

USING CALID / CVN TO QUANTIFY AND ADDRESS AFTERMARKET REPROGRAMMING ACTIVITY

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CALID = Calibration Identification Number

- Essentially a version number for module software

CVN = Calibration Verification Number

- Calculated value using controller software/calibration

Purpose: To verify the integrity of OEM software

Each CALID should have a single correct associated CVN

- Changing any byte within the software/cal space should change CVN

Manufacturers provide lists of CALID/CVN combinations during certification season

- Required for “DEC” ECUs

CARB Competition Vehicle Study: Objective

Estimate Usage Rate of Modified (Non-OEM) Software

- CARB is studying impact of “competition vehicle” provisions
- Misuses of competition only software resulting in tampering of on-road vehicles
 - Hardware changes considered in separate study

Data Source – California’s Smog Check Database



Ideal Methodology

- Compare all the manufacturer CALID/CVN data given to ARB with Smog Check records

Practical up-front problems with ideal methodology

- ARB has not compiled all of the spreadsheets we receive, but doing so would still leave gaps
- Field fixes add to the population of valid CALID/CVN pairs for years after production
- ARB exempted modifications can change CALID

For a given CALID, the most common CVN indicates the correct pair

Other instances of the CALID with a different CVN are not considered OEM

- Assumes that the intended 1 to 1 relationship between CALID and CVN holds true

Analysis focused on CALID/CVN(s) reported by the Engine Controller

Example

Model Year	Make	Model	CALID	CVN	Count
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	C3889BD7	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	CB38450C	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	CF392526	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D1D95E28	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D4C3A4F9	2
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90A3B7F	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90A5033	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90A6FF9	153
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AB653	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AC440	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AC479	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AD817	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AE52B	3
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D90AED51	1
2007	SUBARU	IMPREZA WRX	A8DK100X 33092304	D92AA4F9	1

2010 Model Year “Top” Ten (Preliminary)

Manufacturer	Model	Engine	“Tamper” Rate
Subaru	Impreza WRX STI	2.5L (Gas)	40.9%
Mercedes-Benz	C 63 AMG	6.2L (Gas)	37.7%
Mitsubishi	Lancer Evolution GSR/MR	2.0L (Gas)	30.6%
Jeep	Grand Cherokee SRT-8	6.1L (Gas)	24.4%
Audi	R8	5.2L (Gas)	22.7%
Subaru	Impreza WRX Limited	2.5L (Gas)	21.4%
Mercedes-Benz	CL 65 AMG	6.0L (Gas)	20.0%
Nissan	GT-R	3.8L (Gas)	19.8%
Smart	ForTwo	1.0L (Gas)	18.0% *next slide
Ford	Mustang Shelby GT500	5.4L (Gas)	16.8%

Most Likely Explanation: Multiple calibrations were assigned the same CALID (not tampering)

CALID	CALCVN	COUNT
1329030400170002 0134480110170001	869FBA63 0F2ED724	191
1329030400170002 0134480110170001	869FBA63 C7F75D2C	59
1329030400170002 0134480110170001	3E23DD06 0F2ED724	26
1329030400170002 0134480110170001	28DA2E6B 0F2ED724	1

2010 Model Year “Bottom” Ten (Preliminary)

Manufacturer	Model	Engine	“Tamper” Rate
Toyota	Camry	2.5L (Gas)	0.00%
Honda	Accord	2.4L (Gas)	0.01%
Nissan	Versa S	1.8L (Gas)	0.01%
Mazda	3 I	2.0L (Gas)	0.01%
Nissan	Altima	2.5L (Gas)	0.01%
Mazda	3 S	2.5L (Gas)	0.01%
Ford	Fusion SE	2.5L (Gas)	0.01%
Ford	Focus SE	2.0L (Gas)	0.01%
Ford	Edge SEL	3.5L (Gas)	0.02%
Mini	Cooper	1.6L (Gas)	0.03%

Preliminary Overall Results

Fuel Type	“Tamper” Rate
Gasoline (2006-2011)	1.5%
Diesel (2006-2016)	3.7%
Total	1.7%

Limited roadside inspection data appears to show much lower rate (~ 0.3%)

Still studying why

- Relatively few records available for newer vehicles
- Drivers can refuse roadside inspection

Multiple Valid CVNs for a given CALID

- Incorrect implementation of requirements
 - CALID is not unique to a given controller flash
 - More common in early model years of analysis

Options selectable with service tool (e.g., tire size) affecting CVN calculation?

Exempted Aftermarket Modifications (VC27156)

Mal-Formed CALIDs (software bugs) (next slide)

2006 Ford 2.3L Rangers

CALID	CALCVN	COUNT
PRDO0A4.HEX	E0EC0DD8	3
PRDO0A4.HEX***	E0EC0DD8	94
PRDO0A4.HEX***!	E0EC0DD8	4
PRDO0A4.HEX***#	E0EC0DD8	4
PRDO0A4.HEX***\$	E0EC0DD8	2
PRDO0A4.HEX***%	E0EC0DD8	2
PRDO0A4.HEX***&	E0EC0DD8	4
PRDO0A4.HEX***'	E0EC0DD8	4
PRDO0A4.HEX***(E0EC0DD8	2
PRDO0A4.HEX***)	E0EC0DD8	3
PRDO0A4.HEX****	E0EC0DD8	116
PRDO0A4.HEX***+	E0EC0DD8	2
PRDO0A4.HEX***,	E0EC0DD8	3
PRDO0A4.HEX***.	E0EC0DD8	6

ECU Tampering can be seen and the frequency can be estimated using CALID/CVN data collected in Smog Check

- Tampering rates appear high for many models / Non-issue for many others

Several factors currently exist that complicate the use of CALID/CVN for analysis and other uses

Addressing these factors should improve the usefulness of the parameters

Results of study will contribute to addressing competition vehicle abuses

An ultimate goal would be the ability to accurately identify tampered vehicles and require correction through I/M programs

Possibilities for Improving Cal ID/CVN Usage Going Forward

Create Database to Compile/House Data

Provide for Direct Uploading by Manufacturers

Extend Reporting Period Beyond Certification/Production Window

Resolve problem of multiple calibrations using same ID once and for all

Guard against software bugs affecting data quality

Address exempted ECU modifications

Better Cal ID/CVN Management for Exempted Modifications

ECU Tuners can produce too many CVN variations to practically track all combinations

- Products can cover multiple makes/models/years
- Potentially many options for modification of a given vehicle
- OEM field fixes indefinitely renew the task

ARB is considering CALID renaming convention for approved modifications

- EO number appended to stock CALID
 - Right Hand characters replaced as necessary (16 character limit)
 - Example: 68059517AD-512-7



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