

# GVO Series Pneumatic Linear Valve Operators

## Field-Proven for Safety Shutdown and Control



**BETTIS**

  
**EMERSON.**  
Process Management

**Promotes  
Reliability  
and Safety**

**Operates a Broad  
Range of Valves**

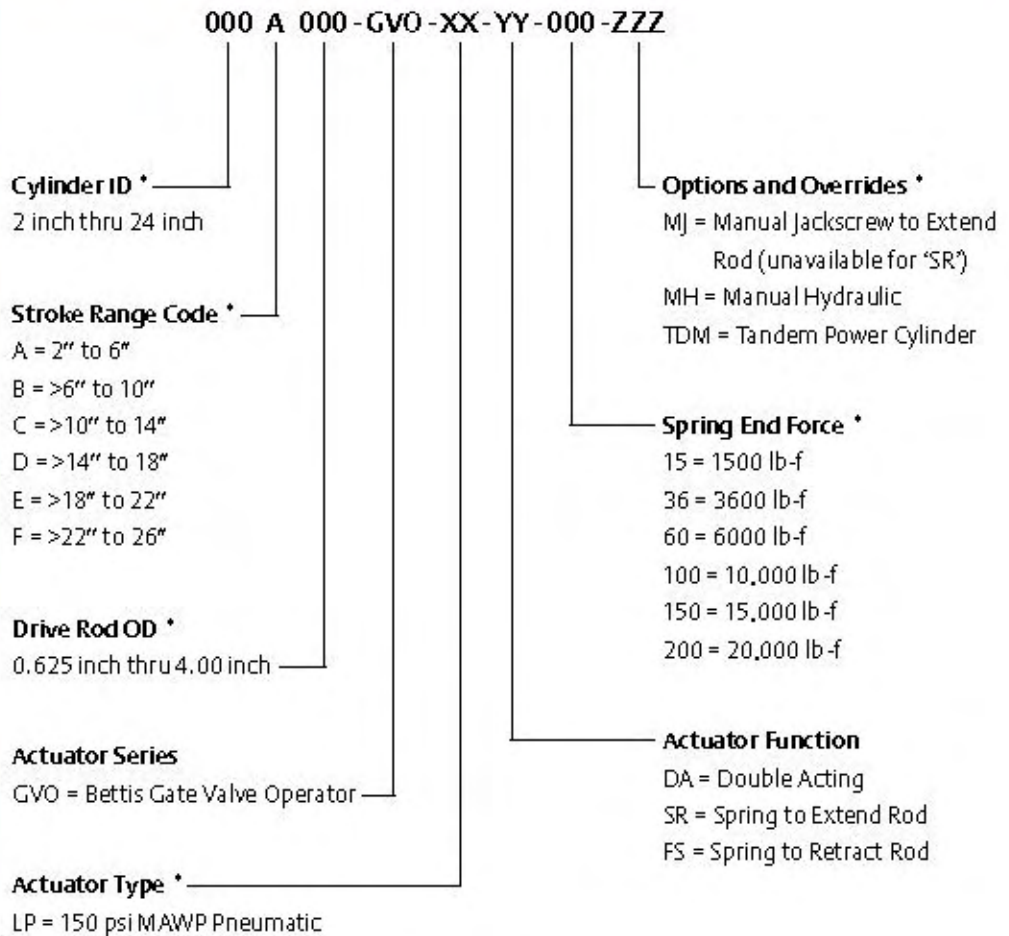
## Description

The Bettis GVO Pneumatic Series represents a broad range of field proven linear valve actuators suitable for automating most types of rising stem valves in safety shutdown and control applications. The GVO actuators are manufactured in accordance with strict quality standards and assure reliability and safety in your specific service. This catalog lists standard models intended to cover a wide range of sizing applications. Custom designed models are also available for specialized thrust or stroke requirements, or those beyond the scope of this listing, including linear hydraulic operated actuators.

The Bettis GVO actuators are designed to operate most types of wedge gate valves, slab gate valves, knife gate valves, globe valves, tank valves and rising stem ball and plug valves. Other applications include dampers and louvers.

## Model Designation

How to Order by Model Number



\* Consult the factory for additional sizes or options

## GVO Series Features

The GVO Series of linear valve actuators incorporates the following features:

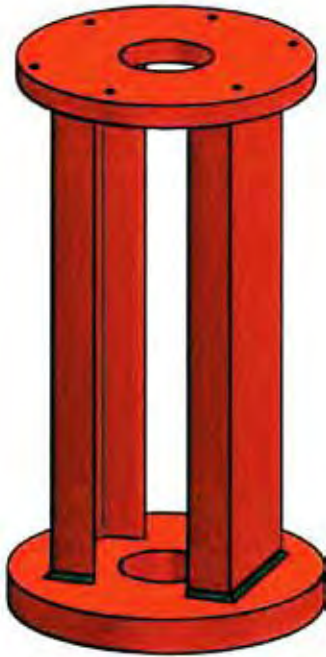
- External tie bars allow contained release of energy in the event of over-pressure and allow ease of inspection and servicing
- Spring rod nut is locked to prevent unauthorized disassembly of the spring cartridge
- Adjustable travel stop for the rod-retract position, piston bottoms out for the rod-extend position. Specific travel applications available, consult factory
- 70 durometer Nitrile seals, other seal materials available upon request
- Piston wear band, drive rod bushing and polyurethane rod wiper are standard for all models
- Pneumatic cylinder material is hard anodized aluminum, 2" thru 8", and fiber composite for sizes 10" and above. Chrome plated carbon steel is available as an option.
- Cylinder plate and endcap material is carbon steel; optional aluminum for 2" thru 8"
- Cylinder plate incorporates a pneumatic distribution groove to maximize break-out thrust
- Drive rod material is carbon steel chrome plated, with option for stainless steel
- Consult factory for custom thrust, travel and pressure requirements
- Factory finish is Bettis Orange gloss alkyd enamel to RAL 2002. Other colors/coatings available upon request
- Removable mounting pedestal allows field adaption to the valve
- Swivel stem connector for ease of installation and stroke adjustment

## Specifications and Approvals

- The GVO Series of linear valve actuators are designed and manufactured as follows:
- Pressure rating of 150 psig MAWP (custom pressure ratings available)
- Static pressure test to 225 psig
- Standard operating temperature range -23° C to +74° C (-10° F to +165° F)
- Low temperature option available, -40° C to +65° C (-40° F to +150° F) for 2" to 14" type DA
- XLT -46° C to +65° C (-50° F to +150° F) for 16" to 24" type DA and all SR/FS models
- High temperature option available, -17° C to +204° C (+1° F to +400° F)
- NPTF cylinder porting, with side porting on the cylinder plate
- Actuators designed and manufactured under an accredited ISO 9001:2000 QA program
- Consult factory for CE compliant actuators



## Optional Mounting Interface



The GVO Series of linear valve actuators incorporates a standard open pedestal valve mounting adaptation, or interface.

The welded pedestal is manufactured from 2 steel channels and is removable from the actuator.

One end of the pedestal is machined for bolting to the GVO actuator and the opposite end can be supplied as a blank to be machined later and fitted to the respective valve at another site. As an option, the pedestal can be custom machined by Bettis, provided that the valve top-works are included with the order.

The open pedestal allows for easy visual position indication, access to packing glands and is suitable for installing a positioner and/or travel position switches.

## Optional Swivel Stem Connector



The GVO Series of linear valve actuators can be supplied with, or without, the valve stem connector.

If ordered, the valve stem dimensional information would be required and the valve-nut part of the connector would be machined at the factory to match the respective valve stem.

The Bettis 3-piece swivel connector allows ease of assembly to the valve stem without the need to rotate the complete actuator as well as allowing for a degree of misalignment.

The rod-extend travel adjustment (down stop) can safely be made after the actuator has been secured to the gear flange.

Optional features include hammer-blow effect couplings, shear couplings, anti-rotation pin and travel position switch triggers.

## Manual Jackscrew Override

The GVO Series of linear valve actuators are available with a unidirectional manual jackscrew handwheel override ('-MJ') for emergency use when plant air or power gas is unavailable. The 'MJ' override can also be used to hold the actuator in a particular position.

For models where a jackscrew override is not feasible due to high thrust requirements, dimensional clearance or lack of accessibility, a manual hydraulic override is available. Also, the 'MJ' override is not available for type 'SR' actuators.



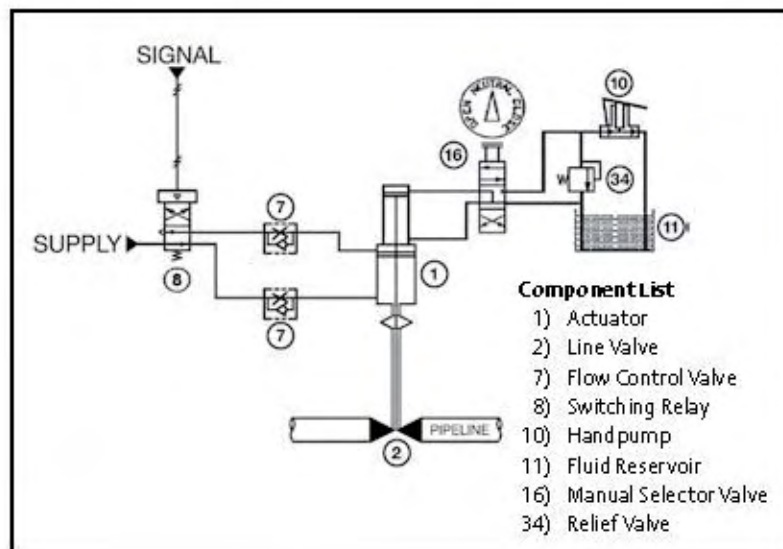
## Hydraulic Manual Override

The GVO actuators are also available with a manual hydraulic override ('-MH'), bidirectional for double-acting and unidirectional for spring-return, type 'FS' or 'SR'. The 'MH' override can also be used as a dampener for precise control of the cylinder speed.

Consult factory for availability on GVO-LP-DA models 2" through 14".



'-DA'



'-SR'

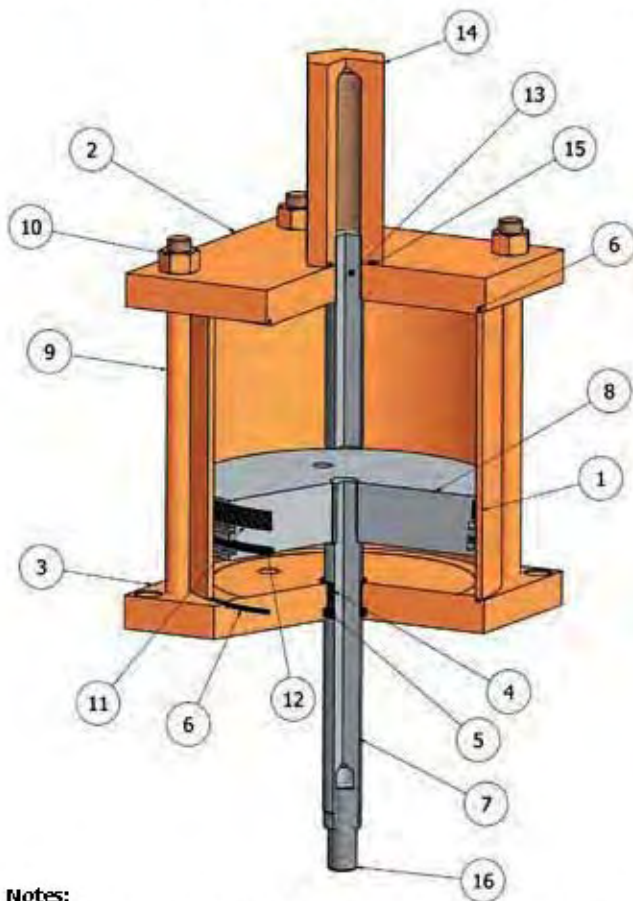
## Optional Accessories

The GVO Series of linear valve actuators can be supplied as a basic actuator or can be configured with various control accessories and related features such as:

- Power supply filter and/or pressure regulator and relief valve
- Pneumatic switching relay, volume booster and/or flow control valve
- Air fail-safe system for one or more emergency cycles
- Mechanical or proximity type electric position switch for discrete (SPDT, DPDT) position indication, with CSA, UL or ATEX electrical certification
- Option for LVDT proximity type continuous position transmitter for current, voltage or resistive feedback with optional discrete (2 X SPST) end position indication, with CSA or ATEX electrical certification
- Solenoid switching valve, AC or DC coil, with CSA, UL or ATEX electrical certification
- 3-way, 4-way or 5-way local auto/manual selector valve
- High or low static pressure pilot, single or dual set point
- Pneumatic positioner or controller; analog or digital
- Fire-proofing to UL 1709

## Model GVO-LP-DA (2" to 14")

### TYPICAL PNEUMATIC DOUBLE ACTING LINEAR ACTUATOR (-DA)



ITEM	QTY.	DESCRIPTION	MATERIAL
1	1	CYLINDER TUBE	6063-T832 ALUMINUM ≤ 8", COMPOSITE FOR 10-14"
2	1	CYLINDER CAP	11L17 STEEL BLACK OXIDE
3	1	CYLINDER HEAD	11L17 STEEL BLACK OXIDE
4	1	BRONZE BUSHING	SINTERED BRONZE
5	1	ROD WIPER	BUNA-N 4180
6	2	TUBE SEAL	BUNA-N DURO 70
7	1	PISTON ROD	1050 CHROME STEEL SHAFT
8	1	PISTON	6061-T6 ALUMINUM
9	4	TIE ROD	1050 STEEL BLACK OXIDE
10	4	HEX NUT	STEEL
11	1	WEAR BAND	GRAPHITE FILLED PTFE
12	1	PISTON SEAL	BUNA-N DURO 70
13	1	STROKE ADJUST	1050 STEEL
14	1	STROKE ADJUST CAP	C1018, C12L14 STEEL
15	1	STROKE ADJUST SEAL	BUNA-N DURO 70
16	1	ROD STUD	STEEL

#### Notes:

MATERIAL SPECIFICATIONS ARE TYPICAL FOR OPERATION AT -23°C TO +74°C (-10°F TO +165°F)

JAM NUT WILL BE USED ON PISTON FOR CYLINDERS GREATER THAN 8" DIAMETER

PISTON SEAL MAY NOT BE EXACTLY AS SHOWN

ALL EXPOSED METAL PARTS COATED WITH CORROSION INHIBITOR

ALL SPECIFICATIONS ARE SUBJECT TO CHANGE OR UPGRADE

## GVO-LP-DA (2" to 14")

Double Acting Linear Actuators, Single Cylinder						Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)											
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	50		60		70		80		100		120	
						Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract
2	A 2-6 B >6-10	0.63	GVO	LP	DA	145	131	174	157	203	184	232	210	291	262	349	315
2.5	A 2-6 B >6-10	0.63	GVO	LP	DA	227	213	272	255	318	298	363	341	454	426	545	511
3.25	A 2-6 B >6-10 C >10-14	1.00	GVO	LP	DA	384	347	460	417	537	486	614	556	767	695	921	834
4	A 2-6 B >6-10 C >10-14	1.00	GVO	LP	DA	581	545	697	654	814	763	930	872	1162	1090	1395	1308
5	A 2-6 B >6-10 C >10-14	1.00	GVO	LP	DA	908	872	1090	1046	1271	1221	1453	1395	1816	1744	2179	2092
6	A 2-6 B >6-10 C >10-14 D >14-18	1.00	GVO	LP	DA	1308	1271	1569	1526	1831	1780	2092	2034	2615	2543	3138	3051
7	A 2-6 B >6-10 C >10-14 D >14-18	1.00	GVO	LP	DA	1780	1744	2136	2092	2492	2441	2848	2790	3560	3487	4272	4185
8	A 2-6 B >6-10 C >10-14 D >14-18	1.00	GVO	LP	DA	2325	2288	2790	2746	3255	3204	3720	3662	4650	4577	5579	5492
10	A 2-6 B >6-10 C >10-14 D >14-18	1.00	GVO	LP	DA	3632	3596	4359	4315	5085	5035	5812	5754	7265	7192	8718	8631
12	A 2-6 B >6-10 C >10-14 D >14-18	1.38	GVO	LP	DA	5231	5162	6277	6194	7323	7227	8369	8259	10462	10324	12554	12389
14	A 2-6 B >6-10 C >10-14 D >14-18 E >18-22	1.38	GVO	LP	DA	7120	7051	8544	8461	9967	9871	11391	11282	14239	14102	17087	16922

Typical model number example: **2A063-GVO-LP-DA-MJ**

Explanation: 2" diameter piston with 2" to 6" stroke range and 0.625" diameter rod, pneumatic double-acting with manual jackscrew override.

### Notes:

- 1) Actuator MAWP is 150 psig (10 barg)
- 2) Thrust values are in Lbf and are de-rated for friction allowance
- 3) Actuators can be fitted with conventional Bettis swivel connector assembly, as an option
- 4) Mounting pedestal, where provided, is an open design twin channel type, removable from the cylinder plate
- 5) Actuator sizes are not oriented to a particular valve type or brand
- 6) Type 'DA' actuators fail in last position
- 7) Consult factory for operating pressures below 50 psig and above 120 psig
- 8) Thrust values shown can be interpolated for other operating pressures
- 9) Consult factory for custom thrust or stroke requirements
- 10) Ambient temperature range is -23° C to +74° C, low and high temp trim available, consult factory

## GVO-LP-DA (16" to 24")

### TYPICAL PNEUMATIC DOUBLE ACTING LINEAR ACTUATOR (-DA)

MATERIAL SPECIFICATIONS ARE TYPICAL FOR OPERATION AT -23°C TO +74°C (-10°F TO +165°F)

ITEM	DESCRIPTION	MATERIAL	QTY.	NOTE
1	DRIVE ROD	C1045	1	(C)
2	CYLINDER PLATE	ASTMA516-70	1	
3	END CAP	ASTMA516-70	1	
4	PISTON	ASTMA516-70	1	
5	CYLINDER	FIBER COMPOSITE	1	
6	STAY ROD	AISI4140	8	(V)
9	PISTON WEAR RING	POLYESTER RESIN	1	(Y)
31	ROD GUIDE	REIN. NYLON	1	(Y)
32	GASKET	FIBER	2	(Y)
33	O-RING, PISTON	NITRILE	1	(Y)
34	O-RING, DRIVE ROD	NITRILE	1	(Y)
35	O-RING, PISTON CENTRE	NITRILE	1	(Y)
36	O-RING, STOP COVER	NITRILE	1	(Y)
45	WIPER	URETHANE	1	(Y)
52	END STOP	ASTM A193 GR. B7	1	
53	END STOP COVER	C12L14	1	
56	NUT, PISTON	HHXN GR.2H	1	
57	NUT, STAY ROD	HHXN GR.2H	8	(V)
105	LIFT LUG	A36	2	

**Notes:**

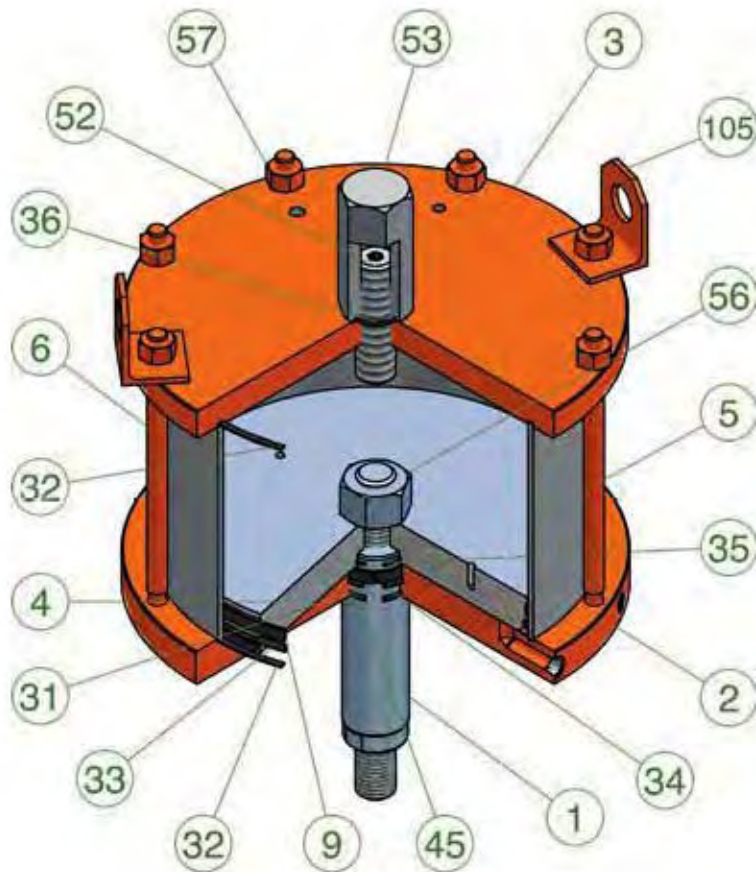
(C) CHROME PLATED OR EQUIVALENT

(V) QUANTITY MAY VARY DEPENDING ON MODEL

(Y) RECOMMENDED SPARE PARTS/REPAIR KIT

ALL METAL PARTS COATED WITH CORROSION INHIBITOR

ALL SPECIFICATIONS ARE SUBJECT TO CHANGE OR UPGRADE





## GVO-LP-DA (16" to 24")

Double Acting Linear Actuators, Single Cylinder							Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)											
							50		60		70		80		100		120	
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	TDM	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract
16	A 2-6	2.50	GVO	LP	DA		9550	9317	11461	11181	13371	13044	15281	14908	19101	18635	22921	22361
	B >6-10																	
	C >10-14																	
	D >14-18																	
	E >18-22																	
18	B >6-10	3.00	GVO	LP	DA		12087	11752	14505	14102	16922	16452	19340	18802	24175	23503	29009	28204
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	
20	B >6-10	3.00	GVO	LP	DA		14923	14587	17907	17504	20892	20422	23876	23339	29845	29174	35814	35008
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	
24	B >6-10	3.00	GVO	LP	DA		21488	21153	25786	25383	30084	29614	34382	33844	42977	42305	51572	50767
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	

Double Acting Linear Actuators, Tandem Cylinder							Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)											
							50		60		70		80		100		120	
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	TDM	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract	Extend	Retract
18	B >6-10	3.00	GVO	LP	DA	TDM	23839	23503	28607	28204	33374	32904	38142	37605	47678	47006	57213	56407
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	
20	B >6-10	3.00	GVO	LP	DA	TDM	29509	29174	35411	35008	41313	40843	47215	46678	59019	58347	70822	70017
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	
24	B >6-10	4.00	GVO	LP	DA	TDM	42380	41783	50856	50140	59332	58496	67808	66853	84760	83566	101712	100280
	C >10-14																	
	D >14-18																	
	E >18-22																	
	F >22-26																	

Typical model number example: **16C250-GVO-LP-DA-MH**

Explanation: 16" diameter piston with 10" to 14" stroke range and 2.50" diameter rod, pneumatic double-acting with manual hydraulic override.

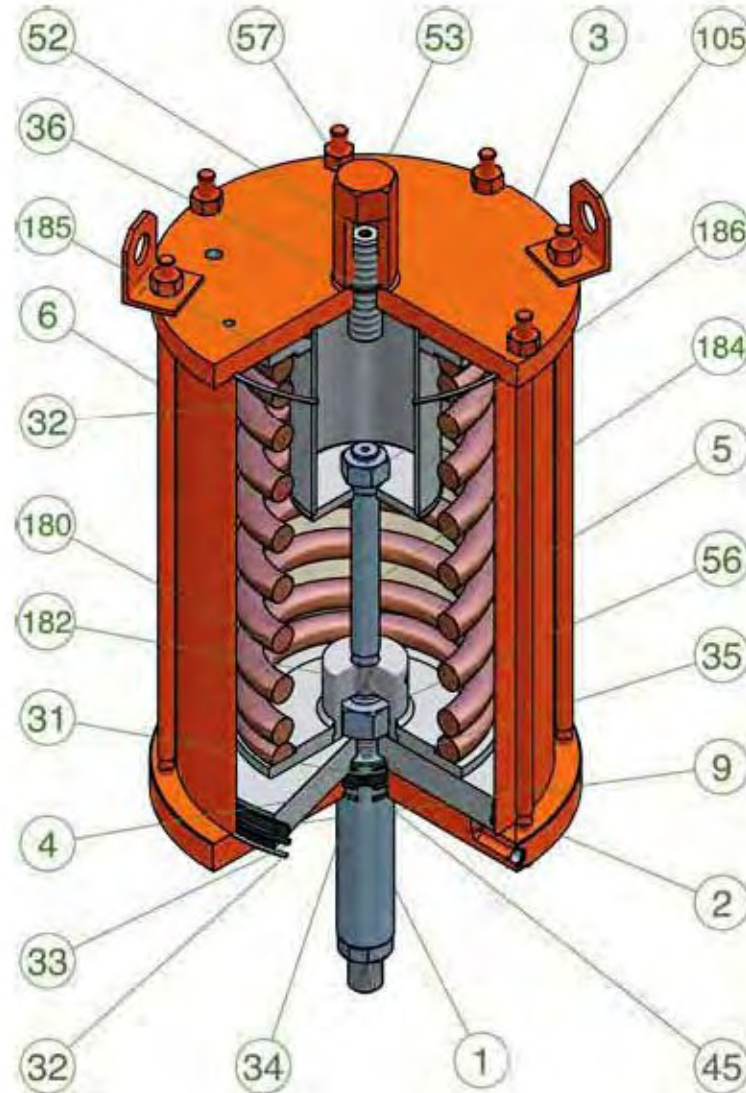
### Notes:

- 1) Actuator MAWP is 150 psig (10 barg)
- 2) Thrust values are in Lbf and are de-rated for friction allowance
- 3) Actuators can be fitted with conventional Bettis swivel connector assembly, as an option
- 4) Mounting pedestal, where provided, is an open design twin channel type, removable from the cylinder plate
- 5) Actuator sizes are not oriented to a particular valve type or brand
- 6) Type 'DA' actuators fail in last position
- 7) Consult factory for operating pressures below 50 psig and above 120 psig
- 8) Thrust values shown can be interpolated for other operating pressures
- 9) Consult factory for custom thrust or stroke requirements
- 10) Ambient temperature range is -23° C to +74° C, low and high temp trim available, consult factory

## Model GVO-LP-SR

### TYPICAL PNEUMATIC SPRING RETURN LINEAR ACTUATOR (-SR)

MATERIAL SPECIFICATIONS ARE TYPICAL FOR OPERATION AT -23°C TO +74°C (-10°F TO +165°F)



ITEM	DESCRIPTION	MATERIAL	QTY.	NOTE
1	DRIVE ROD	C1045	1	(C)
2	CYLINDER PLATE	ASTMA516-70	1	
3	END CAP	ASTMA516-70	1	
4	PISTON	ASTMA516-70	1	
5	CYLINDER	FIBER COMPOSITE	1	
6	STAY ROD	AISI4140	8	(V)
9	PISTON WEAR RING	POLYESTER RESIN	1	(Y)
31	ROD GUIDE	REIN. NYLON	1	(Y)
32	GASKET	FIBER	2	(Y)
33	O-RING, PISTON	NITRILE	1	(Y)
34	O-RING, DRIVE ROD	NITRILE	1	(Y)
35	O-RING, PISTON CENTRE	NITRILE	1	(Y)
36	O-RING, STOP COVER	NITRILE	1	(Y)
45	WIPER	URETHANE	1	(Y)
52	END STOP	ASTMA193 GR.B7	1	
53	END STOP COVER	C12L14	1	
56	NUT, PISTON	HHXN GR.2H	1	
57	NUT, STAY ROD	HHXN GR.2H	8	(V)
105	LIFT LUG	A36	2	
180	SPRING	ALLOY STEEL	1	
182	SPRING RETAINER	ASTMA516-70/C1018	1	
184	SPRING RETAINER ROD	AISI4140	1	
185	SPRING BARREL	ASTMA516-70/A106-B	1	
186	SPRING RETAINING NUT	HEXN GR.2 ZN.PL	1	

#### Notes:

(C) CHROME PLATED OR EQUIVALENT

(V) QUANTITY MAY VARY DEPENDING ON MODEL

(Y) RECOMMENDED SPARE PARTS/REPAIR KIT

ALL METAL PARTS COATED WITH CORROSION INHIBITOR

ALL SPECIFICATIONS ARE SUBJECT TO CHANGE OR UPGRADE

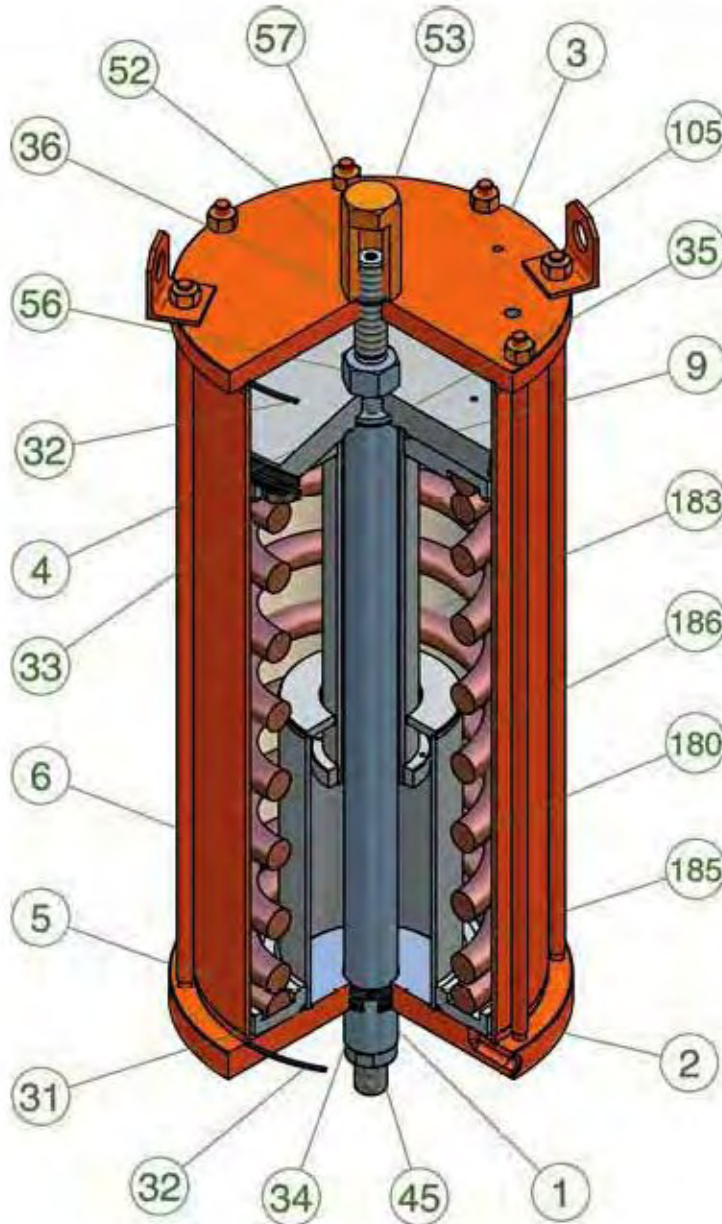


Valve Gate Action	Actuator Type	
	GVO-LP-SR	GVO-LP-FS
Direct Acting	Fail Close	Fail Open
Reverse Acting	Fail Open	Fail Close

## Model GVO-LP-FS

### TYPICAL PNEUMATIC FAILSAFE LINEAR ACTUATOR (-FS)

MATERIAL SPECIFICATIONS ARE TYPICAL FOR OPERATION AT -23°C TO +74°C (-10°F TO +165°F)



ITEM	DESCRIPTION	MATERIAL	QTY.	NOTE
1	DRIVE ROD	C1045	1	(C)
2	CYLINDER PLATE	ASTMA516-70	1	
3	END CAP	ASTM A516-70	1	
4	PISTON	ASTM A516-70	1	
5	CYLINDER	FIBER COMPOSITE	1	
6	STAY ROD	AISI 4140	8	(V)
9	PISTON WEAR RING	POLYESTER RESIN	1	(Y)
31	ROD GUIDE	REIN. NYLON	1	(Y)
32	GASKET	FIBER	2	(Y)
33	O-RING, PISTON	NITRILE	1	(Y)
34	O-RING, DRIVE ROD	NITRILE	1	(Y)
35	O-RING, PISTON CENTRE	NITRILE	1	(Y)
36	O-RING, STOP COVER	NITRILE	1	(Y)
45	WIPER	URETHANE	1	(Y)
52	END STOP	ASTM A193 GR.B7	1	
53	END STOP COVER	C12L14	1	
56	NUT, PISTON	HHXN GR.2H	1	
57	NUT, STAY ROD	HHXN GR.2H	8	(V)
105	LIFT LUG	A36	1	
180	SPRING	ALLOY STEEL	1	
183	SPRING RETAINER	ASTM A516-70/A106-B1	1	
185	SPRING BARREL	ASTM A516-70/A106-B1	1	
186	SPRING RETAINING NUT	C1018	1	

**Notes:**

(C) CHROME PLATED OR EQUIVALENT

(V) QUANTITY MAY VARY DEPENDING ON MODEL

(Y) RECOMMENDED SPARE PARTS/REPAIR KIT

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ALL SPECIFICATIONS ARE SUBJECT TO CHANGE OR UPGRADE



Valve Action		Actuator Type and Position		
Direct	Reverse	GVO-LP-DA	GVO-LP-SR	GVO-LP-FS
Start Close	Break Open	Extend Rod	Spring Start	Air Start
End Close	End Open	Extend Rod	Spring End	Air End
Break Open	Start Close	Retract Rod	Air Start	Spring Start
End Open	End Close	Retract Rod	Air End	Spring End

# GVO-LP-SR and FS (10" to 16")

Spring Return Linear Actuators, Single Cylinder									Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)										
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	SE Thrust	SS Thrust	50		60		70		80		100		120	
								Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End
10	A 2-6	2.00	GVO	LP	SR	1500	2700	1893	693	2572	1372	3250	2050	3929	2729	5286	4086	6643	5443
	FS				2034			834	2741	1541	3448	2248	4155	2955	5569	4369	6982	5782	
10	A 2-6	2.00	GVO	LP	SR	3600	6480									3186	306	4543	1663
	FS														3469	589	4882	2002	
12	A 2-6	2.00	GVO	LP	SR	1500	2700	3448	2248	4438	3238	5427	4227	6417	5217	8396	7196	10375	9175
	FS				3589			2389	4607	3407	5625	4425	6643	5443	8679	7479	10715	9515	
12	A 2-6	2.00	GVO	LP	SR	3600	6480					3327	447	4317	1437	6296	3416	8275	5395
	FS								3525	645	4543	1663	6579	3699	8615	5735			
12	A 2-6	2.00	GVO	LP	SR	6000	10800											5875	1075
	FS														6215	1415			
14	A 2-6	2.50	GVO	LP	SR	1500	2700	5206	4006	6548	5348	7889	6689	9230	8030	11913	10713	14595	13395
	FS				5427			4227	6813	5613	8198	6998	9584	8384	12354	11154	15125	13925	
14	A 2-6	2.50	GVO	LP	SR	3600	6480	3106	226	4448	1568	5789	2909	7130	4250	9813	6933	12495	9615
	FS				3327	447	4713	1833	6098	3218	7484	4604	10254	7374	13025	10145			
14	A 2-6	2.50	GVO	LP	SR	6000	10800									7413	2613	10095	5295
	FS										5084	284	7854	3054	10625	5825			
16	A 2-6	2.50	GVO	LP	SR	3600	6480	5227	2347	6992	4112	8758	5878	10523	7643	14054	11174	17585	14705
	FS				5448			2568	7257	4377	9067	6187	10876	7996	14496	11616	18115	15235	
16	A 2-6	2.50	GVO	LP	SR	6000	10800					6358	1558	8123	3323	11654	6854	15185	10385
	FS								4857	57	6667	1867	8476	3676	12096	7296	15715	10915	
16	A 2-6	2.50	GVO	LP	SR	10000	18000											11185	3185
	FS												8096	96	11715	3715			

**Notes for all 'SR' and 'FS':**

- 1) Actuator MAWP is 150 psig (10 barg)
- 2) Due to characteristics inherent in adjustable stroke spring return actuators, thrust values listed are nominal in Lbf at the maximum stroke range and are de-rated for friction allowance
- 3) Spring Start / Air End thrusts (type SR) and Spring End / Air Start thrusts (type FS) will vary as the stroke length decreases. Consult factory for more detailed sizing applications.
- 4) Actuators can be fitted with conventional Bettis swivel connector assembly, as an option
- 5) Mounting pedestal, where provided, is an open design twin channel type, removable from the cylinder plate
- 6) Actuator sizes are not oriented to a particular valve type or brand
- 7) Type 'SR' actuators fail to extend the drive rod (close a direct-acting valve)
- 8) Type 'FS' actuators fail to retract the drive rod (open a direct-acting valve)
- 9) Consult factory for operating pressures below 50 psig and above 120 psig
- 10) Thrust values shown can be interpolated for other operating pressures
- 11) Consult factory for custom thrust or stroke requirements
- 12) Ambient temperature range is -23° C to +74° C, low and high temp trim available, consult factory

## GVO-LP-SR and FS (18" to 24")

Spring Return Linear Actuators, Single Cylinder								Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)																
								50		60		70		80		100		120						
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	SE Thrust	SS Thrust	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End					
18	B 6-10	3.00	GVO	LP	SR	3600	6480	7533	4653	9760	6880	11986	9106	14213	11333	18666	15786	23120	20240					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS			7851	4971	10141	7261	12432	9552	14722	11842	19302	16422	23883	21003						
18	B 6-10	3.00	GVO	LP	SR	6000	10800	5133	333	7360	2560	9586	4786	11813	7013	16266	11466	20720	15920					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS			5451	651	7741	2941	10032	5232	12322	7522	16902	12102	21483	16683						
18	B 6-10	3.00	GVO	LP	SR	10000	18000									12266	4266	16720	8720					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS									8322	322	12902	4902	17483	9483						
18	B 6-10	3.00	GVO	LP	SR	15000	27000																	
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS														12483	483					
20	B 6-10	3.00	GVO	LP	SR	6000	10800	7819	3019	10583	5783	13347	8547	16111	11311	21638	16838	27166	22366					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS			8137	3337	10965	6165	13792	8992	16619	11819	22274	17474	27929	23129						
20	B 6-10	3.00	GVO	LP	SR	10000	18000					9347	1347	12111	4111	17638	9638	23166	15166					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS							9792	1792	12619	4619	18274	10274	23929	15929						
20	B 6-10	3.00	GVO	LP	SR	15000	27000									12638	638	18166	6166					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS											13274	1274	18929	6929						
24	B 6-10	3.00	GVO	LP	SR	6000	10800	14040	9240	18048	13248	22055	17255	26063	21263	34079	29279	42095	37295					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS			14358	9558	18429	13629	22501	17701	26572	21772	34715	29915	42858	38058						
24	B 6-10	3.00	GVO	LP	SR	10000	18000	10040	2040	14048	6048	18055	10055	22063	14063	30079	22079	38095	30095					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS			10358	2358	14429	6429	18501	10501	22572	14572	30715	22715	38858	30858						
24	B 6-10	3.00	GVO	LP	SR	15000	27000					13055	1055	17063	5063	25079	13079	33095	21095					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS							13501	1501	17572	5572	25715	13715	33858	21858						
24	B 6-10	3.00	GVO	LP	SR	20000	36000									20079	4079	28095	12095					
	C >10-14																							
	D >14-18																							
	E >18-22																							
F >22-26				FS											20715	4715	28858	12858						

Typical model number example: 18B300-GVO-LP-FS-36-MJ

Explanation: 18" diameter pneumatic piston with 6" to 10" stroke range and 3.00" diameter rod, spring-to-retract with 3600 lb spring end force, and manual jackscrew override to extend the rod.

Refer to notes on page #12.

# GVO-LP-SR and FS - TDM

Spring Return Linear Actuators, Single Cylinder									Power Cylinder Thrust Output in Lbf at Operating Pressure (psig)																	
Cyl Dia	Stroke	Rod Dia	Series	LP	Type	SE Thrust	SS Thrust	TDM	50		60		70		80		100		120							
									Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End	Air Start	Air End						
18	B 6-10	3.00	GVO	LP	SR	3600	6480	TDM	18666	15786	23120	20240	27573	24693	32026	29146	40933	38053	49839	46959						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				18984	16104	23501	20621	28018	25138	32535	29655	41569	38689	50602	47722							
18	B 6-10	3.00	GVO	LP	SR	6000	10800	TDM	16266	11466	20720	15920	25173	20373	29626	24826	38533	33733	47439	42639						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				16584	11784	21101	16301	25618	20818	30135	25335	39169	34369	48202	43402							
18	B 6-10	3.00	GVO	LP	SR	10000	18000	TDM	12266	4266	16720	8720	21173	13173	25626	17626	34533	26533	43439	35439						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				12584	4584	17101	9101	21618	13618	26135	18135	35169	27169	44202	36202							
18	B 6-10	3.00	GVO	LP	SR	15000	27000	TDM					16173	4173	20626	8626	29533	17533	38439	26439						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS					12101	101	16618	4618	21135	9135	30169	18169	39202	27202								
20	B 6-10	3.00	GVO	LP	SR	6000	10800	TDM	21638	16838	27166	22366	32694	27894	38222	33422	49277	44477	60332	55532						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				21956	17156	27548	22748	33139	28339	38730	33930	49913	45113	61095	56295							
20	B 6-10	3.00	GVO	LP	SR	10000	18000	TDM	17638	9638	23166	15166	28694	20694	34222	26222	45277	37277	56332	48332						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				17956	9956	23548	15548	29139	21139	34730	26730	45913	37913	57095	49095							
20	B 6-10	3.00	GVO	LP	SR	15000	27000	TDM	12638	638	18166	6166	23694	11694	29222	17222	40277	28277	51332	39332						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				12956	956	18548	6548	24139	12139	29730	17730	40913	28913	52095	40095							
20	B 6-10	3.00	GVO	LP	SR	20000	36000	TDM					18694	2694	24222	8222	35277	19277	46332	30332						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS								19139	3139	24730	8730	35913	19913	47095	31095							
24	B 6-10	4.00	GVO	LP	SR	6000	10800	TDM	33585	28785	41502	36702	49418	44618	57335	52535	73169	68369	89003	84203						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				34150	29350	42180	37380	50210	45410	58240	53440	74300	69500	90360	85560							
24	B 6-10	4.00	GVO	LP	SR	10000	18000	TDM	29585	21585	37502	29502	45418	37418	53335	45335	69169	61169	85003	77003						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				30150	22150	38180	30180	46210	38210	54240	46240	70300	62300	86360	78360							
24	B 6-10	4.00	GVO	LP	SR	15000	27000	TDM	24585	12585	32502	20502	40418	28418	48335	36335	64169	52169	80003	68003						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				25150	13150	33180	21180	41210	29210	49240	37240	65300	53300	81360	69360							
24	B 6-10	4.00	GVO	LP	SR	20000	36000	TDM	19585	3585	27502	11502	35418	19418	43335	27335	59169	43169	75003	59003						
	C >10-14																									
	D >14-18																									
	E >18-22																									
F >22-26				FS				20150	4150	28180	12180	36210	20210	44240	28240	60300	44300	76360	60360							

Typical model number example: 18B300-GVO-LP-SR-36-TDM

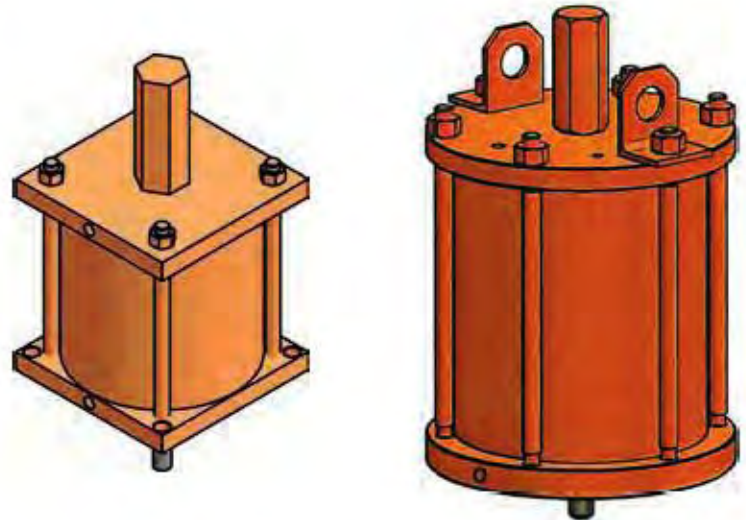
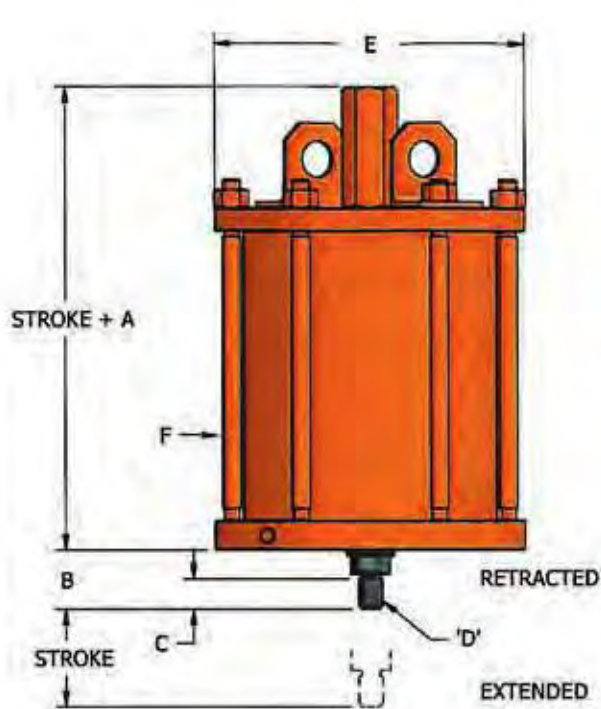
Explanation: 18" diameter pneumatic tandem piston with 6" to 10" stroke range and 3.0" diameter rod, spring-to-extend with 3600 lb spring end force.

Refer to notes on page #12.

## GVO-LP-DA Dimensions

Cylinder Bore	Rod Diameter	Dimensions / Size (Inch)						Weight per Stroke Range (Lbs)				
		A	B	C	D	E	F	2-6	6-10	10-14	14-18	18-22
2.00	0.625	8.6+1S	1.38	0.75	7/16 - 20 NF	2.5 SQR	4	8.5	9.4			
2.50	0.625	8.7+1S	1.38	0.75	7/16 - 20 NF	3.0 SQR	4	10.3	11.3			
3.25	1.00	8.7+1S	1.88	1.13	3/4 - 16 NF	3.8 SQR	4	14.9	16.4	18.5		
4.00	1.00	8.7+1S	1.88	1.13	3/4 - 16 NF	4.5 SQR	4	19.5	21.8	24.2		
5.00	1.00	9.0+1S	1.88	1.13	3/4 - 16 NF	5.5 SQR	4	26.8	29.2	31.6		
6.00	1.00	9.0+1S	1.88	1.13	3/4 - 16 NF	6.5 SQR	4	34.9	37.3	39.8	42.3	
7.00	1.00	9.0+1S	1.88	1.13	3/4 - 16 NF	7.5 SQR	4	45.4	48.5	51.6	54.7	
8.00	1.00	9.1+1S	1.88	1.13	3/4 - 16 NF	8.5 SQR	4	56.1	59.3	62.5	65.7	
10.00	1.00	10.1+1S	2.13	1.13	3/4 - 16 NF	10.6 SQR	4	106	111	116	121	
12.00	1.375	10.6+1S	2.63	1.63	1 - 14 NF	12.8 SQR	4	157	164	170	176	
14.00	1.375	11.6+1S	2.63	1.63	1 - 14 NF	14.8 SQR	4	245	252	260	268	275
16.00	2.50	12.0+1S	2.95	1.95	1-1/2 - 8 UN	18.8 RND	8					
18.00	3.00	12.0+1S	3.45	2.25	1-3/4 - 8 UN	20.9 RND	8					
20.00	3.00	13.0+1S	3.70	2.25	2 - 8 UN	22.9 RND	8					
24.00	3.00	14.0+1S	3.70	2.45	2 - 8 UN	27.4 RND	12					
18.00 TDM	3.00	18.0+2S	3.70	2.45	2 - 8 UN	18.8 RND	12					
20.00 TDM	3.00	18.0+2S	3.70	2.45	2 - 8 UN	22.9 RND	16					
24.00 TDM	4.00	25.0+2S	4.95	3.45	3 - 8 UN	27.9 RND	12					

**Consult  
Factory**



**Notes:**

'S' DENOTES MAXIMUM STROKE FOR EACH MODEL

'F' DENOTES NUMBER OF STAY RODS (TIE-BARS)

END PLATES ON 2" THROUGH 14" 'DA' MODELS ARE SQUARE

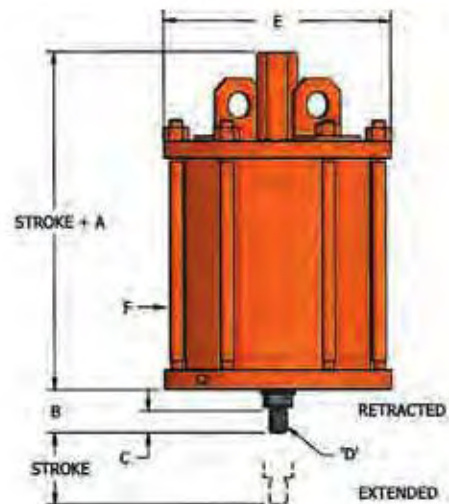
ALL DIMENSIONS ARE IN INCHES, WEIGHT IN POUNDS

## GVO-LP-SR and FS Dimensions

Cylinder Bore	Rod Diameter	SE Thrust	Dimensions / Size (Inch)									
			A						B	C	D	E
			2 - 6	6 - 10	10 - 14	14 - 18	18 - 22	22 - 26				
10	2.00	1500	28	34	43	50			2.5	1.45	1 - 8UN	12.9
		3600	32	43	51	57						
12	2.00	1500	28	34	43	50			2.5	1.45	1 - 8UN	14.8
		3600	32	43	51	57						
		6000	34	43	54	74						
14	2.50	1500	28	34	43	50	50		2.95	1.95	1-1/2 - 8UN	16.9
		3600	32	43	51	57	56					
		6000	34	43	54	74	75					
16	2.50	3600	32	43	51	57	56		2.95	1.95	1-1/2 - 8UN	18.8
		6000	34	43	54	74	75					
		10000	36	48	56	83	85					
18	3.00	3600		43	51	57	56	65	3.45	2.25	1-3/4 - 8UN	20.9
		6000		43	54	74	75	69				
		10000		48	56	83	85	82				
		15000		43	52	73	92	92				
20	3.00	6000		44	55	75	76	70	3.7	2.25	2 - 8UN	22.9
		10000		49	57	84	86	83				
		15000		44	53	74	93	93				
		20000		49	57	83	99	99				
24	3.00	6000		45	56	76	77	71	3.7	2.45	2 - 8UN	27.4
		10000		50	58	85	87	84				
		15000		45	54	75	94	94				
		20000		50	58	84	100	100				
18 TDM	3.00	3600		59	71	81	84	97	3.7	2.45	2 - 8UN	20.9
		6000		59	74	98	103	101				
		10000		64	76	107	113	114				
		15000		59	72	97	120	124				
20 TDM	3.00	6000		59	74	98	103	101	3.7	2.45	2 - 8UN	22.9
		10000		64	76	107	113	114				
		15000		59	72	97	120	124				
		20000		64	76	106	126	130				
24 TDM	4.00	6000		66	81	105	110	108	4.95	3.45	3 - 8UN	27.9
		10000		71	83	114	120	121				
		15000		66	79	104	127	131				
		20000		71	83	113	133	137				

**Note:**

ALL DIMENSIONS ARE IN INCHES



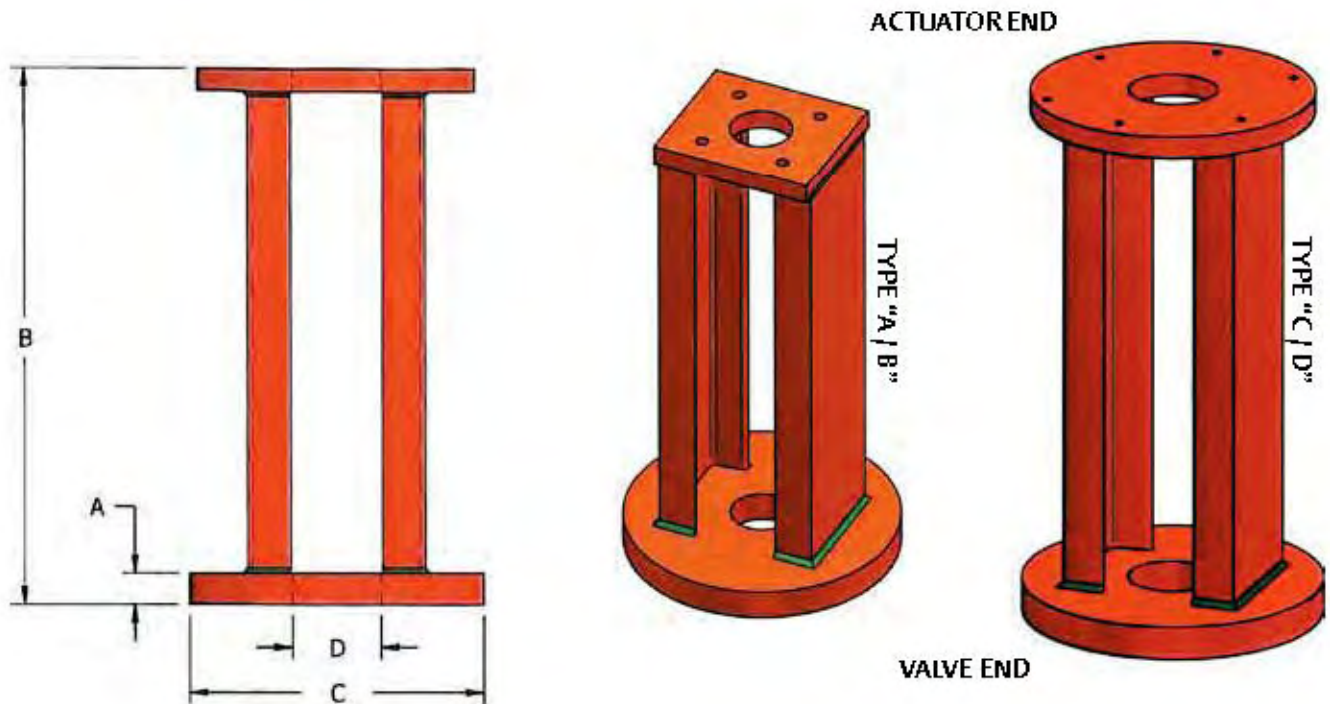


## Pedestal Dimensions

To select a pedestal for a particular model of GVO, the cylinder diameter and stroke range are matched to the corresponding pedestal number (A1 thru D4). For example, model 18E300-GVO-LP-DA has an 18" cylinder and an 'E' stroke range (18" to 22"). Therefore, the proper pedestal would be a number "D2".

### OUTLINE DIMENSIONS TYPICAL GVO PEDESTAL

Pedestal	Cylinder	Stroke	A	B	C	D
A1	2" thru 4"	A	0.50	11.0	7.5	1.50
A2	2" thru 4"	B, C	0.50	19.0	7.5	1.50
B1	5" thru 8"	A	0.75	12.0	10.0	2.75
B2	5" thru 8"	B, C	0.75	20.0	10.0	2.75
B3	5" thru 8"	D	0.75	24.0	10.0	2.75
C1	10" thru 16"	A	1.25	13.5	14.0	4.00
C2	10" thru 16"	B, C	0.75	21.5	14.0	4.00
C3	10" thru 16"	D, E	0.75	29.5	14.0	4.00
D1	18" thru 20" TDM	B, C, D	1.50	26.5	17.0	5.00
D2	18" thru 20" TDM	E, F	1.50	34.5	17.0	5.00
D3	24" TDM	B, C, D	1.75	26.5	17.0	5.00
D4	24" TDM	E, F	1.75	36.0	20.0	6.00



## Gate Valve Generic Sizing

The Bettis GVO linear actuator models are usually selected based on actual thrust requirements and factors of safety as provided by the valve manufacturer, however these values can often be calculated, in part or in whole, by using an industry standard formula along with the operating parameters for the specific application.

There are three major types of forces acting on a gate valve which, when combined with a thrust safety factor, will closely determine the valve thrust requirements and allow generic sizing of a suitable linear actuator.

### Methodology for determining the total thrust requirement:

#### Seat Friction

Seat / Gate Friction = Bore Seating Area x  $\Delta$  Pressure x Gate Drag Factor

Typical gate drag factors are: 0.30 for solid wedge, 0.25 for split/flex wedge, 0.20 for parallel disk, 0.18 for TFE seated, and 1.15 for globe or angle valve

#### Packing Friction

Stem Packing Friction in lbs = Stem Factor

#### Hydrostatic Force (Unbalanced Force)

Hydrostatic Force = Stem Area (thru packing) x Line Pressure

#### Safety Factor

Factor of Safety is usually dictated by the project specifications and/or the valve manufacturer

**Generic Thrust Formula** = (Seat Friction + Packing Friction +/- Hydrostatic Force) x Safety Factor

**[(Seat Area x  $\Delta$ P x Valve Factor) + Stem Factor  $\pm$  (Stem Area x Line P)] x Safety Factor**

The Hydrostatic Force, under line pressure, will assist the rod-retract force of the actuator but will resist the rod-extend force of the actuator. This force can be significant and must be considered when sizing an actuator. For example, a 2.0" diameter valve stem with 2000 psig of line pressure will exert 6283 lbs of force against the actuator drive rod, forcing it to retract. The actuator must compensate for this.

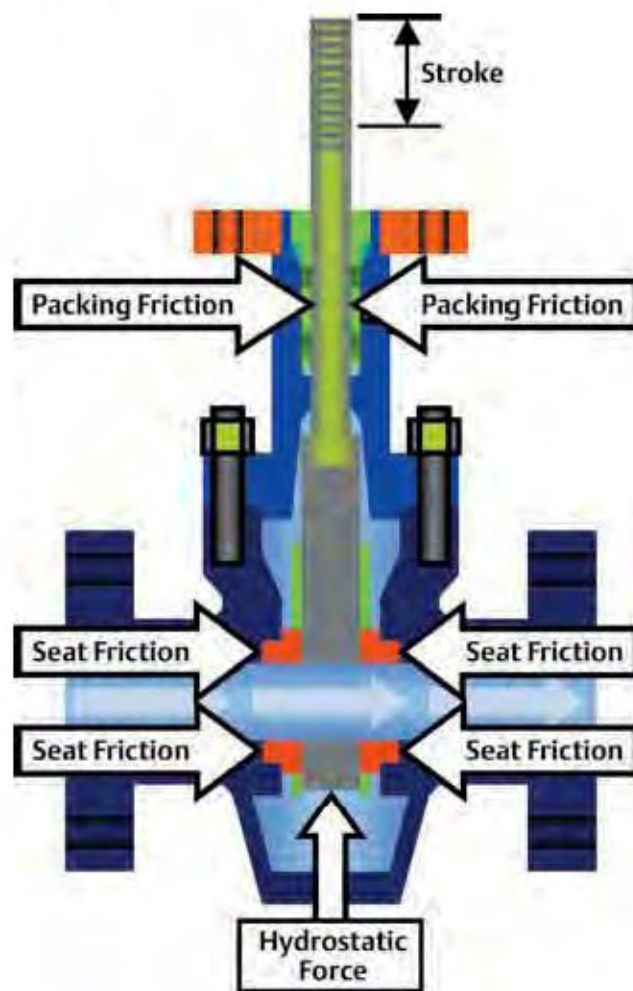
### Determining the valve action:

#### Direct acting / Reverse acting

If the valve stem rises (extends) to open, the gate is direct, or standard, acting. If the valve stem rises (extends) to close, the gate is reverse acting, or self-closing (with sufficient hydrostatic force).

### Determining the valve stroke or stem travel

The valve stem travel for a slab or wedge type of gate is nominally equal to the bore diameter with length added to compensate for seat overlap and manufacturing tolerances. For actuator selection 1" is added to a gate valve's stem travel with bore diameters of 5" or less, and 2" is added to those 6" and larger. For example, a NPS 3" valve would need an actuator with 4" of travel, and a NPS 10" valve would require 12" of actuator travel. Knife gate valves typically do not require actuator over travel. The stem travel for globe valves and rising stem ball valves is not normally directly correlated to the valve bore diameter.



Direct Acting Gate

## Actuator Selection

### Determining the actuator model (double acting)

When selecting a double acting actuator to meet a certain valve's thrust and stroke requirements, there are two main variables; power cylinder diameter and stroke length. The required cylinder diameter is determined by matching the maximum valve thrust requirement, in any position and including safety factors, with the actuator output thrust in the same position (as shown on page 7 or 9 of this brochure) and at the minimum available supply pressure.

**Example:** 10", ANSI 600 parallel disk, direct acting valve with a 2" stem, operating at 1200 psig line pressure, with 700 psi max differential pressure and 80 psig air supply for the actuator, with a 15% factor of safety

**Seat friction** = Nominal Seating Area x  $\Delta$  Press x Gate Drag Factor =  $[\pi (10/2)^2 \times 700 \times 0.20] = 10,990$  lbf

**Packing friction** = Stem Factor = 2000 lbf (estimated)

**Hydrostatic force** = Stem area x line pressure =  $[\pi (2.00/2)^2 \times 1200] = 3770$  lbf

**Generic Thrust Calculation** = (Seat Friction + Packing Friction +/- Hydrostatic Force) x Safety Factor

Thrust to fully close the valve (**End to Close**) =  $(10,990 + 2000 + 3770) \times 1.15 = 19,274$  lbf

Thrust to begin opening the valve (**Break to Open**) =  $(10,990 + 2000 - 3770) \times 1.15 = 10,603$  lbf

The worst case is the force required to close the valve, therefore the actuator will need to develop at least this amount of thrust, in the rod extend position, with 80 psig air supply. The thrust output of an 18" diameter single cylinder is 19,340 lbf, rod extend, at 80 psig air supply (listed on page 9).

The actuator travel will be 10" + 2" = 12", the stroke code will be 'C' and the model is a **18C300-GVO-LP-DA**

### Determining the actuator model (spring return and failsafe)

When selecting a spring return model the spring start and end force, and the fail position need to be considered as well. Using the above example for a fail close (spring to close, air to open) application the thrust to close the valve (End to Close) and the thrust to open the valve (Break to Open) have been calculated. The thrust at the Start to Close and the End to Open positions must be determined. Since there will be no differential pressure in the open position, the valve gate drag is greatly reduced, however the packing friction and hydrostatic force remain.

Thrust to begin closing (**Start to Close**) =  $(0 + 2000 + 3770) \times 1.15 = 6636$  lbf

Thrust to fully open (**End to Open**) =  $(0 + 2000 - 3770) \times 1.15 = -2036$  lbf (self opening)

For this fail close application, the spring must close the valve upon loss of supply pressure and should be capable of producing at least 19,274 lbf (End to Close thrust) at the Spring End position. The Spring Start position will require only 6636 lbf (Start to Close thrust). Since the spring is fully compressed in this position there should be no shortage of available thrust. This is a fail close application for a direct acting valve, therefore the actuator must extend the drive rod upon loss of supply pressure, which is a model GVO-LP-SR.

The actuator power cylinder will need to compress the spring and produce at least 10,603 lbf net (Break to Open thrust) at the Air Start position with 80 psig air supply. For this case, the End to Open valve thrust requirement at the Air End position is negative, however the power cylinder must still be able to fully compress the spring with the 80 psig supply pressure.

Looking at the models listed on page 13, the model 24C300-GVO-LP-SR-200 puts out sufficient Spring End thrust to close the valve however it would need more than 80 psig supply pressure to develop the force required to fully compress the spring. This model would be suitable if 100 psig supply pressure was available.

Therefore, a tandem design cylinder is needed. The model 20C300-GVO-LP-SR-200-TDM (page 14) has 20,000 lbf Spring End thrust and develops 24,222 lbf at the Air Start position with 80 psig supply pressure.

## Sizing Information

The following technical information is necessary in order to efficiently select a Bettis GVO linear actuator

- Valve type: wedge gate, slab gate, expanding gate, knife gate, globe, tank valve, rising stem ball, rising stem plug valve, louver / damper
- Valve stem travel (stroke), stem diameter and seat diameter (if different than bore size)
- Valve maximum operating pressure and differential pressure
- Valve manufacturer
- Valve thrust requirement at 4 positions: break to open, end to open, break to close, and reseal
- Required factor of safety
- Available maximum and minimum supply pressure and type of supply media (air, natural gas, N<sub>2</sub>)
- Valve action: direct acting (standard acting), reverse acting (gate lifts to shut off flow)
- Valve function on loss of supply: fail last (in place), fail open or fail close
- Ambient maximum and minimum temperature
- Required certifications and approvals