
DIAGNOSTIC MANUAL

N9 and N10 Engine

Navistar, Inc.

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TABLE OF CONTENTS

Foreword.....	1
Service Diagnosis.....	2
Safety Information.....	3
Diagnostic Troubleshooting Procedures.....	7
Engine System Tests and Inspections.....	2091
Engine Specifications.....	2399
Diagnostic Tools and Accessories.....	2419
Component Locator.....	2461
Engine Systems Overview.....	2473
Engine and Vehicle Features.....	2549
Abbreviations and Acronyms.....	2557
Terminology.....	2569

Foreword

Navistar, Inc. is committed to continuous research and development to improve products and introduce technological advances. Procedures, specifications, and parts defined in published technical service literature may be altered.

NOTE: Photo illustrations identify specific parts or assemblies that support text and procedures; other areas in a photo illustration may not be exact.

This manual includes necessary information and specifications for technicians to maintain Navistar diesel engines. See vehicle manuals and Technical Service Information (TSI) bulletins for additional information.

Technical Service Literature

4328224	N9 and N10 <i>Engine Operation and Maintenance Manual</i>
0000004021	N9 and N10 <i>Engine Service Manual</i>
0000003721	N9 and N10 <i>Engine Diagnostic Manual</i>
0000003481	N9 and N10 <i>Engine and Aftertreatment Wiring Schematic Form</i>

Technical Service Literature is revised periodically. If a technical publication is ordered, the latest revision will be supplied.

NOTE: To order technical service literature, contact your International® dealer.

Service Diagnosis

Service diagnosis is an investigative procedure that must be followed to find and correct an engine application problem or an engine problem.

If the problem is engine application, see specific vehicle manuals for further diagnostic information.

If the problem is the engine, see specific *Engine Diagnostic Manual* for further diagnostic information.

Prerequisites for Effective Diagnosis

- Availability of gauges and diagnostic test equipment
- Availability of current information for engine application and engine systems
- Knowledge of the principles of operation for engine application and engine systems
- Knowledge to understand and do procedures in diagnostic and service publications

Technical Service Literature required for Effective Diagnosis

- *Engine Service Manual*
 - *Engine Diagnostic Manual*
 - Engine and Aftertreatment Wiring Schematic Form
 - Service Bulletins
-

Safety Information

This manual provides general and specific maintenance procedures essential for reliable engine operation and your safety. Since many variations in procedures, tools, and service parts are involved, advice for all possible safety conditions and hazards cannot be stated.

Read safety instructions before doing any service and test procedures for the engine or vehicle. See related application manuals for more information.

Disregard for Safety Instructions, Warnings, Cautions, and Notes in this manual can lead to injury, death or damage to the engine or vehicle.

Safety Terminology

Three terms are used to stress your safety and safe operation of the engine: Warning, Caution, and Note.

Warning: A warning describes actions necessary to prevent or eliminate conditions, hazards, and unsafe practices that can cause personal injury or death.

Caution: A caution describes actions necessary to prevent or eliminate conditions that can cause damage to the engine or vehicle.

Note: A note describes actions necessary for correct, efficient engine operation.

Safety Instructions

Work Area

- Keep work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure the work area is ventilated and well lit.
- Make sure a First Aid Kit is available.

Safety Equipment

- Use correct lifting devices.
- Use safety blocks and stands.

Protective Measures

- Wear protective safety glasses and shoes.
- Wear correct hearing protection.
- Wear cotton work clothing.
- Wear sleeved heat protective gloves.
- Do not wear rings, watches or other jewelry.
- Restrain long hair.

Vehicle

- Make sure the vehicle is in neutral, the parking brake is set, and the wheels are blocked before servicing engine.
-

- Clear the area before starting the engine.

Engine

- The engine should be operated or serviced only by qualified individuals.
- Provide necessary ventilation when operating engine in a closed area.
- Keep combustible material away from engine exhaust system and exhaust manifolds.
- Install all shields, guards, and access covers before operating engine.
- Do not run engine with unprotected air intakes or exhaust openings. If unavoidable for service reasons, put protective screens over all openings before servicing engine.
- Shut engine off and relieve all pressure in the system before removing panels, housing covers, and caps.
- If an engine is not safe to operate, tag the engine and ignition key.

Fire Prevention

- Make sure charged fire extinguishers are in the work area.

NOTE: Check the classification of each fire extinguisher to ensure that the following fire types can be extinguished.

1. Type A – Wood, paper, textiles, and rubbish
2. Type B – Flammable liquids
3. Type C – Electrical equipment

Batteries

- Always disconnect the main negative battery cable first.
- Always connect the main negative battery cable last.
- Avoid leaning over batteries.
- Protect your eyes.
- Do not expose batteries to open flames or sparks.
- Do not smoke in workplace.

Compressed Air

- Use an OSHA approved blow gun rated at 30 psi (207 kPa).
- Limit shop air pressure to 30 psi (207 kPa).
- Wear safety glasses or goggles.
- Wear hearing protection.
- Use shielding to protect others in the work area.
- Do not direct compressed air at body or clothing.

Tools

- Make sure all tools are in good condition.
 - Make sure all standard electrical tools are grounded.
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- Check for frayed power cords before using power tools.

Fluids Under Pressure

- Use extreme caution when working on systems under pressure.
- Follow approved procedures only.

Fuel

- Do not over fill the fuel tank. Over fill creates a fire hazard.
- Do not smoke in the work area.
- Do not refuel the tank when the engine is running.

Removal of Tools, Parts, and Equipment

- Reinstall all safety guards, shields, and covers after servicing the engine.
 - Make sure all tools, parts, and service equipment are removed from the engine and vehicle after all work is done.
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Table of Contents

Diagnostic Trouble Code (DTC's) List.....	11
Operational Checkout Procedures.....	23
1.0 - Preliminary Vehicle Operational Checkout Procedure.....	23
2.0 - Engine Does Not Start Operational Checkout Procedure.....	26
3.0 - Engine Hard to Start Operational Checkout Procedure.....	30
4.0 - Engine Running, Engine Not Under Load Operational Checkout Procedure.....	34
5.0 - Engine Running, Engine Under Load Operational Checkout Procedure.....	36
6.0 - Cooling System Operational Checkout Procedure.....	38
7.0 - Lube Oil System Operational Checkout Procedure.....	39
8.0 - Fuel System Operational Checkout Procedure.....	40
9.0 - Engine Compression Brake Operational Checkout Procedure.....	41
10.0 - SCR Aftertreatment Operational Checkout Procedure.....	42
11.0 - ECM Loss of Communication.....	43
Engine Does Not Start Symptoms.....	49
2.1 - Engine Cranks Fast, Slow, or Does Not Crank.....	49
2.2 - Engine No Start, Cold Ambient Temperature.....	53
2.3 - Engine at Operating Temperature, No Re-Start.....	54
2.4 - Engine Never Starts.....	57
Engine Hard to Start Symptoms.....	60
3.1 - Engine Hard to Start, Cold Ambient Temperature.....	60
3.2 - Engine at Operating Temperature, Hard to Re-Start.....	62
3.3 - Engine Starts, Then Stalls.....	64
Engine Running, Engine Not Under Load Symptoms.....	66
4.1 - Rough Idle.....	66
4.2 - Engine Unable To Reach Rated Speed (No Load).....	70
4.3 - Popping Noise from Intake.....	72
Engine Running, Engine Under Load Symptoms.....	74
5.1 - Low Power (Slow Acceleration).....	74
5.2 - Misfire (Stumble / Surge / Runs Rough).....	80
5.3 - Engine Unable to Reach Desired Speed During PTO Operation.....	84
Engine Coolant Symptoms.....	88
6.1 - Coolant Contaminated.....	88
6.2 - Coolant Loss.....	89
6.3 - Coolant Over-Temp.....	91
6.4 - Coolant Overflow.....	94
6.5 - Coolant Leak to Exhaust.....	97
6.6 - Coolant Leak to Intake.....	101
6.7 - Coolant Leak to Lube Oil.....	102
Engine Lubrication Symptoms.....	107

7.1 - Lube Oil Contamination.....	107
7.2 - Lube Oil to Coolant.....	108
7.3 - Engine Oil to Intake.....	109
7.4 - Engine Oil to Exhaust.....	111
7.5 - Power Steering Fluid Leak to Lube Oil	112
7.6 - Low Oil Pressure.....	113
7.7 - High Oil Pressure.....	116
7.8 - Excessive Oil Consumption.....	119
Fuel System Symptoms.....	120
8.1 - Fuel Delivery Pressure.....	120
8.2 - Fuel in Engine Oil.....	124
Engine Brake Symptoms.....	126
9.1 - Engine Compression Brake Inoperative.....	126
9.2 - Engine Compression Brake Engaged When Not Commanded.....	129
Aftertreatment Symptoms.....	131
10.1 - Parked Regeneration Will Not Activate.....	131
10.2 - Black Smoke	133
10.3 - White Smoke.....	138
Fault Code Diagnostics.....	142
Section Information.....	142
AAT Sensor (Ambient Air Temperature).....	143
AFT (Aftertreatment) System.....	156
AFT: FEC (Aftertreatment Fuel Enable Control).....	205
AFT: FP1 / AFT: FT (Aftertreatment Fuel Pressure 1 / Aftertreatment Fuel Temperature) Sensor.....	226
AFT: FP2 (Aftertreatment Fuel Pressure 2) Sensor.....	257
AFT: FPC (Aftertreatment Fuel Pressure Control) System.....	279
NH3 (Aftertreatment Ammonia) Sensor and Sensor Module.....	338
AMS (Air Management System).....	381
APP Sensor (Accelerator Pedal Position).....	402
Body.....	428
CACOT Sensor (Charge Air Cooler Outlet Temperature).....	439
CCOSS Sensor (Crankcase Oil Separator Speed).....	458
CKP Sensor (Crankshaft Position).....	465
CMP Sensor (Camshaft Position).....	470
DCU Power (Doser Control Unit).....	475
DEF (Diesel Exhaust Fluid).....	497
DEF: SMH (Diesel Exhaust Fluid Supply Module Heater).....	508
DEF: DU (Diesel Exhaust Fluid Doser Unit) Sensor.....	554
DEF: LHR (Diesel Exhaust Fluid Line Heater Relay).....	570
DEF: AP (Diesel Exhaust Fluid Absolute Pressure).....	591
DEFSLH (Diesel Exhaust Fluid Supply Line Heater).....	629
DEFRLH (Diesel Exhaust Fluid Return Line Heater).....	645
DEF: RCV (Diesel Exhaust Fluid Return Valve).....	662
DEFPLH (Diesel Exhaust Fluid Pressure Line Heater).....	677
DEF: SP (Diesel Exhaust Fluid Supply Pump).....	698
DEF: THC (Diesel Exhaust Fluid Tank Heater Control) Valve.....	727

DEF: TL & DEF: TT (Diesel Exhaust Fluid Tank Level and Temperature) Sensor Module.....	746
DEF: SMH Relay (Diesel Exhaust Fluid Supply Module Heater Relay)	782
DOC Temperature Sensor Module.....	800
DOCIT Sensor (Diesel Oxidation Catalyst Intake Temperature).....	830
DPF (Diesel Particulate Filter) Sensor	840
DPFDP / DPFOP (Diesel Particulate Filter Differential Pressure / Diesel Particulate Filter Outlet Pressure) Sensor.....	844
DPFIT Sensor (Diesel Particulate Filter Intake Temperature).....	876
DPFOT Sensor (Diesel Particulate Filter Outlet Temperature).....	898
EBP Sensor (Exhaust Back Pressure).....	914
EBPV (Exhaust Back Pressure Valve).....	930
ECB1 (Engine Compression Brake Output 1).....	972
ECI Circuit (Engine Crank Inhibit).....	992
ECM (Engine Control Module).....	1000
ECT1 Sensor (Engine Coolant Temperature 1).....	1033
EFP (Engine Fuel Pump).....	1065
EGR Actuator (Exhaust Gas Recirculation).....	1074
EGT Sensor (Exhaust Gas Temperature).....	1115
Engine.....	1132
EOP Sensor (Engine Oil Pressure).....	1152
EOT Sensor (Engine Oil Temperature).....	1163
ETP (Engine Throttle Valve Position).....	1187
EWPS (Engine Warning Protection System).....	1210
FDP (Fuel Delivery Pressure) Sensor.....	1247
FLI (Fuel Level Signal).....	1265
IAHC (Intake Air Heater Control).....	1272
ICP Sensor (Injection Control Pressure).....	1286
IMP (Intake Manifold Pressure).....	1322
IMT Sensor (Intake Manifold Temperature).....	1349
INJ (Injector) Circuits.....	1365
IPR (Injection Pressure Regulator).....	1768
J1939 Data Link Communications.....	1779
MAF Sensor (Mass Air Flow).....	1782
NOx (Nitrogen Oxides) Sensor Module.....	1827
RAPP (Remote APP) Sensor.....	1904
SCR (Temperature Sensor Module).....	1907
SCRIT (Selective Catalyst Reduction Intake Temperature) Sensor.....	1954
SCROT (Selective Catalyst Reduction Outlet Temperature) Sensor.....	1968
TC2CIT (Turbocharger 2 Compressor Intake Temperature).....	1978
TC2WG (Turbocharger 2 Wastegate Position).....	1997
TOSS (Transmission Output Shaft Speed) Sensor.....	2008
VREF (Voltage Reference).....	2025
WIF Sensor (Water In Fuel).....	2074

Diagnostic Trouble Code (DTC's) List

SPN	FMI	Sub-section	Condition Description
27	0	EGR (page 1074)	EGRP fault: over temperature
27	14	EGR (page 1074)	EGR internal circuit failure
51	3	ETP (page 1187)	ETP signal Out of Range HIGH
51	4	ETP (page 1187)	ETP signal Out of Range LOW
51	7	ETP (page 1187)	ETP does not agree with commanded position
91	2	APP (page 402)	APP1 and APP2 signal conflict
91	3	APP (page 402)	APP1 signal Out of Range HIGH
91	4	APP (page 402)	APP1 signal Out of Range LOW
94	0	EFP (page 1065)	Fuel Delivery Pressure above Critical
94	1	EFP (page 1065)	Fuel Delivery Pressure below Critical
94	3	FDP (page 1247)	FDP signal Out of Range HIGH
94	4	FDP (page 1247)	FDP signal Out of Range LOW
94	17	FDP (page 1247)	Fuel Delivery Pressure below minimum
94	18	FDP (page 1247)	Fuel Delivery Pressure below min during cranking
96	3	FLI (page 1265)	Fuel Level signal Out of Range HIGH
96	4	FLI (page 1265)	Fuel Level signal Out of Range LOW
96	19	FLI (page 1265)	Fuel Level not detected on J1939
100	1	EWPS (page 1210)	Engine Oil System below Critical Pressure
100	3	EOP (page 1152)	EOP signal Out of Range HIGH
100	4	EOP (page 1152)	EOP signal Out of Range LOW
100	18	EWPS (page 1210)	Engine Oil System below Warning Pressure
102	2	IMP (page 1322)	IMP signal erratic, intermittent, or incorrect
102	3	IMP (page 1322)	IMP signal Out of Range HIGH
102	4	IMP (page 1322)	IMP signal Out of Range LOW
102	7	IMP (page 1322)	IMP signal not responding as expected
102	10	IMP (page 1322)	Boost slow response fault
102	16	IMP (page 1322)	Overboost
102	18	IMP (page 1322)	Underboost
105	2	IMT (page 1349)	IMT signal Erratic, Intermittent, or Incorrect
105	3	IMT (page 1349)	IMT signal Out of Range HIGH
105	4	IMT (page 1349)	IMT signal Out of Range LOW
108	2	ECM (page 1000)	BARO signal erratic, intermittent, or incorrect
108	3	ECM (page 1000)	BARO signal Out of Range HIGH
108	4	ECM (page 1000)	BARO signal Out of Range LOW

SPN	FMI	Sub-section	Condition Description
110	0	EWPS(page 1210)	Engine Cooling System above Critical Temperature
110	2	ECT1 (page 1033)	ECT1 signal erratic, intermittent, or incorrect
110	3	ECT1 (page 1033)	ECT1 signal Out of Range HIGH
110	4	ECT1 (page 1033)	ECT1 signal Out of Range LOW
110	15	EWPS (page 1210)	Engine Cooling System above Warning Temperature
110	16	EWPS (page 1210)	ECT1 stuck in range High
110	17	ECT1 (page 1033)	ECT1 stuck in range Low
110	18	ECT1 (page 1033)	Engine Coolant System Below closed loop minimum temperature
111	1	EWPS (page 1210)	ECL below Warning / Critical Level
111	2	EWPS (page 1210)	ECL signal erratic, intermittent, or incorrect
132	0	MAF (page 1782)	Engine Intake Air Mass Flow Rate High
132	1	MAF (page 1782)	Engine Intake Air Mass Flow Rate Low
132	4	MAF (page 1782)	MAF signal Out of Range LOW
132	11	MAF (page 1782)	MAF Sensor Calibration – Insufficient number of data points
132	13	MAF (page 1782)	MAF Sensor Calibration Needed
132	14	MAF (page 1782)	MAF Sensor Calibration Failed
132	31	MAF (page 1782)	MAF Frequency out of range HIGH
158	15	ECM (page 1000)	Battery Voltage above 16 volts
158	17	ECM (page 1000)	Battery Voltage below 9 volts
164	0	ICP (page 1286)	ICP above KOEO Spec
164	1	ICP (page 1286)	ICP Unable to Build During Engine Cranking
164	3	ICP (page 1286)	ICP signal Out of Range HIGH
164	4	ICP (page 1286)	ICP signal Out of Range LOW
164	15	ICP (page 1286)	ICP too high during test
164	16	ICP (page 1286)	ICP above desired level
164	17	ICP (page 1286)	ICP unable to build during test
164	18	ICP (page 1286)	ICP below desired level
171	2	AAT (page 143)	AAT signal erratic, intermittent, or incorrect
171	3	AAT (page 143)	AAT Signal Out of Range HIGH
171	4	AAT (page 143)	AAT Signal Out of Range LOW
172	2	MAF (page 1782)	IAT Signal Erratic, Intermittent, or Incorrect
172	3	MAF (page 1782)	IAT signal Out of Range HIGH
172	4	MAF (page 1782)	IAT Signal Out of Range LOW
173	2	EGT (page 1115)	EGT signal erratic, intermittent, or incorrect
173	3	EGT (page 1115)	EGT signal Out of Range HIGH

SPN	FMI	Sub-section	Condition Description
173	4	EGT (page 1115)	EGT signal Out of Range LOW
175	2	EOT (page 1163)	EOT signal erratic, intermittent, or incorrect
175	3	EOT (page 1163)	EOT signal Out of Range HIGH
175	4	EOT (page 1163)	EOT signal Out of Range LOW
175	7	EOT (page 1163)	EOT not warming along with engine
175	15	EWPS (page 1210)	Engine Oil System above Warning Temperature
188	0	Engine (page 1132)	Engine Low Idle RPM above normal
188	1	Engine (page 1132)	Engine Low Idle RPM below normal
190	0	EWPS (page 1210)	Engine Overspeed - Most Severe Level
191	3	TOSS (page 2008)	TOSS/VSS signal out of range HIGH
191	4	TOSS (page 2008)	TOSS/VSS signal out of range LOW
191	5	TOSS (page 2008)	TOSS/VSS Open Circuit fault
191	14	TOSS (page 2008)	TOSS/VSS Error invalid signal
521	2	BODY (page 428)	Brake applied while APP applied
593	31	EWPS (page 1210)	Engine stopped by IST
596	19	BODY (page 428)	Cruise Control Enable Switch not detected on J1939
597	2	BODY (page 428)	Brake switch or circuit fault
597	19	BODY (page 428)	Brake Switch not detected on J1939
609	19	DCU (page 475)	ACM (CES) not detected on J1939
628	12	ECM (page 1000)	ECM Memory Error
629	0	ECM (page 1000)	ECM Error - CPU Load Excessively HIGH
629	8	ECM (page 1000)	ECM Error - Engine Off Timer fault
629	12	ECM (page 1000)	ECM Internal chip Error
636	2	CMP (page 470)	CMP and CKP Synchronization Error
636	7	CMP (page 470)	CMP to CKP incorrect reference
637	8	CKP (page 465)	CKP signal noise
637	10	CKP (page 465)	CKP signal Inactive
639	14	J1939 (page 1779)	J1939 Data Link Error (ECM unable to transmit)
651	4	INJ (page 1365)	Injector 1 open coil - short circuit
651	5	INJ (page 1365)	Injector 1 open coil - open circuit
651	7	INJ (page 1365)	Injector 1 Spool Motion Compensation Max Authority Reached
651	14	INJ (page 1365)	Injector 1 Fuel quantity / timing error
652	4	INJ (page 1365)	Injector 2 open coil - short circuit
652	5	INJ (page 1365)	Injector 2 open coil - open circuit

SPN	FMI	Sub-section	Condition Description
652	7	INJ (page 1365)	Injector 2 Spool Motion Compensation Max Authority Reached
652	14	INJ (page 1365)	Injector 2 Fuel quantity / timing error
653	4	INJ (page 1365)	Injector 3 open coil - short circuit
653	5	INJ (page 1365)	Injector 3 open coil - open circuit
653	7	INJ (page 1365)	Injector 3 Spool Motion Compensation Max Authority Reached
653	14	INJ (page 1365)	Injector 3 Fuel quantity / timing error
654	4	INJ (page 1365)	Injector 4 open coil - short circuit
654	5	INJ (page 1365)	Injector 4 open coil - open circuit
654	7	INJ (page 1365)	Injector 4 Spool Motion Compensation Max Authority Reached
654	14	INJ (page 1365)	Injector 4 Fuel quantity / timing error
655	4	INJ (page 1365)	Injector 5 open coil - short circuit
655	5	INJ (page 1365)	Injector 5 open coil - open circuit
655	7	INJ (page 1365)	Injector 5 Spool Motion Compensation Max Authority Reached
655	14	INJ (page 1365)	Injector 5 Fuel quantity / timing error
656	4	INJ (page 1365)	Injector 6 open coil - short circuit
656	5	INJ (page 1365)	Injector 6 open coil - open circuit
656	7	INJ (page 1365)	Injector 6 Spool Motion Compensation Max Authority Reached
656	14	INJ (page 1365)	Injector 6 Fuel quantity / timing error
679	3	IPR (page 1768)	IPR short to PWR
679	4	IPR (page 1768)	IPR Open or short to GND
729	3	IAHC (page 1272)	IAHC short to PWR
729	4	IAHC (page 1272)	IAHC short to GND
729	5	IAHC (page 1272)	IAHC open load / circuit
729	18	IAHC (page 1272)	IAH Monitor fault: Lack of Heat in the Intake Manifold
931	3	EFP (page 1065)	EFP short to PWR
931	4	EFP (page 1065)	EFP open load / circuit or short to GND
974	3	RAPP (page 1904)	Remote APP signal Out of Range HIGH
1136	0	ECM (page 1000)	ECM Error – over temperature
1173	2	TC2CIT (page 1978)	TC2CIT signal erratic, intermittent, or incorrect
1173	3	TC2CIT (page 1978)	TC2CIT signal Out of Range HIGH
1173	4	TC2CIT (page 1978)	TC2CIT signal Out of Range LOW

SPN	FMI	Sub-section	Condition Description
1173	16	TC2CIT (page 1978)	TC2CIT signal above desired (Low Pressure CAC Interstage under cooling)
1189	3	TC2WC (page 1997)	TC2WC short to PWR
1189	4	TC2WC (page 1997)	TC2WC Open or short to GND
1209	0	AMS (page 381)	EBP above desired level
1209	1	EBP (page 914)	EBP below desired level
1209	2	EBP (page 914)	EBP signal erratic, intermittent, or incorrect
1209	3	EBP (page 914)	EBP signal Out of Range HIGH
1209	4	EBP (page 914)	EBP signal Out of Range LOW
1209	7	AMS (page 381)	EBP signal not responding as expected
1322	31	Engine (page 1132)	Misfire - Multiple Cylinders
1323	31	Engine (page 1132)	Misfire - Cylinder 1
1324	31	Engine (page 1132)	Misfire - Cylinder 2
1325	31	Engine (page 1132)	Misfire - Cylinder 3
1326	31	Engine (page 1132)	Misfire - Cylinder 4
1327	31	Engine (page 1132)	Misfire - Cylinder 5
1328	31	Engine (page 1132)	Misfire - Cylinder 6
1378	31	EWPS (page 1210)	Change Engine Oil Service Interval
1387	31	ECM (page 1000)	Altitude Reference Adder Fault
1569	31	DEFTLT (page 746)	SCR Tamperproof Warning & Protection System Inducement Severe
1659	20	ECT1 (page 1033)	ECT1 below expected: Check Thermostat
1761	1	DEFTLT (page 746)	DEFTL Inducement (Level 3 - 4)
1761	3	DEFTLT (page 746)	DEFTL signal Out of Range HIGH
1761	4	DEFTLT (page 746)	DEFTL signal Out of Range LOW
1761	10	DEFTLT (page 746)	DEF Level abnormal rate of change
1761	11	DEFTLT (page 746)	DEFTL signal erratic, intermittent, or incorrect
1761	17	DEFTLT (page 746)	DEFTL Inducement Level 1
1761	18	DEFTLT (page 746)	DEFTL Inducement Level 2
1761	19	DEFTLT (page 746)	DEFTL not detected on J1939
2623	3	APP (page 402)	APP2 signal Out of Range HIGH
2623	4	APP (page 402)	APP2 signal Out of Range LOW
2630	2	CACOT (page 439)	CACOT signal erratic, intermittent, or incorrect
2630	3	CACOT (page 439)	CACOT signal Out of Range HIGH
2630	4	CACOT (page 439)	CACOT signal Out of Range LOW
2630	16	CACOT (page 439)	CACOT Undercooling

SPN	FMI	Sub-section	Condition Description
2659	10	AMS (page 381)	EGR Slow Response Fault
2659	14	AMS (page 381)	EGR System flow rate error during Air Management Test
2659	20	AMS (page 381)	EGR High Flow Rate detected
2659	21	AMS (page 381)	EGR Low Flow Rate detected
2791	2	EGR (page 1074)	EGR feedback communication fault
2791	3	EGR (page 1074)	EGRV supply voltage is too HIGH
2791	4	EGR (page 1074)	EGRV supply voltage is too LOW
2791	7	EGR (page 1074)	EGR Valve unable to achieve commanded position
2791	8	EGR (page 1074)	EGR valve not receiving ECM PWM signal
2791	12	EGR (page 1074)	EGR Valve Internal self test fault
2791	14	EGR (page 1074)	EGR valve Initialization Fault
2797	6	INJ (page 1365)	Injector Control Group 1 - short circuit (INJ 1, 2, 3)
2798	6	INJ (page 1365)	Injector Control Group 2 - short circuit (INJ 4, 5, 6)
3031	2	DEFTLT (page 746)	DEFTT signal erratic, intermittent or incorrect
3031	3	DEFTLT (page 746)	DEFTT signal Out of Range HIGH
3031	4	DEFTLT (page 746)	DEFTT signal Out of Range LOW
3055	2	INJ (page 1365)	ICP / IPR Adaptation In-Range Fault
3061	31		CSER Exhaust warm up time fault
3216	4	NO _x (page 1827)	NOxIN signal Out of Range LOW
3216	10	NO _x (page 1827)	NOxIN signal abnormal rate of change
3216	13	NO _x (page 1827)	NOxIN Out of Calibration
3216	19	NO _x (page 1827)	NOxIN not detected on J1939
3216	20	NO _x (page 1827)	NOxIN signal drifted HIGH
3216	21	NO _x (page 1827)	NOxIN signal drifted LOW
3218	2	NO _x (page 1827)	NOxIN power supply signal erratic, intermittent or incorrect
3226	2	NO _x (page 1827)	NOxOUT signal erratic, intermittent or incorrect
3226	4	NO _x (page 1827)	NOxOUT signal Out of Range LOW
3226	10	NO _x (page 1827)	NOxOUT signal abnormal rate of change
3226	13	NO _x (page 1827)	NOxOUT Out of Calibration
3226	19	NO _x (page 1827)	NOxOUT not detected on J1939
3226	20	NO _x (page 1827)	NOxOUT signal drifted HIGH
3226	21	NO _x (page 1827)	NOxOUT signal drifted LOW
3228	2	NO _x (page 1827)	NOxOUT power supply signal erratic, intermittent or incorrect
3242	0	DPFIT (page 876)	DPFIT above Critical Temperature
3242	2	DPFIT (page 876)	DPFIT signal erratic, intermittent, or incorrect

SPN	FMI	Sub-section	Condition Description
3242	3	DPFIT (page 876)	DPFIT signal Out of Range HIGH
3242	4	DPFIT (page 876)	DPFIT signal Out of Range LOW
3242	15	DPFIT (page 876)	DPFIT above Warning Temperature
3242	16	DPFIT (page 876)	DPFIT above Maximum Temperature
3246	0	DPFOT (page 898)	DPFOT above Critical Temperature
3246	2	DPFOT (page 898)	DPFOT signal erratic, intermittent, or incorrect
3246	3	DPFOT (page 898)	DPFOT signal Out of Range HIGH
3246	4	DPFOT (page 898)	DPFOT signal Out of Range LOW
3246	15	DPFOT (page 898)	DPFOT above Warning Temperature
3246	16	DPFOT (page 898)	DPFOT above Maximum Temperature
3251	0	AFT (page 156)	DPFDP excessively HIGH (Plugged filter)
3251	2	DPFDP / DPFOP (page 844)	DPFDP signal erratic, intermittent, or incorrect
3251	3	DPFDP / DPFOP (page 844)	DPFDP signal Out of Range HIGH
3251	4	DPFDP / DPFOP (page 844)	DPFDP signal Out of Range LOW
3251	15	AFT (page 156)	DPF Soot Load - Least Severe Level
3251	16	AFT (page 156)	DPF Soot Load - Moderately Severe Level
3361	2	DEF: SP (page 698)	DEFSP signal erratic, intermittent or incorrect
3361	3	DEF: SP (page 698)	DEFSP signal Out of Range HIGH
3361	4	DEF: SP (page 698)	DEFSP signal Out of Range LOW
3362	31	DEF: SP (page 698)	DEF dosing unable to prime
3363	3	DEFTHC (page 727)	DEF Tank Heater Control Valve short to PWR
3363	4	DEFTHC (page 727)	DEF Tank Heater Control Valve short to GND
3363	7	DEFTHC (page 727)	DEF Tank Heater Control Valve Mechanical system not responding
3363	16	DEFTHC (page 727)	DEF Tank Heater Control Valve stuck open fault
3363	18	DEFTHC (page 727)	DEF Tank Heater Control Valve unable to thaw frozen DEF
3364	31	ETP (page 1187)	Intake Throttle Valve short circuit fault
3471	1	AFTFPC (page 279)	AFT Fuel Pressure 1 below desired (Low system pressure)
3471	7	AFTFPC (page 279)	AFT Fuel Doser Valve not responding as expected
3471	10	AFTFPC (page 279)	AFT Fuel Pressure incorrect dosing pressure multiple events
3479	3	AFTFPC (page 279)	AFT Fuel Doser Valve Short to PWR
3479	4	AFTFPC (page 279)	AFT Fuel Doser Valve Short to GND
3479	5	AFTFPC (page 279)	AFT Fuel Pressure Valve Open or Short to GND low side
3479	6	AFTFPC (page 279)	AFT Fuel Doser Valve High Side Short circuit
3480	3	AFTFIS (page 226)	AFTFP1 signal Out of Range HIGH
3480	4	AFTFIS (page 226)	AFTFP1 signal Out of Range LOW










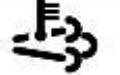
SPN	FMI	Sub-section	Condition Description
3482	3	AFTFSV (page 205)	AFT Fuel Enable Control Valve short to PWR
3482	4	AFTFSV (page 205)	AFT Fuel Enable Control Valve open or short to GND
3509	3	VREF (page 2025)	VREF 1 voltage above maximum
3509	4	VREF (page 2025)	VREF 1 voltage below minimum
3510	3	VREF (page 2025)	VREF 2 voltage above maximum
3510	4	VREF (page 2025)	VREF 2 voltage below minimum
3511	3	VREF (page 2025)	VREF 3 voltage above maximum
3511	4	VREF (page 2025)	VREF 3 voltage below minimum
3521	11	DEFTLT (page 746)	Improper Reductant in DEF Tank
3556	0	AFTFP2 (page 257)	AFT Fuel Pressure 2 excessively high (Restricted injection)
3556	1	AFTFP2 (page 257)	AFT Fuel Pressure 2 below desired (Possible system leak)
3556	7	AFTFP2 (page 257)	AFT Fuel Injector not responding as expected
3610	2	DPFDP / DPFOP (page 844)	DPFOP signal erratic, intermittent or incorrect
3610	3	DPFDP / DPFOP (page 844)	DPFOP signal Out of Range HIGH
3610	4	DPFDP / DPFOP (page 844)	DPFOP signal Out of Range LOW
3659	4	INJ (page 1365)	Injector 1 close coil – short circuit
3659	5	INJ (page 1365)	Injector 1 close coil – open circuit
3660	4	INJ (page 1365)	Injector 2 close coil – short circuit
3660	5	INJ (page 1365)	Injector 2 close coil – open circuit
3661	4	INJ (page 1365)	Injector 3 close coil – short circuit
3661	5	INJ (page 1365)	Injector 3 close coil – open circuit
3662	4	INJ (page 1365)	Injector 4 close coil: short circuit
3662	5	INJ (page 1365)	Injector 4 close coil – open circuit
3663	4	INJ (page 1365)	Injector 5 close coil – short circuit
3663	5	INJ (page 1365)	Injector 5 close coil – open circuit
3664	4	INJ (page 1365)	Injector 6 close coil – short circuit
3664	5	INJ (page 1365)	Injector 6 close coil – open circuit
3695	2	AFT (page 156)	DPF Regen Inhibit Switch erratic, intermittent or incorrect
3695	19	AFT (page 156)	DPF Regen Inhibit Switch status not detected on J1939
3703	31	AFT (page 156)	DPF Active Regeneration Inhibited Due to Inhibit Switch
3713	31	AFT (page 156)	DPF Active Regeneration Inhibited Due to System Timeout
3719	0	AFT (page 156)	DPF Soot Load - Highest (level 3/3)
3719	15	AFT (page 156)	DPF Soot Load - Lowest (level 1/3)
3719	16	AFT (page 156)	DPF Soot Load - Moderate (level 2/3)
3750	31	AFT (page 156)	DPF Regen inhibited due to low exhaust temperatures

SPN	FMI	Sub-section	Condition Description
3936	0	EWPS (page 1210)	DPF Soot Load – Severe De-Rate
3936	14	AFT (page 156)	DOC/DPF Temperature module (Incorrect Part)
3936	15	AFT (page 156)	DPF System above Warning Pressure
3936	16	AFT (page 156)	DPF System above Maximum Pressure
4077	3	AFTFP2 (page 257)	AFTFP2 signal Out of Range HIGH
4077	4	AFTFP2 (page 257)	AFTFP2 signal Out of Range LOW
4094	31	DEFTLT (page 746)	DEF below acceptable quality
4192	3	WIF (page 2074)	WIF signal Out of Range HIGH
4192	4	WIF (page 2074)	WIF signal Out of Range LOW
4192	5	WIF (page 2074)	WIF signal Open or Short to PWR
4192	31	WIF (page 2074)	Water in Fuel Detected
4227	7	CCOSS (page 458)	CC Oil Separator: Not spinning
4257	7	INJ (page 1365)	Injector Coking Compensation Factor Reached Maximum Authority
4257	16	INJ (page 1365)	Multiple Injector High Flow fault
4257	18	INJ (page 1365)	Multiple Injector Low Flow fault
4287	0	ECBP (page 972)	ECBP above desired level
4287	1	ECBP (page 972)	ECBP below desired level
4287	3	ECBP (page 972)	ECBP signal Out of Range HIGH
4287	4	ECBP (page 972)	ECBP signal Out of Range LOW
4334	2	DEF: AP (page 591)	DEFLP signal erratic, intermittent or incorrect
4334	3	DEF: AP (page 591)	DEFAP signal Out of Range HIGH
4334	4	DEF: AP (page 591)	DEFAP signal Out of Range LOW
4334	16	DEF: AP (page 591)	DEF Absolute Pressure above maximum
4334	18	DEF: AP (page 591)	DEF Absolute Pressure below normal
4337	2	DEF: AP (page 591)	DEF Dosing Unit Temperature - Data Erratic, Intermittent, or Incorrect
4337	10	DEF: AP (page 591)	DEF Dosing Unit Temperature abnormal rate of change
4340	3	DEFSLH (page 629)	DEF Supply Line Heater Short to PWR
4340	5	DEFSLH (page 629)	DEF Supply Line Heater open load/circuit
4342	3	DEFRLH (page 645)	DEF Return Line Heater Short to PWR
4342	5	DEFRLH (page 645)	DEF Return Line Heater open load/circuit
4344	3	DEFPLH (page 677)	DEF Pressure Line Heater Short to PWR
4344	5	DEFPLH (page 677)	DEF Pressure Line Heater open load/circuit
4360	0	SCRIT (page 1954)	SCRIT above Critical Temperature
4360	2	SCRIT (page 1954)	SCRIT signal erratic, intermittent or incorrect

SPN	FMI	Sub-section	Condition Description
4360	3	SCRIT (page 1954)	SCRIT signal Out of Range HIGH
4360	4	SCRIT (page 1954)	SCRIT signal Out of Range LOW
4360	16	SCRIT (page 1954)	SCRIT above Maximum Temperature
4363	0	SCROT (page 1968)	SCROT above Critical Temperature
4363	2	SCROT (page 1968)	SCROT signal erratic, intermittent or incorrect
4363	3	SCROT (page 1968)	SCROT signal Out of Range HIGH
4363	4	SCROT (page 1968)	SCROT signal Out of Range LOW
4364	18	SCR (page 1907)	Low NOx Conversion Detected
4376	3	DEF: RCV (page 662)	DEF Reverting Control Valve short to PWR
4376	4	DEF: RCV (page 662)	DEF Reverting Control Valve short to GND
4376	7	DEF: RCV (page 662)	DEF Reverting Control Valve - Mechanical system not responding or out of adjustment
4377	2	Ammonia (page 338)	NH3 in range stuck fault
4377	3	Ammonia (page 338)	NH3 Sensor signal Out of Range HIGH
4377	4	Ammonia (page 338)	NH3 operation fault
4377	12	Ammonia (page 338)	NH3 internal chip error
4377	13	Ammonia (page 338)	NH3 operation fault
4377	19	Ammonia (page 338)	NH3 Sensor Module not detected on j1939
4380	2	Ammonia (page 338)	NH3 signal erratic, intermittent, or incorrect
4382	10	Ammonia (page 338)	NH3 sensor Heater abnormal rate of change
4752	4	EGR (page 1074)	EGR Cooler Efficiency: EGR Outlet Temp above expected
4765	2	DOCIT (page 830)	DOCIT signal erratic, intermittent, or incorrect
4765	3	DOCIT (page 830)	DOCIT signal Out of Range HIGH
4765	4	DOCIT (page 830)	DOCIT signal Out of Range LOW
4765	16	DOCIT (page 830)	DOCIT Above Maximum Temperature
4766	15	DPFIT (page 876)	DPFIT Above Warning Temperature
4766	16	DPFIT (page 876)	DPFIT Above Maximum Temperature
4792	7	SCR (page 1907)	SCR Catalyst System - Mechanical system not responding or out of adjustment
4792	14	SCR (page 1907)	SCR Temperature Module (Incorrect Part)
4794	31	SCR (page 1907)	SCR Catalyst System Missing
4795	31	AFT (page 156)	DPFDP excessively LOW (sensor/circuit fault or missing DPF)
4796	31	AFT (page 156)	Diesel Oxidation Catalyst Missing
5024	10	NOx (page 1827)	NOxIN Sensor Heater abnormal rate of change
5031	10	NOx (page 1827)	NOxOUT Sensor Heater not reading correctly
5109	3	DCU (page 475)	DCU battery voltage above 17 volts

SPN	FMI	Sub-section	Condition Description
5109	4	DCU (page 475)	DCU battery voltage below 10 volts
5109	19	DCU (page 475)	DCU not detected on J1939
5246	15	DEFTLT (page 746)	SCR Tamper Proof Inducement Level 1 status
5298	17	AFT (page 156)	DOC Efficiency fault, Temperature below minimum Regen Aborted
5298	18	AFT (page 156)	DOC Efficiency fault, Temperature below minimum
5302	18	Ammonia (page 338)	Post SCR NH3 Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
5319	31	AFT (page 156)	DPF incomplete regeneration
5394	2	DEF: DU (page 554)	DEF Dosing below desired (Low NOx conversion across SCR)
5394	5	DEF: DU (page 554)	DEF Doser Valve open load/circuit
5394	7	DEF: DU (page 554)	DEF Dosing Unit - Mechanical system not responding
5395	0	Engine (page 1132)	Engine unable to achieve desired idle torque (too high)
5395	1	Engine (page 1132)	Engine unable to achieve desired idle torque (too low)
5397	31	DPF (page 840)	DPF regenerations are occurring too frequently
5456	2	AFTFIS (page 226)	AFTFIT signal erratic, intermittent, or incorrect
5456	3	AFTFIS (page 226)	AFTFT signal Out of Range HIGH
5456	4	AFTFIS (page 226)	AFTFT signal Out of Range LOW
5491	3	DEF: LHR (page 570)	DEF Line Heater Relay Open or short to PWR
5491	4	DEF: LHR (page 570)	DEF Line Heater Relay short to GND
5541	2	EBPV (page 930)	TC1TOP signal erratic, intermittent or incorrect
5541	3	EBPV (page 930)	TC1TOP signal Out of Range HIGH
5541	4	EBPV (page 930)	TC1TOP signal Out of Range LOW
5542	15	EBPV (page 930)	TC1TOP Above Desired
5542	17	EBPV (page 930)	TC1TOP Below Desired
5543	3	EBPV (page 930)	EBPC short to PWR
5543	4	EBPV (page 930)	EBPC short to GND
5543	5	EBPV (page 930)	EBPC open load / circuit
5742	3	DOC (page 800)	DPF Thermocouple Controller Out of Range HIGH
5742	4	DOC (page 800)	DPF Thermocouple Controller Out of Range LOW
5742	11	DOC (page 800)	DPF Thermocouple Controller signal erratic, intermittent, or incorrect
5742	16	DOC (page 800)	DPF Thermocouple Controller above Maximum Temperature
5742	19	DOC (page 800)	DOC/DPF Temperature module not detect J1939
5743	3	SCR (page 1907)	SCR Thermocouple Controller Out of Range HIGH
5743	4	SCR (page 1907)	SCR Thermocouple Controller Out of Range LOW

SPN	FMI	Sub-section	Condition Description
5743	11	SCR (page 1907)	SCR Thermocouple Controller signal erratic, intermittent, or incorrect
5743	16	SCR (page 1907)	SCR Thermocouple Controller above Maximum Temperature
5743	19	SCR (page 1907)	SCR Temperature module not detect J1939
5745	3	DEFSMH (page 508)	DEF Supply Module Heater Out of Range HIGH
5745	4	DEFSMH (page 508)	DEF Supply Module Heater Out of Range LOW
5745	18	DEFSMH (page 508)	DEF Dosing Unit Heater below Warning Temperature
5746	3	DEF: SMH Relay (page 782)	DEF Supply Module Heater Relay short to PWR
5746	4	DEF: SMH Relay (page 782)	DEF Supply Module Heater Relay short to GND
5798	2	DEFSMH (page 508)	DEF Supply Module Heater Temperature erratic, intermittent or incorrect
5798	10	DEFSMH (page 508)	DEF Supply Module Heater Temperature abnormal rate of change
520668	31	DEF (page 497)	Controller Adaptation Outer Limits Reached (Low Reductant Delivery)
520669	31	DEF (page 497)	Controller Adaptation Inner Limits Reached (Low Reductant Delivery)

Name	ProStar	LCF	Comments
Warn Engine Lamp (WEL)	 Amber	 Amber	The Warn Engine lamp will illuminate when a non-emissions fault is detected in the engine control system.
Malfunction Indicator Lamp (MIL)	 Amber	 Amber	The Malfunction Indicator lamp will illuminate when an emissions fault is detected in the engine control system.
Stop Engine / Water and Oil Lamp (OWL)	 Red	 Red	The STOP engine lamp will illuminate when a critical engine condition is detected by the engine control system. (Coolant over temp, Low oil pressure, Low coolant level, Critically Over-Loaded DPF)
DPF Regeneration Lamp (Regen)	 Amber	 Amber	The DPF regeneration lamp will illuminate when the DPF is reaching various stages of overloading. The lamp will not be illuminated when the system is performing an ordinary active or inactive DPF Regeneration. This light being on is a requirement to enable a stationary regeneration.
HOT Exhaust Lamp	 Amber	 Amber	The HOT Exhaust lamp will illuminate when the exhaust system temperature goes above 400 F with vehicle speed less than 5 mph

K35294

Figure 1 Warning Lamps

Operational Checkout Procedures

1.0 - Preliminary Vehicle Operational Checkout Procedure

Step 1	Inspect fuel level, quality, and fuel system.	Decision
	Perform Fuel Level Inspection (page 2352), Fuel System Inspection (page 2349), and Fuel Quality Inspection (page 2350). Are fuel level and quality to specification, and did fuel system pass inspection?	Yes: Go to Step 2.
		No: Repair fuel system fault. After repairs are Operational Checkout Procedures complete, retest for original problem.

Step 2	Inspect batteries, electrical system, and connections.	Decision
	Perform Batteries and Electrical System Inspection (page 2393). Are batteries, electrical system, and connections in good condition, tight, not corroded, and is battery voltage in specification?	Yes: Go to Step 3.
		No: Repair broken, loose, or corroded electrical system connections or components. Charge batteries to 12.6 volts. After repairs are complete, retest for original problem.

Step 3	Inspect air intake system for damage or restrictions.	Decision
	Inspect Charge Air Cooler (CAC), Engine Throttle Valve (ETV), Mass Air Flow (MAF) sensor, air filter, intake piping, clamps, and connections for damage or restrictions. Are air intake system components damaged or restricted?	Yes: Repair air intake system damage or restrictions. After repairs are complete, retest for original problem.
		No: Go to Step 4.

Step 4	Inspect exhaust system for damage or restrictions.	Decision
	Inspect Diesel Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), Selective Catalyst Reduction (SCR) catalyst, exhaust brake, and exhaust piping for damage or restrictions. Are exhaust system components damaged or restricted?	Yes: Repair exhaust system damage or restrictions. After repairs are complete, retest for original problem.
		No: Go to Step 5.

Step 5	Inspect engine oil level.	Decision
	Perform Engine Oil Level Inspection (page 2353). Is engine oil level to specification?	Yes: Go to Step 6.
		No: Correct engine oil level problem. After repairs are complete, retest for original problem.
Step 6	Inspect engine coolant level and quality.	Decision
	Perform Coolant Level Inspection (page 2355) and Coolant Quality Inspection (page 2356) procedures. Are coolant level and quality to specification?	Yes: Go to Step 7.
		No: Fill engine coolant to specification. If coolant is contaminated, go to Coolant Contamination (page 88). After repairs are complete, retest for original problem.
Step 7	Verify Engine Control Module (ECM) communicates with Electronic Service Tool (EST), obtain vehicle health report, and check for current Engine Control Module (ECM) calibration.	Decision
	A. Connect EST with ServiceMaxx software and log-in. B. Perform Obtain Vehicle Health Report (page 2107). Is EST communicating with the ECM, and is ECM calibration current?	Yes: Go to Step 8.
		No, ECM calibration not current: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for original problem.
		No, EST not communicating with ECM: Go to 11.0 ECM Loss of Communication (page 43).

Step 8	Review Repair Order (RO) and operator complaint.
<p>Go to operational checkout procedure for specific symptom:</p> <ul style="list-style-type: none">• 2.0 Engine Does Not Start Operational Checkout Procedure (page 26)• 3.0 Engine Hard to Start Operational Checkout Procedure (page 30)• 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure (page 34)• 5.0 Engine Running, Engine Under Load Operational Checkout Procedure (page 36)• 6.0 Cooling System Operational Checkout Procedure (page 38)• 7.0 Engine Oil System Operational Checkout Procedure (page 39)• Go to 8.0 Fuel System Operational Checkout Procedure (page 40)• 9.0 Engine Compression Brake Operational Checkout Procedure (page 41)• 10.0 SCR Aftertreatment Operational Checkout Procedure (page 42)	

2.0 - Engine Does Not Start Operational Checkout Procedure**Overview**

The following steps direct technicians to systematically troubleshoot engine no start conditions and avoid unnecessary repairs.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if injector buzz test will identify a failed injector.	Decision
	Perform Injector (Buzz) Test (page 2154).	Yes: Go to Step 3.
	Is an audible buzz sound heard from each injector?	No: Do injector circuit diagnostics (SPN 651-656 FMI 4, 5; SPN 2797, 2798 FMI 3, 4; SPN 3659-3664 FMI 4, 5) for specific failed injector(s). If circuit diagnostics passes, replace failed injector(s).

Step 3	Check for no start related Diagnostic Trouble Codes (DTC).	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for:	Yes: Go to Fault Code Diagnostics for no start related SPN.
	<ul style="list-style-type: none"> • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electric Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 108, 158, 628, 629, 1136, 1387 Engine Control Module (ECM) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 51, 3464, Engine Throttle Valve (ETV) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) faults • SPN 4287 Engine Compression Brake Pressure (ECBP) 	No: Go to Step 4.
	Does EST DTC list have any active fault codes listed above?	

Step 4	Record snapshot of no start related Key-On Engine-Off (KOEO) Data.	Decision
	<p>Perform Record Snapshot of KOEO data (page 2113).</p> <p>Are battery voltage, FDP, ICP, and engine temperature sensor values within KOEO specifications?</p>	<p>Yes: Go to Step 5.</p> <p>No: Battery voltage out of specification: Repair battery, starting system, charging system, or ECM PWR circuit problem. After repairs are complete, retest for original problem.</p> <p>No: FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 120).</p> <p>No: ICP out of specification: Go to SPN 164 FMI 0 Fault Code Diagnostics (page 1287).</p> <p>No: One or more engine temperature sensors not within 20°F (7°C) of others after cold soak: Go to Fault Code Diagnostics (page 142) for sensor out of specification.</p>
Step 5	Record snapshot of engine cranking data.	Decision
	<p>Perform Engine Cranking Test (page 2172).</p> <p>Are Switch Battery (SWBAT), Engine Speed (rpm), ICP, IPR, FDP, and EGR within engine cranking specification (page 2403)?</p>	<p>Yes: Go to Step 6.</p> <p>No, SWBAT or Engine Speed (rpm) out of specification: Go to 2.1 Engine Cranks Slow or Does Not Crank (page 49).</p> <p>No.: ICP or IPR out of specification: Go to CPA High-Pressure Oil</p>

		Pump (HPOP) Test (page 2227).
		No, FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 2273).
		No, EGR out of specification: Go to SPN 2791 FMI 7 Fault Code Diagnostics (page 1095).

Step 6	Engine no start, cold ambient temperature.	Decision
	Attempt to start engine.	Yes: Go to 2.2 Engine No Start, Cold Ambient Temperature (page 53).
	Does engine fail to start, specifically during cold ambient temperatures?	No: Go to Step 7.

Step 7	Engine at operating temperature, no re-start.	Decision
	A. Run engine to operating temperature. B. Attempt to start engine at operating temperature.	Yes: Go to 2.3 Engine at Operating Temperature, No Re-Start (page 54).
	Does engine fail to start, specifically after being run to operating temperature?	No: Go to 2.4 Engine Never Starts (page 57).

3.0 - Engine Hard to Start Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine hard to start conditions and to avoid unnecessary repairs.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?	Yes: Go to Step 2. No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for hard to start related Diagnostic Trouble Codes (DTC).	Decision
	<p>Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for:</p> <ul style="list-style-type: none"> • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electric Fuel Pump (EFP) • SPN 164 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 108, 158, 628, 629, 1136, 1387 Engine Control Module (ECM) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) faults • SPN 4287 Engine Compression Brake Pressure (ECBP) <p>Does EST DTC list have any of the fault codes listed above?</p>	<p>Yes: Go to Fault Code Diagnostics (page 142) for hard to start related SPN.</p> <p>No: Go to Step 3.</p>

Step 3	Record snapshot of hard to start related Key-On Engine-Off (KOEO) data.	Decision
	Perform Record Snapshot of KOEO Data (page 2113). Are battery voltage, Fuel Delivery Pressure (FDP), Injection Control Pressure (ICP), and engine temperature sensor values within Key-On Engine-Off specifications?	Yes: Go to Step 4.
		No, battery voltage out of specification: Repair battery, starting system, charging system, or ECM PWR circuit problem. After repairs are complete, retest for original problem. No, FDP out of specification: Go to 8.1 - Low Fuel Delivery Pressure (page 120). No, ICP out of specification: Go to SPN 164 FMI 0 Fault Code Diagnostics (page 1287). No, one or more engine temperature sensors Not within 20°F (7°C) of others after cold soak: Go to Fault Code Diagnostics (page 142) for sensor out of specification.

Step 4	Record snapshot of engine cranking data.	Decision
	Perform Engine Cranking Test (page 2172). Are Switch Battery (SWBAT), Engine Speed (rpm), ICP, IPR, FDP, EGR, Turbocharger 1 Turbine Outlet Pressure (TC1TOP), EBP, and DPFDPA within Engine cranking specification?	Yes: Go to Step 5 (page 32). No: SWBAT or Engine Speed (rpm) out of specification: Go to 2.1 Engine Cranks Slow or Does Not Crank (page 49). No: ICP or IPR out of specification: Go to CPA

	<p>High-Pressure Oil Pump (HPOP) Test (page 2227).</p> <p>No: FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 120).</p> <p>No: EGR out of specification: Go to SPN 2791 FMI 7 Fault Code Diagnostics (page 1095).</p> <p>No: TC1TOP, EBP, or DPFDP out of specification: Look for exhaust restrictions. Go To Diesel Particulate Filter (DPF) Inspection (page 2370), Diesel Oxidation Catalyst (DOC) Inspection (page 2373), Selective Catalytic Reduction (SCR) Inspection (Selective Catalytic Reduction (SCR) Inspection, page 2375), and Decomposition Tube Inspection (Decomposition Reactor Tube Inspection, page 2380).</p>
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Step 5	Determine if engine will not start specifically during cold ambient temperatures.	Decision
	<p>Attempt to start engine.</p> <p>Is engine hard to start, specifically during cold ambient temperatures?</p>	<p>Yes: Go to 3.1 Engine Hard to Start, Cold Ambient Temperature (page 60).</p> <p>No: Go to Step 6 (page 32).</p>

Step 6	Determine if engine is hard to re-start after being run to operating temperature	Decision
	<p>A. Run engine to operating temperature.</p> <p>B. Attempt to re-start engine at operating temperature.</p> <p>Is engine hard to re-start specifically after being run to operating temperature?</p>	<p>Yes: Go to 3.2 Engine at Operating Temperature, Hard to Re-Start (page 62).</p> <p>No: Go to Step 7 (page 33).</p>

Step 7	Determine if engine starts, and then stalls.	Decision
	Attempt to start engine. Does engine start and then stall?	Yes: Go to 3.3 Engine Starts, Then Stalls (page 64).
		No: Go to 2.4 Engine Never Starts (page 57).

4.0 - Engine Running, Engine Not Under Load Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine running problems while engine is not under a load.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for related Diagnostic Trouble Codes (DTCs).	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for:	Yes: Go to Fault Code Diagnostics for appropriate SPN.
	<ul style="list-style-type: none"> • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electronic Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) • SPN 105 Intake Manifold Temperature (IMT) 	No: Go to Step 3.
	Does EST DTC list have any of the above listed SPN?	

Step 3	Record snapshot of engine running data and determine if engine idles properly.	Decision
Perform Record Snapshot of Engine Running Data (page 2113) while symptom is occurring. A. Run engine at idle. B. Full throttle for 15 seconds. C. Idle for 30 seconds. D. Full throttle for 15 seconds. E. Idle for 30 seconds. F. Stop recording. Does engine idle rough or surge at idle?		Yes: Go to 4.1 Rough Idle (page 66). No: Go to Step 4.

Step 4	Determine if engine is able to reach rated speed.	Decision
A. Start engine. B. Increase engine rpm to rated speed, and return to idle. Is engine able to reach rated speed?		Yes: Go to Step 5. No: Go to 4.2 Engine Unable to Reach Rated Speed (No Load) (page 70).

Step 5	Determine if a popping noise is coming from engine air intake.	Decision
A. Start engine. B. Listen for popping noise from engine air intake. C. Increase engine rpm to rated speed and return to idle. Is popping noise heard from engine air intake?		Yes: Go to 4.3 Popping Noise from Intake (page 72). No: Review operator complaint.

5.0 - Engine Running, Engine Under Load Operational Checkout Procedure**Overview**

The following steps direct technicians to systematically troubleshoot engine running problems while under a load.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for Diagnostic Trouble Codes (DTCs).	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for:	Yes: Go to Fault Code Diagnostics for appropriate SPN (page 11).
	<ul style="list-style-type: none"> • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electronic Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) • SPN 105 Intake Manifold Temperature (IMT) Does EST DTC list have any of the above listed SPN?	No: Go to Step 3.

Step 3	Record snapshot of engine running data and determine if engine has a misfire.	Decision
	<p>Perform Record Snapshot of Engine Running Data (page 2231) while symptom is occurring.</p> <p>Does engine speed vary by 50 rpm or more while symptom is occurring?</p>	<p>Yes: Go to 5.2 Misfire (Stumble/Surge/Runs Rough) (page 80).</p> <hr/> <p>No: Go to Step 4.</p>
Step 4	Determine if engine has low power or slow acceleration.	Decision
	<p>Review engine running snapshot.</p> <p>Does vehicle have low power or slow acceleration?</p>	<p>Yes: Go to 5.1 Low Power (Slow Acceleration) (page 74).</p> <hr/> <p>No, if equipped with Power Takeoff (PTO): Go to Step 5.</p> <hr/> <p>NOTE: No, if not equipped with PTO: review operator complaint.</p>
Step 5	Determine if engine is able to reach desired speed during PTO operation.	Decision
	<p>A. Start engine.</p> <p>B. Operate PTO.</p> <p>C. If vehicle is equipped with a manual PTO, increase engine rpm to desired operating speed.</p> <p>Does engine reach desired speed during PTO operation?</p>	<p>Yes: Review operator complaint.</p> <hr/> <p>No: Go to 5.3 Engine Unable to Reach Desired Speed During PTO Operation (page 84).</p>

6.0 - Cooling System Operational Checkout Procedure

CONTENT
UNDER
DEVELOPMENT

7.0 - Lube Oil System Operational Checkout Procedure

CONTENT
UNDER
DEVELOPMENT

8.0 - Fuel System Operational Checkout Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?		Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).
Step 2	Determine if engine has a fuel delivery problem.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273).		Yes: Go to Step 3.
Is fuel pressure between 60 and 100 psi?		No: Go to 8.1 Fuel Delivery Pressure (page 120).
Step 3	Determine if engine has fuel in the engine oil.	Decision
Look for engine oil over full $\frac{3}{4}$ " or more and smells like fuel.		Yes: Go to Fuel in Engine Oil (page 124).
Is fuel in the engine oil?		No: Review operator complaint.

9.0 - Engine Compression Brake Operational Checkout Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for related Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: <ul style="list-style-type: none"> • SPN 191 Transmission Output Shaft Speed (TOSS) Vehicle Speed Sensor (VSS) • SPN 597 Engine Compression Brake Switch • SPN 4287 Engine Compression Brake Pressure (ECBP) Does EST DTC list have any of the above listed SPN?		Yes: Go to Fault Code Diagnostics for appropriate SPN.
		No: Perform 0 to 60 MPH Test (page 2236) while symptom is occurring, activate engine brake and deactivate engine brake. Go to Step 3

Step 3	Determine if engine compression brake is operating, or is engaged when not commanded On.	Decision
Review 0 to 60 snapshot Does engine brake activate and deactivate properly when commanded?		No, engine brake does not activate: Go to 9.1 Engine Compression Brake Inoperative (page 126).
		No, engine brake does not disengage when commanded Off: Go to 9.2 Engine Compression Brake Engaged When Not Commanded (page 129).
		Yes: Review operator complaint

10.0 - SCR Aftertreatment Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot Selective Catalyst Reduction (SCR) exhaust aftertreatment system problems and avoid unnecessary repairs.

CAUTION: The following service information **ONLY** applies to N9 and N10 engines with SCR aftertreatment systems. Using these diagnostics for any other engine or aftertreatment system will result in misdiagnosis and unnecessary repairs.

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2 (page 42).
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if parked regeneration will not activate.	Decision
Press Parked Regen Switch.		Yes: Press brake pedal to abort Parked Regen. Go to Step 3 (page 42).
Does exhaust aftertreatment regeneration start?		
		No: Go to 10.1 Parked Regen Will Not Activate (page 131).

Step 3	Determine if excessive black smoke comes out of exhaust.	Decision
Does excessive black smoke come out of exhaust?		Yes: Go to 10.2 Black Smoke (page 133).
		No: Go to Step 4 (page 42)

Step 4	Determine if excessive white smoke comes out of exhaust.	Decision
Does excessive white smoke come out of exhaust?		Yes: Go to 10.3 White Smoke (page 138).
		No: Review operator complaint.

11.0 - ECM Loss of Communication

Overview

Diagnose Engine Control Module (ECM) will not communicate with Electronic Service Tool (EST).

Possible Causes

- Theft Deterrent System
- Public CAN Circuit (terminating resistor, etc.)
- Any failed module on Public CAN
- Power and ground circuits to Diagnostic Connector
- Engine Control Module (ECM) power circuit (ECM fuse, ECM PWR Relay, etc.)
- ECM ground circuit
- Low Battery Voltage
- Faulty ECM

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if Electronic Service Tool (EST) is working properly.	Decision
A. Key-On Engine-Off (KOEO) B. Connect EST with ServiceMaxx™ to a second vehicle and log in. Does EST communicate properly with second vehicle?		Yes: Go to Step 3
		No: Repair EST. After repairs are complete, retest for original problem.

Step 3	Determine if EST communicates with other modules.	Decision
A. Key-On Engine-Off (KOEO) B. Connect EST with ServiceMaxx™ to initial vehicle and log in. C. Under the Connection (Sniffer) tab verify equipped modules are listed under Module Name and Count is actively changing. Does EST communicate with modules other than the Engine Control Module (ECM)?		Yes: Go to Step 4
		No: Go to Step 15

CAUTION: Always use the latest version of *N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481*. Failure to comply will cause misdiagnosis and unnecessary repairs.

Step 4	Determine if Engine Control Module (ECM) ground circuits are working properly.	Decision
A. Key Off B. Connect Breakout Harness 00-00959-01 to ECM 76-pin gray chassis connector and ECM. C. Connect Breakout Harness 00-00959-01 to 180-pin Breakout Box 00-00956-08. D. Key-On Engine-Off (KOEO) E. Measure voltage between battery positive and pins C-2, 4, and 6. Are ECM ground circuits between pins C-2, 4, 6 and battery positive within 0.5V of battery voltage?		Yes: Go to Step 5
		No: Repair ground circuits. After repairs are complete, retest for original problem.

Step 5	Determine if ECM is receiving ignition switch power.	Decision
A. Key-On Engine-Off (KOEO) B. Measure SWBAT circuit voltage between battery ground and pin C-31. Is voltage between pin C-31 and battery negative within 0.5V of battery voltage?		Yes: Go to Step 7
		No: Go to Step 6

Step 6	Determine if vehicle has an anti-theft system installed.	Decision
Look for anti-theft password switch panel on vehicle center panel. Does vehicle have an anti-theft system installed?		Yes: See <i>Electrical System troubleshooting Guide for Anti-Theft System</i> checks. After repairs are complete, retest for original problem. No: Repair SWBAT ignition switch circuit. After repairs are complete, retest for original problem.

Step 7	Determine if ECM MPR ground circuit is operating properly.	Decision
A. Key-On Engine-Off (KOEO) B. Remove ECM PWR Relay C. Measure voltage between battery positive and ECM PWR relay pin-85 Is voltage between pin 85 and battery positive within 0.5V of battery voltage?		Yes: Go to Step 10 No: Go to Step 8

Step 8	Determine if ECM MPR ground circuit is open	Decision
A. Key-On Engine-Off (KOEO) B. Measure voltage between battery positive and pin C-70 Is voltage between pin C-70 and battery positive within 0.5V of battery voltage?		Yes: Go to Step 10 No: Go to Step 9

Step 9	Determine if Engine Control Module (ECM) is operating properly.	Decision
A. Install a known good test ECM B. Attempt to recreate original problem Does original problem occur with test ECM?		Yes: Install original ECM. Verify each step was completed correctly and the proper decision was made. No: Replace ECM. After repairs are complete, retest for original problem.

Step 10	Determine if power circuits to the ECM are working properly.	Decision
A. Key-On Engine-Off (KOEO) B. Measure voltage between battery ground and pins C-1, 3 and 5 Are power circuits between pins C-1, 3 and 5 and battery ground within 0.5V of battery voltage?		Yes: Go to Step 11
		No: Diagnose and repair ECM power circuit (40A fuse, ECM PWR Relay, etc.). After repairs are complete, retest for original problem.

Step 11	Determine if Public CAN circuits between ECM and Diagnostic Connector are Open or have high resistance.	Decision
A. Key Off B. Disconnect Batteries C. Measure resistance between 9-pin Diagnostic Connector pin-D and ECM pin C-62 (CAN-L) D. Measure resistance between Diagnostic Connector pin-C and ECM pin C-61 (CAN-H) Are measured resistances 5 ohms or less?		Yes: Go to Step 12
		No: Repair open or high resistance in Public CAN circuit(s). After repairs are complete, retest for original problem.

Step 12	Measure resistance between Public CAN circuits.	Decision
Measure resistance between Diagnostic Connector pin-C and pin-D. Is resistance between Diagnostic Connector pin-C and pin-D approximately 60 ohms?		Yes: Go to Step 14
		No: Go to Step 13

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