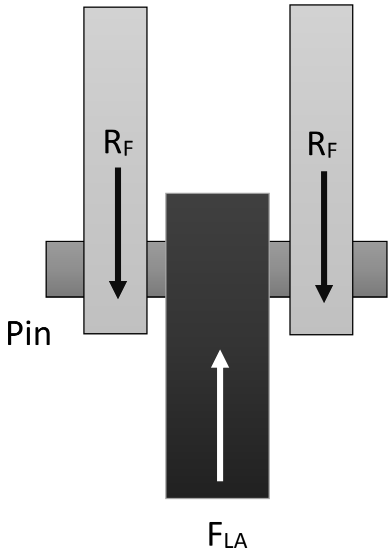


- The linear actuator can exert a maximum force of 400 lbf. The reaction force along each side member is then 200 lbf.
- The pin is nominally 0.5” in diameter.
- The material properties for the calculations below will assume the pin material is 316 stainless steel, with a shear ultimate of $0.577 * 75\ Kpsi = 43{,}275\ psi$.

The stress in the pin is given by $\tau = \frac{F}{2A}$ for a pin in double shear, where F is R_F in the diagram above and A is the cross sectional area of the pin.

$$\tau = \frac{F}{2A} = \frac{400lbf}{2 * \pi * 0.25^2} = 1019\ Psi$$

This value is very small compared to the ultimate shear of even soft steels, which means the pin will not be close to failure under normal conditions. To increase the stress in the pin and bring its breaking point closer to 400 lbf, there are a few things that can be done. The first is that a hollow 0.5” sleeve can be used around a smaller diameter pin. This would allow the pin “assembly” to fit snugly in the LA hole, which transferring the stress to a smaller diameter pin.

Working backwards from the shear calculation above. The cross sectional area of the pin required can be found.

$$A = \frac{F}{2\tau} = \frac{400\ lbf}{2 * 43275\ psi} = .0046216\ in^2$$

This corresponds to a pin diameter of:

$$Diameter = 0.0767\ in\ \left(\sim \frac{5}{64} in\right)$$

Theoretically, with type 316 stainless steel a 5/64” pin will shear at 400 lbf. Under normal operations, the pin should experience less than half of this force.

Other alternative for creating the shear pin include turning down the area of the pin near the LA head to create stress concentrations, or picking a weak and brittle material, such as ceramic.

Shear calculations from “*Shigley’s Mechanical Engineering Design, 9th ed”* by R. Budynas and J Nisbett
Page reference 452-455, Table A-15 Page 1030

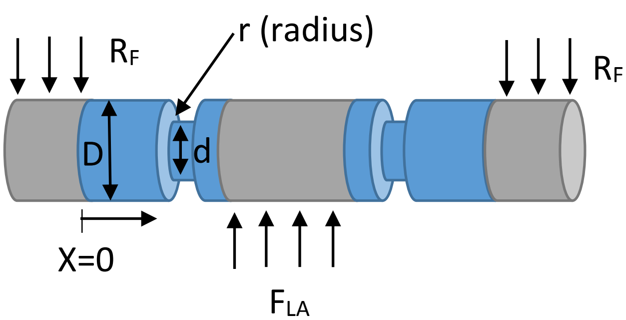
The first method is optimal for easy replacement, because a new standard 1/16” dowel can be inserted into the sleeve after a failure. There would be no machining of materials required.

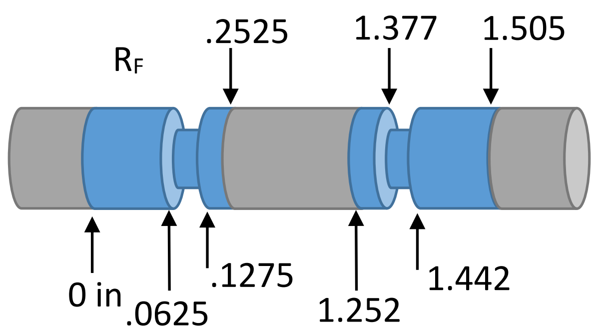
The Mechanical engineering department has a number of tensile testers where the team could test the pin design.

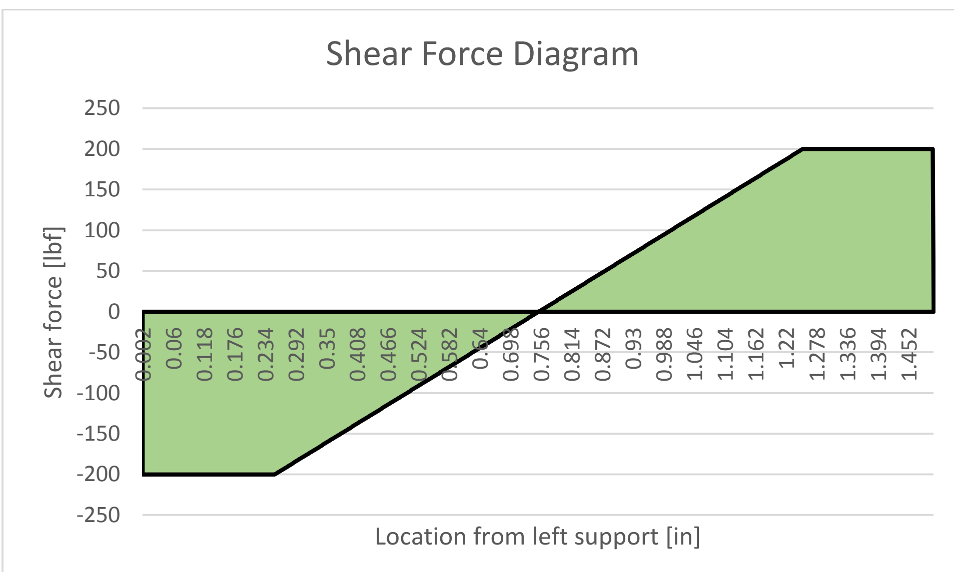
Reducing the diameter of the pin on both sides of the LA mounting hole are investigate below. These are preliminary calculations and parameters are subject to change.

A grooved shaft design is shown below. The grey zones represent the supported areas.

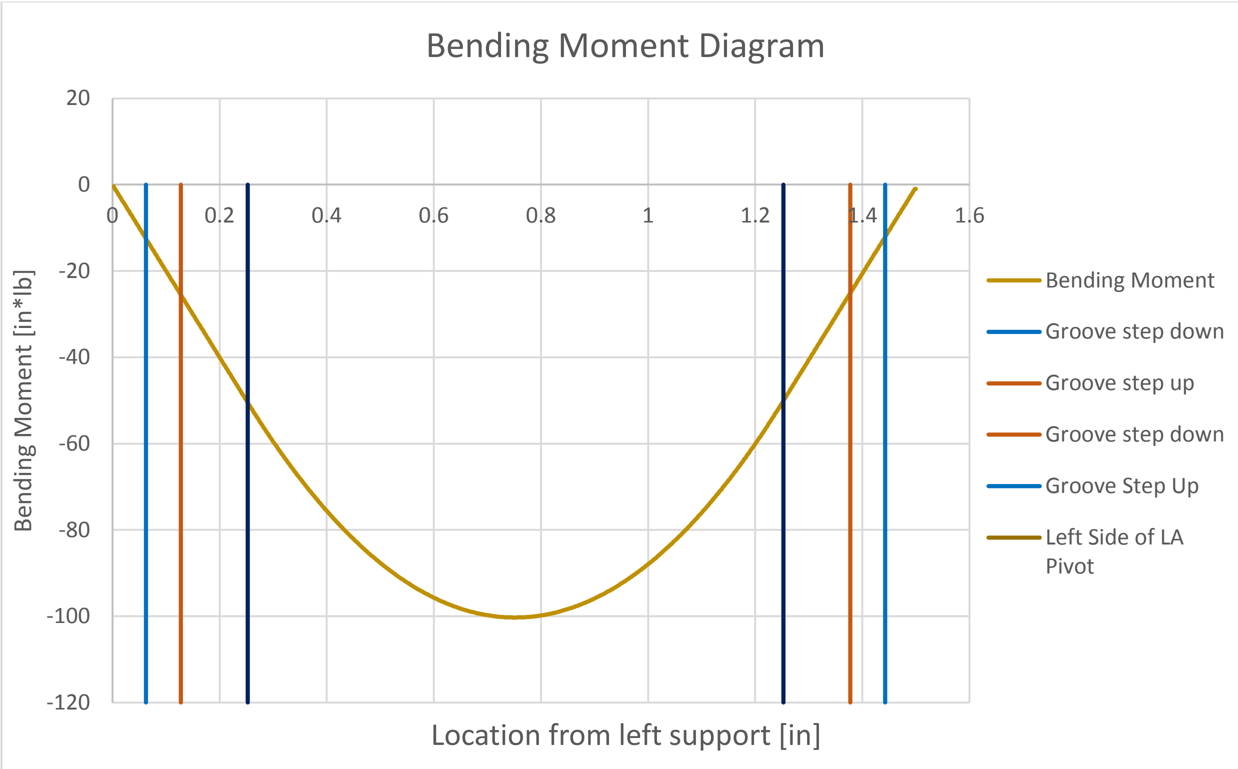
[Calculations to be detailed further]







Shear calculations from “*Shigley’s Mechanical Engineering Design, 9th ed*” by R. Budynas and J Nisbett
Page reference 452-455, Table A-15 Page 1030



Bending Moment	30	in lb
σ_0	11317.68	psi
Kt	**5.75**	-
σ_{actual}	65076.69	psi

Shear calculations from "*Shigley's Mechanical Engineering Design, 9th ed*" by R. Budynas and J Nisbett
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