Model 3201
Liquid Level Switch

The Model 3201 (Figure 1) Liquid Level Controller is ideal for oilfield scrubber and separator applications where level control is required. Its rugged and versatile design make it the preferred choice of production operators. The controller is available in caged or cageless configurations with a variety of vessel connection options, as well as displacer sizes and materials, to provide reliable service in a diversity of applications.

Features:

- **Pneumatic Non-bleeding Pilots** - The Model 3201 level controller can be fitted with either of two non-bleeding pilots. A snap pilot for on/off service or a throttle pilot for modulating service. These pneumatic pilots are interchangeable for "quick change" applications.

- **Field Reversible Action** - The Model 3201 level controller's design makes reversing the controller action simple. Action reversal requires no additional parts or special tools.

- **Field Reversible Mounting** - The Model 3201 level controllers design also makes reversing the body to case mounting orientation of right-hand to left-hand or left hand to right-hand simple. Mounting reversal also requires no additional parts c special tools.

- **Liquid Interface Control** - The Model 320 level controller is ideally suited for liquid interface control. Utilizing a large array of displacer sizes in conjunction with a large selection of displacer arm lengths, interfac applications are considered an every day application for Mallard.

- **Displacers** - Mallard offers a wide variety displacer materials and designs for the Model 3201 level controller to facilitate you design and application requirements. Standard material offerings are PVC, Acrylic, and 316 Stainless Steel.

- **NACE** - The Model 3201 level controller is optionally available with wetted materials that meet NACE MR-01-75 specifications for sour service.

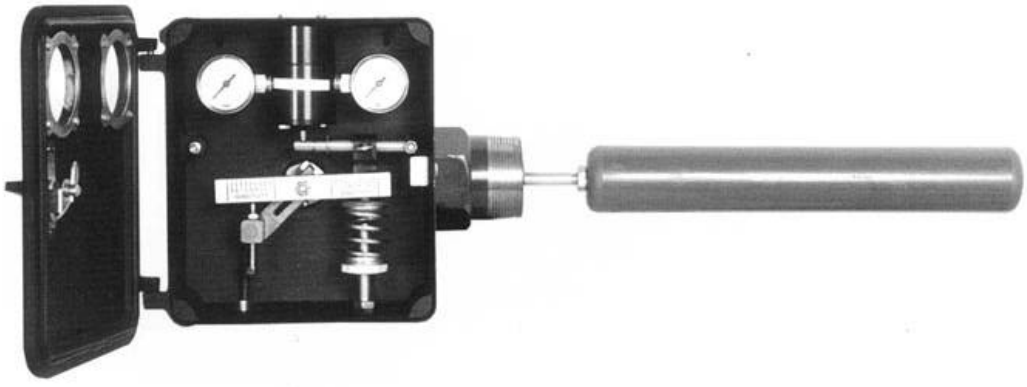


Figure 1. Model 3201 Level Controller

SPECIFICATIONS

Available End Connection Sizes
- Threaded: 1.50" & 2.00"
- Butt Weld: 1.50" & 2.00"
- Flanged 2.00", 3.00", 4.00", 6.00", 8.00"

End Connection / Pressure Ratings(1)
- MNPT / 6000 psig (414 bar)
- 150# RF / 275 psig (19 bar)
- 300# RF / 740 psig (51 bar)
- 600# RF / 1480 psig (102 bar)
- 600# RTJ / 1480 psig (102 bar)
- 900# RF / 2220 psig (152 bar)
- 900# RTJ / 2220 psig (152 bar)
- 1500# RF / 3750 psig (259 bar)
- 1500# RTJ / 3750 psig (259 bar)
- 2500# RF / 6170 psig (426 bar)
- 2500# RTJ / 6170 psig (426 bar)

Available Pilots

Pneumatic	Output
Snap (On/Off)	0-20 / 0-30 psig
Throttle (Modulating)	3-15 / 6-30 psig

Supply Pressure Requirements
- 3-15 psig or 0-20 psig 20-30 psig min.
- 6-30 psig or 0-30 psig 35-40 psig min.

Supply & Output Connections
- 1/4" FNPT

Operating Temperature Limits
See Table 1

Seal Temperature Ratings
- Buna: -20° to 180°F (-29° to 82°C)
- Viton: -20° to 400°F (-29° to 204°C)

1.Maximum pressure ratings @100of/38°c

Diplacer Pressure Ratings
See Table 2

Minimum Allowable Fluid Specific Gravity
See Table 3

Materials of Construction
- MNPT or B.W. Body: A696 Gr. C
- Flanged Body: A696/A105C.S.
- Case & Cover: Anodized Die Cast Aluminum
- Pilots: Anodized Aluminum with Aluminum Seats and SST Internals
- Pilot Gaskets/Diaph.: Buna N (Std.) Viton (Opt.)
- Gauges: Bronze (Std.) 316 SST (Opt.) 316 SST LF (Opt.)
- Shaft: 303 SST (Std.) 316 SST (Opt.)
- Bearing Blocks: 303 SST (Std.) 316 SST (Opt.)
- Bearings: 440C SST
- Seals: Buna N Viton
- Displacer: PVC (Std.) Acrylic (Opt.) 316 SST (Opt.)
- Displacer Arm: 302 SST (Std.)
- Vertical Hanger (Swivel): 316 SST
- Vertical Displ. Ext. Chain:302 SST

Note: Materials certified to meet NACE MR-01-75 specification are available upon request.

Table 1. Operating Temterature Limits

Body Material	seals	Displacer Material	Temperature Limits	
			F	C
C.S	Buna	PVC	-20° to 140°	-29° to 60°
C.S	Buna	Acrylic	-20° to 180°	-29° to 82°
C.S	Buna	316 SST	-20° to 180°	-29° to 82°
C.S	Viton	PVC	-20° to 140°	-29° to 60°
C.S	Viton	Acrylic	-20° to 200°	-29° to 93°
C.S	Viton	316 SST	-20°to 400°	-29° to 204°

Table 2. Displacer Pressure Ratings

Material	Maximum Pressure	
	Psig	Bar
PVC	6170	426
Acrylic	6170	426
316 SST	2000 @ 180°F(1) 1595 @ 400°F	138 @ 82°C(1) 110 @ 204°C

1. 2000 psig pressure rating is based @ 180°F (82°C(1)). The maximum pressure rating @ 400°F (204°C) is 1595 psig (110 bar). For applications requiring higher pressure ratings for SST displasers @ 400°F (204°C), consult Factory or your local Mallard Representative.

Table 3. Minimum Allowable Fluid Specific Gravity

Top Level Control			Interface Differential Detection				
Pilot	Horizontal Displ.	Vertical Displ.	Pilot	Horizontal Displ.		Vertical Displ.	
	Std.(1)	Std.(2)		Std.(1)	Special(3)	Std.(2)	Special(3)
Snap	0.28	0.21	Snap	0.28	0.030	0.21	0.050
Throttle	0.56	0.42	Throttle	0.56	0.060	0.42	0.100

1. Based upon 1.88” Dia. X 12” Lg. Displacer with 12.50” Lg displacer Arm.
2. Based upon 1.88” Dia. X 12” Lg. Displacer with 15.00” Lg. 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 3201 Liquid Level Controller is based upon the "Force Balance Principle", illustrated in Figure 2. 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 or a pneumatic modulating signal by using the throttle pilot.

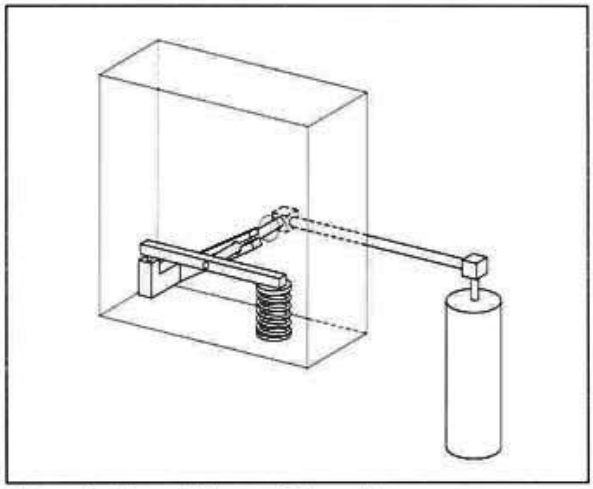


Figure 2. Force Balance Schematic

Controller Action

Controller action is determined by the installation of the Flapper Bar, as shown in Figure 3. Control is considered "Direct-Acting" when the controller output changes in the same direction as the liquid level. For example, 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.

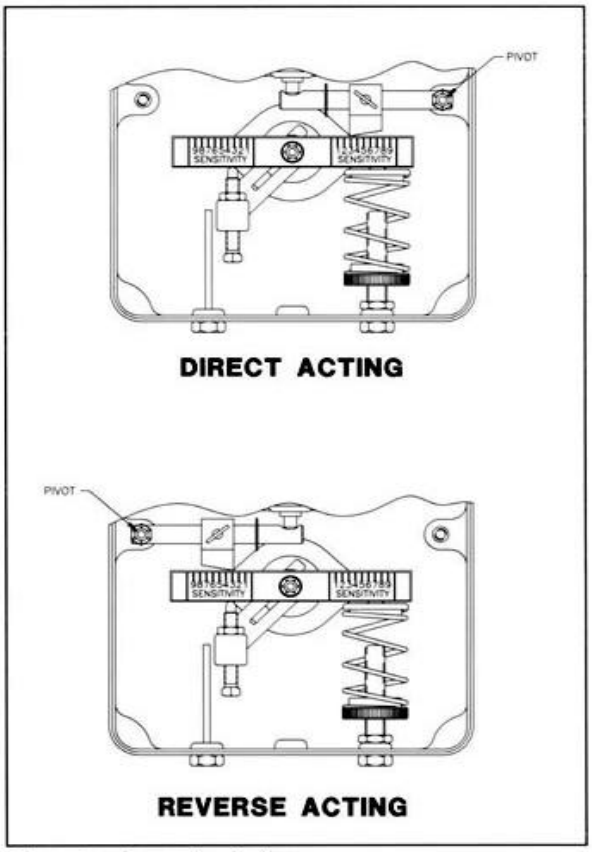


Figure 3. Controller Action

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, while sliding the fulcrum on the flapper bar away from the snap ring toward the pivot pin will increase proportional band. 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.

Snap Pilot Operation

The snap pilot (Figure 4) 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 give this pilot its "snap" action.

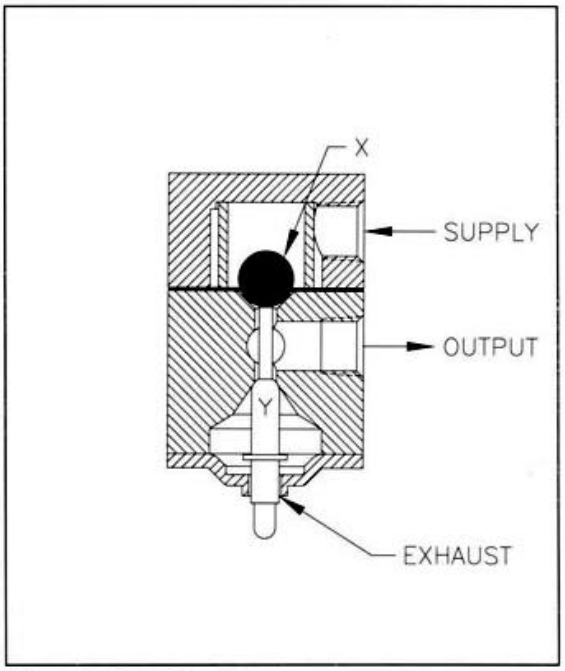


Figure 4. Snap Pilot

Throttle Pilot Operation

The throttle pilot (Figure 5), 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.

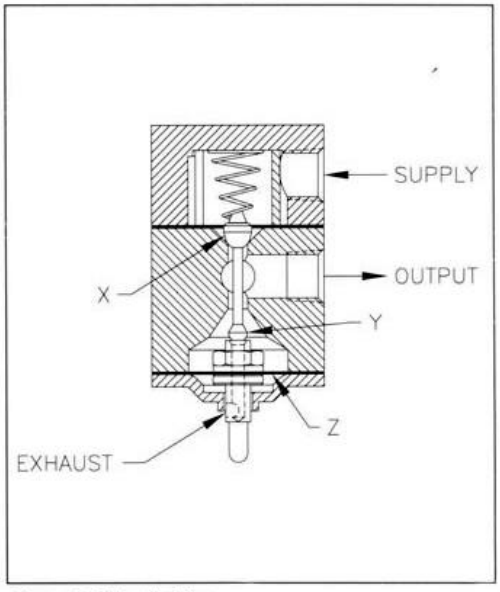
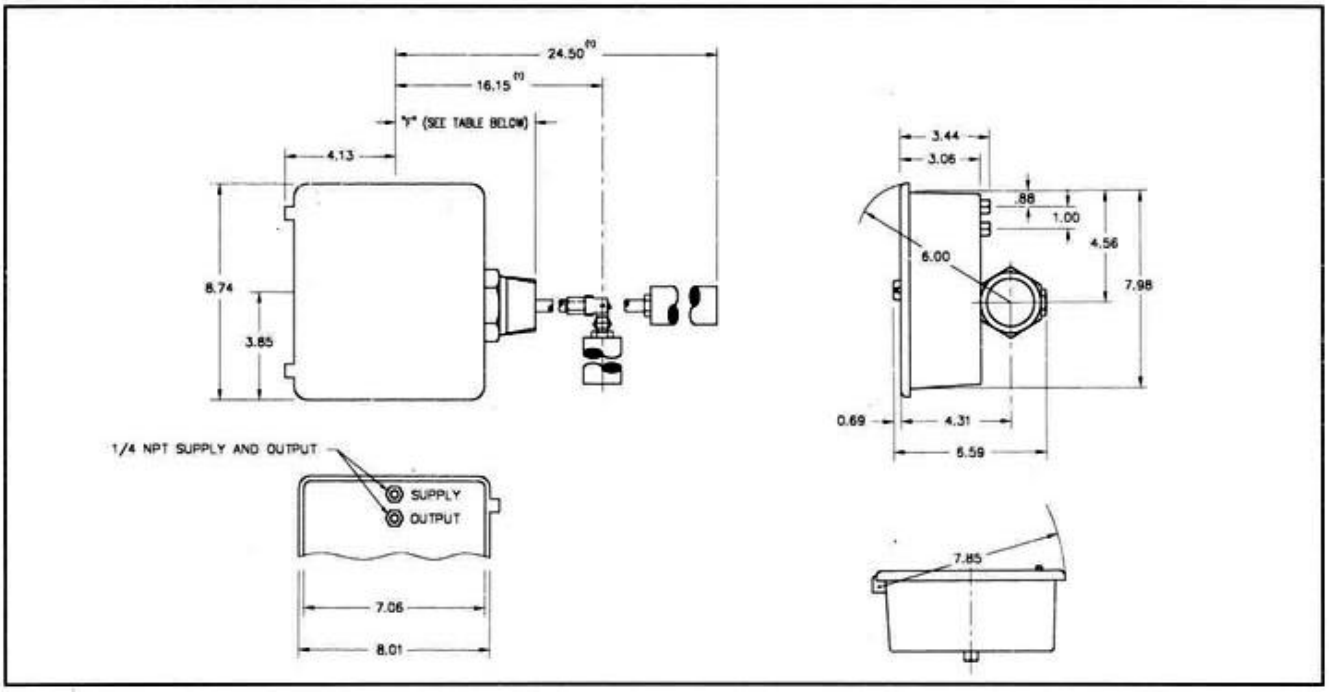


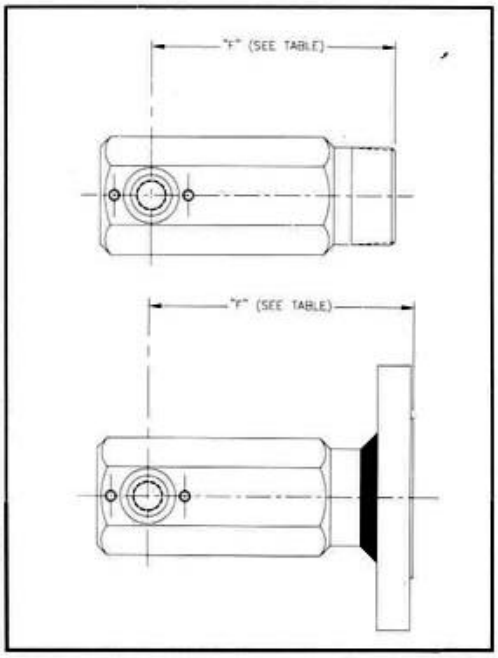
Figure 5. Throttle Pilot

DIMENSIONS:



(1) 16.15" dimension based upon standard vertical service configuration of 15" arm with a 12"lg. Displacer. Other arm lengths and displacer sizes are available upon request. 24.50" dimension based upon standard horizontal service configuration of 12.50" arm with a 12" lg displacer. Other arm lengths and displacer sizes are available upon request.

Dimension "F"					
Body End connections	Body size				
	2.00	3.00	4.00	6.00	8.00
Butt-Weld Sch.40	6.00	-	-	-	-
Sch.80	6.00	-	-	-	-
Sch.160	6.00	-	-	-	-
Sch.XXH	6.00	-	-	-	-
Slip-on	6.00	-	-	-	-
Screwed Male NPT	6.00	-	-	-	-
Grooved	6.00	6.88	6.94	6.04	*
150# RF	6.50	6.56	6.56	6.50	*
150# RTJ	6.69	6.88	6.88	6.69	*
300# RF	6.81	6.75	6.88	6.94	*
300# RTJ	7.06	7.00	7.25	7.19	*
600# RF	7.19	7.12	7.50	7.62	*
600# RTJ	7.25	7.31	7.56	7.69	*
900# RF	8.00	9.63	10.13	*	*
900# RTJ	8.06	9.69	10.19	*	*
1500# RF	8.00	10.25	10.63	*	*
1500# RTJ	8.06	10.31	10.69	*	*
2500# RF	8.50	11.06	11.75	*	*
2500# RTJ	8.56	11.13	11.81	*	*



Information Required for Proper Selection of the 3201 Liquid Level Controller:

1. Fluid Media
2. Fluid Temperature: Maximum & Minimum
3. Operating & Design Pressure
4. Body Connection Size & Type
5. Displacer Orientation: Horizontal or Vertical
6. 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 121/2" for Horizontal displacers and 15" for Vertical Displacers. Other arm lengths are available upon request.
7. Determine mounting orientation (See Figure 6).

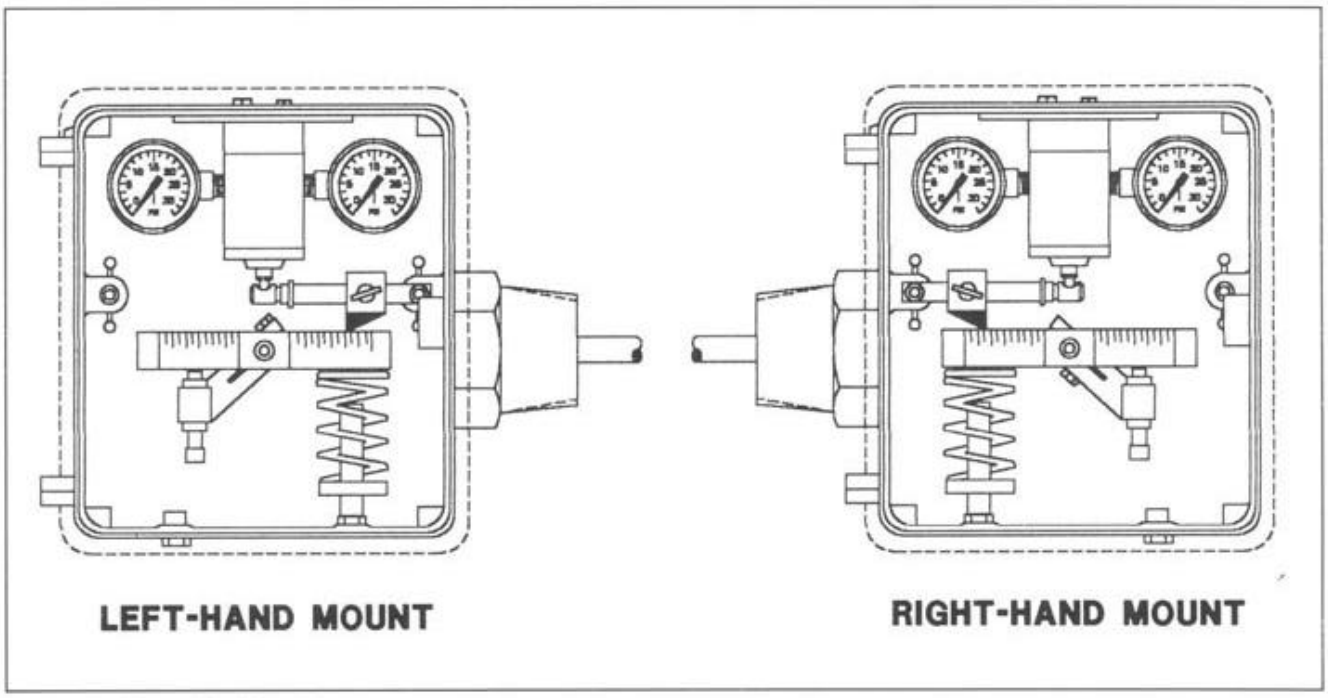


Figure 6. Controller Mounting

Right Hand Mount vs. Left Hand Mount

The Model 3201 Liquid Level Controller can be setup as Right Hand Mount 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.

Model Number Informataion

Sample Model Number: 3201 - 20 MS 0 - S RD B - S A

END CONNECTION SIZE	CODE
1.50"	15
2.00" (Standard)	20
2.50"	25
3.00"	30
4.00"	40
6.00"	60
8.00"	80

END CONNECTION TYPE	CODE
Screwed MNPT (Standard)	MS
Grooved	GR
Butt-Weld, Sch. 40 (1.50-2.00 Only)	B4
Butt-Weld, Sch. 80 (1.50-2.00 Only)	B8
Butt-Weld, Sch. 160 (1.50-2.00 Only)	B1
Butt-Weld, Sch. XXH (1.50-2.00 Only)	BX
Union Type	UT
For Slip-On Flange	SO
Raised Face Flange	RF
Ring Type Joint Flange	RJ
Special - to be specified	SP

PRESSURE RATING	CODE
MNPT (6000 psig) (Standard)	0
ANSI 150 (275 psig)	1
ANSI 300 (740 psig)	3
ANSI 600 (1480 psig)	6
ANSI 900 (2220 psig)	9
ANSI 1500 (3750 psig)	5
ANSI 2500 (6170 psig)	2
Other	X

MATERIALS OF CONSTRUCTION			CODE
Body	Shaft	Brg. Block	
1018 / A105 C.S.	303 SST	303 SST	-
1018 / A105 C.S.	316 SST	316 SST	A
1018 / A105 C.S. (NACE)	316 SST	316 SST	N

PILOT	CODE
Snap (Pneumatic On/Off)	S
Throttle (Pneumatic Modulating)	T

MOUNTING / CONTROLLER ACTION	CODE
Left Hand / Direct	LD
Left Hand / Reverse	LR
Right Hand / Direct	RD
Right Hand / Reverse	RR

SEAL MATERIAL	CODE
Buna-N (Standard)	B
Viton	V
Special - to be specified	X

GAUGE TYPE	CODE
Brass Internals (standard)	S
316 SST Internals	3

CONTROLLER CASE	CODE
Standard	A

Mallard Control Company, Inc.

P.O.Box 7554

Beaumont, Texas, USA 77726-7554