



Motivation

- Aid Hazardous Material (HAZMAT) teams in containing gas & liquid leaks
- HAZMAT teams lack efficient solution for sealing stainless steel (SS) tubing
- Tasked with creating a user-friendly, small, and dependable tool for crimping and sealing

Specifications

- Seal 1/8" 316 SS tubing (0.028" 0.035" wall thickness) with internal pressure of 200 psi to a leak rate of 10^{-4} cc/s
- Design test systems to characterize crimp force, geometry, and associated leak rates
- Hand operable while wearing HAZMAT gloves
- Removeable lever arm no greater than 6" in length
- Seal tube recessed & offset within a small hole
- \$2000 budget
- Mechanical body fits into 2" cube
- Weigh less than 1lb

Finite Element Analysis (FEA)



Miniature HAZMAT Crimp and Seal Tool

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Grip Strength Testing



- Tested grip strength using a Vernier Hand Dynamometer
- Team avg. of 100 lbf.
- Tool requires mechanical advantage of 25



Creates mechanical advantage (MA) of 39 $MA = \left(1 + \frac{L_1}{L_2}\right) \left(\frac{L_4}{L_2}\right) \left(\frac{L_6}{L_5}\right)$

Testing Systems and Analysis



Leak Testing System

Withstand compression testing up to 5000 lbf.

- rate fitting
- Minimized test volume



Tool Design – High Pivot 4-Bar Linkage



Crimp and Leak Testing Results Leak/Crimp Test Round to Triangular Green: Pass Max: 2369.28 lbf **Red**: Fail Severed tube, *ello* $\frac{1}{2}$ pass, $\frac{1}{2}$ fail **[Jq]** 1500 Conclusion 1000 L Triangular-Round Anvil Combination Critical Zone 2500 lbf. required to seal Displacement [in] Successful Crimp and Seal

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FEA on Anvil Components Min. FOS: 1.16 & 1.67 Blue: FOS > 3.00 4140 Dowel Pin Hardened A2 tool steel Elongated crimp nose

> Alloy Steel Shoulder Bolts

Conclusions

Quick, repeatable, handheld crimping capability Average leak rate • 2.33×10⁻⁵ cc/s

- Seals with one crimp
- Weight: 1.74 pounds
- Dimensions: 2" x 2.25" x 2.75"

Future Changes

- Weight & size optimization
- Improved removeable handle mechanism

Thank You

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