

uSTART testing – Grocery Day Cab

Bryce Gregory and Dan Cox

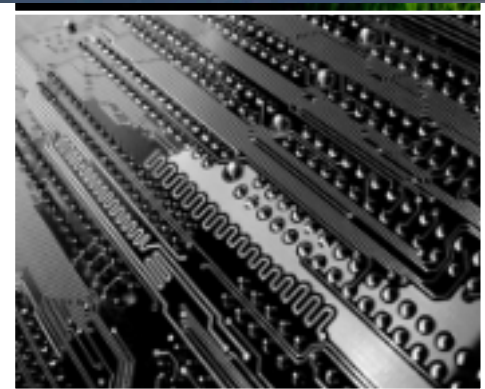
- TRANSPORTATION
- RENEWABLE ENERGY
- UPS / BACK UP
- INDUSTRIAL





General Installation

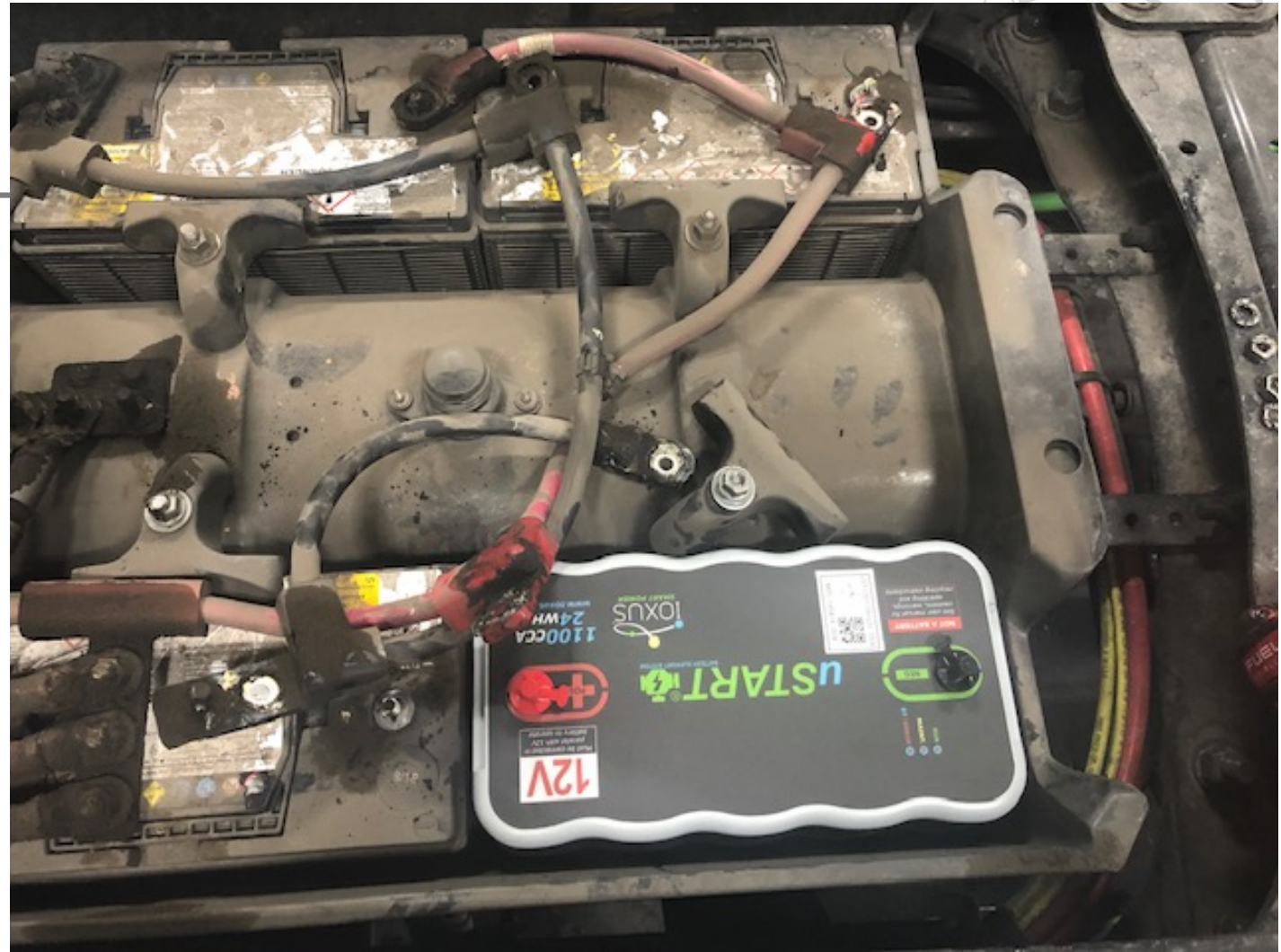
- Tested cold engine cranking
 - Sat for 8 hours
- Hi Res Test 1-4 batteries
- Hi Res Test 1-3 batteries w/uSTART
- Geotab
 - 4 battery
 - 3 battery + uSTART
 - 2 battery + uSTART



Before and after Install

Mid frame 4 battery tray

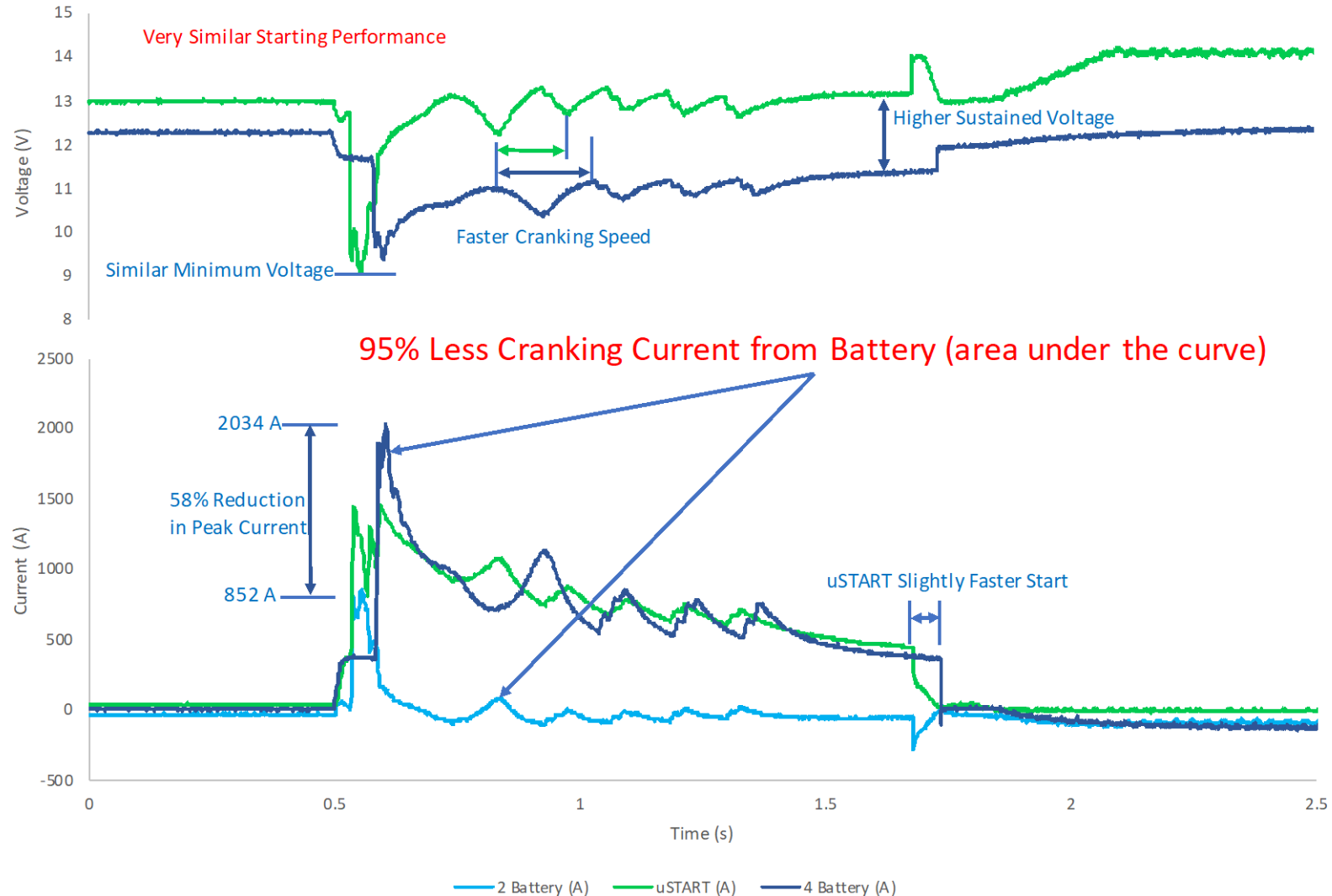
- Positive on one side negative on the other
 - **No battery closest to starter**



uSTART[®] does the work – Battery is on vacation



4 Battery Start vs 2Battery+ uSTART MD @ ~30C Oil Temp



Data from 13L
2019 Freightliner
Detroit Diesel
~Cold Start in
PHX May/2019





Installation

- 4 battery parallel base system
- Reduction to 2 batteries offers no negatives
 - **Similar results with 2 or 3 batteries**
- Better overall starting performance in all KPI's Regardless of battery count with uSTART
- May improve battery life (better OCV)
 - **Typical batteries replaced ~18 month interval**
- Truck life 8 years

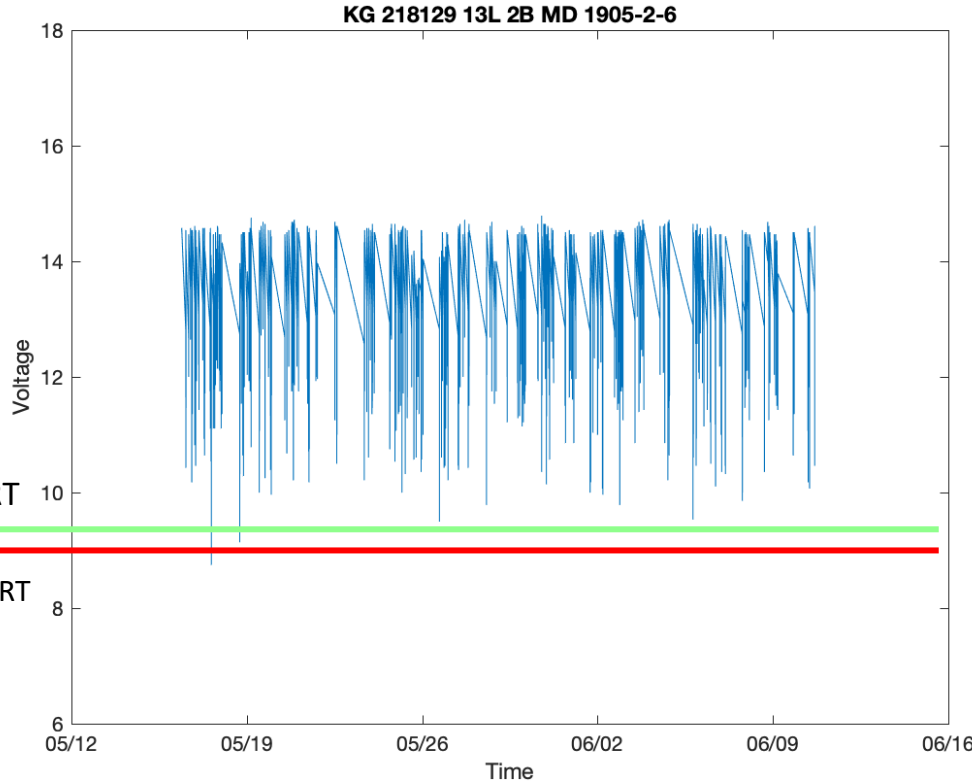
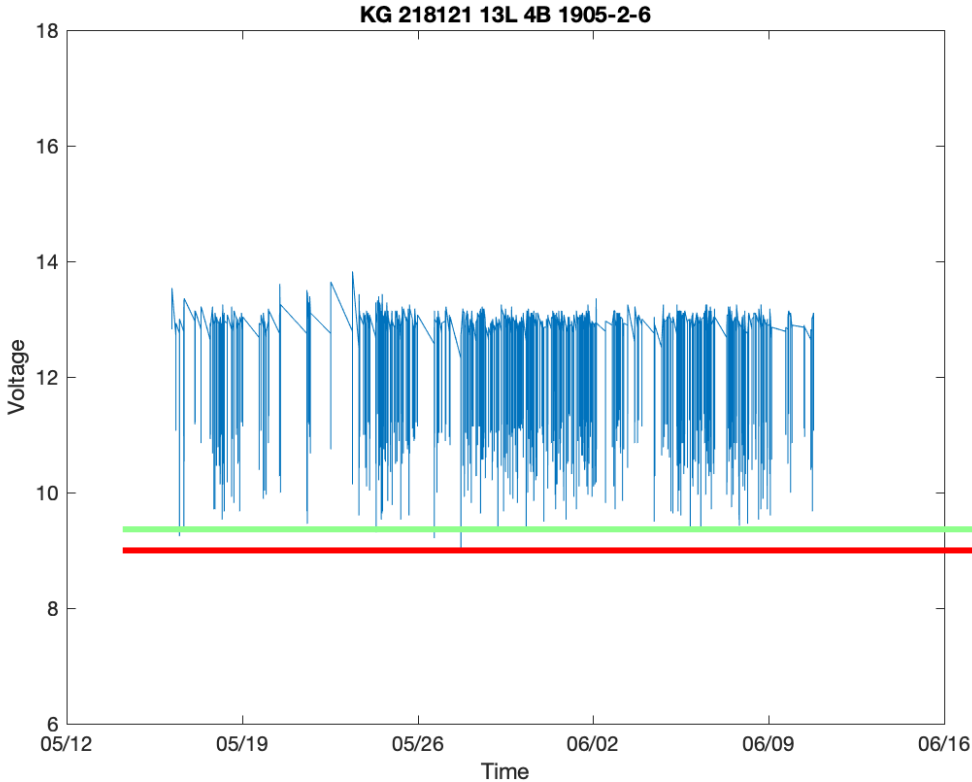
13L Daycab with and without uSTART



Birdseye View

W/O uSTART

W/ uSTART-2 Battery



13L Daycab

Start Time Improvement



High Resolution Single Captures

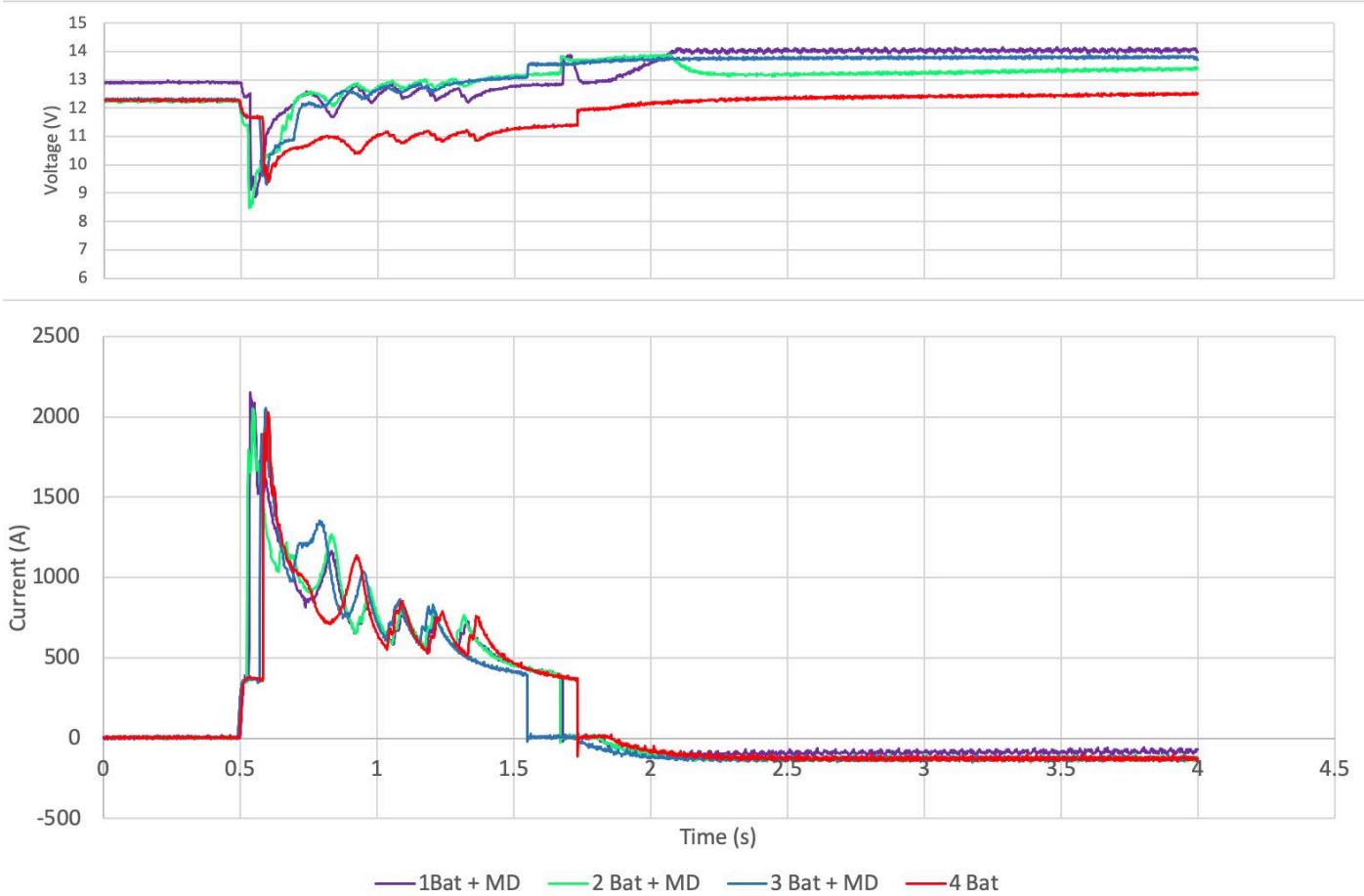
uSTART® Trial Result

- Excellent Improvement in start time: Even with only 1 battery uSTART supported start was faster than with 4 batteries

uSTART® Benefit

- Fast, clean starts extend the life of the starter

13L DD 30C Cranking 1-3 Batteries +MD and 4 Battery Configurations



13L Daycab

Minimum Voltage Improvement

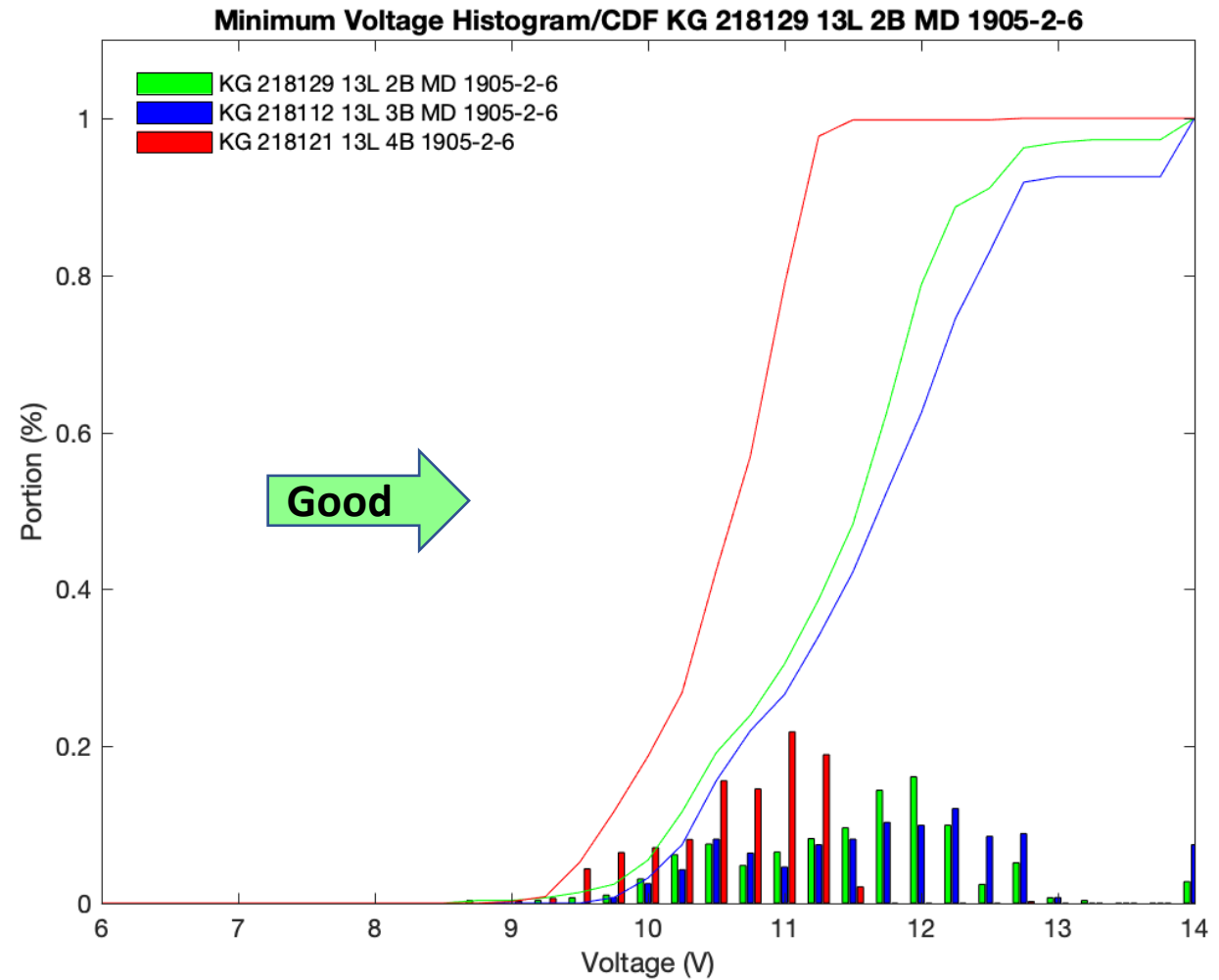


uSTART® Trial Result

- Significant improvement w/ uSTART® (~1V)

uSTART® Benefit

- Higher bus voltage- even intermittent, prevents brownouts – saving:
 - Starter
 - ECMs
 - Contactors/relays
 - Other electrical components



13L Daycab

Cranking Profile Voltage Improvement

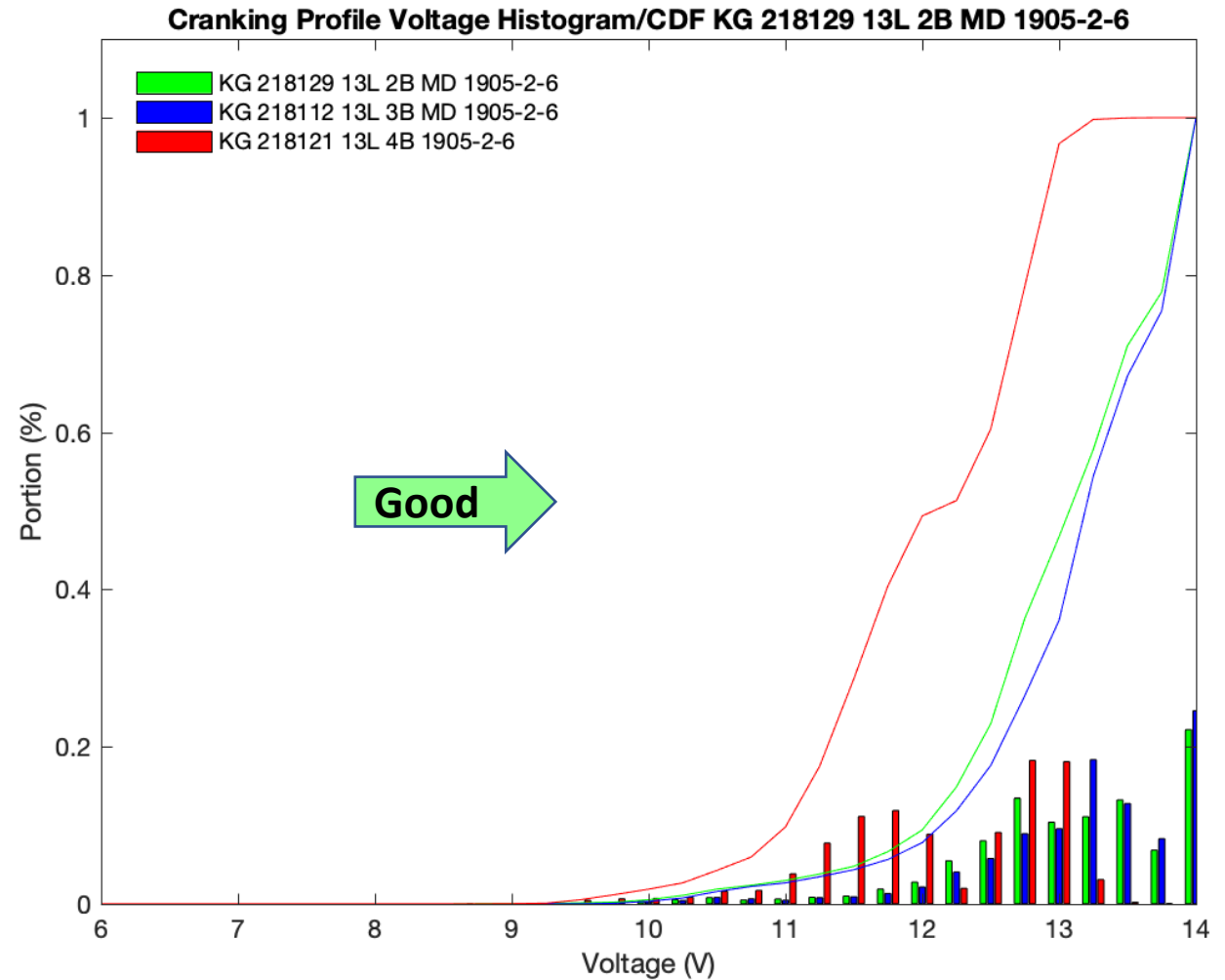


uSTART® Trial Result

- Significant Improvement w uSTART (Nominally >1V)
- 95% of Cranking Voltage above 12V w/ uSTART - 50% below without

uSTART® Benefit

- Higher bus voltage- even intermittent, prevents brownouts – saving:
 - Starter
 - ECMs
 - contactor/relay
 - other electrical components



13L Daycab Battery Open Circuit Voltage Comparison



uSTART® Trial Result

- Some improvement, likely improve battery incrementally

