SERVICE MANUAL

6010 / 6510 / 7510

Tractor

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SERVICE MANUAL

6010
6510
7510

Contents

INTRODUCTION

Engine 10

[10.001] Engine and crankcase 10.1

[10.102] Pan and covers 10.2

[10.106] Valve drive and gears 10.3

[10.101] Cylinder heads 10.4

[10.105] Connecting rods and pistons 10.5

[10.103] Crankshaft and flywheel 10.6

[10.210] Lift pump and lines 10.7

[10.206] Fuel filters 10.8

[10.218] Fuel injection system 10.9

[10.202] Air cleaners and lines 10.10

[10.250] Turbocharger and lines 10.11

[10.400] Engine cooling system 10.12

[10.414] Fan and drive 10.13

[10.310] Aftercooler 10.14

[10.304] Engine lubrication system 10.15

[10.408] Oil cooler and lines 10.16

Clutch 18

[18.110] Clutch and components 18.1

Transmission 21

[21.114] Mechanical transmission 21.1

[21.112] Power shuttle transmission 21.2

[21.110] Master clutch housing 21.3

[21.134] Power shuttle transmission external controls 21.4

[21.154] Power shuttle transmission internal components 21.5

[21.120] Gearbox 21.6

[21.126] Gearbox external controls 21.7
[21.145] Gearbox internal components 21.8
[21.160] Creeper 21.9
[21.162] Reverser 21.10
[21.168] Hi-Lo unit 21.11
[21.200] Dropbox 21.12
Front axle system 25
[25.100] Powered front axle 25.1
[25.102] Front bevel gear set and differential 25.2
[25.108] Final drive hub, steering knuckles, and shafts 25.3
[25.400] Non-powered front axle 25.4
Rear axle system 27
[27.100] Powered rear axle 27.1
[27.106] Rear bevel gear set and differential 27.2
[27.120] Planetary and final drives 27.3
Power Take-Off (PTO) 31
[31.114] Two-speed rear Power Take-Off (PTO) 31.1
Brakes and controls 33
[33.120] Mechanical service brakes 33.1
[33.202] Hydraulic service brakes 33.2
[33.110] Parking brake or parking lock 33.3
Hydraulic systems 35
[35.000] Hydraulic systems 35.1
[35.104] Fixed displacement pump 35.2
[35.204] Remote control valves 35.3
[35.100] Main lift system 35.4
Steering 41

[41.101] Steering control 41.1
[41.200] Hydraulic control components 41.2
[41.216] Cylinders 41.3
Wheels 44
[44.511] Front wheels 44.1
Electrical systems 55
[55.000] Electrical system 55.1
[55.100] Harnesses and connectors 55.2
[55.201] Engine starting system 55.3
[55.301] Alternator 55.4
[55.302] Battery 55.5
[55.640] Electronic modules 55.6
[55.404] External lighting 55.7
[55.408] Warning indicators, alarms, and instruments 55.8
Platform, cab, bodywork, and decals 90
[90.118] Protections and footboards 90.1
[90.114] Operator protections 90.2
[90.120] Mechanically-adjusted operator seat 90.3
[90.100] Engine hood and panels 90.4
[90.116] Fenders and guards 90.5

INTRODUCTION

Contents

INTRODUCTION

Safety rules 3
Safety rules - Health and safety 5

Safety rules

PAY ATTENTION TO THIS SYMBOL

This warning symbol points out important messages involving personal safety. Carefully read the safety rules contained herein and follow advised precautions to avoid potential hazards and safeguard your safety and personal integrity. In this manual you will find this symbol together with the following key-words:

WARNING – It gives warning about improper repair operations and deriving potential consequences affecting the service technician's personal safety.

DANGER – It gives specific warning about potential dangers for personal safety of the operator or other persons directly or indirectly involved.

TO PREVENT ACCIDENTS

Most accidents and personal injuries taking place in workshops are due from non-observance of some simple and essential prudential rule and safety precautions. The possibility that an accident might occur with any type of machines should not be disregarded, no matter how well the machine in question was designed and built.

A wise and careful service technician is the best precautions against accidents

Careful observance of this only basic precaution would be enough to avoid many severe accidents.

NOTE: *Never carry out any cleaning, lubrication or maintenance operations when the engine is running.*

SAFETY RULES

Generalities

- Carefully follow specified repair and maintenance procedures.
- Do not wear rings, wrist watches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get caught in moving parts. Use approved safety clothing such as anti—slipping footwear, gloves, safety goggles, helmets, etc.
- Wear safety glasses with side guards when cleaning parts using compressed air.
- Damaged or frayed wires and chains are unreliable. Do not use them for lifting or towing.
- Wear suitable protection such as approved eye protection, helmets, special clothing, gloves and footwear whenever welding. All persons standing in vicinity of the welding process should wear approved eye protection. NEVER LOOK AT THE WELDING ARC IF YOUR EYES ARE NOT SUITABLY PROTECTED.
- Never carry out any repair on the machine if someone is sitting on the operator's seat, except they are qualified operators assisting in the operation to be carried out.
- Never operate the machine or use attachments from a place other than sitting at the operator's seat or at the side of the machine when operating the fender switches.
- Never carry out any operation on the machine when the engine is running, except when specifically indicated. Stop the engine and ensure that all pressure is relieved from hydraulic circuits before removing caps, covers, valves, etc.
- All repair and maintenance operations should be carried out with greatest care and attention.
- Disconnect the batteries and label all controls to warn that the tractor is being serviced. Block the machine and all equipment which should be raised.
- Never check or fill fuel tanks or batteries, nor use starting liquid if you are smoking or near open flames as such fluids are flammable.
- The fuel filling gun should always remain in contact with filler neck. Maintain this contact until the fuel stops flowing into the tank to avoid possible sparks due to static electricity build-up. • To transfer a failed tractor, use a trailer of a low loading platform trolley if available.
- To load and unload the machine from the transportation means, select a flat area providing a firm support to the trailer or truck wheels. Firmly tie the machine to the truck or the trailer platform and block wheels as required by the transporter.
- Always use lifting equipment of appropriate capacity to lift or move heavy components.

- Chains should always be safely fastened.
- Ensure that fastening device is strong enough to hold the load foreseen. No persons should stand near the fastening point.
- The working area should be always kept CLEAN and DRY. Immediately clean any spillage of water or oil.
- Never use gasoline, diesel oil or other flammable liquids as cleaning agents. Use non flammable non-toxic proprietary solvents.
- Do not pile up grease or oil soaked rags, as they constitute a great fire hazard. Always place them into a metal container.

START UP

- Never run the engine in confined spaces which are not equipped with adequate ventilation for exhaust gas extraction.
- Never bring your body, arms, legs, feet, hands, fingers near fans or rotating belts.

ENGINE

- Always loosen the radiator cap very slowly before removing it to allow pressure in the system to dissipate. Coolant should be topped up only when the engine is stopped.
- Do not fill up fuel tank when the engine is running.
- Never adjust the fuel injection pump when the tractor is moving. Never lubricate the tractor when the engine is running.

ELECTRICAL SYSTEMS

- If it is necessary to use auxiliary batteries, cables must be connected at both sides as follows: (+) to (+) and (-) to (-). Avoid short-circuiting the terminals. GAS RELEASED FROM BATTERIES IS HIGHLY FLAMMABLE. During charging, leave the battery compartment uncovered to improve ventilation. Avoid sparks or flames near the battery area. Do not smoke.
- Do not charge batteries in confined spaces.
- Always disconnect the batteries before performing any type of service on the electrical system.

HYDRAULIC SYSTEMS

- Some fluid coming out from a very small port can be almost invisible and be strong enough to penetrate skin. For this reason, NEVER USE YOUR HANDS TO CHECK FOR LEAKS, but use a piece of cardboard or a piece of wood for this purpose. If any fluid is injected into the skin, seek medical aid immediately. Lack of immediate medical attention may result in serious infections or dermatitis.
- Always take system pressure readings using the appropriate gauges.

WHEELS AND TIRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer. Periodically check for possible damage to the rims and tyres.
- Check the pressure only when the tractor is unloaded and tyres are cold to avoid wrong reading due to over- pressure.
- Never cut, nor weld a rim with the inflated tire assembled.
- Never cut, nor weld a rim with the inflated tire assembled.
- Deflate the tire before removing any object caught into the tire tread.
- Never inflate tyres using flammable gases as they may originate explosions and cause injuries to bystanders.

Safety rules - Health and safety

Health and safety precautions

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This section lists, alphabetically, some of these hazardous operations and the materials and equipment associated with them.

The precautions necessary to avoid these hazards are identified. The list is not exhaustive and all operations and procedures and the handling of materials, should be carried out with health and safety in mind.

Acid and alkalis

see Battery acids, e.g. caustic soda, sulfuric acid.
Used in batteries and cleaning materials

Irritant and corrosive to the skin, eyes, nose and throat. Causes burns.

Avoid splashes to the skin, eyes and clothing. Wear suitable protective gloves and goggles. Can destroy ordinary protective clothing. Do not breathe mists.
Ensure access to water and soap is readily available for splashing accidents.

Adhesive and sealers

see Fire Highly Flammable, Flammable, combustible.
Generally should be stored in " No Smoking" areas; cleanliness and tidiness in use should be observed, e.g. disposable paper covering benches; should be dispensed from applicators where possible; containers, including secondary containers, should be labeled.

Solvent based Adhesive/Sealers

See Solvents. Follow manufacturer's instructions.

Water base Adhesive/ Sealers

Those based on polymer emulsions and rubber lattices may contain small amounts of volatile toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use. Follow manufacturer's instructions

Resin based Adhesives/Sealers

e.g. epoxied and formaldehyde resin based.
Mixing should only be carried out in well ventilated areas as harmful or toxic volatile chemicals may be released.
Skin contact with uncured resins and hardeners can result in irritation; dermatitis and absorption of toxic of harmful chemicals through the skin. Splashes can damage the eyes
Provide adequate ventilation and avoid skin and eye contact . Follow manufacturers' instructions.

Anaerobic, Cyanoacrylate and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin. Some are eye irritants.
Skin and eye contact should be avoided and the manufacturers' instructions followed.
Cyanaocrylate adhesives (super-glues) must not contact the skin or eyes. If skin or eye tissue is bonded cover with a clean moist pad and get medical attention. Do not attempt to pull tissue apart. Use in well ventilated areas as vapors can cause irritation of the nose and eyes.
For two-pack systems see Resin based adhesives/sealers.

Isocyanate (Polyurethane) Adhesives/ Sealers

—see Resin based Adhesives.
Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.
Any spraying should preferably be carried out in exhaust ventilated booths removing vapors' and spray droplets form the breathing zone. Individual's working with spray applications should wear supplied air respirators

Antifreeze

- see Fire, Solvents e.g. Isopropanol, Ethylene Glycol, Menthol.
Highly Flammable, Flammable, Combustible. Used in vehicle cooling systems, brake air pressure systems, screen wash solutions.
Vapors given off from coolant antifreeze (glycol) arise only when heated.
Antifreeze may be absorbed through skin in toxic or harmful quantities. Antifreeze if swallowed is fatal and medical attention must be found immediately.

Arc welding

see Welding

Battery acids

see Acids and Alkalis.
Gases released during charging are explosive. Never use naked flames or allow sparks near charging or recently charged batteries.

Brake and clutch fluids (Polyalkylene Glycols)

- see Fire Combustible.
Splashes to the skin and eyes are slightly irritating. Avoid skin and eye contact as far as possible. Inhalation of vapors hazards do not arise at ambient temperatures because of the very low vapor pressure

Brazing

See welding

Chemical materials - General

- see Legal Aspects
Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, brake fluids, oils and grease should always be used with caution and stored and handled with care. They may be toxic, harmful, corrosive irritant or highly inflammable and give rise to hazardous fumes and dusts.
The effects of excessive exposure to chemicals may be immediate or delayed; briefly experienced or permanent; cumulative; superficial; life threatening or may reduce life expectancy.

Do’s

Do remove chemical materials from the skin and clothing as soon as practicable after soiling. Change heavily soiled clothing and have it cleaned.
Do carefully read and observe hazard and precaution warning given on material containers (labels) and in any accompanying leaflets, poster or other instructions. Material health and safety data sheets can be obtained from manufacturers’.
Do organise work practices and protective clothing to avoid soling of the skin and eyes; breathing Vapors/aerosols/dusts/fumes inadequate container labelling; fire and explosion hazards.
Do wash before job breaks; before eating, smoking, drinking or using toilet facilities when handling chemical materials.
Do keep work areas clean, uncluttered and free of spills.
Do store according to national and local regulations.
Do keep chemical materials out of reach of children.

Do not's

Do not mix chemical materials except under the manufacturers' instructions; some chemicals can form other toxic or harmful chemicals; give off toxic or harmful fumes; be explosive when mixed together.
Do not spray chemical materials, particular those based on solvents, in confined spaces e.g. when people are inside a vehicle.
Do not apply heat or flame to chemical materials except under the manufacturers' instructions. Some are highly inflammable and some may release toxic or harmful fumes.
Do not leave containers open. Fumes given off can build up to toxic, harmful or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas, pits etc.
Do not transfer chemical materials to unlabeled containers.
Do not clean hands or clothing with chemical materials. Chemicals, particularly solvents and fuels will dry the skin and may cause irritation with dermatitis. Some can be absorbed through the skin in toxic or harmful quantities.
Do not use emptied containers for other materials, except when they have been cleaned under supervised conditions.
Do not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be toxic or harmful.

Clutch fluids

see Brake and Clutch Fluids.

Clutch linings and pads

see Brake and Clutch Linings and Pads.

Corrosion protection materials

see Solvents, Fire.
Highly flammable, flammable.
These materials are varied and the manufactures' instructions should be followed. They may contain solvents, resins, petroleum products etc. skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Cutting

see Welding

De-waxing

see Solvents and Fuels (Kerosene).

Dusts

Powder, dusts or clouds may be irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

Electric shock

Electric shocks can result from the use of the faulty electrical equipment or from the misuse of equipment even in good condition.
Ensure that electrical equipment is maintained in good condition and frequently tested.
Ensure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged.
Ensure that electric equipment is protected by the correct rated fuse.
Never misuse electrical equipment and never use equipment which is in anyway faulty. The results could be fatal.
Use reduced voltage equipment where possible in preference to electrical equipment.

In cases of electrocution:-

- switch off electricity before approaching victim
- if this is not possible, push or drag victim from source of electricity using dry non— conductive material
- Commence resuscitation if trained to do so.
- SUMMON MEDICAL ASSISTANCE

Exhaust fumes

These contain asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should only be run under conditions of adequate extraction or general ventilator and not in confined spaces.

Gasoline (petrol) engine

There may not be adequate warning properties of odor or irritation before immediate and delayed toxic or harmful effects arise.

Diesel engine

Soot, discomfort and irritation usually give adequate warning of hazardous fume concentrations.

Fibre insulation

see Ducts
Used in noise and sound insulation.
The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect.
Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

Fire

see Welding, Foams, and Legal Aspects.
Many of the materials found on or associated with the repair of vehicles are highly inflammable. Some give off toxic or harmful fumes if burnt.
Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.
Ensure before using electrical or welding equipment but that there is no fire hazard present.
Have suitable fire extinguisher available when using welding or heating equipment.

First aid

Apart from meeting any legal requirements its desirable for someone in the workshop to be trained in first aid procedures.
Splashes in the eye should be flushed with clean water for at least ten minutes.
Soiled skin should be washed with soap and water.
Inhalation affected individuals should be removed to fresh air immediately.
If swallowed or if effects persist consult a doctor with information (label) on material used.
Do not induce vomiting (unless indicated by manufacturer)

Foams

see Fire.
Used in sound and noise insulation. Cured foams used in seat and trim cushioning.
Follow manufacturers' instructions.
Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.
Individuals with chronic respiratory diseases, asthma, bronchial medical problems or histories of allergic diseases should not work with or near uncured materials.
The components, vapors, spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.
Vapors and spray mists must not be breathed. These materials must be applied with adequate ventilation and respiratory protection. Do not remove respirator immediately after spraying, wait until vapor/ mists have cleared.
Burning of the uncured components and the cured foams can generate toxic and harmful fumes.
Smoking, open flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured - foams should be conducted with extraction ventilation (see Body Section 44 Legal and Safety Aspects).

Fuels

see Fire, Legal Aspects, Chemicals - General, Solvents.
Used as fuels and cleaning agents.

Gasoline (petrol)

Highly flammable.
Swallowing can result in mouth and throat irritation and absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs, e.g. through vomiting, is a very serious hazard.
Gasoline dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid in the eye causes severe smarting.
Motor gasoline may contain appreciable quantities of benzene, which is toxic upon inhalation and the concentrations of gasoline vapors must be kept. very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.
Ensure there is adequate ventilation when handling and using gasoline. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor build up arising from spillages in confined spaces.
Special precautions apply to cleaning and maintenance operations on gasoline storage tanks. Gasoline should not be used as a cleaning agent. It must not be siphoned by mouth.
Kerosene (Paraffin)
Used also as heating fuel, solvent and cleaning agent.
Flammable.
Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs. Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating.
In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperatures should be avoided (mists may arise in de-waxing). Avoid skin and eye contact and ensure there is adequate ventilation.

Gas-oil (diesel fuel)

see Fuels (Kerosene). Combustible.
Gross or prolonged skin contact with high boiling gas oils may also cause serious skin disorders including skin cancer.

Gas cylinders

see Fire.
Gases such as oxygen, acetylene, carbon dioxide, argon and propane are normally stored in cylinders at pressures of up to 2000 lb/sq. in. (13,790 kn/m2) and great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.
Cylinders should be stored in well ventilated enclosures, and protected from ice and snow, or direct sunlight. Fuel gases (e.g. acetylene and propane) should not be stored in close proximity to oxygen cylinders.
Care should be exercised to prevent leaks from gas cylinders and lines, and to avoid sources of ignition. Only trained personnel should undertake work involving gas cylinders

Gases

see Gas Cylinders

Gas shielded welding

-see Welding.

Gas welding

-see Welding.

General workshop tools and equipment

It is essential that all tools and equipment are maintained in good condition and the correct safety equipment used where required.
Never use tools or equipment for any purpose other than that for which they were designed.
Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure he next time that the equipment is used.
Do not use damaged or defective tools or equipment, particularly high speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.
Wear suitable eye protection when using grinding, chiseling or sand blasting equipment
Wear a suitable breathing mask when using sand blasting equipment, working with asbestos based materials or using spraying equipment

Glues

see Adhesives and Sealers.

High pressure air, lubrication and oil test

Equipment

see Lubricants and Greases.
Always keep high pressure equipment in good Condition and regularly maintained, particularly at joints and unions.
Never direct a high pressure nozzle at the skin as the fluid may penetrate to the underlying tissue etc. and cause serious injury.

Legal aspects

Many laws and regulations make requirements relating to health and safety in the use of materials and equipment in workshops.

Workshops should be familiar, in detail, with associated laws and regulations. Consult local factory inspectors if in any doubt.

Lubricants and greases

Avoid all prolonged and repeated contact with mineral oils, especially used oils. Used oils contaminated during service (e.g. routine service change sump oils) are more irritating and more likely to cause serious effects including skin cancer in the event of gross and prolonged skin contact. Wash skin thoroughly after work involving oil. Proprietary hand cleaners may be of value provided they can be removed from the skin with water. Do not use petrol, paraffin or other solvents to remove oil from the skin.
Lubricants and greases may be slightly irritating to the eyes.
Repeated or prolonged skin contact should be avoided by wearing protective clothing if necessary. Particular care should be taken with used oils and greases containing lead. Do not allow work clothing to be contaminated with oil. Dry clean or launder such clothing at regular intervals. Discard oil soaked shoes.
Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.
Used oils may only be disposed of in accordance with local regulations.
There are publications describing the problems and advising on precautionary measures.

Noise insulation materials

See Foams, Fibre Insulation.

Paints

see Solvents and Chemical Materials - General.
Highly Flammable, Flammable.

ONE PACK.
Can contain harmful or toxic pigments, driers and other components as well as solvents. Spraying should only be carried out with adequate ventilation.

TWO PACK.
Can also contain harmful and toxic unreacted resins and resin hardening agents. The manufacturer's instructions should be followed and the section of page 5 on resin based adhesives, isocyanate containing Adhesives and Foams should be consulted.
Spraying should preferably be carried out in exhausted ventilated booths removing vapor and spray mists from the breathing zone. Individuals working in booths should wear respiratory protection. Those doing small scale repair work in the open shop should wear supplied air respirators.

PAINT THINNERS -see Solvents.

PETROL -see Fuels (Gasoline).
Pressurised Equipment -see High Pressure Air, Lubrication and Oil Test Equipment.

Resistance Welding

see Welding

Sealers

see Adhesives and Sealers.

Solder

see Welding.
Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used. Oxy - acetylene flames should not be used, as they are much hotter and will cause lead fumes to be evolved.
Some fumes may be produced by the application of any flame to surfaces coated with grease etc. and inhalation of these should be avoided.
Removal of excess solder should be undertaken with care, to ensure that fine lead dust is not produced, Which can give toxic effects if inhaled. Respiratory protection may be necessary.
Solder spillage and filing should be collected and removed promptly to prevent general air contamination by lead.
High standards of personal hygiene are necessary in order to avoid indigestion of lead or inhalation of solder dust from clothing.

Solvent

see Chemical Materials -General
Fuels (Kerosene), Fire.
e.g. Acetone, white spirit, toluene, xylene, trichlorethane.
Used in cleaning materials, de-waxing, paints, plastics, resins, thinners etc.
Highly Inflammable, Flammable.
Skin contact will decrease the skin and may result in. -irritation and dematitis following repeated or prolonged contact.
Some can be absorbed through the skin in toxic or harmful quantities.
Splashes in the eye may cause severe irritation and could lead to loss of vision.
Brief exposure to high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and in the worst circumstances, unconsciousness.
Repeated or prolonged exposures to excessive but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects. Aspiration into the lungs (e.g. through vomiting) is the most serious consequence of swallowing.
Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.
Ensure good ventilation when in use, avoid breathing fumes, vapors and spray mists and keep containers tightly sealed. Do not use in confined spaces.
When the spraying material contains solvents, e.g. paints, adhesives, coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.
Do not apply heat or flame except under specific and detailed manufacturers instructions.

Sound Insulation

see Fibre Insulation, Foams.

Spot Welding

-see Welding.

Suspended loads

There is always a danger when loads are lifted or suspended. Never work under an unsupported suspended or raised load, e.g. jacked up vehicle, suspended engine, etc.
Always ensure that lifting equipment such as jacks, hoists, axle stands, slings, etc. are adequate and suitable for the job, in good condition and regularly maintained.
Never improvise lifting tackle.

Underseal

see Corrosion Protection

Welding

see Fire, Electric Shock, Gas Cylinders. Welding processes include Resistance Welding (Spot Welding), Arc Welding and Gas Welding.

Resistance welding

This process may cause particles of molten metal to be emitted at high velocity and the eyes and skin must be protected.

Arc welding

This process emits a high level of ultraviolet radiation which may cause eye and skin burns to the welder and to other persons nearby. Gasshielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.
Metal spatter will also occur and appropriate eye and skin protection is necessary.
The heat of the welding arc will produce fumes and gases from the metals being welded and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation should always be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary, particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases where adequate ventilation cannot be provided, supplied air respirators may be necessary.

Gas welding

Oxy-acetylene torches may be used for welding and cutting and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.
The process will produce metal spatter and eye and skin protection is necessary.
The flame is bright and eye protection should be used, but the ultra-violet emission is much less than that from arc welding and lighter filters may be used.
The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts and inhalation of the fumes should be avoided.
In brazing, toxic fumes may be evolved from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.
Special precaution must be taken before any welding or cutting takes place on vessel which have contained combustible materials, e.g. boiling or steaming out of fuel tanks.

White spirit

See solvents

SERVICE MANUAL

Engine

6010
6510
7510

Contents

Engine - 10

[10.001] Engine and crankcase 10.1

[10.102] Pan and covers 10.2

[10.106] Valve drive and gears 10.3

[10.101] Cylinder heads 10.4

[10.105] Connecting rods and pistons 10.5

[10.103] Crankshaft and flywheel 10.6

[10.210] Lift pump and lines 10.7

[10.206] Fuel filters 10.8

[10.218] Fuel injection system 10.9

[10.202] Air cleaners and lines 10.10

[10.250] Turbocharger and lines 10.11

[10.400] Engine cooling system 10.12

[10.414] Fan and drive 10.13

[10.310] Aftercooler 10.14

[10.304] Engine lubrication system 10.15

[10.408] Oil cooler and lines 10.16

Engine - 10

Engine and crankcase - 001

6010
6510
7510

Contents

Engine - 10

Engine and crankcase - 001

TECHNICAL DATA

Engine

General specification 3

Torque 8

Sealing 8

Special tools 8

FUNCTIONAL DATA

Engine

Overview DESCRIPTION AND OPERATION (*) 10

SERVICE

Engine

Remove 14

Install 24

Disassemble 25

Overhaul CYLINDER BLOCK OVERHAUL 32

Test 35

DIAGNOSTIC

Engine

Troubleshooting 43

(*) See content for specific models

Engine - General specification

Table 1

GENERAL SPECIFICATIONS	
Make	IVECO
Type	4 stroke, diesel, naturally aspirated, direct injection, water cooled
Power	**55/60/65/75 Hp**
No of Cylinders	3
Bore	**104 mm**
Stroke	**115 mm**
Cubic Capacity	**2931 cm³**
Compression Ratio	18:1
Firing Order	1–2–3
Idle Speed	**650 ± 50 RPM**
Maximum no Load Speed	**2550 ± 50 RPM**
Rated Speed	**2300 RPM**
Engine block	
Cylinder liner seat diameter in engine block	**106.850 - 106.900 mm**
Cylinder sleeve O.D	**106.94 - 106.97 mm**
Interference between liners and seats in block	**0.04 - 0.12 mm**
Liner O.D oversize	**0.2 mm**
Cylinder liner inner diameter	**104.00 - 104.024 mm**
Maximum ovality and taper due to wear	**0.12 mm**
Liner inner diameter oversize	**0.4 - 0.8 mm**
Camshaft bush seat diameters	
Front	**54.780 - 54.805 mm**
Intermediate	**54.280- - 54.305 mm**
Rear	**53.780 - 53.805 mm**
Tappet seat bore diameter	**15.000 - 15.018 mm**
Tappet oversize	**0.1–0.2 - 0.3 mm**
Main bearing seat bore diameter	**84.200 - 84.230 mm**
Cylinder head	
Valve guide seat bore diameter in head	**13.950 - 13.983 mm**
Valve guide oversize	**0.2 mm**
Valve stand-in	**0.7 - 1.0 mm**
Maximum stand-in permitted	**1.3 mm**
Injector standout	**0.05 - 0.7 mm**
Max. standout permitted	**1.0 mm**
Original cylinder head height	**92 mm**
Maximum head dressing allowed	**0.5 mm**
Compression pressure	**28 bar**
Engine cracking speed	**250 RPM**
Exhaust valves	
Valve head diameter	**40.75 - 41.25 mm**
Valve stem diameter	**7.975 - 7.990 mm**
Face angle	**45 30’ ± 7’ °**
Tappet clearance	**0.30 ± 0.05 mm**
Cam lift	**6.127 mm**
Valve lift	**10.445 mm**
Intake valves	
Valve head diameter	**45.300 - 45.500 mm**
Valve stem diameter	**7.985 - 8.000 mm**
Face angle	**60 30´ ± 7´ °**
Tappet clearance (cold)	**0.30 ± 0.05 mm**
Cam lift	**5.889 mm**

Valve lift	**10.445 mm**
Tiner - Internal Exhaust Gas Recirculation(EGR)	
Intake opening (After BDC, during exhaust stroke)	**3 °**
Intake valve closing (Before TDC, during Exhaust stroke)	**61 °**
'Tiner' cam lobe lift	**1.076 mm**
Intake valve lift (tiner)	**1.908 mm**
Valve springs	
Number per valve	**1 mm**
Free length	**44.6 mm**
Length loaded at **26.1 - 28.9 kg**	**34 mm**
Length loaded at **51.2 - 56.5 kg**	**23.8 mm**
Valve timing	
Intake opening (before top dead centre)	**15 °**
Intake closing (after bottom dead centre)	**45 °**
Exhaust opening (before bottom dead centre)	**56 °**
Exhaust closing (after top dead centre)	**26 °**
Valve inserts	
Valve guide OD	**13.933 - 14.016 mm**
Valve guide oversize	**0.2 mm**
Valve guide interference fit in housing cylinder head	**0.005 - 0.050 mm**
Valve guide fitted ID after reaming	**8.023 - 8.043 mm**
Valve stem clearance in guide	**0.023 - 0.058 mm** (for intake valve) **0.033 - 0.068 mm** (for exhaust valve)
Maximum wear clearance .	**0.13 mm**
Maximum valve stem eccentricity over one revolution with stylus on sealing face	**0.03 mm**

Crank gear

Crankshaft- Bearings	
Main journal diameter	**79.791 - 79.810 mm**
Main journal undersize	**0.254-0.508-0.762-1.016 mm**
Main bearing wall thickness	**2.168 - 2.178 mm**
Main bearing undersize	**0.254-0.508-0.762-1.016 mm**
Main journal clearance in bearings	**0.034 - 0.103 mm**
maximum wear clearance	**0.180 mm**
Crank pin diameter	**63.725 - 63.744 mm**
Crank pin undersize	**0.254-0.508-0.762-1.016 mm**
Big end bearing wall thickness	**1.805 - 1.815 mm**
Big end bearing undersize	**0.254-0.508-0.762-1.016 mm**
Crank pin clearance in big end bearing	**0.033 - 0.087 mm**
maximum wear clearance	**0.180 mm**
Crankshaft thrust washer thickness	**3.378 - 3.429 mm**
Thrust washer oversize	**0.127-0.254-0.508 mm**
Width of main bearing housing over thrust washers	**31.766 - 31.918 mm**
Length of corresponding main journal	**32.000 - 32.100 mm**
Crankshaft end float	**0.082 - 0.334 mm**
maximum wear end float	**0.40 mm**
Maximum main journal and crank pin ovality or taper after grinding	**0.01 mm**
Maximum main journal and crankpin ovality or taper due to wear or taper due to wear	**0.05 mm**
Maximum main journal misalignment	
Crankshaft resting on end journals	**0.10 mm**
Maximum misalignment of crank pins relative to main journals(in either direction)	**0.25 mm**
Tolerance from outer crankpin edge to crank-shaft center line	**±0.10 mm**

Maximum crankshaft flange run-out with gauge, over 108 mm (4.25”) diameter (total gauge reading)	**0.025 mm**
Maximum flywheel seat eccentricity relative to main journals (total gauge reading)	**0.04 mm**
Connecting rods	
Small end bore diameter	**41.846 - 41.884 mm**
Small end bushing outer diameter	**41.979 - 42.017 mm**
Bushing interference fit in small end	**0.095 - 0.171 mm**
Small end bushing fitted I.D .	**38.004 - 38.014 mm**
Big end bore diameter	**67.407 - 67.422 mm**
Maximum connecting rod axis misalignment at **125 mm**	**± 0.07 mm**
Maximum connecting rod weight difference over a complete set from the same engine	**25 g**
Pistons	
Piston diameter: measured at **12 mm** from base of skirt and right angles to pin	**103.852 - 103.870 mm**
Piston clearance in liner	**0.130 - 0.172 mm**
max. wear clearance	**0.30 mm**
Piston oversize range	**0.6 mm**
Piston stand-out with respect to head at T.D.C	**0.430 - 0.840 mm**
Piston pin diameter	**37.983 - 37.99 mm**
Piston pin seat bore in piston	**38.000 - 38.006 mm**
Piston pin clearance in piston	**0.010 - 0.023 mm**
Piston pin clearance in small end bushing	**0.014 - 0.031 mm**
maximum wear clearance	**0.06 mm**
Maximum weight difference between pistons on same engine	**20 g**
Piston ring clearance in groove	
• Top	**0.090 - 0.122 mm**
• 2nd	**0.060 - 0.092 mm**
• 3rd	**0.040 - 0.080 mm**
Maximum wear clearance	
• Top	**0.50 mm**
• 2nd and 3rd .	**0.20 mm**
Piston ring gap	
• Top	**0.30 - 0.45 mm**
• 2nd	**0.60 - 0.85 mm**
• 3rd	**0.30 - 0.55 mm**
Maximum wear gap	**1.20 mm**

Valve gear

Valve timing gears	
Timing gear backlash	**0.160 mm**
Idler gear jack shaft diameter	**36.975 - 37.000 mm**
Idler gear bushing fitted I.D. after reaming	**37.050 - 37.075 mm**
Jack shaft journal clearance in bushing	**0.050 - 0.100 mm**
Max. wear clearance	**0.15 mm**
Bushing interference fit in idler gear	**0.063 - 0.140 mm**
Lift and power steering pump drive gear shaft	
Diameter	**36.975 - 37.000 mm**
Bushing fitted I.D. after reaming	**37.050 - 37.075 mm**
Shaft clearance in bushing	**0.050 - 0.100 mm**
Bushing interference fit in housing	**0.063 - 0.140 mm**
Pump drive gear thrust washer thickness	**1.45 - 1.50 mm**

Camshaft	
Camshaft bushing O.D.	
• Front	**54.875 - 54.930 mm**
• Intermediate	**54.375 - 54.430 mm**
• Rear	**53.875 - 53.930 mm**
Bushing interference fit in housing	**0.070 - 0.150 mm**
Camshaft bushing fitted I.D after reaming:	
- Front	**51.080 - 51.130 mm**
- Intermediate	**50.580 - 50.630 mm**
- Rear	**50.080 - 50.130 mm**
Camshaft journal diameter:	
- Front	**50.970 - 51.000 mm**
-Intermediate	**50.470 - 50.500 mm**
- Rear	**49.970 - 50.000 mm**
Camshaft journal clearance in bushing	**0.080 - 0.160 mm**
Maximum wear clearance	**0.20 mm**
Camshaft end float (thrust plate to associated seat in camshaft)	**0.070 - 0.220 mm**
Tappets	
Tappet O.D	**14.950 - 14.970 mm**
Tappet clearance in housing on engine block	**0.030 - 0.068 mm**
Maximum wear clearance	**0.15 mm**
Tappet oversize	**0.1-0.2-0.3 mm**
Rocker bore diameter	**18.016 - 18.034 mm**
Rocker shaft diameter	**17.982 - 18.000 mm**
Rocker shaft clearance in bracket	**0.016 - 0.052 mm**
maximum wear clearance	**0.15 mm**
Rocker spacer spring length:	
- Free	**59.5 mm**
under load **4.7 - 5.3 kg**	**44 mm**
Valves, guides and springs	
Valve head diameter inlet	**45.300 - 45.500 mm**
Exhaust	**40.75 - 41.25 mm**
Valve stem diameter	Inlet- **7.985 - 8.000 mm** Exhaust **7.975 - 7.990 mm**
Valve face angle: inlet	**60 o 30'±7 ' °**
Exhaust	**45 o 30±77' °**
Tappet clearance	**0.45 °**
Engine inlet	**0.30±0.05 mm**
Exhaust (cold)	**0.30±0.05 mm**
Cam lift: inlet	**5.889 mm**
exhaust	**6.127 mm**
Valve lift: inlet	**10.445 mm**
Exhaust	**10.868 mm**

Lubrication system

Oil pump	Gear, crankshaft driven
Oil pump drive ratio	1.27:1
Oil pressure	Rated – **3 - 4.5 bar** Peak torque – **2.5 - 3.5 bar**
Relief valve crack-off setting .	**3.6 bar**
Assembly. clearance between shaft and bushing oil pump drive	**0.016 - 0.070 mm**
Shaft clearance in driven gear	**0.016 - 0.054 mm**
Gear backlash	**0.100 mm**
Gear radial clearance in pump housing	**0.015 - 0.067 mm**
Drive and driven gear width	**15.973 - 16.000 mm**

Gear housing depth in pump body	**16.016 - 16.080 mm**
Drive and driven gear end float	**0.016 - 0.107 mm**
Relief valve spring length:	
- Free	**35.9 mm**
- AT load 134.55±6.73 N	**29 mm**
- AT load 245.70±12.3 N	**23.2 mm**
Oil filter	Mesh on suction and cartridge on delivery

Cooling system

Water pump		Centrifugal, vane	
	60 / 55 Hp	**65 Hp**	**75 Hp**
Water pump drive ratio	1.04	1.18	1.38
Shaft interference fit in impeller		**0.017 - 0.059 mm**	
Shaft interference fit in fan hub		**0.024 - 0.058 mm**	
Face sealing bushing interference fit in impeller		**0.012 - 0.058 mm**	
Thermostat type		Wax	
Opening temperature		**79±2 °C**	
Close off temperature		**94 °C**	
Valve travel when fully open		**7.5 mm**	
Radiator		Vertical tube and Aluminium fins	
Fan		Suction, steel, 6 blades	
Water temperature gauge		Three colored sectors	
Temperature range for each sector:			
- white sector		**0 - 40 °C**	
- green sector		**40 - 112 °C**	
- red sector		**112 - 120 °C**	

Fuel system

Fuel feed pump		Double diaphragm	
Operation		Engine driven	
Minimum fuel flow at **1600 RPM** shaft speed		**100 L/hour**	
Drive shaft eccentricity		**3 mm**	
Fuel pump drive Shaft journal dia		**31.975 - 32.000 mm**	
Bushing fitted I.D. after reaming		**32.050 - 32.075 mm**	
Shaft clearance in bushing		**0.050 - 0.100 mm**	
Bushing interference fit in housing		**0.063 - 0.140 mm**	
Inner washer thickness		**1.45 - 1.50 mm**	
Outer washer thickness		**2.93 - 3.00 mm**	
Injection pump		Distributor, integral governor and advance device	
- BOSCH			
	55 Hp	**60 Hp**	**65 Hp**
	0460423063 (with LDA) 0460423079 (without LDA)	(0460423072) With KSB (0460423076) Without KSB	0460423073 With KSB (0460423077) Without KSB
		75 Hp (0460423075) With KSB (0460423078) Without KSB	
Firing order :		1-2-3	
Injectors:		**55 / 60 / 65 Hp**	**75 Hp**
Make		BOSCH	BOSCH
Nozzle holder		F002 C70 567 (KBAL 86 P 163)	F002 C70 567 (KBAL 86 P 163)
Nozzle.		F002 C40 750 (DSLA 142 P 5565)	F002 C40 738 (DSLA 145 P 5544)

Number of spray orifices	6	6
Spray orifice diameter	**0.176 mm**	**0.193 mm**
Pressure setting	**260 - 268 Kg/cm²**	**260 - 268 Kg/cm²**
Delivery pipes		
Type	5801439057	
pipe dimensions	6X1.6X530	
Pump timing, cylinder no. 1 in compression stroke (delivery connection of cylinder no. 1: marked with letter “A”	55 hp-0.45±0.05 mm plunger lift @ TDC (without LDA) 55 hp- 0.6±0.05 mm plunger lift @ TDC (with LDA) 60 hp- 1±0.05 mm plunger lift @ TDC 65 hp- 1±0.05 mm plunger lift @ TDC 75 hp- 1.2±0.05 mm plunger lift @ TDC	

Engine - Torque

TIGHTENING TORQUES

Description	Thread size	Torque (Nm)	Angle
Cap screw, cylinder head (C1)	**M12 x 1.25**	40	**130±5 + 140±5 °**
Cap screw, main bearing caps (C2)	**M14 x 1.25**	80	**90 °**
Cap screw, timing cover and case (C3)	**M12 x 1.25**	40	
Cap screw, connecting rod caps (C4)	**M11 x 1.25**	40	**60 °**
Cap screw, flywheel (C5)	**M12 x 1.25**	40	**60 °**
Cap screw, rocker shaft bracket (C6)	**M8x1.25**	25	
Nut, crankshaft pulley hub (C7)	**M30 x 1.5**	300	
Cap screw, fan and alternator drive pulley(C8)	**M12 x 1.25**	49	
Nut, injection pump shaft gear (C9)	**M12 x 1.25**	64	
Nuts, injection pump to support (C10)	**M12 x 1.25**	23	
Retaining screws, additional weights (C11)	**M12 x 1.25**	110	

Engine - Sealing

SEALANTS

Operation Description	Sealant Specification
Adopter for Oil Filter (S1)	**LOCTITE® 270**
Adopter for Tachometer Cable (S2)	**LOCTITE® 243™**
Flywheel Housing to Engine Block (S3)	**LOCTITE® 510™**
Timing Gear case Studs (S4)	**LOCTITE® 270**
Timing Gear cover Dowel pin(S5)	**LOCTITE® 270**
Starter Motor to Flywheel Housing (S6)	**LOCTITE® 510™**
Allen Plug in Cylinder Head Thermostat Housing (S7)	**LOCTITE® 243™**
Cylinder Head Exhaust Manifold Studs (S8)	**LOCTITE® 270**
Oil Sump to Engine Block (S9)	**LOCTITE® 5900®**
Silencer mounting Studs on Exhaust Manifold(S10)	**LOCTITE® NICKEL ANTI-SEIZE 77164**
Flywheel Bolt (S11)	**LOCTITE® 243™**

Engine - Special tools

Serial number	Special tool description	Special tool number
1	Engine stand with support	380000301
2	Nozzle tester	380000215
3	Sling hook engine	380000216
4	Adopter for slide hammer	380000541
5	Tappet adjusting screw driver	380000232
6	Angular torquing gauge	380000304

Serial number	Special tool description	Special tool number
7	Remover, filters	380200593
8	Engine oil pressure gauge with adapter	380200591
9	Remover, fuel injection pump nut	380200594
10	Wrench to remove solenoid switch	380200595
11	Compression gauge	380200596
12	Dummy injector (turbo engine)	380200334

Engine - Overview DESCRIPTION AND OPERATION

6510	APAC
7510	APAC

The engine is a 3 cylinder engine with Turbo Charger and a inter-cooler. This engine features cross flow cylinder heads, with the inlet and exhaust manifolds on opposite sides of the cylinder head. The fuel and air combustion process, takes place in the specially designed bowel in the crown of the pistons

CYLINDER HEAD ASSEMBLY

The cylinder head consists of valves and springs, with the valve rocker arm shaft assembly bolted to the cylinder block through the cylinder head. Cylinder head retaining bolts are evenly spaced with a six- point pattern around each cylinder; this ensures an even clamping load across the cylinder head. The intake and exhaust manifolds are bolted to the head; the intake manifold is mounted on the right side of the engine, with the diesel injectors mounted outside the rocker cover. The exhaust manifold is mounted on the left side of the engine. Water outlet connections and thermostat being attached to the front of the cylinder block directly behind the radiator Valve guides are inserted into the cylinder head, and replaceable. Special replaceable cast alloy valve seats are pressed into each valve port during manufacturing. No oversize valve seats on guides are available. All valves are fitted with positive value rotators; valve clearance is maintained by adjustment of the self locking adjusting screw, mounted in each of the rocker arms.

CAMSHAFT ASSEMBLY

The camshaft runs in 3 replaceable bushes. The camshaft drive gear is in mesh with and driven by the camshaft idler gear which is driven by the crankshaft timing gear. Camshaft end thrust is controlled by a thrust plate bolted to the block, and located between the camshaft gear and the front camshaft journal. A helical gear is integral on rear of cam shaft, and drives the engine oil lubrication pump mounted forward of the flywheel.

Cylinder block assembly

The cylinder block is an alloy cast iron with deep cylinder skirts & water jackets for cooling the cylinders. The cylinder bores are machined integral with the cylinder block, during the manufacturing process. Cylinders are inline and vertical and numbered from 1 to 3 from front of the engine to the rear. The oil sump, which is attached to the bottom of the cylinder block, is the reservoir for the engine oil lubrication system. A cast iron engine front cover and front plate is attached to the front of the engine and covers all of the timing gear assembly.

CRANKSHAFT ASSEMBLY

The crankshaft is supported in the cylinder block by 4 main bearings. The crankshaft is manufactured from steel with machined finished crank webs, End thrust is controlled by a thrust bearing. A dynamic balancer is fitted and driven by crankshaft to ensure smooth running operation. Front and rear crankshaft oil sealing is affected by one piece seals that are designed for long and durable service life.

CONNECTING RODS

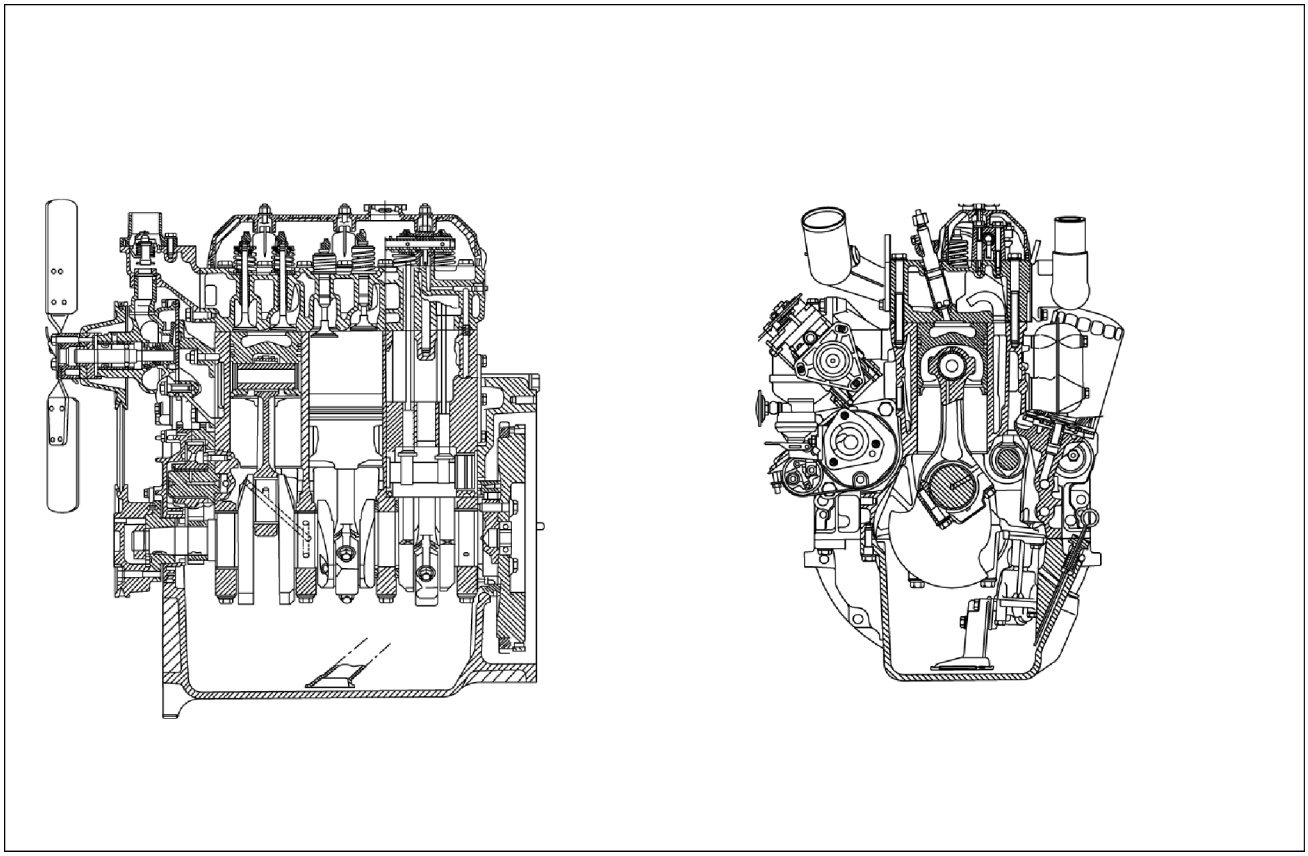
The “Wedge” shaped at the small end of the connecting rod has been designed to reduce the reciprocating weight at the piston end. The connecting rods have a heavy beam construction and are assembled as a matched set to each engine. They are attached to the crankshaft, by means of insert type bearings. They are retained in position by the connecting rod big end cap and secured by two bolts per rod. The small end of the connecting rod is fitted with a replaceable bronze bushing, through which the free floating piston pin is fitted. The steel pin being held in place within the piston by two snap rings.

PISTONS

Pistons are constructed of an aluminium silicon alloy with notch type combustion chamber being recessed in to the piston crowns.
Each piston has two compression rings and one oil control ring, to reduce the friction and increase positive seating. All rings are located above the piston pin.

Manifolds

The cross flow design aluminium intake, and cast iron exhaust manifolds are on opposite sides of the cylinder head. This is designed to maintain balanced heat distribution within the cylinder head. The configuration of the manifolds also ensures minimum heat transfer to the intake manifold. The intake manifold is connected through hose to air cleaner.



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Timing gears

The crankshaft timing gear is heated and press fitted on to the front of the crankshaft, to a high degree of accuracy during manufacturing. This enables precise timing being maintained during the life of the engine. The crankshaft gear drives the idler gear, which is attached to the front of cylinder block. The idler gear then drives the camshaft and the injection pump via meshing helical gears

The camshaft gear is bolted to the front of the shaft and is keyed to maintain position of the gear on the camshaft.

LUBRICATION SYSTEM

Lubrication of the engine, Figure 7 & 8 is maintained by a gear type oil pump mounted in the rear of the engine block., forward of the flywheel on the left hand side viewing from rear side of the engine. The oil pump is driven from the rear of the camshaft and drains oil from the engine oil sump through a tube and screen assembly

A spring loaded relief valve is integral with the oil filter and prevents over pressurization of the system. A spin on type oil filter is mounted externally to its support housing on the left hand side of the engine. Oil flows from the filter to the main oil gallery, which runs the length of the cylinder block, which also intersects the camshaft follower chamber.

The main gallery also supplies oil to the crankshaft main bearings, connecting rods both big and small ends and timing gear bushes. The underside of the pistons and pins are lubricated by oil pressure jets.

Timing gears are lubricated by splashed oil from the cam follower chamber and the pressure lubricated camshaft drive gear bushing.