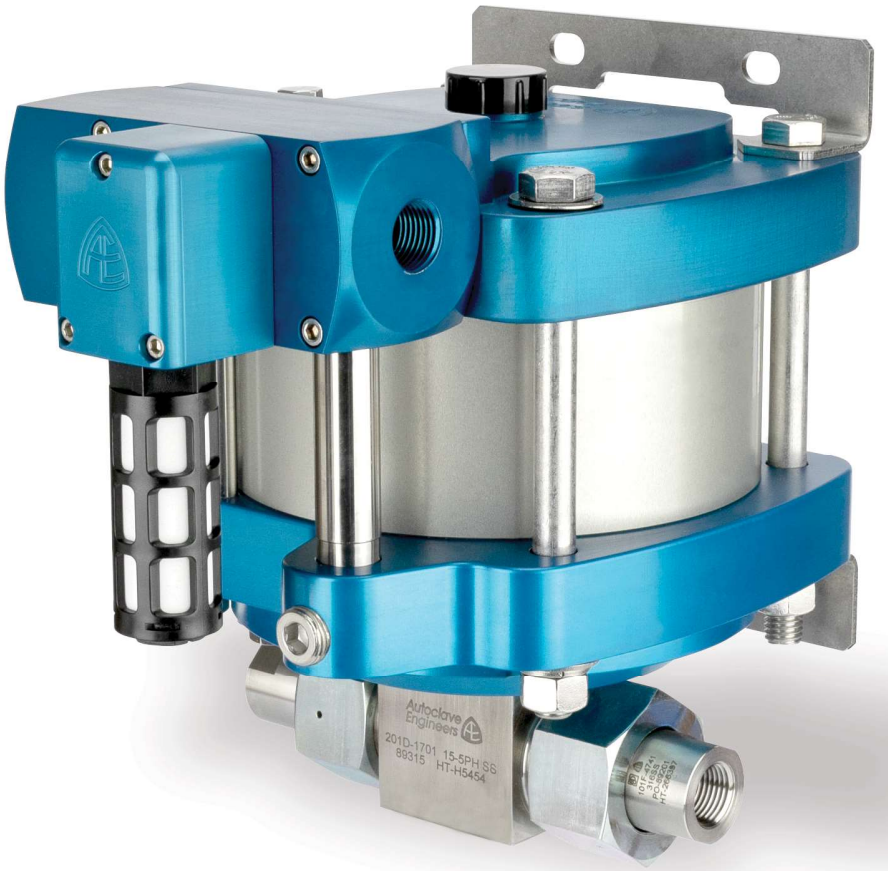


# ASL Series Pump

## Air Driven, High Pressure Liquid Pump

## Operation and Maintenance Manual

Manual: **02-9233ME** | April 2022

Parker

Autoclave Engineers

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## Parker Instrumentation Products Divison (IPD)

Live Chat Support is available from www.parker.com/IPD when the Chat icon " " is visible on screen.

**Model #** _____ **Order #** _____

**Serial #** _____ **Mfg. Date** _____

**Drawing #** _____ Complete information above for future reference.

**WARNING**

FAILURE, 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 Parker Hannifin Corporation, 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 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 products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

ALL PARKER VALVES MUST PASS A RIGID OPERATIONAL AND LEAKAGE TEST BEFORE LEAVING THE FACTORY. IT IS RECOMMENDED AFTER ANY REASSEMBLY, THE VALVE SHOULD BE TESTED BY THE USER FOR OPERATION AND LEAKAGE. IF THESE INSTRUCTIONS ARE NOT FULLY COMPLIED WITH, THE REPAIRED PRODUCT MAY FAIL AND CAUSE DAMAGE TO PROPERTY OR INJURY TO PERSONS. PARKER HANNIFIN CANNOT ASSUME RESPONSIBILITY FOR PERFORMANCE OF A CUSTOMER SERVICED VALVE.

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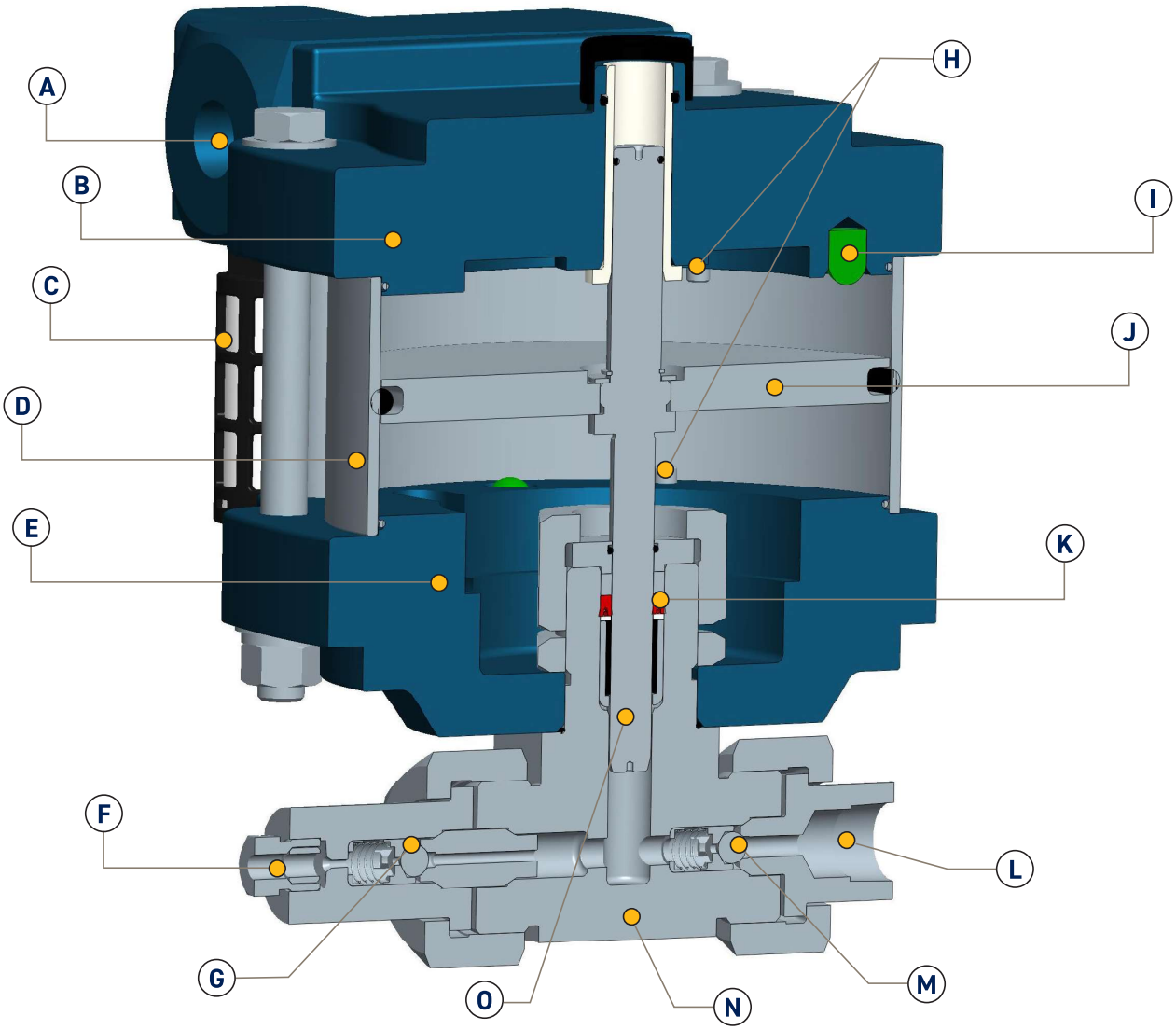
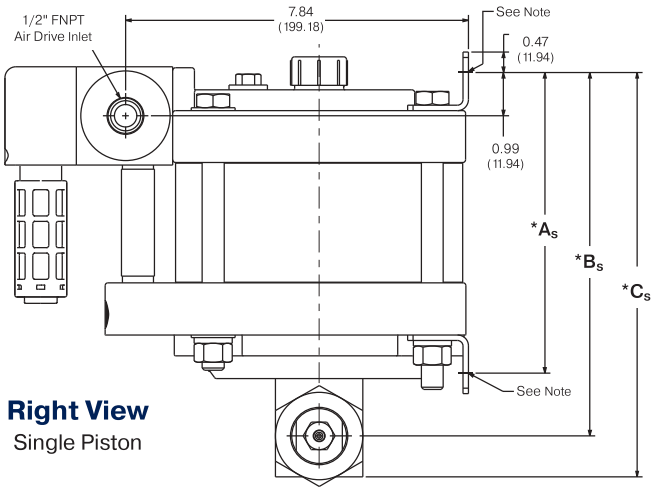
# Typical Pump: Cross Sectional View




| | Description |
|---|---|
| A | Air Inlet |
| B | Top End Cap |
| C | Air Muffler |
| D | Air Cylinder |
| E | Bottom End Cap |
| F | High Pressure Outlet Connection |
| G | Outlet Check Valve |
| H | Pilot Valve |

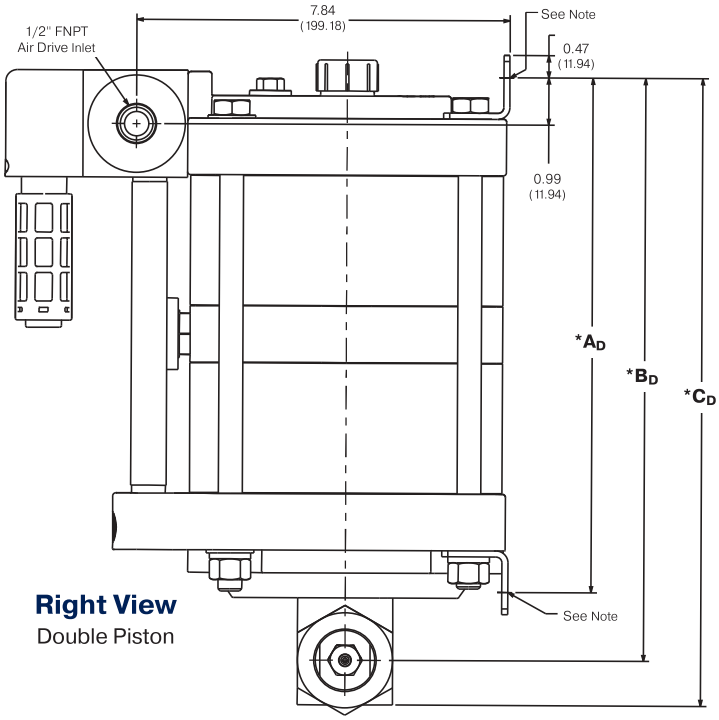
| | Description |
|---|---|
| I | Air Piston Bumper |
| J | Air Piston |
| K | High Pressure Seal Assembly |
| L | Liquid Inlet Connection |
| M | Inlet Check Valve |
| N | Pump Head Body |
| O | Hydraulic Plunger |

# ASL Pump Dimensional View

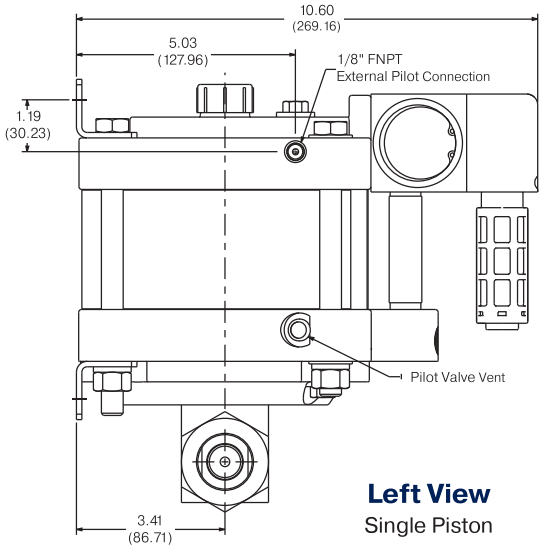



**Right View**
Single Piston

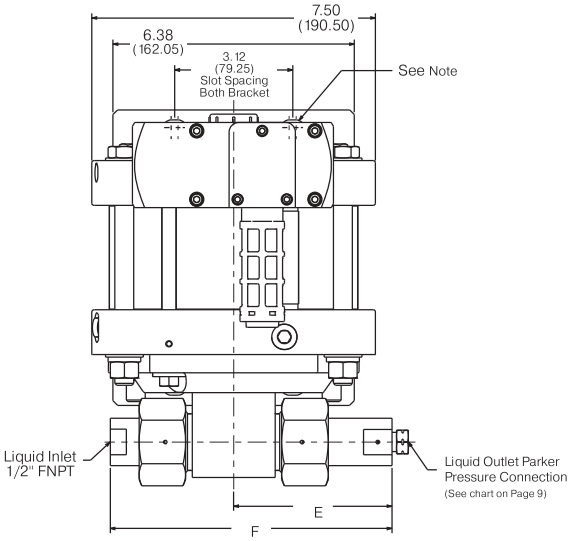
*See following page for product dimensions.




**Right View**
Double Piston




**Left View**
Single Piston




**Front View**
Single Piston

**Note:**
- Each mounting bracket includes (2) x 11/32" (8.73) slots for 5/16" bolts.
- All dimensions are for reference only and are subject to change without notice.
- Primary dimensions: Inches, Secondary Dimensions: (Millimeters)

## ASL Pump: Height Dimension

| Catalog Number | $A_S$ | $B_S$ | $C_S$ |
|---|---|---|---|
| **Single Piston Air Drive** | | | |
| ASL10-01 | 6.87 (175) | 8.25 (210) | 9.83 (250) |
| ASL25-01 | 6.87 (175) | 8.25 (210) | 9.83 (250) |
| ASL35-01 | 6.87 (175) | 8.25 (210) | 9.83 (250) |
| ASL60-01 | 6.87 (175) | 8.31 (211) | 9.25 (235) |
| ASL100-01 | 6.87 (175) | 8.31 (211) | 9.25 (235) |
| ASL150-01 | 6.87 (175) | 8.31 (211) | 9.25 (235) |
| ASL250-01 | 6.87 (175) | 8.31 (211) | 9.25 (235) |
| ASL400-01 | 6.87 (175) | 8.37 (213) | 9.39 (239) |

| Catalog Number | $A_D$ | $B_D$ | $C_D$ |
|---|---|---|---|
| **Double Piston Air Drive** | | | |
| ASL35-02 | 10.81 (275) | 12.19 (310) | 13.77 (350) |
| ASL60-02 | 10.81 (275) | 12.25 (311) | 13.19 (335) |
| ASL100-02 | 10.81 (275) | 12.25 (311) | 13.19 (335) |
| ASL150-02 | 10.81 (275) | 12.25 (311) | 13.19 (335) |
| ASL400-02 | 10.81 (275) | 12.30 (312) | 13.32 (338) |

**Note:**

Each mounting bracket includes two (2) x 13/32" (10.32) slots for 3/8" bolts. Bottom inlet pump head and side inlet pump head are mutually exclusive. All dimensions are for reference only and are subject to change without notice.

Primary Dimensions: Inches
Secondary Dimensions: (Millimeters)

## Operation & Maintenance Information

### Section 1.0 Introduction

The Parker Autoclave Engineers pump discussed in this manual is operated using compressed air up to 150 psi (10 bar). Autoclave Engineers ASL Series pumps are used for pumping oil, water and oil/water mixtures. Special seals are also available for chemical service.

Please contact Autoclave Engineers to discuss availability of special seals. The pump operates using a pressure ratio of the air piston diameter to the liquid plunger diameter. Pumps are available in pressure ranges up to 60,000 psi (4137 bar).

The pump model number coincides with the approximate nominal ratio of the pump; ex. ASL400-01 is a 400:1 ratio, with an input air of 100 psi the output pressure would amount to 40,000 psi (2758 bar). (Output pressure = actual ratio x input air pressure). Refer to the product literature for the actual air pressure ratio.

### Section 2.0 Meaning of Safety Words

A safety related message is identified by a safety alert symbol and a signal word to indicate the level of risk involved with a particular hazard. The definitions of the three signal words are as follows:

**⚠ WARNING**

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

**⚠ CAUTION**

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Special notes intended to bring attention to procedures that must be followed to ensure proper installation and performance will be placed in a box labeled **NOTICE**.

## Section 3.0
## Product Specifications

See assembly drawing for product specifications:

- Pump Geometry
- Pump Materials of Construction
- Maximum Allowable Working Pressure
- Maximum Working Temperature
- Pressure Ratio
- Displacement
- Repair Kit Part Numbers
- Torque Information
- Weights

## Section 4.0
## Unpacking

The pump has been assembled and pressure tested at Parker Autoclave Engineers and is ready to be put into service. The shipping carton should be opened and the contents carefully examined upon receipt from the carrier. Make sure there is no obvious damage to the contents. **DO NOT** use the equipment if any damage is evident. If damage has occurred, file a claim with the shipper before contacting Parker Autoclave Engineers Service Department.

Examine all material within the container and check against the packing list to be sure all items are accounted for and are not damaged. Verify that the equipment model number supplied agrees with what was ordered.

## Section 5.0
## Tools

At minimum, the tools required for installation of the pump include a torque wrench, an open end wrench adapter (crows foot adapter) and an open end adjustable wrench.

Refer to the Tools, Maintenance and Installation Manual provided with the Data Book for information on torque wrenches and torque values for Parker Autoclave Engineers tubing and fittings.

## Section 6.0
## Installation

**⚠ WARNING**

Please read this manual in its entirety before attempting to operate an Parker Autoclave Engineers high pressure liquid pump

**⚠ WARNING**

Installation to be performed only by properly trained individuals.

**⚠ WARNING**

Proper protective safety gear must be worn while installing and operating the pump.

For best performance and life, the pump should be installed in the vertical position. This will prevent side loading on the air piston seals. The pump will, however, function in any position.

The pump will attach to the mounting location using (4) 3/8" bolts. There are 4 holes provided on each pump for mounting.

**⚠ WARNING**

Always bolt the pump to a substantially solid surface using the slotted holes provided.

**⚠ CAUTION**

ASL Pumps have a maximum sound level of 75 dBA. Wear hearing protection while working with or near the pump.

## Section 6.1
## Compressed Air Supply

**NOTICE**

Unless otherwise noted, all air line accessories for the pump air drive should have, at minimum, a 1/2" FNPT connection. The tubing/piping used to connect the components should have the maximum ID the pressure rating will allow. Reducing the size before the air inlet will reduce air pressure flow and reduce flow rate of the pump.

The main air drive connection port on the pump is a female 1/2" FNPT and is located in the spool valve housing. An additional female 1/8" FNPT air pilot valve connection port is located in the top end cap at the opposite side of the 1/2" NPT air inlet.

This pilot connection must be plumbed to an unregulated filtered air source. The purpose of this connection is to aid in low pressure differential start-up and restart of the pump while providing a more accurate pressure control. The pump will not function if this unregulated air supply is not connected to the pilot valve port.

The pump is assembled at the factory using permanent synthetic grease in the air drive moving parts.

**NOTICE**

**The use of an air line lubricator is not required and is not recommended.** The oil in the air lubricator will cause the factory installed grease to be purged from the pump. Once an air lubricator is used the pump can never again be operated without an air lubricator.

An air line filter with a minimum 5 microns filtration rating must be used on the supply line. If the air supply is not dry, a mist separator must be used to remove moisture in the air line.

The pump is designed to function from 15 psi to 150 psi (1 to 10 bar) air input pressure.

## Section 6.2
## Liquid Section

All ASL series pumps have a high pressure liquid outlet port located on the side of the pump head. The suction inlet port on all ASL series pumps is positioned either at the bottom or side of the head depending on the model purchased. See order code details in the product literature for catalog number suffix.

**Inlet:** A liquid filter with at least a 100 mesh size must be installed before the suction port inlet to prevent damage to the check valves and high pressure seals due to debris.

**NOTICE**

Unless otherwise noted, all air line accessories for the pump air drive should have, at minimum, a 1/2" FNPT connection. The tubing/piping used to connect the components should have the maximum ID the pressure rating will allow. Reducing the size before the air inlet will reduce air pressure flow and reduce flow rate of the pump.

The tubing or piping should be made from a corrosion resistant material and sized with a maximum ID to fit the 1/2" pipe connections.

**NOTICE**

Restricting flow at the liquid inlet will cause problems with check valve performance and reduce output flow.

**Outlet:** The outlet tubing ID must, at minimum, match the same size of the pump check valve gland port. Refer to product literature for outlet connections details for each pump. Reducing outlet tubing or connection will reduce output liquid flow capacity.

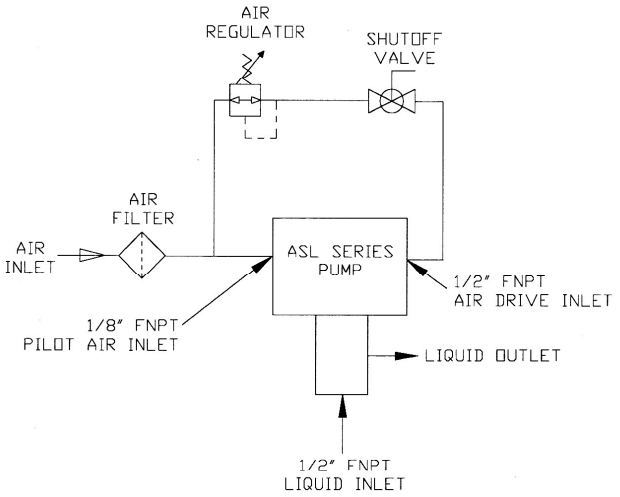
**WARNING**

The high pressure tubing must be rated to at least the maximum pump output pressure.

**WARNING**

Verify liquid pressure system is protected with an over pressure relief device.

## Section 7.0
## Pump Start-Up




**Air Line Schematic**

As shown above, a filtered main air supply line is required. The filtered air supply will go to a pressure regulator which can be set to achieve the desired output liquid pressure according to the pressure ratio of the pump.

**WARNING**

Use an air pressure regulator to assure maximum air drive pressure listed on the pump label is not exceeded. An air pressure regulator must also be used to assure the pump will not exceed maximum liquid output pressure listed on the pump label.

**WARNING**

The pump and high pressure liquid system must be vented prior to installation and start-up.

The pumps unique design allows for self priming. To prime, regulate the air pressure to between 15 psi (1 bar) or lower or use an air flow regulator to reduce to a slow stroke frequency.

With the high pressure side connected to a vented system, allow the pump to cycle until a consistent flow of liquid is achieved. Let the pump flow freely to purge any air in the liquid system. Loosening the outlet gland or pipe can also assist in priming the pump.

**WARNING**

Be sure to securely tighten high pressure tube, pipe or gland with the appropriate torque after the priming has been achieved.
Reference Tools, Installation, Operation and Maintenance Manual for tube gland torque value.

Increase the air pressure using the air pressure regulator until you achieve your desired output liquid pressure. At this point the pump will stall. You can calculate the output pressure by multiplying the input air supply by the actual pressure ratio of the pump. The pump will automatically restart if there is a drop in downstream high pressure.

**WARNING**

**DO NOT** exceed the maximum liquid pressure and temperature rating specified on the assembly drawing and label for your pump.

It is recommended to use a liquid relief valve or rupture disk to prevent over pressurization of your high pressure system.

**DO NOT** exceed the maximum air drive pressure listed on your pump label.

## Section 8.0
## Process Media

Parker Autoclave Engineers pumps discussed in this manual are used for pumping oil, water and oil/water mixtures. Special seals are also available for chemical service. Please contact Parker Autoclave Engineers to discuss availability of special seals.

**⚠ WARNING**

While testing has shown o-rings to provide satisfactory service life, actual life will vary widely with differing service conditions, properties of reactants, pressure and temperature cycling and age of the o-ring.
**FREQUENT INSPECTIONS SHOULD BE MADE** to detect any deterioration and o-rings replaced as required.

**⚠ WARNING**

The user is required to verify material compatibility with fluid based on corrosion resistance. A material list is provided on the assembly drawing to aid you in the evaluation.

**Pumps are not designed to run for long periods of time without liquid process media.** Short, dry pumping cycles should not be a cause for concern. However, pumps are built using lubricant in the seal areas and **pumping without fluid will wear away lubricant and compromise the seal**.

The operating temperatures of the pump are between 0°F to 140°F (18°F to 60°F).

## Section 9.0
## Pump Functionality

When the pump is installed, maximum system air is connected to 1/8" FNPT pilot air inlet and is sealed off by pilot valve assembly in the top end cap and does not enter the spool housing. Regulated air is connected to the spool housing at the 1/2" FNPT pump inlet.

1. Regulated inlet air pressure enters spool housing and moves spool to the left directing air into large pressure tube to the bottom end cap pushing the air piston and liquid plunger upward.
2. The upward movement causes a suction of liquid into the high pressure pump head while inlet check valve is open and outlet check valve is closed.
3. The air piston continues to move up until it hits the pilot valve assembly in the top end cap.
4. The top pilot valve opens allowing max system air pressure to shift the spool valve so that it now directs air drive pressure through the top end cap and pushes the air piston and liquid plunger downward.
5. The plunger action moving down compresses the fluid on the high pressure pump head while the inlet check valve is closed and outlet check valve is open.
6. While the air drive pressure is acting on top of the piston, the bottom area of the piston is vented through the exhaust muffler.
7. Piston continues to move down until it hits the pilot valve assembly in the bottom end cap.
8. The bottom pilot opens which vents max system air pressure from the large diameter side of the spool.
9. This causes spool to move to the left, while air is vented from the top end of the air cylinder through the exhaust muffler.
10. The entire process starts again at step one until the maximum outlet hydraulic pressure in reached based on the pressure ratio of the pump.

## Section 10.0
## Suggested Maintenance

**WARNING**

All pumps must be inspected periodically in order to assure proper and safe operating condition. Failure to inspect pump can result in serious and catastrophic harm to personnel and the surrounding facility.

A. Before each pump use, a quick inspection should be performed to insure there are no loose bolts, nuts, set screws or check valve glands. Tighten any lose bolts and fittings according to the torque values listed on the pump assembly drawing. A visual inspection should also be made before each use and at startup to make sure there is no evidence of fluid leaks from isolation chamber drain ports, check valves connections and muffler. If liquid mists out of the muffler for more than 5 strokes, it is time to replace your hydraulic high pressure seals. Refer to the troubleshooting guide for solutions to these fluid leaks.

B. The maintenance schedule of the pump depends on the frequency of use, cleanliness of media, type of media, cycle rates, output pressures, cleanliness of air or any other conditions that may be damaging to seal integrity. Once a clear pattern develops of how long a pump is in service before pump performance declines, it is recommended to perform maintenance in advance of this time frame. At minimum, perform maintenance on the pump once a year as described below.

**Maintenance would include:**

- Re-lubrication or replacement of spool valve o-ring
- Re-lubrication or replacement of air drive seals
- Re-lubrication or replacement of pilot valve o-rings and gaskets
- Replace check valve components
- Replace high pressure hydraulic seals

C. Maintenance instructions are supplied with appropriate rebuild kits. Kit part numbers are listed on the assembly drawing.

**WARNING**

Before attempting to disassemble the pump or loosen fittings in a pressure system, be sure that liquid pressure has been totally vented.

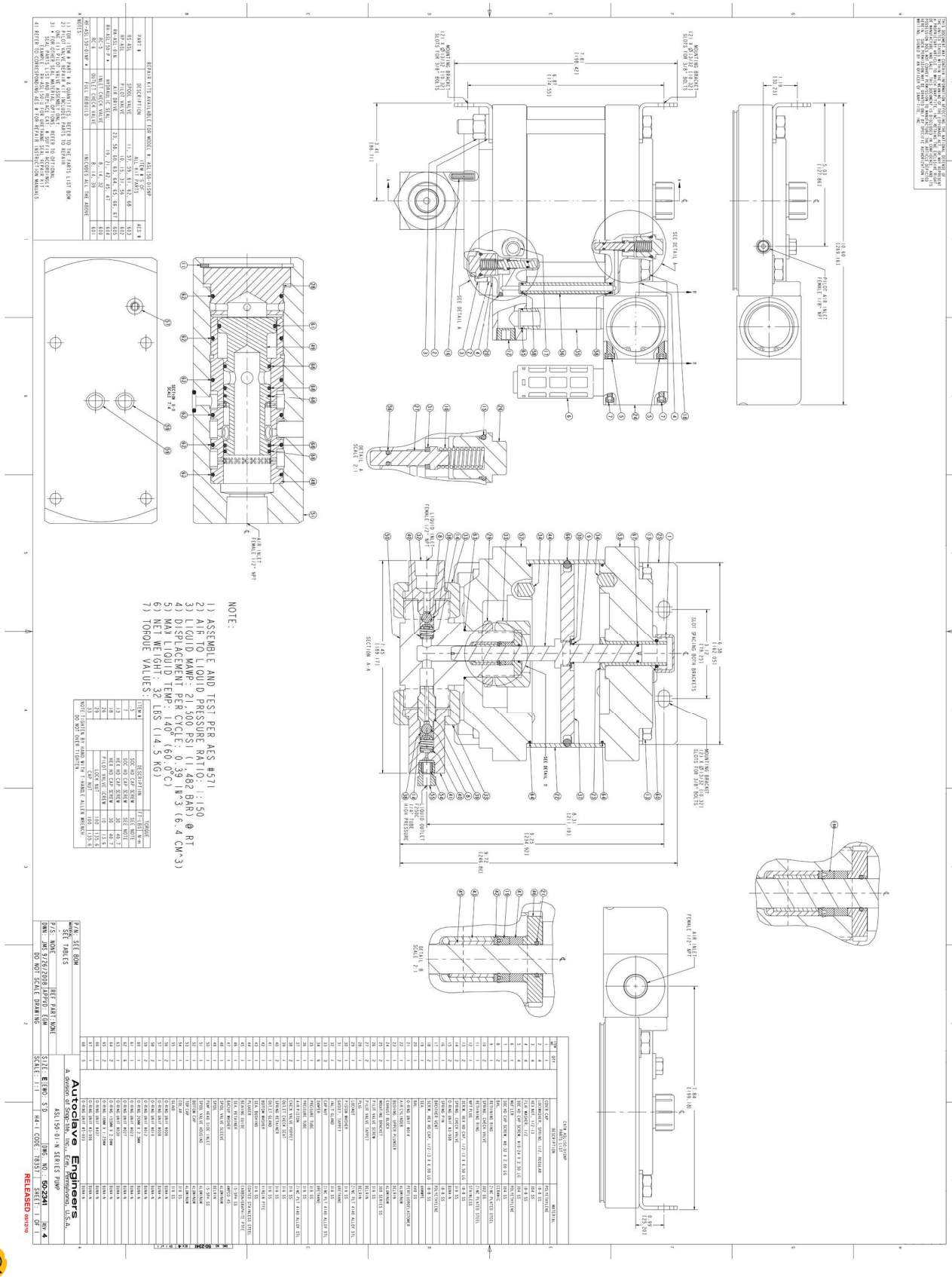
**WARNING**

Before attempting to perform maintenance on the pump, assure that air supply pressure is shut off and vented from the pump.

## Section 11.0
## ASL Series Repair Kit Options

| Pump Model Number | O-Ring Material | Spool Valve Kit | Pilot Valve Kit | Air Drive Kit | Hydraulic Seal Upper | Inlet Check Valve Kit | Outlet Check Valve w/ Seal | Full Rebuild Kit |
|---|---|---|---|---|---|---|---|---|
| ASL10-01SNPV | FKM | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL10-PV | RC-1-V | RC-2-V | RF-ASL10-01NPV |
| ASL25-01SNPV | FKM | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL25-PV | RC-2-V | RC-2-V | RF-ASL25-01NPV |
| ASL35-01SNPV | FKM | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL35-PV | RC-2-V | RC-2-V | RF-ASL35-01NPV |
| ASL60-01SNP | None | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL60-P | RC-3 | RC-4 | RF-ASL60-01NP |
| ASL100-01SNP | None | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL100-P | RC-3 | RC-4 | RF-ASL100-01NP |
| ASL150-01SNP | None | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL150-P | RC-5 | RC-6 | RF-ASL150-01NP |
| ASL250-01SNP | None | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL250-P | RC-5 | RC-6 | RF-ASL250-01NP |
| ASL400-01SNP | None | RS-ASL | RP-ASL | RA-ASL-01N | RH-ASL400-P | RC-7 | RC-8 | RF-ASL400-01NP |
| ASL35-02SNPV | FKM | RS-ASL | RP-ASL | RA-ASL-02N | RH-ASL35-PV | RC-11-V | RC-11-V | RF-ASL35-02NPV |
| ASL60-02SNP | None | RS-ASL | RP-ASL | RA-ASL-02N | RH-ASL60-P | RC-3 | RC-4 | RF-ASL60-02NP |
| ASL100-02SNP | None | RS-ASL | RP-ASL | RA-ASL-02N | RH-ASL100-P | RC-5 | RC-6 | RF-ASL100-02SNP |
| ASL150-02SNP | None | RS-ASL | RP-ASL | RA-ASL-02N | RH-ASL150-P | RC-5 | RC-6 | RF-ASL150-02SNP |
| ASL400-02SCP | None | RS-ASL | RP-ASL | RA-ASL-02C | RH-ASL400-P | RC-7 | RC-8 | RF-ASL400-02SCP |

# Section 12.0
# ASL150-01-N Series Pump Drawing



## Section 13.0
## Troubleshooting - Pneumatic Section

**Problem:** Pump will not operate with low air pressure.

**Cause:** Excessive friction of o-rings on the spool valve has increased the pressure required to move spool.

**Solution:** Replace and lubricate the o-rings on spool

---

**Problem:** Pump can only be actuated at high air pressure.

**Cause:**
a) Air is leaking through the piston guide bushing in the top end cap.
b) Air is leaking through the o-rings between the top end cap and air cylinder.

**Solution:**
a) Replace and lubricate o-rings on upper plunger and between bushing and top cap.
b) Replace and lubricate o-ring on lip of top end cap.

---

**Problem:** Pump will not run and air escaped through the exhaust muffler.

**Cause:**
a) Spool valve o-rings are leaking.
b) Spool sleeve o-rings are leaking.
c) Outside o-ring(s) on air piston(s) is leaking.
d) Seal between air piston and liquid plunger is leaking.

**Solution:**
a) Replace and lubricate spool valve o-rings.
b) Replace and lubricate sleeve o-rings.
c) Replace and lubricate air piston o-ring(s).
d) Replace o-ring on bottom plunger (two piece plunger designs), or add Loctite 2760 thread locker with sealant on plunger threads (one piece plunger designs).

**Problem:** Pump will not run and air escapes through the small hole in the spool valve housing.

**Cause:** Spool valve sleeve o-rings are leaking.

**Solution:** Replace and lubricate spool valve o-rings.

---

**Problem:** Pump will not run and air escapes through the pilot valve vent in the bottom end cap.

**Cause:** Pilot valve gasket or o-ring is not sealing in the bottom cap.

**Solution:** Replace and lubricate pilot valve gasket and o-ring. If necessary, also replace the tappet rod.

---

**Problem:** Pump operates at a high frequency and short strokes.

**Cause:** The top or bottom pilot valves are defective.

**Solution:** Replace and lubricate both pilot valve gaskets and o-rings. If necessary also replace the tappet rods.

---

**Problem:** Pump will not run and air flows out of the separation plate vent (double stage pump only).

**Cause:** The rod seal in the separation plate is leaking.

**Solution:** Replace and lubricate rod seal assembly.

---

**Problem:** Pump functions slowly or doesn't operate at all.

**Cause:**
a) Condensation from air supply is freezing the spool valve.
b) Air muffler is clogged.

**Solution:**
a) Stop pump for a short period and replace or add a mist separator in the air line.
b) Clean or replace air muffler.

## Section 14.0
## Troubleshooting - High Pressure, Liquid Section

**Problem:** Pump does not produce liquid flow, operates irregularly or does not maintain pressure.

**Cause:**
a) Air in the hydraulic system.
b) Suction line excessively long.
c) Suction tubing sized too small.
d) Failure of one of the check valves.
e) Liquid inlet filter is blocked.
f) High pressure seal excessively worn.

**Solution:**
a) Check inlet suction line and connections for leaks and allow pump to flow freely downstream so as to remove any air.
b) Shorten liquid supply line.
c) Increase tubing ID size between reservoir and pump inlet.
d) Clean or replace both inlet and outlet check valve assemblies.
e) Clean or replace liquid inlet filter.
f) Replace high pressure seal assembly.

---

**Problem:** Fluid escapes through the air exhaust (non-isolation chamber version only).

**Cause:** High pressure seal is leaking.

**Solution:**
a) Clean fluid from air section.
b) Replace and lubricate o-rings as necessary in the air section.
c) Replace high pressure seal.

## Section 15.0
## Service

Parker Autoclave Engineers now require all pump repair be sent to an authorized repair facility. Contact Parker Autoclave Engineers for recommendations.

Pumps returned for service should be accompanied with the model number, serial number, manufacture date and problems you are experiencing.

**⚠ WARNING**

Use only originally specified parts when installing or maintaining high-pressure equipment and follow all Parker Autoclave Engineers maintenance and assembly procedures. Do not use any parts from other equipment to make repairs or modifications. Contact Parker Autoclave Engineers with any questions or if sufficient information to complete the installation, maintenance and operation of the equipment has not been included.

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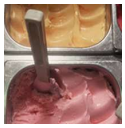
|---|---|---|---|---|
| **AEROSPACE** | Aircraft Engines Commercial<br>Commerical Transports<br>Military Aircraft<br>Regional Transports | Business and General Aviation<br>Land-Based Weapons Systems<br>Missiles and Launch Vehicles<br>Unmanned Aerial Vehicles | Flight Control Systems & Components<br>Fluid Conveyance Systems<br>Fluid Metering Delivery & Atomization Devices<br>Fuel Systems & Components | Hydraulic Systems & Components<br>Inert Nitrogen Generating Systems<br>Pneumatic Systems & Components<br>Wheels & Brakes |
|  **CLIMATE CONTROL** | Agriculture<br>Food, Beverage and Dairy<br>Precision Cooling<br>Transportation | Air Conditioning<br>Life Sciences & Medical Processing | Co2 Controls<br>Electronic Controllers<br>Filter Driers<br>Hand Shut-Off Valves<br>Hose & Fittings | Pressure Regulating Valves<br>Refrigerant Distributors<br>Safety Relief Valves<br>Solenoid Valves<br>Thermostatic Expansion Valves |
| **ELECTRO-MECHANICAL** | Aerospace<br>Life Science & Medical<br>Packaging Machinery<br>Plastics Machinery & Converting<br>Semiconductor & Electronics<br>Factory Automation | Machine Tools<br>Paper Machinery<br>Primary Metals<br>Textile<br>Wire & Cable | AC/DC Drives & Systems<br>Electric Actuators, Gantry Robots & Slides<br>Electrohydrostatic Actuation Systems<br>Electromechanical Actuation Systems<br>Human Machine Interface | Linear Motors<br>Stepper Motors, Servo Motors<br>Drives & Controls<br>Structural Extrusions |
| **FILTRATION** | Food & Beverage<br>Life Sciences<br>Mobile Equipment<br>Power Generation<br>Transportation | Industrial Machinery<br>Marine<br>Oil & Gas<br>Process | Analytical Gas Generators<br>Compressed Air & Gas Filters<br>Condition Monitoring<br>Engine Air, Fuel & Oil Filtration & Systems | Hydraulic, Lubrication & Coolant Filters<br>Process, Chemical, Water Microfiltration Filters<br>Nitrogen, Hydrogen & Zero Air Generators |
| **FLUID and GAS HANDLING** | Aerospace<br>Agriculture<br>Bulk Chemical Handling<br>Construction Machinery<br>Food & Beverage<br>Fuel & Gas Delivery | Industrial Machinery<br>Mobile<br>Oil & Gas<br>Transportation<br>Welding | Brass Fittings & Valves<br>Diagnostic Equipment<br>Fluid Conveyance Systems<br>Industrial Hose | PTFE & PFA Hose, Tubing & Plastic Fittings<br>Rubber & Thermoplastic Hose & Couplings<br>Tube Fittings & Adapters<br>Quick Disconnects |
| **HYDRAULICS** | Aerospace<br>Aerial lift<br>Agriculture<br>Construction Machinery<br>Forestry | Industrial Machinery<br>Mining<br>Oil & Gas<br>Power Generation & Energy<br>Truck Hydraulics | Diagnostic Equipment<br>Hydraulic Cylinders & Accumulators<br>Hydraulic Motors & Pumps<br>Hydraulic Systems<br>Hydraulic Valves & Controls | Power Take-Offs<br>Rubber & Thermoplastic Hose & Couplings<br>Tube Fittings & Adapters<br>Quick Disconnects |
| **PNEUMATICS** | Aerospace<br>Conveyor & Material Handling<br>Factory Automation<br>Life Science & Medical | Machine Tools<br>Packaging Machinery<br>Transportation & Automotive | Air Preparation<br>Brass Fittings & Valves<br>Manifolds<br>Pneumatic Accessories<br>Pneumatic Actuators & Grippers<br>Pneumatic Valves & Controls | Quick Disconnects<br>Rotary Actuators<br>Rubber & Thermoplastic Hose & Couplings<br>Structural Extrusions<br>Thermoplastic Tubing & Fittings<br>Vacuum Generators, Cups & Sensors |
| **PROCESS CONTROL** | Chemical & Refining<br>Food, Beverage & Dairy<br>Medical & Dental | Microelectronics<br>Oil & Gas<br>Power Generation | Analytical Sample Conditioning<br>Products & Systems<br>Fluoropolymer Chemical Delivery Fittings, Valves & Pumps<br>High Purity Gas Delivery Fittings, &<br>Valves & Regulators | Instrumentation Fittings, Valves<br>Regulators<br>Medium Pressure Fittings & Valves<br>Process Control Manifolds |
| **SEALING and SHIELDING** | Aerospace<br>Chemical Processing<br>Consumer<br>Energy, Oil & Gas<br>Fluid Power<br>General Industrial | Information Technology<br>Life Sciences<br>Military<br>Semiconductor<br>Transportation | Dynamic Seals<br>Elastomeric O-Rings<br>Emi Shielding<br>Extruded & Precision-Cut, Fabricated Elastomeric Seals | Homogeneous & Inserted Elastomeric Shapes<br>High Temperature Metal Seals<br>Metal & Plastic Retained Composite Seals<br>Thermal Management |

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