



FG Wilson Diesel Generator Set Operator & Maintenance Manual

3, 4 & 6 Cylinder Diesel Engine

Dear Customer,

We are glad that you have selected our state of art "FG WILSON DG SETS".

Each FG Wilson Generator Set is a result of long term research & development. The research & development takes into consideration the arduous operating conditions and user practices to create a world class reliable product.

Every Generating Set is thoroughly tested and passes through a series of checks & stringent quality control to ensure trouble free operation.

This Operation & Maintenance manual has been prepared by keeping in mind needs of most of the users starting from the installation right up to the maintenance schedules and trouble shooting charts.

Kindly study the manual carefully before operating the Genset.

Use only genuine FG WILSON spare parts for servicing and maintenance to keep the generating set running in good condition.

We are sure this FG Wilson Generator Set will serve you well for years as you continue to maintain it, as presented in this manual.

Yours faithfully,

For FG Wilson.

(Sales & Service)

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1. INTRODUCTION

This Engine is designed to provide you superior performance and reliability. The Engine is a complete system that incorporates advanced engineering concepts.

As the engine is compact and light weight in its class, it gives the advantage of optimizing valuable space.

While asking for assistance Please provide the following Information

- ✓ Your Name , Phone or Fax Number & Email-ID
- ✓ Genset Serial No
- ✓ Name of the Customer
- ✓ Genset Location
- ✓ Type of Use
- ✓ Approx Running Hrs of Engine
- ✓ General Description of Assistance Required

SERVICES

PREVENTIVE MAINTENANCE CHECKS - DIESEL ENGINE					
Daily	Weekly	Monthly	Every Six Months / 500 Hrs	Every 1 Year / 1000 Hrs	24 Months/ 2000 Hrs
	Repeat Daily Checks	Repeat daily & weekly checks	Repeat daily weekly & monthly checks	Repeat daily, weekly monthly & 6 months checks	Repeat daily, weekly monthly, 6 months & yearly checks
Check engine oil level. Top up if required with same grade.	Check air system for hoses, clamps, pipings etc.	Check foundation bolts	Change oil.	Change Air filter element	Change coolant
Check / Fill diesel in Fuel Tank	Check lubrication system for leakages and rectify.		Change lube oil filter Element.	Clean Radiator Externally	
Drain water in fuel if water in fuel signal ON & drain if required	Check fuel system for leakages and rectify.		Change fuel filter element	Turbocharger visual inspection	
Check leakages & Service Indicator.	Check cooling system for leakages and rectify.		Clean air cleaner housing & change filter element if required.	Check condition of rubber hoses	
Clean Engine Externally.	Check Battery & Battery connection.		Check Sensors / wiring	Check & replace belt	
	Check Fasteners and retighten.		Check & if required replace oil separator assembly	Check the free rotation of fan hub, tensioner, idler pulley and battery charging alternator	
	Check alternator & control Panel connection.				
	Check Gauges & Indicators on control panel.				
	Check battery charger connection & charging voltage				

INSTALLATION & COMMISSIONING REPORT

Genset Model No.		Details of Alternator	
Sr. No & Mfg. Date (as mentioned on Name plate)		Alternator Make :	
		Alternator Model :	
Engine Model No.		KVA Rating :	
Engine Sr. No. (as mentioned on Name plate)		No. of Phases :	
		Alternator Sr. No. :	
Battery Make			
Battery Serial No			
Control Panel Model / Sr. No.			
Date of Installation			
Name & Address of Customer		Site Address of Customer	
Contact Person Name	Phone No.	Mobile No	e-mail id
1			
2			
3			
PRE COMMISSIONING CHECKS			
Sr. No.	Nature of Checks	Status	Remarks
1	Genset Installation.		
2	No obstruction to cooling air inlet and air outlet.		
3	All canopy doors must open fully for service access.		
4	DG set room ventilation, if installed in a room.		
5	Fitment of exhaust silencer and exhaust piping.		
6	Earthing a) 2 Nos. of earthing pits for genset / control panel Body. b) 1 Nos. of earthing pit for neutral. c) 1 Nos. of earthing pit for alternator.		

7	Visually check for all fasteners.		
8	Visually check for all wiring connection in control panel.		
9	230 V supply connections from Electricity for battery charger if standard control panel used.		
10	Visually check all the connectors and actuators on engine.		
11	Electricity board Load		
	a) R- Phase		
	b) Y- Phase		
	c) B- Phase		
	Please ensure electricity board load equally distributed in all three phase		
12	Electricity board Voltage		
	a) R-Y Phase		
	b) Y-B Phase		
	c) B-R Phase		
	a) R-N Phase		
	b) Y-N Phase		
	c) B-N Phase		

CARRY OUT FOLLOWING INSTRUCTIONS DURING COMMISSIONING

Sr. No.	Check Details		OK	NOT OK	Remarks
1	Lub Oil Level				
2	Fuel Level				
3	Coolant Level				
4	Leakages				
	a) Oil Leakage	<ul style="list-style-type: none"> • Cam cover • Chain case Cover • Oil sump • Oil filter • Turbo • All hoses 			
	b) Coolant Leakage	<ul style="list-style-type: none"> • Radiator • Radiator inlet and outlet Hoses • Coolant Pump • Engine inlet and outlet Hoses • Oil Cooler 			
	d) Fuel Leakage	<ul style="list-style-type: none"> • Fuel Filter • Fuel Feed pump • Low pressure pipe • IMV Pump • HP Pipe • Back Leak pipe • Fuel tank • Fuel tank Drain plug 			
	e) Air Leakage				
5	Phase Difference	Reading in Amp			
	R- Phase				
	Y- Phase				
	B- Phase				

Performance Trial :

Load (%)	Testing Time (min)	Load (Amps)			Voltage (Volts)			Frequency (Hz)	Remarks
		R	Y	B	R	Y	B		
0	5								
25	5								
50	5								
75	5								
100	10								

Commissioning Date & hrs

Customer's remarks, if any :

I hereby declare that Generator has been tested under load conditions and performance is found to be satisfactory.

**Name and Sign of
Customer**

**Name and Signature of
Service Engineer / Dealer**

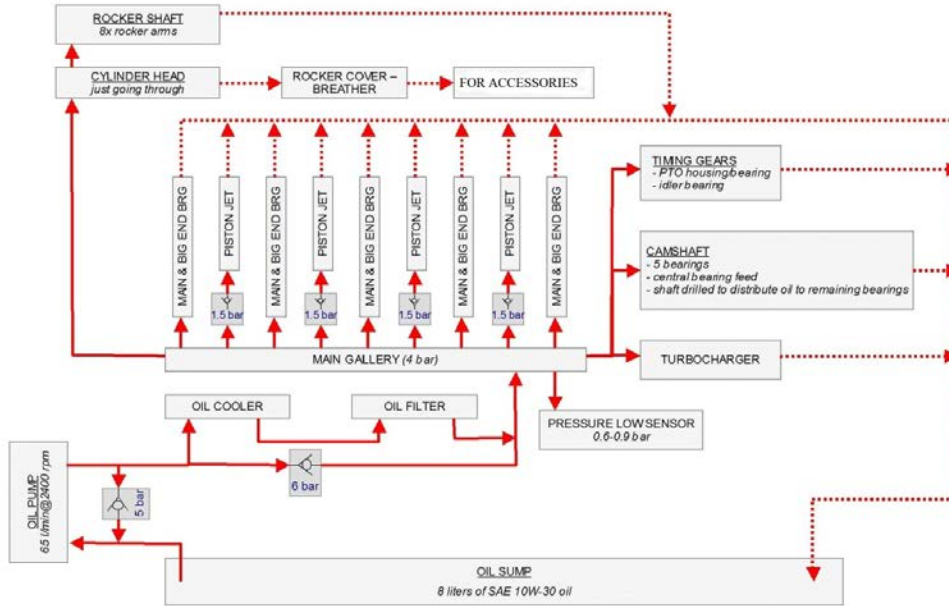
START – UP AND FUNCTIONS

Before Starting

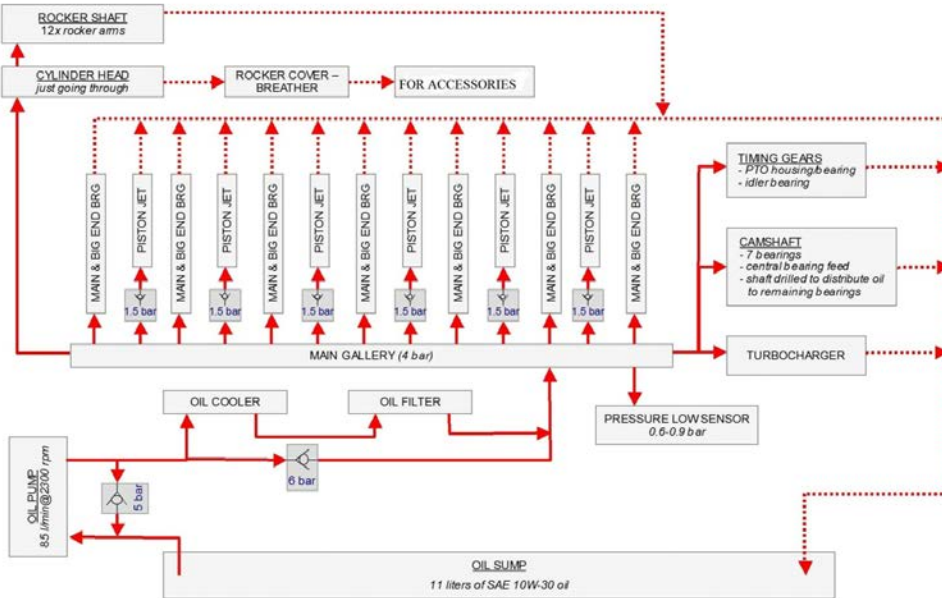
Familiarize yourself with the handling of the Engine/ Product.

1. Please check & fill the appropriate amount of fresh and clean oil in the engine If necessary,.
2. Pay attention to the oil level of the oil dip stick while adding engine oil, which should not exceed the upper limit mark on the oil dip stick and also no lower than lower mark.
3. USE OIL 15W40 CH4 GRADE Only. If CH4 not available than only use CF4 Grade Oil.
4. Please check & fill the diesel fuel in fuel tank. The signs are as follows
5. Note: Use commercial High Speed Diesel fuel.
6. Please fill the Ethylene Glycol Based Premixed coolant in radiator tank if necessary.
7. Don't use purified water with chlorine.
8. Don't use hard water for top up the coolant system
9. Check the electric system; ECU/ ESU & Battery Status.
10. Bleed the fuel system as per Guidelines.
 - ❖ When does a system need bleeding?
 - ✓ Whenever there has been the possibility of air being introduced into the fuel system
 - ✓ Examples of when the fuel system needs bleeding?
 - ✓ Fuel filter or water separator servicing.
 - ✓ Running out of fuel.
 - ✓ Fuel system component removal.
 - ✓ Any loosening of fuel lines.
 - ❖ Why air must be bled out of the system?
 - ✓ Air can be compressed & is 100 times thinner
 - ✓ The fuel system must consist of a solid column of fuel from the tank to the injectors.

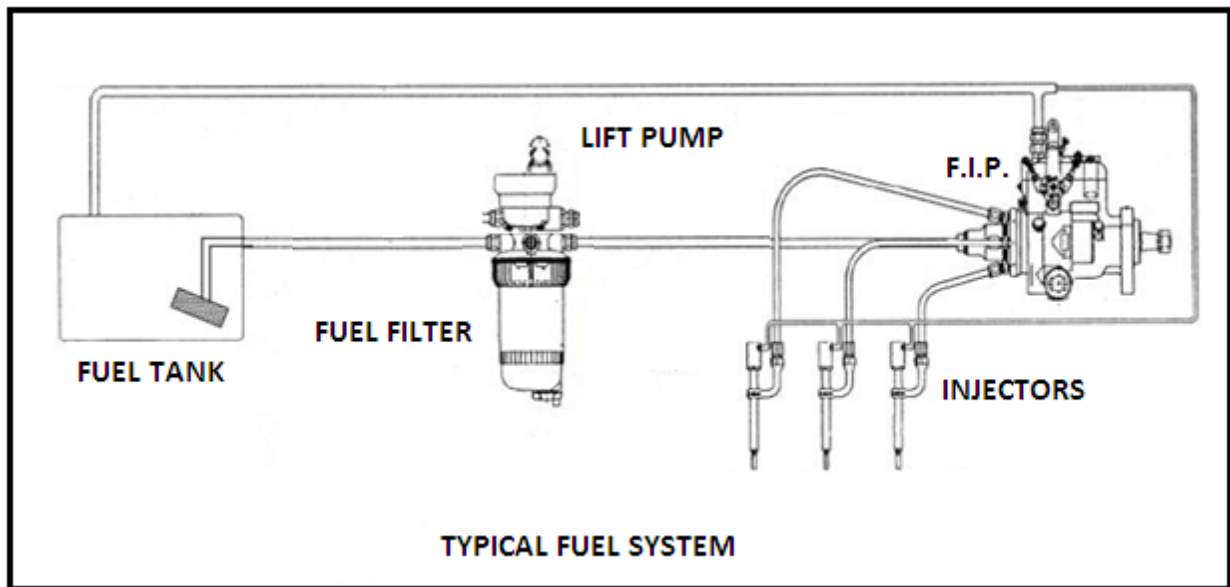
4 Cylinder Lubrication System Schematic



6 Cylinder Lubrication System Schematic



Typical Fuel System

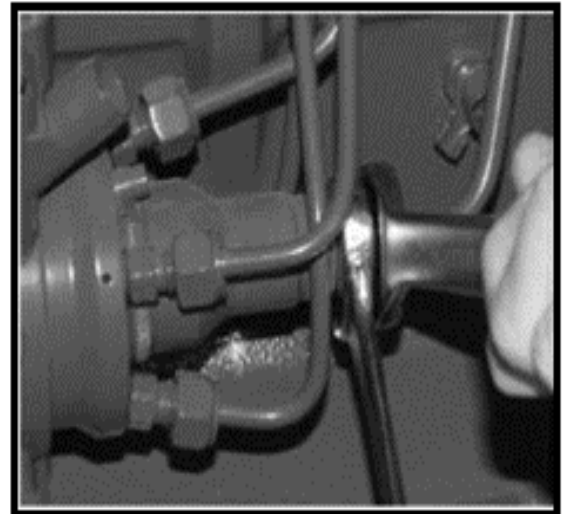


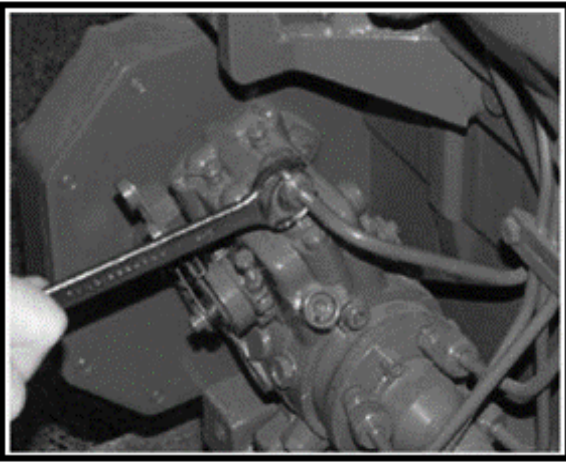
How to Bleed Air out of the system?

- Complete Fuel System should be bled in the following order.
- ✓ Final Filter
- ✓ Injection Pump
- ✓ Injectors

INJECTION PUMP

1. Slightly loosen the fuel supply line connector at Injection Pump.
2. On mechanical fuel supply pumps, operate fuel supply pump primer lever until fuel without air bubbles flows from fuel line connection.
3. On electric supply pump press start button until fuel without air bubbles flows from fuel line connection.
4. Tighten fuel supply line connector to specification.



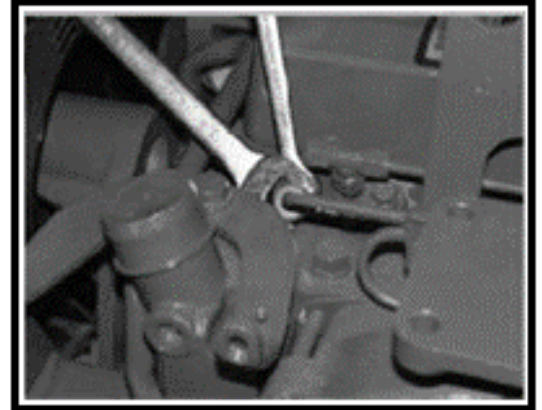


INJECTION PUMP

5. Slightly loosen the fuel return line connector at Injection Pump.
6. On mechanical fuel supply pumps , operate fuel supply pump primer lever until fuel without air bubbles flows from fuel line connection.
7. On electric supply pump press start button until fuel without air bubbles flows from fuel line connection.
8. Tighten fuel return line connector to specification.

INJECTION NOZZLES

1. Move the speed control lever to half throttle position
2. Using two open- end wrenches loosen fuel line connection at all injection nozzles.
3. Crank engine over starting motor (But do not start engine) until fuel free from air bubbles flows out of loosened connection. Tighten connection to specification.



In Brief, before cranking

1. Bleed Air at the Pump Inlet.
2. Also at the Pump Return Fitting.
3. Bleed Air from All Injection Nozzle

After Filter Change

On electric supply pumps, turn key switch to 'ON' position until fuel flow is free from air bubbles

Tighten bleed plug securely by hand



STARTING THE ENGINE

Check & ensure all above points are OK

Check & ensure battery and Panel wiring connections are proper.

Turn ON the DC Supply switch.

Wait for 'initialising' the GMU Controller.

Press the "START" button

GMU will give START command to the Engine after completion of START Delay.

After this Engine will start.

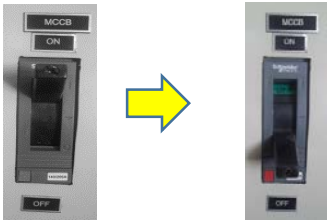
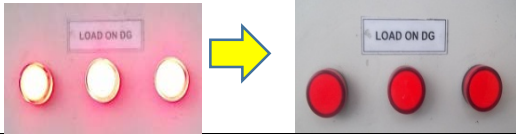



DG Set ON Lamp s will glow

GMU will display all engine and alternator parameters scrolling one by one

Switch ON the load by using Load ON / Off Switch

LOAD ON DG Lamps will glow

STOPPING THE ENGINE

1	Switch Off the load by using Load ON / Off Switch	 A vertical MCCB switch is shown in two states. On the left, the handle is in the 'ON' position. A yellow arrow points to the right, where the handle is in the 'OFF' position.
2	LOAD ON DG Lamps will off	 A panel with three glowing yellow lamps is shown on the left, labeled 'LOAD ON DG'. A yellow arrow points to the right, where the same panel has three unlit red lamps.
3	Press the 'STOP' button	 A red oval button with the word 'STOP' in white capital letters.
4	GMU will give STOP command to the Engine after completion of STOP Delay.	 A GMU control panel is shown on the left with a yellow arrow pointing to a diesel engine on the right.
5	Turn Off the DC Supply switch.	 A rotary DC SUPPLY switch is shown in two states. On the left, the knob is turned to the 'ON' position. A yellow arrow points to the right, where the knob is turned to the 'OFF' position.

MAINTENANCE, TROUBLE SHOOTING

"1st & 2nd" Check Maintenance Daily & Weekly

Make a Daily Report of Engine Operation to the Maintenance Department to get Good Performance from Engine.

The engine must be maintained in top mechanical condition if the operator is to get optimum satisfaction from its use. The maintenance department needs daily running reports from the operator to make necessary adjustments in the time allotted and to make provisions for more extensive maintenance work as the reports indicate the necessity. Comparison and intelligent interpretation of the daily report along with a practical follow-up action will eliminate practically all failures and emergency repairs.

Report to the Maintenance Department any of the following conditions:

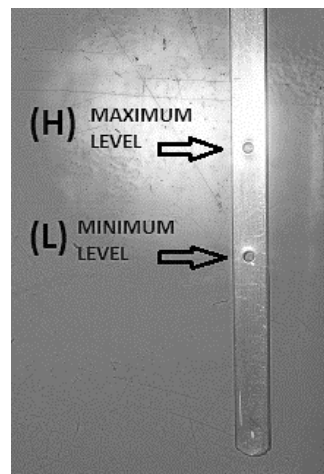
1. Low lubricating oil pressure.
2. Low power.
3. Abnormal water or oil temperature.
4. Unusual engine noise.
5. Excessive smoke.
6. Excessive use of coolant, fuel or lubricating oil.
7. Any fuel, coolant or lubricating oil leaks.

Check Engine Oil Level:



Check oil level with dipstick oil gauge located on the engine. Fig. M1 For accurate readings, oil level should not be checked for approximately 15 minutes after engine shut-down. Keep dipstick with the oil pan with which it was originally shipped. Keep oil level as near "H" (high) mark as possible. If necessary, add oil of the same quality and brand as already in the engine.

Caution: Never operate the engine with oil level below the "L" (low) mark or above the "H" (high) Mark.



Check coolant (closed cooling circuit)



ATTENTION: With hot engine, the closed cooling circuit is under pressure. Do not try to open the radiator cap or the drain plug when engine is hot. This may cause severe injuries by hot coolant. As soon as the engine has cooled down, the cap may be opened.

Remove radiator cap; Coolant level should reach the "MAX" marking in the expansion tank.

ATTENTION: Only add FG WILSONCOOL Coolant to top up the cooling system. Do not use chlorine purified water for top up the cooling system. If using concentrate coolant use only distilled water for top up the cooling system.

COOLANT SPECIFICATIONS

Ethylene Glycol based Anti-freeze with corrosion inhibitor / coolant usage is required for all FG Wilson engines. Never operate engines with the cooling system with only water. First the anti-freeze coolant mixture prevents the potential for corrosion within the cooling system. Secondly, it increases the boiling point of cooling fluid, reducing the potential of localized boiling within the engine and overheat in general. Lastly, it reduces the freezing point of the engine coolant, thereby reducing or preventing potential engine damage caused by freezing.



Check Belt Condition:



Visually check belts for looseness if there is evidence of belt slippage.

NOTE: Engine is fitted with Auto-Tensioner as a standard fitment, Confirm marking should be within Limit.

Pulley misalignment must not exceed 1/16 in (1.6 mm) for each ft (0.3mm) of distance between pulley centres. Do not allow belts to rub any adjacent parts.

Fuel System Check:



Visually check fuel system, etc., including AFC fuel pump, for miss adjustment or tampering.

Check all connections for leaks or damage. Check engine for damage; correct as necessary. Drain water Sediment from Filter. If more moisture than usual is present when checking the fuel tanks, it may be advisable to install a water separator.

Air Cleaner Check:

Clean Pre-Cleaner and Dust Pan & Check Inlet Air Restriction

Under extremely dirty conditions an air pre cleaner may be used.

Suggested procedure to replace the Air Filter element:

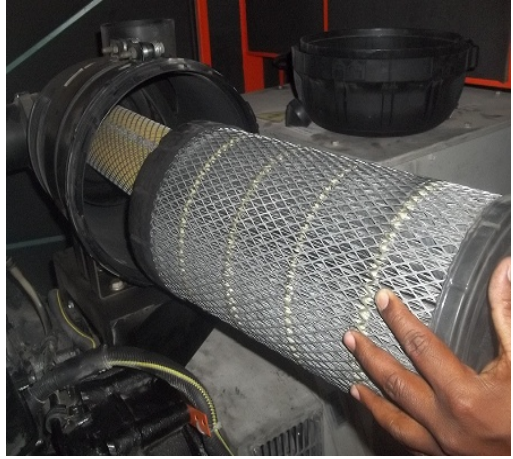
Replace the primary cartridge when red band appears on the service Indicator, in Engine stopped condition

Replace the safety cartridge after two years of duration or at the time of 3rd replacement of primary cartridge whichever is earlier.



Do Not Use Screw Driver or Spanner during replacement of the Air Filter





Charging Alternator Check

The alternator is driven via a poly-V-belt and charges the battery at all engine speeds. Output at idle speed is 30amps-12v or 80amps-24v.



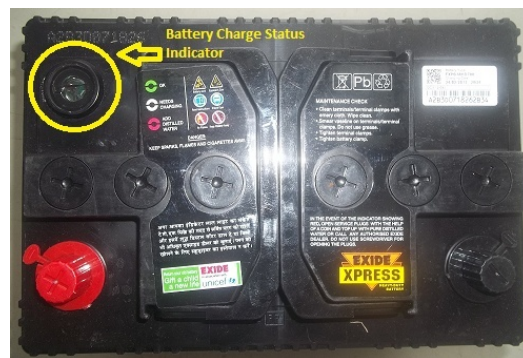
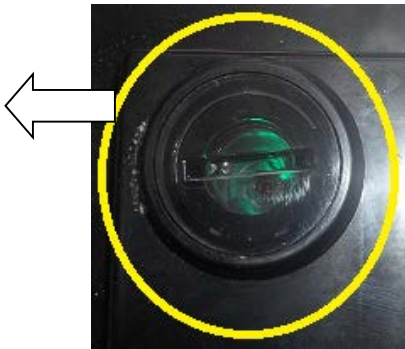
Check alternator wiring connections (Positive, Negative and Warning Lamp Connections) for looseness as per the diagram



Battery

All Three cylinder engines are equipped with a 12v battery.

All Four and Six cylinder engines are equipped with 2 x 12v battery.

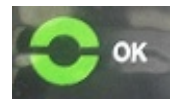


Batteries (Battery Charge Status Indicator)

Visually check Battery for oxidation at battery terminals. If oxidation observed clean with water and apply petroleum jelly to the terminals.

Check Battery charge status indicator

- If the indicator is showing Green colour, the battery charge status is OK.
- If the indicator is showing XXXXXXXXXX, the battery needs charging.
- If the indicator is showing Red colour, Add distilled water.



Scheduled Maintenance

Maintenance is the key to lower operating costs. A diesel engine requires regularly scheduled maintenance to keep it running efficiently.

A Good Maintenance Schedule Depends on Engine Application; actual operating environment of the engine governs the maintenance schedule. The suggested check sheet on the following page indicates some checks have to be performed more often under heavy dust or other special conditions.

Oil Change procedure

1. Bring engine to operating temperature, shut down engine, remove drain plug from bottom oil pan, and drain oil.
2. Install drain plug in oil pan.
3. Fill the crankcase to "H" (high level) mark on the dipstick.
4. Start engine and visually check for oil leaks.
5. Shut down the engine; allow 15 minutes for oil to drain back into the pan; recheck the oil level with the dipstick. Add oil, as required.

Note: Use lubricating oil as per specifications and genuine FG WILSON filters on engines.

Change Lubricating Oil Filter

- Remove the oil filter by hand or special spanner and drain the oil completely.
- Check the condition of sealing ring, if necessary change it.
- Add fresh oil (@ 0.5 liters) in the filter assembly.
- Replace the oil filter in place of old one. Apply slight oil on sealing ring and assemble the oil filter until sealing ring is evenly seated.
- Check oil level, oil pressure and leakage through sealing ring, if any.

Change Fuel Filter

Bleed the air completely out of pump before starting the engine

o Ensure that no part of pump is fouling on the engine

o Pump inlet pressure should maintained between (3 – 8 psi) at all speed & load
Conditions

o Check whether the throttle lever is in locked condition before and after engine testing

(for Genset applications)

o Do not let the power supply to ESO continuously when the engine is not running.
Continuous power supply will lead solenoid failure

o Do not apply final torque (90 – 100 Nm) to FIP shaft nut before loosening lock shaft
Screw

o Do not interchange Fuel Inlet and Return connections

o Do not assemble additional components like bracket on throttle lever for actuation in industrial
applications. This will apply more loads on the lever and will lead to breakage of the same.

Air Filter Maintenance:

- Don't remove element for inspection.
- Never tap a filter to clean it.
- Never judge the filter's life by looking at it.
- Measure the airflow restriction.
- Never leave an air cleaner open longer than necessary.
- Don't ignore a worn or damaged gasket in the housing.
- Don't use a damaged or bunched filter.
- Never use a warped cover on housing.
-
- Never substitute an incorrect element model number.

7-STEP FILTER ELEMENT REPLACEMENT

1. Remove the old element gently 'Baby' that dirty filter, until you get it clear of the housing. Accidentally bumping it while still inside means dropped dirt and dust that will contaminate the clean side of your filter housing before the new filter element has a chance to do its job.
2. Always clean the inside of the housing carefully Dirt left in the air cleaner housing spells death for your engine. Use a clean, damp cloth to wipe every surface clean. Check it visually to make sure it's clean before putting in a new filter.
3. Always clean the gasket sealing surfaces of the housing; An improper gasket seal is one of the most common causes of engine contamination. Make sure that all hardened dirt ridges are completely removed, both on the bottom and top of the air cleaner.
4. Check for uneven dirt patterns; Your old filter has valuable clues to dust leakage or gasket sealing problems. A pattern on the element clean side is a sign that the old filter element was not firmly sealed or that a dust leak exists. Identify the cause of that leak and rectify it before installing a new filter.
5. Press your fresh gasket to see that it springs back; Make sure your new filter is made with a highly compressible gasket that springs back (promptly) when finger pressure is released. A high quality gasket is one of the most important parts of the filter.
6. Make sure the gasket seats evenly; If you don't feel the gasket seating evenly for a perfect seal, you don't have protection. Re-check to see if the sealing surface in the housing is clean, and ensure that the filter is the correct model. It may be too short for the housing.
7. Ensure air-tight fit on all connections and ducts; Check that all clamps and flange joint are tight, as well as the air cleaner mounting bolts. Seal any leaks immediately — leaks mean dirt is directly entering your engine

RADIATOR CLEANING

If Radiator or Charge Air Cooler fins are found clogged during periodic checking. The system should be cleaned thoroughly. Remove the radiator service door, if fitted. If possible use compressed air for cleaning. Start blowing air on to the radiator & charge air cooler from protection screen side. (i.e. opposite direction to normal cooling air flow). While removing dirt on the fins, do not use hard brush. Remount radiator service door.

Fuel and Fluid specifications:

Fuel Specification

Diesel fuel must be clean, fresh, meet fuel specifications and be sourced from known and reputable supplier. Clean, fresh and properly specified diesel fuel will provide assurance of maximum engine performance and maximum fuel injection system longevity. The use of out-of-specification, dirty or questionable quality diesel fuel will result in engine performance and start ability problems as well as reductions in engine and fuel injection system life. FG Wilson diesel engines are operating on commercial High Speed Diesel fuel.

RECOMMENDED OIL

API- CH4 15W-40

ITEM	VISCOCITY GRADE	OIL PERFORMANCE GRADE	QTY
Engine Oil	15W40 (Ambient Temp. 5 ^o c to 55 ^o c) 5W30 (Ambient Temp. -30 ^o c to 5 ^o c)	API – CH 4 Grade or Better Grade	3 Cylinder 6 Liters, 4 Cylinder 8 Liters 6 Cylinder 11 Liters

RECOMMENDED COOLANT

ITEM	SPECIFICATION
Coolant (ANTI FREEZE AGENT WITH CORROSION INHABITER)	Ethylene Glycol Premixed

CPCB – 2 & EGR SYSTEM

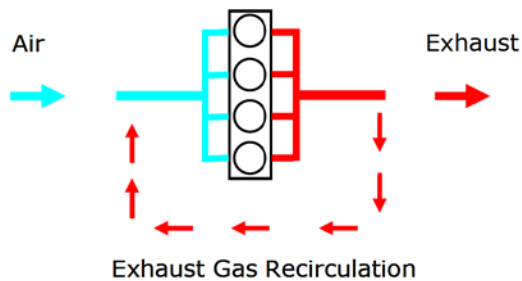
What is CPCB? (Central Pollution Control Board)

To implement pollution control norms defined by Ministry Of Environment & Forests. (MOEF)

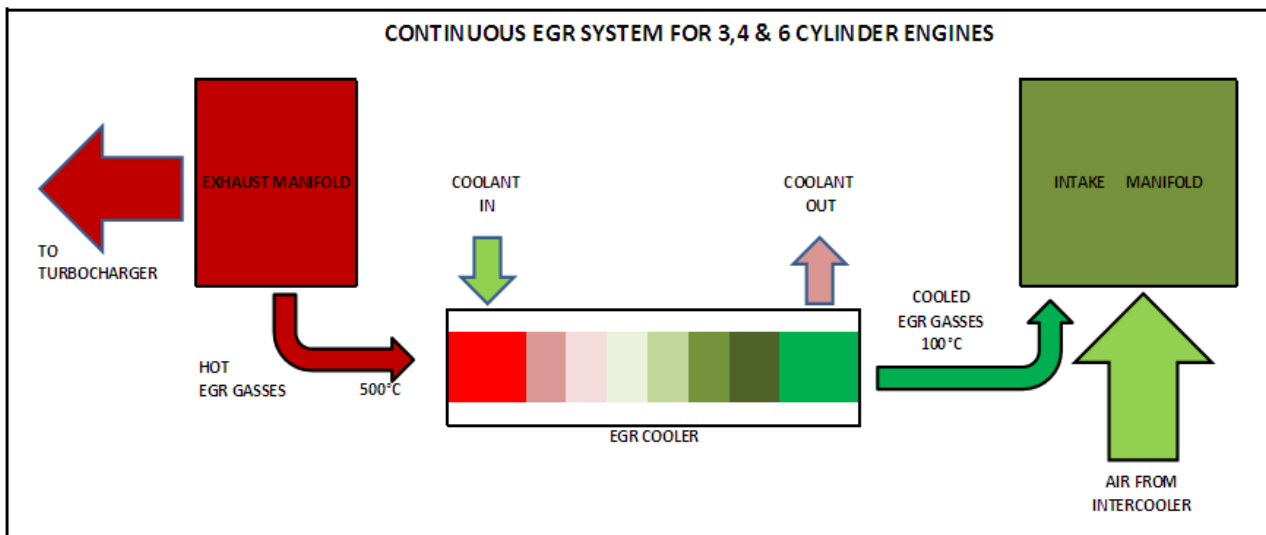
What is CPCB-II ?

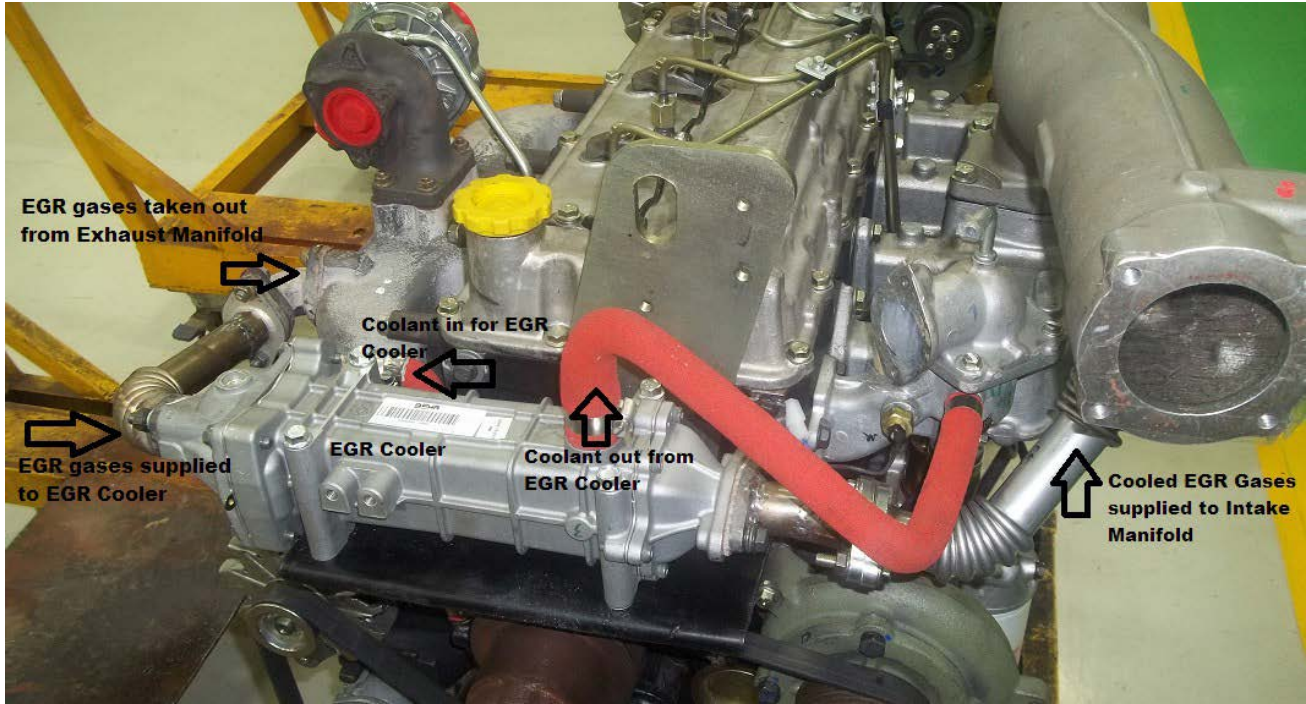
Next level of emission norms after CPCB I mandating significant reduction in exhaust emissions for Diesel gensets upto 800 KW.

E G R – Exhaust Gas Recirculation

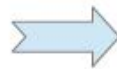


In EGR System, Part of the exhaust gas is rerouted into the combustion chamber, where it helps to attenuate the formation of NOX which is the most problematic emission in Diesel Engines by reducing the local reaction temperature. The exhaust gas acts as an inert gas in the combustion chamber, it does not participate in the combustion reaction. This leads to a reduction of the combustion temperature and controls Nitrogen Oxides.





**Continuous EGR System for 3,4 & 6 Cylinder Engine
Flow - Chart**



The continuous EGR system in 3,4 & 6 cylinder FG Wilson engines is a maintenance free system, There is no need of service for the EGR system.

FAULT FINDING CHARTS

The Engine will normally not give trouble, if maintained and serviced properly as per instructions given in previous sections. However, defects of elementary nature may arise and following suggestions will help operator to trace out the trouble and to rectify it effectively.

SYMPTOM	CAUSES	REMEDIAL ACTION
Engine fails to start	1. Leakages or Air trapped in fuel system. or No fuel.	Check & rectify fuel leaks, Check fuel and fuel quality
	2. High exhaust back pressure.	Clean exhaust silencer and manifold.
	3. Battery runs down.	Recharge battery.
	4. Battery of wrong capacity.	Use battery of recommended capacity.
	5. Faulty starter.	Repair the starter.
	6. Loose or dislodged wiring.	Tighten all wiring.
Engine is difficult to start	1. Clogged air cleaner.	Clean air cleaner/Change air filter Element.
	2. Engine used after a long time	Flush & service engine thoroughly
	3. Run down battery terminal loose or oxidized causing starter motor to run slowly.	Have battery inspected, clean terminals and coat with acid free grease.
	4. Grade of lube oil used is too viscous (applies particularly in winter).	use correct grade of recommended lube oil
Engine starts but stops after some time	1. Clogged air cleaner.	Clean air cleaner/Change air filter Element.
	2. Engine seized	Check engine Thoroughly.
	3. One or more cylinders not working.	Check engine Thoroughly.

FAULT FINDING CHARTS

SYMPTOM	CAUSES	REMEDIAL ACTION
Engine gives poor performance or engine lacks power	1. Clogged air cleaner.	Clean air cleaner, Change air filter element.
	2. High exhaust back pressure. 3. Derating due to altitude and temperature.	Clean exhaust silencer and manifold. Calculate Derating due to altitude and temperature and put correct load on the engine.
	4. Choked exhaust silencer.	Knock out soot from exhaust silencer.
	5. Loose fan.	Tighten fan mounting bolts.
	6. Clogged radiator fins & radiator core.	Clean radiator fins & radiator core.
	7. Broken/seized/worn out piston rings.	Replace with new piston rings.
	8. Worn out cylinder liner.	Replace with new one.
	9. One or more cylinders not working.	Contact nearest dealer.
	Exhaust smoke badly	1. Insufficient compression due to sticking/broken compression rings.
2. Cooling fins of radiator tubes choked.		Clean cooling fins of radiator tubes.
3. Insufficient cooling.		Ensure free cooling air flow.
4. Belt damaged/ broken.		Replace the belt.

SYMPTOM	CAUSES	REMEDIAL ACTION
Engine overheats (shut down engine immediately)	1. Choked suction tube.	Clean suction tube thoroughly.
	2. Clogged oil passage.	Flush oil passage.
	3. Defective relief valve.	Replace with new one.
	4. Faulty oil pump.	Replace with new one.
	5. Engine oil not changed at recommended period.	Change the oil.
	6. Excessive play in main bearing.	Change bearing.
	7. Leaks in the lube oil system.	Check connections on filter & oil cooler, turbo drain & feed pipe.
	8. Loose wiring.	Tighten all loose wiring.

