3.5.6 Severity (S)

Severity is a rating number associated with the most serious effect for a given failure mode for the process step being evaluated. It is a relative rating within the scope of the individual FMEA and is determined without regard for Occurrence or Detection.

For process-specific effects, the Severity rating should be determined using the criteria in evaluation Table P1. The table may be augmented to include corporate or product line specific examples.

The evaluations of the Failure Effects should be mutually agreed to by the customer and the organization.

> NOTE: If the customer impacted by a Failure Mode is the next manufacturing or assembly plant or the product user, assessing the severity may lie outside the immediate process engineer's/team's field of experience or knowledge. In these cases, the Design FMEA, design engineer, and/or subsequent manufacturing or assembly plant process engineer, should be consulted in order to comprehend the propagation of effects.

Process General Evaluation Criteria Severity (S)					
Potential Failure Effects rated according to the criteria below.					Blank until filled in by user
S	**Effect**	**Impact to Your Plant**	**Impact to Ship-to Plant (when known)**	**Impact to End User (when known)**	**Corporate or Product Line Examples**
10	**High**	Failure may result in an acute health and/or safety risk for the manufacturing or assembly worker	Failure may result in an acute health and/or safety risk for the manufacturing or assembly worker	Affects safe operation of the vehicle and/or other vehicles, the health of driver or passenger(s) or road users or pedestrians.	
9		Failure may result in in-plant regulatory noncompliance	Failure may result in in-plant regulatory noncompliance	Noncompliance with regulations.	
8	**Moderately high**	100% of production run affected may have to be scrapped. Failure may result in in-plant regulatory noncompliance or may have a chronic health and/or safety risk for the manufacturing or assembly worker	Line shutdown greater than full production shift; stop shipment possible; field repair or replacement required (Assembly to End User) other than for regulatory noncompliance. Failure may result in in-plant regulatory noncompliance or may have a chronic health and/or safety risk for the manufacturing or assembly worker.	**Loss** of primary vehicle function necessary for normal driving during expected service life.	
7		Product may have to be sorted and a portion (less than 100%) scrapped; deviation from primary process; decreased line speed or added manpower	Line shutdown from 1 hour up to full production shift; stop shipment possible; field repair or replacement required (Assembly to End User) other than for regulatory noncompliance	**Degradation** of primary vehicle function necessary for normal driving during expected service life.	

Process General Evaluation Criteria Severity (S)					
Potential Failure Effects rated according to the criteria below.					Blank until filled in by user
S	**Effect**	**Impact to Your Plant**	**Impact to Ship-to Plant (when known)**	**Impact to End User (when known)**	**Corporate or Product Line Examples**
6	**Moderately low**	100% of production run may have to be reworked off line and accepted	Line shutdown up to one hour	**Loss** of secondary vehicle function.	
5		A portion of the production run may have to be reworked off line and accepted	Less than 100% of product affected; strong possibility for additional defective product; sort required; no line shutdown	**Degradation** of secondary vehicle function.	
4		100% of production run may have to be reworked in station before it is processed	Defective product triggers significant reaction plan; additional defective products not likely; sort not required	Very objectionable appearance, sound, vibration, harshness, or haptics.	
3	**Low**	A portion of the production run may have to be reworked in-station before it is processed	Defective product triggers minor reaction plan; additional defective products not likely; sort not required	Moderately objectionable appearance, sound, vibration, harshness, or haptics.	
2		Slight inconvenience to process, operation, or operator	Defective product triggers no reaction plan; additional defective products not likely; sort not required; requires feedback to supplier	Slightly objectionable appearance, sound, vibration, harshness, or haptics.	
1	**Very low**	No discernible effect	No discernible effect or no effect	No discernible effect.	

Table P1 - PFMEA SEVERITY (S)

3.5.7 Occurrence (O)

The Occurrence rating (O) describes the occurrence of Failure Cause in the process, taking into account the associated current prevention controls.

The occurrence rating number is a relative rating within the scope of the FMEA and may not reflect the actual occurrence.

The Occurrence rating describes the potential of the failure cause to occur, according to the rating table, without regard to the detection controls.

Expertise or other experiences with comparable processes, for example, can be considered in the assessment of the rating numbers.

In determining this rating, questions such as the following should be considered:

- What is the equipment history with similar processes and process steps?
- What is the field experience with similar processes?
- Is the process a carryover or similar to a previous process?
- How significant are changes from a current production process?
- Is the process completely new?
- What are the environmental changes?
- Are best practices already implemented?
- Do standard instructions exist? (e.g., work instructions, set-up and calibration procedures, preventive maintenance, error-proofing verification procedures, and process monitoring verification checklists)
- Are technical error-proofing solutions implemented? (e.g., product or process design, fixture and tool design, established process sequence, production control tracking/traceability, machine capability, and SPC charting)

Occurrence Potential (O) for the Process				
Potential Failure Causes rated according to the criteria below. Consider Prevention Controls when determining the best Occurrence estimate. Occurrence is a predictive qualitative rating made at the time of evaluation and may not reflect the actual occurrence. The occurrence rating number is a relative rating within the scope of the FMEA (process being evaluated). For Prevention Controls with multiple Occurrence Ratings, use the rating that best reflects the robustness of the control.				Blank until filled in by user
O	**Prediction of Failure Cause Occurring**	**Type of Control**	**Prevention Controls**	**Corporate or Product Line Examples**
10	**Extremely high**	None	No prevention controls.	
9	**Very high**	Behavioral	Prevention controls will have little effect in preventing failure cause.	
8				
7	**High**	Behavioral or Technical	Prevention controls somewhat effective in preventing failure cause.	
6				
5	**Moderate**		Prevention controls are effective in preventing failure cause.	
4				
3	**Low**	Best Practices: Behavioral or Technical	Prevention controls are highly effective in preventing failure cause.	
2	**Very low**			
1	**Extremely low**	Technical	Prevention controls are extremely effective in preventing failure cause from occurring due to design (e.g. part geometry) or process (e.g. fixture or tooling design). Intent of prevention controls - Failure Mode cannot be physically produced due to the Failure Cause.	

Prevention Control Effectiveness: Consider if prevention controls are technical (rely on machines, tool life, tool material, etc.), or use best practices (fixtures, tool design, calibration procedures, error-proofing verification, preventive maintenance, work instructions, statistical process control charting, process monitoring, product design, etc.) or behavioral (rely on certified or non-certified operators, skilled trades, team leaders, etc.) when determining how effective the prevention controls will be.

Table P2 - PFMEA OCCURRENCE (O)

3.5.8 Detection (D)

Detection is the rating associated with a prediction of the most effective process control from the listed detection-type process controls. Detection is a relative rating, within the scope of the individual FMEA and is determined without regard for Severity or Occurrence. Detection should be estimated using the criteria in Table P3. This table may be augmented with examples of common detection methods used by the company.

The intent of the term “control discrepant product” used in Table P3 Ranks 3 and 4 is to have controls/systems/procedures in place

that controls the discrepant product in such a manner, that the probability of the product escaping the facility is very low.

The controls start from when the product is identified as discrepant to the point of final disposition. These controls usually exceed controls that are used for discrepant products with higher Detection Ranks.

After implementation of any unproven control, the effectiveness can be verified and re-evaluated.

In determining this estimate, questions such as the following should be considered:

- Which test is most effective in detecting the Failure Cause or the Failure Mode?
- What is the usage Profile / Duty Cycle required detecting the failure?
- What sample size is required to detect the failure?
- Is the test procedure proven for detecting this Cause/Failure Mode?

Detection Potential (D) for the Validation of the Process Design				
Detection Controls rated according to the Detection Method Maturity and Opportunity for Detection.				Blank until filled in by user
D	**Ability to Detect**	**Detection Method Maturity**	**Opportunity for Detection**	Corporate or Product Line Examples
10	Very low	No testing or inspection method has been established or is known.	The failure mode will not or cannot be detected.	
9		It is unlikely that the testing or inspection method will detect the failure mode.	The failure mode is not easily detected through random or sporadic audits.	
8	Low	Test or inspection method **has not been** proven to be effective and reliable (e.g. plant has little or no experience with method, gauge R&R results marginal on comparable process or this application, etc.).	Human inspection (visual, tactile, audible), or use of manual gauging (attribute or variable) that should detect the failure mode or failure cause.	
7			Machine-based detection (automated or semi-automated with notification by light, buzzer, etc.), or use of inspection equipment such as a coordinate measuring machine that should detect failure mode or failure cause.	

Detection Potential (D) for the Validation of the Process Design				
Detection Controls rated according to the Detection Method Maturity and Opportunity for Detection.				Blank until filled in by user
D	**Ability to Detect**	**Detection Method Maturity**	**Opportunity for Detection**	Corporate or Product Line Examples
6	Moderate	Test or inspection method **has been** proven to be effective and reliable (e.g. plant has experience with method; gauge R&R results are acceptable on comparable process or this application, etc.).	Human inspection (visual, tactile, audible), or use of manual gauging (attribute or variable) that will detect the failure mode or failure cause (including product sample checks).	
5			Machine-based detection (semi-automated with notification by light, buzzer, etc.), or use of inspection equipment such as a coordinate measuring machine that will detect failure mode or failure cause (including product sample checks).	
4	High	System has been proven to be effective and reliable (e.g. plant has experience with method on identical process or this application), gauge R&R results are acceptable, etc.	Machine-based automated detection method that will detect the failure mode **downstream**, prevent further processing or system will identify the product as discrepant and allow it to automatically move forward in the process until the designated reject unload area. Discrepant product will be controlled by a robust system that will prevent outflow of the product from the facility.	
3			Machine-based automated detection method that will detect the failure mode **in-station**, prevent further processing or system will identify the product as discrepant and allow it to automatically move forward in the process until the designated reject unload area. Discrepant product will be controlled by a robust system that will prevent outflow of the product from the facility.	
2		Detection method has been proven to be effective and reliable (e.g. plant has experience with method, error-proofing verifications, etc.).	Machine-based detection method that will detect the cause and prevent the failure mode (discrepant part) from being produced.	
1	Very high	Failure mode cannot be physically produced as-designed or processed, or detection methods proven to **always** detect the failure mode or failure cause.		

Table P3 - PFMEA DETECTION (D)

3.5.9 Action Priority (AP)

Once the team has completed the initial identification of failure modes and effects, causes and controls, including ratings 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 Action Priority (AP) method is introduced in this handbook. It accounts for all 1000 possible combinations of S, O, and D. It was created to give more emphasis on severity first, then occurrence, then detection. This logic follows the failure-prevention intent of FMEA. The AP table offers a suggested high-medium-low priority for action. Companies can use a single system to evaluate action priorities instead of multiple systems required from multiple customers.

Risk Priority Numbers are the product of S x O x D and range from 1 to 1000. The RPN distribution can provide some information about the range of ratings, but RPN alone is not an adequate method to determine the need for more actions since RPN gives equal weight to S, O, and D. For this reason, RPN could result in similar risk numbers for very different combinations of S, O, and D leaving the team uncertain about how to prioritize. When using RPN it is recommended to use an additional method to prioritize like RPN results such as S x O. The use of a Risk Priority Number (RPN) threshold is not a recommended practice for determining the need for actions. The RPN and S x O methods are not included in this publication.

Risk matrices can represent combinations of S and O, S and D, and O and D. These matrices provide a visual representation of the results of the analysis and can be used as an input to prioritization of actions based on company-established criteria not included in this publication.

Since the AP Table was designed to work with the Severity, Occurrence, and Detection tables provided in this handbook, if the organization chooses to modify the S, O, D, tables for specific products, processes, or projects, the AP table should also be carefully reviewed.

> Note: Action Priority rating tables are the same for DFMEA and PFMEA, but different for FMEA-MSR.

Priority High (H):	Highest priority for review and action. The team needs to either identify an appropriate action to improve prevention and/or detection controls or justify and document why current controls are adequate.

Priority Medium (M): Medium priority for review and action.
The team should identify appropriate actions to improve prevention and / or detection controls, or, at the discretion of the company, justify and document why controls are adequate.

Priority Low (L): Low priority for review and action.
The team could identify actions to improve prevention or detection controls.

It is recommended that potential Severity 9-10 failure effects with Action Priority High and Medium, at a minimum, be reviewed by management including any recommended actions that were taken.

This is not the prioritization of High, Medium, or Low risk, it is the prioritization of the need for actions to reduce risk.

> Note: It may be helpful to include a statement such as “No further action is needed” in the Remarks field as appropriate.

Action Priority (AP) for DFMEA and PFMEA							
Action Priority is based on combinations of Severity, Occurrence, and Detection ratings in order to prioritize actions for risk reduction.							Blank until filled in by user
Effect	**S**	**Prediction of Failure Cause Occurring**	**O**	**Ability to Detect**	**D**	**ACTION PRIORITY (AP)**	**Comments**
Product or Plant Effect Very high	9-10	Very high	8-10	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	H	
				Very high	1	H	
		High	6-7	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	H	
				Very high	1	H	
		Moderate	4-5	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	H	
				Very high	1	M	
		Low	2-3	Low - Very low	7-10	H	
				Moderate	5-6	M	
				High	2-4	L	
				Very high	1	L	
		Very low	1	Very high - Very low	1-10	L	
Product or Plant Effect High	7-8	Very high	8-10	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	H	
				Very high	1	H	
		High	6-7	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	H	
				Very high	1	M	
		Moderate	4-5	Low - Very low	7-10	H	
				Moderate	5-6	M	
				High	2-4	M	
				Very high	1	M	
		Low	2-3	Low - Very low	7-10	M	
				Moderate	5-6	M	
				High	2-4	L	
				Very high	1	L	
		Very low	1	Very high - Very low	1-10	L	

Effect	S	Prediction of Failure Cause Occurring	O	Ability to Detect	D	ACTION PRIORITY (AP)	Comments
Product or Plant Effect Moderate	4-6	Very high	8-10	Low - Very low	7-10	H	
				Moderate	5-6	H	
				High	2-4	M	
				Very high	1	M	
		High	6-7	Low - Very low	7-10	M	
				Moderate	5-6	M	
				High	2-4	M	
				Very high	1	L	
		Moderate	4-5	Low - Very low	7-10	M	
				Moderate	5-6	L	
				High	2-4	L	
				Very high	1	L	
		Low	2-3	Low - Very low	7-10	L	
				Moderate	5-6	L	
				High	2-4	L	
				Very high	1	L	
		Very low	1	Very high - Very low	1-10	L	
Product or Plant Effect Low	2-3	Very high	8-10	Low - Very low	7-10	M	
				Moderate	5-6	M	
				High	2-4	L	
				Very high	1	L	
		High	6-7	Low - Very low	7-10	L	
				Moderate	5-6	L	
				High	2-4	L	
				Very high	1	L	
		Moderate	4-5	Low - Very low	7-10	L	
				Moderate	5-6	L	
				High	2-4	L	
				Very high	1	L	
		Low	2-3	Low - Very low	7-10	L	
				Moderate	5-6	L	
				High	2-4	L	
				Very high	1	L	
		Very low	1	Very high - Very low	1-10	L	
No discernible Effect	1	Very low - Very high	1-10	Very high - Very low	1-10	L	

Table AP – ACTION PRIORITY FOR DFMEA and PFMEA