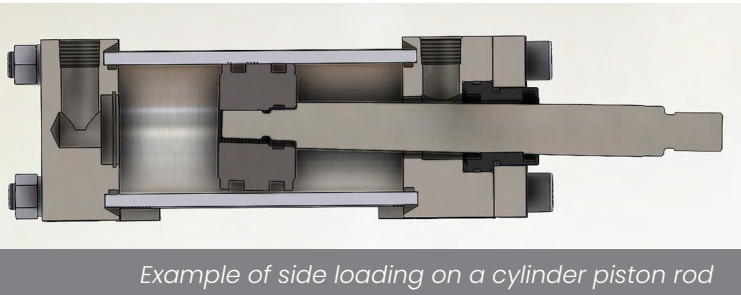


HYDRAULIC CYLINDER DESIGN: Preventing Side Loading

By: James Czegledi, Engineering Manager

Quality-built hydraulic and pneumatic cylinders are designed to last for long life, and when installed and maintained properly, cylinders are expected to meet or exceed projected lifecycles. However, misalignment and/or side load on the rod bearing and/or the piston can cause premature damage leading to cylinder failure.



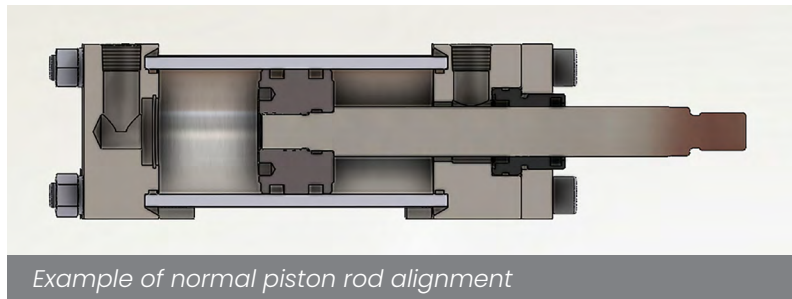
Example of side loading on a cylinder piston rod

Side loading occurs when a piston rod is forced from its designed travel route. Misalignment or bending force can occur at any point of the cylinder orientation and can cause at minimum, cylinder wear usually 180 degrees opposite of the actual side load, consequently causing seal failure through contaminants generated from scored piston rods, rod bearing, piston and/or tube.

The manufacturer of the cylinder has a responsibility to maintain specific tolerance specifications especially concentricity to center as any deviation from the designed specification and tolerance will induce an unwanted side load to the cylinder.

Proper machine alignment is critical when installing a cylinder. For example, in an assembly-type system, where a cylinder and load are disconnected the cylinder is pushing a load in various directions for the next process. If the cylinder does not hit the load square, it could create a deflection of the piston rod, which could create side load.

Applications as described above would benefit from the use of a stop tube. Stop tubes would provide additional bearing support and minimize deflection of the piston rod. Stop tubes are usually used for

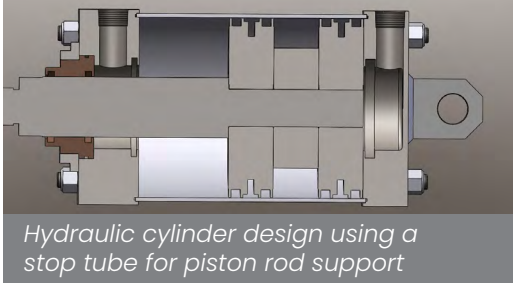


Example of normal piston rod alignment

HYDRAULIC CYLINDER DESIGN:

Preventing Side Loading

longer strokes (of more than 36 or 40 in.) to increase the distance between the piston and the rod cartridge or commonly referred as L over D. Increased bearing surface and support reduces the amount of deflection in the piston rod. The best stop tube design incorporates a two piston stop tube design.



Proper mounting selection like a spherical bearing mount or spherical bearing rod eye can compensate for some side loading. Trunnion mounted cylinders move with the side load to reduce their impact.

EXCESSIVE WEAR

Excessive wear on the bearing surface will create friction, heat and possibly scoring or galling of the materials and potential surface degradation. You can tell when this has occurred because you will have uneven wear on the rod. A common indicator of this are shiny spots or polishing on one side of the rod but not the other. Frequent visual inspections of the piston rod are encouraged to spot such wear early.

ENVIRONMENTAL IMPACTS

Understanding what type of environment where the cylinder will be installed is also crucial to preventing side loading. The surroundings are important when it comes to contamination ingress into the cylinder. Contamination will always evolve into a catastrophic failure.

Cylinder manufacturers work closely with customers to obtain all the information necessary about the application and environment. This allows us to design against these potential contaminants and other possible causes of failure.

Using an application data sheet, customers will supply information such as:

- stroke length
- how much weight the cylinder needs to push or pull in terms of weight
- whether it is a guided or unguided load
- what type of fluid is being used
- will the cylinder be exposed to extreme temperatures
- mounting style

The knowledge of the cylinder orientation — whether mounted horizontally or vertically — is one of the most important data points for understanding side load possibilities. Side loading is more likely to happen in the horizontal orientation, because of the forces of gravity against the piston rod. A vertical orientation has a more natural resistance.

CONCLUSION

Side loading is one of the most common causes of hydraulic cylinder failure. The uneven wear, fluid leaks, seal failure and possibly bent rods caused by side loading can all be prevented from the start and proper installation, alignment and mounting. Finally, preventative care should be taken, including visual inspection of the piston rod regularly to examine it for scoring and galling.



APPLICATION DATA SHEET

for NON-STANDARD Air or Hydraulic Cylinders

- COPY this APPLICATION DATA SHEET
- FILL IN the Required Information on BOTH PAGES
- COPY the SIZING CHART for the cylinder you need
- FAX BOTH PAGES to Peninsular at (586) 775-4545

BELOW: Check ALL Applicable Boxes & provide ALL INFORMATION to best describe the Cylinder

Date Submitted: _____		Type of Business: _____	
Company Name: _____		Contact Name: _____	
Address: _____		Title: _____	
City: _____ State: _____ Zip: _____		Telephone: _____ Fax: _____	
Country: _____		Email: _____	
CHECK ONE: Distributor ☐ End User ☐ OEM ☐ Other ☐		Website: _____	

CYLINDER SPECIFICATIONS

☐ AIR CYLINDER - Indicate <u>Working Pressure</u> : _____	BORE Size: _____ STROKE Length: _____
☐ HYDRAULIC CYLINDER	MOUNTING STYLE: _____
If Hydraulic - Indicate <u>Working Pressure</u> : _____	PISTON ROD DIAMETER: _____
If Hydraulic - Indicate <u>Maximum Rated Pressure</u> : _____	PISTON ROD THREADS: Male ☐ Female ☐ Other ☐
If Hydraulic - Indicate <u>Fluid Type</u> : _____	(describe Piston Rod Threads): _____
(necessary because some Hydraulic Fluids destroy Seals)	Does the Cylinder have CUSHION(s)? Yes ☐ No ☐
☐ OTHER - Describe: _____	If Yes: FRONT END CAP ☐ REAR END CAP ☐

What is the Work Being Performed?

Weight of Load moved: on Extend: _____ lbs. on Retract: _____ lbs. on BOTH Extend & Retract: _____ lbs.
Cylinder Cycle Rate: _____ Cycles per Minute _____ Cycles per Hour _____ Cycles per Day
Rod Speed: Extending _____ "/sec. Retracting _____ "/sec. How many days per week will this cylinder operate? _____

What is the Cylinder Orientation?

Cylinder is Mounted: Vertically ' Rod Up ' Rod Down ' Angle Degrees: from Vertical _____ from Horizontal _____
Is Cylinder Piston Rod or Load Guided or Supported? Yes ' No ' (if Yes, explain) _____
Is Side Load Present? Yes ' No ' (if Yes, explain) _____ Side Load Weight: _____ lbs.

What are the Environmental Conditions that the Cylinder is Subjected to?

What is the present Cylinder Type & Model Number if applicable? _____
Temperature at the Cylinder (if applicable) is _____ Degrees F. Is the temperature constant? Yes ' No '
What is the variable temperature range (if applicable)? from: _____ Minimum Degrees F to _____ Maximum Degrees F.
Cylinder Environment conditions: Corrosive Chemicals present ' Abrasives present ' Water present ' Outdoors '
Other (please explain): _____

What is the Application or Special Requirements?

Are there any optional features applicable to this cylinder? Yes ' No ' If yes, please explain: _____
What industry is the cylinder used in? _____
What type of machine is the cylinder used on? _____
What is the present problem/failure mode? _____

Is a Cylinder ACCESSORY Required? (ex. a Rod Clevis) : No ☐ Yes ☐ (indicate the type of Accessory _____ & provide Dimensions on Page 10)

**Describe Application and/or Draw a Sketch of the Cylinder Within the Application.
Draw any Special Features Contained on this Cylinder (attach drawing if necessary)**