



**The Guiding Light to
Pneumatic Machine
Safeguarding**



**Complete Your System with
ROSS CONTROLS[®] Safety-Related Products**

Where Does Your Safety System End?

A Complete Safety System should always include all of the components (both electrical and mechanical) – not just the electrical

SAFETY INFORMATION AND TRAINING

Fluid Power Safety for Machine Guarding Book (order A10264)



- Over 50 pages of information providing an overview of topics related to the safe application of fluid power in industrial applications
- Topics include Control Integrity, Control Categories, LOTO, Alternative LOTO, Risk Assessment, Risk Assessment as Related to Fluid Power, Clutch/Brake Controls for Mechanical Stamping Presses, Understanding the Function of Counterbalance on Mechanical Stamping Presses, and FAQ's

Fluid Power Safety Risk Locator Program

(electronic format, downloadable from the Safety Industry page at www.rosscontrols.com)

- Simply answer questions about your machine and the interactive program provides guidance to areas of possible safety concerns for closer examination

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ROSS CONTROLS and concern for machine safety: the two go hand-in-hand

ROSS has been designing and supplying the “industry standards” of safety products for pneumatic energy isolation (LOTO) and control reliable double valves for the metal-forming industry for clutch/brake applications and the general manufacturing sector for decades. Originally pioneered by ROSS before Federal and State Occupational Safety and Health Administrations (OSHA) existed, ROSS designed and supplied valves for energy isolation and mechanical press clutch/brake control valves that were later widely recognized as aids to companies for regulatory compliance in non-press applications. In most of the safety critical pneumatic valve applications in manufacturing today, ROSS has been there to help make jobs safer for workers, protect investments in machinery, and increase productivity.

Total Machine Safety Training Program



TOTAL MACHINE SAFETY™ ROSS CONTROLS

INTRODUCTION

Total Machine Safety is the first fully-integrated electrical and fluid power machine safeguarding training program.

A comprehensive approach to evaluating and designing safety controls systems is critical in the overall success of a safety program.

An understanding of global safety standard requirements for lockout and machine guarding is critical to implementing safety systems that both protect employees and promote greater productivity. When safety is addressed in the machine design process, you begin to realize that safety is just another aspect of good business practices.

WHAT'S IN IT FOR YOU?

You will learn to:

- Understand the existing global safety standard landscape and future direction
- Assess and minimize risk when evaluating machines for safety
- Examine work environments and recognize potential problems
- Grasp the basics of electrical and fluid power safety components
- Manage productivity and uptime by taking a holistic approach to machine safety

WHAT DOES THE PROGRAM COVER?

This eight hour course is anchored on a fictional case study that addresses current safety standards, hazard & risk assessment, integration of safety devices, lockout/togout, and pneumatic & electrical components.

Total Machine Safety will cover topics such as Standards, Risk Assessment requirements, Lockout/Energy Isolation, Electrical and Fluid Power Safety Devices and applications, and overall machine safeguarding requirements and solutions. This class will not cover detailed component specifications, detailed component selection, or specific detailed circuit design. It will, however, provide a broad basis and understanding of what is required from a design standpoint, how to implement a machine guarding process, and how to select the components that will most effectively provide a solution while avoiding common pitfalls.

Accredited for 0.8 CEUs by M-TEC (Michigan Technical Education Center).



Electrical



Pneumatic



Lockout/Togout

**Go to www.totalmachinesafety.com for more information on scheduled seminars.
For additional information please contact ROSS.**



Pneumatic Energy Isolation for LOTO

L-O-X® Valves (Lockout and Exhaust)

Lockout / Tagout

- Fluorocarbon slipper seals for easy shifting, even after long periods of inactivity
- Easily identified by yellow body with red handle
- Integrated sensing port for pressure verification - see page 19 for verification accessories
- Lockable only in the OFF position
- Large exhaust port exceeds inlet size for rapid release of pressure
- Simple push/pull of the large red handle provides positive direct manual operation



Sizes 1/4 and 3/8

Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exhaust
Y1523D2002	1/4	3/8	1.84	1.79
Y1523D3012	3/8	3/8	2.67	2.64

* NPT port threads. For BSPP threads, insert "D" after "Y" to the model number, e.g., YD1523D2002.



Sizes 3/8, 1/2, 3/4, 1 and 1 1/4

Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exhaust
Y1523C3002	3/8	3/4	4.74	3.57
Y1523C4002	1/2	3/4	7.10	4.00
Y1523C5012	3/4	3/4	8.26	4.10
Y1523C5002	3/4	1 1/4	13.12	8.98
Y1523C6002	1	1 1/4	16.56	9.52
Y1523C7012	1 1/4	1 1/4	19.25	9.74

* NPT port threads. For BSPP threads, insert "D" after "Y" to the model number, e.g., YD1523C3002.



Sizes 1 1/2 and 2

Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exhaust
Y1523C8002	1 1/2	2	35.53	50.98
Y1523C9012	2	2	40.38	52.23

* NPT port threads. For BSPP threads, insert "D" after "Y" to the model number, e.g., YD1523C8002.

Size 3

Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exhaust
Y3900A0829#	3	2 1/2	140	140
Y3900A0896##	3	2 1/2	140	140

* NPT port threads. For BSPP threads, insert "D" after "Y" to the model number, e.g., YD3900A0829.

#Manual Pilot. ##Solenoid Pilot.



See bulletin 372 for more information.



Pneumatic Energy Isolation for LOTO

Stainless Steel L-O-X[®] Valves

- Corrosion-resistant 316 Stainless Steel construction
- Reliable Fluorocarbon seals withstand contaminant ingress
- Easily identified by unique shape
- Self-draining, washdown suitable design
- Trusted L-O-X[®] performance
- Lockable only in the OFF position
- Large exhaust port for rapid release of pressure
- Standard pressure sensing port with optional pressure switch or visual indicator
- Simple push/pull of the large handle provides direct manual operation
- Pressure sensing port allows installation of either the visual indicator or pressure switch to verify pressure downstream to the next obstruction is released

Lockout / Tagout



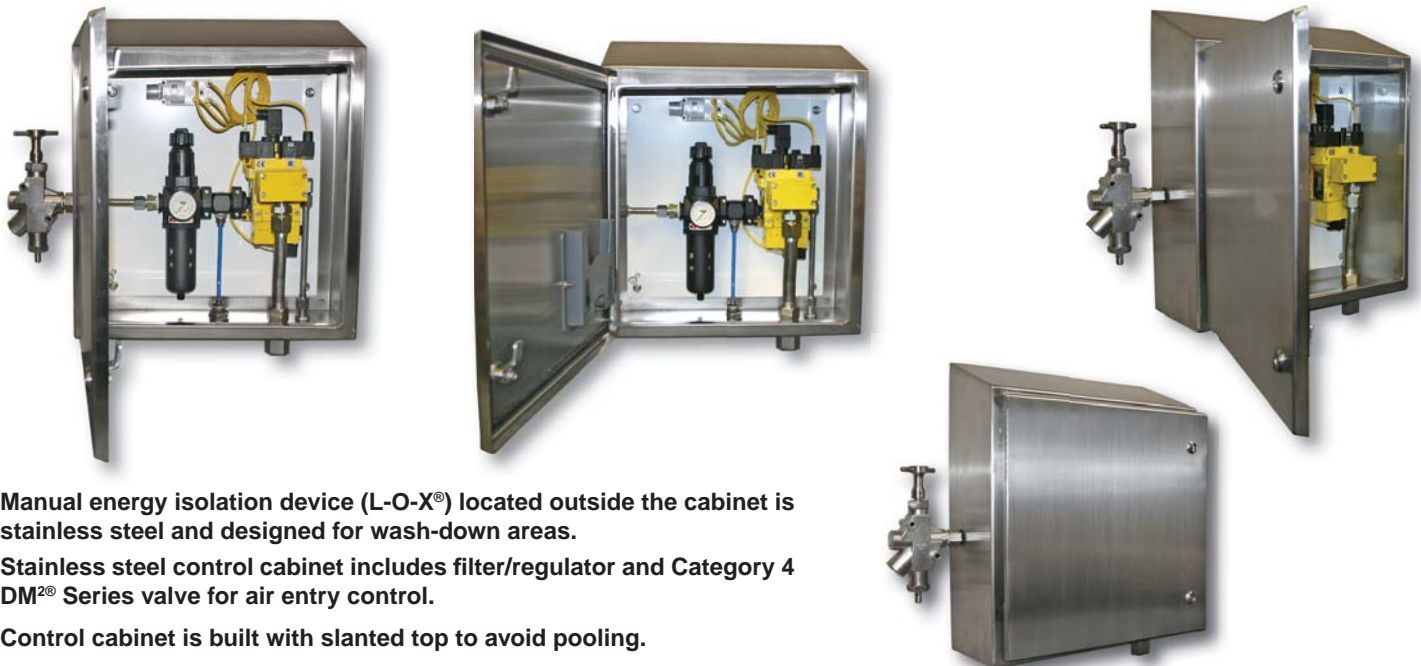
Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exhaust
1523A2004	1/4	1/4	2.14	2.08
1523A3004	3/8	1/2	5.79	6.24
1523A4004	1/2	1/2	5.79	6.24
1523A5004	3/4	1	14.30	17.00
1523A6004	1	1	14.30	17.00
1523A8004	1½	2	39.00	45.00
1523A9004	2	2	39.00	45.00

* NPT port threads. For BSPP threads, add a "D" prefix to the model number, e.g., D1523A2004.

See Digest Catalog 104 for more information.

Control Reliable Energy Isolation

Cabinet for Wash-Down Applications



Manual energy isolation device (L-O-X[®]) located outside the cabinet is stainless steel and designed for wash-down areas.

Stainless steel control cabinet includes filter/regulator and Category 4 DM²⁰ Series valve for air entry control.

Control cabinet is built with slanted top to avoid pooling.

Will build to your specifications!



Modular L-O-X[®] Air Entry Combination

Lockout Valve with Integrated Filter/Regulator



Lockout / Tagout

- Filter and regulator consolidated into a single space-saving assembly
- Modular mounting for easy servicing
- Internal automatic drain; optional manual drain or float drain (metal bowl only)
- Reverse flow, self-relieving piston-type regulator; non-relieving optional
- Tamper-resistant pressure setting
- Has a visible indicator of pressure release (verification port)
- Only lockable in the off position
- Has a full size exhaust port (equal to or larger than supply)
- Easy to operate (positive push/pull operation-detented)
- Optional EEZ-ON[®] function available

HOW TO ORDER

MD3 53P B A

BOWL SIZE

- 53P - Polycarbonate Bowl (4 oz)
- 53M - Metal Bowl with sight gauge (6 oz)

ELEMENT TYPE

- A - 40 Micron
- B - 5 Micron; standard

BOWL DRAIN

- A - Auto Drain/Differential Pressure
- M - Manual Drain
- F - Float Drain (metal bowl only)

B 4 B X

PIPE SIZE

- 2 - 1/4 NPTF
- 3 - 3/8 NPTF
- 4 - 1/2 NPTF
- C - 1/4 BSPP
- D - 3/8 BSPP
- E - 1/2 BSPP

GAUGE

- A - No Gauge
- B - (0-200 psig)
- C - (0-60 psig)
- D - No Gauge with Panel Mount Nut
- E - (0-200 psig) Gauge with Panel Mount Nut
- F - (0-60 psig) Gauge with Panel Mount Nut

ADJUSTMENT RANGE

- A - 0-150 psig (0-10 bar); reverse flow
- B - 0-100 psig (0-6.8 bar); standard, reverse flow
- C - 0-50 psig (0-3.4 bar); reverse flow

ADD ON L-O-X[®]

- 1 - Outlet Side
- 2 - Inlet Side
- 3 - L-O-X[®] with EEZ-ON[®] on Outlet Side
- 4 - L-O-X[®] with EEZ-ON[®] on Inlet Side
- X - no L-O-X[®]

Accessories not included with the product, see bulletin 372 for more information.

Energy Isolation for Lockout/Tagout (LOTO)

L-O-X[®] Function (Lockout and Exhaust) with Combination Manual/Solenoid Operation



- Easily identified by red handle
- Lockable only in the OFF position
- Large exhaust port exceeds inlet size for rapid release of pressure
- Simple push/pull of the large red handle accommodates reduced manual actuation forces, allowing easy operation
- Integrated sensing port for pressure verification - see page 19 for verification accessories
- Solenoid-operated models for air dump function (Category 1). For Category 2 versions see page 11.



Lockout / Tagout

See bulletin 372 for more information.

Combination Solenoid / Manual Models

Model Number*	Port Size		C _v	Out-Exh.
	In-Out	Exhaust		
Y2773A2072**	1/4	1/2	2.5	3.1
Y2773A3072**	3/8	1/2	3.6	5.3
Y2773A4082**	1/2	1/2	3.3	5.3
Y2773A4072**	1/2	1	6.3	9.2
Y2773A5072**	3/4	1	7.7	11
Y2773A6082**	1	1	8.0	12
Y2773A6072**	1	1½	23	34
Y2773A7072**	1¼	1½	30	32
Y2773A8082**	1½	1½	30	31
Y2773A8072**	1½	2½	68	70
Y2773A8072**	2	2½	70	70
Y2773A9082**	2½	2½	70	71

* NPT port threads. For BSPP threads, insert letter "D" after "Y" in the model number, e.g. YD2773A2072. Body paint: Yellow.

** Specify voltage and hertz when ordering.



Energy Isolation with Soft Start for LOTO

Combination L-O-X[®] Valve with EEZ-ON[®] Function

- Easily identified by blue handle
- Gradual re-application of pneumatic pressure prevents rapid equipment movement at startup
- Lockable only in the OFF position
- Large exhaust port exceeds inlet size for rapid release of pressure
- Positive action (2 positions only)
- Simple push/pull of the large blue handle provides positive direct manual operation
- Integrated sensing port for pressure verification - see page 19 for verification accessories

Model Number*	Port Size		C _v	
	In-Out	Exhaust	In-Out	Out-Exh.
Y1523B3102	3/8	3/4	6.0	8.0
Y1523B4102	1/2	3/4	7.1	8.3
Y1523B5112	3/4	3/4	8.0	9.5
Y1523B5102	3/4	1¼	12.0	10.9
Y1523B6102	1	1¼	13.7	12.0
Y1523B7112	1¼	1¼	16.2	12.8

* NPT port threads. For BSPP threads, insert letter "D" after "Y" in the model number, e.g., YD1523B3102. Body paint: Yellow.

See bulletin 372 for more information.



Soft Start
Lockout / Tagout

Combination L-O-X[®] Valve with EEZ-ON[®] Function with Manual or Manual /Solenoid Operation

- Easily identified by blue handle
- Gradual re-application of pneumatic pressure prevents rapid equipment movement at startup
- Lockable only in the OFF position
- Large exhaust port exceeds inlet size for rapid release of pressure
- Simple push/pull of the large blue handle provides positive direct manual operation
- Integrated sensing port for pressure verification - see page 19 for verification accessories

Manual Model Number*	Combination Solenoid / Manual Model Number*	Port Size		C _v	
		In-Out	Exhaust	In-Out	Out-Exh.
Y2783B2055	Y2773B2075**	1/4	1/2	2.5	3.1
Y2783B3055	Y2773B3075**	3/8	1/2	3.6	5.3
Y2783B4065	Y2773B4085**	1/2	1/2	3.3	5.3
Y2783B4055	Y2773B4075**	1/2	1	10.0	13.0
Y2783B5055	Y2773B5075**	3/4	1	12.0	15.0
Y2783B6065	Y2773B6085**	1	1	12.0	16.0
Y2783A6055	Y2773B6075**	1	1½	23.0	34.0
Y2783A7055	Y2773B7075**	1¼	1½	30.0	32.0
Y2783A8065	Y2773B8085**	1½	1½	30.0	31.0

* NPT port threads. For BSPP threads, insert letter "D" after "Y" in the model number, e.g., YD2773B2075. Body paint: Yellow.

** Specify voltage and hertz when ordering.



Soft Start
Lockout / Tagout

See bulletin 372 for more information.

Control Reliable Energy Isolation



DM¹ Series E Size 2 3/2 Double Valve with Dynamic Monitoring



ISO 13849-1:2006 Category 3
PL e applications
(approval pending)

Air Dump /
Release

See brochure NPS006 for more information.

- Rapid response time to minimize stopping time
- Self-contained dynamic monitoring system
- Status Indicator switch for valve condition (ready to run) feedback
- Highly contaminant tolerant poppet construction
- Line mounted

Do not use in power press clutch/brake applications.

Model Number*	Port Size		C _v	
	In	Out	In-Out	Out-Exh.
DM1ENA20**31	1/4	1/2	1.34	2.43
DM1ENA21**31	3/8	1/2	1.92	2.43

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".
** Insert voltage code: "A" = 24 volts DC, "B" = 110 volts AC, "C" = 220 volts AC, "D" = 12 volts DC; M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.
Sistema library data available (see page 24).



DM²® Series E Size 2 3/2 Double Valve with Dynamic Monitoring and Memory



ISO 13849-1:2006 Category 4
PL e applications
(approval pending)

Air Dump /
Release

See brochure NPS007 for more information.

- Rapid response time to minimize stopping time
- Dynamic memory of abnormal function retains lockout condition and this prevents unintentional reset with removal of air or electricity
- Self-contained dynamic monitoring system requires no additional valve monitoring controls
- Electrical reset valve
- Status Indicator switch for valve condition (ready to run) feedback
- Highly contaminant tolerant poppet construction
- Line mounted

Do not use in power press clutch/brake applications.

Model Number*	Port Size		C _v	
	In	Out	In-Out	Out-Exh.
DM2ENA20**21	1/4	1/2	1.34	2.43
DM2ENA21**21	3/8	1/2	1.92	2.43

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".
** Insert voltage code: "A" = 24 volts DC, "B" = 110 volts AC, "C" = 220 volts AC, "D" = 12 volts DC; M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.
Sistema library data available (see page 24).



Air Entry Package with Control Reliable Energy Isolation



Category 3 with Modular L-O-X[®] and DM¹ Series E

- Pre-engineered panel-mounted design with air entry with: filter and regulator “FR”, or filter, regulator and lubricator “FRL”
- Includes DM¹ Series E Double Valve with Monitoring

Do not use in power press clutch/brake applications.



Pressure Switch not shown

Model Number*	Air Entry Type	Port Size		C _v		Dimensions (inches/mm)		
		In	Out	In-Out	Out-Exh.	Length	Width	Depth
RC304-09	FR	1/4	1/2	1.3	2.4	13.00 (330.0)	11.00 (279.0)	5.40 (134.7)
RC306-09	FR	3/8	1/2	1.9	2.4	13.00 (330.0)	11.00 (279.0)	5.40 (134.7)
RC304L-09	FRL	1/4	1/2	1.3	2.4	13.00 (330.0)	11.00 (279.0)	5.40 (134.7)
RC306L-09	FRL	3/8	1/2	1.9	2.4	13.00 (330.0)	11.00 (279.0)	5.40 (134.7)

Electrical / Pneumatic Energy Isolation (LOTO)

* NPT port threads. Specify voltage and hertz when ordering, M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.

See brochure NPS015 for more information.

Category 4 with Modular L-O-X[®] and DM^{2®} Series E



- Pre-engineered panel-mounted design with air entry with: filter and regulator “FR”, or filter, regulator and lubricator “FRL”
- Includes DM^{2®} Series E Double Valve with Monitoring & Memory

Do not use in power press clutch/brake applications.



Electrical / Pneumatic Energy Isolation (LOTO)

Model Number*	Air Entry Type	Port Size		C _v		Dimensions (inches/mm)		
		In	Out	In-Out	Out-Exh.	Length	Width	Depth
RC404-09	FR	1/4	1/2	1.3	2.4	13.00 (330.0)	11.68 (296.7)	5.40 (134.7)
RC406-09	FR	3/8	1/2	1.9	2.4	13.00 (330.0)	11.68 (296.7)	5.40 (134.7)
RC404L-09	FRL	1/4	1/2	1.3	2.4	13.00 (330.0)	11.68 (296.7)	5.40 (134.7)
RC406L-09	FRL	3/8	1/2	1.9	2.4	13.00 (330.0)	11.68 (296.7)	5.40 (134.7)

* NPT port threads. Specify voltage and hertz when ordering, M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.

See brochure NPS015 for more information.

- Air Dump / Release
- Electrical / Pneumatic Energy Isolation (LOTO)



Control Reliable Energy Isolation

DM²® Series C Sizes 4, 8, 12, 30 3/2 Double Valve with Dynamic Monitoring and Memory



- Rapid response time to minimize stopping time
- Dynamic memory of abnormal function retains lockout condition and this prevents unintentional reset with removal of air or electricity
- Electrical reset valve
- Status Indicator switch for valve condition (ready to run) feedback
- Self-contained dynamic monitoring system requires no additional valve monitoring controls
- Highly contaminant tolerant poppet construction
- Base mounted

Do not use in power press clutch/brake applications.



ISO 13849-1:2006 Category 4
PL e applications

**Air Dump /
Release**

Model Number*	Port Size		C _v	
	In	Out	In-Out	Out-Exh.
DM2CNA42**21	1/2	1/2	3	10
DM2CNA54**21	3/4	3/4	4.4	13
DM2CNA55**21	1	1	4.4	13
DM2CNA66**21	1	1	8.5	20
DM2CNA88**21	1½	2	22	64

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".

** Insert voltage code: "A" = 24 volts DC, "B" = 110 volts AC;

M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.

Sistema library data available (see page 24).

See brochure NPS010 for more information.

Air Entry Package with Control Reliable Energy Isolation



Category 4 with Manual L-O-X[®] and DM²® Series C



- Pre-engineered panel-mounted design with air entry with a filter and regulator "FR", or filter, regulator and lubricator "FRL"
- Includes DM²® Series C Double Valve with Monitoring & Memory

Do not use in power press clutch/brake applications.

**Electrical /
Pneumatic Energy
Isolation (LOTO)**

Model Number*	Air Entry Type	Port Size		C _v		Dimensions (inches/mm)		
		In	Out	In-Out	Out-Exh.	Length	Width	Depth
RC408-06	FR	1/2	1/2	3	10	24.0 (610)	14.5 (369)	7.4 (187)
RC412-06	FR	3/4	3/4	4.4	13	24.0 (610)	15.7 (399)	8.3 (211)
RC416-06	FR	1	1	4.4	13	27.0 (686)	19.0 (483)	9.0 (229)
RC408L-06	FRL	1/2	1/2	3	10	24.0 (610)	14.5 (369)	7.4 (187)
RC412L-06	FRL	3/4	3/4	4.4	13	24.0 (610)	15.7 (399)	8.3 (211)
RC416L-06	FRL	1	1	4.4	13	31.0 (788)	19.0 (483)	9.0 (229)

* NPT port threads. Specify voltage and hertz when ordering, M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.



3/2 Normally Closed Sensing Valve



Air Dump / Release



***EN 954-1, ISO 13849-1, & AS4024-1

- Senses internal position & state
- Electrical feedback via DPST switch (Double-Pole Single-Throw)
- Directly operated safety-rated force-guided positive-break status switch (DPST)
- Poppet construction for near zero leakage & dirt tolerance

Solenoid Pilot Controlled Model Number*	Pressure Controlled Model Number*	Port Size		C _v	
		In-Out	Exhaust	In-Out	Out-Exh.
SV27NC305407PSAA1A**	SV27NC305405ASAA	1/2 ***	1	6.3	9.2
SV27NC305507PSAA1A**	SV27NC305505ASAA	3/4 ***	1	7.7	11
SV27NC305607PSAA1A**	SV27NC305605ASAA	1 ***	1	8.0	12
SV27NC307607PSAA1A**	SV27NC307605ASAA	1 ***	1½	23	34
SV27NC307707PSAA1A**	SV27NC307705ASAA	1¼ ***	1½	30	32
SV27NC307807PSAA1A**	SV27NC307805ASAA	1½ ***	1½	30	32
SV27NC309807PSAA1A**	SV27NC309805ASAA	1½	2½	68	70
SV27NC309907PSAA1A**	SV27NC309905ASAA	2	2½	70	70
SV27NC309957PSAA1A**	SV27NC309955ASAA	2½	2½	70	71

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".

** "1A"=120 volts 60 Hz solenoids. For 240 volts 60 Hz, change "1A" to "2A"; for 24 volts 60 Hz to "3A"; for 24 volts DC to "1D".

Wiring kits and accessories available, see pages 19 thru 23.

See brochure NPS279 for more information.

3/2 Normally Closed Sensing Valve with L-O-X®



- Senses internal position & state
- Electrical feedback via DPST switch (Double-Pole Single-Throw)
- Directly operated safety-rated force-guided positive-break status switch (DPST)
- Poppet construction for near zero leakage & dirt tolerance

Solenoid Pilot Controlled Model Number*	Pressure Controlled Model Number*	Port Size		C _v	
		In-Out	Exhaust	In-Out	Out-Exh.
SV27NC3L5407PSAA1A**	SV27NC3L5405ASAA	1/2	1	6.3	9.2
SV27NC3L5507PSAA1A**	SV27NC3L5505ASAA	3/4	1	7.7	11
SV27NC3L5607PSAA1A**	SV27NC3L5605ASAA	1	1	8.0	12
SV27NC3L7607PSAA1A**	SV27NC3L7605ASAA	1	1½	23	34
SV27NC3L7707PSAA1A**	SV27NC3L7705ASAA	1¼	1½	30	32
SV27NC3L7807PSAA1A**	SV27NC3L7805ASAA	1½	1½	30	32

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".

** "1A"=120 volts 60 Hz solenoids. For 240 volts 60 Hz, change "1A" to "2A"; for 24 volts 60 Hz to "3A"; for 24 volts DC to "1D".

Wiring kits and accessories available, see pages 19 thru 23.

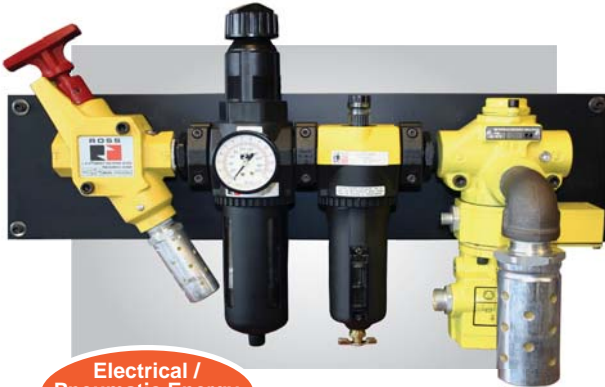


Air Dump / Release

Air Entry Package with 3/2 Normally Closed Sensing Valve



Category 2 with Manual L-O-X® and SV27 Sensing Valve



Electrical /
Pneumatic Energy
Isolation (LOTO)

- Pre-engineered panel-mounted design with air entry with filter and regulator “FR”, or filter, regulator, and lubricator “FRL”
- Includes 3/2 Normally Closed Sensing Valve

Model Number*	Air Entry Type	Port Size		C _v		Dimensions (inches/mm)		
		In	Out	In-Out	Out-Exh.	A	B	C
RC208-06	FR	1/2	1/2	6.3	9.2	23.0 (585)	12.8 (326)	6.7 (171)
RC212-06	FR	3/4	3/4	7.7	11	23.0 (585)	12.8 (326)	6.7 (171)
RC216-06	FR	1	1	8.0	12	28.0 (712)	17.0 (432)	9.5 (242)
RC208L-06	FRL	1/2	1/2	6.3	9.2	23.0 (585)	12.8 (326)	6.7 (171)
RC212L-06	FRL	3/4	3/4	7.7	11	23.0 (585)	12.8 (326)	6.7 (171)
RC216L-06	FRL	1	1	8.0	12	31.8 (808)	17.0 (432)	9.5 (242)

* NPT port threads. Specify voltage and hertz when ordering, M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.



Category 2 with Modular L-O-X® and SV27 Sensing Valve



Electrical /
Pneumatic Energy
Isolation (LOTO)

- Pre-engineered panel-mounted design with air entry with filter and regulator “FR”, or filter, regulator, and lubricator “FRL”
- Includes 3/2 Normally Closed Sensing Valve

Model Number*	Air Entry Type	Port Size		C _v		Dimensions (inches/mm)		
		In	Out	In-Out	Out-Exh.	A	B	C
RC208-09	FR	1/2	1/2	6.3	9.2	14.80 (374.9)	11.00 (279.0)	6.60 (167.7)
RC208L-09	FRL	1/2	1/2	6.3	9.2	14.80 (374.9)	11.00 (279.0)	6.60 (167.7)

* NPT port threads. Specify voltage and hertz when ordering, M12 connectors available, consult ROSS.

Wiring kits and accessories available, see pages 19 thru 23.

See brochure NPS015 for more information.



Control Reliable 5/2 Double Valve - Series 77 CROSSMIRROR®

Solenoid Pilot Controlled



- Self-contained dynamic monitoring system requires no additional valve monitoring controls
- Base mounted, stainless steel spool valve construction
- Status indication switch (ready-to-run) to inform machine controller of valve condition; MUST be integrated into machine controls in order to prevent run signal until fault is cleared in valve
- Applications include small size pneumatic cylinder-operated presses, valve operators, and safety latches
- Base mounted, stainless steel spool valve construction

Do not use in power press clutch/brake applications.

Cylinder Return to Home Position



Size 2

Model Number*	Port Size		C _v				Pressure Switch	Replacements*	
	1	2, 3, 4, 5	1-2	1-4	2-3	4-5		Valve No.	Base No.
7776A3410	1/2	3/8	2.0	1.6	1.6	2.8	Without	7776A3400	996C91
7776A3411	1/2	3/8	2.0	1.6	1.6	2.8	With	7776A3401	996C91

Size 4

7776A4420	3/4	1/2	3.2	3.4	2.7	7.2	Without	7776A4400	1049C91
7776A4421	3/4	1/2	3.2	3.4	2.7	7.2	With	7776A4401	1049C91
7776A5410	3/4	3/4	3.2	3.4	2.7	7.2	Without	7776A4400	1153C91
7776A5411	3/4	3/4	3.2	3.4	2.7	7.2	With	7776A4401	1153C91

* Model number includes base supplied with NPT threads. For G threads, order model or base with a "D" prefix, e.g., D7776A3410, D996C91.

For pressure switch option, order model or valve with a "Z" suffix for 110 AC or "W" suffix for 24 volts DC, e.g., 7776A3411Z, 7776A3401W.

Sistema library data available (see page 24).

ISO 13849-1:2006 Category 4 PL e applications

See bulletin E383 for more information.

Two-Hand Pressure Controlled



- Requires two inputs within 500 ms
- Self-contained dynamic monitoring system requires no additional valve monitoring controls
- Senses asynchronous inputs via status indicator switch
- Status indication switch available to be integrated with electrical safety control system where available
- Applications include small size pneumatic cylinder-operated presses, valve operators, and safety latches
- Base mounted, stainless steel spool valve construction

Do not use in power press clutch/brake applications.

Cylinder Return to Home Position



Size 2

Model Number*	Port Size		C _v				Pressure Switch	Replacements*	
	1	2, 3, 4, 5	1-2	1-4	2-3	4-5		Valve No.	Base No.
7786A3410	1/2	3/8	2.0	1.6	1.6	2.8	Without	7786A3400	996C91
7786A3411	1/2	3/8	2.0	1.6	1.6	2.8	With	7786A3401	996C91

Size 4

7786A4420	3/4	1/2	3.2	3.4	2.7	7.2	Without	7786A4400	1049C91
7786A4421	3/4	1/2	3.2	3.4	2.7	7.2	With	7786A4401	1049C91
7786A5410	3/4	3/4	3.2	3.4	2.7	7.2	Without	7786A4400	1153C91
7786A5411	3/4	3/4	3.2	3.4	2.7	7.2	With	7786A4401	1153C91

* Model number includes base supplied with NPT threads. For G threads, order model or base with a "D" prefix, e.g., D7786A3410, D996C91.

For pressure switch option, order model or valve with a "Z" suffix for 110 AC or "W" suffix for 24 volts DC, e.g., 7786A3411Z, 7786A3401Z.

Sistema library data available (see page 24).

ISO 13849-1:2006 Category 4 PL e applications

See brochure NP005 for more information.



2/2 PO Check with Sensing

Pressure Controlled or Solenoid Pilot Controlled



Load Holding



EN 954-1, ISO 13849-1,
& AS4024-1

- Poppet construction for near zero leakage & dirt tolerance
- Directly operated safety-rated force-guided positive-break status switch (DPST)
- Holds a vertical load in the event of loss of air pressure (and loss of electrical power with solenoid operated)

Solenoid Pilot Controlled Model Number*	Pressure Controlled Model Number*	Port Size	C _v In-Out
SV27NC115408CSAA1A**	SV27NC115405ASAA	1/2	4.5
SV27NC115508CSAA1A**	SV27NC115505ASAA	3/4	8.3
SV27NC115608CSAA1A**	SV27NC115605ASAA	1	10.3
SV27NC117608CSAA1A**	SV27NC117605ASAA	1	20.2
SV27NC117708CSAA1A**	SV27NC117705ASAA	1¼	29.1
SV27NC117808CSAA1A**	SV27NC117805ASAA	1½	31.4

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".
** "1A"=120 volts 60 Hz solenoids. For 24 volts DC change "1A" to "1D".

Wiring kits and accessories available, see pages 19 thru 23.

See bulletin 430 for more information.



Redundant 2/2 PO Check with Sensing

Pressure Controlled or Solenoid Pilot Controlled



Load Holding



EN 954-1, ISO 13849-1,
& AS4024-1

- Poppet construction for near zero leakage & dirt tolerance
- Directly operated safety-rated force-guided positive-break status switch (DPST)
- Holds a vertical load in the event of loss of air pressure (and electrical power with solenoid operated models)

Solenoid Pilot Controlled Model Number*	Pressure Controlled Model Number*	Port Size	C _v In-Out
SV27NC555408CSAA1A**	SV27NC555405ASAA	1/2	4.5
SV27NC555508CSAA1A**	SV27NC555505ASAA	3/4	8.3
SV27NC555608CSAA1A**	SV27NC555605ASAA	1	10.3
SV27NC557608CSAA1A**	SV27NC555405ASAA	1	12.1
SV27NC557708CSAA1A**	SV27NC555505ASAA	1¼	18.7
SV27NC557808CSAA1A**	SV27NC555605ASAA	1½	22.3

* NPT port threads. For BSPP threads, replace "N" in the model number with a "D".
** "1A"=120 volts 60 Hz solenoids. For 24 volts DC change "1A" to "1D".

Wiring kits and accessories available, see pages 19 thru 23.

See bulletin 430 for more information.



Right-Angle PO Check Valves

Models with Threaded Banjo and Push-to-Connect Fitting

- Right angle design with banjo for easy positioning of pipe or tubing
- Threaded outlet ports available with NPT or G threads
- Inlet ports available with NPTF threaded or push-to-connect fittings
- Quick and easy installation
- Galvanized zinc plated brass body construction
- Lube or non-lube operation

Cylinder Position Holding



Models with Threaded Banjo

Signal Port Thread	Port Size		Valve Model Number	Avg. C _v		Tightening Torque Max. Ft-lb (Nm)
	Port 1*	Port 2**		1 to 2	2 to 1	
10-32 UNF	1/8	1/8	1958A1010	0.4	0.4	22.13 (30)
10-32 UNF	1/4	1/4	1958A2010	0.8	0.7	14.75 (20)
10-32 UNF	3/8	3/8	1958A3010	1.2	1.3	22.13 (30)
10-32 UNF	1/2	1/2	1958A4010	2.3	2.2	29.50 (40)
M5	G1/8	G1/4	D1958A1010	0.4	0.4	7.38 (10)
M5	G1/4	G1/4	D1958A2010	0.8	0.7	8.85 (12)
M5	G3/8	G3/8	D1958A3010	1.2	1.3	14.75 (20)
M5	G1/2	G1/2	D1958A4010	2.3	2.2	22.13 (30)

* Threads in port 1 are female.

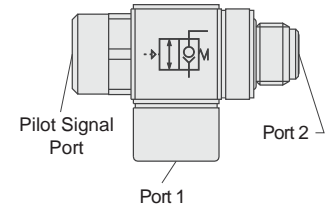
** Port 2 threads are male.

Models with Push-to-Connect Fitting

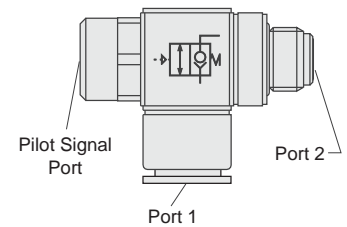
Signal Port Thread	Port Size		Valve Model Number	Avg. C _v		Tightening Torque Max. Ft-lb (Nm)
	Port 1# (tube size)	Port 2** (thread size)		1 to 2	2 to 1	
10-32 UNF	5/32"	1/8	1958A1115	0.4	0.4	11.06 (15)
10-32 UNF	1/4"	1/8	1958A1120	0.4	0.4	11.06 (15)
10-32 UNF	1/4"	1/4	1958A2120	0.8	0.7	14.75 (20)
10-32 UNF	3/8"	1/4	1958A2130	0.8	0.7	14.75 (20)
10-32 UNF	3/8"	3/8	1958A3130	1.2	1.3	22.13 (30)
M5	4 mm	G1/8	D1958A1140	0.4	0.4	7.38 (10)
M5	6 mm	G1/8	D1958A1160	0.4	0.4	7.38 (10)
M5	8 mm	G1/8	D1958A1180	0.4	0.4	7.38 (10)
M5	6 mm	G1/4	D1958A2160	0.8	0.7	8.85 (12)
M5	8 mm	G1/4	D1958A2180	0.8	0.7	8.85 (12)
M5	10 mm	G1/4	D1958A2110	0.8	0.7	8.85 (12)
M5	8 mm	G3/8	D1958A3180	1.2	1.3	14.75 (20)
M5	10 mm	G3/8	D1958A3110	1.2	1.3	14.75 (20)

Port 1 tubing size in inches (") or millimeters (mm).

** Port 2 threads are male.



Threaded Banjo



Push-to-Connect Fitting

Manual Overrides

Model Number	Port Size	Description
for Models with Threaded Banjo		
1998A1010	10-32	10-32 Manual Operated Check
for Models with Push-to-Connect Fitting		
1998A1020	1/4	10-32 Manual Operated Check
1998A1015	5/32	10-32 Manual Operated Check

- Load Holding
- Cylinder Position Holding



PO Check Valves (Non-Critical)

For Cylinder Position Holding And Load Holding with Trapped Pressure Release

- Available with automatic or manual trapped pressure release when pressure is removed from the Blowdown Signal Port (BP)
- Poppet construction for near zero leakage
- Applications include Air Holding and Cylinder Load Holding

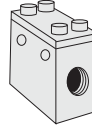


Load Holding

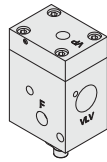


Cylinder Position Holding

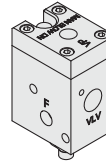
Type A Single PO Check Valve



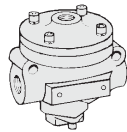
Type A Single PO Check Valve (Remote Trapped Pressure Relief)



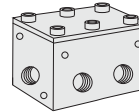
Type A Single PO Check Valve (Manual Trapped Pressure Relief)



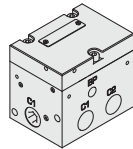
Type B Single PO Check Valve



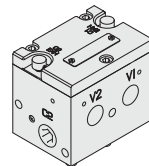
Type C Dual PO Check Valve



Type D Internal Pilot Dual PO Check Valve (Remote Trapped Pressure Relief)



Type D Internal Pilot Dual PO Check Valve (Manual Trapped Pressure Relief)



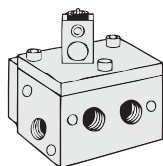
Pressure Controlled

Valve Type**	Port Size	PO Check Model Number	Avg. C _v
A Single	1/4	2751A2908	2.2
	3/8	2751A3908	2.9
	1/2	2751A4915	3.2
A Remote	3/8	2751B3922	2.6
	1/2	2751B4922	2.8
	3/4	2751B5917	9.2
A Manual	3/8	2751A3920	2.6
	1/2	2751A4920	2.8
	3/4	2751A5919	9.2
B Single	1/4	2751A2903	2.3
	3/8	2751A3901	3.8
	1/2	2751A4902	4.0
	1/2	2751A4905	7.7
	3/4	2751A5903	9.0
	1	2751A6901	9.0
	1	2751B6490	24
	1 1/4	2751B7901	29
	1 1/2	2751B8920	29
C Dual	3/8	2768C3900	2.9
	1/2	2768C4900	3.2
	3/4	2798C5900	8.5*
D Remote	1	2798A6900	8.5*
	3/8	2768D3901	2.9
	1/2	2768D4901	3.2
	3/4	2768D5901	8.5*
	1	2768A6901	8.5*
D Manual	3/8	2768D3904	2.9
	1/2	2768D4904	3.2
	3/4	2768D5904	8.5*
1	2768D6904	8.5*	

*Effective C_v varies with load and pressure drop. Consult ROSS for specifics on your system.

** NPT port threads. For BSPP threads, add a "D" prefix to the model number.

Solenoid Pilot Controlled



Type E Solenoid Pilot Dual PO Check Valve

Valve Type**	Port Size	DIN Connector	3-Pin Mini Connector	24 volts DC		Avg. C _v
				3-Pin Mini Connector	4-Pin Micro Connector	
E	3/8	2778D3900	2778D3901	2778D3902	2778D3904	2.9
	1/2	2778D4900	2778D4901	2778D4902	2778D4904	3.2
	3/4	2778D5900	2778D5901	2778D5902	2778D5904	8.5*
	1	2778B6900	2778B6901	2778B6902	2778B6904	8.5*

*Effective C_v varies with load and pressure drop. Consult ROSS for specifics on your system.

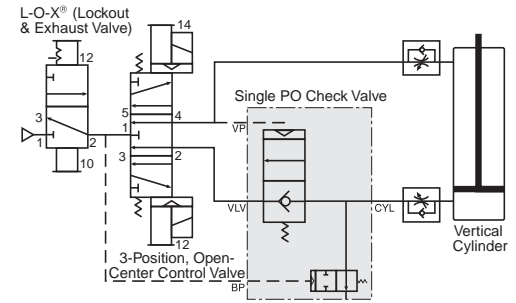
** NPT port threads. For BSPP threads, add a "D" prefix to the model number.

See bulletin 430 for more information.

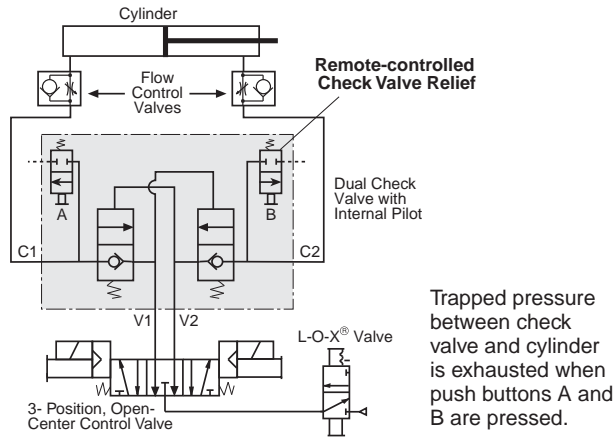
CIRCUIT FEATURES:

- Trapped pressure between check valve and cylinder is exhausted when the air supply at the Blowdown Signal Port (BP) is lost or locked-out
- Cylinder moves as long as the control valve solenoid is energized; use for continuous motion or jogging
- Cylinder remains stationary if neither control valve solenoid is energized, or if electrical signal is lost

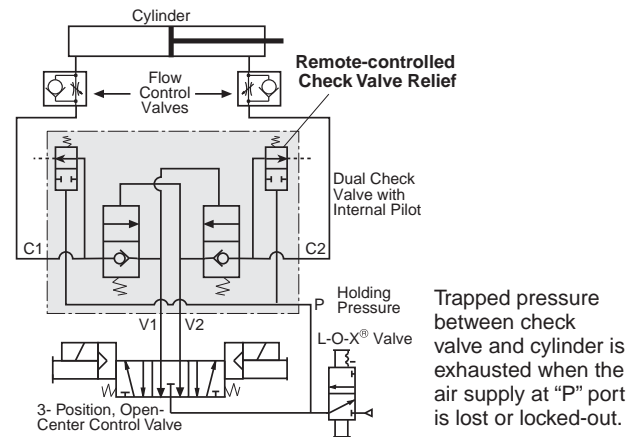
Single Pilot Operated Check Valve with Trapped Pressure Relief Application



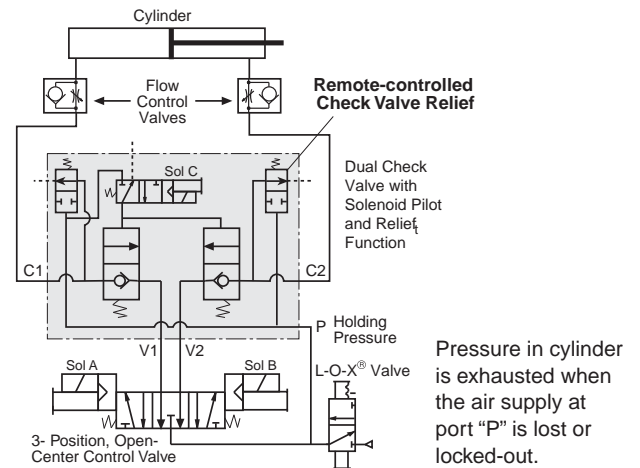
Dual Pilot Operated Check Valve Manual Trapped Pressure Relief Application



Dual Pilot Operated Check Valve Remote Trapped Pressure Relief Application



Dual Pilot Operated Check Valve Solenoid Pilot Controlled Application



CIRCUIT FEATURES:

- To operate cylinder, simultaneously energize solenoids A and C *RUB* and C
- Pilot supply and exhaust are independent of control valve
- Response time is not affected by exhaust restrictions of the control valve
- Cylinder remains stationary if neither control valve solenoid is energized, or if electrical signal is lost
- Pressure in cylinder is exhausted when the air supply at "P" port is lost or locked-out
- L-O-X® valve provides lockable shut-off of air supply, and exhausting of trapped downstream air

IMPORTANT NOTES and CAUTIONS:

- Cylinder movement may occur when inlet pressure is lost. The cylinder's movement is slowed only by the restrictions of the flow control valves, and by the exhaust capacity of the check valve relief flow capacity

- For best response, flow control valves should be installed between the check valve and the cylinder
- Pressurizing the system after supply air has been off may cause rapid movement of the cylinder because cylinder air was exhausted while the supply air was off



● Soft Start

EEZ-ON® Valves - Line Mounted

3-Way Normally Closed EEZ-ON®

- Gradual re-application of pneumatic pressure prevents rapid equipment movement at startup
 - Large exhaust port exceeds inlet size for rapid release of pressure
 - Pressure sensing port allows installation of either the Pop-Up Indicator or Pressure Switch option to verify pressure is released
- See page 19 for accessories.



Soft Start

Internal Pressure Controlled Model Number*	Solenoid Pilot Controlled Model Number*	Port Size In-Out Exhaust		C _v In-Out Out-Exh.	
2783B2037	2773B2037**	1/4	1/2	2.5	3.1
2783B3037	2773B3037**	3/8	1/2	3.6	5.3
2783B4047	2773B4047**	1/2	1/2	3.3	5.3
2783B4037	2773B4037**	1/2	1	6.3	9.2
2783B5037	2773B5037**	3/4	1	7.7	11
2783B6047	2773B6047**	1	1	8.0	12

* NPT port threads. For BSPP threads, add a "D" prefix to the model number, e.g., D2773B2037.

** Specify voltage and hertz when ordering.

See bulletin 372 for more information.

EEZ-ON® Valves – Port Mounted

Right Angle Style 2-Way Normally Closed EEZ-ON®

- Gradual re-application of pneumatic pressure prevents rapid equipment movement at startup
- Right angle style mounts directly in cylinder ports
- Available with threaded ports or push-in-tubing ports



Soft Start

Models with Threaded Banjo

Model Number	Port 1 (female)	Port 2 (male)	C _v In-Out
1969A1010*	1/8	1/8	0.7
1969A2010*	1/4	1/4	1.1
1969A3010*	3/8	3/8	1.9
1969A4010*	1/2	1/2	2.2
D1969A1010**	1/8	1/8	0.7
D1969A2010**	1/4	1/4	1.1

* NPT port threads.

**BSPP port threads.



HOZE-FUZE®

Protection from Broken Hose or Plastic Tubing

- Automatically reduces flow to minimize hose whip upon sensing a broken hose/tube
- Simple installation
- Reset by shutting off air supply
- For use with only non-corrosive, non-flammable, non-hazardous gases



Minimize Hose Whip

Model Number*	Port Size**
1969A2001	1/4 Male-Female
1969B3001	3/8 Male-Female
1969A4001	1/2 Male-Female
1969A5002	3/4 Female-Female
1969A6002	1 Female-Female
1969B2002	1/4 Female - 1/4 Tube*

* NPT port threads. For BSPP threads, add a "D" prefix to the model number, e.g., D1969A2001.

** HOZE-FUZE® size should match actual hose inside-diameter size.

Approximate Flow Before Shut-Off in CFM (Liters/Min.) Inlet Pressure

Pipe Size	50 psi (3.4 Bar)	75 psi (5.1 Bar)	100 psi (6.9 Bar)	125 psi (8.6 Bar)	150 psi (10.3 Bar)	180 psi (12.4 Bar)
1/4	13 (368)	15 (424)	18 (509)	21 (594)	23 (651)	26 (736)
3/8	39 (1,104)	49 (1,387)	58 (1,642)	67 (1,897)	76 (2,152)	87 (2,463)
1/2	65 (1,840)	80 (2,265)	96 (2,718)	111 (3,143)	126 (3,568)	144 (4,077)
3/4	110 (3,114)	126 (3,567)	142 (4,020)	158 (4,474)	174 (4,927)	193 (5,465)
1	173 (4,898)	210 (5,946)	248 (7,022)	285 (8,070)	322 (9,118)	367 (10,392)

Energy Release Verification Options

Pop-Up (Visual) Indicator or Pressure Switch (Electrical)

- May be installed on all L-O-X® valves and L-O-X® valves with EEZ-ON® function with pressure sensing port
- Provides a means to verify the release of downstream pressure to next obstruction

Model Number*	Inlet Port Size	Description
988A30	1/8	Pop-Up Indicator
586A86	1/8	Pressure Switch

* NPT port threads.

Pneumatic Energy Release Verification Options for Stainless Steel L-O-X® Valves

- 316 Stainless Steel Body, Internals and Springs
- Nitrile Seal
- Visual Indicator piston Acetal, Visual Indicator assembly Acetal with acrylic lens
- DPDT (Double-Pole Double-Throw) Pressure Switch
- Factory preset Pressure Switch, 5 psi (0.3 bar) - falling

Model Number*	Inlet Port Size	Description
1155H30	1/8	Visual Indicator
1162A30	1/8	Pressure Switch

* NPT port threads.

Pressure Release Verification



Visual Indicator



Pressure switch



● Exhaust Noise Reduction

MUFFL-AIR® Silencers

- Reduces exhaust noise
- Diffuses exhausting air
- Back pressure, minimal
- Typical impact noise reduction is in the 20-25 dB range



Exhaust Noise Reduction

Male Ported Models

Model Number*	Port Size	C _v
5500A1003	1/8	2.0
5500A2003	1/4	2.0
5500A3013	3/8	2.0
5500A3003	3/8	5.7
5500A4003	1/2	7.0
5500A5013	3/4	7.0
5500A5003	3/4	15
5500A6003	1	18
5500A7013	1 1/4	18

* NPT port threads. For BSPT threads, add a "D" prefix to the model number, e.g., D5500A1003.

Female Ported Models

Model Number*	Port Size	C _v
5500A7001	1 1/4	37
5500A8001	1 1/2	38
5500B9001	2	50
5500A9002	2 1/2	62

* NPT port threads. For BSPT threads, add a "D" prefix to the model number, e.g., D5500A7001.

Stainless Steel Silencers

- Constructed for corrosive situations
- Available in different port sizes, offering continuous heavy-duty use
- Recommended for air exhaust applications for pressures up to 125 psig (8.6 bar)



Exhaust Noise Reduction

Male Ported Models

Model Number*	Port Size	Material
5500A2004	1/4	Stainless Steel
5500A4004	1/2	Stainless Steel
5500A6014	1	Stainless Steel
5500A9004	2	Nickel Plated

* NPT port threads. For BSPT threads, add a "D" prefix to the model number, e.g., D5500A2004.



Silencer Kits

High-flow, high-reduction silencers for DM¹, DM²® Series E & DM²® Series C double valves.

- Reduces the Exponentially Perceived Noise (EPNdB)
- Improves equipment performance
- Impact noise reduction in the 35–40 dB range
- **Pressure Range:** 125 psig (8.6 bar) maximum

Valve Size	Threads Type	Kit Model Number*	Flow scfm
DM¹ & DM²® Series E			
2	NPT	2323H77	256
2	BSPP	2328H77	256
DM²® Series C			
4	NPT	2324H77	800
8	NPT	2325H77	800
12	NPT	2326H77	2080
30	NPT	2327H77	7200
4	BSPP	2324H77	800
8	BSPP	2325H77	800
12	BSPP	2331H77	2080
30	BSPP	2332H77	7200

* Kits include all plumbing required for installation.



Exhaust Noise Reduction

Silencer/Reclassifiers

- Reduces exhaust noise at exhaust ports of valves
- Captures 90% of exhausted lubricants
- Use on air tools, valve with piped exhaust cylinder and air motor applications, or any system that requires air line lubrication
- Both a drain cock and a 1/8 tube fitting are supplied for the manual or constant draining of accumulated liquids
- Sound attenuation & back pressure data available, see Catalog 420 for more information

Model Number*	Port Size	C _v
5055B4009	1/2	5.4
5055B5009	3/4	7.4
5055B6009	1	7.4

* NPT port threads. For BSPP threads, add a "C" prefix to the model number, e.g., C5055B4009.



Exhaust Conditioning

Pre-assembled Wiring Kits

DM¹ Series E Wiring Kits

These kits include 2 cables with either a DIN or M12 connector plus a cord grip for each. They are available in lengths of 5 or 10 meters. Separate kits are available for the Status Indicator.

(Note: Each cable has one connector.)

Kit Number	Solenoid Connector Type	Length (meters)
2243H77	DIN	5
2244H77	DIN	10
2245H77	M12	5
2246H77	M12	10

Status Indicator Kits

include one cable with DIN connector and a cord grip.

See brochure NP011 for more information.

Kit Number	Length (meters)
2247H77	5
2248H77	10

DM²® Series Wiring Kits

Standard Wiring Kits

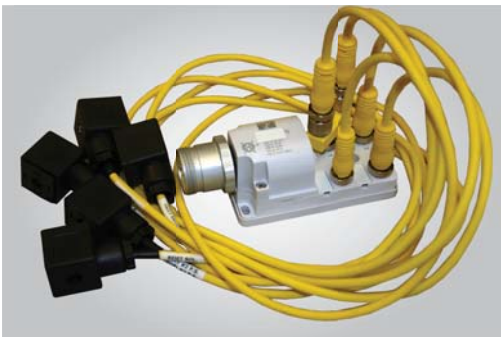
Kits include three cables for the solenoids and one cable for the status indicator. All cables come with a cord grip. Solenoid cables come with either DIN or M12 connectors. They are available in lengths of 5 or 10 meters.

(Note: Each cable has one connector.)

See brochure NP011 for more information.

Kit Number	Solenoid Connector Type	Length (meters)
2283H77	DIN	5
2284H77	DIN	10
2288H77	M12	5
2289H77	M12	10

Wiring Kits with J-Box



A J-Box is a junction box with a 10-pin MINI connector for connecting to the user's control system and (4) 5-pin M12 ports for connecting to the 3 solenoids and the status indicator on the DM²® Series valve. The J-Box kits include the J-Box as described above and (4) 1-meter cables for connecting to the valve. These cables have a connector on each end. The status indicator cable and the (3) solenoid cables have an M12 connector on one end and a DIN connector on the other end (M12-DIN).

Standard valves come with DIN type solenoid connections, but could be bought with M12 type connections as well. Therefore we also offer a kit that provides solenoid cables with an M12 connector on each end (M12-M12).

See brochure NP011 for more information.

Kit Number*	Solenoid Connector Type	Length (meters)
2249H77	M12 - DIN	1
2250H77	M12 - M12	1

*24 volts DC only.



Pre-assembled Wiring Kits

10 PIN MINI Cable

These cables have a 10-pin MINI connector for connecting the J-Box kits above to the user's control system. Kits include one cable with connector and cord grip.

Cable conductors are 18-gage wire.

See brochure NP011 for more information.

Kit Number	Length (meters)
2253H77	12
2254H77	20
2255H77	30
2256H77	50

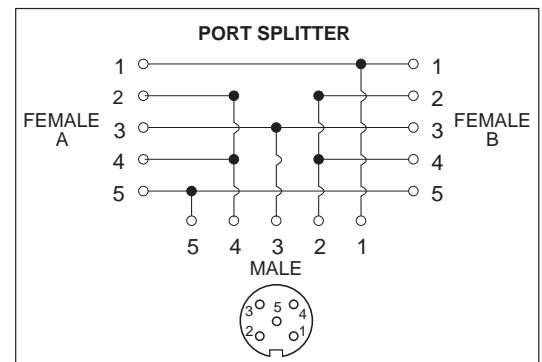
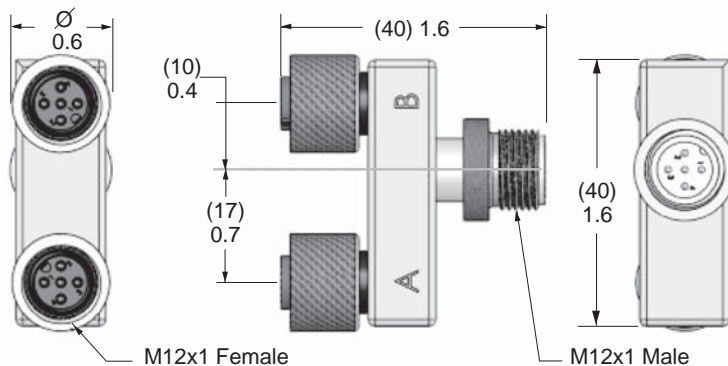
Outlet Port Pressure Monitoring Wiring Kit

Some customers prefer to monitor downstream pressure in addition to using the DM²⁰ or DM¹ Series valve. A convenient way to do this is to install a pressure switch in the extra outlet port that is provided on the valve. The Outlet Port Pressure Monitoring kit can be used with one of the J-Box kits above to split one of the M12 ports on the J-Box so that a pressure switch can be wired in as well. These kits consist of one port splitter (a Tee with three M12 connectors) and one M12-DIN cable (1 meter).

The pressure switch is available separately - order part number 586A86.

See brochure NP011 for more information.

Kit Number 2251H77



Series SV27 Sensing Valve Wiring Kits

These kits are available in lengths of 4 or 10 meters, with a cord grip for each cable. The kits for solenoid piloted SV27 models come with 2 cables; one with a 3-pin MINI connector for the solenoid and one with a 5-pin M12 (Micro) connector for the sensing switch. The kits for the air piloted models include only one cable with a 5-pin M12 connector for the sensing switch. (Note: Each cable has one connector.)

See brochure NP011 for more information.

Kit Number	Valve Type	Length (meters)	No. of Cables
2239H77	Solenoid Pilot	4	2
2240H77	Solenoid Pilot	10	2
2241H77	Air Pilot	4	1
2242H77	Air Pilot	10	1

For Redundant SV27 (CAT 3) Pilot Operated Check valve order 2 kits.



Safety Clamping Devices

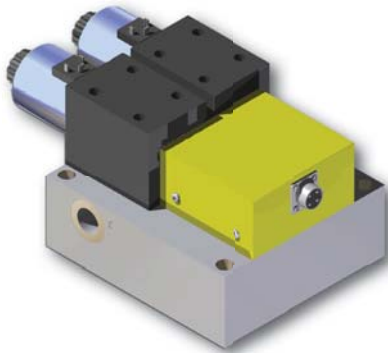


ROSS CONTROLS specializes in pneumatic and hydraulic safety solutions. When needing rod locks, rod brakes or safety catchers ROSS will provide you the optimum solution for every application.

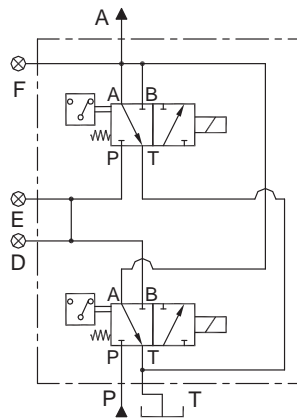
For information or technical assistance please call ROSS Technical Services in the U.S.A. at 1-888-TEK-ROSS(835-7677)

Control Reliable Hydraulic Double Valve

Size 12, 16 and 30



Ports: Inlet: SAE #12, 16 and 30
Outlet: SAE #12, 16 and 30
Tank: SAE #12, 16 and 30



APPLICATIONS:

- Bending Machines
- Trimming Machines
- Cutting, Forming, Piercing Machines
- Special Purpose Hydraulic Applications

This valve package features redundant valve elements that allow series flow from the inlet to the outlet of the valve package and allows parallel flow from the outlet to tank. This configuration assures that if either valving element fails to operate as requested, inlet flow will be blocked and fluid from the outlet is directed to the tank. The shifting of each valving element is monitored by its own safety switch.

Solenoid Voltage:
12, 24, 48 volts DC
115, 230 voltsAC/60 Hz

For additional information or order placement, consult ROSS.

Safety Product Data for SISTEMA Library Users

ROSS CONTROLS has available a safety product data library designed for use with the innovative new Safety Integrity Software Tool for the Evaluation of Machine Applications (SISTEMA).

Developed by the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA, formerly know as the BGIA), SISTEMA is available to download for no charge at the IFA web site. This software tool is expected to prove invaluable to system designers because of its potential time savings and safety implications.

Besides having data suitable for use in this world-class system development tool, ROSS CONTROLS is conveniently providing free library data for a selection of its safety products. ROSS expects to expand the data offerings in the future.

Currently, data library for the following products is available: DM2® Series C, D and E -Cat-4 double valves, DM1 Series -Cat-3 double valves, 5/2 CrossMirror® Series -Cat-4 double valves.

The ROSS DM2® Series safety products meet all global requirements for machine safety and are commonly used for exhausting the downstream air to help meet stop-time requirements in machine guarding applications.

ROSS safety valve customers will find convenience and increased system design accuracy with this free software tool and data library. It can enhance their overall safety program and offers a simple way to help ensure compliance with the EN ISO 13849-1:2006 standard.

To download a copy of ROSS' safety product data for the SISTEMA library, visit the Safety Industry page at www.rosscontrols.com.



Safety & Control Reliability

Your safety system is only as strong as its weakest link. If you are already using safety-rated guard switches, light curtains, safety mats and e-stops, and tying them to safety relays or PLCs, you have already acknowledged the need for safety-rated controls. Such electrical safety devices, however, can be for naught if they are controlling non-safety-rated valves. If there is a solenoid valve that dumps system air during a safety event, then that valve should have the same safety rating as the rest of the system. According to ISO 13849-1 the Safety Related Portion of the Control System (SRPCS) includes the pneumatic and hydraulic controls, too.

ROSS' control-reliable DM2® valves are rated to CAT 4 according to the definitions of control categories in EN954-1:2006 and also rated to Performance Level e according to ISO 13849-1. Think of these valves as pneumatic safety modules (relays).

Productivity

Single-point Lockout systems can be an effective way to enhance worker safety as well as improve productivity. Large production equipment often have several LOTO points, with corresponding "commute times" between these points. Therefore, an alternative method of LOTO or Single-point Lockout system can reduce the time to perform LOTO and further reduces the likelihood that a LOTO point might be overlooked. Because the procedure is simpler with a single-point LOTO, there is less risk of someone choosing to skip one or more LOTO points to save time.

A single-point lock-out system consists of multiple, keyed, remote LOTO stations situated at work areas around the machine, and any of these stations alone can lock out the entire zone or machine. As such, a single lock-out safely disables air power, without any delay due to commute time between LOTO points. Every remote station is constantly sensed by a control-reliable system including safety PLC and control-reliable valves and contactors which effectively shut off the energy to the areas of the machine to be accessed.

One company was able to reduce the time required for their LOTO procedure by 5 minutes. Since this particular machine averaged 8 jams per shift, they gained 40 minutes of production time per shift or 2 hours per day over 3 shifts.

Note that LOTO equipment and procedures must still be in place for all maintenance tasks that do not meet these exceptions.

A full-size exhaust port, equal to or larger than supply, is a requirement of the ANSI B11.0 GSR and PMMI B155.1-2010 standard for energy isolation devices. This is good for personnel safety in that they can expect the valve to exhaust the downstream air at least as fast as it gets supplied. A huge benefit of this for production is that in productivity. Why? Because the time to lockout and exhaust can be greatly reduced, especially when compared to the exhaust capability of a ball valve that at best has a 1/16" diameter exhaust port even on a 1" ported valve. Exhausting a cubic foot of air at 90 psig with a 1" ported L-O-X® valve (with full size exhaust port) can take only 1.2 seconds whereas exhausting the same amount of air with a similarly sized ball valve can take 4 minutes. That's 200 times longer with the ball valve. **How much is 4 minutes of machine "up time" per lockout worth?**

Energy Savings

The critical workload on most pneumatic cylinder applications is in one direction only. The required air pressure and size of the cylinder is based on this "worst case" scenario. This same pressure level is applied to retract the cylinder as well even though that pressure is usually not needed because there is no real load being moved in that direction. By reducing the pressure applied during the retract stroke, the ROSS EnergySaver® valve can save you as much as 30% on compressed air costs for that application.

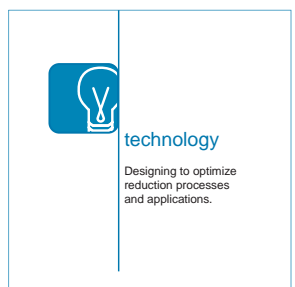
Leaks in compressed air systems are also a huge source of energy waste. Most leaks occur at joints in the piping/tubing. ROSS' modular assemblies replace these joints with O-ring seals, which significantly reduce the normal leak points that are found in most systems, thus reducing the cost of operation over the life of the system. Leaks cost you \$\$ even when the system is not running!

Also, using the ROSS L-O-X® valve with positive on/off construction is a good way to prevent unwanted air from flowing downstream as opposed to ball valves or slide type shut-off valves that provide no feedback that they are fully in the desired "on" or "off" position. The ROSS L-O-X® valve has a positive detent, so that you know when the valve is fully shifted. How often have you seen a ball valve that, upon closer inspection, you find is not quite fully on or off? --- **wasting energy and valuable \$\$\$\$**

Technology

ROSS/FLEX® Expands with New Dale Series

Utilizing the revolutionary new Dale™ cartridge style poppet valve, the ROSS/FLEX® engineering team has greatly expanded their capabilities to meet the requirements of even the most demanding applications. A cost-effective ROSS/FLEX® manifold solution can greatly reduce assemble time, minimize the space required, and alleviates the need for complex and lengthy trouble shooting in the field.



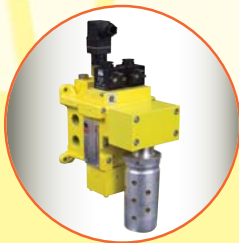


ROSS Safety-related Solutions

ROSS has been manufacturing fluid power products since 1920. In 1954, ROSS patented the first double valve for the most demanding of safety applications: metal forming press clutch and brake control. Since that time, ROSS has patented several improved versions of the double valve and expanded its safety product offering. ROSS has become recognized as the premier supplier of high-quality pneumatic and hydraulic safety components for various applications in metal forming.

- Control-reliable solenoid operated pneumatic valves
- L-O-X® lockout and exhaust pneumatic energy isolation valves
- EEZ-ON® soft start pneumatic valves
- Pilot-operated pneumatic check valves with pressure release
- HOZE-FUZE® air hose blow-out protection

Critical Application Control-Reliable Valve



Critical Application 5-Way Solenoid Valve with Pressure Switch



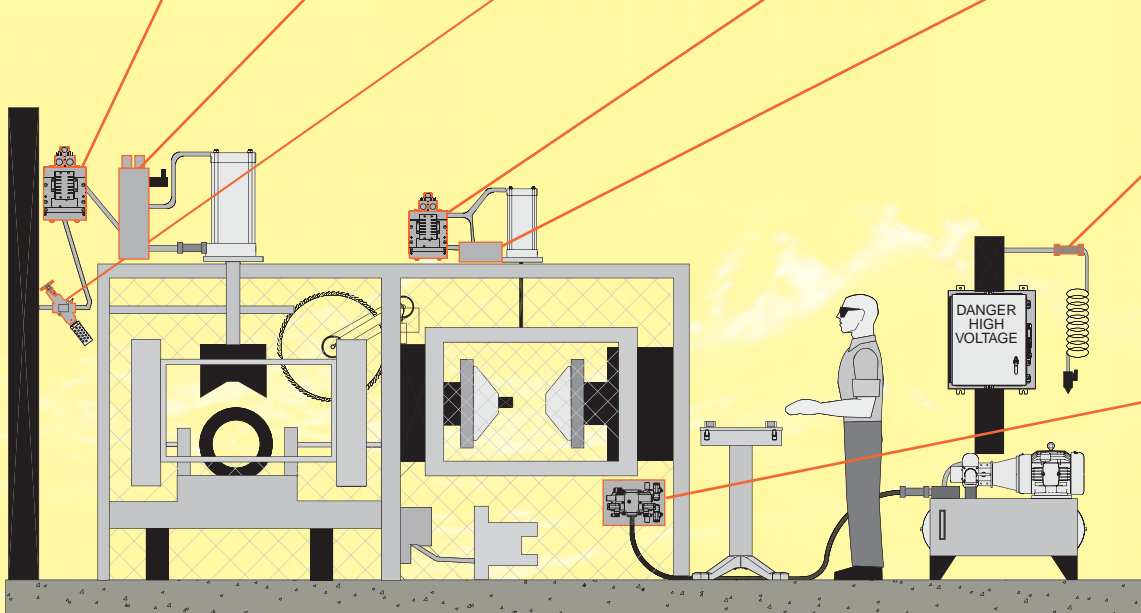
Lockout Isolation & Visual Verification



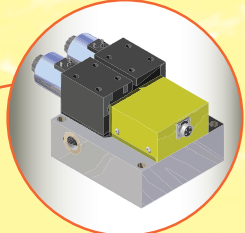
Critical Application Control-Reliable Valve



Load Holding SV27 PO Check with Sensing



Hose Failure Protection



Hydraulic Double Valve



Pneumatic Solutions to Complete your Safety System

ROSS CONTROLS Helps You Address ANSI/PMMA B155.1-2006 Requirements with Control Reliable, Energy Isolation Valves

DM²⁰ Series E Pneumatic Valves
Air Dump/Release

Category
3 & 4
Applications



Safety relays
Safety PLCs

Safety Mats Light Curtains Area Scanners "Electrical Interlocks" (gates, guards, etc.)



Stainless Steel L-O-X[®]
for Energy Isolation

Safety-related Pneumatics Products:

- Energy isolation valves for Lockout
- Electrical / Pneumatic Energy Isolation (LOTO)
- Load-holding valves
- Soft start Lockout-Tagout
- Cylinder Return to Home Position
- Minimize Hose Whip
- Exhaust Noise Reduction
- Wash-Down Applications Cabinets



Pneumatic
Lockout and Safety
Exhaust Valve Cabinet for
Wash-Down

E-mail: sales.info@rosscontrols.com

General Illustration - Safety-related Applications

ROSS Safety-related Applications

- * Cylinder hazard in 2 directions
- * Pinch points
- * Tooling or product damage
- * Single Point Lockout

- * Press clutch/brake
- * Counterbalance
- * Monitored power systems
- * Partial de-energization

- * Vertical loads
- * Cylinder hazard in one direction
- * Load holding

- * Cylinder hazard in 2 directions
- * Cylinder mid-stroke positioning

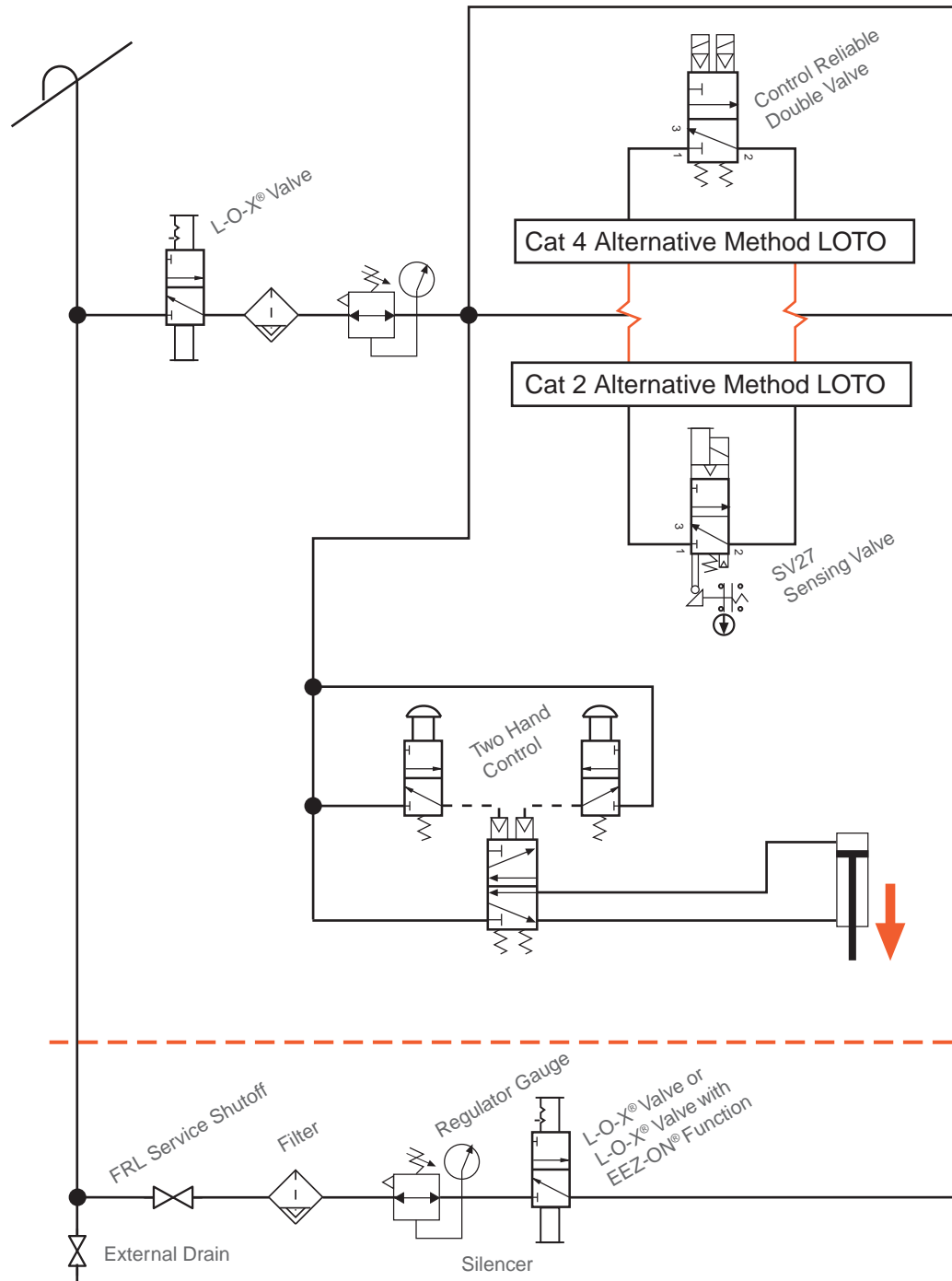
- * Two-hand control

- * Energy isolation
- * EEZ-ON® gradual pressure build-up
- * Noise reduction
- * 2-hand anti-tie-down machine start

- * Hose and/or fitting failure

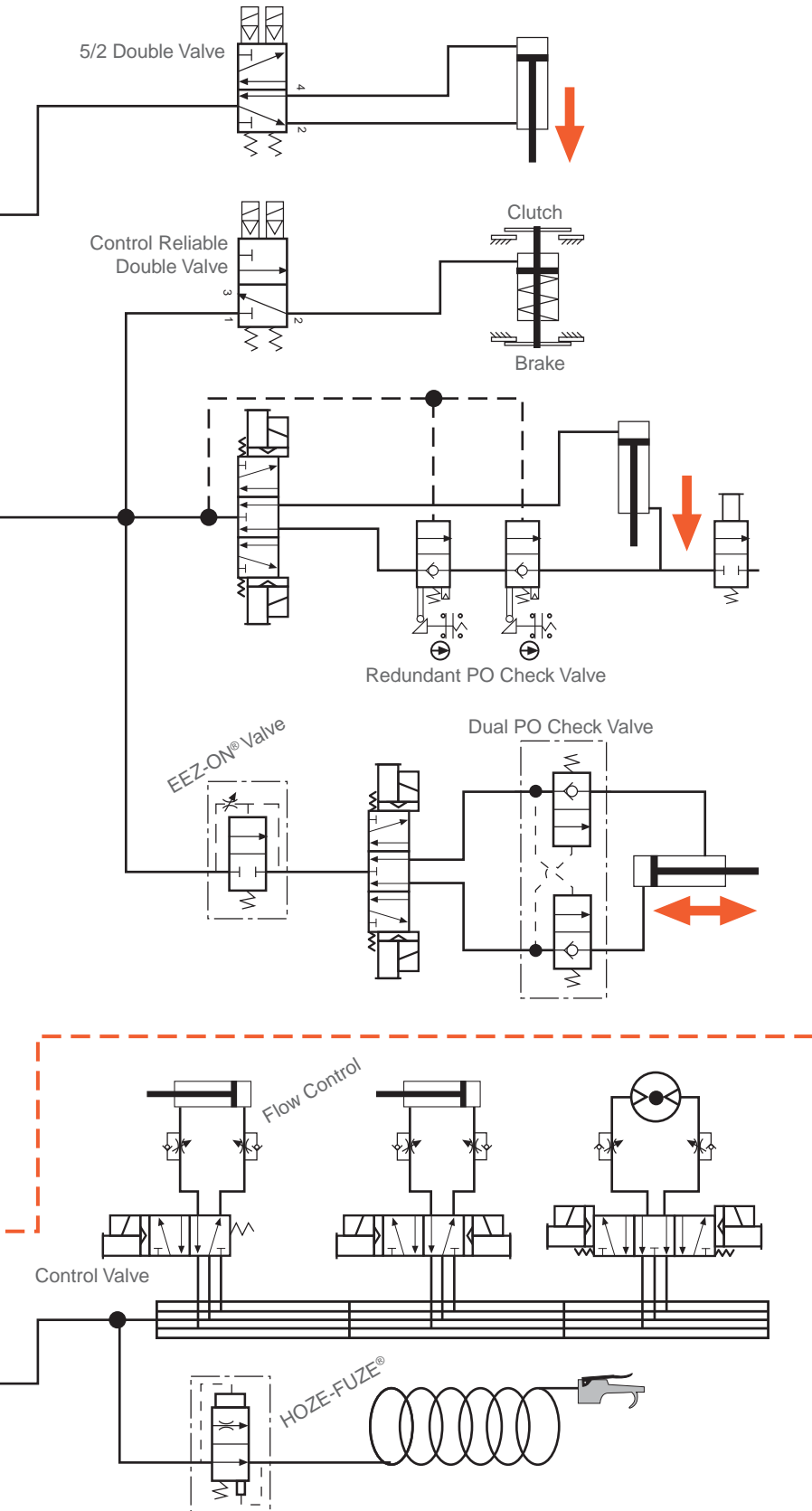
DISCLAIMER

These circuits are illustrative only and not intended to be used literally for your application. Each machine is unique and has individual characteristics that must be considered when designing a safety circuit. In addition, the referenced standards are not an exhaustive list. There may be many additional local, state, national, and international standards as well as machine function specific standards pertinent to your machine. This document is not a substitute for a complete risk assessment of a machine's hazards, professional circuit design or acquiring an in depth understanding of standards/regulations relevant to an application or machine.





General Illustration - Safety-related Applications



Various Safety-related Standards that Apply to Air Systems:

ANSI/ASSE Z244.1-2003 (R2008)
Lockout/Tagout Control of Hazardous Energy

OSHA 29 CFR 1910.147,
 ANSI B11.0-2010
 RIA 15.06
 ISO13849
Machine Safeguarding

ANSI/PMMI B155.1-2010
Safety Requirements for Packaging Machinery

ANSI B11.1
Safety Requirements for Mechanical Power Presses

ANSI B11.2
Safety Requirements for Hydraulic Power Presses

ANSI B11.3
Safety Requirements for Power Press Brakes

ANSI B11.19-2010
Performance Requirements for Safeguarding (Stop Time)

ANSI B11.TR6-2010
Safety Control Systems for Machine Tools

OSHA 29 CFR 1910.211-219
Safeguarding Mechanical Power Presses

A Global Snapshot of Fluid Power and Safety

Valves enhance machine and worker safety

Critical-application safety valves are functionally redundant, self monitoring, and return to a safe position.

It is easy to say that “Safety is everyone’s goal”, but what is really meant by that? Sound workplace safety practices can reduce the risk of injury to not only machine operators but to other people such as maintenance technicians; it can also reduce the risk that there is accidental damage to machinery and other company assets, or harm to the environment. Common industry standards acknowledge that there is no such thing as zero risk, while nonetheless providing guidance to machine builders and operators regarding how to take steps to minimize risks. This is commonly referred to as machine safeguarding. Here’s a look at some key factors.

Control Integrity

The most important point in machine safeguarding is in evaluating the entire system and not just the electrical portion to minimize exposure to unnecessary risk. That’s because systems are rated based on the weakest link in the control chain.

Several standards (including ISO 13849-1:2006, ANSI/ASSE Z244.1-2003 (R2008) and ANSI/PMMI B155.1-2006) define the control system as including not only input, sensing, and interlock devices but also output devices such as pneumatic and hydraulic valves.

The function of a fluid control valve mimics that of an electrical-control relay and, therefore, is subject to the same rules for classifying safety integrity. Thus, properly specified machine safeguarding systems include provisions for pneumatic valves, including:

- Must be functionally redundant
- Must be monitored for faults (including diminished performance faults which may create the loss of redundancy), without depending on external machine controls or safety circuitry
- Must return to a safe position in the event of a loss of pressure or other such event
- Able to inhibit further operation upon detection of a fault condition until such condition is corrected
- Should have a dedicated, specific function-reset input and should prohibit the ability to perform a reset by simply removing or re-applying pneumatic or hydraulic power
- Must not automatically reset

Control reliability is generally considered safety Category-3 or -4 as defined in ISO 13849-1/ EN954-1 Standard for all types of circuits. This ISO standard regarding Category-3 states “a single fault in any of these parts does not lead to the loss of the safety function” and that “a fault shall be detected at or before the next demand upon the safety function.” According further to this ISO standard for Category-4, “an accumulation of undetected faults shall not lead to the loss of the safety function.”

Providing control reliability with fluid power is not quite the same as with electrical controls, however. For instance, plain redundancy in a safety circuit requires the equivalent function of four valve elements, not just two. Two of the four valve element handle the inlet function while the other two elements handle the stop function (energy release). Many self-designed systems risk having hidden, potential flaws, which can lead to unsafe conditions because they are unseen, unexpected and, therefore, excluded from design and safety reviews. A good example is the spool cross-over conditions or ghost positions of a valve, which are usually not shown on schematics.

Two general abnormal conditions can affect valve safety. The first is similar to an electrical-control fault, such as when a relay might be stuck in the open or closed position. The second abnormal condition is when a valve develops diminished performance, as when a valve becomes sticky or sluggish. In these cases the valve reaches the proper position, but slower shifting affects safe stopping distances or precise timing. The ANSI B11.19-2010 Standard mandates a monitoring system that detects these conditions for critical applications and the ANSI/PMMI B155.1-2010 Standard requires diminished performance monitoring if stopping time can be affected. An easy solution is to use a self-monitoring, Category-3 or -4 valve, designed to detect both conditions.

The use of double valves remained relatively unheard of for many years except in a few select industries, such as stamping presses, which first initiated control reliability requirements. Double valves provide dual internal functions (redundancy) so that an abnormal function of one side of the valve does not interfere with the overall normal operation. At the same time, the double valves sense abnormal operation on either side of the valve and then inhibit further operation until the problem has been corrected and the valve deliberately reset. This sensing and inhibiting function is commonly referred to as monitoring.

Two standard air valves, whether in parallel or in series, cannot perform the same safeguarding function as does a double valve critical function. By simply incorporating two standard air valves into the circuit, no provision is made to sense the abnormal operation of one side of the valve or, even more preferable, diminished performance such as slow shifting. In addition, there is no provision for inhibiting further operation of the circuit until the valve is repaired. If one valve actuates abnormally, the second one continues to function and redundancy is lost. The circuit doesn’t recognize lost redundancy nor would it halt operations as a warning that redundancy has been compromised. Then, if the second valve also actuates abnormally, there is no “back up” and control integrity no longer exists.

Double valves are appropriate for pneumatic and hydraulic equipment anytime reliability is an issue. Typical applications include E-stop, two-hand-control, light curtains, safety gates, pneumatic locking devices for safety gates, hydraulic brakes, air brakes, amusement rides, hoists, elevators, pinch-point applications, or any other application where control system integrity depends on valve operation.

Energy isolation

Lockout/tagout (LOTO) is another high-priority safety topic. Under standard LOTO, before a worker can enter a protected area of a machine, all energy must be dissipated and machine-status verified. The standards define the “de-energized” state as existing when all energy sources are disconnected from the machine and there are not any circuits containing residual stored energy. For fluid power, this requires a manually operated energy-isolation valve that must:

- Have a secure and tamper-resistant method of lock attachment
- Be located outside the protected area in an easily accessible location
- Have a method for employees to verify energy dissipation prior to entering the protected area
- Not be used in normal production
- Have a full-size exhaust port (ANSI/PMMI B155.1-2010, CSA Z142-02)
- Be positive acting (only two possible positions)
- Be easily identifiable
- Can only be locked in the off position



Alternative lockout

The ANSI/ASSE Z244.1-2003 (R2008) standard also addresses other lockout techniques, called alternative methods of controls. These systems can save costs and improve machine up time. But alternative methods controls only apply to routine, repetitive tasks that are integral to the production process and are based on risk assessment providing effective personal protection. The machine must still have a standard lockout system for repairs and other tasks.

Alternative methods of controls offer two time-saving advantages. First, it uses a single lock-point (a remote, low-voltage system) that simplifies and speeds lockout, and enhances safety by avoiding the chance of a point being missed. The operator need not travel all around the machine to access various points to lockout or unlock operations. These systems place electrical lockout switches, connected to the control system, at locations that require machine access, and incorporate appropriate safety valves for pneumatic and hydraulic lockout.

The second feature of alternative lockout systems is that not all energy needs to be removed. In fact, sometimes removing all the energy creates a more-hazardous condition. This can result in significant time and cost savings when systems contain large volumes of compressed air.

The standard is also useful for tasks that are not routine, repetitive, or integral to production, but require power for, say, troubleshooting a control circuit. The new standard recognizes that there is no such thing as zero risk, and that some risk is present in order to perform certain tasks. In this case, the standard requires that the control system and valve controlling the non-isolated energy be control-reliable, Category-3 or -4.

Risk reduction

There is no such thing as “zero risk”. Therefore, the standards require that you assess all possible risks, and determine what possible ways can be accomplished for most-effectively reducing those risks.

The best approach to risk assessment is as a team. One big change ANSI B11.0-2010 brought about is that both the machine manufacturer and user are responsible for performing the assessment for new and rebuilt machines. In the past, machine safety was considered the user’s responsibility.

Perhaps the most difficult part is defining the subjective words for the assessment. There are no precise answers, and even the standards differ. Users need to develop their own risk assessment program.

Many companies hold that there are two degrees of injury: minor and major. Minor injuries can be treated with a first aid kit, and anything requiring more extensive care is considered a major injury for risk assessment purposes.

When a company uses a risk matrix that leans toward the “better-to-be-safe” side, the first question is, of course, “Will it entail additional expense to eliminate a rare possibility?” But to error on the high side forces the assessment team to look more carefully at each hazard. Often, safety can pay back in machine up time, reduced employee absenteeism, saving the time and cost to investigate an accident, insurance savings, and other hidden costs involved with accidents. Safety is part of a company’s loss-prevention program.

Avoiding using the wrong category valve should be the primary concern when performing a risk assessment. For example, a circuit with a single valve that suffers a broken spring or a sticky spool would have a different fault result than a similar circuit employing a double valve experiencing a broken spring or sticky valve. ANSI B11.0-2010 sets the recommended minimum level of control integrity as follows.

Highest degree of risk reduction. Control systems having redundancy with continuous self-checking to ensure continuous performance.

High/intermediate risk reduction. Control systems having redundancy with self-checking upon startup.

Low/intermediate risk reduction. Control systems having redundancy that may be manually checked.

Lowest degree of risk reduction. Hydraulic or pneumatic devices and associated control system using single-channel configuration. Here are a few areas which are commonly considered during an assessment for safety and risk reduction in fluid power.

1. Hydraulic accumulator dump valves, which must be monitored or manually operated
2. Pilot operated check valves (PO checks), which are designed to hold a load in place and inherently trap pressure (which must be released during lockout procedures)
3. Use of 3-position all ports blocked valves, which trap pressure
4. Hazard created when a hose or tube fitting blows off
5. Sudden surge of compressed air being reapplied after LOTO, causing cylinders to move quickly and subjecting the machine to shock

For all of these, and more, a complete analysis of the circuit should be taken to uncover potential hazards, even though the hazards have never occurred in the past.

The standards say if it can happen, it must be considered.

To design a control reliable circuit, the engineer must be able to break the reliability chain into links. Each link must represent a control device that meets the control reliability specifications listed above. If the device does not meet all these criteria, it is not considered a control device but only a component for integration into a circuit, thus requiring additional components or requiring even a redesign to achieve control reliability.

Updating a system may not be difficult if the electrical controls are already control reliable. Because some valves have all of the monitoring logic built right in, there is no need to modify existing external control circuitry for valve monitoring. Simply replacing existing pneumatic or hydraulic valves with critical-application valves and properly wiring them into the existing system may easily bring the fluid controls into a control-reliable performance state.

So, the next time you design a circuit, remember that the ANSI, OSHA, ISO, and consensus standards apply to the entire control circuit from beginning to end and you will not break the chain.

Additional resources

ROSS Controls offers an expanded technical reference book, “Fluid Power Safety for Machine Guarding,” a “Risk Locator for Machinery with Pneumatic Power” CD-ROM, and a course in Fluid Power Safety. TOTAL MACHINE SAFETY. For more info, visit www.rosscontrols.com.

Design Standards and Certifications

ROSS valves for Safety-related applications are designed to meet many Global standards including the following:

CSA, Australian AS, EN, ISO, OSHA, ANSI, & CE

When required, ROSS products can be tested and certified by the following authorities:

UL, CSA, TUV, BG

Please visit www.rosscontrols.com for detailed technical information about any product contained in this brochure. Products containing the ROSS CONTROLS® safety logo are certified by ROSS to be engineered and designed for safety-related applications.





GLOBAL Reach with a LOCAL Touch^{VP}

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