NEW HOLLAND

Repair Manual – TM Series Tractors

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GENERAL INSTRUCTIONS

IMPORTANT NOTICE

All maintenance and repair operations described in this manual should be carried out exclusively by New Holland authorised workshops. All instructions should be carefully observed and special equipment where indicated should be used.

Anyone who carries out service operations described without carefully observing these prescriptions will be directly responsible for any damage caused.

NOTES FOR EQUIPMENT

Equipment which NEW HOLLAND proposes and shows in this manual is:

– studied and designed expressly for use on NEW HOLLAND tractors;
– necessary to make a reliable repair;
– accurately built and strictly tested to offer efficient and long–lasting working life.

NOTICES

The words “front”, “rear”, “right hand”, and “left hand” refer to the different parts as seen from the operator’s seat oriented to the normal direction of movement of the tractor.

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.
In this manual you will find this symbol together with the following key–words:

WARNING *– it gives warning about improper repair operations and 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 in the operation.*

TO PREVENT ACCIDENTS

Most accidents and personal injuries taking place in workshops are due from non–observance of some essential rules 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.

DANGER

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, wristwatches, jewels, unbuttoned or flapping clothing such as ties, torn clothes, scarves, open jackets or shirts with open zips which could get caught on 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 the vacinity 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 if 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 the 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 the 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 or 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 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 head, 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 no 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 the 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 TYRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer. Periodically check for possible damage to the rims and tyres.

- Stay at the tyre side when inflating.

- Check the pressure only when the tractor is unloaded and tyres are cold to avoid wrong readings due to over–pressure.

- Never cut, nor weld a rim with the inflated tyre assembled.

- To remove the wheels, block both front and rear tractor wheels. Raise the tractor and install safe and stable supports under the tractor in accordance with regulations in force.

- Deflate the tyre before removing any object caught into the tyre tread.

- Never inflate tyres using flammable gases as they may originate explosions and cause injuries to bystanders.

REMOVAL AND INSTALLATION

- Lift and handle all heavy components using lifting equipment of adequate capacity. Ensure that parts are supported by appropriate slings and hooks. Use lifting eyes provided to this purpose. Take care of the persons near the loads to be lifted.

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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.

ACIDS AND ALKALIS – see Battery acids, e.g. caustic soda, sulphuric 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 oridnary protective clothing. Do not breathe mists.

Ensure access to water and soap is readily available for splashing accidents.

ADHESIVES 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 labelled.

Solvent based Adhesives/Sealers – See Solvents.

Follow manufacturers instructions.

Water based Adhesives/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 manufacturers instructions.

Resin based Adhesives/Sealers – e.g. epoxide 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 or 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.

Cyanoacrylate 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 vapours 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 vapours and spray droplets from the breathing zone. Individuals working with spray applications should wear supplied air respirators.

ANTIFREEZE – see Fire, Solvents e.g. Isopropanol, Ethylene Glycol, Methanol.

Highly Flammable, Flammable, Combustible.

Used in vehicle coolant systems, brake air pressure systems, screenwash solutions.

Vapours given off from coolant antifreeze (glycol) arise only when heated.

Antifreeze may be absorbed through the 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 vapour hazards do not arise at ambient temperatures because of the very low vapour 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 warnings 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 soiling of the skin and eyes; breathing vapours/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 NOTS

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, particularly 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 unlabelled 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 manufacturers 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 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 any way faulty. The results could be fatal.

Use reduced voltage equipment (110 volt) for inspection and working lights where possible.

Ensure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

Use air operated mobile 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 ventilation and not in confined spaces.

Gasolene (Petrol) Engine

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

Diesel Engine

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

FIBRE INSULATION – see Dusts.

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 organisation of work practices and the use of gloves.

FIRE – see Welding, Foams, Legal Aspects.

Many of the materials found on or associated with the repair of vehicles are highly flammable. 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 a suitable fire extinguisher available when using welding or heating equipment.

FIRST AID

Apart form meeting any legal requirements it is 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 – Polyurethane – 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, vapours, spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapours 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 vapour/ 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 vapours/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.

Gasolene (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.

Gasolene dries the skin and can cause irritation and dermatitis on prolonged or repeated contact. Liquid in the eye causes severe smarting.

Motor gasolene may contain appreciable quantities of benzene, which is toxic upon inhalation and the concentrations of gasolene vapours must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkeness. Very high concentrations will result in rapid loss of consciousness.

Ensure there is adequate ventilation when handling and using gasolene. Great care must be taken to avoid the serious consequences of inhalation in the event of vapour build up arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasolene storage tanks.

Gasolene 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 vapours. Exposure to mists and vapours 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/m^2) 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 the 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, chiselling 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. Some of these laws which apply in the U.K. are listed. Similar laws exist for other territories:–

- The Factories Act (1961).
- The Asbestos Regulations (1969).
- Highly Flammable Liquids and Liquified Petroleum Gases Regulations (1972).
- Deposit of Poisonous Waste Act (1972).
- Control of Pollution Act (1974).
- Health and Safety at Work Act (1974).
- The Packaging and Labelling of Dangerous Substances Regulations (1978).
- Control of Lead Regulations (1981).

Workshops should be familiar, in detail, with these and associated laws and regulations. Consult local factory inspectorate 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, e.g. in the U.K., the Control of Pollution Act.

There are publications describing the problems and advising on precautionary measures. For the U.K. these include:

SHW 295:	Effects of mineral oil on the skin
SHW 295A:	Cancer of the skin caused by oil
SHW 397:	Cautionary notice: Effects of mineral oil on the skin

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 manufacturers 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 vapour 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 (Gasolene).

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.

SOLVENTS – 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 degrease 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 vapours or mists will cause eye and throat irritation, drowziness, dizziness, headaches and in the worst circumstances, unconsciousness.

Repeated or prolonged exposures to excessive but lower concentrations of vapours 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, vapours 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. Gas–shielded 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 PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, E.G. BOILING OR STEAMING OUT OF FUEL TANKS.

White Spirit – see Solvents.

SECTION 10 – ENGINE

Chapter 1 – Engine

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GROUP 10 – GENERAL FEATURES AND SPECIFICATIONS

Model (T = Turbocharged)		TM115	TM125 (T)	TM135 (T)	TM150 (T)	TM165 (T)
No of Cylinders		6	6	6	6	6
Bore	ins	4.4	4.4	4.4	4.4	4.4
	(mm)	111.8	111.8	111.8	111.8	111.8
Stroke	ins	5.0	5.0	5.0	5.0	5.0
	(mm)	127.0	127.0	127.0	127.0	127.0
Displacement	cu in	456	456	456	456	456
	(cu cm)	7472	7472	7472	7472	7472
Compression Ratio		17:5–1	17:5–1	17:5–1	17:5–1	17:5–1
Cylinder Bore Compression at cranking speed of 200 R.P.M.	lbs in^2 bar	375 25.5	375 25.5	375 25.5	375 25.5	375 25.5
Firing Order		153624	153624	153624	153624	153624
Idle Speed R.P.M		750 – 850	750 – 850	750 – 850	750 – 850	750 – 850
Maximum no Load Speed R.P.M		2350 – 2400	2350 – 2400	2350 – 2400	2350 – 2400	2460 – 2510
Rated Engine Speed		2200	2200	2200	2200	2300

CYLINDER BLOCK

Taper of Cylinder Bore	0.025mm (0.001 in) Repair Limit 0.127mm (0.005 in) Wear Limit
Cylinder Bore out of Round	0.030mm (0.0015 in) Repair Limit 0.127mm (0.0050 in) Wear Limit
Cylinder Bore Diameters	111.778–111.841mm (4.4007–4.4032 in)
Rear Oil Seal Bore Diameter	140.77–140.87mm (5.542–5.546 in)
Block to Head Surface Flatness	0.08mm (0.003 in) in any 152mm (6 in) 0.03mm (0.001 in) in any 25.40mm (1 in)

CYLINDER HEAD

Valve Guide Bore Diameter	9.469–9.495mm (0.3728–0.3738 in)
Head to Block Surface Flatness	0.03mm (0.001 in) in any 25.40mm (1 in), or 0.127mm (0.005 in) overall limit

EXHAUST VALVES

Face Angle	44°15'–44°30' Relative to the Head of Valve
Stem Diameter	Std : 9.401–9.421mm (0.3701–0.3709 in) 0.076mm (0.003 in) Oversize : 9.477–9.497mm (0.3731–0.3739 in) 0.38mm (0.015 in) Oversize : 9.781–9.802mm (0.3851–0.3859 in) 0.76mm (0.030 in) Oversize : 10.163–10.183mm (0.4001–0.4009 in)
Head Diameter	42.88–43.13mm (1.688–1.698 in)
Stem to Guide Clearance	0.048–0.094mm (0.0019–0.0037 in)
Lash Clearance (Cold)	0.43–0.53mm (0.017–0.021 in)

INTAKE VALVES

Face Angle	29°15'–29°30' Relative to Head of Valve
Stem Diameter	Std : 9.426–9.446mm (0.3711–0.3719 in) 0.076mm (0.003 in) Oversize : 9.502–9.522mm (0.3741–0.3749 in) 0.381mm (0.015 in) Oversize : 9.807–9.827mm (0.3861–0.3869 in) 0.762mm (0.030 in) Oversize : 10.188–10.208mm (0.4011–0.4019 in)
Head Diameter	47.37–47.63mm (1.865–1.875 in)
Stem to Guide Clearance	0.023–0.069mm (0.0009–0.0027 in)
Lash Clearance (Cold)	0.36–0.46mm (0.014–0.018 in)

VALVE SPRINGS

Number per Valve	1
Free Length	60.70mm (2.390 in)
Length, loaded at 27.7–31.3kg (61–69 lb)	48.26mm (1.900 in)
Length, loaded at 61–69kg (135–153 lb)	35.69mm (1.405 in)

VALVE TIMING

Intake Opening	12° Before Top Dead Centre
Intake Closing	38° After Bottom Dead Centre
Exhaust Opening	48° Before Bottom Dead Centre
Exhaust Closing	12° After Top Dead Centre

VALVE INSERTS

Insert Oversize	Exhaust Valve Insert Counterbore Diameter in Cylinder Head	Intake Valve Seat Insert Counterbore Diameter in Cylinder Head
0.254mm (0.010 in)	44.17–44.20mm (1.739–1.740 in)	50.01–50.04mm (1.969–1.970 in)
0.508mm (0.020 in)	44.42–44.45mm (1.749–1.750 in)	50.27–50.29mm (1.979–1.980 in)
0.762mm (0.030 in)	44.68–44.70mm (1.759–1.760 in)	50.52–50.55mm (1.989–1.990 in)

VALVE SEATS

Exhaust Valve Seat Angle	45°00’ – 45°30’
Intake Valve Seat Angle	30°00’ – 30°30’
Interference Valve Face Angle to Valve Seat Angle	0°30’ – 1°15’
Concentricity With Guide Diameter	0.051mm (0.002 in) Total Indicator Reading Max
Seat Width Exhaust Valve	1.8–2.3mm (0.072–0.092 in)
Intake Valve	1.9–2.5mm (0.078–0.098 in)

CAMSHAFT IDLER GEAR

Number of teeth	47
End Play	**0.051–0.18mm (0.002–0.007 in)**
Bushing Inside Diameter	50.813–50.838mm (2.005–2.0015 in)
Adaptor Outside Diameter	50.762–50.775mm (1.9985–1.9990 in)
Backlash with Crankshaft Gear	**0.15–0.45mm (0.006–0.018 in)**
Backlash with Camshaft Gear	**0.15–0.45mm (0.006–0.018 in)**
Backlash with Fuel Injection Pump	0.10–0.15mm (0.004–0.006 in)

CAMSHAFT GEAR

Number of Teeth	52
Timing Gear Backlash with idler	**0.15–0.45mm (0.006–0.018 in)**

ROCKER ARM SHAFT

Shaft Diameter	1.000–1.001 in (25.40–25.43mm)
Shaft Support Internal Diameter	1.002–1.004 in (25.45–25.20mm)

ROCKER ARM

Inside Diameter	1.003–1.004 in (25.48–25.50mm)

TAPPETS

Clearance to Bore	0.0006–0.0021 in (0.015–0.053mm)
Tappet Diameter	25.118–25.130mm (0.9889–0.9894 in)
Tappet Bore Diameter	25.15–25.17mm (0.9900–0.9910 in)

CAMSHAFT

Bearing Journal Diameter	60.693–60.719mm (2.3895–2.3905 in)
Bearing Clearance	0.025–0.076mm (0.0010–0.0030 in)
End Play	0.051–0.18mm (0.0020–0.0070 in)

CONNECTING RODS

Small End Bushing (Internal Diameter)	
Normally Aspirated	38.113–38.120mm (1.5005–1.5008 in)
Turbocharged	41.288–41.259mm (1.6255–1.6258 in)
Clearance Bushing to Piston Pin	0.013–0.025mm (0.0005–0.0010 in)
Side Float	0.13–0.33mm (0.0050–0.0130 in)
Maximum Twist	0.30mm (0.0120 in)
Maximum Bend	0.10mm (0.0040 in)

PISTON PIN

Outside Diameter	
Normally Aspirated Engine	38.095–38.100mm (1.4998–1.5000 in)
Turbocharged Engine	41.270–41.275mm (1.6248–1.6250 in)

PISTONS

Skirt to Cylinder Clearance Naturally Aspirated	0.140–0.171mm (0.0055–0.0067 in) New or unrun engine 0.140–0.28mm (0.0055–0.011 in.) For run engines
Skirt to Cylinder Clearance Turbocharged	0.166–0.196mm (0.0065–0.0077 in) New or unrun engine 0.166–0.28mm (0.0065–0.011 in.) For run engines
Grading Diameter (at Right Angles to Piston Pin)	111.64–111.74mm (4.3951–4.3991 in) in increments of 0.0127mm (0.0005 in)
Piston Pin Clearance	0.0030–0.0140mm (0.00012–0.00055 in) at 21°C (70°F)
Piston Crown to Block Face,	
Naturally Aspirated	0.28–0.58mm (0.011–0.023 in)
Turbocharged	0.0–0.3mm (0.0–0.012 in)

PISTON RINGS

Compression,		
Number and Location		2 off,1st and 2nd from the top of the piston
Naturally Aspirated,		
Top Compression Ring		Parallel Sides–Barrelled face
2nd Compression Ring		Lower side internal chamfer – tapered face
Turbocharged,		
Top Compression Ring		Keystone Tapered sides – Barrelled face
2nd Compression Ring		Lower side internal chamfer – tapered face
Oil Control,		
Number and Location		1 off,–Directly above the Piston Pin,
Type		Slotted With Expander
Side Face Clearance To Ring Groove,		
Top Compression Ring		0.103–0.153mm (0.0041–0.0060in)
2nd Compression Ring	– Turbocharged	0.075–.125mm (0.0030–0.0049in)
	– N.A.	0.055–0.105mm (0.0022–0.0042in)
Oil Control Ring		0.040–0.090mm (0.0016–0.0035in)
Gap Width,		
Top Compression Ring	– Turbocharged	0.40–0.90mm (0.016–0.036in)
	– N.A.	0.38–0.84mm (0.015–0.033in)
2nd Compression Ring		0.40–0.90mm (0.016–0.036in)
Oil Control Ring		0.40–0.90mm (0.016–0.036in)

CRANKSHAFT

Main Journal Diameter	– Blue	85.631–85.644mm (3.3713–3.3718 in)
	– Red	85.644–85.656mm (3.3718–3.3723 in)

Main Journal Length (except thrust, rear, or intermediate)	36.96–37.21mm (1.455–1.465 in)
Main Journal Wear Limits	0.127mm (0.005 in) Maximum
Main and Crankpin Fillet Radius	3.048–3.556mm (0.12–0.14 in)
Thrust Bearing Journal Length	37.06–37.11mm (1.459–1.461 in)
Intermediate Bearing Journal Length	36.96–37.21mm (1.455–1.465 in)
Rear Bearing Journal Length	37.97–38.48mm (1.495–1.515 in)
Crankpin Journal Length	42.62–42.72mm (1.678–1.682 in)
Crankpin Diameter – Blue	69.840–69.850mm (2.749–2.7500 in)
– Red	69.850–69.860mm (2.750–2.7504 in)
End Play	0.10–0.20mm (0.004–0.008 in)
Crankpin Out of Round	0.005mm (0.0002 in) Total Indicator Reading
Taper Surface Parallel to Centre Line of Main Journal	0.005mm (0.0002 in)
Crankshaft Rear Oil Seal Journal Diameter	122.12–122.28mm (4.808–4.814 in)
Crankshaft Pulley Journal Diameter	44.45–44.48mm (1.750–1.751 in)
Crankshaft Timing Gear Journal Diameter	46.23–46.25mm (1.820–1.821 in)
Crankshaft Flange Runout	0.038mm (0.0015 in) Max

CRANKSHAFT DRIVE GEAR

Number of teeth	26

MAIN BEARING

Liner length (except thrust liner)	27.94–28.19mm (1.10–1.11 in)
Liner Length (Thrust Liner)	39.91–39.96mm (1.453–1.455 in)
Vertical Assembled Bearing Clearance	0.055–0.117mm (0.0021–0.0046 in)

CRANKPIN BEARINGS

Liner Length	35.56–35.81mm (1.40–1.41 in)
Vertical Assembled Bearing Clearance	0.035–0.094mm (0.0014–0.0037 in)

CRANKSHAFT RE–GRINDING

When re–grinding a crankshaft the main and crankpin journal diameters should be reduced the same amount as the undersize bearings used, and the following dimensions apply. The rear end of the crankshaft should be located on the 60° Chamfer of the pilot bearing bore.

UNDERSIZE BEARING AVAILABLE	MAIN JOURNAL DIAMETERS
0.051mm (0.002 in)	85.580–85.593mm (3.3693–3.3698 in)
0.254mm (0.010 in)	85.390–85.402mm (3.3618–3.3623 in)
0.508mm (0.020 in)	85.136–85.148mm (3.3518–3.3523 in)
0.762mm (0.030 in)	84.882–84.894mm (3.3418–3.3423 in)
1.016mm (0.040 in)	84.628–84.640mm (3.3318–3.3323 in)

UNDERSIZE BEARING AVAILABLE	CRANKPIN JOURNAL DIAMETERS
0.051mm (0.002 in)	69.789–69.799mm (2.7476–2.7480 in)
0.254mm (0.010 in)	69.956–69.606mm (2.7400–2.7404 in)
0.508mm (0.020 in)	69.342–69.352mm (2.7300–2.7304 in)
0.762mm (0.030 in)	69.088–69.098mm (2.7200–2.7204 in)
1.016mm (0.040 in)	68.834–68.844mm (2.7100–2.7104 in)