Telescoping Ratchet Wrench

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Abstract

Conventional ratchet wrenches lack the versatility necessary to make them an efficient, affordable home-use tool. Ratchets tend to vary in size, and tool sets often come with up to three or four ratchets. This wastes space and materials. A telescoping ratchet wrench which offered the structural reliability of a conventional ratchet and the versatility of three to four ratchets would save the user time and money.

Benchmarking and Testing

Three conventional ratchet wrenches were obtained and tested:

- One standard ratchet, Length 9.75 in.
- One standard ratchet, Length 7.6875 in.
- One flex-head ratchet, Length 11 in.

Tests were performed to determine the average and maximum forces experienced by ratchet wrenches. Based on these forces, resulting torque loads were calculated in order to compare the maximum torque output from the telescoping ratchet compared to the benchmarks.

Design and Analysis

The design team modeled and selected one benchmark ratchet to test against the telescoping ratchet. The two designs were modeled in Solidworks and then analyzed in ABAQUS. The stresses and displacements resulting from a maximum torque load were compared and documented. The telescoping ratchet was revised until the resultant stresses and displacements were within acceptable engineering tolerances.

Conclusions

The final design met and exceeded all tested design criteria. When fully extended, the telescoping ratchet measured almost 35 inches in length, and delivered over twice as much torque as the nearest benchmark. In addition, the telescoping ratchet weighed in at 1.34 lbs., just under the 1.5 lb. design requirement and the 1.41 lb. benchmark ratchet. Finally, the maximum stress was well below the yield strength for tool steel.

References

1. http://www.mcmaster.com

Design Requirements

The Telescoping Ratchet Wrench must meet the following performance criteria:

- Minimum Deliverable Torque: 200 ft. lbs.
- Maximum Weight: 1.5 lbs.
- Maximum Stress: 135 ksi
- Maximum Length (Compact): 15 in.
- Maximum Length (Telescoped): 36 in.

Results

- Maximum Deliverable Torque: 550 ft. lbs.
- Maximum Stress: 57 ksi
- Maximum Displacement at tip: 0.0315 in.
- Length (Compact): 14.85 in.
- Length (Telescoped): 34.67 in.
- Weight: 1.34 lbs.

Acknowledgments

Stephen Lagquette, Mary Dinh, Home Depot, COE Machine Shop