FIATALLIS®

FR160.2

WHEEL LOADER

S/N 582101-UP

SERVICE MANUAL

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V/1996

FR160.2

WHEEL LOADER

Service Manual

Print N° 604.02.207 English

⚠ THIS ALERT SYMBOL SIGNALS IMPORTANT MESSAGES INVOLVING YOUR SAFETY.

Read and heed carefully the safety instructions listed and follow the precautions recommended to avoid potential risks and to safeguard your health and your safety.

You will find this symbol in the text of this Manual referred to the following key words:

***WARNING*- Cautions directed to avoid improper repair interventions involving potential consequences for the operator's safety.**

***DANGER*- These warnings qualify specifically potential dangers for the safety of the operator or other persons directly or indirectly involved.**

IMPORTANT NOTICE

All maintenance and repair interventions explained in this Manual **must be performed exclusively by the Service Organization of the Manufacturer,** observing strictly the instructions explained using, whenever necessary, the recommended specific tools.
Whoever performs the operations reported without following exactly the precautions is responsible on his own, for the damages that may result.

Neither the Factory nor any Organizations in its Distribution Network, including but not limited to national, regional or 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 products manufactured or merchandized by the Factory.
In any case, no warranty of any kind is made or shall be imposed with respect to products manufactured or merchandized by the Factory, when failures are caused by the use of parts and/or components not approved by the Factory.

AVOID ACCIDENTS

Most accidents and injuries occurring in industry, on the farm, at home or on the road, 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 taking the necessary precautions, before the accident occurs.

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

A careful operator is the best insurance against accidents. The complete observance of one simple rule would prevent many thousands serious injuries each year.

This rule is: Never attempt to clean, lubricate or adjust a machine while it is in motion.

WARNING

On machines having hydraulically, mechanically and/or cable controlled equipment (such as showels, loaders, dozers, scrapers etc.) be certain the equipment is lowered to the ground before servicing, adjusting and/or repairing.

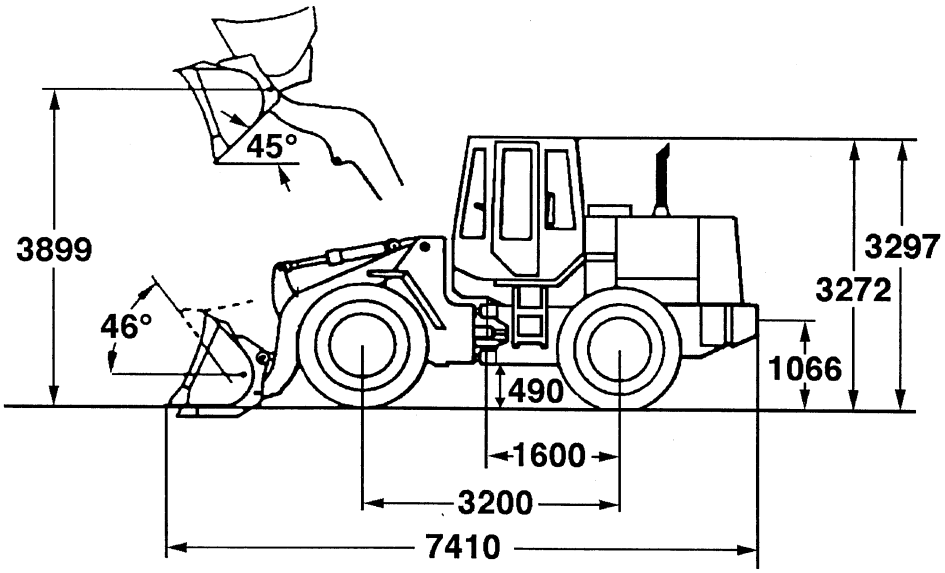
If it is necessary to have the equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and/or mechanical device used for controlling the equipment.

SUMMARY

TECHNICAL SPECIFICATIONS

FR160.2

MAIN DIMENSIONS



IDENTIFICATION - 2611.200.00.3

MARKING - R 160.2

ENGINE

Brand and model ..... Iveco-Fiat 8365.25.584
Type ..... diesel, 4 stroke, injection, turbocharged
Number of cylinders 6
Bore and stroke ..... 115 x 130 mm
Total displacement ..... 8102 cucm
Compression ratio ..... 15.8 : 1
Net power at flywheel ..... 191 CV / 140 KW
Max. torque speed ..... 1400 rpm
Max. power speed ..... 2150 rpm
Injector setting ..... 200 ÷ 208 bar

Valve/rocker arm clearance:
intake / exhaust ..... 0.3 / 0.5
Firing order 1-5-3-6-2-4

ENGINE SPEEDS

Low idle ..... 870 ÷ 920 rpm
Max. idle ..... 2360 ÷ 2420 rpm
Converter stall ..... 2210 ÷ 2350 rpm
Equipment stal ..... 2230 ÷ 2370 rpm
Full stall ..... 1680 ÷ 1880 rpm

Minimum starting temperature:
standard version ..... - 15°C
with cold starting version ..... - 25°C
Setting of engine coolant high temperature sender ..... 107 ± 3°C
Setting of engine oil low pressure switch and hourmeter drive ..... 0.4 ± 0.2 bar
Setting of engine oil resistor for pressure gauge ..... 0 ÷ 8 bar

Engine lubrication:
Normal lubrication pressure with engine max. power output and stabilized temperature ..... 4 ÷ 8 bar
Stabilized engine oil temperature with engine max. power output: 95 ÷ 105°C (203 ÷ 220°F) + ambient temperature.

TORQUE CONVERTER

Type ..... single stage, single phase type
Conversion ratio at stall ..... 2.57 : 1
Converter main pressure ..... 2.5 ÷ 5.0 bar
Converter safety valve pressure ..... 8 bar

TRANSMISSION

Down-shift device for down-shifting of speeds and use of engine brake with machine travelling down-hill.

Forward speed	Km/h	Reverse speed	Km/h
1°	6.96	1°	6.96
2°	12.46	2°	12.46
3°	24.49	3°	24.55
4°	39.94	–	–

With tyres ..... 23.5 x 25
A safety device prevents the starting of the engine with a speed engaged.
Transmission pump delivery ..... 97 Ltr/min (25.6 USGal/min) at 2150 r.p.m.
Main pressure ..... 16 ÷ 18 bar
Transmission oil temperature ..... 70 ÷ 90°C (158 ÷ 194°F)
Pressure reduction valve ..... 10 bar
Transmission oil filters (q.ty 2) one paper and one metal.
Setting distance between induction sensors on transmission and gear teeth ..... .5 ÷ .8 mm
Setting of transmission oil low pressure switch ..... 11.5 ± 0.5 bar
Setting of transmission oil high temperature sensor ..... 119 ± 3°C (248 ± 3°F)
Transmission oil low pressure time ..... 5 ÷ 7 sec.s

AXLES

Front axle, rigid supportin type
Reduction ratio ..... 1 : 21.700
Rear axle, full-floating supporting type
Reduction ratio ..... 1 : 21.700
Axles complete with oil bath disc brakes.
Super Max-Trac self-locking differentials.
Planetary reduction gears in wheel hubs.

Tyres:
Type ..... tubeless
Radials ..... 23.5 x 25 XHA
Inflation pressure ..... (bar)
Operation ..... front: 3.00.....rear: 2.00
Travel ..... front: 2.00.....rear: 2.00
Wheel tightening torque ..... 60 daNm

BRAKES

Brakes pump delivery ..... 8.17 Ltr/min (3.0 USGal)
Operation pressure ..... 65 bar
Accumulators recharge starting pressure ..... 115 ÷ 121 bar
Accumulators recharge ending pressure ..... 150 ÷ 160 bar
Accumulators precharge pressure ..... 60 bar (2 Ltr)
Accumulators precharge pressure ..... (0.7 Ltr)

Setting of brakes oil low pressure sensor ..... 95 ± 5 bar
Setting of stop lights pressure switch ..... 1.8 ± 0.5 bar
Transmission cut-off pressure ..... 15 ± 1 bar
Setting of parking brake engaged sensor ..... 60 ± 5 bar
Setting of transmission cut-off pressure switch ..... 15 ± 1 bar

STEERING SYSTEM

Pump delivery
(at 100 rpm - 7 bar) ..... 170 cucm/turn
Max. operating pressure ..... 185 bar
Cylinders 2
Bore x rod diameter x stroke ..... 80 x 45 x 440

Emergency pump:
Gear type, driven by transmission
Setting of priority valve ..... 185 bar
Setting of emergency steering pump low pressure switch ..... 0.8 ÷ 1.2 bar
Setting of steering main pump low pressure switch ..... 0.8 ÷ 1.2 bar
Emergency steering timer ..... T = 5 ÷ 7 sec.s

EQUIPMENT HYDRAULIC SYSTEM

Type:
Sealed with anticavitation and safety valve
Pump ..... vane, double body
- delivery at 2150 engine r.p.m. ..... 250 Ltr/min (66 USGal/min)
- max. operating pressure ..... 200 bar
Control valve ..... 3 spools
Control ..... piloted, single lever

Hydraulic cylinders, double-stroke:
- boom 2
- bore x rod diameter x stroke ..... 140 x 70 x 901
- bucket control 2
- bore x rod diameter x stroke ..... 140 x 70 x 555

Eqipment operation times:
- raise ..... 6.3 sec.
- lowering ..... 2.8 sec.
- dumping ..... 1.3 sec.
Setting of oil filter clogging sensor equipment ..... 2 ÷ 2.2 bar
Setting of oil high temperature sensor equipment ..... 97 ± 3 °C

ELECTRICAL SYSTEM

Operation voltage ..... 24 V
Batteries, in series 2
Type ..... maintenance-free
Starter motor with automatic engagement pinion ..... 7.5 KW
Alternator with voltage regulator ..... 55 A

FLUID CAPACITIES

Engine:
Lubrication oil ..... 17 Kg
Coolant ..... 44 Ltrs
Fuel ..... 286 Ltrs

Transmission:
Torque converter oil ..... 20 Ltrs
Hydraulic system ..... 112 Ltrs

Axles:
Front ..... 39 Ltrs (10.3 USGal)
Rear ..... 30 Ltrs (7.9 USGal)

CAB

Modular type cab, elastically suspended by elastic pads, integrated with safety structure.

WEIGHT

The weight of the machine with 23.5 x 25 tires and 2.8 cum (3 cuyd), filled and with operator ..... 15730 Kg

OPTIONALS

Electronic Load Travel Stabilizer (LTS). The controls switch ON can have two positions.

Position 0: OFF

Position 1: LTS engaged for speeds over 5 km/hour (3.1 mph).

Position 2: (to be used only for maintenance or repair operations) - LTS permanently ON with speeds lower than 5 km/hour.

SAFETY RULES

GENERALITIES

Study this Manual before starting, operating, maintaining, fuelling or servicing the machine.

Read and heed all safety rules before any intervention.

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

Do not wear rings, wrist watches, jewellery, loose or hanging apparels, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as recommended for the job. Examples: hard hat, heavy gloves, ear protection, safety glasses or goggles, reflector vests, respirator. Consult your employer for specific safety equipment requirements.

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.

Do not jump on or off the machine. Keep two hands and one foot, or two feet and one hand in contact with step 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.

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.

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.

Do not leave the machine until it is completely stopped.

Check the seat safety belt at least twice a year. If there are signs of wear or fraying or other signs of weakness that could lead to failure, replace it.

STARTING

NEVER START OR OPERATE AN UNSAFE MACHINE. Before operating a machine, always ensure 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 conditions.

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

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

Fasten your seat belt (when provided).

Obey all flag signals and signs.

Due to the presence on the machine of flammable fluids, never check or fill fuel reservoirs or batteries near open flames, smoking materials or sparks.

REMEMBER THAT STARTING FLUID IS FLAMMABLE. Follow recommendations printed on containers and in the Operation and Maintenance Manual.

DO NOT PUNCTURE OR BURN CONTAINERS.

Containers must be stored in fresh, well ventilated places, out of reach of unauthorised persons. Follow strictly the instructions provided by the Manufacturer.

Never use these preducts near open flames, smoking materials or sparks.

OPERATING

Check the fasteners of wheels and rims before starting a working shift. If necessary, retighten to the prescribed torque.

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

Roll Over Protective Structures are required on loaders, dozers, graders, excavators. NEVER OPERATE machines without ROPS.

Make sure the Operator's compartment is free of foreign objects, especially if not firmly secured. Never use the machine to transport objects, unless proper securing points are provided.

DO NOT CARRY RIDERS ON MACHINE.

Study and familiarize with escape routes alternate to normal exit routes.

Seat belts are required to be provided with Roll Over Protection Structures or cabs. Keep safety belts fastened around you during operation.

For your personal protection, do not climb on or off machine while machine in motion.

Make sure that exposed persons in the area of operation are clear of the machine, before starting the engine and

SAFETY RULES

operating the equipment. Obey all indications provided by flags and signals.

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

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

Do not operate machine with brakes out of adjustment.

Operate the machine at speeds slow enough to ensure complete control at all times.

Travel slowly over rough terrain, on slopes or near drop-offs, in congested areas or on ice or slippery surfaces.

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. STOP THE MACHINE.

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

Maintain clear vision of areas of travel or work. Keep cab windows clean and repaired.

When machines are operating in tandem, the pusher (rear) must be equipped with the appropriate deflectors to protect the unit in front from the air stream coming from the radiator.

When pulling or towing through a cable or chain, do not start suddenly at full throttle; take-up slack carefully.

Inspect carefully for flaws or troubles before using.

Avoid kinking chains or cables. Do not pull through a kinked chain or cable to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chains or cables.

Be sure chains and cables are anchored and the anchor points are strong enough to handle the expected load. Keep exposed personnel clear of anchor points and cables or chains.

DO NOT PULL UNLESS OPERATOR's COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.

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

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

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

On machines supplied with suction radiator fans, be sure to periodically check engine exhaust parts for leaks, as exhaust fumes are dangerous to the operator.

Operators must know thoroughly the performances of the machine they are operating. When working on slopes or near sudden level drops of the terrain, avoid areas where ground is loose or soft since rolling-over or loss of control of machine could result.

Where noise exposure exceeds 90 dBA for 8 hours, wear approved ear protection.

When counterweights are provided, do not work machine if they have been removed.

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

The bucket load must always be properly arranged; move with extreme care when transporting oversized loads.

Use only the type of bucket recommended for the machine and the materials to be handled. Follow the recommendations for the loading capacity and the arrangement of the materials, the specifications of the terrain and the job to be performed.

Do not lift and haul loads overhead where persons are standing or working, or downhill when working on slopes; in the latter case, the bucket must be unloaded on the uphill side, whenever possible.

With a full bucket, start and stop the machine carefully; avoid starting without first reducing the engine r.p.m.

Overtaking manoeuvres must be performed only when absolutely necessary and unavoidable. Beware of possible uneven terrains, poor visibility conditions, the presence of other machinery or persons out of sight.

Operate the machine at a speed adequate to the working conditions in the site and slow enough to ensure complete control at all times.

Check monitoring instruments at start-up and frequently during operations. In case of abnormal condition warnings, stop immediately the machine.

Never use the bucket as a man lift or to carry riders.

Never use the machine as a work platform or scaffolding, nor other inappropriate operations (i.e. pushing railway cars, trucks or other machines).

Be alert of people in the operating area of the machine. Load trucks from the driver's side whenever possible.

When operating a machine, know what clearances will be encountered, overhead doors, cables, pipes, bearing load limitations of ground, bridges, floors or ramps.

SAFETY RULES

When roading, find-out what conditions are likely to be encountered, clearances, traffic congestion, type of road surfacing, etc. Beware of fog, smoke or dust elements that obscure visibility.

When crossing gullies or ditches, move at an angle with reduced speed after ensuring ground conditions will permit a safe traverse.

Explore the working area to identify potential risks such as: slopes, overhangs, pits, demolition rubble, fires, ravines, ditches, soft terrain, heavy traffic, crowded parking areas, closed ambients. In such conditions, proceed with extreme care.

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

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

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

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

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

Avoid operating equipment too close to an overhang 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 undergrowth of these danger.

When pushing-over trees, the machine must be equipped with proper overhead 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.

NEVER DRIVE QVER THEM or other surface irregularities that brake traction with the ground, especially when on slopes or near drop-offs.

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.

Working in virgin and rough terrains is characterized by the presence of all the perils and risks listed above. In these conditions, it is emphasised the danger represented by large tree limbs (possibly falling on the machine), large roots (acting as a leverage under the machine when up-rooted causing the roll-over of the unit) etc.

STOPPING

When the machine is stopped for whatever reason, follow the instructions of chapters **"Stopping the machine"** and **"Stopping the engine"** of the Operation and Maintenance Instruction Manual.

Always remember to position the transmission drive control in neutral and engage the control lock to secure the machine.

Set parking brake (when provided).

NEVER LEAVE THE MACHINE UNATTENTED with the engine running. Always before leaving the operator's seat and after making sure all people are clear of the machine, slowly lower the attachments or tools flat to the ground in a positive ground support position.

Park in a non- operating and no-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 movements. Set parking brake.

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

Keep head, body, limbs, hands and feet clear of the dozer, arms, bucket or ripper in lifted position.

Always disconnect the master switch before any intervention (i.e. cleaning, repairing, maintaining, refuelling etc.). Do the same when parking for prolonged periods of time to avoid accidental or unauthorized starting.

Never lower attachments or tools other than seated in operator's seat. Sound horn. Make sure area near the attachment is clear. Lower the attachment slowly. DO NOT USE FLOAT POSITION of hydraulic system.

Securely block the machine and lock it every time you leave it unattended. Return keys to authorized security. Heed all shut-down operations of the Operation and Maintenance Instruction Manual are followed. Every time you leave the machine, engage parking brake (if equipping unit).

MAINTENANCE

GENERALITIES

Before operating or performing any intervention on the machine:
- read carefully all the rules contained by this Manual;
- read and obey all safety related plates and instructions located on the machine.

SAFETY RULES

Do not allow unauthorized personnel to perform any maintenance operation. Do not perform maintenance operation without prior authorization. Follow all recommended maintenance and service procedures.

Keep operator's compartment free of all loose objects that are not properly secured.

Do not wear rings, wrist watches, jewellery, loose or hanging apparels, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as recommended for the job. Examples: hard hat, heavy gloves, ear protection, safety glasses or goggles, reflector vests, respirator. Consult your employer for specific safety equipment requirements.

Do not perform any service operation on the machine with a person seated in the operator's compartment, unless he is an authorized operator co-operating in the operation to be performed.

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.

Keep shoes free of mud or grease before climbing or driving the machine.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat.

Never stand under the boom.

When maintenance operations require moving hydraulically operated attachments by means of machine's hydraulic system remember that all manoeuvres must be made only when seated in the operator's seat. Before starting machine or moving attachment or tools, set brakes , sound horn and call for an all clear. Raise attachment slowly.

Always lock by means of outside devices the machine arms or parts that must be lifted for intervention, while your are below. Do not allow to anybody to pass near or even below the lifted, and not locked device. If you are not absolutely sure about your safety, do not stay below the lifted device, even if it is locked.

Do not place head, body, limbs, feet, hands and fingers near rotating fans or belts, or cutting parts of the machine, unless they are suitably and safely locked.

Never perform interventions with engine running, except as called for in a Manual. Do not wear loose clothing or jewellery near moving parts.

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

Shop and/or field service platforms or ladders must be constructed and maintained in accordance with local and national regulations.

Disconnect batteries and TAG all controls according to current regulations to warn that work is in progress. Block machine and all attachments that must be raised according to current regulations.

Due to the presence of flammable fluids, never check or fill fuel tanks, batteries, nor use starting fluid near lighted smoking materials or open flames.

Do not check or fuel the tanks, batteries and accumulators, nor use the starting liquid if you smoke or near open flames. These fluids are flammable!

BRAKES ARE INOPERATIVE when manually released for servicing. Provisions must be made to maintain control of the machine by blocking or other means.

The fuel filling nose must be kept constantly inside the filling neck. Keep this contact from the beginning to the end of the fuelling operation to avoid the possibility that sparks due to static electricity are generated.

Use only designated towing or attaching points. Use care in making attachments. Make sure pins and/or locks are secure before pulling. Stay clear of drawbars, cables or chains under load.

To move a disabled machine, use a trailer or a low-boy, if available. In case towing is needed , use all necessary signals required by local and national regulations, and follow the directions provided in this Manual.

To load/unload a machine from transporter, choose a level surface ensuring firm support to the wheels of truck or trailer. Use strong access ramps, with adequate height and angle. Keep surface free of mud, oil or slippery materials.

Anchor the machine securely to the bed of truck or trailer and block wheels or tracks with appropriate wedges.

Never align holes with fingers or hands; always use appropriate aligning tools.

Eliminate all sharp edges and burrs from re-worked parts.

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

Lift and handle 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.

Never pour gasoline or diesel fuel into open, wide and low containers. Never use gasoline, solvent or other flammable fluid to clean parts. Use exclusively qualified, non-flammable, non-toxic commercial solvents.

When using compressed air for cleaning parts, used safety glasses with side shields or goggles. Limit pressure to 2 bar, in accordance with local and national regulations.

SAFETY RULES

Do not run the engine in closed areas without proper ventilation to remove deadly exhaust fumes.

Do not smoke or permit any open flames or spark near when re-fuelling or handling flammable materials.

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

Make sure that all mechanic's tools are in good conditions. NEVER USE tools with mushroomed heads or frayed. Always wear eye protections.

Move with extreme care when working under the machine, its attachments and or on or near them. Always wear protective safety equipment as required, such as hard hat, goggles, safety shoes, ear plugs.

When performing operations requiring running of the engine, have a qualified operator in the operator's seat at all times with the mechanic on sight. Place the transmission in neutral and set the brakes and safety lock. KEEP HANDS AND CLOTHING AWAY FROM MOVING PARTS.

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

Do not trust worn and /or kinked chains and cables: do not use them for lifting or pulling operations. To handle them, always use heavy gloves.

Avoid kinking chains or cables. Do not pull through a kinked chain or cable to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chains or cables.

Be sure chains and cables are anchored and the anchor points are strong enough to handle the expected load. Keep exposed personnel clear of anchor points and cables or chains.

DO NOT PULL UNLESS OPERATOR'S COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.

Keep the area where maintenance operations are performed CLEAN and DRY. Eliminate immediately all water and oil spillages.

Do not pile oily or greasy rags; they represent a fire hazard. Store in closed metal container.

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine. Be sure exposed personnel in the area of operation are clear of the machine before moving it or its attachments. Sound horn.

Rust inhibitors are volatile and flammable Use only in well ventilated areas. Keep open flames away - DO NOT SMOKE - Store containers in a cool well ventilated place, secure against unauthorised personnel.

Do not carry loose objects in pockets that might fall unnoticed into open compartments.

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.

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 zones. DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.

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 jack is appropriate and stable. Transfer load to appropriate blocking as a safety measure, before proceeding with service or maintenance work, according to local or national regulations.

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.

Steel cables are frayed after prolonged use; always wear appropriate protections (heavy gloves, goggles, etc.).

Handle all parts carefully. Keep hands and fingers away from structures, gears or moving parts. Use and wear always the appropriate protections.

Compressed air systems can have water deposits created by moisture condensation due to changes of atmospheric conditions. If required, discharge deposits, as instructed.

Before performing any maintenance or service operation, lock the frames of the machine with the appropriate safety device. Remember to remove it at the end of the operation.

If the machine is equipped with hydraulic brakes, make sure that the reservoir is always filled up to the correct level.

Block always all wheels, front and rear, before proceeding with any maintenance or service operation involving the bleeding of braking system or removal of piping or cylinders.

STARTING

Do not run the engine in closed areas without proper ventilation to remove deadly exhaust fumes.

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

REMEMBER THAT STARTING FLUID IS FLAMMABLE. Follow recommendations printed on containers and in the Operation and Maintenance Manual.

SAFETY RULES

Containers must be stored in fresh, well ventilated places, out of reach of unauthorised persons. Follow strictly the instructions provided by the Manufacturer.

DO NOT PUNCTURE OR BURN CONTAINERS.

ENGINE

Loosen the radiator cap very slowly, to release pressure from the system, before removing it. All coolant level top-ups must be performed with engine OFF.

Avoid that flammable materials touch exhaust parts. Should this be possible, provide the necessary protections.

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

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

Do not adjust engine fuel pump when machine is moving.

Do not lubricate the machine with engine running.

Do not run the engine with air intakes, door or protections open.

ELECTRICAL SYSTEM

Disconnect batteries prior to any intervention on machine or electrical system (cleaning, repair, maintenance).

Should booster batteries be used, remember to connect both ends of the booster cables in the proper manner (+) with (+) and (-) with (-). Avoid short-circuits of the terminals. Follow thoroughly the instructions of this Manual.

Before any intervention, make sure that the main switch is OFF.

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

Before any intervention, make sure that there are no fuel or electrolyte leakages; eliminate them before proceeding with further work.

HYDRAULIC SYSTEM

Fluid escaping under pressure from a very small hole can be almost invisible and can have sufficient force to penetrate the skin. Use a piece of cardboard 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.

Stop the engine and release all pressures in the system before removing panels, housings, plugs or covers.

In case pressures must be measured, use instruments of adequate capacity. Always follow the recommended procedures.

TOOLS

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

Prior to any intervention, install all safety devices according to current rules and regulations. In case equipment on the machine must be operated by hydraulic systems, remember to proceed only after seating in the operator's compartment. Make sure that there are no persons in the operating area of the machine. Alert people before operating using the horn and by voice. Move the equipment very carefully.

Do not use machine to transport loose objects, unless proper devices for this purpose are provided.

Clutches and brakes of this machine and eventual auxiliary equipment and attachments (such as operating cylinder or winches control valves) must always be properly adjusted in accordance with the instructions provided by the Manuals of the Manufacturer. Never perform adjustments with engine running, except when called for by the above instructions.

TYRES AND WHEELS

Make sure that the inflation pressure of the tyres is according to the specifications issued by the Manufacturer and check it periodically.

Should the pressure be changed, stand on the side of the tyre at a safe distance.

Pressure check operations must be performed with unloaded machine and cold tyres.

Never use reconditioned tyre rims, since eventual weldings, heat-treatments or repairs not performed correctly can weaken the wheel, thus causing subsequent damages or dangers.

Do not perform torch cutting or welding operations on rims with inflated tyres installed.

Spare tyres must be inflated only as far it is necessary to keep the rim components assembled; remember that when

not installed on the disc, a tyre inflated to maximum pressure can **explode**.

Maximum care must be taken when handling a tyre inflated to maximum pressure.

Before operating on tyres, block all wheels, front and rear.

After jacking the machine, block it with stands according to current safety rules and regulations.

Before removing objects from the tyre tread, deflate it.

Never inflate tyres with flammable gas; explosions and serious bodily injuries may result!

When changing work shift, check that wheel or rim securing screws and brackets are not loosen; if necessary, retighten to the prescribed torque.

WARNING

On machines having hydraulically, mechanically, and/or cable controlled equipment (such as shovels, loaders, dozers, excavators 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.

UNITS OF MEASURE

The units of measure used in this Manual are those adopted by the International System (I.S.) superseding those previously used by the M.K.S. system.

Force: decanewton (daN), supersedes kilogram (kg)

Pressure: bar, supersedes kg/sqcm

Torque: decanewton x meter (daN • meter), supersedes kg • m

To convert the units of measure, the following table applies:

	multiply	by	to obtain
Force	kg	0.9807	daN
Pressure	kg/sqcm	0.9807	bar
Torque	kg • m	0.9807	daN • m

Note - For standard repair requirements, the following equivalences can be considered appropriate: kg = daNm; Kg/sqcm = bar; Kg • m = daNm.

CLASSIFICATION OF STANDARD COMPONENTS TO DETERMINE THE TIGHTENING TORQUES

Note - In case, in the different sections, the tightening torque is not listed, refer to the table "TIGHTENING TORQUES", only after identifying exactly the component.

The latter is identified by a coded eight digit number, allowing a complete description of the item.
Example:

l	/	a	b	c	d	e	/	f	g

l - Standard index digit

It is always represented by the digit 1. This number indicates that the item can be fabricated in different versions differing for the material and coating.

a - b - c - d - e - Standard base digits

It is a number always composed of five digits identifying the dimensional specifications of the item.

f - Material index digit

This digit indicates the material used for a defined item. Its meaning is indicated in the table that follows.

g - Coating index digit

It indicates the coating applied to a defined item.

Material index (f)	Resistance class and material					
	FIAT	**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	Brass	Brass	Messing	Brass	Brass	Laiton
5	Aluminium	Aluminium	Aluminium	Aluminium	Aluminium	Aluminium
6	Copper	Copper	Kupfer	Copper	Copper	Cuivre
7	Free for other metallic materials					

WARNING

- Lubricate by motor oil all screws and bolts until 24 dia., with grease the larger diameters.
- Tolerance on torque: ± 5%
- Resistance classes R80, R100, R120 must be understood as follows:

10.9 substitutes R100
12.9 " R120
for screws

10 substitutes R80
12 " R100
for nuts

CDT = cadmed; FOSF = phosphated; ZNT = zinked.

TORQUE TABLES

If the corresponding torque is not indicated, the following tables can aid you for this purpose.

NUTS (ZNT)					SCREWS (ZNT / DEIDR)		
Strength grade: 10 (R 80)					Strength grade: 10.9 (R 100)		
Diameter and pitch mm	normal daNm	low type daNm	with polyamide ring		Diameter and pitch mm	normal ZNT daNm	self-locking ZNT daNm
			normal daNm	low type daNm			
M6 x 1	1.3	1.2	-	-	M6 x 1	1.3	-
M8 x 1.25	3.2	2.6	3.9	3.2	M8 x 1.25	1.3	3.5
M10 x 1.25	7.2	5.2	8.2	6.2	M10 x 1.25	7.1	7.9
M10 x 1.5	6.5	5	7.7	6	M10 x 1.5	6.5	7
M12 x 1.25	13	8.7	14.5	10.2	M12 x 1.25	12.7	13.9
M12 x 1.75	11	8.1	12.9	9.6	M12 x 1.75	11	12
M14 x 1.5	19.5	13	21.6	15	M14 x 1.5	20	22
M14 x 2	18	12.5	20	14.6	M14 x 2	18	19
M16 x 1.5	30	17	34	20	M16 x 1.5	30	33
M16 x 2	-	-	-	-	M16 x 2	-	-
M18 x 1.5	45	25	50	29	M18 x 1.5	45	48
M18 x 2.5	-	-	-	-	M18 x 2.5	-	-
M20 x 1.5	60	30.5	64.5	35	M20 x 1.5	60	65
M20 x 2.5	-	-	-	-	M20 x 2.5	-	-
M22 x 1.5	80	41	-	-	M22 x 1.5	80	90
M22 x 2.5	-	-	-	-	M22 x 2.5	-	-
M24 x 2	100	47	108	52.5	M24 x 2	100	110
M24 x 3	-	-	-	-	M24 x 3	-	-
M27 x 2	95	40.1	-	-	M27 x 2	100	-
M30 x 2	130	49.4	-	-	M30 x 2	140	-
M33 x 2	170	-	-	-	M33 x 2	190	-
M36 x 3	220	-	-	-	M36 x 3	240	-

FLUID CAPACITIES

ITEM	QUANTITY	FIAT PRODUCT	REFILL
	Liters	Product	(International Spec.s)
Cooling system	44	PARAFLU 11	50-50 mixture of water and anti-freeze. The mixture provides anti-oxidation, anti-corrosion, anti-scaling, anti-foaming and freezing protection to –35° C (-31° F)
Fuel reservoir	286	–	ASTM N. 2-D type TT good quality diesel fuel
Engine	17 Kg	AMBRA SUPER	Engine oil "CCMC D-4" or "API CF-4" Service or "MIL-L- 2104 F"
Transmission	20	AMBRA SUPER	Engine oil "CCMC D-4" or "API CF-4" Service or "MIL-L- 2104 F"
		TUTELA GI/M (1)	ATF Type A SUFFIX A
Hydraulic and brakes system	112	IDRAULICAR AP 31, 46 or 51	Hydraulic oil DIN 51524/51525/ ISO VG 32, 46 or 68
Grease fittings	–	TUTELA G9	Lithium-calcium base grease N.L.G.I. 2 consistency
Super Max Trac axles			SAE 20W30 oil with "anti-stick and slip" LS additives API GL-4+
front	39	TUTELA TRANSFLUID	
rear	30		

(1) To be used at temperature below -20°C (-4° F).

The quantities of oil indicated are those required for periodic changes, following the draining and refilling directives indicated in detail for each group.

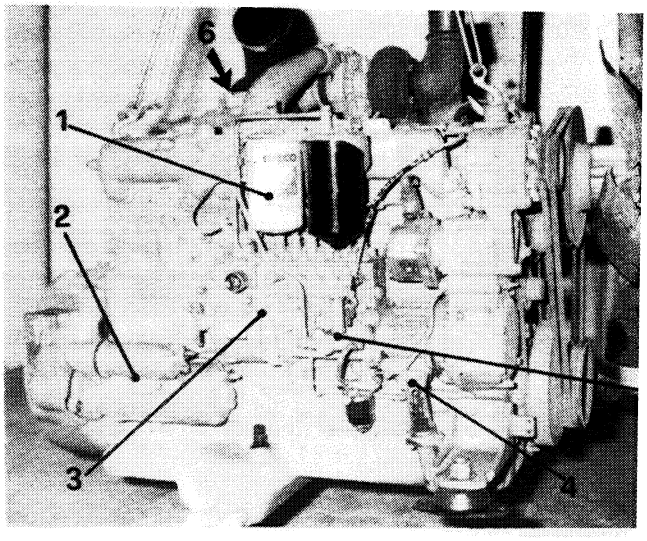
SECTION 1

ENGINE COMPONENTS

TABLE OF CONTENTS

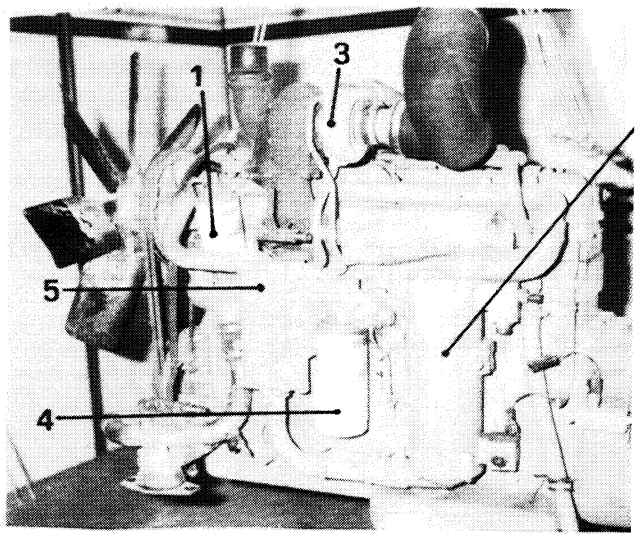
1.1 GENERAL DESCRIPTION

Model FR160.2 is equipped with FIAT-IVECO turbo-charger engine type 8365.25.584.
The repair procedures as well as trouble-shooting and testing procedures are listed in the Manual print no. 604.06.184, available from your local FIAT-HITACHI Dealer.



L.H. SIDE VIEW OF ENGINE

1. Fuel filter.
2. Starter motor.
3. Injection pump.
4. Engine oil dipstick.
5. Fuel priming pump.
6. Engine breather.



R.H. SIDE VIEW OF ENGINE

1. Coolant filter.
2. Transmission heat exchanger.
3. Turbo-charger.
4. Engine oil filter.
5. Engine oil heat exchanger.

1.1.1 TURBO-CHARGER

The turbo-charger increases the power and the efficiency of the engine providing compressed air to the engine intake manifold. The power to drive the turbo-charger is provided by the energy of the exhaust gases.
The turbo-charger includes a main housing and two air ducts for air and exhaust gases in aluminum alloy, housing respectively, the compressor wheel (**2**) and the turbine (**4**).

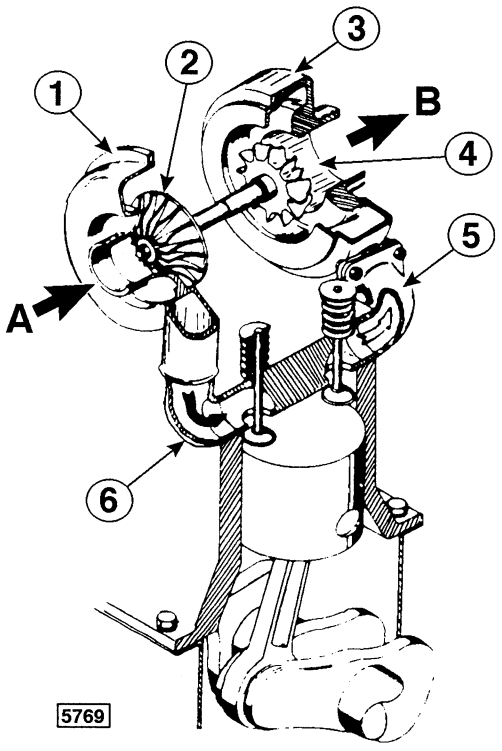


Fig. 1.3 - Functional diagram of turbo-charger

A. Air flow through compressor intake - **B.** Exhaust gases flow through the turbine - **1.** Compressor housing - **2.** Compressor wheel - **3.** Turbine housing - **4.** Turbine - **5.** Exhaust manifold - **6.** Intake manifold.

The compressor wheel is made of aluminum alloy and is mounted on one end of the turbine shaft. Wheel (**4**) located inside the turbine housing is made with high temperature resistant aluminum alloy and is fitted to the turbine shaft. Consequently a solid rotating assembly is obtained.

When the engine is started, the exhaust gases flow, at high temperature and pressure, are directed toward the discharge by the manifold inside housing where part of their energy is transferred to the blades of turbine (**4**), causing a fast rotation; subsequently, the gases are sent to the silencer.
The rotation is transferred to the shaft of compressor (**1**); this sucks clean air from the dry type air cleaner and sends it, compressed, through the vane inside the intake ducts and then to the cylinders.
The turbo-charger provides the needs of the engine, reacting, in effect, to the flow of expanding exhaust gases.
With the increase of the power output of the engine, the energy provided by the exhaust gases increases proportionally. When the demand of power is reduced or when the engine speed is reduced, the energy of the exhaust gases decreases, so as the turbine-compressor assembly speed.
The turbo-charger is lubricated by the engine oil through an external piping.

Effects of altitude on turbo-charger

The main effect that an engine equipped with turbo-charger feels with relation to altitude is the increase of the exhaust gases temperature, with a subsequent increase of exhaust smoke emission.
The maximum altitude the machine can stand without interventions on the engine is 2,500 m (8,000 ft) above sea level.
At higher altitudes, to avoid an excessive increase of the exhaust gases temperature (normal operating temperature 500 ÷ 550°C; 930 ÷ 1020°F), it is recommended to under-calibrate the injection pump 2% of max. output every 100 m or 328 ft above 2,500 m altitude.

WARNING

Avoid accelerating in the stopping stage of the engine, since there is the risk that the turbo-charger turbine shaft will rotate without lubrication even after the engine has stopped, due to the effect of inertia.
This will cause serious damage to the turbine shaft bushing.

WARNING

Before switching off the engine, when it is hot, run at idle for a few minutes to allow the turbo-charger to slow-down and cool gradually.

1.1.2 LDA AIR INTAKE DEVICE

The air intake device is meant to adjust the delivery of fuel to the quantity of air (in weight) sent into the cylinders by the turbo-charger. This because in turbo-charged engines, at low speeds, the turbo-charging pressure is too low, thus the quantity of air (in weight) sent into the cylinders is insufficient. Consequently, the fuel delivery must be referred to the turbo-charging pressure. This is obtained by the variable position stop of the maximum stroke of the rake actuated by the above device, starting from a pre-set turbo-charging pressure (selected during the calibration phase).

The **LDA** device includes housing (**10,** fig. 1.4) and cover (**11**) blocking between them, membrane (**5**) that must be air tight. On the cover, connection (**1**) picks-up the turbo-charging pressure, whereas the membrane is pushed by spring (**6**) positioned against ring nut (**9**) mounted on the device cover. The latter can change, within certain limits, the spring pre-load, thus changing the beginning of the intervention of the **LDA** device, that should work at 0.13 ± 0.05 bar.

Access to adjusting ring nut (**9**) is gained through the threaded hole on the pump body, after removing the relevant plug. Rod (**7**) is connected to the membrane through the plate and guide disc, actuating regulation rod (**8**) through an lever.

When turbo-charging pressure increases, the membrane is lowered against the spring load, lowering with it the rod, through the lever, allowing the rake to travel further. Once the turbo-charging pressure 0.31 ± 0.05 bar is reached, the **LDA** device ends its intervention, allowing the rake to run the whole stroke (max. delivery).

Before setting the **LDA** device, check that the device is free of leakages under a pressure of 0.5 bar.

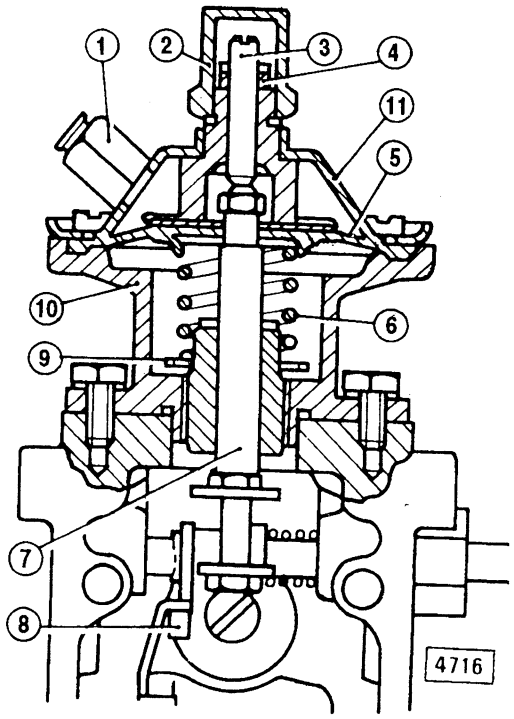


Fig. 1.4 - Section view of LDA device

1. Connection to turbo-charged air pressure - **2.** Cover - **3.** Regulation rake stroke adjusting screw - **4.** Jam nut (3) - **5.** Membrane - **6.** Spring - **7.** Rod - **8.** Rake - **9.** Intervention adjusting ring nut - **10. LDA** housing - **11. LDA** cover.

1.2 DIAGNOSTIC AND TESTS

1.2.1 TROUBLE-SHOOTING

To trouble-shoot this engine refer to Service Manual print no. 604.06.184, available from your FIAT-HITACHI Dealer.

1.2.2 TESTS

For the tests not included in this Manual, refer to Service Manual print no. 604.06.184, available from your FIAT-HITACHI Dealer.

SUMMARY TABLE OF TIGHTENING TORQUES

IVECO ENGINE TYPE	8365
FLYWHEEL SECURING SCREW	Screw P/N 4765553 M16 x 1.5 1st phase, pre-torque 100 Nm 2nd phase, rotation 60°
CON-ROD CAP SECURING SCREW	Screw P/N 4722162 M14 x 1.5 1st phase, pre-torque 40 Nm 2nd phase, rotation 35°
CRANKSHAFT CAP SECURING SCREW	Screw P/N 8829588 M16 x 1.5 1st phase, pre-torque 55 Nm 2nd phase rotation 75°
HEAD SECURING SCREW	Nut P/N 8505174 for studs P/N 4707320 1st phase, pre-torque 88 Nm 2nd phase, rotation 90° 3rd phase, rotation 90° Nut P/N 8505174 for studs P/N 4718322 and P/N 4718319 - 4718316 1st phase, pre-torque 88 Nm 2nd phase, rotation 90° 3rd phase, rotation 180°

1.2.3 OUTPUT DATA ON BENCH FOR 8365.25.584 ENGINE

Test conditions:

- engine on bench without fan, air cleaner and exhaust silencer;
- atmospheric pressure 740 ± 5 mm Hg (986 ± 7 mbar);
- ambient temperature 20 ± 3°C (68 ± 5°F);
- relative humidity 70% ± 5;
- fuel density 830 ± 10 g/lt;
- injection timing 23 ± 1° BTDC, cylinder 1 on compression stroke.

Throttle control lever position	Engine Speed	Engine power with run-in engine for:		Fuel consumption per hour	Related pressure of air intake
	rpm	2 hours total KW (HP)	50 hours total KW (HP)	Kg/H	bar
Max. power	2150	_	136.3 ÷ 150.7 (185 ÷ 205)	31.5 ÷ 33	1.18 ÷ 1.33
Max. torque	1400	_	104.5 ÷ 115.5 (142.5 ÷ 157.5)	22.5 ÷ 24	0.68 ÷ 0.83
Max. (no load)	2400 ÷ 2440				
Min. (idle)	900 ÷ 950				

1.2.4 INJECTION PUMP CALIBRATION DATA

Injection pump: PES6P110A720RS530 (BOSCH)

Governor: RQV450 - 1075 PA1016 - 3

Fuel pump: FP/K22P9

Pressure piping (ENGINE): diam. 6 x diam. 1.5 length for no. 1 cylinder = 320 mm, no. 2 - 3 = 340 mm, no. 4 = 420 mm, no. 5 = 490 mm, no. 6 = 565 mm.

Injector setting (ENGINE): 200 ÷ 208 bar.

Min. engine speed, no-load: 880 ÷ 960 rpm.

Static timing mounting 23° ± 1° BTDC, plunger 1 of injection pump in beginning of fuel injection and piston no. 1 on compression stroke.

Test bench with static and dynamic specifications according to ISO 4008/1 and 4008/2 standards.

Piping diam. 6 x diam. 1.5 x 600 mm length (according to ISO 4093.3 standard).
(Outside diameter x wall thickness x length).
Injectors ISO standard (calibrated orifice).
Injector setting 172 ÷ 175 bar.
Test fluid according to ISO 4113 standard, temperature: 38 ÷ 42 °C (100 ÷ 108 °F).
Feeding pressure 1.5 bar.
Burette emptying time: 30 sec.
Relief valve set at 1.3 ÷ 1.8 bar.

INJECTION PUMP PHASING

(Spill point test - Stop block removed)

Plunger lift (corresponding to covering of port)	2.00 ÷ 2.10 mm (from BTDC)
Firing order	1 - 5 - 3 - 6 - 2 - 4
Rotation	clockwise

PUMP BASIC CALIBRATION (Stop block removed)

Type of operation	Pump rpm	Position of rake (mm)	cucm/1000 strokes	Max. discrepancy between cylinders (cucm)	Press. on LDA (bar)
Calibration	1075	10.80 ÷ 10.90	122 ÷ 124	4	0.7
Test	700		126 ÷ 130		0.7
Test	500		93 ÷ 95		0
Test	450	6.0 ÷ 6.4	17 ÷ 22	4	0