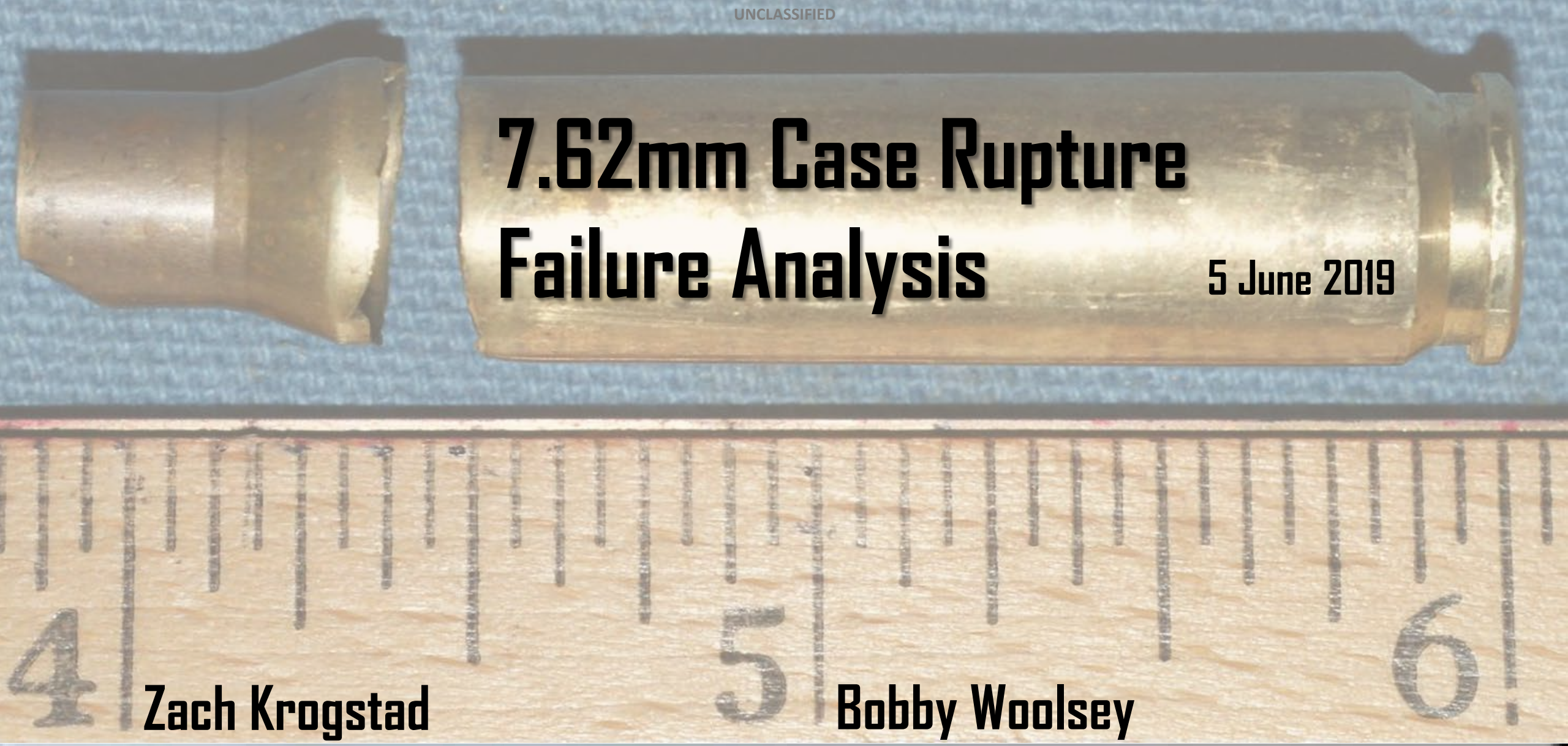

7.62mm Case Rupture Failure Analysis

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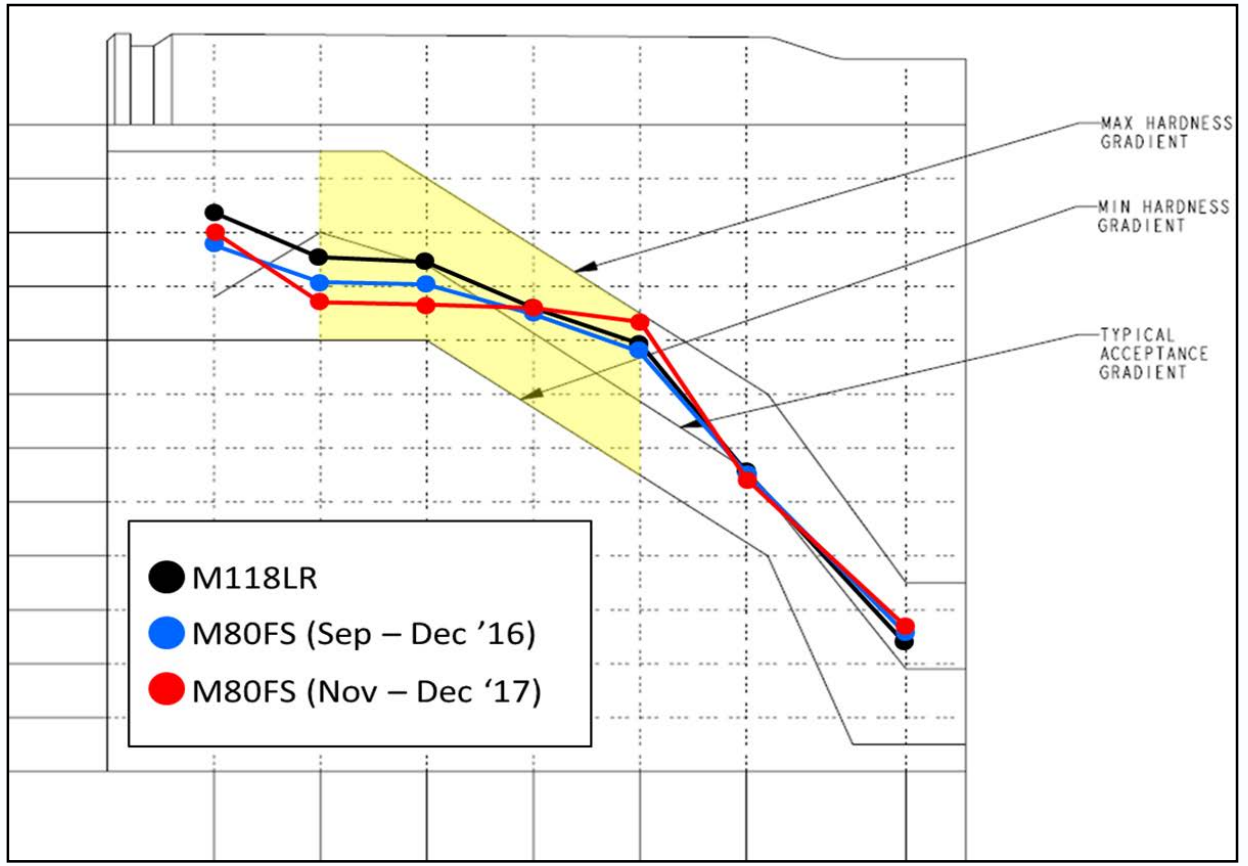
Problem Statement

- Multiple lot acceptance tests at the Lake City Army Ammunition Plant (LCAAP) from 2017-2018
  - 10 partial and complete circumferential ruptures
- 7.62mm M80 shot in the M240 weapon system

M80 ruptured case and subsequent cartridge which failed to chamber (middle)

Root Cause Identification

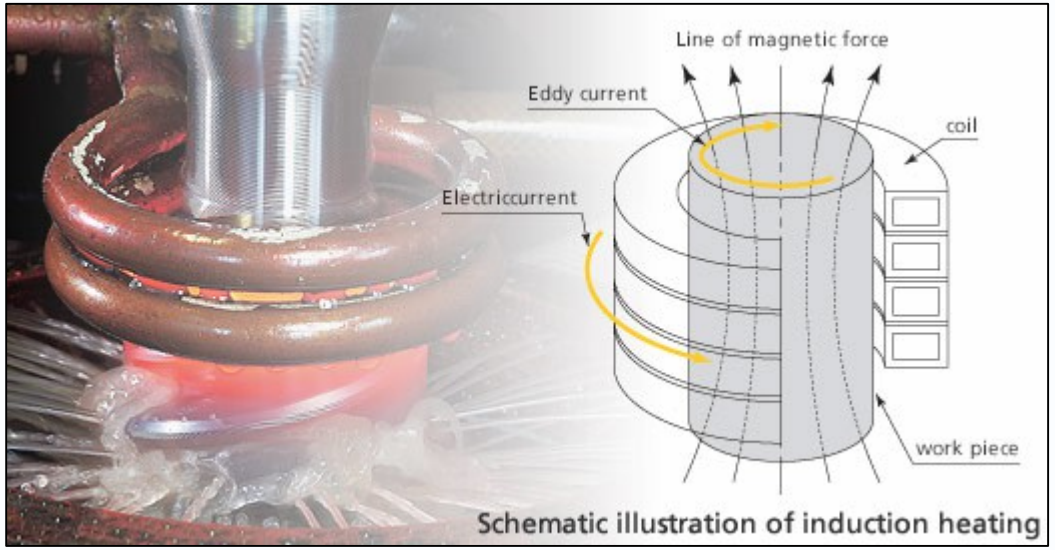
- All cartridge case hardness data were within acceptable limits
- However, the **hardness gradient** appeared significant
- A steep hardness gradient can cause a **localized region of stress**
- The technical team worked to ***improve the hardness gradient***



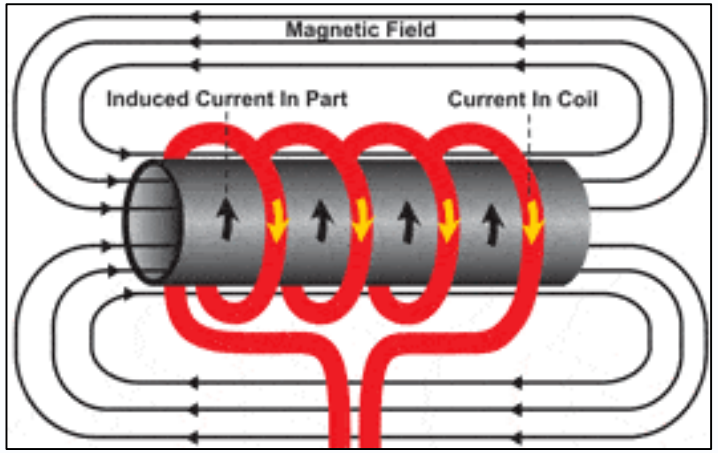
CASE DWG NOTE: "The greatest probability of satisfactory function of cartridges assembled with these cases occurs when the graph of these average readings is ***generally parallel to the limit gradients*** and is ***free from sharp angular departures*** therefrom in the region 0.5" from the head to 1.875" from the head."

Induction Annealing

- 7.62mm cases rely on induction heating coils to rapidly anneal the body of the case
- **Precise coil manufacture** and **precise positioning** with respect to the case are required in order to yield consistent anneal results
- Coil geometry and position resulted in cases with a large hardness gradient just below the shoulder

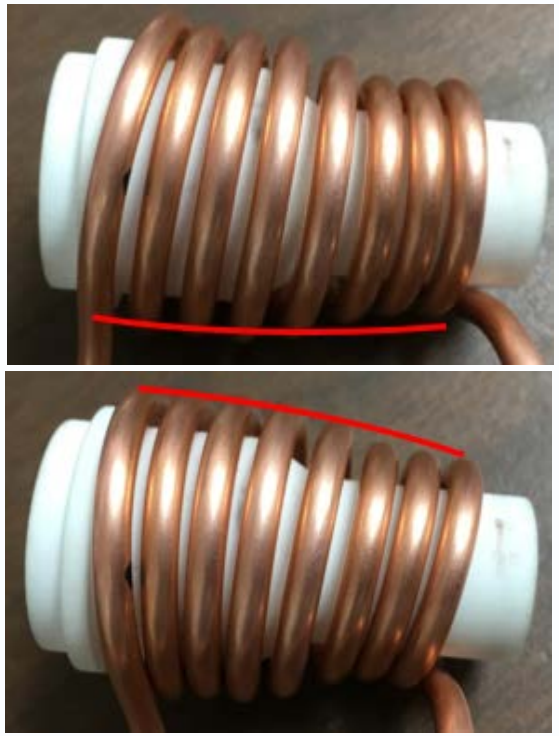


Schematic illustration of induction heating

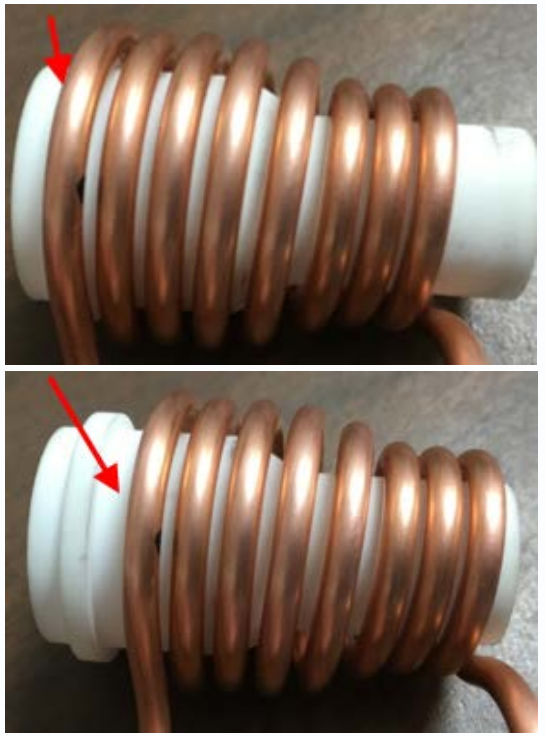


Anneal Coil Variability

- The design of the ceramic insert allowed the copper anneal coil to shift during setup
- Across 16 case manufacturing machines, each coil functioned differently because of variation in setup
- The team worked to reduce the sources of annealing variability across the machines



Coil spacing variation or bent coil axis



Axial position of coil in relation to insert and block

New Anneal Coil Design

Old ceramic insert design

New ceramic insert design

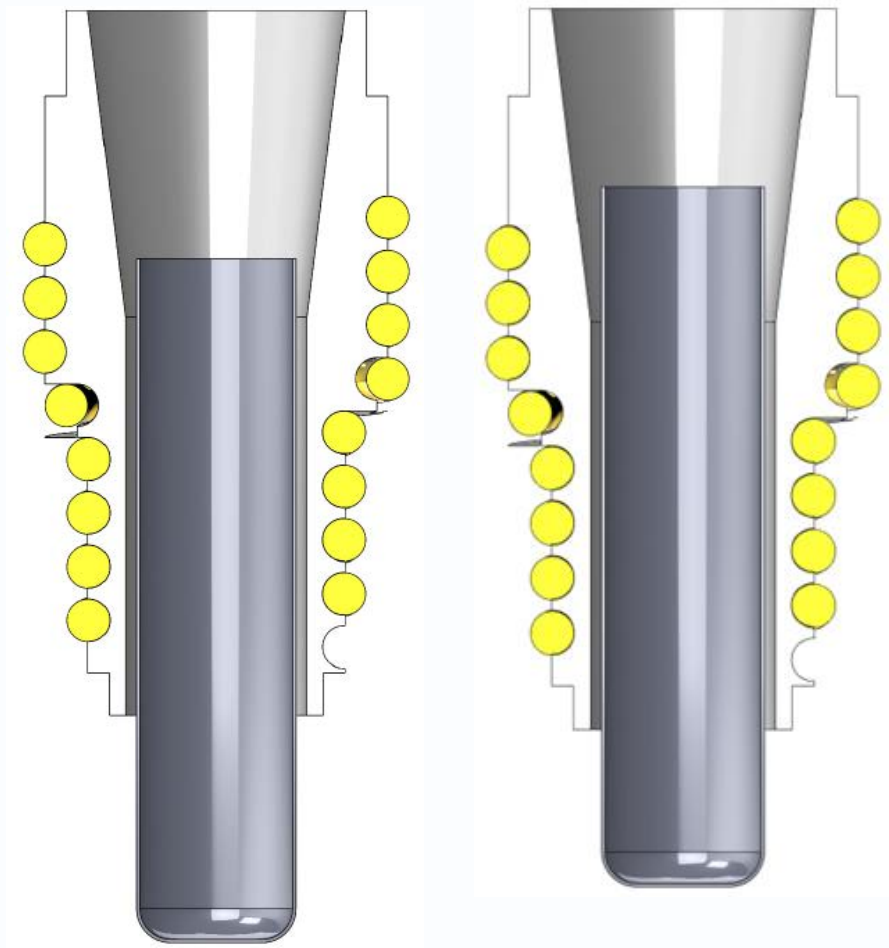
New ceramic insert design with coil

A redesigned anneal coil reduced setup variability among machines

Annealing Location

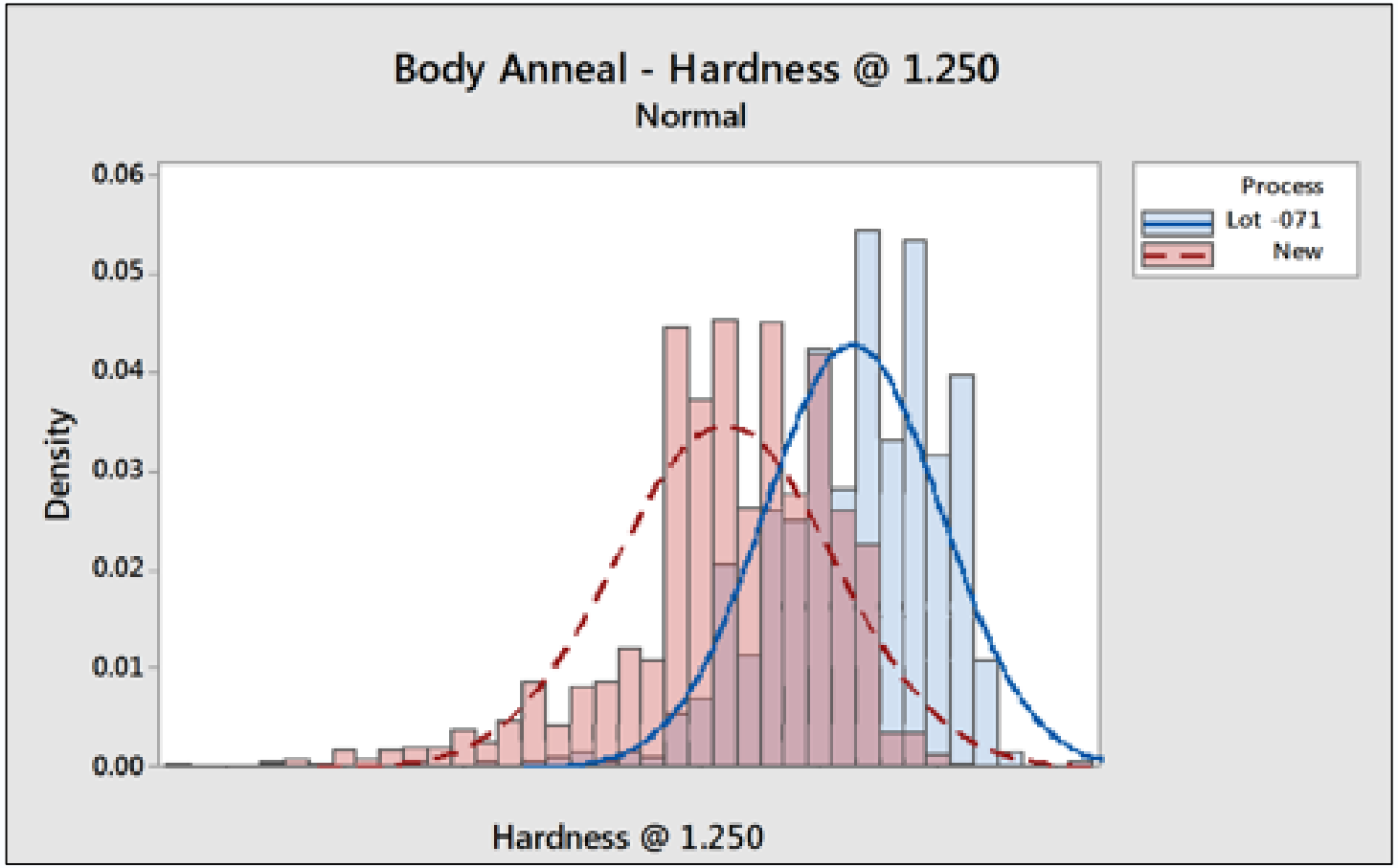
- Positioning the part further in the coil allows for more **heat applied lower** on the body of the case
- This shift reduced hardness in the 1.25” region which reduced the hardness gradient and resulting localized stress
- Results in case hardness parallel to the drawing limits

Before **After**



RESULTS

- These changes caused a shift at our most critical location on the case
- The improvements have prevented any further case ruptures to date



Conclusion

- An improved 7.62mm case manufacturing process was implemented at LCAAP
- Resulted in a more robust 7.62mm case which is less prone to rupturing in the M240 weapon system
- Zero (0) case ruptures have occurred since new process implementation

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