

# Series VL Air Cylinders for Valve Actuation

Catalog AC0947-1  
April, 2004



**ATLAS**  
CYLINDERS

 **Warning**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

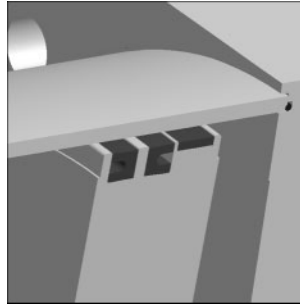
This document and other information from The Company, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application, including consequences of any failure and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The product described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by The Company and its subsidiaries at any time without notice.

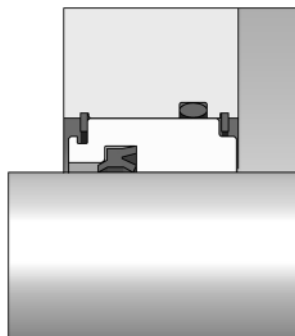
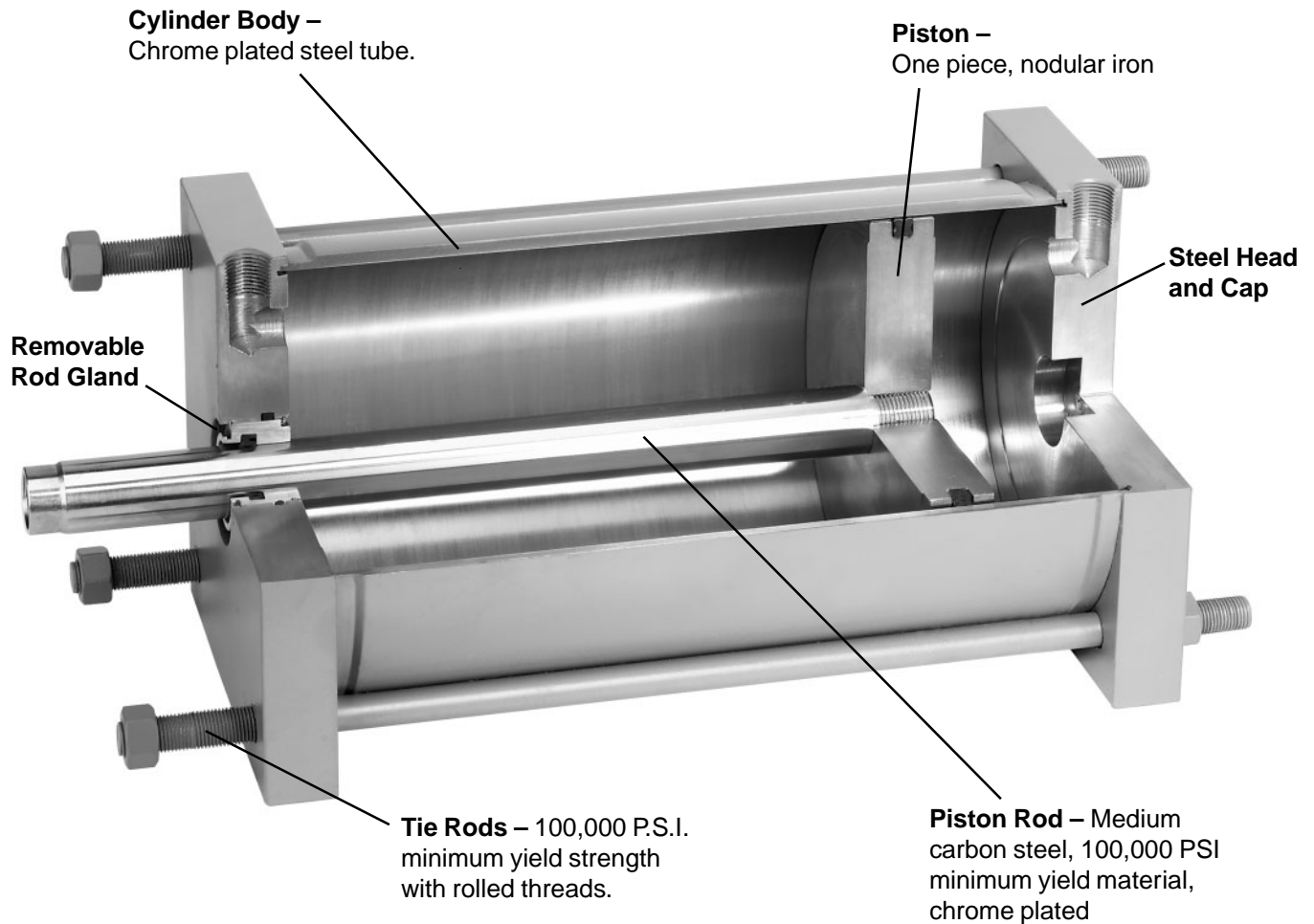
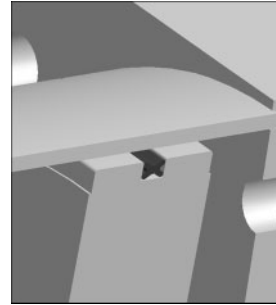
**Offer of Sale**

The items described in this document are hereby offered for sale by The Company, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by provisions stated on a separate page of this catalog in the document entitled 'Offer of Sale'.

**Piston Seal –**  
Two Nitrile lipseals, 2 - 5"  
and 16 - 24" bores. Wear  
bands provided on the  
16 - 24" bores.



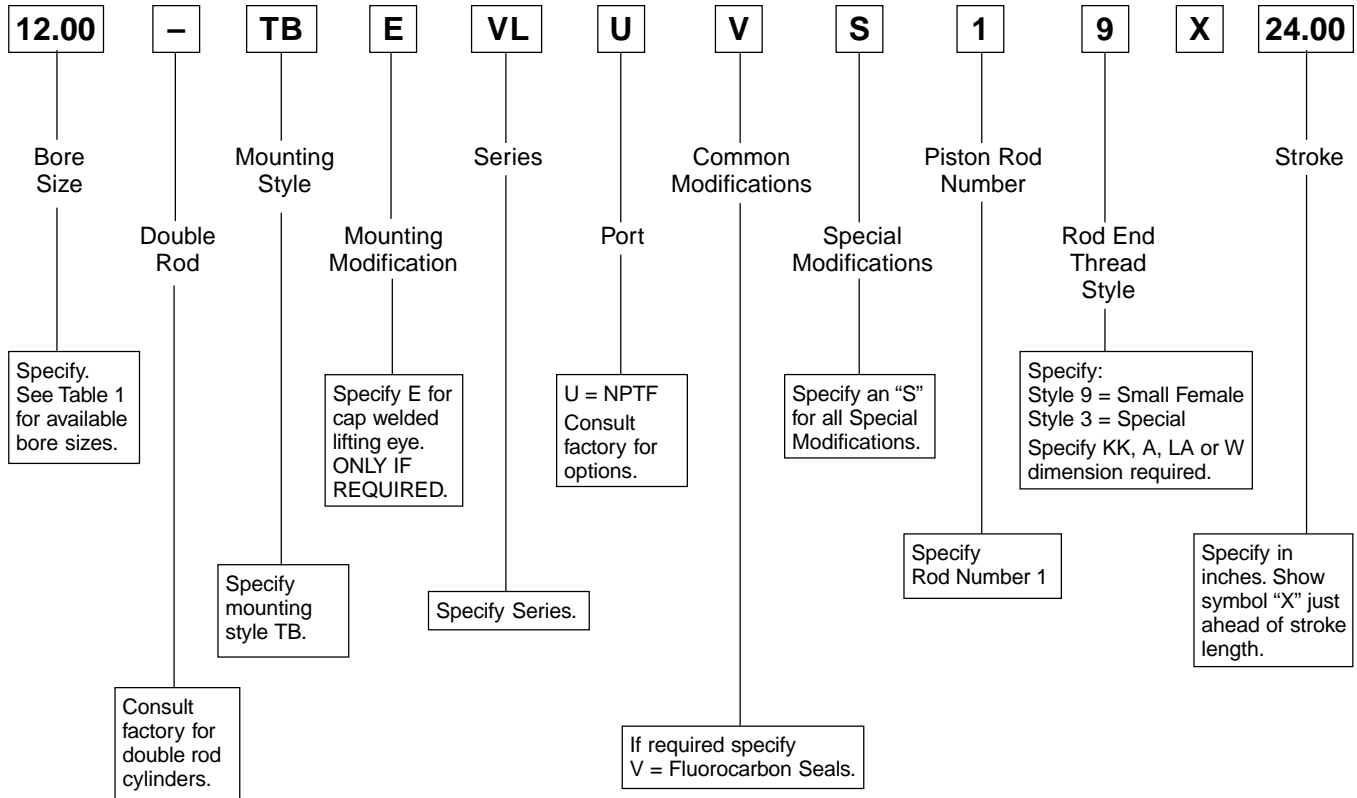
**Piston Seal –**  
Nitrile "Quad" seal,  
6 - 14" bores.



**Removable Rod Gland –**  
Heavy duty rod bearing with  
Nitrile rod seal/wiper, 3 1/4 - 24"  
bores. (Removable glands are  
not provided for the 2 and 2 1/2"  
bores.)

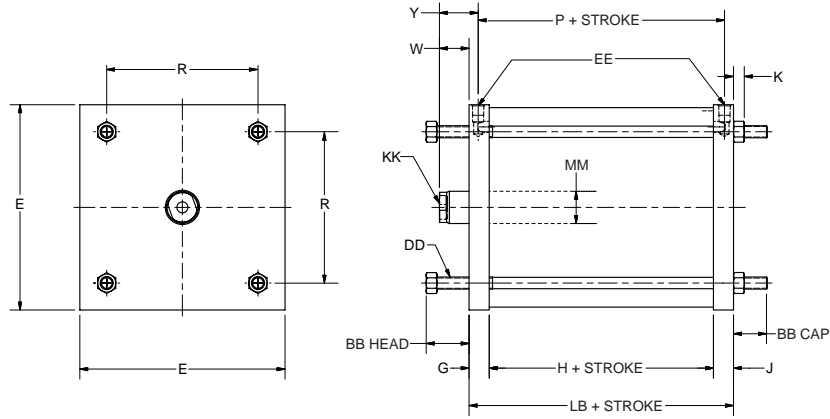
**How to Order Series VL Air Cylinders for Valve Actuation**

**How to Order Code**



**Available Options**

- Individual Rod Seal and Rod Wiper
- Stainless Steel Piston Rods
- Spring Extend or Retract
- Double Rod End Style
- Hi-Temp Seals (Fluorocarbon rated to 250°F)
- Water Service
- Lifting Eyes
  - Tie rod mount (ordered as an accessory)
  - Welded on cap face



**Table 1 – Dimensional Table**

BORE	MM	KK STYLE 9	A	C	D	LA	W	Y	BB HEAD	BB CAP	DD
2"	5/8	7/16-20	3/4	3/8	1/2	1 3/8	5/8	1 1/16	1 1/8	1	5/16-24
2 1/2"	5/8	7/16-20	3/4	3/8	1/2	1 3/8	5/8	1 1/16	1 1/8	1	5/16-24
3 1/4"	1	3/4-16	1 1/8	1/2	7/8	1 7/8	3/4	1 3/16	1 3/8	1 1/4	3/8-24
4"	1	3/4-16	1 1/8	1/2	7/8	1 7/8	3/4	1 3/16	1 3/8	1 1/4	3/8-24
5"	1	3/4-16	1 1/8	1/2	7/8	1 7/8	3/4	1 3/16	1 13/16	1 1/4	1/2-20
6"	1	3/4-16	1 1/8	1/2	7/8	2	7/8	1 5/16	1 13/16	1 1/4	1/2-20
7"	1	3/4-16	1 1/8	1/2	7/8	2	7/8	1 5/16	2	1 1/2	5/8-18
8"	1	3/4-16	1 1/8	1/2	7/8	2	7/8	1 5/16	2	1 1/2	5/8-18
10"	1	3/4-16	1 1/8	1/2	7/8	2 1/8	1	1 9/16	2 1/4	1 1/2	3/4-16
12"	1 3/8	1-14	1 5/8	5/8	1 1/8	2 5/8	1	1 9/16	2 1/4	1 1/2	3/4-16
14"	1 3/8	1-14	1 5/8	5/8	1 1/8	2 5/8	1	1 11/16	2 1/2	2	7/8-14
16"	1 3/4	1-14	1 5/8	3/4	1 1/2	2 7/8	1 1/4	1 15/16	2 3/4	2	1-14
18"	2	1 1/2-12	2 1/4	7/8	1 11/16	3 3/4	1 1/2	2 1/4	3 1/4	2 1/2	1 1/8-12
20"	2	1 1/2-12	2 1/4	7/8	1 11/16	3 3/4	1 1/2	2 1/4	3 1/4	2 1/2	1 1/4-12
22"	3	2 1/4-12	3 1/2	1	2 5/8	5 3/4	2 1/4	3 7/16	3 1/2	2 1/2	1 1/4-12
24"	3 1/2	2 1/2-12	3 1/2	1	3	5 3/4	2 1/4	3 3/4	3 1/2	2 1/2	1 1/4-12

BORE	E	EE (NPTF)	G	J	K	NA	R	Add Stroke			*MAX STROKE
								LB	H	P	
2"	2 1/2	1/4	1	1	5/16	9/16	1.84	3 1/8	1 1/8	2 1/4	60"
2 1/2"	3	1/4	1	1	5/16	9/16	2.19	3 1/4	1 1/4	2 3/8	50"
3 1/4"	4	1/4	1	1	3/8	15/16	2.76	3 1/4	1 1/4	2 3/8	100"
4"	4 1/2	3/8	1	1	3/8	15/16	3.32	3 1/4	1 1/4	2 3/8	80"
5"	5 1/2	3/8	1	1	7/16	15/16	4.10	3 1/2	1 1/2	2 5/8	65"
6"	6 1/2	3/8	1	1	7/16	15/16	4.88	3	1	2 1/8	55"
7"	7 1/2	3/8	1	1	9/16	15/16	5.73	3 1/4	1 1/4	2 3/8	45"
8"	8 1/2	3/8	1	1	9/16	15/16	6.44	3 1/4	1 1/4	2 3/8	40"
10"	10 5/8	1/2	1 1/4	1 1/4	11/16	15/16	7.92	4	1 1/2	2 7/8	30"
12"	12 3/4	1/2	1 1/4	1 1/4	11/16	1 5/16	9.40	4 1/4	1 3/4	3 1/8	50"
14"	14 3/4	3/4	1 1/2	1 1/2	13/16	1 5/16	10.90	4 3/4	1 3/4	3 3/8	40"
16"	17	3/4	1 1/2	1 1/2	7/8	1 11/16	12.59	5	2	3 5/8	60"
18"	19	3/4	1 3/4	1 3/4	1	1 15/16	14.14	5 3/4	2 1/4	4 1/4	70"
20"	21	3/4	1 3/4	1 3/4	1 1/16	1 15/16	15.77	6	2 1/2	4 1/2	65"
22"	23	3/4	2	2	1 1/4	2 7/8	17.18	7 1/2	3 1/2	5 1/8	60"
24"	25 1/4	3/4	2 1/2	2 1/2	1 1/4	3 3/8	18.74	8 1/2	3 1/2	5 1/2	60"

\*Based upon rod buckling calculation at 100 PSI operating pressure.

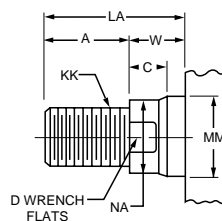
**Rod End Dimensions**

**"Special" Thread Style 3**

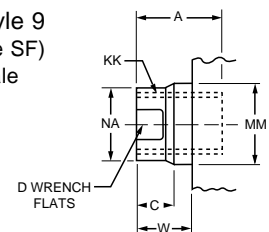
Special thread, extension, rod eye, blank, etc., are also available.

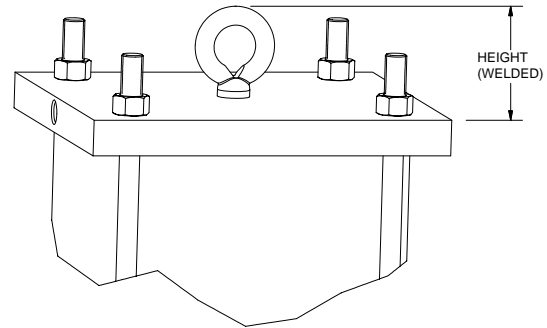
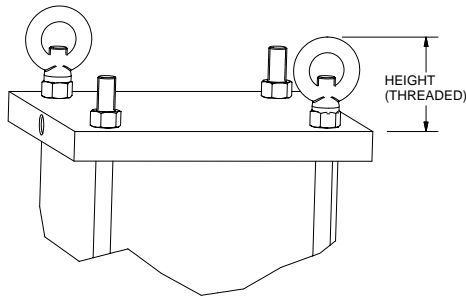
To order, specify "Style 3" and give desired dimensions for KK, A and LA. If otherwise special, furnish dimensioned sketch.

Thread Style 3  
Special Thread



Thread Style 9  
(NPTA Style SF)  
Small Female





**Table 2 – Lifting Eyes**

BORE	DD THREAD	HEIGHT		THREADED LIFTING EYE CAPACITY (lbs/eye)	THREADED LIFTING EYE PART NUMBER
		WELDED	THREADED		
2"	5/16-24	1 5/8	1 15/16	200	0882360031
2 1/2"	5/16-24	1 5/8	1 15/16	200	0882360031
3 1/4"	3/8-24	3 3/16	3 9/16	200	0882160038
4"	3/8-24	3 3/16	3 9/16	200	0882160038
5"	1/2-20	3 3/16	3 5/8	500	0882160050
6"	1/2-20	3 3/16	3 5/8	500	0882160050
7"	5/8-18	3 3/16	3 3/4	800	0882160063
8"	5/8-18	3 3/16	3 3/4	800	0882160063
10"	3/4-16	3 3/16	3 7/8	600	0882160075
12"	3/4-16	3 3/16	3 7/8	600	0882160075
14"	7/8-14	3 3/16	5 3/16	1650	0882180088
16"	1-14	3 3/16	5 1/4	1650	0882180100
18"	1 1/8-12	3 3/16	6 5/8	1650	0882180113
20"	1 1/4-12	3 3/16	6 11/16	1650	0882180125
22"	1 1/4-12	3 3/16	6 11/16	1650	0882180125
24"	1 1/4-12	3 3/16	6 11/16	1650	0882180125

**Table 3 – Tie Rod Torque**

BORE	TIE ROD NUT TORQUE* (Steel Tube) (ft-lbs/N-m)
2"	11/15
2 1/2"	11/15
3 1/4"	25/34
4"	25/34
5"	60/81
6"	60/81
7"	90/122
8"	110/149
10"	148/201
12"	172/233
14"	275/373
16"	390/529
18"	540/732
20"	745/1010
22"	745/1010
24"	745/1010

\* Tolerance of -0%, +5%; when assembling the cylinder, be sure to torque the tie rods evenly.

**Table 4 – Cylinder Weight Chart**

BORE	ROD DIA.	Weight at zero stroke with steel tube (lbs)	Weight per in. stroke with steel tube (lbs)
2"	5/8	3.1	0.3
2 1/2"	5/8	5.3	0.4
3 1/4"	1	9.5	0.6
4"	1	14.7	0.8
5"	1	22.9	1.0
6"	1	34.6	1.1
7"	1	50.3	1.6
8"	1	66.7	2.0
10"	1	125.1	2.6
12"	1 3/8	173.1	3.3
14"	1 3/8	268.8	3.8
16"	1 3/4	373.3	5.9
18"	2	490.3	6.9
20"	2	752.1	10.0
22"	3	971.5	12.2
24"	3 1/2	1413.4	15.0

## Atlas Cylinders Safety Guide for Selecting and Using Pneumatic Cylinders and Their Accessories

**WARNING: ⚠ FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF CYLINDERS AND THEIR RELATED ACCESSORIES CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.**

Before selecting or using Atlas cylinders or related accessories, it is important that you read, understand and follow the following safety information.

### User Responsibility

Due to very wide variety of cylinder applications and cylinder operating conditions, Atlas Cylinders does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to Atlas Cylinders' design guide lines and do not necessarily meet the design guide lines of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

### Seals

Part of the process of choosing a cylinder is the selection of seal compounds. Before making this selection read the Operating Fluids and Seals information in the Application Engineering Data section of the current Series A catalog, or contact our engineering department.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

### Piston Rods

Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendation for the maximum cylinder stroke found in Dimensional Table 1 of this catalog. The suggested maximum stroke in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinder which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

### Port Fittings

Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure} \times \text{effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

### Cylinder Modifications or Repairs

Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at Atlas Cylinders locations or by Atlas Cylinders certified facilities. It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

## Storage, Installation, Mounting Recommendations, and Cylinder Troubleshooting

### Storage

At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

1. Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.
2. Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.
3. Port protector plugs should be left in the cylinder until the time of installation.
4. If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

### Installation

1. Cleanliness is an important consideration, and Atlas cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.
2. Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.
3. Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

### Mounting Recommendations

Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

### Cylinder Trouble Shooting

#### External Leakage

1. Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland bearing wear. If clearance is excessive, replace rod gland and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

2. Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

#### Internal Leakage

1. With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Replace piston seals as required.
2. What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

#### Cylinder Fails to Move the Load

1. Pneumatic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.
2. Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.
3. Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.
4. Piston rod broken. Bring the operating conditions of the cylinder to the attention of our engineering department and have our factory repair the cylinder.

#### Erratic or Chatter Operation

1. Excessive friction at gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.
2. Cylinder sized too close to load requirements – Reduce load or install larger cylinder.
3. Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

**REGIONAL PLANTS****California**

221 Helicopter Circle  
Corona, CA 92880  
Tel.: (909) 280-3800  
Fax: (909) 280-3808  
Fax: (800) 869-9886

**Connecticut**

80 Shaker Road  
Enfield, CT 06082  
Tel.: (860) 749-2215  
Fax: (800) 323-0105

**Georgia**

1300 Six Flags Road  
Lithia Springs, GA 30122  
Tel.: (770) 819-3400  
Fax: (800) 437-3498

**Illinois**

Bensenville Plant  
800 N. York Road  
Bensenville, IL 60106  
Tel.: (630) 766-3400  
Fax: (630) 766-3012

**Indiana**

Goodland Plant  
715 South Iroquois Street  
Goodland, IN 47948  
Tel.: (219) 297-3182  
Fax: (800) 328-8120

**Michigan**

900 Plymouth Road  
Plymouth, MI 48170  
Tel.: (734) 455-1700  
Fax: (734) 455-1007

**Ohio**

1000 Home Avenue  
Akron, OH 44310  
Tel.: (330) 253-4375  
Fax: (330) 253-4883

**Oregon**

13908 N. Lombard  
Portland, OR 97203  
Tel.: (503) 285-0884  
Fax: (800) 323-0195

**CANADA**

8485 Parkhill Drive  
Milton, Ontario  
Canada L9T 5E9  
Tel.: (905) 693-3000  
Fax: (905) 876-1958

## Offer of Sale

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**1. Terms and Conditions of Sale:** All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

**2. Payment:** Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

**3. Delivery:** Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

**4. Warranty:** Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from The Company. THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.

NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.

**5. Limitation of Remedy:** SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

**6. Changes, Reschedules and Cancellations:** Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

**7. Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

**8. Buyer's Property:** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

**9. Taxes:** Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

**10. Indemnity for Infringement of Intellectual Property Rights:** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter "Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

**11. Force Majeure:** Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

**12. Entire Agreement/Governing Law:** The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.



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