X-Mark Pro Trigger Pull

## November 5, 2007

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Agenda

- How we got here...
- The current process
- Review of trigger pull audit results
- Issues with the current process
- 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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Current Trigger Pull Setting Process

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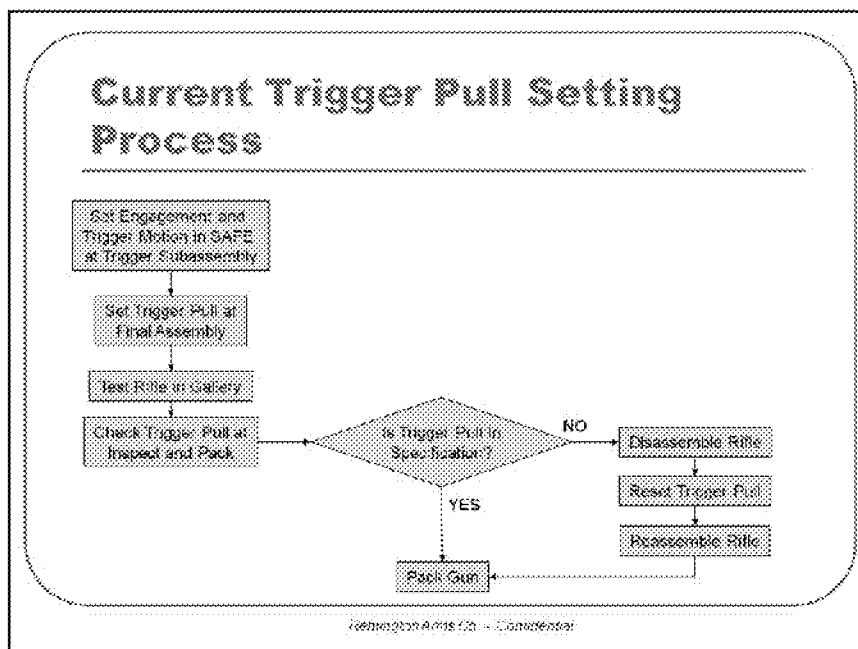
XMP Trigger Pull Audit Review

- 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, ¼ 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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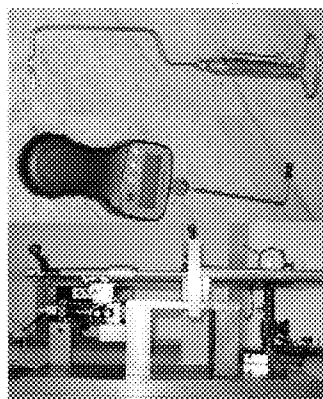
XMP Trigger Pull Audit Review

- 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 CDL	8	27042	700 CDL	1	84012	700 CDL SF	1
27315	700 SPS DM	7	27049	700 CDL	1	84050	700 CDL S&C	1
84111	700 SPS SM C	6	7702	700 ADL Syn V Su	1	84014	700 CDL S&C	1
27315	700 SPS DM	5	27057	700 ADL Syn St	1	84007	700 CDL S&C	1
27011	700 CDL	2	27142	700 SPS SS DM C	1	84124	700 SPS SM C	1
27088	700 ADL Syn Su	2	27143	700 SPS SS DM C	1	84132	700 Alaskan T	1
84054	700 CDL S&C	2	27258	700 VSF	1	84270	700 Mtn LSS	1
84217	700 SPS Var	2	27343	700 SPS DM *	1			

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XMP Trigger Pull Audit Review

- Production dates for audited sample ranged from 1/3/07 to 8/30/07
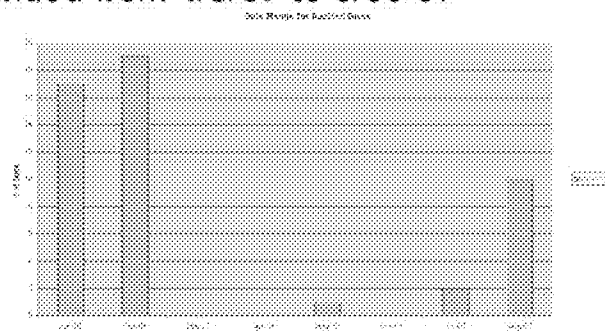
XMP Trigger Pull Audit – Data Analysis

- 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
  - Chatillon sample mean ~ 0.49 lbs lower (↓) than Dvorak SC
  - Lyman sample mean ~ 0.36 lbs higher (↑) than Dvorak SC
  - Dvorak 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 SDs 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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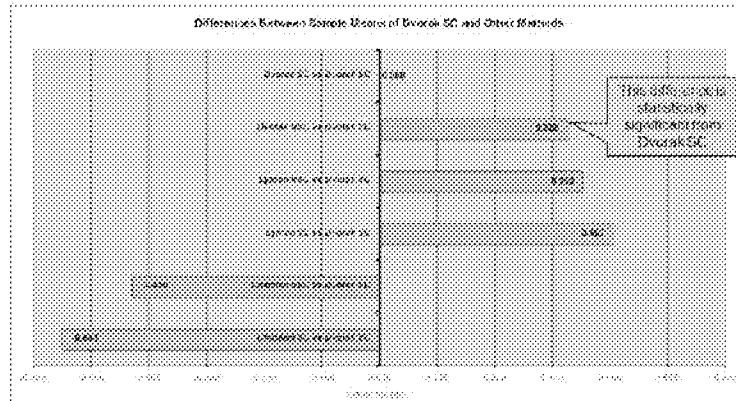
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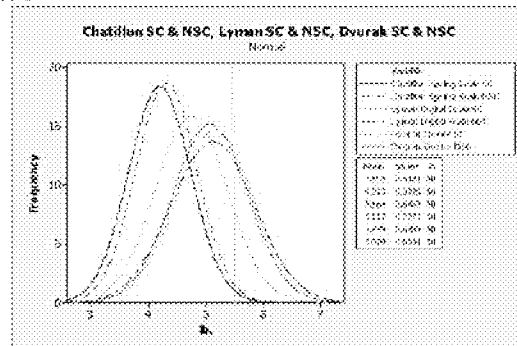
XMP Trigger Pull Audit – Data Analysis

Comparison of Average SD by Method

SD (lbs.)

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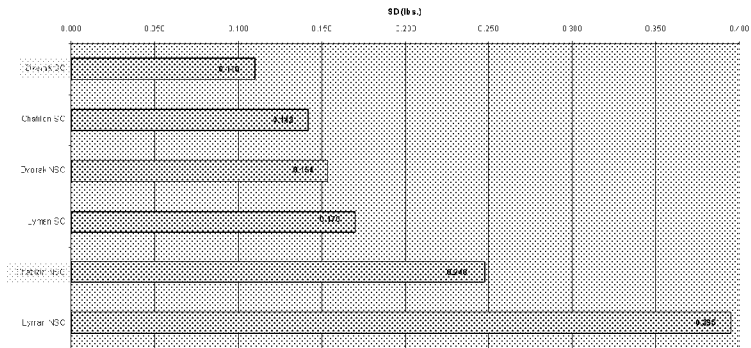
XMP Trigger Pull Audit – Data Analysis

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 trigger pull setting and measurement method yielded no product over the upper set limit (USL)
- Regardless of the measurement method chosen, the current trigger pull setting process yields $\geq$ 2 lb range at the end of the line
- 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 was ~0.49 lb lower (↓) than Dvorak SC
- Lyman digital force gage measured trigger pull ~0.38 (↑) 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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Current XMP Trigger Pull Setting Process

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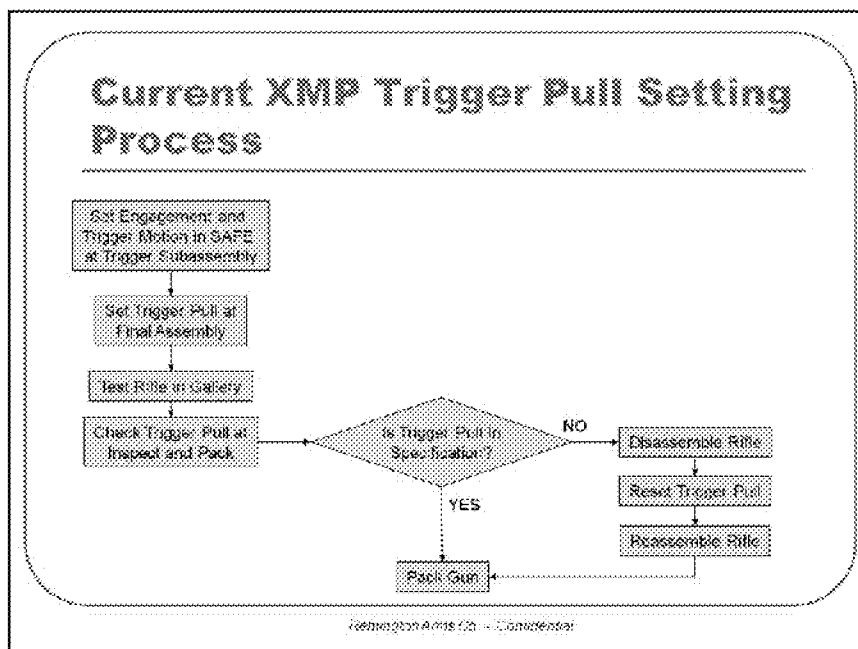
Marketing Issues with the Current Process

- 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 larger 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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What is the real target?

- Current process XMP trigger pull specification is 3½ - 5½ lbs
- Competitive products:
  - Browning X-Bolt (2008 introduction)
    - User-adjustable from 3-5 lbs, set to approximately 3½ lbs from the factory
  - Winchester Model 70 (2008 re-introduction)
    - 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

- What is the target XMP trigger pull and range?

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Path Forward

- Where do we go from here?

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