DAIMLER Daimler India Commercial Vehicles Pvt. Ltd.	Document No	SCMQ.C.01
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Guidelines for PFMEA

Revision History:

Rev No.	Date	Description	Originated By	Reviewed	Approved
00	02.12.2013	Initial release	QMS	SCMQ-QR	SCMQ-QR

Objective:

To describe a procedure to detail the activities necessary to carry out Process Failure Mode & Effects Analysis (PFMEA)

Operating Scope :

Applicable to all processes involved in determining of final product characteristics.

Responsibility :

Head – Quality, CFT

Input for Preparation:

- Process Flow Diagram
- Drawing & DFMEA
- AIAG FMEA manual 4th edition as guideline standard for PFMEA preparation.
- PFMEA check sheet for carrying out the PFMEA.
- Historical data (e.g. Customer Return / Warranty Rejection, In-house Rejection, Process Capability Report etc)
- Quality and Reliability History
- Occurrence matrix and feedback ratio
- CFT approach for making PFMEA.
- Identify the potential failure mode of each process and find out the effect of each potential failure mode at the current operation, next operation(s) and at customer end.
- Lesson learned cards (LLCs)
- List of M/C tools, Gauges

Based on the effects of failure mode, identify the severity of the failure mode by using severity-ranking chart given in AIAG FMEA manual 4th edition

Output:

1) Detection Rating
2) Occurrence Rating
3) Severity Rating
4) RPN Rating
5) Prevention Method
6) Detection Method
7) Recommended action, as applicable

Operating procedure

- **FMEA no.**: Enter the alphanumeric string which is used to identify the PFMEA document. This is used for document control.
- **Item**: Enter the name and number of the system, subsystem or component for which the process is being analyzed.
- **Process Responsibility**: Enter the OEM, organization, and department or group who is process design responsible. Also enter the supply organization name, if applicable.
- **Model Year(s) / Program(s)**: Enter the intended model year(s) that will use or be affected by the process being analyzed (if known).
- **Key date**: Enter the initial PFMEA due date, which should not exceed the scheduled SOP date. In case of supply organization, this date should not exceed the customer required Production Part Approval Process (PPAP) submission date.
- **FMEA date**: Enter the date the original PFMEA was completed and the latest revision date.
- **Core Team**: Enter the team members responsible for developing the PFMEA. Contact information (e.g., name, organization, telephone number, and email) may be included in a referenced supplemental document.
- **Prepared By**: Enter the name and contact information including the organization (company) of the engineer/team leader responsible for preparing the PFMEA.
- **Process Step / Process Function/ Requirements**: simple explanation of the analyzed process and procedure
- **Potential failure mode**: The manner in which the process could potentially fail to meet the process requirements (including the design intent).
- **Potential Effect(s) of Failure**: It refers to the effects caused by the invalid mode. To describe the consequence according to the founded or experienced condition by the customers

  Identify potential effects on the following:

  i. Next Operation
  ii. Downstream users
  iii. Ultimate customer
  iv. Vehicle operation
  v. Operator safety
  vi. Compliance with government regulations
  vii. Machines / Equipment

For a Process FMEA, downstream users can include an Assembly operation / plant, or a Service (dealer) operation.

- **Severity (S):** Severity is the value associated with the most serious effect for a given failure mode. Severity is a relative ranking within the scope of the individual FMEA.

Table 1 – PFMEA SEVERITY RANKING

Effect	CRITERIA : Severity of effect on product (customer effect)	Rank	Effect	CRITERIA : Severity of effect on process (manufacturing / assy. effect)
Failure to meet safety and / or regulatory requirements	Potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation without warning.	10	Failure to meet safety and / or regulatory requirements	May endanger operator (machine or assembly) without warning.
	Potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation with warning.	9		Or may endanger operator (machine or assembly) with warning.
Loss or degradation of primary function	Loss of primary function (Vehicle inoperable, does not affect safe vehicle operation)	8	Major Disruption	100% of product may have to be scrapped. Line shutdown or stop ship.
	Degradation of primary function (Vehicle operable but at a reduced level of performance)	7	Significant Disruption	A portion of the production may have to be scrapped. Deviation from the primary process including decreased line speed or added manpower.
Loss or degradation of secondary function	Loss of secondary function (Vehicle operable, but Comfort/Convenience functions inoperable)	6	Moderate Disruption	100% of the product may have to be reworked offline and accepted.
	Degradation of secondary function (Vehicle operable, but Comfort/Convenience functions operable at a reduced level of performance)	5		A portion of the production run may have to be reworked offline and accepted

Annoyance	Appearance or audible noise, vehicle operable, item does not conform and noticed by most customers (>75%)	4		100% of the production run may have to be reworked in station before it is processed.
	Appearance or Audible noise, vehicle operable, item does not conform and noticed by many customers (50%)	3	Moderate Disruption	A portion of the production run may have to be reworked in-station before it is processed.
	Appearance or Audible noise, vehicle operable, item does not conform and noticed by discriminating customers (<25%)	2	Minor Disruption	Slight inconvenience to process, operation or operator,
No effect	No discernible effect.	1	No effect.	No discernible effect.

- **Classification**: This column may be used to highlight high priority failure modes or causes that may require additional engineering assessment. This column may also be used to classify any special product or process characteristics (e.g., critical, key, major, significant) for components, subsystems, or systems that may require additional process controls.

- **Potential Cause(s) of Failure Mode**: Potential cause of failure is how the failure happened and describes the cause according to rectified or controlled principles.
- **Occurrence** (O): It's the likelihood that a specific cause of failure will occur. The likelihood of occurrence ranking number has a relative meaning rather than an absolute value (see table 2). It is the only way to reduce the frequency by design change, process change or controlling cause or mechanism of failure mode.

Table 2 – PFMEA OCCURRENCE RANKING

Likelihood of Failure	Criteria: Occurrence of cause – PFMEA (Incidents per items/vehicles)	Rank
Very High	100 per thousand, 1 in 10	10
High	50 per thousand, 1 in 20	9
	20 per thousand, 1 in 50	8
	10 per thousand, 1 in 100	7

Moderate	2 per thousand, 1 in 500	6
	0.5 per thousand, 1 in 2000	5
	0.1 per thousand, 1 in 10,000	4
Low	0.01 per thousand, 1 in 1,000,00	3
	≤ 0.01 per thousand, 1 in 1,000,000	2
Very low	Failure is eliminated through preventive control	1

- **Current Process Controls**: Current Process Controls are descriptions of the controls that can either prevent to the extent possible, the cause of failure from occurring or detect the failure mode or cause of failure should it occur. There are two types – Prevention & Detection.

- **Detection (D)**: Detection is the rank associated with the best detection control listed in the Detection Control column. Detection is a relative ranking within the scope of the individual FMEA.

Table 3 – PFMEA DETECTION RANKING

Opportunity for detection	**Criteria: Likelihood of detection by process control**	**Rank**	**Likelihood of Detection**
No detection opportunity	No current Process Control; Cannot detect or is not analyzed.	10	Almost Impossible
Not likely to detect at any stage	Failure Mode and / or error (Cause) is not easily detected (Ex: Random Results)	9	Very Remote
Problem detection post processing	Failure Mode detection post processing is by operator through visual detection / tactile / audible means	8	Remote
Problem Detection at source	Failure Mode detection in station by operator through visual / tactile / audible means or post-processing through use of attribute gauging (go / no-go, manual torque check / clicker wrench, etc.).	7	Very Low

Problem Detection post processing	Failure Mode detection post-processing by operator through use of variable gauging or in-station by operator through use of attribute gauging (go / no-go, manual torque check / clicker wrench, etc.).	6	Low
Problem Detection at source	Failure Mode or error (cause) detection in-station by operator through use of variable gauging or by automated controls in-station that will detect discrepant parts and notify operator (lighter, buzzer etc). Gauging performed on set up and first piece check (for set up causes only)	5	Moderate
Problem Detection post processing	Failure Mode detection post-processing by automated controls that will detect discrepant part and lock part to prevent further processing	4	Moderatel y high
Problem Detection at Source	Failure Mode detection in-station by automated controls that will detect discrepant part and automatically lock part in station to prevent further processing	3	High
Error detection and / or problem prevention	Error (Cause) detection in-station by automatic controls that will detect error and prevent discrepant parts from being made.	2	Very High
Detection not applicable; Error prevention	Error (Cause) prevention as a result of fixture design, machine design or part design. Discrepant parts cannot be made because item has been error proofed by process / product design.	1	Almost Certain

Determining Action priorities:

- Once the team has completed the initial identification of failure modes and effects, causes and controls, including rankings for severity, occurrence and detection, they must decide if further efforts are needed to reduce the risk. Due to the inherent limitations on resources, time, technology, and other factors, they must choose how to best prioritize these efforts.
- The initial focus of the team should be oriented towards failure modes with highest severity rankings. When the severity is 9 or 10, it's imperative that the team must ensure that the risk is addresses through existing design controls or recommended actions (as documented in the FMEA)
- For failure modes with severities 8 or below the team should consider causes having highest occurrence or detection rankings. It's teams responsibility to look at the

information identified, decide upon an approach, and determine how to best prioritize the risk reduction efforts that best serve their organization and customers.

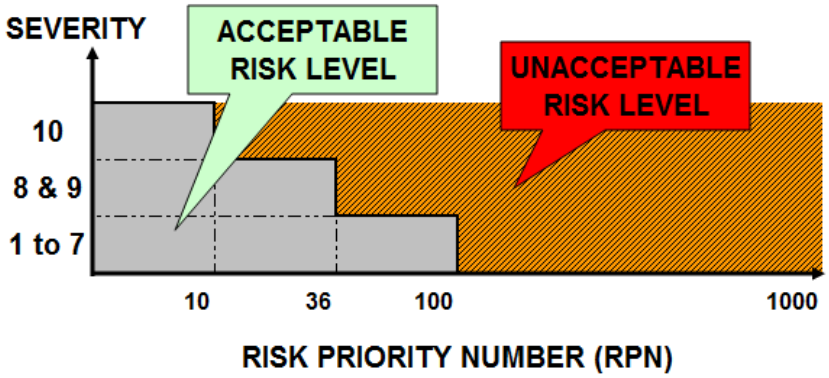
Risk Evaluation:

- **Risk priority number (RPN)**: Risk Priority number is Severity multiplies by frequency and detection. The use of an RPN threshold is NOT a recommended practice for determining the need for actions.

(S)X(O)X(D)= RPN

Setting of RPN target:

- RPN target will be fixed based on the Severity ranking for initiating action on failure mode / causes. The following RPN Target will be used during PFMEA unless otherwise specified by the customer.



(Note: RPN for Severity = 8 or 9 can be adapted to the customer requirements (for instance, raised to 50 if customer requires only this and not 36)

Recommended Action (s):

- In general, prevention actions (i.e., reducing the occurrence) are preferable to detection actions. An example of this is the use of process design error proofing rather than random quality checks or associated inspection.
- The intent of any recommended action is to reduce rankings in the following order: severity, occurrence, and detection.
- If RPN value is higher than the RPN Target, then action(s) is initiated to reduce the RPN value
- If Occurrence rate is greater than 8, then action(s) is initiated irrespective of RPN Target in order to reduce the Occurrence rate.

Example approaches to reduce these are explained below:

- *To reduce Severity (S) ranking:* Only a design or process revision can bring about a reduction in the severity ranking.
- *To reduce Occurrence (O) ranking:* To reduce occurrence, process and design revisions may be required. A reduction in the occurrence ranking can be effected by removing or controlling one or more of the causes of the failure mode through a product or process design revision.
- *To reduce Detection (D) ranking:* The preferred method is the use of error/mistake proofing. A redesign of the detection methodology may result in a reduction of the detection ranking.

If the assessment leads to no recommended actions for a specific failure mode/cause/control combination, indicates this by entering "None" in this column. It may be useful to also include rationale if "None" is entered, especially in case of high severity.

- **Responsibility & Target completion date:** Enter the name of the individual and organization responsible for completing each recommended action including the target completion date. The process-responsible manager is responsible for ensuring that all actions recommended have been implemented or adequately addressed.
- **Action Results:** This section identify the results of any completed actions and their effect on S, O, D rankings and RPN.
- **Action(s) Taken and Completion date:** After the action has been implemented, enter a brief description of the action taken and actual completion date.
- **Severity, Occurrence, Detection and RPN:** After the preventive/corrective action has been completed, determine and record the resulting severity, occurrence, and detection rankings.

PFMEA Management:

- When the process is out of control or the product is failure, FMEA CFT should evaluate FMEA again, ensure whether existing control measure can poses all the failure or not and definitude resolving.
- Review and update the PFMEA during each milestone of NPD.
- when any 4m change, FMEA should be reviewed and approved.
- When any customer claims / warranty claims, exceptional in-house rejection & quality catastrophe.
- Once in 6 months if any of the above not happened.

Records:

- Process Failure Mode& Effect Analysis
- PFMEA review checksheet

Reference:

- AIAG FMEA manual - 4th EDITION