

Agenda

- ◆ How we got here...
- ◆ Short review of trigger pull audit results
- ◆ Issues with the status quo
- ◆ What is the real target?
- ◆ How do we get there?

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How we got here...

- ❖ Eight writers' rifles from a June'07 hunt had higher than expected trigger pull forces
- ❖ Marketing measured trigger pull forces on 4 of the 8 guns above high limit (>5.5 lbs) after the hunt
- ❖ Marketing requested that production review the production trigger pull setting and verification process to understand why trigger pulls above high limit were found
- ❖ A warehouse audit of the trigger pull force on rifles with XMP trigger assemblies was requested by marketing at the August Product Team meeting
- ❖ The audit was conducted jointly with Ilion Quality Engineering on September 11-12, 2007

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XMP Trigger Pull Audit Review

❖ The Task

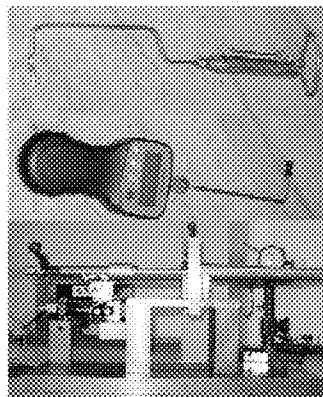
- ❖ Measure trigger pull on a statistically valid sample of production rifles with XMP trigger assemblies
- ❖ Measure trigger pull using multiple methods
- ❖ Analyze the data
- ❖ Report back on findings

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XMP Trigger Pull Audit Review

• Test Equipment Used

- Handheld Chatillon spring scale (0-10 lbs, 1/4 lb resolution)
- Handheld Lyman digital trigger pull gage (0-12 lbs, 0.5 oz. resolution)
- Dvorak TriggerScan System (0-20 lbs, 0.007 lb resolution)



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XMP Trigger Pull Audit Review

- ◆ Measure trigger pulls using the Chatillon gage
 - ◆ 3 measurements – no cycling the safety (NSC) between trigger pulls
 - ◆ 3 measurements – cycling the safety (SC) between each pull
- ◆ Measure trigger pulls using the Lyman gage
 - ◆ 3 measurements – no cycling the safety (NSC) between trigger pulls
 - ◆ 3 measurements – cycling the safety (SC) between each pull
- ◆ Remove the action from the stock
- ◆ Measure trigger pulls using the Dvorak
 - ◆ 5 measurements – cycling the safety (CS) between each pull
 - ◆ 5 measurements – no cycling the safety (NSC) between trigger pulls
- ◆ Reassemble the action to the stock, verify function

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XMP Trigger Pull Audit Review

- A snapshot of bolt action centerfire rifle warehouse inventory on 8/30/07 served as the basis for SKUs selected
- 23 SKUs for test were selected proportionally to their warehouse inventory position
- Several SKUs from the original order required alternate selections as none of the available inventory had XMP trigger assemblies

| SKU | Description | Qty | SKU | Description | Qty | SKU | Description | Qty |
|-------|----------------|-----|-------|------------------|-----|-------|---------------|-----|
| 27053 | 700 COL | 6 | 27047 | 700 COL | 1 | 84092 | 700 COL SP | 1 |
| 27039 | 700 SPS DM | 7 | 27048 | 700 COL | 1 | 84088 | 700 COL B&C | 1 |
| 84115 | 700 SPS DM C | 6 | 27052 | 700 ADL Syn V Bz | 1 | 84094 | 700 COL B&C | 1 |
| 27035 | 700 SPS DM | 6 | 27047 | 700 ADL Syn Bz | 1 | 84095 | 700 COL B&C | 1 |
| 27011 | 700 COL | 2 | 27142 | 700 SPS SS DM C | 1 | 84174 | 700 SPS DM C | 1 |
| 27085 | 700 ADL Syn Bz | 2 | 27143 | 700 SPS SS DM C | 1 | 84092 | 700 Adapter B | 1 |
| 84054 | 700 COL B&C | 2 | 27186 | 700 VSP | 1 | 84075 | 700 Mbr USS | 1 |
| 84217 | 700 SPS Var | 2 | 27343 | 700 SPS DM * | 1 | | | |

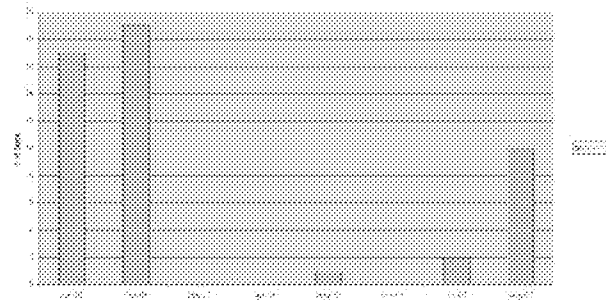
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* uses XMP trigger assembly

XMP Trigger Pull Audit Review

- Production dates for audited sample ranged from 1/3/07 to 8/30/07

Data Source: For Audited Data



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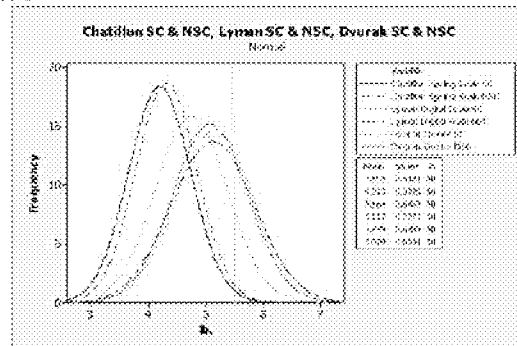
XMP Trigger Pull Audit – Data Analysis

- Analysis of dataset validity done by Jim Snedeker
 - All six measurement sets passed tests for valid normal distributions
- Sample size for audit was 49 – gun #12 had old style trigger assembly even though box label was coded for XMP (production date was 2/23/07)
- Different methods of measurement yielded different mean and SD values
 - Chaitlin sample mean = 0.49 lbs lower () than Overak SC
 - Lyman sample mean = 0.38 lbs higher () than Overak SC
 - Overak SC yielded lowest average SD for a given gun
 - Lyman NSC yielded highest average SD for a given gun
- Lyman data is suspect
 - Pull-to-pull variations of up to 2.38 lbs within a single test
 - Highest SCs within a single test of all methods used
- Percentage of rifles that failed to meet trigger pull specifications varied from 8.2% to 22.4%, depending on the method chosen

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XMP Trigger Pull Audit – Data Analysis

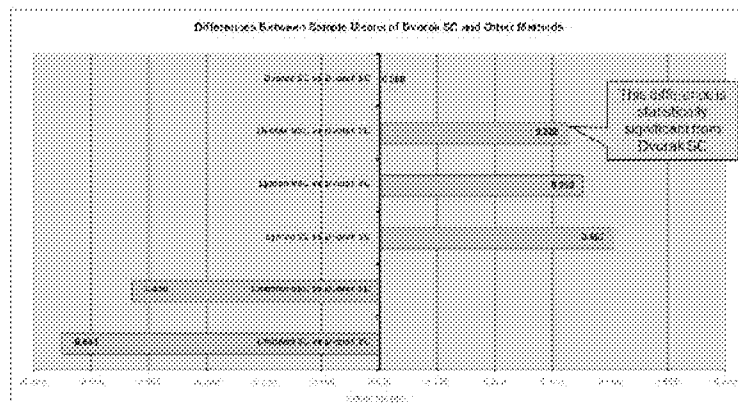
- Comparison of distribution of averages of measurements by method



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* Data includes data for gun #11 - non-XMP trigger assembly

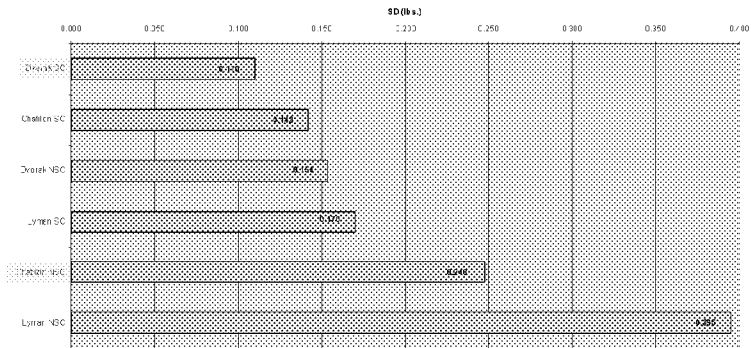
XMP Trigger Pull Audit – Data Analysis



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XMP Trigger Pull Audit – Data Analysis

Comparison of Average SD by Method



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XMP Trigger Pull Audit – Data Analysis

Comparison of Nonconformity Found By Each Method

| Method | # < LSL | # > USL | # OUT | % nonconforming |
|---------------|---------|---------|-------|-----------------|
| Chatillon SC | 4 | 0 | 4 | 8.2% |
| Chatillon NSC | 4 | 0 | 4 | 8.2% |
| Lyman SC | 0 | 11 | 11 | 22.4% |
| Lyman NSC | 1 | 9 | 10 | 20.4% |
| Dvorak SC | 2 | 6 | 8 | 16.3% |
| Dvorak NSC | 0 | 10 | 10 | 20.4% |

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XMP Trigger Pull Audit – General Observations

- ✦ Production's current measurement method yielded no product over the upper set limit (USL)
- ✦ Regardless of measurement method chosen, the current trigger pull setting process yields ≈ 2 lb range
- ✦ Some trigger assemblies show more pull-to-pull variation than others
 - ✦ Variation seemed to be independent of measurement method
 - ✦ Source of the variation is unknown
- ✦ Chatillon spring scale measured trigger pull ~ 0.49 lb lower (.) than Dvorak SC
- ✦ Lyman digital force gage measured trigger pull ~ 0.38 (1) higher than Dvorak SC
- ✦ Dvorak SC yielded lowest average pull-to-pull SD
- ✦ Lyman NSC yielded highest average pull-to-pull SD

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Issues with the Status Quo

- The measured trigger pull forces on rifles with XMP trigger assemblies are higher than marketing desires
- The range of measured trigger pull forces on rifles with XMP trigger assemblies is wider than marketing desires
- Trigger pull forces on the XMP trigger assemblies are higher than customer's expectations
- Competitive products advertise lower, more uniform out-of-the-box pull forces than we currently achieve
- It is believed that this puts us at a competitive disadvantage

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XMP Trigger Pull Audit - Recommendations

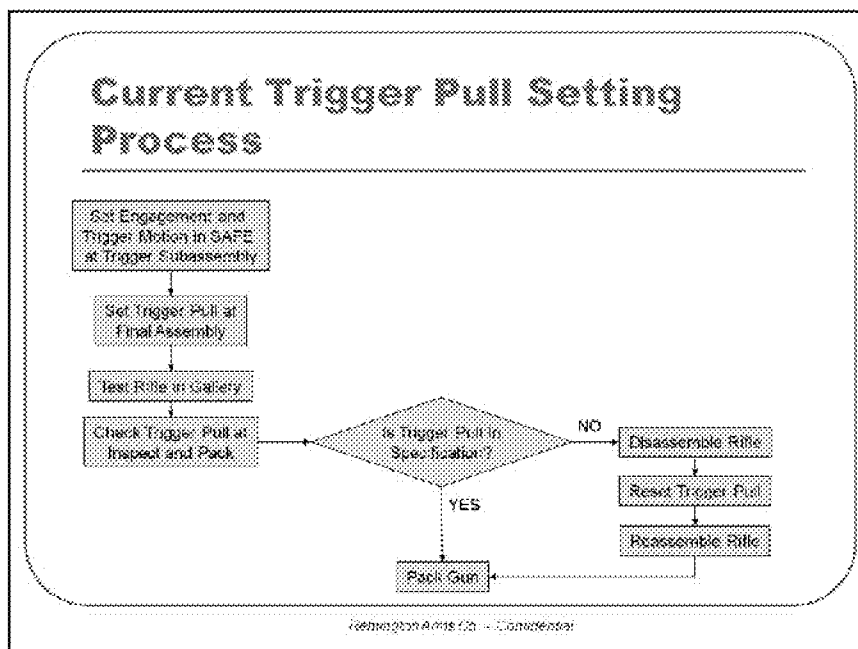
- ◆ Need a new trigger pull setting and measuring process
- ◆ The new process should:
 - ◆ Provide better resolution of the measurement than current method
 - ◆ Provide a tighter setting range (if possible)
 - ◆ Remove the effects of the operator on the measurement wherever possible
 - ◆ Minimize impact on product cost while maximizing productivity
 - ◆ Provide information on trigger pull other than just peak force

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What is the real target?

- Current process trigger pull specification is 3½-5½ lbs
- Competitive products:
 - Browning X-Bolt
 - User-adjustable from 3-5 lbs, set to approximately 3½ lbs from the factory
 - Winchester Model 70
 - User-adjustable from 3-5 lbs, set to approximately 3¾ lbs from the factory
 - Savage Accu-Trigger
 - User-adjustable from 1½ -6 lbs or 2½-6 lbs depending on model
- Where should the XMP be?

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Desirable Process Attributes

- ❖ Set trigger pull immediately prior to packing the rifle
- ❖ Provide a tighter setting range (if possible)
- ❖ Provide better resolution of the measurement than current method
- ❖ Remove the effects of the operator on the measurement wherever possible
- ❖ Minimize impact on product cost while maximizing productivity
- ❖ Provide information on trigger pull other than just peak force

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