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Innovating Illumination

Lot 6, BatuBerendam, FTZ Phase III,
75350 Melaka, Malaysia
Tel : +60 (06) 2833566 , Fax : +60 (06) 2830566

CUSTOMER RETURNED FAR / CAR

FA Report #:	FAR250587	Customer:	DURA AUTOMOTIVE PVT LTD
Package:	Mini DomiLED	Requestor:	Hemaraj Balakrishna
Dominant Part Number:	DNW-PJG-V2W-I1L3	Received Date:	30.04.2025
Customer Part Number:	NA	Response Date:	08.05.2025 09.05.2025 Updated
Lot No.:	D24505EC.01 (B6X7)	Quantity Received:	2 PCB modules
		Quantity Analyzed:	2 pieces LEDs

8D PROBLEM SOLVING METHODOLOGY – D1 and D2 must be completed for ALL requests

D1: TEAM FORMATION

Team Leader: Mahendran

Team Members: Desmond, Chan KM, Lee SY, Lim CW, Hazirah, Afifah, Fauzi

D2: PROBLEM DESCRIPTION & FAILURE ANALYSIS RESULTS

Background Information:

1.0 BACKGROUND

Customer has returned 2 PCB module mounted with LEDs of DNW-PJG-V2W-I1L3 for failure analysis.

Customer claimed *short circuit & LED no light*. Failure detected at *Field (Warranty claim <1000KM).*

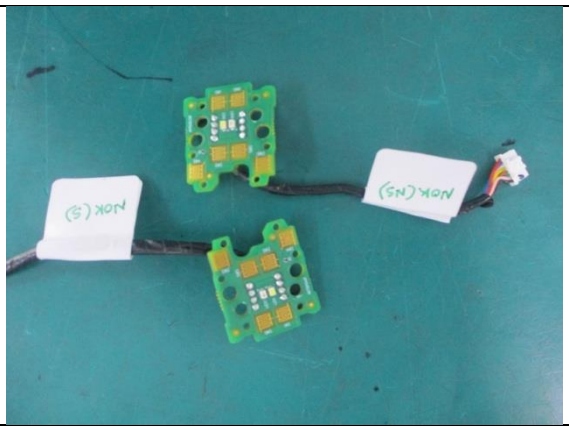

Fig 1a : Overview on returned PCB modules

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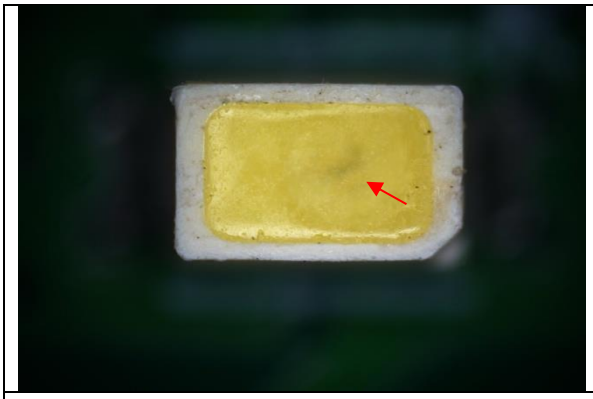
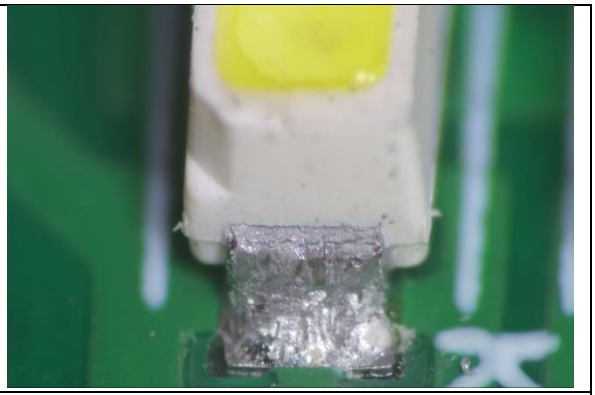
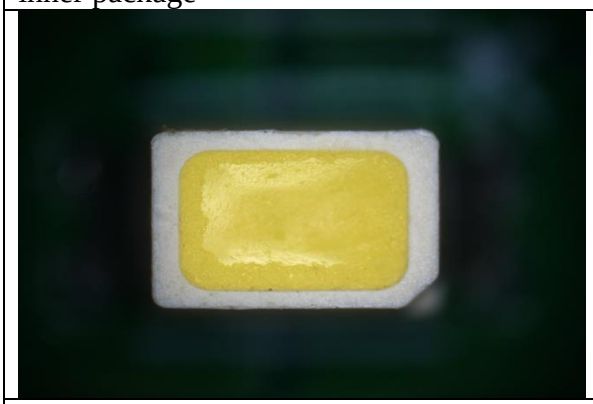
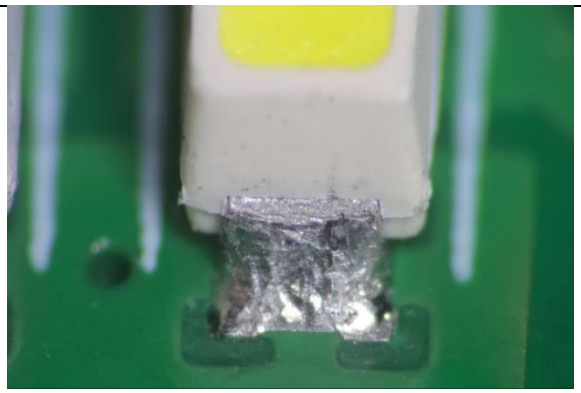
2.0 DETAIL ANALYSIS

Optical Inspection

2.1 The complained LEDs were proceeded for optical inspection via high power scope; it revealed blackish appearance at inner package for No Short Circuit LED while no anomaly for Short Circuit LED, as shown in Fig 2a - Fig 2d.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Fig 2a : No Short Circuit LED:
Top view observed blackish appearance at inner package</td><td>Fig 2b : No Short Circuit LED:
Side view observed no anomaly on soldering</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Fig 2c : Short Circuit LED:
Top view observed no anomaly on top encapsulant surface</td><td>Fig 2d : Short Circuit LED:
Side view observed no anomaly on soldering</td></tr>
</table>

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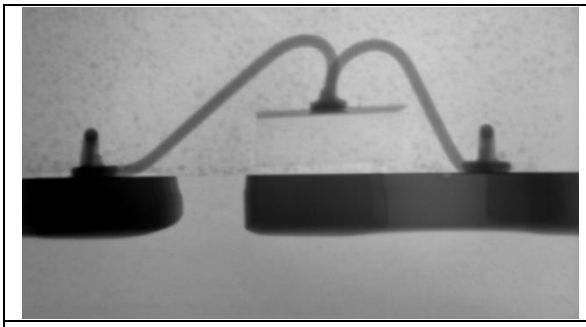
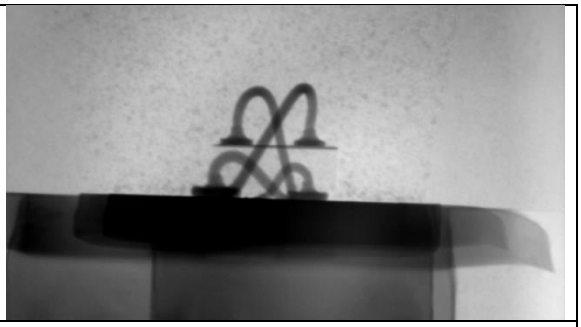
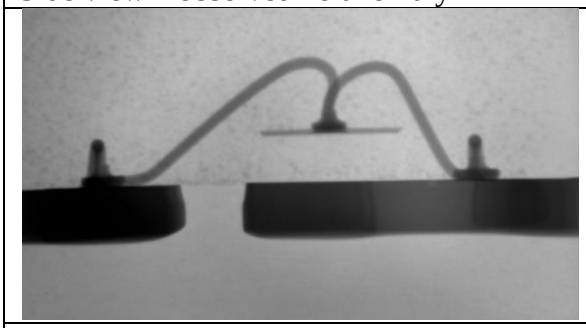
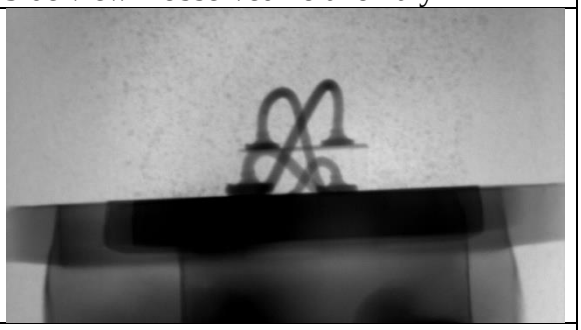
X-Ray Inspection

2.2 The complained LEDs were proceeded for X-ray inspection; it revealed no anomaly, as shown in Fig 3a - Fig 3d.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Fig 3a :No Short Circuit LED:
Side view 1 observed no anomaly</td><td>Fig 3b : No Short Circuit LED:
Side view 2 observed no anomaly</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Fig 3c: Short Circuit LED:
Side view 1 observed no anomaly</td><td>Fig 3d : Short Circuit LED:
Side view 2 observed no anomaly</td></tr>
</table>

Electrical Test

2.3 The complained LEDs were then measured by using CAS140B spectrometer. Measurement result was tabulated as below table.

Complained LED #	VF @ 20mA (2.8V-3.3V)	IR @ 5V (max 0.5µA)	IV @ 20mA (mcd)	Cx	Cy	Remarks
NS (B6X7)	5.0507	4.9257	0	0	0	High VF & Leakage current
S (B6X7)	2.8862	1.0734	1115.6	0.2722	0.2608	Leakage Current

Note : Luminous Intensity Test Specification Limit :
V2 = 900mcd – 1125mcd

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2.4 The electrical test results showed complained LED No Short Circuit has high VF & leakage current while complained LED Short Circuit has leakage current.

Chemical Decapsulation

2.5 The complained LEDs were then proceeded for chemical decapsulation followed by SEM & optical inspection; it revealed burn mark on Die surface for No Short Circuit LED while blow hole on Die surface near metal trace for Short Circuit LED which may result from EOS, as shown in Fig 4a – Fig 4g.

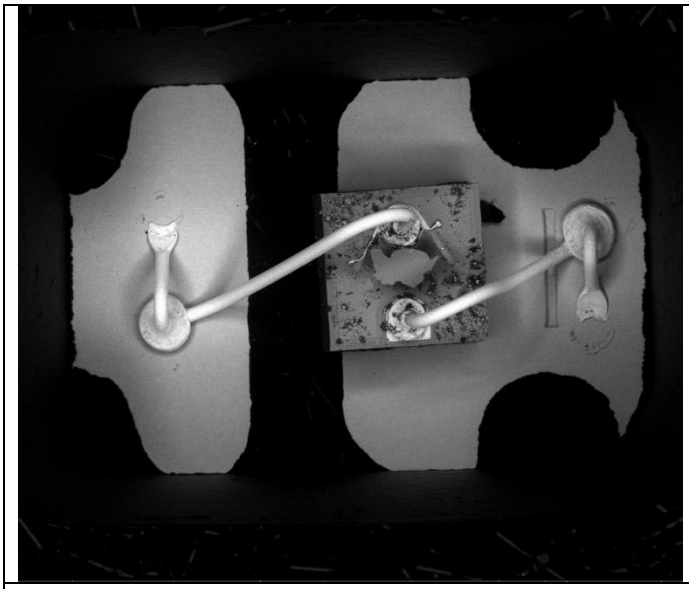

Fig 4a: No Short Circuit LED:
SEM top view after chemical decapsulation

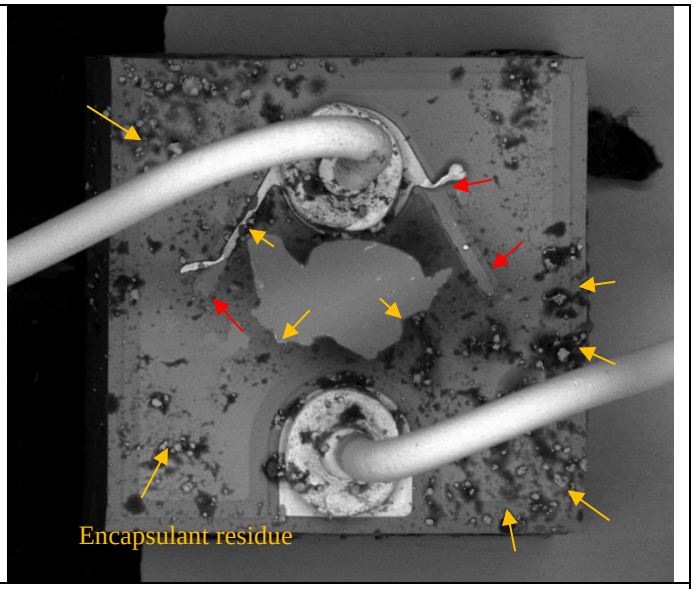

Fig 4b : No Short Circuit LED:
SEM closed up view observed burn mark on Die surface and decomposed encapsulant on Die surface which may result from EOS

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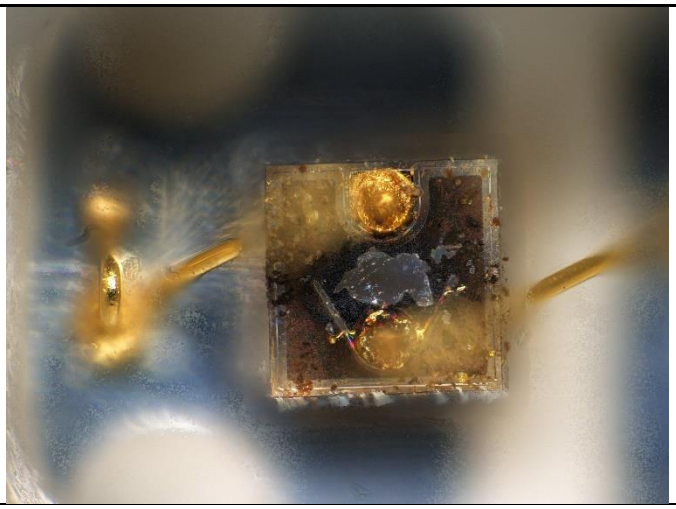

Fig 4c : No Short Circuit LED:
Optical view observed burn mark on Die surface and decomposed encapsulant on Die surface which may result from EOS

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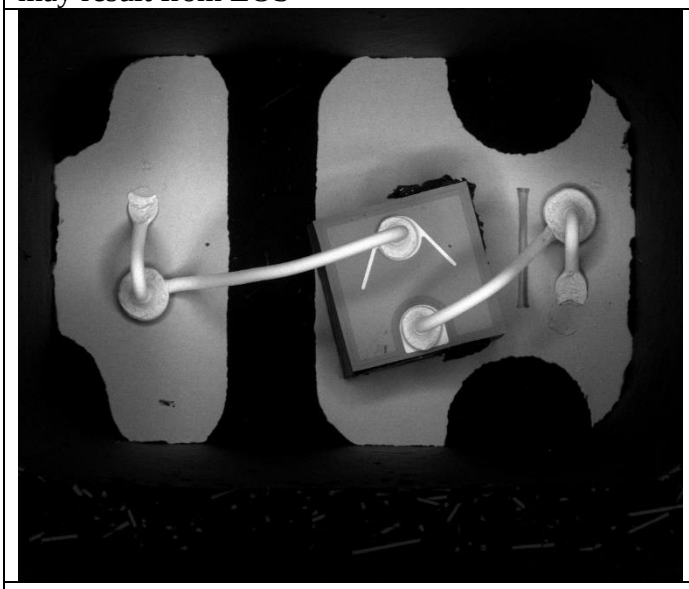

Fig 4d: Short Circuit LED:
SEM top view after chemical decapsulation

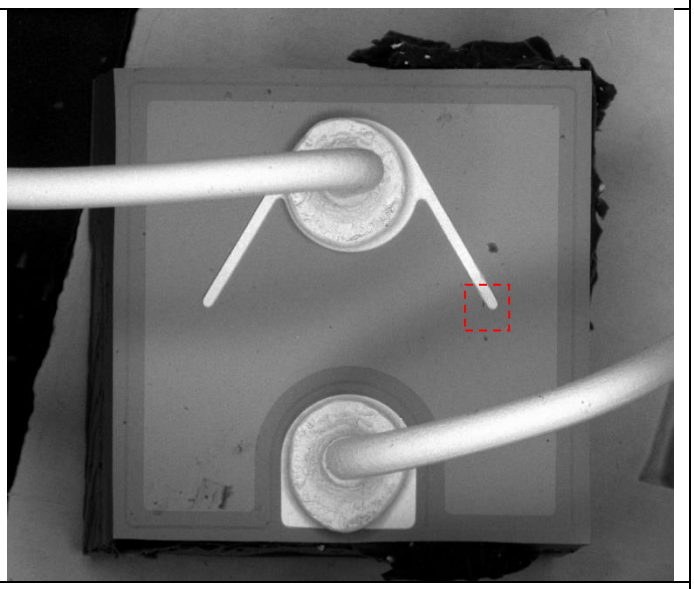

Fig 4e : Short Circuit LED:
SEM closed up view observed blow hole on Die surface near metal trace

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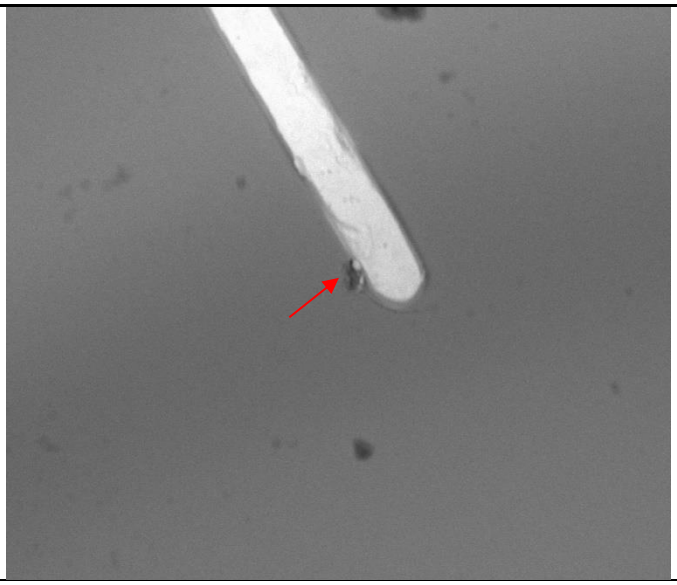	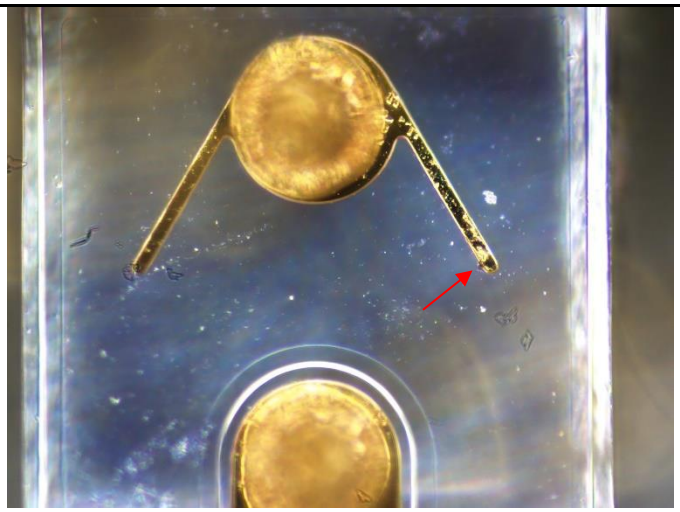
Fig 4f : Short Circuit LED: SEM closed up view observed blow hole on Die surface near metal trace	Fig 4g : Short Circuit: Optical view observed blow hole on Die surface near metal trace

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3.0 CONCLUSION

3.1 Optical inspection revealed blackish appearance at inner package for No Short Circuit LED while no anomaly for Short Circuit LED.

3.2 X-ray inspection revealed no anomaly.

3.3 The electrical test results showed complained LED Short Circuit has leakage current while complained LED No Short Circuit has high VF & leakage current.

3.4 Chemical decapsulation followed by SEM & optical inspection revealed burn mark on Die surface for No Short Circuit LED while blow hole on Die surface near metal trace for Short Circuit LED which may result from EOS.

3.5 Based on FA analysis, burn mark & blow hole on Die surface had led to conclusion that LED failure was caused by electrical overstressed. These observations showed LED was subjected to current or voltage that are beyond the specification limits, or operated beyond its absolute maximum ratings as specified in data sheet, which is common causes of EOS events.

3.6 When LED is subjected to high voltage or current, resistive heating in the connections within the device generates excessive heat. If the excessive heat is localized around the area where the electrical stress is exerted and exceeds thermal limits of material in the LED construction, it will cause thermal damage to the materials used in the LED device which is resulted from excessive heat generated during EOS events.

Final Status of Return: Invalid. LED failure was caused by EOS (Electrical Over-stressed) event that had occurred at post Dominant process as all LEDs have been 100% electrical tested as good part before deliver to customer.

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APPLICATION NOTE:

LED Electrical Failure Prevention

Background

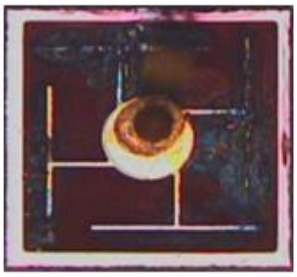
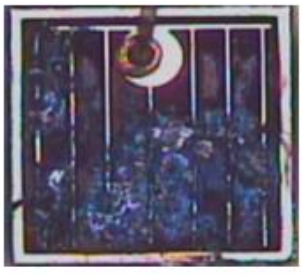
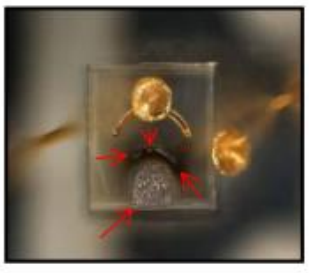
All LED (light-emitting diode) should be operated below the absolute maximum ratings specified in the data sheet in order to safeguard its reliability and service life. Key factors that contribute to LED electrical failure are Electrical Overstress (EOS), Electrostatic Discharge (ESD), Thermal Overstress and Solder Bridging across LED Leads. This application note will cover main known causes that can induce electrical failure in LED and provide guidance and recommendations to prevent it.

A. Electrical Overstress (EOS)

EOS happened when LED is operated above its absolute maximum electrical rating either in a single event, repeated event or continuous in nature. The maximum electrical rated values refer to maximum forward current or maximum forward voltage, maximum surge current, maximum reverse current or voltage, maximum permissible continuous pulse current at specific temperature. All these parameters should be kept below the maximum rated values to ensure that EOS is not experienced by LED.

There are many different sources which can induce EOS including power-on and power-off transients (also known as spikes), inrush current and excessive voltages or currents (also known as overdriving).

Photo below show some example of LED chip damaged due to EOS:

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If the final status from D2 is Valid, continue to complete D3 to D8.
Otherwise, D3 to D8 is not applicable and shall be skipped.

D3: IMPLEMENT & VERIFY CONTAINMENT ACTION

Containment Action, Responsibility & Target Completion:
NA

Risk and Safe Lot identification:
NA

Recovery Shipment Plan:
NA

D4: ROOT CAUSE ANALYSIS

(To include appropriate root cause finding tools – 4M1E/FTA/5-why analysis)

Occur Root Cause
NA

Escape Root Cause
NA

D5: DEVELOP PERMANENT CORRECTIVE ACTIONS

Occur Root Cause Corrective Action
NA

Escape Root Cause Corrective Action
NA

D6: IMPLEMENT & VALIDATE PERMANENT CORRECTIVE ACTIONS

Corrective Action Effectiveness Monitoring / Verification Data
NA

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D7: PREVENT RECURRENCES

Documentation Review:

Document Type	Reviewed? (Yes/No)	Who	Date
FMEA	NA	NA	NA
Control Plan / Process Specification / SOP / WI	NA	NA	NA

Lessons Learnt & Fan out Actions:

Type	Required (Yes/No)	Who	Date
Similar Product / Process	NA	NA	NA
Others	NA	NA	NA

D8: CONGRATULATE TEAM

NA