DELPHI

Delphi Mechatronic Systems

Quality Department

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5.- DFMEA

Delphi Mechatronics Division
System
Subsystem
Component *Delta Ignition Switch :*
Model Year(s)/Vehicle(s): 2004
Core Team: Ron Wojtecki, Erik Mattson

Potential Failure Mode and Effects Analysis (Design FMEA)

Design Responsibility: *Delphi Mechatronics Division*
Key Date: *6/19/01*

FMEA Number: df-741-76307
Page 1 of 7
Prepared By: *Ron Wojtecki,* [redacted]

FMEA Date (Orig. taken from 741-76307) 04/30/04 (Rev. A)
(09/30/05) AA FMEA Date (Orig.) 04/30/04
(01/05/06) JBC/E.Rodriguez CN 56989 (Rev. C)
(04/21/06) E.Rodriguez CN 57128 (Rev D)

Item / Function	Potential Failure Mode	Potential Effects(s) of Failure	Sev	Class	Potential Cause(s) / Mechanism(s) of Failure	Occur	Current Design Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
Cover Z741-79235-1																
Locates detent plunger assy	Plunger barrel cocks in bore Plunger binds in bore	Detent positions not repeatable Loss of detents	7 8		Guide bore oversize Guide bore undersize	3 3	Tolerance study / CAD Model / PV Test Tolerance study / CAD model / PV Test	1 1	21 24	None None		Plunger bore lengthened per rev F1 for improved guiding	7	1	1	7
Locates stops for total travel	Insufficient overtravel	Rotational travel does not meet specification	2		Stops positioned improperly	2	CAD model / PV parametrics	1	4	None						
Locates anti-theft sleeve	Resistor breakage "foot" not centered under resistor	Resistor not broken In "slam-pull" test	8		Sleeve orientation keys positioned incorrectly	1	CAD model / PV Test	1	8	None						
Provides cantilever snaps to retain base	Assembly comes apart In handling / shipping	Unit not functional	8		Insufficient engagement of snap tabs	3	CAD model / Design copied from Catera / PV Drop Test	2	48	None		Lowered RPN based on pilot builds	8	2	2	32
Provides protective enclosure for internal parts	Foreign materials / contaminents in unit	Intermittent circuits	8		Gaps on perimeter of assembly	3	PV Test / CAD model / Base and cover over-lap around perimeter / PV Test	1	24	None						
Detent Plunger Assy 741-79378																
Provides tactile feel for accessory and run positions	Detent engagement not positive	Rotor overshoots "Run" detent on return from "crank" position	8		Detent spring force low	3	PV Test / customer subjective evaluation	1	24	Change spring/plunger to provide more torque force to the switch	Eduardo Rodriguez to implement new detent plunger by 6/30/06	New detent plunger provide more torque force to the switch	6	2	1	12

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Contact Plates 741-75184																
Provide electrical make and break to appropriate circuits	High circuit resistance	Excessive millivolt drop	7		Contact blade spring force low	3	PV Test	1	21	None		New contact released 9/14/01 to lower contact force	7	2	1	14
Provide electrical make and break to appropriate circuits	Excessive wear with PCB – debris generated	PCB shorted out	8		Excessive contact force	2	100% inspect on line fixture probes contacts for correct height – height & material control contact force	1	16	None						
Rotor Z741-79240																
Provides bearing surface to anti-theft sleeve	Rotor binds in sleeve	Excessive force required to rotate lock cylinder	7		Inadequate clearance between rotor and antitheft sleeve	2	CAD model / tolerance study / PV Test	1	14	None						
Provides bearing surface to base	Rotor binds on base	Excessive force required to rotate lock cylinder	7		Inadequate clearance between rotor and base bearing post	2	CAD model / tolerance study / PV Test	1	14	None						

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Retains torsion return spring	Torsion spring engagement begins before "Run" detent	Rotor overshoots "Run" detent on return from "crank" position	8		Installed position of spring incorrect	2	CAD model / DV Test / PV Test	1	16	None						
	Torsion spring engagement begins after "Run" detent	Rotor does not return to "Run" detent from "crank" position	8		Installed position of spring incorrect	2	CAD model / DV Test / PV Test	1	16	None						
Provides profile for detent plunger assy	Profile allows detent plunger to "cam-out" of position	Rotor is in wrong position relative to pcb circuits	8		Incorrect detent ramp profile	2	Proven design copied from Catera / DV Test / PV Test	1	16	None						
Guides key-in plunger	Key-in plunger binds in rotor	Key-in circuit inoperative	8		Inadequate clearance between guide bore and plunger shaft	2	CAD model / tolerance study	1	16	None						
Provides drive slot for customer interface	Drive slot in wrong orientation	Customer interface will not mate to switch	8		Modeled incorrectly in CAD file	2	CAD model	1	16	None						
Transmits torque from LCI	Drive slot fractured / deformed	Switch binds in crank position	8		Stress exceeds allowable values	3	DV / PV Testing	1	24	None		Drive slot redesigned per revs D & E. Passed over-torque test, lab #01-295	8	2	1	16
Provides features to secure contact blades	Contact blades loose and / or break off	Unit inoperative	8		Heat stake posts short	3	CAD model / Pilot build	2	48	None						
	Staked post after forming rubs on pcb	Reduced contact force	5		Heat stake posts too tall	3	CAD model / Pilot build	2	48	None						
Antitheft Sleeve Z741-79233																
Breaks resistor in "slam-pull" test	Hook fractures without breaking resistor	Anti-theft feature defeated	8		Hook overstressed	2	DV Test / PV Test	1	16	None						
Provides index features to cover	Hook not positioned correctly under resistor	Resistor not destroyed in "slam-pull" test	8		Hook out of position relative to index tabs	2	CAD model / DV Test / PV Test	1	16	None						

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Return Spring Z741-79242																
Provides rotary tactile feel in crank position	Drive tang of spring broken	Loss of return force	8		Fatigue failure	3	DV/PV Durability Test	1	24	None						
	Spring binding on anti-theft sleeve	Delayed return from crank / binding in crank position	8		Spring ID reduces in crank position loaded position	3	DV/PV Durability Test	1	24	None		Spring ID increased per rev D3	8	1	1	8
Printed Circuit Board 12861211																
Provides mechanical attachment for terminals	Terminals loose in pcb prior to wave solder operation	Terminals out of position after soldering	8		Terminal holes oversize	2	Hole sizes specified per supplier (Autosplice) recommendations	1	16	None						
Positions terminals	Terminals bent / skewed after installation	Mating connector will not engage	8		Terminal holes oversize	2	Hole sizes specified per supplier (Autosplice) recommendations	1	16	None						
Provides electrical signal as a function of rotary motion	Electrical signal out of sequence with rotary motion	Car will not start Car stops when running	8		Circuit traces out of position relative to detents Contact Bounce/ Intermittency presented in the signals	3	CAD layout / DV Test / PV Test EOLT detects change in signal.	1	24	Enlarge vias and Change gold specification to provide better conductivity between contact plate and PCB	Eduardo Rodriguez to implement New PCB by 6/30/06	New PCB reduce mili volt drops and contact bounce.	5	3	1	15

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Positions resistor	Body of resistor not exposed in pcb slot	Assembly problem- Anti-theft sleeve hook will not fit under resistor	8		PCB slot undersize	2	CAD layout	1	16	None						
Terminals Z741-74944																
Provides electrical connection with mating terminal	High resistance connection	Erratic operation / car will not start	8		Improper plating specified	1	Specified Sn/Pb over Nickel / DV Test / PV Test	1	8	None						
Conducts current to various circuits	High resistance connection	Erratic operation / car will not start	8		Improper plating specified	1	Specified Sn/Pb over Nickel / DV Test / PV Test	1	8	None						
Resistor Z741-74943																
Provides "unknown" correct resistance value for antitheft feature	Resistance shifts out of tolerance	Non detection of resistance by module- Car does not start	8		Overvoltage or overcurrent stress in application	2	System designed by GM. ¼ Watt resistor was requested. Max dissipation is less than 1/10 th resistance wattage.	1	16	None						
Key-In Plunger Z741-79236																
Lift key-in contact to open circuit	Plunger arm shears off	Key-In circuit always closed	8		Plunger arm overstressed / fatigue failure	3	Stress calculations / DV Test / PV Test	1	24	None						
Positions key-in spring	Key-in spring stuck in compressed position	Key-in circuit always closed	7		Plunger spring bore undersize	1	Cad layout / Tolerance study	1	7	None						

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Key-In Spring Z741-79237																
Provides force to lift key-in contact	Spring does not lift Key-in contact	Key-In circuit always closed	8		Spring force low	3	Force determined from force / travel curve for prototype blades. DV Test / PV Test	1	24	None						
Lubricant MS-76255																
Reduce friction between contact plates and pcb	Lubricant solidifies at cold temperature extremes	Increased operating effort / switch does not return to run detent	7		Switch operating environment exceeds temperature limits of grease	1	Operating temperature Limits of grease is -40F to 202F / DV Test / PV Test.	1	7	None						
Reduce friction between rotor and detent plunger	Increased rotary operating effort	Switch binds in a detented position	7		Worn detent plunger	5	DV / PV Test	1	35	None						
Base Z741-79234-1																
Provides mounting ears to secure assy to steering column	Mounting ear(s) fracture from applied fastener load	Erratic switch operation	8		Material overstressed	2	Material same as Catera design / Switch retention test	1	16	None						
Locates pcb	PCB out of position relative to rotor bearing	Intermittent and open circuits	8		Excessive clearance between pcb and base	2	CAD layout	2	32	None						
Guides key-in Plunger	Plunger binds in bore with key inserted	Key-In circuit remains closed when key is removed	8		Bore undersize	1	CAD layout / tolerance study	1	8	None						
Provides bearing surface for rotor	Rotor binds on bearing	Rotor stuck in crank position	8		Bearing for rotor too large	1	CAD layout / tolerance study	1	8	None						
	Rotor loose on bearing	Open and intermittent Circuits	8		Bearing for rotor too small	1	CAD layout / tolerance study	1	8	None						

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Provides mating feature for cover snaps	Assembly comes apart In handling / shipping	Unit not functional	8		Insufficient engagement of snap tabs	2	Carryover design : same as Catera	1	16	None						
Provides protective enclosure for internal parts	Foreign materials / contaminents in unit	Intermittent circuits	8		Gaps on perimeter of assembly	2	Dust test / environmental exposures / teardown Analysis	1	16	None						

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