



POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

Customer : ENDURANCE TECHNOLOGIES .LTD		FMEA Number :FMEA/ETL/011		Process Responsibility : Prod / QA															
Part No: S1HT011070/XB		Key Date : .02/11/17		30.04.21		02		100% ID sorting Started at OP90 against customer complain.											
Part Name : Outer Spring		Item Code : FFFS70052		Core Team : Mr.Shashank,Mr.Chandrasekhar, Mr.Manikant,Mr.Yash,Mr.Paresh, Mr. Maheshwar, Mr.Parmanand		Prepared By :Manikant		24.04.2019		01		Recommended action criteria updated as per FMEA 4th edition requirements							
Supplier : Stumpp, Schuele & Somappa Springs Pvt Ltd								02.11.2017		00		Originated							
								FMEA DATE		REV.NO		CHANGE DETAILS							
Process No	Process Function	Potential Failure Mode	Potential Effect (s) of Failure	S	Class	Potential Cause(s) / Mechanism(s) of Failure	Occur	Current process control		Defect	RPN	Recommended Action (S)	Responsibility Target Date	Action Results					
	Requirements							Prevention	Detection					Action Taken	SEV	OCC	DET	RPN	
OP 05	Receipt & Inspection of raw material	Wrong grade of raw material supplied by the supplier	Next / Further : Component will not meet the drawing specification Customer : Customer dissatisfaction	8	--	Supplier not checked the material before loading	1	Supplier has to ensure the grade of material and identification of grade before loading	Verification of TC & DC and Identification tag as per PO before unloading	8	64	None	---	--	--	--	--	--	--
		Wire dia not as per purchase order.		8	--		1	Supplier has to ensure the wire dia of the material and identification of wire on the packing before loading	Verification of DC and Identification tag as per PO before unloading	8	64	None	---	--	--	--	--	--	--
		Raw material received in damaged and / or rust condition	Next / Further : Unfit for production Customer : Customer dissatisfaction	8	--	1. Improper handling during transportation 2. Improper packing by the supplier	2	Supplier has to ensure the condition of packing as per the specification before loading	Visual Inspection of RM condition and packaging condition as per visual aid before unloading	8	128	None	---	--	--	--	--	--	--
		Receipt of raw material without test certificate & identification	Next / Further : material will not be inward Customer : Not able to meet the customer schedule	2	--	Supplier does not sent the test certificate	2	Supplier has to ensure the test certificate should be sent along with all consignments before loading	Verification of TC & DC and Identification tag as per PO before unloading	8	32	None	---	--	--	--	--	--	--
		The supplier test certificate doesn't match with the specification	Next / Further : material will not be inward Customer : Not able to meet the customer schedule	8	--	Supplier not checked the material with the specification before loading	1	Supplier has to ensure the test certificate matching with the specification	Verification of TC as per incoming Inspection standard	8	64	None	---	--	--	--	--	--	--
	Storage of raw material	Raw material damaged and / or rusted	Next / Further : material will not be inward Customer : Not able to meet the customer schedule	8	--	Raw material not stored in good condition	1	1.Supplier has to ensure the raw material with good packaging & transport 2. SSS should store the material in proper location	periodic verification of raw material condition and proper packing & Oiling will be carried out	8	64	None	---	--	--	--	--	--	--
		Mixup of raw material with other grade / size	Next / Further : material will not be inward Customer : Not able to meet the customer schedule	2	--	Raw material not identified and stacked properly	1	periodic verification of raw material for tag & stacking in the specifically allocated & Identified racks to be carried out	Identification of raw material by tag & stacking in the specifically allocated & Identified racks	8	16	None	---	--	--	--	--	--	--

OP 10	Winding - RH	Free length less / More than the specification	Next / Further Operation: Load week / strong Customer : Not fit for assy and customer dissatisfaction	6	--	1.Improper pitch tool position & cams	2	1. Machine setting card 2. Setup approval to be done.	Inprocess inspection	6	72	None	---	---	--	--	--	---
		Inner / Outer diameter less / more than the specification	Next / Further Operation: Load week / strong Customer : Not fit for assy and customer dissatisfaction	7	--	1. Improper setting of coiling roller	2	1. Machine setting card 2. Setup approval to be done.	Inprocess inspection	6	84	None	---	---	--	--	--	---
		No of coils more / less than the specification	Next / Further Operation: Load week /strong Customer : customer dissatisfaction	7	--	Improper engagement of clutch during coiling	2	1. Machine setting card 2. Setup approval to be done.	Inprocess inspection	6	84	None	---	---	--	--	--	---
		Excess Burr	Next / Further : Poor appearance Customer : Customer dissatisfaction	7	--	Blunt tool	2	Regrinding of cuttingtool & coiling roller after the production of 100K pieces	Inprocess inspection by visual	7	98	None	---	---	--	--	--	---
		Tool / Roller / Surface marks	Next / Further : Reduced spring life Customer : Failure of spring in field	7	--	Improper alignment of feed rollers	2	Work instruction	Inprocess Inspection	7	98	None	---	---	--	--	--	---
		Mix up	Next / Further : Rejection Customer : Not fit for assy	7	--	Work insturctions not followed	2	100% load sorting	Inprocess Inspection	4	56	None	---	---	--	--	--	---

OP 20	Stress Relieving	Duration less / more	Next / Further : Spring load will become strong / Weak Customer : Fitment & Functional Problem	6		1Duration of tempering time more / less than the specification	3	By Adjusting The Knob and locking System	Calibration Record	5	90	None	---	---	--	--	--	---	
		Temperature less / more	Next / Further : Spring load will become strong / Weak Customer : Fitment & Functional Problem	6		1.Improper Adjustment	3	Proper Set Up and locking System	Calibration Record	5	90	None	---	---	--	--	--	--	---
		Tempering delay	Next / Further : Deformed / breakage Customer : Vehicle operable at Reduced level of performance	6		Due to over load, Machine b/d	2	Work instruction	Tmer Control	5	60	None	---	---	--	--	--	--	---
		Delayed Tempering	Next / Further : Deformed / breakage Customer : Vehicle operable at Reduced level of performance	6		Due to over load, Machine b/d	2	Work instruction	Tmer Control	5	60	None	---	---	--	--	--	--	---
		Diameter less / more than the specification	Next / Further : Spring load will become strong / Weak Customer : Fitment & Functional Problem	7		1.Furance temprature more / less than the specification 2.Stress relieving duration more / less than the specification.	2	1. Setup approval to be done for the process & product parameters as per Work std / Machine setting card with a)Furnace temperature b) Duration c) Generator switch on instruction when the power	Inprocess inspection	6	84	None	---	---	--	--	--	--	---
				7		Power failure	4	Generator will be switched on within 5'		2	56	None	---	---	--	--	--	--	---
		Improper stress relief	Next / Further : Spring load will become strong / Weak Customer : Fitment & Functional Problem	6		1.Furance temprature more / less than the specification 2.Stress relieving duration more / less than the specification.	3	1. Setup approval to be done for the process & product parameters as per Work std / Machine setting card with a)Furnace temperature b) Duration c) Generator switch on instruction when the power failure	Inprocess inspection	5	90	None	---	---	--	--	--	--	---
				6		Power failure	3	Generator will be switched on within a 5'		5	90	None	---	---	--	--	--	--	---
		Operation Missing	Next / Further : Spring may yield during functioning Customer : Fitment and Functional Problem	7	--	Working slip not followed	2	Work instruction	Inprocess inspection	6	84	None	---	---	--	--	--	--	---
		Mixup	Next / Further : Rejection at next operation Customer : Not able to meet the customer schedule	6	--	Conveyor not cleaned before loading	2	Error proofing in Operation No.30	Inprocess inspection	6	72	None	---	---	--	--	--	--	---

OP 30	Grinding	Free length less / more than the specification	Next / Further : Spring load will become strong / weak Customer : Fitment and Functional Problem	6	--	VariationFeed rate of magazine plate	4	1. Setup approval to be done as per grinding advice card 2.Preventive maintenance of the machine 3.Periodical check of Magazine plate feed rate 4.Periodical Dressing of grinding wheel	Inprocess inspection	4	96	None	---	---	--	--	--	---
		Axial squareness more than the specification	Next / Further : Rejected at final inspection Customer : Customer dissatisfaction	6	--	1.Excess clearance in magazine plate bush & spring 2.Improper setting of magazine plate	3	Clearance between bush and spring and magazine plate position to be checked during setup approval	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Solid height more than the specification	Next / Further : Rejected at final inspection Customer : Functional Problem	6	--	No of coils more than the specification during winding	3	Solid height to be checked during Set up approval	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Parallelism more than the specification	Next / Further : Rejected at final inspection Customer : Customer dissatisfaction	6	--	1.Excess clearance in magazine plate bush & spring 2.Improper setting of magazine plate	2	Clearance between bush and spring and magazine plate position to be checked during setup approval	Inprocess inspection	7	84	None	---	---	--	--	--	---
		End coil gap more than the specification	Next / Further : Rejected at final inspection Customer : Fitment & Functional Problem	7	--	1.Excess clearance in magazine plate bush & spring 2.Improper setting of magazine plate	2	Clearance between bush and spring and magazine plate position to be checked during setup approval	Inprocess inspection	7	98	None	---	---	--	--	--	---
		Tip thickness less than the specification	Next / Further : Rejected at final inspection Customer : Fitment & Functional Problem	6	--	1.Excess clearance in magazine plate bush & spring 2.Improper setting of magazine plate	3	Clearance between bush and spring and magazine plate position to be checked during setup approval	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Ground face angle less than the specification	Next / Further : Rejected at final inspection Customer : Fitment & Functional Problem	6	--	1.Excess clearance in magazine plate bush & spring 2.Improper setting of magazine plate	3	Clearance between bush and spring and magazine plate position to be checked during setup approval	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Grinding damage & Burr	Next / Further : Rejection at next operation Customer : Not able to meet the customer schedule	6	--	1.Misalignment of guide plate 2.Excess depth of cut 3. Improper dressing of grinding wheel	3	1.Magazine plate alignment , Depth of cut to be checked during Set up approval 2. Periodic Dressing of grinding wheel	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Breakage to grinding	Next / Further : Rejection at next operation Customer : Not able to meet the customer schedule	6	--	1.Misalignment of guide plate 2.Excess depth of cut 3. Improper dressing of grinding wheel	3	1.Magazine plate alignment , Depth of cut to be checked during Set up approval 2. Periodic Dressing of grinding wheel	Inprocess inspection	5	90	None	---	---	--	--	--	---
		Operation Missing	Next / Further : Rejection at next operation Customer : Not able to meet the customer schedule	6	--	Working slip not followed	2	Pokayoke in Operation No.60	Inprocess inspection	8	96	None	---	---	--	--	--	---

OP 40	Shot Peening	Less Intensity	6	--	1. Duration less	2	Timer	Setup approval	5	60	None	---	---	--	--	--	---		
			6	--	2. Shot size variation	2	Periodical seiving	Setup approval	5	60	None	---	---	--	--	--	---		
			6	--	3. Shot level less	2	Setup for every batch	Visual Inspection	8	96	None	---	---	--	--	--	---		
		Insufficient Coverage	Next/Further Operation: Rework Customer : Customer dissatisfaction	6	--	1. Duration less 2. Less qty of shots 3. Ark height variation	2	Set Up approval & Periodical checking	Inprocess Inspection	5	60	None	---	---	--	--	--	---	
				6	--	1. Shot level less 2. Shot sieving not done	2	1. Periodical seiving 2. Work Instruction	Inprocess Inspection	5	60	None	---	---	--	--	--	---	
		Shot size variation			6	--	1. Shot sieving not done Periodically	2	Periodical seiving	Inprocess Inspection	8	96	None	---	---	--	--	--	---
		Shot level variation			6	--	Work insturctions not followed	2	Shot level indicator	Inprocess Inspection	8	96	None	---	---	--	--	--	---
		Delayed Shotpeening	Next / Further : Corrosion,Rust & Pits Customer:Rust or Damage and not fit for assy , Customer : dissatisfaction	5	--	Due to over load, Machine b/d	2	Work instruction	Visual Inspection	7	70	None	---	---	--	--	--	---	
		Shotpeening delay	Next / Further : Corrosion,Rust & Pits Customer:Rust or Damage and not fit for assy , Customer : dissatisfaction	5	--	Due to over load, Machine b/d	2	Work instruction	Visual Inspection	7	70	None	---	---	--	--	--	---	
		Mixup	Next / Further : Rejection at next operation Customer : Not able to meet the customer schedule	6	--	Old batch spring held up in shotpeening M/c	2	Work instruction	Inprocess inspection	8	96	None	---	---	--	--	--	---	
Operation Missing	Next / Further : Spring may yield during functioning Customer : Fitment and Functional Problem	7	--	Working slip not followed	2	Work instruction	Inprocess Inspection	7	98	None	---	---	--	--	--	---			

OP 50	Stress Relieving-2	Tempering operation missing.	Next / Further : Spring may yield during functioning Customer : Fitment and Functional Problem	7	--	Working slip not followed	2	Root card.	Inprocess inspection	5	70	None	---	--	--	--	--	---
OP 60	Scragging	Free length Less / more than the specification	Next / Further : Load weak / strong Customer : Customer dissatisfaction	6	--	Not set to the proper height Improper tempering	3	Setup approval	100% Inspection	5	90	None	---	--	--	--	--	---
		Deformation Bend / Buckling	Next/Further: Rework / Rejected Customer : Not fit for assy	6	--	Improper alignment of end fixture	2	100% load group identification	Inprocess Inspection	8	96	None	---	--	--	--	--	---
		Operation Missing	Next / Further :- Customer : Fitment and Functional Problem	7	--	Working slip not followed	2	100% load group identification	Inprocess Inspection	6	84	None	---	--	--	--	--	---
OP 70	100% Lo,e1, e2 Sorting	e1 More e2 More Length more/Les	Assembly problem Performance failure	6	--	Unskilled Operator Improper setting of machine Worn out contour gauge	4	Work instruction	100% Inspection with gauge	4	96	None	---	--	--	--	--	---
OP 80	Powder Coating	In house (QS – FMEA – 001)																
OP 90	Final Inspection	Product parameters not meeting the specifications	Next / Further : Rework / Reject Customer : Fitment / Functional problem / Premature failure	6	--	1.Error in measuring instruments 2.Inspection standard not followed during Inprocess inspection 3. Final inspection not carried out	2	1.Calibration of Instruments as per the defined frequency 2.Product audit 3.Layout inspection	Final inspection as per the specified qty and frequency in the control plan	8	96	100% ID sorting will be done.	Production	100% ID sorting Started.	6	2	6	72
OP 100	Packing	1.Damage of parts	Next / Further : Rework / Reject Customer : Poor appearance and Premeture fatigue failure	7	--	1.Wrong packing material used 2.Wrong packing method	1	Packing approval to be done Packing material and packing method	Product audit	8	56	None	---	--	--	--	--	---
		Shortage / excess no of packing	Next / Further : material will not be inwards at customer end Customer : Not able to meet the customer schedule	6	--	packing operator not followed the packing standard	2	Packing approval to be done for no parts		8	96	None	---	--	--	--	--	---
		Mix up	Next / Further : Reject Customer: Customer dissatisfaction	6	--	Old batch spring held up in Packing table	2	1.Work Instruction		8	96	None	---	--	--	--	--	---
Note : Next review Oct'21 or update against any complaints / improvements (Eg. PY /RPN/HD)																		

(Note : (1)Determining Review / Action Priorities






Having updated the rankings for severity, occurrence and detection, efforts are put to reduce the risk. Following guideline is given when prioritizing the actions;

- a). Failure modes with highest rankings- when severity is 9 or 10 the risk has to be addressed through existing design controls or recommended actions (as documented in FMEA)
- b). For failure modes with severities of 8 or below, consideration is given to causes with highest occurrence or detection ranking..
- c). While recognizing acceptable risk, it is important to do a thorough analysis of severity, occurrence and detection and not on the basis of RPN.

CONTROL PLAN

<input type="checkbox"/>	Prototype	<input type="checkbox"/>	Pre-launch	<input checked="" type="checkbox"/>	Production						
Control Plan Number :		Control Plan Number : CP/ ETL /011			Key Contact / Phone :		Udham Singh / 9729202173 udham.singh@ssssprings.com		Control plan Date	Rev.no	Change Details
									02.11.2017	00	Originated
									17.08.2019	1	DH grade added.
									10.07.2020	02	Process parameter added at grinding
Part Number / Latest Change Level :		SIHT011070/XB			Core Team :		Mr.Shashank,Mr.Chandrasekhar, Mr.Manikant,Mr.Yash,Mr.Paresh, Mr. Maheshwar, Mr.Parmanand		30.04.21	03	100% ID sorting Started at OP90 against customer complain.
Part Name / Description :		Outer Spring							-----	-----	-----
Supplier / Plant : SS&S - HALOL		Customer : Endurance technology Ltd.			Supplier / Plant Approval / Date		02.11.17		-----	-----	-----
					Other Approval / Date (if Req'd)		-----		Customer Quality Approval / Date (if Req'd)		-----

Reaction Plan & Corrective action : 1. Reject and return to supplier , raise CAR for corrective & preventive action , 2. Stop production Quarantine the suspect parts and Check some more parts (Sort if required) / do 100 % inspection / Rework (MF-WI-0011) / Reject / reset the parameters in consultation with Engineers and revalidate process (if necessary)

Part / Process No.	Process Name / Operation Description	Machine, Device, Jig Tools for Mfg.	Characteristics			Special Char. Class	Methods		Evaluation / Measurement Technique	Sample		Control Method & Error Proofing	Responsibility & Record	Reaction Plan & Corrective action		
			No.	Product	Process		Product/Process Specification/Tolerance as per drg	Stage specification of Product / Process parameters		Size	Freq.					
5	Receipt & Inspection of raw material	-----	1	Diameter of the wire	-----	-----	4.0 ± 0.030 mm	4.0 ± 0.030 mm	Verification of Sup.TC /Insp. report , DC and Identn tag	Once	Every Lot	Verification during Receipt	Stores Incharge, Goods Receipt Note / SAP	1		
			2	Grade	-----	-----	GR 3,SH As per IS 4454	SH/DH								
			3	Mechanical properties	-----	-----	GR 3,SH As per IS 4454	Tensile strength / Chemistry	As per Sampling Plan QS - WI - 100	Incoming Inspection & Cross verification	Quality Inspector, Inward inspection record Supplier TC	1				
			4	Diameter of the wire	-----	-----	4.0 ± 0.030 mm	4.0 ± 0.030 mm					Micrometer (0-25 mm,			
	Visual	-----	5	Appearance	-----	-----	Should be free from Oiled,Rust and Damage	Should be free from Oiled,Rust and Damage	Visual	-----	-----	-----	-----	-----		
	Storage of materials	-----	1	Appearance	-----	-----	-----	1.Should be free from Rust and Damage and to be Stacked in the allocated & identified racks with proper packing & Identification tag	Visual Verification	Once	Every week	Cross verification	Stores Incharge	2		
10	Winding RH	Winding machine TK-550 TK-590	1	Wire diameter	-----	-----	4.0 ± 0.030 mm	4.0 ± 0.030 mm	Micrometer	2Nos	Every setup & 30 Minutes	First Sample approval & PMC	Operator MF-FR-001A/02	2		
			2	Outside Diameter.	-----	-----	28.25 mm Max	28.2 ± 0.2 mm	Vernier caliper							
			3	Free Length	-----	-----	254 ± 2.0 mm	260-265mm	Vernier caliper							
			4	Total coils	-----	-----	27.10±0.25	26.9±0.20mm	Manual Count							
			5	Tool mark,Burr,breakage	-----	-----	Free from Tool mark,Burr,breakage	Free from Tool mark,Burr,breakage	Visual							
			6	Coil Direction	-----	-----	RH	RH	Visual							
			7	Deflection @ 20 mm		-----	16.3 ± 7% kgf	16.3 ± 7% kgf	Elasticometer	2Nos	Every setup	First Sample approval	Operator MF-FR-001A/02			
			8	Deflection @ 40 mm		-----	32.6 ± 7% kgf	32.6 ± 7% kgf	Elasticometer							
			9	Deflection @ 75 mm		-----	65.3 ± 7% kgf	65.3 ± 7% kgf	Elasticometer							
			10	Deflection @ 85 mm		-----	79.4 ± 7% kgf	79.4 ± 7% kgf	Elasticometer							
			11	Deflection @ 93 mm		-----	90.6 ± 7% kgf	90.6 ± 7% kgf	Elasticometer							
			12	Spring rate K1	-----	-----	0.82 kgf/mm	0.82 kgf/mm	Elasticometer							
						13	Spring rate K2	-----	-----	1.41 kgf/mm	1.41 kgf/mm	Elasticometer				
						14	Solid Height	-----	-----	112.4mm Max	112.4mm Max	Elasticometer				
						15	-----	Program No.	-----	TK-550-3 TK-590-17	TK-550-3 TK-590-17	Visual	once	Every Setup	First sample approval	
						16	-----	Feed roller pressure	-----	0.4 to 0.6 Mpa.	0.4 to 0.6 Mpa.	Visual	once	Every Shift	DPM Check sheet	Operator MF-FR-018

CONTROL PLAN

<input type="checkbox"/> Prototype		<input type="checkbox"/> Pre-launch		<input checked="" type="checkbox"/> Production						Control plan Date		Rev.no		Change Details				
Control Plan Number :		Control Plan Number : CP/ ETL /011				Key Contact / Phone :		Udham Singh / 9729202173 udham.singh@ssssprings.com				02.11.2017		00		Originated		
Part Number / Latest Change Level :		SIHT011070/XB				Core Team :		Mr.Shashank,Mr.Chandrasekhar, Mr.Manikant,Mr.Yash,Mr.Paresh, Mr. Maheshwar, Mr.Parmanand				17.08.2019		1		DH grade added.		
Part Name / Description :		Outer Spring										10.07.2020		02		Process parameter added at grinding		
												30.04.21		03		100% ID sorting Started at OP90 against customer complain.		
Supplier / Plant : SS&S - HALOL		Customer :		Endurance technology Ltd.		Supplier / Plant Approval / Date		02.11.17										
						Other Approval / Date (if Req'd)		-----								Customer Quality Approval / Date (if Req'd)		
Reaction Plan & Corrective action : 1. Reject and return to supplier , raise CAR for corrective & preventive action , 2. Stop production Quarantine the suspect parts and Check some more parts (Sort if required) / do 100 % inspection / Rework (MF-WI-0011) / Reject / reset the parameters in consultation with Engineers and revalidate process (if necessary)																		
Part / Process No.	Process Name / Operation Description	Machine, Device, Jig Tools for Mfg.	Characteristics			Special Char. Class	Methods		Evaluation / Measurement Technique	Sample		Control Method & Error Proofing	Responsibility & Record	Reaction Plan & Corrective action				
			No.	Product	Process		Product/Process Specification/Tolerance as per drg	Stage specification of Product / Process parameters		Size	Freq.							