Eaton Corporation
4200 HWY 30 East
Kearney NE

8D Report

Date:

THE DISCIPLINED PROBLEM SOLVING PROCESS REPORT		
Title: JT4E-6507-AB High Tip End Hardness	**Date Opened:** 10/18/21	**Last Updated:** 10/20/21
Product/Process Information: P/N JT4E-6507-AB (Eaton 372237) Nano Intake Valve	**Organization Information:** Ford-Lima	**Ref. No.:** Ford Concern Number: QR# UF50198
D0 Symptoms At Ford: Hardness found above the maximum specification adjacent to keeper grooves.		
D1 Team (Name, Dept., Tel) **Champion:** Jonn Nebbe – Quality Supervisor (308-233-5447) Ken Bentley – Metallurgical Technician Lynette Buss – Metallurgical Technician		

D2 Problem statement:

DESCRIBE THE PROBLEM: At Ford: Parts found to have hardness > 58 – 60 HRC in the keeper groove region of valves that allow for a maximum hardness of 57 HRC. These valves were field failures in the 3rd keeper groove.

Before trying to define the root cause or jump to solutions – stop and take time to describe the problem, using as much data and facts as you can gather. Use the questions below to guide you.

PROBLEM PROFILE

DESCRIPTION AREA	DESCRIPTION DATA Be as specific as possible, identifying part numbers, machines, dates, quantities etc.	QUESTIONS CHECKLIST
WHAT		
Object?	Intake valve	**What object has the defect?**
Defect?	Tip hardness adjacent to the keeper grooves above specification at 58-60 HRC. Specification is 57 HRC maximum	**What is the defect?**
WHERE		**Where specifically on the object do you see the defect?**
Seen on object?	Valve keeper groove region.	
Seen geographically?	Field failures in various North American locations.	**Where geographically is the defective object observed?**
WHEN		**When in time, was the defect first observed?**
First seen? · **By the customer?** · **When did we make the part?**	July 2021 field failure at customer	**When were the defectives made?**

When seen since?	Five total failures from this date code.	**When, since the first observation, has the defect been observed? (e.g. continuously, in patterns, only on Mondays?)**
When seen in • Process flow?	At customer (field failures)	**When is the defect seen in the process of making the object?**
• Operating cycle?	Field failures.	**When is the defect seen in the operating cycle of the object? (i.e. when the object/system is used)**
• Life cycle?	Typically, several thousand miles.	**When is the defect seen in the life of the object? (e.g. when new or after 200 hours?)**
HOW BIG **How many objects have the defect?**	Approximately 15. About half of the total field failures have hardness above the maximum hardness specification.	**How many objects have the defect?**
How many/much defect(s) per object?	1	**How much or how many defect(s) per object? (ie are all bad parts defective to the same extent?)**
What is the trend?	Stable. Raw material has been changed from Sil-lite to Silchrome 1. Expect field failures to stop. Hardness set-up changed.	**How has the trend developed since first observation and what is it now? (e.g. stable/erratic, getting better/ worse)**
Consider Similar Parts	***Could this problem affect other similar parts: on other lines, in other plants with the same process, other parts with the same materials/process? List those areas or parts you consider at risk, and inform the Champion to enable communication with others.***	

Pictures of concern

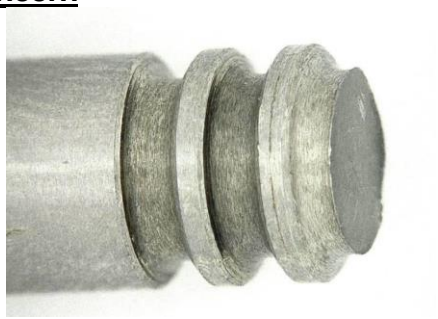

Figure 1: Tip Fracture in 3rd Keeper Groove

Figure 2: As-received Failed Valve from Ford

	Left Side	Right Side
KG 1	59.4	59.0
KG 2	59.5	59.0
KG 3	60.2	59.7

Figure 3: Hardness Measurements in the Keeper Groove Region

IS / IS NOT CHART

	Problem Statement:	Several failed valves have been found to have hardness above the maximum specification adjacent to the keeper groove.				
	Problem Description	**Is**	**Logically could be but Is Not**	**Need Information**	**Differences**	**Changes**
WHAT	**What Object**	Intake valve	Exhaust valve	N/A	N/A	N/A
	What Defect	Tip end hardness is too high.	Worn tip	Contamination to be analyzed at Eaton-Marshall	N/A	N/A
WHERE	**Where On Object**	Keeper groove region.	Valve stem	N/A	N/A	N/A
	Where First Observed	Ford-Lima	Eaton-Kearney	N/A	N/A	N/A
	Where Seen Since	5 total failures from same date code	New valve made with Silchrome 1	N/A	N/A	N/A
WHEN	**When First Observed**	August 4, 2021	N/A	N/A	N/A	N/A
	What Pattern Since	Hardness mainly in the middle of specification	Hardness outside the specification	N/A	N/A	N/A

D3 Containment Actions:

Containment Instructions		Increased inspection frequency and additional hardness checks				
AREAS TO EVALUATE						
WHAT TO EVALUTE		**Person Verifying**	**Potential Quantity**	**Actual Quantity located and identified**	**Product Disposition**	**Containment Completed (signature required)**
Production Records	Product produced in same time frame	Jonn Nebbe	0 pallets	0 pallets	OK	Jonn Nebbe
	Product produced with same raw material or components	No, raw material has changed.	0 pallets	0 pallets	OK	Jonn Nebbe
In-house Inventory	Receiving Area	N/A	N/A	N/A	N/A	N/A
	Laboratory	N/A	N/A	N/A	N/A	N/A
	Sort / Rework Areas	Jonn Nebbe	variable	0 pieces	N/A	Jonn Nebbe
	In-Process Area A	Jonn Nebbe	variable	0 pieces	N/A	Jonn Nebbe
	In-Process Area B	N/A	N/A	N/A	N/A	N/A
	In-Process Area C	N/A	N/A	N/A	N/A	N/A
	Finish Bank	Jonn Nebbe	variable	0 pieces	N/A	Jonn Nebbe
Product Shipped	At Customer	Jonn Nebbe	0 pallets	0 pallets	N/A	Jonn Nebbe
	End User	N/A	N/A	N/A	N/A	N/A
	In Transit	N/A	N/A	N/A	N/A	N/A
	Warehouse	N/A	N/A	N/A	N/A	N/A
Outsourced Processes	Heat Treat	N/A	N/A	N/A	N/A	N/A
	Plating	N/A	N/A	N/A	N/A	N/A
	Machining	N/A	N/A	N/A	N/A	N/A
	Other	N/A	N/A	N/A	N/A	N/A
Supplier Product	In transit	N/A	N/A	N/A	N/A	N/A
	At Supplier Warehouse	N/A	N/A	N/A	N/A	N/A
	At Supplier facility	N/A	N/A	N/A	N/A	N/A

D4 Root cause analysis:

Cause and effect category	Potential root cause for occurrence link to problem statement	Task to validate root cause	Who?	When?	Results
Man	Parts set-up at high end of the hardness range.	Technicians have been historically instructed to make tips as hard as possible.	Jonn Nebbe	August 2021	Technicians instructed to put the hardness in the middle of the specification.
Method	Induction hardening and tempering.	No change other than temperature increase to accommodate new material.	Jonn Nebbe	10/6/21	Parts sheared on induction shear press
	Hardness was only performed on valve tip. No profile or keeper groove hardness verification was performed.	Added checks for microhardness profile down the center of the tip and keeper groove were added.	Jonn Nebbe	July 30, 2021	Added additional hardness check at tip harden set-up.
Material	Material correct, Sil-lite	Lab to verify material – material certificate	Jonn Nebbe	10/19/21	Material correct
	Material changed from Sil-lite to Silchrome 1	Already completed.	Jonn Nebbe	8/24/21	First order processed on this date.
Machine	Induction tip harden	No issues reported	Jonn Nebbe	10/20/21	No machine issues
Mother nature	No known issues	N/A	N/A	N/A	N/A

5 Why Analysis: *(Perform 5 Why Analysis on selected probable cause(s) from cause and effect analysis. Use additional rows if more than one probable cause.)*

#	Technical Causes (Related to Machine, Process, & Material)	Why 1	Why 2	Why 3	Why 4	Why 5	Is the Potential Root Cause a Real Root Cause (Yes or No)
1	Valve tip hardness was above maximum specification of 57 HRC.	Valve was not tempered sufficiently to drop the entire tip end hardness to 57 HRC or below.	Valve hardness was only checked on valve tip. Hardness was 57 HRC or below.	This was the standard hardness inspection at tip harden for 50+ years.	The belief was the measured tip hardness was representative of the rest of the tip hardened zone.	Historic requirements were minimum hardnesses, not maximum hardnesses. Harder tips are more resistant to tip wear, which was the historic concern.	Yes
#	Detection Causes (Process Error Proofing, Gaging Methods, Inspection Methods, etc.)	Why 1	Why 2	Why 3	Why 4	Why 5	Is the Potential Root Cause a Real Root Cause (Yes or No)
1	Valve tip hardness was above maximum specification of 57 HRC.	Valve was only checked on the tip for hardness.	This was the standard hardness inspection at tip harden for 50+ years.				Yes
#	Management Processes (PROLaunch Process, Change Management Process, Management Review Process, Training process, etc.)	Why 1	Why 2	Why 3	Why 4	Why 5	Is the Potential Root Cause a Real Root Cause (Yes or No)
1	Valve tip hardness was above maximum specification of 57 HRC.	Hardness was not centered within the specification.	The belief was the measured tip hardness was representative of the rest of the tip hardened zone.	Historic requirements were minimum hardnesses, not maximum hardnesses. Harder tips are more resistant to tip wear, which was the historic			Yes

				concern.			

Cause #	*Root Cause*
1	Hardness only checked on the tip end.
2	Hardness not centered within the specification.
3	
4	

D5 Develop and verify solution:

(Long term corrective actions to prevent reoccurrence of problem)	**Who?**	**When?**	**Status**	**Results**
Added microhardness profile check at set-up and in-process.	Jonn Nebbe	7/30/21	OK	Improved hardness data
Increased hardness testing frequency.	Jonn Nebbe	7/30/21	OK	Increased hardness data

D6 Implement corrective actions:

Countermeasures: *(Long term corrective actions to prevent reoccurrence of problem)*	**Who?**	**Start Date**	**Status**	**Breakpoint/Due Date**
Added microhardness profile check at set-up and in-process.	Jonn Nebbe	7/30/21	OK	8/24/21
Added keeper groove hardness check at keeper groove grind.	Jonn Nebbe	7/30/21	OK	8/24/21

D7 Prevent reoccurrence:

(How did you verify the countermeasure worked?) ***All questions are required for closure.***			
	Enter Status (Yes, No, N/A)	**Responsible**	**Explanation for No or N/A Status**
Can you show proof of the problem elimination? *(Via measurement chart or metric - Attach supporting charts)*	**Yes/No**	J. Nebbe	
Has a Quality Alert been posted?	**No**	J. Nebbe	8D requested on 10/18/21

Has a containment worksheet been completed?	**No**	J. Nebbe	8D requested on 10/18/21
Have PFMEAs been completed/updated? (Failure mode comprehended) **Old RPN #** **New RPN #**	**No**	J. Nebbe	8D requested on 10/18/21
Was the Process Control Plan adequate and followed?	**Yes**	J. Nebbe	
Has Error Proofing been reviewed and verification completed?	**N/A**	J. Nebbe	No error proofing
Have the Job/Work Instructions been updated?	**Yes**	J. Nebbe	
Has training been completed and documented?	**Yes**	J. Nebbe	
Have the check sheets or other forms been updated?	**Yes**	J. Nebbe	
ECR/ECA/PCR(s) initiated? #	**Yes**	J. Nebbe	
The results/changes were communicated to the relevant Team Members on all shifts?	**Yes**	J. Nebbe	
Has the PM been reviewed and updated, if required?	**N/A**	J. Nebbe	No PM required.

Issue resolved?	**X**	**Yes, issue closed**
		No, assigned to **Date**

Lessons Learned:

Could the communication of this problem and its fixes possibly prevent other departments from incurring the same problem?

If "Yes", check relevant boxes and send a copy of this form to those departments (attach copy of email if applicable).

Yes	**X**
No	

Date sent: **10/20/21**

L1/2		L3S/N		L4/5		PTS		HV			
VF		RE		CP		HT		Gears		Other	MCO

If "No", document explanation	

D8 Recognize project team:

Final Review/Coaching: *(Document signature & date for applicable role - initiator required for closure)*				**Signatures required for closure**
Date & Signature	**8D Leader**	**Production supervisor**	**Team Leader**	Area Mgr
1st Shift				Quality Mgr
2nd Shift				ME Mgr
3rd Shift				Product Line Mgr