

Design FMEA Linkage

Potential Significant Characteristics transferred to Characteristics Matrix

x System
 — Sub System
 — Component:
 Model Year/Vehicle (s):
 Core Team:

Process Responsibility:
 Key Date:

Potential Failure Mode and Effects Analysis
 (Design FMEA)

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Class	Potential Cause(s)/ Mechanism(s) Failure	Occurrence	Current Process Controls
Provide adequate Time to 1/2 amplitude	Time to 1/2 amp inadequate	•Poor handling quality (7)	7	CC	Inadequate Stiffness of transmission cover assembly	3	•Performance Testing •FEA – Transmission cover stiffness

•Inputs from Requirements & Specifications
 •Inputs from QFD relationships

Anti function for functional approach

- full
- partial
- intermittent
- excess function

Customer focus/experience

- end user
- assembler
- maker
- regulatory body

Brainstorm causes

- man
- material
- method
- machine
- environment

 Output to Characteristics Matrix

Detect
 Planned tests

- Transfer to or from DV Plan
- evaluations
- builds
- bucks

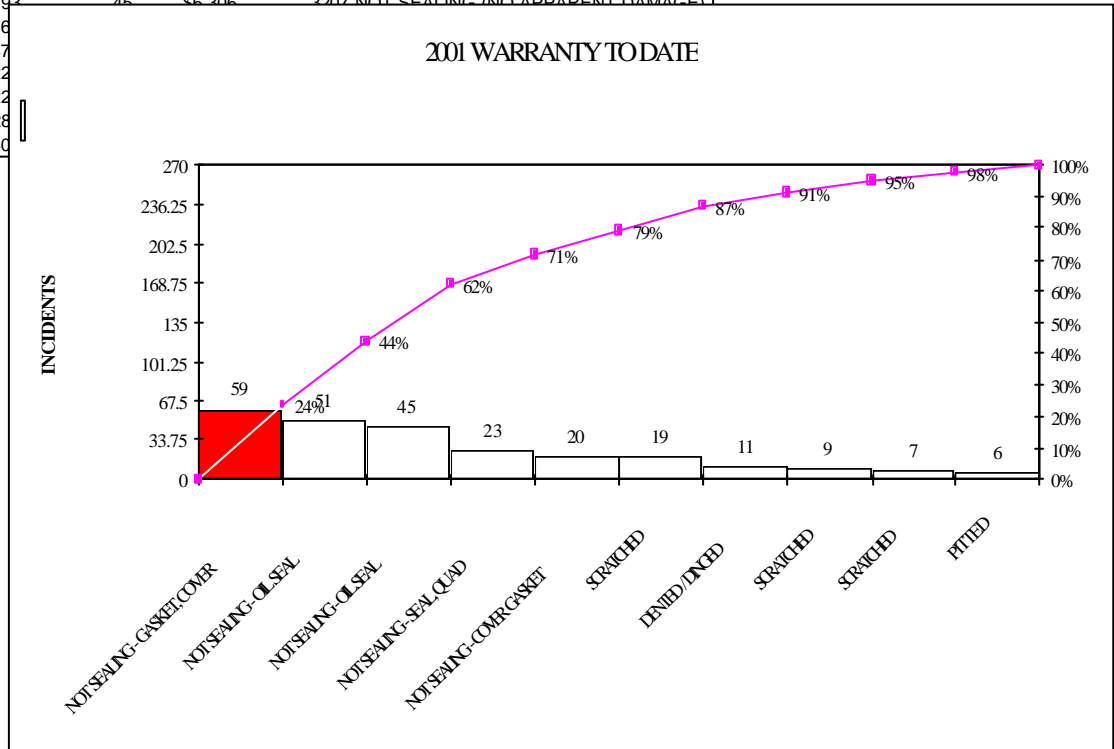
 Note: Must have written instructions.

Prevent
 •Reduces Occurrence

DFMEA Inputs – Warranty Data

**2001 - All Models
Top Parts & Conditions**

Part #	Part Description	Total Part Incid	Total Part Cost	Condition Incidents	Condition Cost	Condition Code	Condition Description
60539-94	GASKET, PRIMARY COVER	69	\$3,513	59	\$2,984	3207	NOT SEALING (NO APPARENT DAMAGE)
12052	OIL SEAL	62	\$9,230	51	\$7,739	3207	NOT SEALING (NO APPARENT DAMAGE)
12066	OIL SEAL	59	\$8,192	45	\$6,206	3207	NOT SEALING (NO APPARENT DAMAGE)
25416-99A	SEAL, QUAD	33	\$26				
60567-90A	PRIMARY COVER GASKET	29	\$37				
60543-99	CHROME PRIMARY COVER	53	\$15,22				
60543-99	CHROME PRIMARY COVER	53	\$15,22				
60562-99	PRIMARY COVER, POLISHED	25	\$6,28				
25414-99	POLISHED DERBY COVER	12	\$40				



DFMEA Linkage to PFMEA

Characteristics Matrix Development

- Potential Significant Characteristics Are Typically Transferred from the DFMEA
- Characteristics are compared with the process steps to Identify potential causes of failure.
 - Causes are transferred to the PFMEA

Characteristics Matrix - Linkage from DFMEA to PFMEA

Potential Significant and Critical Characteristics from DFMEA

Process Operation from Process Flow

Special Characteristics Matrix	Severity	Process Steps																Customer Assessment																				
		Rel. Importance	Material	Shipping Data	Component Manufacturing	Vehicle Assembly	Op 100 Step 1 PRE-LOAD DOWEL PINS TO FIXTURE	Op 100 Step 2 PRE-LOAD JACK SHAFT SEAL TO FIXTURE	Op 100 Step 3 PRE-LOAD PRIMARY HOUSING BUSHING TO FIXTURE	Op 110 Pre-load bearing to fixture #2	Op 120 Pre-load main shaft oil seal to mandrel	Op 200 Housing to fixture #1	Op 210 Operate press	Op 220 Retaining ring to top groove	Op 230 Reload fixture #1	Op 300 Housing to fixture #2	Op 310 Operate press		Op 320 Retaining ring to top groove	Op 330 Mandrel to main shaft bore I.D.	Op 340 Operate press	Op 350 Pre-load fixture #2 and mandrel	Op 400 Housing to table	Op 410 Reserved	Op 420 Chain and sub assy to housing	Op 430 Lubricate bushing & seal	Op 445 Move or stage for final assy	Op 10 O-ring to shifter tube	Op 500 Shifter tube to housing	Op 510 Clamp to shifter tube	Op 20 Assemble shifter lever	Op 520 Wave washer to shifter lever	Op 530 Shifter lever to shifter tube	Op 535 Queue for final assy line				
Direction of Improvement																																						
Potential Critical and Significant	1.090 TO 1.110 * FACE OF PRIMARY HOUSING BUSHING TO FACE OF JACK SHAFT SEAL	5						G					F																									
	DOWEL PINS 0.260 TO 0.270 TO FACE	3					H						F																									
	JACK SHAFT SEAL AGAINST SHOULDER	9							H				F																									
	BEARING FLUSH TO SNAP RING FACE	3												G					F		G																	
	SEAL COMPRESSION HEIGHT	9							H				G						H	H																		
	PRIMARY GASKET SEAL SURFACE FINISH	9		F	F	Y							H	H					H	H					H									G	G			
	OPERATION DAMAGE	5																																				
Weighted Importance		0	81	81	72	0	9	41	0	0	27	54	261	3	0	54	81	0	27	0	45	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Relative Importance			[Bar]	[Bar]	[Bar]		[Bar]	[Bar]		[Bar]	[Bar]	[Bar]	[Bar]		[Bar]	[Bar]	[Bar]		[Bar]		[Bar]	[Bar]	[Bar]															

High/Medium Interactions are causes/failure modes in PFMEA

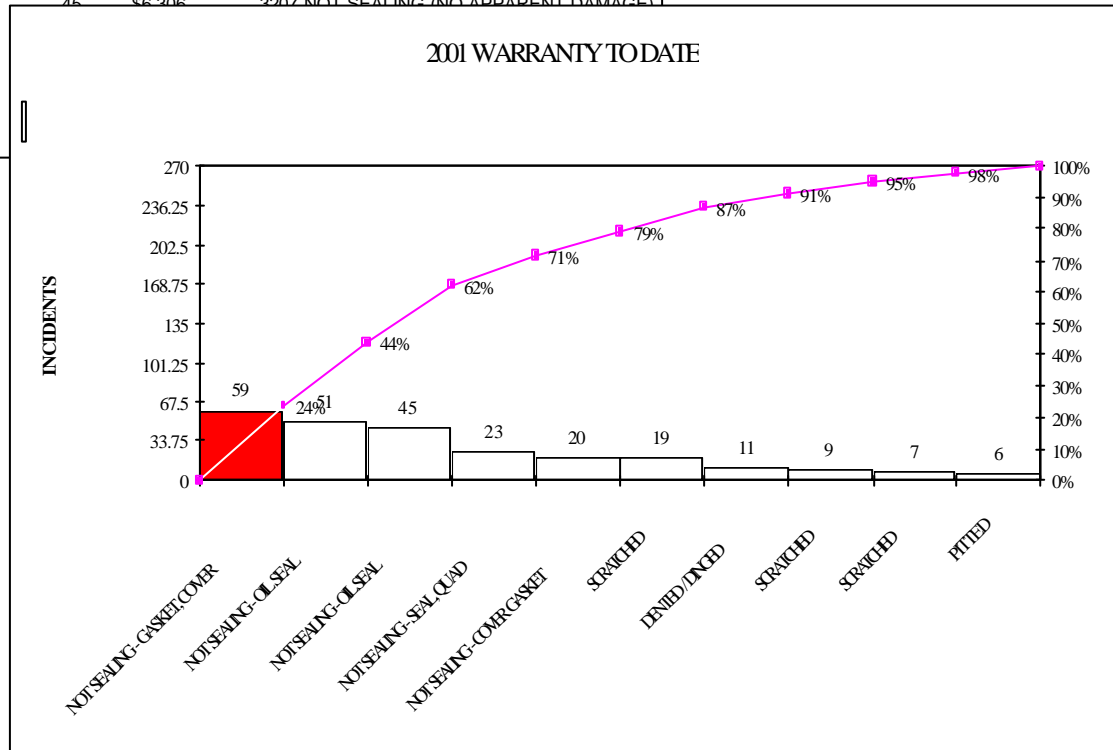
Failure Mode Development

- Developed Through Brainstorming
 - PFMEA Team make-up is crucial for accurate Failure Mode Development
- Internal Failures
- External Failures
 - Warranty Data
- All Stakeholders Considered
 - Internal and External

PFMEA Inputs – Warranty Data

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12066	OIL SEAL	59	\$8,193	45	\$6,206	3207	NOT SEALING (NO APPARENT DAMAGE)
25416-99A	SEAL, QUAD	33	\$261				
60567-90A	PRIMARY COVER GASKET	29	\$377				
60543-99	CHROME PRIMARY COVER	53	\$15,227				
60543-99	CHROME PRIMARY COVER	53	\$15,227				
60562-99	PRIMARY COVER, POLISHED	25	\$6,289				
25414-99	POLISHED DERBY COVER	12	\$404				



Potential Cause Development

- Developed Through Brainstorming
- Information gathered from surrogate problem resolution activities (Corrective Action Reports)
- Manufacturing operators provide the best input to Root Cause Analysis
- A tour of the manufacturing area may identify several possible causes of failure

Process FMEA Linkage

ITEM: Primary Drive Housing Assembly
 Model Year/Vehicle (s):
 Core Team:

Process Responsibility:
 Key Date:

Potential Failure Mode and Effects Analysis (Process FMEA)

Process Function	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) Failure	Occur	Current Process Controls
Op 120 Assemble Transmission Cover	Case not properly assembled - torque inadequate	•Poor handling quality (7) -T to ½ amp inadequate	7	CC	Torque tool malfunction	3	•Weekly calibration •Daily quality audits

•Inputs from process flow

•Anti function
 •Warranty Data
 •From Characteristics Matrix

Customer focus/experience

- end user
- assembler
- maker
- regulatory body

Brainstorm causes

- man
- material
- method
- machine
- environment

Recommended Actions

- Actions are mandatory for ALL failure modes resulting in a Severity of 9 or 10
- Actions recommended for any severity of 5 or higher with an occurrence of 4 or higher
- Actions recommended for any failure modes resulting in a high RPN regardless of Severity X Occurrence combination
- Actions center around reduction of occurrence
 - Improving detection is only used as a temporary measure

PFMEA Selection

