


0L2-4

For Model: L1066H

OPERATOR'S MANUAL

Marine Generators | Marine Diesel Engines | Land-Based Generators

NORTHERN LIGHTS®

LUGGER




— CALIFORNIA —
Proposition 65 Warning:

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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Printed in U.S.A.
PART NO.: OL2-4 03/10

OPERATOR'S MANUAL

#OL2-4 for Model
L1066H

Read this operator's manual thoroughly before starting to operate your equipment.
This manual contains information you will need to run and service your new unit.

Table of Contents

Introduction

Servicing of marine engines and generator sets presents unique problems. In many cases boats cannot be moved to a repair facility. Marine engines cannot be compared to the servicing of automobiles, trucks or even farm equipment. Failures often occur in remote areas far from competent assistance. Marine engines are taxed far more severely than auto or truck engines; therefore, maintenance schedules must be adhered to more strictly.

Failures begin with minor problems that are overlooked and become amplified when not corrected during routine maintenance.

As operator, it is your obligation to learn about your equipment and its proper maintenance. This is not a comprehensive technical service manual. Nor will it make the reader into an expert mechanic. Its aim is to aid you in maintaining your unit properly.

Model Numbers

Model numbers give the unit's application, block model, and aspiration:

L	+	1066	+	H
L - Lugger propulsion engine		Model number **106 mm bore 6 cylinder**		H - High Output

L1066H = Northern Lights® turbocharged propulsion engine with a John Deere engine block, Tier II compliant, 4 valve electronic fuel system.

Serial Numbers

When referencing Northern Lights, Inc. equipment by serial number, please refer only to the number stamped on the Northern Lights® or Lugger® serial number plate.

Warranty

A warranty registration certificate is supplied with your set. The extent of coverage is described in the Limited Warranty Statement. We recommend that you study the statement carefully.

NOTE: If the warranty is to apply, the servicing instructions outlined in this manual must be followed. If further information is needed, please contact an authorized dealer or the factory.

Safety Rules

CAUTION: Accident reports show that careless use of engines causes a high percentage of accidents. You can avoid accidents by observing these safety rules. Study these rules carefully and enforce them on the job.

- Never leave engine without proper security.
- Turn the coolant tank cap slowly to relieve pressure before removing. Add coolant only when the engine is stopped and cool.
- Mount a fire extinguisher near engine.
- Always disconnect the battery ground strap before making adjustments.
- Operate engines in properly ventilated areas.
- Keep trash and other objects away from engine.
- Escaping fluids under pressure can penetrate your skin. Use a piece of cardboard or wood, not your hands, to search for leaks.
- Avoid wearing loose clothing when working around engines.
- Do not oil or grease engine while it is running.
- Always disconnect the ECU (Electronic Control Unit) connectors and remove the ground connection for the engine control system-to-machine frame before welding on engine. Make sure no other electronic components are in the ground path also.
- Use caution in handling fuel. Never refuel a hot or running engine. Do not smoke while filling fuel tank or servicing fuel system.
- Keep your hands, feet, hair and clothing away from power-driven parts.
- Check for any loose electrical connections or faulty wiring.
- Engines should be operated only by knowledgeable, qualified personnel.
- Look completely around engine to make sure that everything is clear before starting.
- Do not operate an engine that isn't in proper working order. If an unsafe operating condition is noted, tag the set and control panel so others will also know about the problem.
- Provide first aid kits.

CALIFORNIA Proposition 65 Warning:

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CAUTION: This symbol is used throughout this book to alert you to possible danger areas. Please take special notice of these sections.

Lugger Component Locations

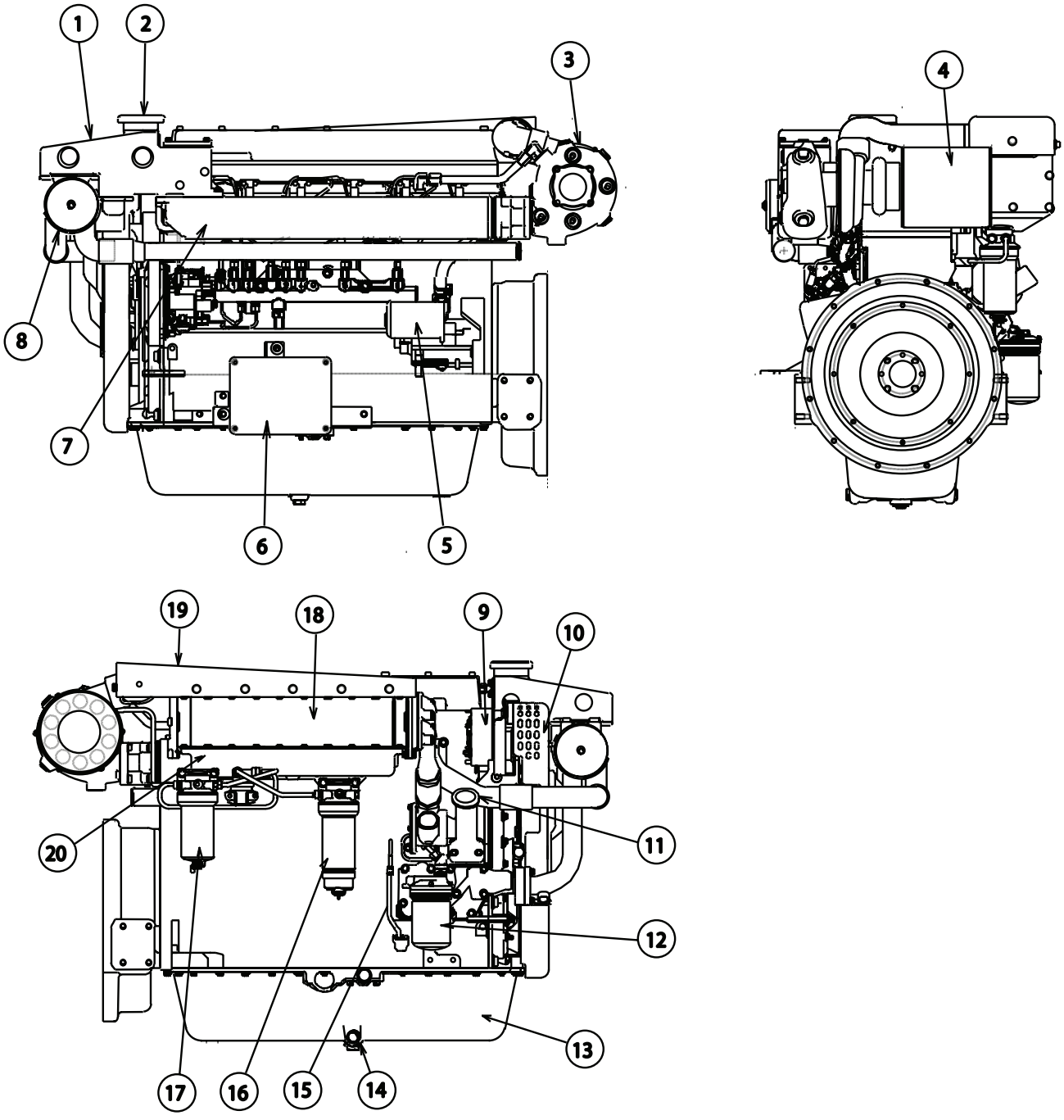

Figure 3: *L1066H*

1. Expansion Tank
2. Coolant Fill
3. Turbocharger
4. Air Cleaner
5. Starter
6. ECU (Electronic Control Unit)
7. Exhaust Manifold
8. Heat Exchanger
9. Alternator
10. Belt Guard
11. Oil Fill
12. Oil Filter
13. Oil Pan
14. Oil Drain
15. Dipstick
16. Primary Fuel Filter
17. Secondary Fuel Filter
18. Intake Aftercooler
19. Aftercooler Heat Shield
20. Intake Manifold

Figure 4: *Lugger Powerview Control Panel*

1. TACHOMETER

The tachometer shows the engine speed in revolutions per minute (RPM). Numbers are multiples of 100.

2. HOUR METER

Keeps track of the engine running time.

3. DC VOLTMETER

When the engine is stopped, the voltmeter shows the condition of the battery, When the engine is running, it indicates the voltage output of the alternator.

4. KEY SWITCH

Turning the key clockwise to the first position will switch on the current. continue turning the key clockwise to start the engine. When the engine starts, immediately turn the key back to the first position while the engine is running.

The key must be kept in the on or first position while the engine is running.
Turn the key counterclockwise as far as possible to stop the engine.

Note:
Optional flybridge panels have engine start switches instead of key switches.

5. POTENTIOMETER

Dims the panel lights.

6. ALARM HORN

Shut down engine if possible and investigate immediately.

7. COOLANT TEMPERATURE GAUGE

Water temperature gauge shows the temperature of the cooling water. If the gauge registers over 200° or drops below 140°, stop the engine and investigate.

8. OIL PRESSURE GAUGE

The oil pressure gauge shows the oil pressure in the engine lubricating system. If the pressure drops below 15 PSI at a speed higher than idling, stop the engine immediately.

BEFORE STARTING

1. Check the water level by removing the pressure cap from the expansion tank. In order to give the cooling water room to expand, the level should be about 1 3/4 in. (4-5 cm) below the filler cap sealing surface when the engine is cold. When filling with coolant, the venting cock on top of the turbocharger should be opened to ensure that no air pockets form in the cooling system **(see Service Point #13).**

CAUTION: *Use protective clothing and open the filler cap carefully when the engine is warm to prevent burns.*

2. Check the oil level in the crankcase with the dipstick. The oil level should be between the "waffled area" and the "oo". Never allow the level to go below the "oo". Always add the same viscosity of oil as is already in the crankcase **(see Service Point #1)**.
3. Check the fuel tank level and open any fuel valves.
4. Disengage clutch, if equipped.
5. Close the seacock, check and clean the strainer and reopen the seacock.
6. Place the battery switch in the ON position.

NOTE: *The battery switch must always be kept ON while the engine is running. If the switch is turned OFF while the engine is running, the battery charging regulator could be ruined.*

Starting

1. Put the gear control in the neutral position.
2. Move the throttle control to the full speed position and return back to idle.
3. Turn the key switch to the first position. Check the voltage meter to see the condition of the batteries. For starting, the voltmeter should not read below 12 volts (24 volts for 24 volt systems).
4. Turn the key to the starting position and as soon as the engine starts, release the key. Move the throttle up until the engine is running at approximately 1000 RPM.
5. Do not crank the starter for more than 15 seconds consecutively. If the engine fails to start with the first attempt, be sure that the starter has stopped completely before re-engaging.

NOTE*: Never race a cold engine. Operate at 1000 RPM for a 3 to 5 minute warm-up period.*

Operating

1. Check oil pressure as soon as the engine has started. Oil pressure should be above 15 PSI. The engine must never be run if the oil pressure is below 15 PSI.
2. Check the voltmeter. It should read 13 to 14 volts (26 to 28 volts for 24 volt systems) at 60°F (16°C).
3. Water temperature should not rise over 200°F (94°C). If it does, shut down the engine and investigate the cause of overheating.
4. Do not exceed 800 RPM when shifting marine gear. Repeated shifts at higher engine speeds can damage the reverse gear.
5. If the proper propeller is used, the engine should reach its approximate RPM's at full throttle. If the maximum rated RPMs for your engine application is exceeded at full throttle, then your propeller is too small. If you cannon reach your maximum rated RPMs at full throttle, either your propeller is too large or bottom growth is slowing the boat.
6. To establish maximum cruising RPM: establish the RPM at full throttle and subtract 200-300 RPM. This will promote engine life and reduce fuel consumption.

Shutdown

1. Run engine three to five minutes in neutral at 1000 RPM, for cool down period.
2. Return engine to low idle.
3. Turn the key switch counterclockwise as far as possible to stop the engine.
4. Close the sea cock and fuel valves and put the battery switch in OFF position.
   NOTE: *Do not turn the battery switch to OFF while the engine is running.*

SHUTDOWNS AND ALARMS

1. Your unit is fitted with a warning system to indicate high water temperature or low oil pressure. Propulsion engines have warning horns to sound and warn you of a problem. Remember - when the engine is not running the horn will sound when key is in the "ON" position because there is no oil pressure.

   NOTE: *Do not rely on your warning or shutdown system to the exclusion of careful gauge monitoring. Watching your gauges can prevent damage to the unit and dangerous power losses.*

2. Do the following when your shutdown system is activated:
   a. Check the temperature gauge. If the temperature is above 205°F (97°C), shut off the engine immediately.
   b. Use the Trouble Shooting Guide on pages 20- 22 to isolate the cause of the overheat.

CAUTION: *Do not remove the water fill cap of an overheated engine. Escaping high temperature steam can cause severe burns. Allow the engine to cool and then remove the cap slowly,* ***using protective clothing.***

   c. Make repairs and restart after the temperature gauge registers below 180°F (83°C).
   d. Watch the temperature gauge regularly and turn off the unit if the temperature rises above 200°F (94°C). Repeat the troubleshooting process.

3. If the shutdown is activated and the temperature gauge shows temperature within normal temperature range:

   a. Check the engine crankcase oil level.
   b. If the oil level is low, fill with recommended lubricating oil and restart. Watch the oil pressure gauge carefully and shut off the engine if it does not show a normal reading after a few seconds of operation.
   c. If the oil level was normal, DO NOT restart the engine. Call your Northern Lights or Lugger dealer for assistance.

BREAK-IN PERIOD

1. The first 100 hours on a new or reconditioned engine are critical to its life and performance.

2. Constantly check the engine temperature and oil pressure gauges.

3. Oil consumption is greater during break-in as piston rings and cylinder liners take time to seat.

4. Break-In Oil Changes: Change engine oil and filter at 50 hours. Change oil and filter again at 100 hours (See Gear Owner's Manual for break-in oil change procedures. Consult Lubricants Section for oil recommendation).

Operating Instructions

Never run full speed for more than 5 minutes during the first 50 hours. Run engine at 50% to 75% of maximum working speed for the first 20 hours with as little idling time as possible. Extended idling can inhibit ring seating, causing cylinder walls to glaze.

Service Schedule Chart

The Servicing Schedule Chart below shows the service schedule required for proper maintenance of your marine engine or generator set. More detailed coverage of each Service Point (SP) is listed on the page noted in the 'page' column.

DAILY:
- SP1 Check oil level in engine
- SP8 Check primary fuel filter
- SP15 Check cooling water level

AFTER FIRST 50 HOURS:
- SP2 Change engine oil
- SP3 Change lube oil filter

EVERY 50 HOURS:
- SP21 Check electrolyte in batteries

AFTER FIRST 100 HOURS/ EVERY TWO WEEKS [5]:
- SP2 Change engine oil after first 100 hrs., then check every 2 wks.
- SP3 Change oil filter after first 100 hrs., then check every 2 wks.
- SP4 Check air cleaner valve & restriction indicator gauge [6]
- SP7 Check crankshaft vibration damper[7]
- SP15 Check coolant level

EVERY 250 HOURS:
- SP2 Change engine oil & filters (fuel filter/water bowl)

EVERY 500 HOURS / YEARLY:
- SP5 Check V-belt condition
- SP9 Change primary filter element (Racor)
- SP10 Change secondary fuel filter
- SP14 Check turbocharger boost pressure
- SP16 Check cooling system
- SP20 Change impeller in raw water pump
- SP22 Check the state of the charge of the batteries
- SP25 Check engine mounts
- SP26 Clean crankcase vent tube
- SP27 Check air intake hoses
- SP29 Check electrical ground connection
- SP30 Check engine speeds

EVERY 2000 HOURS:
- SP6 Check & adjust valve clearance
- SP7 Check crankshaft vibration damper
- SP12 Check fuel injection pump
- SP17 Check and clean heat exchanger
- SP18 Check and clean gear oil cooler
- SP23 Test thermostats

SERVICE POINT	PAGE	OPERATION		DAILY	50 Hours	100 Hours	250 Hours	500 Hours	2000 Hours
		ENGINE:							
SP1	12	Check oil level		●					
SP2	12	Change engine oil	1) 2)			●	●		
SP3	12	Change lube oil filters	1) 2)			●	●		
SP4	12	Check air cleaner valve	2) 4) 6)			●		●	
SP5		Check belt condition	2)					●	
SP6	13	Check valve clearances	2)						●
SP7	15	Check crankshaft vibration damper	7)						●
SP25		Check engine mounts						●	
SP27		Check air intake hoses						●	
SP30		Check engine speeds						●	
		FUEL SYSTEM:							
SP8	14-15	Check primary filter (Racor)	3)	●					
SP9	14-15	Change primary filter element (Racor)	3) 4)					●	
SP10	15	Change secondary fuel filter	2) 4)					●	
SP11		Check injectors	9)						
SP12		Check fuel injection pump							●
		TURBOCHARGER:							
SP13	17	Check air, oil & cooling water lines for leakage	2)			●			
SP14	17	Check boost pressure						●	
		COOLING SYSTEM:							
SP15	17-18	Check cooling water level		●					
SP16	17-18	Check cooling system	2) 8)					●	●
SP17	20	Check and clean heat exchanger	2)						●
SP18		Check and clean gear oil cooler	2)						●
SP19	20	Check zinc electrodes	2) 4)			●			
SP20	20	Change impeller in raw water pump	2) 4)					●	
		ELECTRICAL SYSTEM:							
SP21	21	Check electrolyte level in batteries	2) 4)		●				
SP22	21	Check condition of batteries with hydrometer	2)					●	
SP23		Test thermostats							●
SP29		Check electrical ground connection						●	

1) Change the oil and filter before the first 100 hours of operation during engine break-in.
2) Perform all maintenance once a year even if hour level has not been reached.
3) Consult manufacturer's maintenance schedule, note on chart.
4) Whenever necessary.
5) Operate engine at rated speed with 50-70% load for 30 minutes at least.
6) Replace air cleaner element when restriction indicator shows vacuum of 625 mm (25 in.) H_20.
7) Replace damper every 4500 hours or after 60 months.
8) Flush cooling system at 2000 hours.
9) Check injectors at 5000 hours.

Service Point	OPERATION	HOURS/DATE									
	EVERY 50 HOURS										
SP21	Check electrolyte in batteries										
	100 HOURS										
SP2	Change engine oil (and every 250 hours after)										
SP3	Change lubricating oil filters (every 250 hours after)										
SP4	Check air cleaner										
SP9	Change primary fuel filter element										
SP13	Check turbocharger air, oil & cooling lines for leakage										
SP19	Check zinc electrodes										
	500 HOURS										
SP4	Replace air cleaner										
SP5	Check belt condition										
SP10	Change secondary fuel filter										
SP14	Check turbocharger boost pressure										
SP16	Check and flush cooling system										
SP20	Change impeller in raw water pump										
SP22	Check state of charge of batteries										
	2000 HOURS										
SP6	Check valve clearances										
SP7	Check vibration damper										
SP12	Check fuel injection pump										
SP17	Check and clean heat exchanger										
SP18	Check and clean reverse gear oil cooler										
SP23	Test thermostats										

LUBRICATION

Break-in oil

1. Use one of the following during the first 100 hours of operation:
   a. John Deere Engine Break-In Oil
   b. API Service CE oil
   c. ACEA Specification E1
2. *Do not use* John Deere PLUS-50 oil or engine oils meeting API CG4, API CF4, ACEA E3, or ACEA E2 performance levels during the first 100 hours of operation of a new or rebuilt engine. These oils will not allow the engine to break-in properly.

Lubrication - General

1. Use only clean, high quality lubricants stored in clean containers in a protected area.
2. These oils are acceptable after the first 100 hours:
   a. API Service CC/CD single viscosity oils.
   b. API Service CD/CG-4/CF-4 multi-viscosity oils.
   c. ACEA Specification E3/E2 multi-viscosity oils.
   d. CCMC Specification D5 and Mercedes Benz MB228.3.
   e. CCMC Specification D4 and Mercedes Benz MB228.1.
3. Use the proper weight oil for your average operation temperature.

Air Temperature	Single Viscosity	Multi Viscosity
Above 32°F (0°C)	SAE-30W	SAE15-40W
-10°F to 32°F (-23°C to 0°C)	SAE-10W	SAE10-30W
Below -10°F (-23°C)	SAE-5W	SAE5-20W

4. Some increase in oil consumption may be expected when SAE 5W and SAE 5-20W oils are used. Check oil level frequently.
5. Never put additives or flushing oil in crankcase.

SP1. CHECK ENGINE OIL LEVEL

1. Check the oil level in the crankcase, with the oil dipstick, daily.
2. The oil level must be between the “Waffled area” and the “oo”. Never allow the level to go below the “oo”.
3. Always add the same viscosity of oil as is already in the crankcase.

SP2. OIL CHANGES

1. Using the oil recommended above, change the engine oil and filter after the first 50 hours of operation, the first 100 hours and every 250 hours thereafter.
2. During intermittent cold weather operation, change oil every 100 hours or six weeks, whichever comes first.
3. Change oil at any seasonal change in temperature when a new viscosity of oil is required.
   Refill engine with recommended oil.
4. Engine Lube Oil Capacity:

L1066H	33.3 qts.	31.5 liters

SP3. CHANGING OIL FILTER

1. Change the lube oil filter every 250 hours.
2. Use a filter wrench to remove old filter. Dispose of filter in approved manner.
3. Make sure the gasket from the old filter is removed and discarded.
4. Lubricate the rubber gasket on the new filter and screw it on nipple until gasket meet the sealing surface.
5. Using hands only, no wrench, tighten filter one-half turn farther. Overtightening can do damage to filter housing.
6. Fill engine with recommended oil. Start engine and check for leakage. Stop engine and check oil level. Add additional oil if necessary.

SP4. AIR CLEANER

1. Inspect air cleaner every 100 hours. Replace air cleaner element every 500 hours, or yearly, more often if needed.
2. Clean the rubber tube at the cleaner. Loosen the hose clamp and the attaching strip for the cleaner.
3. Make sure the rubber tube is in good condition and that new filter is absolutely clean and installed properly.
4. Start the engine and check for leaks.
   NOTE: *Make absolutely sure no impurities enter the engine while changing the element. Do not run the engine with the air cleaner removed.*

SP6. VALVE CLEARANCES

CAUTION: *Disconnect the negative (-) battery terminal before starting valve adjustments to prevent accidentally starting the engine. Valve clearance must be checked and adjusted with the engine cold.*

The following special tools will be needed:
JDE 820 or JDE 83 Flywheel Turning Tool.
JDE 81-4 Timing Pin.

1. Remove rocker arm cover with ventilator tube.
   NOTE: *Inspect the valve tips, bridges, rocker arm wear pads and contact surfaces for cracks or excessive wear. Replace parts that show damage.*
2. Remove plastic plugs or cover plate in engine timing holes on front side of flywheel *(Figure 5 A & B)*.

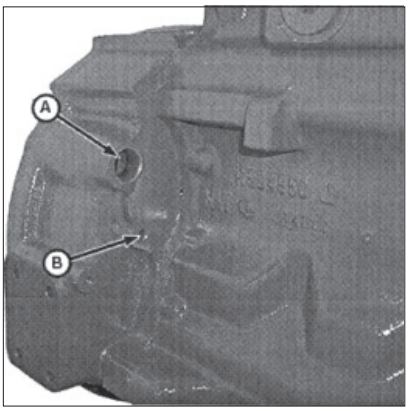

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Figure 5

3. Rotate flywheel in clockwise direction (viewed from water pump) with the Flywheel Turning Tool until the Timing Pin engages timing hole in the flywheel. Both rocker arms for No. 1 cylinder will be loose at Top Dead Center. If not, remove the timing pin and rotate the flywheel one complete turn and reinstall the timing pin in the flywheel.
4. Valve clearances:
   Intake Valve: 0.014 in. (0.36 mm)
   Exhaust Valve: 0.018 in. (0.46 mm)
5. If the valves need adjusting, loosen the jam nut (*A* on *Figure 6)* on the rocker arm adjusting screw. Turn the adjusting screw until you feel a slight drag when the feeler gauge slips. With a screwdriver, hold the adjusting screw from turning while tightening the jam nut to specifications. Check the clearance again after tightening the jam nut. Re-adjust as needed.

Valve Clearance Adjustment Specifications:
Intake Valve Adjustment Clearance
(Rocker arm to bridge).....0.36 mm (0.014 in.)
Exhaust Valve Adjustment Clearance
(Rocker arm to bridge).....0.46 mm (0.018 in.)
Rocker Arm Adjusting Screw
Jam Nut Torque.....27 N•m (20 lb-ft)

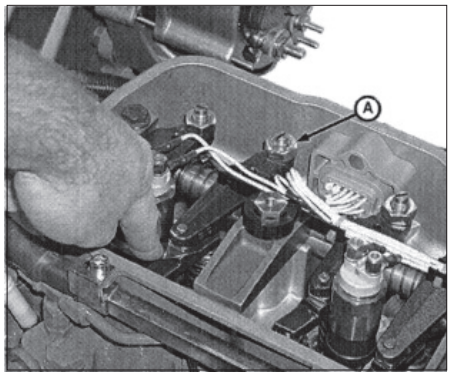

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Figure 6

6-CYLINDER ENGINES

Lock No. 1 piston at TDC compression stroke *(Figure 7-B)* Adjust valve clearance on No. 1, No. 3, and No. 5 exhaust valves and No. 1, No. 2, and No. 4 intake valves. Rotate flywheel 360°. Lock No. 6 piston at TDC compression stroke *(Figure 7-C)*.

Note: *Firing Order is 1-5-3-6-2-4*

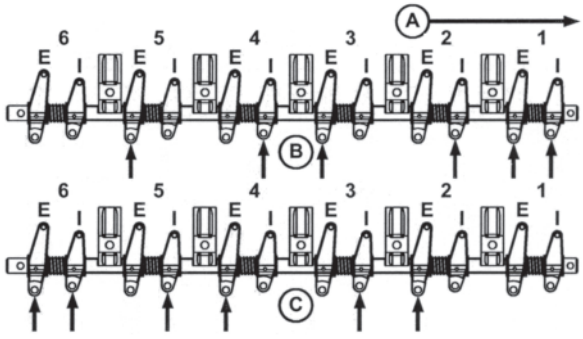

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Figure 7

A - Front of Engine
B - No. 1 Piston at TDC Compression Stroke
C - No. 4 Piston at TDC Compression Stroke
E - Exhaust Valve
I - Intake Valve

Adjust valve clearance on No. 2, No. 4, and No. 6 exhaust valves and No. 3, No. 5, and No. 6 intake valves.

SP6. VALVE CLEARANCES *Continued*

Check each glow plug while the rocker arm cover is removed, with a multimeter for continuity. Check the continuity between the glow plug and ground on the cylinder head. If the resistance is infinite (no current) the glow plug should be replaced as it is damaged. Install the new glow plugs and torque to below specification.

Glow Plug Torque.....12-18 N• m (9-13 lb-ft)

Install rocker arm cover and crankcase ventilator tube. Reconnect battery terminal.

FUELS - GENERAL

1. Use only clean, high quality fuels of the following specifications, as defined by ASTM designation D975 for diesel fuels:
   a. Use Grade No. 2 diesel at ambient temperatures above freezing 30°F (0°C).
   b. Use Grade No.1 at ambient temperatures below freezing and for all temperatures at an altitude of above 5,500 ft. (1500 meters).
2. Sulphur content should not exceed 0.5% (preferably less than 0.5%).
3. The cetane number should be a minimum of 45.
4. DO NOT use these unsuitable grades of fuel:
   a. Domestic heating oils, all types.
   b. Class B engine.
   c. Class D domestic fuels.
   d. Class E, F, G or H industrial or marine fuels.
   e. ASTM-D975-60T No. 4-D and higher number fuels.
   f. JP4
5. Storing fuel:
   a. Keep dirt, scale, water and other foreign matter out of fuel.
   b. Avoid storing fuel for long periods of time.
   c. Fill the fuel tank at the end of each day's operation. This will reduce condensation.

SP8-10. FUEL FILTERS

1. Your engine or generator set should have a primary fuel filter installed. We recommend the Racor brand of fuel filter - water separators.
   a. Check the primary fuel filter daily as recommended by the filter manufacturer. Empty the collection bowl as necessary.
   b. Change the element every 500 hours or whenever necessary.
   c. If the bowl fills with water, change the primary and secondary elements immediately.
2. Change secondary fuel filter every 500 hours.

NOTE: *The fuel filter on the engine is considered the "secondary fuel filter". The engine will be fitted with a quick change disposable secondary fuel filter.*

SP8-10. FUEL FILTERS *(Continued)*

CAUTION: *Serious injury can result from escaping high pressure fluid. Relieve pressure before disconnecting fuel or other lines. Before applying pressure, tighten all connections. Do not use your hand to search for leaks - use a piece of cardboard or paper. Gangrene could develop if fluid is accidentally injected into the skin, a doctor needs to surgically remove the fluid within a few hours of the accident.*

a. Turn off the fuel.
b. Clean filter assemblies and surrounding areas. Disconnect the water sensor wiring, if equipped.

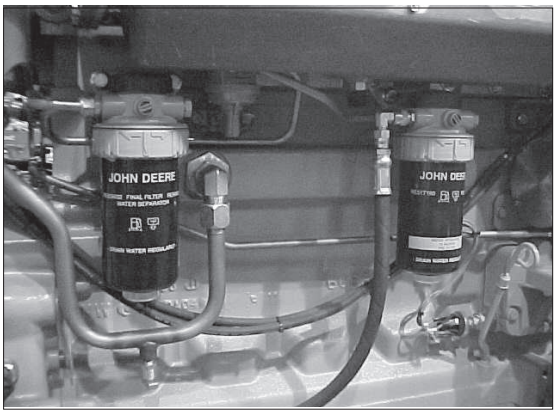


Figure 8: Secondary & primary filters

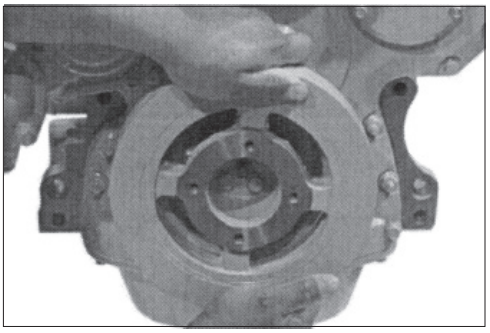
c. Loosen the filter drain plug on the bottom and drain the filters.
d. Remove the filter by turning the filter clamp on the top with your hand, while lifting up on the clamp while it is turning, counter clockwise until the filter cartridge slides out.

NOTE: *Before installing a new filter cartridge make sure the surfaces where the cartridge comes in contact with the mounting plate are absolutely clean. Dirt can be washed into the fuel injection system. This may result in severe damage to the fuel injection pump or nozzles.*

e. Install new filter cartridge, do not reuse the old one. A stalled engine could result from air bubbles in the old filter cartridge causing fuel to overflow from the housing.
f. Filter cartridge numbers are:
RE509031 and RE517181 (water separator).
g. Turn on the fuel.

SP7. CRANKSHAFT VIBRATION DAMPER (6 Cylinder Engines)

1. Remove belts.
2. Try to turn the vibration damper in both directions while grasping it with both hands. If rotation can be felt, the damper is defective and should be replaced.

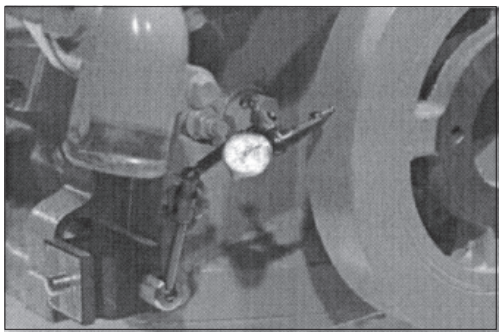


RG8018 *Figure 9*

NOTE: *The vibration damper assembly should be replaced every 4500 hours or 60 months, whichever occurs first, as the vibration damper assembly is not repairable.*

3. Place a dial indicator *(Figure 10)* so that the probe contacts the damper's outer diameter in order to check the damper radial runout.
4. Make sure the engine is at operating temperature, then rotate the crankshaft using the JD281A, JDE81-4, or the JDE83 Flywheel Turning Tool.
5. If the runout reading exceeds the below specification, replace the vibration damper.

Vibration Damper Maximum
Radial Runout .....1.50 mm (0.060 in.)



RG7508 *Figure 10*

FUEL SYSTEM

CAUTION: *DO NOT OPEN THE HIGH PRESSURE FUEL SYSTEM.*

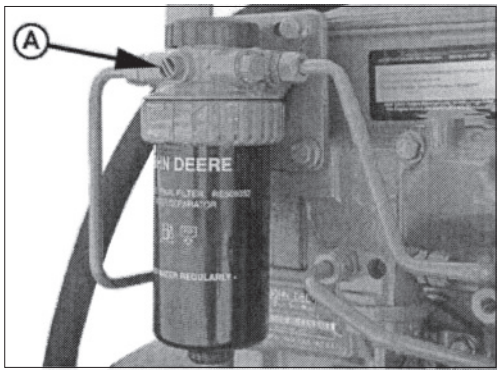
Serious injury can be caused by the high-pressure fluid in the fuel lines. Do not disconnect or attempt to repair fuel lines, sensors, or any components between the high-pressure fuel pump and nozzles on engines with High Pressure Common Rail (HPCR) fuel system.

See your dealer for qualified technicians to perform these repairs.

NOTE: Altering or modifying the injection pump, the injection pump timing, or the fuel injectors in ways not recommended by the manufacturer will result in the termination of the warranty obligation to the owner.

Also, tampering with the fuel system that alters emission-related equipment on engines could result in fines or other penalties per EPA regulations or other local emissions laws.

See your dealer for qualified technicians to perform repairs on the injection pump or fuel injectors.

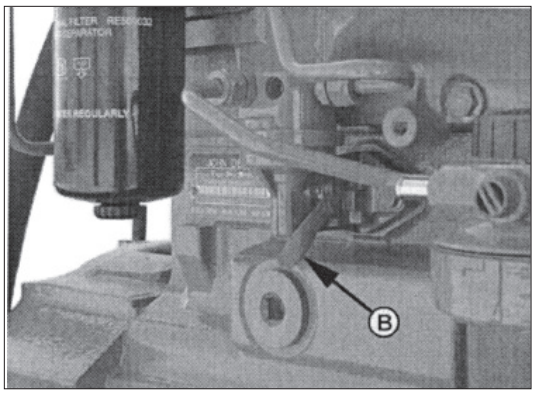


RG12220 *Figure 11*

Bleeding the Fuel System

NOTE: Four valve cylinder head engines are sensitive to fuel contamination. Do not crack any fuel lines to bleed the fuel system.

1. On the fuel filter base loosen the air bleed vent screw (Figure 11-A) by hand two full turns.

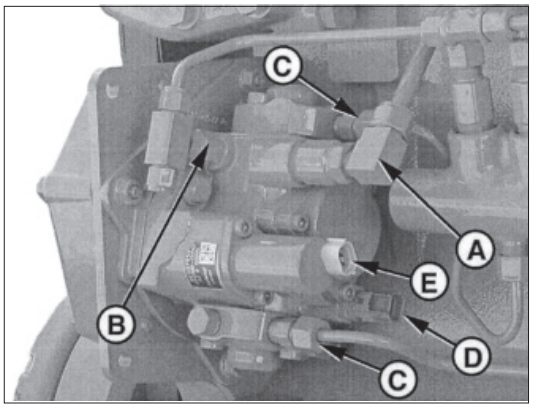


RG12221 *Figure 12*

2. Operate the fuel supply pump primer lever (Figure 12-B) or primer button on fuel filter base if equipped, until fuel flows out of bleed vent screw.
3. Tighten the bleed vent screw securely. Continue operating primer until pumping action is no longer felt.
4. If the engine does not start, repeat #1-4.

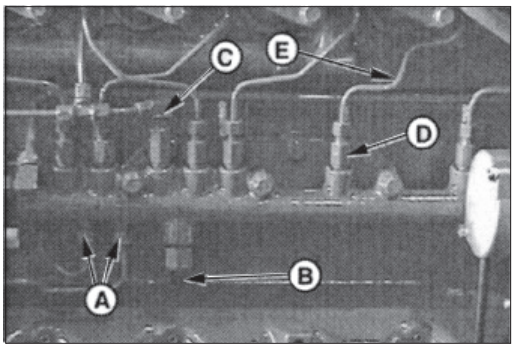
Denso HP3 High Pressure Fuel Pump Operation

The fuel inlet (Figure 13-A) is the location where the filtered fuel enters the high pressure pump. After the fuel goes through the inlet, it continues through a fuel inlet filter and then goes through an internal transfer pump.



RG12465B *Figure 13*

There is a chamber at the top of the pump and at the bottom that holds fuel. This fuel is pressurized in each chamber when the pump camshaft rotates. Excess fuel goes through the overflow orifice (Figure 13-B) back to the fuel tank. The fuel temperature sensor (13-D) measures the temperature of the pump housing. Fuel outlets (13-C) are on the top and bottom of the pump.



RG12459C *Figure 14*

High Pressure Common Rail Operation

Two high pressure pump delivery lines (Figure 14-A) deliver fuel to the high pressure common rail. Fuel is transported to the electronic injectors through the high pressure common rail delivery lines (14-E). The fuel pressure inside the rail is detected by the fuel rail pressure sensor (14-B). The ECU uses this sensor in monitoring the fuel pressure to determine timing of the pump control valve on the high pressure fuel pump. If unusually high pressure occurs within the HPCR, the pressure limiter (14-C) is used to release the excess pressure and drain fuel back to the tank. The maximum fuel flow to the electronic injectors is controlled by the flow dampers (14-D) and help prevent damage if the electronic injector fails or a high pressure leak develops; by shutting off fuel to the electronic injector in trouble.

SP13. TURBOCHARGER

1. Check for air leaks every 100 hours. Air leakage will lower engine output and may cause black exhaust smoke and soot.
2. Listen along air line while engine is running. A whistling or hissing sound indicates leakage.
3. Leakage on the pressure side, between turbo and engine, can be found by applying soapy water to the air line.
4. Tighten the hose clamps, replace hose or gaskets as required.
5. Check to see that the lubrication and cooling lines are tight and without leaks.

SP14. TURBO BOOST

1. This check measures the amount of air the turbo is pushing into the engine. It should be done by an authorized dealer every 500 hours.
2. On the inlet manifold there is a 1/8" NPT threaded port. Remove the plug and install the boost gauge hose. Refer to your engine specifications for correct pressure.

COOLING REQUIREMENTS

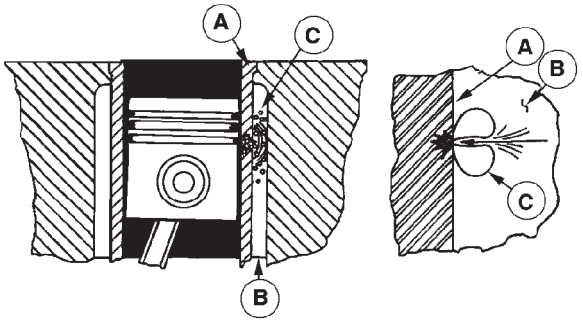
1. To meet cooling system protection requirements, the coolant solution must consist of:
   a. Quality water
   b. Ethylene glycol concentrate (EGC) commonly known as antifreeze.
   c. Supplemental coolant additives (SCA's).
2. A coolant solution of ethylene glycol concentrate (EGC-antifreeze), quality water and supplemental coolant additives (SCA's) ***MUST*** be used ***YEAR ROUND*** to protect against freezing, boil-over, liner erosion or pitting and to provide a stable, noncorrosive environment for cooling system components.
3. **Ethylene glycol coolant concentrate (antifreeze) normally DOES NOT contain the SCA chemical inhibitors needed to control liner pitting or erosion, rust, scale, and acidity.**

LINER EROSION (PITTING)

1. Cylinder liner walls (Figure 15-A) which are in contact with engine coolant (Figure 15-B) can be eroded or pitted unless the proper concentration and type of SCA's are present in the coolant. Water pump impellers are also susceptible to pitting.

LINER EROSION (PITTING) *[continued]*

2. Vapor bubbles (Figure 15-C) are formed when the piston's impact causes the liner walls to vibrate, sending pressure waves into the coolant.
3. These tiny vapor bubbles collect on the surface of metal parts. As the bubbles collapse (pop) a microscopic piece of metal is eroded from the metal part. Over a period of time, this pitting may progress completely through the cylinder liner of a wet-sleeve, heavy-duty diesel engine. This allows coolant to enter the combustion chamber. Engine failure or other serious damage will result.



A - Cylinder Liner Walls **B** - Engine Coolant **C** - Vapor Bubbles

Figure 15

4. Unprotected engines with low quality water as coolant can have liner failure in as few as 500 hours.

WATER QUALITY

1. Distilled, deionized, soft water is preferred for use in cooling systems. Bottled distilled water from a food store or water supplier is recommended. Tap water often has a high mineral content. Tap water should NEVER be put in a cooling system unless first tested by a water quality laboratory. Do not use water made by the reverse osmosis method unless it has been PH neutralized.

2. Here are acceptable water quality specifications:

Contaminates	Parts per Million	Grains per Gallon
Maximum Chlorides	40	2.5
Maximum Sulfates	100	5.9
Maximum Dissolved Solids	340	20.0
Maximum Total Hardness	170	10.0
		PH Level 5.5 to 9.0

3. If chlorides, sulfates or total dissolved solids are higher than the above given specification, the water must be distilled, demineralized, or deionized before it is used in a cooling system.
4. If total hardness is higher than 170 ppm and all other parameters are within the given specifications, the water must be softened before it is used to make coolant solution.

EGC: ETHYLENE GLYCOL CONCENTRATE (ANTIFREEZE)

CAUTION: *EGC (Antifreeze) is flammable. Keep it away from any open flame. Avoid contact with eyes. Avoid contact with skin. Do not take internally. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call a physician. KEEP OUT OF REACH OF CHILDREN. Follow all warnings on the container.*

1. Ethylene glycol coolant concentrate is commonly mixed with water to produce an engine coolant with a low freeze point and high boiling point.
2. A ***low silicate*** form of ethylene glycol coolant is recommended for all diesel engines.
3. Use an ethylene glycol coolant concentrate meeting ASTM D 4985P, SAEJ1941, General Motors Performance Specification GM1899M, or formulated to GM6038M.
4. This product is concentrated and should be mixed to the following specification.
5. If additional coolant solution needs to be added to the engine due to leaks or loss, the glycol concentration should be checked with a hydrometer to assure that the desired freeze point is maintained.

	Distilled Water %	EGC % Antifreeze	Freeze Point	Boiling Point
Optimum	50%	50%	-37°C -34°F	+109°C +226°F
Minimum	60%	40%	-24°C -12°F	+106°C +222°F
Maximum	40%	60%	-52°C -62°F	+111°C +232°F

IMPORTANT

1. **DO NOT** use methyl alcohol or methoxy propanol base EGC. These concentrates are not compatible with chemicals used in supplemental coolant additives. Damage can occur to rubber seals on cylinder liners which are in contact with coolant.
2. **DO NOT** use an EGC containing sealer or stop-leak additives.
3. **DO NOT** use EGC containing more than 0.1% anhydrous metasilicate. This type of concentrate, which is intended for use in aluminum engines, may cause a gel-like deposit to form that reduces heat transfer and coolant flow. Check container label or consult with supplier.

SUPPLEMENTAL COOLANT ADDITIVE (SCA)

CAUTION: *Supplemental coolant additive contains alkali. Avoid contact with eyes. Avoid contact with skin. Do not take internally. In case of contact immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call a physician. KEEP OUT OF REACH OF CHILDREN. Follow all warnings on the container.*

1. ***Important heat exchanger cooled engines***
   Additional SCA's should NOT be added to the mixture of EGC/H_20 on initial fill up of engines with a coolant conditioner-filter. A high SCA concentration will result and can cause silicate-dropout. When this happens, a gel-type deposit is created in the cooling system which retards heat transfer and coolant flow.
2. If additional SCA's are needed, prepare a mixture of 50% quality water and 50%EGC (antifreeze). Add liquid SCA at a rate of 3%, by volume.
   Example: 30 mL of SCA per liter of H_2O/EGC mixture (1.0 fl oz of SCA per qt of H_2O/EGC).
   Add the resulting mixture to the cooling system in quart increments. Run the engine for 2 hours and retest the coolant. Continue process until SCA concentration meets recommended levels.
3. SCA is available from your Northern Lights dealer in the following sizes.
   Pint - Part Number.....20-00002
   1/2 gallon - Part Number.....20-00003
4. ***DO NOT*** *use any coolant system additives containing soluble oil.*

COOLANT TESTING

1. Coolant test kits are available to allow on-site evaluation of the coolant condition.
2. The kits use small strips of paper which are dipped into the coolant. The paper changes color and indicates the SCA concentration. It also indicates the amount of EGC (antifreeze).
3. Test kits are available through your Northern Lights or Lugger Dealer.
   4 Pack - Part Number.....20-00005
   50 Pack - Part Number.....20-00010

SP15. CHECKING COOLANT LEVEL

CAUTION: *The cooling water in the engine reaches extremely high temperatures. You must use extreme caution when working on hot engines to avoid burns. Allow the engine to cool before working on the cooling system. Open the filler cap carefully, using protective clothing when the engine is warm.*

1. Check the coolant level each day before starting the engine.
2. Remove the pressure cap from the expansion tank and check water level. In order to give the coolant an opportunity to expand, the level should be about 1 3/4 in. (4-5 cm) below the filler cap sealing surface when the engine is cold. When filling with coolant, the venting cock on top of the turbocharger (for engines fitted with turbocharger) should be opened to ensure that no air pockets form in the cooling system.
2. The pressure valve in the filler cap releases when the pressure is approximately 7 PSI (0.5 bar). Use a cap pressure tester to check cap if you suspect it is faulty.
4. The makeup coolant, added to compensate for loss or leaks, must meet engine coolant requirements outlined in previous section.

SP16. FLUSHING THE COOLING SYSTEM

CAUTION: *The cooling water in the engine reaches extremely high temperatures. You must use extreme caution when working on hot engines to avoid burns. Allow the engine to cool before working on the cooling system. Open the filler cap carefully, using protective clothing when the engine is warm.*

SP16. FLUSHING THE COOLING SYSTEM

(CONTINUED)

1. Flush the cooling system and check for leaks and blockage every 500 hours, or yearly. **The engine must be stopped and cold.**
2. Close the seacock.
3. Remove the pressure cap from the expansion tank with caution. If applicable, open the cooling system air vent on top of turbocharger.
4. Open the drains on the exhaust manifold and engine block. Drain the fresh water system (see Component Locations, pages 4 - 5).
5. For vessels with keel cooling, the vessel must be out of the water to allow draining of the keel cooler.
6. With drains open, pour clean water into the expansion tank. When the water from drain is clear and free from discoloration and sediment, close that drain. When all drains are closed, flushing is complete.
7. Fill the fresh water system by pouring the recommended coolant mixture as described in previous sections.
8. Close cooling system air vent on turbocharger.
9. Open the seacock.
10. Start the engine. Check hoses and connections and repair any leakage.

SP17. HEAT EXCHANGER CLEANING

1. Drain the cooling system.
2. Remove the cooling water pipes between the heat exchanger and the water pump inlet.
3. Disconnect hose to seawater pump.
4. Unscrew the attaching bolts holding the heat exchanger to the expansion tank.
5. Remove bolts holding heat exchanger cover.
6. Wash the core inside and out. If necessary, chemical agents can be used. Also clean the accessible parts of the heat exchanger housing.
7. Reassemble, using new gaskets and sealing rings.

SP19. ZINC ANODES

1. Zincs are installed in the cooling system to protect your engine from electrolysis. Check them faithfully every 100 hours. If you are in warm salt water or where electrolysis is a known problem, check them more often.

   Heat exchanger cooled engine:

   a. Drain the raw water from heat exchanger (see Component Locations).
   b. Remove zinc holders from back of the tank and from front and port side of the heat exchanger (see Component Locations).

   Keel Cooled engines.

   a. Drain expansion tank and remove zinc holder from tank (see Component Locations).
2. Scrape or steel brush the zinc electrode clean. If more than 50% of the electrode has eroded away, replace it with a new one. The electrode screws out of the holder.
3. Reinstall the zinc holders. Be sure the threads are clean and have good metal to metal contact.

SP20. RAW WATER PUMP

Heat exchanged cooled engines only.

1. Change the sea water pump impeller as needed.
2. Remove the pump end cover. Remove impeller with water pump pliers. Be sure you remove all pieces of a failed impeller.
3. Clean the inside of the housing.
4. Press in the new impeller and place the sealing washer in the outer end of the impeller center if this has not already been done.
5. Replace the cover using a new gasket.

Note: *Make sure there is always an extra impeller and cover gasket in reserve and on-board.*

DRIVEN EQUIPMENT

Gears and PTO's

1. Manufacturer's service recommendations vary. See your Owner's Manual for service information. If you do not have a manual, see your local dealer for the equipment in question.

NOTE: *Some PTO and marine gears have rigid lubrication requirements. Follow service recommendations closely.*

ELECTRICAL SYSTEM - GENERAL

1. Never switch battery switch off or break the circuit between the alternator and batteries while the engine is running. Regulator damage can result.
2. DO NOT reverse the polarity of battery cables when installing the battery.
3. When welding on the unit, disconnect the regulator and battery. Isolate the leads.
4. Disconnect battery cables when servicing the DC alternator.
5. Never test with a screwdriver, etc., against any terminal to see if it emits sparks.
6. A DC circuit breaker protects your control panel and wiring harness.

BOOSTER BATTERIES

CAUTION: *Battery Gas Can Explode. Keep all flames and sparks away from batteries.*

1. Before changing or using booster batteries, check battery electrolyte level. Add distilled water.
2. Booster and main batteries must have the same voltage rating.
3. First, connect positive (+) terminal of booster battery to positive (+) terminal of main battery.

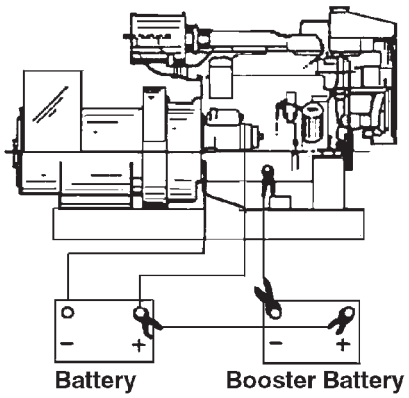


Figure 16: *Booster Battery Connections*

4. Then, connect negative (-) terminal of booster battery to ground on the engine block (see Figure 16).
5. Remove booster battery after starting engine.
6. Sealed batteries: see manufacturer charging and booster instructions.

SP21-22. BATTERY CARE - LEAD/ACID TYPE BATTERIES

1. Check electrolyte level every 50 hours or once per month. Add distilled water to manufacturer's recommended level.
2. Batteries, cables and cable terminals should be checked and cleaned every 100 hours. Clean corrosion with a water and baking soda solution. Flush with clean water. Tighten terminals and grease them to inhibit corrosion.
3. Check the battery condition with a hydrometer every 750 hours.

SP24. WINTERIZING, OUT-OF-SERVICE

If the generator set will not be used for more than 6 months the following preparations should be taken for long term storage.

1. Change the engine oil and replace the filter. Service the air cleaner.
2. Drain, flush, and refill the cooling system.
3. Crank the engine a few times with a starter, without starting the engine.
4. Remove and clean batteries.
5. All engine openings should be sealed with plastic bags and tape.
6. Store in a dry protected place.

To Remove Generator Set from Long-Term Storage:

1. Take off all protective coverings and unseal all the openings that were covered up.
2. Install batteries that are fully charged and connect the terminals.
3. Install the fan and alternator belts if they had been removed.
4. Fill the fuel tank.
5. Perform all pre-start checks.
6. Crank the engine for 20 seconds with the starter, without letting the engine start. Wait 2 minutes and crank the engine an additional 20 seconds to make sure all bearing surfaces are well coated.
7. Start the engine and run at no load in a low idle for several minutes. Make sure the engine is warmed up and check gauges before going under load.
8. Check all gauges and check for leaks.

Troubleshooting

If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.

DC ELECTRICAL SYSTEM

✔ Battery Will Not Charge

Loose or corroded connections:
- Clean and tighten battery connections.

Sulfated or worn out batteries:
- Check specific gravity of each battery cell.
- Check electrolyte level of each battery cell.

Loose or defective alternator belt:
- Adjust belt tension.
- Replace belt.

✔ Undercharged Electrical System

Excessive electrical load from added accessories:
- Take off accessories or install higher output alternator.

Engine idling excessively.
- Increase the engine RPM when there is a heavy electrical load.

Poor electrical connections on battery, ground strap, starter, or alternator.
- Inspect connections and clean if necessary.

Defective battery.
- Test battery.

Battery charging rate too high.
- Test charging system.

✔ Starter Inoperative

Check DC circuit breaker:
- If the breaker is tripped, reset it.

Faulty start circuit relay.
- See dealer.

Blown main system fuse.
- Replace fuse.

Loose or corroded connections:
- Clean and tighten loose battery and harness plug connection.

Low battery output:
- Check specific gravity of each battery cell.
- Check electrolyte level of each battery cell.

Defective electrical system ground wire:
- Repair or replace.

✔ Starter Cranks Slowly

Low battery output:
- Battery is too small.
- Battery cables are too small.

Check specific gravity of each battery cell:
- Replace battery if necessary.

Check electrolyte level of each battery cell:
- If low, fill cells with distilled water.

Crankcase oil too heavy:
- Fill with oil of appropriate viscosity.

Loose or corroded connections:
- Clean and tighten loose connections.

✔ Starter and Hour Meter Function but rest of Electrical System Does Not Function

Blown fuse on magnetic switch.
- Replace fuse.

✔ Entire Electrical System Does Not Function

Check DC circuit breaker:
- If breaker is tripped, reset it.

Faulty connection:
- Clean and tighten battery and harness plug connections.

Sulfated or worn out batteries:
- Check specific gravity and electrolyte level of each battery cell.

ENGINE

✔ Engine Hard to Start or Will Not Start

Improper starting procedure:
- See starting section of this manual. Take special note of Bypass Switch operation.

No fuel:
- Check level of fuel in fuel tank.

Low battery output:
- Check electrolyte level and condition.

Excessive resistance in starting circuit:
- Clean and tighten all battery connections.

Crankcase oil too heavy:
- Use oil of proper viscosity.

Improper type of fuel:
- Consult fuel supplier and use proper type of fuel for operating condition.

Water, dirt or air in fuel system:
- Drain, flush, fill and bleed system.

Clogged primary fuel filter element:
- Clean or replace filter element.

Clogged secondary fuel filter element:
- Replace filter element.

Dirty or faulty injection nozzles:
- Have your dealer check injection nozzles.

Electronic Fuel System problem:
- See your dealer.

Injection pump not getting fuel or air in fuel system.
- Check fuel flow at supply pump or bleed fuel system.

If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.

✔ Engine Runs Irregularly or Stalls Frequently

Below normal engine temperature:
- Remove and check thermostat.

Clogged primary fuel filter element:
- Clean or replace filter element.

Clogged secondary fuel filter element:
- Replace secondary filter element.

Water or dirt in the fuel system:
- Drain, flush, fill and bleed system.

Dirty or faulty injection nozzles:
- Have your dealer check injection nozzles.

Air in fuel system:
- Inspect clamps and hoses on suction side of fuel pump for air leak, bleed fuel system.

Improper type of fuel:
- Consult fuel supplier and use proper type of fuel for operating condition.

✔ Lack of Engine Power

Intake air restriction:
- Service air cleaner.
- Service aftercooler.

Clogged primary fuel filter element:
- Clean or replace filter element.

Clogged secondary fuel filter element:
- Replace filter element.

Improper type of fuel:
- Consult fuel supplier and use proper type of fuel for operating conditions.

Overheated engine:
- See “Engine Overheats” in next category.

Below normal engine temperature:
- Remove and check thermostat.

Injection pump out of time.
- See your dealer.

Electronic fuel system problem.
- See your dealer.

Turbocharger not functioning (if equipped).
- See your dealer.

Leaking exhaust manifold gasket.
- See your dealer.

Defective aneroid control line.
- See your dealer.

Restricted fuel hose.
- Clean or replace fuel hose.

Low fast idle speed.
- See your dealer.

Improper valve clearance:
- Reset valves. Best done by dealer.

Dirty or faulty injection nozzles:
- Replace injectors. Best done by dealer.
- See your local dealer.

✔ Engine Overheats

Engine overloaded.
- Reduce the load.

Low coolant level:
- Fill tank or radiator to proper level.
- Check hoses for loose connections and leaks.

Keel cooling tubes have been painted (marine):
- Remove paint from tubes.

Stretched belt or defective belt tensioner.
- Check automatic belt tensioner and check belts for stretching. Replace as required.

Low engine oil level.
- Check oil level, add oil as needed.

Incorrect grade of fuel.
- Use correct grade of fuel.

Cooling system needs flushing:
- Flush cooling system.

Defective thermostat:
- Remove and check thermostat.

Defective temperature gauge:
- Check water temperature with thermometer and replace gauge if necessary.

Water pump impeller worn/broken:
- Check impeller and replace if necessary.

✔ Engine Knocks

Low oil level:
- Add oil to engine crankcase.

Injection pump out of time:
- Call your dealer.

Below normal engine temperature:
- Check your thermostats.
- Check water temperature to see if temperature gauge is working properly.

Engine overheating:
- See “Engine Overheating” section.

Troubleshooting

If you cannot correct problems with these procedures, see your **Lugger or Northern Lights** dealer.

✔ High Fuel Consumption

Engine overloaded.
- Reduce load.

Air in fuel system:
- Bleed fuel system.

Improper type of fuel:
- Use correct fuel for temperature.

Clogged or dirty air cleaner:
- Service air cleaner.

Improper valve clearance:
- See your dealer.

Injection nozzles dirty:
- See your dealer.

Injection pump out of time:
- See your dealer.

Electronic fuel system problem.
- See your dealer.

Engine not at proper temperature:
- Check your thermostats.
- Check water temperature with thermometer and replace gauge if necessary.

✔ Below Normal Engine Temperature

Thermostats not working properly:
- Check thermostats.

Temperature gauge not working properly:
- Check water temperature with thermometer.

✔ Low Oil Pressure

Low oil level:
- Fill crankcase to proper level.

Improper type of oil:
- Drain and fill crankcase with correct oil.

Partially plugged oil filter:
- Replace filter.

✔ High Oil Consumption

Break-in period:
- Oil consumption decreases after break in.

Crankcase oil too light:
- Use proper viscosity oil.

Oil leaks:
- Check for leaks in lines around gaskets and drain plug.

✔ Engine Emits Black or Gray Exhaust Smoke

Clogged or dirty air cleaner:
- Service air cleaner.

Clogged aftercooler:
- Service aftercooler.

Defective muffler (back pressure too high):
- Have dealer check back pressure.

Improper fuel:
- Use correct fuel for temperature.

Engine overloaded.
- Reduce load.

Electronic fuel system problem.
- See your dealer.

Turbocharger not functioning.
- See your dealer.

Injection nozzles dirty:
- See your dealer.

Engine out of time:
- See your dealer.

✔ Engine Emits White Smoke

Improper fuel:
- Use correct fuel for temperature.

Cold engine:
- Warm up engine to normal operating temperature.

Defective thermostat:
- Remove and check thermostat.

Engine out of time:
- See your dealer.

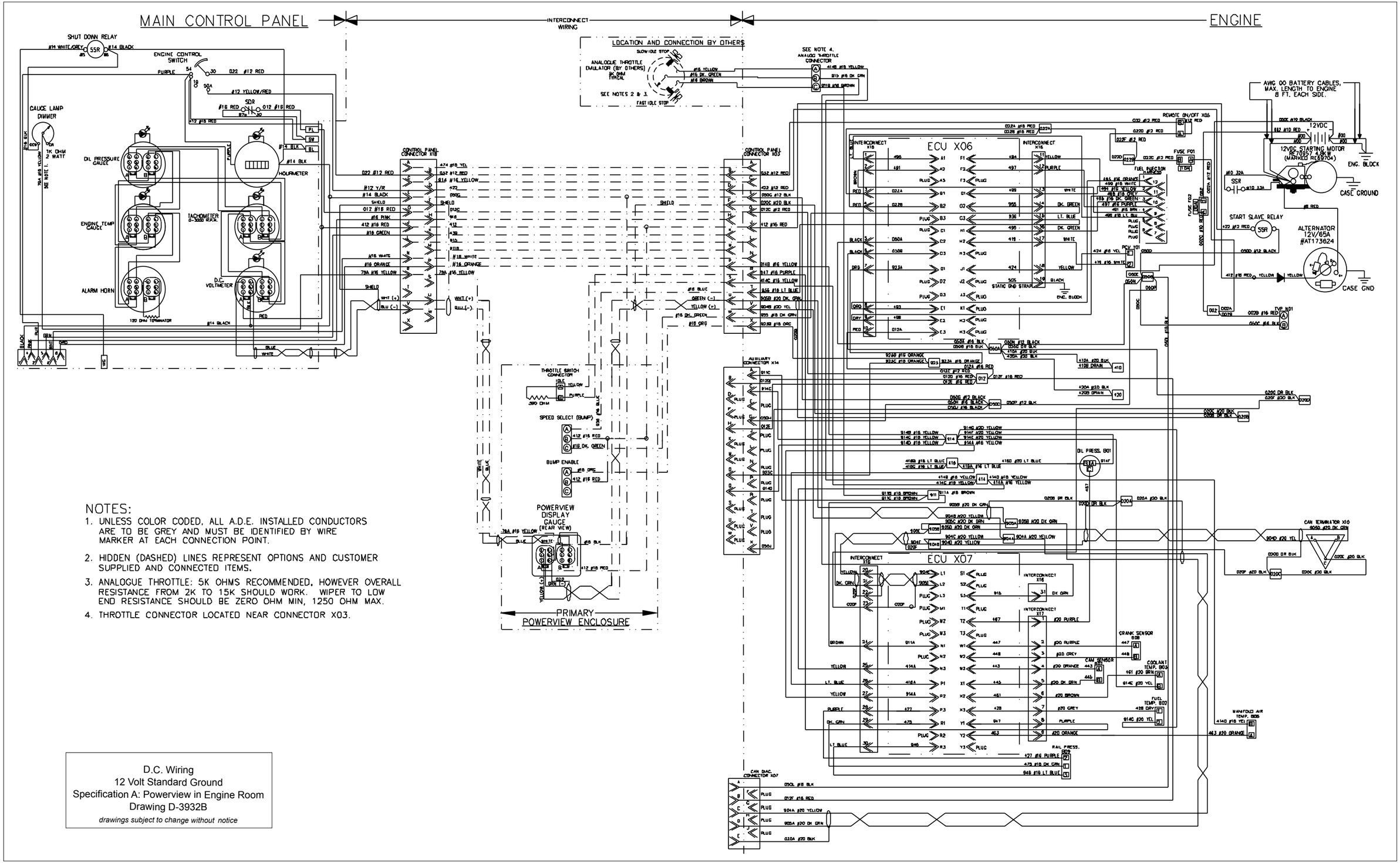
Defective injection nozzles.
- See your dealer.

INSTALLATION DATA L1066H

Model Number	**L1066H**
Crankshaft Hp[1]: High Output/	275 @ 2400 RPM/
Medium Duty	250 @ 2200 RPM
Crankshaft kW[2]: High Output/	203 @ 2400 RPM/
Medium Duty	185 @ 2200 RPM

1. Based on SAE J816b. 2. Based on EN ISO 8665: 2006

Cooling (General)	
Freshwater circulating pump flow	61 US gal @ 2400 rpm (230 ltr @ 2400 rpm)
Heat rejection to jacket water	5453 BTU-min
Cooling (Heat Exchanger)	
Raw water intake & discharge dia.	2 inch NPT
Raw water pump flow @ RPM	53 gpm @ 2400 rpm (200 ℓ pm @ 2400 rpm)
Raw water pump max. suction head	39 in (1 m)
Max. raw water temp. at inlet	86° F (30° C)
Freshwater system capacity	6.5 US gal (24.6 ltr)
Electrical	
Minimum battery capacity - 12V	800 CCA
Battery cable size up to 10 ft run	"000"
Standard harness length	20 ft (6 m)
Air	
Engine air consumption	622 cfm @ 2400 rpm (17.6 m^3/min @ 2400 rpm)
Minimum engine room vent area	182 sq in (.012 m^2)
Exhaust gas flow	1480 cfm @ 2400 rpm (41.9 m^3/min @ 2400 rpm)
Exhaust gas temperature at rpm	883° F @ 2400 rpm (473° C @ 2400 rpm)
Maximum exhaust back pressure	30 in (762 mm) H_20
Suggested dry exhaust I.D.	
Dry	4 in (100 mm)
Wet	5 in (127 mm)
Fuel and Oil	
Min. fuel suction and return line	3/8 in (9.5 mm)
Maximum fuel pump head	39 in (1 m)
Crankcase oil capacity	32.5 US qts (34.34 ltr)
Gear, PTO, Engine Angle	
Engine rotation (facing flywheel)	Counter-Clockwise
Flywheel housing size	SAE #2
Front PTO size (optional)	SAE #5
Max. intermittent operating angle	
Front down	0°
Rear down	12°



NOTES:

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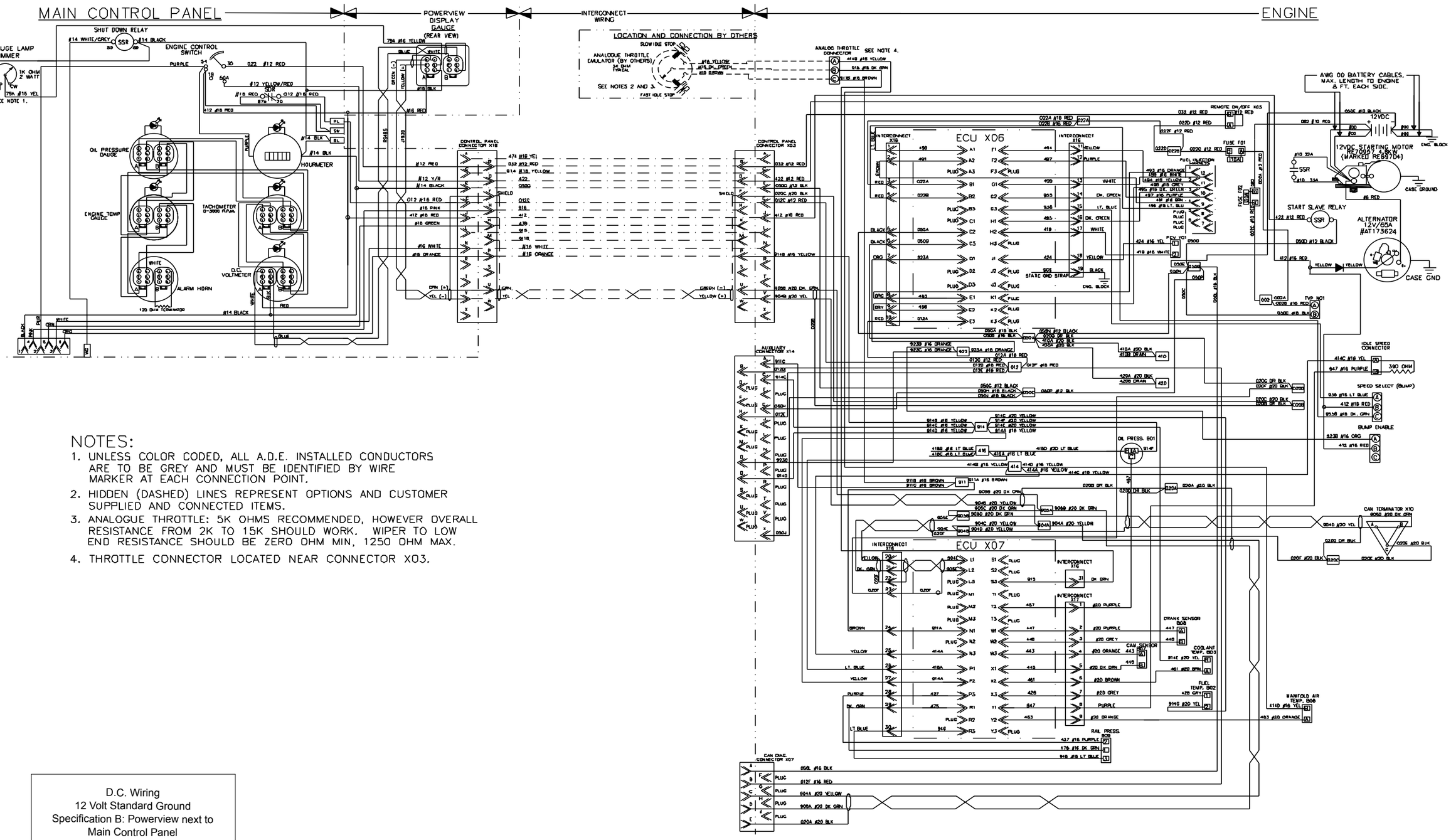
2. HIDDEN (DASHED) LINES REPRESENT OPTIONS AND CUSTOMER SUPPLIED AND CONNECTED ITEMS.
3. ANALOGUE THROTTLE: 5K OHMS RECOMMENDED, HOWEVER OVERALL RESISTANCE FROM 2K TO 15K SHOULD WORK. WIPER TO LOW END RESISTANCE SHOULD BE ZERO OHM MIN, 1250 OHM MAX.
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
12 Volt Standard Ground
Specification A: Powerview in Engine Room
Drawing D-3932B
drawings subject to change without notice



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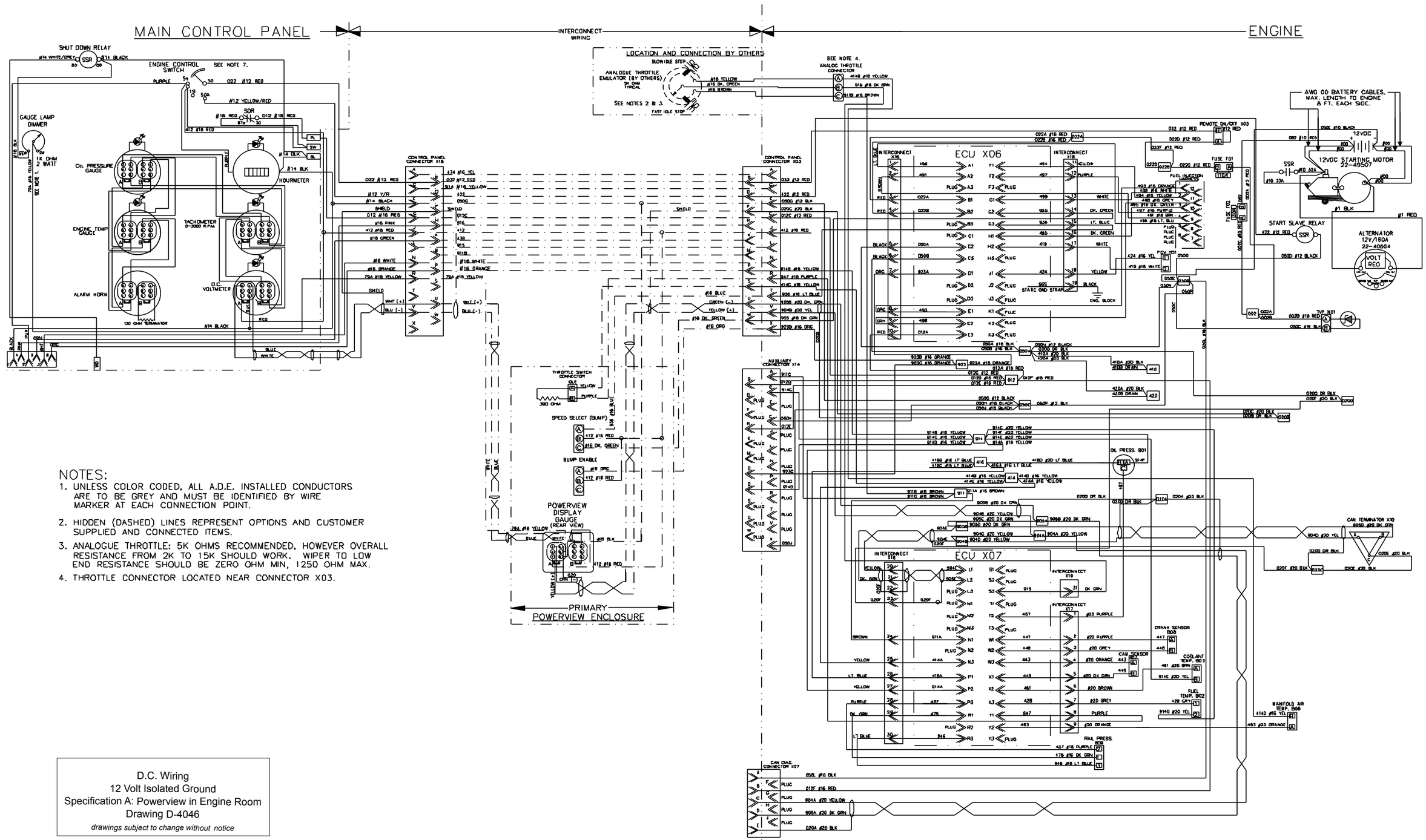
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
12 Volt Standard Ground
Specification B: Powerview next to
Main Control Panel
Drawing D-4045
drawings subject to change without notice



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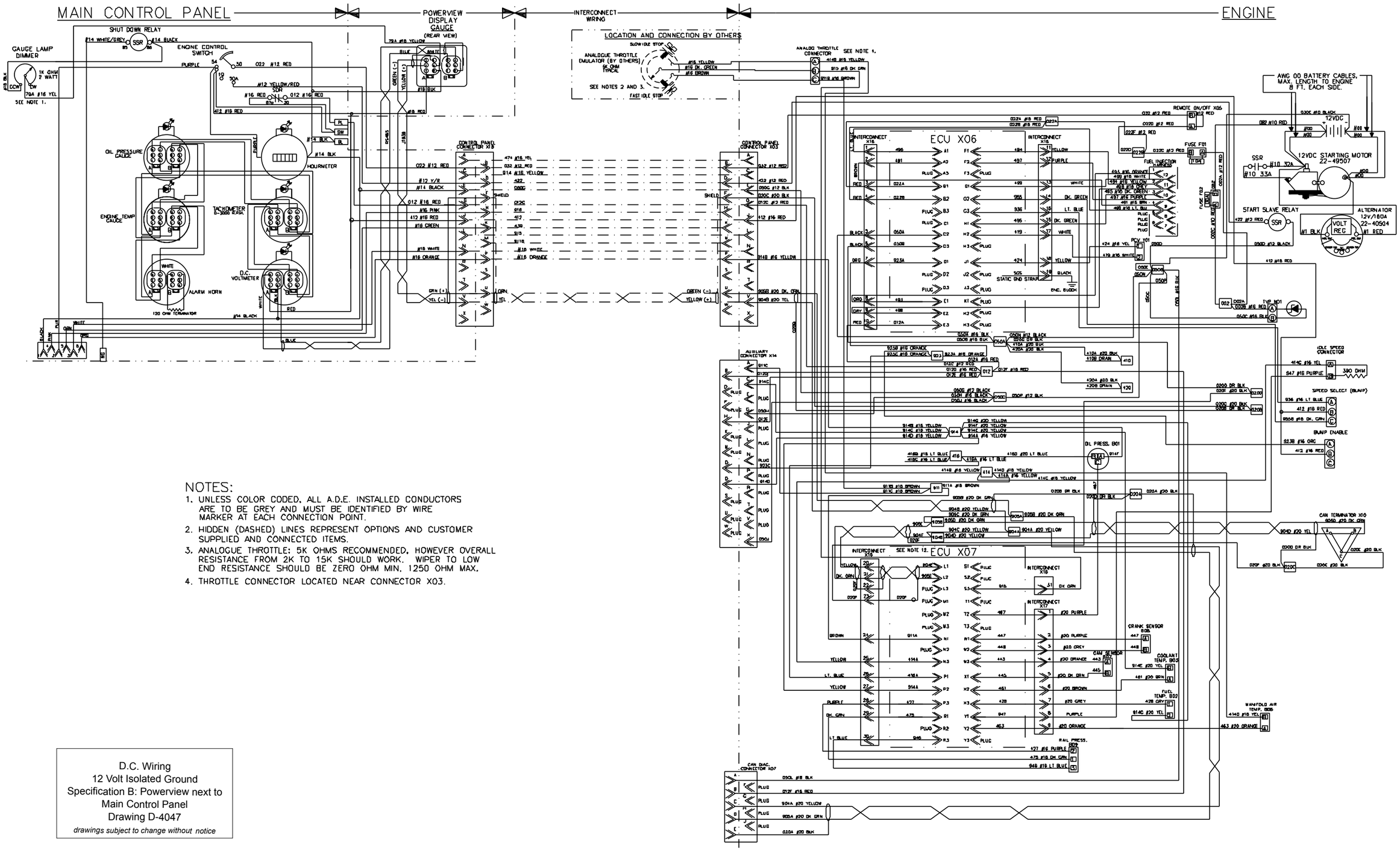
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
12 Volt Isolated Ground
Specification A: Powerview in Engine Room
Drawing D-4046
drawings subject to change without notice



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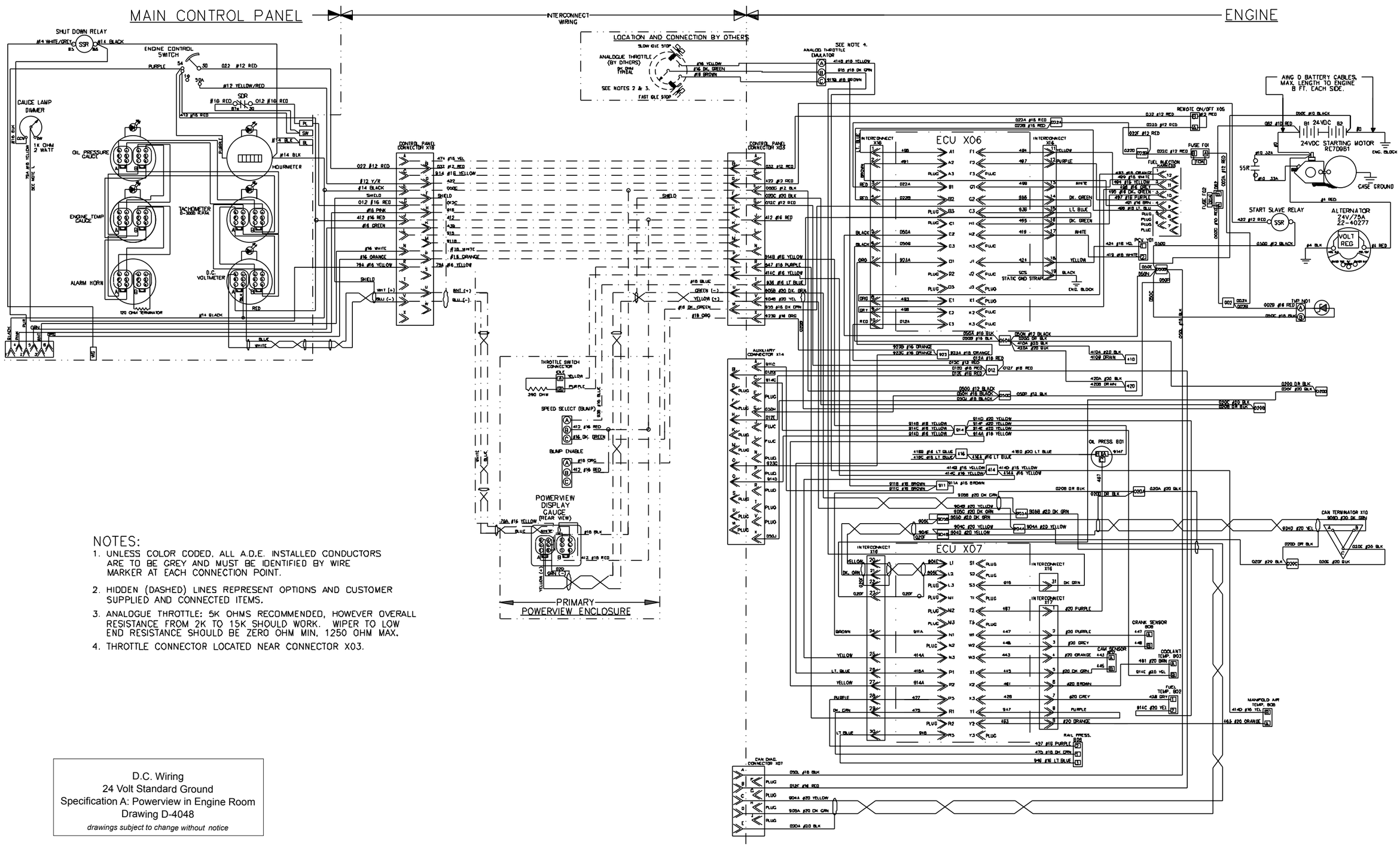
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
12 Volt Isolated Ground
Specification B: Powerview next to Main Control Panel
Drawing D-4047

drawings subject to change without notice



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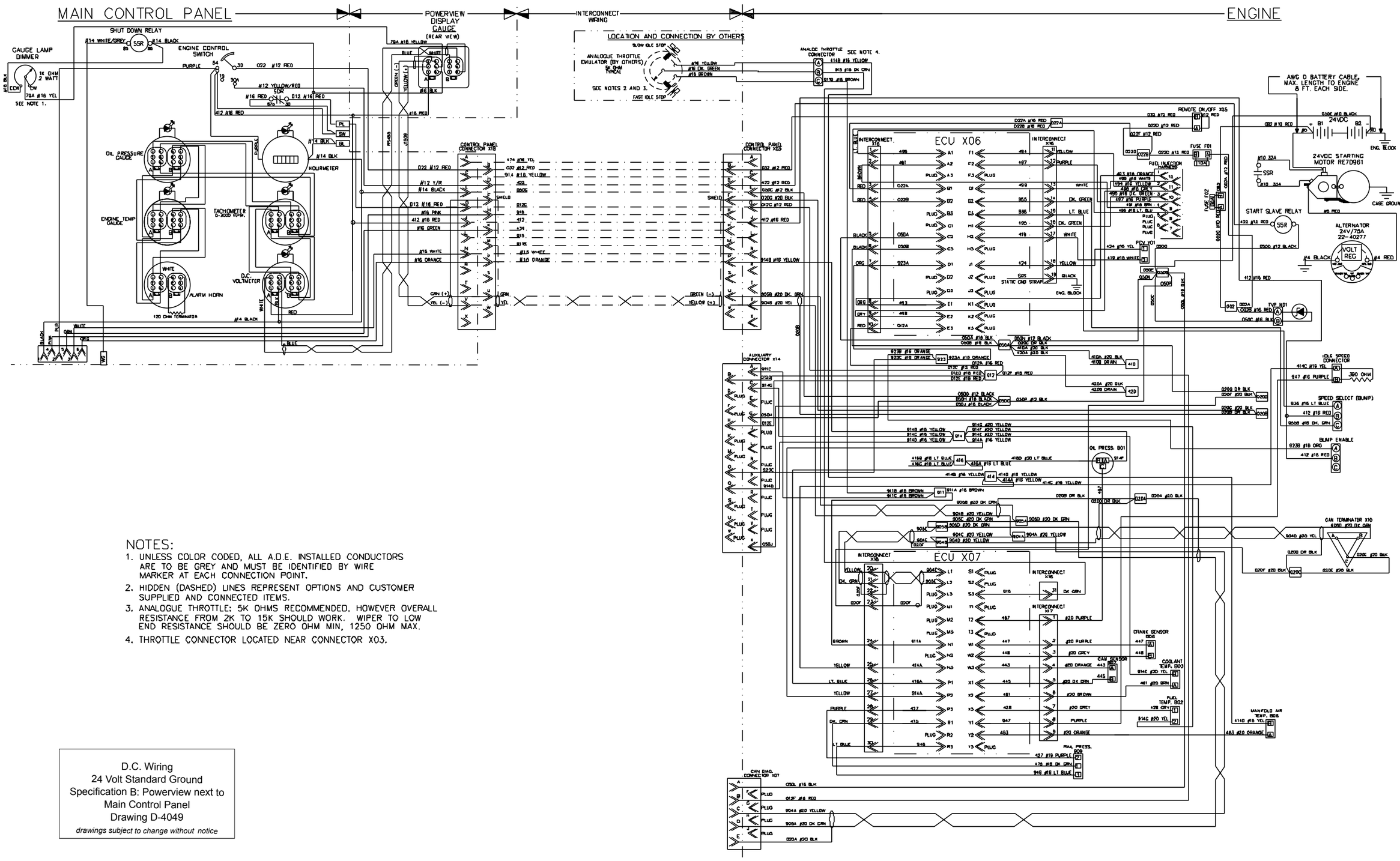
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
24 Volt Standard Ground
Specification A: Powerview in Engine Room
Drawing D-4048
drawings subject to change without notice



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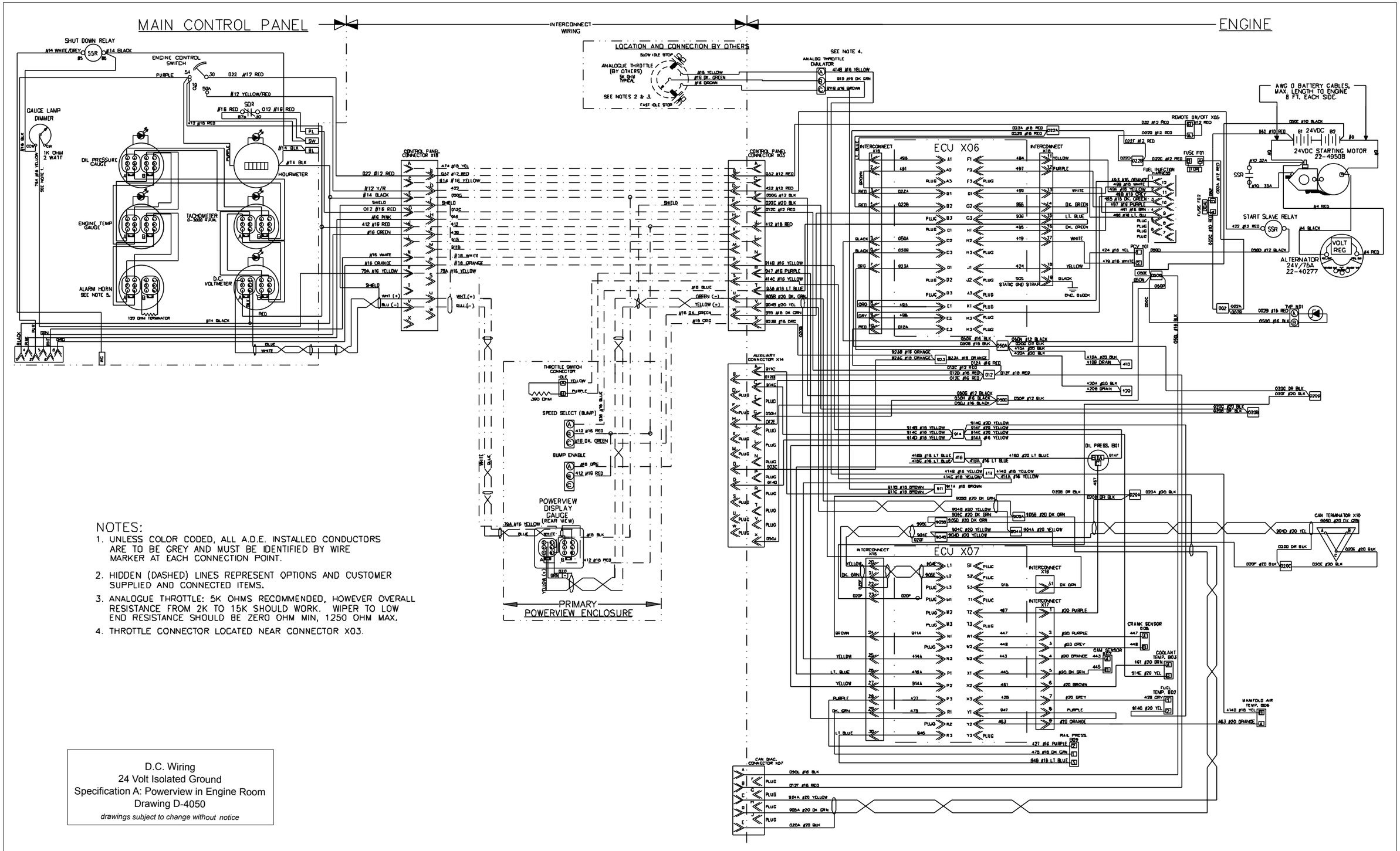
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
24 Volt Standard Ground
Specification B: Powerview next to
Main Control Panel
Drawing D-4049
drawings subject to change without notice



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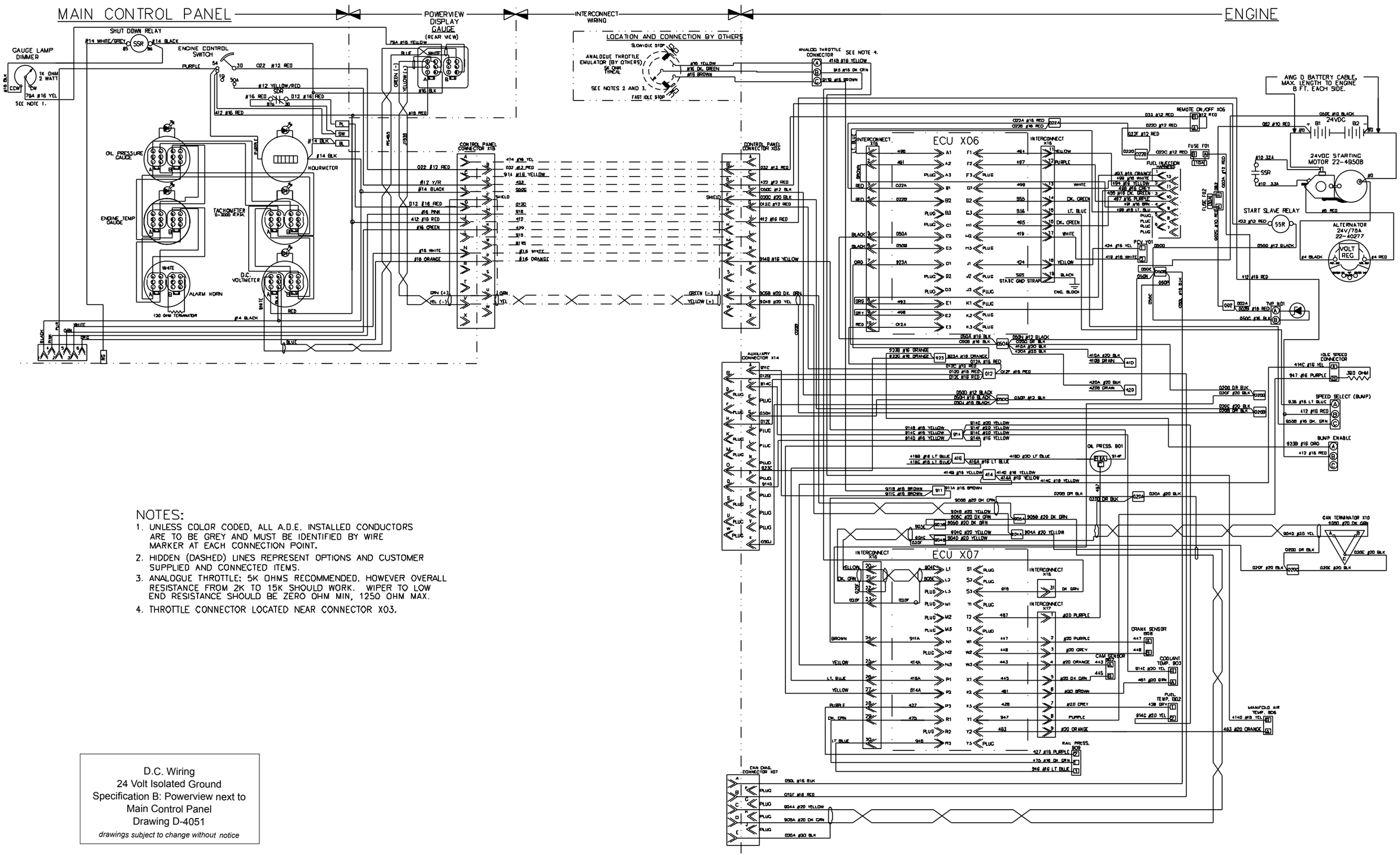
4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
24 Volt Isolated Ground
Specification A: Powerview in Engine Room
Drawing D-4050
drawings subject to change without notice



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4. THROTTLE CONNECTOR LOCATED NEAR CONNECTOR X03.

D.C. Wiring
24 Volt Isolated Ground
Specification B: Powerview next to Main Control Panel
Drawing D-4051
drawings subject to change without notice

Safety at sea depends on careful preparation, product knowledge, and having the right tools and parts. Below is a list of parts Alaska Diesel Electric, Inc. recommends you carry onboard at all times.

Onboard Parts Kits are available from your dealer. “Standard” Kits are suitable for inland and offshore cruising. “World Class” Kits are for world cruising and trans-ocean cruising.

We consider these minimum quantities. Your vessel's operating conditions may require more of a given part. Consult your dealer.

Item	Description	Standard	World Class
1	Lube Oil Filter	4	4
2	Air Filter Element	1	1
3	Fuel Filter	2	2
4	Injector	0	6
5	Thermostat	2	2
6	Thermostat Ring	2	2
7	Relay	0	2
8	Valve Cover Gasket	1	2
9	Gasket Kit Top	0	1
10	Gasket Kit Bottom	0	1
11	Zinc*	6	12
12	Raw Water Pump Impeller*	2	2
13	Raw Water Pump Cover Gasket*	2	2
14	Raw Water Pump*	0	1
15	Workshop Manual	0	1
16	Set of Alternator Belts	1	1
17	Fuel Washer Kit	Std.1	w/c 1

*Heat exchanger cooled engines only

www.northern-lights.com

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