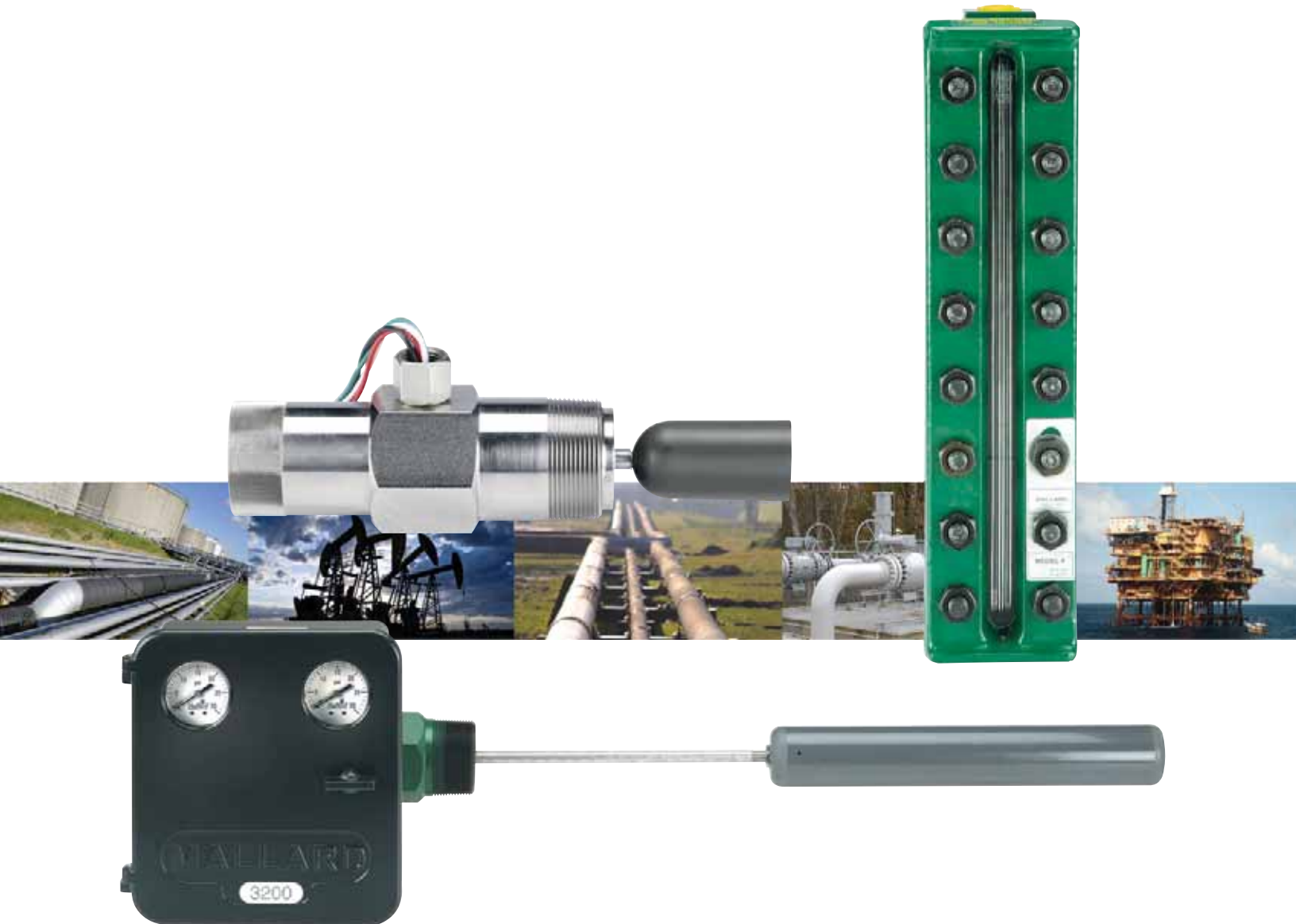


Mallard Control Level Instrumentation



Mallard Model 3100E & 3100P/P1 Liquid Level Switches

Specifications

Model 3100E

Process connection: 2" MNPT
 Maximum operating pressure
 Stainless steel float
 1500 psig
 Polystyrene float
 2000 psig
 Minimum operating specific gravity
 Polystyrene float: 0.50
 316 stainless steel float: 0.68
 Approvals: UL class 1, groups C & D
 Leadwires: 18 AWG x 36" long

Model 3100P/P1

Process connection: 2" MNPT
 Maximum operating pressure
 Stainless steel float
 1500 psig
 Polystyrene float
 2000 psig
 Supply pressure connection
 1/8" FNPT
 Exhaust connection: 1/4" FNPT
 Supply pressure: 30 to 60 psig
 Minimum operating specific gravity
 Polystyrene float: 0.50
 316 stainless steel float: 0.68

The model 3100E is an electric, float-operated switch which can be used as a high or low level alarm or for liquid level control.

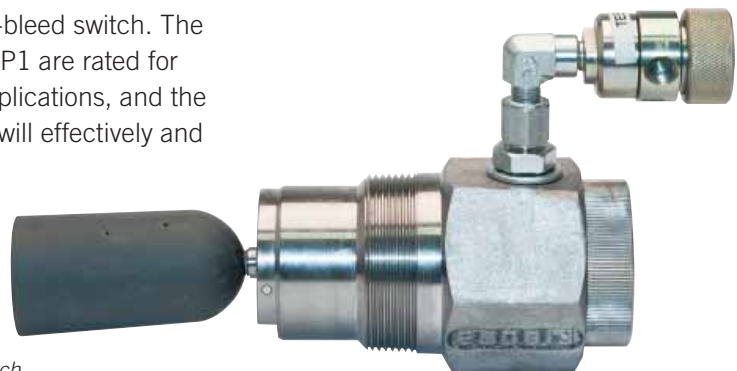
*Model 3100E
 Electric Level
 Switch*



The 3100E is rated for high pressure applications, and the polystyrene float will effectively and consistently operate the switch at specific gravities as low as 0.50. The switch can be mounted directly onto the vessel nozzle or into an external float chamber.

The model 3100P and 3100P1 are pneumatic, float-operated switches for liquid level control. The 3100P is a 2-way normally-open or normally-closed switch and the 3100P1 is a 3-way block-and-bleed switch. The 3100P and 3100P1 are rated for high pressure applications, and the polystyrene float will effectively and

*Model 3100P/P1
 Pneumatic Level Switch*



consistently operate the switch at specific gravities as low as 0.50. Both models can be mounted directly onto the vessel nozzle or into an external float chamber.

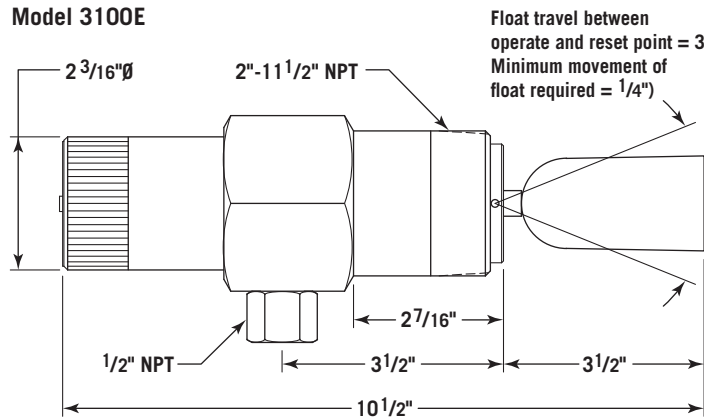
Contents

Model 3100E & 3100P/P1 Liquid Level Switches	2-3
Model 3200/3201 Liquid Level Controllers	4-10
Model 3208-V, 3208-H & 3208-D Chambers	11-15
Model 3900 Liquid Level Controller	16-18
Model 3150 Pneumatic Liquid Level Switch	19
Model 3500/3510 Gauge Valves	20
Model 3520 Liquid Level Gauges	21-23

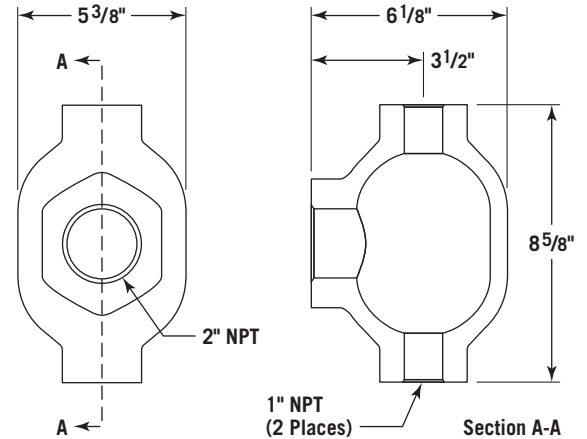
Mallard Model 3100E & 3100P/P1 Liquid Level Switches

Dimensional Data (in.)

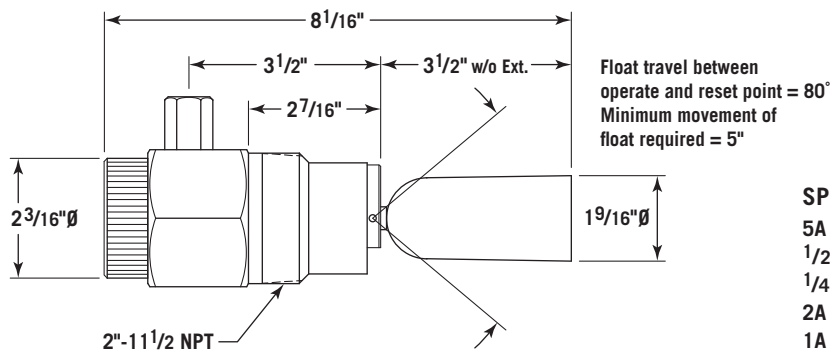
Model 3100E



External Float Chamber - P/N 31124-2 (Standard)
P/N 31124N-2 (NACE)



Model 3100P/P1



SPDT Switch Rating
5A @ 125-250-480 VAC
1/2A @ 125 VDC
1/4A @ 250 VDC
2A @ 6-30 VDC Resistive
1A @ 6-30 VDC Inductive

DPDT Switch Rating
10A @ 125-250 VAC
1/2A @ 125 VDC
1/4A @ 250 VDC
10A @ 6-24 VDC
Inductive/Resistive

Part Number Codes, Model 3100E

Part Number	Model Number	Body	Float (Viton® Seals)	Switch
91200	3100E	CS	Polystyrene	SPDT
91201	3100E2	CS	Polystyrene	DPDT
91210	3100E2	CS	SS	DPDT
91219	3100E	CS	SS	SPDT
91224	3100E2-SS	SS	SS	DPDT
91225	3100E-SS	SS	SS	SPDT
91227	3100E-SS	SS	Polystyrene	SPDT
91232	3100E2-SS	SS	Polystyrene	DPDT

Part Number Codes, Model 3100P/P1

Part Number	Model Number	Body	Float (Viton® Seals)	Pilot
91000	3100P	CS	Polystyrene	No
91001	3100P1	CS	SS, 1" Ext.	Yes
91002	3100P	CS	SS	No
91004	3100P1	CS	SS	Yes
91006	3100P1	CS	Polystyrene	Yes
91008	3100P-SS	SS	Polystyrene	No
91025	3100P1-SS	SS	Polystyrene	Yes
91026	3100P1-SS	SS	SS	Yes
91027	3100P1-SS	SS	SS	No
91206	3100P1	CS	Poly., 1" Ext.	Yes
91207	3100P	CS	Poly., 1" Ext.	No

Materials of Construction

Description	Material
Body	Low Temp CS (Plated) 316 Stainless Steel (Optional)
Float	Polystyrene 316 Stainless Steel (Optional)
Seals	Viton®

Temperature Limits

Model 3100E & 3100P/P1	
Polystyrene Float	Stainless Steel Float
-20 to 300°F (-29 to 200°C)	-20 to 400°F (-29 to 204°C)



Mallard Control

Mallard Model 3200/3201 Liquid Level Controllers

Features

- Pneumatic throttling, snap, or **ECO Pilot™**: Pneumatic model 3200/3201 can be fitted with any of the three pneumatic pilots. A snap pilot for on/off service, a throttle pilot for modulating service, or ECO pilot for environmentally friendly, non-bleed applications. The controller can be quickly and easily converted from one pilot style to another.
- Electric pilots: The model 3200 is also available with explosion proof SPDT or DPDT electric switches.
- Weather-proof case: Utilizes a gasket between its cover and case to seal out the effects of outside weathering.
- Liquid-liquid interface control: The model 3200/3201 is well suited for liquid-liquid interface detection.
- Field reversible action: The model 3200/3201 design makes reversing the controller action simple. Requires no additional parts or special tools.
- Displacers: Mallard offers a variety of displacer materials and designs for the model 3200/3201 to satisfy your design and application requirements. Standard material offerings are PVC, acrylic and 316 stainless steel.
- Available with wetted materials that meet NACE MR0175 specifications for sour service.

The model 3200/3201 liquid level controller is ideal for oilfield scrubber and separator applications. Its rugged and versatile design make it the preferred choice of production operators for reliable service in a wide variety of applications.

Model 3200 is available in pneumatic snap and throttling pilots, or electric SPDT and DPDT limit switches; direct or reverse action; with a variety of displacer sizes, materials, and vessel connections.



Specifications

Available end connection sizes
 Threaded & butt weld: 1.5" & 2"
 Flanged: 2", 3", 4", 6" & 8"

Pilot
 Pneumatic (standard)
 Snap (on/off),
 0-20/0-30 psig output
 Throttle (modulating),
 3-15/6-30 psig output
 Electric (optional)
 SPDT (explosion proof)
 DPDT (explosion proof)

Supply pressure requirement
 3-15 or 0-20 psig output
 20-30 psig min.
 6-30 or 0-30 psig output
 35-40 psig min.

Electric switch rating
 SPDT: 15 amps @ 125, 250 or 480 VAC
 DPDT: 10 amps @ 125, 250 or 480 VAC

Supply & output connections
 Pneumatic pilots: 1/4" FNPT
 Electric switches: 1/2" FNPT

Pressure ratings
 2" threaded: 6000 psig
 Flanged: 6170 psig (2500#)

Materials of Construction

Description	Material
Body	Low Temp Carbon Steel
Case & Cover	Die Cast Aluminum
Pilots	Aluminum w/SS Internals
Pilot Gaskets / Diaphragm	Buna Viton® (Optional)
Gauges	Brass or Brass LF 316SS or 316SS LF (Optional)
Shaft	303 Stainless Steel 316 SS (Optional)
Bearing Blocks	303 Stainless Steel 316 SS (Optional)

Description	Material
Bearings	440C Stainless Steel
Seals	Buna-N Viton® (Optional)
Displacer	PVC Acrylic or 316 SS (Optional)
Displacer Arm	304 Stainless Steel
Vertical Hanger (Swivel)	316 Stainless Steel
Vertical Displacer Ext. Chain	302 Stainless Steel

Mallard Model 3200/3201 Liquid Level Controllers

Operating Temperature Limits

Body Material	Seals	Displacer Material	Temperature Limits	
			°F	°C
Low Temp Viton® and/or Buna with Min. Temp. Rating of -50°F (-46°C)	Buna	PVC	-40 to 140	-40 to 60
		Acrylic	-40 to 180	-40 to 82
		316SS	-40 to 225	-40 to 107
	Viton®	PVC	-20 to 140	-29 to 60
		Acrylic	-20 to 200	-29 to 93
		316SS	-20 to 400	-29 to 204

Displacer Pressure Ratings

Displacer Material	Maximum Pressure (psig)
PVC	6170
Acrylic	6170
316 Stainless Steel	2000 at 180°F (82°C) 1595 at 400°F (204°C)*

*For applications requiring higher pressure ratings for SS displacers, consult factory or your local Mallard representative.

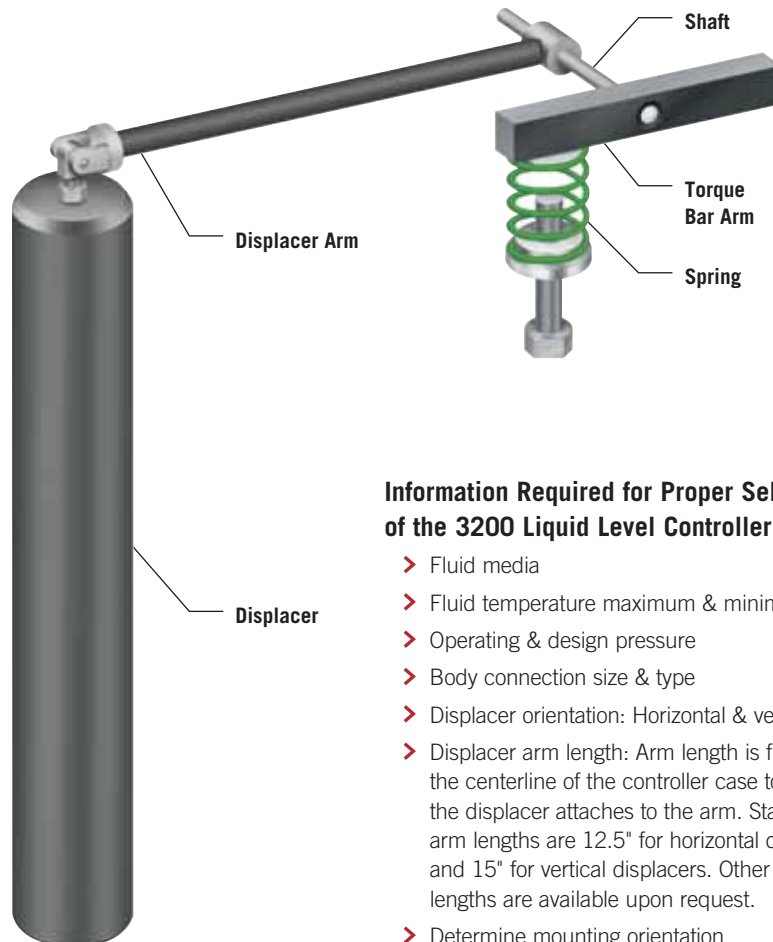
Minimum Allowable Fluid Specific Gravity

Pilot	Top Level Control		Liquid-Liquid Interface Level Control			
	Horizontal Displacer Standard ¹	Vertical Displacer Standard ²	Horizontal Displacer Standard ¹	Horizontal Displacer Special ³	Vertical Displacer Standard ²	Vertical Displacer Special ³
Snap	0.28	0.21	0.28	0.030	0.21	0.050
Throttle	0.56	0.42	0.56	0.060	0.42	0.100

1. Based on 1.88" dia. x 12" displacer with 12" displacer arm.
2. Based on 1.88" dia. x 12" displacer with 15" displacer arm.
3. Special displacer and displacer arm configurations required. Consult factory or your local Mallard representative.

Theory of Operation

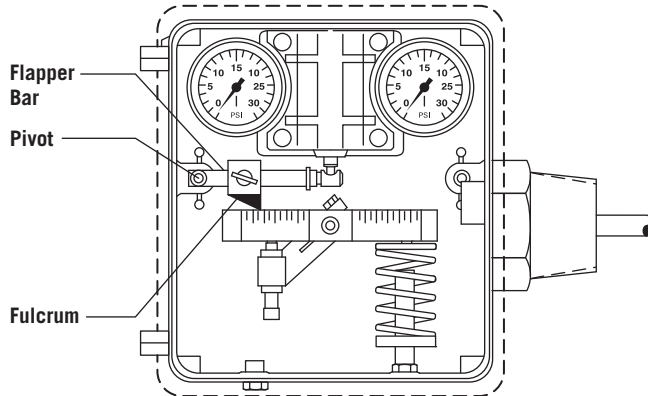
The operation of the model 3200 liquid level controller is based upon the "force balance principle". The weight of a displacer-type level sensing element produces a force which is applied to one side of the torque bar through a series of shafts and levers. This force is balanced by the opposing force of a compressed spring on the other side of the torque bar. As the level rises, the increased immersion of the displacer in the liquid causes the relative weight of the displacer to decrease, due to the buoyancy force being produced. This, in turn, results in a decrease in force applied to the torque bar. The torque bar then rotates until the forces are again balanced. Torque bar rotation is detected by the pilot through a fulcrum mounted on a lever (flapper bar) to affect the desired controller output. The output signal can be a pneumatic on/off signal by using the snap pilot, a pneumatic modulating signal by using the throttle pilot, or it can be an electrical SPDT or DPDT output signal by using an electric limit switch.



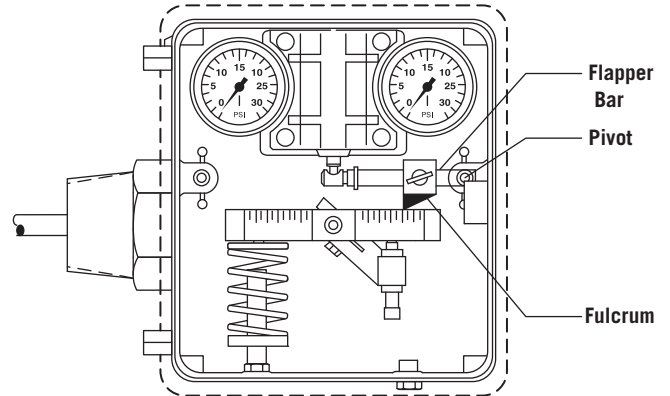
Information Required for Proper Selection of the 3200 Liquid Level Controller

- > Fluid media
- > Fluid temperature maximum & minimum
- > Operating & design pressure
- > Body connection size & type
- > Displacer orientation: Horizontal & vertical
- > Displacer arm length: Arm length is figured from the centerline of the controller case to where the displacer attaches to the arm. Standard arm lengths are 12.5" for horizontal displacers and 15" for vertical displacers. Other arm lengths are available upon request.
- > Determine mounting orientation

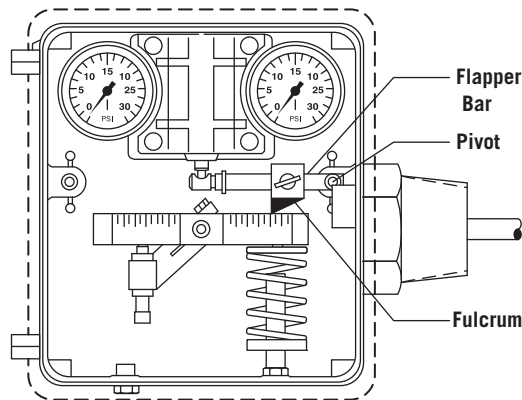
Mallard Model 3200/3201 Action & Mounting



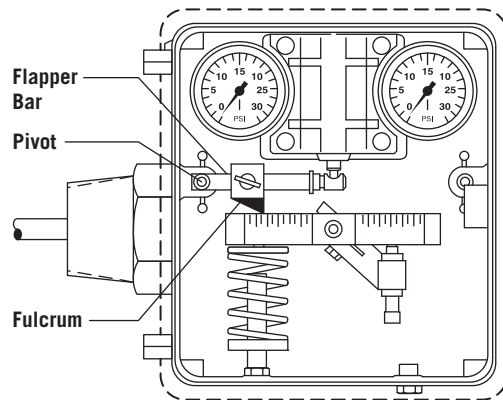
Left-Hand Mount Reverse Acting



Right-Hand Mount Reverse Acting



Left-Hand Mount Direct Acting



Right-Hand Mount Direct Acting

Proportional Band

Proportional band is the ratio of used displacer length versus the total length of the displacer to achieve a desired output signal. Example: If six inches of liquid level change will develop the required output signal (such as 3-15 psi) and a 12" long vertical displacer is used, then the level controller is said to have a 50% proportional band. Sliding the fulcrum on the flapper bar away from the pivot pin toward the snap ring decreases proportional band (increases sensitivity), while sliding the fulcrum on the flapper bar away from the pivot pin toward the spring increases proportional band (decreases sensitivity). A desired output signal (such as 3-15 psi or 6-30 psi) may be accomplished over any portion of the displacer by adjusting the fulcrum as described above.

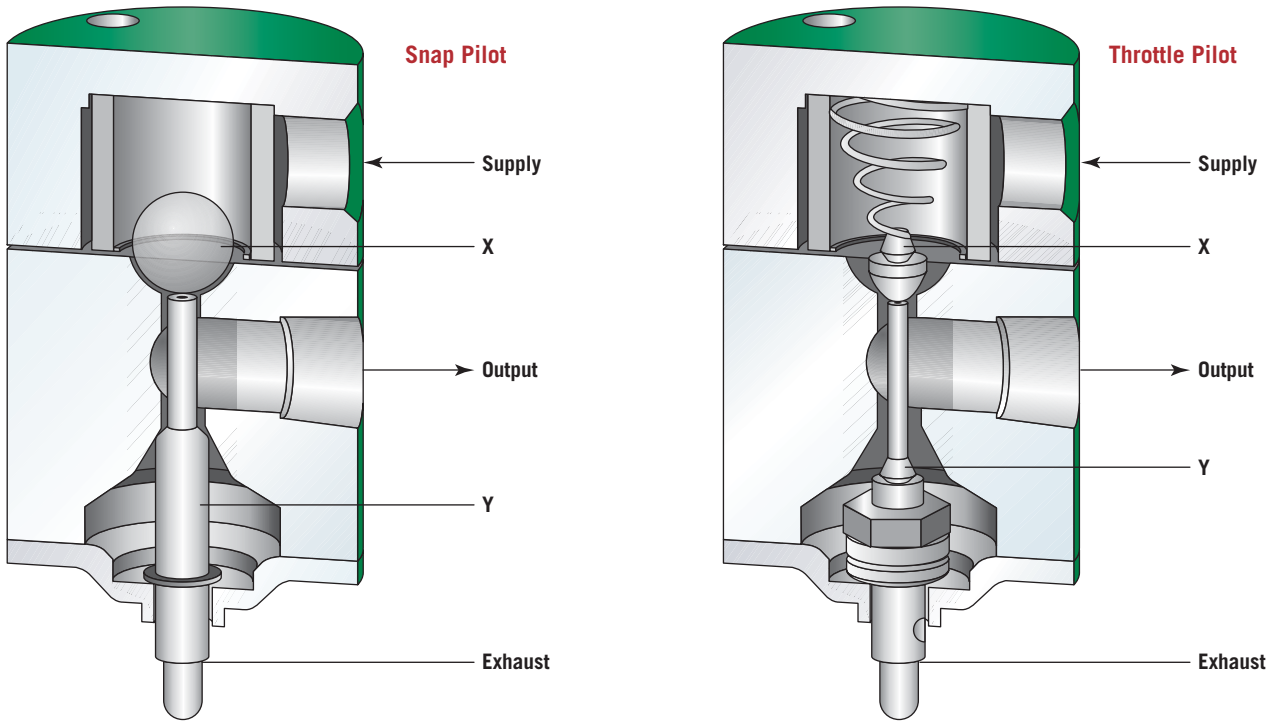
Controller Action

Controller action is determined by the installation of the flapper bar, as shown above. Control is considered "direct acting" when the controller output changes in the controller output signal will increase when the liquid level the controller is sensing increases, and vice versa. Control is considered "reverse acting" when the controller output changes in the opposite direction as the liquid level. For a direct acting controller, the flapper bar pivot point is on the same side as the spring. For a reverse acting controller, the flapper bar pivot point is on the opposite side as the spring.

Mounting

The model 3200 liquid level controller can be set up as right-hand or left-hand mount. The orientation of the level controller mounted to the vessel, while facing the front of the controller, determines the mounting style. If the controller is to be mounted on the right side of the vessel, then it is considered "right-hand". If the controller is to be mounted on the left side of the vessel, then it is considered "left-hand". The mounting orientation can be easily reversed in the field.

Mallard Model 3200/3201 Pilot Operation



Snap Pilot Operation

The snap pilot is made up of two valves. One to admit system supply pressure and one to exhaust system pressure. Ball "X" controls the flow of supply gas into the pilot and is held closed on the pilot seat by force exerted by the supply pressure acting upon the seating area of the ball.

When force transmitted from the flapper bar to the thrust pin "Y" becomes sufficient to overcome the force holding ball "X" seated, ball "X" snaps off the pilot seat allowing supply gas to flow past ball "X" and through the output port of the pilot. The spherical seating end of the thrust pin "Y" seats and closes the exhaust port simultaneously when ball "X" snaps open. The seating area of the thrust pin is smaller than the seating area of ball "X"; therefore, the thrust pin must remain seated against the supply pressure until force on the thrust pin from the flapper bar diminishes.

A simultaneous action occurs as force from the flapper bar on the thrust pin "Y" is removed. When this happens, the supply pressure will unseat the thrust pin and open the exhaust port in the pilot and ball "X" will reseat and close off the supply port. The difference in seating areas gives this pilot its "snap" action.

The **Mallard ECO Pilot™** is an easy and affordable solution to convert your existing level controllers to a more efficient non-bleed design. By reducing fugitive emissions into the atmosphere, oil & gas operators regain lost profits while lowering their carbon footprint.

These simple modifications may soon provide another benefit. According to the Clean Air act and EPA STAR program, such modifications may soon qualify users to earn valuable carbon credits as well.

Throttle Pilot Operation

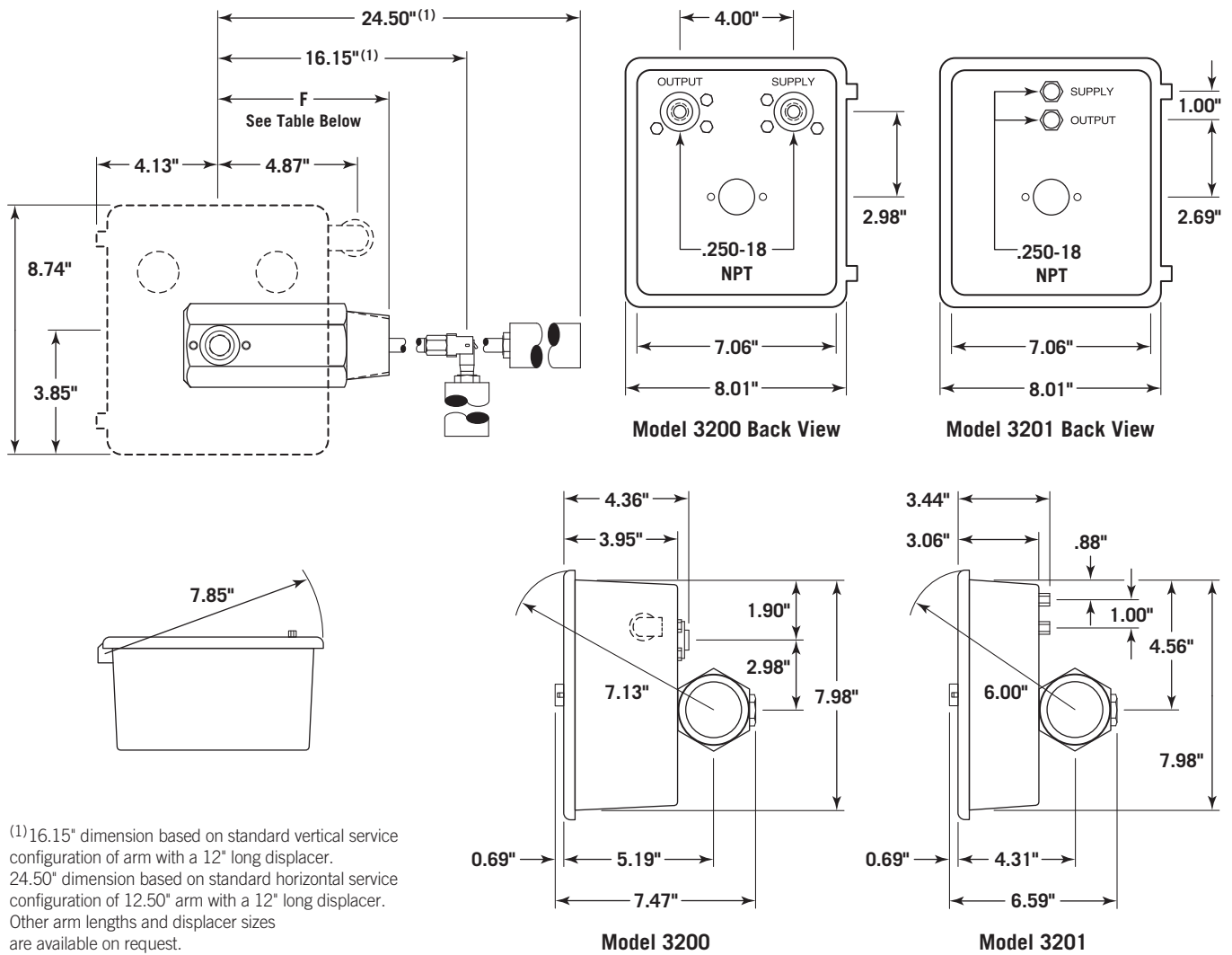
The throttle pilot, like the snap pilot, is also made up of two internal valves. In addition, the throttle pilot utilizes a resilient diaphragm "Z" in conjunction with the valves to create a force balance pilot.

The pilot output supply pressure acts upon the diaphragm "Z" so that the diaphragm pushes back with the same force being applied to the thrust pin by the flapper bar, thus the term force balance.

The throttle pilot functions in a similar manner as the snap pilot except that the output pressure is proportional to the amount of force applied to the lower seat by the flapper bar. An increase in force on the thrust pin produces a proportionate increase in pilot output pressure.

As forces change on the thrust pin, the pilot seeks a new balance point by exhausting the supply output at valve "Y" or unseating valve "X" to increase output pressure. Supply gas does not flow while the pilot is in balance.

Mallard Model 3200/3201 Dimensional Data



(1) 16.15" dimension based on standard vertical service configuration of arm with a 12" long displacer.
 24.50" dimension based on standard horizontal service configuration of 12.50" arm with a 12" long displacer.
 Other arm lengths and displacer sizes are available on request.

Dimension F Data (in., mm)

Vessel Connection	Size (in., mm) / Dimension F								
	2.00		3.00		4.00		6.00		8.00
	in.	mm	in.	mm	in.	mm	in.	mm	in. / mm
Butt Weld / Schedule 80	6.00	152.4	—	—	—	—	—	—	—
Butt Weld / Schedule 160	6.00	152.4	—	—	—	—	—	—	—
Screwed Male NPT	6.00	152.4	—	—	—	—	—	—	—
Grooved End	6.00	152.4	6.88	174.8	6.94	176.3	6.04	153.4	*
150# RF	6.50	165.1	6.56	166.6	6.56	166.6	6.50	165.1	*
300# RF	6.81	173.0	6.75	171.5	6.88	174.8	6.94	176.3	*
600# RF	7.19	182.6	7.12	180.9	7.50	190.5	11.0	279.4	*
600# RTJ	7.25	184.2	7.31	185.7	7.56	192.0	11.0	279.4	*
900# RF	8.00	203.2	9.63	244.6	10.13	257.3	*	*	*
900# RTJ	8.06	204.7	9.69	246.1	10.19	258.8	*	*	*
1500# RF	8.00	203.2	10.25	260.4	10.63	270.0	*	*	*
1500# RTJ	8.06	204.7	10.31	261.9	10.69	271.5	*	*	*
2500# RF	8.50	215.9	11.06	280.9	11.75	298.5	*	*	*
2500# RTJ	8.56	217.4	11.13	282.7	11.81	300.0	*	*	*

Mallard Model 40MU Hammer Union Connection

Features

- > Hammer nut closure for quick & easy installation & removal
- > Built-in sight glasses for local liquid level indication

Options

- > 8" long mating pipe nipple
- > NACE MR0175 compliance

Specifications

Process connection size & type
4" Mallard hammer nut union

Pressure rating: 1500 psig
Max. pressure rating at 100°F (38°C).
Rating dependent on displacer selection

Hammer nut closure designed to be used in conjunction with the model 3200/3201 liquid level controller.

The Mallard union also incorporates compact sight glasses for liquid level indication at the entry point of the level control into the vessel.

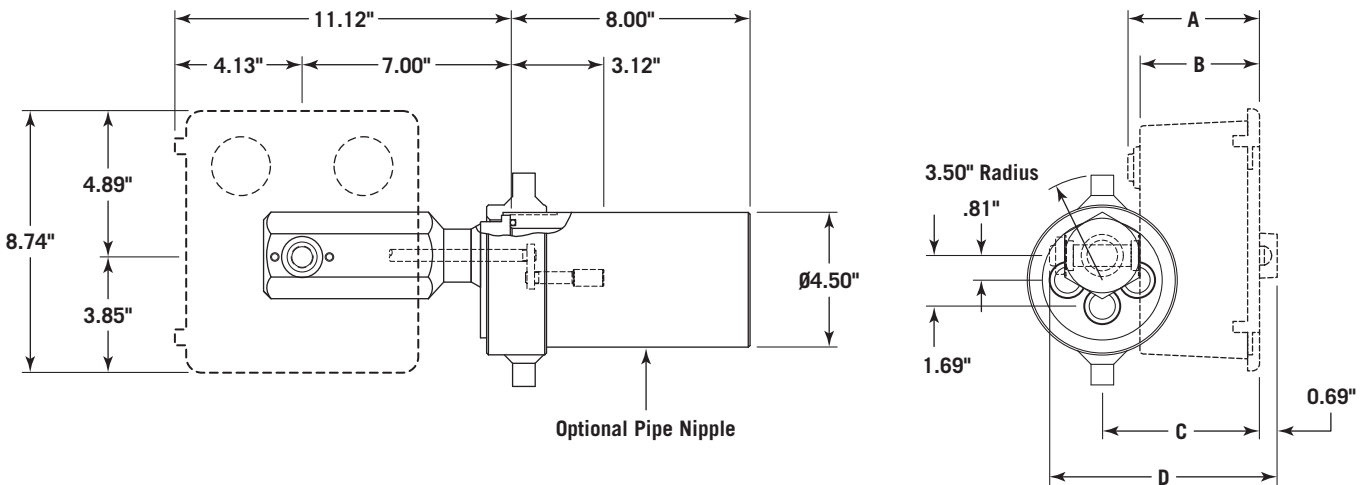


Materials of Construction

Description	Material
Body	Low Temp Carbon Steel
Hammer Nut	Carbon Steel
8" Union Nipple	Carbon Steel
Sightglasses	Acrylic
Reflector	316 Stainless Steel

Description	Material
Seals	Buna Viton® (Optional)
Offset Connector	316 Stainless Steel
Displacer Arms	304 Stainless Steel

Dimensional Data (in.)



See page 5 for part number codes and ordering information.

Mallard Model 3208-V Vertical Style Chamber

Designed to be used with the 3200/3201 liquid level controller in applications where internal obstructions prevent direct installation of the level control, or to isolate the level control from fluid turbulence within the vessel.



Features

- > Rotatable head design
- > NACE MR0175 compliance option
- > Available with threaded or flanged controller & vessel connections

Specifications

Level controller connection
2" threaded or flanged

Vessel connection: 1", 1 1/2" & 2"

Materials of Construction

Description	Material
Chamber & Dome	Carbon Steel or 316SS
Studs	ASTM A193-B7 ASTM A193-B8M (Opt.)
Nuts	ASTM A194-2H ASTM A193-8M (Opt.)
Gasket	316 / Grf. CS Gr. Inconel® / Grf 316SS Gr. (Opt.)

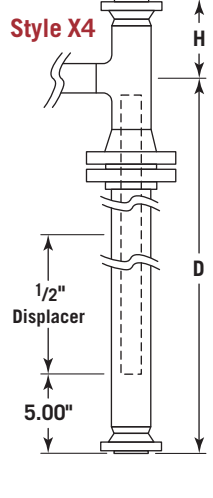
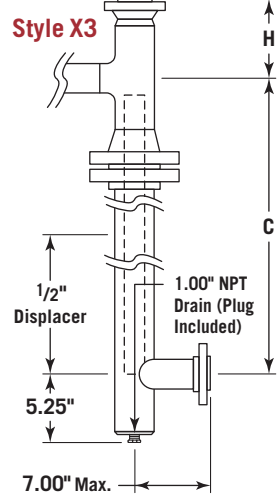
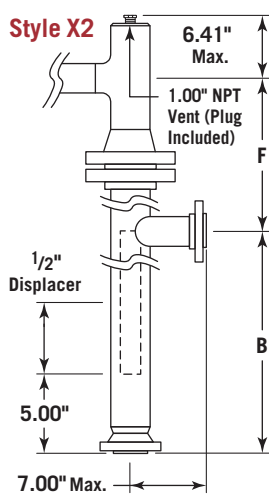
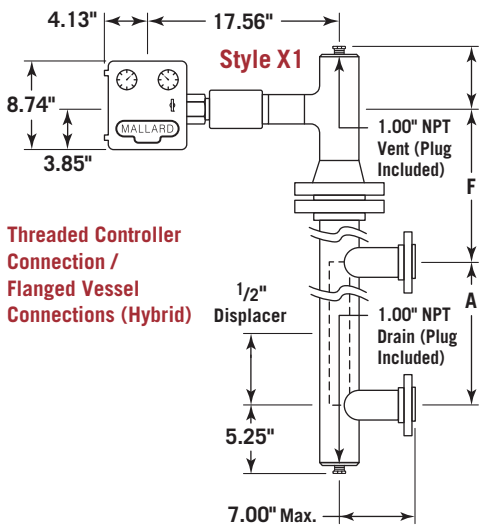
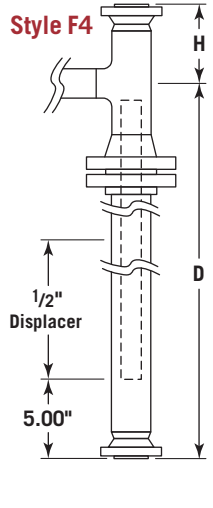
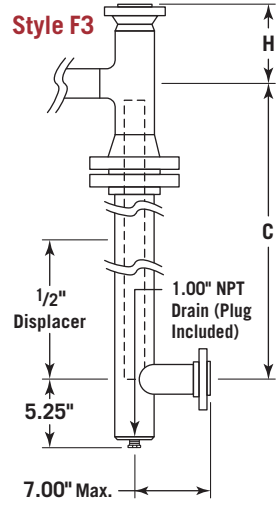
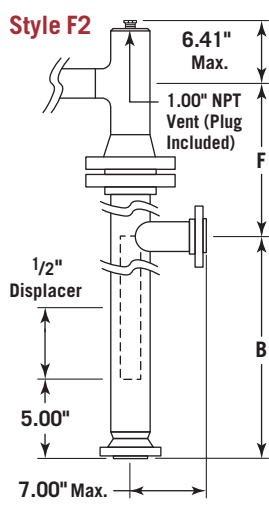
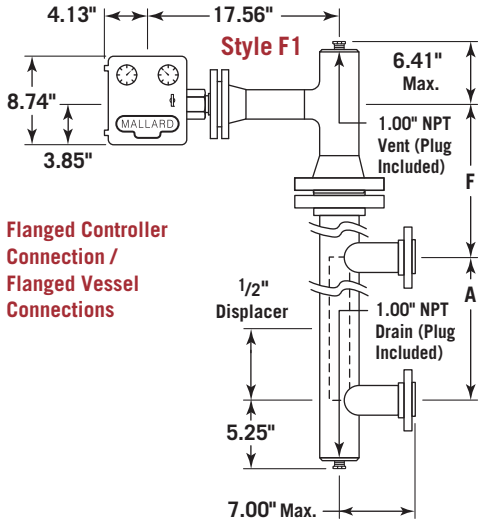
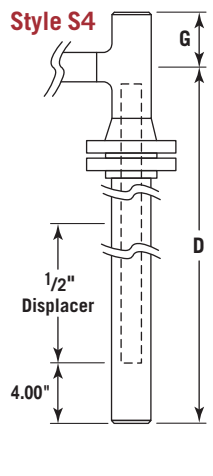
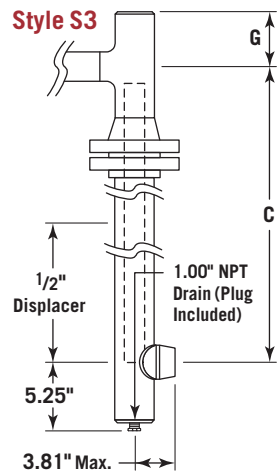
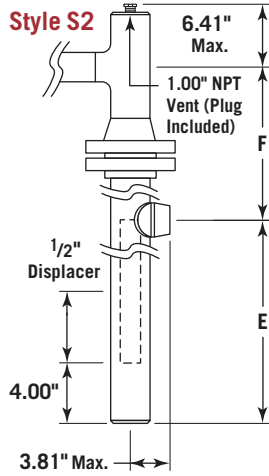
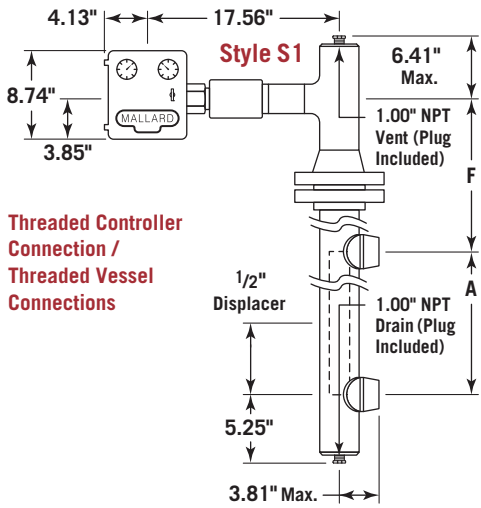
Dimensional Data (in., mm)

Dim.	Style	Displacer Length		in.	mm
		in.	mm		
A	S1, F1, X1	14	355.6	14	355.6
		32	812.8	32	812.8
B	F2, X2	14	355.6	19	482.6
		32	812.8	37	939.8
C	S3, F3, X3	14	355.6	15	381.0
		32	812.8	33	838.2
D	S4, F4, X4	14	355.6	20	508.0
		32	812.8	38	965.2
E	S2	14	355.6	18	457.2
		32	812.8	36	914.4

Dim.	Style	Chamber Size	Vessel Connection		in.	mm
			Size	Rating		
F	S1, S2, F1, F2, X1, X2	3"	All	ANSI 150, 300 & 600	14.25	362.0
			All	ANSI 150 & 300	14.25	362.0
			All	As Required	18.00	457.2
G	S3, S4	3"	All	All	4.91	124.7
			All	All	5.72	145.3
H	F3, F4, X3, X4	3"	1"	150# RF	7.10	180.3
				300# RF	7.35	186.7
				600# RF	7.60	193.0
			1 1/2"	150# RF	7.35	186.7
				300# RF	7.60	193.0
				600# RF	7.91	200.9

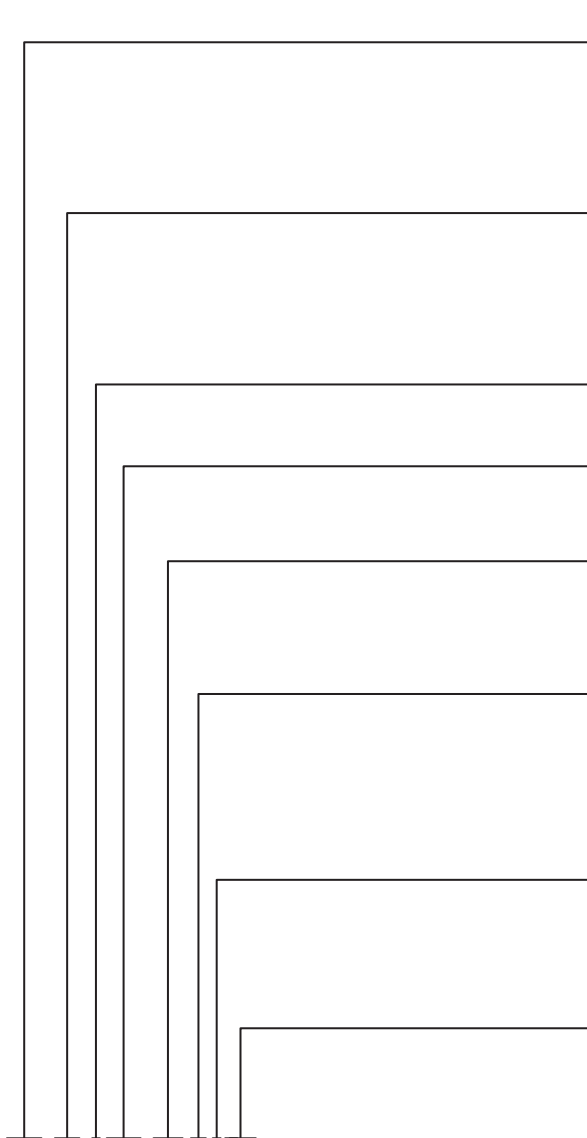
Dim.	Style	Chamber Size	Vessel Connection		in.	mm
			Size	Rating		
H	F3, F4, X3, X4	3"	2"	150# RF	7.41	188.2
				300# RF	7.66	194.6
				600# RF	8.04	204.2
			1"	150# RF	7.91	200.9
				300# RF	8.16	207.3
				600# RF	8.41	213.6
		4"	1 1/2"	150# RF	8.16	207.3
				300# RF	8.41	213.6
				600# RF	8.72	221.5
			2"	150# RF	8.22	208.8
				300# RF	8.47	215.1
				600# RF	8.85	224.8

Mallard Model 3208-V Dimensional Data



Mallard Model 3208-V Vertical Style Chambers

Part Number Codes



3208-V3 F1 -20 RF 6-14
Example

Chamber Size

- V3 • Vertical 3"
- V4 • Vertical 4"

Chamber Style

- F1 • Flanged, Side / Side
 - F2 • Flanged, Side / Bottom
 - F3 • Flanged, Top / Side
 - F4 • Flanged, Top / Bottom
 - S1 • Threaded, Side / Side
 - S2 • Threaded, Side / Bottom
 - S3 • Threaded, Top / Side
 - S4 • Threaded, Top / Bottom
 - X1 • Hybrid, Side / Side
 - X2 • Hybrid, Side / Bottom
 - X3 • Hybrid, Top / Side
 - X4 • Hybrid, Top / Bottom
- (See Page 12 for Reference)

Chamber Material

- • Carbon Steel
- N • CS, NACE MRO175
- S • Stainless Steel
- T • SS, NACE MRO175

Vessel Connection Size

- 10 • 1" 15 • 1½"
- 20 • 2"

Vessel Connection Style

- B8 • BW, Schedule 80
- B1 • BW, Schedule 160
- FS • FNPT, Screwed Female
- RF • Raised Face Flange
- RJ • Ring Type Joint

Chamber Rating

- ANSI Class / Flanged Connections / Screwed Connections**
- 1 • ANSI 150 / V3 or V4 / —
 - 3 • ANSI 300 / V3 or V4 / —
 - 6 • ANSI 600 / V3 or V4 / V3 or V4
 - 9 • ANSI 900 / V4 Only / —
 - 5 • ANSI 1500 / V4 Only / —

Stud & Gasket Material

- Stud & Nut / Raised Face Gasket / Ring Joint Gasket**
- • ASTM A194-2H / 316SS or Grafoil® CS Gr. / CS Solid
 - N • ASTM A194-2H, NACE / Inc. or Grafoil® CS Gr., NACE / CS Solid, NACE
 - S • ASTM A194-SS8M / 316SS or Grafoil® 316SS / 316SS Solid
 - T • ASTM A194-SS8M, NACE / Inc. or Grafoil® 316SS, NACE / 316SS Solid

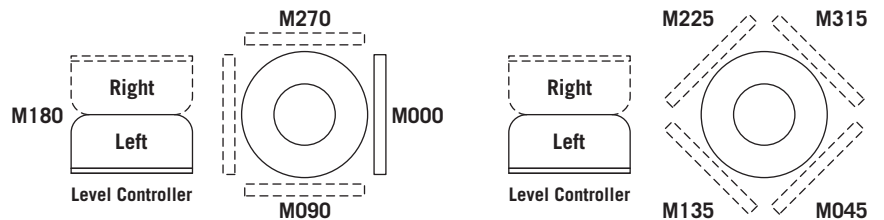
Displacer Length

- 14 • 14" Long 32 • 32" Long Length • Special

Note: All vertical chambers are required to be ordered in conjunction with level controller. See page 5 for level controller part number codes and ordering information.

Vessel Connection Orientation Options with Corresponding Model Codes

Vessel Connection Model Code	Orientation (LLC @ 180°)
M000	0°
M045	45°
M090	90°
M135	135°
M180	180°
M225	225°
M270	270°
M315	315°



Mallard Model 3208-H/3208-D Chambers

Features

- > Compact design for limited spaces
- > Threaded level controller & vessel connections

Specifications

Level controller connection
2" threaded FNPT

Vessel connection
1" threaded FNPT

Materials of construction
Carbon steel or 316 stainless steel

Maximum pressure rating
2000 psi

The model 3208-H horizontal style chamber is designed to be used with the 3200/3201 liquid level controller in applications where

internal obstructions prevent direct installation of the level control, or to isolate the level control from fluid turbulence within the vessel.



Model 3208-H
Horizontal Style Chamber

Features

- > Screwed or flanged level controller connections
- > Multiple vessel connection sizes & flange ratings (ANSI 150 through 2500)
- > NACE MR0175 compliance option

Specifications

Level controller connection
2" FNPT or ANSI flange

Vessel connection sizes: 2", 3" & 4"

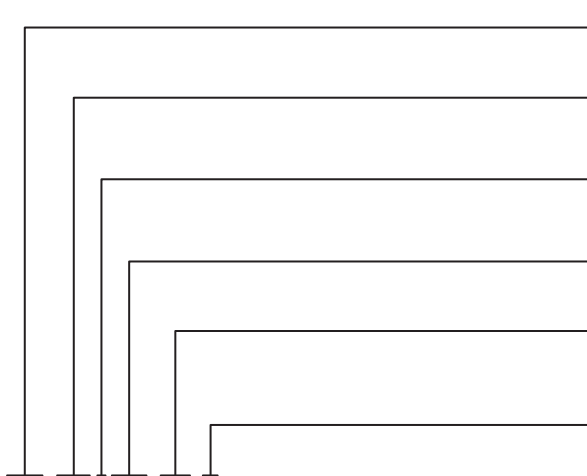
Materials of construction
Carbon steel or 316 stainless steel

The model 3208-D dome style chamber is designed to be used with the 3200/3201 liquid level controller in applications where the vessel connection is located on top of the vessel.



Model 3208-D
Horizontal Style Chamber

Part Number Codes



3208-D4 2S-40 RF 6

Example

Dome Size

D2 • 2" D3 • 3" D4 • 4"

Level Controller Connection

2F • 2" Flanged 2S • 2" FNPT

Chamber Material

- • Carbon Steel S • 316 Stainless Steel
N • CS, NACE MR0175 T • 316 SS, NACE MR0175

Vessel Connection Size

20 • 2" 30 • 3" 40 • 4"

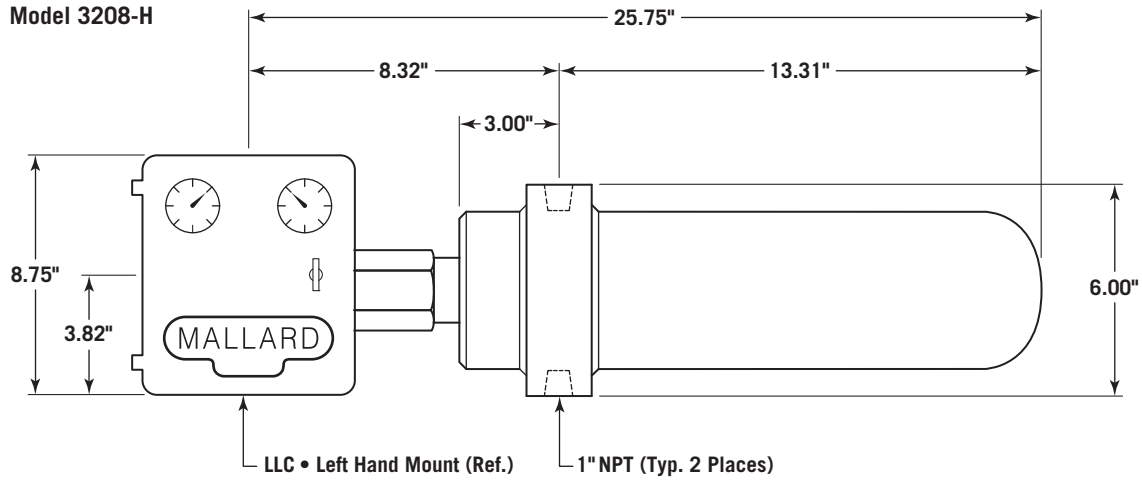
Vessel Connection Style

RF • Raised Face Flange RJ • Ring Type Joint

Vessel Connection Rating

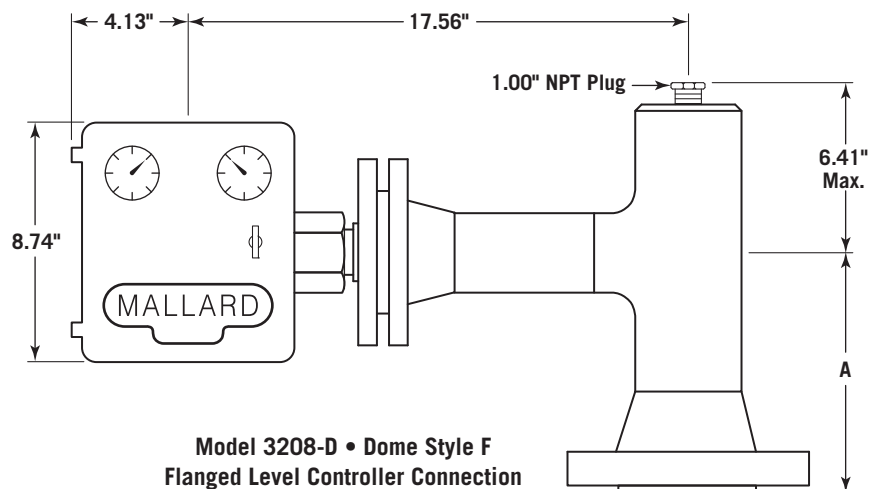
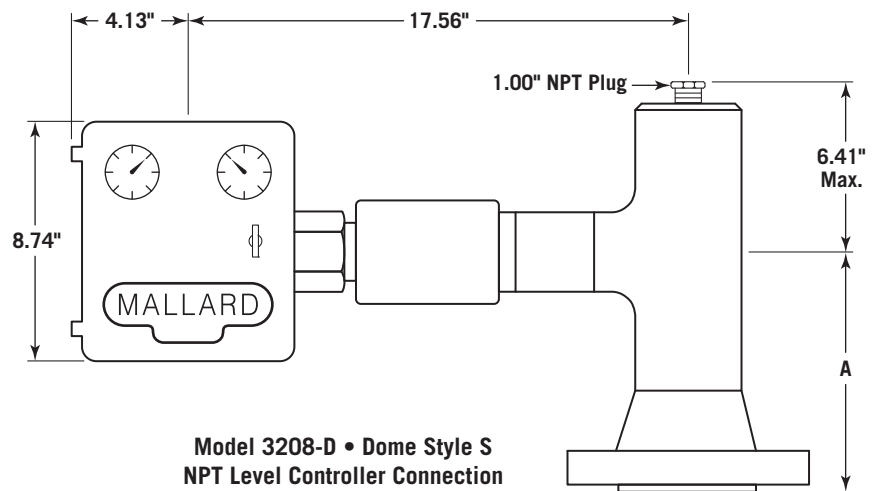
1 • ANSI 150 (285 psig) 9 • ANSI 900 (2220 psig)
3 • ANSI 300 (740 psig) 5 • ANSI 1500 (3705 psig)
6 • ANSI 600 (1480 psig) 2 • ANSI 2500 (6170 psig)

Mallard Model 3208-H/3208-D Dimensional Data



Dimension A Data (in., mm)

End Connection	Dome Size (in.)/Dimension A		
	2.00	3.00	4.00
150 RF	5.00	6.19	7.19
300 RF	5.25	6.56	7.56
600 RF	5.56	6.93	8.44
600 RTJ	5.62	7.00	8.50
900 RF	6.69	7.69	8.94
900 RTJ	6.75	7.75	9.00
1500 RF	6.69	8.31	9.31
1500 RTJ	6.75	8.38	9.38
2500 RF	7.69	10.31	11.69
2500 RTJ	7.75	10.37	11.75
Dome Size (mm)/Dimension A			
150 RF	127.0	157.2	182.6
300 RF	133.4	166.6	192.0
600 RF	141.2	176.0	214.4
600 RTJ	142.8	177.8	215.9
900 RF	169.9	195.3	227.1
900 RTJ	171.5	196.9	228.6
1500 RF	169.9	211.1	237.5
1500 RTJ	171.5	212.9	238.3
2500 RF	195.3	261.9	296.9
2500 RTJ	196.9	263.4	298.5



Mallard Model 3900 Liquid Level Controller

Features

- Electric or pneumatic:
Can be fitted with either a non-bleeding pneumatic snap (on/off) pilot or a SPDT or DPDT electric switch.
- Field reversible switch action:
Changing switch action requires no special tools, no additional parts, and can be easily done without removing the instrument from the vessel. Refer to the switch action section on page 17.
- Field reversible mounting:
Simply follow the instructions provided on the inside of the instrument's cover. No special tools and no additional parts are required.
- Comes standard with stainless steel internals for marine type environments.
- Can be made to meet NACE MR0175 material specifications for sour service.

The model 3900 liquid level controller is a pneumatic snap acting or electric SPDT or DPDT high/low level switch. This rugged instrument applies the same “force balance” control mechanism as the model 3200 liquid level controller,

combined with a compact vertical cage assembly. The model 3900 is designed specifically to meet the level control requirements found on onshore and offshore oil and gas production equipment.



Specifications

Process connection

- Threaded: 1" FNPT
- Flanged: 2"
- Butt weld: 1", 1.5" & 2"
- Socket weld: 1"

Temperature limit:

-20 to 400°F (-29 to 204°C)

Switch type

- Pneumatic snap pilot (on/off), (standard)
- Electric SPDT (optional)
- Rated class I, groups C & D
- Rated class II, groups E, F, G
- Electric DPDT, optional
- Rated class I, groups B, C & D
- Rated class II, groups E, F & G

Min. allowable fluid specific gravity

- Snap pilot: 0.50
- SPDT switch: 0.50
- DPDT switch: 0.75

Supply pressure requirements

(Pneumatic pilot)

- 0-20 psig output: 25 psig supply
- 0-30 psig output: 35 psig supply

Materials of Construction

Level Switch	
Description	Material
Case & Cover	Anodized Die-Cast Alum.
Snap Pilot	Anodized Aluminum with Aluminum Seat & Stainless Steel Internals
Gauges	Brass Internals (Std.) 316 SS Internals (Opt.) 316 Stainless Steel, Liquid-Filled (Opt.) Brass Internals, Liquid-Filled (Opt.)

Electric switch rating

- SPDT: 15A @ 125, 250 or 480 VAC
- DPDT: 10A @ 125 or 250 VAC

Supply & output connections

- Pneumatic pilot: 1/4" FNPT
- Electric switch
1/2" FNPT (conduit connection)

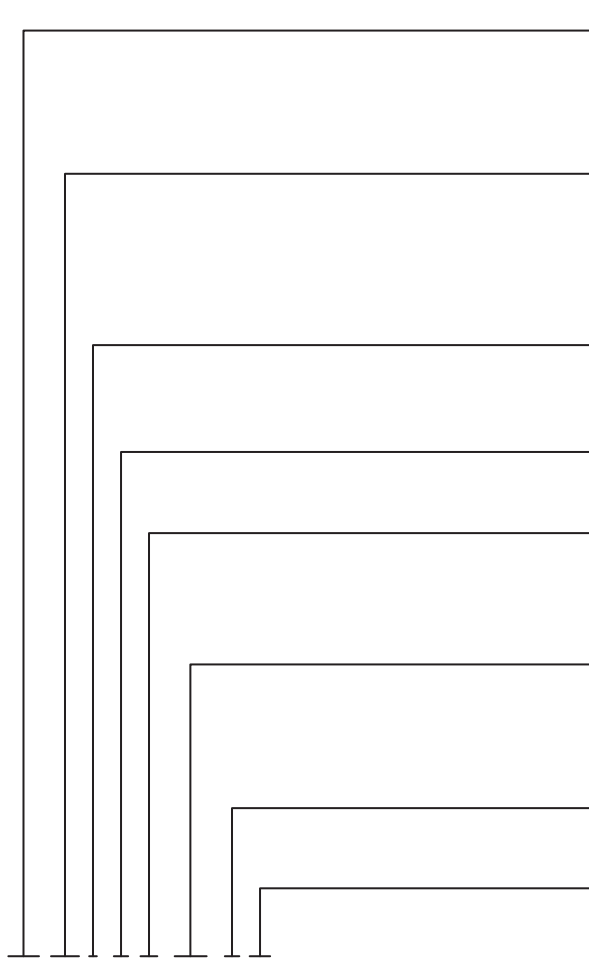
Cage & Body Assembly	
Description	Material
Chamber	Carbon Steel
Body	Carbon Steel
Displacer	316 SS (Std.) Alloy 20 (Opt. for NACE)
Displacer Arm	304 Stainless Steel
Seals	Viton® (Std.) Buna-N (Opt.)

Pressure Ratings, Displacer Cage

End Connection	Pressure Rating (psig)
FNPT, BW, SW	2250
150 RF	285
300 RF	740
600 RF/RTJ	1480
900 RF/RTJ	2220

Mallard Model 3900 Liquid Level Controller

Part Number Codes



3900-10 FS - S V RD-S M
Example

Process Connection Size

10 • 1" 15 • 1.5" 20 • 2"

Process Connection Style

FS • FNPT, Screwed (1" Only) F6 • Flng. RF, ANSI 600
 SW • SW F9 • Flng. RF, ANSI 900
 B4 • BW, Sched. 40 J1 • Flng. RTJ, ANSI 150
 B8 • BW, Sched. 80 J3 • Flng. RTJ, ANSI 300
 B1 • BW, Sched. 160 J6 • Flng. RTJ, ANSI 600
 F1 • Flng. RF, ANSI 150 J9 • Flng. RTJ, ANSI 900
 F3 • Flng. RF, ANSI 300

Controller Materials

Cage & Body / Displacer / Shaft & Block Bearing

- • CS / 316 SS / 303 SS N • CS, NACE / Alloy 20/316SS
 A • CS / 316 SS / 316 SS

Pilot

D • Electric DPDT (Explosion Proof) S • Pneumatic Snap
 E • Electric SPDT (Explosion Proof) Z • ECO Pilot™ (Non-Bleed)

Seal Material

V • Viton® (Standard) B • Buna-N

Mounting Orientation / Switch Action

LD • Left Hand / Direct (Open Pneumatic Pilot on Rising Level)
 LR • Left Hand / Reverse (Open Pneumatic Pilot on Falling Level)
 LE • Left Hand / Electric Pilot
 RD • Right Hand / Direct (Open Pneumatic Pilot on Rising Level)
 RR • Right Hand / Reverse (Open Pneumatic Pilot on Falling Level)
 RE • Right Hand / Electric Pilot

Supply/Output Gauges (0-60 psi)

S • Brass (Standard) 6 • 316 SS E • Electric
 B • Brass, Liquid-Filled D • 316 SS, Liquid-Filled

Case

M • Marine Service N • Marine Service w/Piped Exhaust

Switch Action

Action refers to the change in instrument output that results from a change in instrument input. The input is the liquid level, which is detected through the mechanical force applied to the instrument linkage from the relative weight of the displacer. The output is the "making" or "breaking" of a circuit. A reverse acting level switch is one that "breaks" a circuit on rising level. A direct acting level switch is one that "makes" a circuit on rising level. The model 3900 liquid level switch is available in either direct or reverse acting configurations. For switches equipped with the pneumatic snap pilot, "making" the pneumatic circuit means connecting supply air to the output port in order

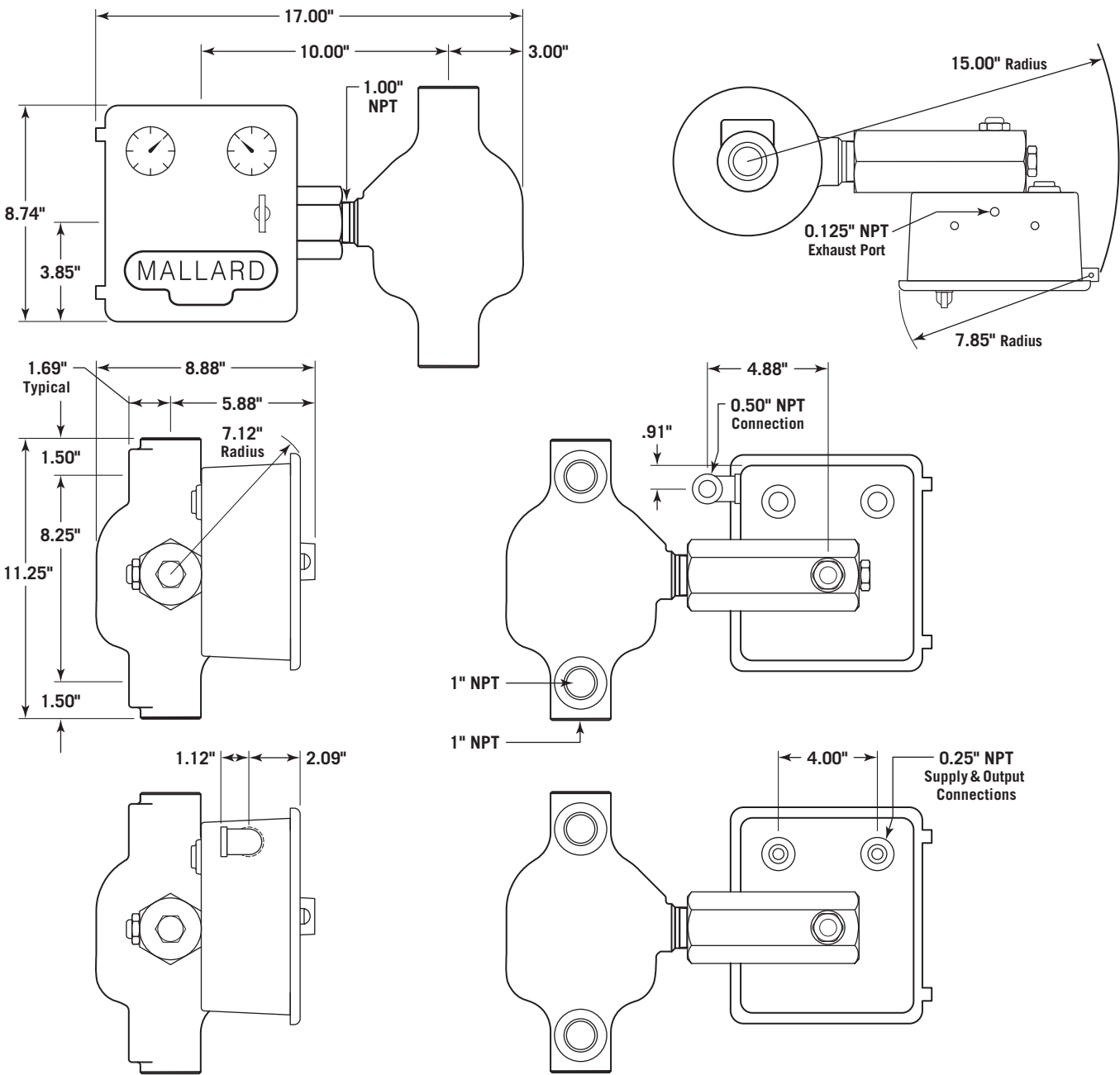
to pressurize a signal-receiving device. "Breaking" the pneumatic circuit is done by connecting the exhaust port to the output port to remove pressure from the signal-receiving device. Changing the switch action is done by moving the flapper bar pivot point to the opposite side of the switch housing. This is easily performed in the field and requires no special tools. For switches equipped with electric SPDT or DPDT pilots, "making" the electrical circuit means closing the electrical contacts, while "breaking" the circuit means opening the electrical contacts. The switch is supplied with three leadwires per set of contacts - "C" (common), "NO" (normally open) and "NC" (normally closed) - and a

ground leadwire. A direct acting switch (contacts to close on rising level) is achieved by using "C" and "NO" wires. A reverse acting switch (contacts to open on rising level) is achieved by using "C" and "NC" wires.

Important Note: Moving the flapper bar pivot point is not necessary to change switch action for electrical switches. All model 3900 switches with electric pilots are shipped from the factory conforming to the above wiring requirements. If the flapper bar pivot point is reversed, the action of the switch contacts will be reversed.

Mallard Model 3900 Liquid Level Controller

Dimensional Data (in.)



Approximate Shipping Weight (lbs., kg)

End Connection	Process Connection (in.) / Weight (lbs., kg)					
	1		1.5		2	
	lbs.	kg	lbs.	kg	lbs.	kg
FNPT	47	21	—	—	—	—
Butt Weld	—	—	—	—	47	21
Socket Weld	47	21	—	—	—	—
150# RF	52	23	54	25	59	27

End Connection	Process Connection (in.) / Weight (lbs., kg)					
	1		1.5		2	
	lbs.	kg	lbs.	kg	lbs.	kg
300# RF	55	25	59	27	63	29
600# RF/RTJ	55	25	63	29	67	31
900# RF/RTJ	64	29	81	37	95	43

Note: Top/bottom connection only



Mallard Control

Mallard Model 3150 Pneumatic Liquid Level Switch

Simple pneumatic level switch device designed for low pressure applications. Available with either 2" NPT or 4" union vessel connection,

the model 3150 is designed with few moving parts to provide consistent, dependable service.

Features

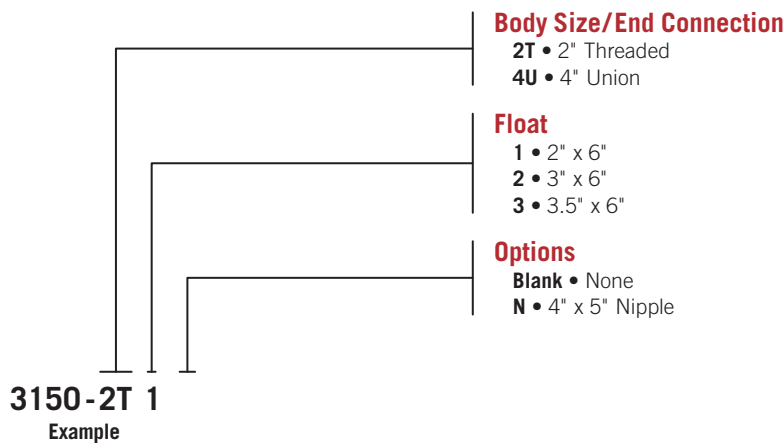
- > Pneumatic pilot
- > Cost effective
- > 2" threaded or 4" union connections
- > Choice of float size & float arm extension length

Specifications

- Body size
2" threaded & 4" union
- Operating pressure limit: 500 psi
- Operating temperature limits
-20 to 212°F (-29 to 100°C)
- Supply pressure: 75 psi
- 3-way pilot connections: 1/4" FNPT



Part Number Codes



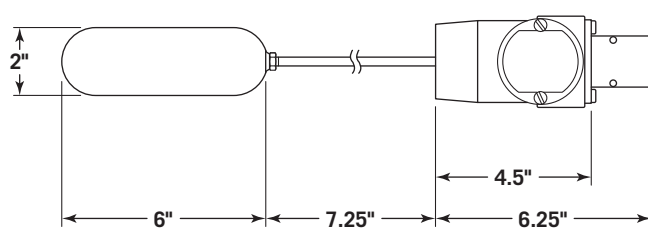
Materials of Construction

Description	Material
Body	Ductile Iron
Float	Stainless Steel
Float Arm	Stainless Steel
Seals	Buna
Bushing	Brass

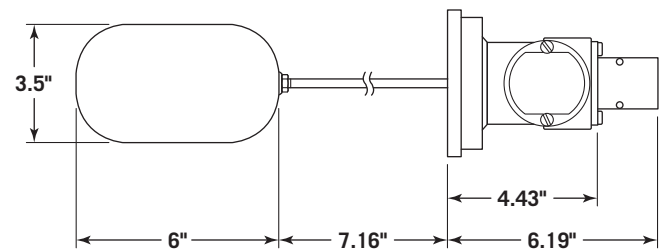
Float Pressure Ratings

Float Size (in.)	Pressure Rating (psi)	
	Working Pressure	Collapse Pressure
2 x 6	500	720
3.5 x 6	500	800
3 x 6	500	850

Dimensional Data (in.)



2" NPT w/Standard Float & Arm



4" Union w/Standard Float & Arm

Mallard Model 3500/3510 Gauge Valves

Features

- Safety shutoff: Equipped with a stainless steel ball check located upstream of the seat, which instantaneously shuts off flow of medium in case of gauge glass breakage.
- Union gauge connection: Allows top and bottom connected gauges to be rotated to any angle for convenient visibility. Enables gauge removal without removing the gauge valves, a significant time saver.
- Offset pattern: Gauge and drain connections are offset 0.75" from the vessel connection centerline, enabling the glass liquid level gauge to be cleaned in place.
- Materials of construction which comply with NACE MR0175 specifications are available on request.

Specifications

- Gauge connections
1/2" or 3/4" FNPT, rigid or union
- Vessel connection
1/2" or 3/4" MNPT, union only
- Seating service
Integral to valve body
- Approximate weight
5.5 lbs. (2.49 kg)
- Maximum operating pressure
4000 psi

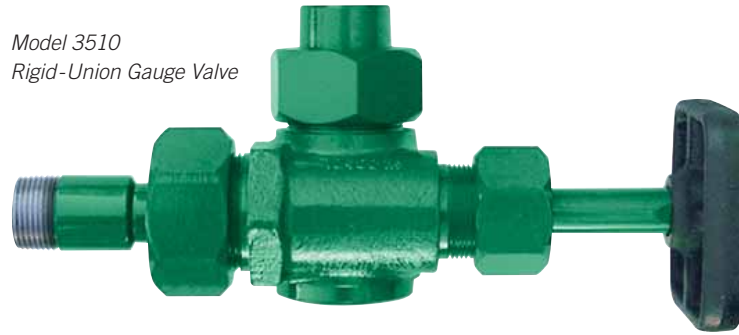
The model 3500 (rigid-union) and model 3510 (union-union) gauge valves are recommended for use with model 3520 glass liquid level gauges and are compatible with all

armored flat-glass liquid level gauges. Consistent with Mallard's reputation, the model 3500 is designed and built to the highest standards.

Model 3500
Rigid-Union Gauge Valve



Model 3510
Rigid-Union Gauge Valve



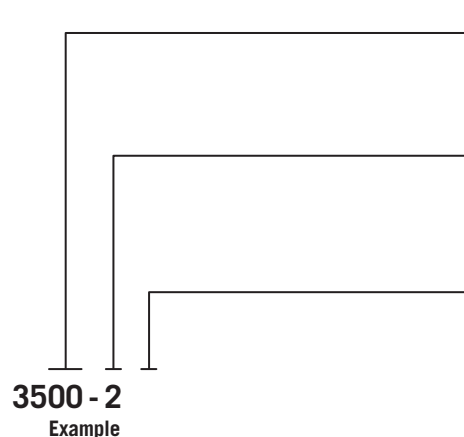
Materials of Construction

Description	Material
Body	Low Temperature Carbon Steel
Stem	416SS (Standard) 316SS (NACE Option)
Ball Check	302 Stainless Steel
Handwheel	Cast Iron

Vent & Drain Connections

Gauge Connection (in.)	Vent / Drain Connection (in.)	
	Model 3500	Model 3510
1/2 NPT	1/2 NPT	1/2 NPT
3/4 NPT	3/4 NPT	3/4 NPT

Part Number Codes



Gauge-Vessel Connection Style

00 • Rigid-Union 10 • Union-Union

Connection Size

Gauge Connection / Vessel Connection

1 • 1/2" FNPT / 1/2" MNPT

2 • 1/2" FNPT / 3/4" MNPT

3 • 3/4" FNPT / 1/2" MNPT

4 • 3/4" FNPT / 3/4" MNPT

Materials of Construction

Blank • Carbon Steel, Standard Service

N • Carbon Steel, NACE MR0175

Note: Sold in two-piece sets.

Mallard Model 3520 Liquid Level Gauge

The model 3520 glass liquid level gauge is a rugged flat glass gauge. Standard construction includes a solid one-piece chamber, steel

covers, alloy steel bolts and nuts, and tempered glass. The model 3520 is available in a variety of materials to meet specific corrosion conditions.



Model 3520
Reflex Liquid
Level Gauge



Model 3520
Transparent
Liquid Level
Gauge

Materials of Construction

Description	Material
Liquid Chamber	Carbon Steel (Standard)
Cover	Carbon Steel
Bolts & Nuts	Steel, Treated to Prevent Rust (Std.) 316 SS (Marine Option)
Glass	Tempered Borosilicate to 800°F (427°C)
Gaskets	Bonded Compressed Fibers or Glass Filled PTFE

Features

- Quality materials:
Tempered borosilicate glass conforms to BS3463, JIS B8211, Din 7080, and DIN 7081. All parts are ASTM grade and listed in ANSI 31.3.
- Quality assurance testing:
All gauges are hydrostatically tested to 1.5 times the rated pressure at 100°F (38°C).
- No-leak design: Recessed gasket seat in chamber and cover prevents leaks often caused by shifting gaskets.
- Liquid-gas or liquid-liquid interface applications:
Available in either reflex or transparent styles to satisfy all application requirements.
- Wetted parts conform to NACE MR0175 specifications
- Marine option: 316 stainless steel bolts and nuts plus three-coat paint system for optimal protection against corrosive environments.

Specifications

Connections
 1/2" Top-bottom (standard)
 3/4" Top-bottom (optional)

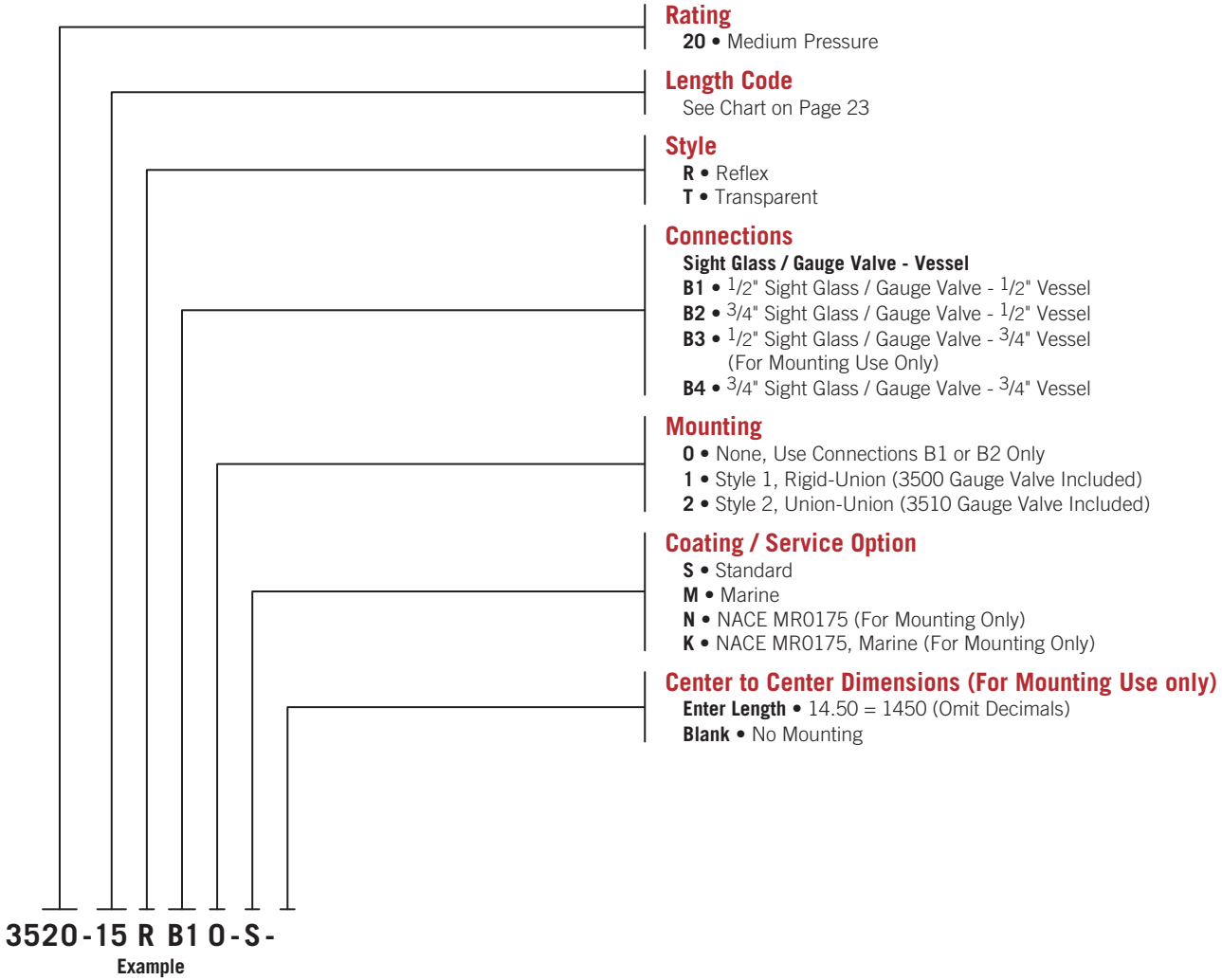
Gauge length
 Gauge sections are available in nine standard glass sizes. For longer size requirements, units are constructed with multiple vision slots in a continuous solid bar chamber.

Pressure Temperature Ratings

Temp. (°F)	Maximum Pressure (psi) / Saturated Steam Rating 300 WSP									Maximum Pressure (psi) / Saturated Steam Using Mica 750 WSP								
	Reflex Gauge Glass Size (in)									Transparent Gauge Glass Size (in)								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
100	3270	3140	3000	2880	2750	2630	2510	2390	2250	2000	1850	1750	1600	1500	1350	1250	1100	1000
200	3090	2970	2860	2740	2620	2500	2380	2260	2150	1900	1780	1660	1550	1440	1300	1175	1060	950
300	2900	2790	2670	2560	2450	2340	2220	2110	2000	1770	1660	1550	1450	1330	1220	1100	1000	900
400	2700	2600	2490	2380	2270	2170	2060	1950	1850	1675	1575	1470	1350	1250	1150	1050	925	850
500	2510	2410	2305	2205	2100	2000	1900	1800	1700	1530	1450	1350	1250	1150	1050	950	850	750
600	2285	2190	2100	2010	1915	1820	1730	1640	1550	1350	1275	1180	1100	1010	925	850	750	675

Mallard Model 3520 Liquid Level Gauge

Part Number Codes



Notes

Mallard Model 3520 Liquid Level Gauge

Length Code & Center to Center Dimensional Data (in., mm)

Length Code	No. of Sections	Length				Center to Center			
		Visible		Overall		3500		3510	
		in.	mm	in.	mm	in.	mm	in.	mm
11	1	3.75	95.25	5.25	133.4	8.13	206.5	11.38	289.1
12		4.75	120.7	6.25	158.8	9.13	231.9	12.38	314.5
13		5.75	146.1	7.25	184.2	10.13	257.3	13.38	339.9
14		6.75	171.5	8.25	209.6	11.13	282.7	14.38	365.3
15		7.88	200.2	9.38	238.3	12.25	311.2	15.50	393.7
16		9.13	231.9	10.63	270.0	13.50	342.9	16.75	425.5
17		10.25	260.4	11.75	298.5	14.63	371.6	17.88	454.2
18		11.88	301.8	13.38	339.9	16.25	412.8	19.50	495.3
19	2	12.63	320.8	14.13	358.9	17.00	431.8	20.25	514.4
23		13.00	330.2	14.50	368.3	17.38	441.5	20.63	524.0
24		15.00	381.0	16.50	419.1	19.38	492.3	22.63	574.8
25		17.25	438.2	18.75	476.3	21.63	549.4	24.88	632.0
26		19.75	501.7	21.25	539.8	24.13	612.9	27.38	695.5
27		22.00	558.8	23.50	596.9	26.38	670.1	29.63	752.6
28		25.25	641.4	26.75	679.5	29.63	752.6	32.88	835.2
29		26.75	679.5	28.25	717.6	31.13	790.7	34.38	873.3
36	3	30.38	771.7	31.88	809.8	34.75	882.7	38.00	965.2
37		33.75	857.3	35.25	895.4	38.13	968.5	41.38	1051
38		38.63	981.2	40.13	1019	43.00	1092	46.25	1175
39		40.88	1038	42.38	1076	45.25	1149	48.50	1232
47	4	45.50	1156	47.00	1194	49.88	1267	53.13	1350
48		52.00	1321	53.50	1359	56.38	1432	59.63	1515
49	5	55.00	1397	56.50	1435	59.38	1508	62.63	1591
57		57.25	1454	58.75	1492	61.63	1565	64.88	1648
58		63.38	1610	66.88	1699	69.75	1772	73.00	1854
59	6	69.13	1756	70.63	1794	73.50	1867	76.75	1949
68		78.75	2000	80.25	2038	83.13	2112	86.38	2194
69		83.25	2115	84.75	2153	87.63	2226	90.88	2308
78	7	92.13	2340	93.63	2378	96.50	2451	99.75	2534
79		97.38	2473	98.88	2512	101.8	2586	105.0	2667
88	8	105.5	2680	107.0	2718	109.9	2791	113.1	2873
89		111.5	2832	113.0	2870	115.9	2944	119.1	3025

Center to center with 1.13" length nipple. To match different center to centers, subtract the longest center to center that will fit needed center to center, divide by 2 and then add the nipple length.

Formula:
 (needed center to center –
 closest center to center from chart / 2)
 + 1.13
 = nipple length needed

Example:
 3500 needed center to center - 25
 (25 – 24.13 / 2) + 1.13
 = 1.57

Example:
 3510 needed center to center - 25
 (25 – 24.88 / 2) + 1.13
 = 1.19

Overall nipple length can be divided between nipples to suit the application.

Minimum length required for each nipple is 1 1/8" for 1/2" NPT nipple and 1 3/8" for 3/8" NPT nipple.

Sizes above Length Code 28 cannot be mounted for shipping purposes.

Notes



CIRCOR Energy is a global manufacturer of highly engineered valve and pipeline products that continuously develops precision technologies to improve our customers' ability to control the flow of the world's natural resources, from sub-sea to land, and in severe environments.

Continuously Improving Flow Control. Worldwide.

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