

Fine Familia

This article is a true description of an AECS technical help desk problem and how it was solved.

Vehicle

2004 Mazda Familia ZL 4cyl petrol engine.

Problem presented to the Helpdesk

Car is driving fine, P0351 fault code is popping up every 10 minutes or so while idling or driving.

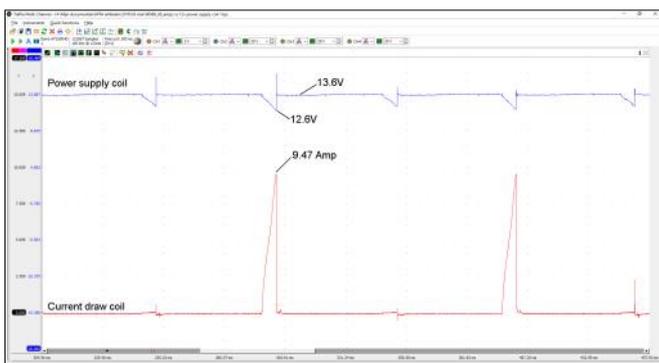
The code description in the Launch for P0351 is: Ignition Coil A Primary/Secondary Circuit Malfunction.

We scoped the ignition system and cannot understand the fault code detection logic as everything is basically there and the car is running fine.

Can you please explain a little about this?

Let's look at the measurements

The diagnostician spotted from this first recording (picture 1), that the coils have a very poor power supply (about 1 volt is lost when the coil is triggered) and draw a seemingly very high current (9.5 Amp).



Picture 1: ATScope recording Coil power supply vs coil current

Coil Trigger

We have also recorded the poor coil power supply and ECU trigger signal to the coil (Picture 2). The trigger voltage is somewhat low (10.3V), could this be due as a result of poor connection/wiring, or point to an ECU problem?



(Picture sourced from internet)

jaltest Truck/Trailer Kit

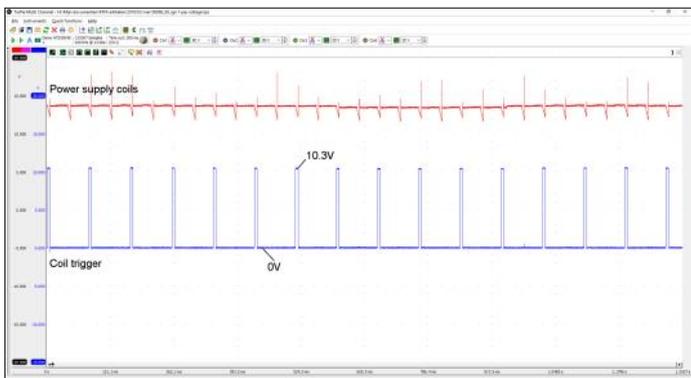
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Picture 2: Coil Power supply vs coil trigger, recorded with the ATS scope.

With these patterns and a fine running car how can the ECU set the P0351 fault code and turn the check engine light on?

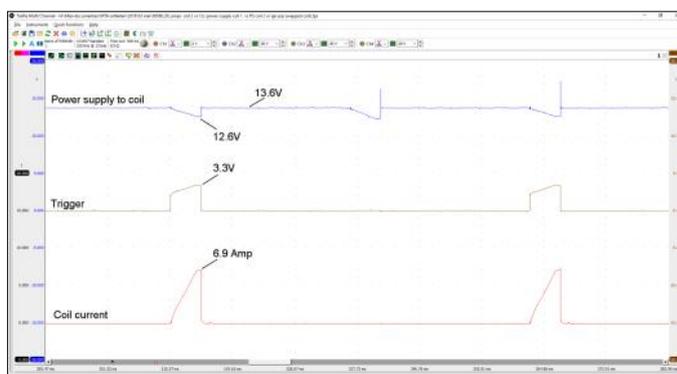
Response from the AECS help desk

The short and direct answer is "I do not know" as I did not design the system.

I believe the car is too old for misfire detection from Delta-N (RPM variations in two crankshaft revolutions) where the RPM lower rise time on one cylinder is a different code to lower fall time on one cylinder.

Some coils measure the inductive voltage height upon firing, some coils measure the spark duration, that feedback needs to go back to the ECU through an IGF wire (e.g. Toyota), or by having the primary wires passing through a circuit in an ignition feedback module (e.g. Mitsi), or having the primary wires going directly back to the ECU (GM).

On some systems the ECU detects the trigger voltage height, if that is wrong the ECU will log a fault (e.g. Nissan). These vehicles have just 3 wire coils (power, earth and trigger)



Picture 3: ATS scope recording on a good coil

where the ignitor is part of the coil.

"In your pattern the trigger voltage odd, its neither system voltage, nor 5V or anything else we have seen. This is maybe where the code comes from, you will have to compare with good vehicle.

Also in your recording is the current very high (9.5 Amp) you might have a current detection circuit inside the ignitor if you have a 4 wire coil.

Do you have a 3 wire or a 4 wire coil? Also when you test a coil on a different car could you please record the trigger signal and the current?"

Got it!

The recording on the good coil in Picture 3 shows the lower current (6.9 Amp instead of 9.5 Amp), it also shows a clearly different trigger pulse, going up to 3.3V instead of 10.3V.

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Yes, the power supply to the coil is still very poor (1V loss), but that is not the direct cause of the fault code. The poor power supply to the coil needs fixing alright! It will damage the new coil in a short period of time, as we explain in the AED and EMS 1-1 training (coil killer spikes).

Fault code logic

It is now obvious that the fault code detection logic on this car, is through measuring the trigger signal voltage height. On later model cars (and other brands) is this a far more elaborate logic.

Fitting new coils and fixing the coil power supply fixed the car, properly.

Conclusion

How would you have found this fault conclusively without measuring the signals? Swapping the coils and find that the car comes back with the same fault in a month's time? How would you have found the reason for even the new coil faulting if you did not measure with a proper scope?

I have many technicians calling me for support(!) saying they don't really go into the vehicles as deep as we do.... kind of making excuses for not having a decent diagnostic scope. They either have no scope or a scope which does not do what they expect. In almost all cases is the technician doubting him - or herself, rather than seeing that it is the scope that holds them back from performing simple and accurate diagnostics.

The ATS scope with back up from AECS made this job efficient and effective with minimal time spend and only with a little help from the AECS back up team.



For **AECS** Ltd
Herbert Leijen
(trainer/research)

[AED & EMS1-1 Training dates for 2016](#)

AED - Automotive Electronic Diagnostics

7th & 8th April 2016 - Hastings - **ENROL NOW!**
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14th & 15th June 2016 - Christchurch
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EMS1-1 - Engine Management Systems 1-1

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AECS 2016 Training Calendar

April	May	June	July
			ATS1-2 - Hamilton ECAC1-1 - Hamilton
		DMS1-3 - Hamilton	
	ECAC1-1 - Gisborne	DMS1-3 - Hamilton	
	ECAC1-1 - Gisborne		
DMS1-3 - Orange, Australia	SCAN1-1 - Gisborne		EMS1-5 - Tauranga
DMS1-3 - Orange, Australia	SCAN1-1 - Gisborne	Queens birthday	EMS1-5 - Tauranga
AED - Hastings DMS1-3 - Orange, Australia AED - Hastings		<i>AED - Auckland (closed)</i>	<i>AED - Tauranga (closed)</i>
DMS1-3 - Orange, Australia		<i>AED - Auckland (closed)</i>	<i>AED - Tauranga (closed)</i>
		<i>AED - Auckland (closed)</i>	
	EMS1-3 - Auckland	<i>AED - Auckland (closed)</i>	
	EMS1-3 - Auckland AEED - Ohakea - CLOSED		<i>ECAC1-1 & AEED - Wellington - CLOSED</i>
AED - Wellington	<i>AEED - Ohakea - CLOSED</i>		<i>ECAC1-1 & AEED - Wellington - CLOSED</i>
AED - Wellington	<i>AEED - Ohakea - CLOSED</i>		<i>ECAC1-1 & AEED - Wellington - CLOSED</i>
EMS1-4 - Palmerston North ATS1-2 - Wellington		AED - Christchurch	<i>ECAC1-1 & AEED - Wellington - CLOSED</i>
EMS1-4 - Palmerston North Canbus- Palmerston North		AED - Christchurch	<i>ECAC1-1 & AEED - Wellington - CLOSED</i>
	EMS1-4 - Auckland ECAC1-1 - Wellington	EMS1-4 - Christchurch	
	EMS1-4 - Auckland ECAC1-1 - Wellington	EMS1-4 - Christchurch	
	AED - Whangarei SCAN1-2 - Auckland	CANBus - Christchurch	
<i>AED - Auckland (closed)</i>	AED - Whangarei SCAN1-2 - Auckland		
<i>AED - Auckland (closed)</i>		AED - Dunedin	
<i>AED - Auckland (closed)</i>		AED - Dunedin	
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		ATS1-1 - Hamilton TRUCKSCAN - Hamilton	
		ATS1-1 - Hamilton ECAC1-1 - Hamilton	

Please note: Dates & Courses may change without notice, refer to WWW.AECS.net for updated information and to enrol online.

AECS Course Key

- AED—Automotive Electronic Diagnostics
- ATS1-1— ATS Comprehensive Scope training on software
- ATS1-2— Competent scope users Supplement training seminar
- EMS1-1—Engine Management Systems 1 (module 1) (EMS1-1) training seminar
- EMS1-3— Engine Management Systems 1 (module 3) (EMS1-3) training seminar (cam timing , variable lift and direct injection petrol
- EMS1-4—Hybrid Management Systems (EMS1-4) training seminar
- EMS1-5—Engine Management Systems 1 (module 5) (EMS1-5) training seminar (immobiliser)
- DMS1-3—Diesel Management Systems 1 (module 3) (DMS1-3) training seminar (common rail)
- ECAC 1-1— Electronic Controlled Air-conditioning 1 (module 1) (ECAC1-1) training seminar
- SCAN 1-1— Scan Tool Diagnostics (SCAN1) training seminar
- SCAN 1-2— Scan Tool Diagnostics (SCAN2) training seminar
- RBM1-1—RBM training for COF VI's



Full comprehensive descriptors with training content pictures on www.aecs.net

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