

D15 Inspection Process Optimization Kaizen

Report Out Presentation
Monday, February 10th 2020



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D15 Inspection Process Optimization Kaizen



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Team Lead	Milan Stojanovic	Quality Engineer
Facilitator	Rick Wojtysiak	Quality Manager
Team Member	Mitchell Ott	Quality Engineer (EDP)
Team Member	Anthony Stephan	Training/Subject-matter
Team Member	Erik Knoll	Department Supervisor
Team Member	Meredith Johnson	Industrial Engineer
Team Member	Adam H.	Manufacturing Engineer
Team Member	Bill Sorenson	Quality Specialist
Team Member	Jon G / Shawn S.	Operators/Subject-matter

D15 Inspection Process Optimization Kaizen



Problem / Challenge

On average D15 windings undergo a combined total of 40 manufacturing and quality sign-offs per coil produced. This team has been chartered to review D15 inspection processes to see if non-value added checks can be eliminated or shifted to ensure wait time and inspection time is minimized.



D15 Inspection Optimization Kaizen - Overview

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Objectives

- Eliminate non-value added signoffs and formal inspection requests while maintaining or improving current level of quality.

Expected Benefits

Metric	Current	Goal	% Red.
Total QA Insp. Time	3391hrs	2800hrs	- 20%
Total Wait Time	1750hrs	1400hrs	- 20%
Ave Max Tollgate / Wdg.	5	4	- 20%

- Reduction in time spent signing checklists, performing redundant verifications and requesting non-critical QA inspections.
- Drive quality ownership at the source of the production processes.

Support Needed

- **Accountable:** Milan Stojanovic (QE)
- **Facilitators:** Rick Wojtysiak (QM)
- **Requested Team:** Quality Specialist, D15 Operator(s) from each function, Erik Knoll (Sup), Meredith Johnson (IE)
- **On-Call Support:** Adam Hodge (ME)

Scope

In Scope

Review, consolidation and optimization of:

- HV 10% Mfg. & QA signoffs.
- Mandrel HV, LV, TV, RV and Booster Mfg.& QA signoffs.
- Sizing HV, LV, TV, RV and Booster MFG & QA signoffs.

Out of Scope

- Any QA signoffs deemed a critical characteristic to the test-floor & customer performance of the transformer.

Proposed Methods / Milestones

Perform a kaizen event in Q1 2020 to develop new processes as a team and drive waste reduction

Starting February 3rd, 2020:

- Day 1: Current state definition and value-add discussion.
- Day 2: Define gaps & develop improvements.
- Day 3: Create future-state iterations & define Best Practice
- Day 4/5: Implement future-state & train on changes
- Day 5: Wrap up work and report out.



Current State by Inspection Point



Current State of D15 Inspection Performance									
	Inspection	Quantity of Inspections	Insp. W/Defects	Insp. W/ Crit. Defects	% Inspections with Defects	% Inspections with Critical Defects	Total Wait Time (Hours)	Total Inspection Time (Hrs)	Total Inventory Time (Hrs)
Mandrel	10% HV	488	5	3	1.02%	0.61%	146:24	260:16	406:40
	Mand. HV	705	172	120	20.43%	14.25%	199:45	528:45	728:30
	Mand. LV	731	107	91	10.55%	8.97%	219:18	523:53	743:11
	Mand. RV	1001	18	12	3.37%	2.25%	266:56	450:27	717:23
	Mand. TV	182	8	6	4.40%	3.30%	54:36	118:18	172:54
	Mand. BST	661	56	46	20.29%	16.67%	198:18	341:31	539:49
Processing	Proc. HV	546	33	14	6.04%	2.56%	172:54	263:54	436:48
	Proc. LV	731	35	13	7.26%	2.70%	182:45	328:57	511:42
	Proc. RV	534	1	1	0.19%	0.19%	115:42	213:36	329:18
	Proc. TV	182	1	1	0.55%	0.55%	54:36	57:38	112:14
	Proc. BST	539	5	2	3.62%	1.45%	152:43	215:36	368:19
	Pre ISO	168	4	1	2.3%	0.6%	44:48	126:00	170:48

Inspection Info			
	Inspection	Manufacturing Checks	QA Checks
Mandrel	10% HV	8	12
	Mand. HV	29	13
	Mand. LV	22	15
	Mand. RV	21	37
	Mand. TV	22	19
	Mand. BST	18	29
Processing	Proc. HV	21	33
	Proc. LV	14	24
	Proc. RV	12	14
	Proc. TV	14	25
	Proc. BST	12	20
	Pre ISO	3	17

Review and optimization of checklists:

- I15002M&I Screw and Disc Winding
- I15006M&I Sling (RV) Winding
- I15002AM&I Combined Booster Winding

Specific focus on the following:

- 10% High Volt Inspection
- Processing – RV Inspection
- Processing – TV Inspection
- Processing – BST Inspection
- Processing – Pre ISO Static



Screw Disc Winding (I15002M&I)

- 2-4 QA tollgates depending on winding type.
- 10% Inspection, Mandrel Inspection, Pre-ISO, Final-Sizing/Post-ISO.
- 91 Mfg. and QA signoffs combined.

Sling/RV Winding (I15006M&I)

- 3-5 QA tollgates depending on number of layers.
- 1st Layer, Buildup Check, 2nd Layer, OD Check, Final-Sizing.
- 50 Mfg. and QA Signoffs combined.

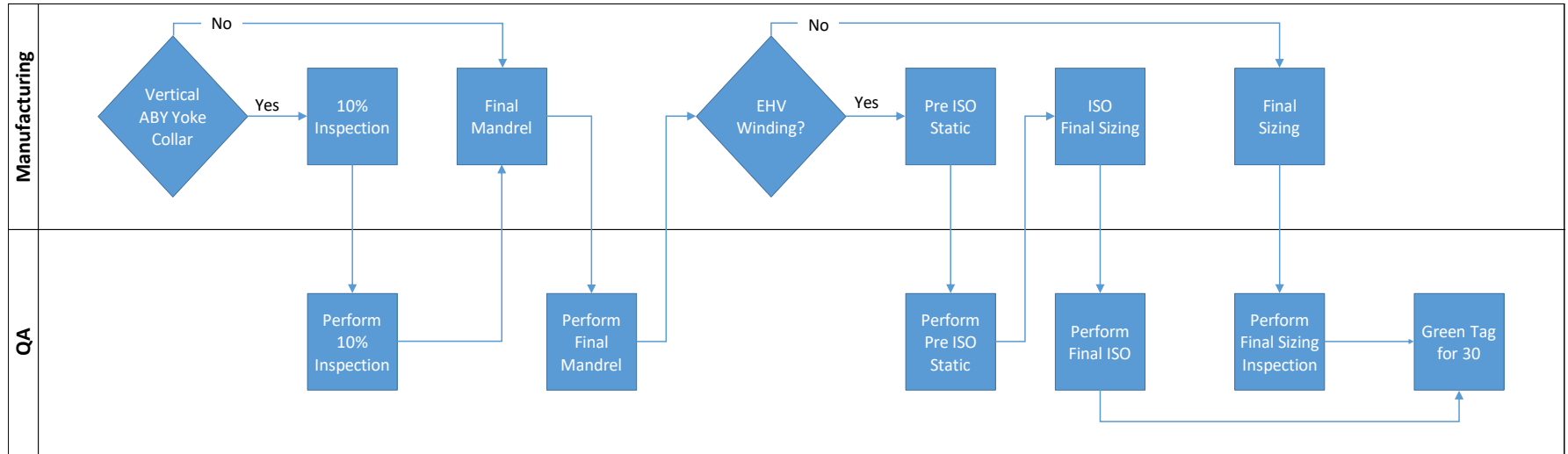
Booster Winding (I15002AM&I)

- 3 QA tollgates per booster winding (inner and outer)
- Inner winding, Outer winding, Final-Sizing.
- 60 Mfg. and QA Signoffs combined.

Current State (Screw/Disc Windings)



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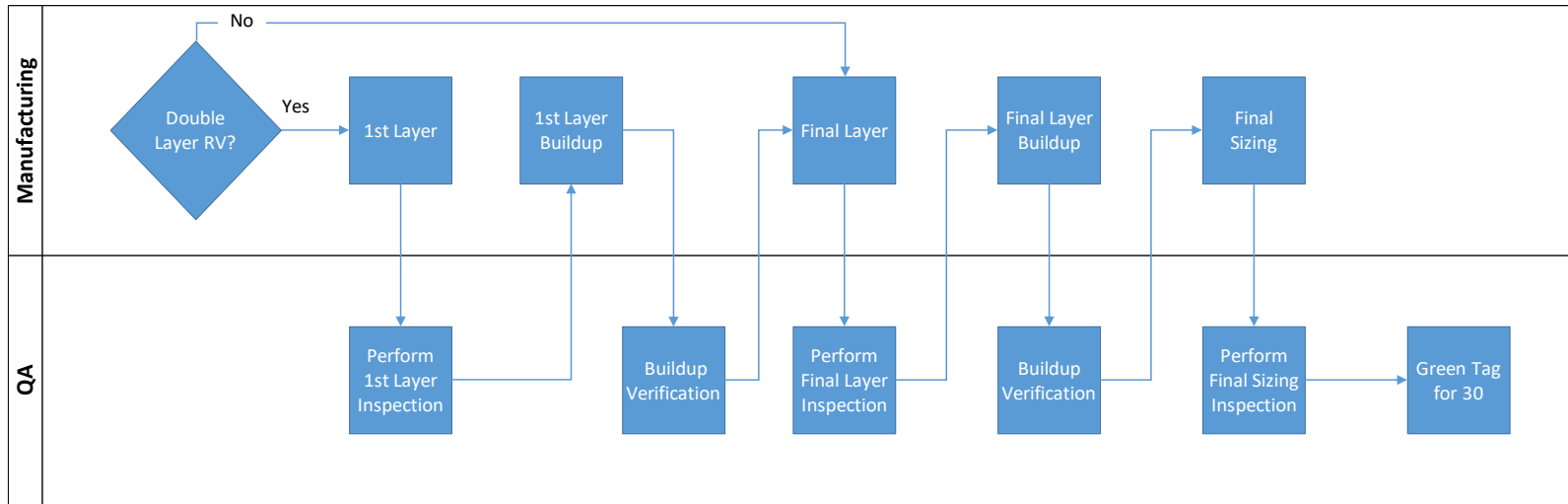


- 2-4 QA tollgates depending on winding type.
- 10% Inspection, Mandrel Inspection, Pre-ISO, Final-Sizing/Post-ISO.
- 91 Mfg. and QA signoffs combined.

Current State (RV/Sling Winding)

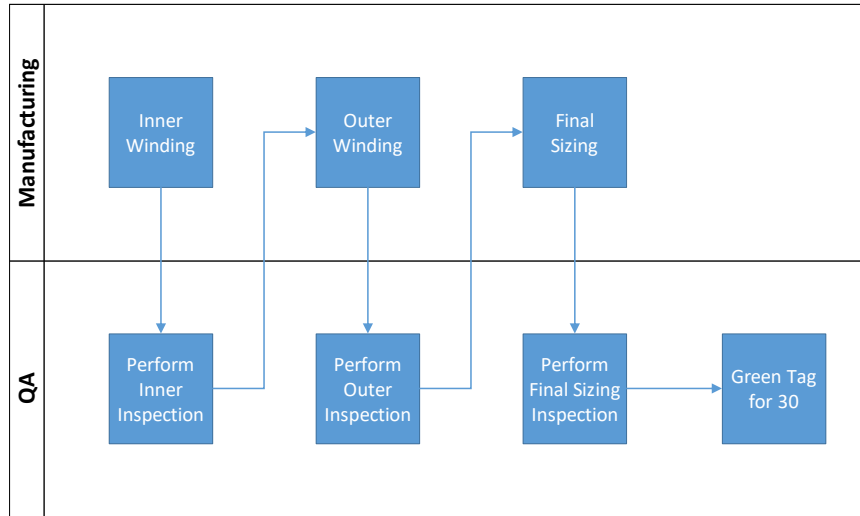


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- 3-5 QA tollgates depending on number of layers.
- 1st Layer, Buildup Check, 2nd Layer, OD Check, Final-Sizing.
- 50 Mfg. and QA Signoffs combined.

Current State (Booster Winding)



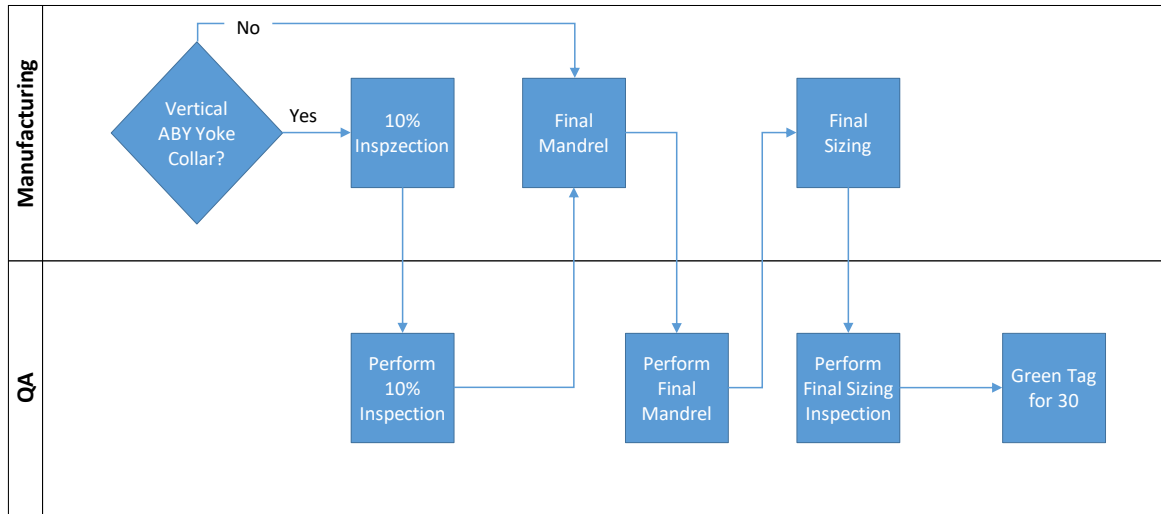
- 3 QA tollgates per booster winding (inner and outer)
- Inner winding, Outer winding, Final-Sizing.
- 60 Mfg. and QA Signoffs combined.



Team Approach for Process Improvement

- ✓ Observed the Process to establish high-level flow.
- ✓ Reviewed Checklists for redundant sign-offs.
- ✓ Used Defect and NC data, operator experience, and critical characteristics to provide basis for tollgate & sign-off removal.
- ✓ Noted manufacturing procedures needing standardization.
- ✓ Analyzed benefits of changes.
- ✓ Created Current and Future State Process Maps.

Future State (Screw/Disc Windings)



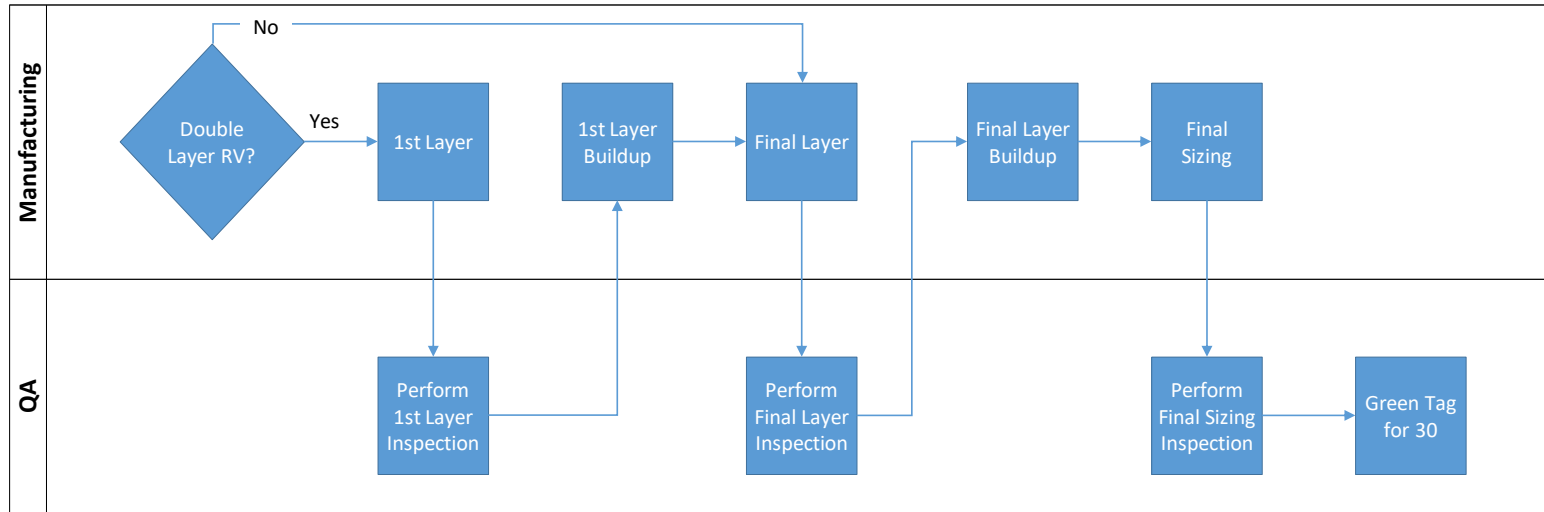
Changes Made

- Removed Pre-ISO Static QA Tollgate for EHV windings, and merged Post-ISO into Final Sizing.
- Removed redundancies in setup verification for QA.
- Removed redundancies in continuity-checking for Manufacturing.
- Re-enforced checks for operators to perform each disc/turn.
- Reduced sign-offs from 91 to 62 total.

Future State (RV/Sling Winding)



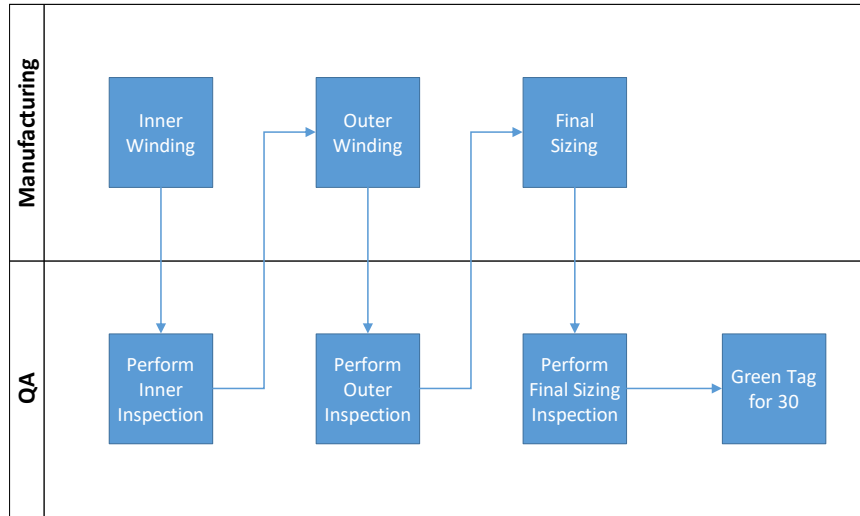
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Changes Made

- Removed 1st layer build-up and final layer OD QA verification.
- Eliminated end-to-end continuity check for manufacturing.
- Eliminated sequence check with beeper for QA, and redundant continuity check at final-sizing.
- Total signoffs reduced from 51 to 41.

Future State (Booster Winding)



Changes Made

- Tollgates did not change.
- Removed continuity check for manufacturing, and QA setup verification.
- Signoffs reduced from 60 to 48.

Future State Time Savings

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Checklist	QA Signoff Reduction	Mfg. Signoff Reduction	Tollgate Reduction	Est. Mfg. Hours Saved	Est. QA Hours Saved
Screw/Disc	15	15	1	179	131
RV/Sling	9	5	2	14	225
Booster	7	5	0	13	22

Top Savings Highlights

- **QA Layer 1 and Layer 2 OD Verification:** 147 Inspection Hours + 220 Wait Hours
- **QA Setup Verifications:** 121 Inspection Hours
- **QA Pre-ISO Static:** 56 Inspection Hours + 45 Wait Hours
- **Mfg. Green-press Damage Check:** 125 Mfg. Hours
- **Mfg. Continuity & Sequence Checks:** 81 Mfg. Hours

Metric	Current State	Goal	Future State
Total QA Insp. Time	3391hrs	2800hrs (-20%)	3012 hrs (-12%)
Total Wait Time	1750hrs	1400hrs (-20%)	1483 hrs (-15%)
Ave Max Tollgate / Wdg.	5	4 (-20%)	3 (-40%)

Direct Benefits

- Reduced wait and sign-off/inspection time.
- Reduced direct labor interruptions.
- Increased Quality Specialists availability.
- Minimized checklist sign-off and page counts.

Indirect Benefits

- Quality at the Source – reduction in secondary QA verifications.
- Increased operator involvement in the process resulting in improved product knowledge and quicker issue resolution.
- Supports schedule attainment – On Time Delivery
- Increased Quality Specialists availability for proactive quality improvements.

Standardization for Processes

Shop-floor knowledge gaps that contribute to over-inspecting & verifying.

- Multi-wire Windings – Fixing crossover defects, adjusting marks, tension.
- Start/Finish leads - Forming conductor fill.
- Cutting yoke collar cutouts – Good vs Bad practice.
- CTC Wire - Forming, Handling, Leads/Taps and Crossover Blocks.
- Boosters - Build-up forming.
- Crossover-patches – installation and correct positioning.

With standards and controls in place for manufacturing processes, sign-offs & inspections can be further reduced.

Operator Based Defect Tracking and Follow-up

Separating the operator performance from process performance.

Process Changes	Benefits
1. Operators record clock numbers on windings.	<ul style="list-style-type: none">• Operator Quality Accountability• Build Quality into Winding• Monitor Defect Patterns to Guide Improvement Needs
2. During inspections – all defects recorded and associated with clock numbers regardless of severity or rework.	
3. Occurrences and Severity by Operator Clock number will be tracked.	
4. Quality Accountability Program used to track performance of individual operators.	

Newspaper (Follow-up Items)



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Action Item	Responsible	Estimated Completion Date
Defect Data Collection Analysis: 10% Inspection	QA	2/5 – 2/29
10% Inspection Decision: Needed/Not-Needed	Team	3/5
Manufacturing Procedures Creation	Adam, Milan, Tony	End of Q2
Defect Accountability Program – Establishment/Rollout	Erik, Jamar, Meredith	End of Q1 4/5
Pull Obsolete Checklist	Erik, Meredith	2/11
Restore Insp. Request Database on D15 Kiosks.	Mitch	3/6
Inspection Instructions Creation	Milan	2/14