

## PRODUCTION PART APPROVAL PROCESS

[ PPAP REPORTS]

**CUSTOMER NAME:** SAI INDUSTRIES

**PART NAME :** BALL RACE

**PART NUMBER :** ENA102B

**SUBMISSION  
LEVEL :** 3

**SUPPLIER :** DECK INDIA ENGINEERING PVT.LTD  
S.NO.671,KUDALWADI (CHIKHALI),  
PUNE-411 062

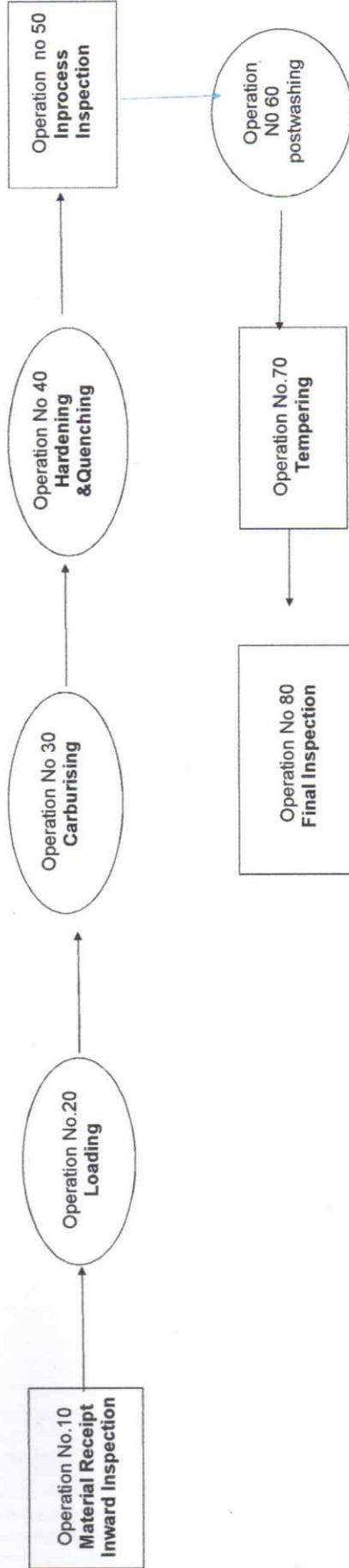
# Deck

## PROCESS FLOW DIAGRAM

System \_\_\_\_\_  
Sub-system \_\_\_\_\_  
Component \_\_\_\_\_  
X  
Part Number(s) : ENA102B  
Part Name(s) : Ball Race  
Material: SCM435H  
Core Team \_\_\_\_\_

PFD Number : PFD/SA/CHT/Ball Race/00  
PFD (Orig.) Date : 23/12/2022  
PFD (Rev.) Date :

AVS, SLD, MKK, TPM, KRA, NSP



- Operation    ⇨ - Transportation    D - Delay     - Inspection    ▽ - Storage

Prepared by: SLD

Approved by: AVS

DECK INDIA ENGINEERING PVT. LTD. PROCESS FLOW CHART

Part No: ENA102B		Customer Name: SAI INDUSTRY		Process flow chart No. PFD/SA/CHT/Ball Race/00	
Part Name: Ball Race Material: SCM435H		Process responsibility: Mahajan, Kadam, Basvraj, Krushna		Key Date	Date (Orig) 23/12/2022
Supplier: DECK INDIA ENGINEERING PVT.LTD.		Core Team: AVS,SLD,MKK,KRA,TPM,NSP		Date (Rev)	
Prepared By: SLD					
PART PROCESS /PRO NAME/OPERATION CESS DESCRIPTION	Incoming Source of Variation	PROCESS FLOW	PRODUCT CHARACTERISTICS	PROCESS CHARACTERISTICS	
10 Receiving Inspection	Dentmarks;Rusty surface	○ □ → △ ⊕	Free From Dent ,Rust ,Damages (Identification Tag)	Visual Inspection	
20 Loading	Manual	○ — □ — △ — ⊕	Bar Loading	As per capacity of furnace. ( F23,F22 )	
30 Carburising	Equipment ( Time & Temp. variation)	○ — □ — △ — ⊕	As quench Hardness 62 - 64 HRC	As per Process sheet(QF/PD/10/02) /control plan	
40 Hardening & Quenching	Time & Temp.	○ — □ — △ — ⊕	As per Process sheet	As per Process sheet(QF/PD/10/02) /control plan	
50 In-Process Inspection	Manual error OR Equipment error	○ — □ — △ — ⊕	As per Process sheet	As per Sampling Plan	
60 Postwashing	Heater Temp & Time & Skimmer	○ — □ — △ — ⊕	Free from oil	PH -8-10 R.I - 2-4 %	
70 Tempering	Temp & Time	○ — □ — △ — ⊕	Tempered Hardness - 60 - 64 HRC	160 ± 10 / 90±5 min	
80 Final Inspection	Manual error OR Equipment error	○ — □ — △ — ⊕	HT/MHT/01 - HT/RHT/01	As per quality plan (QR/QA/03)	

Legends: ○ Operation; □ Transportation; △ Storage; ⊕ Inspection; ○ Operation & inspection

Prepared by: SLD

Approved by: AVS

Control Plan Number CP/SA/CHT/BEARING//Key Contact / Phone :-MKK - 9561065642/ AVS-9561065641

Customer SAI INDUSTRY Control plan : Pre-launch  / Prototype  / Production

Part Name/Description :- BALL RACE

Part Number :-ENA102B

Material :SCM435H

Core Team :-AVS,SLD,MKK,KRA,TPM,NSP

Process/Operation No	Process Name/Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics		Product Specification/ Tolerance	No.	Characteristics		Special Char. Cla	Methods		Sample Size	Control Method	Reaction Plan
			Material	Product			Process	Process Specification/ Tolerance		Evaluation/ Measurement Technique	Frequency			
10	Material Receipt Inward	--	1	Material specification	1. Material Grade 2. Oil, Rust, Dent free	1	1. Drawing/MTC 2. Visual Inspection	Free from surface cracks, dent	*M	Material Receipt slip (QF/MK/11)	Every Batch	Material Receipt slip (QF/MK/11)	Communicate to Customer	
20	Loading	Fixture	1	Charge Preparation /Material Loading		1	Loading	Loading without stacking	*M	As per loading pattern	Every Lot	Visual Inspection	Stop & Correct /Re loading	
30	Carburising	SQF 23	1			1 2 3 4 5 6 7 8	Carburising Temp. Methanol Flow LPG Carbon potential Carburising Time	910 ± 10 °C 2.0-2.5LPH 150-200 0.75% 45 ± 10 Min	M	DTC Flow-meter Flow Meter mV/CP controller Timer Timer	Every 1/2 hr	DTC/ QF/PD/10/02	Re-adjust as per Process Qualification Record / Process Sheet (TEMP/02/00)	
40	Hardening & Quenching	SQF 23	1	Case Depth	0.5 TO 0.7 MM @700HV	1 2 3 4	Hardening Temperature Methanol Flow LPG CP% Soaking Time	860 ± 30 °C 2.0 L/Hrs. 150-200 0.60% 15 Min	M	DTC Flow-meter mV Controller Timer	Every 1/2 hr	DTC/ QF/PD/10/02	Re-adjust/ Process Sheet/Rework as per Rework procedure /	
		Oil tank(Hiq quench MT650)	1	Surface Hardness, Core Hardness	60-64 HRC, 48- 52 HRC	1	Oil temperature	Temperature 90-100°C	M	DTC/ QF/PD/10/02	Every lot	DTC/ QF/PD/10/02	Rework as per Rework procedure / Process sheet	

APPROVED BY: AVS

APPROVED BY: SLD

Special Characteristics Class: C-Critical M-Major \* M-Minor

QF/QA/09

Control Plan Number: CP/CHT/SA/BEARINGE/Key Contact / Phone :-MKK - 9561065642/ AVS-9561065641  
 Process / CHT: Control plan : Pre-launch  / Prototype  / Production   
 Customer Name: SAI INDUSTRY  
 Part Name/Description :- BALL RACE  
 Part Number :-ENA102B  
 Material :SCM435H  
 Core Team : AVS,SLD,TPM,MKK,KRA,NSP

Process / Operation No	Process Name/ Operation Description	Machine, Device, Jig, Tools For Mfg.	Characteristics		Characteristics		Special Char.	Methods Evaluation/ Measurement Technique	Sample		Control Method	Reaction Plan
			No.	Product Specification/ Tolerance	Process Specification/ Tolerance	Process			Size	Freq.		
50	In-Process Inspection	Rockwell Hardness Tester	S/F Hardness	60-64 HRC	--	--	*M	150 Kg Load & diamond indenter	As Per QA Plan	Every Batch	WI/QA/02/04	Reinspection/Inform To PD Supervisor/Identify the RCA
60	Postwashing	WM2			Temp.	60-70 °C	M	DTC/ QF/PD/10/02	--	Every Batch	QF/PD/10/02	Stop & Correct
70	Tempering	Tempering Furnace F21,F20			Temp.	160± 10 ° C	M	DTC	Every Batch	Every Batch	DTC/ QF/PD/02/03	Stop & Correct
80	Final Inspection	Rockwell Hardness Tester	S/F Hardness Core Hardness	60-64 HRC 48-52 HRC	Time	90±30 min	M	Timer	Every Batch	Every Batch	Timer	Stop & Correct
		Micro Hardness Tester	Case Depth	0.5-0.7 MM @ 700 HV1	--	--	*M	150 Kg Load & diamond indenter	As Per QA Plan	Every Batch	WI/QA/02/04	Reinspection/Inform To PD Supervisor/Identify the root Cause(Rework)
		Microscope	Case Microstructure Core Microstructure	Fine Temp Martensite Low Carbon Martensite	--	--	*M	Micro Hardness Tester	1 No	Every Batch	(QR/QA/03)	Reinspection/Inform To PD Supervisor/Identify the root Cause/Rework
					--	--	*M	Microscope	1 No	Every Batch	(QR/QA/03)	Reinspection/Inform To PD Supervisor/Identify the root Cause/Rework

PREPARED BY: SLD  
 Special Characteristics Class:-  
 C-Critical M-Major \* M-Minor  
 APPROVED BY: AVS

Potential Failure Mode & Effects Analysis (Process FMEA)

FMEA No.	FPD/SA/CHT/Rail Race/00
Prepared by	NSP
FMEA Date (Orig)	23/12/2022
FMEA Date (Rev.)	

Process Responsibility	PROD
Key Date	

Customer Name	SAI INDUSTRY
Part Name	Ball Race
Part Number	ENA102B
Material:	SCM435H
Core Team	AVS,SLD,TPM,MKK,KRA,NSP

Process Function No	Process Function	Requirements	Potential Failure Mode	Potential Effects of Failure N-Next Operation, S-Subsequent Process, A- Assembly, E-End Customer	SEVERITY	Potential Causes / Mechanisms of Failure	OCCURRENCE	Current Process Controls Prevention	Current Process Controls Detection	D E T E R I O N	Recommended Actions	Responsibility & Target Completion Date	Action Results														
													Action Taken	S O D E V C T E R U R C													
10	Receiving and Inspection	Material must be clean, no dent, no burr, no crack & no rust	Handling damages	N- Cracks, burrs S- discernible effect A - Product may have to be sorted with no scrap E- No discernible effect	4	1) Improper Handling a) Transportation b) material unloading	2	a) Proper packaging (if not inform to customer) b) Careful handling	Material receipt slip (QF/MK/11)	7	56																
																As per mentioned Drawing & Material TC	Material grade not confirm to spec	N- Quality issues S- Unable to process, A - 100% product may have to be reworked E- item operable at reduce level of performance	5	Chemical composition not meet to the spec /Material mixup	3	Verified customer MTC/ Randomly checked in case of hardness not achieved	4	60			
Loading in Bar	Distortion/ Bend	N- Distortion/Bend product S- Dimension issue/Bend A - 100% product may have to be reworked E- item operable at reduce level of performance	5	1.Wrong Loading pattern	3	1.Loading Pattern	1.Visual Inspection/Follow	4	60																		
													Prewashing	Rusty & oily components	N- Preheating f/c atmosphere S-Q oil contamination A - No effect E- No effect	1	1.Bath pH & bath concentration is <or > 2-4 % Bath concentration -pH-8-10	3	Maintain Bath concentration PH (8-10) & R.I (2-4)	pH Inspection log Book (QF/PD/10/02)	7	21					
Preheating	Hardening temp gradient/Quench stress	N- Increase temp drop S- Require more time to reach carb. Temp A - No effect E- No effect	2	Preheat temp > or < than 500 ° C	3	Alarm /Poka yoke System every high & low temp/Timers/Hooters	PCRS (QF/PD/02/03) /SCADA	4	24																		
													Higher Case Depth	N- affects on tempering temp S- It will impart brittleness A-100% product may have to be scrapped E- item operable at reduce level of performance	4	Temp > 940 ° C	3	Excess Temp Alarm ,Confirmation of temp. setting,Calibration of thermocouple.	PCRS / SCADA /Calibration Record	4	48						
																	Carburising Time > 1.15 HRS	2	Confirmation of temp & mV. setting,Calibration of probe & mV Controller.	5	40						
						Carburising CP > 1%	2	Confirmation of Timer setting,Confirmation of temp & mV. setting,Calibration of probe & mV Controller	5	40																	

50	Carburising Temp-910 ± 10°C Methanol Flow- 2-2.5 LPH LPG-160-200 gm/hr Carbon potential-0.75% Carburising Time - 45 ± 10Min	Lower Case Depth	N- affects on Tempering temp S- It will impart brittleness A-100% product may have to be reworked E- Vehicle item operable but customer dissatisfied	4 M	Temp. < 920° C	3	Confirmation of temp. setting, Calibration of thermocouple.	PCRS / SCADA /Calibration Record	4	48
				4 M	Carburising Time < 1.15 HRS	2	Confirmation of Timer setting, Confirmation of temp & mV, setting, Calibration of probe & mV Controller	PCRS / SCADA /Calibration Record	5	40
				4 M	Carburising CP < 1%	2	CP set confirmation, Calibration of oxygen probe/Safety CP controller	PCRS(QF/PD/10/02) / SCADA /Calibration Record	5	40
				4 M	LPG Flow < 200 gm/h methanol Flow < 2.0 LPH	2	LPG Flow meter Cleaning Methanol flow meter Cleaning	PCRS(QF/PD/10/02) / SCADA /Calibration Record	5	40
		Retained Austenite	N- Surface hardness getting less S- Grinding allowed upto 0.2 mm A-100% product may have to be reworked E- Vehicle item operable but customer dissatisfied	4 M	1. Hardening Temperature > 830 2. High CP %	2	1. Temp confirmation/TC&DTC calibration 2) O2 probe calibration, F/C desooting fortnightly	PCRS(QF/PD/10/02) / SCADA /Calibration Record	5	40
		Carbide formation	N- Surface hardness getting High S- Grinding allowed upto 0.2 mm A-100% product may have to be reworked E- Vehicle item operable but customer dissatisfied	4 M	Carburising CP > 1 %	2	Excess CP Alarm , Confirmation of temp & Carbon potential, setting, Calibration of probe & CP Controller.	PCRS(QF/PD/10/02) / SCADA /Calibration Record	5	40

PREPARED BY: SLD

QF/QA/08/01

APPROVED BY: AVS 

# Potential Failure Mode & Effects Analysis (Process FMEA)

Customer Name	SAI INDUSTRY	Page No	: 3/3
Part Name	BALL Race	FMEA No.	PF/SA/CHT/Ball Race/00
Part Number	ENA102B	Prepared by	SLD
Material:	SCM435H	FMEA Date (Orig.)	23/12/2022
Core Team	AVS,SLD,MIKK,TPM,KRA,NSP	FMEA Date (Rev.)	

Process Function No	Process Function	Requirements	Potential Failure Mode	Potential Effects of Failure	SEVERITY	OCCURRENCE	Current Process Controls Prevention	Current Process Controls Detection	D E T E R I O N	RPN	Recommended Actions	Responsibility & Target Completion Date	Action Results	
													Action Taken	S O D E C T E U E R
70	In-Process Inspection	Hardness -60-64 HRC	Wrong Observations	N-Tempering S-Wrong readings,Wrong temp will be set A - 100% product may have to be reworked E- Item operable at reduce level of performance	3 M	1. Machine out of calibration,2. Improper seating of component to be checked,3.Unskilled Inspector	Calibration of machine for every year. Daily master verification 3. Trained Inspector	Hardness verification record / Calibration record/Training Record	4	36				
80	Postwashing	Free from oil	Inproper Washing	N-Tempering S- fic atmosphere ,Aesthetic look A - No effect E- No discernible effect	4 M	Alkali Heater Temperature & Oil Skimmer ,pH ,Concentration Of Soln.	Confirmation of Heater Temp.&Skimmer tank level	PCRS(QF/PD/02/03/)	5	40				
90	Tempering	Temp-160± 10 ° C Time-90±5 min	High hardness/Incomplete stress relieving  Low hardness	N-High Hardness S-Next operation get affected A - 100% product may have to be reworked E- Item operable at reduce level of performance  N-Low hardness S-Product life reduced A - 100% product may have to be reworked E- Item operable at reduce level of performance	5 M	Lower tempering temperature than specified  Lower tempering temperature than specified	Confirmation of temp. setting,Calibration of thermocouple.  Confirmation of temp. setting,Calibration of thermocouple.	PCRS(QF/PD/02/03)/SCADA	4	60				
100	Inspection	Hardness - 60-64 HRC , Core Hardness - 45-55 HRC, Case Depth- 0.50 TO 0.70 MM @ 700 HV	Wrong Observations	N-Grinding S-Low High Hardness & case Depth A - 100% product may have to be reworked E- Item operable at reduce level of performance	3 M	1. Machine out of calibration,2. Improper seating of component to be checked,3.Unskilled Inspector	1. Calibration of machine yearly/Weekly hardness verification 2. Inspection fixture/Plane microsample 3. Trained Operator	Hardness verification record / Calibration record/Training Record	4	36				
110	Shot Blasting	Time -20 min±5 Shots size	Defects /Dent/Damages	N-Surface dull S-Phosphating issues A - 100% product may have to be reshotblast E- Item operable at reduce level of performance	4 M	Big Shot Size & Excess time	Confirmation of Shot & Cycle time	Visual Inspection	5	40				

APPROVED BY : AVS 

PREPARED BY: SLD 



Customer Name SAI INDUSTRY  
 Part Name Ball Race  
 Part Number ENA102B  
 Material: SCM435H  
 Core Team AVS,SLD,TPM,MKK,KRA,NSP

Process Responsibility PROD  
 Key Date 23/12/2022

FMEA No. PFD/SA/CHT/Ball Race/00  
 Prepared by SLD  
 FMEA Date (Orig.) 23/12/2022  
 FMEA Date (Rev.)

Process Function No	Process Function	Requirements	Potential Failure Mode	Potential Effects of Failure	SEVERITY	CLASSIFICATION	Potential Causes / Mechanisms of Failure	OCCURRENCE	Current Process Controls Prevention	Current Process Controls Detection	DETENTION	Recommended Actions	Responsibility & Target Completion Date	Action Taken	Action Results		
															S O C I E T Y	D E T E R M I N E D	
60	Hardening & Quenching	Q oil Temp 100°C	Quench temp High	N-Low hardness, S-Product life reduced, A - 100% product may have to be reworked, E- item operable at reduce level of performance	4	M	Quenching oil temp > 120 °C	4	Alarm /Poka yoke System every high & low quench oil temp	PCRS(QF/PD/10 /02)/SCADA	4	#				RPN	
		0.75% CP	Low CP	N-Low hardness S-Product life reduced A -100% product may have to be reworked E- item operable at reduce level of performance	4	M	Low CP/Failure of O2 Probe	4	Alarm /Poka yoke System For every Low /High CP %	PCRS(QF/PD/10 /02)/SCADA	4	#					
		As per Drawing/ MTC	Material mixup/Wrong chemistry	N-Low hardness S-Product life reduced A - 100% product may have to be reworked E- item operable at reduce level of performance	6	C	Poor hardnability of material	1	Verified customer MTC/ Randomly checked in case of hardness not	PCRS(QF/PD/10 /02)/SCADA	9	#					
		Auto quench	Quench delay	N-Low hardness S-Product life reduced A - 100% product may have to be reworked E-item operable at reduce level of performance	5	M	Quench delay time > 15 seconds.	3	Auto Quenching	PCRS(QF/PD/10 /02)/SCADA	4	#					

PREPARED BY: SLD

QF/QA/08/01

APPROVED BY: AVS

