HPS Cooling

Cooling requirements

The SVT cooling system has the goal to control the temperature of the sensors and remove the heat dissipated by the Electronics. Since the SVT is in vacuum, the cooling system is key for the safety and performance of the detector. The main heat sources are the sensors with the hybrids and the heat dissipation of the Front End Boards which fan in the services to reduce the amount of wires through the vacuum flanges. An additional heat load is coming from the radiative heat exchange between the SVT U-support and the detector vacuum. The sensor modules need to be controlled to a sub-zero temperature, while the Front End board needs to be only thermally managed, removing the heat dissipated and keeping the active components to safe temperature, slightly above the room temperature. For this reason it has been decided to have two separate chillers with independent loops and controls.

	Set point	Heat Load	Radiative
Sensor Modules	-20^{o}C	75 W	10 W
Front End Board	< 30^{o}C	100 W	0

The thermal impedance between the refrigerant and the sensor is expected to be better than 10^{o}C and the set point for the two chiller are:

Set point Chiller1	-30C
Set point Chiller2	+20C

Additional thermal losses will take place through the cold lines for the SVT. With the chiller located at 25 ft max from the SVT and for a 3/8” pipe with 1” Armaflex insulation the thermal loss is

Piping Chiller1	-30^{o}C	100 W

Operations Requirements

The cooling system is required to be operated remotely from the control room since the experimental Hall will be locked when the beam is on. The operations must be continuous for several days, at least for the duration of a physics run. Moreover the detector may be required to be kept cold also when the beam is not in operation or at least all the time the electronics is powered. The main functionalities that must be monitored are the set point of the chiller, the presence of flow and the temperature of the coolant as is delivered to the SVT. A set of interlocks have to be established to protect the apparatus with respect the three main failure modes:

Cause	Probability	Detectable Signs	Consequences	Mitigation
Refrigerant Loss in the primary vacuum	Low	Vacuum pressure increase Overheating of the sensors Flow Switch trigger	Beam abort SVT Power Supply Off	Stop the chiller pump
Refrigerant Loss in the Hall-B	Low	Overheating of the sensors	SVT Power Supply Off	Stop the chiller pump
Chiller Trip	Low	Overheating of the sensors	SVT Power Supply Off	Restart the chiller pump Power Cycle On/Off

The Chiller

The chiller is a commercial unit from JULABO, Model Presto A80, air cooled, made for highly precise temperature control. It has a large heating and cooling capacities covering a working temperature range from -92 °C to +250 °C still with high flow rates, constant pressure, and a controlled build-up of pump pressure. All important information is displayed clearly and concisely over an integrated 5.7" industrial touch screen. Multiple interfaces, RS232 and Ethernet, permit remote control of the PRESTO® across networks and in superordinate control systems.

The refrigerant

Given the low temperature required, three heat transfer fluids might be considered: A Water-Ethanol mixture (50/50), a Silicone Oil (SYLTHERM) and a Hydrofluoroether (HFE-7000). In the comparison of these fluids the HFE has by far the lowest viscosity, which is also quite stable in the range from +20C to -40C. In heat capacity and heat conductivity HFE is, however, inferior to the other fluids. In order to compare the cooling performance of the different fluids one can for a fixed pressure drop derive the resulting flow and the temperature gradients along and perpendicular to the pipe. Assuming a pressure drop of Δp = 1 bar over a pipe of length L = 1m and inner diameter D = 4.86 mm (0.19"), one finds the values indicated in Table 1. At +20C the resulting flow is very similar for all fluids. At -20C, however, the flow of the ethanol-water mixture is reduced by a factor 10, while the flow for the other fluids does not change very much. The small flow of the ethanol-water mixture at -20C implies large temperature gradients along and perpendicular to the pipe, which rules out this fluid for our application. At -20C HFE and SYLTHERM show a similar temperature gradient along the pipe, being slightly higher for SYLTHERM. However, in the gradient perpendicular to the pipe the difference is more pronounced, HFE having a temperature gradient which is 30 % smaller than that of SYLTHERM. As can be seen from the table, there is no dramatic change in the properties of HFE even down to -40C. This means that a cooling system based on HFE is quite flexible in terms of operating temperature. Another advantage of HFE is the fact that it evaporates quickly and leaves a very small residue. Actually, HFE is commercially used as cleaning agent. A small leak in a cooling system filled with HFE would most likely not damage other components and the quantity of fluid lost would evaporate. On the other hand the SYLTHERM silicon oil does not evaporate and is very difficult to remove. That is of special concern in case of leaks inside vacuum. Given the above, 3M-HFE-7000 is our best candidate for the cooling fluid of the SVT.

Product		3M-HFE-7000 $C_4F_9OCH_3$	SYLTHERM XLT Silicon oil	Ethanol-Water 40:60	units
Density ρ	+20C	1506	846	935	kg/m^3
	-20C	1609	881	962	
	-40C	1660	899	974	
Viscosity ν	+20C	0.405	1.46	2.9	10^{-6} m2/s
	-20C	0.724	3.04	25.3	
	-40C	1.067	4.8	172	
Heat capacity cp	+20C	1173	1650	4027	J/(kg.K)
	-20C	1093	1547	3727	
	-40C	1053	1494	3507	
Heat Conductivity k	+20C	0.07	0.111	0.361	W/(m.K)
	-20C	0.078	0.119	0.344	
	-40C	0.082	0.123	0.336	
Vapor pressure	+20C	0.21	negligible		bar
	-20C	0.03	negligible		
	-40C	0.009	negligible		
Residue		< 2.0	106		ppm
Cost		~ 100	~ 100	10	USD/liter

for Δp = 1 bar, l = 1m and d = 4.8mm :2

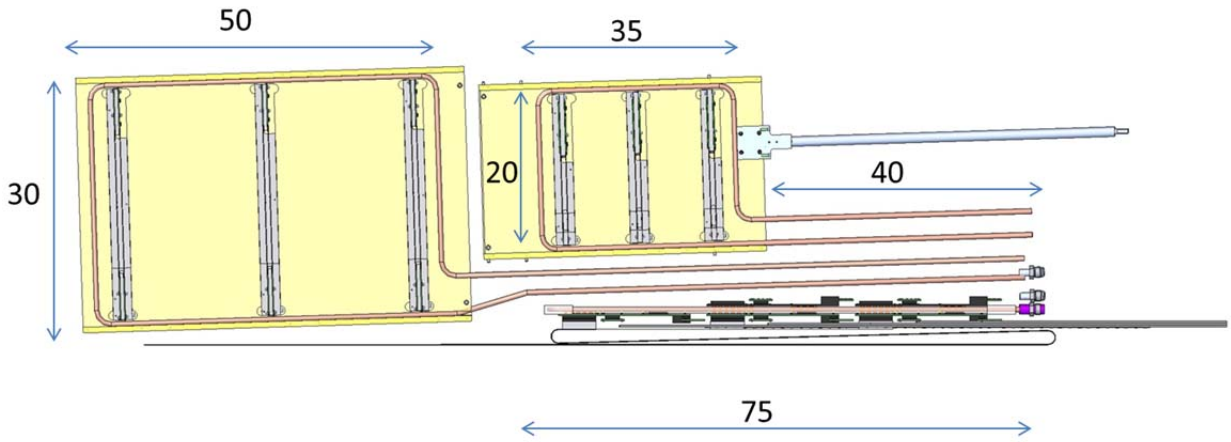
volumetric flow	+20C	0.58	0.67	0.56	l/min
	-20C	0.52	0.56	0.06	
	-40C	0.48	0.35	0.01	
$(T_{out}-T_{in})/P$	+20C	0.058	0.064	0.029	K/W
	-20C	0.066	0.078	0.27	
	-40C	0.072	0.128	1.952	
$\Delta T_{perp}*(A/P)$	+20C	2.2	2.7	1.4	$10^{-4}m^2K/W$
	-20C	2.9	4.1	20.1	
	-40C	3.5	7.1	209	

Internal Piping

The SVT will be operated under magnetic field (1.5 T max) and vacuum (~ 1e-6 Torr). The internal cooling line must be in not magnetic metal and with the minimum number of fittings to prevent potential leak, ideally brazing or welding where it is possible.

The SVT cooling is subdivided in two cooling channels, Top and Bottom, where the respective Layers13 and Layers46 are connected in series with full metal lines. The part of the circuit in close contact with the detector assembly is a rigid line made of OFE Copper 0.25", brazed to a flexible metal hose 0.25" in stainless steel which connects to the cooling feed through on the vacuum box. To allow the assembly and maintenance of the single layers, there are two sets of VCR fittings on each cooling line, one between Layer13 and Layer46 and one between Layer13 and the flexible hose to the feedthrough.

The FEB assembly plate is on an independent circuit made of a single line connected to a different chiller. As for the SVT, it is made of a rigid OFE copper pipe pressed in the cold plate, brazed to a flexible metal hose in Stainless Steel. A set of two VCR fittings connect the cooling line to the flexible meat hose brazed on the cooling feedthrough.

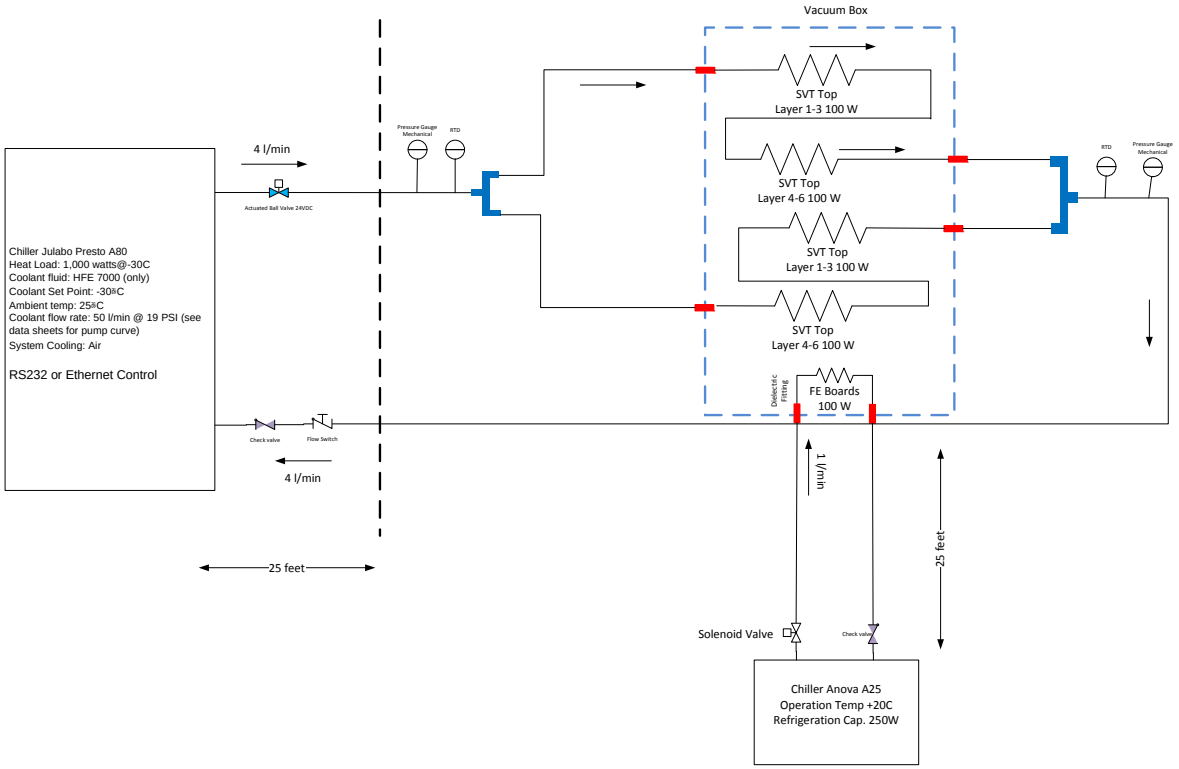


External Piping

The external piping connects the two chillers to the feedthrough on the vacuum box. The distance between the chiller and the HPS apparatus is expected to be < 25 feet. Because of the high volatility of the HFE, the SVT lines are 3/8" OFE copper with VCR fittings to minimize refrigerant losses, which may become a limiting factor for the operations and potential leaks in the Hall-B. The lines will be insulated with 1" foam sleeves to allow safe operation below the dew point and reduce the thermal losses when operated at the nominal temperature, i.e. -30C.

The FEB assembly will be cooled with a water-glycol mixture at ~ 20C, and the lines will be 3/8" non-metallic (FEP) and therefore flexible, with Swagelok fittings.

The dew point of the Hall-B is expected to be at ~18°C. The cold line from the Julabo Chiller to the vacuum box will be insulated with 1" thick not flammable Armaflex.



Control

All the instrumentation is placed on the external piping to facilitate the access. Two mechanical pressure dial gauges are located on the main lines close the vacuum box, before the manifold the split the flow for the Top and the bottom circuit of the SVT. Two RTDs (Pt100) temperature sensors are located at the same location and they are directly glue on the lines. An electrically (24VDC) actuated ball valve is located on the supply line at the chiller, with purpose to stop the flow in case of leaks. A flow switch flags leaks when the coolant flow is under a defined threshold. The two RTD sensors and the flow switch are interfaced with the Slow Control to provide diagnostic interlocked to the actuated ball valve and the chiller pump. Additional diagnostic and interlocks are available through the temperature sensors built-in the SVT modules and the functional parameters of the chillers like the bath temperature and the pump pressure, are controlled through an RS232 or Ethernet software interface.

Electrical Grounding.

The cooling line of the SVT is metallic and it must be electrical broken to provide the desired Grounding and Shielding. Liquid line feedthroughs with ceramic breaks are used to feed the cooling lines in the vacuum. They only break the electrical continuity with the vacuum box. Moreover, four ceramic breaks are mounted on the four lines (two inlets and two outlets) just before the vacuum feedthrough to

physically break the electrical path through the cooling line, upstream the vacuum box. Finally the metal hoses inside the vacuum box are electrically inslulated with dielectric sleeves.

Pressure Design and Test

The Internal piping has been pressure tested. Under normal operation the maximum pressure delivered by the chiller is 30 psi. When the pump is not circulating for long periods and the cold fluid is trapped inside the piping, it can still expand freely during the warm up, with the main chiller reservoir as expansion vessel. Even in case the ball valve is closed, the check valve has a cracking pressure low enough (few psi) to prevent pressure build up in the SVT volume. As worst case, assuming a thermal expansion coefficient for the HFE of 2.19e-3 K^{-1} and the fluid warming up from -30C to RT, i.e. $\Delta T=60$, the volume increase would be ~ 13%.

The system has been leak tested with Helium several time, at least every time the fittings were opened during the different assembly steps. Only in one occasion a small leak was detected on the ceramic break feedthrough, which was replaced and strain relieved. A pressure test up to 50 psi with an holding time of 15 minutes has been performed according the Pressure System Department at SLAC (See appendix)

Operation

Start up procedure

The chiller must be switched on before the detector is powered. For cold operations, i.e. below the dew point of the experimental hall, the primary vacuum around the SVT is required. These safe conditions are interlocked. Once the flow is stable and the temperature of the Silicon sensors is close to the chiller set point, the Power Supplies can be switched on.

Drain

To drain the system in case of an access required for maintenance, the entire detector must be powered off, the actuated valve open and the chiller set in Drain Mode (see manual).

Parts List (See appendix for the individual datasheets)

	Vendor/ specs
Chiller Presto A80	Julabo
Actuated Ball Valve 24VDC	STC
Flow Switch FS-380	GEM Sensor
Solenoid Valve	ASCO
Check Valve	Swagelok
Pressure Gauge	
RTD Sensors Pt100	Mouser
Ceramic Electrical Break 3/8”	ISO

SLAC
NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 14: Pressure Systems

Pressure Test Plan Form

Product ID: 614 | Revision ID: 1407 | Date Published: 24 July 2012 | Date Effective: 24 July 2012
URL: http://www-group.slac.stanford.edu/esh/eshmanual/references/pressureFormTestPlan.pdf

This form is required for documenting the test plan required for all pressure tests. The supervisor in charge of the test must approve; the pressure systems program manager must approve all tests other than routine hydrostatic tests of existing systems. Copies of the approved plan are kept by the custodian (for five years) and the pressure systems program manager (permanently). A single approved test plan may be used for several similar tests, but a separate test record is required for each test. (See Pressure Systems: Pressure Test Procedures.)

Pressure test plan number: PTP - 59	Project number:	Pressure system ID:
System description: HPS Cooling System - 20 FT LONG PIPE ASSEMBLY (B-084, R231)		
Test Information		
Type of test: ☐ hydrostatic ☒ pneumatic *(attach justification)*		
System design pressure: 2 bar	System design temperature: -30C	
Description of test configuration *(attach sketch or piping and instrument diagram)*:		
Test Parameters		
Required test pressure: 3 bar	Holding time: 15 MINS	
Test fluid: Argon	Fluid temperature: RT	
Test Equipment		
Type: gauge	Range: 0-60	Calibration date:
Environmental Controls		
Exclusion zone for safety of people *(consult project engineer or calculate stored energy)*:		
Test area controls *(barricades, signage, etc.)*: signs	Safe disposal of test fluid:	
Administrative Controls		
Qualifications of the test inspector(s) and technician(s):		
Inspection requirements *(before, during, and after the test)*: visual		
Pressure test procedures *(attach detailed steps)*:		
Approvals		
Supervisor in charge of test: Marco Oriunno	Signature: [signature]	Date: 10/01/2014
Pressure systems program manager *(not required for routine hydrostatic test of existing systems)*:	Signature: Mohammad Mahdi	Date: 10-1-2014

PRESTO A80

temperature control system / process system

Reactor temperature control, tests for all kinds of substances or temperature simulation – the new PRESTO are made for highly precise temperature control and rapid temperature changes.
PRESTO provide large heating and cooling capacities covering a working temperature range from -92 °C to +250 °C. Highly efficient components allow extremely fast compensation of exothermic and endothermic reactions.

Lab users benefit from high flow rates, constant pressure, and a controlled build-up of pump pressure. Changes in the temperature-control liquid's viscosity are balanced dynamically. Permanent internal monitoring and self-lubricating pumps contribute to the new PRESTO®'s long service life.

A special feature of the new PRESTO® is the integrated 5.7'' industrial touch screen.
All important information is displayed clearly and concisely enhancing ease of use considerably.
The new PRESTO® can be operated intuitively with the tip of your finger.

As the new PRESTO® operate whisper quiet, you will hardly hear them in your laboratory. Even high room temperatures of up to +40 °C will not make the new PRESTO® sweat. Maintenance-free pumps and drives guarantee operational readiness.

Multiple interfaces permit remote control of the PRESTO® across networks and in superordinated control systems. The Design does away with venting slots at the sides. The required installation space is reduced to an absolute minimum.

Your advantages

- For highly precise, external temperature applications
- Rapid heating and cooling
- Fast compensation of exothermic reaction
- Wide working temperature ranges without changing fluids
- Highest performance with small footprint
- Space-saving design optimizes space utilization in your lab
- NEW 5,7" industrial color TFT touch screen
- well-organized view of important information with unmatched, intuitive user friendliness
- Up to 3 user level with password management
- NEW USB (Host und Device)
- NEW Ethernet
- NEW SD-Card slot
- RS232 / optional RS485 / optional Profibus DP
- Stand-by input
- Filling system accessible from the top

Technical Data

Order No.	9420801
Category	Temperature Control PRESTO
Working temperature range (°C)	-80 ... 250
Temperature stability (°C)	±0.01 ... ±0.05
Setting / display resolution	0.01 °C
Integrated programmer	8x60 steps
Temperature Display	TFT Touchscreen
Heating capacity (kW)	1.5
Cooling capacity (Medium Ethanol)	
200°C	1.2 kW kW
100°C	1.1 kW kW
0°C	1.2 kW kW
-20°C	1.1 kW kW
-40°C	1.1 kW kW
-60°C	0.65 kW kW
-80°C	0.1 kW kW
Pump capacity flow rate (l/min)	16 ... 40
Pump capacity flow pressure (psi)	1.45...18.85
Pump connections	M24x1.5
Refrigerant	R23R507
External Pt100 sensor connection	integrated
Digital interface	RS232 RS485 Optional Profibus SD memory card USB Ethernet Modbus
Ambient temperature	5 ... 40 °C
Dimensions W x L x H (inch)	16.9 x 25.6 x 49.5
Weight (LBS)	362
Classification according to DIN12876-1	Classification III (FL)according to DIN 12876-1
Analog connection input / output	Optional
Cooling of compressor	2-stage Air

3M™ Novec™ 7000 Engineered Fluid

Introduction

3M™ Novec™ 7000 Engineered Fluid, 1-methoxyheptafluoropropane, is a nonflammable, low global warming potential (GWP) heat transfer fluid capable of reaching -120°C. It is also useful as a direct expansion refrigerant.

Applications

- Semiconductor
  - Ion implanters
  - Dry etchers
  - CVD/PVD tools
  - Electronic Automated Test Equipment (ATE)
- Industrial/Pharmaceutical
  - Chemical reactors
  - Freeze dryers
  - VOC capture
- Fuel cells
- Electronic Cooling
  - Supercomputers
  - Sensitive military electronics
  - High voltage transformers
- Electronics
  - Reliability testing
  - Temperature calibration
- Autocascade refrigeration
  - HCFC-123 replacement
- Medical Lab
  - Histobath working fluid

Benefits

- Low GWP (370, 100-year ITH)
- Excellent dielectric properties
  - In event of leakage or other failure, will not damage electronic equipment
- Zero ozone depletion potential (ODP)
- Good materials compatibility
- Low toxicity
- Nonflammable
- Non-corrosive
- Good thermal stability
- Useful at extreme low temperatures
  - Viscosity is less than 20 cSt at -120°C

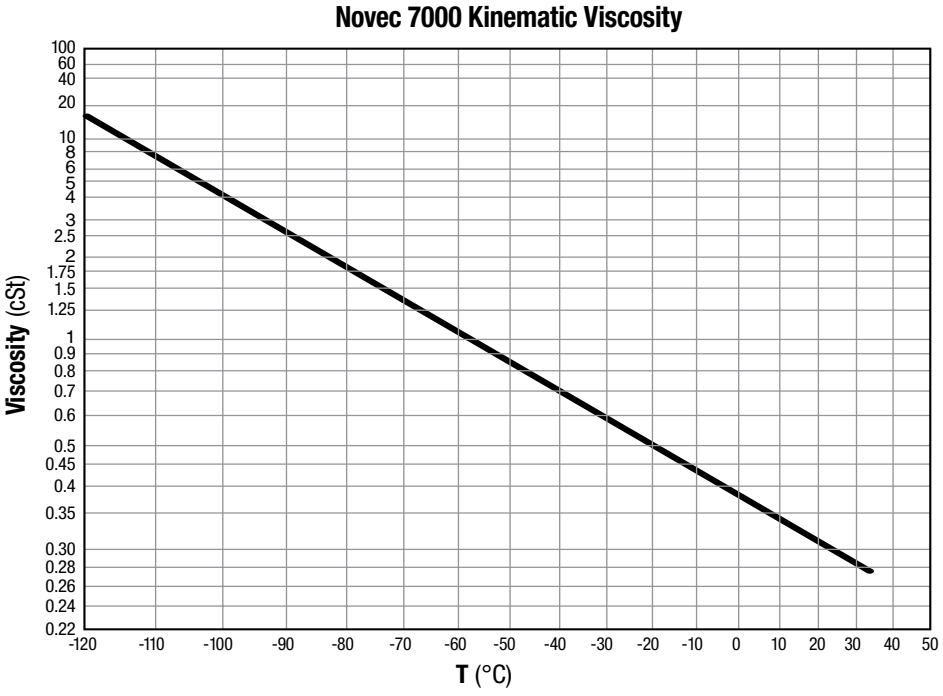
Material Description

Ingredients	Novec™ 7000 Engineered Fluid
1-methoxyheptafluoropropane ($C_3F_7OCH_3$)	99.5% by weight
Appearance	Clear, colorless
Non-volatile residue (NVR)	25.0 ppm maximum

Typical Physical Properties

Not for specification purposes. All values @ 25°C unless otherwise specified.

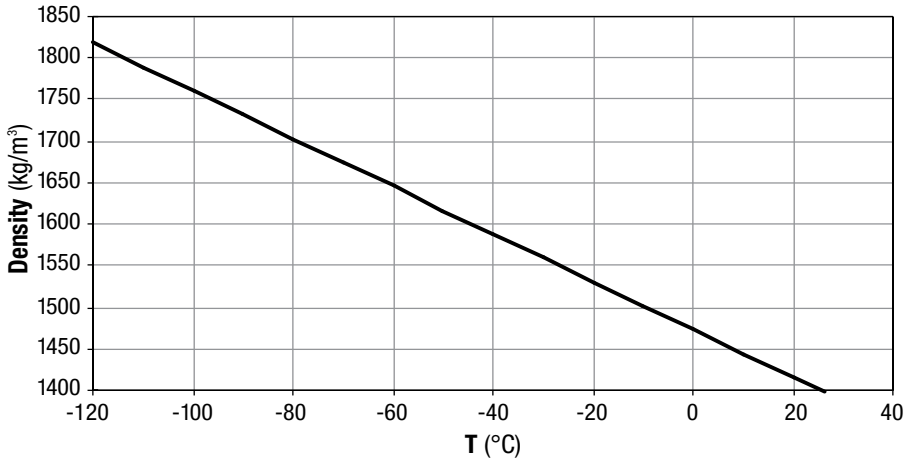
Properties	3M™ Novec™ 7000 Engineered Fluid
Molecular Weight (g/mol)	200
Boiling Point @ 1 atmosphere (°C)	34
Freeze Point (°C)	-122.5
Liquid Density (kg/m^3)	1400
Kinematic Viscosity (cSt)	0.32
Kinematic Viscosity @ -80°C (cSt)	2.0
Kinematic Viscosity @ -120°C (cSt)	17
Coefficient of Expansion	0.00219 K^{-1}
Critical Density (kg/m^3)	553
Critical Pressure (MPa)	2.48
Critical Temperature (°C)	165°C
Dielectric Constant	7.4
Dielectric Strength (kV)	~40
Latent Heat of Vaporization (kJ/kg)	142
Solubility of water in fluid (ppmw)	~60
Solubility of air in fluid (vol %)	~35
Specific Heat (J·kg^{-1}·K^{-1})	1300
Surface Tension (dynes/cm)	12.4
Thermal Conductivity (W·m^{-1}·K^{-1})	0.075
Vapor Pressure (kPa)	64.6
Volume Resistivity (ohm-cm)	108



Typical Physical Properties (continued)

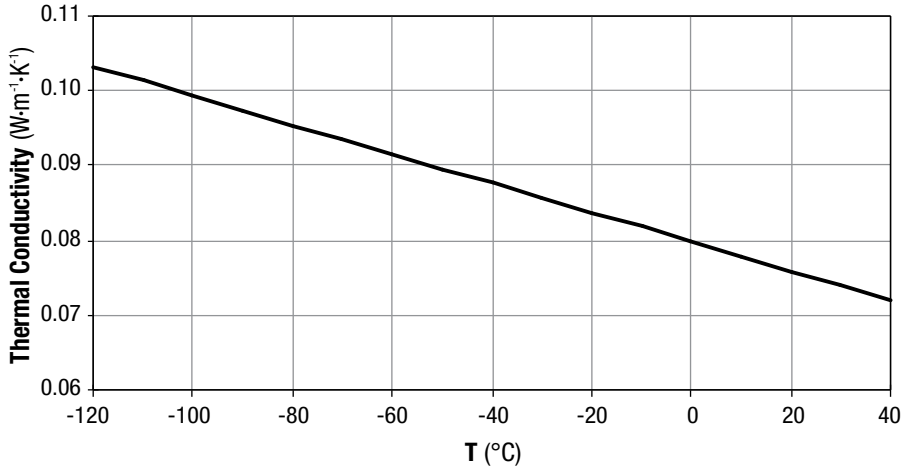
Not for specification purposes. All values @ 25°C unless otherwise specified.

Novec 7000 Liquid Density



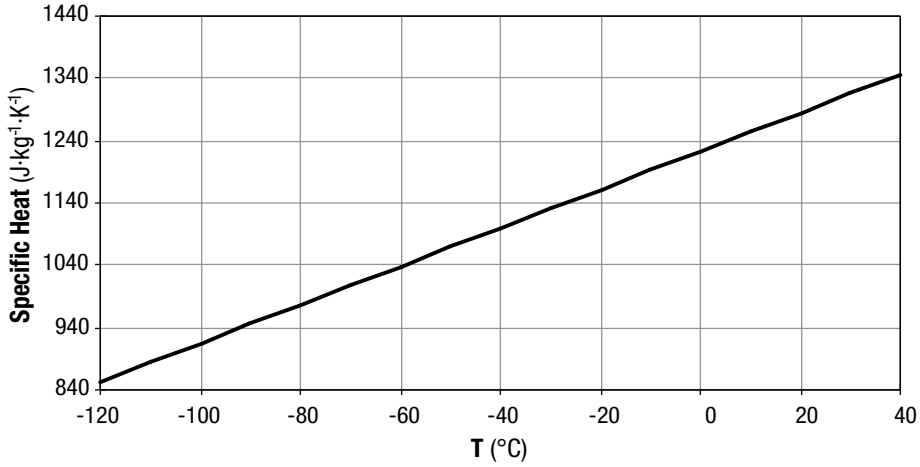
Liquid Density [kg/m^3] = 1472.6 - 2.880·T(°C)

Novec 7000 Thermal Conductivity



Thermal Conductivity [W·m^{-1}·K^{-1}] = 0.0798 - 0.000196·T(°C)

Novec 7000 Liquid Specific Heat



Liquid Specific Heat [J·kg^{-1}·K^{-1}] = 1223.2 + 3.0803·T (°C)

Novec 7000 Vapor Pressure

$$\ln(P[Pa]) = -3548.6/T[K] + 22.978$$
$$-30°C < T < T_c$$

Toxicity Profile

Not for specification purposes. All values @ 25°C unless otherwise specified.

The toxicological testing completed on 3M™ Novec™ 7000 Engineered Fluid indicates low acute and sub-acute toxicity. A 28-day inhalation study conducted at 1000, 10,000 and 30,000 ppm helped establish an exposure guideline of 75 ppmv for an average 8 hour work day. The No Adverse Effect Level (NOAEL) in this study was 1000 ppm. This data suggests there is a large margin of safety for use of this fluid in relatively non-emissive heat transfer systems.

Toxilogical Test Results

Properties	Novec™ 7000 Engineered Fluid
Acute Lethal Concentration (ppmv)	>30,000
8 hr Exposure Guideline (ppmv)	75
Skin Irritation	Negative[1]
Mutagenicity	Negative[1]
Ecotoxicity (water solubility < 2.5 ppb)	Very low aquatic toxicity
Acute Oral Toxicity	LD50 > 2000 mg/kg[1]
28-day Inhalation	NOAEL=1000 ppm

[1] A. Sekiya and S. Misaki, "*The potential of hydrofluoroethers to replace CFCs, HCFCs and PFCs*" J. of Fluorine Chemistry, 101, 2000, pp. 215-221.

Environmental Properties

Properties	Novec™ 7000 Engineered Fluid
Ozone Depletion Potential[1] (ODP)	0.0
Global Warming Potential[2] (GWP)	370
Atmospheric Lifetime (years)	4.9
Flash Point	None

[1] CFC-11 = 1.0
[2] GWP 100-year integrated time horizon (ITH)

Environmental, Health and Safety

Before using this product, please read the current product Material Safety Data Sheet (available through your 3M sales or technical service representative) and the precautionary statement on the product package. Follow all applicable precautions and directions.

3M™ Novec™ 7000 Engineered Fluid is nonflammable. The fluid is resistant to thermal breakdown and hydrolysis during storage and use. Recommended handling procedures are provided in the Material Safety Data Sheet, which is available from your local 3M representative upon request.

Materials Compatibility

Novec 7000 fluid is compatible with most metals and hard polymers such as:

Metals	Plastics
Stainless Steel	Polypropylene
Brass	Polyethylene
Copper	Nylon
Aluminum	Polyacetyl
	PEEK
	PTFE

Elastomeric materials should be limited to those compounds that contain the least amount of extractible plasticizer. 3M engineers can suggest appropriate compounds or assist with test procedures.

Heater Selection

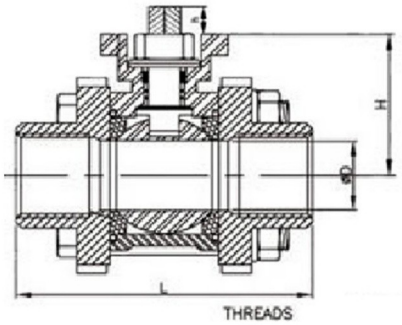
The critical heat flux of Novec 7000 fluid is 18 W/cm^2 when boiling from a horizontal 0.5 mm diameter platinum wire in a quiescent pool of saturated fluid. The maximum heat flux obtainable in forced convection applications will be significantly higher, but depends strongly upon the geometry and flow conditions. A safety interlock between the pump and heater is strongly recommended in applications with heat fluxes exceeding 15 W/cm^2.

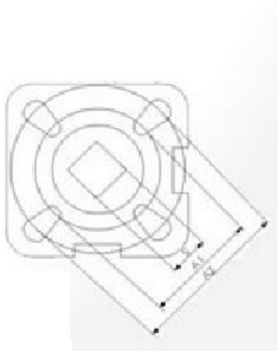
Regulatory Status

Novec 7000 fluid is available for commercial sale in the United States, China, Malaysia, Singapore and Taiwan and is currently under review by regulatory agencies in Europe, Japan, the Philippines and Korea.

Contact your local 3M representative for an update on the regulatory status of Novec 7000 fluid.

2 & 3 WAY BALL VALVE BODY DIMENSIONS & SPECIFICATIONS



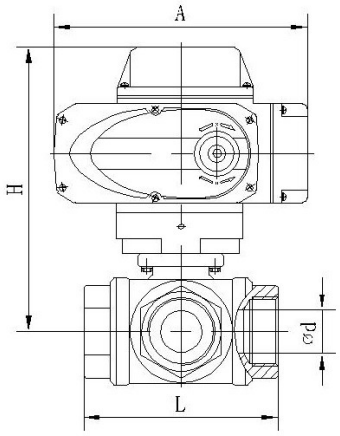


2 & 3 WAY VALVE BODY Dimensions (mm)									
Part No.	Part No.	SIZE						ISO05211	
2 WAY	3 WAY (L port)	NPT	D	L	H	h	S	A1	A2
V3-1/2A	V3-1/2LA	1/2"	15	75	38	9	9	F03	F04
V3-3/4A	V3-3/4LA	3/4"	20	80	47	9	9	F03	F04
V3-1A	V3-1LA	1"	25	90	57.2	11	11	F04	F05
V3-1 1/4A	V3-1 1/4LA	11/4"	32	110	62.5	11	11	F04	f05
V3-1 1/2A	V3-1 1/2LA	11/2"	38	120	77.5	14	14	F05	F07
V3-2A	V3-2LA	2"	50	140	86.5	14	14	F05	F07
V3-2 1/2A	V3-2 1/2LA	21/2"	65	162	108	17	17	F07	F10
V3– 3A	V3– 3LA	3"	80	184	115	17	17	F07	F10
V3-4A	V3-4LA	4"	100	228	141	22	22	F07	F10

Valve Specifications		
	2 Way Valve	3 Way Valve
Operating Pressure	3/8" to 2": 1000 PSI @ 100ºF WOG	
	2 1/2" to 4" : 800 PSI @ 100ºF WOG	
Operating Temperature	-60 to 450ºF*	
Port	Full Port	Reduced Port
Port Connection	End Connections: FNPT; Options: Tri-clamp, Flange, Butt Weld	
Mounting standard	DIN 3203-M3, ISO 5211 MOUNTING PAD, ISO5211 PLATFORM	

Main Parts and Materials			
No	Part Name	Material	Qty
1	SEAT	PTFE	2
2	BALL	SS316	1
3	JOINT GASKET	PTFE	1
4	CAP	SS316	1
5	BODY, BODY CONNECTOR	SS316/ CF8M	1, 2
6	STEM	SS316	1
7	THRUST WASHER	PTFE	1
8	STEM PACKING	PTFE	1
9	GLAND NUT	SS304	1
10	STEM WASHER	SS304	1
11	STEM NUT	SS304	1
14	BODY CONNECTOR BOLT	SS304	4
15	BODY CONNECTOR NUT & WASHER	SS304	4

ELECTRIC ACTUATED 3 WAY BALL VALVE SPECIFICATIONS



Port (NPT)	d, Orifice (mm)	L (mm)	A (mm)	H (mm)	ACTUATOR
1/2”	10	68	55	103	E-02
3/4”	15	78	55	112	E-02
1/2”	10	68	160	144	E-05
3/4”	15	78	160	154	E-05
1”	18	86	160	164	E-05
1 1/4”	25	111	160	178	E-05
1 1/2”	32	126	160	188	E-05
2”	40	143	198	230	E-10
2 1/2”	50	200	255	290	E-20

Specifications		
	2 Way Valve	**3 Way Valve**
Operating Pressure	3/8" to 2": 1000 PSI @ 100ºF WOG	
	2 1/2" to 4" : 800 PSI @ 100ºF WOG	
Media Temperature	14 to 356ºF* (-10 to 180ºC)	
Ambient Temperature	14 to 140ºF* (-10 to 60ºC)	
Port	Full Port	Reduced Port
Port Connection	End Connections: FNPT; Options: Tri-clamp, Flange, Butt Weld	
Mounting standard	DIN 3203-M3, ISO 5211 MOUNTING PAD, ISO5211 PLATFORM	

Main Parts and Materials			
No	Part Name	Material	Qty
1	SEAT	PTFE	2
2	BALL	SS316	1
3	JOINT GASKET	PTFE	1
4	CAP	SS316	1
5	BODY, BODY CONNECTOR	SS316/ CF8M	1, 2
6	STEM	SS316	1
7	THRUST WASHER	PTFE	1
8	STEM PACKING	PTFE	1
9	GLAND NUT	SS304	1
10	STEM WASHER	SS304	1
11	STEM NUT	SS304	1
14	BODY CONNECTOR BOLT	SS304	4
15	BODY CONNECTOR NUT & WASHER	SS304	4

ELECTRIC ACTUATOR SPECIFICATIONS

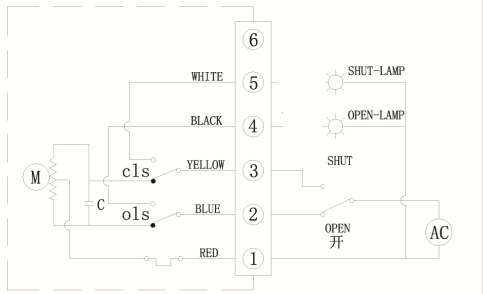
Electric Actuator Specifications		
Model	E-02	E-05 to 200
Operating Temperature & RH	60-130 ºF, 10-90%RH	-22 to 140 ºF (-30 to 60 ºC) , 10-90%RH
Electrical Protection	IP 65	IP 68
Installation Position	Any Orientation	Any Orientation
Voltage Options	24VDC, 110 & 220 VDC (50/60HZ)	24VDC, 110 & 220 VDC (50/60HZ)
Enclosure	Die-Cast Aluminum (Powder Coated)	Die-Cast Aluminum Alloy (Powder Coated)

	Model	Torque	Cycle Time DC/AC	Drive Motor 24DC	Drive Motor 24-380AC	Weight	Special function	Signal	Ball Valve Diameter (DN)	Butterfly Valve Diameter (DN)	Rotation
	E-02	6N * M	7S		4.6W	0.5Kg	On-off light	Light Indicator	15-20		90°
	E-05	50N * M	7S/20S	10W	15W	2.6Kg	On-off light	Light Indicator	15-40	32-65	90°
	E-10	100N * M	10S/30S	20W	25W	3.7Kg	On-off light	Light Indicator	50-65	50-125	90°
	E-20	200N * M	12S/30S	40W	40W	6.7Kg	On-off light	Light Indicator	65-80	150-200	90°
	E-40	400N * M	15S/30S	70W	90W	7.2Kg	On-off light	Light Indicator	80-100	200-250	90°
	E-60	600N * M	20S/45S		90W	7.3Kg	On-off light	Light Indicator	100-125	250-300	90°
	E-100	1000N * M	NA/30S		100W	7.3Kg	On-off light	Light Indicator	125-150	300-400	90°
	E-200	2000N * M	NA/100S		100W	11.2Kg	On-off light	Light Indicator	150-300	450-700	90°
	E-02S	6N * M	7S		4.6W	0.5Kg	On-off light	Light Indicator	15-20		90°
	E-05S	50N * M	20S	10W	15W	2.6Kg	Passive contact	contact signal	15-40	32-65	90°
	E-10S	100N * M	30/60S	20W	25W	3.7Kg	Passive contact	contact signal	50-65	50-125	90°
	E-20S	200N * M	30/60S	40W	40W	6.7Kg	Passive contact	contact signal	65-80	150-200	90°
	E-40S	400N * M	30/60S	70W	90W	7.2Kg	Passive contact	contact signal	80-100	200-250	90°
	E-60S	600N * M	45S		90W	7.3Kg	Passive contact	contact signal	100-125	250-300	90°
	E-100S	1000N * M	50S		100W	7.3Kg	Passive contact	contact signal	125-150	300-400	90°
	E-200S	2000N * M	100S		100W	11.2Kg	Passive contact	contact signal	150-300	450-700	90°
	E-02R	6N * M	7S		4.6W	0.5Kg	On-off light	Light Indicator	15-20		90°
	E-05R	50N * M	20S	10W	15W	2.6Kg	1K、5K potentiometer	Opening signal	15-40	32-65	90°
	E-10R	100N * M	30/60S	20W	25W	3.7Kg	1K、5K potentiometer	Opening signal	50-65	50-125	90°
	E-20R	200N * M	30/60S	40W	40W	6.7Kg	1K、5K potentiometer	Opening signal	65-80	150-200	90°
	E-40R	400N * M	30/60S	70W	90W	7.2Kg	1K、5K potentiometer	Opening signal	80-100	200-250	90°
	E-60R	600N * M	45S		90W	7.3Kg	1K、5K potentiometer	Opening signal	100-125	250-300	90°
	E-100R	1000N * M	50S		100W	7.3Kg	1K、5K potentiometer	Opening signal	125-150	300-400	90°
	E-200R	2000N * M	100S		100W	11.2Kg	1K、5K potentiometer	Opening signal	150-300	450-700	90°
	E-02T	6N * M	7S		4.6W	0.5Kg	On-off light	Light Indicator	15-20		90°
	E-05T	50N * M	20S	10W	15W	2.6Kg	Proportional Control	4-20mA	15-40	32-65	90°
	E-10T	100N * M	30/60S	20W	25W	3.7Kg	Proportional Control	4-20mA	50-65	50-125	90°
	E-20T	200N * M	30/60S	40W	40W	6.7Kg	Proportional Control	4-20mA	65-80	150-200	90°
	E-40T	400N * M	30/60S	70W	90W	7.2Kg	Proportional Control	4-20mA	80-100	200-250	90°
	E-60T	600N * M	45S		90W	7.3Kg	Proportional Control	4-20mA	100-125	250-300	90°
	E-100T	1000N * M	50S		100W	7.3Kg	Proportional Control	4-20mA	125-150	300-400	90°
	E-200T	2000N * M	100S		100W	11.2Kg	Proportional Control	4-20mA	150-300	450-700	90°

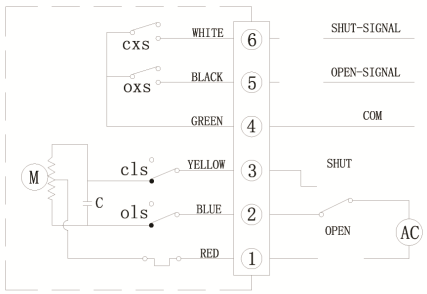
Electric Actuator Wiring Diagram

Actuator with ON/OFF Indicator

B type：ON-OFF TYPE WIRING DIAGRAM （standard）

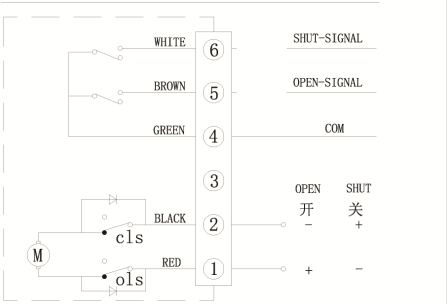


S type：PASSIVE CONTACT SIGNAL WIRING DIAGRAM

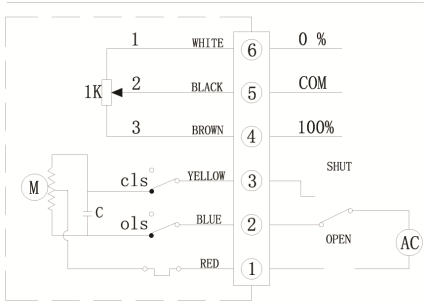


Actuator with 1 to 5 K Potentiometer

D type：ON-OFF TYPE QIRING DIAGRAM (VOLTAGE:DC)

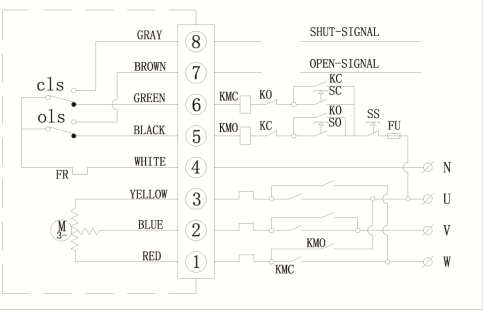


R type：WITH 1K OR 5K POTENTIOMETER

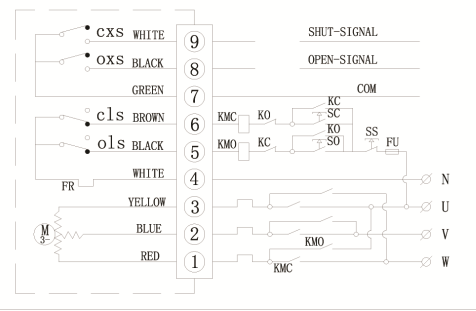


Actuator with Passive Contact

H type：AC380V ON-OFF TYPE WIRING DIAGRAM



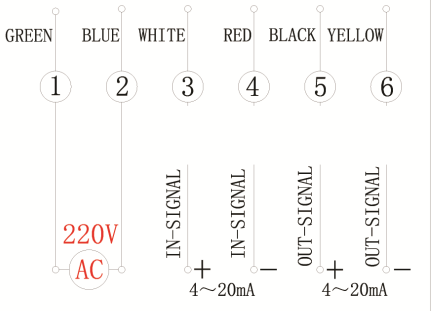
T type：AC380V PASSIVE CONTACT SIGNAL WIRING DIAGRAM



Actuator with 4-20mA Proportional Control

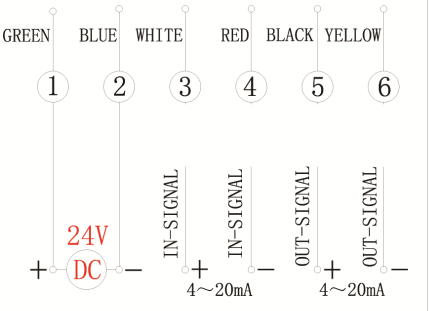
PROPORTIONAL CONTROL

A type：INTELLIGENT REGULATOR TYPE (VOLTAGE:AC)

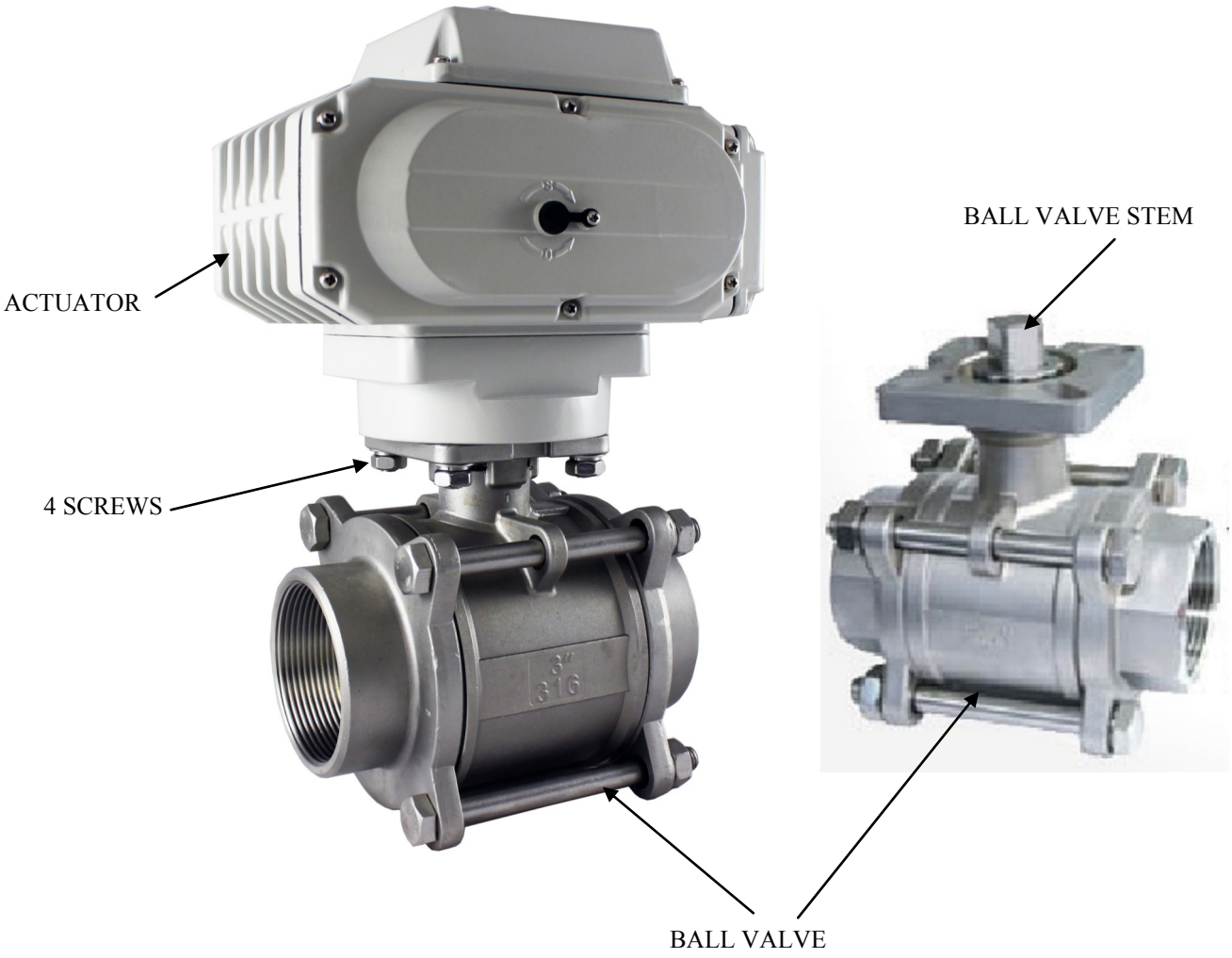


PROPORTIONAL CONTROL

A type：INTELLIGENT REGULATOR TYPE (VOLTAGE:DC)



To re-configure a normally closed air actuated valve to a normally open valve



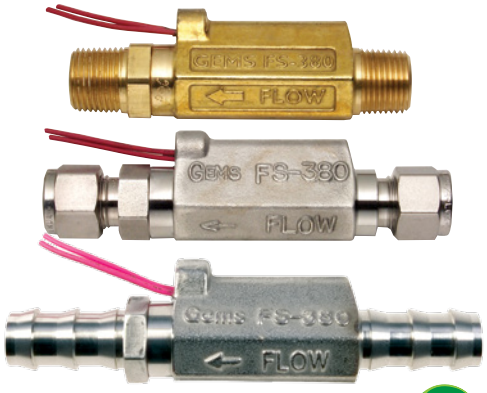
To re-configure a normally closed valve to a normally open valve:

1. Disconnect the power supply to the electric ACTUATOR.
2. Remove the 4 SCREWS on the bottom of the ACTUATOR
3. Remove the BALL VALVE from the ACTUATOR
4. Turn the BALL VALVE STEM on the ball valve 90 degree such at the valve is fully open (visually inspect the ball to make sure it is open)
5. Put the BALL VALVE back into the ACTUATOR and re-install the 4 SCREWS.

FS-380 Series – Compact Flow Switch for High Inline Pressures

Flow Rate Settings: 0.15 GPM to 2.00 GPM
Port Size: Multiple
Primary Construction Material: Brass or Stainless Steel
Setting Type: Fixed

These rugged inline flow switches require 100 micron filtration and are less susceptible to clogging than other high-pressure inline flow switches. The one-piece magnetic PPS composite piston makes the FS-380 ideal for high-pressure applications such as industrial cleaning equipment. The FS-380 is also an excellent choice for semicon cooling applications where simple design and reliable operation are required.



U.L. Recognized
File No. E31926

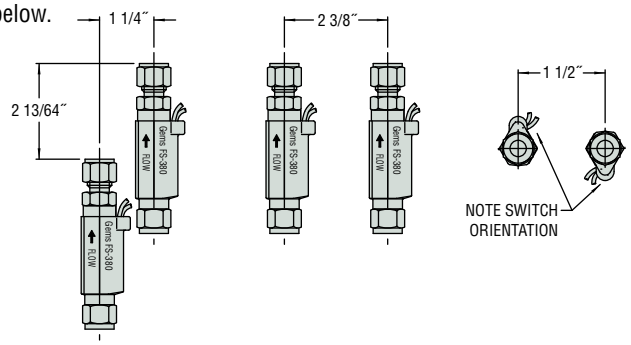
Specifications

Wetted Materials	
Housing	Brass or 316 Stainless Steel
Piston	PPS Composite, Epoxy
Spring	316 Stainless Steel
O-Ring	Fluorocarbon
Operating Pressure, Maximum	1500 PSI (107 bar); 500 PSI (34 bar) for 1/2″ Barb Models
Operating Temperature	-20°F to +275°F (-28.8°C to +135°C)
Set Point Accuracy	±20% Maximum
Set Point Differential	20% Maximum
Switch*	SPST, 20VA, N.O. at no Flow
Electrical Termination	No. 22 AWG, 24″ to 26″ Polymeric leads

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

Spacing

To prevent sensor to sensor magnetic field interference, follow the spacing guidelines below.



How To Order – Standard Models

Specify Part Number based on flow settings.

Flow Settings GPM[1]	Brass		Stainless Steel		
	1/2″ NPT Male	3/8″ NPT Male	3/8″ NPT Male	3/8″ Compression	1/2″ Barb
0.15	—	181130 ⚡	193482 ⚡	212136	239693
0.25	192562 ⚡	168432 ⚡	179992 ⚡	177592 ⚡	239692
0.50	192563	168433 ⚡	179993 ⚡	177593	239691
1.00	192564 ⚡	168434 ⚡	179994 ⚡	177594 ⚡	239690
1.50	192566	168435	179995 ⚡	177595 ⚡	239689
2.00	192567	178353 ⚡	179996	225525	239688

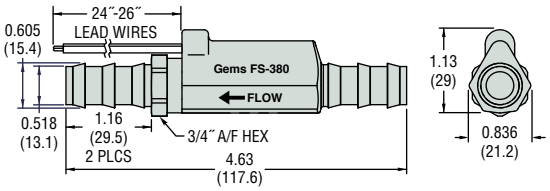
⚡ – Stock Items.

Note:
1. Flow settings are calibrated using water @ 70°F on increasing flow with units in horizontal position. Consult factory for other fluid compatibility.

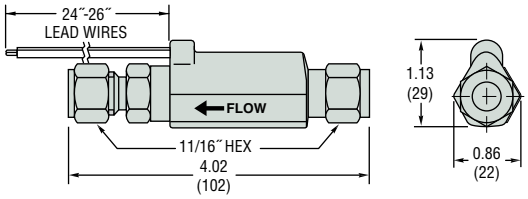
Dimensions

inch (mm)

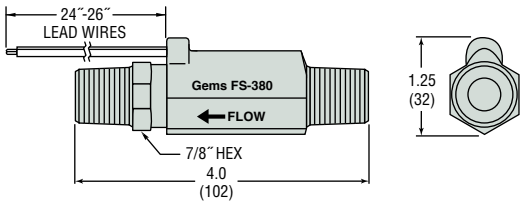
1/2″ Hose Barb Fitting



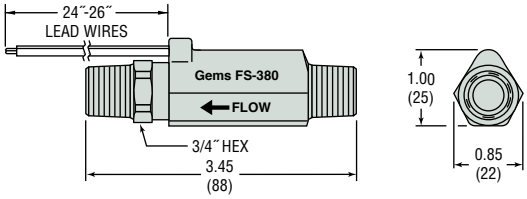
3/8″ Tube End Compression Fitting



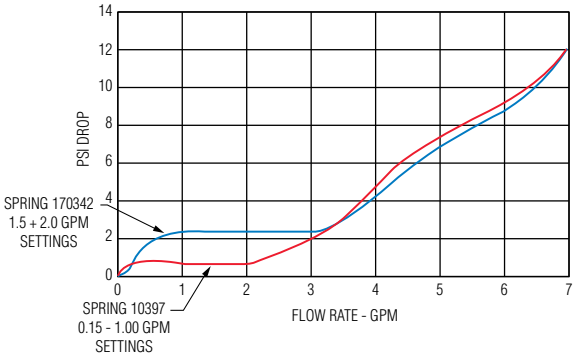
1/2″ NPT Ports



3/8″ NPT Ports



Pressure Drop – Typical



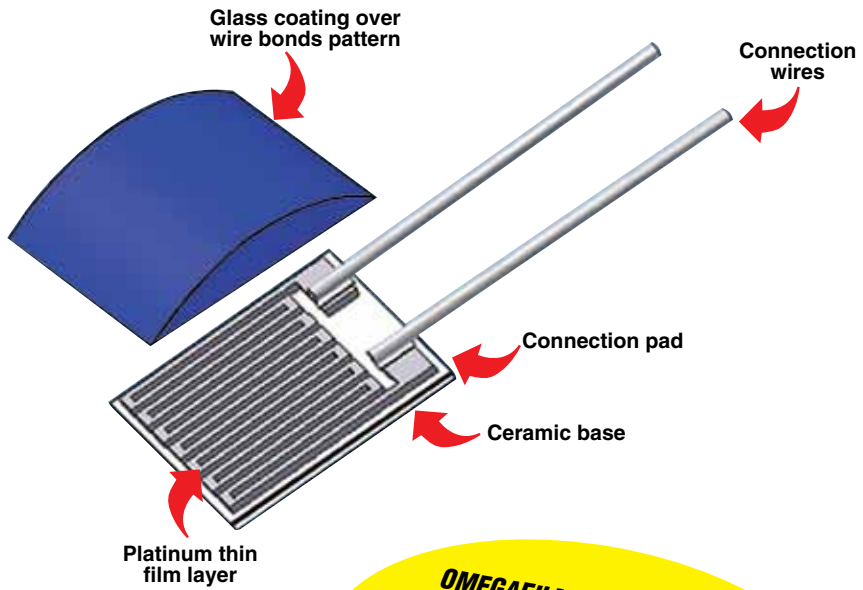
FLOW SWITCHES

OMEGAFILM® Platinum RTD Sensors

"F" SERIES
In Multiples of 100 Pieces

MADE IN USA

- **Available in Various Sizes, Resistances, and Accuracies**
- **Single and Dual Element Configurations**
- **Flat or Cylindrical Shapes**
- **Response Times Equivalent or Better Than Wire Wound Elements**



OMEGAFILM® Sensing Elements Can Be Used As-Is, or Packaged in a Wide Variety of Sensor Styles. Custom Packaging Options Are Also Available, Contact Omega's Applications Engineering Department to Discuss Your Specific Needs.

OMEGAFILM® platinum RTD elements are manufactured using materials and processes similar to those employed in the manufacture of integrated circuits. This results in a rugged, reliable sensing element that can be produced in a wide range of sizes, resistances, and accuracies to meet even the most demanding of applications.

The resistance vs. temperature relationship of OMEGAFILM RTDs conform to the internationally accepted IEC60751 standard. RTDs conforming to this standard have a temperature coefficient of resistance (also known as Alpha) of 0.00385Ω/Ω/°C between 0 and 100°C.

As a result OMEGAFILM RTD elements can be used worldwide with a multitude of controllers and instruments designed to function within these requirements.

OMEGAFILM RTDs are available in flat, round, and specialty shapes for maximum flexibility. They are also available in resistances at 0°C that include 100, 500, and 1000 Ω depending on the element style (the resistances available for each style will be shown on their individual pages).

OMEGAFILM® elements are manufactured to meet the requirements of IEC Standard 60751. This standard uses “Classes” to define the accuracy and interchangeability for the elements, the basic resistance vs. temperature characterisitcs, temperature ranges and other technical information relating to the OMEGAFILM RTD elements. Key portions of these requirements are summarized below.

Thin Film Interchangeability in °C			
Temp °C	Class B	Class A	⅓ DIN (AA)
-50	0.55	—	—
-30	0.45	0.21	—
0	0.30	0.15	0.10
100	0.80	0.35	0.27
150	1.05	0.45	0.36
200	1.30	0.55	—
300	1.80	0.75	—
400	2.30	—	—
500	2.80	—	—

Accuracy Classes

There are three accuracy “Classes” defined in IEC60751 for film type RTDs, they are: “Class A”, “Class B”, and ⅓ DIN (also known as AA).
These “Classes” are defined as follows:

Tolerance (°C)	Temperature Range*
Class A = ±(0.15 + 0.002t)	(-30 to 300°C)
Class B = ±(0.30 + 0.005t)	(-50 to 500°C)
Class AA (was ⅓ DIN) = ±(0.1 + 0.0017t)	(0 to 150°C)
t = Temperature °C	

Note: *There is also an industry standard 1/10 DIN accuracy not available in film style RTDs.*
**** Note:*** *The temperature ranges shown are not the temperature ratings for the sensors. Temperature ranges for each product have been provided, please see the applicable page.*

Equations

Platinum RTD resistance can be calculated using the Callendar-Van Dusen Equation as follows:

For temperatures below 0°C:
$Rt = R0 [1 + At + Bt^2 + C(t-100)t^3]$

For temperatures above 0°C, this simplifies to:
$Rt = R0 (1 + At + Bt^2)$

where: $A = 3.9083 \times 10^{-3}$ (C^{-1})
$B = -5.775 \times 10^{-7}$ (C^{-2})
$C = -4.183 \times 10^{-12}$ (C^{-4})
R0 = Resistance at 0°C
t = Temperature in degrees celsius

Maximum Operating Current

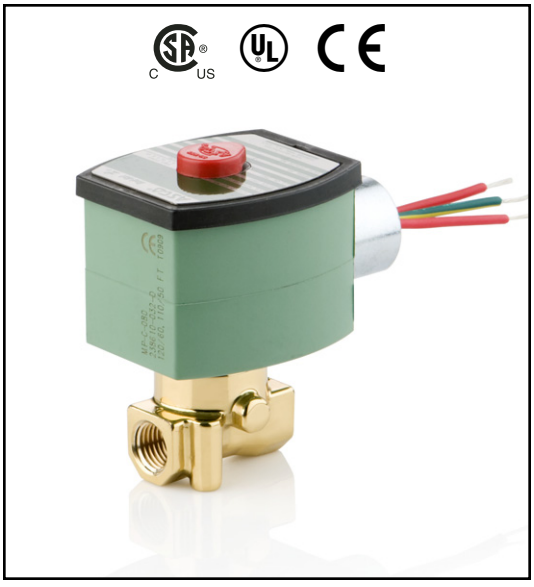
The maximum operating current is determined by the amount of electrical current that can be passed through the element without significant self heating occuring. OMEGA recommends a maximum operating current of 1 milliamp for all of the 100 ohm elements and sensors we supply. Higher or lower currents may be suitable for other resistances or sensor products, OMEGA recommends testing, for self heating effects before use.

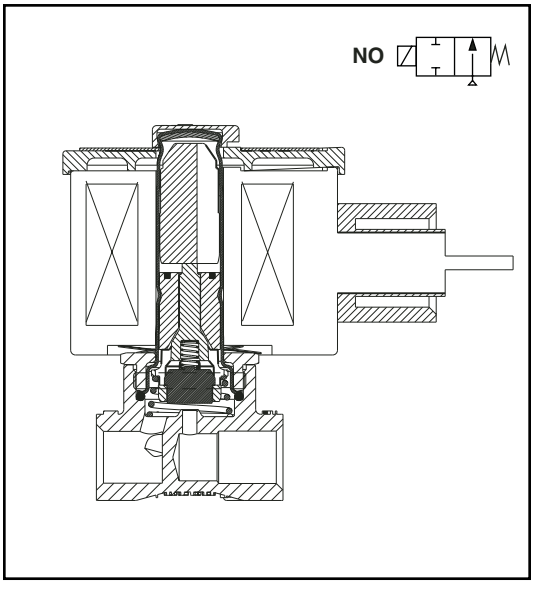
Resistance vs. Temperature Values per IEC60751

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-200	18.52	150	157.33	450	264.18
-150	39.72	200	175.86	500	280.98
-50	80.31	250	194.10	550	297.49
0	100.00	300	212.05	600	313.71
50	119.40	350	229.72	650	329.64
100	138.50	400	247.09	700	345.28

Features

- Reliable, proven design with high flows
- Small poppet valves for tight shutoff
- Wide range of elastomers for specialty service
- Mountable in any position
- Brass and stainless steel constructions





Construction

Valve Parts in Contact with Fluids		
Body	Brass	303/304 Stainless Steel
Seals and Discs	NBR or Cast UR	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
Stem	PA	

Electrical

Watt Rating and Power Consumption				Spare Coil Part No.			
	AC			General Purpose		Explosionproof	
DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
11.6	10.1	25	50	238610	238910	238614	238914
22.6	17.1	40	70	238810	238910	238814	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X.

Optional: Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9. (To order, add prefix "EF" to catalog number)

See Optional Features Section for other available options.

Options

Mounting bracket (suffix MB)
High Vacuum service (suffix VH; *see Vacuum Section for more details.*)
Oxygen service (suffix N)
Silicone Free (suffix SF)

Elastomers: FKM (suffix V), Ethylene Propylene (suffix E), CR (suffix J), PTFE* (suffix T), Low Temp. NBR** (suffix A)

Note: *PTFE reduces pressure rating by 25% (i.e. 750 psi reduced to 560 psi)

**For Low Temp. NBR, fluid temperature range is -40˚F to 167˚F

Refer to Engineering Section for fluid and temperature compatibility.

Nominal Ambient Temp. Ranges

AC: -13˚F to 131˚F (-25˚C to 55˚C)
DC: -13˚F to 131˚F (-25˚C to 55˚C)

Optional: For AC Class H coil option with 10.1 W coil, the max. ambient temperature is 140˚F (60˚C) (with or without prefix EF)

Note: Max. ambient for explosionproof (EF) is 125˚F (52˚C) for AC, 131˚F (55˚C) for DC.

Refer to Engineering Section for details.

Approvals

CSA certified. UL listed, as indicated.
Meets applicable CE directives.

Refer to Engineering Section for details.

2/2 SERIES 8262 8263

Specifications (English units)

Pipe Size (in)	Orifice Size (mm)	Cv Flow	Min Press	Operating Pressure Differential (psi)						Max. Fluid Temp °F		Catalog Number		Const. Ref	UL Listing	Watt Rating/ Class of Coil Insulation	
				Max AC@131°F			Max DC@131°F										
				Air-Inert Gas	Water	Lt. Oil @ 300 SSU	Air-Inert Gas	Water	Lt. Oil @ 300 SSU	AC	DC	Brass	Stainless Steel			AC	DC
1/8	3/64	0.06	0	1500	1375	1125	700	600	510	140	140	8262H154 ①	-	1	●	17.1/H	22.6/H
1/8	3/64	0.06	0	1650	1375	1125	700	600	510	140	140	-	8262H167 ①	1	●	17.1/H	22.6/H
1/8	3/64	0.06	0	1150	900	800	640	490	325	140	140	8262H155 ①	8262H168 ①	1	●	10.1/F	11.6/H
1/8	3/64	0.06	0	750	750	750	650	560	400	180	180	8262H156	8262H169	1	●	10.1/F	11.6/H
1/8	3/32	0.21	0	350	305	275	230	190	155	167	180	8262H157	8262H172	1	●	17.1/H	22.6/H
1/8	3/32	0.21	0	275	230	180	160	135	95	180	180	8262H128	8262H236	1	●	10.1/F	11.6/H
1/8	1/8	0.35	0	210	195	175	135	110	100	167	180	8262H158	8262H228	1	●	17.1/H	22.6/H
1/8	1/8	0.35	0	160	145	125	100	100	70	180	180	8262H129	8262H237	1	●	10.1/F	11.6/H
1/4	3/64	0.06	0	1500	1375	1125	940	600	510	140	140	8262H159 ①	-	2	●	17.1/H	22.6/H
1/4	3/64	0.06	0	1650	1375	1125	940	600	510	140	140	-	8262H198 ①	2	●	17.1/H	22.6/H
1/4	3/64	0.06	0	1150	900	800	640	490	325	140	140	8262H161 ①	8262H199 ①	2	●	10.1/F	11.6/H
1/4	3/64	0.06	0	750	750	750	650	560	400	180	180	8262H260	8262H130	2	●	10.1/F	11.6/H
1/4	3/32	0.21	0	350	305	275	230	190	155	167	180	8262H162	8262H205	2	●	17.1/H	22.6/H
1/4	3/32	0.21	0	275	230	180	160	135	95	180	180	8262H261	8262H134	2	●	10.1/F	11.6/H
1/4	1/8	0.35	0	210	195	175	135	110	100	167	180	8262H163	8262H219	2	●	17.1/H	22.6/H
1/4	1/8	0.35	0	160	145	125	100	100	70	180	180	8262H262	8262H138	2	●	10.1/F	11.6/H
1/4	5/32	0.54	0	120	110	105	75	65	55	167	180	8262H164	8262H223	2	●	17.1/H	22.6/H
1/4	5/32	0.54	0	90	90	70	60	55	45	180	180	8262H263	8262H142	2	●	10.1/F	11.6/H
1/4	7/32	0.83	0	60	55	55	35	35	30	167	180	8262H165	8262H224	2	●	17.1/H	22.6/H
1/4	7/32	0.83	0	45	45	40	30	25	25	180	180	8262H264	8262H148	2	●	10.1/F	11.6/H
1/4	9/32	0.96	0	38	38	38	25	25	25	167	180	8262H166	8262H225	2	●	17.1/H	22.6/H
1/4	9/32	0.96	0	30	30	30	20	17	17	180	180	8262H265	8262H152	2	●	10.1/F	11.6/H
3/8	1/8	0.35	0	210	195	175	135	110	100	167	180	8263H100	8263H104	3	●	17.1/H	22.6/H
3/8	1/8	0.35	0	160	145	125	100	100	70	180	180	8263H070	8263H080	3	●	10.1/F	11.6/H
3/8	5/32	0.54	0	120	110	105	75	65	55	167	180	8263H101	8263H105	3	●	17.1/H	22.6/H
3/8	5/32	0.54	0	90	90	70	60	55	45	180	180	8263H071	8263H081	3	●	10.1/F	11.6/H
3/8	7/32	0.83	0	60	55	55	35	35	30	167	180	8263H102	8263H106	3	●	17.1/H	22.6/H
3/8	7/32	0.83	0	45	45	40	30	25	25	180	180	8263H072	8263H082	3	●	10.1/F	11.6/H
3/8	9/32	0.96	0	38	38	38	25	25	25	167	180	8263H103	8263H107	3	●	17.1/H	22.6/H
3/8	9/32	0.96	0	30	30	30	20	17	17	180	180	8263H073	8263H083	3	●	10.1/F	11.6/H

① Cast UR disc supplied as standard. ● General Purpose Valve.

Specifications (Metric units)

Pipe Size (in)	Orifice Size (mm)	Kv Flow Factor (m^3/h)	Min Press	Operating Pressure Differential (bar)						Max. Fluid Temp ˚C		Catalog Number		Const. Ref	UL Listing	Watt Rating/ Class of Coil Insulation	
				Max AC @ 55°C			Max DC @ 55°C										
				Air-Inert Gas	Water	Lt. Oil @ 300 SSU	Air-Inert Gas	Water	Lt. Oil @ 300 SSU	AC	DC	Brass	Stainless Steel			AC	DC
1/8	1.2	0.05	0	103	95	78	48	41	35	60	60	8262H154 ①	-	1	●	17.1/H	22.6/H
1/8	1.2	0.05	0	114	95	78	48	41	35	60	60	-	8262H167 ①	1	●	17.1/H	22.6/H
1/8	1.2	0.05	0	79	62	55	44	34	22	60	60	8262H155 ①	8262H168 ①	1	●	10.1/F	11.6/H
1/8	1.2	0.05	0	52	52	52	45	39	28	82	82	8262H156	8262H169	1	●	10.1/F	11.6/H
1/8	2.4	0.18	0	24	21	19	16	13	11	75	82	8262H157	8262H172	1	●	17.1/H	22.6/H
1/8	2.4	0.18	0	19	16	12	11	9	7	82	82	8262H128	8262H236	1	●	10.1/F	11.6/H
1/8	3.2	0.30	0	14	13	12	9	8	7	75	82	8262H158	8262H228	1	●	17.1/H	22.6/H
1/8	3.2	0.30	0	11	10	9	7	7	5	82	82	8262H129	8262H237	1	●	10.1/F	11.6/H
1/4	1.2	0.05	0	103	95	78	65	41	35	60	60	8262H159 ①	-	2	●	17.1/H	22.6/H
1/4	1.2	0.05	0	114	95	78	65	41	35	60	60	-	8262H198 ①	2	●	17.1/H	22.6/H
1/4	1.2	0.05	0	79	62	55	44	34	22	60	60	8262H161 ①	8262H199 ①	2	●	10.1/F	11.6/H
1/4	1.2	0.05	0	52	52	52	45	39	28	82	82	8262H260	8262H130	2	●	10.1/F	11.6/H
1/4	2.4	0.18	0	24	21	19	16	13	11	75	82	8262H162	8262H205	2	●	17.1/H	22.6/H
1/4	2.4	0.18	0	19	16	12	11	9	7	82	82	8262H261	8262H134	2	●	10.1/F	11.6/H
1/4	3.2	0.30	0	14	13	12	9	8	7	75	82	8262H163	8262H219	2	●	17.1/H	22.6/H
1/4	3.2	0.30	0	11	10	9	7	7	5	82	82	8262H262	8262H138	2	●	10.1/F	11.6/H
1/4	4.0	0.47	0	8	8	7	5	4	4	75	82	8262H164	8262H223	2	●	17.1/H	22.6/H
1/4	4.0	0.47	0	6	6	5	4	4	3	82	82	8262H263	8262H142	2	●	10.1/F	11.6/H
1/4	5.6	0.72	0	4	4	4	2	2	2	75	82	8262H165	8262H224	2	●	17.1/H	22.6/H
1/4	5.6	0.72	0	3	3	3	2	2	2	82	82	8262H264	8262H148	2	●	10.1/F	11.6/H
1/4	7.1	0.83	0	3	3	3	2	2	2	75	82	8262H166	8262H225	2	●	17.1/H	22.6/H
1/4	7.1	0.83	0	2	2	2	1	1	1	82	82	8262H265	8262H152	2	●	10.1/F	11.6/H
3/8	3.2	0.30	0	14	13	12	9	8	7	75	82	8263H100	8263H104	3	●	17.1/H	22.6/H
3/8	3.2	0.30	0	11	10	9	7	7	5	82	82	8263H070	8263H080	3	●	10.1/F	11.6/H
3/8	4.0	0.47	0	8	8	7	5	4	4	75	82	8263H101	8263H105	3	●	17.1/H	22.6/H
3/8	4.0	0.47	0	6	6	5	4	4	3	82	82	8263H071	8263H081	3	●	10.1/F	11.6/H
3/8	5.6	0.72	0	4	4	4	2	2	2	75	82	8263H102	8263H106	3	●	17.1/H	22.6/H
3/8	5.6	0.72	0	3	3	3	2	2	2	82	82	8263H072	8263H082	3	●	10.1/F	11.6/H
3/8	7.1	0.83	0	3	3	3	2	2	2	75	82	8263H103	8263H107	3	●	17.1/H	22.6/H
3/8	7.1	0.83	0	2	2	2	1	1	1	82	82	8263H073	8263H083	3	●	10.1/F	11.6/H

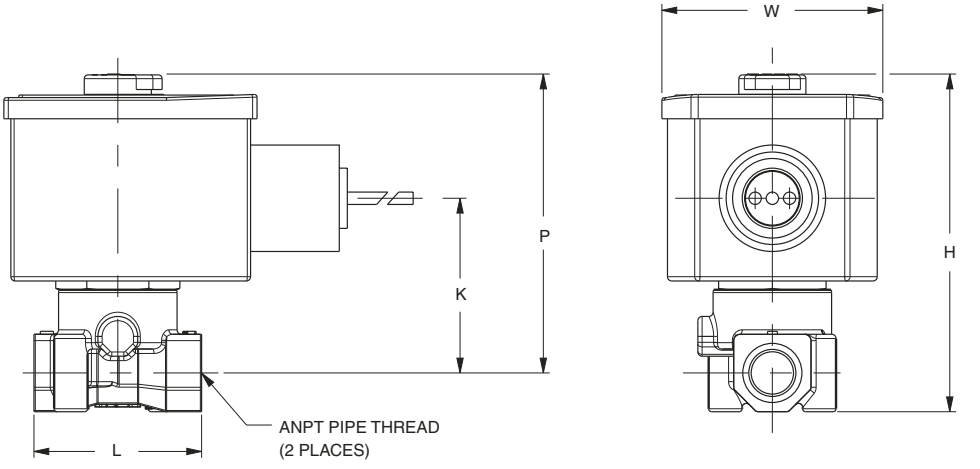
① Cast UR disc supplied as standard. ● General Purpose Valve.

2/2 SERIES 8262 8263

Dimensions: inches (mm)

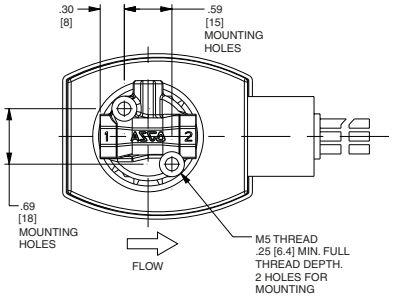
Const. Ref.		H	K	L	P	W
1	in	3.00	1.54	1.19	2.69	2.06
	mm	76	39	30	68	52
2	in	3.12	1.62	1.56	2.76	2.06
	mm	79	41	40	70	52
3	in	3.20	1.62	1.88	2.77	2.06
	mm	81	41	48	70	52
IMPORTANT: Valves may be mounted in any position.						

Const. Ref. 1-3

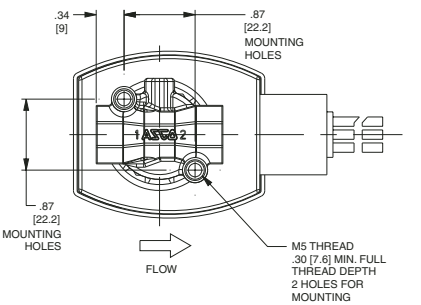


Mounting Dimensions

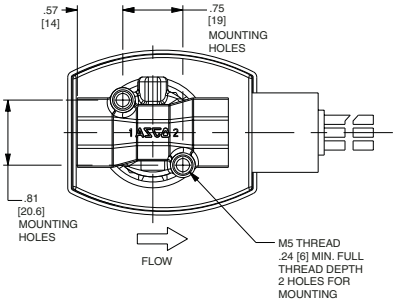
Const. Ref. 1
(1/8" Pipe)



Const. Ref. 2
(1/4" Pipe)



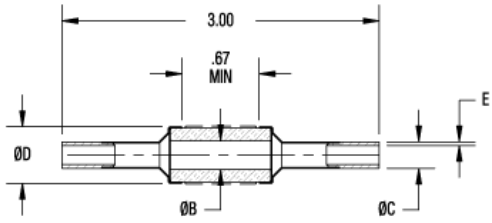
Const. Ref. 3
(3/8" Pipe)



Note: Mounting holes will accept a standard #10-32 machine screw.

Electrical Feedthroughs
Breaks & Envelope - Crynogenic & Liquid Breaks

Introduction | **3000 to 6000 Volts- Weldable 3000 Volts** | 3000 to 6000 Volts- Weldable 6000 Volts | **3000 to 6000 Volts- Brazable 3000 Volts** | **3000 to 6000 Volts- Brazable 5000 Volts**



6kV Weld Style

Features

- Voltage isolation to 6kV
- Nominal tube size from 1/8" to 1/2"
- Weld and braze configurations

Specifications	
Voltage[1]	6,000 VDC
Flange	304ss
Adapter	See tables for options
Insulation	Alumina ceramic
Vacuum Range UHV / HV	$1x10^{-10}$ Torr / $1x10^{-8}$ Torr
Temperature Range[2]	-200ºC to 450ºC
For conversion tables click here	
[1] See *INTENDED OPERATING CONDITIONS* in introductory section [2] Overall assembly ratings must be adjusted to that of lowest rated component	

Insulator Seal (ISI) brand catalog and custom engineered ceramic to metal seal products are manufactured to **ISO 9001:2008** standard utilizing our qualified hermetic brazing and joining processes.

For any question on this Section **Ask Our Experts**

There are 4 parts in this category. Scroll down to browse the result tables
For more details, available options and accessories click on desired Part Number link.

All "In Stock" parts ships same business day as ordered. Lead Time indicates **business days**. Please Note that cut off time for same day shipment is 1:30 p.m. Pacific Standard Time. Prices and specifications are subject to change without notice. See **full terms of sale here.**

Drawings download if available are indicated by in the Part Number column. Click on to go to Downloads Page

NOM.TUBE	VOLTS	TYPE	ADAPTER MATERIAL	B	C	D	E	Part Number	UOM	List Price	Net Price	Lead Time	Qty	
5/16	6000	WELD	STN STL	0.270	0.312	0.54	0.030	**9611000** 0033101	EACH	$82.00	$82.00	In Stock		Buy
1/4	6000	WELD	STN STL	0.270	0.250	0.54	0.035	**9611005** 0609401	EACH	$95.00	$95.00	20 days		Buy
7/16	6000	WELD	STN STL	0.430	0.437	0.79	0.030	**9611001** 0033102	EACH	$141.00	$141.00	In Stock		Buy
3/8	6000	WELD	STN STL	0.430	3.75	0.79	0.035	**9611006** 0609402	EACH	$141.00	$141.00	20 days		Buy

Capsule Pressure Gauges

Black-Painted Steel Case
Copper Alloy Wetted Parts

Low Pressure Series • Type 611.10

Pressure Gauges

Application
Fluid medium, gaseous or dry, which does not clog connection port or corrode copper alloy.
Example: low pressure pneumatic systems.

Sizes
2½" (63 mm)

Accuracy
± 1.5% of span (± 2.5% for 10" H2O range)

Ranges (All ranges not stocked)
2½": 10 "H2O to 240 "H2O (25 to 600 mbar)
or other equivalent units of pressure or vacuum

Working Range
Steady: Full scale value
Fluctuating: 0.9 x full scale value

Operating Temperature
Ambient: -4°F to 140°F (-20°C to 60°C)
Media: max. 140°F (+60°C)

Temperature Error
Additional error when temperature changes from reference temperature of 68°F (20°C) ±0.4% for every 18°F (10°C) rising or falling. Percentage of span.

Standard Features

Connection
Material: copper alloy
Lower mount (LM)
Center back mount (CBM)
1/8" NPT or 1/4" NPT

Capsule Element
Material: copper alloy

Movement
Copper alloy, nickel-silver pinion gear and shaft. Zero adjustment screw on dial

Dial
White aluminum with black lettering

Pointer
Black aluminum (zero adjust on dial- remove window to access)

Case
Black steel

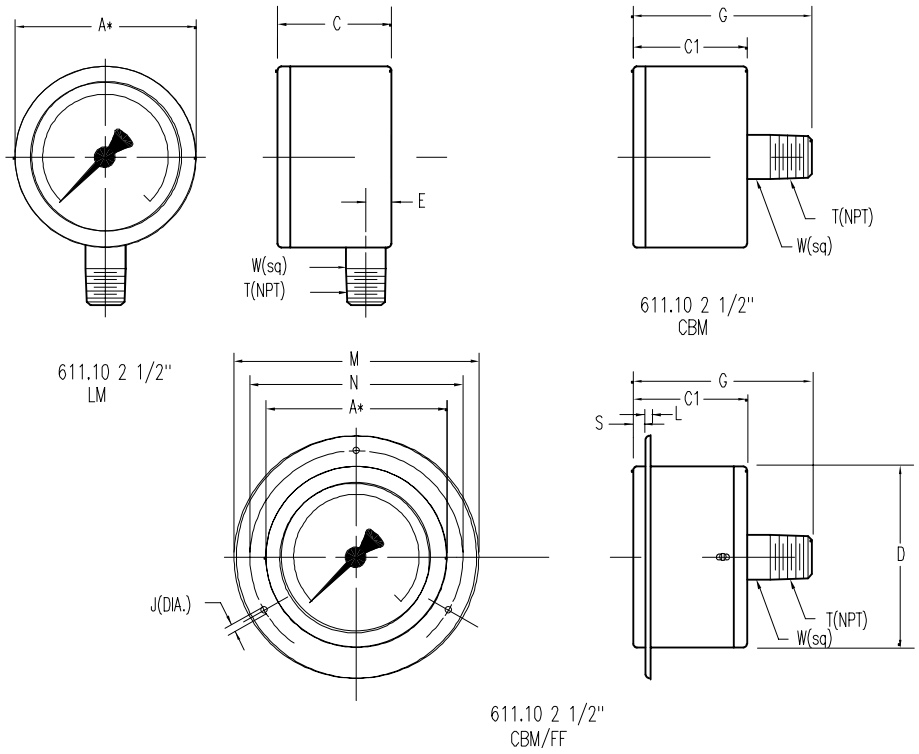
Weather Protection
Dust resistant (NEMA 2 / IP 32)

Standard Scales
in. H2O/mm H2O
oz.-sq. in./mm H2O
oz.-sq. in./in. H2O
PSI

Window
Snap-in acrylic window

Order Options (min. order may apply)
Front or rear flange
Brass threaded restrictor
U-Clamp steel zinc plated with stainless steel polished profile ring
Stainless steel case and ring
Safety glass and instrument glass window
Overpressure and underpressure protection
Cleaned for oxygen service
Medical specification
Special connections limited to wrench flat area
Nickel plated connection
Special case colors
Externally adjustable red mark pointer(set pointer)
Externally adjustable red drag pointer (max. hand)
Custom dial layout
DIN standards
Other pressure scales available

Dimensions:



A* NOMINAL SIZE																
TYPE	WEIGHT	KEY	A*	B	C	C1	D	E	G	J	L	M	N	S	T	W
611.10		mm	63	52	40	36.5	63	9.5	55.5	3.6	2	85	75	2	--	14
2½"	0.45 lbs.	in	2.5	2.05	1.58	1.44	2.48	0.37	2.19	0.14	0.08	3.35	2.95	0.08	1/4"	0.55

Recommended panel cut-out: D + 1mm

THE MEASURE OF

Total Performance™

Ordering Information:
State computer part number (if available) / type number / size / range / connection size and location / options required.

05/02

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Lawrenceville, Georgia 30043-5868
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http://www.wika.com e-mail: info@wika.com