08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Circuit Continuity													
	P0035	circuit continuity - voltage	voltage	IC Internal	V	engine speed	>	80	rpm	0.01 sec	continuous	4 sec	two driving
	P0034	circuit continuity - ground				battery voltage	<	18.1	V				cycles each
	P0033	circuit continuity - open				battery voltage	>	9.99	V				with: 4 sec
													continuous
													or 50 sec
													cumulative
Air / Fuel Ratio Sensor Heating													
heater circuits - electrical													
bank 1 sensor 1 (primary)	P0030	circuit continuity - open	Voltage	IC Internal	-	engine	running			0.01 sec	0.01 sec	4 sec	two driving
	P0031	circuit continuity - ground				battery voltage	>	10.5	V		continuous	continuous	cycles each
	P0032	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
						output	activated and deactivated for complete checking					cumulative	continuous
													or 50 sec
													cumulative
heater performance													
bank 1 sensor 1	P0053	correction value for A/F sensor	absolute value of correction value for	45	Ohms	battery voltage	>	10.5	V	40 sec	0.1 sec	4 sec	two driving
		internal resistance measurement	A/F sensor internal resistance >			battery voltage	<	18.1	V		continuous	continuous	cycles each
		too much				engine starting	complete	-	-			or 50 sec	with: 4 sec
												cumulative	continuous
													or 50 sec
													cumulative
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor)													
Rationality													
	P0096	response check	temperature delta during evaluation period:	1.5	° C	drive period - count	>=	10	count	2 sec	0.1 sec	4 sec	two driving
			(max intake air temp. - min intake air temp.) <			each with					continuous	continuous	cycles each
						coolant temperature at start	<=	110.3	° C				with: 4 sec
						Intake Air Temperature Sensor 2						or 50 sec	continuous
						Electrical Failure	FALSE					cumulative	or 50 sec
						Mass Air Flow	>	111.1	g / sec				cumulative
						Mass Air Flow	<	6.7	g / sec				
						Vehicle speed	>	25	mph				
						idle period - count	>=	4	count				
						each with							
						coolant temperature at start	<=	110.3	° C				
						Intake Air Temperature Sensor 2							
						Electrical Failure	FALSE						
						Mass Air Flow	<	5.6	g / sec				
						Vehicle speed	<	9.4	mph				
						engine coolant temperature	>	60	° C				
Intake Air Temperature Sensor 2 (Boost Pressure Temperature Sensor)													
Circuit Continuity Check													
	P0098	circuit continuity - high	Intake Air Temperature Sensor 2 Voltage >	4.76	V	Engine Coolant Temperature	>	-10.5	° C	2 sec	0.01 sec	4 sec	two driving
	P0097	circuit continuity - low	Intake Air Temperature Sensor 2 Voltage <	0.156	V	Mass air flow	<	27.8	g / sec			continuous	cycles each
						Vehicle speed	<	2.5	mph			or 50 sec	with: 4 sec
	P0099	intermittent (discontinuity)	difference >			Intermittent (discontinuous) time	>	1	sec			cumulative	continuous
			(Intake Air Temperature Sensor 2 Raw Voltage -	0.4	V								or 50 sec
			Intake Air Temperature Sensor 2 Filtered Voltage)										
Mass Air Flow (MAF) Sensor													
Rationality													
	P0101	range check low	MAF sensor mass air flow * THRESHOLD < model	1.12	-	min / max MAP sensor air flow ratio	<	0.35	-	1.2 sec	0.1 sec	4 sec	two driving
		comparison to MAP based model				battery voltage	>	10.5	V				cycles each
						for time	>	0.1	sec				with: 4 sec
						time after start	>	0.3	sec				continuous
						crankshaft revolution counter	>	150	rev				or 50 sec
						turbocharger bypass valve closed	TRUE	-	-				cumulative
			or			no boost pressure oscillation	FALSE	-	-				
		fuel trim limits exceeded	delta lambda correction >	20	%	error - intake air temperature sensor #2	not set	-	-				
		range - multiplicative				error : ambient pressure sensor electrical	not set	-	-				
		and				error : ambient pressure sensor rationality	not set	-	-				
		correction factor (modeled air	correction factor air mass <	80	%	error : throttle position sensor	not set	-	-				
		mass at throttle / air mass				error : boost pressure sensor electrical	not set	-	-				
		measured by air mass flow meter)				error : boost pressure sensor rationality	not set	-	-				
						error : MAP pressure sensor electrical	not set	-	-				
		range check high -	MAF sensor mass air flow * THRESHOLD > model	0.88	-	error : MAP pressure sensor rationality	not set	-	-				
		comparison to MAP based model				Desired cam angle valid	TRUE	-	-				
			or			Long term fuel trim enabled	TRUE	-	-				
		fuel trim limits exceeded	delta lambda correction <	-20	%	Fuel trim stabilized	TRUE	-	-				
		range - multiplicative				MAF sensor signal valid (until detection)	TRUE	-	-				
		and				Air flow error gradient	<	0.4	-				
		correction factor (modeled air	correction factor air mass >	120	%	Throttle position gradient	<	2	Deg / sec				
		mass at throttle / air mass				Engine coolant temperature	>	9.8	° C				
		measured by air mass flow meter)				Engine running time	>	1	sec				
						Pressure ratio across throttle	<	0.8	-				
						for time	>	0.5	sec				
	P0100	open circuit check	sensor signal time period =	0	uS	battery voltage	>	10.5	V				
						Engine is running	TRUE						
						Key on	TRUE						
	P0102	range check low	sensor signal time period <	66	uS	for time	>	0.1	sec				

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P0103	range check high	sensor signal time period >	2480	uS								
Manifold Absolute Pressure Sensor													
Rationality														
	P0106	range check high	sensor signal >	255.0	KPa	error : MAP sensor electrical	not set	-	-	3 sec	continuous	4 sec	two driving cycles each
													with: 4 sec
		range check low	sensor signal <	12.4	KPa	error : MAP sensor electrical	not set	-	-	3 sec	continuous	4 sec	continuous or 50 sec
			or										cumulative
		rationality check low - model	sensor signal + THRESHOLD < model	3.0	KPa	error : initial throttle learn failed	not set	-	-	3 sec	continuous	4 sec	
						error : throttle potentiometer fault	not set	-	-				
			or			error : intake air temperature sensor fault	not set	-	-				
		rationality check high - model	sensor signal - THRESHOLD > model	3.0	KPa	error : under pressure in fuel tank	not set	-	-				
						error : intake / exhaust camshaft control	not set	-	-				
						error : intake / exhaust camshaft electrical	not set	-	-				
						error : ambient pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor rationality	not set	-	-				
						error : boost pressure sensor electrical	not set	-	-				
						error : boost pressure sensor rationality	not set	-	-				
						error : MAP sensor electrical	not set	-	-				
						crankshaft revolution counter since engine start	>	200	counts				
						block diagnosis if :							
						start-up coolant temperature	<	-7.5	C				
						until							
						engine coolant temperature	>	30	C				
						conditions met once during drive cycle							
						throttle position	<	25	%				
						engine speed	>	1500	rpm				
						MAP sensor reading change	>	10	KPa				
			or										
		rationality check high : 3 sensor check	sensor signal - THRESHOLD > mean sensor output	7.5	KPa	engine speed	<	400	rpm	200 ms	during engine cranking only	4 sec	two driving cycles each
			or			engine off timer	>	4	sec				with: 4 sec
		rationality check low : 3 sensor check	sensor signal + THRESHOLD < mean sensor output	7.5	KPa	error : ambient pressure sensor electrical	not set	-	-				continuous
						error : boost pressure sensor electrical	not set	-	-				or 50 sec
						error : MAP sensor electrical	not set	-	-				cumulative
Manifold Absolute Pressure Sensor													
Electrical														
	P0108	circuit continuity - voltage	MAP sensor output voltage >	4.805	V	engine speed	>	80	rpm	1.0 sec	continuous	4 sec	two driving
	P0107	circuit continuity - ground	MAP sensor output voltage <	0.1855	V								cycles each
													with: 4 sec
													continuous
													or 50 sec
													cumulative
Intake Air Temperature Sensor 1 (MAF Intake Air Temperature Sensor)													
Electrical														
	P0113	circuit continuity - high	Intake Air Temperature Sensor 1 Voltage >	4.76	V	Engine Coolant Temperature	>	-10.5	° C	2 sec	0.01 sec	4 sec	two driving
	P0112	circuit continuity - low	Intake Air Temperature Sensor 1 Voltage <	0.175	V								cycles each
													with: 4 sec
	P0114	intermittent (discontinuity)	Intake Air Temperature Sensor 1 Raw Voltage -	0.4	V	Intermittent (discontinuous) time	>	1	sec	2 sec			continuous
			Intake Air Temperature Sensor 1 Filtered Voltage										or 50 sec
													cumulative
Air / Fuel Ratio Sensor (primary A/F)													
integrated circuit interface														
bank 1	P0130	A/F sensor voltage	absolute value of A/F sensor voltage			battery voltage	<	18.1	V	0.1 sec	0.1 sec	4 sec	two driving
		IC correction too high	IC corrective value >	0.15	V	battery voltage	>	10.7	V		continuous	continuous	cycles each
						engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
													or 50 sec
													cumulative
Air / Fuel Ratio Sensor (primary A/F)													
reference ground circuit; reference voltage circuit; or measuring current circuit														
bank 1 sensor 1 - low volt	P0131	A/F sensor signal at VM	IC Circuit Status shorted low	IC Internal	-	battery voltage	<	18.1	V	20 sec	0.1 sec	4 sec	two driving
		(reference ground) below lower limit				battery voltage	>	10.7	V		continuous	continuous	cycles each
		or A/F sensor signal at UN	IC Circuit Status shorted low	IC Internal	-	engine	running	-	-			or 50 sec	with: 4 sec
		(reference voltage [Nernst voltage]) below lower limit				engine starting	complete	-	-			cumulative	continuous
		or A/F sensor signal at IA	IC Circuit Status shorted low	IC Internal	-								or 50 sec
		(measuring current trim circuit) below lower limit											cumulative
bank 1 sensor 1 - high volt	P0132	A/F sensor signal at VM	IC Circuit Status shorted high	IC Internal	-								
		(reference ground) above upper limit											
		or A/F sensor signal at UN	IC Circuit Status shorted high	IC Internal	-								
		(reference voltage [Nernst voltage]) above upper limit											
		or A/F sensor signal at IA	IC Circuit Status shorted high	IC Internal	-								
		(measuring current trim circuit) above upper limit											
Air / Fuel Ratio Sensor (primary A/F)													
response														
Bank 1 Sensor 1	P0133	dynamic response	A/F sensor dynamic value <	0.3	ratio	fuel trim forced amplitude	active	-	-	1.6 sec	0.01 sec	4 sec	two driving

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		slow or low amplitude				A/F sensor	ready	-	-		continuous	continuous	cycles each
						short term fuel trim (o.k.)	< MAX	1.25	factor			or 50 sec	with: 4 sec
					(versus	short term fuel trim (o.k.)	> MIN	0.75	factor			cumulative	continuous
					reference	measured A/F minus integral	<	1.08	lambda				or 50 sec
					sensor)	control of secondary O2				then			cumulative
						measured A/F minus integral	>	0.92	lambda	dynamic			
						control of secondary O2				test			
						engine speed	<	3520	rpm	sample			
						engine speed	>	1520	rpm	count			
						volumetric efficiency	<	60	%	>			
						volumetric efficiency	>	20	%	40			
						volumetric efficiency gradient	<	100	%/sec	samples			
						A/F sensor housing model temp	<	600	°C				
						absolute value of forced amplitude	>	0.01	lambda				
						filtered purge HC conc. factor	<	15	factor				
						or evap purge	not active	-	-				
						all fuel injectors active	TRUE	-	-				
						evap purge high HC conc.	FALSE	-	-				
						A/F pumping current circuit	checked OK	-	-				
						error: evap purge valve	not set	-	-				
						error: evap purge valve circuit	not set	-	-				
						scheduled by System Manager	TRUE	-	-				
						heater reached set temperature	TRUE	-	-				
heater performance (primary A/F)													
bank 1 sensor 1	P0135	A/F sensor calculated temperature	A/F sensor temperature calculation <	620	°C	battery voltage	>	10.5	V	70 sec	0.1 sec	4 sec	two driving
		too low				battery voltage	<	18.1	V		continuous	continuous	cycles each
						internal resistance measurement	valid	-	-			or 50 sec	with: 4 sec
						all injectors activated	TRUE	-	-			cumulative	continuous
						A/F sensor internal resistance	FALSE	-	-				or 50 sec
						excessive correction required							cumulative
						engine stop time	>	300	sec				
						engine temperature at start	>	-30	°C				
						A/F sensor heating ready	TRUE	-	-				
						A/F heater control shut off	FALSE	-	-				
						scheduled by System Manager	TRUE	-	-				
heater performance (primary A/F)													
bank 1 sensor 1 (primary)	P0135	A/F sensor calculated	A/F sensor temperature calculation <	765	°C	A/F Heater at Maximum Power	TRUE			20 sec	0.1 sec	4 sec	two driving
		temperature below threshold		TKERDCMN		modeled exhaust temp. at sensor	>	350	°C		continuous	continuous	cycles each
						timer expires after either:	>	20	sec			or 50 sec	with: 4 sec
						fuel shut off >= 3 sec dur. ends	-	-	-			cumulative	continuous
						or initial A/F heater turn on	-	-	-				or 50 sec
						battery voltage	>	10.5	V				cumulative
						battery voltage	<	18.1	V				
						A/F heater control shut off	FALSE	-	-				
						modeled exhaust temp. valid	FALSE						
						scheduled by System Manager	TRUE	-	-				
Oxygen Sensor (Secondary O2 sensor)						deceleration fuel cut-off (DCFO)	active	-	-	4sec		4 sec	two driving
Delayed response voltage during DCFO						Since DCFO, secondary O2 sensor voltage	>	0.55	V		continuous		cycles each
bank 1 sensor 2	P013A	secondary O2 sensor	time from start of DCFO till secondary O2 sensor	3	sec	has ever exceeded upper threshold							with: 4 sec
		delayed response to DFCO	voltage below the lower threshold			battery voltage	>	11	V				continuous
						secondary O2 sensor readiness	TRUE	-	-				or 50 sec
						modeled exhaust gas temperature at	>	500	°C				cumulative
		or	the oxygen mass integration from start of DCFO	8	g	secondary O2 sensor temperature							
			exceeded upper threshold before the voltage below			secondary O2 sensor internal resistance	<	500	Ohms				
			the lower threshold			secondary O2 sensor has measured lean and rich	TRUE	-	-				
						exhaust gas mass flow rate	>	5.56	g/s				
			voltage lower threshold	0.15	V	primary A/F sensor	ready	-	-				
						primary A/F sensor measured lambda	>	3	lambda				
Slow response voltage during DCFO						Since DCFO, secondary O2 sensor voltage	>	0.59	V				
bank 1 sensor 2	P013A	secondary O2 sensor	time from secondary O2 sensor voltage crosses	0.4	sec	has ever exceeded upper threshold							
		slow response to DFCO	upper threshold till it corsses lower threshold			battery voltage	>	11	V				
						secondary O2 sensor readiness	TRUE	-	-				
			voltage upper threshold	0.4	V	modeled exhaust gas temperature at	>	500	°C				
						secondary O2 sensor temperature							
			voltage lower threshold	0.2	V	secondary O2 sensor internal resistance	<	500	Ohms				
						secondary O2 sensor has measured lean and rich	TRUE	-	-				
						exhaust gas mass flow rate	>	5.56	g/s				
						primary A/F sensor	ready	-	-				
						primary A/F sensor measured lambda	>	3	lambda				
Turbocharger boost control system													
Rationality													
	P0234	actual boost pressure above desired	difference (desired versus actual boost pressure) <	-128...-20	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	3.2 sec	continuous	4 sec	two driving
						error : rationale diagnosis of boost pressure sensor	not set	-	-				cycles each
													with: 4 sec
	P0299	actual boost pressure below desired	time filtered deviation	20	kPa	error : electrical diagnosis of boost pressure sensor	not set	-	-	0.2 sec	continuous	4 sec	continuous
			(desired versus actual boost pressure) >			error : rationale diagnosis of boost pressure sensor	not set	-	-				or 50 sec
						error : turbocharger boost control system	not set	-	-				cumulative
						error : limp home mode activated	not set	-	-				
						error : limp home mode activated with safety fuel cut-	not set	-	-				
						engine speed	>	2600...3520	rpm				
						desired manifold pressure > base boost pressure	>	110..130	KPa				
						ambient barometric pressure	>	65	KPa				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Boost Pressure Sensor													
Rationality													
	P0236	range check low	sensor signal <	13	KPa	error : boost pressure sensor electrical	not set	-	-	3 sec	continuous	4 sec	two driving
													cycles each
			or										with: 4 sec
		rationality check low - baro comparison	sensor signal + THRESHOLD < baro pressure	23	KPa	crankshaft revolution counter since engine start	>	3	counts				continuous
						error : throttle potentiometer fault	not set	-	-				or 50 sec
			or			error : limp home mode	not set	-	-				cumulative
		rationality check high - baro comparison	sensor signal - THRESHOLD > baro pressure	18	KPa	error : boost pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor rationality	not set	-	-				
						engine speed	<	1000	rpm				
						throttle position	<	24	%				
			or										
		rationality check high - 3 sensor check	sensor signal - THRESHOLD > mean sensor output	4.5	KPa	engine speed	<	400	rpm	200 ms	during engine	4 sec	two driving
						engine off timer	>	4	sec		cranking		cycles each
			or			error : ambient pressure sensor electrical	not set	-	-		only		with: 4 sec
		rationality check low - 3 sensor check	sensor signal + THRESHOLD < mean sensor output	4.5	KPa	error : boost pressure sensor electrical	not set	-	-				continuous
						error : MAP sensor electrical	not set	-	-				or 50 sec
													cumulative
Boost Pressure Sensor													
Electrical													
	P0238	circuit continuity - voltage	Boost sensor output voltage >	4.85	V	engine speed	>	80	rpm	0.20 sec	continuous	4 sec	two driving
	P0237	circuit continuity - ground	Boost sensor output voltage <	0.1855	V								cycles each
													with: 4 sec
													continuous
													or 50 sec
													cumulative
Turbocharger Boost Control Actuator													
Circuit Continuity													
	P0246	circuit continuity - voltage	voltage	IC Internal	V	engine speed	>	80	rpm	0.01 sec	continuous	4 sec	two driving
	P0245	circuit continuity - ground				battery voltage	<	18.1	V				cycles each
	P0243	circuit continuity - open				battery voltage	>	9.99	V				with: 4 sec
													continuous
													or 50 sec
													cumulative
Catalyst System	P0420	oxygen storage of catalyst	EWMA filtered catalyst aging factor	0.2	factor	exhaust gas mass flow	>	10	g/sec				
Performance			less than catalyst aging factor			exhaust gas mass flow	<	42	g/sec	approx.	0.2 sec	4 sec	immediate
			of a limit catalyst <			catalyst temp. model	<	750	° C	1000 sec	continuous	additional	once code
						catalyst temp. model	>	525	° C	during		after block	has
						engine speed	>	1320	rpm	active			been set
						engine speed	<	2840	rpm	driving			
						engine load	>	21 ... 34	%				
						engine load	<	50 ... 68	%	Fast Initialization phase	Up to 4		approx.
						modeled catalyst temp. gradient	<	30	° C / sec		samples per		3 test
						relative exhaust gas mass flow gradient	<	0	%		driving cycle		average
						fuel system closed loop	active	-	-	Step Change phase	Up to 4		run length
						time after secondary O2 sensor exceeded	>	20	sec		samples per		(6 samples)
						dewpoint					driving cycle		
						ambient temperature	>	-15	° C	Stablized phase	1 sample per		
						measured lambda	>	0.96	-		driving cycle		
						measured lambda	<	1.04	-				
						catalyst damaging misfire rate exceeded	not set	-	-				
						error: fuel system	not set	-	-				
						closed loop control at limit	not set	-	-				
						strong transient compensation present	not set	-	-				
						catalyst clear out active (after fuel cutoff)	not set	-	-				
						Trigger condition for step change							
						Measured OSC < % of EWMA							
						normalized filtered OSC	<	0.73	-				
Electronic Throttle Control													
	P1551	limp-home throttle position	throttle position <	13.1	%	vehicle speed	<=	0	mph	5 sec	0.01 sec	4 sec	code set
		out of range	OR			engine speed	<	40	rpm		at key on		then 5 sec
			throttle position >	42.8	%	engine coolant temperature	>=	5.25	° C			or 50 sec	
						engine coolant temperature	<=	100.5	° C			cumulative	
						intake air temperature	>=	5.25	° C				
						intake air temperature	<=	143.8	° C				
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Air / Fuel Ratio Sensor (primary A/F)													
integrated circuit interface													
	P167A	A/F sensor IC operating voltage	low voltage	TRUE	-	battery voltage	>	10.7	V	10 sec	0.1 sec	4 sec	two driving
		too low				battery voltage	<	18.1	V		continuous	continuous	cycles each
		A/F sensor IC SPI interface	communication error	TRUE	-	engine	running	-	-	0.1 sec		or 50 sec	with: 4 sec
		communication error											cumulative
		A/F sensor IC circuit write error	write error	TRUE	-	engine starting	TRUE	-	-	0.1 sec			or 50 sec
		at INIT register											cumulative

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
Bank 1	P2096	A/F sensor long term secondary trim - rich shift - correction below threshold	secondary O2 sensor trim integral control <	-0.03	lambda	engine starting secondary O2 trim active and secondary O2 oscillation check finished then timer	TRUE TRUE TRUE >	- - - 60	- - - sec	0.1 sec continuous	4 sec continuous or 50 sec cumulative	two driving cycles each with: 4 sec continuous or 50 sec cumulative
Bank 1	P2097	A/F sensor long term secondary trim - lean shift - correction above threshold	secondary O2 sensor trim integral control >	0.03	lambda	scheduled by System Manager sec. O2 trim - fast lean correction sec. O2 trim - fast rich correction suspicion A/F sensor lean shift secondary O2 oscillation test	TRUE FALSE FALSE FALSE checked OK					
Accelerator Pedal Position Sensor 1	P2122 P2123	range check low range check high	voltage	0.74 4.82	V V	battery voltage	>	7	V	0.2 sec	0.01 sec continuous or 50 sec cumulative	4 sec cont. then 5 sec	code set
Accelerator Pedal Position Sensor 2	P2127 P2128	range check low range check high	voltage	0.68 4.82	V V	battery voltage	>	7	V	0.2 sec			
Accelerator Pedal Position 1 versus Position 2	P2138	plausibility	voltage difference > idle range voltage difference pedal partially pressed > voltage difference > pedal fully pressed	0.18 0.29 0.29 1.72	V V V V	-	-	-	-	0.24 sec			
Oxygen Sensor (secondary O2) Trim of Air / Fuel Ratio Sensor (primary A/F)													
Bank 1	P2195	A/F sensor offset calculation rich shift - correction below threshold	A/F sensor offset correction <	-0.07	lambda	engine starting secondary O2 trim active and secondary O2 oscillation check finished then timer	TRUE TRUE TRUE >	- - - 60	- - - sec	0.1 sec continuous	4 sec continuous or 50 sec cumulative	two driving cycles each with: 4 sec continuous or 50 sec cumulative
Bank 1	P2196	A/F sensor offset calculation lean shift - correction above threshold	A/F sensor offset correction >	0.07	lambda	scheduled by System Manager sec. O2 trim - fast lean correction sec. O2 trim - fast rich correction suspicion A/F sensor lean shift secondary O2 oscillation test	TRUE FALSE FALSE FALSE checked OK					
Intake Air Temperature Sensor 1 (MAF Intake Air Temperature Sensor) Rationality													
	P2199	Intake Air Temperature Correlation Check	Intake Air Temperature Sensor 1 - Intake Air Temperature Sensor 2 >	24.8	° C	mass air flow mass air flow vehicle speed boost pressure to ambient pressure ratio	> < > <	6.7 83.3 34.4 1.4	g / sec g / sec mph ratio	25 sec	0.01 sec	5 seconds after enable condition	two driving cycles each with: 4 sec continuous or 50 sec
		Intake Air Temperature Correlation Check	Intake Air Temperature Sensor 1 - Intake Air Temperature Sensor 2 <	20.3	° C								
Barometric Pressure Sensor Rationality													
	P2227	range check high or	sensor signal >	112	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	two driving cycles each with: 4 sec continuous or 50 sec cumulative
		range check low or	sensor signal <	60.5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
		sensor offset / jump test low	sensor output change within 20 sec period > OR	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
			barometric pressure signal pressure jump from previous key off > AND	10	KPa	time since engine start error : barometric pressure sensor electrical	< not set	5 -	sec -				
			sensor output + THRESHOLD < boost pressure sensor output or	5	KPa	engine speed throttle position error : barometric pressure sensor electrical	< < not set	1000 23.99 -	rpm % -				
		sensor offset / jump test high	sensor output change within 20 sec period > OR	5	KPa	error : barometric pressure sensor electrical	not set	-	-	2 sec	continuous	4 sec	
			barometric pressure signal pressure jump from previous key off > AND	10	KPa	time since engine start error : barometric pressure sensor electrical	< not set	5 -	sec -				
			sensor output - THRESHOLD > boost pressure sensor output or	5	KPa	engine speed throttle position error : barometric pressure sensor electrical	< < not set	1000 23.99 -	rpm % -				
		rationality check high - 3 sensor check or	sensor signal - THRESHOLD > mean sensor output	4.52	KPa	engine speed engine off timer error : ambient pressure sensor electrical	< > not set	400 4 -	rpm sec -	200 ms	during engine cranking only	4 sec	
		rationality check low - 3 sensor check	sensor signal + THRESHOLD < mean sensor output	4.52	KPa	error : boost pressure sensor electrical error : MAP sensor electrical	not set not set	- -	- -				

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Barometric Pressure Sensor Electrical													
	P2228	range check low	voltage <	0.332	V	enabled by scheduler for time	>	2	sec	2 sec	continuous	4 sec	
	P2229	range check high	voltage >	4.708	V	enabled by scheduler for time	>	2	sec	2 sec	continuous	4 sec	
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open		lambda control factor change	absolute value of lambda control factor	0.075	lambda	battery voltage	<	18.1	V	1.5 sec	0.1 sec	4 sec	two driving
	P2237	above threshold	change from the point when the			battery voltage	>	10.7	V		continuous	continuous	cycles each
			secondary conditions are met >			engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
						A/F sensor voltage	<	1.51	V				or 50 sec
						A/F sensor voltage	>	1.48	V				cumulative
						A/F sensor electrical trimming	not active	-	-				
						A/F sensor heater at op.temp.	TRUE	-	-				
						A/F sensor warm up control	complete	-	-				
						lambda closed loop control	TRUE	-	-				
						forced fuel trim amplitude	TRUE	-	-				
						| fuel trim forced amplitude |	>	0.01	lambda				
						catalyst warm up control	stable	-	-				
						sec. O2 sensor proportional trim	stable	-	-				
						lean mixture inhibit	stable	-	-				
						lambda closed loop control init	FALSE	-	-				
						closed loop control startup	FALSE	-	-				
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open		A/F sensor voltage within upper	A/F sensor voltage <	1.51	V	battery voltage	<	18.1	V	approx.	0.1 sec	4 sec	two driving
	P2237	and lower thresholds	and A/F sensor voltage >	1.48	V	battery voltage	>	10.7	V	8 sec	continuous	continuous	cycles each
		and desired lambda is outside				engine	running	-	-	once the		or 50 sec	with: 4 sec
		of upper or lower threshold				engine starting	complete	-	-	driving		cumulative	continuous
						target lambda above upper limit	>	1.03	lambda	condition			or 50 sec
						or below lower limit	<	0.97	lambda	is met			cumulative
						closed loop control	TRUE	-	-				
						A/F sensor heater	TRUE	-	-				
						at operating temperature							
						A/F sensor electrical trimming	active	-	-				
						A/F sensor dynamic response	not slow	-	-				
						error: A/F sensor heating	not set	-	-				
						integrated exhaust gas mass	>	200	g				
Air / Fuel Ratio Sensor (primary A/F) pumping current circuit open		A/F sensor not lean enough	A/F sensor voltage <	1.7	V	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
	P2237	during fuel shut off operation				battery voltage	>	10.7	V		continuous	continuous	cycles each
						engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
						time after fuel shut off	>	3	sec				or 50 sec
						A/F sensor heater	TRUE	-	-				cumulative
						at operating temperature							
Air / Fuel Ratio Sensor (primary A/F) reference voltage circuit open		A/F sensor voltage	A/F sensor voltage <	0.2	V	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
	P2243	above upper threshold	A/F sensor voltage >	4.7	V	battery voltage	>	10.7	V		continuous	continuous	cycles each
		or below lower threshold				engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
			for time	1	sec	A/F sensor heating normal	>	10	sec				or 50 sec
						operation range for time							cumulative
						error: A/F sensor heater circuit	not set	-	-				
						A/F sensor internal resistance	>	950	Ohms				
Air / Fuel Ratio Sensor (primary A/F) reference ground circuit open		A/F sensor voltage within range	A/F sensor voltage	1.480	V	battery voltage	<	18.1	V	5sec	0.1 sec	4 sec	two driving
	P2251					battery voltage	>	10.7	V		continuous	continuous	cycles each
				1.35	V	engine	running	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
													or 50 sec
													cumulative
						The following conditions met for	>	5	sec				
						A/F sensor heating normal	>	10	sec				
						operation range for time							
						A/F sensor internal resistance	>	950	Ohms				
						error: A/F sensor heater circuit	not set						
						The following conditions met for	>	20	sec				
						A/F sensor heating ready	TRUE	-	-				
						and engine	running	-	-				
						and A/F heater control shut off	FALSE	-	-				
						and finished a DFCO longer than	>	2	sec				
						and battery voltage	>	11	V				
Turbocharger Bypass Valve (mechanical) Rationality													
	P2261	induction system pulsation	detected pulsations >	7	counts	minimum time - bypass valve activation time	>	1.05	sec	200 ms	continuous	4 sec	two driving
		monitor				bypass valve command							cycles each
						boost versus ambient pressure ratio	>	1.1…3.3	ratio				with: 4 sec
						battery voltage	>	18.1	V				continuous

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						error : MAF electrical	not set	-	-				or 50 sec
						error : MAF rationality	not set	-	-				cumulative
						error : ambient pressure sensor electrical	not set	-	-				
						error : ambient pressure sensor rationality	not set	-	-				
						error : battery voltage	not set	-	-				
						error : turbocharger bypass valve electrical	not set	-	-				
						error : throttle valve potentiometer	not set	-	-				
						error : boost pressure sensor electrical	not set	-	-				
						error : boost pressure sensor rationality	not set	-	-				
						error : intake air temperature sensor 2	not set	-	-				
						error : MAP sensor electrical	not set	-	-				
						error : MAP sensor rationality	not set	-	-				
Air / Fuel Ratio Sensor (primary A/F)													
sensor voltage		A/F sensor voltage	A/F sensor voltage >	3.7	V	A/F sensor heater	TRUE	-	-	10 sec	0.1 sec	4 sec	two driving
	P2297	exceeds threshold	and			at operating temperature					continuous	continuous	cycles each
		but not out of full range	A/F sensor voltage <	4.81	V	engine starting	complete	-	-	additional		or 50 sec	with: 4 sec
						desired A/F	<	1.6	lambda	time if		cumulative	continuous
			or			all injectors activated	TRUE	-	-	fuel level			or 50 sec
						scheduled by System Manager	TRUE	-	-	is low and			cumulative
			AF sensor voltage >	2.5	V	A/F sensor	ready	-	-	not failed			
			and			suspicion A/F sensor lean shift	FALSE	-	-	600 sec			
			A/F sensor voltage <	3.06	V								
			(if using rich calibration										
			curve characteristic)										
Air / Fuel Ratio Sensor (primary A/F)													
measuring (trim) current	P2626	A/F sensor voltage	A/F sensor voltage >	4.81	V	battery voltage	<	18.1	V	2 sec	0.1 sec	4 sec	two driving
circuit open		above threshold				battery voltage	>	10.7	V		continuous	continuous	cycles each
						engine	running	-	-	additional		or 50 sec	with: 4 sec
						engine starting	complete	-	-	time if		cumulative	continuous
						fuel cut off	TRUE	-	-	fuel level			or 50 sec
						modeled exhaust temp	<	780	° C	is low and			cumulative
						in front of catalyst				not failed			
						A/F sensor heater	TRUE	-	-				
						at operating temperature				600 sec			
End LNF Unique													

LOOK-UP TABLES (LNF)

P0234   **KLDLUL**   (internal manufacturer cross reference)
Pressure deviation for overboost detection

	Difference : Desired manifold pressure - base (mechanical) boost level (KPa)							
	-10	-5	0	25	50	75	100	120
Delta Pressure (kPa)	-127.5	-127.5	-60	-30	-23	-20	-18	-18

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Camshaft Control													
Electrical													
Bank 1 Intake	P0010	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P2088	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P2089	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
Bank 1 Exhaust	P0013	circuit continuity - open				output	activated and deactivated for complete checking					cumulative	continuous
	P2090	circuit continuity - ground											or 50 sec
	P2091	circuit continuity - voltage											cumulative
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.	0.01 sec	4 sec	two driving
Bank 1 Exhaust	P0014		angle versus filtered desired angle) >	KFDWNWDMXE / 2		engine run time	>	1	sec	20 sec	continuous		cycles each
Bank 2 Intake	P0021		(desired must remain above value	KFDWNWDMXA / 2		camshaft control circuit test	complete	-	-				or 50 sec
Bank 2 Exhaust	P0024		to test to complete the evaluation)			error: camshaft control circuit	not set	-	-	(2 times		cumulative	with: 4 sec
			same as above, but offset added to the	0	degrees	coolant temperature	<	143	° C	for 2.5 sec			continuous
			difference, during cold start only:			coolant temperature	>	-48	° C	each)			or 50 sec
			filtered actual angle			engine oil temperature	<	143	° C				cumulative
			< 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)							
			no difference is seen between desired										
			and actual)										
			same as above, but during cold start only:	4	count								
			difference (filtered actual angle max	1.5	degrees								
			versus actual at test start) >										
			(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 >	9.9	degrees	engine run time >	>	50	sec	approx.	0.2 sec	4 sec	two driving
Bank 1 Exhaust	P0017	limit check	or adapted angle <	9.9	degrees	engine coolant temp >	>	0	° C	600 sec	continuous	continuous	cycles each
Bank 2 Intake	P0018	(applies for each camshaft)	or actual angle with parked cams >	15	degrees	engine coolant temp <	<	95.25	° C			or 50 sec	with: 4 sec
Bank 2 Exhaust	P0019		and <	21	degrees	model: engine oil temp <	<	120	° C	fail after		cumulative	continuous
Bank 1 / Idler Sprocket	P0008		adapted angle for both cams >	6.0	degrees	error: camshaft sensor	not set	-	-	2 adaptation			or 50 sec
Bank 2 / Idler Sprocket	P0009		adapted angle for both cams <			error: camshaft control circuit	not set	-	-	cycles -			cumulative
										required			
Air / Fuel Ratio Sensor Heating and Oxygen Sensor Heating													
heater circuits - electrical													
bank 1 sensor 2 (secondary)	P0036	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0037	circuit continuity - ground				battery voltage	>	10	V		continuous	continuous	cycles each
	P0038	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
bank 2 sensor 2 (secondary)	P0056	circuit continuity - open				secondary O2 sensor heating	ready					cumulative	continuous
	P0057	circuit continuity - ground				secondary O2 sensor dew point	reached						or 50 sec
	P0058	circuit continuity - voltage				output	activated and deactivated for complete checking						cumulative
High Pressure Fuel Control System													
Rationality													
	P0088	pressure deviation from desired -	difference (desired versus actual fuel rail pressure	-2000	Kpa	error: electrical diagnosis of fuel volume c	not set	-	-	2 sec	continuous	4 sec	Immdediate once
		over pressure				tester request for open fuel flow control va	FALSE	-	-				code has been set
	P0087	pressure deviation from desired -	difference (desired versus actual fuel rail pressure	1500	Kpa	error: electrical diagnosis of fuel rail press	not set	-	-	2 sec	continuous	4 sec	
		under pressure				airbag deployed	FALSE	-	-				
	P0089	C/L controller output value - above	Controller output value ("p" part plus "i" part) >	2500	Kpa	battery voltage	<	18.1	V	2 sec	continuous	4 sec	
		expected				relative injected fuel mass	>	5.016	%				
	P0089	C/L controller output value - below	Controller output value ("p" part plus "i" part) <	-2500	Kpa	relative injected fuel mass	<	500	%	2 sec	continuous	4 sec	
		expected				first engine start at assembly plant	FALSE	-	-				
						DFCO active	FALSE						
						engine speed	>	25	rpm				
						syncronisation reference mark detected	TRUE						
						engine start temperature	>	-48	C				
High Pressure Fuel Volume Control Valve													
Circuit rationality													
	P0092	circuit rationality - feed-back voltage	voltage test pulse - on command >	4.502	V	battery voltage	>	6	V	0.5 sec	continuous	4 sec	Immdediate once
	P0091	circuit rationality - feed-back voltage	voltage test pulse - off command <	2.749	V	battery voltage	<	18.1	V				code has been set
	P0090	circuit rationality - feed-back voltage	voltage test pulse - off command within window	49 < Voltage < 4.5	V	battery voltage	<	ff command voltage	V				
						circuit switched off due to 5 volt supply fau	not set	-	-				
Engine coolant	P0116	difference from Engine	filtered difference			Engine coolant model (cooled down)	<	50	° C	100 sec	0.2 sec	4 sec	immediate
temperature sensor		temperature model after soaking	(ECT at key on - ECTmodel at key on)	14.3	° C	Soaking time after shut down	>	19800	sec	for block	continuous	additional	once code
										heating		after block	has
						previous accumulated air mass **AND**	>	6000	g	check		check	been set
			or			previous engine run time	>	600	sec		one filter	heater	
						or					update per	check when	
			filtered difference			ECT at shut down	>	81.75	° C		cold start	filtered	approx.
			(ECTmodel at key on - ECT at key on)	14.3	° C	Controller Shut Down at end of last cycle	-	-	-			difference	6 test
						Error - Engine Off Timer	not detected	-	-			exceeds	average
						Powerfail during previous drive	not detected	-	-			threshold	run length
						Block Heater	not detected	-	-				(15°C delta)
Engine coolant	P0117	range check high	coolant temperature >	140.3	° C	if Startup IAT	>	72	° C	0.1 sec	0.1 sec	4 sec	two driving

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
temperature sensor						hot restart timer	>=	60	sec		continuous	continuous	cycles each
	P0118	range check low	coolant temperature <	-42	° C		-	-	-			or 50 sec	with: 4 sec
												cumulative	cont. or 50
													sec cum.
	P0119	intermittent (discontinuity)	delta coolant temp. during evaluation period <	-4.5	° C		-	-	-	0.1 sec	0.01 sec		
			delta coolant temp. during evaluation period >	4.5	° C						continuous		
			weighted counter >	60000	count								
			(up 5,000 w/jump; down 1 with steady)										
Throttle Position Sensor 1 (primary)	P0121	range check poti voltage	sensor difference >	9	%	battery voltage	>	7	V	continuous	0.1 sec	4 sec	two driving cycles each
											continuous	continuous	with: 4 sec
												or 50 sec	cont. or 50
												cumulative	
	P0122	plausibility to other poti	sensor circuit low voltage <	0.176	V	battery voltage	>	7	V	continuous	0.1 sec	4 sec	Immdediate once
	P0123		sensor circuit high voltage >	4.629	V						continuous	continuous	code has been set
												or 50 sec	
												cumulative	
Sensor 2 (redundant)	P0221	range check poti voltage,	sensor difference >	9	%	battery voltage	>	7	V	continuous	0.1 sec	4 sec	two driving
											continuous	continuous	cycles each
												or 50 sec	with: 4 sec
												cumulative	cont. or 50
	P0222	plausibility to other poti	sensor circuit low voltage <	0.156	V	battery voltage	>	7	V	continuous	0.1 sec	4 sec	Immdediate once
	P0223		sensor circuit high voltage >	4.883	V						continuous	continuous	code has been set
												or 50 sec	
												cumulative	
Engine Coolant Thermostat Monitoring	P0128	Coolant Temperature Below Thermostat Regulating Temperature (plausibility check)	(calculated reference model coolant temp minus measured coolant temperature) >	10.5	° C	error: engine coolant temp	not set	-	-	5 sec	0.1 sec	4 sec	two driving
						error: vehicle speed sensor	not set	-	-		continuous	continuous	cycles each
						est. ambient temperature	>	-10.5	°C			or 50 sec	with: 4 sec
			reference model calculation limit	89.3	° C	est. ambient temperature	<	70	°C			cumulative	continuous
						vehicle speed	>=	9.375	mph	typical fault			or 50 sec
			(development vehicles indicated			engine speed	>	960	rpm	detection time for			cumulative
			steady thermostat regulating			coolant temperature at start	<	60.8	°C	stuck open t-stat =			
			temperatures of 89°C, as measured			integrated air mass flow	>	3000	g	~ 700 sec			
			by the engine coolant temp. sensor.										
			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.)										
			or										
Engine coolant temperature sensor		plausibility check	calculated coolant temperature model minus measured temperature >	9.8	° C	the model temperature increases depending on air flow				120 to 300 sec			
						coolant temp at start	<	40.5	°C	approx.			
						ECT Electrical Failure	not set	-	-	500 sec			
						Blockheater Detection	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	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
						and secondary O2 dew point end	TRUE				continuous	continuous	cycles each
						for time	>	90	sec			or 50 sec	with: 4 sec
						engine running	TRUE	-	-			cumulative	continuous
						battery voltage	>	10.4	V				or 50 sec
						mod. exhaust-gas temp.	<	800	° C				cumulative
						time after start	<	1	sec				
						engine temp at stop	>	60	° C				
						engine temp	<	40	° C				
						error: engine coolant temp	not set	-	-				
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	TRUE	-	-	5.1 sec			
						and secondary O2 dew point end	TRUE						
						for time	>	90	sec				
						engine running	TRUE	-	-				
						battery voltage	>	10.4	V				
						mod. exhaust-gas temp.	<	800	° C				
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	TRUE	-	-	60 sec			
						and secondary O2 dew point end	TRUE						
			or			for time	>	90	sec				
			secondary O2 sensor internal resistance >	40000	Ohm	engine running	TRUE	-	-				
			when modeled exhaust gas temperature >	450	° C	battery voltage	>	10.4	V				
						mod. exhaust-gas temp.	<	800	° C				
Oxygen Sensor Heating heater performance (secondary O2) bank 1 sensor 2 (secondary) bank 2 sensor 2 (secondary)	P0141 P0161	secondary O2 sensor internal resistance above threshold	measured secondary O2 sensor internal resistance >			battery voltage	>	10.5	V	approx.	0.1 sec	4 sec	two driving
						battery voltage	<	18.1	V	100 sec	continuous	continuous	cycles each
			nominal internal resistance	104 . . . 296	Ohms	engine running	TRUE	-	-			or 50 sec	with: 4 sec
						engine starting	complete	-	-			cumulative	continuous
			multipy times degradation factor	3.5 . . . 7.5	factor	fuel cut off	FALSE	-	-				or 50 sec
						sec. O2 internal resistance	valid	-	-				cumulative
			for time	6	sec	intake air temperature	>	-30	C				
						engine off soak time	>	120	sec				
						modeled exhaust temp. at secondary O2 sensor	in range	300 . . . 550	C				
						suspicion of secondary O2 sensor open circuit	FALSE						

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						secondary O2 voltage supply	ON						
						from the deactivation for time	>	120	sec				
Fuel Rail Pressure Sensor Rationality													
	P0191	rationality check low	Fuel pressure during power up init. <	250	KPa	engine speed	>	25	rpm	0.1 sec	During	4 sec	two driving
			AND			for time	>	0.5	sec		engine	continuous	cycles each
			Fuel system fault exists:			engine run time	>	30	sec		start only		with: 4 sec
			P0087 or P2188 or P2187										continuous
													or 50 sec
													cumulative
			or										
		rationality check high	Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm				
			AND			for time	>	30	sec				
			Fuel system faults exist:			block heater active	-	FALSE	-				
			P0088 or P2187 or P2177			engine coolant at shutdown	>	84.5	C				
						engine coolant at start	<	54.8	C				
						difference : engine coolant at start - intake air temperature	<	35.3	C				
						differenec : intake air temperature - engine coolant at start	<	9.75	C				
						engine off time during soak	>	16000	sec				
			or										
		rationality check high	Fuel pressure during power up init. >	1500	KPa	engine speed	>	25	rpm				
			AND			for time	>	30	sec				
			Fuel pressure rise during fuel pump prime >	3500	KPa	block heater active	-	FALSE	-				
						engine coolant at shutdown	>	84.5	C				
						engine coolant at start	<	54.8	C				
						difference : engine coolant at start - intake air temperature	<	35.3	C				
						differenec : intake air temperature - engine coolant at start	<	9.75	C				
						engine off time during soak	>	16000	sec				
Fuel Rail Pressure Sensor Electrical													
	P0193	circuit continuity - high	Fuel pressure sensor output voltage >	4.70	V		-	-	-	0.5 sec	0.01 sec	4 sec	Immdediate once
	P0192	circuit continuity - low	Fuel pressure sensor output voltage <	0.30	V		-	-	-	0.5 sec	0.01 sec	4 sec	code has been set
High Pressure Fuel Injection Valve Circuit Continuity - High side (HS) and Low Side (LS)													
Cylinder #1	P0201	circuit continuity - open LS or HS	Voltage	IC Internal		engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0261	circuit continuity - ground LS				battery voltage	>	8	v				cycles each
	P0262	circuit continuity - battery LS				battery voltage	<	18.1	v				with: 4 sec
	P2146	circuit continuity - ground or battery HS											continuous
													or 50 sec
Cylinder #2	P0202	circuit continuity - open LS or HS											cumulative
	P0264	circuit continuity - ground LS											
	P0265	circuit continuity - battery LS											
	P2149	circuit continuity - ground or battery HS											
Cylinider #3	P0203	circuit continuity - open LS or HS											
	P0267	circuit continuity - ground LS											
	P0268	circuit continuity - battery LS											
	P2152	circuit continuity - ground or battery HS											
Cylinder #4	P0204	circuit continuity - open LS or HS											
	P0270	circuit continuity - ground LS											
	P0271	circuit continuity - battery LS											
	P2155	circuit continuity - ground or battery HS											
Cylinder #5	P0205	circuit continuity - open LS or HS											
	P0273	circuit continuity - ground LS											
	P0274	circuit continuity - battery LS											
	P216A	circuit continuity - ground or battery HS											
Cylinder #6	P0206	circuit continuity - open LS or HS											
	P0276	circuit continuity - ground LS											
	P0277	circuit continuity - battery LS											
	P216D	circuit continuity - ground or battery HS											
SPI Communication	P062B	Internal SPI Communication Fault		IC Internal		engine speed	>	80	rpm	1.10 sec	0.01 sec	4 sec	
		or				battery voltage	>	8	v				
		Internal ADC Voltage Booster Failure		IC Internal		battery voltage	<	18.1	v	0.50 sec	0.01 sec	4 sec	
Diagnosis of Stuck Open Fuel Injector Rationality													
	P029D	fuel injector stuck open - cylinder #1	fuel pressure deviation from desired - under pressure (P0087)	set		misfire monitor active (see P0300 details)				200 ms	continuous	4 sec	Immdediate once
			and			engine speed	>	1520	rpm				code has been set
			cylinder # 1 misfire counts >	100	counts	engine speed	<	4520	rpm				
						relative engine load	<	114.8	%				
	P02A1	fuel injector stuck open - cylinder #2	fuel pressure deviation from desired - under pressure (P0087)	set		misfire counters accumulate within period <	<	80	rev				
			and										
			cylinder # 2 misfire counts >	100	counts								
	P02A5	fuel injector stuck open - cylinder #3	fuel pressure deviation from desired - under pressure (P0087)	set									
			and										
			cylinder # 3 misfire counts >	100	counts								

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
	P02A9	fuel injector stuck open - cylinder #4	fuel pressure deviation from desired - under pressure (P0087)	set									
			and										
			cylinder # 4 misfire counts >	100	counts								
	P02AD	fuel injector stuck open - cylinder #5	fuel pressure deviation from desired - under pressure (P0087)	set									
			and										
			cylinder # 5 misfire counts >	100	counts								
	P02B1	fuel injector stuck open - cylinder #6	fuel pressure deviation from desired - under pressure (P0087)	set									
			and										
			cylinder # 6 misfire counts >	100	counts								
Misfire													
Emission Level													
Multiple Cylinder	P0300	crankshaft speed	emissions relevant misfire rate	1.82	%	engine speed	>	420	rpm	1000 revs	cylinder	4 sec	Fault during
Cylinder #1	P0301	fluctuation cylinder 1 to				engine speed	<	7000	rpm		firing	continuous	1st interval:
Cylinder #2	P0302	cylinder 6				indicated torque (idle, no drive)	>	5.86	%		frequency		2 faults in
Cylinder #3	P0303					indicated torque (drive) (MISALUN)	>	7.05 . . . 29.3	%			After	2 different
Cylinder #4	P0304					engine speed gradient	<	2500 . . . 4600	rpm/sec			detection,	drive cycles.
Cylinder #5	P0305					volumetric efficiency gradient	<	225 . . . 1350	%/rev		continuous	the	
Cylinder #6	P0306					cylinder events after engine start	>	6	ignitions			diagnostic	Fault during
						air temperature	>	-30	° C			can only	remaining
						rough road (GMX295 only)	not detected	-	-			pass if	intervals:
						clutch switch press / release	transition	FALSE	-			similar	8 faults in 2
						leak detection pull-down phase	off	-	-			conditions	different
						fuel cut off	not active	-	-			are	drive cycles
						fuel level	>	11.4	-			encountered	with at least
						OR fuel level	<	11.4	%				4 faults in
						AND solid misfire MIL	on	-	%				each.
						OR fuel level error	set	-	-				
						error: throttle position	not set	-	-				
						error: crankshaft sensor	not set	-	-				
						error: ref.mark of crank sensor	not set	-	-				
			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	°C	all remaining			flashing
Cylinder #3	P0303					fuel level	>=	11.4	%	intervals			while error
Cylinder #4	P0304		18.1 . . . 5	%		OR fuel level	<	11.4	%				present, then
Cylinder #5	P0305		see Misfire			AND blinking MIL	blinking	-	-				no MIL
Cylinder #6	P0306		supplemental			AND NOT first blink event	-	-	-				with no error.
			data										
			(h) (2.5.1)										Second
													occurance:
													immediate
													flashing
													while error
													present, then
													solid MIL
													with no error.
Knock Control													
Circuit	P0324	test pulse	test pulse integral <	4	V					0.1 sec	0.1 sec	4 sec	two driving
			for consecutive events	4	count	engine coolant temp.	>	60	° C		continuous	continuous	cycles each
						knock control	active	-	-			or 50 sec	with: 4 sec
						zero test , parity fault assumptions	not set	-	-			cumulative	continuous
		or				measuring window	>	1	ms				or 50 sec
		null test (zero test)	absolute value (integrator gradient) >	200	V / sec	engine coolant temp.	>	60	° C				
						knock control	active	-	-				
			for consecutive events	4	count	test pulse , parity fault assumptions	not set	-	-				
		or											
		parity check	fficient RAM errors in knock IC, per 250 working cy	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 cy	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 worl	25	count	engine speed	>	2200	rpm	approx.	0.1 sec	4 sec	two driving
Performance	P0327	range check low	reference voltage <	0.055 . . . 0.221	V	engine speed gradient (NGKRWN)	<	500 . . . 2300	rpm / sec	20 sec	continuous	continuous	cycles each
				UDKSNU		engine load gradient	<	50 . . . 100	kPa / sec			or 50 sec	with: 4 sec
						error: knock control circuit (IC)	not set	-	-			cumulative	continuous
			for consecutive events	30	count								or 50 sec
	P0328	range check high											cumulative
			reference voltage >	3.1 . . . 39.1	V								
				UDKSNO									
			for consecutive events	30	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				
Circuit check	P0331	short circuit to B+ or GND	faults detected on knock sensor pins, per 250 worl	25	count	engine speed (NGKRWN)	<	500 . . . 2300	rpm	approx.	0.1 sec	4 sec	two driving
Performance	P0332	range check low	reference voltage <	0.088 . . . 0.331	V	engine load gradient	<	50 . . . 100	kPa / sec	20 sec	continuous	continuous	cycles each
						error: knock control circuit (IC)	not set	-	-			or 50 sec	with: 4 sec
												cumulative	continuous

08 GRP02 LNF Engine

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		for consecutive events		100	count								or 50 sec
	P0333	range check high											cumulative
			reference voltage >	3.1 . . . 39.1 UDKSNO	V								
			for consecutive events	100	count								
Crankshaft Position Sensor	P0335	circuit continuity	no engine signal	0	rpm	camshaft revolutions detected	>	12	counts	approx.	0.01 sec	4 sec	immediate
			but phase signals available							5 sec	continuous	continuous	once code
		rationality check	reference gap missing >	6	gaps							or 50 sec	has
			(sensor signal but no reference)									cumulative	been set
	P0336	rationality check	unexpected re-synchronization >	2600	count								
			(loss of reference mark)										
		rationality check	intermittent loss of engine speed signal >	28	count								
	P0338	rationality check	difference in counted teeth between	250	crankshaf					approx.	1 per rev		
			reference gap position events >		teeth					2 sec	continuous		
Camshaft Position Sensor													
Bank 1 Intake	P0341	plausibility check	signal erratic or out of position	4	count	engine in synchronized mode	TRUE	-	-	10	1 per rev	4 sec	two driving
	P0342	circuit low	signal permanently low	5	count					revolutions	continuous	continuous	cycles each
	P0343	circuit continuity or high	signal permanently high	5	count							or 50 sec	with: 4 sec
												cumulative	continuous
Bank 2 Intake	P0346	plausibility check	signal erratic or out of position										or 50 sec
	P0347	circuit low	signal permanently low										cumulative
	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										
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	IC Internal	-	engine speed	<	6000	rpm	approx.	engine	4 sec	two driving
	P2300	circuit continuity - ground				engine speed	>	9.99	V	1 sec	cycle	continuous	cycles each
	P2301	circuit continuity - voltage				battery voltage	<	18.1	V		frequency	or 50 sec	with: 4 sec
Cylinder #2	P0352	circuit continuity - open				battery voltage						cumulative	continuous
	P2303	circuit continuity - ground									continuous		or 50 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				
Evaporative System and Leak Monitor													
Small Leak - 0.020 "	P0442	natural pressure/vacuum	filtered fault index >	0.6	-	Eng. Running Vac. pull down	not set	(see P0455 for details)		approx.	0.1 sec	filtered	immediate
		in tank				or vac. pulldown suspect leak	0.020" leak	(see P0455 for details)		600 sec	once per	value	once code
			based on:			est amb air temp	>	1.5	° C	each test	engine off	exceeds	has
			(peak pressure - peak vacuum) <	540 . . . 1430	Pa	est amb air temp	<	32.25	° C		cycle	threshold	been set
			[Table KFEONVPT]			Engine stop coolant temp	>	74.25	° C	approx.		then	
						engine run time	>	600	sec	6 test		4 sec	
						trip distance travelled	>	5.1	miles	average	continuous		approx.
						@ vehicle speed above	>	1.6	mph	run length			6 test
						evap fuel volatility factor	<	8	factor				average
						fuel level	>	11.0	%				run length
						fuel level	<	88.1	%				
						fuel level change from keyoff	<	10.2	%				(The MIL
						error: vehicle speed	not set	-	-				actually is
						error: engine coolant temp	not set	-	-				requested
						error: purge valve	not set	-	-				during shut
						error: fuel tank pressure	not set	-	-				down soak.
						error: system voltage	not set	-	-				It becomes
						error: air mass meter	not set	-	-				visible on
						error: intake air temp	not set	-	-				the
						error: canister vent valve	not set	-	-				following
						altitude adaption	valid	-	-				drive.)
						tank vacuum out of range	FALSE	-	-				
						start (coolant - intake air)	<	9.75	° C				
						start engine coolant temp	<	42	° C				
						Start intake air temp	>	1.5	° C				
						Start intake air temp	<	32.3	° C				
						time since previous test	>	0	sec				
						amb pressure	>	68	kPa				
						battery voltage	>	10.8	V				
						vehicle odometer	>	12.5	miles				
Evaporative Emission System													

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
Purge Solenoid Control Circuit	P0443	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0458	circuit continuity - ground				battery voltage	>	9.99	V		continuous		cycles each
	P0459	circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	with: 4 sec
						output	activated and deactivated for complete checking					cumulative	continuous
													or 50 sec
													cumulative
Evaporative System and Leak Monitor													
Canister Vent Valve	P0446	underpressure in tank	tank pressure <	-800	Pa	fuel system status	closed loop	-	-	approx.	0.1 sec	4 sec	two driving
						vehicle speed	<	1.9	mph	5 sec	continuous		cycles each
						engine	idling	-	-		one		with: 4 sec
						battery voltage	>	10.5	V	Only one	completed		continuous
						battery voltage	<	18.1	V	test per	test per		or 50 sec
						fuel tank pressure	>	-2500	Pa	will be	driving		cumulative
						fuel tank pressure	<	1300	Pa	completed.	cycle		
						ratio: (MAP Model / Baro)	<	0.812	-				
						est amb air temp	>	1.5	°C	The test			
						est amb air temp	<	32.25	°C	will attempt			
						fuel level	>	11.2	%	to run up			
						fuel level	<	91.2	%	to 10 times			
						engine start temp - amb. temp	<	9.75	°C	until it			
						time after engine start	>	600	sec	successfully			
						or fuel mixture adaptation	stable	-	-	completes			
						amb pressure	>	68	kPa	a test			
						maximum number of attempts	<	10	-				
						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	-	-				
Evap Vent Solenoid Control Circuit	P0449	circuit continuity - open	Voltage	IC Internal	-	engine speed	>	80	rpm	0.01 sec	0.01 sec	4 sec	two driving
	P0498	circuit continuity - ground				battery voltage	>	9.99	V		continuous		cycles each
	P0499	circuit continuity - voltage				battery voltage	<	18.1	V	Only one		or 50 sec	with: 4 sec
						output	activated and deactivated for complete checking			test per		cumulative	continuous
													or 50 sec
													cumulative
Fuel Tank Pressure Sensor	P0450	rationality - signal oscillation	| delta pressure signal |	813	Pa	ambient temperature model	>	-7.5	°C	25.5	0.1 sec	4 sec	two driving
			(= current pressure - old pressure) >			vehicle speed >=	<=	18.75	mph	sec	continuous	continuous	cycles each
						time after canister vent valve open	>	4	sec			or 50 sec	with: 4 sec
													or 50 sec
													cumulative
	P0451	rationality - signal range check	sensor signal >=	1750	Pa	time after engine start	>	1	sec	25.5	0.1 sec	4 sec	two driving
			sensor signal >=	-3500	Pa	time after canister vent valve open	>	4	sec	sec	continuous	continuous	cycles each
												or 50 sec	with: 4 sec
		or											or 50 sec
		rationality - drift check	| delta pressure signal |	344	Pa	Vent solenoid valve open	TRUE	-	-				cumulative
			(= current pressure			Caniter purge flow (closed)	<=	0.0	g / sec				
			- reference pressure at start) >			ambient pressure	>	68000	Pa				
						fuel level	<	88.4	%				
						fuel level	>	11.2	%				
						fuel level	<	150	%				
						Or							
						fuel level valid for running							
						Evap. leak detection	TRUE	-	-				
						Vehicle speed	>	0	mph				
						Vehicle speed	<	93.75	mph				
						Or							
						ambient temperature model	<=		°C				
						ambient temperature model	>=		°C				
						time	>	3	sec				
	P0452	circuit continuity - ground	sensor signal voltage <	0.1514	V	engine running	TRUE	TRUE		10 sec	0.1 sec	4 sec	two driving
	P0453	circuit continuity - voltage	sensor signal voltage >	4.702	V						continuous	continuous	cycles each
												or 50 sec	with: 4 sec
													or 50 sec
													cumulative
Large leak	P0455	vacuum pulldown slope	absolute value			fuel system status	closed loop	-	-	11 sec	0.1 sec	4 sec	two driving
			of vacuum pulldown slope <			vehicle speed	<	1.9	mph		continuous		cycles each
				4.5 ... 7.6	Pa/sec	engine	idling	-	-	Only one	one		with: 4 sec
				[KLTLDSFS05]		battery voltage	>	10.5	V	test per	completed		continuous
						battery voltage	<	18.1	V	driving cycle	test per		or 50 sec
						fuel tank pressure	>	-2500	Pa	completed.	driving		cumulative
						fuel tank pressure	<	1300	Pa		cycle		
						ratio: (MAP Model / Baro)	<	0.81	-	The test			
						est amb air temp	>	1.5	°C	will attempt			
						est amb air temp	<	32.25	°C	to run up			
						fuel level	>	11.4	%	to 10 times			
						fuel level	<	88.1	%	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	-	-				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specified Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						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	P0461	rationality	fuel level change < and cumulative driving distance >	4.6 120.0	% km	Primary fuel level Secondary fuel level Or Primary fuel level Secondary fuel level and battery voltage battery voltage engine starting electrical fuel level sensor(s) without failure	< <= < > >= <= TRUE TRUE	41.1 6.2 41.1 6.2 10.5 18.1 - -	% liter liter liter V V - -	0.1 sec	continuous	4 sec continuous or 50 sec cumulative	no
			Or cumulative driving distance >=	162.0	km	OR Primary fuel level Secondary fuel level battery voltage battery voltage engine starting electrical fuel level sensor(s) without failure	>= < >= <= TRUE TRUE	41.1 6.2 10.5 18.1 - -	% % V V - -				
	P0462	range check low	voltage <	0.25	V	battery voltage battery voltage engine started	>= <= TRUE	10.5 18 -	V V -	60 sec	0.1 sec continuous	4 sec cont. or 50 sec cumulative	no
	P0463	range check high	voltage >	3.2	V	battery voltage battery voltage engine started	>= <= TRUE	10.5 18 -	V V -	60 sec	0.1 sec continuous	4 sec cont. or 50 sec cumulative	no
Cooling fan 1 relay Control Circuit	P0480 P0691 P0692	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-	engine speed battery voltage battery voltage	> > <	80 9.99 18.1	rpm V V	0.01 sec	0.01 sec continuous continuous	4 sec with: 4 sec continuous or 50 sec cumulative	two driving cycles each
Cooling fan 2 relay Control Circuit	P0481 P0693 P0694	circuit continuity - open circuit continuity - ground circuit continuity - voltage	Voltage	IC Internal	-							or 50 sec cumulative	
Evaporative System and Leak Monitor Leaking purge valve	P0496	underpressure in tank	tank pressure loss gradient <	-60	Pa	fuel system status vehicle speed engine battery voltage battery voltage fuel tank pressure fuel tank pressure ratio: (MAP Model / Baro) fuel level fuel level engine start temp - amb. temp time after engine start or fuel mixture adaptation amb pressure maximum number of attempts est amb air temp est amb air temp error: mass air flow error: coolant temp error: intake air temp error: fuel tank pres error: system voltage error: purge valve error: vehicle speed error: canister vent valve error: purge valve flow error: accelerator pedal	closed loop < idling > < > < < > < < > stable > < > < not set not set not set not set not set not set not set not set not set not set	- 1.9 - 10.5 18.1 -2500 1300 0.81 11.4 88.1 9.75 600 - 68 10 1.5 32.25 - - - - - - - - - -	- mph - V V Pa Pa - % % ° C sec - kPa - ° C ° C - - - - - - - - - -	about 4 sec Only one test per driving cycle completed. The test will attempt to run up to 10 times until it successfully completes a test	0.1 sec continuous one completed test per driving cycle	4 sec two driving cycles with: 4 sec continuous or 50 sec cumulative	two driving cycles
Stuck Closed Purge valve	P0497	vacuum pulldown slope	tank vacuum >	-1.221	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 error: mass air flow error: coolant temp error: intake air temp error: fuel tank pres error: system voltage error: purge valve	closed loop < idling > < > < < > < > < < > stable > not set not set not set not set not set not set	- 1.9 - 10.5 18.1 -2500 1300 0.81 1.5 32.25 11.4 88.1 9.75 600 - 68 - - - - - -	- mph - V V Pa Pa - ° C ° C % % ° C sec - kPa - - - - - -	11 sec Only one test per driving cycle completed. The test will attempt to run up to 10 times until it successfully completes a test	0.1 sec continuous one completed test per driving cycle	4 sec two driving cycles with: 4 sec continuous or 50 sec cumulative	two driving cycles each with: 4 sec continuous or 50 sec cumulative

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						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)	<	99.9 … 99.9	%	10 sec	0.1 sec	4 sec	two driving
						coolant temp.	>	-11.3	° C		continuous	continuous	cycles each
	P0507		desired rpm - actual rpm <	-200	rpm	intake air temp	>	-11.3	° C			or 50 sec	with: 4 sec
			or			vehicle	at idle					continuous	continuous
		fuel cut off due to overspeed >	3	count	altitude factor (sea level = 1.0)	>	0.594	factor				or 50 sec	
			during this idle			time after engine start	>	3.84	sec				
						evap purge (high HC conc.)	FALSE						cumulative
						cold start idle speed control	FALSE						
						intrusive evap test	not active						
						intrusive secondary air test (=not applicab	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 >	100	rpm	Engine coolant start temp.	>	-10 …. +40	° C	7 sec	0.1 sec	4 sec	two driving
			during catalyst heating on			vehicle	at idle				continuous	continuous	cycles each
			desired rpm - actual rpm <	-200	rpm	altitude factor (sea level = 1.0)	>	0.594	factor			or 50 sec	with: 4 sec
			during catalyst heating on			Engine coolant start temp.	<	80	° C			cumulative	continuous
						catalyst heating	TRUE	-	-				or 50 sec
						evap purge (high HC conc.)	FALSE	-	-				cumulative
						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	-	-				
System Voltage				powertrain supply relay feedback input									
	P0562	range check low	voltage	9.99	V	time after engine start	>	180	sec	2 sec	0.1 sec	4 sec	no
											continuous	continuous	
	P0563	range check high	voltage	18.1	V	time after engine start	>	180	sec			or 50 sec	
						vehicle speed	>	3.1	mph			cumulative	
ECM monitoring													
	P0601	rationality	wrong ROM checksum during initialization reaches ROMRSTA_UM times.	5	times	checksum calculation at power	TRUE	-	-	30 sec	0.01 sec	4 sec	code set
						down in the last driving cycle					at key off	continuous	then 5 sec
						completely finished							
		rationality	wrong cyclic ROM checksum of	-	-	partial checksum on critical				30 sec	0.01 sec	4 sec	code set
			critical regions			variables					at key on	continuous	then 5 sec
	P0602	rationality -	service ECU bit set in calibration	service ECU bit se	-	-		-	-	1 sec	0.01 sec	4 sec	code set
		programming incomplete									at key on	continuous	then 5 sec
	P0603	ETC monitoring controller reset	SW internal. Error from shut-down path test reaches DURNPRST_A times	3	times	power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
						in the last driving cycle	finished				continuous	continuous	then 5 sec
												or 50 sec	
												cumulative	
	P0604	functional check	RAM writeability check			power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
			read and write test			in the last driving cycle	finished				at key off	continuous	then 5 sec
		cyclic RAM-check	writeability check of RAM										
	P0606	Electronic Throttle Control (ETC) checks	SW internal	SW internal		power down calculation	completly	-	-	5 sec	0.01 sec	4 sec	code set
		ETC monitoring torque comparison				in the last driving cycle	finished				continuous	continuous	then 5 sec
		ETC monitoring engine speed signal										or 50 sec	
		ETC monitoring volumetric efficiency signal										cumulative	
		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											
		Electronic Throttle Control (ETC) checks	SW internal	SW Internal									
		SPI failure of throttle output stage											
Fuel Pump Relay Control	P0627	circuit continuity - open	voltage <	2.74	V	pump command off	-	-	-	0.1 sec	0.1 sec	50 sec	two driving
Circuit			voltage >	2.21	V	engine speed	>	80	rpm				cycles each
	P0629	circuit continuity - voltage	voltage >	2.21	V	battery voltage	>	9.99	V			cumulative	with: 4 sec
						battery voltage	<	18.1	V				continuous
													or 50 sec
													cumulative
	P0628	circuit continuity - ground	voltage <	2.21	V	pump command on	-	-	-	0.5 sec			
						engine speed	>	80	rpm				
						battery voltage	>	9.99	V				
						battery voltage	<	18.1	V				
Electronic Throttle Control													
	P0638	motor control range check	| circuit duty cycle | >	80	%	battery voltage	>	7	V	0.6 sec	0.01 sec	4 sec	code set
		short term	(absolute value)							(recoverable)	continuous	continuous	then 5 sec
												or 50 sec	

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
		motor control range check long term								5.0 sec (latched)	cumulative		
5V reference voltage monitoring	P0641	circuit continuity - open	Voltage	IC Internal	-	ignition key on	TRUE	-	-	3 sec	0.01 sec	4 sec	code set
	P0642	circuit continuity - ground				ECM power relay	TRUE	-	-		continuous		then 5 sec
	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	0.01 sec	4 sec	no
		circuit continuity - ground				battery voltage	>	10	V		continuous		(but is
		circuit continuity - voltage				battery voltage	<	18.1	V			or 50 sec	shown in
						output	activated and deactivated for complete checking					cumulative	Mode $03)
Transmission Control Module MIL Illumination Request	P0700	OBD emission fault detected by the TCM	signal input	-	-	-	-	-	-	0.01 sec	0.01 sec	4 sec cont.	code set
		(Specific TCM DTC shown in freeze frame)									continuous	or 50 sec cumulative	then 5 sec
Vehicle speed sensor Manual Transmission	P0501	rationality (high range check)	vehicle speed	171.9	mph	-	-	-	-	2 sec	0.1 sec continuous	4 sec continuous	two driving cycles each
	P0502	rationality (low range check)	vehicle speed	3.1	mph	engine speed	>	1800	rpm	3 sec	or 50 sec continuous	with: 4 sec cumulative	
						engine speed	>	3520	rpm				
						fuel shut off	TRUE	-	-			or 50 sec	
						coolant temperature	>	40	° C			cumulative	
Clutch Pedal Position Sensor Manual Transmission	P0806	rationality - input clutch pos. state changes	detected clutch pedal press count <	2	count - senso presses detected	gear changes detected (ratio of engine speed to vehicle speed -- range change)	>	20	count	approx. 500 sec	0.1 sec continuous	4 sec or 50 sec cumulative	code set then 5 sec
						Delay between shift detections	>	10	sec				
						vehicle speed between gear change detects	>	25.0	mph				
	P0807	Circuit Continuity - Ground	Voltage <	0.249	V								
	P0808	Circuit Continuity - Voltage	Voltage >	4.75	V								
Ignition Coil Driver Circuit Serial Communication													
	P167D	Internal SPI communication fault		IC Internal		battery voltage	<	18.1	v	0.01 sec	0.01 sec	4 sec	two driving
						battery voltage	>	9	v				cycles each
						engine speed	<	6000	rpm				with: 4 sec
													continuous
													or 50 sec
													cumulative
Electronic Throttle Control	P2100	circuit switch-off	output circuits not deactivated as commanded	-	-	-	-	-	-	0.1 sec	0.01 sec at key on continuous	4 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 > [Table DWDKSBAMX]	4 ... 50 dep. on rate of change	%	electronic throttle adaptation	not active	-	-	0.5 sec	0.01 sec continuous	4 sec cont. or 50 sec cumulative	code set then 5 sec
						battery voltage	>	7	V				
	P2105	Electronic Throttle Control (ETC) checks ETC monitoring watchdog shutdown path				power down processing in the last driving cycle	completly finished	-	-	5 sec	0.01 sec at key on continuous	4 sec	code set then 5 sec
	P2119	functionality of return spring	throttle blade return response	0.56	sec	vehicle speed	<=	0	mph	0.56 sec	0.01 sec at key on continuous	4 sec	code set then 5 sec
						engine speed	<	40	rpm				
						engine coolant temperature	>=	5.25	° C	once			
						engine coolant temperature	<=	100.5	° C	per			
						intake air temperature	>=	5.25	° C	ignition			
						intake air temperature	<=	143.8	° C	on			
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Electronic Throttle Control	P2176	throttle exchange detection learn fail or initial throttle learn failed or learning prohibited due to secondary parameters not met or minimum throttle position out of range	range check poti1 value at lower stop throttle potentiometer 1 voltage < or throttle potentiometer 1 voltage > or range check poti2 value at lower stop throttle potentiometer 2 voltage < or throttle potentiometer 2 voltage >	4.12 4.55 0.341 0.988	V V V V	vehicle speed	<=	0	mph	1 sec	0.01 sec at key on continuous	4 sec	code set then 5 sec
						engine speed	<	40	rpm				
						engine coolant temperature	>=	5.25	° C	once			
						engine coolant temperature	<=	100.5	° C	per			
						intake air temperature	>=	5.25	° C	ignition			
						intake air temperature	<=	143.8	° C	on			
						battery voltage	>	10.0	V				
						accelerator pedal position	<	14.9	%				
Fuel System Lean/Rich Multiplicative						air mass flow	>=	6.9	g/sec	approx.	0.1 sec	4 sec	two driving
						air mass flow	<=	41.7	g/sec	300 sec	continuous	or 50 sec	cycles each
						engine load	>=	18.0	%	from engine			with: 4 sec
Bank 1	P2177	fuel trim limits exceeded	delta lambda correction >	1.23	factor	engine load	<=	80.0	%	start (after		cumulative	continuous
	P2178	range - multiplicative (load > threshold and air flow > threshold)	or delta lambda correction <	0.78	factor	engine speed	>=	1200.0	rpm	adaptation			or 50 sec
						engine speed	<=	4000.0	rpm	has		After	cumulative
Bank 2	P2179		delta lambda correction >	1.23	factor	closed loop control	TRUE	-					
	P2180		or delta lambda correction <	0.78	factor	throttle angle	<=	99.6	99.6				
						engine coolant temperature	>	60	°C				

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specific Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
						intake air temperature	<=	60	°C				
						primary A/F sensor 1 readiness	TRUE	-	-				
						primary A/F sensor 2 readiness	TRUE	-	-				
						command lambda	>	0.83	-				
						catalyst heating	not set	-	-				
						critical misfire rate detected	not set	-	-				
						deceleration fuel cut-off	not set	-	-				
						transient compensation	not set	-	-				
						wide open throttle	not set	-	-				
						integrated fuel mass	>	700.0	g				
						and empty-valid fuel level	not set	-	-				
						error: cam control diagnosis	not set	-	-				
						error: inection value fault	not set	-	-				
						error: catalyst damaging misfire	not set	-	-				
Fuel System Lean/Rich additive													
Bank 1	P2187	range - additive	delta fuel load correction >	6.1	%	air mass flow	>=	1.7	g/sec				
	P2188	low speed and low load	or delta fuel load correction <	-6.0	%	air mass flow	<=	7.8	g/sec				
						engine load	>=	11.0	%				
Bank 2	P2189		delta fuel load correction >	6.1	%	engine load	<=	45.0	%				
	P2190		or delta fuel load correction <	-6.0	%	engine speed	>=	520.0	rpm				
						engine speed	<=	1120.0	rpm				
						closed loop control	TRUE	-	-				
						engine coolant temperature	>	60	°C				
						intake air temperature	<=	60	°C				
						primary A/F sensor 1 readiness	TRUE	-	-				
						primary A/F sensor 2 readiness	TRUE	-	-				
						command lambda	>	0.83	-				
						catalyst heating	not set	-	-				
						critical misfire rate detected	not set	-	-				
						deceleration fuel cut-off	not set	-	-				
						transient compensation	not set	-	-				
						wide open throttle	not set	-	-				
						integrated fuel mass	>	700.0	g				
						and empty-valid fuel level	not set	-	-				
						error: cam control diagnosis	not set	-	-				
						error: inection value fault	not set	-	-				
						error: catalyst damaging misfire	not set	-	-				
Oxygen Sensor sensor circuit (secondary O2)													
bank 1 sensor 2	P2232	sensor line short circuit	secondary O2 sensor			secondary O2 heating stable	TRUE	-	-	10 sec	0.01 sec	4 sec	two driving
bank 2 sensor 2	P2235	to heater output line	voltage gradient >	2	V	and secondary O2 dew point end	TRUE				continuous	continuous	cycles each
			within time after heater turn off <	0.04	sec	for time	>	90	sec			or 50 sec	with: 4 sec
			for occurrences >	4	count	engine running	TRUE	-	-			cumulative	continuous
			out of heater turn offs	6	count	battery voltage	>	10.4	V				or 50 sec
						mod. exhaust-gas temp.	<	800	°C				cumulative
						time after dew point exceeded	>	10	sec				
Oxygen Sensor sensor response (secondary O2)						engine running	TRUE	-	-				
						battery voltage	>	10.4	V				
bank 1 sensor 2	P2270	oscillation check low	secondary O2 sensor voltage <	0.582 . . . 0.661	V	secondary O2 sensor	ready	-	-	approx.	0.1 sec	4 sec	two driving
bank 2 sensor 2	P2272		for time >	100	sec	for time	>	10	sec	600 sec	continuous	continuous	cycles each
			then			secondary O2 closed loop control	active	-	-			or 50 sec	with: 4 sec
			ramping in enrichment by	0.2	lambda	DFCO	FALSE	-	-	additional		cumulative	continuous
			at gradient	0.017	λ / sec	engine air flow (intrusive test)	>	5.56	g/sec	time if			or 50 sec
			for time (after enrichment limit reached)	10	sec	and engine air flow	<	33.33	g/sec	fuel level			cumulative
						for time	>	3	sec	is low and			
						engine air flow (passive monitor)	>	9.72	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	running						
						scheduled by System Manager	TRUE						
bank 1 sensor 2	P2271	oscillation check high	secondary O2 sensor voltage >	0.582 . . . 0.661	V	engine running	TRUE	-	-				
bank 2 sensor 2	P2273		for time >	100	sec	battery voltage	>	10.4	V				
			then			secondary O2 sensor	ready	-	-				
			ramping in enleanment by	0.07	lambda	for time	>	10	sec				
			at gradient	0.017	λ / sec	secondary O2 closed loop control	active						
			for time (after enleanment limit reached)	10	sec	DFCO	FALSE						
						engine air flow (intrusive test)	>	5.56	g/sec				
						and engine air flow	<	33.33	g/sec				
						for time	>	3	sec				
						engine air flow (passive monitor)	>	9.72	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	running						
						scheduled by System Manager	TRUE						
Real time clock													
Engine Off Timer Status	P2610	engine off timer signal check	engine off timer not valid	3.0		engine start successful during previous dr	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving
(performed during						real time clock active	TRUE	-	-		continuous	continuous	cycles each
engine off operation)												or 50 sec	with: 4 sec
												cumulative	continuous
													or 50 sec
													cumulative
Real time clock													
Engine Off Timer Rationality	P2610	engine off timer incremental	reference clock time delta -	6	counts	engine start successful	TRUE	-	-	0.1 sec	0.1 sec	4 sec	two driving

Component/ System	Fault Code	Monitor Strategy Description	Primary Malfunction Signal and Criteria	Threshold Value	Specifie Units	Secondary Parameters	Enable Condition	Enable Value	Units	Time Required	Frequency of Checks	Criteria for Code	MIL Illumination
(performed during		check	engine off timer delta >			failure counts	>=	3	3		continuous	continuous	cycles each
engine running operation)												or 50 sec	with: 4 sec
												cumulative	continuous
(reference clock = independantly			reference clock time delta -	6	counts	engine start successful	TRUE	-	-				or 50 sec
captured time value)			engine off timer delta <			failure counts	>=	3	counts				cumulative
OBD ISO-15765 Communication Bus													
	U0073	ISO-15765 Bus Error	Invalid Message Received			CAN Bus	initialized			1 sec	0.01 sec	4 sec	code set
			or Dual Port Ram Hardware Error;			consisting of:	and ready				0.01 sec	continuous	then 5 sec
			or No Communication / Bus Off			ignition on for	>	3	sec	0.02 sec	continuous	or 50 sec	
						battery voltage	>	9.9	V			cumulative	
						battery voltage	<	18.1	V				
						normal bus communication	running	-	-				
	U0101	Communication with TCM	TCM Message Timeout	message		Automatic Transmission	equipped	-	-	2.5 sec	0.01 sec	4 sec	code set
				missing,		CAN Bus	initialized	-	-		continuous	continuous	then 5 sec
				delayed,		consisting of:	and ready					or 50 sec	
				or		ignition on for	>	3	sec			cumulative	
				invalid		battery voltage	>	9.9	V				
				content		battery voltage	<	18.1	V				
						normal bus communication	running	-	-				

LOOK-UP TABLES (COMMON)

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** (internal manufacturer cross reference)
Engine coolant temperature model based on ambient temperature + engine off timer output

Time (seconds)	1000	7200	10800	14400	21600	32400	43200	50400
Coefficient:	0.996	0.488	0.270	0.191	0.106	0.063	0.031	0.008

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)	300	360	420	480	540
0.7	344	328	304	272	224
0.8	248	240	232	200	168
1.0	200	184	168	152	128

296

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)				
	300	360	420	480	540
factor	15.00	10.00	6.00	4.00	2.50

LOOK-UP TABLES (COMMON)

P0327, P0332, P0328, P0333 **NGKRWN** (internal manufacturer cross reference)

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
RPM per second	500.01	600.01	800.01	1000.01	1200.02	1400.02	1600.02	1700.02	1800	1900	2000	2100	2100

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
Peak RMS Voltage (V)	0.056	0.060	0.067	0.079	0.089	0.104	0.121	0.132	0.139	0.145	0.155	0.181	0.192

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
Peak RMS Voltage (V)	3.120	4.904	5.796	6.815	7.834	9.108	10.000	11.911	18.790	22.714	25.287	27.197	30.637

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
5%	10.61	12.07	12.60	11.25	9.92	9.67	12.24	14.02	14.32
16%	10.94	12.67	13.19	11.57	10.03	10.08	12.58	14.16	14.22
27%	8.27	9.99	10.91	10.24	9.59	8.29	10.29	12.17	13.60
38%	6.93	8.24	8.14	8.64	9.83	7.44	7.82	8.67	8.95
49%	7.32	8.11	6.36	6.43	7.50	5.24	7.80	8.91	8.76
60%	7.09	7.29	7.01	6.53	5.82	5.60	7.57	8.95	8.78
71%	5.03	4.72	5.71	7.15	6.68	6.16	7.72	8.91	8.78
82%	5.48	5.53	5.30	6.80	6.15	5.67	7.62	8.94	8.78
93%	5.36	5.35	5.40	6.83	6.16	5.63	7.61	8.94	8.78

Tank Capacity **65.8 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
5%	1061	1207	1260	1125	992	967	1224	1402	1432
16%	1094	1267	1319	1157	1003	1008	1258	1416	1422
27%	827	999	1091	1024	959	829	1029	1217	1360
38%	693	824	814	864	983	744	782	867	895
49%	732	811	636	643	750	524	780	891	876
60%	709	729	701	653	582	560	757	895	878
71%	503	472	571	715	668	616	772	891	878
82%	548	553	530	680	615	567	762	894	878
93%	536	535	540	683	616	563	761	894	878

LOOK-UP TABLES (COMMON)

P0455 **KLTLDSFS05** (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
hPa / sec	0.045	0.045	0.052	0.054	0.055	0.056	0.068	0.076	0.076	0.076

Tank Capacity   68.1 Liters

Fuel Level **(%)**	0	14.7	29.4	36.7	44.1	51.4	58.7	66.1	73.4	88.1
Pa / sec	4.5	4.5	5.2	5.4	5.5	5.6	6.8	7.6	7.6	7.6

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