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| MVML Chakan |
| Industry Training and Project Report |
| 17th June 2013 to 17th July 2013 |

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| Aditya Oak  4th Year Mechanical Engineering  Lokmanya Tilak College Of Engineering, Navi Mumbai  7/17/2013 |

**THE FLOW PROCESS**

**INTRODUCTION**

The report highlights the learning and projects completed in MVML Chakan Plant during the period 17th June 2013 to 17th July 2013.

The learning consists of understanding the assembly line, process involved, methods and operations used, etc.

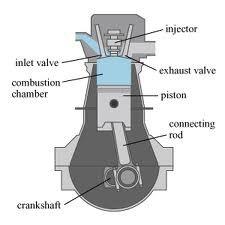
The projects consist of dealing with variability reduction, determination of appropriate dimensions and some other minor concerns from quality point of view.

*ENGINE*

Engine is the heart of any vehicle. It is the part where energy required to do work is generated by converting heat energy from combustion to useful mechanical work. It uses the traditional piston-cylinder system to do so. The crankshaft converts the reciprocating motion of piston into rotary motion.

The engines manufactured here are mostly diesel engines, also known as CI engines. The air is first compressed to very high pressure, fuel is then injected into the highly compressed air which causes combustion and starts off the process.

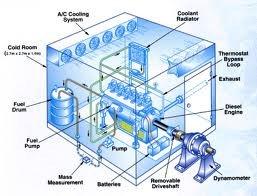
Diesel engines have seen remarkable advancements in recent years. With the development of Common Rail Direct injection (CRDi) engines, the whole of the timing aspect of the engine is now controlled electronically using an Electronic Control Unit (ECU) which injects a very small amount of fuel before the actual process starts. This is known as *pilot injection.*



Engine assembly

* **Engine assembly**-
  1. Block Loading.
  2. Piston, connecting rod (con.rod) sub-assembly (S/A) dropping.
  3. Bearing shell assembly.
  4. Con. Rod cap torquing (Z):
  5. Mass Balancer assembly:
  6. Torque to turn (TTT): Torquing of crankshaft to check motion of pistons.
     + Plotting graph of Torque (Nm) v/s angle (degree).
     + For 2-cylinder engine, both pistons move up and down simultaneously with a difference in strokes by 2. i.e. for intake stroke of cyl-1 , cyl-2 will undergo combustion/expansion stroke.
  7. Cylinder head S/A dropping.
  8. Cylinder head torquing. (Z)
  9. Camshafts dropping, starter motor, chain guide assembly.
     + Small rocker arms attached below camshafts (new concept).
     + Starter motor (having small pinion which meshes with flywheel during start-up).
  10. Chain guides:
      + For maintaining motion of chain as it passes over sprockets connecting camshaft to crankshaft.
      + One fixed guide. Other movable guide having hydraulic tensioner at its back.
  11. Cam cover joint sealant dispensing:
      + Automated.
  12. Cam cover torquing:
      + Manual.
  13. Timing chain assembly:
      + Assembling chain connecting camshaft and crankshaft.
  14. Cam Gear Bolt Torquing.
  15. CCV Assembly:
      + Assembling the CCV after sealant dispensing on its contact surface.
  16. Front cover dropping.
  17. Front cover torquing.
  18. Vacuum pump assembly.
  19. ROSR Torquing:
      + Torquing of the rear oil seal retainer.
  20. High Pressure pipe assembly.
  21. Oil sump joint face sealant dispensing
  22. Oil sump dropping.
  23. Oil sump torquing.
  24. Engine mounting bracket assembly.
  25. EGR assembly.
  26. Water pump pulley assembly.
  27. Intake manifold assembly.
  28. LBLT Rigging:
      + Long block leak test.
  29. Flywheel dropping:
      + The flywheel stores a part of energy developed by the engine and is used while start-up.
  30. Flywheel and damper pulley torquing (Z).
  31. Intercooler mounting bracket assembly.
  32. Buy-Off.
* **Head assembly:**
  1. Cylinder Head Loading.
  2. Stem seal pressing.
  3. Valve assembly
     + Valves allow passage of fresh charge into engine and help in attaining air tight compression.
  4. Spring and retainer dropping.
  5. Intake valve lock pressing.
  6. Exhaust valve lock pressing.
  7. Rework Loop in
  8. Valve Oscillation.
  9. Valve lock presence checking.
  10. Valve leak test.
  11. Rework loop out.
  12. Intake manifold assembly.
  13. Buy-Off.
* **EABL:**
  1. Engine unloading on buffer pallet.
  2. Clutch plate assembly:
     + The clutch plate is responsible to connect and disconnect engine to the transmission.
  3. Exhaust stud assembly.
  4. Turbocharger assembly.
  5. Turbo oil line assembly.
  6. EGR cooler & EGR valve assembly.
  7. Alternator & PSP assembly.
     + The alternator uses engine power to charge the battery.
  8. Oil cooler & oil filter assembly.
  9. Buy-Off
* **Piston Con.Rod assembly:**
  1. Piston and con.rod circlip assembly.
  2. Piston ring assembly.

Engine Testing



* After assembly, engine is tested for the following parameters:

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| --- | --- |
| Parameter | Unit |
| Speed | RPM |
| Observed Torque | Nm |
| Corrected Torque | Nm |
| Smoke | FSN |
| Boost pressure | Mbar |
| Max. BSFC | g/kW-hr |
| Fuel consumption | kg/hr |
| Blowby | lpm |

Machining

* Processes-
  1. Face milling of i/p plate:
     + Contact surfaces are face milled to provide smooth finishing and ease during automated sealant dispensing.
  2. Drilling & Tapping:
     + Drilling holes on housings for gear train fitment.
  3. Boring:
     + Front housing is bored for accommodating shaft.
  4. Tapping:
     + Bolt tightening.
  5. Reaming:
     + Reamers used to finish drill surfaces from inside.

*AXLE*

Axle is the part through which power is transmitted to the wheels. It consists of the differential and the drive shafts.

The differential is used to maintain the torque transmitted to the wheels especially when the vehicle is taking turns. The final velocity reduction from engine is done in the differential.

The drive shafts are made from materials with high torsional strength.

* Differential-
* Ring gear fitted on the diff. Case.
* Pinion shaft gear meshed with ring gear.
* Pinion gears meshed with side gears.
* Companion flange assembled, which connects differential to propeller shaft.
* Dust shield for protecting axle components from dust.
* Pinion oil seal to prevent leakage of lubricating oil.
* Spacer.
* Pinion and ring gear together make the hypoid gears.
* Contact pattern- Contact between hypoid gears. Every pair of hypoid gears has a distinct pattern.
* Backlash- clearance distance between a pair of meshed teeth. It’s indispensable. It should neither be zero, nor very much greater than zero.
* Axle-
* Types- Banjo beam, Salisbury.
* Housing distance, bearing height, Pinion height, End Difference.

*AXLE ASSEMBLY*

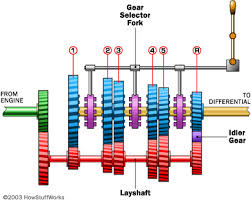
*TRANSMISSION*

Transmission systems are basically used to harness the required output from the engine, since engines run at very high speeds of about 3600 rpm.

The whole system consists of shafts and gears and synchronal rings. All gears are meshed with their respective counter gears at all times. However, only one gear actually transmits the power. This is achieved by mounting the gears on bearings and using synchronal rings which engage the dog teeth with the required gears.

Cars need transmission because of the physics of the engine. Firstly, any engine has a **redline -** a maximum rpm value above which the engine cannot go without exploding. Secondly, engines have narrow rpm ranges where horsepower and torque are at their maximum.

The transmission allows the gear ratio between the engine and the drive wheels to change as the car speed up and slows down. You shift gears so the engine can stay below the redline and near rpm band of its best performance.



*ASSEMBLY FLOW*

* Transmission assembly:
* Washing of components:
  + In a mixture of 2 to 8% ponol in water.
* No. Punching:
  + Oil seal + bearing
* Main shaft (M.D. shaft):
  + Assembling 1st, 2nd, 3rd gear on M.D. shaft.
* SRSF (Shift Rail Shift Fork):
  + Assembly of SRSF at various gear points and control housing points.
* Automated sealant dispensing:
  + On rear, front housing and intermediate plate (ip plate).
* Gear train insertion:
  + Inserting M.D. shaft, countershaft in the housings.
* Peripheral fitment:
  + Reverse light, speed sensor, drain plug, filler plug.
* Control Housing:
  + Fitment of control housing and dry leak test of gearbox.
* Testing:
  + Run test of gearbox for up and down shifting/
* Buy Off:
  + Mounting of wire guides on front housing.

*PRESS SHOP*

* Distribution of press shop area:
* Raw material area.
* Die storage.
* Main press shop.
* Types Of dies:
  + Male.
  + Female.
* Rectangular metal sheet pressed between female and male die.
* Pressed sheet further pressed at various points using high speed automation (Schuler).
* Trim Line:
  + Cutting of edges for required shapes and cavities.
* RH and LH parts channelized on different conveyor belts.
* 4 presses on press line:
  + 2400 ton load applied.
* Cushion for strength.
* Types of Blanks:
  + Low carbon to high carbon steel.
  + EDD, D, BH, DP
  + Low carbon (ductile).
* Inspection fixture:
  + Thinning should not be less than 20% of original thickness.
  + Check for waviness.
* Performance:
  + OLE (Overall Line Efficiency)
  + Benchmark for OLE is 75%.

***XUV 500 TCF***

* Type of Body-
  + XUV is a Môn coupe ( No chassis)
* Removal of doors after paint shop.
* 4-cyl engine mounted on front cradle.
* Type of drives-
  + 2WD and 4WD.
* No propeller shaft for 2WD.
* Type of transmission-
  + Transaxle (Transmission with differential/axle).
* Brakes-
  + Rear and front disc brakes different.
  + ABS- Antilock braking system: Brake obtained as per force applied on brake pedal.
  + ESP- Brake obtained at a constant magnitude irrespective of force applied on brake pedal.
  + In XUV, ESP as well as ABS.
  + Brake Liners-
    - 1 fixed 1 movable.
    - Movable using 2 pressure cylinders.
* Dual-exhaust at end (silencer).
* Pillars-
  + 4 pillars-
    - A windshield part.
    - B-rear of front seat.
    - C-rear of middle seat.
    - D-extreme rear near dickey.
* Airbags-
  + DAB- Driver Air bag in steering wheel.
  + 6 airbags provided in the car-
    - 2 on pillar A, B.
    - 2 on pillar C, D.
    - 2 on..?
* Middle Seat arrangement- 60/40.
* Fuel tank capacity- 70 L.
* Metallic foils on following places:
  + Wall between engine and dashboard (firewall).
  + As a cover on fuel tank, situated under the body.
* ECU- Bosch.
* Catalytic converter near steering column.

*XUV TRANSAXLE*

* Gear Hobbing:
  + Process of cutting teeth on gears.
  + Hobs are inclined with respect to gear.
* Gear Honning:
  + Process of cutting chamfer on teeth.
* Three Shafts:
  + Input shaft (i/p shaft).
  + Countershaft-1 (cs-1).
  + Countershaft-2 (cs-2).
* Ring gear:
  + Ring gear of large radius assembled in transaxle.
  + Power transmission unit (PTU) assembled with transaxle **in case of 4WD**.
  + BHT- Before Heat Treatment.
* Heating of gear and shafts components at very high temperatures followed by hardening.
* Driven gears mounted on needle roll bearings.

***Conclusion***

Got the practical experience of the working of the industry.

Studied machining, assembly and testing techniques.