

**Mahindra**

**Jivo 365 DI**



**SERVICE MANUAL**

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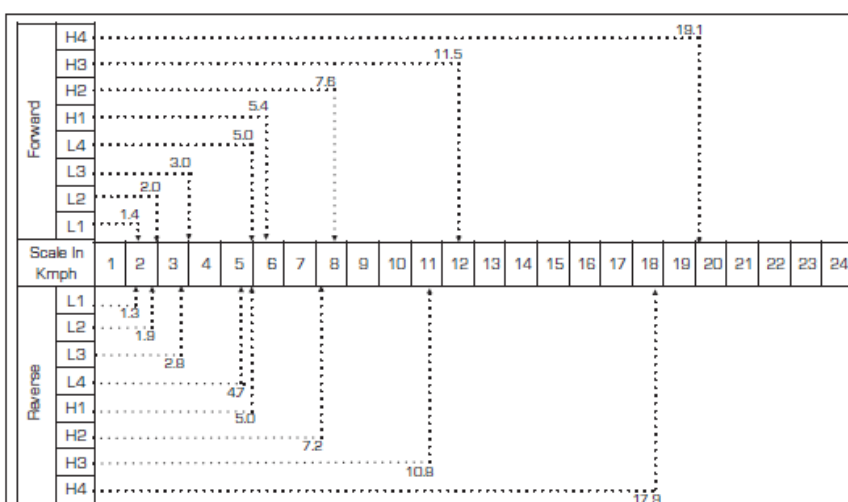
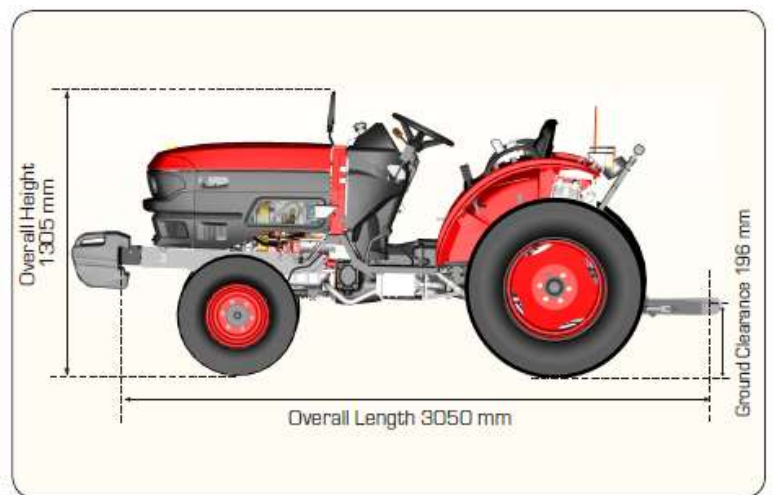
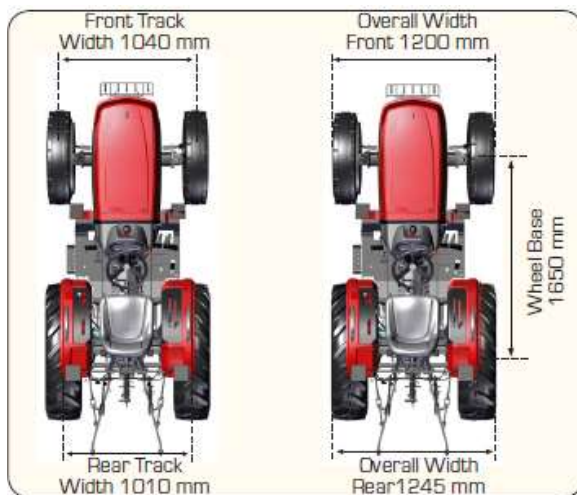
## PRODUCT SPECIFICATION

### Mahindra Jivo 365

<b>ENGINE</b>	
Type	Mahindra MDI
No of Cylinders	3
Engine Power	36 HP
Bore	88.9
Stroke	110
Displacement CC	2048
Rated Governor Speed	2600
Low Idle RPM	850 ± 50
High Idle RPM	2850 ± 50
Air Cleaner	Dry Type
Cooling System	Forced Circulation of Coolant
<b>Clutch</b>	
Clutch Type	9.5" Dry Friction Plate
<b>TRANSMISSION</b>	
Type	Forward Reverse – Synchro Speed – Constant Range – Sliding
No of Gears	8 Forward & 8 Reverse
Power Take Off	Rear mounted Six Splines, 590 & 845 @ 2600 erpm
PTO RPM at Rated Engine Speed	590 & 845 @ 2600 erpm
Brakes	Mechanical Dry Disc Type Oil Immersed Brake (OIB)
<b>HYDRAULICS</b>	
Type	Fully Live Hydraulic with Position & Draft Controls
Lifting Capacity (Kgs)	900 @ Hitch
<b>TRACTOR</b>	
Steering Type	Power Steering
Tyre Size Front	<b>Vineyard</b> - 152 X 305 mm (6.0 x 12 inch) 4 PR <b>Paddy</b> - 203 X 406 mm (8.0 x 16 inch) 4 PR
Tyre Size Rear	<b>Vineyard</b> - 241 X 508 mm (9.5 x 20 inch) 6 PR <b>Paddy</b> - 315 X 610 mm (12.4 x 24 inch) 6 PR
<b>CAPACITIES (Litres)</b>	
Engine (Including Filter)	6.5
Cooling System (Approx)	5.7
Fuel Tank	<b>Vineyard</b> - 25 <b>Paddy</b> - 35
Transmission & Hydraulic System	31
Total Weight Of Tractor Without Ballast (Kg)	<b>Vineyard</b> - 1213 <b>Paddy</b> - 1450

**PRODUCT SPECIFICATION**

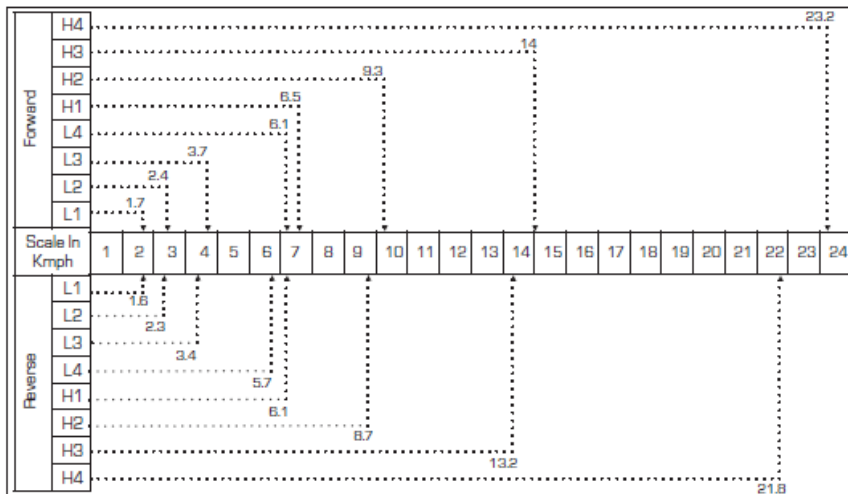
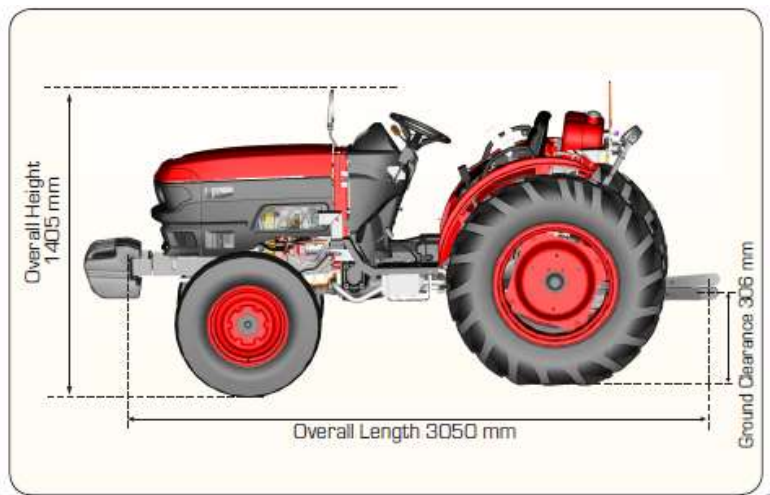
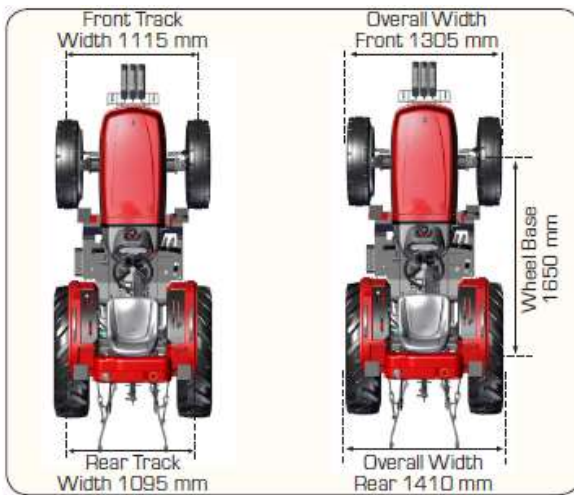
TRACTOR DIMENSIONS (mm) - Vineyard	
Overall Height	1305 ± 20
Overall Length	3050 ± 20
Ground Clearance	196 ± 20
Overall Width	"Front - 1200 ± 20, Rear - 1245 ± 20"
Wheel Base	1650
Front Track Width	1040 ± 20
Rear Track Width	1010 ± 20



Application Suitability Chart		
Sr. No	Application	Recommended Gear
1	Plough (10 Inch)	H1
2	Cultivator / Duck Foot	H2
3	Rotavator (1.2m)	L3
4	Seed Drill	H2

**PRODUCT SPECIFICATION**

TRACTOR DIMENSIONS (mm) - Paddy	
Overall Height	1405 ± 20
Overall Length	3050 ± 20
Ground Clearance	306 ± 20
Overall Width	"Front - 1305 ± 20, Rear - 1410 ± 20"
Wheel Base	1650
Front Track Width	1115 ± 20
Rear Track Width	1095 ± 20



Application Suitability Chart		
Sr. No	Application	Recommended Gear
1	Plough (12 Inch)	H1
2	Cultivator / Duck Foot	H1
3	Rotavator (1.6m)	L2 or L3
4	Seed Drill	H4

## PRODUCT SPECIFICATION

### SAFETY - ALERT SYMBOL AND TERMS

Why is SAFETY important to you?

ACCIDENTS DISABLE AND KILL

ACCIDENTS ARE COSTLY

ACCIDENTS CAN BE AVOIDED





This Safety Alert Symbol means ATTENTION! BE ALERT! YOUR SAFETY IS INVOLVED!

The safety alert symbol identifies important safety messages on machines, safety signs, in manuals, or elsewhere. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions given in the safety messages.

Remember that YOU are the key to safety. Good safety practices not only protect you, but also the people around you. Study the features in this manual and make them a working part of your safety program. Keep in mind that this safety section is written only for this type of machine. Practice all other usual and customary safe working precautions, and above all - REMEMBER - SAFETY IS YOUR RESPONSIBILITY. YOU ONLY CAN PREVENT SERIOUS INJURY OR DEATH.

SAFETY - DANGER, WARNING and CAUTION

Whenever you see the words and symbols shown below, used in this book and on decals, you MUST take note of their instructions.

- |  |   |  |
|--|---|--|
|  <b>DANGER</b>  | - | The symbol and the word DANGER indicates an imminently hazardous situation with, if not avoided, will result in DEATH OR SERIOUS INJURY.   |
|  <b>WARNING</b> | - | The symbol and the word WARNING indicates a potentially hazardous situation. If the instructions or procedures are not correctly followed it could result in PERSONAL INJURY, OR LOSS OF LIFE. |
|  <b>CAUTION</b> | - | The symbol and the word CAUTION identifies special instructions or procedure which if not strictly observed, could result in DAMAGE, DESTRUCTION OF EQUIPMENT, OR PERSONAL INJURY.             |
|  <b>NOTE</b>    | - | The word NOTE indicates points of particular interest for more efficient and convenient repair or operation.   |



**MAINTENANCE**

## MAINTENANCE CHART

<b>Preventive Maintenance Schedule</b>						
Details	Activity	To be done by Operator	To be done by Dealer Technician			
		10 Hrs / Periodic	100 Hrs	350 Hrs	600 Hrs	850 Hrs
<b>Tractor</b>						
Tractor Cleaning & washing	Do	✓	✓	✓	✓	✓
Grease all Nipples	Do	✓	✓	✓	✓	✓
Toe- In	Check	☐	✓	✓	✓	✓
All Visible Nuts & Bolts	Tighten	✓	✓	✓	✓	✓
Oil Leakages	Check & rectify	✓	✓	✓	✓	✓
<b>Engine</b>						
Oil Level	Check	✓	✓	✓	✓	✓
Oil M- Star Premium	Change	☐	✓	✓	✓	✓
Oil Filter	Change	☐	✓	✓	✓	✓
Valve Clearance (Tappet Setting)	Check	☐	✓	✓	✓	✓
Low-Hi Idle Engine R.P.M.	Check	☐	✓	✓	✓	✓
Power, Response & Exhaust Smoke	Check	☐	✓	✓	✓	✓
Belt Tension	Check & Set	☐	✓	✓	✓	✓
<b>Air Cleaner</b>						
Primary Element*	Clean / Change	✓	✓	✓	✓	<b>Change</b>
Safety Cartridge	Clean / Change					
Hose Connections	Check	✓	✓	✓	✓	✓
<b>Fuel System</b>						
Fuel Filter	Change			✓	✓	✓
Injector	Check			✓	✓	✓
* - Air cleaner primary element to be cleaned only after indication of its chocking. Air cleaner element to be changed after three cleanings or at 850 Hrs. Safety Cartridge not to clean.						



## MAINTENANCE CHART

<b>Preventive Maintenance Schedule</b>						
Details	Activity	To be done by Operator	To be done by Dealer Technician			
			10 Hrs / Periodic	100 Hrs	350 Hrs	600 Hrs
<b>Transmission</b>						
Oil level	Check	✓	✓	✓	✓	✓
Oil (Common Transmission & Hydraulic), Grade: Mahindra M-Star Oil (OIB)"	Change				□	✓
<b>Cooling System</b>						
Thrash Guard	Clean	✓	✓	✓	✓	✓
Radiator Fins	Clean	✓	✓	✓	✓	✓
Coolant - Water	Check & Top Up	✓	✓	✓	✓	✓
Fan Belt & Fan Belt Tension	Check & Correct	✓	✓	✓	✓	✓
<b>Hydraulics</b>						
Suction Filter	Change		✓	✓	✓	✓
<b>Electrical System</b>						
Battery Electrolyte Level	Check		✓	✓	✓	✓
Battery Terminals	Clean		✓	✓	✓	✓
Battery Vent Plug Holes	Clean		✓	✓	✓	✓
Alternator Belt & Alternator Belt Tension	Check		✓	✓	✓	✓
Instruments & Gauges	Check		✓	✓	✓	✓
Light & Horn	Check		✓	✓	✓	✓
<b>Clutch</b>						
Free Play*	Check		✓	✓	✓	✓
<b>Brakes</b>						
Free Play*	Check		✓	✓	✓	✓
Breather	Check		✓	✓	✓	✓
Rubber Boot	Check		✓	✓	✓	✓
Working Of Hand Brake	Check		✓	✓	✓	✓

## MAINTENANCE CHART

<b>Preventive Maintenance Schedule</b>						
Details	Activity	To be done by Operator	To be done by Dealer Technician			
		<b>10 Hrs / Periodic</b>	<b>100 Hrs</b>	<b>350 Hrs</b>	<b>600 Hrs</b>	<b>850 Hrs</b>
<b>Tyre</b>						
Air Pressure	Check	✓	✓	✓	✓	✓
<b>Front Axle</b>						
Front Wheel Bearing free play*	Check		✓	✓	✓	✓
<b>Front Axle (4WD)</b>						
Oil Level	Check		✓	✓	✓	✓
Toe - in (3 to 5 mm)	Check & Set		✓	✓	✓	✓
Oil (80 W 90 GL5)	Change		✓	□	□	✓

## SPECIAL SERVICE TOOLS

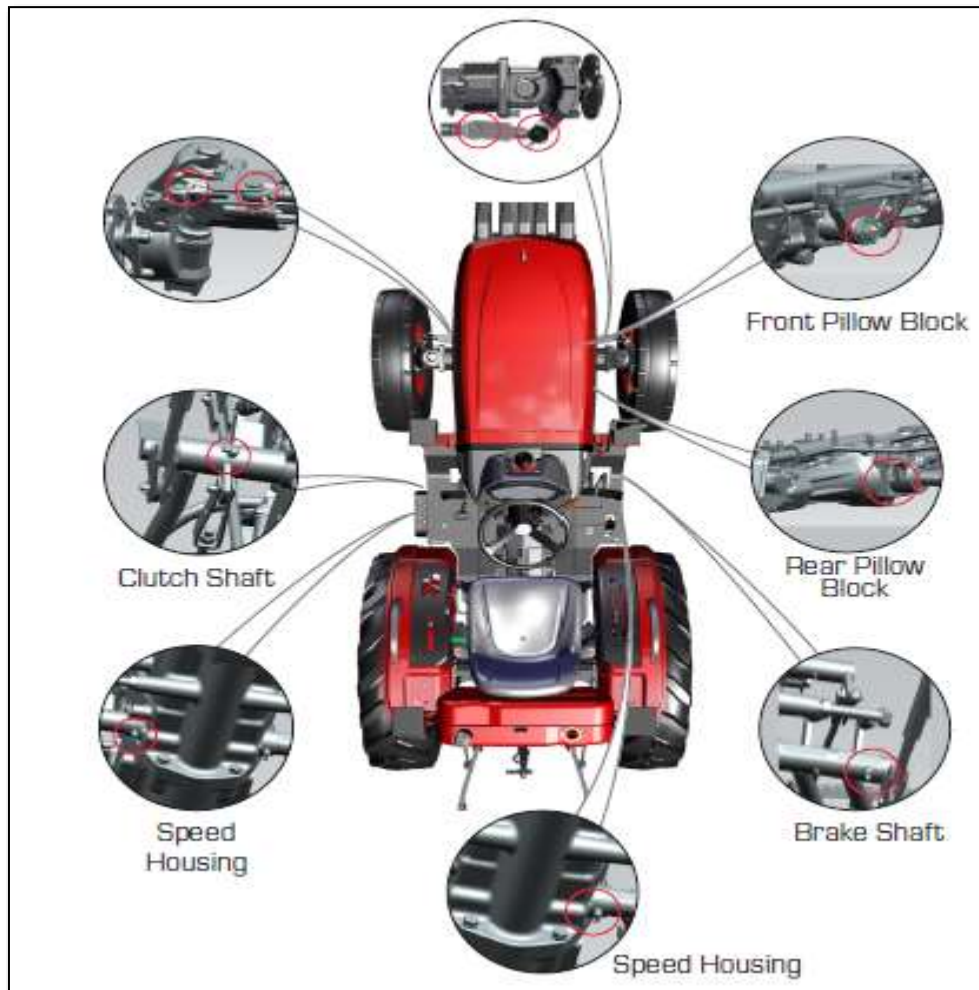
### Kit Part No 00000030071K

Sr. No	Tool No	Tool Description	Aggregate
1	MST-9A01-FA-101	Front Axle King Pin Seal Dolly	4WD Front Axle
2	MST-9A01-TN-102	Main Shaft Oil Seal Pressing Tool	Transmission
3	MST-9A01-4W-103	4WD Pinion Check Nut Loosening Tool	4WD Front Axle
4	MST-9A01-FA-104	Power Cylinder Check Nut Loosening Tool	Tractor
5	MST-9A01-EN-105	Dummy Injector	Engine
6	MST-9A01-EN-106	Crankshaft Rear Oil Seal Retainer	Engine
7	MST-9A01-TN-107	Shaft	Transmission
	MST-9A01-TN-107 (1)	Washer	
	MST-9A01-TN-107 (2)	Nut	
	MST-9A01-TN-107 (3)	Shaft	
	MST-9A01-TN-107 (4)	Flange	
8	MST-9A01-EN-108	FIP Removal Tool	

### Kit Part No 0000003016TK

Sr. No	Tool No	Tool Description	Aggregate
1	MST-9A01-FA-108	Front Axle CCD	4WD Front Axle
2	MST-9A01-FA-109	Cover Bearing Stack Height	4WD Front Axle
3	MST-9A01-FA-110	Cover Bottom End Play	4WD Front Axle
4	MST-9A01-FA-111	Holder Top End Play	4WD Front Axle

## GREASING POINTS LOCATIONS



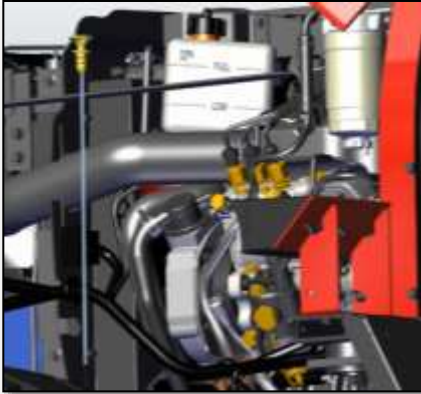
Sr.No	Location	Greasing points
1	Steering Fork & Radial Ball Joint (LH)	2
2	Clutch Shaft	1
3	Speed Housing (LH)	1
4	Speed Housing (RH)	1
5	Brake Shaft	1
6	Rear Pillow Block	1
7	Front Pillow Block	1
8	Steering Fork & Radial Ball Joint (RH)	2

## CONSUMABLE DETAILS

Type	Quantity In litres	Grade	Change Frequency
Engine Oil	6.5	Mahindra M Star Premium	Every Service
Transmission Oil	31	Mahindra M Star Genuine OIB Oil / Servo M Trac 30	Every 850 Hours
Front Axle ( 4WD)	3.7 – Vineyard 4.0 – Paddy	Servo M Trac 30	1 <sup>st</sup> at 100 & then at every 850 hours
Cooling System	5.7	Mahindra M Star Coolz or Coolant Confirming to JIS K - 2234	800 hours
Fuel Tank	25 – Vineyard 35 – Paddy	NA	NA

## PRIMARY CHECKUP

1



### Checking Engine Oil Level

- Check the engine oil before starting the engine or '5' minutes or more after the engine has stopped.
- To check the oil level, draw out the dipstick, wipe it clean, insert it and draw it out again. Check to see that the oil level lies between the two marks.
- Add oil only when the oil level reaches the lowest mark.

**Caution** -Do not run the engine if the oil level is low than specified.

2



### Checking Coolant Level

- Check coolant level in recovery bottle & Top-up if required.
- Use redimix coolant for top up.

**Warning** -Do not open the coolant cap when the engine is hot. Do not remove the radiator cap when the engine is hot

3



### Checking Radiator Fins

- Clean chaff guard daily or earlier if chocked.
- Blow compressed air through the radiator fins to remove foreign material

**Caution** -To avoid personnel injury, ensure to stop the engine before working on radiator.

4



### Checking Radiator Fins

- The tension is correct when the belt can be pressed by thumb to 9 - 12 mm. midway between the two pulleys without much effort.
- In case the tension is not correct then adjust the tension by adjusting alternator position on brace plate.

## TYRE MAINTENANCE

### Checking tyre pressure

For normal load and operation of the tractor the following tyre pressure is recommended.

Operation	Puddling		Vineyard	
	Front Tyre 8 x 16	Rear Tyre 12.4 x 24	Front Tyre 6 x 12	Rear Tyre 9.5 x 20
<b>Field</b>	1.60 kg/cm <sup>2</sup> (23)	1.60 kg/cm <sup>2</sup> (23)	1.3 kg/cm <sup>2</sup> (19)	1.2 kg/cm <sup>2</sup> (17)
<b>Road</b>	1.60 kg/cm <sup>2</sup> (23)	1.60 kg/cm <sup>2</sup> (23)	2.0 kg/cm <sup>2</sup> (29)	1.4 kg/cm <sup>2</sup> (20)

### Note:

1. Keep the tube valve always closed with the dust cap, to protect the valve from mud/dust/slush.
2. To achieve best performance and maximum tyre life, maintain air pressure as per tyre size and load carrying capacity as recommendation.

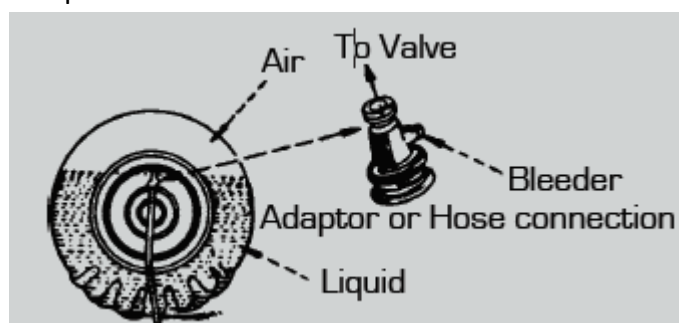
### Addition of Wheel Weights At Rear – To increase drawbar pull of the tractor & reduce wheel slip (Increase tyre life)

Cast Iron weights can be attached to the rear driving wheels.  
In case the slip continues, it may be necessary to liquid ballast the tyre.

### Adding Water:

Tractor tyre can be 80% filled with water as follows, Remove excess air from Tyre.

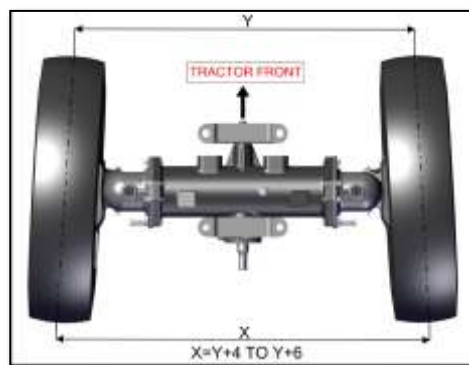
1. Remove all air from tyre.
2. Raise the wheel. Rotate the tyre until the valve, stem is at 1'O Clock position.
3. Remove the valve core housing and screw on the adaptor.
4. Force water into the tyre from a tank placed at least five feet higher than the tractor tyre, or by using a compressor and pressure tank filled with water.
5. When the liquid has reached the required level, remove the adapter, screw in the valve core and inflate to the recommended pressure.
6. Maintain air pressure as per recommendation.



## TYRE MAINTENANCE

### Front Axle - Front Wheel "Toe In Check"

In the event of the tie rod setting being interfered with, then it is necessary to adjust the TOE-IN. Before measuring and adjusting the TOE-IN, ensure the front wheels are in the straight ahead position and the front axle is not tilted. **Calculation of Toe In-:** (Refer image TOE-IN ADJUSTMENT) Measure distance between centres of both front wheels from front of tractor. Let that distance be "Y". Now adjust track rod ball joints such that distance" will remain same in front side of front wheels and at rear side of front wheel distance will increase in **4 to 6 mm**. let distance let distance in rear of Front wheel be "X". Therefore **X= (Y+4) To (Y+6) in mm**



### Toe In Adjustment

#### Procedure To Adjust Toe In-:

Loosen check nut of wheel cylinder from both sides and adjust Toe in position of front wheel. While adjusting position maintain centre of ram in wheel cylinder with exact centre of Front axle position.

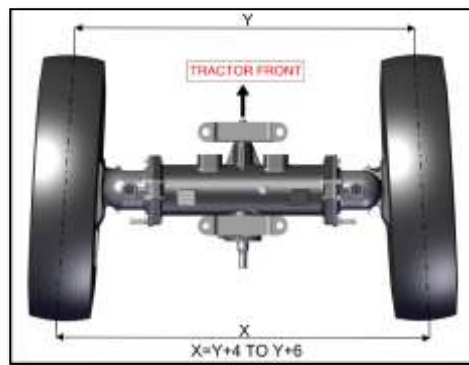




## TYRE MAINTENANCE

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### Toe In Adjustment

#### Procedure To Adjust Toe In-:

Loosen check nut of wheel cylinder from both sides and adjust Toe in position of front wheel. While adjusting position maintain centre of ram in wheel cylinder with exact centre of Front axle position.





# ENGINE

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
1	Number of Cylinder	3
2	Bore	88.9
3	Stroke	110
4	Displacement	2048
5	Compression Ratio	19.8:1
6	Compression Pressure	35-38
7	Firing Order	1-3-2
8	Rated Power	36 HP @ 2600 RPM
9	Maximum Torque	118 NM @1700 RPM
10	Rated Speed	2600 RPM
11	High Idle	2850 ± 50 RPM
12	Low Idle	850 ± 50 RPM
13	Injection Nozzle opening Pressure	250 ± 8 bar
<b>Manifold, Cylinder Head &amp; Inlet Valve Specifications</b>		
14	Numbers of Valve Per Cylinder	1
15	Stem diameter (mm)	Ø8.695 / Ø8.707
16	Head diameter (mm)	Ø38.25 / Ø38.50
17	Clearance in guide (mm)	0.051 / 0.025
18	Valve Seat angle (mm)	45° -20' / +0'
19	Tappet Clearance (mm)	Inlet (Cold / Hot) - 0.4 / 0.3
<b>Exhaust Valves</b>		
20	Numbers of Valve Per Cylinder	1
21	Stem diameter (mm)	Ø8.675 / Ø8.687
22	Port Diameter	26.06
23	Head diameter (mm)	Ø35.80 / Ø36
24	Clearance in guide (mm)	0.076 / 0.051
25	Valve Seat angle (mm)	45° -20' / +0'
26	Tappet Clearance (mm)	Exhaust (Cold / Hot) - 0.5 / 0.4

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
<b>Valve Guide</b>		
27	Length - inlet (mm)	59.94
28	Length - exhaust (mm)	59.94
29	Inside diameter (mm)	8.763 / 8.738
<b>Valve Springs</b>		
31	Initial length (mm)	42
32	Initial load (N)	250.0 N $\pm$ 10%
33	Final length (mm)	32.6
34	Final load	439.0 $\pm$ 10%
35	Free length (mm)	54.40 approx.
36	Spring rate ( at 30-70% of final load) N/mm	20.1 $\pm$ 0.8
<b>Valve Tappets</b>		
37	Diameter (mm)	14.224 / 13.97
38	Running clearance (mm)	0.013 / 0.076
<b>Valve Push Rods</b>		
39	Diameter (mm)	7.94 Thick solid Push rod
40	Length (mm)	248.3
<b>Valve Timing</b>		
41	Inlet opens 7	7.94 Thick solid Push rod
42	Inlet closes	35° ABDC $\pm$ 2°
43	Exhaust opens	46° BBDC / 42° BBDC
44	Exhaust closes	10° ATDC $\pm$ 2°
<b>Connecting Rod, Pistons &amp; Cylinder Sleeves</b>		
45	Material	S48C
46	Bearing (big end) type	Replaceable Steel Backed Bimetal

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
<b>Connecting Rod, Pistons &amp; Cylinder Sleeves</b>		
47	Material	Steel Backed Overlay Plated
48	Small end (bearings)	Replaced
49	Type	Bush
50	Material	Cu-Lead
51	Small end bush dia. (mm)	31.950 / 31.975
<b>Piston Rings</b>		
52	Number of rings per piston	3
53	Type	Cam Ground Oval
54	Top	KS Semi-Inlaid Half Keystone
55	Middle	Reverse Torsion Ring
56	Bottom	Coil Spring Loaded Bevel edged oil ring
<b>Width (Axial)</b>		
57	Top	Top 2.5
58	Middle	2.0 -0.005/-0.030
59	Bottom	2.5 -0.005/-0.030
<b>Ring Gap (mm)</b>		
60	Top	0.2 to 0.4
61	Middle	0.4 to 0.6
62	Bottom	0.25 / 0.50
<b>Piston</b>		
63	Material	Aluminium Alloy FM120
64	Graded (gms)	Weight difference should not be more than 9 gms

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
<b>Cavity Volume</b>		
65	Cylinder dia	Ø 88.9
66	Dia at skirt (Ø D1) mm	Ø 88.81 ± 0.007
67	Dia at just below oil control ring (Ø D2) mm	Ø 88.730 ± 0.009
68	Dia at top land (Ø D3) Ø mm	Ø 88 +/- 0.012 ± 0.015
69	Piston pin bore (mm)	29 +0.049 /
70	Number of ring grooves	3
<b>Width of groove</b>		
71	Top Groove	2.5
72	Middle groove	2.06 +/- 0.01
73	Bottom groove	2.53 +/- 0.01
<b>Clearance In grooves</b>		
74	Middle groove	0.075/0.014
75	Bottom groove	0.065/0.080
<b>Piston Pins</b>		
76	Diameter (mm)	29-0.005
77	Clearance in piston (mm)	0.014 / 0.004
78	Length (mm)	68-0.03
<b>Cylinder Sleeves</b>		
79	Type	Wet Liners
80	Material	C.I.
81	Wall thickness (mm)	5.05
82	Sleeve O.D (mm)	98.8 / 99
83	Sleeve I.D (mm)	88.9 / 88.92
84	Flange stand out / liner protrusion (mm)	0.051 above face to 0.025 below face.
85	Flange width (mm)	5.715 / 5.705 (for spare)
86	Max. taper (mm)	0.013

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
<b>Cylinder Sleeves</b>		
87	Max. ovality (mm)	0.013
88	Sleeve I.D Discard limit (mm)	88.976 and above
<b>Lubrication System Pressure Regulating Valve</b>		
89	Location	On oil pump
90	Spring free length (mm)	63.5 ± 0.010
91	Spring Initial length (mm)	44.5
92	Spring Initial load (N)	17 LBS ± 6%
93	Opening pressure (PSI)	30-35
94	Valve clearance in bore (mm)	0.127 / 0.0889
<b>Oil Pump Clearances</b>		
95	Gears to housing (mm)	0.135 / 0.211
96	Gears to end plate (mm)	0.05 / 0.1
97	Drive shaft to body (mm)	0.038 / 0.089
98	Drive Pinion to Body (mm)	0.051 / 0.102
<b>Water Pump Impeller Shaft Diameter</b>		
99	Front (mm)	Ø78.8±0.3
100	Rear (mm)	Ø78.8±0.3
<b>Thermostat</b>		
101	Range	80° - 96°
<b>Camshaft</b>		
102	Material	Monochrome cast iron
103	Number of bearings	5
104	Front (mm)	46.787 / 46.761
105	Centre (mm)	46.025 / 45.999
106	Rear (mm)	38.1 / 37.846

## ENGINE SPECIFICATIONS

Sr. No	Description	Specification
<b>Camshaft</b>		
107	Running clearance (mm)	0.089 / 0.038
108	Exhaust cam lift	6.325
109	Inlet cam lift	6.274
<b>Timing Gears – Number Of Teeth</b>		
110	Crankshaft gear	33
111	Cam shaft gear	66
112	Injection pump gear	66
113	Idler gear	46
<b>Tandem Pump Gear</b>		
114	Backlash between any pair of gear (mm)	0.1 to 0.3
115	Idler gear end clearance (mm)	0.1 to 0.3
116	Idler gear end float (mm)	0.1 to 0.3
<b>Crankshaft</b>		
117	Material	EN19 B
118	Main journal diameter (mm)	53.980 to 53.998
119	Running clearance main journal (mm)	0.271 to 0.0965
120	Crank pin diameter (mm)	53.980 to 53.998
121	End clearance (Float) (mm)	0.1 to 0.4
122	Slide clearance main journal (mm)	0.1 to 0.4
123	Running clearance crank pin (mm)	0.024 to 0.071
124	Rear end oil seal dia (mm)	91.999
<b>Main Bearings</b>		
125	Type	Replaceable, Shell
126	Material	Steel backed babbitt



## ENGINE TORQUE CHART

Sr. No	Assembly Stage	Part	Torque In NM
1	Crankcase Sub Assy	Plug 1/4" For main Oil Gallery	20-24
2		Plug Pipe C 3.175 mm	10-12
3		Adaptor Oil Filter 235D1	27-33
4		Adaptor Oil Gauge	24-30
5		Nut For Tube Oil Level Gauge M12 x 1	08-12
6		Water Pump Mounting Studs	16-20
7		Plug 6.3 mm Water Drain	19-22
8	Crankshaft Assy	Main Bearing Cap Bolt -1/2"-13 UNC	122-128
9	Front Plate Fitment	Bolt Hex 67.9375 x 1.41 x 19.05 x BS5	24-30
10		Front Plate Mounting Bolt On Crankcase	10-16
11		Screw	06-08
12	Piston & Con Rod Assy	Connecting Rod Bolt M10 x 1.0 x 57	54-61
13	Camshaft Assy	Bolt Camshaft Thrust Plate	27-33
14	FIP Fitment	FIP Flange Bolt- M10 x 1.5 x 35.5	34-41
15		Nut - FIP Shaft M14 X 1.5	80-90
16		Front Plate To FIP Adapter - M8 x 1.25 x 20	24-30
17		Feed Pump Outlet Adapter Nut	40-50
18		FIP Inspection Window Screw	3-4
19	Oil Pump Assy	Strainer Mounting Bolt- G6.35 x 1.27 x 12.7	8-11
20		Bolt Hex G9.525 x 1.59 x 28.57 x 8.8	34-41
21	Idler Gear Assy	Bolt Idler Gear Shaft	88-100
22	Front Cover & Water Pump Fitment	Bolt Front Cover To Crankcase Mounting ( Short)	22-28
23		Bolt For Crankshaft Pulley Mounting	175-185
24		Nut For Water Pump Mounting	33-40
25		Bolt Hex G7.9375 x 1.41 x 63.5 x 10.9	22-28
26		Bolt Hex M10X1.5X110X8.8	22-28
27		Nut Hex M10 X 1.5 X 8.0 X 6.6	22-28

## ENGINE TORQUE CHART

Sr. No	Assembly Stage	Part	Torque In NM
28	Front Cover & Water Pump Fitment	Nut C 7.938mm	22-28
29	FIP Cover Gear Front	Bolt Hex 67.9375 x 1.41 x 19.05 x BS5	07-10
30	ROSR Fitment	Bolt Crankshaft Rear Oil Seal Retainer	22-28
31	Crank Pulley Fitment	Crank Pulley Bolt- M14 x 1.5 x 32	160-190
32	Oil Pump Fitment	Oil Sump To Ladder Frame Mounting	22-28
33		Magnetic Drain Plug	40-55 (REF)
34		Ladder Frame To Crankcase Mounting	22-28
35		Crankcase To Rear Plate	08-10
36	Head Assy	Valve Housing Cover Stud - M10 x 1.5 x 160.8	16-19
37	Injector Assy	Stud Clamp Nozzle Holder - M10	16-19
38		Stud Clamp Nozzle Holder – M8	10-15
39	Water Temp Sensor Fitment	Sensor Temperature Gauge	24-30
40	Intake Manifold Fitment	Bolt M8 x 1 x 40 x 8.8	24-30
41	Thermostat Assembly	Thermostat Housing Bolt Huh_ M8 x 1.25 x 55.5	24-30
42		Bolt M8 x 1.25 x 22	20-24
43		Thermostat Cover Bolt - M8 x 1.25 x 22 x 8.8	20-24
44		Hose Clip Thermostat By Pass	10-15
45	Cylinder Head Mounting	Bolt Cylinder Head To Crankcase	35 + 90
46		Bolt Rocker Arm Mounting On Cylinder Head Bolt	105 + 5 cc
47	Push Road & Rocker Arm Assembly	Rocker Arm Assembly Nut - M10 x 1.5 x 8	33-40
48	Spill Pipe Fitment	Pipe Injector Spill Bolt	5-8
49	Pulley, Alternator & Belt Assembly	Pulley Mounting Bolt - M8 x 1.25 x 16	24-30
50		Bolt Hexfl M10 x 1.5 x 35.5 x 8.8	22-28
51		Bolt Hex For Alternator Mounting Bottom	25-30
52		Bolt Hex For Front Bracket to Rear Bracket	25-30
53		Nut Hexfl M8 x 1.25 x 8.7 x8	25-30

## ENGINE TORQUE CHART

Sr. No	Assembly Stage	Part	Torque In NM
54	HPP Assembly	High Pressure Assy Both Ends	25-30
55		HPP Clamping Nut - M6 x 1.0 x 5	05-07
56	Exhaust Manifold Assembly	Screw Hex FL M10 x 1.5 x 25.5 x 8.8	40-45
57	Valve Housing Cover Fitment	Valve Housing Cover MTC Nut - M10 x1.5 x 8	12-14
58	Flywheel Fitment	Flywheel Mounting Bolt -M12 x 1.5 x 40	Pre 40-45 Final 90-95
59	Fuel Filter Fitment	Bolt Hex FL M10X1.5X25.5X8.8	25-30
60		Bolt Hex FL M8 x 1,25 x 17.5 x8.8	25-30
61	Low Pressure Pipe Fitment	Low Pressure Pipes Bolt Banjo -M14 x 1.5 x 26	30-37
62		FIP Lube Pipe Bolt Banjo M10 x 1.5	11-16
63		Adaptor Lube Oil Fitment	20-25
64		FIP Overflow Bolt Banjo- M14	30-37
65	Oil Filter Fitment	Oil Filter Assembly	10-14
66		Oil Filter Mounting Bolt M8 x 1.25 x 35.5	24-30
67	FIP Oil Filling	FIP Oil Filling Plug	30-40



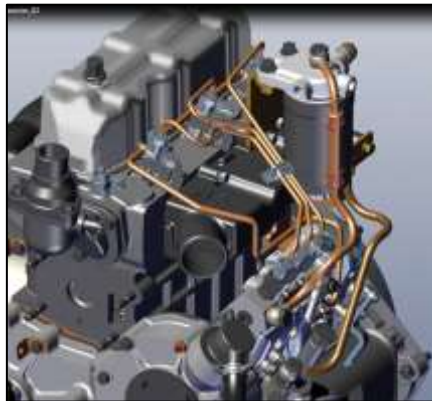
# **Manifolds & Cylinder Head**

## Manifold & Cylinder Head

### Manifolds

#### Intake & Exhaust Manifold Removal:

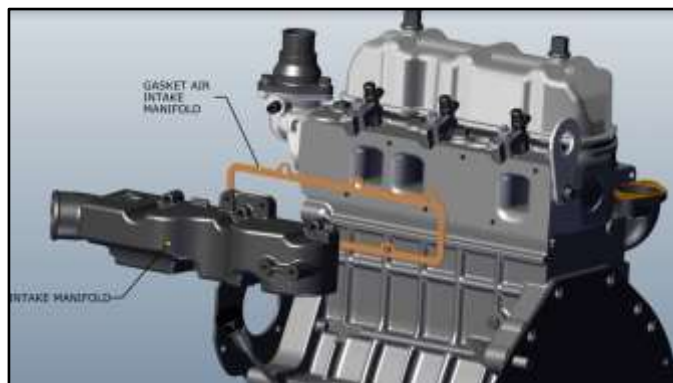
1. Remove Hose between Intake manifold and Air cleaner
2. Remove High Pressure, Low Pressure pipes, Fuel Filter and Bracket assy.



3. Remove 02 nos M8 bolts and remove Pull to Stop Mounting Bracket.

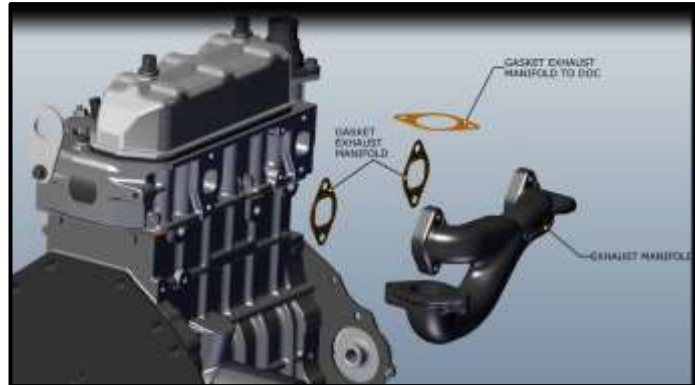


4. Remove 06 nos, M10 bolts and pull Intake Manifold & gasket.



## Manifold & Cylinder Head

- Remove 04 nos, M10 bolts and pull Exhaust Manifold and gasket.



### Intake & Exhaust Manifold Installation:

- Reverse the removal procedure.
- It is always advisable to replace the Inlet & exhaust manifold gaskets with new ones.
- Torque the mounting bolts at the specified torque to avoid leakage of gases.

### Cleaning, Inspection & Repair

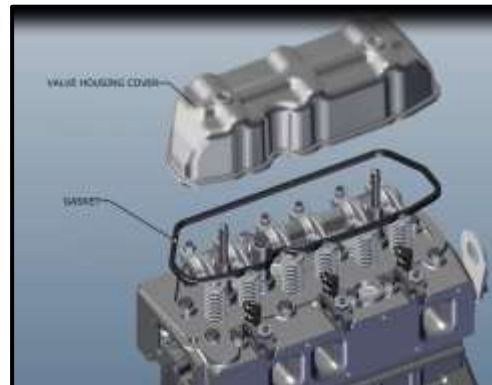
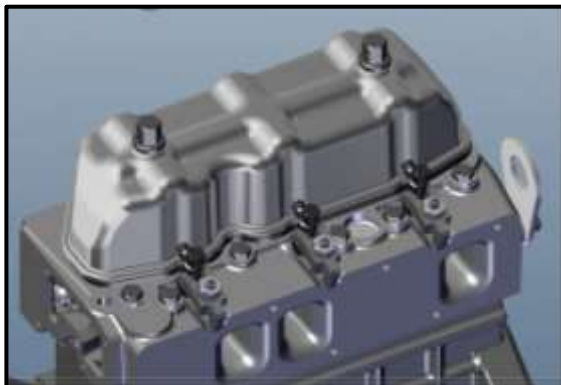
Clean the manifold and inspect for cracks and distortion. Replace the manifold with new one, whenever distortion is more than 0.4 mm (.016 in) per 250mm (10 inch) length. Inspect Air Hose & Clamps. Inspect retainer bolts and their washers, replace damage parts.

### Rocker Arm Shaft Assembly

#### Removal:

Thoroughly clean the engine externally.

- Remove **02 nos** Cap Nut and washer from Valve housing cover. Remove the valve housing cover and the gasket.

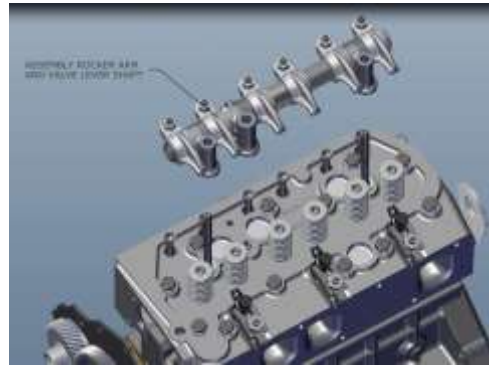
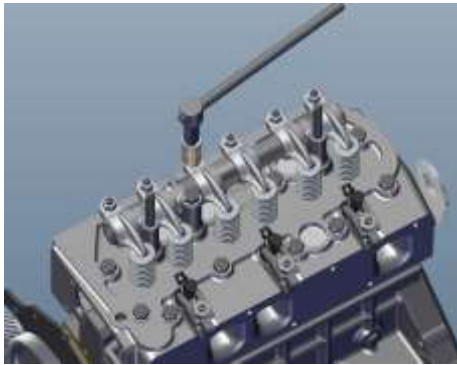


## Manifold & Cylinder Head

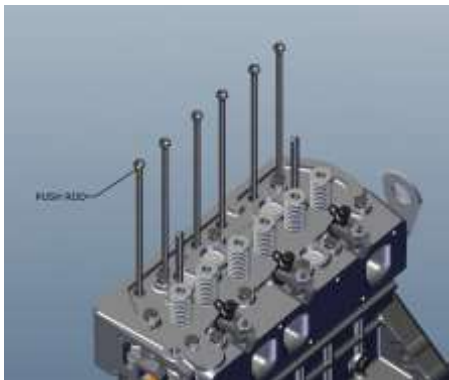
2. Loosen 06 nos Nut Valve adjusting & 06 nos, grub screw.



3. Remove M12 bolt, Washer and lift Rocker Arm assembly & Valve Lever Shaft.



4. Lift out all six Push Rods.

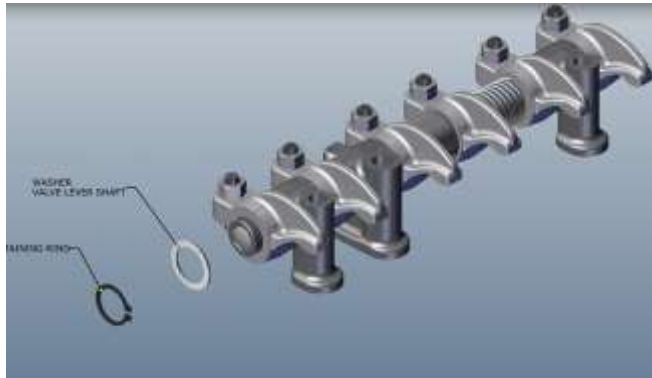


## Manifold & Cylinder Head

### Rocker Arm Shaft Assembly

#### Dismantling:

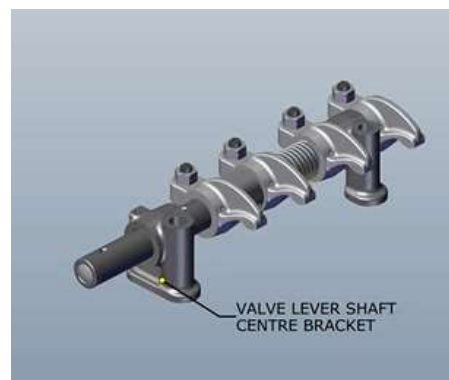
1. Remove Circlip and washer.



2. Remove 1st rocker arm, Bracket & 2nd rocker arm.



3. Remove roll pin with punch and pull bracket.





## Manifold & Cylinder Head

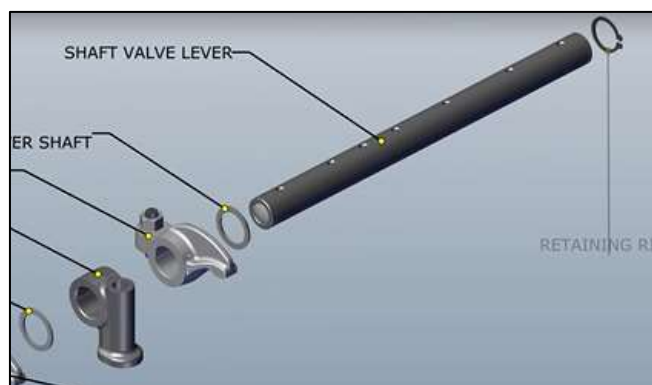
5. Remove 3rd rocker arm, Valve Lever spacer and Washer.



6. Remove 4th rocker arm, Spring Valve Lever, 5th rocker arm.



7. Remove Washer lever shaft, bracket, 6th rocker arm, Washer and circlip.



## Manifold & Cylinder Head

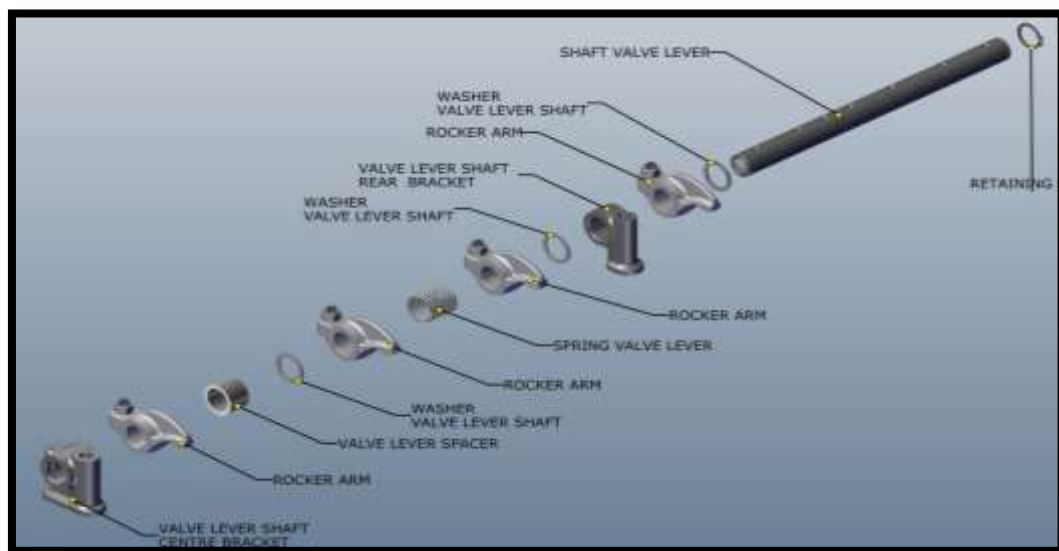
### Inspection & Repairs

1. Thoroughly clean all components in Kerosene or Diesel and blow using compressed air.
2. Be sure all oil passages are free from sludge and sediment.
3. Check the valve lever shaft expansion plugs.
4. Check the clearance between the valve rocker arm shaft and valve rocker arm bushings.
5. Check the valve lever bracket for wear in the bore.
6. Replace valve rocker arms that show excessive wear of hammering at the ends (2-3) which contact the valve, remove only enough material to give an even face on the end of the valve lever and take care that the rounding is maintained lengthwise to ensure perfect grinding action on valve stem.

**Note: Replace worn screw & nut with new ones**

7. Check expansion plugs on both ends of the lever shaft for leakage and replace plugs, if necessary, using sealer.
8. Check valve lever springs against specifications and replace with new ones if signs of corrosion chafing or fatigue show.

### Assembly

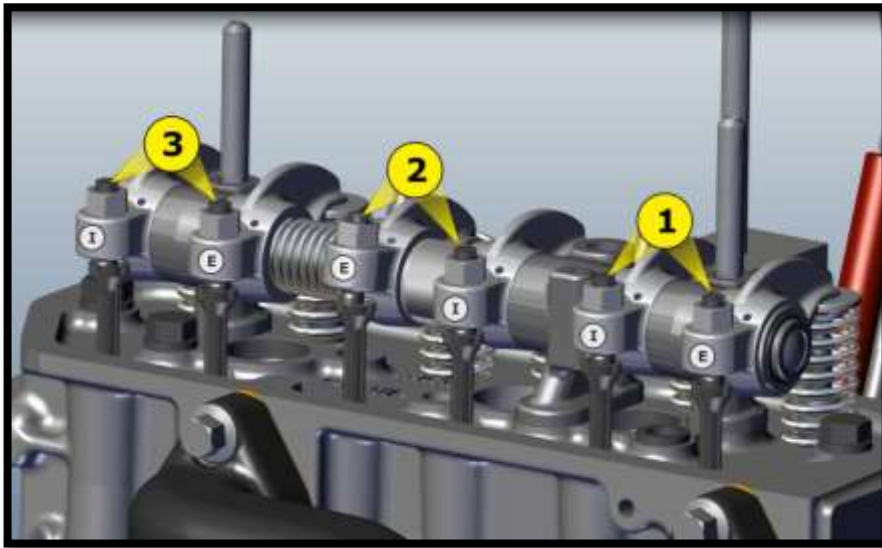


1. Insert Circlip, Washer, 6th rocker arm.
2. Insert Bracket, Washer, 5th Rocker arm & Spring.
3. Insert 4th Rocker arm, Washer, Spacer,
4. Insert 3rd rocker arm, bracket and locating pin.
5. Now insert 2nd rocker arm, bracket, 1st rocker arm, Washer & insert circlip with plier.

## Manifold & Cylinder Head

### Tappet Setting

View From front, 1<sup>st</sup> Exhaust Valve-Intake Valve Then Intake valve-Exhaust valve Then Exhaust valve-Intake valve.



1. Rotate flywheel anti-clockwise.
2. Press 2<sup>nd</sup> Cylinder exhaust valve.
3. Do tappet setting of 1<sup>st</sup> cylinder.
4. Insert filler gauge of **0.50 mm for Exhaust valve**
5. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

6. Tighten the nut by keeping filler gauge in insert position.
7. Insert filler gauge of **0.40 mm for Inlet valve**
8. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

9. Tighten the nut by keeping filler gauge in insert position.
10. Rotate flywheel anti-clockwise.
11. Press 1<sup>st</sup> cylinder exhaust valve.
12. Do tappet setting of 3<sup>rd</sup> Cylinder.
13. Insert filler gauge of **0.40 mm for Inlet valve**
14. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

## Manifold & Cylinder Head

### Tappet Setting

15. Tighten the nut by keeping filler gauge in insert position.
16. Insert filler gauge **of 0.50 mm for Exhaust valve**
17. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

18. Tighten the nut by keeping filler gauge in insert position
19. Rotate flywheel anti-clockwise.
20. Press 3<sup>rd</sup> cylinder exhaust valve.
21. Do tappet setting of 2<sup>nd</sup> cylinder.
22. Insert filler gauge **of 0.40 mm for Inlet valve**
23. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

24. Tighten the nut by keeping filler gauge in insert position.
25. Insert filler gauge **of 0.50 mm for Exhaust valve**
26. Loose nut, tighten grub screw & insert filler gauge.

**Note:** - Filler gauge movement should not be more tight or loose.

27. Tighten the nut by keeping filler gauge in insert position.

## Manifold & Cylinder Head

### Cylinder Head

#### Removal

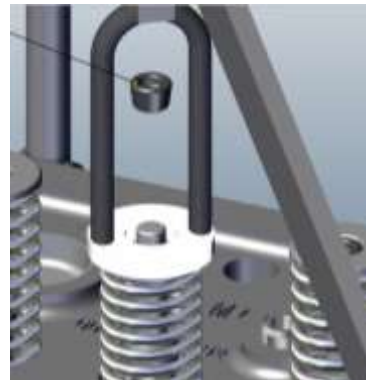
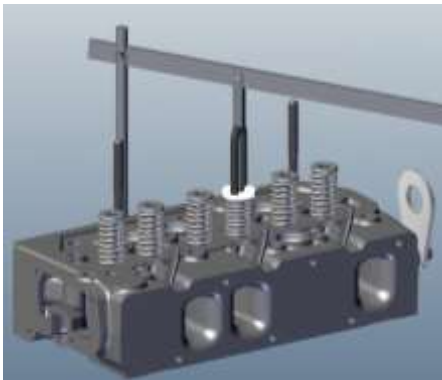
1. Remove the Manifolds, Rocker Arm Shaft Assembly as detailed earlier.
2. Remove Push rods and identify them so they can be installed in their original positions.
3. Remove thermostat housing by pass hose.
4. Remove three bolts then remove the thermostat housing.
5. Remove fuel injector pipes. It is not advisable to disconnect them at the injector only. They may become distorted.
6. Remove 13 nos Cylinder head bolts progressively in the reverse order to the tightening sequence
7. Remove Cylinder head and gasket.

#### Note

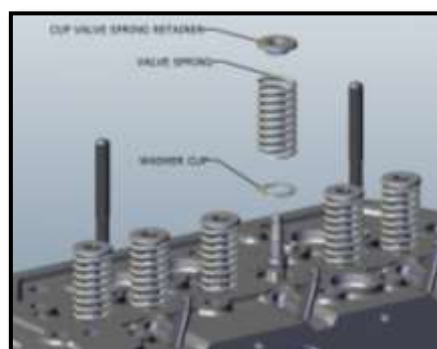
1. Clean the Engine externally. Mark dismantled parts such as valves, Valve stem guides and springs and place them on a table in removal order to facilitate reassembly.
2. Always cap all exposed openings of injector pump, injector pipes, fuel lines and nozzle holders to prevent entry of dirt into the fuel system.
3. To avoid warpage do not remove cylinder head bolts unless the engine has cooled down.

#### Dismantling

1. Use special tool to press valve spring. Remove Collect and slowly release spring



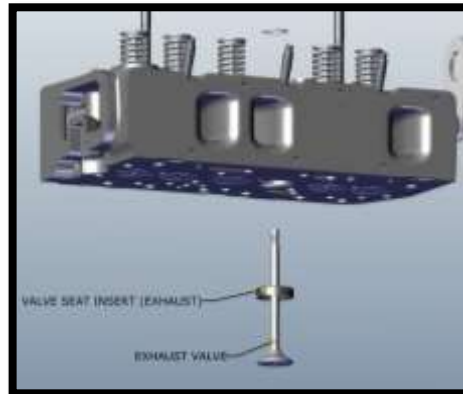
2. Remove cup retainer, washer, spring & washer.



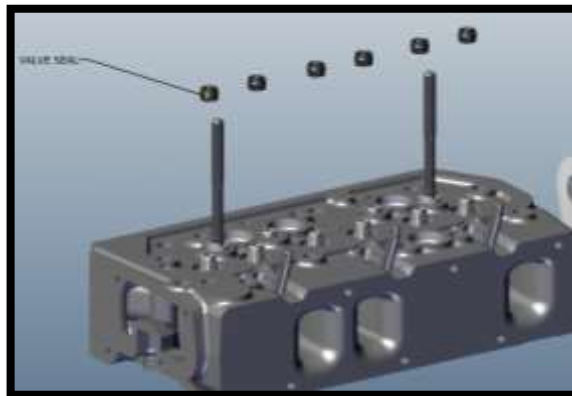
## Manifold & Cylinder Head

### Cylinder Head

3. Remove Valve.



4. Similarly remove remaining 05 valves from cylinder head.
5. Remove valve steam seals.



### Cleaning, Inspection & Repairs

#### Cleaning

1. Wash all parts in a suitable solvent and blow dry with compressed air.
2. Remove any old gasket material from the faces of the cylinder head.
3. Blow through all oil passages to ensure that they are clear.
4. Remove all carbon deposits from the cylinder head and valves.
5. Remove any carbon deposits from the valve guides, using a wire brush. Blow out loose carbon with compressed air.

**Note:** Guides require careful cleaning because any remaining carbon will deflect

## Manifold & Cylinder Head

### Inspection

1. Inspect the casting for cracks and burnt metal around the valve ports.
2. Check the valve seats for cracks and pitting.
3. Position a lamp underneath the valve guides and examine the bore of the guide for burning, cracks or signs of excessive wear.
4. Check the diameter of the guides at several points against the dimensions given in specifications.
5. If the running clearance between valve and valve guide exceeds 0.2 mm (0.008 in) the valve guide should be replaced.
6. Inspect the cylinder head and crank case for warpage if engine has been run with a blown head gasket.
7. Check the valve stems for bends, wear, pitting or mushrooming of the ends. Check the collet grooves in the stems to ensure they have not lost their shoulders
8. Check that the valve heads are not excessively worn or pitted.
9. Check the valve springs for rust, pitting or cracks and against the loads given in specification.
10. Check the retainers for rust and cracks.
11. Check and replace valve seals.
12. Check the outside face and the ribs inside the collets for wear. It is advisable to always use new collets.
13. If the new valve guides are replaced, ream the valve guides to the dimensions given in specifications.
14. If the valve seat inserts are to be replaced, take a fine cut, if necessary, from the bottom of the counter bore, to ensure a square seat for the replacement insert.
15. Thoroughly chill the new valve seat inserts at -60 deg. C in dry ice before installation.
16. This prevents metal scraping from the side of the counter bore, ensuring full contact of the insert on the bottom and side of the counter bore. After installation insertspeen over the edge of the inserts around it's entire circumference.
17. The inserts should be recessed in the Head 0.006" to 0.014"
18. When using carbon dioxide or dry ice, strictly adhere to instructions to avoid injuries.
19. Do not touch deep frozen parts with bare hands. Reface the valve seats to the correct angle seats that are too wide after refacing should be narrowed by grinding the top edge of the seat with a stone of a similar angle (15 deg angle)
20. Mount a dial indicator on the pilot shank and check that seat run out does not exceed 0.003".
21. Reface the valves but reject valves that grind down to a fine edge.
22. Using carborundum paste lap-in the valves
23. Ensure that all carborundum paste is removed from the valve and valve seats after lapping.
24. Excess paste must be removed with a cloth and the head washed in the solvent and blown dry with compressed air. Check the valves in their seats using engineers blue. A complete ring of contact must be shown on both faces.

## Manifold & Cylinder Head

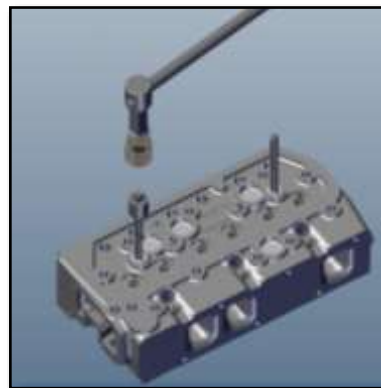
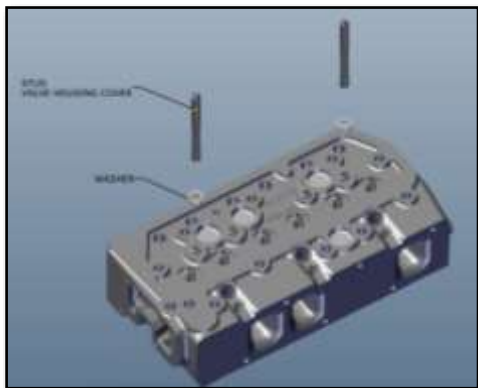
### Before Rework

#### Note:

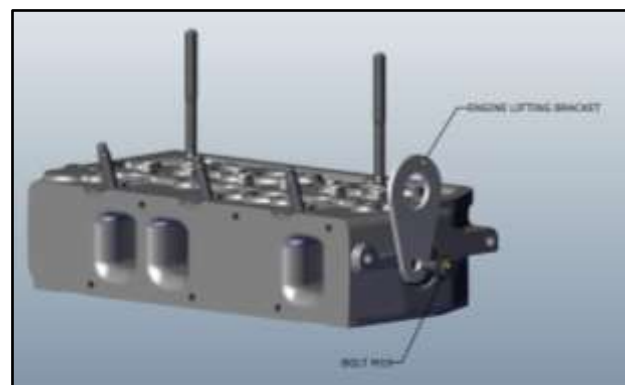
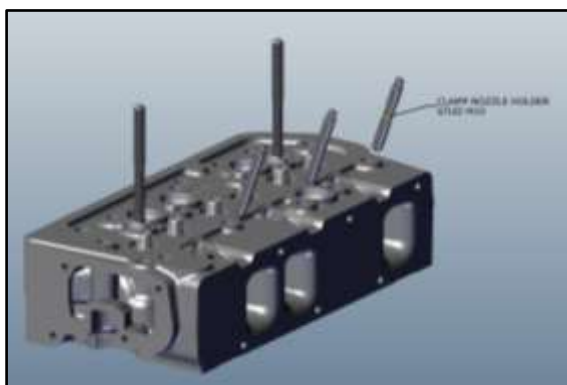
1. Check whether the cylinder height permits reworking.
2. Check to see if nozzle tip protrusion will retain within specified limits after rework.
3. Nozzle protrusion of 2.3/1.8 mm/0.90"/0.70" is to be ensured.
4. To remove valves compress valve springs with compressor tool and take out spring retainer locks.
5. Clean the cylinder head thoroughly.
6. Remove carbon deposits from the bottom of the cylinder head and out of exhaust valve ports.
7. Flush out the water jacket to remove scale and dirt.

#### Assembly: -

1. Insert 2 no, M8 studs. Use stud tightening tool to tighten the studs.



2. Similarly tighten 3 nos, M10 injector holding studs. Place Engine Lifting bracket and tighten M10 Bolt.

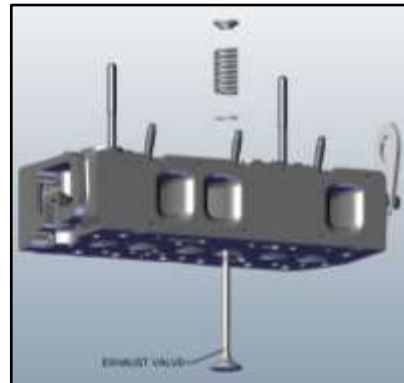
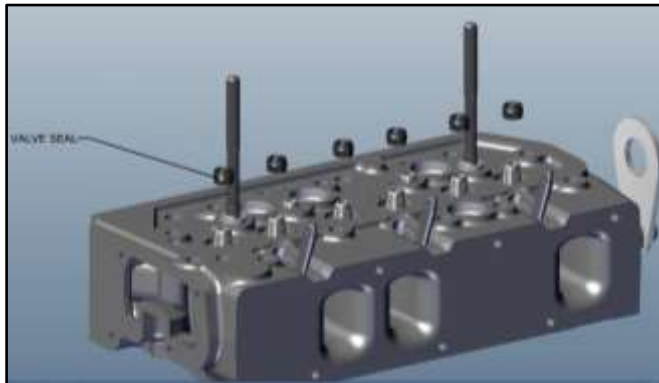




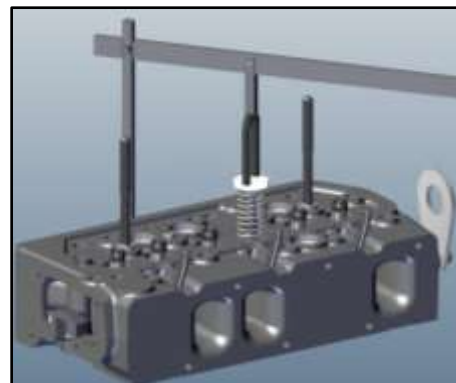
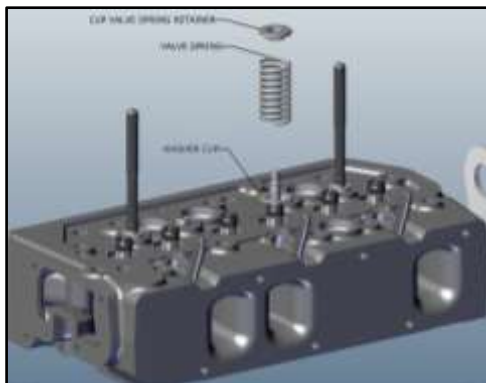
## Manifold & Cylinder Head

### Assembly: -

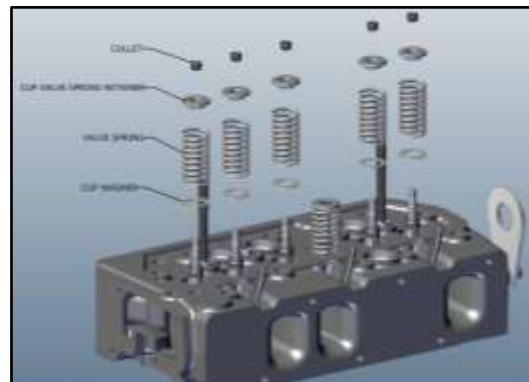
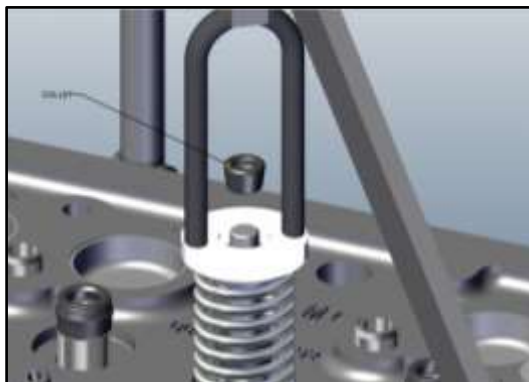
3. Insert Valve Stem Seals. Now insert valve from bottom side.



4. Insert Washer, spring, Cup Valve Retainer. Press the spring by using special tool.



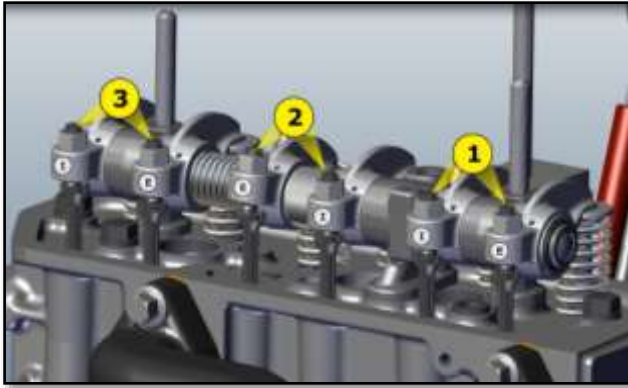
5. Insert Collet. Similarly complete assembly of remaining valves.



## Manifold & Cylinder Head

### Assembly: -

6. Valves fitment should be as per sequence shown in picture. From front, 1<sup>st</sup> Exhaust Valve-Intake Valve Then Intake valve-Exhaust valve Then Exhaust valve- intake valve.



### Tips for service of Cylinder head

1. During cylinder head overhaul, Nozzle protrusion (protrusion of nozzle tip from head bottom face) should be checked thoroughly as it affects the fuel spray pattern of the nozzle.
2. Excessive carbon deposition on valve neck and valve stem indicates engine oil consumption due to excessive clearance between stem and valve guide.
3. Discard valve springs if they have lost tension or are broken.
4. Always replace valve collectors whenever valves are opened for inspection or repairs.
5. Improper valve spring tension, valve lapping, tappet setting, timing or excessive cam lobe wear will cause valve seat damage and subsequent leakage.
6. While replacing piston rings ensure that the valve seats are ground/lapped for perfect seating to avoid oil throw from the exhaust.
7. While regrinding the valve maintain its concentricity with the guide to ensure proper seating.
8. Never remove the cylinder head in hot condition.



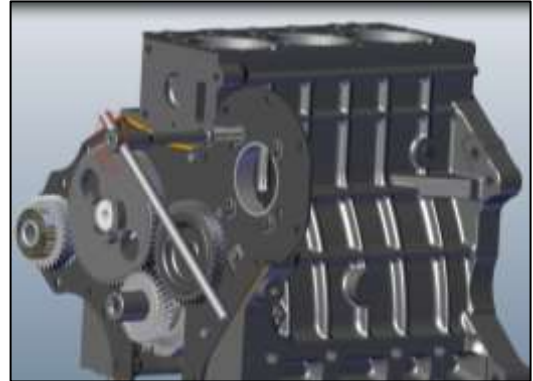
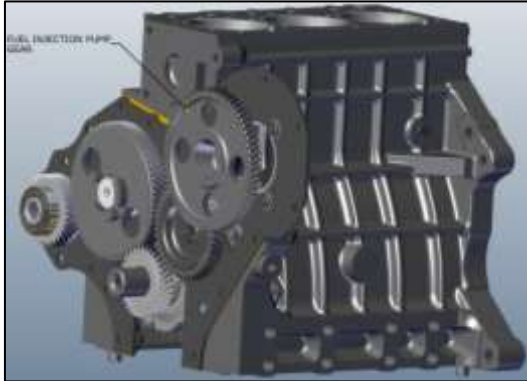
# **Timing Gears Camshaft & Front Plate**

## Timing Gears, Camshaft & Front Plate

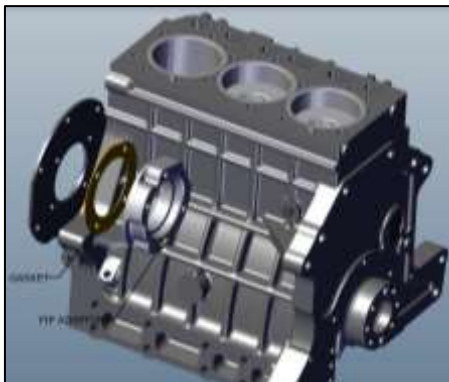
### Timing Gears, Camshaft & Front Plate.

#### Dismantling:

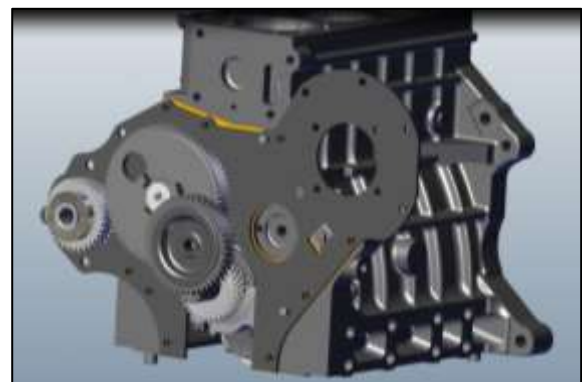
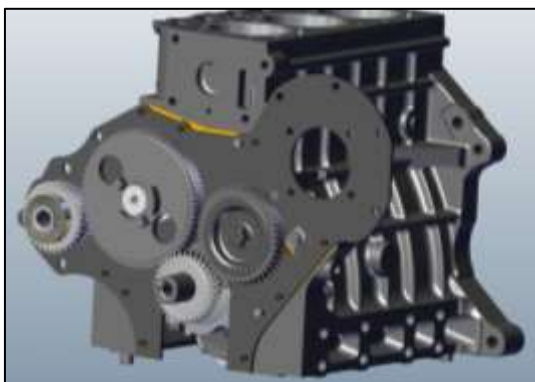
1. Remove FIP gear and 4 nos, M8 bolts and washers.



2. Remove FIP Adapter Plate and Gasket.



3. Remove G12.7 **bolt** and Idler Gear assembly.

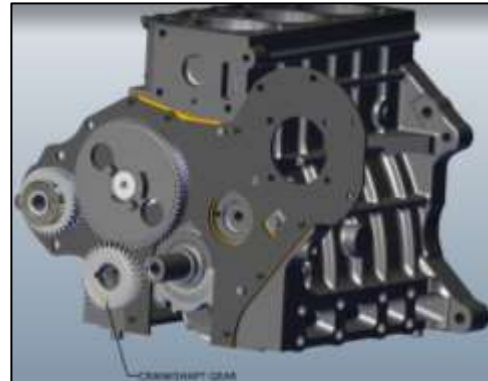
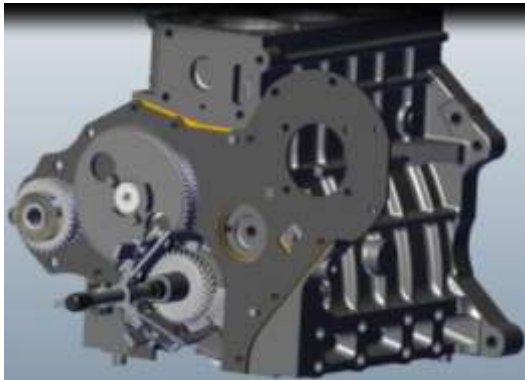


## Timing Gears, Camshaft & Front Plate

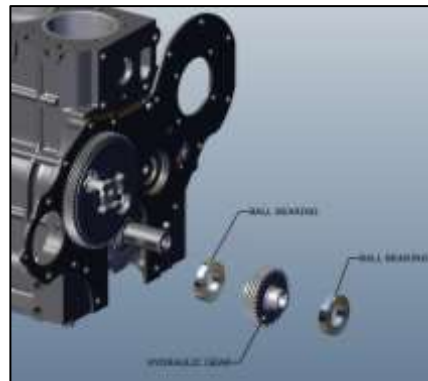
### Timing Gears, Camshaft & Front Plate.

#### Dismantling:

4. Use puller to remove Crank shaft gear.



5. Remove Hydraulic Gear and bearing.



6. Keep tappets in vertical position.

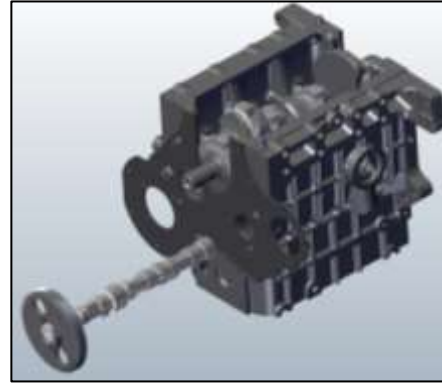
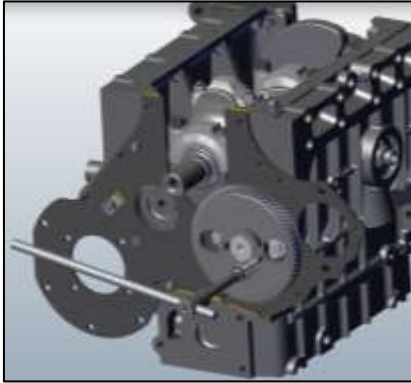


## Timing Gears, Camshaft & Front Plate

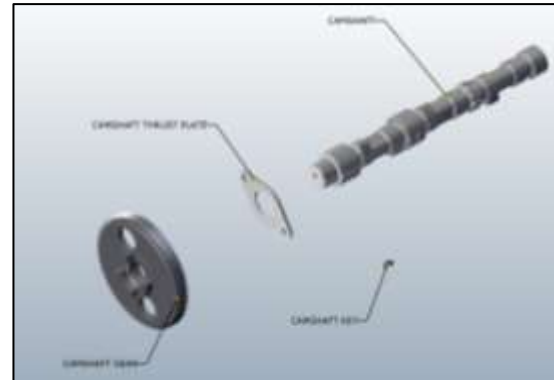
### Timing Gears, Camshaft & Front Plate.

#### Dismantling:

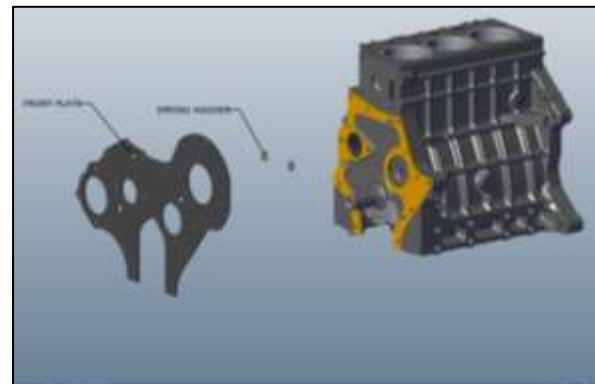
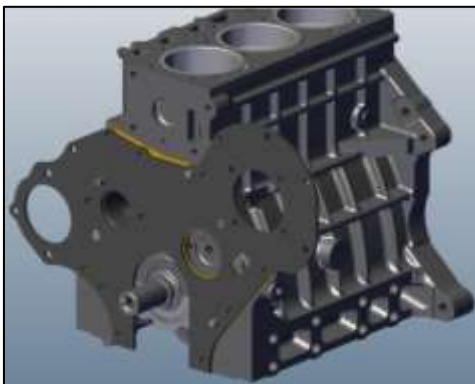
7. Remove **2 nos, M8 bolts** of thrust plate and pull Camshaft assembly.



8. Remove Cam Gear, Camshaft Key & Thrust Plate.



9. Remove **M6 screw & 2 no M8 Bolts G 7.93 and tap washer**

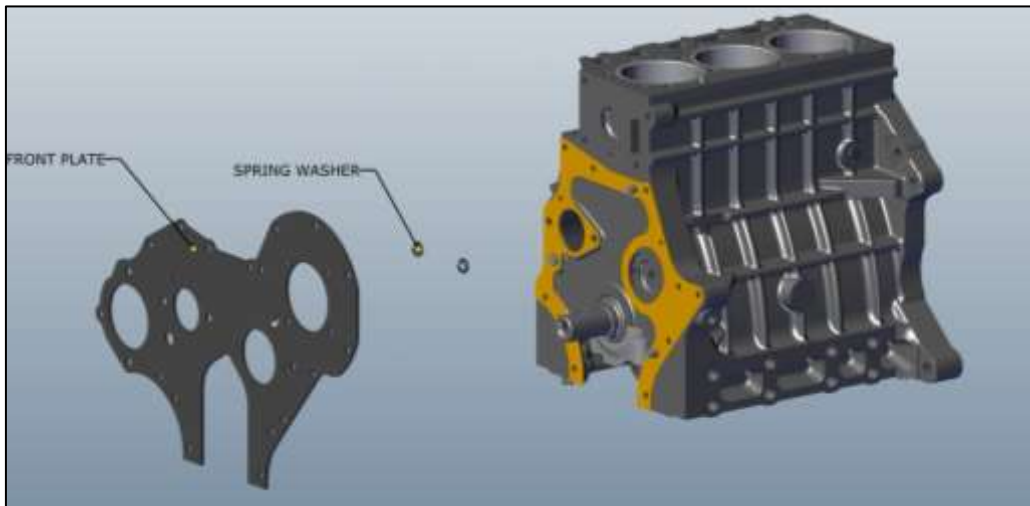


## Timing Gears, Camshaft & Front Plate

### Timing Gears, Camshaft & Front Plate.

#### Dismantling:

10. Take out Front Plate, washer and gasket.

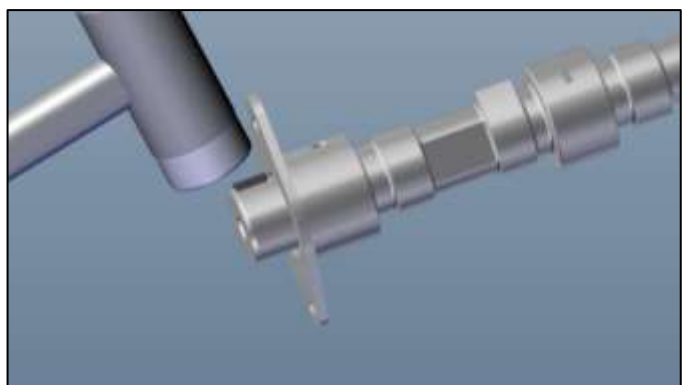
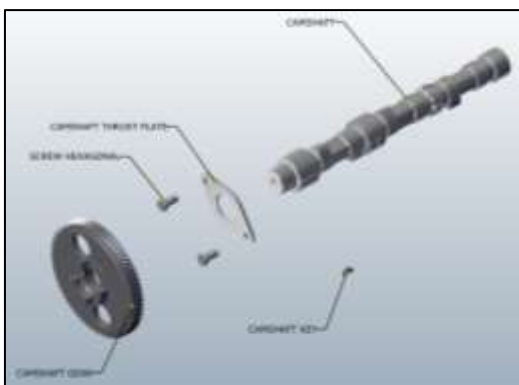


#### Assembly

#### Cam shaft & gear

Sub Assembly: -

1. Insert thrust plate and press woodruff key with mallet.



## Timing Gears, Camshaft & Front Plate

Sub Assembly: -

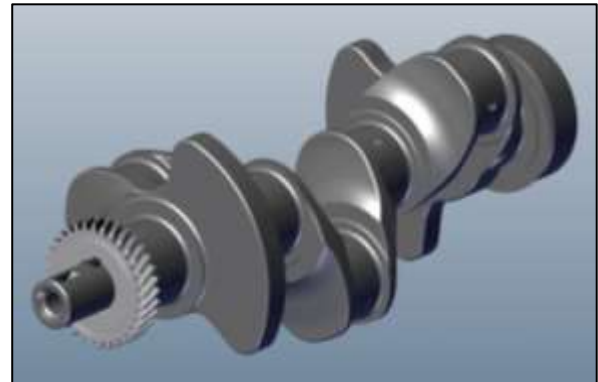
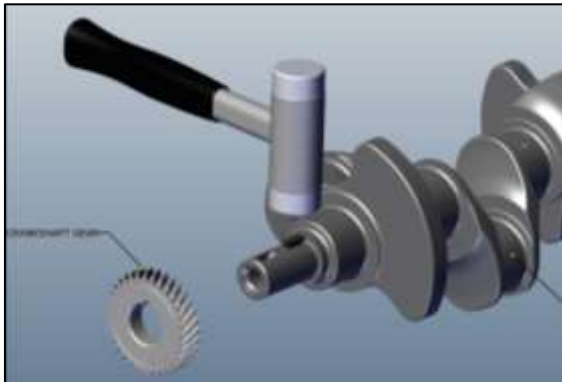
2. Place **2 nos, M8 bolts** on thrust plate & Insert Cam shaft gear.



### Crankshaft & Gear

Sub Assembly: -

1. Press woodruff key with mallet and insert gear.



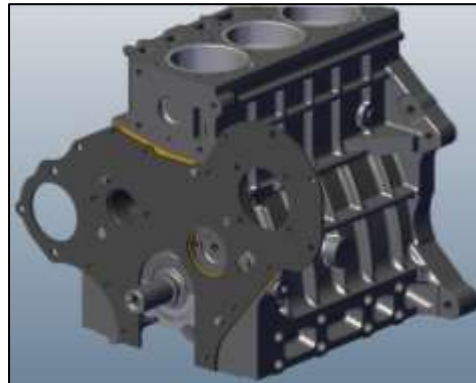
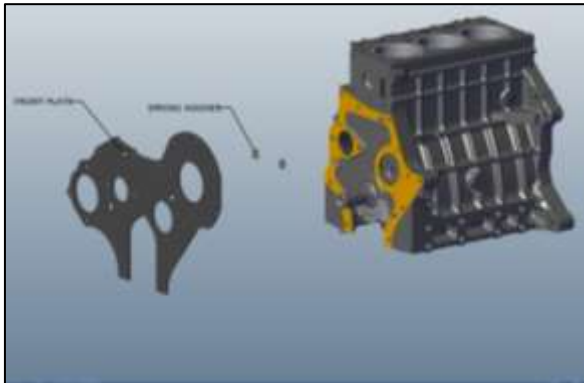


## Timing Gears, Camshaft & Front Plate

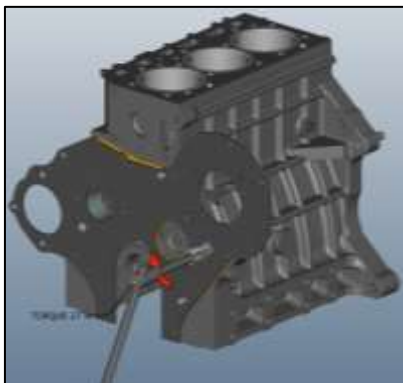
### Front Plate

Assembly: -

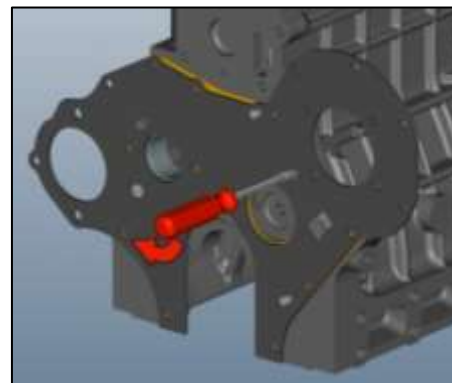
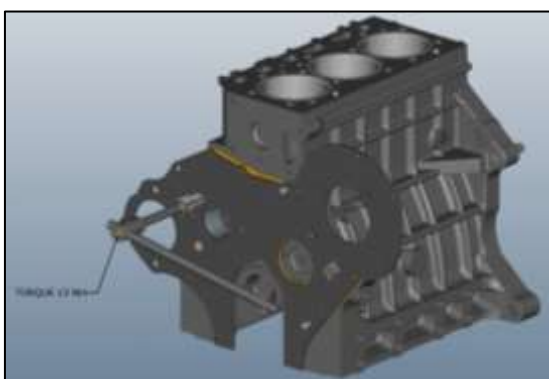
1. Insert Gasket, 2 no's screw and Front plate.



2. Tighten G7.93 M6 bolt with Tap Washer and apply 27 Nm torque.



3. Tighten G6.35 bolt with 13 Nm torque. Insert screw and tighten it with Screw driver.



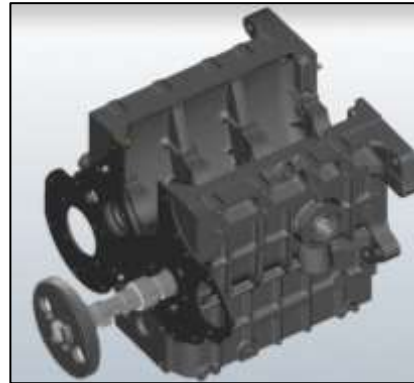
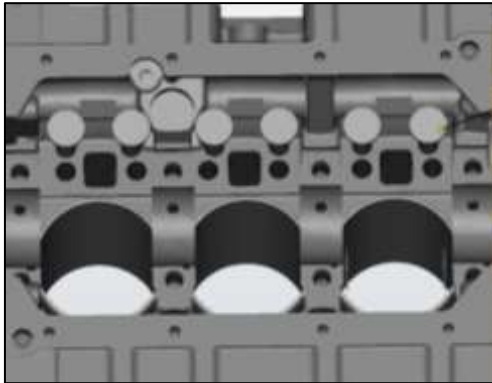
4. Bend the lock plate around bolt.

## Timing Gears, Camshaft & Front Plate

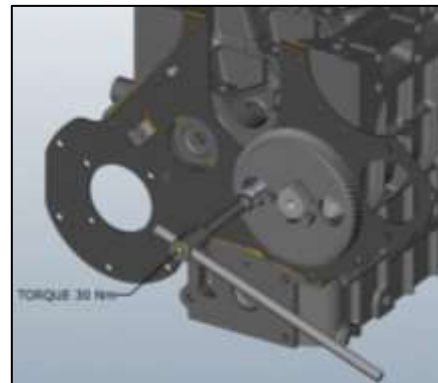
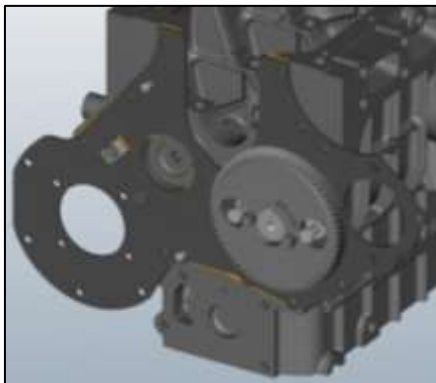
### Tappets & Camshaft

Assembly: -

1. Insert tappets and Cam shaft assembly.



2. Tighten 2 no's, G 9.5 bolts with 30 Nm torque.





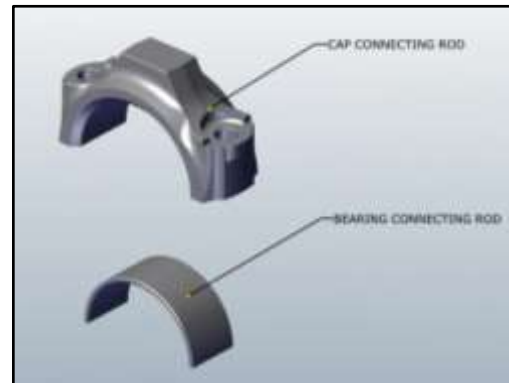
**Connecting Rods**  
**Pistons**  
**&**  
**Cylinder Liners**

## Connecting Rods, Pistons & Cylinder Sleeves

### Connecting Rods

#### Removal: -

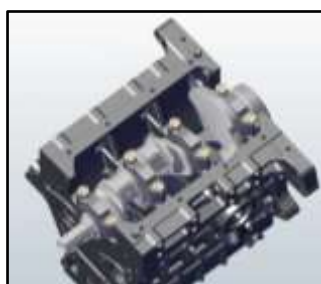
1. Remove Cylinder head (Refer Cylinder Head section for detail).
2. Remove all the bolts securing the oil pan to the crankcase and pull out the oil pan (Refer Oil Sump section for detail).
3. Remove the gasket from the crankcase and discard it.
4. Remove 2 no's nut and bolts from Connecting Rod Cap. Now Remove Connecting Rod Cap & Bearing shell.



5. Similarly remove other Connecting Rod Caps & Bearing shell.
6. Push Connecting rod with mallet and take out Piston Assembly. Similarly remove other Piston assembly.



7. Remove 8 nos, M12 bolts and washers from Main Bearing Cap.

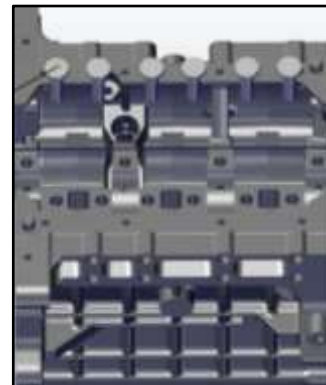
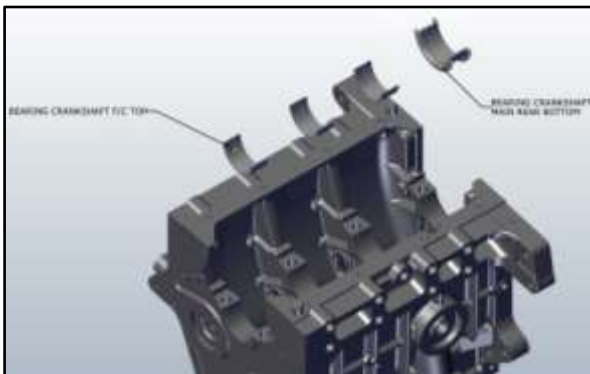


## Connecting Rods, Pistons & Cylinder Liners

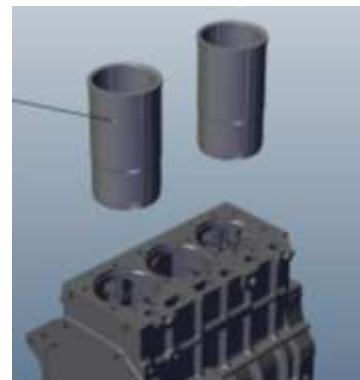
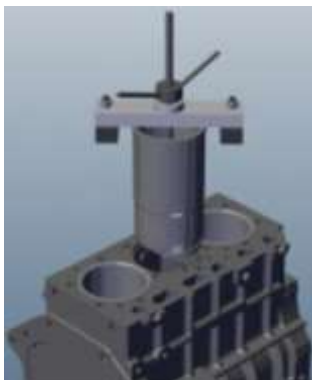
8. Remove Main Bearing Cap, & Bearing shell bottom. Take out Crank shaft.



9. Remove Bearing shell top & Valves Tappets.

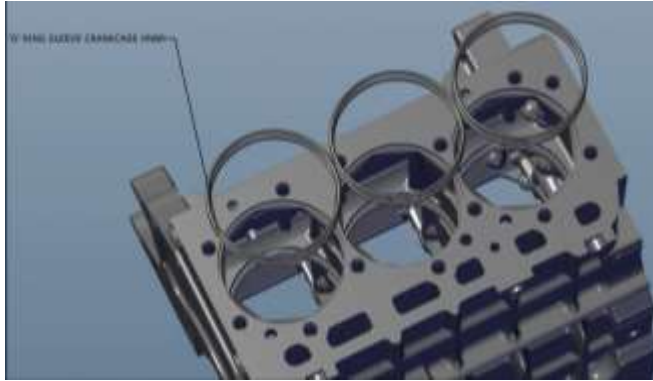


10. Use Yuvo Special tool (MST-H1-EN-1) to remove Cylinder Sleeves.



## Connecting Rods, Pistons & Cylinder Liners

11. Remove Cylinder Sleeve "O" rings from Crankcase.



12. Remove Retainer, Piston Pin, Retainer, Piston & bush.



13. Remove Piston rings with Special plier.



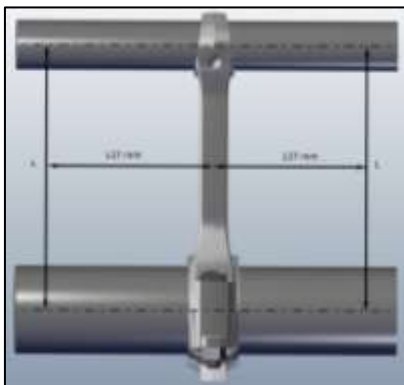
## Connecting Rods, Pistons & Cylinder Liners

### Connecting Rod Alignment

1. Insert two rods into the Connecting Rod big end and small end bore as shown.



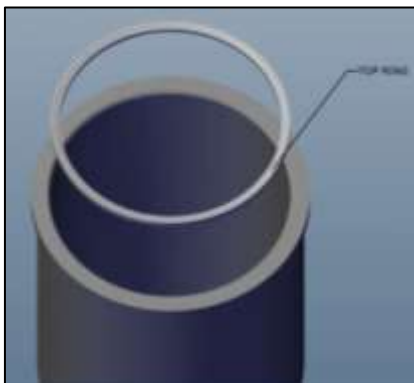
2. The Big end and Small end bores must be square and parallel with each other in all the planes.
3. Measure 127 mm on each side of connecting rod.



Note: If alignment is not ok then please replace the connecting rod.

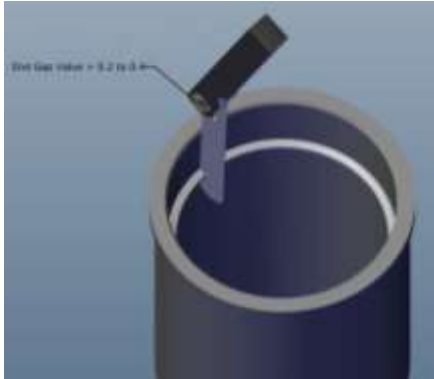
### Butt Clearance & Land Clearance of Piston Rings

1. Take liner and put 1<sup>st</sup> Ring by ensuring Top mark should be on top side.

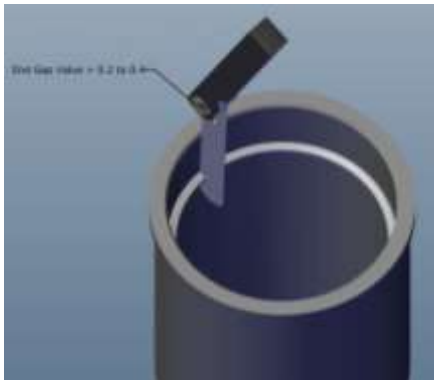


## Connecting Rods, Pistons & Cylinder Liners

2. Measure End gap with the help of Feeler Gauge. End Gap should be 0.2 mm to 0.4 mm.



3. Put 2<sup>nd</sup> Ring by ensuring Top mark on should be on Top side.
4. Measure the End Gap. It should be 0.4 mm to 0.6 mm.



5. Similarly put 3<sup>rd</sup> Ring by ensuring Top mark on should be on Top side and measure the End Gap. It should be 0.25 mm to 0.50 mm.

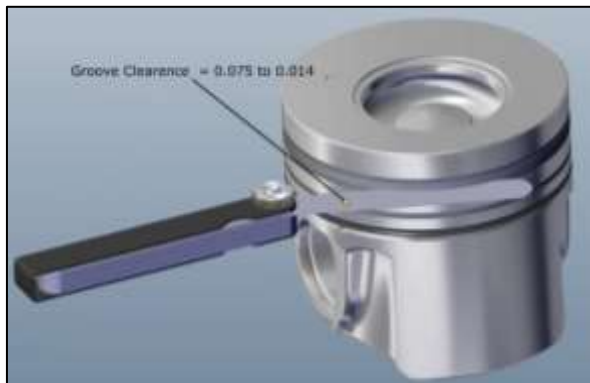
Note: If End Gap is observed more than the specified value, then please replace Piston Rings as a set.



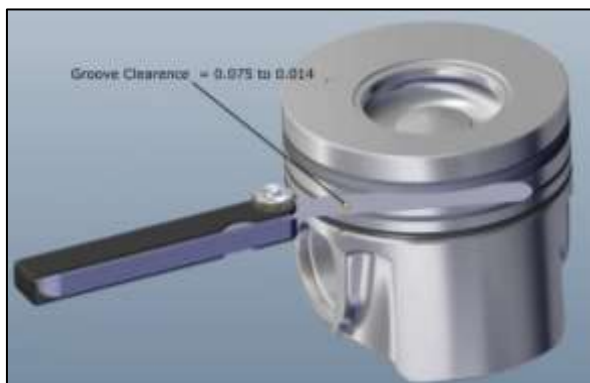
## Connecting Rods, Pistons & Cylinder Liners

### Land Clearance of Piston Rings

1. Check Piston Rings grooves for wear by using new rings and feeler gauge.
2. Land Clearance for 1<sup>st</sup> Ring should be 0.075 mm to 0.014 mm.



3. For 2<sup>nd</sup> Ring Land Clearance should be 0.075 mm to 0.014 mm.



4. For 3<sup>rd</sup> Ring Land Clearance should be 0.065 mm to 0.080 mm.

Note: If Land Clearance is observed more than the specified value, then please replace Piston.

## Connecting Rods, Pistons & Cylinder Liners

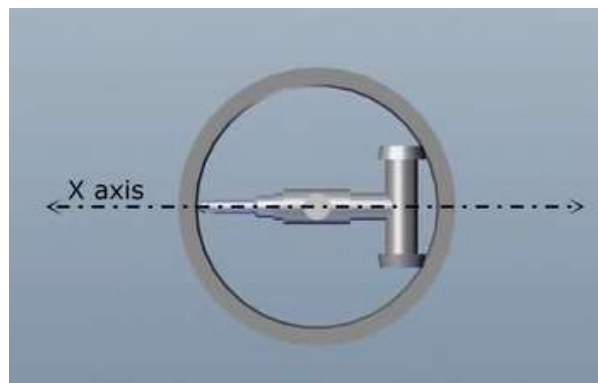
### Engine Liner Bore Ovality Check

Caption on Top Left Side

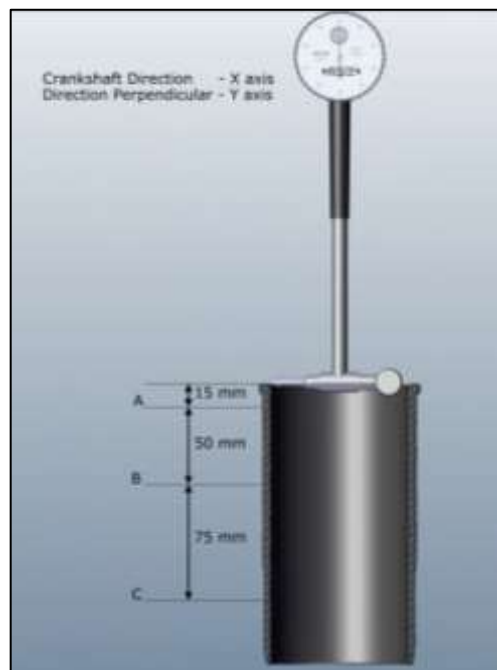
Crankshaft Direction – X Axis

Direction Perpendicular – Y axis

1. Take Dial Bore Gauge and measure Sleeve bore diameter first in a direction along the Crankshaft axis i.e. '**X**' axis
2. Measure at the distance of 15 mm i.e. '**A**' (Caption X = X)



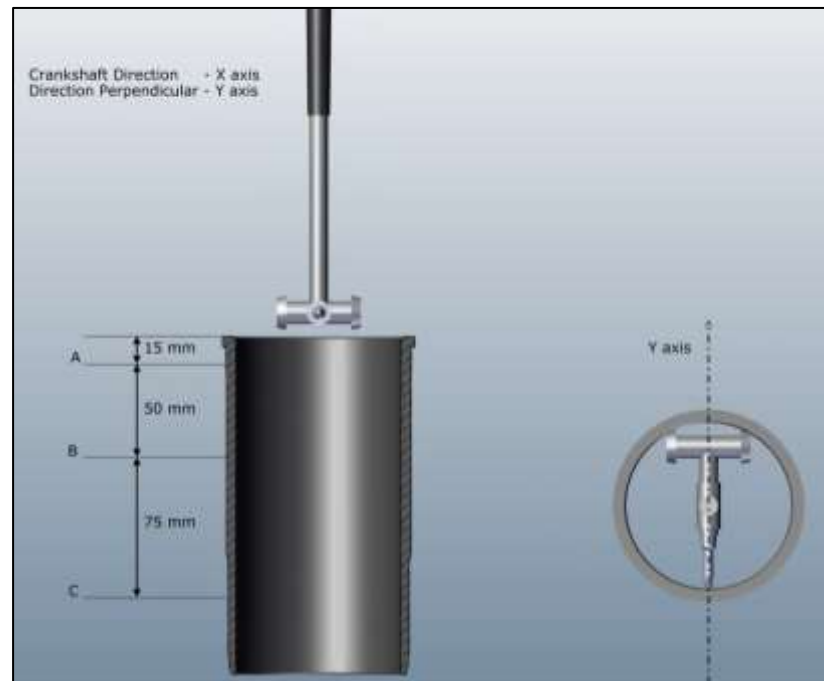
3. 50 mm i.e. '**B**' (Caption X = X1) and 75 mm i.e. '**C**' (Caption X = X2)



## Connecting Rods, Pistons & Cylinder Liners

### Engine Liner Bore Ovality Check

- And then measure Sleeve bore diameter perpendicular to the Crankshaft axis i.e. 'Y' axis, at the distance of 15 mm i.e. 'A' (Caption Y = Y) , 50 mm i.e. 'B' (Caption Y = Y1) and 75 mm i.e. 'C' (Caption Y = Y2)



- Maximum Sleeve Taper is the maximum difference between X, X1 and X2 or Y, Y1 or Y2
- Maximum Sleeve Ovality is X minus Y or X1 minus Y1 or X2 minus Y2.

Note: If value of Sleeve Taper and Ovality is observed more than the specifications, then replace the Sleeve.

## Connecting Rods, Pistons & Cylinder Liners

### Piston & Connecting Rod.

#### Assembly: -

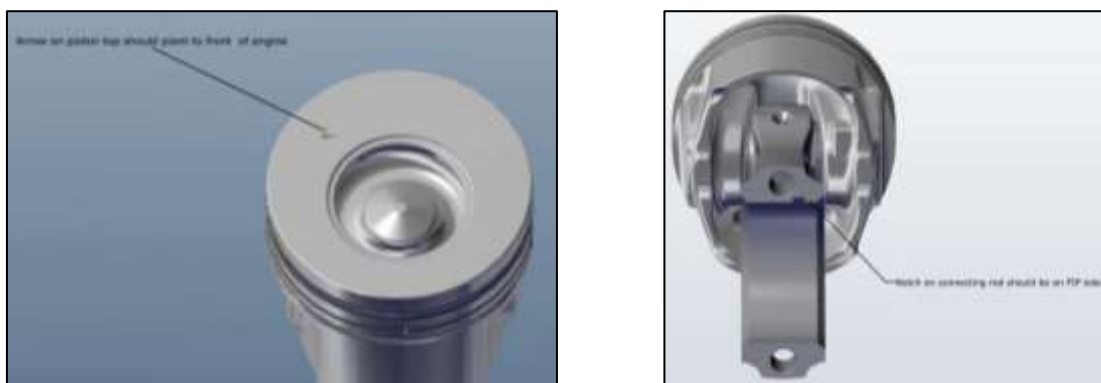
1. Insert Piston Rings with special plier.



2. Insert Connecting rod, Piston pin and retainers.



3. Please ensure during sub assembly, arrow mark on piston top should be on front side of engine & notches on connecting rod big end should be on FIP side.

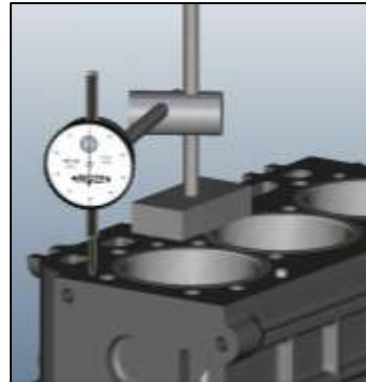
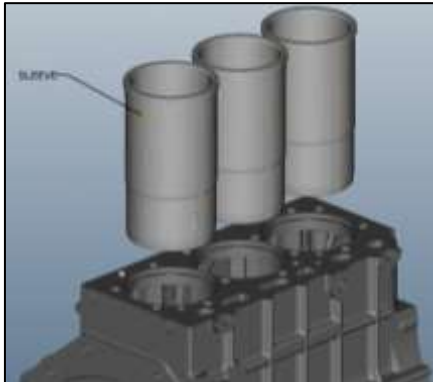


## Connecting Rods, Pistons & Cylinder Liners

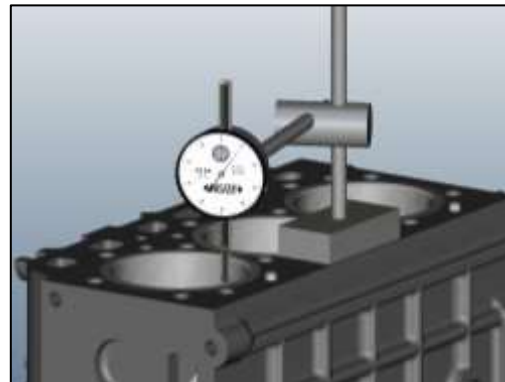
### Cylinder Liners.

#### Assembly: -

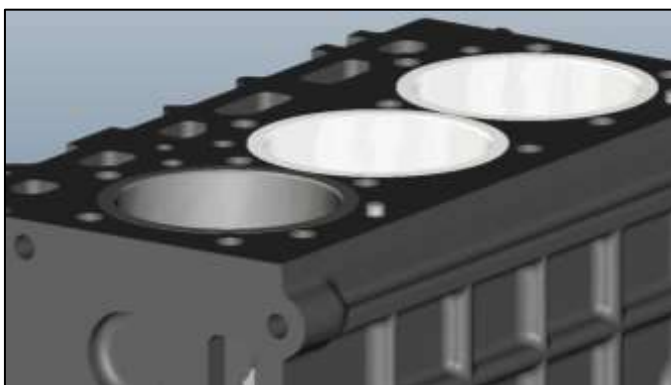
1. Insert liner without "O" ring. Fix dial gauge base on plane surface & put needle under some tension & ensure zero.



2. Put needle on liner collar. Measure readings at two opposite position. **Liner protrusion should be 0.051 above face to 0.025 below face.**



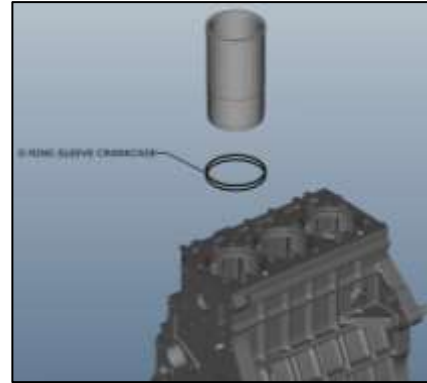
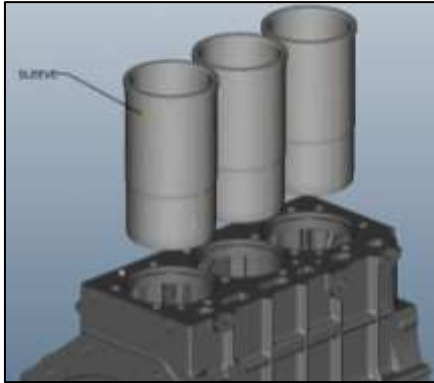
3. Take readings at two opposite positions
4. Similarly check Liner protrusion for remaining Liners.



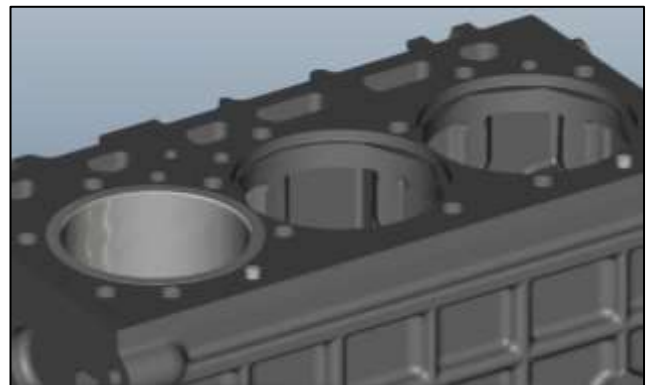
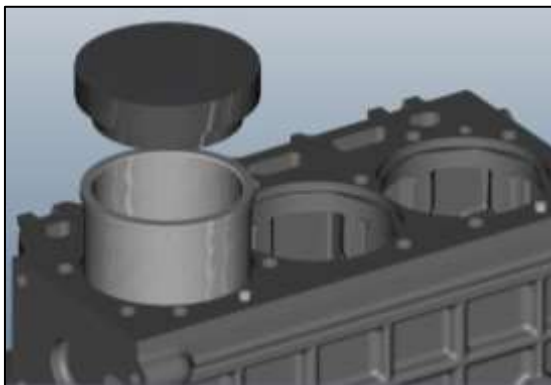
## Connecting Rods, Pistons & Cylinder Liners

### Assembly: -

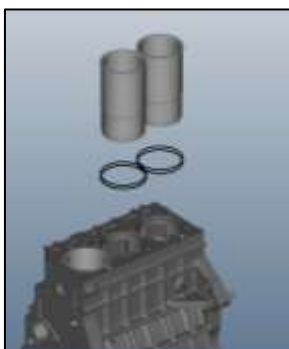
5. Remove Liners and insert 'O' rings and insert Liner.



6. Press Liner with dolly.



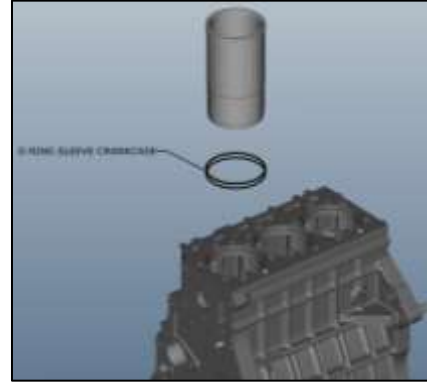
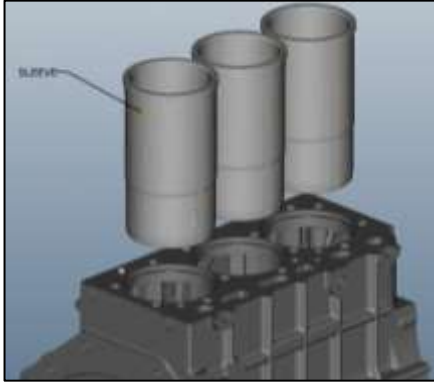
7. Similarly insert 'O' rings for remaining Liners.



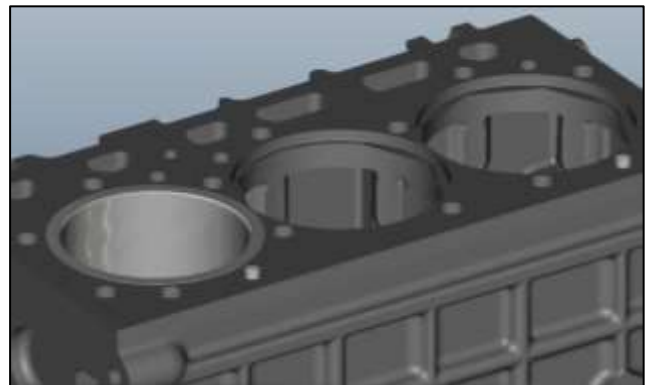
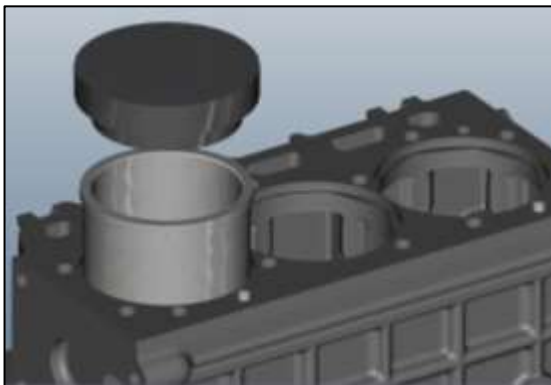
## Connecting Rods, Pistons & Cylinder Liners

### Assembly: -

8. Remove Liners and insert 'O' rings and insert Liner.



9. Press Liner with dolly.



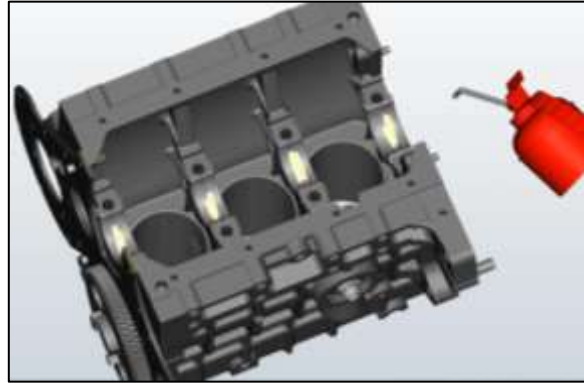
10. Similarly insert 'O' rings for remaining Liners.



## Engine Assembly

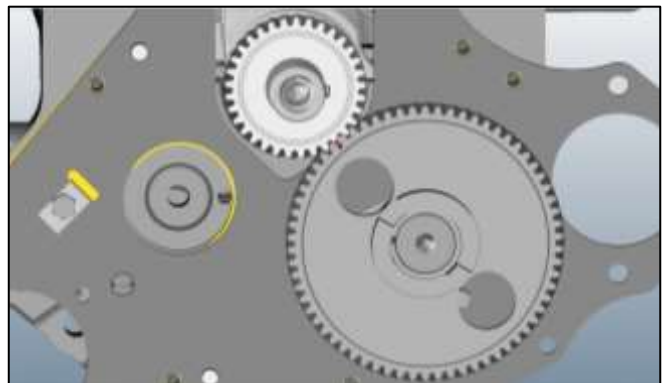
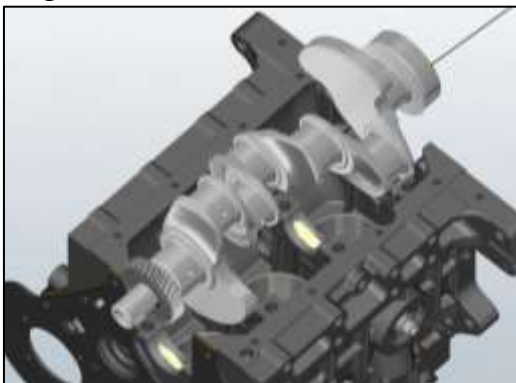
### Assembly: -

1. Insert upper main bearing shell. Apply oil for initial lubrication.

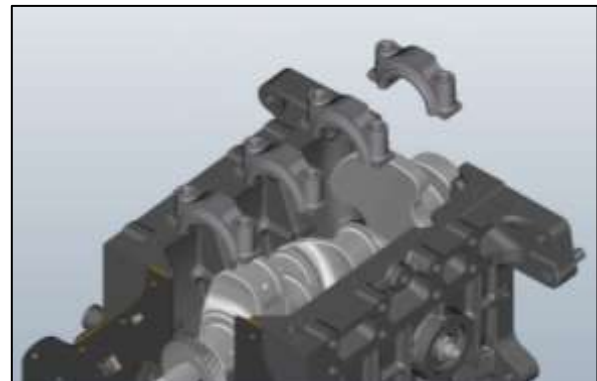
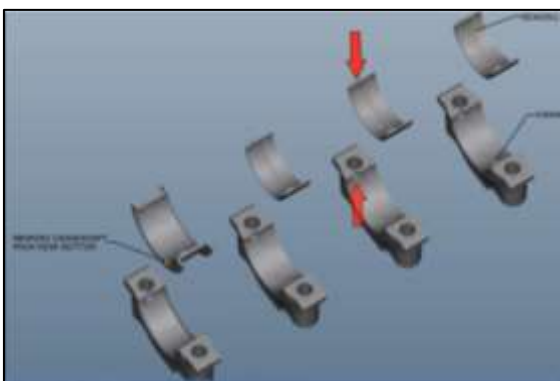


Note: - Ensure bearing shell notch should be match with crankcase notch. Ensure thrust bearing should be fitted on flywheel side.

2. Insert crankshaft assembly. Ensure timing marks should match with reference to mark available on gears



3. Insert bottom bearing shell in cap. Ensure bearing shell notch should be match with crankcase notch.

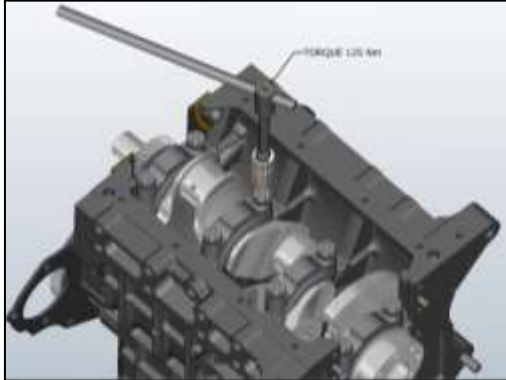




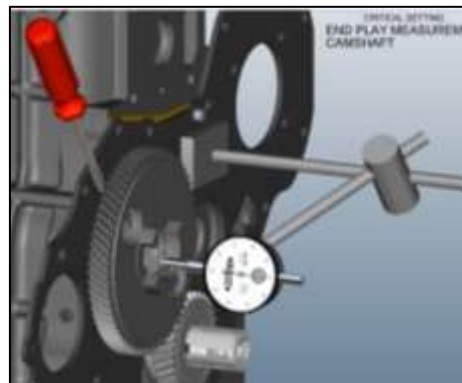
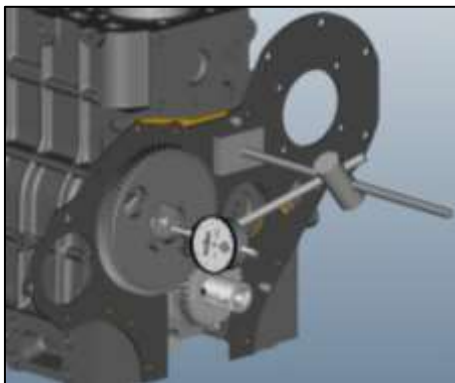
## Engine Assembly

### Assembly: -

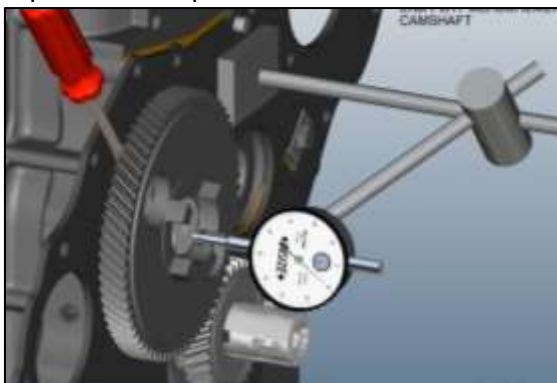
- Fit Main bearing caps serially. i.e. 1 to 4 sequentially from front to rear. Tighten the opposite  $\frac{1}{2}$ "-13 UNC bolts simultaneously and apply **122 to 128 Nm torque**.



- Similarly tighten remaining bolts from inside out.
- Cam shaft End Float measurement.
- Fix dial gauge base on plane surface. Put dial gauge needle on cam shaft under tension. Ensure zero. Move cam shaft gear axially



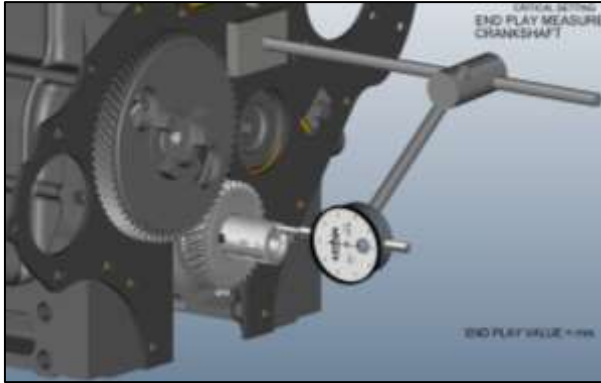
- Measure the reading. End float should be between 0.1mm to 0.4 mm. If readings are not ok, then replace thrust plate.



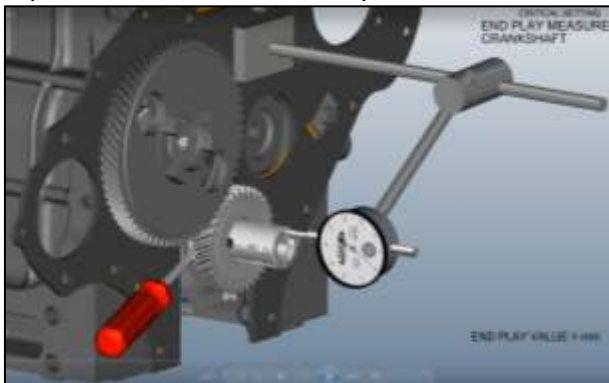
## Engine Assembly

### Assembly: -

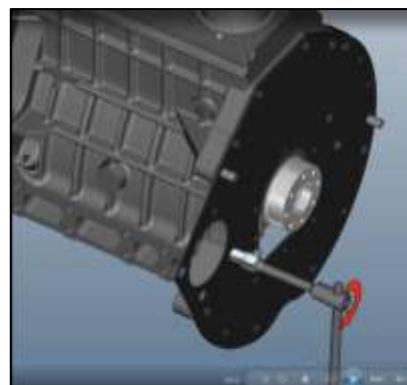
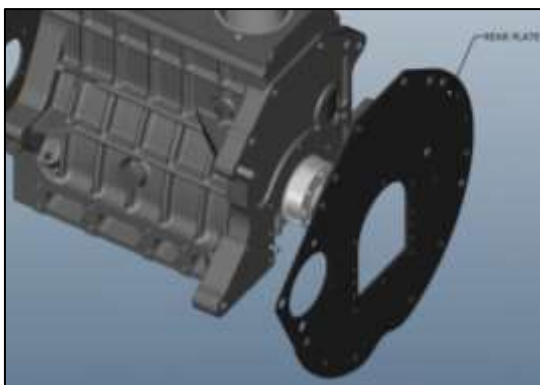
9. Similarly put dial gauge needle on Crankshaft and ensure zero. Move crank shaft axially.



10. Measure the reading. End float should be between 0.1mm to 0.4 mm. If readings are not ok then replace Crankshaft assembly.



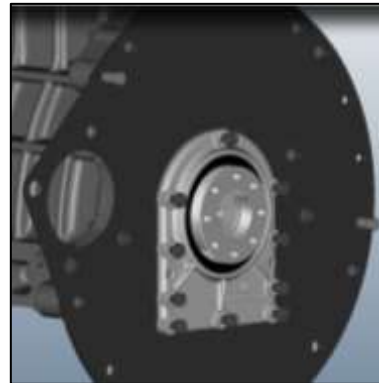
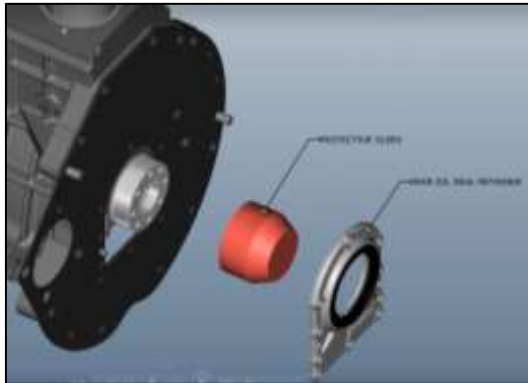
9. Insert Rear Plate and 2 nos M6 bolts and tighten with 10 Nm torque.



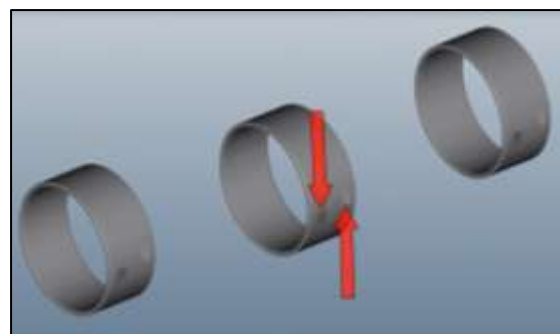
## Engine Assembly

### Assembly: -

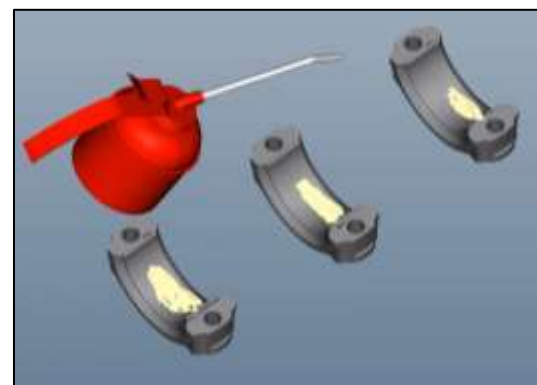
1. Insert protecting sleeve & rear oil seal retainer. Tighten 10 nos, **M8 bolts** with 22 to 28 Nm torque.



2. Take Piston assembly. Ensure arrow mark on piston should be on front side & big end notches are on FIP side.



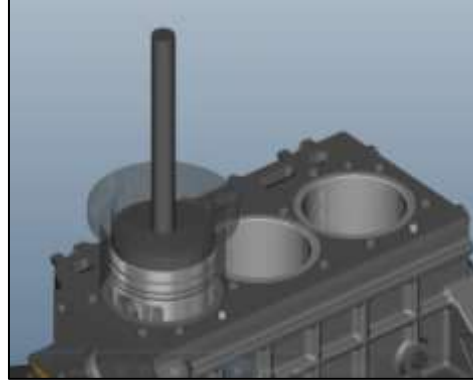
3. Remove caps, apply oil for initial lubrication.



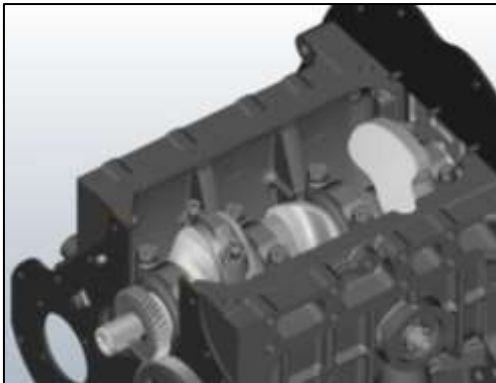
## Engine Assembly

### Assembly: -

4. Insert piston assembly in to tapered dolly. Put dolly on crankcase surface and push the piston into liner with pusher.



5. Locate connecting rod in to proper position. Put Cap & tighten 2 no's, M10 bolts with 60 Nm torque.



6. Similarly insert remaining piston assembly, locate connecting rod in to proper position. Put cap & tighten bolts with 60 Nm torque.

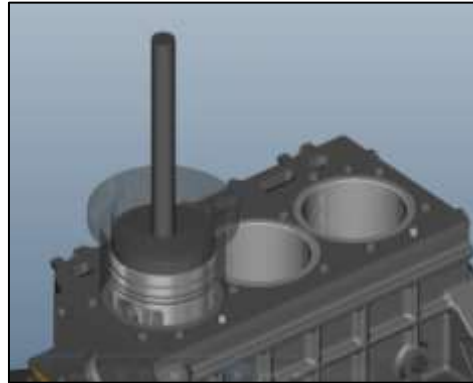


## Engine Assembly

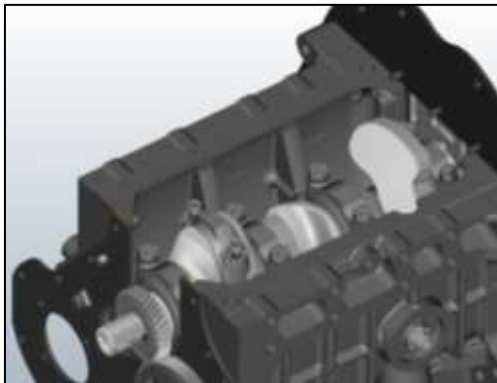
### Crankshaft.

#### Assembly: -

7. Insert piston assembly in to tapered dolly. Put dolly on crankcase surface and push the piston into liner with pusher.



8. Locate connecting rod in to proper position. Put Cap & tighten 2 no's, M10 bolts with 60 Nm torque.



9. Similarly insert remaining piston assembly, locate connecting rod in to proper position. Put cap & tighten bolts with 60 Nm torque.



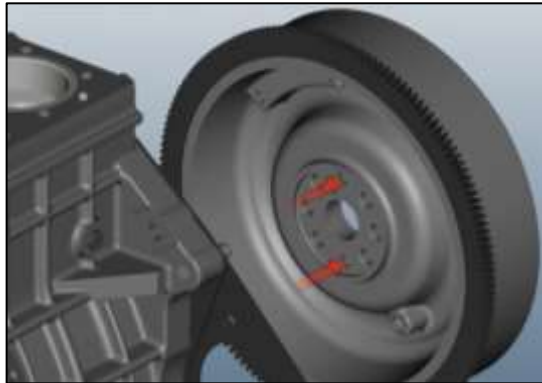
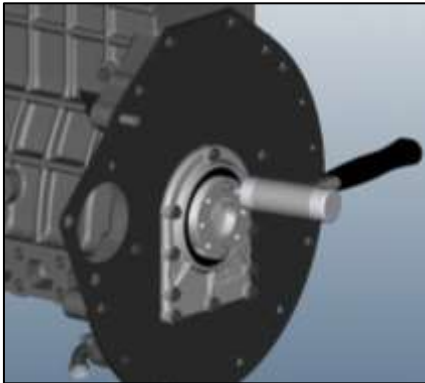
## Engine Assembly

### Assembly: -

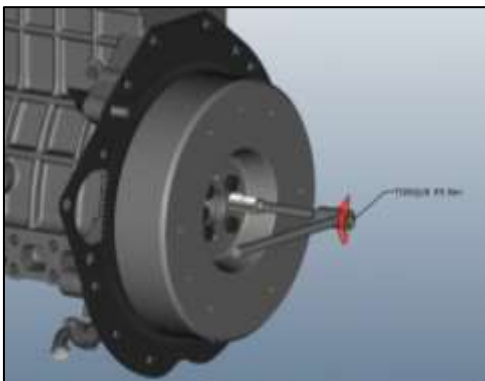
1. Insert oil pump assembly. Tighten Hex bolt G9.525 with 40 nm torque.



2. Insert 2 no's, Flywheel dowels on Crankshaft. Assemble Flywheel correctly with respect to dowel pin.



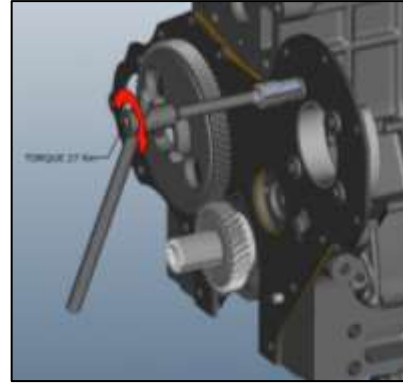
3. Tighten 6 no, M12 bolts with 95 Nm torque.



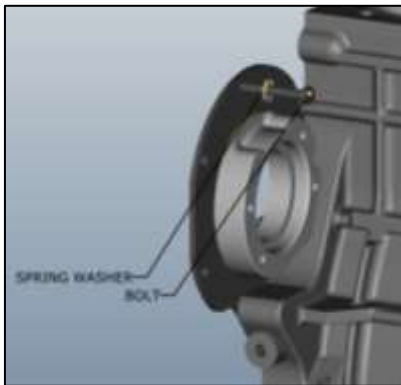
## Engine Assembly

### Assembly: -

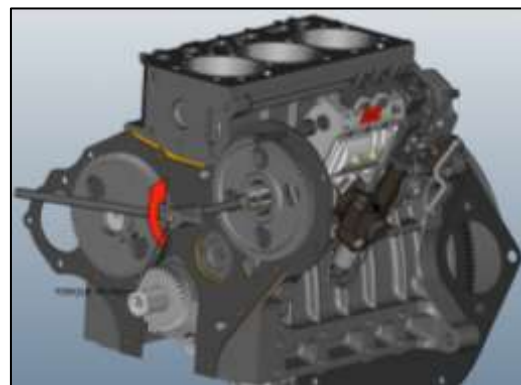
4. Place Gasket and FIP Adapter on Crankcase and tighten 4 nos, M8 bolts with 27 Nm torque.



5. Insert **Hex bolt G7.937** with Washer. Assemble FIP & tighten 4no, M10 bolts with 40 Nm torque.



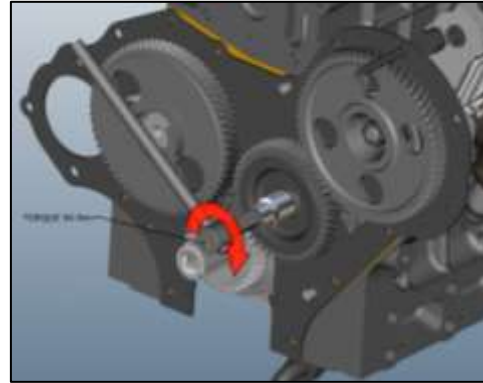
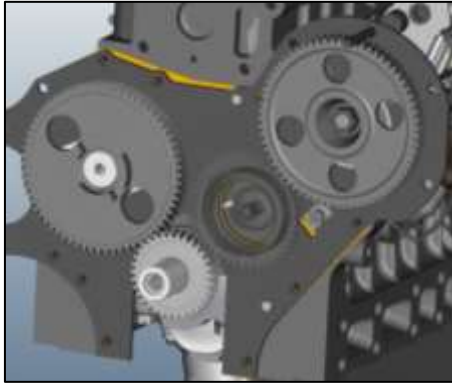
6. Put wood ruff key carefully. Insert gear, washer & Nut. Tighten **M8 nut** with **20 Nm** torque.



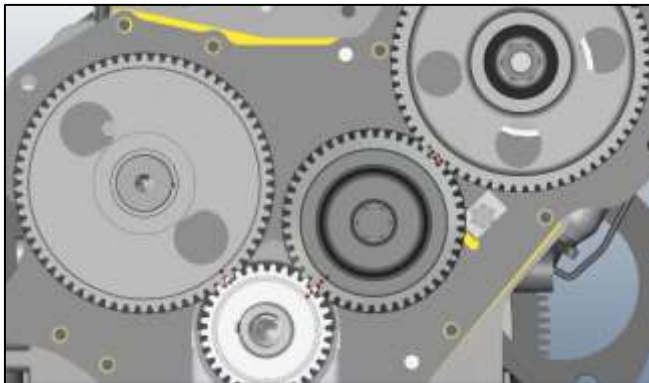
## Engine Assembly

### Assembly: -

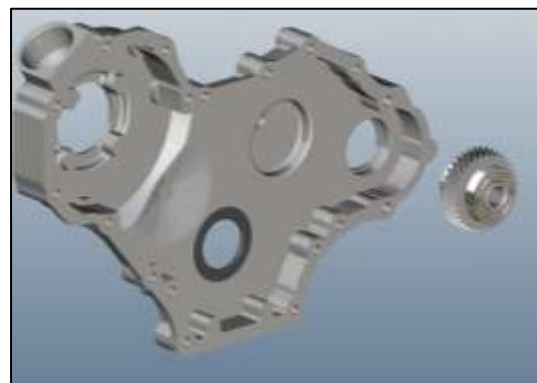
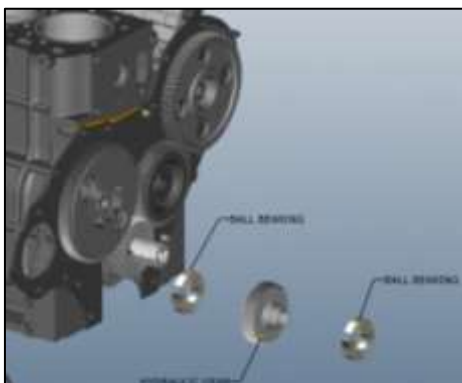
7. Insert idler gear along with shaft by properly locating roll pin in to the crankcase. Tighten **Hex Bolt G12.7** with **90 Nm torque**.



8. Ensure timing marks provided should match with reference to marks available on all gears.



9. Insert 2 no's bearing on Hydraulic Gear and assemble it on Front Cover.

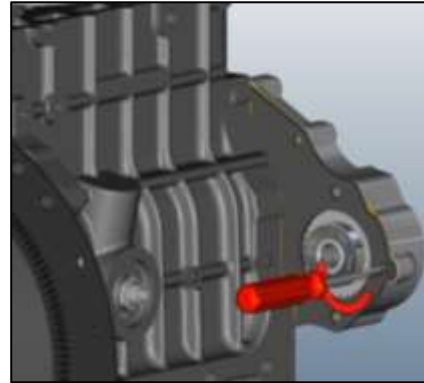
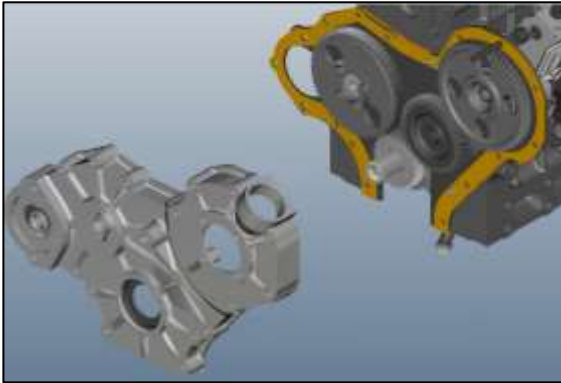




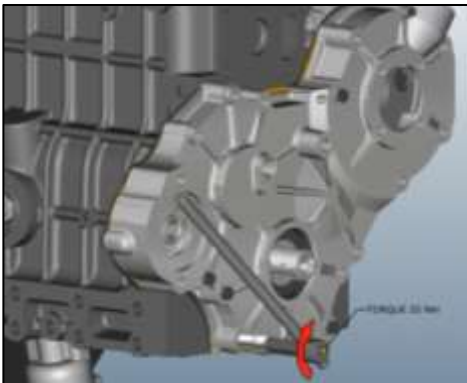
## Engine Assembly

### Assembly: -

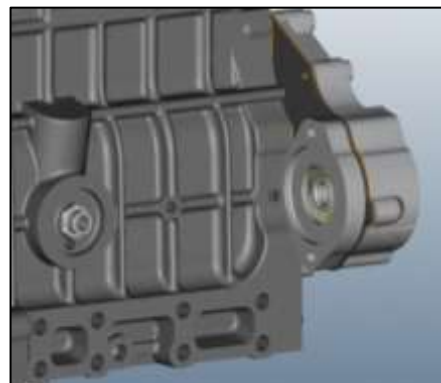
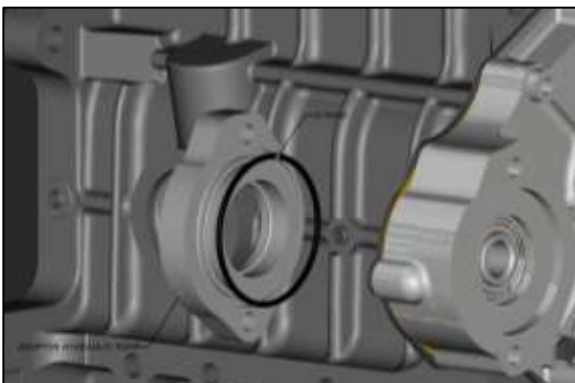
1. Insert gasket & front cover. Tighten Screw on Front Cover with screw driver and **Nut G 7.93**



2. Tighten **05 no's Hex Bolt G 7.93** and with **25 Nm torque**.



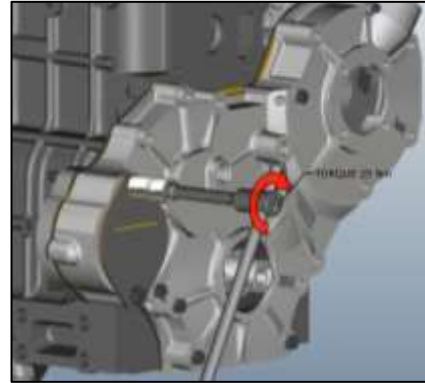
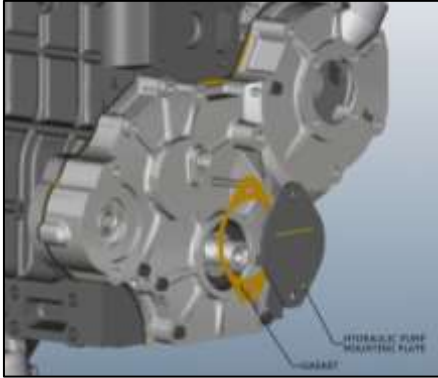
3. Put "O" ring on Adapter Hydraulic Pump and place it on Front Plate.



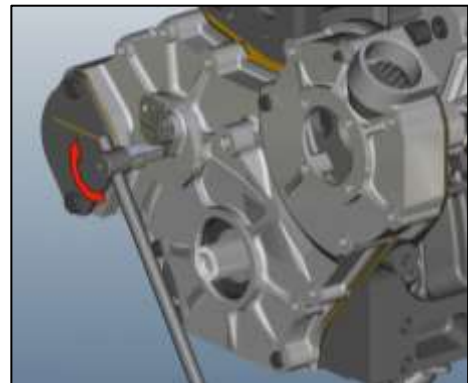
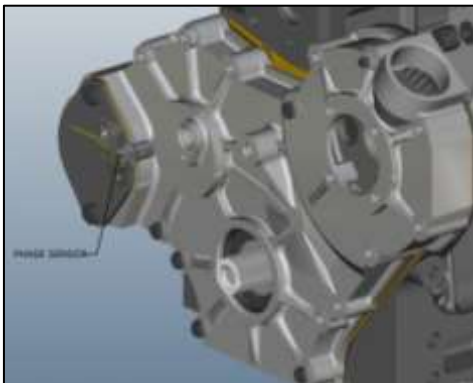
## Engine Assembly

### Assembly: -

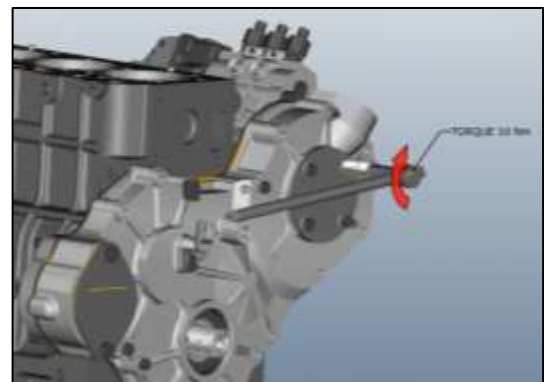
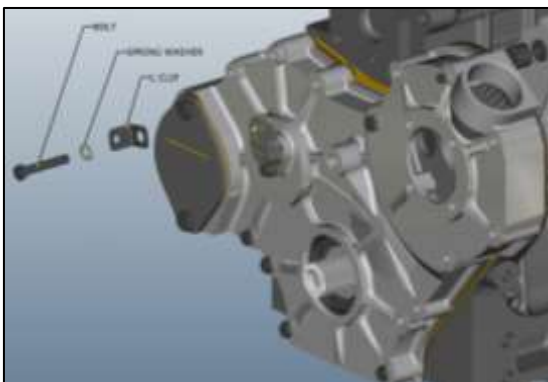
- Place Plate Hydraulic Pump with Gasket on Front Cover and tighten 2 no's M10 bolts with 25 Nm torque.



- Insert Phase Sensor on Front Cover and tighten **M10 bolt with 10 Nm torque.**



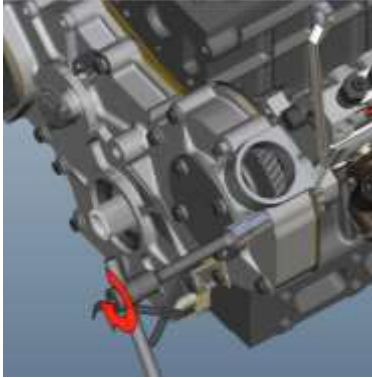
- Place 'L' bracket and washer on Front Cover and tighten **M10 bolt with 25 Nm torque.** Put Gasket and FIP Gear Cover on Front Cover and tighten 4 no's **M8 bolt with 10 Nm torque.**



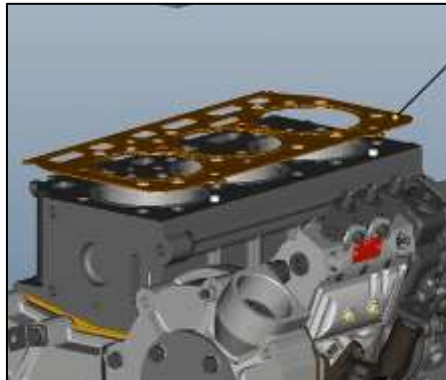
## Engine Assembly

### Assembly: -

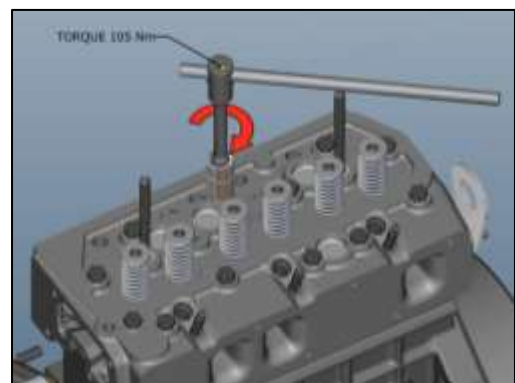
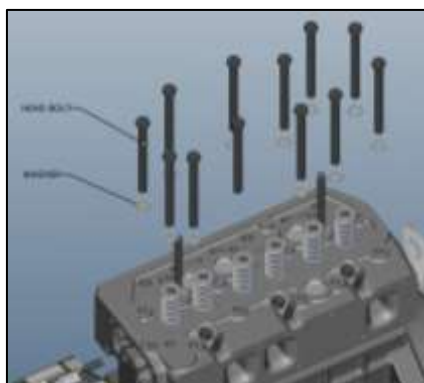
- Place 2 no's Maxi-fuse bracket on Front Cover and tighten **M8 bolts with 10 Nm torque. Insert 3nos Hex Bolt G7.93 with washer and tighten nut with 25 Nm torque.**



- Locate cylinder head gasket correctly with respect to dowel pin. Locate cylinder head correctly with respect to dowel pin.



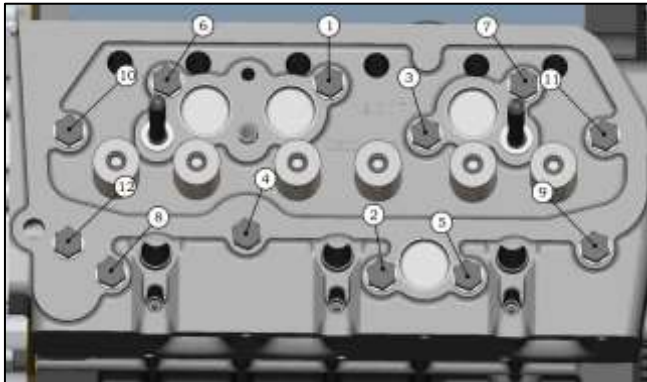
- Insert 12 no, **M11 bolts.**



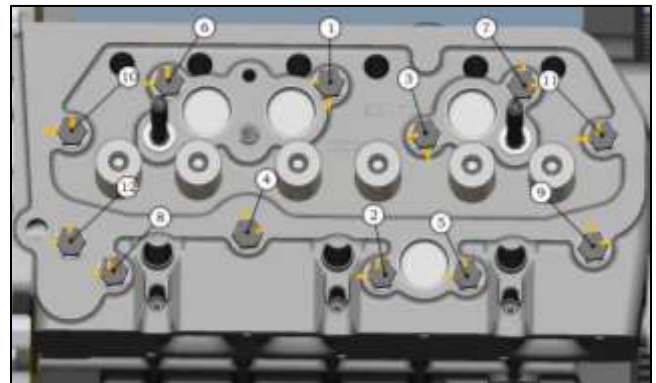
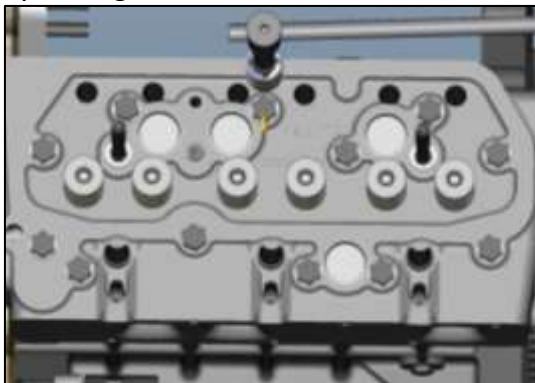
## Engine Assembly

### Assembly: -

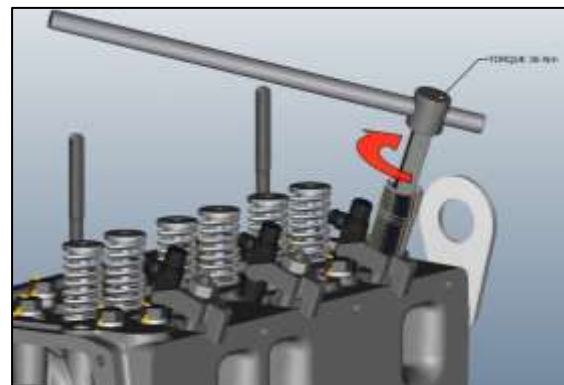
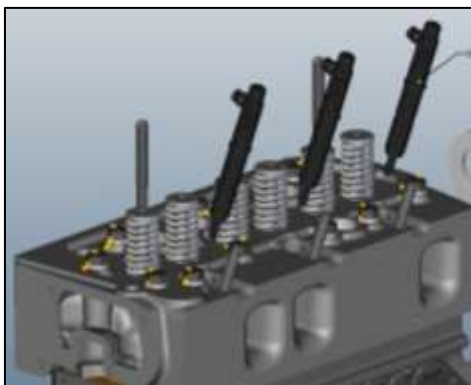
10. Cylinder head mounting bolts torque sequence should be followed sequentially & in two stages.
11. Tighten all bolts sequentially as shown, with 35 Nm torque then apply 90 degree angular torque.



12. For angular torque, Mark the bolt with chalk at one position. Then apply torque till mark rotate by 90 degree.



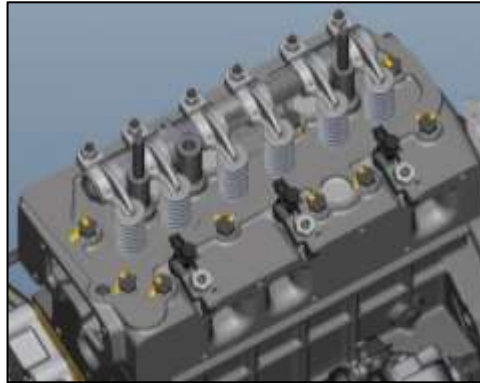
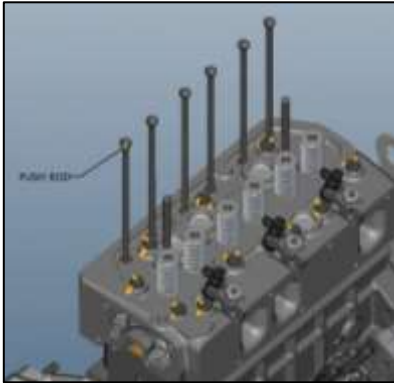
13. Insert copper washer & Injectors. Insert nozzle holder clamp, conical washer & tighten M8 nut with 15 Nm Torque



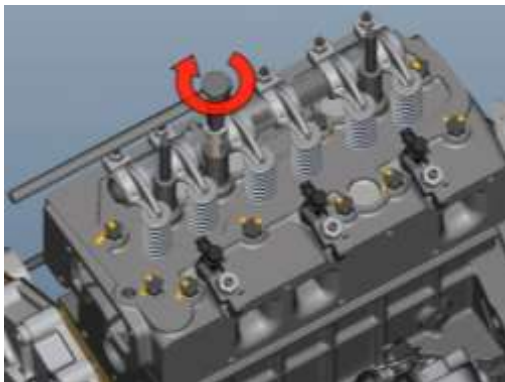
## Engine Assembly

### Assembly: -

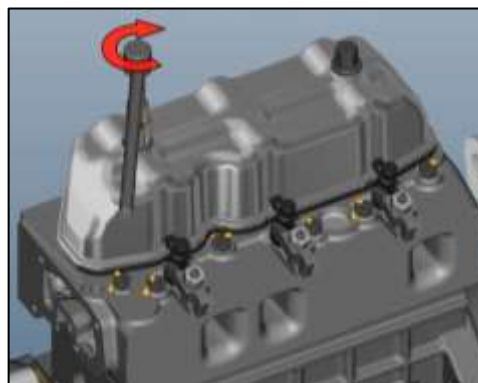
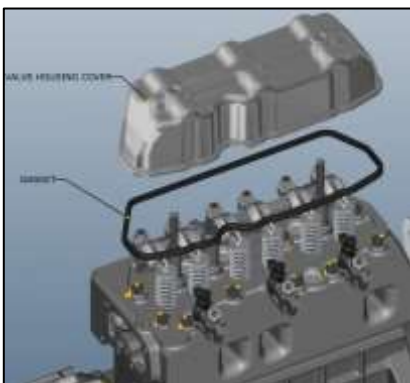
14. Insert push rods & rocker arm assembly.



15. Tighten **M11, Long bolt** with 60 Nm torque and then apply 90 degree angular torque.



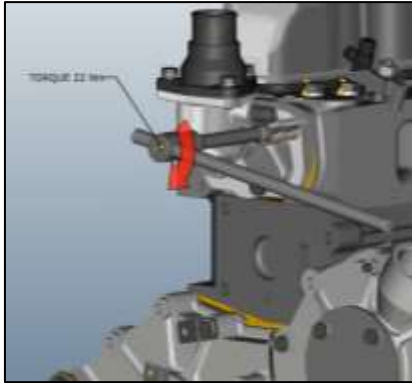
16. Insert gasket, & Valve housing cover. Tighten 2 nos, washer & **M 10 Cap Nuts** with 20 Nm torque.



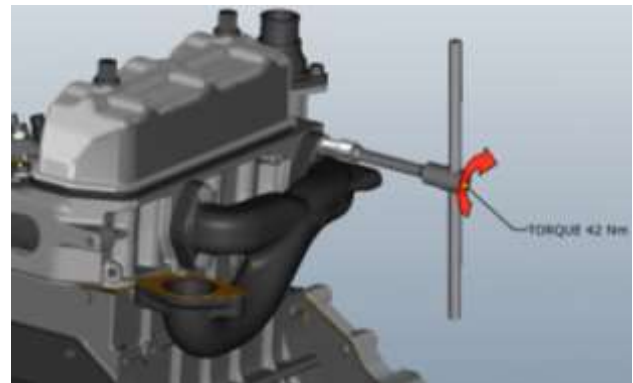
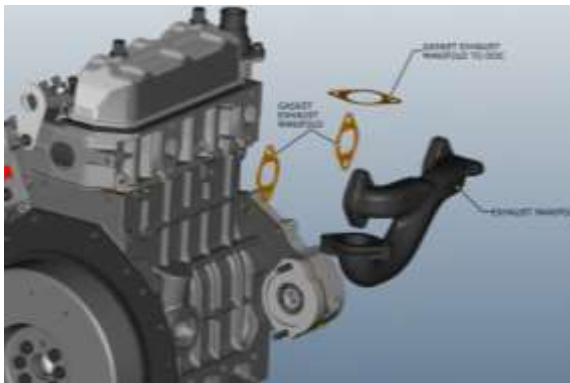
## Engine Assembly

### Assembly: -

17. Put gasket & Thermostat housing. Tighten 3no, M8 bolts with 30 nm torque.



18. Insert gasket & exhaust manifold. Tighten 4 no, M10 bolts with 40 Nm torque.



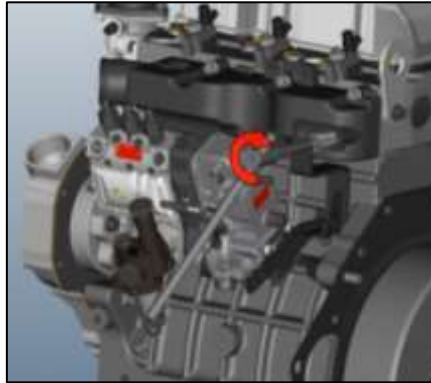
19. Insert gasket, intake manifold & pull to stop bracket. Tighten 6 no's, M8 bolts with 30 nm torque.



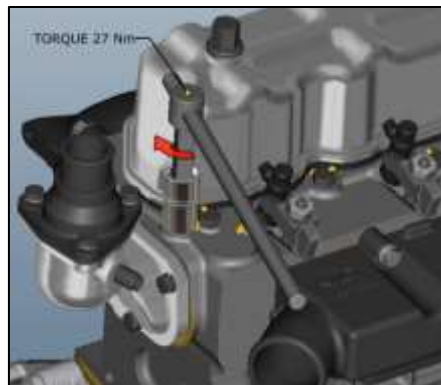
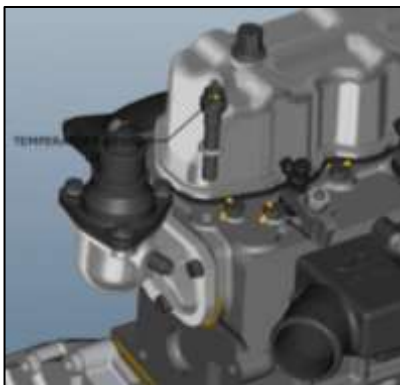
## Engine Assembly

### Assembly: -

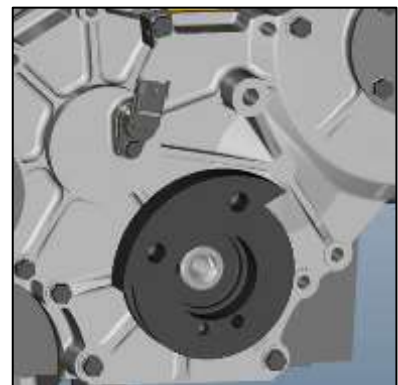
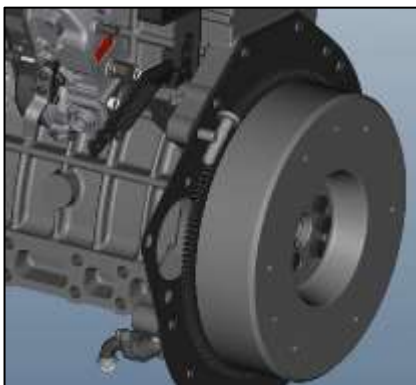
20. Place Pull To Stop Bracket and tighten 2 no's **M8 bolts with 30 nm torque.**



21. Tighten Temperature Sensor and washer with **27 Nm torque**



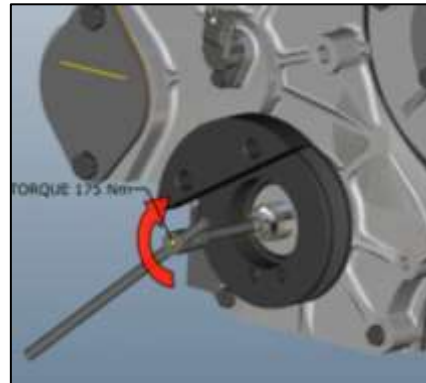
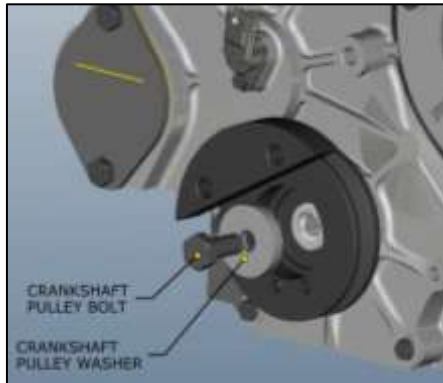
22. Lock the fly wheel with tappet and insert woodruff key, main drive pulley.



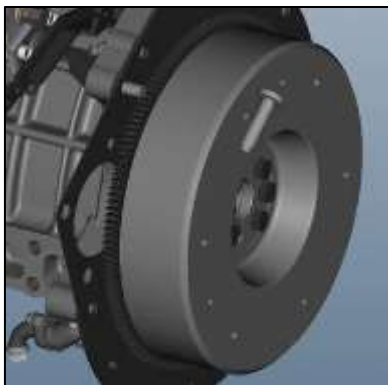
## Engine Assembly

### Assembly: -

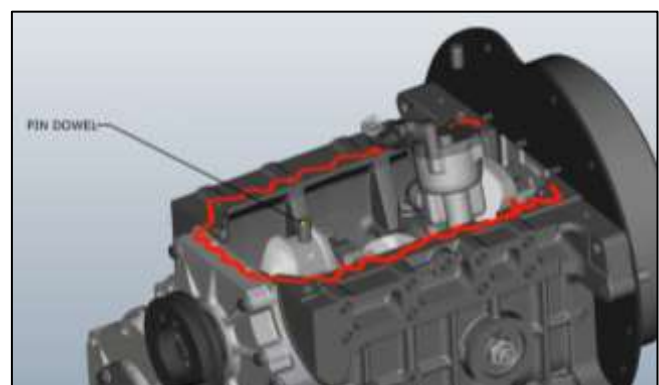
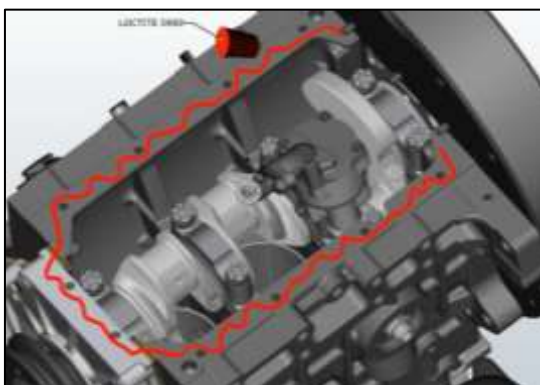
23. Insert Crankshaft Pulley washer and tighten **M14 bolt with 190 Nm torque.**



24. Remove tappet.



25. Apply **Loctite 5900** and insert **2 nos Pin Dowels**.

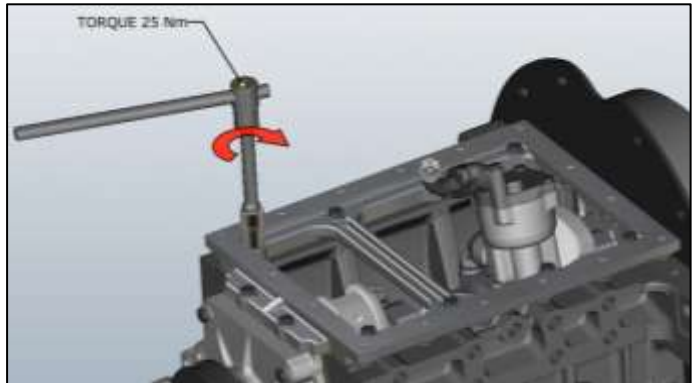
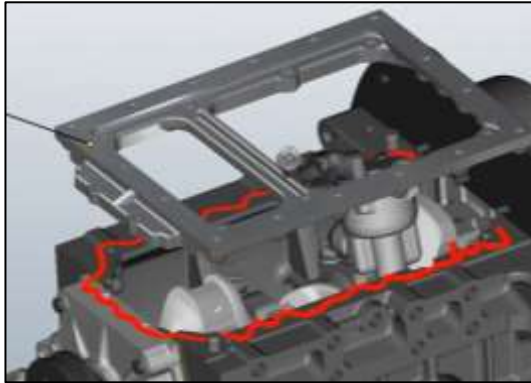




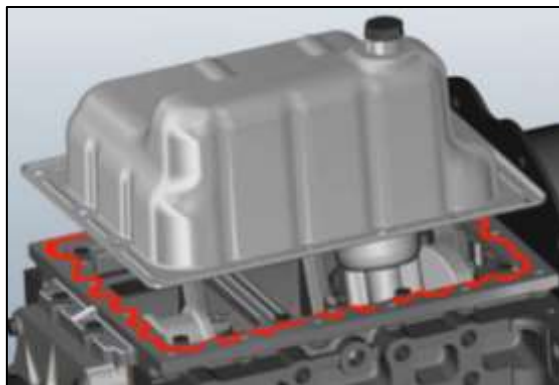
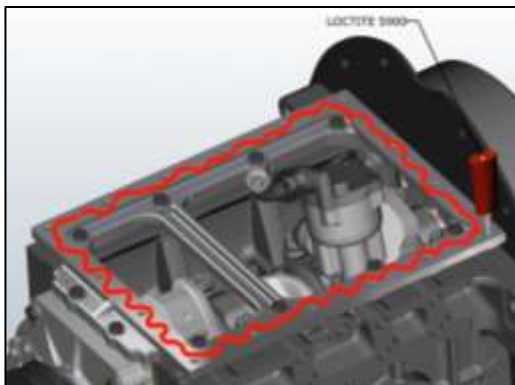
## Engine Assembly

### Assembly: -

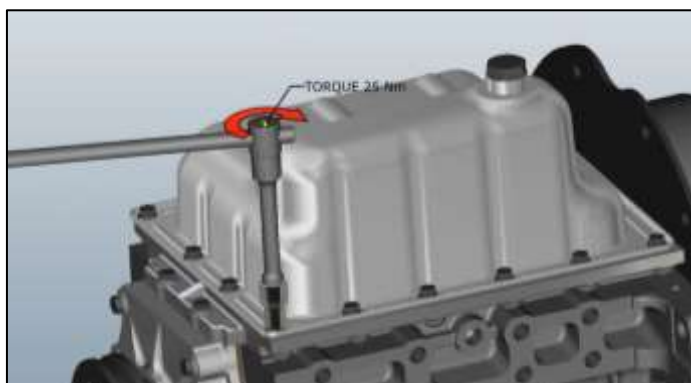
26. Place Ladder Frame on Crankcase and tighten 10 nos M10 bolts with 28 Nm torque.



27. Apply **Loctite 5900** on Ladder Frame and place oil sump.



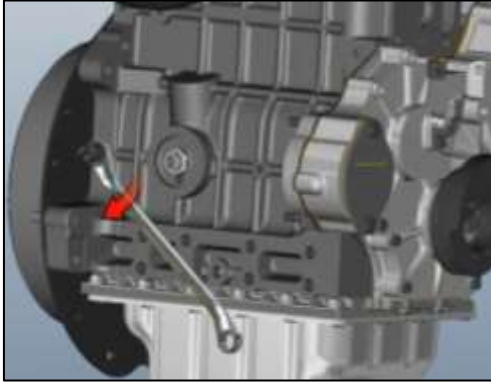
23. Tighten 16 nos, **M10 bolts** with tighten with 28 NM torque. Tighten **M26 drain plug** with washer and apply 90 Nm torque.



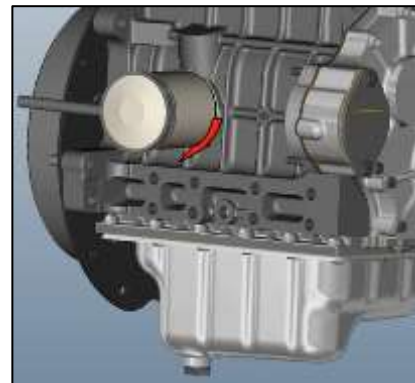
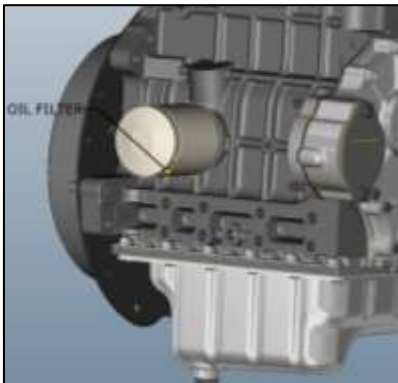
## Engine Assembly

### Assembly: -

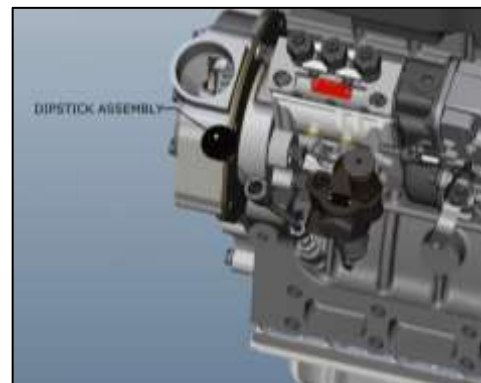
24. Tighten Oil Pressure switch with **apply 20 Nm torque.**



25. Fit Oil Filter.



26. Fit Dip Stick Guide assembly.



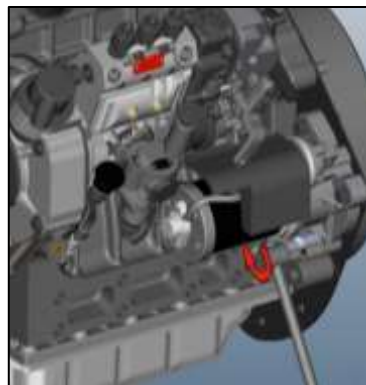
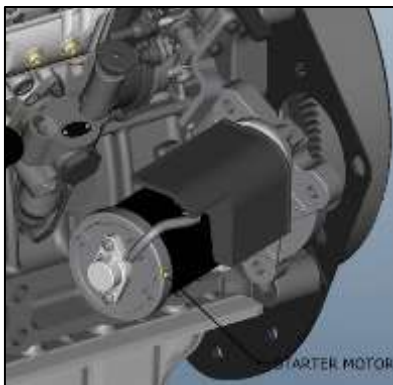
## Engine Assembly

### Assembly: -

#### 27. Fit Oil Filler Cap with O Rings.

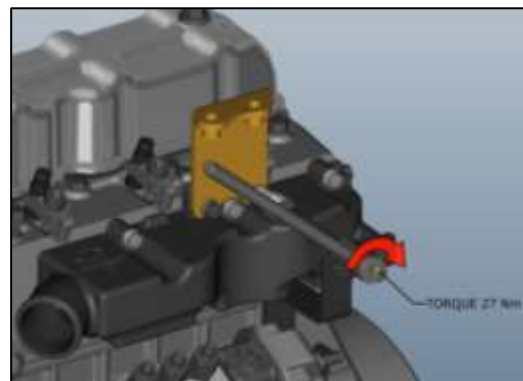
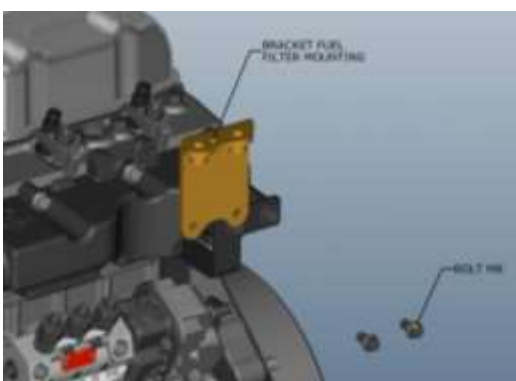


#### 28. Insert starter motor and tighten 2 no, M10 bolts with 40 Nm torque.



#### 29. Place Bracket Fuel Filter Mounting and tighten 2 no's, M8 bolts with 10 Nm torque.

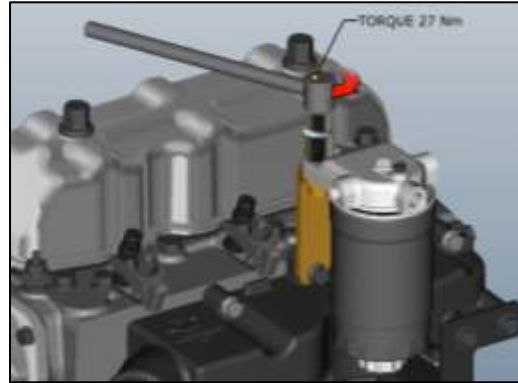
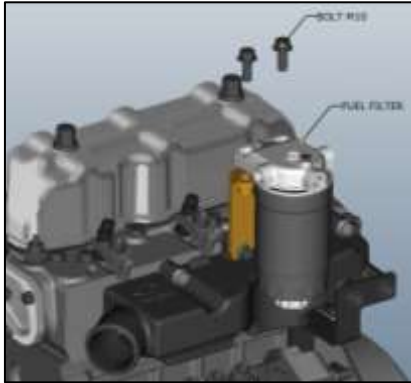
#### 30. Fit Fuel Filter on bracket and tighten 2 no's M10 bolts with 10 Nm torque.



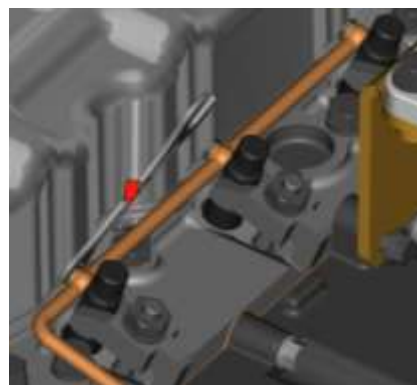
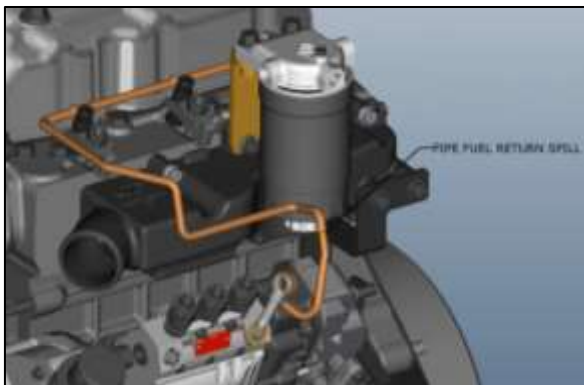
## Engine Assembly

### Assembly: -

31. Fit Fuel Filter on bracket and tighten 2 no's M10 bolts with **10 Nm torque**.



32. Fit Return Line on FIP and Injector **3 no's Banjo and Washer**.



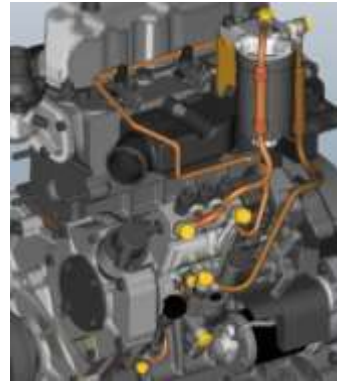
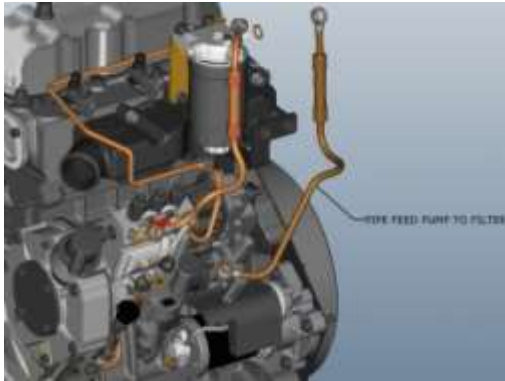
33. Fit FIP Lubrication Pipe with M10 Banjo and washer.



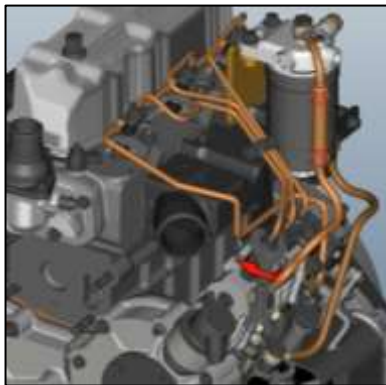
## Engine Assembly

### Assembly: -

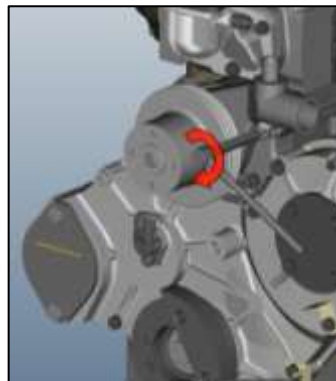
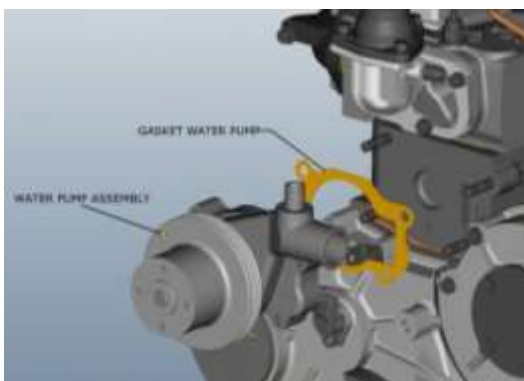
34. Fit Pipe Feed Pump to Filter with M14 Banjo and washer. Fit Pipe Filter to FIP with **M14 Banjo and washer.**



35. Fit High pressure pipes & tighten with **30 Nm torque.**



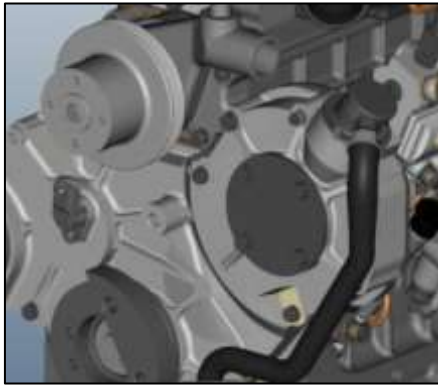
36. Place Water Pump on Cylinder Head assembly and tighten 4 no's **Hex Nut G9.525.**



## Engine Assembly

### Assembly: -

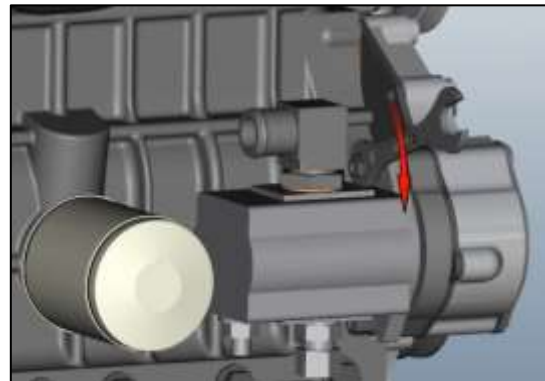
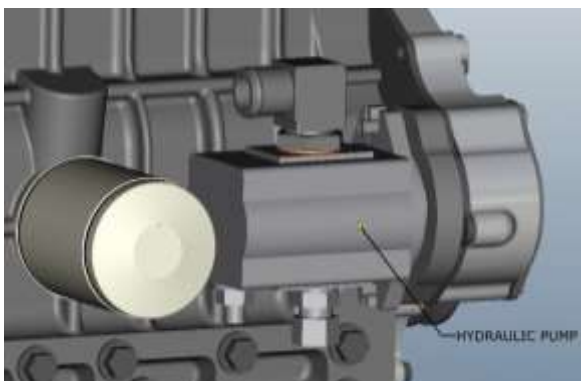
37. Insert blow-by pipe & tighten hose clip with screw driver.



38. Insert thermostat by-pass tube & tighten hose clip with screw driver. Insert Radiator Lower Hose & tighten hose clip with screw driver.



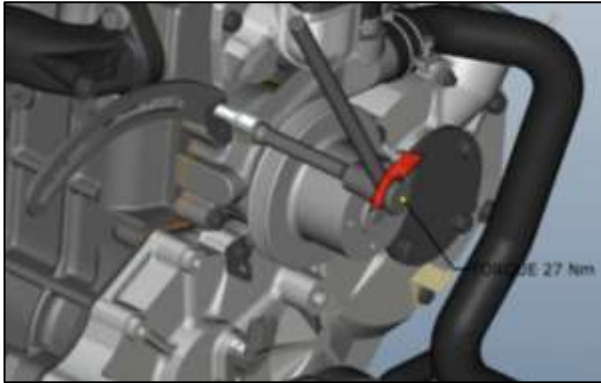
39. Fit Hydraulic Pump on and tighten 4 nos nut with 30 Nm torque.



## Engine Assembly

### Assembly: -

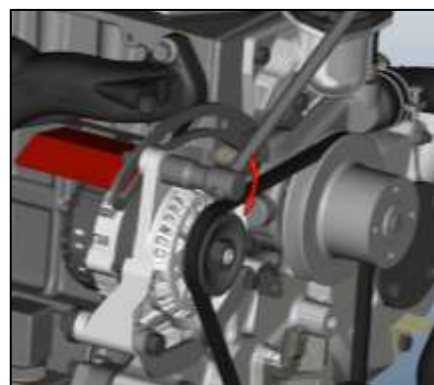
40. Fit Alternator Brace, 'L' Clamp and tighten **bolt with 27 nm torque**



41. **Hold Alternator Bracket Rear on Front Cover Rear side. Hold Alternator in-between Bracket Rear and Brace and place Bracket Front on alternator. Now tighten 3 nos Hex Bolts with 20 Nm torque.**



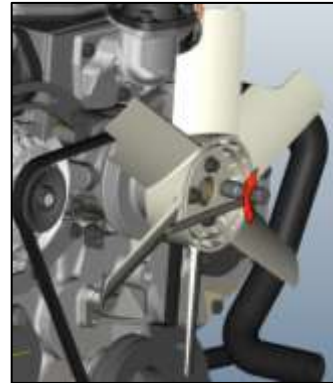
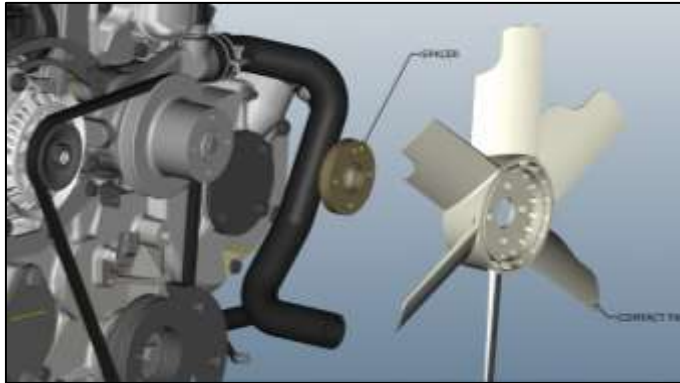
42. Insert Belt on Alternator and Water Pump. Hold Heat Shield on Alternator and insert M10 bolt through it and tighten with M10 nut .



## Engine Assembly

### Assembly: -

43. Fit Spacer and Fan on Water Pump and tighten 4 nos M8 bolts with **20 Nm torque**. Assemble fan & tighten 4no, M8 bolts with 25 Nm torque.







# Trouble Shooting

## Troubleshooting

Sr. No	Probable Causes	Remedy
<b>Engine Fails To Turn</b>		
1	Batteries too low to turn engine	Charge battery or install new one.
2	Starting switch inoperative	Inspect for faulty cables and terminals. Replace starting switch if necessary.
3	Engine oil too heavy	Use correct grade of lubricating oil as specified in the operator's manual.
4	Internal seizure	Hand crank the engine. If the engine does not turn easily, seizure due to internal damage; including gear train, pistons, sleeves, connecting rods or main bearings, is indicated.
5	Hydrostatic lock	Remove all the injection nozzles and crank the engine. Check for fuel or coolant in the cylinder.
<b>Engines Does Not Start / Engine Start But does not Develop Full Power</b>		
1	Low or no fuel pressure	Low or no fuel pressure
	a. Insufficient fuel	Check fuel tank.
	b. Fuel oil filter clogged	Replace filters.
	c. Fuel filter gaskets defective (air being drawn into fuel)	Fuel filter gaskets defective
	d. Moisture in fuel tank	Drain entire system and fuel filter. Refill with clean fuel, and vent the air from the system.
2	Poor fuel	Use a good grade of fuel.
3	Air cleaner clogged	Remove and service air cleaner as described in operator's manual
4	Injection pump not properly timed	Check timing.
5	Fuel line clogged or air in line	Clean fuel line and vent fuel system. Refer operator's manual.
6	Injection pump not operating properly	Remove injection pump and check calibration.
7	One or more fuel injection nozzles not operating properly	Replace the injection nozzles.
8	Loose or broken fuel lines or fittings between injection pump and injection nozzles	Tighten or repair.
9	Loose or broken connections or leaking gaskets at intake manifold or exhaust manifold	Tighten or repair.
10	Improper valve settings excessive amount, check for bent.	Reset as necessary. If out of adjustment an excessive amount, check for bent
11	Lack of compression	Refer to "Poor Compression " probable causes.

## Troubleshooting

Sr. No	Probable Causes	Remedy
<b>Poor Compression</b>		
1	Piston rings worn, broken or cracked	Install new rings
2	Cylinder sleeve worn	Install new sleeves.
3	Valves damaged or worn	Install new valves.
4	Broken valve spring	Install new springs.
5	Worn cylinder head gasket	Install new gasket.
6	Valve seats worn or cracked	Grind valve seats. If cracked, install new valves.
7	Worn pistons	Install new pistons.
8	Excessive valve guide wear	Install new valve guides.
9	Sticking valves or bent valves stems	Free stem and correct cause. Replace valves.
10	Faulty valve action	Adjust valve clearance.
<b>Engine Overheats</b>		
1	Water pump air bound	Vent air from water pump and thermostat housing.
2	Insufficient coolant in cooling system	Check level and add if necessary. Check hose connections for leaks.
3	Dirt & trash on outside of Radiator	Clean between the tube fins with air or water pressure.
4	Cooling system clogged	Drain and flush cooling system.
5	Hose connection leaking or collapsed	Change hose.
6	Insufficient oil	Maintain proper oil level.
7	Engine oil diluted with fuel.	Change oil. Inspect for loose fuel line connections on the injection nozzles. Check for defective FIP.
8	Radiator cap not sealing or defective	Replace
9	Defective thermostat	Remove and test thermostat. Replace if necessary.
10	Water pump defective	Repair pump.
11	Clogged oil filter	Replace oil filter element.
12	Fan belt slipping	Adjust belt tension.
13	Engine overloaded	Reduce load.
14	Cylinder head gasket/leaking	Install new head gasket properly using sealing compound

## Troubleshooting

Sr. No	Probable Causes	Remedy
<b>Engine Misses on One or More Cylinders</b>		
1	Insufficient air to engine	Remove and clean air cleaner and air cleaner pipe.
2	Defective injection nozzles	Replace with serviceable unit.
3	Air lock in the injection pump or fuel filter	Vent air from system and check all fuel lines and connections for leaks.
4	Poor Fuel	Use good grade of fuel.
5	Air leaks around intake manifold	Remove and install new manifold gasket.
6	Injection pump not operating properly	Remove injection pump and test it.
7	Injection pump not properly timed to	Check and adjust timing if necessary.
<b>Excessive Oil Consumption</b>		
1	Piston rings worn or broken	Install new rings.
2	Oil level in crankcase too high	Maintain proper oil level.
3	Crankcase oil pan gasket leaking	Install new gasket.
4	Worn valve guides	Install new valve guides.
5	Cylinder sleeves worn	Install new sleeves.
6	Front and rear crankshaft oil seal leaking	Install new oil seals.
7	Piston rings not seating	Install new rings.
8	Clogged oil ring	Remove and inspect and, if necessary, replace.
9	Oil pan drain plug loose or worn	Install new drain plug and gasket tighten plug.
10	Overheating	Refer to "Engine Overheats" on previous page.
11	Excessive oil poured into crankcase	Drain oil and fill to correct level only.
12	Wrong specification oil used	Refer operator's manual for recommended oil specifications.
13	Air cleaner clogged	Disassemble & clean air cleaner.

## Troubleshooting

Sr. No	Probable Causes	Remedy
<b>Engine Does Not Idle Properly</b>		
1	Injection Nozzle defective	Test Nozzle and repair and reset as per specifications.
2	Restriction to fuel delivery or leaking	Inspect fuel lines and valves; inspect for proper level in fuel tank
3	Poor compression	See poor compression problems.
4	Sticking valves	See valves sticking problem.
5	Improper adjustment of injection pump linkages and controls	Readjust
6	Valve and spring assembly in operative	Repair and install parts needed.
<b>Engine Knocks</b>		
1	One or more cylinders misfiring.	Locate and correct cause. Disconnect the injection lines at the valve housing one at a time and check for rpm drop of each cylinder.
2	Loose connecting rod	Tighten connecting rod.
3	Poor grade of fuel, or water in fuel	Use good grade of fuel and check for water in fuel.
4	Incorrect engine temperature	Keep temperature in work range of heat indicator. Check thermostat for proper operation.
5	Injection pump timing not correct	Check and adjust Injection Timing.
<b>Excessive Smoke</b>		
1	Air cleaner clogged	Service air cleaner as described in the operator's manual.
2	Engine overloaded	Reduce load.
3	Improper fuel	Use good grade of fuel.
4	Defective injection nozzle	Install new injection nozzle.
5	Worn pistons, rings and sleeves	Install new parts.
6	Incorrect valve adjustment	Adjust valves properly.
7	Incorrect injection pump timing	Time injection pump Refer Group
8	Leaking manifold gaskets	Install new gaskets.
9	Incorrect lubricating oil	Use grade of oil specified in operator's manual.

## Troubleshooting

Sr. No	Probable Causes	Remedy
<b>Abnormal Noise from engine</b>		
1	Low oil level	Maintain proper oil level.
2	Lack of oil	Maintain proper oil level.
3	Engine runs too hot	Keep engine at normal operating temperature.
4	Loose bearings	Install new bearings.
5	Use of improper lubricating oil	Use grade of oil specified in operator's manual.
6	Foreign materials entering engine	Use clean oil containers when filling engine with oil and see that there no leaks in the air cleaner or in the air induction system.
7	Oil lines clogged	Clean all oil passages.
8	Connecting rod bent	Align rod or install new.
9	Crankshaft out of alignment	Install new crankshaft.
10	Piston rings not fitter properly to cylinder.	Install new rings and fit properly.