Abstract
Door mounted pull-up bars offer the user quick and easy access to at home exercise without having to permanently change their door frame. Nevertheless, with existing products problems of scuffing, stability, and height adjustability typically arise. These issues can cause the consumer to have a greater out of pocket cost for accidental damages to oneself or one’s home. Using the “Iron Gym” as a benchmark, the goal was to provide a product that allowed each individual user to choose between three vertical positions, reduce stresses on the door frame, and improve overall stability.

Design Objectives
There were three main concerns with the benchmark; lack of height adjustability, damage to the door frame, and structural stability. To remedy the height concerns, the arch bars were extended above the door frame and three height options were added. The surface area of the contact pads was increased and their color was changed from black to white to reduce scuffing. Stability was addressed by replacing all the bolted connections with welds, which reduced unwanted movement. These design objectives are illustrated in the CAD model of the Prototype in Figure 1.

Testing
The contact pads’ coefficient of friction (CoF) was tested for multiple materials to determine which had the highest CoF; these values are shown in Table 1. Durometer Neoprene had a 130% greater CoF when compared to the benchmark material.

The benchmark and prototype were load tested until failure, which was defined as visible deformation. Deformation occurred at 500 lbs and 610 lb for the benchmark and prototype respectively.

Results
By increasing the coefficient of friction (CoF) of all the contact pads from $\mu = 0.456$ to $\mu = 1.051$ as well as increasing the length of the back support from 18 to 24 in., the pressure on the trim was reduced by 43.3%. The load test confirmed the modeling results since it showed a 22% increase (110 lbs) in the prototype’s load capacity.

Conclusion
The prototype provides three height options, increased overall stability, and reduce damage to user’s door frame.

Acknowledgments
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