Case Weight Variation Reduction and Subsequent Ballistic Dispersion Improvements in M118LR

Ms. Dionne Dillon
Manager, Manufacturing Engineering, 7.62mm and Cal .50
ATK Small Caliber Systems
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Current Condition

• Demand For M118LR Increased 900% Between 2001 And 2009

• Considerable Field Experience Yielded Helpful User Feedback
  • Overall Quality And Performance Very Good
  • Accuracy And Consistency Typically Exceeds Specifications

• Some Users Requested Improvements
  • Improve Consistency Between Sublots
  • Reduce Need For Re-zero Between Sublots

Users – “Reduce Variation Between Sublots”
Project Objective:

*Identify Process-Related Measures that Can Be Implemented at the Lake City Army Ammunition Plant To Improve Average Extreme Horizontal and Vertical Spreads and Reduce the Need to Re-zero Between Sublots*
M118LR Case Requirements

• M118LR Case Is Essentially Identical To An M80 7.62 Case Except For:
  • Primer Pocket Diameter
  • Head-stamp Requirements
  • Note 10 On M118LR Drawing

“Unit wt: 190-20 Grains. Case Weight Variation For Each Cartridge Sublot Shall Not Exceed 2 Grains After Taper.”

M118LR Cases Nearly Identical to M80 Cases
Why Is Note 10 There?

• Studies Show Relationship Between Case Volume, Pressure & Accuracy
• Minimize Case Volume Variation To Achieve The Best Accuracy
• Case Volume Can Be Correlated To Case Weight
• Case Weight Is Inherently Easier To Measure At High Production Levels
• Result Was Case Weight Variation Requirement

Control Case Weight For Best Performance
M118LR Case Manufacturing Process

Case Manufacturing Process

Classify Cases By Weight

Zone 1
- Priming
- Loading
- Lot Formation & Testing

Zone 2
- Priming
- Loading
- Lot Formation & Testing

Zone 3
- Priming
- Loading
- Lot Formation & Testing

Cases Separated By Weight
M80 Case Manufacturing Process

Case Manufacturing Process → Priming → Loading

Lot Formation & Testing

Could M118LR Cases Be A Subset of M80 Cases?
M80 Case Weight Study

• Weigh Random Samples Of M80 Cases

• Over A Long Period Of Time, Capture Differences In Brass Strip Gauge Variation

• Calculate The Proportion Of M80 Cases That Fall Into The Desired Weight Range

Case Manufacture Process → Priming → Loading

Lot Formation & Testing

SPC Utilized To Measure Current M80 Process
### M80 Case Weight Study Results

**Process Capability**

<table>
<thead>
<tr>
<th>Process Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LSL</td>
<td>196</td>
</tr>
<tr>
<td>Target</td>
<td>*</td>
</tr>
<tr>
<td>USL</td>
<td>198</td>
</tr>
<tr>
<td>Sample Mean</td>
<td>197.02</td>
</tr>
<tr>
<td>Sample N</td>
<td>1200</td>
</tr>
<tr>
<td>StDev(Within)</td>
<td>0.973117</td>
</tr>
<tr>
<td>StDev(Overall)</td>
<td>1.15733</td>
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</tbody>
</table>

**Exp. Overall Performance**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>% &lt; LSL</td>
<td>18.91%</td>
</tr>
<tr>
<td>% &gt; USL</td>
<td>19.86%</td>
</tr>
<tr>
<td>% Total</td>
<td>38.76%</td>
</tr>
</tbody>
</table>

61.24% Of M80 Cases Fall In A Two Grain Range
Conclusions and Actions For Improvement

• Data Collection And SPC Analysis Supported Changes
  • Different Raw Material Dimensions
  • Elimination Of 1 Draw, 1 Anneal, & 1 Trim Operation
  • M118LR And M80 Cases Are Now Manufactured Using The Same Process

M118LR Process Mimics Proven M80 Process
M118LR and M80 – Unified Process Flow

Drawing Operations → Case Weigh

- NATO
  - Priming
  - Loading
  - Lot Formation & Testing

- M118LR
  - Priming
  - Loading
  - Lot Formation & Testing

M118LR Cases Are The Same Weight In Every Sublot

LR Cases Come From The Center Of The Case Process
Horizontal Spread

Average Extreme Horizontal Spread

AEHS Is Statistically Different At 1,000 Yards
Vertical Spread – A Better Measurement

The AEVS Is Statistically Different At 1,000 Yards
Summary

- M118LR Accuracy Was Improved
  - Reduced AEHS From 6.06 To 5.89
  - Reduced AEVS From 6.85 To 6.29

- Contributing To Less Variation In Point Of Impact Between Sublots

A More Consistent Product For The User
Dionne Dillon
ATK
816.796.5017
dionne.dillon@atk.com