ZENITH POWER PRODUCTS LLC

Purpose Built Industrial Engines Powering Industry

NA857

Stationary Emergency

Industrial engines

Operator Manual

and Maintenance Log

⚠ WARNING ⚠

This product may contain a chemical known to the state of California to cause cancer, or birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Revision 6
July 7, 2022

⚠ California Prop 65 Warning

Engine exhaust from this product, some of its constituents, along with certain machine components contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. In addition, certain fluids contained in the machine and certain products of component wear contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Service Parts

To ensure that your engine continues to run reliably and efficiently for as long as possible, use only genuine Zenith Power Products (ZPP) parts.

For genuine ZPP service parts for your engine, or for technical assistance in servicing your engine, call:

1-715-453-9317
Hours:

Monday-Friday: 8:00 – 4:00 Central Time

Maintenance Providers

Maintenance and repair services may be performed by you or any qualified engine service provider that you choose. However, your engine warranty does not cover damage or failure caused by improper maintenance or repairs.

Operators Manual & Maintenance Log Storage & Use

Store this Operators Manual and Maintenance Log in a safe, visible place by your engine. The maintenance log must be updated whenever your engine is serviced.

Disclaimer

All information and specifications in this manual are based on the latest data available at the time of the publication. Zenith Power Products reserves the right to make changes or improvements at any time without notice.

For additional information, see:
www.ZenithPP.com

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U.S. EPA Legal Requirements

The ZPP NA857 Natural Gas and LPG Vapor engines have been certified by the U.S. Environmental Protection Agency (EPA) as ***Stationary Emergency Engines***. It is illegal to operate these engines in a prime or emergency mobile application or a prime stationary application.

Per 40 CFR 60.4243(d), you may operate your ***Stationary Emergency Engine*** for an unlimited number of hours in emergency situations. You may also operate your engine for up to 50 hours per year in non-emergency situations for maintenance purposes.

To ensure emissions compliance, the U.S. EPA requires you to do one of the following two options:

1. Operate and maintain your engine as specified in this Operators Manual. In addition, you are required by law to keep detailed maintenance records.

2. If you operate your engine as a ***Stationary Emergency Engine*** but do not operate and maintain your engine as specified in this Operators Manual, your engine will be considered a non-certified engine.

   In this case, you must:

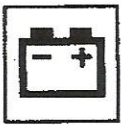
   - Keep a maintenance plan and records of conducted maintenance.
   - To the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions.
   - Conduct an initial performance test within 1 year of engine startup to demonstrate compliance. Contact your regional EPA office for instructions on how to conduct an initial performance test.

Per section 113 of the U.S. Clean Air Act, failure to abide by these legal requirements can result in fines up to $30,750 per day.

A maintenance plan and log are provided at the back of this manual for you to record your engine maintenance. Update the log each time you service your engine.

SAFETY SYMBOLS

This section identifies the ISO 8999 symbols that may be used in this manual.



Battery

Electrical hazards

Engine coolant fill level

Engine coolant temperature

Engine oil fill level

Engine oil pressure

Hot surface warning

Warning

Read the handbook

No Smoking or Flame

SAFETY PRECAUTIONS – STARTING

WARNING

Starting an engine incorrectly may cause injury to the operator and/or cause damage to the engine. Engine operators must be instructed in the correct procedures before attempting to start any engine.

Before Starting

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- Inspect the engine, intake, exhaust, cooling system, and drivetrain to verify that the engine is fully assembled and not in the process of being serviced.
- Ensure the engine is free to turn without obstruction.
- Check that all safety guards are in their correct position and secure.
- Check that the coolant level in the radiator overflow bottle is between "Add" and "Full".
- Check that the oil level on the dipstick is between "Add" and "Full".
- Check that the fuel supply is connected, shut-off valves are open, and there are no leaks.
- If a LPG fuel system is being used, verify that there is fuel in the cylinder/tank.
- If a natural gas fuel system is being used, verify that the correct fuel supply pressure is being supplied to the engine.
- Check that the battery is connected and charged.
- When possible, disengage any driven equipment while starting.

SAFETY PRECAUTIONS – ELECTRICAL



The battery produces flammable and explosive hydrogen gas. The battery electrolyte contains poisonous and corrosive sulfuric acid. The precautions listed below must be followed to ensure operator safety.

- Do not smoke or allow any flame near the battery.
- With the engine stopped and the ignition switch in the OFF position, disconnect the negative battery cable from the battery before working on the engine.
- Be careful not to short circuit battery positive to ground with tools when working on the engine.
- Avoid getting battery electrolyte in your eyes or on your skin or clothes. If electrolyte gets in your eyes, flush with clean water immediately and get medical help. If electrolyte gets on your skin, wash immediately with soap and water and get medical help if you feel pain or burning. Remove and wash any clothing that is exposed to electrolyte.
- Never remove any electrical cables while the battery is connected in the circuit.
- Be careful to not short-circuit or cross battery positive and negative.
- Never ‘flash’ any connection to check the current flow.
- The battery and alternator must be disconnected before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.
- When charging the battery, only do a slow charge (5 A or less), and ensure there is good ventilation.

FUELS

Natural gas and LPG are combustible gases, and can be explosive if leaked and contained in a confined area. Keep cigarettes and all other flame sources away from these areas.

If you can hear a fuel leak, shut off the fuel supply at the source immediately and fix the leak or have it serviced. Check the entire fuel supply line from the cylinder/tank to the engine for leaks with a soapy water bubble mixture anytime a cylinder/tank is changed or the fuel supply line is worked on. Fuel leaks should also be checked as part of the regular engine maintenance.

Depending on your engine and fuel system configuration, your engine is designed to run on natural gas and/or vapor LPG. The fuel requirements for each are discussed below. See the "SPECIFICATIONS" section for the required fuel supply pressures for each fuel.

Natural Gas

Your engine is certified to run on "pipeline-quality natural gas". EPA defines pipeline-quality natural gas as being composed of at least 70% methane by volume or having a heating value of 950-1100 BTUs per cubic foot. In addition, pipeline-quality natural gas must be provided by a supplier through a pipeline. If your natural gas supply does not meet these specifications, your engine is considered to be being operated as a non-certified engine. See "U.S. EPA Legal Requirements" at the front of this manual.

LPG

In order to maintain emissions compliance and the engine warranty, use commercial-grade HD-10 or better LPG.

Liquid LPG is drawn off of the bottom side of a LPG tank or cylinder and is a liquid until it has passed through the regulator/vaporizer, at which point it is vaporized to a gas. If you connect vapor LPG to a liquid LPG fuel system, you may starve the engine for fuel, causing it to produce low power and excessive emissions.

Vapor LPG is drawn off of the top side of a LPG tank or cylinder and is a gas from the tank/cylinder through to the engine intake. If you connect liquid LPG to a vapor LPG fuel system the fuel will not vaporize properly, causing the engine to run rich, produce low power and excessive emissions.

STARTING, RUNNING, & STOPPING THE ENGINE

Observe the safety precautions listed in "SAFETY PRECAUTIONS - STARTING" before starting the engine.

Starting the engine

- Turn the key switch to the ON position and verify that the MIL is illuminated. If not determine why the lamp is not working.
- Turn the key switch to the START position and hold until the engine has started.
- Release the key promptly after the engine starts to avoid grinding the starter.
- Do not crank the engine for more than 15 seconds at a time.
- Allow at least 30 seconds between cranking attempts.
- If the engine does not start after 3 starting attempts, review the "Before Starting" checklist.

Running the engine

- Do not race or fully load the engine during the first 3 minutes of operation.
- Verify that the "CHECK ENGINE" light is off while the engine is running. If it is on, refer to the DIAGNOSTICS section.
- Verify that there are no fuel, coolant, or oil leaks while the engine is running. If there are leaks, stop the engine and fix them or have the engine serviced.
- Listen to the engine. If you hear an abnormal noise while the engine is running, turn it off and correct the problem or have the engine serviced.
- No adjustments are necessary to the fuel or ignition systems.

Stopping the engine

- If the engine has been running under load and is hot, run the engine at no load for 3 minutes to allow the engine to cool before stopping the engine.
- Stop the engine by turning the key switch to the OFF position. The engine may run-on for 1-5 seconds while the fuel is depleted from the carburetor and the air/fuel mixture is depleted from the intake manifold.

ENGINE MAINTENANCE

You should properly maintain your engine for the following reasons.

- You are legally required to maintain your engine and keep maintenance records to ensure emissions compliance. See "U.S. EPA Legal Requirements" at the front of this manual.
- Your engine warranty will be void if the engine is not properly maintained.
- Keeping your engine properly maintained will ensure the best engine life, power, and fuel economy.

Scheduled Maintenance

A schedule of the required engine maintenance tasks is listed on the following page. The scheduled maintenance should be performed when the engine reaches the specified operating hours or the specified months have elapsed, whichever comes first.

Daily Maintenance

In addition to the scheduled maintenance, daily checks are required to keep your engine running properly. These checks are listed in the "SAFETY PRECAUTIONS - STARTING" and "STARTING, RUNNING, & STOPPING THE ENGINE" sections.

Maintenance Log

Keep a record of your engine's scheduled maintenance in the Maintenance Log at the back of this manual.

ZPP NA857 STATIONARY EMERGENCY ENGINE AND

This table lists the periodic maintenance required to ensure quality performance

			MAINTENANCE
Periodic maintenance should be performed after specified intervals have elapsed in years or hours, whichever comes first	Years Hours	1 250	2 500
Air filter	(A)		I
Battery		I	I
Drive Belt		I	I
Engine coolant (L.L.C.)		I	I
Radiator outside	(A)	C	C
Engine oil	(A)	R	R
Oil Filter	(A)	R	R
Distributor Cap & Rotor			
Spark Plugs			
Spark Plug Wires			
Oxygen sensor	(A)		
PCV system			
	ADDITIONAL MAINTENANCE REQUIREMENTS		
Check fuel hoses and fittings for gas leakage	(B)	I	I
Fuel lock-off valves			

Notes: A) Under heavy duty operating condition, more frequent maintenance may be necessary

B) At time of LPG cylinder replacement, inspect tank connections for leakage with soapy water.

Abbreviations: I = Inspection
R= Replace
A= Adjust
C= Clean

EMISSIONS CONTROL SYSTEM MAINTENANCE SCHEDULE

and good reliability of the engine and emission control system in your application.

INTERVAL				
3 750	4 1000	5 1250	6 1500	7 1750
	R		I	
I	I	I	I	I
I	I	I	I	I
I	I	I	I	I
C	C	C	C	C
R	R	R	R	R
R	R	R	R	R
	I			
	I			
	I			
	I			
	I			
FOR LPG FUEL SYSTEM				
I	I	I	I	I
	I			

STORAGE

If the Stationary Emergency engine will not be placed in service right away, or if the unit is removed from service and will be stored for an unanticipated length of time, please follow the steps below to avoid damage to your engine.

1. Clean the air cleaner evacuator valve and body.

2. Replace air filter.

3. Drain, flush and fill the cooling system with the correct antifreeze engine coolant mixture to protect the engine to the lowest anticipated temperature.

4. The battery does not need to be removed, unless extended storage will be more than 30 days, or if temperatures will fall below freezing. The battery MUST be fully charged to prevent freezing. Disconnect negative and positive battery cables to prevent discharge and damage to controls and other connected components. Check battery charge every 90 days.

5. Remove all drive belts.

6. Cover the exhaust stack with a can or other appropriate cover to prevent the entry of rainwater, debris, or animals.

   DO NOT seal up tight as this may cause condensation to collect inside the exhaust system.

Do not prepare engine for storage if it is in-use for *Emergency Standby* purposes. Only prepare if unit is Not in Use.

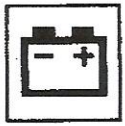
AIR FILTER

NA857 Air Filter: 200469 Primary
200289 Secondary (If Equipped)

Inspection

1. Remove air filter element from enclosure.
2. Tap filter to knock off loose dirt.
3. Visually check filter.
4. If filter is clean, reinstall old filter.
   If filter is dirty, replace with a new filter.

BATTERY



The battery produces flammable and explosive hydrogen gas. The battery electrolyte contains poisonous and corrosive sulfuric acid. Review the safety precautions in "SAFETY PRECAUTIONS - ELECTRICAL" before working on the battery.

Battery Specifications	
Nominal Voltage:	12 V
Cranking Amps:	750
Cold Cranking Amps:	600
Ampere Hours	56
Battery voltage during alternator charging:	14.0 -15.0 V
Fully charged battery with key off @ 20 C (68 F):	12.5 -13.0 V
Half charged battery with key off @ 20 C (68 F):	12.0 - 12.5 V
Discharged battery with key off @ 20 C (68 F):	less than 12.0 V

Battery electrolyte inspection

1. Check electrolyte level.
2. If low, top off with distilled water. Do not overfill.

Battery corrosion inspection

1. Check battery posts and clamps for corrosion.
2. If corroded, remove negative cable first, then positive.
3. Clean both posts and both clamps with a small wire brush.
4. Reconnect cables, positive cable first.

If the engine is cranking slowly or not at all:

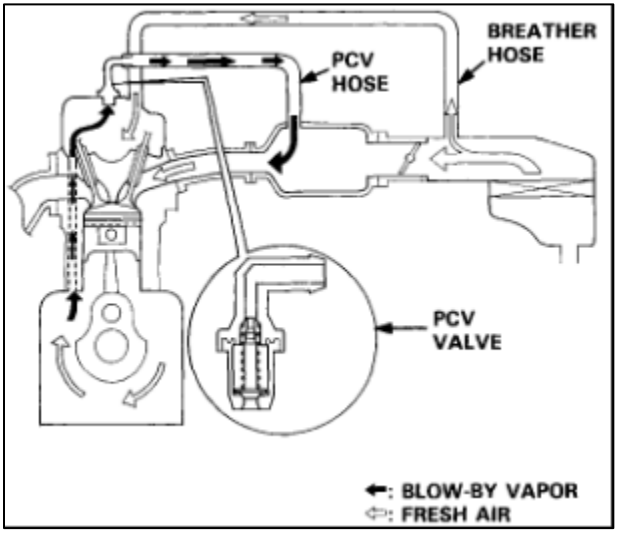
1. Remove the battery negative lead from the battery.
2. Remove the positive lead from the battery.
3. Clean the battery posts and cables with a small wire brush.
4. Replace leads, positive lead first.

If the engine is still cranking slowly or not at all:

1. Remove the battery negative leads.
2. Recharge the battery in a well-ventilated area.
3. Reinstall the battery.

If the engine is still cranking slowly or not at all:
Replace the battery.

PCV SYSTEM



The Positive Crankcase Ventilation (PCV) system recirculates the crankcase blow-by gases into the intake manifold to be combusted in the engine. When the blow-by vapor pressure is high enough to overcome the spring pressure in the PCV valve, the valve opens to allow blow-by vapor into the intake manifold for combustion along with the fuel/air mixture.

Inspection & Cleaning:

1. Remove and inspect the breather hose and fitting.
   Clean or replace if needed.

2. Remove and inspect the PCV hose.
   Clean or replace if needed.

3. Remove and inspect the PCV valve.
   Clean the PCV valve if needed.

ENGINE COOLANT, RADIATOR, AND COOLING SYSTEM



To avoid being scalded or burned, never remove the radiator cap unless the engine is off and coolant has fully cooled. The coolant in the radiator is pressurized when hot and may boil over when the radiator cap is loosened.

When using antifreeze coolant, mix the antifreeze coolant with water, observing instructions attached to antifreeze container. Use only antifreeze approved for aluminum components in a 50/50 mixture ratio.

Clean radiator outside

Clean outside of radiator with dry compressed air.

Inspect cooling system, hoses and connections

Check hoses and fittings for loose connections or for any sign of oil deterioration or soft spots in the hoses. Retighten connections or replace hoses if needed.

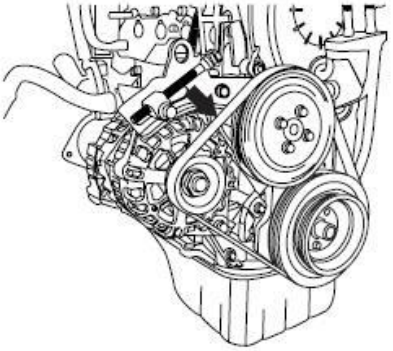
Check coolant level. If low, top off coolant with a premixed 50/50 mixture of antifreeze and water.

Engine Coolant Replacement

1. Open overflow bottle cap.
2. Drain old coolant.
3. Flush system with fresh, clean water.
4. Slowly refill system with premixed 50/50 antifreeze/water mixture.
5. Idle engine with radiator cap off to allow air to escape.
6. Top off coolant in overflow bottle if needed.
7. Stop engine.
8. Replace radiator cap and close overflow bottle cap.

DRIVE BELT

857 Belt P/N: 200196



ABHE028A

Inspection

Check the belt for visible cracks, missing chunks, and fraying. Small cracks on the inside of the belt are OK. Replace the belt if cracks are visible on the outside of the belt, chunks are missing from the inside of the belt, or the belt is frayed.

Belt Tension

Measure the belt tension midway between the alternator and water pump pulley as specified by the arrow in the left figure above. Use a tensioning tool such as the one shown in the right figure above (OTC 6673LG or equivalent).

Deflection:

A second method of measuring belt tension is to apply a force of 98N (10kg, 22lb), and measure the deflection between the alternator and water pump pulley. If the belt tension is not as specified, adjust it.

DEFLECTION	
New belt	8.5 ~ 9.5mm (0.3346 ~ 0.3740in.)
Used belt	9.5 ~ 11.0mm (0.3740 ~ 0.4331in.)

DRIVE BELT – CONTINUED

NOTE:

"New belt" *refers to a belt which has been used less than 5 minutes on a running engine.*

"Used belt" *refers to a belt which has been used on a running engine for 5 minutes or more. After installing a belt, check that it fits properly in the ribbed grooves. Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley. After installing a new belt, run the engine for about 5 minutes and recheck the belt tension.*

Belt Replacement

1. Release all tension from the old belt.
2. Remove the old belt.
3. Install the new belt.
4. Apply tension to the belt as specified in "Belt Tension".
5. Recheck tension after 25-50 hours of operation.

ENGINE OIL AND FILTER REPLACEMENT

	NA857
Filter:	201105
Oil Grade:	See “SELECTION OF ENGINE OIL”
API Certification:	SJ or better, CNG/LNG
Oil Capacity (with filter):	5.0 qt/4.7 L

*Low ash oil is recommended for engines using Natural Gas

DRAIN THE ENGINE OIL

1. Remove the oil filler cap.
2. Remove the oil drain plug and drain the oil into a container.

REPLACE THE OIL FILTER

1. Remove the oil filter.
2. Check and clean the oil filter installation surface.
3. Check that the part number of the new oil filter is correct.
4. Apply clean engine oil to the gasket of the new oil filter and screw on until finger tight.
5. Tighten it an additional ¾ turn.

REFILL WITH ENGINE OIL

1. Clean and install the oil drain plug with a new gasket.
2. Fill with fresh engine oil. Do not overfill.
3. Install the oil filler cap.
4. Start engine and check for oil leaks.
5. Recheck the engine oil level.

Dispose of used oil at your local oil recycling center.

SELECTION OF ENGINE OIL

API SERVICE GRADE CERTIFIED

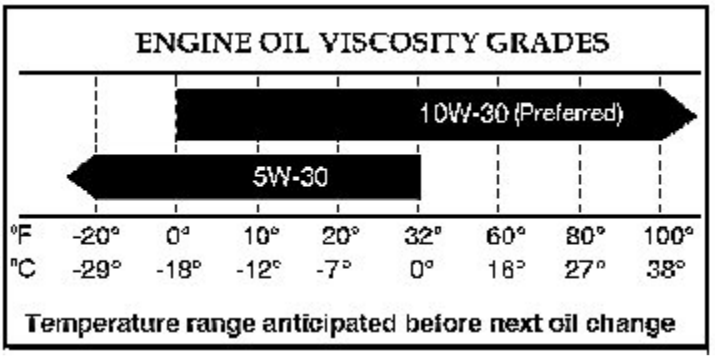
Use engine oil that is API Service Grade Certified. Standard engine oil identification notations have been adapted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans.

API recommendation: SJ or above, CNG/LNG

NOTE: This applies to all automotive/industrial applications regardless of the fuel selection, i.e., gasoline, LPG or natural gas.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. **SAE 15W-40** specifies multiple viscosity engine oil. When choosing engine oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Select engine oil that is best suited to your area's particular ambient temperature range and variation.



CAUTION: Do not use an oil filter with metric threads. An oil filter with metric threads can result in oil leaks and engine failure. The correct oil filter has SAE 3/4-16 threads.

CHECKING FOR GAS LEAKS

Natural gas and LPG are combustible gases, and can be explosive if leaked and contained in a confined area. Keep cigarettes and all other flame sources away from these areas.

Inspection

1. If you can hear a fuel leak, shut off the fuel supply at the source immediately and fix the leak or have it serviced.

2. If there are no audible leaks, start the engine.

3. Check the entire fuel supply line from the source to the engine with a soapy water mixture. A stream of bubbles indicates leak sources.

4. Tighten fittings and clamps as needed to eliminate slow leaks.

5. If any fuel line components (hoses, pipe, fittings, etc.) need to be replaced, first bleed the fuel out of the line by shutting off the gas supply at the source with the engine running at idle. Wait for the engine to stop before disassembling the fuel line.

NATURAL GAS & LPG FUEL LOCK-OFF VALVES

ZPP recommends the following fuel lock-off for the 857 engine.

201471

The fuel lock-off valve is located between the final stage regulator and NG fuel supply line or LPG cylinder. The Engine Control Module (ECM) opens the fuel lock-off when the ECM detects engine speed from the CRANK sensor during cranking. The ECM turns off the fuel lock-off when the key switch is turned off or the ECM shuts down the engine for low oil pressure or engine overheat.

The lock-off can sometimes "gum up" due to fuel deposits in the lock-off. The procedure below will verify if the lock-off is opening and closing correctly.

Inspection

1. Turn off the engine.
2. Disconnect the fuel lock-off positive and negative wires from the wiring harness.
3. Apply 12 VDC across the lock-off.
4. You should hear the valve open immediately when 12 V is applied and hear the valve close immediately when 12 V is removed. This indicates that the valve is moving freely.

If you cannot hear the valve open and close, replace the valve.

OXYGEN SENSOR

ZPP Part Number: 201279

Sensor Locations:

The NA857 oxygen sensor is located in the exhaust pipe.

Snug the exhaust manifold and exhaust pipe bolts when replacing the oxygen sensor, but do not overtighten!

Check for exhaust leaks by feeling for escaping air about 2-3 inches from the exhaust pipe while the engine is running at light load. Stop the engine and fix any leaks that are found.

SPARK PLUGS, WIRES, DISTRIBUTOR CAP AND ROTOR

Ignition System Part Specifications	
	NA857
Distributor cap	202354
Distributor rotor	202355
Spark plugs	200174
Spark plug gap	0.028 in. 0.711 mm
Spark plug wires	201106

Distributor cap inspection

1. Remove distributor cap from base.
2. Visually check inside and outside of cap for cracks.
3. Check posts for excessive wear.
4. Replace cap if cracked or posts are badly worn.

Distributor rotor inspection

1. Remove rotor and check tip for wear.
2. If tip is worn 1/16" or more, replace rotor.

Spark plug inspection

1. Remove one plug from each bank.
2. Inspect plugs for fouling and erosion.
3. Clean or replace plugs if needed.

Ignition wires inspection

1. Visually check ignition wires.
   - Look for spark arcing while the engine is running.
   - Check for cracks in the wire insulation.
2. If arcing and/or cracked insulation is evident, replace the entire set of ignition wires.

DIAGNOSTICS

How to manage and retrieve fault codes

A MIL (malfunction indicator lamp) is provided to notify the engine operator of potential problems with the emissions control system. With the key ON and engine OFF the MIL will illuminate to indicate it is functioning properly. If the key switch is ON and the engine is OFF and the MIL is not illuminated there is a problem with the MIL circuit. Diagnose and repair this problem before proceeding.

If the key is ON and an active fault exists, the MIL will automatically flash. The flashing sequence indicates the DTC that occurred. DTC's are 3 digit codes. Count the flashes to determine which DTC is set.

If the engine is stopped the MIL flashes a '12' code before and after an active fault that might exist. If the engine is running it will flash just the fault code. Refer to the following table to determine which fault(s) is set.

Faults can also be viewed through the CAN Gauge, if so equipped. Faults are located near the end of the *Live Data* group. Faults can be viewed and cleared with the CAN Gauge, simply follow the steps when prompted.

Faults can also be viewed through the use of a PC tool with the appropriate software and communications cable. The PC is most often used by the service technician when more detailed diagnostic information is required.

The action taken when a fault occurs can be different for each fault. The engine manufacturer (MOR) assigns these actions based on the specific application of the engine. Fault actions include illumination of the MIL, power limiting, engine shutdown, delayed engine shutdown, cut throttle, and disable closed-loop fuel control.

A DTC normally requires a service technician to diagnose and repair the problem. If the MIL is illuminated it is recommended that the engine be stopped and repaired immediately to avoid potential damage to the engine or non-compliance.

If the fault condition disappears on its own, the MIL will stay illuminated for three (3) consecutive engine starts subsequent to the fault condition no longer existing, after which the MIL will turn off by itself. Refer to Service Manual or call your authorized service center for additional diagnostic and service information.

Diagnostic Trouble Code (DTC) List

DTC	Fault Description	MIL Flash Code
121	Auto engine crank function exceeded specified number of engine crank attempts without succesful engine start	121
123	Manual engine crank function exceeded specified number of engine cranks without succesful engine start	123
141	Engine Coolant Temperature Sensor voltage is Low. Normally set if the coolant sensor wire has shorted to chassis ground or the sensor has failed.	141
151	Engine Coolant Temperature Sensor voltage is High. Normally set if coolant sensor wire has been disconnected or circuit has opened to the SECM or shorted to power	151
161	Engine Coolant Temperature is High. The sensor has measured an excessive coolant temperature typically due to the engine overheating	161
171	Engine Coolant Temperature not changing as expected	171
191	No CAM signal when engine is known to be rotating, broken CAM sensor leads or defective CAM sensor	191
192	Loss of synchronization on the CAM sensor, normally due to noise on the signal or an intermittent connection on the CAM sensor	192
193	No crankshaft signal when engine is known to be rotating, broken crankshaft sensor leads or defective crank sensor	193
194	Loss of synchronization on the crankshaft sensor, normally due to noise on the signal or an intermittent connection on the crankshaft sensor	194
199	Communication response longer than expected	199
221	TPS1 sensor voltage out of range low, normally set if TPS1 signal has shorted to ground, circuit has opened or sensor has failed	221
222	TPS2 sensor voltage out of range low, normally set if the TPS2 signal has shorted to power, circuit has opened, or sensor has failed	222
231	TPS1 sensor voltage out of range high, normally set if TPS1 signal has shorted to power or ground for the sensor has opened	231
232	TPS2 sensor voltage out of range high, normally set if the TPS2 signal has shorted to power or ground for the sensor has opened	232
241	Learned closed throttle end of TPS1 sensor range lower than expected	241
242	Learned closed throttle end of TPS2 sensor range lower than expected	242
251	Learned WOT end of TPS1 sensor range higher than expected	251
252	Learned WOT end of TPS2 sensor range higher than expected	252
271	Learned WOT end of TPS1 sensor range lower than expected	271
272	Learned WOT end of TPS1 sensor range lower than expected	272
281	Learned closed throttle end of TPS1 sensor range higher than expected	281
282	Learned closed throttle end of TPS1 sensor range higher than expected	282
291	TPS sensors differ by more than expected amount. **NOTE: The TPS is not a serviceable item and can only be repaired by replacing the DV-EV throttle assembly.**	291
292	TPS1 and/or TPS2 is going in and out of range rapidly	292

DTC List – Continued

DTC	Fault Description	MIL Flash Code
331	Manifold Absolute Pressure Sensor Voltage is Low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	331
332	Manifold Absolute Pressure Sensor Voltage is Low, normally set if the TMAP pressure signal wire has been disconnected or shorted to ground or the circuit has opened to the SECM	332
341	Manifold Absolute Pressure Sensor Voltage is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the IAT signal, the TMAP has failed or the SECM has failed.	341
342	Manifold Absolute Pressure Sensor Voltage is High, normally set if the TMAP pressure signal wire has become shorted to power, shorted to the MAT signal, the TMAP has failed or the SECM has failed.	342
351	MAP sensor indicates higher pressure than expected	351
352	MAP sensor indicates lower pressure than expected	352
353	MAP sensor not changing as expected	353
354	MAP sensor pressure higher than expected for a specified period of time	354
371	Manifold Air Temperature Sensor Voltage is Low normally set if the MAT temperature sensor wire has shorted to chassis ground or the sensor has failed.	371
381	Manifold Air Temperature Sensor Voltage is High normally set if the MAT temperature sensor wire has been disconnected, the circuit has opened to the SECM, or a short to Vbatt or sensor power has occurred.	381
391	Manifold Air Temperature not changing as expected	391
392	Manifold Air Temperature is too high	392
421	EST1 output open circuit: possible open EST1 signal or defective spark module	421
422	EST2 output open circuit, possible open EST2 signal or defective spark module	422
423	EST3 output open circuit, possible open EST3 signal or defective spark module	423
424	EST4 output open circuit, possible open EST4 signal or defective spark module	424
425	EST5 output open circuit, possible open EST5 signal or defective spark module	425
426	EST6 output open circuit, possible open EST6 signal or defective spark module	426
427	EST7 output open circuit, possible open EST7 signal or defective spark module	427
428	EST8 output open circuit, possible open EST8 signal or defective spark module	428

DTC List – Continued

DTC	Fault Description	MIL Flash Code
431	EST1 output shorted high or low, EST1 signal shorted to ground or power or defective spark module	431
432	EST2 output shorted high or low, EST2 signal shorted to ground or power or defective spark module	432
433	EST3 output shorted high or low, EST3 signal shorted to ground or power or defective spark module	433
434	EST4 output shorted high or low, EST4 signal shorted to ground or power or defective spark module	434
435	EST5 output shorted high or low, EST5 signal shorted to ground or power or defective spark module	435
436	EST6 output shorted high or low, EST6 signal shorted to ground or power or defective spark module	436
437	EST7 output shorted high or low, EST7 signal shorted to ground or power or defective spark module	437
438	EST8 output shorted high or low, EST8 signal shorted to ground or power or defective spark module	438
461	Electronic Throttle Control is Sticking. This can occur if the throttle plate (butterfly valve) inside the throttle bore is sticking. The plate sticking can be due to some type of obstruction, a loose throttle plate, worn components, or sticking shaft bea	461
471	Electronic Throttle Control Driver has failed. Normally set if either of the ETC driver signals have opened or become disconnected, electronic throttle or SECM is defective.	471
481	Electronic Throttle Control Spring Return Test has Failed. The SECM will perform a safety test of the throttle return spring following engine shutdown. If this spring has become weak the throttle will fail the test and set the fault.**NOTE: Throttle assembly**	481
491	(Electronic Throttle Control Driver has Failed)Indeterminate fault on Hbridge driver for Electronic Throttle Control. Possibly either ETC+ or ETC- driver signals have been shorted to ground	491
511	Coolant Level or Oil Level is Low. The coolant level in the radiator tank or the oil level in the oil pan or oiler has fallen below the desired minimum level for safe operation	511
521	Low engine oil pressure	521
522	Oil Pressure sensor voltage out of range low, sensor signal shorted to ground	522
523	Oil Pressure sensor voltage out of range high, sensor signal shorted to power	523
524	Oil Temperature Sensor voltage is Low. Normally set if the sensor wire has shorted to chassis ground or the sensor has failed.	524
525	Oil Temperature Sensor voltage is High. Normally set if sensor wire has been disconnected or circuit has opened to the SECM or shorted to power	525
526	Oil Temperature not changing as expected	526
527	Oil Temperature is too high	527

DTC List – Continued

DTC	Fault Description	MIL Flash Code
528	Pre-Throttle sensor is out of range low, possible short to ground	528
529	Pre-Throttle sensor is out of range high, possible short to power	529
531	+12V or +24V System voltage too low	531
541	+12V or +24V System voltage too high	541
551	+5V Sensor reference voltage XDRP too low	551
561	+5V Sensor reference voltage XDRP too high	561
571	Engine speed has exceeded the third level (3 of 3) of overspeed protection	571
572	Engine speed has exceeded the second level (2 of 3) of overspeed protection	572
573	Engine speed has exceeded first level (1 of 3) of overspeed protection	573
581	Fuel valve sensor voltage out of range low, normally set if signal has shorted to ground, circuit has opened or sensor has failed	581
582	Fuel valve sensor voltage out of range high, normally set if signal has shorted to power or ground for the sensor has opened	582
583	LSeries Fuel Trim Valve Fault, the LSeries monitors its control functions internal to itself, a fault can occur if the actuator doesn't maintain position set point, the position sensor fails, the temperature sensor fails, or over temperature	583
612	Intergal term on the boost control PID is at it's upper limit for a specified amount of time and the desired boost pressure set point has not been reached	612
613	Intergal term on the boost control PID is at it's lower limit for a specified amount of time and the desired boost pressure set point has not been reached	613
631	FSeries or LSeries Throttle Valve Fault, the smart throttle monitors its control functions internal to itself, a fault can occur if the actuator doesn't maintain position set point, the position sensor fails, the temperature sensor fails, or over temperature	631
641	EGT Sensor Voltage is High, normally set if the pessure signal wire has become shorted to power or the SECM input circuit has failed	641
642	EGT Sensor Voltage is Low, normally set if the signal wire has become disconnected or shorted to ground or the input circuit to the SECM is open	642
644	Exhaust Gas Temperature (EGT) has reached the maximum allowable limit for a specified period of time	644
651	Intergal term in the EGR valve control PID reached it's upper limit for a specified amount of time and the desired EGR dP flow set point has not been reached	651
652	Intergal term on the EGR valve control PID is at it's lower limit for a specified amount of time and the desired EGR dP flow set point has not been reached	652
653	EGR dP Sensor Voltage is High, normally set if the pressure signal wire has become shorted to power or the SECM input circuit has failed	653

DTC List – Continued

DTC	Fault Description	MIL Flash Code
654	EGR dP Sensor Voltage is Low, normally set if the pressure signal wire has been disconnected or shorted to ground or the input circuit to the SECM is open	654
655	EGT is to High which caused the Torque Limiting fault action to be enabled	655
666	Emergency shutdown of the engine either manually by the operator or automatically by specified external conditions	666
671	APP1 sensor voltage out of range high, normally set if the APP1 signal has shorted to power or the ground for the sensor has opened	671
672	APP1 sensor voltage out of range low, normally set if the APP1 signal has shorted to ground, circuit has opened or sensor has failed	672
711	Fuel Trim Valve 1 Fault, signal has opened or shorted to ground or power or defective Fuel Trim Valve	711
712	Fuel Trim Valve 2 Fault, signal has opened or shorted to ground or power or defective Fuel Trim Valve	712
713	Post Catalyst O2 Sensor Heater Fault, Heater has opened or shorted to ground or power or defective heater element	713
714	Pre Catalyst O2 Sensor Heater Fault, Heater has opened or shorted to ground or power or defective heater element	714
715	EGR Control Solenoid Fault, control wire is open or shorted to power or ground, or defective Boost Control Solenoid	715
716	Smart Air Throttle Valve Fault, signal has opened or shorted to ground or power or defective Throttle Valve	716
717	Fuel Lock Off Fault on Valve 1, signal has opened or shorted to ground or power or defective Fuel lock off valve	717
718	Malfunction Indicator Lamp Fault, signal has opened or shorted to ground or power or defective MIL lamp	718
719	Boost Control Solenoid Fault, control wire is open or shorted to power or ground, or defective Boost Control Solenoid	719
721	Fuel system had to adapt lean more than expected on Gas 1 in response to a rich operating condition	721
722	Fuel system had to adapt lean more than expected on Gas 2 in response to a rich operating condition	722
727	Fuel Lock Off Fault on Valve 2, signal has opened or shorted to ground or power or defective Fuel lock off valve	727
731	Fuel system had to adapt rich more than expected on Gas 1 in response to a lean operating condition	731
732	Fuel system had to adapt rich more than expected on Gas 2 in response to a lean operating condition	732

DTC List – Continued

DTC	Fault Description	MIL Flash Code
741	Pre-catalyst O2 sensor inactive on Gas 1, may be due to open O2 sensor signal or heater leads, defective O2 sensor	741
743	Post-catalyst fuel control on Gas 1 has sensed the O2 sensor is changing too frequently and too much. Normally, the sensor voltage should be steady. Possible causes for this fault are a faulty sensor, air leak in exhaust sytem or failed catalyst	743
744	Post-catalyst fuel control on Gas 2 has sensed the O2 sensor is changing too frequently and too much. Normally, the sensor voltage should be steady. Possible causes for this fault are a faulty sensor, air leak in exhaust sytem or failed catalyst	744
745	Pre-catalyst O2 sensor inactive on Gas 2, may be due to open O2 sensor signal or heater leads, defective O2 sensor	745
751	Pre-catalyst O2 sensor indicates extended lean operation on Gas 1	751
752	Post-catalyst O2 sensor control has reached rich limit on Gas 1 and sensor still reads too lean. This could be caused by an exhaust leak, catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2	752
753	Post-catalyst O2 sensor control has reached rich limit on Gas 2 and sensor still reads too lean. This could be caused by an exhaust leak, catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2	753
761	Pre-catalyst O2 sensor indicates extended lean operation on Gas 2	761
762	Post-catalyst O2 sensor control has reached lean limit on Gas 1 and sensor still reads too rich. This could be caused by catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults exist, diagnose and repair them first, then check and see if this fault resets.	762
763	Post-catalyst O2 sensor control has reached lean limit on Gas 2 and sensor still reads too rich. This could be caused by catalyst failure, sensor failure, or wiring/relay failure causing the sensor to not be properly heated. If any Pre-O2 sensor faults exist, diagnose and repair them first, then check and see if this fault resets.	763
764	Post-catalyst O2 sensor signal out of range due to disconnected sensor or open circuit	764
771	Pre-catalyst O2 sensor indicates extended rich operation on Gas 1	771
781	Pre-catalyst O2 sensor indicates extended rich operation on Gas 2	781
791	Rotary Fuel Trim Valve 1 Fault, signal has opened or shorted to ground or power or defective Rotary Fuel Trim Valve	791
792	Rotary Fuel Trim Valve 2 Fault, signal has opened or shorted to ground or power or defective Rotary Fuel Trim Valve	792
811	Engine knock multiplier above amplitude defined for Level1 derate	811
812	Engine knock multiplier above amplitude defined for Level2 derate	812

DTC List – Continued

DTC	Fault Description	MIL Flash Code
831	Fuel pressure sensor signal indicates higher pressure than expected	831
832	Fuel pressure sensor signal indicates lower pressure than expected	832
841	Fuel pressure sensor voltage out of range high, normally set if the pessure signal wire has become shorted to power or the SECM input circuit has failed	841
842	Fuel pressure sensor voltage out of range low, normally set if the pessure signal wire has become shorted to ground, disconnected, or the SECM input circuit has failed	842
851	Sensor Air Calibration lower limit reached before calibration achieved	851
852	Sensor Air Calibration correction is has adjusted to it's maximum limit	852
853	Sensor Air Calibration upper limit reached before calibration achieved	853
854	Sensor Heater duty cycle lower limit reached and sensor hasn't reached set point temperature	854
855	Sensor Heater duty cycle upper limit reached and sensor hasn't reached set point temperature	855
856	Sensor Temperature Set Point not reached after a specified period of time	856
911	Pre-catalyst O2 sensor voltage out of range low, sensor signal shorted to ground	911
921	Pre-catalyst O2 sensor voltage out of range high, sensor signal shorted to power	921
951	Trim valve command reached the lower duty cycle limit for the specified time limit, fuel system is unable to reach the desire PHI setpoint, it could be rich or lean depending on trim valve configuration	951
961	Trim valve command reached the upper duty cycle limit for the specified time limit, fuel system is unable to reach the desire PHI setpoint, it could be rich or lean depending on trim valve configuration	961
991	Service Interval 1 has been reached	991
992	Service Interval 2 has been reached	992
993	Service Interval 3 has been reached	993
994	Service Interval 4 has been reached —time to replace HEGO sensors	994
995	Service Interval 5 has been reached —time to replace engine timing belt	995

SPECIFICATIONS

Component	Part Number or Specification
Air Filter:	200467 Primary 200289 Secondary (If Equipped)
Drive belt:	200196
Battery:	12 V, 750 Cranking Amps, 600 Cold Cranking Amps 56 Ampere Hours
Oil:	See “ENGINE OIL AND FILTER REPLACEMENT”
Oil Filter:	201105
Oxygen Sensor:	201279
Spark Plugs:	200174
Spark Plug Gap:	0.028 in. (0.711) mm
Spark Plug wires:	200174
Recommended Natural Gas & Vapor LPG Lock-Off Valves:	201471

Engine Identification

Engine part number _____

Engine serial number _____

Engine application _____

Purchased from _____

In-service date _____

Engine hours at delivery _____

Engine Warranty

Warranty Provisions

Zenith Power Products, LLC warrants that this engine was designed, built, and equipped so that it fully complies with the applicable emissions standards of U.S. EPA 40 CFR 60 and 90 at the time of sale to you, the end customer, and that the engine is free of defects in materials and workmanship that may keep it from meeting the emissions standards.

Base Warranty Period

The engine's base warranty period is 400 hours or 1 year, whichever comes first.

Emissions-Related Warranty Period

Your engine's emissions-related warranty period is 2 years.

The warranty period begins when your engine is sold to the “ultimate purchaser” (the original owner of the engine).

Owner Obligations

This warranty is valid only if you operate and maintain your engine as specified in this Operators Manual. You must maintain your engine as specified in the Maintenance Schedule and record your maintenance in the Maintenance Log.

You are responsible for initiating the warranty process. You should present Emergency Standby Engine to ZPP or a ZPP-authorized agent as soon as any problem occurs. The warranty repairs will be completed by ZPP or a ZPP-authorized agent as expeditiously as possible
If you have any questions regarding your warranty rights or responsibilities, contact Zenith Power Products LLC at **1-715-453-9317**

Engine Warranty

Components Covered under the 2 year Warranty

- Air Valve Carburetor
- CAM sensor
- CRANK sensor
- Distributor cap & rotor (NA857 only)
- Engine Coolant Temperature (ECT) sensor
- Engine Control Module (ECM)
- Electronic throttle
- Engine wiring harness
- Exhaust manifold
- Final stage natural gas fuel pressure regulator
- Fuel supply pressure trim valve
- Ignition coil pack
- Intake manifold
- Manifold Absolute Pressure (MAP)/Intake Air Temp (IAT) sensor
- Oxygen sensor

MAINTENANCE LOG

Service Interval: 250 Hours or 1 Year

- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Inspect engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 500 Hours or 2 Years

- ☐ Inspect air filter
- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Inspect engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 750 Hours or 3 Years

- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Inspect engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 1000 Hours or 4 Years

- ☐ Replace air filter
- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Replace engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect spark plugs
- ☐ Inspect spark plug wires
- ☐ Inspect distributor cap and rotor (NA857 only)
- ☐ Inspect PCV system
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage
- ☐ Inspect fuel lock-off valve(s)

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 1250 Hours or 5 Years

- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Inspect engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 1500 Hours or 6 Years

- ☐ Inspect air filter
- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Replace engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

MAINTENANCE LOG

Service Interval: 1750 Hours or 7 Years

- ☐ Inspect Drive belt
- ☐ Inspect battery
- ☐ Inspect engine coolant
- ☐ Clean radiator outside
- ☐ Replace engine oil and filter
- ☐ Inspect fuel lines, hoses, and fittings for gas leakage

Date:	
Engine Hours:	
Mechanic:	

Notes

⚠ WARNING ⚠

This product may contain a chemical known to the state of California to cause cancer, or birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.