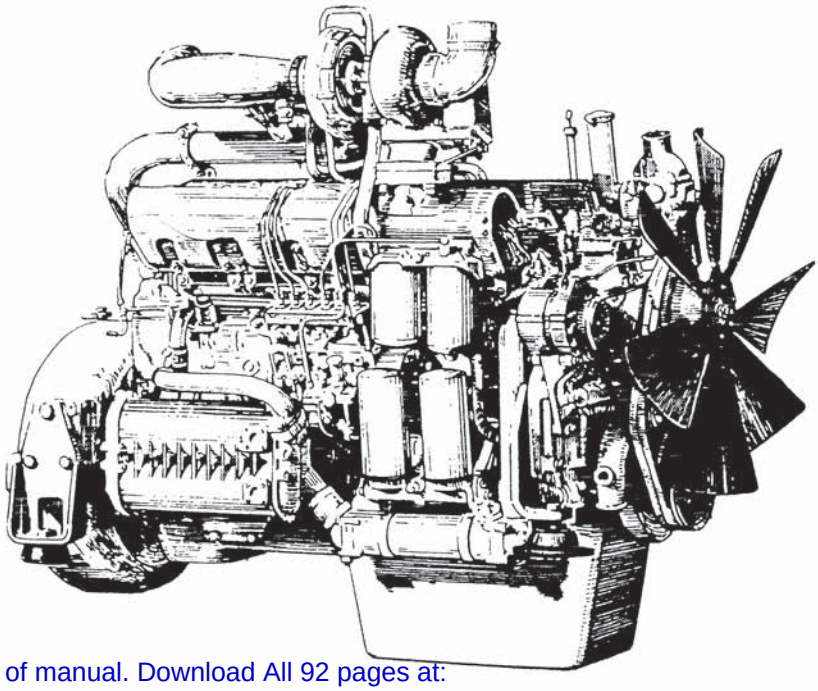
FIATALLIS®

8465
ENGINE

Service manual



Form 604.06.543 - English

AVOID ACCIDENTS

Most accidents, whether they occur in industry, on the farm, at home or on the highway, are caused by the failure of some individual to follow simple and fundamental safety rules or precautions. For this reason MOST ACCIDENTS CAN BE PREVENTED by recognizing the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment there are many conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

A careful operator is the best insurance against an accident. The complete observance of one simple rule would prevent many thousand serious injuries each year. That rule is:

Never attempt to clean, oil or adjust a machine while it is in motion.

WARNING

On machines having hydraulically, mechanically, and/or cable controlled equipment (such as shovels, loaders, dozers, scrapers, etc.) be certain the equipment is lowered to the ground before servicing, adjusting and/or repairing. If it is necessary to have the hydraulically, mechanically, and/or cable controlled equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and/or mechanical devices used for controlling the equipment.

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Service manual

Form N°. 604.06.543 - English

THIS SYMBOL IS YOUR SAFETY ALERT SIGN. IT MEANS ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED.

Carefully read and heed the safety instructions and recommended cautions to avoid danger and harm to your health and prevent injury.

In this manual you will find the above symbol next to the following words:

***WARNING*- When the cautions are finalized to avoid improper repair procedures with potential consequences involving the safety of the person performing the job.**

***DANGER* - When the cautions signal specifically potential danger of harm to the operator or to other persons either directly or indirectly involved.**

IMPORTANT

All maintenance and repair procedures explained in this manual **must be performed exclusively by the Service Network of the Factory,** following strictly the indications provided and using, whenever necessary, the specific tooling as indicated.
Whoever performs the operations described in this manual without strictly respecting the procedures indicated, is directly responsible for any liability arising for any consequential damages.

Neither the Factory nor any organization in its distribution chain, including but not limited to national, regional of local distributors, are responsible for any liability arising from any damage resulting from defects caused by parts and/or components not approved by the Factory for use in maintaining and/or repairing product manufactured or merchandized by the Factory.
In any case, no warranty of any kind is made or shall be imposed with respect to product manufactured of merchandized by the Factory when failures are caused by the parts and/or components not approved by the Factory.

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Contents

SAFETY RULES

GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black border and lettering for ***WARNING*** and red with white border and lettering for ***DANGER*** points.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat. Keep head, body, limbs, hands and feet inside operator's compartment at all times to reduce exposure to hazards outside the operator's compartment.

Do not allow unauthorized personnel to operate service or maintain this machine.

Always check work area for dangerous features. The following are examples of dangerous work areas: slopes, over hangs, timber, demolitions, fire, high walls, drop off, back fills, rough terrain, ditches, ridges, excavations, heavy traffic, crowded parking, crowded maintenance and closed areas. Use extreme care when in areas such as these.

An operator must know the machine's capabilities. When working on slopes or near drop offs be alert to avoid loose or soft conditions that could cause sudden tipping or loss of control.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps grab rails and handles at all times.

Do not use controls or hoses as hand holds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls also may be inadvertently moved causing accidental machine or equipment movement.

Keep operator's compartment, stepping points, grab-rails and handles clear of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Be careful of slippery conditions on stepping points, hand rails, and on the ground. Wear safety boots or shoes that have a high slip resistant sole material.

For your personal protection. Do not attempt to climb on or off machine while machine is in motion.

Never leave the machine unattended with the engine running.

Always lock up machine when leaving it unattended. Return keys to authorized security. Heed all shut down procedures of the Operation and Maintenance Instruction Manual. Always set the parking brake when leaving the machine for any reason.

Do not wear rings, wrist watches, jewelry, loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vests, or respirators. Consult your employer for specific safety equipment requirements.

Do not carry loose objects in pockets that might fall unnoticed into open compartments. Do not use machine to carry loose objects by means other than attachments for carrying such objects.

DO NOT CARRY RIDERS unless the machine is equipped for carrying people to reduce personal exposure to being thrown off.

Do not operate machinery in a condition of extreme fatigue or illness. Be especially careful towards the end of the shift.

Roll Over Protective Structures are required on wheel loaders, dozer tractors, track type loaders, graders and scrapers by local or national requirements. *DO NOT* operate this machine without a Roll Over Protective Structure.

Do not operate a machine without a falling object protective structure (FOPS).

Do not operate this machine without a rear canopy screen when machine is equipped with rear mounted towing winch.

Seat belts are required to be provided with roll over protective structures or roll protection cabs by local or national regulations. Keep the safety belt fastened around you during operation.

Where noise exposure exceeds 90 dBA for 8 hours, wear authorized ear protective equipment per local or national requirements that apply.

Keep clutches and brakes on machine and attachments such as power control units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturers at all times. *DO NOT* adjust machine with engine running except as specified.

Do not operate a machine with brakes out of adjustment. See the Operation and Maintenance Instruction Manual.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow Operation and Maintenance Instruction Manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

SAFETY RULES

To prevent entrapment in cabs or mounted enclosures, observe and know the mechanics of alternate exit routes.

On machines equipped with suction radiator fans, be sure to periodically check all engine exhaust parts for leaks as exhaust gases are dangerous to the operator. Keep a vent open to outside air at all times when operating within a closed cab.

STARTING FLUID IS FLAMMABLE. Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. *DO NOT PUNCTURE OR BURN CONTAINERS.*

Follow the recommendations of the manufacturer for storage and disposal.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

OPERATION

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

DO NOT START OR OPERATE AN UNSAFE MACHINE. Before working the machine, be sure that any unsafe condition has been satisfactorily remedied. Check brakes, steering and attachment controls before moving. Advise the proper maintenance authority of any malfunctioning part or system. Be sure all protective guards or panels are in place, and all safety devices provided are in place and in good operating condition.

Check instruments at start-up and frequently during operation.

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Be sure exposed personnel in the area of operation are clear of the machine before moving the machine or its attachments. *WALK COMPLETELY AROUND* the machine before mounting. Sound horn. Obey flag man, safety signals and signs.

Know the principles of cross steering of crawler tractors. Read section in Operation and Maintenance Instruction Manual on cross steering.

Keep engine exhaust system and exhaust manifolds clear of combustible material. Equip machine with screens and guards when working under conditions of flying combustible material.

If engine has a tendency to stall for any reason under load or idle, report this for adjustment to a proper maintenance authority immediately. Do not continue to operate machine until condition has been corrected.

Never use bucket as a man-lift.

Use recommended bucket for machine and material load ability and heaping characteristics of material, terrain, and other pertinent job conditions.

Avoid abrupt starts and stops when transporting a loaded bucket.

Inspect your seat belt webbing and hardware at least twice a year for signs of fraying, wear or other weakness that could lead to failure.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of draw bars, cables or chains under load.

When pulling or towing through a cable or chain, do not start suddenly at full throttle. Take up slack carefully. Guard against kinking chains or cables. Inspect carefully for flaws before using. Do not pull through a kinked chain or cable due to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. *DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.*

During operation always carry ripper in full raised position when not in use and lowered to ground when parked.

When counterweights have been provided, do not work machine if they have been removed unless their equivalent weight has been replaced. See the Operation and Maintenance Instruction Manual.

When operating a machine know what clearances will be encountered, overhead doors, wires, pipes, aisles, roadways; also the weight limitations of ground, floor, and ramps.

Know bridge and culvert load limits and do not exceed them. Know machine's height, width, and weight. Use a signal person when clearance is close.

Be sure that the exact location of gas lines, utility lines, sewers, overhead and buried power lines, and other obstructions or hazards are known. Such locations should be precisely marked by the proper authorities to reduce the risk of accidents. Obtain shut-down or relocation of any such facilities before starting work, if necessary.

Be certain to comply with all local, state, and federal regulations regarding working in the vicinity of power lines.

When roading find out what conditions are likely to be met - clearances, congestion, type of surface, etc. Be aware of fog, smoke or dust element that obscure visibility.

When backing, always look to where the machine is to be moved. Be alert to the position of exposed personnel. *DO NOT OPERATE* if exposed personnel enter the immediate work area.

SAFETY RULES

Never travel a machine on a job site, in a congested area, or around people without a signal person to guide the operator.

In darkness, check area of operation carefully before moving in with machine. Use all lights provided. Do not move into area of restricted visibility.

Maintain clear vision of all areas of travel or work. Keep cab windows clean and repaired. Carry blade low for maximum visibility while traveling. Obtain and use fan blast deflectors where tractors are used a pusher tractors in tandem.

Transport a loaded bucket with the bucket as far tipped back and in as low a position as possible for maximum visibility, stability, and safest transport of the machine. Carry it at a proper speed for the load and ground conditions.

Carry the bucket low when traveling with a load.

Maintain a safe distance from other machines. Provide sufficient clearance for ground and visibility conditions. Yield right-of-way to loaded machines.

Avoid going over obstacles such as rough terrain, rocks, logs, curbs, ditches ridges, and railroad tracks whenever possible. When obstructions must be crossed, do so with extreme care at an angle if possible. Reduce speed - down-shift. Ease up to the break over point - pass the balance point slowly on the obstruction and ease down on the other side.

Cross gullies or ditches at an angle with reduced speed after insuring ground conditions will permit a safe traverse.

Be alert to soft ground conditions close to newly constructed walls. The fill material and weight of machine may cause the wall to collapse under the machine.

Operate at speeds slow enough to insure complete control at all times. Travel slowly over rough ground, on slopes or near drop offs, in congested areas or on ice or slippery surfaces.

Be alert to avoid changes in traction conditions that could cause loss of control. *DO NOT* drive on ice or frozen ground conditions when working the machine on steep slopes or near drop offs.

Keep the machine well back from the edge of an excavation.

Be especially careful when traveling up or down slopes. Position the bucket in such a way as to provide a possible anchorage on the ground in case of a slide.

When proceeding across a hill side proceed slowly. Never turn sharply up hill or down hill.

Avoid side hill travel whenever possible. Drive up and down the slope. Should the machine start slipping sideways on a grade, turn it immediately downhill.

In steep down hill operation, do not allow engine to over speed. Select proper gear before starting down grade.

There is no substitute for good judgement when working on slopes.

The grade of slope you should attempt will be limited by such factors as condition of the ground, load being handled, the type of machine, speed of machine and visibility.

NEVER COAST the machine down grades and slopes with the transmission in neutral on power shift machines, or clutch disengaged on manually shifted machines.

To reduce the danger of uncontrolled machine, choose a gear speed before proceeding down grade that will hold machine to proper speeds for conditions.

Operating in virgin rough terrain that includes previously mentioned hazards is called pioneering. Be sure you know how this is done. Danger from falling branches and upturning roots is acute in these areas.

When pushing over trees, the machine must be equipped with proper over head guarding. Never allow a machine to climb up on the root structure particularly while the tree is being felled. Use extreme care when pushing over any tree with dead branches.

Avoid brush piles, logs or rocks. *DO NOT DRIVE THE MACHINE ONTO BRUSH PILES, LOGS, LARGE ROCKS* or other surface irregularities that break traction with the ground especially when on slopes or near drop offs.

Avoid operating equipment too close to an over hang or high wall either above or below the machine. Be on the look out for caving edges, falling objects and slides.Beware of concealment by brush and under growth of these dangers.

Park in a non-operating and non-traffic area or as instructed. Park on firm level ground if possible. Where not possible, position machine at a right angle to the slope, making sure there is no danger of uncontrolled sliding movement. Set the parking brake.

Never park on an incline without carefully blocking the machine to prevent movement.

If parking in traffic lanes cannot be avoided, provide appropriate flags, barriers, flares and warning signals as required. Also provide advance warning signals in the traffic lane of approaching traffic.

Move the machine away from pits, trenches, overhangs and over head power lines before shutting down for the day.

When stopping operation of the machine for any reason, always return the transmission or hydrostatic drive control to neutral and engage the control lock to secure the machine for a safe start up. Set parking brake, if so equipped.

Never lower attachments or tools from any position other than seated in operator's seat. Sound the horn. Make sure the area near the attachment is clear. Lower the attachment slowly. *DO NOT USE* float position to lower hydraulic equipment.

SAFETY RULES

Always before leaving the operator's seat and after making certain all people are clear of the machine, slowly lower the attachments or tools flat to the ground in a positive ground support position. Move any multi purpose tool to positive closed position. Return the controls to hold. Place transmission control in neutral and move engine controls to off position. Engage all control locks, set parking brake, and open and lock the master (key, if so equipped) switch. Consult Operation and Maintenance Instruction Manual.

Always follow the shut down instructions as outlined in the Operation and Maintenance Instruction Manual.

MAINTENANCE

Do not perform any work on equipment that is not authorized. Follow the Maintenance or Service Manual procedures.

Machine should not be serviced with anyone in the operator's seat unless they are qualified to operate the machine and are assisting in the servicing.

Shut off engine and disengage the Power Take Off lever if so equipped before attempting adjustments or service.

Always turn the master switch (key switch if so equipped) to the *OFF* position before cleaning, repairing, or servicing and when parking machine to forestall unintended or unauthorized starting.

Disconnect batteries and *TAG* all controls according to local or national requirements to warn that work is in progress. Block the machine and all attachments that must be raised per local or national requirements.

Never lubricate, service or adjust a machine with the engine running, except as called for in the Operation and Maintenance Instruction Manual. Do not wear loose clothing or jewelry near moving parts.

Do not run engine when refueling and use care if engine is hot due to the increased possibility of a fire if fuel is spilled.

Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.

Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow. To reduce the chance of a static electricity spark, keep contact until after fuel flow is shut off.

Do not adjust engine fuel pump when the machine is in motion.

Never attempt to check or adjust fan belts when engine is running.

When making equipment checks that require running of the engine, have an operator in the operator's seat at all times with the mechanic in sight. Place the transmission in neutral and set the brakes and lock. *KEEP HANDS AND CLOTHING AWAY FROM MOVING PARTS.*

Avoid running engine with open unprotected air inlets. If such running is unavoidable for service reasons, place protective screens over all inlet openings before servicing engine.

Do not place head, body, limbs, feet, fingers, or hands near rotating fan or belts. Be especially alert around a pusher fan.

Keep head, body, limbs, feet, fingers, or hands away from bucket, blade or ripper when in raised position.

If movement of an attachment by means of machine's hydraulic system or winches is required for service or maintenance, do not raise or lower attachments from any position other than when seated in the operator's seat. Before starting machine or moving attachments or tools, set brakes, sound horn and call for an all clear. Raise attachments slowly.

Never place head, body, limbs, feet, fingers, or hands into an exposed portion between uncontrolled or unguarded scissor points of machine without first providing secure blocking.

Never align holes with fingers or hands - Use the proper aligning tool.

Disconnect batteries before working on electrical system or repair work of any kind.

Check for fuel or battery electrolyte leaks before starting service or maintenance work. Eliminate leaks before proceeding.

BATTERY GAS IS HIGHLY FLAMMABLE. Leave battery box open to improve ventilation when charging batteries. Never check charge by placing metal objects across the posts. Keep sparks or open flame away from batteries. Do not smoke near battery to guard against the possibility of an accidental explosion.

Do not charge batteries in a closed area. Provide proper ventilation to guard against an accidental explosion from an accumulation of explosive gases given off in the charging process.

Be sure to connect the booster cables to the proper terminals (+ to +) and (- to -) at both ends. Avoid shorting clamps. Follow the Operation and Maintenance Instruction Manual procedure.

Due to the presence of flammable fluid, never check or fill fuel tanks, storage batteries or use starter fluid near lighted smoking materials or open flame or sparks.

Rust inhibitors are volatile and flammable. Prepare parts in well ventilated place. Keep open flame away - *DO NOT SMOKE.* Store containers in a cool well ventilated place secured against unauthorized personnel.

Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.

DO NOT pile oily or greasy rags - they are a fire hazard. Store in a closed metal container.

SAFETY RULES

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

Never place gasoline or diesel fuel in an open pan.

Shut off engine and be sure all pressure in system has been relieved before removing panels, housings, covers, and caps. See Operation and Maintenance Instruction Manual.

Do not remove hoses or check valves in the hydraulic system without first removing load and relieving pressure on the supporting cylinders. Turn radiator cap slowly to relieve pressure before removing. Add coolant only with engine stopped or idling if hot. See Operation and Maintenance Instruction Manual.

Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of card board or wood to search for suspected pressure leaks. *DO NOT USE HANDS.* If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

Never use any gas other than dry nitrogen to charge accumulators. See Operation and Maintenance Instruction Manual.

When making pressure checks use the correct gauge for expected pressure. See the Operation and Maintenance Instruction Manual or Service Manual for guidance.

For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Block all wheels before bleeding or disconnecting any brake system lines and cylinders.

Never use make shift jacks when adjusting track tension. Follow the Undercarriage Service Manual.

Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support of the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance work according to local or national requirements.

Always block with external support any linkage or part on machine that requires work under the raised linkage, parts, or machine per local or national requirements. Never allow anyone to walk under or be near unblocked raised equipment. Avoid working or walking under raised blocked equipment unless you are assured of your safety.

When servicing or maintenance requires access to areas that cannot be reached from the ground, use a ladder or step platform that meets local or national requirements to reach the service point. If such ladders or platforms are not available, use the machine hand holds and steps as provided. Perform all service or maintenance carefully.

Shop or field service platforms and ladders used to maintain or service machinery should be constructed and maintained according to local or national requirements.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

In lifting and handling heavy parts, slings must be of adequate strength for the purpose intended and must be in good condition.

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 207 kPa (30 psi) according to local or national requirements.

Wear welders protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding or burning. Wear dark safety glasses near welding. *DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.*

Replace seat belts every two years on open canopy units and every three years on machines with cabs or at change of ownership.

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.

Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazards of electrical shock.

Keep maintenance area *CLEAN* and *DRY.* Remove water or oil slicks immediately.

Remove sharp edges and burrs from reworked parts.

Be sure all mechanics tools are in good condition. *DO NOT* use tools with mushroomed heads. Always wear safety glasses with side shields.

Do not strike hardened steel parts with anything other than a soft iron or non-ferrous hammer.

Do not rush. Walk, do not run.

Know and use the hand signals used on particular jobs and know who has the responsibility for signaling.

SAFETY RULES

Face the access system when climbing up and down.

Apply the parking device and place the transmission in neutral before starting the machine.

Do not bypass the starter safety switch. Repair the starter safety controls if they malfunction.

Fasten seat belt before operating.

Steering should be checked to both right and left. Brakes should be tested against engine power. Clutch and transmission controls should be moved through or to neutral positions to assure disengagement. Operate all controls to insure proper operation. If any malfunctions are found, park machine, shut off engine, report and repair before using machine.

If the power steering or the engine ceases operating, stop the machine motion as quickly as possible. Lower equipment, set parking device and keep machine securely parked until the malfunction is corrected or the machine can be safety towed. Never lift loads in excess of capacity.

Should the machine become stuck or frozen to the ground, back out to avoid roll over.

Know and understand the job site traffic flow patterns.

Keep the machine in the same gear going down hill as used for going up hill.

When roading a machine, know and use the signaling devices required on the machine. Provide an escort for roading where required.

Always use the recommended transport devices when roading the machine.

Do not attempt repairs unless proper training has been provided.

Use extreme caution when removing radiator caps, drain plugs, grease fittings or pressure taps. Park the machine and let it cool down before opening a pressurized compartment.

Release all pressure before working on systems which have an accumulator.

When necessary to tow the machine, do not exceed the recommended towing speed, be sure the towing machine has sufficient braking capacity to stop the towed load. If the towed machine cannot be braked, a tow bar must be used or two towing machines must be used - one in front pulling and one in the rear to retard. Avoid towing over long distances.

Observe proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts.

Always keep the brakes and steering systems in good operating condition.

Replace all missing, illegible or damaged safety signs. Keep all safety signs clean.

Do not fill the fuel tank to capacity. Allow room for expansion.

Wipe up spilled fuel immediately.

Always tighten the fuel tank cap securely. Should the fuel cap be lost, replace it only with the original manufacturers approved cap. Use of a non-approved cap may result in overpressurization of the tank.

Never drive the machine near open fires.

Use the correct fuel grade for the operating season.

MACHINE THEFT AND VANDALISM

ACTIONS TO DISCOURAGE THEFT AND VANDALISM

Immediately upon receipt of a new machine, record the serial numbers of the machine and of all major components and attachments. Keep this list up-to-date as components are replaced or exchanged on the machine. File these numbers in a safe location for fast retrieval.

Report all model, machine and component serial numbers to the insurance company at the time of purchase. If the numbers are noted on the insurance policy, make certain that the numbers are correct.

Remove keys from unattended machines.

Attach, secure, and lock all anti-vandalism and anti-theft devices on the machine.

Lock doors of cabs when not in use.

Immobilize machine by lowering the blade, bucket, or boom to the ground, removing the battery or removing a critical electrical or starting system component.

Discourage the thief! Inspect the gates and fences of the machinery storage yard or construction site. If possible, keep machines in well-lighted areas. Ask the law enforcement agency having local jurisdiction to make frequent checks around the storage or work sites, especially at night, during weekends or on holidays.

Establish liaison with neighbors and ask them to watch equipment left at job sites and report suspicious activities to the applicable law enforcement agency.

Make frequent inventories of machines to promptly detect losses and vandalism.

ACTIONS TO AID IN RECOVERY OF STOLEN MACHINES

Take photographs of the machine for identification purposes.

In the event of theft, immediately notify the law enforcement agency having jurisdiction. Provide the investigating officer with brand name, type of equipment, and serial numbers of the machine and of major attachments and components. It is helpful to show the investigating officer an Operator's Manual, photographs, and advertising to familiarize him with the appearance of the machine.

Report the theft to the insurance company. Provide the model and all serial numbers.

Report the model and serial numbers of the stolen machine to a dealer handling the respective line of equipment. Request that the dealer forward this same information to the equipment manufacturer.

Ask the dealer to post a description of the stolen machine, including serial numbers, and to inform his sales and service personnel.

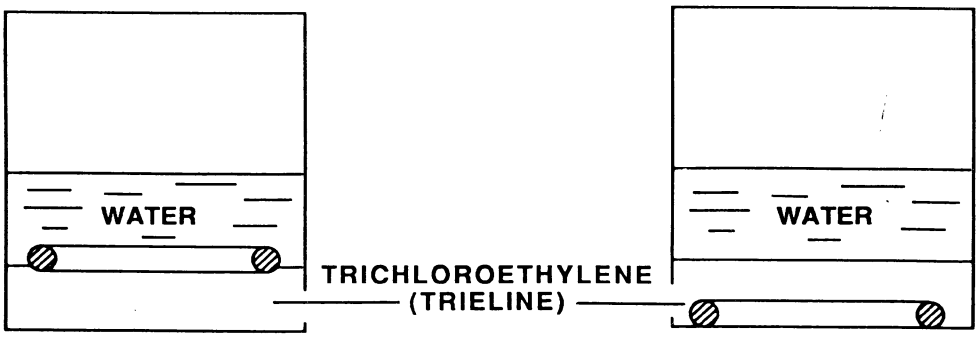
GENERAL NOTES ON SEALS

VITONS SEALS (Fluoro-elastomers).

All VITON seals, the O-rings in particular, are used in applications subject to high service temperatures, because of the satisfactory resistance to heat of this material. However, when Viton is subjected to temperatures exceeding 315° C (in practice, only in case of fires or when oxy-acetylene torches are used) hydrofluoric acid is emitted. This acid is highly corrosive and may cause serious burns when in contact with the skin. Every time an action is needed on components fitted with Viton rings suspected to have undergone exposure to excessively high temperatures, proceed as follows :

1) Visually inspect, without touching them, all seals which appear to be damaged by excessive heat : these would be black and sticky.
2) Assess the material of the seals to identify if they are of Viton by making the test illustrated on the annex using a spare seal.
3) If it is ascertained or positive grounds to suspect that Viton items are involved, the contaminated area MUST BE decontaminated before proceeding with any further servicing.
4) Wear neoprene or PVC gloves and protective goggles or visor. Wash the contaminated area accurately using a calcium hydrate solution (obtainable from tile industries) in water which should have a milky aspect. Rinse thoroughly with steam or running water.
5) Discard safely any removed material and the gloves used: DO NOT BURN.

HOW TO DISTINGUISH THE RUBBER (BUNA N) AND VITON (FLUORO-ELASTOMER) MATERIALS



NITRILE/BUNA N RUBBER

FLOATS

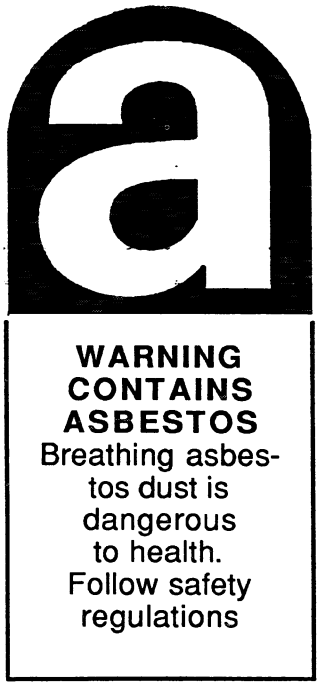
VITON FLUORO-ELASTOMER

SINKS

WARNING

Some components fitted to your vehicle such as gaskets, brake linings, clutch discs, may contain asbestos.

Inhaling asbestos powder is dangerous to health. The following precautions must be observed when working on components containing asbestos :



- Work in the open air or in a well ventilated area.
- Asbestos powder found on the vehicle or produced during operations on the vehicle should be eliminated using extraction methods and not blown or brushed.
- The powder residues must be completely dampened, placed in a sealed container and marked to make sure they are safely eliminated.
- If the components containing asbestos require cutting, drilling or grinding, the part should be dampened first and only manually operated tools should be used or with the motor running at low speed.

1.17 STANDARD PART CLASSIFICATION TO DETERMINE TORQUE DATA

IMPORTANT: When a specific torque is not given the FIAT STANDARD TORQUE CHART should be used after fully indentifying the part.

Part may only be fully identified by the eight-digit code number, as follows:

l / a b c d e / f g

l - Standard part code
Always represented by figure 1. Such a number indicates that the part can be produced in various versions which differ in material and coating.

a-b-c-d-e-Standard part basic number

It always consists in five figures to identify the part in its dimensional characteristics.

f - Material code number
This number represents the material provided for a specific part. Its meaning is indicated in the table below.

g - Coating code number
This number represents the coating provided for a specific part.

1.18 FIAT STANDARD TORQUE CHARTS

When a specific fastener torque is not given, the following charts may be used:

IMPORTANT
- Fasteners with nominal diameter up to 24 mm to be lubricated with engine oil, major diameter fasteners with tallow.

- Torques for cadmium plated fasteners are valid also for not coated parts.

- Nominal torque tolerance is ±5%

- R80, R100, R120 strength classes are to be considered as follows:

10.9 replaces R100
12.9 replaces R120 bolts & screws

10 replaces R80
12 replaces R100 nuts

- Coating abreviation meaning:

CDT = Cadmium plated
FOSF = Phosphatized
ZNT = Zinc plated

Material code (f)	FIAT	Strength class and type of material				
		UNI	DIN	SAE	BSI	BNA
0	R40	4D - 4S - 4A		1	A	42
1	R50	5S - 6S		3	P	56
2	R80	8G		5	T	80
3	R100	100	10K	8	V	100
4	Ottone	Ottone	Messing	Brass	Brass	Laiton
5	Alluminio	Alluminio	Aluminium	Aluminium	Aluminium	Aluminium
6	Rame	Rame	Kupfer	Copper	Copper	Cuivre
7	open to other metallic material					

BOLT AND SCREW TORQUE CHART

)iameter ınd width ıf thread mm	Strength class: 10.9				Strength class: 12.9	
	standard ZNT daNm (*/**) lbs ft (°/°°)	self locking ZNT daNm (*/**) lbs ft (°/°°)	standard CDT daNm (*/**) lbs ft(°/°°)	self locking CDT daNm (*/**) lbs ft (°/°°)	standard FOSF daNm (*/**) lbs ft (°/°°)	self locking FOSF daNm (*/**) lbs ft (°/°°)
M6 x 1	1.3 (9.5/6.5) 9.6 (0.37/0.25)	-	-	-	1.4 (12/8) 10 (0.47/0.31)	-
M8 x 1.25	3.2 (12.5/9) 23 (0.5/0.35)	3.5 (12/8) 26 (0.47/0.31)	-	3 (13.5/9.5) 22(0.53/.037)	3.5 (16.5/11) 26 (0.65/0.43)	3.8 (16.5/11) 28 (0.65/0.43)
M10 x 1.25	-	7.9 (18/12.5) 58 (0.70/0.50)	-	6.5 (18/12.5) 48 (0.70/0.50)	-	-
M10 x 1.5	6.5 (16/11) 48 (0.63/0.43)	7 (15.5/10.5) 52 (0.61/0.41)	-	6 (17/11.5) 44 (0.66/0.45)	7 (21/14) 52 (0.82/0.55)	7.8 (21/14.5) 57 (0.82/0.57)
M12 X 1.25	-	13.9 (23/15.5) 102 (0.90/0.61)	-	11.4 (23/15.5) 84 (0.90/0.61)	-	-
M12 X 1.75	11 (19.5/13.5) 81 (0.76/0.53	12 (18.5/12.5) 88 (0.73/0.50)	-	10.1 (20.5/14) 74 (0.80/0.55)	12 (26/17.5) 88 (1.02/0.68)	13 (26/17.5) 96 (1.02/0.68)
M14 X 1.5	-	22 (26.25/18) 162 (1.04/0.70)	-	18 (26.5/18) 132 (1.04/0.70)	-	-
M14 X 2	18 (23/16) 133 (0.90/0.62)	19 (22/15) 140 (0.86/0.59)	-	16.2 (24/16.5) 119 (0.94/0.65)	19 (30/20) 140 (1.18/0.78)	21 (30/20) 155 (1.18/0.78)
M16 X 1.5	30 (30/20) 221(1.18/0.78)	33 (29/19.5) 243 (1.14/0.76)	25 (31/21) 184 (1.22/0.82)	27 (31/21) 199 (1.22/0.82)	33 (40/26.5) 243 (1.57/1.04)	36 (40/26.5) 265 (1.57/1.04)
M16 X 2	-	-	23 (28.5/19.5) 170 (1.12/0.76)	24.8 (28/19.5) 183 (1.10/0.76)	-	-
M18 X 1.5	45 (34/23) 332 (1.34/0.91)	48 (33.5/22) 354 (1.21/0.86)	36 (35.5/24) 265 (1.39/0.76)	39 (35.5/24) 288 (1.39/0.94)	48 (46/30.5) 354 (1.81/1.20)	52 (46.5/30.5) 383 (1.83/1.20)
M18 X 2.5	-	-	31 (30.5/21) 229 (1.20/0.82)	33.5 (30.5/21) 247 (1.20/0.82)	-	-
M20 X 1.5	60 (38/25.5) 412 (1.50/1.00)	65 (38/25) 479 (1.50/0.98)	50 (39.5/26.5) 369 (1.55/1.04)	-	65 (52.5/34.5) 479 (2.06/1.35)	70 (53/35) 516 (2.08/1.37)
M20 X 2.5	-	-	44 (35/44) 324 (1.37/1.73)	-	-	-
M22 X 1.5	80 (42/28) 590 (1.65/1.10)	90 (42.5/28) 664 (1.67/1.10)	66 (44/29.5) 487 (1.73/1.16)	-	90 (59/38.5) 664 (2.32/1.51)	95 (59.5/39) 700 (2.34/2.32)
M22 X 2.5	-	-	59 (39/26.5) 435 (1.53/1.04)	-	-	-
M24 X 2	100 (44/29.5) 737 (1.73/1.16)	110 (44.5/29.5) 811 (1.75/1.16)	83 (45.5/31) 612 (1.79/1.22)	-	110 (62/40.5) 811 (2.44/1.59)	120 (62/41) 885 (2.44/1.61)
M24 X 3	-	-	74 (41/28) 545 (1.61/1.10)	-	-	-
M27 X 2	100 (54/36) 737 (2.12/1.41)	-	-	-	100 (75/50) 811 (2.95/1.96)	-
M30 X 2	140 (61/40.5) 1032 (2.40/1.60)	-	-	-	150 (85/56) 1106 (3.34/2.20)	-
M33 X 2	190 (68/45) 1401 (2.67/1.77)	-	-	-	200 (95/63) 1475 (3.74/2.48)	-
M36 X 3	240 (71/47) 1770 (2.80/1.85)	-	-	-	250 (97/65) 1844 (3.81/2.55)	-

*/) Minimum thread length in mm, specified for cast iron with 255 N/mm² tensile strength- (/**)Minimum thread length in mm, specificed for steel with 0 N/² tensile strength - (°/)Minimum tread length in inches, specified for cast iron with 37,000 psi tensile strength- (/°°)Minimum tread length in ıches, specified for steel with 74,000 psi tensile strength.

NUTS TORQUE CHART - Unit of measure daNm (lbs ft)

Diameter and width of thread mm	Strength class: 10 (RBO)					Strength class 12 (R100)
	standard ZNT	standard CDT	jam type	with polyamide ring standard	with polyamide ring jam type	standard FOSF
M6 x 1	1.3 (96)	-	-	-	-	1.4 (10)
M8 x 1.25	3.2 (23)	-	*2.6 (19)	*3.9 (19)	*3.2 (23)	3.5 (26)
M10 x 1.25	-	-	*5.2 (38)	*8.2 (60)	*6.2 (48)	-
M10 x 1.5	6.5 (48)	7.2 (53)	*5 (37)	*7.7 (57)	*6 (44)	7 (52)
M12 X 1.25	-	13 (96)	*8.7 (64)	*14.5 (107)	*10.2 (75)	-
M12 X 1.75	11 (81)	-	*8.1 (60)	*12.9 (95)	*9.6 (71)	12 (88)
M14 X 1.5	-	19.5 (144)	*13 (96)	*21.6 (159)	*15 (110)	-
M14 X 2	18 (133)	-	*12.5 (92)	*20 (147)	*14.6 (107)	19 (140)
M16 X 1.5	30 (221)	23.5 (173)	°13 (96)	°26.8 (198)	°16 (118)	30 (221)
M16 X 2	-	23 (170)	°12.5 (92)	°26.5 (195)	°16 (118)	-
M18 X 1.5	45 (332)	34.5 (254)	°19 (140)	°39 (236)	°23.5 (173)	45 (332)
M18 X 2.5	-	32 (236)	°17.5 (129)	°36.5 (269)	°22 (162)	-
M20 X 1.5	60 (442)	46 (339)	°23.5 (173)	°51.7 (381)	°29 (214)	60 (442)
M20 X 2.5	-	44.5 (328)	°21.5 (158)	°50 (369)	°27 (199)	-
M22 X 1.5	80(590)	62 (457)	°32 (236)	-	-	80 (590)
M22 X 2.5	-	61 (450)	°29.5 (217)	-	-	-
M24 X 2	100 (737)	78 (575)	°37 (273)	°85.8 (633)	°45 (332)	100 (737)
M24 X 3	-	76 (560)	°33 (243)	°84 (619)	°41 (302)	-
M27 X 2	95 (700)	-	-	-	-	95 (700)
M30 X 2	130 (959)	-	-	-	-	130 (959)
M33 X 2	170 (1254)	-	-	-	-	160 (1180)
M36 X 3	220 (1622)	-	-	-	-	220 (1622)

*ZNT (Zinc plated) °CDT (Cadmium plated)

CAPSCREW AND TORQUE VALUES

Capscrew Head Markings	SAE Grade Number	Capscrew Size									
		1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Manufacturer's marks may vary		Threads per inch									
		20	18	16	14	13	12	11	10	9	8
		28	24	24	20	20	18	18	16	14	14
	1 or 2	Torque Ft-Lb									
		5	11	18	28	39	51	83	105	160	235
		6	13	20	30	41	55	95	115	175	250
	5	8	17	31	49	75	110	150	270	395	590
		10	19	35	55	85	120	170	295	435	660
	6 or 7	10	19	34	55	85	120	167	280	440	660
		12	21	38	61	95	130	187	300	480	730
 	8	12	24	44	70	105	155	210	375	605	910
		14	27	49	78	120	170	240	420	675	990

Notes:

1. Always use the torque values listed above when specific torque values are not available.
2. Do not use above values in place of those specified in other sections of this manual; special attention should be observed.
3. The above is based on use of clean, dry threads.
4. Reduce torque by 10% when engine oil is used as a lubricant.
5. Reduce torque by 20% if new plated capscrews are used.
6. Capscrews threaded into aluminum may require reductions in torque of 30% of more of Grade 5 capscrews torque and must attain two capscrew diameters of thread engagement.

CAUTION:
If replacement capscrews are of a higher grade than originally supplied, adhere to torque specifications for that replacement.

FOREWORD

This manual describes the components of the basic engine type 8465.21... Please refer to the Service Manual for each specific model equipped with this engine for the related components for each installation.

DESCRIPTION

Engine 8465.21... is of direct injection type supercharged by a turbocharger, and consists of the following.

Engine block in cast iron with seven main bearings and interchangeable wet fitted cylinder liners.

Crankshaft in steel with main journals and crankpins induction hardened, and vibration damper flywheel.

Rod and main bearings consisting of two thin shell half-bearings with antifriction lining, four shoulder half-bearings located on main central support.

Pistons of ellipsoidal shapes in steel, on the crown of which a high turbolence combustion chamber is machined. The pistons are equipped with three rings: the top one is a double-taper ring, the second a straight one, the third one is an oil scraper ring.

Connecting rods in drop-forged steel with fly weights on which operate to obtain weight equality and balance.

Timing system with overhead valves controlled by the camshaft by means of tappets, rockers and rods. The camshaft is fitted laterally in the cylinder block and is rotated by the crankshaft by means of gears.

Forced lubrication through a gear pump controlled by the crankshaft through gears.The lubrication circuit accommodates a heat exchanger and a cartridge filter, with a breather regulator on the rear cover of tappets. On oil filter support are fitted oil pressure relief and by-pass valves.

Forced cooling through a centrifugal pump controlled by the crankshaft via gearwheels. Water circulation is controlled by two thermostats; cooling of cooling fluid is obtained through an upright radiator crossed by an air flow generated by a fan coaxially fitted on the crankshaft.
A water cleaner inhibiting corrosion.

Turbocharger on the exhaust manifold. To compress air into intake manifolds, it uses the energy developed by exhaust gases. It consists of a center housing, a compressor and a turbine. In the center housing is supported the shaft to which ends are connected the turbine and compressor wheels.

Fuel feed by means of feed pump, injection pump, speed governor for all speeds, thermostarter for cold starting, rich mixture control controlled electromagnetically, fuel filter and injectors.

Engine starter by an electric motor controlled by an electromagnet.

SPECIFICATIONS

Type	8460.21.
Cycle	Diesel, 4 stroke, direct injection, supercharged
Number of cylinders	6, in line
Bore	mm 120
Stroke	mm 140
Capacity	cm^3 9500
Compression ratio	16
T.D.C. pressure (*)	kg/cm^2 30
Minimum permissible T.D.C. pressure (*)	kg/cm^2 28
Min. output	rpm 575 ± 25

(*) Pressure is measured with starter-driven engine with oil temperature at 40° to 50°C and injection pump at shut-off.

VALVE GEAR

Inlet opens	27°6′ B.T.D.C.
Inlet closes	35° 39′ A.T.D.C.
Exhaust opens	41° 39′ B.T.D.C.
Exhaust closes	4° 54′ A.T.D.C.
Valve clearance (cold)	
□ inlet	mm 0.25
□ exhaust	mm 0.50

FUEL FEED

Combustion chamber high turbolence in piston crowns, with spray nozzles of BOSCH type	DLLA 150 P99
Firing order reference on pump	1-5-3-6-2-4

FUEL SYSTEM

Lift pump: piston
Fuel filter: paper cartridge
Injection pump:
□ BOSCH, PES 6P 120 A
Gorvened speeds; enrichment jet for cold starting;

SUPERCHARGING

Through turbocharger:
□ HOLSET, type H 2C.

LUBRICATION SYSTEM

Type: forced feed
Pump: Gear, crankshaft driven
Oil filter: Full flow, paper cartridge
Oil pressure (warm)

□ at idle	bar ≥ 1.1
□ at governed speed	bar 4.5 ÷ 6.5.

COOLING SYSTEM

Type: Water
Pump: Centrifugal
Thermostats: Two, side by side on engine water outlet
Fan: viscostatic to cool radiator

Water-oil heat exchanger

FITTING - DATA

DESCRIPTION		mm
ENGINE BLOCK - CONNECTING RODS		
Cylinder sleeve bore dia.		119.990 to 120.015
Standard cylinder sleeve O.D.	to one	137.010 to 137.035
	bottom one	134.000 to 134.025
Cylinder sleeve housing bore dia.	top one	136.975 to 137.000
	bottom one	133.972 to 133.990
Sleeve and housing fit in block	top one	0.010 to 0.060
	bottom one	0.010 to 0.053
Sleeve protrusion from engine block face		0.040 to 0.070
Sleeve protrusione ring thickness		0.08 - 0.10 - 0.12 - 0.14
Camshaft bush housing bore dia.		63.000 to 63.030
Main bearing housing bore dia.		96.000 to 96.022
Standard tappet housing bore dia.		18.000 to 18.027
Big end bore dia.		86.213 to 86.235
Small end bush housing bore dia.		52.000 to 52.025
Big end bearing thickness		2.079 to 2.089
Spare big end bearing undersize range		0.254 - 0.508 - 0.762 - 1.016
Small end bushing fitted I.D.		48.023 to 48.033
Piston pin clearance in smal end bushing		0.030 to 0.048
Bushing clearance in small end		Interference always necessary
Crankpin clearance in big end bearing		0.035 to 0.097
Max. connecting rod misalignment (measured at 125 mm from axes)		0,07
PISTON - PINS - RINGS		
Piston dia. at right angle to pin bore and at 24 mm from base of skirt		119.851 to 119.869
Piston pin bore dia. in piston		47.994 to 48.000
Ring groove width in piston	top groove, double (taper, on 117 mm dia)	3.200 to 3.230
	2nd groove	3.060 to 3.080
	3rd groove	5.030 to 5.050

DESCRIPTION	mm
Ring thickness:	
□ Top compression ring, double taper, chromium plated (measured on 117 mm dia)	3.075 to 3.095
□ 2nd compression ring, straight	2.975 to 2.990
□ Oil scraper ring, slotted, spring loaded	4.975 to 4.990
Piston fit in sleeve (37.5 mm from piston base):	
□ clearance	0.121 to 0.164
Piston pin clearance in piston	0.001 to 0.015
Ring clearance in piston (vertical):	
□ Top compression	0.105 to 0.155
□ 2nd compression ring, straight	0.070 to 0.105
□ Oil scraper ring, slotted, clearance	0.040 to 0.075
Ring gap in sleeve:	
□ Top compression ring, double taper	0.40 to 0.65
□ 2nd compression ring, straight	0.25 to 0.50
□ Oil scraper ring, slotted, assembly clearance	0.30 to 0.45
CRANSHAFT - BEARINGS	
Standard main journal dia.	89.958 to 89.980
Main bearing housing bore dia.	96.000 to 96.022
Standard main journal thickness	2.981 to 2.991
Spare main bearing undersize range	0.254 - 0.508 - 0.762 - 1.016
Standard crankpin dia.	81.978 to 82.000
Main journal - bearing fit:	
□ clearance	0.038 to 0.102
Center main journal width (among thrust washers)	55.940 to 56.000
Center main bearing housing width among thrust washer faces	48.000 to 48.050
Center main bearing housing width over thrust washers	55.740 to 55.890
Standard thrust washer thickness	3.870 to 3.920
Oversized thrust washer thickness	0.127 - 0.254 - 0.508
Crankshaft washer thrust and center bearing:	
□ clearance	0.050 to 0.260
Max. main journal misalignment (total gauge reading)	0.05
Max. crankpin misalignment vs. main journals	±0.25
Max. main journal and crankpin ovalization after grinding	0.010
Max. main journal and crankpin taper after grinding	0.010

DESCRIPTION	mm
CYLINDER HEAD	
Valve guide housing in head	16.000 to 16.018
Valve guide O.D.	16.028 to 16.039
Valve guide fitted I.D.	9.025 to 9.045
Valve guide interference fit in head	0.010 to 0.039
Valve stem dia.	8.980 to 8.995
Valve stem in guide: □ clearance	0.030 to 0.065
Valve seat angle { Inlet Exhaust	60° 45°
Valve face angle { Inlet Exhaust	60° 15′ + 15′ 45° 15′ + 15′
Max. valve stem distorsion over one complete revolution with dial gauge stylus in midstem position	0.04
Valve seat width	~4
Valve seat O.D. { Inlet Exhaust	51.070 to 51.085 44.060 to 44.015
Valve seat I.D. { Inlet Exhaust	50.995 to 51.020 43.985 to 44.075
Valve seat interference fit in head { Inlet Exhaust	0.050 to 0.090 0.045 to 0.090
Valve fitted depth in cylinder head	0.35 to 0.60
Max. allowed valve fitted depth after overhaul	0.80 to 1.05
Spray nozzle protrusion in cylinder head	3.1 to 3.9
VALVE SPRINGS	
Free spring height	83.3
Spring height under 52 ± 2 kg	53
Spring height under 78.75 ± 3 kg	40
VALVE GEAR	
Camshaft bushing dia.	65.000 to 65.030
Bushing fit in housing	Interference always necessary
Bushing fitted I.D. after reaming	62.000 to 62.030
Camshaft journal dia. □ front □ intermediates and rear	 61.910 to 61.940 61.870 to 61.900
Camshaft journal fit in bushing: □ clearance { front intermediate and rear	 0.060 to 0.120 0.100 to 0.160

DESCRIPTION	mm
Cam lift - intake and exhaust	8
Standard tappet housing dia.	18.000 to 18.027
Standard tappet O.D. { measured at top and bottom measured at the middle	17.860 to 17.892 17.938 to 17.970
Spare tappet oversize range	0.5 - 1
Tappet fit in housing (at tappet max. dia.): □ clearance	0.030 to 0.089
Rocker shaft dia.	24.015 to 24.036
Rocker shaft housing dia.	24.060 to 24.080
Rocker housing fit in rocker shaft: □ clearance	0.024 to 0.065
Camshaft retaining plate thickness	7.760 to 7.820
Camshaft retaining plate housing width (after fit)	7.950 to 8.100
Camshaft end float	0.130 to 0.340
INJECTION PUMP CONTROL SUPPORT	
Bush housing dia. in gear shaft support controlling injection pump	70.850 to 70.890
Bush housing I.D. in gear shaft support controlling injection pump	65.060 to 65.090
Injection pump gear shaft dia.	65.000 to 65.030
Bush fit in support housing	Interference always necessary
Injection pump gear shaft bushing fit in shaft □ clearance	0.030 to 0.090
OIL PUMP	
Driving shaft bushing seat dia. in pump housing and cover	30.000 to 30.033
Bushing I.D. after fitting	27.000 to 27.033
Gear shaft O.D.	26.959 to 26.972
Driving gear I.D.	26.923 to 26.944
Bush and seat fit in pump cover and housing	Interference always necessary
Shaft fit in bushing: □ clearance	0.028 to 0.074
Driving shaft interference fit in gear	0.015 to 0.049
RELIEF VALVE	
Opening star pressure	5 bar
OVERPRESSURE VALVE	
Opening start pressure	8 bar
SPRING FOR RELIEF AND OVER PRESSURE VALVES	
Height of released spring	79.2
Height of spring under load of hg { 14.1 ± 0.7 8.8 ± 0.4	58 66

INCONVENIENCE	POSSIBLE CAUSE	ACTION
The engine doesn't start	Batteries partially down.	Check batteries and recharge them if necessary, replace them.
	Battery terminals connections worn-out loose.	Clean, check and tighten nuts of battery terminals. Replace tag terminals and nuts if excessively corroded.
	Injection pump timed erroneously.	Check and time injection pump.
	Deposits or water in fuel lines.	Disconnect lines and clean with air blows. Remove and clean injection pump. Dry fuel tank and refuel.
	Fuel reserve insufficient.	Refuel.
	Fuel feed pump defective.	Overhaul or replace pump.
	Air bubbles in fuel lines or injection pump.	Inspect lines and feed pump for possible air; purge air from injection pump unscrewing the suitable plug and manually operating feed pump.
	Defective starter.	Repair or replace starter.
	Thermo-starter inefficient.	At low temperature, use thermostarter. Replace it, if inefficient.
The engine stops	Idle speed too low.	Control through adjusting screw.
	Uneven injection pump deliveries.	Set deliveries. Replace plunger spring, if broken. Replace tappet, plunger and barrel if seized or no sealing.
	Foreign matter or water in fuel lines.	Disconnect lines, clean with compressed air. Remove and clean injection pump. Clean fuel tank and refuel.
	Fuel filters clogged.	Disconnect filters; replace, if necessary.
	Abnormal valve-rocker clearance.	Adjust valve-rocker clearance.
	Valves burnt, worn-out or cracked.	Replace valves.
	Air present in feed and injection systems.	Check lines for cracks or loose joints. Replace worn-out parts, then bleed air from lines and remove air from injection pump and fuel filter by unscrewing the suitable plugs and manually acting on feed pump.
	Fuel filter and feed pump valves clogged.	Replace fuel filter and overhaul feed pump valves.
	Injection pump controls broken.	Replace defective parts and check pump timing.

INCONVENIENCE	POSSIBLE CAUSE	ACTION
The engine warms up excessively	Water pump defective.	Replace assembly.
	Thermostats damaged.	Valve stem jammed in its guide. Replace.
	Radiator partially inefficient.	Remove possible scales thorougly washing with a scales remover, following inherent directions carefully. Inspect and repair possible leaks from radiator tubes.
	Scales in water inlet in head and engine block.	Thoroughly wash following scales remover directions carefully.
	Cooling fluid level too low.	Top up radiator.
	Uncorrect engine timing.	Check timing and correct it.
	Pump over or under-calibrated.	On test bench correct pump delivery so that injection ca take place at prescribed delivery.
	Air cleaner clogged.	Clean air cleaner and inherent system.
The engine loses power and runs unevenly	Uncorrect injection pump timing.	Check timing and position pump correctly.
	Excessive wear in injection pump plungers and barrels.	Overhaul injection pump and replace worn-out parts.
	Uncorrect calibration of speed governor.	Check and exactly calibrate speed governor.
	Nozzles partially clogged or injector operations defective.	Clean nozzle holes with suitable tools and totally overhaul injectors.
	Foreign matter or water in injection and feed system.	Thorougly clean and refuel.
	Feed pump defective.	Disassemble fuel feed pump and replace as necessary.
	Uncorrect valve - rocker clearances.	Check clearace and adjust.
	Compression loss.	With tool 99395682 check cylinder pressure equality at TDC and pressure value.
	Turbocharger defective.	Overhaul or replace the unit.

INCONVENIENCE	POSSIBLE CAUSE	ACTION
The engine loses power and runs unevenly	Air cleaner clogged.	Clean air cleaner and inherent system.
	Too low tie rods between accelerator pedal and governor lever.	Adjust tie rod so that the control lever can attain its max. range position.
	Uncorrect adjustment of injection pump set screw or of push rod lever stop.	Correctly adjust stop devices.
The engine has abnormal knocks	Defective injector operations.	Check that the pin in nozzle spray is not causing resistance and that calibration value is as prescribed.
	Fuel lines clogged.	Remove lines and clean. Replace those too much dented.
	Uncorrect injection pump position.	Correct pump position so that injection can take place at required advanced angles.
	Crankshaft knocks due to excessive main bearing or big end bearing end float or too high thrust clearance.	Grind crankshaft journals and fit undersized bearings. Replace bearing valves with oversized ones.
	Crankshaft unbalanced.	Check for crankshaft misalignment; correct, if necessary, and check balance.
	Flywheel capscrews loose.	Replace loose screws and tighten to required torque.
	Connecting rod misalignments.	Straighten connecting rods using a hydraulic press and check axle parallelism.
	Piston slaps.	Replace sleeves and pistons.
	Piston pins noisy because of excessive clearance in piston hubs & connecting rod bushes. Loose bushings in connecting rod seat.	Replace piston pin and connecting rod bushings and also piston if necessary. Replace bushings with new ones.
	Tapping due to noisy valve system.	Adjust clearance between valves and rockers; check that there are no broken springs and there is not excessive clearance between stems and guides or tappets and seats.
The engine smokes abnormally **1) Black or dark gray smokes**	Excessive max. pump delivery.	Disconnect pump and adjust delivery as per data in calibration table.
	After starting, the excess fuel device doesn't come back to rest position.	Check and, in case, replace excess fuel device.
	Injection pump excessively retarded.	Correct position.
	Injection pump excessively advanced.	Correct position.

INCONVENIENCE	POSSIBLE CAUSE	ACTION
1) Black or dark gray smokes	Nozzle holes (or some of them) partially or totally clogged.	Replace nozzles with a series of new injectors, or clean and recondition the original ones using suitable tools.
	Air cleaner clogged or damaged.	Clean or replace filter cartridge.
	Nozzle needle desultorily jammed in open position.	Inspect injectors; check for jammed needles, or broken springs be sure that calibration is not too low.
	Governor adjustment higher than maximum allowed.	Bench adjust governor, according to table data.
	Nozzle sprays are directed to the head because the injector has been fitted erroneously.	Verify nozzle protrusion as to head face.
	Excessive injector needle lift due to abnormal wear.	Replace anomalous nozzle.
	Loss of engine compression due to: □ piston rings stuck; □ sleves worn-out; □ valves damaged or valve timed uncorrectly.	Overhaul engine or limit repair action to the concerned parts.
	Improper injector type, or injectors of different types, or uncalibrated.	Replace injectors.
	Injection lines of improper I.D., or pipe ends squashed due to repeated jams.	Verify conditions of ends and connections; in case replace pipes.
2) Blue or blue/ gray smoke, or gray smoke verging on white:	Excessive injection lag.	Correct injection pump position.
	Injector needles jammed or defective injectors.	Be sure that the needle is not jammed or the spring is not broken.
	Oil seeps through piston rings because the rings are jammed or sleeve walls are worn-out.	Overhaul engine.
	Engine oil goes through intake valve-guides due to valve stem or valve guide wears.	Re-grind cylinder heads.
	Engine too cold (thermostat blocked or not present)	Replace thermostat.

INCONVENIENCE	POSSIBLE CAUSE	ACTION
The engine does not stop	Governor broken.	Unscrew the joint connecting fuel delivery line; then repair as required.
	Delivery push rod seized.	Unscrew the joint connecting fuel delivery line and repair as required.
	Resistance in push rod motion.	Clean push rod housing, also verifying if the malfuction is due to a not well performed fitting.
	Governor parts cause resistances.	Remove any cause of resistance from governor sleeve and control lever.
	Excessive clearance in governor parts.	Take up clearances, only leaving min. tolerances; in case replace too worn-out components.
INJECTION PUMP Difficult starting	Electromagnet for extra power supply.	Check electric connections on electromagnet control switch.
	Atmospheric air inlet release solenoid valve to thermo-starter tank.	Check operation.
	Air in fuel feed system.	Use specific manual pump to bleed system until Diesel fuel only comes out from bleed screw.
	Clogged fuel filters.	Replace filters. Clean filter located near manual blead pump.
	Injector nozzles seized or clogged.	Check injectors; overhaul or replace nozzles and calibrate.
	Pump erroneously keyed on engine.	Check that static keying of injection pump on engine has been carried out correctly.
	Starting deliveries do not correspond to calibration table.	Install injection pump on test bench and check enrichment deliveries.
Uncorrect idle speed	Accelerator control lever stop screw.	Carry ont exact adjustment with vehicle running at idle speed.
	Linkages.	Check linkages from accelerator pedal to attachment on governor control lever and eliminate possible hardened points.
Uneren idle speed	Erroneously calibrated injectors or jammed / clogged nozzles.	Check injectors; overhaul or replace nozzles and calibrate.
	Speed governor.	On test bench, check exact positioning and operation of speed governor.
	Idle speed deliveries nueven.	Check on test bench and adjust if necessary.

INCONVENIENCE	POSSIBLE CAUSE	ACTION
Low performance	Clogged fuel filters.	Replace filters, clean filter on manual bleed pump and on tank float.
	Air filter dirty.	Look at telltale to check cartridge is not clogged; clean or replace if necessary.
	Erroneously calibrated injectors or jammed / clogged nozzles.	Check injectors; overhaul or replace nozzles and calibrate.
	Pump erroneously keyed on engine.	Check that static keying of injection pump on engine has been correctly carried out.
	Injection pump delivery insufficient.	Remove injection pump from engine and check exact calibration on test bench.
Excessive exhaust fumes when engine is cold	Pump erroneously keyed on engine.	Check that static keying of injection pump on engine has been carried out correctly.
	Erroneonsly calibrated injectors or jammed / clogged nozzles.	Check injectors; overhaul or replace nozzles and calibrate.
	Insufficient pressure at end of compression stroke.	Check using motometer.
Excessive exhaust fumes (black) with fully - loaded engine	Excessive fuel delivery to engine.	Check max. output on test bench.
	Low air intake.	Check telltale to verify filter condition.
	Pump erroneously keyed on engine.	Check that static keying of injection pump on engine has been carried out correctly.
	Erroneously calibrated injectors or jammed / clogged nozzles.	Check injectors; overhaul or replace nozzles and calibrate.
Excessive fuel consumption	Fuel leakes.	Check pipes and unions.
	Air filter dirty.	Look at telltale to check cartridge is not clogged; clean or replace if necessary.
	Erroneously calibrated injectors or jammed / clogged nozzles.	Check injectors; overhaul or replace nozzles and calibrate.
	Erroneously calibrated injection pump.	Check and time injection pump on test bench.
	Pump erroneously keyed on engine.	Check that static keying of injection pump on engine has been carried out correctly.