2005-2007 Cobalt/Pursuit/G5
Ignition Switch
778,563 Vehicles
Cost Estimate: $41.3M

ETQ N-130454

Locations: US, CAN, MEX

Condition:
Front airbag non-deployment has been identified in certain crash events. In those events the ignition switch had moved from RUN to ACCESSORY or OFF.

Effects: The airbags will not deploy if the ignition has moved from RUN.

Root Cause: The ignition switch torque performance may be below specifications.

Service Bulletin: Bulletin #05-2-35-007 – Inadvertent key turning – issued Oct 2005.

Number of Reports:

- 23 allegations of front airbag nondeployment.
  Field incidents involve vehicles going off the road or hitting smaller objects shortly before a more significant impact.
- 26 VOQs for "Ignition Off" while driving.
- 355 TREAD reports or application of Service Bulletin.

Ignition Switch Change: Increased effort for RUN to ACCESSORY.

Rate & Injury Comparison: GMT800 SDM Switch Contact Bounce.

Potential Field Remedy: Add key inserts on all, replace ignition switch builds < Nov '06.

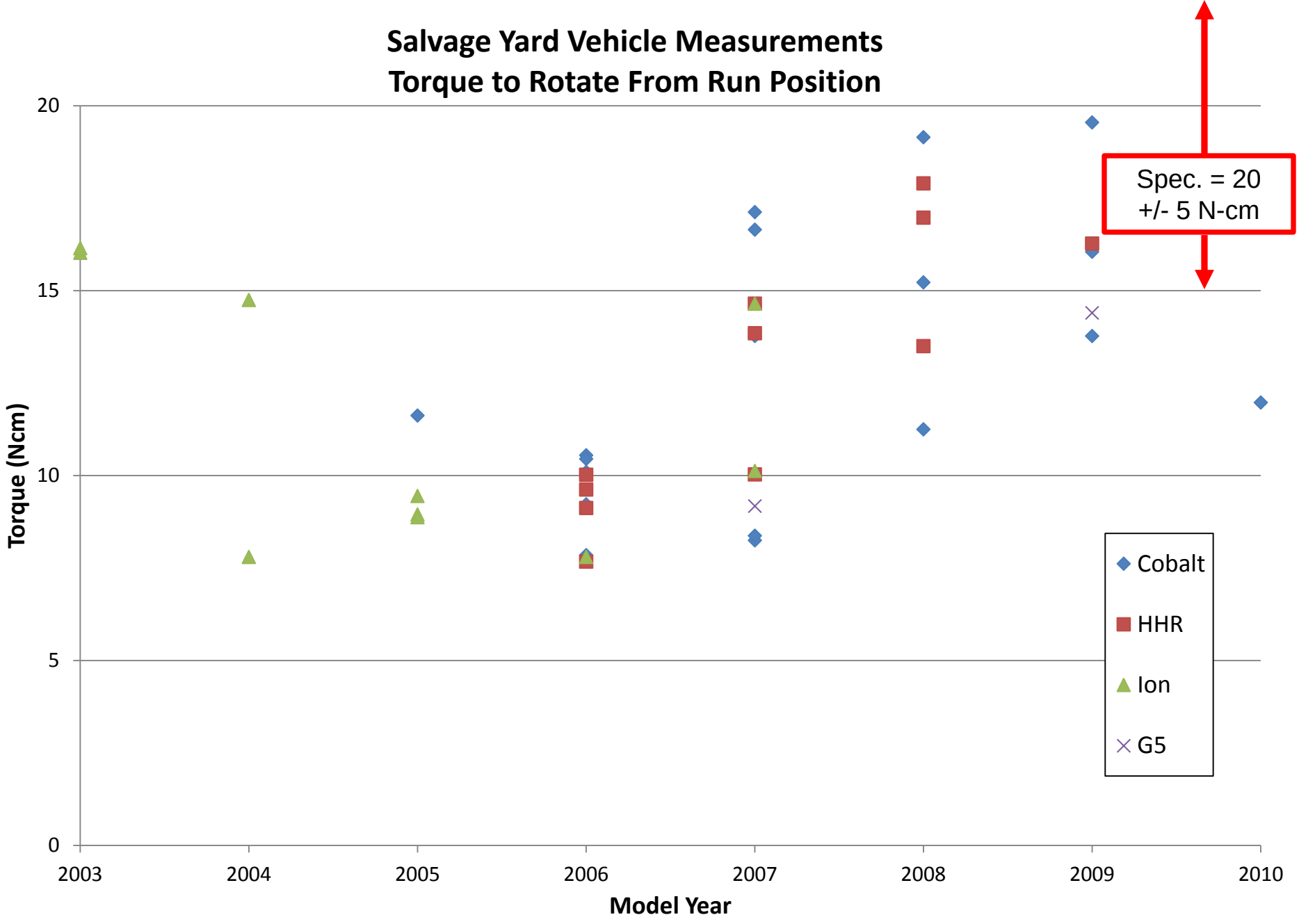
Potential Field Action Category: Safety Recall

Follow-up from December 17, 2013 FADC Review:

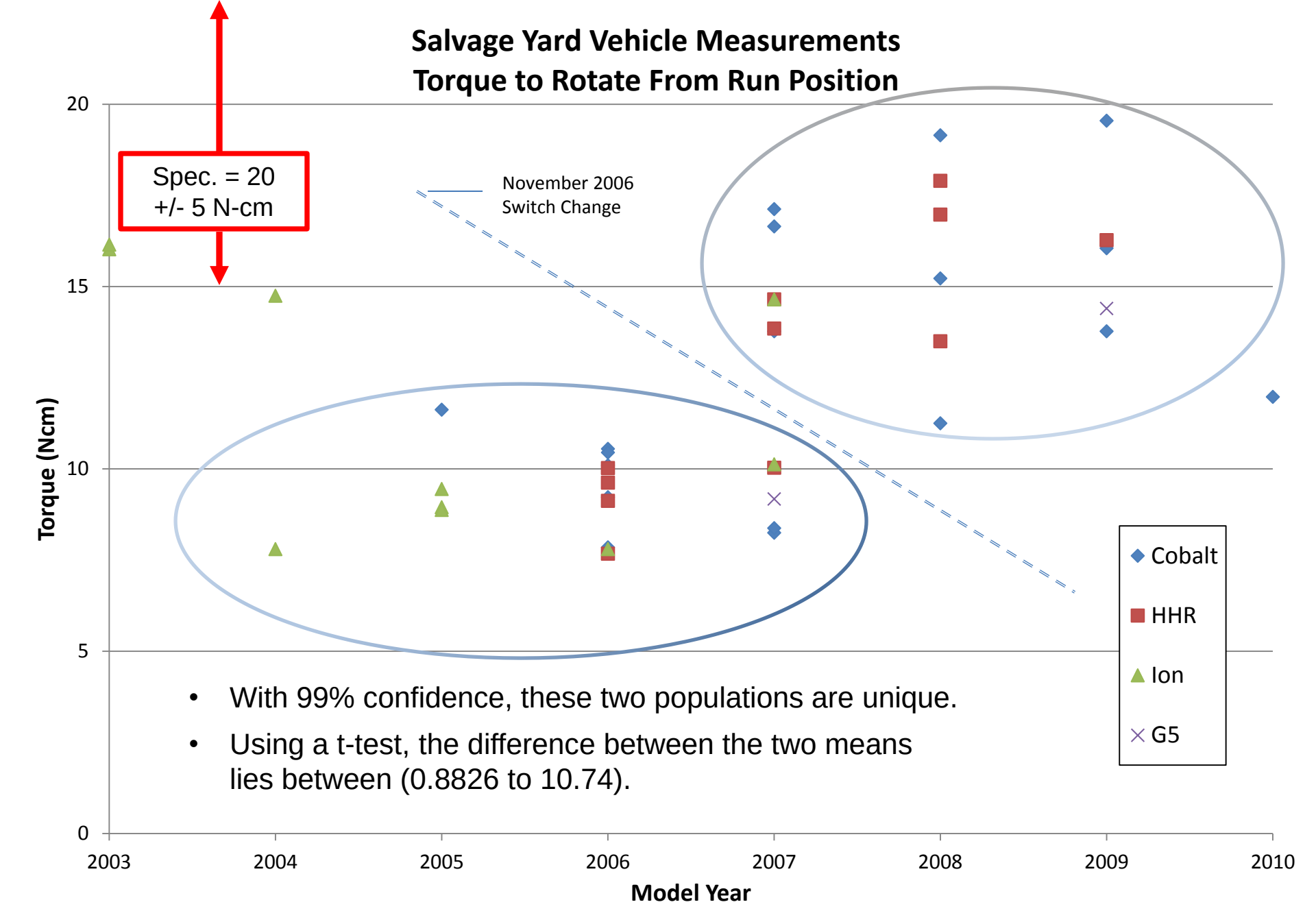
1. Forces required to rotate ignition from RUN to ACCESSORY/OFF
    - Mass/number of keys
    - Road inputs (rough road data – interior accelerations)

2. Knee Clearance to Key Cylinder
    - GM Fleet vs. Cobalt

3. Power Mode Deactivation Delay
    - Extend the time the SDM algorithm remains active after the vehicle exits the RUN power mode.



Original Switches only.



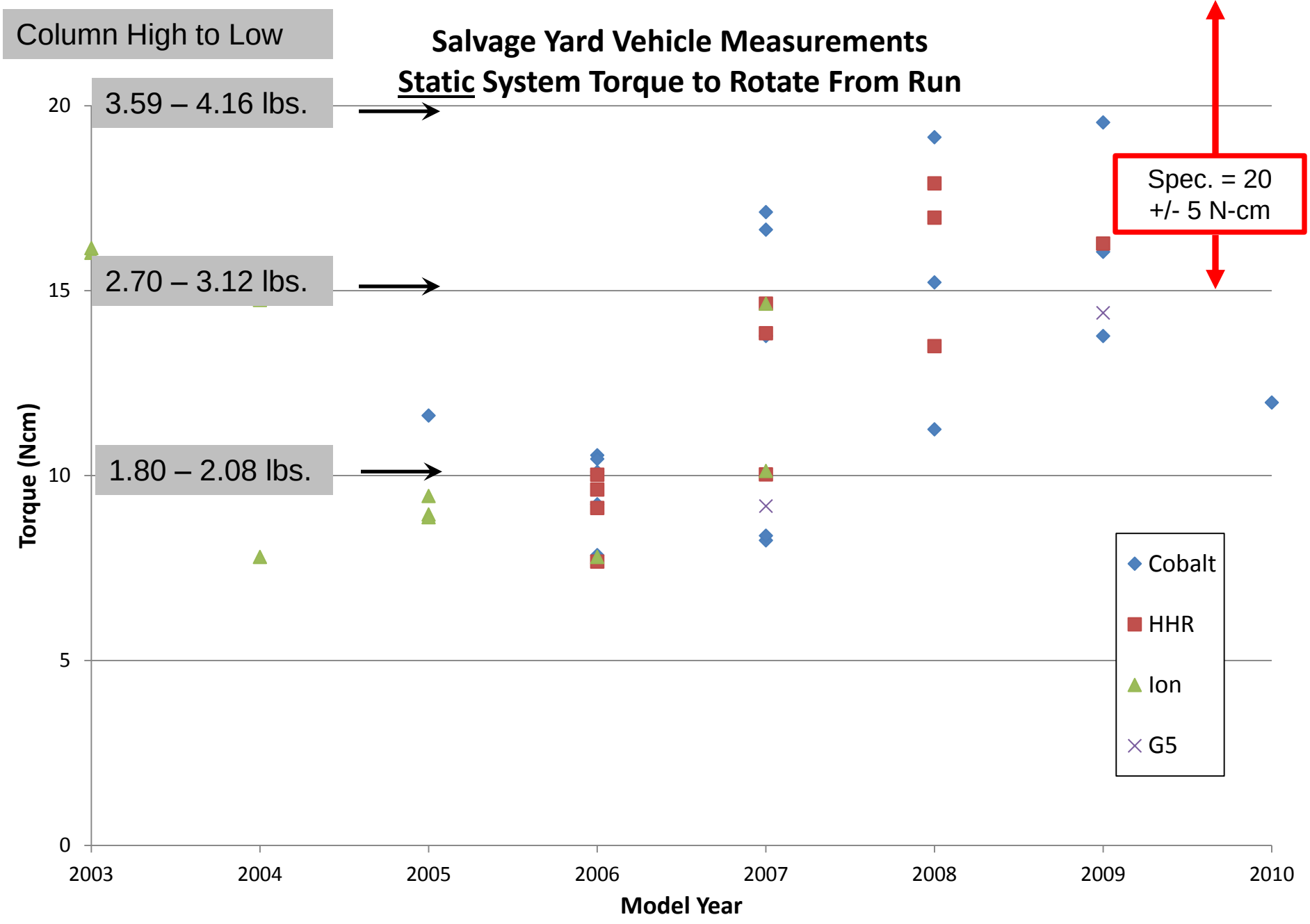
Original Switches only.

1. Forces required to rotate ignition from RUN to ACCESSORY/OFF

Static Key Ring Mass (lbs.) to Rotate Ignition Switch from Run

	Column Position		
Switch Force	Low	Mid	High
25 N-cm	5.20	4.97	4.49
20 N-cm	4.16	3.97	3.59
15 N-cm	3.12	2.98	2.70
10 N-cm	2.08	1.99	1.80

Switch Specification = 20 +/- 5 N-cm
Internal Cylinder Force (approx.) = 2 N-cm



Original Switches only.

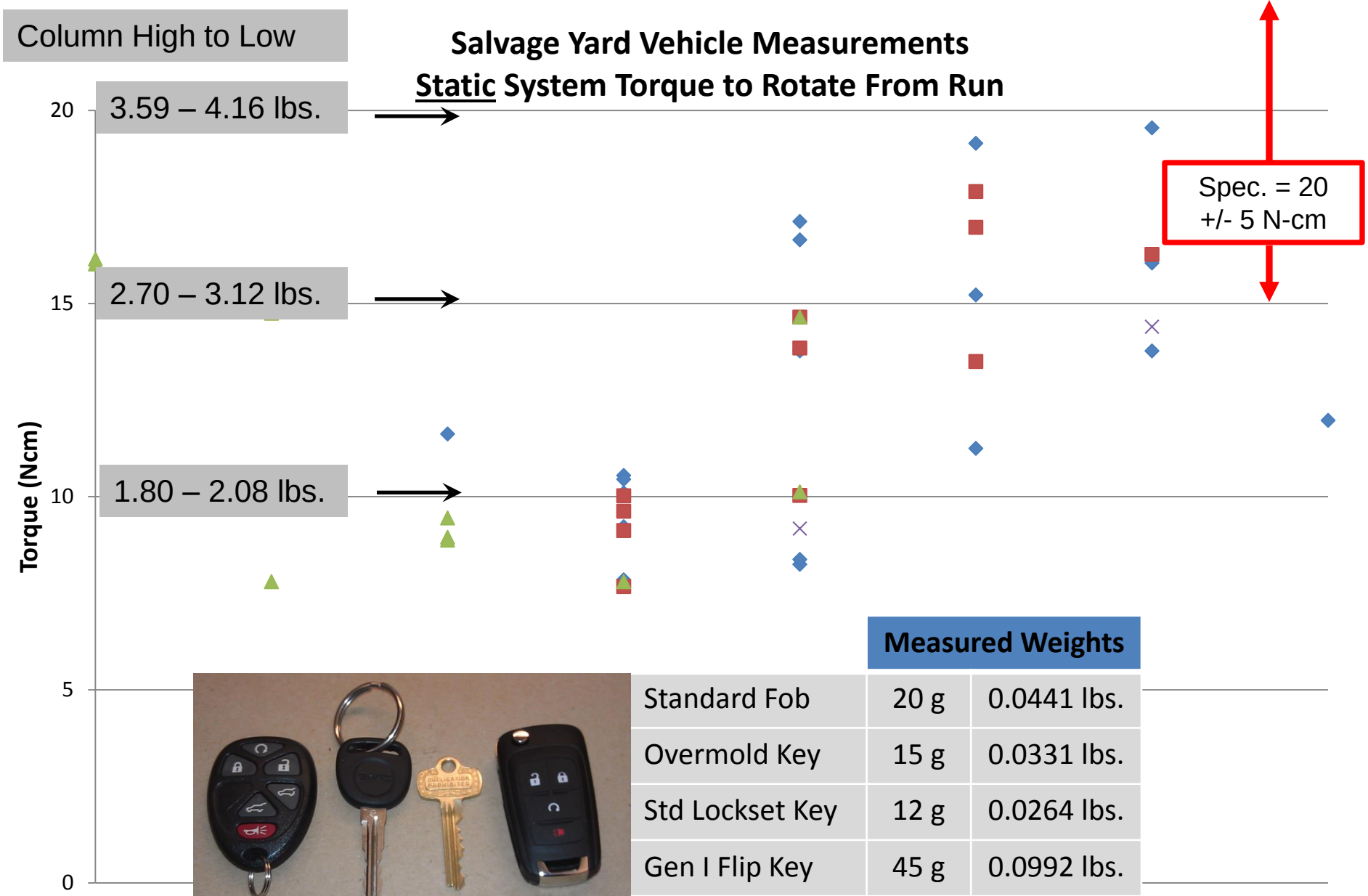
Column High to Low

3.59 – 4.16 lbs.

2.70 – 3.12 lbs.

1.80 – 2.08 lbs.

Salvage Yard Vehicle Measurements
Static System Torque to Rotate From Run



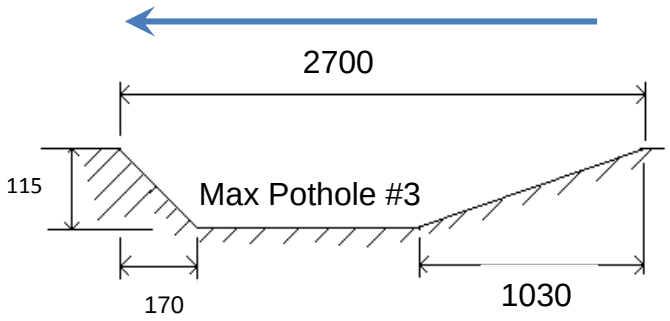
Measured Weights		
Standard Fob	20 g	0.0441 lbs.
Overmold Key	15 g	0.0331 lbs.
Std Lockset Key	12 g	0.0264 lbs.
Gen I Flip Key	45 g	0.0992 lbs.
Total	**92 g**	**0.2028 lbs.**

Original Switches only.

Cadillac ATS Rough Road Testing – Interior Accelerations @ SDM / MPG Evaluations

Test	Speed	Z Accel. Max
550/629 Hop	30 MPH	7.25 G
550/629 Tramp	30 MPH	4.87 G
Square Block	30 MPH	5.42 G
Washboard	40 MPH	5.06 G
#3 Pothole	25 MPH	13.10 G
Chatter Bumps	60 MPH	1.32 G
Massoit Bump	45 MPH	1.87 G
Curb Impact	5 MPH	1.88 G
Curb Drop-Off	20 MPH	2.83 G
Belgian Blocks	35/40 MPH	1.92 G

25mph Max Pothole #3



Column High to Low

Salvage Yard Vehicle Measurements
Static System Torque to Rotate From Run

3.59 – 4.16 lbs.

2.70 – 3.12 lbs.

1.80 – 2.08 lbs.

Spec. = 20
+/- 5 N-cm

Torque (Ncm)

20
15
10
5

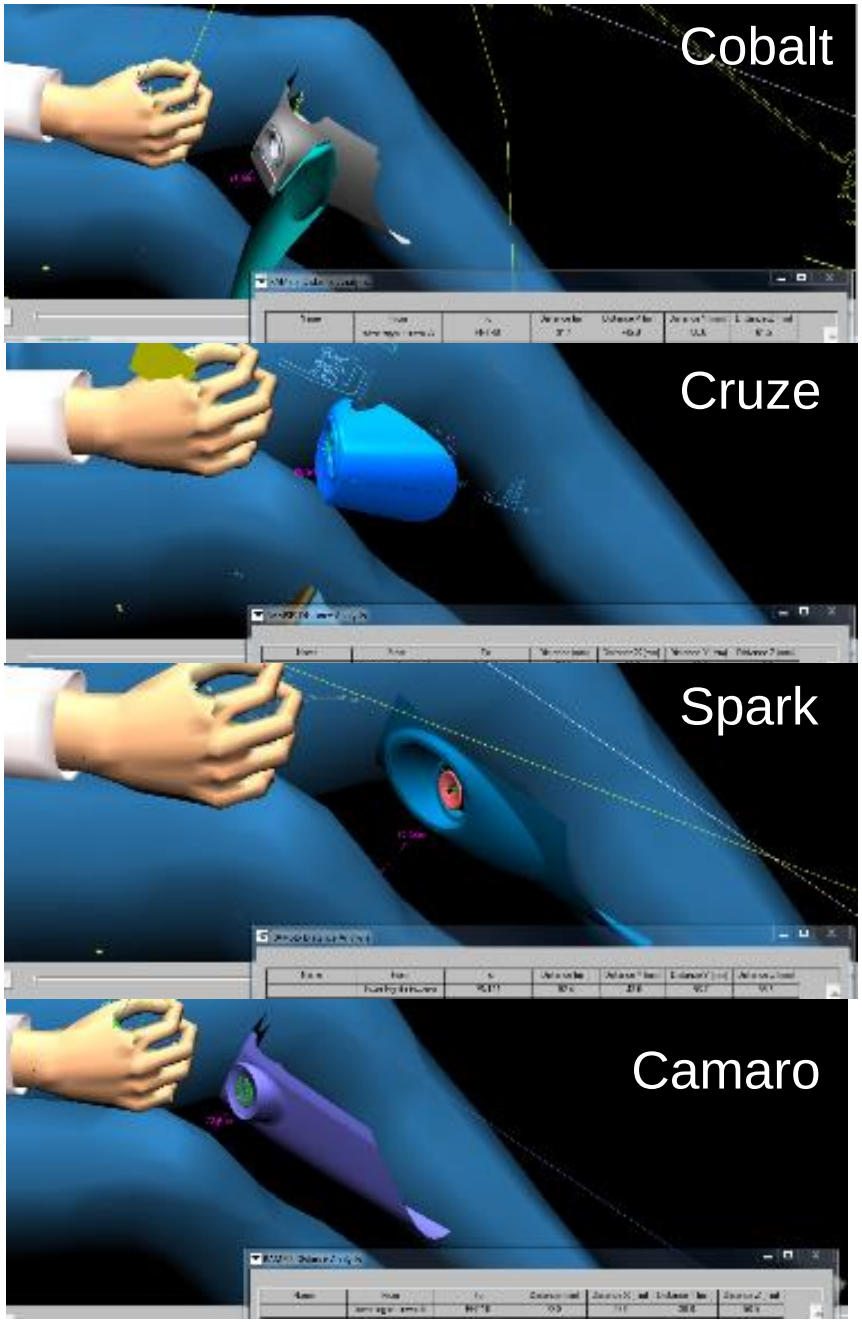
	Measured Weights		@ 13.1 G		
Standard Fob	20 g	0.0441 lbs.	0.58 lbs.	1.01 lbs.	2.66 lbs.
Overmold Key	15 g	0.0331 lbs.			
Std Lockset Key	12 g	0.0264 lbs.			
Gen I Flip Key	45 g	0.0992 lbs.			

Knee Clearance to Key Cylinder:

Model	Program	Knee to Cyl (MM)
Lacrosse	GMX353	55.8
Malibu	GMX351	56.4
Cruze	D1SC	58.9
Verano	D1SB	58.9
Impala	GMX352	67.7
Traverse	GMT561	70.7
	M2xx	73.4
Camaro	GMX521	73.9
	D2LC	76.2
	D2SB	76.2
Cobalt	GMX001	91.1
Regal	GMX350	91.7
Spark	M1xx	92.4
Equinox	GMT172	106.7
Sonic	G1xx	149.2
Volt	D1JCl	Keyless
CTS	A1LL	Keyless
NG	E2SC	Keyless
SRX	GMT166	Keyless

RAMSIS Assumptions:

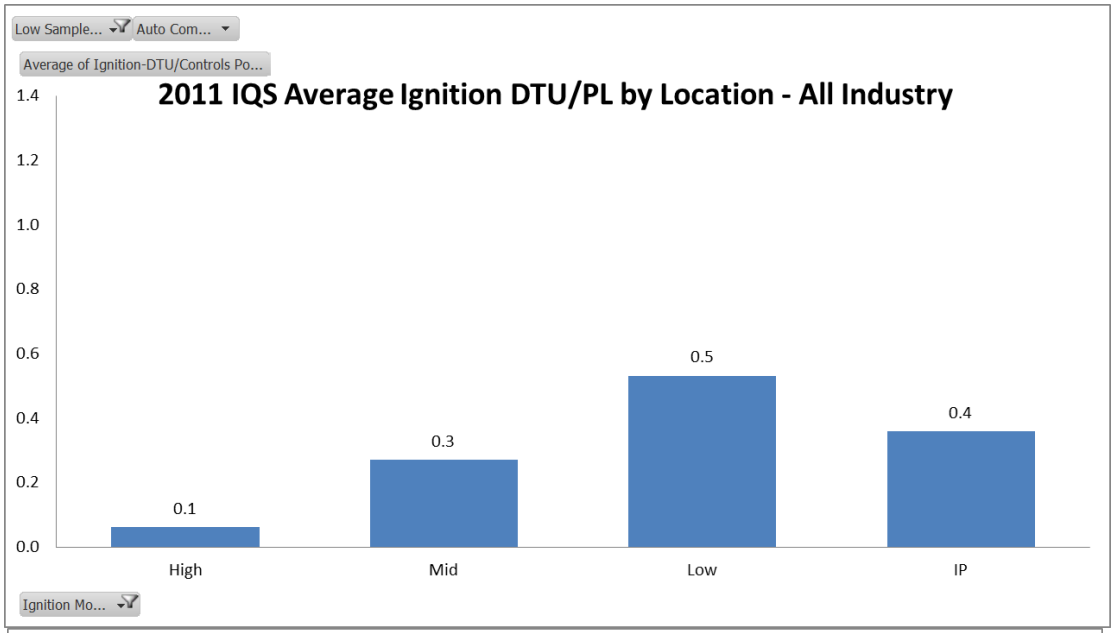
- 95th US male.
- H-pt located within seat travel box, mid travel (up/down).
- Posture prediction algorithm used .
- Distance calculated from right inner leg to center of key Cylinder face.
- Driver right ball of foot placed on center of brake pedal pad surface at unapplied position.

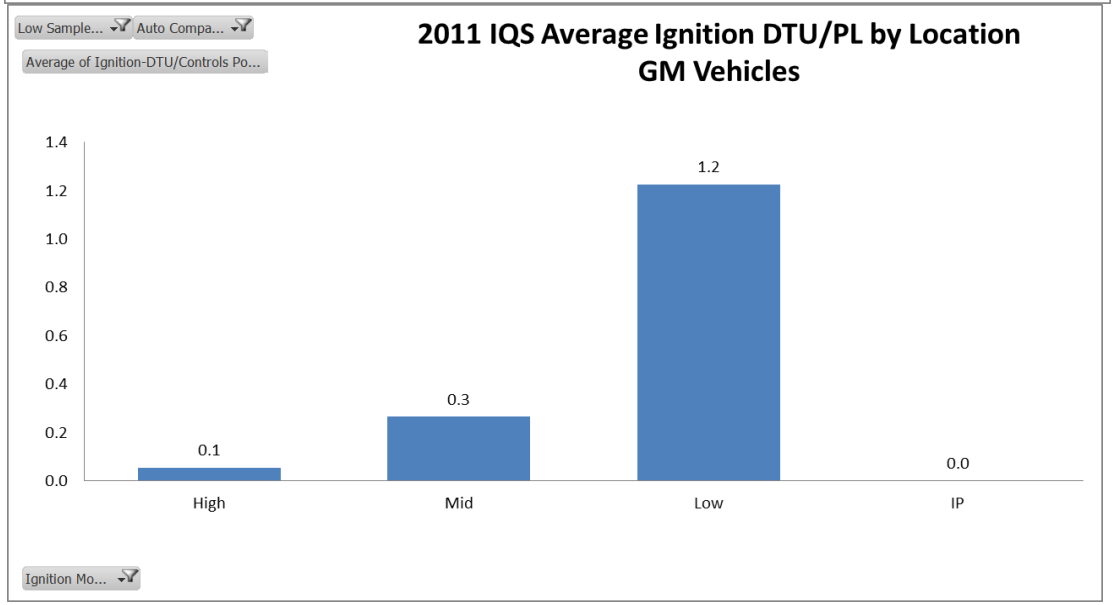


Photo

Ignition Cylinder JDP Comparison

High mount executions show lowest pph – low mount highest.



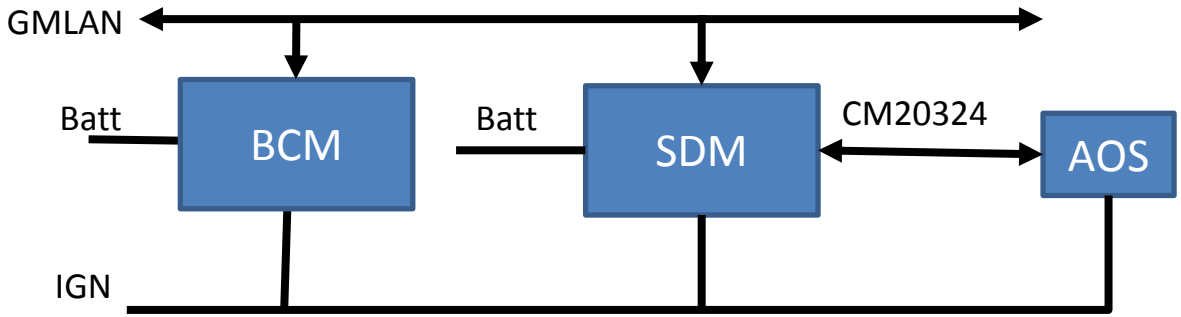


Colorado/Canyon – low mount and awkward key insertion

Equinox - mid mount – increases shroud width

Tahoe - high mount – eliminates ability to have RH wiper stalk

Extend the time the SDM algorithm is active after the vehicle exits the RUN power mode:



SDM: Software for power moding, fail safe operation, and diagnostics would require modification.

- Must address driver seat belt reminder (MVSS) on a quick ignition cycle.
- Requires modification to the diagnostics of the IGN line and AOS module (and other U-Codes).
- Software design changes would be done by Conti engineers who were not part of the original design team (originally Siemens).
- AOS: The occupant sensor module is powered from IGN and will power off when the key transitions from run. MVSS requirements for airbag state display would be violated if a transition of airbag state occurred within 2-3 seconds of power mode change.
- Not designed to be programmable. Approximately 25% would require replacement.
- Replacing with a newer (2011 MY) unit requires replacement of all crash sensors and crash testing to develop calibrations.
- Possible introduction of other issues or non-conformances that would be typically discovered in a full IVER.

Chronology:

10/29/04	PRTS N182276 issued. For ignition key low effort, may turn while driving. Closed w/o action (Code 19 – part met requirements).
6/23/05	Investigation opened on 2005 Cobalt stall – Focus on key rotation.
6/28/05	Investigation closed: Plan for Bulletin adding insert and possibly changing key from slot to hole.
11/28/05	Service Bulletin #05-2-35-007 issued to remedy inadvertent turning of key cylinder (reduce content on key chain and add insert).
4/26/06	Ignition switch PPAP completed with new plunger and spring (effort increase). No P/N change, production implementation date unknown.
8/1/09	Ignition key changed from slot to hole.
7/1/11	Service Bulletin #05-2-35-007 updated to add model years.
8/24/11	Investigator assigned for airbag nondeployment.

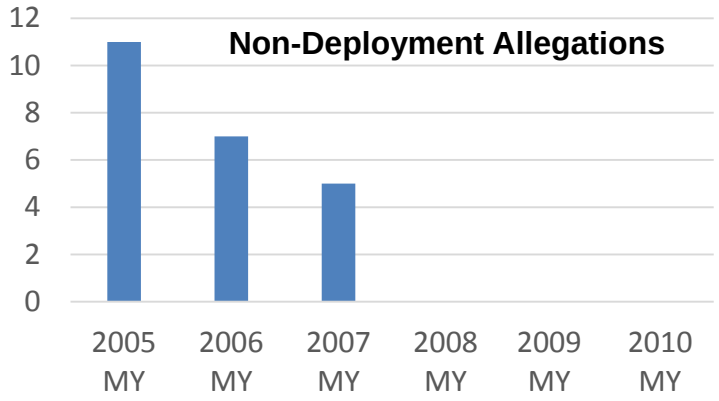
From Aug 2011 to Dec 2013

- Management updates
- Red X Study (2)
- DFSS Project
- Outside consultant analysis

10/29/13	Delphi confirms spring and plunger change made to switch. Validation completed 4/26/06. No part number change. Implementation date unknown.
12/17/13	FADC review.
12/19/13	FPET review.
TBD	FADC review.

Backup

Summary Points



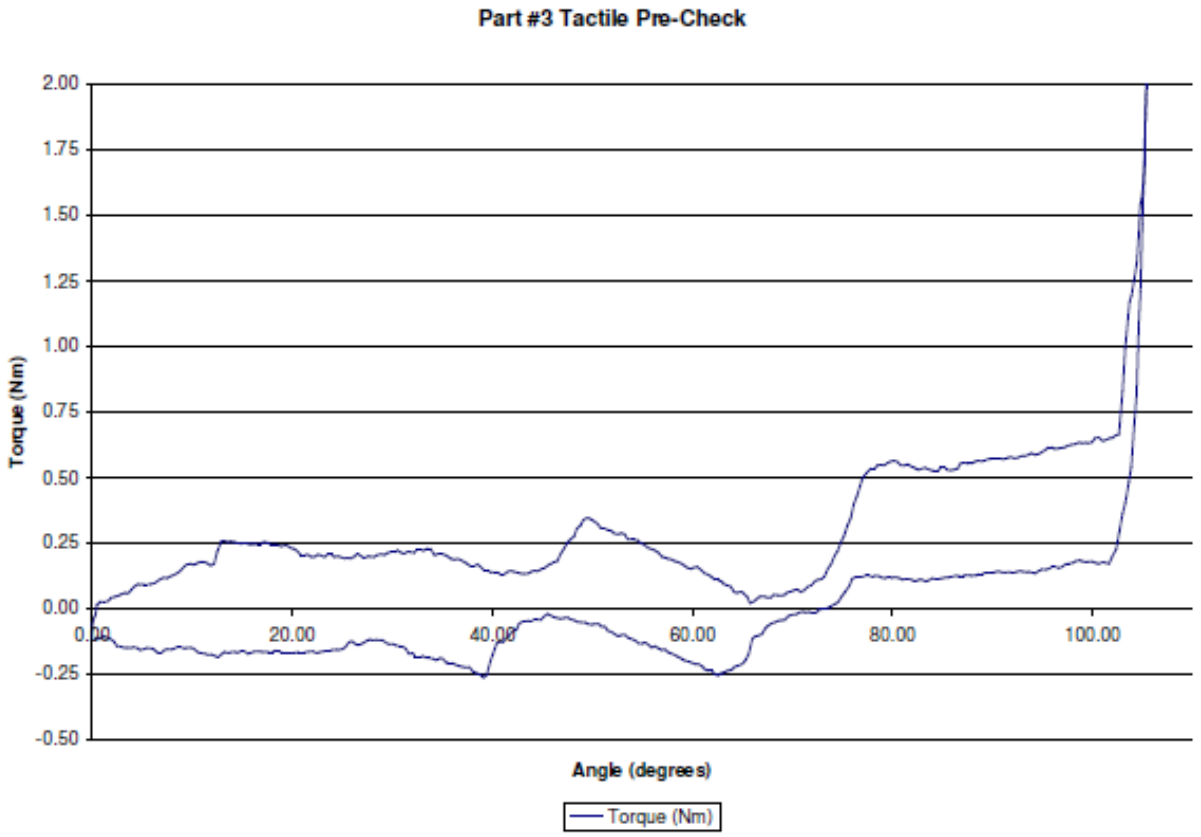
Total Reports

	2005	2006	2007	2008	2009	2010
Total	248	134	22	2	1	0

1. The rate of reported stall or non-deployment incidents has decreased significantly from ‘05 to ‘06 without any known changes.
2. The rate of reported stall or non-deployment incidents from ‘06 to ‘07 has decreased significantly. 80% of the ‘07 MY reports are after the switch change (believed to have occurred Nov ’06).
3. The 2008 and later models do not have any non-deployment allegations. There are no known differences between ‘07 MY (produced after Nov ’06) and these vehicles.
4. The same switch is used on Ion and HHR which have a total of 2 unconfirmed reports.
5. Two thirds (16) of the non-deployment allegations occurred in the 4 calendar years from 2005-2008. Only one third (7) have occurred in the 5 calendar years from 2009-2013.
6. There have been only two non-deployment events in the last 3 calendar years. Random off road crashes should be continuous, not decreasing (91% of the vehicles are still in use).
7. Of the 12 VOQs for 2005MY, all occurred prior to Dec 2007.
8. The 2006MY VOQs (13) are consistent with the most recent Aug 2013.

December 8, 2006

- Evaluation of rotational effort of key locking/parklock cable system prior to lock cylinder durability.
- 2008 Prototype GMT-900 steering column assemblies tested per DTP.5014.1.44.




Cobalt


Cobalt


All


Cobalt

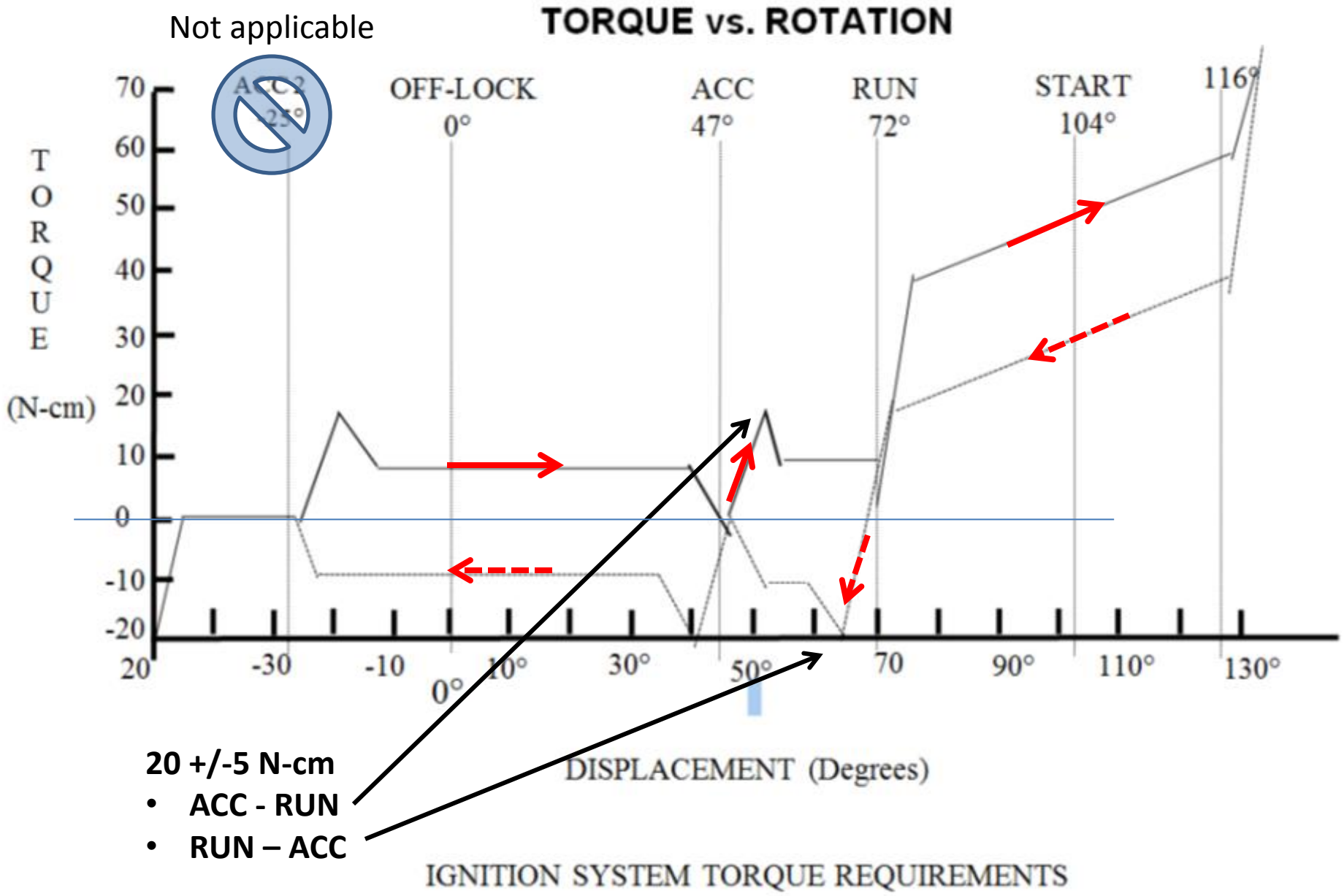

Saturn

Lower Column Shroud (Key Bump)

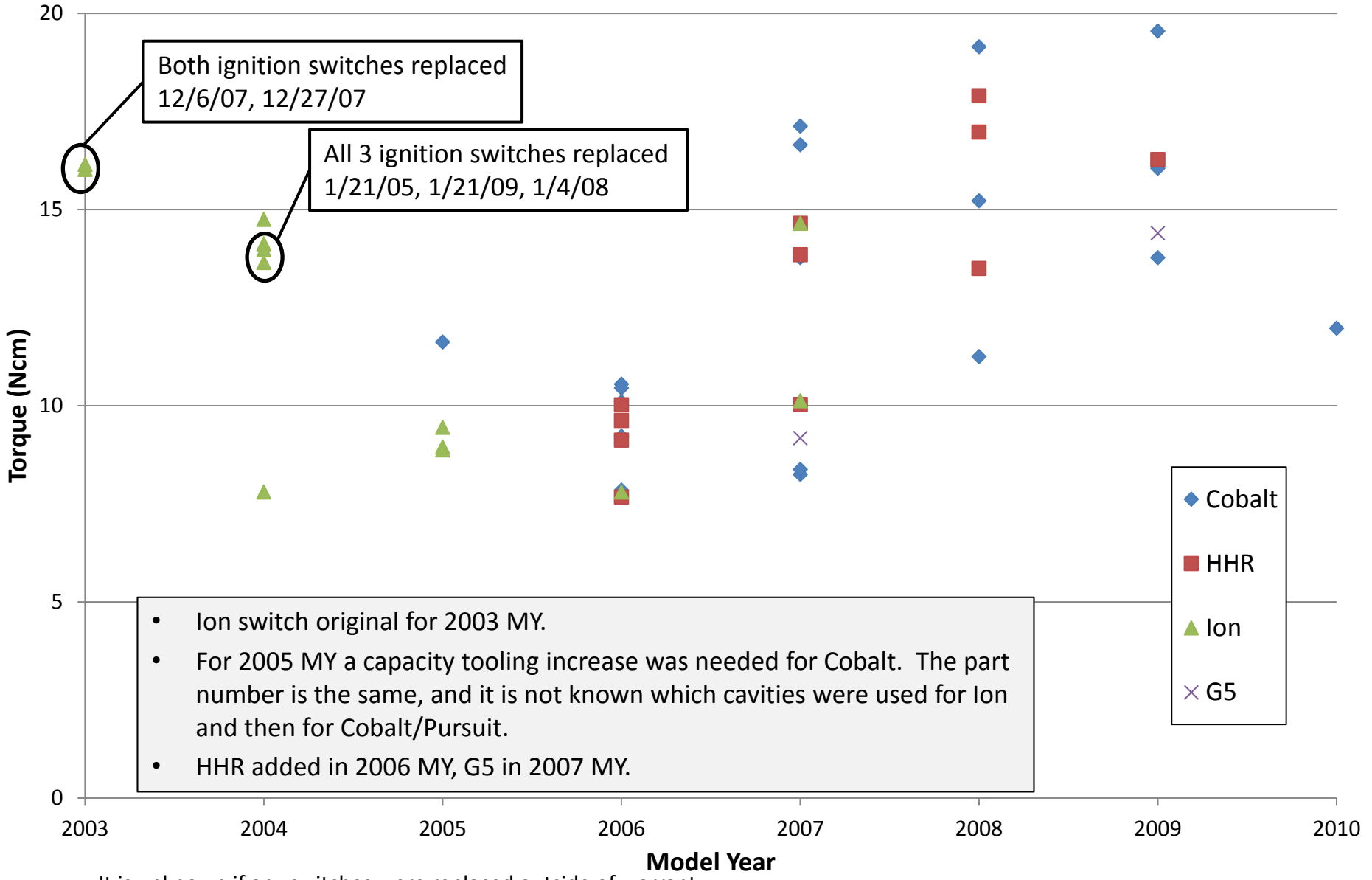
Cobalt

Traverse

Not applicable



Torque to Rotate From Run to Accessory



It is unknown if any switches were replaced outside of warranty

The Chevrolet Cobalt began production with the Saturn Ion ignition switch.
All model years Cobalt, Pursuit, G5, Ion and HHR have the same mechanical properties for the ignition switch.

Ignition Switch Position from SDM Download - Airbag Non-Deployment Incidents

2005-2007 Cobalt, Pursuit (Canada only) & 2007 G5[A]
- 13 Accessory
- 1 Off
- 8 Run
- 1 No Event (not recorded)

2008 – 2010 Cobalt, Pursuit, G5
- 0

2003-2006 Ion
- 2 Not available from SDM[B]

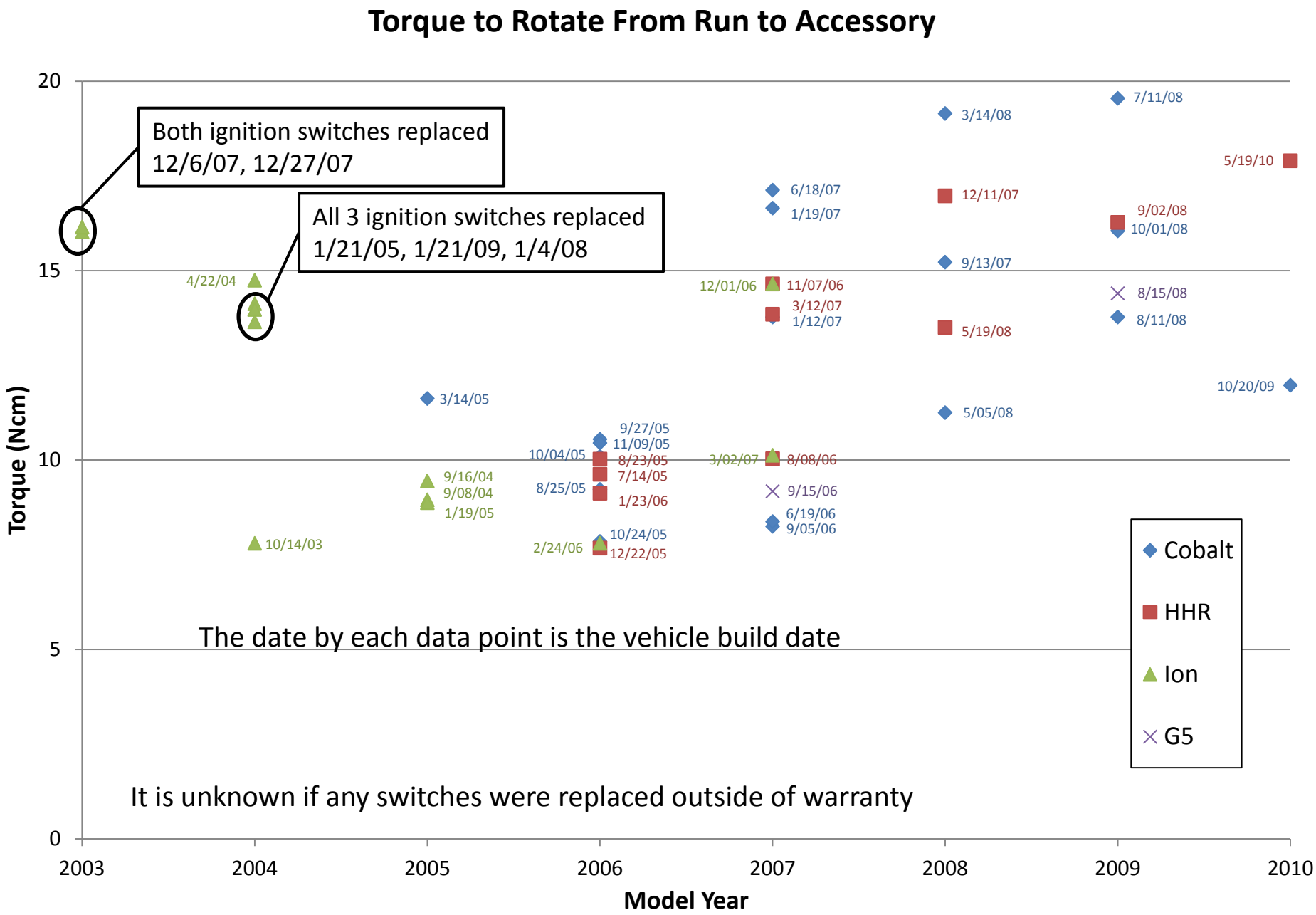
2006-2008 HHR
- 0

Cobalt versus Ion (2 Potential Incidents) & HHR (No Reports)

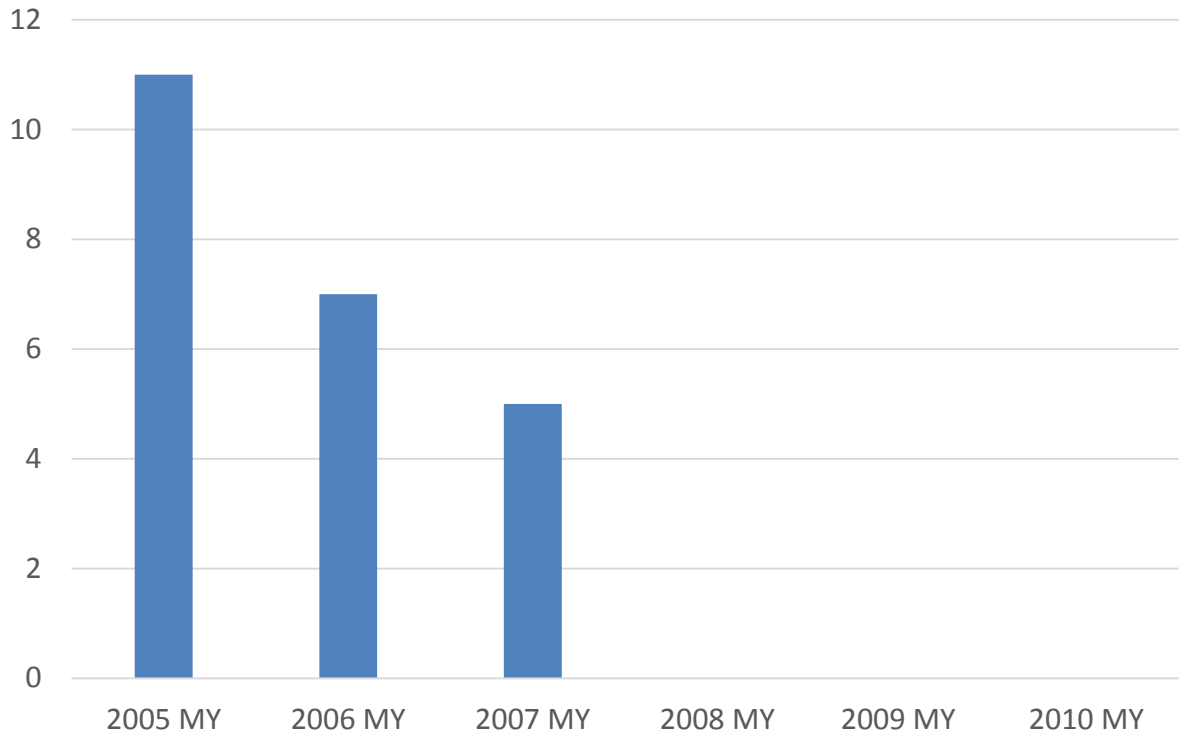
- Review indicates 2 potential non-deploys for Ion, but are not confirmed to be the same cause.
- Ion has different column shroud which could affect potential for key interaction
- HHR has more clearance to the driver's knee

[A] One G5 incident, all others are Cobalt.

[B] Ion uses Class 2 architecture which does not record in ACCESSORY. Cobalt, G5 & HHR use the GM LAN which records to the SDM even with ignition in ACCESSORY

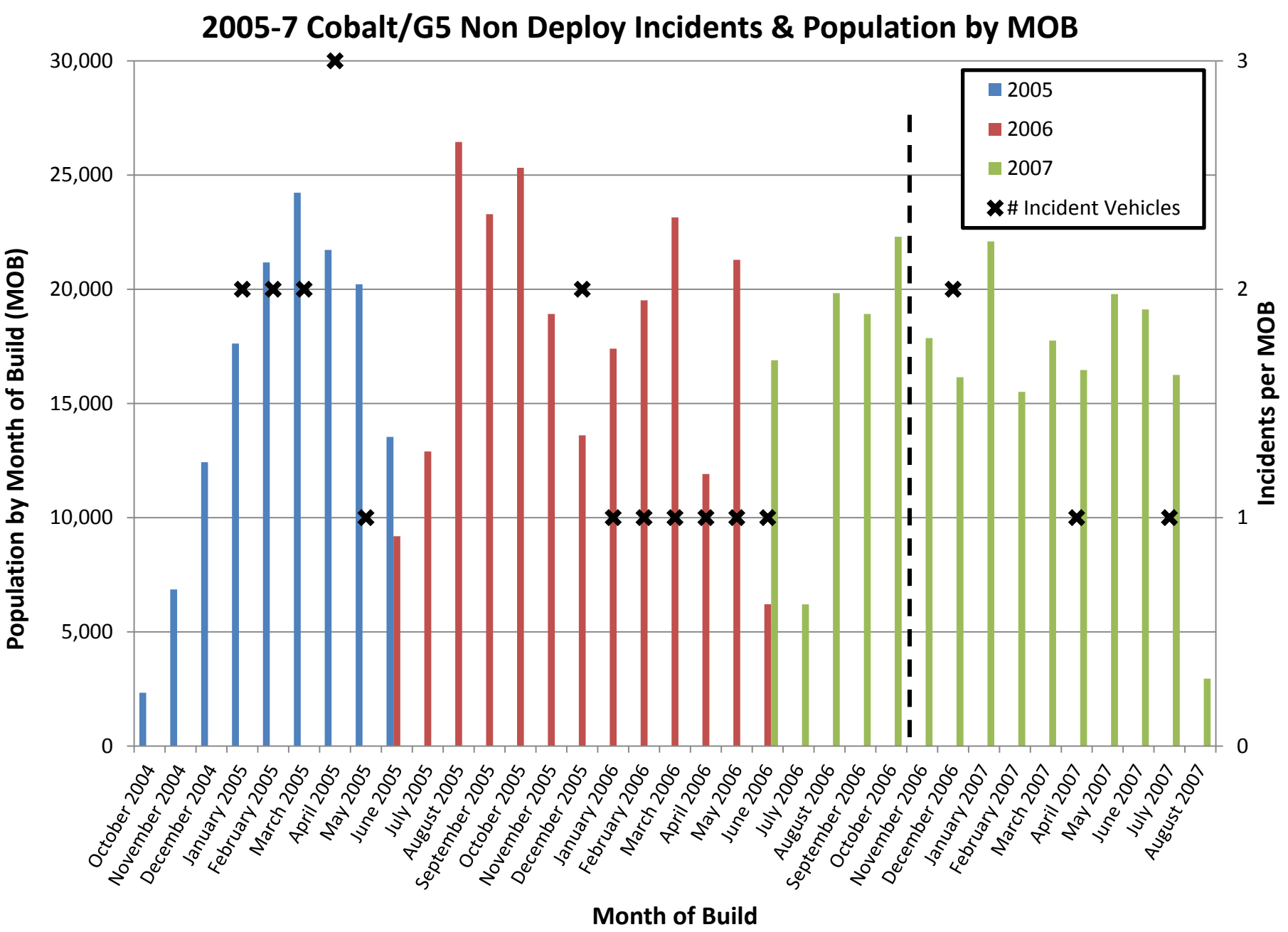

Torque to Rotate From Run to Accessory
Torque (Ncm)
Model Year
20
15
10
5
0
2003
2004
2005
2006
2007
2008
2009
2010
Both ignition switches replaced
12/6/07, 12/27/07
All 3 ignition switches replaced
1/21/05, 1/21/09, 1/4/08
4/22/04
10/14/03
3/14/05
9/16/04
9/08/04
1/19/05
10/04/05
9/27/05
11/09/05
8/23/05
7/14/05
8/25/05
1/23/06
2/24/06
10/24/05
12/22/05
12/01/06
11/07/06
3/12/07
1/12/07
6/18/07
1/19/07
3/02/07
8/08/06
9/15/06
6/19/06
9/05/06
3/14/08
12/11/07
9/13/07
5/19/08
5/05/08
7/11/08
9/02/08
10/01/08
8/15/08
8/11/08
5/19/10
10/20/09
The date by each data point is the vehicle build date
It is unknown if any switches were replaced outside of warranty
Cobalt
HHR
Ion
G5

Non-Deployment Allegations by Model Year
Cobalt (22), G5 (1)



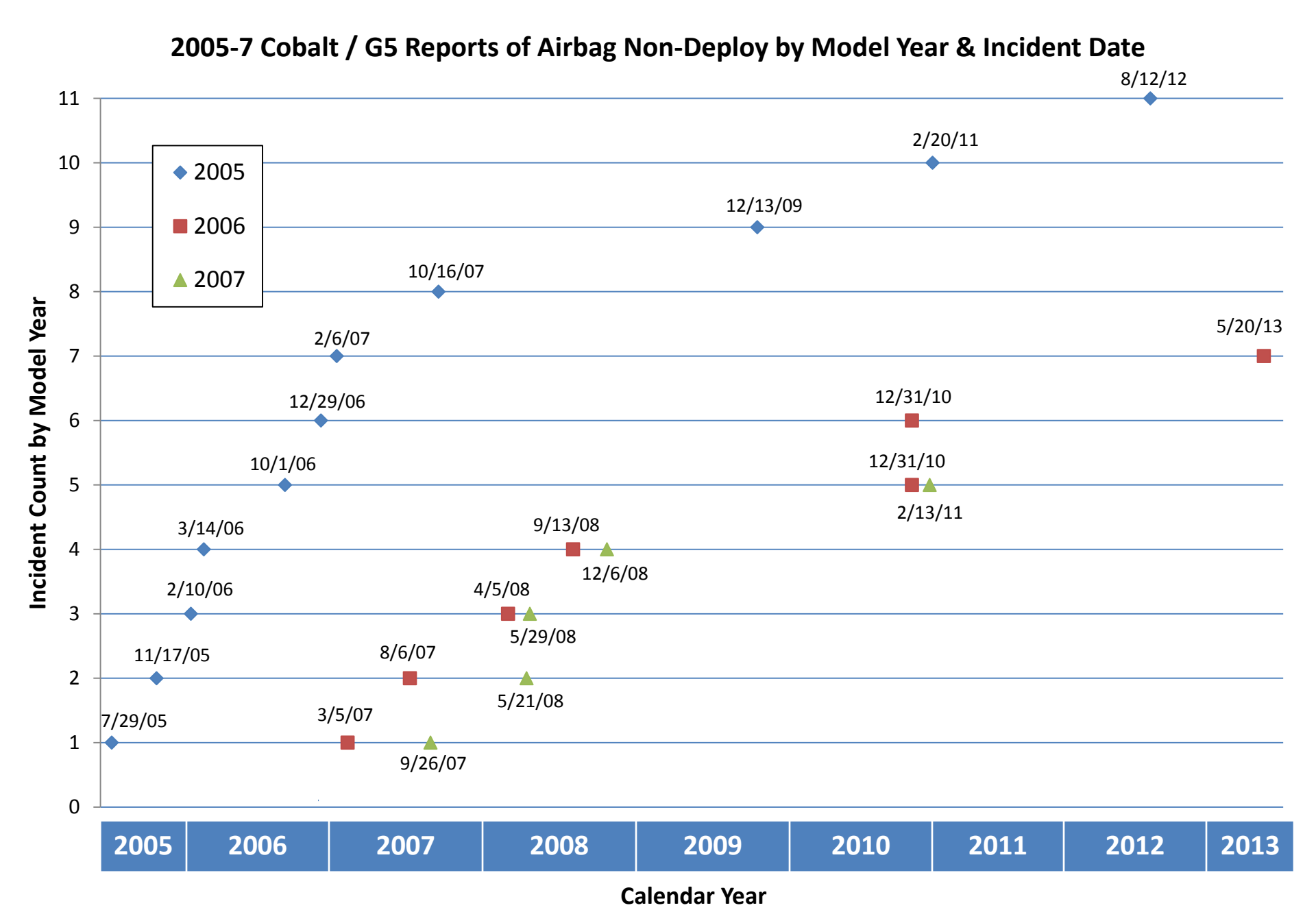
A revision to the switch occurred during the 2007 MY to increase the torque to rotate.

- The part number was not changed and the breakpoint is unconfirmed, but is believed to be in early November 2006.
- 4 of the allegations within the 2007 MY are after November 2006.

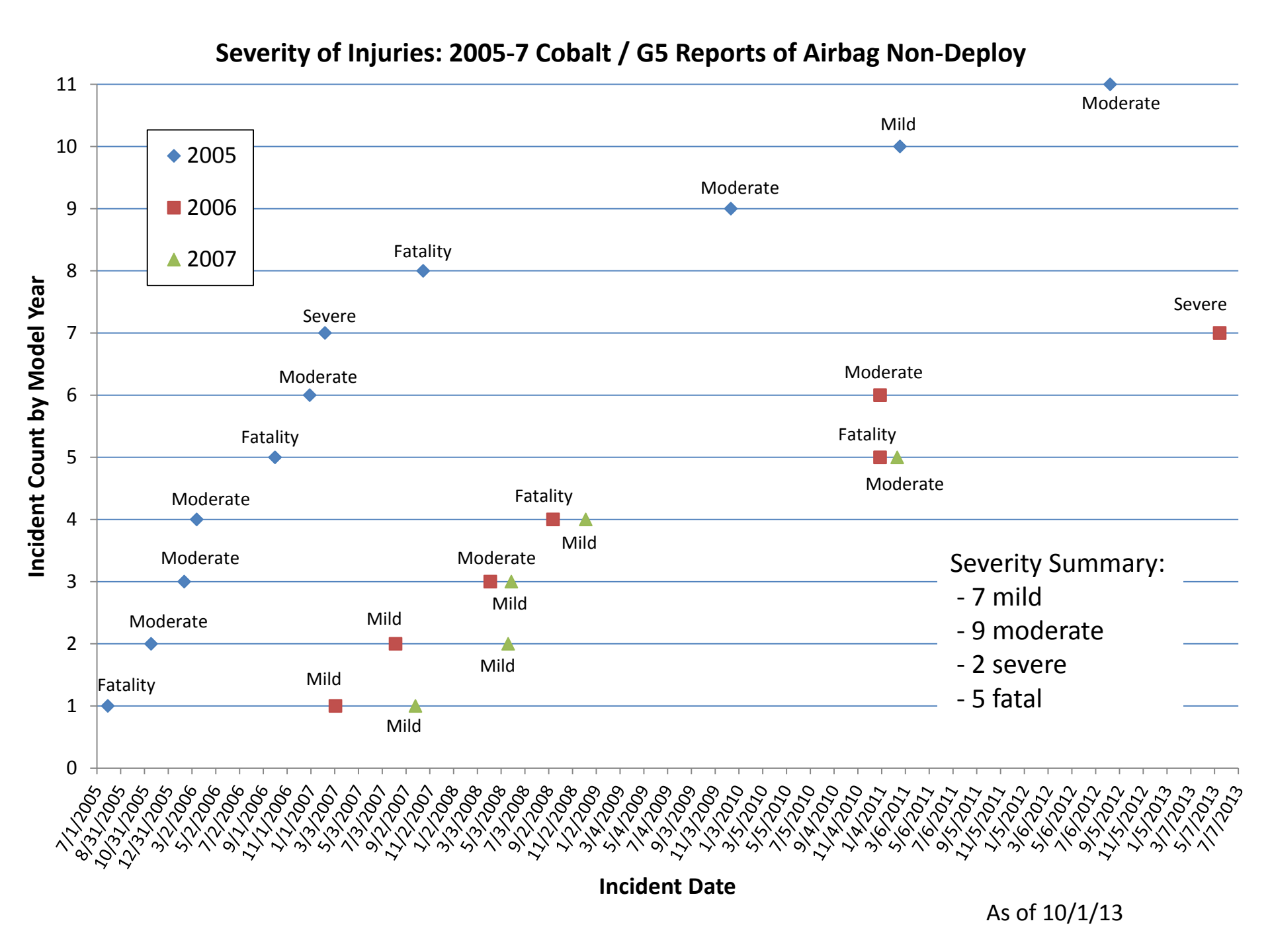


Build date not available for one 2005 vehicle

As of 10/1/13


2005-7 Cobalt / G5 Reports of Airbag Non-Deploy by Model Year & Incident Date
Incident Count by Model Year
0
1
2
3
4
5
6
7
8
9
10
11
2005
2006
2007
7/29/05
11/17/05
2/10/06
3/14/06
10/1/06
12/29/06
2/6/07
10/16/07
12/13/09
2/20/11
8/12/12
3/5/07
9/26/07
8/6/07
5/21/08
4/5/08
5/29/08
9/13/08
12/6/08
12/31/10
2/13/11
12/31/10
5/20/13
2005
2006
2007
2008
2009
2010
2011
2012
2013
Calendar Year

As of 10/1/13


Severity of Injuries: 2005-7 Cobalt / G5 Reports of Airbag Non-Deploy
Incident Count by Model Year
Incident Date
2005
2006
2007
Fatality
Moderate
Mild
Severe
Severity Summary:
- 7 mild
- 9 moderate
- 2 severe
- 5 fatal
As of 10/1/13

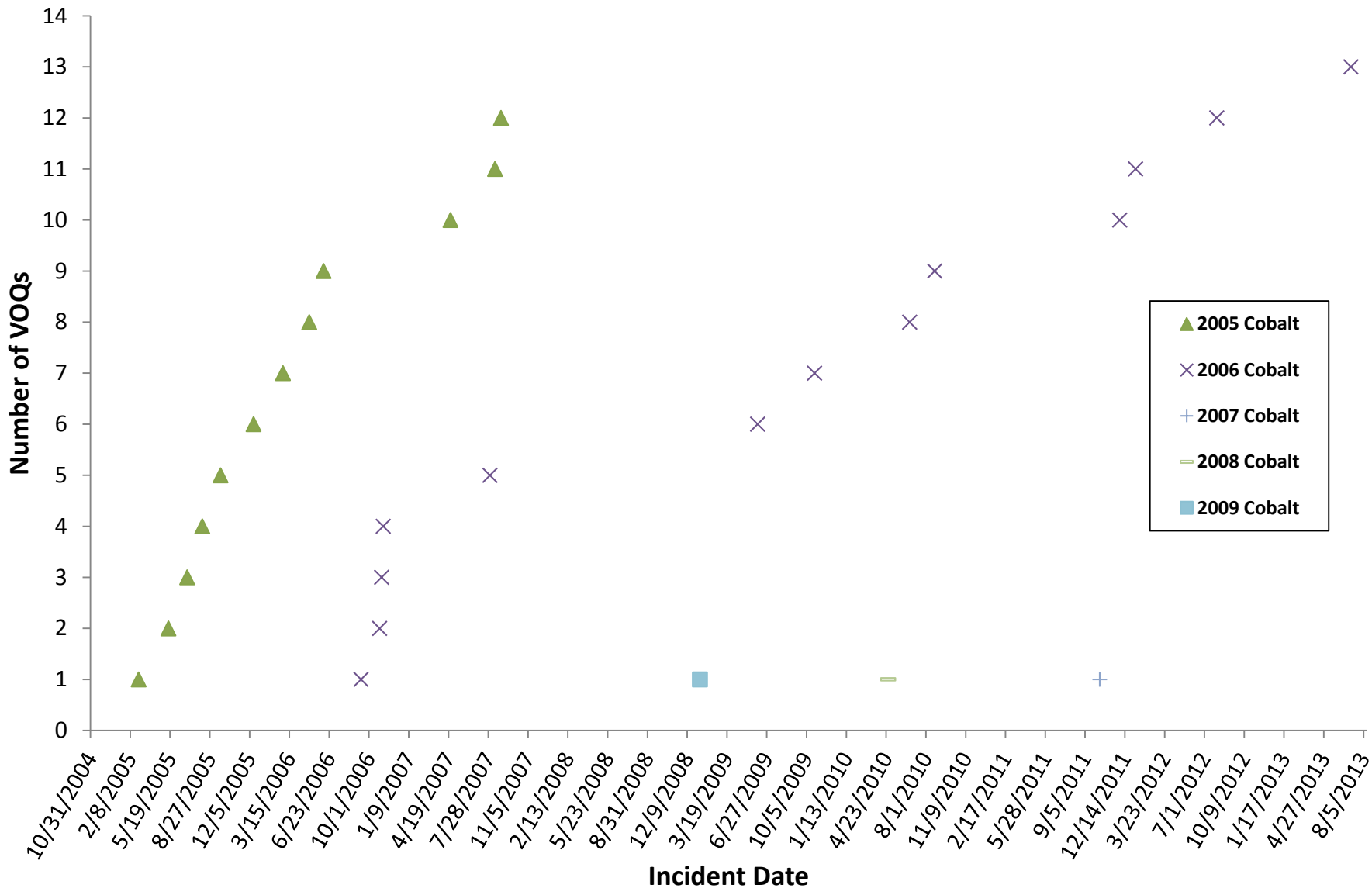
Reports - Potential Key Rotation – Cobalt, G5 and Pursuit

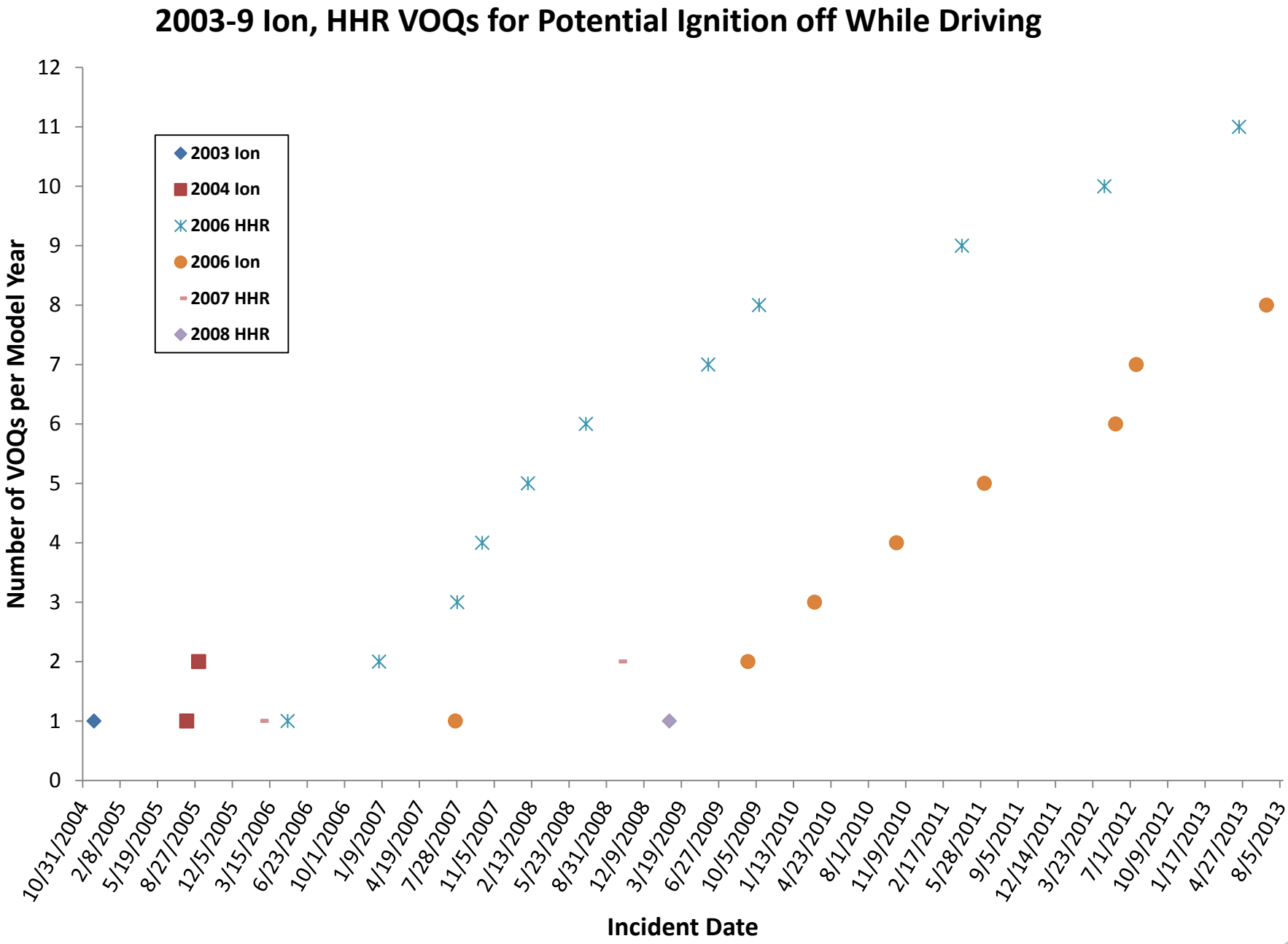
	2005	2006	2007	2008	2009	2010
Airbag Non-Deploy	11	7	5			
Stalling VOQs	12	13	1	1	1	
TREAD Search	56	43	10	1		
Key Insert (Svc. Bulletin)	169	71	6			
Total	**248**	**134**	**22**	**2**	**1**	**0**

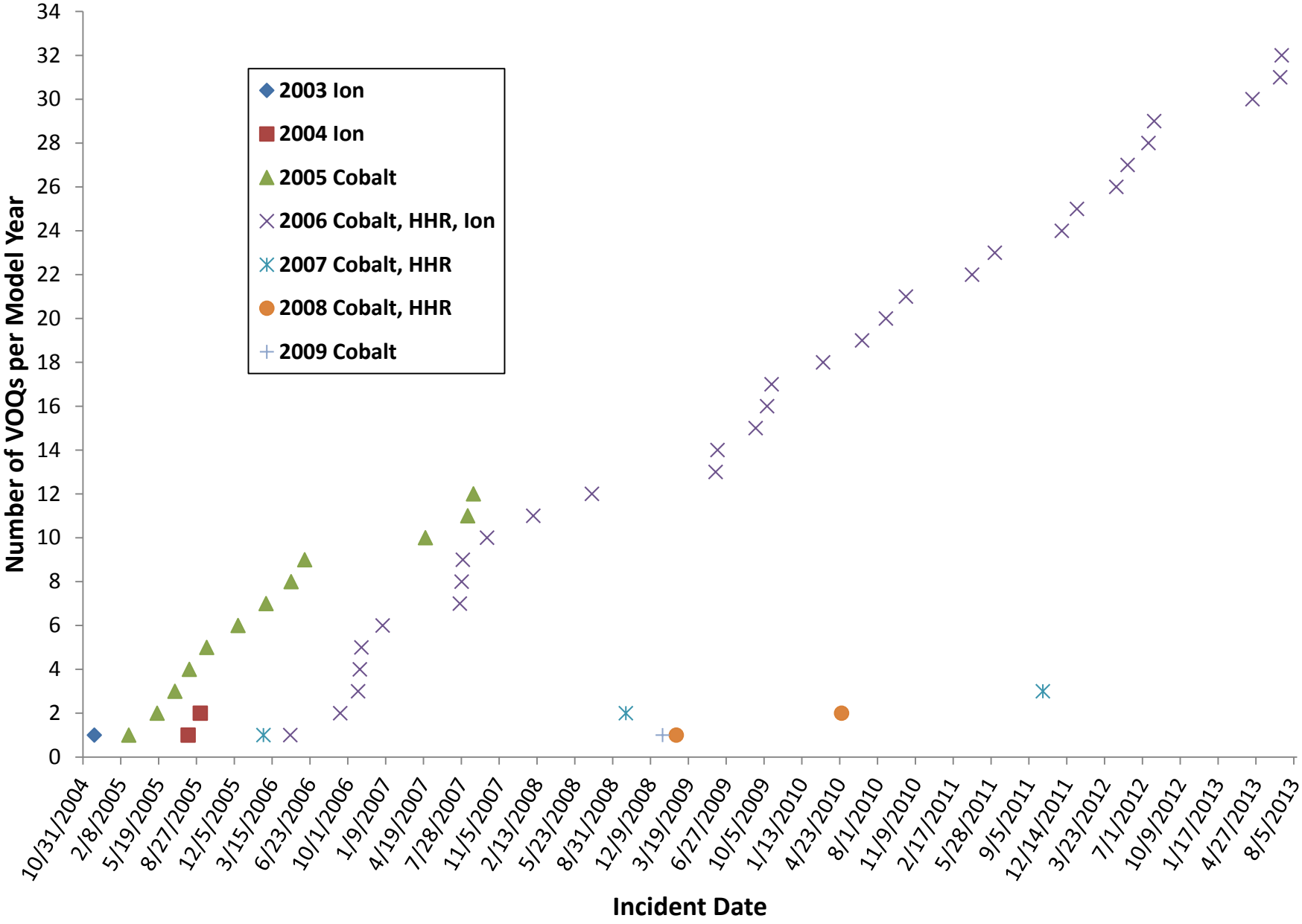
- 24 of the 407 total reports are G5 or Pursuit. All others are Cobalt.
- All airbag Non-Deployment reports included vehicles that had left the road surface.

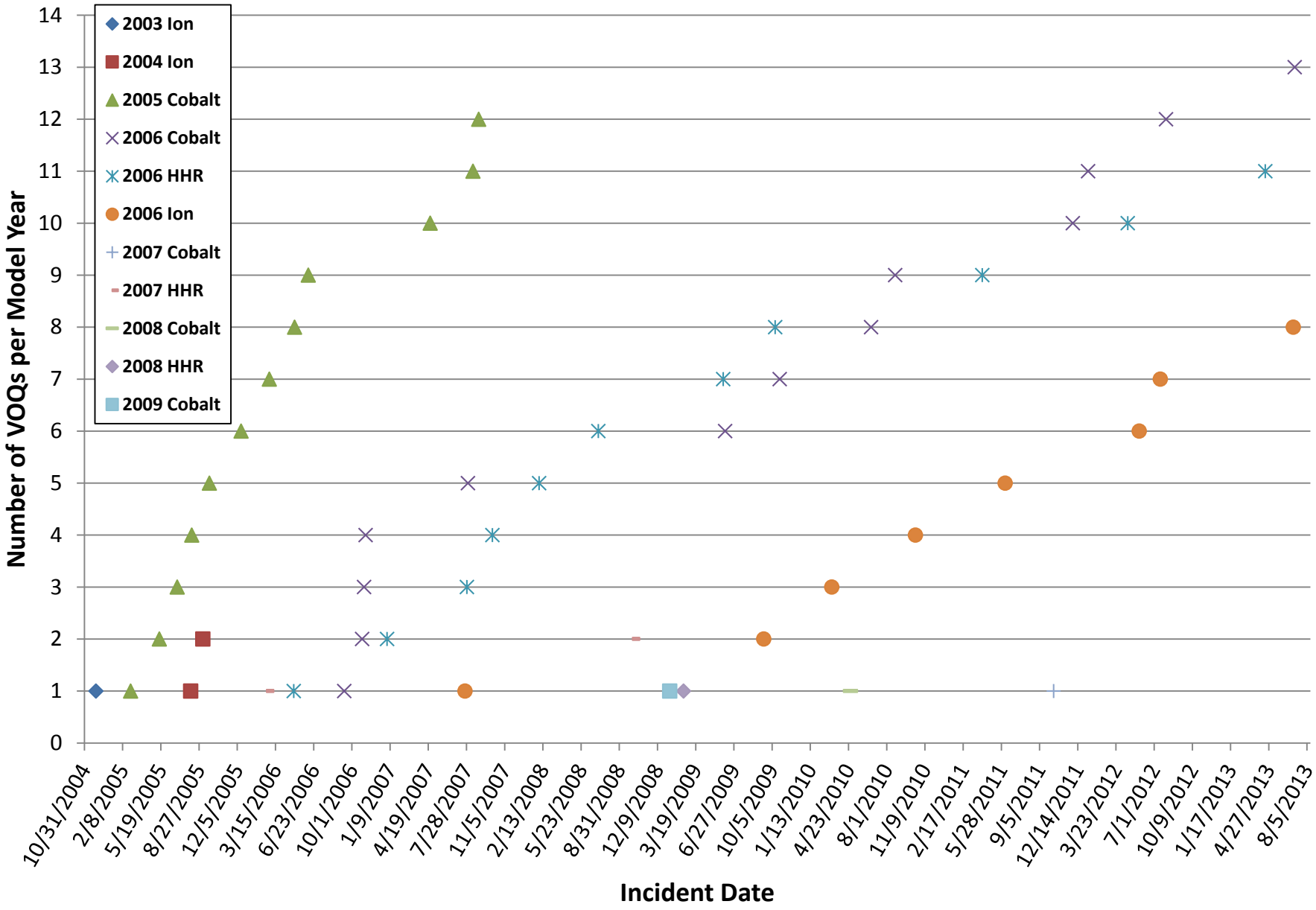
Normalized Report Rate

Model Year	Total Reports	U.S. Population	Reports / 100k Vehicles / Years Exposure
2005	**248**	**140,646**	**19.6**
2006	**134**	**229,231**	**7.4**
2007	**22**	**248,137**	**1.3**


2005-2009 Cobalt VOQs for Potential Ignition off While Driving
Number of VOQs
Incident Date
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
10/31/2004
2/8/2005
5/19/2005
8/27/2005
12/5/2005
3/15/2006
6/23/2006
10/1/2006
1/9/2007
4/19/2007
7/28/2007
11/5/2007
2/13/2008
5/23/2008
8/31/2008
12/9/2008
3/19/2009
6/27/2009
10/5/2009
1/13/2010
4/23/2010
8/1/2010
11/9/2010
2/17/2011
5/28/2011
9/5/2011
12/14/2011
3/23/2012
7/1/2012
10/9/2012
1/17/2013
4/27/2013
8/5/2013
2005 Cobalt
2006 Cobalt
2007 Cobalt
2008 Cobalt
2009 Cobalt


2003-9 Ion, HHR VOQs for Potential Ignition off While Driving
Number of VOQs per Model Year
Incident Date
2003 Ion
2004 Ion
2006 HHR
2006 Ion
2007 HHR
2008 HHR
0
1
2
3
4
5
6
7
8
9
10
11
12
10/31/2004
2/8/2005
5/19/2005
8/27/2005
12/5/2005
3/15/2006
6/23/2006
10/1/2006
1/9/2007
4/19/2007
7/28/2007
11/5/2007
2/13/2008
5/23/2008
8/31/2008
12/9/2008
3/19/2009
6/27/2009
10/5/2009
1/13/2010
4/23/2010
8/1/2010
11/9/2010
2/17/2011
5/28/2011
9/5/2011
12/14/2011
3/23/2012
7/1/2012
10/9/2012
1/17/2013
4/27/2013
8/5/2013


2003-9 Ion, Cobalt, HHR, VOQs for Potential Ignition off While Driving
Number of VOQs per Model Year
Incident Date
2003 Ion
2004 Ion
2005 Cobalt
2006 Cobalt, HHR, Ion
2007 Cobalt, HHR
2008 Cobalt, HHR
2009 Cobalt
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
10/31/2004
2/8/2005
5/19/2005
8/27/2005
12/5/2005
3/15/2006
6/23/2006
10/1/2006
1/9/2007
4/19/2007
7/28/2007
11/5/2007
2/13/2008
5/23/2008
8/31/2008
12/9/2008
3/19/2009
6/27/2009
10/5/2009
1/13/2010
4/23/2010
8/1/2010
11/9/2010
2/17/2011
5/28/2011
9/5/2011
12/14/2011
3/23/2012
7/1/2012
10/9/2012
1/17/2013
4/27/2013
8/5/2013


2003-9 Ion, Cobalt, HHR, VOQs for Potential Ignition off While Driving
Number of VOQs per Model Year
Incident Date
2003 Ion
2004 Ion
2005 Cobalt
2006 Cobalt
2006 HHR
2006 Ion
2007 Cobalt
2007 HHR
2008 Cobalt
2008 HHR
2009 Cobalt
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
10/31/2004
2/8/2005
5/19/2005
8/27/2005
12/5/2005
3/15/2006
6/23/2006
10/1/2006
1/9/2007
4/19/2007
7/28/2007
11/5/2007
2/13/2008
5/23/2008
8/31/2008
12/9/2008
3/19/2009
6/27/2009
10/5/2009
1/13/2010
4/23/2010
8/1/2010
11/9/2010
2/17/2011
5/28/2011
9/5/2011
12/14/2011
3/23/2012
7/1/2012
10/9/2012
1/17/2013
4/27/2013
8/5/2013

- Issued Nov 2005
- Reissued July 2011 to add the 2007 MY.

Document ID: 1869035

#05-02-35-007 Information on Inadvertent Turning of Key Cylinder, Loss of Electrical System and No DTCs -

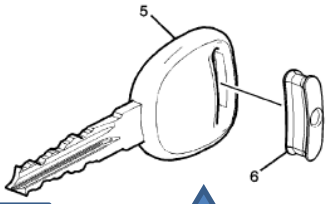
Subject: **Information on Inadvertent Turning of Key Cylinder, Loss of Electrical System and No DTCs**

This bulletin is being revised to add a model year. Please discard Corporate Bulletin Number 05-02-35-007 (Section 02 – Steering).

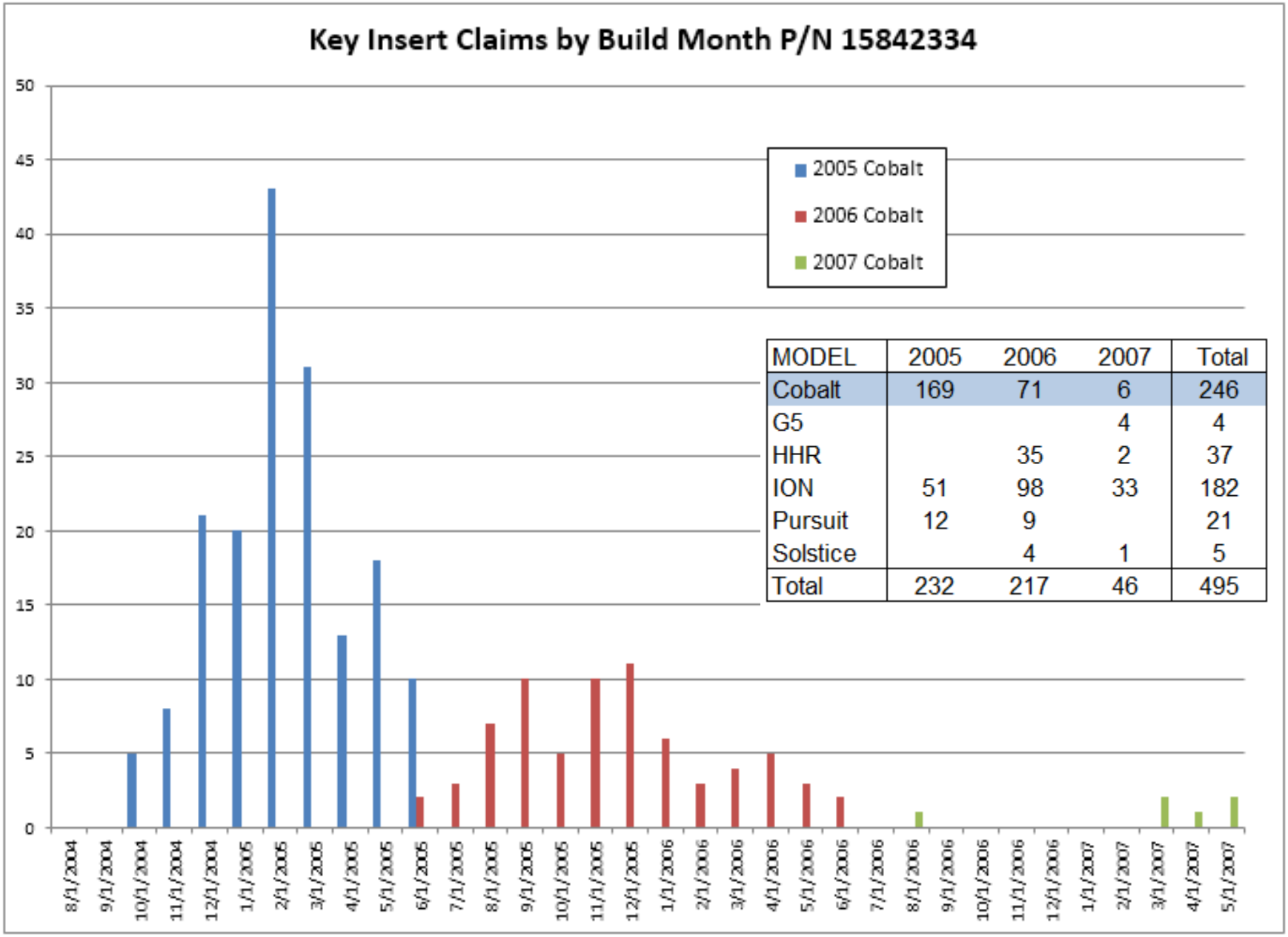
There is potential for the driver to inadvertently turn off the ignition due to low ignition key cylinder torque/effort.

The concern is more likely to occur if the driver is short and has a large and/or heavy key chain. In these cases, this condition was documented and the driver's knee would contact the key chain while the vehicle was turning and the steering column was adjusted all the way down. This is more likely to happen to a person who is short, as they will have the seat positioned closer to the steering column.

In cases that fit this profile, question the customer thoroughly to determine if this may the cause. The customer should be advised of this potential and should take steps to prevent it – such as removing unessential items from their key chain.



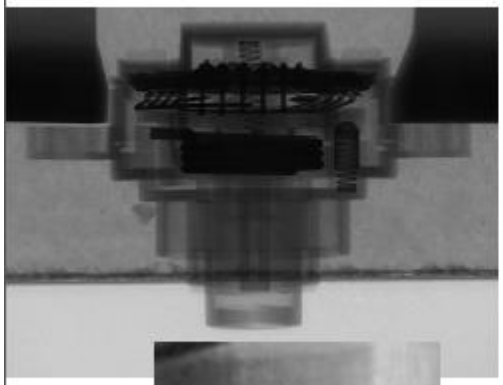
Engineering has come up with an insert for the key ring so that it goes from a "slot" design to a hole design. As a result, the key ring cannot move up and down in the slot any longer – it can only rotate on the hole. In addition, the previous key ring has been replaced with a smaller, 13 mm (0.5 in) design. This will result in the keys not hanging as low as in the past.

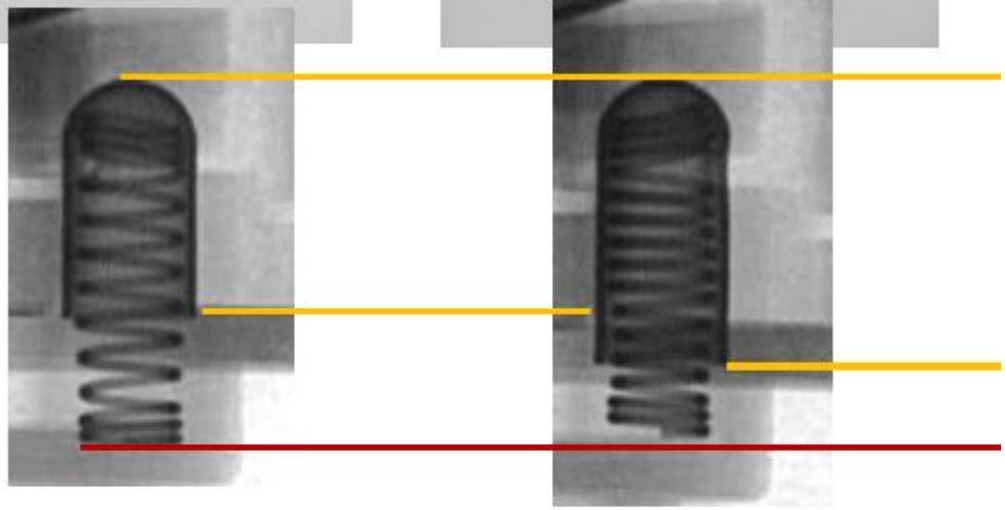


MODEL	2005	2006	2007	Total
Cobalt	169	71	6	246
G5			4	4
HHR		35	2	37
ION	51	98	33	182
Pursuit	12	9		21
Solstice		4	1	5
Total	232	217	46	495

Key
Slot vs. Hole
Cobalt

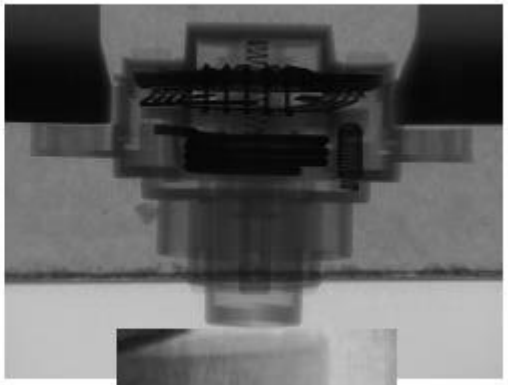
2005 Salvage Yard Cobalt





- 12 spring coils
- Run to Acc: -7.7 N-cm
- Cap is shorter than observed in MY 07+ and aftermarket switches

2008 Salvage Yard Cobalt



- 15 spring coils
- Run to Acc: -22.6 N-cm

- Ignition switch with increased effort passed validation 4/26/06.
- Part number not changed.
- Implementation date is unknown.

EDWARDO [redacted]

GENERAL MOTORS COMMODITY VALIDATION SIGN-OFF

Buyer's concurrence on the Seller's completion of validation shall not limit, impair, or otherwise modify Buyer's right to assert any legal or equitable remedy, or relieve Seller of its responsibility to provide conforming goods.

Part Name* GMX 357 Delta Ignition Switch | Part Number* 10392423 | Suffix/ Release Level* 001

Shown on Drawing No.* 10392423 / 22673957 | Engineering Design Record Change Level* N/A | Dated* 27AP04

Procuring Division* NAO | Application/Program* GMX 357 | Purchase Order No.*

GM Lead Engineer* Ray DeGiorgio | GM Validation Engineer*

SUPPLIER MANUFACTURING INFORMATION

Supplier Name* Delphi Mechatronic | DUNS Number* 812502961

Street Address* [redacted]

REASON FOR SUBMISSION*

[ ] Initial Submission [x] Resubmission due to Engineering Change(s) [ ] Resubmission to correct problems in initial submission

COMMODITY VALIDATION SIGN-OFF REQUIREMENTS*

Specified by Procuring Division in SOR or in separate written request. Page 2 lists more information about the required documentation.

1.	The Supplier has submitted the required proof of validation completion as specified in SOR Appendix G, Section 4 (i.e., GP-11 ADV or executive letter certifying that commodity is validated).	Yes	X	No		
2.	All issues that are the responsibility of the Supplier have been classified as "closed" and the resolution of each issue has been confirmed by successful validation. This includes those issues that were identified during development, design validation, or product validation, whether those issues are tracked by GM or by the Supplier.	Yes	x	No		
3.	All Corrective Action Plans (CAP) that are the responsibility of the Supplier have been classified as "closed."	Yes	x	No		
4.	The information in the Supplier's issue tracking system has been updated and is consistent with the final resolution of all supplier issues and CAPs.	Yes	x	No		
5.	The Supplier has completed its final ADV P&R (GM 1829-2) summarizing ADV execution status.	Yes	x	No		
6.	Supplier's ADV Plan(s) and all specified ADV activities have been completed, including activities required to resolve issues identified during development and validation.	Yes	x	No		
7.	Supplier has obtained GM approval of the detailed validation results for those requirements for which GM approval was specified in the "Other Validation Requirements" column of the Final VCRI.	Yes		No		Not required by SOR x
8.	Supplier evaluation reports have been completed for all regulatory requirements for which the Supplier conducted ADV activities to confirm compliance of the commodity.	Yes		No		Not required by SOR x
9.	Supplier evaluation reports have been completed for those non-regulatory requirements or procedures that were identified in SOR Appendix G, in the Final VCRI, or in writing by the program.	Yes		No		Not required by SOR x
10.	The Supplier has submitted the commodity models, etc. required for the Virtual Archive.	Yes		No		Not required by SOR x
11.	Other:	Yes		No		
12.	Other:	Yes		No		

Note that the during cycling, 1 amp was applied on the Delta Ignition Sw. This validation was submitted with New PCB correct timings adjusts as Customer required, also New detent plunger (Catera spring/Plunger) was implemented to Increase torque force in the switch.

Supplier Name (please print)* Eduardo Rodriguez | Title* Present Product Eng | Phone No.* [redacted]

Supplier Authorized Signature* [redacted] | Dated:* 4/24/06

GM DECISION:

Rejected (see comments below) [ ] Re-submit (see comments below) [ ] Sign-Off Complete [X]

GM Name (please print) Ray DeGiorgio | Phone No. [redacted]

GM Authorized Signature [redacted] | Code: C2E4 | Dated: APRIL 26, 2006

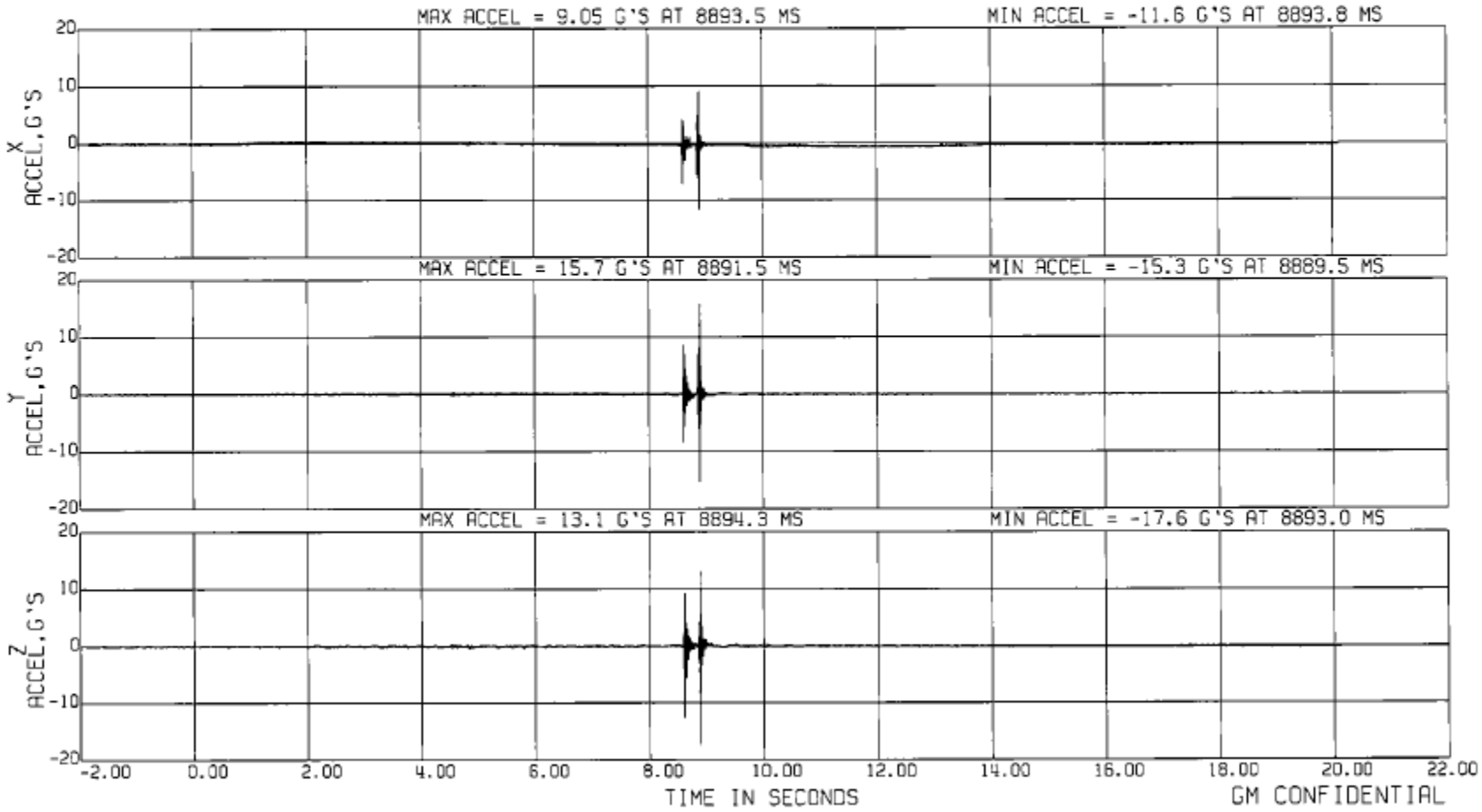
Note that the during cycling, 1 amp was applied on the Delta Ignition Sw. This validation was submitted with New PCB correct timings adjusts as Customer required, also New detent plunger (Catera spring/Plunger) was implemented to Increase torque force in the switch.

RAR1W9G LEFT #3 POTHOLE 25MPH

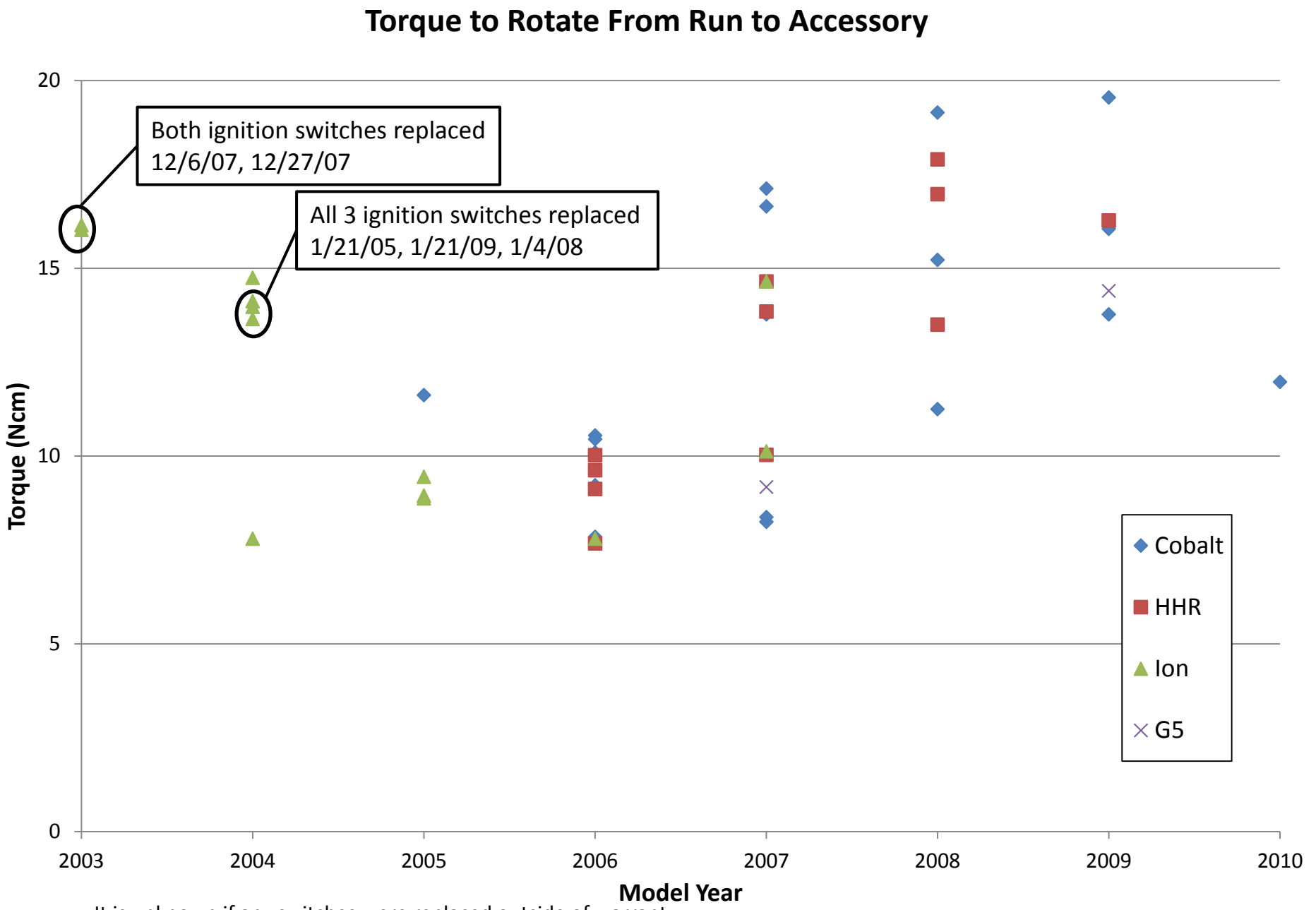
A1BL 6FAN4822 (18IN/32F/35R)
ELEC DATA, NO DIGITAL FILTER

SDM-30 TOP CASE #7 ACCEL.

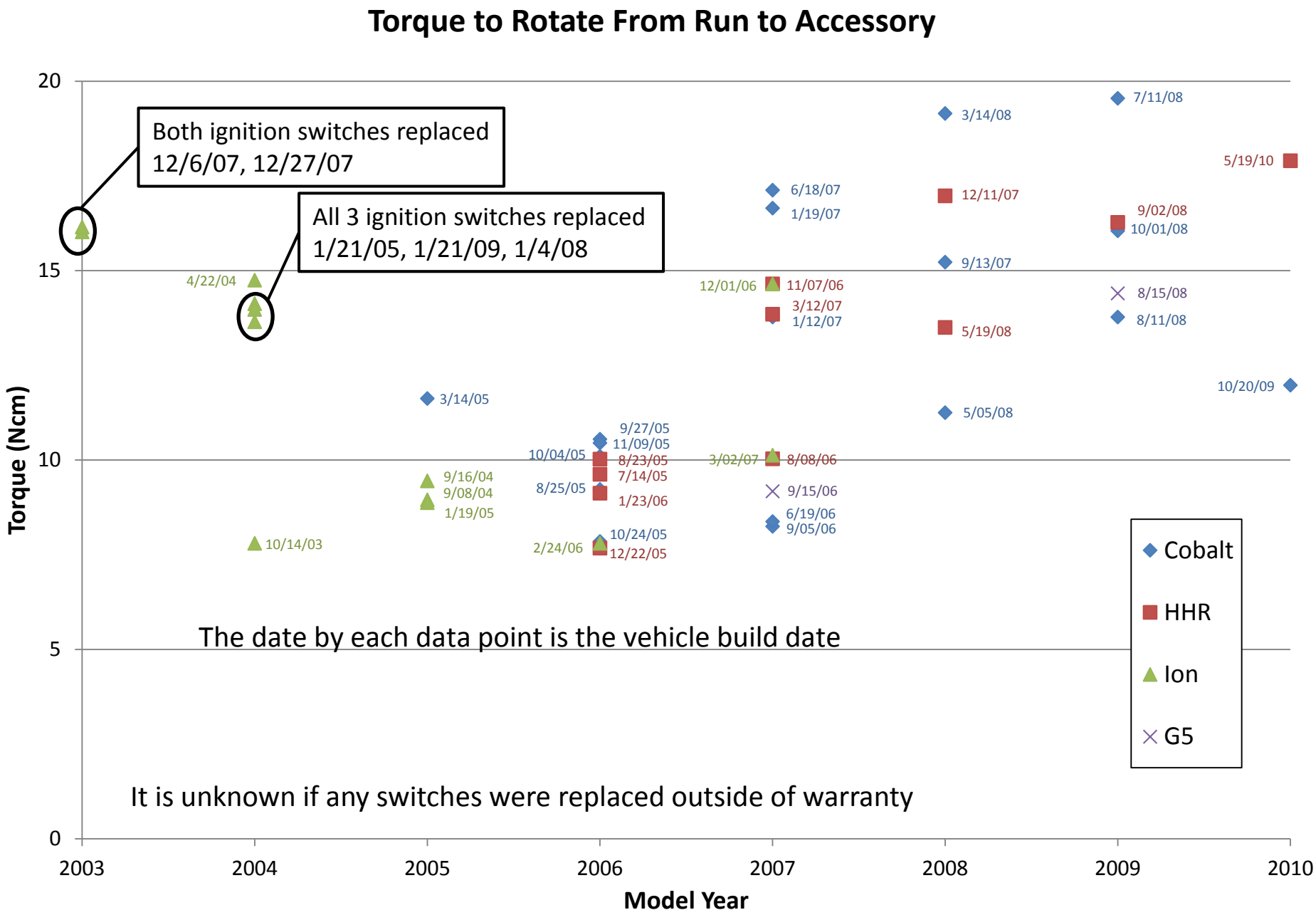
TEST DATE:10/03/2013



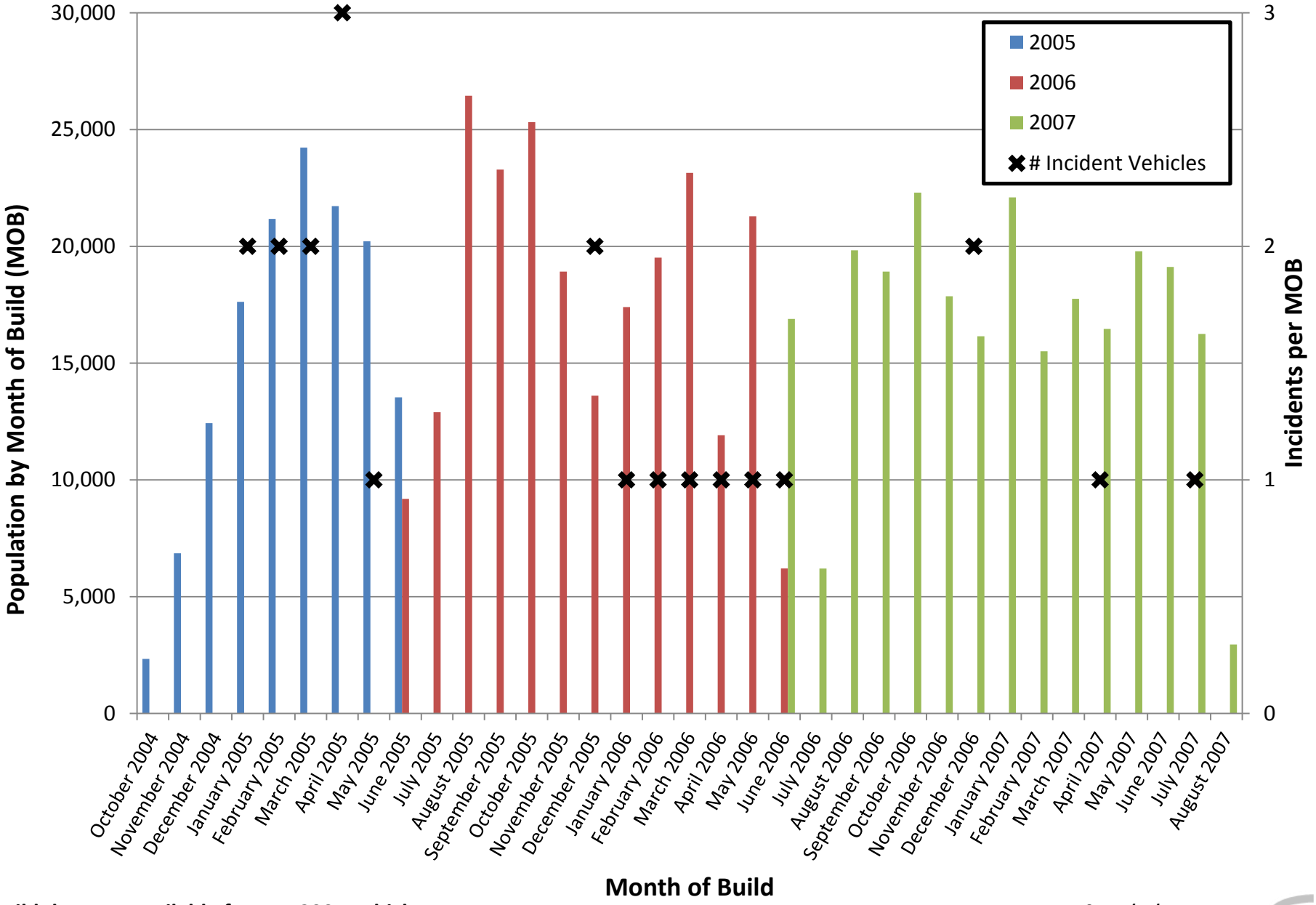
5 PROCESSED 10/24/2013 10:31 V2.22.1



It is unknown if any switches were replaced outside of warranty


Torque to Rotate From Run to Accessory
Torque (Ncm)
Model Year
20
15
10
5
0
2003
2004
2005
2006
2007
2008
2009
2010
Both ignition switches replaced
12/6/07, 12/27/07
All 3 ignition switches replaced
1/21/05, 1/21/09, 1/4/08
4/22/04
10/14/03
3/14/05
9/16/04
9/08/04
1/19/05
10/04/05
9/27/05
11/09/05
8/23/05
7/14/05
8/25/05
1/23/06
2/24/06
10/24/05
12/22/05
12/01/06
11/07/06
3/12/07
1/12/07
6/18/07
1/19/07
3/02/07
8/08/06
9/15/06
6/19/06
9/05/06
3/14/08
12/11/07
9/13/07
5/19/08
5/05/08
7/11/08
9/02/08
10/01/08
8/15/08
8/11/08
5/19/10
10/20/09
The date by each data point is the vehicle build date
It is unknown if any switches were replaced outside of warranty
Cobalt
HHR
Ion
G5

2005-7 Cobalt/G5 Non Deploy Incidents & Population by MOB



Build date not available for one 2005 vehicle

As of 10/1/13

Torque Gauge Measurements (Steering Columns from Salvage Yards)

Model Year	Model & VIN	P/N	Cap Size	Off to Acc (N-cm)	Acc to Run (N-cm)	Run to Start (N-cm)	Run to Acc (N-cm)	Acc to Off (N-cm)
2005	Cobalt VIN 1306	10392423	Short	2.8	7.4	50.9	-6.0	-6.7
2005	Cobalt VIN 2380	10392423	Short	3.2	7.8	48.0	-7.8	-8.1
2006	Cobalt VIN 7326	10392423	Short	2.1	7.8	50.9	-7.1	-8.1
2006	Cobalt VIN 6342	10392423	Short	2.1	8.5	50.9	-7.8	-8.5
2007	Cobalt VIN 9561	10392423	Long	3.5	19.8	50.9	-16.2	-16.2
2008	Cobalt VIN 4195	15886190	Long	5.3	19.8	48.0	-22.6	-22.6
2008	Cobalt VIN 0386	15886190	Long	4.9	17.0	48.0	-19.8	-22.6
2009	Cobalt VIN 3438	15886190	Long	3.2	19.8	53.7	-15.5	-15.9

Non-deploys due to Ignition Switch Rotation

2005-7 Cobalt, G5, Pursuit, 2003-2007 Ion, 2006-2007 HHR

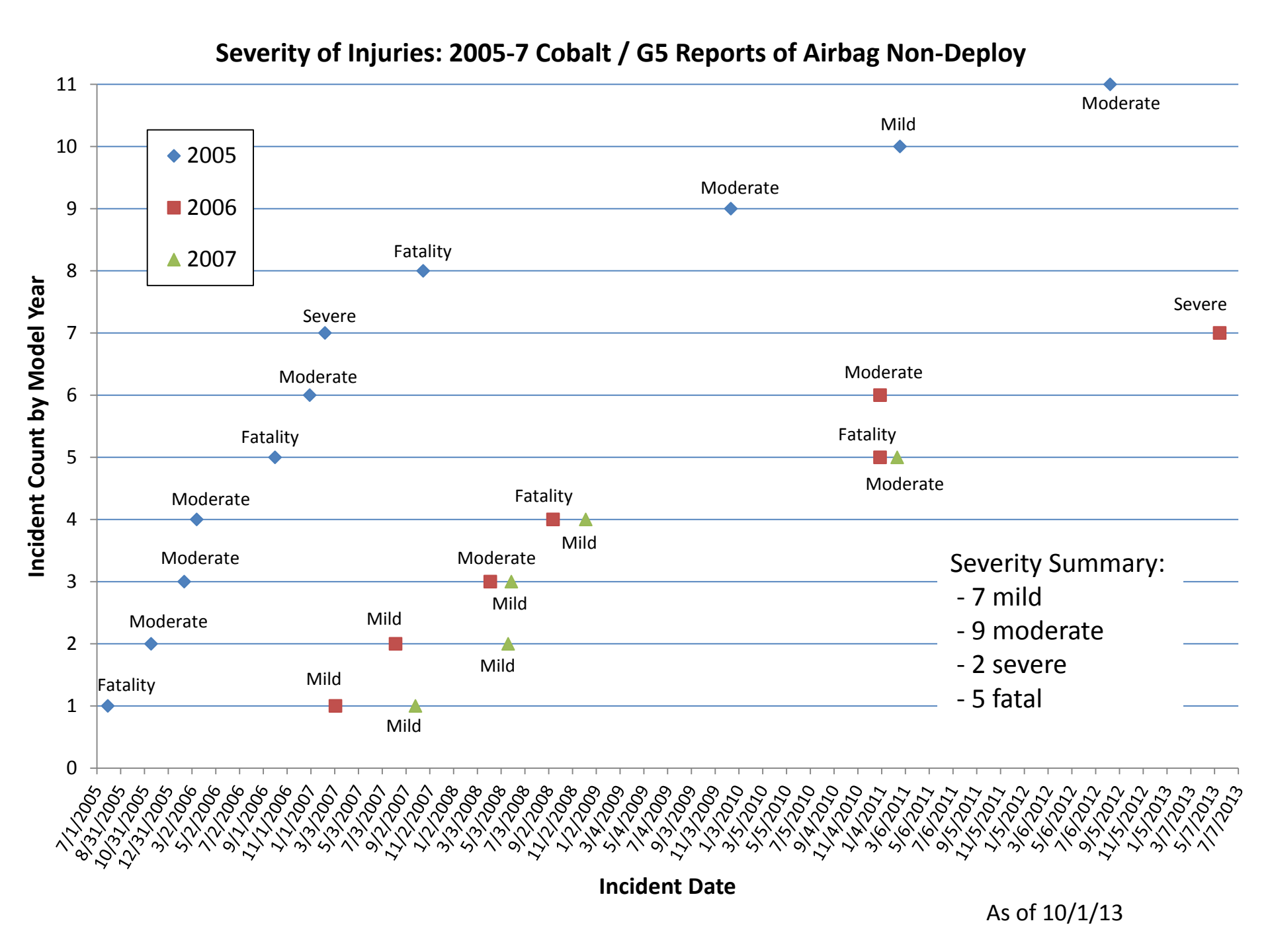
	Incident Reports	U.S. Population	IPHTV / Year Exposure
2005-2007 Cobalt	**23**	**618,014**	**0.47**
2005 Cobalt	11	140,646	0.89
2006 Cobalt	7	229,231	0.38
2007 Cobalt	5	248,137	0.29
2006-2007 HHR	**0**	**214,072**	**0**
2003-2007 Ion	**2[A]**	**478,986**	**0.04**

[A] Incidents can not be confirmed to be due to ignition switch rotation.

SDM Sensor Bounce Anomaly – Safety Recall - Decision June 2002 *(approx.. 2 yrs. Exposure)*

2000 GMT800 (Safety); 2000 S/T (No field action); 2000 M/L (No field action)

	Incident Reports	Population	IPHTV / Year Exposure
2000 GMT800	**9**	**572,108**	**0.70**
2000 S/T	**1**	**455,500**	**0.11**
2000 M/L	**0**	**96,328**	**0**


Severity of Injuries: 2005-7 Cobalt / G5 Reports of Airbag Non-Deploy
Incident Count by Model Year
Incident Date
2005
2006
2007
Fatality
Moderate
Mild
Severe
Severity Summary:
- 7 mild
- 9 moderate
- 2 severe
- 5 fatal
As of 10/1/13

Injury Severity Comparison

2000 GMT800 Sensor Bounce: 9 Total (3 mild, 3 moderate, 2 severe, 1 fatal)

Fatal	fatal
Skull & nose fracture, laceration right side of face & mouth. Whiplash. Lost consciousness. Wrist, knee, ankle, and foot injury. 6 days ICU	Severe
Belted - Significant head and chest & lower leg injury.	Severe
Fractured neck vertebrae	moderate
Fractured neck vertebrae. Fractured shoulder	moderate
Concussion, sore shoulder, and chest	moderate
No treatment. Claimed chest injury	mild
Head trauma, bruises - treated at hospital	mild
Broken nose	mild

2005-2007 Cobalt, G5, Pursuit: 23 Total (7 mild, 9 moderate, 2 severe, 5 fatal)

Fatality	Fatal
Fatality	Fatal
Driver & Front Passenger: Fatal	Fatal (2)
Fatality	Fatal
Fatality	Fatal
Traumatic Brain Injury	Severe
Quadriplegic	Severe
Bruising to left side of head, cuts to left knee and back P: Fractured ribs, shoulder blade, cuts, and bruises	Moderate
Unknown Injuries (D) P: Broken neck (w/o paralysis), fractured ribs, sternum, laceration to head, facial bruises	Moderate
Fractured ribs, nose, femur, and ankle	Moderate
Fractured vertebrae and severe ear laceration	Moderate
Kidney damage, left arm fracture, internal bleeding	Moderate
Lost teeth, several stiches in mouth, broken ankle, broken wrist	Moderate
Syncope, concussion, occipital laceration, multiple contusions, seizure disorder	Moderate
Fractured nose & scapula P:fractured leg	Moderate
Severe TBI, Basilar skull fracture, right hip fracture, right sacral fracture	Moderate
Facial FX including: R. Orbital floor, R. Maxillary Sinus, and Bilateral Nasal Bone. Facial laceration & concussion	Mild
Bruised chest area, Bruises on head	Mild
Fractured front teeth and multiple contusions	Mild
Laceration to liver, cut nose, bruised chest, bumps all over, sore left knee	Mild
Laceration to head with scarring	Mild
Facial Laceration and dislocated hip	Mild
Broken nose , broken cheekbone, bruised lung, pain in right elbow	Mild

Non-deploys due to Ignition Switch Rotation
2005-7 Cobalt, G5, Pursuit, 2003-2007 Ion, 2006-2007 HHR

	Incidents Per 100k Vehicles /Year Exposure		
	Cumulative	2005-2008	2009-2013
2005-2007 Cobalt	**0.47**	**0.86**	**0.20**
2005 Cobalt	0.89	1.42	0.45
2006 Cobalt	0.38	0.58	0.28
2007 Cobalt	0.29	0.81	0.09

SDM Sensor Bounce Anomaly – Decision June 2002 *(approx. 2 yrs. Exposure)*

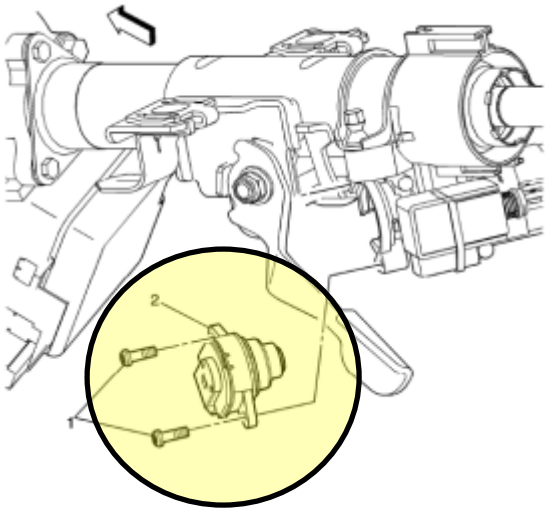
2000 GMT800 - Safety Recall

2000 S/T - No field action.

	Incident Reports	Population	IPTV / Year Exposure
2000 GMT800	**9**	**572,108**	**0.70**
2000 S/T	**1**	**455,500**	**0.11**
2000 M/L	**0**	**96,328**	**0**

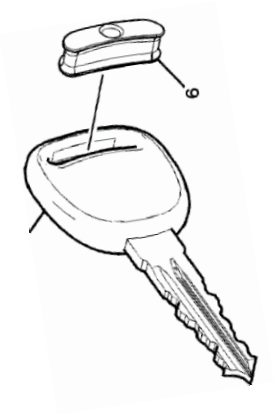
Cost Estimates (w/o Vehicle Attrition)

2005-2007 Cobalt, G5, Pursuit	Ignition Switch Replacement (Build Dates <11/1/06)	2 Key Inserts (all build dates)
778,563 vehicles	$41.3M	



Replace Switch

P/N 10392423



Add Insert

P/N 15842334

Vehicle scrap/survival rates are at approximately 91% for this population.

From: Brian Stouffer
Sent: Monday, December 02, 2013 8:14 PM
To: Greib, Gary R
Cc: John Murawa; Mark A Johnson
Subject: Request for PPAP & Quality Plan Data for Chevrolet Cobalt Ignition Switch P/N 10392423

The information you provided on the change to the Cobalt ignition switch plunger and spring has been very helpful.

Today, I gave an update to some of our directors regarding the status of the investigation into 2005-7 Cobalt frontal airbag non-deployments. I was asked to get the actual PPAP data and not just warrants for the switch in 2005 and then when the plunger and spring change was approved in April 2006 (Change Approval Longer Spring & Plunger 57128dat.doc). Specifically, the data for the switch torque testing is requested (see Ignition Switch Torque Requirements.pptx) attached.

In addition to the torque data for PPAP, any KPC data that was taken from the 2005 – 2008 model years is desired. Torque curves are the item of primary interest. Ultimately, any data taken to support the quality plan is desired.

I understand it may take a several days to gather the requested information. That is significant because my last day of work at GM is Wednesday December 4, 2013. I will be on vacation from that point on until my official retirement 2/1/14 (30 years). Another member of my group will be taking over this project. He is John Murawa. I've included him on this e-mail. His contact information is:

From: Greib, Gary R [redacted]
Sent: Tuesday, December 10, 2013 7:10 AM
To: John Murawa
Subject: FW: Request for Information Chevrolet Cobalt Ignition Switch P/N 10392423

John – See below and attached. There appears to be some torque testing data in the attached PPAP sign-off. If there are more specifics, please spell-out exactly what you are looking for and I will forward it on to the plant.

Gary R. Greib
Manager, Product Investigations / Patent Agent
Delphi Legal Staff
[redacted]

From: Cuervo, Antero
Sent: Monday, December 09, 2013 5:46 PM
To: Greib, Gary R
Cc: Lopez Martinez, Guadalupe; Miller, Lyle D; Villarreal, Mauricio
Subject: FW: Request for Information Chevrolet Cobalt Ignition Switch P/N 10392423

Gary, our PPAP coordinator found the following documentation. It is a newer warrant with some validation data attached. No data related to the original warrant was found.

March 17, 2006

GENERAL MOTORS
COMMODITY VALIDATION SIGN-OFF **

Pg. 1 of 2

Buyer's concurrence on the Seller's completion of validation shall not limit, impair, or otherwise modify Buyer's right to assert any legal or equitable remedy, or relieve Seller of its responsibility to provide conforming goods.

Part Name * GMX001/002 IGNITION SW		Part Number* 15886190 Rev 001	
Shown on Drawing No.* 15886190		Eng'g Design Record 001 Change Level*	Dated* March 17,2006
Procuring Division* NAO	Application Program* GMX001/002		Purchase Order No.* 1336 (JTEKT)
GM Lead Engineer* Raymond DeGiorgio		GM Validation Engineer* Eugene P Carnago	
Supplier Resident Engineer N/A			

SUPPLIER MANUFACTURING INFORMATION

Supplier Name* Delphi Mechatronic Systems DUNS Number* 812502961

Street Address* [redacted]

REASON FOR SUBMISSION*

☐ Initial Submission ☐ Re-submission due to Engineering Changes ☒ Re-submission to correct problems in initial submission

EWO #(s) WO 573558

COMMODITY VALIDATION SIGN-OFF REQUIREMENTS

Specified by Procuring Division in Appendix G2 (or G) and GMN3600 or in separate written request. Page 2 lists more information about the required documentation.	YES	NO	Not Req'd by SOR
1. Supplier has submitted the required 'Proof of Validation Letter' as specified in GMN3600 Section 5.1 and any required regulatory compliance documentation.	☒	☐	
2. The Supplier has completed execution of their ADV Plan(s) including activities to resolve issues identified during development and validation.	☒	☐	
3. All ADV issues that are the responsibility of the Supplier have been addressed and classified as 'closed'. This includes those Supplier commodity issues identified during development, design validation, or product validation, validation assurance testing and post-validation audits whether or not those issues are tracked by GM or by the Supplier.	☒	☐	
4. The information in the Supplier's issue tracking system has been updated and is consistent with the final resolution of all ADV issues.	☒	☐	
5. The Supplier has completed its final ADV PSR (GM1828) which indicates completion of validation to the technical requirements as specified in the Final Technical Specification, approved Engineering Work Order or in writing by GM.	☒	☐	
6. All other ADV tasks/deliverables specified in the SOR are complete.	☒	☐	
7. If applicable, all regulatory compliance evaluation reports and documentation have been completed and documents requested by GM have been submitted to the Validation Engineer.	☐	☐	☒
8. If applicable, the Supplier shall have obtained approval of the detailed validation results for those product technical requirements for which GM approval was specified in the 'Other Validation Requirements' column of the Final VGRL in SOR Appendix G2 (or G) or an approved Engineering Work Order.	☐	☐	☒
9. The Supplier has submitted to the GM CAE Engineer for the commodity the models required for the Virtual Archive Vehicle as specified in the SOR.	☐	☐	☒
10. Other: Validation for carry over program GMX001 with Resistor value of 1.3 kOhms. Controlling the amount of grease in the PCB assembly	☒	☐	☐

Explanation of 'NO' answers or comments here:

Supplier Name (please print)* Manny Gonzalez Title* Present Product En Phone No* [redacted]

Supplier Authorized Signature* [redacted] Dated* 05/02/07

GM DECISION: Rejected ☐ (see comments) Re-submit ☐ (see comments) Only Req'ts 1 & 5 met ☐ (see comments) Sign-Off ☐ Complete

GM Validation Engineer Name*(please print) [redacted] Phone* [redacted]

GM Validation Engineer Signature* Date* 3-17-06

GM Lead Engineer Name* (please print) [redacted] Phone*

GM Lead Engineer Signature* [redacted] Mail Station: 6204 Date* 5/3/07

Comments:

Analysis/Development/Validation Plan & Report (ADV P & R) —GM 1829

SECTION I — COMMODITY DESCRIPTION

PART #: [illegible]
PART NAME: [illegible] IGNITION SWITCH
CPC #:
REVISION DATE / LEVEL: [illegible]

MODEL YEAR: [illegible]
PLATFORM: [illegible]
MODEL #: [illegible]

SECTION II A — SUPPLIER INFORMATION

SUPPLIER NAME: DELPHI [illegible]
SUPPLIER CONTACT: [illegible]
SUPPLIER CONTACT PHONE NUMBER: [illegible]
SUPPLIER CONTACT E-MAIL ADDRESS: [illegible]

SECTION II B — GM CONTACT INFORMATION/APPROVAL

[illegible]: Ray De Giorgio
PHONE NUMBER: [illegible]

[redacted]

3 mar 07

[illegible]: Ray De Giorgio
PHONE NUMBER: [illegible]

DATE: [illegible]

SECTION III — ADV PLAN SUMMARY / **SEC IV — ADV REPORT**

ITEM #	PROCEDURE #	PROCEDURE TITLE	REQMT #	REQMT TITLE	REGULATORY	REQMT VALUE	RESPONSIBILITY	EVALUATION PHASE	EVALUATION METHOD	SAMPLE QTY	SAMPLE TYPE	TIMING START	TIMING COMPL	SAMPLES TESTED QTY	SAMPLES TESTED TYPE	SAMPLES TESTED STAGE	RESULTS	NOTES
1	12450250	COMPONENT TECHNICAL SPECIFICATION	3.2.1.3	Voltage Drop	USA	350 mV Max.	DELPHI	PVA	T	12	F	4/6/07	4/6/07	12	F	Prod.	Met Requirements	
2	12450250	COMPONENT TECHNICAL SPECIFICATION	3.2.1.5	Open Circuit Resistance	USA	20 Mohm Min.	DELPHI	PVA	T	12	F	4/6/07	4/6/07	12	F	Prod.	Met Requirements	
3	12450250	COMPONENT TECHNICAL SPECIFICATION	3.2.1.6	Isolation Resistance	USA	20 Mohm Min.	DELPHI	PVA	T	12	F	4/6/07	4/6/07	12	F	Prod.	Met Requirements	
4	12450250	COMPONENT TECHNICAL SPECIFICATION	3.2.2.3	Tactile Characteristics (Torque-Angle)	USA	Actuation Torque All in [illegible] Displacement (As per Drawing)	DELPHI	PVA	T	12	F	4/6/07	4/6/07	12	F	Prod.	Did not meet requirements OK 5/3/07	[illegible] exhibited issues as follows: Travel ACC MAKE (Limits: -45.000 degrees to -39.000 degrees). DUT #2 = -45.307 degrees. DUT #3 = -45.629 degrees. DUT #5 = -45.629 degrees. DUT #7 = -45.439 degrees. DUT #8 = -45.358 degrees. DUT #9 = -46.274 degrees. DUT #11 = -49.287 degrees & DUT #12 = -45.885 degrees. Travel: RUN CRANK MAKE (Limits: -11.000 degrees to -9.000 degrees). DUT #2 = -11.645 degrees. DUT #3 = -11.023 degrees. DUT #6 = -11.864 degrees. DUT #7 = -11.835 degrees. DUT #8 = -11.499 degrees. DUT #9 = -12.290 degrees. DUT #11 = -11.484 degrees & DUT #12 = -11.715 degrees. Travel: KEY IN BREAK (-38.000 degrees to -32.000 degrees). DUT #8 = -38.180 degrees. Travel: OCR MAKE (-17.000 degrees to -11.000 degrees). DUT #1 = -17.343 degrees. DUT #2 = -18.125 degrees. DUT #3 = -16.778 degrees. DUT #4 = -17.296 degrees.

Evaluation approved
Tactile characteristics
[signature] 3 mar 07

2005-7 Cobalt, G5, Pursuit, 2003-2007 Ion, 2006-2007 HHR

Condition:

A review of selected Cobalt & G5 frontal crash events indicates some airbag non deploys have occurred where the ignition switch was in accessory or off. The condition appears to be limited to 2005-07 Cobalt & G5 vehicles. The noted field events involve vehicles going off the road and/or hitting smaller objects shortly before a more significant impact.

Questions:

- Why no incidents on Ion or HHR
  - Ion is Class 2 architecture vs GM LAN on Cobalt and HHR
    - Both disable SDM with key off, but Cobalt/HHR will store ignition state & crash record while Ion will not
    - NISM review indicates 2 potential non-deploys for Ion
  - Ion has different column shroud which could affect potential for key interaction
  - Ion customers may be less likely to have the type of crash needed for the condition
  - Ion has different SDM and supplier than Cobalt
  - HHR has more clearance to the driver's knee
- Why no incidents on 2008-10 Cobalt?
  - Ignition switch was revised to have longer plunger and spring to increase effort (confirmed 10/29/13)
    - Part number <u>not</u> changed, so implementation date is unknown (Validation complete 4/26/06). Salvage yard samples included 2007 vehicles with longer plunger (unknown if any had been replaced in service).

Root Cause:

- The hypothesis is that during the off road event the driver's knee is interacting with the keys and/or the mass of the keys is causing the ignition to rotate

Vehicle Population & Incident Rate 2005-2007

Vehicles Sold in US

	2005	2006	2007
Cobalt/G5# Pursuit	140,464	229,231	248,137
Incidents	11	7	5
IPTV/Yrs Exposure	0.0089	0.0039	0.0030
SOP – 1/1/09	8	4	4
IPTV/Yrs Exposure	0.0142	0.0058	0.0081
1/1/09-10/1/13	3	3	1
IPTV/Yrs Exposure	**0.0045**	**0.0028**	**0.00085**

- 2000 GMT800 0.0070 IPTV/yr (approx 2 yrs exposure @ decision June 2002)
- 2000 S/T truck 0.0011 IPTV/yr no field action
  - SDM anomaly may result in no-deploy

Vehicle Population & Incident Rate 2005-2007 Cobalt & G5

Vehicles Sold in US

	2005	2006	2007#
Cobalt/G5# Pursuit	140,464	229,231	248,137
Incidents*	11	7	5
IPTV/Yrs Exposure	0.0089	0.0039	0.0030

(as of 10/1/13)

Incident rate for 2005 is over 2 times higher than 2006 and about 3 times higher than 2007

Combined IPTV/Yrs Exposure 0.0053

*Except for 1 2007 G5, all reports are Cobalt. There is 1 incident reported on a 2008 vehicle. 2008 vehicle had front sensor fault that disabled system prior to crash.

G5 was 2007 start.

Cobalt, Ion & HHR Ignition Switch Measurement

- 5/22/12 44 vehicles in Davison salvage yard
  - Measured torque (Ncm) and force (N) to turn the ignition switch from Run to Accessory.
    - Five of the vehicles had a replacement key, or a key with a hole vs slot (force not measured)

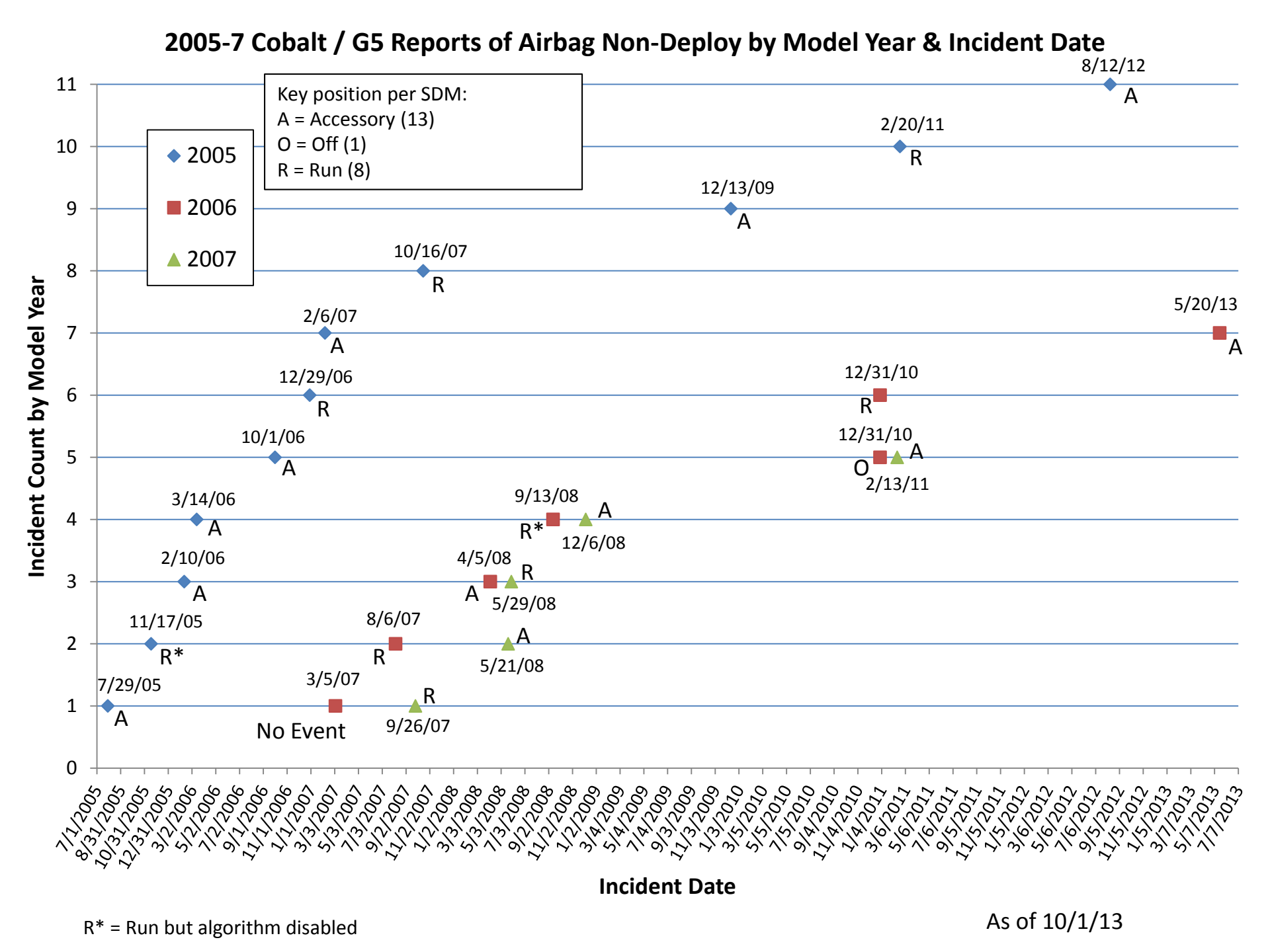
	Model Year								
Model	2003	2004	2005	2006	2007	2008	2009	2010	Grand Total
Cobalt			1	5	5	3	3	1	18
G5					1		1		2
HHR				4	3	2	1	1	11
Ion	2	5	3	1	2				13
Grand Total	2	5	4	10	11	5	5	2	44

Switch Background

- Ion switch original for 2003. For 2005 capacity tooling was needed for Cobalt. The part number is the same, so it is not known what cavities were used for Ion and then for Cobalt. HHR added in 2006
  - A change was initiated in 2006 to implement a new printed circuit board (12861211 Rev 5) and a new detent plunger (741-79378). The taller plunger and spring with more coils completed validation testing 4/24/06. The switch p/n was not changed, so it is unknown when switches with the new content were put into production or service.*

**The change to the plunger and spring was not confirmed until Delphi provided details with that information on 10/29/13*

2003 Ion vs 2007 Cobalt


2005-7 Cobalt / G5 Reports of Airbag Non-Deploy by Model Year & Incident Date
Key position per SDM:
A = Accessory (13)
O = Off (1)
R = Run (8)
2005
2006
2007
Incident Count by Model Year
Incident Date
0
1
2
3
4
5
6
7
8
9
10
11
7/29/05 A
11/17/05 R*
2/10/06 A
3/14/06 A
10/1/06 A
12/29/06 R
2/6/07 A
10/16/07 R
12/13/09 A
2/20/11 R
8/12/12 A
3/5/07 No Event
8/6/07 R
9/26/07 R
4/5/08 A
5/29/08 R
5/21/08 A
9/13/08 R*
12/6/08 A
12/31/10 R
12/31/10 O
2/13/11 A
5/20/13 A
7/1/2005
8/31/2005
10/31/2005
12/31/2005
3/2/2006
5/2/2006
7/2/2006
9/1/2006
11/1/2006
1/1/2007
3/3/2007
5/3/2007
7/3/2007
9/2/2007
11/2/2007
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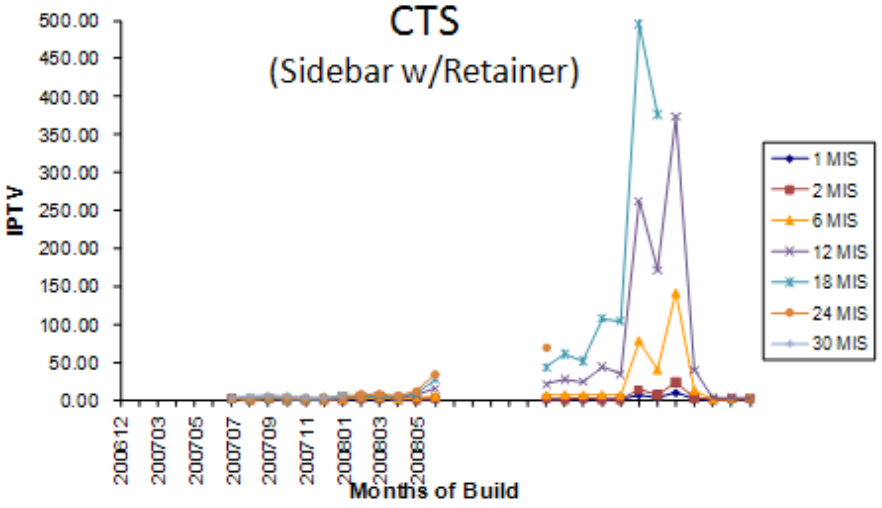
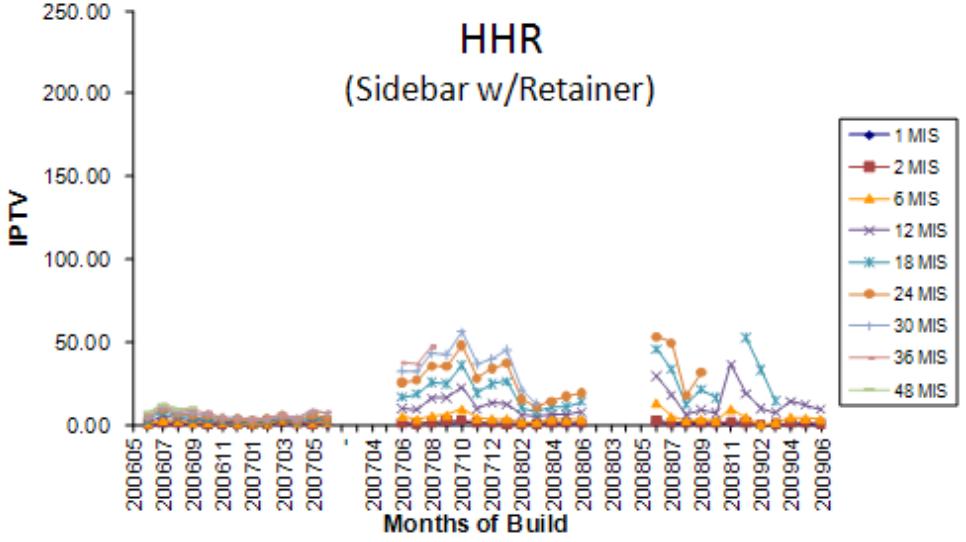
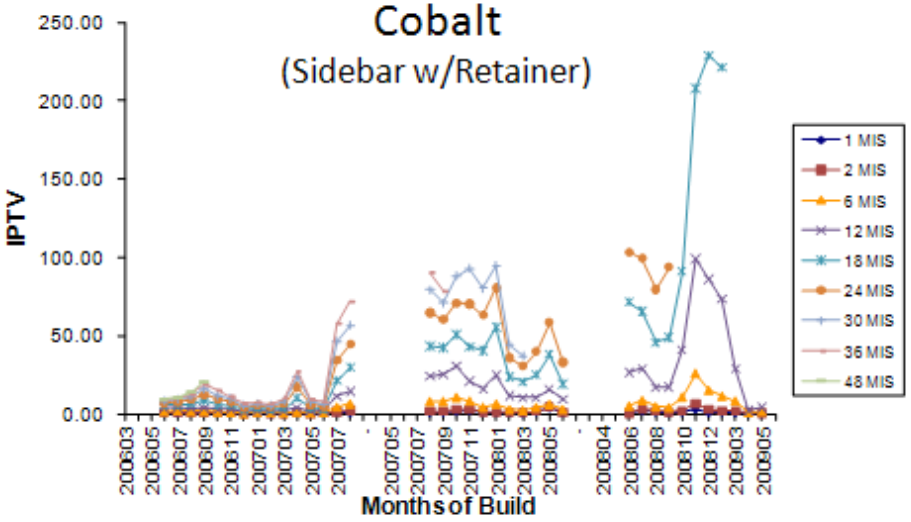
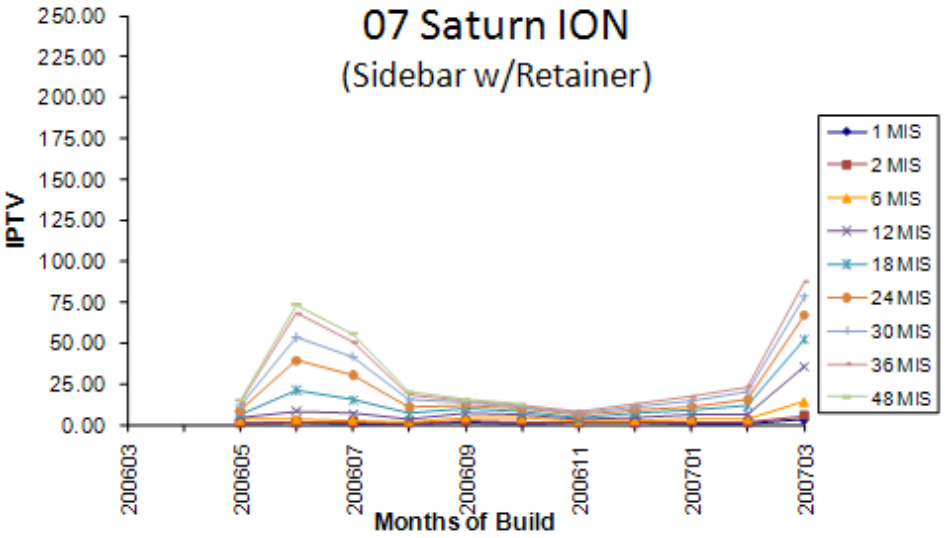
1/4/2011
3/6/2011
5/6/2011
7/6/2011
9/5/2011
11/5/2011
1/5/2012
3/6/2012
5/6/2012
7/6/2012
9/5/2012
11/5/2012
1/5/2013
3/7/2013
5/7/2013
7/7/2013
R* = Run but algorithm disabled
As of 10/1/13

Ignition Cylinder Warranty (N100256)







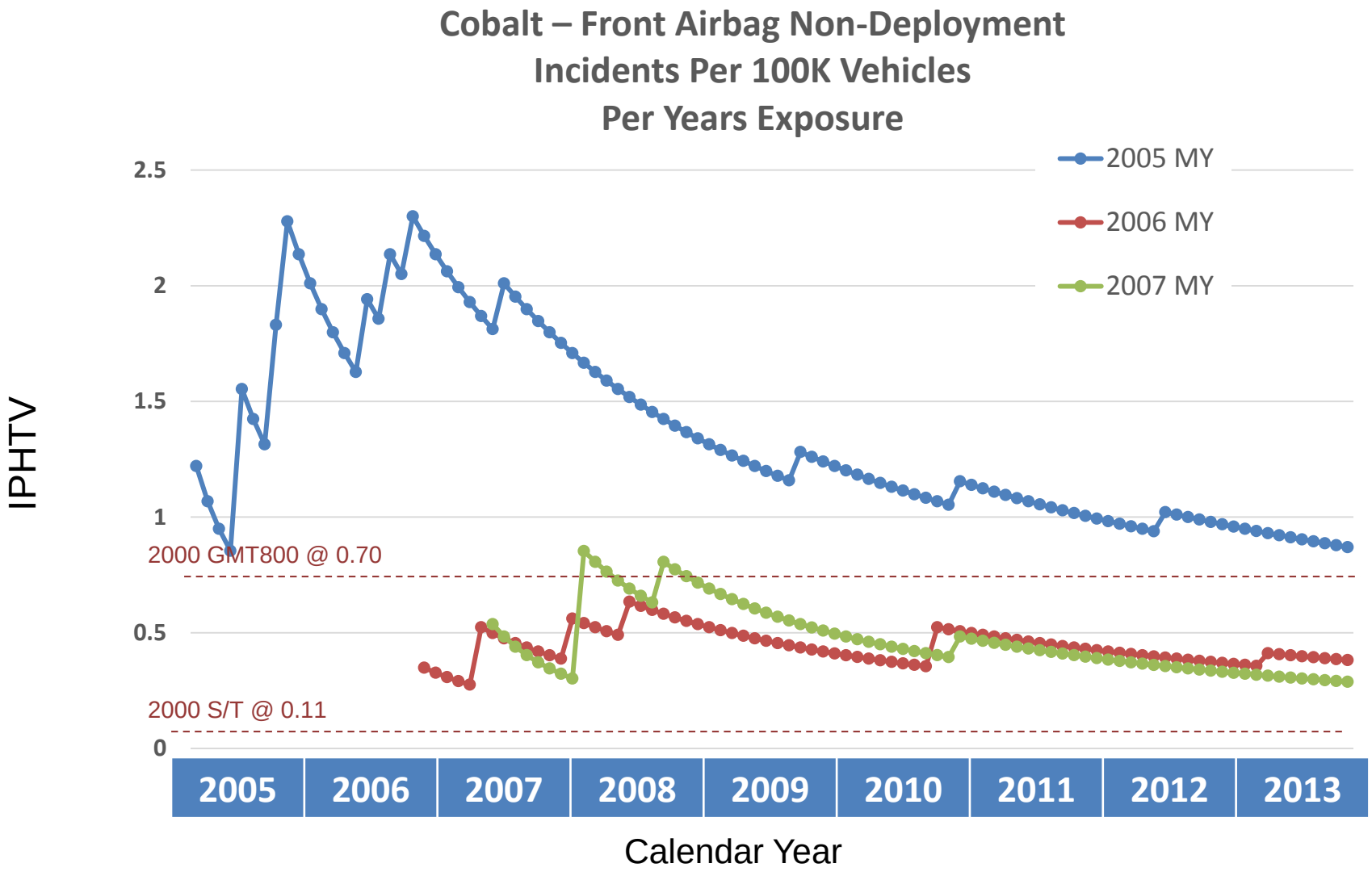


Vehicle Scrap Rates

AGE	TRUCKS (Full Size Trucks and Vans)	CARS (All others)
1	**100%**	**100%**
2	**99%**	**99%**
3	**99%**	**99%**
4	**98%**	**97%**
5	**95%**	**95%**
6	**94%**	**93%**
7	**93%**	**92%**
8	**92%**	**91%**
9	**92%**	**89%**
10	**91%**	**85%**
11	**86%**	**82%**
12	**79%**	**76%**

**data pulled by RL Polk in March 2012*

2003 Ion vs 2007 Cobalt


Cobalt – Front Airbag Non-Deployment
Incidents Per 100K Vehicles
Per Years Exposure
2005 MY
2006 MY
2007 MY
IPHTV
2.5
2
1.5
1
0.5
0
2000 GMT800 @ 0.70
2000 S/T @ 0.11
2005
2006
2007
2008
2009
2010
2011
2012
2013
Calendar Year