Iplt 4201. Farm Power and Machinery (0+6)

# TRAINING REPORT

2012 Admission, B.Tech. (Ag.Engg.)

Group 2

Kerala Agricultural University


Department of Farm Power Machinery and Energy

KelappajiCollege of Agricultural Engineering and Technology,

Tavanur-679573, Malappuram, Kerala

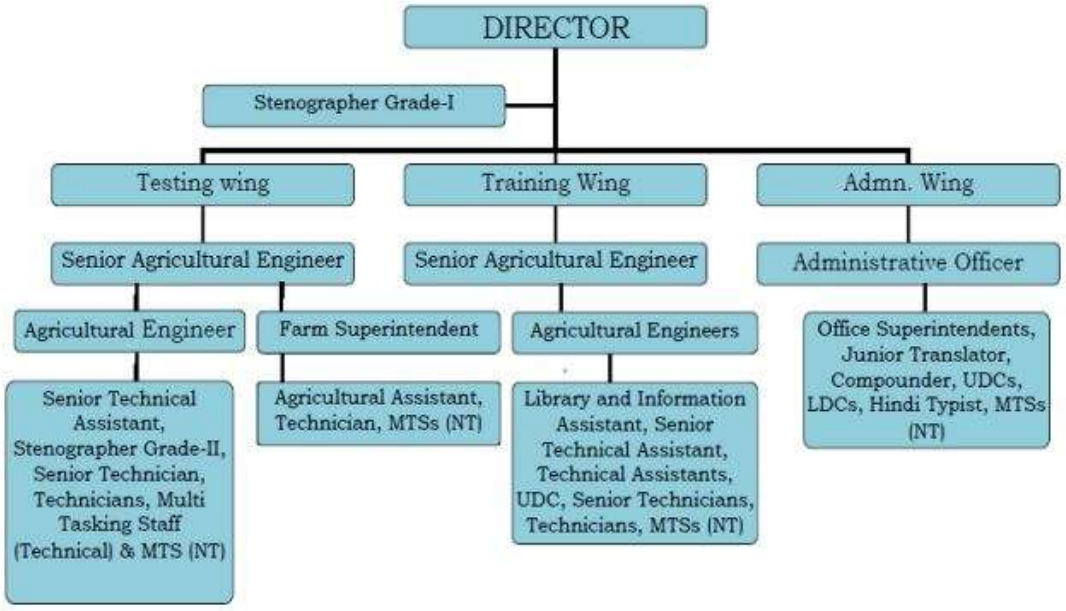
2016

Group Members

1. Akhila Tom Thekkanady (2012-02-024)
2. Sa-ada Abdurahiman (2012-02-026)
3. Sabitha R (2012-02-027)
4. Saroop C L (2012-02-028)
5. Shahama K (2012-02-029)
6. Sharmina V K (2012-02-030)
7. Sharon L George (2012-02-031)
8. Shiya Paul (2012-02-032)
9. Sibin C Baby (2012-02-033)
10. Soumya Krishnan V (2012-02-034)
11. Sreesha K R(2012-02-035)
12. Sreeja K (2012-02-036)
13. Sruthi N U (2012-02-037)
14. Rifna E J (2012-02-038)
15. Vidhya C (2012-02-039)
16. Muhammed Suhail T T (2012-02-022)
17. Anagha Balan (2012-02-041)
18. Jayalakshmi R (2012-02-042)
19. Jagath K M (2012-02-043)
20. Kurias Thomas (2012-02-044)
21. Shaheemath Suhara K K (2012-02-045)

# INTRODUCTION

Our batch had our FPME training at Southern Region Farm Machinery Training and Testing Centre, Garladinne, Anantapur in Andhra Pradesh from 29-2-2016 to 24-3-2016. This institute enjoys the pioneer status under the ministry of agriculture, Dept. of Agriculture and Co-operation, Govt. of India. The responsibility for the institute and its management rests upon thedirector. The technical and other staff assists him for testing, training, farm and other sections at the institute. The training staff consists of senior agricultural engineer, agricultural engineer, senior technical assistant,training assistants and technicians. A full fledged library with a large collection of technical and otherreference books, periodicals and magazines on mechanized farming, general agriculture and related subjects is provided for the use of trainees and staff. The organization setup of the institute is as follows.




The whole batch was divided into two groups. Each group was guided by two persons during the entire training program. We were the group 2 having strength of 19 members.

Er. D. Kanakappa guided us in our training program. Classes were taken according to the training schedule given to us.

Theobjectives of the training were:

1. Study, operation, adjustment and maintenance of various agricultural implements and machinery, plant protection equipments and irrigation equipments.

2. Study of various engine assemblies, their operation, maintenance and repair of a single cylinder diesel engine and tractor.

## FARM MECHANIZATION

The mechanization of agricultural operations for crops other than rice and wheat is need of hour. The oil seed, pulses, fodder crops, cash crops, vegetables and fruits and tremendous crops to adopt improves tools and the equipment for timeliness of operation and cost effectiveness. There are various proven designs for adoption and cultivation of pulses, oil seeds, fodder crops, fruits and vegetables suitable for various agro ecological regions. The farm mechanization is the removal of human and animal power and replacing it with mechanical power. The resulting improvements in productivity are often obtained through selective and total mechanization. Modern agriculture involves different electrical and mechanical power sources to mechanize various agricultural operations for saving of input and energy conservation.

GENERAL PRACTICES ON FIELD OPERATION FOR CROP GROWTH

- Land development, tillage and seed bed preparation
- Sawing and planting
- Weeding and intercultivation
- Plant protection
- Irrigation
- Harvesting
- Threshing
- Winnowing

## TILLAGE

It is the mechanical manipulation of soil to provide favorable condition for crop production. Soil tillage consists of breaking compact surface of earth to a certain depth and loosens the soil mass, so as to enable the root of the crops to penetrate and spread in to the soil. Tillage is divided into two classes; Primary tillage and secondary tillage. Primary tillage is the operation performed to open up any cultivable land with a view to prepare the

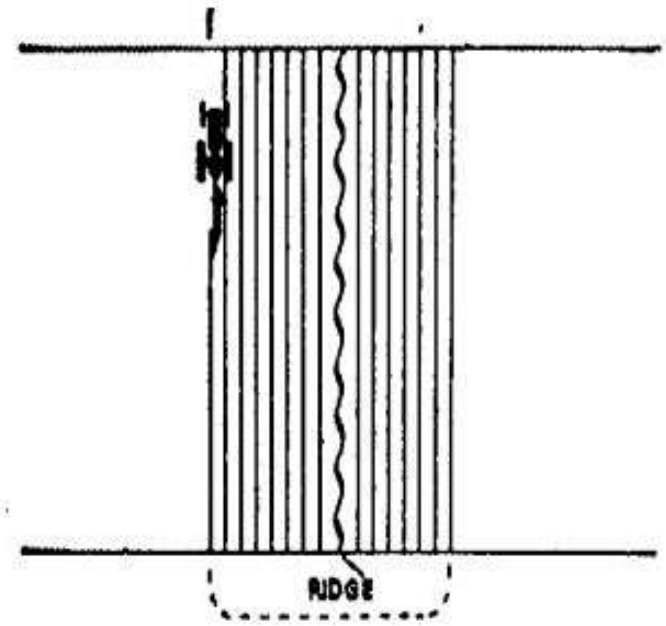
seedbed for growing crops.. Primary tillage is done mainly with heavy implements like Mould board plough, disc plough, chisel plough, subsoiler, and rotary plough. Primary tillage usually serves as a basis for the preparation of a good seedbed by subsequent pulverization and leveling.

Lighter and finer operations performed on the soil after primary tillage, but before and after seed placement, are termed as the secondary tillage, these operations are generally done on the surface of soil and very little inversion and shifting of soil takes place and consequently and there is less power requirement for unit area. Secondary tillage implements include cultivator, harrows, rotovator etc.

**PLOUGHING METHODS**

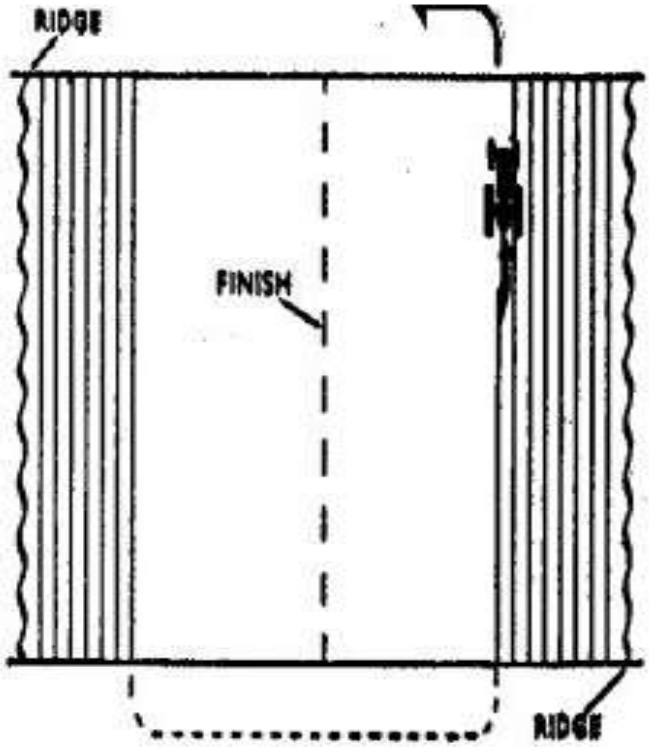
*Gathering*

In this method plough works round a strip of ploughed land. Ridge is formed exactly midway between the two side boundaries. This method is used if the field has lower elevation in the centre.



*Casting*

Whenever a plough works round a strip of unploughed land it is said to be casting. The tractor with the plough turns to the left each time. A trench will be left in the center in the end .This method is used in fields having higher elevation in the center




**PRIMARY TILLAGE EQUIPMENTS**

*Mould board plough*

MB plough is a primary tillage implement used for cutting, lifting, turning and pulverizing the soil. Major parts includes: share, mould board, landside, frog, bar point, standard, beam, coulter, jointer, shoe, gauge wheel, gunnel.

Selection of matching implement

Drawbar hp = $\frac{Draft(kg) * speed\ (kmph)}{270}$

Draft (kg) = size of plough (cm) × depth of ploughing (cm) ×soil resistance (kg/cm$^2$)

*Adjustments of MB plough*

For proper penetration and efficient work by the MB plough, some adjustments are done.

1) Cross shaft setting
2) side draft adjustment
3) Vertical suction
4) Horizontal suction
5) Coulter adjustment

Width of cut of MB plough can be adjusted by cross shaft setting . Side draft can be controlled by adjusting the check chain in order to stabilize the implement and to prevent slippage. Vertical suction is the maximum clearance between landside and horizontal ground surface. Usually 3-5 mm vertical suction is provided. The depth of cut increases with vertical suction. Horizontal suction is the maximum clearance between landside and horizontal plane touching point of share and is usually 5 mm. It maintains proper width of furrow slice. Coulter adjustment is done to allow the coulter to swing outward freely to a limited amount from the beam, but at the same time, not free enough to swing in to touch plough beam or bottom

.

Fig.Mould Board Plough

*Disc plough*

Disc plough is the implement in which the cutting and inversion is performed by meansofdisc.

Parts: Disc, adjusting lever, main frame, standard, furrow wheel, scraper.

*Adjustments:*

1) Disc angle - Angle at which the plane of cutting edge of the disc is inclined to the direction of travel. Width of cut increases with increase in disc angle. Range : 40°-45°
2) Tilt angle - Angle at which the plane of cutting edge of the disc is inclined to a vertical line. Penetration increases as tilt angle increases. Range : 15°-25°

Disc plough reduces draft and hence is considered better than mould board plough. Clearance between scraper and the disc is 2mm.

Fig.Disc Plough

*Rotovator*

Rotovator is a primary cum secondary tillage equipment. It is a negative draft implement which can be used in both dry and wet land. It is operated by the PTO shaft of the tractor, attached to the three point linkage. Depth can be controlled by linkage and hydraulic system. When rotavator is used, seed bed is prepared directly, which makes it a primary cum secondary tillage equipment. Excess use of rotavator in the fields causes destruction of earthworms.

Rotovators are of two types – mounted type and integral part of power tiller type. Factors affecting good tilth :

a) Number of blades
b) RPM
c) Speed
d) Type of soil

e) Moisture content of soil

Parts : Propeller shaft or drive shaft, safety lock, bevel gear box, chain or gear type drive, shoe, rear hood, L shaped blade for wetland or straight blade for dry land. The oil used for lubrication is SAE 140.

Fig.Rotovator

SECONDARY TILLAGE EQUIPMENTS

1) Disc harrow
    - Offset type
    - Tandem type
    - Single acting
2) Cultivator
    - Spring tyne
    - Rigid tyne
3) Blade harrow
4) Spring loaded harrow

5) Spike toothed harrow
6) Leveller
7) Polish plough

The offset disc harrow is suitable for use in orchard cultivation where the soil is hard and stony. When a number of discs are attached to one shaft, it's called a gang. Gang angle is the angle between the line of travel and gang shaft. It ranges between 17°-24°. The use of rotavator and disc harrow helps in cultivation operations upto stem level. There are notched type or cutaway type discs for front gang, making penetration into soil easier. The bearing used is pedestal type. Spring loaded cultivator has tynes, springs and showel.

MISCELLANEOUS EQUIPMENTS

- Bund former
- Post hole digger


- Front mounted leveler
- Hydraulic scraper
- Culti packer
- Shrub master
- Blade harrow

- Forage harvester
- Cage wheels

**PLANT PROTECTION EQUIPMENTS**

Many different types of spraying and dusting machines are available to meet the requirements of agriculturists in controlling insects, diseases and weeds. Few of the plant protection equipment's are discussed below.

*Hand compression sprayers*

The compressed air sprayer consists of an air pump mounted in an airtight chamber, which is filled three quarter with spraying material. The pressure is developed by pumping air into the tank and spray is forced out under pressure. Here no continuous cranking of handle, so spraying is non-uniform. The tank capacities are up to 14 litres.


Fig. Hand compression sprayers

*Rocking sprayer*

This type of sprayer has an externally placed horizontal centrifugal pump. It is a hand operated sprayer. Due to the spherical shape of pressure chamber more and more pressure can be created inside the chamber.


Fig. Rocking sprayer

*Knapsack sprayer*

The knapsack sprayer is provided with a vertical reciprocating pump inside tank. Here the spraying handle is fixed on one side. The side fixed pump is a drawback as the whole sprayer sags to one side. Due to this, the load is not equally spread. To overcome this, backpack sprayers are introduced. Tank capacity varies up to 23 liters.

*Backpack sprayer*

This is the modification of knapsack sprayer. Here continuous cranking can be done, thus achieves uniform spraying. The pump is centrally fixed and the length is reduced. The spraying handle can be shifted from left to right. The main drawback is, the pump and pressure chamber is inside the tank, which restricts the ease of repair and maintenance. These defaults are erased by hi-tech sprayers.

*Pesto blast sprayer*

It is a high volume sprayer and is used in orchard and plantation spraying. Tank capacity is about 400 lit. Power source is from 35 hp tractor and it is pto operated. Pump capacity is about 13-24 lit/min.


Fig. Pesto blast sprayer

*Orchard sprayer*

The sprayer consists of fluid tank, rotary atomizer with hydraulic motor and a flow control valve. The atomizer blows the chemical up to a max swath providing uniform and efficient spraying pattern. Uniformity in spraying is obtained even at maximum height. Volume can be adjusted. It is operated by 35 hp tractor. Output is 0.20- 0.50 ha/h with 3 m penetration of droplets inside the plant canopy.

*Foot sprayer*

It is a high volume spray. It can be applied for orchards, gardens and plantation crops. The nozzle type used in foot sprayer is hyjet gun and a pressure of 80-100 psi can be developed. Spray height is about 4 m and weight 8 kg. Field capacity of foot sprayer is 1 ha/ day with one lance and 1.5-2 ha/ day with 2 lance.


Fig. Foot sprayer

*Uni blast sprayer*

For this type of sprayer, the power source is 2 stroke petrol engines and the pump suction capacity is 7.1 lit/min. working pressure of unit blast sprayer is 100-200 psi and its weight is about 11.5 kg.

Fig. Uni blast sprayer

*Tractor mounted boom sprayer*

It is used for spraying in field crops, vegetable garden and flower crops. The power is obtained from pto of tractor and suction capacity is 36 lit/min and the pressure of 200 psi. The tank capacity of sprayer is 600 lit and field capacity is about 8-10 lit/day. The sprayer cost is about rupees 60000.

Fig. Tractor mounted boom sprayer

## IRRIGATION PUMPS

Irrigation is the application of water to assist in the production of crops in temporary drought seasons. The quality and quantity of water available, the topography of the land, the crop to be irrigated, the cost of the water application system and the availability of labour determines the method of irrigation which is most desirable.

Efficient irrigation results in increased crop yield, with soil fertility maintained and water utilized economically.

Water application methods may be classified into surface irrigation and pressurized irrigation. Surface irrigation comprises of water by means of open surface flow which includes border strip irrigation, check basin/ ring basin irrigation, level furrows or contour furrow irrigation etc. In pressurized irrigation system water is conveyed through pipes under pressure and applied to the crops by sprinkling it over the plant canopy or applied on the soil surface as a point source usually in the form of drops, these are respectively sprinkler irrigation and drip irrigation respectively.

### Pumps

Pumps are used to lift and transfer water from one place. Pumps are mainly classified into two viz. positive displacement pumps and variable displacement pumps. In positive displacement pumps the discharge does not vary with the change in head, while in the case of variable displacement pump discharge decreases with increase in head.

Positive displacement pumps include reciprocating pump and rotary pump. Hand lift pump is a kind of reciprocating pump in which the water flow is due to pressure difference. Rotary pumps are of external gear type and internal gear type which are commonly used in automobiles. Variable displacement pumps commonly used in lifting water are centrifugal pumps, jet pumps and submersible pumps.

*Centrifugal pumps*

Centrifugal pumps are most commonly used in irrigation pumping which works on the principle of centrifugal force. It consist of two main parts namely impeller which adds energy to the water in the form of increased velocity and pressure, and a volute casing which guides the water to and from the impeller. Impellers are disc mounted on the drive shaft and are provided with a number of vanes. Water coming in at the eye of the impeller is picked up by the vanes and accelerated to high velocity by the rotation of the impeller and thrown out by the centrifugal force into the volute. Water passes through the volute Casing from small area to large area thus converting kinetic energy to pressure energy which causes the discharge. Priming should be done before working to remove the entrapped air. Foot valves are provided at the bottom of suction pipe to prevent the backflow of water which also help in priming. The only disadvantage of centrifugal pump is its suction head limit, theoretically its 10m and practically about 6-7 m.

Fig. Centrifugal pump

*Submersible pumps*

The submersible pump consists of a pump and motor assembly, a head assembly, discharge column and a cable to supply power to the motor. Pump and motor operates submerged in the well at all times. Multistage impellers are used which conveys water from one impeller to the other with the help of diffusers.

Diffusers are used to change the flow direction of water, water coming out through the periphery of impeller is directed to the eye of next impellers by diffusers. Cooling of motor is by water itself.

Fig.Submersible pump

ELECTRICAL SYSTEM

Auto electrical system consists of:-

- Starting circuit
- Charging circuit
- Lighting circuit
- Horn circuit
- Instruments, gauges and warning lamp circuit

Battery is an electrochemical device which converts chemical energy into electrical energy and stores the same. Lead acid battery is commonly used in automobiles.

*Lead acid battery*

A lead acid battery consists of six compartmentswith a number of plates (usually 5 negative and 4 positive plates). The other important parts are:

1. Positive terminal: Made of lead peroxide. Usually chocolate brown in colour.

2. Separator: Non-conductive material commonly made of fibre, rubber etc.

3. Negative plate: Made of spongy lead. Ash in colour.

4. Cell cover: It covers the cells and has two holes for pole connection.

5. Sediment space: Empty space provided to prevent sulphation.

6. Air vent hole: For discharging hot gases.

7. Cell connectors: They are made of lead alloy material

The electrolyte used in lead acid battery is a mixture of diluted sulphuric acid (36 %)and distilled water(64 %). Its level should be half inch above the plates.

Specific gravity is usually measured using hydrometer.

1.25 – 1.30 : Fully charged

1.2 – 1.22 : Charging required

1.1 – 1.20 : electrolyte need to be changed

<1.11 : battery need to be changed

*Starting motor / self motor*

In starting motor electrical energy is converted into mechanical energy for starting the engine.Operates at less rpm and more torque.

Parts: Armature, commutator,brushes, Bendex drive,yoke, solenoid switch,end cover,fork or liver spring, drive end bracket, commutator end bracket, brush holder, field terminals, retaining spring

brushes


Dynamo

Fig: Starter motor

**TESTING**

We were fortunate to visit the testing wing of SRFMTTI carrying out the testing of Power tillers and Self propelled crop production machineries/equipments including power drawn agricultural machines and equipments. Mr. Pratap explained us the objectives of testing, categories of tests and took us to different testing labs.

The objectives of testing are as follows:

1. To test agricultural machinery, engines, etc. manufactured in the country with a view to assess their functional suitability and performance characteristics under different agro climatic conditions so that the published test results would:

* Conditions which could be encouraged for production and popularization.

* Help the farmers and other prospective purchasers in determining the comparative performance of machinery

* Provide material to researchers/designers for undertaking development work on agricultural machinery, engineers and extension workers for guiding farmers and other users in the proper selection of equipment.

* Form basis for standard specifications to be used by the manufacturers and distributors.

* Help financial Institutions in recommending financial assistance to the manufacturers as well as the farmers.

2. To carryout trials on machinery and implements which have proven successful in other regions of the world with a view to explore the possibility of their introduction in the Country.

3. To assist Bureau of Indian Standards in the formulation of various standards on agricultural implements and machines.

*Categories of tests:*

1. Commercial
2. Confidential

a) Commercial Tests: are for establishing performance characteristics of machines thatare in or ready for commercial production. The following types of commercial tests willbe under taken:

- Initial Commercial Tests on indigenous or imported prototype machines readyfor commercial production.
- Batch Test on machines, which have already undergone initial commercial test and/or are being manufactured commercially in the country.

b) Confidential Tests: are for providing confidential information on the performance of machines, whether ready for commercial production or not or to provide any special data that may be required by the manufacturer/applicant.

Different tests under commercial tests are as follows

i. Engine Performance Test

ii. Rotary Performance Test
iii. Drawbar Performance Test
iv. Turning Ability Test
v. Haulage Performance Test
vi. Brake Test
vii. Noise Level Test
viii. Mechanical Vibration Test
ix. Air Cleaner Oil Pull Over Test
x. Field Performance Test

**SOIL HEALTH CARD**

Soil Health Card Scheme is implemented and expanded by Govt. of India, Dept. of Agricultural Operations and Farmers' Welfare. Soil Health Card provides farmers with information about soils and the kind of crops to be grown in various regions. It helps farmers take major decisions about crops and fertilizers suitable for their land. Based on free in- depth soil studies, the Soil Health Cards list the vital components of a particular patch of land. They provide detailed information on various minerals present on the land, suitable crops, fertilizers to be used, and also whether the land is acidic or alkaline.

The cards which are based on the principles of the ration card provide permanent identification and the status of the land to farmers. They are made out after a detailed analysis of samples of soil collected from land held by individual farmers. All soil samples are to be tested in various soil testing labs across the country. Thereafter the experts will analyze the strength and weakness of the soil and suggest measures to deal with it. The result and suggestion will be displayed in the card.

*Procedure of collecting soil sample*

i. Select the areas in the land for the soil test.
ii. Samples are collected randomly from different locations.
iii. Dig a pit of V shape up to a depth of 20 – 30 cm.
iv. From both sides of V shaped pit, a parallel cutting offset of 1 – 3" was made.
v. Thereafter soil is collected in a polythene cover and is sent for lab testing.

# TRACTOR SYSTEMS

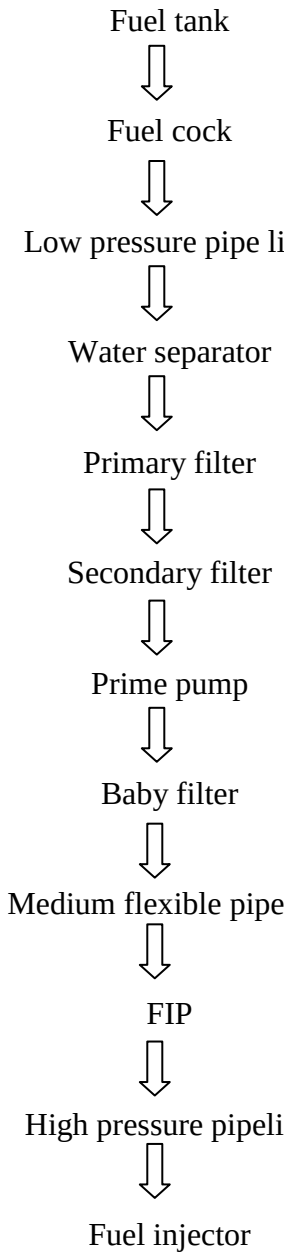
There are various systems that perform integratedly to the successful functioning of a tractor. Each system is an inevitable part of the tractor as it enhances the efficiency and life of the farm machine. The systems involved are as follows:

1. Fuel and ignition system
2. Lubrication system
3. Cooling system
4. Air intake and exhaust system
5. Electrical system

## FUEL AND IGNITION SYSTEM

It is the most important part of the tractor that supplies the fuel required to power the engine. It is composed of several parts including fuel tank, water separator, fuel filter, fuel injection pump, fuel /injector, high pressure pipeline, medium flexible pipeline and governor. There are two types of fuel supply system:

1. Gravity system
2. Forced circulation system
    i) vane type
    ii) gear type




1. FIP

Fuel injection pump is the main part of the fuel system. It maintains the following:

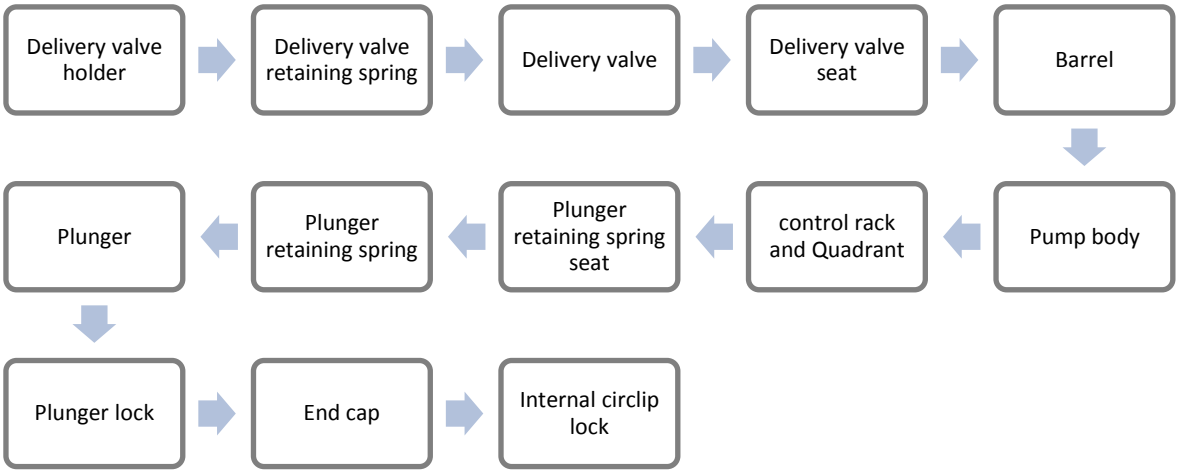
i) Pressure of the fuel

ii) Fuel timing

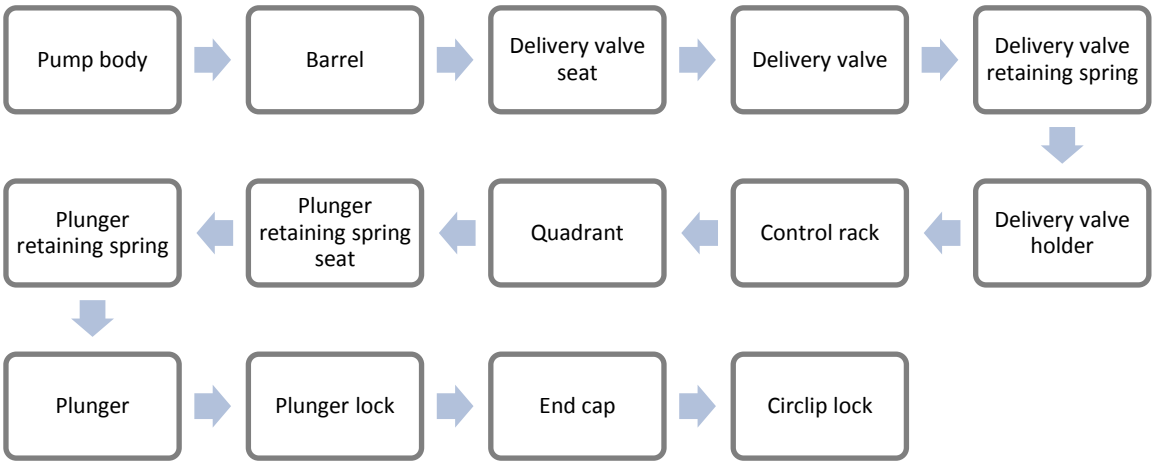
iii) Specific fuel consumption (SFC)

The governor is connected to the FIP which controls the amount of fuel entering FIP. It should maintain a greater pressure than the desired pressure for efficient supply of fuel to the engine. The main parts of FIP include the plunger, barrel, control rack, quadrant, delivery valve. The plunger have a helical groove which increases the surface area, hence more fuel is supplied. The barrel consist of an upper hole which delivers the fuel. Two holes are present in the side, one is suction hole and other is leak off hole. The control rack and quadrant are meshed for obtaining the rated rpm. The control rack is in contact with the governor lever.

*Dismantling*



*Assembling*




2. Fuel injector

The main parts of a fuel injector include:

- Nozzle
- Nozzle cap
- Nozzle pressure setting screw
- Nozzle pressure setting spring
- Spindle
- Nozzle body
- Needle
- Needle body
- Nozzle nut

The pressure inside nozzle is adjusted by the pressure setting screw. If the pressure inside nozzle is greater than 130 kg/cm$^2$, then it is a direct injection engine. If the pressure is less than 130 kg/cm$^2$ then it is an indirect injection engine. In IDI engines, single hole is present in the nozzle while in DI engines multi holes are

present. When the pressure is greater than the desired pressure the needle rises and the fuel is atomized.  A non retain adapter is used to prevent backflow of fuel.

*Dismantling*

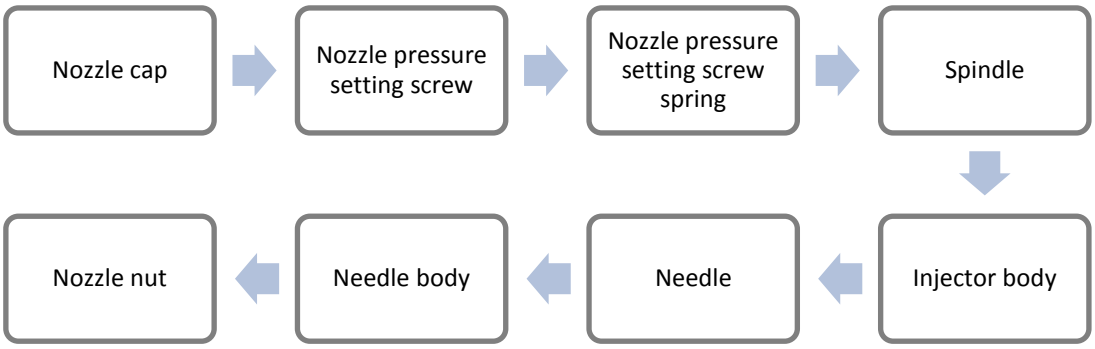
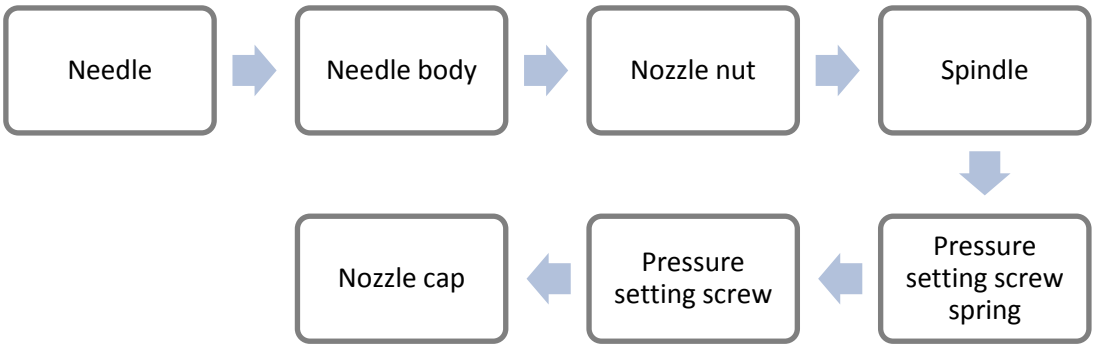



Fig.Parts of fuel injector

*Assembling*




3. Governor

Two types of governor:-

- Constant speed governor
- Variable speed governor

Governor controls the supply of fuel. For a centrifugal governor, as the speed increases the fly weights expands and push rod push the governor lever outside which in turn pushes the control rack of FIP thereby increases the supply of fuel.

**LUBRICATION SYSTEM**

- Splash lubrication system

  In this system oil is supplied either by a gear pump or by gravity. A dipper is provided, the splashing action of which maintains a fog or mist of oil.
- Vapour type lubrication system

Heat is generated in the piston around the cylinder liner. Due to this heat generation, the oil content which is presented will vaporize. Since vapour is having low density, it goes upside and lubricates the parts.

- Pressure lubrication system

  In this system, pumps such as plunger type, rotor vane type, gear type, centrifugal type are needed.

- Petro oil lubrication system

  In this system, fuel is mixed up with lubrication oil. Hence, no further oil sump is provided.

*Requirements of a lubricant*

- Viscosity
- Resistivity
- Pour point
- Flash point
- Physical stability
- Chemical stability
- Cleanliness

*Types of lubricants*

Three types of lubricants are used in engines. These are solid, semi solid and liquid type. Graphite, mica and soap stone are some examples of solid type lubricant. Grease is a semi solid type lubricant. Animal oils and vegetable oils comes under liquid type.

*Grades of oil*

Engine oils are of two grades namely single grade and multi grade.

SAE10 – SAE40 : Engine oils

SAE40 – SAE60 : Hydraulic oils

SAE60 – SAE90 : Transmission oils

SAE ≥ 90 : Heavy viscous oils

**COOLING SYSTEM**

Cooling system is one of the prior systems in engine. It maintains the thermal efficiency of engine. There are two types of cooling system.

- Natural circulation
- Forced circulation

In natural system, fins are provided around the engine, which causes the flow regulation of air naturally. Air cooled engine is an example for this system.

Forced circulation system is further classified into thermosyphon type, direct or non-return system and forced thermostat cooling system. Thermosyphon system is based on the temperature gradient. When the temperature in the engine exceeds 90c, the valve which is presented will open and the cool water which is having less density moves upwards. In direct systems, water jackets are provided to allow the passing of coolant. Forced circulation or pump circulation is used in heavy machines which are of in need to cool down the engines.

**AIR INTAKE AND EXHAUST SYSTEM**

This system is used for air intake and exhausting the used air.

*Air intake system*

An engine air intake system is an arrangement of tubes, filters and fittings that conduct the air into the cylinders. Engine intake system has several parts such as pre-cleaner, air cleaner, intake manifold, intake valve, and cylinder.

*Pre-cleaner*

It excludes and arrests large particles of dirt, chaff and lint from the incoming air to prevent their entry into the engine and guard against likely damage. It is mounted on the extension pipe above the air cleaner assembly. Centrifugal forces cause the heavier dust and other foreign matters to be thrown into the space between inner and outer shells.

Fig: Pre-cleaner

*Air cleaner*

The function of the air-cleaner is to supply clean air to the engine. The characteristics of ideal air cleaner include high efficiency in dust removal from air, small air restriction, small size etc. There are two types of air cleaner wet type and dry type air cleaner

**1 .Dry type air cleaner**

- ✓ 100% clean the air

- ✓ Maintenance cost is high
- ✓ Inside the air cleaner paper is used it consists of numerous micro pores
- ✓ Do not use air pressure above 200kPa (30 psi). High pressure might puncture a hole in the filter paper
- ✓ Cleaning of filter is done from inside to outside
- ✓ Change the filter after 10000km of operation

**2. Wet type air cleaner**

- ✓ 80% clean the air
- ✓ Also called oil bath type air cleaner
- ✓ Inside the bowl oil of grade SAE 30/40 is used to clean the air

**EXHAUST SYSTEM**

The exhaust gas goes out from cylinder bore through exhaust valve, exhaust port, exhaust manifold and silencer

*Silencer*

It is used for silencing the engine sound. In this the high pressure exhaust gas is permitted to pass through the small pores. By slow releasing the exhaust gas the sound get reduced. When the silencer is blocked the pressure of the burnt gases will increases and there is a chance of entering $co_2$ into cylinder bore. This results the incomplete combustion.

Fig: silencer

***Turbo charger and super charger***

Turbo charger and super charger is driven by exhaust gases. In super charger some engine power is required. These are providing for increasing the mileage. Super charger is suitable for hilly areas and mines. A turbo charger increases the power of the engine by pushing extra air into the cylinders to burn the fuel better. Turbo charger wears out fast, if engine is shut off at higher speed because its bearings will run out of oil before they stop spinning. Super chargers are employed in sports cars which have meant for fast speed rather than better economy.

**SEEDING EQUIPMENTS**

A large number of implements have been developed for easier, faster and better sowing of seeds. These implements have been broadly classified as:

- Seed drills
- Planters

In seed drills, the sowing mechanism is based on placing of seeds continuously in a furrow without any spacing between the seeds but maintaining a constant row-to-row spacing.

In planters, the sowing mechanism follows a constant seed-to-seed and row-to-row spacing.

The other seeding equipments popularly available are transplanters, check row planters, etc,.Transplanters are used to transfer germinated seedlings grown in the nursery to the field. Check row planters maintain the same seed-to-seed and row-to-row spacing in the field.

The various sowing equipments tested and in use at SRFMTTI are raised bed planter, happy seeder, inclined plate planter, pneumatic planter, direct size planter, maize-cum-castor planter, multispeed seeder cum fertilizer planter, groundnut planter, Pusa seed-cum-fertiliser disc drill, strip till drill, sugarcane cutter-cum-planter, vegetable transplanter and plastic mulch laying machine.

The different methods of sowing are:

- Broadcasting- non-uniform distribution of seeds.
- Dribbling- placing seeds in the furrow.
- Drilling- placing seeds in the furrow continuously.
- Planting- placing seeds in the furrow with a pre-defined seed-to-seed and row-to-row distance.

The main parts of a drill/planter are:

- Ground wheel
- Seed hopper
- Fertilizer hopper
- Metering mechanism
- Seed tubes
- Furrow openers
- Frame

- Ridger

Seed dropping tubes used are made of different materials.

- Telescopic type- It is the best type of tube.
- Spiral type
- Funnel type
- Plastic type- It is the lowest in quality but most commonly used.

Furrow openers are of two types mainly-

- Zero till/T type – has only one blade.
- Disc type – similar to disc ploughs

*Raised bed planter*

- It completes 3 to 4 operations in one pass.
- These operations are raising of soil, making of bed and planting on the bed.
- Mechanisms involved in the planter are inclined plate type metering mechanism, furrow opening mechanism and seed dropping.
- It requires 35 hp.
- It covers 028 to .45 ha/h.


Fig. Raised bed planter

*Happy seeder*

- It lifts the straw from the field and prepares the field with the rotovator.
- The sowing operation is followed by spreading of the cut straw which was lifted from the field.
- These operations help to maintain the temperature of seeds, moisture, provide protection against birds and reduce weed growth.
- The cut straw slowly changes to manure by decomposition.
- Seed rate is adjusted by fluted roller mechanism.
- Zero till furrow opener is employed.
- It requires 45 hppower.
- 0.25 to 0.42 ha/h is the field capacity.


Fig. Happy seeder

*Inclined plate planter*

- Metering mechanism is of inclined plate type.
- Furrow opener is of zero till/T type.
- It requires 45 hppower.
- Area covered is 0.45 to 0.65 ha/h.

Fig. Inclined plate planter

*Pneumatic planter*

- Blower sucks seed and drops into furrow opening.
- Disc type metering mechanism is employed.
- Zero till furrow opener is used here.
- 35 hp is required to power the planter.
- It covers 1ha area in an hour.

Fig.Pneumatic planter

*Tractor drawn upland paddy seeder*

- It uses germinated seeds.
- Cup feed metering mechanism is in use.
- Shovel type furrow opener is used for furrow making.
- 45 hptractor is needed.
- Its field capacity is 0.68 ha/h.

Fig.Tractor drawn upland paddy seeder

*Maize-cum-castor planter*

- Star wheel type metering mechanism for seeds and shovel type furrow opener is employed.
- Orifice type metering mechanism is used for fertilizer dropping.

Fig. Maize-cum-castor planter

*Multiseedseeder cum fertilizer planter*

- Roller type metering mechanism is in use.
- The seed rate commonly used is 0.5 kg/acre.
- Tynes are adjustable.

*Groundnut planter*

- Cup feed type mechanism is used.
- 35 hp tractors are employed.
- 0.35 ha/h is the are covered.

*Pusa seed cum fertiliser disc drill*

- Furrow opener is of disc type.
- It is considered best for hard soil.
- The metering mechanism is fluted roller type.

Fig. Pusa seed cum fertiliser disc drill

*Strip till drill*

- It completes 3 operations at a time – field preparation, sowing and fertilizer application.
- It has a rotovator attached.
- Small seeds are drilled into the soil.
- The metering mechanism is fluted roller type.
- 45 hptractor is required for its operation.
- Area covered is .35 ha/h.


Fig. Strip till drill

*Sugarcane cutter and planter*

- It cuts sets of sugarcane and drops them into soil.
- It applies chemical on the set.
- It works with power greater than 45 hp.

Fig. Sugarcane cutter and planter

*Vegetable planter*

- It is a semi-automatic planter.
- It forms bed with the help of a blade.
- The wheels form holes.
- Tray holds the mat.

Fig. Vegetable planter

*Plastic mulch laying machine*

- It lays a plastic sheet for mulching on the field.
- It performs a couple of operations together.
- It prepares the bed and lays the plastic.
- It presses the plastic into the soil and then gathers soil on the edges of the sheet.
- It achieves reduction in labour by 50%.

Fig. Plastic mulch laying machine

## HARVESTING EQUIPMENTS

Several equipments have been designed and developed for quicker and more efficient harvesting of crops and fruits. These machines have taken into consideration ergonomical aspects to improve the workability of operators on these implements. They have been developed in a crop specific and soil specific manner.

*Groundnut digger-cum-shaker*

- It is a very effective implement.
- It consists of v-shaped blades.
- Area covered is 0.3-0.45 ha/h.

Fig. Groundnut digger-cum-shaker

*Reaper-cum-binder*

- It is used for crops having a height of about 2-2.5 ft.
- 10 hpengine is used in this machine.
- Area covered is 6 acres/day.
- Fuel consumption is 1-1.5 l/h.

*Windrower paddy reaper*

- Model : KAMCO KR120
- It has a cutter bar of 1.2m length.
- It is a petrol start, kerosene run implement.
- Power required is 2.8 kw.

*Combine harvester*

- It is generally classified as self propelled and mounted type with tractor as prime mover.
- Model: Panesar TDC-513
- It is a tractor mounted combine.
- Operated by tractor model, New Holland 3630.
- The number of threshers/ straw walkers is 5.
- The size of cutter bar is 13 ft.
- The header unit, threshing unit and cleaning units are the main parts of a combine.
- The header unit includes a reel which feeds the crop to the cutter bar, cutter bar which cuts the crop, auger transports the crop to the threshing unit.
- The thresher unit consists of a peg type threshing cylinder that rotates at 600 to 800 rpm and has a concave clearance of 10 to 15 mm.
- The remaining grain, chaff and straw are then delivered to oscillating straw walkers.
- The cleaning unit includes sieves and blower.
- An air compressor is used for blowing the grains clean.
- Elevators and conveyors are used to convey the clean grain to the storage drum and conveying unthreshed grain to the threshing unit,respectively.
- It is power steering operated.
- The front tyres are larger compared to the rear tyres due to larger load in the front and to balance the centre of gravity.

Fig. Combine harvester

## STUDY OF ENGINE

Engine is a mechanical device which converts heat energy to mechanical energy for useful work.

*Engine parts*

1. Rocker arm box assembly
    - Star nut
    - Rocker arms
    - Rocker arm shaft
    - Decompression lever
    - Rocker arm box packing

Fig.Rocker arm assembly box

2. Cylinder head
    - Fuel injector
    - Push rods
    - Water pump inlet
    - Air pre cleaner
    - Silencer
    - Water pump outlet
    - Gaskets

Fig.Fuel injector

Fig.Push rods

Fig.Air pre cleaner

Fig.Silencer

Fig.Cylinder head

3. Cylinder block
    - Piston
    - Piston pin
    - Connecting rod
    - Cylinder liner
    - Shims
    - Fuel injection pump
    - Medium pressure pipeline
    - Fuel filter
    - Oil filter assembly

Fig.Piston with Connecting rod

Fig.Fuel injection pump assembly

Fig.Fuel injection pump


Fig.Oil filter assembly

4. Oil sump
    - Crank shaft
    - Crank shaft timing gear wheel
    - Flywheel
    - Camshaft
    - Camshaft timing gear wheel
    - Woodruff key
    - Balancing weights
    - Lub oil pump
    - Governor
    - Dipstick

Fig.Crank shaft with Flywheel

Fig.Camshaft and Camshaft timing gear wheel

Fig.Crank case timing gear wheel

Fig.Woodruff key

Fig.Balancing weights

Fig.Lub oil pump

Fig.Centrifugal governor

## KIRLOSKAR WATER COOLED, STATIONARY, 5HP DIESEL ENGINE

| | |
|---|---|
| **1. TYPE** | **A. V-1, ENGINE** |
| **2. Description** | Cold starting, Vertical, Water cooled, Totally enclosed, Compression ignition, 4 stroke cycle engine |
| **3. Horse Power** | 5HP, at 1500 rpm |
| **4. No. of cylinders** | 1 |
| **5. Bore** | 80 mm (3.15") |
| **6. Stroke length** | 110 mm (4.724") |
| **7. Fuel** | High Speed Diesel |
| **8. Cubic Capacity** | 553 cc (cubic centimetre)<br>(Swept volume + Clearance volume) |
| **9. Oil Sump Capacity** | 2.85 litres |
| **10. Fuel Tank Capacity** | 4.87 litres |
| **11. Compression Ratio** | 16.5:1 |
| **12. Fuel Injection Pump** | Bosch type S.P.E.I.A |
| **13. Fuel Injection Timing** | $27^{\circ}$ before TDC |
| **14. Fuel Injection Pressure** | 211 $kg/cm^2$ ( 3000 psi) |
| **15. Dumping Clearance** | 0.90 to 1.005 mm |
| **16. Valve Clearance** | 1) Inlet 0.20 mm (8 thou)<br>2) Outlet 0.25 mm (10 thou) |
| **17. Crank Shaft End Clearance** | 0.125 to 0.30 mm |
| **18. Connecting rod Big end clearance** | 0.10 to 0.254 mm (8 to 10 thou) |
| **19. Minimum Piston ring end gap** | 0.2 to 0.25 mm |
| **20. Maximum Piston ring end** | 0.87 mm |

| | |
|---|---|
| **gap** | |
| **21. Piston ring end clearance** | a) Top ring 0.05 to 0.08 mm<br>b) Compression 0.04 to 0.05 mm<br>c) Oil ring 0.025 to 0.05 mm |
| **22. Small end Bearing clearance** | 0.20 to 0.25 mm (8 to 10 thou) |
| **23. Maximum permissible wear (on the crank shaft, ovality)** | 0.075 mm (3 thou) |
| **24. Maximum permissible wear** | 0.025 mm |
| **25. Maximum Ovality** | 2 thou |
| **26. Maximum permissible liner wear** | 0.125 mm (2 thou) |
| **27. Liner Ovality** | 0.05 mm (2 thou) |
| **28. Crank shaft main journal dia.** | 57 mm |
| **29. Crank shaft crank pin dia.** | 54 mm |
| **30. Under size main bearing availability up to 2.5 mm in 10 steps of 0.25 mm** | |
| **31. Over size piston ring availability in 10 steps 0.25mm to 2.5 mm** | |
| **32. Distance between valve face and cylinder head place** | 0.80 mm to 2.5 mm |
| **33. Valve seat angle** | $15^{\circ}$ inlet and exhaust |
| **34. Lubricating oil consumption** | 2.758 gm/BHP/hr |
| **35. Fuel oil consumption** | 199 gm/BMP/hr |

**TIGHTENING TORQUE**

| | |
|---|---|
| **1) Connecting rod bolts** | 5.7 kg-m (40 ft-lb) |
| **2) Balancing weight bolts** | 9 kg-m (62 ft-lb) |
| **3) Cylinder block stud in crank case** | 9 kg-m (62 ft-lb) |
| **4) Cylinder head nut in** | 13.4 kg-m (94 ft-lb) |

| | | |
|---|---|---|
| | **cylinder block** | |
| **5)** | **Injector nut** | 2 kg-m (14 ft-lb) |
| **6)** | **Fuel injection pump** | 2 kg-m (14 ft-lb) |

## ENGINE DISMANTLING AND ASSEMBLING

1. *Dismantling of engine from tractor*
   - i) All the electric connections are removed.
   - ii) All the liquids such as fuel, engine oil, gear oil, hydraulic oil etc. are drained.
   - iii) All the accessories/ safety precautionary parts, pipe lines, mounting are removed.
   - iv) Crucial elements such as fan, fan belt, radiator, feed pump etc. are disconnected.
   - v) Engine is disconnected from the tractor

2. *Dismantling of Kirloskar water cooled stationary 5 hp diesel engine*
   - i) Engine oil is drained out through the drain plug.
   - ii) The mounting such as silencer, air pre cleaner and fuel tank are removed.
   - iii) The dismantling starts from the top most part, rocker arm assembly.
   - iv) Then the cylinder head is removed by loosening the nuts and the push rods are taken out.
   - v) The cylinder block is pulled out carefully without damaging the piston.
   - vi) Now the fuel injection pump ( FIP ) and oil filter are disconnected from the engine body.
   - vii) The crank shaft timing gear wheel is took out from the crank shaft by removing the crank shaft timing gear wheel cup and the woodruff key.
   - viii) By holding the tappets unscrewed the cam shaft locking nut and the camshaft is taken out. The cam shaft timing gear wheel and the governor are on the cam shaft.

ix) The tappets are taken out.

x) By loosening the nuts and bolts of connecting rod coupler the piston with connecting rod is dismantled.

xi) Now the balancing weights are removed from the crank shaft.

xii) Finally the flywheel with the crank shaft is taken out from the engine body and the lubrication oil pump is removed from the crank shaft eccentric portion.

Drain engine oil

⇩

Pipe lines

⇩

Silencer, Air pre cleaner and Fuel tank

⇩

Rocker arm assembly

⇩

Cylinder head

⇩

Push rods

⇩

Cylinder block

⇩

FIP and Oil filter

⇩

Crank shaft timing gear wheel

⇩

Camshaft and Tappets

⇩

Piston with Connecting rod

⇩

Balancing weights

⇩

Flywheel and Lubrication oil pump

3. *Assembling of ( Kirloskar water cooled stationary 5 hp diesel engine)*

i) The engine oil is filled into the crank case and simultaneously the oil level is checked with the dipstick.

ii) Flywheel is inserted into the crank case keeping in mind that the crank webs upward and the lubricating portion downward. The lubrication oil pump is also inserted in to the crank shaft eccentric portion.

iii) The balancing weights are mounted on the crank shaft such that the markings are kept facing each other.

iv) Now the piston with connecting rod is placed in the crank shaft keeping in mind in that the markings outside the coupler and the position of the lock on the half shell bearings of the connecting rod.

v) By inserting the tappets and holding it upward cam shaft is inserted such that the groove on the cam shaft coincides with the key hole.

vi) Now the crank shaft timing gear wheel is inserted such that the zero marking on the cam shaft timing gear wheel comes in between the two zero markings on the crank shaft timing gear wheel after placing the washer. The gear is locked with the woodruff key and covered with crank shaft timing gear wheel cup.

vii) The cylinder block is fixed with nuts over the piston carefully considering the valve position.

viii) Cylinder head is also placed over the block.

ix) The push rods are inserted through the respective holes.

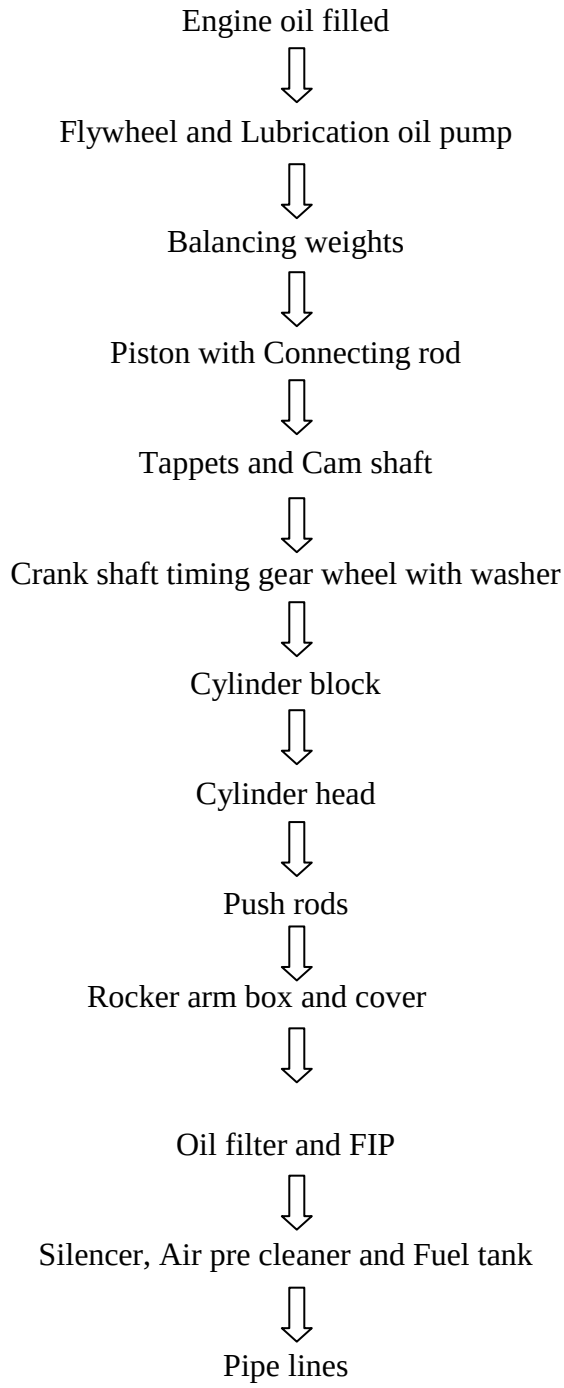
x) The rocker arm box is mounted above it and covered with the cover. The inspection box cover is also placed.

xi) Oil filter is fixed on the respective position.

xii) FIP assembly is placed with FIP push rod.

xiii) The silencer, pre cleaner and the fuel tank are assembled on the engine.

xiv) The fuel pipe lines are connected.



**TROUBLESHOOTING OF ENGINE PROBLEM**

| FAULT | CAUSES | REMEDY |
|---|---|---|
| **Engine does not start** | Fuel is not supplied to FIP<br>• Fuel in the pipeline is clogged<br>• Fuel filter is not working<br><br>Fuel supplied to FIP still does not start due to<br>• FIP malfunctioning<br>• Crank shaft bearing worn out<br>• Injection washer leak | • Inspect fuel pipe line<br>• Take needed steps<br>• Repair or replace |
| **Engine starts and stops** | • Pulsed flow of fuel due to air in tank<br>• Pressure adjusting screw loose<br>• Air removing screw loose<br>• Discontinuous supply of fuel | • Inspect , repair and replace element |
| **Engine runs at higher rpm** | • Control rack gets stuck<br>• Throttle lever gets stuck<br>• Fault in governor mechanism<br>• Fuel supply more due to faulty FIP | • Inspect ,repair or replace<br>• Check governor mechanism |
| **Knocking tendency** | • Lub oil pump fault<br>• Advanced pre- ignition temperature development | • Inspect, repair or replace |
| **Black smoke severely** | • Fault in FIP | • Inspect |

| | | |
|---|---|---|
| | • Advanced injection timing<br>• Throttle lever gets stuck | ,repair or replace |
| **White smoke** | • Presence of water in fuel<br>• Water separator not working<br>• Untimely inspection of water separator bowl<br>• Over cooled engine | • Inspect , repair or replace<br>• Check and periodical servicing |
| **Engine over heating** | Lubrication faulty<br>• Thermostat valve regulation not working<br>• Valve stuck<br>• Clogging of lubrication line by impurities<br>Cooling system faulty<br>• Pump not functioning<br>• Radiator not working<br>• Extension or slipping of fan belt | • Inspect , repair or replace supply lines, hoeses |
| **Fuel consumption more** | • FIP not properly working<br>• Overloading<br>• Gear mesh between control rack and control sleeve gets stuck<br>• Governor improper working-misalignment | • Inspect , repair or replace |
| **Oil consumption more** | • Lub oil pump improper working<br>• Oil filter faulty<br>• High pressure generation in pump | • Inspect , repair or replace |

| | | |
|---|---|---|
| **Engine not fully powered in** | • Incomplete compution<br>• Over cooled engine<br>• Advanced pre-ignition occurs<br>• Timing gear wheel teeth misaligned | • Inspect , repair or replace |

# CONCLUSION

The subjects that were studied included adjustment and operation of tractor and agricultural machinery,demonstration and maintenance of tractor, power tiller and tillage equipments like MB plough, disc plough and rotovator. A detailed study on seeding equipments like seed drill and planters and harvesting equipments such as reapers, binders, thresher and combines etc was also done. The construction and parts of a 5hp water cooled, single cylinder engine (Kirloskar) was studied. Several weeding and plant protection equipments were deliberated on. These topics were covered at large under farm power and machinery sections.

Irrigation module comprised of study of pumps chiefly, centrifugal and submersible pumps. A training class on soil health card was taken to create awareness on the use of this card to assist farmers to determine the requirement of nutrients and fertilizers for the soil.

A highly informative practical experience and theoretical sessions were delivered in a one month capsule programme.