

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

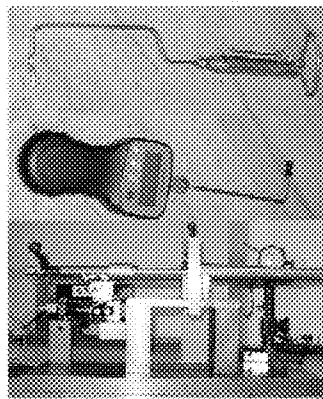
- ❖ Measure trigger pull on a statistically valid sample of production rifles with XMP trigger assemblies
- ❖ Measure trigger pull using multiple methods
- ❖ Analyze the data
- ❖ Report back on findings

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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

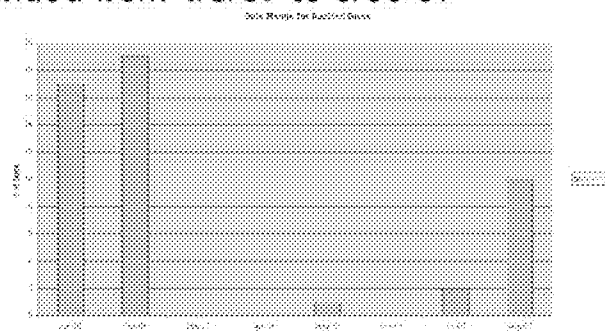
SKU	Description	Qty	SKU	Description	Qty	SKU	Description	Qty
27053	701 COL	6	27047	700 COL	1	84092	701 COL SP	1
27039	701 SPS DM	7	27048	700 COL	1	84088	701 COL B&C	1
84115	701 SPS DM C	6	27052	700 ADL Syn V Bz	1	84094	701 COL B&C	1
27035	701 SPS DM	6	27047	700 ADL Syn Bz	1	84095	701 COL B&C	1
27011	701 COL	2	27142	700 SPS SS DM C	1	84174	701 SPS DM C	1
27085	701 ADL Syn Bz	2	27143	701 SPS SS DM C	1	84092	701 Adapter T	1
84054	701 COL B&C	2	27186	700 VSP	1	84075	700 Mbr USS	1
84217	701 SPS Var	2	27343	700 SPS DM *	1			

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* does XMP trigger assembly

XMP Trigger Pull Audit Review

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



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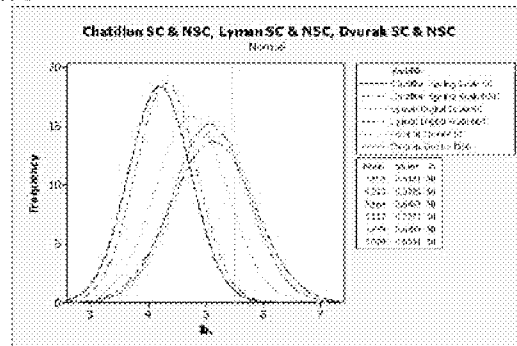
XMP Trigger Pull Audit – Data Analysis

- 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 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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XMP Trigger Pull Audit – Data Analysis

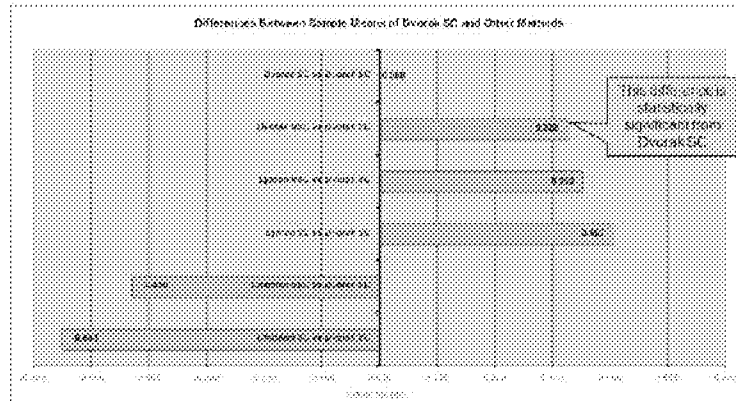
- Comparison of distribution of averages of measurements by method



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* Data includes data for gun #12 - non-XMP trigger assembly

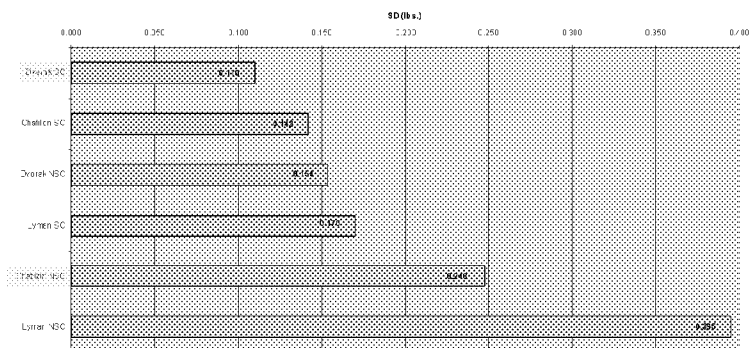
XMP Trigger Pull Audit – Data Analysis



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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 (†) 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

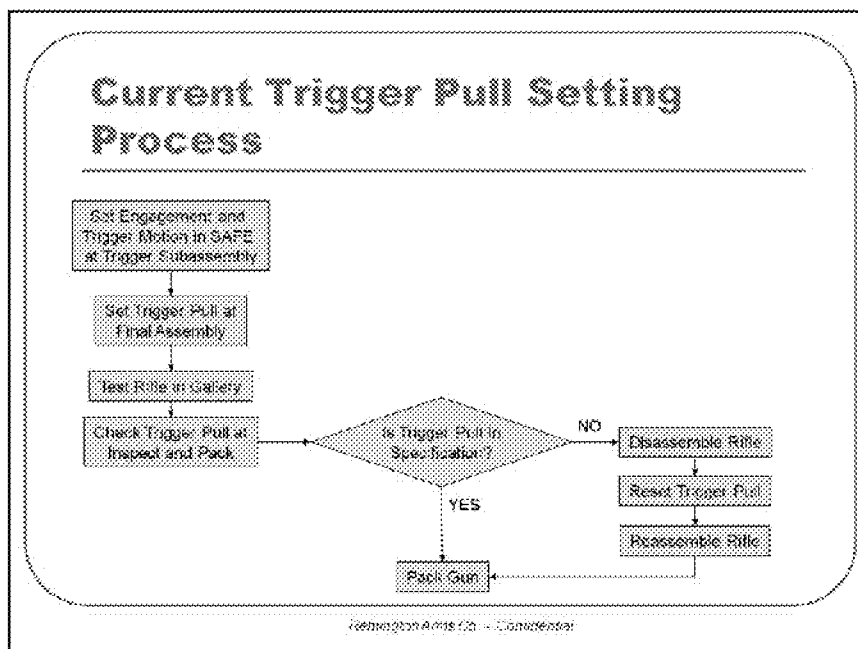
- ◆ Need a new trigger pull setting and measuring process
- ◆ The new process should:
 - ◆ Provide better resolution of the measurement than current method
 - ◆ Provide a tighter setting range (if possible)
 - ◆ Remove the effects of the operator on the measurement wherever possible
 - ◆ Minimize impact 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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