

Load Cell vs. Pressure Transducer

Comparative Analysis

Introduction

Instron®'s SATEC™ series LX, DX, KN and 5590 HVL models use strain gauge load cell technology. Load cells independently and directly measure the force being applied to the specimen. Many other manufacturers use pressure transducers which measure force indirectly based on oil pressure observed in the cylinder. Systems employing load cell measuring technology are superior... why?

Flaws in Using a Pressure Transducer

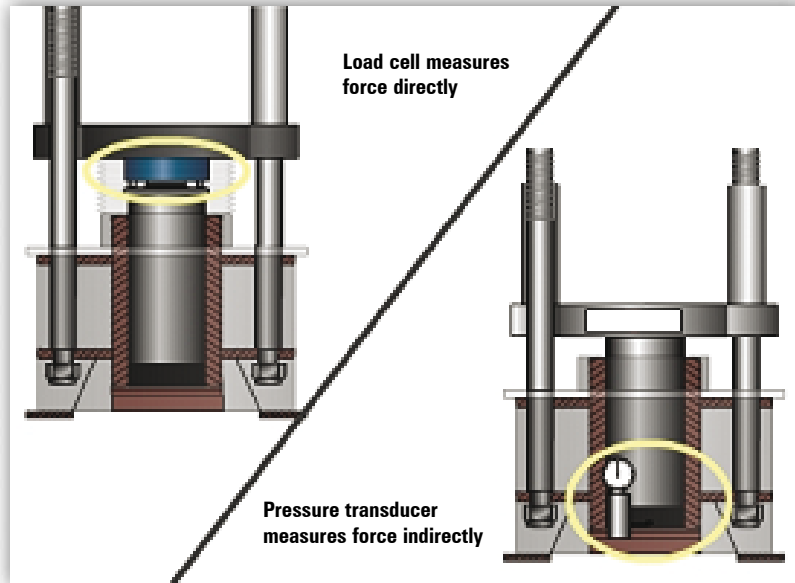
Some of the pressure in a hydraulic system has NOTHING to do with the load being applied to the specimen. Moving the cylinder requires some hydraulic pressure to overcome the friction between the piston and cylinder. Raising the piston off the cylinder bottom can require a significant amount of pressure. The weight of the oil itself creates pressure in the system. This pressure increases as the actuator strokes. The pressure from these sources creates errors in the indication of load. This can raise the lowest calibrated reading (sometimes as high as 10% of capacity). Therefore, machines using pressure transducers must be designed in a way that attempts to eliminate such inherent load measuring errors.

Schemes Used to Overcome Load Measuring Errors

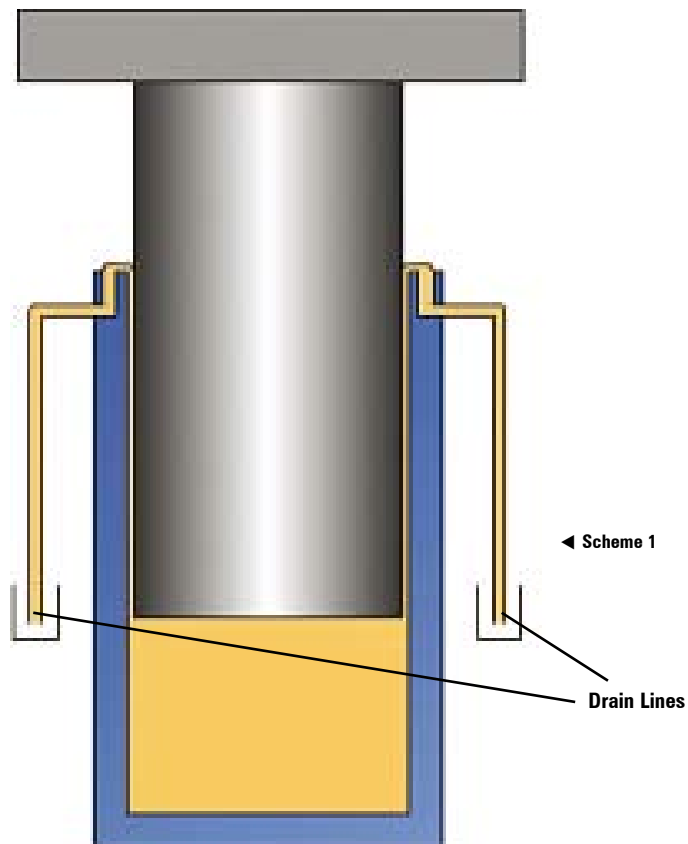
Scheme 1 - Systems are designed without seals

Piston seals cannot be used on Pressure Transducer systems because of the frictional forces that would result. Thus, hydraulic fluid spills out the top of the cylinder. Extra drain lines are required to return this overflowing fluid to the reservoir. This overflow can increase as the piston and cylinder assembly wear. As a result, testing speeds may decrease. Furthermore, the overflowing oil is exposed to debris and contamination.

Since Instron's SATEC series LX, DX, KN and 5590 HVL models measure load directly via a load cell, seals can be used between the piston and cylinder. A sealed actuator assembly eliminates oil leakage and helps keep the hydraulic oil supply free of debris and contamination.



▲ Design differences

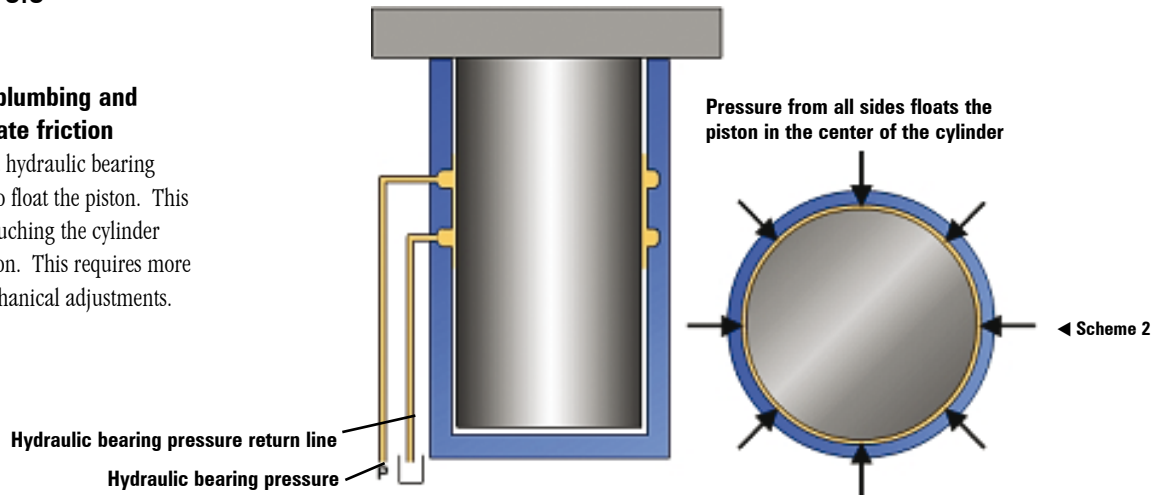


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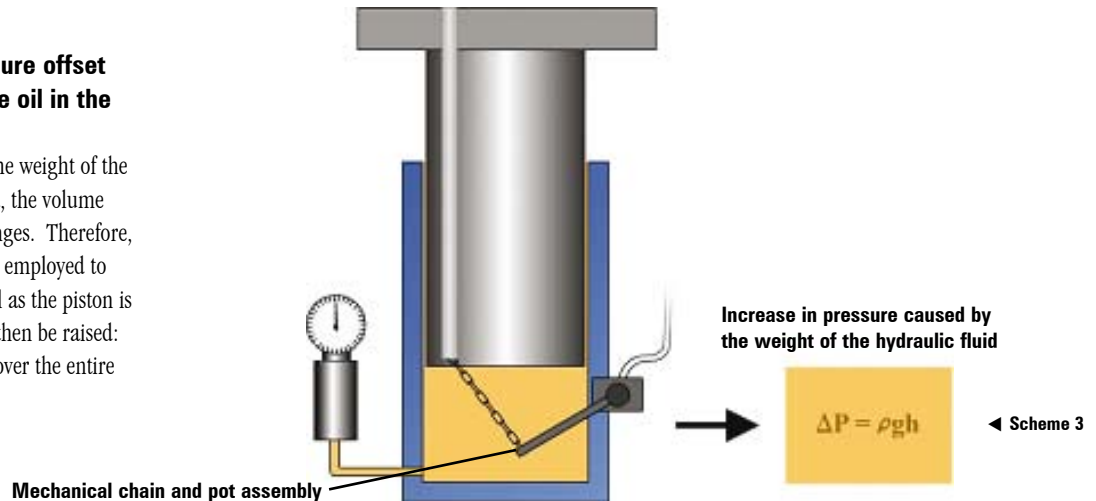
Scheme 2 - Additional plumbing and fittings needed to eliminate friction

Hydraulic bearing pressure and hydraulic bearing pressure return lines are used to float the piston. This design keeps the piston from touching the cylinder sides, thereby eliminating friction. This requires more parts and potentially more mechanical adjustments.



Scheme 3 - Electrical pressure offset required for the weight of the oil in the cylinder

The pressure reading is affected by the weight of the column of oil. As the piston is raised, the volume and height of oil in the cylinder changes. Therefore, a complex chain and pot assembly is employed to electrically offset the weight of the oil as the piston is moved. The following question can then be raised: How accurate are the load readings over the entire stroke of the machine?



Summary and Conclusions

Pressure Transducer Systems

- Measure load indirectly from hydraulic oil pressure in the cylinder
- Do NOT use piston seals and are prone to leakage and hydraulic oil contamination
- More parts and adjustments: Could this mean more maintenance costs?
- The load accuracy over the entire stroke of the machine must be questioned:
- Is the chain and pot assembly providing the proper offset over the entire stroke?
- Is lubrication properly mitigating friction over the entire stroke?

VS.

Load Cell Systems

- Measure load directly with a load cell
- System is sealed and therefore:
 - Free of messy oil leaks
 - Protected against oil contamination
- Fewer parts and adjustments: This could mean fewer maintenance costs
- The load accuracy is the same over the entire stroke of the machine since load is measured independently of the hydraulic pressure

You must ask yourself... When making critical business, design or process decisions based on the mechanical properties of a material, shouldn't these properties be measured directly with a load cell rather than indirectly with a pressure transducer?



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