: 5052-aluminum
Power input: 100-240 VAC, 50-60Hz, 100W max (60W nominal) power input.
Battery Back-up: N/A
Ambient operating conditions: 0 - 45°C @ 0 - 95% humidity, non-condensing

System interface

Serial communication: RS-232 or RS-485 on DB-9 female connector.
Analog / TTL communication: Six (6) analog I/O and thirteen (13) TTL I/O on DB-37 female connector
DeviceNet communication: N/A
Analog setpoint input: 0-10 or 0-5 VDC linearly proportional tp pressure or valve position
Pressure output: 0-10 VDC analog output proportional to pressure, one for each vacuum gauge attached
Valve position output: 0-10 VDC or 0-5 VDC analog output proportional to valve position

Device interface

Gauge connection: Differential analog signal input with ±15 VDC power output to one or two gauges
Valve connection: DB-15 female connector provides power and transmits position information required to operate the high performance valve

User interface

Switches: Power ON / OFF, Valve OPEN / CLOSE
Indicating LEDs: Power, Fault, Control, Valve open and closed
Graphic display: N/A
(Touch screen LCD on listed model)

Pressure control performance

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)
MTBF: >50,000 hours continuous operation

Approvals

CE *(EMC and Low Voltage Directives)*
NRTL *(United States)*
SCC *(Canada)*
EU Directives *(Europe)*

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

Downstream Pressure Control
Capacitance Diaphragm Gauges

Measurements of Superior Accuracy and Repeatability

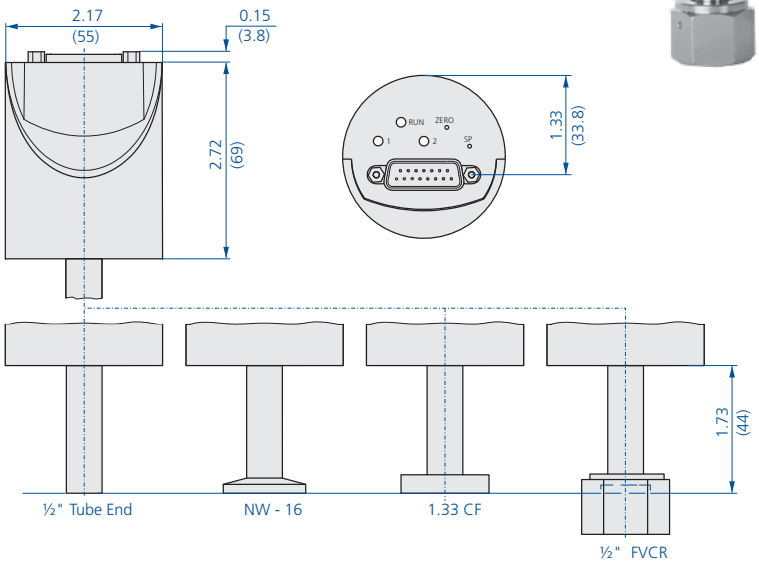
The **CDG025X-series Capacitance Diaphragm Gauge** line of highly accurate temperature compensated manometers is designed for stable performance in harsh manufacturing tool environments. Advanced digital electronics improve gauge performance and offer easy handling features such as one push button zero function and set point adjustment. The corrosion resistant ultra pure ceramic sensor provides excellent zero stability with a long life expectancy of several million pressure cycles, including atmospheric bursts. A robust mechanical design and digital electronics improve EMC compatibility, long term stability and temperature compensation. The **CDG025X-series** sets new standards for fast stability after power on and fast recovery from atmospheric pressure exposure.

Advantages

- Full scale ranges from 1 Torr to 1000 Torr
- Fast stability after power on
- Fast recovery from atmospheric pressure
- Corrosion resistant ceramic sensor
- Temperature compensated
- Sensor protected from contamination
- One push button zero function
- Wide range power supply
- Excellent long term signal stability

MODEL NUMBER	F.S. RANGE	TUBE FITTING	HEATED
CDG025X-T01	1 Torr	1/2" Tube End	NO
CDG025X-T01-CF	1 Torr	1.33" CF	NO
CDG025X-T01-NW1	1 Torr	NW-16	NO
CDG025X-T01-VCR	1 Torr	1/2" FVCR	NO
CDG025X-T02	2 Torr	1/2" Tube End	NO
CDG025X-T02-CF	2 Torr	1.33" CF	NO
CDG025X-T02-NW1	2 Torr	NW-16	NO
CDG025X-T02-VCR	2 Torr	1/2" FVCR	NO
CDG025X-T11	10 Torr	1/2" Tube End	NO
CDG025X-T11-CF	10 Torr	1.33" CF	NO
CDG025X-T11-NW1	10 Torr	NW-16	NO
CDG025X-T11-VCR	10 Torr	1/2" FVCR	NO
CDG025X-T12	20 Torr	1/2" Tube End	NO
CDG025X-T12-CF	20 Torr	1.33" CF	NO
CDG025X-T12-NW1	20 Torr	NW-16	NO
CDG025X-T12-VCR	20 Torr	1/2" FVCR	NO
CDG025X-T21	100 Torr	1/2" Tube End	NO
CDG025X-T21-CF	100 Torr	1.33" CF	NO
CDG025X-T21-NW1	100 Torr	NW-16	NO
CDG025X-T21-VCR	100 Torr	1/2" FVCR	NO
CDG025X-T31	1,000 Torr	1/2" Tube End	NO
CDG025X-T31-CF	1,000 Torr	1.33" CF	NO
CDG025X-T31-NW1	1,000 Torr	NW-16	NO
CDG025X-T31-VCR	1,000 Torr	1/2" FVCR	NO

	INTERNAL VOLUME in³ (cm³)	WEIGHT grams
1/2" Tube End	0.22 (3.6)	310
NW - 16	0.22 (3.6)	330
1.33 CF	0.22 (3.6)	350
1/2" FVCR®	0.22 (3.6)	370



MEASUREMENT RANGE F.S. (FULL SCALE)	TORR	1000	100	20/10	2/1
Accuracy [1]	% of reading	0.2	0.2	0.2	0.2
Temperature effect on zero on span Resolution	 % F.S./°C % of reading/°C % F.S.	 0.005 0.01 0.003	 0.005 0.01 0.003	 0.005 0.01 0.003	 0.015 0.01 0.003
Pressure, max.	kPa (absolute)	400	260	260	260
Response Time [2]	ms	30	30	30	30
Lowest reading	% F.S.	0.01			
Lowest suggested reading	% F.S.	0.05			
Lowest suggested control pressure	% F.S.	0.05			
Temperature Operation (ambient) Bakeout at flange [3] Storage	 °C °C °C	 +5 to +50 ≤110 -40 to +65			
Supply voltage	VDC	14 to +30			
Power consumption	W	≤1			
Output signal (analog)	VDC	0 to +10			
Degree of protection		IP 30			
Standards		EN 61000-6-2, EN 6100-6-3, EN 61010, UL 61010-1, CSA 22.2 No. 61010-1, RoHS			
Electrical connection		D-sub, 15 pin, male			
Materials exposed to vacuum		Aluminum oxide ceramic (A203), Vacon 70[4], stainless steel (AISI 316L [5]), AgCuTi hard solder, sealing glass			

[1] Non-linearity, hysteresis, repeatability at 25°C ambient operating temperature without temperature effects after 2 hours operation.
[2] Incease 10 to 90% F.S. *[3] Non operation*
[4] 28% Ni, 23% Co, 49% Fe *[5] 18% Cr, 10% Ni, 3% Mo, 69% Fe*

Downstream Pressure Control
Capacitance Diaphragm Gauges

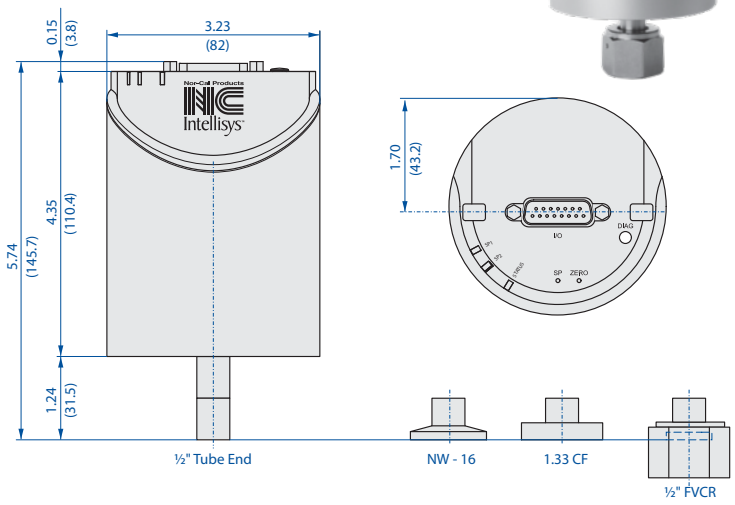
The **CDG045-series** manometers are your best choice for high accurate total pressure measurement and control.

Advantages

- Lower cost of ownership, 50% faster warm up, energy efficient low power consumption
- Easy integration, wide variety of full scales, flanges and interfaces, standard with two set points
- Easy one push button or remote signal zero command, zero offset adjustable
- Two year warranty, longer life time with advanced heating concept and gauge protection
- No long term recalibration due to excellent signal stability and repeatability, even in harsh plasma applications
- Diagnostic port for quick service and maintenance
- Compliance and standards: CE, EN, UL, SEMI, RoHS

MODEL NUMBER	F.S. RANGE	TUBE FITTING	HEATED
CDG045-M11	100 mTorr	1/2" Tube End	45ºC
CDG045-M11-CF	100 mTorr	1.33" CF	45ºC
CDG045-M11-NW1	100 mTorr	NW-16	45ºC
CDG045-M11-VCR	100 mTorr	1/2" FVCR	45ºC
CDG045-T01	1 Torr	1/2" Tube End	45ºC
CDG045-T01-CF	1 Torr	1.33" CF	45ºC
CDG045-T01-NW1	1 Torr	NW-16	45ºC
CDG045-T01-VCR	1 Torr	1/2" FVCR	45ºC
CDG045-T02	2 Torr	1/2" Tube End	45ºC
CDG045-T02-CF	2 Torr	1.33" CF	45ºC
CDG045-T02-NW1	2 Torr	NW-16	45ºC
CDG045-T02-VCR	2 Torr	1/2" FVCR	45ºC
CDG045-T11	10 Torr	1/2" Tube End	45ºC
CDG045-T11-CF	10 Torr	1.33" CF	45ºC
CDG045-T11-NW1	10 Torr	NW-16	45ºC
CDG045-T11-VCR	10 Torr	1/2" FVCR	45ºC
CDG045-T12	20 Torr	1/2" Tube End	45ºC
CDG045-T12-CF	20 Torr	1.33" CF	45ºC
CDG045-T12-NW1	20 Torrr	NW-16	45ºC
CDG045-T12-VCR	20 Torr	1/2" FVCR	45ºC
CDG045-T21	100 Torr	1/2" Tube End	45ºC
CDG045-T21-CF	100 Torr	1.33" CF	45ºC
CDG045-T21-NW1	100 Torr	NW-16	45ºC
CDG045-T21-VCR	100 Torr	1/2" FVCR	45ºC
CDG045-T31	1,000 Torr	1/2" Tube End	45ºC
CDG045-T31-CF	1,000 Torr	1.33" CF	45ºC
CDG045-T31-NW1	1,000 Torr	NW-16	45ºC
CDG045-T31-VCR	1,000 Torr	1/2" FVCR	45ºC

	INTERNAL VOLUME in³ (cm³)	WEIGHT grams
1/2" Tube End	0.26 (4.2)	837
NW - 16	0.26 (4.2)	852
1.33 CF	0.26 (4.2)	875
1/2" FVCR®	0.26 (4.2)	897



MEASUREMENT RANGE F.S. (FULL SCALE)	TORR	1000	100	20/10	2/1	0.1
Accuracy [1]	% of reading	0.15				
Temperature effect on zero on span	 % F.S. / °C % of reading / °C	 0.0025 0.01				0.005
Pressure, max.	kPa (absolute)	400		260		130
Resolution	% F.S.	0.003				
Lowest reading	% F.S.	0.01				
Lowest suggested reading	% F.S.	0.05				
Lowest suggested control pressure	% F.S.	0.05				
Temperature Operation (ambient) Bakeout at flange Storage	 °C °C °C	 +10 to +40 ≤110 -40 to +65				
Supply voltage		+14 to +30 VDC or ± 15 V (±5%)				
Power consumption During Heat up At operating temperature	 W W	 ≤12 ≤8				
Output signal (analog)	VDC	0 to +10				
Response time [2]	ms	30				130
Degree of protection		IP 40				
Standards		EN 61000-6-2/6-3, EN 61010, UL 61010-1, CSA 22.2 No. 61010-1, SEMI S-2				
Electrical connection		D-sub, 15 pin, male				
Set point Relay Contact Hysteresis	 VDC / ADC % F.S	 two set points (SPT, SP2) ≤30 / ≤0.5 1				
Diagnostic port Protocol Reed Set		 RS232-C Pressure, status, ID, set points, filter, zero adjust, factory reset, DC offset				
Materials exposed to vacuum		Aluminum oxide ceramic (A203), stainless steel (AISI 316L [3]), Nickel, sealing glass				

[1] *Non-linearity, hysteresis, repeatability at 25°C ambient operating temperature without temperature effects after 2 hours operation.*
[2] *Increase 10 to 90% F.S.* [3] *18% Cr, 10% Ni, 3% Mo, 69% Fe*

Downstream Pressure Control
Capacitance Diaphragm Gauges

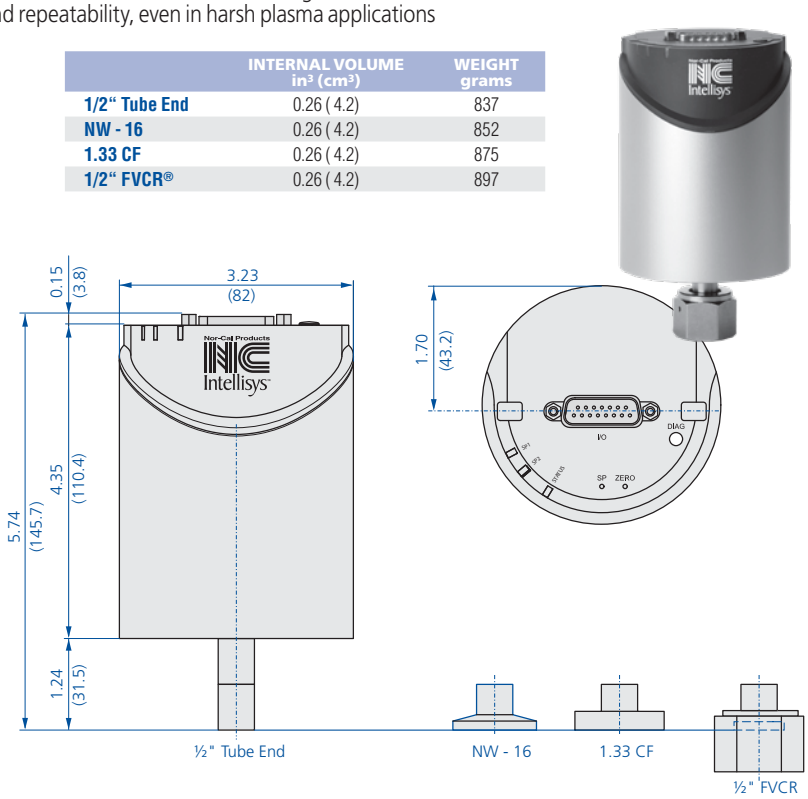
CDG100-series gauges are temperature controlled at 100°C for superior performance in demanding semiconductor and plasma processes.

Advantages

- Lower cost of ownership, 50% faster warm up, energy efficient low power consumption
- Easy integration, wide variety of full scales, flanges and interfaces, standard with two set points
- Easy one push button or remote signal zero
- command, zero offset adjustable
- Two year warranty, longer life time with advanced heating concept and gauge protection
- No long term recalibration due to excellent signal stability and repeatability, even in harsh plasma applications
- Diagnostic port for quick service and maintenance
- Compliance & standards: CE, EN, UL, SEMI, RoHS

MODEL NUMBER	F.S. RANGE	TUBE FITTING	HEATED
CDG100-M11	100 mTorr	1/2" Tube End	100ºC
CDG100-M11-CF	100 mTorr	1.33" CF	100ºC
CDG100-M11-NW1	100 mTorr	NW-16	100ºC
CDG100-M11-VCR	100 mTorr	1/2" FVCR	100ºC
CDG100-T01	1 Torr	1/2" Tube End	100ºC
CDG100-T01-CF	1 Torr	1.33" CF	100ºC
CDG100-T01-NW1	1 Torr	NW-16	100ºC
CDG100-T01-VCR	1 Torr	1/2" FVCR	100ºC
CDG100-T02	2 Torr	1/2" Tube End	100ºC
CDG100-T02-CF	2 Torr	1.33" CF	100ºC
CDG100-T02-NW1	2 Torr	NW-16	100ºC
CDG100-T02-VCR	2 Torr	1/2" FVCR	100ºC
CDG100-T11	10 Torr	1/2" Tube End	100ºC
CDG100-T11-CF	10 Torr	1.33" CF	100ºC
CDG100-T11-NW1	10 Torr	NW-16	100ºC
CDG100-T11-VCR	10 Torr	1/2" FVCR	100ºC
CDG100-T12	20 Torr	1/2" Tube End	100ºC
CDG100-T12-CF	20 Torr	1.33" CF	100ºC
CDG100-T12-NW1	20 Torr	NW-16	100ºC
CDG100-T12-VCR	20 Torr	1/2" FVCR	100ºC
CDG100-T21	100 Torr	1/2" Tube End	100ºC
CDG100-T21-CF	100 Torr	1.33" CF	100ºC
CDG100-T21-NW1	100 Torr	NW-16	100ºC
CDG100-T21-VCR	100 Torr	1/2" FVCR	100ºC
CDG100-T31	1,000 Torr	1/2" Tube End	100ºC
CDG100-T31-CF	1,000 Torr	1.33" CF	100ºC
CDG100-T31-NW1	1,000 Torr	NW-16	100ºC
CDG100-T31-VCR	1,000 Torr	1/2" FVCR	100ºC

	INTERNAL VOLUME in³ (cm³)	WEIGHT grams
1/2" Tube End	0.26 (4.2)	837
NW - 16	0.26 (4.2)	852
1.33 CF	0.26 (4.2)	875
1/2" FVCR®	0.26 (4.2)	897



MEASUREMENT RANGE F.S. (FULL SCALE)	TORR	1000	100	20/10	2/1	0.1
Accuracy [1]	% of reading	0.2				0.4
Temperature effect						
on zero	% F.S./ °C	0.00025				0.005
on span	% of reading / °C	0.02				
Pressure, max.	kPa (absolute)	400		260		130
Resolution	% F.S.	0.003				
Lowest reading	% F.S.	0.01				
Lowest suggested reading	% F.S.	0.05				
Lowest suggested control pressure	% F.S.	0.05				
Temperature						
Operation (ambient)	°C	+10 to +50				
Bakeout at flange	°C	≤110				
Storage	°C	-40 to +65				
Supply voltage		+14 to +30 VDC or ± 15 V (±5%)				
Power consumption						
During Heat up	W	≤15				
At operating temperature	W	≤10				
Output signal (analog)	VDC	0 to +10				
Response time [2]	ms	30				130
Degree of protection		IP 40				
Standards		EN 61000-6-2/6-3, EN 61010, UL 61010-1, CSA 22.2 No. 61010-1, SEMI S-2				
Electrical connection		D-sub, 15 pin, male				
Set point		two set points (SPT, SP2)				
Relay Contact	VDC / ADC	≤30 / ≤0.5				
Hysteresis	% F.S	1				
Diagnostic port						
Protocol		RS232-C				
Read		Pressure, status, ID,				
Set		set points, filter, zero adjust, factory reset, DC offset				
Materials exposed to vacuum		Aluminum oxide ceramic (A203), stainless steel (AISI 316L [3]), Nickel, sealing glass				

[1] *Non-linearity, hysteresis, repeatability at 25°C ambient operating temperature without temperature effects after 2 hours operation.*
[2] *Increase 10 to 90% F.S.* [3] *18% Cr, 10% Ni, 3% Mo, 69% Fe*

Downstream Pressure Control
Capacitance Diaphragm Gauges

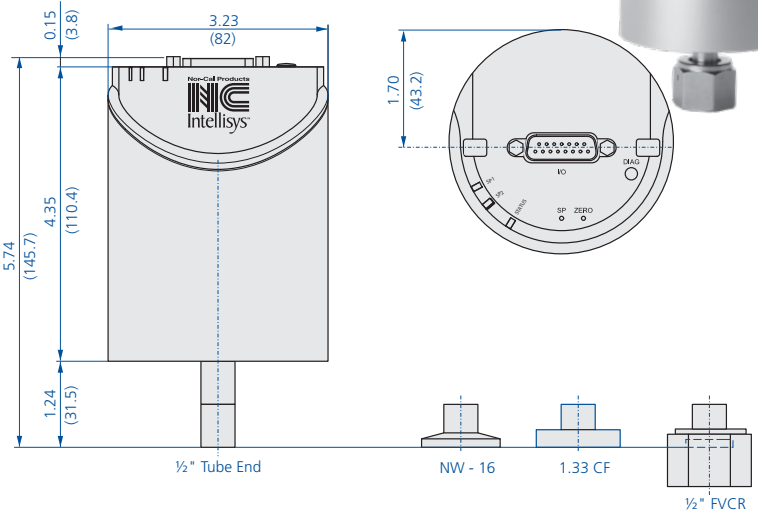
CDG160-series gauges are temperature controlled at 160°C for superior signal stability and repeatability.

Advantages

- Lower cost of ownership, 50% faster warm up, energy efficient low power consumption
- Easy integration, wide variety of full scales, flanges and interfaces, standard with two set points
- Easy one push button or remote signal zero command, zero offset adjustable
- Two year warranty, longer life time with advanced heating concept and gauge protection
- No long term recalibration due to excellent signal stability and repeatability, even in harsh plasma applications
- Diagnostic port for quick service and maintenance
- Compliance & standards: CE, EN, UL, SEMI, RoHS

MODEL NUMBER	F.S. RANGE	TUBE FITTING	HEATED
CDG160-T01	1 Torr	1/2" Tube End	160°C
CDG160-T01-CF	1 Torr	1.33" CF	160°C
CDG160-T01-NW1	1 Torr	NW-16	160°C
CDG160-T01-VCR	1 Torr	1/2" FVCR	160°C
CDG160-T02	2 Torr	1/2" Tube End	160°C
CDG160-T02-CF	2 Torr	1.33" CF	160°C
CDG160-T02-NW1	2 Torr	NW-16	160°C
CDG160-T02-VCR	2 Torr	1/2" FVCR	160°C
CDG160-T11	10 Torr	1/2" Tube End	160°C
CDG160-T11-CF	10 Torr	1.33" CF	160°C
CDG160-T11-NW1	10 Torr	NW-16	160°C
CDG160-T11-VCR	10 Torr	1/2" FVCR	160°C
CDG160-T12	20 Torr	1/2" Tube End	160°C
CDG160-T12-CF	20 Torr	1.33" CF	160°C
CDG160-T12-NW1	20 Torr	NW-16	160°C
CDG160-T12-VCR	20 Torr	1/2" FVCR	160°C
CDG160-T21	100 Torr	1/2" Tube End	160°C
CDG160-T21-CF	100 Torr	1.33" CF	160°C
CDG160-T21-NW1	100 Torr	NW-16	160°C
CDG160-T21-VCR	100 Torr	1/2" FVCR	160°C
CDG160-T31	1,000 Torr	1/2" Tube End	160°C
CDG160-T31-CF	1,000 Torr	1.33" CF	160°C
CDG160-T31-NW1	1,000 Torr	NW-16	160°C
CDG160-T31-VCR	1,000 Torr	1/2" FVCR	160°C

	INTERNAL VOLUME in³ (cm³)	WEIGHT grams
1/2" Tube End	0.26 (4.2)	837
NW - 16	0.26 (4.2)	852
1.33 CF	0.26 (4.2)	875
1/2" FVCR®	0.26 (4.2)	897



MEASUREMENT RANGE F.S. (FULL SCALE)	TORR	1000	100	20/10	2/1
Accuracy [1]	% of reading	0.4			
Temperature effect on zero on span	% F.S./°C % of reading/°C	0.005 0.02			
Pressure, max.	kPa (absolute)	400	260		
Resolution	% F.S.	0.003			
Lowest reading	% F.S.	0.01			
Lowest suggested reading	% F.S.	0.05			
Lowest suggested control pressure	% F.S.	0.05			
Temperature Operation (ambient) Bakeout at flange Storage	 °C °C °C	 +10 to +50 ≤110 -40 to +65			
Supply voltage		+14 to +30 VDC or ± 15 V (±5%)			
Power consumption during heat up	W	≤18			
Power consumption at opperating temperatures	W	≤18			
Output signal (analog)	VDC	0 to +10			
Response time [2]	ms	30			
Degree of protection		IP 40			
Standards		EN 61000-6-2/6-3, EN 61010, UL 61010-1, CSA 22.2 No. 61010-1, SEMI S-2			
Electrical connection		D-sub, 15 pin, male			
Set point Relay Contact Hysteresis	 VDC / ADC % F.S	 two set points (SPT, SP2) ≤30 / ≤0.5 1			
Diagnostic port Protocol Reed Set		 RS232-C Pressure, status, ID, set points, filter, zero adjust, factory reset, DC offset			
Materials exposed to vacuum		Aluminum oxide ceramic (A203), stainless steel (AISI 316L [3]), Nickel, sealing glass			

[1] *Non-linearity, hysteresis, repeatability at 25°C ambient operating temperature without temperature effects after 2 hours operation.*
[2] *Incease 10 to 90% F.S.* [3] *18% Cr, 10% Ni, 3% Mo, 69% Fe*

Downstream Pressure Control
Accessories and Spare Parts

To make the completion of an Intellisys downstream pressure control system easy, Nor-Cal Products offers a comprehensive selection of cables and related accessories. These include signal and communications cables, power cords, power supplies as well as spare parts.

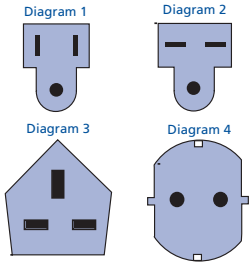
Cable Nomenclature Clarification

Most cable and cord part numbers listed below end with the number 10 as a suffix, which represents the cable length, measured in feet. Thus, our standard cable length is 10′ (3m). However, any length between 1′ (0.3m) and 30′ (9.1m) can be supplied as a special request. Please contact Nor-Cal Products for price and availability information.

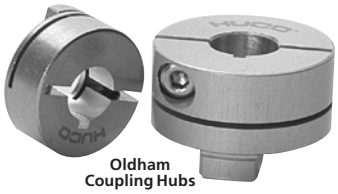
Power Supply APC-PSM-DB15

For use with all buried box DC powered APCs as well as IQ-series valves. 24 VDC, 2.5A power supply (100-240 VAC input). Includes CRD-PWR-US1 power cord and 6′ (2m) DC supply cable with DB15 D-sub connector.

APC & IQ Valve Power Supply



AC Power Cord Plug Configurations



Oldham Coupling Hubs

Cables and Power Cords

MODEL NUMBER	CABLE OR CORD TYPE	DESCRIPTION
TBV-CRD-10	Controller-to-Valve	Cable needed to connect any Intellisys throttle valve to any buried box controller. This cable is NOT needed for IQ-series valves.
CDG-CRD-10	Controller-to-Gauge	A/C powered APC-to-Gauge cable, where the gauge has screw terminals
CDG-CRD-DB9-10	Controller-to-Gauge	A/C powered APC-to-Gauge cable, where the gauge has a 9-pin D-sub connector
CDG-CRD-DB15-10	IQ Controller-to-Gauge	A/C powered APC-to-Gauge cable, where the gauge has a 15-pin D-sub connector. This is the correct cable to use for all Nor-Cal gauges.
CDG-IQ-CRD-10	IQ Controller-to-Gauge	DC powered (including all IQ and IQ+ models) APC-to-Gauge cable, where the gauge has screw terminals
CDG-IQ-CRD-DB9-10	IQ Controller-to-Gauge	DC powered(including all IQ and IQ+ models) APC-to-Gauge cable, where the gauge has a 9-pin D-sub connector
CDG-IQ-CRD-DB15-10	IQ Controller-to-Gauge	DC powered (including all IQ and IQ+ models) APC-to-Gauge cable, where the gauge has a 15-pin D-sub connector. This is the correct cable to use for all Nor-Cal gauges.
CDG-IQ-CRD-Y	IQ Controller-to-Gauge	A 1′ (0.3m) long Y-cable to be used if two gauges are interfaced with a DC powered APC (including IQ). Use of this Y-cable also requires two extension cables. Use either CDG-CRD-10, CDG-CRD-DB9-10 or CDG-CRD-DB15-10.
APC-CRD-RS232-10	Serial Communication	Use to connect any AC powered APC to a standard PC or laptop DB-9 serial port.
IQ-CRD-RS232-10	Serial Communication	Same as above, but for use with DC powered APC models, including IQ.
RD-PWR-US1	AC Power Cord	7′ (2m), 10A-125V rating. US standard power plug. See diagram 1.
CRD-PWR-US2	AC Power Cord	7′ (2m), 10A-250V rating. US high voltage power plug. See diagram 2.
CRD-PWR-UK	AC Power Cord	7′ (2m), 10A-250V rating. United Kingdom grounded power plug. See diagram 3.
CRD-PWR-EU	AC Power Cord	7′ (2m), 10A-250V rating. Continental Europe grounded power plug. diagram 4.

APC Spare Parts

APC controllers do not contain any user serviceable parts except for replacement battery packs.
All other service work needs to be performed by authorized Nor-Cal personnel. Please contact us for details.

MODEL NUMBER	SPARE PART	DESCRIPTION
APC-BAT-1518	Replacement battery pack	15-cell, 18-volt replacement battery pack
IQP-BAT-1518	IQ+ Replacement battery pack	15-cell, 18-volt replacement battery pack

TBV Spare Parts

PART NUMBER	SPARE PART	DESCRIPTION
54-310-004	Oldham Coupling Disk	Acetal. For all valves up to and including 4" (ISO-100)
54-330-006	Oldham Coupling Disk	Acetal. For 6 inch (ISO-160) valve and some UVD assemblies.
54-330-016	Oldham Coupling Disk	Acetal. For 8 inch (ISO-200) valve and some UVD assemblies
54-330-017	Oldham Coupling Disk	PEEK. For all valves up to and including 4" (ISO-100)
54-330-018	Oldham Coupling Disk	PEEK. For 6 inch (ISO-160) valve and some UVD assemblies.
54-330-019	Oldham Coupling Disk	PEEK. For 8 inch (ISO-200) valve and some UVD assemblies
TBV-400-90	FKM O-ring kit.	Set of four. For all TBV sizes up to and including 4" (ISO-100)
TBV-600-90	FKM O-ring kit.	Set of four. For 6 inch (ISO-160) TBV
TBV-800-90	FKM O-ring kit.	Set of four. For 8 inch (ISO-200) TBV and 10" (ISO-250) TBV

TPV Spare Parts

Please contact Nor-Cal Products technical support department for details.

CDG Spare Parts

CDG gauges do not contain any user serviceable parts. All service work needs to be performed by authorized Nor-Cal Products personnel. Please contact us for details.