



# PROJECT / 21

## Compliant Mechanism Mechanical Arm

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### Introduction

The field of compliant mechanisms has the potential to yield considerable advantages in replacing rigid body systems, this project seeks to realise these advantages in the development of a compliant mechanism mechanical arm.

### Background and Application

A flexure joint is a type of compliant mechanism that utilises the deflection of a flexible member to achieve a desired motion, unlike a traditional rigid body mechanism that uses rigid links connected at movable joints. By reducing the number of parts in a kinematic system the manufacturing process is simplified and the cost is reduced.

Market research of various desk lamps with 3-point adjustable arms shows positive correlation between the maximum reach of the adjustable arm and the retail price of the lamp; resulting in products with the highest maximum reaches having exceedingly high recommended retail prices.

Due to the compliant mechanism's manufacturing advantages it was concluded that a 3-point adjustable desk lamp arm, that used flexure joints instead of rigid body hinges, would be able to provide a competitive maximum reach at a significantly lower price.

### Project Aim

To design a flexure joint in a mechanical arm, using CAD, that can support a load (Lamp Head) and provide the same motion to that of a traditional desk lamp's mechanical arm with hinges.

### Testing and Conclusions

Using Solidworks FEA, two elements of the model were tested to determine the design's success in fulfilling the project's aims, background and objectives.

The 'Head Load Test' simulated the arm's capability bearing the lamp head load. The 'Flexure Joint Flexibility Test' was used to determine if the flexure joint could provide a sufficient angular stroke to fulfill the arm's motion and adjustability requirements.

After a redesign of the flexure joint's spring, due to a failed flexibility test, the arm successfully supported the applied load and deflection. However the stress experienced at the maximum angular stroke was close to exceeding the yield stress.

In summary, the test results and the estimated manufacturing cost confirm that the compliant mechanism mechanical arm fulfilled the project's aims background and objectives. However the narrow factor of safety during the flexibility test indicates the design's current lifetime would make it unsuitable for commercial use.