DELPHI

Delphi Mechatronic Systems

Quality Department

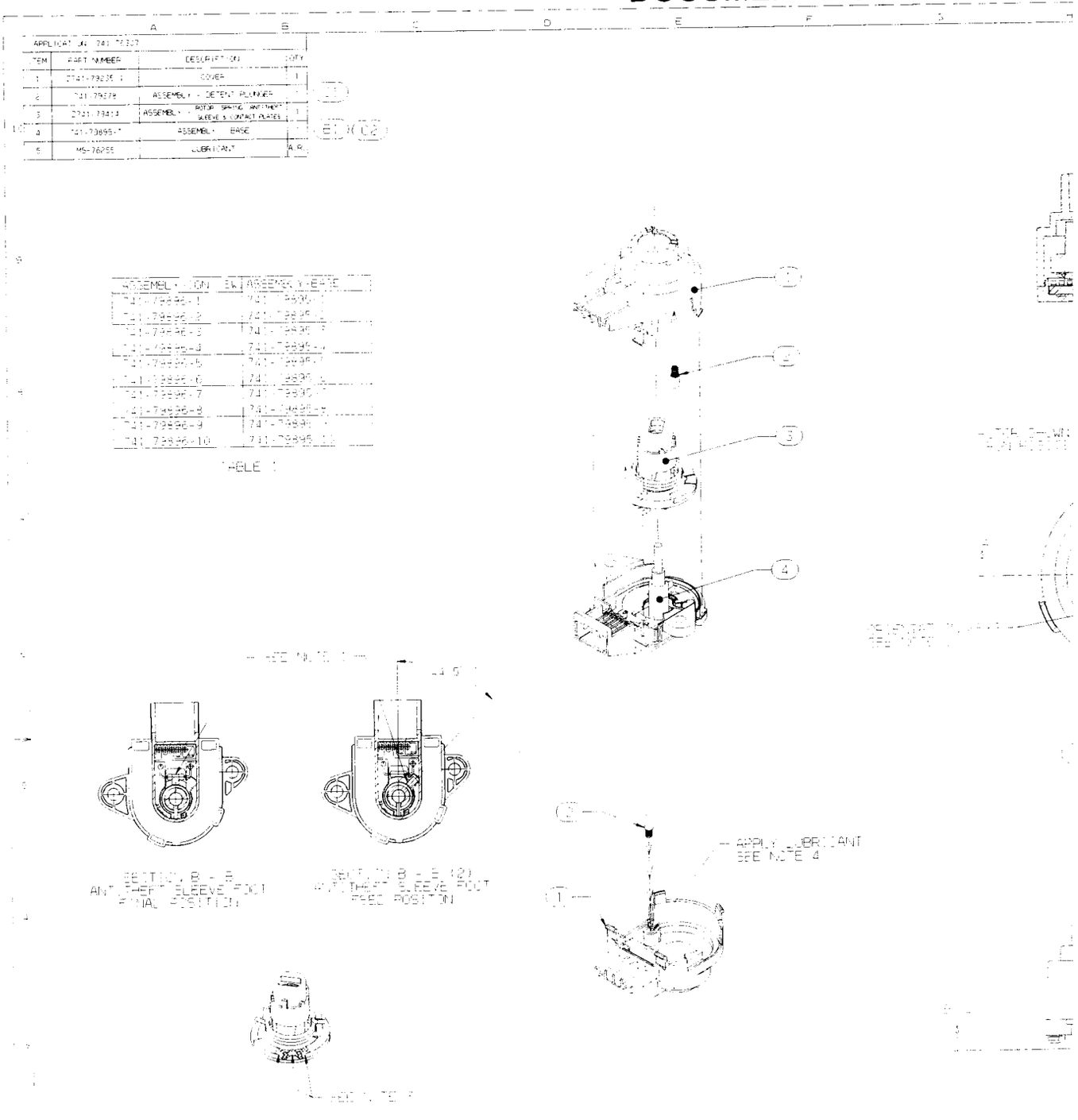
[redacted]

Phone: [redacted]

E-Mail: [redacted]

2.- DESIGN RECORDS

Date: 05-09-06 08:56:22 AM



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User: QZV3SM

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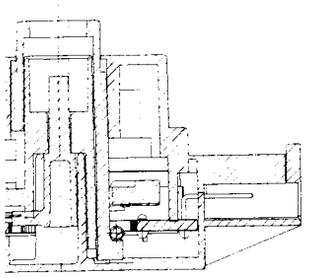
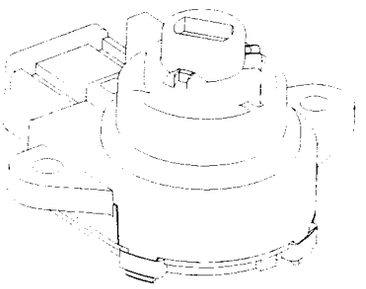
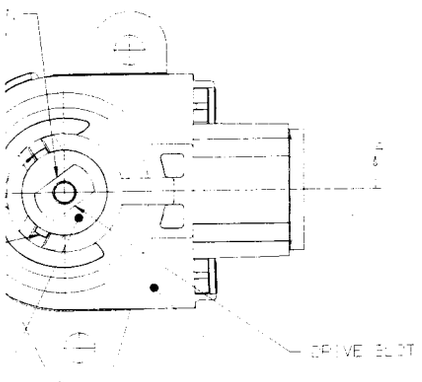
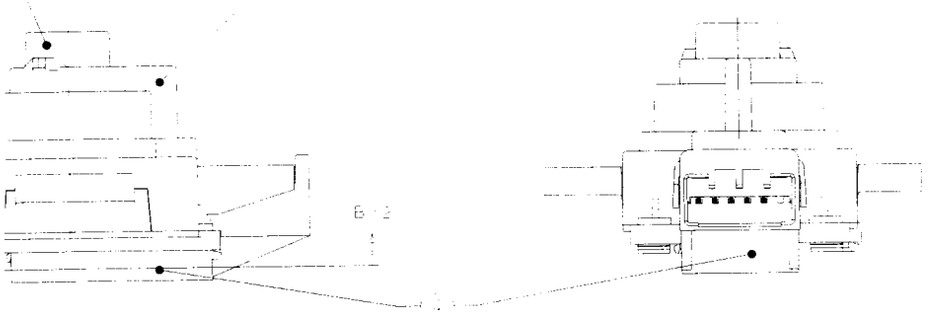




SECTION A - A





Date: 05-09-06 08:58:03 AM

APPLICATION:

ITEM	PART NUMBER	DESCRIPTION	QTY
1	12867211	PRINTED CIRCUIT BOARD	1
2	Z741-7994	TERMINALS	5
3	Z741-7943-T	RESISTOR, SEE TABLE	1
4	12353 1	PLUG	AR
5	9161-05	SOLDER	AR

TRIM RESISTOR LEAD

0.70 MAX
ONE PLACE ONLY

SECTION A - A

PLUG ASSEMBLY	RESISTOR
741-7989-1	Z741-7943-1
741-7989-2	Z741-7943-2
741-7989-3	Z741-7943-3
741-7989-4	Z741-7943-4
741-7989-5	Z741-7943-5
741-7989-6	Z741-7943-6
741-7989-7	Z741-7943-7
741-7989-8	Z741-7943-8
741-7989-9	Z741-7943-9
741-7989-10	Z741-7943-10

2.54 MAX
UNTRIMMED
RESISTOR LEAD

4.00

SEE NOTE 1

NOTES:

1. RESISTOR LEADS TO BE FLUSH AGAINST BOTTOM OF PC BOARD.
2. COMPONENT SIDE TO BE FREE OF FLUX RESIDUE AND ALL FOREIGN MATERIALS.
3. HANDLING OF BOARDS TO BE DONE WITH GLOVES OR SIMILAR PROTECTION TO PREVENT CONTAMINATION TO COMPONENT SIDE TERMINALS.
4. A SAMPLE APPLIED TO ENSURE THAT ALL NO TABULATED RESISTANCE VALUES ARE USED.

REFERENCE

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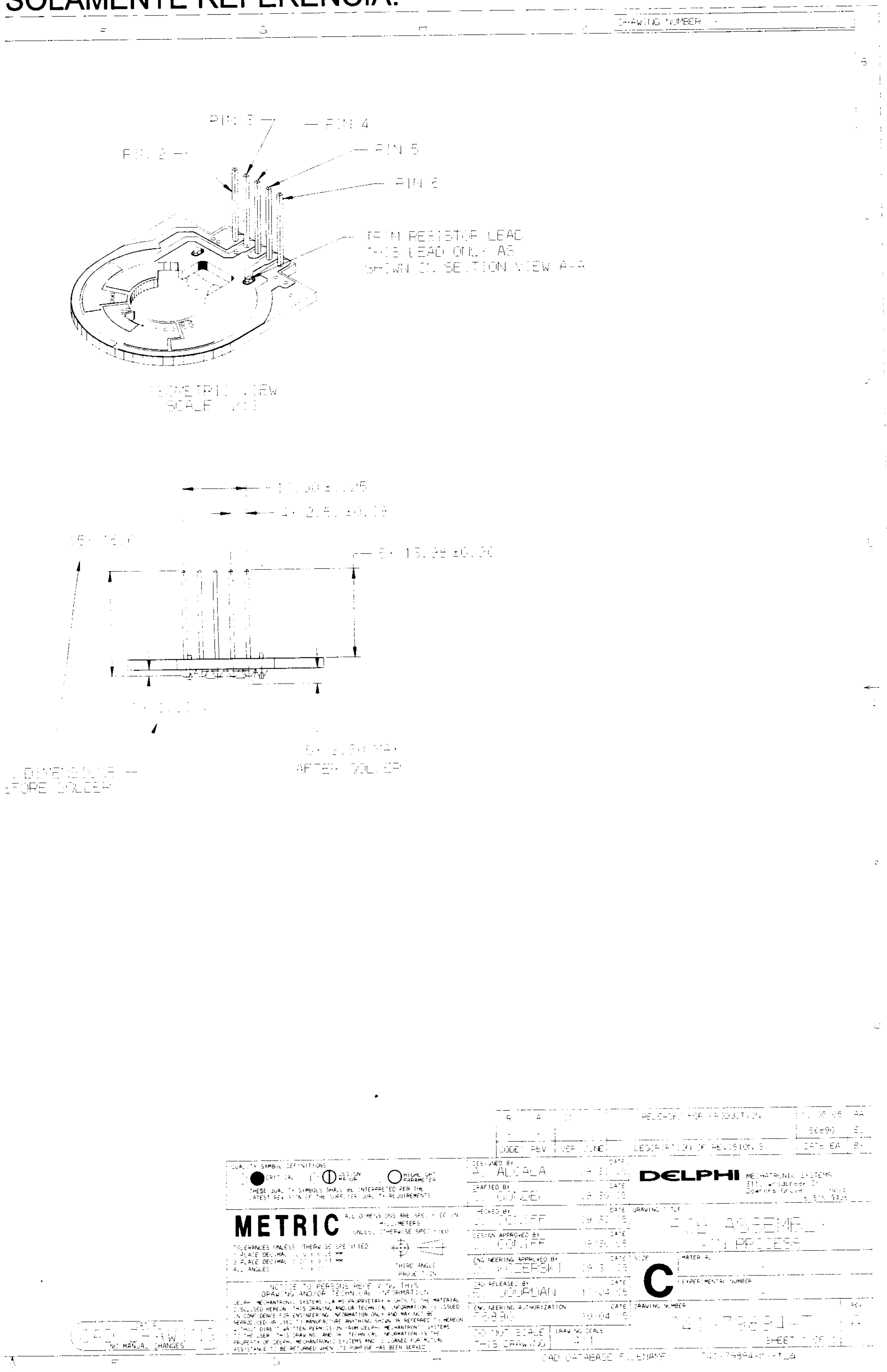

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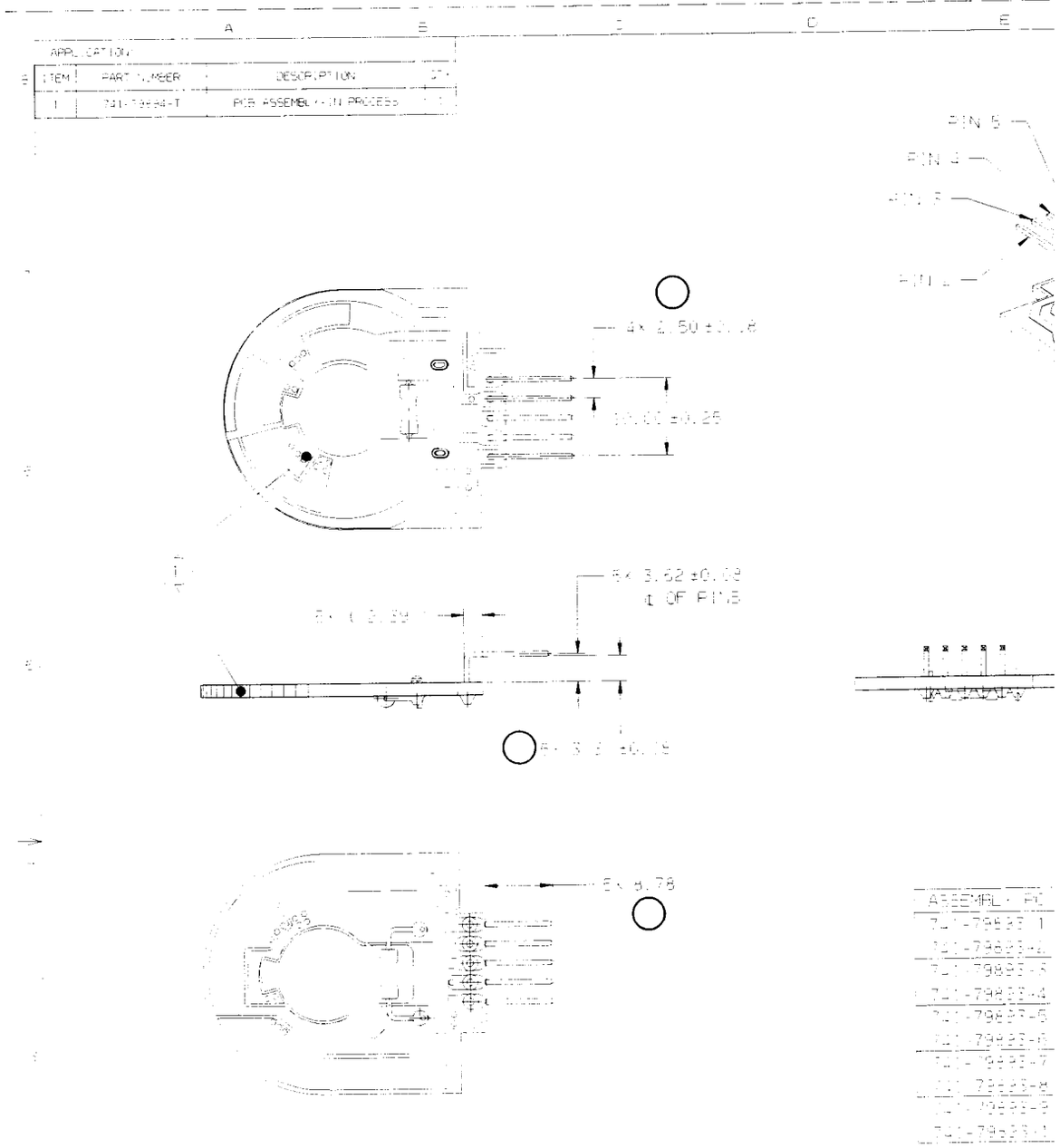

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SOLAMENTE REFERENCIA.

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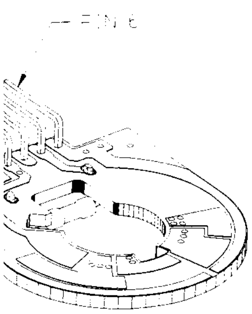

ARE	PCB ASSEMBLY [illegible]	REPLACES [illegible]
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	741-79884-2	Z741-74843-2
	741-79884-3	Z741-74843-3
	741-79884-4	Z741-74843-4
	741-79884-5	Z741-74843-5
	741-79884-6	Z741-74843-6
	741-79884-7	Z741-74843-7
	741-79884-8	Z741-74843-8
	741-79884-9	Z741-74843-9
	741-79884-10	Z741-74843-10

PRODUCTION RELEASE

CODE | REV | APP. DATE | DESCRIPTION OF REVISIONS | DATE EA | BY

QUALITY SYMBOL DEFINITIONS: CRITICAL, DESIGN MAJOR, HIGHLIGHT PARAMETER. THESE QUALITY SYMBOLS SHALL BE INTERPRETED PER THE LATEST REVISION OF THE SUPPLIER QUALITY REQUIREMENTS

METRIC ALL DIMENSIONS ARE SPECIFIED IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

TOLERANCES UNLESS OTHERWISE SPECIFIED
1 PLACE DECIMAL
2 PLACE DECIMAL
ALL ANGLES

THIRD ANGLE PROJECTION

NOTICE TO PERSONS RECEIVING THIS DRAWING AND/OR TECHNICAL INFORMATION
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CAD DRAWING — MANUAL CHANGES

DESIGNED BY: A. ALCALA
DRAFTED BY: D. [illegible]
CHECKED BY: JAC[illegible]
DESIGN APPROVED BY: JAC[illegible]
ENGINEERING APPROVED BY: D. [illegible]
CAD RELEASED BY: E. JOURDAN
ENGINEERING AUTHORIZATION
DO NOT SCALE THIS DRAWING — DRAWING SCALE

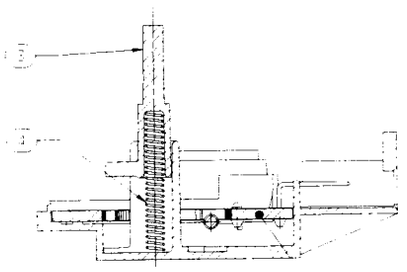
DELPHI MECHATRONIC SYSTEMS
3110 [illegible]
Downers Grove, Illinois
60515-[illegible]

DRAWING TITLE: ASSEMBLY PC BOARD

SIZE: C — MATERIAL: SEE NOTES
EXPERIMENTAL NUMBER
DRAWING NUMBER: [illegible]-T — REV: A
SHEET 1 OF [illegible]

CAD DATABASE FILENAME [illegible]

ITEM	PART NUMBER	DESCRIPTION	QTY
1	741-7963-1	PC BOARD ASSEMBLY	1
2	2741-79634-1	BASE	1
3	2741-79636	KEY-IN PLUNGER	1
4	2741-79637	KEY-IN SPRING	1
5	MS-76255	LUBRICANT	A.R.



SECTION A - A

BASE ASSEMBLY	PCB ASSEMBLY
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741-7989-2	741-7963-2
741-7989-3	741-7963-3
741-7989-4	741-7963-4
741-7989-5	741-7963-5
741-7989-6	741-7963-6
741-7989-7	741-7963-7
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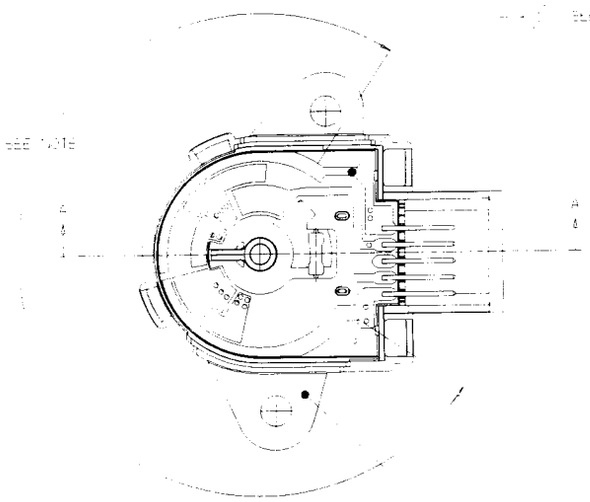
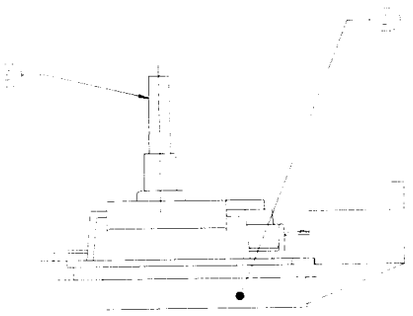
741-7989-9	741-7963-9
741-7989-10	741-7963-10

TABLE 1





NOTES:

1. KEY-IN SPRING IS SHOWN IN FREE LENGTH POSITION.
2. APPLY A 0.5-1.0 GRAM LUBRICANT (ITEM 5) TO PC BOARD EVENLY DISTRIBUTED IN ZONE INDICATED.
3. REGISTER TO BE ONE OF THE VALUES SHOWN IN 2741-79843-T

REFERENCE

User: QZV3SM

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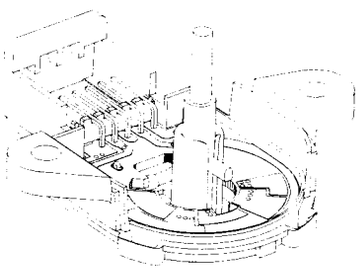
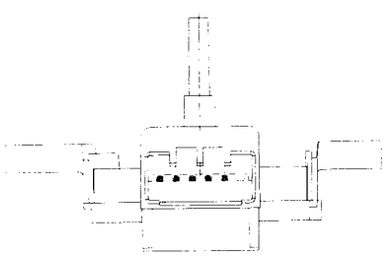
SOLAMENTE REFERENCIA.





METRIC

D

DELPHI

Date: 05-09-06 09:26:34 AM

PAGE TITLE	PAGE
TITLE BLOCK	1
REVISION BLOCK	2
PART BLOCK	3
GENERAL NOTES	4
KPC CHART AND VIEWS	5
DATUM AND VIEWS	6
LABELED MATERIALS	7

GM CONFIDENTIAL
UNTIL 01MR03

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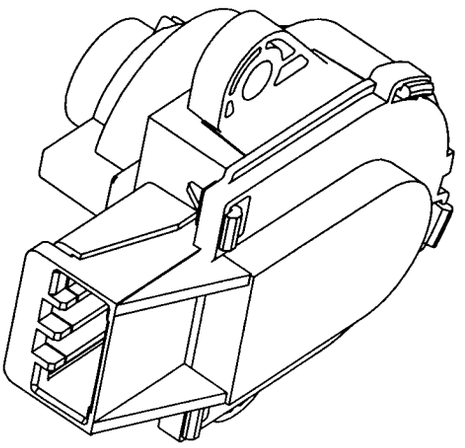

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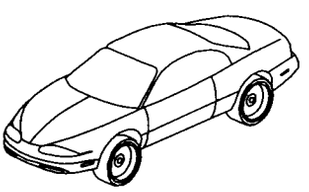

VIEW 1

GM

UG

CHANGE RESTRICTED
NO MANUAL CHANGES

UNLESS OTHERWISE SPECIFIED:

THIS DOCUMENT IS IN ACCORDANCE WITH ASME Y14.5M-1994 AS AMENDED BY THE GM GLOBAL DIMENSIONING AND TOLERANCING ADDENDUM - 1997. ALL GEOMETRIC TOLERANCES AND RELATED DATUMS APPLY RFS. RULE #1 (PERFECT FORM AT MMC) DOES NOT APPLY WHEN A RELATIONSHIP BETWEEN FEATURES IS ESTABLISHED BY ORIENTATION OR LOCATION TOLERANCES. SEPARATE POSITION CALLOUTS MAY BE GAGED SEPARATELY REGARDLESS OF DATUM REFERENCES.

		DATE
DR ARIF IQBAL		26AP04
APVD1		
APVD2		
APVD3 RAY DEGIORGIO		26AP04
APVD4		
APVD5		

COPY OF MATH DATA
DO NOT SCALE

REFERENCE
DELPHI MECHATRONIC SYSTEM
[redacted]

METRIC
DIMENSIONS SHOWN IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

THIRD ANGLE PROJECTION

DRAWING NAME
ANTI-THEFT IGNITION SWITCH

DRAWING NUMBER
10392423

DWG STATUS			PAGE NUMBER
STG	REL	PDI	
R	001		1 OF 7

Date: 05-09-06 09:26:56 AM

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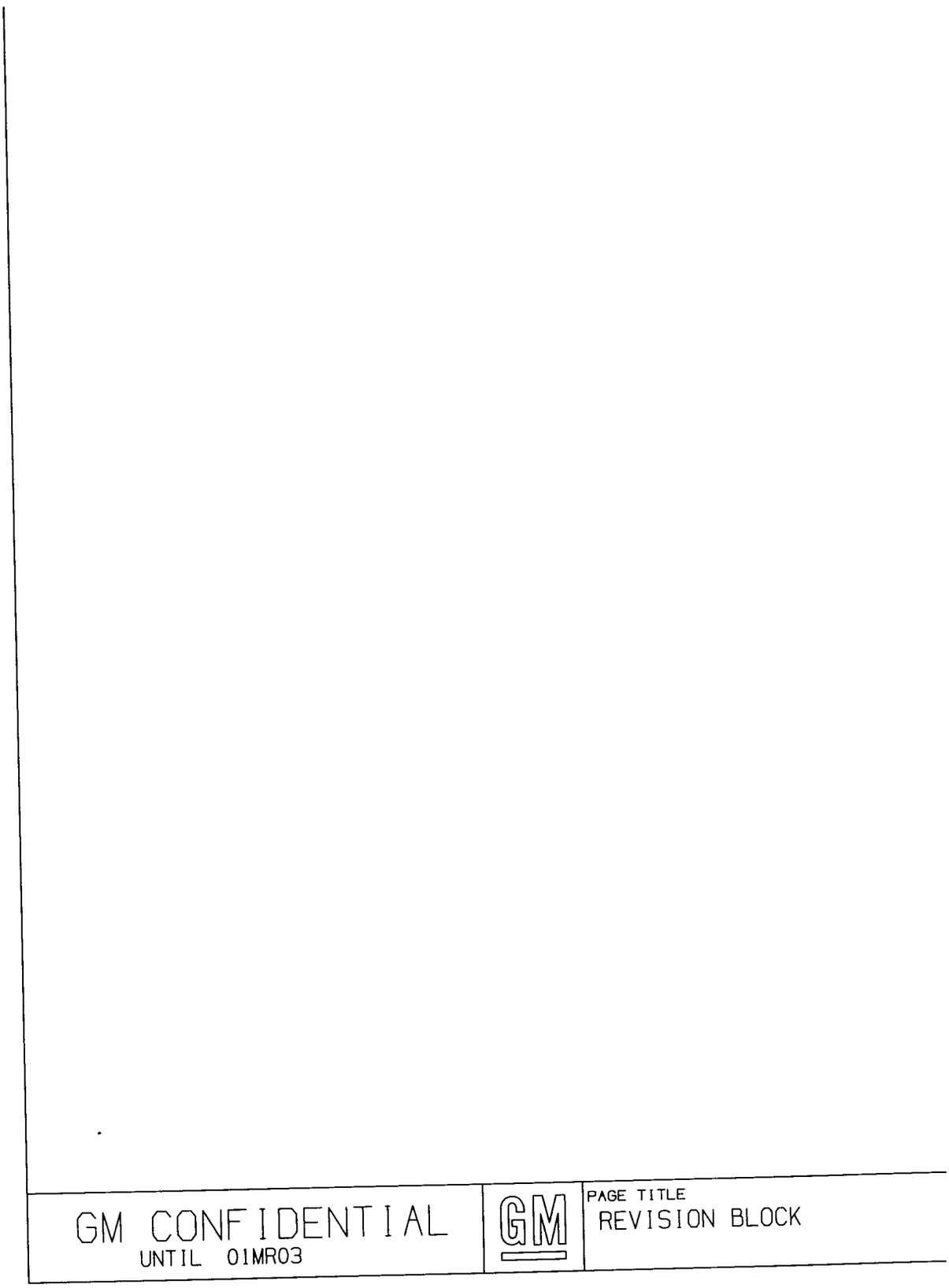

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SOLAMENTE REFERENCIA.

2	27AP04	R	001			PART NUMBER CHANGED PER WO# 302726	BGDMG	AI	EM	RD

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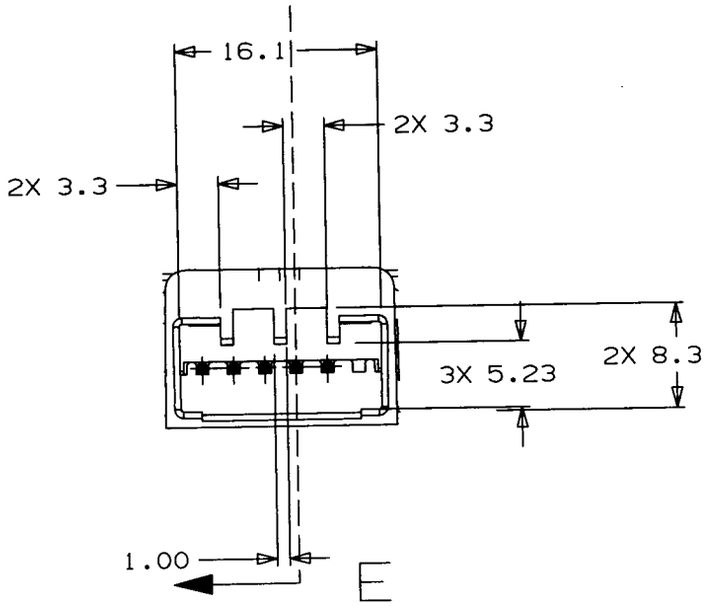

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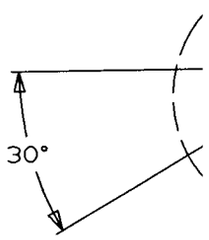

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PARTS SHOWN ON DRAWIN									

GM CONFIDENTIAL UNTIL 01MR03	GM	PAGE TITLE PART BLOCK

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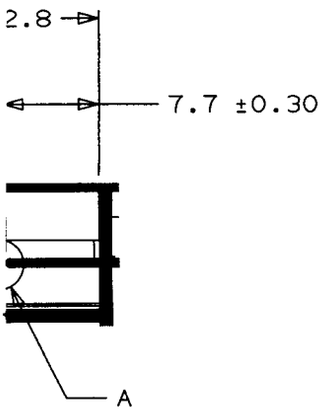

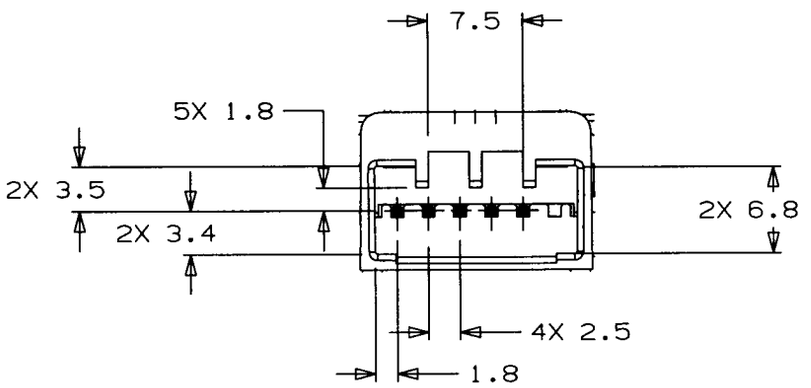

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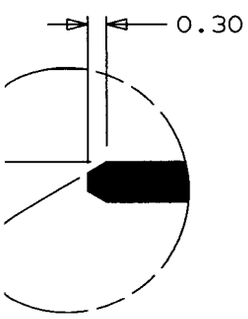

DETAIL A

NOTE:

1. MUST MATE WITH JAE CONNECTOR P/N IL-AG5-6S-S3C1-DG
2. CONNECTOR INSERTION FORCE MUST NOT EXCEED 50 N

	ANTI-THEFT IGNITION SWITCH	10392423				PKG	0001	
	DRAWING	10392423				DWGFMT	0001	
MASS (Kg)	PART NAME	OBJECT	SHT	ITM	MFI	CLASS	SEQ NO	DWG COLLECTOR
		FILES TO BUILD DRAWING						

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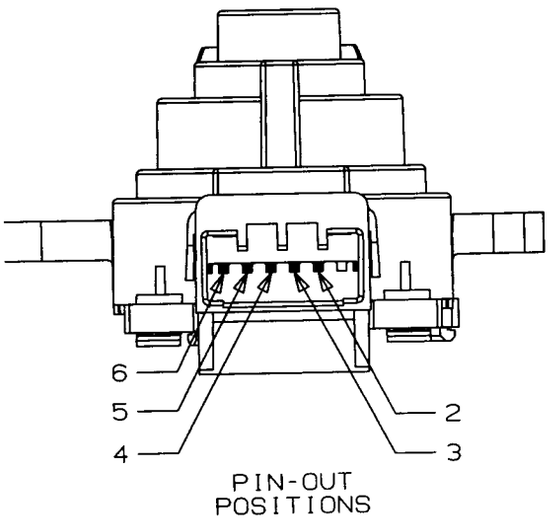

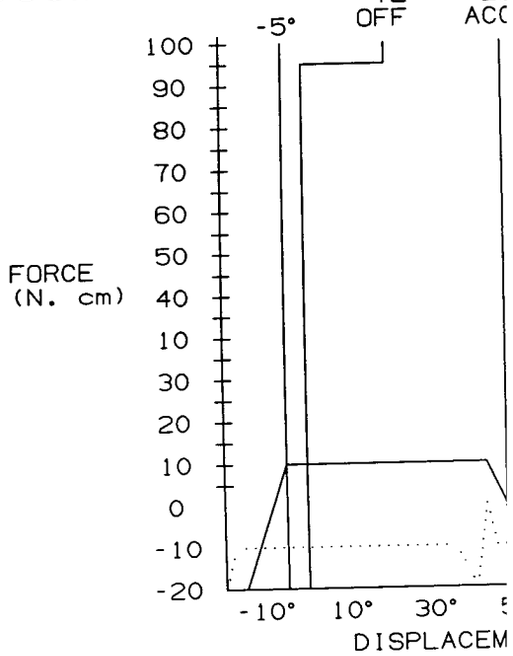

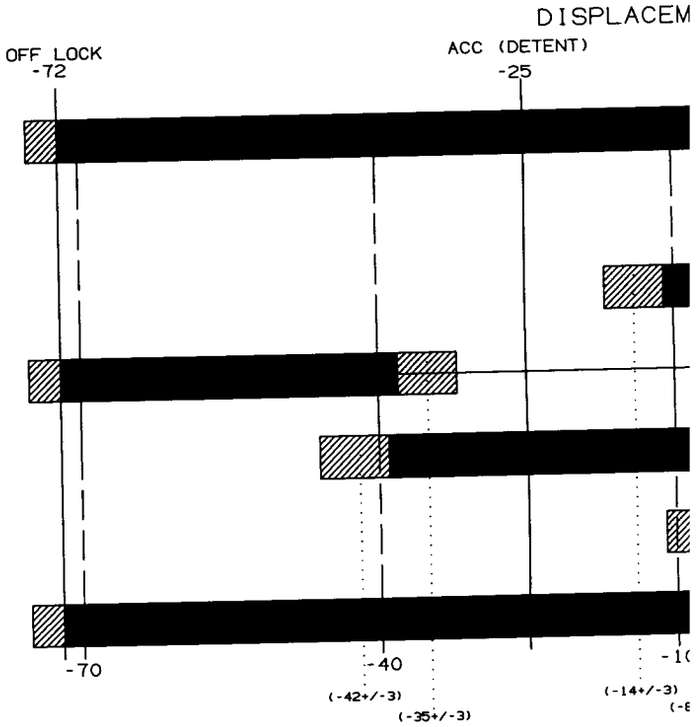

MAY MAKE CONTACT (±3

MUST MAKE CONTACT

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UNTIL 01MR03

GM

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User: QZV3SM

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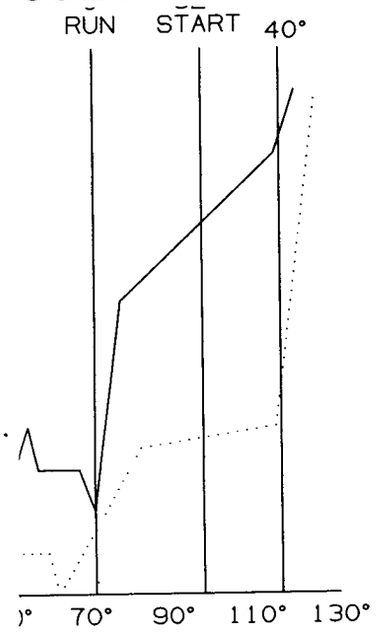

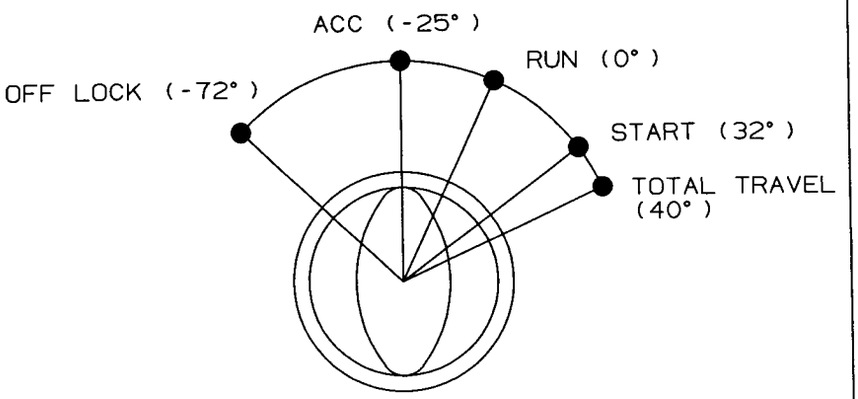

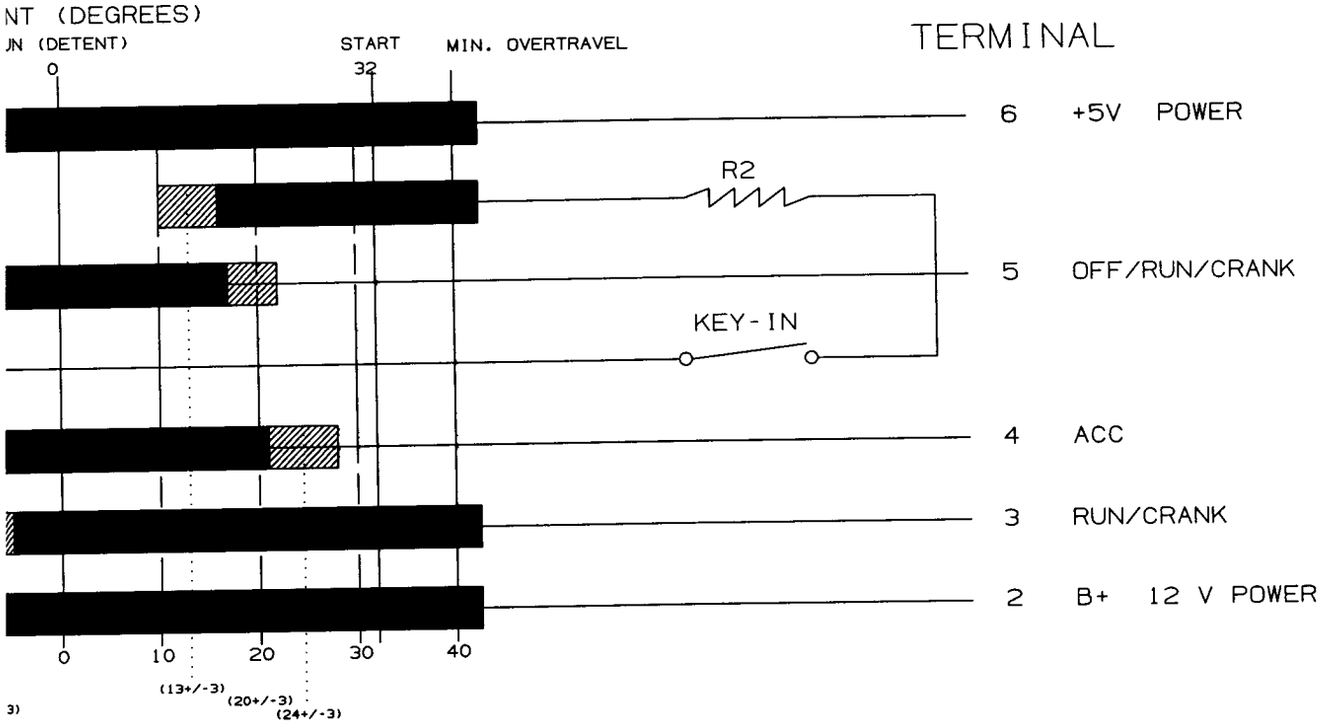

TERMINAL

6 +5V POWER
5 OFF/RUN/CRANK
4 ACC
3 RUN/CRANK
2 B+ 12 V POWER

EGREES OF ROTATION
OLERANCE)

R2: THEFT RESISTOR, 1/4 W, 1%
1 OF 10 POSSIBLE PREDEFINED STANDARD VALUES
RANGING FROM 300 Ohms to 9K Ohms

	DRAWING NUMBER	DWG STATUS			PAGE NUMBER
		STG	REL	PDI	
	10392423	R	001		4 OF 7

Date: 05-09-06 09:28:18 AM

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SAFETY/COMPLIANCE F

S/C CHECKPOINTS K F

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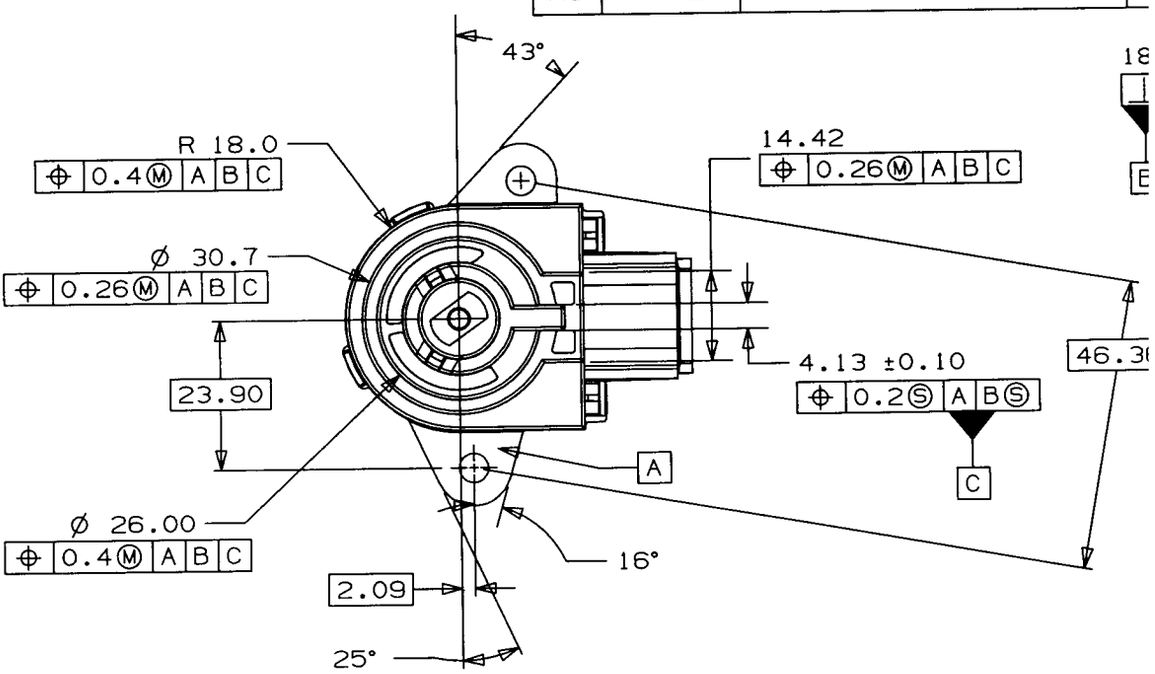

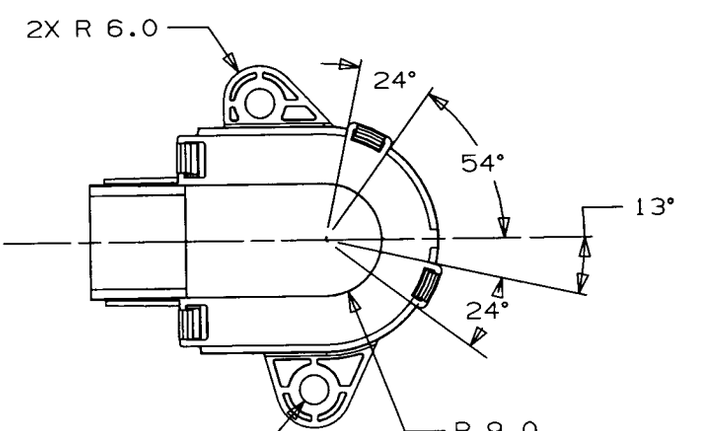

GM CONFIDENTIAL
UNTIL 01MR03

GM

PAGE TITLE
KPC CHART AND VIEWS

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Part: 10392423.dwgFmt. 0001 Date: 27-Apr-04 Time: 11:30
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Title: C:\CMS\users\manufact\view\10392423.hpg

User: QZV3SM

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SOLAMENTE REFERENCIA.

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F CHECKPOINTS	LAST NO. USED	-

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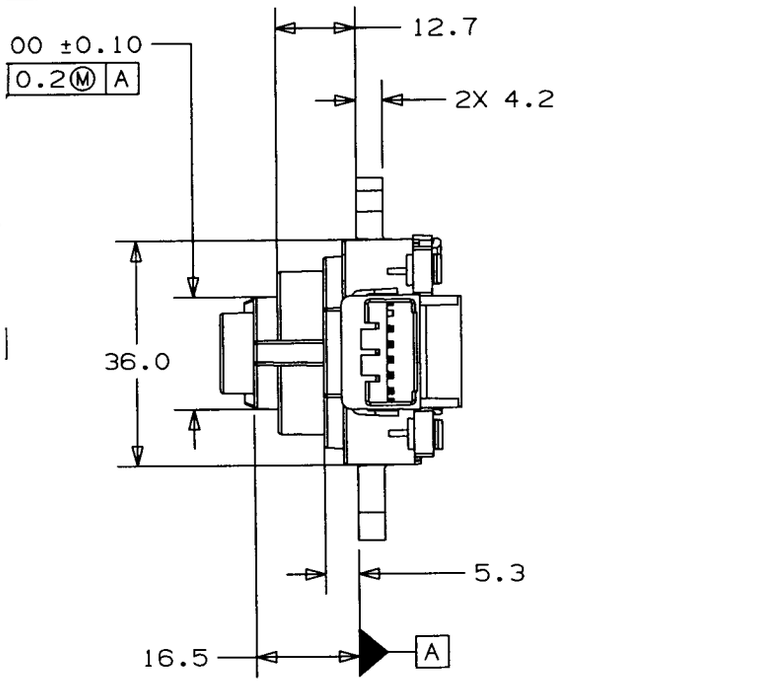

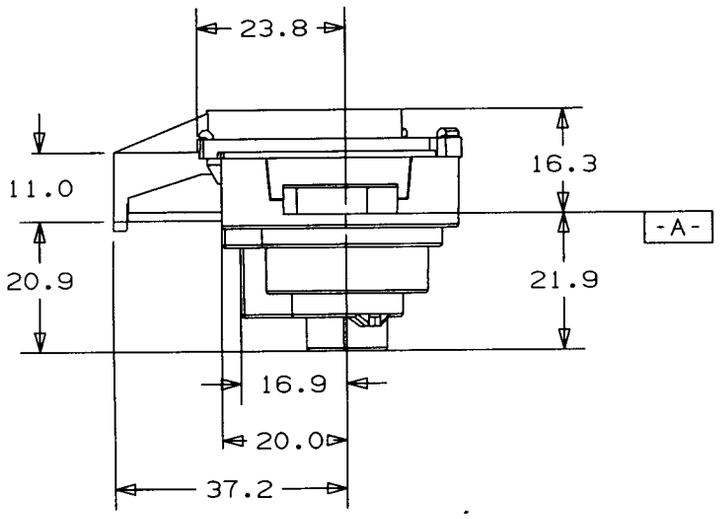

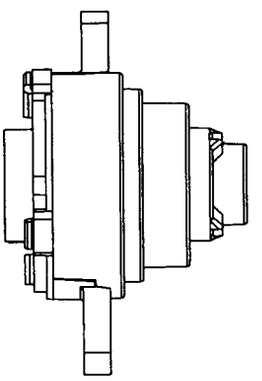

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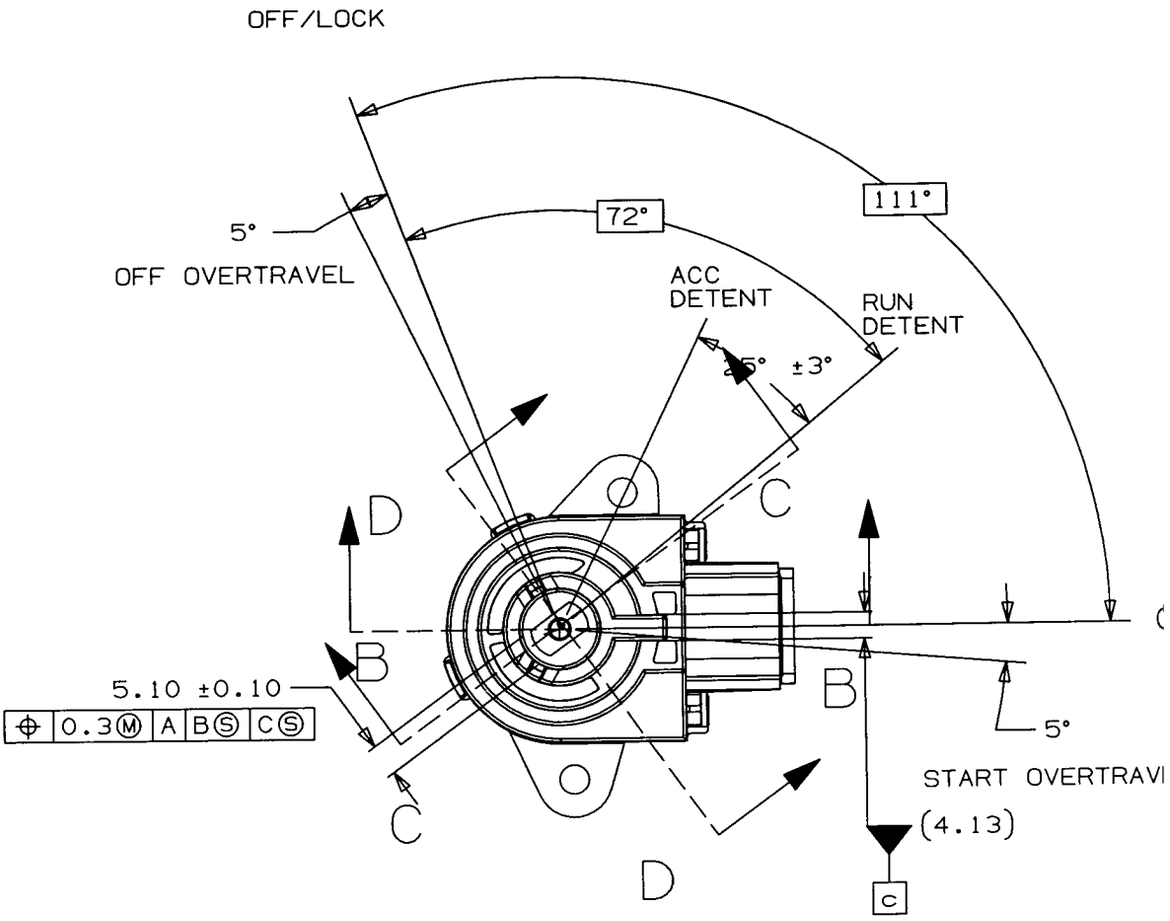

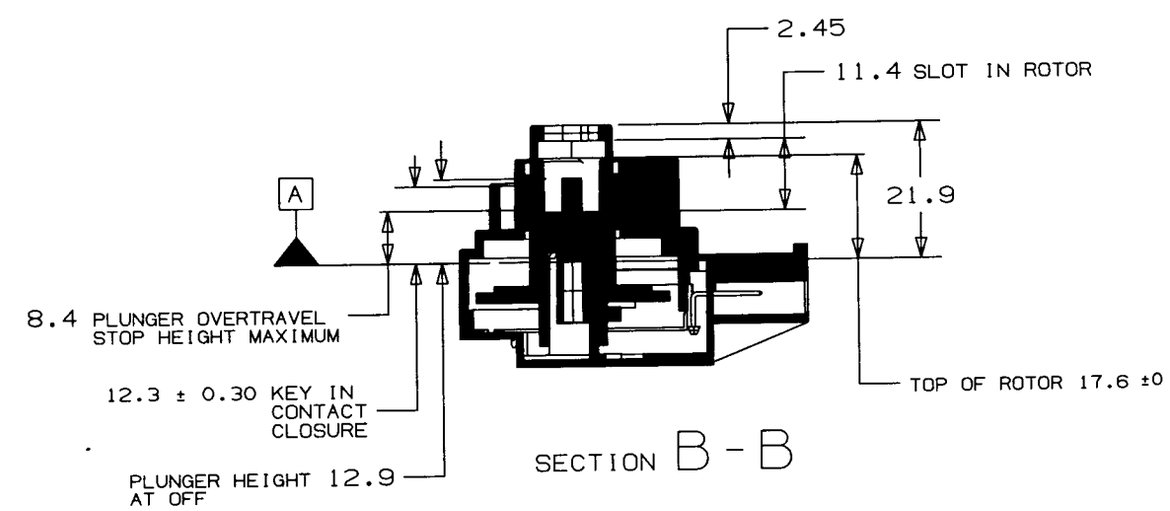

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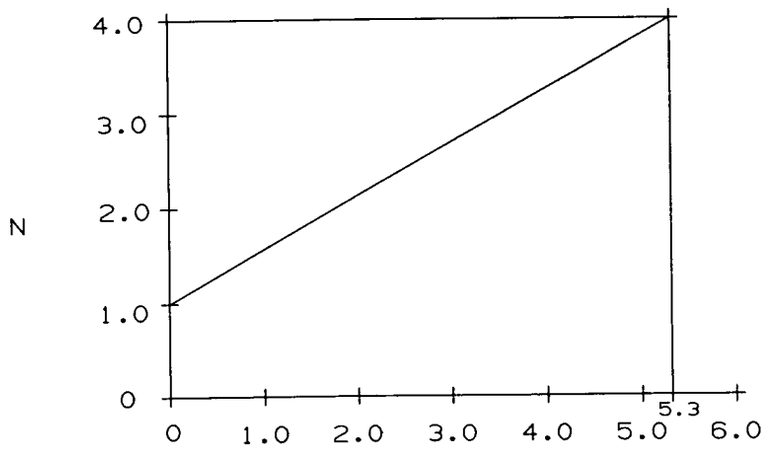
Title: C:\CMS\users\manufact\view\10392423.hpg

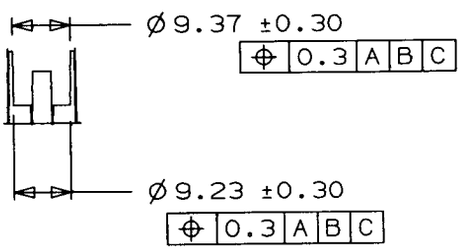
User: QZV3SM

ENT, REFERENCE ONLY.
SOLAMENTE REFERENCIA.

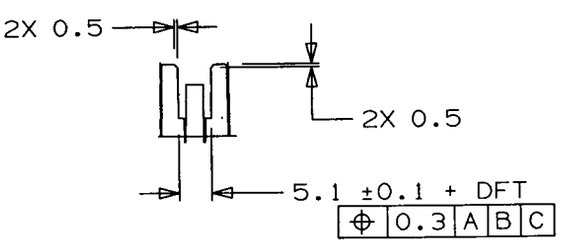
PAGE	DATUM	DESCRIPTION	DIRECTION
5	A	MOUNTING FLANGE	
5	B	DELTA MOUNTING ANG. LOCATOR	
5	C	DELTA MOUNTING CYLINDER	



KEY-IN SWITCH FORCE VS. DISPLACEMENT



SECTION C - C



SECTION D - D

	DRAWING NUMBER	DWG STATUS			PAGE NUMBER
		STG	REL	PDI	
	10392423	R	001		6 OF 7

Date: 05-09-06 09:29:10 AM

UNCONTROLLED DOCUM
DOCUMENTO SIN CONTROL

MATERIAL : SEE BELOW

TOLERANCE AND DIMENSIONS UNLESS

X.X (+/- 0.26MM)

X.XX (+/- 0.13MM)

(+/- 2 DEGREES)

RECYCLING GUIDELINES
PER GM502M. MARK PARTS
PER SAE J1344 METHOD 2

RESTRICTED AND REPORTABLE
CHEMICALS PER GMW3059

FLAMMABILITY: MOLDED PLASTICS MUST MEET GM 6090M (B4-A)

MOLDED PLASTIC MUST MEET GM 7400M (DS85).

GENERAL NOTES

1. THEFT SLEEVE - 25% GLASS FILLED ACETAL PER GMP.POM.006
2. COVER - 33% GLASS FILLED NYLON 66 PER GMP.PA66.013, COLOR: BLACK
3. BASE - 33% GLASS FILLED NYLON 66 PER GMP.PA66.013, COLOR: BLACK
4. TERMINAL HEADER PINS - COPPER ALLOY UNS C51000 PER SAE J461
   TIN/LEAD SOLDER PLATE CU/SNPB5 SCI PER ASTM B579
5. TORSION SPRING - MUSIC WIRE PER ASTM A228
6. CONTACT TERMINALS - COPER ALLOY UNS C77000, SPRING TEMPER PER SAE J46
7. PCB BOARD TYPE: CHEM - 3 PRINTED CIRCUIT BOARD
8. MECHANICAL GREASE FOR DETENT PLUNGER - GM2793M OEO (NS-1304-G)
9. ELECTRICAL GREASE FOR PCB CONTACT - GM2793M OEO (NS-1304-G)
10. DETENT PLUNGER: METAL CAP - NICKEL PLATED STEEL
    METAL COIL SPRING - MUSIC WIRE PER ASTM A228

GM CONFIDENTIAL UNTIL 01MR03	GM	PAGE TITLE LABELED MATERIALS

User: CZ3044
Part: 10392423.dwgFmt.0001 Date: 27-Apr-04 Time: 11:30
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User: QZV3SM

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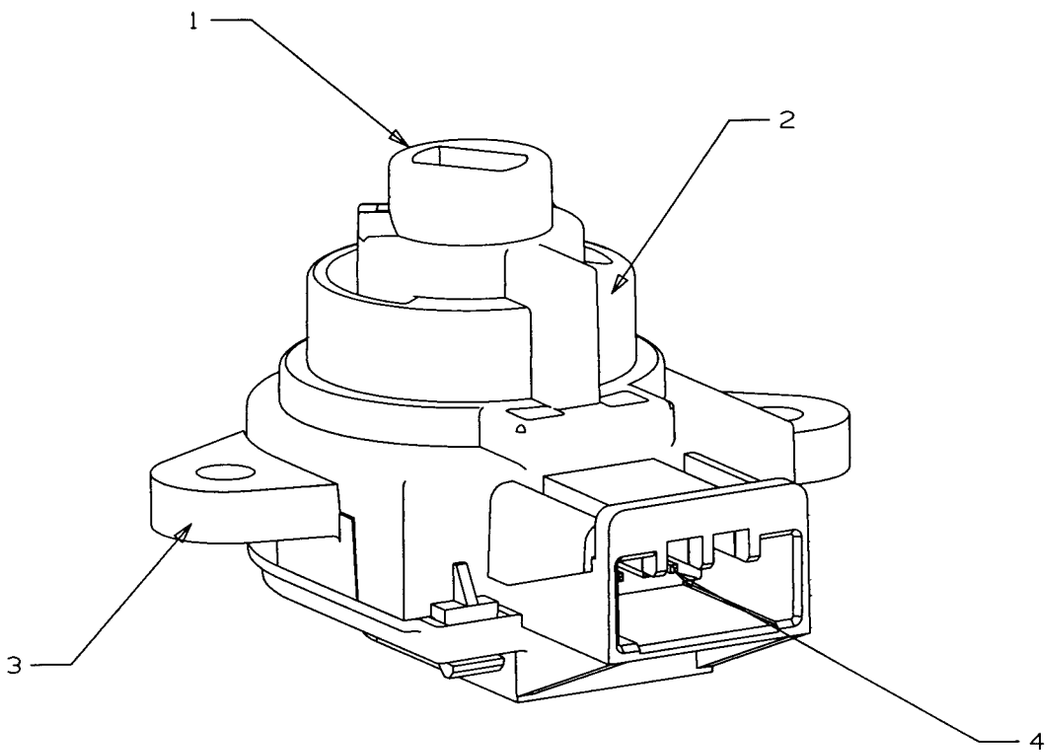

	DRAWING NUMBER	DWG STATUS			PAGE NUMBER
		STG	REL	PDI	
	10392423	R	001		7 OF 7

General Motors Corporation

North American Operations

COMPONENT TECHNICAL SPECIFICATION

ORIGINATING CENTER: **Electrical, Information and Controls Center**

SUBSYSTEM: **Power and Signal Distribution**

COMPONENT: **Column Mounted Discrete Logic Ignition Sensor**

PART NUMBER: **12450250**

FIRST USAGE: **2001 GMX 320 Program**

MODELS: **2003 Delta Z Program**

ENGINEER: _____ _____

Ray DeGiorgio **phone** [redacted] **Date**

fax

REVISION HISTORY

DATE	EWO	REV	Paragraph	DESCRIPTION	RESP.
10/2/97				Initial Publication	teu
2/17/98		001	Cover Page	Renamed component, revised resp. engineer	teu
			3.1.2.2.1	Revised mechanization drawing	teu
			3.2.1	Signal level ckts: deleted 150mV drop req.	teu
			3.2.1	Signal level ckts: revised contact resistance from 100Ω	teu
			3.2.1.4	Revised contact resistance req. from 100Ω to 100mΩ	teu
			3.2.1.7.1	Clarified short ckt. test, revised resistive values	teu
			3.2.2.15	Completed all theft deterrence TBD's.	teu
10/19/99		002	3.2.2.3	Update switch timing	rgd
			3.2.2.3	Revise tactile plots	rgd
			3.2.1	Include switch loads for GMX 320 Program	rgd
			3.1.2.2.1	Add Switch Mech	rgd
03/22/01		003		Finalized	rgd

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TABLE OF CONTENTS

General Motors Corporation North American Operations

1.0 INTRODUCTION

1.1 SCOPE OF DOCUMENT

This specification outlines the design, performance, appearance and validation requirements for a low current column mounted ignition switch.
This specification should not prevent the manufacturer from suggesting alternative approaches which would result in an improved or more cost effective product.

1.2 MISSION/THEME

The ignition switch shall be used to operate the vehicle's power moding and ignition systems and is located on the steering column upper head assembly opposite the lock cylinder.

1.3 CLASSIFICATION

The following are specific classifications of the ignition switch described in this document.
The ignition switch shall contain a means of translating a manual input (rotation of the ignition key) into electrical signals which may be interpreted by one or more electronic modules and relays. In addition, the switch shall contain detents and a return spring to provide tactile feedback to indicate key position.
The ignition switch shall functionally support the following vehicle features:

Determine Power Mode (OFF, ACC, RUN, START)
Determine Key-In State (KEY-IN or KEY-OUT)
Include theft resistor and breakage mechanism to support theft deterrent system.

1.4 DOCUMENT CONTROL

1.4.1 Definition

The word "shall' will be used to state binding requirements of the component defined by this document.
The word "must" will state requirements of other components and/or subsystems whose definitions are outside the scope of this document.
The word "will" is intended to state either of the following:

Conditions that result from immutable laws of physics
Conditions that result from adherence to their stated, binding requirements

The words "are" and "is" will state definitions and facts that do not require verification.
The word "withstand" will be defined as: "Maintains design-intended functional and structural integrity while being subjected to the specified conditions."

2.0 APPLICABLE DOCUMENTS

2.1 ORDER OF PRECEDENCE

The order of precedence for all applicable documents shall be:

1. Purchase Order
2. Statement of Requirements and Component Specification
3. Other Referenced Documents

In the event of a conflict between the text of this specification and the documents cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.2 GOVERNMENT DOCUMENTS

Suppliers are expected to be aware of and comply with worldwide component and vehicle standards and regulations where applicable. Requirements of national governments shall apply even if not explicitly stated below. Specific national requirements may be waived under specific purchase orders or engineering part drawings.

2.2.1 United States Documents

The switch shall comply with all applicable FMVSS regulations, including, but not limited to:
FMVSS 101 -- Control location, identification, and illumination.
FMVSS 114 -- Theft protection.
FMVSS 201 -- Occupant protection in interior impact.
FMVSS 203 -- Impact protection for the driver from the steering column system.
FMVSS 208 -- Occupant crash protection.
MVSS 302 -- Flammability of interior materials.
FSREG 554 -- Standard enforcement and defects investigation.
FSREG 581 -- Low speed impact resistance of vehicles.

2.2.2 Canadian Documents

The switch shall comply with applicable CMVSS regulations.

2.2.3 Export Requirements

The switch shall comply with all applicable intended export country regulations, including, but not limited to:
ECE 18 -- Theft protection.
EEC 95/56 Directive (New), EEC 74/61 Directive (Old) -- Theft Protection.
EEC 91/338 Directive -- Cadmium Restriction.
ECE 12 R 12.03 -- Body (torso) impact.

2.3 GENERAL MOTORS DOCUMENTS

2.3.1 Part Drawing

The part drawing shall show all views to clearly define dimensions not contained herein, the device part number, labeling requirements, and any parameters necessary to fully define the product on a "purchased part level."

2.3.2 GM Materials and Process Standards

Suppliers are expected to subscribe to the applicable books or individual specifications of the GM Engineering Materials and Process Standards as several of these standards are called out in this specification. Suppliers must work to a current copy of these standards; specifically those listed below:

GM 1000M	Restricted and Reportable Chemicals
GM 6090M	Flammability of Materials
GM 9100P	Automotive Component EMC Specification
GM 9105P	Immunity to Conducted Transients
GM 9109P	Immunity to Electrostatic Discharge
GM 9110P	Procedure for Testing Switches
GM 9117P	Immunity to Jump Start Voltages
GM 9604P	Standard Practice for Specifying Switches
GM 9605P	Developmental Tests for Low Level Switching
GM 9123P	Electronic Module (Interior Mounted, Unexposed) Validation Test Standard

2.3.2.1 Plastic Parts

Plastic materials used in all portions of the switch should be approved to the GMP material specifications. The actual switch material must be approved to the GM 4350M Class C0, Oven Aging and Impact, specification.

2.4 INDUSTRY DOCUMENTS

Suppliers must work to a current copy of the following documents:

QN 2101	Production Parts Approval Process (PPAP)
QS 9000	Quality Systems Requirements
QN 2102	Potential Failure Mode and Effects Analysis

2.5 SUPPLIER DOCUMENTS

2.6 OTHER DOCUMENTS

USCAR/EWCAP PF1 - Performance Standard for Automotive Electrical Connection Systems

3.0 REQUIREMENTS

3.0.1 Drawing Requirements

The design configuration of the switch shall be specified by a suitably sized drawing. The switch drawing shall include the items as specified in Section 1.1 of GM 9604P and the items listed in section 4.4.2 of the Statement of Requirements for this part.

3.1 COMPONENT DEFINITIONS

3.1.1 Appearance

The switch shall have no sharp edges for handling purposes. All flash must be removed from mounting holes. Switch assemblies shall be free of any cracks or blisters. The switch shall exhibit no permanent deformation that exceeds the released print tolerance, and shall have no separation or loosening of mechanical/chemical bonds or displacement of switch components.

3.1.2 Content

The required physical and functional content for the ignition switch are identified in the following paragraphs.

3.1.2.1 Physical Content

The ignition switch shall conform to the ignition switch packaging and dimensional requirements specified in the component part drawing.

Baseline content requirements:

1. **Four positions: OFF, ACC, RUN, START.**
2. **Detents for the OFF, ACC, and RUN positions.**
3. **Mechanism to return the key from START to RUN position.**
4. **Theft resistor (random one of ten values, 1% lot tolerance, unmarked) to support a Passlock theft deterrent system.**
5. **Integral key-in switch**
6. **Mechanism to destroy (damage beyond value determination) the theft resistor in the case of attempted removal of the switch actuator or tamper of the ignition switch in the OFF state.**
7. **Maximum five terminal connection, max. terminal size DPE 150 series or equivalent**

3.1.2.2 Functional Content

During actuation no switch shall change the state of any circuit not associated with that switch function. Release of the switch from any actuated position shall not cause activation of unwanted functions or the opening or closing of other contacts.

Baseline functional requirements:

1. **Ability to continuously diagnose the theft deterrent circuit for failures (short-to-ground, short-to-battery, or open circuit) in the RUN position.**
2. **Inability to externally determine the theft resistor value on the OFF position.**
3. **START key position shall not be falsely interpreted in the case of any single-point circuit failure (short-to-ground, short-to-battery, or open circuit).**
4. **Survivability of switch under all conditions involving a single-point circuit failure.**
5. **The ignition switch shall meet the performance objectives of GM9105P, Immunity to Conducted Transients, and GM9109P, Immunity to Electrostatic Discharge, for a Class C device.**
6. **For all 12Vdc circuits, ability to interpret OFF,ACC, START positions and theft resistor value with a 9.0 to 26.5Vdc source voltage, and ability to interpret RUN position with a 4.5 to 26.5Vdc source voltage.**

Desired features:

1. **Retained ability to interpret ALL key positions with any single-point circuit failure.**
2. **Minimal number of circuits.**
3. **Minimal system cost impact.**
4. **Ability to sample the theft resistor value in the START and RUN key positions.**

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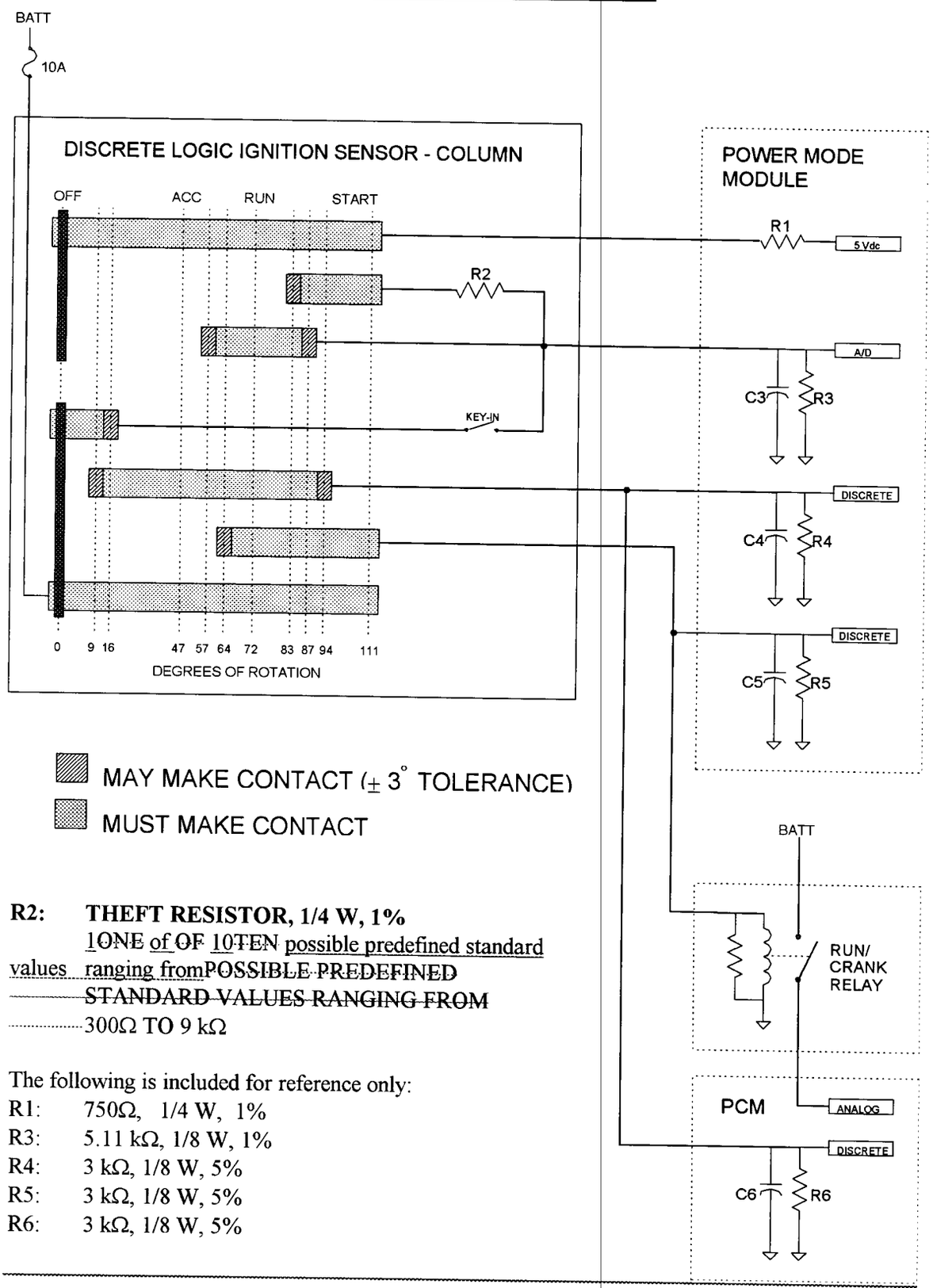
3.1.2.2.1 Electrical Mechanization Delta Z Switch Mechanization



MAY MAKE CONTACT (± 3° TOLERANCE)

MUST MAKE CONTACT

R2: THEFT RESISTOR, 1/4 W, 1%

1ONE of ~~OF~~ 10~~TEN~~ possible predefined standard values ranging from~~POSSIBLE PREDEFINED STANDARD VALUES RANGING FROM~~ 300Ω TO 9 kΩ

The following is included for reference only:

R1: 750Ω, 1/4 W, 1%
R3: 5.11 kΩ, 1/8 W, 1%
R4: 3 kΩ, 1/8 W, 5%
R5: 3 kΩ, 1/8 W, 5%
R6: 3 kΩ, 1/8 W, 5%

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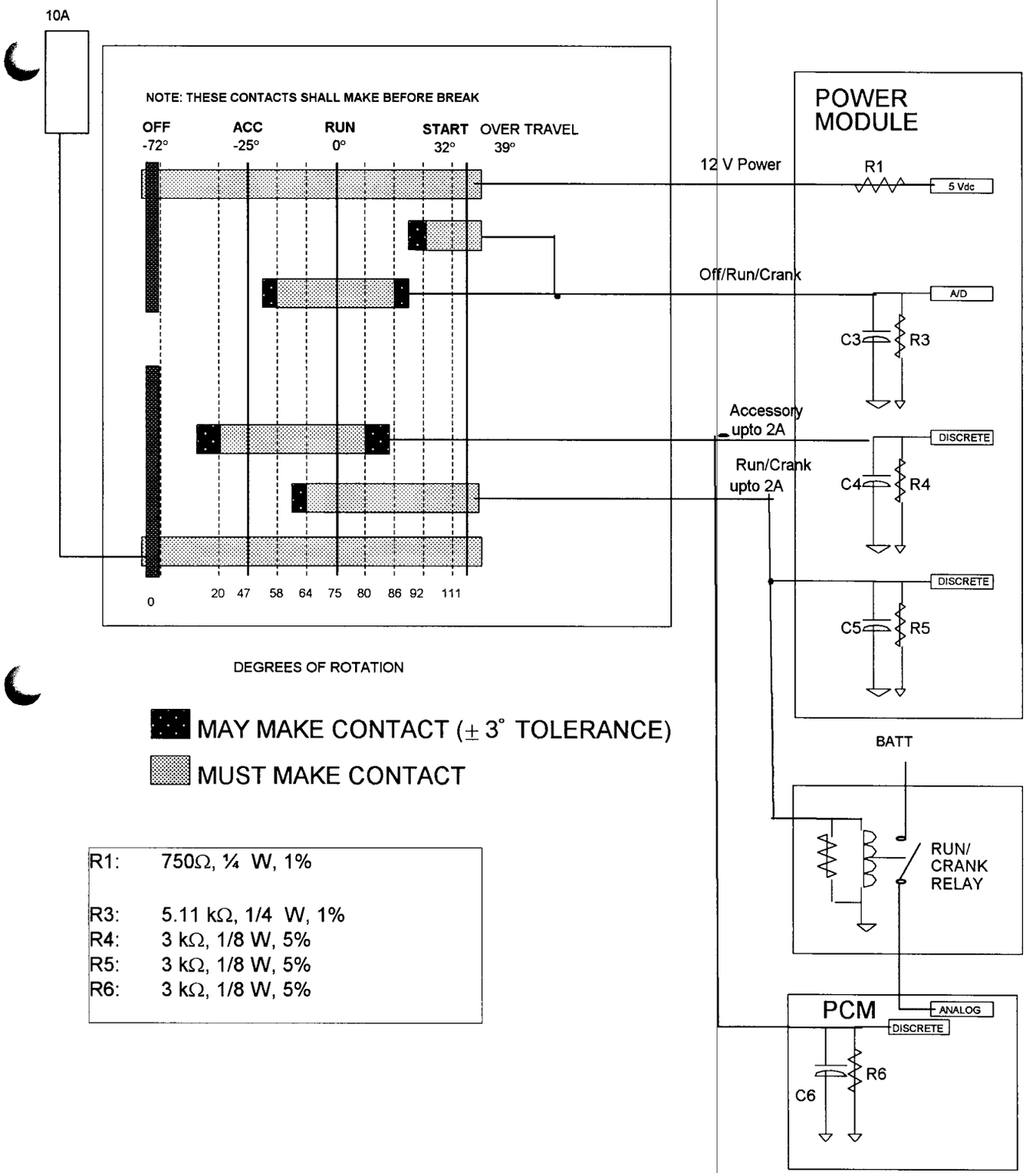
GMX320 Ignition Switch – Column Mounted



R1:	750Ω, ¼ W, 1%
R3:	5.11 kΩ, 1/4 W, 1%
R4:	3 kΩ, 1/8 W, 5%
R5:	3 kΩ, 1/8 W, 5%
R6:	3 kΩ, 1/8 W, 5%

3.1.2.2.2 Ignition Switch Functions

The ignition switch shall be a rotary type switch with four positions consisting of: OFF, ACC, RUN, START. The switch shall have three detent positions and one spring loaded position. Make and break positions vs. displacement have been arranged to meet vehicle electrical requirements.

3.1.2.2.2.1 Start

START shall be the extreme clockwise (CW) position and shall be a momentary contact spring loaded position. When released from the START position, the switch shall return to the RUN position and shall not over-travel past the RUN detent in either direction.

3.1.2.2.2.2 Run

RUN shall be located counter clockwise (CCW) from START. The RUN position shall be a detented position.

3.1.2.2.2.3 Accessory

ACC shall be a detented position located CW of LOCK and CCW of the RUN position..

3.1.2.2.2.4 Off

OFF shall be a detented position and shall be CCW from the ACC position.

3.1.2.2.3 Key Alarm Switch

The key alarm switch consists of a single pole normally open switch, which detects insertion of the ignition key into the lock cylinder.

1. The key alarm switch contacts shall make when the ignition key is inserted into the lock cylinder assembly. The key alarm switch contacts shall break when the ignition key is removed. Switch make/break points and overtravel allowances shall be identified on the component release drawing.
2. Any axial play within the ignition switch assembly shall not cause closure of the key alarm switch contacts with the key removed; and shall not break the key alarm switch contacts with the key fully inserted.
3. The key alarm contact shall remain made as the lock cylinder is rotated through its operating range.
4. The key alarm switch action shall be smooth with no detents.
5. The key alarm switch mechanism shall provide enough force to return the lock cylinder key alarm actuator to the retracted position as the key is removed.

3.1.3 Ambient Environment

The ambient environment is the range of environmental conditions that the switch is expected to be exposed to during its lifetime. The switch shall meet the functional objectives of this document when exposed to the environmental conditions defined in this specification.

3.1.3.1 Operating Temperature

The switch shall be able to operate, without damage or functional degradation, within an operating temperature range of -40°C to +85°. Normal operating temperature shall be designated at 23°C. The switch shall comply with this requirement when tested according to the schedule shown in Figure 20-1 in Section 9.4 of GM 9110P.

3.1.3.1.1 Storage Temperature

The switch shall operate without damage or functional degradation when subjected to a storage temperature range of -40°C to +105°C for 96 hours when tested as follows.

1. Place test samples in environmental chamber. Lower the chamber air temperature to -40°C at a rate not exceeding 10°C per minute.
2. Maintain -40°C temperature for 48 hours. At the end of this period increase the chamber air temperature to +25°C at a rate not exceeding 10°C per minute. Perform simple function check.
3. Repeat procedure for high temperature storage; chamber temperature to be +105°C

3.1.3.2 Humidity

The switch shall operate without damage or performance degradation in an atmosphere of 95% ± 3% non-condensing relative humidity when tested as specified in Section 8.2 of GM 9110P.

3.1.3.2.1 Moisture Susceptibility

The switch shall meet all specified performance test requirements during and after exposure to conditions of high humidity and condensation. Test per the following procedure:

1. Test samples should be dried, placed in a moisture proof container, and soaked for minimum of two hours at -20°C. Transfer the samples to the second chamber maintained at 45°C and 95 % RH within 1 minute and remove from protective container. Mount in the normal operating position using care to protect from drips. After 5 minutes, power up the switch with 14.0 ± 0.1 Vdc.
2. Perform functional tests immediately, after 30 minutes, and at 2 hours recording any anomalies. Class C functional requirements per GM 9100P must be met immediately upon power up. Class B functions return at 30 minutes and Class A functions return at 2 hours.

   (NOTE: Moisture proof container refers to the standard product shipping bag. Use the bag to transfer the product between locations (test chambers) if two locations are utilized for the -20°C and +45°C environments.)

3.1.3.3 Vibration

The switch shall operate during exposure to a vibration environment without damage or loss of function according to the actual vehicle vibration profile for component usage, as defined below.

1. The switch shall be tested in the RUN detent, key-in simulated, with continuous monitoring of all switch circuits. No circuit interruption or unintended makes shall be allowable.
2. SAE Sin vibration: the frequency range is to be from 10 to 55 to 10 Hz with a linear sweep period of 2 minutes per cycle. Excursion shall be 1.0 mm (.0393 in) peak to peak over the entire frequency range (ref. GM9110 section 7.7 for procedure).
3. Each sample is to be vibrated in each of 3 mutually perpendicular planes for the period of time specified in section 4.4.1.2 Test Sequence.

3.1.3.4 Thermal Shock

The switch shall resist cracking and delamination of surfaces, cracking and crazing of encapsulated compounds, opening of case seams, or changes in electrical or mechanical characteristics due to component displacement or rupture, upon completion of 10 thermal shock cycles per Section 8.5 of GM 9110P (-40°C to maximum operating temperature).

All components must withstand 10 cycles through the following thermal schedule:

1. Soak components at -40C (-40F) for 1 hour.
2. Remove components from chamber and allow to warm at room temperature for 4 minutes. Samples should be energized during warm-up.
3. Soak components at 85C (185F) for 1 hour. Samples should be energized during this period.
4. Remove components from chamber and allow to cool at room temperature for 2 minutes before soaking at -40C (-40F).
5. Samples must meet all functional requirements after frost has formed by removal from -40C.

3.1.3.5 Corrosion (Salt Fog)

The switch shall meet all performance test requirements during and after exposure to a corrosive environment consisting of salt spray, salt fog, and humidity. Switches shall be exposed to 96 hours of a salt fog test of a 5% salt solution at 35°C as tested according to Section 8.3 of GM 9110P.

3.1.3.6 Fluid Compatibility

The switch shall be able to withstand exposure to the fluids listed below.

Part must with stand contact with the following fluids with no degradation of performance, appearance, materials, sealants or identification.

Passenger Compartment:

Coffee	Alcohol Base Cleaner -10% by volume
Lubricating Oil (WD40)	Cola
Hand Cleaner	Lock-Ease Graphite/Oil
Soapy Water - 10% concentration	Vinyl Plasticizer
Salt Water - 5% saline solution	Ammonia Base Cleaner - 10% by volume
Silicon Hand Lotion	

The part shall be fixtured in a representative vehicle orientation, in the OFF detent, key-out, with applicable power and ground circuits connected. Two hundred milliliters of the test liquid shall be poured on the part from a height of 76 mm. Part should be allowed to set for a period of 24 hours while holding temperature at 21°C (70°F) to 29°C (85°F) without being wiped. Wash with water or wipe any remaining fluid from the part before applying the sequential fluid application. Use a minimum of 2X optical powered device to examine parts for degradation.

3.1.3.7 Dust Exposure

The switch shall meet all performance test requirements after exposure to 8 hours of dust exposure per Section 8.1 of GM 9110P.

3.1.3.8 Flammability Requirements

The materials used in the switch shall comply with GM6090M - Flammability of Materials.

3.1.3.9 Xenon Weatherometer

Not Applicable.

3.1.3.10 Altitude

Not Applicable.

3.1.3.11 Ozone

The switch shall meet all performance test requirements after exposure to ozone as tested per GM4486P. (Applicable to switches containing silicone-based materials only.)

3.1.3.12 Salt Water Immersion

Not Applicable.

3.1.3.13 Mixed Flowing Gas

For low current (<100mA) applications, the switch shall perform as specified when tested according to Section 15 of GM 9605P. The switches shall be able to withstand an environmental severity level of the engine/passenger compartment (class II) for a duration equivalent to 10 years of exposure. Time of exposure is (TBD).

3.1.3.14 Temperature Endurance Tests

Switches that contain electronic devices require special testing to verify switch capability of surviving stresses caused by extended exposure to temperature extremes. (Sections 3.1.3.14 1, 3.1.3.14.2 and 3.1.3.14.3 are provided for switches which contain electronics).

3.1.3.14.1 High Temperature Endurance

The switch shall perform as specified when tested according to Section 9.5 of GM9123P.

3.1.3.14.2 Low Temperature Endurance Test

The switch shall perform as specified when tested according to Section 9.6 of GM9123P.

3.1.3.14.3 Power Temperature Cycling

The switch shall perform as specified when tested according to Section 9.1 of GM9123P.

3.1.4 Interfaces

3.1.4.1 Electrical Interface

Pinouts shall be specified on the released product drawing. Pinouts cannot be changed without written authorization of GM Engineering.

3.1.4.2 Mechanical Interface

3.1.4.2.1 Column Lock Housing Interface

The ignition switch shall attach to the column housing as specified in the component part drawings.

3.1.4.2.2 Actuator Interface

The ignition switch shall interface with an actuator as specified in the component part drawings.
The actuator shall transfer forces from the ignition cylinder to rotate the switch contact mechanism during normal operation, and shall interact with the switch's theft deterrence mechanism to destroy the theft resistor during a slam-pull of the ignition cylinder or attempted removal of the switch in the OFF state.
In addition, the ignition switch shall utilize the linear motion of the actuator's key-in plunger to toggle an integral key-in switch.

3.1.4.3 Wiring Interface

Vehicle application wire gage size is determined by circuit protection and application load. For test purposes the wire gage size shall be 22 AWG.

3.1.4.4 Connector Interface

The ignition switch shall attach to the column wiring harness through a Packard Electric connector. The specific connector shall be specified in the component release drawing.
Connection interfaces shall comply with USCAR/EWCAP PF-1, Standard for Automotive Electrical Connection Systems.

3.1.5 Usage Definition

3.1.5.1 Target Life

GM has estimated the following profile for customer usage of the switch based on ten year exposure.

SWITCH FUNCTION	CYCLES
Ignition Switch	50,000

3.1.5.2 Duty Cycle

For purposes of durability testing, the switch duty cycle is defined as follows:

Step	Position	Dwell Time
1, Actuate Key-In switch	Off	>.5 sec.
2	Run	>.5 sec.
3	Start	1 sec.
4	Free Return to Run	>1 sec.
5	Off	1 sec.
6	Off	Deactivate Key-In for 1 sec.
Every 3rd cycle	Accessory	1 sec, return to "Off"

3.1.5.3 Actuation Rate

SWITCH FUNCTION	ACTUATION RATE
Ignition Switch Mode	6 cycles per minute
Ignition Switch Key-In	15 mm/sec.

3.2 PRODUCT CHARACTERISTICS

The required physical characteristics for the switch are specified in the following paragraphs.

3.2.1 Electrical Performance Requirement

Delta – Z SWITCH ELECTRICAL PARAMETERS

Circuit Identification		Signal Level (typ.)	Relay Level (typ.)	Key-In
Switch Temperature Rating		-40°C to +85°C		
Current Rating		30 µA - 3 mA	3 mA - 2 A	30 µA - 3 mA
	Duty Cycle	CONT	CONT	CONT
Rate of Actuation[1]	Minimum	50°/sec	50°/sec	1 mm/sec
	Maximum	1500°/sec	1500°/sec	20 mm/sec
Wire Size (mm^2)		0.35	0.35	0.35
Voltage Drop (max.)			350 mV	
Contact Resistance (max.)		100mΩ		100mΩ
Open circuit Resistance (min) [2]		20 Meg-Ohm	20 Meg-Ohm	20 Meg-Ohm
Temperature Rise		50°C		
Contact Bounce	% O.C.V.	10	10	10
Maximum Duration	Individual	1 ms	1 ms	1 ms
	Total	10 ms	10 ms	10 ms
	No. Bounces	5 max	5 max	5 max
Durability Equipment	Rate	100± 1°/s	100± 1°/s	15 ± 1 mm/s
	Level	2 Nm	2 Nm	4 N

1. Min-Max rates of actuation are based on timing requirements
2. 1 M-Ohm min @ 24V at conclusion of testing
3. Each circuit shall be capable of handling both min and max currents during validation testing.

GMX 320 – Switch Electrical Parameters

Circuit Identification		Signal Level (typ.)	Relay Level (typ.)	Key-In N/A
Switch Temperature Rating		-40°C to +85°C		
Current Rating		30 µA - 3 mA	3 mA - 2 A	
	Duty Cycle	CONT	CONT	
Rate of Actuation[1]	Minimum	50°/sec	50°/sec	
	Maximum	1500°/sec	1500°/sec	
Wire Size (mm^2)		0.35	0.35	
Voltage Drop (max.)			250 mV	
Contact Resistance (max.)		100mΩ		
Open circuit Resistance (min) [2]		20 Meg-Ohm	20 Meg-Ohm	
Temperature Rise		50°C		
Contact Bounce	% O.C.V.	10	10	
Maximum Duration	Individual	1 ms	1 ms	
	Total	10 ms	10 ms	
	No. Bounces	5 max	5 max	
Durability Equipment	Rate	100± 1°/s	100± 1°/s	
	Level	2 Nm	2 Nm	

3.2.1.1 Operating/Test Voltage

The switch shall function as specified in this document without interruption within the operating voltage range of 9.0 - 16.0 Volts dc (for high/low current applications when operated at ignition or battery voltage) and 5 ± 0.1 Volts dc (for low current, regulated voltage applications).

The switch shall be tested at a nominal voltage rating of 14.0 ± 0.1 V dc for 12 V circuits and 5 ± 0.1 V dc for 5 V circuits.

3.2.1.2 Applied Loads (Current)

The switch shall be capable of performing functions defined in Section 3.1 of this document when used to control the electrical loads specified.

3.2.1.3 Voltage Drop

Voltage drop on all low current switches (>3.0 mA, < 2.0 A) is not to exceed 350 mV at the rated current when tested according to Section 5.1 of GM 9110P.

3.2.1.4 Contact Resistance

Contact resistance on all logic level switches (< 3.0 mA) is not to exceed 100 mOhms at the rated current.

3.2.1.5 Open Circuit Resistance

The open circuit resistance of all circuits shall be greater than 20 MΩ when tested according to Section 5.2 of GM 9110P.

3.2.1.6 Isolation Resistance

The isolation resistance of all circuits shall be greater than 20 MΩ when tested according to Section 5.3 of GM 9110P.

3.2.1.7 Continuous Current Overload

The switch shall conform to the maximum current requirements when tested according to Section 7.4 of GM 9110P.

3.2.1.7.1 Short Circuit Requirement

The switch must be able to sustain a short circuit condition as tested below. A test to verify that circuit protection is adequate is as follows:

Use a power supply with a minimum steady state capability of 20 Amps and an automotive lead acid battery in parallel. Use a 0.35 mm^2 wire with length to provide less than 20 milliohms of resistance. Use a series fuse rated at 10 Amps unless otherwise specified. Apply power at 14.0 V DC per design pinout. Battery circuits are exempt from shorts to ground. Follow the procedure below:

1. Test with the ignition switch in the 'RUN' position for all contacts, with the exception of the key-in contact, which shall be tested in the 'OFF' position with key-in simulated. The 'START' circuit contact (through the theft resistor, R2) is exempt from this test.
2. Short circuits to ground through a 1.4 ohm resistance, one circuit at a time.
3. Apply shorts for one hour or until unit fails.
4. Record results. Measure actual current flow and time duration. Indicate if fuse blows, and any other visual results of the test.
5. Repeat steps 1 through 3 using a 1.0 ohm resistance, and a direct short circuit to ground.
6. Disassemble switches and record results of visual inspection.

General Motors shall review all test results and samples for approval.

3.2.1.8 Contact Bounce

No individual bounce shall exceed 1.0 msec in duration. There shall be no more than 5 contact bounces. A contact bounce shall not occur 10 msec after the initial make or break. For analysis purposes, the contact bounce duration shall be defined as the time periods when the voltage across the contacts exceeds 10% OCV (Open Circuit Voltage) for Normally Open contacts and 90% OCV for Normally Closed contacts. Contact bounce shall be measured at the rated electrical loads using an oscilloscope as specified in Section 5.12 of GM 9110P.

3.2.1.9 Electro-Magnetic Compatibility (EMC)

The switches shall meet any applicable EMC requirements set in GM 9100P series. In particular, the device shall meet the performance objectives of GM9105P, Immunity to Conducted Transients, and GM9109P, Immunity to Electrostatic Discharge, for a Class C device. (This requirement is applicable only to products with discrete electronic components.)

3.2.1.10 Reverse Polarity

The switch shall operate without damage or performance degradation when tested according to Section 7.2 of GM 9110P

3.2.1.11 24-Volt Jump Start

The switch shall operate without damage or functional degradation when tested according to Section 7.3 of GM 9110P.

3.2.1.12 1000 Hour Load Soak Test

The switch must meet performance requirements after exposure to 1000 hours continuous duty when tested according to Section 9.10 of GM9110P.

3.2.2 Physical/Mechanical Requirements

3.2.2.1 Dimensions and Capacities

Dimensional requirements shall be specified in the component part drawing.

3.2.2.2 Mass Properties

Mass of the switch shall not exceed 150 grams.

3.2.2.3 Tactile Characteristics

Refer to the Force Displacement Curve(s). Final switch tactile feel is subject to GM Engineering approval. Switch efforts shall be smooth with clearly defined detents. The switch shall not be damaged when the maximum allowable torque is applied to the actuator, clockwise or counterclockwise. All functionally detented switches must operate without noticeable friction or binding.

The supplier shall maintain GM approved master samples for comparison throughout the life of the program.

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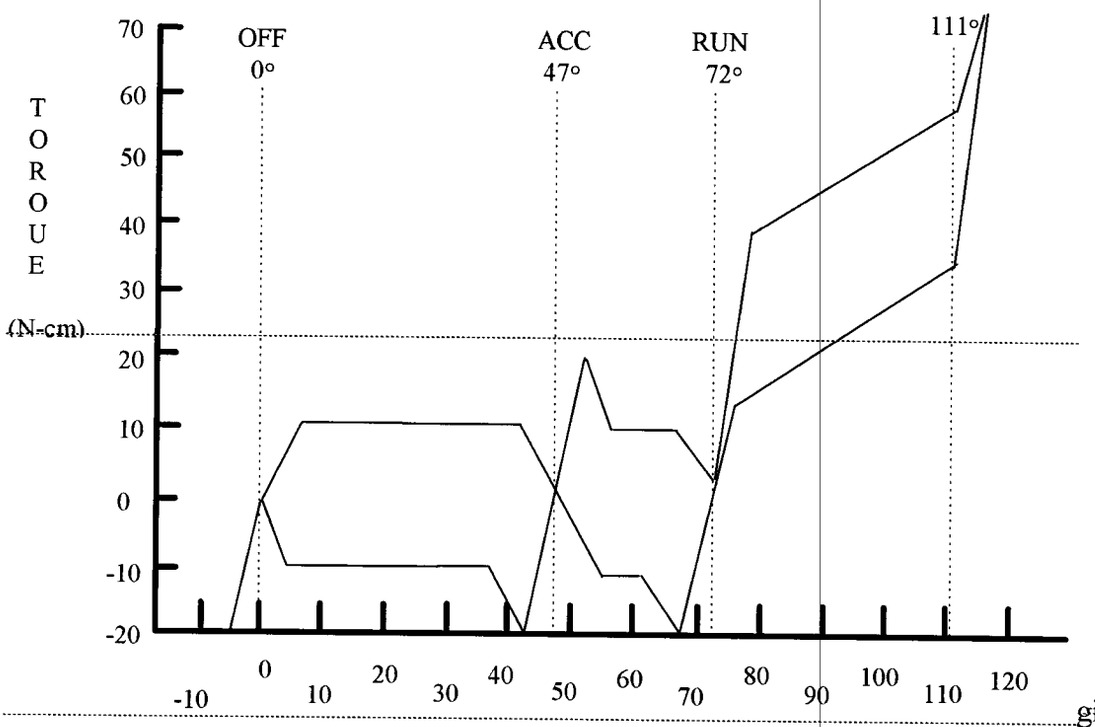
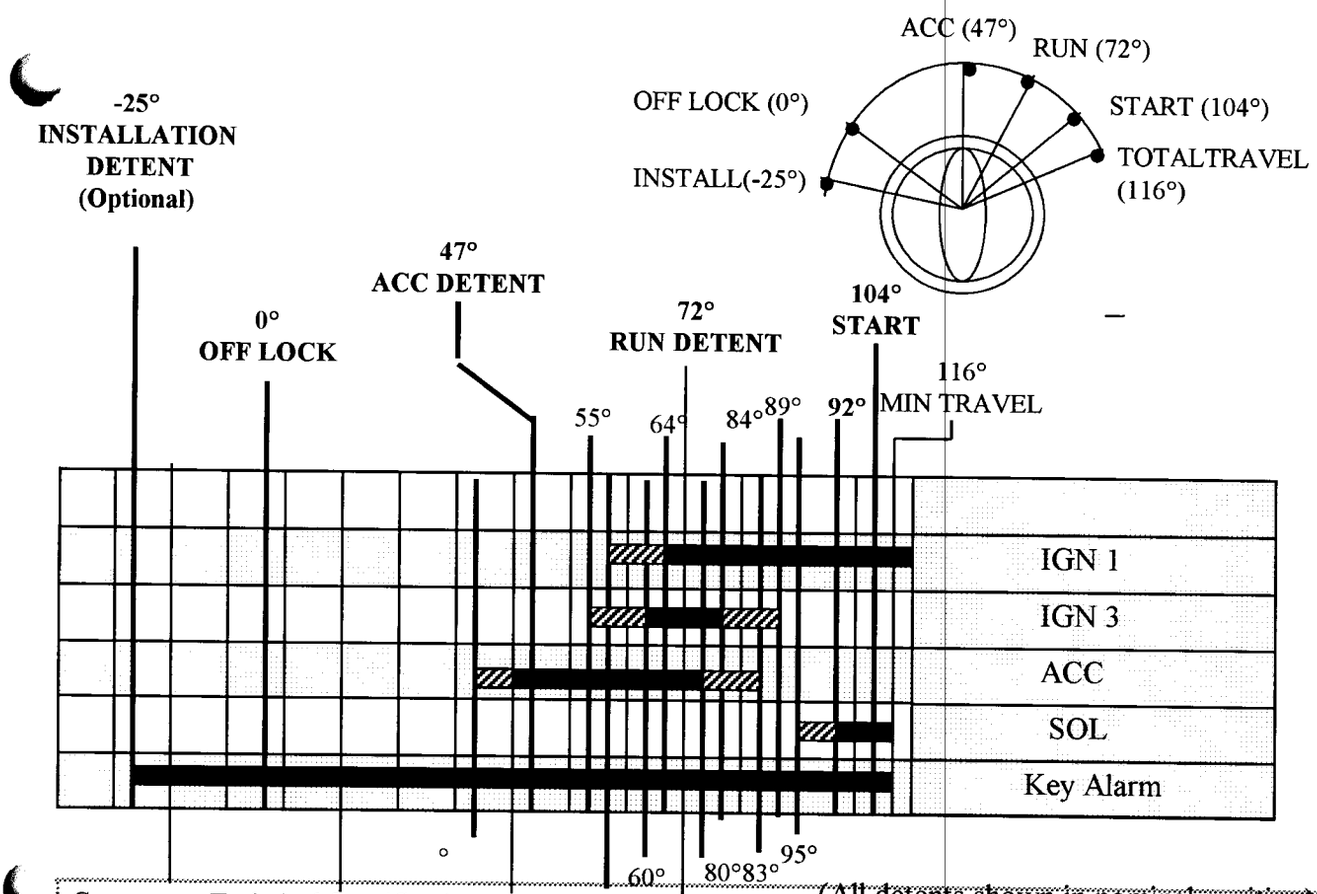


gineering approval.

FIGURE B: SWITCH TRAVEL REQUIREMENTS



Notes:

1. IGN3 MUST MAKE A MAXIMUM OF 10° AND A MINIMUM OF 2° PRIOR TO IGN1 MAKING GOING FROM OFF TO RUN

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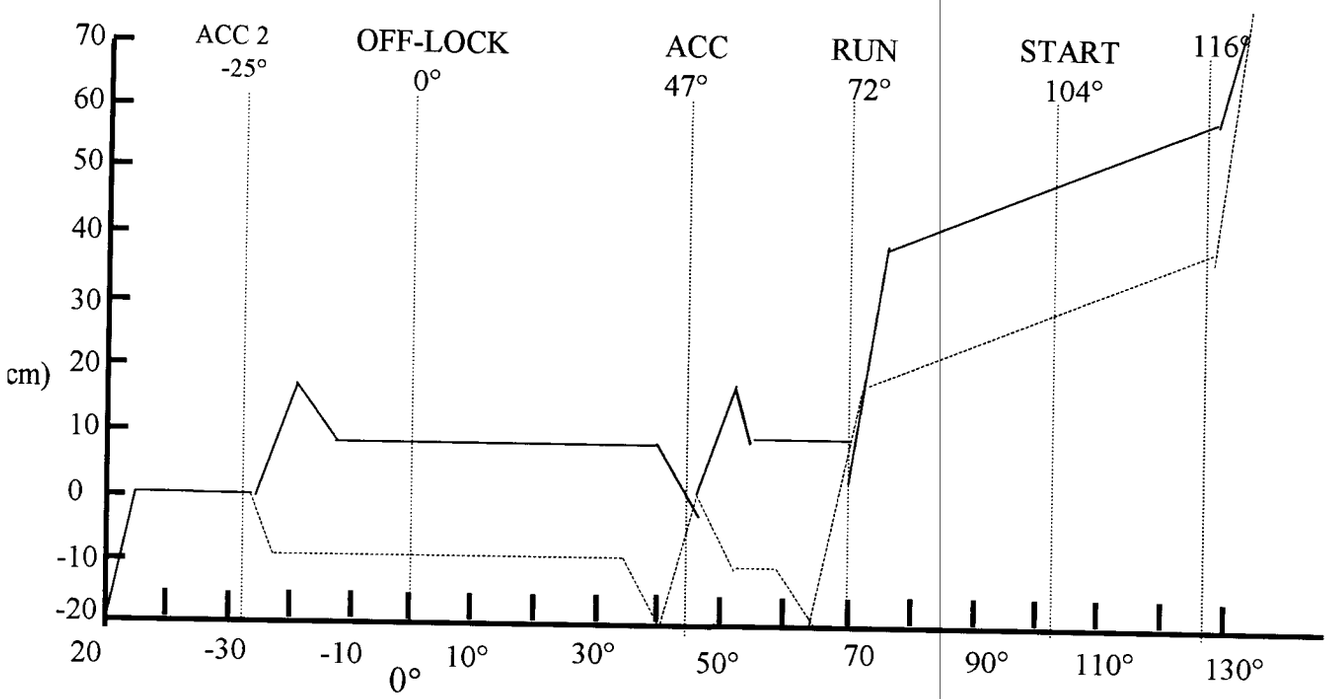
TORQUE vs. ROTATION



DISPLACEMENT (Degrees)

IGNITION SYSTEM TORQUE REQUIREMENTS

Actual curve to be furnished by supplier after GM Engineering approval.

Column Torque Requirement:
The maximum allowable torque of the Lock Housing/ Key Lock Cylinder interface (excluding the ignition switch) MUST not exceed 10 N-cm.

Ignition Switch Torque Requirement:
The minimum torque required by the switch, on the return side of the ignition switch from CRANK to the RUN position MUST be 15 N-cm.

NOTE:

Torque Curve allowable tolerance shall not exceed +/- 5 N - cm.

3.2.2.4 Sound/Audible Requirements

The switch shall produce no more than an average audible sound of 50 dBA over 250 ms in the 20 Hz to 20 KHz range when tested at a distance of 900mm according to the procedure specified in Section 5.11 of GM 9110P.

3.2.2.5 Rattle

The switch shall not rattle, squeak, or make any undesirable noise as tested per Section 5.15 of GM 9110P. Six switches that have completed the 3 times life cycle testing must be submitted to NAO engineering to demonstrate compliance to this requirement.

3.2.2.6 Mechanical Drop

The switch shall withstand a 1 meter drop onto a concrete surface in three mutually perpendicular axes without loss of function when tested as specified in Section 7.5 of GM 9110P.

3.2.2.7 Mechanical Shock

The switch shall meet the electrical and mechanical requirements when subjected to 3 shock pulses in both the positive and negative directions in each of three mutually perpendicular axes (a total of 18 pulses) as specified in Section 7.6 of GM 9110P. Nuisance contact openings shall be of less than 1.0 ms duration.

3.2.2.8 Terminal Retention

Each terminal shall not sustain permanent deflection exceeding 0.1 mm or functional damage when subjected to a 50 N force as specified in Section 6.2 of GM 9110P. Each terminal shall also withstand an axial pull out force of 25 N. Apply force at a rate of 50 ± 10 mm/minute.

3.2.2.9 Connector Insertion

The maximum force required for connector insertion shall not exceed 80 N when tested according to Section 6.3 of GM 9110P.

3.2.2.10 Connector Retention

The connector and switch shall withstand a 75 N pull to the harness in a 360° arc perpendicular to the connector axis as well as a 150 N pull normal to the connector without pulling loose or effecting the electrical function. A simulated vehicle harness with a maximum length of 200 mm and all locking features engaged shall be used for test purposes.

3.2.2.11 Switch Case Integrity

The switch shall conform to the following switch case integrity requirements when tested as specified in Section 6.4 of GM 9110P.

Minimum Case to Base Retention Force (Pull)	110N
Minimum Case Strength Force (Push)	110N

3.2.2.12 Switch Retention and Insertion

The switch shall be installed with two screws. The switch shall be retained during the application of 220N in the direction to remove the switch from a representative column head. Apply the load perpendicular and in the center of the switch.

Note: Apply force at a rate of 50 ± 10mm/minute.

3.2.2.13 Mechanical Overload

The switch actuator shall be capable of withstanding, with no structural or functional damage (no permanent deformation that exceeds the released print tolerance, and shall have no separation or loosening of the components or switch), the following forces when tested as specified in Section 6.5 of GM 9110P.

Push-Key In	110 N
Push-Theft Deterrence Mechanism	220 N
Torsional-Key Rotation (Against Stops)	4 N-m

3.2.2.14 Switch Surface Temperature

For non-touchable surfaces, the maximum temperature rise shall not exceed 50°C at rated load (ref. section 5.5 of GM9604P) when tested in a representative vehicle location and orientation.

3.2.2.15 Theft Deterrence

The integral theft resistor shall be destroyed (damaged beyond value determination) during a slam-pull of the switch actuator or attempted removal of the switch from the ignition cylinder housing with the switch and actuator in the OFF orientation.

Compliance to this requirement shall be demonstrated by the following:

1. Mount each ignition switch in a representative column housing with the correct cam/actuator interface. Place the switches and actuators in the OFF position.
2. Six samples shall be subjected to a force applied to the switch actuator, along its axis in the direction of key/cylinder removal, for a distance of 5.0 mm. The maximum applied force shall be between 40 N and 300 N.
3. An additional six samples, with mounting screws removed, shall be subjected to a force capable of separating each switch from the column housing a minimum distance sufficient to rotate the switch to its RUN position. Apply the force at the center of the switch housing and normal to its mounting plane.
4. Disassemble each switch without further disturbing the switch internals. Each theft resistor shall be damaged beyond visual or measured determination of its value. All samples shall be submitted to GM Engineering for review and approval following this test.

The ignition switch shall be protected from determination of the theft resistor value (with the switch in the OFF position) through tamper of the switch utilizing commonly available tools (hammer, screwdriver, ohmmeter, etc.). Six switch samples shall be submitted to GM Engineering to validate compliance to this requirement.

3.2.3 Dependability

3.2.3.1 Target Life

Refer to Section 3.1.5.1 in this document for switch cycle definition.

3.2.3.2 Reliability Requirements

The switch shall demonstrate a reliability of 98% at one life with 50% confidence. The supplier is responsible for initial and ongoing failure rate verification of the switch.

3.2.3.2.1 Reliability Testing/Demonstration

Twelve switch samples (from durability testing) shall continue to test to 3 times life without failure with the same temperature profile as specified in Section 3.1.3.1. Performance parameters shall be measured at 150%, 200%, 250%, and 300% of the test. If a failure occurs before 3 times life, continue testing until five samples fail with the same failure mode. Perform a Weibull Analysis and determine the B2 life. If the B2 life is greater than 1 times life, the test samples may be approved by Engineering. All failed switches shall be analyzed for root cause of failure.

3.2.3.2.2 Reliability Calculation

Median Rank Approximation shall be used to calculated the reliability of the ignition switch. The Weibull analysis data shall include the following:

- Minimum Life,
- Slope,
- Characteristic Life,
- 50% Confidence Interval, and
- Reliability at the end of one life.

3.2.4 Serviceability

Parts must be serviceable with commonly available tools The ignition switch shall be serviceable without damage to the theft resistor with the ignition key/cylinder oriented in the RUN position.

3.3 DESIGN and CONSTRUCTION

3.3.1 Identification and Marking (Component Labeling)

An eight digit part number is to be clearly marked on each separate part. The pin designator (number or letter) shall be marked near each terminal.

Theft resistor value shall not be identified (coded or otherwise) on any interior or exterior surface of the switch.

The Julian date code shall appear on each part only after successful completion of End-of-Line tests. (Refer to GM 9604P.) The first digit shall indicate the year of manufacture, the last three digits shall be the day of the year. For example, 7365 is 1987, December 31.

The manufacturer's identification shall appear on each part, including the line number, shift, and/or facility where duplication exists. The minimum height of the each character shall be 1.5 mm.

3.3.1.1 Marking of Plastic Parts

All plastic parts shall have a polymer identification symbol per SAE J1344 for recyclability purposes.

3.3.2 Interchangeability

The ignition switch shall be designed for maximum utilization of common components when multiple ignition switches are developed to enable cross-carline compatibility.

4.0 VALIDATION

4.1 GENERAL

The Validation Plan consists of the test procedures required to satisfy component validation. The tests are to be performed by the supplier, unless otherwise indicated.

4.2 PERFORMANCE TESTS

The tests referred to in this section are quantitative or semi-quantitative in nature. Performance tests are to administered as specified in the validation matrix. Tests shall be performed as specified in Columns 1 and 2 of Table 4.2

STANDARD	SECTION	SPECIFICATION REQUIREMENT	TEST
		3.1.2.2	P0 - Simple Function Check[1]
GM 9110P	5.1	3.2.1.3	P1 - Voltage Drop/Circuit Resistance
GM 9110P	5.2	3.2.1.5	P2 - Open Circuit Resistance
GM 9110P	5.3	3.2.1.6	P3 - Isolation Resistance
GM 9110P	5.6	3.2.1	P4 - Function Check
GM 9110P	5.7, 5.8	3.2.2.3	P5 - Force Displacement
GM 9110P	5.12	3.2.1.8	P8 - Contact Bounce
GM 9110P	5.15	3.2.2.5	P9 - Rattle Evaluation
GM 9110P	5.11	3.2.2.4	P10 - Audible Sound
GM 9605P	2.0	3.2.1.4	P11 - Contact Resistance
GM 9110P	5.10	3.1.1	P12 - Appearance

TABLE 4.2

1. Quickly check the continuity or circuit resistance on a bench top while operating each control. The intent is to establish a minimum level of functionality between tests.

4.3 VALIDATION TESTS

All the tests specified in this section and the following sections apply to all switch types. Each switch type shall be validated independently according to the test sequences and procedures specified.

GM 9110P SECTION	SPECIFICATION REQUIREMENT	TEST	COMMENTS
6.6		Visual (Teardown) Inspection	
9.1	3.1.5.1	Durability	
	3.1.3.1.1	Storage Temperature	
8.2	3.1.3.2	Humidity Test	
	3.1.3.2.1	Moisture Susceptibility	
7.7.4.1	3.1.3.3	Vibration	
8.5	3.1.3.4	Thermal Shock Test	
8.3	3.1.3.5	Corrosion (Salt Fog)	
8.4	3.1.3.6	Fluid Compatibility	
8.1	3.1.3.7	Dust Test	
GM6090M	3.1.3.8	Flammability Requirements	
	3.1.3.11	Ozone	
	3.1.3.13	Mixed Flowing Gas	
	3.1.3.14.1	High Temperature Endurance	Components with electronics only.
	3.1.3.14.2	Low Temperature Endurance	Components with electronics only.
	3.1.3.14.3	Power Temperature Cycling	Components with electronics only.
7.4	3.2.1.7	Continuous Current Overload	
	3.2.1.7.1	Short Circuit Test	
GM9100P Series	3.2.1.9	EMC	Components with electronics only.
7.2	3.2.1.10	Reverse Polarity	
7.3	3.2.1.11	24-Volt Jump Start	
9.10	3.2.1.12	1000 Hour Load Soak Test	
7.5	3.2.2.6	Mechanical Drop Test	
7.6	3.2.2.7	Mechanical Shock Test	
6.2	3.2.2.8	Terminal Retention	
6.3	3.2.2.9	Connector Insertion	
	3.2.2.10	Connector Retention	
6.4	3.2.2.11	Case Integrity	
	3.2.2.12	Switch Retention/Insertion	
6.5	3.2.2.13	Mechanical Overload	
GM9604P, Sect. 5.5	3.2.2.14	Switch Surface Temperature	
	3.2.2.15	Theft Deterrence	

TABLE 4.3

4.4 VALIDATION TEST MATRIX

Each test sequence is independent. The tests in each sequence shall be performed in the same order as listed in this document. (Refer to the Validation Test Matrix Template.)

4.4.1 General Requirements

Before PV and DV testing shall begin, the following conditions must be satisfied:

1) The tools shall be complete and capable of making parts to design intent.
3) The manufacturing process shall be capable of assembling and producing parts to design intent.

The supplier shall provide GM Engineering two switches of each part number with clear housings prior to design validation (DV), and two additional switches of each part number with clear housings prior to process validation (PV).

4.3 VALIDATION TESTS

All the tests specified in this section and the following sections apply to all switch types. Each switch type shall be validated independently according to the test sequences and procedures specified.

GM 9110P SECTION	SPECIFICATION REQUIREMENT	TEST	COMMENTS
6.6		Visual (Teardown) Inspection	
9.1	3.1.5.1	Durability	
	3.1.3.1.1	Storage Temperature	
8.2	3.1.3.2	Humidity Test	
	3.1.3.2.1	Moisture Susceptibility	
7.7.4.1	3.1.3.3	Vibration	
8.5	3.1.3.4	Thermal Shock Test	
8.3	3.1.3.5	Corrosion (Salt Fog)	
8.4	3.1.3.6	Fluid Compatibility	
8.1	3.1.3.7	Dust Test	
GM6090M	3.1.3.8	Flammability Requirements	
	3.1.3.11	Ozone	
	3.1.3.13	Mixed Flowing Gas	
	3.1.3.14.1	High Temperature Endurance	Components with electronics only.
	3.1.3.14.2	Low Temperature Endurance	Components with electronics only.
	3.1.3.14.3	Power Temperature Cycling	Components with electronics only.
7.4	3.2.1.7	Continuous Current Overload	
	3.2.1.7.1	Short Circuit Test	
GM9100P Series	3.2.1.9	EMC	Components with electronics only.
7.2	3.2.1.10	Reverse Polarity	
7.3	3.2.1.11	24-Volt Jump Start	
9.10	3.2.1.12	1000 Hour Load Soak Test	
7.5	3.2.2.6	Mechanical Drop Test	
7.6	3.2.2.7	Mechanical Shock Test	
6.2	3.2.2.8	Terminal Retention	
6.3	3.2.2.9	Connector Insertion	
	3.2.2.10	Connector Retention	
6.4	3.2.2.11	Case Integrity	
	3.2.2.12	Switch Retention/Insertion	
6.5	3.2.2.13	Mechanical Overload	
GM9604P, Sect. 5.5	3.2.2.14	Switch Surface Temperature	
	3.2.2.15	Theft Deterrence	

TABLE 4.3

4.4 VALIDATION TEST MATRIX

Each test sequence is independent. The tests in each sequence shall be performed in the same order as listed in this document. (Refer to the Validation Test Matrix Template.)

4.4.1 General Requirements

Before PV and DV testing shall begin, the following conditions must be satisfied:

1) The tools shall be complete and capable of making parts to design intent.
3) The manufacturing process shall be capable of assembling and producing parts to design intent.

The supplier shall provide GM Engineering two switches of each part number with clear housings prior to design validation (DV), and two additional switches of each part number with clear housings prior to process validation (PV).

4.4.1.1 Documentation

All test samples shall be documented with the appropriate part number, design level, and assembly level prior to the start of test. If a part is from a multi-cavity tool, the cavity number should also be recorded. Any key dimensions or features of components or subassemblies should be recorded prior to test.

Copies of test results shall be sent to GM Engineering. The test results shall be kept on file per QS9000 Quality System Requirements and shall be available for review by GM Engineering. All test incidents, regardless of point of origin, are to be answered by the supplier per GP-5 procedure requirements within the following timing: 1)Initial response, 48 hours. 2) Final response 30 days.

4.4.1.2 Test Sequence

The required validation test sequence is depicted in the validation test matrix. These tests shall be performed as a minimum requirement. It is recommended that additional testing be performed on the ignition switch as deemed necessary by the switch manufacturer. The validation test matrix shows the required test sequence, sample size, performance test requirements, and conditions required to complete validation testing. Any deviation to the test sequence or requirements stipulated in the validation test matrix must be approved by GM Engineering in writing before the start of test. ***The destructive nature of some tests shown in the validation test matrix may require additional test samples to complete.***

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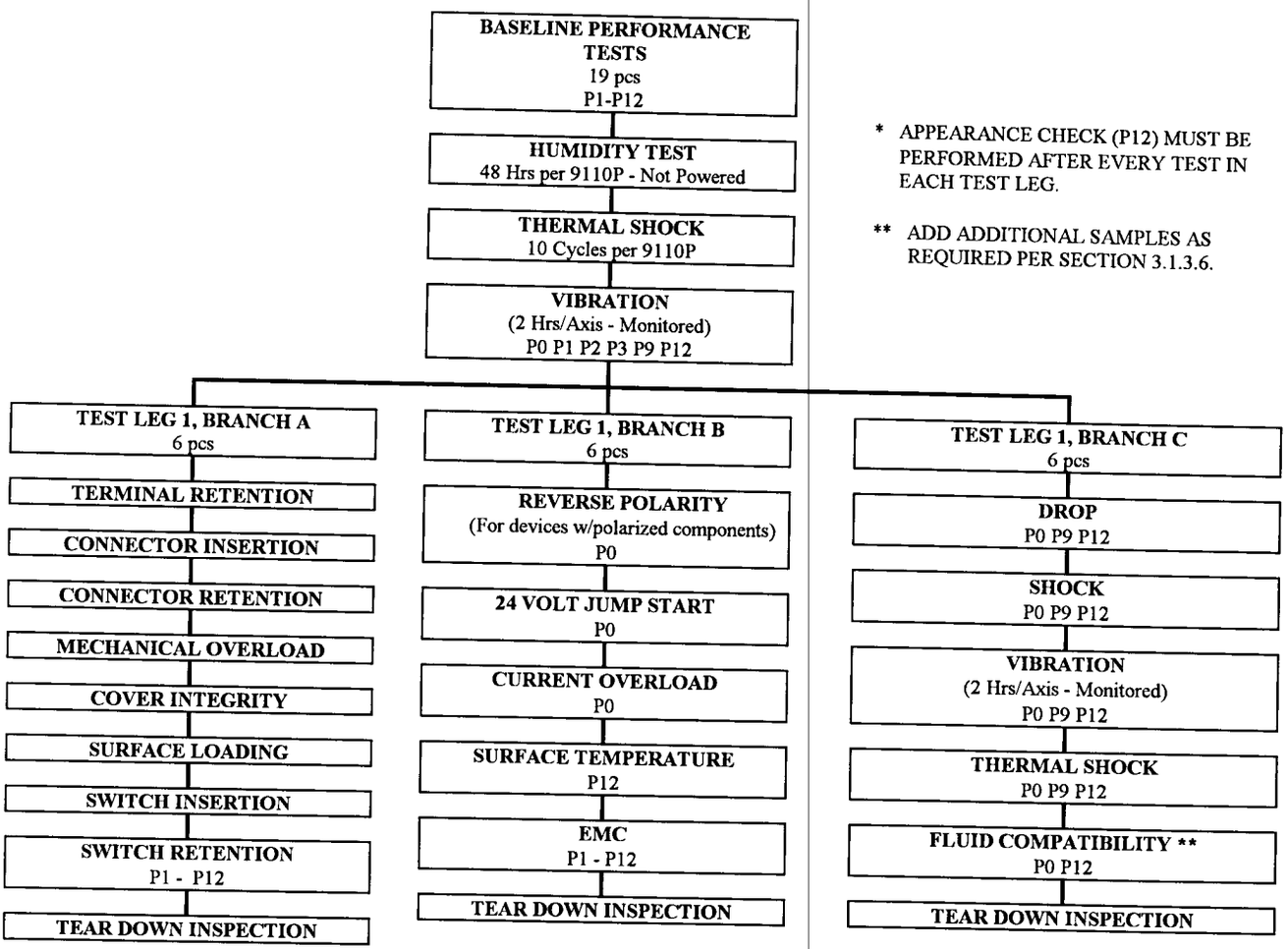
TEST LEG #1
MECHANICAL AND ELECTRICAL TESTS*

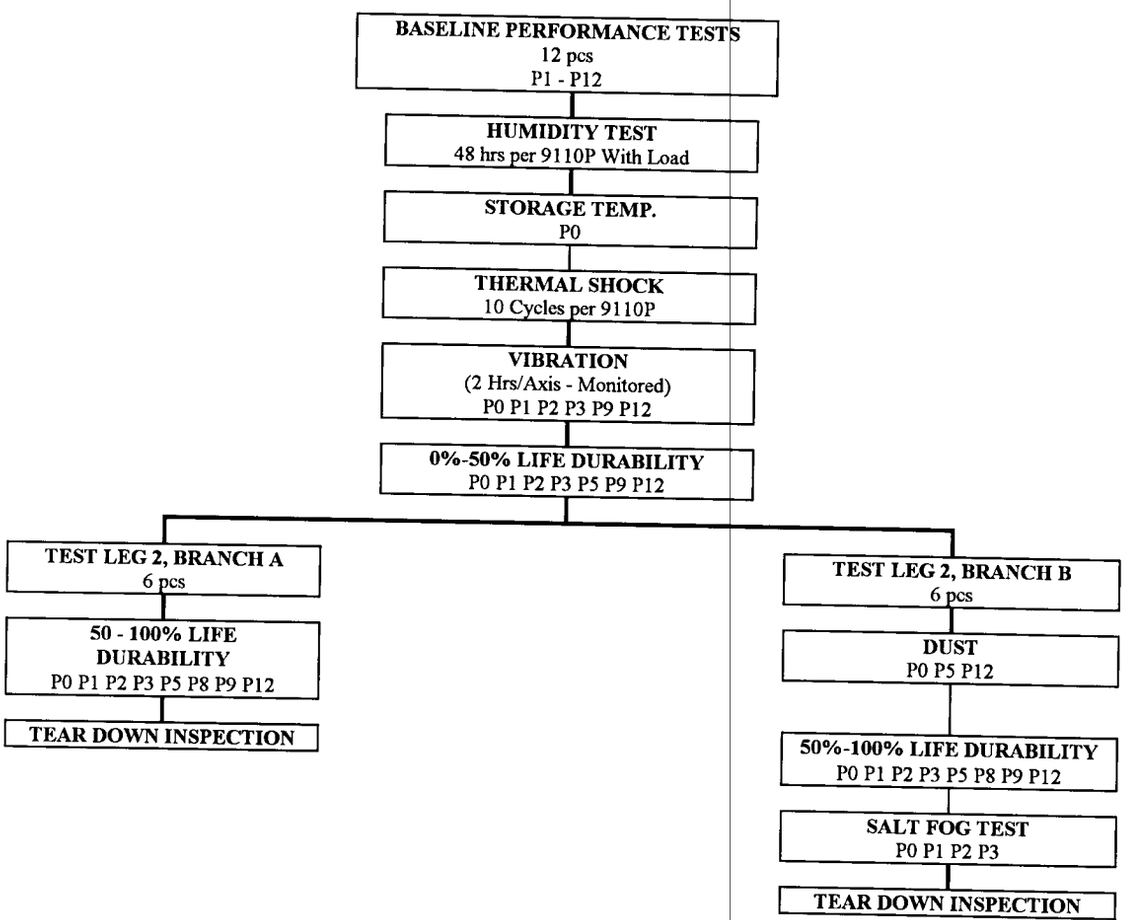


* APPEARANCE CHECK (P12) MUST BE PERFORMED AFTER EVERY TEST IN EACH TEST LEG.

** ADD ADDITIONAL SAMPLES AS REQUIRED PER SECTION 3.1.3.6.

NOTE: TEAR DOWN INSPECTION IS TO BE COMPLETED ON SELECTED SAMPLES WITH GM PARTICIPATION.

TEST LEG #2
ACCELERATED DURABILITY



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TEST LEG #3
RELIABILITY

BASELINE PERFORMANCE TESTS
12 pcs
P1 - P12

↓

0%-100% LIFE DURABILITY
P1 - P12

↓

100%-150% LIFE DURABILITY
P1 - P12

↓

150%-200% LIFE DURABILITY
P1 - P12

↓

200%-300% LIFE DURABILITY
P1 - P12

↓

TEAR DOWN INSPECTION

Note: Per Section 3.2.3.2 - 3X life bogey test (0 failure plan). If a failure occurs before 3X life, continue testing until 5 samples fail in the same mode. Perform a Wiebull Analysis and determine B_2 life. If $B_2 \geq 1X$ life (cycles), test samples may be approved.

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TEST GROUP #4
ADDITIONAL TESTS

P11
MIXED FLOWING GAS - 6 SAMPLES
P11

P0
OZONE - 6 SAMPLES
P0

P0
MOISTURE SUSCEPTIBILITY - 6 SAMPLES
P1 - P4

P0
SHORT CIRCUIT - 3 SAMPLES PER CIRCUIT
P0, Evaluation by GM Engineering

P0
TEMPERATURE ENDURANCE - 6 SAMPLES
P1 - P4

P0
1000 HR LOAD SOAK - 6 SAMPLES
P0 P1 P2 P3 P5 P8 P9 P10 P12

P0
OVERTORQUE - 2 SAMPLES
P12, Record Torque

P0
THEFT DETERRENCE - 18 SAMPLES
Evaluation by GM Engineering

4.4.1.3 Teardown Inspection

A Teardown inspection shall be performed on a minimum of half of the test samples used during any validation test leg, or branch, sequence. A teardown inspection shall consist of a visual and performance based examination of key switch design features, identified in the component DFMEA, to identify the root cause (or potential root cause) of test failure and to identify anomalies which could cause customer dissatisfaction. A switch teardown inspection report documenting all teardown inspection observations shall be required for each switch inspected. Teardown inspection test reports must be reviewed with GM Engineering prior to PPAP approval.

4.4.1.3.1 Teardown Inspection Procedure

Prepare the inspection area by cleaning any debris which could be mistaken for component contamination and covering the inspection area with a clean sheet of white paper for each sample inspected. Carefully disassemble the test sample and inspect all key design features for conformance to design specification; and also for signs of wear, deterioration, contamination, assembly/processing defects, or material defects. Sections 4.4.1.3.2 through 4.4.1.3.4 describe typical visual inspection test and analysis procedures.

4.4.1.3.2 Workmanship

Magnification up to 10X may be used in performing visual inspection for requirements identifying and controlling the following:

A) Cracks, burs, chips or filings, oil weld or solder splatter, and other forms of extraneous contamination.
B) Clearances between fixed and moving parts.
C) Irregularities such as scratches or nicks on contact surfaces.
D) Contact alignment or registration.
E) Damage due to quality, shipping or handling.
F) Corrosion (typically a green or white paste formation), staining, or lubricant discoloration seen on current carrying members.

4.4.1.3.3 Contact Force

On many switches contact force cannot be measured directly and must be calculated based on the force deflection characteristics of the spring system. The force-displacement fixture shown in Figure 3A, of GM9110P, is capable of accurately discerning contact forces (Item 2, Figure 8, GM9110P) due to the change in spring rate inherent to the contact system.

4.4.1.3.4 Joined Parts

Strength of brazed or soldered parts shall be tested by applying a force that produces deformation of the joined parts and then examining the joint for evidence of cracking. Strength of welded joints, except contacts, shall be tested by applying a force that causes the parts to be torn apart. A post test examination shall be made to determine if the failure occurred at the weld or within the part material, see GM4499P for detailed procedure. Strength of the contact joint shall be measured by applying a shearing force parallel to the longitudinal axis. Observation shall be made for perceptible movement of the contacts at 110 N applied force and symmetry of weld. Stake integrity for riveted contacts shall be tested by scribing a line across the contact joint and applying a 0.4 Nm torque to turn the rivet. No movement shall be observable. (Note: Round shank in round hole only). Other punch geometries require GM engineering approval.

4.4.2 Accelerated Durability Test (Test Leg #2)

4.4.2.1 Durability Test Stand

Supplier shall submit a full set of test stand detail drawings, electrical schematics, definition of switch and test stand data collection method, schematics detailing data acquisition channel allocation and measurement points, samples of good and fail data summary plots to GM Engineering prior to the start of Design Validation (DV) testing.

4.4.2.1.1 Application Test Circuit

All cyclic durability testing shall be performed using actual application test loads when available. The use of simulated loads for cyclic durability testing shall require pre-approval from GM Engineering. See Section 3.2.1.2 for Applied Loads.

4.4.2.1.2 Power-Temperature-Cycling (PTC)

All cyclic durability testing shall be performed with power-temperature-cycling per GM9110P

4.4.2.1.3 Test Stand Data Acquisition (DAS)

During durability testing, voltage drops shall be measured and recorded on a per cycle basis on each switch circuit in each position. In addition, all switch circuits with application test currents above 100 ma shall have in line shunts for per cycle monitoring and recording of circuit current. Durability test equipment shall be capable of analyzing voltage drop measurements across switch contacts and shunt resistors for open circuit voltage (OCV), closed circuit voltage (CCV), open circuit current (OCI), closed circuit current (CCI), closures out of position (COP), and missed cycles (MISS) failures (see descriptions of the six key performance characteristics below). Durability test stand data acquisition (DAS) equipment shall store voltage and current drop information to a good and fail data file, Fail data file shall consist of each discrete measured value which is out of the specification range during durability testing (i.e. OCV, CCV, OCI, CCI, COP and MISS values). Good data file shall consist of per cycle voltage drop measurements for each switch contact and shunt resistor. Data averaging of the good data file must be reviewed and approved by GM Engineering prior to the start of the test.

Descriptions of the six key performance characteristics:

Closed Circuit Voltage (CCV) - Voltage drop measurements across a set of switch contacts above specification voltage drop limits stipulated in the component technical specification. Used to flag out of range voltage drop measurements.

Open Circuit Voltage (OCV) - Voltage drop measurements across a set of switch contacts which is less than 90% supply voltage in a position on non-contact closure.

Closed Circuit Current (CCI) - A measure of high current circuit load current flow during closed circuit voltage drop measurements. A CCI failure occurs when load current is outside of a range defined as ± 15% of the switch current specified in the component technical specification. Used to confirm missed cycles and also used to flag bad test stand durability loads.

Open Circuit Current (OCI) - a measure of high current circuit load current flow above 0.2 amps across a set of switch contacts in a position of non-contact closure. Used to confirm closures out of position and also used to flag bad test stand durability loads.

Missed Cycles (MISSED) - A voltage drop across a set of switch contacts above 10% of supply voltage in a position of contact closure. (NOTE: GM9110P defines a missed cycle as any open circuit voltage drop below 90% supply and any closed circuit voltage above 10% of supply.)

Closure Out of Position (C.O.P.) - A voltage drop across a set of switch contacts below 90% supply voltage in a position of non-contact closure.

4.4.2.1.3.1 Data Storage

Good and fail data information shall be written to two separate hard drives during test. A provision shall be made to monitor the size of the good and fail data file on a per cycle basis to insure that the test files are increasing in size. Should the data file fail to increase in size after a test cycle, the DAS or control system should stop the test.

4.4.2.1.3.2 Data Conditioning

Fail data information shall be summarized graphically by scatter plot with the x-axis representing cycles, and the y-axis representing voltage or current. Good data shall be summarized graphically with the x-axis representing cycles, and the y-axis representing voltage or current.

4.4.2.1.4 Test Stand Interrupts

Test stand DAS or control system shall be capable of monitoring critical test stand and switch operating parameters and levels on a continuous basis and shall be capable of taking the appropriate action in the event of an out of range occurrence. The following minimum test stand interrupts and action shall be required:

TEST INTERRUPT	ACTION
Power Failure	Stop Test. Stop Thermocycle. Remove Power From Samples.
Chamber Temperature Out of Range	Stop Test. Stop Thermocycle. Remove Power From Samples.
3 Consecutive CCV, CCI, OCV, OCI Readings Out of Range Across Any One Switch Contact.	Stop Test. Stop Thermocycle. Remove Power From Samples.
Supply Voltage Out of Range	Stop Test. Stop Thermocycle. Remove Power From Samples.
Fixture Positioning Error	Stop Test. Stop Thermocycle. Remove Power From Samples.

Durability test stand software should allow user to configure test stand interrupt and action features at the start of durability testing. Thus during developmental testing, when switch performance may be less than ideal, test interrupt values and actions can be waived in order to evaluate the component on tests.

Should a test stand interrupt occur during durability testing, determine root cause of interrupt (switch or test stand) then correct test stand failures or report switch failures to GM Engineering before restarting test.

4.5 PRODUCT ASSURANCE

The supplier must submit a plan for approval by NAO Engineering that assures day to day compliance to this specification. This plan should contain the following:

Process control plan including SPC and all KPC's (Key Product Characteristics).
Periodic long term life testing
Incoming material quality certification plan
Quality traceability and containment plan

5.0 SHIPPING and PACKAGING

6.0 NOTES