

EA02025

TEXAS INSTRUMENTS, INC.'S

09/10/03 LETTER TO ODI

REQUEST 13

BOX 13

PART A - E

PART E

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 58378A
Revision Level: C
Revision Date: 4-Nov-83
Original (print) Date: 28-Dec-83

System: _____
Subsystem: _____
Component: Program Switch

Design Responsibility: Planning Switch Group

Model Year(s)/Release(s): None

Key Date: 1983

Prepared By: C. Wagner

Core Team: Design Engineers, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S E V E R E	C O N S E Q U E N C E	Potential Cause(s) / Mechanism(s) of Failure	O C C U R E N C E	Current Design Controls	D E T R I M E N T	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Action Taken	S E V	O C C	D E T	R P N	
BASE (P/S) (48313) Provides a system of slots which guide, locate, and physically support terminals.	Fails to properly locate terminals.	Terminals out of position.	5		Incorrect dimensions under tolerances specified between slots and terminals. Inadequate slaking design concept.	1	Comparison with dimensions of similar STPS product.	1	3								
	Fails to properly guide the terminals off-axis insertion.	Device will not assemble properly; shift pins or relay.	6		Incorrect dimensions under tolerances specified between slots and terminals. Insufficient lead-in.	1	Review with assembly equipment designers to determine correct dimensions and lead in.	1	5								
	Fails to properly support the terminals.	Terminals move relative to each other at the base (push or shear) (contact).	6		Incorrect material specified. Excessively large dimensions specified on terminal slots.	1	Comparison with design of similar STPS product.	1	9								
Provides features to enhance the effectiveness of terminal slaking.	Terminal slaking is insufficient.	Loose terminals. Subfunctionalities in signal supports.	5		Inadequate engineering of design of slaking features.	1	Comparison with design of similar STPS product. Slaking investigation.	1	0	CONFIDENTIAL							
Provides a electrical isolation for the electrical elements.	Current leakage between terminals or internal to housing.	Improper slaking action.	5		Low insulation resistance. Incorrect material specified.	1	Comparison with design of similar STPS product. Material evaluation.	1	5								

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(SECTION FWER)

Document Number 503788
Revision Level C
Revision Date 4-Sep-88

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 20-Dec-83

Model Year(s)/Part(s) Version _____

Key Date 1985

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	P o t e n t i a l C o v e r a g e M e c h a n i s m (s) o f F a i l u r e	D e s i g n C o n t r o l	D e t e r m i n e d P. F. M.	R e c o m m e n d e d A c t i o n(s)	Responsibility & Target Completion Date	Action Results						
										Action Taken	S e v e r e	C o n s e q u e n c e	P o t e n t i a l C o v e r a g e	R e c o m m e n d e d A c t i o n		
BASE (P) (4831B) Provides physical location of the switch components.	Fails to physically locate ingress of water from external environment.	High current leakage. High voltage drop. Erratic or inoperative switch action.	6		Insufficient material specified. Poor molded part design i.e. wall thickness too thin, etc.	1		Comparison with design of other SPV product. Design review with vendor. Mold flow analysis.								
Provides a reference surface which locates the electrical elements relative to the pressure sensor.	Fails to properly locate the switch elements relative to the pressure sensor.	Shift in response. Erratic or inoperative switch.	6		Warping of the reference surface. Intrusion of other design elements into the plane of the reference surface. Excessive clearance specified between mating features.	1		Specification of features on print. Finish this surface to prevent intrusion of other elements. Tolerance stackup analysis.								
Provides a flange to compress the internal environmental seal.	Inproper compression of internal environmental seal.	Inadequate compression may lead to ingress of water. Excessive compression may prevent switch from cycling correctly in sensor assembly.	7		Incorrect seal gland design. Warping.	1		Review of standard gland design practice. Comparison to similar products. Features specified on print.								

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System _____
 Subsystem _____
 Component _____ Part/Item Name _____

POTENTIAL
 FAILURE MODE AND EFFECTS ANALYSIS
 (POTENTIAL FAILURE)

Design Responsibility Program SW-62 Group _____

Document Number 503788
 Revision Level C
 Revision Date 4-Nov-88
 Original (issue) Date 20-Dec-83

Model Year(s)/Article(s) Year(s) _____

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	O c c u r e n c e	Current Design Controls	D e t e r m i n e d	R. P. M.	Recommended Actions	Responsibility & Target Completion Date	Action Details					
												Action Taken	S e v e r i t y	O c c u r e n c e	D e t e r m i n e d	R. P. M.	
BASE P/N 148319 Provides interference tabs to locate and temporarily hold the tabs in position to the crimp ring prior to crimp.	Fails to properly locate prior to crimp.	The tabs may cause difficulty in assembly, loose touching, or prevent switch from seating to carrier. Too small provides an effect, possibly affecting subsequent assembly operations.	5		Design of interference tabs is insufficient.	1	Calculation and substantiation to determine limits of tabs. Tolerance stackup analysis.	1	5								
Provides a large surface for the crimp ring.	Fails to provide adequate geometry for crimp ring.	Sharp leads or insufficient taper indicated. Sharp cracked.	7		Incorrect design of shape for crimp ring.	1	Comparison with design of similar MPD product.	1	7		CONFIDENTIAL						
Provides lock tabs, keys, and features which mate to electrical connector.	Mating electrical connector doesn't fit properly.	Connector difficult to install. Connector fills oil.	8		Connector geometry improperly specified.	1	Review of dimensions relative to mating connector pins.	1	8								
Provides compression in environmental test of connector.	Mating connector head is not properly compressed.	Ingress of water into switch cavity. Connector difficult to install under fills oil.	7		Connector geometry under surface ovalness is improperly specified. Incorrect material specified.	1	Review of dimensions relative to mating connector pins. Material analysis.	1	7								

TI-NHTSA 018355

**POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(FORM 781A)**

Document Number: 503789
 Revision Level: D
 Revision Date: 28 May 88
 Original (initial) Date: 20 Dec 83

System: _____
 Subsystem: _____
 Component: Primary Switch

Design Responsibility: FRANCO SERRI (S)

Model Year(s)/Vehicle(s) Variant: _____

Key Date: 1983

Prepared By: C. WISNER

Core Team Data (Experience, Manufacturing Experience, Manufacturing, Quality)

Item Function	Potential Failure Mode	Potential (Effect(s)) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r e n c e	Critical Design Criteria	O c c u r e n c e	R. F. N.	Reinstatement Action(s)	Responsibility & Target Completion Date	Action Required						
												Action Taken	M e t r i c	O b j e c t i v e	D e t e r m i n e d	R. e p o r t e d		
STATIONARY TERMINAL CROSS & 38728)	Provide a loop lead for interconnection.	Device appears opera- tional until mating connector inserted.	7		Contamination of loop leads. Material specified for leads.	1	Review design and dimensions of mating connector to ensure proper interference and wiping action.	1	7									
	leads geometry improper.	Difficult to insert mating connector.	5		Lead-in chamfers on terminal are insufficiently specified. Material specified for leads.	1	Review design and dimensions of mating connector. Comparison with design of similar COTS product.	1	5									
TI-NHTSA 019366	Provides a shor- t-circuit surface for electrical contact.	Device appears opera- tional. Intermittent continuity. High voltage drop.	7		Incorrect contact material specified. Contamination. Silver layer specified for leads.	1	Review of TI specification and general contact design info. Eliminate points for regions of contamination.	1	7		CONFIDENTIAL							
	Excessive loss of contact height dimension (mechanical leads).	Shift to wet points over life.	7		Silver layer specified for leads.	1	Review of TI specification and general contact design info. Life Testing.	1	7									
	Erosion of contacts due to electrical loads.	Shift to wet points over life. Intermittent or no continuity.	7		Incorrect material specified for particular electrical loading.	1	Review of TI specification and general contact design info. Review and testing with actual electrical loads.	1	7									

TI-NHTSA 019366

POTENTIAL
FALLING MOUSE AND EFFECTS ANALYSIS
(COMMON FAILURE)

Document Number: 001700
Revision Lr. #: 0
Revision Date: 28 May 83
Original (Initial) Date: 28 Dec 82

System: _____
Subsystem: _____
K Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Vehicle(s) Variant: _____

Key Date: 1983

Prepared By: C. Wagner

Case Team Dept: Electrical, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S I A V E	C I A S E	Potential Cause(s) Mechanism(s) of Failure	O C C U R E N C E	Current Design Controls	D I F F E R E N C E	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v	O c c u r	D i f f e r e n c e	R. P. N.
STATIONARY TERMINAL (3800 & 38720) Provides Station for device collection.	Force collection	off, yield loss will in anticipate over life.	3		Design is excessively soft. Design has excessive spring back. Material hardness is incorrectly specified. Initial position requires excess deflection to collect. Design has inadequate strength to maintain collection over life.	1	Mechanical (static FEA) analysis Force collection springback testing Testing with actual production collection equipment.	1	5							
Provides feature to engage adequate mating into hole.	Terminal is inadequately retained into hole.	once terminal withdrawn in excess capacity.	7		Incomplete understanding of design of mating feature.	1	Comparison of design with similar SPE product. Sliding experiments.	2	7		CONFIDENTIAL					
Provides feature which mate with hole in base for location of terminal.	Fails to properly mate terminal.	Terminal out of position.	3		Incorrect dimension specified between slot and terminal. Inadequate sliding design contact.	3	Comparison of design with similar SPE product.	1	8		CONFIDENTIAL					
Provides electrical path from wire to contact in mating connector.	Fails to provide adequate conductivity.	High resistance shown on high current drop.	5		Incorrect material specified. Inadequate con- struction.	1	Calculation of resistance Testing	1	5							

TI-NHTSA 019367

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 803780
Revision Level: C
Revision Date: 4-Nov-88
Original (Initial) Date: 28-Dec-83

Page 1

System: _____
Subsystem: _____
X Component: Engine Brake

Design Responsibility: Passage Switch Group

Model Year(s)/Vehicle(s): Various

Key Date: 1983

Prepared By: C. Wagner

Cover Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R e l e v a n c e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R e l e v a n c e	
MYD88E TERMINAL (06887) Provides a brass shell for interconnection.	Form interconnection.	Device appears oper- ational when connector installed.	7		Material specified too thin.	2	Review design and specification of mating connector to ensure proper interference and plating action.	1	7								
	Weld geometry inproper.	Difficult to install mating connector.	6		Lead-in chamfers on terminal not specifically specified. Material specified too thick.	1	Review design and specification of mating connector. Comparison with design of other EVP's product.	1	6								
Provides a counting point for the spring wire test.	Weld to allow proper spring wire installation.	Distortion in switch contacts (some short). Inoperative device (weld falls out completely). Wtg. yield loss.	7		Flux hole size is specified incorrectly. Flux hole position is specified incorrectly. Support surface for spring is incorrectly specified. Choice of solder wire inappropriate.	1	Comparison with design of other products. Check with specifications of flux manufacturer. Testing.	1	7	CONFIDENTIAL							
Provides features to ensure adequate spacing into base.	Terminal is inadequately spaced into base.	Loose terminal. Distortion in switch contacts.	7		Incomplete understanding of design of spring features.	1	Comparison of design with other EVP's product. Solder specification.	1	7								

TI-NHTSA 019368

System _____
 Subsystem _____
 X Component Product Switch

**POTENTIAL
 FAILURE MODE AND EFFECTS ANALYSIS
 (POTENTIAL FAILURE)**

Document Number 983790
 Revision Level C
 Revision Date 4-May-98

Model Name(s)/Part(s) Name(s) _____

Design Responsibility Process Switch Group

Original (Initial) Date 28-Dec-95

Key Date 1998

Prepared By C. Wagner

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	E S S	C I S	Potential Cause(s) / Mechanism(s) of Failure	O C C M I	Current Design Controls	O S C	R P N	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S P V	O C O	D P I	R P N
MOVABLE TERMINAL (MNT) Provides features which mate with slots on base for location of terminal. Provides vertical path from movable contact via spring to mating connector.	Fails to properly locate terminal. Fails to provide adequate conductivity.	Transmits out of position. High resistance shown on high current amp.	3		Incorrect dimensions under tolerance specified between slots and terminals. Inadequate spacing design control.	3	Comparison of design with similar NPS product.	1	0		CONFIDENTIAL					
					Incorrect material specified. Inadequate inter-section gap.	1	Calculations of resistance Testing	1	5							

TI-NHTSA 019369

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PRELIMINARY)

Document Number 663792
Revision Level C
Revision Date 4 Apr 88

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (initial) Date 20-Dec-87

Model Year(s)/Model(s) Various

Key Date 1988

Prepared By C. Winger

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k P. e l. e v. e n. t	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Action Taken	S u c c e s s	O n c o u r s e	O u t s t a n d i n g	R e p e r t i n g		
SPRING (3000) Provides contact force	Low contact force	High without drop across contacts.	8		Incorrect geometry specified. Incorrect material specified.	3	Stress deflection equations. Force-deflection testing.	1	15									
	High contact force.	Stall in outpoints. Elec. arcing over life.	7		Incorrect geometry specified. Incorrect material specified.	3	Stress deflection equations. Force-deflection testing.	1	21									
Provides electrical path from movable contact to movable terminal.	Fails to provide adequate conductivity.	High resistance across or high without drop.	5		Incorrect material specified. Inadequate cross-sectional area.	1	Calculations of resistance using $R = \rho(l/A)$ Testing	1	5									
Provides feature to interface with another pin.	Fails to interface correctly with another pin.	Spring failure over life. Stall in outpoints over life. Misfiring transfer pin causes intermittent operation.	7		Inadequate height of feature specified. Inadequate shape of feature specified. Improper position of feature specified.	1	Comparison of design with similar product. Dimension and tolerance stacking analysis. Actual measurement. Testing	1	7		CONFIDENTIAL							
Provides feature for attachment to movable contact.	Fails to provide adequate mounting for movable contact.	Intermittent or erratic operation. Open circuit.	6		Pin disposition incorrectly specified. Fit/force inadequate.	1	Fit/relief calculations. Comparison of design with similar product. Testing	1	6									
Locates movable contact	Fails to adequately locate movable contact relative to stationary contact.	High without drop over life. Excessive contact erosion gear life.	7		Spring geometry incorrectly specified.	1	Dimension and tolerance stacking analysis. Testing	1	7									

TI-NHTSA 019380

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)**

Document Number 583792
 Revision Level C
 Revision Date 4-09-85
 Original Issue Date 20-Dec-83

System _____
 Subsystem _____
 E. Component Passive Switch

Design Responsibility Passive Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1988

Prepared By C. Whittier

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Situations of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e r m i n e d	C o n t r o l	D e t e r m i n e d	R. P. N.	R e c o m m e n d e d A c t i o n (s)	Responsibility & Target Completion Date	Action Items							
												Action Taken	E v e n t	C o n c e p t	D e t e r m i n e d	R. P. N.			
Connect (switch)	Fails to properly attach to movable terminal	Event or intermittent operation. Switch in open state. Open or short circuit.	6		Sheet hole size or position incorrectly specified. Fitless terminals. Choice of terminal style incorrect.	1			1	4									
Allow disc contact mat.	Fails to allow disc separation.	Switch in open state. Disc cracking. Device inspection at assembly. Poor alignment.	6		Incorrect geometry specified. Incorrect material specified.	2			1	4		CONFIDENTIAL							
Provides force to open contacts.	Insufficient force to open contacts	Insufficient attachment to mechanical support. Short circuit.	6		Incorrect geometry specified. Incorrect material specified.	1			1	4									
	Excessive force to open contacts.	Switch in open state. Disc cracking. Device inspection at assembly. Poor alignment.	7		Incorrect geometry specified. Incorrect material specified.	3			1	21									

TI-NHTSA 019361

**POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
FOR THE FMEA**

Document Number 503794
 Revision Level C
 Revision Date 4-Nov-88
 Original (date) Date 20-Dec-83

System _____
 Subsystem _____
 Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Mode(s) of Failure	S E V E R I T Y	C O N S I D E R E D	Potential Cause(s) Mechanism(s) of Failure	D I S C R I M I N A T O R Y	Current Design Controls	D E T E R M I N E D	R I S K	Recommended Action(s)	Responsibility & Target Completion Date	Action Request			
												Action Taken	S E V E R I T Y	O C C U R E N C E	D E T E R M I N A T O R Y
GASLET (ACMS) Provides field seal between input and output.	Fails to provide adequate field seal.	Seals field leakage.	5	1	Insufficient compressor specified. Very excessive compressor specified, leading to displacement from gland. Incorrect ID and/or OD leading to displacement from gland. Incorrect cross-section shape specified. Incorrect material specified, field incompatibility. Incorrect design of field mechanism.	1	Review of general seal design principles. Manufacturer's recommendations. Burst, rupture, and thermal cycle tests. Comparison with design of similar products.	1	5		CONFIDENTIAL				

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 583795
Revision Level C
Revision Date 4-Mar-93
Original Draft Date 20-Dec-92

System
Subsystem
X Component Pressure Switch

Design Responsibility Process Batch Group

Model Year(s)/Release(s) 1993

May Date 1993

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	P o t e n t i a l C a u s e(s) M e c h a n i s m(s) o f F a i l u r e	O c c u r r e n c e	C o n s e q u e n c e	D e t e c t i o n	R. i. P. o n s. e	R. e c o m m e n d e d A c t i o n(s)	Responsibility & Target Completion Date	Action Required					
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e c t i o n	R. i. P. o n s. e	
CUP DIVISOR 27290 Provides compatible seal which holds pressure sensor together.	Fails to provide a suitable geometry for cup.	Leakage. Low level	5		Cup wall thickness incorrectly specified. Cup wall weight incorrectly specified. Incorrect material specified.	1				Shut and inspect testing. Comparison of design with similar product.							
Locates support, diaphragm, and washer	Fails to correctly locate support, diaphragm, or washer.	Difficult assembly.	5		LD specified incorrectly.	1				Tolerance stackup analysis.							
Provides support and location for disc	Fails to support and locate the diaphragm correctly.	Shift in supports. Erratic operation. Stuck open at assembly. Reduced disc life.	7		Incorrect disc overlap specified. Bump two-position incorrectly specified. Face surface condition of bump, as control specified.	1				Tolerance stackup analysis. Inspect testing.							
Provides guide for transfer pin.	Fails to guide transfer pin correctly.	Erratic operation. Device stuck closed.	7		Pin guide geometry is incorrectly specified.	1				Tolerance stackup analysis.							
Provides portion of environmental seal gland.	Fails to allow a proper environmental seal.	Ingress of matter. Switch does not seal correctly to cup.	7		Surface condition required for good seal not maintained or not correctly specified. Geometry incorrectly specified.	1				Environmental testing. Switch cavity preservation testing. Review of standard seal design rules.							

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TI-NHTSA 019363

POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(FMEA/FMEA)

Document Number: 503785
Revision Level: C
Revision Date: 4-Nov-85
Original (Initial) Date: 20-Dec-83

Page 2

System: _____
Subsystem: _____
K Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Vehicle(s): _____

Key Date: 1985

Prepared By: C. Utiger

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	C	Potential Cause(s) / Mechanism(s) of Failure	O	Control Design Controls	D	E	R	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	S	O	D	R
CUP 27713 OR 27288 Provide surface for interface with base/switch assembly.	Fails to properly locate relative to switch.	Shift in operation. Erratic or insensitive switch.	5		Incorrect geometry of mating surface specified.	1	Tolerance stacking analysis. Cross-section sketch device for inspection of interface.	1	5		CONFIDENTIAL						
Proof seal - (crimp) provides economy for final assembly with crimp ring.	Fails to allow proper final assembly with crimp ring.	Erratic operation. Ingress of water. Cracked base.	7		Poor crimp geometry is not controlled per design intent. Cup diameter incorrectly specified.	1	Tolerance stacking analysis. Flow through testing.	1	7								

TI-NHTSA 019384

POTENTIAL
FALLING MODE AND EFFECTS ANALYSIS
(FORM 900 FWH)

Document Number 583786
Revision Level D
Revision Date 4-Nov-98
Original (Initial) Date 20-Dec-93

System
Subsystem
Component Program Switch

Design Responsibility Program Switch Group

Model Year(s)/Phase(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	C	Potential Cause(s) / Mechanism(s) of Failure	D	C	Current Design Controls	D	R	P	M	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
															Actions Taken	S	C	D	R
DISPERSED (OR SEAL) (SR) (74178) Forms Sealable element of fluid containment cavity	Failure to contain fluid.	Fluid leakage.	9	1	Cracked cap over life due to improper design of supporting elements.	1	1	Short impulses, and thermal cycle tests.	1	5	1	5	Minimal only recommendations.	Completion of design with similar products.	CONFIDENTIAL				
					Cracked cap over life due to excessive manufacturing tolerance.			Cracked cap over life due to stress concentrations caused by asymmetric strain distribution.											
Transfer pressure from fluid to pressure-transmitting elements.	Change in area of pressure transfer over life. Excessive change of pressure transfer area versus pressure.	Seal is subjected over life. Excessively high pressures needed to adequately flow pressure transfer over wide angles on supports due to irregularity at lower pressure.	9	1	Dielectric too stiff. Increased material specified.	1	1	Life testing of characteristics of intermediate points.	1	5	1	5							
					Dielectric too stiff.			Force and pressure versus deflection testing to calculate effective areas.											

TI-NHTSA 019385

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(FORM FMEA)

Document Number: 883797
Revision Level: C
Revision Date: 4-26-95
Original (Initial) Date: 28-Dec-93

Page 1

System: _____
Subsystem: _____
X Component: System Switch

Design Responsibility: Program Switch Group

Model Year(s)/Vehicle(s) Variant: _____

Key Date: 1993

Prepared By: C. Wagner

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	O c c u r r e n c e	Potential Cause(s) (Mechanism(s) of Failure)	O c c u r r e n c e	Control Design Controls	D i s c r i m i n a t e	R i s k P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Required				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D i s c r i m i n a t e	R i s k P. N.
<p>MAINDER (P/S) (27000)</p> <p>Provides a portion of the support surface for diaphragm.</p>	Fails to correctly support the diaphragm.	Reduced diaphragm life results in leakage.	6	1	<p>Curvature of diaphragm support surface not specified accurately.</p> <p>Condition of edges of support surface specified inaccurately.</p> <p>Clearance between member I.D. and converter bump is specified too wide.</p>	1	<p>Start, Inspect, and Thermal Cycle Tests.</p> <p>Comparison of design with similar products.</p>	1	5							
Provides support for compression of gasket.	Fails to allow proper gasket compression.	Leakage.	6	1	<p>Washer distance is incorrectly specified or unspecified.</p> <p>Washer thickness is specified too small.</p> <p>Washer material under test used is incorrectly specified.</p>	1	<p>Start, Inspect, and Thermal Cycle Tests.</p> <p>Comparison of design with similar products.</p>	1	5							
Locates and guides converter with respect to cap.	Converter is not properly located relative to cap.	Will be outpoints.	6	1	<p>Incorrectly specified button guide I.D.</p> <p>Incorrectly specified button O.D.</p>	1	<p>Comparison of design with similar products.</p> <p>Tolerance stackup analysis.</p>	1	8							
	Converter head is restrained by member.	Will cause release; results in shock operation.	7	1	<p>Washer distance is incorrectly specified or unspecified.</p> <p>Washer thickness is specified too small.</p> <p>Washer material under test used is incorrectly specified.</p> <p>I.D. of button guide is too small.</p>	1	<p>Start, Inspect, and Thermal Cycle Tests.</p> <p>Comparison of design with similar products.</p> <p>Tolerance stackup analysis.</p>	1	7							

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TI-NHTSA 019386

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number 503292
Revision Level C
Revision Date 4-Mar-86
Original (Initial) Date 20-Dec-83

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Article(s) Model

Key Date 1983

Prepared By C. Wagner

Core Team: Design Engineering, Manufacturing Engineering, Maintenance, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	C o n s e q u e n c e s	I m p a c t s	Potential Cause(s) / Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R e l a t i v e	P r i o r i t y	Recommended Actions	Responsibility & Target Completion Date	Action Status					
													Actions Taken	S e v e r e	O c c u r r e n c e	D e t e r m i n e d	R e v i s e d	
WASHER PIN (27838) Interacts with cap bottom and provides a guide of component stack for clamp.	Fails to interface correctly with cap.	Critical assembly greater O.D. the design. Poor workmanship location relative to cap greater O.D. the design.	7		Washer O.D. specified incorrectly.	1	Comparison of design with similar projects. Tolerance stackup analysis.	1	7									
	Fails to allow proper wiring.	Reduced burst capability leads to leakage. Fluxural fatigue resistance leads to leakage.			Dimension incorrectly specified. O.D. incorrectly specified. Edge condition incorrectly or unspecified.		Tolerance stackup analysis. Burst, fatigue, and Thermal Cycle tests.											

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503788
Revision Level E
Revision Date 13-May-88
Original (Title) Date 28-Dec-85

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Prepared By Di Ho

Model Year(s)/Function 1983

Key Date 1983

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r e n c e	Critical Design Controls	D e t e r m i n e d	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Number			
												S e v e r e	O c c u r e n c e	D e t e r m i n e d	R e p a r t u r e
CONVERTER PSI (27402) Transfer pressure from fuel jets (diaphragm) to a lock or pressure sensing disc.	Fails to correctly transfer fuel pressure to lock or disc.	Fail to operate	5	C	Ballon O.D. incorrectly specified relative to washer I.D.	1	Tolerance stacking analysis.	1	5	CONFIDENTIAL					
					Converter major O.D. incorrectly specified relative to cap I.D.		Force/deflection analysis to determine strength and resistance to plastic deformation, stress, fatigue, and thermal cycle tests.								
TI-NHTSA 019388 Provides alignment and support to disc.	Fails to properly align and support disc.	Loose tolerances allow misalignment which may cause shift in supports or create squeal. Disc out-of-place relative to converter may cause erratic operation or impingement (noise, shock operation).	5	C	Ballon O.D. incorrectly specified relative to washer I.D.	1	Tolerance stacking analysis.	1	5	CONFIDENTIAL					
					Converter major O.D. incorrectly specified relative to cap I.D.		Comparison of design with similar product. Disc support hole incorrectly specified. Disc retaining wall incorrectly specified.								

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)**

Document Number: 503786
 Revision Level: E
 Revision Date: 13-May-88
 Original (Initial) Date: 28-Dec-83

System: _____
 Subsystem: _____
 Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Prepared By: D. H.

Model Year(s)/Vehicle(s) Variant: _____

Key Date: 1983

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C i r c u l a r i t y	Potential Cause(s) / Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e c t i o n	R e p a r a b l e n e s s	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												Action Taken	S e v e r i t y	C i r c u l a r i t y	D e t e c t i o n
CONVERTER PCV (27488) Provides a cushion of air between the support surface for diaphragm.	Fails to properly support diaphragm.	Reduced diaphragm life results in leakage.	0		Condition of surface in contact with diaphragm are specified incorrectly. Condition of edges in contact with diaphragm are specified incorrectly. Clearance between converter base and inletter I.D. are specified incorrectly.	1	Short, impact, and Thermal cycle tests. Comparison of design with similar product.	1	0	CONFIDENTIAL					
Provides air support during over pressure (occasional).	Fails to properly support disc during over pressure.	Disc deformation results in shift in setpoints. Reduced disc travel if disc location is restricted permanently. Reduced disc life.	0		Features which caused disc motion during over pressure are incorrectly specified.	3	Pre and post proof characteristics. Pressure-deflection measurements of disc motion.	1	0						
Shift in converter prevents pressure buildup from affecting setpoints.	Disc not vent properly.	Shift in setpoints over temp. Reduced disc temp.	3		Vent hole incorrectly specified.	1	Comparison of design with similar product. Temperature characteristics.	1	0						

TI-NHTSA 019389

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(FORM PMSA)**

Document Number 503798

Page 1

Revision Level C

Revision Date 4-Mar-88

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Project Staff/Chief

Original (initial) Date 20-Dec-83

Model Year(s)/Vehicle(s) Yukon

Key Date 1983

Prepared by C. Hopper

Case Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S		Potential Cause(s) Mechanism(s) of Failure	O		Current Design Controls	D		Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
			1	2		1	2		1	2			S	O	D	R
SPACER (PMSA) Reduce friction between disc and converter	Fails to effectively reduce friction.	Shift in setpoints over life. Reduced disc life.	4		Incorrect material specified. Incorrect dimensions specified.	1		Angular and Thermal Cycle tests. Fit- and Post-life characterization. Temperature storage analysis.	1	S		CONFIDENTIAL				
Allow venting of chamber formed by disc and converter	Fails to allow venting.	Shift in setpoints over time. Reduced disc action.	5		Vent hole incorrectly specified.	1		Comparison of design with similar product. Temperature characterization.	1	S						

TI-NHTSA 019370

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN PHASE)**

Document Number 503808
 Revision Level C
 Revision Date 4-Mar-88
 Original (Initial) Date 29-Dec-87

System _____
 Subsystem _____
 X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Model(s) Various

Key Date 1988

Prepared By C. Winger

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	D e t e r m i n e d	Current Design Controls	D e t e r m i n e d	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Required				
												Action Taken	S e v e r e	C o n s e q u e n c e	D e t e r m i n e d	R. P. N.
DISC (2000) Controls selection and release and points of switch relative to applied force.	Fails to actuate under release at the proper points of assembly.	Wg. joint loss.	6		Disc material improperly specified. Characteristics and tolerances improperly specified.	1	Characterization requirements. Comparison of design with similar product.	1	6							
Key component in driving stable service life of device.	Disc actuates under release at points change progressively over life.	Still in device at points over life.	5		Disc material improperly specified. Disc test-test improperly specified. Material thickness improperly specified. Excessive force applied by spring.	1	Impact testing. Pre- and post-characterization.	1	5	CONFIDENTIAL						
	Device life shorter than customer requirements.	Device still in operation over life. Device inoperative - open circuit.	7		Disc material improperly specified. Disc test-test improperly specified. Material thickness improperly specified. Excessive force applied by spring.	1	Impact testing. Pre- and post-characterization.	1	7							

TI-NHTSA 019371

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(FORM FMEA)**

Document Number 503861
 Revision Level C
 Revision Date 4-Nov-88
 Original (initial) Date 20-Dec-83

System _____
 Subsystem _____
 X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Version(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Priority					
												Action Taken	R e v	O c c	D e t	R i s k	
CRIMP RINGS (74/75) Hold together brass assembly and sensor assembly.	Fails to hold brass assembly correctly.	Cracks within operation. Checked tape. Still in operation. Low level tapes utilized.	6		Incorrect geometry of crimpable end specified. Incorrect geometry of flared end. Incorrect material specified.	3	Regular, flared ends, have tapes, and standardized inspect tests.	1	10								
Provides a surface for part identification/cable code	ID characters illegible.	Improperly identified parts at assembly plant	2		Geometry/dimensions not properly specified. Wrong material specified.	1	Coding tests. Environmental tests.	1	2		CONFIDENTIAL						
Improve environmental protection and resistance to shock.	Ability to withstand environment.	Corrosion caused material consumption, loss of mechanical properties, switch possibly fails at power. Switch failing.	7		Wrong material specified.	1	Environmental tests.	1	7								
Provide instructions to change size etc. of crimp.	Insufficient instructions.	Missed dimensions/specs on external device functions.	5		Incorrect or insufficient spec specified.	1	Crimping tests.	1	5								

TI-NHTSA 019372

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN PMEA)

Document Number 5E3802
Revision Level C
Revision Date 4-Nov-88
Original (initial) Date 29-Dec-82

Page 1

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1985

Prepared By C. Wagner

Core Team Design, Electronics, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e s	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e r a t e	Critical Design Constraints	D i s t r i b u t i o n	P. W.	Recommended Action(s)	Responsibility & Target Completion Date	Action (month)				
												Actions Taken	S e v e r i t y	O c c u r r e n c e r a t e	D i s t r i b u t i o n	P. W.
TRANSFER PIN (74079) Transfer slide motion in provide electrical contact	Fails to properly transfer slide motion.	Contacts short open. Contacts short closed. Excess operation.	7		Diameter incorrectly specified. Chip/dimples cause pin to seize.	1	Tolerance stacking between pin and pin guide in cup. Check with supplier for material properties regarding chips.	1	7		CONFIDENTIAL					
Isolates electrical components from switch housing.	Fails to isolate.	Continuity between movable terminal and housing to ground.	6		Wrong material specified.	1	Check with supplier for material properties. Check with customer for electrical type of movable terminal.	1	6							

TI-NHTSA 019373

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)**

Document Number: 501802
 Revision Level: C
 Revision Date: 4-Nov-93
 Original (Initial) Date: 20-Dec-93

System: _____
 Subsystem: _____
 Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Vehicle(s) Name(s): _____

Key Date: 1993

Prepared By: C. Wagner

Cost Team: Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e c t a b i l i t y	Control Design Controls	D e t e c t a b i l i t y	P. F. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Action Taken	S e v e r i t y	C o n s e q u e n c e	D e t e c t a b i l i t y	P. F. N.		
Transfer disc motion at movable electrical contact.	Fails to properly transfer disc motion.	Contact stack open.	7		Discs not properly specified.	1	Tolerance stacking between pin and pin guide in top.	1	7	CONFIDENTIAL								
		Contact stack closed.			Chip fragments cause pin to wedge.		Check with supplier for material properties. Inspecting chips.											
Contact open/closed.																		
Prevents electrical components from switch heating.	Fails to insulate.	Contact between movable terminal and housing to ground.	5		Wrong material specified.	1	Check with supplier for material properties. Check with customer for material type of movable terminal.	1	5	CONFIDENTIAL								

TI-NHTSA 019374

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(SHELL FMEA)

Document Number 503803
Revision Level C
Revision Date 4-Nov-85
Original (Initial) Date 28-Dec-83

Page 1

System _____
Subsystem _____
X Component Propose Switch

Design Responsibility Propose Switch Group

Model Year(s)/Vehicle(s) 1985

Key Date 1985

Prepared By C. Wigger

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing Quality

row / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Control Design Controls	D i f f e r e n c e	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Action Taken	S e v e r e	O c c u r r e n c e	D i f f e r e n c e	R e p a r t u r e	
ENVIRONMENTAL SEAL (74247)										CONFIDENTIAL							
Prevents ingress of matter to switch cavity.	Contaminants enter switch cavity.	High current leakage High voltage drop. Stalls or inoperative switch operation.	7		Control thickness is specified too small. Lacks a) properly seal specified. Inadequate material	1	Review of standard practices for gasket design. Design with gasket manufacturer Comparison of design with similar product.	1	7								
Provides friction to aid in reversing base rotation	Base rotates too easily.	Perceived as inadequate by assembly plant under certain conditions.	5		Control thickness improperly specified.	1	Review of standard practices for gasket design. Temper-to-rotate testing. Comparison of design with similar product.	1	5								

TI-NHTSA 018376

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PFMEA)

Document Number 507883

Page 1

Revision Level C

Revision Date 4-Nov-88

System
Subsystem
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 28-Dec-83

Master Yawp/Vehicle(s) Yawp

Key Date 1983

Prepared By C Wagner

Core Team (Design Engineers, Manufacturing Engineers, Manufacturing Quality)

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n t r o l s	P o t e n t i a l C o n t r o l s (M e c h a n i s m s) of Failure	D e t e c t i o n	C o n t r o l s	D e t e c t i o n	R e s p o n s i b i l i t y	P r e v e n t i o n	P o t e n t i a l A c t i o n (s)	R e s p o n s i b i l i t y & Target Completion Date	Action Items				
													Y e a r	M o n t h	D a y	P e r s o n	S t a t u s
ENVIRONMENTAL SEAL (74267) Provides ingress of water to switch cavity.	Contaminants enter switch cavity.	High current leakage High contact drop. Stalls or improper switch operation.	7		Contact thickness is specified but weak. Limits on geometry not specified. In-Covered contact.	1	Review of standard practices for glass design. Review with glass manufacturer. Comparison of design with similar product.	1	7		CONFIDENTIAL						
Provides friction to aid in covering lens rotation.	Base rotates too easily.	Prevented as indicated by assembly plant under service program.	5		Contact thickness improperly specified.	1	Review of standard practices for glass design. Turns-to-rotate testing. Comparison of design with similar product.	1	5			CONFIDENTIAL					

TI-NHTSA 019376

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(FORM FMEA)

Document Number 503804
Revision Level C
Revision Date 4-29-90
Original (initial) Date 28-Dec-85

Page 1

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model (temp/altitude) System

Key Date 1985

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S		Potential Cause(s) Mechanism(s) of Failure	O	Current Design Controls	D	R	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
			1	2								Severity	Detectability	Preventability	Repairability
THREAD CAP (74888) Protects integral threads from damage during shipping and handling Prevents dust from entering the fuel cavity	Increased length	Does not protect threads sufficiently.	4	1	Length incorrectly specified.	1	Dimensional check only.	1	6						
	Loose Cap	Allows dust to enter fuel cavity.	4	1	Incorrect diameter specified.	1	Dimensional analysis.	1	4						

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TL-NHTSA 019377

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FAILURE)

Document Number: 45825
Revision Level: C
Revision Date: 20-Oct-88

Page 1

System: _____
Subsystem: _____
X Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Original (Initial) Date: 20-Oct-88

Model Name(s)/Vehicle(s): Various

Key Date: 1988

Prepared By: C. Wagon

Case Team: Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Control Design Controls	D e t e c t i o n	R. P. M.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results							
												Action Taken	S e v e r i t y	C o n s e q u e n c e	D e t e c t i o n	R. P. M.			
REPORT [blank]																			
Provides a hydraulic sealing surface per SAE J512.	Fails to seal.	Leakage of brake fluid.	9	FF	Incorrect surface finish specification. Incorrect material specification. Incorrectly specified geometry. Excessive pressure.	1	Cross-check of pilot dimensions vs. SAE standard. Comprehensive evaluation of design at tolerance levels. Burn testing to confirm specified tests.	1	8										
Provides external thread for installation into rotating part.	Fails to properly install in rotating part.	Damage to seals in rotating part during installation. Does not allow installation.	7	FF	Threads specified improperly. Threads not gauged per AMS spec. Pitting failure.	3	Cross-check of applicable SAE and AMS standards.	3	sh										
	Improperly installs, but fails to properly seal and seal.	Brake fluid leakage.	9	FF	Threads specified improperly. Threads not gauge per AMS spec. Pitting failure.	1	Cross-check of applicable SAE and AMS standards.	3	27										
Provides line cutback for 3/16" switch.	Incorrect line size.	Damage to line with during assembly. 3/16" switch does not fit.	5		Line feature improperly specified per established SAE/AMS spec's.	1	Cross-check of applicable SAE and AMS standards.	1	5										
Provides fluid passage to pressure sensing element.	Fluid passage is too small.	Electrical signal from switch is delayed vs. pressure signal proportionality of very low range. Subject to blockage by foreign matter.	7	FF	Integrate size of fluid passage specified.	1	Review of Ford standard practices. Review of industry practices.	1	7										
	Fluid passage is too large.	Preventing this will exceed desired range: during installation during unattended service operations	7	FF	Fluid passage specified excessively large.	1	Torque testing.	1	7										

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TI-NHTSA 019378

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DEFINITION FMEA)

Document Number: 58365
Revision Level: C
Revision Date: 29-Oct-95
Original (Initial) Date: 28-Dec-83

System: _____
Subsystem: _____
Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Name(s)/Model(s) Number: _____

Key Date: 1995

Prepared By: C. Weyer

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r e n c e	Current Design Controls	D e t e r i n i n g	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results							
												Action Taken	E v e n t	O c c u r e n c e	D e t e r i n i n g	R. P. N.			
EXPORT (2000)																			
Provides gland for external gland.	Flange to seal internal gland properly.	Leakage of brake fluid.	3		Gland dimensions improperly specified. Surface finish improperly specified. Gland geometry incorrectly defined.	1	Cross-check with recommendations of gland supplier. Compression testing.	1	9										
Provides flange which interfaces with other components to form pressure-sensor structure.	Flange fails to mate properly with other components of pressure sensor.	Dis. too large results in assembly difficulty. Diameter too small results in lost component alignment. Flange too thick results in poor mating. Flange too thin results in reduced burst capacity. Improper edge chamfer results in stress concentration which reduces mating.	3		Improper or incomplete specification of dimensions and tolerances.	1	Experiments and analysis to determine proper thickness for required strength. Tolerance stack-up analysis. Part supplier.	1	9										
	Material too soft or weak.	Inadequate burst capacity. Damage/overage during installation or subsequent service. Threaded parts to damage. Leads to assembly difficulty.	3		Improper material selection.	1	Comprehensive evaluation of physical properties.	1	9			CONFIDENTIAL							
	Material creeps.	Loosening of clamp leads to leakage.	3		Improper material selection.	1	Review of material properties.	1	8			CONFIDENTIAL							
	Material degrades in presence of working fluids.	Leakage	3		Improper material selection.	1	Cross-check with similar products.	1	8			CONFIDENTIAL							
	Inefficient environmental protection.	Long term attack causes weakening of key areas which leads to leakage or breakage.	3		Improper or insufficient plating specification.	1	Comparative environmental testing.	3	17			CONFIDENTIAL							

TI-NHTSA 019378

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DDMCM FORM 3)

Document Number 563865

Page 2

Revision Level C

Revision Date 29-Oct-85

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 29-Dec-83

Model Year(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	C I S S		Potential Cause(s) Mechanism(s) of Failure	D C M I	D I P C		Recommended Action(s)	Responsibility & Target Completion Date	Action Planned				
			S	I			S	O			D	R			
REPORT ACTION Provides design input information with other components to form pressure switch design.		Control problem.				1	2	27							

CONFIDENTIAL

TI-NHTSA 019380

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 508770 Page 1

Revision Level B
Revision Date 5-Nov-95

System _____
Subsystem _____
X Component Fusible Switch

Design Responsibility Fusible Switch Group

Original (Date) Date 20-Dec-93

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By D. Ho

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o s t	Potential Cause(s) Mechanism(s) of Failure	O c c u r r	Current Design Controls	D e t e r m i n e	H i g h P. R.	Recommended Action(s)	Responsibility & Target Completion Date	Action Verdict				
												Action Taken	B e t t e r	D e c i d e	D e c i n e	R e p l a c e
SOLET (74818) Fastens spring to movable terminal. Provides a force between movable terminal and spring which causes intimate contact for current flow.	Fails to adequately fasten spring to movable terminal. Spring rotates about axis of rivet. Spring falls off movable terminal.	Spring rotates about axis of rivet. Spring falls off movable terminal.	6		Improper rivet diameter for given hole size. Improper rivet length for given material thickness. Improper head size. Improper tabular features. Improper material.	1	Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to rotate spring.	1	6							
	Inadequate force between spring and movable terminal.	High resistance or no continuity at interface of spring and movable terminal.	High resistance or no continuity at interface of spring and movable terminal.	6		Improper rivet diameter for given hole size. Improper rivet length for given material thickness. Improper head size. Improper tabular features. Improper material.	1	Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to rotate spring.	1	6		CONFIDENTIAL				

TI-NHTSA 019382

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503785
Revision Level C
Revision Date 4-Nov-88

Page 1

System _____
Subsystem _____
K Component Features Set(s) _____

Design Responsibility Power Switch Group

Original (Issue) Date 28-Dec-83

Model Year(s)/Vehicle(s) Various

Key Date MSJ

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) (Mechanism(s) of Failure)	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R i s k
BASE (P8) 463154 Provides a system of slots which guide, locate, and physically support terminals	Fails to properly locate terminals.	Terminals out of position.	3		Incorrect dimensions (width tolerances) specified between slots and terminals. Inadequate slating design control.	1	Comparison with dimensions of similar STPS product.	1	3						
	Fails to properly guide the terminals in difficult insertion.	Device will not assemble properly; yield loss is high.	1		Incorrect dimensions (width tolerances) specified between slots and terminals. Insufficient lead-in.	1	Review with assembly equipment designers to determine correct clearance and lead in.	1	5						
	Fails to properly support the terminals.	Terminals move relative to each other or the frame (such as under physical or thermal loading).	5		Incorrect material specified. Excessively large dimensions specified on terminal slots.	1	Comparison with design of similar STPS product.	1	5						
Provides features to enhance the effectiveness of terminal slating	Terminal slating is insufficient.	Loose terminals. Misalignment in switch assembly.	5		Incomplete understanding of design of slating features.	1	Comparison with design of similar STPS product. Slating evaluation.	1	5						
Provides a electrical interface for the electrical elements	Current leakage between terminals or terminal-to-housing	Improper switching action.	5		Low insulation resistance Incorrect material specified	1	Comparison with design of similar STPS product. Material evaluation.	1	5						

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TI-NHTSA 018383

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 583786
Revision Level C
Revision Date 4-May-88
Original (Initial) Date 20-Dec-83

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) 1983

Key Date 1983

Prepared By C. WOOD

Core Team Design Engineers, Manufacturing Engineers, Manufacturer's Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	C	Potential Cause(s) Mechanism(s) of Failure	C	Current Design Controls	D	R	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Occurrence	Severity	Priority	Open	Close	Delay
BASE (P8) (P8513) Provides physical isolation of the switch components	Fails to physically isolate: ingress of water from engine compartment.	High current leakage. High voltage drop. Erratic or inoperative switch action.	1	1	Incorrect material specified. Poor material part design (i.e. wall sections too thin, etc.	1	Comparison with design of similar SVP's product. Design review with supplier. Material flow analysis.	1	1								
Provides a reference surface which locates the electrical elements relative to the pressure sensor	Fails to properly locate the switch elements relative to the pressure sensor	Shift in setpoints. Erratic or inoperative switch.	5	1	Warpage of the reference surface. Inclusion of other design elements into the plane of the reference surface. Excessive clearance specified between mating features.	1	Specification of tolerance on part. Polish this surface to prevent inclusion of other elements. Tolerance stackup analysis.	1	3								
Provides a flange to compress the internal environmental seal	Improper compression of internal environmental seal	Inadequate compression may lead to ingress of water. Excessive compression may prevent switch from seating correctly to sensor assembly.	7	1	Incorrect seal gland design. Warpage.	1	Review of standard gland design practice. Comparison to similar products. Fitness specified on print.	1	7								

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TI-NHTSA 019384

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number EDDNE
Revision Level C
Revision Date 4 Nov 85

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Date) Date 26 Dec 83

Model Year(s)/Model(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	P o t e n t i a l C o v e r e d M e c h a n i s m (s) of Failure	O c c u r r e n c e F r e q u e n c y	C u r r e n t D e s i g n C o n t r o l s	D i s c r i m i n a t e	R e p a r a b l e n e s s	R e c o m m e n d e d A c t i o n (s)	R e s p o n s i b i l i t y & Target Completion Date	Action Results					
												A c t i o n T a k e n	S e v e r i t y	C o n s e q u e n c e	D i s c r i m i n a t e	R e p a r a b l e n e s s	
BASE (PC) 48013; Provides reference tabs to locate and temporarily hold the base in relation to the crimp ring prior to crimp.	Fails to properly locate/hold prior to crimp.	Too large may cause difficulty in assembly, base cracking, or prevent switch from sealing to sensor. Too small provides no effect, possibly affecting subsequent assembly operations.	5		Design of reference tabs is insufficient.	1	Calculation and experimentation to determine limits of size Tolerance stacking analysis.	1	5								
Provides a flange surface for the crimp ring.	Fails to provide adequate geometry for crimp ring.	Flange large or insufficient taper withstand flange cracked.	7		Incorrect design of flange for crimp ring.	1	Comparison with design of similar SPS product.	1	7		CONFIDENTIAL						
Provides lock tabs, keys, and features which mate to electrical connector.	Mating electrical connector doesn't fit properly.	Connector difficult to install. Connector falls off.	6		Connector geometry improperly specified.	1	Number of dimensions relative to mating connector parts.	1	6		CONFIDENTIAL						
Provides compression in environmental test to connector	Mating connector seal is not properly compressed.	Ingress of moisture into switch cavity. Connector difficult to install and/or falls off.	7		Connector geometry and/or surface contour/features is improperly specified. Incorrect material specified.	1	Number of dimensions relative to mating connector parts. Material specification.	1	7		CONFIDENTIAL						

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 003789
Revision Level D
Revision Date 28 May 99
Original (Initial) Date 29 Dec 97

Page 1

System
Subsystem
X Component Passenger Switch

Design Responsibility Passenger Switch Group

Prepared By C. Wagner

Model Year(s)/Vehicle(s) 1999

Key Date 1995

Case Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	O c c u r r e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Control Design Controls	D e t e r m i n e d	P r e v e n t	R e p a r t u r e	Represented (Y/N)	Responsibility & Target Completion Date	Action Results				
													Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	P r e v e n t
STATIONARY TERMINAL (36786 & 36728) Provides a brass lead for interconnection	Lead interconnection	Device appears operational	7		Contamination of brass lead. Material specified too thin.	1	System design and discussion of mating connector to ensure proper interference and mating action.	1	7								
	Lead geometry improper.	Difficult to install mating connector	8		Lead in drawing on terminal not sufficiently specified. Material specified too thin.	1	Review design and discussion of mating connector. Consultation with design of similar GPR project.	1	5								
Provides a silver alloy surface for electrical contact	Fails to provide adequate electrical contact.	Device appears operational. Intermittent continuity. High contact drop.	7		Incorrect contact material specified. Contamination. Silver layer specified too thin.	1	Review of TI proprietary and general contact design info. Evaluate paths for legend of contamination.	1	7			CONFIDENTIAL					
	Excessive loss of contact height dimension (mechanical loads)	Chill in hot points over life.	7		Silver layer specified too thick.	4	Review of TI proprietary and general contact design info. Life Testing.	1	7								
	Excess of contacts due to electrical loads.	Chill in cold points over life. Intermittent or no continuity.	7		Incorrect material specified for particular electrical loading.	1	Review of TI proprietary and general contact design info. Review and testing with actual electrical loads.	1	7								

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 583785
Revision Level D
Revision Date 28-May-88

Page 2

System _____
Subsystem _____
X Component Primary Switch

Design Responsibility Primary Switch Group

Original (Issue) Date 20-Dec-83

Model Year(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Wagner

Case Title Design Engineering, Manufacturing Engineering, Manufacturing, Dealer

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e F r e q u e n c y	Current Design Controls	D e t e r i n i n g C o e f f i c i e n t	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												S e v e r i t y	D e t e r i n i n g C o e f f i c i e n t	R i s k P r o b a b i l i t y	D e t e r i n i n g C o e f f i c i e n t
STATEMENT TERMINAL (26808 & 26728) Provides feature for device contacts	Poor calibration	Weg. yield rate Shift in output near 0.	3		Design is extremely soft. Design has excessive spring back. Material hardness is incorrectly specified. Initial position requires excess displacement to collapse. Design has inadequate strength to maintain collapse over life.	1	Mechanical (with FEM) analysis Force deflection springback testing Testing with actual production collapses equipment	1	3						
Provides feature to ensure adequate mating into base	Terminal is inadequately mated into base.	Loose terminals. Distortion in mating output.	7		Incorrect manufacturing of design of mating features.	1	Comparison of design with other SVP's product. Shrink evaluation.	1	7		CONFIDENTIAL				
Provides feature which mate with slot in base for location of terminal	Failure to properly locate terminal.	Terminal out of position.	2		Incorrect dimension major tolerance specified tolerance slot and terminal. Inadequate mating design control	2	Comparison of design with other SVP's product.	1	9		CONFIDENTIAL				
Provides electrical path from other mating contact to mating connector.	Failure to provide adequate conductivity	High resistance shown on high voltage test.	5		Incorrect material specified Inadequate cross- section area	1	Calculations of resistance Testing	1	5						

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503700
Revision Level C
Revision Date 4-Nov-88
Original (init) Date 20-Dec-83

Page 1

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (init) Date 20-Dec-83

Model Year(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e r m i n e d	Concurrent Design Controls	D e t e r m i n e d	R e p. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Action Taken	S e v e r e	C o n s e q u e n c e	D e t e r m i n e d	R e p. N.		
PROVIDE TERMINAL (6687)																		
Provides a brass base for interconnection	Poor interconnection	Device appears open- circuit when connector installed.	7		Material specified too thin.	1		Review design and dimensions of mating connector to ensure proper interference and mating action.	1	7								
	Block geometry impover	Difficult to install mating connector.	6		Lead-in chamfers on terminal are insufficiently specified. Material specified too thick.	1		Review design and dimensions of mating connector. Comparison with design of similar SVP's product.	1	5								
Provides a mounting point for the spring up fuel	Fails to allow proper spring/valve operation.	Disturbances in valve setpoints (open valve). Responsive device (valve lifts out completely). Wg. yield loss.	7		Valve hole size is specified incorrectly. Valve hole position is specified incorrectly. Support surface for spring is incorrectly specified. Choice of ball/rod style incorrect.	1		Comparison with design of similar product. Check with recommendations of steel manufacturer. Testing.	1	7								
Provides features to ensure adequate sliding into base	Terminal is inadequately shaped into base.	Excess terminal. Disturbances in valve setpoints	7		Incomplete understanding of design of sliding features.	1		Comparison of design with similar SVP's product. Sliding evaluation.	1	7								

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 583780

Page 2

System _____
Subsystem _____
X Component Pressure Switch

Revision Level C

Revision Date 4 Nov 86

Design Responsibility Pressure Switch Group

Original (Date) Date 20-Dec-83

Model Year(s)/Make(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e r m i n e d	C u r r e n t D e s i g n C o n t r i b u t i o n	D i s c r i m i n a t i o n	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	E v a l u e	C o n f i r m	D i s c r i m i n a t i o n	R e p a r t u r e
MOVABLE TERMINAL (35487) Provides keylock which mate with slots in base for location of terminal	Fails to properly locate terminal	Terminal out of position.	3		Incorrect dimensioned and/or tolerances specified between slots and terminal. Inadequate starting design concept	3	Comparison of design with similar SPS product	1	9		CONFIDENTIAL					
Provides electrical path from movable contact via SPRING to mating connector	Fails to provide adequate conductivity	High resistance shown on high voltage drop.	5		Incorrect material specified Inadequate cross- section area	1	Calculations of resistance Testing	1	5							

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 503792
Revision Level: C
Revision Date: 4-Nov-88
Original (Issue) Date: 28-Dec-83

System: _____
Subsystem: _____
K Component: FRONT SWICH

Design Responsibility: FRONT SWICH GRP

Prepared By: C. Wagner

Model Year(s)/Vehicle(s): VANOS

Key Date: 1983

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	O c c u r r e n c e	C o n t r o l	D e t e c t i o n	R e p a r a b l e	Recommended Action(s)	Responsibility & Target Completion Date	Action Required				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e c t i o n	R e p a r a b l e
SPRING (2000) Provides contact force	Low contact force	High millvolt drop across contacts.	5		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection equations. Force/deflection testing.	1	15							
	High contact force.	Shift in outputs. Disc cracking over life.	7		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection equations. Force/deflection testing.	1	21							
Provides electrical path from movable contact to movable terminal	Fails to provide adequate conductivity	High resistance causes an high millvolt drop.	6		Incorrect material specified. Inadequate cross-section area.	1	Calculations of impedance using $R = \rho L / A$. Testing.	1	6		CONFIDENTIAL					
Provides interface to surface with transfer pin	Fails to interface correctly with transfer pin.	Spring failure over life. Shift in outputs over life. Sticking transfer pin causes intermittent operation.	7		Inadequate height of feature specified. Inadequate slope of feature specified. Improper position of feature specified.	1	Comparison of design with master product. Dimension and tolerance stacking analysis. Actual measurement. Testing.	1	7							
Provides feature for attachment to movable contact	Fails to provide adequate covering for movable contact	Intermittent or erratic operation. Open circuit.	6		Plate misposition incorrectly specified. Platen inadequate	1	Plot wfg. accommodations. Comparison of design with master product. Testing.	1	6							
Locates movable contact	Fails to adequately locate movable contact relative to stationary contact	High millvolt drop over life. Excessive electrical arcing over life.	7		Spring geometry incorrectly specified.	1	Dimension and tolerance stackup analysis. Testing.	1	7							

TI-NHTSA 019390

POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number: 500792
Revision Level: C
Revision Date: 4-14-95
Original (Date) Date: 28-Dec-93

System: _____
Subsystem: _____
Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Vehicle(s): Various

Key Date: 1995

Prepared By: C. Wagner

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Control Design Controls	D i s c r i m i n a t e	R e p a r t i c i p l e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Action Taken	R e v	O c c u r r e n c e	D i s c r i m i n a t e	R e p a r t i c i p l e	
SPRING (Failure) Provides feature for attachment to movable terminal	Fails to properly attach to movable terminal	Electric or intermittent operation. Shift to outpoints. Open or short circuit.	6	1	Sheet hole size or position incorrectly specified Fitment inadequate. Choice of contact style incorrect.	1	Platting. Recommender. Comparison of design with similar product. Testing.	1	4								
Alum. Disc Overtravel	Fails to allow disc overtravel	Shift to outpoints. Disc cracking. Device inoperative at assembly. Pier collection.	5	1	Incorrect geometry specified Incorrect material specified	3	Stem deflection inspection. Force/deflection testing.	1	4		CONFIDENTIAL						
Provides force to open contacts	Adequate force to open contacts	Inadequate resistance to mechanical vibration. Short circuit.	6	1	Incorrect geometry specified Incorrect material specified	1	Stem deflection inspection. Force/deflection testing.	1	4		CONFIDENTIAL						
	Excessive force to open contacts.	Shift to outpoints. Disc cracking. Device inoperative at assembly. Pier collection.	7	1	Incorrect geometry specified Incorrect material specified	2	Stem deflection inspection. Force/deflection testing.	1	21		CONFIDENTIAL						

TI-NHTSA 019391

**POTENTIAL
FAILING MODE AND EFFECTS ANALYSIS
(PME/FEA Failure)**

Document Number 503754
Revision Level C
Revision Date 4-Nov-85

Page 1

Design Responsibility Pressure Switch Group

Original (Print) Date 28-Dec-83

Key Date 1983

Prepared By C. Wagner

Case No.

Engineering, Manufacturing, Quality

Item Failure	Mode	Effect of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e r m i n e d	C o n t r o l	D e t e r m i n e d	R e c o m m e n d e d	R e s p o n s i b l e P a r t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Action Taken	S e v e r i t y	C o n s e q u e n c e	D e t e r m i n e d	R e c o m m e n d e d
GASKET (74383) Provides fluid seal between port and shrapnel.	Fail to provide adequate fluid seal.	Brake fluid leakage.	E	C	Insufficient compression specified. Very excessive compression specified, leading to displacement from groove Increased ID and/or OD leading to displacement from groove Incorrect cross-section shape specified. Incorrect material specified, fluid compatibility. Incorrect design of sealing mechanism.	1	1	1	1	1	Review of general seal design principles. Manufacturer's recommendations Burst, rupture, and pressure cycle tests Comparison with design of similar products.	CONFIDENTIAL					

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503785
Revision Level C
Revision Date 4-Nov-98
Original (Initial) Date 28-Dec-93

Page 1

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	Severity		Potential Cause(s) Mechanism(s) of Failure	Occurrence	Current Design Controls	Detection		Recommended Action(s)	Responsibility & Target Completion Date	Action Taken	S	O	D	R
			3	1				e	R							
CUP (27713 OR 27298) Provides compacts over which bolts pressure sensor together	Fails to provide a suitable geometry for clamp. Low burst	Leakage Low burst	3	1	Clamp wall thickness incorrectly specified. Clamp wall height incorrectly specified Increased material specified	1	Burst and impulse testing Comparison of design with similar product	1	8							
It or also inspect, disassemble, and reassemble	Fails to correctly locate inspect, disassemble, or reassemble	Difficult assembly	3	1	A.O. specified incorrectly	1	Tolerance stackup analysis	1	5							
Provides support and location for disc	Fails to support and locate the disc/coupler correctly. Exotic operation. Shut open at assembly. Reburst disc life.	Shut in outpoints. Exotic operation. Shut open at assembly. Reburst disc life.	7	1	Increased disc opening specified. Shut-in position incorrectly specified. Poor surface condition of bump, no control specified	1	Tolerance stackup analysis. Impulse testing	1	7							
Provides guide for transfer pin	Fails to guide transfer pin correctly.	Exotic operation. Device shut short-circuit	7	1	Pin guide geometry is incorrectly specified	1	Tolerance stackup analysis	1	7							
Provides portion of environmental seal gland	Fails to allow a proper environmental seal	Ingress of water Switch does not seal correctly to cup	2	1	Surface condition required for good seal not understood or not correctly specified. Geometry incorrectly specified	1	Environmental testing. Switch cavity pressurization testing. Review of standard gland design notes	1	7							

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 583789
Revision Level C
Revision Date 4-MAR-98
Original (Initial) Date 28-DEC-93

Page 2

System
Subsystem
X Component System Switch

Design Responsibility Physical Switch Group

Model Year(s) (Aircraft) Variant

Key Date 1993

Prepared By C. Wagon

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e r v i c e	I n t e n s i t y	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e c t i o n	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e n s i t i v e	O c c u r r e n c e	D e t e c t i o n	R e p a r t u r e
CUP (27713 OR 27268) Provides surface to interface with hatch/latch assembly.	Fail to properly locate surface to hatch.	Stall in airplane. Erratic or inoperative switch.	5	1	Incorrect geometry of mating surface specified.	1	Tolerance stacking analysis. Cross-section checked drawings for inspection of surface.	1	5							
Foot sensor- creep) provides assembly for foot assembly with creep stop	Fail to allow proper foot assembly with creep stop.	Erratic operation. Ingress of matter. Cupped foot.	7	1	Foot-Creep geometry is not controlled per design intent Cup diameter incorrectly specified.	1	Tolerance stacking analysis. Shim target loading.	1	7							

TI-NHTSA 019394

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503708
Revision Level D
Revision Date 4 Apr 95
Original (issue) Date 25 Dec 93

Page 1

System _____
Subsystem _____
K Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Model

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item	Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C a u s e s	Potential Cause(s) Mechanism(s) of Failure	D e t e c t i v e	Current Design Controls	D e t e c t i v e	R e p a r a b l e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results							
													Actions Taken	S e v e r i t y	O c c u r r e n c e	D e t e c t i v e	R e p a r a b l e			
1000100001 (OR SEAL) (SR) (N178) Forms feasible element of fluid containment cavity		Fails to contain fluid	Fluid leakage	9		<p>Cracked rupture over life due to improper design of supporting elements.</p> <p>Cracked rupture over life due to excessive stress/strain/impact</p> <p>Cracked rupture over life due to stress concentrations caused by asymmetric stress distributions.</p> <p>Chemical attack due to incorrect material specified.</p> <p>Incorrect thickness (or J all layers) of diaphragm material.</p> <p>Inadequate manufacturing of diaphragm.</p>	1	Shut, inspect, and thermal cycle tests.	1	9										
Transfer pressure from shell to pressure sensing element	Change in size of pressure indicator over life.	Shell is cupped over life.	Excessively high pressure needed to adequately flex pressure transfer area, with signs on cupping due to unpredictability of local pressure.	5		Diaphragm too stiff, incorrect material specified.	1	Life testing or characterization of intermediate points.	1	5										
				4		Diaphragm too stiff.	1	Force and pressure versus deflection testing to calculate effective modulus.	1	4										

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T1-NHTSA 019395

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FAILURE)

Document Number 503797
Revision Level C
Revision Date 4-Mar-88
Original (Initial) Date 21-Dec-83

Page 1

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Article(s) 1980

Key Date 1980

Prepared By C. Wheeler

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C i r c u l a r	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Actual Taken	E v e n	O c c u r	D e t e r	R i s k	
WASHER (PS) (27638) Provides a portion of the support surface for diaphragm	Fail to correctly support the diaphragm	Diaphragm diaphragm the results in leakage	6		Condition of diaphragm support surface as specified incorrectly Condition of edges of support surface specified incorrectly Clearance between washer I.D. and converter bump is specified too wide	1	Shard, Impact, and Thermal Cycle tests. Comparison of design with similar products	1	5								
Provides support for compression of gas at	Fail to allow proper contact (overpressure)	Leakage	8		Washer thickness is incorrectly specified or unspecified. Washer thickness is specified too great. Washer material and/or heat-treat is incorrectly specified.	1	Shard, Impact, and Thermal Cycle tests. Comparison of design with similar products.	1	5								
Locates and guides converter with respect to cup	Converter is not properly located relative to cup.	Stiff in setpoints. Fracture behavior.	5		Incorrectly specified button guide I.D. Incorrectly specified button O.D.	1	Comparison of design with similar products. Tolerance stackup analysis.	1	5								
	Converter travel is restricted by washer.	Disc cannot release; device is stuck open-circuit	7		Washer thickness is incorrectly specified or unspecified. Washer thickness is specified too great Washer material and/or heat-treat is incorrectly specified I.D. of button guide is too great	1	Shard, Impact, and Thermal Cycle tests. Comparison of design with similar products. Tolerance stackup analysis.	1	7								

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TI-NHTSA 019396

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 583757
 Revision Level C
 Revision Date 4-Nov-95
 Original (initial) Date 20-Dec-92

System _____
 Subsystem _____
 Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Name(s)/Version(s) _____

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e c t e r	Current Design Controls	D i s c o n t r o l	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												Action Taken	S e v e r e	C o n s e q u e n c e	D i s c o n t r o l
WASHER (P8) (27834) Interfaces with cap feature and provides a portion of component stack for ramp	Fail to interface correctly with cap	Difficult assembly (washer O.D. too large) Poor assembly/counter location relative to cap (washer O.D. too small)	7		Washer O.D. specified incorrectly	1	Comparison of design with similar products Fatigue stackup analysis	1	7		CONFIDENTIAL				
	Fail to allow proper ramp	Reduced burst capability leads to leakage. Reduced fatigue resistance leads to leakage.	8		Thickness incorrectly specified O.D. incorrectly specified Edge condition incorrectly of connector	1	Fatigue stackup analysis. Burst, Impact, and Thermal Cycle tests	1	8						

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POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 582788

Page 7

Revision Level E

Revision Date 13 May 88

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (issue) Date 20 Dec-83

Model Name(s)/Part Name(s) Variable

Key Date 1983

Prepared By D. Ha

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanisms of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k P r i o r i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												Actions Taken	E v e n t	D e c i s i o n	R e v i s i o n
CONVERTER (PS) (27488) Transfers pressure from fuel (via diaphragm) to a force on pressure sensing disc.	Fails to correctly transfer fuel pressure to force on disc.	Giv. in subpoints	5	1	Bulb O.D. incorrectly specified relative to washer I.D.	1	Tolerance stack-up analysis.	1	5	Force/deflection analysis in addition to strength and reference to plastic deformation, burst, rupture, and thermal cycle tests.	CONFIDENTIAL				
					Converter major O.D. incorrectly specified relative to cap I.D.		Converter thickness incorrectly specified.								
Provides alignment and support to disc.	Fails to properly align and support disc.	Loose tolerances allow misalignment which may cause shift in subpoints or result in plastic deformation. Disc not in place relative to converter may cause erratic operation or inoperative device, check operation.	5	1	Bulb O.D. incorrectly specified relative to washer I.D.	1	Tolerance stack-up analysis.	1	5	Comparison of design with master product.	CONFIDENTIAL				
					Converter major O.D. incorrectly specified relative to Cap I.D.		Disc support bump incorrectly specified.			Disc spacing not incorrectly specified.					

TI-NHTSA 019398

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DEEMED FMEA)**

Document Number 503708
 Revision Level E
 Revision Date 13-May-98
 Original print Date 20-Dec-93

System _____
 Subsystem _____
 Component Pressure Switch

Design Responsibility Pressure Switch Group

Master Year(s)/Vehicle(s) Various

Key Draw 1993

Prepared By DLH

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	D e t e c t i o n	Current Design Controls	D e t e c t i o n	R e p a r a b l e n e s s	Recommended Actions	Responsibility & Target Completion Date	Action Results			
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e c t i o n
CONVERTER (PS) (27488) Provides a surface of the support surface for diaphragm.	Fails to properly support diaphragm.	Reduced diaphragm life results in leakage.	6		Contours of surface in contact with diaphragm are specified incorrectly. Condition of edges in contact with diaphragm are specified incorrectly. Clearance between converter bump and vent hole I.D. are specified (not with).	1	Start, impulse, and thermal cycle tests. Comparison of design with similar product.	1	6						
Provides disc support during over pressure (peak/burst)	Fails to properly support disc during over pressure.	Disc deformation results in shift in setpoint. Reduced disc travel if disc surface is ruptured prematurely. Reduced disc life.	6		Fasteners which control disc motion during over pressure are incorrectly specified.	3	Pre and post-pool characterization. Pressure deflection measurements of disc surface.	3	6						
Vent in case does not prevent pressure buildup from affecting setpoint	Does not vent properly.	Shift in setpoints over temp. Reduced disc temp.	5		Vent hole incorrectly specified.	1	Comparison of design with similar product. Temperature characterization.	1	6						

CONFIDENTIAL

TI-NHTSA 019399

System _____
 Subsystem _____
 X Component Pressure Switch

**POTENTIAL
 FAILURE MODE AND EFFECT ANALYSIS
 (POTENTIAL FAILURE)**

Document Number 583795
 Revision Level C
 Revision Date 4-Nov-98
 Original (print) Date 29-Dec-93

Model Year(s)/Part(s) Various

Design Responsibility Pressure Switch Group

Key Date 1993

Prepared By C. Wagoner

Cost Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Failure	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	O c c u r e n c e	Current Design Controls	D e t e r m i n e d	P r e v e n t e d	Recommended Actions	Responsibility & Target Completion Date	Action Results				
												Accomplished	S u c c e s s f u l	O n t i m e	D o n e	R e v i s e d
SPACER (7263) Prevents friction between disc and converter	Fails to effectively reduce friction	Shell is subjected over life. Reduced disc life.	5		Incorrect material specified. Incorrect dimensions specified.	1	Regulate and Thermal Cycle tests. Pre- and Post-life observations. Tolerance stackup analysis.	1	5							
Allow venting of chamber formed by first and converter	Fails to allow venting	Shell is subjected over time. Reduced disc action.	5		Vent hole incorrectly specified	1	Comparison of design with similar product. Temperature characterization.	1	5							

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TI-NHTSA 019400

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 903880
Revision Level C
Revision Date 4 Nov 98
Original (Initial) Date 29-Dec-93

Page 1

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1990

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e F r e q u e n c y	Current Design Controls	D e t e r m i n e d R i s k	R e c o m m e n d e d A c t i o n(s)	Responsibility & Target Completion Date	Action Results				
											Actions Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d R i s k	R e s u l t
DISC (38898) Controls activation and release set-points of switch relative to applied force.	Fail to activate under release of the proper points of assembly.	Alg. prod loss.	6		Disc material improperly specified. Chamfering and tolerances improperly specified.	1	Characterization requirements. Comparison of design with similar product.	1 5							
Key component in defining usable service life of device	Disc activation and/or release setpoints change excessively over life.	Shift in device setpoints over life.	5		Disc material improperly specified. Disc heat treat improperly specified Material thickness improperly specified Excessive force applied by users.	1	Regular testing. Pre- and post-characterization.	1 5	CONFIDENTIAL						
	Service life shorter than customer requirements.	Excessive shift in setpoints over life. Cracks/impurities - open circuit.	7		Disc material improperly specified. Disc heat treat improperly specified. Material thickness improperly specified Excessive force applied by users.	1	Regular testing. Pre- and post-characterization.	1 7							

TI-NHTSA 019401

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PFMEA)**

Document Number 583801

Page 1

System _____
Subsystem _____
Component Power Switch

Revision Level C

Revision Date 4-Nov-88

Design Responsibility Power Switch Group

Original (Print) Date 20-Dec-83

Model Year(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Hopper

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

New Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	P o t e n t i a l C o u n t e r p a r t M e c h a n i s m(s) of Failure	O c c u r r e n c e	C u r r e n t D e s i g n C o n t r o l s	D e t e c t i o n	R e p a r t u r e	R e c o m m e n d e d A c t i o n(s)	R e s p o n s i b i l i t y & Target C o m p l e t i o n D a t e	Action Results				
												A c t i o n T a k e n	E v e n t	O c c u r r e n c e	D e t e c t i o n	R e p a r t u r e
CRIMP RING (T4787) Held together does assembly and cannot assembly	Fails to hold down in circuit correctly	Electric switch operation. Circuit fails. Shift in voltage. Low level signal returned.	6		Incorrect geometry of cable pins was specified. Incorrect geometry of terminal pins. Incorrect material specified	3	Insulate, thermal cycle, beam target, and environmental impact tests	1	10							
Provides a surface for part identification/ code	ID characters fugitive	Improperly identified parts at assembly plant	2		Quantity/quality not properly specified. Wrong material specified	1	Coding tests Environmental tests.	1	2							
Input environmental protection and aesthetics to device	Ability to withstand environment	Corrosion causes contact maloperation, loss of mechanical properties, switch eventually fails off circuit. Fugitive coding	7		Wrong material specified	1	Environmental tests.	1	7							
Provides insulation to keep dirt out and cooling	Insufficient insulation.	Abnormal temperatures on external device surfaces.	8		Insulated or insufficient was specified.	1	Climping tests.	1	6							

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T1-NHTSA 019402

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number: 503892
Revision Level: C
Revision Date: 4-Nov-95
Original (Initial) Date: 28-Dec-93

Page 1

System: _____
Subsystem: _____
Component: Passage Switch

Design Responsibility: Passage Switch Group

Model Year(s)/Vehicle(s): Various

Key Date: 1993

Prepared By: C. Wagner

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	I	Potential Cause(s) Mechanism(s) of Failure	O	C	Current Design Controls	D	R	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
													Severity	Occurrence	Detectability	Prevalence
TRANSFER PWR (2-4178) Transfer slip motor in possible electrical contact	Fails to properly transfer slip motor.	Contacts stick open. Contacts stick closed. Faulty operation.	7	1	Diameter incorrectly specified. Chips/fragments cause pin to bridge.	1	1	Tolerance stacking between pin and pin guide in cap. Check with supplier for material properties regarding chips.	1	7		CONFIDENTIAL				
Insulates electrical components from switch housing	Fails to insulate	Continuity between movable terminal and housing to ground.	5	1	Wrong material specified.	1	1	Check with supplier for material properties. Check with customer for electrical logic of movable terminal.	1	5						

TI-NHTSA 019403

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number 582802
Revision Level C
Revision Date 4 June 96
Original (Initial) Date 20 Dec 92

Page 1

System _____
Subsystem _____
X Component Transfer Switch

Design Responsibility Transfer Switch Group

Model Year(s)/Version(s) Various

Key Date 1993

Prepared By C. Wagner

Cross Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential (Effects) of Failure	S	C	Potential Cause(s) Mechanism(s) of Failure	D	Current Design Controls	D	R	Recommended Action(s)	Responsibility & Target Completion Date	Action Priority			
			1	2		1		F	1			P	S	O	D
			1	2		1		1	2			S	O	D	R
			1	2		1		1	2			1	2	3	4
(TRANSFER SW (74078)) Transfers disc system to available electrical contact	Fails to properly transfer disc motion	Contacts stick open. Contacts stick closed. Erratic operation	7		Dimension incorrectly specified Chip dimensions cause gap to lodge.	1	Tolerances violate between pin and slot guide in cap. Check with supplier for material properties regarding chips	1	2		CONFIDENTIAL				
Isolates electrical components from switch housing	Fails to isolate	Continuity between movable terminal and housing to ground.	5		Wiring terminal specified.	1	Check with supplier for material properties. Check with customer for electrical leg of movable terminal.	1	5						

TI-NHTSA 019404

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 582803
Revision Level C
Revision Date 4 May 86
Original (initial) Date 20 Dec 83

Page 1

System _____
Subsystem _____
X Component Paraglider Switch

Design Responsibility Paraglider Switch Group

Model Name(s)/Article(s) 582803

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e	R i s k P r o b a b i l i t y
ENVIRONMENTAL SEAL (74247) Prevents ingress of water in switch cavity	Contaminants in air switch cavity.	High current leakage High contact drop. Erratic or inoperative switch operation.	7	C	Gasket thickness is specified too great. Limits on porosity not specified. Inertness material	1	Review of standard practices for gasket design. Review with gasket manufacturer. Comparison of design with similar products.	1	7		CONFIDENTIAL					
Allows action to be taken preventing base rotation	Base rotates too easily	Prevented on manufacture by inspection plan under service program.	5	C	Gasket thickness improperly specified.	1	Review of standard practices for gasket design. Teague-to-rotate testing. Comparison of design with similar products.	1	5							

TI-NHTSA 019406

POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 603803
Revision Level: C
Revision Date: 4-Nov-88
Original (Initial) Date: 28-Dec-83

Page 1

System: _____
Subsystem: _____
K. Component: Programm Switch

Design Responsibility: Programm Switch Group

Model Year(s)/Vehicle(s): Various

Key Date: 1983

Prepared By: C. Wessner

Case Team: Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Etiology of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D i c t o r y	C o n s e q u e n c e	D e t e r m i n e d	R e p a r t u r e	R e c o m m e n d e d A c t i o n (s)	Responsibility & Target Completion Date	Action Number					
												Action Taken	S e v e r e	O c c u r e n c e	D e t e r m i n e d	R e p a r t u r e	
ENVIRONMENTAL SEAL (76247)											CONFIDENTIAL						
Prevents ingress of matter to switch cavity	Contaminants enter switch cavity.	High current leakage High contact drop. Erratic or inoperative switch operation.	7		Contact thickness is specified too small. Limits on porosity not specified. Incorrect material	1	Review of standard practice for glass design. Review with glass manufacturer. Comparison of design with similar product.		1	7							
Provides linkage to aid in servicing base station	Base rotates too easily	Placed on baseplate by assembly plant under service personnel	5		Contact thickness improperly specified.	1	Review of standard practice for glass design. Therms to which facing. Comparison of design with similar product.		1	5							

TI-NHTSA 019406

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PFMEA)

Document Number 50284
Revision Level C
Revision Date 4-22-95
Original (Title) Date 20-Dec-93

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Prepared By C. Wagner

Model Year(s)/Model(s) Various

Key Date 1993

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure -	O		Potential Cause(s) / Mechanism(s) of Failure	O	Current Design Controls	D		Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
			S	C				S	P			S	O	S	R	
TREADCAP (7488) Protects bearing threads from damage during shipping and transit. Prevents dust from entering the fuel cavity.	Increased length.	Does not protect threads sufficiently.	2	1	Length incorrectly specified.	1	Dimensional drawing study.	1	2	CONFIDENTIAL						
	Loose Cap	Allows dust to enter fuel cavity.	4	1	Incorrect diameter specified.	1	Dimensional analysis.	1	2							

TI-NHTSA 019407

POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number: 582605
Revision Level: C
Revision Date: 30-Oct-86
Original (Rev) Date: 29-Dec-83

System: _____
Subsystem: _____
Component: Passure Switch

Design Responsibility: Passure Switch Group

Prepared By: C. Wagner

Model Year(s)/Vehicle(s): 1986

Key Date: 1985

Core Team: Design Engineers, Manufacturing Engineers, Manufacturer, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	C		Potential Cause(s) Mechanism(s) of Failure	D		Recommended Action(s)	Responsibility & Target Completion Date	Action Required					
			S	O		C	P			W	C	D	R	N	
EXPORT (35000) Provides a hydraulic testing surface per SAE J512	Fails to seal	Leakage of brake fluid.	8	FF	Incorrect machine state specification. Incorrect material specification. Incorrectly specified geometry. Excessive pressure	1		Cross-check of part dimensions vs. SAE standard. Comprehensive inspection of design of brackets. Test testing to customer specified tests.							
Provides external thread for installation into valve part	Fails to properly install in mating part	Damage threads in mating part during installation. Does not allow installation.	7	FF	Threads specified incorrectly. Threads not gauged per AMSI spec's. Flaring failure.	3		Cross-check of applicable SAE and AMSI standards.							
	Assembles into valve and fails to properly seal and seat	Brake fluid leakage.	8	FF	Threads specified incorrectly. Threads not gauged per AMSI spec's. Flaring failure.	1		Cross-check of applicable SAE and AMSI standards.							
Provides hex feature for 3/16" wrench	Incorrect hex size.	Damage to hex face during wrenching. 3/16" wrench does not fit.	8		Hex feature improperly specified per established GENERAL spec's.	1		Cross-check of applicable SAE and AMSI standards.							
Provides fluid passage to pressure sensing element	Fluid passage is too small	Electrical signal from switch is delayed or pressure signal capability at very low temp. Subject to blockage by foreign matter.	7	FF	Inadequate size of fluid passage specified. Inadequate review of fluid standard practices.	1		Review of Ford standard practices. Review of industry practices.							
	Fluid passage is too large.	Passing this will restrict pressure sensing. Blockage during installation during installation cycle operations	7	FF	Fluid passage specified excessively large.	1		Tempe testing.							

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TI-NHTSA 019408

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(POTENTIAL FMEA)

Document Number 503805
Revision Level C
Revision Date 28-Oct-95
Original (Issue) Date 20-Dec-93

System _____
Subsystem _____
K. Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Model(s) 1993

Key Date 1993

Prepared By C. Wagner

Cross Team (Design Engineers, Manufacturing Engineers, Manufacturing Quality)

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	I n t e r m e d i a t e	C o n s i d e r e d	Potential Cause(s) / Mechanism(s) of Failure	D i s c r i m i n a t e	C o n t r o l s	D i s c r i m i n a t e	R e c o m m e n d e d A c t i o n s	Responsibility & Target Completion Date	Action Results				
												A c t i o n s T a k e n	S e v e r e	I n t e r m e d i a t e	C o n s i d e r e d	D i s c r i m i n a t e
BENCHPORT (30590) Provides Range which interfaces with other components to form pressure- control structure		Control problems						Failure of gasket function	3	27						

CONFIDENTIAL

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PROM/FMEA)**

Document Number 508770 Page 1
 Revision Level B
 Revision Date 5-Nov-96
 Original (Initial) Date 20-Dec-93

System _____
 Subsystem _____
 E. Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Viridian

Key Date 1993

Prepared By D. Hg

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R e p a r t s	Recommended Action(s)	Responsibility & Target Completion Date	Action Status			
												Action Taken	E v a l u e	D e c i d e	D o c u m e n t
RIVET (74918) Fastens spring to movable terminal. Provides a force between movable terminal and spring which causes intimate contact for current flow.	Fails to adequately fasten spring to movable terminal.	Spring rotates about axis of rivet. Spring falls off movable terminal.	6	1	Improper rivet diameter for given hole sizes. Improper rivet length for given material thickness. Improper head size. Improper tubular features. Improper material.	1	1. Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to retain spring.	1	B						
	Inadequate force between spring and movable terminal.	High resistance or no continuity at interface of spring and movable terminal.	6	1	Improper rivet diameter for given hole sizes. Improper rivet length for given material thickness. Improper head size. Improper tubular features. Improper material.	1	1. Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to retain spring.	1	B	CONFIDENTIAL					

TI-NHTSA 019412

POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (POTENTIAL FMEA)

Document Number
Revision Level
Revision Date

System
Subsystem
Component Primary Switch

Design Responsibility Primary Switch Group

Original (Initial) Date

Model Year/Vehicle(s) 1993

Key Date 1993

Prepared By

Core Team Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Document #

Kapton

TI-NHTSA 018413

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Control Design Controls	D e t e r m i n e d	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Items Action Taken	
58228 CUR (217) FOR 77281 Provides integrable area which holds pressure sensor together.	Fails to provide a suitable geometry for mating.	Leakage	8		Clamp wall thickness incorrectly specified.	1	Heat and impulse testing.	1	8			print specified	
58229 CAP (100) FOR SEAL (217) FOR 77281 Forms flexible sealant of this component sealy.	Fails to contain fluid.	Fluid leakage.	8		Control system over life due to improper design of supporting elements. Control system over life due to excessive flexing/torsion. Control system over life due to stress concentration caused by compressive strain disturbances. Control system due to incorrect material specified. Incorrect thickness (or or layer) of diaphragm material. Inadequate location/spacing of diaphragm.	1	Heat, impulse, and thermal cycle tests. Material only recommendation. Comparison of design with other products.	1	8			industry user comparison	Leakage
58230 SEALER (217) 77281 Provides a surface of the support surface for diaphragm	Fails to correctly support the diaphragm.	Reduced diaphragm life results in leakage.	8		Contours of diaphragm support surface not specified accurately.	1	Heat, impulse, and Thermal Cycle tests.	1	8			FEA	

CONFIDENTIAL

				Condition of edges of support surface specified incorrectly. Clearance between washer I.D. and converter flange is specified too wide.	Comparison of design with similar products.			
	Provides support for compression of gasket.	Fails to allow proper gasket compression.	Leakage.	6	Washer thickness is incorrectly specified or unspecified. Washer thickness is specified too small. Washer material and/or post-treat is incorrectly specified.	Dist. Impulse, and Thermal Cycle tests. Comparison of design with similar products.	1	4
	Interacts with cap feature and provides a portion of component block for clamp.	Fails to interface correctly with cap.	Difficult assembly (washer O.D. too large). Poor manufacturing location relative to cap (washer O.D. too small).	7	Washer O.D. specified incorrectly.	Comparison of design with similar products. Tolerance stacking analysis.	1	7
		Fails to allow proper clamp. wash. I.D. = .218 I.D. = .211	Reduced clamp capability leads to leakage. Reduced flange resistance leads to leakage.	8	Thickness incorrectly specified. O.D. incorrectly specified. Edge condition incorrectly specified.	Tolerance stacking analysis. Dist. Impulse, and Thermal Cycle tests.	1	8
	CONVERTER (flange)	Ao = .217 .293						
	Provides a portion of the support surface for diaphragm.	Fails to properly support diaphragm.	Reduced diaphragm resistance to leakage.	9	Contours of surface in contact with diaphragm are specified incorrectly. Condition of edges in contact with diaphragm are specified incorrectly. Clearance between converter flange and washer I.D. are specified too wide.	Dist. Impulse, and Thermal cycle tests. Comparison of design with similar product.	1	9

O.D. Wash
IS 1.0149
I.D. 1.023
I.D. 1.059
Cap 1.064
I.D. 1.065
Wash. I.D. = .002
I.D. = .010

CONVERTER
Flange
I.D. = .011

TI-NHTSA 019414

Comparison of Wash...

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POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503780
Revision Level C
Revision Date 4-Nov-98
Original (Initial) Date 20-Dec-83

Page 1

System
Subsystem
K Component Process Switch

Design Responsibility Process Switch Group

Model Type(s)/Vehicle(s) Various

Key Date 1983

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e r v i c e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Action Taken	S e v e r e	O c c u r r e n c e	D e t e r m i n e d	R i s k P r o b a b i l i t y		
MOVABLE TERMINAL (SMA?) Provides a brass mate for interconnection	Poor interconnection	Device operates incorrectly mating connector installed.	7		Material specified too thin	1			1	7								
	Badly geometry impairs.	Difficult to install mating connector.	5		Lead-in chamfers on terminal are insufficiently specified. Material specified too thick.	1			1	5								
Provides a mounting point for the spring air nut	Fail to allow proper spring/nut installation.	Disturbance in switch contacts (from lead). Respective device (rivet falls out completely) Qty. yield loss.	7		Rivet hole size is specified incorrectly Rivet hole position is specified incorrectly. Support surface for spring is incorrectly specified. Chain of isolator style incorrect.	1			1	7								
Provides features to allow adequate mating into base.	Terminal is inadequately seated into base.	Loose terminals. Disturbance in switch signaling.	7		Incomplete understanding of design of mating features.	1			1	7								

CONFIDENTIAL

TI-NHTSA 019416

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503740
Revision Level C
Revision Date 4-9-90-86

Page 2

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 20-Dec-90

Model Year(s) (Asterisks) Valid

Key Date 1990

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e s	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R e l a t i v e	P r i o r i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
													Actions Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R e l a t i v e		
MINIATURE TERMINAL (36087)																			
Provides features which mate with slots in base for location of terminal	Fails to properly locate terminal	Terminal out of position	5		Incorrect dimensions and/or tolerances specified between slots and terminals. Inadequate mating design concept	2	Comparison of design with similar STPS product	1	8			CONFIDENTIAL							
Provides electrical path from movable contact via spring to mating connector	Fails to provide adequate conductivity	High resistance shown as high millivolt drop.	6		Incorrect material specified. Inadequate connection area.	1	Calculations of resistance Testing	1	6										

T1-NHTSA 019417

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 501782
Revision Level C
Revision Date 4-Nov 86
Original (Initial) Date 20-Dec 83

System _____
Subsystem _____
Component Propose Switch

Design Responsibility Propose Switch Group

Model Year(s)/Part(s) VF04

Key Date 1983

Prepared By C. Wagner

Can Tests Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e f	Current Design Controls	D e t e r m i n e	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
								F r e q u e n c y	P o t e n t i a l			A c t i v e	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e	R e p a r t u r e	
Provides contact force.	Low contact force.	High roll-off deep contact.	6		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection equations. Force-deflection testing.	1	15								
	High contact force.	Wear in artpoints. Disc cracking over life.	7		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection equations. Force-deflection testing.	1	21								
Provides electrical path from movable contact to movable terminal.	Fails to provide adequate conductivity.	High resistance shown as high artpoint drop.	5		Incorrect material specified. Inadequate cross-section area.	1	Calculations of resistance using $R = \rho l / A$. Testing.	1	5								
Provides feature to interface with transfer pin.	Fails to interface correctly with transfer pin.	Spring takes over life. Wear in artpoints over life. Sticking transfer pin causes intermittent operation.	7		Inadequate height of feature specified. Inadequate shape of feature specified. Inproper position of feature specified.	1	Comparison of design with similar product. Distortion and tolerance stackup analysis. Actual measurement. Testing.	1	7								
Provides feature for attachment to movable contact.	Fails to provide adequate mounting for movable contact.	Intermittent or artpoint operation. Open circuit.	6		Hole disposition incorrectly specified. Fit/raze inadequate.	1	Plural w/g. recommended above. Comparison of design with similar product. Testing.	1	8								
Locates movable contact	Fails to adequately locate movable contact relative to stationary contact.	High roll-off deep over life. Excessive contact erosion over life.	7		Spring geometry incorrectly specified.	1	Distortion and tolerance stackup analysis. Testing.	1	7								

CONFIDENTIAL

T.N.H.T.S.A. 019418

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 501762
Revision Level C
Revision Date 4 Nov 86

Page 2

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Insert) Date 20 Dec 93

Model Name/Part Number _____

Key Date 1993

Prepared By C. Wagner

Case Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e r v i c e	C o n s e q u e n c e	Failure Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Actions Taken	S e v e r e	D e t e r m i n e	D e t e r m i n e	R i s k	
Provides function as attached to assembly mounted.	Fail to properly attach to assembly mounted.	Wiring ground fault opening. Short to output. Open or short circuit.	6		Pin hole size or position incorrectly specified. Fitless fasteners. Change of fastener type incorrect.	1	Shorting. Intermittent. Comparison of design with similar product. Testing.	1	6								
Align disc external.	Fail to align disc external.	Short to output. Disc cracking. Device inoperative at assembly. Fire collection.	5		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection inspection. Functional testing.	1	5		CONFIDENTIAL						
Provides force to open contacts.	Inadequate force to open contacts.	Insufficient resistance in mechanical situation. Short circuit.	6		Incorrect geometry specified. Incorrect material specified.	1	Beam deflection inspection. Functional testing.	1	6								
	Excessive force in open contacts.	Short to output. Disc cracking. Device inoperative at assembly. Fire collection.	7		Incorrect geometry specified. Incorrect material specified.	3	Beam deflection inspection. Functional testing.	1	21								

TN-NHTSA 019419

POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 603794
Revision Level C
Revision Date 4-Nov-98

Page 1

System
Subsystem
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 20-Dec-93

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R e p a r t s	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	S e v e r e	O c c u r r e n c e	D e t e r m i n e	R e p a r t s
SECRET (7-8B) Provide fluid and transmit pressure and discharge.	Fail to provide adequate fluid seal.	Leaks fluid leakage.	0		Insufficient compression specified. Very excessive compression specified, leading to displacement flow gland Incorrect ID or/for OD leading to displacement flow gland. Incorrect cross-section size specified. Incorrect material specified, fluid incompatibility. Incorrect design of valve mechanism.	1	Review of general valve design principles. Manufacturer's recommendations Burst impulse, and burst cycle tests Comparison with design of similar products.	1	9		CONFIDENTIAL					

TI-NHTSA 019420

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503795
Revision Level C
Revision Date 4-Nov-85
Original (release) Date 20-Dec-83

Page 1

System _____
Subsystem _____
X Component Program Switch

Design Responsibility Program Switch Group

Model Year(s)/Release(s) Various

Key Date 1985

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Name / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	D e t e r m i n e d	Current Design Controls	D e t e r m i n e d	R. I. P. e n v. i o n	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r e	C o n s e q u e n c e	D e t e r m i n e d	R. I. P. e n v. i o n
CUP (D7TS OR 27288) Provides crimpable area which holds pressure sensor together.	Fails to provide a suitable geometry for crimp.	Leakage Low level.	6		Crimp wall thickness incorrectly specified. Crimp wall height incorrectly specified. Incorrect material specified.	1	Dural and impulse testing. Comparison of design with similar product	1	6							
Locates heater, diaphragm, and washer.	Fails to correctly locate heater, diaphragm, or washer.	Difficult assembly.	6		I.D. specified incorrectly.	1	Tolerance stackup analysis.	1	5	CONFIDENTIAL						
Provides support and location for disc.	Fails to support and locate the diaphragm correctly.	Shift in endpoint. Extrude separator. Check open at assembly. Reduced disc life.	7		Incorrect disc envelope incorrectly specified. Dimp too shallow incorrectly specified. Poor surface condition of stamp, no control specified.	1	Tolerance stackup analysis. Impulse testing.	1	7							
Provides guide for transfer pin.	Fails to guide transfer pin correctly.	Extrude separator. Device shift short-circuit.	7		Pin guide geometry is incorrectly specified.	1	Tolerance stackup analysis.	1	7							
Provides portion of environmental seal gland.	Fails to allow a proper environmental seal.	Ingress of matter. Switch does not seal correctly at top.	7		Surface condition required for good seal not understood or not correctly specified. Geometry incorrectly specified.	1	Environmental testing. Switch cavity penetrations testing. Presence of standard sized design rules	1	7							

TI-NHTSA 018421

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(VERSION FMEA)**

Document Number 803785
Revision Level C
Revision Date 4-Nov-98
Original (initial) Date 20-Dec-93

System _____
Subsystem _____
Component Passage Switch

Design Responsibility Passage Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	D e s c r i b e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R e l a t i v e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S u c c e s s f u l	C o m p l e t e	O n t i m e	R e p e r t e d
CUP (27713) ON 27209) Provides sealant to interface with front/side assembly.	Failure to properly locate relative to mating.	Seal is inadequate. Seal is impervious to water.	2		Flawed geometry of mating surface specified.	1	Tolerance stackup analysis. Cross-section actual drawings for inspection of interface.	1	8	CONFIDENTIAL						
Post-assembly geometry for front assembly with OVRB ring.	Failure to allow proper final assembly with OVRB ring.	Excessive operation. Degree of sealant cracked loose.	7		Post-clip geometry is not controlled per design intent. Clip diameter incorrectly specified.	1	Tolerance stackup analysis. Draw torque testing.	1	7							

TI-NHTSA 019422

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503797
Revision Level C
Revision Date 4 Nov 86
Original (initial) Date 28 Dec 93

Page 1

System
Subsystem
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Project(s) Various

Key Date 1993

Prepared By C Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	D e f e c t	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	C o n s e q u e n c e	D e t e r m i n e d	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Results					
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R i s k	
WASHER (P6) C17634 Provides a portion of the support surface for diaphragm.	Fails to correctly support the diaphragm.	Reduced diaphragm life results in leakage.	8		Condition of diaphragm support surface are specified incorrectly. Condition of edge of support surface specified incorrectly. Clearance between washer I.D. and converter bump is specified too small.	1			1	Burst, impact, and Thermal Cycle tests. Comparison of design with similar products.							
Provides support for compression of gasket.	Fails to allow proper gasket compression.	Leakage.	8		Washer thickness is incorrectly specified or unspecified. Washer thickness is specified too small. Washer material and/or heat-treat is incorrectly specified.	1			1	Burst, impact, and Thermal Cycle tests. Comparison of design with similar products.							
Latches and guides converter with respect to cup.	Converter is not properly located within to cup.	Stall is subjective. Elastic behavior.	9		Incorrectly specified button guide I.D. Incorrectly specified button O.D.	1			1	Comparison of design with similar products. Tolerance stackup analysis.							
Converter bump is contacted by washer.	Disc contact element device is stuck open-circuit.		7		Washer thickness is incorrectly specified or unspecified. Washer thickness is specified too small. Washer material and/or heat-treat is incorrectly specified. I.D. of button guide is too small.	1			1	Burst, impact, and Thermal Cycle tests. Comparison of design with similar products. Tolerance stackup analysis.							

CONFIDENTIAL

TI-NHTSA 019423

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 515757
Revision Level C
Revision Date 4 Nov 98
Original (Draft) Date 20 Dec 93

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S E V E R I T Y	C O N S I D E R E D	Potential Cause(s) (Mechanism) of Failure	O C C U R E N C E	Current Design Controls	D E T E R M I N E	R E P A R A B L E	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	S e v e r i t y	O c c u r e n c e	D e t e r m i n e	R e p a r a b l e
WASHER (P2) (22834) Interface with cap feature and provides a portion of component stack for creep.	Fails to interface correctly with cap.	Difficult assembly (washer O.D. too large). Poor seal/washer interface relative to cap (washer O.D. too small).	7		Washer O.D. specified incorrectly.	1	Comparison of design with similar products Tolerance stackup analysis	1	7		CONFIDENTIAL					
	Fails to allow proper creep.	Reduced burst capability leads to leakage. Reduced fatigue resistance leads to leakage.	8		Thickness incorrectly specified. O.D. incorrectly specified. Edge contour incorrectly or insufficient.	1	Tolerance stackup analysis. Burst, Inpulse, and Thermal Cycle tests.	1	8							

TI-NHTSA 019424

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 593796
 Revision Level C
 Revision Date 4-Nov-96
 Original (Issue) Date 20-Dec-93

Page 1

System _____
 Subsystem _____
 X Component Pressure Switch

Design Responsibility Pressure Switch Group

Motor Year(s)/Vehicle(s) Volvo

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	D e t e r m i n e d	R i s k	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
										Action Taken	S e v e r e	C o n c e	D e t e r m i n e d	R i s k
SPACER (75020) Reduce friction between disc and coverplate	Fail to effectively reduce friction.	Shift in setpoints over life. Reduced disc life.	6		Incorrect material specified Incorrect tolerances specified.	1	5	Regulate and Thermal Cycle test. Fat- and First-life characterizations. Tolerance stacking analysis.						
Allow venting of chamber formed by disc and coverplate	Fail to allow venting	Shift in setpoints over temp. Reduced disc action.	6		Vent hole incorrectly specified	1	5	Comparison of designs with similar product Temperature characterization						

CONFIDENTIAL

TI-NHTSA 019426

System
 Subsystem
 Component Program Switch

**POTENTIAL
 FAILURE MODE AND EFFECTS ANALYSIS
 (METHOD FMEA)**

Document Number 503801
 Revision Level C
 Revision Date 4-MAY-93
 Original (Initial) Date 20-Dec-93

Design Responsibility Program Switch Group

Model Year(s)/Vehicle(s) Modeling

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	D I S C R I B E	C I R C U I T R Y	Potential Cause(s) / Mechanism(s) of Failure	D I S C R I B E	Current Design Controls	D I S C R I B E	R P M	Recommended Action(s)	Responsibility & Target Completion Date	Action Results							
												Actions Taken	S e v e r i t y	O c c u r r e n c e	D e t e c t i v e	R e p a r a b l e			
DSC (2000)																			
Controls inclusion and release not points of switch relative to applied force.	Fails to actuate under release at the proper points of assembly.	Self, yield loss.	6		Disc material improperly specified. Dimensions and tolerances improperly specified.	1	Characterization experiments. Comparison of design with similar product.	1	5										
Key component in defining usable service life of device.	Disc actuation under release outputs change substantially over life.	Shift in device outputs over life.	5		Disc material improperly specified. Disc test-load improperly specified. Material thickness improperly specified. Excessive force applied by spring.	1	Impulse testing. Pre- and post-characterizations.	1	5		CONFIDENTIAL								
	Service life shorter than customer requirements.	Excessive shift in response over life. Device responsive - open circuit.	7		Disc material improperly specified. Disc test-load improperly specified. Material thickness improperly specified. Excessive force applied by spring.	1	Impulse testing. Pre- and post-characterizations.	1	7										

TI-NHTSA 019428

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 503803
Revision Level: C
Revision Date: 4-Nov-86
Original (Issue) Date: 20-Dec-83

Page 1

System: _____
Subsystem: _____
Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Part(s)/Version: _____

Key Date: 1985

Prepared By: C. Wagner

Core Team: Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	C	Potential Cause(s) / Mechanism(s) of Failure	O	Current Design Controls	D	R	P	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Occurrence	Severity	Priority	Active Tests	E
<p>CRIMP RING (74787)</p> <p>Hold together base assembly and sensor assembly</p>	<p>Fails to hold base to sensor correctly</p>	<p>Exotic switch operation.</p> <p>Cracked base.</p> <p>Stall in operation.</p> <p>Low base torque reflected.</p>	6		<p>Incorrect geometry of crimpable area specified.</p> <p>Incorrect geometry of sensor ribs.</p> <p>Incorrect material specified.</p>	3	<p>Insulate, thermal cycle, base torque, and base/terminal impact tests.</p>	1	15								
<p>Provides a surface for pin identification</p>	<p>Pin clearance negligible.</p>	<p>Improperly identified parts of assembly piece</p>	2		<p>Geometry/dimensions not properly specified.</p> <p>Wrong material specified.</p>	1	<p>Coating tests.</p> <p>Environmental tests.</p>	1	2								
<p>Input wire electrical protection and isolation to driver</p>	<p>Ability to withstand environment.</p>	<p>Chemical damage possible contamination, loss of mechanical properties, initial porosity fills oil sensor, flaking coating.</p>	7		<p>Wrong material specified.</p>	1	<p>Environmental tests.</p>	1	7								
<p>Provide lubrication or dry film on wire coating</p>	<p>Inadequate lubrication.</p>	<p>Moisture hydrolysis on electrical insulation surfaces.</p>	5		<p>Incorrect or insufficient spec specified.</p>	1	<p>Crushing tests.</p>	1	5								

CONFIDENTIAL

TI-NHTSA 019427

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number: 503802
Revision Level: C
Revision Date: 4-Nov-86
Original (Invent) Date: 20-Dec-81

Page 1

System: _____
Subsystem: _____
X Component: Pressure Switch

Design Responsibility: Pressure Switch Group

Model Year(s)/Vehicle(s): Various

Key Date: 1983

Prepared By: C. Wagner

Core Team: Design Engineers, Manufacturing Engineers, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	D e t e c t a b i l i t y	Current Design Controls	D e t e c t a b i l i t y	R e p a r a b l e i n t e n d e n c e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	E v e n t	O c c u r r e n c e	D e t e c t e d	R e p a r e d
TRANSFER PIN (740789) Transfers disc section to movable electrical contact	Fails to properly transfer disc section.	Contacts stuck open. Contacts stuck closed. Erratic operation.	7		Diameter incorrectly specified. Depth/geometry cause pin to wedge.	1	Tolerance stackup between pin and pin guide in cup. Check with supplier for material properties regarding chips.	1	7		CONFIDENTIAL					
Operates electrical components from switch housing.	Fails to operate	Continuity between movable terminal and housing to ground.	5		Wrong material specified.	1	Check with supplier for material properties. Check with customer for electrical logic of movable terminal.	1	5							

TI-NHTSA 019428

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503801
Revision Level C
Revision Date 4-Nov-96
Original (Initial) Date 20-Dec-93

Page 1

System _____
Subsystem _____
Component Passive Switch

Design Responsibility Program Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effects of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D i s c r i m i n a t e d	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	E v a l u e d	O c c u r r e n c e	D i s c r i m i n a t e d	R e p a r t u r e
ENVIRONMENTAL SEAL (74347) Prevents ingress of water to switch cavity	Contaminants enter switch cavity.	High current leakage High contact drop. Erratic or inoperative switch operation.	7		Contact thickness is specified too small. Leads on primary not specified. Informed material	1	Review of standard practices for glass design. Review with glass manufacturer Comparison of design with similar product	1	7		CONFIDENTIAL					
Prevents leakage of air in air/ironing base rotation	Glue retires too early	Perceived as leakage by assembly plant under bench parameter.	6		Contact thickness improperly specified.	1	Review of standard practices for glass design. Temp-to-retire testing. Comparison of design with similar product.	1	5							

TI-NHTSA 019429

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503804
Revision Level C
Revision Date 4 Nov 93
Original (Issue) Date 20 Dec 93

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Part(s) Various

Key Date 1993

Prepared By C. Wright

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) / Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results			
												S e v e r i t y	O c c u r r e n c e	D e t e r m i n e	R i s k P r o b a b i l i t y
THREAD CAP (74488) Protect support flange from damage during shipping and repair Prevents dust from entering the fuel cavity	Incorrect length.	Does not protect flange sufficiently.	4	1	Length incorrectly specified.	1	Dimensional checking study.	1	5	CONFIDENTIAL					
	Loose Cap.	Allows dust to enter fuel cavity.	4	1	Incorrect diameter specified.	1	Dimensional analysis.	1	4						

TLNHHTSA 019430

System _____
 Subsystem _____
 X Component Engine Sump

POTENTIAL
 FAILURE MODE AND EFFECTS ANALYSIS
 (POTENTIAL FAILURE)

Document Number 303798
 Revision Level D
 Revision Date 4-Mar-95

Design Responsibility Engine Sump Group

Original (Date) Date 25-Dec-93

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	O v e r	O c c u r r e n c e	D e t e r m i n e d	R. P. N.
(DAMPERS) (OR SEAL) (SR) (74176) Feeds fuel to prevent slippage of fuel containment seals.	Fails to contain fuel.	Fuel leakage.	6		Cracked sump over life due to improper design of supporting elements. Cracked sump over life due to excessive manufacturing tolerances. Cracked sump over life due to stress concentrations caused by repetitive strain distribution. Chemical attack due to incorrect material specified. Improper thickness (or a of layout) of discharge manifold. Insufficient manufacturing of discharge manifold.	1	Flare, torque, and thermal cycle tests. Material mfg. recommendations. Comparison of design with similar products.	1	9							
Feeds pressure from fuel to pressure sensing elements.	Change in area of passage transfer over life.	Shift in response over life.	6		Discharge too stiff, incorrect material specified.	1	Life testing of characteristics at intermediate points.	1	5							

TI-NHTSA 019431

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PFMEA/FMEA)

Document Number 003795
Revision Level D
Revision Date 4-Nov-98
Original (Initial) Date 20-Dec-93

System _____
Subsystem _____
X Component Process Seal

Design Responsibility Process Seal/Seal

Most Vulnerable/High Value _____

Key Date 1998

Prepared By C. Wagner

Core Team Design, Engineering, Manufacturing, Packaging, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	O	Potential Cause(s) / Mechanism(s) of Failure	D	C	R	P	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Severity	Occurrence	Detectability	Prevention	Postvention
ON SEAL (BR) (24178)	Excessive change of process transfer area versus process.	Excessively high pressures applied to adjacent force process transfer area; white signs on outpoints due to impossibility of lower pressure.	6	1	Displacement of seal Incorrect material used	1	1	1	6	Force and pressure versus deflection testing to establish reflective areas.						

TI-NHTSA 019432

POTENTIAL
FALLING MODE AND EFFECTS ANALYSIS
(FMEA/FMEA)

Document Number 303784
Revision Level C
Revision Date 4-Nov-98
Original (Title) Date 20-Dec-93

System _____
Subsystem _____
X Component Friction Drive

Design Responsibility Francis Smith Group

Model Year(s)/Vehicle(s) Volvo

Key Date 1995

Prepared By G. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D i s t r i b u t i o n	F. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D i s t r i b u t i o n	F. P. N.
GARRET (FRISK) Provides hold over tolerance bump and slingshot.	Fail to provide adequate hold over.	Drive belt slings.	3	1	Insufficient compression specified. May excessive compression specified, leading to displacement from gland. Increased ID under OD leading to displacement from gland. Increased cross-section shape specified. Increased material specified, hold compatibility. Increased design of holder mechanism.	1	Review of general and design principles. Manufacturer's recommendations. Burst, impact, and fatigue cycle tests. Comparison with design of similar products.	1	3							

TI-NHTSA 019433

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(GDSM/FMEA)

Document Number 508770 Page 1

Revision Level B

Revision Date 5-Nov-96

System
Subsystem
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Issue) Date 20-Dec-95

Model Year(s)/Model(s) Various

Key Date 1993

Prepared By D. Hy

Core Team Design Engineering, Manufacturing Engineering, Manufacture, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R e p a r t u r e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R e p a r t u r e
RIVET (74878) Factors spring to movable terminal. Provides a force between movable terminal and spring which causes intimate contact for current flow.	Failure to adequately fasten spring to movable terminal.	Spring rotates about axis of rivet. Spring falls off movable terminal.	8		Improper rivet diameter for given hole diam. Improper rivet length for given material thickness. Improper head size. Improper tubular feature. Improper material.	1	Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to rotate spring.	1	8							
	Inadequate force between spring and movable terminal.	High resistance or no contact at interface of spring and movable terminal.	8		Improper rivet diameter for given hole diam. Improper rivet length for given material thickness. Improper head size. Improper tubular feature. Improper material.	1	Rivet manufacturer recommendations. Comparison with similar products. Testing to determine torque to rotate spring.	1	8		CONFIDENTIAL					

TI-NHTSA 019434

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 508770 Page 1
Revision Level B
Revision Date 5-Nov-95
Original (Instat) Date 20-Dec-93

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1993

Prepared By D. Ha

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

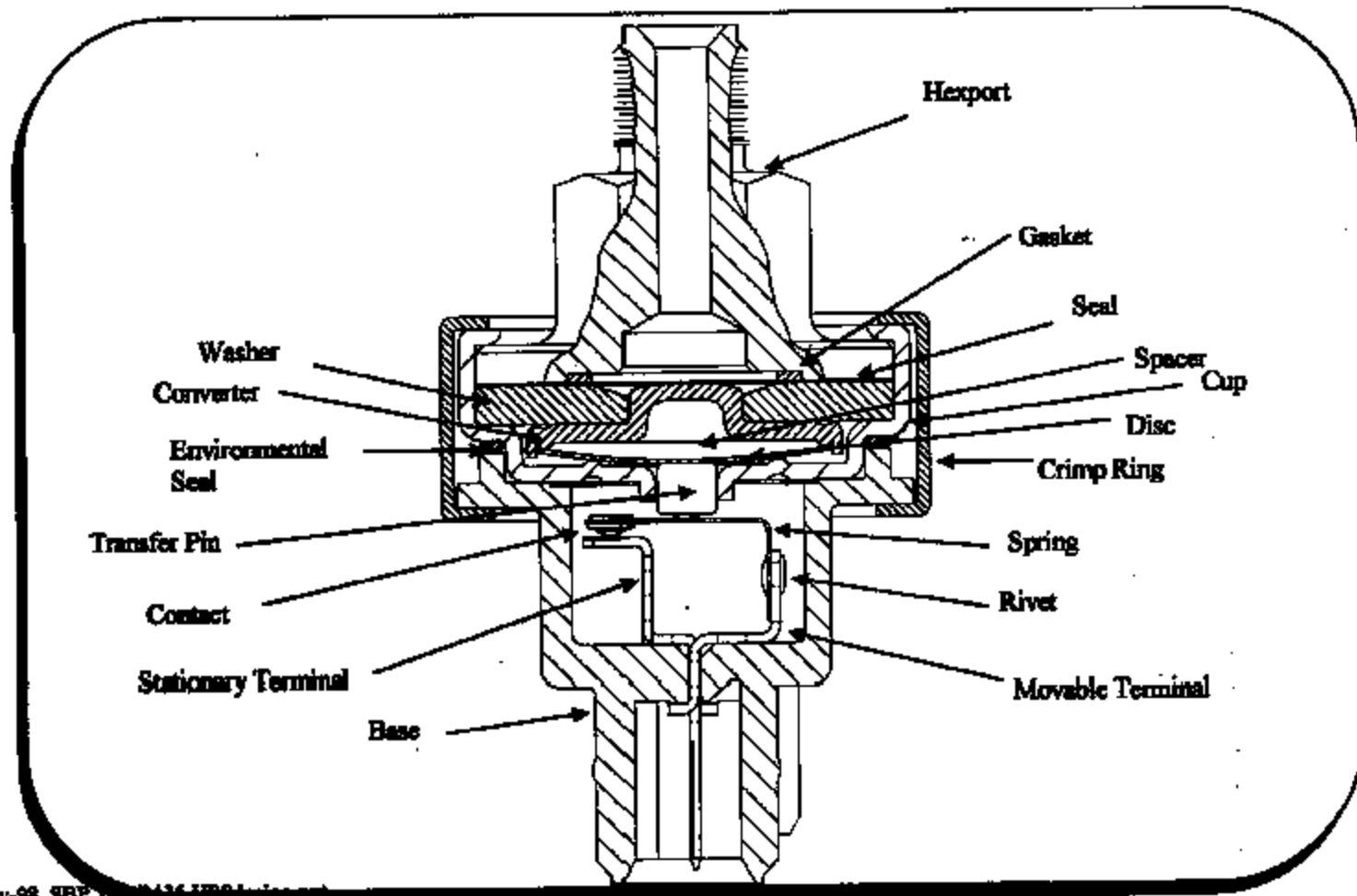
Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e F r e q u e n c y	Current Design Controls	D e t e r m i n e d	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R i s k P r o b a b i l i t y
SWET (74314) Fastens spring to movable terminal	Fails to adequately fasten spring to movable terminal.	Spring retains about half of load. Spring fails off movable terminal.	6	6	Improper rivet diameter for given hole size. Improper rivet length for given material thickness. Improper load size. Improper tubular features. Improper material.	1	Rivet manufacturer recommendations Comparison with similar products Testing to determine torque to rotate spring.	1	6							
Provides a lock between movable terminal and spring which causes intimate contact for current flow	Inadequate force between spring and movable terminal.	High resistance or no continuity at interface of spring and movable terminal.	6	6	Improper rivet diameter for given hole size. Improper rivet length for given material thickness. Improper load size. Improper tubular features. Improper material.	1	Rivet manufacturer recommendations Comparison with similar products. Testing to determine torque to rotate spring.	1	6	CONFIDENTIAL						

TI-NHTSA 019436

77PS Overview Appendix

- 1. Pressure Switch Cross Section**
- 2. Hexport Print (TI # 36900)**
- 3. Gasket Print (TI# 74353)**
- 4. DFMEA for Gasket and Kapton Seal**
- 5. Life Test to Failure Test Report (Weibull Analysis)**
- 6. Customer Specification (ES-F2VC-9F924_AA)**
- 7. PFMEA**
- 8. IP Test Reports**
- 9. Endurance Test Report**

Pressure Switch Cross Section



TI-NHTSA 019437

**POTENTIAL
FAILURE MODES AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 503798
Revision Level D
Revision Date 4-Nov-88
Original (Initial) Date 25-Dec-83

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Vadose

Key Date 1989

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Actions Taken	S e v e r e	O c c u r r e n c e	D e t e r m i n e d	R. P. N.
DIAPHRAGM (OR SEAL) (BF) (74178) Forms flexible element of fluid containment cavity.	Falls to contain fluid.	Fluid leakage.	6		Gradual rupture over life due to improper design of supporting elements. Gradual rupture over life due to excessive flexure/displacement. Gradual rupture over life due to stress concentrations caused by asymmetric strain distributions. Chemical attack due to incorrect material specified. Incorrect thickness (or # of layers) of diaphragm material. Insufficient location/clamping of diaphragm.	1	Burst, impulse, and thermal cycle tests. Material mg. recommendations. Comparison of design with similar products.	1	5							
Transfers pressure from field to pressure-sensing elements.	Change in area of pressure transfer over life.	Shift in setpoints over life.	5		Diaphragm too stiff. Incorrect material specified.	1	Life testing w/ characteristics at intermediate points.	1	5							

TI-NHTSA 018440

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)**

Document Number 503798
 Revision Level D
 Revision Date 4-Nov-85
 Original (Initial) Date 20-Dec-83

System _____
 Subsystem _____
 X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Vehicle(s) Various

Key Date 1985

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	P o t e n t i a l C o u s e (s) M e c h a n i s m (s) o f F a i l u r e	O c c u r r e n c e	C u r r e n t D e s i g n C o n t r o l s	D e t e c t i o n	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Actions Taken	S o l v e d	O c c u r r e n c e	D e t e c t e d	R. P. N.		
DIAPHRAGM (OR SEAL) (SR) (74178)	Excessive change of pressure transfer area versus pressure.	Excessively high pressures needed to adequately form pressure transfer area; wide spread on setpoints due to unpredictability at lower pressures.	8		Diaphragm too stiff. (incorrect material specified)	1			1	d								

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 505784

Page 1

Revision Level C

Revision Date 4-Nov-98

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (Initial) Date 30-Dec-93

Model Year(s)/Vehicle(s) Various

Key Date 1998

Prepared By G. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R e l a t i v e	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r e	C o n s e q u e n c e	D e t e r m i n e d	R e l a t i v e
GASKET (74353) Provides fluid seal between inport and diaphragm.	Fails to provide adequate fluid seal.	Brake fluid leakage.	9		Insufficient compression specified. Very excessive compression specified, leading to displacement from gland. Incorrect ID and/or OD leading to displacement from gland. Incorrect cross-section shape specified. Incorrect material specified, fluid incompatibility. Incorrect design of sealing mechanism.	1	Review of general seal design principles. Manufacturer's recommendations. Burst, impulse, and thermal cycle tests. Compare with design of similar products.	1	9							

TI-NHTSA 018442

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(RISKIN FMEA)

Document Number 543798
Revision Level E
Revision Date 13-May-88
Original (Initial) Date 20-Dec-83

Page 1

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Version(s) Variant _____

Key Date 1983

Prepared By D. H.

Core Team Design Engineers, Manufacturing Engineers, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S	C	Potential Cause(s) / Mechanism(s) of Failure	O	Current Design Controls	D	R	P	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
													W	C	E	P	N		
CONVERTER (PQ) (ZF488) Transfer pressure from fluid (oil) (air) (air) to a face on pressure sensing disc.	Fails to correctly transfer fluid pressure to face on disc.	Shill in output	S		Ballon O.D. incorrectly specified relative to cap I.D.	1	Tolerance stackup analysis.	1	S		Force/deflection analysis to determine strength and resistance to plastic deformation. Burst, impulse, and thermal cycle tests.								
					Converter major O.D. incorrectly specified relative to cap I.D.		Converter thickness incorrectly specified. Incorrect material specified.												
Pressure alignment and support to disc.	Fails to properly align and support disc.	Leads to incorrect alignment which may cause shill in output or erratic operation. Disc out-of-plate relative to converter may cause erratic operation or inoperative device, shock operation.	S		Ballon O.D. incorrectly specified relative to cap I.D.	1	Tolerance stackup analysis.	1	S		Comparison of design with other product.								
					Converter major O.D. incorrectly specified relative to cap I.D.		Disc support bump incorrectly specified. Disc retaining wall incorrectly specified.												

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TI-NHTSA 018443

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 563786
Revision Level E
Revision Date 13 May 88

Page 2

System _____
Subsystem _____
X Component Pressure Switch

Design Responsibility Pressure Switch Group

Original (brief) Date 20 Dec 83

Model Year(s)/Model(s) Various

Key Date 1983

Prepared By D. Ho

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
												Action Taken	S e v e r i t y	O c c u r r e n c e	D e t e r m i n e d	R. P. N.
CONNECTER (PS) (21488) Provides a portion of the support surface for diaphragm.	Fails to properly support diaphragm.	Reduced diaphragm life results in leakage.	6		Condition of surface in contact with diaphragm are specified incorrectly. Condition of edges in contact with diaphragm are specified incorrectly. Clearance between connector body and venting I.D. are specified too wide.	1	Start, impulse, and Thermal cycle tests. Comparison of design with similar product.	1	8							
Provides disc support during over pressure condition.	Fails to properly support disc during over pressure.	Disc deformation results in shift in setpoint. Reduced disc travel if disc motion is restricted prematurely. Reduced disc life.	8		Features which control disc motion during over pressure are incorrectly specified.	3	Pre and post proof characterization Pressure-deflection characteristics of the valve.	1	10							
Used in connector prevents pressure buildup from affecting setpoint.	Does not vent properly.	Shift in setpoint over temp. Reduced disc wear.	5		Vent hole incorrectly specified.	1	Comparison of design with similar product. Temperature characteristics.	1	6							

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TI-NHTSA 019444

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Document Number 503789
Revision Level D
Revision Date 25 May 90
Original (Initial) Date 20 Dec 83

System _____
Subsystem _____
K Component Pressure Switch

Design Responsibility Pressure Switch Group

Model Year(s)/Product(s) System

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Item Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r e	C o n s e q u e n c e	Potential Cause(s) Mechanism(s) of Failure	O c c u r r e n c e	Current Design Controls	D e t e r m i n e d	R i s k P r o b a b i l i t y	Recommended Action(s)	Responsibility & Target Completion Date	Action Results						
												Actions Taken	S e v e r e	O c c u r r e n c e	D e t e r m i n e d	R i s k P r o b a b i l i t y		
STATIONARY TERMINAL (36480 & 36728) Provides a brass plate for interconnection.	Poor interconnection.	Device operates sporadically resulting connector installed.	7		Contamination of brass plate. Material specified too thin.	1	Review design and dimensions of mating connector to ensure proper interference and wiping action.		1	7								
	Brake proximity sensor.	Difficult to install mating connector.	6		Lead-in channels on terminal are insufficiently specified. Material specified too thick.	1	Review design and dimensions of mating connector. Compare with design of similar SVP's product.		1	6								
Provides a silver entry surface for electrical contact.	Fails to provide adequate electrical contact.	Device operates sporadically. Intermittent continuity. High voltage drop.	7		Incorrect contact material specified. Contamination. Silver layer specified too thin.	1	Review of TI proprietary and general contact design info. Establish paths for degree of contamination.		1	7	CONFIDENTIAL							
	Excessive loss of contact length (dynamic mechanical loads).	Stall in all points over life.	7		Silver layer specified too thick.	1	Review of TI proprietary and general contact design info. Life Testing		1	7								
	Erosion of contacts due to electrical loads.	Stall in separate over life. Intermittent or no continuity.	7		Incorrect material specified for particular electrical loading.	1	Review of TI proprietary and general contact design info. Review and testing with actual electrical loads.		1	7								

TR-NHTSA 018448

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DEMON FMEA)

Document Number 583784
Revision Level D
Revision Date 29 May 98
Original (week) Date 20 Dec 93

System _____
Subsystem _____
Component Pressure Switch

Design Responsibility Program Switch Group

Model Year(s)/Vehicle(s) Model _____

Key Date 1993

Prepared By C. Wagner

Core Team Design Engineering, Manufacturing Engineering, Manufacturing Quality

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	C i r c u l a r i t y	Potential Cause(s) / Mechanism(s) of Failure	D e t e r m i n e d	Current Design Controls	D e t e r m i n e d	R e l e a s e d	Recommendation / Action(s)	Responsibility & Target Completion Date	Action Results					
												Actions Taken	S e v e r i t y	C i r c u l a r i t y	D e t e r m i n e d	R e l e a s e d	
STATIONARY TERMINAL (2004 & 36724) Provides feature for device calibration	Poor calibration	High yield loss Unit is scrapped over life.	5		Design is excessively stiff. Design has excessive spring back. Material hardness is incorrectly specified. Initial position requires excess deflection to calibrate. Design has inadequate strength to maintain calibration over life.	1	Mechanical (static FEA) analysis Force deflection springback testing Testing with actual production calibration equipment	1	5								
Provides feature to ensure adequate spring rate loss.	Terminal is inadequately staked into base.	Loose terminals. Intermittent to single electrical.	7		Incomplete understanding of design of spring feature.	1	Comparison of design with similar GYPS product Staking evaluation.	1	7		CONFIDENTIAL						
Provides feature which mate with pins in base for location of terminal.	Fails to properly locate terminal.	Terminals out of position.	3		Incorrect dimensions and/or tolerances specified between slots and terminals. Inadequate staking design concept.	3	Comparison of design with similar GYPS product	1	8								
Provides electrical path from other relay contact to mating connector.	Fails to provide adequate conductivity.	High resistance shows as high contact drop.	5		Incorrect material specified. Inadequate cross-section area.	1	Calculations of resistance Testing	1	5								

TLNHTSA 019446