SPARTAN SCIENTIFIC

About Spartan Scientific

Spartan Scientific was formed in 1978 with a goal to redefine industrial solenoid valves and related products. First with DIN quick connect solenoid coils, quick mounting solenoid operators and interchangeable coil versions, Spartan has effectively reduced installation costs and related setup while reducing retrofit and service times.

While you read the pages of the catalog, you will not find “me too” products so often found in the industry today. Spartan strives to meet tough challenges with innovation of design. Our solenoid operators can be placed directly into your assembly for a neater, more compact end product which meets functional as well as aesthetic demands. Many of the products manufactured by Spartan Scientific are specials, or variations of standard products in this catalog. If you do not see a specific valve or accessory, please ask one of our sales consultants for additional information. Perhaps Spartan Scientific can produce a special product for your application.

Mission Statement

It is the mission of Spartan Scientific to search out and solve customer fluid control applications using ingenuity, integrity and innovation. Using customer satisfaction as the standard, Spartan Scientific will foster an atmosphere of growth for customers and employees using the latest technologies and systems available. Spartan will always seek to attain 100% customer satisfaction as an integral part of our corporate identity.

Vision Statement

It is the vision of Spartan Scientific to surpass customer expectations with products made of the highest quality materials, designed to surpass specifications, and tested prior to delivery to ensure highest possible quality. Spartan shall take the lead in the market with innovation of design. Each application will be given careful study and will be met with enthusiasm and technological expertise. Spartan shall employ continuous proactive improvement methods creating a positive foundation for the establishment of long term employment opportunities and customer relationships.

Certified To
ISO 9001:2000
With Design

SPARTAN SCIENTIFIC
www.spartanscientific.com

P.O. Box 9792, Boardman, Ohio 44513
(330) 758-8446 Fax: (330) 758-3314

Standard Terms of Sale and Restocking

1. PAYMENT: Terms as shown (subject to credit approval) f.o.b. Seller's plant. Payment shall not prejudice claims on account of omissions or shortage in shipment, but no such claim will be allowed unless made within 30 days after receipt by Buyer.

2. DELIVERY: Sellers shall not be liable for any delays in or failures of delivery due to acts of God or public authority, labor disturbances, accidents, fires, floods, extreme weather conditions, failures of and delays by carriers, shortages of material, delays of a supplier due to causes beyond its control, or any other cause beyond the control of Seller. Seller shall notify Buyer of any such delays as soon as it becomes apparent. In no event shall Seller be liable for consequential or special damage arising out of delay in or failure of delivery. Buyer's requested delivery date or schedule shall be approximate and subject to Seller's approval and acceptance.

3. PACKING: All goods shall be packed in suitable containers for protection in shipment and storage. No special charges for packing or crating shall be made unless specifically listed as an additional and separate charge on Seller's quotation or acceptance of Buyer's order.

4. INSPECTION: All goods ordered by the Buyer shall be subject to final inspection and approval of Buyer and/or Government at destination. All products, material and workmanship shall be open to inspection and test at Seller's plant by authorized representatives of Buyer and/or of the United States.

5. WARRANTIES: All goods sold hereunder are warranted to be free from defects in material and workmanship and to conform to applicable specifications, drawings, blueprints and/or samples. These express warranties are in lieu of and exclude all other warranties, express or implied. Seller's sole obligation under these warranties shall be to issue credit, repair, or replace any item or part thereof which is proved to be other than as warranted. No allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller. If goods are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller upon notice promptly given will either examine the goods at their site, or issue shipping instructions for return to Seller (transportation costs prepaid by Buyer). In the event any goods are proved to be other than as warranted, transportation costs to and from Seller's plant will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. These warranties shall not extend to any goods or parts thereof which have been subjected to misuse or neglect, damage by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of Seller's plant except when performed under Seller's specific authority. These warranties shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications.

6. CHANGES IN SPECIFICATION OR DESIGNS: Should Buyer request that changes be made in the specifications or design relating to any goods, delivery dates and schedules shall be revised accordingly, if necessary, and an equitable adjustment, upward or downward, shall be made in price in so far as warranted.

7. TERMINATION, REDUCTION IN QUANTITY, RESCHEDULING DELIVERY: In the event Buyer desires to terminate any part or all of the work to be done hereunder, reduce the quantity of goods ordered, or reschedule the delivery of any goods, fair compensation shall be made to Seller. Seller shall recover, without duplication, the contract price for items, which have been completed, the actual costs incurred by Seller which are properly allocatable or apportionable under recognized commercial accounting practices to terminate work (including cost of discharging liabilities) plus a reasonable profit, the reasonable costs and expenses incurred by Seller in making settlement hereunder and in protecting property in which Buyer has an interest, and/or the increased costs incurred by Seller by reason of a revision in the delivery schedule.

8. BUYER'S PROPERTY: Any designs, tools, patterns, material, drawings, information or equipment furnished by Buyer, or any special tools made or acquired for the Buyer by the Seller which becomes Buyer's property, shall be used only in the production of the goods called for herein and not otherwise, unless by Buyer's written consent. Seller agrees to exercise reasonable care with respect to such property and equipment while in its possession and control, but shall not be responsible for loss or damage occurring without its fault or negligence or for ordinary wear and tear.

9. PATENTS: Unless the design for the goods shall have been furnished by the Buyer to the Seller and used by the Seller in manufacturing the goods, Seller shall defend and save harmless the Buyer from any claim that any product or article sold to the Buyer hereunder in and of itself infringes any United States letters patent by reason of its sale or use/ provided Seller is notified in writing within ten (10) days after any such claim is made against the Buyer, and provided further that Seller is permitted to defend the same in Buyer's name if action be brought. If the product or article sold to the Buyer hereunder is manufactured by the Seller according to a design furnished by the Buyer, the Buyer will defend and save harmless the Seller from any claims of infringement of any United States Letters patent.

10. TAXES: Sales and use taxes, payable by Buyer, which are presently or may hereafter be imposed by any taxing authority, are not included in the sale price; any direct or indirect tax, payable by Seller, which may hereafter be imposed by any taxing authority upon the manufacture, sale or delivery of products covered by this order, or any increase in rate of such tax now in force, shall be added to the sale price; if not collected at time of payment of sale price, Buyer will hold Seller harmless.

11. COMPLIANCE WITH LAW: Seller agrees to comply with all federal, state and local laws which may be applicable to the manufacture or sale of the products furnished hereunder. Seller agrees to furnish Buyer with a written statement on its invoice representing that the goods produced or services performed hereunder were produced in compliance with the requirements of Section 12(A) and all other applicable requirements of the Fair Labor Standards Act of 1938, all amendments thereof, all applicable regulations and orders of the Administrator of the Wage and Hour Division of the Department of Labor issued thereto.

12. PRICE REVISION: Prices are binding on Seller when Buyer's order is accepted; no revision of prices shall be made on request, except as specifically provided herein, unless there is attached to Seller's quotation and/or acceptance of Buyer's order a rider specifically setting forth the terms and conditions of such revision, which rider shall become a part of Seller's terms as though fully set forth in Seller's quotation and acceptance of Buyer's order.

13. GOVERNMENT CONTRACTS: Should the Buyer notify the Seller that its order is placed under a prime contract with an agency of the United States Government, the following terms and conditions shall be incorporated into Seller's terms of sale in so far as the Buyer is required to incorporate such provisions in its purchase orders or subcontracts of terms in so far as applicable to the goods sold hereunder.

A) Armed Services Procurement Regulation: The following clause set forth or referred to in Sections 7 and 12 of the Armed Services Procurement Regulations are hereby incorporated by reference: Renegotiation (7-103.13), Eight Hour Law of 1912 (7-103.16 12-303.1), Walsh-Healy Public Contracts Act (7-103.17 12-604), Nondiscrimination in Employment (7-103.18 12-802), Officials Not to Benefit (7-103.19), Buy American Act (7-104.3 6-104.5), Notice to the Government of Labor Disputes (7-104.4), Excess Profit (7-104.11), Military Security Requirements (7-104.12), Examination of Records (7-104.15), Convict Labor (7-104.17 12-203). In order to make the context of the above clauses applicable to these terms of sale, the word "Buyer" shall be substituted for the word "Government" and the word "Seller" shall be submitted for the word "contractor" whenever necessary.

14. RESTOCKING POLICY: Merchandise that is returned must be accompanied by pre-approved Returned Goods Authorization (RGA). Return authorizations will be approved by Spartan Scientific. When materials are received, an inspection will be performed to determine if restocking charges are applicable. Material that does not have an authorization will be returned to the purchaser at their expense.

**DISCLAIMER: Product changes including specifications, features, designs, and availability are subject to change anytime without notice. For critical dimensions or specifications, contact factory.*

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Solenoid Valve Selection Checklist

Please fill in parameters for your application and let Spartan engineers recommend the right valve to suit your needs.

DATE: _____
NAME: _____
COMPANY: _____

1) TYPE OF MEDIA††
___ AIR
___ WATER
___ INERT GAS
___ HYDRAULIC OIL
___ OTHER _____

2) PRESSURE RANGE
MINIMUM _____ MAXIMUM _____ NOMINAL _____

3) FUNCTION
___ 2-WAY, 2 POSITION NORMALLY CLOSED
___ 2-WAY, 2 POSITION NORMALLY OPEN
___ 3-WAY, 2 POSITION NORMALLY CLOSED
___ 3-WAY, 2 POSITION NORMALLY OPEN
___ 3-WAY DIVERTER FUNCTION †
___ 3-WAY MIXING FUNCTION †

4) VALVE TYPE
___ DIRECT ACTING ___ INTERNAL PILOT ___ EXTERNAL PILOT

5) PORT SIZE OR TYPE
___ #10-32 UNF
___ 1/8" NPT
___ 1/4" NPT
___ 3/8" NPT
___ 1/2" NPT
___ 3/4" NPT
___ 1.0" NPT
___ 2.0" NPT
___ OTHER _____

6) ORIFICE SIZES
___ 0.6 MM
___ 0.8 MM (1/32")
___ 1.0 MM (3/64")
___ 1.2 MM
___ 1.5 MM (1/16")
___ 2.0 MM
___ 2.4 MM (3/32")
___ 3.0 MM (1/8")
___ 4.0 MM (5/32")
___ 6.0 MM (1/4")
___ 8.0 MM (5/16")
___ 12.5 MM (1/2")
___ 25 MM (1")
___ 38 MM (1 1/2")
___ 50 MM (2")
___ OTHER _____

7) FLOW RATE
GALLONS PER MINUTE _____ GALLONS PER HOUR _____
LITERS PER MINUTE _____ STANDARD CU FT. PER MIN. _____
OTHER _____

8) FLOW FACTOR (Cv) _____

9) MATERIALS IN CONTACT WITH MEDIA
___ ALUMINUM
___ BRASS
___ STAINLESS STEEL
___ NYLON
___ ACETAL
___ COPPER
___ SILVER

SEAL MATERIAL
___ BUNA N, NITRILE
___ VITON
___ EPDM
___ AFLAS®
___ CHEMRAZ®
___ OTHER

10) MANUAL OVERRIDE
___ YES ___ NO

11) COIL DATA
VOLTAGE _____ WATTAGE _____ HERTZ _____

12) COIL TYPE
___ DIN SPADE ___ FLYING LEAD ___ DIN SPADE WITH CONNECTOR

13) TEMPERATURE
AMBIENT _____ MEDIA _____

14) OTHER SPECIAL CONSIDERATIONS...
(i.e. MOUNTING THREADS, PLATING, SPECIAL ARMATURE AND/OR BODY MATERIAL)

_____

_____

NOTE: NOT ALL COMBINATIONS ARE POSSIBLE. CONSULT FACTORY FOR ANY SPECIAL APPLICATIONS.
†NOTE: Standard pressure ratings of orifices do not apply for these functions. Please contact factory for details.
††NOTE: Caution should be taken when requiring media in AC (alternating current) applications that are not compatible with copper.

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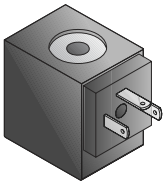
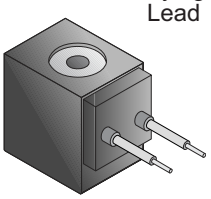
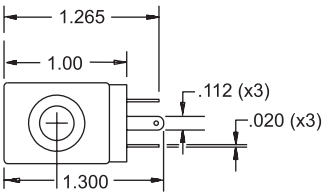
Coil Dimensional Data

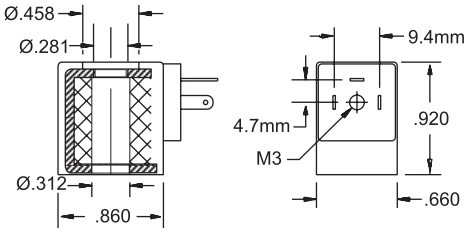
2C00 - Sub-Micro DIN
(Series 2500, 2510)



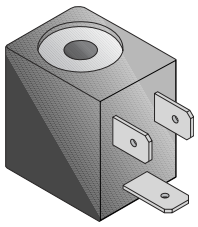
Sub-Micro Flying Lead



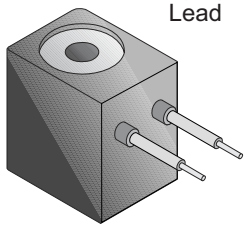


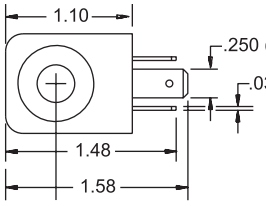


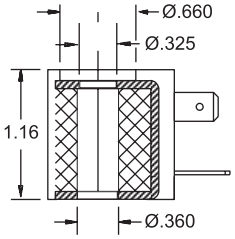
3C00 - MINI DIN
(Series 3800, 3822, 3823, 3824, 3825, 3826, 3835, 3900, 3923)

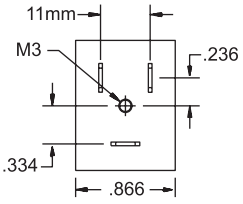


MINI Flying Lead

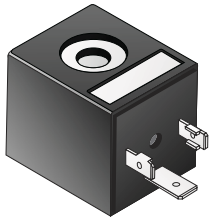




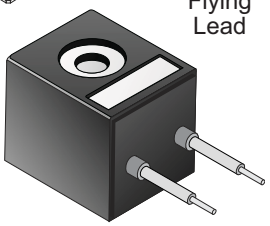


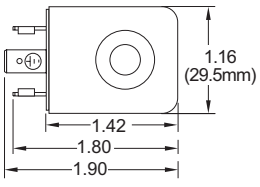


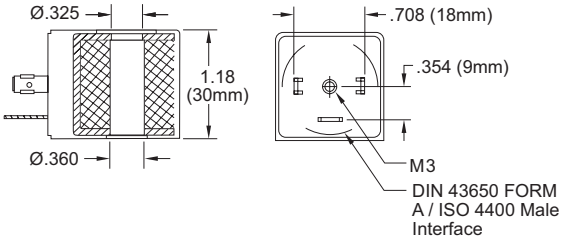
3C30 - 30mm MINI ISO DIN
(Series 3500, 3505, 3510, 3800, 3822, 3823, 3824, 3825)



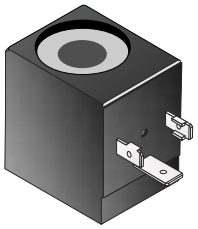
MINI ISO Flying Lead



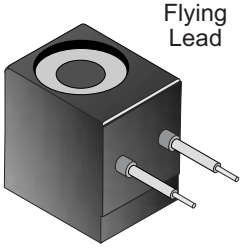


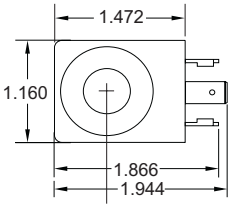


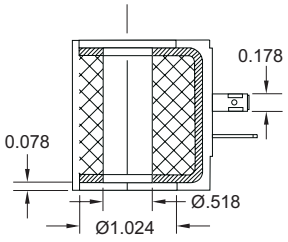
4C00 - ISO DIN
(Series 4000, 4100,4200, 4500, 4600, 4700)

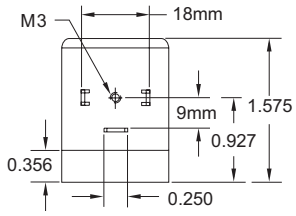


ISO Flying Lead









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Choose the corresponding digit from the chart to build the valve with the options of your choice.
Coils are always the 10th significant digit of each part number.

Example:

3822-01-538S — Suffix consistent with all series of valves and operators.

- 3822 — Valve Series
- 01 — Orifice/Pressure/Flow
- 5 — Body Material
- 3 — Function
- 8 — Port Size
- S — Suffix

	Coil Options		
Volts	**Male DIN**	**Flying lead**	**Male DIN w/ black connector**
6 VDC	1	A	S
12 VDC	2	B	T
24 VDC	3	C	U
24 VAC	6	F	X
120 VAC	7	G	Y
220 VAC	8	H	Z
240 VAC	9	I	R

Sub-Micro connector (9.4mm)

MINI connector

ISO connector

Cross Reference

Sub-Micro connector fits valve series: 2500, 2510

MINI connector fits valve series: 3800, 3822, 3823, 3824, 3825, 3826, 3835, 3900, 3923

ISO connector fits valve series: 3500, 3510, 4000, 4100, 4200, 4280, 4500, 4600, 4700

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Series 3C24

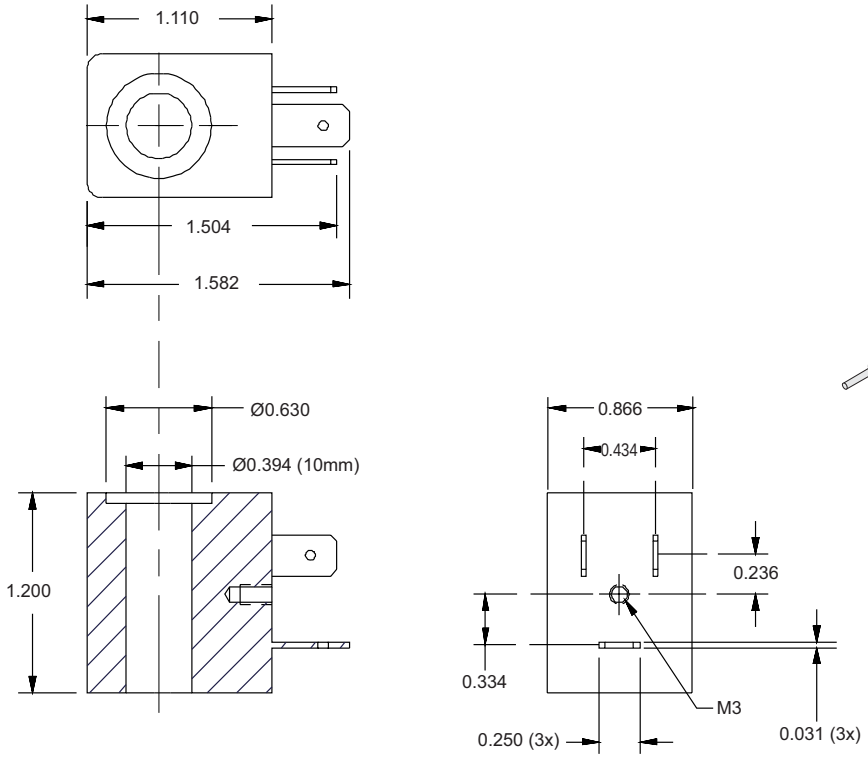
8-22 10mm ID Coil

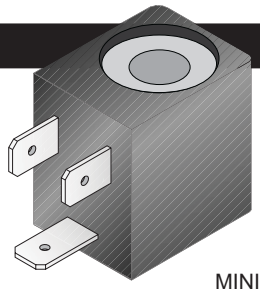
General Description

The 3C24 Series Coils are available in Mini Din Spade to DIN 43650 industry standard, or with 22AWG, 18" long flying leads. Spartan Scientific coils are specifically designed to be robust in industrial applications. Spartan Scientific coils feature 30% glass filled thermoplastic glass-filled nylon resin encapsulation, using class H insulation (200° C), and are rated for class F use. The magnetic force is concentrated by use of a low carbon iron yoke. The coils are made specifically for use in industrial ambient conditions. Special solutions are available for conditions exceeding NEMA 4/ IP65, or high humidity.

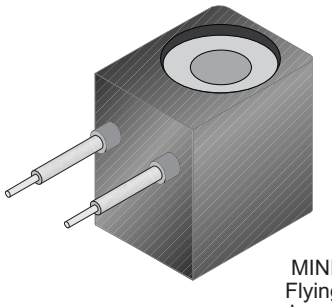
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED





MINI DIN SPADE



MINI Flying Lead

How To Order

3C24☐ -☐☐☐☐☐

Connection Option
0 - DIN Spade
5 - Flying Lead

Coil Options
00606 - 6 VDC 6.5 W
01206 - 12 VDC 6.5 W
02406 - 24 VDC 6.5 W
02416 - 24 VAC 50/60 Hz
12016 - 120 VAC 50/60 Hz
22016 - 220 VAC 50/60 Hz
24016 - 240 VAC 50/60 Hz

Technical Data

Coil Data: DuPont Zytel glass-filled nylon encapsulation
(Encapsulation Class F. Windings Class H)
Voltage: 6, 12 and 24 VDC
24, 120, 220 V 50/60 Hz AC
(Other voltages and power ratings available on request. Consult factory for details.)
Voltage Tolerance: +/-10% nominal
Power Rating: 6.5 W (VDC), 8 VA (VAC) standard

Degree of Protection: IP65 (with sealed connector in place)

Duty Cycle: 100% continuous

Temperature Range: -30° C to +50° C

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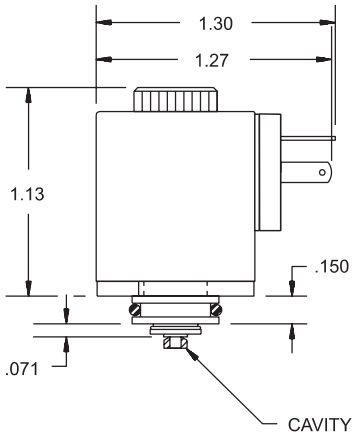
Series 2500

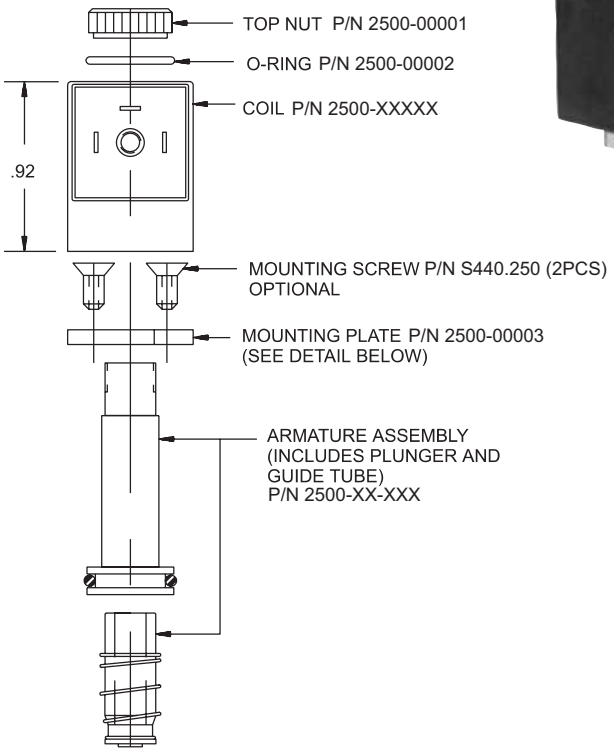
Sub-Micro Solenoid Operator

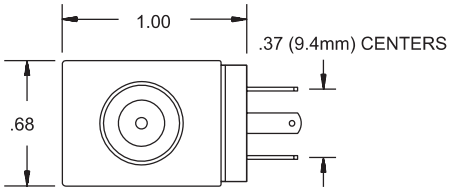
The Spartan Scientific Series 2500 Sub-Micro solenoid operators are designed for piloting 3 and 4-way directional control valves and pneumatic actuators. The plate-mount operators are interchangeable with most solenoids of comparable size. The nylon encapsulated coil has an operating temperature range of -30°C to +50°C and is rated to IP65 (IEC 144) with electrical connector. Shading ring is standard so that both AC and DC coils can be used on all armatures.

Dimensional Data

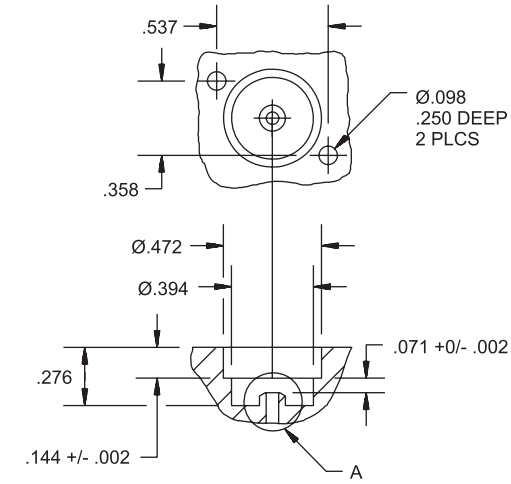
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



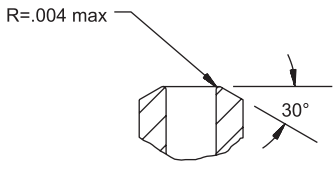




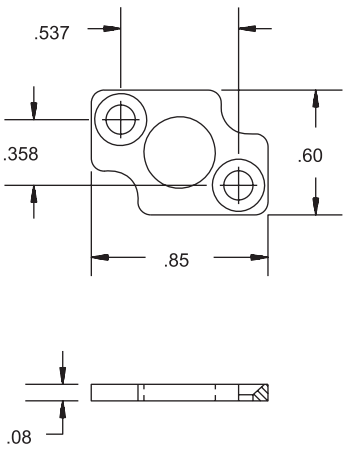
Armature Cavity Details



VALVE CAVITY DETAIL



ORIFICE DETAIL A - 4x



MOUNTING PLATE

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Series 2500

Sub-Micro Solenoid Operator

Technical Data

Voltages: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz

Pressure Range: Vacuum - 300 psi depending on orifice size and function

Temp. Range: (Fluid max. 90°C) Ambient -20° to +50° C

Voltage Tolerance: +/-10%

Cycle Rate: 18 ms

Coil Construction: Glass filled nylon encapsulation (Class F, continuous duty)

Environment Protection: Dust-tight and water resistant to IP65 (IEC 144) (with electrical connector)

Wattage Available: 2.4 Watt (other power ratings available on request)

Materials: Operator: AISI 400 and Brass, or 300 Series Stainless Steel
Shading Ring: Copper
Seal: Nitrile standard (other materials available on request)
Mounting Plate: Zinc-plated Steel

ORIFICE SIZE / VOLTAGE

FUNCTION	1.0 mm		1.5 mm	
	AC	DC	AC	DC
2/2 NC	120	95	110	90
2/2 NO	120	120	60	60
3/2 NC	120	95	70	60
3/2 NO	120	95	80	70

MAX. PRESSURE RANGE (psi)

How To Order

2500 - □□ - □□ 0□

Orifice / Wattage / NO/NC
01 - 0.5mm / 2.4 w / NC
02 - 1.0mm / 2.4 w / NC
03 - 1.5mm / 2.4 w / NC
11 - 0.5mm / 2.4 w / NO
12 - 1.0mm / 2.4 w / NO
13 - 1.5mm / 2.4 w / NO

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Materials in Contact with Media
4 - Brass / Nitrile
9 - Stainless Steel / Nitrile

Function
2 - 2-way
3 - 3-way

Mounting Screw
Specify Part Number S440.250

Order Example: 2500-02-4307
Series 2000, 1.0mm orifice, 2.4 w, normally closed, brass / nitrile, 3-way, 120 VAC 50/60 Hz

*For more coil options see page 7.

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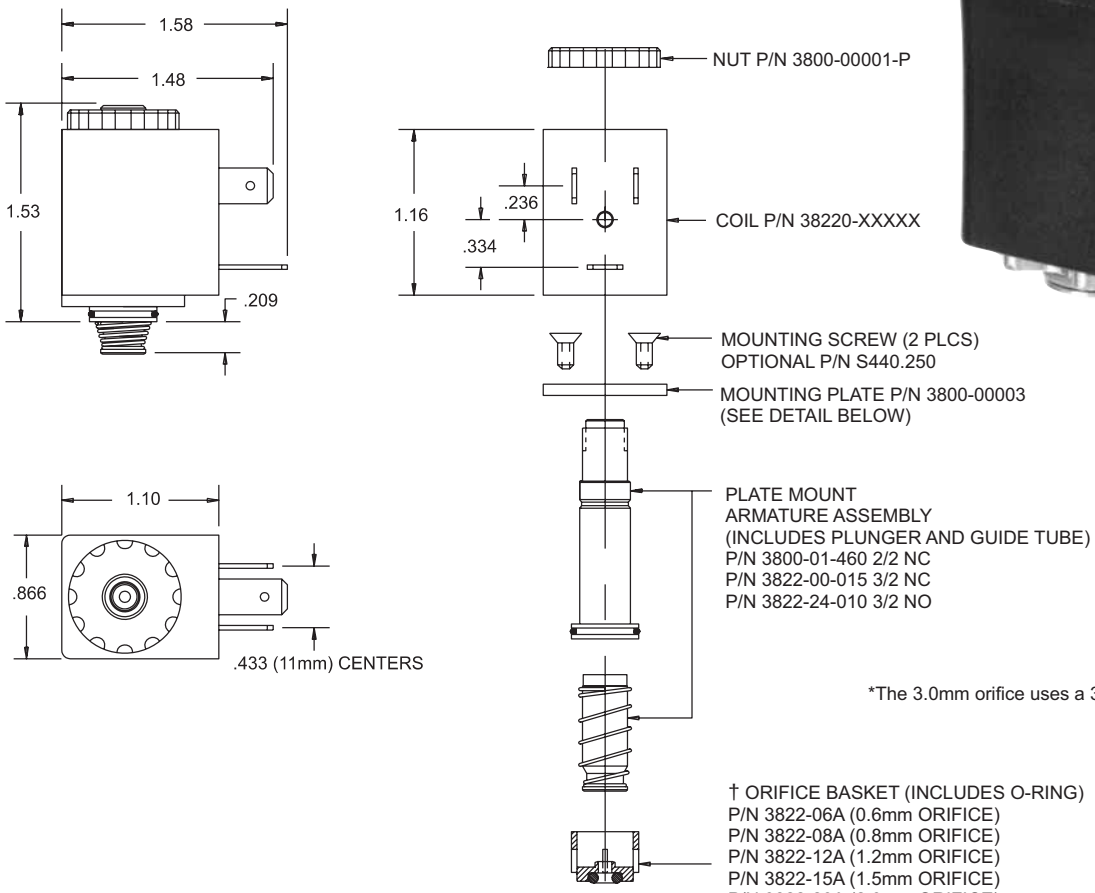
Series 3800

Mini Solenoid Operators

The Spartan Scientific Series 3800 solenoid operators are specially designed for the pilot function of 3 and 4-way pneumatic directional control valves. Available in plate mount, the operators are interchangeable with most solenoid operator interfaces. Sealing discs are spring compensated. Shading ring is standard so that both AC and DC coils can be used on all armatures. Coils are glass filled nylon encapsulation.

Dimensional Data

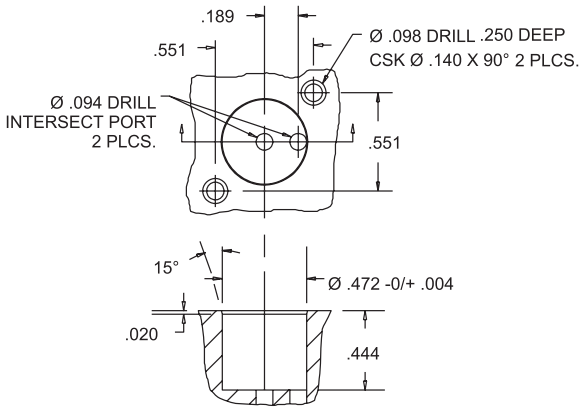
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



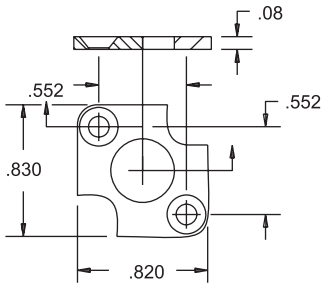
*The 3.0mm orifice uses a 30mm coil. Refer to pages 6 - 7.

† Orifice Baskets are optional.
Consult factory for part numbers and pricing.

Orifice Basket / Armature Cavity Details



MOUNTING PLATE DETAILS



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Technical Data

Voltages: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz

Pressure Range: Vacuum - 200 psi depending on orifice size and function

Temp. Range: 50° C Ambient temperature

Voltage Tolerance: +/-10%

Cycle Rate: 12 ms

Coil: Glass filled nylon encapsulation (Class F, continuous duty)

Environment Protection: Dust-tight and water resistant to IP65 (with electrical connector)

Wattage Available: 6.5 watt standard. 2.5 watt and other wattages available on request.

Materials: Operator: AISI 400 and Brass, or 300 Series Stainless Steel
Shading Ring: Copper standard
Nut: Nylon
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Mounting Plate: Zinc plated steel

ORIFICE SIZE / VOLTAGE

FUNCTION	1.5 mm	
	AC	DC
2/2 NC	200	200
2/2 NO	200	200
3/2 NC	150	150
3/2 NO	150	150

MAX. PRESSURE RANGE (psi)

How To Order

3800 - □□ - □□□□

Orifice / Wattage / NO/NC
01 - 1.5mm / 6.5 w / NC
03 - 1.5mm / 6.5 w / NO

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Function
400 - 3-way Brass Plate Armature
410 - 2-way Brass Plate Armature
900 - 3-way Stainless Steel Plate Armature
910 - 2-way Stainless Steel Plate Armature

Mounting Screw
Specify Part Number S440.250

Order Example: 3800-01-4107
Series 3000, 1.5mm orifice, 5.0 w, normally closed, 2-way brass plate armature, 120 VAC 50/60 Hz

*For more coil options see page 7.

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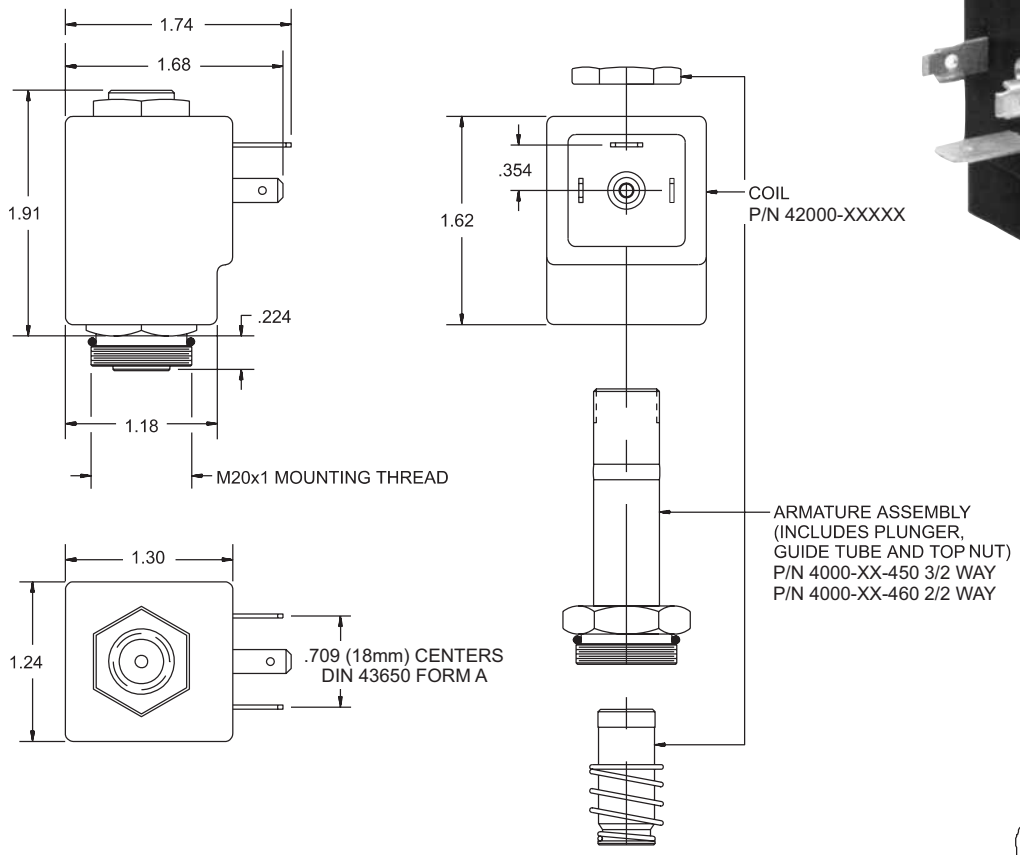
Series 4000

The Spartan Scientific Series 4000 solenoid operators are used as 2 & 3-way in-line poppet valves or to pilot larger 3 & 4-way spool valves. With orifice ranges from .08mm to 3.0mm, the Series 4000 can control air up to 1200 psi. There are both normally open and normally closed versions with all versions featuring the DIN 43650 Form A quick connect interface.

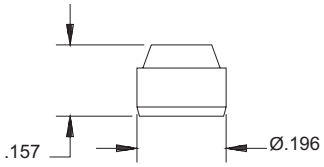
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

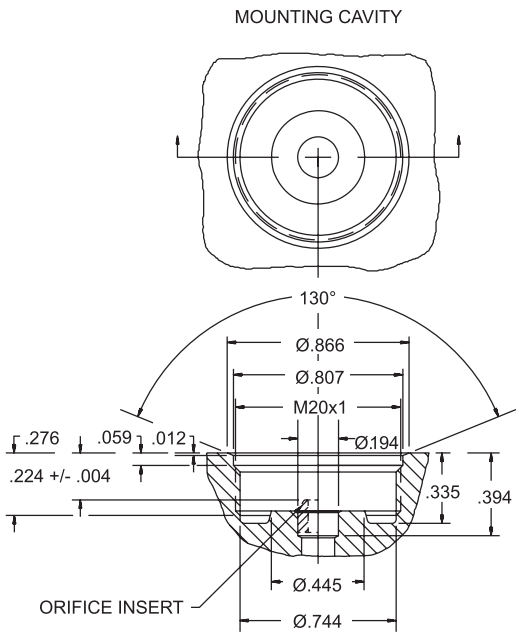


Orifice Insert / Armature Cavity Details

Orifice Insert



MOUNTING CAVITY



Orifice Insert Ordering Guide

4000 - □□ - □□

Orifice Diameter
01 - 0.8mm
02 - 1.6mm
03 - 2.4mm
04 - 3.0mm

Material
40 - Brass
90 - Stainless Steel

*NOTE: Orifice inserts available on request.

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Technical Data

Voltages: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC

Pressure Range: Vacuum - 1200 psi depending on orifice size and function

Temp. Range: (Fluid max. 90°C) Ambient -20°C to +50°C

Voltage Tolerance: +/-10%

Cycle Rate: 12 ms

Coil: Glass filled nylon encapsulation (Class F, continuous duty)

Environment Protection: Dust-tight and water resistant to IP65 (with electrical connector)

Wattage Available: 10 watt VDC / 8 watt VAC

Materials: Operator: AISI 400 and 300 Series Stainless Steel
Shading Ring: Copper standard (Silver available on request)
Seal: Viton standard (other materials available on request)
Springs: 300 Series Stainless Steel

ORIFICE SIZE / VOLTAGE

FUNCTION	0.8 mm		1.6 mm		2.4 mm		3.0 mm		4.0 mm		6.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	1200	900	900	525	450	225	270	150	100	80	70	60
2/2 NO	525	345	255	225	150	120	90	82	N/A	N/A	N/A	N/A
3/2 NC	525	375	255	225	150	120	90	82	60	50	30	20
3/2 NO	450	345	255	225	150	120	105	90	N/A	N/A	N/A	N/A

MAX. PRESSURE RANGE
(psi)

How To Order

4000 - □□ - □□□□

Orifice / Cv / NO/NC
01 - 0.8mm / .035 / NC
02 - 1.6mm / .120 / NC
03 - 2.4mm / .245 / NC
04 - 3.0mm / .315 / NC
0C - 2.4mm / .245 / NO

Function
450 - 3/2-way
460 - 2/2-way

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Order Example: 4000-03-4507
Series 4000, 2.4mm orifice, .245 Cv,
normally closed, 3/2-way, 120 VAC 60 Hz

**For more coil options see page 7.*

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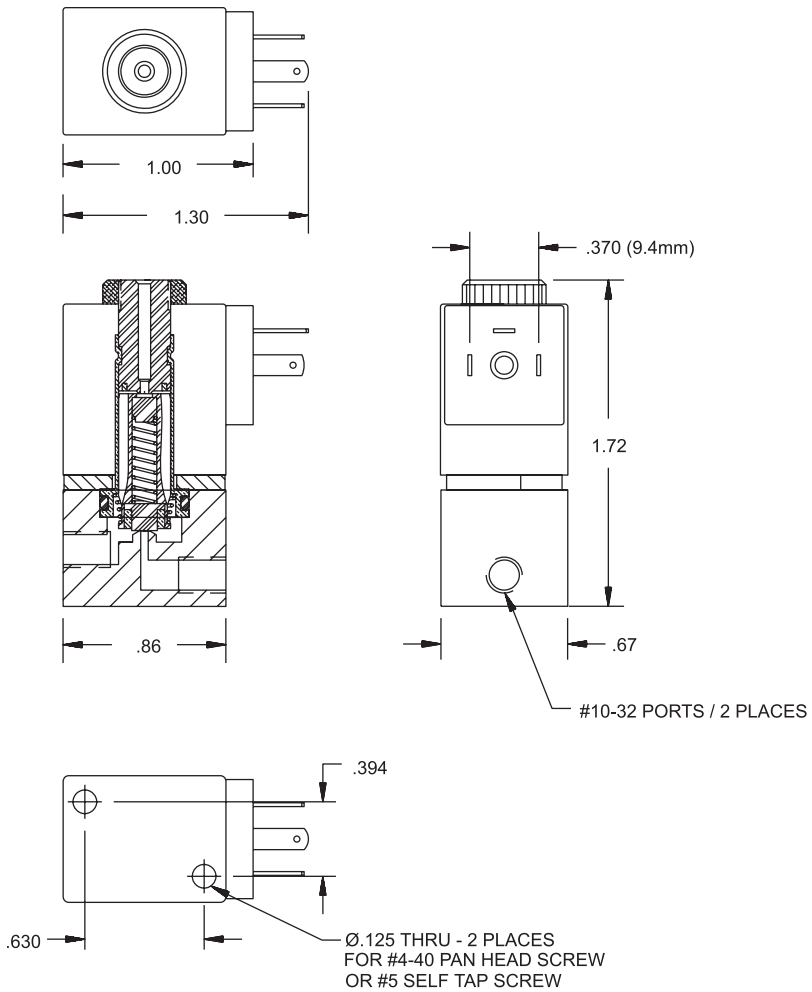
Sub Micro 2-way & 3-way
#10-32 Ported Solenoid Valves

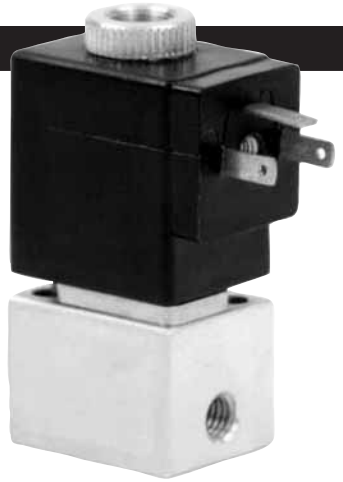
Series 2510

The compact size of the Spartan Scientific Series 2510 Sub-Micro solenoid valve allows it to be used in applications when size restrictions prohibit the use of larger valves. With two orifice sizes to choose from, the 2510 provides a range of flow possibilities at various pressures. The low power consumption, 2.4 watt standard, is an ideal combination for programmable controller applications. The 2510 coil can be rotated 360° and is of completely molded construction. The brass / stainless armature assembly is constructed to provide a long trouble free life. The aluminum body with #10-32 ports has convenient through holes for panel mounting in a size to fit most applications.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED





ORIFICE SIZE / VOLTAGE

FUNCTION

	1.0 mm		1.5 mm	
	AC	DC	AC	DC
2/2 NC	120	95	110	90
2/2 NO	N/A	N/A	N/A	N/A
3/2 NC	120	95	70	60
3/2 NO	120	95	80	70

MAX. PRESSURE RANGE

Features

- Fast cycle times
- Compact size
- Low power consumption
- 2 orifice sizes available
- #10-32 ports
- DIN spade interface for quick connection
- 2 or 3-way 2-position
- All standard voltages

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Series 2510

Sub Micro 2-way & 3-way
#10-32 Ported Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position, direct acting, normally closed or normally open

Port Sizes: #10-32 UNF

Orifice Sizes/ Flow Factor:
1.0mm / .04 Cv
1.5mm / .08 Cv

Pressure Range:
Vacuum - 120 psi (1.0mm)
Vacuum - 60 psi (1.5mm) depending on orifice size and function

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 18 ms complete cycle

Materials:
Operator: 400 Series Stainless and Brass
Shading Ring: Copper
Springs: 300 Series Stainless Steel
Seals: Nitrile standard (other materials available on request)
Valve Body: Aluminum standard (other materials available on request)
Mounting Plate: Zinc-plated Steel

Media: Air, oil, inert gas, water

Mounting: .125" Diameter through holes for pan head screw (#4-40) or M3

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty) DIN spades, 9.4mm centers or flying leads, 2.4 watt standard (other wattages on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

How To Order

2510 - □ □ - 5 □ 1 □

Orifice / Cv / NO/NC
02 - 1.0mm / .04 / NC
03 - 1.5mm / .08 / NC
12 - 1.0mm / .04 / NO
13 - 1.5mm / .08 / NO

Function
2 - 2-way, 2 position
3 - 3-way, 2 position

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 2510-03-5317
Series 2510, 1.5mm orifice, normally closed, 3-way, 2-position, 120 VAC 50/60 Hz

*For more coil options see page 7.

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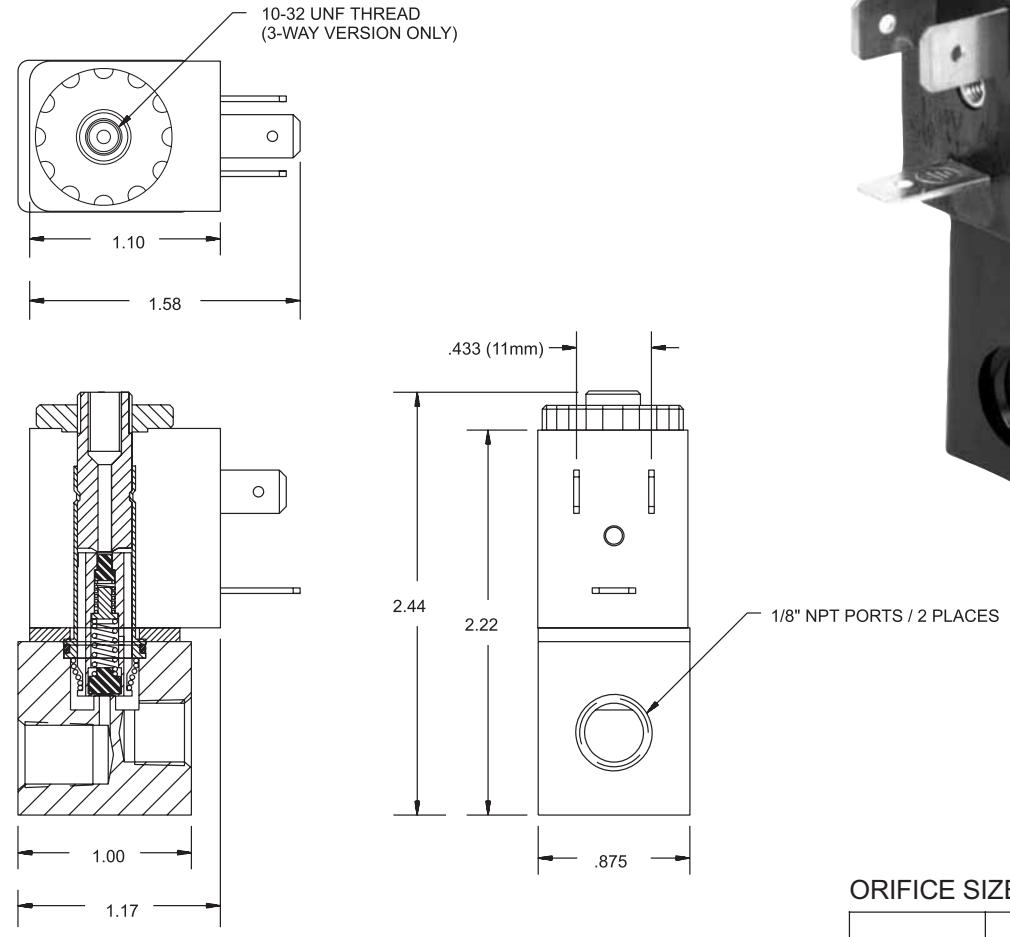
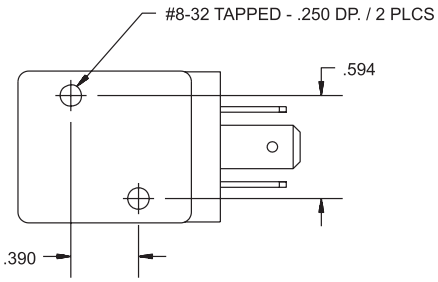
Series 3822

The Spartan Scientific Series 3822 is a 2 or 3-way single solenoid valve with a spring return. Constructed from highest grade materials, the Series 3822 features a completely glass filled nylon encapsulated coil, stainless steel plunger and stop, and spring compensated plunger seals for long trouble free service. The Series 3822 is offered with DIN quick connect male pin out, wire leads or with DIN connector installed. The standard body is aluminum but can be made of brass or stainless steel materials. The Series 3822 is a long life, low cost solution to many automation applications.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED





ORIFICE SIZE / VOLTAGE

FUNCTION	1.5 mm	
	AC	DC
2/2 NC	200	200
2/2 NO	200	200
3/2 NC	150	120
3/2 NO	150	120

MAX. PRESSURE RANGE (psi)

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Series 3822

2-Way & 3-Way Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position, direct acting, normally closed or normally open

Port Sizes: 1/8" NPT

Orifice Sizes/ Flow Factor: 1.5mm / .08 Cv

Pressure Range: Vacuum-200 psi

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 12 ms complete cycle

Materials: Operator: 400 Series Stainless and Brass
Shading Ring: Copper standard
Springs: 300 Series Stainless Steel
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Aluminum standard (Brass and Stainless Steel available on request)

Media: Air, oil, inert gas, water

Mounting: For #8-32 machine screw

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard
(other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

How To Order

3822 - □ □ - 5 □ 8 □

Seat Material♦
0 - Viton
B - Nitrile
E - EPDM

Orifice / Wattage / Cv / NC/NO
1 - 1.5mm / 6.5 w / .080 / NC
3 - 1.5mm / 6.5 w / .080 / NO

Function
2 - 2-way
3 - 3-way

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

♦Seat material comes in contact with media.

Order Example: 3822-01-5387
Series 3822, 1.5mm orifice, .080 Cv, normally closed, 3-way, 120 VAC 50/60 Hz

For more coil options see page 7.

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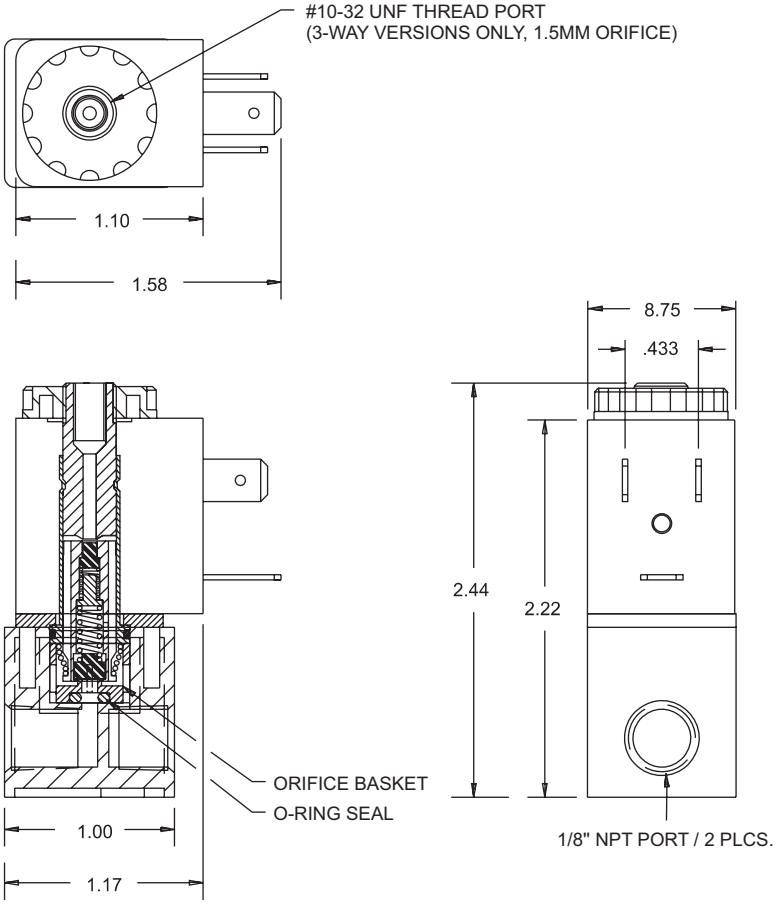
Series 3823

The Spartan Scientific Series 3823 is a composite body solenoid valve offered in both 2-way and 3-way normally open or closed functions and seven orifice sizes. Component features include the proven Spartan Series 3000 solenoid operator available in brass/stainless or all stainless pilot design, optional seal materials and nylon encapsulated coil. The "basket" orifice design feature allows the possibility of changing the orifice diameter to meet flow requirements within a matter of seconds.

The Du Pont Zytel® composite material is media compatible, eliminating the need for stocking multiple body materials.

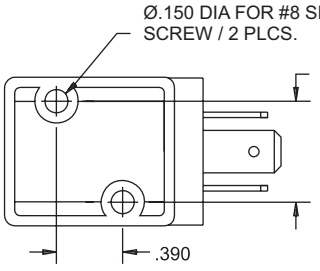
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



Features

- Composite material
- Chemical compatibility
- FDA approved materials
- 8 orifice sizes
- Quick change orifice
- Low wattage coil options available



ORIFICE SIZE / VOLTAGE

FUNCTION

	0.6 mm		0.8 mm		1.0 mm		1.2 mm		1.5 mm		2.0 mm		2.4 mm		*3.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	200	200	200	200	200	200	200	200	200	200	200	200	200	200	75	60
2/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	150	N/A	N/A	N/A	N/A	N/A	N/A
3/2 NC	200	200	200	200	200	200	180	180	150	150	90	75	60	60	25	25
3/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	150	N/A	N/A	N/A	N/A	N/A	N/A

MAX. PRESSURE RANGE
(psi)

*3.0mm uses 30mm coil. Refer to pages 6 - 7.

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Series 3823

Composite 2-way & 3-way Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position direct acting, normally closed or normally open

Port Sizes: 1/8" NPT

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv
3.0mm / .31 Cv

Pressure Range: Vacuum - 200 psi depending on orifice size and function

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 12-14 ms complete cycle

Materials: Operator: 400 Series Stainless and Brass standard (400 and 300 Stainless upon request)
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Du Pont Zytel® FDA Approved
Mounting Plate: Zinc-plated Steel

Media: Air, oil, inert gas, water, caustics, etc.

Mounting: Ø.150" drill, 2 places for a #8 self-tapping screw

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

Consult factory for available versions recognized under the Component Program of Underwriters Laboratories, Inc.

How To Order

3823 - □ □ - □ □ 8 □

Seat Material♦
0 - Viton
B - Nitrile
E - EPDM

Orifice / Wattage / Cv / NC/NO
1 - 0.6mm / 6.5 w / .025 / NC†
2 - 1.0mm / 6.5 w / .05 / NC†
3 - 1.2mm / 6.5 w / .065 / NC†
4 - 1.5mm / 6.5 w / .08 / NC
5 - 2.0mm / 6.5 w / .17 / NC†
6 - 2.4mm / 6.5 w / .24 / NC†
7 - 3.0mm / 6.5 w / .31 / NC†
8 - 0.8mm / 6.5 w / .035 / NC
D - 1.5mm / 6.5 w / .08 / NO

Function
2 - 2-way
3 - 3-way
4 - Diverting†
5 - Mixing†

† Not available in all configurations

Coil Options❖
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Materials in Contact with Media♦♦
A - Brass / Nylon
B - Stainless Steel / Nylon

Order Example: 3823-01-A387
Series 3823, Viton seat, 0.6mm orifice, .025 Cv, normally closed, brass / nylon, 3-way, 120 VAC 50/60 Hz

♦Seat material comes in contact with media.

♦♦All versions come in contact with a copper shading ring. Other versions available on request.

❖*For more coil options see page 7.*

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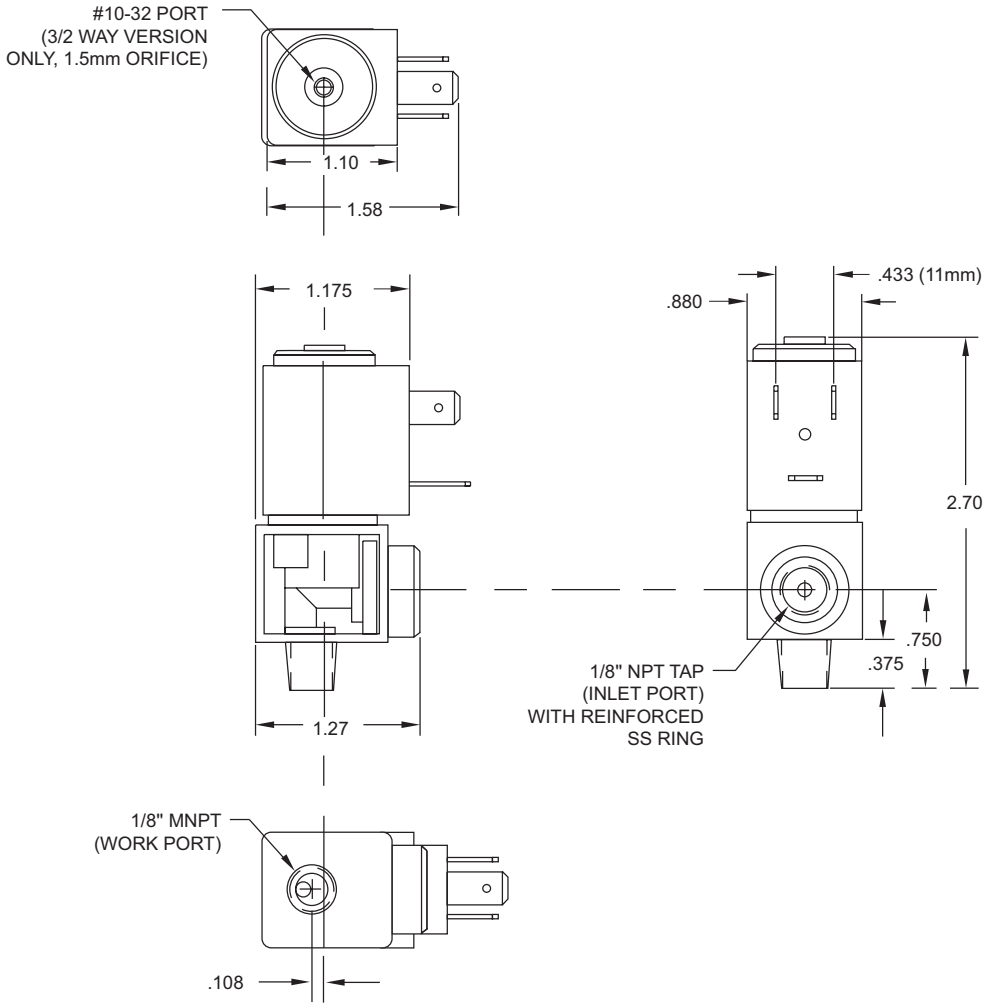
Series 3824

The Series 3824 is a 2 or 3-way, 2-position composite body solenoid valve designed to take the place of a fitting using a female inlet and male outlet port. The valve is generally mounted into an air cylinder port to control a single acting linear actuator. Component features include the proven solenoid operator available in brass/stainless or all stainless pilot design, optional seal materials and nylon encapsulated coil. The "basket" orifice design feature allows the possibility of changing the orifice diameter to meet flow requirements within a matter of seconds.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



Plastic bodied version shown.

Features

- Composite material
- Chemical compatibility
- 8 orifice sizes
- Quick change orifice

ORIFICE SIZE / VOLTAGE

FUNCTION

	0.6 mm		0.8 mm		1.0 mm		1.2 mm		1.5 mm		2.0 mm		2.4 mm		*3.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	200	200	200	200	200	200	200	200	200	200	200	200	200	200	75	60
2/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	200	200	N/A	N/A	N/A	N/A	N/A	N/A
3/2 NC	200	200	200	200	200	200	180	180	150	150	90	75	60	60	25	25
3/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	150	N/A	N/A	N/A	N/A	N/A	N/A

MAX. PRESSURE RANGE
(psi)

*3.0mm uses 30mm coil. Refer to pages 6 - 7.

Series 3824

Composite 2-way & 3-way Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position direct acting, normally closed or normally open

Port Sizes: 1/8" NPT
1/8" MNPT

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv
*3.0mm / .31 Cv

Pressure Range: Vacuum - 200 psi (depending on orifice size) NPT version

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 12-14 ms complete cycle

Materials: Operator: 400 Series Stainless and Brass tube standard (300 Stainless tube available on request)
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Celcon GB25, or Aluminum
Mounting Plate: Zinc-plated Steel

Media: Air, oil, inert gas, water, caustics, etc.

Mounting: 1/8" NPT male port

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

*3.0mm uses 30mm coil. Refer to pages 6 - 7.

How To Order

3824 - □□ - □□ 8 □

Seat Material♦
0 - Viton
B - Nitrile
E - EPDM

Orifice / Wattage / Cv / NC/NO
1 - 0.6mm / 6.5 w / .025 / NC†
2 - 1.0mm / 6.5 w / .05 / NC†
3 - 1.2mm / 6.5 w / .065 / NC†
4 - 1.5mm / 6.5 w / .08 / NC
5 - 2.0mm / 6.5 w / .17 / NC†
6 - 2.4mm / 6.5 w / .24 / NC†
7 - 3.0mm / 6.5 w / .31 / NC†
8 - 0.8mm / 6.5 w / .035 / NC
D - 1.5mm / 6.5 w / .08 / NO

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Function
2 - 2-way
3 - 3-way

Materials in Contact with Media♦♦
A - Brass / Nylon
B - Stainless Steel / Nylon
C - Brass / Aluminum
D - Stainless Steel / Aluminum

Order Example: 3824-01-A387
Series 3824, Viton seat, 0.6mm orifice, .025 Cv, normally closed, brass / nylon, 3-way, 1/8" NPT female to 1/8" MNPT port, 120 VAC 50/60 Hz

† Not available in all configurations

♦Seat material comes in contact with media.

♦♦All versions come in contact with a copper shading ring. Other versions available on request.

*For more coil options see page 7.

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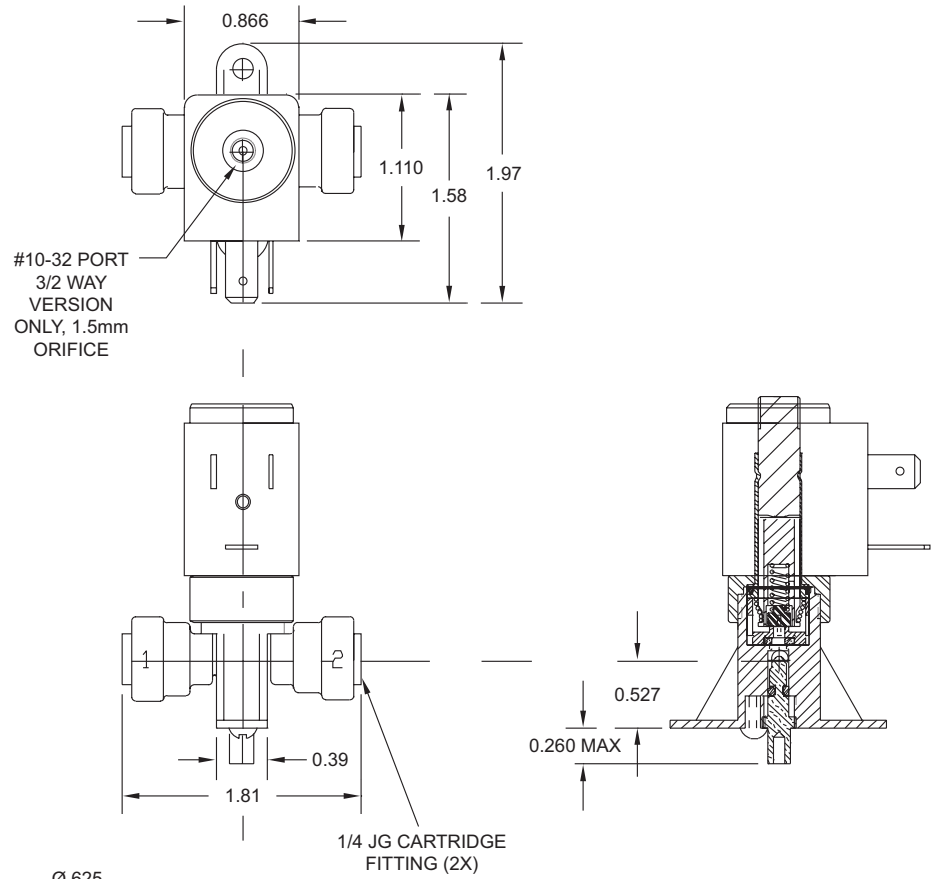
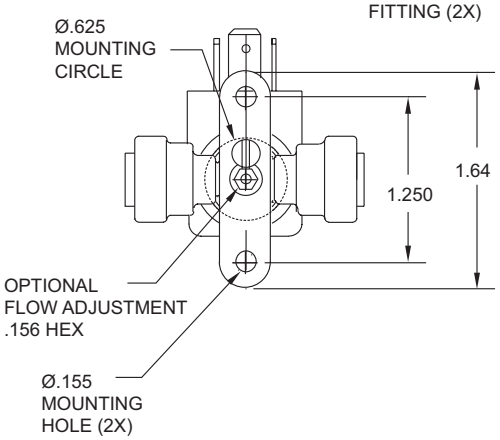
Series 3825

The Spartan Scientific Series 3825 is a composite body solenoid valve featuring integrated .250 inch O.D. quick connect tube fittings right in the valve body. Advantages include reduced leak points and a lower installation cost. Additional features include 2-way and 3-way, 2-position function in either normally open, normally closed, mixing or diverting versions. This versatile series incorporates the orifice basket technology ensuring rapid assembly of many orifice sizes from 0.6 to 3.0 mm. A unique option is that this valve can be made with an externally adjustable flow control effectively giving the operator the ability to dial in a custom flow rate after the valve has been installed in the application. The valve coil is available in all standard voltages with flying leads or DIN quick connect and all versions are fully nylon encapsulated. The 3825 is available in media compatible materials that include stainless steel, or brass, and FDA and NSF approved thermo-plastics. Many seal materials are available with viton as standard.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED





Features

- Composite material
- Chemical compatibility
- 8 orifice sizes
- Quick change orifice
- Integrated fittings
- Molded coil
- Optional metering adjustment
- DIN spades or flying lead coils

ORIFICE SIZE / VOLTAGE

FUNCTION

	0.6 mm		0.8 mm		1.0 mm		1.2 mm		1.5 mm		2.0 mm		2.4 mm		*3.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	150	150	150	150	150	150	150	150	150	150	150	150	150	150	75	60
2/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	150	N/A	N/A	N/A	N/A	N/A	N/A
3/2 NC	150	150	150	150	150	150	150	150	150	150	90	75	60	60	25	25
3/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	150	N/A	N/A	N/A	N/A	N/A	N/A

MAX. PRESSURE RANGE
(psi)

*3.0mm uses 30mm coil. Refer to pages 6 - 7.

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Series 3825

Composite 2-Way & 3-Way Solenoid Valves

Technical Data

Function: 2/2 way or 3/2 way normally open or closed, direct acting. Diverting or mixing

Port Sizes: 1/4" O.D. JG (John Guest) tube cartridges (2x)

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv
3.0mm / .31 Cv

Pressure Range: Vacuum to 150 psi (depending on orifice size)

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +55°C

Response Time: 14-20 ms

Materials: Operator: 400 Series Stainless and Brass tube standard (400 and 300 Stainless tube available on request)
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: DuPont® Celcon GB25 Acetal resin
Fittings: DuPont® Celcon GB25 Acetal resin

Media: Air, water, potable water, light oils (consult factory for chemical compatibility)

Mounting: Ø.155" mounting holes, 2 places

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

How To Order

3825 - □□ - □□□□

Seat Material♦
0 - Viton
B - Nitrile
E - EPDM

Orifice / Wattage / Cv / NC/NO
1 - 0.6mm / 6.5 w / .025 / NC†
2 - 1.0mm / 6.5 w / .05 / NC†
3 - 1.2mm / 6.5 w / .065 / NC†
4 - 1.5mm / 6.5 w / .08 / NC
5 - 2.0mm / 6.5 w / .17 / NC†
6 - 2.4mm / 6.5 w / .24 / NC†
7 - 3.0mm / 6.5 w / .31 / NC†*
8 - 0.8mm / 6.5 w / .035 / NC
D - 1.5mm / 6.5 w / .08 / NO

Materials in Contact with Media♦♦
A - Brass / Stainless Steel and Nylon
B - Stainless Steel / Nylon

Function
2 - 2-way
3 - 3-way
4 - Diverting†
5 - Mixing†

With or Without Metering Stem
0 - No Adjustment
1 - With Adjustment

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3825-01-A307
Series 3825, Viton seat, 0.6mm orifice, .025 Cv, normally closed, brass / stainless steel and nylon, 3-way, without metering stem, 120 VAC 50/60 Hz

*3.0mm uses 30mm coil. Refer to pages 6 - 7.

† Not available in all configurations

♦Seat material comes in contact with media.

♦♦Media will contact shading ring in all versions. Other versions available on request.

**For more coil options see page 7.*

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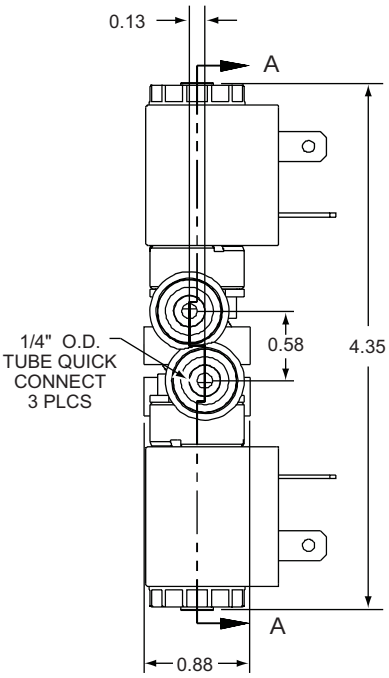
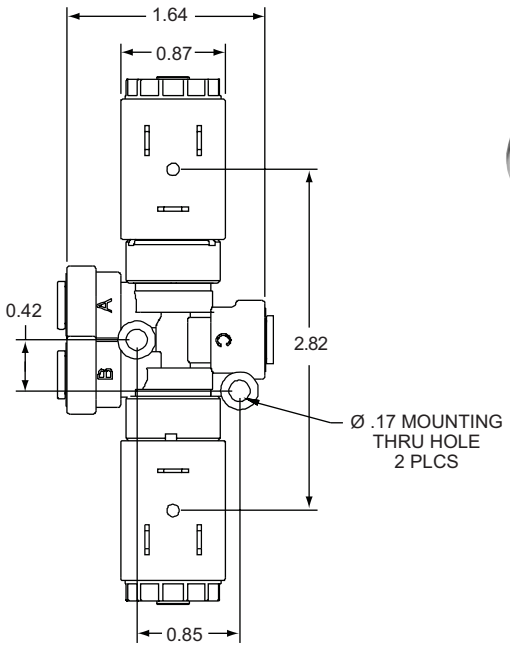
Series 3826

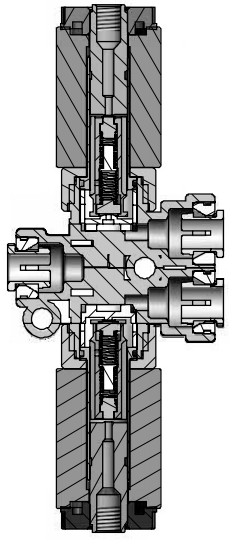
The Spartan Scientific Series 3826 is a unique answer to inert gas and liquid mixing, diverting and media control. Designed for the “feed and bleed” control of linear actuators, the 3826, in conjunction with position feedback and an electronic circuit, can fill and remove gas or liquid from a linear actuator to accomplish linear positioning. In another configuration, the valve can mix two media, at different flow rates, independently or shut off as the need arises. The 3826 incorporates two orifice baskets which accommodate flow rates from .025 to .31 Cv for a custom flow requirement. The valve employs two 2-way operators which function as a 3-way, 3-position blocked center, or two 3-way operators which function as a 4-way, 3-position exhaust center valve. The 3826 operators are designed with spring compensated valve seats for long trouble free life. Operators are available in all standard elastomers with all stainless or brass and stainless guide tubes. Coils are available with spades for DIN connectors or flying-lead termination. The valve body has integrated 1/4” tubing quick connect fittings and is made of Hoechst Ticona Celcon GB25 Acetal resin.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED







SECTION A-A

Features

- Fully encapsulated coils
- 20 million cycles lifetime
- Integrated fittings remove leaking threads
- Multiple function/multiple orifice size valve meets many applications
- DIN quick connect or flying leaded coils
- Light weight yet rugged construction
- Quick change orifice
- FDA approved materials
- Chemical compatibility

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Series 3826

Multiple Function
Solenoid Valves

Technical Data

Function: 3/3 way, 4/3 way, or 3/4 way normally open or closed, direct acting. Diverting or mixing

Port Sizes: 1/4" O.D. JG (John Guest) tube cartridges (3x)

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv
3.0mm / .31 Cv

Pressure Range: Vacuum to 150 psi (depending on orifice size)

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +55°C

Response Time: 14-20 ms

Materials:
Operator: 400 Series Stainless and Brass tube standard (400 and 300 Stainless tube available on request)
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: DuPont® Celcon GB25 Acetal resin
Fittings: DuPont® Celcon GB25 Acetal resin

Media: Air, water, potable water, light oils (consult factory for chemical compatibility)

Mounting: Ø.175" mounting holes, 2 places

Coil Data:
Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

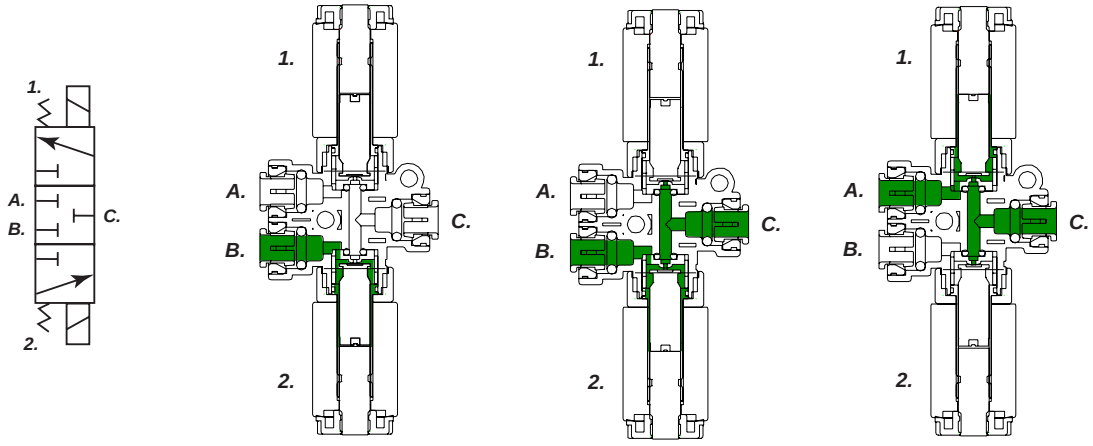
Principles of Operation and Application

OPTION 1:

Direct Acting, 3-Way, 3-Position, Blocked Center, Feed and Bleed

This version of the 3826 is made to fix or change position and or pressure applied to a single acting linear actuator.

- Both solenoids de-energized, pressure enters the valve through port “B” and is blocked. Ports “A” and “C” are also blocked.
- Energize solenoid 2 and pressure flows from “B” to “C” filling the actuator.
- De-energization of solenoid 2 blocks the pressure in the actuator holding its position.
- Energizing solenoid 1 connects port “C” with port “A”, relieving the pressure in the actuator and dropping the actuator position.
- The solenoids can be alternately energized and de-energized to attain precise positioning of the actuator. Pressure can then be used in conjunction with closed loop sensing and a comparator circuit.



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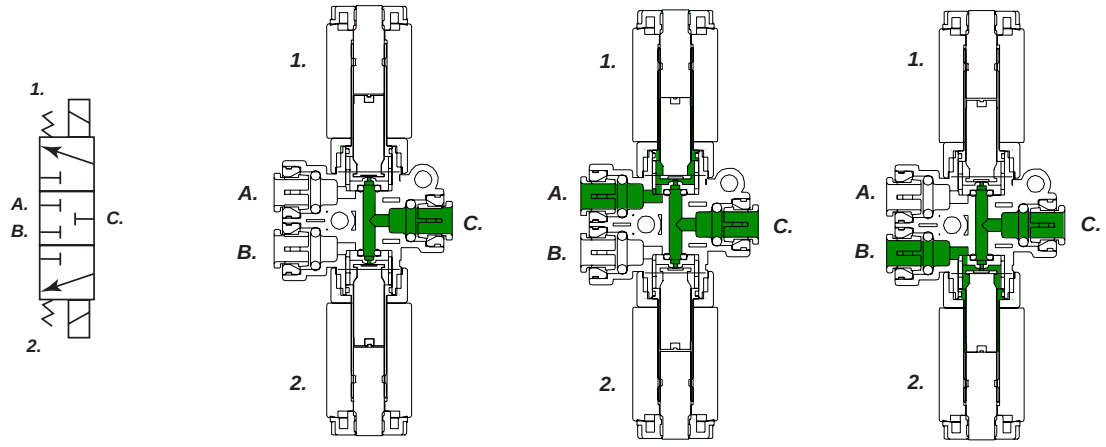
OPTION 2:

Direct Acting, 3-Way, 3-Position, Blocked Center, Diverting

This valve is made to control a single media and divert it into two different locations. Media is presented to port "C" and diverted to ports "A" and "B".

- Pressure / media enters through port “C” and is normally blocked.
- Energization of solenoid 1 connects port “C” to port “A”.
- De-energization of solenoid 1 blocks media flow once again.
- Energization of solenoid 2 connects port “C” to port “B” effectively diverting the same media to another location.

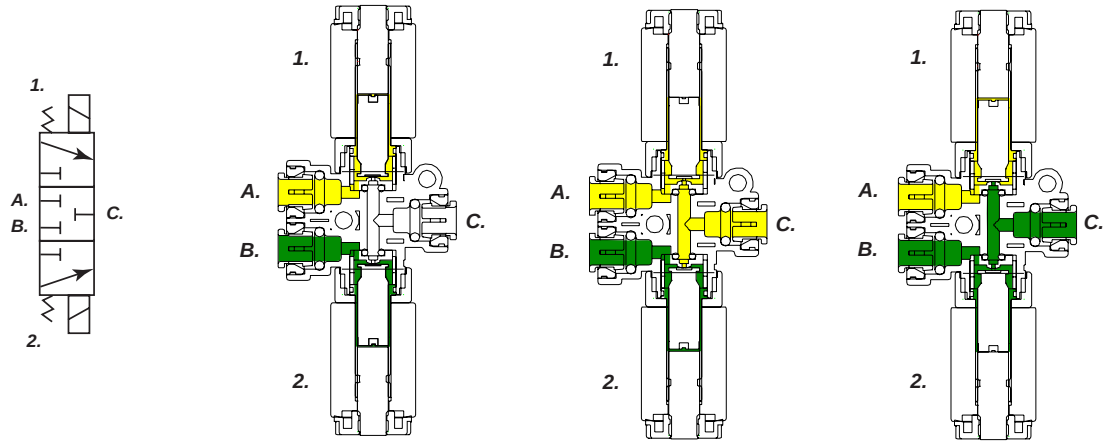


OPTION 3:

Direct Acting, 3-Way, 3-Position, Blocked Center, Mixing (or Function)

This valve is made to control two separate and distinct Medias. The two Medias will be presented to ports “A” and “B” separately.

- Pressure/media entering through ports “A” and "B" is normally blocked.
- Energization of solenoid 1 connects port “A” to port “C”.
- De-energization of solenoid 1 blocks media flow once again.
- Energization of solenoid 2 connects port “B” to port “C”.
- De-energization of solenoid 2 blocks media flow once again

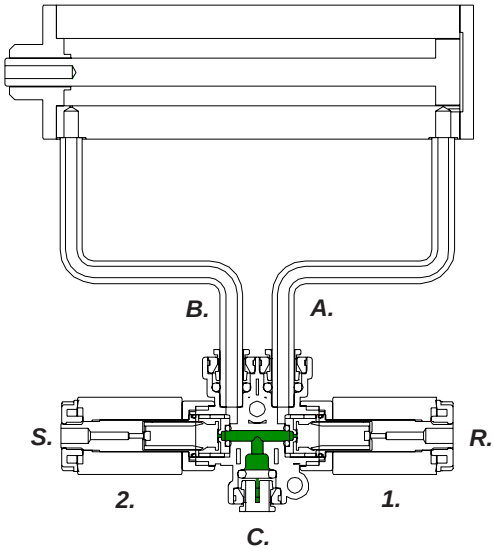


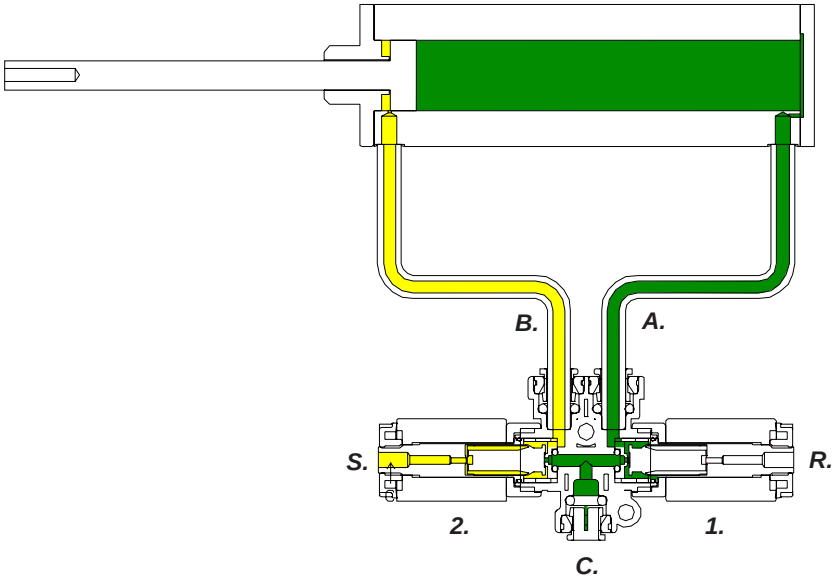
OPTION 4:

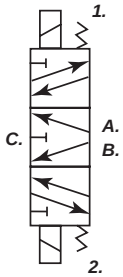
Direct Acting, 4-Way, 3-Position, Exhaust Center, Directional Control

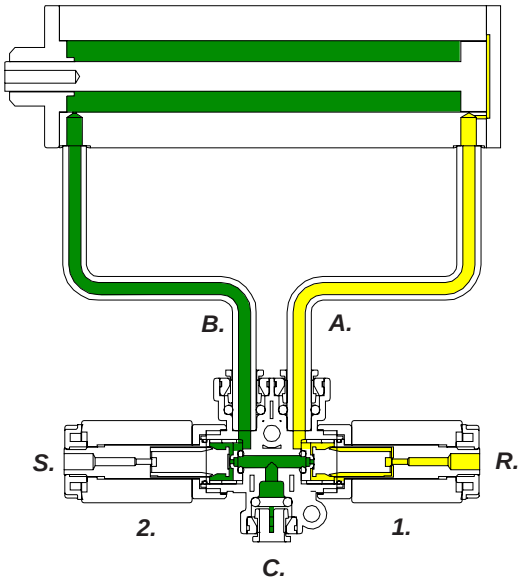
This configuration is most often used to control the flow of air to a double acting, linear actuator. The valve features an exhaust middle position.

- Solenoid 1 and solenoid 2 are de-energized; pressure is blocked on port "C". Ports "B" and "A" are connected to exhaust (atmosphere).
- Solenoid 1 is energized, pressure is connected from port "C" to port "A". Air from the actuator is then forced through port "B" to the exhaust port "S" to atmosphere.
- When solenoid 2 is energized, pressure is connected from port "C" to port "B" shifting the actuator into it other position. The pressure trapped in the downstream side of the actuator travels through the "A" port to exhaust port "R" to atmosphere.









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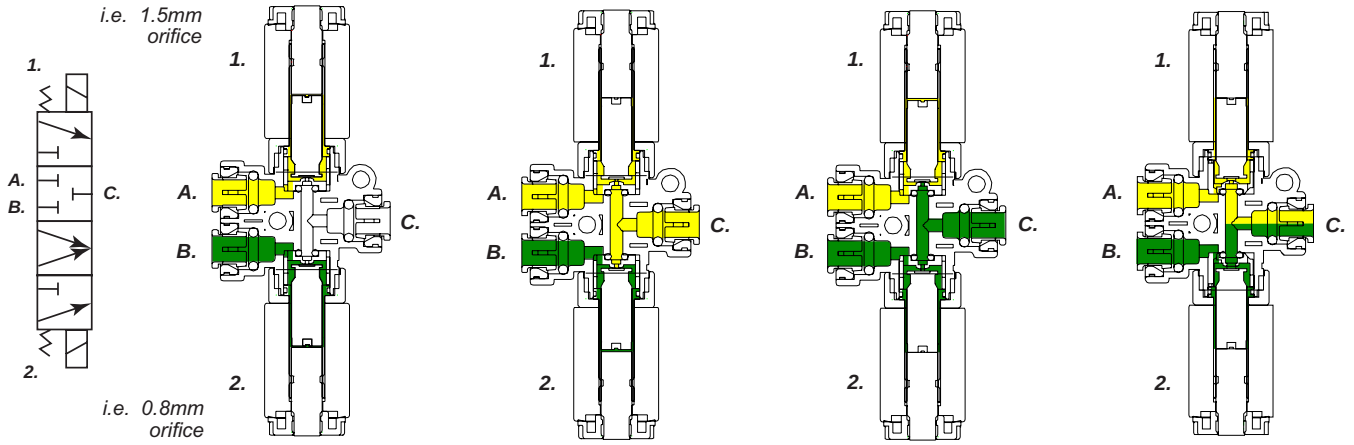
OPTION 5:

Direct acting, 3-way, 4-Position, Blocked Center, Flow Multiplication

Flow multiplication can be accomplished by tailoring orifice sizes to media flow rates, (both main valve orifices), as needed assuming the same media at ports “A” and “B”.

- Solenoids de-energized all ports are blocked.
- Energization of solenoid 1 connects port “A to port “C” at a specified flow rate dependent on orifice chosen.
- Energization of solenoid 2 connects media from port “B” to port “C” at a specific flow rate depending on orifice chosen.
- Simultaneous energization of solenoids 1 and 2 with effectively multiplies flow through port “C” by the sum of the orifice from “A” and “B”. Either solenoid can then be de-energized at any time to tailor the flow rates desired. In this way the valve acts as a digital flow control.

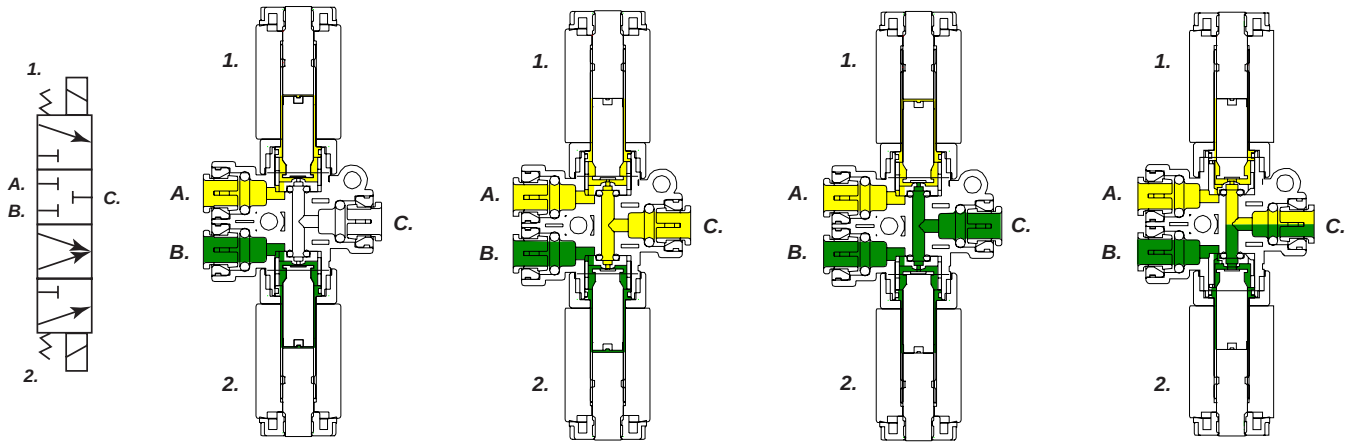


OPTION 6:

Direct acting, 3-Way, 4-Position, Blocked Center, Mixing

Assume that two different media are plumbed to ports “A” and “B”. Selective energization of solenoid 1 and solenoid 2 flow each media through common port “C”.

- De-energization of solenoids blocks media to all ports.
- Energization of solenoid 1 connects port “A” and port “C”.
- Energization of solenoid 2 connects port “B” and port “C”.
- Simultaneous energization of solenoid 1 and 2 connect port “A” and “B” with port “C”. Simultaneous energization of solenoids effectively mixes the two medias through port “C”. This also assumes that the pressures of each media are the same.



How To Order

3826 - □ - □ □ - □ □ C □

Seat Material
0 - Viton
B - Nitrile
E - EPDM

Orifice "A"
1 - 0.6 mm
2 - 1.0 mm
3 - 1.2 mm
4 - 1.5 mm
5 - 2.0 mm
6 - 2.4 mm
7 - 3.0 mm
8 - 0.8 mm

Orifice "B"
1 - 0.6 mm
2 - 1.0 mm
3 - 1.2 mm
4 - 1.5 mm
5 - 2.0 mm
6 - 2.4 mm
7 - 3.0 mm
8 - 0.8 mm

Materials in Contact with Media
A - Brass / Nylon
B - Stainless Steel / Nylon

Option
1 - Option 1 (3/3 Feed and Bleed)
2 - Option 2 (3/3 Diverting)
3 - Option 3 (3/3 Mixing)
4 - Option 4 (4/3 Directional Control)
5 - Option 5 (3/4 Flow Multiplication)
6 - Option 6 (3/4 Mixing)

Coil Options
1 - 6 VDC DIN
2 - 12 VDC DIN
3 - 24 VDC DIN
6 - 24 VAC / 50/60 Hz
7 - 120 VAC / 50/60 Hz
8 - 220 VAC / 50/60 Hz
9 - 240 VAC / 50/60 Hz

Order Example: 3826-0-12-A3C7
Viton seat, 0.6 mm orifice "A",
1.0 mm orifice "B", Brass / Nylon,
3/3 Mixing, 120 VAC / 50/60 Hz

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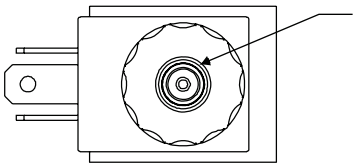
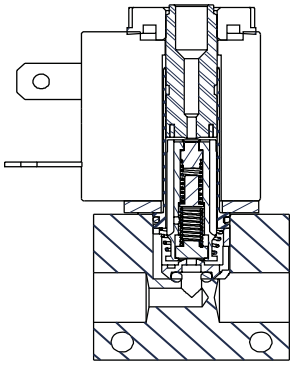
Series 3835

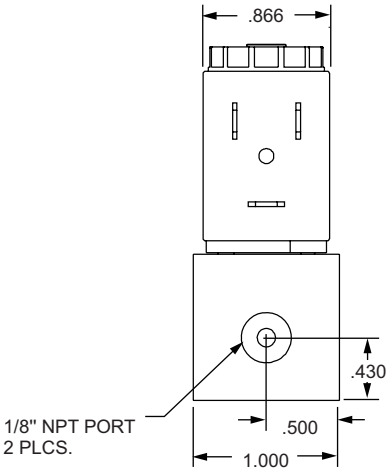
The Spartan Scientific Series 3835 is an aluminum body, 2-way or 3-way, 2-position, direct pilot solenoid valve that features drop in replacement to many popular valve styles for mounting. The 3835 features the full compliment of elastomers including Viton, Nitrile, EPDM and Chemraz and is available in orifice sizes from 0.6mm to 3.0mm in normally open and normally closed configurations. The coil is an all encapsulated unit with internal yoke, Mini spades or flying leads and class H insulation. Current consumption ranges from .9 watt up to 10 watt dependent upon the orifice and pressure ratings.

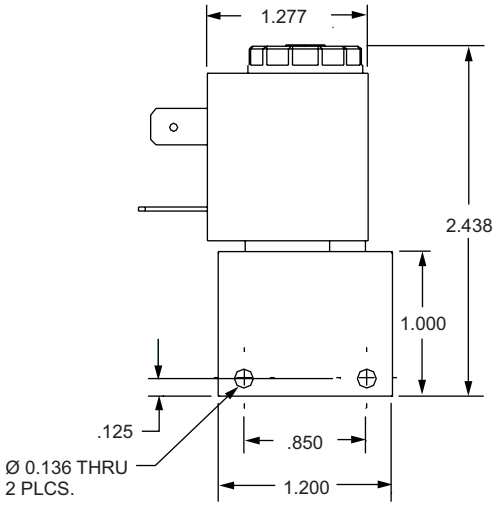
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED









FUNCTION

ORIFICE SIZE / VOLTAGE

	0.6 mm		0.8 mm		1.0 mm		1.2 mm		1.5 mm		2.0 mm		2.4 mm		*3.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	200	200	200	200	200	200	200	200	200	200	200	200	200	200	75	60
2/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	200	200	N/A	N/A	N/A	N/A	N/A	N/A
3/2 NC	200	200	200	200	200	200	180	180	150	150	90	75	60	60	25	25
3/2 NO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	170	150	N/A	N/A	N/A	N/A	N/A	N/A

MAX. PRESSURE RANGE (psi)

*3.0mm uses 30mm coil.

Features

- Compact size
- Long cycle life
- 8 orifice sizes
- Quick change orifice
- Industrial interchangeable valve body
- Low wattage coil options available

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Series 3835

2-way & 3-way Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position, direct acting, normally closed or normally open

Port Sizes: 1/8" NPT

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv
3.0mm / .31 Cv

Pressure Range: Vacuum - 200 psi depending on orifice size and function

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 12-14 ms complete cycle

Materials:
Operator: 400 Series Stainless and Brass standard (400 and 300 Stainless on request)
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Anodized Aluminum (Other material available on request)
Mounting Plate: Zinc-plated Steel
Orifice Basket: Nylon

Media: Air, oil, inert gas, water, caustics, etc.

Mounting: Ø.136" thru hole (2 places)

Coil Data:
Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

How To Order

3835 - □ □ - A □ 8 □

Seal Material♦
0 - Viton
B - Nitrile
E - EPDM

Orifice / Wattage / Cv / NC/NO†
1 - 0.6mm / 6.5 w / .025 / NC
2 - 1.0mm / 6.5 w / .05 / NC
3 - 1.2mm / 6.5 w / .065 / NC
4 - 1.5mm / 6.5 w / .08 / NC
5 - 2.0mm / 6.5 w / .17 / NC
6 - 2.4mm / 6.5 w / .24 / NC
7 - 3.0mm / 6.5 w / .31 / NC
8 - 0.8mm / 6.5 w / .035 / NC
D - 1.5mm / 6.5 w / .08 / NO

Function†
2 - 2-way
3 - 3-way
4 - Diverting
5 - Mixing

Coil Options
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3835-01-A387
Series 3835, Viton seal, 0.6mm orifice, .025 Cv, normally closed, 3-way, 120 VAC 50/60 Hz

† Not available in all configurations

♦Seal material comes in contact with media.

Note: Media comes in contact with a copper shading ring. Other versions available on request.

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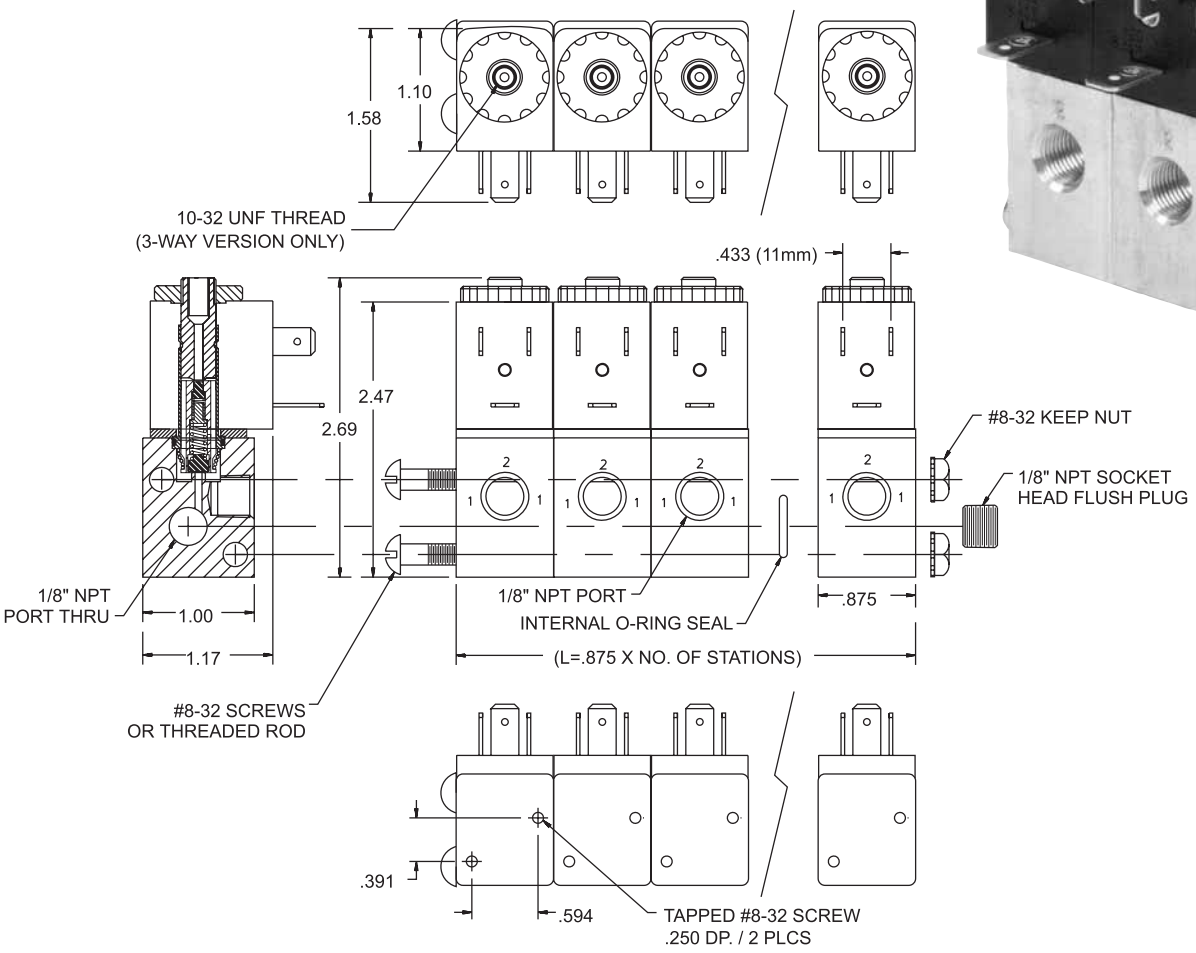
Series 3900

The Spartan Scientific Series 3900 contains all the features of the Series 3822 solenoid valve but can be stacked into a multiple output bank of solenoid valves. The Series 3900 features a fully encapsulated coil, spring compensated plunger seats for long life and a miniature stackable valve body. The advantage to this design is the versatility to stock single units and build, mix and match to meet specifications. In most cases the Series 3900 reduces inventory costs and lowers cost per installation over conventional manifold valve series. The coils are available with DIN quick connect pin out, wire leads or with DIN connectors installed.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



Features

- Mini DIN quick connection
- Direct poppet actuation
- Aluminum or Stainless Steel valve body
- Available 2 or 3-way
- Vacuum to 150 psi
- Single inlet with multiple outlets
- Modular components reduce inventory costs

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Series 3900

Stackable Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way, 2-position direct acting, normally closed

Port Sizes: 1/8" NPT

Orifice Sizes/ Flow Factor: 1.5mm / .08 Cv

Pressure Range: Vacuum-150 psi

Temp. Range: (Fluid 90°C max.) Ambient - 10 to +50°C

Response Time: 12 ms complete cycle

Materials:
Operator: 400 Series Stainless and Brass
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Aluminum, Stainless Steel
Mounting Plate: Zinc-plated Steel

Media: Air, oil, inert gas, water

Mounting: Tapped #8-32 machined screw, .250" deep

Coil Data:
Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard (other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

How To Order

3900 - □ 0 - □ □ □ □

Seat Material♦
0 - Viton
B - Nitrile
E - EPDM

Materials in Contact with Media♦♦
5 - Aluminum / Brass
9 - Stainless Steel

Function
2 - 2-way
3 - 3-way

Stations
1 - 1 Station
2 - 2 Stations
3 - 3 Stations
4 - 4 Stations
5 - 5 Stations
6 - 6 Stations

Coil Options❖
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3900-00-5357
Series 3900, Viton seat, aluminum / brass,
3-way, 5 station, 120 VAC 50/60Hz

Mounting Kits Alone

Description - Model Number
2 Station - 3900-02-00
3 Station - 3900-03-00
4 Station - 3900-04-00
5 Station - 3900-05-00
6 Station - 3900-06-00

Mounting kit contains:
Two mounting screws,
two locking nuts and o-rings.

❖*For more coil options see page 7.*

♦Seat material comes in contact with media.

♦♦All versions come in contact with a copper shading ring.
Other versions available on request.

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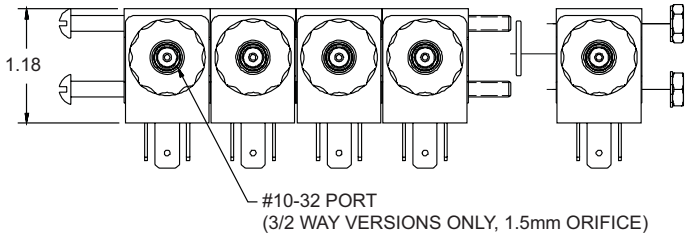
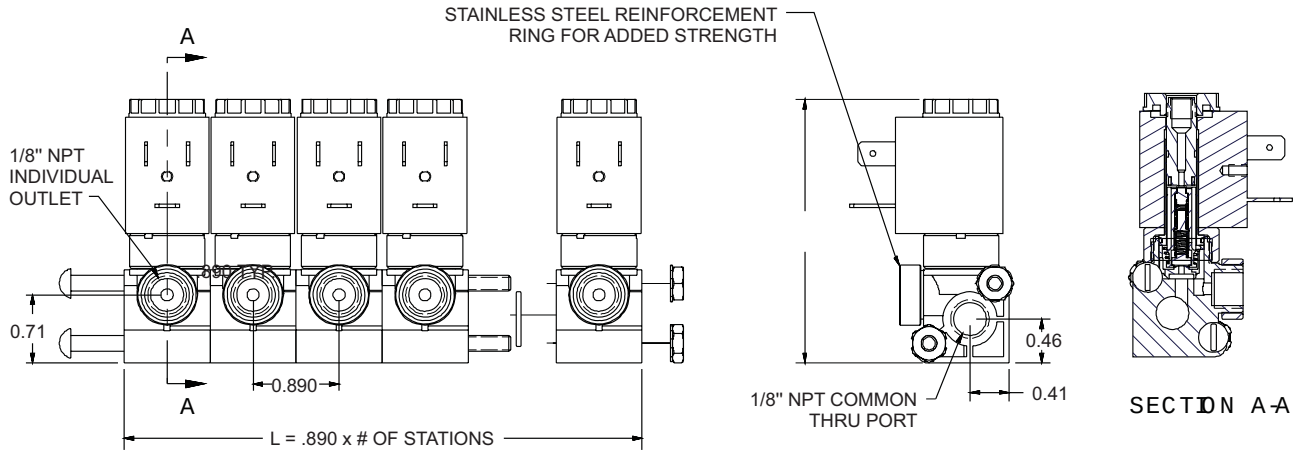
Series 3923

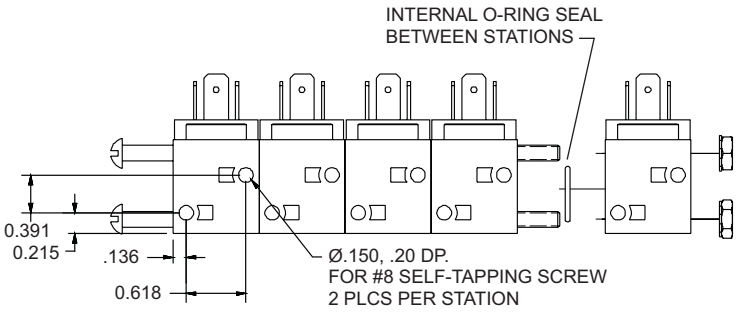
The Spartan Scientific Series 3923 contains all the features of the Series 3823 solenoid valve but can be stacked into a multiple output bank of solenoid valves. The Series 3923 features a fully encapsulated coil, spring compensated plunger seats for long life, and a miniature stackable composite valve body. The advantage to this design is the versatility to stock single units and build, mix, and match to meet specifications. In most cases the Series 3923 reduces inventory costs and lowers cost per installation over a conventional manifold valve series. The coils are available with DIN quick connect pin out, wire leads or with DIN connectors installed.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED







Features

- Chemical compatibility
- Direct poppet actuation
- Composite valve body
- Available 2 or 3-way
- Vacuum to 200 PSI
- Single inlet with multiple outlets
- Modular components reduce inventory costs

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Series 3923

Stackable Composite Solenoid Valves

Technical Data

Function: 2-way, 2-position and 3-way,
2 position direct acting, normally closed

Port Sizes: 1/8" NPT

Orifice Sizes/ Flow Factor:
0.6mm / .025 Cv
0.8mm / .035 Cv
1.0mm / .05 Cv
1.2mm / .065 Cv
1.5mm / .08 Cv
2.0mm / .17 Cv
2.4mm / .24 Cv

Pressure Range: Vacuum - 200 psi depending on orifice size and function

Temp. Range: (Fluid 90°C max.) Ambient -10 to +50°C

Response Time: 12 to 14 ms complete cycle

Materials:
Operator: 400 Series Stainless and Brass
Shading Ring: Copper standard
Springs: 300 Series Stainless
Seals: Viton, Nitrile, EPDM standard (Chemraz® available on request)
Valve Body: Du Pont Zytel® FDA Approved
Mounting Plate: Zinc-plated Steel

Media: Air, oil, inert gas, water, caustics, etc.

Mounting: Ø.150" drill, .250" deep for #8 self tapping screw

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
DIN spades or flying lead 6.5 watt standard
(other wattages available on request)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage Tolerance: +/- 10%

ORIFICE SIZE / VOLTAGE

MAX. PRESSURE RANGE (psi)

FUNCTION	0.6 mm		0.8 mm		1.0 mm		1.2 mm		1.5 mm		2.0 mm		2.4 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	200	200	200	200	200	200	200	200	200	200	200	200	200	200
3/2 NC	200	200	200	200	180	180	160	160	150	150	90	75	60	60

Consult factory for available versions recognized under the Component Program of Underwriters Laboratories, Inc.

How To Order

3923 - □□ - □□□□

Seat Material♦
0 - Viton
B - Nitrile
E- EPDM

Orifice / Wattage / Cv / NC/NO
1 - 0.6mm / 6.5 w / .025 / NC†
2 - 1.0mm / 6.5 w / .05 / NC†
3 - 1.2mm / 6.5 w / .065 / NC†
4 - 1.5mm / 6.5 w / .08 / NC
5 - 2.0mm / 6.5 w / .17 / NC†
6 - 2.4mm / 6.5 w / .24 / NC†
8 - 0.8mm / 6.5 w / .035 / NC

Materials in Contact with Media♦♦
A - Brass / Nylon
B - Stainless Steel / Nylon

Function
2 - 2-way
3 - 3-way

Stations
1 - 1 Station
2 - 2 Stations
3 - 3 Stations
4 - 4 Stations
5 - 5 Stations
6 - 6 Stations

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Mounting Kits Alone

Description - Model Number
2 Station - 3900-02-00
3 Station - 3900-03-00
4 Station - 3900-04-00
5 Station - 3900-05-00
6 Station - 3900-06-00

Mounting kit contains:
Two mounting screws,
two locking nuts and o-rings.

Order Example: 3923-01-A357
Series 3923, Viton seat, 0.6mm orifice, .025 Cv, normally closed, brass / nylon, 3-way, 5 station, 120 VAC 50/60Hz

*For more coil options see page 7.

† Not available in all configurations

♦Seat material comes in contact with media.

♦♦All versions come in contact with a copper shading ring.
Other versions available on request.

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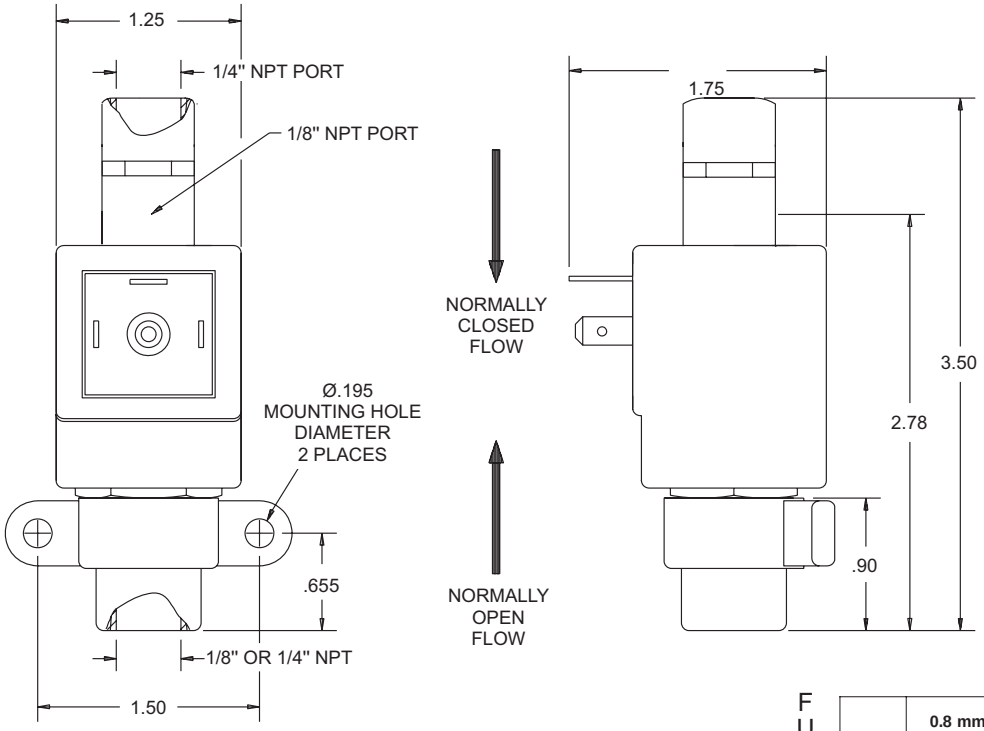
Series 4100

The Spartan Scientific Series 4100 2-way solenoid valves are a compact mechanism using one moving part. Offered in 1/8" and 1/4" NPT, the valves are available with orifices ranging from 0.8 to 4.0mm. Pressure range is vacuum to 600 psi with Nitrile, Viton and EPDM seals. Designed mainly as a safety device on motor vehicles, the 4100 can also be used in water, air and oil systems.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



ORIFICE SIZE / VOLTAGE

FUNCTION

	0.8 mm		1.6 mm		2.4 mm		3.0 mm		4.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	600	480	450	360	255	200	150	120	75	60
2/2 NO	480	385	405	325	195	155	135	110	N/A	N/A

MAX. PRESSURE RANGE
(psi)

Technical Data

Function: 2-way, 2-position, normally closed or normally open, direct acting

Port Sizes: 1/8" or 1/4" NPT

Orifice Sizes: 0.8 to 4.0mm

Pressure Range: Vacuum to 600 psi, depending on orifice size

Flow Factors: Up to .266

Temperature Range: (Fluid Max. 90°C) Ambient -10° to +50°C

Response Time: 16 to 36 ms complete cycle

Materials:
Operator: AISI 400 and 300 Series Stainless Steel
Shading Ring: Copper standard (Silver available on request)
Orifice: Brass
Seal: Viton standard (other materials available on request)
Valve Body: Brass

Media: Air, inert gas, gasoline, oil, water, hydraulic oil, emulsion, etc.

Mounting: In line

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage tolerance: +/- 10%

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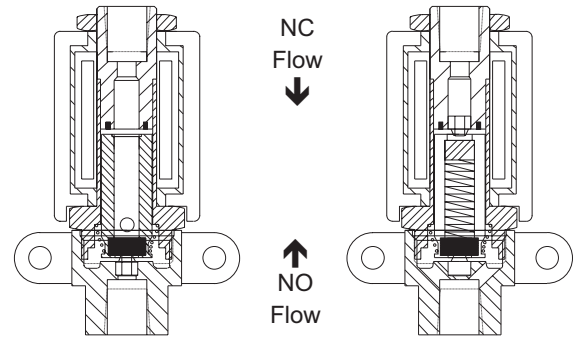
Principle of Operation

Closed Position / Normally Closed Function

With the valve de-energized, media enters through the stem port of the valve and fills the valve chamber. Media pressure, with the aid of the plunger spring, holds the seat against the orifice.



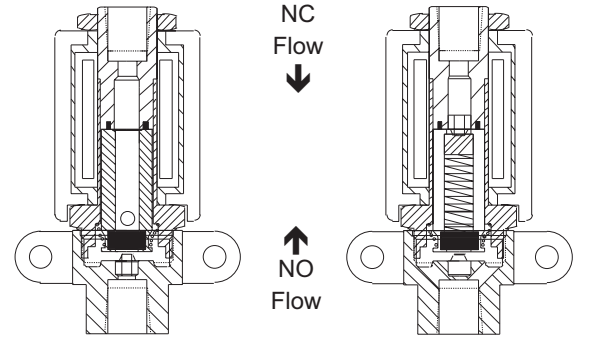
Normal position (non-passing) Normal position (passing)

Open Position / Normally Open Function

With the valve de-energized, media enters through the Normally Open port. Media flows through the hollow plunger and cross drill, and exits through the stem port.

Open Position / Normally Closed Function

When energized, the solenoid coil pulls the plunger off the orifice. Media flows through the hollow plunger and cross drill, and exits through the lower port.



Energized position (passing) Energized position (non-passing)

Closed Position / Normally Open Function

When energized, the solenoid coil pulls the plunger to the raised position. The upper plunger seat closes the stem port orifice stopping the media flow.

How To Order

4100 - □□ - 4 2 □□

Orifice / Cv / NC/NO
01 - 0.8mm / .035 / NC
02 - 1.6mm / .112 / NC
03 - 2.4mm / .224 / NC
04 - 3.0mm / .266 / NC
06 - 4.0mm / .350 / NC
0A - 0.8mm / .035 / NO
0B - 1.6mm / .112 / NO
0C - 2.4mm / .224 / NO
0D - 3.0mm / .266 / NO

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Body Ports
4 - 1/4" NPT
8 - 1/8" NPT

Order Example: 4100-03-4287
Series 4100, 2.4mm orifice, .224 Cv, normally closed, 1/8" NPT ports, 120 VAC 60 Hz

**For more coil options see page 7.*

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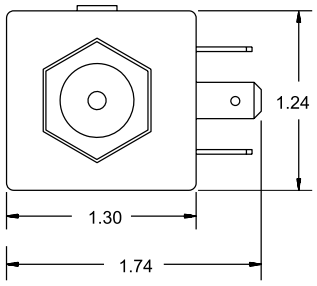
Series 4200

The Series 4200 solenoid valves are larger solenoid valves with an orifice range from 0.8 to 6.0mm. These control valves are offered standard in 1/8" and 1/4" NPT. A manual override is standard on most versions with a completely environment resistant encapsulated coil. Electrical connection is DIN 43650 Form A, a highly versatile quick-connect design. This valve features an all stainless steel (430FR and 316 SS) operator and has bodies available in Zamak, stainless and brass. Functions include normally closed, normally open, mixing and diverting.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



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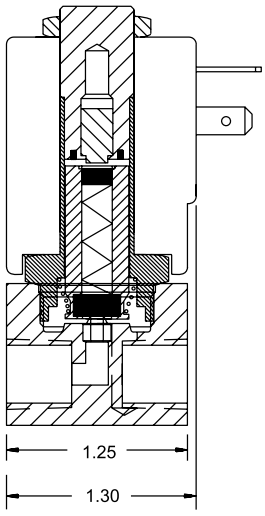

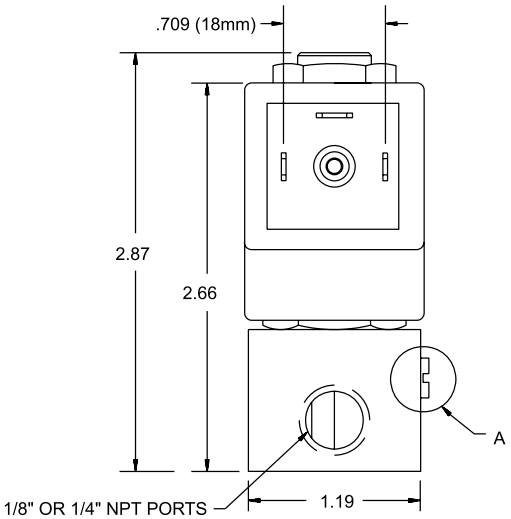

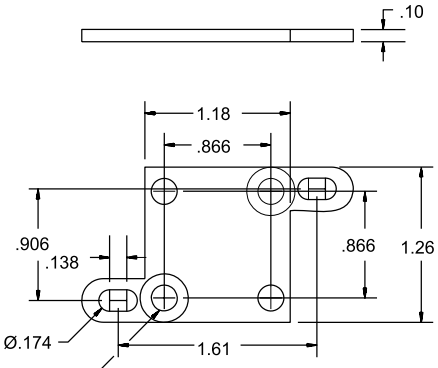

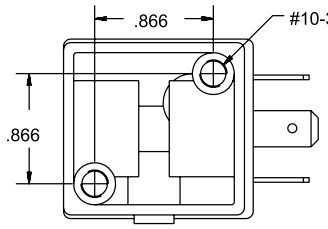

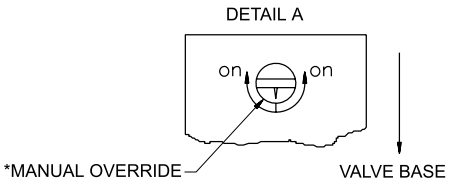

Series 4200

Air-Sol 2-Way & 3-Way Solenoid Valves

Technical Data

Function: 2 or 3-way, normally open or normally closed, direct acting.

Port Size: 1/8" or 1/4" NPT

Orifice Size: 0.8mm to 6.0mm

Pressure Range: Vacuum to 350 psi (depending on function and orifice size)

Flow Factors: Up to .72 Cv

Temp. Range: (Fluid max. 90°C) Ambient -10°C to +50°C

Response Time: 16 to 40 ms complete cycle

Materials: Operator: AISI 300 and 400 Series Stainless Steel
Shading Ring: Copper standard (Silver available on request)
Orifice: Brass (Stainless available on request)
Seals: Viton standard (Optional seal materials include Nitrile, EPDM, Aflas and Neoprene. Contact factory for a complete list and reference numbers.)
Valve Bodies: Aluminum (Zamak), Brass or Stainless Steel

Manual Override: Standard up to 350 psi (not available with 6 mm orifice or higher pressures)

Media: Air, gases, water, oil, etc.

Mounting: Any position by 10-32 screw on bottom or optional mounting plate

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
10 watt VDC, 8 watt VAC.
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage tolerance: +/- 10%

ORIFICE SIZE / VOLTAGE

MAX. PRESSURE RANGE (psi)

FUNCTION	0.8 mm		1.6 mm		2.4 mm		3.0 mm		4.0 mm		6.0 mm	
	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	350	350	350	350	350	225	270	150	100	80	70	55
2/2 NO	350	345	255	225	150	120	90	82	N/A	N/A	N/A	N/A
3/2 NC	350	350	255	225	150	120	90	82	60	50	30	20
3/2 NO	350	345	255	225	150	120	105	90	N/A	N/A	N/A	N/A
3/2 DIV	N/A	N/A	N/A	N/A	150	120	85	80	N/A	60	N/A	N/A
3/2 MIX	N/A	250	N/A	150	90	90	N/A	40	N/A	N/A	N/A	N/A

Consult factory for available versions recognized under the Component Program of Underwriters Laboratories, Inc.

How To Order

4200 - □□ - □□□□

Orifice / Cv / NC/NO
01 - 0.8mm / .035 / NC
02 - 1.6mm / .120 / NC
03 - 2.4mm / .245 / NC
04 - 3.0mm / .315 / NC
06 - 4.0mm / .52 . NC‡
09 - 6.0mm / .72 / NC‡
0C - 2.4mm / .245 / NO

Body Material
4 - Brass
5 - Aluminum (Zamak)
9 - 316 Stainless

Function
2 - 2-way
3 - 3-way
4 - Diverting †
5 - Mixing †

Coil Options❊
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Body Ports
4 - 1/4" NPT
8 - 1/8" NPT

Mounting Plate❊
Specify Part Number 4200-01-110

❊Screws included

Order Example: 4200-03-5387
Series 4200, 2.4mm orifice, .245 Cv, normally closed, Aluminum, 3-way, 1/8" NPT, 120 VAC 60 Hz

† Standard pressure ratings of orifices do not apply for these functions. Please contact factory for details.
‡ Larger orifice sizes not available in all body materials. Not available in all configurations.

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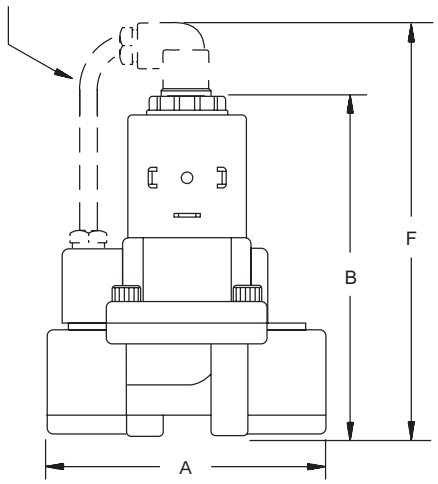
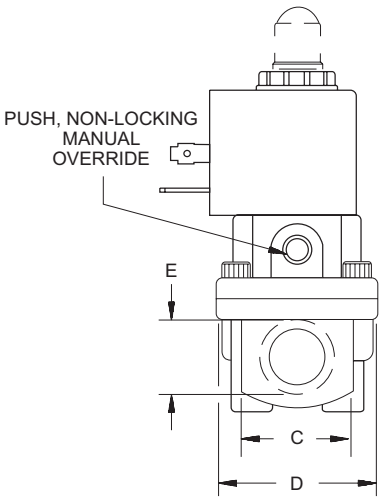
Series 3500

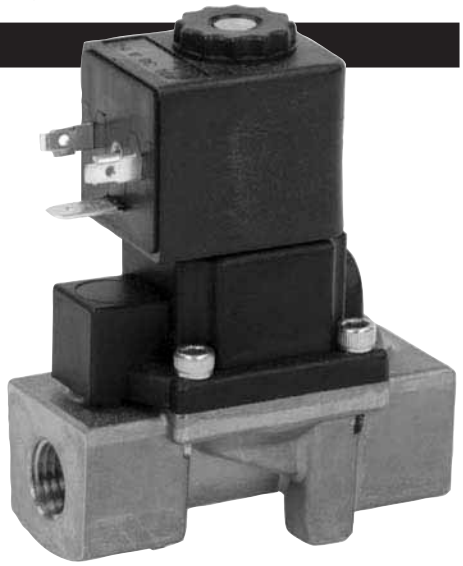
The Spartan Scientific Series 3500 2-way, 2-position solenoid/air operated pilot valve uses the latest combinations of technologies for materials and function. This combination provides the user with the highest quality, smallest size per Cv of flow and most competitive pricing of any valve on the market. The 3500 utilizes the latest injection molding and forging technologies available which garner the highest quality yields of components. When coupled with the Spartan 3000 series solenoid operator, and used as a direct acting/pilot operated valve, the 3500 gives full flow throughout the pressure range starting with an MOPD of 0 psi. The forged body section gives strength and robustness to the valve, and is available in 1/4", 3/8" and 1/2" NPT sizes. The molded pilot section features a push, non-locking manual override, high cycle life solenoid parts and quick connect DIN 43650 “A” or “flying lead” electrical connection options. Typical applications include air control, inert gas control, water, inert fluids, condensate drainage, hot water plumbing and sprinkler systems.

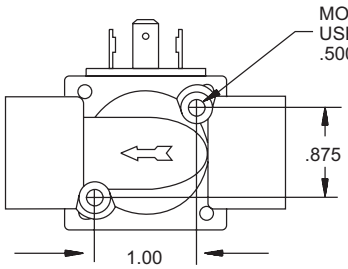
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED









FLOW DATA	
PORT SIZE	**FLOW RATE**
1/4"	8.2 gpm
3/8"	9.3 gpm
1/2"	11.2 gpm
120 psi Δ p 25 psi	

DIMENSIONAL TABLE	
PORTS	1/4" - 3/8" - 1/2"
A	2.75"
B	3.50"
C	1.10"
D	1.50"
E	1/4" - 3/8" - 1/2" NPT
F	4.45"

Technical Data

Function: 2-way, 2-position normally closed or normally open internal pilot diaphragm

Port Sizes: 1/4", 3/8", 1/2" NPT

Orifice Sizes: 1/2"

Pressure Range: 0 - 230 psi 1/4" to 1/2" NPT
(Valve requires 1.5 psi differential to fully open.)

Flow Factors: 1/4" NPT 1.55 Cv
3/8" NPT 1.95 Cv
1/2" NPT 2.45 Cv

Temperature Range: (Fluid max. 90°C) Ambient -10° to +50°C

Response Time: 20 to 80 ms complete cycle

Materials: Operator: AISI 400 and 300 Series Stainless Steel or Brass
Shading Ring: Copper standard
Valve Body: Forged brass and glass filled nylon
Seals: Viton, Nitrile, EPDM

Manual Override: Push non-locking

Media: Air, oil, water, emulsion, inert gases

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24, 120, 220 VAC 50/60 Hz
Voltage tolerance: +/- 10%

VOLTAGE

FUNCTION	AC	DC
2/2 NC	230	150
2/2 NO	185	150

MAX. PRESSURE RANGE (psi)

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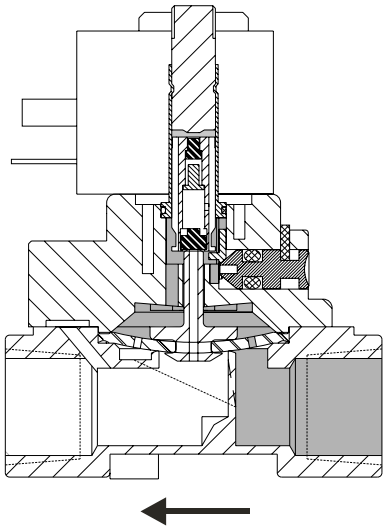
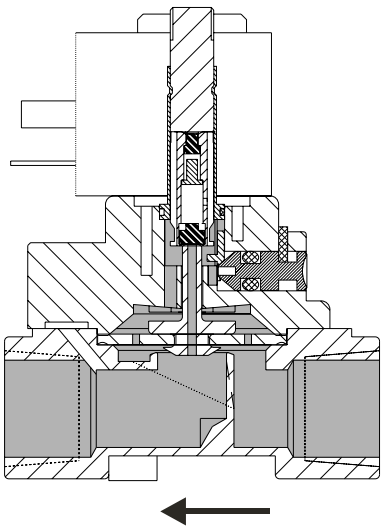
Principle of Operation

Closed Position
With no supply pressure and the valve de-energized, spring force from the armature holds the valve closed. As the supply pressure is increased, pressure builds up on top of the diaphragm via the bleed hole. This force, acting on the larger effective area, holds the valve closed (in conjunction with the armature spring).



Open Position
When energized with no supply pressure, the armature lifts allowing the pre-loaded diaphragm to lift, opening the valve. When supply pressure is applied, pressure above the diaphragm is relieved via the open pilot gallery. The fluid pressure below assists in holding the diaphragm open.



How To Order

3500 - □ □ - 42 □ □

Function
0 - 2-way, Normally Closed
1 - 2-way, Normally Open

Seal Material
1 - Viton
2 - Nitrile
3 - EPDM

Port Size / Orifice / Cv
1 - 1/4" NPT / 1/2" (12.5mm) / 1.55
2 - 3/8" NPT / 1/2" (12.5mm) / 1.95
3 - 1/2" NPT / 1/2" (12.5mm) / 2.45

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3500-01-4237
Series 3500, 2-way, normally closed,
1/2" NPT, 120 VAC 50/60 Hz

Replacement Diaphragm Kits
Kit includes: Diaphragm and Orifice insert

Specify Part Number		
Viton	3500-01-0001	Normally Closed
Nitrile	3500-B1-0001	
EPDM	3500-E1-0001	
Viton	3500-01-0003	Normally Open
Nitrile	3500-B1-0003	
EPDM	3500-E1-0003	

*For more coil options see page 7.

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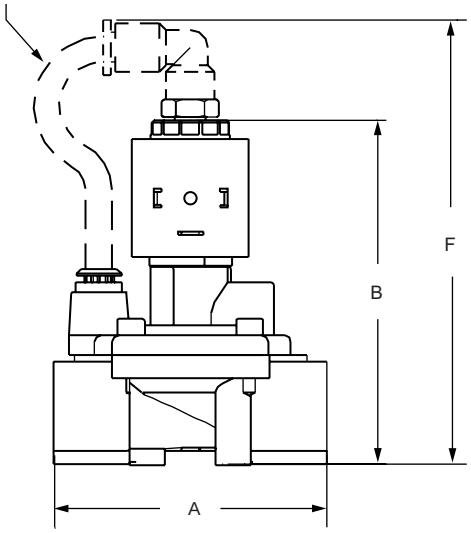
Series 3505

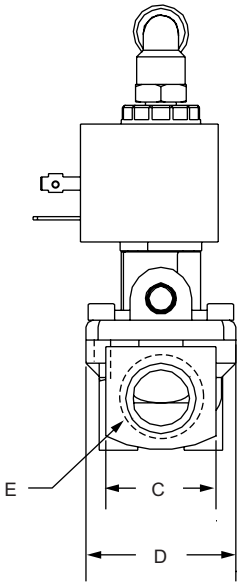
The Spartan Scientific Series 3505 is a 2-way, 2-position, normally closed or normally open valve for the control of air, oil, water, or media that is compatible with valve materials of manufacture. The valve features an all brass body and a 0 minimum pressure differential while still boasting a full flow 1/2" orifice. Available in 1/4", 3/8" and 1/2" NPT, the 3505 can handle pressures to 230 psi. The encapsulated coil construction ensures that the valve functions well under long periods of energization (100% duty), as well as providing a high degree of environmental protection (NEMA 4). The inner valve functions as a direct assist using a flat diaphragm and orifice plate. Pressure differentials shift the valve to full open or full closed. A push, non-locking manual override is standard.

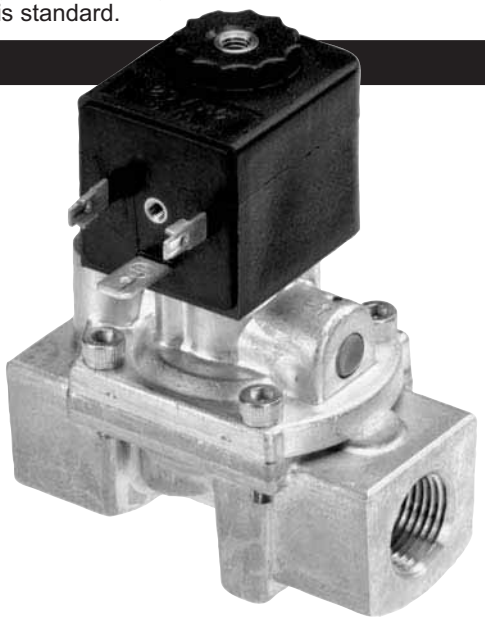
Dimensional Data

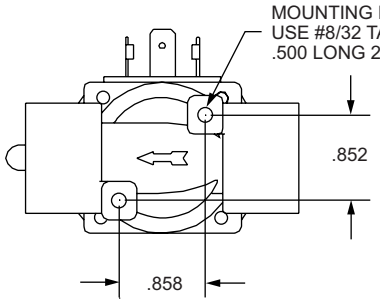
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

TUBE AND FITTING INSTALLED WITH
NORMALLY OPEN VERSION ONLY









FLOW DATA	
PORT SIZE	FLOW RATE
1/4"	8.2 gpm
3/8"	9.3 gpm
1/2"	11.2 gpm
120 psi Δ p 25 psi	

DIMENSIONAL TABLE	
PORTS	1/4" - 3/8" - 1/2"
A	2.75"
B	3.50"
C	1.10"
D	1.50"
E	1/4" - 3/8" - 1/2" NPT
F	4.45"

Technical Data

Function: 2-way, 2-position normally closed or normally open internal pilot diaphragm

Port Sizes: 1/4", 3/8", 1/2" NPT

Orifice Sizes: 1/2"

Pressure Range: 0 - 230 psi 1/4" to 1/2" NPT
(Valve requires 1.5 psi differential to fully open.)

Flow Factors: 1/4" NPT 1.55 Cv
3/8" NPT 1.95 Cv
1/2" NPT 2.45 Cv

Temperature Range: (Fluid max. 90°C) Ambient -10° to +50°C

Response Time: 20 to 80 ms complete cycle

Materials: Operator: AISI 400 and 300 Series Stainless Steel or Brass
Shading Ring: Copper standard
Valve Body: Forged brass
Seals: Viton, Nitrile, EPDM

Manual Override: Push non-locking

Media: Air, oil, water, emulsion, inert gases

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24, 120, 220 VAC 50/60 Hz
Voltage tolerance: +/- 10%

MAX. PRESSURE RANGE (psi)

FUNCTION	VOLTAGE AC	VOLTAGE DC
2/2 NC	230	180
2/2 NO	150	150

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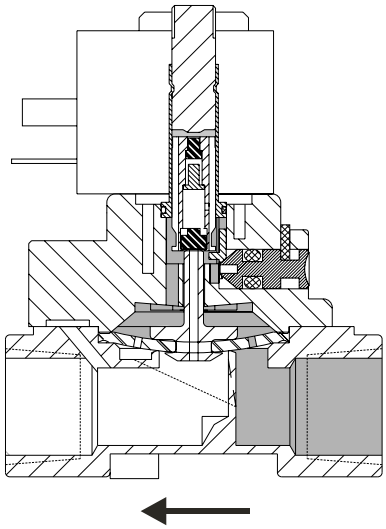
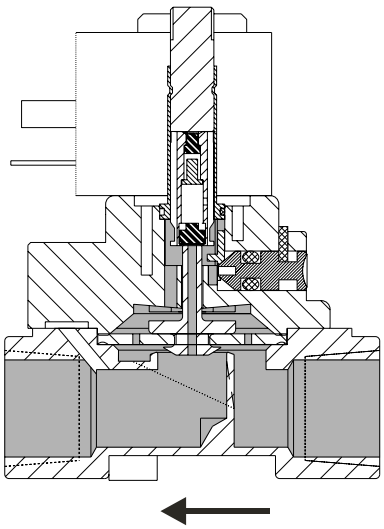
Principle of Operation

Closed Position
With no supply pressure and the valve de-energized, spring force from the armature holds the valve closed. As the supply pressure is increased, pressure builds up on top of the diaphragm via the bleed hole. This force, acting on the larger effective area, holds the valve closed (in conjunction with the armature spring).



Open Position
When energized with no supply pressure, the armature lifts allowing the pre-loaded diaphragm to lift, opening the valve. When supply pressure is applied, pressure above the diaphragm is relieved via the open pilot gallery. The fluid pressure below assists in holding the diaphragm open.



How To Order

3505 - □ □ - 42 □ □

Function
0 - 2-way, Normally Closed
1 - 2-way, Normally Open

Seal Material
1 - Viton
2 - Nitrile
3 - EPDM

Port Size / Orifice / Cv
1 - 1/4" NPT / 1/2" (12.5mm) / 1.55
2 - 3/8" NPT / 1/2" (12.5mm) / 1.95
3 - 1/2" NPT / 1/2" (12.5mm) / 2.45

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3505-01-4237
Series 3505, 2-way, normally closed,
1/2" NPT, 120 VAC 50/60 Hz

Replacement Diaphragm Kits
Kit includes: Diaphragm and Orifice insert

Specify Part Number		
Viton	3500-01-0001	Normally Closed
Nitrile	3500-B1-0001	
EPDM	3500-E1-0001	
Viton	3500-01-0003	Normally Open
Nitrile	3500-B1-0003	
EPDM	3500-E1-0003	

*For more coil options see page 7.

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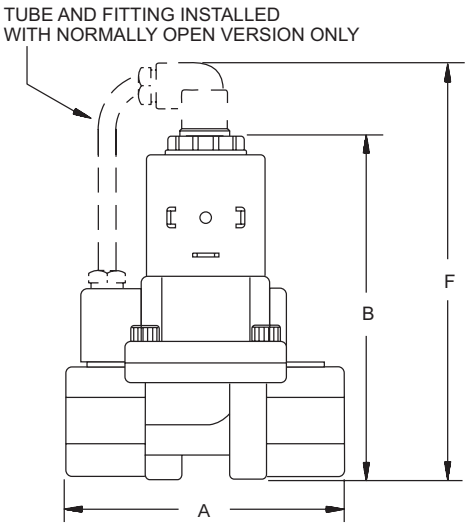
Air-Sol 2-Way
Process Composite Solenoid Valves

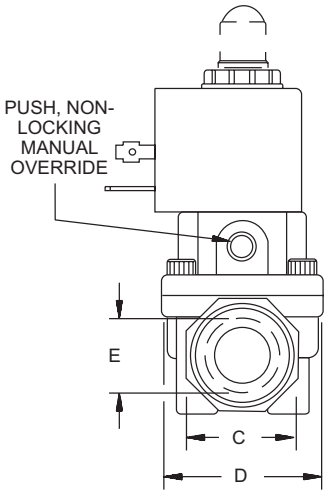
Series 3510

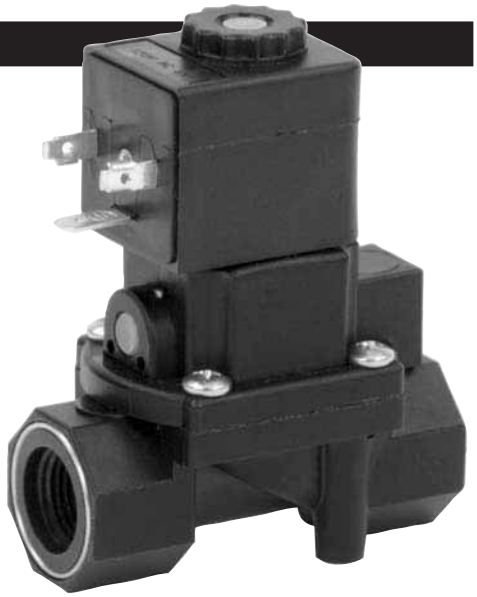
The Spartan Scientific Series 3510 2-way, 2-position solenoid/air operated pilot valve uses the latest technologies for materials and function. This combination provides the user with the highest quality, smallest size per Cv of flow and most competitive pricing of any valve on the market. When coupled with the Spartan 3000 series solenoid operator, and used as a direct acting/pilot operated valve, the 3510 gives full flow throughout the pressure range starting with an MOPD of 0 psi. The polymer body section is available in 1/4", 3/8" and 1/2" NPT sizes and features a stainless steel anti-flex ring for port strength. The molded pilot section features a push, non-locking manual override, high cycle life solenoid parts, and quick connect DIN 43650 "A" or "flying lead" electrical connection options. Typical applications include air control, inert gas control, water, condensate drainage, hot water plumbing and sprinkler systems.

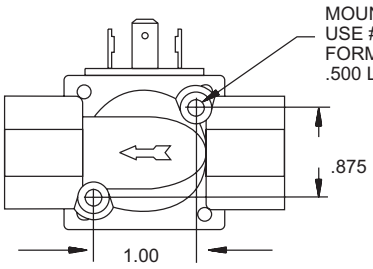
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED









FLOW DATA	
PORT SIZE	FLOW RATE
1/4"	8.2 gpm
3/8"	9.3 gpm
1/2"	11.2 gpm
120 psi Δ p 25 psi	

DIMENSIONAL TABLE	
PORTS	1/4" - 3/8" - 1/2"
A	2.75"
B	3.50"
C	1.10"
D	1.50"
E	1/4" - 3/8" - 1/2" NPT
F	4.45"

Technical Data

Function: 2-way, 2-position normally closed or normally open internal pilot diaphragm

Port Sizes: 1/4", 3/8", 1/2" NPT

Orifice Sizes: 1/2" (12.5mm)

Pressure Range: 0 - 150 psi 1/4" to 1/2" NPT
(Valve requires 1.5 psi differential to fully open.)

Flow Factors: 1/4" NPT 1.55 Cv
3/8" NPT 1.95 Cv
1/2" NPT 2.45 Cv

Temperature Range: (Fluid max. 90°C) Ambient -10° to +50°C

Response Time: 20 to 80 ms complete cycle

Materials: Operator: AISI 400 and 300 Series Stainless Steel or Brass
Shading Ring: Copper standard
Seals: Viton, Nitrile, EPDM
Valve Body: Du Pont Zytel® 77G33, glass filled nylon, NSF approved

Manual Override: Push non-locking

Media: Air, oil, water, potable water, emulsion, inert gases

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24, 120, 220 VAC 50/60 Hz
Voltage tolerance: +/- 10%

VOLTAGE

FUNCTION	AC	DC
2/2 NC	150	150
2/2 NO	150	120

MAX. PRESSURE RANGE (psi)

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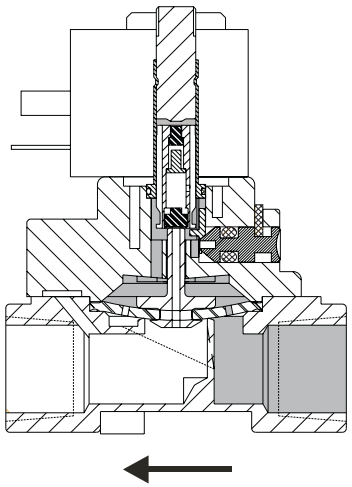
Series 3510

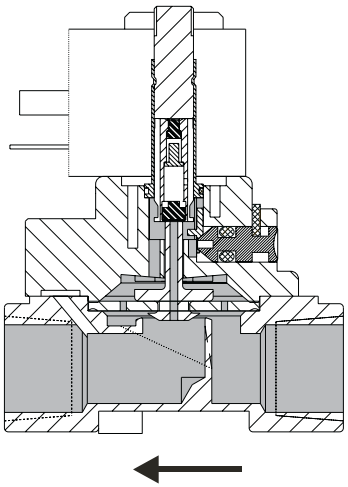
Air-Sol 2-Way
Process Composite Solenoid Valves

Principle of Operation

Closed Position
With no supply pressure and the valve de-energized, spring force from the armature holds the valve closed. As the supply pressure is increased, pressure builds up on top of the diaphragm via the bleed hole. This force, acting on the larger effective area, holds the valve closed (in conjunction with the armature spring).



Open Position
When energized with no supply pressure, the armature lifts allowing the pre-loaded diaphragm to lift, opening the valve. When supply pressure is applied, pressure above the diaphragm is relieved via the open pilot gallery. The fluid pressure below assists in holding the diaphragm open.



How To Order

3510 - □ □ - □ 2 □ □

Function
0 - 2-way, Normally Closed
1 - 2-way, Normally Open

Seal Material ♦
1 - Viton
2 - Buna N / Nitrile
3 - EPDM

Materials in Contact with Media ♦♦
8 - Brass / Nylon
9 - Stainless Steel / Nylon

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Port Size / Orifice / Cv
1 - 1/4" NPT / 1/2" (12.5mm) / 1.55
2 - 3/8" NPT / 1/2" (12.5mm) / 1.95
3 - 1/2" NPT / 1/2" (12.5mm) / 2.45

Order Example: 3510-01-8237
Series 3510, 2-way, normally closed, Viton seal, brass / nylon, 1/2" NPT, 120 VAC 50/60 Hz

♦ Seal material comes in contact with media.
♦♦ All versions come in contact with a copper shading ring. Other versions available on request.

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Replacement Diaphragm Kits
Kit includes: Diaphragm and Orifice insert

Specify Part Number		
Viton	3500-01-0001	Normally Closed
Nitrile	3500-B1-0001	
EPDM	3500-E1-0001	
Viton	3500-01-0003	Normally Open
Nitrile	3500-B1-0003	
EPDM	3500-E1-0003	

*For more coil options see page 7.

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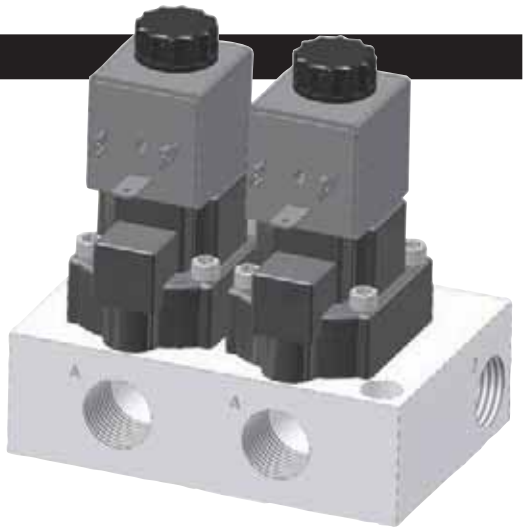
Series 35KR

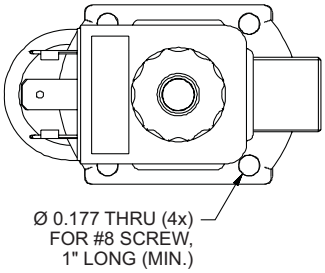
The Spartan Scientific Series 35KR 2-way, 2-position solenoid valve is a variation on the popular 3500 Series valves which feature miniaturized size vs. flow rate while allowing the user to manifold multiple outlets with one inlet. The 35KR design features the direct pilot design which controls zero to 150 PSI in the all plastic version and 0 to 230 in the Brass Plastic version. The intermediate orifice plate design is the key to the 35KR in that it includes all the details of careful orifice design and creates a simple sealing pattern which can be mounted to integrated equipment and complex manifolds with simple mounting screws. The mounting style reduces leak points and numbers of connections. The 12mm orifice promotes full flow while the valve body, at only 1.5 inches wide, can be gang mounted to give impressively small envelope packages with many outputs. The simple mounting pattern is shown under dimensional data and can be machined into many varied manifold configurations.

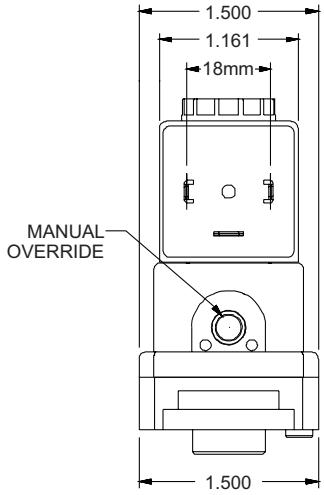
Dimensional Data

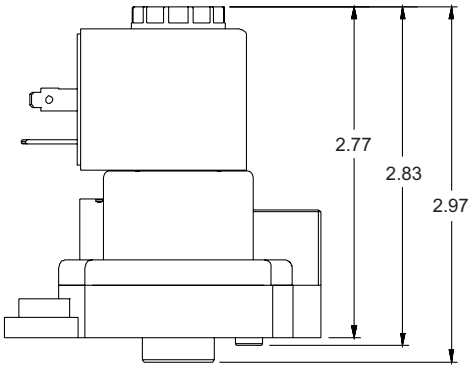
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

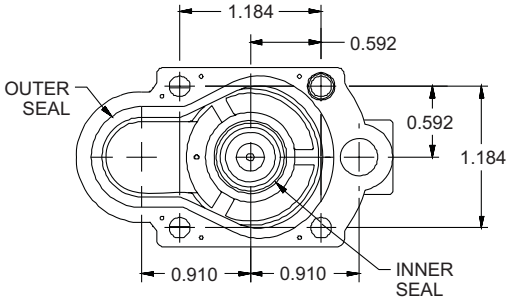


Note: SubBase not supplied.

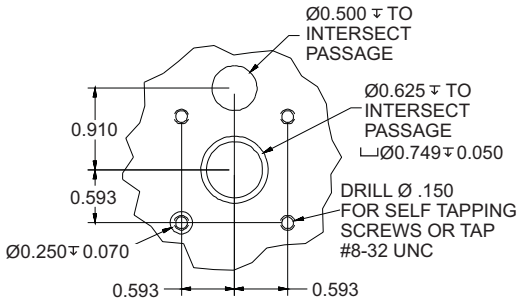








MOUNTING HOLE / PASSAGE PATTERN



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Series 35KR

2-Way Solenoid Valves

Technical Data

Function: 2-way, 2-position normally closed or normally open internal pilot diaphragm

Orifice Sizes: 1/2"

Pressure Range: 0 - 230 psi 1/4" to 1/2" NPT
(Valve requires 1.5 psi differential to fully open.)

Flow Factors: Up to 2.45 Cv

Temp. Range: (Fluid max. 90°C) Ambient -10° to +50°C

Response Time: 20 to 80 ms complete cycle

Materials: Operator: AISI 400 and 300 Series Stainless Steel or Brass
Shading Ring: Copper standard
Valve Body: Forged brass and glass filled nylon
Seals: Viton, Nitrile, EPDM

Manual Override: Push non-locking

Media: Air, oil, water, emulsion, inert gases

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage tolerance: +/- 10%

VOLTAGE

FUNCTION	AC	DC
2/2 NC	230	150
2/2 NO	185	150

MAX. PRESSURE RANGE (psi)

How To Order

35KR - □ □ - □ 20 - □

Function
0 - 2-way, Normally Closed
1 - 2-way, Normally Open

Seal Material
0 - Viton
B - Nitrile
E - EPDM

Coil Options
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Materials in Contact with Media
A - Brass / Stainless Steel / Nylon
B - Stainless Steel / Nylon

Order Example: 35KR-00-B20-7
Series 35KR, 2-way, normally closed,
Viton seal, Stainless Steel / Nylon, 120 VAC 50/60 Hz.

Replacement Diaphragm Kits
Kit includes: Diaphragm and Orifice insert
Specify Part Number

Viton	3500-01-0001	Normally Closed
Nitrile	3500-B1-0001	
EPDM	3500-E1-0001	
Viton	3500-01-0003	Normally Open
Nitrile	3500-B1-0003	
EPDM	3500-E1-0003	

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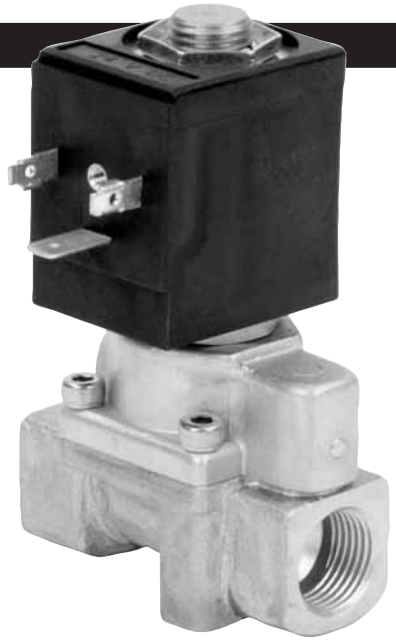
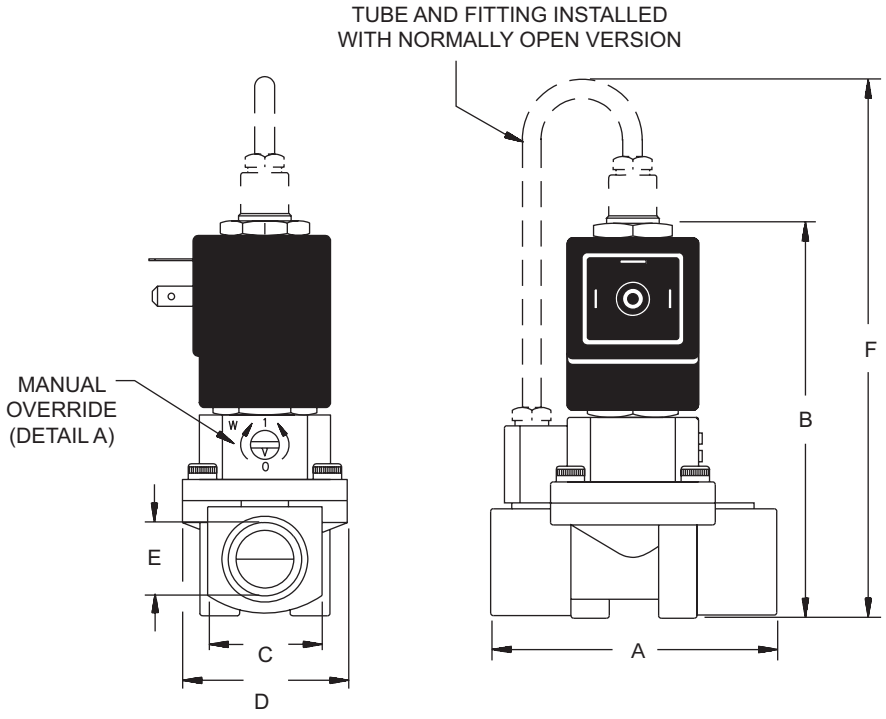
Series 4500

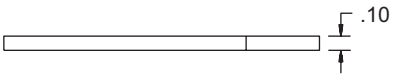
The Series 4500 solenoid valves are designed specifically for high flow, high pressure applications. With orifice sizes of 8mm to 12mm and port sizes of 1/4", 3/8" or 1/2" NPT, the valve is offered with a manual override standard. The coil is a quick connect DIN 43650 Form A design and is encapsulated for environment resistance. Typical applications include condensation removal, car washes, autoclaves or irrigation control.

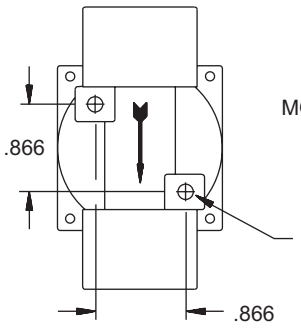
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



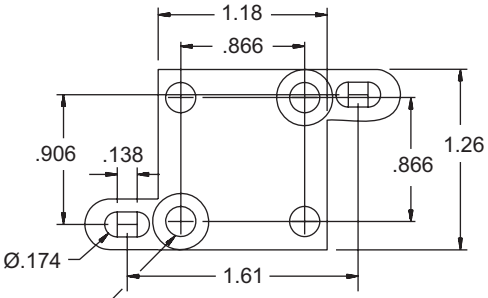




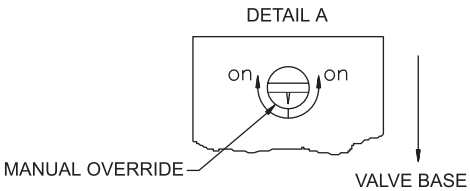


MOUNTING DETAILS

#10-32 THD./.500 DP.
(2 PLACES)



.218 THRU / CSK FOR #10-32 F.H. MACH.
SCREW MOUNTING PLATE (OPTIONAL)
P/N 4200-01-110



FLOW DATA	
PORT SIZE	FLOW RATE
1/4"	3.2 gpm
3/8"	4.2 gpm
1/2"	21 gpm
120 psi Δ p 25 psi	

DIMENSIONAL TABLE		
Ports	1/4" - 3/8"	1/2"
A	2.25"	2.75"
B	3.50"	4.25"
C	.870"	1.38"
D	1.25"	1.73"
E	1/4" - 3/8" NPT	1/2" NPT
F	4.50"	4.90"

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Series 4500

Air-Sol 2-Way Process Solenoid Valves

Technical Data

Function: 2-way, 2-position, normally open or normally closed, pilot diaphragm operated

Port Size: 1/4", 3/8" - 8mm orifice
1/2" - 16mm orifice

Pressure Range: 10 to 300 psi

Flow Factors: 8mm - 1/4" NPT .840 Cv (3.2 gpm)
8mm - 3/8" NPT 1.12 Cv (4.2 gpm)
16mm - 1/2" NPT 4.2 Cv (21 gpm)

Temp. Range: (Fluid max. 90°C) Ambient -10°C to +50°C

Response Time: 20 to 80 ms complete cycle

Materials: Operator: AISI 300 and 400 Series Stainless Steel
Shading Ring: Copper standard (Silver available on request)
Orifice: Brass
Seals: Viton, Nitrile or EPDM
Valve Body: Cast Bronze

Manual Override: Standard

Media: Air, oil, gas, water, emulsion

Mounting: On pipe or 10-32 mounting holes on bottom

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage tolerance: +/- 10%

Consult factory for available versions recognized under the Component Program of Underwriters Laboratories, Inc.

How To Order

4500 - □□ - 42 □□

Function
0 - Normally Closed
1 - Normally Open

Seal Material
1 - Viton
2 - Nitrile
3 - EPDM

Port Size / Orifice / Pressure
1 - 1/4" NPT / 8mm (5/16") / 10 to 300 psi
2 - 3/8" NPT / 8mm (5/16") / 10 to 300 psi
3 - 1/2" NPT / 16mm (5/8") / 10 to 300 psi

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Order Example: 4500-01-4227
Series 4500, normally closed, Viton seal,
3/8" NPT, 8mm orifice, 120 VAC 60 Hz

*For more coil options see page 7.

Replacement Diaphragm Kits
Kit includes: Diaphragm, Spring and Brass Insert

		Specify Part Number
Viton	1/4" or 3/8" Ports	4500-01-0001
	1/2" Ports	4500-01-0003
Nitrile	1/4" or 3/8" Ports	4500-01-B001
	1/2" Ports	4500-01-B003
EPDM	1/4" or 3/8" Ports	4500-01-E001
	1/2" Ports	4500-01-E003

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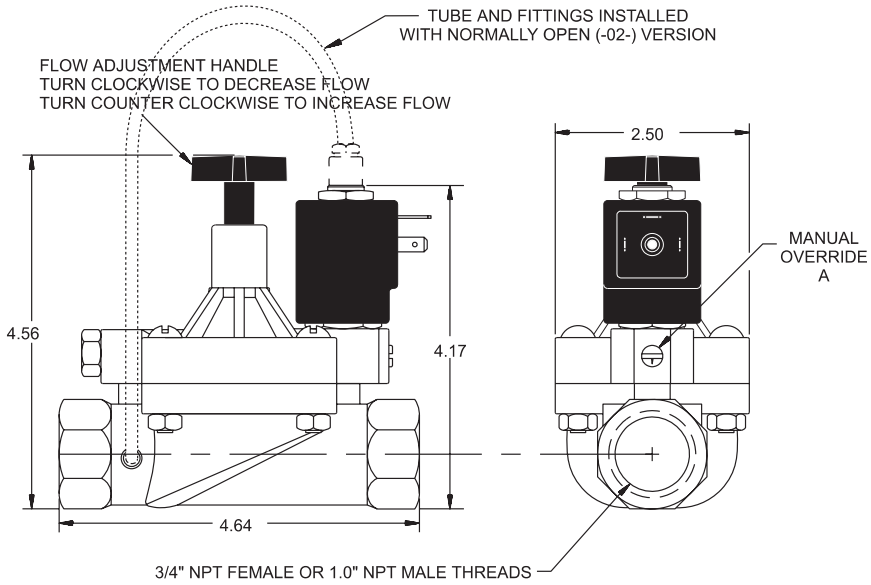
The Series 4600 2-way solenoid valves are pilot operated and available in 3/4" and 1" sizes. Offered standard with an adjustable metering handle to restrict or manually shut off media flow. The valves can be controlled by either internal or external pilot allowing control of low pressure to high pressure applications. Media and pilot can be separated to extend life by keeping corrosive material out of pilot section.

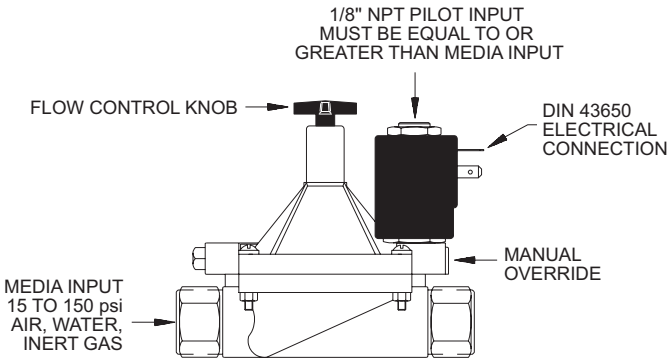
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

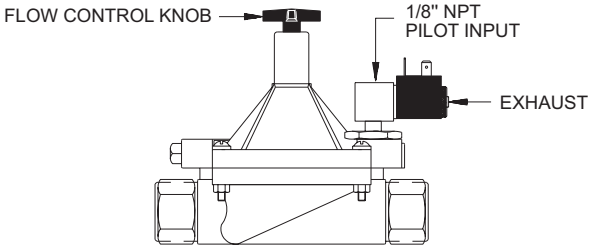
- 01 - 02 -
Internal Pilot



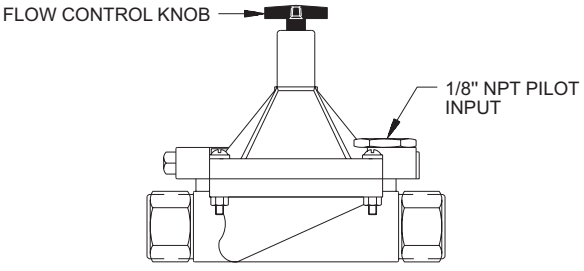
- 03 -
External Pilot
Normally Closed

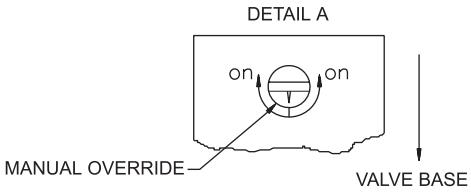


- 04 -
External Pilot
Normally Open



- 05 -
Air Pilot





Series 4600

Air-Sol Pilot Operated
2-Way Solenoid Valves

Technical Data

Function: 2-way, normally open or normally closed, pilot operated diaphragm

Orifice Size: 25mm (1.0 inch)

Pressure: Minimum: 15 psi
Maximum: 150 psi
(input pressure can be lower than 15 psi with external pilot operation)

Flow Ranges: 36 gpm for 3/4" NPT female - 9.7 Cv
53 gpm for 1.0" NPT male - 14 Cv

Temp. Range: (Fluid max 90°C) Ambient -10°C - +50°C

Materials: Body and Cover: Glass-filled nylon
Diaphragm: Nitrile
Internal Components: Stainless Steel, Acetal
Seals: Nitrile
Shading Ring: Copper standard (Silver available on request)

Manual Override: Standard

Media: Inert gas, air, water, emulsion

Mounting: On pipe

Coil Data: Glass filled nylon encapsulation (Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage tolerance: +/- 10%

FLOW DATA	
PORT SIZE	**FLOW RATE**
3/4"	36 gpm
1.0"	53 gpm
120 psi Δ p 20 psi	

How To Order

4600 - □□ - 82 □ □

Function
01 - Internal Pilot Normally Closed
02 - Internal Pilot Normally Open
03 - External Pilot Normally Closed
04 - External Pilot Normally Open
05 - Air Pilot Fitting*

Port Sizes
1 - 3/4" NPT female
2 - 1.0" NPT male

Coil Options*
0 - No Coil*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

***NOTE**: 'Air Pilot Fitting' option includes externally piloted main valve with 1/8" NPT supply port. Consult factory for details

Order Example: 4600-01-8217
Series 4600, internal pilot, normally closed,
3/4" NPT female port size, 120 VAC 60 Hz

Replacement Diaphragm Kit	
Kit includes: Diaphragm and Spring	
Specify Part Number	
3/4" or 1" Ports	4600-01-1000

***For more coil options see page 7.*

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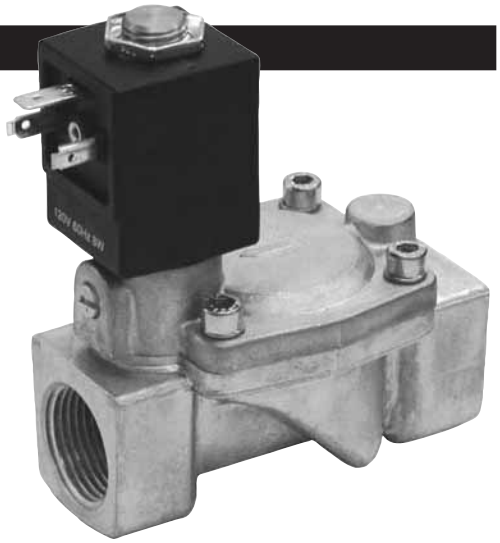
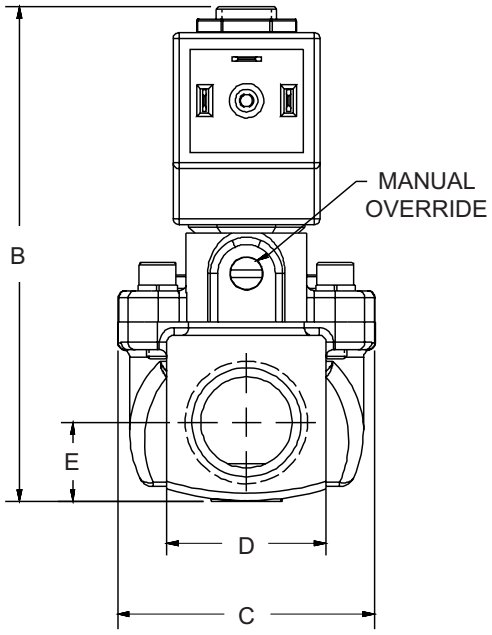
Series 4700

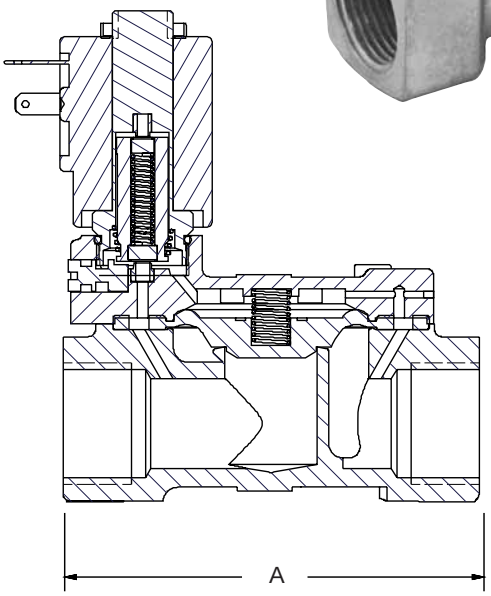
The Series 4700 solenoid valves are designed specifically for high flow, high pressure applications. With orifice sizes of 20mm to 25mm and port sizes of 3/4" and 1.0" NPT, the valve is offered with a manual override standard. The coil is a quick connect DIN 43650 Form "A" design and is encapsulated for environment resistance. Typical applications include condensation removal, car washes, autoclaves or irrigation control.

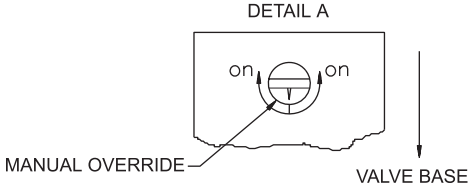
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED









FLOW DATA	
PORT SIZE	FLOW RATE
3/4"	34 gpm
1.0"	53 gpm
120 psi Δ p 20 psi	

DIMENSIONAL TABLE		
Ports	3/4"	1.0"
A	3.54	3.94
B	4.17	4.43
C	2.17	2.56
D	1.30	1.52
E	0.67	0.83

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Series 4700

Air-Sol 2-Way Process Solenoid Valves

Technical Data

Function: 2-way, 2-position, normally open or normally closed, pilot diaphragm operated

Port Size: 3/4" or 1.0" NPT

Orifice Size: 20"mm (3/4" Port), 25mm (1.0" Port)

Pressure Range: 4.5 to 220 psi - 3/4"
7 to 220 psi - 1.0"

Flow Factors: 9.1Cv - 3/4" (34 gpm)
14Cv - 1.0" (53 gpm)

Temp. Range: (Fluid -10°C to +80°C)
Ambient -15°C to +50°C

Response Time: 40 to 90 ms (Slow-Close system available to prevent water hammer)

Materials: Valve Body: Brass
(Stainless Steel available upon request)
Armature Assembly: 300 and 400 Series Stainless Steel
Seals: Nitrile

Manual Override: Available on NC version only

Media: Air, oil, gas, water, fuel

Mounting: On pipe

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage tolerance: +/- 10% Nominal

How To Order

4700 - □□ - 42 □□

Function
0 - Normally Closed
1 - Normally Open

Seal Material
2 - Nitrile

Port Size / Orifice / Pressure
4 - 3/4" NPT / 20mm / 4.5 to 220 psi
5 - 1" NPT / 25mm / 7 to 220 psi

Coil Options*
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Order Example: 4700-02-4247
Series 4700, normally closed, Nitrile seal, 3/4" NPT, 20mm orifice, 120 VAC 50/60 Hz

*For more coil options see page 7.

Consult factory for available versions recognized under the Component Program of Underwriters Laboratories, Inc.

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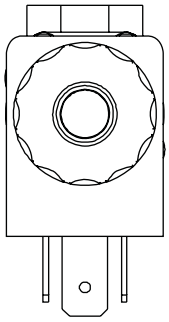
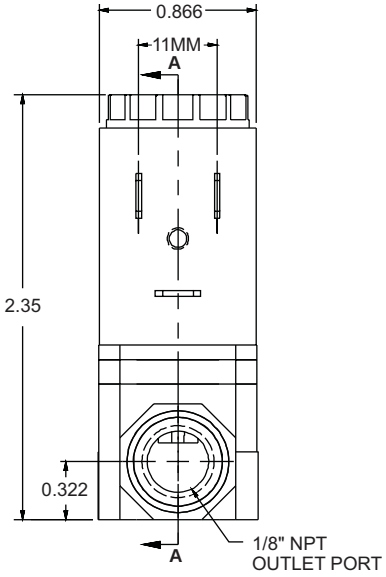
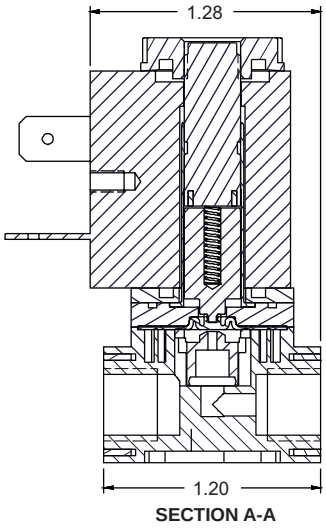
The Spartan Scientific Series 3B23 is a compact, media separated 2-way normally closed solenoid valve for use with chemicals or water whereby the media is contained in the nylon body valve cavity and does not come into contact with the metal parts of the solenoid operator. The 3B23 features a long life solenoid that incorporates a fully encapsulated coil, stainless steel plunger and tube assembly as well as a rolling diaphragm which enables the valve to function at pressures up to 150 psi with orifice sizes ranging from 0.6mm to 2.0mm. Flow rates of 1.5 gpm can be attained. The single in-line valve body features metal reinforced 1/8"NPT threads and has an ultra small volume and simple flow path for clean switching. The valve is available in all standard voltages and comes standard with a 6.5 watt coil.

Dimensional Data

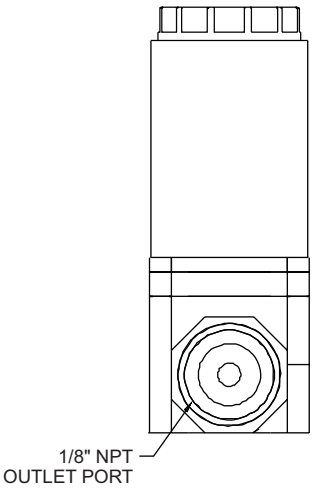
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

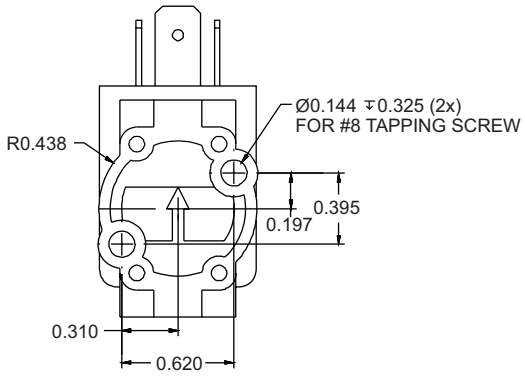






SECTION A-A





Series 3B23

Media Separated 2-Way Solenoid Valves

Technical Data

Function: 2-way, 2-position normally closed, direct acting, media separated solenoid

Port Size: 1/8"NPT

Orifice Size/Flow Factor(Cv): 1.2mm (.047")/ .065. Other Orifices available upon request (2.0mm Max.)

Pressure Range: 0 - 150 psi
(NOTE: Pressure ratings obtained with outlet port open to atmosphere. 15 psi back pressure maximum.

Temperature Range: (Fluid max. 90°C) Ambient -10° to +55°C

Response Time: 18 to 25 ms complete cycle

Materials in Contact with Fluid:
Valve Body: Zytel GF Nylon (NSF approved)
Elastomers: EPDM (Viton or Nitrile available on request) FDA approved
Media: water, chemicals, air, gases

Coil Data:
Zytel Glass filled nylon encapsulation, (Class F, continuous duty)
Coil Windings: Class H
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC
Voltage Tolerance: +/- 10%
Power Rating: 6.5 Watts

How To Order

3B23 - □ □ - □ 28 □

Elastomer Material
0 - EPDM
1 - Viton
2 - Nitrile

Orifice (mm)	Cv	NO / NC
3 - 1.2	0.065	NC

Contact factory for additional Orifice sizes.

Valve Body / Armature Assembly Material
1 - G.F. Nylon / Brass
2 - G.F. Nylon / Stainless Steel

Coil Options
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: 3B23-03-1287
Series 3B23, EPDM, 1.2mm Orifice, 0.025 Cv, NC,
G.F. Nylon / Brass, 120 VAC 50/60 Hz.

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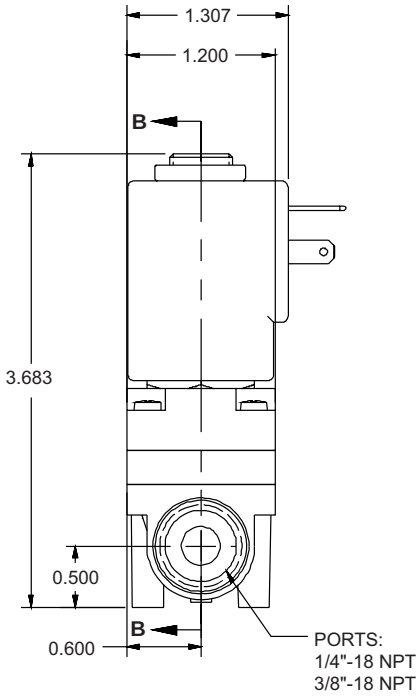
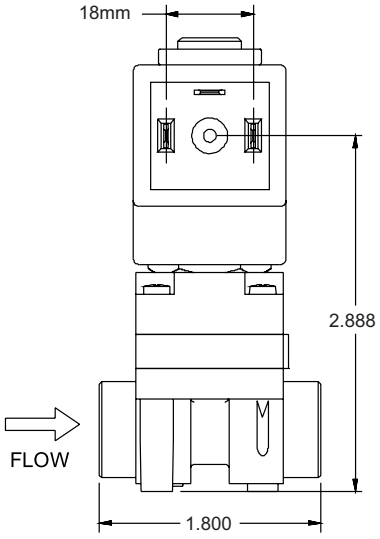
Series 4B23

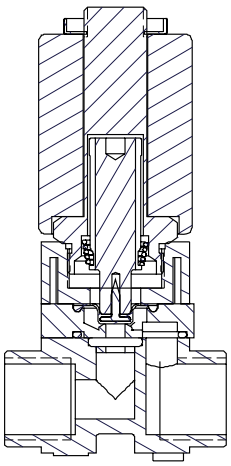
The Spartan Scientific Series 4B23 is a media separated, dry operator type 2-way 2-position solenoid operated valve where the media remains isolated from the metal working components within the valve. This creates a barrier to contamination to both the fluid and the operator which serves two purposes. The media remains untainted by the metals in the operator while the close tolerance moving parts of the valve are insulated from the effects of particulates, aggressive chemicals which can effect long term life of solenoid valves. The 4B23 is available in 1/4 or 3/8 inch NPT connections with orifice ranges from .8 to 5mm which gives the 4B23 great flow and operating pressure ranges to meet differing applications. The 4B23 features a DIN quick connect coil or flying leads connection. The valve is designed for long trouble free life with the incorporation of a rolling type diaphragm, life cycle proven metal operator components and a fully encapsulated coil system. The Valve is available in normally closed or normally open configurations and has two body ports for convenient fluid connection.

Dimensional Data

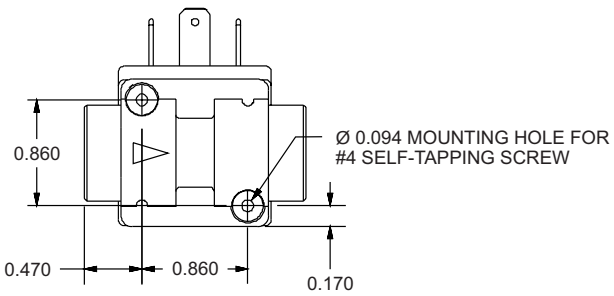
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED







SECTION B-B



Series 4B23

2-Way In Line Body Solenoid Valves

Technical Data

Function: 2-way, 2-position normally closed or normally open,
Direct acting, media separated

Port Sizes: 1/4"-18 NPT and 3/8"-18 NPT

Orifice Size (Cv): 2.4mm (0.24)
3.0mm (0.31)
4.0mm (0.52)
5.0mm (0.63)

Pressure Rating*: 15" Vacuum to 150 psi (depending on orifice size)

Temperature Range: (Fluid max. 90°C) Ambient -10° to +50°C

Response Time: 18 to 26 ms

Wetted Materials: Orifice Plate - Ultem 1000
Valve Body - DuPont Zytel GF Nylon (molded)
- Delrin (machined)
Seals - EPDM, Vition or Buna N

Media: Air, ideal gases, oils, medical fluid applications

Mounting: 2, 0.116 diameter holes for #4 self tapping screw

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
10 watt VDC, 8 watt VAC
Volts: 6, 12, 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz,
240/60 Hz VAC
Voltage tolerance: +/- 10%

VOLTAGE

FUNCTION

	2.4mm		3.0mm		4.0mm		5.0mm	
	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	150	120	75	60	55	45	30	20
2/2 NO	80	75	60	55	45	40	35	40

*MAX. PRESSURE RANGE (psi)

*Note - Maximum allowable back pressure is 20 psi regardless of voltage.

How To Order

4B23 - □ □ - □ 2 □ □

Seal Material
0 - Viton
1 - EPDM
2 - Nitrile

Orifice / Cv / NO, NC
1 - 2.4mm / 0.24 NC
2 - 3.0mm / 0.31 NC
3 - 4.0mm / 0.52 NC
4 - 5.0mm / 0.63 NC
A - 2.4mm / 0.24 NO
B - 3.0mm / 0.31 NO
C - 4.0mm / 0.52 NO
D - 5.0mm / 0.63 NO

Body Material
1 - Delrin
8 - Nylon Zytel

Port Size
1 - 1/4" NPT
2 - 3/8" NPT

Coil Options
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Order Example: 4B23-01-1211
Series 4B23, Viton, 2.4mm / 0.245
normally closed, Delrin, 1/4" NPT, 6 VDC.

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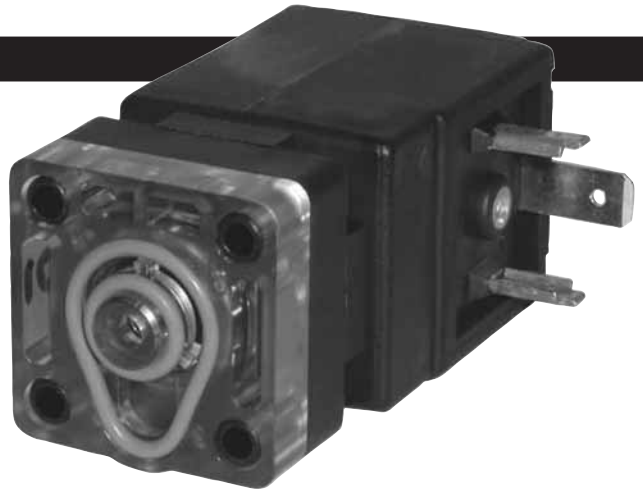
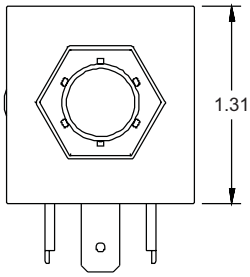
Series 4BKR

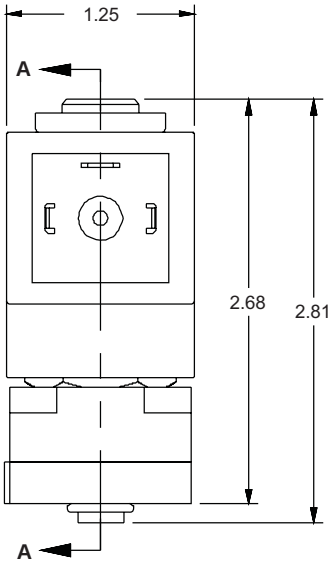
The Spartan Scientific 4BKR is a 2-way, 2-position media separated solenoid valve that is used for the control of ultra pure or corrosive media that would otherwise cause premature failure on wetted type solenoid valves. Featuring the Spartan Scientific low volume valve cavity and the rolling diaphragm, the 4BKR has no convolutions for chemicals to congregate or dead spots for flow. The all encapsulated coil, stainless tube and plunger assembly are designed for a long trouble free life. Also featuring a quick connect interface, the valve can be mounted in a gang style on a manifold block by using four fasteners and two o-rings. The valve is available in Normally Open and Normally Closed functions, with orifice ranges from 2.4mm to 5.0mm and boasts Cv ranges from .245 to .63.

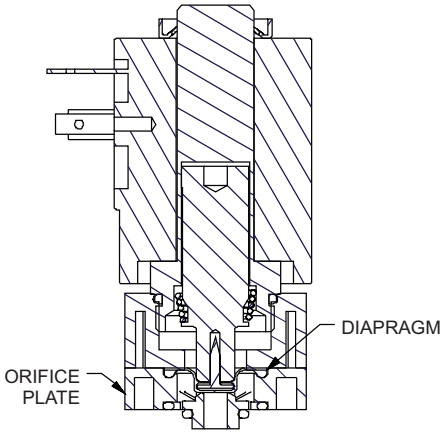
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

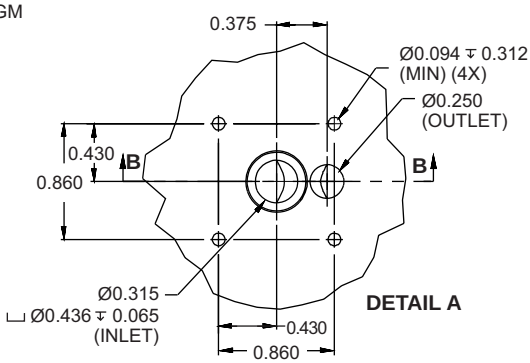




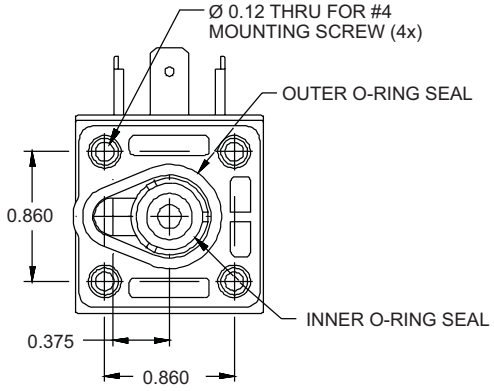


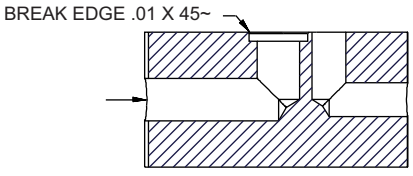


SECTION A-A



DETAIL A





SECTION B-B

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Series 4BKR

2-Way Media Separated Solenoid Valves

Technical Data

Function: 2-way, 2-position normally closed or normally open, media separated, direct acting

Orifice Size / Flow Factor (Cv):
2.4 mm / 0.245
3.0 mm / 0.315
4.0 mm / 0.520
5.0 mm / 0.630

***Pressure Range:** 15" Hg Vacuum to 150 psi (depending on orifice size)

Temp. Range: (Fluid max 90 C) Ambient -10° C to +55° C

Response Time: 20 to 40 ms complete cycle

Materials in Contact with Fluid:
Orifice Plate: Ultem 1000
Diaphragm: EPDM (standard)
(Viton and Nitrile available on request)
Seals: FDA Approved Silicone
(Viton, EPDM, Nitrile available on request)

Additional Materials:
Armature Assembly: 300 and 400 Series Stainless Steel
Operator Cavity: DuPont Zytel GF Nylon
Coil Encapsulation: DuPont Zytel GF Nylon
Operator Nut: Zinc-plated Steel
(Stainless steel available on request)

Mounting: 4, 0.125 dia holes as shown for #4 pan-head screw

Coil Data:
Encapsulation Class: F
Windings Class: H
Duty Cycle: Continuous
Voltage: 6, 12 and 24 VDC
24/60 Hz, 120/60 Hz, 220/50 Hz, 240/60 Hz VAC
Voltage Tolerance: +/-10% Nominal
Power Rating: VDC 10W, VAC 8W

VOLTAGE

FUNCTION	2.4mm		3.0mm		4.0mm		5.0mm	
	AC	DC	AC	DC	AC	DC	AC	DC
2/2 NC	150	120	75	60	55	45	30	20
2/2 NO	80	75	60	55	45	40	35	40

*MAX. PRESSURE RANGE (psi)

*Note - Maximum allowable back pressure is 20 psi regardless of voltage.

How To Order

4BKR - □ □ - □ 2 0 □

Seal Material
0 - EPDM
1 - Viton
2 - Nitrile

Orifice / Cv / NO, NC
3 - 2.4mm / 0.24 NC
4 - 3.0mm / 0.31 NC
6 - 4.0mm / 0.52 NC
8 - 5.0mm / 0.63 NC
C - 2.4mm / 0.24 NO
D - 3.0mm / 0.31 NO
F - 4.0mm / 0.52 NO
H - 5.0mm / 0.63 NO

Orifice Plate Material
1 - Ultem

Coil Options
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 60 Hz
7 - 120 VAC 60 Hz
8 - 220 VAC 50 Hz
9 - 240 VAC 60 Hz

Order Example: 4BKR-03-1207
Series 4BKR,EPDM,
2.4mm / 0.24Cv, NC,
120 VAC 60 Hz

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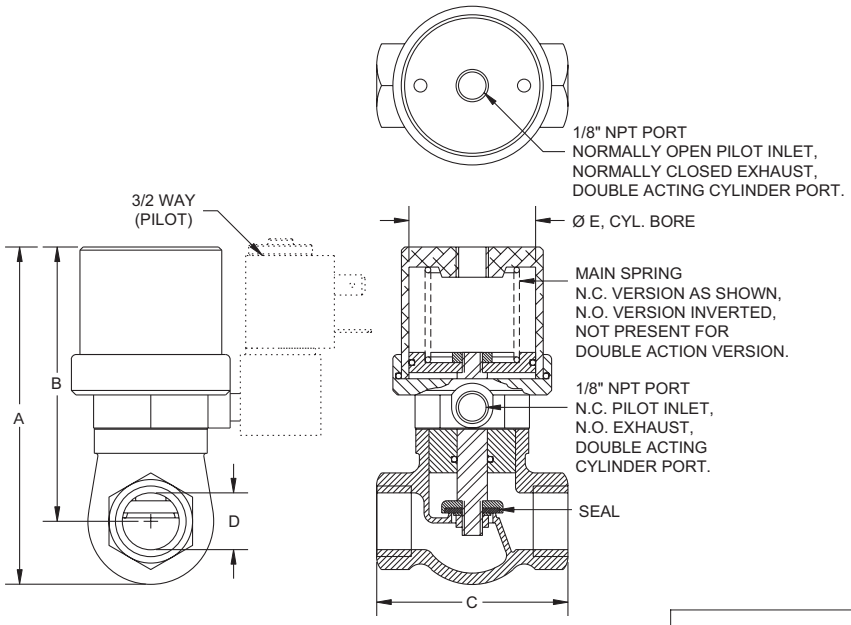
Series APV-10

The Spartan Scientific Series APV-10 is a versatile 2-way, 2-position air piloted valve that can be controlled by a three-way, four- way solenoid valve or hand pilot valve. The APV-10 features a reciprocating piston operator which is media separated and controls air, fluids, fluid emulsions, water, or any media compatible with the valve body materials. Standard sealing materials include Buna, Viton or PTFE. The bronze valve body is available in 1/2 " to 2" NPT port sizes in various versions. The valve is offered with single acting normally open, normally closed, remote air pilot, or double acting pilot operation. Operating pressure ranges from 0 to 235 psi with pilot pressures of 30 to 80 psi dependent upon function. Soft shifting can be obtained by the use of flow controls on the pilot ports. Typical applications for the APV-10 are media control of solvents, water, water with suspended particles, and coolants. Also available is a three way solenoid pilot valve (Spartan Series 3823), which may be added to operate the APV-10.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



DIMENSIONAL TABLE				
Port Size (D) NPT	A	B	C	Weight (lbs)
1/2"	3.78"	3.07"	2.32"	1.00"
3/4"	4.21"	3.27"	2.91"	1.25"
1.0"	4.80"	3.70"	3.23"	2.75"
1.25"	5.35"	4.00"	3.74"	3.25"
1.5"	6.38"	4.88"	4.25"	5.00"
2.0"	7.00"	5.25"	4.27"	6.50"

DIFFERENTIAL PRESSURE CHART							
		Normally Closed Normally Open Version			Double Acting Version		
Port Size (D) NPT	Cv / GPM @ Δ P = 10 psi	Δ p (psi)	Pilot Pressure (psi)	Cylinder Bore (E)	Δ p (psi)	Pilot Pressure (psi)	Cylinder Bore (E)
1/2"	4.7 / 15	75	80	1.50"	225	80	1.50"
3/4"	10.9 / 35	105	80	1.50"	135	80	1.50"
1.0"	15.1 / 48.5	105	80	2.50"	240	80	2.50"
1.25"	24.7 / 79.3	65	80	2.50"	180	80	2.50"
1.5"	38.5 / 123.3	125	80	3.00"	180	80	3.00"
2.0"	60.5 / 193.7	60	80	3.00"	135	80	3.00"

Technical Data

Function: 2/2-way, normally closed, normally open, remote air pilot, double acting

Port Size: 1/2", 3/4", 1.0", 1.25", 1.5", 2.0" NPT

Orifice Size: 15mm - 50mm

Pressure: Normally closed, normally open version (depending on orifice size): 0-125 psi
Double acting version: 0-240 psi
Pilot pressure max. 80 psi

Flow Range: 4.7 - 60.5 Cv

Temp. Range: -20°C - +80°C

Materials: *Actuator:* Cylinder: Anodized Aluminum
Spring: Music wire
Rod: Stainless Steel
Seals: Viton
Seat: Nitrile, Viton, P.T.F.E.
Lock nut: Stainless Steel
Valve body: Bronze

Media: All fluids and gases compatible with wetted materials

Mounting: On pipe

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
Voltage tolerance: +/- 10%

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Principles of Operation

Normally Closed Version:

Closed (normal) position - Pilot supply pressure is connected to port #1 and is normally blocked. Media supply is connected to port #3. Outlet port #4 is blocked due to the force the main spring exerts on the valve seat.

Open position - Pilot valve energized. Pilot pressure is supplied through port #1 creating the force to raise the cylinder piston. The valve seal is directly attached to the piston rod and is pulled from the orifice as the cylinder reacts, allowing the media to flow from port #3 to port #4.

Note: In the event that pilot pressure is interrupted, valve will switch to the closed position.

Normally Open Version:

Open (normal) position - Pilot supply pressure is connected to port #2 and is normally blocked. The piston/valve seal assembly is raised to the open position due to the force of the main spring. Media flows from port #3 to port #4.

Closed position - Pilot valve energized. Pilot pressure is supplied through port #2 creating the force to push the piston/valve seal assembly downward, closing the flow orifice. Media flow is interrupted as port #4 is closed.

Note: In the event that pilot pressure is interrupted, valve will switch to the open position.

Double Acting Version:

The double acting version can be made normally open or normally closed depending on how the 4-way pilot is connected to ports #1 and #2.

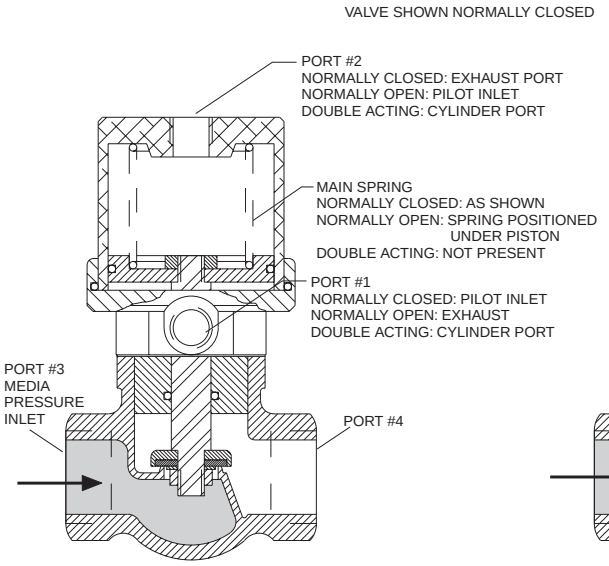

FIG. 1

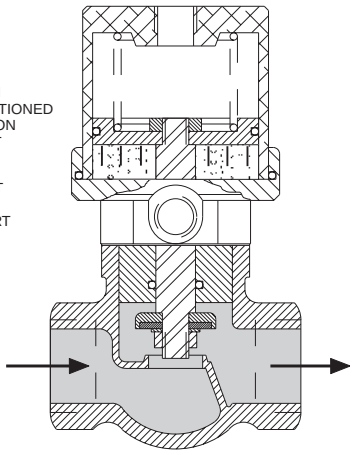

FIG. 2

How To Order

APV10 - □ 0 - 4 □ □ □

Seal Material
0 - Viton
B - Nitrile
T - P.T.F.E.

Function
1 - 2/2 NC
2 - 2/2 NO
3 - Double acting

Coil / Pilot Options*
0 - No Pilot
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

***Port Size / Orifice / Cv**
1 - 1/2" NPT / 15mm / 4.7
2 - 3/4" NPT / 20mm / 10.9
3 - 1.0" NPT / 25mm / 15.1
4 - 1.25" NPT / 32mm / 24.7
5 - 1.5" NPT / 40mm / 38.5
6 - 2.0" NPT / 50mm / 60.5

* All thread sizes available in BSP. Contact factory for details.

Order Example: APV10-00-4127
Series APV10, Viton seal, 2/2 NC, 3/4" NPT port size, 20mm orifice, 10.9 Cv, 120 VAC 50/60 Hz

******For more coil options see page 7.*

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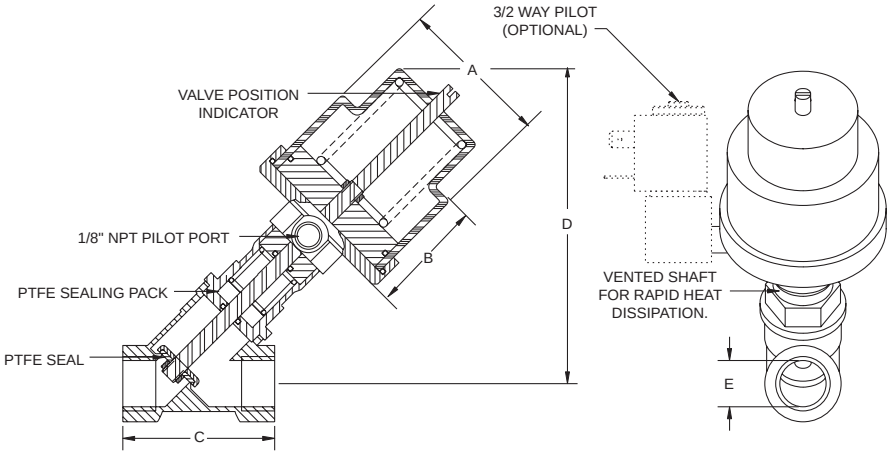
Angle Steam
2-Way Air Pilot Valves

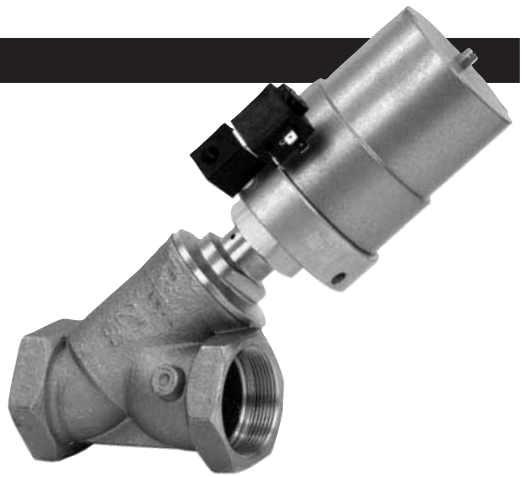
Series APV-20

The Spartan Scientific Series APV-20 is a 2-way, 2-position valve specifically designed for the control of steam. The APV-20 uses a specially designed Teflon Chevron® seal which ensures separation of the media and pilot sections. In the single acting normally closed version, the APV-20 uses a spring extended pneumatic operator connected to a sealing disc which when retracted, unseats from a precision orifice and allows fluid flow. When pilot pressure is removed, the APV-20 seat returns to the orifice and flow stops. A feature of the APV-20 is the ON-OFF indicator at the top of the pneumatic actuator. The APV-20 can be used for high temperature liquids compatible with the materials of construction and steam. The bronze body is standard and is available in sizes ranging from 1/2" to 2" NPT and can control media up to 300 psi. Also available is a three way solenoid pilot valve (Spartan Series 3823), which may be added to operate the APV-20. Consult factory for details.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED





DIMENSIONAL TABLE				
Port Size (E) NPT/BSP	A	B	C	D
1/2"	2.50"	3.62"	2.32"	4.80"
3/4"	2.50"	3.62"	2.72"	5.12"
1.0"	2.50"	3.62"	3.00"	5.43"
1.25"	4.00"	5.12"	3.75"	7.87"
1.5"	4.00"	5.12"	4.25"	8.15"
2.0"	4.00"	5.12"	5.08"	8.66"

DIFFERENTIAL PRESSURE CHART				
Port Size (E) NPT/BSP	Cv / GPM @ Δ P = 10 psi	Δ p (psi)	Pilot Pressure (psi)	Cylinder Bore (A)
1/2"	6.2 / 20	255	75	2.50
3/4"	15 / 48.5	165	75	2.50
1.0"	18 / 57.2	120	75	2.50
1.25"	41 / 132	180	82.5	3.15
1.5"	58 / 185	180	82.5	3.15
2.0"	91 / 291	105	82.5	3.15

Technical Data

Function: 2/2-way, normally closed, remote air pilot

Port Size: 1/2", 3/4", 1.0", 1.25", 1.50", 2.0" NPT

Orifice Size: 15, 20, 25, 32, 40, 50 mm

Pressure: 0 - 255 psi (Depending on orifice size)

Flow Range: 6.2 - 91 Cv

Temp. Range: -30°C - +180°C

Media: All fluids and gases compatible with wetted materials.
Steam to +180°C food applications with solid particles.

Mounting: On pipe

Materials:
Actuator: Cylinder: Anodized Aluminum
Spring: Music wire
Rod: Stainless Steel
Seals: Viton
Seat: P.T.F.E.
Central body: Brass
Intermediate spring: Stainless Steel
Chevron® sealing pack: Loaded P.T.F.E.
Valve body: Brass

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
Volts: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
(3/2 way pilot optional)
Voltage tolerance: +/- 10%

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Principles of Operation

Normally Closed Version:

Closed (normal) position - Pilot supply is connected to port #1 and is blocked. Piston/seal assembly is held firm against the valve seat by means of the main spring. Media flow passage port #2 to port #3 is blocked.

Open position - Pilot supply is opened allowing pressure to enter the cylinder creating the force to raise the piston/seal assembly. Media flows from port #2 to port #3.

Note: In the event that pilot pressure is interrupted, valve will switch to the closed position.

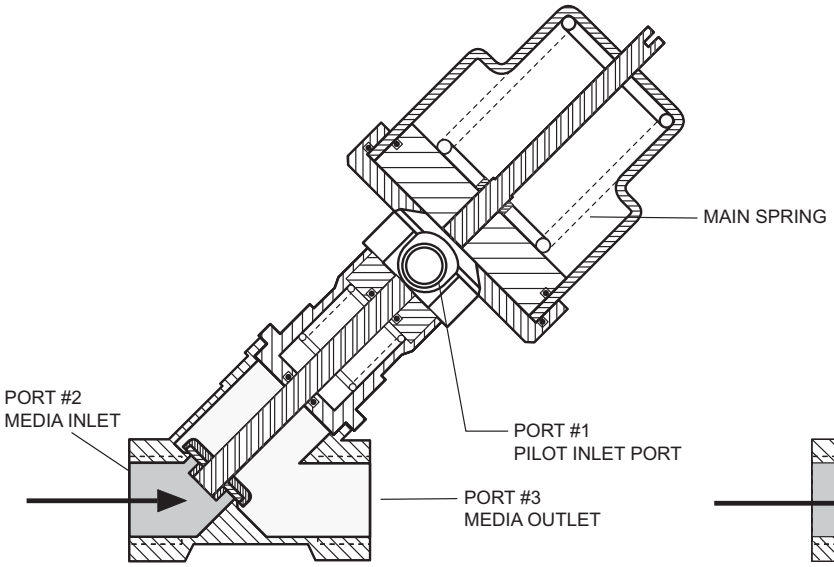

FIG. 1

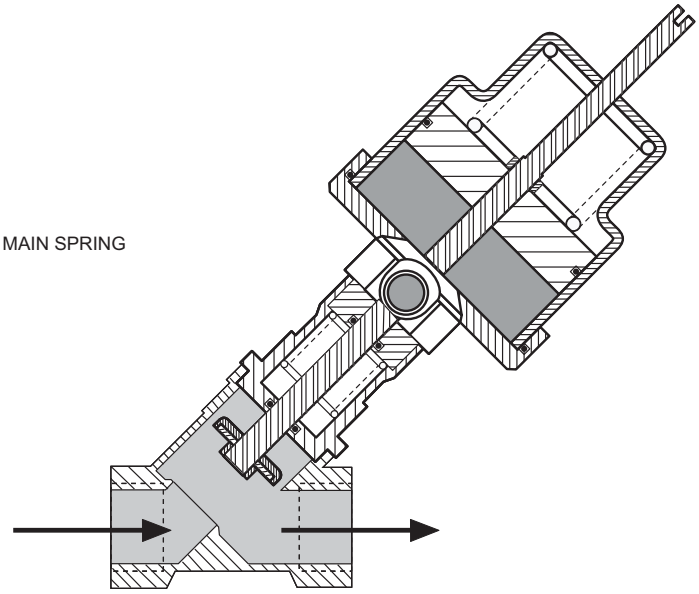

FIG. 2

How To Order

APV20 - 00 - 41 □ □

***Port Size / Orifice / Cv**
1 - 1/2" NPT / 15mm / 6.2
2 - 3/4" NPT / 20mm / 15
3 - 1.0" NPT / 25mm / 18
4 - 1 1/4" NPT / 32mm / 41
5 - 1 1/2" NPT / 40mm / 58
6 - 2.0" NPT / 50mm / 91

* All thread sizes available in BSP. Contact factory for details.

Coil / Pilot Options*
0 - No Pilot
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Order Example: APV20-00-4127
APV20, 3/4" NPT port size, 20mm orifice, 15 Cv, 120 VAC 50/60 Hz

**For more coil options see page 7.*

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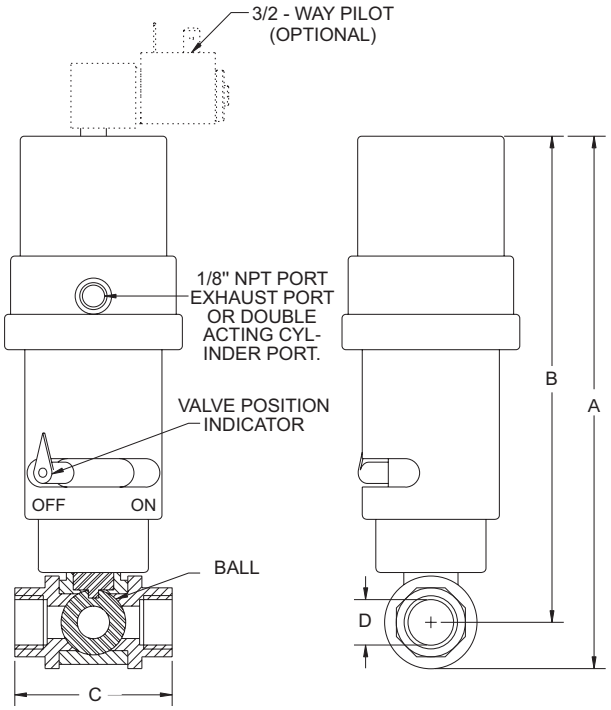
Pneumatic Actuated
2-Way Solenoid Ball Valves

Series APV-30

The Spartan Scientific Series APV-30 is a rugged full featured, pneumatically piloted ball valve. The unit is available in normally open, normally closed or double acting versions. With sizes from 1/2" to 2" NPT or BSP, the APV-30 will flow up to 85 gpm. The unit is compact as compared to competitive rack and pinion or motorized ball valves and comes standard with an ON-OFF indicator. The APV-30 features PTFE ball valve sealing using Chrome plated Brass or 316 Stainless balls. The valve body materials are Nickel plated Brass and 316 Stainless. Also available is a three way solenoid pilot valve, (Spartan Series 3823) which may be added to operate the APV-30.

Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED



DIMENSIONAL TABLE				
Port Size (D) NPT	A	B	C	Weight (lbs)
1/2"	8.30"	7.64"	2.70"	2.50
3/4"	9.50"	8.70"	3.00"	2.50
1.0"	9.85"	9.25"	3.50"	3.50
1.25"	11.00"	9.52"	4.00"	5.30
1.5"	11.60"	10.40"	4.50"	7.70
2.0"	12.50"	10.80"	5.25"	11.50

DIFFERENTIAL PRESSURE CHART			
Port Size (D) NPT	Max. Pressure (psi) @ Temp. Range 0 to +25°C	Cv / GPM @ Δ P = 10 psi	Pilot Pressure (psi) Max.
1/2"	750	23.3 / 74.8	70 - 120
3/4"	750	56.4 / 180.5	70 - 120
1.0"	750	93.7 / 300	70 - 120
1.25"	600	165 / 528	70 - 120
1.5"	600	272.5 / 872	70 - 120
2.0"	480	400 / 1277	70 - 120

Technical Data

Function: 2/2-way, normally closed, normally open, remote air pilot, double acting

Port Size: 1/2", 3/4", 1.0", 1.25", 1.5", 2.0" NPT or BSP

Orifice Size: 15 - 50mm

Pressure: 0 - 750 psi (Depending on orifice size)
Pilot pressure: 70 - 120 psi (Depending on orifice size)

Flow Range: 23.3 - 400 Cv

Temp. Range: -20° to +150°C

Media: All fluids and gases compatible with wetted materials. Steam to +180°C

Mounting: On pipe

Coil Data: Glass filled nylon encapsulation
(Class F, continuous duty)
Voltage: 6, 12, 24 VDC
24, 120, 220, 240 VAC 50/60 Hz
(3/2 - way pilot optional)
Voltage tolerance: +/- 10%

Materials:
Actuator: Cylinder: Anodized Aluminum
Spring: Music wire
Rod: Stainless Steel
Seals: Viton
Valve body/ball: E-nickel plated Brass/ heavy duty
Chromium plated; 316 Stainless Steel/
316 Stainless Steel

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Series APV-30

Pneumatic Actuated
2-Way Solenoid Ball Valves

Principles of Operation

Normally Closed Version:

Closed (normal) position - Pilot inlet is connected to port #1 and blocked. Media inlet passage port #3 to port #4 is blocked as ball passage is rotated closed, interrupting media flow.

Open position - Pilot pressure is applied to the cylinder piston which causes the actuator to rotate, connecting the ball passage with ports #3 and #4. Media flows from port #3 to port #4.

Note: In the event that pilot pressure is interrupted, valve will switch to the closed position.

Normally Open Version:

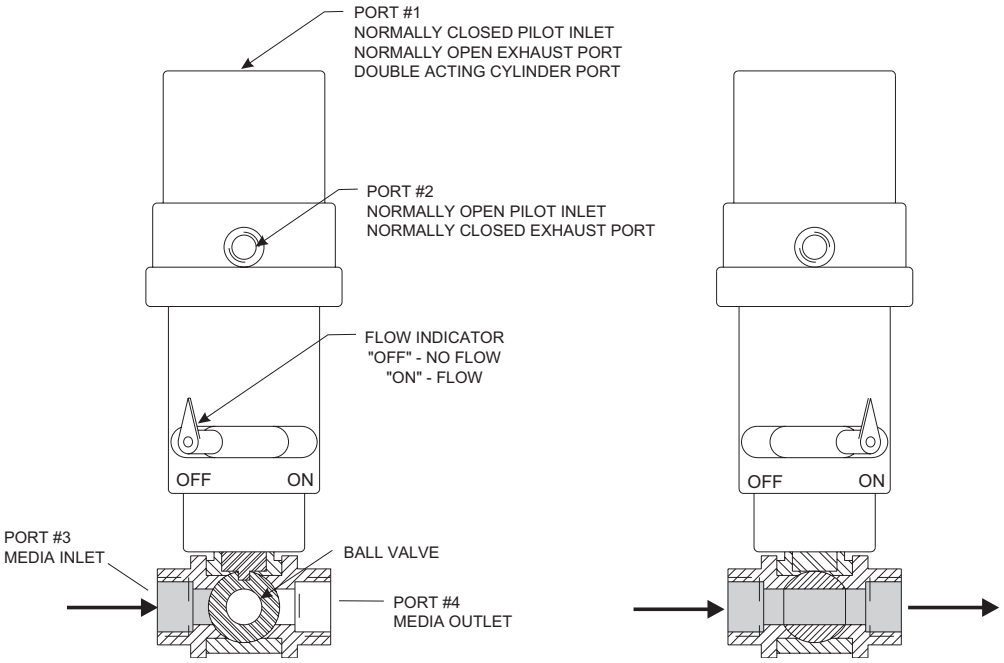
Open (normal) position - Pilot inlet is connected to port #2 and blocked. Media inlet pas-sage port #3 is open to port #4 as ball pas-sage is normally in-line with both ports. Media flows from port #3 to port #4.

Closed position - Pilot pressure is applied to the cylinder through port #2 causing actuator to rotate ball assage, interrupting flow and blocking port #4.

Note: In the event that pilot pres-sure is interrupted, valve will switch to the open position.

Double Acting Version:

The double acting version can be made normally open or normally closed depending on how the 4-way pilot is connected to ports #1 and #2.



How To Order

APV30 - 00 - □□□□

Body Material
4 - E-Nickel plated Brass
9 - 316 Stainless Steel

Function
1 - 2/2 NC
2 - 2/2 NO
3 - Double acting

***Port Size / Orifice / Cv**
1 - 1/2" NPT / 15mm / 23.3
2 - 3/4" NPT / 20mm / 56.4
3 - 1.0" NPT / 25mm / 93.7
4 - 1.25" NPT / 32mm / 165
5 - 1.5" NPT / 40mm / 272.5
6 - 2.0" NPT / 50mm / 400

* All thread sizes available in BSP. Contact factory for details.

Coil Options❖
0 - No Pilot
1 - 6 VDC
2 - 12 VDC
3 - 24 VDC
6 - 24 VAC 50/60 Hz
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Replacement Ball Valves
Description - Model Number

1/2" NPT	-	APV30-01-0001
3/4" NPT	-	APV30-01-0002
1.0" NPT	-	APV30-01-0003
1.25" NPT	-	APV30-01-0004
1.5" NPT	-	APV30-01-0005
2.0" NPT	-	APV30-01-0006

Order Example: APV30-00-4127
Series APV30, E-Nickel plated brass, 2/2 normally closed, 3/4" NPT port size, 20mm orifice, 56.4 Cv, 120 VAC 50/60 Hz

❖For more coil options see page 7.

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General Principles

The Spartan Scientific Model CRDV is a unique and efficient way to remove unwanted water from modern industrial pneumatic systems. The age old problem of condensation in compressed air systems has plagued those using tools and machinery since the invention of the first compressors in 1650. Compressors which convert mechanical power into fluid power, by nature, efficiently saturate air and water as a mix during the compression cycle. Outside air is drawn through the compressor inlet filters. As the air is heated during compression, its ability to hold water in the form of vapor and mist is increased. This water filled air is normally held in a tank placed at the outlet of the compressor. Water begins to precipitate out of the compressed air anytime it travels from a warmer area to a colder area. This is the reason compressor manufacturers recommend regular drainage of compressor tanks. Dependent on the humidity outside, the amount of load placed on the compressor, and taking into account what air is being used for, your decision of just how much is too much becomes important. A jack hammer has a much higher tolerance to water in the air than does a paint sprayer, for example.

In defining the problem of how much water is too much for your system, take into account the requirements and jobs you plan to accomplish. There are two forms of water in air systems, mist and vapor. Ninety-five percent of water in mist form can be removed by specially designed filters. Water in vapor form is a gas and as such can travel unimpeded throughout your compressed air system. Air dryers are needed to remove water in vapor form. Air dryers are placed somewhere after the air is compressed, between the compressor and the application. Water drip legs placed strategically through the air system also help remove unwanted condensation from your system.

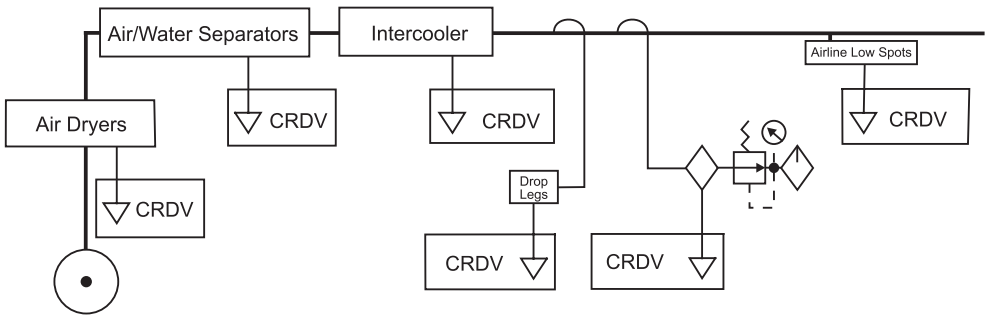
The versatile Spartan Scientific Model CRDV (Condensation Removal Drain Valve) can help remove water from any one of the points along your air system. The Model CRDV is made up of two main components, timer and valve. The timers use electricity to accurately delay and recycle an electrical impulse. The solenoid valve converts the electrical impulse into mechanical motion to control the flow of air and condensate out of the air system. To best describe the concept, Spartan surveyed hundreds of customers that were currently using one piece, one-for-all type condensate drains. We learned that in many cases, customers made do with those one-for-all drains, and when they didn't perform as well as hoped, the customer just moved on to something else. Spartan's solution allows a choice of standardized components that are 100% interchangeable between timer and valve. We offer just the right fit for your particular application.

The first component, the Sandwich CRT timer, features an all solid state design, CSA approval and quick disconnect electrical connections. Our timers are specifically engineered for condensation removal, and have standard time ranges of 0.5 - 25 seconds "ON and 1 - 45 minutes "OFF'. We can also make special "custom" time ranges to meet your needs. The Sandwich CRT is a compact, modular, plug design, and lives up to its name by "sandwiching" between a DIN 43650 cord set and the Spartan solenoid valve. Advantages to this type of design include retrofit with a screwdriver in less than one minute without disconnection from the power source. This water resistant, nylon shell timer has easily adjustable knobs placed and marked strategically for user friendly results. Two status indicator lights depict the timer states; one LED indicates when power is attached or removed from the timer, the other LED when the valve is draining. The industry's first membrane electrical override is within easy touch of the adjustments for troubleshooting and testing.

The second variable in the drain valve equation is the valve itself. Starting with the proven Series 3000 solenoid operator, Spartan Scientific valves use quality materials and workmanship. The stainless/brass operator uses Viton elastomer sealing materials and is impervious to synthetic compressor lubricants. Our solenoid operators offer high cycle life and low maintenance, and are used at the heart of all our drain valves.

The valve used in the Model CRDV is offered in port sizes dependent on your application. The 2-way, 2-position, normally closed valve features a zero minimum pressure differential while boasting a full flow 1/2" orifice. Low cost competitors offer only miniscule orifices that need strainers in order to function in these environments. Available in 1/4", 3/8", and 1/2" NPT, the Model CRDV valve can handle pressures to 300 PSI. The encapsulated coil construction ensures that the valve functions properly under long periods of energization (100% duty) as well as providing a high degree of environmental protection (NEMA4). The inner valve functions as a direct assist using a flat diaphragm and orifice plate. Pressure differentials shift the valve to full open or full closed. A push, non-locking manual override is standard. Flow rates in excess of 11 gallon per minute are possible in 1/2" NPT version.

The basic premises of Spartan's Model CRDV, is its modularity. We are able to offer the user a higher degree of customization as well as serviceability with our separate, but interchangeable components. The Model CRDV offers its users the most versatile combination of timing and flow capacities in the industry today, and is proudly made by Americans in the USA.



Condensation Removal Drain Valve

Model CRDV

The Model CRDV (Condensation Removal Drain Valve) is a compact, modular combination specifically designed for air line condensation removal. With two timer / connection options and three valve sizes to choose from, an optimal system can be attained for most condensation problems.

Features

- NEMA 4 construction
- All solid state timer
- Three valve sizes: 1/4", 3/8", 1/2" NPT
- Orifice size: 1/2" (12.5mm)
- Time ranges: 0.5 - 25 seconds "ON"
  1 - 45 minutes "OFF"
- Environment resistant package
- Modular - All valves and timers are interchangeable to improve serviceability
- Indicator lights show valve and power status
- 1 Year warranty
- Easy installation: Plug into wall socket and connect to air line
- Electrical & Manual overrides

Technical Data

Function:	2-way, 2-position normally closed or normally open piloted diaphragm
Port Sizes:	1/4", 3/8", 1/2" NPT
Orifice Size:	1/2" NPT (12.5mm)
Pressure Range:	0-300 psi
Flow Factors:	1/4" NPT 1.55 Cv (8.2 gpm) 3/8" NPT 1.95 Cv (9.3 gpm) 1/2" NPT 2.45 Cv (11.2 gpm)
Temp. Range:	(Fluid 90°C max.) Ambient - 10° to 50°C
Response Time:	20 to 80ms complete cycle
Materials:	Operator: AISI 400 and 300 Series Stainless Steel or Brass Shading Ring: Copper Seals: Viton, Nitrile, EPDM Valve Body: Forged Brass
Manual Override:	Push non-locking
Media:	Air, Oil, Gas, Water, Emulsion, Inert Gases
Mounting:	In-line

Electrical Data

Coil Data:	Glass filled nylon encapsulation (Class F, continuous duty) 8 watt Voltages: 120, 220, 240 VAC / 50/60 Hz Voltage tolerance: +/- 10%
Ambient Temperature Range:	-20 to 65° C
ISO DIN Interface:	DIN 43650 / ISO 4400
Electrical Connection:	120 V CRDV's get 6 ft. cord set with ground wall plug. All other voltage options receive 6 ft. cord with wire leads (no plug)

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Dimensional Data

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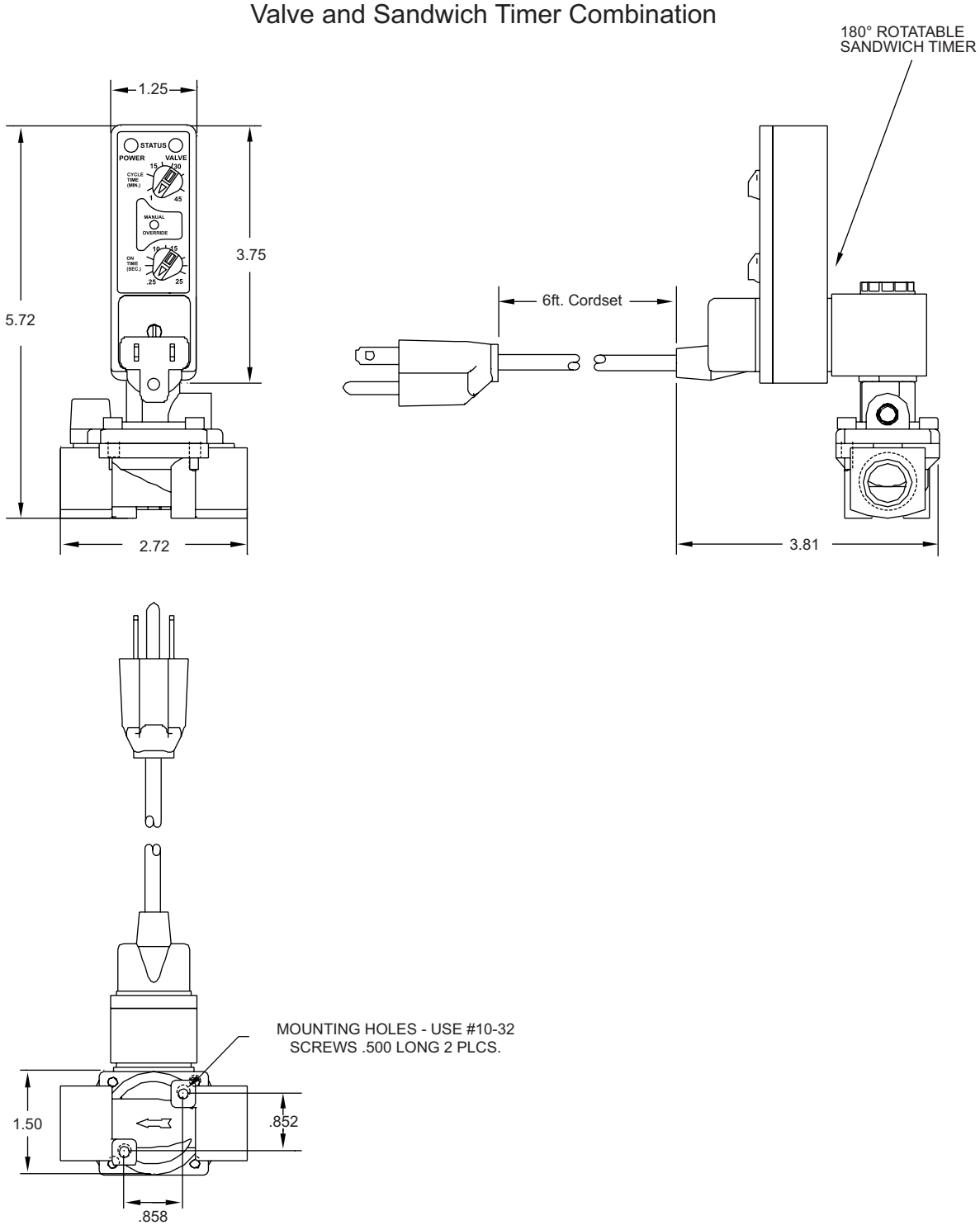
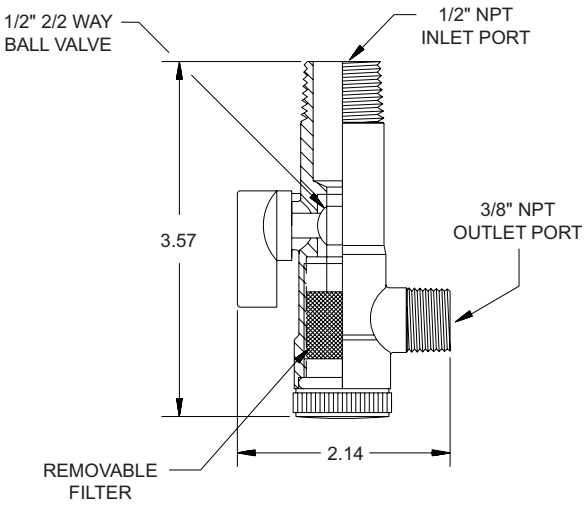
Valve and Sandwich Timer Combination

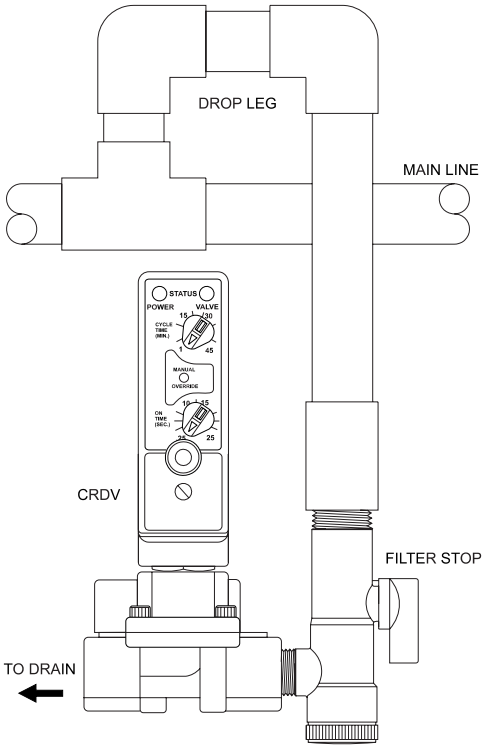


Options

Filter Stop

MATERIALS
CHROME PLATED BRASS BODY
STAINLESS STEEL STRAINER





How To Order

CRDV - □□□□

Port Size	Orifice	PSI	Construction
1 - 1/4" NPT	8mm	300 psi	Brass (4500)
2 - 3/8" NPT	8mm	300 psi	Brass (4500)
3 - 1/2" NPT	12.5mm	300 psi	Brass (4500)
4 - 1/4" NPT	12.5mm	230 psi	Brass (3505)
5 - 3/8" NPT	12.5mm	230 psi	Brass (3505)
6 - 1/2" NPT	12.5mm	230 psi	Brass (3505)
7 - 1/4" NPT	12.5mm	150 psi	Nylon (3510)
8 - 3/8" NPT	12.5mm	150 psi	Nylon (3510)
9 - 1/2" NPT	12.5mm	150 psi	Nylon (3510)
A - 1/8" NPT	0.8mm	600 psi	Brass (4100)
B - 1/8" NPT	1.6mm	450 psi	Brass (4100)
C - 1/8" NPT	2.4mm	255 psi	Brass (4100)
D - 1/8" NPT	3.0mm	150 psi	Brass (4100)
E - 1/4" NPT	0.8mm	600 psi	Brass (4100)
F - 1/4" NPT	1.6mm	450 psi	Brass (4100)
G - 1/4" NPT	2.4mm	255 psi	Brass (4100)
H - 1/4" NPT	3.0mm	150 psi	Brass (4100)

Ball / Strainer
0 - Without
1 - With

Coil Options*
7 - 120 VAC 50/60 Hz
8 - 220 VAC 50/60 Hz
9 - 240 VAC 50/60 Hz

Timer Style
2 - Sandwich timer and power cord with wall plug
4 - 1/2" Conduit junction connector
5 - CSA approved sandwich timer and power cord

Order Example: CRDV - 1270
Model CRDV, 1/4" NPT port size, 8mm, 300 psi, Brass (4500), sandwich timer and powercord with wall plug, 120 VAC 50/60.

*For more coil options see page 7.

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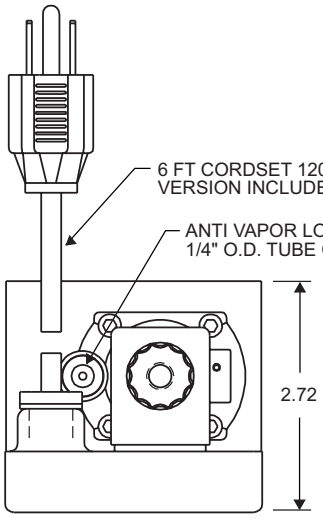
Closed Loop Demand Solenoid Drain Valve

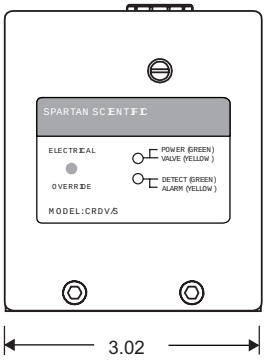
CRDV/S

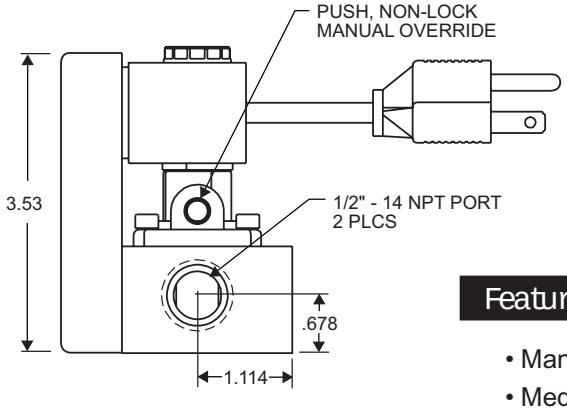
The Spartan Scientific CRDV/S is an electronic on-demand drain which couples an electronic sensor integrated with a solid-state logic analysis circuit to determine the exact amount of time the modular solenoid valve should be energized to empty condensate from the pneumatic system. As opposed to the hit-and-miss adjustments with traditional timed electric drain valves; the CRDV/S has incorporated a technological breakthrough that allows only the necessary amount of compressed air needed to purge excess fluid. The CRDV/S reduces the wear and tear on expensive compressors, air dryers and filters by reducing the loss of compressed air. It also reduces rust and clogged air components while increasing compressor cycling and machine life by eliminating dirty condensate buildup. This product includes a status light for power, an indicator light to denote the purge cycle, and an environment resistant package for long life. The utility, size, ease of installation and price rival the features and cost of conventional timed electric drains. The Spartan Scientific CRDV/S is the future of electronic drain units.

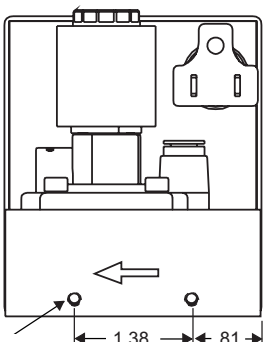
Dimensional Data

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED









Features

- Manual override
- Media compatible materials
- Easy installation
- Solid state electronics
- Indicator lights for power and purge
- Environment resistant package
- Solid state sensor senses all fluids, no floats
- Direct acting solenoid - 0 pressure differential
- Purges only when condensate is present / or manual override

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CRDV/S

Closed Loop Demand Solenoid Drain Valve

Technical Data

Function:	2-way, 2-position normally closed diaphragm, internal pilot
Port Size:	1/2" NPT
Pressure Range:	10 to 230 psi
Flow Factors:	1/2" orifice, Cv 2.45
Temp. Range:	(Fluid 90°C max.) Ambient -10 to 50°C This device is not recommended for use in below freezing temperatures.
Response Time:	20 to 80ms complete cycle
Materials:	Operator: AISI 400 Series Stainless and Brass Shading Ring: Copper Seals: Viton standard Valve Body: Brass Timer Enclosure: ABS Cable: PVC
Media:	Air, Oil, Gas, Water, Emulsion
Mounting:	On pipe or #8-32 mounting holes on valve base

Electrical Data

Voltage:	120 VAC 50/60 Hz
Transient Suppression:	MOV
Power Consumption:	8 Watts max.

6 ft.cord with grounded wall plug

How It Works

Normal Mode:

When the CRDV/S is first connected to electricity, the unit automatically energizes the solenoid valve for 1 second to indicate the presence of electricity and to self-test. As condensate is generated, the water and effluent falls by gravity through the piping to the inlet of the CRDV/S. Nothing happens until the CRDV/S solid-state sensor senses the presence of condensate. At that time the electronics sends the signal to energize the solenoid valve, which opens and exhausts the condensate from the pneumatic system. After a 1 second purge interval the valve de-energizes and the sensor no longer senses water at the inlet port. The CRDV/S then goes dormant for a minimum of 30 seconds after which the unit will stand ready to purge condensate again, only when it is sensed. As condensate once again builds up, the sensor senses the presence of condensate and the purge cycle continues.

High Flow Mode:

If, during Normal mode, there is a high production of condensate, the CRDV/S functions change to accommodate the increased need to remove the water from the system. As in Normal Mode, the CRDV/S remains dormant, sensing for condensate. As there is a high amount of condensate at the inlet port, so much so that the 1 second purge will not remove it all from the port, the CRDV/S "learns" and opens for a 4 second purge interval. The unit then goes into a 30 second wait cycle after which the CRDV/S, if it continues to sense condensate, re-cycles once again at 4 second purge interval. The sensor goes into alarm mode. During alarm mode the CRDV/S repeats a 4 second purge interval and 30 second wait until such time as the sensor stops sensing condensate. When the sensor runs free of condensate the CRDV/S then returns to normal mode.

Electrical and Manual Override:

The CRDV/S is equipped with both a manual override and an electrical override. The manual override is the green push button found on the side of the valve at the back of the unit. Pressing this button allows for drainage of the condensate line without the need for electricity. The electrical override is a button found at the front of the unit which energizes the solenoid and drains the condensate line. Both overrides are momentary contact, spring return.

One 1 second purge cycle every 24 hours

There is one 1 second purge cycle every 24 hours just to ensure that the condensate lines are clear and effluent is flowing to the CRDV/S.

How To Order

CRDVS - 307

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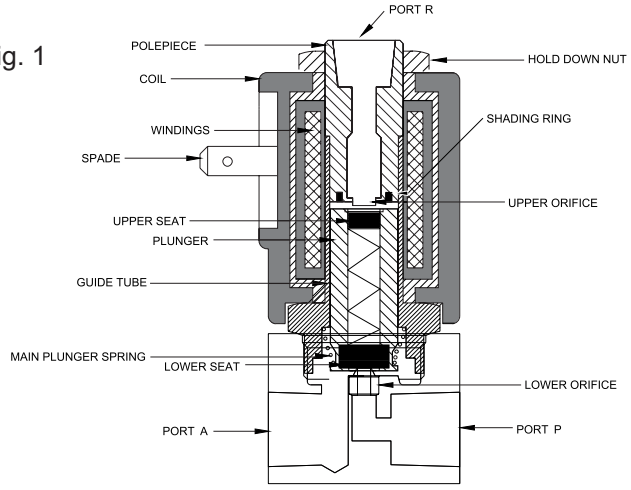
Solenoid Operators and Valves -

Solenoid operators and valves are devices which control the flow of liquids, gases, steam and other media. When electrically energized they either open, shut off or direct the flow of media.

Fig. 1



OPERATION -

The solenoid consists of a coil of wire wound in the form of a cylinder around the bobbin. When an electrical current is introduced, it resembles a bar magnet. When energized by an electrical signal, a magnetic field builds up which attracts the movable plunger to the polepiece against the tension of the main plunger spring. When de-energized, the magnetic field dissipates and the plunger returns to its original position, under the action of the main plunger spring. (See Fig. 1).

In order to be usable on AC current as well as DC, the polepiece contains a shading ring to average the alternating sine wave and minimize AC hum. (Note - It is not necessary to use a shading ring for DC applications as DC current does not produce an alternating wave function.) The flowing media is normally permitted to enter the area between the plunger and plunger guide tube, and caution should be used to assure that these components are compatible with the media when selecting a valve.

CONSTRUCTION -

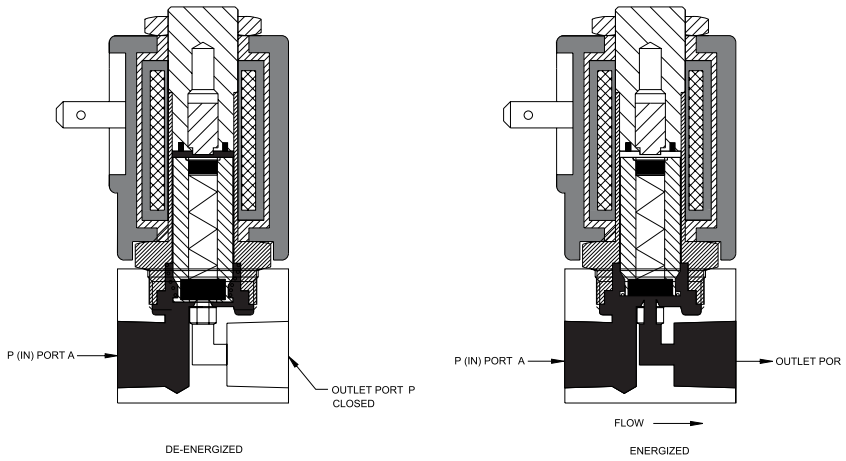
There are two types of construction available; Direct-Acting and Internal Pilot Operated.

Direct-Acting Operators and Valves - Similar to 2500, 2510, 3800, 3822, 3823, 3824, 3825, 3826, 3835, 3900, 3923, 4000, 4100, 4200

With a direct-acting valve, the solenoid plunger directly opens or closes the orifice, and the sealing disc is attached to the plunger. In the case of a normally closed operator or valve, the orifice is closed when de-energized. In the energized condition, the orifice is open. The valve will operate from zero (0) psi (pounds per square inch) to its maximum rated pressure. In the case when the operator or valve is normally open, the orifice is open when de-energized. When energized, the orifice is closed. The valve begins at its maximum rated pressure and is operated to close flow or zero (0) psi.

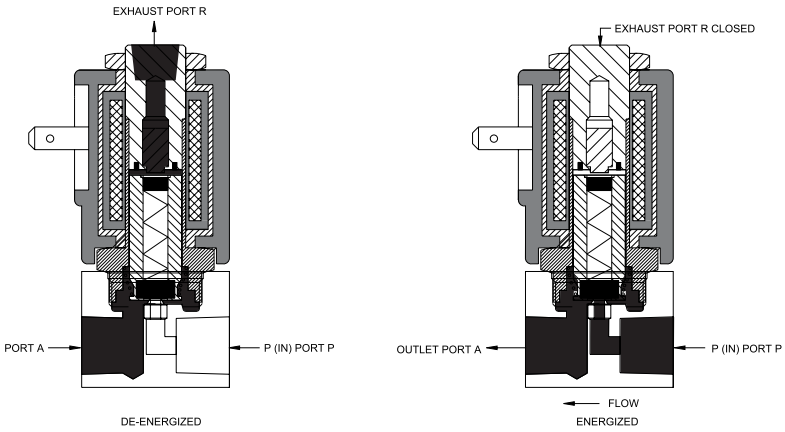
Direct-Acting 2-way valves are shut-off valves with one valve inlet and one valve outlet port (Fig. 2).

Fig. 2



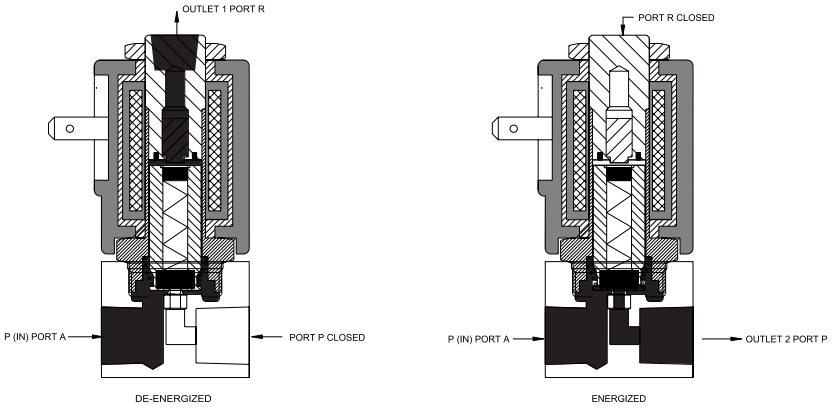
Direct-Acting 3-way valves have three port connections and two orifices. One orifice is always open and the other closed. When the valve is energized, the mode reverses, hence the description 2-position. Figure 3 shows a 3-way, 2-position normally closed valve. With the coil de-energized, the plunger main spring tension holds the lower seating disc tightly against the lower orifice, and shuts off flow. Port A is exhausted through Port R. When the coil is energized, the plunger is pulled in and the orifice at Port R is sealed off by the spring loaded upper seat disc. The fluid media now flows from Port P to Port A.

Fig. 3

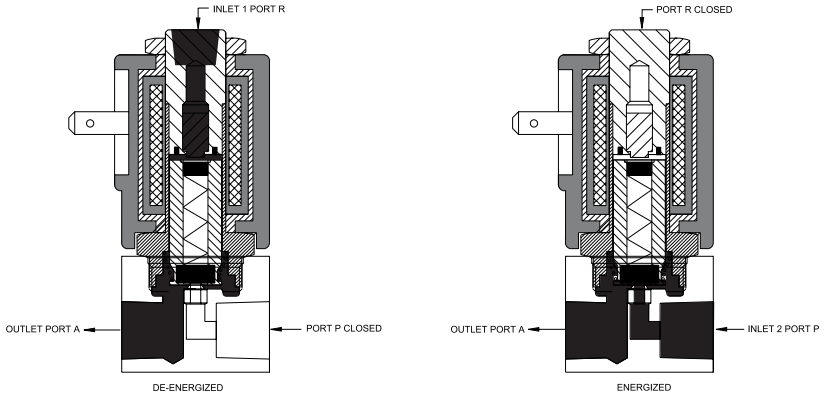


Other Functions -
Various functions can be obtained according to where the fluid media is connected.

† **3-Way Diverting -** Pressure enters the valve through a common inlet Port A. The flow is diverted through the two outlets Port R and Port P by energizing or de-energizing the solenoid. (See Fig. Below).



† **3-Way Mixing -** This valve allows the selection of two different pressures through two different inlets Port R and Port P by energizing and de-energizing the solenoid. The fluid media is then routed through a common outlet Port A. (See Figure below).



† NOTE: Standard pressure ratings of orifices do not apply for these functions. Please contact factory for details.

Internal Pilot Operated Valves - Similar to 3500, 3505, 3510, 35KR, 4500, 4600, 4700 Series

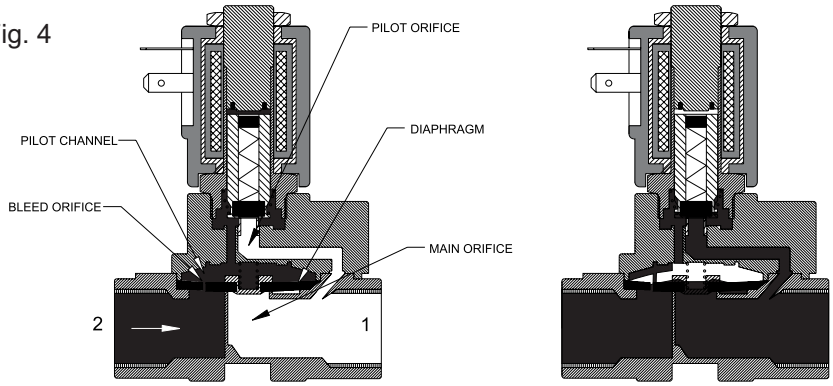
This type of valve is provided with a 2-way pilot solenoid operator. A diaphragm or piston provides the seal for the main seat. These valves are used for switching pressures in conjunction with orifice sizes larger than those available with direct-acting valves.

The floating diaphragm construction requires a pressure drop across the main valve seat to remain in the open position, or a coupled diaphragm or piston which is mechanically held open by the solenoid plunger (i.e. Chem-o-sol). The coupled type will operate with zero pressure drop across the main valve seat.

An Internal Pilot Operated 2-way valve is shown in fig. 4. When the solenoid is energized, the plunger opens the pilot orifice and relieves pressure from the top of the diaphragm to the outlet side of the valve, through the pilot channel in the main body. This results in an unbalanced condition which causes the main line pressure to lift the diaphragm off the main seat, thereby opening the valve. When the solenoid is de-energized, the pilot orifice is closed and full line pressure is applied to the top of the diaphragm, through the bleed orifice located in the diaphragm, from the inlet side of the valve, thereby providing a seating force for tight shut-off. As long as a pressure differential exists between the inlet and outlet ports, a residual shut-off force is available by virtue of the larger effective area on the top side of the diaphragm.

In certain cases an internally piloted valve will require a minimum line pressure to insure sealing of the main orifice. This is due to the fact that the diaphragm is usually produced in a flat fashion and is made of some type of elastomeric material which will have a tendency to pull the diaphragm back to its normal position.

Fig. 4



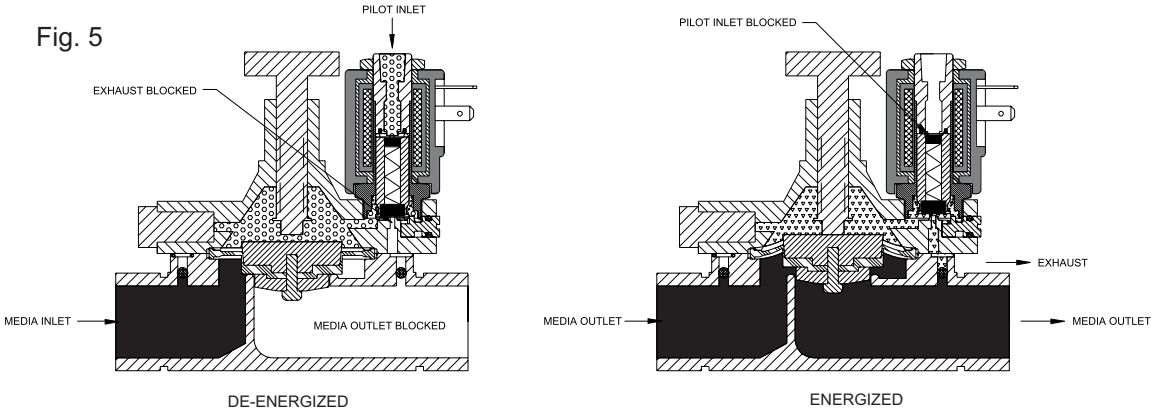
External Pilot Operated Valves - Similar to 4600 and APV Series

With these types of valves, an independent external pilot source is used for controlling the pressure for actuation purposes. These valves are either piston or diaphragm types and may be actuated by either air or liquids.

A 3-way solenoid pilot valve controls the independent external pilot media. In the case of Spartan externally piloted valves, the standard internal pilot valves are manipulated in a manner which separates the main valve into two sections. The upper section is the pilot pressure chamber and the lower section is for main media control. In the normal position, with pilot pressure, the main valve is closed preventing the flow of media. Pilot pressure is interrupted when the solenoid is energized. The plunger is pulled from its normal position to the raised position, closing off the pilot inlet orifice. At the same time the pressure is released from the pilot chamber of the valve by means of an exhaust port. When the solenoid is de-energized, the plunger returns to its normal position closing the exhaust port and the pilot pressure again builds in the pilot chamber, creating the diaphragm closing force. Fig. 5. (Note - All Spartan externally piloted valves will fail open if for some reason the pilot supply pressure is interrupted).

The normally open and closed functions of the main valve rely on the function of the pilot valve. For example, a normally closed external pilot valve requires a normally open pilot valve. Conversely, a normally open external pilot valve requires a normally closed pilot valve.

Fig. 5



Component Construction -

Coils - All Spartan solenoid valves contain a completely nylon encapsulated magnetic circuit. The bobbin windings have a class H insulation rating or 390°F. For the DIN spaded version, each connector tab is silver plated to assure excellent conductivity. Each coil is fastened to the plunger guide tube by means of a hold down nut for ease of change-over without interrupting the pneumatic circuit.

Armature Assembly - All Spartan armature assemblies are constructed of metallic components designed to provide protection against incompatibilities of various fluid medias. However it is necessary to use caution when specifying a solenoid valve for an unfamiliar fluid. Some basic materials are: All plungers and polepieces - 430F Stainless Steel. Plunger guide tubes - Brass standard for 2500, 3800, and 3900 Series. 303 Stainless Steel standard for Series 4000. All springs - 316 Stainless Steel. Types of sealing materials - Nitrile standard for 2500. Viton is standard on all 3000, 3900 and 4000 Series operators and valves. Other seal materials are available upon request. Use caution when selecting a material suited specifically for the media.

Valve Bodies - Standard valve body material for Series 2510, 3822, 3835 and 3900 is aluminum. Other body materials are available upon request. Series 4200 valves use a Zamak die cast material as standard. Other materials such as brass and 316 Stainless Steel are available and are stocked items in most cases (depending on the orifice size selected). Again, it is suggested to use caution in selecting a body material for unfamiliar media.

Series APV10 bodies are available in Bronze only.
Series 3510, 3823, 3824, 3825, 3826, 3923, 3B23 bodies are constructed of Du Pont Zytel® material which is approved for potable water applications.
Series 4500 valves are Bronze standard. Stainless Steel is optional.
Series 4BKR orifice plate is Ultem 1000 with Stainless Steel solenoid operator and seals are available in Viton, Buna and EPDM.
Series 4B23 contain the 4BKR coupled to a Du Pont® Zytel valve body.
Series APV-30 body is E-nickel plated Brass or 316 Stainless Steel.
Series APV-20 body is available in Brass.
Series 3500 valves are Brass and Du Pont® Zytel.
Series 3505 valves are available in Brass.
Series 4600 valves are Stainless Steel and glass filled nylon.

Temperature Considerations - Spartan valves are manufactured to operate with fluids at a maximum of 90°C (194°F) max., and an ambient temperature range of -10°C to +50°C. (+14°F to +122°F). Other temperature limits can be supplied upon request for special applications.

Response Times - With Direct-Acting valves, the response time is measured from the moment of electrical energization to the point when a figure of 90% of the pressure rating is attained at the valve outlet. The small moving masses and relatively high magnetic forces involved means that rapid response times, mostly in the region of 10 to 20 milliseconds, are obtained. The response time for an internally piloted valve is determined by the size, design, operating function, fluid media, temperature, inlet pressure and pressure drop. Most Spartan valves have a response time range from 20 to 80 milliseconds.

Pressure Range - Spartan valves will work reliably within the pressure ranges as shown in the catalog. The data is valid for a voltage band from -10% to +10% of nominal rated voltage. When a 3-way valve is used for a function other than that which it was supplied, the permissible pressure range is altered. DC voltage valves operate at a lower maximum pressure than AC counterparts. Pressure ranges listed in the catalog are for DC voltages.

Flow Rates - The flow rate through a valve is basically determined by the nature of the design and flow path through the valve. The size of the valve required for a particular application is generally established by the Cv flow factor.

The Cv Flow Coefficient is defined as "the number of gallons per minute of water that will pass through a given flow restriction with a pressure drop of 1 psi".

In most cases, the size of a valve can be determined graphically given a few known factors: gallons per minute, cubic feet per minute, pressure drop, inlet pressure, outlet pressure & Cv coefficient.

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Determining the rate of flow for a valve used on air -
To properly choose the right valve by size or flow capacity, the following things must be known: the fluid used, upstream and downstream pressures in PSIG, and the Cv factor of the solenoid valve.

To show the use of this flow chart we'll use the following information:

Media - Air
Downstream Pressure - 100 PSIG
Upstream Pressure - 120 PSIG
Sample Valve 4200-03-534 - 2.4mm Orifice, Cv factor .245

Step 1: Locate the downstream pressure (100 PSIG) on the chart (Fig. 1)

Step 2: Draw a vertical line from 100 PSIG until it intersects the upstream pressure line (120 PSIG).

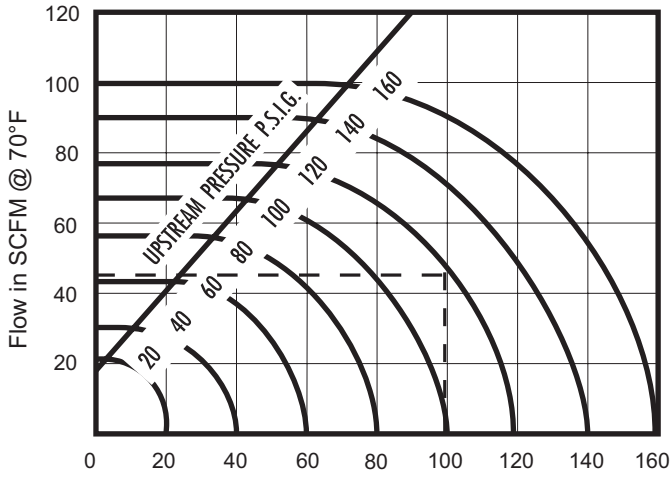
Step 3: Now draw a horizontal line to meet the left hand scale; then read the scale: 45. This is the flow in SCFM (standard cubic feet per minute) for a valve with a Cv factor of 1.

Step 4: The Cv factor of the valve sample is .245. We multiply this by 45 to get the air flow through the valve.

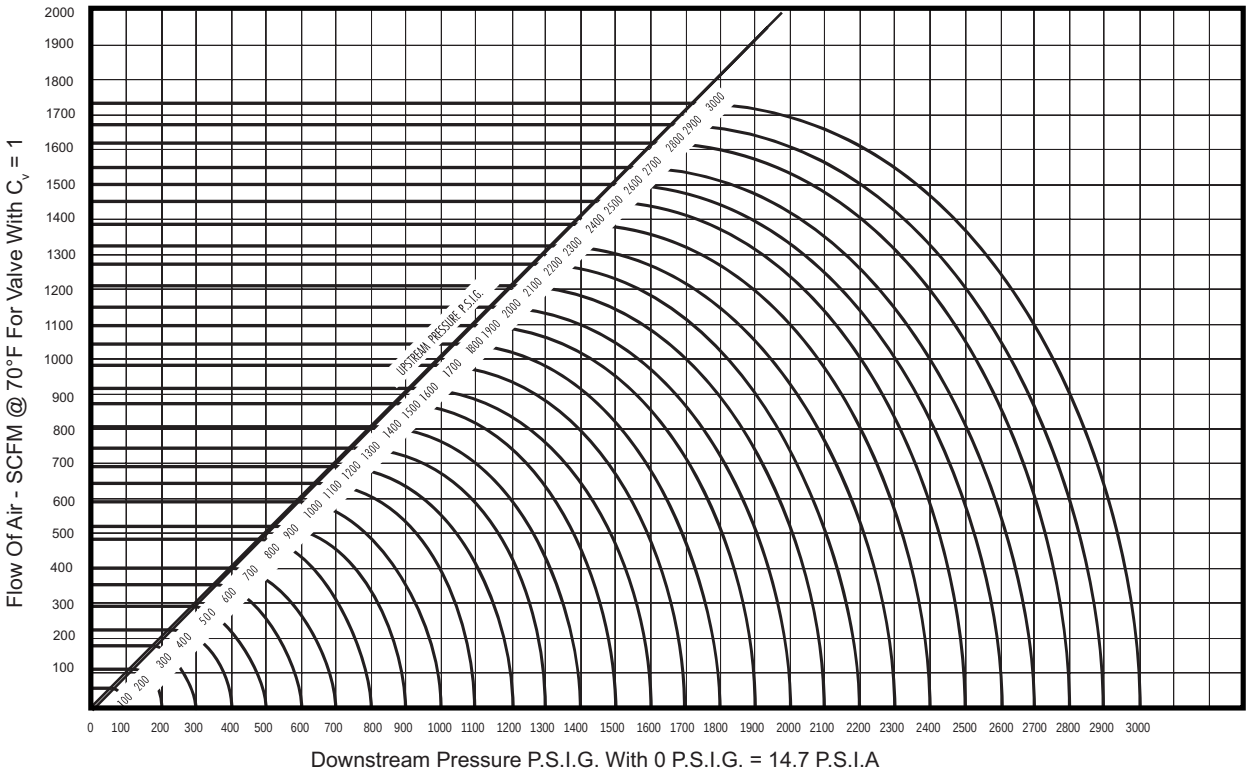
Cv factor x 45 = Flow (SCFM)
.245 x 45 = 11.02 SCFM

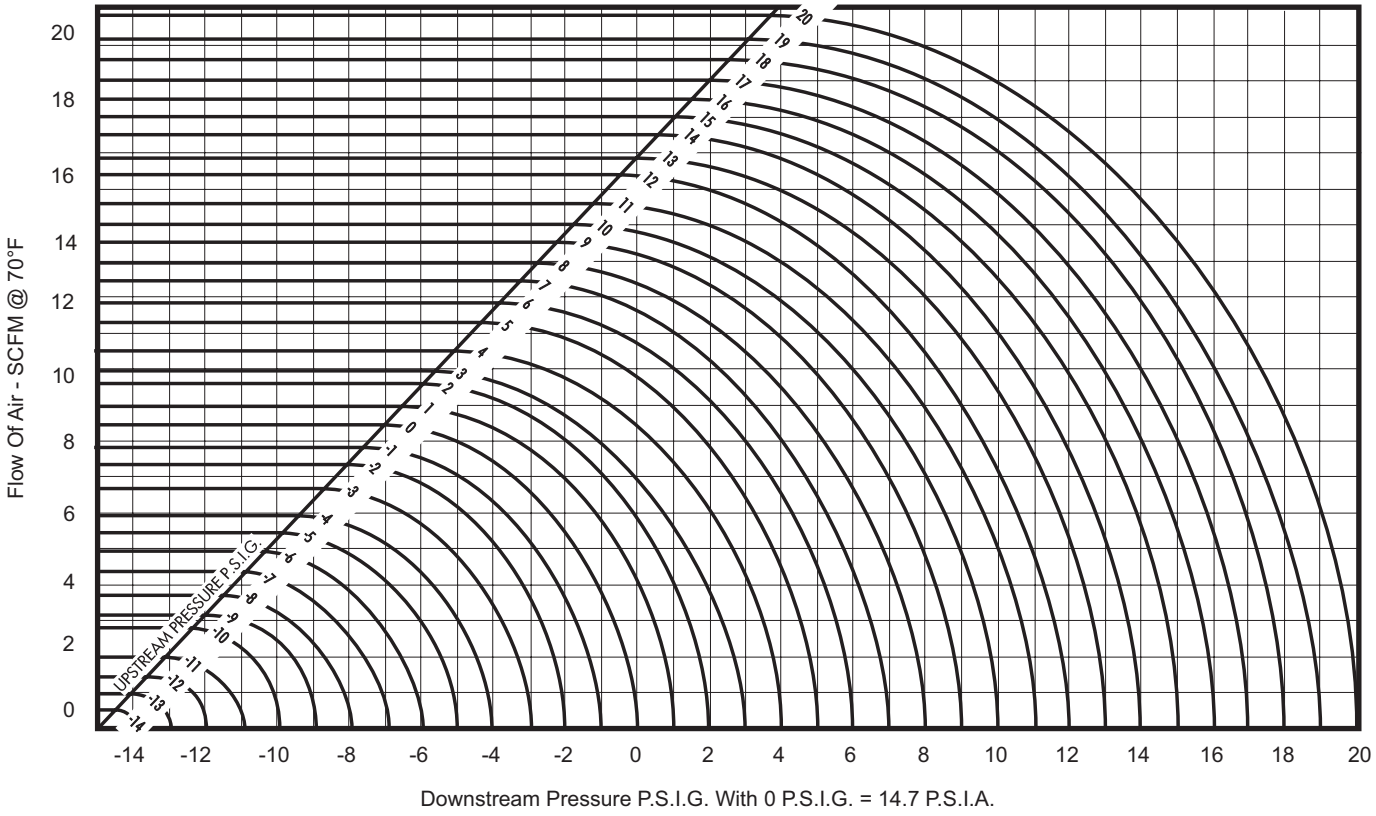
Since the media is air, no correction is needed. If using another media, it would be necessary to multiply 11.02 by a correction factor for the fluid used. (Table 1, page 78)

Flow charts -
The flow charts for air and water are based on a valve with a Cv factor of 1. Correction factors are included for other media.



(Fig. 1)





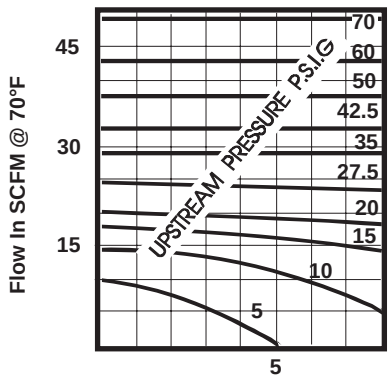
Correction Factors @ 70°F (Table 1)

Acetylene	1.05	Methane	1.34
Ammonia	1.30	Neon	1.20
Argon	.85	Nitrogen	1.02
Hydrogen	3.79	Oxygen	.95

For correction factor of gases not listed, use the following formula:

$$\text{Correction Factor} = \sqrt{\frac{1}{\text{Specific gravity of gas}}}$$

Air Flow Chart For Valve With C_v Factor = 1



NOTE: Table for specific gravity of various gases provided on page 80.

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Determining the rate of flow for a valve used to control liquid -
As stated earlier, to choose the right valve by size or flow capacity, the following information must be known: the fluid used, upstream and downstream pressures in PSIG, and the Cv factor of the solenoid valve.

To show the use of this flow chart, use the following information:
Media - Water
Pressure Drop - 50 PSIG
Valve 4500-01-421 - 8mm Orifice, Cv factor .84

Step 1: Locate the pressure drop (50 psi) on the Cv scale of the chart (Fig. 2). Draw a vertical line up to intersect curve.

Step 2: Now draw a horizontal line to meet the left hand scale; then read the C scale: 7. This is the flow in GPM (gallon per minute) for a valve with a Cv factor of 1.

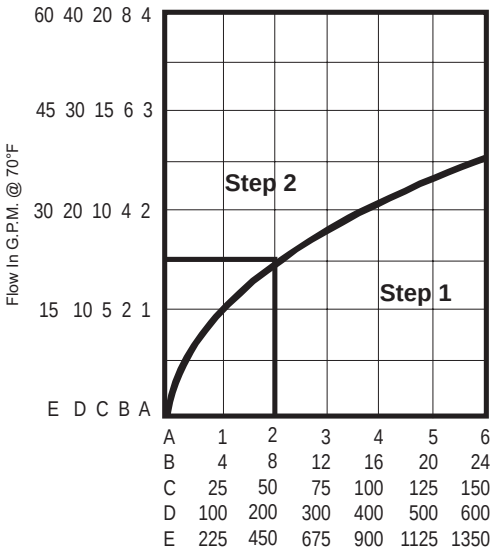
Step 3: Multiply 7gpm by the Cv factor of known value: .84.

Cv factor x 7 = Flow (GPM)
.84 x 7 = 5.88 GPM Water flow

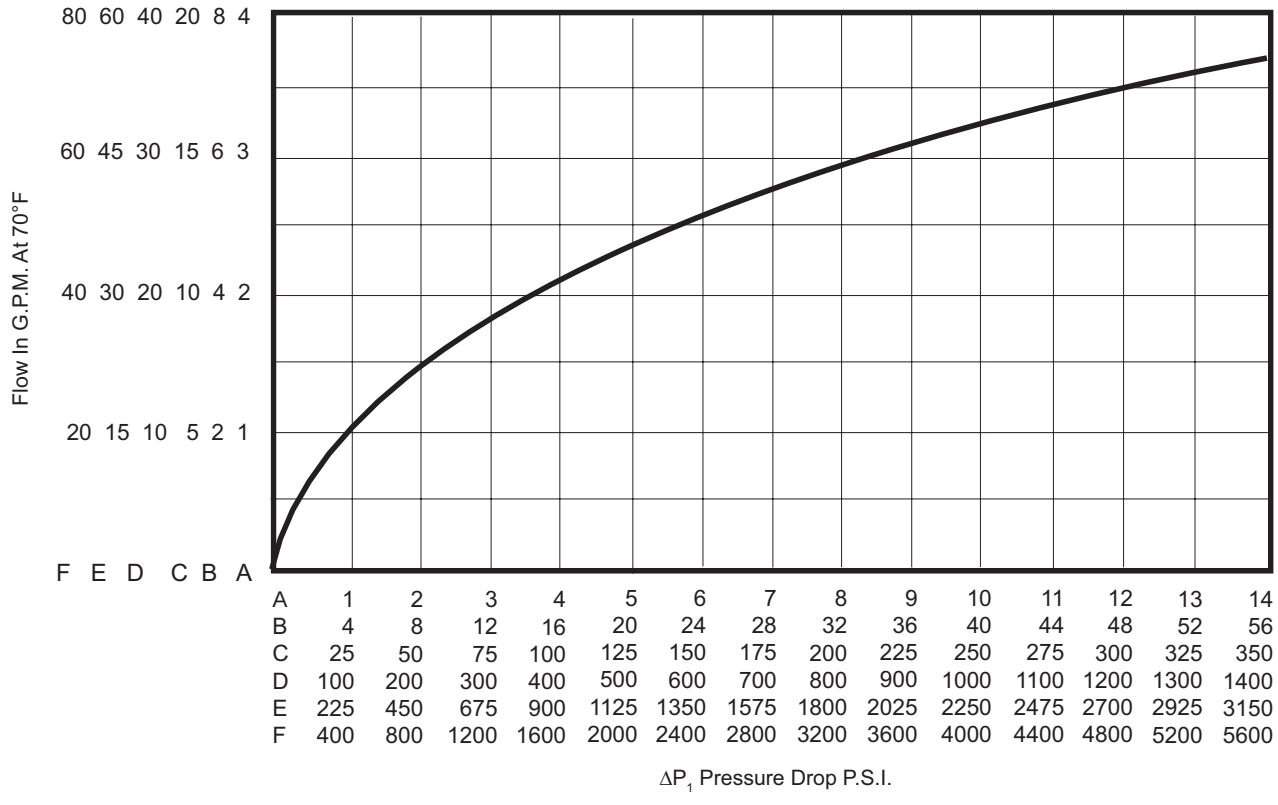
Step 4: If the media is something other than water, it will be necessary to multiply our value by a correction factor corresponding to our specific media. The correction factor can be obtained by the following formula.

$$\text{Correction Factor} = \sqrt{\frac{1}{\text{Specific Gravity of Fluid}}}$$

NOTE: Tables 2 & 3 on page 80 provide lists of specific gravities for some common fluids and gases.



(Fig. 2)



Specific Gravity Of Gases And Liquids

Specific gravity is the ratio of the density of a substance, with respect to the density of air or water, at a reference temperature and pressure.

For both gases and liquids, the reference temperature is 60°F and the reference pressure is atmospheric pressure, 14.7 psi absolute.

Gas specific gravities are density ratios with respect to air, the weight of which is .0793 pounds/ft^3 at 60°F and 14.7 psi absolute.

Liquid specific gravities are density ratios with respect to water, the weight of 62.4 pounds/ft^3 at 60°F - the pressure being irrelevant since liquids are non-compressible.

Gases (in relationship to Air)

Table 2

GASES	SPECIFIC GRAVITY
Acetylene	0.897
Air	1.000
Butane	2.050
Carbon Dioxide	1.516
Carbon Monoxide	0.967
Chlorine	2.423
Dimethylamine	1.521
Ethane	1.049
Ethylene	0.967
Fluorine	1.312
Helium	0.138
Hydrogen	0.069
Hydrogen Sulfide	1.190
Illuminating Gas	0.400
Methane	0.554
Methylamine	1.080
Methyl Chloride	1.785
Methyl Fluoride	1.195
Natural Gas	0.570
Nitrogen	0.966
Nitric Oxide	1.039
Nitrous Oxide	1.527
Oxygen	1.103
Sulphur Dioxide	2.208

Liquids (in relationship to Water)

Table 3

LIQUIDS	SPECIFIC GRAVITY
Acetic Acids	1.05
Acetone	0.79
Alcohol, Commercial	0.83
Alcohol, Ethyl	0.79
Alcohol, Methyl	0.81
Ammonia	0.66
Benzoic Acid	1.27
Calcium Chloride 25%	1.23
Sodium Chloride 25%	1.19
Hydrochloric Acid, Concentrated	1.19
Hydrofluoric Acid, Concentrated	0.99
Kerosene	0.81
Linseed Oil	0.94
Milk	1.03
Mineral Oil	0.92
Muriatic Acid	1.20
Bromine	2.97
Carbolic Acid	0.96
Carbonic Acid	0.92
Carbon Disulfide	1.26
Carbon Tetrachloride	1.59
Chlorine	1.56
Ether	0.73
Ethyl Acetate	0.90
Fuel Oil	0.82
Gasoline	0.72
Glycerine	1.26
Naphtha	0.77
Nitric Acid	1.50
Oleic Acid	0.90
Petroleum Oil	0.82
Phosphoric Acid	1.78
Sulphuric Acid	1.83
Tar	1.00
Turpentine	0.87
Vinegar	1.07
Water	1.00
Water, Sea	1.02

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Purpose

The type of media being controlled by the solenoid valve will have a direct effect on its ability to function properly. The purpose of this guide is to briefly introduce some materials commonly used when selecting a solenoid valve for specific applications. The guide includes Descriptions, Key Uses, Features and Limitations. The Chemical Compatibility Table (pages 84 - 91) lists 31 commonly used materials and rates their performance when exposed to various media.

Because the development of new and improved alloys, thermoplastics and elastomeric compounds are a continuing process. We offer this information as a basic material selection guide only.

Delrin (Acetal)

Standard Color: White

Description: Acetals are polymers of formaldehyde which technically are called polyoxymethylenes. Acetals are widely used engineering thermoplastics with high load-bearing characteristics and low coefficient of friction.

Key Uses: Industrial/mechanical products, appliances and plumbing. Based on excellent performance of Acetal copolymers in water at temperatures up to 212° F, they are widely used to mold faucet underbodies, shower heads, housings for pumps and filters, valves and fittings.

Maximum Working Temperature: +212° F

Features: Acetals are available in several specific grades. Easy-flow acetals which can be used in very thin-walled injection moldings, lubricated for low coefficient of friction and glass reinforced for strength and dimensional stability to name a few.

Limitations: Acetals are attacked by ultraviolet radiation, becoming brittle with long term exposure to sun light. UV-stabilization can provide significant improvements.

Nylon

Standard Color: Neutral, Black

Description: Nylons, or polyamides, are melt processable thermoplastics that contain an amide group as a recurring part of the chain. The first and largest volume of the engineering thermoplastics, they offer a combination of properties including high strength even at elevated temperatures, ductility, wear and abrasion resistance and good chemical resistance.

Key Uses: Nylons are used in virtually every industry and market. Transportation represents the largest single market for unreinforced and glass-reinforced nylons ranging from electrical connectors and wire jackets to engine fans and brake and power steering reservoirs.

Maximum Working Temperature: +266° F

Features: The mechanical properties of nylons are strength, stiffness and toughness and the combination thereof. Fiber reinforcement increases stiffness, strength and heat resistance. Excellent chemical resistance to hydrocarbon fuels, lubricants and various organic solvents is a distinguishing feature of nylons compared to other engineering plastics.

Limitations: Nylons are attacked by strong acids, oxidizing agents and concentrated solutions of certain salts. Absorbed moisture acts as a plasticizer and causes slight dimensional changes that must be considered in design.

PVC

Standard Color: Gray

Description: PVC is a vinyl-based resin and is produced by an oxyhydrochlorination process. It is the most versatile of all plastics because of its ability to be used to manufacture products ranging from heavy-walled pressure pipe to thin, crystal clear food packaging. PVC is easily machinable and can be injection molded.

Key Uses: Traditional uses for PVC compounds are hot- and cold-water distribution piping and industrial liquid handling pipe, fittings, valves and the like.

Maximum Working Temperature: +219° F

Features: The chemical resistance of PVC has prompted its use in industrial liquid handling, especially for high temperature liquids in paper and pulp operations, and acids and bases in plating and electrochemical operations.

Limitations: PVC is highly flammable and subject to rigorous protective measures because of health hazards.

Stainless Steel

Description: Stainless steels are high-alloy steels and have superior corrosion resistance to the carbon and conventional low-alloy steels because they contain relatively large amounts of chromium. In the broadest sense, the standard stainless steels can be divided into three groups based on their structures: austenitic (300 Series), ferritic (400 Series), and martensitic.

Key Uses: Applications for 300 series stainless steels include highly corrosive environments. Spartan utilizes 300 stainless steel in production of valve bodies where control of corrosive media and compatibility is an issue.
Applications for 400 series stainless steels include magnetic solenoid plungers and stops.

Features: 300 series stainless steels are austenitic and are non-magnetic in the annealed condition. They combine outstanding corrosion and heat resistance with good mechanical properties over a broad temperature range.
400 series stainless steels are ferritic grades and are always magnetic and contain chromium but no nickel. They combine corrosion and heat resistance with moderate mechanical properties.

Limitations: The ferritic grades are generally restricted to a narrower range of corrosion conditions than the austenitic grades.

Cast Bronze and Brass

Description: Bronze and brass are high copper alloys which are highly malleable, and are of the first to be found and utilized. These alloys are widely used because of their excellent electrical and thermal conductivities, outstanding resistance to corrosion, ease of fabrication, and a broad range of obtainable strengths and special properties.

Key Uses: Safety tools, molds for plastic parts, cams, bushings, bearings, valves, pump parts and gears.

Features: There are almost 400 commercial copper and copper-alloy compositions available from mills as wrought products (rod, plate, sheet, strip, tube, pipe, extrusions, foil, forgings and wire) and from foundries as castings.

Limitations: Bronze and brass are restricted to a narrow range of corrosion conditions as the copper tends to oxidize and sometimes dissolve in some damp and harsh chemical environments.

Aluminum

Description: Pure aluminum is a silver-white metal characterized by a slightly bluish cast. It has a specific gravity of 2.70, resists the corrosive effects of many chemicals and has a malleability approaching that of gold. When alloyed with other metals, numerous properties are obtained which make these alloys useful over a wide range of applications.

Key Uses: The automotive industry is the prime user of aluminum alloys for wheels and wheel covers and other light weight and decorative trim. It is also used in the pneumatic industry to produce light weight valve bodies and components.

Features: When aluminum surfaces are exposed to the atmosphere, a thin invisible oxide forms immediately which protects the metal from further oxidation. This self-protecting characteristic gives aluminum its high resistance to corrosion.

Limitations: Although the metal can safely be used in the presence of certain mild alkalies with the aid of inhibitors, in general, direct contact with alkalies should be avoided. Direct contact with certain other metals should be avoided in the presence of electrolyte; otherwise galvanic corrosion of aluminum mat takes place in the vicinity of the contact area. The use of a bituminous paint coating or insulating tape is recommended.

Buna N

Standard Color: Black

Description: Buna is the most widely used elastomer. It combines excellent resistance to petroleum-based oils and fuels, silicone greases, hydraulic fluids, water and alcohols, with a combination of working properties such as low compression set, high tensile strength, and abrasion resistance.

Key Uses: Oil resistant applications of all types. Low temperature military uses. Fuel systems. Can be compounded for FDA applications.

Temperature Range: -40° F to +250° F (Dry Heat Only)

Features: Increasing acrylonitrile content gives Buna its better resistance to petroleum-based oils and hydrocarbon fuels, enhancing resistance to the degrading effects of heat, at a cost of reduced low temperature performance.

Limitations: Precautions should be taken to avoid exposure of Buna to such highly polar solvents as acetone, MEK, chlorinated hydrocarbons and nitro hydrocarbons, which are known to cause rapid deterioration.

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Aflas®

Standard Color: Black

Description: A copolymer of tetrafluoroethylene and propylene, Aflas exhibits excellent chemical resistance properties.

Key Uses: Seals for oil field, industrial and chemical applications.

Temperature Range: +60° F to +400° F (Dry Heat Only)

Features: Aflas features good resistance to petroleum fluids; steam; a number of acids and alkalies; amines (anti-freeze); phosphate esters and brake fluids. It has generated considerable interest as a seal material for oil field, industrial and chemical applications.

Limitations: Compression set of 52% after 30 days at 400° F may be considered too high for some sealing applications.

Chemraz®

Standard Color: Black

Description: A perfluoroelastomer possessing exceptional resistance to degradation by aggressive fluids and/or gases.

Key Uses: Severe chemical exposure and high temperatures. Seals for chemical processing & transportation.

Temperature Range: -35° F to +500° F (Dry Heat Only)

Features: Chemraz parts combine the high temperature toughness of a fluorocarbon elastomer, with the chemical inertness of Teflon®. As a group, parts resist attack by nearly ALL chemical reagents and provide long term service in virtually ALL chemical and petrochemical process streams.

Limitations: Chemraz parts can be made to significantly swell upon exposure to some fluorinated solvents; fully halogenated freons; and uranium hexafluoride.

EPDM (Ethylene-Propylene)

Standard Color: Black

Description: A copolymer of ethylene and propylene. Ethylene propylene has gained acceptance for its excellent ozone and chemical resistance.

Key Uses: Outdoor weather resistant uses. Hydraulic and automotive brake systems. Water appliances.

Temperature Range: -60° F to +300° F (Dry Heat Only)

Features: EPDM features good resistance to polar solvents such as MEK and acetone. It is also highly recommended for effective resistance to steam (to 400° F); hot water; silicone oils and greases; dilute acids and alkalies; alcohol and automotive brake fluids.

Limitations: With the exception of resistance to polar solvents, EPDM is not recommended for its overall solvent resistance.

Fluorocarbon (Viton)

Standard Color: Black

Description: Combining high temperature resistance with outstanding chemical resistance, Fluorocarbon-based compounds are the ideal seal material.

Key Uses: High temperature/low compression set applications. Wide chemical exposure situations.

Temperature Range: -20° F to +400° F (Dry Heat Only)

Features: Fluorocarbons are highly resistant to swelling in gasoline and gasoline/alcohol blends, as well as resistant to the degrading effects of U.V. light and ozone.

Limitations: Fluorocarbons are not recommended for exposure to ketones. They are also not recommended for situations requiring good low temperature flexibility.

Neoprene

Standard Color: Black

Description: Neoprene is a homopolymer of chloroprene and is one of the earliest of the synthetic materials to be developed as an oil-resistant substitute for Natural Rubber.

Key Uses: Recommended for exposure to weathering. Preferred sealing material for refrigeration industry. FDA approved for food and beverage industry use.

Temperature Range: -45° F to +250° F (Dry Heat Only)

Features: Neoprene has a good resistance to ozone, sunlight and oxygen aging; relatively low compression set; good resilience; and reasonable production cost.

Limitations: Neoprene is generally attacked by strong oxidizing acids, esters, ketones, chlorinated, aromatic and nitro hydrocarbons.

Chemical Compatibility Table

Exposure Rating Guide:
A Good
B Fair
C Questionable
D Poor
Blank Insufficient Data

	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Acetaldehyde	A	A	C	D	D	A	A	A	A	A	A	A		A	A	C					D	D	C	D	C	B	A	A	A	A	A
Acetamide	A	A	A	D		D	A	B	A	A	A	B		A	D	D	B				B	A	B	A	B	C	A	A	B	A	A
Acetate Solvent	A	D	A	D		A	A		A	A	A	A		A	C	D					D	C	D	C	C	B	A	A	C	A	A
Acetic Acid, Glacial	B	A	A	D	D	D	A	C	A	A	A	C	A	A	C	D	A	A	A		D	B	D	B	B	C	B	A	B	A	A
Acetic Acid 20%	A	A	A	D	C	C	B	B	A	A	A	B	D	A	C	D	A	A	A		B	B	A	A	A	A	A	A	B	A	A
Acetic Acid 80%	C	A	A	D	D	D	D	C	A	A	A	C	D	A	C	D	A	A	A		B	C	C	C	B	C	A	A	B	A	A
Acetic Acid	C	B	A	D	D	D	A	C	A	A	A	C	D	A	C	D	A	A	A		B	C	B	C	B	C	A	A	C	A	A
Acetic Anhydride	A	B	D	D	D	A	A	D	A	A	A	A	D	A	C		A	A	A		B	D	A	C	B	A	B	A	C	A	A
Acetone	D	A	B	D	D	A	A	C	A	A	A	A	B	A	A		A	A	A	A	D	D	A	D	B	B	A	A	B	A	A
Acetyl Bromide			D	D			D			A						A							D								
Acetyl Chloride (dry)	A		D	C	D		D	D	A	A	A	A			C	A	A	A			A	D	D	B	D	D	D	A	B	C		
Acetylene	A	A	A	A		A	A		A	A	A	A	A			A		A	A	A	A	B	D	B	B	B	A	A	B	A	A
Acrylonitrile	A	A	A		D	D	A			A	A	A			A		B	B	A	A	D	B	D	B	B	C	A	D	B	A	B
Alcohols: Amyl	D	B	B	A		A	A	A	A	A	A	A		B	A	A	B	B	A	A	B	D	B	C	A	B	A	A	D	A	A
Benzyl	A	A	D	D	D	A	D	A	A	A	A	A		A	A	D	B	A	A	A	A	D	C	A	B	A	B	A		A	
Butyl	A	A	A	A		C	A	A		A	A	A		A	A	A	A	A	A		A	A	A	B	A	A	B		B	A	
Diacetone	A	B	B	B		A	A	A	A	A	A	A		A	A	A	A	A	A		D	D	D	D	A	A	A	D	A	A	A
Ethyl	A	A	B	C	B	A	A	B		A	A	A	A	A	A	A	B	A	A	A	A	C	A	C	A	A	A		B	A	
Hexyl	A		A	A		A	A	A		A	A	A		A	A	C	A	A	A		C	A	A	A	A	B	A		B	A	
Isobutyl	A	A	A	A	B	C	A	A		A	A	A		B	A	C	B	A	A		A	B	A	A	A	A	A		A	A	A
Isopropyl	A	A	A	A		A	B	A		A	A	A		A	A	A	B	B	A		A	B	B	B	A	A	A		A	A	
Methyl	B	A	A	A	D	A	A	C	A	A	A	A		B	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	
Octyl	A		A			A	A	A			A	A	B	A	A	C	A	C	A		B	B	B	A	B	B	A		B	A	
Propyl	A	A	A	A		C	B	A	A	A	A	A	A	A	A	D	A	C	A		A	A	A	A	B	A	A		A	A	A
Aluminum Chloride 20%	A	A	B	A		D	D	C	A	A	C	D	D	B	D	D	D	A	A		A	A	A	A	A	A	A	A	A	A	A
Aluminum Chloride	A	A	B	A			D		A	A	C	A	A	B	D	D	A	B	A		A	A	A	A	A	B	A	A	B	A	A
Aluminum Fluoride	B	A	A	A			A	C	A	A	C	B	D	A			B	B	A		A	A	A	A	B	A	A				A
Aluminum Hydroxide	B	A	A	A		D	A	B		A	C	A	A	B	C	A	B	B	A	A	A	A	A	A	D	A	A	A		A	A
Aluminum Potassium Sulfate 10%	A	A	A	A			A	C		A	B	C	B	A		D	C	C	A		A	A	A	A	A	A	A	B	A	A	A
Aluminum Potassium Sulfate 100%	A	A	A	A			D	C		A	B	C	D	A		D	C	C	A		A	A	A	A	A	A	A	A	A	A	A
Aluminum Sulfate	A	A	A	A		A	A	C	A	A	B	B	D	A	C	D	B	B	A		A	A	A	A	A	A	A	A	A	A	
Alums	A	A	A				A			A	A		A	A			A	B			A	A	A	A	A		A		C		
Amines	A		C	D		D	D	D	B	A	A	A	A	B	D	D	A	B	C	A	D	D	B	A	D	A	B	A	B	B	A	A
Ammonia 10%	A	A	C	B		A	A	D	A	A	A	A	A	C	A	D	A	A	A	A	D	A	A	C	B	A	D	A		A	A	A
Ammonia, anhydrous	A	A	B	A		A	A	D	A	A	A	A	A	C	D	D	A	A	B	C	D	B	A	C	D	D	D	A	D	A	A	A
Ammonia, liquid	A	A	C	A		A	B	D	A	A	A	B	B	C	D	A	C	A	A		D	C	A	C	D	D	A	A		A	A
Ammonia Nitrate	A	A		B		A	D	C	A	A	A	A	A		D	A	C		A		D	C	C	C		D	A			A	
Ammonium Acetate			A	A			A			A														A			A				
Ammonium Bifluoride	A	A	A	A		A		D		A		C			D	D	B	B			A	A	A	A			A		A	A	A
Ammonium Carbonate	A	A	B	A		D	A	D	A	A	B	B	B	A	D	A	B	B	A			D	A	B	A		A		A	A	A
Ammonium Casenite	A					D		D			A												A								
Ammonium Chloride	A	A	A	A		A	C	B	A		D	C	C	B	D	D	C	B	A		A	B	A	B	A	A	A	A	A	A	A
Ammonium Hydroxide	A	A	A	A	B	A	A	C	A	A	A	A	B	A	A	A	B	B	A		B	D	A	D	A	A	A	A	A	A	A
Ammonium Nitrate	A	A	A	A		D	B	C	A	A	A	A	A	A	D	A	A	B	A		A	A	B	A	C	A	A				
Ammonium Oxalate	A	A		A		D		B			A	A	A									A	A								
Ammonium Persulfate	A	A	A	A		C	C	D		A	B	A	A	A	D	D	B	B	A		A	D	A	D	A	A	A	A		A	A
Ammonium Phosphate, Dibasic	A	A	A	A		A	C	B		A	B	B	B	A	C	C	B	B	A		A	A	A	A	A	A	A	A	A	A	A
Ammonium Phosphate, Monobasic	A	A	A	A		A	B	B		A	C	B	B	A	D	C	B	B	A		A	A	A	A	A	A	A		A		
Ammonium Phosphate, Tribasic	A	A	C	A		A	B	B		A	B	D	B	A	D	A	B	B	A		A	A	A	A	A	A	A		A		
Ammonium Sulfate	A	A	A	A		A	A		A	A	B	D	B	A	D	C	A	B	A		A	A	A	A	A	A	A	A	A	A	A
Ammonium Thiosulfate			A			A		B	A		A			A	D	D			A			A	A	A					A		
Amyl Acetate	A	B	C	C		D	C	A	A	A	A	A	B	A	C	C	A	A	A		D	D	D	D	D	D	A	A	D	A	A
Amyl Alcohol	D	B	B	A		A	A	A	A	A	A	A		B	C		B	A	A		B	B	A	D	B	B	A	A	D	A	A
Amyl Chloride	A	D	D	A			A	A		A	A	A	C	B	A		A	A	A		B		D	B	D	D	A	D	A	A	A
Aniline	C	C	B	C	D	D	C	A	A	A	B	A	C	C	C	C	C	B	A		C	D	D	D	D	D	B	A	D	A	A
Aniline Hydrochloride		D		D			D				D	D	D	A			D	A			A		D	C	A		B		D		D
Anti-Freeze	A	D		A	B	A	D	D		A	A				A	A	A		A		A	A	C	C	A					A		
Antimony Trichloride		A	B	A			D			A	C	D	D	B			D				A						A				
Aqua Regia (80%HCl, 20%HNO_3)	D	B	B	C		D	D	D	D	A	D	D		A	D		D	C			B	D	D	D	C	D	C	A	D	D	D
Arochlor 1248	A	D	C				A			A	B	D		A			A	A			A	C	D	C	D	D	B	A			
Aromatic Hydrocarbons	A	D	C	D		A		A			C				C	A	A		A		A	C	D	C	D	D	D		D		
Arsenic Acid	A	A	B	A		A	C	D	A	A	A	A	B	B	D	A	D	B			A	A	A	C	D	B	A	A	A	A	A
Asphalt	A	B	A	A		D	A	A	A	A	A	B	B	B	A	A	A			A	A	A	B	C	B	D	D	A	D	A	A	A
Barium Carbonate	A	A	B	A			A	A		A	B	B	B	A	B	B	D	B	A	A	A	A	A		A		A	A		A	A	A
Barium Chloride	A	A	A	A		A	A	A	A	A	A	B	B	A	C	C	D	B	A		A	A	A	A	A	A	A	A	A	A	A	A
Barium Cyanide	A	D	B	D				B		A	A	A			C		C		A		A	C	A	C			A				
Barium Hydroxide	A	B	B	A		A	A	D	A	A	B	B	B	B	A	A	D	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Nitrate	A	A	B	A		D	A	A		A	B	B	B	A	D	A	B		A		A	A	A	A			A	A	A	A	A	A
Barium Sulfate	C	B	B	B			A	A	A	A	B	B	B	B	C		B	A	A		A	A	A	A	A	A	A	A	A	B	A	A
Barium Sulfide	B	B	B	A			A	A		A	B	B	B	A	C		D		A		A	A	A	A	A	A	S		A	A	A	A

***Delrin, Hypalon, Teflon, Viton** - Reg TM E. I. Du Pont de Nemours & Co.
***Chemraz -** Reg TM Green, Tweed & Co., Inc.
***Ryton** - Reg TM Phillips Petroleum Co.
***Cycolac** - Reg TM Borg-Warner Corp.
***Aflas** - Reg TM Asahi Glass Co., Ltd. (This chart is available upon request)

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	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Beer	A	A	A	A		A	A	B		A	A	A	A	B	A	D	A	A	A	A		A	A	A	A	A	A	A	A	A	A	A
Beet Sugar Liquids	A	B	A	A	B	A	A	B		A	A	A	B	A	C	A	A	A	A	A		A	A	D	A	A	A	A	A	A	A	A
Benzaldehyde	A	A	A	D	B	D	C	A		A	B	A	B	A	A	A	A	B	B	A		D	A	D	A	A	A	A	A	A	A	A
Benzene	C	C	A	C	B	A	A	A	A	A	B	B	B	A	A	A	A	B	B	A	A	D	D	A	D	A	D	B	D	A	A	A
Benzene Sulfonic Acid	B	D	D	D	A		D		A	A	B	B	B	B				D	B		A	A	A	D	A		D		D	A	A	A
Benzoic Acid	A	C	B	A		C	C	B	A	A	B	B		B	D	D	B	B	A		A	D	D	D	D	D	D	A	B	B	A
Benzol	A	A	C			A	D	A	A	A	A	A	A		A	A	B	B	A	A	A	D	B	D	D	B	B	A		A	
Bleaching Liquors			B	B			C			A			B	A							A		C				A		B		
Borax (Sodium Borate)	A	B	A	B		D	A	A	A	A	A	A		A	A	A	B	B	A	A	A	D	C	D	D	A	A	A	B	A	A
Boric Acid	A	A	A	A		A	B	A	A	A	A	B	D	A	B	D	D	D	A	A	A	A	A	D	A	A	A	A	B	A	A
Brewery Slop	A					A		A			A		A		A	A			A		A	A	A	A					A		
Bromine	D	D	D	C	D	D	D	D	D	A	D	D	A	D	D		D	A	D	D	A	D	D	D	D	D	D	D	A	A	D
Butadiene	A	D	D	C			A	A	D	A	D	A	A		C		A		A		B	D	B	D	D	B	C	D	A	A	A
Butane	A	C	C	C	B	C	A	A	A	A	A	A		A	C		A	A	A		B	D	A	D	D	B	D	D	A	A	A
Butanol (Butyl Alcohol)	D	A	A	B		A	B	A	A	A	A	B	A	B	A		B	A	A		A	A	A	A	A	A	B	A	A	A	A
Butter	A				B	D		A		A	A	C	A		D	D	A		A		A	A	B	A	D	B	A		B	A	
Buttermilk	A	A	A	A	B	D	B	A		A	A	A	B		D'	D	A	A	A		A	A	A	A	D			A		A	A
Butylene	A		B	C		A	B	A	A	A	A	A	C		D		A		A		A	B	C	B	D	D	D	B	D	A	A
Butylacetate	B	B	C	D		D	A	A	A	A	A	B		A	A	A	B	A	A		A	D	C	D	D	D	D	B	A	A	A
Butyric Acid	C	C	D	B	D	D	B	C	A	A	B	B		A	A	D	B	A	A		B	D	D	D	D		B	A		D	A
Calcium Bisulfate	A					D					A		D		C	D							A								
Calcium Bisulfide	A	A		A			A	D		A	B	B	A	A	C		C		A		A	A	A	A			C	A		A	
Calcium Bisulfite	A	B	A	B			A	D	A	A	A	B		A			D	B			A	A	A	A	D	A	D	A	A		A
Calcium Carbonate	A	A	B	A			A	A		A	B	A	C	B	A		D	B	A		A	A	A	A	A	A	A		A	A	A
Calcium Chlorate				A		A				A			C								A	C		C			A				
Calcium Chloride	A	A	B	A	B	A	A	D	A	A	B	C	D	A	A	C	D	A	A	B	A	A	A	A	A	A	A	A	A	A	A
Calcium Hydroxide	A	A	B	A		D	A	D		A	B	C	B	A	D	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Calcium Hypochlorite	A	A	B	B		A	C	D	A	A	B	C		A	D	D	B	B	A		A	C	C	D	A	A	B	B	A	A	A
Calcium Oxide	A	A	B	B	D	D	B	A	A	A	B	A		A	D		C	A		A	A	B	D	C	A	B	A		A	A	A
Calcium Sulfate	A	A	B	A	C	D	D	D	A	A	A	B	B	A	A	A	C	B	A		A	A	C	A			A	A		A	A	A
Calgon	A	A				D	A	B			A	A	A		C	D			A		A	A	A	A			A			A	
Cane Juice	A	C		A		A	A	A		A	A	A	A		C	A	B		A		A	A	A	A	A	A	B	A	A	D	
Carbolic Acid (see Phenol)	C	B	B	C		D	D	D	A	A	B	B	A	A	A	D	B	A	A	A	A	D	C	D	D	C	B	A	D	A	A	A
Carbon Bisulfide	A	C		D			A	A			B	D	A		B		B		A	A	A	C	D	C		D	D			A	
Carbon Dioxide	A	A	C	A	B	A	A	A	A	A	A	A	A	A	B	D	B	A	A		A	B	A	C	A	B	B	A	A	A	A
Carbon Dioxide (Dry)	A	A	C	A	B	A	A	A	A	A	A	A	A	A	A	D	B	A	A		B	A	B	A	B	B	B	A	B	A	A
Carbon Dioxide (Wet)	A	A	C	A	B	A	A	A	A	A	A	A	B	A	D	D	B	A	A		B	A	D	A	B	B	B	A	B	A	A
Carbon Disulfide	C	D	C	D		A	B	A	A	A	B	A	A	B	D	A	A	A	A		A	D	D	A	D	D	D	A	A	A	A
Carbon Monoxide	A	A	B	A		A	A	A		A	A	A	B		C	D	A	A	A		A	A	D	A	B	D	A		A	A	A
Carbon Tetrachloride	A	B	B	B	D	A	D	B	A	A	B	B	A	A	A	C	D	A	A	A	A	C	D	C	D	D	D	A	D	A	A	A
Carbonated Water	A	B	A	A			A	A			A	A	D		C	D	A		A		A	A	A	A					A		
Carbonic Acid	B	B	B	A		A	A	B	A	A	A	A	D	B	A	D	B	A	A		A	B	A	B	A	A	A	A	A	A	A
Catsup	A	A		A	B	D	A	B			A	A			C	D	D		A		A	A	C	A			C		A		
Chloroacetic Acid	C	C	C	B			D	D	A	A	A	B	D	A				B	A		D	B	D	B	D		B	A			A	
Chlorobromomethane				D			C			A			C								A	D	D	D	D	D	B		D			
Chloric Acid				A			D	D		A	C	D	D		A		D	A										A			D
Chlorinated Glue	A					D					A		B		D	D											B				
Chlorine, anhydrous liquid	C	B	B	C		D	D	A	D	A	C	C	A	B		C	D	B	A		A	C	D	C	D	D	C	B	C	D	A
Chlorine, dry		C	B	A			D	D	D	A	B	C	D	D			C	B			A	D	C	D	D	D	B	A	D		A
Chlorine Water	A	C	B	A			C	D	D	A	C	C		A			D	A			A	D	D	D	D	C	A		A		A
Chlorobenzene (Mono)	C	C	C	D	D	D	B	A	A	B	B	A	B	B	A	D	A	B	A		A	D	D	D	D	D	D	A	D	A	A
Chloroform	C	C	C	D	D	A	D	B	A	A	A	B	B	A	D	D	B	A	A	A	A	D	D	D	D	D	D	B	D	A	A
Chlorosulfonic Acid	C	D	D	C		D	D	B	D	A	B	D	C	A	D	D	C	A			C	D	D	D	D	D	D	A	D	A	C
Chocolate Syrup	A	A				D	A	A		A	A	A	D		D	D	A				A	A	A	A	D					A	
Chromic Acid 5%	B	A	B	A	B	C	D	B	A	A	A	B	A	A	D	D	C	B	D		A	D	D	A	B	B	A	A	C	C	A
Chromic Acid 10%	C	A	A	A	B	D	D	B	A	A	B	B	C	B	D	D	D	B	D		B	D	D	D	D	B	C	A	C	D	A
Chromic Acid 30%	C	A	A	B	C	C	D	C	B		B	B		A	D	D	D	B	D		A	D	D	D	D	B	B	A	C	D	A
Chromic Acid 50%	D	B	A	C	C	C	D	D	A	A	B	C		A	D	D	D	B	D		A	D	D	D	D	B	B	A	C	D	A
Chromium salts			B	A			B						A																		
Cider	A	A	B	A		D		B		A	A	A	B		A	D	B		A		A	A	A	A					A		
Citric Acid	A	A	A	B	C	A	A	B	A	A	A	B	B	A	C	D	C	A	A	B	A	A	A	A	A	A	A	A	A	A	A
Citric Oils	A	A				D		B			A	A			D	D	C		A		A	A	D	A					A		
Clorox (Bleach)	A	D		A	B	D	A	D	C	A	A	A	B		D	D	A	A	A		A	B	B	B	D	B	B	D		A	
Coffee	A	A					A	A		A	A	A	B	A	D		A	A	A		A	B	A	A	A	A	A		A	A	
Copper Chloride	A	A	B	A		D	A	B	A	A	D	D	B	A	D	D	D				A	A	A	A	A	A	A		A	A	
Copper Cyanide	B	A	B	A		A	A	B	A	A	B	B		B	C	D	D	B	A		A	A	A	A	A	A	A		A	A	A
Copper Fluoborate	A			A		A		B			D	D			D	D		B	A		A	B	A	B							
Copper Nitrate	A	A	B	B			D	D	A	A	B	A		B	D		D	A	A		A	A	A	A				A	A	A	A
Copper Sulfate 5%	A	A	B	A		A	C	D	A	A	B	B		A	C	D	D	A	A		A	A	A	A	B	A		A	A	A	A
Copper Sulfate >5%	A	A	B	A		A	C	D	A	A	B	B		A	C	D	D	A	A		A	A	A	A	B	A		A	A	A	A

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Cream	A	A				A	A	A		A	A	A			D	D	A		A		A	A	C	A							
Cresols	A	D	C	D	D	D	D	D	A		A	A		B	C	C	A	B	A		A	D	D	D	D	D	D	A	D	A	A
Cresylic Acid	A	D	B	C		D	D	D		A	A	A	A	A	C	C	C	B	A		A	D	D	D	D	D	D		D	A	A
Cyanic Acid	A					D		D		A	A	A			D	D	A				A	C	C	C							A
Cyclohexane	A	C	B	D		D	A	A	A	A	A	A		A	D	A		B	A		A	A	D	A	D	D	D	A	D	A	A
Cyclohexanone	C	D	D	D	D			A	A	A	A	A		A			A				D		C	D	D		C		A	A	A
Detergents	A	B	A	A	B			A	A	A	A	A			A		B	B	A		A	A	D	B	B		A	A	A	A	A
Diacetone Alcohol	B	B	A	D				A		A	A	A					A						D	A			A		D		A
Dichlorethane	B	A	C	D				C	A	A	B	B		B				A					D		D			A			A
Diesel Fuel	A	A	C	A				A	A	A	A	A		B	A	A	A	B	A		A	A	B	A	D	B	D	A	D	A	A
Diethylamine	A	B	D	D			A	B		A	B		A	D	A		B		A	A	D	C	B	C			B	A	B	A	A
Diethylene Glycol	C	A	B	A	B		A	A		A	A	A	A	A	A	A	B	B	A	A	A	A	A	A	A	A	B	A	B	A	A
Dimethyl Formamide		A	A	D	D		A	B	A	A	A	A					A						A				B	A	C		
Diphylene Oxide	A	D		D				D	A	A	B	B	A	A	A	A	B	B	A	A	A	A	D	D	D	D	D		C	A	
Dyes	A			B			A	C		A	A	A	A	A	C		B	B			A		C				D				
Epsom Salts (Magnesium Sulfate)	A	A	A	A		A	A	B	A	A	B	B	B	A	C	A	B	B	A	A	A	A	A	B	B	A	A	A	A	A	A
Ethane	A	C		D			A			A	A		A		A				A	A	A	A	B	D	B	C	D	A		D	A
Ethanolamine	A	B		D		A	A	D	A	A	A	A	A	B	A			B	B	A	A	B	D	B	D	C	D	B	D	B	D	A
Ether[3]	A	D	C	D		D	A	A	A	A	B	B	B	A	A	C		B	B	A	A	D	D	B	D	C	D	C	B	D	A
Ethyl Acetate	C	B	C	C	C	A	A	A	A	A	B	B	B	A	A	A		B	A	A	D	D	D	D	D	C	D	B	A	B	A
Ethyl Chloride	A	C	C	D	D	D	A	A	A	A	A	A	A	C	A	C	B	B	A	A	A	A	B	A	B	D	A	B	D	A	A
Ethyl Sulfate	A									A	D		A		A				A	A	A	A		A				A		A	A
Ethylene Bromide		D	D	D						A	B	B	A				D	B			A			A			C	B	D	A	A
Ethylene Chloride	B	C	D	D			B	A	A	A	A	A	B	B			B	B	A		B	D	D	D	D	D	D	A		A	A
Ethylene Chlorohydrin		D					D	C		A	B		D	B			B				B	D	A		C	B	B		C		A
Ethylene Diamine	A			C			B	A	A	A	A	A					C	C			D	A	B	B	B	B	A	D	A	A	A
Ethylene Dichloride	C	C	C	D	D	D	B	B	A	A	A	A	A	B	C	A	B	B	C		A	D	D	D	B	D	C	A	D	A	A
Ethylene Glycol	C	A	A	A	B	A	B	B	A	A	A	A	B	A	A	A	B	B	A	A	A	A	D	D	D	A	A	A	A	A	A
Ethylene Oxide	A	C	C	C		D	A	A	D	A	C	C			A	D	C		A		A	D	A	D	A	D	A	A	A	A	A
Fatty Acids	A	B	B	C		D	A	A		A	A	B	B	B	C	C	A	A	A		D	B	B	D	B	D	D	C	D	A	A
Ferric Chloride	A	B	A	A		A	C	D	A	A	C	D	D	A	D	D	D	B	A		A	A	B	A	A	B	A	A	B	A	A
Ferric Nitrate	A	B	B	A			A	D	A	A	A	B	B	A	D	D	C	B	A		A	A	A	A	A	A	A	A	C	A	A
Ferric Sulfate	A	B	A	A	C	D	A	D	A	A	A	B	B	A	D	D	C	B	A		A	A	A	A	A	A	A	A	B	A	A
Ferrous Chloride	A	A	A	A		A	A	D	A	A	C	D	D	A	C	D	D	B	A		A	A	A	A	A	A	A		C	A	A
Ferrous Sulfate	A	A	A	A		D	A	D	A	A	B	B	D	A	D	D	A	B	A		A	A	A	A	A	A	A	A	A	A	A
Fluoboric Acid	A	A	B	A		A	D		A	A	C	B		D	D	D	D	A	A		A	A	A	A	A	A	A		D	A	
Fluorine	D	D	C	D			D		D	A	C	C	C	D	D	D	D	B	D		B						A	A	D		C
Fluosilicic Acid	C	A	B	A			D		A	A	B	C	C	D	D	D	C	B	A			A	A	A	A	A	A	A		D	A
Formaldehyde 40%	A	A	A	A			C	A	A	A	A	A	B	D	A	B	B	B		A	A	B	A	B	A	A	A	C	A	A	A
Formaldehyde 100%	A	C	B	A	B	B	D	A	B	A	A	C	B	A	A	C	A	B	A	A	D	C	C	C	B	C	A	A	B	A	
Formic Acid	C	A	B	A	B	C	C	D	A	A	C	B	B	C	C	D	B	A	A	B	C	B	A	A	A	A	A	A	A	A	A
Freon* 11	A	D	C	A	C		D	D	A	C	A	B	A	A	A	C		A	A	B	A	B	D	A	D	A	D	A	C		
Freon 12	A	D	C	A	C		D	B	A	A		D	A	A	A	A	A	A	A	A	B	A	A	D	B	A	D				
Freon 22	A	A		B			B	A	A	A			A	A	A	C		A	A	A	B	D	A	A	D	A	D				
Freon 113	A	D		B				A	A	A			A	C	A			A	A	A	B	A	C	D	A	A	D				
Freon TF	A	D		B			D	A	D	D			A	B	A		D	A	A	A	B	A	A	A	D	A	D		D	A	
Fruit Juice	A	A		A	B	D	A	A		A	A		A	A	C	D	A	A	A	A	A	A	A	D	D			A		A		
Fuel Oils	A	C	C	A	D		A	B	A	A	A	A	A	A	A	A	C	A	A	A	A	B	A	C	D	D	D		C	D	A	A
Furan Resin	A	D	D	A		A		D	A	A	A	A	A	A	A		A			A		D	A	C	D	D	D	D		D		
Furfural	A	D	C	D	D	D	B	D	A	A	B	B	B	A	A	A	A	A	B	A	D	D	D	D	D	D	D	C	D	D	A	A
Gallic Acid		A	B	A			B		A	A	B	B	B	A	A		C	B			A	B	B	B	A	B	B	B			B
Gasoline	A	C	B	C	D	A	A	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	B	A	D	B	B	D	A	D	A	A
Gelatin	B	A	A	C		D	A	A	A	A	A	A	A	A	A	D	A	B	A	A	A	A	A	A	A	A	A	A		A	A	A
Glucose	B	A	A	A	B	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	A
Glue, P.V.A.	A		A	C			A	A		A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A		A	A	B
Glycerin	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glycolic Acid	A	A	A	A	B			A	A	A	A	A	A	B						A	A	A	A	A	A	A	A	A	A	A	A	A
Gold Monocyanide	A					A		A		D	A	A	A		A	D				A	A	A	A	A					A	A	
Grape Juice	A		B	B	B	A	A	A		D	A	A	A	A	C	D				A	A	A	A	A					A	A	
Grease	A			A		D		D		A	A		A		A	A		A		A	A	D	D	D					A		
Heptane	A	C	B	C	D	D	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	A	D	A	D	A	A	B
Hexan	B	B	C	B		D	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	D	B	D	A	D	A	A	A
Honey	A	A	B	A		D	A	A		A	A		A		A	A	A	A	A	A	A									A		
Hydraulic Oil (Petro)	A	D	C	A		D	A	B	D	A	A	A	A		A	A	A	A	A	A	A	A	B	A	D	B	D		C	A	B	
Hydraulic Oil (Synthetic)	A	D	A	A			A			A	A	A	A		A		A	A	A	A	A									A	B	
Hydrazine	A	C				A		B		C	A	A			D	C					A	B	B	B		B	A		C	A	
Hydrobromic Acid 20%	B	A	B	B		D	D	C			D	D	D	A	C	D	D	D	A	B	A	D	B	D	A	A	A	A	D		A	
Hydrobromic Acid 100%	D	C	B	A	B	D	D	D	A	A	D	D	D	A	D	D	D	D	A	A	A	D	D	D	A	A	A	A	D	A	A	A
Hydrochloric Acid, Dry Gas	A	B	A	A		D	A		A	A	D	D	D	C	D			D	A	A								A		A	A	A
Hydrochloric Acid 20%	A	B	A	A	A	A	D	C	A	A	D	D	D	C	D	D	D	D	A	A	A								A		A	A

***Delrin, Hypalon, Teflon, Viton** - Reg TM E. I. Du Pont de Nemours & Co.
***Chemraz -** Reg TM Green, Tweed & Co., Inc.
***Ryton** - Reg TM Phillips Petroleum Co.
***Cycolac** - Reg TM Borg-Warner Corp.
***Aflas** - Reg TM Asahi Glass Co., Ltd. (This chart is available upon request)

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Exposure Rating Guide:

A	Good
B	Fair
C	Questionable
D	Poor
Blank	Insufficient Data

	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Hydrochloric Acid 37%	A	C	B	B	A	C	D	C	A	A	D	D	D	C	D	D	D		A	C	A	B	B	B	B	A	A	A	B	A	A
Hydrochloric Acid 100%		B		B	A		D	C	A	A	D	D	D	D	D	D	D	B	A	C	A	D	D	D	D	D	C	A	D	A	A
Hydrocyanic Acid	A	A	A	A	B	D	C	B	B	A	B	B	B	B	D	D	B	A	A	A	A	B	A	B			A			A	A
Hydrocyanic Acid (Gas 10%)		A		A				C		A			A	A	D						A	B	A	B			A				
Hydrofluoric Acid 20%	A	A	A	B	C	D	C	D	A	A	D	D	D	D	D	D	D	A	B	C	A	B	A	B	B	A	A	A	D	C	A
Hydrofluoric Acid 50%	C	A	A	B	C	D	D	D	A	A	D	D	D	D	D	D	D	B	D	D	A	B	A	B	B	A	A	A	D	D	A
Hydrofluoric Acid 75%	B	C	C	C	C	D	D	D	B	A	D	D	D	D	D	D	D	B	D	D	A	D	D	D	D	A	C	A	D	D	A
Hydrofluoric Acid 100%		C		C	D	D	D	D	D	A	B	B	D	D	D	D	D	B	D	D	A	D	D	D	D	A	C		D	D	
Hydrofluosilicic Acid 20%	C	A	B	A		D	D	B	A	A	B	C	D	D	D	D	D	B	A	D	A	A	C	A			A	A		A	A
Hydrofluosilicic Acid 100%	C	A	B	B			D	A	A	A	C	D	D	D	D	D	D	B	A		A	B	B	B	A	A	A	A	D	A	A
Hydrogen Gas		A	A	A			A		A	A	A	A	A	A	A	A	A	A			A	A	A	A	B	A	A	A	C		A
Hydrogen Peroxide 10%	C	B	A	A	A	D	C	D	A	A	B	B	B	B	C	C	A	A	A	A	A							A	B	A	C
Hydrogen Peroxide 30%	B	B	C	A		D	D	D	A	A	B	B	B	B	B	B	A	A			A							A	B		C
Hydrogen Peroxide 50%		B	C	A		D	D	D		A	A	B	B	B	B	B	A	A			A							A	B		C
Hydrogen Peroxide 100%	A	B	C	C	B	D	D	D	C	A	A	B	B	B	D	D	A	D		A	A	B	A	B	B	B	A	A	B		C
Hydrogen Sulfide (aqua)	A	A	A	B	B	D	C	C	A	A	C	C	C	A	D	D	B	A	A	A	D	D	A	D	D	B	A	A	C	A	A
Hydrogen Sulfide (dry)	A	A	A	A		D	C		A	A	B	C	C	A	D	D	B	A		A	D	A	A	A	A	A	A	A	C		A
Hydroquinone		A	A	B	D		B	A		A											B	C		D	A	D	D				
Hydroxyacetic Acid 70%	A			D				A						A	D	D			A	A	A	A	A	A			A			A	
Ink	A			C	B		C	A		D	C	C			D	D			A	A	A	A	A	A	D					A	
Iodine	C	C	A	C	D		D	D	D	A	C	C	C	C	D	D	A	B	D	A	A	B	D	B		B	B	A		D	A
Iodine (in alcohol)			B				C	D									B	D		A							A				
Iodoform				A						C	B			D	A			A					A		B						
Isotane	A	D		A			D						A				D			A	A	A	D	A							
Isopropyl Acetate	A	B	B	D			B	D		A	A	C	A		B		B	B		A	D	D	D	D	D	D	B		D	A	A
Isopropyl Ether	D	B	A	B				D		A	A	A			A		A	A	A	A	D	B	C	B	D	C	D	A	D	A	A
Jet Fuel (JP3, -4, -5)	A	A	B	A		D	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	A	D	D	D	A	D	A	A
Kerosene	A	A	C	A	D	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	D	D	D	A	D	A	A
Ketones	C	C	C	B	D		A	D	A	A	A	A	C	A	A		A	A	C	A	D	D	D	D	A		D	B		C	A
Lacquers	A	C	B	C		A	A	D		A	A	A	A		A	C	A	A	A	A	D	D	D	D	D	D	D		D	A	A
Lacquer Thinners	A	C	B	C		A	A	D		A	A	A	A	C	A	C	A	A		A	D	D	D	D	D	D	D		D		A
Lactic Acid	B	A	A	C	B	D	C	B	A	A	B	B	B	B	C	D	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A
Lard	B	B	B	B		D	A	B		A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	D	D	D		B	A	A
Latex	A	A			B	D	A	C		A	A	A			A		A	A		A	A	A		A			A				
Lead Acetate	A	A	A	A	B		B	D	A	A	B	B	B	A	A	A	D	B	A	A	D	B	B	B	A	D	A	A	D	A	A
Lead Sulfamate	A	A	A	A			B	A		A	C	C	A				C				A	B	A	B	B	A	A		B		
Ligroin	A	A	C				D	B			A		A		A		D			A	A	A	B	A	D	C	D		D		
Lime	A		B	A		D	A	B		A	A	A	A	A	A	A	D		A	A	A	A	A	A			D			A	A
Lithium Hydroxide										A	B	B	B		D		D	B				C									B
Lubricants	A	A	D	B		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	D	D	D		D	A	A
Magnesium Carbonate	A	A	A	A	B			A		A	A	A	A	A	A		B			A	A	A		A			A				
Magnesium Chloride	A	A	A	A	B	A	A	A	A	A	A	B	B	A	C	D	D	A		A	A	A	A	A	A	A	A	A	A		A
Magnesium Hydroxide	A	A	A	A	B	D	B	A	A	A	A	B	B	A	A	A	C	B	A	A	A	B	B	B	B	A	A	A	A	A	A
Magnesium Nitrate	A	A	A	A	B	A	A	A	A	A	A	A	A	A	D	D	C	A		A	A	A	A	A			A				
Magnesium Oxide	A					D		A			A		A		A	A				A	C	A	A	A							
Magnesium Sulfate	A	A	A	A	B	A	A	A	A	A	B	B	B	A	C	A	B	A	A	A	A	A	A	A	B	A	A	A	A	A	A
Maleic Acid	A	A	B	A			B	A	B	A	B	A	A	A	A	A	B	B	A	A	A	D	D	D	D	D	D			A	A
Maleic Anhydride	A	D						D					A				A		A	A	A	D	D	D	D	D	D			A	
Malic Acid		A	B	A			C	A		A	A	A	B	A	A		B	B		A	A	A	B	A	A	B	D		B		A
Mash	A						A	A			A		A		A		A		A	A	A	A	A	A			A			A	
Mayonnaise	A		B	D			A			D	A	C	A		D	D	A	A	A	A	A	C	A	C	D					A	
Melamine	A	A		A		D	A			A	D				D	D			A	A	A	C	D	C			A			A	D
Mercuric Chloride (Dilute)	A	A	A	A		A	D	B	A	A	C	D	D	A	D	D	D	C	A	A	A	A	A	A	A	A	A	A		A	C
Mercuric Cyanide	A	A	A	B			A			A	B	B	D	A	D		D		A	A	A	A	A	A	D			A		A	A
Mercury	A	B	A	B	B	D	A	A		A	A	A	A	A	D	A		A	A	A	A	A	A	A	A	A	A	A		A	C
Methane		A		B			A			A	A	A	A		A		A	A			A	A	B	A	D	B	D		D		B
Methanol (Methyl Alcohol)	B	A	A	A	B	A	C	A	A	A	A	A	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Methyl Acetate	D	D	B	D			A	B		A	A	A			A		A	A	A	A	D	D	B	D	D	D	B	A	D	A	A
Methyl Acrylate	A	D						B					A						A	A	D	D	B	D	D	D	B		D	A	
Methyl Acetone	C			D			A	D		A	A	A	C		B		A			A	A	D	D	D	A						A
Methyl Alcohol 10%	B	A	A	A		A	C	A	A	A	A	A	B	B	A	A	A	A			D	A	A	A	A	A	A	A	A		A
Methyl Bromide	B	C		D	D		C	D		A	A	A	B						A	A	A	B	D	B	D	D	D			A	A
Methyl Butyl Ketone	C	D		A			D	D			A		B		A				A	A	D	D	D	D	D	D	A		D	A	
Methyl Cellosolve	C	B		B			C	D		A	A	A	C				A		A	A	D	C	B	C	D	D	B		D	A	A
Methyl Chloride	A	D	C	D			C	D	A	A	A	A	C	A	C	A	D	B	A	A	A	D	D	D	D	D	C	A	D	A	A
Methyl Dichloride	A	D		A			C	D					A						A	A	A	D		D			D			A	
Methyl Ethyl Ketone	C	A	B	D	D	A	A	B	A	A	A	A	B	A	A	A	A	A	A	A	D	D	D	D	D	D	A	A	D	A	A
Methyl Ethyl Ketone Peroxide																					D	D	D	D	D	D	D		B		
Methyl Isobutyl Ketone	C	D	C	D	D		C		A	A	A	A		A	C		A	A		A	D	D	D	D	D	D	B	A	D	A	A
Methyl Isopropyl Ketone	A		D	D		A	A			A	A	A									D	D	D	D	D	D	C		C	A	A

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Chemical Compatibility Table

Exposure Rating Guide:
A Good
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D Poor
Blank Insufficient Data

	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Methyl Methacrylate	A	D		A				D					A						A	A	D	D	D	D	D	D	D			A	
Methylamine	A			D						A	A		A		D				A	A	D	C		C	B		A			A	
Methylene Chloride	A	B	C	A	D	A	C	A	A	A	B		B	B	A	A	A	B	A	A	B	D		D	B		D	A	A	A	A
Milk	A	B	A	A	B	A	A	A		A	A	B	B	A	C	D	A	A	A	A	A	A	A	A	A	A	A		D		
Mineral Spirits	A	C	B	A	D	A	A	A	A	A	A	A	B	B	C	B	A	A	B		A	A	C		D	C	D	A	A	A	A
Molasses	A	A	A	D	B	A	A	A		A	A	A	B	A	D	A	A	B	A	A	A	A	A	A	A			A		A	A
Monoethanolamine	A	B	C	B			A	D	A	A	B	A	A	B				B					D		B	D	A		B		A
Mustard	A	A	A	C		D	A	C		A	A	A	C	A	D	D	A	B	A	A	A	C	A	C	B			A		A	A
Naphtha	A	C	A	D	D	A	A	D	A	A	A	A	A	B	B	A	A	B	A	A	A	C	D	C	B	D	D	A	D	A	A
Naphthalene	A	B	A	A	D	A	A	D	A	A	A	A	A	A	C	A	B	A	A	A	A	D	D	D	D	D	D	A	D	A	A
Natural Gas		A	A							A	A										A	C	A		A		A		A		
Nickel Chloride	A	A	B	A	B	A	C	A	A	A	C	D	D	A	D	D	D	B	A	A	A	A	B	A	A	A	A	A	A	A	A
Nickel Sulfate	A	A	B	A	B	C	A	A	A	A	B	C	B	B	D	D	D	A	D	A	A	A	A	A	B	A	A	A	A	A	A
Nitrating Acid (≤15% H_2SO_4)		C		D					C	A	C	C		A	D	A	D	A	D	A			A	C							
Nitrating Acid (≥15% H_2SO_4)	D	C		D					D	A	C	C	D	C	D	C	D	A	D	A			A		C						
Nitrating Acid (≤1% Acid)		C		D					C	A	A	C		C	D		D	A	D	A			A	C					A		
Nitrating Acid (≤15% HNO_3)		C		D					C	A	D	C		C	D	C	D	A	D	A			A	C					A		
Nitric Acid (5-10%)	A	A	B	A	B	D	C	D	A	A	A	A	B	A	D	D	D	A	C	B	A	D	A	D	C	B	B	A	C	C	A
Nitric Acid (20%)	B	A	C	A	B	D	D	D	A	A	A	A	B	A	D	A	D	A	D	B	A	D	A	D	D	B	B	A	D	D	A
Nitric Acid (50%)	D	D	C	B	C	D	D	D	B	A	A	A	B	A	D	D	C	A	D	C	A	D	A	D	D	D	D	A	D	D	D
Nitric Acid (Concentrated)	D	D	C	D	D	D	D	D	B	A	A	A	C	A	D	D	A	B	D	A	A	D	D	B	D	D	D	A	D	D	D
Nitrogen Fertilizer										A														B							
Nitrous Acid		A		A				D		A	A	A			A					A	A		D		C		A			A	
Nitrous Oxide		D	C	A			C			A	B				B		B	C					A	D	A	D	A				C
Nitrobenzene	C	B	C	D	D	D	B	B	A	A	A	B	B	A	C	C	A	D	A		B	D		D	D	D	D	A	D	A	B
Oils Aniline	A	A		D	D	D	A	D		A	A	A	A	D	A	A	D	B	A	A	C	D	D	D	D	D	B		D	A	
Anise	A					A		D			A		A		A	A			A	A				D							
Bay	A					A		D			A		A		A	A			A	A	A			D							
Bone	A	A						D			A		A		A	A			A	A	A	A		D	A						
Castor	A	A		A		A	A	A		A	A	A	A	A	A	A			A	A	A	A		A	A	A	B		A	A	
Cinnamon	A					A		D			A	A	A		A				A	A	A		C						A		
Citric	A					A		D		D	A		A		D	D	A	A	A	A	A		D						A		
Clove	A					A					A	A	A		A		B	A	A	A	A	A	C	C	B				A		
Cocoa Nut	A	A		A		A		A		A	A	A	A		A	A	A	A	A	A	A	A	C	D	D	C	C		A		
Cod Liver	A	A		A		A		B		A	A	A	A		A		A	A	A	A	A	A	B	D	D	B	A		B		
Corn	A	A	C	B				D		A	A		A		C	A	A	A	A	A	A	A	C	A	D	B	C		A	A	
Cotton Seed	A	A	B	B		A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	D	B	C	A	A	A	A
Creosote	A	C	C	C			D	D		A	B	B	B	A	C		B	B			A	D	C	B	D	D	D	A	D		A
Diesel Fuel (20,30,40,50)	A	A	C	A		A	A	D	A	A	A	A	A	B	A	A	B	A	A	A	A	D	C	B	D	D	D	A	D	A	A
Fuel (1,2,3,5A,5B,6)	A	C	C	A		A	A	D	A	A	A	A	A	A	A	A	C	A	A	A	A	B	D	B	D	D	D	D	C	A	A	A
Ginger	A					A		A			A	A	A		D				A	A	A	A	A	A			A			A	
Lemon	A					A		D		A	A	A	A		A		D		A	A	A		D				D			A	
Linseed	A	A	C	A		A	A	A	B	A	A	A	A	A	A		B	A	A	A	A	A	C	A	D	C	C	A	C	A	A
Mineral	A	B	B	A		A	A	A	A	A	A	A	A	A	A		A	A	A	A	A	A	B	A	D	B	D	A	C	A	A
Olive	A	A	A	C		A	A			A	A	A	A	A	A		A	A	A	A	A	A	B	D	D	B	B		D	A	A
Orange	A					A		D			A	A	A	A	A		A	A	A	A	A	A	C	A					D	A	
Palm	A			A		A		D			A	A	A	A	A	A			A	A	A	A	D	A					A	A	
Peanut	A	D		A		A		D		A	A	A	A	A	A	A	D		A	A	A	A	B	A	D	B	C		A	A	
Peppermint	A					A		D			A	A	A		A		D		A	A	A	D	B	D						A	
Pine	A	D		C		C	A	D		A	A	A	A	A	D	C			A	A	A	B	B	D	D	D	D		D		
Rapeseed	A	D				A		D			A	A	A	A	A	A			A	A	A	B	B	B	D	D	A		D	A	
Rosin	A	A	B	C		A	A			A	A	A	B		A		B	A	A	A	A	A		A						A	A
Sesame Seed	A			A		A		D		A	A	A	A	A	A	A			A	A	A	A	D	A					A		
Silicone	A	A	A	A		A	A	A	A	A	A	B	A		A	A	A	A	A	A	A	A	A	A	A	A	A		C	A	A
Soybean	A	A	A	A		D	B	D		A	A	A	A	A	A	A	B	A	A	A	A	D	C	D	D	C	C		A	A	A
Sperm	A					A		D			A	A	A	A	A	A			A	A	A	A	D	A					A		
Tanning	A					A		D			A	A	A		A				A	A	A	A	D	A					A		
Transformer	B	B	B	B			A				A	A			A		A				A	A	B	D			D		B	D	A
Turbine	A	B	C	A	D	A		D		A	A	A	A	A	A	A			A	A	A	B	C	B	D	D	D		D	A	A
Oleic Acid	A	B	C	C		C	B	C	A	A	B	B	B	B	C		B	A	A	A	B	C	C	C	D	C	B	A	D	A	A
Oleum 25%	D	D	D	D			D	D	A	A	B	B	A	D	D		B	B		A	A	D	D	D	D	D	D	A	D		D
Oleum 100%	D	D	D	D		C	D	D	A	A	B	B	A	D	D		B	B		A	A	D	D	D	D	D	D	A	D		D
Oxalic Acid (cold)	A	A	A	A	A	C	B	D	A	A	B	B	B	B	D	C	B	B	A	A	A	B	D	B	B	B	A	A	B	A	A
Ozone		D	C	A			D	C	A	A	A	B					B				A	D	C	D	D	A			A		
Paraffin	A	A	B	A			A	A		A	A	A	A	A	A		A	A	A	A	B	A	A	A	B		D			A	A
Pentane	A	D	D	A			A	B		A	C	C	A		C		A	B	A	A	A	A	B	A	D	B	D		D	A	A
Perchloric Acid		C	B	A			D	C		A				A							A	D	A				B	B	D		
Perchloroethylene	D	D	D	C			C	A		A	A	B	A	A	D	A	B	B	A	A	A	C	D	A	D	D	D	A	D	A	A
Petrolatum	A	D	B	B			D	B	A	C	A		A	A	A			A			A	A	C	A	D	C	A		A		
Phenol (10%)	C	B	A	C		D	D	B	A	A	B	B	B	A	C	D	B	A	A		A	D	A	D	D	D	B		D		A

***Delrin, Hypalon, Teflon, Viton** - Reg TM E. I. Du Pont de Nemours & Co.
***Chemraz -** Reg TM Green, Tweed & Co., Inc.
***Ryton** - Reg TM Phillips Petroleum Co.
***Cycolac** - Reg TM Borg-Warner Corp.
***Aflas** - Reg TM Asahi Glass Co., Ltd. (This chart is available upon request)

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Chemical Compatibility Table

Exposure Rating Guide:
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C Questionable
D Poor
Blank Insufficient Data

	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Phenol (Carbonic Acid)	C	B	B	C	D	D	C	D	A	A	B	B	A	A	C	D	B	A	A	D	A	D	D	D	D	D	B	B	D	A	A
Phosphoric Acid (≤40%)	A	A	A	B	B	D	D	C	A	A	B	A	B	B	D	D	C	A	B	C	A	D	B	D	D	B	B	A	C	B	A
Phosphoric Acid (≥40%)	B	B	B	B	C	D	B	D	A	A	B	A	B	C	D	D	B	A	B	D	A	D	D	D	D	C	B	A	C	B	A
Phosphoric Acid Anhydride		A				D		D	A					D	A				A				A								
Phosphoric Acid (crude)	B	B	B	B	C	D	B	D	A	A	B	D	D	C	D	D	B	A	C	D	A	D	D	D	D	C	B	A	C	C	A
Phosphoric Acid (molten)		D		D	D	D		D					A	D	A			A					A								
Photographic Developer	A	A	A	A	B	A		A		A	A	C	C	A	D	D			A	A	A	A	A	A	A	A	B		A	A	A
Phthalic Anhydride		D		D						A	A	A	A	A	B		A	A			A	B	A	B	C		A			A
Picric Acid	A	B		D	A	D	C		A	A	B	B	B	A	D	A	A	B			A	B	B	B	B	B	B	A	D		A
Plating Solutions																															
Antimony Plating 130F	B	A		A		A	D	A		A	A	A	B	A	A	A	A	A		A	A	A	A	A					A		
Arsenic Plating 110F	B	A		A		A	A	A		A	A	A	B	A	A	A	A	A		C	A	A	A	A					C		
Brass Plating:																															
Reg Brass Bath 100F	B	A	B	A		A	A	A		A	A	A	B	A	A	A	A	A		C	A	A	A	A					C		A
High Speed Brass Bath	B	A	B	A		A	A	A		A	A		B	A	A	A	A	A		D	A	A	A	A					D		A
Bronze Plating:																															
Cu-Cd Bronze Bath R.T.	B	A		A		A	A	A		A	A	A	B	A	A	A	A	A		C	A	A	A	A			A		C		
Cu-Sn Bronze Bath 160F	C	A		D		A	A	B		A	A	A	C	D	A	A	A	A		D	A	A	A	A			A		D		
Cu-Zn Bronze Bath 100F	B	A		A		A	A	A		A	A	A	B	A	A	A	A	A		C	A	A	A	A					C		
Cadmium Plating:																															
Cyanide Bath 90F	B	A		A			A	A		A	A		B	A	A	A	A	A		C	A	A	A	A					C		
Fluoborate Bath 100F	B	A		A		A	D	C		A	A	A	B	D	A	D	A	D		D	A	B	C	B					D		
Chromium Plating:																															
Chromic-Sulfuric Bath	C	A		A			D	D		A	C		D	A	C	A	A	D		A	C	D	D	D					A		
Fluosilicate Bath 95F	C	D		A			D	D		A	C		D	C	C	C	A	D		B	C	D	D	D					B		
Fluoride Bath 130F	C	A		A			D	D		A	D		D	C	D	C	A	D		B	C	D	D	D					B		
Black Chrome Bath 115F	C	A		A			D	D		A	C		D	A	C	A	A	D		A	C	C	D	C					A		
Barrel Chrome Bath 95F	C	A		A			D	D		A	D		D	C	D	C	A	D		A	C	D	D	D					A		
Copper Plating (Cyanide):																															
Copper Strike Bath 120F	B	A		A		A	A	A		A	A					A		A		C	A	A	A	A					C		
Rochelle Salt Bath 150F	C	A		D			A	B		A	A		C	D		A	A	A		D	A	A	B	A					D		
High Speed Bath 180F	C	A		D			A	B		A	A		C	D		A	A	A		D	A	A	B	A					D		
Copper Plating (Acid):																															
Copper Sulfate Bath R.T.	D	A		A			D	A		A	D		D	A	D	A	A	D		A	A	A	A	A					A		
Copper Fluoborate Bath	D	A		A		A	D	C		A	D	A	D	D	D	D	A	D		D	A	B	C	B					D		
Copper Plating (Misc.)																															
Copper Pyrophosphate	B	A		A			A	A		A	A		B	A	A	A	A	A		B	A	A	A	A					B		
Copper (Electroless)	B	A		A			A	D		A			B	A			A			A	A	D	D	D					A		
Gold Plating:																															
Cyanide 150F	D	A		D			A			A	A			A				A			A	A	A	A					B		
Neutral 75F	A	A		A			A			A	C			A				A			A	A	A	A					A		
Acid 75F	A	A		A			A			A	C			A				A			A	A	A	A					A		
Indium Sulfamate Plating R.T.	A	A		A			D			A	C			A				A			A	A	A	A					A		
Iron Plating:																															
Ferrous Chloride Bath	D	C		D		A	D			A	D			A				D			A	B	D	B					A		
Ferrous Sulfate Bath	D	A		D		A	D			A	C			A				A			A	A	B	A					A		
Ferrous Am Sulfate Bath	D	A		D		A	D			A	C			A				A			A	A	B	A					A		
Sulfate-Chloride Bath	D	A		D		A	D			A	D			A				D			A	B	C	B					A		
Fluoborate Bath	D	A		D			D			A	D			D				B			A	B	C	B					D		
Sulfamate	A	A		A			D			A	D			A				B			A	A	A	A					A		
Lead Fluoborate Plating	A	A		A		A	D			A	C			D				A			A	B	A	B					D		
Nickel Plating:																															
Watts Type 115-160F	D	A		D			A			A	C			A				A			A	A	A	A					A		
High Chloride 130-160F	D	A		D			D			A	C			A				A			A	A	B	A					A		
Fluoborate 100-170F	A	A		A		A	D			A	C			D				A			A	B	A	B					D		
Sulfamate 100-140F	A	A		A			A			A	C			A				A			A	A	A	A					A		
Electroless 200F	B	D		D			D			A											A	D	D	D					A		
Rhodium Plating 120F	A	A		A			D			A	D			D				D			A	A	B	A			A		A		
Silver Plating 80-120F	A	A		A		A	A			A	A			A				A			A	A	A	A			A		B		
Tin-Fluoborate Plating 100F	A	A		A		A	D			A	C			D				A			A	B	C	B					D		
Tin-Lead Plating 100F	A	A		A			D			A	C			D				A			A	B	C	B					D		
Zinc Plating:																															
Acid Chloride 140F	A	A		A			D			A	D			A				D			A	A	A	A					A		
Acid Sulfate Bath 150F	D	A		D		A	D			A	C			A				A			A	A	B	A					A		
Acid Fluoborate Bath RT	A	A		A		A	D			A	C			D				A			A	B	C	B					D		
Alkaline Cyanide Bath RT	A	A		A		A	A			A	A			A				A			A	A	A	A					D		
Potash	A	A	B	C		C	A	B			A	A			D	C	C	B	A	A	A	A	D	A	B			A		A		
Potassium Bicarbonate	A	A	A	A	C	A	A	C	A	A	B	B	B	A	D	A	D	B	A		A	A	A	A	B			A		A	A
Potassium Bromide	A	A	A	A			A	A	A	A	B	C	B	A	C		B	B	A		A	A	A	A	B		A	A		A	A
Potassium Carbonate	A	A	A	A		A	A	B	A	A	B	B	B	A	D	A	D	B	A	A	A	A	A	A	B		A	A		A	A

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Potassium Chlorate	A	A	A	A			C	B	A	A	B	B	B	A	B		B	C	A		A	C	A	C	B		A	A		A	C
Potassium Chloride	A	A	A	A	C	A	B	A	A	A	B	A	B	A	D	A	D	B	A		A	A	A	A	A	A	A	A	A	A	A
Potassium Chromate	C	A	A	A		A	A	C		A	B	B	B		A	A	B	A	A		A	A	A	A	B		A			D	A
Potassium Cyanide Solutions	A	A	A	A		D	A	C	A	A	B	B	B	A	D	A	D	B	A		A	A	A	A	B	A	A	A	A	A	A
Potassium Dichromate	C	A	A	A		D	D	C	A	A	B	B	B	A	A	A	A	B	B		A	A	A	A	B	A	A	A	A	A	A
Potassium Ferrocyanide	A	A	A	B			B			A	B	B	C	A	A		B	B	A		A	A		A	A		A	A			A
Potassium Hydroxide (Caustic Potash)	A	A	A	A	C	C	C	D	A	A	B	B	B	D	D	C	D	B	B	A	B	B	B	A	B	A	A	B	C	D	C
Potassium Nitrate	A	A	B	A			B	B	A	A	B	B	B	A	B		B	B	A		A	A	A	B	A	A	A		A	A	A
Potassium Permanganate	A	A	A	A	C	A	D	C	A	A	B	B	B	A	C	A	B	A	B		A	C	A	C	B		A			A	A
Potassium Sulfate	A	A	A	A		A	A	B	A	A	B	B	B	A	C	A	D	B	A		A	A	A	A	B	B	A	A	A	A	A
Potassium Sulfide		A	A	A						A	A	B	B	A							A	A	A	A	B	B	A	A	A		A
Propane (liquefied)	A	B	C	A			A	A		A	A	A	A		A		A	B	A		A	A	B	A	D	B	D	A	D		A
Propylene Glycol	C	A	C	A	B	A		B		A	B	B		A	A	A	B	B	A		A	A	C	A						A	
Pyridine	A	A	B	D		D	C	A	A	A	A	A	B	B	D	A	B	B	A		D	D	D	A	D	D	B	A	D	A	A
Pyrogallic Acid	A	A		A				D		A	B	B			B		B	B	A		A			A				A		A	A
Rosins	A	A	B	C			A	B			A	A	B		B		B		A			A		A				A		A	A
Rum	A	A		A		A	A	A			A	A							A		A	A	A	A						A	
Rust Inhibitors	A	A				B		A			A	A			B	C			A		A	A	C	A						A	
Salad Dressings	A	A					A	A			A	A			B	D	B		A		A	A		A						A	
Sea Water	A	A	A	A		A	A	A	A	A	A	C	C	A	A		B	A	A	C	A	A	A	A	A	A	A	A	A	A	A
Shellac (Bleached)	A	A	A				A	A			A	A	A		A	A	A					A	D	A						A	A
Shellac (Orange)	A	A	A				A	A			A	A	A		A	A	A					A	D	A						A	A
Silicone	A	A		A		D	A	A	A		A	A	B		A	A	A		A		A	A	A	A	A	A	A		C	A	A
Silver Bromide	A							C			A	A	D	D				D	A									A			
Silver Nitrate	A	A	B	A		A	A	A	A		A	B	B	B	A	D	D	D	A		A	B	A	B	A	A	A	A	A	A	A
Soap Solutions	A	A	C	A		A	A	A	A	A	A	A	A	A	C	A	C	A	A	A	A	A	A	A	B	A	A		A	A	A
Soda Ash (see Sodium Carbonate)											A								A											A	A
Sodium Acetate	A	A	B	B			B	B	A	A	B	B	B	A	A		B	A	A		D	B	B	B	A	D	A	A	D	A	A
Sodium Aluminate	A						A	B	A	A	A	A		A	B			B	A		A	A	A	A	B		A			A	A
Sodium Bicarbonate	A	A	A	A	B	A	A	A	A	A	B	A	B	A	A	C	D	B	A	A	A	B	B	B	A	D	A	A	D	A	A
Sodium Bisulfate	A	A	A	A	C	A	B	B	A	A	B	D	D	A	C	D	D	B	A		A	B	C	B	A		A	A		A	A
Sodium Bisulfite	A	A	A	A	B	D	C		A	A	B	B	C	A	C	D	D	B	A		A	A	A	A	A	A	A		A	A	A
Sodium Borate	A	A	A	A			A		A	A	B	C	A	A	A		C	A			A	A	A	A	A	A	A	A		A	A
Sodium Carbonate	C	A	B	A	C	A	B	A	A	A	B	B	B	A	B	A	D	A	B		A	A	A	A	A	A	A	A	D	A	A
Sodium Chlorate	A	A	B	A			D	A	A	A	B	B	B	A	B		C	B	A		A	C	A	C	A		A			A	C
Sodium Chloride	A	A	A	A	B	A	A	A	A	A	C	B	B	C	A	C	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Chromate	C					D	D	A	A	A	B	B	B	A	A	A	A	B	A		A	A	A	A			A	A		B	A
Sodium Cyanide	A	A	A	A		A	A	A	A	A	A	B	A	A	D	A	A	A	A		A	A	A	A	A	A	A	A	A	A	A
Sodium Ferrocyanide		A	A	A				A		A								A			A									A	A
Sodium Fluoride	A	A	A	A			B			A	D	D	C	A	C		B	A			A	A	D	A	D		A				A
Sodium Hydrosulfite				C			A			A					C		A	A			A		A		A				A		
Sodium Hydroxide (20%)	A	A	A	A	C	C	A	A	A	A	A	B	B	A	D	A	D	B	C	A	B	B	B	B	A	A	A	A	B	D	A
Sodium Hydroxide (50%)	B	A	A	A	C	D	A	C	A	A	B	B	B	B	D	A	D	B	C	C	B	B	B	B	A	A	A	A	C	D	A
Sodium Hydroxide (80%)	A	A	B	A	C	D	C	D	A	A	C	B	B	D	D	C	D	A	C	C	B	B	B	B	A	A	A	A	C	A	A
Sodium Hypochlorite (<20%)	C	B	A	A		D	D	D	A	A	C	C	D	C	D	D	D	A	D	B	A	B	B	B	C	B	B	A	B	A	B
Sodium Hypochlorite (100%)	D	B	B	C		D	D	D	A	A	D	D	D	C	D	D	D	B	B		A	B	B	B	C	B	B	A	B	D	C
Sodium Hyposulfate	C									A	A	A			D		D		C				C		C						
Sodium Metaphosphate	A	A	A	B		A	A	B		A	A	A	B		C	D	C		A		A	A	B	A	A	B	A			A	A
Sodium Metasilicate	A	A		A				D		A	A	A	A		B		D	A	A		A	A	A	A			A				
Sodium Nitrate	A	A	A	A		A	A	A	A	A	B	B	B	A	C	A	B	B	A	A	A	B	B	B	B	A	A	A	D	A	C
Sodium Perborate	B	A	A	A		A	B	B		A	B	B	B		D	C	C	B	A		A	B	B	B	B	B	A	A	B	A	C
Sodium Peroxide	C	B	A	B		D	A	D		A	A	A	B		D	C	D	B	A		A	B	B	B	B	B	A	A	D	A	A
Sodium Polyphosphate	A	A	A	A		A	A	B		A	B	B	B	A	C	D	D	A	A		A	A	B	A	A	A	A	A	D	A	A
Sodium Silicate	A	A	A	A		A	A	C	A	A	A	B	B	A	A	A	D	B	A		A	A	A	A	A	A	A	A		A	A
Sodium Sulfate	A	A	A	A		A	A	B	A	A	B	B	D	A	C	A	A	B	A		A	A	A	A	B	A	A	A	A	A	A
Sodium Sulfide	A	A	A	A		D	A	B	A	A	B	D	D	A	D	A	D	B	A		A	A	A	A	B	A	A	A	A	A	A
Sodium Sulfite	A	A	B	A		A	D			A	B	A	C	A	C	A	C	B	A		A	A	A	A	B	A	A	A	A	A	A
Sodium Tetraborate	A		A	A			A	B		A	A	A	C				C		A		A	A		A						A	A
Sodium Thiosulfate (hypo)	A	A	A	A		A	B	C	A	A	A	B	C	A	D	C	A	A	A		A	B	A	B	B	A	A	A	A	A	A
Sorghum	A					D	A	A			A	A			D	A			A		A	A	A	B					A		
Soy Sauce	A					D	A	A			A	A			A	D	A		A		A	A	A	A	D				A		
Stannic Chloride	A	A	A	A			B	C	A	A	D	D	D	A	D	D	D	B			A	A	D	A	A	D	B	A	B	A	A
Stannic Fluoborate	A					A		C			A				D	D					A	A	A	A						A	
Stannous Chloride	A	A	B	A			C		A	A	A	C	C	A	D		D	B			A	A	A	A	A	A	A	A	B		
Starch	A	A	B	A		A	A	A		A	A	A			A	C	A		A		A	C	A	C			A	A		A	A
Stearic Acid	B	A	B	B		D	A	A	A	A	A	B	B	A	C	C	B	B	A	A	A	B	B	B	B	B	B		B	A	A
Stoddard Solvent	A	C	C	C		D	A	A		A	A	A		A	A	A	A	A	A		A	A	C	C	D	D	D	A	D	A	A
Styrene	A			D		D	A	A		A	A	A			A		A	D	A		B	D	D	D	D	D	D		D	A	A
Sugar (Liquids)	A	A					A	A		A	A	A	A		A		A	A	A	A	A	D	B	A	A	B	A		A	A	A
Sulfate (Liquors)	A	A	A	B		D	B	A	D	A	B	D	A		D	D	D	B	A		A	A	A	A			A			A	A

***Delrin, Hypalon, Teflon, Viton** - Reg TM E. I. Du Pont de Nemours & Co.
***Chemraz-** Reg TM Green, Tweed & Co., Inc.
***Ryton** - Reg TM Phillips Petroleum Co.
***Cycolac** - Reg TM Borg-Warner Corp.
***Aflas** - Reg TM Asahi Glass Co., Ltd. (This chart is available upon request)

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Exposure Rating Guide:

A	Good
B	Fair
C	Questionable
D	Poor
Blank	Insufficient Data

	Epoxy	Polypropylene	Polyethylene	PVC	Cycolac* (ABS)	Phenolic	Nylon	Delrin* (Acetal)	Ryton* to 200°F	Teflon*	Stainless steel (316)	Stainless steel (304)	Stainless steel (440)	Titanium	Cast bronze	Cast iron	Aluminum	Hastelloy C	Carbon/ceramic	Cermagnet A	Viton*	Buna N	Neoprene	Nitrile	Natural rubber	Hypalon*	EPDM	Chemraz*	Silicone	Ceramic	Carbon/graphite
Sulfur Chloride	C	C	C	C			A	D		A	D	D	D	D	D		D	B	C		A	D	D	D	D	D	D	A	A	C	D
Sulfur Dioxide	A	A	B	A	D		C	B	A	A	A	D	D	A	B		B	B	A		A	D	B	D	B	C	A	A	A	B	A
Sulfur Dioxide (Dry)	A	A	A	A		A	B	B	A	A	A	D	D	A	A	A	B	B	C		A	D	D	D	C	D	A	A	A	A	A
Sulfur Hexaflouride			B	B			B	D											A		C	B	D	B	D	C	A				A
Sulfur Trioxide	A	C		A			D			A	C	A			A		A		A		A	D	D	D	C	B	B		B		B
Sulfur Trioxide (Dry)	A	D	C	A			A	D		A	A	D	D	D	B		A	B	B		A	D	D	D	B	D	B		A	A	D
Sulfuric Acid (<10%)	A	A	A	A		D	C	D	A	A	B	D	C	D	D	D	D	B	A		A	D	B	D	C	C	B	A	D	A	A
Sulfuric Acid (10-75%)	A	A	A	A	B	D	D	D	A	A	D	D	D	D	D	D	D	B	A	C	A	D	C	D	D	C	D	A	D	D	A
Sulfuric Acid (75-100%)	C	C	B	D	B	D	D		A	A	D	C	D	D	D	D	D	B			A	D	D	D	D	C	D	A	D	A	C
Sulfuric Acid (Hot Conc)	D	D	D	D		D	D		D	A	C	D	B	D	D	D	D	D			A	D	D	D	C	B	B		A	C	D
Sulfuric Acid (Cold Conc)	D	A	C	D		D	D	C	A	A	B	C	C	D	D	D	B	A	D		A	D	D	D	D	B	B	A	D		D
Sulfurous Acid	A	A	B	A			D	A	A	A	B	B	B	A	D	D	B	B	B		A	B	B	B	D	A	B	A	D	A	A
Sulfuryl Chloride	A									A																				A	
Tallow	A	A	C				A	C	A	A	A	A	A	A			A		A		A	A		A			A		A	A	A
Tannic Acid	A	A	B	A			C	B	A	A	A	B	B	A	A	C	C	B	A	A	A	A	B	A	A	B	A	A	B	A	A
Tanning Liquors	A	A	A	A		C	A	B	B	A	A	A	A		A		A	B	A		A	A	A	A			B			A	A
Tartaric Acid	A	A	A	A		A	B	B	A	A	C	C	C	A	A	C	B	B	A		A	A	A	B	A	A	B	A	A	A	A
Tetrachloroethane	A	C		C			C	A		A	A	B		A			C	A	A		A	D			D				A	A	A
Tetrachloroethylene		D	B	D			A	A		A	A			A							A	D	D	D	D	D	D		A		A
Tetrahydrofuran	A	C	C	D			A	A	A	A	A	A	B		D			A	A		D	D	D	D	D	D	B	A		A	A
Tin Salts		A		A						A	D			A			D	C					A			B		B			
Toluene (Toluol)	B	C	C	D	D	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	D	D	A	D	D	D	B	D	A	A
Tomato Juice	A	A	A	A	B		A	B	A	A	A	A	C	A	C		A	A	A			A	A					A		A	A
Trichloroacetic Acid	D	A	A	B			C		A	A	C	D	D	D			D	B	A		C			B			B	A	D	A	A
Trichloroethane	A	C		C		D	C	A		A	A	B		A	A	A	C	A	A		A	D	D	D	D	D	D	A	D	A	A
Trichloroethylene	C	C	C	D	D	A	C	B	A	A	B	B	B	A	A	C	A	B	A	C	A	C	D	C	D	D	D	A	D	A	A
Trichloropropane	A				D	D		A		A	A	A	A		A	A		A	A		A	A	A	A			A			A	
Tricresylphosphate	A	A	B	D			A	C		A	A	B		B	A		D	A	A		B	D	D	D	D	D	A		C	A	A
Triethylamine	A	D		A			A	D		A	A				A	A			A		A	D	B	A			A	A		A	A
Trisodium Phosphate	A	A	A	A			A	A	A	A	B	A	B		C		D	A			A		A				A		A		A
Turpentine	B	B	C	B			A	A	A	A	A	A	B	B	C		A	B	A		A	A	D	A	D	D	D	A	D	A	A
Urea		A	A	D			A	A	A	A	A	A	B	A			B	B						B			A		B	A	A
Uric Acid			B	A			A			A	B	A	A				D	B					A							A	A
Urine	A	A	A	A		A	A	A		A	A	A	A		C	A	B		A		A	A	D	A			A	A		A	A
Varnish	A	A	C	D		A	C	A		A	A	A	A		A	C	A		A	A	A	B	D	B	D	D	D	A	D	A	A
Vegetable Juice	A					A	A	A			C	A			C	D	A		A		A	C	C	D				A			
Vinegar	A	A	B	A	B		A	B	A	A	A	A	A	A	C	C	B	A	A	A	A	B	B	B	B	A	A	A	A	A	A
Water, Acid, Mine	A	A	A	A	B		C	B	A	A	A	A	C	A	C	C	C	B	A	A	A	D	C	A	A		A	A	B	A	A
Water, Distilled	A	A	A	A	A	A	A	A	A	A	A	A	A	A	D	D	A	A	A	A	A	A	A	A	A		A	A		A	A
Water, Fresh	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	D	A	A		A	A	B	A	A
Water, Salt	A	A	A	A		A	A	A	A	A	B	B	C	A	D	A	B	A	A	A	A	A	A	A	A		A	A		A	A
Weed Killers	A						A	A			A	A			C		C		A		A	A	C	A	A					A	
Whey	A							A			A	A					B		A		A	A		A	A					A	
Whiskey & Wines	B	A	C	A		A	A	A		A	A	A	C	A	C	D	C		A	A	A	A	A	A	A	A	A	A	A		A
White Liquor (Pulp Mill)	A	A	A	A		A	A	D		A	A	B			D	C		A	A		A	A	A	A						A	A
White Water (Paper Mill)	A	A		A		A	A	B			A	A			A	A			A		A		A		D	D			A		
Xylene	A	C	C	D	D	A	A	A	A	A	A	D	A	A	A	A	A	A	A	A	A	D	A	D	A	D	D	A	D	A	A
Zinc Chloride	A	A	A	A		A	C	C	A	A	D	A	D	A	D	D	D	B	A		A	A	A	A	D	A	A	A		A	A
Zinc Hydrosulfite	A					A	A	C	A			A			D	D	D		A		A	D	A	A	A		A			A	
Zinc Sulfate	A	A	A	A		A	C	C	A	A	B	B	C	A	C	C	D	B	A		A	A	A	A	B	A	A	A	A	A	A

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Decimal Equivalents

DRILL SIZE	mm	DECIMAL INCHES	DRILL SIZE	mm	DECIMAL INCHES	DRILL SIZE	mm	DECIMAL INCHES	DRILL SIZE	mm	DECIMAL INCHES
-	0.10	.0039	45	2.08	.0820	5	5.22	.2055	7/16	11.11	.4375
-	0.20	.0079	44	2.18	.0860	4	5.31	.2090	29/64	11.51	.4531
-	0.25	.0098	43	2.26	.0890	3	5.41	.2130	15/32	11.91	.4688
-	0.30	.0118	42	2.37	.0935	7/32	5.56	.2188	-	12.00	.4724
80	0.34	.0135	3/32	2.38	.0938	2	5.61	.2210	31/64	12.30	.4844
79	0.37	.0145	41	2.44	.0960	1	5.79	.2280	1/2	12.70	.5000
1/64	0.40	.0156	40	2.50	.0980	A	5.94	.2340	-	13.00	.5118
78	0.41	.0160	39	2.53	.0995	15/64	5.95	.2344	33/64	13.10	.5156
77	0.46	.0180	38	2.58	.1015	-	6.00	.2362	17/32	13.49	.5312
-	0.50	.0197	37	2.64	.1040	B	6.05	.2380	35/64	13.89	.5469
76	0.51	.0200	36	2.71	.1065	C	6.15	.2420	-	14.00	.5512
75	0.53	.0210	7/64	2.78	.1094	D	6.25	.2460	9/16	14.29	.5625
74	0.57	.0225	35	2.79	.1100	1/4	6.35	.2500	37/64	14.68	.5781
-	0.60	.0236	34	2.82	.1110	E	6.35	.2500	-	15.00	.5906
73	0.61	.0240	33	2.87	.1130	F	6.53	.2570	19/32	15.08	.5938
72	0.64	.0250	32	2.95	.1160	G	6.63	.2610	39/64	15.48	.6094
71	0.66	.0260	-	3.00	.1181	17/64	6.75	.2656	5/8	15.88	.6250
-	0.70	.0276	31	3.05	.1200	H	6.76	.2660	-	16.00	.6299
70	0.71	.0280	1/8	3.18	.1250	I	6.91	.2720	41/64	16.27	.6406
69	0.74	.0292	30	3.26	.1285	-	7.00	.2756	21/32	16.67	.6562
-	0.75	.0295	29	3.45	.1360	J	7.04	.2770	-	17.00	.6693
68	0.79	.0310	28	3.57	.1405	K	7.14	.2810	43/64	17.07	.6719
1/32	0.79	.0313	9/64	3.57	.1406	9/32	7.14	.2812	11/16	17.46	.6875
-	0.80	.0315	27	3.66	.1440	L	7.37	.2900	45/64	17.86	.7031
67	0.81	.0320	26	3.73	.1470	M	7.49	.2950	-	18.00	.7087
66	0.84	.0330	25	3.80	.1495	19/64	7.54	.2969	23/32	18.26	.7188
65	0.89	.0350	24	3.86	.1520	N	7.67	.3020	47/64	18.65	.7344
-	0.90	.0354	23	3.91	.1540	5/16	7.94	.3125	-	19.00	.7480
64	0.91	.0360	5/32	3.97	.1562	-	8.00	.3150	3/4	19.05	.7500
63	0.94	.0370	22	3.99	.1570	O	8.03	.3160	49/64	19.45	.7656
62	0.97	.0380	-	4.00	.1575	P	8.20	.3230	25/32	19.84	.7812
61	0.99	.0390	21	4.04	.1590	21/64	8.33	.3281	-	20.00	.7874
-	1.00	.0394	20	4.09	.1610	Q	8.43	.3320	51/64	20.24	.7969
60	1.02	.0400	19	4.22	.1660	R	8.61	.3390	13/16	20.64	.8125
59	1.04	.0410	18	4.31	.1695	11/32	8.73	.3438	-	21.00	.8268
58	1.07	.0420	11/64	4.37	.1719	S	8.84	.3480	53/64	21.03	.8281
57	1.09	.0430	17	4.39	.1730	-	9.00	.3543	27/32	21.43	.8438
56	1.18	.0465	16	4.50	.1770	T	9.09	.3580	55/64	21.84	.8594
3/64	1.19	.0469	15	4.57	.1800	23/64	9.13	.3594	-	22.00	.8661
55	1.34	.0520	14	4.62	.1820	U	9.35	.3680	7/8	22.23	.8750
54	1.40	.0550	13	4.70	.1850	3/8	9.53	.3750	57/64	22.62	.8906
53	1.51	.0595	3/16	4.76	.1875	V	9.56	.3770	-	23.00	.9055
1/16	1.59	.0625	12	4.80	.1890	W	9.80	.3860	29/32	23.02	.9062
52	1.61	.0635	11	4.85	.1910	25/64	9.92	.3906	59/64	23.42	.9219
51	1.70	.0670	10	4.91	.1935	-	10.00	.3937	15/16	23.81	.9375
50	1.78	.0700	9	4.98	.1960	X	10.08	.3970	-	24.00	.9449
49	1.85	.0730	-	5.00	.1968	Y	10.26	.4040	61/64	24.21	.9531
48	1.93	.0760	8	5.05	.1990	13/32	10.32	.4062	31/32	24.61	.9688
5/64	1.98	.0781	7	5.11	.2010	Z	10.49	.4130	-	25.00	.9842
47	1.99	.0785	13/64	5.16	.2031	27/64	10.72	.4219	63/64	25.00	.9844
-	2.00	.0787	6	5.18	.2010	-	11.00	.4331	1"	25.40	1.0000
46	2.06	.0810									

Temperature

°F = (1.8 x °C) + 32
°C = 0.555 (°F-32)
°K = °C + 273.2

Fahrenheit	Celsius	Rankine	Kelvin
602	316.7	1061.7	589.9
572	300.0	1031.7	573.2
542	283.3	1001.7	556.5
512	266.7	971.7	539.9
482	250.0	941.7	523.2
452	233.3	911.7	506.5
422	216.7	881.7	489.9
392	200.0	851.7	473.2
362	183.3	821.7	456.5
332	166.7	791.7	439.9
302	150.0	761.7	423.2
272	133.3	731.7	406.5
242	116.7	701.7	389.9
212	100.0	671.7	373.2
182	83.3	641.7	356.5
152	66.7	611.7	339.9
122	50.0	581.7	323.2
92	33.3	551.7	306.5
62	16.7	521.7	289.9
32	0.0	491.7	273.2
2	-16.7	461.7	256.5
-28	-33.3	431.7	239.9
-58	-50.0	401.7	223.2
-88	-66.7	371.7	206.5
-118	-8303	341.7	189.9
-148	-100.0	311.7	173.2
-178	-116.7	281.7	156.5
-208	-133.3	251.7	139.9
-238	-150.0	221.7	123.2
-268	-166.7	191.7	106.5
-298	-183.3	161.7	89.9
-328	-200.0	131.7	73.2
-358	-216.7	101.7	56.5
-388	-233.3	71.7	39.9
-418	-250.0	41.7	23.2
-459.7	-273.2	0.0	0.0

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TAP DRILL SIZES

TAP SIZE	DRILL SIZE	PROBABLE % THREAD	TAP SIZE	DRILL SIZE	PROBABLE % THREAD	TAP SIZE	DRILL SIZE	PROBABLE % THREAD
0-80	3/64	71-81	10-32	21	68-76	5/8-18	37/64	58-65
M1.6 X .35	1.25mm	69-77	M5 X .8	4.2mm	69-77	M16 X 2	35/64	76-81
1-64	53	59-67	12-24	16	66-72	3/4-10	21/32	68-72
M2 X .4	1/16	72-79	12-28	15	70-78	3/4-16	11/16	71-77
1-72	53	67-75	M6 X 1	10	76-84	M20 X 2.5	11/16*	74-78
2-56	50	62-69	1/4-20	7	70-75	7/8-9	49/64	72-76
2-64	50	70-79	1/4-28	3	72-80	7/8-14	13/16	62-67
M2.5 X .45	2.05mm	69-77	5/16-18	F	72-77	M24 X 3	53/64	72-76
3-48	5/64	70-77	5/16-24	1	67-75	1-8	7/8	73-77
3-56	46	69-78	M8 X 1.25	6.7mm	74-80	1-12	59/64	67-72
4-40	43	65-71	3/8-16	5/16	72-77	1-14	15/16	61-67
4-48	42	61-68	3/8-24	Q	71-79	1-1/8-7	63/64	72-76
M3 X .5	40	70-79	M10 X 1.5	8.4mm	76-82	1-1/8-12	1-3/34	66-72
5-40	38	65-72	7/16-14	U	70-75	M30 X 3.5	1-3/64*	75
5-44	37	63-71	7/16-20	25/64	65-72	1-1/4-7	1-7/64*	76
M3.5 X 6	33	72-81	M12 X 1.75	13/32	69-74	1-1/4-12	1-11/64*	72
6-32	36	71-78	1/2-13	27/64	73-78	1-3/8-6	1-7/32*	72
6-40	33	69-77	1/2-20	29/34	65-72	1-3/8-12	1-16/64*	72
M4 X .7	3.25mm	74-82	M14 X 2	15/32	76-81	M36 X 4	1-1/4*	82
8-32	29	62-69	9/16-12	31/64	68-72	1-1/2-6	1-11/32*	72
8-36	29	70-78	9/16-18	33/64	58-65	1-1/2-12	1-27/64	72
10-24	25	69-75	5/8-11	17/3	75-79			

PIPE TAP DRILL SIZES

TAP SIZE	TAPER PIPE NPT & NPTF	DECIMAL EQUIVALENT	STRAIGHT PIPE NPS	DECIMAL EQUIVALENT
1/8-27	R	.3390	11/32	.3438
1/4-18	7-16	.4375	29/64	.4531
3/8-18	37/64	.5781	37/64	.5781
1/2-14	45/64	.7031	23/32	.7188
3/4-14	59/64	.9219	59/64	.9219
1 - 11-1/2	1-5/32	1.1562	1-5/32	1.1562
1-1/4 - 11-1/2	1-1/2	1.5000	1-1/2	1.5000
1-1/2 - 11-1/2	1-47/64	1.7344	1-3/4	1.7500
2 - 11-1/2	2-7/32	2.2188	2-7/32	2.2188
2-1/8 - 8	2-41/64	2.6406	2-21/32	2.6562
3 - 8	3-17/64	3.2656	-	-

METRIC TO STANDARD CONVERSIONS

Millimeters (mm) x 0.03937	=	inches (") (in)
Centimeters (cm) x 0.3937	=	inches (") (in)
Meters (m) x 39.37	=	inches (") (in)
Meters (m) x 3.281	=	feet (') (ft)
Meters (m) x 1.094	=	yards (yds)
Kilometers (km) x 0.62137	=	miles (mi)
Kilometers (km) x 3280.87	=	feet (') (ft)
Liters (l) x 0.2642	=	gallons (U.S.) (gals)
Liters (l) x 0.0353	=	cubic feet
Bars x 14.5038	=	pounds per square inch (PSI)
Kilograms (kg) x 2.205	=	pounds (P)
Kilometers (km) x 1093.62	=	yards (yds)
Square centimeters x 0.155	=	square inches
Square meters x 10.76	=	square feet
Square kilometers x 0.386	=	square miles
Cubic centimeters x 0.06102	=	cubic inches
Cubic meters x 35.315	=	cubic feet

Density

	slug / ft ^{3}	Kilogram / Meters ^{3}	g / cm ^{3}	lb / ft ^{3}	lb / in. ^{3}
1 slug per ft ^{3} =	1	515.4	.5154	32.17	1.862×10^{-2}
1 Kilogram per Meter ^{3} =	1.940×10^{-3}	1	0.001	6.243×10^{-2}	3.613×10^{-5}
1 gram per cm ^{3} =	1.940	1000	1	62.43	3.613×10^{-2}
1 pound per ft ^{3} =	3.108×10^{-2}	16.02	1.602×10^{-2}	1	5.787×10^{-4}
1 pound per in. ^{3} =	53.71	2.768×10^{4}	27.68	1728	1

Force

Quantities in the shaded areas are not force units but are often used as such. For instance, if we write 1 gram-force "=" 980.7 dynes, we mean that a gram-mass experiences a force of 980.7 dynes under standard conditions of gravity (g = 9.80667 m/s^2)

	dyne	NEWTON	lb	pdl	gf	kgf
1 dyne =	1	10^{-5}	2.248×10^{-6}	7.233×10^{-5}	**1.020×10^{-3}**	**1.020×10^{-6}**
1 NEWTON =	10	1	0.2248	7.233	**102.0**	**0.1020**
1 pound =	4.448×10^{5}	4.448	1	32.17	**453.6**	**0.4536**
1 poundal =	1.383×10^{4}	0.1383	3.108×10^{-2}	1	**14.10**	**1.410×10^{-2}**
1 gram-force =	**980.7**	**9.807×10^{-3}**	**2.205×10^{-3}**	**7.093×10^{-2}**	1	0.001
1 kilogram-force =	**9.807×10^{5}**	**9.807**	**2.205**	**70.93**	1000	1

Pressure

	atm	dyne / cm ^{2}	inch of water	cm Hg	PASCAL	lb / in. ^{2}	lb / ft ^{2}
1 atmosphere =	1	1.013×10^{6}	406.8	76	1.013×10^{5}	14.70	2116
1 dyne per cm ^{2} =	9.869×10^{-7}	1	4.015×10^{-4}	7.501×10^{-5}	0.1	1.405×10^{-5}	2.089×10^{-3}
1 inch of water [a] at 4°C =	2.458×10^{-3}	2491	1	0.1868	249.1	3.613×10^{-2}	5.202
1 centimeter of mercury at 0°C =	1.316×10^{-2}	1.333×10^{4}	5.353	1	1333	0.1934	27.85
1 PASCAL =	9.869×10^{-6}	10	4.015×10^{-3}	7.501×10^{-4}	1	1.450×10^{-4}	2.089×10^{-2}
1 pound per in. ^{2} =	6.805×10^{-2}	6.895×10^{4}	27.68	5.171	6.895×10^{3}	1	144
1 pound per ft ^{2} =	4.725×10^{-4}	478.8	0.1922	3.591×10^{-2}	47.88	6.944×10^{-3}	1

[a] Where the acceleration of gravity has the standard value 9.80665 m/s^2.
1 bar = 10^6 dyne / cm^2 = 0.1 MPa 1 millibar = 10^3 dyne / cm^2 = 10^2 Pa 1 Torr = 1 millimeter of mercury

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Bubbletight Sealing - Air leakage between the internal sealed ports of a valve in either the energized or de-energized position is undetectable in a 5 second soap bubble test.

Current Drain - The amount of current (expressed in amperes) that flows through the coil of a solenoid valve when it is energized.

Continuous Duty - A rating given to a valve that can be energized continuously without overheating.

Cv Factor - The Cv factor of a valve is the quantity of 60°F water, expressed in gallons per minute, which will flow through a valve with a one psi pressure drop. Spartan Cv factors for solenoid valves are listed for each series in the catalog.

Cycle - The normal opening of a closed valve and then closing is one complete cycle.

Cycle Rate - The number of times a valve can open and close in a given time frame.

Dead-End Gas Service - A condition in which a valve is energized but has no cooling fluid flowing through it because of a dead-end line (a cylinder pressurized for a long period).

Drip-Proof - See NEMA classifications.

Dust-Tight - See NEMA classifications.

Duty Cycle - The longest time that a valve is energized, followed by the shortest time that it is de-energized. Expressed in percent =

$$\frac{\text{ON}}{\text{ON + OFF}} \times 100$$

Explosion-Proof Construction - A solenoid valve constructed to meet the specifications of Underwriter's Laboratories, Inc. for operation in hazardous locations. See NEMA classifications also.

Flow - The movement of fluid created by a pressure differential.

Flow Capacity - The amount of fluid a valve will pass under given temperature and pressure conditions in gallons per minute or cubic feet per minute as measured at the outlet port. Cv is a measure of flow capacity.

Flow-Rate - The amount of fluid that passes a given point at a given period of time.

Floating Bottom or Top Seal - A plunger assembly construction in 2-way and 3-way valves in which the seal is movable against a spring within the plunger.

Flux Plate - A magnetic steel plate used in the magnetic circuit of a solenoid valve to help carry magnetic flux from the enclosure to the sleeve assembly. A flux plate is required on valves with non-metallic body material.

General Purpose Valve - Valves suitable for application indoors under normal atmospheric conditions. See NEMA classifications.

Intermittent Duty Coil - A valve coil not designed for continuous duty but which will perform satisfactory for a specified duty cycle.

Heat Rise - The difference between the stabilized temperature of the solenoid coil when energized and de-energized in a constant ambient temperature. As current flows through a coil, heat is generated. The coil temperature rises until the coil enclosure dissipates heat as fast as it is generated, and the temperature stays at a stabilized level.

Insert - A material used in the plunger assembly to seal an orifice.

Insert Materials

Buna-N - A soft synthetic rubber which has excellent compatibility characteristics for most air, water and light oil applications up to the 180°F - 200°F range.

Ethylene Propylene (EPDM) - A soft synthetic rubber which is suitable for water above 180°F and steam under 50 psi. EPDM has a wide range of fluid compatibilities but cannot be used with petroleum based fluids or fluids so contaminated (such as lubricated air).

Kel-F®** - A combination of carbon and halogens which yields a colorless material that is exceptionally stable, temperature resistant, chemically inert, and a true thermo plastic. The Kel-F®** plastic is an extremely versatile material and is impervious to the action of corrosive chemicals and highly resistant to most organic solvents.

Nitrile - See Buna-N.

Teflon®* - A synthetic material used for many semi-corrosive and corrosive media. It is virtually indestructible by any fluid, and its temperature resistance makes it especially suitable for steam application. Teflon®* has excellent lubricating characteristics. It is not recommended for vacuum service.

Viton®* - A soft fluorocarbon insert material, developed primarily for handling hydrocarbons and high temperatures. Viton®* is the standard seal material in most Spartan Scientific general purpose direct poppet 2-way and directional 3-way valves.

Leakage, External - The leakage between the internal part of the valve and the external part of the valve. Spartan valves are bubbletight.

Leakage, Internal - The leakage between the internal sealed ports of a valve in either the energized or de-energized position. Leakage rate is normally described in cc (cubic centimeters) per minute or as bubbletight.

Manual Override - A mechanical device that permits manual opening of normally closed valves or closing of normally open valves.

Metering - A mechanical device that permits manual adjustment of fluid flow through a valve. Speed control.

Glossary

NEMA CLASSIFICATIONS (Solenoid Enclosures)

***Type 1*: General Purpose** - Enclosures are intended for indoor use, primarily to prevent accidental contact of personnel with the enclosed equipment in areas where unusual service conditions do not exist.

***Type 2*: Drip-Proof** - Enclosures are intended for indoor use to protect the enclosed equipment against falling non-corrosive liquids and falling dirt.

***Type 3R*: Rainproof and Sleet Resistant (Ice Resistant)** - Enclosures are intended for outdoor use to protect the enclosed equipment against rain, sleet and external ice formation.

***Type 4*: Watertight and Dust-Tight** - Enclosures are intended for indoor or outdoor use to protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water and severe external condensation.

***Type 4X*: Watertight, Dust-Tight and Corrosion-Resistant** - Enclosures have the same provisions as Type 4 enclosures and are corrosion-resistant.

***Type 6*: Submersible** - Enclosure protected against entry of water during occasional temporary submersion at a limited depth.

***Type 7*: Explosion-Proof** - Designed to be used in hazardous atmospheres classified as Class I, Groups A, B, C or D, as defined by NEC (National Electric Code). The explosion-proof enclosure must be able to withstand an internal explosion and prevent the ignition of atmospheric gases which may be caused by the shorts or sparks occurring within the enclosure. Additionally, the external enclosure temperature must be low enough as to not ignite a surrounding flammable atmosphere.

***Type 9*: Class II, Division I, Group E, F or G** - Enclosures are intended for indoor use in the atmospheres and locations as defined as Class II, Division I or Division II, and Group E, F or G in the NEC to prevent the entrance of explosive amounts of hazardous dust. If gaskets are used, they must be of non-combustible, non-deteriorating, vermin proof material.

***Type 12*: Industrial Use - Dust-Tight and Drip-Tight** - Enclosures are intended for indoor use to protect enclosed equipment against fibers, filings, lint, dust and dirt; and light splashing, seepage, dripping and external condensation of non-corrosive liquids.

Port - An opening or passageway for the inlet or outlet of a fluid in a valve. The terminus of the port is threaded (NPT) to accommodate a line connection. A port designated with an NPTF indicates dry seal threads.

Port, Cylinder - A port which provides a passage to or from an actuator.

Port, Exhaust - A port which provides a passage to the atmosphere.

Port, In - A port which provides a passage from the source of fluid.

Port, Out - A port where the fluid leaves a two-way valve.

Port, Normally Closed - A port that is closed to fluid flow when the valve is de-energized.

Port, Normally Open - A port that is open to fluid flow when the valve is energized.

Power Consumption - The number of watts a solenoid valve draws when energized.

Pressure - Force per unit area. Pressure is induced into a system by means of a pump, compressor or by gravity. Pressure may be expressed as pounds per square inch absolute (PSIA) or as pounds per square inch gauge (PSIG). PSIG is most often used for valve ratings and is 14.7 psi greater than absolute pressure, when measured at sea level.

Burst Pressure - The maximum pressure that would not cause the weakest section of the valve to fail and cause external leakage when pressure is reduced back to rated pressure. Depends on the individual valve construction. For most valves it is at least 5 times rated pressure.

Pressure, Differential (Drop) - The difference in pressure measured between two given points. (P_1 - P_2).

Maximum Operating Pressure Differential (MOPD) - The maximum difference in pounds per square inch between the pressure at an inlet port and the pressure at an outlet port at which a solenoid valve will operate.

Minimum Operating Pressure Differential - The minimum difference in pounds per square inch between the pressure at an inlet port and the pressure at an outlet port required for proper operation of the solenoid valve. The minimum operating pressure must be maintained throughout the operating cycle of pilot-operated valves to ensure proper shifting from the closed position to the open position or vice versa.
Note: 2-way and 3-way pilot-operated valves will start to move to their normal positions when the pressure falls below the minimum operating pressure. Direct acting valves do not require a minimum pressure to operate.

Proof Pressure - The maximum pressure the valve may be exposed to without suffering any damage. It does not have to be capable of operating at this pressure. For most valves it is at least 1-1/2 times the rated pressure. (This is a non-destructive test).

Response Time - The length of time required for an operating mechanism of a valve to move from the fully closed to the open position, or vice versa. Response time will vary according to pressure, fluid, voltage and system. It also varies with type of valve (direct operated or pilot operated). For specific valves, consult factory with complete application details.

Spring-Loaded - The term used to indicate that the valve has a plunger return spring. A spring-loaded plunger permits the valve to be mounted in any position without causing malfunction.

Temperature Range - Spartan Scientific valves are equipped with high quality coils suitable for continuous energization. The permissible coil temperature, as measured by the change in resistance method, is 155°C for Class F and 180°C for Class H.

Vibration and Shock - Most valves will resist 10 G's or more.

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