Crimped vs Soldered and Crimped Terminals

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Impetus

The purpose of this testing is to determine if an FRC can reliably create crimped wire terminals over the course of years and to determine the effectiveness of soldering said crimped terminals in regards to joint strength and reliability.

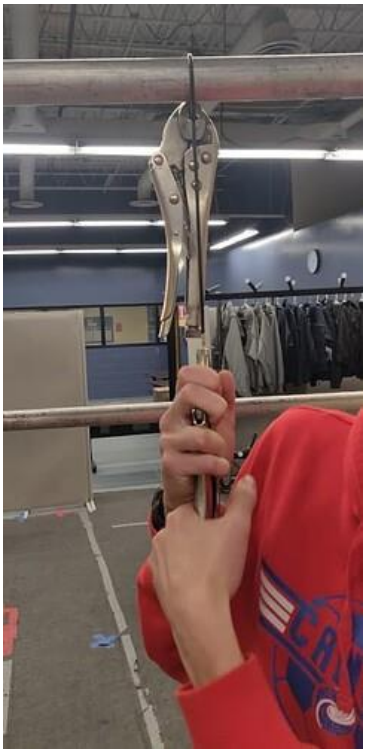
Preparation

A collection of old CIM motor leads that were assembled with terminals between ~2015 and 2019 were used as samples for this test. The represent a spread of tools, wear states of those tools, students, and student training levels.

The leads were then split into four populations: APP (Anderson Power Pole) vs ring terminals, and crimped (all black wires) vs soldered (all red wires). Soldering was performed on the day of the test by 4 students of variable skill levels and one skilled coach. The choice to split the population by color ensures that there is a mate for each terminal in the other population that was made at the same time, by the same person, with the same tool. This removes operator skill and tools as a confounding variable.

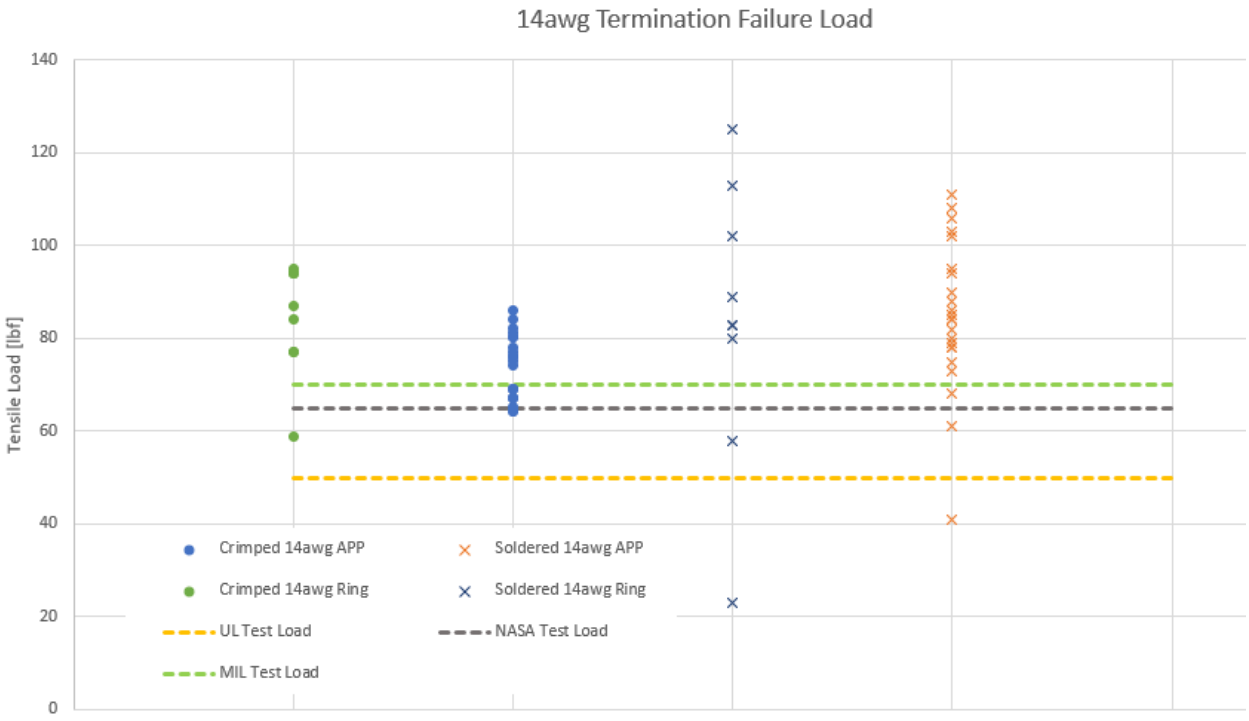
Testing

1. Clip sample lead to bar
2. Clip student to terminal
3. Look at scale
4. Record minimum weight when sample fails
5. Subtract minimum weight from student static weight



Results

Results are plotted below, divided by population and compared to 14awg terminal tensile load specifications from UL, NASA and MIL.



The solder joints that failed at a low force generally appeared to be okay from visual inspection but had not flowed into the entire joint. Generally, they did not bond well to the un-split side of the terminal.

Both populations had failures where the wire slid out of the terminal or the terminal itself broke. The very strongest soldered joints failed in the wire itself.

Conclusions

- It is totally possible for an FRC team to execute high-quality crimps over the course of years (every crimp exceeded UL strength threshold, a vast majority passed NASA and MIL strength)
- Soldering does improve the average strength of the joint
- Soldering stress-relieves the terminal and wire, so if there is a defect/incomplete solder flow the joint is dramatically weakened
- Crimping is certainly ‘good enough’ for FRC uses, and has a higher reliability and consistency vs soldered joints

Appendix 1: Data

See raw data below. We did have test errors in two of the first three crimped terminal tests as we figured out the details of exactly how to execute the tests.

Units: [lbf]

Crimped 14awg APP	Soldered 14awg APP	Crimped 14awg Ring	Soldered 14awg Ring
Test error	106	87	113
86.2	88	77	23
Test error	94	77	83
64.2	84	94	125
69.2	108	94	83
74.2	79	95	80
67.2	68	94	89
84.2	95	84	102
69.2	80	59	58
75.2	73		
65.2	82		
67.2	78		
69.2	85		
67.2	103		
64.2	86		
77.2	78		
78.2	102		
76.2	61		
80.2	90		
81.2	84		
80.2	75		
82.2	111		
76.2	41		