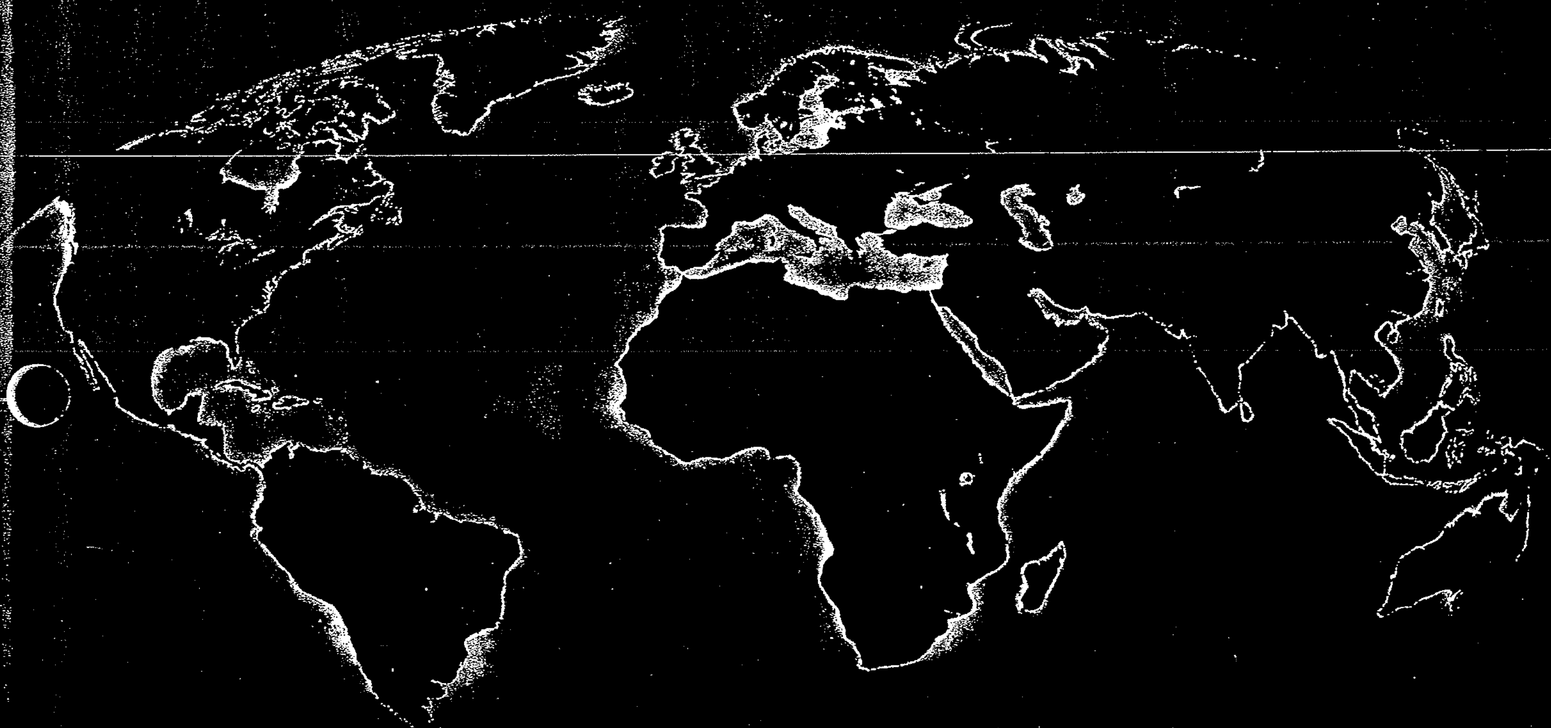
Potential Failure Mode and Effects Analysis

FMEA



Ford

GM

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

REFERENCE MANUAL

The content of this document is the technical equivalent of SAE J-1739. Potential Failure Mode and Effects Analysis (FMEA) should be used by suppliers to companies subscribing to QS-9000.

First Edition Issued February, 1993 • Second Edition, February, 1995

FOREWORD

This reference Manual and Reporting Format was developed by the Failure Mode and Effects Analysis (FMEA) teams at Chrysler, Ford and General Motors, working under the auspices of the Automotive Division of the American Society for Quality Control (ASQC) and the Automotive Industry Action Group (AIAG).

The ASQC/AIAG Task Force charter is to standardize the reference manuals, procedures, reporting formats and technical nomenclature used by Chrysler, Ford, and General Motors in their respective supplier quality systems. Accordingly, this manual and format, which is approved and endorsed by Chrysler, Ford and General Motors, should be used by suppliers implementing FMEA techniques into their design/ manufacturing processes.

In the past, Chrysler, Ford and General Motors each had their own guidelines and formats for insuring supplier FMEA compliance. Differences between these guidelines and formats resulted in additional demands on supplier resources. To improve upon this situation, Chrysler, Ford and General Motors agreed to develop, and, through AIAG, distribute this Manual. The work group responsible for the Manual was led be George Baumgartner of Ford Motor Company.

This Manual provides general guidelines for preparing an FMEA. It does not give specific instructions on how to arrive at each FMEA entry, a task best left to each FMEA team. This Manual also is not intended to be a comprehensive FMEA reference source or training document.

While these guidelines are intended to cover all situation normally occurring either in the design phase or process analysis, there will be questions that arise. These questions should be directed to your customer's Supplier Quality Assurance (SQA) activity. If you are uncertain as to how to contact the appropriate SQA activity, the buyer in your customer's Purchasing office can help.

The Task Force gratefully acknowledges: the leadership and commitment of Vice Presidents Thomas T. Stallkamp at Chrysler, Norman F. Ehlers at Ford, and J. Ignasio Lopez de Arriortua of General Motors; the assistance of the AIAG in the development, production, and distribution of the Procedure; the guidance of Task Force principals Russ Jacobs (Chrysler), Steve Walsh (Ford), Dan Reid (General Motors), and Rad Smith; and the assistance of the ASQC Automotive Division Reading Team. This team, led by Tripp Martin (Peterson Spring), reviewed the Manual for technical content and accuracy and made valuable contributions to form and content. Since the Manual was developed to meet specific needs of the automotive industry, the ASQC voluntary standards process defined by ASQC policies and procedures was not used in its development.

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APPENDICES

GENERAL INFORMATION

Overview

This manual introduces the topic potential Failure Mode and Effects Analysis (FMEA) and gives general guidance in the application of the technique. An FMEA can be described as a systemized group of activities intended to: 1) recognize and evaluate the potential failure of a product/process and its effects, 2) identify actions which could eliminate or reduce the chance of the potential failure occurring, and 3) document the process. It is complementary to the design process of defining positively what a design must do to satisfy the customer.

History

Although engineers have always performed an FMEA type of analysis on their designs and manufacturing processes, the first formal application of the FMEA discipline was an innovation of the aerospace industry in the mid-1960s.

Manual Format

For ease of use, this reference manual retains the presentation of the FMEA preparation instructions in two distinct sections (design and process). However, having both sections in the same manual facilitates the comparison of techniques used to develop the different types of FMEAs, as a means to more clearly demonstrate their proper application and interrelation.

FMEA Implementation

Because of a company's commitment to continually improve its products whenever possible, the need for using the FMEA as a disciplined technique to identify and help eliminate potential concern is as important as ever. Studies of vehicle campaigns have shown that a fully implemented FMEA program could have prevented many of the campaigns.

Although responsibility for the "preparation" of the FMEA must, of necessity, be assigned to an individual, FMEA input should be a team effort. A team of knowledgeable individuals should be assembled; e.g., engineers with expertise in Design, Manufacturing, Assembly, Service, Quality, and Reliability.

One of the most important factors for the successful implementation of an FMEA program is timeliness. It is meant to be a "before-the-event" action, not an "after-the-fact" exercise. To achieve the greatest value, the FMEA must be done before a design or process failure mode has been unknowingly designed into the product. <u>Up front time spent in doing a comprehensive FMEA well, when product/process changes can be most easily and inexpensively implemented, will alleviate late change crises. An FMEA can reduce or eliminate the chance of implementing a corrective change which could create an even larger concern. Properly applied, it is an interactive process which is never ending.</u>

DESIGN FMEA

INTRODUCTION

A Design potential FMEA is an analytical technique utilized primarily by a Design Responsible Engineer/Team as a means to assure that, to the extent possible, potential failure modes and their associated causes/mechanisms have been considered and addressed. End items, along with every related system, subassembly and component, should be evaluated. In its most rigorous form, an FMEA is a summary of an engineer's and the team's thoughts (including an analysis of items that could go wrong based on experience and past concerns) as a component, subsystem or system is designed. This systematic approach parallels, formalizes and documents the mental disciplines that an engineer normally goes through in any design process.

The Design potential FMEA supports the design process in reducing the risk of failures by:

- Aiding in the objective evaluation of design requirements and design alternatives.
- Aiding in the initial design for manufacturing and assembly requirements.
- Increasing the probability that potential failure modes and their effects on system and vehicle operation have been considered in the design/development process.
- Providing additional information to aid in the planning of thorough and efficient design test and development programs.
- Developing a list of potential failure modes ranked according to their effect on the "customer," thus establishing a priority system for design improvements and development testing.
- Providing an open issue format for recommending and tracking risk reducing actions.
- Providing future reference to aid in analyzing field concerns, evaluating design changes and developing advanced designs.

Customer Defined

The definition of "CUSTOMER" for a Design potential FMEA is not only the "END USER", but also the design responsible engineers/ teams of the vehicle or higher level assemblies, and/or the manufacturing process responsible engineers in activities such as Manufacturing, Assembly, and Service.

When fully implemented, the FMEA discipline requires a Design FMEA for all new parts, changed parts, and carryover parts in new applications or environments. It is initiated by an engineer from the responsible design activity, which for a proprietary design may be the supplier.

INTRODUCTION (Continued)

Team Effort

During the initial Design potential FMEA process, the responsible engineer is expected to directly and actively involve representatives from all affected areas. These areas should include, but are not limited to: assembly, manufacturing, materials, quality, service and suppliers, as well as the design area responsible for the next assembly. The FMEA should be a catalyst to stimulate the interchange of ideas between the functions affected and thus promote a team approach. In addition, for any (internal/external) supplier designed items, the responsible design engineer should be consulted.

The Design FMEA is a living document and should be initiated before or at design concept finalization, be continually updated as changes occur or additional information is obtained throughout the phases of product development, and be fundamentally completed before the production drawings are released for tooling.

Considering that manufacturing/assembly needs have been incorporated, the Design FMEA addresses the design intent and assumes the design will be manufactured/assembled to this intent. Potential failure modes and/or causes/mechanisms which can occur during the manufacturing or assembly process need not, but may be included in a Design FMEA, when their identification, effect and control are covered by the Process FMEA.

The Design FMEA does not rely on process controls to overcome potential weaknesses in the design, but it does take the technical/physical limits of a manufacturing/assembly process into consideration, e.g.:

- necessary mold drafts
- limited surface finish
- assembling space/access for tooling
- limited hardenability of steels
- process capability/performance

DEVELOPMENT OF A DESIGN FMEA

The design responsible engineer has at his or her disposal a number of documents that will be useful in preparing the Design potential FMEA. The process begins by developing a listing of what the design is expected to do, and what it is expected not to do, i.e., the design intent. Customer wants and needs, as may be determined from sources such as Quality Function Deployment (QFD), Vehicle Requirements Documents, known product requirements and/or manufacturing/assembly requirements should be incorporated. The better the definition of the desired characteristics, the easier it is to identify potential failure modes for corrective action.

DEVELOPMENT OF A DESIGN FMEA (Continued)

A Design FMEA should begin with a block diagram for the system, subsystem, and/or component being analyzed. An example block diagram is shown in Appendix A. The block diagram can also indicate the flow of information, energy, force, fluid, etc. The object is to understand the deliverables (input) to the block, the process (function) performed in the block, and the deliverables (output) from the block.

The diagram illustrates the primary relationship between the items covered in the analysis and establishes a logical order to the analysis. Copies of the diagrams used in FMEA preparation should accompany the FMEA.

In order to facilitate documentation of the analysis of potential failures and their consequences, a form has been designed and is in Appendix F.

Application of the form is described below; points are numbered according to the numbers encircled on the form shown on the facing page. An example of a completed form is contained in Appendix B and on the facing pages of this section.

1) FMEA Number

Enter the FMEA document number, which may be used for tracking.

2) System, Subsystem, or Component Name and Number

Indicate the appropriate level of analysis and enter the name and number of the system, subsystem or component being analyzed.

3) Design Responsibility

Enter the OEM, department and group. Also include the supplier name if known.

4) Prepared By

Enter the name, telephone number, company of the engineer responsibile for preparing the FMEA.

5) Model Year(s)/ Vehicle(s)

Enter the intended model year(s) and vehicle line(s) that will utilize and/or be affected by the design being analyzed (if known).

6) Key Date

Enter the initial FMEA due date, which should not exceed the scheduled production design release date.

7) FMEA Date

Enter the date the original FMEA was compiled, and the latest revision date.

8) Core Team

List the names of the responsible individuals and departments which have the authority to identify and/or perform tasks. (It is recommended that all team members names, departments, telephone numbers, addresses, etc. be included on a distribution list.)

DEVELOPMENT OF A DESIGN FMEA (Continued)

9) Item/Function

Enter the name and number of the item being analyzed. Use the nomenclature and show the design level as indicated on the engineering drawing. Prior to initial release, experimental numbers should be used.

Enter, as concisely as possible, the function of the item being analyzed to meet the design intent. Include information regarding the environment in which this system operates (e.g., define temperature, pressure, humidity ranges). If the item has more than one function with different potential modes of failure, list all the functions separately.

10) Potential Failure Mode

Potential Failure Mode is defined as the manner in which a component, subsystem, or system could potentially fail to meet the design intent. The potential failure mode may also be the cause of a potential failure mode in a higher level subsystem, or system, or be the effect of one in a lower level component.

List each potential failure mode for the particular item and item function. The assumption is made that the failure could occur, but may not necessarily occur. A recommended starting point is a review of past things-gone-wrong, concerns reports, and group "brainstorming".

Potential failure modes that could only occur under certain operating conditions (i.e. hot, cold, dry, dusty, etc.) and under certain usage conditions (i.e. above average mileage, rough terrain, only city driving, etc.) should be considered.

Typical failure modes could be, but are not limited to:

Cracked	Sticking
Deformed	Short circuited (electrical)
Loosened	Oxidized
Leaking	Fractured

Note: Potential failure modes should be described in "physical" or technical terms, not as a symptom noticeable by the customer.

11) Potential Effect(s) of Failure

Potential Effects of Failure are defined as the effects of the failure mode on the function, as perceived by the customer.

Describe the effects of the failure in terms of what the customer might notice or experience, remembering that the customer may be an internal customer as well as the ultimate end user. State clearly if the function could impact safety or noncompliance to regulations. The effects should always be stated in terms of the specific system, subsystem or component being analyzed. Remember that a hierarchial relationship exists between the component, subsystem, and system levels. For example, a part could fracture, which may cause the assembly to vibrate, resulting in an intermittent system operation. The intermittent system operation could cause performance to degrade, and ultimately lead to customer dissatisfaction. The intent is to forecast the failure effects to the Team's level of knowledge.

DEVELOPMENT OF A DESIGN FMEA (Continued)

11) Potential Effect(s) of Failure (Continued)

Typical failure effects could be, but are not limited to:

- Noise
- Erratic Operation
- Poor Appearance
- Unstable
- Intermittent Operation
- Rough
- Inoperative
- Unpleasant Odor
- Operation Impaired

12) Severity (S)

Severity is an assessment of the seriousness of the effect (listed in the previous column) of the potential failure mode to the next component, subsystem, system or customer if it occurs. Severity applies to the effect only. A reduction in Severity Ranking index can be effected only through a design change. Severity should be estimated on a "1" to "10" scale.

Suggested Evaluation Criteria:
(The team should agree on an evaluation criteria and ranking system, which is consistent, even if modified for individual product analysis.)

Effect	Criteria: Severity of Effect	Ranking
Hazardous-without warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation without warning.	10
Hazardous-with warning	Very high severity ranking when a potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation with warning	9
Very High	Vehicle/item inoperable, with loss of primary function.	8
High	Vehicle/item operable, but at reduced level of performance. Customer dissatisfied.	7
Moderate	Vehicle/item operable, but Comfort/Convenience item(s) inoperable. Customer experiences discomfort.	6
Low	Vehicle/item operable, but Comfort/Convenience item(s) operable at reduced level of performance. Customer experiences some dissatisfaction.	5
Very Low	Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by most customers.	4
Minor	Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by average customer.	3
Very Minor	Fit & Finish/Squeak & Rattle item does not conform. Defect noticed by discriminating customer.	2
None	No Effect.	1

13) Classification

This column may be used to classify any special product characteristics (e.g., critical, key, major, significant) for components, subsystems, or systems that may require additional process controls.

DEVELOPMENT OF A DESIGN FMEA (Continued)

Any item deemed to require special process controls should be identified on the Design FMEA form with the appropriate character or symbol in the Classification column and should be addressed in the Recommended actions column.

Each item identified above in the Design FMEA should have the special process controls identified in the Process FMEA.

14) Potential Cause(s)/ Mechanism(s) of Failure

Potential Cause of Failure is defined as an indication of a design weakness, the consequence of which is the failure mode.

List, to the extent possible, every conceivable failure cause and/or failure mechanism for each failure mode. The cause/mechanism should be listed as concisely and completely as possible so that remedial efforts can be aimed at pertinent causes.

Typical failure causes may include, but are not limited to:

Incorrect Material Specified
Inadequate Design Life Assumption
Over-stressing
Insufficient Lubrication Capability
Inadequate Maintenance Instructions
Poor Environment Protection
Incorrect Algorithm

Typical failure mechanisms may include, but are not limited to:

Yield	Creep
Fatigue	Wear
Material Instability	Corrosion

15) Occurrence (O)

Occurrence is the likelihood that a specific cause/mechanism (listed in the previous column) will occur. The likelihood of occurrence ranking number has a meaning rather than a value. Removing or controlling one or more of the causes/mechanisms of the failure mode through a design change is the only way a reduction in the occurrence ranking can be effected.

Estimate the likelihood of occurrence of potential failure cause/mechanism on a "1" to "10" scale. In determining this estimate, questions such as the following should be considered:

- What is the service history/field experience with similar components or subsystems?
- Is component carryover or similar to a previous level component or subsystem?
- How significant are changes from a previous level component or subsystem?
- Is component radically different from a previous level component?
- Is component completely new?

DEVELOPMENT OF A DESIGN FMEA (Continued)

- Has the component application changed?
- What are the environmental changes?
- Has an engineering analysis been used to estimate the expected comparable occurrence rate for the application?

A consistent occurrence ranking system should be used to ensure continuity. The "Design Life Possible Failure Rates" are based on the number of failures which are anticipated during the design life of the component, subsystem, or system. The occurrence ranking number is related to the rating scale and does not reflect the actual likelihood of occurrence.

15) Occurrence (O)

Suggested Evaluation Criteria:

(The team should agree on an evaluation criteria and ranking system, which is consistent, even if modified for individual product analysis.)

Probability of Failure	Possible Failure Rates	Ranking
Very High: Failure is almost inevitable	≥ 1 in 2	10
	1 in 3	9
High: Repeated failures	1 in 8	8
	1 in 20	7
Moderate: Occasional failures	1 in 80	6
	1 in 400	5
	1 in 2,000	4
Low: Relatively few failures	1 in 15,000	3
	1 in 150,000	2
Remote: Failure is unlikely	≤ 1 in 1,500,000	1

16) Current Design Controls

List the prevention, design validation/verification (DV), or other activities which will assure the design adequacy for the failure mode and/or cause/mechanism under consideration. Current controls (e.g., road testing, design reviews, fail/safe (pressure relief valve), mathematical studies, rig/lab testing, feasibility reviews, prototype tests, fleet testing) are those that have been or are being used with the same or similar designs.

There are three types of Design Controls/features to consider; those that : (1) Prevent the cause/mechanism or failure mode/effect from occurring, or reduce their rate of occurrence,(2) detect the cause/mechanism and lead to corrective actions, and (3) detect the failure mode.

DEVELOPMENT OF DESIGN FMEA (Continued)

The preferred approach is to first use type (1) controls if possible; second, use the type (2) controls; and third, use the type (3) controls. The initial occurrence rankings will be affected by the type (1) controls provided they are integrated as part of the design intent. The initial detection rankings will be based upon the type (2) or type (3) current controls, provided the prototypes and models being used are representative of design intent.

17) Detection (D)

Detection is an assessment of the ability of the proposed type (2) current design controls, listed in column 16, to detect a potential cause/mechanism (design weakness), or the ability of the proposed type (3) current design controls to detect the subsequent failure mode, before the component, subsystem, or system is released for production. In order to achieve a lower ranking, generally the planned design control (e.g., preventative, validation, and/or verification activities) has to be improved.

Suggested Evaluation Criteria:

(The team should agree on an evaluation criteria and ranking system, which is consistent, even if modified for individual product analysis.)

Detection	Criteria: Likelihood of Detection by Design Control	Ranking
Absolute Uncertainty	Design Control will not and/or can not detect a potential cause/mechanism and subsequent failure mode; or there is no Design Control.	10
Very Remote	Very remote chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	9
Remote	Remote chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	8
Very Low	Very low chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	7
Low	Low chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	6
Moderate	Moderate chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	5
Moderately High	Moderately high chance the Design Control will detect a potential cause/ mechanism and subsequent failure mode	4
High	High chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	3
Very High	Very high chance the Design Control will detect a potential cause/mechanism and subsequent failure mode	2
Almost Certain	Design Control will almost certainly detect a potential cause/mechanism and subsequent failure mode	1

DEVELOPMENT OF A DESIGN FMEA (Continued)

18) Risk Priority Number (RPN)

The Risk Priority Number is the product of the Severity (S), Occurrence (O), and Detection (D) ranking

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

The Risk Priority Number, as the product S X O X D, is a measure of design risk. This value should be used to rank order the concerns in the design (e.g., in Pareto fashion). The RPN will be between "1" and "1,000". For higher RPNs the team must undertake efforts to reduce this calculated risk through corrective action(s). In general practice, regardless of the resultant RPN, special attention should be given when severity is high.

19) Recommended Action(s)

When the failure modes have been rank ordered by RPN, corrective action should be first directed at the highest ranked concerns and critical items. The intent of any recommended action is to reduce any one or all of the occurrence, severity, and/or detection rankings. An increase in design validation/verification actions will result in a reduction in the detection ranking only. A reduction in the occurrence ranking can be effected only by removing or controlling one or more of the causes/mechanisms of the failure mode through a design revision. Only a design revision can bring about a reduction in the severity ranking. Actions such as the following should be considered, but are not limited to:

- Design of Experiments (particularly when multiple or interactive causes are present).
- Revised Test Plan.
- Revised Design.
- Revised Material Specification.

If no actions are recommended for a specific cause, indicate this by entering a "NONE" in this column.

20) Responsibility (for the Recommended Action)

Enter the Organization and individual responsible for the recommended action and the target completion date.

21) Actions Taken

After an action has been implemented, enter a brief description of the actual action and effective date.

22) Resulting RPN

After the corrective action have been identified, estimate and record the resulting severity, occurrence, and detection rankings. Calculate and record the resulting RPN. If no actions are taken, leave the "Resulting RPN" and related ranking columns blank.

All Resulting RPN(s) should be reviewed and if further action is considered necessary, repeat steps 19 through 22.

DEVELOPMENT OF A DESIGN FMEA (Continued)

Follow-Up

The design responsible engineer is responsible for assuring that all actions recommended have been implemented or adequately addressed. The FMEA is a living document and should always reflect the latest design level, as well as the latest relevant actions, including those occurring after start of production.

The design responsible engineer has several means of assuring that concerns are identified and that recommended actions are implemented. They include, but are not limited to the following:

- Assuring design requirements are achieved.
- Review of engineering drawings and specifications.
- Confirmation of incorporation to assembly/manufacturing documentation.
- Review of Process FMEAs and Control Plans.

DESIGN FMEA

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

____ System
_x__ Subsystem
____ Component 01.03/Body Closures (2)

Model Years(s)/Vehicle(s) 199X/Lion 4dr/Wagon (5)

Design Responsibility Body Engineering (3)

Key Date 9X 03 01 ER (6)

FMEA Number 1234 (1)

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Prepared By A. Tate - X6412- Body Engr (4)

FMEA Date (Orig.) 8X 03 22 (Rev.) 8X 07 14 (7)

Core Team T.Fender-Car Product Dev., Childers-Manufacturing, J. Ford-Assy Ops (Dalton, Fraser, Henley Assembly Plants (8)

Item (9) Function	Potential Failure Mode (10)	Potential Effect(s) of Failure (11) (12)	Sev	Class (13)	Potential Cause(s)/ Mechanism(s) of Failure (14)	Occur (15)	Current Design Controls (16) (17)	Detec	R.P.N.	Recommended Action(s) (18) (19)	Responsibility & Target Completion Date (20)	Action Results: Actions Taken (21)	Sev	Occ	Det	R.P.N. (22)
Front Door L.H. H8HX-0000-A • Ingress to and egress from vehicle • Occupant protection from weather, noise, and side impact • Support anchorage for door hardware including mirror, hinges, latch and window regulator • Provide proper surface for appearance items • Paint and soft trim	Corroded interior lower door panels	Deteriorated life of door leading to: • Unsatisfactory appearance due to rust through paint over time • Impaired function of interior door hardware	7		Upper edge of protective wax application specified for inner door panels is too low	6	Vehicle general durability test vah. T-118 T-109 T-301	7	294	Add laboratory accelerated corrosion testing	A Tate-Body Engrg 8X 09 30	Based on test results (Test No. 1481) upper edge spec raised 125mm	7	2	2	28
					Insufficient wax thickness specified	4	Vehicle general durability testing- as above	7	196	Add laboratory accelerated corrosion testing Conduct Design of Experiments (DOE) on wax thickness	Combine w/test for wax upper edge verification A Tate Body Engrg 9X 01 15	Test results (Test No. 1481) show specified thickness is adequate. DOE shows 25% variation in specified thickness is acceptable.	7	2	2	28
					Inappropriate wax formulation specified	2	Physical and Chem Lab test- Report No.1265	2	28	None						
					Entrapped air prevents wax from entering corner/edge access	5	Design aid investigation with non-functioning spray head	8	280	Add team evaluation using production spray equipment and specified wax	Body Engrg & Assy Ops 8X 11 15		7	1	3	21
					Wax application plugs door drain holes	3	Laboratory test using "worst case" wax application and hole size	1	21	None		Based on test, 3 additional vent holes provided in affected areas				
					Insufficient room between panels for spray head access	4	Drawing evaluation of spray head access	4	112	Add team evaluation using design aid buck and spray head	Body Engrg & Assy Ops	Evaluation showed adequate access	7	1	1	7

SAMPLE

DESIGN FMEA

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

____ System
_x__ Subsystem ②
____ Component 01.03/Body Closures

Model Years(s)/Vehicle(s) 199X/Lion 4dr/Wagon ⑤

Design Responsibility Body Engineering ③

Key Date 9X 03 01 ER ⑥

FMEA Number 1234 ①

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Prepared By A. Tate - X6412- Body Engr ④

FMEA Date (Orig.) 8X 03 22 (Rev.) 8X 07 14 ⑦

Core Team T.Fender-Car Product Dev., Childers-Manufacturing, J. Ford-Assy Ops (Dalton, Fraser, Henley Assembly Plants ⑧

Item ⑨ Function	Potential Failure Mode ⑩	Potential Effect(s) of Failure ⑪	Sev ⑫	Class	Potential Cause(s)/ Mechanism(s) of Failure ⑬ ⑭	Occur	Current Design Controls ⑮ ⑯ ⑰	Detec	R.P.N.	Recommended Action(s) ⑱ ⑲	Responsibility & Target Completion Date ⑳	Action Results: Actions Taken ㉑	Sev	Occ	Det	R.P.N. ㉒
Front Door L.H. H8HX-0000-A • Ingress to and egress from vehicle • Occupant protection from weather, noise, and side impact • Support anchorage for door hardware including mirror, hinges, latch and window regulator • Provide proper surface for appearance items • Paint and soft trim	Corroded interior lower door panels	Deteriorated life of door leading to: • Unsatisfactory appearance due to rust through paint over time • Impaired function of interior door hardware	7		Upper edge of protective wax application specified for inner door panels is too low	6	Vehicle general durability test vah. T-118 T-109 T-301	7	294	Add laboratory accelerated corrosion testing	A Tate-Body Engrg 8X 09 30	Based on test results (Test No. 1481) upper edge spec raised 125mm	7	2	2	28
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					Inappropriate wax formulation specified	2	Physical and Chem Lab test- Report No.1265	2	28	None						
					Entrapped air prevents wax from entering corner/edge access	5	Design aid investigation with non-functioning spray head	8	280	Add team evaluation using production spray equipment and specified wax	Body Engrg & Assy Ops 8X 11 15		7	1	3	21
					Wax application plugs door drain holes	3	Laboratory test using "worst case" wax application and hole size	1	21	None		Based on test, 3 additional vent holes provided in affected areas				
					Insufficient room between panels for spray head access	4	Drawing evaluation of spray head access	4	112	Add team evaluation using design aid buck and spray head	Body Engrg & Assy Ops	Evaluation showed adequate access	7	1	1	7

SAMPLE

DESIGN FMEA

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

___ System
_x_ Subsystem
___ Component 01.03/Body Closures (2)

Model Years(s)/Vehicle(s) 199X/Lion 4dr/Wagon (5)

Design Responsibility Body Engineering (3)

Key Date 9X 03 01 ER (6)

FMEA Number 1234 (1)

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FMEA Date (Orig.) 8X 03 22 (Rev.) 8X 07 14 (7)

Core Team T.Fender-Car Product Dev., Childers-Manufacturing, J. Ford-Assy Ops (Dalton, Fraser, Henley Assembly Plants (8)

Item (9) Function	Potential Failure Mode (10)	Potential Effect(s) of Failure (11)	Sev (12)	Class (13)	Potential Cause(s)/ Mechanism(s) of Failure (14)	Occur (15)	Current Design Controls (16)	Detec (17)	R.P.N.	Recommended Action(s) (18) (19)	Responsibility & Target Completion Date (20)	Action Results: Actions Taken (21)	Sev	Occ	Det	R.P.N. (22)
Front Door L.H. H8HX-0000-A • Ingress to and egress from vehicle • Occupant protection from weather, noise, and side impact • Support anchorage for door hardware including mirror, hinges, latch and window regulator • Provide proper surface for appearance items • Paint and soft trim	Corroded interior lower door panels	Deteriorated life of door leading to: • Unsatisfactory appearance due to rust through paint over time • Impaired function of interior door hardware	7		Upper edge of protective wax application specified for inner door panels is too low	6	Vehicle general durability test vah. T-118 T-109 T-301	7	294	Add laboratory accelerated corrosion testing	A Tate-Body Engrg 8X 09 30	Based on test results (Test No. 1481) upper edge spec raised 125mm	7	2	2	28
					Insufficient wax thickness specified	4	Vehicle general durability testing- as above	7	196	Add laboratory accelerated corrosion testing Conduct Design of Experiments (DOE) on wax thickness	Combine w/test for wax upper edge verification A Tate Body Engrg 9X 01 15	Test results (Test No. 1481) show specified thickness is adequate. DOE shows 25% variation in specified thickness is acceptable.	7	2	2	28
					Inappropriate wax formulation specified	2	Physical and Chem Lab test- Report No.1265	2	28	None						
					Entrapped air prevents wax from entering corner/edge access	5	Design aid investigation with non-functioning spray head	8	280	Add team evaluation using production spray equipment and specified wax	Body Engrg & Assy Ops 8X 11 15		7	1	3	21
					Wax application plugs door drain holes	3	Laboratory test using "worst case" wax application and hole size	1	21	None		Based on test, 3 additional vent holes provided in affected areas				
					Insufficient room between panels for spray head access	4	Drawing evaluation of spray head access	4	112	Add team evaluation using design aid buck and spray head	Body Engrg & Assy Ops	Evaluation showed adequate access	7	1	1	7

SAMPLE