

INTRODUCTION

These instructions apply specifically to the CVS Rack and Pinion pneumatic actuator. This manual provides maintenance, operation, installation, and parts ordering information. These actuators may be equipped with valve bodies, ball valves and accessories. Please refer to the appropriate instruction manuals.

The CVS Rack and Pinion Actuator has been designed, developed and tested utilizing the latest technology, and materials. This design is a rugged, reliable, high quality performer. The materials used allow for excellent corrosion protection and is NACE compliant. This design matches up to the latest global specifications; Full conformance to the latest specifications: ISO 5211, DIN 3337 and VDI/VDE 3845 NAMUR for product interchangeability and easy mounting of solenoids, limit switches and other accessories.

CONSTRUCTION

The CVS Rack and Pinion Pneumatic Actuator is constructed of an extruded aluminum body, with both internal and external corrosion protection.

This design utilizes a dual piston rack and pinion for compact construction, symmetrical mounting, high cycle life, and fast operation. Reverse rotation can be accomplished in the field by simply inverting the pistons.

Two independent external travel stop adjustments permit an easy and precise adjustment of $\pm 4^\circ$ in both the open and closed positions for accurate valve alignment.

Universal and anti-blowout patented drive shaft with easy conversion from parallel to diagonal square and vice versa. This feature permits a lower and more flexible stock.



Figure 1. CVS Rack and Pinion Actuator

A compact design with identical body and end caps for double acting and spring return models. This reduces inventory and allows for field conversion, by adding or removing the modular spring cartridge.

These units come furnished with a multi-function position indicator with NAMUR slot. This slot aids as a visual indicator, allowing for easy installation, accommodates all accessories, and the most popular sensors.

Multiple bearings with guides on racks and pistons for precise operation, low friction, and high cycle life.

Modular preloaded spring cartridge design with coated springs for simple versatile range, greater safety and corrosion resistance.

Fully machined teeth on piston rack and pinion allows for minimum backlash and pinion engagement for maximum efficiency.

Electroless nickel plated blowout resistant bearing guided one-piece pinion for improved safety and maximum cycle life.

High quality bearings and seals were selected for low friction, high cycle life and a wide operating temperature range.

Internal and external stainless steel fasteners provide long term corrosion resistance.

QUALITY MANUFACTURING

The CVS Rack and Pinion actuator is manufactured under a quality system independently assessed and approved to ISO 9001: ISO 5211, DIN 3337 and VDI/VDE 3845 NAMUR.

Every actuator is factory tested and provided with a serial number for traceability.

Each actuator is packed in a special cardboard carton with a full description of the product for easy identification.

AVAILABLE ACCESSORIES

- Connector Brackets
 - Couplings
 - Solenoid valves
 - Switch boxes
 - Proximity sensors
 - Gearboxes
 - Positioners
-

SPECIFICATIONS

Position indication:

The Actuator/Valve position is shown via a color-coded insert and NAMUR slot. The indicator is suitable for either direction of actuator rotation, and drive shaft size.

Actuator drive:

The NAMUR drive slot on the position indicator permits direct drive engagement of switch boxes and positioners.

Direct mounting of sensors:

The indicator can be supplied with metal inserts to allow for easy installation of many types of sensors.

Operating media:

Dry or lubricated air or inert/non-corrosive gases on condition that they are compatible with wetted internal actuator parts and lubricant. The operating media dew point must equal either -20°C (-40°F) or 10°C below the ambient temperature. The maximum particle size must not exceed 30 microns.

Supply pressure:

For Double Acting and Spring Return actuators the maximum supply pressure is 8 bar (116 psi). The minimum supply pressure is 2.5 bar (36 psi).

Operating Temperature:

Low temperature (LT) actuator with nitrile "O-rings" from -50°C(-58°F) to +80°C(+176°F)
High temperature (HT) actuator with FPM "O-rings" from -15°C(+5°F) to +150°C(+300°F).

CAUTION: For high and low temperature service special grease is required. High and low temperature will vary the output torque of the actuator. Please contact a CVS sales representative for each application.

Stroke:

The stroke of the CVS rack and pinion actuators is as follows (see technical data):
Standard construction: 90° rotation with stroke adjustment at 0° and 90° ± 4°

Operating time:

See Technical Data sheet

Lubrication:

The CVS Rack and Pinion Actuator comes factory lubricated for the life under normal operating conditions. The standard lubricant is suitable for use from -50°C (-58°F) +80°C (+176°F). For high and low temperature service where special grease is required please contact a CVS sales representative.

Construction:

Durable twin piston rack and pinion actuator design is suitable for both indoor and outdoor applications.

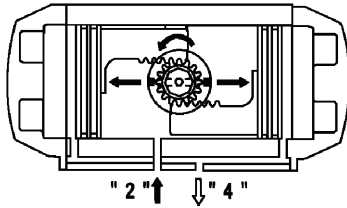
Protection and Corrosion resistance:

Actuators are supplied with corrosion protection for normal environments. For severe duties contact your CVS sales representative.

OPERATING FUNCTION and DIRECTION OF ROTATION:

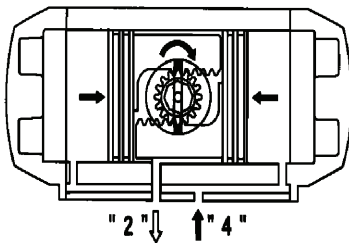
The standard rotation is clockwise to close; counter-clockwise rotation is achieved when port 2 is pressurized. For an actuator marked LF the rotation is counter-clockwise, clockwise rotation is obtained when port 2 is pressurized.

Double Acting (standard rotation)



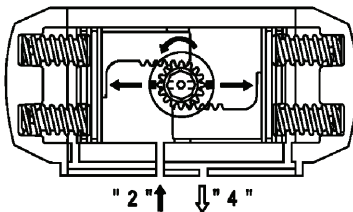
TOP View:

1. Air supplied to port 2 forces the pistons to separate and move toward the end caps, with the exhaust air exiting at port 4, a counter-clockwise rotation is achieved.



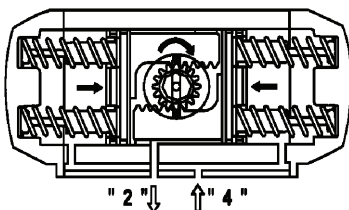
2. Air supplied to port 4 forces the pistons together with exhaust air exiting at port 2, a clockwise rotation is achieved.

Single Acting (standard rotation)



TOP View:

1. Air supplied to port 2 forces the pistons apart and toward the actuator end caps, compressing the springs, the exhaust air exits through port 4, a counter clockwise rotation is achieved.



2. A loss of air pressure (air or electric failure) at port 2 will allow the springs to force the pistons together exhausting air through port 2, a clockwise rotation is achieved.

In spring return applications the output torque is obtained in two different operations as shown in fig 2 and 3 (following page), each operation produces two different values in relation to the stroke position (0° or 90°). For spring return actuators the output torque is produced by multiplying the force (air or springs acting on the pistons) by the lever arm.

First condition (fig 2, following page):

The output torque is generated by supply air pressure at port 2 after compressing the springs; this is called "Output Torque Air Stroke". In this case the air forces the pistons from the 0° to the 90° position and consequently the torque starts at a high value and during the stroke it continually decreases until 90° due to the natural force the springs generate (oppose) when they are compressed (see diagram C)

Second condition (fig 3):

The output torque is generated by the force the springs release onto the pistons when air fails; this is called "Output Torque Spring Stroke". In this case the torque, starting from the 90° position, continually decreases until 0° because the spring extends (see diagram D).

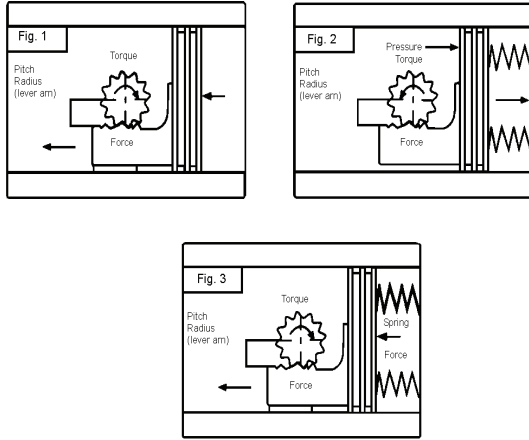
The CVS spring return actuator is designed to produce a balanced torque in the two conditions explained above when the number of springs per side is equal to the air pressure supply (4 bar-4 springs each side) as shown in diagram E. For specific applications it is possible to achieve (where desired) the unbalanced torque as shown in diagram F, by changing the relation between the number of springs per side and air pressure supply in bar (for example 6 springs and 5.5 bar or vice versa).

In spring return applications two conditions can be achieved: air failure to close or failure to open. The suggested safety factor for spring return actuators in normal working conditions is 25%.

Sizing example of AT Spring Return actuator (see also technical data):

1. Spring to close (when air fails)
2. Published ball valve torque + 708 in.lbs
3. Safety factor (25%)=708 in.lbs +25%=885 in.lbs
4. Air supply pressure available = 80 psi
5. The spring return CVS actuator selected is: CVS125SR10 because it produces the following values:

- A. Spring stroke at 0° =930 in.lbs
- B. Spring stroke at 90° =1459 in.lbs
- C. Air stroke 0° =1772 in.lbs
- D. Air stroke 90° =1246 in.lbs (see diagram G)

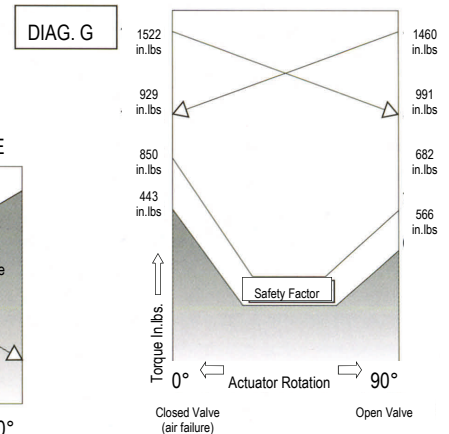
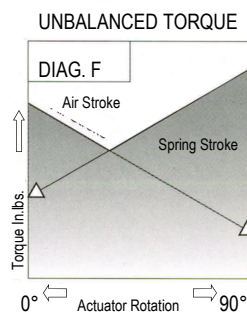
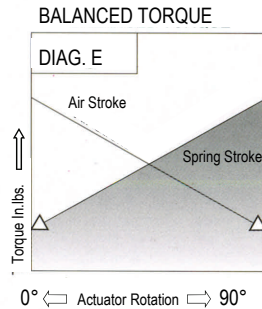
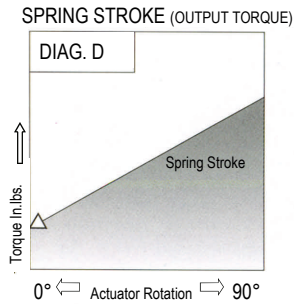


PARTS ORDERING

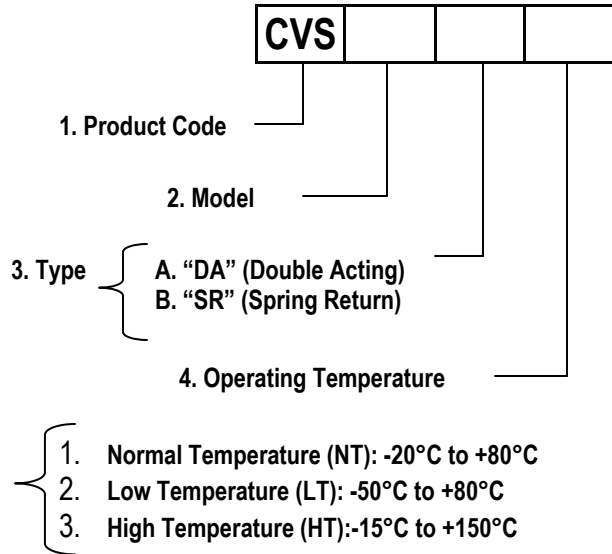
Each Rack and Pinion Actuator is assigned a serial number, which can be found on the front of the actuator. Refer to this serial number when contacting your CVS Controls representative. When ordering replacement parts, specify the serial number, key number, and part description from the following Parts Lists

REPAIR KITS

Recommended spare parts are available as complete kits.



PRODUCT SPECIFICATION



Example:

- 1. CVS 88SRLT = CVS Model 88 Spring Return, Low Temperature

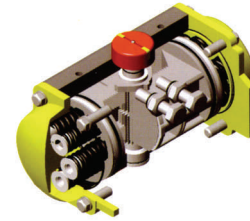
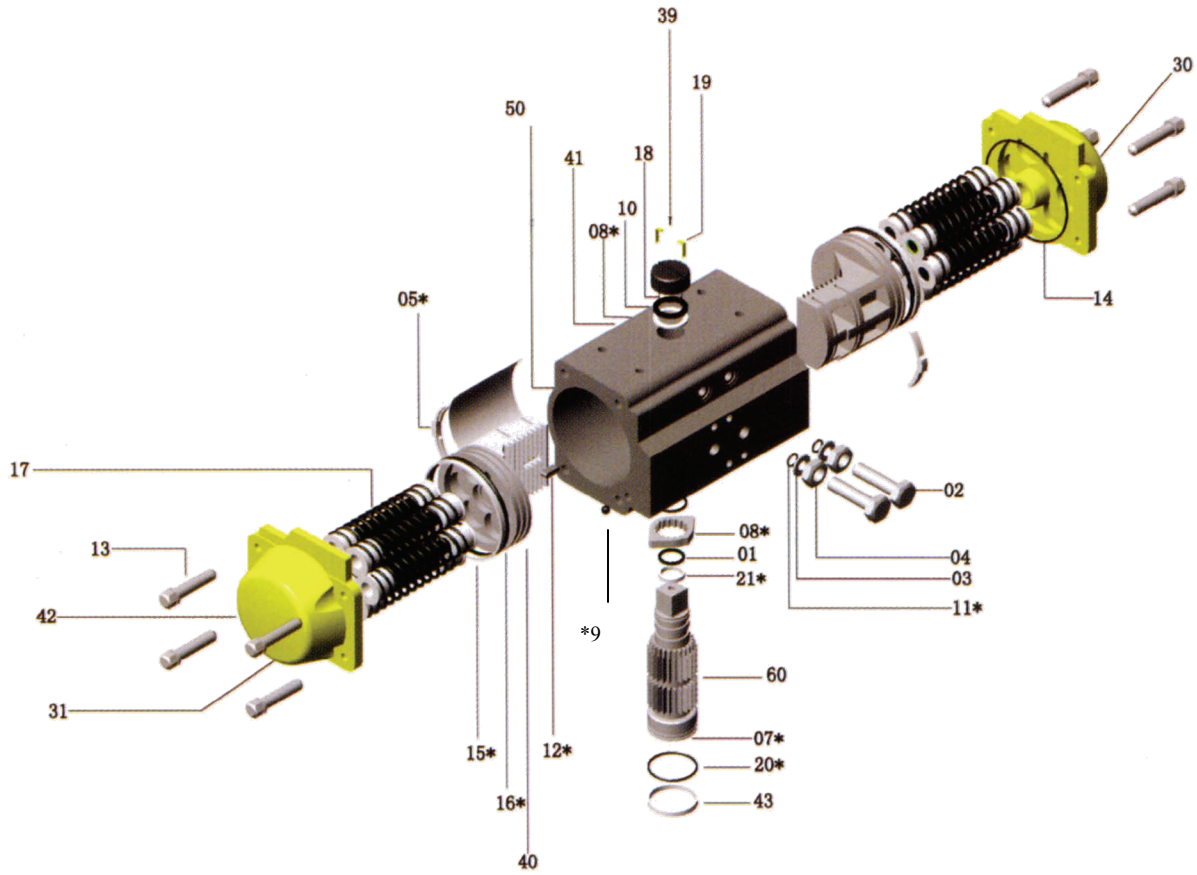


Figure 2. CVS Rack and Pinion Actuator Assembly



Dimensional Data – See Table 2

TABLE 1

Part #	Spare Parts	Qty	Description	Std. Material	Corrosion Resistant "1"	Optional Material
1		1	OCTI-CAM (Stop Arrangement)	SS (B)	--	--
2		2	Capscrew	SS	--	--
3		2	Washer	SS	--	--
4		2	Nut (Stop Screw)	SS	--	--
5*	○	2	Bearing (Piston Back)	Polyphthalamide	--	--
6*	○	1	Bearing (Pinion Top)	Nylon 46	--	--
7*	○	1	Bearing (Pinion Bottom)	Nylon 46	--	--
8*	○	2	Thrust Bearing (Pinion)	Polyphthalamide	--	--
9*	○□	2	Plug	Nitrile (NBR)	--	FPM Silicon
10		1	Thrust Washer	SS	--	
11*	○□	2	O-ring (Stop Screw)	Nitrile (NBR)	--	FPM Silicon
12		2	Piston Guide	Polyphthalamide+GF	--	
13		8 (3)	Capscrew (End Cap)	SS	--	
14*	○□	2	O-ring (End Cap)	Nitrile (NBR)	--	FPM Silicon
15*	○	2	Bearing (Piston Head)	Polyphthalamide	--	
16*	○□	2	O-ring (Piston)	Nitrile (NBR)	--	FPM Silicon
17		5-12	Spring (Cartridge)	High Alloy Spring Steel	FPM Silicon	
18		1	Spring Clip (Pinion)	High Alloy Spring Steel	Nickel Plated	SS
19		1	Position Indicator	Polpropylene+GF	--	
20*	○□	1	O-ring (Pinion Bottom)	Nitrile (NBR)	--	FPM Silicon
21*	○□	1	O-ring (Pinion Top)	Nitrile (NBR)	--	FPM Silicon
30 (D)		1	Right End Cap	Die Cast Aluminum Alloy	Polyester Coated	--
31 (D)		1	Left End Cap	Die Cast Aluminum Alloy	Polyester Coated	--
39		1	Capscrew (Indicator)	SS		--
40		2	Piston	Die Cast Aluminum Alloy	Anodized	--
41		1	Actuator I.D. Label	Polyester-Aluminum	--	--
42		2	End Cap Label	Polyester-Aluminum	--	--
43		1	Spigot (Upon Request)	Extruded Aluminum Alloy	Alodur	--
50		1	Body	Extruded Aluminum Alloy	Alodur	--
60		1	Drive Shaft	Steel Alloy	Nickel Plated	SS-

Notes:

For other protection levels contact your CVS Sales Representative
 For models CVS115 and bigger the OCTI-CAM material is cast iron
 For model CVS265 and Model CVS300 the capscrews are 12 pieces
 For models CVS and bigger the two end caps are symmetrical
 * - Suggested Spare Parts
 ○ - Parts included in spare parts kit
 □ - Parts included in O-ring Kit

DIMENSIONS: CVS50 - CVS265

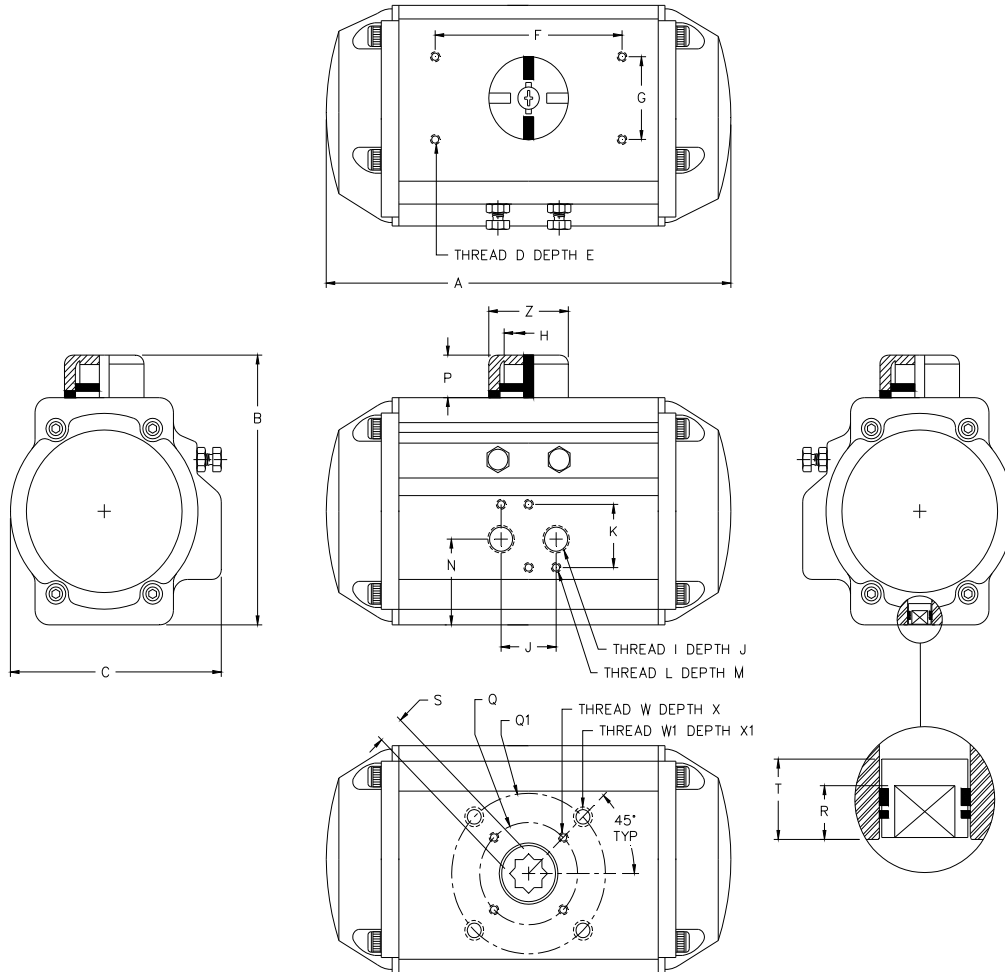
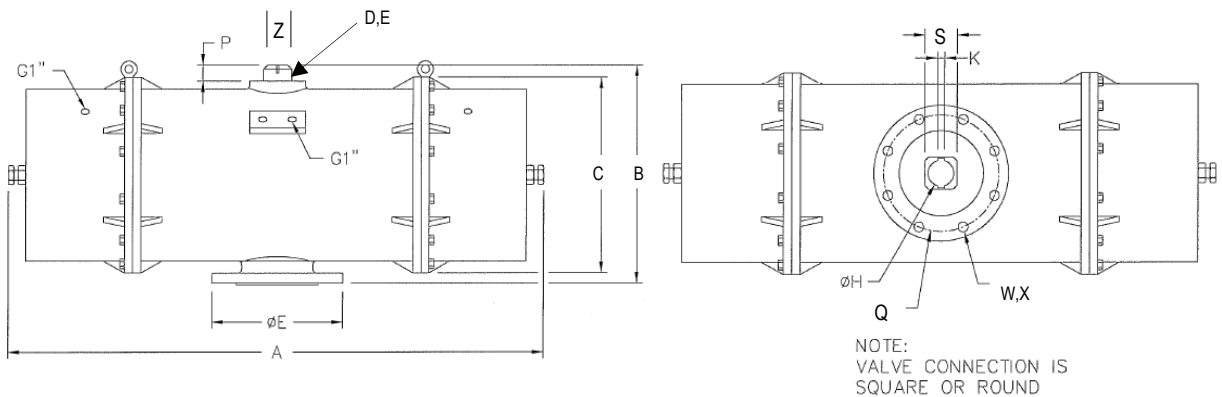


TABLE 2 - External Dimensions CVS50 - CVS265 (INCHES)

Dim.	CVS50	CVS63	CVS75	CVS88	CVS100	CVS125	CVS145	CVS160	CVS180	CVS200	CVS240	CVS265
A	5.53	6.24	8.29	9.74	10.57	13.58	16.08	17.22	19.17	21.38	24.45	26.96
B	3.50	4.13	4.80	5.31	5.79	7.36	8.15	8.90	10.65	11.61	13.72	14.96
C	2.78	3.27	3.72	4.19	4.84	5.96	6.75	7.36	8.03	8.74	10.31	12.97
D	M5	M5	M5	M5	M5	M5	M5	M5	M5	M5	M5	M5
E	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
F	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	5.12	5.12	5.12	5.12
G	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
H	0.43	0.43	0.58	0.58	0.58	0.83	1.06	1.06	1.26	1.26	1.42	1.42
I	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"
J	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	1.57	1.57
K	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.77	1.77
L	M5	M5	M5	M5	M5	M5	M5	M5	M5	M5	M6	M6
M	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.39	0.39
N	1.04	1.22	1.20	1.32	1.48	1.81	1.87	2.11	2.28	2.46	3.09	6.52
P	0.79	0.79	0.79	0.79	0.79	1.18	1.18	1.18	1.97	1.97	1.97	1.97
R	0.47	0.63	0.71	0.71	0.87	1.06	1.26	1.34	1.54	1.57	1.93	2.72
S	0.43	0.55	0.67	0.67	0.87	1.06	1.06	1.06	1.42	1.42	1.81	1.81
T	0.49	0.65	0.77	0.77	0.93	1.12	1.32	1.40	1.61	1.65	2.03	2.81
Q	1.65	1.97	1.97	1.97	2.76	2.76	4.02	4.02	5.51	5.51	6.50	6.50
Q1	-	-	2.76	2.76	4.02	4.02	4.92	4.92	-	-	-	-
W	M5	M6	M6	M6	M8	M8	M10	M10	M16	M16	M20	M20
W1	-	-	M8	M8	M10	M10	M12	M12	-	-	-	-
X	0.35	0.35	0.35	0.35	0.47	0.47	0.59	0.59	0.94	0.94	1.18	1.18
X1	-	-	0.47	0.47	0.59	0.59	0.71	0.71	-	-	-	-
ISO5211	F04	F05	F05/F07	F05/F07	F07/ F10	F07/F10	F10/F12	F10/F12	F14	F14	F16	F16
Z	1.57	1.57	1.57	1.57	1.57	2.20	2.56	2.56	3.15	3.15	4.53	4.53

DIMENSIONS: CVS300 - CVS1000



Dim.	CVS300	CVS350	CVS400	CVS500	CVS600	CVS700	CVS800	CVS900	CVS1000
IS05211	F16	F16	F25/F16	F30	F35	F40	F40	F48	F48
A	36.0	37.4	41.6	64.9	76.7	83.85	103.1	111.0	126.8
B	17.3	19.2	20.6	28.3	31.8	35.8	40.2	44.5	48.8
C	14.2	16.5	17.5	24.4	29.1	33.9	37.8	42.5	46.5
D	M5	M5	M5	M5	M5	M5	M5	M5	M5
E	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
F	5.11	5.11	5.11	5.11	5.11	5.11	5.11	5.11	5.11
G	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
H	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
I	1/2"	1/2"	1/2"	1"	1"	1"	1"	1"	1"
J	1.57	1.57	1.57	-	-	-	-	-	-
K	0.87	0.87	0.87	0.87	0.87	0.98	1.10	1.10	1.26
L	M6	M6	M6	-	-	-	-	-	-
M	0.47	0.47	0.47	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-
P	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96
Q	6.49	6.49	9.99	11.73	14.00	16.00	16.00	19.02	19.02
Q1	-	-	6.49	-	-	-	-	-	-
R	1.96	1.96	2.75	-	-	-	-	-	-
S	13.6	13.6	2.36	3.94	3.94	4.33	4.33	4.72	4.72
T	2.04	2.04	2.87	-	-	-	-	-	-
W	M20	M20	M16	M20	M30	M36	M36	M36	M36
W1	-	-	M20	-	-	-	-	-	-
X	1.18	1.18	0.94	1.18	-	-	-	-	-
X1	-	-	1.18	-	-	-	-	-	-
Z	4.52	4.52	4.52	4.52	4.52	4.52	4.52	4.52	4.52

TECHNICAL DATA

Model	Piston Diameter (in)	Travel 1°/Turn	Air Volume OPEN (In ³)	Air Volume CLOSED (In ³)	OPEN Time (Seconds)		CLOSED Time (Seconds)		WEIGHT (Lbs)	
					SR	DA	SR	DA	SR	DA
CVS50	1.97	1/6 Turn	5.5	9.2	0.25	0.20	0.30	0.25	2.30	2.10
CVS63	2.48	1/6 Turn	9.8	15.9	0.30	0.25	0.35	0.30	3.70	3.50
CVS75	2.95	1/6 Turn	18.9	29.9	0.35	0.30	0.50	0.40	6.90	5.90
CVS88	3.46	1/5 Turn	31.1	47.6	0.50	0.40	0.60	0.50	9.70	8.40
CVS100	3.94	1/5 Turn	43.3	67.7	0.60	0.50	0.90	0.70	14.40	11.90
CVS125	4.92	1/5 Turn	94.0	142.8	1.10	0.90	1.40	1.20	27.80	22.50
CVS145	5.71	1/5 Turn	147.1	230.7	1.40	1.20	1.80	1.50	39.90	32.00
CVS160	6.30	1/4 Turn	191.6	300.2	1.70	1.50	2.10	1.80	52.90	43.70
CVS180	7.09	1/4 Turn	260.0	420.5	2.20	2.0	2.80	2.40	69.70	55.10
CVS200	7.87	1/4 Turn	362.5	577.3	3.20	2.70	4.00	3.50	99.40	78.30
CVS240	9.45	1/4 Turn	610.2	927.6	4.00	3.50	4.60	4.10	139.00	115.00
CVS265	10.43	1/4 Turn	884.8	1304.7	4.50	4.00	5.00	4.50	224.90	183.00

The above data was obtained using the following test conditions: Room Temperature, 90° Actuator Stroke, Solenoid Valve with a 5/32ø (4mm) Orifice and a flow capacity of 105gpm (400 L/min), Inside Pipe Diameter = 5/16ø (8mm), Clean Air, Supply Pressure (Air) = 79.8psi (5.5 bar), Actuator without external loading

CAUTION: When one or more of the above parameters are different, the moving time may vary slightly.

TABLE 4 - Spring & Torque Ratings: Tables 4, 5, 6, & 7

Spring Return Torque Ratings (in.lbs)																						Spring Stroke	
Supply Press.		40psi		50psi		60psi		70psi		80psi		90psi		100psi		110psi		116psi					
Model	Spring	0°		90°		0°		90°		0°		90°		0°		90°		0°		90°			
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End		
CVS50SR	S05	51.3	38	71.6	58.3	91.9	78.6	112	98.9	132	119	153	139	173	160	187	171			43.1	29.8		
	S06	45.4	29.4	65.6	49.7	85.9	70	106	90.3	127	111	147	131	167	151	181	163			51.8	35.8		
	S07	39.4	20.8	59.7	41.1	80	61.3	100	81.6	121	102	141	122	161	142	175	154	194	175	60.4	41.8		
	S08			53.7	32.4	74	52.7	94.3	73	115	93	135	114	155	134	169	146	188	166	69	47.7		
	S09					68	44.1	88.3	64.4	109	85	129	105	149	125	163	137	182	158	77.6	53.7		
	S10							82.4	55.8	103	76	123	96.3	143	117	158	128	176	149	86.3	59.7		
	S11									96.7	67.4	117	87.7	137	108	152	120	170	140	94.9	65.6		
	S12													131	99			164	132	103.6	71.7		
CVS63SR	S05	94	68.5	130	104	166	140	201	176	237	212	273	247	309	283	335	304			74.7	49.1		
	S06	84.2	53.5	120	89.3	156	125	192	161	227	197	263	232	299	268	325	304			89.6	58.9		
	S07	74.4	38.6	110	74.4	146	110	182	146	218	182	253	218	289	253	315	274	346	311	105	68.8		
	S08			100	59.5	136	95.2	172	131	208	167	243	203	279	238	305	259	337	296	119	78.6		
	S09					126	80.3	162	116	198	152	234	188	269	223	295	244	327	281	134	88.4		
	S10							152	101	188	137	224	173	260	209	286	229	317	266	149	98.2		
	S11									178	122	214	158	250	194	276	214	307	251	164	108		
	S12													240	179			297	236	179	118		
CVS75SR	S05	186	131	257	202	328	273	399	344	470	415	541	486	612	557	664	597			153	97.8		
	S06	167	100	238	171	309	242	380	313	451	284	522	455	593	526	644	567			184	117		
	S07	147	70	218	141	289	212	360	283	431	354	502	425	573	496	625	536	687	609	214	137		
	S08			198	110	269	181	340	252	412	323	483	394	554	465	605	505	667	579	245	157		
	S09					250	150	321	221	392	292	463	363	534	434	585	475	648	548	276	176		
	S10							301	191	372	262	443	333	514	404	566	444	628	517	306	196		
	S11									353	231	424	302	495	373	546	413	608	487	337	215		
	S12													475	342			589	456	368	235		
CVS88SR	S05	285	191	396	303	508	415	620	526	731	638	843	750	955	862	1034	922			256	162		
	S06	252	140	476	252	476	364	587	475	699	587	811	699	922	810	1002	871			307	195		
	S07	220	89	331	201	443	313	555	424	667	536	778	648	890	759	969	820	1069	938	358	227		
	S08			299	150	411	261	522	373	634	485	746	597	858	708	937	769	1036	887	409	260		
	S09					378	210	490	322	602	434	713	545	825	657	904	718	1004	836	460	292		
	S10							457	271	569	383	681	494	793	606	872	687	971	785	511	325		
	S11									537	331	648	443	760	555	839	616	939	734	562	357		
	S12													728	504			906	683	613	389		
CVS100SR	S05	425	301	587	463	750	625	912	787	1074	950	1236	1112	1399	1274	1516	1367			349	224		
	S06	380	231	542	393	705	555	867	718	1029	880	1192	1042	1354	1205	1471	1297			418	269		
	S07	335	161	498	323	660	486	822	648	984	810	1147	973	1309	1135	1426	1227	1569	1395	488	314		
	S08			453	254	615	416	777	578	964	741	1102	903	1364	1065	1382	1158	1524	1325	558	359		
	S09					570	346	732	509	895	671	1057	833	1219	995	1337	1088	1479	1255	627	404		
	S10							688	439	850	601	1012	763	1174	925	1292	1018	1434	1185	697	449		
	S11									805	531	967	694	1130	856	1247	949	1389	1116	767	493		
	S12													1085	786			1344	1046	837	538		

TABLE 5

Spring Return Torque Ratings (in.lbs)																					Spring Stroke	
Supply Press.		40psi		50psi		60psi		70psi		80psi		90psi		100psi		110psi		116psi		90°	0°	
Model	Spring	0°	90°	0°	90°	0°	90°	0°	90°	0°	90°	0°	90°	0°	90°	0°	90°	0°	90°			
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End			
CVS125SR	S05	888	623	1226	961	1564	1299	1902	1637	2240	1976	2578	2314	2916	2652	3161	2844			729	465	
	S06	795	477	1133	815	1471	1154	1809	1492	2147	1830	2485	2168	2823	2506	3069	2698			875	558	
	S07	702	331	1040	670	1378	1008	1716	1346	2054	1684	2392	2022	2730	2360	2976	2552	3271	2901	1021	651	
	S08			947	524	1285	862	1623	1200	1961	1538	2299	1876	2637	2214	2883	2407	3178	2755	1167	744	
	S09					1192	716	1530	1054	1868	1392	2206	1730	2544	2068	2790	2261	3085	2609	1313	837	
	S10							1437	908	1772	1246	2113	1584	2452	1923	2697	2115	2993	2646	1459	930	
	S11									1682	1100	2020	1439	2359	1777	2604	1969	2900	2318	1604	1023	
	S12													2266	1631			2807	2172	1750	1116	
CVS145SR	S05	1394	983	1925	1514	2456	2044	2897	2575	3517	3106	4048	3637	4579	4167	4964	4470			1140	729	
	S06	1248	755	1779	1285	2310	1816	2841	2347	3372	2878	3902	3409	4433	3939	4818	4242			1369	875	
	S07	1103	527	1633	1057	2164	1588	2559	2119	3226	2650	3757	3181	4287	3711	4672	4014	5137	4561	1597	1021	
	S08			1488	829	2018	1360	2549	1891	3080	2422	3611	2952	4142	3483	4572	3786	4991	4333	1825	1166	
	S09		811			1873	1132	2403	1663	2934	2194	3465	2724	3996	3255	4381	3558	4845	4104	2053	1312	
	S10							2258	1435	2788	1965	3319	2496	3850	3027	4235	3330	4699	3876	2281	1458	
	S11									2643	1737	3173	2268	3704	2799	4089	3102	4553	3648	2501	1604	
	S12													3558	2571			4408	3420	2737	1706	
CVS160SR	S05	1777	1300	2469	1992	3162	2685	3854	3377	4547	4070	5239	4762	5931	5455	6425	5853			1470	993	
	S06	1578	1006	2271	1698	2963	2391	3655	3083	4348	3776	5040	4468	5733	5161	6227	5559			1764	1192	
	S07	1380	712	2072	1404	2764	2097	3657	2789	4149	3482	4842	4174	5534	4867	6028	5265	6642	5975	2058	1390	
	S08			1873	1110	2566	1803	3258	2495	3851	3188	4643	3880	5336	4573	5829	4971	6444	5681	2354	1589	
	S09					2367	1509	3060	2201	3752	2894	4445	3586	5137	4279	5631	4677	6245	5387	2646	1788	
	S10							2861	1907	3553	2600	4246	3292	4938	3985	5432	4383	6046	5093	2940	1986	
	S11									3355	2306	4047	2998	4740	3691	4235	4089	5848	4799	3234	2185	
	S12													4541	3397			5649	4505	3528	2383	
CVS180SR	S05	2340	1644	3275	2578	4210	3513	5145	4448	6079	5383	7014	6318	7949	7253	8604	7768			2096	1399	
	S06	2060	1225	2995	2159	3930	3094	4865	4029	5800	4964	6734	5899	7669	6833	8324	7349			2515	1679	
	S07	1780	805	2715	1740	3650	2675	4585	3610	5520	4545	6454	5480	7389	6414	8044	6930	8885	7910	2934	1959	
	S08			2435	1321	3370	2256	4305	3191	5240	4126	6175	5060	7109	5995	7764	6511	8605	7491	3353	2239	
	S09					3090	1837	4025	3772	4960	3706	5895	4641	6830	5576	7485	6092	8325	7072	3772	2519	
	S10							3745	2353	4680	3287	5615	4222	6650	5157	7205	5673	8045	6653	4191	2798	
	S11									4400	2868	5335	3803	6270	4738	6925	5254	7766	6234	4610	3078	
	S12													5990	4319			7486	5814	5029	3358	

TABLE 5

		Spring Return Torque Ratings (in.lbs)																		Spring Stroke	
Supply Press.		40psi		50psi		60psi		70psi		80psi		90psi		100psi		110psi		116psi			
Model	Spring	0°		90°		0°		90°		0°		90°		0°		90°		0°		90°	
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
CVS200SR	S05	3312	2406	4610	3704	5908	5003	7207	6301	8505	7599	9803	8898	11102	10196	12024	10937	12427	11159	2787	1882
	S06	2935	1849	4235	3147	5532	4445	6830	5744	8129	7042	9427	8340	10725	9639	11648	10380	12050	10601	3345	2258
	S07	2559	1291	3857	2589	5156	3888	6454	5186	7752	6485	9051	7783	10349	9061	11271	9822	11674	10044	2902	2634
	S08			3481	2032	4779	3330	6078	4629	7376	5927	8674	7225	9917	8524	10695	9265	11297	9486	4460	3011
	S09					4403	2773	5701	4071	7000	5370	8298	6668	9565	7966	10518	8707	10921	8929	5017	3387
	S10							5325	3514	6623	4812	7922	6110	9220	9409	10142	8106	10545	8371	5575	3761
	S11									6247	4255	7545	5553	8844	6851	9766	7592			6132	4140
	S12													8467	6294					6690	4516
CVS240SR	S05	5535	4113	7716	6294	9898	8475	12079	10657	14260	12838	16441	15017	18623	17200	20168	18459	20837	18848	4612	3190
	S06	4897	3190	7078	5372	9260	7553	11441	9374	13622	11915	15803	14097	17985	16278	19528	17537	20199	17923	5534	3828
	S07	4259	2268	6440	4449	8622	6631	10803	8812	12984	10993	15165	13174	17347	15356	18890	16614	19561	17001	6457	4466
	S08			5802	3527	7984	5708	10165	7889	12346	10071	14527	12252	16709	14433	18252	15692	18923	16078	7379	5104
	S09					7346	4786	9527	6967	11708	7148	13889	13229	16071	13511	17614	14700	18285	15156	8302	5742
	S10							8889	6045	11070	8226	13251	10407	15433	12588	16976	13847	17647	14233	9224	6380
	S11									10432	7303	12613	9485	14795	11666	16338	12925			10147	7018
	S12													14157	10743					11069	7656
CVS265SR	S05	7836	5576	11002	8742	14908	11907	17333	15073	20499	18239	23665	21405	26831	24571	29031	26319	29965	26801	7088	4828
	S06	6870	4158	10036	7324	13202	10490	16368	3566	19534	16822	22700	19967	25865	23153	28066	24902	29000	25384	8505	5793
	S07	5905	2741	90702	5906	12236	9072	15402	12238	18588	15404	21734	18570	24900	21736	27100	23484	28034	23966	9923	6759
	S08			8105	4489	11271	7655	14437	10821	17633	17969	20769	17152	23934	20318	26135	22067	27069	22549	11340	7724
	S09					10305	6237	13471	9403	16637	12569	19803	15736	22969	18901	25169	20649	26103	21131	12758	8690
	S10							12506	7896	15672	11151	18837	14317	22003	17483	24204	19231	25135	19713	14176	9655
	S11									14706	9734	17872	12900	21038	16066	23238	17814			15593	10621
	S12													20072	14648					17011	11585

** PLEASE NOTE: FORMAT CHANGE

		Spring Return Torque Ratings (in.lbs)										Spring Stroke	
Supply Press.		36psi	44psi	51psi	58psi	65psi	73psi	80psi	87psi	102psi	116psi		
CVS300SR	S06	4221	8390	12550								9957	
	S07		5629	9788	13957							11621	
	S08			7018	11187	15347	19515					13276	
	S09				8425	12585	16754	20914	25083	33411	41740	14940	
	S10					9815	13984	18144	22312	30641	50033	16595	
	S11						11222	15382	19551	27879	48378	18259	
	S12						8452	12612	16781	25109	46714	19914	
CVS350SR	S06	7788	12966	18144	23312							12453	
	S07		9948	15125	20294	25428						14532	
	S08			12116	17285	22463	27632					16604	
	S09				14276	19453	24622	29800	34978	45324	55671	18683	
	S10					16435	21604	26782	31960	42306	52653	20755	
	S11						18515	23773	28950	39297	49643	22834	
	S12						15586	20763	25941	36288	46634	24906	
CVS400SR	S06	2398	8717	15046								14603	
	S07		3850	10178	16497							17037	
	S08			5310	11629	17949	24268					19471	
	S09					13081	19400	25729	32048	44696	57335	21905	
	S10					8213	14532	20861	27180	39828	52467	24339	
	S11						9665	15993	22312	34960	47599	26773	
	S12						4797	11125	17444	30092	42731	29207	

** PLEASE NOTE: FORMAT CHANGE

TABLE 6												
Spring Return Torque Ratings (in.lbs)											Spring Stroke	
Supply Press.	36psi	44psi	51psi	58psi	65psi	73psi	80psi	87psi	102psi	116psi		
CVS500SR	S06	14674	28897	43120							28453	
	S07		19498	33721	47935						33305	
	S08			24313	38529	52750	71753				38058	
	S09				29127	43350	62353	71797	86011	114457	142895	42819
	S10					33942	52946	62388	76603	105049	133487	47572
	S11						43545	52989	67203	96650	124087	52334
	S12						34137	43581	57795	86241	114679	57087
CVS600SR	S06	92065	124822	157569							35181	
	S07		112873	145621	178378						41049	
	S08			133672	166429	199177	231933				46908	
	S09				154481	187228	219985	252733	285489	350994	416498	52777
	S10					175280	208036	240784	273541	339045	404550	58636
	S11						196088	228836	261592	327097	392601	64504
	S12						184139	216887	249644	315148	380653	70363
CVS700SR	S06	32013	46165	92100							91383	
	S07		6195	52927	99659						106607	
	S08			13754	60486	107218	153949				33331	
	S09				21312	68044	114776	161508	208240	301713	395177	137071
	S10					28880	75611	122343	169075	262548	356189	152303
	S11						36438	83170	129902	223375	316839	167527
	S12							43997	90729	184201	277665	182759
CVS800SR	S06	28464	104766	181059							120122	
	S07		45953	122228	198531						140142	
	S08			63389	13969	215984	292287				160163	
	S09				80851	157145	223447	309740	386043	538638	691234	180183
	S10					98314	174616	250909	327212	579808	632403	200204
	S11						115776	192070	268372	420968	573564	220224
	S12						56945	133239	209541	362137	514733	240244
CVS900SR	S06	14170	110740	207302							162526	
	S07		32632	129194	225756						189616	
	S08			51086	147648	244218	340780				216701	
	S09				69540	16610	262672	359234	455804	648937	842060	243793
	S10					88003	184564	281126	377696	570829	763952	270877
	S11						106456	203018	299589	492721	685844	297296
	S12						28348	124910	221481	414613	607736	325052
CVS1000SR	S06		150170	270275	389486						218958	
	S07			176236	295446	414666	533877				255450	
	S08				201407	320627	439838				291942	
	S09					226588	345798	465018	584229	822668	1061099	328433
	S10						340267	370979	490189	728629	967059	364925
	S11						157720	276940	396150	634589	837020	401416
	S12						63681	182900	302111	540550	778981	437917

TABLE 7

Double Acting Torque Ratings (in.lbs)									
Model	40psi	50psi	60psi	70psi	80psi	90psi	100psi	110psi	116psi
CVS 50DA	81.1	101	122	142	162	183	203	223	235
CVS 63DA	143	179	215	251	286	322	358	394	415
CVS 75DA	284	355	426	497	568	639	710	781	824
CVS 88DA	447	559	670	782	894	1005	1117	1229	1296
CVS 100DA	649	811	974	1136	1298	1461	1623	1785	1883
CVS 125DA	1352	1691	2029	2357	2706	3043	3381	3719	3992
CVS 145DA	2123	2654	3158	3716	4246	4777	5308	5839	6157
CVS 160DA	2770	3462	4155	4847	5540	6232	6925	7617	8032
CVS 180DA	2739	4674	5609	6544	7479	8413	9348	10283	10844
CVS 200DA	5193	6492	7790	9088	10387	11685	12984	14282	15061
CVS 240DA	8725	10906	13087	12569	17450	19631	21812	23994	25302
CVS 265DA	12663	15829	18995	22161	25327	28493	31659	34825	36724

Double Acting Torque Ratings (in.lbs)										
Model	36psi	44psi	51psi	58psi	65psi	73psi	80psi	87psi	102psi	116psi
CVS 300DA	19931	23923	27906	31898	35880	39863	43855	47838	55812	66628
CVS 350DA	25861	31039	36217	41386	46563	51732	56910	62088	72434	82781
CVS 400DA	31606	37925	44244	50573	56892	63212	69540	75859	88498	101146
CVS 500DA	71098	85321	99544	113758	127981	142205	156428	170642	199088	227526
CVS 600DA	163756	196513	229261	262017	294765	327522	360269	393026	458530	524035
CVS 700DA	267044	280391	327123	373855	420587	467319	514051	560783	654256	747720
CVS 800DA	381485	457787	534080	610383	686676	762978	839272	915574	1068170	1220766
CVS 900DA	482817	579387	675949	87282	869081	965463	1062255	1158776	1351908	1545031
CVS 1000DA	596071	715291	834510	953721	1072941	1192152	1311371	1430582	1669021	1907452

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