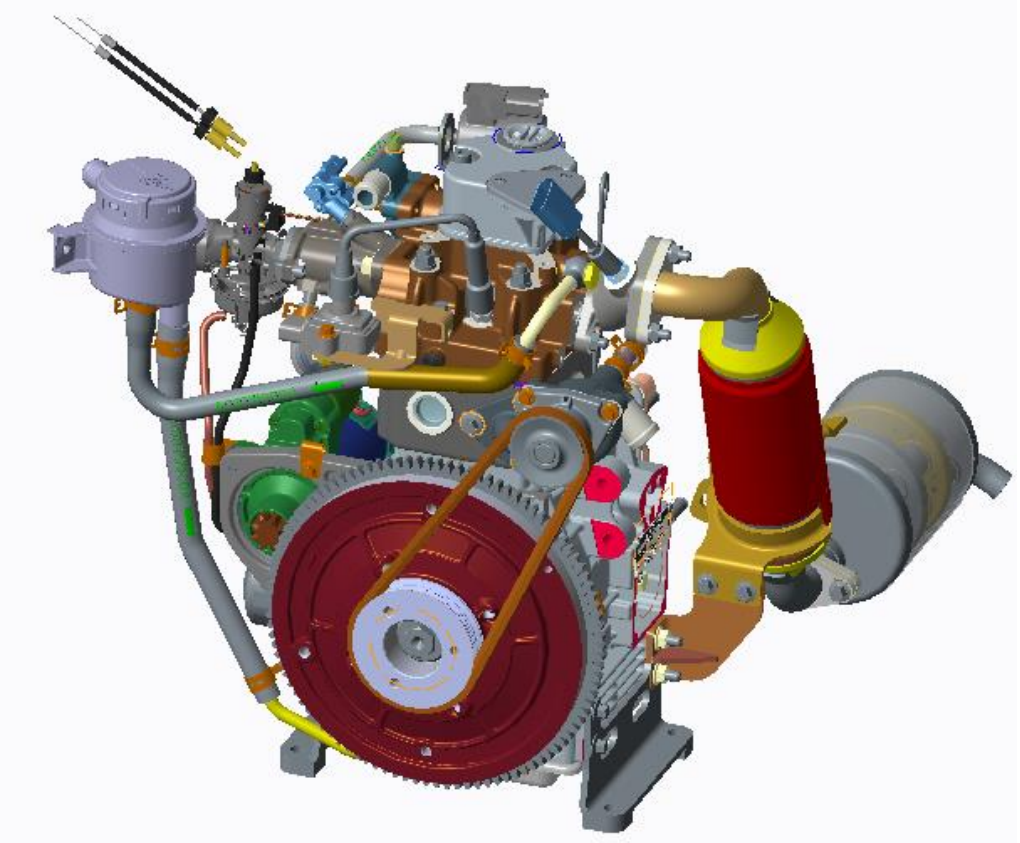
WORKSHOP MANUAL

Part No. A03G140018

WATER COOLED BIFUEL
CNG/LPG ENGINE
MODEL – G400 W VI



GREAVES COTTON LIMITED

AUTOMOTIVE ENGINE BUSINESS, AURANGABAD

ALTERATION RECORD SHEET FOR WORKSHOP MANUAL

ISSUE NO.	FORM NO.	ALTERATION DETAILS	PAGE NO.	LINE NO.	DATE	APPD. BY
00	--	FIRST RELEASE	--	--	10 DEC19	BSB
01	--	1. SERVICE SCHEDULE UPDATED 2. CNG AIR FILTER A03A200004 WAS 600-086-68 2. ENGINE VIEWS UPDATED	20 53 1,8	--	26 OCT 20	BSB

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PREFACE

Every attempt has been made to present within this workshop manual, accurate and up to date technical information.

However, development on the GREAVES engine is continuous.

Therefore, the information within this manual is subject to change without notice and without obligation.

Information presented within this manual assumes the following:

- The person or people performing service work on GREAVES series engines is properly trained and equipped to safely and professionally perform the subject service operation.

- The person or people performing service work on GREAVES series engines possess adequate hand and GREAVES special tools to safely and professionally perform the subject service operation.

- The person or people performing service work on GREAVES series engines has read the pertinent information regarding the subject service operations and fully understand the operation at hand.

- This manual was written by the manufacturer to provide technical and operating information to authorized GREAVES after-sales service centers to carry out assembly, disassembly, overhauling, replacement and turning operations.

- As well as employing good operating techniques and observing the right timing for operations operator must read the information very carefully and comply with it scrupulously.

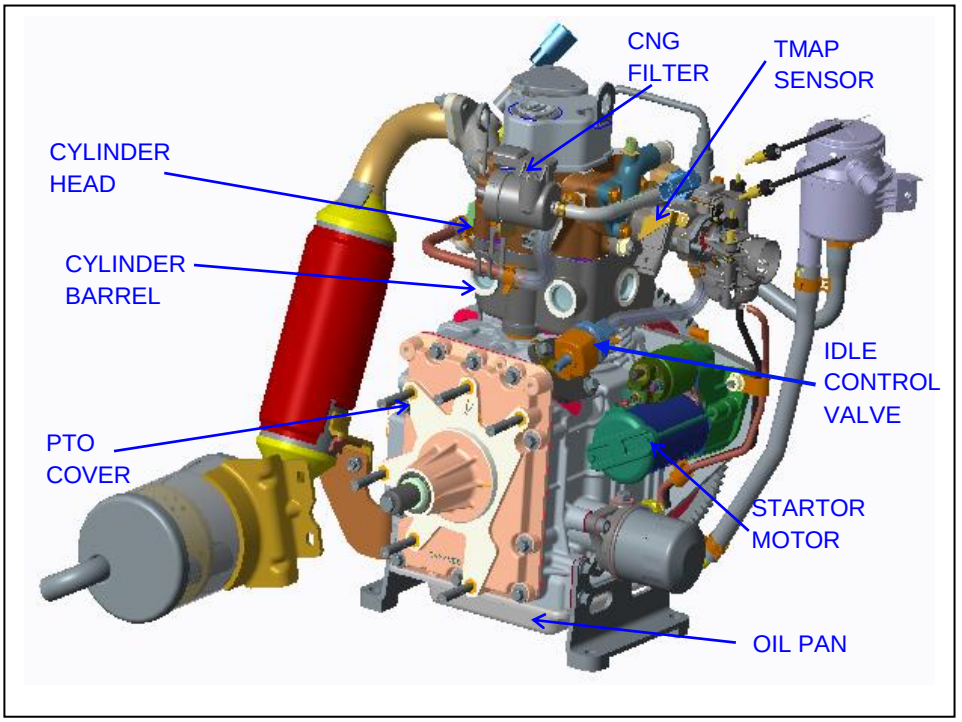
- Time spent reading this information will help to prevent health and safety risks and financial damage. Written information is accompanied by illustration in order to facilitate you understanding of every step of the operating phases.

Contents

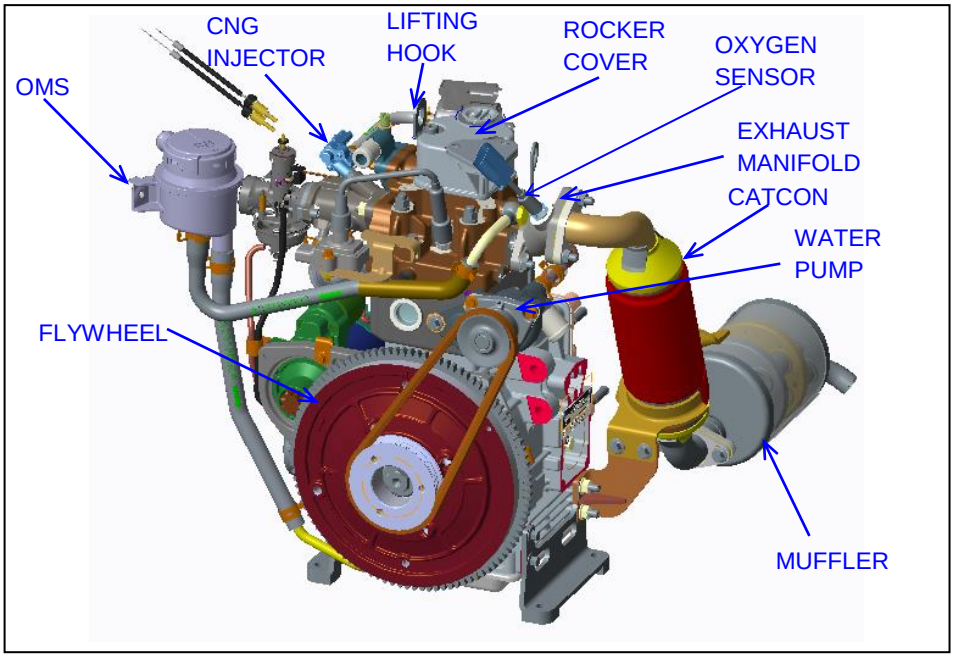
1. GENERAL INFORMATION

1.1 General Description of Engine:

Single Cylinder, 4-stroke, Naturally Aspirated (NA), Water cooled, electronically controlled CNG injection engine complying BSVI emissions norms.



PTO Side



Flywheel Side

1. 2 Safety and Warning details

1.2.1 These “safety alert symbols” are used throughout this manual & which itself warns personal injury. Read these instructions carefully.

1.2.2 It is essential that you read instructions & safety regulations before you attempt to repair or service the engine.

DANGER

Failure to comply with the instructions could result in damage to persons and property.

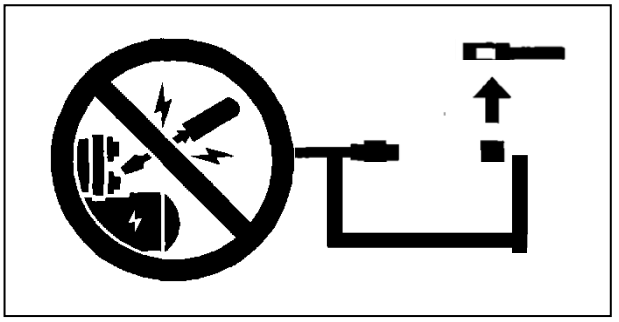
IMPORTANT

Failure to comply with the instructions could result in equipment of property damage

CAUTION

Failure to comply with the instructions could result in technical damage to machine &or system

1.3 Safety Instructions



1.3.1 Safe Starting:

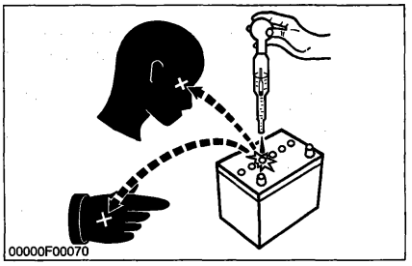
- Do not start the engine by shorting across starting terminals.
- Unauthorized modifications to the engine may impair the function or safety or affect engine life.

1.3.2 Safe Working :

- Wear apron and safety equipment appropriate to the job.
- Do not touch the rotating or hot parts while the engine is running.
- Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Only remove radiator cap when it is cool enough to touch with bare hands. Slowly loosen the cap to first stop to relieve pressure before removing completely.
- Escaping fluid (fuel or hydraulic oil) under pressure can penetrate into the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- Wear a suitable hearing protective device such as earplugs to protect against objectionable or uncomfortable loud noises.

1.3.3 Avoid Fire

- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- Make sure that no fuel has been spilled on the engine.



1.3.4 Ventilate Working Area:

- If the engine must be running to do some work, make sure the area is well ventilated.
- Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

1.3.5 Prevent Acid Burns:

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and cause blindness if splashed into eyes.
- Keep electrolyte away from eyes, hands and clothing. If you spill electrolyte on yourself, flush with water, and get medical attention immediately.

1.3.6 Dispose Fluids Properly:

- Do not pour fluids into the ground, down a drain, or into a stream, pond, or lake.
- Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, electrolyte and other harmful waste.

1.3.7 Prepare for Emergencies:

- Keep a first aid kit and fire extinguisher handy at all times.
- Keep emergency numbers of doctors, ambulance Service, hospital and fire department near your telephone.

1.4 Workshop Regulations

The user must read these instructions carefully & follow during servicing:

1. The engine must only be used or assembled on a machine by technicians who are adequately trained about its operation and the deriving dangers.
2. Make sure that the ground or floor on which the machine is standing has not soaked up any fuel or oil.
3. Before starting, remove any tools that were used to service the engine and/or machine. Make sure that all guards have been refitted.
4. During operation, the surface of the engine can become dangerously hot. Avoid touching the exhaust system in particular.
5. Before proceeding with any operation on the engine, stop it and allow it to cool.
6. Never carry out any operation whilst the engine is running.
7. The oil must be drained while the engine is hot (oil T ~ 80°C).
8. Particular care is required to prevent burns.
9. Do not allow the oil to come into contact with the skin.
10. The coolant fluid is polluting and must therefore be disposed of in the correct way to safeguard the environment.
11. To minimize your exposure to engine oil, wear a long sleeve shirt and moisture proof gloves when changing engine oil. If engine oil contacts your skin, wash thoroughly with running water and soap.
12. After servicing fuel, oil, coolant & exhaust system; check all lines related to the system for leaks.

1.5 Safety Precautions for Engine on Rotating Stand

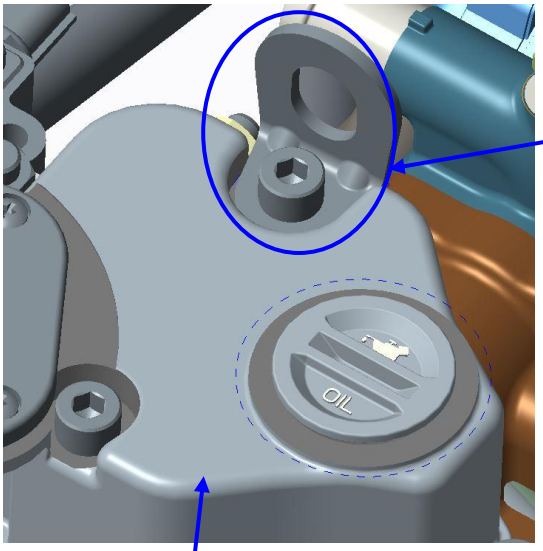
! Important

- Before removing the engine from the vehicle on which it is installed, disconnect the power supply;
- Detach the fuel and coolant supply, and all connections including the mechanical ones.
- Disconnect all electrical connections on engine, before engine removal from vehicle.
- Hook the lifting device in the engine lifting points, as shown in the figure.
- Close all engine openings accurately (exhaust, intake, etc.). Then wash the outside and dry with a jet of compressed air.
- Place the engine on a rotating stand to easily work on it.

1.6 Engine lifting hook

Important

- Lifting hook is designed to lift Engine only.
- They are not intended nor approved to lift additional weights.
- Do not use different methods to lift the engine than those described herein.
- In case different methods are used, no warranty shall be granted for any consequential damage.



1.6 Dos and Don'ts

Although it may not be necessary for owner of the "Greaves" Engine to make a close study of the engine designs, knowledge for how his engine works and what routine care is to be taken in maintaining the engine, the following "DO's" and "DO NOTs" will enable him to get the best out of the engine and to take timely action to avoid breakdowns.

DO

DO study "Maintenance instructions" in detail.

DO keep the engine room well ventilated.

DO USE ONLY GENUINE GREAVES LIGHT ENGINES SPARE PARTS.

DO use only proper tools to suit the job and avoid unnecessary dismantling.

DO keep all bolts and nuts tight.

DO check lubricating oil level in Crankcase periodically and replenish, if necessary.

DO change lubricating oil in accordance with schedule for maintenance.

DO replace fuel filter and lubricating oil filter in accordance with schedule for maintenance
DO attend immediately to fuel, coolant and lubrication oil leaks.

DO attend the engine for any unusual sound and carry out necessary repairs.

DO quote engine number when ordering spare parts.
DO read the workshop manual, if in doubt.
DO Start the vehicle with choke and hold for 16-20 seconds to maintain engine idle RPM in cold climatic conditions

DO NOT

DO NOT neglect the routine attention.

DO NOT repair any part when the engine is running

DO NOT unnecessarily interfere with any adjustment.

DO NOT attempt to start the engine unless the fault detected is rectified.

DO NOT allow the engine to idle for long periods.

DO NOT use any but approved brands/grades of lub oils & coolant

DO NOT load the engine beyond the rated output.

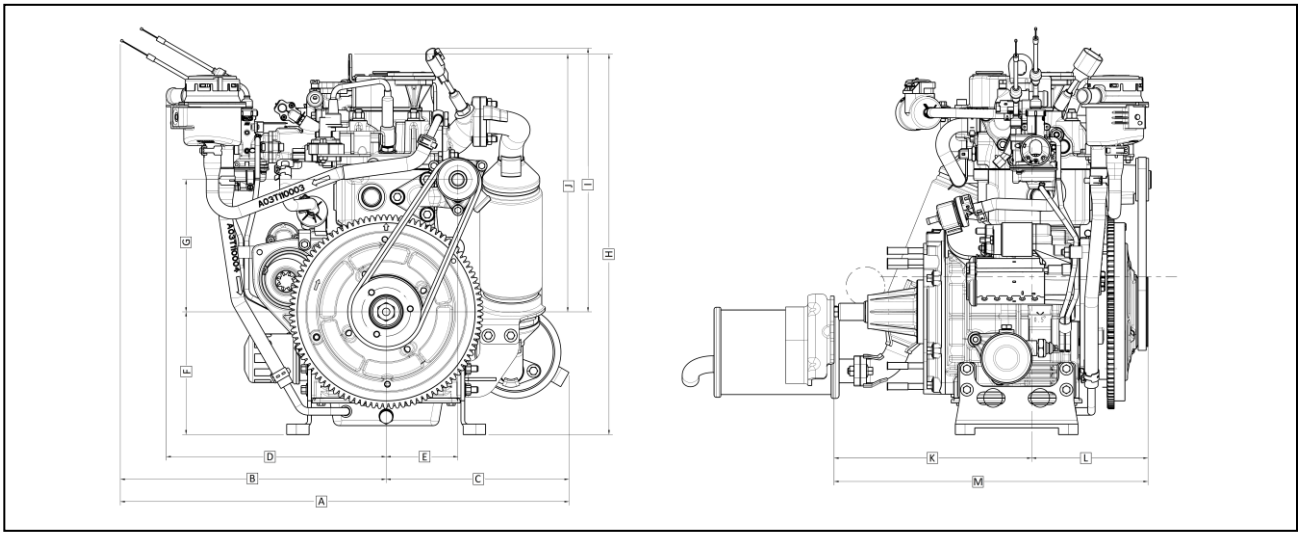
DO NOT guess. Contact us for additional information.

DO NOT operate starter motor for more than 10-15 seconds continuously.

DO NOT increase the engine speed above 4000 rpm as the engine will misfire due to Spark Cut-Off
DO NOT hammer the flywheel during disassembly

2. TECHNICAL INFORMATION

2.1 Technical Information.



DIMENSIONS (mm)									
A	599.8	**D**	294	**G**	176.7	**J**	344.5	**M**	419.6
B	355.4	**E**	96	**H**	508.5	**K**	264.1		
C	244.5	**F**	164	**I**	352.4	**L**	155.5		

GENERAL INFORMATION		
Model	G 400 W VI	
Type	Water cooled, Naturally Aspirated, Electronically controlled Port Injection CNG/LPG Engine.	
Cylinders	Nos.	1
Bore x stroke	mm x mm	86X68
Displacement	Cc	396
Compression ratio	9.5 : 1	
Crankshaft rotation	Anticlockwise viewed from GEAR END(PTO)COVER side	
Injection	CNG/LPG Injection	
Engine dry weight with alternator & without starter motor.	Kg	~47 kg
Installation	Vertical	

POWER AND TORQUE		
Power	HP	9.5+/-5% @ 3400rpm
Maximum torque	N-m	22.5+/-5% @ 1800-2200rpm

LUBRICATION CIRCUIT	
Engine oil capacity (With oil filter)	1.450 ±50 ml (Top up:1.4 L, In oil filter: 50-70 ml))
Oil Filter	Spin-on full flow type

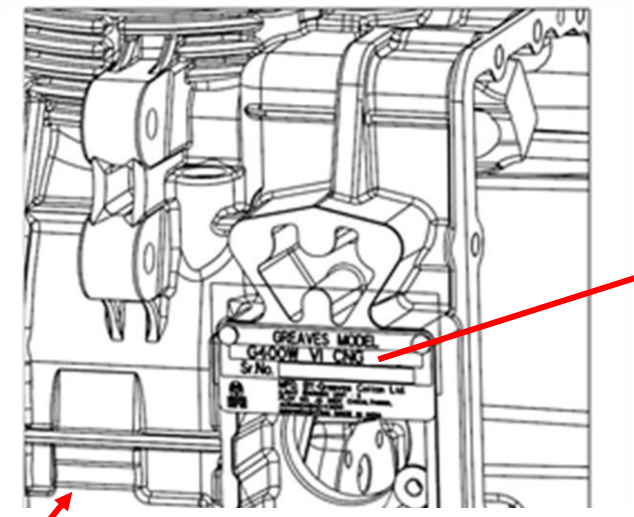
2.2 Recommended Fuel, Lube Oil and Coolant details

Fuel Supply Details	
Fuel type	BSVI Bifuel-CNG + Petrol Use commercial CNG and Petrol
Electric Feed pump	Make: Pricol
Fuel filter	CNG Filter Make: Advantek Petrol Filter Make: Lub Oil filtration systems
Coolant Details	
Coolant	60% decalcified water - 40% anti-freeze Ethylene glycol coolant
Water pump	Suction type mounted on engine block, driven by 3pk belt
Lube Oil Details	
Lube Oil Details	GEO 15W50 API SL & above grade Caution: - To avoid adverse effect on engine performance, do not use adulterated & adulterated engine oil. Important: Use of oil other than our recommended oil will make our warranty null and void.

2.3 Features of Engine

- Electronically controlled fuel injection system.
- BS VI emissions & OBD-I compliance.
- Cast Iron Cylinder Head & Aluminum Crankcase
- Individual crankcase & cylinder barrel.
- Push rod type valve actuating mechanism.
- Cast iron Cylinder barrel with Integral Liner.
- Belt driven water pump.
- Installation on vehicle:- Vertical
- Crankshaft rotation: - Anticlockwise viewed from drive side (PTO side)

2.4 Engine Identification Information



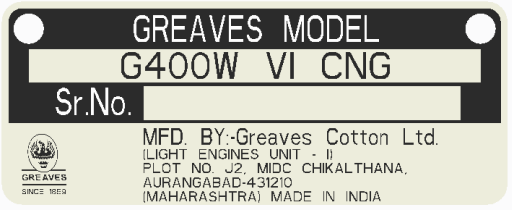
Engine Name Plate Location on Engine: The Engine Number plate is fitted on the Crankcase Governor support assembly.

Engine Name Plate: Engine number plate includes engine model, engine number, engine details and company details. There are two different number plates for CNG and LPG variants.

Engine Serial number location on crankcase: The serial number is punched on the Engine number Plate and on the crankcase & close to PTO side.

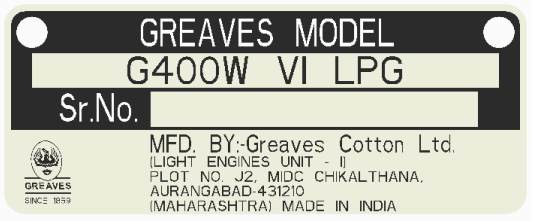
2.4.1 Name Plate for CNG BOM

:BOM No. A03A000002



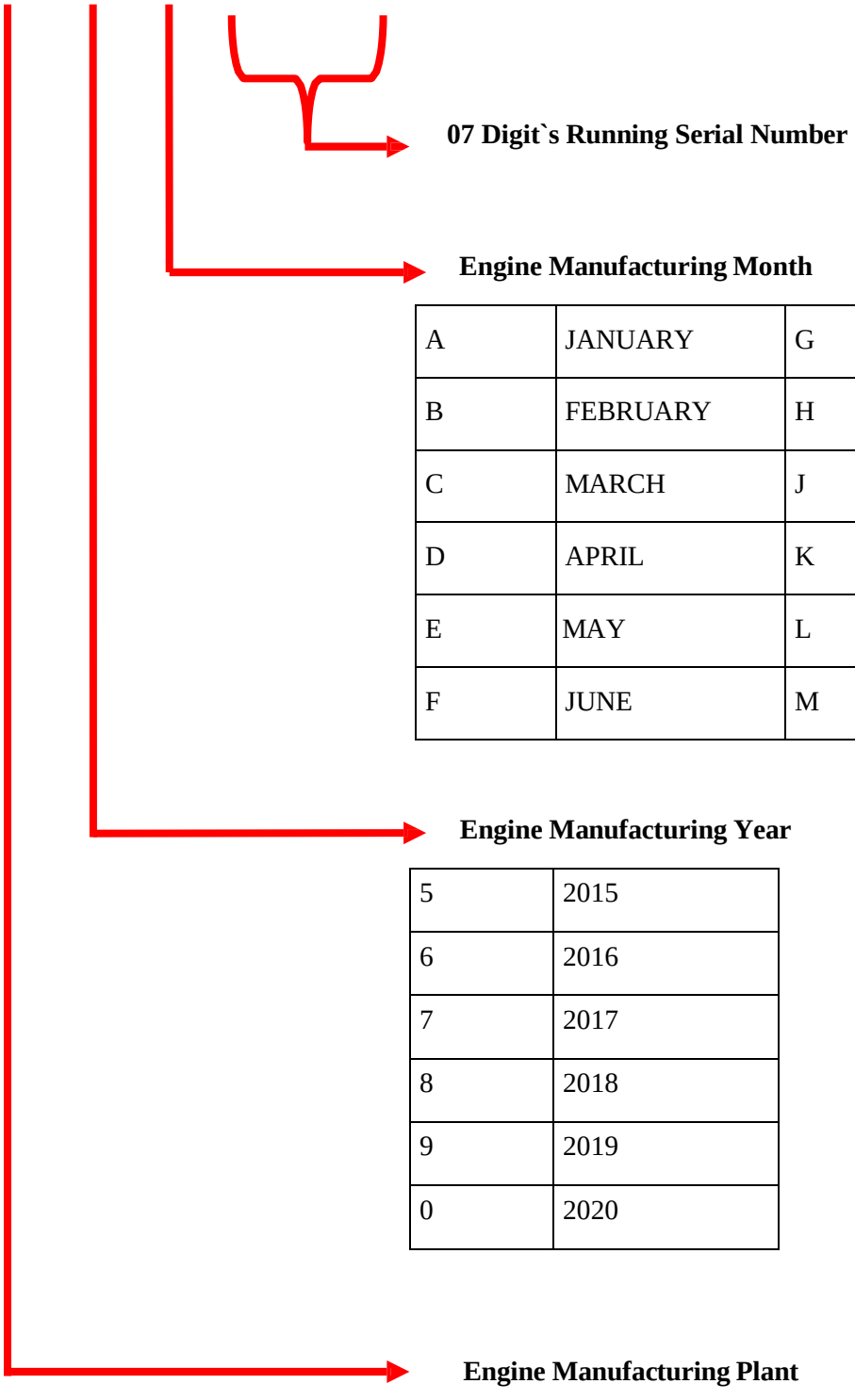
2.4.2 Name Plate for LPG BOM

: BOM no. A03A000006



2.5 Engine Numbering System

A 9 H 1339057 (Total 10 Digits number)



07 Digit`s Running Serial Number

Engine Manufacturing Month

A	JANUARY	G	JULY
B	FEBRUARY	H	AUGUST
C	MARCH	J	SEPTEMBER
D	APRIL	K	OCTOBER
E	MAY	L	NOVEMBER
F	JUNE	M	DECEMBER

Engine Manufacturing Year

5	2015
6	2016
7	2017
8	2018
9	2019
0	2020

Engine Manufacturing Plant

A	**Aurangabad (LEU-I)**
S	**Shendra (LEU-V)**

3. SCHEDULE FOR MAINTENANCE, ADJUSTMENT AND REPAIR

Periodic Maintenance Schedule										
Sr. No.	Items	Kilometer Run								
		Operation	1000	5000	10000	15000	20000	25000	30000	40000
1	AIR FILTER CARTRIDGE	CL			●				●	
		R					●			●
2	ENGINE OIL GEO 15W50 API SL & ABOVE	R	●		●		●		●	●
3	LUB OIL FILTER	R	●		●		●		●	●
4	PETROL FUEL FILTER	R	●		●		●		●	●
5	CNG FILTER LPG FILTER	R			●					●
		R	●		●		●		●	●
6	TAPPET CLEARANCE	C , A	●		●		●		●	●
7	SPARK PLUG	R					●			●
8	CARBURETOR / IDLE SPEED / CO% & HC	CL, C, A			●		●		●	●
9	EXHAUST SYSTEM TORQUE	C, T			●		●		●	●
10	BELT	R	To be replaced at every 50000km or Belt frequency less than 154 Hz, Whichever is earlier.							

In partial overhaul after 50,000kms; all rubber components, joints, Gaskets, Con rod LE Bearing Kit should be replaced. Check & replace (if required) cylinder barrel, piston, piston rings, valve guides, valves, valve springs and seat insert. Do complete engine over-haul at 100,000 km.

NOTE: Check oil level at every 2500km and top up if required.
For Odometer readings > 40000km, repeat the above maintenance frequency interval.

A: ADJUST, C: CHECK
CL: CLEAN, T: TIGHTEN, R: REPLACE

4. Trouble Shooting & Diagnosis

4.1 Mechanical Failures Troubleshooting:

Fault	Causes	Suggested Remedy
1. Engine Fails to Start		
a. Faulty Fuel Supply	a. No fuel in tank b. Obstructed fuel lines c. Fuel filter clogged. d. Air in fuel system. e. Fuel feed pump erratic behavior. f. 1. Carburetor clogged 2. Carburetor over flow	a. Fill tank with clean petrol. b. Flush out the pipes and tighten the connections. c. Replace the fuel filter. d. Bleed out air. e. Check fuel feed pump operation. Replace if required. f.1.Check & clean carburetor 2. Adjust float.
b. Poor Compression	a. Tappet clearance improper b. Valve sticking. c. Cylinder head loose. d. Piston rings stuck in the grooves. e. Worn cylinder liner & piston. f. Valve not sealing properly. g. Spark Plug loose	a. Set tappet clearance b. Free the valves by slight hammering on valve spring. c. Tighten all nuts to specified torque. d. Check rings; clean the piston & replace if necessary. e. Replace barrel & piston assembly f. 1. Lap the valves if necessary. 2. Check tappet clearance & adjust if required. g. Tighten to required torque.
c. Faulty Electrical System	a. Discharged battery. b. Cable connections loose & incorrect. c. Faulty starting switch. d. Faulty starter motor.	a. Check battery & rectify or replace if required. b. Check, correct & tighten. c. Replace. d. check, repair & replace if required.
2. Engine starts but runs irregularly		
1. Faulty Fuel Supply	a. Air in the fuel line. b. Fuel filter clogged. c. Clogged tank vent hole in the cap. d. Water in the fuel tank.	a. Bleed out air b. Replace fuel filter. c. Clean. d. Drain the fuel tank and fill clean fuel.
2. Faulty Compression	a. Broken valve springs, valve sticking. b. Valve sticking / leaking c. Piston ring stuck or worn d. Spark Plug loose	a. Change the spring. b. Free the valves & lap if necessary c. Checks & change piston rings, replace barrel piston assembly if required. d. Tighten to required torque.

Fault	Causes	Suggested Remedy
3. Poor acceleration		
a. Faulty Fuel Supply	Carburetor clogged	Clean the carburetor
b. Faulty air intake System	Air filter clogged	Clean air filter element. Replace if required.
c. Faulty Operation	Vehicle Overloaded.	Check and reduce the load.
4.Unsteady speed/misfiring		
a. Faulty Spark Plug b. Faulty timing c. Improper combustion	a. Incorrect Spark plug gap b. Incorrect spark timing c. Air fuel mixture not correct	a. Check gap, replace spark plug if required b. Check & confirm. c. Clean air filter element & carburetor.
5. Low lub. oil pressure		
Faulty Lubrication	a. Oil pressure relief valve sticking or not properly adjusted. b. Worn oil pump c. Faulty pressure gauge	a. Check the spring and change if necessary. b. Replace c. Replace
6. Excessive lube oil consumption		
a. Faulty lub oil system	a. Leakages b. Oil level in sump too high. c. Usages of un-recommended oil	a. Find leakages and replace faulty parts with new one b. Drain out excess oil c. Use recommended oil
b. Faulty air intake system	Barrel, piston & piston rings wear due to unfiltered air leakage into the engine.	Ensure there is no leakage in the air intake system between air filter & engine
c. In-correct Setting	Excessive clearance in the bearings	Check and replace bearings, if required.
d. Faulty Breather system	OMS malfunctioning	Check Hose Connections Clean / Replace if required
e. Repairs	a. Worn or sticking oil control ring. b. Badly worn cylinder c. Valve guide worn out d. Damaged valve stem seal	a. Check & replace b. Check & replace c. Check & Replace d. Check & replace

Trouble Shooting (Cont.....)

Fault	Causes	Suggested Remedy
7. Overheating		
a. Engine cooling Hampered	a. Lack of coolant or cooling system not properly vented b. Defective Switch c. Coolant leak d. Water pump faulty e. '3pk' belt torn/excessively loose.	a. Add coolant and bleed the system b. Check & replace, if required. c. Tight all upper connections d. Replace water pump e. Replace
b. Inefficient combustion.	a. Valve clearance incorrect. b. Ignition timing incorrect	a. Readjust b. Check & confirm
c. Lubricating system problems.	a. Insufficient lub oil in the engine sump. b. Lub oil filter clogged. c. Lub oil pump worn out. d. Incorrect grade of lub oil used. e. Pressure relief valve sticky or worn out. f. Oil pressure switch faulty	a. Replenish with recommended lub oil b. Replace. c. Check and replace. d. Drain and fill correct grade of oil. e. Replace / rectify. f. Check and replace
d. Operating conditions and others	a. Clutch slipping, plates worn out. b. Brake setting improper / wheels jam. c. Vehicle overloaded. d. Air fuel mixture not correct	a. Adjust / replace clutch plates. b. Reset c. Reduce load. d. Clean air filter element & carburetor.
8.High fuel consumption		
a. Fuel system.	a. Fuel leakage. b. Poor quality fuel. c. Spark ignition timing incorrect. d. Air Filter Chocked.	a. Rectify leakage. b. Drain fuel tank and refill with clean petrol c. Check & confirm. d. Clean air filter element. Replace if required.
b. Lack of proper maintenance.	a. Valve clearance incorrect, valve sticky.	a. Rectify and readjust.
c. Mechanical adjustments.	a. Broken or worn piston rings. b. Excessive clearance in the bearings. c. Worn or scored barrel / piston assly.	a. Replace b. Replace bearing using u/s main and con rod bearing. c. Replace barrel & piston assembly.
d. Operating conditions and others	a. Clutch slipping, plates worn out. b. Brake setting improper / wheels jam. c. Vehicle overloaded. d. Air fuel mixture not correct	a. Adjust / replace clutch plates. b. Reset c. Reduce load. d. Clean air filter element & carburetor.

Fault	Causes	Suggested Remedy
9. Abnormal Lub Oil Pressure		
a. Faulty lub Oil system.	a. Restriction in the lub oil suction line of the pump b. Faulty lub oil pressure regulator (Relief Valve). c. Oil level in the sump too low. d. Wrong grade lub oil of low viscosity	a. Rectify. b. Check relief valve spring tension. Replace, if required. c. Fill in lub oil to correct level. d. Use proper grade lub oil.
b. Operation.	a. Engine overheated due to over loading. b. Lub oil needs changing.	a. Avoid overloading. b. Change lub oil.
c. Mechanical adjustment.	a. Excessive bearing clearances. b. Engine due for overhaul. c. Worn lub oil pump. d. Faulty oil pressure switch.	a. Check and rectify. b. Overhaul the engine. c. Replace. d. Replace.
10. Unusual Noise		
a. Mechanical faults.	a. Worn or loose gudgeon pin bush (Sharp rap at idling speed). b. Con rod bearings worn or loose. (Metallic knocks especially during idling speed and de-accelerating, but disappearing when engine is under load). c. Main bearing loose/worn (heavy metallic knock when engine is accelerating under load.) d. Valve clearances excessive. e. piston rings sticky/seized barrel piston worn out.	a. Replace. b. Replace. c. Replace. d. Readjust. e. Get engine overhauled
b. Mechanical adjustments or repairs.	a. Bumping clearance on lower side. b. Air Filter Chocked. c. Engine overheating. d. Excessive carbon deposits in combustion chamber.	a. Readjust. b. Clean air filter element. Replace if required. c. Reduce load. d. De-carbonize.

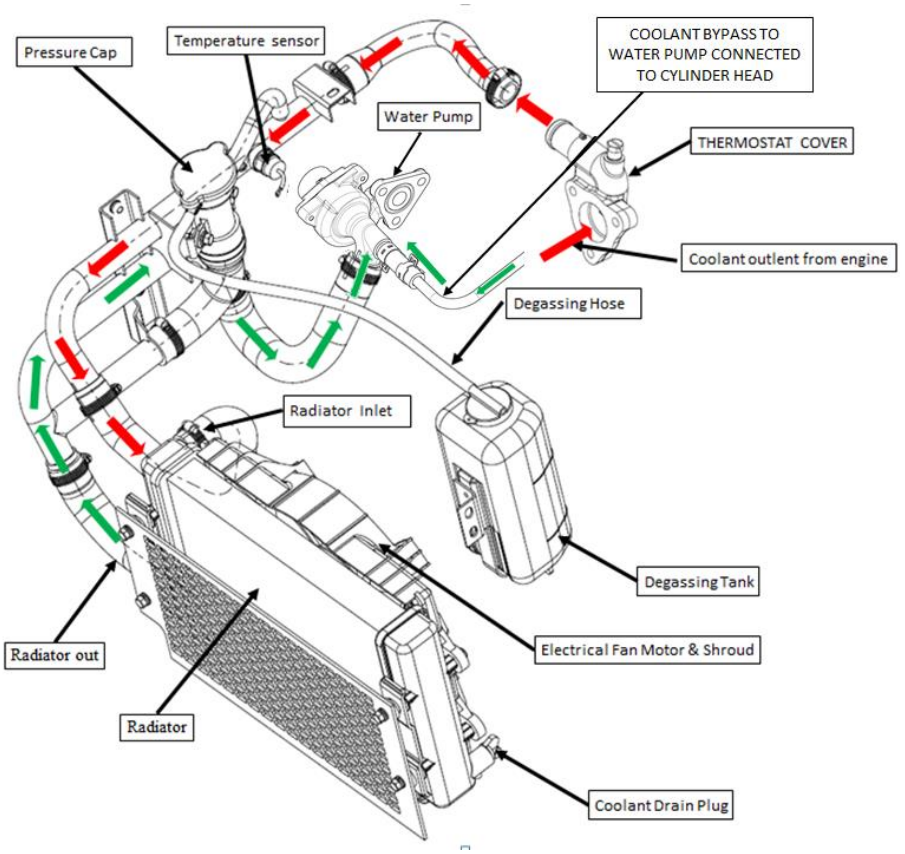
4.2 Electrical / electronic components failure diagnostics trouble codes

Sr. No.	Component	Fault Code	Monitor Strategy	Secondary Parameter	MI Illumination
1	Fuel Injector	P0261	Fuel injector open circuit and short to ground	Engine Started	Immediate
		P0262	Fuel injector signal short to supply	Engine Started	Immediate
2	Ignition coil Primary	P2300	Ignition coil open circuit and short to ground	Engine Started	Immediate
		P2301	Ignition coil signal short to supply	Engine Started	Immediate
3	Manifold Absolute pressure sensor(MAP)	P0107	MAP sensor open circuit and short to ground	Ignition ON	After 2 driving cycle
		P0108	MAP sensor signal short to supply	Ignition ON	After 2 driving cycle
4	Intake air temperature sensor (IAT)	P0113	Intake air temperature sensor open circuit and short to supply	Ignition ON	After 2 driving cycle
		P0112	Intake air temperature sensor signal short to ground	Ignition ON	After 2 driving cycle
5	Throttle position sensor (TPS)	P2122	Throttle position sensor input open circuit and short to ground	Ignition ON	Immediate
		P2123	Throttle position sensor input signal short to supply	Ignition ON	Immediate
6	O2 sensor	P0131	O2 sensor input signal short to ground	Engine Started	After 2 driving cycle

		P0132	O2 sensor input signal short to supply	Engine Started	After 2 driving cycle
		P0134	O2 sensor input signal open circuit	Ignition ON & Engine started	After 2 driving cycle
		P0031	O2 sensor heater open circuit and short to ground	Ignition ON & Engine started	After 2 driving cycle
		P0032	O2 sensor heater signal short to supply	Ignition ON & Engine started	After 2 driving cycle
7	Crank position sensor	P0335	Crank position sensor signal	Engine Started	Immediate
8	Coolant Temperature Sensor	P0118	Engine temperature sensor open circuit and short to supply	Ignition ON	Immediate
		P0117	Engine temperature sensor signal short to ground	Ignition ON	Immediate
9	Fuel rail Pressure Sensor	P0192	Fuel Rail Pressure Sensor short to ground and open circuit	Ignition ON	After 2 driving cycle
		P0193	Fuel Rail Pressure Sensor signal short to supply	Ignition ON	After 2 driving cycle
10	Fuel rail Temperature sensor	P0183	Fuel temperature sensor open circuit and short to supply	Ignition ON	After 2 driving cycle
		P0182	Fuel temperature sensor signal short to ground	Ignition ON	After 2 driving cycle
11	Gas Solenoid	P0006	Fuel solenoid signal line short to ground and open Circuit	Ignition ON	Immediate
		P0007	Fuel solenoid signal line short to supply	Ignition ON & Engine started	Immediate

12	Engine Temperature Sensor(overheat)	P0217	Engine Temperature Sensor Signal	Ignition ON & Engine started	Immediate
13	Fuel Rail pressure	P0087	Rail pressure too low	Engine Started	After 2 driving cycle

5. COOLANT CIRCUIT



The cooling system consists of following components:

1) Radiator
2) Degassing Tank
3) Electrical Fan Motor & Shroud
4) Hot coolant outlet routing
5) Radiator Inlet
6) Degassing Tank (Air vent Inlet)
7) Degassing Hose
8) Radiator out and water pump inlet routing
9) Water Pump
10) Temperature sensor
11) Pressure Cap
12) Coolant Drain Plug

Function:

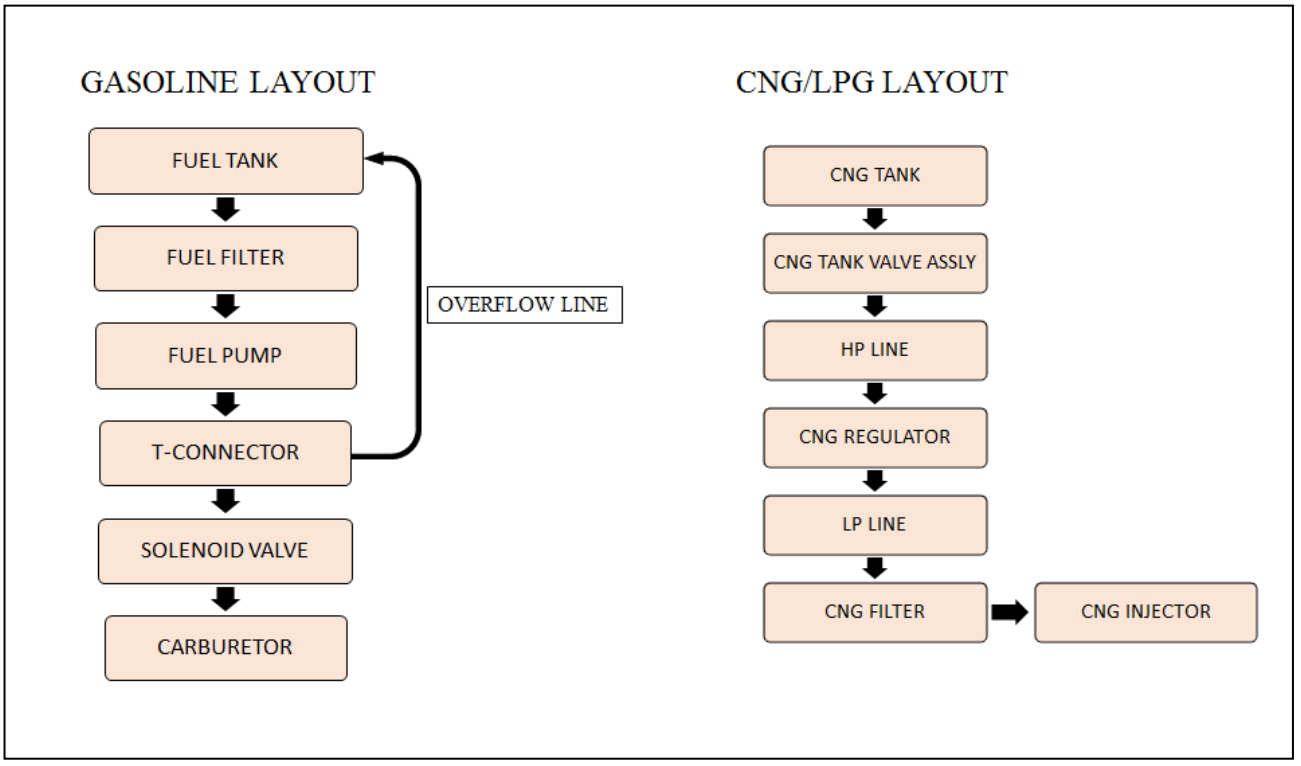
The cooling system quickly increases the temperature of a cold engine, removes excess heat from the engine and maintains constant engine operating temperature. Thermostat allows engine to heat up quickly which starts to open at temperature around 72◦ and fully opens at 80◦. The 0.9bar pressure cap raises the boiling point of coolant up to 110deg C. A 40:60 mixture of antifreeze and water protects the cooling system to sustain -5 deg C against freezing. Coolant is forced through the engine and other above mentioned system parts by the water pump. The radiator transfers engine coolant heat to outside air. Temperature sensor gives signal to ECU which controls Fan ON/OFF operation (84deg C is ON and 78deg C OFF). The fan draws air through the radiator. The degassing tank releases the entrapped air and gasses from the coolant to improve the cooling performance.

Note:

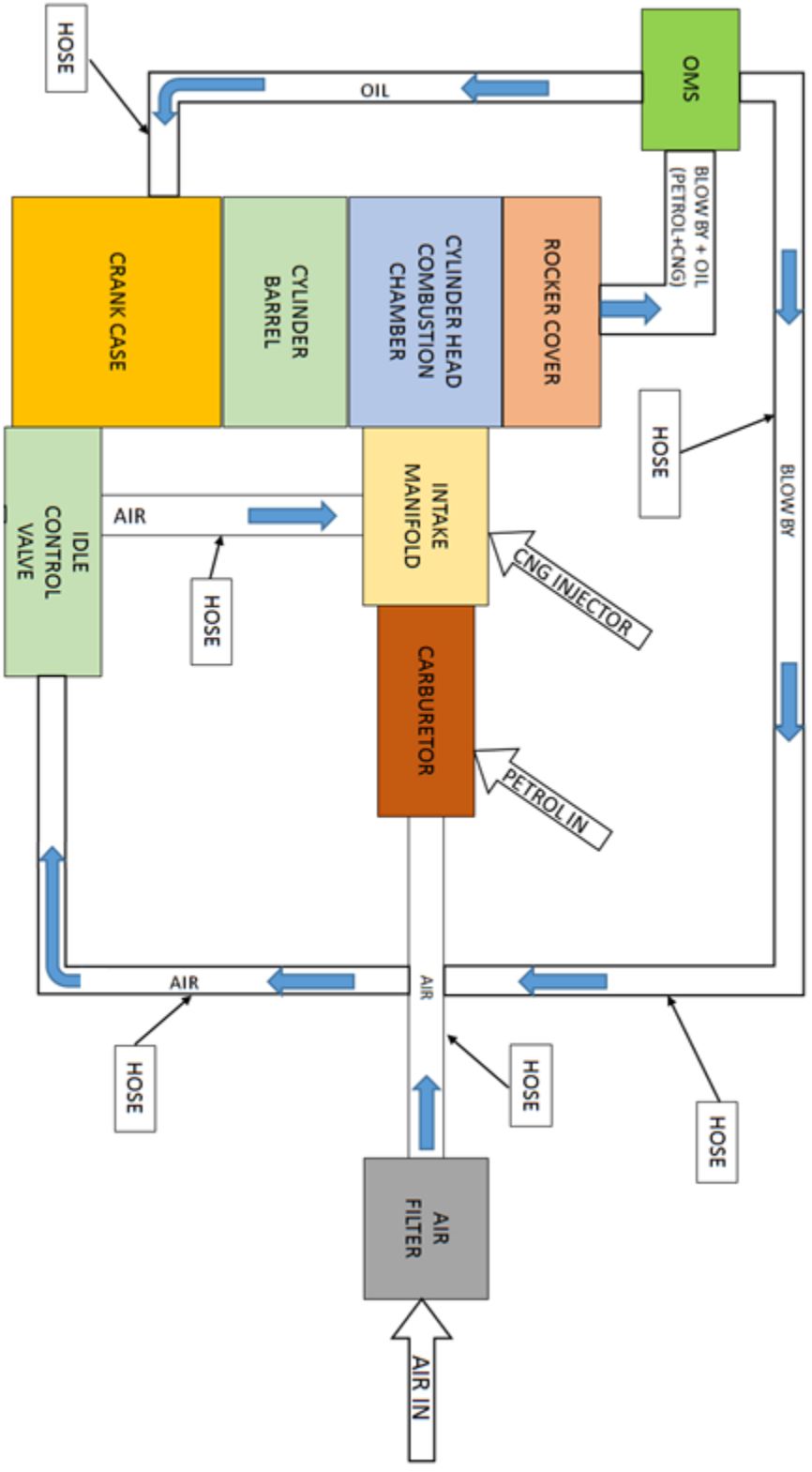
1) Ensure that hose clamps are intact, hoses are not torn & there is no coolant leakage.
2) Use only recommended coolant.
3) Temperature sensor should be installed on cylinder head to sense coolant temperature which can be displayed on temperature gauge on dash board which controls the fan ON/OFF operation.
4) Supply of above accessories depends upon the application & agreement.
5) Don’t open the pressure cap in hot condition.

6. FUEL SYSTEM

6.1 High & Low pressure fuel line layout:



7. OMS & AIR LAYOUT

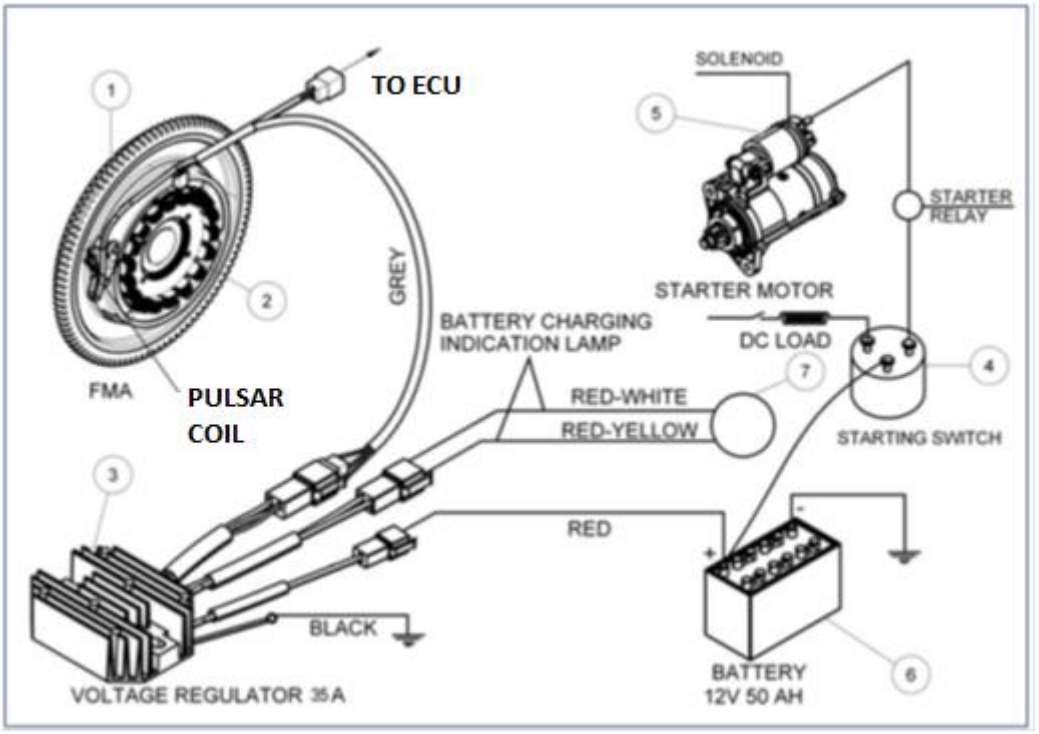


8. ELECTRICAL SYSTEM AND PERIPHERAL COMPONENTS

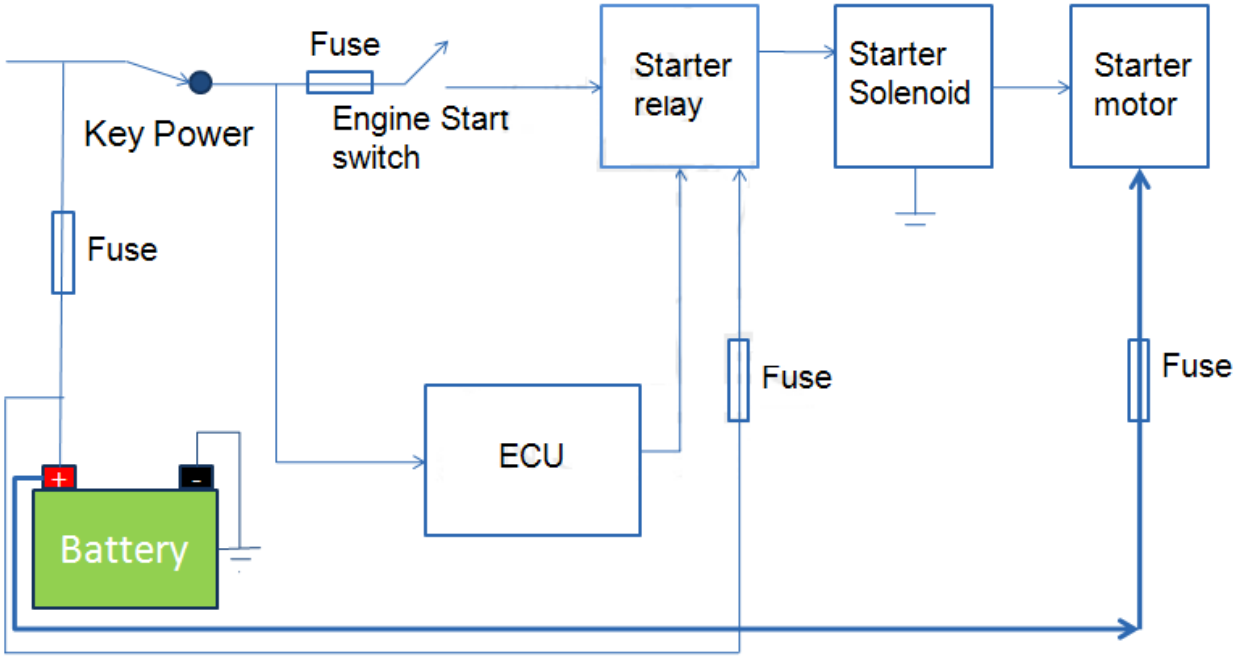
8.1. Battery Charging and 2D schematic:

Below figure includes Electrical wiring diagram of battery charging and 2D schematic explained as below:

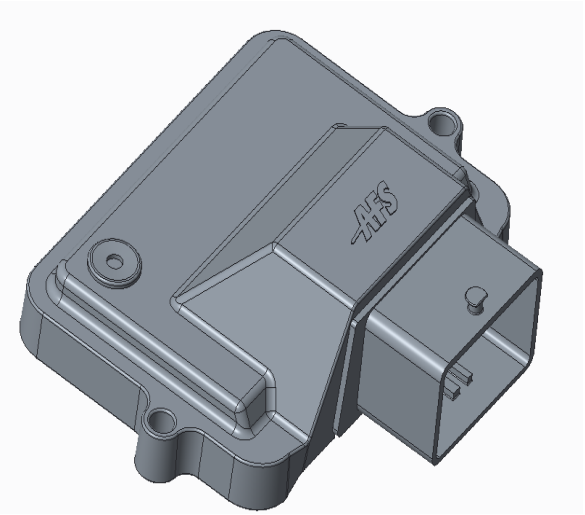
1. Flywheel Assembly with magnets
2. Stator Assembly
3. Voltage Regulator / Rectifier (3 phase)
4. Starting Switch
5. Starter Motor
6. 12V Battery

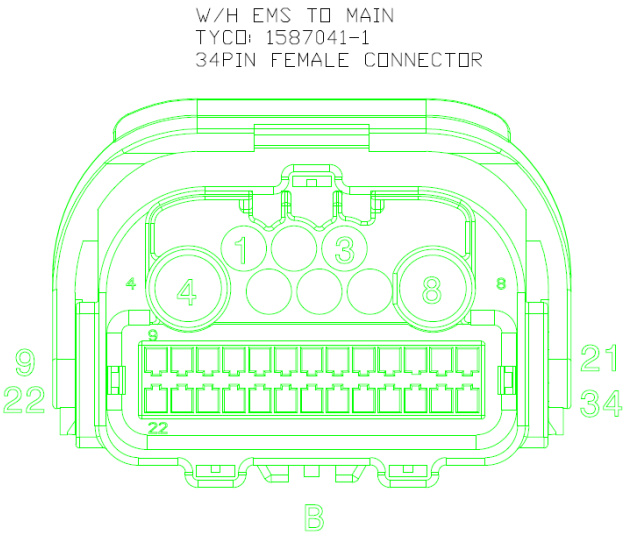


8.2. Starting system



8.3. Engine control unit (ECU)





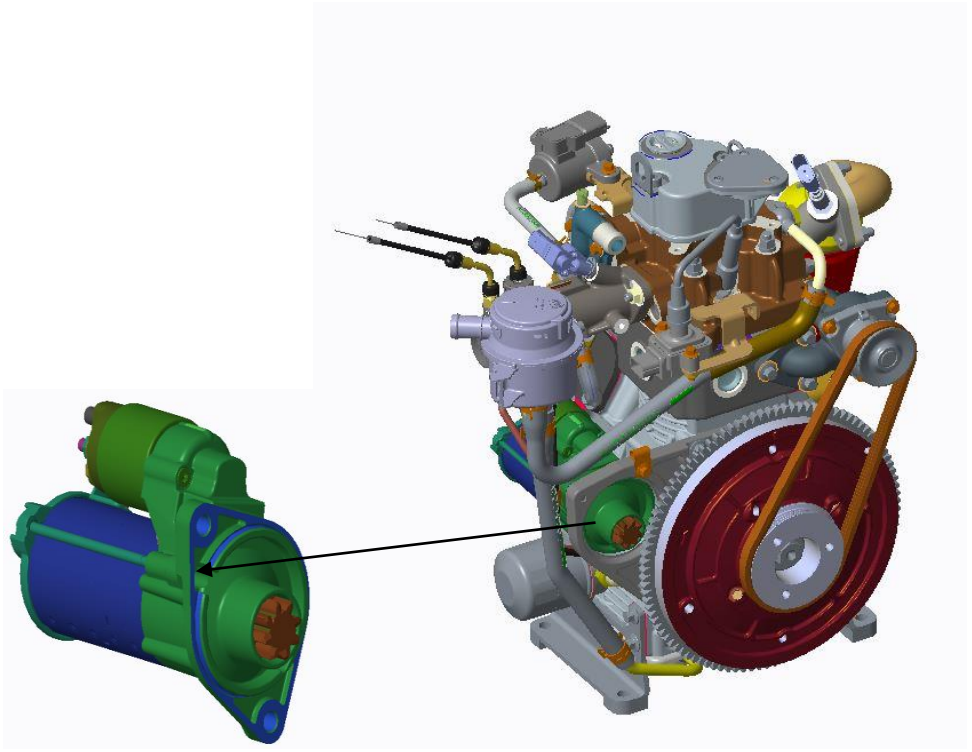
Key features:

- 32bits high performance micro-controller
- 1.5M Flash memory
- Fulfill EUIV emission standard, EOBD function
- 48 Pins platform design can guarantee future expanded functions with two CAN and One K Line diagnostics
- Fulfill IP67 protection level
- Voltage range: 9 ~ 16 V

DESCRIPTION	CAV	NO.	SPEC	COLOUR	OPTION	CAVITY	NO	SPEC	COLOUR	OPTION	DESCRIPTION
TO ECU 2L	1	13A	1.50	R/Y		18	25A	1.50	BR		TO IGN COIL PIN 3
TO MAIN RLY CONTACT	2	19A	1.50	R/W		19	22A	0.75	BR/W		TO ECU 3F
	3					20	23A	0.75	O/W		TO ECU 2A
	4					21	24A	0.75	W/R		TO ECU 4B
	5					22	1A	0.50	LG/P		TO ECU 2C
	6					23	2A	0.75	W		TO ECU 1G
	7					24	3A	0.75	G/B		TO ECU 4C
	8					25	4A	0.50	GR		TO ECU 1D
TO ECU 1L	9	9A	0.75	G/L		26	5A	0.50	B		TO ECU 2D
	10					27	6A	0.50	G/P		TO ECU 2B
	11					28	7A	0.75	O/L		TO ECU 1B
	12					29	8A	0.75	R/W		TO ECU 3C
TO IGN FUSE	13	21A	1.50	Y/B		30	26A	0.75	G/R		TO ECU 3G
TO ECU 3L	14	14A	1.50	G/Y		31	18A	0.75	L/W		TO ECU 4H
TO INST CLUSTER (OPS)	15	15A	1.00	B/L		32	27A	0.75	W/L		TO ECU 4D
TO ECU 2G	16	16A	0.75	P/B		33					
TO ECU 3E	17	17A	0.75	R/G		34					

8.4. Starter motor

- Make: Bosch
- Power: 1 kW



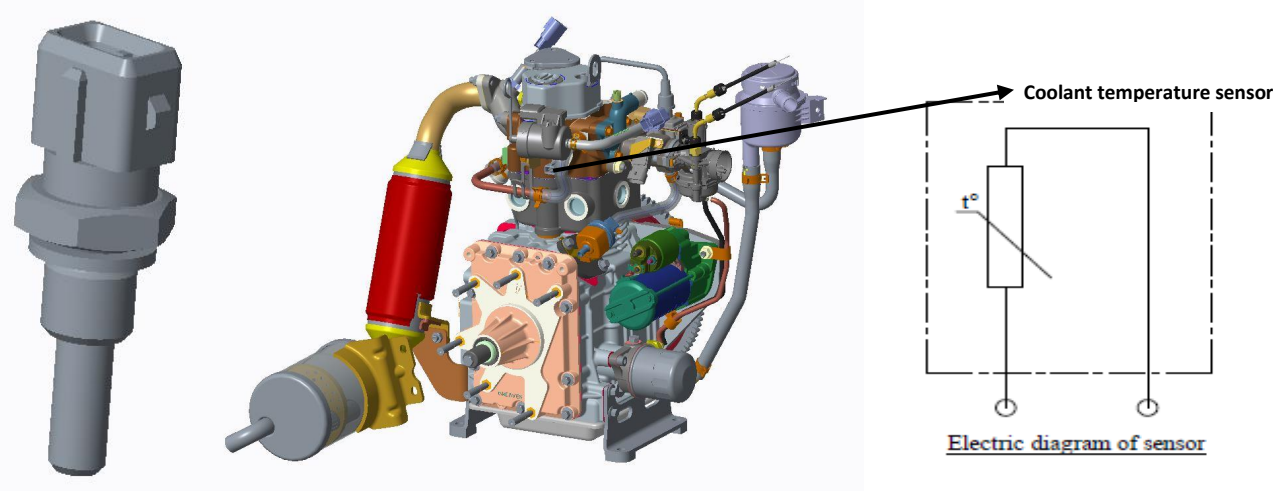
8.4.1. Starter Function

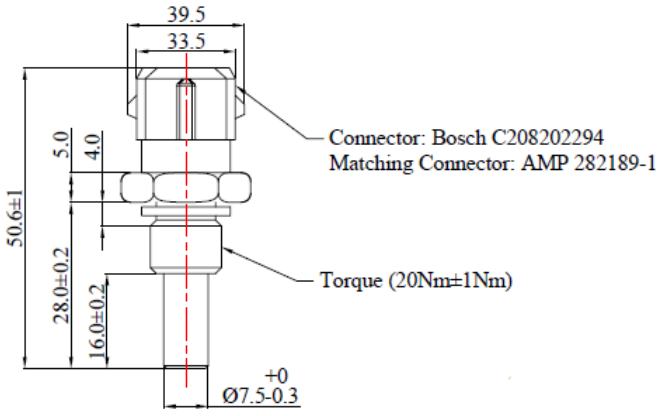
The behavior of Starter motor is as per below logic:

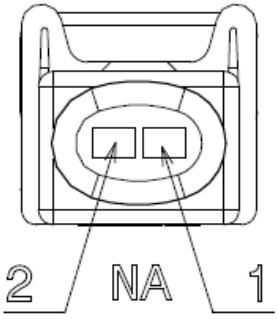
1. False cranking: No crank when engine running condition (RPM > 700).
2. Prolonged cranking: Max. 10 seconds, no crank when no demand.
3. Successive cranking: 4 seconds between two consecutive cranks.
4. Protection from abuse by Driver: No successive crank before stopping the flywheel rotation.
5. Cranking cutoff RPM: 700 RPM.
6. Quick crank: No delay for first crank.
7. Maximum continuous allowable crank: 3 Times. (To restart cranking use Ignition key to OFF and ON).
8. Cut off cranking time if the Engine does not rotate after start: 2 Sec.

8.5. Coolant temperature sensor

Coolant Temperature Sensor is used to monitor/measure the engine out coolant temperature. It is mounted on cylinder head.



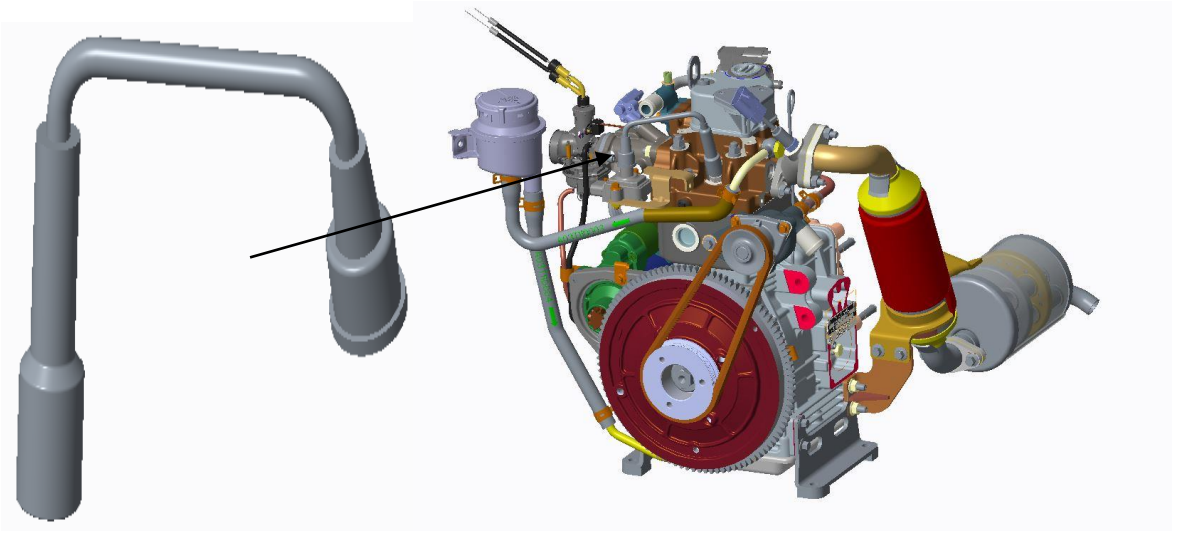


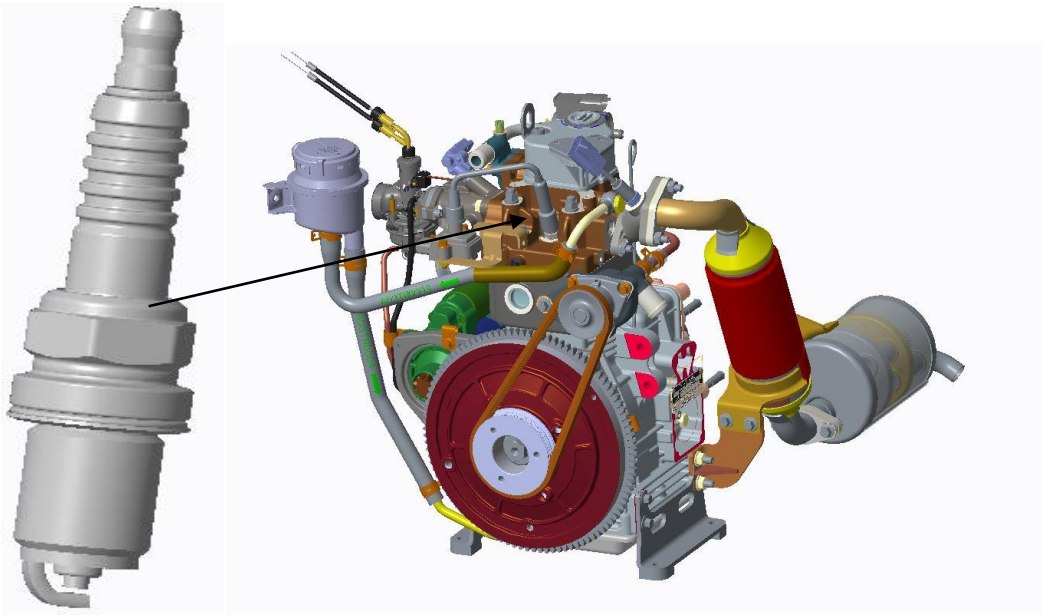


CAV	NO.	SPEC	COLOUR	OPTION
1	1A	0.50	LG/P	
2	16D	0.50	P/B	

8.6. HT Cable and Spark Plug

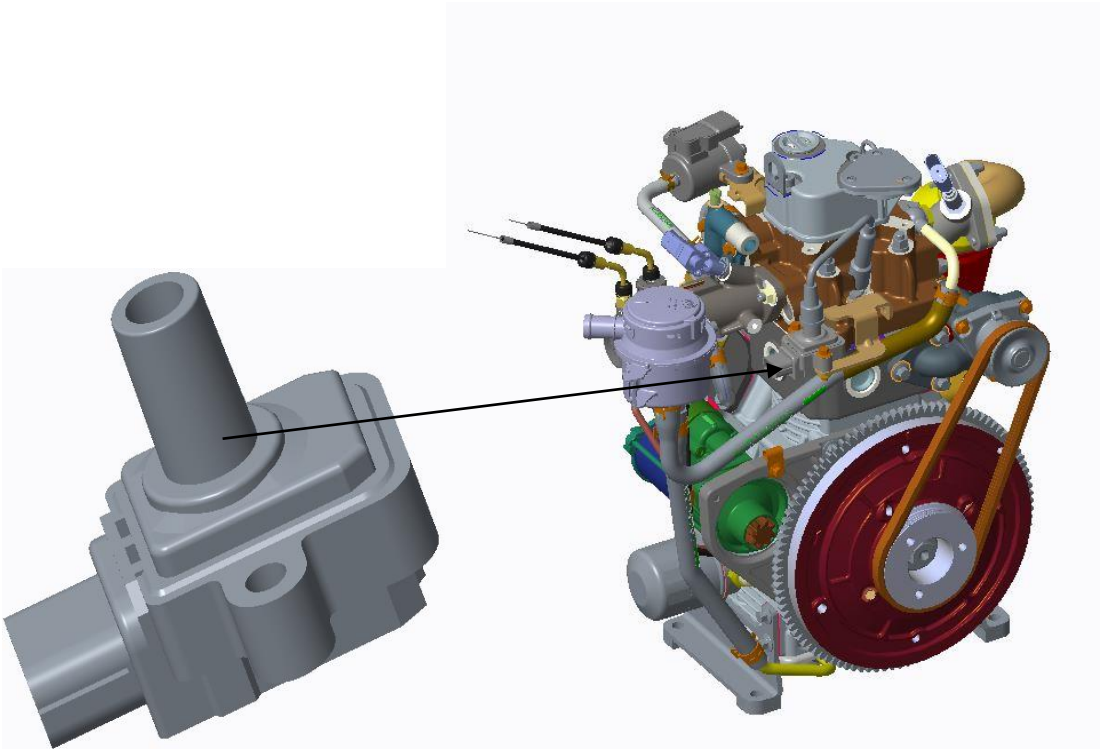
HT cable carries high voltage generated by Ignition coil to spark plug

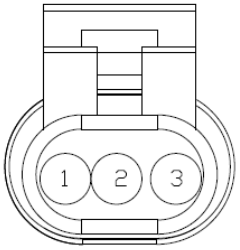




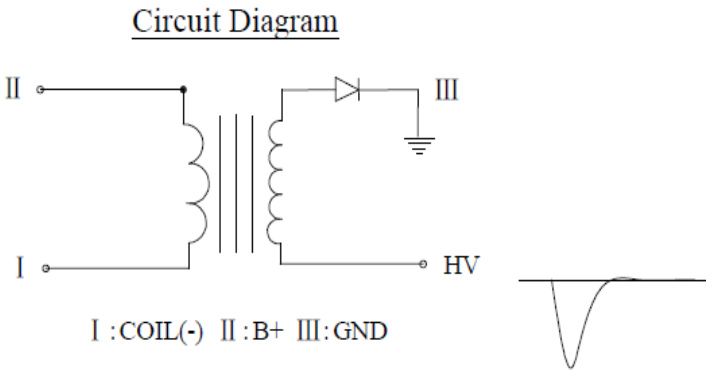
Spark plug generates high voltage spark in combustion chamber to ignite the fuel.

8.7. Ignition coil



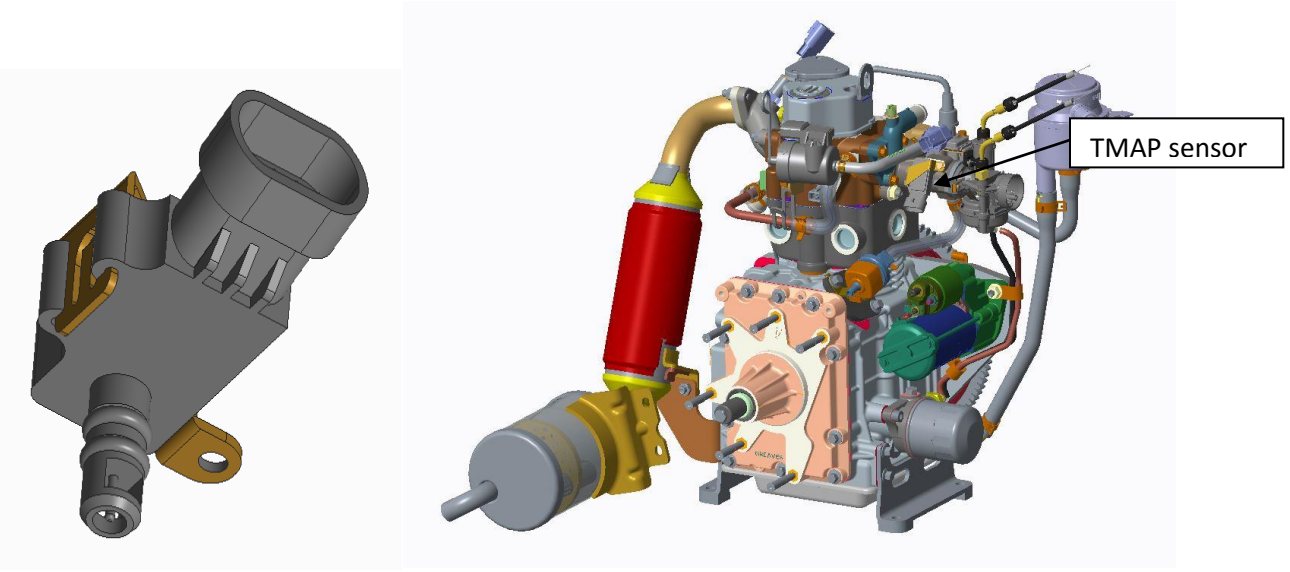


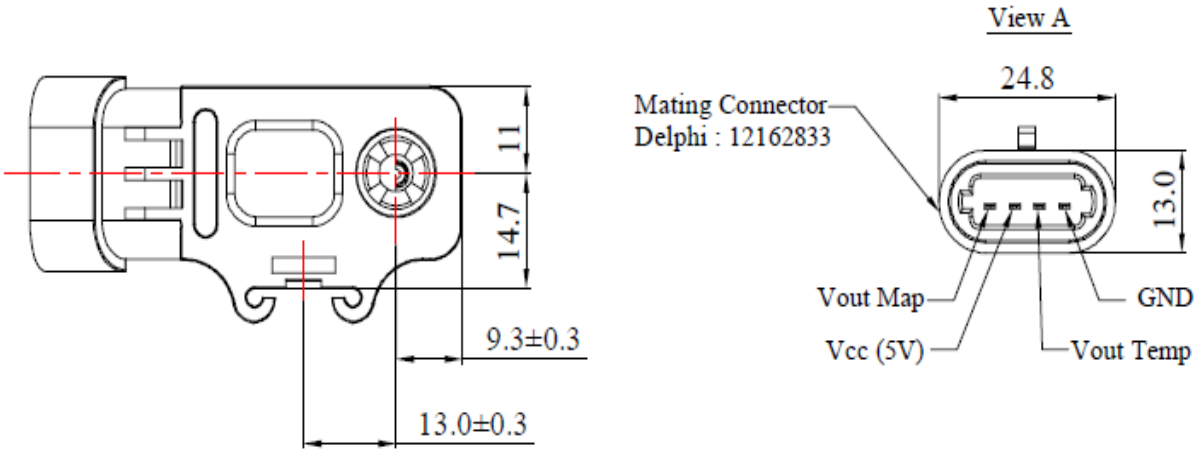
CAV	NO.	SPEC	COLOUR	OPTION
1	14A	1.50	G/Y	ECU 3L
2	21B	1.50	Y/B	+VE
3	25B	1.50	BR	GND



Ignition Coil-It acts as a transformer. It transforms low voltage to high voltage up to 33KV

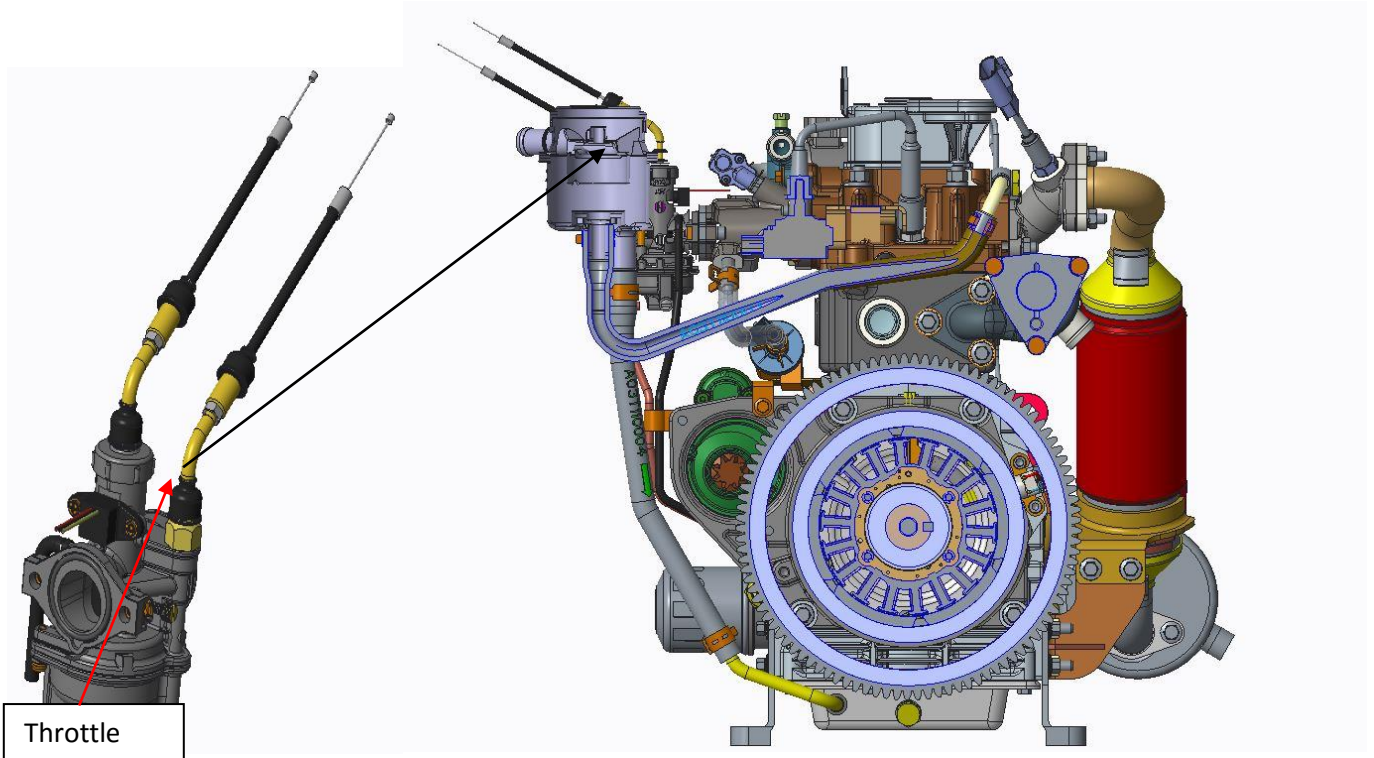
8.8. TMAP Sensor





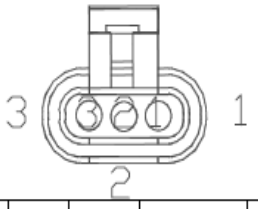
Manifold Air Temp & Pressure Sensor(TMAP)-Used to capture Intake air temperature & pressure

8.9. Carburetor with TPS



Throttle position sensor

THROTTLE POSITION SENSOR
TYCO: 282087-1
S-SEAL-WP3PF-BLK

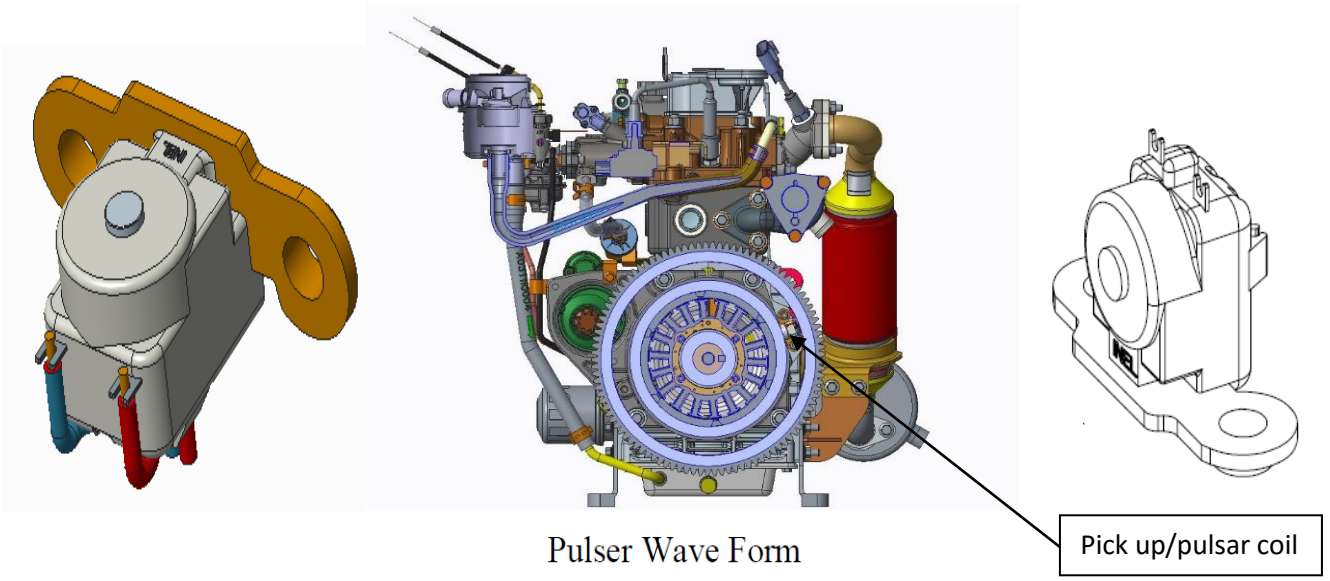


CAV	NO.	SPEC	COLOUR	OPTION
1	17B	0.75	R/G	+5V SUPPLY
2	6A	0.50	G/P	SIGNAL OUTPUT
3	16C	0.75	P/B	GROUND

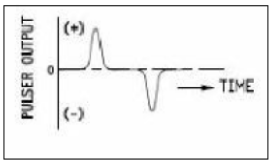
Carburetor with throttle position sensor is introduced in BSVI.

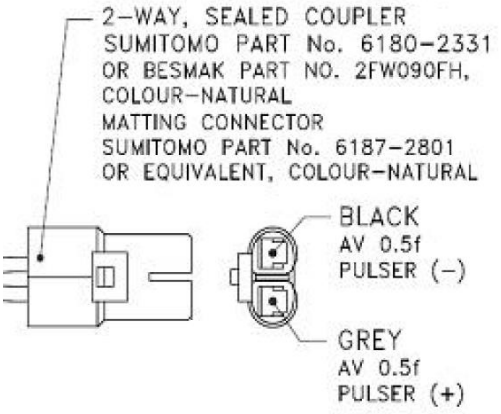
TPS-It is used to sense throttle opening as demanded by driver.

8.10. Pick up Coil/Pulsar Coil



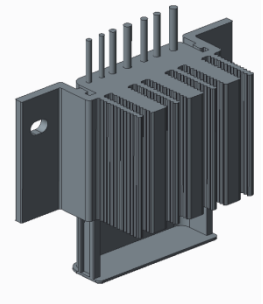
Pulser Wave Form

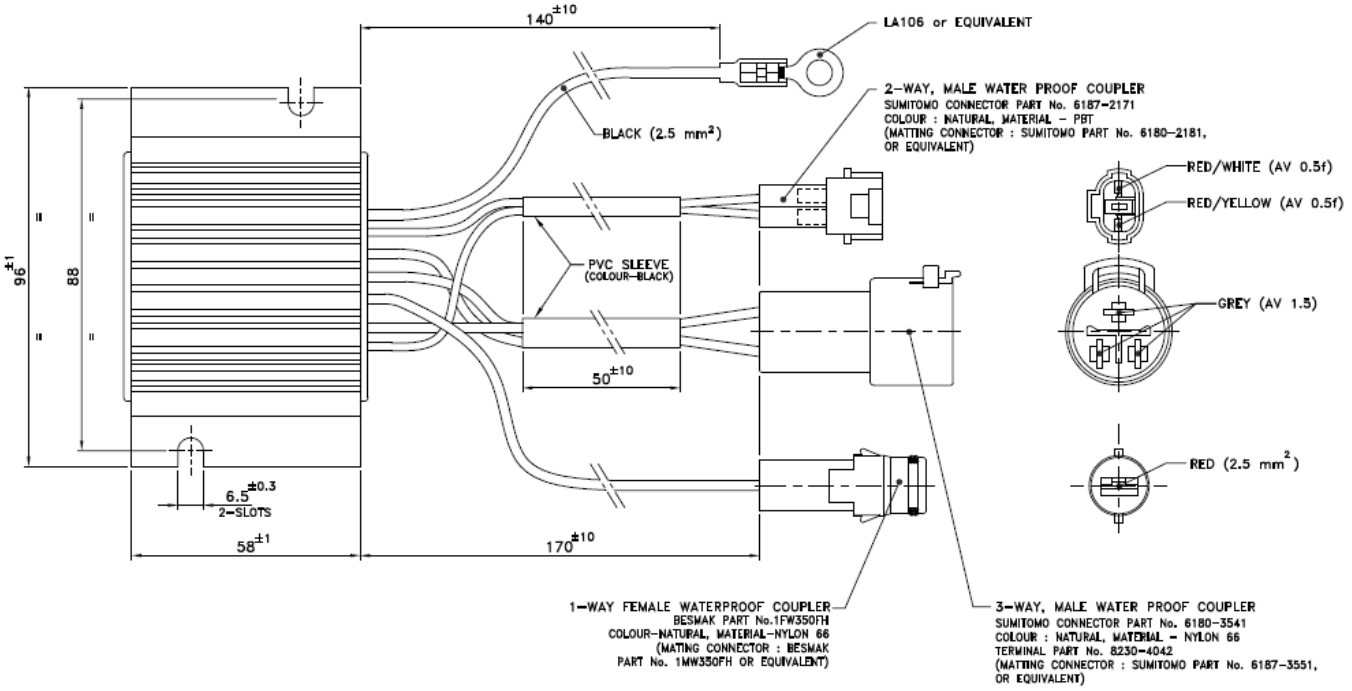


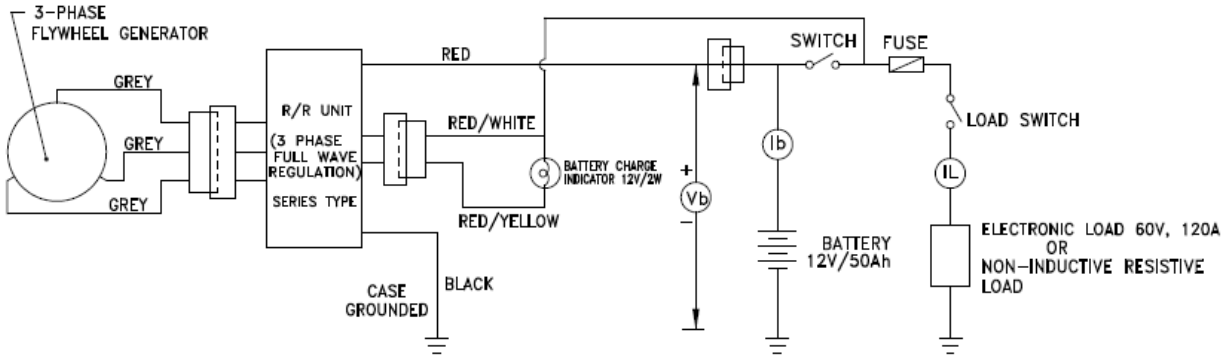


Pulsar coil-Pulsar coil is mounted on fly wheel assembly. It is used to sense the crank shaft angle & engine RPM.

8.11. RR Unit



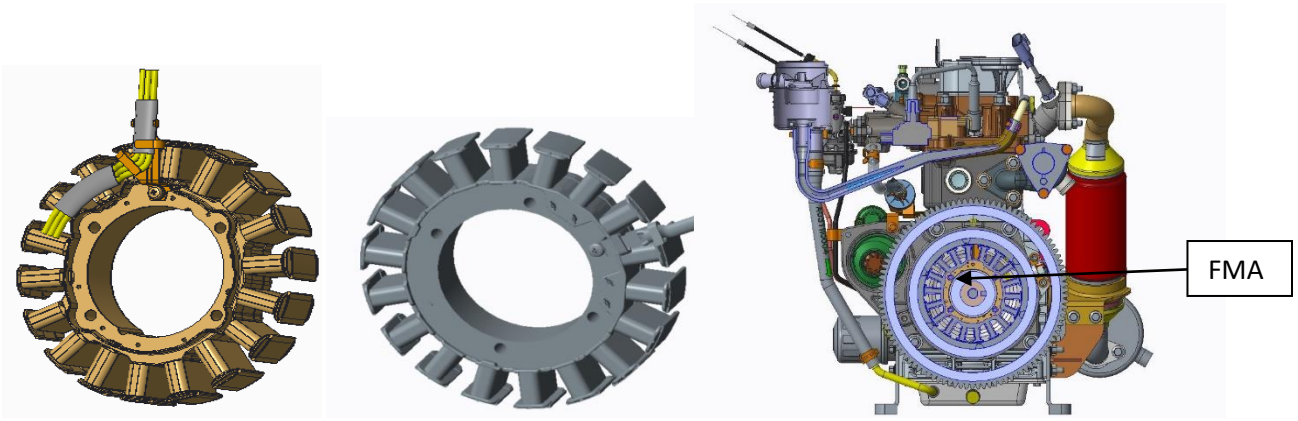


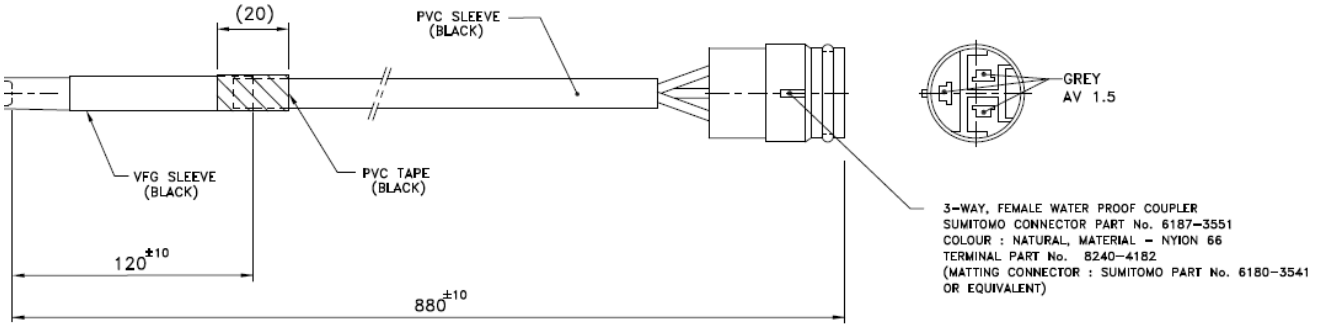


APPLICATION CIRCUIT DIAGRAM

RR unit- it is used to convert FMA output to regulated DC voltage for battery charging

8.12. Stator





WIRING HARNESS

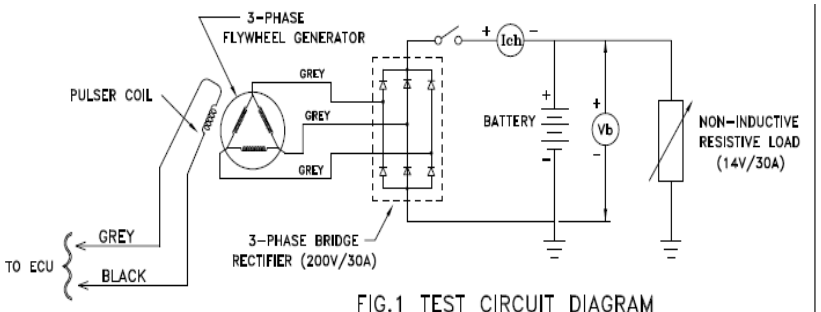
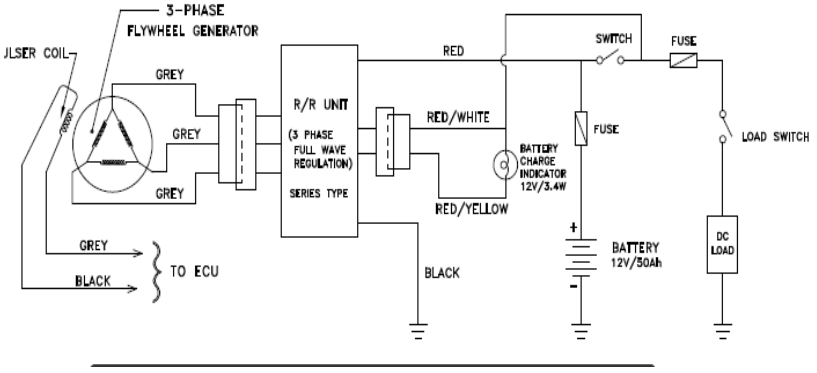
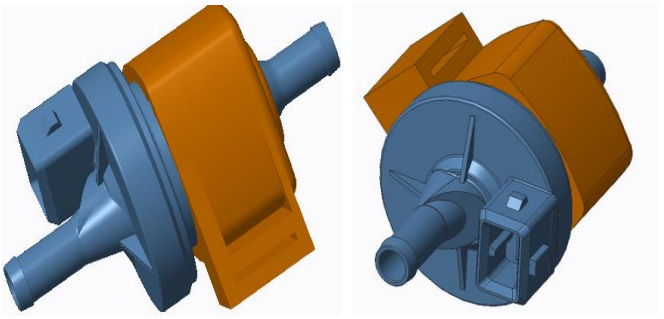
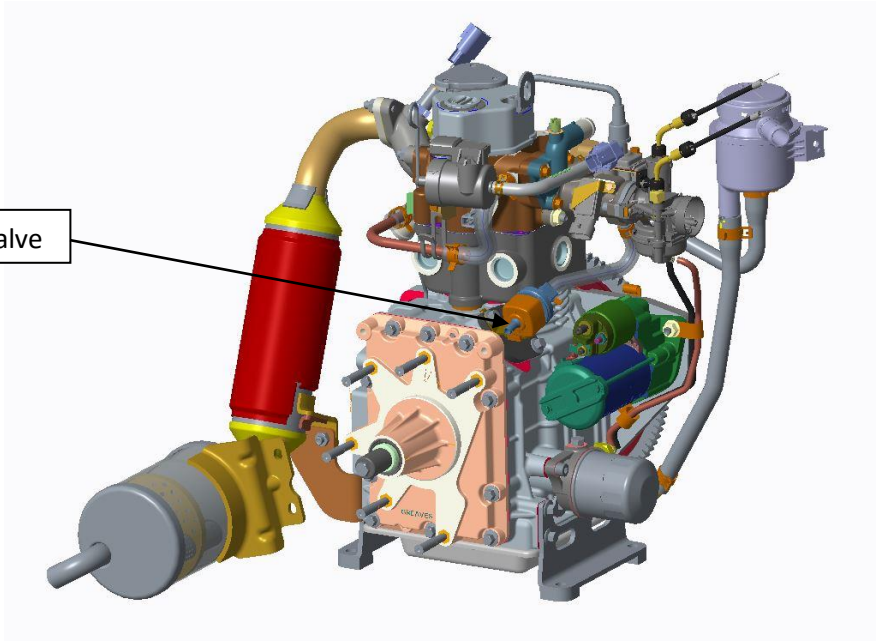


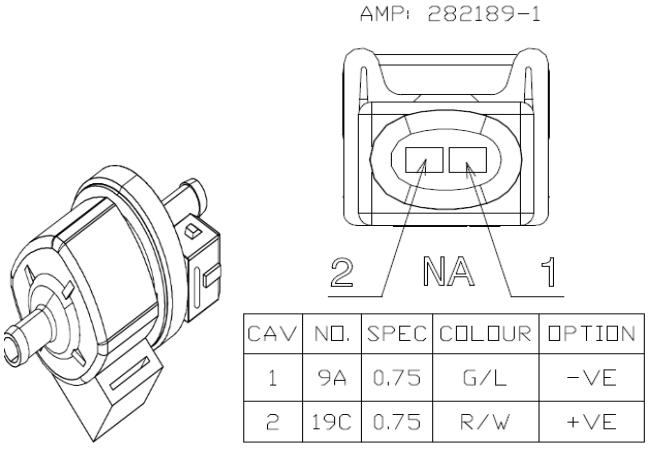
FIG.1 TEST CIRCUIT DIAGRAM



8.13. Idle air control valve



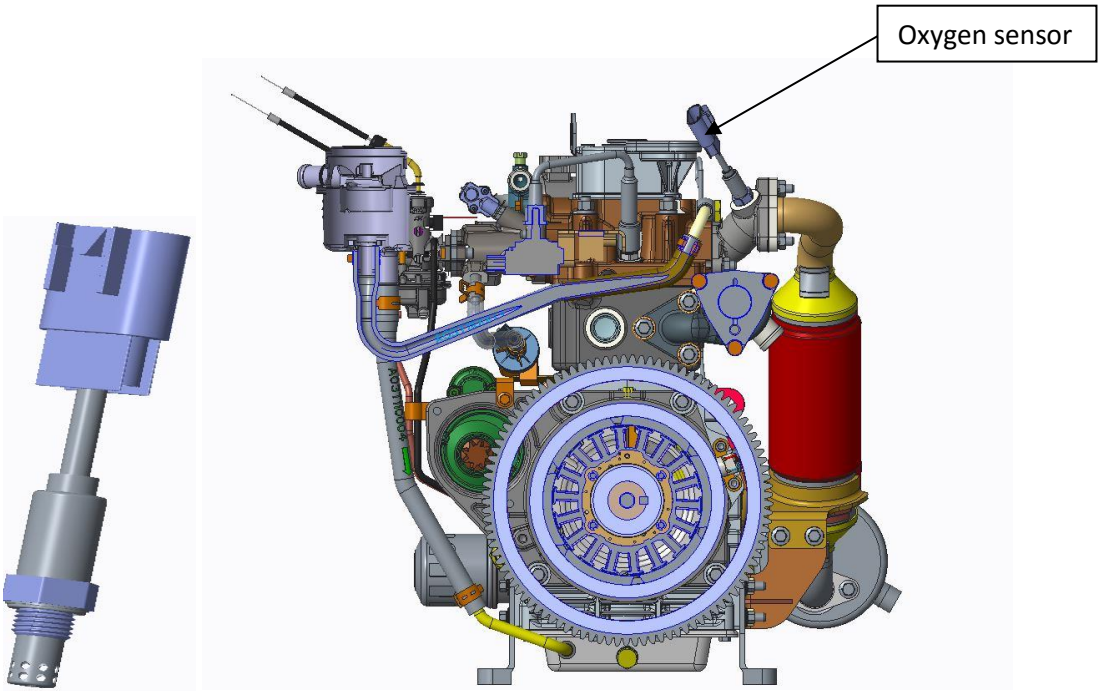


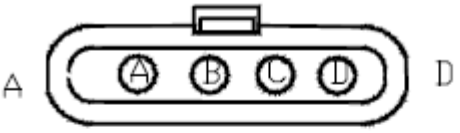


CAV	NO.	SPEC	COLOUR	OPTION
1	9A	0.75	G/L	-VE
2	19C	0.75	R/W	+VE

Idle speed Control (IACV)-to control the idle air intake to control the idle speed of the engine.

8.14. Oxygen Sensor

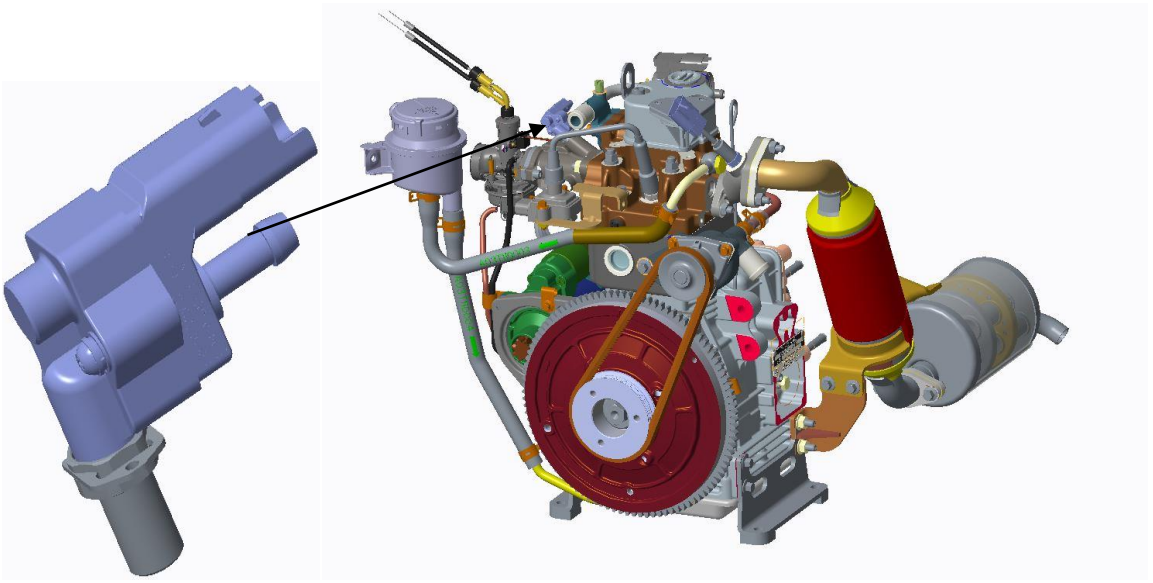


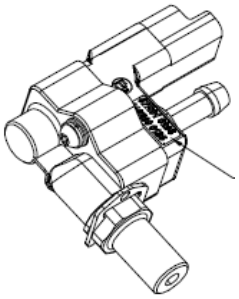


CAV	NO.	SPEC	COLOUR	OPTION
A	19D	0.75	R/W	
B	2A	0.75	W	
C	3A	0.75	G/B	
D	22B	0.75	BR/W	

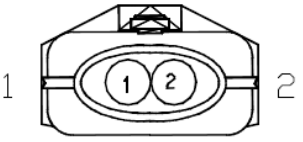
Oxygen sensor is used indicate the content of oxygen present in exhaust gas

8.15. Injector





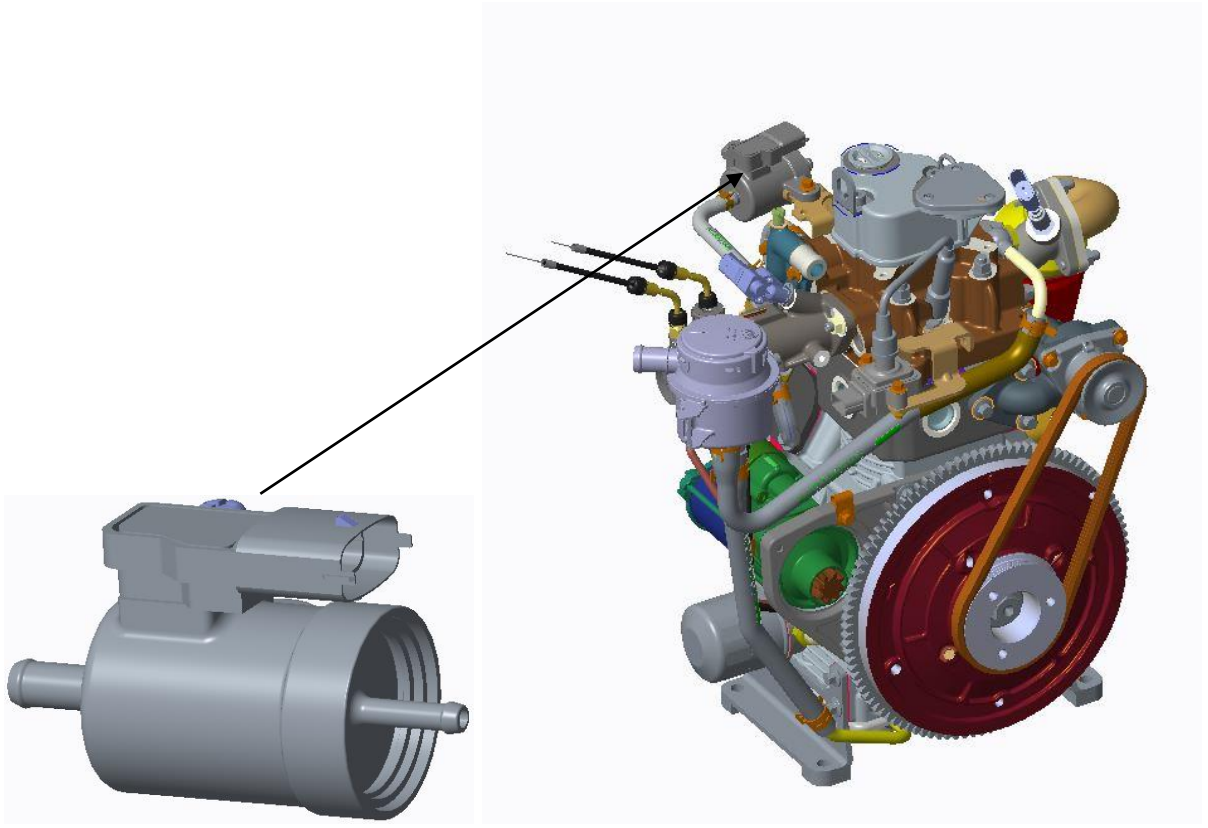
Built-in connector Type Female SICMA-2 211 — Matting connector Type male SICMA-2 211

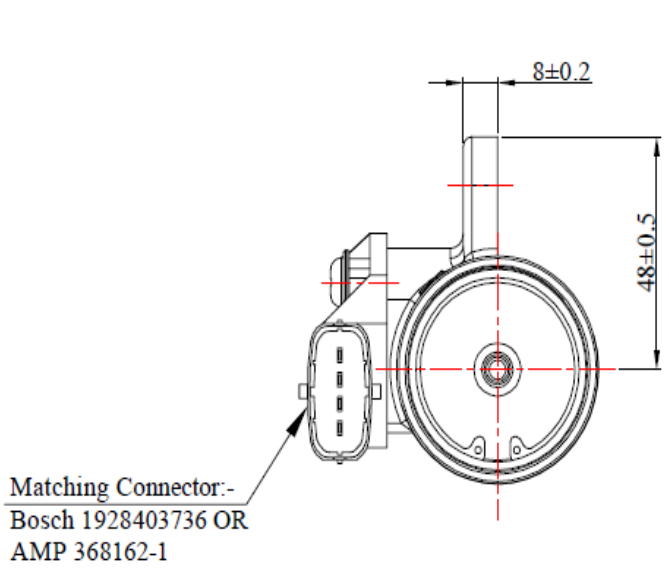


CAV	NO.	SPEC	COLOUR	OPTION
1	13A	1.50	R/Y	
2	19B	1.50	R/W	

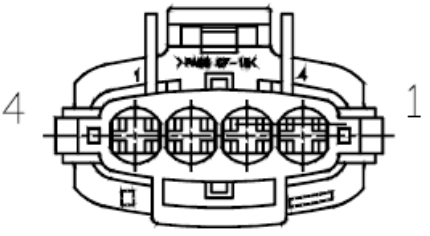
CNG Injector- it is driven by ECU to inject CNG in combustion chamber.

8.16. CNG Filter (Combined Rail Pressure & Temperature Sensor)





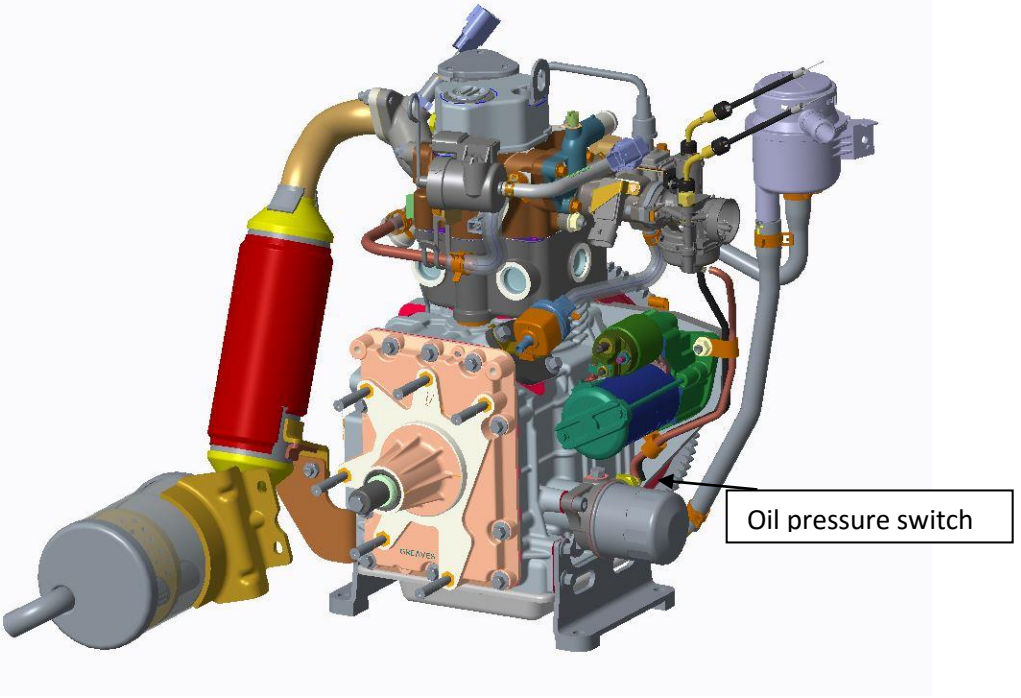
BOSCH 1928403736



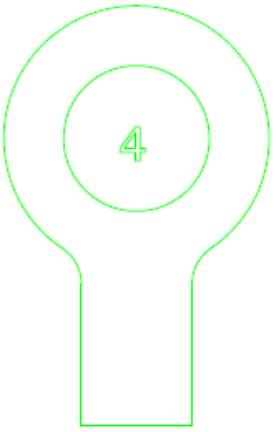
CAV	NO.	SPEC	COLOUR	OPTION
1	22C	0.75	BR/W	GND 3F
2	24A	0.75	W/R	FRT 4B
3	18B	0.75	L/W	5V 4H
4	23A	0.75	O/W	FRP 2A

Combined Rail Pressure & Temperature Sensor- it is used to measure CNG rail pressure & temperature before CNG injection

8.17. Oil pressure switch



YAZAKI:7009-1326-02

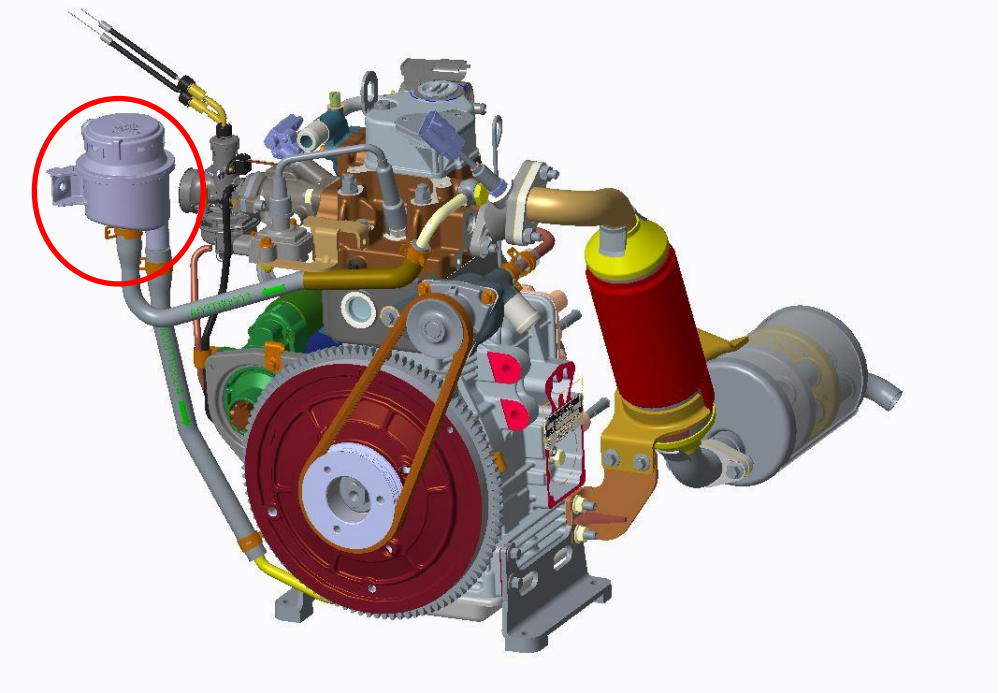


CAV	NO.	SPEC	COLOUR	OPTION
1	15A	1.00	B/L	

8.18. OMS System:

OMS system separates generated blow buy mixture into Oil and Blow by gases. Oil is returned to crank case while blow by gases go to air intake hose. Refer air circuit layout for more details.

Blow by mixture= Blow by gases (CNG/LPG + Petrol) + Oil

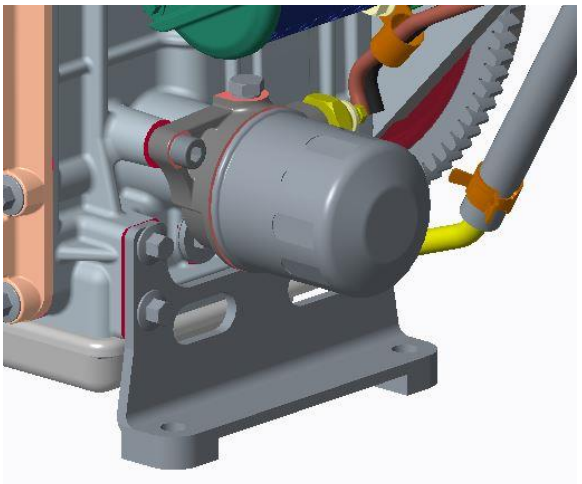


8.19. Oil Filter

Oil Filter capacity: 50-70 ml

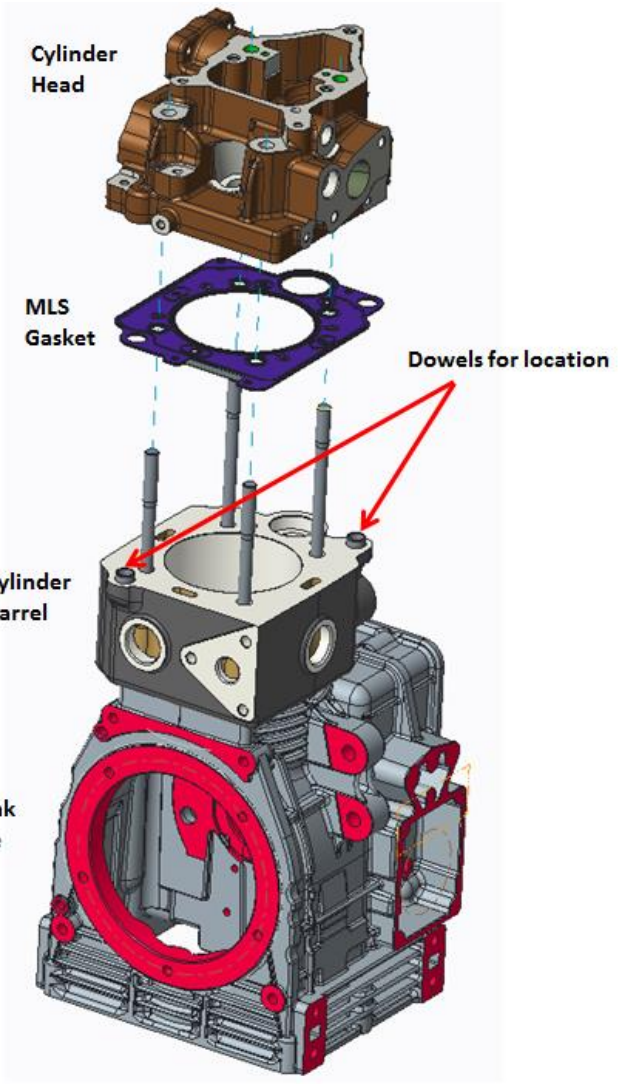
Make: Lube Oil filtration systems

Note: This Oil filter has higher capacity than filter in G400WG BS4 version.



9. Key Components list

9.1 MLS gasket



Caution !

1. Note that MLS gasket is for one time use i.e. it should not be re-used.
2. Ensure MLS gasket is dent free with dust free surfaces before mounting.
3. Please ensure surfaces of Barrel, Cylinder head are clean, dust free and without burr/ scratches. Use soft cloth for cleaning. While doing cleaning, scratch marks, dents, damages are not allowed on the mating surfaces.
4. Refer Cylinder Head Tightening Torque Details described in chapter 7.2 of workshop manual.
5. No coolant should be left over between stud and barrel holes. Ensure proper cleaning of coolant to avoid rust.

9.2 3pk Belt

Details and guidelines: **Caution** !

Ensure belt is crack free and dust free before installation. Ensure no foreign objects between ribs.

Do not rub the belt along edges.

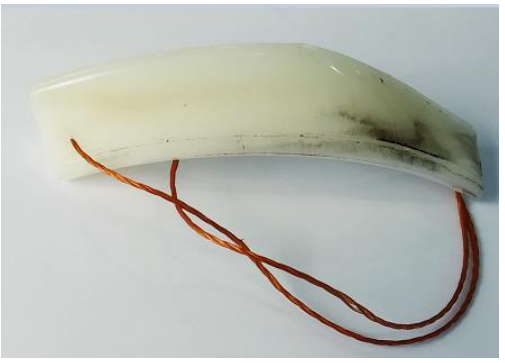
9.2.1 Belt Details:

Fig. describes 3pk belt. Identification with GATES details are also describe below.

Belt installation and removal tools are as per fig.

Installation Tool

Removal Tool



9.2.2 Belt Installation Guidelines:

Step 1: Fit 3pk belt on water pump pulley (belt should fit properly inside water pump grooves).

Step 2: Fit two M8 studs on flywheel holes. Mount installation tool as shown in fig.

Wrap other side of belt around flywheel pulley as shown below.

Step 3: Using ratchet & guide, rotate flywheel in anticlockwise direction. Belt should automatically align on both flywheel and water pump pulleys.
Step 4: Rotate flywheel two times to check whether belt is fitted properly inside flywheel and water pump pulley grooves.

Imp: If belt is not mounted properly, uninstall and repeat the installation procedure from step 1.

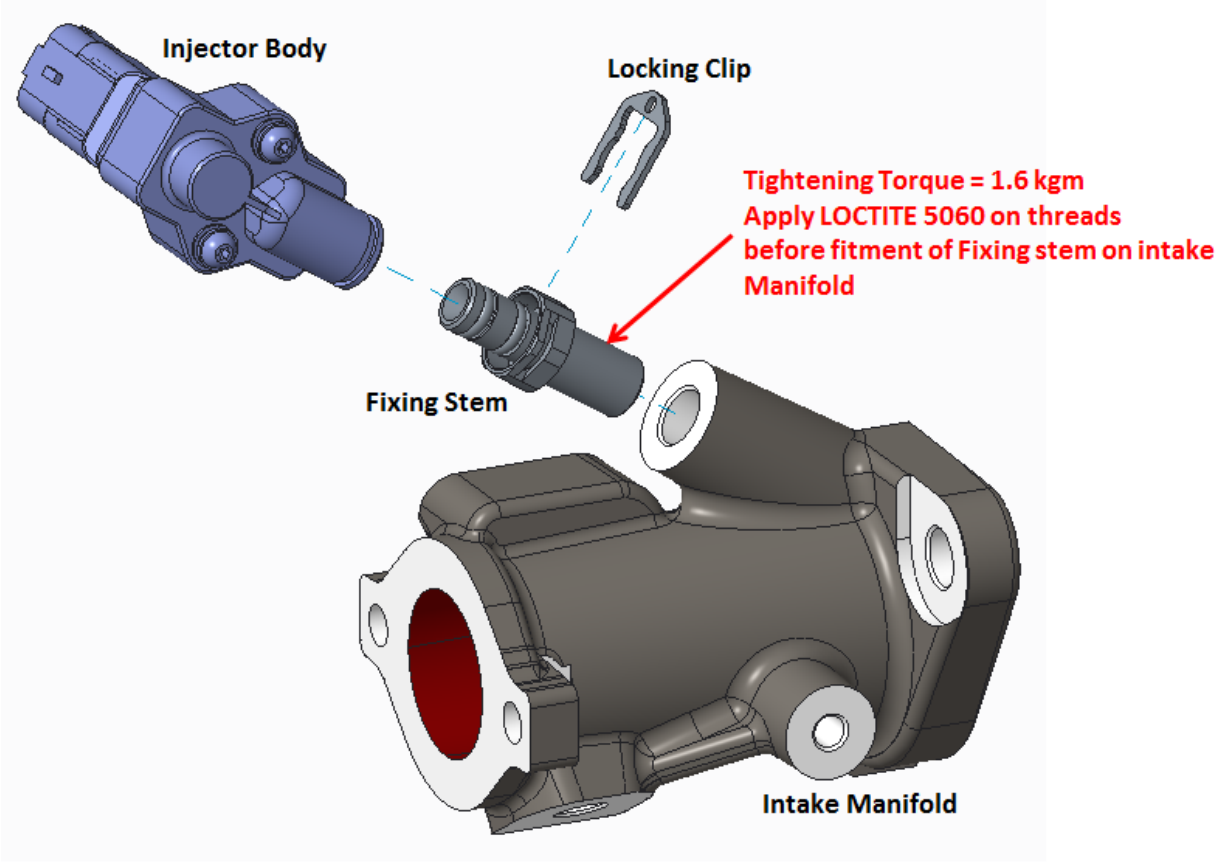
Fig. shows proper mounting of belt on flywheel and water pump pulleys.

9.2.3 Belt Uninstallation Guidelines:

Step 1: Fit removal tool as shown in fig.
Thread of removal tool should fit with ratchet as shown.

Step 2: Rotate flywheel in clockwise direction.
Belt should automatically slide off from flywheel pulley.

9.3 CNG Injector Assembly



Assembly:
Step 1: Assemble fixing stem as shown in fig.
Step 2: Assemble Injector Body on fixing stem
Step 3: Put Locking clip in Fixing Stem grooves

Disassembly:
Step 1: Remove Locking Clip
Step 2: Pull out injector Body
Step 3: Remove fixing Stem

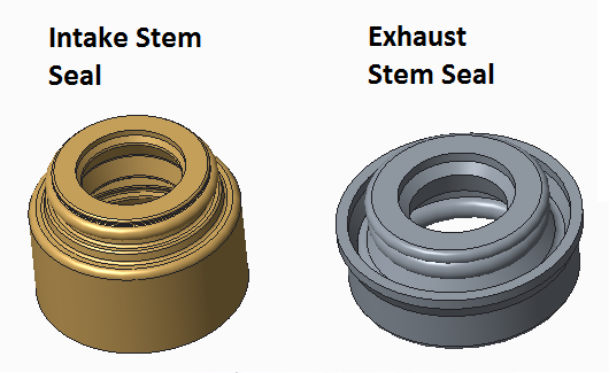
Caution ! :

Make sure injector body is safe from foreign particle entry while assembly.

Properly locate/Push locking pin in Fixing stem grooves while assembly.

Make sure components are not damaged while assembly/Dis assembly.

9.4 Valve Stem Seal



Intake and Exhaust valve stem seals are different as shown in fig. Exhaust stem seal is single lip while intake stem seal is double lip.

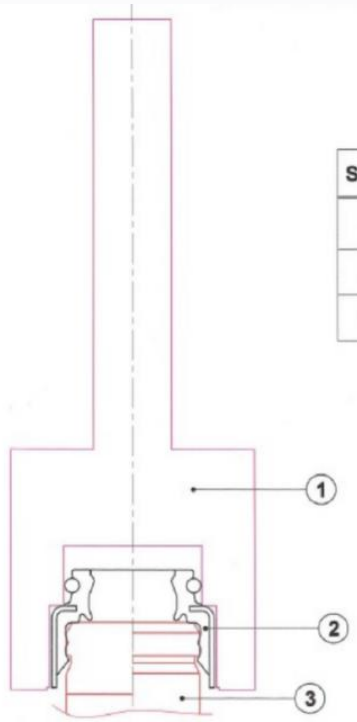
Use dolly as shown in fig. for fitment of stem seals.

9.4.1 Intake Stem Seal

Part No.: A03G060002

9.4.2 Exhaust Stem Seal

Part No.: 500-063-42

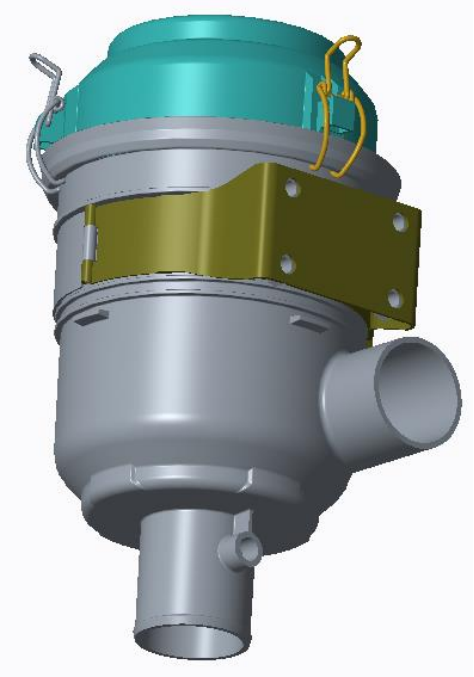


S.NO.	PART NAME
1	DOLLY
2	STEM SEAL
3	GUIDE

9.5 Air filter

9.5.1 CNG Air Filter

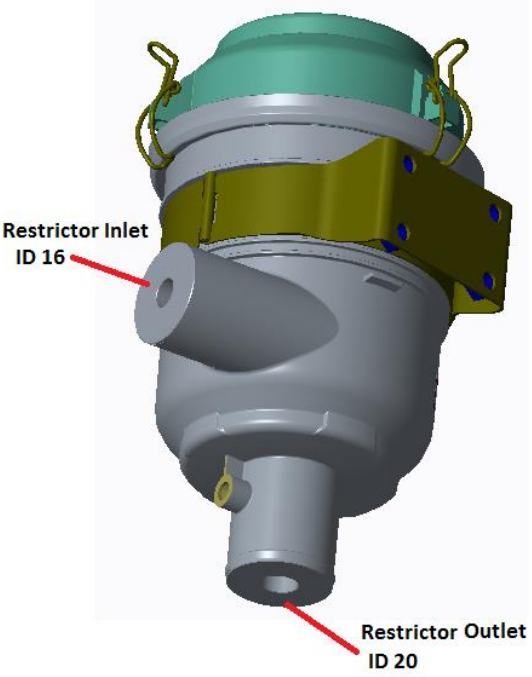
Part No. A03A200004



There are no restrictors in CNG filter air inlet and Outlet.

9.5.2 LPG Air Filter

Part No. E34A140002



Restrictors are present at air inlet and outlet as shown in above image.

9.5.3 General Guidelines

1. Remove and Clean filter element by air. If damaged, replace filter element.
2. Under normal driving conditions, clean and replace air filter as per defined schedule in chapter 3.
3. Replace filter element in extremely dusty conditions or if any damage.
4. Do not tap/Hammer filter element. Element cleaning should be done by directing pressurized air (<2 bar) from in towards out. Never blow air from outside.

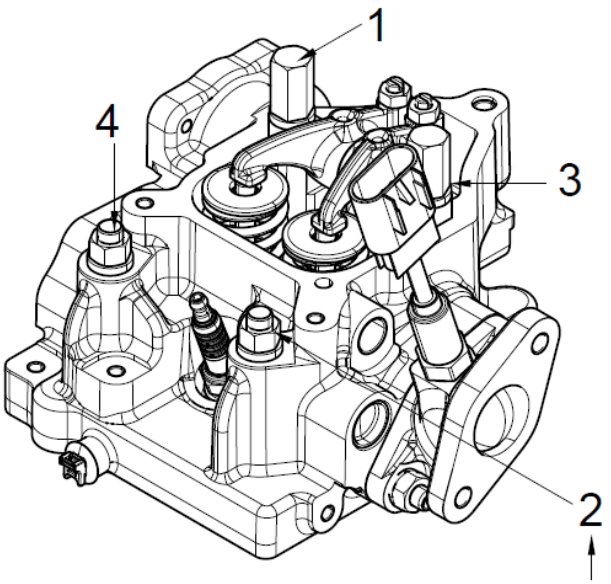
10. TIGHTENING TORQUE DETAILS

10.1 General tightening Torque Table:

G400WG BI Fuel BSVI TORQUE CHART
General Torque tolerance for 1. Torque wrench & DC nut runner:± 5%
2. Pneumatic nut runner:± 15%

SR.NO.	PART NAME	SPECIFICATION	TORQUE Kg-m	TORQUE Nm	ALLOWABLE TORQUE ALLOWANCE	SC,CC
CRANKCASE						
1	engine feet bolt	M8x1.25	2.5	24.5	+/-15%	
2	engine feet nut	M8x1.25	2.5	24.5	+/-15%	
3	Oil pan assy.bolts	M8x1.25	2.5	24.5	+/-5%	<SC>
4	Spin Oil filter central bolt	M12x1.5	3.5	34.3	+/-15%	
5	Lub.oil filter cap screw	M8x1.25	2.5	24.5	+/-15%	
	Lub.oil filter bolt (upside)	M8x1.25	2.5			
6	Spin on Filter		1.2-1.6	11.7-15.6		
8	Lub.oil pump bolt	M6x1	1	9.81	+/-15%	
9	Lub oil pump gear nut	M10x1.5	2.5	24.5	+/-15%	
10	Plug relief valve	M18X1.5	3.5-4	34.3-39.2	+/-15%	
11	Governor support assembly cap screw	M6x1	1.2	11.7	+/-15%	
13	flywheel side stud	M8x1.25	0.1 (till locking of stud)	0.98	+/-15%	
14	FEW Cover nut	M8x1.25	2.5	24.5	+/-5%	<SC>
15	FEW cover Stud	M8x1.25	0.1 (till locking of stud)	0.98	+/-15%	
16	FIP blank plate bolt	M8x1.25	2.5	24.5	+/-15%	
PTO COVER						
17	PTO Cover -gearbox stud	M8x1.25	0.1 (till locking of stud)	0.98	+/-15%	
18	PTO Cover mounting stud	M8x1.25	0.1 (till locking of stud)	0.98	+/-15%	
CRANKSHAFT						
19	bolt for crankshaft cap	M8x1.25	2.5	24.5	+/-15%	
CONNECTING ROD ASSEMBLY						
20	Con. Rod bolts	M8x1	4-4.5	39.2-44.1	+/-5%	<SC>
SUCTION BULB ASSEMBLY						
21	Suction bulb assembly bolt	M12x1.5	2.5	24.5	+/-15%	
FLYWHEEL ASSEMBLY						
22	Flywheel bolt (Left handed thread)	M14x1.5	17	166.7	+/-5%	<SC>
CYLINDER HEAD ASSEMBLY						
23	Nut for Exhaust manifold mounting on head	M8x1.25	2.5	24.5	+/-15%	
24	Nut for Intake manifold mounting on head	M8x1.25	2.5	24.5	+/-15%	
25	Carburetor bolt	M6x1	1	9.81	+/-5%	
26	Thermostat housing bolt	M6x1	1.2	11.7	+/-15%	
27	Thermostat Bleding screw	M6x1	0.8	7.8	+/-15%	
28	Bypass hose clamp bolt	M6x1	1.2	11.7	+/-15%	
29	Spark plug	M14x1.25	3	29.4	+/-5%	<SC>
30	dipstick clamp plate screw	M5x0.8	0.7	6.8	+/-15%	
31	CNG Filter bracket on head bolt	M8x1.25	2.5	24.5	+/-15%	
32	CNG Filter sensor		1.2	11.7		
33	CNG Filter bolt	M6x1	1.2	11.7	+/-15%	
34	Ignition coil mounting bracket bolt	M6x1	1.2	11.7	+/-15%	
35	Ignition coil mounting bolt	M6x1	1.2	11.7	+/-15%	
36	TMAP screw	M4x0.7	0.2-0.3	1.9 -2.9	+/-15%	
ROCKER COVER ASSEMBLY						
37	Rocker cover mounting bolt	M8x1.25	2.5	24.5	+/-5%	
OMS ASSEMBLY						
38	OMS Banjo bolt	M14x1.5	2.5	24.5	+/-5%	
BARREL-WATER PUMP ASSEMBLY						
39	Bolt for mount of Water pump housing on barrel	M8x1.25	2.5	24.5	+/-5%	
40	Bolt for mount of Water pump on housing	M6x1	1.2	11.7	+/-5%	
ELECTRICAL SYSTEM						
41	Starter motor stud	0.1 (till locking of stud)	1	9.81	+/-5%	
42	Starter motor mounting -Nut	M8x1.25	2.5	24.5	+/-5%	
43	Starter mounting plate bolts	M8x1.25	2.5	24.5	+/-15%	
44	Pulsor coil nut	M6x1	1-1.2	9.81-11.7	+/-5%	
45	Coolant temperature sensor	12x1.5	2			
46	clamp for alternator cable bolt	M6x1	1	9.81	+/-15%	
47	FMA Stator assy. bolt	M5x0.85	0.7	6.8	+/-15%	
48	TMAP Sensor		0.7			
49	Oxygen sensor		2			
50	Injector		1.6			

10.2 Cylinder Head Tightening Torque Details:



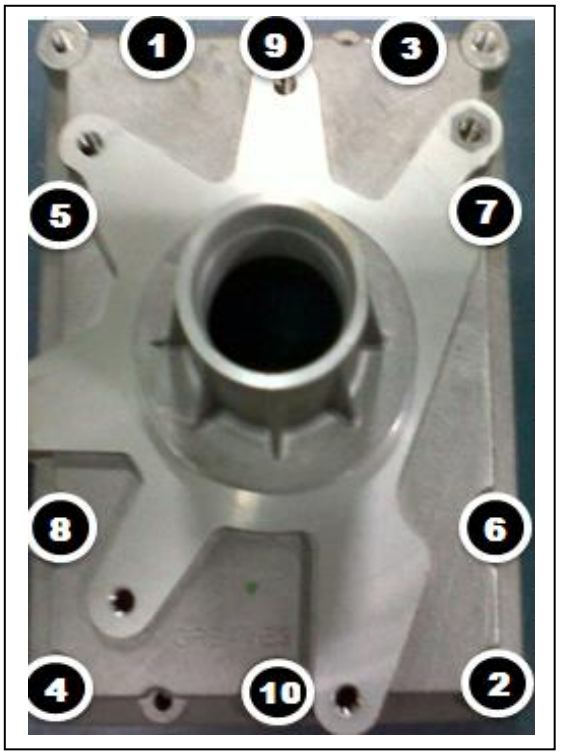
NUMBER SEQUENCE INDICATES TIGHTENING OF CYLINDER HEAD

Following tightening torque sequence needs to be followed:

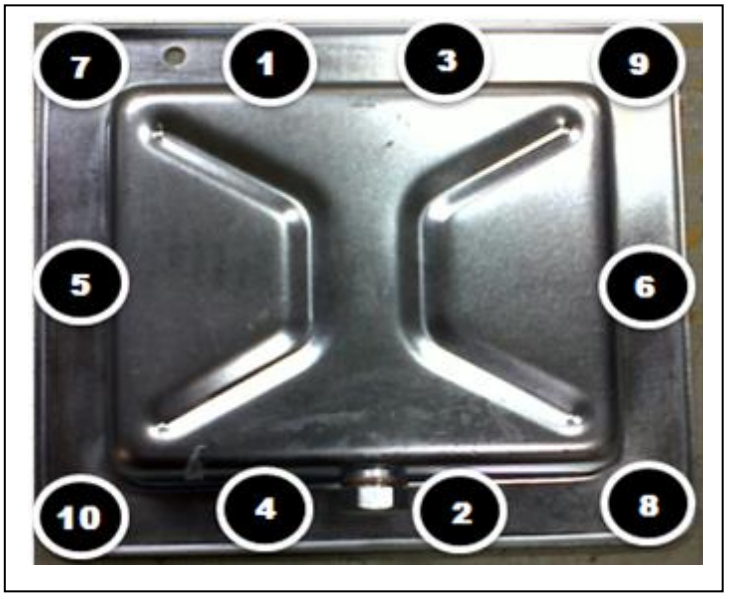
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Tightening torque	Pause Time	Tightening torque	Reverse	Tightening torque	Pause Time	Torque extension
15 Nm	3 Seconds	30 Nm	360 Degrees	30 Nm	3 Seconds	70 Degrees
(Spindle speed: 50 RPM)		(Spindle speed: 50 RPM)	(Spindle speed: 30 RPM)	(Spindle speed: 50 RPM)		(Spindle speed: 50 RPM)

10.3 Tightening Sequence for FWE Cover, PTO Cover and Cylinder Head

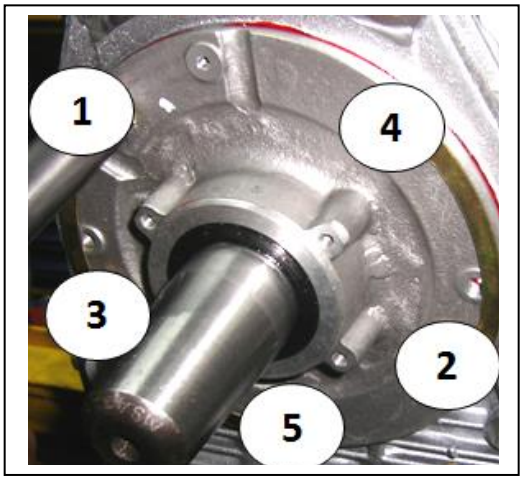
PTO COVER



OIL PAN



FWE COVER



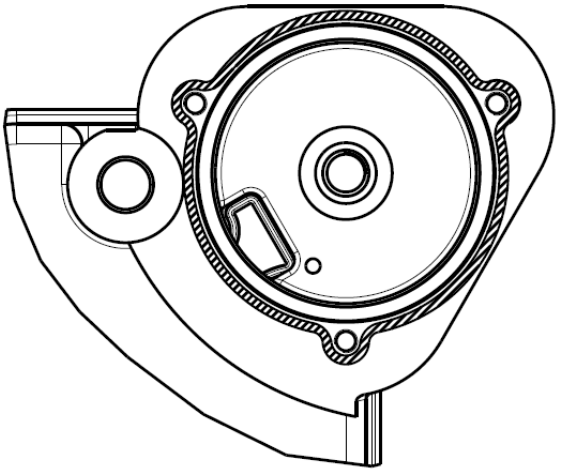
10.4 Sealant Profile on FWE Cover, Oil Pan and PTO End

PTO cover

FWE cover

Oil pan

Rocker Cover: Breather Cap area



11. DISMANTLING

11.1 General Guidelines

Before starting actual dismantling of any sub-assembly or any component please pay attention to following aspects :-

1. Ascertain the correct cause of the trouble to avoid unnecessary stripping down of the Components / assemblies.

2. Ensure availability of proper tools required for the job. Do not try to use improper tools. This may cause accidents and damage the components.

3. Clean the assemblies, sub-assemblies / components thoroughly before stripping down, taking care to see that dirt/ dust does not enter inside stripped down components.

4. Keep the work area absolutely clean.

5. Use clean trays and measuring cans etc. for storing fuels / lubricants and keeping stripped down components.

6. Use cloth for cleaning the components. Do not use cotton-waste while repairing / overhauling engine.

7. Keep the information viz. tightening torques, permissible tolerances, clearances handy while dismantling and re-assembling the Components.

8. Do not apply used lubricating oils or grease to the components while re-assembly. The used oil or grease may contain metallic dust or foreign abrasive particles, which may spoil / damage the components.

9. Before fitting bearings or oil seals, apply fresh lubricating oil, so that the lips will not get damaged and assembly will be smooth.

10. Gaskets, washers, lock washers “o” rings, Oil seals and circlips removed from the engine being overhauled should not be re-used.

11.2 Engine dismantling:

1. Remove dipstick. & drain oil.
2. Remove hose connection & drain coolant, ensure that cylinder head is completely dry from coolant
3. Remove spark plug from cylinder head.
4. Unscrew lube oil filter and remove flange from the crankcase.
5. Remove Relief Valve.
6. While removing peripheral parts, make sure that not to do any damage to electrical components as described in electrical systems chapter. Put all electrical/electronic components in a sealed plastic bag until further assembly.
7. Remove flywheel, starter plate, stator assembly & starter motor.
8. Remove rocker arm cover. Unscrew cylinder head nuts and remove rocker fulcrum with levers.
9. Remove push rods and cylinder head along with seal push rod.
10. Unscrew bolts securing oil pan and take away oil pan from crankcase.
11. Unscrew suction bulb from crankcase.
12. Now turn the crankshaft to reach the piston to the BDC position. Unscrew con rod bolts. Take out con rod cap.
13. Turn the crankshaft to reach the piston to T.D.C. position. Remove cylinder liner with piston assy. Push con rod and piston assy out of cylinder liner.
14. Remove gudgeon pin circlip with the help of internal circlip plier and separate the con rod from piston by tapping out gudgeon pin from the piston.
15. Remove piston rings from the piston with the help of piston ring expander.
16. Remove the circlip with the help of external plier and take out the cam follower levers.
17. Remove the LOP drive gear.

18. Using the puller MS422703 remove the flywheel (Fig. 6.1).
Note: Flywheel bolt threading is anticlockwise (Fig. 6.2).
Remove stator coil from crankshaft support by unscrewing hex head bolts(M5).
Adapter radiator fan may also be used as the flywheel puller.

Do not hammer on the flywheel for dis-assembly.

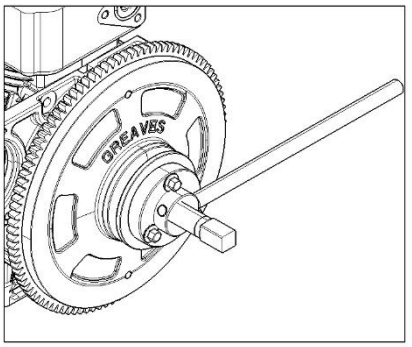


Fig. 6.1

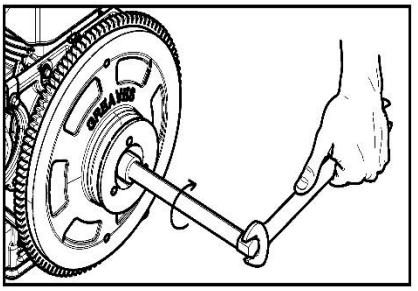


Fig. 6.2

19. Remove the crankshaft support by unlocking nuts. Take out the crankshaft.

20. Using puller T-09-00-0119 remove crankshaft needle bearing on PTO cover. (Fig 6.3)

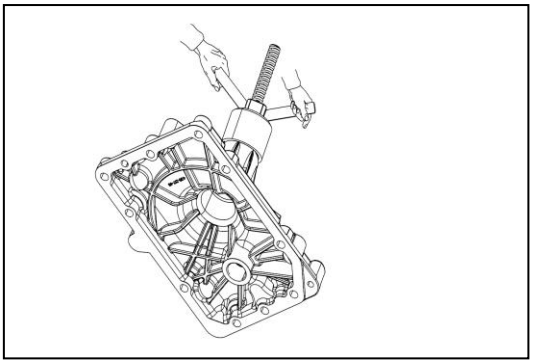


Fig. 6.3

21. Using puller T-09-00-0118 remove crankcase main bush from crankcase and F.W.E. bush from crankshaft support (Fig. 6.4)

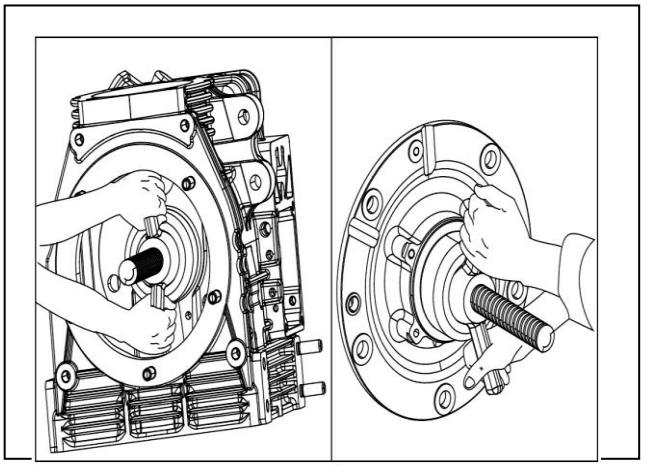


Fig. 6.4

12. ASSEMBLY PLAY

1. Cylinder and Piston:

Grade	Cylinder ID	Piston OD	Clearance
A	86.00-86.01	85.933-85.947	0.053-0.077 FOR ALL GRADES
B	86.01-86.02	85.943-85.957	

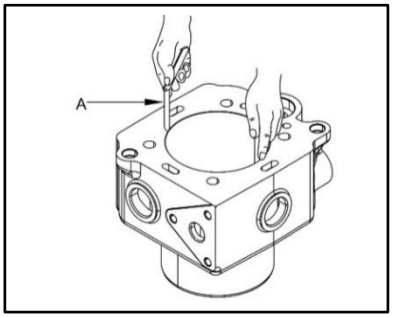


Fig. 7.1

Piston classes

Depending on diameter, pistons are divided into class A & B, the class reference is stamped on the piston crown.

2. Piston Ring end Gap and Ring to Groove Clearances:
   Piston rings - End gaps (mm). (Fig. 7.1)
   Introduce piston rings into the lower part of cylinder and measure that end gap.
   1st chromium plated ring end gap A = 0.2-0.35mm
   2nd torsion ring end gap A = 0.5-0.7mm
   3rd oil control ring end gap A = 0.25-0.5mm

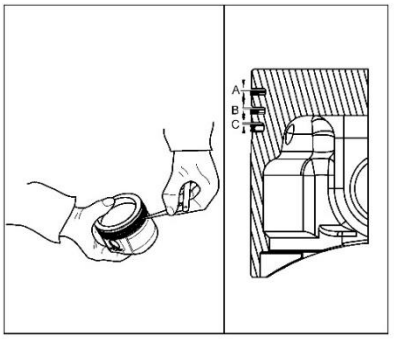


Fig. 7.2

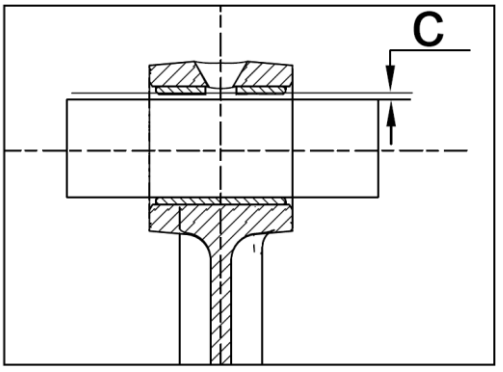


Fig. 7.3

Ring to Groove Clearance: (mm) (Fig. 7.2)
Piston rings - Clearance between grooves (mm)
A=0.045-0.09; limit value = 0.20
B=0.025-0.07; limit value = 0.14
C=0.03-0.07; limit value = 0.14

3. Clearance between small end bush and gudgeon pin: (Fig. 7.3)

Clearance (C)	Wear Limit
0.015-0.030 mm	0.05 mm

4. Main Bearing Internal Diameter after Assembly (mm) : (Fig. 7.4)

Standard	1st U/S 0.25	2nd U/S 0.50
40.05/40.06	39.80/39.81	39.55/39.56

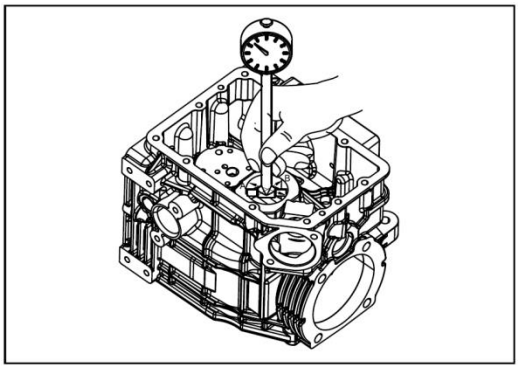


Fig. 7.4

Dimensions of Crank Journals and Crank Pin (mm) (Fig. 7.5)

Dimension	Journal-Crank Pin Diameter	Bearing-Journal Assy Clearance
Standard	39.99 / 40.00	0.05 - 0.07
1st U/S 0.25	39.74 / 39.75	
2nd U/S 0.50	39.49 / 39.50	

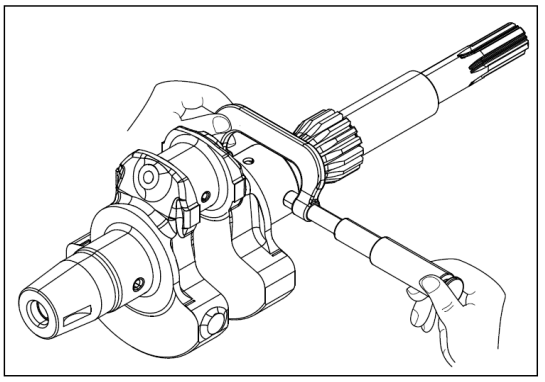


Fig. 7.5

Limit value = 0.1 mm (for crank journal and crank pin)

Crank pin diameter	Crank pin bearing assy. Clearance
39.99 / 40.00	0.029 - 0.064
39.74 / 39.75	
39.49 / 39.50	

6. Dimensions of Valves, Guides and Seats after assembling in Cylinder Head (mm) (Fig. 7.6)

Dimension	Value
A	7.03 - 7.06
B	6.985 - 7.00
C Int.	1.5-1.7
Exh.	1.8-2
D Int.	0.52 - 0.72
Exh.	0.52 - 0.72

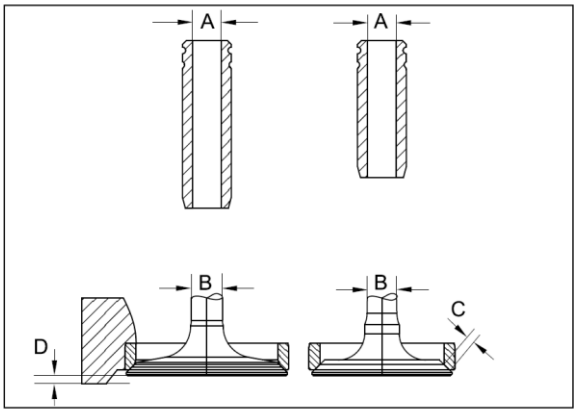


Fig. 7.6

7 . Valve seats and valve seat bores (Fig. No.7.7)

A = 37.015 – 37.040 B = 37.100 - 37.120

C = 33.015 – 33.040 D = 33.100 - 33.120

8. Permissible Tolerances:

	Assembly Tolerances in mm.	Discard Limit in mm.
Crankshaft end float	0.12-0.37	Adjustable
Cam Shaft end float	0.20 -0.60	
Valve Clearance (cold)	0.10-0.15	
Rocker lever bore to rocker fulcrum clearance	0.032-0.061	0.12

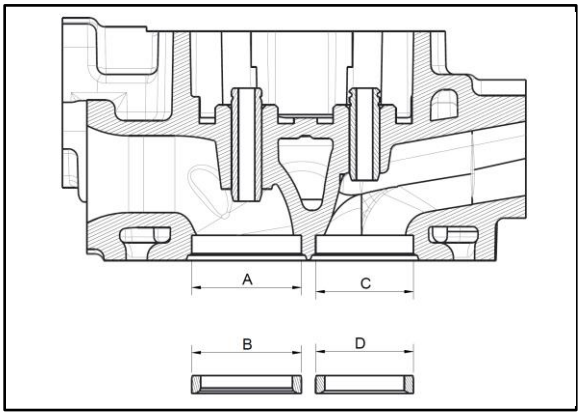


Fig. 7.7

9. Bumping Clearance, Spark Plug protrusion and Valve sink

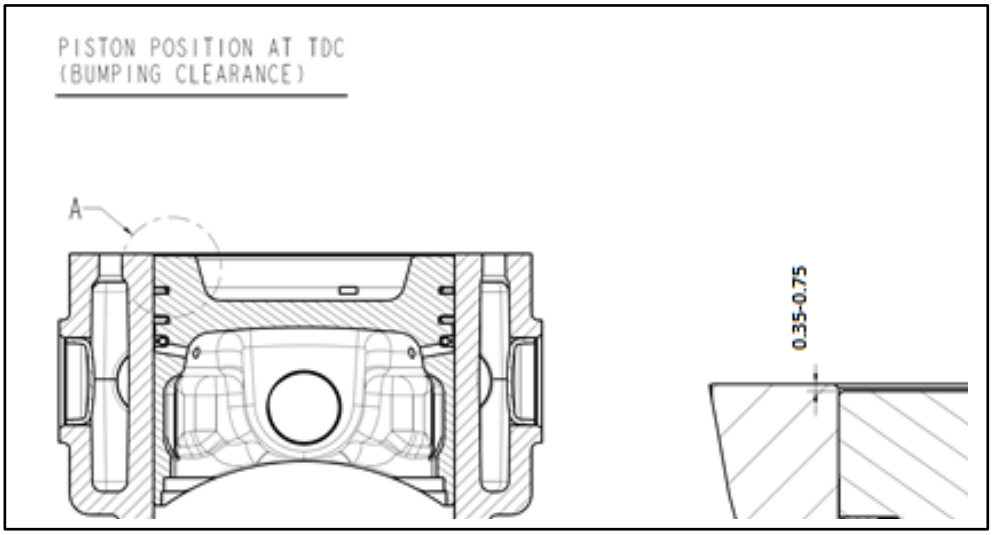


Fig.7.8

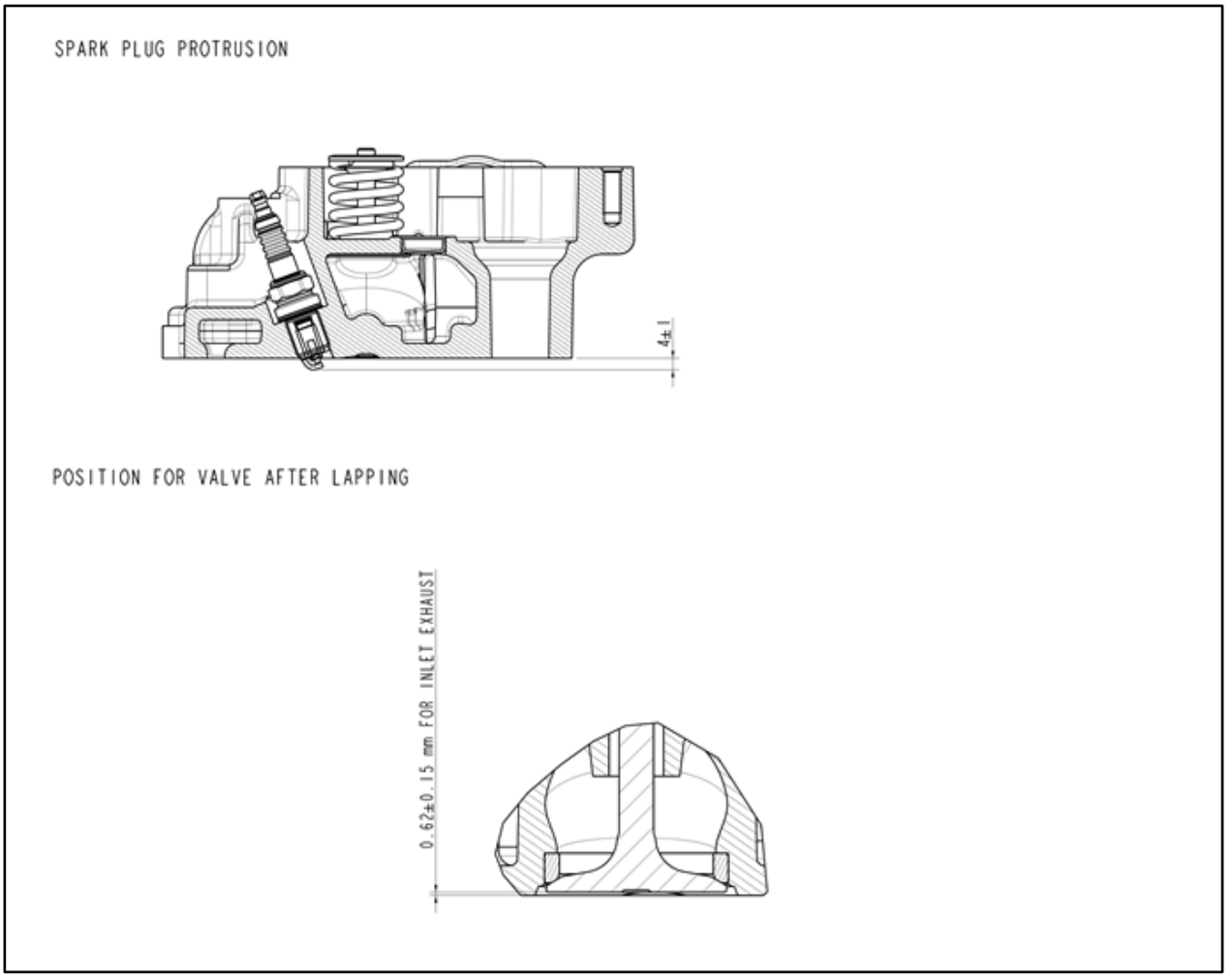


Fig. 7.9

Details of Starter plate assembly on FWE cover

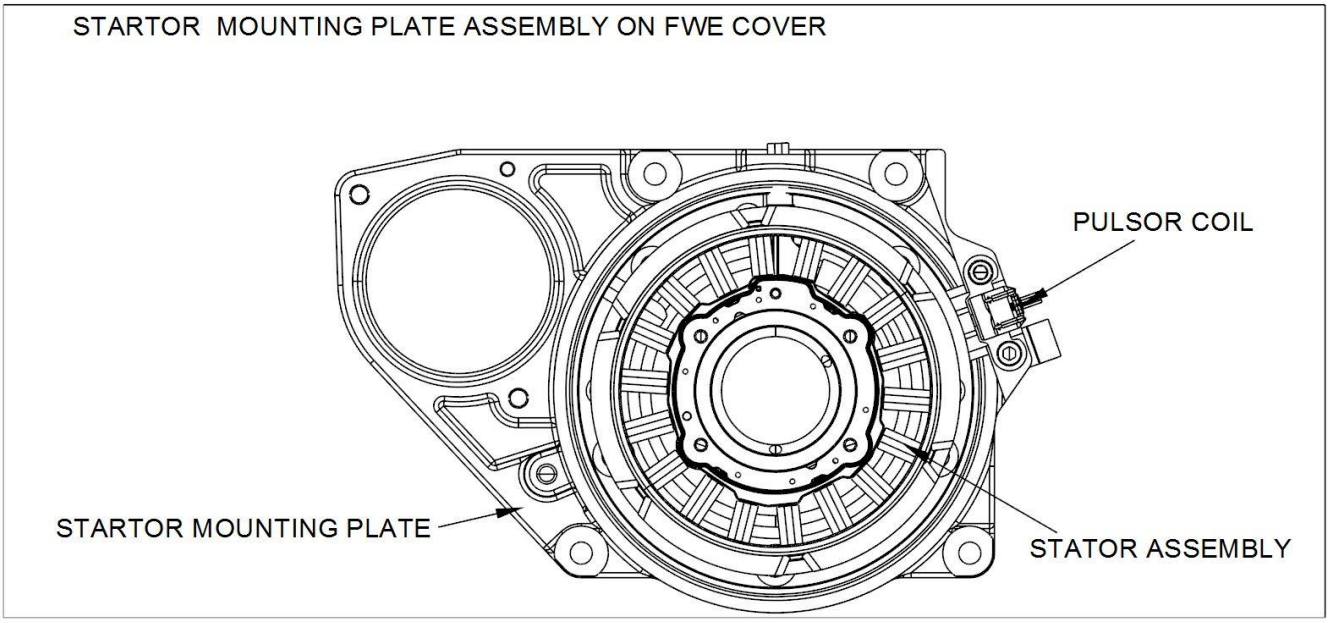


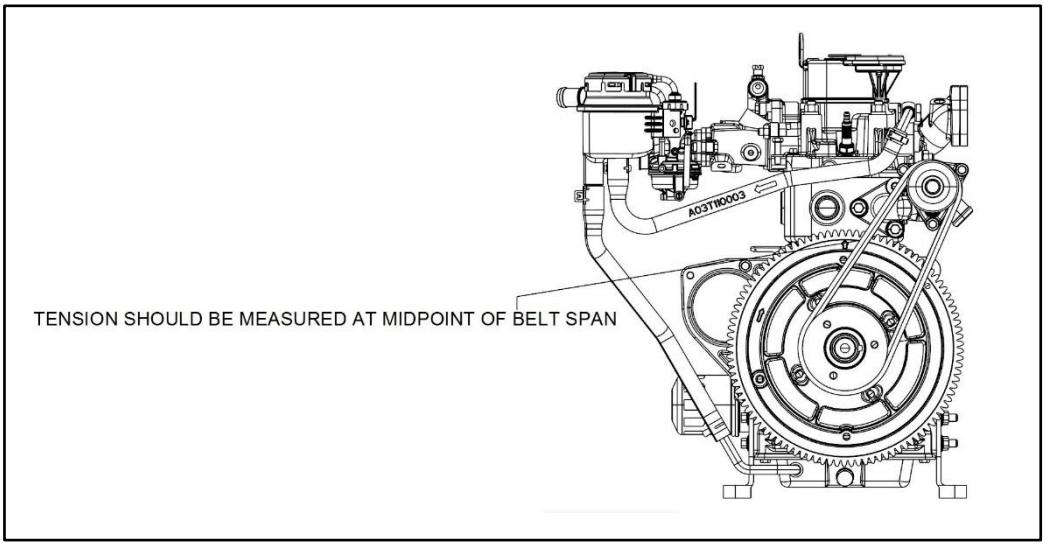
Fig. 7.10

10. 3pk Belt Details:

- Belt Make: GATES Stretch Fit Belt 617
- Tension values are as per below table**:**

Tension Characteristics	**Newton (N)**	**Frequency (Hz)**
Installation Belt Tension (after cranking 2-3 cycles)	299-479	212-269
Initial Stable Tension (at cold engine after running @ 25±7°C)	207-413	177-250
Replacement Tension (at cold engine after tension decay at ~50000 km vehicle run)	160	154

- Measurement layout:



13. OVERHAULING AND CHECKINGS

Engine:

Do not remove cylinder head when hot as this would cause deformation. De-scale carbon deposits and check mating face on cylinder. If deformed or pitted, lap cylinder face max, 0.3 mm if necessary.

Valves, Guides and Seats:

After dismantling and de-scaling with wire mesh, check condition of valves and replace if valve heads are out of shape, cracked or too worn. To re-use slightly worn valves, we recommend restoring seat area "C" with a 30° valve seat grinding.

Dimensions of valves, guides and seats after assembling in cylinder head (Fig. 9.2)

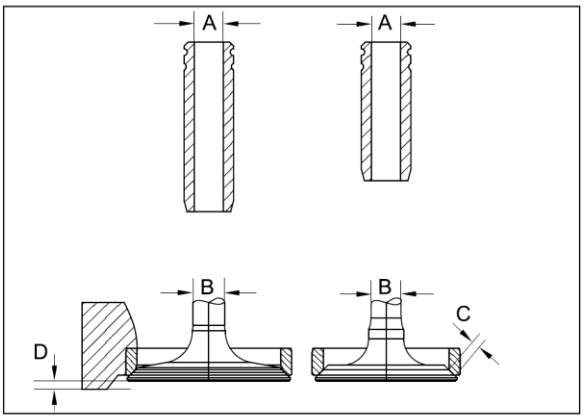


Fig. 9.1

Dimensions	New	Clearance	Discard Limit
A	7.03-7.06	0.030-0.075	0.13
B	6.985 -7.00		
C Inlet	1.5-1.7		3.0
Exhaust	1.8-2.0		
D Inlet	0.52 - 0.72		1.65
Exhaust	0.52 - 0.72		Sink

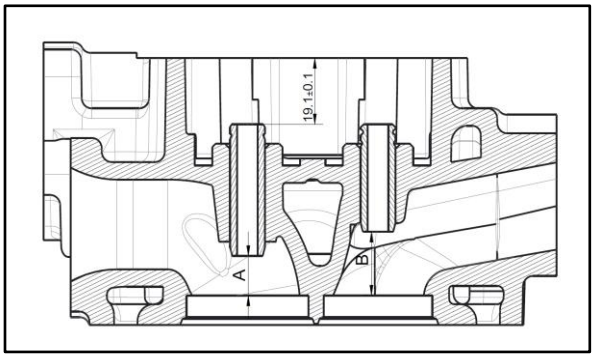


Fig. 9.2

Check that the guide bore has no grooves, seizure marks or carbon deposits. Clean with wire brush and petrol and check clearance from table above.
Guides can be replaced with new guides proceeding as follows:

1. Remove worn guides with tool no. T-09-00-0204 from cylinder head.
2. Ream housing in cylinder head.
3. Heat up cylinder head in oven to 160°- 180°C.
4. Press guides up to 18.5±0.1 from top of the cylinder Head &check A & B. value of A & B must be 20.5±0.1 & 27.5±0.1 resp. (fig. no.22)
5. Insert valves and check that they slide freely in Guides. Cut valve seat and grind valves even for slight Scoring on the parts.
   Lap valves in seat using fine grinding compound.

If seat cutting causes excessive recess of the valve or its contact face width (C) exceeds 3.00 mm. replace Seat as follows:

1. Drill a few 2-3 mm diameter holes through the seat and cut it through with a chisel avoiding Damage to the seat housing.
2. Pull seat out.
3. Warm head in oven to 160^0-180^0 C.
4. Press new seat in using discarded valve or pilot drift.

We recommend this job to be done by a skilled machining shop.
Seat and valve grinding or replacement always required lapping.

When assembling valves, insert valve stem seal on intake & exhaust valve guides.

Valve Springs: Check if springs are damaged or have lost their elasticity. Free length (H) should be 40.85 mm. (Fig. 9.3) Spring compressed under a load of 27kg, must have a length of 32 mm. Replace spring if length is less by 1 mm than specified.

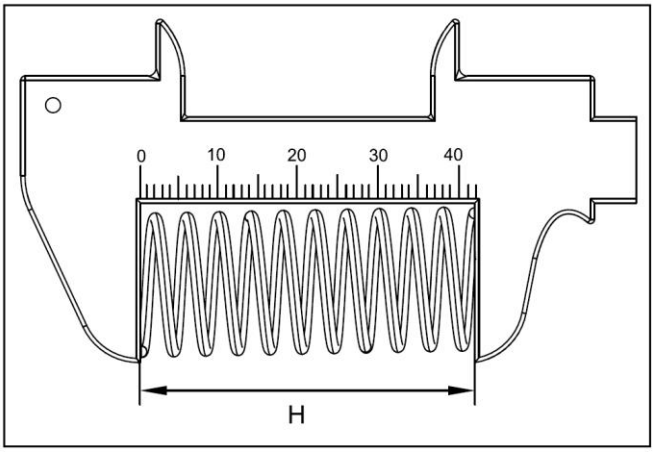


Fig. 9.3

Valve Train:
Components in figure: (Fig. 9.4)

1. Cylinder Head.	2. Guides.
3. Seats.	4. Springs.
5. Valve Collets.	6. Spring Retainer.
7. Valves.	8. Roller Tappet.
9. Push Rods.	10. Rocker Arms.
11. Rocker Fulcrum.	12. Pin Roller Tappet.
13. Valve Stem Seal.	

Replace cam follower pin if badly worn, scored or damaged through seizure.
Tappets and pin Roller Tappet, clearance should not exceed 0.10 mm.
Check that tappet rollers are free and that shaft-roller clearance is not greater than 0.2mm. Inlet and exhaust cam followers are inter-changeable.
Push rods must be straight, end tips in good condition.

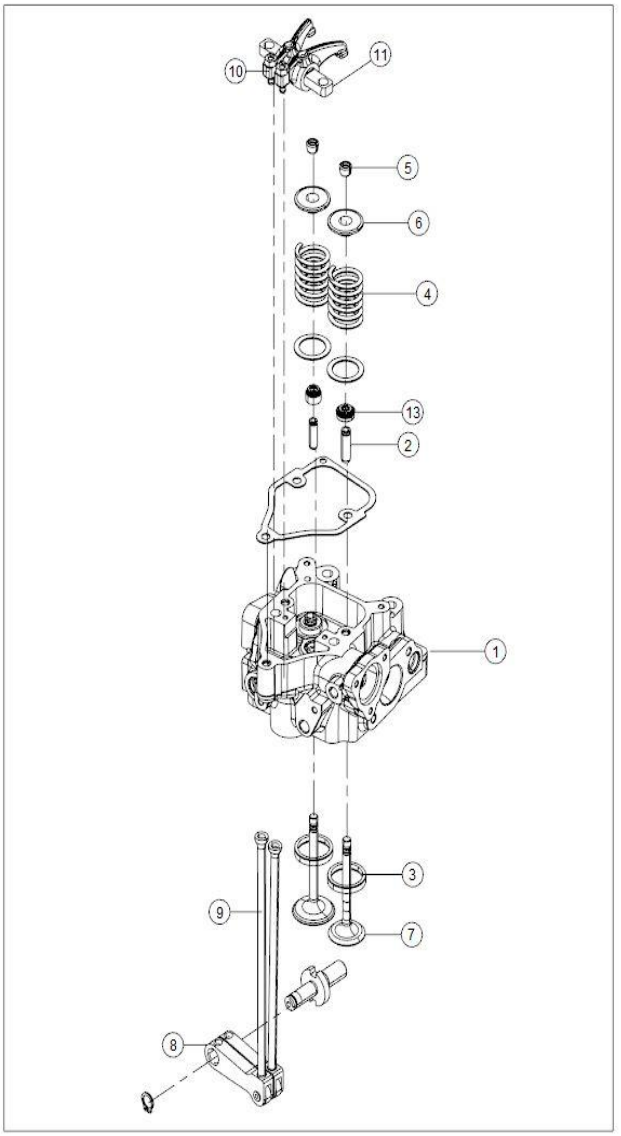


Fig. 9.4

Rocker Arms:
Rocker arms and Rocker fulcrum clearance after assembling should be 0.032-0.061 mm.
Replace both rocker arms and/or Rocker fulcrum if clearance exceeds 0.12 mm.
Rocker arms and valves are lubricated by oil vapors passing from crankcase through the push rod hole in barrel and head.

Spark Plug
Spark plug protrusion:
Check spark plug protrusion
A = 4.0 ± 1 mm. (Fig. 9.6)

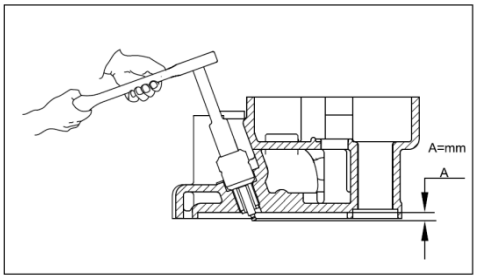


Fig. 9.6

Spark plug designation: FR7DE
Bosch Part No. 0241 A3 5300
Earth Electrode Gap A = 0.7 + 0.1 mm.

(Fig. 9.7)

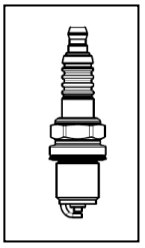


Fig. 9.7

Cylinder:
Set the dial gauge to zero with a calibrated ring. Check diameter (at A and B at three different heights as shown in the figure (Fig. 9.8)
If wear exceeds max. given value by 0.06 mm replace the cylinder. See page 21 for diameter values.

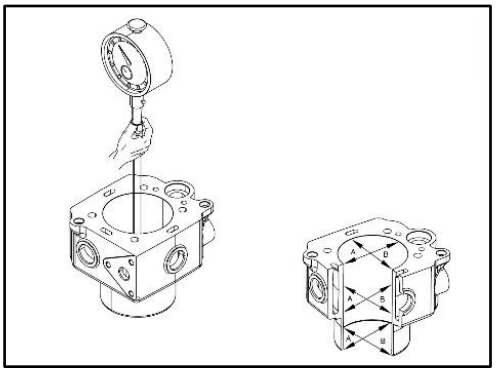


Fig. 9.8

Cylinder classes According to diameter, cylinders are divided into class A & B which feature corresponding piston sizes. (See page No.21)
Each class is identified by a specified marking as A & B on top face of cylinder barrel (Fig. 9.9).

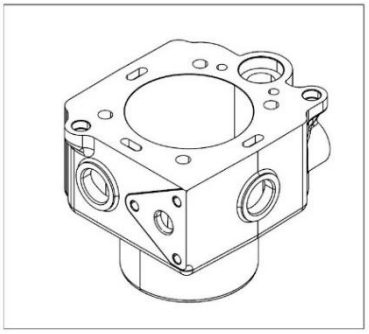


Fig. 9.9

Cylinder roughness
The cross-hatch pattern should be at an angle of 90°-120° lines should be uniform and clean in both directions. (Fig. 9.10)

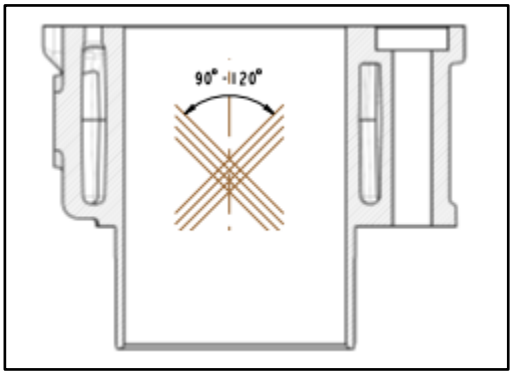


Fig. 9.10

The cylinder surface which comes into contact with piston rings should be machined with plateau method.
Warning: Do not manually hone the cylinder bore surfaces with emery cloth.

Piston and Rings:

Measure piston skirt diameter at 12 mm from base perpendicularly to gudgeon pin (fig. 9.11) (please refer table shown in ASSEMBLY PLAY).

Maximum piston skirt wear must not exceed 0.05 mm on maximum diameter.

Check that clearance between piston pin and piston pin bore is not more than 0.10mm. Otherwise replace piston and piston pin.

Remove rings with the help of expander and scrape away all carbon deposits from ring grooves using a discarded ring and wash in kerosene or solvent. Check for perfect mating between rings and cylinder throughout entire cylinder circumference and measure ring end gap. (Fig. 9.12) File ring end if necessary. (please refer ASSEMBLY PLAY.) Make sure rings move freely in grooves and Measure ring to groove clearance with filler gauge. Replace piston or /and rings if wear limit exceeds.

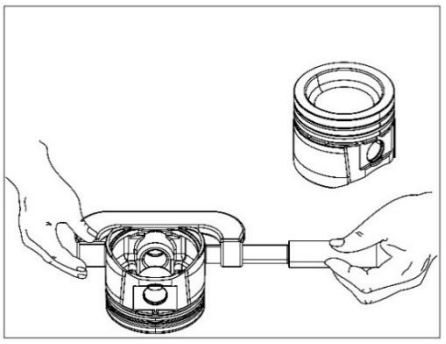


Fig. 9.11

Piston Pin and Connecting Rod:

Ensure that piston pin bears no scoring or seizure marks, otherwise replace it. Measure piston pin and small end bushing diameters to make sure that assembly clearance is 0.015-0.030 mm. If clearance exceeds 0.05 mm, replace both parts.

Connecting rod alignment (Fig. 9.13)

Use a gauge as shown in the figure.

Check that axes are aligned using the piston pin; axial misalignment A=0.05. Moderate warpage may be corrected by gradually working with a press.

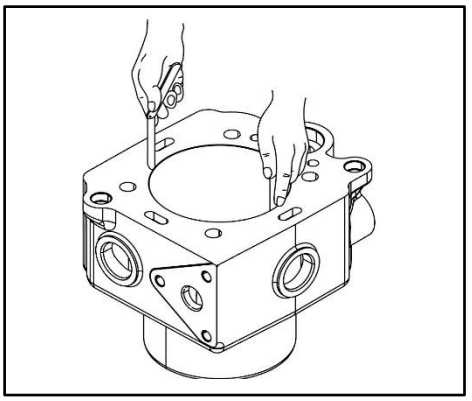


Fig. 9.12

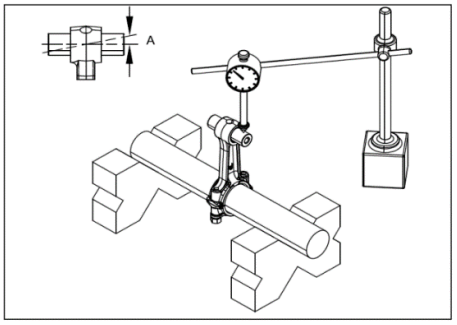


Fig. 9.13

Flywheel:

Replace flywheel, if tapered bore or keyway is damaged. Ensure that the threads of Fan adaptor mounting are not damaged and that machined surfaces have no deformations.

PTO Cover:

1. Check that mating face is not indented. Coupling threaded holes and machining on cover should be free from foreign bodies and should be undamaged.
2. Measure with dial gauge crankshaft bearing, oil seal and cam shaft housings. Check housing diameters (Fig. 9.14) at three different heights.

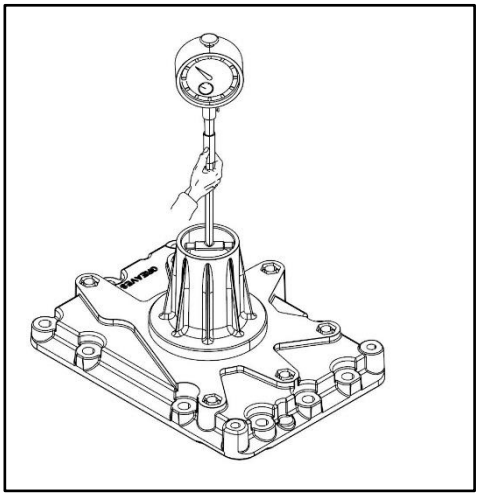


Fig. 9.14

PTO cover bearing and oil seal housing dimensions:

Crank shaft Bearing Housing	Oil Seal Housing	Wear limit
35.975-36.00	38.00-38.039	0.02

Crankshaft:

Cleaning:

Remove plugs A and B by drilling (Fig. 9.15). Dip crankshaft in kerosene or solvent bath, with a metal point remove sludge from oil holes. Insert new plugs and do caulking. Test sealing with compressed air.

Check:

Make sure crankshaft has no cracks, if necessary replace it.

Examine:

Examine gear teeth for wear or dents. Replace crankshaft if necessary. Crankshaft journals and crankpin must be free from seizure marks or grooves. Light grooves or dents should be removed with a very fine carborundum stone and finished with an equally fine grained emery cloth. Tapered ends, key slots and threads must not be worn or out of shape. If they are so, replace crankshaft. Measure with micrometer in two perpendicular directions the diameter of main journals and crankpin (Fig. 9.16). If wear exceeds; grind shaft and install undersize bearings.

Main bearing and connecting rod big end bearing inside diameter and clearance between the corresponding journals (mm)

D = F = 40.050 - 40.060

E = 40.025 - 40.054

(D-A) = 0.050 - 0.070 (D-A) limit value = 0.13

(E-B) = 0.029-0.064 (E-B) limit value = 0.14

(F-C) = 0.050-0.070 (F-C) limit value = 0.1

After seizure, overheating or grinding, make a magna flux check the shaft to detect surface cracks. After cleaning or grinding, the hardness of the journals should be 50-60 Rockwell C, if below, replace crankshaft.

Journal surfaces must be neatly finished without helical grooves and should have a roughness of 0.2-0.5 microns.

Restore journal fillet radii as indicated in figure. (Fig. 9.17)

When grinding crankshaft, do not remove any material from faces C and D.

To remove main bearing from housings of crankcase

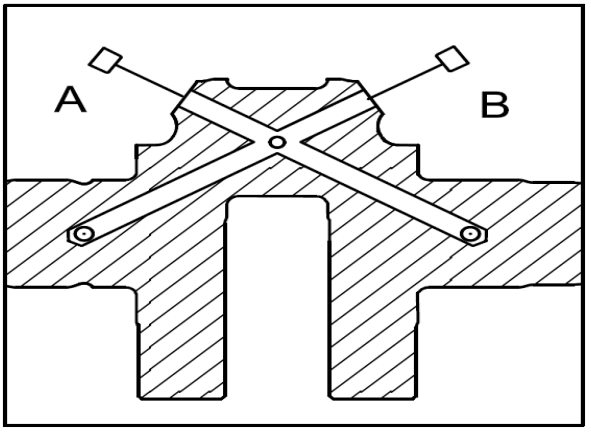


Fig. 9.15

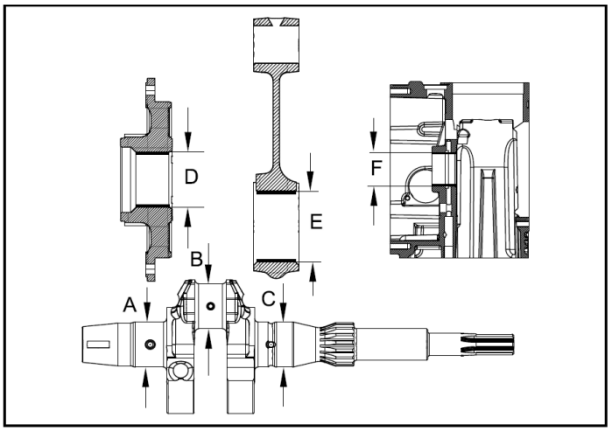


Fig. 9.16

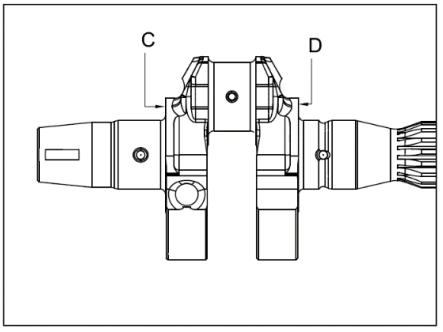


Fig. 9.17

and flywheel end cover, use puller T-09-00-0118 (Fig. 9.18.)

While assembling, match holes with oil drillings and apply Loctite 609 on bearing outer periphery to facilitate bearing holding and to prevent air pockets.

Please refer table given in the Assembly Play for main bearing I.D. and dimensions of crank journals and crank pin.

Big end bearing shells are of thin layer type and do not need machine finishing. Crankshaft journal for P.T.O. cover needle bearing has a diameter of 27.98 - 28.00mm and must not be ground. If wear of this journal exceeds 0.10 mm. replace crankshaft.

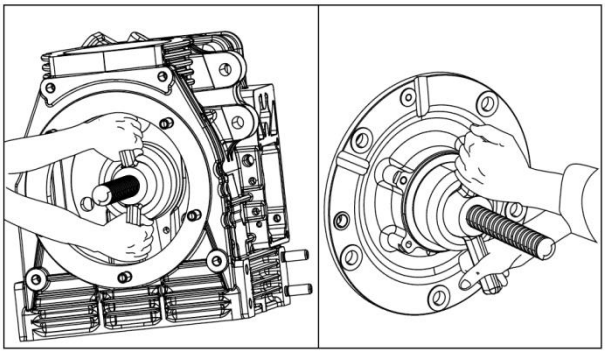


Fig. 9.18

End Play:

Check that thrust washer is of thickness 2.31-2.36 mm, taking measure around washer circumference at different points 90^0 apart. (Fig. 9.19)

Replace thrust washer if thickness is less than 2.2 mm.

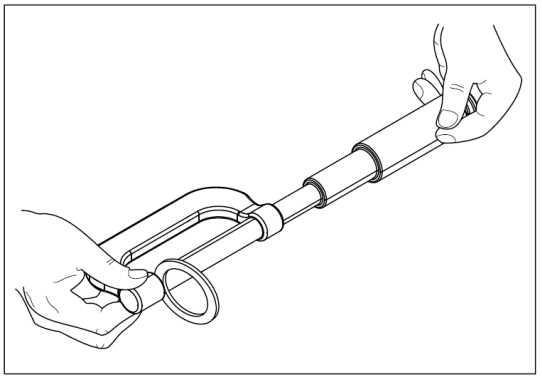


Fig. 9.19

Flywheel Side Crankshaft Support:

1. Check that support resting face is not damaged and that the thrust bearing seat faces and support resting face are true, limit of irregularity is 0.10mm.
2. To remove oil seal ring and bearing support use puller T-09-00-0118.
3. Measure with dial gauge bearing and seal ring housing diameters a-b at three different heights and check support locating diameter (Fig. 9.20)

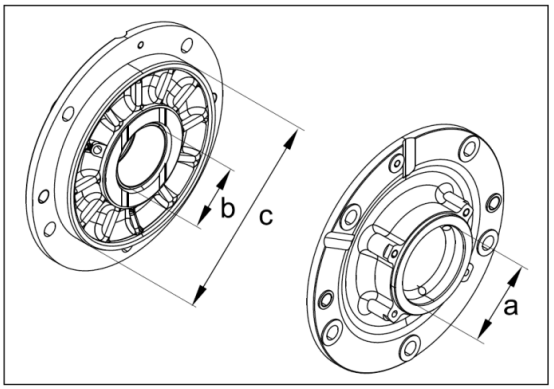


Fig. 9.20

Oil Seal Housing	Bearing Housing	Support Locating Dia.
a	b	C
52.0-52.046	44.0-44.025	124.015-124.04

Replace support if dimensions differ from above table by more than 0.02 mm.

Camshaft:

Clean oil ducts. Make sure that journals, gear and cams are not worn or grooved. Camshaft journal diameters are: 25.937-25.950, 19.957-19.970 and must not be ground. If journal wear exceeds 0.10 mm, replace camshaft. Dimensions of camshaft journal and bore (mm) (Fig. 9.21)

A = 25.976-25.989 (crankcase housing)
B = 25.937-25.950
C = 20.000-20.021 (gear cover housing)
D = 19.957-19.970
(A-B) = 0.026-0.052 (A-B) limit value = 0.095
(C-D) = 0.030-0.064 (C-D) limit value = 0.110
(Fig. 9.22)

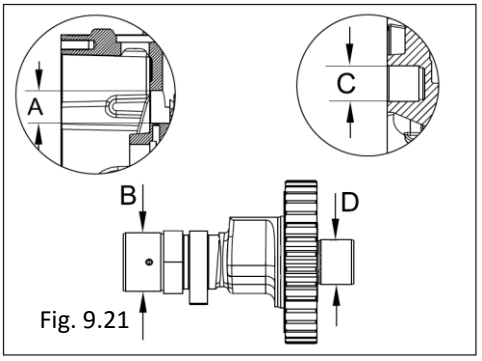


Fig. 9.21

Cam height

Exhaust and intake lobes feature the same height.
Dimensions (mm).
H = 33.05-33.15 (Intake and exhaust)
Light dents or grooves should be removed with a fine Carborundum files and finished with an equally fine grained emery paper. If cam wear is more than 0.1mm replace camshaft.

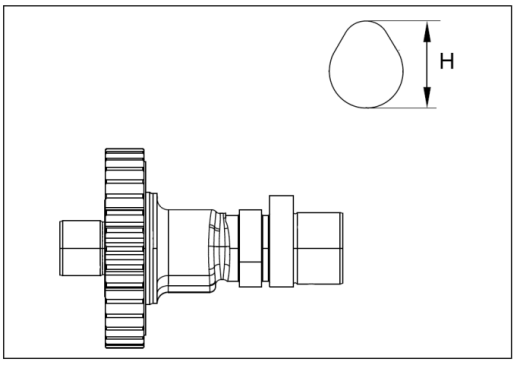


Fig. 9.22

Crankcase:

1. Check conditions of oil passages, threaded holes and cylinder head studs.
2. Measure with dial indicator the diameter A-B of camshaft bearing and crankshaft bearing housings at three different heights. (Fig. 9.23)

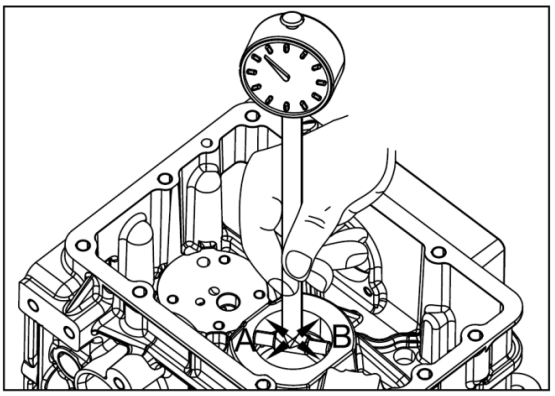


Fig. No 9.23

Lubricating System:

Lubrication in gear pump forced type with full flow filtering at pump outlet.
A by-pass valve is provided in the spin-on type filter/oil filter to allow full oil circulation when filter is clogged Lub. oil, through oil passages, lubricates main bearings and con rod L.E. bearings. Piston, gears, rocker arm, valves and valve guides are splash/mist lubricated. Clean and check all oil passages in crankcase.
Check and clean oil pressure relief valve and its seat in crankcase. Relief valve diameter is 11.939-11.960 mm. If wear exceeds 0.15 mm replace it (Fig.9.24) Pressure relief valve spring should be in good condition and have a free length of 37 mm. Oil pressure must be:

2.0 - 4.5 kg/cm^2 - Max. Engine Speed

1.0 - 2.0 kg/cm^2 - Low Idle Speed

If pressure is low, check relief valve, oil pump or the entire lubrication system and if necessary insert shims between relief valve and spring. When pressure is high replace relief valve spring and check that the valve plunger moves freely in its seat.

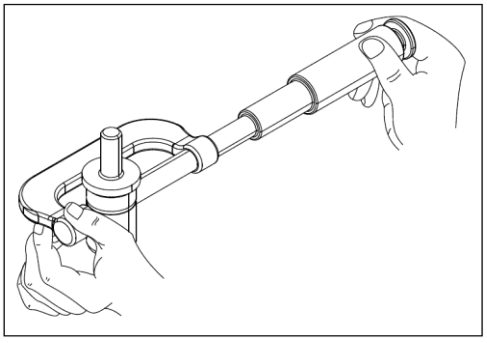


Fig. 9.24

14. RE-ASSEMBLY

Engine:

After checking parts according to the work instructions outlined in the "Overhauls & Checking" chapter, assemble engine according to sequence specified.
Before assembly clean parts with kerosene and dry them with compressed air. Lubricate moving parts to prevent seizure during first starting. Use clean engine oil to lay a lubricating coat on parts. At each assembly, replace gaskets and oil seals.
Use torque wrenches for correct bolt tightening.

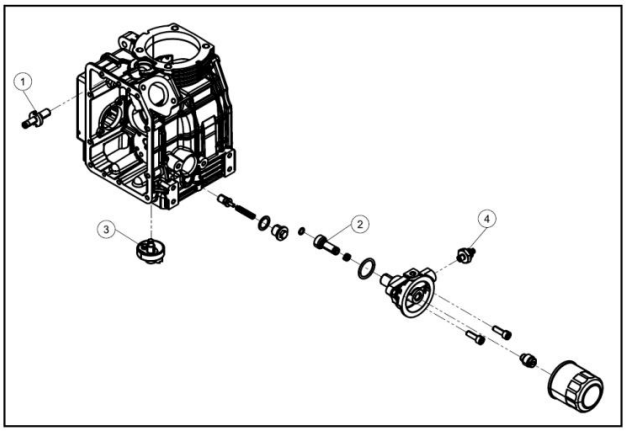


Fig. 10.1

Crankcase: (Fig. 10.1)

1. Clean oil ducts and internal parts with Kerosene and blow crankcase dry with Compressed air.
2. Apply loctite 609 on bearing outer face. Insert main bearing using tool T-09-00-0118 and check that bearing oil hole and crankcase oil grooves are matched. Maintain position of clinch joint of bearing (Fig. 10.2)
3. Install suction bulb, checking that gasket & O-ring are not damaged. Tighten it to 2.5 kg-m.
4. Assemble oil pressure relief valve, flange-oil filter, spin-on type oil filter and oil level dipstick.

Tighten oil pressure relief valve plug to 2.5 kg-m.

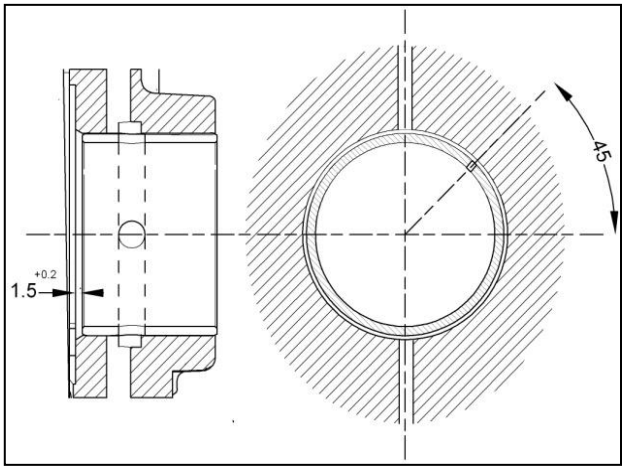


Fig. 10.2

Oil Pump:

1. Thoroughly clean pump sealing face and crankcase face.
2. Assemble pump and gradually tighten socket head screws to 1.0 kg-m.

Dip suction bulb in kerosene and turn pump by hand to test sealing and working of the pump. Kerosene must come out freely from the pump outlet.
To discharge kerosene from pump body and filter, reverse rotation. Fill oil pump with lub oil.

PTO Cover:

Insert needle bearing using tool no. T-09-00-0119 (Fig. 10.3), apply tool on needle cage at engraved number side. Blank side of the cage to be inserted first.

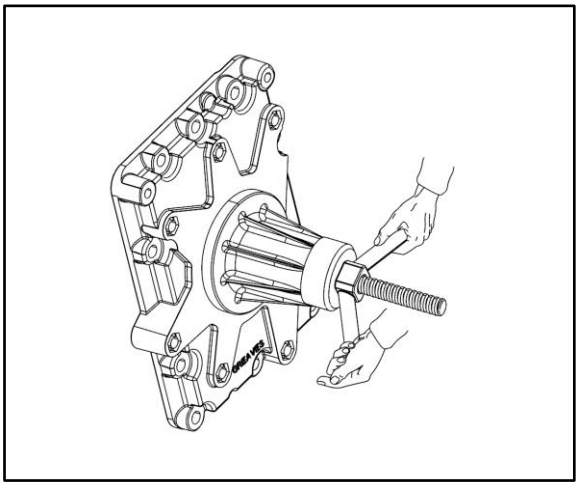


Fig. 10.3

Crankshaft Support Bush (Flywheel End):

Apply loctite 609 to external face of bearing to facilitate holding and to prevent formation of air pockets between bearing and housing. Drive bearing with tool no. T-09-00-0118 (Fig. 10.4). Oil seal must be replaced when signs of burns or cracks on seal faces are detected. Always replace seal while dismantling the bushes.

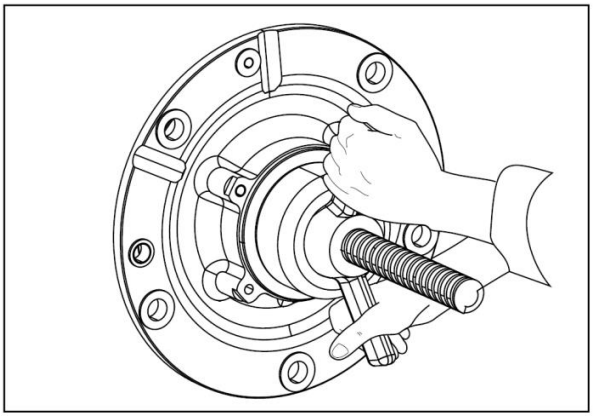


Fig. 10.4

Crankshaft:

Place side thrust bearing in its seat applying some grease to keep it in place. Apply fresh oil on main bearing bush and mount crankshaft carefully to avoid
touching bearing face with crankshaft main drive gear.
Install main support at flywheel side & tighten nuts to 2.5 kg-m.
Check end float of crankshaft with feeler gauge. End float must be 0.12-0.37 mm (Fig. 10.5).

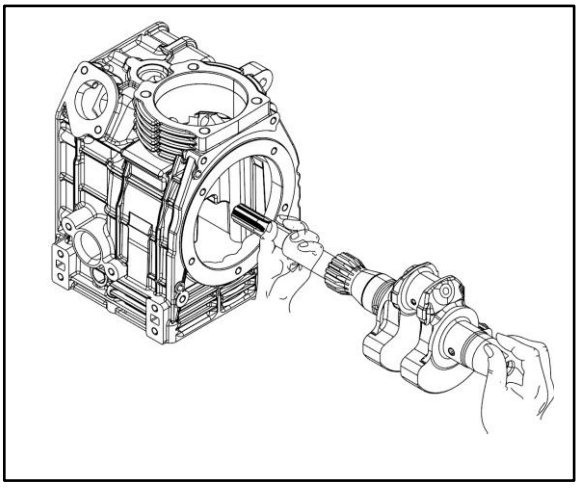


Fig. 10.5

Cam Follower Lever:
Insert cam follower lever in fulcrum placing inlet tappet and exhaust tappet. (Fig. 10.6)
Secure cam follower lever in place with circlip. Cam follower levers are interchangeable.
Note: - The threading of fulcrum is left hand.

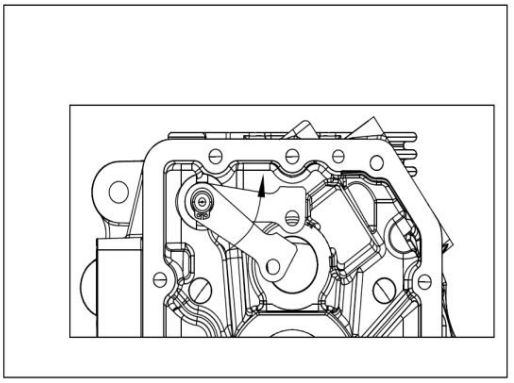


Fig. 10.6

Timing: Lift hinged tappets as shown in fig 52 and insert camshaft matching timing marks on teeth with piston crank pin position at TDC. (Fig. 10.7
When timing marks are not punched on gears, do the following:
Locate crank pin position at TDC (piston A at TDC).
Lift tappets B and introduce camshaft so that intake cam C and exhaust cam D are balanced (intake cam opens, exhaust closes).
Perform the final check, Intake and exhaust tappets B should be at the same level when resting on the corresponding cams.
Punch or Mesh-timing on gears. Camshaft end play must be 0.2-0.6 mm and can be adjusted with gaskets between crankcase and cover. Gaskets are supplied in 0.2-0.3 mm thickness. The gap between camshaft thrust face and crankcase machined cover mating face must not be greater than 0.10 mm. Cover mating face and camshaft thrust face should be at the same height, therefore amount of end play can be easily ascertained and adjusted with the gaskets.

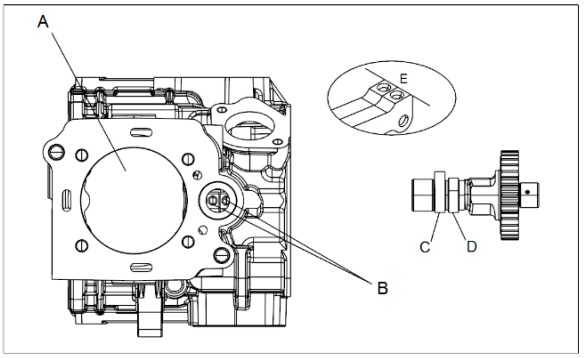


Fig. 10.7

OIL PUMP:- Assemble the oil pump as shown in fig 10.8. Insert the gear oil pump matching the teeth with crankshaft teeth.

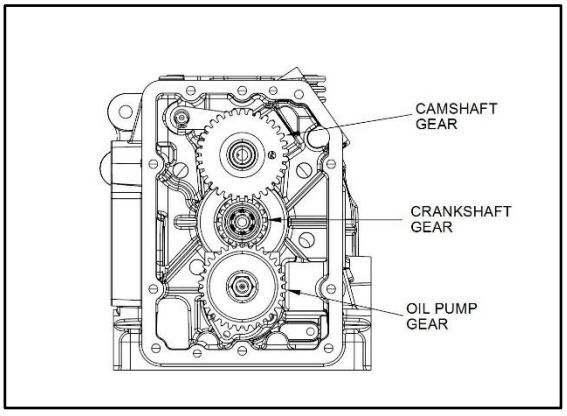


Fig. 10.8

Stator Assembly :
Assemble the Stator Assembly on flywheel end cover.

Starter Plate :
Assemble starter plate at flywheel end side, and mount the pulsar coil on starter plate.

Flywheel:
Clean crankshaft taper end and flywheel tapered bore. Mount flywheel and check that key fits correctly into slot.
Tighten flywheel bolt to 17 kg-m turning always in the opposite direction of engine rotation. (Fig.10.9). To stop flywheel movement while applying torque use "Locking Tool for Flywheel" Part number MS432955.

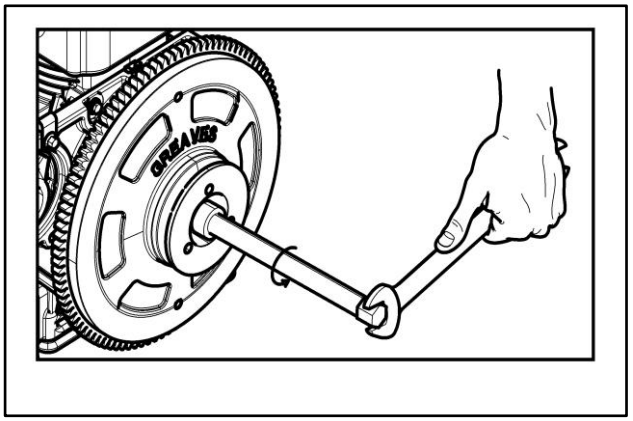


Fig. 10.9

Piston and Connecting Rod:

Crown face is indexed with an arrow that must point towards flywheel side (Fig.10.10). Assemble piston and connecting rod inserting the piston pin by hand pressure without preheating piston. Secure pin with circlips.

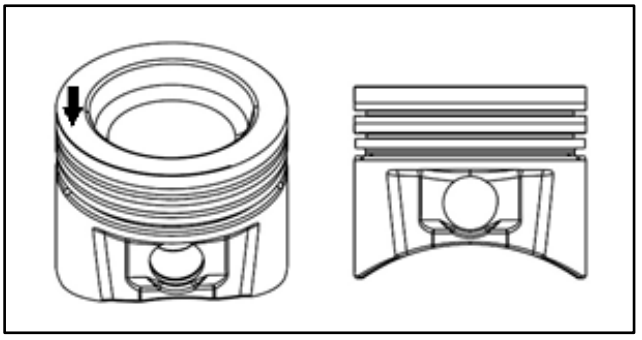


Fig. 10.10

Ensure Piston Ring end gaps 120° apart in circular fashion before fitment

Apply oil to cylinder surface and piston with rings. Install complete piston-connecting rod assembly pressing ring on piston with ring compressor to insert piston into cylinder.

Mount connecting rod cap making sure that bearing notch on cap and on con. Rods are on the same side (Fig. 10.11). Tighten con. rod bolt to 4 kg-m

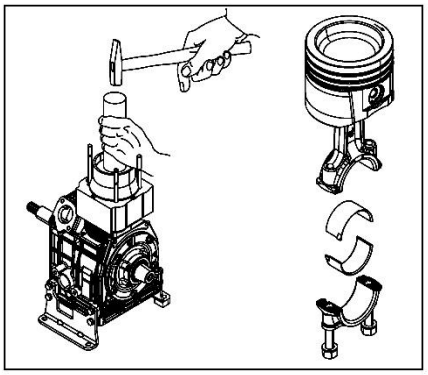


Fig. 10.11

Note: Whenever major overhauls are carried out, replace connecting rod bolts, washers and bearings.

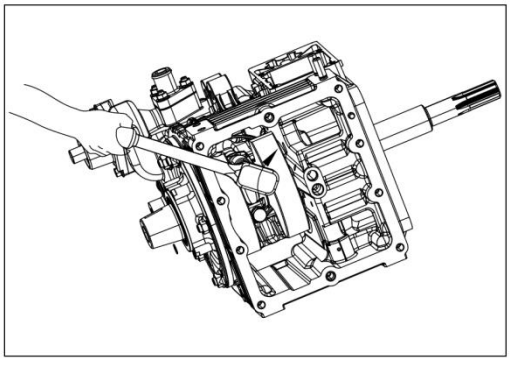


Fig. 10.12

Bumping Clearance:

Always measure bumping clearance from barrel face instead MLS gasket top face. Nominal value is 0.35-0.75 mm measured from barrel top face before assy of MLS gasket.

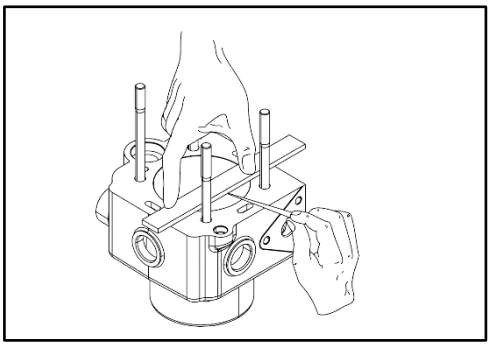


Fig. 10.13

Push Rod:

Mount first push rod (from cylinder center) Towards intake side manifold rocker arm & second push rod(from cylinder center) Towards exhaust side manifold rocker arm.
(Fig. 10.14).

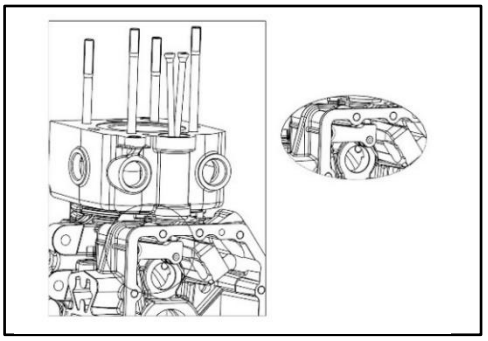


Fig. 10.14

Cylinder Head:

Assemble cylinder head components:

1. Introduce valves and check that stems move freely in guides.
2. Insert spring plate and oil seal ring on inlet valve stem.
3. Mount spring, spring retainer & collets.
4. Compress spring with tool no. T-09-00-0063 and insert locks (Fig. 10.15*)*, Make sure the collets are properly seated by few taps on valve stem ends.
5. Mount Spark plug & tighten it applying 3-4 kg-m torque.

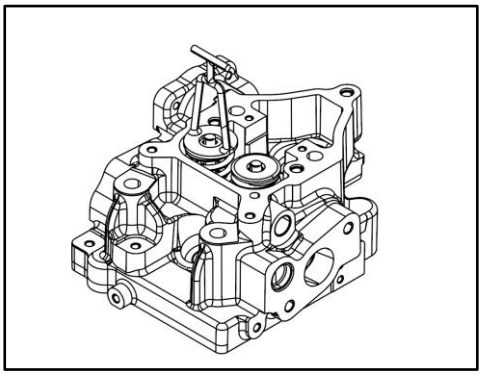


Fig. 10.15

After mounting MLS gasket, Mount cylinder head on cylinder, Place rocker arms and rocker arm shaft with plain washers on cylinder Head and gradually tighten cylinder head nuts, working crosswise to 3.5 kg-m (Fig. 10.16). Pay attention to correct positioning of Seal push rod.

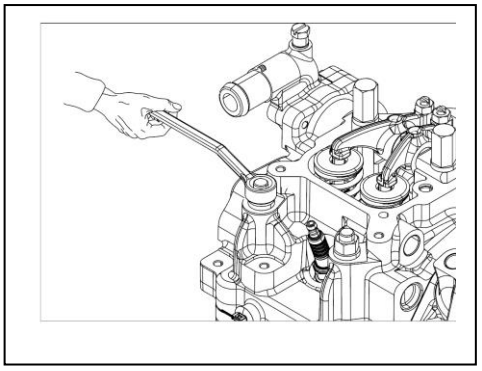


Fig. 10.16

Valve Clearances:

Fig. 10.17

With cold engine, set both valves tappet clearance to ~0.15 mm after turning flywheel until piston reaches T.D.C. position on compression stroke (Fig. No. 58) Mount rocker arm cover.

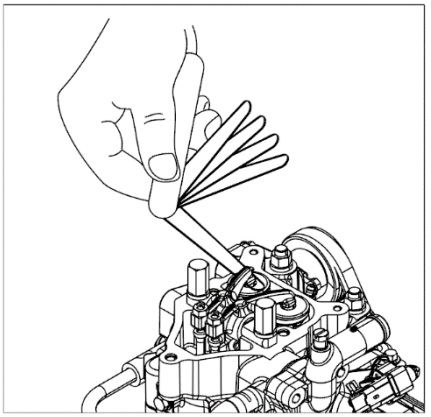


Fig. 10.17

15. STORAGE

Instructions for Storage

Temporary Protection (1 to 6 months)

1. Run engine at low idle for at least 15 minutes with normal oil & drain it.
2. Fill crankcase with protection oil MIL-1-644-P9-and run the engine at 3/4 maximum speed for 5-10 minutes.
3. With engine hot, drain oil and fill with normal oil as recommended.
4. Remove fuel line and drain tank.
5. Drain coolant.
6. Dismantle fuel filter, replace if dirty.
7. Seal all openings with adhesive tape.
8. Remove spark plug, pour a tablespoon of SAE 30 oil in cylinder and turn crankshaft to spread oil. Reassemble spark plug.
9. Spray SAE 10 W oil in exhaust and intake manifolds, rocker arms, valves, and tappet and protect unpainted parts with grease.
10. Wrap engine in a plastic sheet.
11. Store engine in a dry place, possibly off the ground and away from high power lines.

Permanent Protection (over 6 months)

After following the same procedure as above, we recommend taking the following precautions.

1. Treat lubrication systems, and all moving parts with anti-rust oil with MIL-L-21260 P10 Grade 2, SAE 30 Characteristics (such as ESSO Rust-Ban 339, Valvoline Tectyl 873) by turning engine and discharging excess anti-rust compound.
2. Coat all external unpainted parts with an anti-rust product with MIL-C-1617 C-3 Grade 3 characteristics (Such as ESSO Rust-Ban 392: Valvoline Tectyl 894).

Return to service

1. Clean exterior.
2. Remove protections and covers.
3. Remove anti-rust products from exterior with appropriate solvent or grease solvent.
4. Dismantle spark plug fill with normal engine oil and turn crankshaft a few times.
5. Remove oil sump and remove oil containing protective agent.
6. Check spark plug, valve clearance, cylinder head torque, oil filter and air cleaner. If engine has been stored for a long period (over six months) inspect one bearing for possible corrosion marks.
7. Make normal pre-starting checks as indicated on page 7 to 10 before starting engine.

INSTALLATION

Engines are supplied in a range of versions for application on different machines.

The following information is given for a correct Installation.

For special application consult GREAVES COTTON LIMITED TECHNICAL DEPARTMENT.

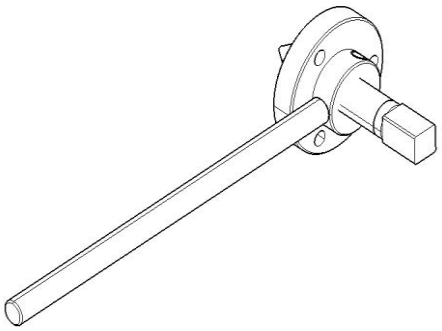
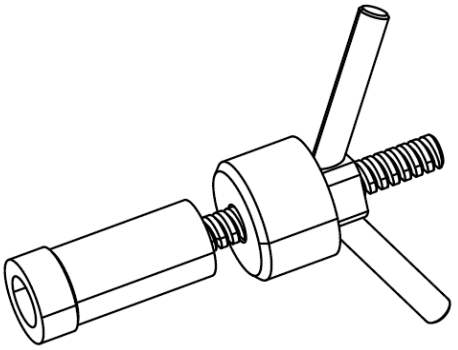
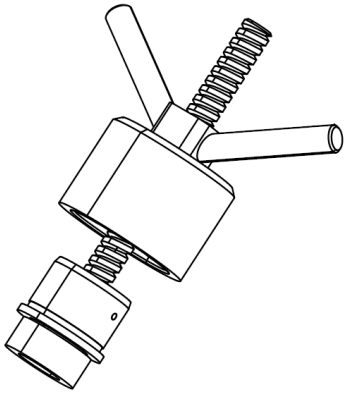
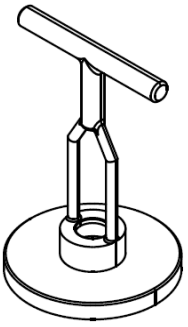
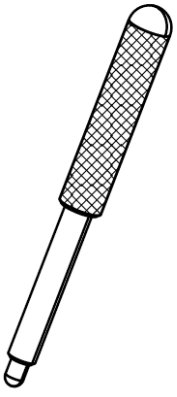
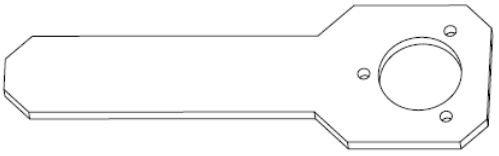
ENTIRE RATED POWER TAKES OFF.

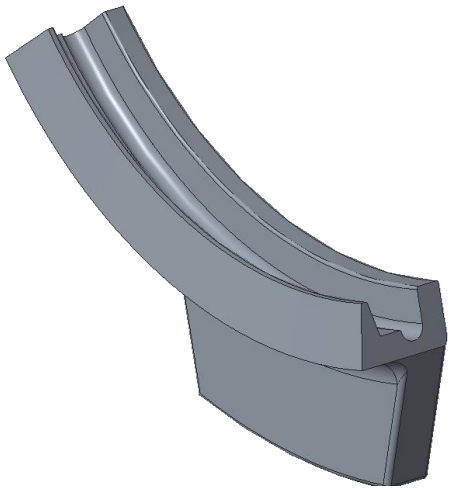
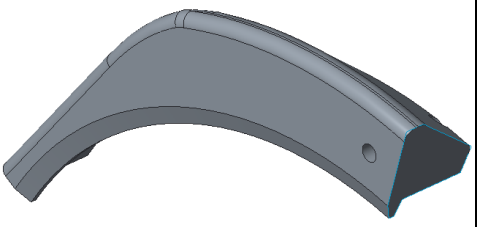
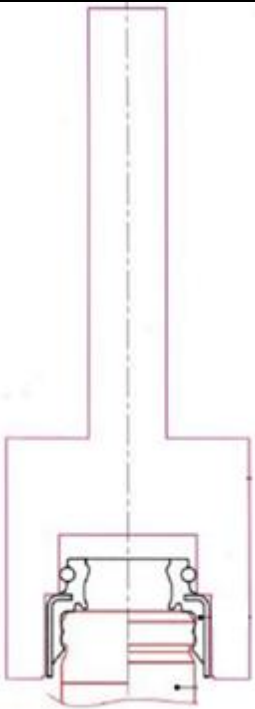
MAIN PTO		AUXILIARY P.T.O.	
RPM	ROTATION	RPM	ROTATION
3400		3400	

16. PRECAUTIONARY MEASURES

1. OEMs to ensure proper engine intake system to avoid dust entry.
2. Air intake should be positioned to ensure minimum dust loading in the intake system.
3. Spark cut off at 4000 rpm is provided within the TCI Unit. Increasing engine speed above this rpm will result in engine misfire. Hence engine speed should never be increased above 4000 rpm.
4. Check whether the gap between cylinder head & barrel is within 0.3 to 0.7mm.
5. Radiator should be selected such that ATB is more than 55 ^{0}C
6. Use12V, 50Ah Battery

17. INDEX FOR SPECIAL SERVICE TOOL FOR G400WG ENGINE

TOOLS	REFERED ON PAGE	TOOLS	REFERED ON PAGE
 MS422703 Puller for removing flywheel	20	 T-09-00-0119 Puller for needle bearing and sealing ring	20,35
 T-09-00-0118 Puller for removing main bush	20,31,35	 T-09-00-0063 Tool for compressing valve spring	38
 T-09-00-0204 Punch for removing worn valve guides	26	 LOCKING TOOL FOR FLYWHEEL MS432955	37

TOOLS	REFERED ON PAGE	TOOLS	REFERED ON PAGE
 MS422703 Tool for Belt installation	49	 T-09-00-0119 Tool for belt uninstallation	50
 Dolly for Stem Seal Fitment	52		

18. CARBURETOR ASSEMBLY

Make - SPACO
Type AW 20 Series

Description	Tightening Torque
Main Jet	15 ± 4 kgf.cm
Pilot Jet	15 ± 4 kgf.cm
Needle Jet Holder	25 ± 6 kgf.cm
Drain Plug	15 ± 4 kgf.cm
Screw Assly	21 ± 6 kgf.cm
Housing Choke	18 to 22 kgf.cm
Screw TPS fixing	4 to 6 kgf.cm
Mixing Chamber Cover	25 ± 6 kgf.cm

16.1 Tuning of Carburettor for Idle

1. If carburettor setting is disturbed, set it to 1 to 1.5 turns (std. setting) from closed position
2. Warm up engine by running the vehicle for 3 to 4 km to maintain engine Temp 55 - 60 Degree.
3. Adjust the idle RPM to as per your requirements mentioned in SIB.
4. Always keep the RPM at higher tolerance band for better start ability & idle Stability in cold conditions.

16.2 Do's and Don'ts

Sr No	DO'S	DON'Ts
1	Always keep Carburettor clean from outside	Do not use sharp objects to clean the passages of Body, Jets and Needle Jet Holder
2	Clean the air filter regularly with compressed air.	Do not use dirty petrol / kerosene for cleaning of Carburettor
3	Run The vehicle at a reasonable and steady speed	Do not change original setting
4	Always use SPACO genuine parts procured from SPACO's Authorized Distributors.	Do not temper / change original Main Jet & Pilot Jet
5	Use dry Compressed air for Cleaning the holes / passages, Jets & Needle Jet Holder	Do not over tighten Jets and other removable parts
6	Always fit Carburettor in a vertical position on the vehicle	Do not over-tighten Carburettor Fixing Screw while fitting it on the intake manifold.
7	Check for TPS connectors are properly connected	Magnet polarity should not be disturbed in field
8	TPS screw should be properly tightened	TPS & magnet should not be removed from carburettor during service

16.3 Carburetor Trouble Shooting

PROBLEM	CAUSE	RECTIFICATION
STARTING TROUBLE	Clogged starter circuit	Clean starter circuit with crab cleaner
	Pilot jet clogging	Clean jet with spray/replace if necessary
	Low fuel level	Adjusts floats height to spec.
	Flooding	Check float for damage or float height.
IDLING NOT STABLE	Pilot jet clogging	Clean jet spray/ replace
	Incorrect pilot screw setting	Adjusts pilot screw as per specification
	High/low fuel level	Adjusts float heights to spec.
	Piston valve sticky	Clean piston valve/ mixing body and ensure no damage in piston valve and diaphragm.
FLOODING	High fuel level	Adjusts float height for spec.
	Improper seating of needle valve in valve seat.	Clean needle valve/ replace if necessary.
	Float puncture	Replace
POOR PICK UP	Main/ Pilot jet clogged	Clean/ Replace
	High / Low Fuel level	Adjusts float height to spec.
	Incorrect E-ring position in jet needle.	Assemble E- ring in correct position.
POOR MILEAGE	Clogging of main air / pilot air circuit	Clean with crab .Cleaner
	High fuel level	Adjusts float height to spec.
	Incorrect E- ring position in jet needle	Assemble E-ring in the correct notch.
BLOCKING OF FUEL	Clogging of fuel hose coming from fuel tank	Change the fuel hose
	Clogging of fuel inlet nipple	Remove the dust with small needle and clean with air
MISFIRE	Clogging of main air / pilot air circuit	Clean with carburetor Cleaner
	Part missing	Check the presence of Ball plugs and Air jets

Trouble Shooting

When the carburetor setting is not correct for the engine, various irregularities are noticed, These can be traced to two causes as a whole.

A Mixture too rich: - It is caused by improper setting and leaking starter valve & results in the following

1 The engine noise is dull and intermittent.

2 The condition grows, worse, when the starter is opened.

3 The condition is worse when engine gets hot.

4 Removal of the air cleaner will improve the condition somewhat.

5 Exhaust gases are heavy.

6 Spark plug is fouled.

B Mixture too lean: - It is caused by improper setting and chocked passages/jets and results in the following :-

1 The engine gets overheated.

2 The condition improves when the starter is opened.

3 Acceleration is poor.

4 Spark plug burns.

5 The revolution of the engine fluctuates and lack of power is noticed.