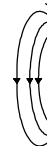


P&ID/PFD SYMBOLS (GENERAL INSTRUMENT OR FUNCTION SYMBOLS)

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	4/14/2016	J. KELSEY

TAG	SYMBOL	DESCRIPTION
		VALVES AND REGULATORS
		VALVE
		BALL VALVE
		ANGLE VALVE
		NEEDLE VALVE (MFC)
		CHECK VALVE
		SAFETY OR RELIEF VALVE
		PRESSURE-REDUCING REGULATOR, SELF-CONTAINED.
		CONTROL ACCUATORS
		SOLENOID ACTUATOR
		HAND ACTUATOR OR HAND WHEEL
		PIPE CONNECTIONS
		FLEX CONNECTION
		FLANGED CONNECTION (PIPING OR EQUIP)
		FLOW ORIFICE FIXED
		EXHAUST HEAD
		INDICATORS
		PRESSURE INDICATOR
		PUMPS
		TURBO MOLECULAR VACUUM PUMP
		ROOTS BLOWER VACUUM PUMP
		MISC. DEVICES
		DC POWER SUPPLY
		PRESSURIZED GAS BOTTLE
		SOLENOID MAGNET

TAG	SYMBOL	DESCRIPTION
		ELECTRICAL AND CONTROLS
		DC POWER SUPPLY
		VACUUM GAUGE CONTROLLER
		PROGRAMABLE LOGIC CONTROLLER
		FLOW SWITCH
		SWITCH
		LINE TYPES
	----	ELECTRICAL SIGNAL
	→	FLOW DIRECTION
	//	COMPRESSED AIR
	// (XX)	COMPRESSED GAS (XX) DENOTES GAS TYPE
	—/—	WATER FLOW

VALVE & INSTRUMENTATION IDENTIFIER LETTERS									
Tag	Description	Manufacturer	Model Number	Size	Tag	Description	Manufacturer	Model Number	Size
BAR-01	BARATRON GAUGE	INFICON	CDG025D	DN 16 ISO KF	TS-01	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BAR-02	BARATRON GAUGE	INFICON	CDG025D	DN 16 ISO KF	TS-02	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BAR-03	BARATRON GAUGE	INFICON	CDG025D	DN 16 ISO KF	TS-03	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BAR-04	BARATRON GAUGE	INFICON	CDG025D	DN 16 ISO KF	TS-04	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BCG-01,02,03	BARATRON GAUGE CONTROLLER	INFICON	VCG503	N/A	TS-05	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BV-01	BALL VALVE	SWAGELOK	SF-63TF8	1/2" NPT	TS-06	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
BV-012	BALL VALVE	SWAGELOK	SF-63TF8	1/2" NPT	TS-07	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
CK-01	CHECK VALVE	CIRCLE SEAL	249B-16PP	1 1/2"	TS-08	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
CK-02	CHECK VALVE	CIRCLE SEAL	249B-16PP	1 1/2"	TS-09	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
FS-01	FLOW SWITCH	GEM SENSORS	FS-10798	1/2" NPT	TS-10	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
FS-02	FLOW SWITCH	GEM SENSORS	FS-10798	1/2" NPT	TS-11	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
GAS INT	GAS INTERLOCK CONTROLLER	BATES	CUSTOM	N/A	TS-12	TEMPERATURE SWITCH	UCHIYA LTD	U 12	85C
GV-01 NC	SOLENOID VALVE	SWAGELOK	6LV-RDVR4-CM	1 1/2" VCR	V-01 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
GV-02 NC	SOLENOID VALVE	SWAGELOK	6LV-RDVR4-CM	DN 40 ISO KF	V-02 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
MFC-01	MASS FLOW CONTROLLER	MKS INSTRUMENTS	GE50A007103RBV020	DN 40 ISO KF	V-03 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
MV-01	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	V-04 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
MV-02	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	V-05 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
MV-03	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	V-06 NC	GATE VALVE	VAT	SERIES 108 UHV	CF-10.0
MV-04	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	V-07 NC	GATE VALVE	VAT	SERIES 472 UHV	CF-4.50
MV-05	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	V-08 NC	GATE VALVE	VAT	SERIES 472 UHV	CF-4.50
MV-06	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	VCG-01, 02, 03	VACUUM GAUGE CONTROLLER	INFICON	VCG403	N/A
MV-07	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	VCG-04, 05, 06	VACUUM GAUGE CONTROLLER	INFICON	VCG403	N/A
MV-08	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	VCG-07, 08, 09	VACUUM GAUGE CONTROLLER	INFICON	VCG403	N/A
MV-09	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	VAC INT	VACUUM INTERLOCK CONTROLLER	BATES	CUSTOM	N/A
MV-10	MANUAL GATE VALVE	VAT	01232-KA06	DN 40 ISO KF	VAC RGH-01	ROOTS BLOWER PUMP	EDWARDS	QDP-40	55 L/M
DRF-01	KAPTON BAFFLE	N/A	N/A	2.5" DD-3mm ID	VAC RTS-01	ROOTS BLOWER PUMP	EDWARDS	IH1000	1000 L/M
DRF-02	KAPTON BAFFLE	N/A	N/A	2.5" DD-3mm ID	VAC RTS-02	ROOTS BLOWER PUMP	EDWARDS	IH1000	1000 L/M
DRF-03	KAPTON BAFFLE	N/A	N/A	2.5" DD-3mm ID	VAC TP-01	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
DRF-04	KAPTON BAFFLE	N/A	N/A	5.75" DD-3mm ID	VAC TP-02	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
DRF-05	KAPTON BAFFLE	N/A	N/A	5.75" DD-3mm ID	VAC TP-03	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
DRF-06	KAPTON BAFFLE	N/A	N/A	5.75" DD-3mm ID	VAC TP-04	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
DRF-07	RESTRICTION DRIFICE	O'KEEFE	G-21-55	1/4" NPT	VAC TP-05	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
DRF-08	RESTRICTION DRIFICE	O'KEEFE	G-21-55	1/4" NPT	VAC TP-06	TURBO MOLECULAR PUMP	OSAKA	TG1110M	CF-10.0
PRLF-01	PRESSURE RELIEF VALVE	PFEIFFER VACUUM	120VUS040	DN 40 ISO KF	VG-01	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRS-01	PRESSURE GAUGE	MATHESON	3810-350	1/4" NPT	VG-02	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRS-02	PRESSURE GAUGE	MATHESON	3810-350	1/4" NPT	VG-03	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRS-03	PRESSURE GAUGE	MATHESON	3810-350	1/4" NPT	VG-04	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRS-04	PRESSURE GAUGE	MATHESON	3810-350	1/4" NPT	VG-05	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRV-01	PRESSURE REGULATOR	MATHESON	3810-350	1/4" VCR	VG-06	VACUUM GAUGE	INFICON	BPG400	CF-2.75
PRV-02	PRESSURE REGULATOR	MATHESON	3810-350	1/4" VCR	VG-07	VACUUM GAUGE	INFICON	BPG400	

MATERIAL: N/A		SHOP NOTES: - DO NOT SCALE DRAWING. - BREAK ALL SHARP EDGES.			MASSACHUSETTS INSTITUTE OF TECHNOLOGY LABORATORY FOR NUCLEAR SCIENCE BATES LINEAR ACCELERATOR CENTER	
		SURFACE FINISH: ☒ MAXIMUM ALL MACHINE SURFACES				
APPROVALS:		DATE:		DARKLIGHT EXPERIMENT PROCESS AND INSTRUMENTATION DIAGRAM		
ORIGINATOR: C. VIDAL		4/14/2016				
DRAWN BY: C. VIDAL		4/14/2016				
CHECKED BY: J. KELSEY		4/14/2016				
APPROVED BY: J. KELSEY		4/14/2016				
		UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS: DECIMALS: ANGLES: $\pm 1/32$ ± 0.005 $\pm 1^\circ$				
NEXT ASSEMBLY:		SolidWorks GENERATED DRAWING. FILE LOCATION AND NAME:		SCALE: N/A	PROJECT #:	SIZE: D DRAWING #:
						SHEET #: 2 OF 2 REV: A

TAG	DESCRIPTION	MANUFACTURER	MODEL NUMBER	SPECIFICATIONS
BAR-01,02,03,04	BARATRON GAUGE	INFICON	CDG025D	
BCG 01,02,03	BARATRON GAUGE CONT.	INFICON	VCG 503	
BV-01,02	BALL VALVE	SWAGelok	SF-63TF8	
CK-01,02	CHECK VALVE	CIRCL SEAL	249B-16PP	
FS-01,02	FLOW SWITCH	GEM SENSORS	FS-10798	
GAS INT	GAS INTERLOCK CONT.	BATES	CUSTOM	
GV-01,02-NC	SOLENOID VALVE	SWAGelok	6LV-RDVR4-CM	
MFC-01	MASS FLOW CONTROLLER	MKS INSTRUMENTS	GE50A007	
MV-01 THRU 10	MANUAL GATE VALVE	VAT	01232-KA06	
ORF-07,08	RESTRICTION ORIFICE	O'KEEFE CONTROLS	G-21-55	
PRLF-01	PRESSURE RELIEF VALVE	PFEIFFER VACUUM	120VSO40	
PRS-01 THRU 04	PRESSURE GAUGE	MATHESON	3810-350	
PRV-01,02	PRESSURE REGULATOR	MATHESON	3810-350	
PWS-01	POWER SUPPLY	ALPHA SCIENTIFIC ELECTRIC	N/A	
SOL-01	SOLENOID MAGNET	TOKIN	N/A	
TS-01 THRU 12	TEMPERATURE SWITCH	UCHIYA LTD	U12 85C	
V-01 THRU 06-NC	GATE VALVE	VAT	SERIES 108	
V-01,08, NC	GATE VALVE	VAT	SERIES 472	
VAC INT	VACUUM INTERLOCK CONT.	BATES	CUSTOM	
VAC RGH-01	ROOTS BLOWER PUMP	EDWARDS	QDP-40	
VAC RTS-01,02	ROOTS BLOWER PUMP	EDWARDS	IH1000	
VAC TP-01 THRU 06	TURBO MOLECULAR PUMP	OSAKA	TG110M1	
VG-01 THRU 11	VACUUM GAUGE	INFICON	BPG 400	
VCG 01 THRU 09	VACUUM GAUGE CONT.	INFICON	VCG 403	

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SKY® CDG025D 0.1 ... 1000 Torr / mbar

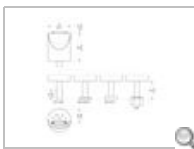
The INFICON SKY CDG025D Capacitance Diaphragm Gauge line of highly accurate temperature compensated manometers is designed for stable performance in harsh manufacturing tool environments. Advanced digital electronics improve gauge performance and offer easy handling features such as one pushbutton zero function and setpoint adjustment. The corrosion resistant ceramic sensor provides excellent zero stability with a long life expectancy of several million pressure cycles, including atmospheric bursts. A unique sensor shielding (patent pending) protects the gauge from process contamination. A robust mechanical design and digital electronics improve EMC compatibility, long term stability and temperature compensation. The CDG025D sets new standards for fast stability after power on and fast recovery from atmospheric pressure exposure.

BENEFITS

- Full scale ranges from 100 mTorr ... 1000 Torr
- Fast stability after power on
- Fast recovery from atmospheric pressure
- Corrosion resistant ceramic sensor
- Excellent long term signal stability
- Temperature compensated
- Sensor protected from contamination
- One pushbutton zero function
- Wide range power supply

TYPICAL APPLICATIONS

- Semiconductor manufacturing equipment for Etch, CVD, PVD, ALD
- Data storage and display manufacturing equipment
- Industrial vacuum equipment
- General high accuracy pressure measurement



SPECIFICATIONS

Type		1000 Torr / 1100 mbar	500 ... 10 Torr / mbar	1 Torr / mbar	0.25 Torr	0.1 Torr / mbar
Accuracy (1)	% of reading	0.2	0.2	0.2	0.25	0.5
Temperature effect						
on zero	percent FS/°C	0.005	0.005	0.015	0.02	0.02
on span	% of reading / °C	0.01	0.01	0.01	0.03	0.03

Resolution	percent FS	0.003	0.003	0.003	0.003	0.003
Pressure, max.	kPa (absolute)	400	260	260	130	130
Response time (2)	ms	30	30	30	130	130
Lowest reading	percent FS	0.01	0.01	0.01	0.01	0.01
Lowest suggested reading	percent FS	0.05	0.05	0.05	0.05	0.05
Lowest suggested control pressure	percent FS	0.5	0.5	0.5	0.5	0.5
Temperature						
Operation	°C (ambient)	+5 ... +50	+5 ... +50	+5 ... +50	+5 ... +50	+5 ... +50
Bakeout at flange (3)	°C	≤110	≤110	≤110	≤110	≤110
Storage	°C	−40 ... +65	−40 ... +65	−40 ... +65	−40 ... +65	−40 ... +65
Supply voltage	V (dc)	+14 ... +30	+14 ... +30	+14 ... +30	+14 ... +30	+14 ... +30
Power consumption	W	≤1	≤1	≤1	≤1	≤1
Output signal (analog)	V (dc)	0 ... +10	0 ... +10	0 ... +10	0 ... +10	0 ... +10
Degree of protection		IP 30	IP 30	IP 30	IP 30	IP 30
Standards						
CE conformity		EN 61000-6-2, EN 61000-6-3, EN 61010 & RoHS	EN 61000-6-2, EN 61000-6-3, EN 61010 & RoHS	EN 61000-6-2, EN 61000-6-3, EN 61010 & RoHS	EN 61000-6-2, EN 61000-6-3, EN 61010 & RoHS	EN 61000-6-2, EN 61000-6-3, EN 61010 & RoHS
ETL certification		UL 61010-1, CSA 22.2 No.61010-1	UL 61010-1, CSA 22.2 No.61010-1	UL 61010-1, CSA 22.2 No.61010-1	UL 61010-1, CSA 22.2 No.61010-1	UL 61010-1, CSA 22.2 No.61010-1
Electrical connection		D-sub, 15 pole, male	D-sub, 15 pole, male	D-sub, 15 pole, male	D-sub, 15 pole, male	D-sub, 15 pole, male
Setpoint (4)						
Number of setpoints		2 (SP1,SP2)	2 (SP1,SP2)	2 (SP1,SP2)	2 (SP1,SP2)	2 (SP1,SP2)
Relay contact	V (dc)	30	30	30	30	30
Hysteresis	percent FS	1	1	1	1	1


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VGC50x Vacuum Gauge Controller

Sustainable solution for process measurement, control and data log

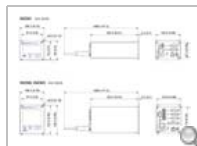
Compatible to the wide range of INFICON active gauges, the new VGC50x series of active gauge controllers are able to monitor and data log the entire pressure range from 10^{-10} to 1500 mbar (10^{-10} to 1125 Torr) and the set point status.

BENEFITS

- Simple operation with dot matrix menu guided display for parameter, sensor or general settings
- Very bright and clear Display for long distance Instrument read- out
- Bar graph display with setpoints's or pressure vs. time display
- Data log and parameter log function with USB port (rear side) and USB stick (front side)
- Ethernet interface
- Firmware upgrade available online or with USB stick
- Two free definable setpoints per channel with adjustable hysteresis
- High Resolution - 16 bit A/D converter
- Automatic identification of the INFICON active gauges
- Programmable 0 to 10 V Chart Recorder Output with logarithmic/ linear characteristics for single gauge or gauge combination (only VGC502 and VGC503)

NEWS

NEW Generation Active Gauge Controller series is ready for order now !



SPECIFICATIONS

Type		VGC501	VGC502	VGC503
Measurement channels		1	2	3
Display		LCD, LED backlight	LCD, LED backlight	LCD, LED backlight
Rate	1/s	10	10	10
Connectable gauges with display range				
CDG (A/D)	Torr	$1 \times 10^{-3} \times \text{F.S.}$... $1 \times \text{F.S.}$	$1 \times 10^{-3} \times \text{F.S.}$... $1 \times \text{F.S.}$	$1 \times 10^{-3} \times \text{F.S.}$... $1 \times \text{F.S.}$
PCG		$5 \times 10^{-4} \dots 1500$	$5 \times 10^{-4} \dots 1500$	$5 \times 10^{-4} \dots 1500$
PSG		$5 \times 10^{-4} \dots 1000$	$5 \times 10^{-4} \dots 1000$	$5 \times 10^{-4} \dots 1000$
MPG		$1 \times 10^{-9} \dots 1000$	$1 \times 10^{-9} \dots 1000$	$1 \times 10^{-9} \dots 1000$

PEG	mbar	$1 \times 10^{-9} \dots 1 \times 10^{-2}$	$1 \times 10^{-9} \dots 1 \times 10^{-2}$	$1 \times 10^{-9} \dots 1 \times 10^{-2}$
MAG	mbar	$1 \times 10^{-9} \dots 1 \times 10^{-2}$	$1 \times 10^{-9} \dots 1 \times 10^{-2}$	$1 \times 10^{-9} \dots 1 \times 10^{-2}$
BCG	mbar	$5 \times 10^{-10} \dots 1500$	$5 \times 10^{-10} \dots 1500$	$5 \times 10^{-10} \dots 1500$
BPG	mbar	$5 \times 10^{-10} \dots 1000$	$5 \times 10^{-10} \dots 1000$	$5 \times 10^{-10} \dots 1000$
HPG	mbar	$2 \times 10^{-6} \dots 1000$	$2 \times 10^{-6} \dots 1000$	$2 \times 10^{-6} \dots 1000$
Measurement unit (selectable)		mbar, Torr, Pa, hPa, Micron, V	mbar, Torr, Pa, hPa, Micron, V	mbar, Torr, Pa, hPa, Micron, V
Setpoints				
Setpoint relays		2	4	6
Channel assignment		1	1 or 2	1, 2 or 3
Adjustment range		sensor dependent	sensor dependent	sensor dependent
Hysteresis		adjustable	adjustable	adjustable
Relay contact		floating changeover contact	floating changeover contact	floating changeover contact
Contact rating	V (ac) •	30 / 1	30 / 1	30 / 1
Connector		D-sub, 15-pin, male	D-sub, 25-pin, female	D-sub, 25-pin, female
Analog output				
Range	V	0 ... 10.3, sensor analog output signal	0 ... 10.3, sensor analog output signal	0 ... 10.3, sensor analog output signal
Analog output		1	2	3
Programmable analog output		-	1	1
Connector		D-Sub, 15-pin, male	D-Sub, 9-pin, male	D-Sub, 9-pin, male
Interface (digital)				
Connector		USB slave, master and Ethernet, USB Typ A (stick), USB Type B, FCC68/RJ45	USB slave, master and Ethernet, USB Typ A (stick), USB Type B, FCC68/RJ45	USB slave, master and Ethernet, USB Typ A (stick), USB Type B, FCC68/RJ45
Power				
Supply	V (ac)	100 ... 240	100 ... 240	100 ... 240
Frequency	Hz	50 ... 60	50 ... 60	50 ... 60
Consumption	W	≤45	≤65	≤90
Operation temperature (ambiance)	°C	+5 ... +50	+5 ... +50	+5 ... +50

PART NUMBER

Type	VGC501	VGC502	VGC503
Vacuum Gauge Controller	398-481	398-482	398-483
Adapter rack mount 2HE / 3HE	398-499	–	–

ACCESSORIES

Gauges	PCG, PEG, PSG, MAG, MPG, Porter	BCG, BPG, HPG, CDG-D	CDG (unheated)
Signal read out and communication	analog only	digital RS232 / analog	analog only
Cable connectors	FCC / FCC	D-Sub ¹⁾ / D-Sub ¹⁾	FCC / D-Sub ¹⁾

Cable to VGC50x in m (ft)

3 (9.0)	398-500	398-520	398-540
5 (16.5)	398-501	398-521	398-541
10 (33.0)	398-502	398-522	398-542
15 (49.5)	398-503	398-523	398-543
20 (66.0)	398-504	398-524	398-544
30 (99.0)	398-505	398-525	398-545

Other lengths on request

¹⁾ D-Sub 15-pin**DATASHEETS**[VGC50x JA \(755 kB\)](#)[VGC50x DE \(642 kB\)](#)[VGC50x ES \(641 kB\)](#)[VGC50x EN \(640 kB\)](#)[VGC50x ZH \(748 kB\)](#)[VGC50x KO \(663 kB\)](#)**MANUALS**[Operating manual VGC50x \(6 MB\)](#)[Gebrauchsanleitung VGC50x \(5 MB\)](#)[Installation manual deutsch english \(459 kB\)](#)[EU Declaration of Conformity \(19 kB\)](#)**3D STEP FILES**[VGC501 Controller \(7 MB\)](#)[VGC502 Controller \(12 MB\)](#)[VGC503 Controller \(13 MB\)](#)**OTHER FILES**[USBUpdateTool_V1.00.exe \(1 MB\)](#)[EthernetConfigurationTool_V1.00 \(21 MB\)](#)[Firmware_VGC50x_V100 \(365 kB\)](#)[Firmware_VGC50x_V101 \(366 kB\)](#)[Firmware_VGC50x_V102 \(367 kB\)](#)



<https://www.swagelok.com/en/product/Valves/Ball>

Ball



BallValves

Our ball valves are available in a variety of standard materials and end connections. In addition, Swagelok® offers ball valves manufactured or configured to the special needs of your applications.

Ball valves:

- Can be used in a wide range of applications, from general purpose to critical-service applications
- Keep system media where it belongs, control fugitive emissions and leakage
- Are offered in high flow and quick-quarter turn manual or pneumatic actuation
- Have been engineered for repeatable, leak-tight shutoff
- Have low overall cost of ownership
- Can be manufactured or configured to a wide range of specifications

One-Piece Instrumentation BallValve (40G and 40 Series)

The 40 series one-piece instrumentation ball valve has performed reliably for nearly 40 years in multiple industries. Swagelok modified the valve construction and developed an innovative assembly process. The result is the 40G series ball valve, which features an expanded operating temperature rating, improved thermal cycling capabilities, and reduced potential for leaks.

Using a patent-pending seal design, the 40G series ball valve resists packing deformation, or “cold-flow,” for increased thermal performance and improved leak resistance.

Specifications

Working Pressure	up to 3000 psig (206 bar)
Temperature	–65 to 300° F (–53 to 148°C)
Flow Coefficient	0.05 to 12
Body Materials	Stainless steel, brass, alloy 400
Packing Materials	PTFE, modified PTFE, UHMWPE, PFA
End Connections	
Size	1/16 to 3/4 in.; 3 to 12 mm
Configurations	On-off (2-way), switching (3-way, 5-way, and 7-way), crossover (4-way and 6-way)

Three-Piece Process/Instrumentation Ball Valve (60 Series)

With a unique coned-disc, spring-loaded seat; live-loaded, two-piece chevron stem packing; and three-piece, swing-out design, 3-piece process/instrumentation 60 series ball valves are designed for reliability and low maintenance.

Specifications

Working Pressure	up to 3000 psig (206 bar)
Temperature	–65 to 850° F (–53 to 454°C)
Flow Coefficient	1.1 to 130
Body Materials	Stainless steel, carbon steel, brass, special alloys
End Connections	
Size	1/8 to 2 in.; 6 to 25 mm
Configurations	On-off (2-way), switching (3-way)

Trunnion-Style Ball Valve (83 and H83 Series)

Trunnion-style 83 and H83 series ball valves provide durable service in high- and low-pressure applications. They feature a compact, maximum-flow design, low operating torque, and wide temperature range, and can be ordered with ECE R110-type approval.

Specifications

Working Pressure	Up to 10 000 psig (689 bar)
Temperature	0 to 450°F (–17 to 232°C)
Flow Coefficient	0.75 to 1.6
Body Materials	316 stainless steel and alloy 400
Seat Materials	PCTFE, nylon, PTFE, or PEEK
End Connections	
Size	1/8 to 1/2 in.; 6 to 12 mm
Configurations	On-off (2-way), switching (3-way)

Multipurpose Ball Valve (AFS Series)

With flow coefficients up to 13.8, the multipurpose AFS 2-way ball valves meet the demands of compressed natural gas, hydrogen, and other general industrial applications where high flow and higher pressures are required. They feature low operating torque, no need for packing adjustment, compatibility with hydrogen and compressed natural gas (CNG), and ECE R110, NGV 3.1, and NGV 4.6 approval.

Specifications

Working Pressure	Up to 6000 psig (413 bar)
Temperature	−40 to 250°F (−40 to 121°C)
Flow Coefficient	4.0 to 13.8
End Connections	
Type	Swagelok tube fitting, NPT, ISO 7/1
Size	3/8 to 1 in.; 12 and 16 mm
Configuration	On-off

Multipurpose Ball Valve (SK Series)

Multipurpose SK series ball valves offer low-torque, quarter-turn operation in a compact design providing positive shutoff in applications up to 6000 psig (413 bar).

Specifications

Working Pressure	Up to 6000 psig (413 bar)
Temperature	−40 to 302°F (−40 to 150°C)
Flow Coefficient	Up to 1.4
Body Materials	316 stainless steel
Seat Materials	PEEK
End Connections	
Type	Swagelok tube fitting, NPT, ISO pipe, and male VCO®
Size	1/4 and 3/8 in.; 6 and 8 mm
Configuration	On-off

Trunnion-Style Medium-Pressure Ball Valve (IPT Series)

IPT series trunnion-style ball valves offer low-torque, quarter-turn operation in a compact design providing positive shutoff in applications up to 20 000 psig (1378 bar). These valves are available for sour gas applications with materials selected in accordance with NACE MR0175/ISO15156.

Specifications

Working Pressure	Up to 20 000 psig (1378 bar)
Temperature	0 to 250°F (−17 to 121°C)
End Connections	

Type	cone and thread, female NPT
Size	1/4 to 1 in.
Orifice Sizes	0.188 in. (4.78 mm), 0.250 in. (6.35 mm), 0.375 in. (9.52 mm)
Configuration	On-off (2-way), switch/divert (3-way)

Trunnion-Style Medium-Pressure Ball Valve (FKB Series)

Trunnion-style medium-pressure FKB series ball valves offer low-torque, quarter-turn operation in a compact design providing positive shutoff in applications up to 15 000 psig (1034 bar).

Specifications

Working Pressure	Up to 15 000 psig (1034 bar)
Temperature	0 to 250°F (–17 to 121°C)
Flow Coefficient	0.44 to 11.3
End Connections	
Size	1/4, 1/2, 3/8 in.
Configuration	On-off (2-way), switching (3-way)

Subsea Service Ball Valve (PT Series)

Subsea service ball valves are bi-directional, 2-way trunnion-style valves designed for workover applications up to 15 000 psig (1034 bar). These valves are available for sour gas applications with materials selected in accordance with NACE MR0175/ISO15156.

Specifications

Working Pressure	Up to 15 000 psig (1034 bar)
Temperature	0 to 250°F (–17 to 121°C)
End Connections	
Type	medium-pressure cone and thread (C&T), Swagelok medium-pressure tube fitting (FK), female NPT
Size	1/4 to 1 in.
Orifice Sizes	0.25 in. (6.4 mm), 0.38 in. (9.7 mm), 0.47 in. (11.9 mm)

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"Safe Product Selection: The complete catalog contents must be reviewed to ensure that the system designer and user make a safe product selection. When selecting products, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user."

Caution: Do not mix or interchange product components with those of other manufacturers."



Website

200 Series 0 to 3000 psig Check Valves

H200 Series 0 to 6000 psig Check Valves



Features & Benefits

Quick opening/positive closing

- Provides a wide range of adaptability

Large flow capacity

- The patented sealing principle effects complete leakproof closing under all pressure conditions

Zero leakage

- Compact, easy installation. Efficient inline piston reduces size and weight

Floating o-ring

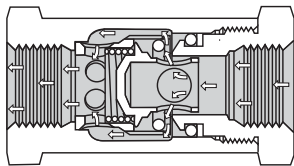
- The streamlined poppet and full ports offer minimum restriction to flow

Technical Data

Body Construction Materials	Aluminum, brass, steel, 303 or 316 stainless steel
O-ring Materials	Buna N, ethylene propylene, fluorosilicone, Kalrez®, neoprene, PTFE, and Viton®
Operating Pressure	200 Series: to 3000 psig (207 bar) H200 Series: to 6000 psig (414 bar)
Proof Pressure	1.5 times operating pressure
Rated Burst Pressure	200 Series: 2.5 : 1 H200 Series: 4 : 1
Cracking Pressure	0.1 to 25 psig (0.007 to 1.72 bar)
Temperature Range	-320° F to +550° F (-196° C to +288° C) Based on o-ring & body material, see "How to Order"
Connection Sizes	½" to 2"

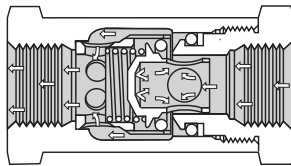
Note: Proper filtration is recommended to prevent damage to sealing surfaces.

How it Works



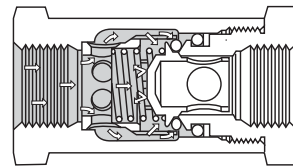
Open

Full flow passages offer minimum restriction to flow. Spring is completely removed from flow path



Closing

Floating o-ring automatically establishes line contact with conical metal surfaces of poppet and seat to cushion closing and insure perfect sealing.



Closed

O-ring only seals. Full pressure load is carried by metal-to-metal seat. Increasing pressure increases sealing efficiency; metal seat prevents any possibility of deformation or extrusion of o-ring.

check valves

Circle Seal Controls

2301 Wardlow Circle • Corona, CA 92880
Phone (951) 270-6200 • Fax (951) 270-6201
www.circlesealcontrols.com

200 Series / H200 Series

Cracking Pressure

Minimum cracking pressure available: 0.1 psig

Standard cracking pressure: see page 7

Maximum cracking pressure available: 25 psig

Note: Cracking pressure is defined at which flow is 5cc/min except for 220 Series for which flow is approximately 0.02 cfm. When ordering a cracking pressure within the standard range or below the standard range of the cracking pressure, the dash number is a "maximum". Example: 259A-4TT-.3 (cracking pressure tolerance will be +0%, -50%). When ordering a cracking pressure equal to or greater than the upper limit of the standard cracking pressure shown above, cracking pressure tolerance will be ±10%. Example: 259A-4TT-5. Cracking pressure over 8 psig should not be specified without consulting the factory. Where 200 Series valves are supplied with higher cracking pressures, a shroud ring may be used to confine the o-ring.

Note: Reseat pressure is the back pressure required to seal a check valve. It varies with different springs and seals. Reseat pressure is not specified unless called out on the sales order.

Leakage

External: Zero

Internal:

Elastomeric seals: Zero

PTFE seals: 0-50 psig = 5cc/min max.

50+ psig = 0.5cc/min max.

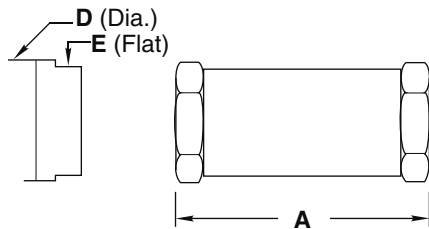
Operating Pressure: 200 Series

Aluminum (A)	Tube	3/16"-1 1/2"	0-3000 psig to 200° F
	Pipe	1/8"-1 1/2"	0-3000 psig to 200° F
Brass	Tube	3/16"-1 1/2"	0-3000 psig to 300° F
	Pipe	1/8"-1 1/2"	0-3000 psig to 300° F
	Pipe	2"	0-1500 psig to 300° F
Steel	Tube	3/16"-1 1/2"	0-3000 psig to 300° F
	Pipe	1/8"-2"	0-3000 psig to 300° F
Stainless steel	Tube	3/16"-1 1/2"	0-3000 psig to 450° F
	Pipe	1/8"-2"	0-3000 psig to 450° F

Operating Pressure: H200 Series

Aluminum (A)	Tube	3/16"-1 1/4"	0-6000 psig to 200° F
	Pipe	1/8"-1 1/2"	0-6000 psig to 200° F
Brass	Tube	3/16"-1 1/4"	0-5000 psig to 300° F
	Pipe	1/8"-1 1/2"	0-5000 psig to 300° F
Steel	Tube	3/16"-1 1/4"	0-5000 psig to 300° F
	Pipe	1/8"-2"	0-5000 psig to 300° F
Stainless steel	Tube	3/16"-2"	0-6000 psig to 450° F
	Pipe	1/8"-2"	0-6000 psig to 450° F

End Connections, Dimensions (Inches) & Weights



Optional
(Based on availability)

-RR, -BB: Female Tube

Dash No.	Tube Size	A ±0.050	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
				D	E	Alum.	All Steel
-4BB	1/4"	1.98	0.75	—	—	0.06	0.16
-5BB	3/16"	2.07*	0.81	—	—	0.08	0.22
-6BB	3/8"	2.44	0.81	—	—	0.08	0.22
-8BB	1/2"	3.06	1.00	—	—	0.13	0.37
-10BB	5/8"	3.42	1.12	—	—	0.18	0.50
-12BB	3/4"	3.83	1.50	1.75	1.50	0.34	0.88
-16BB	1"	4.37	1.75	2.00	1.75	0.52	1.50
-20BB	1 1/4"	4.99	2.00	2.25	2.00	0.68	2.18
-24BB	1 1/2"	5.75	2.75	2.75	2.25	2.05	5.95

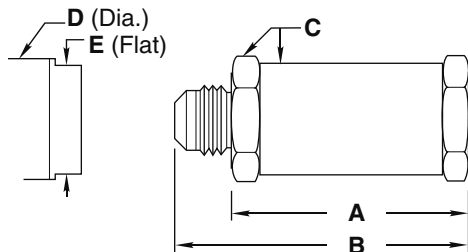
* Exception: 200T-5BB, 'A' dimension is 2.44

-BT: Female Tube to Male Tube

-TB: Male Tube to Female Tube

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-4BT	1/4"	1.53	2.08	0.75	—	—	0.06	0.15
-6BT	3/16"	1.98	2.54	0.81	—	—	0.08	0.21
-8BT	1/2"	2.37	3.03	1.00	—	—	0.12	0.34
-12BT	3/4"	3.00	3.86	1.50	1.75	1.50	0.32	0.96
-16BT	1"	3.50	4.41	1.75	2.00	1.75	0.50	1.46
-20BT	1 1/4"	3.97	4.93	2.00	2.25	2.00	0.68	1.90
-24BT	1 1/2"	4.73	5.81	2.75	2.75	2.25	1.82	5.31

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-4TB	1/4"	1.98	2.53	0.75	—	—	0.07	0.20
-5TB	3/16"	1.98	2.53	0.81	—	—	0.07	0.20
-6TB	3/8"	1.98	2.54	0.81	—	—	0.08	0.21
-8TB	1/2"	2.49	3.15	1.00	—	—	0.14	0.37
-10TB	5/8"	2.80	3.56	1.12	—	—	0.18	0.50
-12TB	3/4"	3.33	4.19	1.50	1.75	1.50	0.37	1.07
-16TB	1"	3.74	4.65	1.75	2.00	1.75	0.55	1.60
-20TB	1 1/4"	4.39	5.35	2.00	2.25	2.00	0.80	2.30
-24TB	1 1/2"	5.06	6.14	2.75	2.75	2.25	2.03	5.90

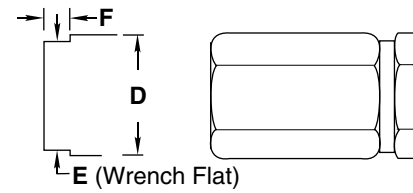


Optional
(Based on availability)

200 Series / H200 Series

H200 Series

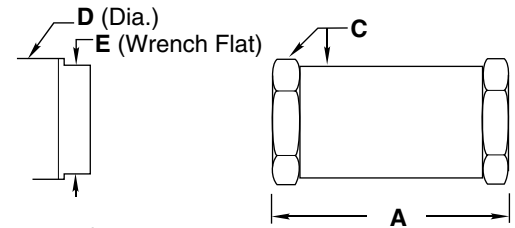
End Connection	Alum.	Brass	St. Steel	Steel		
	(Stock Size Hex)			D Dia.	E	F ± 0.015
-3T / -3C	0.625	0.625	0.625	0.650	0.560	0.220
-4T / -4B	0.875	0.875	0.812	0.875	0.750	0.280
-1P/-5T, -6T, -6B	0.937	0.937	0.875	0.960	0.813	0.280
-2P/-8T, -8B	1.125	1.250	1.125	1.250	1.000	0.300
-3P/-10T, -10B	1.375	1.375	1.250	1.375	1.125	0.350
-4P/-12T, -12B	1.750	1.875	1.750	1.875	1.625	0.450
-6P/-16T, -16B	2.000	2.250	2.000	2.125	1.875	0.500
-8P/-20T, -20B	2.250	2.500	2.250	2.50	2.125	0.620



Optional
(Based on availability)

-PP: Female Pipe

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-1PP	1/8"	1.70	0.81	—	—	0.05	0.15	0.14
-2PP	1/4"	2.25	1.00	—	—	0.12	0.36	0.34
-3PP	3/8"	2.43	1.12	—	—	0.15	0.46	0.43
-4PP	1/2"	2.93	1.50	1.50	1.25	0.32	0.98	0.92
-6PP	3/4"	3.37	1.75	1.75	1.50	0.49	1.50	1.41
-8PP	1"	3.99	2.00	2.00	1.75	0.73	2.25	2.11
-10PP	1 1/4"	4.50	2.75	2.75	2.25	1.60	5.00	4.80
-12PP	1 1/2"	5.35	2.75	2.75	2.25	1.73	5.34	4.97
-16PP	2"	6.10	—	3.50	2.75	2.60	8.00	7.50

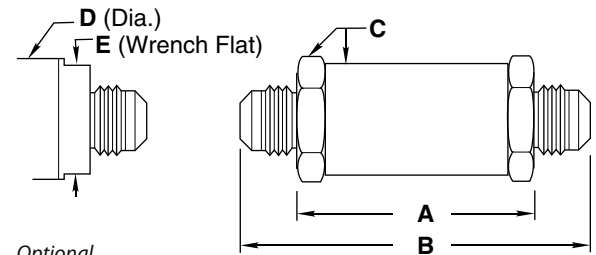


Optional
(Based on availability)

-TT: Female Tube

Dash No.	Tube Size	A ±0.050	B Ref.	C Hex & Rd.	Opt. Dimensions		Weights (Lbs)	
					D	E	Alum.	All Steel
-3TT	3/16"	0.97*	1.93*	0.56*	—	—	0.03	0.08
-4TT	1/4"	1.53	2.63	0.75	—	—	0.07	0.18
-5TT	5/16"	1.53	2.63	0.81	—	—	0.07	0.20
-6TT	3/8"	1.53	2.63	0.81	—	—	0.07	0.20
-8TT	1/2"	1.81	3.12	1.00	—	—	0.13	0.35
-10TT	5/8"	2.06	3.58	1.12	—	—	0.18	0.49
-12TT	3/4"	2.50	4.23	1.50	1.75	1.50	0.35	1.00
-16TT	1"	2.87	4.69	1.75	2.00	1.75	0.53	1.50
-20TT	1 1/4"	3.37	5.29	2.00	2.25	2.00	0.79	2.30
-24TT	1 1/2"	4.04	6.21	2.75	2.75	2.25	1.80	5.22

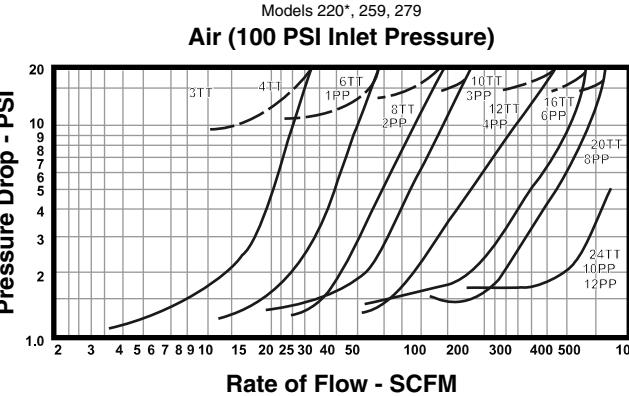
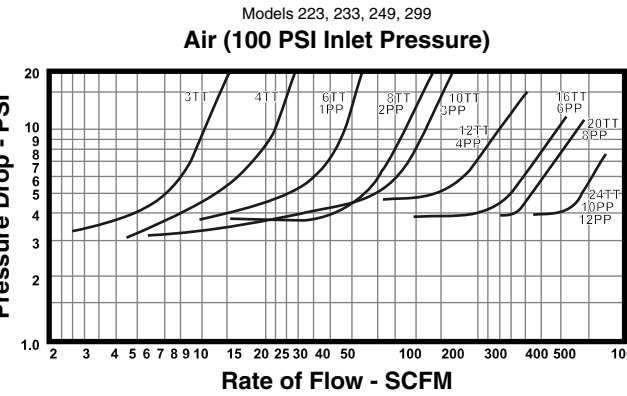
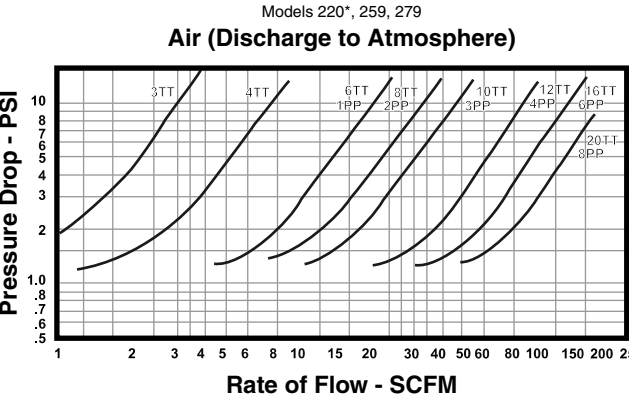
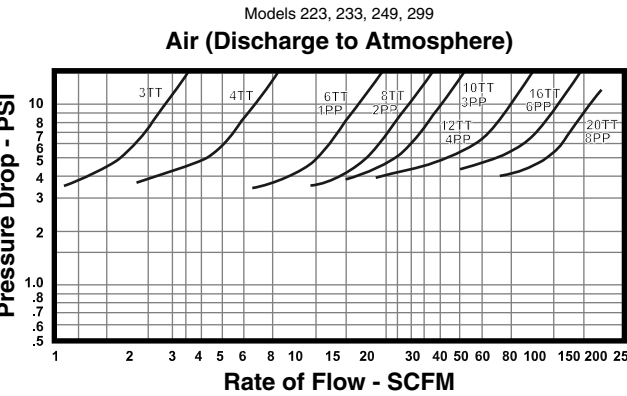
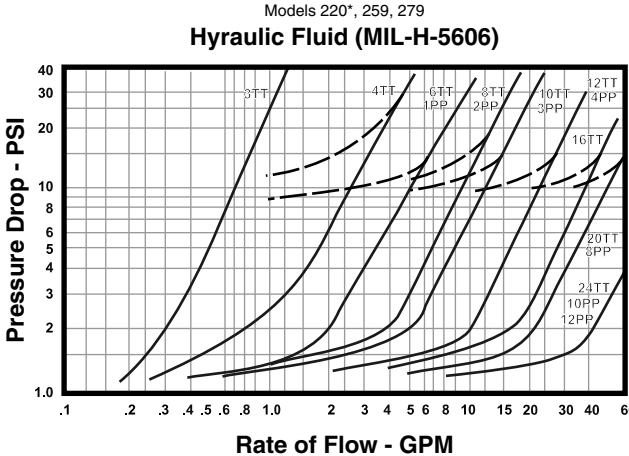
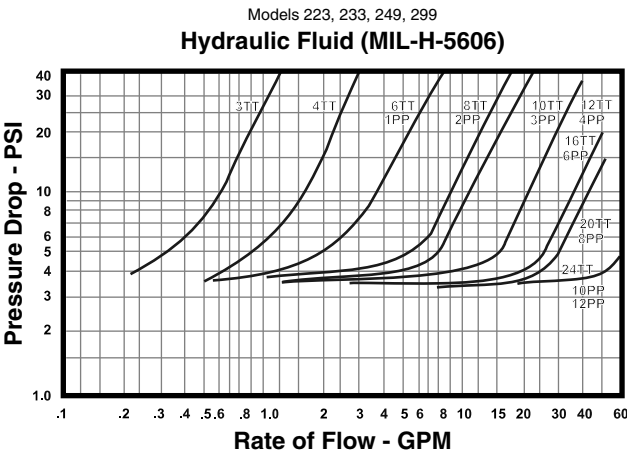
Exception: 200T-3TT: 'A' dimension is 1.00, 'B' dimension is 1.96, 'C' dimension is 0.625



Optional
(Based on availability)

200 Series / H200 Series

Flow Curves



Flow Rates

Valve size	Tube	3	4	6	8	10	12	16	20	24	32
	Pipe	—	—	1	2	3	4	6	8	10-12	16
Cv (nominal)		0.30	0.7	1.6	2.7	3.5	6.6	10.3	12.5	23.2	51

200 Series / H200 Series

How to Order

H 2 49 T1 – 4TT (L) – 1	
VARIATION	CRACKING PRESSURE
H Modified construction for 6000 psig service (¼" to 1½" tube, ⅝" to 1¼" pipe and larger)	Call out dash number if not standard 1 1 psig
K Cryogenic service, special cleaning and testing (stainless steel valves only)	SPECIAL CHARACTERISTICS
O-RING MATERIAL, TEMPERATURE & CRACKING PRESSURE RANGE	030 Hole in poppet head, thousandth of an inch
49 Buna N, –65° F to +250° F, 2–4 psig	L Lock wire
59 Buna N, –65° F to +275° F, 0.5–1 psig	SIZE & END CONNECTIONS (INLET/OUTLET)
69 Buna N (fuels), –65° F to +180° F, 0.5–1 psig	Pipe sizes in ⅝" increments
62 Ethylene propylene, –65° F to +300° F, 2–4 psig	Tube sizes in ⅝" increments
64 Fluorosilicone, –80° F to +350° F, 0.5–1 psig	P Female pipe, NPT
65 Kalrez®, –40° F to +550° F, 0.5–1 psig	T Male tube, AS4395 (MS33656)
33 Neoprene, –40° F to +300° F, 2–4 psig	B Female tube, AND10050
53 Neoprene, –40° F to +250° F, 0.5–1 psig	C Gyrolok® tube fittings
24 Silicone, –70° F to +450° F, 0.5–1 psig	D Male straight thread, AS4395 (MS33656) w/ cone point removed
32 Viton®, –20° F to +400° F, 0.5–1 psig	E Flareless male tube, MS33514 (SAE)
20* PTFE, –100° F to +400° F, 8 psig maximum	F Male tube, SAE flare 45°
20* PTFE (K220T), –320° F to +165° F, 8 psig maximum	H Hose, MS33658
80* PTFE (no cryogenic testing), –320° F to +165° F, 8 psig	J Female tube, MS33649
MATERIAL	K British parallel pipe (male)
A 2024–T4/T351 aluminum ^{††}	L British parallel pipe (female)
B Brass ^{††}	R Female tube, SAE straight thread, MS16142
A1 6061–T6/T651 aluminum ^{††}	S British taper pipe (male)
S Steel [†]	X British taper pipe (female)
T 303 stainless steel [†]	U Bulkhead tube, AS4396 (MS33657)
T1 316 stainless steel	

* For PTFE, specify stainless steel body material. The stainless steel valve design provides a PTFE static seal for use in systems with low or high temperatures or with liquids or gases which would cause excessive swell or shrinkage of elastomeric compounds.

† Not available for PED applications.

†† For PED applications, brass bodies are limited to a maximum temperature of +100° F (+38° C), aluminum bodies are limited to a maximum temperature of +200° F (+93° C)

Repair Kits

In normal service, the only part(s) which may require replacement is(are) the seal(s). A repair kit may be ordered by placing a 'K/' in front of the complete part number (i.e. K/H249T1–4TT(L)–1).

For Your Safety

It is solely the responsibility of the system designer and user to select products suitable for their specific application requirements and to ensure proper installation, operation, and maintenance of these products. Material compatibility, product ratings and application details should be considered in the selection. Improper selection or use of products described herein can cause personal injury or property damage.

Gyrolok® is a registered trademark of HOKE Incorporated.
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FS-10798 Series – Externally Adjustable for Water, Oils and Gases

Flow Rate Settings: Liquids: Infinite Adjustment between 0.5 GPM and 20.0 GPM

Air/Gases: See Gas Flow Adjustment Ranges below

Port Size: 1/2" NPT

Primary Construction Material: Brass or Stainless Steel

Setting Type: Adjustable

These externally adjustable switches are ideal for protecting machine tools from coolant flow failure, for protecting bearings from loss of lubricant or to assure proper airflow. They offer an infinite number of flow settings at pressures up to 1000 PSIG, with low pressure drop and precise repeatability.

The adjusting vane is easily field adjustable using an ordinary flat-bladed screw driver. The adjustment is set-screw-locked for tamper-free operation after field calibration.

Specifications

Wetted Materials	
Housing	Brass or 316 Stainless Steel
Piston	
In Brass Housing	Polysulfone for water; Brass for oil or air
In Stainless Steel Housing	316 Stainless Steel Only
Spring	316 Stainless Steel
O-Ring	Viton®
Other Wetted Parts	Epoxy
Pressure Rating	
Operating	1000 PSIG (69 bar)
Proof	2500 PSIG (172 bar)
Burst	5000 PSIG (345 bar)
Operating Temperature	
With Brass or S.S. Piston	-20°F to +300°F (-29°C to +148.9°C)
With Polysulfone Piston	-20°F to +225°F (-29°C to +107.2°C)
Repeatability	1% Maximum Deviation
Set Point Accuracy	±10% Maximum
Set Point Differential	15% Maximum
Switch*	SPDT, 20 VA
Inlet/Outlet Ports	1/2" NPT
Electrical Termination	No. 18 AWG, 24" L., Polymeric Lead Wires

*See "Electrical Data" on Page X-5 for more information.

Air/Gas Flow Adjustment Ranges

Water or oil flow units should not be utilized for air/gas applications. The FS-10798 Gas Flow configuration utilizes a special dash-pot piston for reliability. The flow adjustment ranges are typical for air service. For other gases, the flow range will vary with the density of the gas. Please consult factory for more information.

For 5 PSIG Line*	1 to 75 SCFM Approx.
For 100 PSIG Line	3 to 160 SCFM Approx.

* Minimum 5 PSI line pressure required.



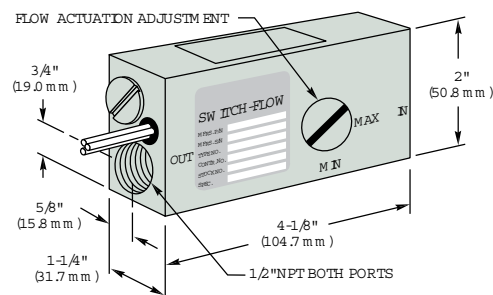
Shown with optional 1/2" conduit connector:



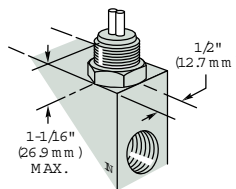
U.L. Recognized – File No. E31926
CSA Listed – File No. LR30200

Dimensions

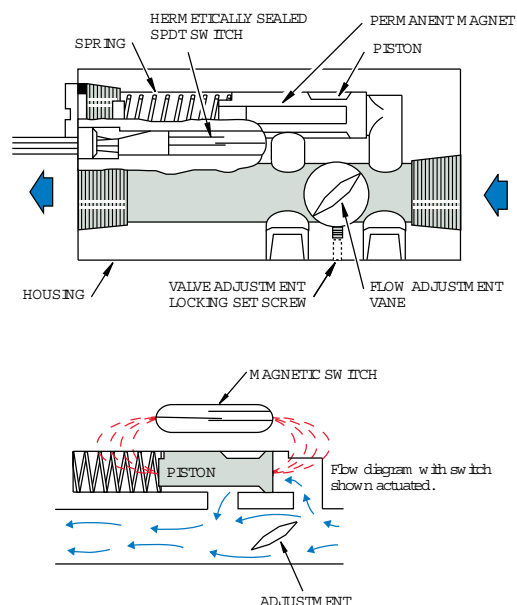
With Wire Leads and Strain Relief



With 1/2" NPT Conduit Connector



How It Works



An externally rotatable vane is positioned in the main flow path within the unit. The magnet carrier piston is located in a bypass flow chamber. Pressure differential, caused by flow around the adjusting vane, displaces the spring-biased piston which actuates a hermetically sealed SPDT reed switch within the unit.

How To Order – Standard Models

Specify Part Number based on desired media, piston material and electrical termination.

Media	Materials		Part Numbers	
	Housing	Piston	With Lead Wires	With 1/2" Conduit Connector
Liquids	Brass	Brass (for Oils)	61205	49073 ⚡
		Polysulfone (for Water)	25357 ⚡	25363 ⚡
	316 Stainless Steel		25358	25364 ⚡
Gases	Brass		25359 ⚡	25365 ⚡
	316 Stainless Steel		25360	25366

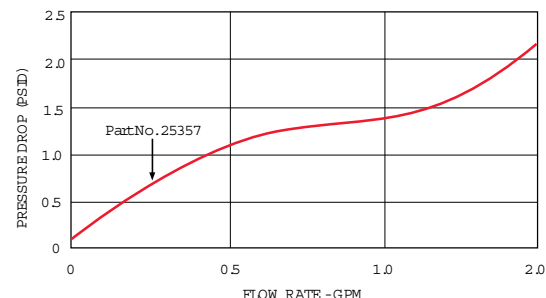
Notes:

- Temperature changes will slightly affect the standard water or gas flow settings listed. Oil flow settings will vary with temperature and viscosity.
- Use of 50 micron filtration is recommended.

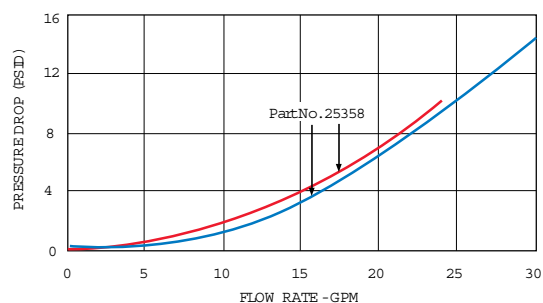
⚡ – Stock Items.

Pressure Drop -Typical

0.5 GPM



10 GPM and 20 GPM



Tests conducted with units in horizontal position with water at +70°F (21°C). Data will vary slightly for vertically mounted units.

FS-10798 switches are U.L. Approved for Class I, Division 2, Groups A, B, C, D hazardous locations. U.L. Approved – File No. E183854

Standard Wiring Color Code

Wire Color	Terminal
Orange	N.O.
Black	Common
Red	N.C.

<https://www.swagelok.com/en/product/Valves/Bellows-Sealed>

Bellows-Sealed



Bellows-Sealed Valves

- Reliable, leak-tight performance with a packless design where a seal to atmosphere is especially critical
- Welded seal which isolates system fluids to prevent leaks to atmosphere
- Multiple options for general and high-purity service

Bellows Valves (B Series)

Specifications

Working Pressure	up to 1000 psig (68.9 bar)
Temperature	–20 to 900° F (–28 to 482°C)
Flow Coefficient	0.12 to 1.2
Body Materials	Stainless steel, brass, alloy 400
Stem Tip Materials	316 stainless steel, PCTFE, cobalt-based alloy
End Connections	
Type	Swagelok® tube fittings, tube butt weld, tube socket weld, VCR® face seal fitting

Sizes	1/4 to 3/4 in.; 6 to 12 mm
Internal Volume	0.10 to 0.26 in ³ (1.6 to 4.3 cm ³)

Bellows Valves with Secondary Packing (U Series)

Specifications

Working Pressure	Up to 2500 psig (172 bar)
Temperature	-20 to 1200°F (-28 to 648°C)
Flow Coefficient	0.36 to 5.3
Body Materials	316 stainless steel
Stem Tip Materials	316 stainless steel, PCTFE, cobalt-based alloy
End Connections	
Type	Swagelok® tube fittings, female VCR face seal fitting, tube socket weld, tube butt weld
Sizes	1/4 to 3/4 in.; 6 to 12 mm
Internal Volume	0.11 to 1.46 in ³ (1.8 to 23.9 cm ³)

Bellows Valves (H and HK Series)

Specifications

Working Pressure	Up to 1000 psig (68.9 bar)
Temperature	-80 to 600°F (-62 to 315°C)
Flow Coefficient	0.11 to 0.28
Body Materials	316 stainless steel or brass
Stem Tip Materials	S17400 or PCTFE
End Connections	
Type	Swagelok® tube fittings, NPT, VCR face seal fitting, tube socket weld, tube butt weld, tube extension
Sizes	1/8 to 3/8 in.; 6 mm
Internal Volume	0.08 and 0.10 in ³ (1.3 and 1.6 cm ³)

Metering Bellows-Sealed Valves (BM Series)

Specifications

Working Pressure	Up to 700 psig (48.2 bar)
Temperature	-20 to 900°F (-28 to 482°C)
Flow Coefficient	0.019 to 0.30

Body Materials	316 stainless steel
Stem Tip Materials	Fluorocarbon FKM-bonded 316 stainless steel
End Connections	
Type	Swagelok tube fittings, integral male VCR face seal fitting, tube socket weld, tube butt weld
Sizes	1/4 and 3/8 in.; 6 mm
Internal Volume	0.07 in.3 (1.1 cm ³)—metering stem tip
	0.11 in.3 (1.6 cm ³)—regulating stem tip

Bellows-Sealed Valve for Switching Service (BY Series)

Specifications

Working Pressure	Vacuum to 150 psig (10.3 bar)
Temperature	0 to 200°F (–18 to 93°C)
Body Material	316 stainless steel
Stem Tip Material	PTFE-coated 316 stainless steel
End Connections	1/4 in. VCR face seal fitting or Swagelok tube fitting

Bellows Valves (BN Series)

Specifications

Working Pressure	Vacuum to 500 psig (34.4 bar)
Temperature	–40 to 200°F (–40 to 93°C)
Flow Coefficient	0.30 and 0.70
Body Materials	316L stainless steel
Stem Insert Materials	PCTFE
End Connections	
Type	Swagelok tube fitting, butt weld, tube weld, tube extension, VCR face seal fitting, VCO® O-ring fitting
Sizes	1/4 to 1/2 in.; 6 to 12 mm
Internal Volume	0.18 and 0.27 in.3 (2.9 and 4.4 cm ³)

Bellows Valves, High-Pressure, Pneumatically Actuated (HB Series)

Specifications

Working Pressure	Up to 3500 psig (241 bar)
------------------	---------------------------

Temperature	–40 to 400°F (–40 to 204°C)
Flow Coefficient	0.3
Body Material	316L stainless steel
Stem Tip Materials	PCTFE
End Connections	
Type	Swagelok tube fitting, VCR face seal fitting tube butt weld, tube socket weld
Sizes	1/4 to 1/2 in.; 6 mm
Internal Volume	0.27 in.3 (4.4 cm ³)

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"Safe Product Selection: The complete catalog contents must be reviewed to ensure that the system designer and user make a safe product selection. When selecting products, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange product components with those of other manufacturers."



Website

SPECIFICATIONS

FLOW MEASUREMENT, CONTROL & VERIFICATION

- Thermal & Pressure-based Mass Flow Controllers & Meters
- In Situ Flow Verifiers
- Flow Ratio Controllers
- Flow-related Products



GE50A ELASTOMER-SEALED, DIGITAL MASS FLOW CONTROLLER

[More about the GE50A here](#)

GE50A	
Full Scale Flow Ranges	5 - 50000 sccm (N ₂ equivalent) (consult factory for available flow ranges)
Maximum Inlet Pressure	150 psig (can not exceed pressure differential requirement across MFC)
Normal Operating Pressure Differential	10 to 5000 sccm; 10 to 40 psid 10000 to 20000 sccm; 15 to 40 psid 30000 to 50000 sccm; 25 to 40 psid (N ₂ Full Scale) (with atmospheric pressure at the MFC outlet)
Proof Pressure	1000 psig
Burst Pressure	1500 psig
Control Range	2% to 100% of Full Scale (range on mech.)
Typical Accuracy	±1% of setpoint for 20 to 100% Full Scale ± 0.2% of Full Scale for 2 to 20% Full Scale (with N ₂ calibration gas)
Repeatability	± 0.3% of Reading
Resolution	0.1% of Full Scale
Temperature Coefficients	
Zero	<0.05% of Full Scale/°C
Span	<0.08% of Reading/°C
Inlet Pressure Coefficient	<0.02% of Reading/psi
Typical Controller Settling Time	<750 msec, typical above 5% Full Scale (per SEMI Guideline E-17-0600)
Warm-up Time	<30 minutes (to within 0.2% of Full Scale of steady state performance)
Operating Temperature Range	10°C to 50°C (Ambient)
Storage Humidity	0 to 95% Relative Humidity, non-condensing
Storage Temperature	-20° to 80°C (-4° to 149° F)
Fittings	Compatible with: Swagelok® 4 VCR® male Swagelok® VCO® male 1/4 inch Swagelok® compression seal Swagelok® 8 VCR® male 1/8 inch Swagelok® 1/2 inch Swagelok® 6 mm Swagelok® 8 mm Swagelok®
Leak Integrity	
External	<1 x 10 ⁻⁹ (scc/sec He)
Through closed valve	Up to 10K valve <0.1% of FS at 40 psig to atmosphere 20K - 50K valve <1.0% of FS at 40 psig to atmosphere (To assure no flow-through, a separate positive shut-off valve is required.)
Wetted Materials	
Standard	316L S.S. VAR (equivalent to 316 S.S. SCQ for semiconductor quality), 316 S.S., Elgiloy®, Nickel

Seals & Valve Seat	Viton, Buna-N, Neoprene, Kalrez
Surface Finish	16 μ inch average Ra
Weight	less than 3 lbs (1.4kg)
Compliance	Compliant to EMC Directive 2004/108/EC
Electrical Analog I/O Input Power Required	+15 to +24 VDC @ (<4 watts)
Electrical Analog I/O Flow Input/Output Signal	
Voltage	(0 to 5 VDC) 15 pin Type "D" male, 9 pin Type "D" male
Current	(4 to 20 mA) 15 pin Type "D" male
Input Power Required	
DeviceNet™	+11 to +25 VDC per (<4 watts)
RS-485	+15 to +24 VDC per (<4 watts)
Profibus®	+15 to +24 VDC per (<4 watts)
EtherCAT®	+24 VDC per (<5 watts)
Connector	
DeviceNet™	5 pin micro connector (power and comm.)
RS-485	9 pin Type D male (power and comm.)
Profibus®	9 pin Type D male (power); 9 pin Type D female (comm.)
EtherCAT®	2 x RJ-45 (comm.) male; M8 male, 5 pin (power)
Data Rate Switch/Selection	
DeviceNet™	4 positions: 125, 250, 500K (Default)programmable over network
RS-485	No switch Set Data Rate via RS485
Profibus®	Set Data Rate via Profibus
EtherCAT®	No switch
Comm. Rate(s)	
DeviceNet™	125 Kbps, 250 Kbps, 500 Kbps
RS-485	9.6 Kbps, 19.2 Kbps, 38.4 Kbps
Profibus®	9.6 Kbps to 12 Mbps
EtherCAT®	100 Mbps
MAC ID Switches/Addresses	
DeviceNet™	2 switches, 10 positions; 0,0 to 6,3 ; 1 to 254
RS-485	Set address over RS485; Station Addresses 0,0 to 9,9
Profibus®	2 switches, 10 positions
EtherCAT®	3 switches, 16 positions
Network Size	
DeviceNet™	Up to 64 nodes
RS-485	Up to 32 nodes
Profibus®	Up to 99 nodes
EtherCAT®	Up to 4095 nodes
Visual Communication Indicators	
DeviceNet™	LED network status (green/red) LED module status (green/red)
RS-485	LED Comm (yellow) LED Error (red)
Profibus®	LED Comm (green/red) LED Error (green/red)
EtherCAT®	LED Power (green) LED Run (green) LED Error (red) LED /Comm (green)

Specifications are subject to change without notice.

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VAT Vakuumventile AG
CH-9469 Haag, Schweiz

Product data sheet

Mini Vakuum gate valve, Series 012, DN 40 (ID 1½")
Ordering No. 01232-KA06

Description

Flange	ISO-KF 40
Actuator	manual
Feedthrough	Shaft feed through

Technical data

Leak rate	– Valve body	$< 1 \cdot 10^{-9} \text{ mbar ls}^{-1}$
	– Valve seat	$< 1 \cdot 10^{-9} \text{ mbar ls}^{-1}$
Pressure range		$1 \cdot 10^{-7} \text{ mbar to 1 bar (abs)}$
Differential pressure on the gate		$\leq 1 \text{ bar}$
Differential pressure at opening		$\leq 30 \text{ mbar}$
Conductance (molecular flow)		140 ls^{-1}
Cycles until first service		50 000
Temperature (Maximum values: depending on operating conditions and sealing materials)	– Valve Body	$\leq 100 \text{ }^{\circ}\text{C}$
	– Actuator	$\leq 80 \text{ }^{\circ}\text{C}$
Heating and cooling rate		$30 \text{ }^{\circ}\text{C h}^{-1}$
Material	– Valve Body	EN AW-6082 (3.2315)
	– Gate	AISI 301 (1.4310)
Seal	– Bonnet	FKM (Viton®)
	– Gate	FKM (Viton®), vulcanized
Mounting position		any
Weight		0.7 kg / 1.5 lbs

Created by: SON	Release date: 2012-12-19	1 of 1
Modified by:	Release date:	271805EA

Description

R qhGslfh frqwxwlrq ri vroq p hwdor lv hp sor | hgIR ul÷ fhvdhdfxudh p dñkqng/ wkrurxjko | fdhghg/ dgg çrz wvwhg wr h{dñkqj wdgdgugv1V1}hvudqjh iurp B37% wr 1458% rul÷ fh gldp hwhu1Vshfldov1}hv fdq eh p dghwr rughu1W | shGHO lvdwz rGslfh frqwxwlrq1.

Applications

- Suhflvwrq Iarz Frqurou
- J dñvruOltxlgv
- Vshhg Frqurouµ
- F | dghv dgg D fxdwv
- D ffxudh Wlp lqj lq Sqhxp dñf ru K | gudxof F lufxlv
- Iarz Uhwulvwrq
- D ffxudh Wkurwldqj
- Vqxeehv OJ djhv dgg lqwxp hqwr
- X ovdvrlf Vrxqg Vrxufhv

Advantages

- Kljk Suhvwxh Fdsdelw
- ElgñhfwlrqdoIarz Frp sdñelw
- Hfrqrp lfdoSuhflvwrq Rul÷ fh
- Ushdñedh Rul÷ fh V1}h dgg Vkdsh
- Suhglfñedh Iarz Udñ

Flow Direction

P hwdor ul÷ fh D vvhv edhv fdq eh xvng iur çrz lq hñkhu gñhfwlrq1Wkh gdw rq sdjhv 53 dgg 54 lv irudçrz gñhfwlrq dvvkrz q lq wkh uljkwfroxp q rq wlv sdjh1

Kits

Vhh sdjhv 63064 irunlvhñhfwlrq1

J hghudoVshfl÷ fdwlrqv

Maximum Operating Pressure µ

Eudw 5333 svlj

636 VV 7333 svlj

Type DEL

Eudw 533 svlj

Flow µ Vhh çrz fkdw iur dñu rq sdjhv 53 dgg 541

Rul÷ fh Gldp hwhuµ B37% wr 1458% wdgdgug1 Frqwxowidwru| irurwkhv1}hv1

Rul÷ fh Gldp hwhu D ffxudf | µ ðB338%

Cv Range µ B3368 wr 16: Vhh sdjhv 53 dgg 541

Fluid Media µ D l1/Z dñu/J dñvdgg Oltxlgv frp sdñedh z lk p dñhldv ri frqwxwlrq1

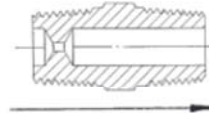
Dimensions µ Vhh gudz lqjv rq sdjh <1

NPT CONNECTIONS

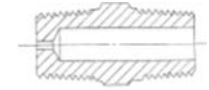
Size Number	Rul÷ fh Dia. In.	Vljh Number Range
4	.0039	
5	.0051	
6	.0059	
7	.0071	
8	.0079	
9	.0091	
10	.0102	
11	.0110	
12	.0122	
13	.0130	W shE / H ruY
14	.0142	Eudw 70458
15	.0150	303SS 4-125
16	.016	
17	.017	
18	.018	
19	.019	W shG / J / K ruYY
20	.020	Eudw 70458
21	.021	303SS 4-125
22	.022	
23	.023	
24	.024	
25	.025	W shEP ruHP
26	.026	Eudw 70458
27	.027	303SS 4-125
28	.028	
29	.029	
31	.031	W shEK ruHK
32	.032	Eudw 70458
33	.033	303SS 4-125
35	.035	
37	.037	
38	.038	
39	.039	
40	.040	W shEP P
41	.041	Eudw 70458
42	.042	303SS 4-125
43	.043	
47	.047	
52	.052	
55	.055	W shGHO
60	.060	Eudw 7096
63	.063	
67	.067	
70	.070	
73	.073	
76	.076	
79	.079	
81	.081	
86	.086	
89	.089	
94	.094	
96	.096	
100	.100	
104	.104	
109	.109	
113	.113	
120	.120	
125	.125	

Construction

W | shE / H ruY

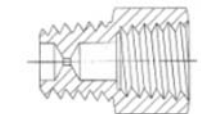


Rul÷ fh gldp hwhu B54% ruñljhu

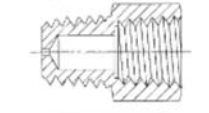


Rul÷ fh gldp hwhu B53% ruvp dñhu

W | shG / J / K ruYY

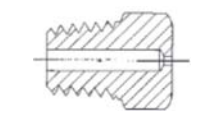


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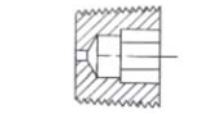


Rul÷ fh gldp hwhu B53% ruvp dñhu

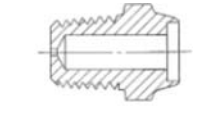
W | shEP ruHP



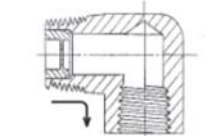
W | shEK ruHK



W | shEP P



W | shGHO



Part Numbers

Wkh frp sdñh sdwqxp ehu irudq rul÷ fh dñvhp eq lqfoxghv W | sh / V1}h Q xp ehu / Erg | P dñhldv dgg R swlrqv1

EXAMPLES

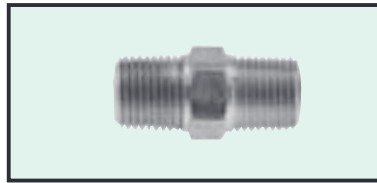
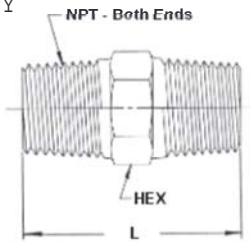
W sh	Vljh Q xp ehu	Erg P dñhldv	R swlrqv	Sdñw Q xp ehu
E	43 +B43%,	Eudw	µ	E 043OEU
J	48 +B48%,	Eudw	µ	J 048OEU
G	53 +B53%,	VV	µ	G 053OVV

Dimensions

NPT CONNECTIONS

Vshfl: fdwlrqv

W|shE/H ruY



W sh	G p 10	KH [	QSW
E	1.38"	:219%	42; %
E	1.38"	9/16"	1/4"
Y	417; %	44219%	62; %

KH [QISSOH

Erg | dgg R ul: fhµ Eudw ru636 VV

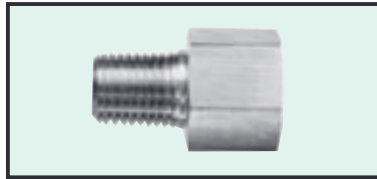
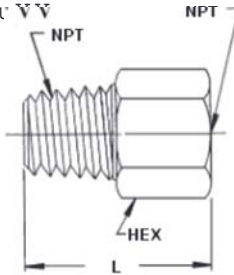
Threads µ 42; %/427% ru62; % QSW

Vwdggdug R ul: fh Vlj}hvµ

Eudw µ B37% wr 1458% G ldl

636 VV µ B37% wr 1458% G ldl

W|shG/J/K ru VV



W sh	G p 10	KH [	QSW
G	1; %	<219%	42; %
J	4158%	627%	427%
YY	4185%	:2; %	62; %
K	419< %	404219%	425%

DGDSWHU

Erg | dgg R ul: fhµ Eudw ru636 VV

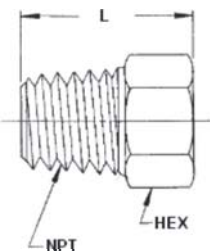
Threads µ 42; %/427%/62; % ru425% QSW

Vwdggdug R ul: fh Vlj}hvµ

Eudw µ B37% wr 1458% G ldl

636 VV µ B37% wr 1458% G ldl

W|shEP ruHP



W sh	G p 10	KH [	QSW
EP	18; 3%	:219%	42; %
EM	.800"	9/16"	1/4"

EOHHG SOXJ

Erg | dgg R ul: fhµ Eudw ru636 VV

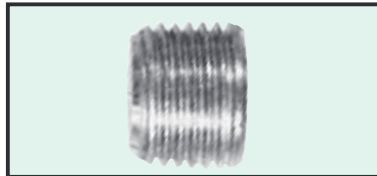
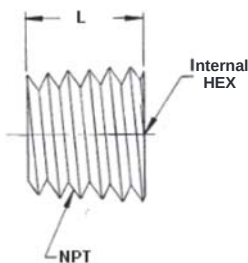
Thread µ 42; % ru427% QSW

Vwdggdug R ul: fh Vlj}hvµ

Eudw µ B37% wr 1458% G ldl

636 VV µ B37% wr 1458% G ldl

W|shEK ruHK



W sh	G p 10	KH [	QSW
EK	163%	6219%	42; %
HK	179%	427%	427%

EOHHG SOXJ

Erg | dgg R ul: fhµ Eudw ru636 VV

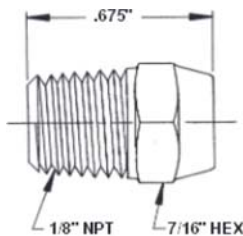
Thread µ 42; % ru427% QSW

Vwdggdug R ul: fh Vlj}hvµ

Eudw µ B37% wr 1458% G ldl

636 VV µ B37% wr 1458% G ldl

W|shEP P



EOHHG SOXJ

Erg | dgg R ul: fhµ Eudw ru636 VV

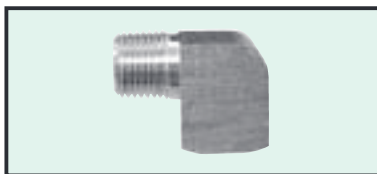
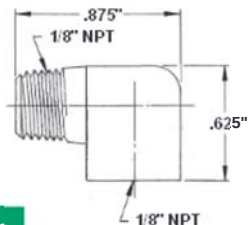
Thread µ 42; % QSW

Vwdggdug R ul: fh Vlj}hvµ

Eudw µ B37% wr 1458% G ldl

636 VV µ B37% wr 1458% G ldl

W|shGHO



HOER Z

Erg | dgg R ul: fhµ Eudw

Threads µ 42; % QSW

Vwdggdug R ul: fh Vlj}hvµ B37% wr B96% G ldl

R ul: fhµ Sthw ÷ wlvhuw

P hwdor ul÷ fh D h I α z μ V F I K

R.ũ.fh g xp hntu lq.fkhv	Size	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	33			
		0.000350.000610.000860.0012 0.0015 0.0019 0.0025 0.0028 0.0034 0.0038 0.0043 0.0050 0.0055 0.0067 0.0073 0.0080 0.0088 0.0096 0.011 0.012 0.013 0.014 0.015 0.016 0.017 0.018 0.019 0.020 0.021 0.022 0.023 0.024 0.025 0.026 0.027 0.028 0.029 0.031 0.032 0.033																															
		C _v																															
		1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	
		0.075	0.136	0.182	0.269	0.360	0.479	0.593	0.653	0.843	0.962	1.11	1.30	1.40	1.64	1.82	2.03	2.22	2.39	2.73	2.99	3.26	3.54	4.05	4.13	4.68	5.06	5.62	6.10	6.42	6.70	6.95	
		0.18	0.33	0.45	0.64	0.85	1.10	1.37	1.51	1.94	2.25	2.56	2.99	3.26	3.73	4.20	4.70	5.23	5.62	6.29	6.87	7.48	8.12	9.20	9.41	10.5	11.3	12.4	13.6	14.4	15.1	15.5	
		0.25	0.47	0.65	0.91	1.21	1.57	1.97	2.14	2.73	3.14	3.56	4.13	4.26	4.79	5.38	6.00	6.70	7.48	9.17	10.1	11.0	11.8	13.0	13.6	15.2	16.6	18.3	19.9	21.1	22.1	22.5	
		0.34	0.59	0.82	1.14	1.53	1.97	2.48	2.67	3.43	3.92	4.45	5.17	5.30	6.04	6.84	7.56	8.50	9.34	11.3	12.6	13.6	14.7	16.1	16.8	18.6	20.3	22.5	24.6	26.1	27.1	27.5	
		0.40	0.70	0.97	1.38	1.80	2.33	2.92	3.16	4.07	4.64	5.28	6.08	6.29	7.20	8.18	9.03	10.3	11.1	13.5	14.7	16.1	17.3	18.9	19.7	21.8	23.7	26.3	28.6	30.3	31.3	31.7	
		0.47	0.82	1.12	1.59	2.08	2.69	3.37	3.62	4.66	5.30	6.06	6.95	7.25	8.31	9.43	10.4	11.8	12.7	15.5	16.8	18.3	19.9	21.6	22.7	24.8	27.1	30.1	32.6	34.5	35.5	35.9	
		0.53	0.92	1.26	1.80	2.37	3.03	3.81	4.09	5.23	5.98	6.80	7.82	8.20	9.39	10.7	11.8	13.4	14.4	17.4	19.0	20.7	22.5	24.4	25.4	28.0	30.5	33.7	36.7	39.0	40.0	40.4	
		0.64	1.15	1.56	2.22	2.92	3.75	4.68	5.02	6.44	7.31	8.33	9.56	10.1	11.6	13.2	14.5	16.5	17.8	21.4	23.3	25.4	27.5	29.9	31.1	34.1	37.1	41.1	44.7	47.7	48.7	49.1	
		0.76	1.37	1.86	2.67	3.50	4.45	5.55	5.93	7.59	8.62	9.83	11.3	12.1	13.8	15.7	17.3	19.6	21.2	25.2	27.5	30.1	32.6	35.2	36.7	40.3	43.9	48.5	53.0	56.4	57.4	57.8	
		0.89	1.59	2.16	3.09	4.05	5.13	6.40	6.84	8.75	10.0	11.3	13.0	14.0	16.0	18.2	20.0	22.7	24.6	29.2	31.8	34.7	37.5	40.7	42.4	46.4	50.4	55.9	61.0	65.0	66.0	66.4	
		1.02	1.82	2.46	3.54	4.60	5.83	7.27	7.76	9.92	11.3	12.8	14.7	16.0	18.2	20.7	22.9	25.9	28.0	33.1	36.0	39.2	42.6	46.0	48.1	52.5	57.2	63.6	69.3	73.9	74.9	75.3	
1.14	2.04	2.75	3.96	5.15	6.53	8.12	8.67	11.1	12.6	14.3	16.5	17.9	20.5	23.3	25.6	29.0	31.6	37.1	40.3	43.9	47.7	51.3	53.6	58.7	64.0	71.2	77.8	82.6	83.6	84.0			
1.27	2.27	3.05	4.41	5.70	7.20	8.96	9.56	12.2	13.9	15.9	18.3	19.9	22.7	25.9	28.4	32.2	35.0	40.9	44.5	48.5	52.8	56.8	59.3	65.0	71.0	78.8	86.0	91.5	92.5	92.9			
1.40	2.48	3.35	4.83	6.25	7.88	9.81	10.5	13.4	15.3	17.4	20.0	21.8	25.0	28.4	31.1	35.2	38.1	44.7	48.7	53.2	58.1	62.3	65.3	71.4	78.0	86.7	94.5	101	101.5	101.9			
5	0.113	0.203	0.273	0.405	0.536	0.703	0.860	0.953	1.23	1.40	1.64	1.90	2.07	2.41	2.70	2.99	3.28	3.60	4.03	4.45	4.87	5.25	5.81	6.00	6.70	7.23	8.01	8.73	9.15	9.19	9.23		
10	0.145	0.263	0.356	0.521	0.687	0.892	1.10	1.20	1.55	1.77	2.06	2.37	2.62	2.99	3.35	3.79	4.15	4.62	5.17	5.68	6.12	6.63	7.29	7.59	8.48	9.11	10.1	10.9	11.5	11.5	11.5		
15	0.188	0.284	0.392	0.568	0.744	0.964	1.20	1.30	1.68	1.91	2.26	2.59	2.86	3.28	3.71	4.11	4.64	4.92	5.53	6.04	6.61	7.08	7.73	8.01	8.90	9.56	10.7	11.5	12.1	12.1	12.1		
20	0.188	0.284	0.392	0.568	0.744	0.964	1.20	1.30	1.68	1.91	2.26	2.59	2.86	3.28	3.71	4.11	4.64	4.92	5.53	6.04	6.61	7.08	7.73	8.01	8.90	9.56	10.7	11.5	12.1	12.1	12.1		
30	0.188	0.284	0.392	0.568	0.744	0.964	1.20	1.30	1.68	1.91	2.26	2.59	2.86	3.28	3.71	4.11	4.64	4.92	5.53	6.04	6.61	7.08	7.73	8.01	8.90	9.56	10.7	11.5	12.1	12.1	12.1		

R.uh-fh G l p hntu lq fkhv	0.035	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.047	0.052	0.055	0.060	0.063	0.067	0.070	0.073	0.076	0.079	0.081	0.086	0.089	0.094	0.096	0.100	0.104	0.109	0.113	0.120	0.125		
In. Hg.	Size	68	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61		
	Q xp ehv	0.028	0.031	0.032	0.033	0.036	0.038	0.039	0.041	0.048	0.059	0.068	0.081	0.088	0.10	0.11	0.12	0.13	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.25	0.27	0.31	0.34	0.37	
	Cv	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145
	1	7.37	8.12	8.75	9.45	9.75	10.6	11.4	13.6	17.0	19.9	23.7	25.9	30.1	33.6	35.9	39.3	43.0	46.0	49.7	53.7	60.2	63.7	69.8	75.2	83.9	91.4	101	106	106	
	5	16.3	18.0	19.3	20.6	21.6	22.5	23.9	25.6	30.1	37.3	43.0	50.6	55.3	64.2	71.6	76.5	83.5	91.3	97.5	108	116	131	138	150	162	180	195	216	229	
	10	22.5	25.0	26.5	28.8	30.5	31.4	33.1	35.6	41.0	51.9	57.4	68.2	74.6	86.2	96.6	103	112	121	131	144	153	172	181	196	216	237	250	286	314	
	15	27.8	30.7	32.6	35.4	37.5	38.6	40.5	43.2	50.0	62.9	69.7	82.6	90.3	104	117	125	136	147	158	174	185	207	218	235	261	286	303	345	377	
	20	32.4	36.0	38.4	41.5	44.3	45.3	47.7	50.9	58.7	74.2	82.0	97.3	106	123	138	146	160	172	185	203	216	242	256	275	305	335	354	403	445	
	25	37.5	41.5	44.1	47.9	50.9	52.3	54.9	58.5	67.6	85.4	94.5	112	122	141	158	168	183	198	212	233	248	278	292	316	347	381	405	464	511	
	30	42.4	47.0	50.0	54.2	57.6	59.3	62.3	66.3	76.3	96.6	107	126	138	160	179	190	206	222	239	265	280	314	331	356	382	432	458	525	578	
50	62.5	69.1	73.7	79.7	85.0	87.5	91.7	97.5	112	142	157	185	202	233	261	278	301	324	347	384	407	456	481	523	576	634	672	771	850		
60	72.7	80.5	86.0	92.8	99	102	107	113	130	165	182	214	233	269	301	320	347	375	400	445	473	530	559	606	667	735	780	884	985		
70	83.1	91.7	98.1	106	113	117	122	129	148	187	207	244	267	307	343	362	394	428	458	509	538	604	638	693	763	839	892	1021	1125		
80	93	103	110	119	127	131	137	145	167	210	231	273	298	343	384	405	443	481	513	570	604	678	716	778	856	943	1000	1146	1263		
90	106	115	122	132	141	146	151	161	185	231	256	303	331	379	424	447	489	532	568	631	670	750	792	860	947	1042	1106	1267	1398		
100	114	126	135	146	156	164	167	177	203	254	282	331	362	415	468	496	540	587	627	697	739	831	875	951	1047	1153	1225	1403	1545		
5	10.4	11.4	12.3	13.3	14.3	14.5	15.4	16.3	19.2	23.9	26.4	31.4	36.2	42.4	47.7	50.6	55.1	60.0	64.0	70.3	76.1	84.9	88.6	96.1	104	114	123	138	150	157	
10	13.1	14.4	15.4	16.6	17.6	18.0	19.2	20.3	23.6	29.4	32.7	38.6	44.9	51.7	57.6	63.4	68.9	74.8	79.9	87.9	94.9	106	110	120	130	142	153	173	187		
15	13.8	15.2	16.2	17.4	18.3	18.8	20.0	21.1	24.5	30.5	33.7	39.4	46.8	54.0	60.2	66.1	71.8	76.0	83.5	91.7	99.0	110	115	125	135	148	160	180	195		
20	13.8	15.2	16.2	17.4	18.3	18.8	20.0	21.1	24.5	30.5	33.7	39.4	46.8	54.0	60.2	66.1	71.8	76.0	83.5	91.7	99.0	110	115	125	135	148	160	180	195		
30	13.8	15.2	16.2	17.4	18.3	18.8	20.0	21.1	24.5	30.5	33.7	39.4	46.8	54.0	60.2	66.1	71.8	76.0	83.5	91.7	99.0	110	115	125	135	148	160	180	195		
Fitting Index																															

P h w d o R u l ÷ f h D l u I a z μ V O S P

□	OnI2ae Diameter Inches	0.004 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012 0.013 0.014 0.015 0.016 0.017 0.018 0.019 0.020 0.021 0.022 0.023 0.024 0.025 0.026 0.027 0.028 0.029 0.031 0.032 0.033																																
		0.004 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012 0.013 0.014 0.015 0.016 0.017 0.018 0.019 0.020 0.021 0.022 0.023 0.024 0.025 0.026 0.027 0.028 0.029 0.031 0.032 0.033																																
	Size																																	
	Qxp ehv																																	
Vssed StIvwxh 11 svIj	C _v	0.000350.000610.000860.00120.000150.000250.000280.000340.000380.000430.000500.000550.000670.000730.000800.000880.000960.00110.00120.00130.00140.00160.00170.00180.00190.00220.00240.00250.00260.00270.00280.00290.00310.00320.0033																																
	1	0.0035	0.0064	0.0086	0.0127	0.0170	0.0226	0.0280	0.0308	0.0398	0.45	0.52	0.61	0.66	0.77	0.86	0.96	1.05	1.13	1.29	1.41	1.54	1.67	1.91	1.95	2.21	2.39	2.56	2.88	3.03	0.025			
	5	0.09	0.16	0.21	0.30	0.40	0.52	0.65	0.71	0.92	1.06	1.21	1.41	1.54	1.76	1.98	2.22	2.47	2.65	2.97	3.24	3.53	3.83	4.34	4.44	4.94	5.31	5.86	6.42	6.80	0.030			
	10	0.12	0.22	0.31	0.43	0.57	0.74	0.93	1.01	1.29	1.48	1.68	1.95	2.01	2.26	2.54	2.83	3.16	3.53	4.33	4.75	5.18	5.55	6.15	6.43	7.18	7.83	8.63	9.40	9.98	0.035			
	15	0.16	0.28	0.39	0.54	0.72	0.93	1.17	1.26	1.62	1.85	2.10	2.44	2.50	2.85	3.23	3.57	4.01	4.41	5.35	5.93	6.43	6.95	7.58	7.95	8.78	9.58	10.6	11.6	12.3	0.040			
	20	0.19	0.33	0.46	0.65	0.85	1.10	1.38	1.49	1.92	2.19	2.49	2.87	2.97	3.40	3.86	4.26	4.84	5.22	6.35	6.95	7.58	8.15	8.90	9.28	10.3	11.2	12.4	13.5	14.3	0.045			
	25	0.22	0.39	0.53	0.75	0.98	1.27	1.59	1.71	2.20	2.50	2.86	3.28	3.42	3.92	4.45	4.91	5.59	6.01	7.30	7.95	8.65	9.38	10.2	10.7	11.7	12.8	14.2	15.4	16.3	0.050			
	30	0.25	0.44	0.60	0.85	1.12	1.43	1.80	1.93	2.47	2.82	3.21	3.69	3.87	4.43	5.03	5.56	6.33	6.81	8.23	8.98	9.75	10.6	11.5	12.0	13.2	14.4	15.9	17.3	18.4	0.055			
	40	0.30	0.54	0.74	1.05	1.38	1.77	2.21	2.37	3.04	3.45	3.93	4.51	4.78	5.47	6.21	6.85	7.81	8.42	10.1	11.0	12.0	13.0	14.1	14.7	16.1	17.5	19.4	21.1	22.5	0.060			
	50	0.36	0.65	0.88	1.26	1.65	2.10	2.62	2.80	3.58	4.07	4.64	5.31	5.70	6.51	7.46	8.15	9.26	10.0	11.9	13.0	14.2	15.4	16.6	17.3	19.0	20.7	22.9	25.0	26.6	0.065			
	60	0.42	0.75	1.02	1.46	1.91	2.42	3.02	3.23	4.13	4.70	5.34	6.13	6.61	7.56	8.58	9.46	10.7	11.6	13.8	15.0	16.4	17.7	19.2	20.0	21.9	23.8	26.4	28.8	30.7	0.070			
	70	0.48	0.86	1.16	1.67	2.17	2.75	3.43	3.66	4.68	5.32	6.05	6.96	7.53	8.61	9.77	10.8	12.2	13.2	15.6	17.0	18.5	20.1	21.7	22.7	24.8	27.0	30.0	32.7	34.9	0.075			
	80	0.54	0.96	1.30	1.87	2.43	3.08	3.83	4.09	5.23	5.95	6.77	7.79	8.46	9.67	11.0	12.1	13.7	14.9	17.5	19.0	20.7	22.5	24.2	25.3	27.7	30.2	33.6	36.7	39.0	0.080			
	90	0.60	1.07	1.44	2.08	2.69	3.40	4.23	4.51	5.78	6.58	7.49	8.62	9.38	10.7	12.2	13.4	15.2	16.5	19.3	21.0	22.9	24.9	26.8	28.0	30.7	33.5	37.2	40.6	43.2	0.085			
	100	0.66	1.17	1.58	2.28	2.95	3.72	4.63	4.94	6.32	7.22	8.21	9.46	10.3	11.8	13.3	14.7	16.6	18.0	21.1	23.0	25.1	27.4	29.4	30.8	33.7	36.8	40.9	44.6	47.5	0.090			
	In. Hg. Váxxxp Ohyno	5	0.053	0.096	0.129	0.191	0.253	0.332	0.406	0.450	0.582	0.661	0.773	0.899	0.977	1.14	1.28	1.41	1.55	1.70	1.90	2.10	2.30	2.48	2.74	2.83	3.16	3.41	3.78	4.12	4.32	0.095		
		10	0.069	0.124	0.168	0.246	0.324	0.421	0.519	0.564	0.730	0.834	0.972	1.12	1.24	1.41	1.58	1.79	1.96	2.18	2.44	2.68	2.89	3.13	3.44	3.58	4.00	4.30	4.77	5.16	5.43	0.100		
		15	0.075	0.134	0.185	0.268	0.351	0.455	0.566	0.614	0.792	0.902	1.07	1.22	1.35	1.55	1.75	1.94	2.19	2.32	2.61	2.85	3.12	3.34	3.65	3.78	4.20	4.51	5.05	5.45	5.72	0.105		
		20	0.075	0.134	0.185	0.268	0.351	0.455	0.566	0.614	0.792	0.902	1.07	1.22	1.35	1.55	1.75	1.94	2.19	2.32	2.61	2.85	3.12	3.34	3.65	3.78	4.20	4.51	5.05	5.45	5.72	0.110		
30		0.075	0.134	0.185	0.268	0.351	0.455	0.566	0.614	0.792	0.902	1.07	1.22	1.35	1.55	1.75	1.94	2.19	2.32	2.61	2.85	3.12	3.34	3.65	3.78	4.20	4.51	5.05	5.45	5.72	0.115			

On/Size Diameter Inches	Size																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	68	6:	6:	6:	6<	73	74	75	76	7:	85	88	93	96	9:	3:	6	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
Qxp eh	0.028	0.031	0.032	0.033	0.036	0.038	0.039	0.041	0.048	0.059	0.068	0.081	0.088	0.1	0.11	0.12	0.13	0.14	0.15	0.17	0.18	0.2	0.21	0.23	0.25	0.27	0.31	0.34	0.37	0.4	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.7	0.73	0.76	0.79	0.81	0.86	0.89	0.94	0.96	1	1.04	1.09	1.13	1.18	1.22	1.27	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.76	1.81	1.86	1.91	1.96	2	2.04	2.09	2.14	2.19	2.24	2.29	2.34	2.39	2.44	2.49	2.54	2.59	2.64	2.69	2.74	2.79	2.84	2.89	2.94	2.99	3	3.04	3.09	3.14	3.19	3.24	3.29	3.34	3.39	3.44	3.49	3.54	3.59	3.64	3.69	3.74	3.79	3.84	3.89	3.94	3.99	4	4.04	4.09	4.14	4.19	4.24	4.29	4.34	4.39	4.44	4.49	4.54	4.59	4.64	4.69	4.74	4.79	4.84	4.89	4.94	4.99	5	5.04	5.09	5.14	5.19	5.24	5.29	5.34	5.39	5.44	5.49	5.54	5.59	5.64	5.69	5.74	5.79	5.84	5.89	5.94	5.99	6	6.04	6.09	6.14	6.19	6.24	6.29	6.34	6.39	6.44	6.49	6.54	6.59	6.64	6.69	6.74	6.79	6.84	6.89	6.94	6.99	7	7.04	7.09	7.14	7.19	7.24	7.29	7.34	7.39	7.44	7.49	7.54	7.59	7.64	7.69	7.74	7.79	7.84	7.89	7.94	7.99	8	8.04	8.09	8.14	8.19	8.24	8.29	8.34	8.39	8.44	8.49	8.54	8.59	8.64	8.69	8.74	8.79	8.84	8.89	8.94	8.99	9	9.04	9.09	9.14	9.19	9.24	9.29	9.34	9.39	9.44	9.49	9.54	9.59	9.64	9.69	9.74	9.79	9.84	9.89	9.94	10	10.04	10.09	10.14	10.19	10.24	10.29	10.34	10.39	10.44	10.49	10.54	10.59	10.64	10.69	10.74	10.79	10.84	10.89	10.94	10.99	11	11.04	11.09	11.14	11.19	11.24	11.29	11.34	11.39	11.44	11.49	11.54	11.59	11.64	11.69	11.74	11.79	11.84	11.89	11.94	11.99	12	12.04	12.09	12.14	12.19	12.24	12.29	12.34	12.39	12.44	12.49	12.54	12.59	12.64	12.69	12.74	12.79	12.84	12.89	12.94	12.99	13	13.04	13.09	13.14	13.19	13.24	13.29	13.34	13.39	13.44	13.49	13.54	13.59	13.64	13.69	13.74	13.79	13.84	13.89	13.94	13.99	14	14.04	14.09	14.14	14.19	14.24	14.29	14.34	14.39	14.44	14.49	14.54	14.59	14.64	14.69	14.74	14.79	14.84	14.89	14.94	14.99	15	15.04	15.09	15.14	15.19	15.24	15.29	15.34	15.39	15.44	15.49	15.54	15.59	15.64	15.69	15.74	15.79	15.84	15.89	15.94	15.99	16	16.04	16.09	16.14	16.19	16.24	16.29	16.34	16.39	16.44	16.49	16.54	16.59	16.64	16.69	16.74	16.79	16.84	16.89	16.94	16.99	17	17.04	17.09	17.14	17.19	17.24	17.29	17.34	17.39	17.44	17.49	17.54	17.59	17.64	17.69	17.74	17.79	17.84	17.89	17.94	17.99	18	18.04	18.09	18.14	18.19	18.24	18.29	18.34	18.39	18.44	18.49	18.54	18.59	18.64	18.69	18.74	18.79	18.84	18.89	18.94	18.99	19	19.04	19.09	19.14	19.19	19.24	19.29	19.34	19.39	19.44	19.49	19.54	19.59	19.64	19.69	19.74	19.79	19.84	19.89	19.94	20	20.04	20.09	20.14	20.19	20.24	20.29	20.34	20.39	20.44	20.49	20.54	20.59	20.64	20.69	20.74	20.79	20.84	20.89	20.94	20.99	21	21.04	21.09	21.14	21.19	21.24	21.29	21.34	21.39	21.44	21.49	21.54	21.59	21.64	21.69	21.74	21.79	21.84	21.89	21.94	21.99	22	22.04	22.09	22.14	22.19	22.24	22.29	22.34	22.39	22.44	22.49	22.54	22.59	22.64	22.69	22.74	22.79	22.84	22.89	22.94	22.99	23	23.04	23.09	23.14	23.19	23.24	23.29	23.34	23.39	23.44	23.49	23.54	23.59	23.64	23.69	23.74	23.79	23.84	23.89	23.94	23.99	24	24.04	24.09	24.14	24.19	24.24	24.29	24.34	24.39	24.44	24.49	24.54	24.59	24.64	24.69	24.74	24.79	24.84	24.89	24.94	24.99	25	25.04	25.09	25.14	25.19	25.24	25.29	25.34	25.39	25.44	25.49	25.54	25.59	25.64	25.69	25.74	25.79	25.84	25.89	25.94	25.99	26	26.04	26.09	26.14	26.19	26.24	26.29	26.34	26.39	26.44	26.49	26.54	26.59	26.64	26.69	26.74	26.79	26.84	26.89	26.94	26.99	27	27.04	27.09	27.14	27.19	27.24	27.29	27.34	27.39	27.44	27.49	27.54	27.59	27.64	27.69	27.74	27.79	27.84	27.89	27.94	27.99	28	28.04	28.09	28.14	28.19	28.24	28.29	28.34	28.39	28.44	28.49	28.54	28.59	28.64	28.69	28.74	28.79	28.84	28.89	28.94	28.99	29	29.04	29.09	29.14	29.19	29.24	29.29	29.34	29.39	29.44	29.49	29.54	29.59	29.64	29.69	29.74	29.79	29.84	29.89	29.94	30	30.04	30.09	30.14	30.19	30.24	30.29	30.34	30.39	30.44	30.49	30.54	30.59	30.64	30.69	30.74	30.79	30.84	30.89	30.94	30.99	31	31.04	31.09	31.14	31.19	31.24	31.29	31.34	31.39	31.44	31.49	31.54	31.59	31.64	31.69	31.74	31.79	31.84	31.89	31.94	31.99	32	32.04	32.09	32.14	32.19	32.24	32.29	32.34	32.39	32.44	32.49	32.54	32.59	32.64	32.69	32.74	32.79	32.84	32.89	32.94	32.99	33	33.04	33.09	33.14	33.19	33.24	33.29	33.34	33.39	33.44	33.49	33.54	33.59	33.64	33.69	33.74	33.79	33.84	33.89	33.94	33.99	34	34.04	34.09	34.14	34.19	34.24	34.29	34.34	34.39	34.44	34.49	34.54	34.59	34.64	34.69	34.74	34.79	34.84	34.89	34.94	34.99	35	35.04	35.09	35.14	35.19	35.24	35.29	35.34	35.39	35.44	35.49	35.54	35.59	35.64	35.69	35.74	35.79	35.84	35.89	35.94	35.99	36	36.04	36.09	36.14	36.19	36.24	36.29	36.34	36.39	36.44	36.49	36.54	36.59	36.64	36.69	36.74	36.79	36.84	36.89	36.94	36.99	37	37.04	37.09	37.14	37.19	37.24	37.29	37.34	37.39	37.44	37.49	37.54	37.59	37.64	37.69	37.74	37.79	37.84	37.89	37.94	37.99	38	38.04	38.09	38.14	38.19	38.24	38.29	38.34	38.39	38.44	38.49	38.54	38.59	38.64	38.69	38.74	38.79	38.84	38.89	38.94	38.99	39	39.04	39.09	39.14	39.19	39.24	39.29	39.34	39.39	39.44	39.49	39.54	39.59	39.64	39.69	39.74	39.79	39.84	39.89	39.94	40	40.04	40.09	40.14	40.19	40.24	40.29	40.34	40.39	40.44	40.49	40.54	40.59	40.64	40.69	40.74	40.79	40.84	40.89	40.94	40.99	41	41.04	41.09	41.14	41.19	41.24	41.29	41.34	41.39	41.44	41.49	41.54	41.59	41.64	41.69	41.74	41.79	41.84	41.89	41.94	41.99	42	42.04	42.09	42.14	42.19	42.24	42.29	42.34	42.39	42.44	42.49	42.54	42.59	42.64	42.69	42.74	42.79	42.84	42.89	42.94	42.99	43	43.04	43.09	43.14	43.19	43.24	43.29	43.34	43.39	43.44	43.49	43.54	43.59	43.64	43.69	43.74	43.79	43.84	43.89	43.94	43.99	44	44.04	44.09	44.14	44.19	44.24	44.29	44.34	44.39	44.44	44.49	44.54	44.59	44.64	44.69	44.74	44.79	44.84	44.89	44.94	44.99	45	45.04	45.09	45.14	45.19	45.24	45.29	45.34	45.39	45.44	45.49	45.54	45.59	45.64	45.69	45.74	45.79	45.84	45.89	45.94	45.99	46	46.04	46.09	46.14	46.19	46.24	46.29	46.34	46.39	46.44	46.49	46.54	46.59	46.64	46.69	46.74	46.79	46.84	46.89	46.94	46.99	47	47.04	47.09	47.14	47.19	47.24	47.29	47.34	47.39	47.44	47.49	47.54	47.59	47.64	47.69	47.74	47.79	47.84	47.89	47.94	47.99	48	48.04	48.09	48.14	48.19	48.24	48.29	48.34	48.39	48.44	48.49	48.54	48.59	48.64	48.69	48.74	48.79	48.84	48.89	48.94	48.99	49	49.04	49.09	49.14	49.19	49.24	49.29	49.34	49.39	49.44	49.49	49.54	49.59	49.64	49.69	49.74	49.79	49.84	49.89	49.94	50	50.04	50.09	50.14	50.19	50.24	50.29	50.34	50.39	50.44	50.49	50.54	50.59	50.64	50.69	50.74	50.79	50.84	50.89	50.94	50.99	51	51.04	51.09	51.14	51.19	51.24	51.29	51.34	51.39	51.44	51.49	51.54	51.59	51.64	51.69	51.74	51.79	51.84	51.89	51.94	51.99	52	52.04	52.09	52.14	52.19	52.24	52.29	52.34	52.39	52.44	52.49	52.54	52.59	52.64	52.69	52.74	52.79	52.84	52.89	52.94	52.99	53	53.04	53.09	53.14	53.19	53.24	53.29	53.34	53.39	53.44	53.49	53.54	53.59	53.64	53.69	53.74	53.79	53.84	53.89	53.94	53.99	54	54.04	54.09	54.14	54.19	54.24	54.29	54.34	54.39	54.44	54.49	54.54	54.59	54.64	54.69	54.74	54.79	54.84	54.89	54.94	54.99	55	55.04	55.09	55.14	55.19	55.24	55.29	55.34	55.39	55.44	55.49	55.54	55.59	55.64	55.69	55.74	55.79	55.84	55.89	55.94

Standard Conditions 70°F, 14.7 psia

SCFH – Standard Cu. Ft. Per Hour
SLPM – Standard Liters Per Minute

Above data obtained with Type B restrictor. Flow rates for other metal restrictors are essentially the same as for Type B. Above data supercedes previous publications.

P hwdor ul÷ fh Z dwhu Iαz μ J dæqvðp lq xwh

R ù÷ fh G ðp hwhu lq fkhv	Size Q xp ehv	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	33
	C _v	0.00035	0.0006	0.0009	0.0012	0.0015	0.0019	0.0025	0.0028	0.0034	0.0038	0.0043	0.0050	0.0055	0.0067	0.0073	0.0080	0.009	0.010	0.011	0.012	0.013	0.014	0.016	0.017	0.018	0.019	0.022	0.024	0.025
1		0.00035	0.0006	0.0009	0.0012	0.0015	0.0019	0.0025	0.0028	0.0034	0.0038	0.0043	0.0050	0.0055	0.0067	0.0073	0.0080	0.009	0.010	0.011	0.012	0.013	0.014	0.016	0.017	0.018	0.019	0.022	0.024	0.025
2		0.00049	0.0009	0.0012	0.0017	0.0021	0.0027	0.0035	0.0040	0.0048	0.0054	0.0061	0.0071	0.0078	0.0095	0.0103	0.0113	0.012	0.014	0.016	0.017	0.018	0.020	0.023	0.024	0.025	0.027	0.031	0.034	0.035
3		0.00061	0.0011	0.0015	0.0021	0.0026	0.0033	0.0043	0.0048	0.0059	0.0066	0.0074	0.0087	0.0095	0.0116	0.0126	0.0139	0.015	0.017	0.019	0.021	0.023	0.024	0.028	0.029	0.031	0.033	0.038	0.042	0.043
4		0.00070	0.0012	0.0017	0.0024	0.0030	0.0038	0.0050	0.0056	0.0068	0.0076	0.0086	0.0100	0.0110	0.0134	0.0146	0.0160	0.018	0.019	0.022	0.024	0.026	0.028	0.032	0.034	0.036	0.038	0.044	0.048	0.050
5		0.00078	0.0014	0.0019	0.0027	0.0034	0.0042	0.0056	0.0063	0.0076	0.0085	0.0096	0.0112	0.0123	0.0150	0.0163	0.0179	0.020	0.021	0.025	0.027	0.029	0.031	0.036	0.038	0.040	0.042	0.049	0.054	0.056
6		0.00086	0.0015	0.0021	0.0029	0.0037	0.0047	0.0061	0.0069	0.0083	0.0093	0.0105	0.0122	0.0135	0.0164	0.0179	0.0196	0.022	0.024	0.027	0.029	0.032	0.034	0.039	0.042	0.044	0.047	0.054	0.059	0.061
7		0.00093	0.0016	0.0023	0.0032	0.0040	0.0050	0.0066	0.0074	0.0090	0.0101	0.0114	0.0132	0.0146	0.0177	0.0193	0.0212	0.023	0.025	0.029	0.032	0.034	0.037	0.042	0.045	0.048	0.050	0.058	0.063	0.066
8		0.00099	0.0017	0.0024	0.0034	0.0042	0.0054	0.0071	0.0079	0.0096	0.0107	0.0122	0.0141	0.0156	0.0190	0.0206	0.0226	0.025	0.027	0.031	0.034	0.037	0.040	0.045	0.048	0.051	0.054	0.062	0.068	0.071
9		0.0105	0.0018	0.0026	0.0036	0.0045	0.0057	0.0075	0.0084	0.0102	0.0114	0.0129	0.0150	0.0165	0.0201	0.0219	0.0240	0.026	0.029	0.033	0.036	0.039	0.042	0.048	0.051	0.054	0.057	0.066	0.072	0.075
10		0.00111	0.0019	0.0027	0.0038	0.0047	0.0060	0.0079	0.0089	0.0108	0.0120	0.0136	0.0158	0.0174	0.0212	0.0231	0.0253	0.028	0.030	0.035	0.038	0.041	0.044	0.051	0.054	0.057	0.060	0.070	0.076	0.079
15		0.00136	0.0024	0.0033	0.0046	0.0058	0.0074	0.0097	0.0108	0.0132	0.0147	0.0167	0.0194	0.0213	0.0259	0.0283	0.0310	0.034	0.037	0.043	0.046	0.050	0.054	0.062	0.066	0.070	0.074	0.085	0.093	0.097
20		0.00157	0.0027	0.0038	0.0054	0.0067	0.0085	0.0112	0.0125	0.0152	0.0170	0.0192	0.0224	0.0246	0.0300	0.0326	0.0358	0.039	0.043	0.049	0.054	0.058	0.063	0.072	0.076	0.080	0.085	0.098	0.107	0.112
30		0.00192	0.0033	0.0047	0.0066	0.0082	0.0104	0.0137	0.0153	0.0186	0.0208	0.0236	0.0274	0.0301	0.0367	0.0400	0.0438	0.048	0.053	0.060	0.066	0.071	0.077	0.088	0.093	0.099	0.104	0.120	0.131	0.137
40		0.00221	0.0039	0.0054	0.0076	0.0095	0.0120	0.0158	0.0177	0.0215	0.0240	0.0272	0.0316	0.0348	0.0424	0.0462	0.0506	0.056	0.061	0.070	0.076	0.082	0.089	0.101	0.108	0.114	0.120	0.139	0.152	0.158
50		0.00247	0.0043	0.0061	0.0085	0.0106	0.0134	0.0177	0.0198	0.0240	0.0269	0.0304	0.0354	0.0389	0.0474	0.0516	0.0566	0.062	0.068	0.078	0.085	0.092	0.099	0.113	0.120	0.127	0.134	0.156	0.170	0.177
60		0.00271	0.0047	0.0067	0.0093	0.0116	0.0147	0.0194	0.0217	0.0263	0.0294	0.0333	0.0387	0.0426	0.0519	0.0565	0.0620	0.068	0.074	0.085	0.093	0.101	0.108	0.124	0.132	0.139	0.147	0.170	0.186	0.194
70		0.00293	0.0051	0.0072	0.0100	0.0125	0.0159	0.0209	0.0234	0.0284	0.0318	0.0360	0.0418	0.0460	0.0561	0.0611	0.0669	0.074	0.080	0.092	0.100	0.109	0.117	0.134	0.142	0.151	0.159	0.184	0.201	0.209
80		0.00313	0.0055	0.0077	0.0107	0.0134	0.0170	0.0224	0.0250	0.0304	0.0340	0.0385	0.0447	0.0492	0.0599	0.0653	0.0716	0.079	0.086	0.098	0.107	0.116	0.125	0.143	0.152	0.161	0.170	0.197	0.215	0.224
90		0.00332	0.0058	0.0082	0.0114	0.0142	0.0180	0.0237	0.0266	0.0323	0.0360	0.0408	0.0474	0.0522	0.0636	0.0693	0.0759	0.083	0.091	0.104	0.114	0.123	0.133	0.152	0.161	0.171	0.180	0.209	0.228	0.237
100		0.00350	0.0061	0.0086	0.0120	0.0150	0.0190	0.0250	0.0280	0.0340	0.0380	0.0430	0.0500	0.0550	0.0670	0.0730	0.0800	0.088	0.096	0.110	0.120	0.130	0.140	0.160	0.170	0.180	0.190	0.220	0.240	0.250

R ù÷ fh G ðp hwhu lq fkhv	Size Q xp ehv	68	6:	6:	6:	73	74	75	76	7:	85	88	93	96	9:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	C _v	0.028	0.031	0.032	0.033	0.036	0.038	0.039	0.041	0.048	0.059	0.068	0.081	0.088	0.100	0.110	0.120	0.130	0.140	0.150	0.170	0.180	0.200	0.210	0.230	0.250	0.270	0.310	0.340	0.370	
1		0.028	0.031	0.032	0.033	0.036	0.038	0.039	0.041	0.048	0.059	0.068	0.081	0.088	0.100	0.110	0.120	0.130	0.140	0.150	0.170	0.180	0.200	0.210	0.230	0.250	0.270	0.310	0.340	0.370	
2		0.040	0.044	0.045	0.047	0.051	0.054	0.055	0.058	0.068	0.083	0.096	0.115	0.124	0.141	0.156	0.170	0.184	0.198	0.212	0.240	0.255	0.283	0.297	0.325	0.354	0.382	0.438	0.481	0.523	
3		0.048	0.054	0.055	0.057	0.062	0.066	0.068	0.071	0.083	0.102	0.118	0.140	0.152	0.173	0.191	0.208	0.225	0.242	0.260	0.294	0.312	0.346	0.364	0.398	0.433	0.468	0.537	0.589	0.641	
4		0.056	0.062	0.064	0.066	0.072	0.076	0.078	0.082	0.096	0.118	0.136	0.162	0.176	0.200	0.220	0.240	0.260	0.280	0.300	0.340	0.360	0.400	0.420	0.460	0.500	0.540	0.620	0.680	0.740	
5		0.063	0.069	0.072	0.074	0.080	0.085	0.087	0.092	0.107	0.132	0.152	0.181	0.197	0.224	0.246	0.268	0.291	0.313	0.335	0.380	0.402	0.447	0.470	0.514	0.559	0.604	0.693	0.760	0.827	
6		0.069	0.076	0.078	0.081	0.088	0.093	0.096	0.100	0.118	0.145	0.167	0.198	0.216	0.245	0.269	0.294	0.318	0.343	0.367	0.416	0.441	0.490	0.514	0.563	0.612	0.661	0.759	0.833	0.906	
7		0.074	0.082	0.085	0.087	0.095	0.101	0.103	0.108	0.127	0.156	0.180	0.214	0.233	0.265	0.291	0.317	0.344	0.370	0.397	0.450	0.476	0.529	0.556	0.609	0.661	0.714	0.820	0.900	0.979	
8		0.079	0.088	0.091	0.093	0.102	0.107	0.110	0.116	0.136	0.167	0.192	0.229	0.249	0.283	0.311	0.339	0.368	0.396	0.424	0.481	0.509	0.566	0.594	0.651	0.707	0.764	0.877	0.962	1.047	
9		0.084	0.093	0.096	0.099	0.108	0.114	0.117	0.123	0.144	0.177	0.204	0.243	0.264	0.300	0.330	0.360	0.390	0.420	0.450	0.510	0.540	0.600	0.630	0.690	0.750	0.810	0.930	1.020	1.110	
10		0.089	0.098	0.101	0.104	0.114	0.120	0.123	0.130	0.152	0.187	0.215	0.256	0.278	0.316	0.348	0.379	0.411	0.443	0.474	0.538	0.569	0.632	0.664	0.727	0.791	0.854	0.980	1.075	1.170	
15		0.108	0.120	0.124	0.128	0.139	0.147	0.151	0.159	0.186	0.229	0.263	0.314	0.341	0.387	0.426	0.465	0.503	0.542	0.581	0.668	0.697	0.775	0.813	0.891	0.968	1.046	1.201	1.317	1.433	
20		0.125	0.139	0.143	0.148	0.161	0.170	0.174	0.183	0.215	0.264	0.304	0.362	0.394	0.447	0.492	0.537	0.581	0.626	0.671	0.760	0.805	0.894	0.939	1.029	1.118	1.207	1.386	1.521	1.655	
30		0.153	0.170	0.175	0.181	0.197	0.208	0.214	0.225	0.263	0.323	0.372	0.444	0.482	0.548	0.602	0.657	0.712	0.767	0.822	0.931	0.986	1.095	1.150	1.260	1.369	1.479	1.698	1.862	2.027	
40		0.177	0.196	0.202	0.209	0.228	0.240	0.247	0.259	0.304	0.373	0.430	0.512	0.557	0.632	0.696	0.759	0.822	0.885	0.949	1.075	1.138	1.265	1.328	1.455	1.581	1.708	1.961	2.150	2.340	
50		0.198	0.219	0.226	0.233	0.255	0.269	0.276	0.290	0.339	0.417	0.481	0.573	0.622	0.707	0.778	0.849	0.919	0.990	1.061	1.202	1.273	1.414	1.485	1.626	1.768	1.909	2.192	2.404	2.616	
60		0.217	0.240	0.248	0.256	0.279	0.294	0.302	0.318	0.372	0.457	0.527	0.627	0.682	0.775	0.852	0.930	1.007	1.084	1.162	1.317	1.394	1.549	1.627	1.782	1.936	2.091	2.401	2.634	2.866	
70		0.234	0.259	0.268	0.276	0.301	0.318	0.326	0.343	0.402	0.494	0.569	0.678	0.736	0.837	0.920	1.004	1.088	1.171	1.255	1.422	1.506	1.673	1.757	1.924	2.092	2.259	2.594	2.845	3.096	
80		0.250	0.277	0.286	0.295	0.322	0.340	0.349	0.367	0.429	0.528	0.608	0.724	0.785	0.894	0.984	1.073	1.163	1.252	1.342	1.521	1.610	1.789	1.878	2.057	2.236	2.415	2.773	3.041	3.309	
90		0.266	0.294	0.304	0.313	0.342	0.360	0.370	0.389	0.455	0.560	0.645	0.768	0.835	0.949	1.044	1.138	1.233	1.328	1.423	1.613	1.708	1.897	1.972	2.182	2.372	2.561	2.941	3.226	3.510	
100		0.280	0.310	0.320	0.330	0.360	0.380	0.390	0.410	0.480	0.590	0.680	0.810	0.880	1.000	1.100	1.200	1.300	1.400	1.500	1.700	1.800	2.000	2.100	2.295	2.500	2.700	3.100	3.400	3.700	

P hwdOR ul÷fh Z dwhu Iαz μ O'khuvƳo lq xwh

R. ul÷fh g lāp hwhu lq'fkhv	Vssed' Slvwxth μ svlj																																
	Size	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	33			
Qxp ehv C _v	0.00035	0.0006	0.0009	0.0012	0.0015	0.0019	0.0025	0.0028	0.0034	0.0038	0.0043	0.0050	0.0055	0.0067	0.0073	0.0080	0.009	0.010	0.011	0.012	0.013	0.014	0.016	0.017	0.018	0.019	0.022	0.024	0.025				
1	0.0013	0.0023	0.0033	0.0045	0.0057	0.0072	0.0095	0.0106	0.0129	0.0144	0.0163	0.0189	0.0208	0.0254	0.0276	0.0303	0.033	0.036	0.042	0.045	0.049	0.053	0.061	0.064	0.068	0.072	0.083	0.091	0.095				
2	0.0019	0.0033	0.0046	0.0064	0.0080	0.0102	0.0134	0.0150	0.0182	0.0203	0.0230	0.0268	0.0294	0.0359	0.0391	0.0428	0.047	0.051	0.059	0.064	0.070	0.075	0.086	0.091	0.096	0.102	0.118	0.128	0.134				
3	0.0023	0.0040	0.0056	0.0079	0.0098	0.0125	0.0164	0.0184	0.0223	0.0249	0.0282	0.0328	0.0361	0.0439	0.0479	0.0525	0.058	0.063	0.072	0.079	0.085	0.092	0.105	0.111	0.118	0.125	0.144	0.157	0.164				
4	0.0026	0.0046	0.0065	0.0091	0.0114	0.0144	0.0189	0.0212	0.0257	0.0288	0.0326	0.0379	0.0416	0.0507	0.0553	0.0606	0.067	0.073	0.083	0.091	0.098	0.106	0.121	0.129	0.136	0.144	0.167	0.182	0.189				
5	0.0030	0.0052	0.0073	0.0102	0.0127	0.0161	0.0212	0.0237	0.0288	0.0322	0.0364	0.0423	0.0466	0.0567	0.0618	0.0677	0.074	0.081	0.093	0.102	0.110	0.119	0.135	0.144	0.152	0.161	0.186	0.203	0.212				
6	0.0032	0.0057	0.0080	0.0111	0.0139	0.0176	0.0232	0.0260	0.0315	0.0352	0.0399	0.0464	0.0510	0.0621	0.0677	0.0742	0.082	0.089	0.102	0.111	0.121	0.130	0.148	0.158	0.167	0.176	0.204	0.223	0.232				
7	0.0035	0.0061	0.0086	0.0120	0.0150	0.0190	0.0250	0.0280	0.0341	0.0381	0.0431	0.0501	0.0551	0.0671	0.0731	0.0801	0.088	0.096	0.110	0.120	0.130	0.140	0.160	0.170	0.180	0.190	0.220	0.240	0.250				
8	0.0037	0.0065	0.0092	0.0128	0.0161	0.0203	0.0268	0.0300	0.0364	0.0407	0.0460	0.0535	0.0589	0.0717	0.0782	0.0857	0.094	0.103	0.118	0.128	0.139	0.150	0.171	0.182	0.193	0.203	0.236	0.257	0.268				
9	0.0040	0.0069	0.0098	0.0136	0.0170	0.0216	0.0284	0.0318	0.0386	0.0432	0.0488	0.0568	0.0625	0.0761	0.0829	0.0908	0.100	0.109	0.125	0.136	0.148	0.159	0.182	0.193	0.204	0.216	0.250	0.273	0.284				
10	0.0042	0.0073	0.0103	0.0144	0.0180	0.0227	0.0299	0.0335	0.0407	0.0455	0.0515	0.0599	0.0658	0.0802	0.0874	0.0958	0.105	0.115	0.132	0.144	0.156	0.168	0.192	0.203	0.215	0.227	0.263	0.287	0.299				
15	0.0051	0.0089	0.0126	0.0176	0.0220	0.0279	0.0367	0.0411	0.0498	0.0557	0.0630	0.0728	0.0846	0.0931	0.1070	0.1173	0.129	0.141	0.161	0.176	0.191	0.205	0.235	0.249	0.264	0.279	0.323	0.352	0.367				
20	0.0059	0.0103	0.0146	0.0203	0.0254	0.0322	0.0423	0.0474	0.0576	0.0643	0.0728	0.0846	0.0931	0.1134	0.1236	0.1354	0.149	0.163	0.186	0.203	0.220	0.237	0.271	0.288	0.305	0.322	0.372	0.406	0.423				
30	0.0073	0.0126	0.0178	0.0249	0.0311	0.0394	0.0518	0.0581	0.0705	0.0788	0.0892	0.1037	0.1140	0.1389	0.1514	0.1659	0.182	0.199	0.228	0.249	0.270	0.290	0.332	0.352	0.373	0.394	0.456	0.498	0.518				
40	0.0084	0.0146	0.0206	0.0287	0.0359	0.0455	0.0599	0.0670	0.0814	0.0910	0.1017	0.1151	0.1338	0.1472	0.1793	0.1954	0.2141	0.236	0.257	0.294	0.321	0.348	0.375	0.428	0.455	0.482	0.509	0.589	0.642				
50	0.0094	0.0163	0.0230	0.0321	0.0402	0.0509	0.0669	0.0749	0.0910	0.1017	0.1151	0.1338	0.1472	0.1793	0.1965	0.2140	0.2346	0.258	0.281	0.323	0.352	0.381	0.411	0.469	0.498	0.528	0.557	0.645	0.704				
60	0.0103	0.0179	0.0252	0.0352	0.0440	0.0557	0.0733	0.0821	0.0997	0.1114	0.1261	0.1466	0.1613	0.1965	0.2140	0.2346	0.258	0.281	0.323	0.352	0.381	0.411	0.469	0.498	0.528	0.557	0.645	0.704	0.733				
70	0.0111	0.0193	0.0272	0.0380	0.0475	0.0602	0.0792	0.0887	0.1077	0.1203	0.1362	0.1584	0.1742	0.2122	0.2312	0.2534	0.279	0.304	0.348	0.380	0.412	0.443	0.507	0.538	0.570	0.602	0.697	0.760	0.792				
80	0.0119	0.0207	0.0291	0.0406	0.0508	0.0643	0.0846	0.0948	0.1151	0.1287	0.1456	0.1693	0.1862	0.2268	0.2472	0.2709	0.298	0.325	0.372	0.406	0.440	0.474	0.542	0.576	0.609	0.643	0.745	0.813	0.846				
90	0.0126	0.0219	0.0309	0.0431	0.0539	0.0682	0.0898	0.1006	0.1221	0.1365	0.1544	0.1796	0.1975	0.2406	0.2622	0.2873	0.316	0.345	0.395	0.431	0.467	0.503	0.575	0.610	0.646	0.682	0.790	0.862	0.898				
100	0.0132	0.0231	0.0326	0.0454	0.0568	0.0719	0.0946	0.1060	0.1287	0.1438	0.1628	0.1893	0.2082	0.2536	0.2763	0.3028	0.333	0.363	0.416	0.454	0.492	0.530	0.606	0.644	0.681	0.719	0.833	0.908	0.946				

Oul÷fh g lāp hwhu lq'fkhv	Vssed' Slvwxth μ svlj																																
	Size	68	6:	6:	6:	73	74	75	0.041	0.042	0.043	0.047	0.052	0.055	0.06	0.063	0.067	0.07	0.073	0.076	0.079	0.081	0.086	0.089	0.094	0.096	0.1	0.104	0.109	0.113	0.12	0.125	
Qxp ehv	0.028	0.031	0.032	0.033	0.036	0.038	0.039	0.041	0.048	0.059	0.068	0.081	0.088	0.100	0.110	0.120	0.130	0.140	0.150	0.170	0.180	0.200	0.210	0.230	0.250	0.270	0.310	0.340	0.370				
C _v	1	0.106	0.117	0.121	0.125	0.136	0.144	0.148	0.155	0.182	0.223	0.257	0.307	0.333	0.379	0.416	0.454	0.492	0.530	0.568	0.644	0.681	0.757	0.795	0.871	0.946	1.022	1.173	1.287	1.401			
	2	0.150	0.166	0.171	0.177	0.193	0.203	0.209	0.219	0.257	0.316	0.364	0.434	0.471	0.535	0.589	0.642	0.696	0.749	0.803	0.910	0.964	1.071	1.124	1.231	1.338	1.445	1.660	1.820	1.981			
	3	0.184	0.203	0.210	0.216	0.236	0.249	0.256	0.269	0.315	0.387	0.446	0.531	0.577	0.656	0.721	0.787	0.852	0.918	0.983	1.115	1.180	1.311	1.377	1.508	1.639	1.770	2.033	2.229	2.426			
	4	0.212	0.235	0.242	0.250	0.273	0.288	0.295	0.310	0.363	0.447	0.515	0.613	0.666	0.757	0.833	0.908	0.984	1.060	1.136	1.287	1.363	1.514	1.590	1.741	1.893	2.044	2.347	2.574	2.801			
	5	0.237	0.262	0.271	0.279	0.305	0.322	0.330	0.347	0.406	0.499	0.576	0.686	0.745	0.846	0.931	1.016	1.100	1.185	1.270	1.439	1.524	1.693	1.778	1.947	2.116	2.285	2.624	2.878	3.132			
	6	0.260	0.287	0.297	0.306	0.334	0.352	0.362	0.380	0.445	0.547	0.631	0.751	0.816	0.927	1.020	1.113	1.205	1.298	1.391	1.576	1.669	1.854	1.947	2.133	2.318	2.504	2.874	3.153	3.431			
	7	0.280	0.310	0.320	0.331	0.361	0.381	0.391	0.411	0.481	0.591	0.681	0.811	0.881	1.002	1.102	1.202	1.302	1.402	1.502	1.703	1.803	2.003	2.103	2.304	2.504	2.704	3.105	3.405	3.706			
	8	0.300	0.332	0.343	0.353	0.385	0.407	0.418	0.439	0.514	0.632	0.728	0.867	0.942	1.071	1.178	1.285	1.392	1.499	1.606	1.820	1.927	2.141	2.248	2.463	2.677	2.891	3.319	3.640	3.961			
	9	0.318	0.352	0.363	0.375	0.409	0.432	0.443	0.466	0.545	0.670	0.772	0.920	0.999	1.136	1.249	1.363	1.476	1.590	1.703	1.931	2.044	2.271	2.385	2.612	2.839	3.066	3.520	3.861	4.202			
	10	0.335	0.371	0.383	0.395	0.431	0.455	0.467	0.491	0.575	0.706	0.814	0.970	1.053	1.197	1.317	1.436	1.556	1.676	1.796	2.035	2.155	2.394	2.514	2.753	2.993	3.232	3.711	4.070	4.429			
	15	0.411	0.454	0.469	0.484	0.528	0.557	0.572	0.601	0.704	0.865	0.997	1.188	1.290	1.466	1.613	1.759	1.906	2.053	2.199	2.492	2.639	2.932	3.079	3.372	3.665	3.958	4.545	4.985	5.424			
	20	0.474	0.525	0.542	0.559	0.609	0.643	0.660	0.694	0.813	0.999	1.151	1.371	1.490	1.693	1.862	2.031	2.201	2.370	2.539	2.878	3.047	3.386	3.555	3.894	4.232	4.571	5.248	5.756	6.264			
	30	0.581	0.643	0.663	0.684	0.746	0.788	0.809	0.850	0.995	1.223	1.410	1.679	1.825	2.073	2.281	2.488	2.695	2.903	3.110	3.525	3.732	4.147	4.354	4.769	5.183	5.598	6.427	7.049	7.671			
	40	0.670	0.742	0.766	0.790	0.862	0.910	0.934	0.982	1.149	1.413	1.628	1.939	2.107	2.394	2.634	2.873	3.112	3.352	3.591	4.070	4.309	4.788	5.028	5.506	5.985	6.464	7.422	8.140	8.858			
	50	0.749	0.830	0.857	0.883	0.964	1.017	1.044	1.097	1.285	1.579	1.820	2.168	2.355	2.677	2.944	3.212	3.480	3.747	4.015	4.550	4.818	5.353	5.621	6.156	6.692	7.227	8.298	9.101	9.904			
	60	0.821	0.909	0.938	0.968	1.056	1.114	1.144	1.202	1.407	1.730	1.994	2.375	2.580	2.932	3.225	3.519	3.812	4.105	4.398	4.985	5.278	5.864	6.158	6.744	7.330	7.917	9.090	9.969	10.849			
	70	0.887	0.982	1.013	1.045	1.140	1.203	1.235	1.299	1.520	1.869	2.154	2.565	2.787	3.167	3.484	3.801	4.117	4.434	4.751	5.384	5.701	6.334	6.651	7.284	7.918	8.551	9.818	10.768	11.718			
	80	0.948	1.050	1.083	1.117	1.219	1.287	1.320	1.388	1.625	1.998	2.302	2.742	2.979	3.386	3.724	4.063	4.401	4.740	5.079	5.756	6.094	6.772	7.110	7.787	8.464	9.142	10.496	11.512	12.527			
	90	1.006	1.113	1.149	1.185	1.293	1.365	1.401	1.472	1.724	2.119	2.442	2.909	3.160	3.591	3.950	4.309	4.668	5.028	5.387	6.105	6.464	7.182	7.541	8.260	8.978	9.696	11.133	12.210	13.287			
	100	1.060	1.173	1.211	1.249	1.363	1.438	1.476	1.552	1.817	2.233	2.574	3.066	3.331	3.785	4.164	4.542	4.921	5.300	5.678	6.435	6.814	7.571	7.949	8.706	9.464	10.221	11.735	12.870	14.006			



Products / Valves / Pressure relief valves / Pressure relief valve, DN 40 ISO-KF



Pressure relief valve, DN 40 ISO-KF

Overview

Technical data

Differential pressure	modifiable to app. +/- 100 hPa
Flange (in)	DN 40 ISO-KF
Flange (out)	DN 40 ISO-KF
Flow rate max.	200 l/min
Housing	Stainless steel
Nominal diameter	DN 40 ISO-KF
Opens to a pressure difference of	app. 200 hPa app. 150 Torr app. 200 mbar
Pressure range	$1 \cdot 10^{-7}$ hPa to 500 hPa over pressure
Seal	FKM
Temperature range	5-60 °C 41-140 °F 278-333 K
Tightness	$1 \cdot 10^{-9}$ Pa m ³ /s $7.5 \cdot 10^{-9}$ Torr l/s $1 \cdot 10^{-8}$ mbar l/s
Type	Pressure relief valve

120VUS016 and 120VUS040 with modifiable differential pressure to app. +/- 100 hPa

Only intended to be used for vacuum chambers. No safety component in terms of the machinery directive 2006/42/EC.

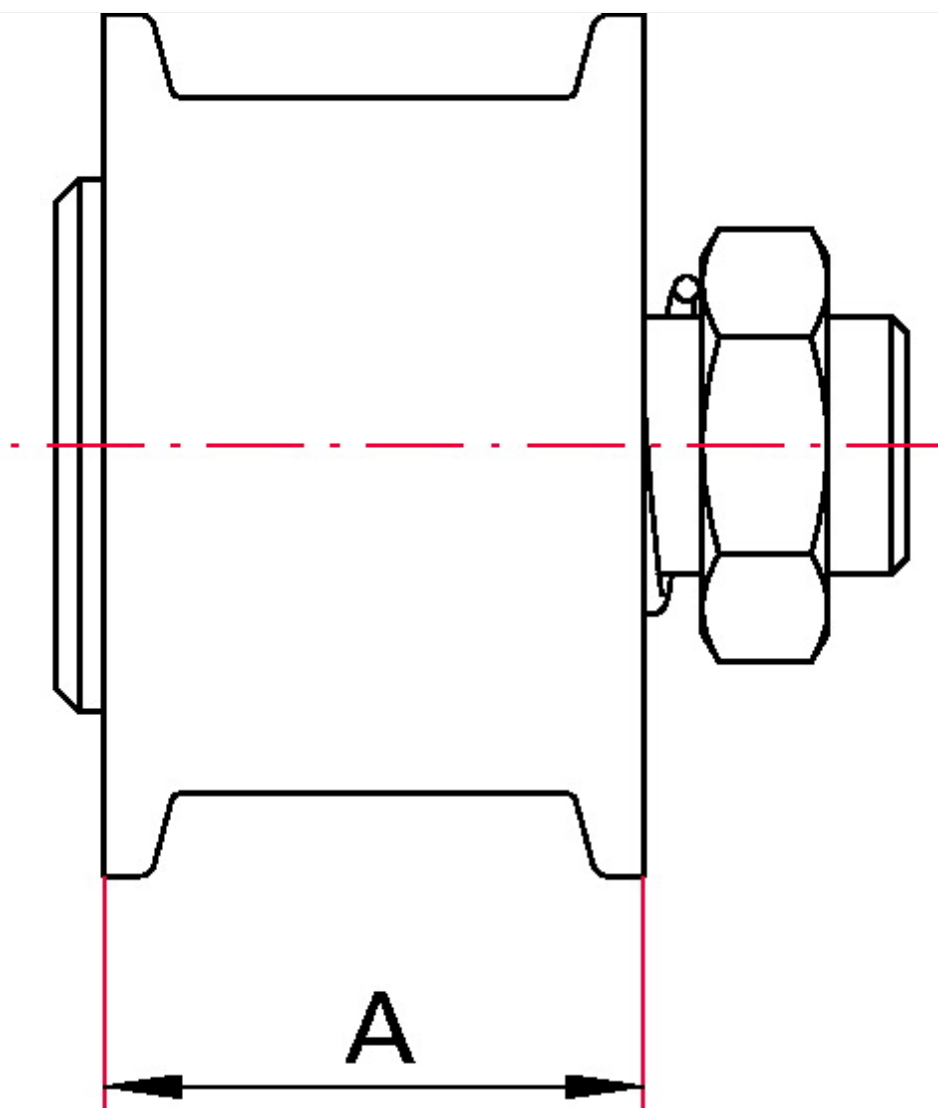
Please observe the maximum flow rate.

The switching time can vary by more than +/- 50 hPa and has hysteresis.

Tightness at 1000 hPa differential pressure

Flanges according to ISO 2861

Dimensions



A 35 mm

Your local contact

Pfeiffer Vacuum Inc.

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NH 03063-1988 Nashua
USA

T: +1 (800) 248-8254

F: +1 (888) 658-7983

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Model 3810A Series

Dual-Stage High-Purity Stainless Steel Regulator



Description

High-purity regulators designed for analytical applications using non-corrosive or semi-corrosive gases.

Gas Chromatography Detectors requiring the Dual-Stage Model 3810A Series Regulator

Detector Type	Detection Level
Electrolytic Conductivity Detector (ELCD or Hall Detector)	Levels < 50 ppm
Electron Capture Detector (ECD)	Levels < 50 ppm
Mass Selective Detector or Mass Spec (MSD or MS)	All levels
Atomic Emission Detector (AED)	All levels

Note: A small amount of polychlorotrifluoroethylene is added to the threads to facilitate assembly. For ECD, MS or AED applications where method detection limits are sub-ppm, it is recommended to use a No Lube (NL) model.

Applications

- Supply of carrier gas/detector support gas for a variety of gas chromatography applications (see table below for details).
- Supply of calibration standards to on-line process analyzers, emission monitoring systems, etc.
- Supply of high-purity non-corrosive or semi-corrosive gases to applications requiring constant delivery pressure.

Design Features/Components

- High-purity 316 stainless steel barstock body
- High-purity 316 stainless steel diaphragm
- Metal to metal seals minimize diffusion of contaminants
- 2" inlet and delivery pressure gauges
- Bonnet ported and threaded to pipe gases away from work area
- Equipped with outlet diaphragm valve
- 1/4" compression tube outlet connection
- 10 micron metal filter protects seat from contamination
- Optional interstage relief valve available
- Panel mountable, front and back bonnet threaded
- Bonnet vent hole size: 1/8" NPTF

Materials of Construction

Gauges:	316 stainless steel
Body:	316 stainless steel
Bonnets:	Chrom plated brass barstock
Diaphragms:	316 stainless steel
Seats:	1st Stage - Teflon 2nd Stage - Teflon
Seals:	Metal to metal

Specifications

Maximum Inlet Pressure:	3000 psig (20,700 kPa)
Maximum Flow Rate:	Model 3810A : 1200 SCFH (564 SLPM) Model 3813A : 960 SCFH (451 SLPM) Model 3816A : 1400 SCFH (658 SLPM)
Flow Capacity (Cv):	0.06
Operating Temperature:	-40°F to 140°F (-40°C to 60°C)
Porting (Regulator Body):	1/4" NPT Female
Porting Configuration:	2 High, 3 Low, 1 Interstage
Shipping Weight:	5 lbs

Ordering Information

Part Number *	Delivery Pressure Range	Delivery Pressure Gauge	Cylinder Pressure Gauge
SEQ 3811A CGA	0-15 psig	30" vac-0-30 psig	0-4000 psig
SEQ 3813A CGA	0-50 psig	30" vac-100 psig	0-4000 psig
SEQ 3810A CGA	0-125 psig	30" vac-0-200 psig	0-4000 psig
SEQ 3816A CGA	0-250 psig	0-400 psig	0-4000 psig
SEQ 3818A CGA	0-500 psig	0-1000 psig	0-4000 psig

For No Lube applications, specify Part Number SEQ 38xxAN LCGA.

*Note: For ordering, replace letters "CGA" with the valve outlet CGA number for the gas cylinder you are using. Some CGA limitations may apply.

Options

Part Number	Description
SEQ 4754 CGA	Tee Purge Assembly
SEQ 4774 CGA	Cross Purge Assembly
SEQ CON0069SA	Bonnet Vent Adapter 1/4" TB x 1/8" M NPT (2 Required)
SEQ PM K2N	Bonnet Panel Mounting Kit - 2 Nuts
SEQ OPN0301SA	Swage Lok 1/4" Tube Fitting (Stainless Steel)
SEQ MSP0012XX	Inboard Helium Leak Rate Certification
SEQ MSP0013XX	Combination Inboard/Outboard Helium Leak Rate Certification

TOKIN

Solenoid

Electric magnet

S422型

S/N

Date of production

3418-
1997. 04

株式会社 トーキン

(Official?) voltage

73 V

(Official?) current

2250 A

直流抵抗 20 °C

mΩ

最高磁束密度

KG

Coil length

φ974 mm

Coil ID

φ706 mm

Iron (steel?) core length

1180 mm

Permitted temperature increase

19 °C

Thermal switch set temp

80 °C

所要冷却水量

l/min

圧力損失

kg/cm

Iron (steel?) mass

5.4 Ton

Total mass

7.2 Ton

Uchiya U12 Thermostat



STANDARD SPECIFICATIONS	FEATURES	SAMPLE APPLICATIONS
Open Temperature, 5° C steps	PBT Enclosure	Transformer Protector
Min: 60 degrees C		
Max: See Approvals	Snap Action Type	Heating Element Protection
	B Metal Thermostat	
Tolerance: +/- 5° C		
Reset: (60° ~ 110°) :30K	AWG #20 Insulated	Protection of
Differential: (115° ~ 125°) :35K	Lead Wire	Electronic Circuits
(130° -) :40K		
Reset	Worldwide safety	Power Transistor
Tolerance: +/-15° C	Approvals	Protection

U12 THERMAL PROTECTORS:

This is the largest of the Uchiya range manufactured by Uchiya Ireland Limited.

CURRENT SENSITIVITY:

Depending on the heat absorption of an application, the U12 will show varying levels of self-heating at higher current loads.

The graphs opposite are for indication only, we recommend that tests be carried out before specifying U12 for high current applications.

APPROVAL DATA FOR U12:

Approval Body	Uchiya File No.	Approval Standard	Approved as	Electrical	Max Temp °C	Max Cycles
UL	UL E50124	UL- 873	Thermostat	125V AC 6A	140	100,000
				125V AC 12A	140	6,000
UL	UL E52703	UL- 547	Motor Protector	125V AC 1/2 HP	150	
CSA	LR 35080-3	CSA C22.2 No. 24 ~ 93 77 ~ 88	Thermal Cut Out Motor Protector	125V AC 6A	145	100,000
VDE	8921-4510-7029	EN60730-1 EN60730-2-9	Thermal Cut Out	250V AC 10A	155	10,000
VDE	8921-4510-7029	EN60730-1 EN60730-2-9	Thermal Cut Out	250V AC 10 (8) A*	155	1,000
VDE	8921-4510-7028	EN60730-1 EN60730-2-2	Thermal Motor Protector	250V AC	155	

* 10 (8) A signifies 10A resistive and 8A inductive

ADDITIONAL SPECIFICATIONS:

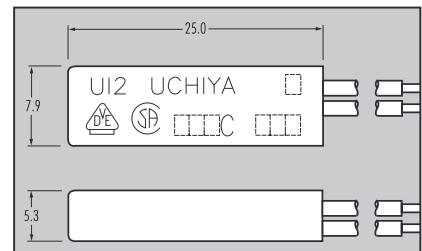
Contact Resistance	High Voltage Insulation	Insulation Resistance	Protection Class	Insulation Class
< 50 m	2.5 kV (10 mA)	1000V DC (100 M)	I	IP00

Holroyd Components Ltd.

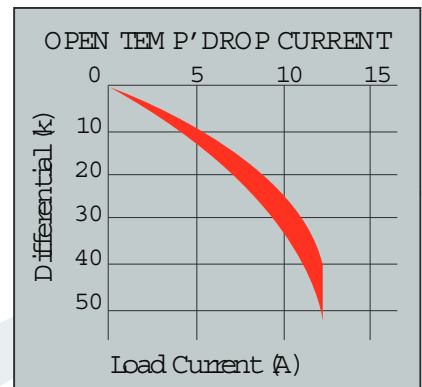
Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ United Kingdom

Tel: +44 (0) 1799 523177

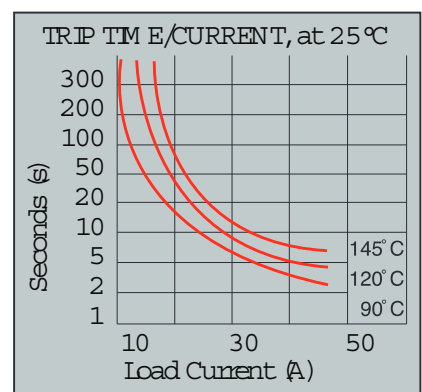
Fax: +44 (0) 1799 513714



U12 = Insulated stranded lead wire
Standard lead wire length 100mm



Graph 1, shows the relationship between change in operation temperature and load current for parts tested in air.



Graph 2, shows the trip time due to self-heating for various over current values. Tests were carried out at 25°C in air. The differential would be lower and the trip time longer if any heat sinking takes place.



Main applications

The standard valve for UHV isolation applications in research and industry



Ordering information

Valve with manual actuator
crank handle

DN		Ordering numbers				
mm	inch	ISO-F	CF-F metric threads	CF-F UNF threads	ASA-LP	JIS
63	2 ½	10836-PE01	10836-CE01	10836-UE01	10836-TE01	10836-JE01
80	3	10838-PE01	10838-CE01	10838-UE01	10838-TE01	10838-JE01
100	4	10840-PE01	10840-CE01	10840-UE01	10840-TE01	10840-JE01
160	6	10844-PE01	10844-CE01	10844-UE01	10844-TE01	10844-JE01
200	8	10846-PE01	10846-CE01	10846-UE01	10846-TE01	10846-JE01
250	10	10848-PE01	10848-CE01	10848-UE01	10848-TE01	10848-JE01
320	12	10850-PE01	on request	on request	10850-TE01	10850-JE01

with position indicator: 108 . . . E08

Valve with pneumatic actuator
double acting
with solenoid valve
with position indicator

DN		Ordering numbers (specify control voltage)				
mm	inch	ISO-F	CF-F metric threads	CF-F UNF threads	ASA-LP	JIS
63	2 ½	10836-PE44	10836-CE44	10836-UE44	10836-TE44	10836-JE44
80	3	10838-PE44	10838-CE44	10838-UE44	10838-TE44	10838-JE44
100	4	10840-PE44	10840-CE44	10840-UE44	10840-TE44	10840-JE44
160	6	10844-PE44	10844-CE44	10844-UE44	10844-TE44	10844-JE44
200	8	10846-PE44	10846-CE44	10846-UE44	10846-TE44	10846-JE44
250	10	10848-PE44	10848-CE44	10848-UE44	10848-TE44	10848-JE44
320	12	10850-PE44	on request	on request	10850-TE44	10850-JE44

without solenoid valve, without position indicator: 108 . . . E14

without solenoid valve, with position indicator: 108 . . . E24

with solenoid valve, without position indicator: 108 . . . E34 (specify control voltage)

————— Further ordering information on next page —————>

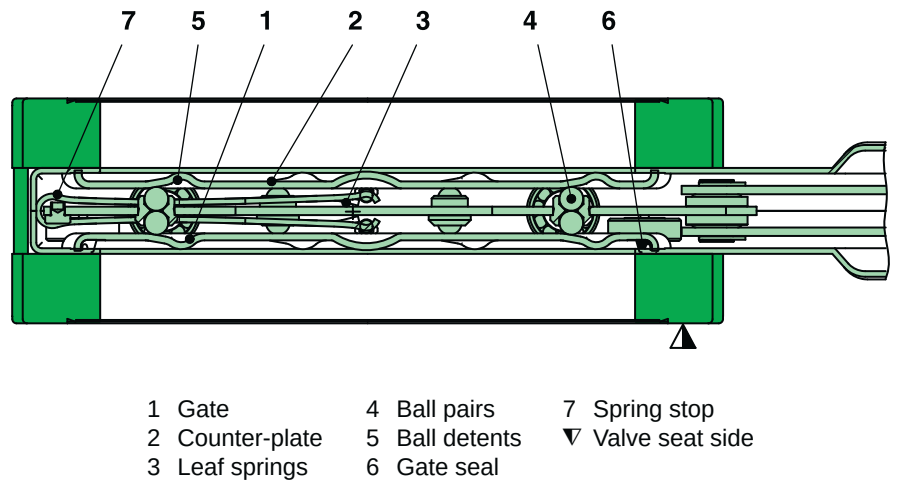
Features

Body material: stainless steel

Bellows sealed, unlubricated mechanism

DN 63–200 with vulcanized seal
(no dead volumes at the gate seal):
see glossary

Functional principle



Technical data

Leak rate

- Valve body $< 5 \cdot 10^{-10}$ mbar ls⁻¹
- Valve seat $< 1 \cdot 10^{-9}$ mbar ls⁻¹

Pressure range

- DN 63–200 $1 \cdot 10^{-10}$ mbar to 1.6 bar (abs)
- DN 250–320 $1 \cdot 10^{-10}$ mbar to 1.2 bar (abs)

Differential pressure on the gate

- DN 63–200 ≤ 1.6 bar
- DN 250–320 ≤ 1.2 bar

Differential pressure at opening

≤ 30 mbar

Cycles until first service

50 000

Temperature ¹⁾

- Valve body ≤ 250 °C open, ≤ 200 °C closed
- Manual actuator ≤ 250 °C
- Pneumatic actuator ≤ 200 °C
- Solenoid valve ≤ 50 °C
- Position indicator ≤ 80 °C

¹⁾ Maximum values: depending on operating conditions and sealing materials

Further technical data on next page →

Continued Ordering information

**Valve with 3-position
pneumatic actuator**
double acting
with solenoid valve
with position indicator

DN		Ordering numbers (specify control voltage)				
mm	inch	ISO-F	CF-F metric threads	CF-F UNF threads	ASA-LP	JIS
63	2 ½	10836-PE48	10836-CE48	10836-UE48	10836-TE48	10836-JE48
80	3	10838-PE48	10838-CE48	10838-UE48	10838-TE48	10838-JE48
100	4	10840-PE48	10840-CE48	10840-UE48	10840-TE48	10840-JE48
160	6	10844-PE48	10844-CE48	10844-UE48	10844-TE48	10844-JE48
200	8	10846-PE48	10846-CE48	10846-UE48	10846-TE48	10846-JE48
250	10	10848-PE48	10848-CE48	10848-UE48	10848-TE48	10848-JE48
320	12	10850-PE48	on request	on request	10850-TE48	10850-JE48

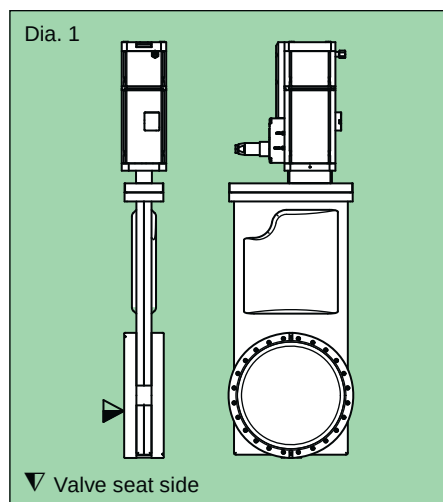
without solenoid valve, with position indicator: 108 . . . E28

Continued Technical data

Heating and cooling rate	≤50 °C h ⁻¹
Material	
– Valve body	AISI 304 (1.4301)
– Mechanism DN 63–200	AISI 316L (1.4404)
DN 250–320	AISI 304 (1.4301)
– Bellows	AISI 316L (1.4404, 1.4435)
Seal	
– Bonnet	metal
– Gate	FKM (Viton®)
Feedthrough	bellows
Mounting position	any
Solenoid valve	24VDC, 5.4W (others on request)
Position indicator: contact rating	
– Voltage	≤50VAC/DC
– Current	≤1.2A
Valve position indication	visual (mechanical)

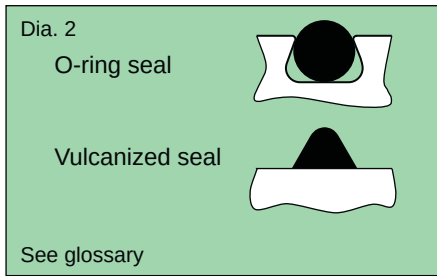
				Valve with manual actuator			Valve with pneumatic actuator						
DN (nominal I.D.)		Standard flanges	Conductance (molecular flow) (depending on A-dimension and flange type)	Turns per stroke	Weight		Compressed air min. – max. overpressure		Volume of pneu- matic actuator		Closing or opening time	Weight	
mm	inch		ls ⁻¹	n	kg	lbs	bar	psi	l	ft ³	s	kg	lbs
63	2½	See pages 42–43	600	10	9	20	4–7	58–102	0.08	0.0028	1	9	20
80	3		765	10	9	20	4–7	58–102	0.08	0.0028	1	9	20
100	4		1740	13	12	26	4–7	58–102	0.11	0.0038	1.2	12	26
160	6		5880	17	18	40	4–7	58–102	0.14	0.0049	1.5	18	40
200	8		12200	17	25	55	4–7	58–102	0.25	0.0087	2	24	53
250	10		21690	40	52	114	5–7	73–102	0.35	0.0122	4	42	92
320	12		29130	45	86	190	5–7	73–102	0.48	0.0167	5	95	210

Options



Actuator

- Solenoid valve for impulse actuation:
last valve position is maintained at power failure
- Solenoid valve separate, for external mounting
- Other solenoid valve voltage (standard: 24VDC)
- Manual emergency operation on solenoid valve lockable
- 3-position pneumatic actuator for throttling (Dia. 1):
ordering information on page 37, technical data on request
- Double position indicator
(2 switches each for the positions «open» and «closed»)
- Bakeable position indicator:
manual actuator bakeable to max. 250 °C, pneumatic actuator to max. 200 °C
- Position indicator with change-over contact

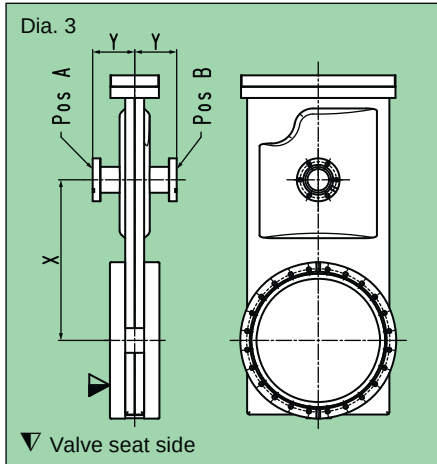


Valve

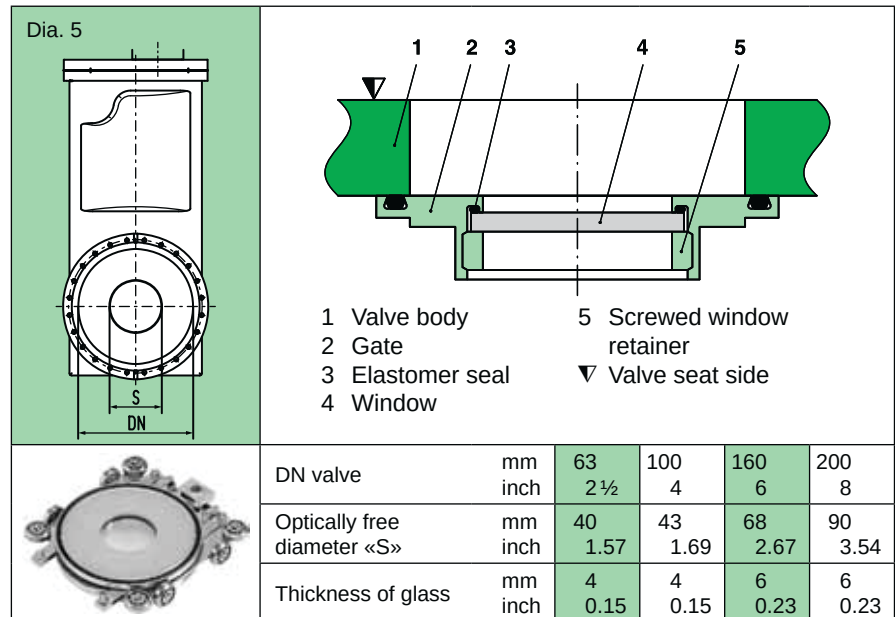
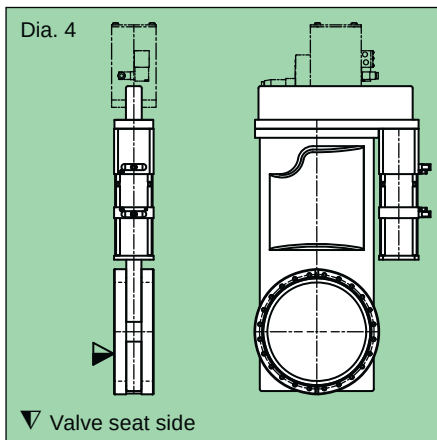
- Customer specified flanges with/without watercooling
- Other sealing materials
- O-ring seal in gate (Dia. 2) with DN 63, 100, 160, 200 (standard: vulcanized seal)
- Ports for roughing (by-pass), venting or for gauges (Dia. 3), possible in positions A and B

DN valve	mm inch	63 2 1/2	80 3	100 4	160 6	200 8	250 10	320 12
Recommended port CF-F		40	40	40	40	40	40	40
X	mm inch	110 4.33	110 4.33	120 4.72	205 8.07	260 10.24	335 13.19	415 16.34
Y	mm inch	44 1.73	44 1.73	44 1.73	44 1.73	48 1.89	62 2.44	72 2.83

Other ports on request



- Space saving compact version, DN 200 + 250 (Dia. 4)
- Special gate for the installation of various foils
- Window in gate with DN 63, 100, 160, 200 (Dia. 5): window screwed into gate, window material: e. g. borosilicate, elastomer seal



Ordering information for options:

Ordering No. of valve-X (e. g. 10846-CE44-X, X = port CF-F 40 in position A)

Spare parts

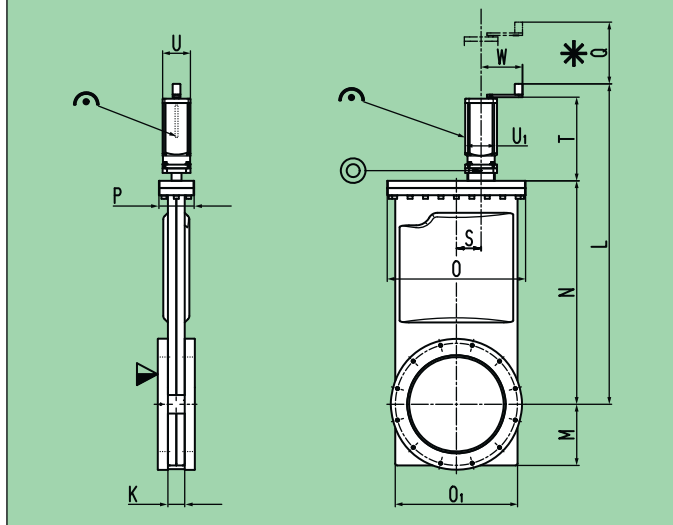
- **Seals**
on request (specify fabrication number of valve)

Accessories

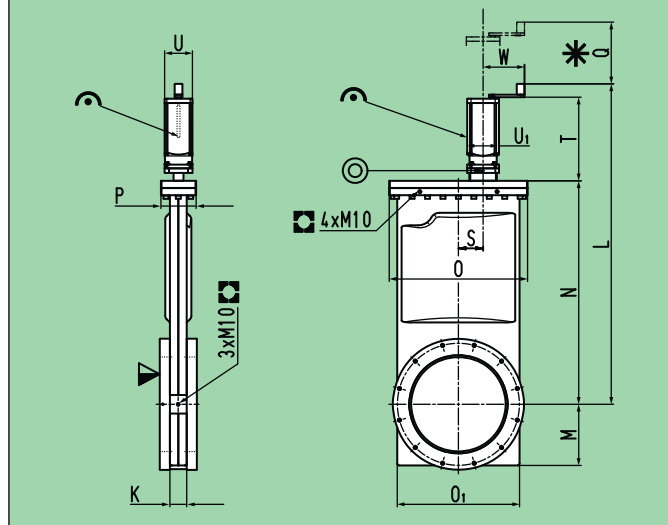
- **Heater**
on request (specify fabrication number of valve)
- **Flange connections**
for installation of the valve: see series 32 and 33

Main dimensions

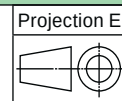
Valve with manual actuator: crank handle
DN 63–200 (2½"–8")



Valve with manual actuator: crank handle
DN 250–320 (10"–12")



- ▽ Valve seat side
- * Required for dismantling
- ☉ Mechanical position indication
- ⊙ Leak detection hole
- For attachment

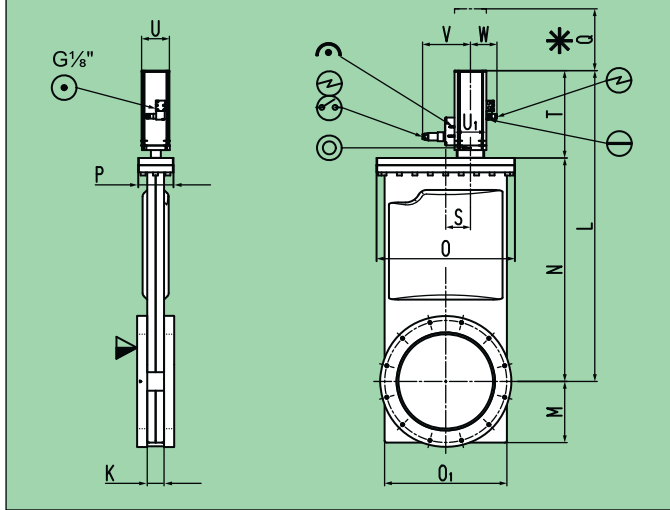


Flange dimensions: see pages 42–43

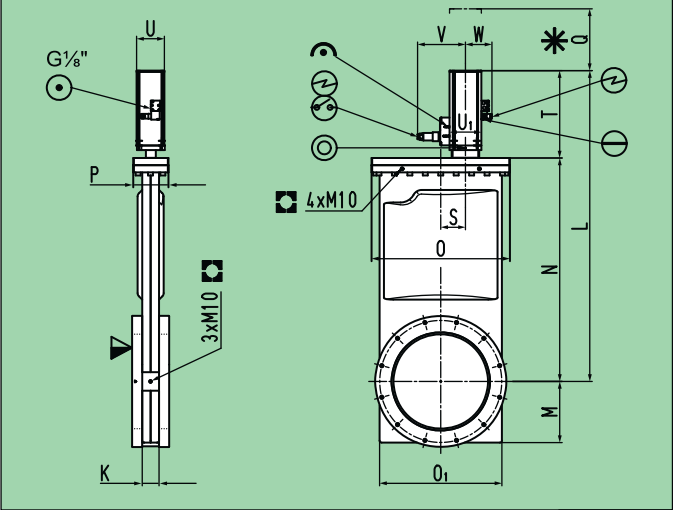
DN	mm inch	63 2½	80 3	100 4	160 6	200 8	250 10	320 12
K	mm inch	25.55 1.01	25.55 1.01	25.55 1.01	25.55 1.01	31 1.22	41 1.61	54 2.13
L	mm inch	408 16.06	421 16.57	462 18.19	552 21.73	660 25.98	841 33.11	1038 40.87
M	mm inch	53 2.09	53 2.09	69 2.72	94.50 3.72	120 4.72	161 6.34	198 7.80
N	mm inch	192 7.56	205 8.07	247 9.72	336 13.23	430 16.93	559 22.01	724 28.50
O	mm inch	115 4.53	115 4.53	145 5.71	200 7.87	250 9.84	344 13.54	448 17.64
O1	mm inch	104.60 4.12	104.60 4.12	134.60 5.30	184.80 7.28	230 9.06	321 12.64	396 15.59
P	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	80 3.15	114 4.49
Q	mm inch	112 4.41	112 4.41	142 5.59	192 7.56	350 13.78	450 17.72	560 22.05
S	mm inch	11 0.43	11 0.43	9 0.35	25 0.98	38.50 1.52	67 2.64	80 3.15
T	mm inch	184 7.24	184 7.24	184 7.24	184 7.24	200 7.87	240 9.45	272 10.71
U	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	90 3.54	90 3.54	90 3.54
U1	mm inch	83 3.27	83 3.27	83 3.27	83 3.27	103 4.06	103 4.06	103 4.06
W	mm inch	77 3.03	77 3.03	77 3.03	77 3.03	94 3.70	134 5.28	134 5.28

Main dimensions

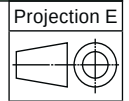
Valve with pneumatic actuator: double acting
DN 63–200 (2½"–8")



Valve with pneumatic actuator: double acting
DN 250–320 (10"–12")



- ▼ Valve seat side
- * Required for dismantling
- ⊙ Compressed air connection
- ⊕ Electrical connection
- ⊖ Mechanical position indication
- ⊙ Position indicator
- ⊙ Leak detection hole
- ⊖ Emergency operation
- For attachment

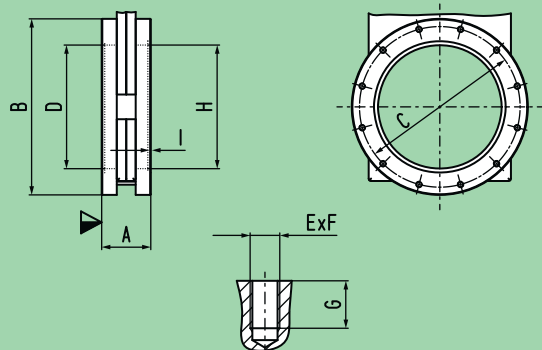


Flange dimensions: see pages 42–43

DN	mm inch	63 2 ½	80 3	100 4	160 6	200 8	250 10	320 12
K	mm inch	25.55 1.01	25.55 1.01	25.55 1.01	25.55 1.01	31 1.22	41 1.61	54 2.13
L	mm inch	346 13.62	358 14.09	418 16.46	523 20.59	630 24.80	800 31.50	1013 39.88
M	mm inch	53 2.09	53 2.09	69 2.72	94.50 3.72	120 4.72	161 6.34	198 7.80
N	mm inch	192 7.56	205 8.07	247 9.72	336 13.23	430 16.93	559 22.01	724 28.50
O	mm inch	115 4.53	115 4.53	145 5.71	200 7.87	250 9.84	344 13.54	448 17.64
O1	mm inch	104.60 4.12	104.60 4.12	134.60 5.30	184.80 7.28	230 9.06	321 12.64	396 15.59
P	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	80 3.15	114 4.49
Q	mm inch	112 4.41	112 4.41	142 5.59	192 7.56	350 13.78	450 17.72	560 22.05
S	mm inch	11 0.43	11 0.43	9 0.35	25 0.98	38.50 1.52	67 2.64	80 3.15
T	mm inch	154 6.06	154 6.06	171 6.73	187 7.36	200 7.87	240 9.45	289 11.38
U	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	90 3.54	90 3.54	90 3.54
U1	mm inch	83 3.27	83 3.27	83 3.27	83 3.27	103 4.06	103 4.06	103 4.06
V	mm inch	145 5.71	145 5.71	145 5.71	145 5.71	155 6.10	155 6.10	155 6.10
W	mm inch	77 3.03	77 3.03	77 3.03	77 3.03	87 3.43	87 3.43	87 3.43

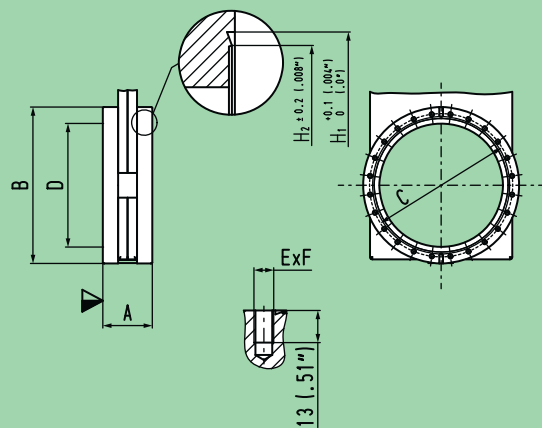
Flange dimensions

ISO-F
DN 63–320 (2½"–12")



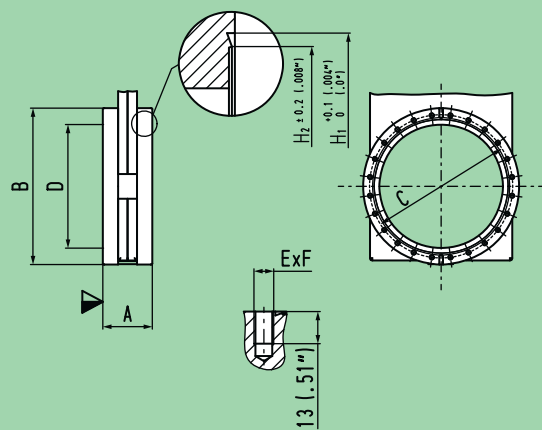
DN	mm inch	63 2½	80 3	100 4	160 6	200 8	250 10	320 12
A	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	100 3.94	120 4.72
B	mm inch	130 5.12	145 5.71	165 6.50	225 8.86	285 11.22	350 13.78	425 16.73
C	mm inch	110 4.33	125 4.92	145 5.71	200 7.87	260 10.24	310 12.20	395 15.55
D	mm inch	70 2.76	76 2.99	100 3.94	150 5.91	200 7.87	261 10.28	306 12.05
E×F		4×M8	8×M8	8×M8	8×M10	12×M10	12×M10	12×M12
G	mm inch	13 0.51	13 0.51	13 0.51	13 0.51	15 0.59	15 0.59	18 0.71
H	mm inch	–	83 3.27	102 4.02	153 6.02	213 8.39	–	318 12.52
I	mm inch	–	3 0.12	3 0.12	5 0.20	5 0.20	–	5 0.20

CF-F, metric threads
DN 63–250 (2½"–10")



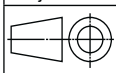
DN	mm inch	63 2½	80 3	100 4	160 6	200 8	250 10	
O.D.	inch	4½	4⅝	6	8	10	12	
A	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	100 3.94	
B	mm inch	113.50 4.47	117.50 4.63	151.60 5.97	202.40 7.97	253.20 9.97	350 13.78	
C	mm inch	92.10 3.63	102.40 4.03	130.20 5.13	181 7.13	231.80 9.13	284 11.18	
D	mm inch	70 2.76	76 2.99	100 3.94	150 5.91	200 7.87	254 10.00	
E×F		8×M8	10×M8	16×M8	20×M8	24×M8	32×M8	
H1	mm inch	82.50 3.25	91.65 3.61	120.70 4.75	171.45 6.75	222.40 8.76	273.15 10.75	
H2	mm inch	77.40 3.05	86.30 3.40	115.50 4.55	166 6.54	217 8.54	267 10.51	

CF-F, UNF threads
DN 63–250 (2½"–10")



DN	mm inch	63 2½	80 3	100 4	160 6	200 8	250 ¹⁾ 10	250 ¹⁾ 10
O.D.	inch	4½	4⅝	6	8	10	12	13¼
A	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	100 3.94	100 3.94
B	mm inch	113.50 4.47	117.50 4.63	151.60 5.97	202.40 7.97	253.20 9.97	350 13.78	350 13.78
C	mm inch	92.10 3.63	102.40 4.03	130.20 5.13	181 7.13	231.80 9.13	284 11.18	306.30 12.06
D	mm inch	70 2.76	76 2.99	100 3.94	150 5.91	200 7.87	254 10.00	254 10.00
E×F		8× ⁵ / ₁₆ " 24 UNF	10× ⁵ / ₁₆ " 24 UNF	16× ⁵ / ₁₆ " 24 UNF	20× ⁵ / ₁₆ " 24 UNF	24× ⁵ / ₁₆ " 24 UNF	32× ⁵ / ₁₆ " 24 UNF	30× ³ / ₈ " 24 UNF
H1	mm inch	82.50 3.25	91.65 3.61	120.70 4.75	171.45 6.75	222.40 8.76	273.15 10.75	294.64 11.60
H2	mm inch	77.40 3.05	86.30 3.40	115.50 4.55	166 6.54	217 8.54	267 10.51	288.30 11.35

Projection E



▼ Valve seat side

¹⁾ O.D. 12" VAT standard, O.D. 13¼" option

Ordering information for option: O.D. 13¼"

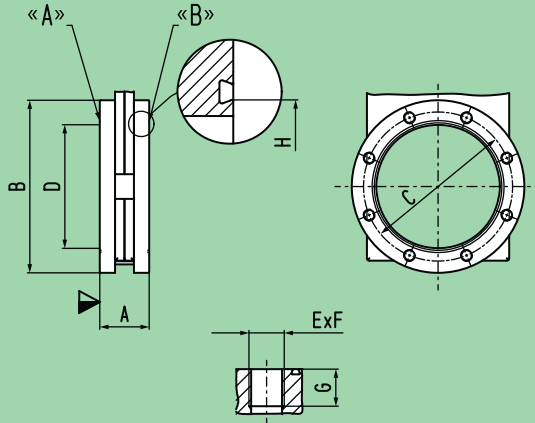
Ordering No. of valve-X (e. g. 10848-UE44-X, X = O.D. 13¼")

Flange dimensions

ASA-LP

DN 63–320 (2½"–12")
with or without O-ring groove

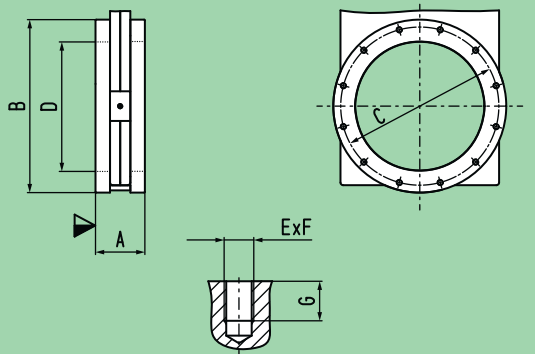
For orders with O-ring groove specify:
«A», «B» or «A+B»



DN	mm inch	63 2½	80 3	100 4	160 6	200 8	250 10	320 12
ASA-LP		2	–	3	4	6	8	10
A	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	100 3.94	120 4.72
B	mm inch	152.40 6.00	177.80 7.00	190.50 7.50	225 8.86	279.40 11.00	350 13.78	425 16.73
C	mm inch	120.70 4.75	139.70 5.50	152.40 6.00	190.50 7.50	241.30 9.50	298.50 11.75	362 14.25
D	mm inch	70 2.76	76 2.99	100 3.94	150 5.91	200 7.87	254 10.00	300 11.81
E x F		4 × ⅜" 16 UNC	4 × ⅜" 16 UNC	8 × ⅜" 16 UNC	8 × ⅜" 16 UNC	8 × ¾" 10 UNC	8 × ¾" 10 UNC	12 × ¾" 10 UNC
G	mm inch	15 0.59	15 0.59	15 0.59	15 0.59	19 0.75	19 0.75	19 0.75
H	mm inch	88.90 3.50	88.90 3.50	120.65 4.75	158.75 6.25	206.40 8.13	266.70 10.50	317.50 12.50
O-ring I.D. x d	mm inch	88.49 × 3.53 3.48 × .139	88.49 × 3.53 3.48 × .139	120.24 × 3.53 4.73 × .139	158.34 × 3.53 6.23 × .139	202.79 × 3.53 7.98 × .139	266.29 × 3.53 10.48 × .139	316.87 × 7.00 12.47 × .275

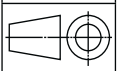
JIS B 2290: 1998 / ISO 1609

DN 65–300 (2½"–12")



DN	mm inch	65 2½	80 3	100 4	150 6	200 8	250 10	300 12
A	mm inch	70 2.76	70 2.76	70 2.76	70 2.76	80 3.15	100 3.94	120 4.72
B	mm inch	136 5.35	165 6.50	185 7.28	235 9.25	300 11.81	350 13.78	425 16.73
C	mm inch	120 4.72	135 5.31	160 6.30	210 8.27	270 10.63	320 12.60	370 14.57
D	mm inch	70 2.76	76 2.99	100 3.94	150 5.91	200 7.87	261 10.28	306 12.05
E x F		4 × M10	8 × M10	8 × M10	8 × M10	8 × M12	12 × M12	12 × M12
G	mm inch	13 0.51	13 0.51	13 0.51	13 0.51	15 0.59	15 0.59	16 0.63

Projection E



▼ Valve seat side



VAT Vakuumventile AG
CH-9469 Haag, Schweiz

Product data sheet

RF all-metal gate valve, Series 472, DN 63 (ID 2 ½")
Ordering No. 47236-CE74-0001

Description

Flange		DN 63 CF-F
Actuator		Pneumatic double acting, compact - with solenoid valve - with position indicator
Feed through		Bellows
Option	=	Standard

Technical data

Leak rate	– Valve body – Valve seat	$< 1 \cdot 10^{-10} \text{ mbar ls}^{-1}$ $< 1 \cdot 10^{-10} \text{ mbar ls}^{-1}$
Pressure range		XUHV to 2 bar (abs)
Test pressure		1 bar
Differential pressure on the gate		$\leq 1 \text{ bar}$
Differential pressure at opening		$\leq 500 \text{ mbar}$, 1 bar with reduced cycle life
Conductance (molecular flow)		400 ls^{-1}
Cycles until first service		10 000
Bake-out temperature (Maximum values: depending on operating conditions and sealing materials)	– Valve body – Actuator – Position indicator – Solenoid	$\leq 200 \text{ }^{\circ}\text{C}$ $\leq 200 \text{ }^{\circ}\text{C}$ (for max. 100h) $\leq 80 \text{ }^{\circ}\text{C}$ $\leq 80 \text{ }^{\circ}\text{C}$
Heating and cooling rate		$\leq 50 \text{ }^{\circ}\text{C h}^{-1}$
Material	– Valve body – Flange – Gate – Mechanism – Bellows – RF contact	1.4435, AISI 316 L 1.4435 ESU, AISI 316 L ESR 1.4435, AISI 316 L 1.4435, AISI 316 L 1.4435, AISI 316 L 1.4310, AISI 301 silver plated
Seal	– Bonnet – Gate – Actuator	metal, silver plated metal, silver plated Viton®
Mounting position		Any with beam line horizontal
Radiation resistance	– Valve body – Actuator – Position indicators – Solenoid	$10^8 \text{ Gy (} 10^{10} \text{ rad)}$ $10^5 \text{ Gy (} 10^7 \text{ rad)}$ $10^5 \text{ Gy (} 10^7 \text{ rad)}$ $10^4 \text{ Gy (} 10^6 \text{ rad)}$
Volume of pneumatic actuator		$0.7 \text{ l / } 0.024 \text{ ft}^3$
Compressed air min. – max. overpressure		4 - 8 bar / 58 - 116 psig
Compressed air connections		R ½" (USA: ⅝" NPT)

Created by: René Brulc	Release date: 09.01.2015	1/2
Modified by:	Release date:	781358EA



VAT Vakuumventile AG
CH-9469 Haag, Schweiz

Product data sheet

RF all-metal gate valve, Series 472, DN 63 (ID 2 ½")
Ordering No. 47236-CE74-0001

Actuation time
(valid for RT, Ø6mm tubing at 4 bar with
flow rate of 400 l/min)

- Closing
- Opening

≤ 2.0 sec
≤ 2.0 sec

Weight

21 kg / 46 lbs

Behavior in case of
compressed air pressure
drop

- Valve closed
- Valve open

Valve remains in closed position
Valve remains in open position

Behavior in case of power
failure

- Valve closed
- Valve open

Valve remains in closed position
Valve closes

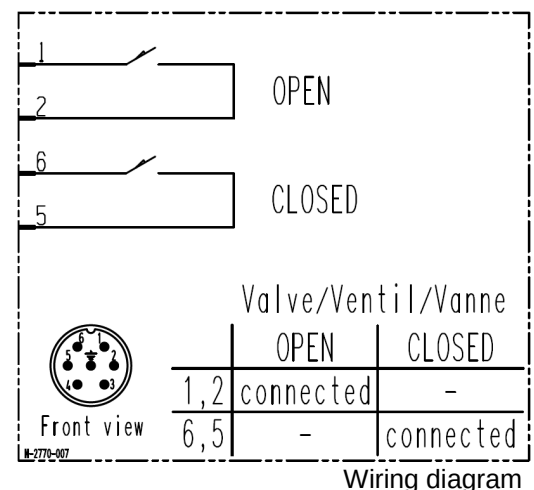
Related documents

Dimensional drawing No. 208127 A

Electrical connections

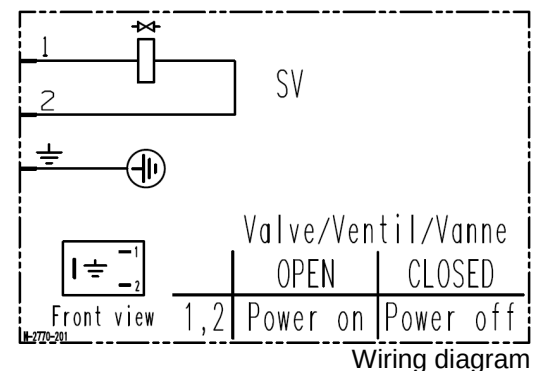
Position indicator

Type micro switch
Voltage ≤ 50 V AC / DC
Current max. ≤ 1.2 A



Solenoid

Voltage according to PO
Power consumption ≤ 2.5 W



Instruction Manual

QDP Drystar[®] Vacuum Pumps

Description

QDP40 Drystar Pump
QDP80 Drystar Pump (4 kW)
QDP80 Drystar Pump (8 kW)

Item Number

A528-40-905
A528-79-905
A528-80-905

Drystar is a registered Trademark of the BOC group of companies



Edwards High Vacuum International

Manor Royal, Crawley, West Sussex, RH10 2LW, UK

Telephone: (01293) 528844 Fax: (01293) 533453 Telex: 87123 Edivac G



We, Edwards High Vacuum International,
Manor Royal,
Crawley,
West Sussex RH10 2LW, UK

declare under our sole responsibility that the product(s)

Standard pumping system configured using the Q-matrix modular build structure,
as shown below

Pump(s) - QDP40 - QDP80 - QDP40/QMB250 - QDP40/QMB500 - QDP80/QMB250 - QDP80/QMB500 - QDP80/QMB1200 Gas Control - None - Gas Module - Gas Module & Exhaust Pressure Module - Shaft Seal Purge Module - Gas Module and Nitrogen Flow Switch - Gas Module, Exhaust Pressure Module and Nitrogen Flow Switch Mechanical Booster Frame - No Booster pump fitted - Direct mount (not available with QMB1200) - Booster Frame Enclosures - None - Standard Enclosures - Extractable Enclosure	Electrical supply 200-208 V, 50 Hz, 3-ph 200-208 V, 60 Hz, 3-ph 230 V 60 Hz, 3-ph 380-415 V, 50 Hz, 3-ph 460 V, 60 Hz, 3-ph Cables - None 1.5 metres (wall mounted controller) 1 metre (frame mounted controller) 7 metres cable only 7 metres armoured cable only Oil Level Monitor(s) - None - Oil Level Monitor Electrical control - None - Motor Control Module (End User version) - Motor Control Module (OEM 24 V d.c.) - Motor Control Module (OEM 24 V a.c.) - Q Series Controller with N₂ Flow/OLM alarms
--	--

and the following standard accessories, not configured via the Q-matrix:

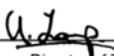
Water Cooled Exhaust Trap	A531-14-000
Enclosure Extraction Fan Kit	A223-01-006
Dual Enclosure Extraction Fans Kit	A528-60-000

to which this declaration relates is in conformity with the following standard(s)
or other normative document(s)

EN 60204-1	Electrical Safety: Machines.
------------	------------------------------

following the provisions of

89/392/EEC	Machinery Safety Directive.
89/336/EEC	Electromagnetic Compatibility Directive.
73/023/EEC	Low Voltage Directive.


Dr. A. P. Troup, Director of Technology


Date and Place

**iH1000 Dry Pump 460V, 60 Hz 3Ø**

A59030908

[Spares For This Pump](#)[Overview](#)[Prices & Options](#)[Features & Benefits](#)[Technical Data](#)[Accessories](#)[Documents & Support](#)**Technical Data**

Peak Speed	1000 m3h-1 589 cfm 16670 l min-1
Ultimate Vacuum	1 x 10-3 mbar 7.5 x 10-4 Torr 0.1 Pa
Typical shaft seal nitrogen flow	4 slm
Inlet Connection	ISO100
Outlet Connection	NW40
Typical cooling water flow at 15 psi pressure drop	240 l h-1
Weight	4 l min-1 430 kg
Power input at ultimate	3.8 kW
Rated motor power	6.1 kW
Oil Capacity	1.48 l

All figures are typical without gas ballast.

Performance 2

Dimensions

- 1 Inlet
- 2 Outlet
- 3 Air Extraction Port
- 4 Inverter Box (iH1000 Only)

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OPERATION MANUAL

MAGNETIC SUSPENDED COMPOUND MOLECULAR PUMP

TG710M/TG713M

→ TG1110M/TG1113M ←

TG2000M/TG2003M

For a safe operation, be sure to read this manual before operating the pump.
This is an important operation manual. Store it safely for a future reference.

OSAKA VACUUM, LTD.

Pump Model		TG710M TG713M	TG1110M TG1113M	TG2000M TG2003M
Specification.				
Flange	inlet foreline	DN160CF/DN160ISO-BF DN40KF	DN200CF/DN200ISO-BF DN40KF	DN250ISO-BF DN40KF
Pumping speed	L/s	700	1100	2000
Rotation speed	rpm	560		400
Startup/Shutdown time	min	5/5		10/10
Standard backing pump	m ³ /h	15		30
Weight	kg	38		70
Installation		In any position		
Permissible ambient temperature	°C	10-40		
Power Supply Model		TD701/1101		TD2001
Input voltage	ACV		200/220	
frequency	Hz		50/60	
phase			single	
power consumption	kVA	max.1.6		max.1.8
Weight	kg		23	
Permissible ambient temperature	°C		0-40	



BPG400 ATM to Ultra-High Vacuum Gauge

The INFICON Bayard-Alpert Pirani Combination Gauge, BPG400, functions as two gauges in a single compact unit measuring from 5×10^{-10} mbar to atmosphere (3.8×10^{-10} Torr to atmosphere). Combining technologies reduces the complexity of installation, setup, and integration. Choose the BPG400 for affordable and repeatable process to base pressure measurements in one economic package.

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Got a shot?

Send us your photo of an INFICON product at work. We'll send you a very cool gift!

Call to order

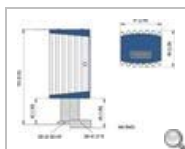
Contact your local representative

BENEFITS

- Extremely wide measurement range from 5×10^{-10} mbar to atmosphere (3.8×10^{-10} Torr to atmosphere)
- Excellent repeatability in the process pressure range from 10^{-8} ... 10^{-2} mbar of 5%
- The Pirani interlock protects the Bayard-Alpert system from premature filament burnout and excess contamination from high pressure operation
- Long-life yttrium oxide coated iridium filament
- Optional graphic display and Fieldbus interfaces available
- Automatic high vacuum Pirani adjustment reduces operator interventions
- RoHS compliance
- General vacuum measurement and control in the low to ultra high vacuum range

TYPICAL APPLICATIONS

- Pressure measurement in semiconductor process and transfer chambers
- Industrial coating
- General vacuum measurement and control in the low to ultra high vacuum range



SPECIFICATIONS

Type			BPG400
Measurement range (air, O ₂ , CO, N ₂)		mbar	5×10^{-10} ... 1000
Accuracy			
10^{-8} ... 10^{-2} mbar	% of reading		±15
Repeatability			
10^{-8} ... 10^{-2} mbar	% of reading		5
Degas (1)			
$p < 7.2 \times 10^{-6}$	mbar		electron bombardment, max. 3 min

Pressure, max.	bar (absolute)	2
Temperature		
Operation (ambient)	°C	0 ... +50
Storage	°C	-20 ... +70
Bakeout at flange with extension	°C	150
Bakeout at flange without extension	°C	80
Bakeout electronics removed	°C	150
Supply voltage	V (dc)	+20 ... +28
Output signal analog		
Output signal	V	0 ... +10
Measurement range	V	+0.774 ... +10
Voltage vs. pressure	volts per decade	0.75
Error signal	V	0.3 / 0.5
Load impedance, min.	kΩ	10
Interface (digital) (2)		RS232C
Electrical connection		D-Sub, 15-pin, male
Cable length, max. (3)	m (ft.)	100 (330)
Materials exposed to vacuum		Yt ₂ O ₃ , Ir, Pt, Mo, Cu, W, NiFe, NiCr, stainless steel, glass
Internal volume KF / CF	cm ³ (in. ³)	24 (1.46) / 34 (2.1)
Weight KF / CF	g	285 / 550
Degree of protection		IP30
Profibus DP		
Baud rates	kBaud	9.6 / 19.2 / 93.75 / 187.5 / 500
Address		2 switches (address 00 - 127) or network programmable
Digital functions		read pressure, select units: Torr, mbar, Pa; degas function, Pirani full scale adjust, monitor gauge status, safe state allows definition of behavior in case of error, detailed alarm and warning information
Analog functions		0 ... 10 V analog output pressure indication, two setpoint relays A + B
Setpoint relays: Number of setpoints		2
Setpoint relays: Range	mbar	1×10 ⁻⁹ ... 100
Setpoint relays: Relay contact		n.o., potential free

Setpoint relays: Hysteresis	% of reading	10
Setpoint relays: Contact rating	V (dc)	60
Connector for Profibus DP		D-Sub, 9-pin, female
Connector for BPG (analog output, supply voltage, setpoints)		D-Sub, 15-pin, male
DeviceNet™		
Protocol		DeviceNet™, group 2 slave only
Data rate switch	kBaud	125, 250, 500 or network programmable
Cable length 125 kbps	m (ft.)	500 (1650)
Cable length 250 kbps	m (ft.)	250 (825)
Cable length 500 kbps	m (ft.)	100 (330)
MAC ID		2 switches (address 00 - 63) or network programmable
Digital functions		read pressure, select units: Torr, mbar, Pa; degas function, Pirani full scale adjust, monitor gauge status, safe state allows definition of behavior in case of error, detailed alarm and warning information
Analog functions		0 ... 10 V analog output pressure indication, two setpoint relays A + B
Specification		DeviceNet™ "Vacuum Gauge Device Profile"
Device type		"CG" for combination gauge
I / O slave messaging		polling only
Setpoint relays: Number of setpoints		2
Setpoint relays: Range	mbar	1×10^{-9} ... 100
Setpoint relays: Relay contact		n.o., potential free
Setpoint relays: Hysteresis	% of reading	10
Setpoint relays: Contact rating	V (dc)	60
Supply voltage for DeviceNet™	V (dc)	+11 ... +25
Supply voltage for gauge	V (dc)	+20 ... +28
Connector for DeviceNet™		Microstyle, 5-pin

Connector for BPG
(analog output, supply
voltage, setpoints)

D-Sub, 15-pin, male

- 1) *Reduced accuracy during degas*
- 2) *Simultaneous use of RS232C or VGC40x controller series and Fieldbus is not allowed*
- 3) *For RS232C operation <30m*

PART NUMBER

BPG400

Part Number	Description
102072681	BPG400 BA Pirani Gauge; DN 25 ISO-KF.
353-500	BPG400 DN 25 ISO-KF
353-500-11	BPG400 BA Pirani Gauge; DN 25 ISO-KF
353-500-10	BPG400 BA Pirani Gauge; DN 25 ISO-KF
353-502-A	BPG400 BA Pirani Gauge; DN 40 CF-R
354-498	Spare electronic BPG400 without Display
354-499	Spare electronic BPG400 with Display
353-501	BPG400 LCD, DN 25 ISO-KF
353-502	BPG400 DN 40 CF-R
353-503	BPG400 LCD, DN 40 CF-R
353-505	BPG400-SP PBus, DN 25 ISO-KF
353-506	BPG400-SP PBus, DN 40 CF-R
353-507	BPG400-SD DNet, DN 25 ISO-KF
353-508	BPG400-SD DNet, DN 40 CF-R

ACCESSORIES

BPG400

Part Number	Description
353-510	100 mm sensor extension tube
353-511	Power supply BPG400 24VDC
353-512	Baffle for BPG400
211-113	Centering ring with baffle DN 25 KF

SPARE PARTS

BPG400

Part Number	Description
354-490	Spare sensor head BPG400, DN 25 ISO-KF
354-491	Spare sensor head BPG400, DN 40 CF-R

DATASHEETS

[BPG400 ES \(229 kB\)](#)

[BPG400 JA \(359 kB\)](#)

[BPG400 KO \(280 kB\)](#)

[BPG400 ZH \(357 kB\)](#)

[BPG400 DE \(229 kB\)](#)

[BPG400 EN \(227 kB\)](#)

BROCHURES

[Hot Ion gauge brochure \(2 MB\)](#)

MANUALS

[TIMA03D1 BPG400xx Gebrauchsanleitung kurz \(319 kB\)](#)

[TIMA03E1 BPG400xx Operating manual short \(314 kB\)](#)

[TINA03E1 BPG400-xx operating manual_long \(1 MB\)](#)

[TIMA36E1 BPG400xx operating manual-supplement \(326 kB\)](#)

[TIRA03E1 DeviceNet BPG400x Communication Protocol.pdf \(319 kB\)](#)

[TIRA36E1 Profibus BPG400x Communication Protocol.pdf \(399 kB\)](#)

3D STEP FILES

[353-500 BPG400 without LCD, DN 25 ISO-KF \(449 kB\)](#)

[353-502 BPG400 without LCD, DN 40 CF-R \(427 kB\)](#)

[352-501 BPG400 with LCD, DN 25 ISO-KF \(456 kB\)](#)

[353-503 BPG400 with LCD, DN 40 CF-R \(468 kB\)](#)

[353-505 BPG400-SP with Profibus DP, DN 25 ISO-KF \(468 kB\)](#)

[353-506 BPG400-SP with Profibus DP, DN 40 CF-R \(468 kB\)](#)

[353-507 BPG400-SD with DeviceNet™, DN 25 ISO-KF \(457 kB\)](#)

[353-508 BPG400-SD with DeviceNet™, DN 40 CF-R \(462 kB\)](#)

[354-490 BPG400 Replacement sensor DN 25 ISO-KF \(48 kB\)](#)

[354-491 BPG400 Replacement sensor DN 40 CF-R \(69 kB\)](#)

OTHER FILES

[BPG400-int.eds \(31 kB\)](#)

[BPG400-float.eds \(35 kB\)](#)

[BPG400_06A9.GSD \(2 kB\)](#)

[Inficon_400_SP_STEP7.zip \(856 kB\)](#)



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VGC40x Vacuum Gauge Controller

Your complete solution for process measurement and control.

Compatible to all INFICON active gauges, the VGC400 series of controllers can monitor the entire pressure range from 10^{-10} to 1500 mbar (10^{-10} to 1125 Torr) and the set point status.

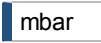
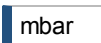
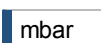
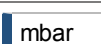
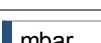
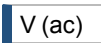
BENEFITS

- Automatic identification of the connected INFICON gauges
- User selectable measurement unit (mbar, Torr, Pascal, micron)
- High resolution – 16 bit A/D converter
- Up to six adjustable setpoints with adjustable hysteresis may be assigned to any channel
- Compliance & standards: CE, ETL, RoHS
- Programmable 0 to 10 V chart recorder output with logarithmic/ linear characteristics for each gauge or gauge combination (VGC402/403 only)
- Firmware upgrades available on-line are easily downloaded via the RS232 interface
- Versatile, compact bench-top model design can easily be mounted in a panel or 19" rack
- Widerange power supply 90 to 250 V, 50 to 60 Hz



SPECIFICATIONS

Type		VGC401	VGC402	VGC403
Measurement channels		1	2	3
Display		LED	LCD	LCD
Display Range		$2 \times 10^{-10} \dots 1500$	$5 \times 10^{-10} \dots 1500$	$5 \times 10^{-10} \dots 1500$
Rate	1/s	10	10	10
A/D converter	bit	16	16	16
Connectable gauges with display range				
CDG (A/D)		$1 \times 10^{-3} \times \text{FS} \dots 1 \times \text{FS}$	$1 \times 10^{-3} \times \text{FS} \dots 1 \times \text{FS}$	$1 \times 10^{-3} \times \text{FS} \dots 1 \times \text{FS}$
PCG550 (1)		$5 \times 10^{-4} \dots 1500$	$5 \times 10^{-4} \dots 1500$	$5 \times 10^{-4} \dots 1500$
PSG		$5 \times 10^{-4} \dots 1000$	$5 \times 10^{-4} \dots 1000$	$5 \times 10^{-4} \dots 1000$

MPG		5×10^{-9} ... 1000	5×10^{-9} ... 1000	5×10^{-9} ... 1000
PEG		1×10^{-9} ... 1×10^{-2}	1×10^{-9} ... 1×10^{-2}	1×10^{-9} ... 1×10^{-2}
BCG		5×10^{-10} ... 1500	5×10^{-10} ... 1500	5×10^{-10} ... 1500
BPG		5×10^{-10} ... 1000	5×10^{-10} ... 1000	5×10^{-10} ... 1000
HPG		2×10^{-6} ... 1000	2×10^{-6} ... 1000	2×10^{-6} ... 1000
BAG		2×10^{-10} ... 1×10^{-1}	2×10^{-10} ... 1×10^{-1}	2×10^{-10} ... 1×10^{-1}
Measurement unit (selectable)		mbar, Torr, Pascal, micron	mbar, Torr, Pascal, micron	mbar, Torr, Pascal, micron
Setpoints				
Setpoint relays		1	4	6
Channel assignment		1	1 or 2	1/2 or 3
Adjustment range		Sensor dependent	Sensor dependent	Sensor dependent
Hysteresis		adjustable	adjustable	adjustable
Relay contact		potential free change over contact	potential free change over contact	potential free change over contact
Contact rating		30	30	30
Connector SP		D-Sub, 9 pin, male	D-Sub, 25 pin, female	D-Sub, 25 pin, female
Analog output				
Range		0 ... 10 Volt , sensor analog output signal	0 ... 10 Volt , sensor analog output signal	0 ... 10 Volt , sensor analog output signal
Programmable analog output				
Connector		D-Sub, 9 pin, male	D-Sub, 9 pin, male	D-Sub, 9 pin, male
Interface RS232C (digital)				
Connector Interface		D-Sub, 9 pin, female	D-Sub, 9 pin, female	D-Sub, 9 pin, female
Power				
Supply	V	90 ... 250	90 ... 250	90 ... 250
Frequency	Hz	50 ... 60	50 ... 60	50 ... 60
Consumption	W	≤30	≤45	≤65
Operation temperature (ambience)	°C	+5 ... +50	+5 ... +50	+5 ... +50
(1) down to 5×10^{-4} with parametermode "PRE" adjustable				

PART NUMBER**VGC401**

Part Number	Description
398-010	VGC401 Vacuum Gauge Controller
398-010#A	VGC401 VACUUM GAUGE CONTROLLER

VGC402

Part Number	Description
398-020	VGC402 Vacuum Gauge Controller

VGC403

Part Number	Description
398-021	VGC403 Vacuum Gauge Controller

DATASHEETS

[VGC40x DE \(309 kB\)](#)
[VGC40x ZH \(413 kB\)](#)
[VGC40x EN \(309 kB\)](#)
[VGC40x JA \(410 kB\)](#)
[VGC40x KO \(354 kB\)](#)
[VGC40x ES \(309 kB\)](#)

MANUALS

[TINB01E1_Operating manual VGC401 \(1 MB\)](#)
[TINB07E1_Operating manual VGC402 and VGC403 \(923 kB\)](#)
[TIQA01D2_Installation manual for Controller \(227 kB\)](#)
[TIUA05D2_EC Declaration of Conformity \(21 kB\)](#)
[TINB07D1_Gebrauchsanleitung VGC402_403 Steuergerät.pdf \(668 kB\)](#)
[TIQA01D2_Installationsanleitung VGC40x.pdf \(226 kB\)](#)
[TINB01D1_Gebrauchsanleitung VGC401 Steuergerät.pdf \(1 MB\)](#)

3D STEP FILES

[398-010 VGC401 \(312 kB\)](#)
[398-020 VGC402 \(399 kB\)](#)
[398-021 VGC403 \(419 kB\)](#)

OTHER FILES

[Firmware Update VGC401 302-519-E.zip \(114 kB\)](#)
[Firmware Update VGC402 302-534-D.zip \(123 kB\)](#)
[Firmware Update VGC403 302-534-D.zip \(123 kB\)](#)