COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Camshaft Control Electrical											
Bank 1 Intake	P0010	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving cycles each with: 1 sec continuous
	P2088	circuit continuity - ground				battery voltage	>	10	V		
	P2089	circuit continuity - voltage				battery voltage	<	18	V		
Bank 1 Exhaust	P0013	circuit continuity - open				output	activated and deactivated for complete checking				
	P2090	circuit continuity - ground									or 5 sec cumulative
	P2091	circuit continuity - voltage									
Bank 2 Intake	P0020	circuit continuity - open									
	P2092	circuit continuity - ground									
	P2093	circuit continuity - voltage									
Bank 2 Exhaust	P0023	circuit continuity - open									
	P2094	circuit continuity - ground									
	P2095	circuit continuity - voltage									
System - Control											
Bank 1 Intake	P0011	rationality low / high	difference to start test (filtered actual	6.0 . . . 11.0	degrees	engine speed	>	480	rpm	approx.	two driving cycles each with: 1 sec continuous
						engine speed	<	10200	rpm		
Bank 1 Exhaust	P0014		angle versus filtered desired angle) >			engine run time	>	1	sec	20 sec	
Bank 2 Intake	P0021		(desired must remain above value			camshaft control circuit test	complete	-	-		
Bank 2 Exhaust	P0024		to test to complete the evaluation)			error: camshaft control circuit	not set	-	-	(2 times	or 5 sec
			same as above, but offset added to the	0	degrees	coolant temperature	<	143	° C	for 2.5 sec	cumulative
			difference, during cold start only:			coolant temperature	>	-48	° C	each)	
			filtered actual angle			engine oil temperature	<	180	° C		
			< filtered desired angle from test start			engine oil temperature	>	-48	° C		
			within time	2.5	sec	cam-crank alignment adaptation	complete	-	-		
			(detects 5 sec slow [time constant])								
			for multiple activation occurrences	10	count						
			(decrements upon activations where	(same as stated in "time required" column)							

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			no difference is seen between desired and actual)			(engine oil temperature is a modeled input					
			same as above, but during cold start only:	3	count	The primary inputs to the model are: engine coolant temp, and engine speed					
			difference (filtered actual angle max versus actual at test start) >	1.5	degrees	Other inputs include: IAT, and EOT. Each of these inputs are diagnosed for OBD failure.)					
			(to detect slow response versus stuck cam if above this limit) at time	2.5	sec						
			(overlaps with time to detect above)								
			(passes after multiple good activations in both cam phase rotation directions)								
System - Cam - Crank Alignment											
Bank 1 Intake	P0016	cam-crank adapted angle	adapted angle >	9.75	degrees	engine run time >	>	50	sec	approx.	two driving
Bank 1 Exhaust	P0017	limit check	or adapted angle <	9.75	degrees	engine coolant temp >	>	0	° C	600 sec	cycles each
Bank 2 Intake	P0018	(applies for each camshaft)	or actual angle with parked cams >	15	degrees	engine coolant temp <	<	95.25	° C		with: 4 sec
Bank 2 Exhaust	P0019		and <	21	degrees	model: engine oil temp <	<	120	° C	fail after	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams >	6	degrees	error: camshaft sensor	not set	-	-	2 adaptation	or 30 sec
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams <			error: camshaft control circuit	not set	-	-	cycles - required	cumulative
Primary O2 Sensor Heating											
heater circuits - electrical											
bank 1 sensor 1 (primary)	P0030	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving
	P0031	circuit continuity - ground				battery voltage	>	10	V		cycles each
	P0032	circuit continuity - voltage				battery voltage	<	18	V		with: 4 sec
bank 2 sensor 1 (primary)	P0050	circuit continuity - open				output	activated and deactivated for complete checking				continuous

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P0051	circuit continuity - ground									or 30 sec
	P0052	circuit continuity - voltage									cumulative
bank 1 sensor 2 (secondary)	P0036	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving
	P0037	circuit continuity - ground				battery voltage	>	10	V		cycles each
	P0038	circuit continuity - voltage				battery voltage	<	18	V		with: 4 sec
bank 2 sensor 2 (secondary)	P0056	circuit continuity - open				secondary O2 sensor heating	ready				continuous
	P0057	circuit continuity - ground				secondary O2 sensor dew point	reached				or 30 sec
	P0058	circuit continuity - voltage				output	activated and deactivated for complete checking			0.5sec	cumulative
Mass air flow sensor	P0101	range check low	measured mass air flow * threshold			battery voltage	>	10	V		two driving
			< Maximum modeled mass air flow	0.9	factor	for time	>	0.1	sec		cycles each
						time after start	>	0.3	sec		with: 0 sec
						crankshaft revolution counter	>	150	rev		continuous
		or				ambient pressure valid	TRUE	-	-		
		fuel trim limits exceeded	> delta lambda correction	0.18	factor	desired cam angle valid	TRUE	-	-		
		range - multiplicative				long term fuel trim	TRUE	-	-		
		and				air flow mass	>	1.39	g/sec		
		correction factor (modeled air	< correction factor air mass	0.8	factor	air flow change gradient	<	0.25	-		
		mass at throttle / air mass				throttle angle change gradient	<	2	-		
		measured by air mass flow meter)				engine speed	>	25	rpm		
						engine coolant temperature	>	9.8	° C		
		range check high	measured mass air flow * threshold			engine running time	>	1	sec		
			< minimum modeled mass air flow	1.1	factor	Air flow meter active	TRUE	-	-		
		or				modeled MAP / BARO	<	0.8	-		
		fuel trim limits exceeded				for time	>	0.5	sec		
		range - multiplicative	< delta lambda correction	-0.18	factor	error: air flow meter (internal)	not set				
		and				error: throttle position sensor	not set	-	-		
		correction factor (modeled air				error: intake air temp. sensor	not set	-	-		
		mass at throttle / air mass	> correction factor air mass	1.2	factor						
		measured by air mass flow meter)									
	P0100	open circuit check	sensor signal in period time	0	uS	battery voltage	>	10	V	5 sec	
						engine speed	>	25	rpm		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						Ignition on	TRUE				
	P0102	range check low	sensor signal in period time	66	uS	time after start	>	0.3	sec	1 sec	
	P0103	range check high	sensor signal in period time	910	uS						
Intake air temperature	P0111	response check	max intake air temperature -			drive segment between idles (count)	>=	13	count	2 sec	two driving
sensor			min intake air temperature >	1.5	° C	each with					cycles each
						vehicle speed	>=	18.75	mph		with: 4 sec
						mass flow	<	66.7	g / sec		continuous
						mass flow	>	6.7	g / sec		or 30 sec
						coolant temperature at start	<=	110	° C		cumulative
						no fuel shut-off					
						idle segments between drives (count)	>=	3	count		
						each with					
						vehicle speed	<=	6.25	mph		
						coolant temperature at start	<=	110	° C		
						coolant temperature	>	60	° C		
						ECT decrease since prior shutdown	>	0	° C		
	P0112	range check low	intake air temperature >	132	° C						
	P0113	range check high	Temperature for closed loop control	-42	° C	time after start	>	180	sec		
						then time in idle	>	10	sec		
						and intake air temperature	<	-42	° C		
						then | IAT change | (abs value)	<=	140.3	° C		
						while					
						integrated air mass increases	>=	1000	g		
Engine coolant	P0116	difference from Engine	filtered difference			Engine coolant model (cooled down)	<	50	° C	35 sec	immediate
temperature sensor		temperature model after soaking	(ECT at key on - ECTmod at key on) >	14.25	° C	Soaking time after shut down	>	19800	sec	for block	once code
(w/ Real time clock)										heating	has
						previous accumulated air mass	>	6000	g	check	been set
			or			previous engine run time	>	600	sec		
						or					
			filtered difference			ECT at shut down	>	81.75	° C		approx.
			(ECT at key on - ECT od at key on) <	-14.25	° C		>	6000	g		6 test
						previous accumulated air mass					average
						Controller Shut Down at end of	last cycle	-	-		run length
						Engine Off Timer value valid	not detected	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						Powerfail or Codeclear on previous drive	not detected				
						Block Heater	not detected	-	-		
Engine coolant temperature sensor	P0117	range check high	coolant temperature >	140.3	° C	If Startup IAT hot restart timer	> >=	72 60	° C sec	0.1 sec	two driving cycles each
	P0118	range check low	coolant temperature <	-42	° C	If Startup ECT | ECT-Startup ECT | (abs value) integrated air mass increases and air mass timer	< <= >= >=	-42 2.25 0 2	° C ° C g sec		with: 1 sec cont. or 10 sec cum.
	P0119	intermittent (discontinuity)	delta coolant temperature < delta coolant temperature > weighted counter > (up 5000 w/jump; down 1 with steady) (fail counter intialized to 10000)	-4.5 4.5 60000	° C ° C count	Ignition On	TRUE			approx. 300 sec	two driving cycles each with: 1 sec cont. or 10 sec cum.
Throttle Position Sensor 1 (primary)	P0121	plausibility to other poti	sensor difference >	9	%	battery voltage	>	7	V	continuous	two driving cycles each with: 1 sec cont. or 10 sec cum.
	P0122 P0123	range check poti voltage	sensor circuit low voltage < sensor circuit high voltage >	0.176 4.629	V V	battery voltage	>	7	V	continuous	code set then 5 sec
Sensor 2 (redundant)	P0221	plausibility to other poti	sensor difference >	9	%	battery voltage	>	7	V	continuous	two driving cycles each with: 1 sec cont. or 10 sec cum.
	P0222 P0223	range check poti voltage,	sensor circuit low voltage < sensor circuit high voltage >	0.156 4.883	V V	battery voltage	>	7	V	continuous	code set then 5 sec
Engine coolant	P0128	Coolant Temperature Below	calculated coolant temperature model							approx.	two driving

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Temperature sensor		Model Temperature	minus measured temperature >	9.8	° C	error: engine coolant temp	not set	-	-	500 sec	cycles each
		(additional pinpointing for coolant sensor, failures				engine speed	>	25	rpm		with: 1 sec cont. or 10
		detected would also be	coolant temp. reference model calculation limit	40.5	° C						sec cum.
		detected by Thermostat monitor)									
			(detection of blockheater resets modeled engine coolant temperature calculation)								
		OR									
Engine Coolant		Coolant Temperature Below	(calculated reference model coolant temp	10.5	° C	debouncing time	>	10	sec	approx.	two driving
Thermostat Monitoring		Thermostat Regulating	minus measured coolant temperature) >			error: engine coolant temp	not set	-	-	900 sec	cycles each
		Temperature (plausibility check)				error: vehicle speed sensor	not set	-	-		with: 4 sec
			reference model calculation limit	89.25	° C	modeled ambient temperature	>	-30	°C		continuous
						modeled ambient temperature	<	70	°C		or 30 sec
			(development vehicles indicated			vehicle speed	>=	9.375	mph		cumulative
			steady thermostat regulating temperatures of 89°C, as measured			engine speed	>	960	rpm		
						coolant temperature at start	<	70.5	°C		
			by the engine coolant temp. sensor.			integrated air mass flow	>	3000	g		
			The thermostat opening temp. is 82°C. The thermostat is fully open								
			by 95°C. All critical OBD and emission functions are enabled								
			above 60°C.)								
Oxygen Sensor sensor circuit (primary O2)											
bank 1 sensor 1	P0130	sensor line short circuit	secondary O2 sensor			engine speed	>	25	rpm		two driving
bank 2 sensor 1	P0150	to heater output line	voltage gradient >	2	V	battery voltage	>	10	V		cycles each
			within time after heater turn off <	0.04	s	primary O2 heater active	TRUE	TRUE	-		with: 0 sec
			for occurrences >	4	count	and pri. O2 heater duty cycle	>	0.7	-		continuous
			out of heater turn offs	6	count	and time	>	8	sec		or 0 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						dew-point end passed	TRUE	TRUE	-		cumulative
						error: injector circuit fault	not set				
								not set	-		
			or			engine speed	>	25	rpm		
			primary O2 sensor voltage >	0.6	V	battery voltage	>	10	V	20 sec	
			and primary O2 sensor voltage <	1.15	V	primary O2 heater active	TRUE	TRUE	-		
			and secondary O2 sensor voltage <	0.1	V	and pri. O2 heater duty cycle	>	0.7	-		
						and time	>	8	sec		
			or			time after	>	30	sec		
			primary O2 sensor voltage >	0.06	V	dew-point end passed	TRUE	TRUE	-	60 sec	
			and primary O2 sensor voltage <	0.4	V	and pri. O2 heater duty cycle	>	0.68	-		
			and secondary O2 sensor voltage >	0.5	V	Or Primary Exhaut gas temp. model	>	600	°C		
						error: injector circuit fault	not set				
								not set	-		
						Integrated air mass	>	2200	g		
						Secondary O2 sensor readiness	TRUE	TRUE	-		
						error: Primary O2 sensor short circuit ground	not set				
								not set	-		
Oxygen Sensor sensor circuit (primary O2)											
bank 1 sensor 1	P0131	short circuit to ground	primary O2 sensor voltage <	0.06	V	engine speed	>	25	rpm	0.1 sec	two driving
bank 2 sensor 1	P0151		and Secondary O2 sensor voltage >	0.5	V	battery voltage	>	10	V		cycles each
						primary O2 heater active	TRUE	TRUE	-		with: 0 sec
						and pri. O2 heater duty cycle	>	0.7	-		continuous
						for time	>	8	sec		or 0 sec
						dew-point end passed	TRUE	TRUE			cumulative
						error: injector circuit fault	not set				
								not set			
						Lamda closed loop control	TRUE	TRUE			
						commanded lambda	<	1.005	-		
						Integrated air mass	>	2200	g		
						time	>	30	30		
			primary O2 sensor voltage < and cold start conditions present	0.06	V	engine speed	>	25	rpm		
						battery voltage	>	10	V		
						primary O2 heater active	TRUE	TRUE	-		
						and pri. O2 heater duty cycle	>	0.7	-		
						for time	>	8	sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						dew-point end passed	TRUE	TRUE	-		
						error: injector circuit fault	not set				
								not set	-		
						time after start	<	1	sec		
						engine temp at stop	>	60	° C		
						engine temp	<	40	° C		
						Diagnostic scheduled to run	TRUE	TRUE	-		
bank 1 sensor 1 bank 2 sensor 1	P0132 P0152	short circuit to battery voltage	primary O2 sensor voltage >	1.15	V	engine speed	>	25	rpm	5 sec	two driving cycles each with: 0 sec continuous or 0 sec cumulative
						battery voltage	>	10	V		
						primary O2 heater active	TRUE	TRUE	-		
						and pri. O2 heater duty cycle	>	0.7	-		
						for time	>	8	sec		
						dew-point end passed	TRUE	TRUE	-		
						error: injector circuit fault	not set				
								not set	-		
						commanded lambda	>	0.995	-		
Primary O2 sensor slow response Bank 1 Bank 2	P0133 P0153	slow response	Continuously filtered normalized switching cycle duration >	2.8	s	closed loop control	active			approx. 400 sec	two driving cycles each with: 0 sec continuous or 0 sec cumulative
								2400	rpm		
						engine speed	<				
						engine speed	>	1240	rpm		
						engine load	<	50.3	%		
						engine load	>	18	%		
								350	° C		
			(note: normalization of cycle duration revised with new enable window and failure threshold)			exhaust gas temperature model	>				
								10	sec		
						purge off or has been on for time scheduled by System Manager	>				
							set				
						Primary O2 heater diagnosis finished	set				
						high purge vapor concentration	not set				
						Evap. Leak diagnosis active	not set				
						error: fuel adaptation	not set				
						error: purge valve	not set				
						error: misfire	not set				
						error: primary O2 heater	not set				
						error: secondary O2 heater	not set				
						error: secondary O2 slow sensor	not set				
						error: secondary O2 sensor	not set				
									sample		
						closed loop switching cycles	>	12	s		
Oxygen Sensor											

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
sensor circuit (primary O2)											
bank 1 sensor 1 bank 2 sensor 1	P0134 P0154	sensor line disconnection	primary O2 sensor voltage > and primary O2 sensor voltage <	0.4 0.6	V V	engine speed battery voltage	> >	25 10	rpm V	5 sec	two driving cycles each with: 0 sec continuous or 0 sec cumulative
			Or primary O2 sensor voltage < and mod. Exhaust gas temp. < or	0.55 800	V ° C	primary O2 heater active and pri. O2 heater duty cycle and time	TRUE > >	TRUE 0.7 8	- - sec		
			primary O2 sensor internal resistance > and when modeled exhaust gas temperature >	20000 600	Ohm ° C	time after dew-point end passed	> TRUE	30 TRUE	sec -		
			or primary O2 sensor voltage > and secondary O2 sensor voltage > and fuel cutoff achieved for time	0.2 0.2 3	V V sec	and pri. O2 heater duty cycle Or Primary Exhaut gas temp. model error: injector circuit fault Integrated air mass Secondary O2 sensor readiness error: Primary O2 sensor short circuit ground	> > not set > TRUE not set	0.68 600 not set 2200 TRUE not set	- °C - g - -		
Oxygen Sensor Heating heater performance (primary O2)											
bank 1 sensor 1 (primary) bank 2 sensor 1 (primary)	P0135 P0155	primary O2 sensor internal resistance above threshold	measured primary O2 sensor internal resistance > nominal internal resistance multipy times degradation factor > for time	88 . . . 392 KFRINH / 2 2.25 . . . 9.25 FRINH1 / 2 12	Ohms factor sec	battery voltage battery voltage engine speed engine start complete fuel cut off pri. O2 internal resistance intake air temperature engine off soak time modeled exhaust temp. at primary O2 sensor modeled exhaust temp. at primary O2 sensor suspicion of primary O2 sensor open circuit primary O2 voltage supply scheduled by System Manager for time primary O2 sensor dewpoint exceeded for	> < > > FALSE valid > > > FALSE ON > >	10 18 25 240 - - ° C 120 260 524 120 10	V V rpm rpm - - ° C sec ° C ° C sec sec	approx. 100 sec	two driving cycles each with: 0 sec continuous or 0 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						no fault clear request during drive cycle	not set				
Oxygen Sensor sensor circuit (secondary O2)											
bank 1 sensor 2 bank 2 sensor 2	P0137 P0157	short circuit to ground	secondary O2 sensor voltage <	0.06	V	secondary O2 heating stable dew-point end of Sec. O2 passed	TRUE TRUE	TRUE TRUE	-	0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
						for time engine speed battery voltage time after start engine temp at stop engine temp error: engine coolant temp	> > > < > < not set	30 25 10 5.1 60 40 -	sec rpm V sec ° C ° C -	600.1 sec	
			Or								
			secondary O2 sensor voltage < short term closed loop controller <	0.06 1.25	V -	secondary O2 heating stable dew-point end of Sec. O2 passed	TRUE TRUE	TRUE TRUE	-		
						for time engine speed battery voltage for time Commanded lambda	> > > > <=	30 25 10 40 1.005	sec rpm V sec -		
bank 1 sensor 2 bank 2 sensor 2	P0138 P0158	short circuit to battery voltage	secondary O2 sensor voltage >	1.15	V	secondary O2 heating stable dew-point end of Sec. O2 passed	TRUE TRUE	TRUE TRUE	-	5.1 sec	
						for time engine speed battery voltage	> > >	30 25 10	sec rpm V		
bank 1 sensor 2 bank 2 sensor 2	P0140 P0160	sensor line disconnection	secondary O2 sensor voltage > and secondary O2 sensor voltage <	0.401 0.519	V V	secondary O2 heating stable dew-point end of Sec. O2 passed	TRUE TRUE	- TRUE	-	60 sec	
						for time and mod. Exhaust-gas temp.	> <	30 800	sec ° C		
			Or								
			secondary O2 sensor voltage > and secondary O2 sensor voltage <	0.401 0.5479	V V	secondary O2 heating stable dew-point end of Sec. O2 passed	TRUE TRUE	- TRUE	-		
						for time and mod. Exhaust-gas temp.	> >=	30 800	sec ° C		
			or								
			secondary O2 sensor internal resistance > when modeled exhaust gas temperature >	40000 450	Ohm ° C	engine speed battery voltage	> >	25 10	rpm V		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					mod. exhaust-gas temp. < 800 ° C secondary O2 heating stable TRUE - - dew-point end of Sec. O2 passed TRUE TRUE for time > 30 sec			
Oxygen Sensor (Secondary O2 sensor) Slow response voltage during DCFO bank 1 sensor 2 (secondary) bank 2 sensor 2 (secondary)	P013A P013C	secondary O2 sensor transient response in DCFO Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle	transient response time > (Transient response time measured between 0.4 and 0.2 Volts)	0.5 sec	Decel. Fuel cut-off (DCFO) TRUE - - Sec. HO2S internal resistance primary HO2S Readiness TRUE - - Secondary HO2S readiness TRUE - - battery voltage > 10 V Secondary HO2S internal resistance <= 500 Ohms mod. exhaust-gas temp. at secondary HO2S >= 450 ° C Sec. HO2S voltage on rich side TRUE - -	1 1	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P013E P014A	secondary O2 sensor delayed response since DCFO Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle	delayed response time > (from start of DFCO to reaching 0.14 Volts)	4.8 sec	Decel. Fuel cut-off (DCFO) TRUE - - secondary O2 sensor voltage since DFCO > 0.59 V primary HO2S Readiness TRUE - - Secondary HO2S readiness TRUE - - Primary HO2S < 0.14 V battery voltage > 10.4 V Secondary HO2S internal resistance <= 500 Ohms mod. exhaust-gas temp. at secondary HO2S >= 450 ° C Sec. HO2S voltage on rich side TRUE - - Or integrated Oxygen storage > 15 g			two driving cycles each with: 4 sec continuous or 30 sec cumulative
Oxygen Sensor Heating heater performance (secondary O2) bank 1 sensor 2 (secondary) bank 2 sensor 2 (secondary)	P0141 P0161	secondary O2 sensor internal resistance	measured secondary O2 sensor internal resistance >		battery voltage > 10 V battery voltage < 18 V	approx. 100 sec	two driving cycles each

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		above threshold	nominal internal resistance	104 . . . 296	Ohms	engine speed	>	25	rpm		with: 0 sec
						engine start complete	>	240	rpm		continuous
			multipy times degradation factor	3.5 . . . 7.5	factor	fuel cut off	FALSE	-	-		or 0 sec
						sec. O2 internal resistance	valid	-	-		cumulative
			for time	6	sec	intake air temperature	>	-30	C		
						engine off soak time	>	0	sec		
						modeled exhaust temp. at sec. O2 sensor	>	300	C		
						modeled exhaust temp. at sec. O2 sensor	<	550	C		
						suspicion of secondary O2 sensor open circuit	FALSE	-			
						secondary O2 voltage supply from the deactivation for time	ON >	120	sec		
Fuel Injector circuit continuity											
Cylinder #1	P0201	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving
	P0261	circuit continuity - ground				battery voltage	>	10	V		cycles each
	P0262	circuit continuity - voltage				battery voltage	<	18.1	V		with: 4 sec
Cylinder #2	P0202	circuit continuity - open				output	activated and deactivated for complete checking				continuous
	P0264	circuit continuity - ground									or 30 sec
	P0265	circuit continuity - voltage									cumulative
Cylinder #3	P0203	circuit continuity - open									
	P0267	circuit continuity - ground									
	P0268	circuit continuity - voltage									
Cylinder #4	P0204	circuit continuity - open									
	P0270	circuit continuity - ground									
	P0271	circuit continuity - voltage									
Cylinder #5	P0205	circuit continuity - open									
	P0273	circuit continuity - ground									
	P0274	circuit continuity - voltage									
Cylinder #6	P0206	circuit continuity - open									
	P0276	circuit continuity - ground									
	P0277	circuit continuity - voltage									
Misfire Emission Level Multiple Cylinder Cylinder #1	P0300 P0301	crankshaft speed fluctuation cylinder 1 to cylinder 6	emissions relevant misfire rate	2.67	%	engine speed	>	390	rpm	1000 revs	Fault during 1st interval: 2 faults in 2 different
						engine speed	<	7000	rpm		
						indicated torque (idle, no drive)	>	6.64	%		
						indicated torque (drive) (MISALUN)	>	6.05 . . . 30.5	%		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Cylinder #2	P0302				engine speed gradient	< 4250 … 4500 rpm/sec		drive cycles.
Cylinder #3	P0303				volumetric efficiency gradient	< 225 . . . 1350 %/rev		
Cylinder #4	P0304				cylinder events after engine start	> 6 ignitions		Fault during
Cylinder #5	P0305				air temperature	> -30 ° C		remaining
Cylinder #6	P0306				clutch position sensor	transition FALSE -		intervals:
					press / release			8 faults in 2
					leak detection	off - -		different
					fuel cut off	not active - -		drive cycles
					fuel level	> 11 %		with at least
					OR fuel level	< 11 %		4 faults in
					AND solid misfire MIL	on - -		each.
					OR fuel level error	set - -		
					Crankshaft position sensing off by 1			
					or more teeth	not set - -		
					error: throttle position	not set - -		
					error: crankshaft sensor	not set - -		
					error: ref.mark of crank sensor	not set - -		
					(temporary delay until re-enablement AT:)	for 2 crank revs		
					(temporary delay until re-enablement MT:)	for 4 crank revs		
			OR					
Catalyst Damaging Level			Catalyst damaging misfire rate		Includes all the above with the		1000 revs	First
Multiple Cylinder	P0300				following exceptions:		First interval	occurance:
Cylinder #1	P0301				First interval extention		200 revs	immediate
Cylinder #2	P0302				engine coolant temperature	< 47.3 °C	all remaining	flashing
Cylinder #3	P0303				fuel level	>= 11 %	intervals	while error
Cylinder #4	P0304			18.1 . . . 5 %	OR fuel level	< 11 %		present, then
Cylinder #5	P0305			see Misfire supplemental data	AND blinking MIL	blinking - -		no MIL
Cylinder #6	P0306			(h) (2.5.1)	AND NOT first blink event	- - -		with no error.
								Second occurance: immediate flashing while error present, then solid MIL with no error.
Knock Control					engine coolant temp.	> 60 ° C		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Circuit	P0324	test pulse	test pulse integral <	4 V	knock control	active - -		two driving cycles each with: 1 sec continuous
			for consecutive events	2 count				
					zero test , parity fault assumptions	not set - -		
		or			measuring window	> 1 ms		or 10 sec
		null test (zero test)	absolute value (integrator gradient) >	200 V / sec	engine coolant temp.	> 60 ° C		cumulative
					knock control	active - -		
			for consecutive events	2 count				
		or			test pulse , parity fault assumptions	not set - -		
		parity check	coef. RAM errors in knock IC, per 250 working cycles	5 count	engine coolant temp.	> 60 ° C		
		or			test pulse fault assumption	not set		
		SPI communication	check word errors in knock IC, per 250 working cycles	25 count				
Bank 1					engine coolant temperature	> 60 ° C		
Circuit check	P0326	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >	25 count	engine speed	> 2200 rpm	approx.	two driving
Performance	P0327	range check low	reference voltage <	0.088 . . . 0.331 V	engine speed gradient	< 1500 … rpm / sec	20 sec	cycles each
				UDKSNU	engine load gradient	< 50 . . . 100 kPa / sec		with: 1 sec
					error: knock control circuit (IC)	not set - -		continuous or 10 sec cumulative
			for consecutive events	100 count				
	P0328	range check high	reference voltage >	5.7 . . . 30.8 V UDKSNO				
			for consecutive events	100 count				
		short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >					
Bank 2					engine coolant temperature	> 60 ° C		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
	P0331	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 working cycles (zkrks) >	25 count	engine speed gradient	< 1500 ... 2500 rpm / sec	approx.	two driving
Performance	P0332	range check low	reference voltage <	0.088 . . . 0.331 V	engine load gradient	< 50 . . . 100 kPa / sec		cycles each
				UDKSNU	error: knock control circuit (IC)	not set - -		with: 1 sec
			for consecutive events	100 count				continuous or 10 sec
	P0333	range check high	reference voltage >	5.7 . . . 30.8 V				cumulative
				UDKSNO				
			for consecutive events	100 count				
Crankshaft Position Sensor	P0335	circuit continuity	no engine signal	0 rpm	camshaft revolutions detected	> 12 counts	approx.	immediate
			but cam phase signals available				5 sec	once code
		rationality check	reference gap missing > (sensor signal but no reference)	3 gaps				has been set
	P0336	rationality check	unexpected re-synchronization >	6 count				with: 1 sec
			(loss of reference mark)					continuous
		rationality check	intermittent loss of engine speed signal >	28 count				or 10 sec
	P0338	rationality check	difference in counted teeth between reference gap position events >	8 teeth			approx. 2 sec	cumulative
Camshaft Position Sensor								
Bank 1 Intake	P0341	plausibility check	signal erratic or out of position	4 count	engine in synchronized mode	TRUE - -	10 revolutions	two driving cycles each with: 1 sec continuous or 10 sec cumulative
	P0342	circuit low	signal permanently low	5 .... 72 count	engine speed	<		
	P0343	circuit continuity or high	signal permanently high	5 .... 72 count				
				KLPHNOKA				
Bank 2 Intake	P0346	plausibility check	signal erratic or out of position					
	P0347	circuit low	signal permanently low					
	P0348	circuit continuity or high	signal permanently high					
Bank 1 Exhaust	P0366	plausibility check	signal erratic or out of position					
	P0367	circuit low	signal permanently low					
	P0368	circuit continuity or high	signal permanently high					

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Bank 2 Exhaust	P0391	plausibility check	signal erratic or out of position					
	P0392	circuit low	signal permanently low					
	P0393	circuit continuity or high	signal permanently high					
Ignition Coil circuit continuity								
Cylinder #1	P0351	circuit continuity - open	Voltage >	20 revs	battery voltage	> 9.9 V	approx.	two driving
	P2300	circuit continuity - ground		20 revs	battery voltage	< 18.1 V	1 sec	cycles each
	P2301	circuit continuity - voltage		20 revs	engine speed	> 400 rpm		with: 4 sec
Cylinder #2	P0352	circuit continuity - open			engine speed	< 5000 rpm		continuous
	P2303	circuit continuity - ground						or 30 sec
	P2304	circuit continuity - voltage						cumulative
Cylinder #3	P0353	circuit continuity - open						
	P2306	circuit continuity - ground						
	P2307	circuit continuity - voltage						
Cylinder #4	P0354	circuit continuity - open						
	P2309	circuit continuity - ground						
	P2310	circuit continuity - voltage						
Cylinder #5	P0355	circuit continuity - open						
	P2312	circuit continuity - ground						
	P2313	circuit continuity - voltage						
Cylinder #6	P0356	circuit continuity - open						
	P2315	circuit continuity - ground						
	P2316	circuit continuity - voltage						
Ignition Coil Driver Circuit	P167D	Internal SPI communication fault	IC Internal	-	battery voltage	< 18.1 v	0.01 sec	
Serial Communication					battery voltage	> 9 v		
					engine speed	< 6000 rpm		
Catalyst Bank 1	P0420	oxygen storage of catalyst	EWMA filtered catalyst aging factor	0.1953 factor	exhaust gas mass flow	> 4.4 g/sec		
Catalyst Bank 2	P0430		less than catalyst aging factor of a limit catalyst <=		exhaust gas mass flow	< 19.4 g/sec	approx.	immediate
					catalyst temp. model	< 750 ° C	1000 sec	once code
					catalyst temp. model	> 480 ° C	during	has
					engine speed	> 1080 rpm	active	been set
					engine speed	< 3000 rpm	driving	
					engine load	> 13 .. 25.5 %		
					engine load	< 45… 50 %		approx.
					difference between modeled cat. temp. model and filtered cat. Temp. model	< 40 °C		3 driving cycles
					difference between exhaust gas mass flow			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					and filterd ex. gas mass flow	< 11.1 g/sec		
					fuel system closed loop	active - -		Avg. run length of 9 samples
					time after secondary O2 sensor exceeded	> 140 … 300 sec		to stabilization
					dewpoint	> -30 ° C		
					ambient temperature model	not set - -		
					catalyst damaging misfire rate exceeded	not set - -		
					error: fuel system	not set - -		
					closed loop control at limit	not set - -		
					strong transient compenstation intervention	not set - -		
					catalyst clear out active (after fuel cutoff)	not set - -		
					fast mixture adaptation completed	not set - -		
					Trigger condition for step change			
					Measured OSC < % of EWMA normalized filtered OSC	< 0.679 -		
Evaporative System and Leak Monitor Small Leak - 0.020 "	P0442	natural pressure/vacuum in tank	filtered fault index >	0.6 -	Eng. Running Vac. pull down or vac. pulldown suspect leak	not set 0.020" leak -	approx. 600 sec	immediate once code
			based on: (peak pressure - peak vacuum) <	535 . . . 800 Pa KFEONVPT	est amb air temp	> 1.5 ° C	each test	has
					est amb air temp	< 32.25 ° C		been set
					Engine stop coolant temp	> 74.25 ° C		
					engine run time	> 600 sec		
					trip distance travelled	> 5.0625 miles		
					evap fuel volatility factor	< 8 factor		approx. 6 test average run length
					fuel level	< 11 %		
					fuel level	> 88 %		
					error: vehicle speed	not set - -		
					error: engine coolant temp	not set - -		(The MIL actually is requested during shut down soak. It becomes visible on the following drive.)
					error: purge valve	not set - -		
					error: fuel tank pressure	not set - -		
					error: system voltage	not set - -		
					error: air mass meter	not set		
					error: intake air temp	not set		
					error: canister vent valve	not set - -		
					start (coolant - intake air)	< 9.75 ° C		
					start engine coolant temp	< 42 ° C		
					amb pressure	> 68 kPa		
					battery voltage	> 10.8 V		
					vehicle odometer	> 12.5 miles		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
Evaporative Emission System Purge Solenoid Control Circuit	P0443 P0458 P0459	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal -	engine speed battery voltage battery voltage output	> 80 rpm > 10 V < 18.1 V activated and deactivated for complete checking	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Evaporative System and Leak Monitor Tank vent valve	P0446	underpressure in tank	tank pressure <	-1000 Pa	fuel system status vehicle speed engine battery voltage battery voltage fuel tank pressure fuel tank pressure ratio: (MAP Model / Baro) est amb air temp est amb air temp fuel level fuel level engine start temp - amb. temp time after engine start or fuel mixture adaptation amb pressure maximum number of attempts error: mass air flow error: coolant temp error: intake air temp error: fuel tank pres error: system voltage error: purge valve	closed loop - - < 1.875 mph idling - - > 10.5 V < 18.1 V > -2500 Pa < 1300 Pa < 0.8125 - > 1.5 ° C < 32.25 ° C < 11 % > 88 % < 9.75 ° C > 600 sec stable - - > 68 kPa < 10 - not set - - not set - - not set - - not set - - not set - - not set - -	5 sec Only one test per will be completed. The test will attempt to run up to 10 times until it successfully completes a test	two driving cycles each with: 4 sec continuous or 30 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						error: vehicle speed	not set	-	-		
						error: canister vent valve	not set	-	-		
						error: purge valve flow	not set	-	-		
						error: accelerator pedal	not set	-	-		
Evap Vent Solenoid Control Circuit	P0449 P0498 P0499	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage output	> > < activated and deactivated for complete checking	80 10 18.1	rpm V V	0.01 sec Only one test per	two driving cycles each with: 4 sec continuous or 50 sec cumulative
Fuel Tank Pressure Sensor	P0450	rationality - signal oscillation	| delta pressure signal | (= current pressure - old pressure) >	813	Pa	ambient temperature model vehicle speed >= time after canister vent valve open	> <= >	-7.5 18.75 3	° C mph sec	25.5 sec	two driving cycles each with: 4 sec or 30 sec cumulative
	P0451	rationality - signal range check	sensor signal >= sensor signal >=	1400 -3500	Pa Pa	time after engine start time after canister vent valve close engine at idling vehicle speed after time and integrated purge mass flow modeled ambient temperature ambient pressure fuel level fuel level	> TRUE > >= >= > > < >	1 4 - 6.25 30 0 -7.5 68000 88.4 11.0	sec sec - mph sec g ° C Pa % %		
		rationality - drift check	| delta pressure signal | (= current pressure - reference pressure at start) >	680	Pa	Vent solenoid valve open Caniter purge flow (closed) ambient pressure fuel level fuel level fuel level Or fuel level valid for running Evap. leak detection Vehicle speed after time and integrated purge mass flow	TRUE <= > < > < TRUE > >= >=	- 0.0005 68000 11 88 73.4 - 6.25 30 0	- g / sec Pa % % % - mph sec g	 7 sec	 two driving cycles each with: 4 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						Vehicle speed	<	46.875	mph		or 30 sec cumulative
						Or					
						ambient temperature model	<=		° C		
						ambient temperature model	>=		° C		
						time	>	3	sec		
	P0452	circuit continuity - ground	sensor signal voltage <	0.2	V	engine running	TRUE	TRUE		10 sec	
	P0453	circuit continuity - voltage	sensor signal voltage >	4.85	V						
Evaporative System and Leak Monitor											
Large leak	P0455	vacuum pulldown slope	integrated air mass flow >	0.8 …. 1.2	g	fuel system status	closed loop	-	-	< 30 sec	two driving
			and vacuum pulldown >	-500	Pa	vehicle speed	<	1.875	mph		cycles each
			Or			engine	idling	-	-	Only one	with: 4 sec
			integrated air mass flow >	1.5	g	battery voltage	>	10.45	V	test per	continuous
			and vacuum pulldown >	-600	Pa	battery voltage	<	18.1	V	driving cycle	or 30 sec
						fuel tank pressure	>	-2500	Pa	completed.	cumulative
						fuel tank pressure	<	1300	Pa	< 20sec	
						ratio: (MAP Model / Baro)	<	0.813	-	The test	
						est amb air temp	>	1.5	° C	will attempt	
						est amb air temp	<	32.25	° C	to run up	
						fuel level	<	11	%	to 10 times	
						fuel level	>	88	%	until it	
						engine start temp - amb. temp	<	9.75	° C	successfully	
						time after engine start	>	600	sec	completes	
						or fuel mixture adaptation	stable	-	-	a test	
						amb pressure	>	68	kPa		
						error: mass air flow	not set	-	-		
						error: coolant temp	not set	-	-		
						error: intake air temp	not set	-	-		
						error: fuel tank pres	not set	-	-		
						error: system voltage	not set	-	-		
						error: purge valve	not set	-	-		
						error: vehicle speed	not set	-	-		
						error: canister vent valve	not set	-	-		
						error: purge valve flow	not set	-	-		
						error: accelerator pedal	not set	-	-		
Fuel Level Sensor Circuit fuel level sensor 1											two driving cycles each
	P0461	rationality	fuel level change <	4.4	%	Primary fuel level	<	41	%		with: 4 sec
			and			Secondary fuel level	<=	6	%		continuous
			cumulative driving distance >	75	mile	Or					or 30 sec
						Primary fuel level	<	41	%		cumulative
						Secondary fuel level	>	6	%		
						Or					
						Primary fuel level	>=	41	%		
						Secondary fuel level	<	6	%		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						and					
						battery voltage	>=	9.99	V		
						battery voltage	<=	18.086	V		
						engine start complete	>	240	rpm		
						electrical fuel level sensor(s) without failure	TRUE	-	-		
	P0462	range check low	voltage <	0.25	V	battery voltage	>=	10	V	60 sec	two driving cycles each with: 4 sec
						battery voltage	<=	18.09	V		
						engine start complete	>	240	rpm		
	P0463	range check high	voltage >	3.2	V	battery voltage	>=	10	V	60 sec	continuous or 30 sec cumulative
						battery voltage	<=	18.09	V		
						engine start complete	>	240	rpm		
Cooling fan 1 relay Control Circuit	P0480	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	two driving cycles each with: 4 sec continuous
	P0691	circuit continuity - ground				battery voltage	>	10	V		
	P0692	circuit continuity - voltage				battery voltage	<	18.1	V		
Cooling fan 2 relay Control Circuit	P0481	circuit continuity - open	Voltage	IC Internal	-						or 30 sec cumulative
	P0693	circuit continuity - ground									
	P0694	circuit continuity - voltage									
Evaporative System and Leak Monitor											
Leaking purge valve	P0496	underpressure in tank	tank pressure loss gradient <	-60	Pa	fuel system status	closed loop	-	-	< 30 sec	two driving cycles with: 4 sec continuous or 30 sec cumulative
						vehicle speed	<	1.875	mph		
						engine	idling	-	-	Only one	
						battery voltage	>	10.45	V	test per	
						battery voltage	<	18.1	V	driving cycle	
						fuel tank pressure	>	-2500	Pa	completed.	
						fuel tank pressure	<	1300	Pa	< 20 sec	
Stuck Closed Purge valve						ratio: (MAP Model / Baro)	<	0.8125	-	The test	
	P0497	vacuum pulldown slope	integrated air mass flow >	0.3	g	fuel level	>	11	%	will attempt	
			tank vacuum >	-1.221	Pa	fuel level	<	88	%	to run up	
						engine start temp - amb. Temp	<	9.75	° C	to 10 times	
						time after engine start	>	600	sec	until it	
						or fuel mixture adaptation	stable	-	-	successfully	
						amb pressure	>	68	kPa	completes	
						maximum number of attempts	<	10	-	a test	
						est amb air temp	>	1.5	° C		
						est amb air temp	<	32.25	° C		
						error: mass air flow	not set	-	-		
						error: coolant temp	not set	-	-		
						error: intake air temp	not set	-	-		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						error: fuel tank pres	not set	-	-		
						error: system voltage	not set	-	-		
						error: purge valve	not set	-	-		
						error: vehicle speed	not set	-	-		
						error: canister vent valve	not set	-	-		
						error: purge valve flow	not set	-	-		
						error: accelerator pedal	not set	-	-		
Idle Speed System (disabled during cold start)	P0506	functional check	desired rpm - actual rpm >	100	rpm	load (for underspeed only)	<	99.75	%	10 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						coolant temp.	>	-11.3	° C		
	P0507		desired rpm - actual rpm <	-200	rpm	intake air temp	>	-11.3	° C		
			or			vehicle	at idle				
			fuel cut off due to overspeed > during this idle	3	count	altitude factor (sea level = 1.0)	>	0.594	factor		
						time after engine start	>	0	sec		
						evap purge (high HC conc.)	FALSE				
						cold start idle speed control	FALSE				
						intrusive evap test	not active				
						error: throttle position	not set				
						error: vehicle speed	not set				
						error: coolant temperature	not set				
						error: intake air temperature	not set				
						error: evap system	not set				
						error: evap purge valve	not set				
Idle Speed System (enabled during cold start)	P050A	functional check	desired rpm - actual rpm > during catalyst heating on	100	rpm	load (for underspeed only)	<	99.75	%	7 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
						Engine coolant start temp.	>	-10 …. +60	° C		
			desired rpm - actual rpm < during catalyst heating on	-200	rpm	vehicle	at idle				
						altitude factor (sea level = 1.0)	>	0.594	factor		
						Engine coolant start temp.	<	60	° C		
						catalyst heating	TRUE	-	-		
						evap purge (high HC conc.)	FALSE	-	-		
						idle speed control catalyst heating	TRUE	-	-		
						intrusive evap test	not set	-	-		
						error: throttle position	not set	-	-		
						error: vehicle speed	not set	-	-		
						error: coolant temperature	not set	-	-		
						error: intake air temperature	not set	-	-		
						error: evap system	not set	-	-		
						error: evap purge valve	not set	-	-		
Vehicle speed sensor Manual Transmission	P0501	rationality	vehicle speed	171.875	mph	-	-	-	-	2 sec	two driving

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
		(high range check)						cycles each
	P0502	rationality (low range check) Unified Cycle required for failure detection when on a specific driving cycle	vehicle speed	3.125 mph	engine speed engine speed decel fuel shut off coolant temperature	> 1400 rpm < 3520 rpm TRUE - - > 40 ° C	3 sec	with: 1 sec continuous or 10 sec cumulative
System Voltage	P0562	range check low	voltage	9.99 V	time after engine start	> 180 sec	2 sec	no
	P0563	range check high	voltage	18.1 V	time after engine start vehicle speed	> 180 sec > 3.125 mph		
ECM monitoring	P0601	rationality	wrong ROM checksum	- -	checksum calculation at power down in the last driving cycle completely finished	TRUE - -	30 sec	code set then 5 sec
		rationality	wrong cyclic ROM checksum of critical regions	- -	partial checksum on critical variables		30 sec	code set then 5 sec
	P0602	rationality - programming incomplete	service ECU bit set in calibration	TRUE -	-	- - -	1 sec	code set then 5 sec
	P0603	ETC monitoring controller reset	SW internal	SW internal	power down calculation in the last driving cycle	completly - - finished	5 sec	code set then 5 sec
	P0604	functional check cyclic RAM-check	RAM writeability check read and write test writeability check of RAM		power down calculation in the last driving cycle	completly - - finished	5 sec	code set then 5 sec
	P0606	Elec. Throttle Cont (ETC) checks ETC monitoring torque comparison ETC monitoring engine speed signal	SW internal	SW internal	power down calculation in the last driving cycle	completly - - finished	5 sec	code set then 5 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		ETC monitoring volumetric efficiency signal ETC mon. vol. Eff., spark advance, A/D conv. grp. A, reaction crosscheck ETC monitoring throttle crosscheck ETC monitoring A/D conv group B, A/D converter supply voltage crosscheck ETC monitoring redundant pedal signal									
Fuel Pump Relay Control Circuit	P0628	circuit continuity - ground	Voltage <	2.21	V	engine speed	>	80	rpm	0.5 sec	two driving
	P0629	circuit continuity - battery	Voltage >	2.74	V	battery voltage	>	10	V		cycles each
	P0627	circuit continuity - open	Voltage <	2.74	V	battery voltage	<	18.1	V	0.1 sec	with: 4 sec
			and			output	activated and deactivated for complete checking				continuous
			Voltage >	2.21	V						or 30 sec cumulative
Electronic Throttle Control											
	P0638	motor control range check short term	| circuit duty cycle | > (absolute value)	80	%	battery voltage	>	7	V	0.6 sec (recoverable)	code set then 5 sec
		motor control range check long term								5.0 sec (latched)	
5V reference voltage monitoring	P0641	circuit continuity - open	Voltage	IC Internal	-	ignition key on	TRUE	-	-	3 sec	code set then 5 sec
	P0642	circuit continuity - ground				ECM power relay	TRUE	-	-		
	P0643	circuit continuity - voltage									
	P0651	circuit continuity - open	Voltage	IC Internal	-						
	P0652	circuit continuity - ground									
	P0653	circuit continuity - voltage									
	P0697	circuit continuity - open	Voltage	IC Internal	-						
	P0698	circuit continuity - ground									
	P0699	circuit continuity - voltage									
MIL Control Circuit	P0650	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	no

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		circuit continuity - ground circuit continuity - voltage				battery voltage battery voltage output	> < activated and deactivated for complete checking	10 18.1	V V		(but is shown in Mode $03)
Intake Manifold Tuning Valve Control Control Circuit	P0660 P0661 P0662	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage output	> > < activated and deactivated for complete checking	80 10 18.1	rpm V V	0.01 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Transmission Control Module MIL Illumination Request	P0700 (Specific TCM DTC shown in freeze frame)	OBD emission fault detected by the TCM	signal input	-	-	-	-	-	-	0.01 sec	code set then 5 sec
Clutch Pedal Position Sensor Manual Transmission	P0806	rationality - input cltuth pos. state changes	detected clutch pedal press count <	2	count - sensor presses detected	gear changes detected (ratio of engine speed to vehicle speed -- range change) Delay between shift detections vehicle speed between gear change detects	> > >	20 4 12.5	count sec mph	approx. 500 sec	code set then 5 sec
	P0807 P0808	Circuit Continuity - Ground Circuit Continuity - Voltage	Voltage < Voltage >	0.25 4.75	V V						

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P080A	rationality -	Pedal Position <	93	%	clutch pedal position greater	>	69	%		
		bottom of pedal travel not learned				start request from driver	FALSE				
Engine Metal Overtemperature Protection	P1258	engine coolant temperature	engine coolant temperature >	135.8	° C	time since engine start	>	30	sec	1 sec	code set
(Limp Home Function Active)		too high				error: engine coolant temp	not set	-	-		then 5 sec
Electronic Throttle Control											
	P1551	limp-home throttle position out of range	throttle position <	10.1	%	vehicle speed	<=	0	mph	5 sec	code set
			OR			engine speed	<	40	rpm		then 5 sec
			throttle position >	39.8	%	engine coolant temperature	>=	5.25	° C		
						engine coolant temperature	<=	100.5	° C		
						intake air temperature	>=	5.3	° C		
						intake air temperature	<=	143.3	° C		
						battery voltage	>	10	V		
						accelerator pedal position	<	14.9	%		
Fuel Level Sensor Circuit fuel level sensor 2											
	P2066	rationality	fuel level change <	4.4	%	Primary fuel level	>=	41	%		two driving cycles each with: 4 sec continuous or 30 sec cumulative
			and			Secondary fuel level	>=	6	%		
			cumulative driving distance >	75	mile	Or					
						Primary fuel level	<	41	%		
						Secondary fuel level	>	6	%		
						Or					
						Primary fuel level	>=	41	%		
						Secondary fuel level	<	6	%		
						And					
						battery voltage	>=	10	V		
						battery voltage	<=	18.09	V		
						engine start complete	>	240	rpm		
						electrical fuel level sensor(s) without failure	TRUE	-	-		
	P2067	range check low	voltage <	0.25	V	battery voltage	>=	10	V	60 sec	two driving cycles each with: 4 sec
						battery voltage	<=	18.09	V		
						engine start complete	>	240	rpm		
	P2068	range check high	voltage >	3.2	V	battery voltage	>=	10	V	60 sec	continuous or 30 sec cumulative
						battery voltage	<=	18.09	V		
						engine start complete	>	240	rpm		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Intake Manifold Tuning (IMT) Valve Position Feedback	P2070	rationality internal valve failure (with an internal failure from the IMT valve module, a unique position of 10% is output to the ECU)	IMT valve position <= and IMT valve position >	12 7	% %	battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical error: IMT valve position range check	> > TRUE > not set not set not set	9.9 5 -12.5 - 	V sec ° C - 	5 sec IMT valve intialization complete 5 sec after first IMT valve command	two driving cycles each with: 4 sec continuous or 30 sec cumulative
		rationality IMT Valve stuck in transient region	IMT valve position <= and IMT valve position >	67 32	% %	battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical error: IMT valve position range check	> > TRUE > not set not set not set	9.9 5 -12.5 - 	V sec ° C - 	5 sec IMT valve intialization complete 5 sec after first IMT valve command	two driving cycles each with: 4 sec continuous or 30 sec cumulative
		rationality IMT Valve stuck open	IMT valve position <= and IMT valve position >	32 11	% %	IMT valve commanded position battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical error: IMT valve position range check error: IMT valve internal error	= > > TRUE > not set not set not set not set	closed 9.9 5 -12.5 - 	- V sec ° C - 	5 sec IMT valve intialization complete 5 sec after first IMT valve command	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P2071	rationality	IMT valve position <=	92	%	IMT valve commanded position	=	open	-	5 sec	two driving

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
		IMT Valve stuck closed	and IMT valve position >	67	%	battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical error: IMT valve position range check error: IMT valve internal error	> > TRUE > not set not set not set not set	9.9 5 -12.5 - 	V sec ° C - 	 IMT valve intialization complete 5 sec after first IMT valve command	cycles each with: 4 sec continuous or 30 sec cumulative
	P2077	range check low	IMT valve position <	7	%	battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical	> > TRUE > not set not set	9.9 5 -12.5 - 	V sec ° C - 	5 sec IMT valve intialization complete 5 sec after first IMT valve command	two driving cycles each with: 4 sec continuous or 30 sec cumulative
	P2078	range check high	IMT valve position >	92	%	battery voltage time after engine start IMT valve intialization complete engine coolant temperature error: engine coolant temp error: IMT valve control electrical	> > TRUE > not set not set	9.9 5 -12.5 - 	V sec ° C - 	5 sec IMT valve intialization complete 5 sec after first IMT valve command	two driving cycles each with: 4 sec continuous or 30 sec cumulative
Secondary O2 Trim of primary O2 Sensor primary O2 sensor signal RICH / secondary O2 sensor signal LEAN Bank1 Bank 2	P2096 P2098	secondary O2 sensor fuel trim - rich shift - correction above threshold	secondary O2 sensor trim integral control >	0.8	sec	engine speed engine speed engine load engine load closed loop control active for time exhaust gas temp. model primary closed loop controller	< > < > TRUE > >	3480 1080 65.3 16.5 …. - 1 250	sec ° C % % - sec ° C	160 sec	two driving cycles each with: 4 sec continuous or 30 sec cumulative

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
primary O2 sensor signal LEAN / secondary O2 sensor signal RICH Bank 1	P2097	secondary O2 sensor fuel trim - lean shift - correction below threshold	secondary O2 sensor trim integral control <	-0.8	sec	at upper limit at lower limit secondary O2 sensor readiness catalyst clear out after DCFO error: purge valve error: secondary O2 sensor response error: secondary O2 heater error: fuel system monitoring error : Evap. Leak error : air flow meter	not set not set set not set not set not set not set not set not set not set	- - - - - - - - - -	- - - - - - - - - -		
Bank 2	P2099										
Electronic Throttle Control	P2100	circuit switch-off	output circuits not deactivated as commanded	-	-	-	-	-	-	0.1 sec	code set then 5 sec
	P2101	difference between set and actual position of throttle blade	difference between set and actual position of throttle blade >	4 . . . 50 dep. on rate of change	%	electronic throttle adaptation battery voltage	not active >	- 7	- V	0.5 sec	code set then 5 sec
	P2105	Electronic Throttle Control (ETC) checks ETC monitoring watchdog shutdown path				power down processing in the last driving cycle	completly finished	-	-	5 sec	code set then 5 sec
	P2119	functionality of return spring	throttle blade return response >	0.56	sec	vehicle speed engine speed engine coolant temperature engine coolant temperature intake air temperature intake air temperature battery voltage accelerator pedal position	<= < >= <= >= <= > <	0 40 5.25 100.5 5.25 143.5 9.99 14.9	mph rpm ° C ° C ° C ° C V %	0.56 sec once per ignition on	code set then 5 sec
Accelerator Pedal Position Sensor 1	P2122	range check low	voltage <	0.859	V	battery voltage	>	7	V	0.2 sec	code set
	P2123	range check high	voltage >	4.8242	V						then 5 sec
Accelerator Pedal Position Sensor 2	P2127	range check low	voltage <	0.625	V	battery voltage	>	7	V	0.2 sec	code set
	P2128	range check high	volteage >	4.824	V						then 5 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
Accelerator Pedal Position 1 versus Position 2	P2138	plausibility	voltage difference > idle range	0.234	V	-	-	-	-	0.24 sec	code set then 5 sec
			voltage difference > pedal partially pressed	0.293	V						
			voltage difference > pedal fully pressed	1.66	V						
Electronic Throttle Control											
	P2176	throttle exchange detection	range check poti1 value at lower stop			vehicle speed	<=	0	mph	1 sec	code set
		learn fail	throttle potentiometer 1 voltage <	4.12	V	engine speed	<	40	rpm		then 5 sec
		or	or			engine coolant temperature	>=	5.3	° C	once	
		initial throttle learn failed	throttle potentiometer 1 voltage >	4.55	V	engine coolant temperature	<=	100.5	° C	per	
		or				intake air temperature	>=	5.3	° C	ignition	
		learning prohibited due to	range check poti2 value at lower stop			intake air temperature	<=	143.3	° C	on	
		secondary parameters not met	throttle potentiometer 2 voltage <	0.34	V	battery voltage	>	10	V		
		or	or			accelerator pedal position	<	14.9	%		
		minimum throttle position	throttle potentiometer 2 voltage >	0.99	V						
		out of range									
Fuel System Lean/Rich Multiplicative											
Bank 1	P2177	fuel trim limits exceded	delta lambda correction >	1.23	factor	engine torque	>=	12.5	%	approx.	two driving
	P2178	range - multiplicative	or delta lambda correction <	0.78	factor	engine torque	<=	40	%	300 sec	cycles each
		(load > threshold and air flow > threshold)				engine speed	>=	1200	rpm	from engine	with: 4 sec
Bank 2	P2179		delta lambda correction >	1.23	factor	engine speed	<=	3340	rpm	start (after	continuous
	P2180		or delta lambda correction <	0.78	factor	intake air temperature	<=	60	°C	adaptation	or 30 sec
						primary A/F sensor 1 readiness	TRUE	-	-	has	cumulative
						primary A/F sensor 2 readiness	TRUE	-	-	begun)	
						command lambda	>	0.83	-		
						command lambda	<	1.2	-		
						catalyst heating	not set	-	-		
						error: misfire detected	not set	-	-		
						deceleration fuel cut-off	not set	-	-		
						transient compensation	not set	-	-		
						wide open throttle	not set	-	-		
						fuel level	<	11	%		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
						and error: fuel level	not set	-	-		
						and integrated fuel mass	>	700	g		
						error: cam control diagnosis	not set	-	-		
						error: injection value fault	not set	-	-		
						error: catalyst damaging misfire	not set	-	-		
Fuel System Lean/Rich additive											
Bank 1	P2187	range - additive	delta fuel load correction >	6	%	engine torque	>=	0	%	approx.	two driving
	P2188	low speed and low load	or delta fuel load correction <	-6	%	engine torque	<=	23	%	300 sec	cycles each
						engine speed	>=	520	rpm	from engine	with: 4 sec
Bank 2	P2189		delta fuel load correction >	6.05	%	engine speed	<=	1000	rpm	start (after	continuous
	P2190		or delta fuel load correction <	-6	%	closed loop control	TRUE	-	-	adaptation	or 30 sec
						engine coolant temperature	>	60	°C	has	cumulative
						intake air temperature	<=	60	°C	begun)	
						primary A/F sensor 1 readiness	TRUE	-	-		
						primary A/F sensor 2 readiness	TRUE	-	-		
						command lambda	>	0.83	-		
						command lambda	<	1.2	-		
						catalyst heating	not set	-	-		
						error: misfire detected	not set	-	-		
						deceleration fuel cut-off	not set	-	-		
						transient compensation	not set	-	-		
						wide open throttle	not set	-	-		
						fuel level	<	11	%		
						and error: fuel level	not set	-	-		
						and integrated fuel mass	>	700	g		
						error: cam control diagnosis	not set	-	-		
						error: inection value fault	not set	-	-		
						error: catalyst damaging misfire	not set	-	-		
Barometric Pressure Sensor Rationality	P2227	range check high	sensor signal >	115	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	two driving cycles each with: 1 sec
			or			for time	>	0.2	sec		
		range check low	sensor signal <	50	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous or 10 sec

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
			or			for time	>	0.2	sec		cumulative
		sensor offset / jump test low	sensor output change within 20 sec period >	10	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	
			OR barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec		
			jump from previous key off > AND			error : barometric pressure sensor electrical	not set	-	-		
			sensor output + THRESHOLD < pressure model	2	KPa	air mass flow meter readiness	TRUE	-	-		
						engine running time	>	1	sec		
						command air flow valid	TRUE	-	-		
						corrector factor calculation for mass-flow substitute load signal	TRUE	-	-		
						air flow meter signal valid	TRUE	-	-		
						enabling air flow meter diag.	TRUE	-	-		
						Evap. Leak detection active	not set	-	-		
						for time	>	1	sec		
						error: throttle position sensor	not set	-	-		
						error: air flow mass meter	not set	-	-		
						error : Baro pressure sensor electrical	not set	-	-		
			or								
		sensor offset / jump test high	sensor output change within 20 sec period >	10	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
			OR barometric pressure signal pressure	30	KPa	time since engine start	<	5	sec		
			jump from previous key off > AND			error : barometric pressure sensor electrical	not set	-	-		
			sensor output - THRESHOLD > pressure model	2	KPa	air mass flow meter readiness	TRUE	-	-		
						engine running time	>	1	sec		
						command air flow valid	TRUE	-	-		
						corrector factor calculation for mass-flow substitute load signal	TRUE	-	-		
						air flow meter signal valid	TRUE	-	-		
						enabling air flow meter diag.	TRUE	-	-		
						Evap. Leak detection active	not set	-	-		
						for time	>	1	sec		
						error: throttle position sensor	not set	-	-		
						error: air flow mass meter	not set	-	-		
						error : Baro pressure sensor electrical	not set	-	-		
	P2228	range check low	voltage <	0.2	V	enabled by scheduler for time	>	1	sec	2 sec	

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE		SECONDARY PARAMETERS	ENABLE CONDITIONS			TIME REQUIRED	MIL ILLUM.
	P2229	range check high	voltage >	4.87	V	enabled by scheduler for time	>	1	sec		
Oxygen Sensor sensor circuit (secondary O2)											two driving
bank 1 sensor 2	P2232	sensor line short circuit	secondary O2 sensor			secondary O2 heating stable	TRUE	TRUE	-	10 sec	cycles each
bank 2 sensor 2	P2235	to heater output line	voltage gradient >	2	V	dew-point end of Sec. O2	TRUE	TRUE			with: 1 sec
						for time	>	30	sec		continuous
			within time after heater turn off <	0.04	sec						
			for occurrences >	4	count	battery voltage	>	10	V		or 10 sec
			out of heater turn offs	6	count	engine running	>	25	rpm		cumulative
Oxygen Sensor sensor response (secondary O2)						engine running	>	25	rpm		
						battery voltage	>	10	V		
bank 1 sensor 2	P2270	oscillation check low	secondary O2 sensor voltage <	0.63	V	secondary O2 sensor	ready	-	-	approx.	two driving
bank 2 sensor 2	P2272		for time >	100	sec	for time	>	10	sec	600 sec	cycles each
								-	-		with: 4 sec
			then			secondary O2 closed loop control	active				
			ramping in enrichment by	0.2	lambda	DFCO	FALSE	-	-	additional	continuous
			at gradient	0.017	l / sec	engine air flow (intrusive test)	>	5.6	g/sec	time if	or 30 sec
			for time (after enrichment limit reached)	10	sec	and engine air flow	<	33.3	g/sec	fuel level	cumulative
						for time	>	3	sec	is low and	
						engine air flow (passive monitor)	>	9.7	g/sec	not failed	
						sec. O2 trim - fast lean correction	FALSE			600 sec	
						sec. O2 trim - fast rich correction	FALSE				
						sec. O2 trim - slow correction	FALSE				
						sec. O2 aging DFCO test failed	FALSE				
						engine start complete	>	240	rpm		
		Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle				scheduled by System Manager	TRUE				
bank 1 sensor 2	P2271	oscillation check high	secondary O2 sensor voltage >	0.63	V	engine running	>	25	rpm		two driving
bank 2 sensor 2	P2273		for time >	100	sec	battery voltage	>	10	V		cycles each
			then			secondary O2 sensor	ready	-	-		with: 4 sec
			ramping in enleanment by	0.15	lambda	for time	>	10	sec		continuous
			at gradient	0.017	l / sec						or 30 sec
						secondary O2 closed loop control	active				cumulative
			for time (after enleanment limit reached)	10	sec	DFCO	FALSE				
						engine air flow (intrusive test)	>	5.6	g/sec		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
					and engine air flow < 33.3 g/sec for time > 3 sec engine air flow (passive monitor) > 9.7 g/sec sec. O2 trim - fast lean correction FALSE sec. O2 trim - fast rich correction FALSE sec. O2 trim - slow correction FALSE sec. O2 aging DFCO test failed FALSE engine start complete > 240 rpm scheduled by System Manager TRUE			
		Unified Cycle or warm FTP (CVS-72) required for failure detection when on a specific driving cycle						
Vehicle speed sensor Automatic Transmission	P2544	condition message interruption SGS condition SGS irreversible not plausible		set - set -	automatic transmission CAN Bus consisting of: ignition on for > 3 sec battery voltage > 9.8 V battery voltage < 18.1 V	configured - - initialized and ready	0.01 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
Real time clock Engine off timer Status Check	P2610	engine off timer signal check	engine off timer not valid	3	engine start complete > 240 rpm real time clock active TRUE - -		0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
Real time clock Engine off timer Rationality check	P2610	engine off timer incremental check	reference clock time delta - Engine Off Timer delta >	6 counts	engine start complete > 240 rpm failure counts >= 3 3		0.1 sec	two driving cycles each with: 1 sec continuous or 10 sec cumulative
			reference clock time delta - Engine Off Timer delta < or	6 counts	engine start complete > 240 rpm failure counts >= 3 counts			

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
			reference clock and Engine Off Time required synchronization time > (reference clock is an independently captured time value based on the ECM processor clock)	6 seconds	ECM afterrun complete	TRUE		
Fuel Level Sensor Circuit fuel transfer pump	P2636	transfer pump failure	fuel level 1 < and fuel level 2 >	10.3 % 22 %	sensor signal without failure engine start complete battery voltage battery voltage	TRUE - - > 240 rpm < 18.09 V > 10 V	240 sec	no
OBD ISO-15765 Communication Bus	U0073	ISO-15765 Bus Error	Invalid Message Received or Dual Port Ram Hardware Error; or No Communication / Bus Off		CAN Bus consisting of: ignition on for battery voltage battery voltage normal bus communication	initialized and ready > 3 sec > 9.8 V < 18.1 V running - -	1 sec 0.01 sec 0.02 sec	code set then 5 sec
	U0101	Communication with TCM	TCM Message Timeout	message missing, delayed, or invalid content	Automatic Transmission CAN Bus consisting of: ignition on for battery voltage battery voltage normal bus communication	equipped - - initialized - - and ready > 3 sec > 9.8 V < 18.1 V running - -	2.5 sec	code set then 5 sec
Cold Start Emissions Reduction Monitor	--	Cold start spark angle limitation (spark angle limitation imposed through torque reserve limit)	commanded torque reserve forced to remain above limitation value: value = nominal torque reserve x FACTOR (determination of FACTOR: the reduced level of torque reserve that does not result in a	0.25 --	limitation active as long as cold start strategy is active	-- -- --		

COMPONENT/ SYSTEM	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA	THRESHOLD VALUE	SECONDARY PARAMETERS	ENABLE CONDITIONS	TIME REQUIRED	MIL ILLUM.
			measureable increase in FTP emissions as compared to baseline)					
	--	Momentary spark angle limitation over-ride	over-ride allowed if requested torque reserve deviates below the limitation value		time since engine start	> 0.6 sec		
					number of over-ride events	<= 4 counts		
					time duration of current over-ride event	< 0.5 sec		
					above conditions present for time	> 0.1 sec		
					Cold start strategy extension with over-ride events time extension = number of over-ride events x FACTOR FACTOR	= 2 sec		

LOOKUP TABLES

P0011, P0021

KFDWNWDMXE / 2 (internal manufacturer cross reference)

Maximum Allowed Deviation - Intake Camshaft Position

degrees crank	Modeled Engine Oil Temperature (° C)				
Engine Speed (rpm)	0	60	80	100	130
800	6.00	6.00	7.00	9.00	11.00
1200	6.00	6.00	6.00	6.00	7.00
1600	6.00	6.00	6.00	6.00	7.00
2000	6.00	6.00	6.00	6.00	6.00
2500	6.00	6.00	6.00	6.00	6.00
4000	6.00	6.00	6.00	6.00	6.00

P0116

KLTCWCSTAB

Engine coolant temperature model based on ambient temperature + engine off timer output

Time (seconds)	300	10800	14400	18000	21600	32400	43200	50400
Coefficient:	0.996	0.367	0.258	0.188	0.160	0.066	0.027	0.004

P0135, P0155

KFRINV / 2 (internal manufacturer cross reference)

Sensor Element (Ceramic) Impedance, Nominal Value - Secondary O2 Sensor

Ohms	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
O2 Heater Power (watts)	260.006	320.006	399.998	459.998	539.991
0.70	184	144	136	120	104
0.80	160	136	128	112	104
1.00	144	128	120	112	104

FRINV1 / 2 (internal manufacturer cross reference)

Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor

	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
	260.006	320.006	399.998	459.998	539.991
factor	8.50	7.00	5.00	3.00	2.50

P0141, P0161

KFRINH / 2 (internal manufacturer cross reference)

Sensor Element (Ceramic) Impedance, Nominal Value - Secondary O2 Sensor

Ohms	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
O2 Heater Power (watts)	239.991	320.006	399.998	459.998	539.991
0.700	200	136	120	112	112
0.800	144	128	120	112	112
1.000	120	120	112	104	104

FRINH1 / 2 (internal manufacturer cross reference)

Multiplication Factor for Internal Resistance KFRINH Nominal Value - Secondary O2 Sensor

	Modeled Exhaust Gas Temperature at Secondary O2 Sensor (° C)				
	239.991	320.006	399.998	459.998	539.991
factor	26.75	15.00	7.50	5.25	3.50

P0300

MISALUN (internal manufacturer cross reference)

Minimum Load Threshold for Misfire Detection

	Engine Speed (rpm)							
	800	1600	2400	3200	4000	4800	5600	6720
Percent Torque (load - %)	9.0	10.9	9.8	10.6	16.8	23.8	30.5	27.7

LOOKUP TABLES

NGKRWN

P0327, P0332, P0328, P033 **RPM dynamic threshold for disabling knock diagnosis**

RPM	400.0	800.0	1200.0	1600.0	2000.0	2400.0	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400
RPM per second	1500.02	1500.02	1600.02	1800.02	1800.02	2000.03	2000.03	2100.03	2200	2300	2300	2400	2400	2500	2500	2500

P0327, P0332 **UDKSNU** (internal manufacturer cross reference)

Reference voltage threshold for knock sensor diagnosis - Lower Limit

	Engine Speed (rpm)															
	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400
Peak RMS Voltage (V)	0.088	0.089	0.091	0.099	0.103	0.109	0.111	0.111	0.109	0.131	0.147	0.170	0.217	0.233	0.301	0.331

P0328, P0333 **UDKSNO** (internal manufacturer cross reference)

Reference voltage threshold for knock sensor diagnosis - Upper Limit

	Engine Speed (rpm)															
	400	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000	6400
Peak RMS Voltage (V)	5.671	7.178	7.916	7.916	8.127	8.611	10.311	13.696	16.522	18.133	20.995	24.329	27.341	28.079	29.425	30.786

P0341, P0342, P0343, P034 **KLPHNOKA** (internal manufacturer cross reference)

Camshaft Position Sensor diagnosis missing counts

	Engine Speed (rpm)			
	600	1200	3000	7200
Cam Edge Missing Counts	6.000	12.000	30.000	72.000

P0442 **KFEONVPT** (internal manufacturer cross reference)

Vacuum / Pressure Threshold for Fuel Tank Leak Detection

Vacuum / Pressure (hPa)	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	5.3	9.8	15	20.3	24.8	30	34.5	39.8
3	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
11	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
18	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
26	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
34	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
45	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
49	5.71	5.71	5.71	7.15	6.68	6.16	7.72	8.00	8.00
56	5.48	5.53	5.30	6.80	6.15	5.67	7.62	8.00	8.00
64	5.36	5.35	5.40	6.83	6.16	5.63	7.61	8.00	8.00

Tank Capacity 68.12 Liters

Vacuum / Pressure (Pa)	Ambient Temperature (Model) (C)								
Fuel Level (%)	0	5.3	9.8	15	20.3	24.8	30	34.5	39.8
3	800	800	800	800	800	800	800	800	800
11	800	800	800	800	800	800	800	800	800
18	800	800	800	800	800	800	800	800	800
26	800	800	800	800	800	800	800	800	800
34	800	800	800	800	800	800	800	800	800
45	800	800	800	800	800	800	800	800	800
49	571	571	571	715	668	616	772	800	800
56	548	553	530	680	615	567	762	800	800
64	536	535	540	683	616	563	761	800	800

P0455 **KLIMSTLD** (internal manufacturer cross reference)

Vacuum Gradient Threshold for Fuel Tank Leak Detection

Fuel Level liters	0	10	20	25	30	35	40	45	50	60
g	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.07	0.80

Tank Capacity 68.12 Liters

LOOKUP TABLES

P2101

DWDKSBAMX (internal manufacturer cross reference)

Maximum Throttle Angle Deviation per computation cycle

	Percent Throttle Opening (%)				
	0	0.3	1	5	15
Percent Throttle Delta (%)	4	6	11	20	50