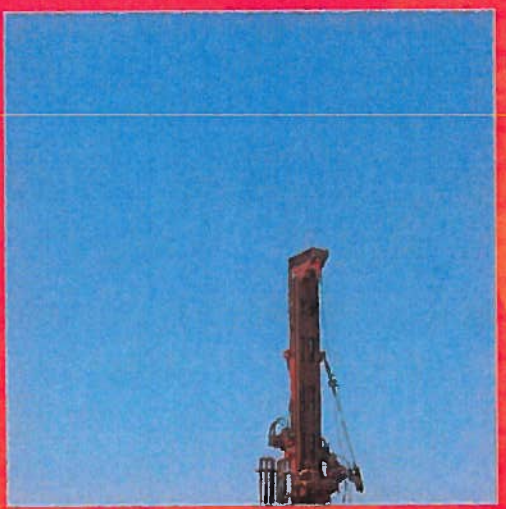
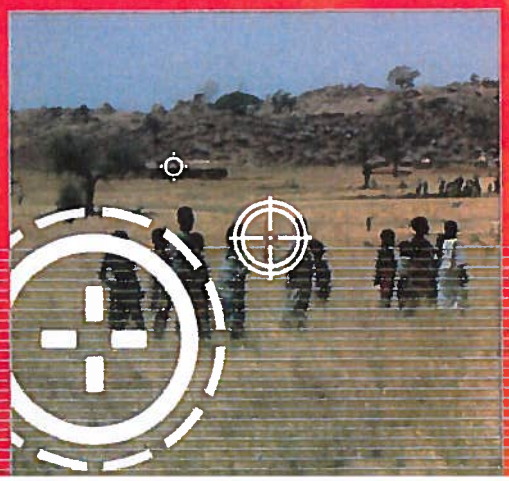
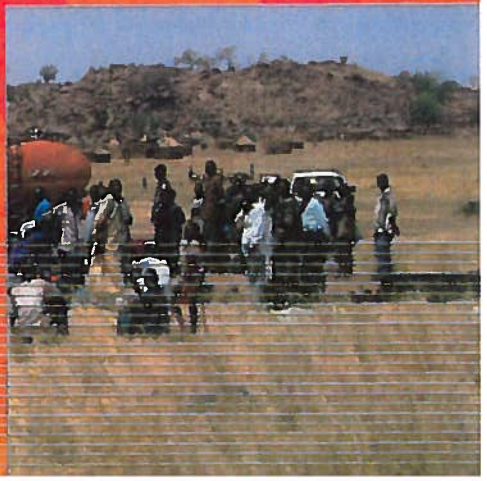
Energold
DRILLING CORP.



DANDO

DANDO DRILLING
INTERNATIONAL
Made in England since 1867





INDEX - DANDO 2500 INVESTIGATOR

INSTRUCTION MANUAL & SPARE PARTS

CONTENTS

INDEX - DANDO 2500 INVESTIGATOR

INSTRUCTION MANUAL & SPARE PARTS

INDEX - DANDO 2500 INVESTIGATOR

INSTRUCTION MANUAL & SPARE PARTS

CONTENTS

SAFETY OF MACHINERY

As Designers, Manufacturers and Suppliers of Specialised Equipment, Dando Drilling International Limited, ensure so far as it is reasonable that our products are safe and without risk to health when properly used.

While every care has been taken to ensure that the information contained in the manual is clear and accurate, the information in it is supplied in performance of our duty under current E.C. Legislation with regard to C.E. Marking, and no legal liability, other than that imposed by the Act, is accepted.

You are requested to take the necessary steps to ensure that the appropriate information is make available to all those involved with the proper use of our products, or to anyone who may work on, purchase, or otherwise acquire products for their own use.

EEC DIRECTIVE 89/392/EEC

The above Directive has been adopted by HM Government and become effective in the United Kingdom from 1.11.1993 with a transitional period up to 31.12.94.

Notwithstanding other and various legally binding requirements, the Directive specifically requires manufacturers of products to provide instructions for the safe use of such products.

Dando Drilling International Ltd. supports all new products being supplied to their customers with a comprehensive Operator Manual, which clearly defines mandatory instructions for the operation, safe use and maintenance of the products.

Further, where proprietary items are incorporated into products of Dando Drilling International Ltd. comprehensive Operators Manuals on these items are also supplied together with the Operating Manuals etc., on any vehicle or other carrier supplied as part of a contract.

It is the responsibility of the owners or hirers of such products to ensure that operators are provided with these Manuals and are suitably instructed regarding the purpose of these Manuals and Safety Instructions. In addition operators should be suitably and adequately trained in the use of the product.

RIG DATA

MANUFACTURER	:	DANDO DRILLING INTERNATIONAL LTD., OLD CUSTOMS HOUSE, WHARF ROAD, LITTLEHAMPTON, WEST SUSSEX, BN17 5DD, ENGLAND.	
RIG MODEL	:	DANDO 2500 INVESTIGATOR	
RIG TYPE	:	PERCUSSION DRILLING RIG	
SERIAL NUMBER	:	2500/14830	
ENGINE TYPE	:	HATZ 2L41 DIESEL ENGINE	
HORSEPOWER	:	Continuous: 24.8 bhp @ 1870 r/min	
ENGINE SERIAL NUMBER	:	**(HATZ 2L41) 1021414 043571**	
MAXIMUM DERRICK LOADING	:	6.0 TON	6,000 KG
WINCH - SINGLE LINE PULL	:	2.5 TON	2,500 KG

SPECIFICATION OF INTENDED USE OF THE MACHINE

DANDO 2500 INVESTIGATOR DRILLING RIG

The Dando 2500 Drilling Rig is intended for drilling of holes in the ground using the Cable Percussion method of drilling. The Dando 2500 is also suitable for performing site investigation work including U100 (U4) and S.P.T. Sampling and Testing.

GENERAL SPEFICIATIONS FOR GUIDANCE ONLY

Engine Power at 1870 rpm	Continuous 24.8 bhp
Winch - Single line pull	2.5 ton
Drilling Depths and Diameters	6 inches (150mm) to 250 feet (75 metres) 15 inches (380mm) to 150 feet (45 metres)

Note: The Maximum drilling capacity is dependent on drilling conditions, type and size of tools. The figures given provide a general guide only.

Derrick Working Height under Sheaves		17 feet	5.2 metres
Overall Height Derrick Erected		22.4 feet	6.83 metres
Derrick Loading		6.0 ton	6000 kg
Travelling Dimensions	**Length**	25 feet	7.6 metres

WINCH AND POWER UNIT

The Winch is powered by a Hatz Diesel Engine and backed by their world-wide service. The drive is transferred to the winch by a roller chain through a hand operated expanding shoe clutch with direct mechanical linkage to the lever. This type of drive gives a "snappy" drilling action and allows the operator to retain "feel" of the drill load. A powerful foot/hand brake allows easy and precise control of all loads. Dando Investigator Rigs provide for the operation of a second line powered from the cathead fitted as standard on the winch, the derrick crown incorporates two sheaves enabling the second line to be readily available for handling sampling and testing equipment. The second sheave also provides for ease of reeving hoisting block for withdrawing casing.

DERRICK

The Derrick is fabricated from rectangular box section steel. Rear legs are hinged on the winch frame and cross braced with crossbars. Front legs are secured at the top on double pivot joints, a strong brace bar with large skid feet joins the ends of the front legs.

SERVICE AGENTS
UNITED KINGDOM

DANDO 2500 DRILL RIG

Spare Parts and Servicing in the United Kingdom can be obtained from the Manufacturer:-

DANDO DRILLING INTERNATIONAL LIMITED
Old Customs House, Wharf Road,
Littlehampton, West Sussex, BN17 5DD.
Tel: +44 (0) 1903-731312 Fax: +44 (0) 1903-730305
e-mail: info@dando.co.uk
Web Site: www.dando.co.uk
Please Ask For The Spares Department

HATZ 2L41 ENGINE

SERVICE AGENTS
OUTSIDE THE UNITED KINGDOM

DANDO 2500 DRILL RIG

Spare Parts and Servicing in the United Kingdom can be obtained from the Manufacturer:-

DANDO DRILLING INTERNATIONAL LIMITED
Old Customs House, Wharf Road,
Littlehampton, West Sussex, BN17 5DD.
Tel: +44 (0) 1903-731312 Fax: +44 (0) 1903-730305
e-mail: info@dando.co.uk

Please Ask For The Spares Department

HATZ 2L41 ENGINE

SECTION 1

OPERATING INSTRUCTIONS

GENERAL

DANDO 2500 INVESTIGATOR DRILL RIG

OPERATING INSTRUCTIONS

GENERAL

It is the responsibility of the owners and hirers of this equipment to ensure that the operators of the equipment are aware that drilling sites can be potential hazardous environments and that safe drilling practice should be adhered to.

Dando Drilling International draw your attention to the code of Safe Drilling Practice as published by the British Drilling Association, and would recommend that all operators are fully conversant with all aspects covered by this publication and take the necessary steps to become B.D.A. Accredited Drillers. For operators outside the United Kingdom, we would recommend that their national equivalent to the B.D.A. publication is adhered to.

The Guidance Notes on Safety Section of this Manual is extracted from the British Drilling Association's publication "Code of Safe Drilling Practice", and Dando Drilling International would like to acknowledge with thanks their permission to reproduce this section.

TRANSPORT AND ASSEMBLY INSTRUCTIONS

1. TRANSPORT

The rig has its own integral trailer. The vehicle used to tow the rig should be of sufficient size and power for this function.

However, the operator should be mindful of any legislation in force in whatever E.C. Country the rig is being used, and comply fully with those regulations.

The rig is supplied with a towing hitch with overrun braking system which complies with current E.C. regulations.

When the rig is parked, the parking brake should be engaged by pulling the lever on the top of the unit.

The operator's attention is drawn to the Guidance Notes on Safety (Section 2) relating to general and specific areas to be noted with regard to transport and towing of the drilling rig.

2. ASSEMBLY OF RIG

2.1 SITE PREPARATION

Before erecting the drilling rig, the drilling site should be inspected and prepared, by removing debris and any obstructions if possible.

In selecting a suitable position for the rig, it is essential to allow sufficient room to swing the derrick legs around and for the derrick to be assembled in its flat position as shown on the appropriate illustration. Also the ground on which the drill hoist base is to be positioned must be reasonably level and firm.

The attention of the operator of the equipment is drawn to the Guidance Notes on Safety (Section 2) relating to general and specific areas to be noted with regard to site preparation and site safety.

2.2 ERECTING AND LOWERING THE RIG WITH THE ELECTRIC WINCH

Familiarise yourself with the Superwinch operation by reading the owner's manual.

ERECTING – refer to figures following

2.2.1 Apply the parking brake. Use chocks under the wheels if required. Unhitch and remove the vehicle.

2.2.2 Remove the pins and slide out the two sinker bar carriers located in the base at the rear of the rig and replace the pins in the second set of holes.

2.2.3 Remove any mast weights, lower crossbar & side stays, any tools or equipment from the derrick.

2.2.4 Place suitable timbers under the base of the rig, one at the front of the base, one under the pivot point and one under the rear. Ensure that they are level and in line with each other, both from side to side and back to front.

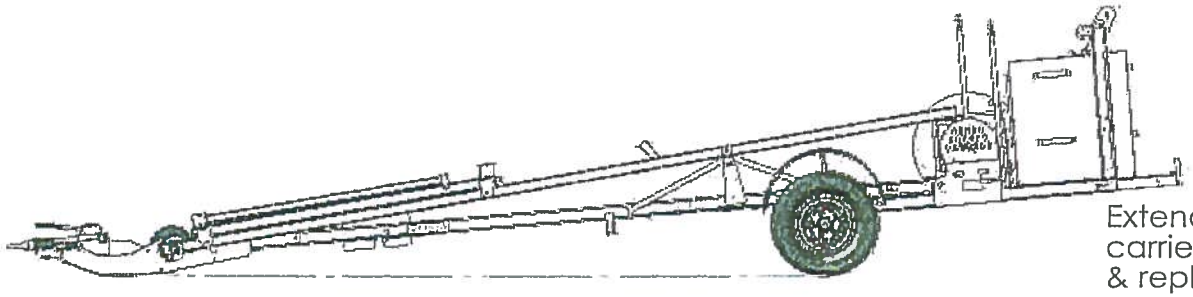
2.2.5 Carefully allow the crown assembly to rise & the rear of the rig to sit on the ground. Remove rear door from the 3 part guard if fitted, fit exhaust extension.

2.2.6 Remove the mudguards and the locking nuts for the legs, and the base locking pins. Release the drill line and allow this to lie on the ground.

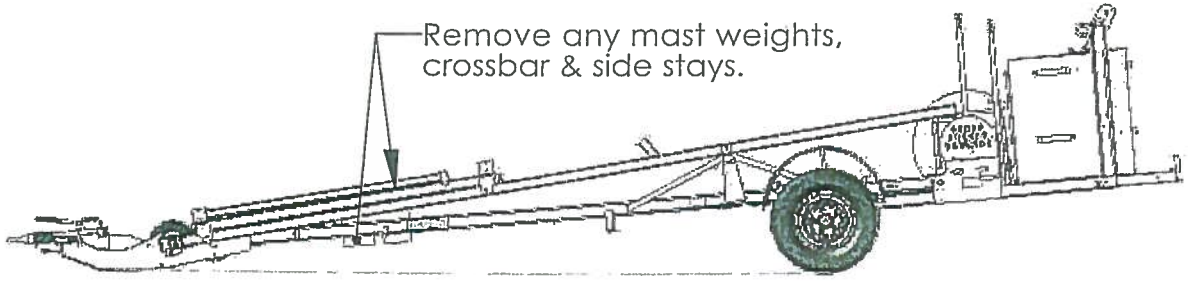
2.2.7 Place an adequate counter balance on the carriers at the rear of the rig, two sinker bars or more should be sufficient.

UNDER NO CIRCUMSTANCES SHOULD A HUMAN COUNTER BALANCE BE USED.

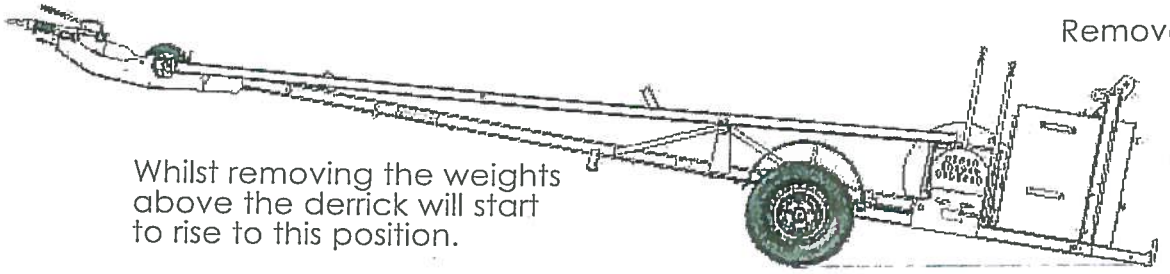
2.2.8 Place the front legs on top of the road wheels. Make sure there are no loose items on the rig. Make a final check that there are no overhead obstructions e.g. overhead cables.



Extend sinker bar carriers to second hole & replace locking pins.



Remove any mast weights, crossbar & side stays.



Remove 3 part guard.

Whilst removing the weights above the derrick will start to rise to this position.

2.2.9 **ENSURE ALL PERSONNEL STAND WELL CLEAR OF THE RIG AND MAST AREA.**

2.2.10 Connect the remote control to the electric winch. The winch can be used without starting the rig engine. Check that the wire rope of the electric winch is seated in the pulleys & has no visible signs of damage. Ensure Wire Rope for the winch is connected to the eye on the Sampson Post.

2.2.11 Move and hold the switch downwards of the remote control to raise the mast until the angle iron support on the rear of the mast is approximately vertical. Release the switch of the remote. This is spring loaded and will return to the centre position and automatically lock the winch brake.

2.2.12 BEFORE REMOVING THE FRONT LEGS FROM THE ROAD WHEELS ENSURE THAT THE SAFETY CABLE IS CONNECTED TO THE MAST AND SAMPSON POST

2.2.13 The front legs can now be walked round to the front of the rig, and the spreader bar can be attached to the rig. The front legs should be as close to the ground as possible during this time

2.2.14 Remove the safety chain from the mast, and adjust the setting of the mast as required to fit the side stays using the remote control.

2.2.15 Remove the remote control and store in a dry area until required.

2.2.16 If the ground permits firmly stake down the lower crossbar. The rig is now ready to operate,

2.2.16 LOWERING

2.2.17 Place an adequate counter balance on the sinker bar carriers at the rear of the rig, two sinker bars or more should be sufficient. If the exhaust extension has been fitted & it is necessary to remove it then adequate hand protection should be used to prevent the possibility of burning the skin.

UNDER NO CIRCUMSTANCES SHOULD A HUMAN COUNTER BALANCE BE USED.

2.2.18 Attach the remote control to the winch, and take up any slack in the wire rope and **CONNECT THE SAFETY CHAIN/CABLE TO THE MAST AND SAMPSON POST**

2.2.19 Remove the side stays and spreader bar The front legs should be as close to the ground as possible during this time.

2.2.20 Walk the front legs around and place on the road wheels.

2.2.21 **ENSURE ALL PERSONNELL STAND WELL CLEAR OF THE RIG AND MAST AREA.**

2.2.22 Move and hold the switch upwards which will lower the mast.

2.2.23 Place front legs onto the brackets and refit the nuts. Replace the base locking pins.

2.3 ERECTING AND LOWERING THE RIG WITHOUT AN ELECTRIC WINCH

ERECTING – refer to figures following

2.3.1 With the rig in the travelling position, place the drill hoist in the correct position relative to the centre of the required borehole. This is done by measuring approximately 1500mm from the centre of the required borehole to the centre line of the rig axle. Remove the locking pins, which secure the base unit to the mast.

2.3.2 Remove any mast weights, lower crossbar & side stays, this should allow the crown assembly to rise & the rear of the base to sit on the ground. Care should be taken during this operation as the derrick will assume a position as shown in the erecting diagrams. The crown assembly should be supported in this position by placing a suitably stable and safe support beneath the derrick legs. Check that the hoist is reasonably level. It may be necessary to level the ground or to pack up the base with timber.

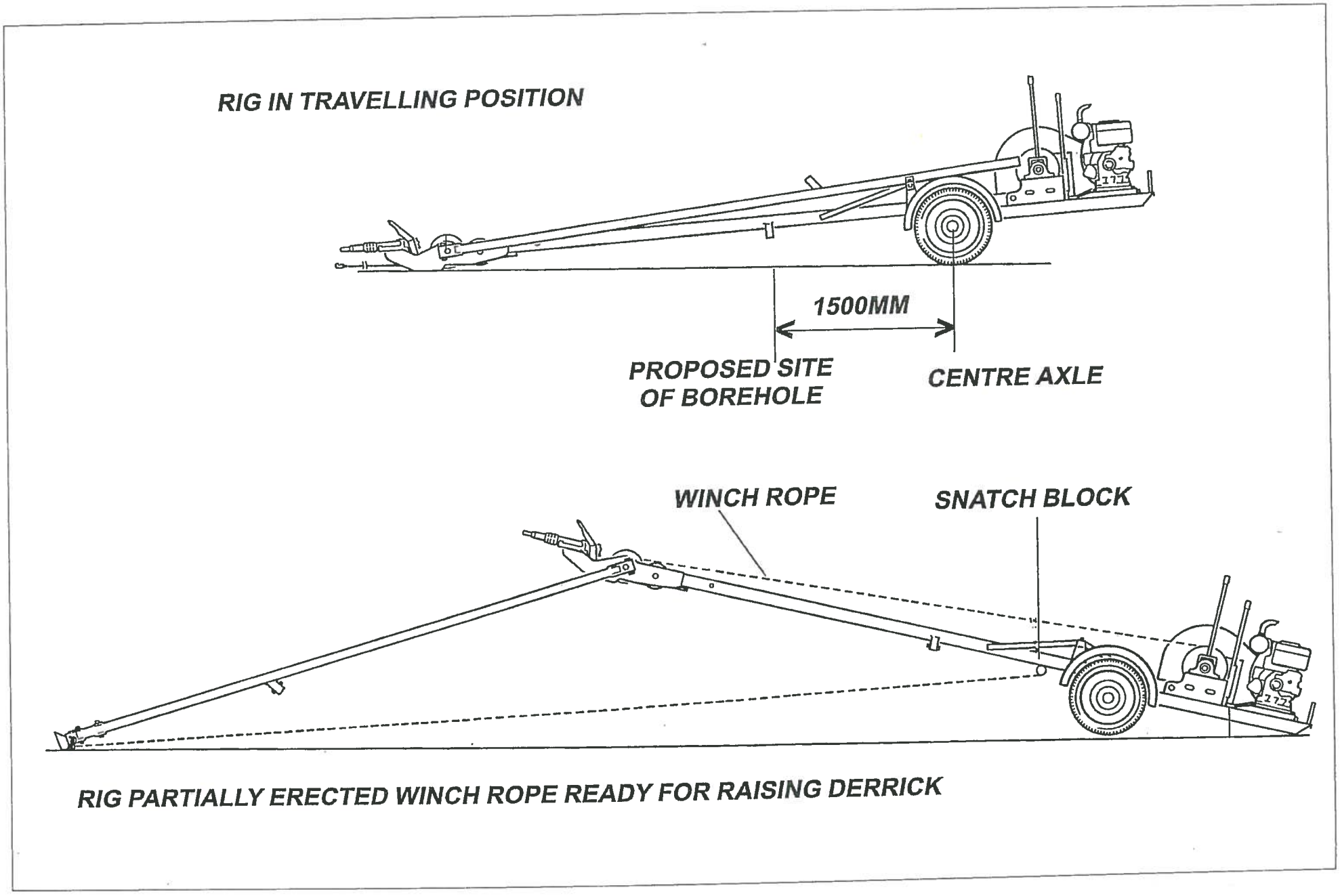
2.3.3 When in the travelling position, the two front legs of the derrick are each locked in position by a locking nut located toward the bottom end of each leg. Unscrew and remove these two locking nuts.

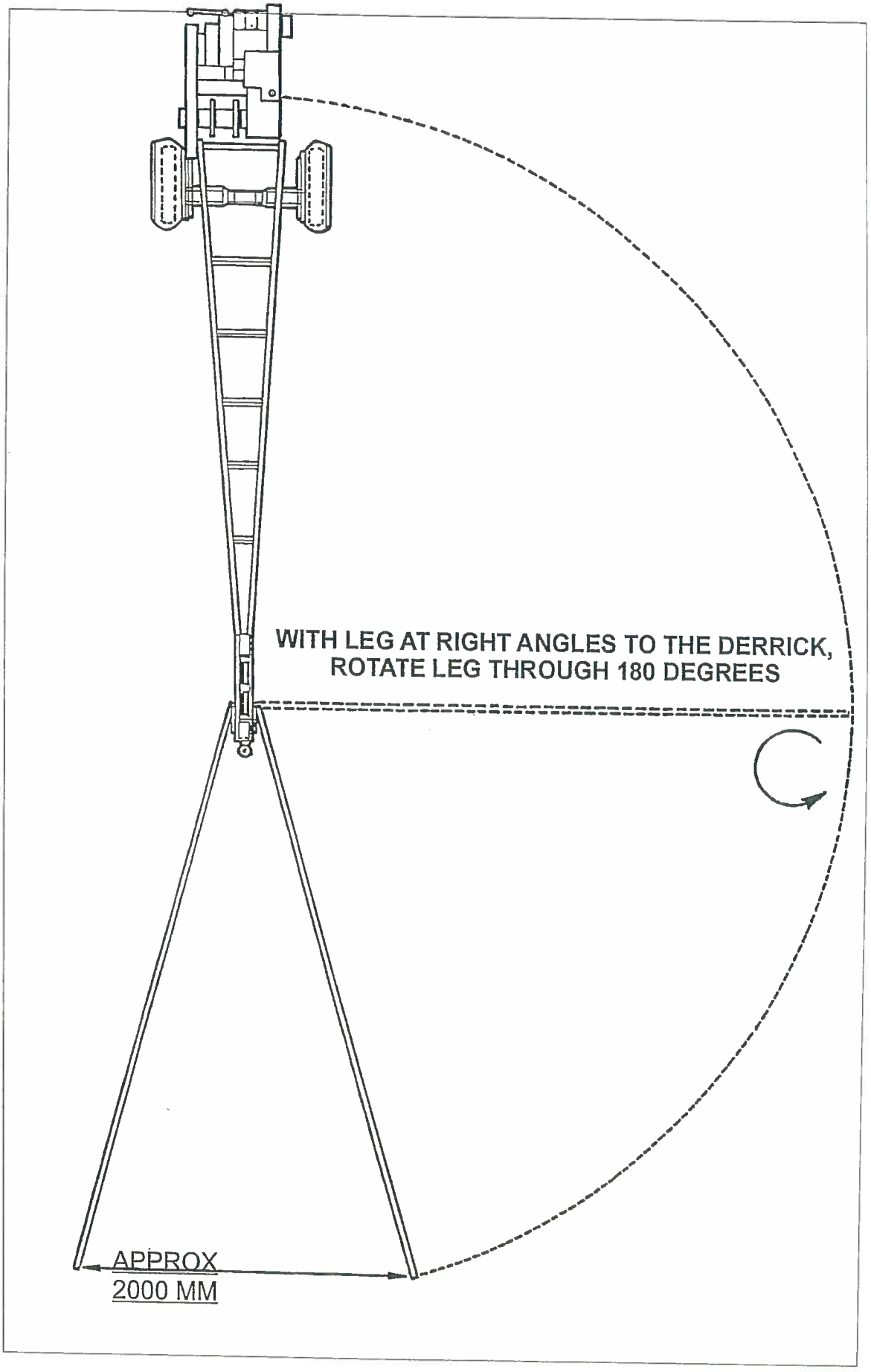
2.3.4 Lift up the bottom end of each front leg and carry it round, following a semi-circular path as necessitated by the other end of the leg pivoting on the hinge block attached to the crown sheave shaft. **Because of the weight involved this operation should not be carried out by one man alone.**

When the leg is at right angles to the rig (in line with crown sheave shaft) STOP AND ROTATE THE LEG THROUGH 180 DEGREES. It is essential to carry out this operation as the centre block on which the leg is hinged will NOT allow further movement until this is done. Having rotated the leg it will then be in correct alignment for the assembly of the derrick and can be carried to the front of the rig. The bottom ends of the two front legs should be positioned so that they are approx. 2500mm apart (i.e. 1000mm either side of the centre line).

2.3.5 Take the lower cross bar and bolt this between the bottom of the front two legs. Attach the feet, with the curved section resting on the ground, to the legs with the bolts provided. Attached to the feet are the front leg lifting chains.

2.3.6 Attach snatch block onto the dead eye on the front of the hoist skid.


RIG IN TRAVELLING POSITION
1500MM
PROPOSED SITE OF BOREHOLE
CENTRE AXLE
WINCH ROPE
SNATCH BLOCK
RIG PARTIALLY ERECTED WINCH ROPE READY FOR RAISING DERRICK


WITH LEG AT RIGHT ANGLES TO THE DERRICK,
ROTATE LEG THROUGH 180 DEGREES
APPROX
2000 MM

2.3.7 With the drum clutch control lever in the disengaged position, and the foot brake control released, unwind the wireline from the drum. Thread the line up the back of the derrick, over and through the crown wheel retainers, then down to the snatch block on the front of the hoist, along the ground, and end up by fixing the line on the centre ring of the front leg lifting chains.

2.3.8 Check that the ground over which the feet of the front legs will travel as the derrick is pulled up, is reasonably open and level. If necessary, timber skid boards can be placed under one or both of the feet as required.

2.3.9 The derrick is now ready to be pulled up by the winch under power.

2.3.10 Start up the engine as described in the engine manufacturer's handbook provided. Disengage the brake locking device by placing foot on brake foot pedal or the hand on brake hand lever to release brake mechanism. Keep brake under control, do not remove hand or foot from control. The Operator then pulls the clutch lever towards him slowly. This will cause the winch to rotate slowly and take up the slack line.

Check to see that the line is clear and is seating correctly on crown sheave and snatch block pulley. Continue to pull in the front legs until they are approximately 3m from the hinge pin of the rear legs (i.e. scissor the derrick to the raised position).

2.3.11 If the borehole is to be accurately sited, make any adjustments necessary to the position of the winch and derrick so as to locate the front of the crown sheave vertically above the required spot. If the ground permits, firmly stake down the lower cross bar.

2.3.12 Disconnect the end of the wireline from the front leg lifting chains, remove the rope block and chains. Fit side stay bars between the front and rear legs using bolts provided. It is important that both the lower crossbar and the two side stay bars are fitted before commencing any drilling or related operation. This will ensure that the derrick structure is locked into the most stable configuration.

2.3.13 The wireline is now attached to a spring hook prior to commencement of drilling operations.

2.4 DISMANTLING THE RIG

To dismantle and remove the derrick; the procedure is described above but in the reverse order. Briefly as follows:-

2.4.1 Fit draw chain block and reeve line as previously; using winch just take up the strain on the line.

2.4.2 Remove side stays and stakes from front legs, check that the ground over which the feet of the front legs will travel is even and reasonably level.

2.4.3 Pull the front legs out, at the same time allowing the line to unwind from the drum by releasing the brake as necessary, using either the foot or hand control lever.

IMPORTANT: The Operator must be in full control of the winch during the time the legs are lowered.

2.4.4 Continue to lower until the rear legs are safely resting on the ground then dismantle in the reverse order to assembly.

2.4.5 Insert the locking pins to secure the base unit to the mast.

2.5 ERECTING AND LOWERING CABLE PERCUSSION BORING RIGS BY THE SAMSON POST METHOD.

The following is the BDA Recommended Procedure for erecting DANDO Boring Rigs fitted with Samson Post.

ERECTING

2.5.1 Apply parking brake. Use chocks if necessary. Unhitch and remove vehicle.

2.5.2 Remove mudguards, **OR** leave mudguards in place if the are fitted with L, or U shaped leg guidance brackets to prevent legs slipping inwards.

2.5.3 Release leg locking nuts and base locking pins.

2.5.4 Place timbers under the leg pivot positions and rig frame at the front and rear of the rig. Ensure that they are level and in line with each other, both from side to side and back to front.

2.5.5 Run the winch cable over the crown wheel, back through the A frame above the first cross member and then attach with a shackle to the Samson Post.

2.5.6 Start the Engine.

2.5.7 Place an adequate counter balance to the rear of the rig. This can be achieved by placing and thoroughly securing drilling tools on the sinker bar carriers until there is enough weight to ensure the rear does not move.

UNDER NO CIRCUMSTANCES SHOULD A HUMAN COUNTER BALANCE BE USED.

2.5.8 Place the front legs on the top of the road wheels or on mud guard if they are fitted with L. or U. shaped leg guidance brackets to prevent legs slipping inwards. If the conditions are slippery the legs should be placed on the ground at the side of the rig.

2.5.9 Ensure that all personnel, other than the winch operator, stand clear of the rig.

2.5.10 Release the winch brake and ensure that the wire rope is located on the empty working side of the drum.

2.5.11 Make sure that there are no loose items that could fall off the rig when it is being erected.

2.5.12 Make a final check that there are no overhead obstructions e.g. overhead cables.

2.5.13 Set throttle and gently winch until the rig base rests on all the timbers then stop.

2.5.14 Check that the timbers are still level and central.

2.5.15 Once checks are complete, winch the rig gently, ensuring that the operators foot is over the brake at all times, until the crown wheel is within 25 degrees (approximately 3 feet or 1 metre) of vertical. Apply winch brake.

2.5.16 Reduce the engine revs. The legs should now be walked round to the front by the assistant driller and the spreader bar and side stay bars attached with the approved bolts. This job is carried out from the floor of the Dando Rig. The front legs should be as close to the floor as possible at all times during this part of the operation.

Only properly designed stay bars and spreader bar should be used.

The Driller **MUST** remain on the controls at all times.

2.5.17 On concrete, soft or boggy ground, place timbers under the feet of the legs before gently lowering to the ground.

2.5.18 Remove shackle and rethread the rope through the A frame.

The rig is now ready to operate.

LOWERING

2.5.19 Thread the wire rope through the A frame above the first cross member and then attach with a shackle to the Sampson Post.

2.5.20 Place and secure sufficient weight on the sinker bar carriers.

2.5.21 Check the position of the timbers. Ensure that the front timber is right to the front of the rig base.

2.5.22 Gently take the weight of the A frame on the winch and switch off the engine. Remove the spreader bar and side straps.

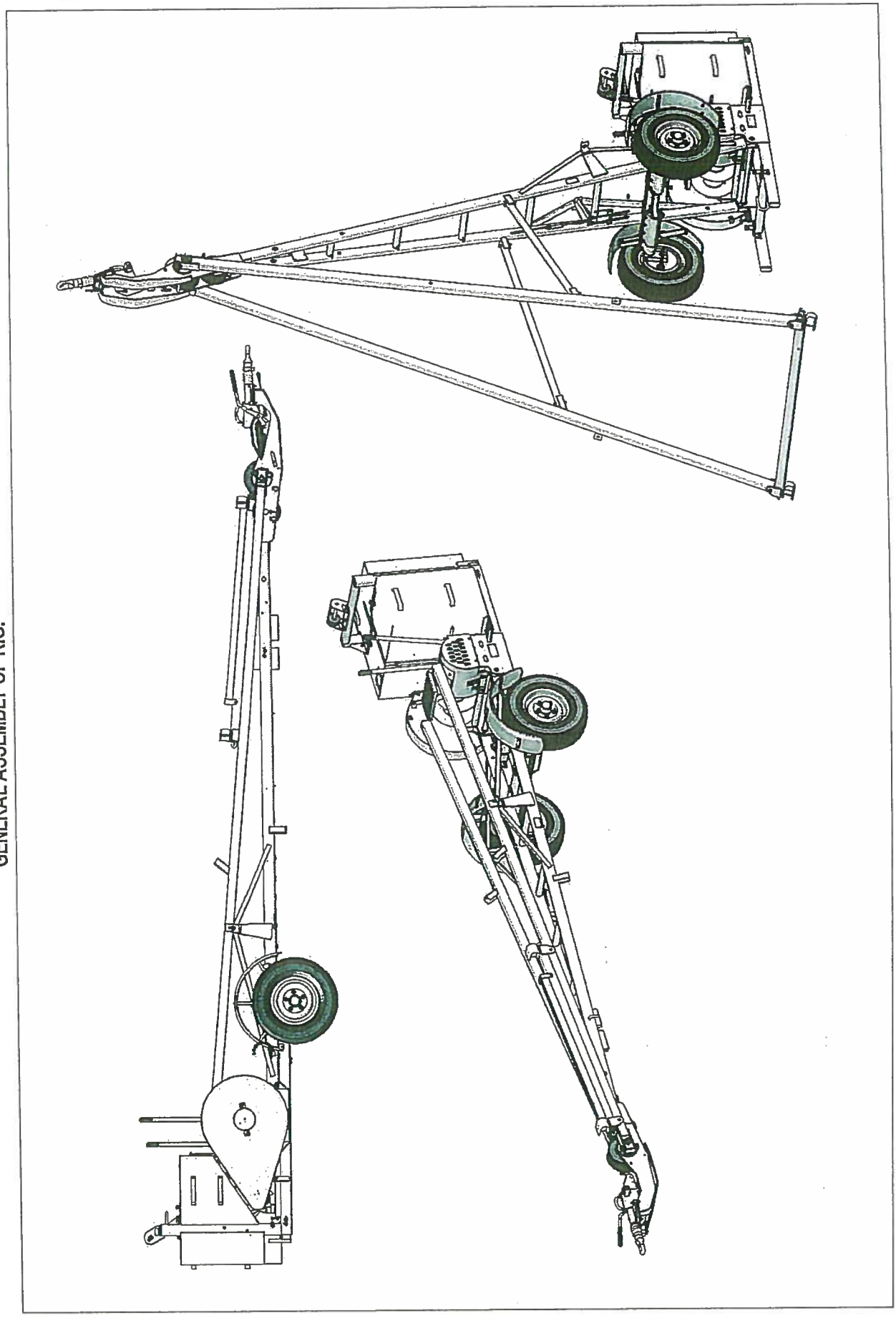
2.5.23 The legs should now be carefully walked round by the assistant driller and rested on the road wheels or on top of the mudguards that may be fitted with L or U shaped guidance brackets.

2.5.24 Check that there are no loose items that can fall off the rig. Ensure that all personnel are clear and that nothing lies under where the rig will be lowered. Gently lower the rig using both the clutch and the brake in a slow and steady manner until the A frame meets the rig base. Ensure that the parking brake is on and position the rig legs into the stirrups. Refit the base locking pins. Remove the counter balances from the rig. The rig is now ready to move to the next location.

SAFETY HARNESSES

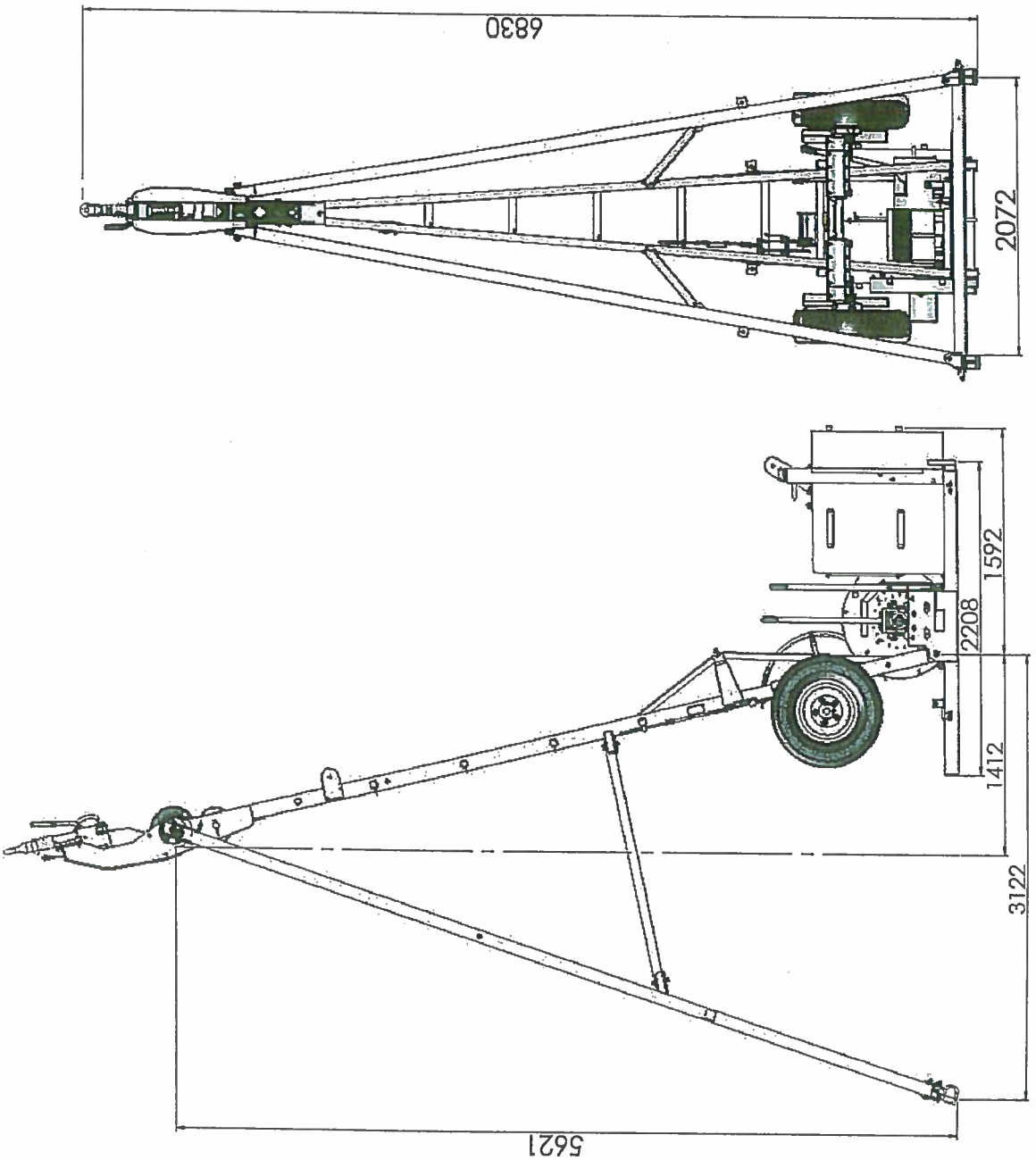
Due consideration should be given to the wearing of safety harnesses when working at a height above 6ft and when undertaking repairs or maintenance the mast and sheaves etc.

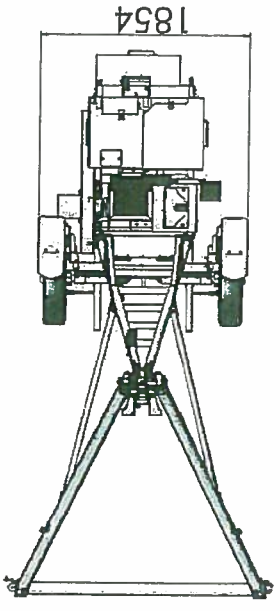
3. ILLUSTRATIONS



GENERAL ASSEMBLY OF RIG.

General Assembly of Rig with Overall Basic Dimensions





4. RIG CONTROLS

PLEASE REFER TO FOLLOWING DIAGRAM FOR THE POSITION AND GENERAL LAYOUT OF THE RIG MAIN COMPONENTS AND CONTROLS.

4.1. HOISTING REEL CLUTCH

The clutch is controlled by the operation of the Clutch Lever. This is pulled towards the operator to engage the clutch, and pushed away from the operator to disengage.

4.2. HOISTING REEL BRAKE

The Hoisting Reel Brake has two controls: a hand lever and a foot pedal.

To engage the Hand Lever is pulled towards the operator, or the foot pedal is depressed.

To disengage the Hand Lever is pushed away from the operator, or the foot pedal allowed to rise.

There is a brake locking device which is situated above the foot pedal. This should be turned to lock the brake on.

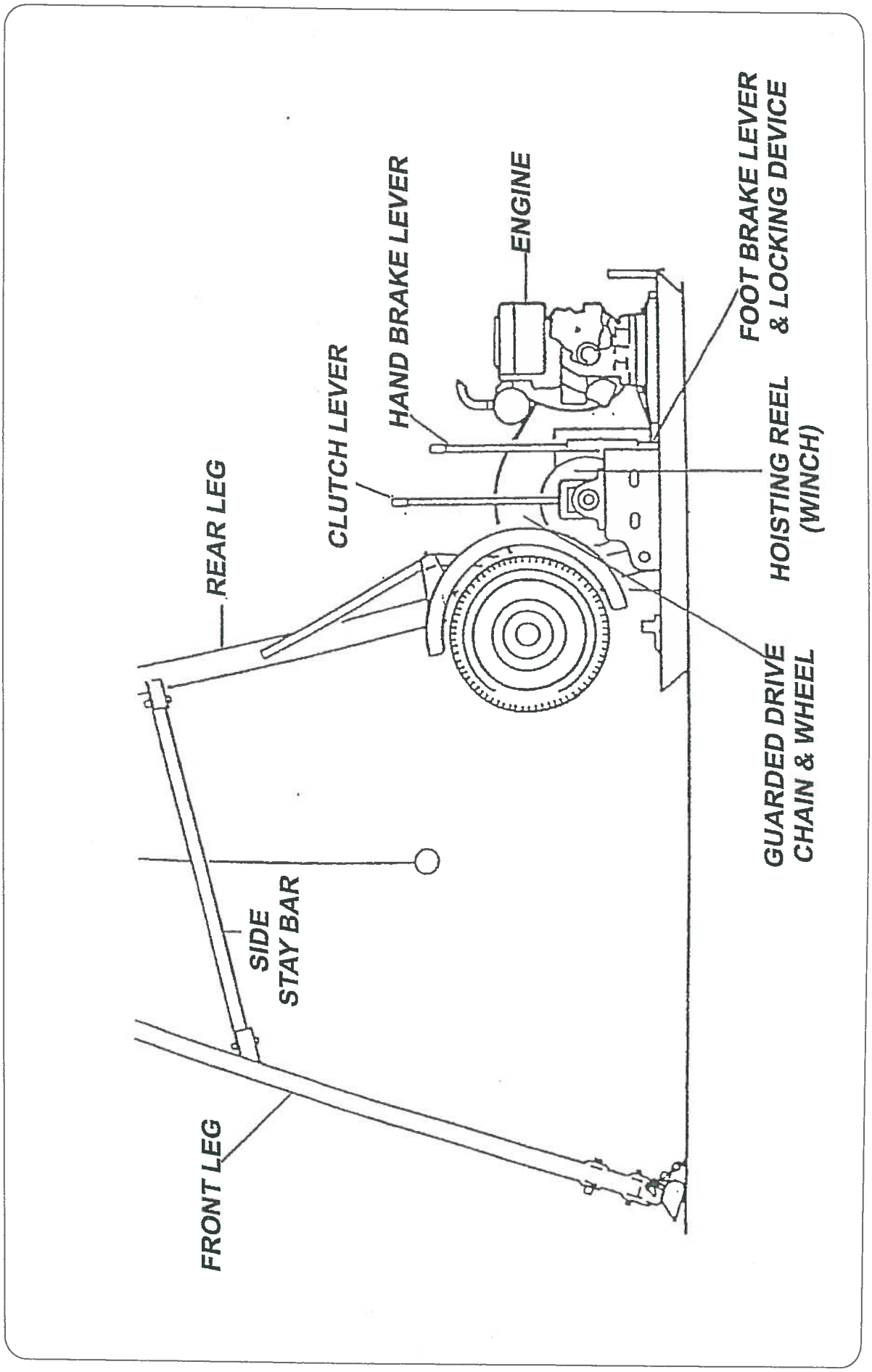
It is important that the brake control be left in the locked position when the machine is not being used, or when tools are being handled in the working area.

The attention of the operator is drawn to the Guidance Notes of Safety - Section 2 - Drilling Operations Cable Percussion, relating to general and specific areas to be noted with regard to the safe operation of the drilling rig.

4.3. ENGINE

Please refer to the instructions in the Engine Manufacturer's Handbook provided.

CONTROL LEVERS AND GENERAL LAYOUT



SECTION 2

GUIDANCE NOTES ON SAFETY

DANDO 2500 INVESTIGATOR DRILL RIG

2. GUIDANCE NOTES ON SAFETY

1. PERSONNEL

1.1. Drilling may entail the employment of men inexperienced in this class of work. Particular care should therefore be taken to explain and enforce safety precautions, and to teach good practice in the handling and use of equipment and plant.

1.2. No workman should be employed on any work unless he has been adequately instructed and trained in that work and is competent to do that work without supervision, or he is working under the instruction and supervision of some person competent to give instruction in and supervision in the doing of that work. This is especially important when employing young persons on drilling sites.

1.3. Alcohol should not be consumed on the site and persons who have been drinking should not be allowed on the site.

1.4. Pranks and horseplay are a common cause of accidents and should be forcefully discouraged. Safe successful work requires serious attention and good teamwork.

1.5. Operators should not lift, carry or move any load which is so heavy as to be likely to cause injury. When lifting it is recommended that the person should stand squarely with a solid footing and should lift the load slowly by straightening the legs rather than the back.

1.6. Care should be exercised when handling weights which must be moved with artificial means, such as pipe used for casing. etc.

1.7. If pipe is to be moved by rolling by hand, this must be done from the ends and the person must ensure that the hands are kept out of the ends of the pipe. Whenever possible the pipe should be rolled away from the person rolling it.

1.8. In general, care should be exercised whenever lifting something, be it heavy or light. In the case of lifting and moving heavy weights, chains, ropes and pipe hooks should be checked to ensure that they are in good conditions and employees should never stand under a raised load.

1.9. Visitors to the drilling site are in more danger than the operator, and should be steered clear of operational areas unless the nature of their visit demands otherwise. If necessary, operations should be suspended until visitors have been moved to a safer part of the site.

2. TRAVELLING TO, ON AND FROM DRILLING SITES.

2.1. Vehicles travelling on public highways must comply with the Highway Code, relevant Road Traffic Acts and with the appropriate Motor Vehicle Regulations currently in force in the United Kingdom or other E.C. Country.

2.2. Before travelling, checks should be made to all vehicles for road worthiness, giving special attention to lights, indicators, screen wiper, registration plates, brakes, brake lights, steering, security of loads, particularly overhanging loads, tyre pressure and wear mud before proceeding onto a public highway.

2.3. Important: It is drawn to your attention that the Dando 2500/3000 models of drilling rigs are **NOT** trailers and should not be loaded with drilling equipment during travel from drilling site to drilling site.

2.4. It is important that checks are make of the coupling and/or hitching of the drilling rig to any towing vehicle. The nose weight of the rig must comply the requirements stated in the vehicle handbook for the necessary positive load.

2.5. Where required long vehicle signs, caution or towing boards should be securely attached.

2.6. When towing equipment, correct towing speeds, reversing and maneuvering procedures should be observed and assistance obtained where necessary. Due regard should be paid to road conditions and visibility at all times. Care should be taken when towing in icy conditions as "jack-knifing" can occur. The safe towing speed should not be exceeded as there is a risk that "snaking" may suddenly develop, which may cause the trailer to lose a wheel.

2.7. Consideration should be given to other road users who may become impatient and take risks - it is advisable to pull into the side occasionally to let them pass.

2.8. Where wide, long or heavy loads are to be moved it is advisable to have all lights on for road travel, even in broad daylight.

2.9. On arrival at the site, ground conditions should be checked before driving in, and a watch kept for temporary overhead obstructions.

2.10. If necessary, an assistant should be used to control traffic if safety dictates.

2.11. Passengers should not be carried on or around the machine.

2.12. The driver of the vehicle should check for all round visibility before commencing any maneuver, especially reversing. If necessary, an assistant should be used to signal. The presence of an assistant does not relieve the driver of his responsibility, so he should constantly check the rear view in his mirror, and by direct sight.

2.13 When maneuvering vehicles, due regard should be paid to soft ground, potholes, gradients, slippery grass and mud, and overhead cables. Special Care should be taken when crossing dykes with improvised bridges. At all times personnel should be kept well clear of moving vehicles in case they overturn. Where winches have to be used, a watch should be kept for flying ground anchors and rope failures.

2.14. Loading and unloading the plant should only be carried out on firm level ground.

2.15. The vehicle's driver should act as assistant during loading and unloading operations. Signals should be agreed beforehand and standard procedures followed.

2.16. When loading or unloading on a public highway, assistants should be used to hold back traffic. These men should be responsible to the vehicle driver only.

2.17. Where the access to and from the site does not have good visibility in all directions, traffic leaving the site should be controlled by a person nominated for that purpose.

2.18. Vehicles should not reverse out of the drilling site on to a public highway.

3. DRILLING SITE PREPARATORY AND RESTORATION WORKS.

3.1. It is of greatest importance that a proper site appraisal should be made before any work is commenced. The results, together with any records of any underground installations, services, workings, etc., should have been made available to the drilling contractor who in any event should take all reasonable steps to obtain them.

3.2. A plan of the site showing the location of hazards to site preparatory work and to drilling operations should be prepared before any equipment is taken on site.

3.3. The drilling contractor should always act with competent engineering advice and assess the general hazards which may arise during construction and drilling due to the nature of the ground, the existence of high water, gas or oil pressures in the strata, surface and underground installations and services.

3.4. The site should be inspected before rig entry to find a safe approach route to the proposed drilling position. Some guidance may be required for winching or lowering rigs on steep slopes and in setting up in marshy or other soft areas.

3.5. It should be ascertained that the load bearing quality of the proposed site is adequate for safe working conditions. Hazardous situations such as old rock fill, unstable material, surface holes on sloping rock surfaces, under dangerous banks or quarry sides and on quarry edges should be avoided.

3.6. A clear access to and from the site should be provided with good visibility in all directions. If this is not possible, traffic leaving the site should be controlled by a person nominated for that purpose.

3.7. The working area should be suitable and where necessary levelled, surfaced and drained. Means should be provided to trap any escape of petrol, diesel fuel or oil which might leak into the water courses, fields or public drains, before it leaves the site.

3.8 The site should be adequately fenced and warning notices posted, with separate fencing and warning notices being provided for any mud or slurry pits.

3.9 Where working platforms are required to support men, equipment and/or materials, the platform should be properly constructed. It should be of adequate dimensions, and if over 2 metres above ground, should have guard rails and toe boards so placed to prevent falls of persons or articles from the platform. Similar guard rails and two boards may be considered desirable on platforms constructed at lesser heights in some circumstances. The platform construction and stability should be checked weekly for defects.

4. SETTING UP

4.1 The site must be kept in a well organised tidy state and clear of all debris and extraneous material.

4.2 It is preferable for acoustic barriers to be constructed of non-flammable material.

4.3 It should be ensured that all relevant machine guards have been installed before starting up any machine.

4.4 Bulk stocks of fuel, oil and gas cylinders should be stored in a designated compound remote from the immediate working area.

4.5 Rods, casings etc. should be neatly stacked, preferably on appropriate racks and maintained in a clean condition.

4.6 Threads and connectors should be regularly cleaned and greased, and preferable protected with thread protectors.

4.7 Tools and materials should be laid out accordingly to requirements and in order of use.

5. DRILLING OPERATIONS - GENERAL

5.1 Drilling may entail the employment of some personnel inexperienced in this class of work. In such circumstances, particular care should be taken to explain and enforce safety precautions, and teach practice in the handling and use of equipment. It is important that safe working systems of work are adhered to by all personnel.

5.2 Inexperienced men should always remain under expert supervision.

5.3 At the commencement of each shift the incoming crew should always make certain that the equipment is in a useable and safe condition. Unsafe conditions and any significant change in operating conditions should be reported in the driller's log book and any action taken thereon should also be logged.

5.4 Each operation must have its set routine, each team member knowing exactly what part he is to play.

5.5 Under no circumstances must a rig be operated by one man.

5.6 High noise level areas should be identified and hearing protection worn where necessary.

5.7 Where engine noise or other sounds prohibit verbal communication, a clear set of signals which are clearly understood and known by each team member should be used. This will also apply when ear defenders are worn.

5.8 It should be ensured that the winch operator has a clear view of men operating equipment at all times.

6. DRILLING OPERATIONS - CABLE PERCUSSION

6.1 A firm and level working surface should be established for the erection of the rig using timber sleepers where necessary. Mast guys, if applicable, should be correctly positioned and securely anchored, properly tensioned and frequently checked.

6.2 The equipment should always be operated in a safe manner and in accordance with the manufacturer's instructions.

6.3 Cable tools which are not in use should be laid down horizontally on timber grillage and should not be left in an upright position resting against the derrick.

6.4 The correct tool should always be used for the operation being undertaken.

6.5 Personnel should keep clear of suspended equipment and use a rope, strap or bail hook to swing tools away from the borehole. They should never look down the borehole beneath a suspended tool.

6.6 When the drive clamps are suspended or in use the operator should not place his hand on the drive head. When casing is being driven the drive clamps should not be suspended above the operator's head. Short lengths of casing can be used for this operation.

6.7 Tools should not be held in suspension be means of only the hand or foot control when personnel are changing or working on them.

6.8 The winch operation should be in accordance with the manufacturer's instructions, and should not be overloaded when pulling casing. When additional force is required proper jacking equipment with positive connections between jack head and casing should be employed, or an appropriate casing jar.

6.9 Casing tubes and tool joints should always be screwed well home in order to avoid damage to the threads and to prevent parting.

6.10 When driving casing, personnel should not place their fingers in tommy bar holes or over the lip of the casing.

6.11 All worn or splintered drive heads, drilling tools, sinker bars. Etc. should be replaced. Crushed, bruised or damaged wirelines should be removed immediately.

6.12 Sheave Wheels shafts and pins should be checked daily, kept well lubricated and replaced when worn.

6.13 Personnel should be alert for indications of broken strands of wire ropes and of shackles becoming undone.

6.14 Cuttings or spoil at the hole collar should not be cleared by hand or any tool unless the rig is in neutral and the clutch disengaged.

6.15 Slurry pits should be positioned so that they can be reached safely and easily by the bailer/shell without danger to the drill crew or undue stress on the bailing line. They should not be so close to the rig as to undermine the rig grillages.

7. PLANT MAINTENANCE

7.1 Plant, machinery and structures should be inspected at regular intervals in accordance with the manufacturer's recommendations. In the case of plant which is subject to corrosion, steps should be taken to effect repairs before corrosion reaches dangerous limits.

7.2 A planned preventative maintenance system covering shaft, daily, weekly and periodic times should be established for the different types of machine used. This should include the inspection of all pulleys, drum surfaces and ropes, and should stipulate their regular cleaning and lubrication. The system should include a three part sequence of inspection, thorough examination and testing. Results of each stage should be recorded and signed.

7.3 Cleaning, repair, maintenance, oiling or greasing of machines or the topping up of fuel tanks should not be carried out whilst a machine is operating.

7.4 If inspection involves the running of a petrol or diesel engine in an enclosed space, all doors and windows to the workshop should be opened and even then the engine should only be run intermittently to avoid dangerous build-up of fumes.

7.5 All plant should be kept clean by the regular removal of mud and dirt and of snow and ice in the winter, if applicable.

7.6 When major dismantling of components is necessary, the correct lifting equipment should always be used and is should be ensured that struts and chocks are strategically placed as the process continues.

7.7 The ignition key should always be removed, and a notice placed in a prominent position that it cannot be missed, if it is necessary to work underneath a machine, or to leave it in an incomplete unsafe state.

7.8 Moving parts of machinery are guarded where possible and such guards should be in position when machinery is in normal operation. Guards should not be removed except as required for maintenance purposes when the machine should be immobilised.

7.9 Lifting machines and tackle should be inspected and tested at set intervals and certified for the maximum permissible working loads, and these loads should not be exceeded. Following and major repair, they should be re-certified before returning into service. The owner/operator should be aware of current legislation in force in their own country and comply with all regulations with regard to re-testing of equipment.

7.10 Electrical installations should be effectively earthed.

7.11 Electrically operated hand tools, together with leads and earth wires, should be inspected at regular intervals to ensure that they have been maintained in good order, and such inspections should be recorded.

7.12 Trailing cables, except for hand-lamps and small portable tools should be of a standard equal to BE 708. Pliable armoured cables are preferred.

7.13 When high pressure grease guns are used, protective gloves should always be worn and care taken to avoid injecting grease under the skin.

7.14 Hose used for steam cleaning should be of the type make for steam service. The metal nozzle should be securely clamped to the hose and maintained in serviceable conditional at all times.

7.15 A flammable liquid with the classification of Class 'A' or Class 'B' petroleum should not be used for cleaning purposes, except in very special circumstances, and then by written permission only.

7.16 Loose board and materials not in use should be removed from the derrick floor.

7.17 Steps and guard rails, where applicable, should be maintained in good condition. If it is necessary to remove them temporarily during installation of the machinery, they should be replaced without delay when finished.

7.18 To eliminate slipping hazards, drilling floors, etc. should be kept as free of mud and oil as practicable. Better footing is provided if the floor is washed while the next stand of pipe is being picked up. Non-skid materials are useful in some areas to prevent slipping.

8. SITE ABANDONMENT

8.1 Every uncompleted borehole should be fenced or temporarily capped in a safe manner when the rig has moved off and until the hole is finally capped.

8.2 Unless a borehole is required to be kept open for some specific purpose, it should be infilled, consolidated and capped in such a manner that there will be no subsequent depression at ground surface due to settlement of the infill material.

8.3 A surface standpipe should be withdrawn or cut at least one metre below ground level prior to infilling the borehole.

8.4 Capping pads should be placed at least one metre below ground level.

8.5 Mud and slurry pits should remain adequately fenced and signposted until emptied, backfilled and consolidated. Any impervious membrane should be removed prior to restoration.

8.6 The site should be left in a safe, clean and tidy state, with all gates and fences left as found.

9. TRAINING

9.1 The most important factor of all on site safety is the full education and practical technical training of all drill crew members, in all aspects of drilling and associated operations.

9.2 Such training should include not only basic safety precautions but also a thorough understanding of the correct use of all plant, equipment and tools.

9.3 In addition, knowledge should be given of the forces of both energy and mass with the crew control through the medium of the drill rig.

9.4 The prime concept of this training is to teach each crew member to do his own job efficiently and safely and to so work with the other members of the crew that good and safe team work become instinctive.

9.5 This not only results in steady and safe progress, but secures higher production.

9.6 All training whatever the size of the organisation, should be formally programmed throughout the number of stages required by the personnel concerned. Each step in the training module or syllabus should be monitored by a fully trained instructor and duly recorded towards the eventual certification of the trained upon completion of the course concerned.

9.7 Training should be presented that the stimulation of personal interest and the known attainment of craft and skill achievement is a main aim and result. Such training therefore, should be initiated and encouraged by both management and supervisory staff.

9.8 One emphasis should be made on the value of efficient teamwork and towards the goal of high and safe production.

9.9 It cannot be too strongly stressed that the operatives involvement and outlook is dependent upon the quality and support of the employer.

9.10 The responsibility for all aspects if site safety rest with all levels of management.

10. WELFARE AND PERSONAL PROTECTION.

10.1 The Health and Safety at Work Act 1974 (United Kingdom) requires every employee, while at work, to take reasonable care for the health and safety of himself and of other personal who may be affected by his acts or omissions at work. In this connection personal and site safety and hygiene are most important.

10.2 Adequate and suitable protective clothing should be provided for any person employed who by reason of the nature of his work is required to continue working in the open air during rain, snow, sleet or hail.

10.3 Adequate accommodation for personnel to take shelter during bad whether, for the storage, drying and changing of clothing and for taking of meals should be available. Such accommodation should include the facility for boiling water, heating food, the provision of washing facilities to permit personal hygiene. Personnel should be encouraged to wash before partaking of food.

10.4 Washing and kitchen waste water should be discharged into a pit or sump dug into the ground remote from ditches and water courses.

10.5 Empty cans, bottles, plastic containers, drums and scrap metal, wire rope etc., should be placed in containers for transport to recognised waste disposal sites.

10.6 Suitable ventilated chemical toilets hosed to provide privacy, should be available. These should be regularly serviced and contents disposed of in accordance with manufacturer's instructions. Personnel should be encouraged to wash after using these facilities.

10.7 Potable/drinking water should be available and containers clearly marked from non-potable/non-drinkable water.

10.8 Oil saturated clothing is a fire risk and also a health risk in that it irritates the skin. They should be changed as soon as possible.

10.9 Advice should be sought from the local water authority and their medical officer of health prior to working in sewers or in waste water disposal sites. When working in these situations rubbing of the nose or mouth with the hands should be avoided. On completion of the work, hands and forearms should be thoroughly washed with soap and clean water with an added disinfectant. Any cut, scratch or abrasion should be cleaned, treated with antiseptic and completely covered until healed.

10.10 The possibility of existing excavations transmitting bacteria carrying liquids into a working area should not be overlooked.

10.11 It is advisable that drilling crews should receive regular anti-tetanus injections, and always carry the anti-tetanus injection card with them.

10.12 Relatively harmless materials can cause irritation leading to more harmful effects by repeated or prolonged exposure so that every effort should be made to avoid inhaling dust, fumes or smoke. Should such conditions have to be endured as a temporary measure, suitable protective equipment should be used.

10.13 Similarly, prolonged or repeated contact with the skin of certain substances, chemicals, oils or other fluids can be harmful. Under these circumstances protective gloves. clothing should be worn, and/or barrier creams used. Any such skin contact should be washed before eating food, and this should not be consumed in the working or contaminated areas.

10.14 Personnel should be fully protected against any hazard likely to be incurred in carrying out their work. Protective clothing and equipment should therefore be issued, maintained in good order and replaced when necessary.

10.15 Rig personnel should wear only close-fitting clothing, preferable distinctly coloured overalls. Clothing should be kept clean by frequent washing, and each crew member should have a clean change of work clothes on location at all times. Particular care should be taken to ensure that drawstrings to hoods or other items of clothing are not left dangling so as to become entangled in any moving parts.

10.16 If overalls are not worn, long-sleeved shirts with tails tucked in will provide protection against sunburn, insect bites, scratches, injurious chemicals and flash burns.

10.17 Safety helmets must be worn by members of the drilling crew and visitors to the site. Safety boots and safety wellingtons should be worn.

10.18 When working on or adjacent to the public highway, a top coat, jerkin or waistcoat, with fluorescent markings should be worn at all times.

10.19 The use of gloves whenever practicable is recommended. Gloves prevent minor injuries when employees are handling rough materials or skin irritants. Only short, tightfitting gloves should be worn. Gauntlets may become caught in the machinery and workers may be pulled into moving machinery they wear them.

10.20 Hairnets should be worn by persons with dangerously long hair. Loose clothing, i.e. trailing scarves, ties etc. should be avoided, especially when working near rotating machinery.

10.21 Rig personnel should never wear finger rings or bracelets while working.

10.22 Eye protection is of the utmost importance. An eye injury, no matter how slight, should receive prompt medical attention. Even a slight eye injury may lead to serious complications.

10.23 The correct eye protection should be provided and should be maintained in good condition on each drilling site. Employees should wear approved safety glasses or goggles when chipping, grinding, scraping, buffing, breaking or cutting any metal or material that involves a flying chip hazard.

10.24 Operators who wear contact lenses should wear eye protection and should always be aware of the problems posed by contact lenses when attempting prompt emergency treatment following the introduction of foreign material into the eye.

10.25 Splashproof chemical goggles or face-shields should be used when handling potentially hazardous or injurious chemical liquids, powders or vapours such as cement, chemicals, chemical cleaning solutions, creosoted material, molten metal, asphalt and bitumastic compounds. Goggles also should be worn by person near operations which require the use of safety goggles by the operator.

11. WIRE ROPES - GENERAL SAFETY AND MAINTENANCE.

11.1 Regular inspection of ropes in service is essential if high standards of safety are to be ensured, and the relevant test certificate obtained and available.

11.2 All running ropes in continuous service should be visually inspected once every working day by an authorised person.

11.3 A thorough inspection of all ropes in use should be made at least once a month and a full written, dated and signed report of rope condition kept on file and be readily available.

11.4 Any deterioration resulting in appreciable loss of strength, such as described below should be carefully noted and the rope should not be used if any of the following situations are present:

a) Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion or wear of outside wires.

b) In any length of diameters of the total number of visible broken wires exceeds five percent of the total number of wires in the rope.

c) Corroded or broken wires at end-connections.

d) Corroded, cracked, bent, worn or improperly applied end-connections.

e) Severe kinking, crushing, cutting or unravelling.

f) Heavy wear and/or broken wires may occur in sections in contact with equaliser sheaves, or other sheaves where rope travel is limited, or with saddles. Particular care should be taken to inspect ropes at these locations.

g) All rope which has been idle for a period of a month or more due to shutdown should be given a thorough inspection before it is placed in service. This inspection should be for all types of deterioration and should be performed by an authorised person whose approval should be required for further use of the rope.

h) Particular care should be taken in the inspection of non-rotation rope.

i) Wire rope removed from service due to defects should be plainly marked or identified as being unfit for further use on load carrying devices.

11.5 Upon receipt of wire ropes, whether they arrive in coil form or on reels, it is advisable to examine, and if necessary remove, the outer protective wrapping. This may have become wet during transit and, if left on the rope, local corrosion will appear in course of time. Ropes should be stored in a dry atmosphere and preferable off the floor, on well seasoned timber.

11.6 Rope delivered in reel form should have the reel jacked up to turn freely, so that the rope can be carried straight from the reel. Provision should be made to stop reel rotation by a braking device, however simple.

11.7 When rope is delivered in coil form, it should be rolled along a smooth surface, like a hoop, away from the end of the rope, and protected from unnecessary bending and abrasion.

11.8 When rope cannot be stretched out straight, it should be arranged in a long narrow "U" or series of "U"s with as wide a radius for the turn of the "U" as possible.

11.9 When handling wire rope it should be manipulated so that this natural twisting action will not cause it to kink.

11.10 A replacement rope must be of the same type and specification as the original fitted to the rig by the manufacturer and also of the correct safe working load.

11.11 Care should be taken when installing ropes on winding drums to ensure that there is even tension of the new rope being pulled round that system, that sharp bends are avoided and that the rope is kept clear of dirt and abrasive materials.

11.12 Rope should be kept tightly and evenly wound on the drums.

11.13 When the rope is feeding onto the drum it should not be touched by hand.

11.14 In order to prevent crushing the rope where a drum divider is used, there should not be more than four turns on the working section when the tools are at the deepest point.

11.15 Overruns should be avoided by correct winch operation.

11.16 The rope should be firmly fastened in the drum with set-screws, or a suitable clamp, and three full turns of the rope should be kept on the drum at all times.

11.17 Every rope should be thoroughly lubricated with the correct wire rope dressing as it is installed, and kept similarly coated throughout its life.

11.18 When equipment using wire rope is kept in dead storage for any length of time, the rope should not be left on the equipment.

11.19 Connections, fittings, fastenings parts, etc. used in connection with cables and ropes should be of good quality and of proper size and strength and should be installed in accordance with the recommendation of the manufacturer.

11.20 Socketing, splicing and sizing of wire rope should be performed by qualified persons.

11.21 All eye splices should contain the proper size of rope thimble.

11.22 When wire rope clips are used, the base of the clip must bear on the "live" end of the rope - the "live" end being the free-running portion of the rope. The "U" section of the clip bears on the dead end of termination fold of the rope. Failure to follow this procedure could cause the "U" bolt to kink or cut the live end of the anchor and cause failure.

11.23 Spacing of the clips, or "U" Bolts, is also important. They should be installed about six rope diameters apart, and tightened securely before the rope is placed in tension - and tightened again after the rope is put into use. The pulling on the rope can cause a slight reduction in its diameter with a resulting loosening of the clips.

11.24 When a wedge socket-type of fastening is used, the dead or shortened end of the rope should be clipped with "U" Bolts or otherwise made secure against loosening.

11.25 Winch ropes should not be looped, knotted or kinked around themselves or any other object except a suitably designed "D" etc.

11.26 Lifting hooks or shackles should be attached to the winch rope via a swivel connection which can operate under maximum load.

11.27 Whenever possible, new wire rope should be run under light load for a short period after it has been installed in order to adjust the rope to working conditions.

11.28 Sudden, severe stresses are injurious to wire rope and such applications should be reduced to a minimum. A jerk line may be rigged and clamped to the drilling line when it is necessary to be subjected to jarring in one place.

11.29 Experience has indicated what wear increases with speed: economy results from moderately increasing the load and diminishing the speed.

11.30 All winch ropes should be checked from time to time for excessive wear and be replaced when necessary.

11.31 Personnel should be kept a safe distance from lines being used for hoisting and pulling. They should never straddle them or reach across them, since serious injuries can result from the whiplash of a line that either breaks or is loosened suddenly. When straightening cable of winding it onto a hoist drum, the operator should be constantly alert at the controls.

11.32 If rope is used to haul equipment to the working areas a straight pull should be maintained from the winch through the pulley to the equipment.

11.33 Protective gloves should be used when handling wire ropes.

SECTION 3

MAINTENANCE AND ADJUSTMENTS

DANDO 2500 INVESTIGATOR DRILL RIG

3. MAINTENANCE AND ADJUSTMENTS

1. ADJUSTMENTS TO WHEELS & BRAKE CABLES.

WARNING:

Due to natural initial stretch associated with wire lines, it is advisable after the first few days of towing the rig to check and adjust the over-run brake operating cable. Adjustment can be made using the turn-buckle.

Brake cable condition etc., should be checked at regular intervals and adjustments made if necessary.

Wheel brakes must be adjusted by rotating wheel forwards & tightening until it locks up, then back off two complete turns.

2. HOISTING REEL - DIVIDING PLATE

CAUTION:

When using hoisting reels fitted with a dividing plate to provide a storage and working section of the drum, it is important that the correct section of the drum is used for each function.

The working section is the part nearest the mast or derrick centre line, while the storage side is off centre and incorporates the rope anchor. Using the storage section on the working side will lead to premature failure of drilling sheaves and damage to the rope.

3. MAINTENANCE

3.1 **ENGINE:** Maintenance of the engine should be carried out in accordance with the engine manufacturer's instructions. (See Section 6)

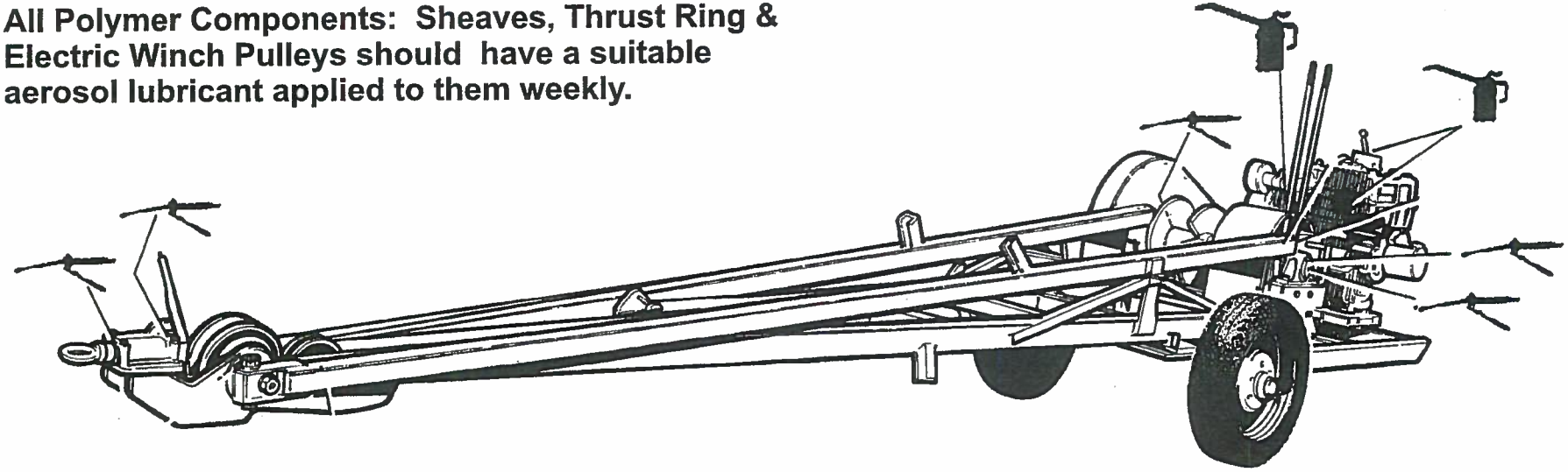
3.2 **DRIVE:** The chain drive should be kept well lubricated using a good quality grease. (See Lubrication Chart).

3.3 **WINCH:** The winch shaft and drum are mounted on sealed roller bearing units which should require no maintenance. The clutch operating mechanism should be greased daily using a grease gun to the nipple provided at the end of the shaft. A suitable aerosol lubricant should be applied to the thrust ring & sheave shafts each week. Occasionally oil the control lever and brake lever pivot points. (See Section 5)

3.4 **GEARBOX:** Check daily level of gearbox oil, all other bearings are sealed units which should require no maintenance. (See Section 7)

DANDO LUBRICATION CHART

All Polymer Components: Sheaves, Thrust Ring & Electric Winch Pulleys should have a suitable aerosol lubricant applied to them weekly.



GREASE POINTS

Overrider & Towing Eye (2)
Pillow Block (2)
Hoisting Reel Shaft

Recommended Grease - Lithium based No. 2 Grease.

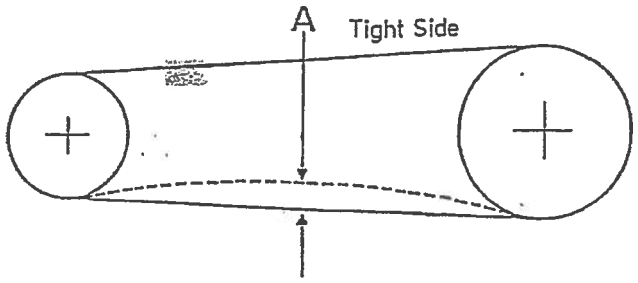
Recommended Oil - SAE EP 90.
Gearbox Oil - 3 Pints - 1.72 Litres (Approx)
Check Daily

Occassionally oil the Control/Brake Lever Pivot Points.
All other Bearings are Sealed Units which should require no maintenance.

4. ADJUSTMENTS

4.1 DRIVE

The chain may in time become slack due to stretch and wear. This should be taken up by pulling back on the engine, slots are provided on the engine bearers.



See diagram above:

N.B. The Drive Chain should be adjusted to allow movement of between 12 and 20mm (Distance A)

4.2 BRAKE - HOISTING REEL
(SEE SPARE PARTS SECTION – ASSEMBLY OF FOOT BRAKE)

It is important to keep the brake correctly adjusted at all times. On the brake there are three points which should be checked in the following order:-

1. There is a screw connection between the brake band and the brake lever which must be clear of the base side member. Small amounts of adjustment are possible by disconnecting the lower 'fork end', and rotating. This should however, only be used to ensure that the rod is vertical in the off position or the free fall performance of the winch will be affected.

2. The main adjustment screw, used to compensate for the wear and stretch, is situated below the brake band. Adjustments are made by slackening the locknut on one side of the pull cable saddles and tightening the lock nut on the opposite side.

3. With the brake lever correctly adjusted position the brake lever retaining catch to suit. To do this turn the bolt head in the centre of the handle clockwise to lower and anti-clockwise to raise the retaining catch.

WARNING: it is essential that the brake control and its lock are kept properly adjusted at all times, such that the blade is seated in its notch with the brake securely on.

4.3 CLUTCH

For the satisfactory operation of the rig, it is essential that the clutch unit should be maintained in correct adjustment. The clutch unit fitted on the drilling hoist is capable of transmitting far more power than is available from the engine.

In consequence if the hoist drum is held stationary by the brake then providing the clutch is in good condition and correctly adjusted it should need only a small amount of pressure on the operating lever to stall the engine.

The power of the clutch cannot be increased, but adjustment can be made to take up wear on the clutch shoes if this is causing excessive movement on the operating lever.

The small expansion and contraction of the clutch shoes resulting from the available movement of the operating lever must be regulated to allow both full application of pressure for driving and complete release to give free drum rotation.

The clutch adjuster provided for this purpose has to be correctly set to allow the shoes to move within the required limit. To make the necessary adjustment see that there is no load on the winch then with the engine stopped and the brake off, remove the Clutch Guard, slacken the locknut and turn adjuster anti-clockwise to slacken operating pull cable.

Rotate clutch assembly 180° to bring clutch shoe adjuster slot to the operational area, and turn the adjuster downwards with a screwdriver until the shoes lock onto the winch drum. Turn adjuster upwards until winch is just free to rotate.

Rotate clutch assembly through 180° to bring Pull Cable into the operational area. Tighten adjuster to give operating handle travel required, locking the Pull Cable in the desired position using the locknut.

NOTE WELL: IN ORDER TO MINIMISE FRICTION IN THE PULL MECHANISM BEFORE PINCHING LOCKNUT TIGHT, ENSURE THAT THE INDICATOR SLOT ON THE END OF THE PULL CABLE IS VERTICAL. ITS POSITION MAY BE ADJUSTED BY EITHER INSERTING A SCREWDRIVER IN THE INDICATOR SLOT AND TURNING, OR EASING BACK THE HEXAGON ADJUSTING NUT.

The clutch should now be set ready for operation, but extraneous causes can however result in the clutch failing to operate correctly, the most common being:-

a) Damage to the Pull Cable operating mechanism. This being most frequently caused by the drill line getting wrapped around it beyond the limits of the drum, but this can only occur if the guard is not fitted.

b) Damage to the surface of the shoes and to the internal face of the drum caused by small pieces of stone or grit getting into the clutch and being trapped between shoe and drum.

In addition to keeping the clutch itself correctly adjusted it is also essential to see the operating mechanism between the clutch lever and the Pull Cable attaching to the clutch expander is maintained in reasonable working order.

If this mechanism including the trust ring is allowed to become slack and badly worn, then it will be impossible to transmit the necessary movement in order to expand and contract the shoe. The main points to be watched are:-

a) See that the nut which locks the Pull Cable plate is kept tightened.

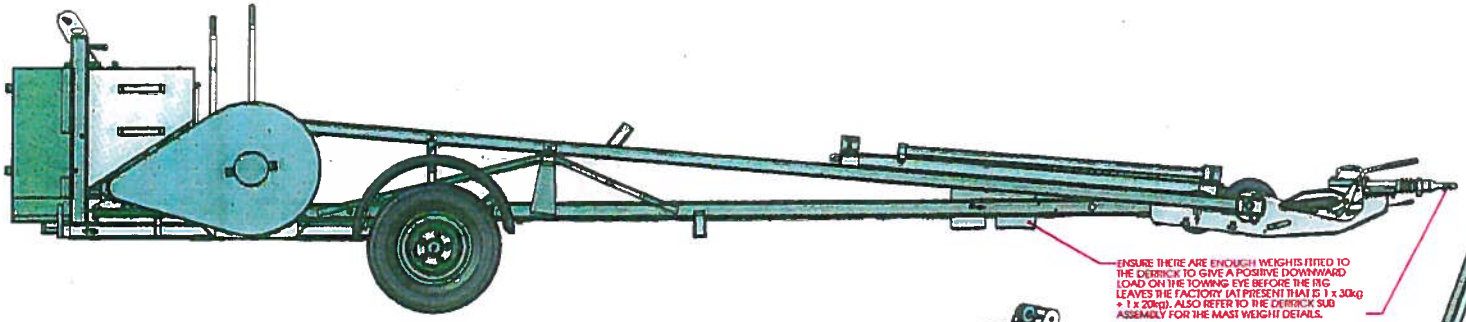
b) The main wearing component is the thrust ring. If this is allowed to become slack, then it will be impossible to transmit the necessary movement between the clutch lever and the clutch unit. The thrust ring is held in position by a locking ring which can be rotated to take up wear as it occurs.

   To carry out this adjustment, remove the two locking screws which seat in keyways on the main body. Then rotate the ring a quarter turn or so in order to take up the wear that has occurred on the thrust ring. Position the ring so that the locking screw holes are opposite the keyways. Insert the locking screws and tighten.

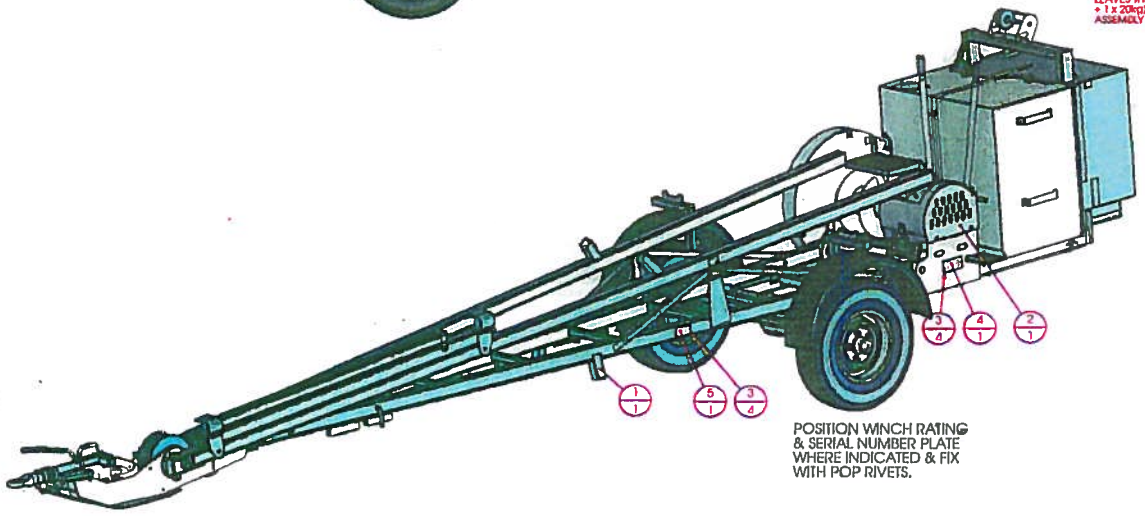
SECTION 4

SPARE PARTS ILLUSTRATIONS AND LISTINGS

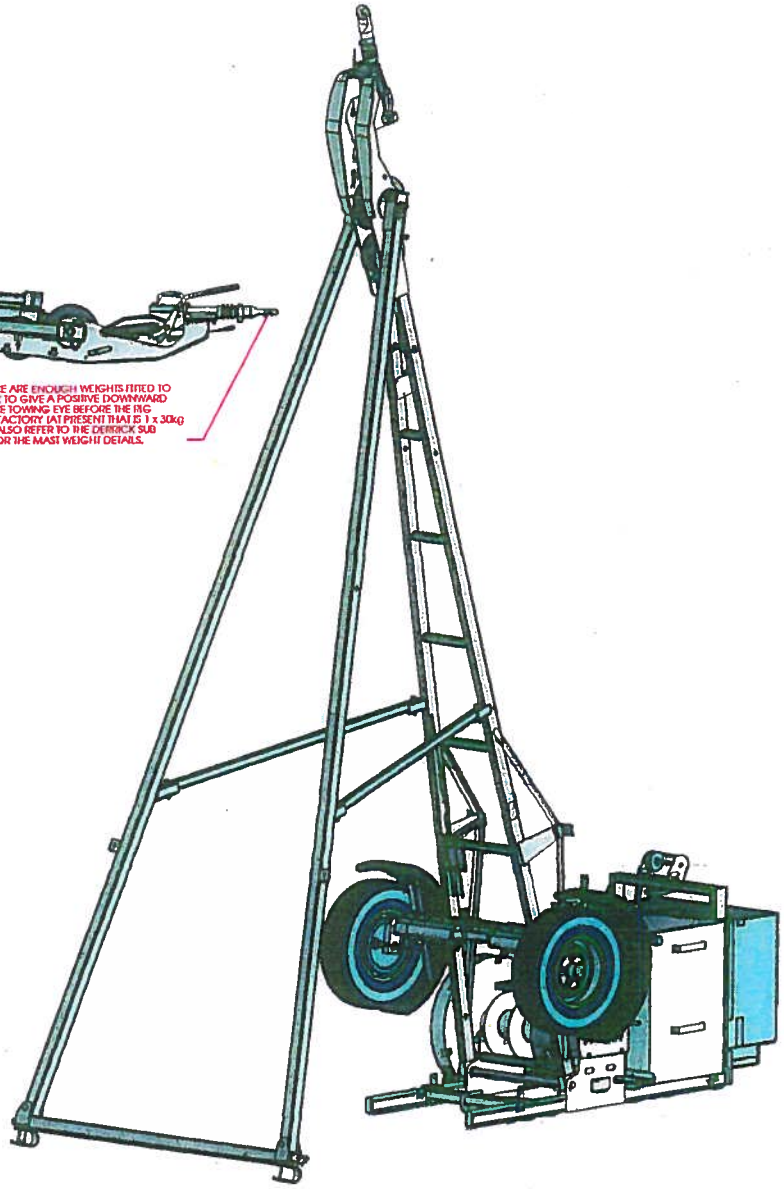
DANDO 2500 INVESTIGATOR DRILL RIG



ENSURE THERE ARE ENOUGH WEIGHTS FITTED TO THE DERRICK TO GIVE A POSITIVE DOWNWARD LOAD ON THE TOWING EYE BEFORE THE RIG LEAVES THE FACTORY. (AT PRESENT THAT IS 1 x 30kg + 1 x 20kg). ALSO REFER TO THE DERRICK SUB ASSEMBLY FOR THE MAST WEIGHT DETAILS.



POSITION WINCH RATING & SERIAL NUMBER PLATE WHERE INDICATED & FIX WITH POP RIVETS.



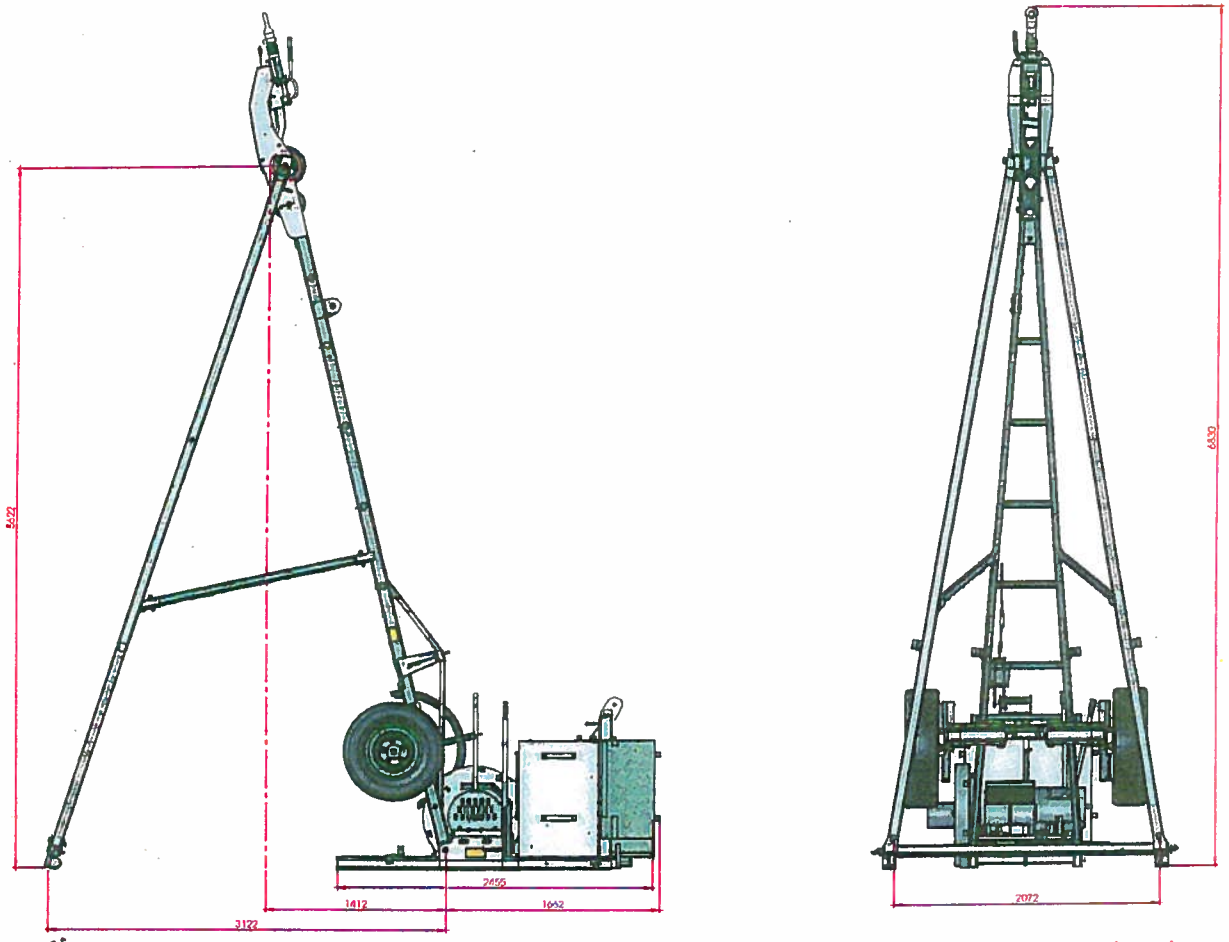
R006002T2 GENERAL ASSEMBLY

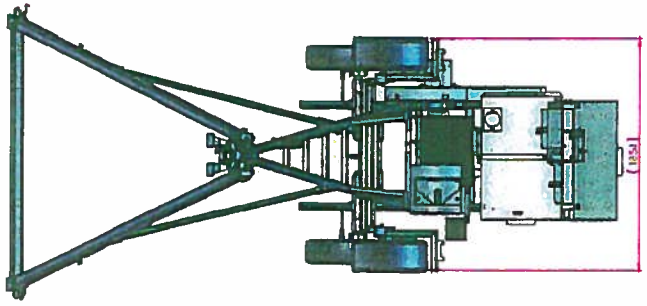
DANDO DRILLING INTERNATIONAL LTD

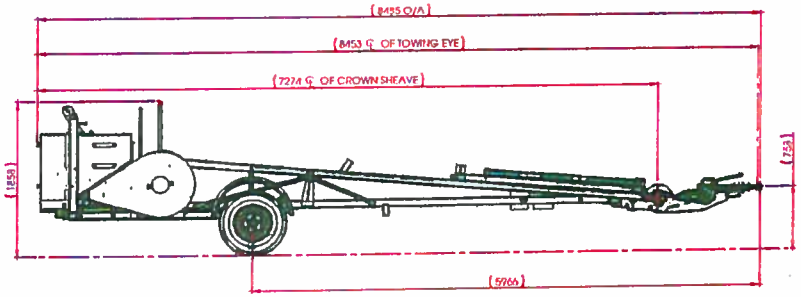
DANDO 2500 INVESTIGATOR

GENERAL ASSEMBLY – R006002T2

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01200L501	1	Derrick Sub-Assembly
2	C006C0013	1	Power Pack Assembly
3	C006C0082	1	Electrical Diagram / Parts Not Shown
4	ST09904X500	2	Name Plate "Dando"
5	ST09903X665	1	9" Quadrafoil – Plastic
6	ST03554X693	16	Pop Rivet.
7	ST09905X500	1	Serial Number Plate
8	ST09906X500	1	Winch Rating Plate







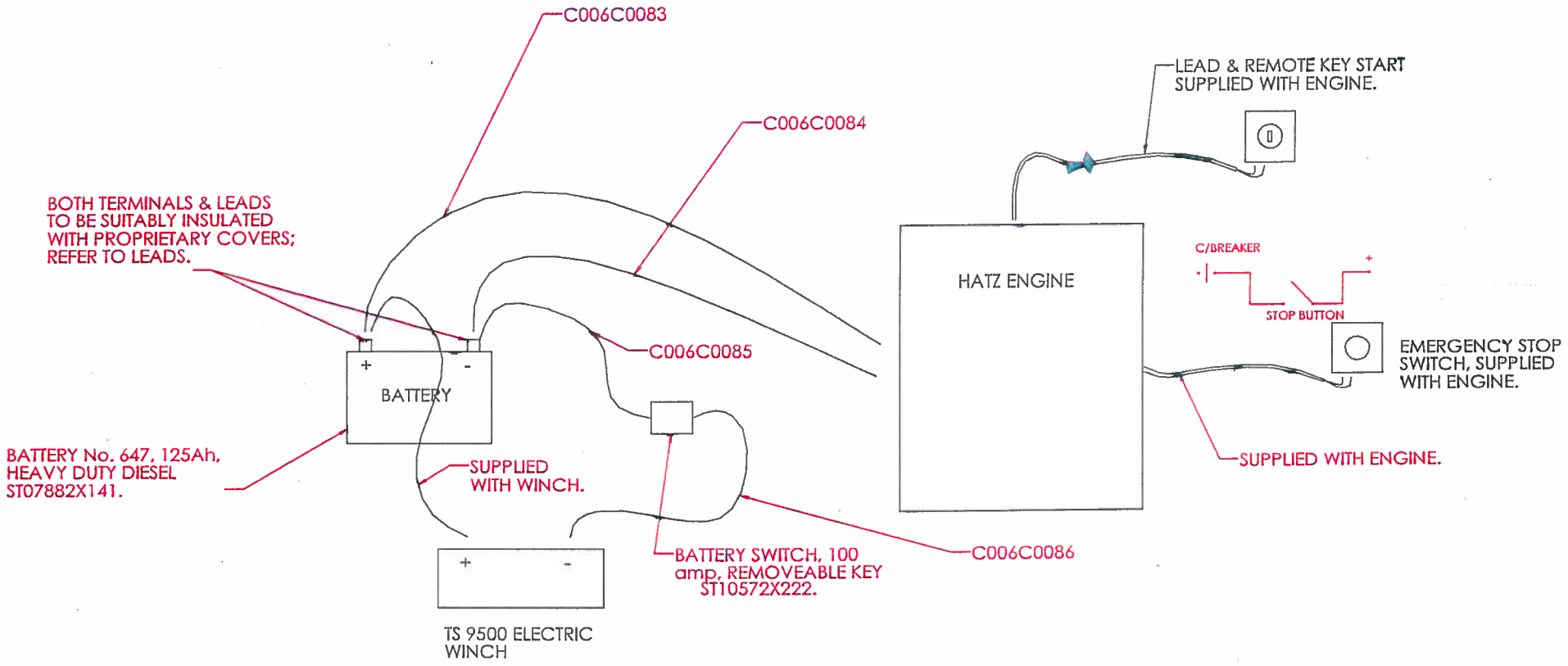
R006002T2 GENERAL ASSEMBLY

DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

GENERAL ASSEMBLY WITH OVERALL BASIC DIMENSIONS – R006002T2

ILLUSTRATION ONLY.



C006C0082 ELECTRICAL DIAGRAM

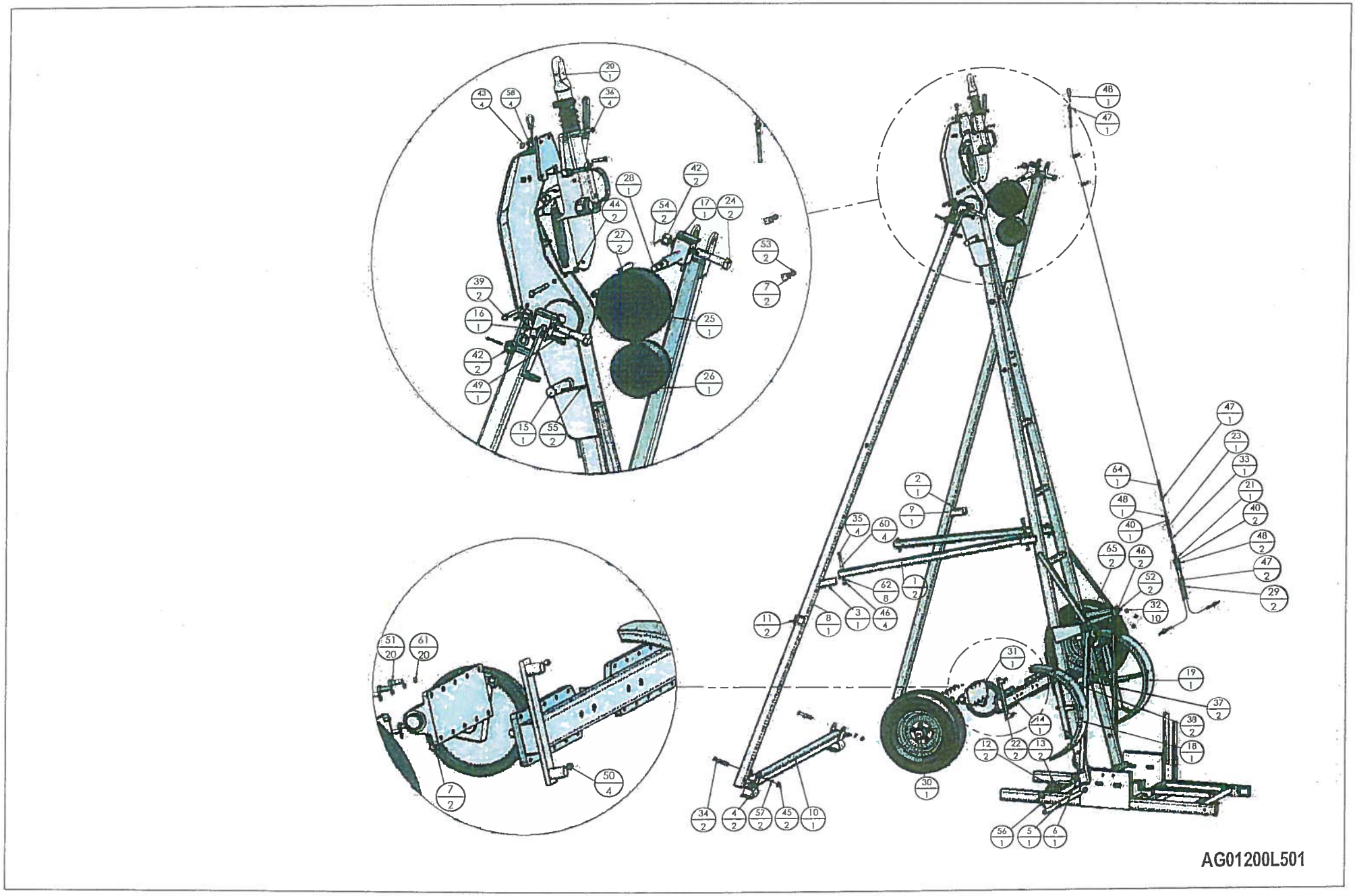
DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

ELECTRICAL DIAGRAM – C006C0082

ITEM	PART NUMBER	QTY	DESCRIPTION
1	C006C0083	1	Positive Battery Lead
2	C006C0084	1	Negative Battery Lead
3	C006C0085	1	Negative Battery/Isolator Lead
4	C006C0086	1	Negative Isolator/Winch Lead
5	ST07882X141	1	Battery 125AH Heavy Duty Diesel
6	ST10572X224	1	Isolator Switch

DERRICK SUB ASSEMBLY

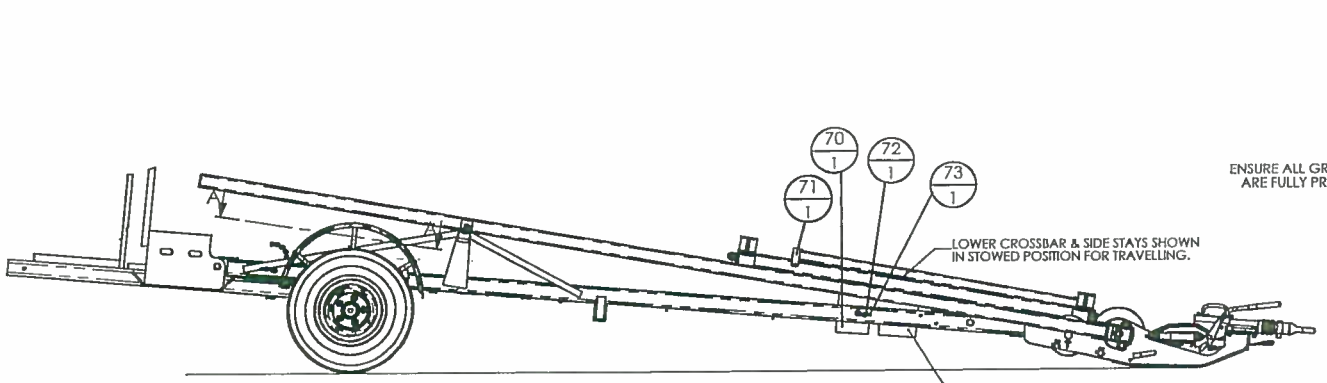


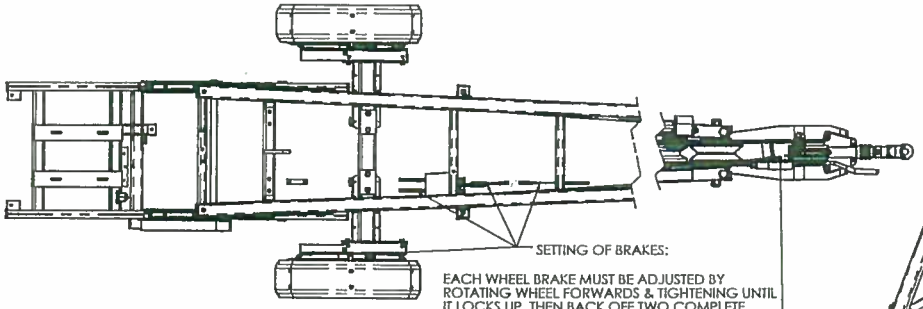
DANDO 2500 INVESTIGATOR

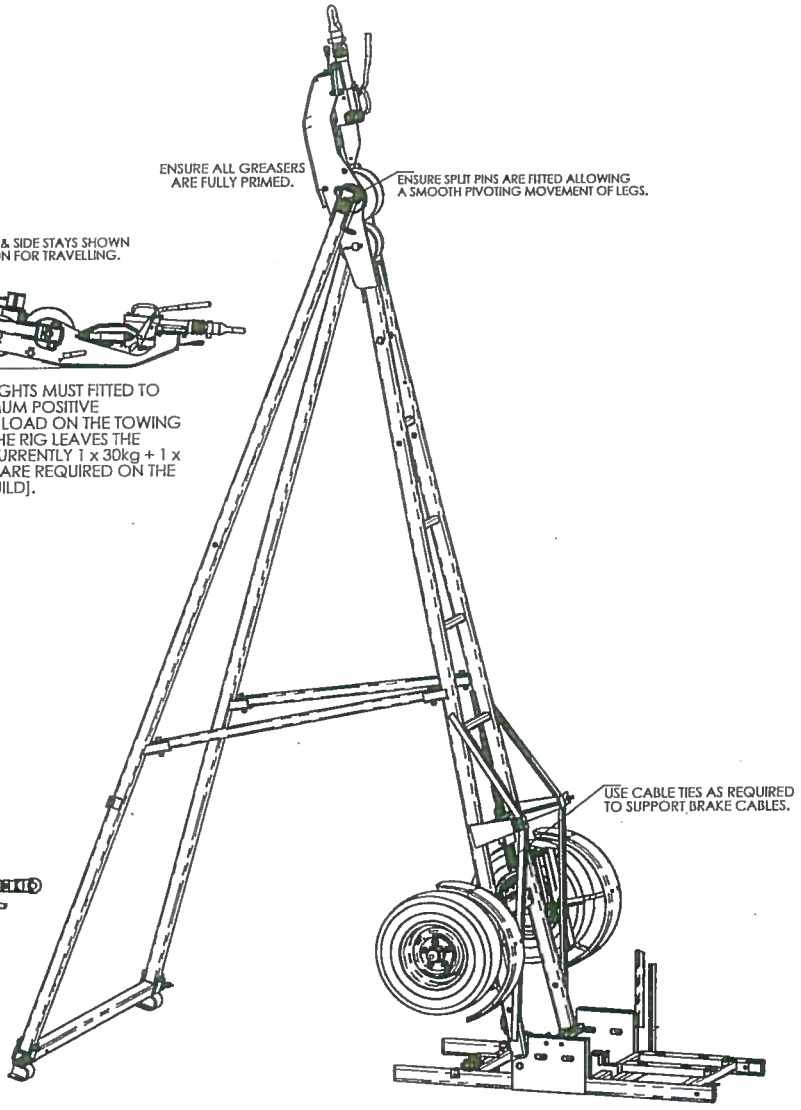
DERRICK SUB-ASSEMBLY AG01200L501

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00335H101	2	Side Stay Bar
2	AG00337H201	1	Front Led Stay Bar Bracket — Offside
3	AG00337H202	1	Front Led Stay Bar Bracket - Nearside
4	AG00386H001	2	Hoisting Chains Set
5	AG00495H001	1	Rear Leg Pivot Pin
6	AG01201L401	1	Rear Leg (Fabrication)
7	AG01222H001	4	Clamp - Cable
8	AG01225F101	1	Front Leg – Nearside
9	AG01225F102	1	Front Leg
10	AG01227H001	1	Lower Crossbar
11	AG01231H001	2	Front Leg Angle
12	AG01233H001	2	Lock Pin - Rear Leg
13	AG01234H001	2	Lock Angle Rear Leg
14	AG01235H101	1	Wheel Suspension Bar
15	AG01236H001	I	Cat Sheave Shaft
16	AG01238H001	1	Front Leg Pivot (Anti Rotation)
17	AG01238H002	1	Front Leg Pivot
18	AG01245F001	1	Mudguard Assembly - Nearside
19	AG01245F002	1	Mudguard Assembly - Offside
20	AG01246H001	2	Support - Mudguard
21	AG01250H004	1	Link Bar
22	AG01680H001	1	Knott Over Rider Towing Eye - Mod
23	AG01681M001	1	Joint Bar
24	AG016B3M001	2	Hex Hd Bolt
25	AG01691H001	1	Crown Sheave
26	AG01692H001	1	Cat Sheave
27	AG01693M001	2	Spacer Tube
28	AJ00653H0001	1	Crown Sheave Shaft
29	ST05918X100	2	Brake Cable To Wheel
30	ST07512X100	1	Flexitor With Brake & Hub

DERRICK SUB ASSEMBLY







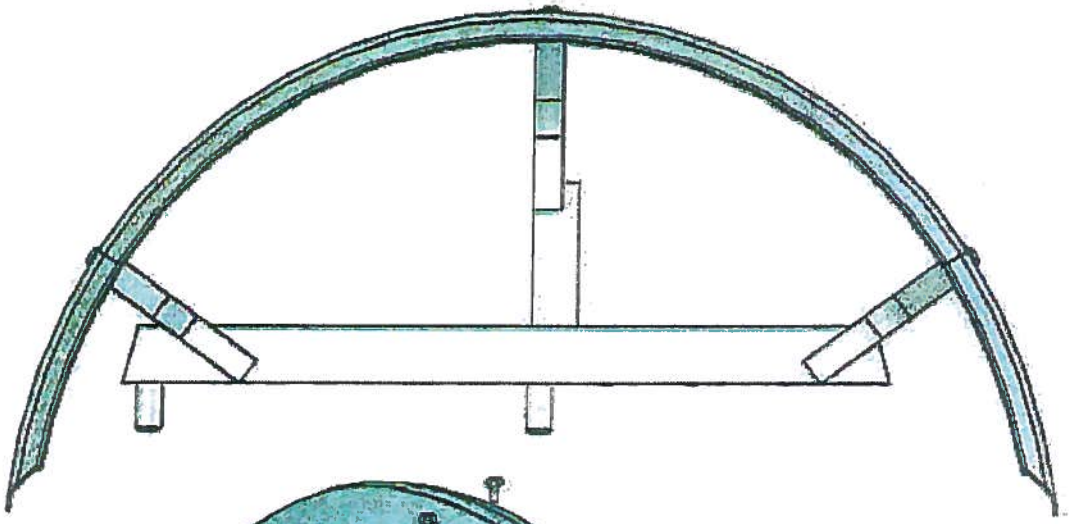
SHEET 2
AG01200L501

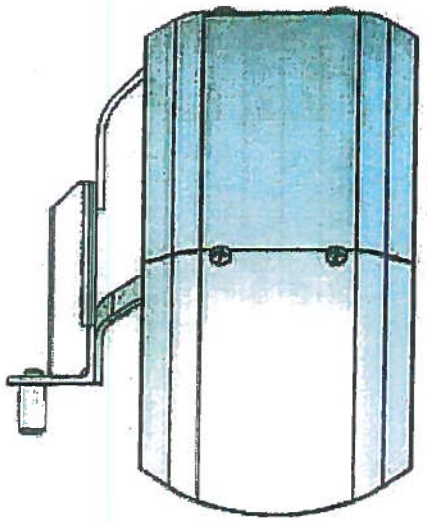
DANDO 2500 INVESTIGATOR

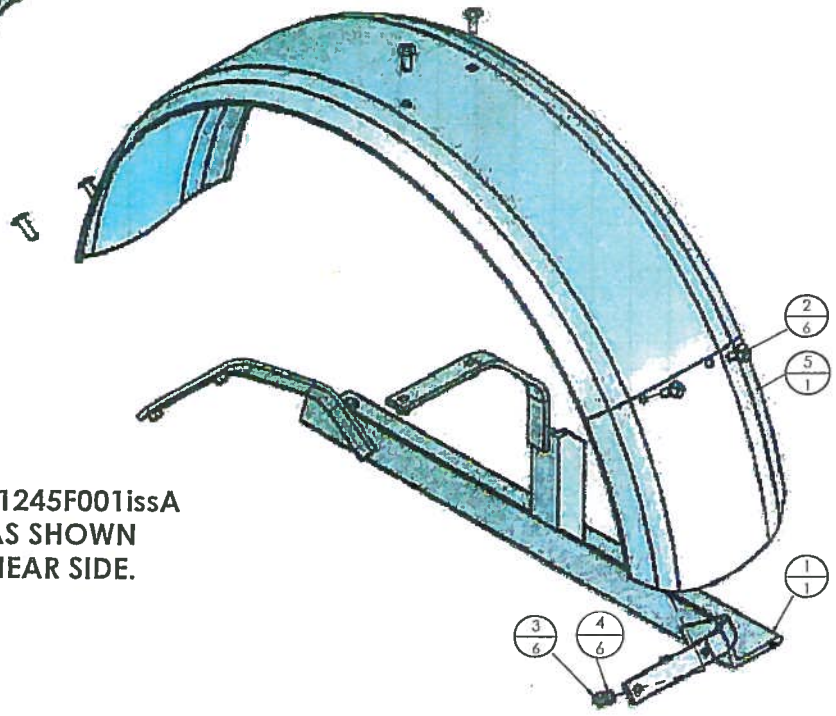
DERRICK SUB-ASSEMBLY AG01200L501

ITEM	PART NUMBER	QTY	DESCRIPTION
31	ST07513X100	1	Flexitor With Brake & Hub Rh
32	ST07514X100	1	Conical Nut
33	ST01219X103	10	Brake Adjuster
34	ST02155X133	1	Hex Head Bolt
35	ST02164X133	2	Hex Head Bolt
36	ST04143X133	4	Hex Head Bolt
37	ST07893X133	4	Hex Head Bolt
38	ST08530X133	2	Hex Head Bolt
39	ST09870X133	2	Hex Head Bolt
40	ST09864X170	2	Clevis Fork End C/W Spring Pin
41	ST07524H178	3	Brake Cable
42	ST01101X509	1	Slotted Nut
43	ST09871X510	4	Nyloc Nut
44	ST00590X511	2	Full Nut
45	ST00650X511	2	Full Nut
46	ST00652X511	6	Thin Nut
47	ST01380X511	4	Thin Nut
48	ST00787X523	4	Nyloc Nut
49	ST03852X691	4	Roll Pin
50	ST00796X715	1	Hex Head Set Screw
51	ST07896X715	4	Set Screw
52	ST05188X715	20	Hex Head Set Screw
53	ST05893X715	2	Hex Head Set Screw
54	ST00714X750	2	Split Pin
55	ST03048X750	4	Split Pin
56	ST05180X750	2	Split Pin
57	5T00665X881	2	Plain Washer
58	ST00788X881	4	Plain Washer
59	ST01322X883	4	Bright Plain Washer
60	ST04295X883	4	Bright Washer
61	ST00648X885	20	Spring Washer
62	ST00651X885	8	Spring Washer
63	ST01360X888	2	Wheel 5 Stud
67	AG01719M001	A/R	Mast Weight
68	AG01722M001	1	Stay Bar Retainer
69	AG01723M001	1	Weight Pin
70	ST00224X163	1	'R' Clip

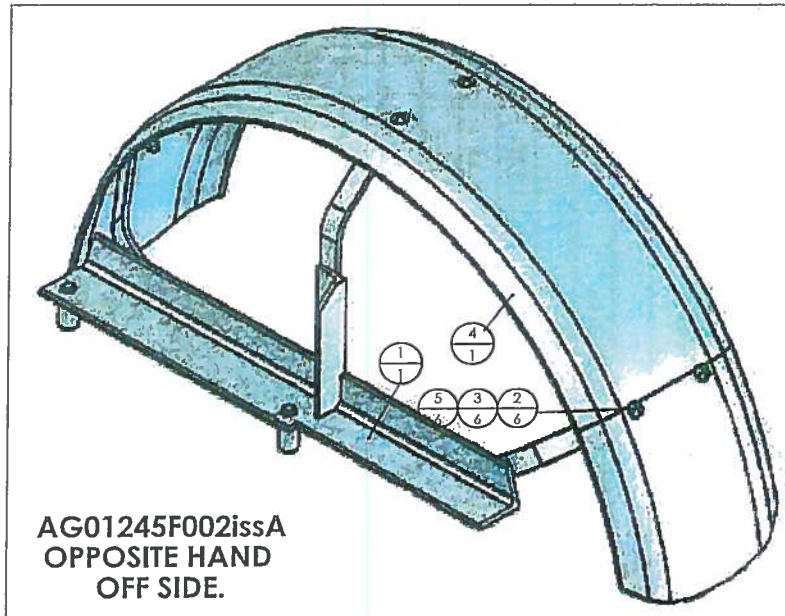
MUDGUARD ASSEMBLY







AG01245F001issA
AS SHOWN
NEAR SIDE.



AG01245F002issA
OPPOSITE HAND
OFF SIDE.

AG01245F001 &F002 Iss.A

DANDO 2500 INVESTIGATOR

NEAR-SIDE MUDGUARD ASSEMBLY – AG01245F001

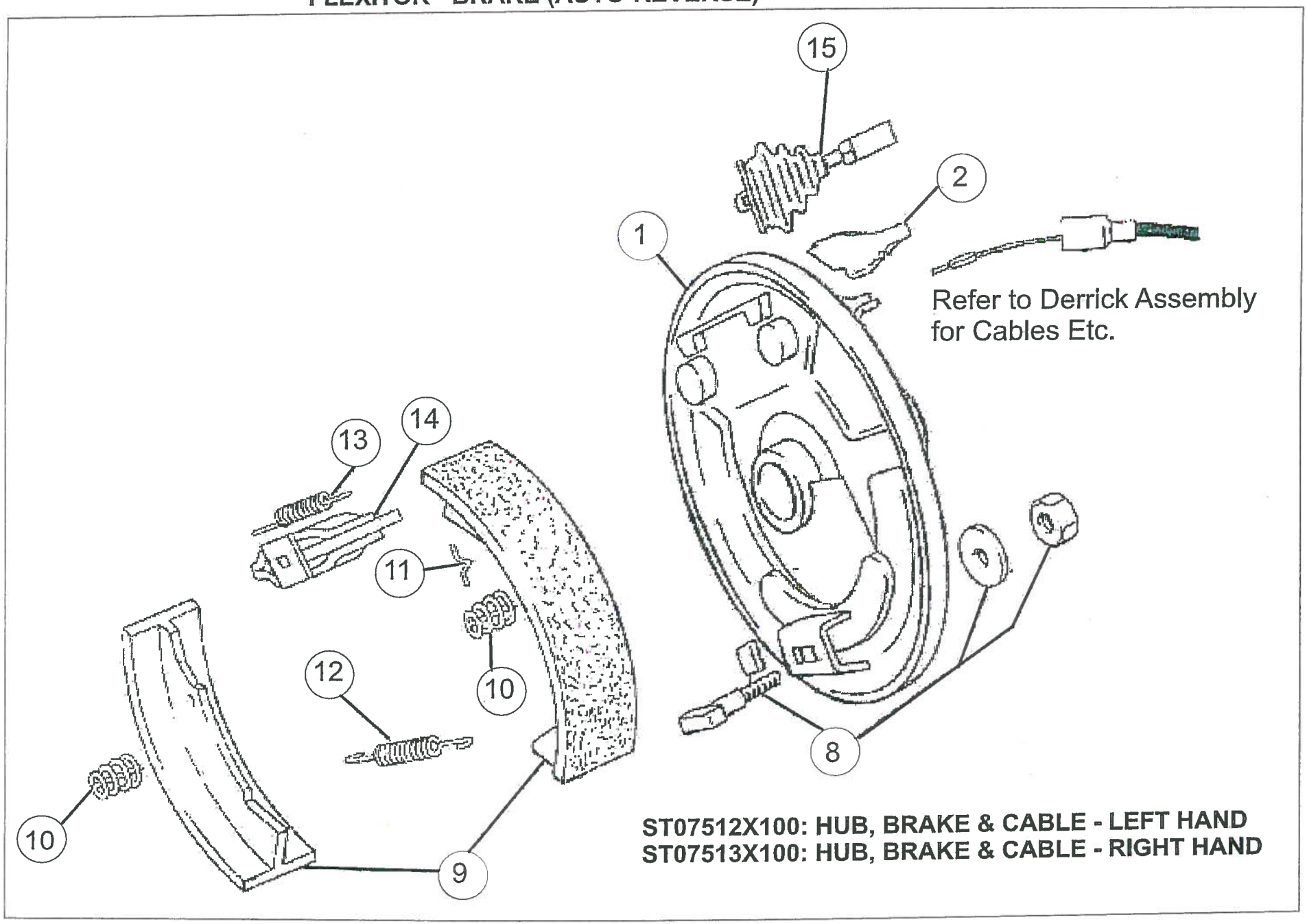
ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01249F001	1	Mudguard Frame – Near Side
2	ST03636X134	6	Roofing Bolt
3	ST01123X511	6	Full Nut
4	ST01146X885	6	Spring Washer
5	ST09915X891	1	Steel Mudguard.

DANDO 2500 INVESTIGATOR

OFF-SIDE MUDGUARD ASSEMBLY – AG01245F002

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01249F002	1	Mudguard Frame – Off Side
2	ST03636X134	6	Roofing Bolt
3	ST01123X511	6	Full Nut
4	ST01146X885	6	Spring Washer
5	ST09915X891	1	Steel Mudguard.

FLEXITOR - BRAKE (AUTO-REVERSE)



ST07512X100: HUB, BRAKE & CABLE - LEFT HAND
ST07513X100: HUB, BRAKE & CABLE - RIGHT HAND

DANDO 2500 INVESTIGATOR

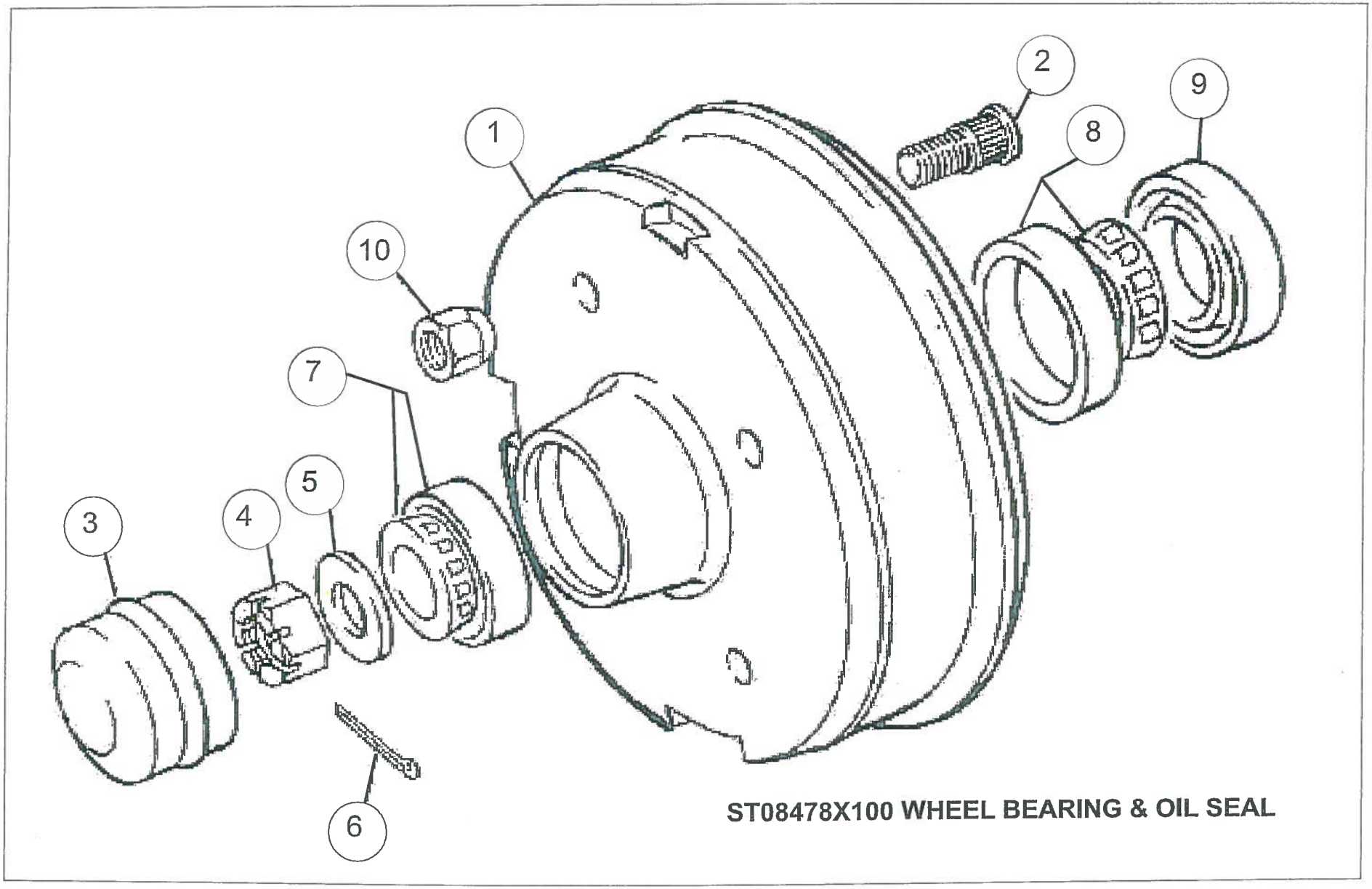
FLEXITOR - BRAKE [AUTO-REVERSE]
ST07512X100: HUB, BRAKE & CABLE L.H.
ST07513X100: HUB, BRAKE & CABLE R.H.

ITEM	PART NUMBER	QTY	DESCRIPTION
1	ST07534X337	1	Backplate L Or R
2	ST07536X337	2	Detachable Input Plate
8 *	ST11370X337	1	Adjuster Assembly
9	ST07530X337	1	Standard Lined Brakeshoe Pair
10	ST06338X337	2	Shoe Steady
11	ST06339X337	2	Retainer
12	ST06341X337	1	Pull Off Spring [Adj. Side]
13	ST06340X337	1	Pull Off Spring [Exp. Side]
14	ST06337X337	1	Expander Sub Assembly
15	ST11393X337	1	Pull Rod & Boot Assembly

* = COMPRISES:			
	ST06334X337	2	Adjuster Shoe post
	ST06335X337	1	Re Adjustment Wedge
	ST07538X337	1	Hex Head Nut

Refer to Derrick Assembly for cables etc..

FLEXITOR - WHEEL HUB



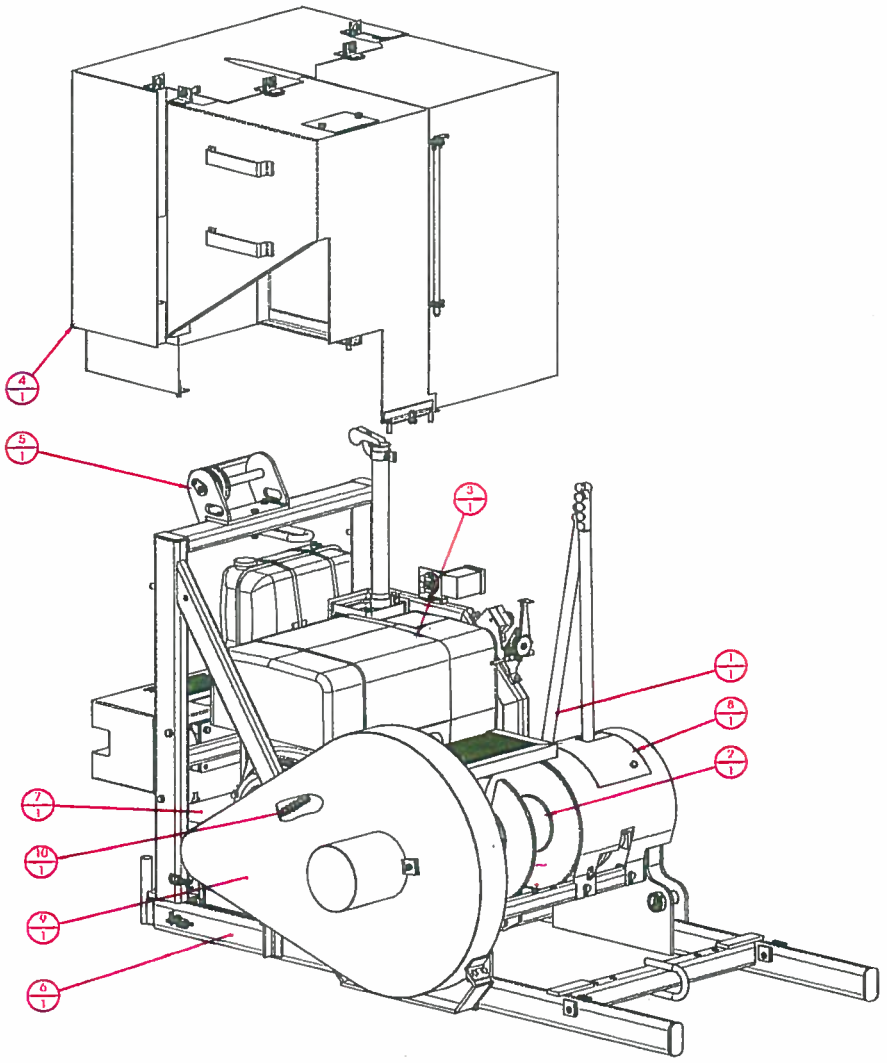
ST08478X100 WHEEL BEARING & OIL SEAL

DANDO 2500 INVESTIGATOR

FLEXITOR - WHEEL HUB

ITEM	PART NUMBER	QTY	DESCRIPTION
1	ST07535X100	1	Hub Shell
2	ST07528X337	5	Wheel Stud
3	ST06342X337	1	Grease Cap
4	ST06344X337	1	Axle Nut
5	ST06343X337	1	Axle Washer
6	ST06345X337	1	Split Pin
7	ST06213X337	1	Outer Bearing
8	ST06212X337	1	Inner Bearing
9	ST06346X337	1	Oil Seal
10	ST07514X100	5	Wheel Nut

ST08478X100 WHEEL BEARING & OIL SEAL KIT.



C006C0013 POWER PACK ASSEMBLY

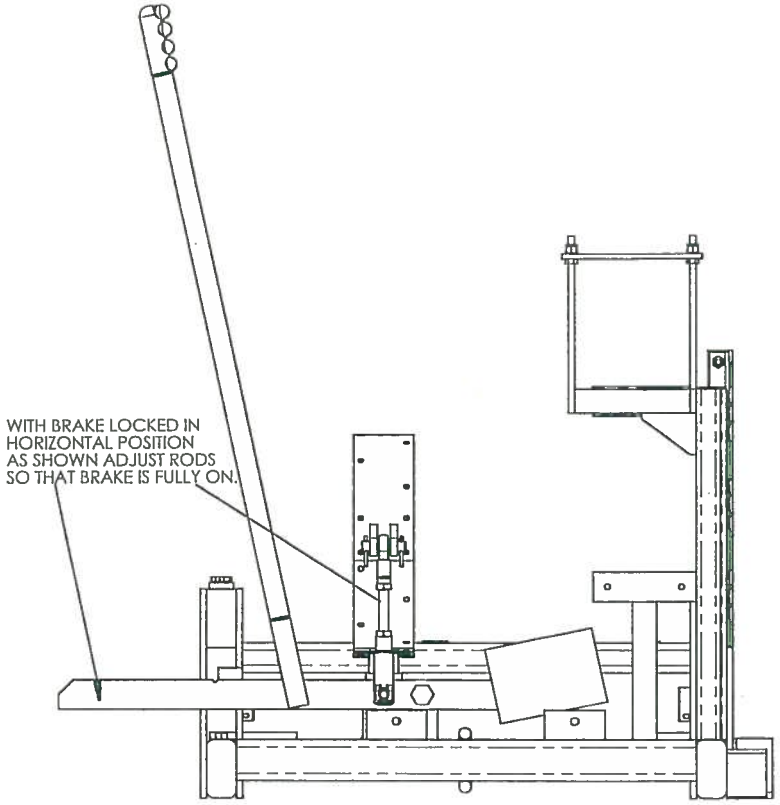
DANDO DRILLING INTERNATIONAL LTD

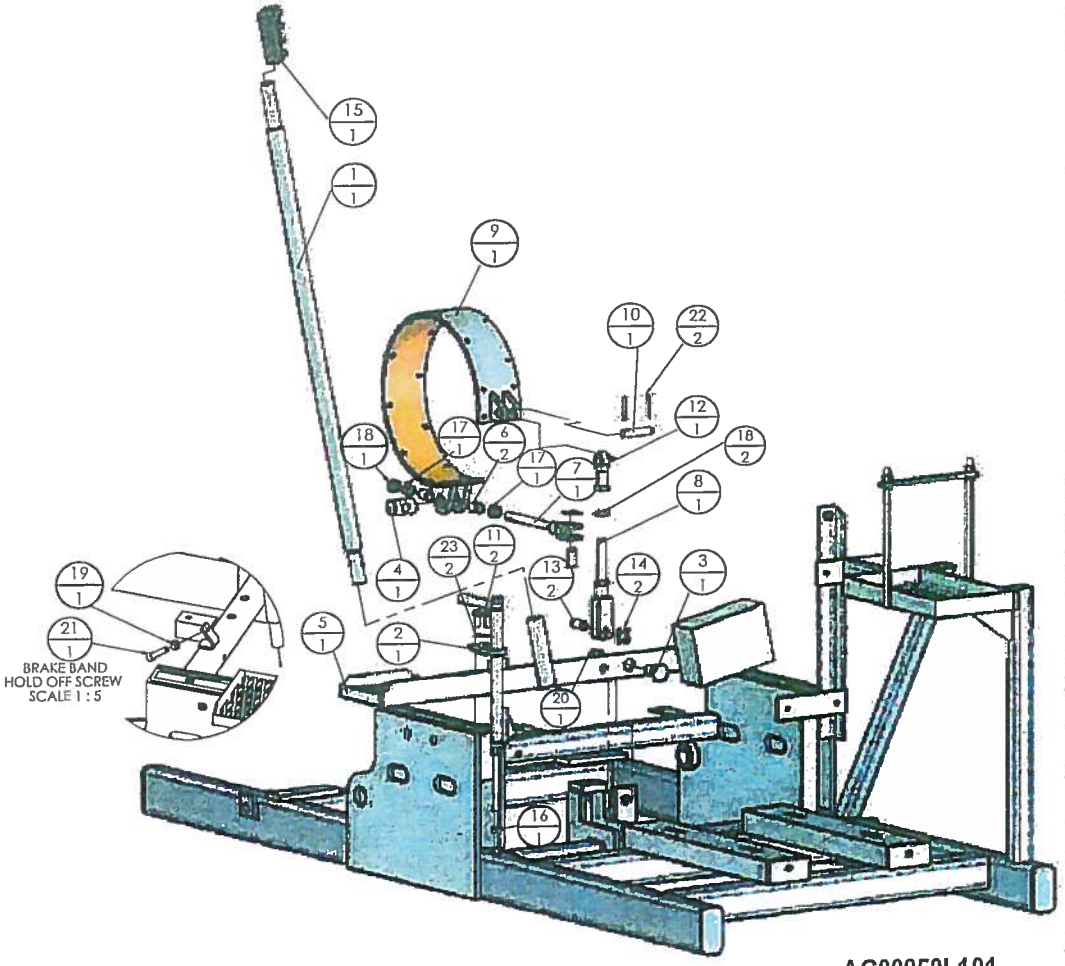
DANDO 2500 INVESTIGATOR

POWER PACK ASSEMBLY (SILENT PACK) C006C0013

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00950L101	1	Foot Brake Assembly
2	AG01627F002	1	Hoisting Reel Assembly
3	C006C0015	1	Engine Mounting Sub Assembly - Silentpack
4	C006C0016	1	Three Part Cover - [Silent Pack]
5	C006C0017	1	Electric Winch
6	C006C0018	1	Sampson Post Base Assembly
7	C006C0082	1	Electrical Diagram / Parts
8	C006C00111	1	Guards Assembly
9	C006C00114	1	Chain Guard Assembly - Silentpack
10	ST03415X161	1	3/4" Duplex Chain X 154 Pitches C/W Connecting Link

FOOT BRAKE ASSEMBLY





AG00950L101

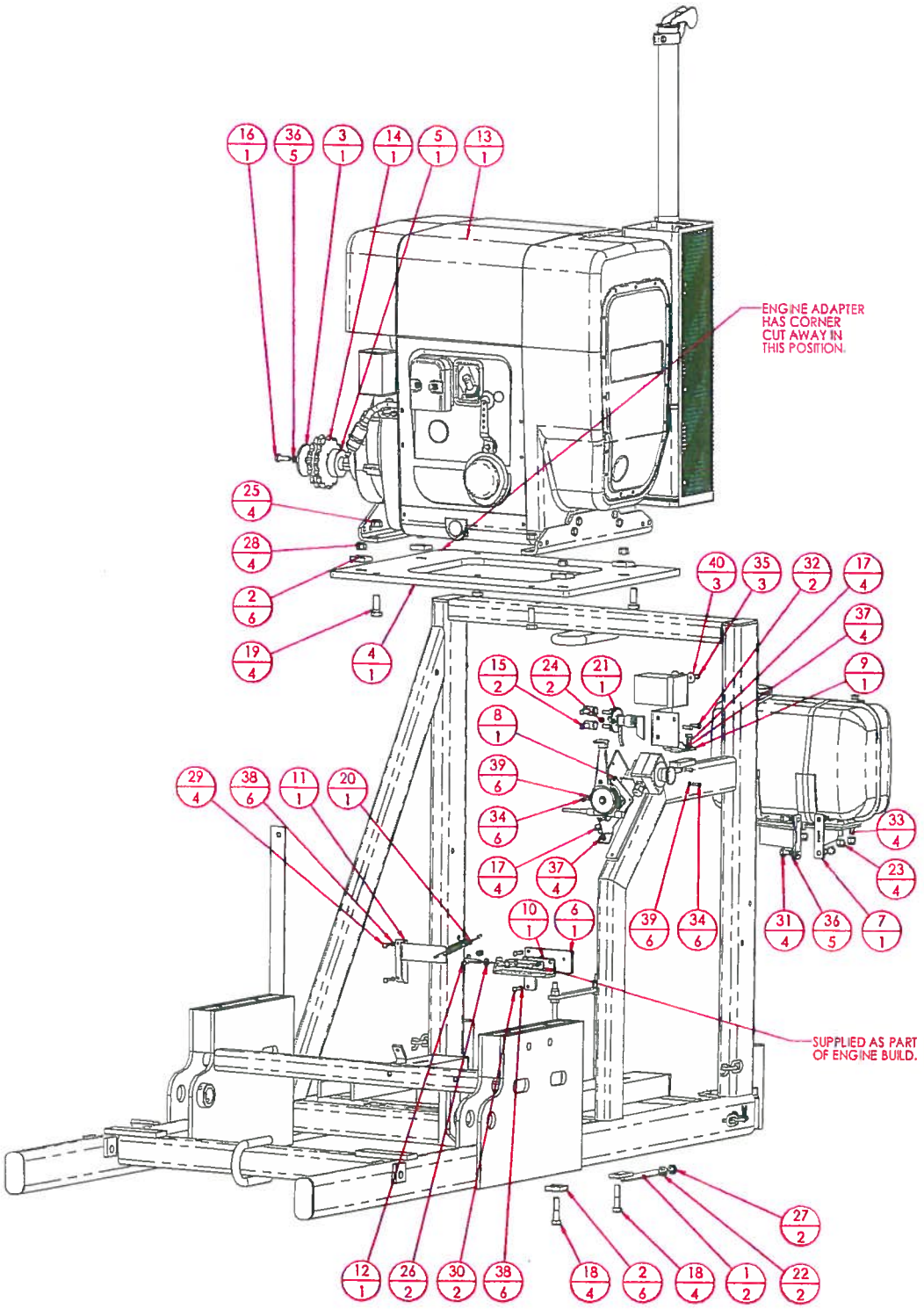
DANDO 2500 INVESTIGATOR

FOOTBRAKE ASSEMBLY – AG00950L101

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00419H001	1	Hand Brake Lever
2	AG00955H001	1	Brake Locking Rod
3	AG00956H001	1	Pivot Pin
4	AG00957H001	1	Brake Band Pin
5	AG00959F101	1	Foot Brake Sub-Assembly
6	AG00960M001	2	Pull Rod Pin Saddle
7	AG00961H001	1	Adjusting Rod
8	AG00961H003	1	Adjusting Rod
9	AG00966F101	1	Brake Band (Complete)
10	AK00747H101	1	Pull Rod Pin
11	ST01258X133	2	Hex Head Bolt
12	ST00795X170	1	Spherical Rod End
13	ST02011X170	2	Pin
14	ST02012X170	2	Safety Clip
15	ST00320X295	1	Handle Grip
16	ST00579X511	1	Full Nut
17	ST00650X511	2	Full Nut
18	ST00652X511	2	Thin Nut
19	ST00776X511	1	Full Nut
20	ST01043X511	1	Thin Nut
21	ST03253X743	1	Socket Head Cap Screw
22	ST00195X749	2	Split Cotter Pin
23	ST00777X885	2	Spring Washer

DANDO DRILLING INTERNATIONAL LTD

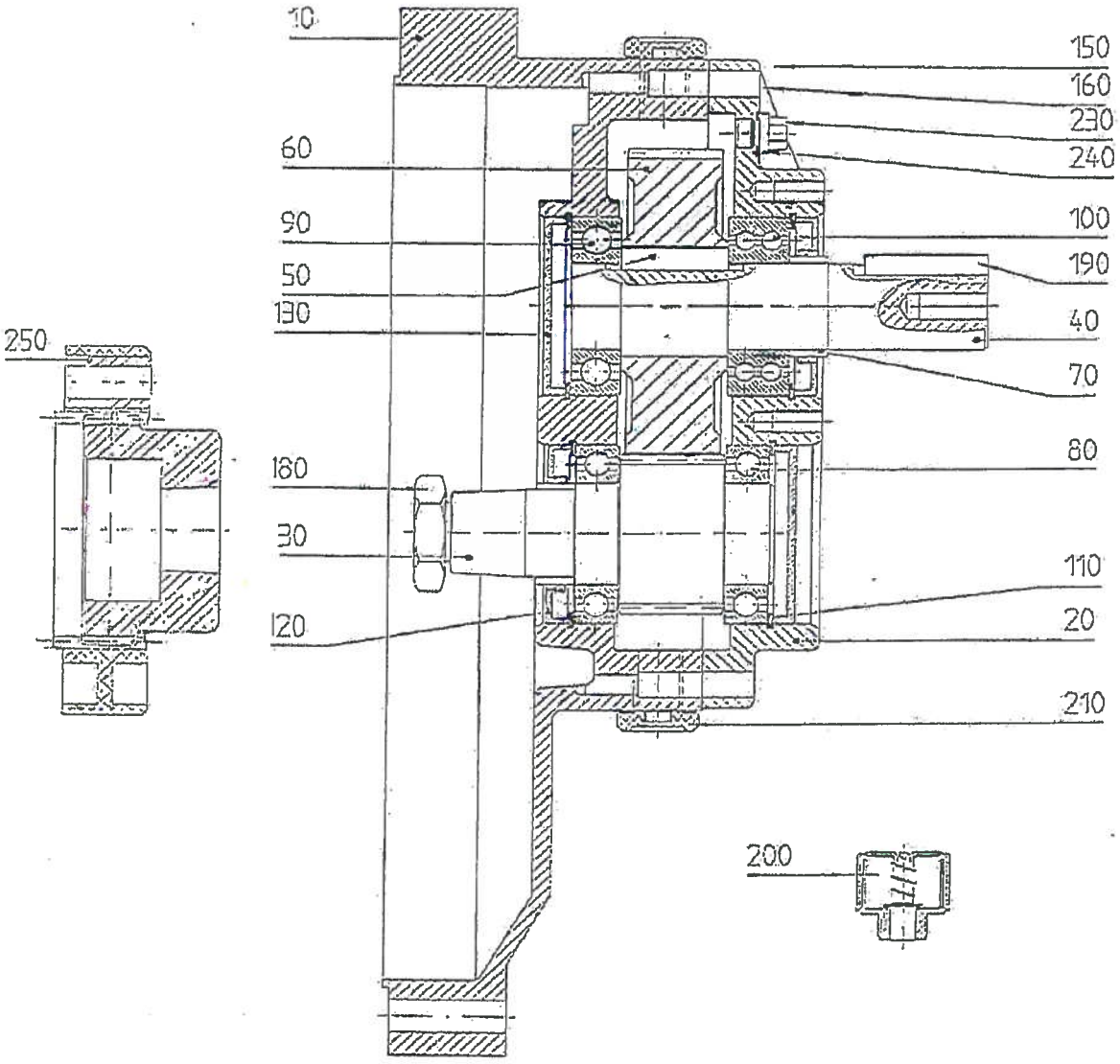
C006C0015 ENGINE MOUNTING SUB ASSEMBLY



DANDO 2500 INVESTIGATOR

ENGINE MOUNTING SUB-ASSEMBLY C006C0015

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00747H101	2	Engine Adjuster
2	AJ00634H001	6	Special Washer
3	AK04323H001	1	Retaining Washer
4	C006C0122	1	Engine Adapter - Silentpack
5	C006C0125	1	Sprocket Spacer
6	C006C0127	1	Throttle Cable Bottom Mount
7	C006C0133	1	Fuel Tank Support - Silentpack
8	C006C0134	1	Throttle And Emergency Stop Bracket - Silentpack
9	C006C01311	1	Engine Control & Isolator Bracket
10	C006C01312	1	Throttle Stop Bracket
11	C007C01211	1	Throttle Return Spring Bracket - Silentpack
12	C007C01316	1	Special Screw - Throttle Stop - Silentpack
13	C106C0153	1	Hatz 2L41C C/W 2:1 Gearbox
14	C1060162	1	Engine Sprocket Taper Lock
15	C10000831	2	Cable Terminal Insulator
16	C10000923	1	Hex Head Set Screw
17	ST02267X133	4	Hex Head Set Screw
18	ST05926X133	4	Hex Head Bolt.
19	ST10360X133	4	Bolt Hex Head
20	ST09619X165	1	Lower Spring
21	ST10572X224	1	Isolator Switch
22	ST00579X511	2	Ordinary Hex Nut
23	ST01109X510	4	Nyloc Nut
24	ST04435X510	2	Nyloc Nut
25	ST09871X510	4	Nyloc Nut
26	ST01123X511	2	Full Nut
27	ST01304X511	2	Lock Nut
28	ST06828X523	4	Nyloc Nut
29	ST02259X715	4	Set Screw
30	ST07729X715	2	Hex Head Set Screw.
31	ST12420X715	4	Hex Head Set Screw.
32	ST12607X715	2	Hex Head Set Screw.
33	ST01393X743	4	Socket Hd Cap Screw
34	ST06149X743	6	Socket Head Cap Screw
35	ST10828X792	3	Socket Button Head Screw
36	ST00777X885	5	Spring Washer, Sc
37	ST01146X885	4	Spring Washer Single Coil
38	ST01179X885	6	Spring Washer
39	ST04149X885	6	Spring Washer
40	ST11681X898	3	Extra Large Plain Washer



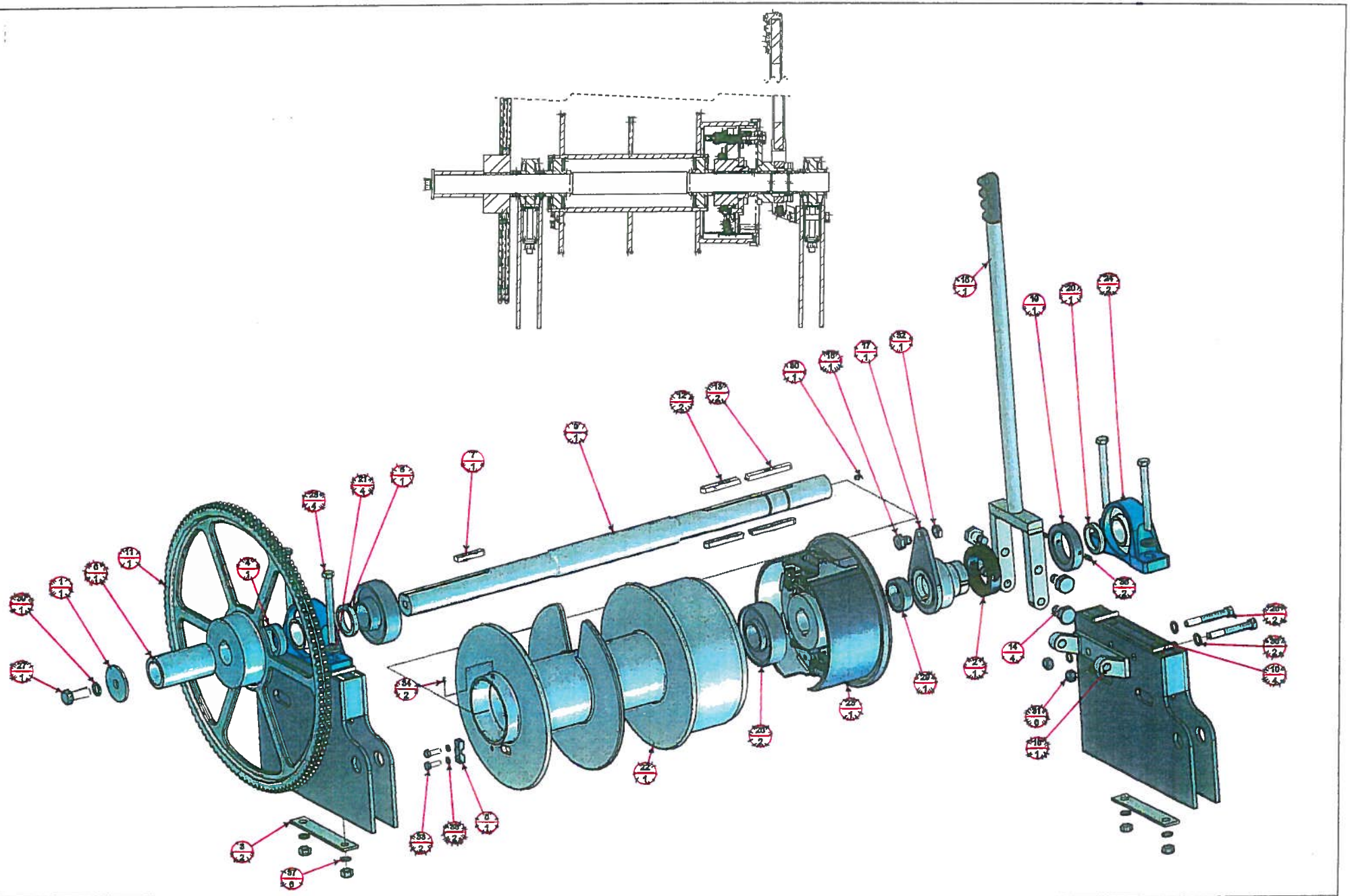
C106C0153 2:1 GEARBOX C/W SAE : 5 MOUNTING

DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

2 : 1 GEARBOX C/W SAE:5 MOUNTING C106C0153

ITEM	PART NUMBER	QTY	DESCRIPTION
10	TR 01	1	Housing
	TR 02	1	Housing Cap
30	TR 03	1	Pinion Shaft
40	TR 04	1	Output Shaft
50	TR 05	1	Key
	TR 06	1	Gear Wheel
70	TR 07	2	Seal Ring
80	TR 08	2	Deep Groove Ball Bearing
9	TR 09	1	Deep groove Ball Bearing
100	TR 10	1	Double Row Deep Groove Ball Bearing
110	TR 11	4	Retaining Ring
	TR 12	2	Lip Seal
130	TR 13	2	Bearing Cover
	TR 14	2	Locating Pin
150	TR 15	10	Hex Head Bolts
160	TR 16	10	Spring Washers
	TR 17	0.086L	Gear Oil (SAE 10W40)
180	TR 18	1	Hex Nut
190	TR 19	1	Key
200	TR 20	1	Breather Plug
210	TR 21	2	Filler Plug
	TR 22		Gasket Sealant
230	TR 23	2	Plug
240	TR 24	2	Brass Washer
2	TR 25	1	Input Coupling



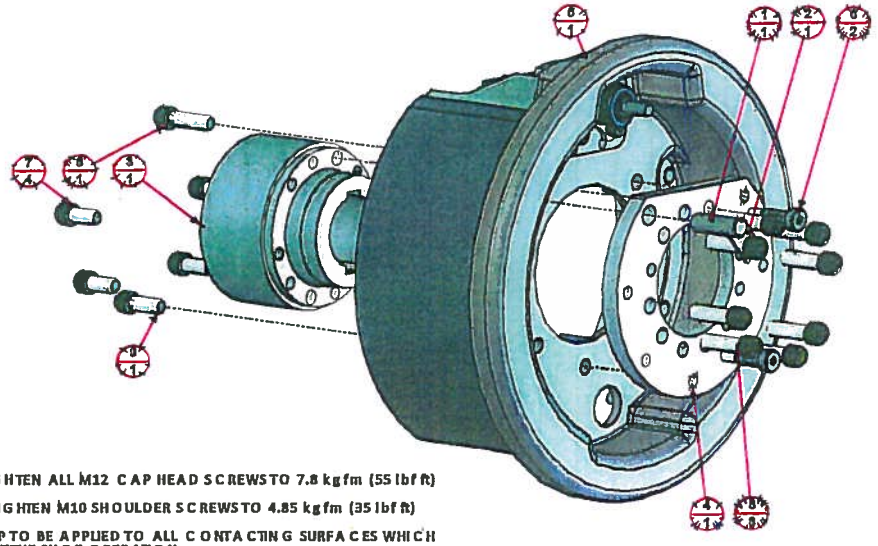
AG01627F002 HOISTING REEL ASSEMBLY

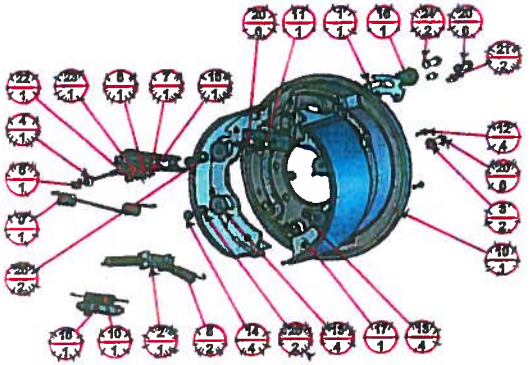
DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

HOISTING REEL ASSEMBLY – AG01627F002

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00145H102	1	Cathead Cover Plate
2	AG00145H103	1	Thrust Ring (Nylon)
3	AG00208M001	2	Clamping Plate
4	AG00211M001	1	Spacer
5	AG00211M002	1	Spacer
6	AG00211M004	1	Spacer
7	AG00237H204	1	Driving Sprocket Key
8	AG00467M001	1	Line Clamp
9	AG00470H101	1	Shaft
10	AG00471M001	4	Bearing Stop
11	AG00499M001	1	Driving Sprocket
12	AG00740H001	2	Boss Key
13	AG00740H002	2	Member Key
14	AG00741H001	4	Pivot Set Screw
15	AG00786H001	1	Handle – Clutch Operating
16	AG00788H001	1	Bracket Pivot
17	AG00789H001	1	Sliding Member
18	AG00792H001	1	Adjuster
19	AG00794H001	1	Locking Ring
20	AG00795H001	1	Spacer
21	AG01620M001	4	Special Washer
22	AG01622F001	1	Drum
23	AG01623F101	1	Clutch Assembly
24	ST01738X127	2	Pillow Block
25	ST03427X127	2	Cartridge Unit
26	ST02164X133	2	Hex Head Bolt
27	ST06170X133	1	Hex Hd Bolt
28	ST09215X133	4	Hex Hd Bolt
29	ST00286X166	1	Set Collar
30	ST00180X270	1	Straight Greaser
31	ST00650X511	6	Full Nut
32	ST01043X511	1	Thin Nut
33	ST00775X715	2	Hex Head Set Screw
34	ST00778X747	2	Socket Set Screw
35	ST01051X747	2	Socket Set Screw
36	ST00656X881	2	Ordinary Washer
37	ST00651X885	6	Spring Washer
38	ST00777X885	2	Spring Washer
39	ST00661X885	1	Spring Washer

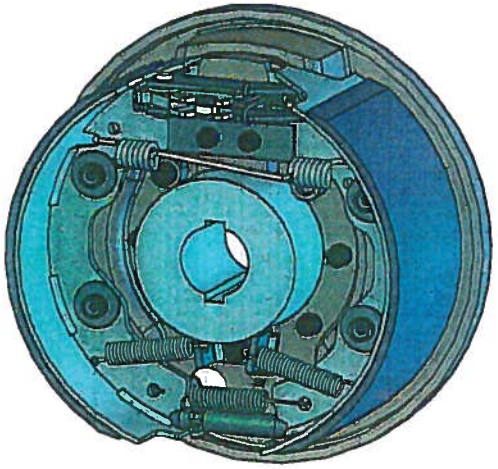


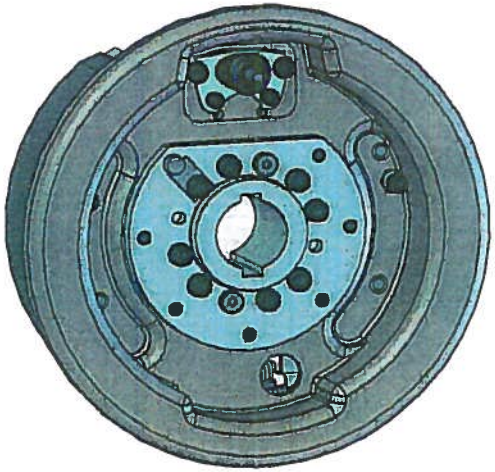


NOTES: 1. TORQUE TIGHTEN ALL M12 CAP HEAD SCREWS TO 7.8 kgfm (55 lbf ft)

2. TORQUE TIGHTEN M10 SHOULDER SCREWS TO 4.85 kgfm (35 lbf ft)

3. COPPER SLIP TO BE APPLIED TO ALL CONTACTING SURFACES WHICH AFFECT THE SHOE OPERATION.





AG01623F101 CLUTCH ASSEMBLY

DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

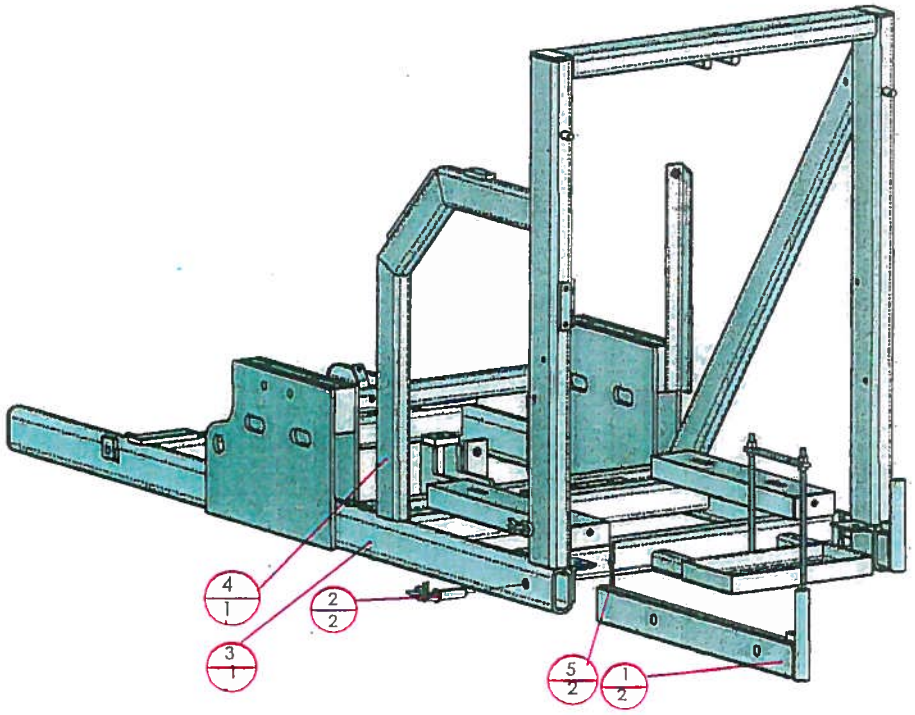
CLUTCH ASSEMBLY AG01623F101

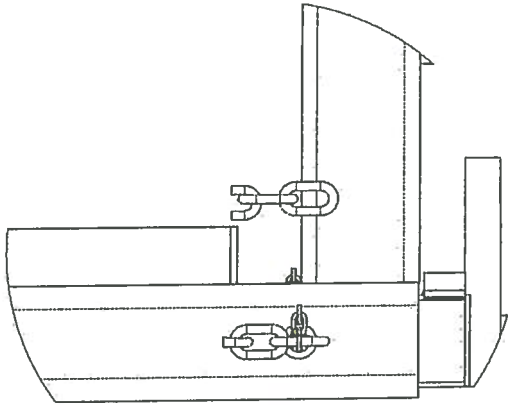
CLUTCH ASSEMBLY REVERSED PULL – AG01623F101 FIG. 1.

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00782H001	1	Dowel
2	AG00783H001	1	Keep Plate
3	AG01621F001	1	Clutch Boss
4	AJ00754H201	1	Drive Flange
5	AJ00851M101	1	Modified Clutch
6	ST06165X782	2	Shoulder Screw
7	ST06772X784	4	Cap Screw
8	ST06773X784	1	Cap Screw
9	ST06775X784	1	Cap Screw
10	ST06776X784	8	Cap Screw

CLUTCH ASSEMBLY REVERSED PULL – AG01623F101 (FIG. 2.)

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AJ00852M101	1	Grommet Plate With Stop Reversed
2	AL01645H001	1	Spring Anchor Bracket
3	ST01380X511	2	Thin Nut
4	ST06192H165	1	Pull Cable
5	ST06701X165	2	Spring
6	ST06705X165	1	Clip Retaining Trunnion
7	ST09617X165	1	Actuator Spring
8	ST09617X165	1	Actuator Rectangular Washer
9	ST09618X165	1	Main Spring
10	ST09619X165	1	Lower Spring
11	ST09620X165	1	Shoe Plate
12	ST09621X165	4	Shoe Retaining Spring
13	ST09621X165-	4	Shoe Retaining Pin
14	ST09621X165-	4	Shoe Retaining Washer Large
15	ST09621X165	4	Shoe Retaining Washer Slotted
16	ST09622X165	1	Bottom Adjuster
17	ST09623X165	1	Rubber Grommet
18	ST11168X165	1	Shoe Pair - Reversed
19	ST11169X165	1	Actuator - Reversed
20	ST11172X165	1	Back Plate
21	ST01393X743	6	Soc Hd Cap Screw
22	ST04180X743	2	Socket Cap Screw
23	ST04435X510	1	Nyloc Nut
24	ST01096X881	1	Plain Washer
25	ST00777X885	2	Spring Washer
26	ST01146X885	2	Spring Washer





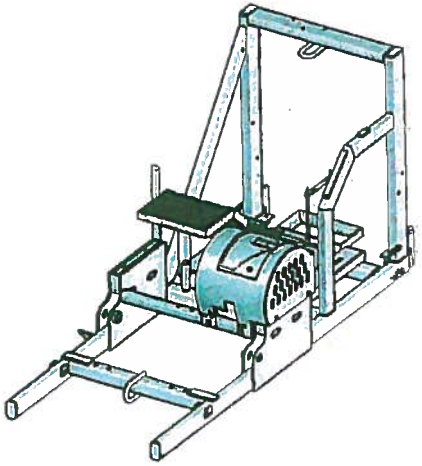
C006C0018 SAMPSON POST BASE ASSEMBLY

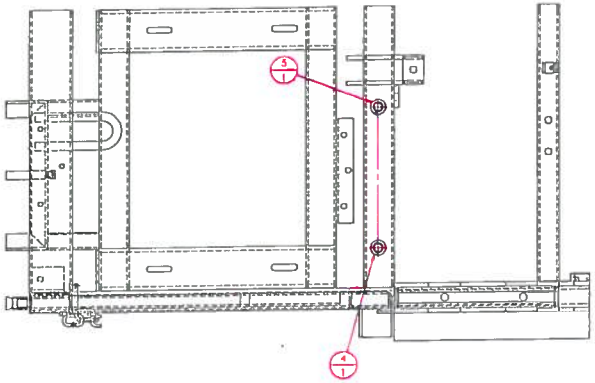
DANDO DRILLING INTERNATIONAL LTD

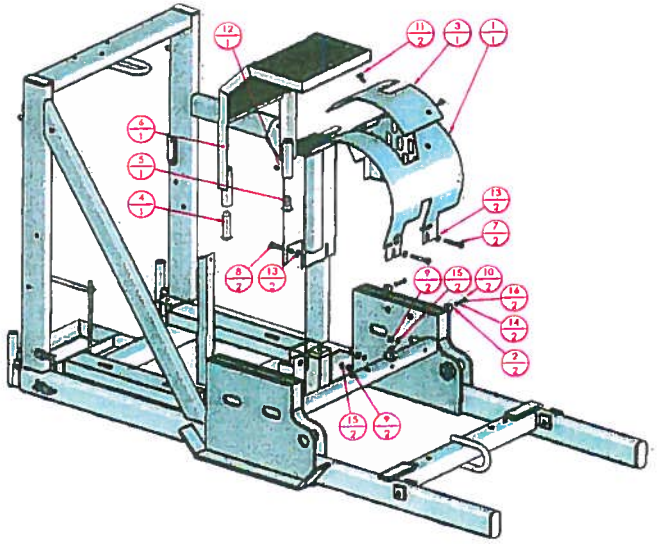
DANDO 2500 INVESTIGATOR

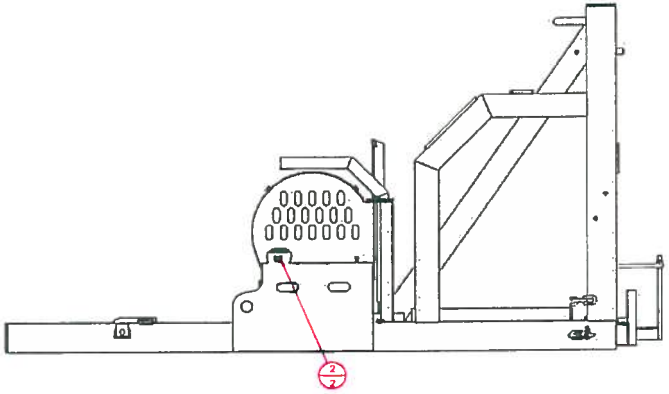
SAMPSON POST BASE ASSEMBLY – C006C0018

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01635F001	2	Sinker Bar Carrier
2	AG01636H001	2	Sinker Bar Carrier Pin
3	C006C00113	1	Hoisting Reel Base Welded Assembly
4	C006C01310	1	Sampson Post Fabrication
5	ST00383X163	2	Grip Clip (3mm)









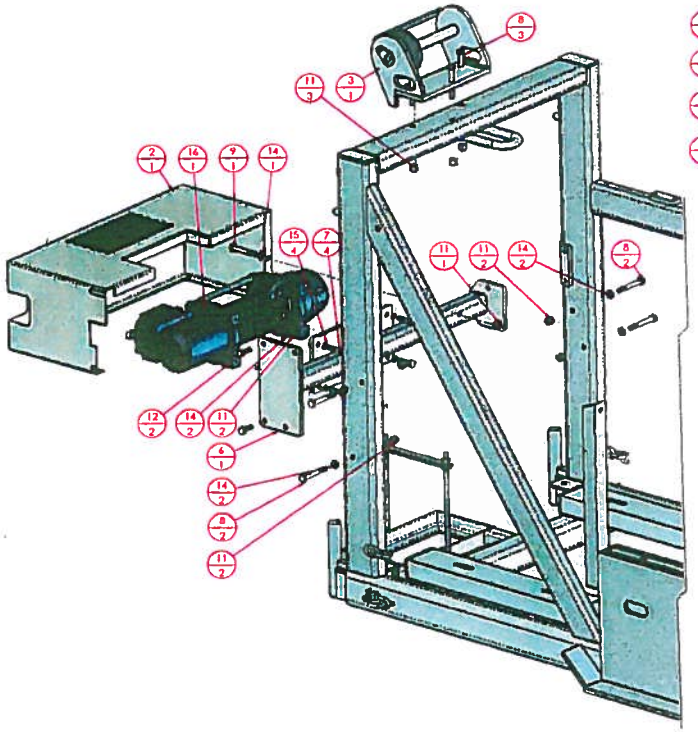
C006C00111 GUARDS ASSEMBLY

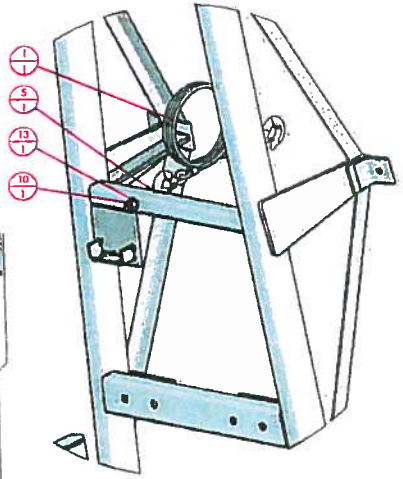
DANDO DRILLING INTERNATIONAL LTD

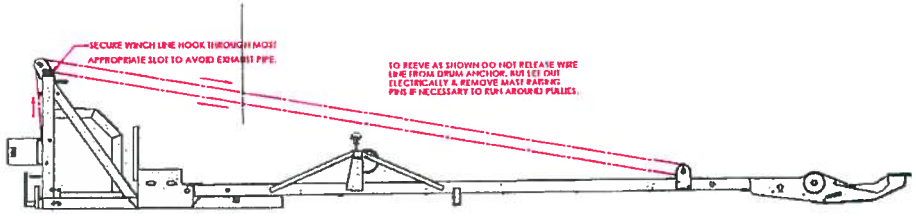
DANDO 2500 INVESTIGATOR

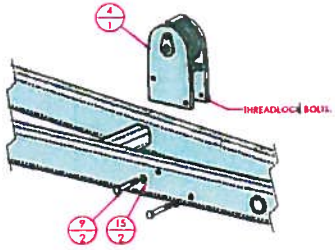
GUARDS ASSEMBLY C006C00111

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01632F001	1	Drum Clutch Guard
2	AG01661M001	2	Pad
3	AG01662M001	1	Inspection Cover
4	AG01724M001	1	Guard Pin
5	AG01724M002	1	Guard Pin - Grooved
6	AG01750F101	1	Reel Guard
7	ST01208X133	2	Hex Hd Set Screw
8	ST04626X133	2	Hex Hd Set Screw
9	ST00776X511	4	Full Nut
10	ST02259X715	2	Set Screw
11	ST04914X715	2	Hex Head Set Screw
12	ST01190X747	1	Socket Set Screw [Grub]
13	ST01048X881	4	Plain Washer
14	ST01096X881	2	Ordinary Washer
15	ST00777X885	4	Spring Washer, Sc
16	ST01179X885	2	Spring Washer









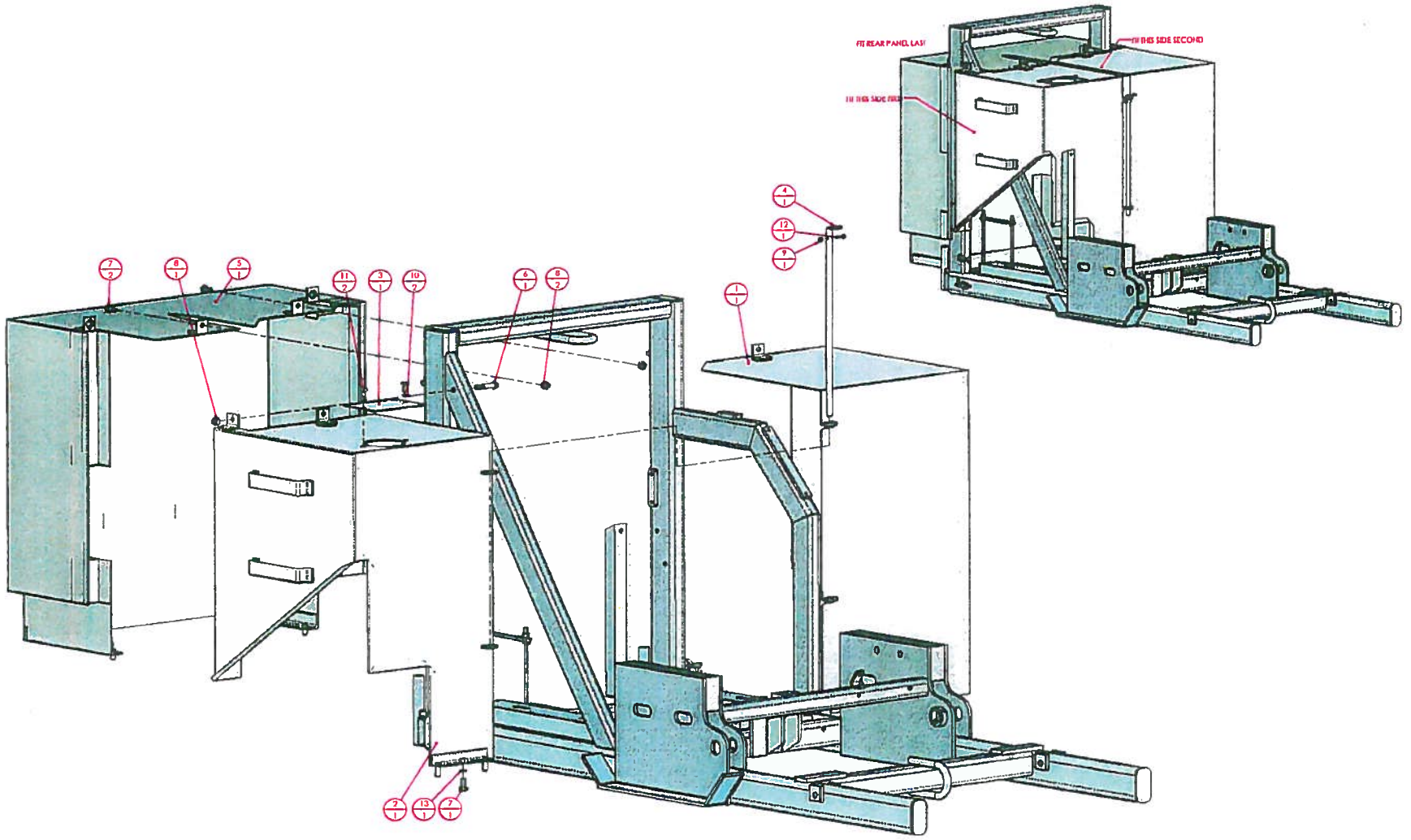
C006C0017 ELECTRIC WINCH ASSEMBLY

DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

ELECTRIC MAST RAISING WINCH ASSEMBLY – C006C0017

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01714M001	1	Electric Winch Safety Wire
2	AG01725F001	1	Winch Guard - Main [TS9500]
3	AG01739H101	1	Sampson Pulley
4	AG01741M001	1	Mast Pulley
5	C006M0122	1	Modified Eyebolt
6	C006C0132	1	Superwinch Bracket - Silentpack
7	ST01084X133	4	Hex Head Bolt
8	ST09810X133	7	Hex Hd Bolt
9	ST10052X133	3	Hex Hd Bolt
10	ST00934X510	1	Nyloc Nut
11	ST01109X510	10	Nyloc Nut
12	ST00775X715	2	Hex Hd Set Screw.
13	ST04295X883	1	Bright Washer
14	ST05104X883	7	Plain Bright Washer
15	ST00777X885	6	Spring Washer, Sc
16	ST12636X889	1	Superwinch TS 9500



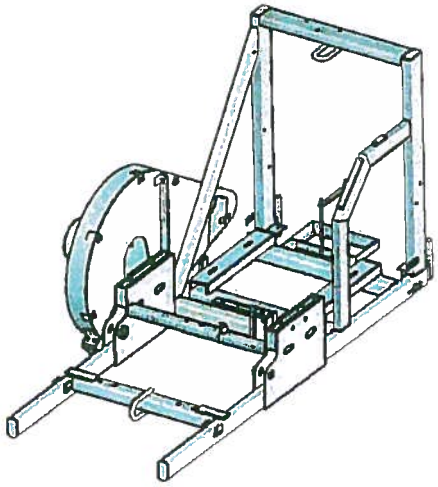
C006C0016 THREE PART GUARD ASSEMBLY

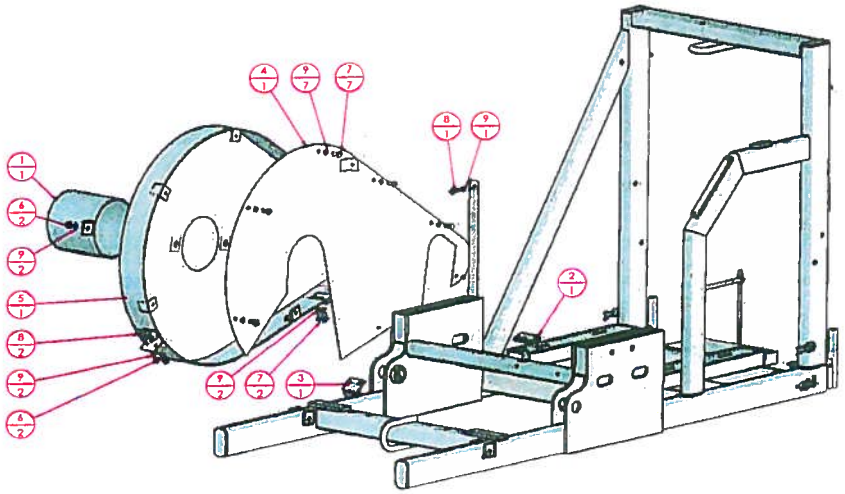
DANDO DRILLING INTERNATIONAL LTD

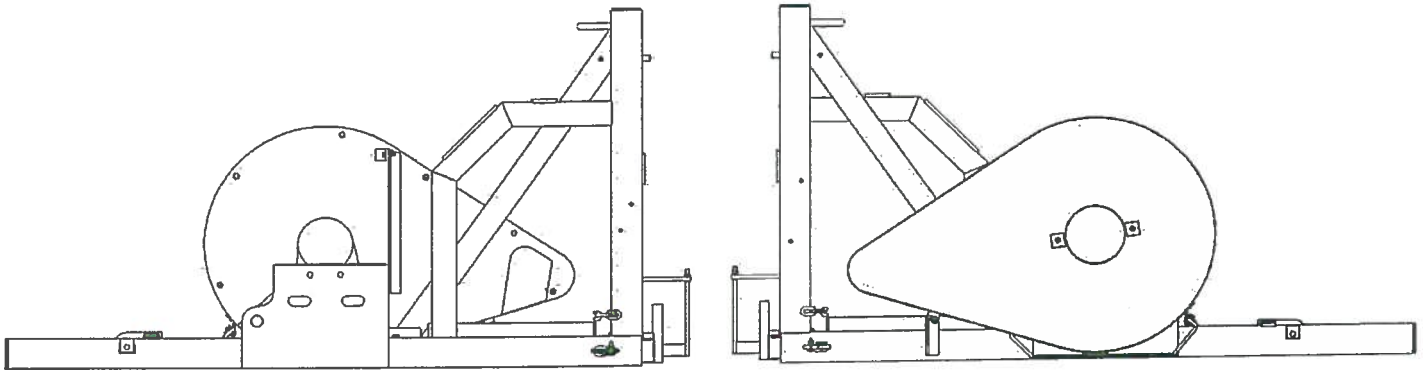
DANDO 2500 INVESTIGATOR

THREE PART COVER ASSEMBLY – C006C0016

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG01676F001	1	Box Cover LH Side
2	AG01677F001	1	Box Cover RH Side
3	AG01679M001	1	Cover
4	AG01694M001	1	Lock Pin
5	C006C0135	1	Box Cover Rear Panel - Hatz Silent Pack
6	ST05970X133	1	Hex Head Bolt
7	ST05893X715	3	Hex Hd Set Screw
8	ST00787X510	3	Nyloc Nut
9	ST04435X510	1	Nyloc Nut
10	ST00777X885	2	Spring Washer, Sc
11	ST08401X715	2	Hex Head Set Screw
12	ST05095X715	1	Hex Head Set Screw







C006C00114 CHAIN GUARD ASSEMBLY

DANDO DRILLING INTERNATIONAL LTD

DANDO 2500 INVESTIGATOR

CHAIN GUARD ASSEMBLY – C006C00114

ITEM	PART NUMBER	QTY	DESCRIPTION
1	AG00676H001	1	Cathead Cover
2	AG01519H101	1	Chain Guard Support Bracket
3	AG01515H001	1	Chain Guard Lower Bracket Support
4	C006C01313	1	Chain Guard Back Plate - Hatz Silentpack
5	C006C01314	1	Chain Guard - Hatz Silentpack
6	ST00776X511	4	Full Nut
7	ST00796X715	9	Hex Hd Set Screw
8	ST08401X715	3	Hex Head Set Screw.
9	ST00777X885	14	Spring Washer, Sc

SECTION 5

WINCH

OPERATION \ MAINTENANCE
&
SPARE PARTS
ILLUSTRATION & LISTING

DANDO DRILLING INTERNATIONAL LTD

OLD CUSTOMS HOUSE, WHARF ROAD,
LITTLEHAMPTON, WEST SUSSEX,
BN17 5DD, ENGLAND

E-MAIL: info@dando.co.uk
WEB: www.dando.co.uk
TEL: +44(0)1903 731312 FAX: +44(0)1903 730305

Energold

Made in England since 1867

TIGER SHARK™ SERIES WINCH

READ AND UNDERSTAND THIS MANUAL BEFORE INSTALLATION AND OPERATION OF YOUR SUPERWINCH.

Superwinch LLC.
359 Lake Road
Dayville, CT 06241, USA
tel: 1.800.323.2031
fax: 1.860.963.0811
info@superwinch.com
www.superwinch.com

Superwinch LTD.
Union Mine Road
Pitts Cleave
Tavistock, Devon
PL19 0NS, UK
tel: +44 (0) 1822 614101
fax: + 44 (0) 1822 615204
sales@superwinch.net
www.superwinch.com

90-14517 Rev - 2/13/2012

SAFETY PRECAUTIONS

The responsibility for safe installation and operation of this winch ultimately rests with you, the operator. Read and understand all safety precautions and operating instructions before installing and operating the winch. Careless winch operation can result in serious injury and/or property damage. Never obscure or remove the warning or instruction labels.

Throughout this manual, you will find notations with the following headings:

⚠ DANGER **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. This notation is also used to alert against unsafe practices.

Note: Indicates additional information in the installation and operation procedures of your winch.

The following symbols on the product and in the Owners manual are used:


Read Owner's Manual


Always Use Handsaver


Keep clear of winch, rope and hook while operating


Never use winch to lift or move people


Never use winch to hold loads in place

Correct installation of your winch is a requirement for proper operation.

Please Note: Winch is designed primarily for intermittent applications. This winch is not designed to be used in industrial or hoisting applications and Superwinch does not warrant it to be suitable for such use. Superwinch manufactures a separate line of winches for industrial/commercial use. Please contact Customer Service Department for further information.

Congratulations on your choice!

AFTER READING AND UNDERSTANDING THIS MANUAL, LEARN TO USE YOUR WINCH. After installing the winch, practice using it so you will be familiar with it when the need arises.

(NOTES,
NOTAS)

(NOTES,
NOTAS)

MOUNTING YOUR WINCH

MOUNTING KITS

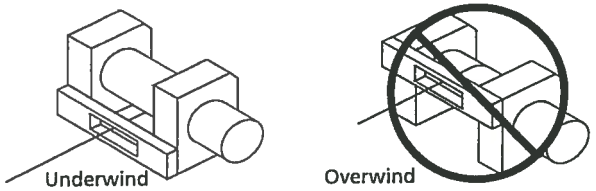
SUPERWINCH RECOMMENDS THE USE OF A MOUNT KIT FOR SECURE MOUNTING TO YOUR VEHICLE. For information on available kits, contact your Superwinch product dealer or go to **www.superwinch.com** for the most current list of kits.

If you choose not to purchase a mounting kit, your Superwinch needs to be attached to a secure and flat mounting location. Note that your winch may not be able to be operated safely without some equipment included in the kit. If you choose not to purchase a mounting kit, contact Superwinch for recommended accessories and the name of a dealer near you.

Detailed mounting instructions for your specific vehicle are provided with each mounting kit. Read and follow directions carefully.

⚠ CAUTION *This winch must be mounted with the rope in the under wound direction (Fig. 1) Improper mounting could damage your winch and void your warranty.*

Fig. 1



Note: Your winch is designed to ROPE IN and ROPE OUT in one direction. Do not attempt to reverse the operation of your winch.

⚠ CAUTION **Do not mount winch inverted (base upward) or put the winch mounting hardware in direct tension condition. In all installations, the unit must be mounted so the rope feeds through the hawse or roller fairlead on the front of the winch and does not rub across housings.**

For winch capacities, a complete parts list, and an exploded diagram of your specific Superwinch, refer to the Technical Data Sheet included in this package.

For instructions on safe winch operation and tips for prolonging the life of your winch, refer to the User's Guide included in this package.

⚠ WARNING ***Improper mounting can cause personal injury.*** **Improper mounting could damage your winch and void the warranty.**

MINIMUM ELECTRICAL REQUIREMENTS

A 60 amp. alternator and battery with 440 cold-cranking amperes capacity are the minimum recommended power sources. If the winch is in heavy use, an auxiliary battery is recommended.

Under some circumstances, it may be appropriate to install additional circuit protection devices (circuit breakers). If in doubt, seek appropriate advice.

Superwinch recommends that all winch electrical systems can be readily and quickly isolated from their electrical supply in the event of an emergency. The winch electrical's system should always be isolated when the winch is not in use.

1. Install mounting kit or structural support for the winch.
2. Mount the winch to a mounting plate or to a mount that you have properly designed.

If not using a Superwinch mounting accessory, follow the general guidelines listed below.

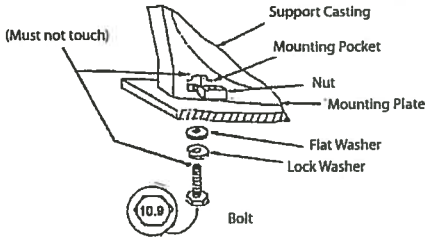
For 9.5 and 11.5 models: (see Fig 2 insert) Mounting plate must be minimum 1/4" (6.3mm) thick. Mounting bolt threads must fully engage nut, but bolt must not contact opposite side of nut pocket in casting. All 4 mounting bolts must be used to secure the winch.

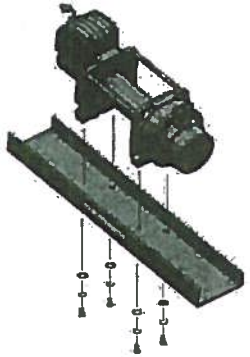
For 13.5 and 15.5, 17.5 models: Mounting hardware suppied with winch is sized for a 5/16" (8mm) thick mounting plate. For thicker mounting plates, minimum 18mm (0.700") bolt engagement in casting is required. Bolts must not bottom out in the tapped holes before being fully tightened. All 8 mounting bolts should be used when possible. Minimum of 4 bolts required.
6.5" x 10" (165.1mm x 254mm) pattered is prefered
4.5" x 10" (114.3mm x 254mm) pattern is acceptable.

⚠ WARNING **Your winch is a very powerful machine. To protect yourself and property, the winch must be properly mounted to a structural support capable of withstanding the high pulling capacity of the winch.**

⚠ WARNING ***Do not substitute any strength grade weaker than SAE Grade 8 (ISO 10.9).***

⚠ CAUTION ***If remote mounting, the soleniod box, the solenoid pack may be mounted in any configuration EXCEPT inverted (i.e. solenoid studs facing down). Inverted mounting may cause erratic operation. Use properly sized wire or contact Superwinch for remote mount kit options.***





INSTALLATION
Figure 2

(NOTES,
NOTAS)

TECHNICAL DATA GUIDE

TIGER SHARK 9,500 / 11,500

PERFORMANCE SPECIFICATIONS AND REPAIR PARTS FOR YOUR
12V DC Electric Winch

GUÍA DE DATOS TÉCNCOS

EPSECIFICACIONES DE DESEMPECÑOY PARTES DE REPUESTO
12V Cabrestante Eléctrico

GUIDE DE DONNÉES TECHIQUES

SPÉCIFICATIONS DE PERFORMANCE ET PIÈCES DERÉPARATION
12V Treuil Electrique

Superwinch LLC.
359 Lake Road
Dayville, Ct 06241, USA
tel: (800) 323 -2031
fax: (860) 963- 0811
e-mail: info@superwinch.com
www.superwinch.com

Superwinch Ltd.
Union Mine Road
Pitts Cleave,
Tavistock, Devon, PL19 0NS, UK
tel: +44 (0) 1822 614101
fax: + 44 (0) 1822 615204
e-mail: sales@superwinch.net

90-14518 Rev - 2/13/2012

SPECIFICATIONS TIGER SHARK 9,500 / 11,500

Working Load* - 9,500 lbs (4,309 kg) / 11,500 lbs (5,216 kg)
Motor - 5.2 hp (3.8 kw), Sealed / 6.0 hp (4.48 kw), Sealed
Gearing Ratio - 218:1
Freespool Clutch - Pull and Turn
Drum Diameter - 2.5" (63.5 mm)
Drum Length - 9" (228.6 mm)
Installed Weight - **9,500**: 90 lbs (41 kg) / **11,500**: 94 lbs (42 kg)
Switching Method - Sealed Handheld Controller
Fairlead - 4-Way Roller

* PERFORMANCE BASED ON THE FIRST LAYER OF ROPE WRAPPED ON DRUM

ESPECIFICACIONES TIGER SHARK 9.500 / 11.500

Carga de Trabajo* - 9.500 lbs (4309 kg) / 11.500 lbs (5216 kg)
Motor - 5.2 hp (3.8 kw), cerrado / 6.0 hp (4.48 kw), Sellado
Relación de los Engranes - 218:1
Embraque de Carrete Libre: - Tire y Gire
Diámetro del Tambor - 2.5" (63.5 mm)
Longitud del Tambor - 9" (228.6 mm)
Peso instalado - **9.5**: 90 lbs (41 kg) / **11.5**: 94 lbs (42 kg)
Método de Interrupción - Controlador Portátil sellado
Fairlead - Rodillo de 4 Maneras

* Desempeño basado en la primera capa de cuerda arrollado en el tambor.

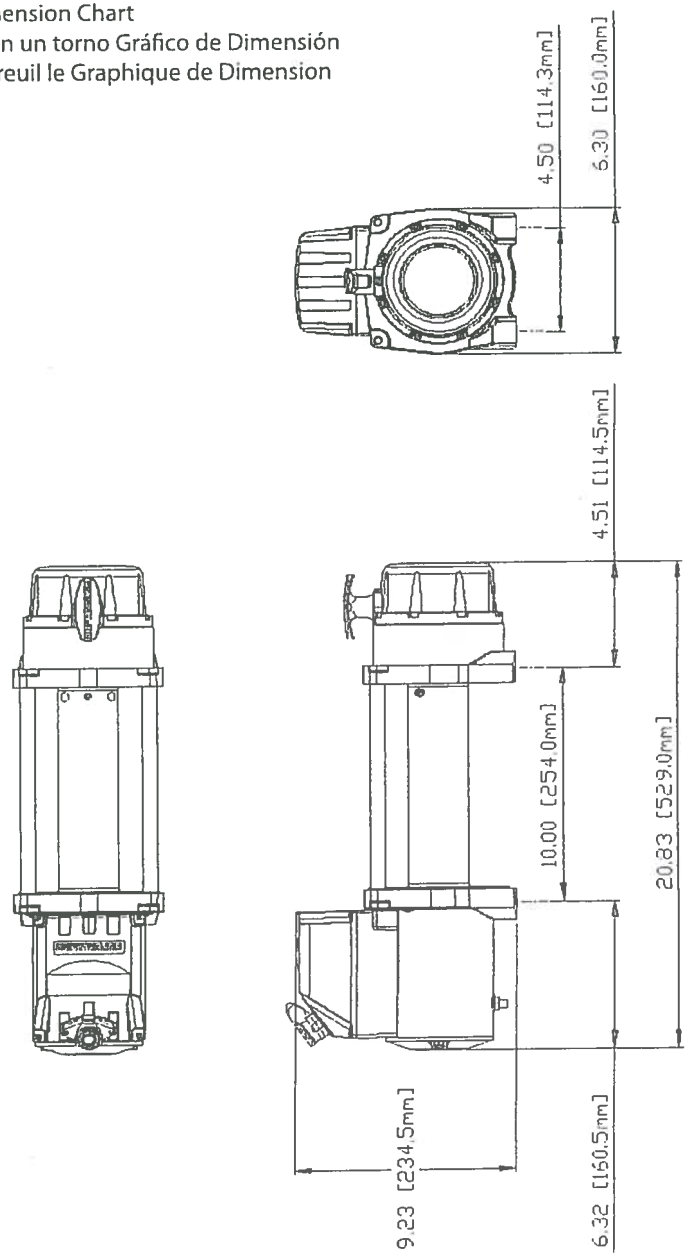
SPECIFICATIONS TIGER SHARK 9.500 / 11.500

Charge de travail* - 9.500 lbs (4309 kg) / 11.500 lbs (5216 kg)
Moteur - 5.2 hp (3.8 kw), scellée / / 6.0 hp (4.48 kw), Scellé
Rapport d'engrenage - 218:1
Embrayage de décrabotage - Tirer et Tourner
Diametre de tanbour - 2.5" (63.5 mm)
Lonqueur de tanbour - 9" (228.6 mm)
Peso instalado - **9.5**: 90 lbs (41 kg) / **11.5**: 94 lbs (42 kg)
Méthode de commutation - Le Contrôleur de poche scellé
Fairlead - Cylindre de 4 Façons

* Performance basée sur la première couche de corde enveloppé sur le tambour.

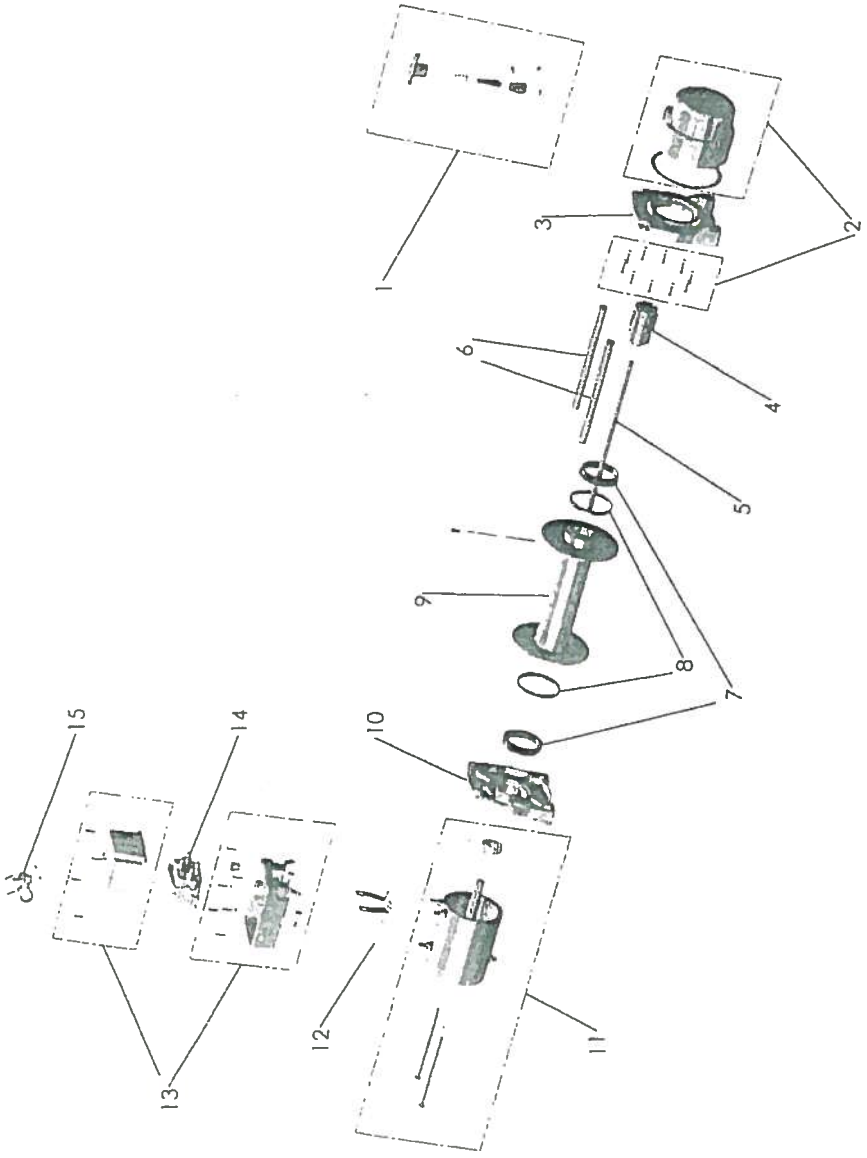
Tiger Shark - 9,500 / 11,500

Winch Dimension Chart
Levante con un torno Gráfico de Dimensión
Hisser au treuil le Graphique de Dimension



Tiger Shark - 9,500 / 11,500

Parts Diagram
Despide Esquema
Sépare le Diagramme



ROLLING LOAD CAPACITIES
CAPACIDADES PARA CARGA RODANTE
CAPACITÉS DE CHARGE ROULANTE

Slope** Pendiente Slope	10% (6°)	20% (11°)	40% (17°)	100% (45°)
9,500				
lb***	47,737	32,294	20,464	12,213
kg**	21653	14648	9282	5540
11,500				
lb***	57,789	39,116	24,784	14,781
kg**	26212	17742	11241	6704

Ratings assume a 10% coefficient of friction.
** A 10% slope is a rise of one foot in ten feet. Slope in approximate degrees is also above.
*** All loads shown are for single-line operation. Double-line operation with optional pulley block approximately doubles capacity of which.

Las capacidades nominales suponen un coeficiente de fricción del 10%
** Un pendiente del 10% es una subida de un metro diez metros. También se muestra arriba el pendiente en grados aproximados.
*** Todas las cargas son para una operación de una linea sencilla. El uso de linea doble con bloque de poleas opcional aproximadamente duplica la capacidad del cabrestante.

Les charges nominales assument un facteur de roulement de 10%.
** Une pente del 10% est une élévation d'un pied par dix pied. La pente en degrés approximatifs est aussi indiquée plus haut.
*** Toutes les charges indiquée sont pour une opération à câble unique. Opération à câble double avec palan optionnel double approximativement la capacitè du treuil.

PERFORMANCE / DESEMPEÑO / PERFORMANCE

Number of Wire Rope Layer(s)	Max. Pulling Capacity lb	kg	Load lb	kg	*Speed ft/min	m/min	*Motor Current Amps
Capa de Cable de Alamb	Capacidad de Jalado Máx. lb	kg	Carga lb	kg	*Velocidad Pies/min	m/min	*Corriente del Motor Amperios
Couche de câble métalliq	Capacité de traction max. lb	kg	Charge lb	kg	*Vitesse ft/min	m/min	*Rendement du Motour Ampères
9,500							
1	9,500	4309	0	0	19@0 lbs	5.7@0 kg	80
2	7,711	3497	**9,500**				
3	6,489	2943	9,500	4,309	4@9,500 lbs	1.2@4309 kg	340
4	5,601	2540					
11,500							
1	11,500	5216	0	0	19@0 lbs	5.7@0 kg	80
2	9,121	4137	**11,500**				
3	7,557	3427	11,500	5216	2@11,500 lbs	0.6@5216 kg	410
4	6,451	2926					

* Performance based on the first layer of wire rope wrapped on drum.
* Desempeño basado en la primera capa de Cable de alambre arrollado en el tambor.
* La performance est établie selon la premère couche de câble métallique enroulée sur le tambour.

TIGER SHARK - 9500 / 11500 PARTS LIST; REFER TO THE DIAGRAM ON PAGE 6,

Legend Number:	Superwinch Part Number:	Part Description :
1	90-24571	Freespool Knob Assembly (includes setscrew)
2	90-41432	Gearbox Assembly with gasket and Mounting bolts
3	90-41433	Drum Support, Gearbox-side
4	90-32487	Brake Assembly
5	90-24572	Driveshaft
6	90-32488	Tie bars (pair) with mounting bolts
7	90-14521	Drum Bushings (pair)
8	90-14520	Drum Seals (pair)
9	90-41434	Drum
10	90-41435	Drum Support, Motor-side
11	90-32489 (9,500) 90-32490 (11,500)	Motor Assembly
12	90-32491	Buss Bars (3 pc. set)
13	90-41436	Solenoid Box Assembly (includes brackets and bolts)
14	90-32492	Solenoid
15	90-24573	Socket for Solenoid box (includes screws)
	90-32493	Roller Fairlead Assembly
	90-24574	Hardware Kit (includes winch mount bolts and fairlead mount bolts)
	90-24575	Wire Rope Assembly (9500)
	90-24576	Wire Rope Assembly (11500)
	90-24577	Hook
	90-24578	Battery Cables (pair, red and black)
	90-22860	Circuit Breaker Assembly (9500)
	90-22147	Circuit Breaker Assembly (11500)
	90-32494	Handheld Controller /
	87-31120	Handsaver /
	90-32495	Label Kit (includes all labels for winch 9,500)
	90-32496	Label Kit (includes all labels for winch (11,500)

SECTION 6

HATZ ENGINE

OPERATION & MAINTENANCE INSTRUCTIONS

DANDO DRILLING INTERNATIONAL LTD

OLD CUSTOMS HOUSE, WHARF ROAD,
LITTLEHAMPTON, WEST SUSSEX,
BN17 5DD, ENGLAND

E-MAIL: info@dando.co.uk
WEB: www.dando.co.uk
TEL: +44(0)1903 731312 FAX: +44(0)1903 730305

Energold DRILLING CORES

Made in England since 1867

1 Notices

Contact data

© 2012
Motorenfabrik HATZ
Ernst-Hatz-Straße 16
94099 Ruhstorf
Germany

Tel. +49 (0)8531 319-0

Fax +49 (0)8531 319-418

marketing@hatz-diesel.de

www.hatz-diesel.com

Copyright

Original Operator's Manual

This Operator's Manual was translated into multiple languages.

The German version is the **original Operator's Manual**. All other language versions are **translations** of the **original Operator's Manual**.

2 General information

Information on the document

This Operator's Manual was created with due care. It is exclusively intended to offer a technical description of the machine and to provide instructions on commissioning, operating and maintaining the machine. When operating the machine, the applicable standards and legal regulations as well as any in-house regulations apply.

Before commissioning, during operation and before maintenance work is begun on the machine, read the Operator's Manual carefully and keep it close by for ready access.

Machine

This Operator's Manual describes the following machine.

Machine name	HATZ diesel engine
Type number	2-4L41C 2-4M41 2-4M41Z 4M42 4L42C

Customer service

Have service work performed by qualified technicians only. We recommend that you work with one of the over 500 **HATZ service stations**. Trained specialists there will repair your machine with **Hatz original spare parts** and with **HATZ tools**. The global HATZ service network is at your disposal to advise you and supply you with spare parts. For the address of the **Hatz service station** nearest you, please see the directory included or visit the Internet at: **www.hatz-diesel.com**

Problems may occur if unsuitable spare parts are installed. We cannot accept responsibility for damage and secondary damage that result from this.

We therefore recommend the use of **Hatz original spare parts**. These parts are manufactured according to strict Hatz specifications and achieve maximum operational reliability through their perfect fit and functionality. The order number can be found in the included spare parts list or on the Internet at: **www.hatz-diesel.com**

Exclusion of liability

The manufacturer cannot be held responsible for personal injury, damage to property, or damage to the machine itself caused by improper use, foreseeable misuse or failure to follow or adequately follow the safety measures and procedures described in this Operator's Manual. This also applies to changes made to the machine and use of unsuitable spare parts.

We reserve the right to make modifications in the interest of technical improvement.

3 Safety

3.1 General information

Introduction

This chapter contains the information you need to work safely with this machine.

To prevent accidents and damage to the machine, it is imperative that these safety instructions be followed.

Read this chapter carefully before beginning work.

3.1.1 Intended use and foreseeable misuse

Intended use

The machine described in this Operator's Manual fulfills the following functions:

- Diesel engine intended for installation in a machine or for assembly with other machines to form a machine. See the chapter *11 Installation declaration, page 103*.

This engine is intended exclusively for the purpose specified and tested by the manufacturer of the machine into which the engine is installed.

Any other use is not intended and therefore not permitted. Violations compromise the safety of the personnel working with the machine. Responsibility is not accepted by Motorenfabrik HATZ for damage resulting from this situation.

The operational safety of the machine is only guaranteed if it is used as intended.

Use according to the intended purpose also includes observance of the instructions in this Operator's Manual.

Foreseeable misuse

The following is considered to be foreseeable misuse:

- Any use that varies from or extends beyond the uses specified above.
- Failure to comply with the instructions in this Operator's Manual.
- Failure to comply with the safety instructions.
- Failure to immediately eliminate malfunctions that impact safety before continuing work with the machine (working with the machine when it is not in perfect condition, either functionally or in terms of safety).
- Failure to perform the necessary inspection and maintenance work.
- Any unauthorized modification of or removal of safety equipment.
- Use of spare parts and accessories that are unsuitable or have not been approved by HATZ.
- Operation in flammable or hazardous environments.
- Operation in closed-off or poorly ventilated rooms.

- Installation of the machine in moving equipment (e.g. vehicles, trailers) or in closed rooms without additional measures to handle supply air, extract air and exhaust.
- Improper operation at variance with DIN 6271 and DIN ISO 8528 (climate, load, safety).

Residual risks

Residual risks result during daily use and in association with maintenance work.

These residual risks are described in the chapter *3.2.2 Machine-specific safety instructions for operation, page 14* and in the chapter *3.2.3 Machine-specific safety instructions for maintenance work, page 16*, and in other parts of the manual directly preceding the affected descriptions and instructions.

3.1.2 Machine user or machine manufacturer obligations

Machine manufacturer obligations

If you have an engine that is not yet installed in a machine, it is imperative that you follow the **Assembly Instructions for HATZ Diesel Engines** before installing the engine. These assembly instructions contain important information on how to safely install the engine and are available at your nearest **HATZ service station**.

It is prohibited to start the engine before it is fully installed.

In addition, please note that it is prohibited to start up the machine before it has been determined that the machine into which this engine is installed fulfills all safety-related requirements and legal regulations.

User obligations

The user is obligated to only operate the machine while it is in perfect condition. The user must check the condition of the machine before using it and ensure that any defects are eliminated before it is taken into service. Operation of the machine while identified defects exist is not permitted. The user must also ensure that the information contained in the Operator's Manual has been read and understood.

Obligations of the operating and maintenance personnel

Personnel assigned with operating and maintaining the machine must have read and understood the Operator's Manual or must be able to demonstrate the necessary qualifications for working with this equipment, acquired in training/instructional courses. No one may work with the machine without the necessary qualifications, even if for just a brief period.

All work performed on the machine must be in compliance with the information provided in the Operator's Manual.

Storing the Operator's Manual

This Operator's Manual is an integral component of the machine (also when being sold). It must be stored in the direct vicinity of the machine and be accessible to personnel at all times.

3.1.3 Representation of safety notes

Overview

This machine has been designed and built according to state-of-the-art technology and the recognized safety standards. Despite these precautions, risks exist when operating the machine and during maintenance work.

These risks are identified in this manual by means of safety notes.

The safety notes precede the related description or operating step.

Structure of the safety notes

The safety notes consist of:

- Warning symbol
- Signal word
- Description of danger
- Possible consequences
- Preventative measures

General danger symbol

The general danger symbol is used to identify the danger of personal injury.

Signal words

Signal words identify the magnitude of the risk and the seriousness of the possible injuries:

Warning symbol/ Signal word	Meaning
DANGER	This signal word is used to indicate imminently dangerous situations which, if not avoided, will lead to serious injury or death.
WARNING	This signal word is used to indicate potentially dangerous situations which, if not avoided, may lead to serious injury or death.
CAUTION	This signal word is used to indicate potentially dangerous situations which, if not avoided, may lead to minor or moderate injury.

Warning symbol/ Signal word	Meaning
CAUTION	This signal word, without a danger symbol, is used to indicate the risk of property damage.
NOTICE	This signal word indicates additional useful information, such as operating tips and cross references.

3.1.4 Meaning of safety symbols

Explanation of symbols

The following table describes the meanings of the safety symbols used in this Operator's Manual.

Symbol	Meaning
	Smoking, fire and open flames are prohibited.
	Warning of personal injury!
	Warning of hot surfaces!
	Warning of flammable substances!
	Warning of explosive substances!
	Warning of toxic engine exhaust!
	Warning of corrosive substances!

Symbol	Meaning
	Warning of heavy loads!
	Warning of environmental damage!
	Comply with the Operator's Manual or additional documentation from other manufacturers or the user.
	Additional information that is useful to the reader.

3.2 Safety notes

3.2.1 Operational safety

Introduction

This chapter contains all of the important safety instructions for personal protection and for safe and reliable operation. Additional, task-related safety instructions can be found at the beginning of each chapter.

DANGER

Danger to life, danger of injury or danger of property damage due to failure to comply with the Operator's Manual and the safety instructions contained therein.

- As the user of the machine, you must ensure that all people working on the machine are familiar with the content of this Operator's Manual.
- Before working on the machine, read this Operator's Manual carefully, paying special attention to the safety notes.
- Fulfill all required safety conditions before working on the machine.
- Follow all general safety instructions as well as the specific task-related safety instructions contained in the individual chapters.

Using the machine

- Only operate the machine for the purposes described in the chapter *3.1.1 Intended use and foreseeable misuse, page 7*.

Compliance with other regulations

- Adhere to the applicable accident prevention regulations of the trade associations.
- Comply with the regulations concerning the minimum safety and health requirements for the use of work equipment by workers at work.
- In addition, local safety, accident prevention and environmental regulations also apply when operating the machine.

Operating personnel

- The machine may only be operated by qualified personnel. The personnel must have read and understood this Operator's Manual or must be able to demonstrate the necessary qualifications for working with this equipment, acquired in training/instructional courses.
- The operating personnel must not be under the influence of drugs, medication or alcohol.

Personal protective equipment

During operation and maintenance of the machine, personal protective equipment must be available and must be used if necessary. The required personal protective equipment is specified in the descriptions of the operating steps.

Personal protective equipment	Pictogram	Function
Safety shoes		Safety shoes offer protection against: ▪ Slipping ▪ Falling objects
Hearing protection		Hearing protection offers protection against ear injuries due to excessive and constant noise.
Safety gloves		Safety gloves protect the hands against injury, for example from battery acid.

Personal protective equipment	Pictogram	Function
Safety goggles (with side shields)		Safety goggles protect the eyes from flying objects (for example, dust particles, spraying liquids, spraying acid).
Working clothes		Wear close-fitting clothing. However, it must not restrict the wearer's freedom of movement.

Warning and notice labels on the machine

The warning and notice labels on the machine must be followed (see the chapter *3.3 Labels, page 19*).

The warning and notice labels must be kept legible and must be replaced if necessary. For this purpose, contact your nearest **HATZ service station**.

Maintenance work

Maintenance work that goes beyond the scope described in this manual must only be performed by qualified technicians (see the chapter *2 General information, page 6*).

Independent maintenance work and constructional changes to the machine, especially to the safety equipment, are not permitted.

Safety equipment

Safety equipment must not be modified and must not be rendered ineffective during normal operation.

General safety notes

DANGER

Danger to life and danger of injury due to failure to follow the warnings on the machine and in the Operator's Manual.

- Heed the warnings on the machine and in the Operator's Manual.

WARNING

Danger of injury and danger of incorrect operation due to inadequate personnel qualifications.

- The personnel must have read and understood this Operator's Manual or must be able to demonstrate the necessary qualifications for working with this equipment, acquired in training/instructional courses.
- Only qualified personnel is permitted to operate and maintain this machine.
- Failure to comply will cause the warranty to be void.

WARNING

Danger of injury from the failure to follow the operating instructions and from performing unauthorized tasks on the machine.

- Follow all instructions.
- Do not perform activities that are not authorized. Contact properly trained personnel if necessary.

CAUTION

Danger of injury from overloading the body.

Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).

- Only lift the machine with a hoist (see the chapter *6.1 Transport, page 31*).

3.2.2 Machine-specific safety instructions for operation

Introduction

The machine can pose residual risks during operation. To eliminate these risks, all persons working on the machine must follow the general and machine-specific safety instructions.

If you have an engine that is not yet installed in a machine, it is imperative that you follow the **Assembly Instructions for HATZ Diesel Engines** before installing the engine.

These assembly instructions contain important information on safe installation.

If the engine is installed in a machine or assembled with other machines to form a machine, it is prohibited to start the engine before it has been determined that the newly created machine fulfills all safety-related requirements and applicable legal regulations .

Safe operation

- Before switching on the machine, ensure that no one can be injured when the machine is started up.
- During machine operation, ensure that unauthorized persons do not have access to the area in which the machine has an impact.
- Parts of the exhaust gas system and the surface of the engine become hot during operation. Risk of injury from touching hot parts! Let the engine cool before maintenance.
- Do not refuel during operation.

Faults

- Immediately eliminate faults that compromise safety.
- Switch off the machine and do not take into service again until all faults have been eliminated.

Safety instructions for operation

DANGER

Danger to life from inhaling exhaust gases.

Toxic engine exhaust gases can lead to loss of consciousness and even death in closed-off and poorly ventilated rooms.

- Never operate the machine in closed-off or poorly ventilated rooms.
- Do not breathe in the exhaust gases.

DANGER

Fire hazard from fuel.

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Only refuel while the engine is switched off.
- Never refuel in the vicinity of open flames or sparks that can cause ignition.
- Do not smoke.
- Do not spill fuel.

⚠ CAUTION	
	**Danger of injury from defective crankhandle.** A damaged or broken handle bar can cause injuries. A worn cranking shaft can slip out of the starting mechanism when starting and also cause injuries. ▪ Check the crankhandle for a broken handle bar, worn cranking shaft, etc.; replace if necessary.

3.2.3 Machine-specific safety instructions for maintenance work

Introduction

The machine can pose residual risks during maintenance. To eliminate these risks, all persons working on the machine must follow the general and machine-specific safety instructions.

Maintenance intervals

- Strictly adhere to the maintenance intervals.
- Check the safety equipment regularly to ensure it is in good condition and functioning properly.
- Check connections, cables and fasteners regularly to ensure they are in good condition.

Maintenance work

Maintenance work that goes beyond the scope described in this manual must only be performed by qualified technicians. We recommend that you work with one of the over 500 **HATZ service stations**.

Replacing parts

- When replacing parts, we recommend the use of **HATZ original spare parts** (see the chapter *2 General information, page 6*).
- When disposing of parts that can no longer be used, do so in accordance with local environmental regulations or send them to a recycling center.

Measures following maintenance and troubleshooting

- Securely reconnect loose electrical connections; check that the electrical components and equipment are functioning properly.
- Check the entire machine for foreign bodies; remove any foreign bodies.

Safety instructions for maintenance work

DANGER

Danger of explosion from flammable cleaning agents.

Cleaning with benzene is an explosion hazard. It is highly flammable, can become electrostatically charged and can generate an explosive gas-air mixture.

- Use halogen-free, cold cleaners with a high flashpoint for cleaning.

WARNING

Danger of injury from compressed air and dust particles.

Eye injuries may occur when cleaning with compressed air.

- Wear safety goggles.

CAUTION

Danger of injury if the maintenance instructions are not followed.

- Only perform maintenance while the engine is switched off.
- In engines with a starter:
  Disconnect the negative terminal of the battery.
  Protect the starting key against unauthorized access.

CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

3.2.4 Electrical equipment

Safety notes

DANGER

Danger to life, danger of injury or danger of property damage due to incorrect use of batteries.

- Do not place tools on the battery.
- Before performing work on the electrical equipment, always disconnect the negative terminal of the battery.
- Never swap the positive (+) and negative (–) battery terminals.
- When installing the battery, first connect the **positive cable** and then the **negative cable**.
- When removing the battery, first disconnect the **negative cable** and then the **positive cable**.
- It is imperative that you prevent short circuits and mass contact of current-carrying cables.
- If faults occur, check the cable connections for good contact.

DANGER

Danger of explosion from flammable substances.

There is a danger of explosion from flammable gases.

- Keep batteries away from open flames and incendive sparks.
- Do not smoke when working with batteries.

CAUTION

Danger of chemical burns

Chemical burns can occur when using batteries for the electrical operation.

- Protect your eyes, skin and clothing from the corrosive battery acid.
- Immediately rinse areas affected by splashed acid with clear water and consult a physician if necessary.

NOTICE

- The necessary wiring diagrams are included with the machine if it is equipped with electrical equipment. Additional wiring diagrams can be requested when needed.
- We cannot be held liable for electrical equipment that is not designed according to HATZ wiring diagrams.

- Promptly replace faulty indicator lamps.
- Do not pull out the starting key during operation.
- Do not disconnect the battery while the machine is running. Resulting voltage peaks could destroy the electronic components.
- When performing a manual emergency start, leave the (possibly depleted) battery connected.
- When cleaning, do no spray the electrical equipment components with a water jet or high pressure cleaner.
- When performing welding work on the machine, disconnect the battery and place the ground clamp of the welding equipment as close as possible to the welding area. Disconnect the plug-in connection to the voltage regulator.

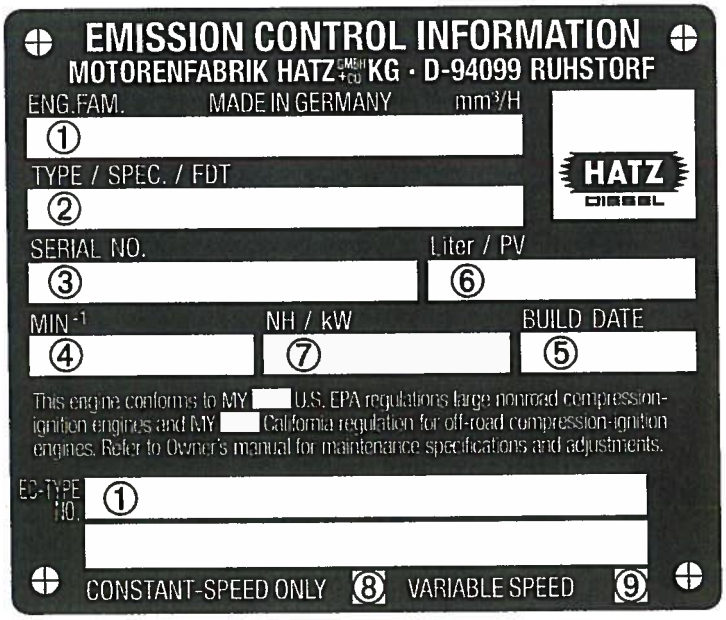
3.3 Labels

Overview

The following labels are found on the machine:

- Engine type plate
- Warning labels and information signs on the engine
- Warning labels and information signs on the crankhandle

Engine type plate



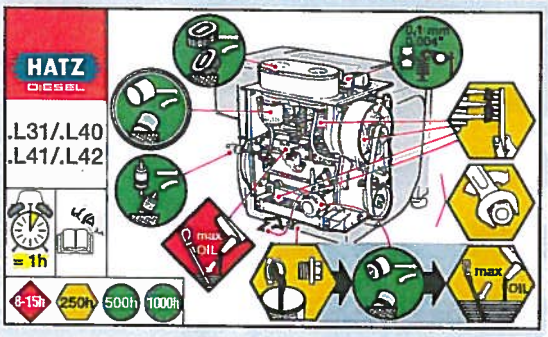
The engine type plate is located on the crankcase or sound protection hood and contains the following engine information:

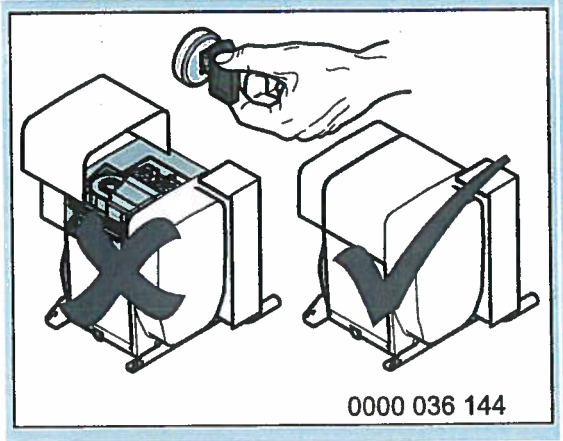
1	Number of the engine family or the EU approval (for engines with exhaust certificate only)
2	Engine type, customer specification and setting of pumping start (° crankshaft before top dead center)
3	Engine serial number
4	Max. engine speed (rpm)
5	Model year
6	Displacement (liters) and inspection requirement for special settings
7	Injection pump effective stroke (mm) and engine capacity (kW)
8	"Constant speed only" (for engines with EPA/CARB exhaust certificate only)
9	"Variable speed" (for engines with EPA/CARB exhaust certificate only)

The following data must always be specified for requests and spare part orders

2	Engine type and customer specification
3	Engine serial number
4	Max. engine speed (rpm)

Warning labels and information signs

Label	Meaning
	Maintenance instructions (see the chapter *8.1 General maintenance instructions, page 55*)

Label	Meaning
	CAUTION! Damage from inadequate engine cooling. ▪ Only run the engine when all covers are installed.
	Refuel with diesel fuel only. For the specification, see the chapter *4.2 Fuel, page 23* Do not use bio diesel.

Warning labels and information signs on the crankhandle

Label	Meaning
	Hold the handle bar so that it cannot twist and quickly turn the crank so that continuous traction between the engine and crank is ensured, see the chapter Starting the engine with crankhandle.

4 Technical data

4.1 Engine

Type		2L41C 2M41.	3L41C 3M41.	4L41C / 4L42C 4M41. / 4M42
Type		Air-cooled four stroke diesel engine		
Combustion system		Direct injection		
Number of cylinders		2	3	4
Bore/stroke	mm	102 / 105	102 / 105	102 / 105
Displacement	cm^3	1716	2574	3432
Engine oil pressure at oil temperature of 100 ± 20°C		Min. 0.6 bar at 850 rpm		
Engine oil consumption (after running-in period)	Max.	1% of fuel consumption, pertaining to full load		
Sense of rotation		When viewing flywheel: left		
Tappet clearance at 10 - 30 °C Inlet/outlet	mm	0,10		
Net weight	Approx. kg			
.M41		258	308	373
.M41Z		263	315	388
4M42				378
.L41C		303	363	433
4L42C				438

Max. perm. inclination during continuous operation in direction	with / without oil sump	with oil sump	without oil sump	only with oil sump
Operating side	30° [1]	30° [1]	25° [1]	25° [1]
Exhaust air side	30° [1]	30° [1]	30° [1]	30° [1]
Timing cover side	30° [1]	25° [1]	25° [1]	15° [1]
Flywheel side	30° [1]	22° [1]	25° [1]	18° [1]

Battery capacity	Min/max	12 V – 88/143 Ah / 24 V – 55/110 Ah

[1] Exceeding these limit values causes engine damage.

Engine oil capacities and dipstick equipment

Type	Oil sump	Engine oil capacity [2] Ltr.	Mark on the dip-stick
2L41C	With	7.5	C
2M41Z	Without	4.5	A
2M41	With	8.5	C
	Without	5.5	A
3L41C	With	10.5	D
3M41Z	Without	8.0	A
3M41	With	11.0	D
	Without	8.5	A
4L41C	With	13.0	D
4L42C	Without	–	–
4M41Z			
4M41	With	14.0	D
4M42	Without	–	–

[2] These values are approximations only. The correct level is indicated by the max. mark on the dipstick (see the chapter *7.9 Checking the oil level and adding oil if necessary, page 53*).

4.2 Fuel

Fuel type

All types of diesel fuel that meet the minimum requirements of the following specifications are suitable:

- **EN 590** or
- **BS 2869 A1 / A2** or
- **ASTM D 975- 1D / 2D**

CAUTION	
	Danger of engine damage from low quality fuel. The use of fuel that does not meet the specifications can lead to engine damage. ▪ The use of fuel that does not meet specifications requires approval by Motorenfabrik HATZ (main plant).

Winter fuel

When outside temperatures drop below 0 °C, use winter fuel or mix in petroleum in advance:

Lowest ambient temperature at start [°C]	Percentage of petroleum [%] for	
	Summer fuel	Winter fuel
0 to -10	20	-
-10 to -15	30	-
-15 to -20	50	20
-20 to -30	-	50

4.3 Engine oil

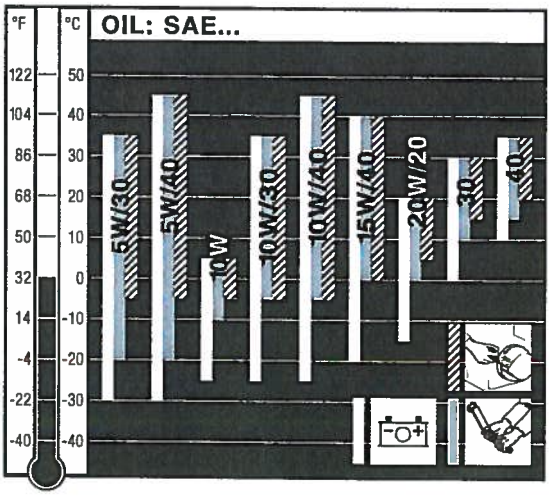
Oil quality

All oil brands that meet at least one of the following specifications are suitable:

- **ACEA – B2 / E2** or better
- **API – CD / CE / CF / CF-4 / CG-4** or better

If engine oils of a low quality standard are used, the oil change interval must be reduced from 250 to 150 or from 500 to 250 operating hours depending on the engine specification.

Oil viscosity



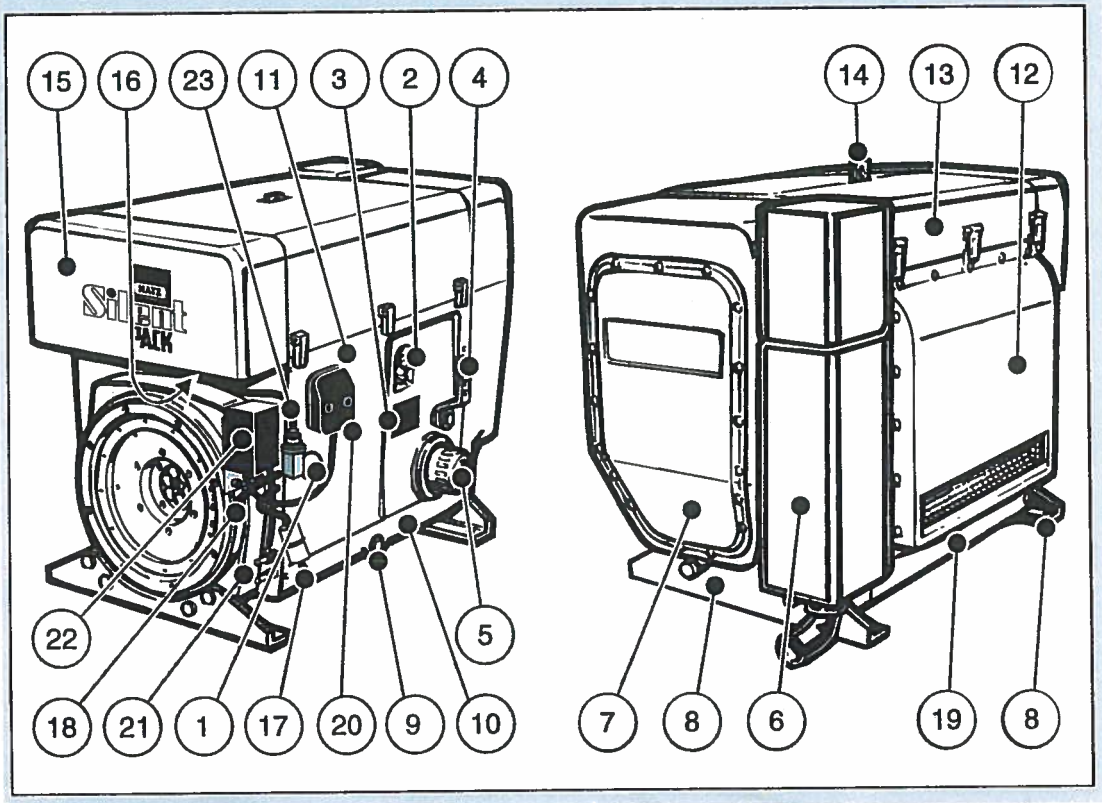
Choose the recommended viscosity based on the type of start (recoil, crank-handle or electric) and on the engine temperature at which the engine will be operated.

CAUTION	
	Engine damage from unsuitable engine oil. Using engine oil that does not meet the above specifications considerably shortens the engine service life.

5 Engine design

Engine 2-4L41C

Encapsulated model "Silent Pack"

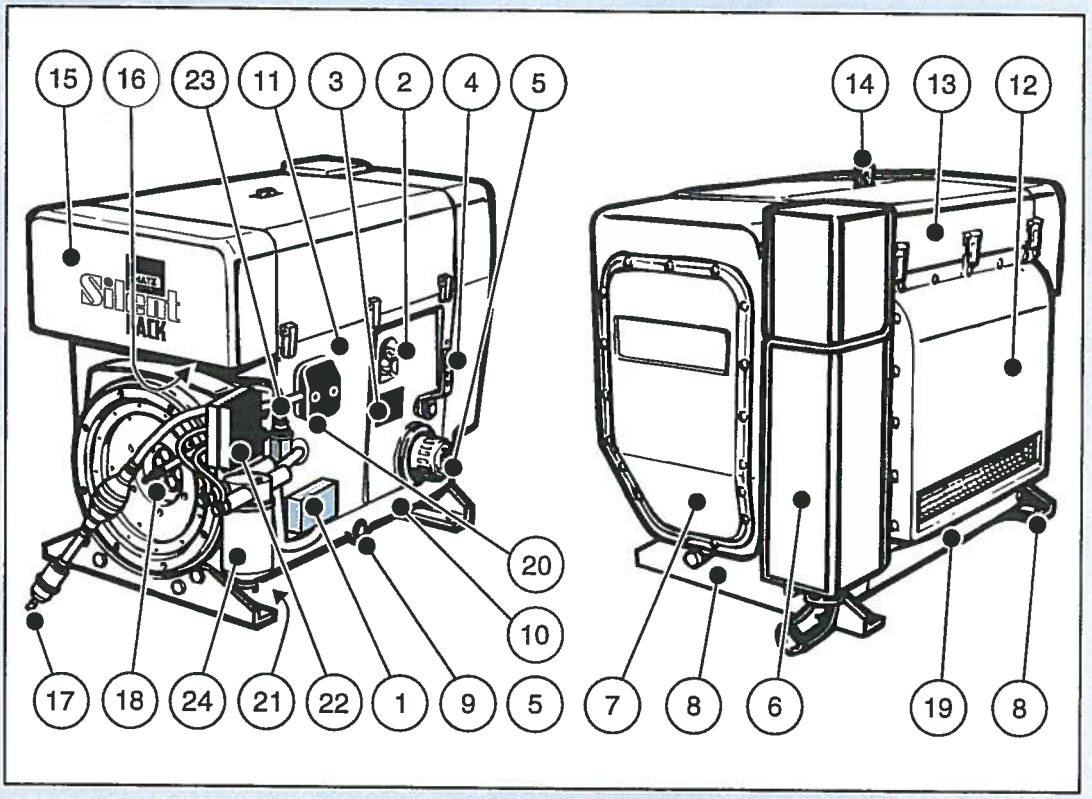


Pos.	Designation
1	Access cap for fuel feed pump
2	Oil filling opening and dipstick
3	Type plate
4	Speed control lever
5	Oil filter
6	Exhaust silencer (encapsulated)
7	Cover for air guide housing (access to cooling fan belt)
8	Engine brackets
9	Oil drain screw
10	Cover plate on operating side
11	Side wall
12	Exhaust air duct
13	Capsule hood

Pos.	Designation
14	Retractable lifting eye, max. load 5000 N
15	Capsule intake shaft
16	Intake opening for combustion air
17	Fuel feed line with fuel prefilter
18	Fuel return line
19	Cover plate on exhaust side
20	Central connector for electrical equipment
21	Battery connections
22	Powerbox
23	Electrical maintenance switch for air filter

Engine 4L42C

Encapsulated model "Silent Pack"

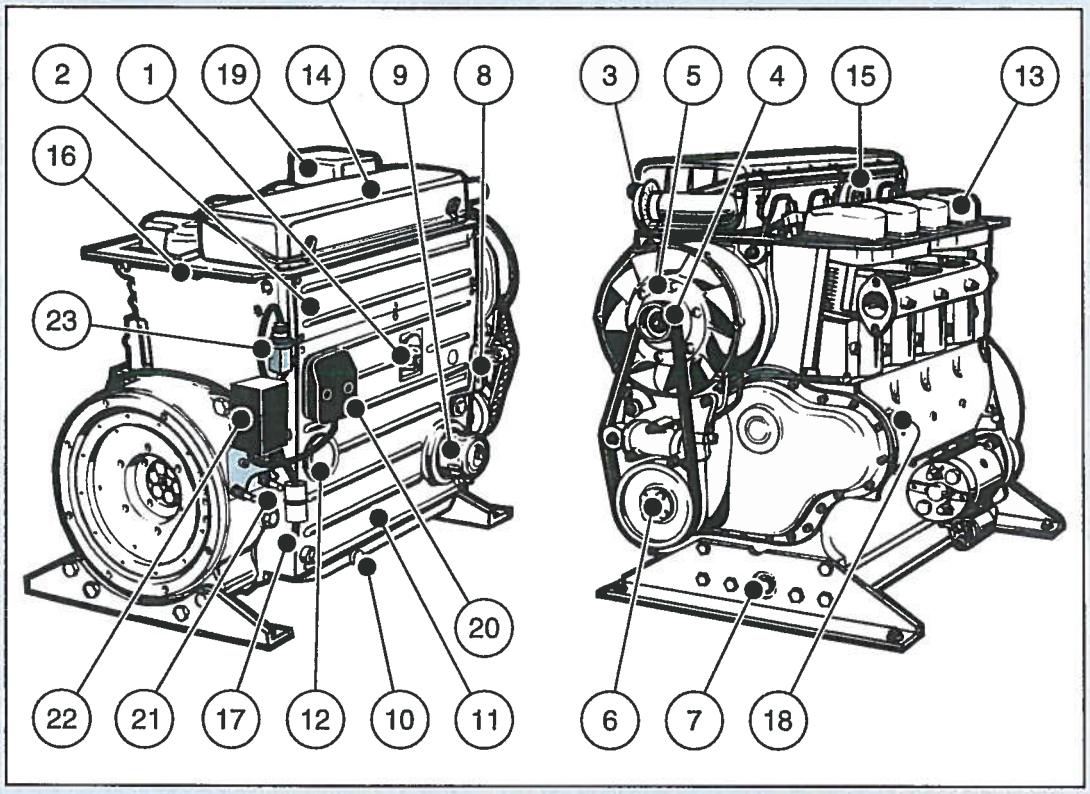


Pos.	Designation
1	Electronic control unit
2	Oil filling opening and dipstick
3	Type plate

Pos.	Designation
4	Speed control lever
5	Oil filter
6	Exhaust silencer (encapsulated)
7	Cover for air guide housing (access to cooling fan belt)
8	Engine brackets
9	Oil drain screw
10	Cover plate on operating side
11	Side wall
12	Exhaust air duct
13	Capsule hood
14	Retractable lifting eye, max. load 5000 N
15	Capsule intake shaft
16	Intake opening for combustion air
17	Fuel feed line with fuel prefilter and manual fuel pump
18	Fuel return line
19	Cover plate on exhaust side
20	Central connector for electrical equipment
21	Battery connections
22	Powerbox
23	Electrical maintenance switch for air filter
24	Fuel filter

Engine 2-4M41, 2-4M41Z

Standard model

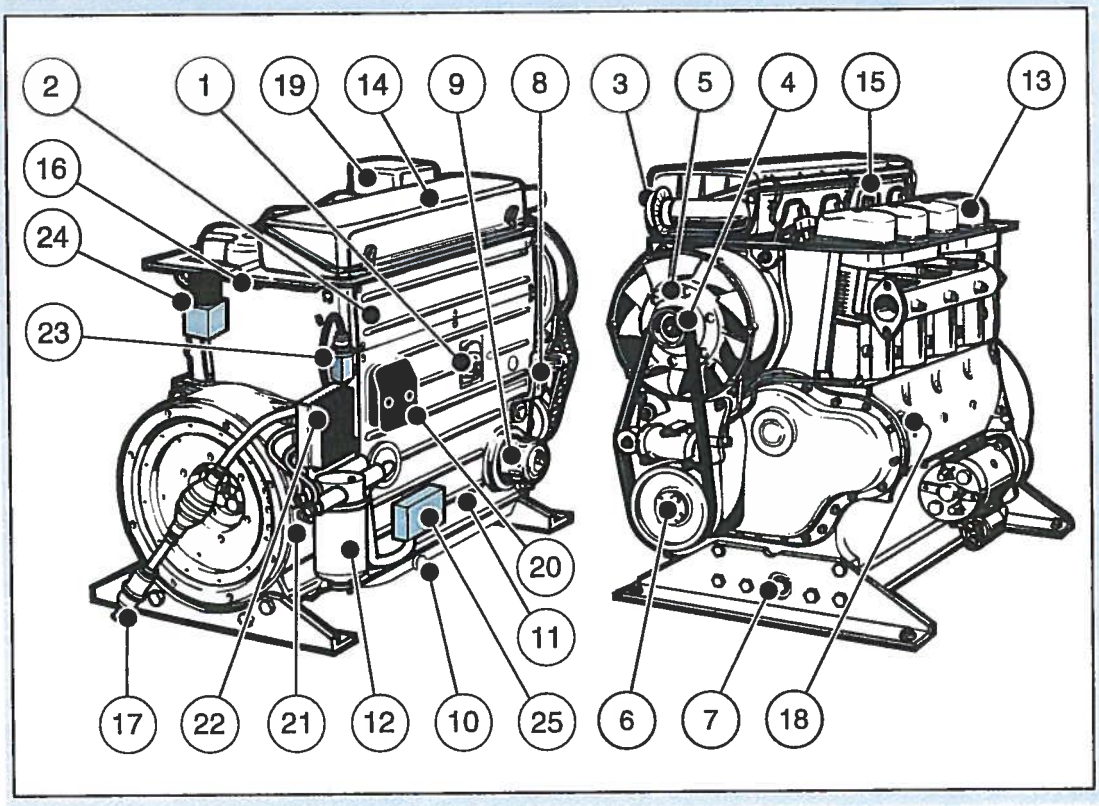


Pos.	Designation
1	Oil filling opening and dipstick
2	Side trim panel
3	Intake opening for combustion air
4	Cooling fan belt
5	Cooling fan with installed three phase alternator
6	1/2-inch square socket for turning the engine
7	Oil drain screw
8	Speed control lever
9	Oil filter
10	Oil drain screw (on oil sump)
11	Cooling air guide for oil cooler
12	Access cap for fuel feed pump
13	Cylinder head cover
14	Air filter housing cover
15	Lifting eye, max. load 5000 N

Pos.	Designation
16	Fuel return line
17	Fuel feed line with fuel prefilter
18	Type plate
19	Silencer
20	Central connector for electrical equipment
21	Battery connections
22	Powerbox
23	Electrical maintenance switch for air filter

Engine 4M42

Standard model



Pos.	Designation
1	Oil filling opening and dipstick
2	Side trim panel
3	Intake opening for combustion air
4	Cooling fan belt
5	Cooling fan with installed three phase alternator

Pos.	Designation
6	1/2-inch square socket for turning the engine
7	Oil drain screw
8	Speed control lever
9	Oil filter
10	Oil drain screw (on oil sump)
11	Cooling air guide for oil cooler
12	Fuel filter
13	Cylinder head cover
14	Air filter housing cover
15	Lifting eye, max. load 5000 N
16	Fuel return line
17	Fuel feed line with fuel prefilter and manual fuel pump
18	Type plate
19	Silencer
20	Central connector for electrical equipment
21	Battery connections
22	Powerbox
23	Electrical maintenance switch for air filter
24	Exhaust gas return valve (EGR)
25	Electronic control unit

6 Transport, assembly and commissioning

6.1 Transport

Safety notes

CAUTION

Danger of injury from overloading the body.

Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).

- Only lift the machine with a hoist.

CAUTION

Only use lifting lugs for transporting the engine.

Do not use for lifting the entire equipment.

NOTICE

Danger of environmental damage from leaking fluid.

If the machine is tilted, engine oil and diesel fuel can run out.

- Only transport the machine in an upright position.

Transport conditions

- Only lift the engine by the standard fitted lifting lugs.
- When transporting the machine, follow the safety instructions.
- When transporting, follow the applicable safety and accident prevention regulations of the trade associations.
- After delivery, check the machine for completeness and transport damage.
- Only transport the machine when it is switched off and has cooled down.
- If you have questions on transporting the machine, please contact your nearest **HATZ service station**. For contact data, see the chapter *1 "Notices", page 5* or **www.hatz-diesel.com**.

6.2 Assembly instructions

Assembly notes

HATZ diesel engines are efficient, robust and long-lived. Therefore, they are usually installed in machines that are used for commercial purposes.

The machine manufacturer must follow the applicable regulations regarding machine safety – the engine is a part of a machine.

Depending on the use and installation of the engine, it may be necessary for the machine manufacturer and machine user to install safety equipment to prevent inappropriate use. Note the following:

- Parts of the exhaust gas system and the engine surface become hot during operation and may not be touched until they cool down after the engine is switched off.
- Incorrect cable connections and incorrect operation of the electrical equipment can lead to sparking and must be avoided.
- After the engine is installed in the machine, rotating parts must be protected against contact.
  HATZ safety equipment is available for the belt drive of the cooling fan and alternator.
- Comply with all notice and warning labels on the engine and keep them in a legible condition. If a label should become detached or be difficult to read, it must be replaced promptly. For this purpose, contact your nearest **HATZ service station**.
- Any improper modification of the engine results in a loss of liability coverage for resulting damage.

Only regular maintenance, as specified in this Operator's Manual, will maintain the operating readiness of the engine.

The assembly instructions contain important information on how to safely assemble the engine. They are available from any **Hatz service station**.

If you have any questions, please contact your nearest **HATZ service station** before commissioning the engine.

6.3 Preparations for commissioning

- Check the delivered parts for completeness, damage and other noticeable issues.
- Ensure that the setup location is adequately ventilated.

⚠ DANGER	
	**Danger to life from inhaling exhaust gases.** Toxic engine exhaust gases can lead to loss of consciousness and even death in closed-off and poorly ventilated rooms. ▪ Never operate the machine in closed-off or poorly ventilated rooms. ▪ Do not breathe in the exhaust gases.

7 Operation and use

7.1 Safety notes

NOTICE

Comply with the safety chapter!

Follow the basic safety instructions in the chapter *3 Safety, page 7*.

DANGER

Danger to life due to damage and defects on the machine.

- Do not take the machine into service if damage has been localized and identified.
- Replace faulty components.

WARNING

Danger of injury from the failure to follow the operating instructions and from performing unauthorized tasks on the machine.

- Define the responsibilities of the personnel taking the machine into service.
- Replace faulty machine parts immediately.
- Check the installation conditions when the machine is first taken into service and after the machine has been inactive for a lengthy period.

CAUTION

Danger of engine damage from low load operation.

Operating the engine at no load or at very low load for an extended period can impair the running characteristics of the engine.

- Ensure that the engine load is at least 15 %.
- Before switching off the engine following low load operation, briefly operate it at a considerably higher load.

7.2 Performing tests

Before starting

Before starting the engine, several tests need to be performed to ensure the machine is working properly.

Procedure

Step	Test
1	The machine is standing securely and on a level surface.
2	The installation location is adequately ventilated.
3	There is a sufficient amount of fuel in the fuel tank (see the chapter *4.2 Fuel, page 23*).
4	There is a sufficient amount of engine oil in the engine housing (see the chapter *4.3 Engine oil, page 24*).
5	For hand start: ▪ Crankhandle in functional condition. ▪ Sliding area between crankhandle and guide sleeve lightly greased.
6	No persons are located in the danger zone of the engine or machine.
7	All safety equipment is in place.

7.3 Start preparation

Procedure

Step	Activity
1	Before the first start and with an empty fuel system: ▪ Pump the fuel with the manual lever (see the chapter *7.3.1 Pumping fuel with the manual lever, page 34*) or ▪ Pump the fuel with the manual fuel pump (see the chapter *7.3.2 Pumping fuel with the manual fuel pump, page 35*)

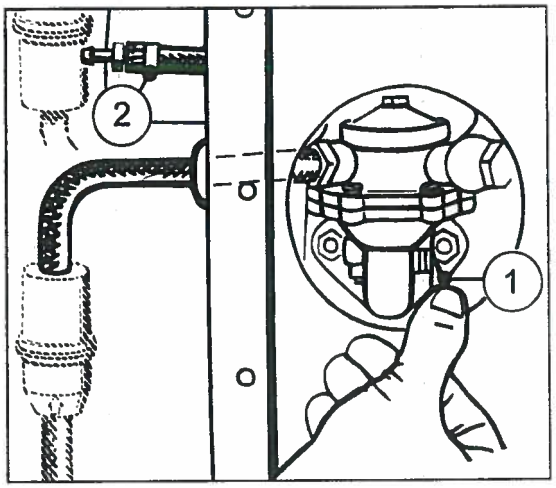
7.3.1 Pumping fuel with the manual lever

Requirements

Pre-pumping of fuel with the manual lever of the fuel feed pump is necessary in the following situations:

- Engine shuts down due to empty fuel tank
- at first filling of the fuel tank
- after changing the fuel filter

Overview



Pos.	Designation
1	Manual lever (fuel feed pump)
2	Return line

Procedure

Step	Activity
1	If there is air in the fuel system: Fill with fuel if necessary.
2	Remove the access cap.
3	Actuate the manual lever (1) on the fuel feed pump until the fuel audibly flows back into the fuel tank through the return line (2).
4	Install the access cap again.

7.3.2 Pumping fuel with the manual fuel pump

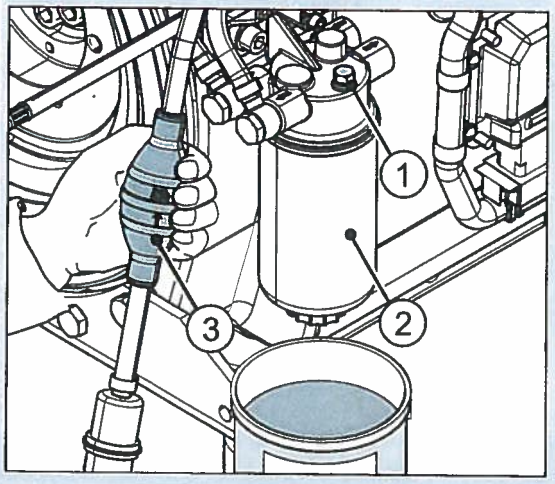
Requirements

Pre-pumping of fuel with the manual fuel pump is necessary in the following situations:

- Engine shuts down due to empty fuel tank
- at first filling of the fuel tank
- after changing the fuel filter

Model with manual fuel pump

Only for 4L42C and 4M42



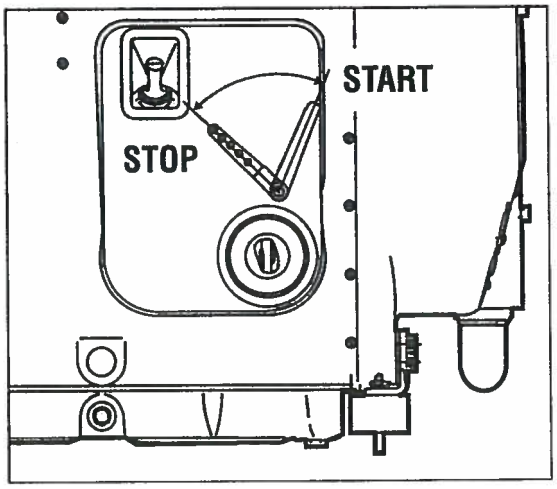
Pos.	Designation
1	Bleed screw
2	Filter
3	Rubber ball

Procedure

Step	Activity
1	If there is air in the fuel system: Fill with fuel if necessary.
2	Place a suitable container under the filter (2) to collect emerging fuel.
3	Open the bleed screw (1) by approx. one turn.
4	Squeeze and release the rubber ball (3) repeatedly until fuel emerges from the bleed screw (1).
5	Close the bleed screw (1) and then activate the rubber ball **two more times.**

7.4 Setting the speed control

Overview



Procedure

Step	Activity
1	Depending on the possibility or requirement, place the speed control lever in either the "1/2" or "Start" position.

NOTICE	
	A lower speed setting will cause less exhaust smoke when starting.

7.5 Starting the engine

Starting options

The standard equipment of the engine is an electric start mechanism. A hand starter can be installed as an option.

If possible, separate the engine from the machine being driven by uncoupling it. Always switch the machine into idle mode.

Safety notes

DANGER

Danger to life from inhaling exhaust gases.

Toxic engine exhaust gases can lead to loss of consciousness and even death in closed-off and poorly ventilated rooms.

- Never operate the machine in closed-off or poorly ventilated rooms.
- Do not breathe in the exhaust gases.

CAUTION

Danger of injury from defective crankhandle.

A damaged or broken handle bar can cause injuries. A worn cranking shaft can slip out of the starting mechanism when starting and also cause injuries.

- Check the crankhandle for a broken handle bar, worn cranking shaft, etc.; replace if necessary.

CAUTION

Danger of injury and danger of engine damage from the use of starting fluid.

- Danger of injury during hand starting because the use of starting fluid can result in uncontrolled ignitions.
- Engine damage from uncontrolled ignitions.
- Never use starting fluid.

7.5.1 Starting the engine with crankhandle

This chapter contains the following sections:

- **Preparations for cranking the engine:**
  Adjust the continuous decompression.
- **Crank the engine:**
  Crank the engine without compression (approx. 10-20 crank turns).
  This lowers the resistance to rotation.
- **Preparations for starting the engine:**
  Adjust the automatic decompression.
- **Start the engine:**
  Cranking starts the cylinders one after the other and the decompression is automatically canceled.

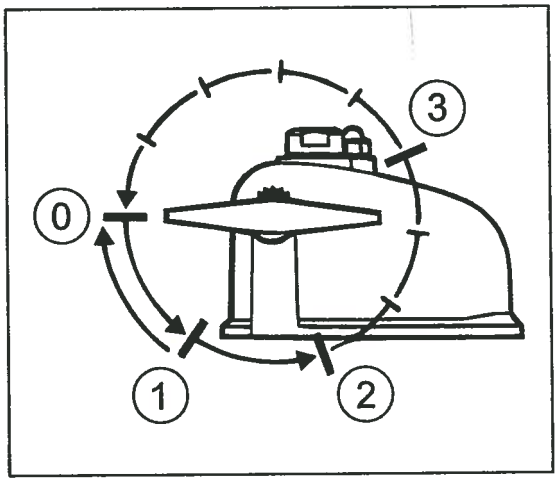
Turning over the engine:

Safety note

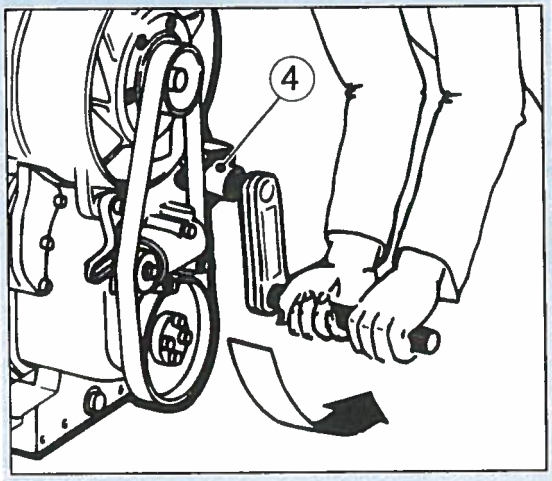
CAUTION	
	Danger of engine damage from decompression while the engine is running. ▪ Do not operate the decompression lever while the engine is running.

Overview

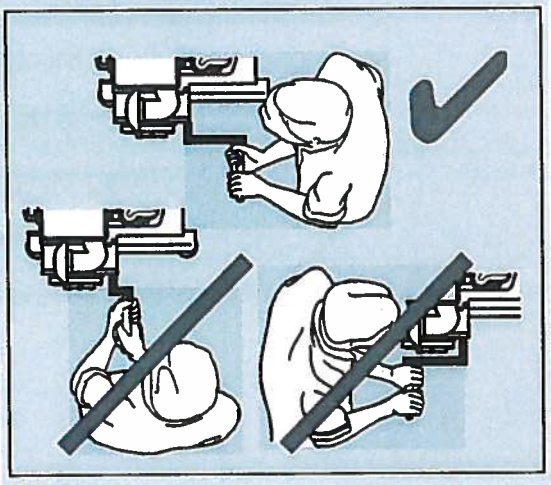
Decompression lever



Attach the crankhandle



Position of operator



Pos.	Designation
0 - 3	Positions of the decompression lever
4	Guide sleeve

Preparation

Step	Activity
1	Carry out start preparations (see the chapter *7.3 Start preparation, page 34*).
2	Move the speed control lever into position "Start" (see the chapter *7.4 Setting the speed control, page 37*).
3	Move all decompression levers to position "1". ▪ 1 lever for two cylinder engine ▪ 3 levers for three cylinder engine ▪ 4 levers for four cylinder engine

	NOTICE
	Only operate the decompression lever while the engine is at a standstill and observe the sense of rotation ▪ Only turn the decompression lever in the direction of the arrow. ▪ Exception: The lever can be turned directly back from position "1" to "0". ▪ Position "1" is the continuous decompression setting.

Procedure

Step	Activity
1	Insert the crankhandle into the guide sleeve (4).
2	Assume the correct position.
3	Grasp the handle bar with both hands.
4	Crank the engine until the crank resistance becomes markedly less.

Starting the engine

Safety note

CAUTION

Danger of injury from recoiling of the engine.

- Use a crankhandle with a recoil damper.
- Hold the handle bar so that it cannot twist and quickly turn the crank so that continuous traction between the engine and crank is ensured.
- If recoil occurs due to cautious turning where the engine starts in the opposite sense of rotation under certain circumstances (smoke from the air filter), release the crankhandle immediately and stop the engine.
- To repeat the starting process, wait until the engine has stopped; only then recommence start preparations.

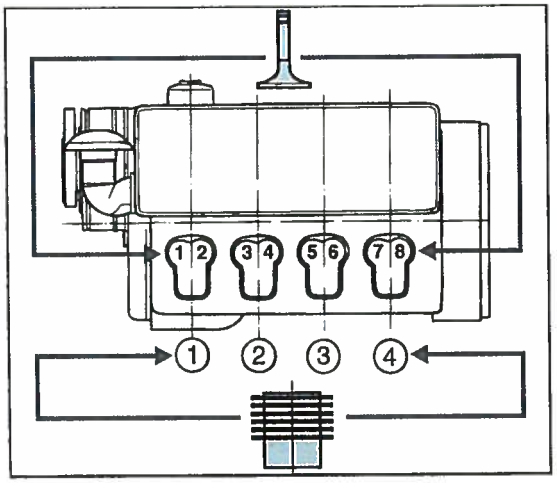
CAUTION

Danger of injury if the crankhandle recoils or turns with the engine.

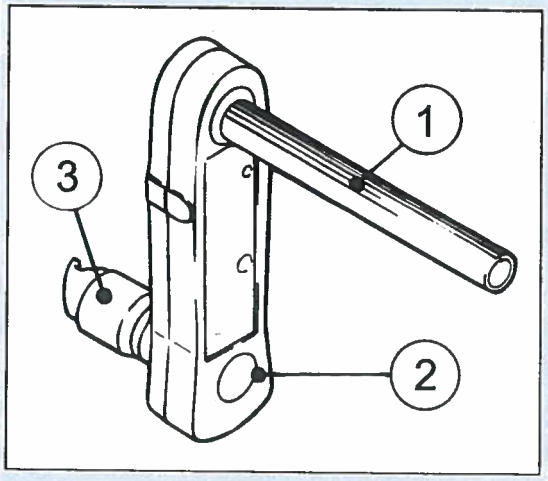
- The use of crankhandles without recoil damping is not permissible within the European Union.

Overview

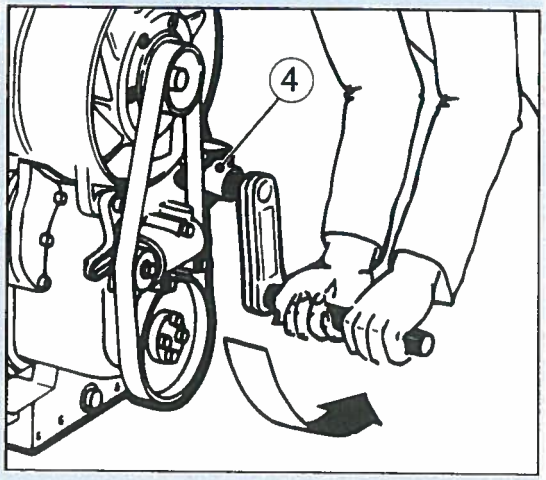
Numbering of the valves and cylinders from the fan side



Crankhandle



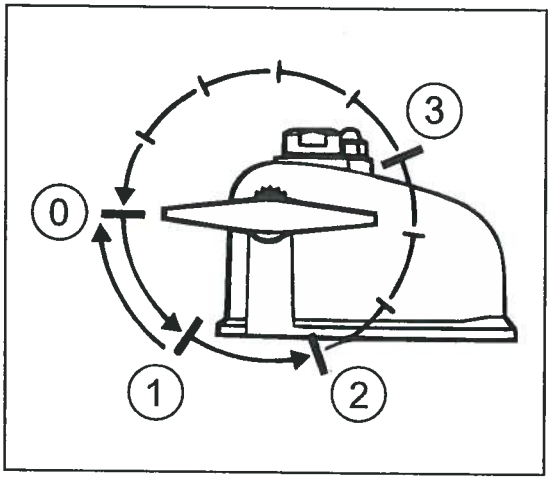
Attach the crankhandle



Pos.	Designation
1	Handle bar
2	Crank arm
3	Drive dog
4	Guide sleeve

Preparation

The decompression lever must be set depending on the number of cylinders of the engines **2-4M41.**.



Step	Activity
1	Setting the decompression lever: ▪ **Two cylinder engine 2M41.** Turn the lever to position "2". ▪ **Three cylinder engine 3M41.** Turn the levers of the 1st and 3rd cylinders to position "2". Turn the lever of the 2nd cylinder to position "3". ▪ **Four cylinder engine 4M41.** Turn the levers of the 1st, 3rd and 4th cylinders to position "2". Turn the lever of the 2nd cylinder to position "3".

Starting the engine with a recoil-dampened crankhandle

Step	Activity
1	Assume the correct position.
2	Grasp the handle bar with both hands.
3	First turn the crankhandle slowly until the drive dog and the engagement mechanism of the crankhandle engage.
4	Turn the crankhandle forcefully with increasing speed. When the decompression lever engages in the "0" position (compression), the highest possible speed must be reached.
5	As soon as the engine starts, pull the crankhandle out of the guide sleeve.

	NOTICE
	If recoil occurs during the starting process, the crank arm/drive dog linkage releases via the handle bar due to the short reverse rotation.

Starting with a crankhandle without recoil damping

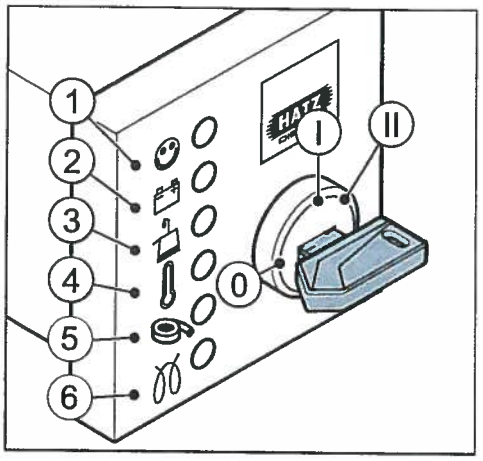
Only applies to engines **2-4M41.**

Step	Activity
1	Assume the correct position.
2	Grasp the handle bar (1) with both hands.
3	Slowly turn the crankhandle until the drive dog (3) engages.

Step	Activity
4	Turn the crankhandle forcefully with increasing speed. When the decompression lever engages in the "0" position (compression), the highest possible speed must be reached.
5	As soon as the engine starts, pull the crankhandle out of the guide sleeve (4).

7.5.2 Starting the engine with an electric starter

Standard model



Pos.	Designation
1	Operating display
2	Charge control
3	Oil pressure display
4	Engine temperature display (option)
5	Air filter maintenance display
6	Pre glow display (option)
Ignition lock	
0	Off
I	Operation
II	Starting

Procedure

NOTICE	
	▪ Start for max. 30 seconds. If the engine still is not running after that, turn the starting key back to position "0" and eliminate the cause (see the chapter *9 Faults, page 93*). ▪ Turn the starting key to position "0" every time you want to start the engine. ▪ The anti-repeat device in the ignition lock makes it impossible for the starter to engage while the engine is running and become damaged.

NOTICE	
	The starter protection module prevents the starter from engaging while the engine is running and becoming damaged. ▪ The starter protection module is required when the user cannot detect at the ignition lock if the engine is still running or is already at a standstill. ▪ In models equipped with a starter protection module, the starting key must be kept in the 0 position for at least 8 seconds before another start is possible after the engine is switched off.

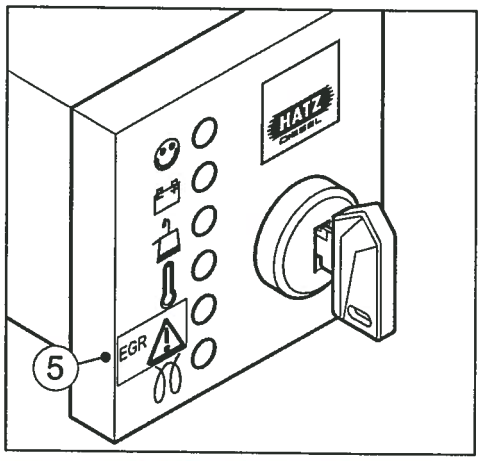
Step	Activity
1	Check the speed control (see the chapter *7.4 Setting the speed control, page 37*).
2	Insert the starting key all the way and turn to position "I". Depending on the model, the following indicators light up: ▪ Charge control (2) ▪ Oil pressure display (3) ▪ Pre glow display (6) at temperatures below 0°C *NOTES:* ▪ If the optional engine temperature display (4) lights up, the cylinder head temperature is impermissibly high. Do not start the engine; eliminate the cause. ▪ The air filter maintenance indicator (5) only lights up during operation if the air filter needs to be cleaned or changed. ▪ When the optional pre glow display (6) goes out, continue with step 3.
3	Turn the starting key to position "II".

Step	Activity
4	As soon as the engine is running, release the starting key. ▪ The starting key springs back to position "I" and remains in this position during operation. ▪ The charge control (2) and oil pressure display (3) go out. ▪ The operating display (1) lights up.

NOTICE	
	▪ In case of irregularities, switch off the engine immediately. ▪ Identify the fault and eliminate it. ▪ For details of troubleshooting, see the chapter *9 Faults, page 93.*

Model with exhaust gas return valve

The engines **4L42C** and **4M42** are equipped with an exhaust gas return valve (EGR). The indicators change as follows:



Pos.	Designation
5	Indicator EGR

Blink codes

The indicator (5) only flashes during operation if a problem arises in connection with the exhaust gas return system. This includes a dirty air filter. This can be identified by the following flash code of the indicator (5):

- 7 times short flash (approx. 0.5 seconds) and 1 long flash (approx. 1.5 seconds).
- The flash code indicates that the air filter must be cleaned or changed (see the chapter *8.2.11 Checking and cleaning the air filter cartridge, page 76*).
- If a different flash code appears, please contact the nearest **Hatz service**.

NOTICE

If the electronics indicate a problem continuously for more than 15 minutes without interruption (flash code - display lamp (5)), the engine switches off automatically.

- If the problem persists, the engine can be started but only for another 15 minutes.
- If necessary, contact your nearest **HATZ service station**.

Electrical automatic shutoff (additional equipment)

The distinguishing feature of the electrical automatic shutoff is brief flashing of all indicators after turning the starting key to position "I".

NOTICE

- If the engine stops again immediately after starting, or stops independently during operation, this is an indication that a monitoring element of the automatic shutoff has been activated.
- Remedy the malfunction before further starting attempts (see the chapter *9.1 Troubleshooting, page 93*).
- Despite the automatic shutoff, check the oil level every 8-15 operating hours (see the chapter *7.9 Checking the oil level and adding oil if necessary, page 53*).
- If the engine switches off due to an electrical fault signal or due to insufficient oil pressure with the aid of the automatic switch-off, an emergency start can be attempted by the user. The user must bear responsibility for any resulting damage (see the chapter *9.2 Emergency start, page 99*).

7.6 Switching off the engine

Methods of switching off the engine

CAUTION

Danger of injury from unauthorized access.

There is a danger of injury if unauthorized persons handle the machine.

- Protect the crankhandle and starting key against unauthorized access upon breaks in operation or after completing work.

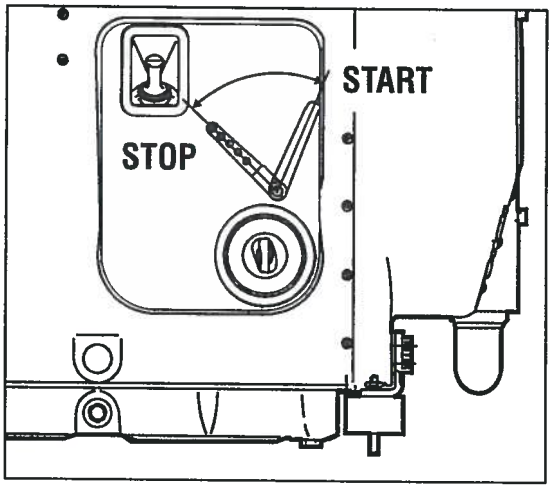
	CAUTION
	Danger of engine damage. ▪ Never stop the engine on the decompression lever.

The engine can be switched off in different ways depending on how it is equipped:

- Speed control lever (mechanical)
- Starting key (electrical)

7.6.1 Switching off the engine (mechanical)

Overview



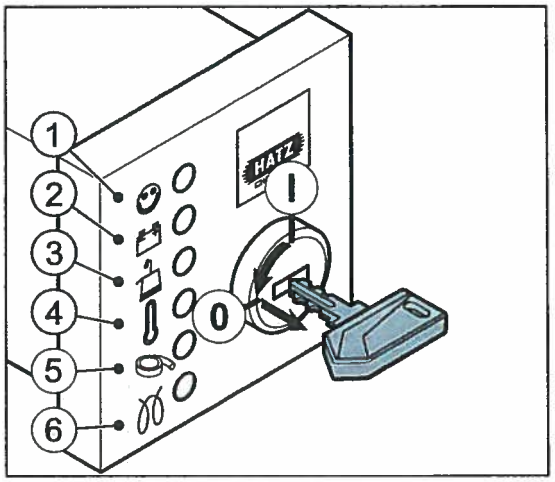
Procedure

Step	Activity
1	Move the speed controller lever to the "STOP" position. The engine switches off.
2	Additional step for engines with a starter: ▪ Turn the starting key to position "0". All indicator lamps go out.

	NOTICE
	Engines with an automatic switch-off can also be switched off by turning the starting key back to position "0".

7.6.2 Switching off the engine (electrical)

Overview



Pos.	Designation
0	Off
I	Operation

Procedure

	NOTICE
	Danger of full battery discharge. ▪ When the machine is switched off, always turn the starting key to position "0" or else the battery may become fully discharged.

Step	Activity
1	Turn the starting key to position "0". The engine switches off. All indicator lamps go out.
2	Remove the starting key.

Automatic electrical switch-off with fault storage

This is identified by brief flashing of all indicators after the starting key is turned to position "I".

NOTICE	
	If the engine stops again immediately after starting, or stops independently during operation, this is an indication that a monitoring element of the automatic shutoff has been activated.

Procedure

Step	Activity
1	Check the indicators (2-4). After the engine comes to a standstill, the fault will continue to be displayed by the indicator for approx. another 2 minutes.
2	Then the electrical equipment switches off automatically.
3	Set the starting key to position "0".
4	Turn the starting key back to position "I". The fault display lights up again. Remedy the fault before further starting attempts (see the chapter *9 Faults, page 93*). The indicator goes out at the next start.

7.7 Refueling

This diesel engine is intended for installation in a machine or for assembly with other machines to form a machine and does not have its own fuel tank. Follow the instructions from the manufacturer and comply with the following safety information.

Safety notes

DANGER	
 	**Fire hazard from fuel.** Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries. ▪ Only refuel while the engine is switched off. ▪ Never refuel in the vicinity of open flames or sparks that can cause ignition. ▪ Do not smoke. ▪ Do not spill fuel.

CAUTION

Danger of environmental damage from spilled fuel.

Do not overfill the fuel tank and do not spill fuel.

- Collect emerging fuel and dispose of it in an environmentally compatible manner.

CAUTION

Engine damage from using low quality fuel.

The use of fuel that does not meet the specifications can lead to engine damage.

- Only use the fuel specified in the chapter *4.2 Fuel, page 23.*
- The use of fuel that does not meet specifications requires approval by Motorenfabrik HATZ (main plant).

7.8 Checking the water separator

Only for engines **4L42C** and **4M42**

Safety notes

CAUTION

Danger of environmental damage from spilled fuel.

When water is drained from the water separator, a small amount of fuel is drained as well.

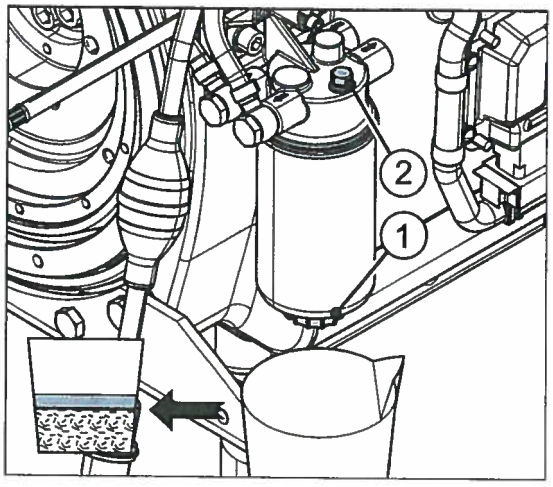
- Catch the emerging water-fuel mixture and dispose of it in an environmentally compatible manner.

NOTICE

The interval for checking the water separator depends entirely on the proportion of water in the fuel and on the care exercised during refueling; the water separator should be checked at least once a week.

Overview

Water in the fuel collects at the lowest point of the fuel filter in the water separator.



Pos.	Designation
1	Drain plug
2	Bleed screw

Procedure

Step	Activity
1	Place a suitable container under the drain plug (1). *NOTE:* In inaccessible locations, an extension hose can be mounted on the drain screw (1).
2	Open the drain screw (1) and drain the water into the container.
3	If not enough liquid escapes, undo additional screw (2).
4	As soon as fuel escapes, close the drain plug (1) and screw (2). *NOTE:* First water escapes then fuel. This can be seen by a clear separator.
5	Dispose of the water-fuel mixture in an environmentally compatible manner.

NOTICE	
	Note - If starting difficulties occur: Bleed the injection system with the aid of the manual fuel pump (see the chapter *7.3.2 Pumping fuel with the manual fuel pump, page 35*).

7.9 Checking the oil level and adding oil if necessary

Safety notes

⚠ CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

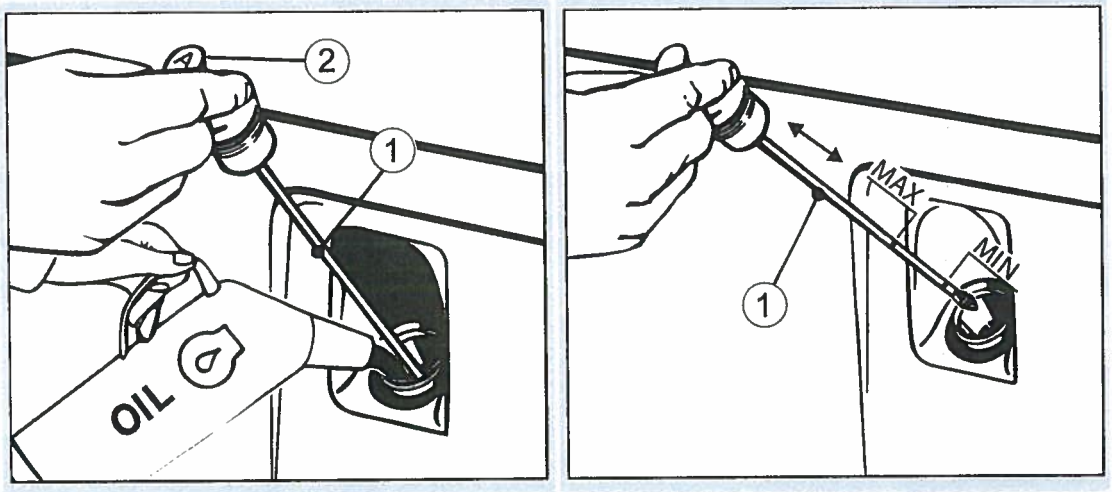
- Wear safety gloves.

CAUTION

Danger of later engine damage.

- Operating the engine with an oil level below the min. mark or above the max. mark can lead to engine damage.
- When checking the oil level, the machine must be horizontal and the engine must be switched off.

Overview



Pos.	Designation
1	Dipstick
2	Mark on the dipstick

Procedure

Step	Activity
1	Switch off the engine and wait several minutes for the engine oil to collect in the crank housing. The machine must be horizontal.
2	Remove contamination on the engine in the area of the dipstick (1).
3	Pull out the dipstick and clean it.
4	Reinsert the dipstick.
5	Pull out the dipstick and check the oil level.
6	If the oil level is close to the **min.** mark, add engine oil to the **max.** mark.
7	Reinsert the dipstick.

8 Maintenance

8.1 General maintenance instructions

Safety notes

WARNING

Danger of injury from the failure to follow the operating instructions and from performing unauthorized tasks on the machine.

- Follow all instructions.
- Do not perform activities that are not authorized. Contact properly trained personnel if necessary.

NOTICE

Comply with the safety chapter!

Follow the basic safety instructions in the chapter *3 Safety, page 7*.

- Maintenance tasks may only be performed by trained personnel.
- Accident prevention measures must be in accordance with the local accident prevention regulations.
- Perform setting and maintenance work at the specified intervals.
- Replace faulty machine parts as soon as possible.
- Always use personal protective equipment.
- Only use fully functional tools.
- Problems may occur if unsuitable spare parts are installed. We cannot accept responsibility for damage and secondary damage that result from this. We therefore recommend the use of **Hatz original spare parts**.
- Closely adhere to the maintenance conditions prescribed in this Operator's Manual.
- Only make changes on the machine in agreement with the manufacturer.
- Only perform maintenance while the engine is switched off.
- Adhere to legal regulations when handling and disposing of used oil, filters and cleaning agents.
- Protect the starting key against unauthorized access.
- For engines with a electric starter: disconnect the negative battery terminal.
- After completing maintenance work, check that all tools, bolts, aids and other objects are removed from the machine and that all safety equipment has been replaced.

- Before starting, ensure that no persons are located in the danger zone of the engine or machine.

Performance of maintenance work

The entire machine is designed to be maintenance friendly. Parts that require maintenance are easily accessible.

- Perform maintenance work faithfully at the specified intervals to prevent premature wear of the machine.
- Follow the notice and warning labels on the machine.
- Always retighten screw connections loosened during maintenance work.
- After the necessary maintenance and repair work is completed, perform a function test (test run).
- For maintenance work that is not listed and described in the maintenance documentation, please contact your nearest **HATZ service station**.

8.2 Maintenance work

Safety note

⚠ CAUTION

Danger of injury if the maintenance instructions are not followed.

- Only perform maintenance while the engine is switched off.
- Protect the starting key against unauthorized access.
- For engines with a starter: disconnect the negative battery terminal.
- After the maintenance work is completed, ensure that all tools have been removed from the machine.

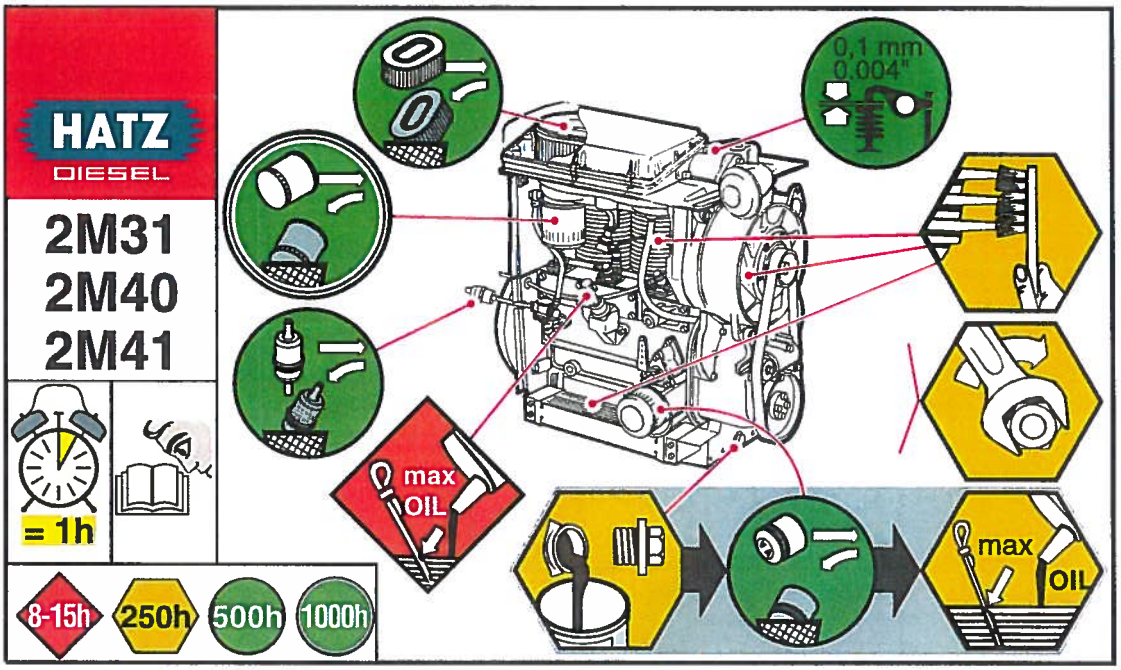
8.2.1 Maintenance notice label

NOTICE

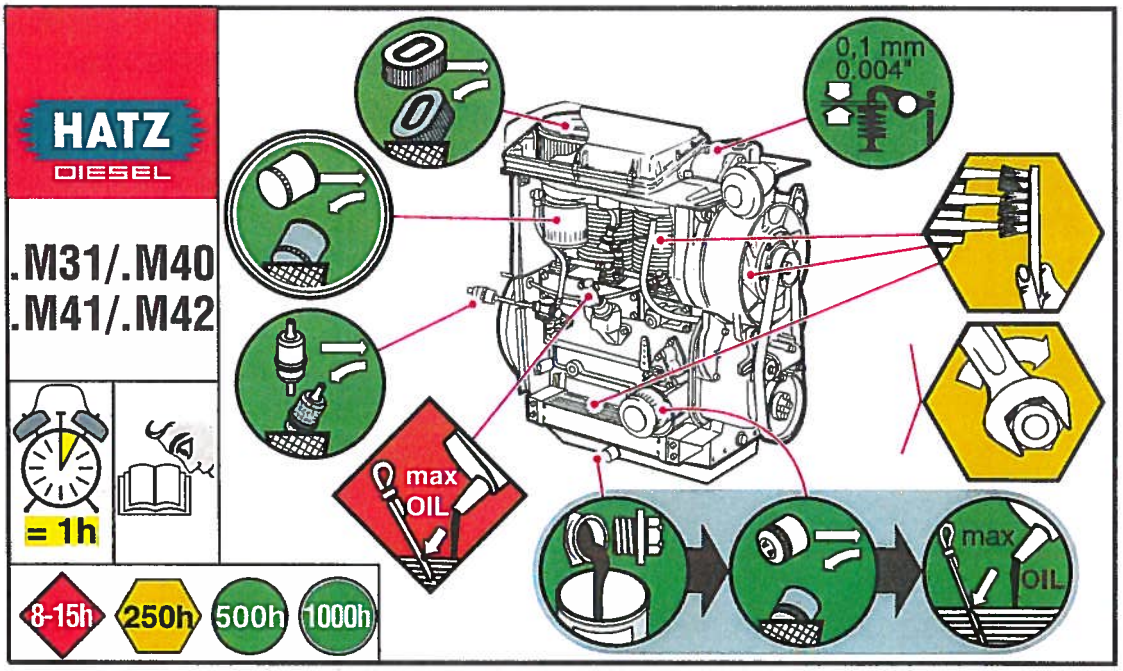
Depending on the engine type, one of the maintenance plans shown below is supplied with the engine.

- It should be mounted on the engine or machine in a clearly visible location.
- The maintenance intervals specified on the maintenance plan must be adhered to (see the chapter *8.2.2 Maintenance plan, page 58*).

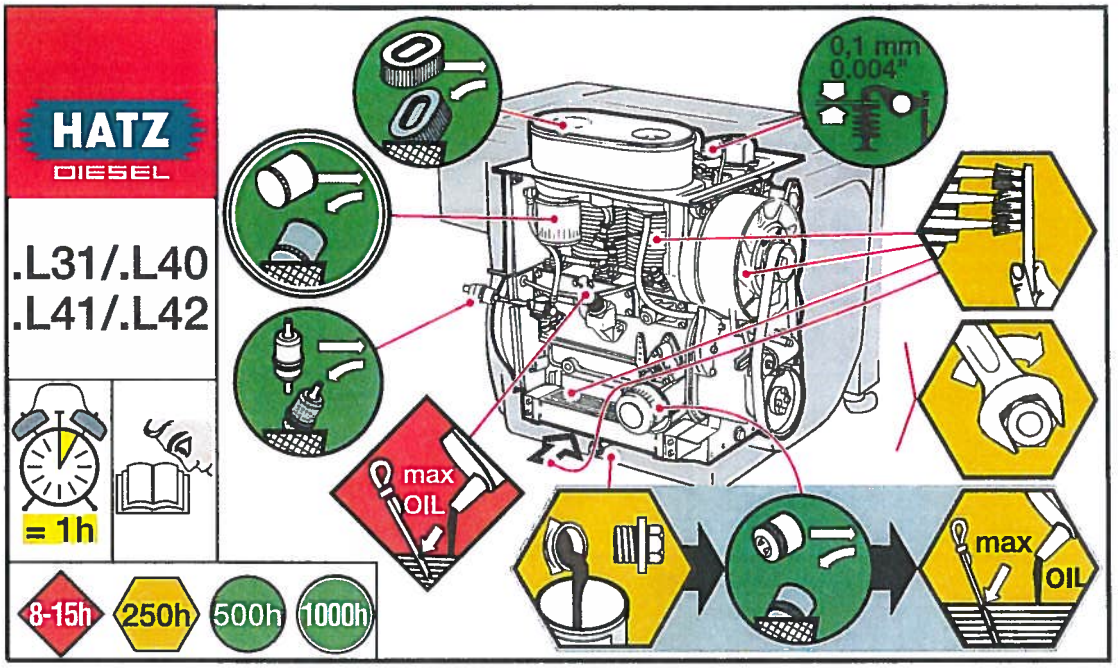
2M41. Without oil sump



2M41. With oil sump; 3-4M41. and 4M42 in general



2-4L41C; 4L42C



8.2.2 Maintenance plan

The degree of contamination of the fuel, the care with which refueling is performed and the soiling on the inside of the fuel tank are decisive in determining the change interval of the fuel **pre**filter and the fuel filter.

Symbol	Maintenance interval	Maintenance activity/check	Chapter
8-15h	Every 8-15 operating hours or every day before starting	Check the oil level.	*7.9 Checking the oil level and adding oil if necessary, page 53*
		Check the intake area of the combustion air.	*8.2.3 Checking the intake area of the combustion air, page 60*
		Check the cooling air area.	*8.2.4 Checking the cooling air area, page 63*
		Visual check of the condition of the crankhandle (handle bar, crank arm, drive dog) If necessary, lightly grease gliding area between crankhandle and guide sleeve.	–

Symbol	Maintenance interval	Maintenance activity/check	Chapter
250h	Every 250 operating hours	Change the engine oil (2M41. **without** oil sump, 2-4L41C and 4L42C in general).	*8.2.5 Change the engine oil, page 64*
		Clean the cooling fan, cooling fins and oil cooler.	*8.2.6 Cleaning the cooling fan, cooling fins and oil cooler, page 66*
		Check the screw connections.	*8.2.7 Check the screw connections, page 70*
		Clean the screen insert in the exhaust pipe.	*8.2.8 Cleaning the screen insert in the exhaust pipe (additional equipment), page 70*
		Check the water separator.	*7.8 Checking the water separator, page 51*
		Check the fuel **pre**filter for contamination and change it if necessary.	*8.2.9 Changing the fuel prefilter, page 72*
		Check the air filter maintenance indicator.	*8.2.15 Checking that the air filter maintenance indicator is working properly, page 87*
500h	Every 500 operating hours	Change the fuel **pre**filter.	*8.2.9 Changing the fuel prefilter, page 72*
		Maintain the dry air filter. Change the filter cartridge.	*8.2.10 Maintaining the dry air filter, page 74*
		Check and set the tappet clearance.	*8.2.12 Check and set the tappet clearance, page 78*

Symbol	Maintenance interval	Maintenance activity/check	Chapter
		Change the engine oil (2M41. with oil sump, 3-4M41. and 4M42 in general).	*8.2.5 Change the engine oil, page 64*
		Changing the oil filter.	*8.2.13 Changing the oil filter, page 81*
	Every 1000 operating hours	Changing the fuel filter.	*8.2.14 Change the fuel filter, page 83*

In new and generally overhauled engines, after 25 operating hours:

- Change the engine oil
- Check the tappet clearance and adjust if necessary
- Check the screw connections (do not retighten the screws for attaching the cylinder head)

In case of a low number of operating hours, change the engine oil no later than every 12 months, regardless of the actual number of operating hours.

8.2.3 Checking the intake area of the combustion air

Safety notes

⚠ CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

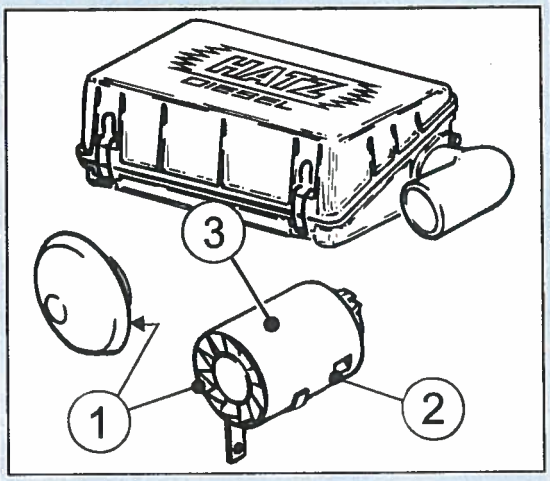
- Let the engine cool.
- Wear safety gloves.

NOTICE

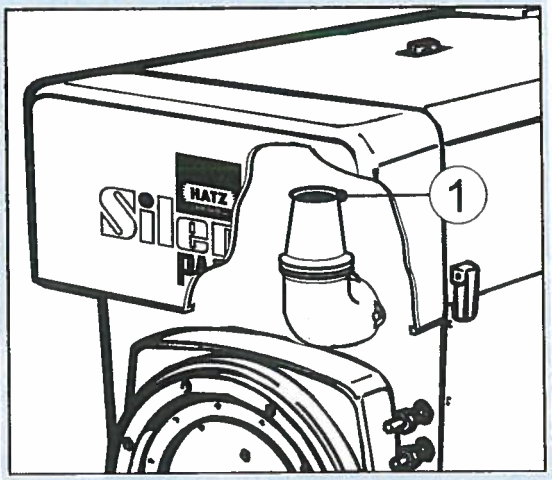
In case of heavy contamination, shorten the maintenance intervals accordingly (see the chapter *8.2.2 Maintenance plan, page 58*).

Overview

2-4M41 and 4M42



2-4L41C and 4L42C



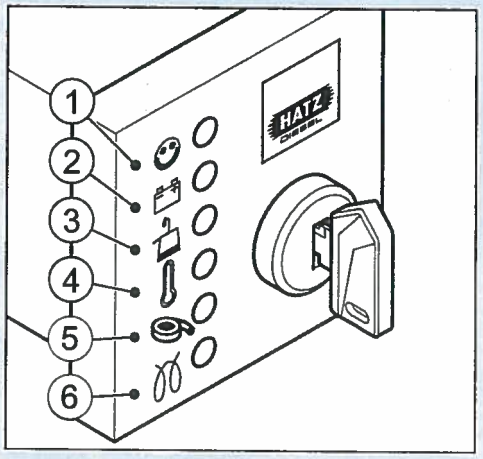
Pos.	Designation
1	Intake opening for combustion air
2	Dust outlet opening
3	Cyclone (option)

Procedure

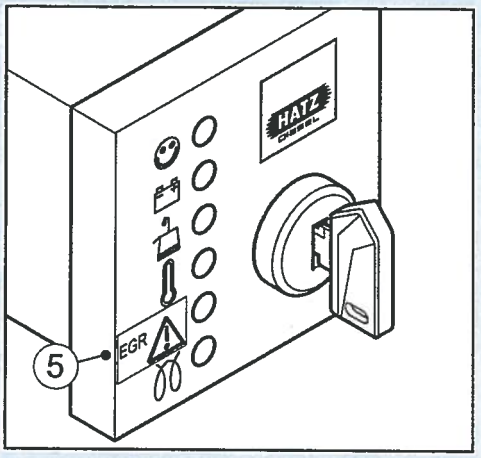
Step	Activity
1	Check the intake opening (1) for coarse contamination such as leaves, heavy dust deposits, etc., and clean if necessary.
2	Check that the dust outlet opening (2) at the bottom of the cyclone precleaner is clear.
3	If the dirt contamination is oily, remover the cyclone (3) and clean it.

Electrical air filter maintenance display

2-4L41C and 2-4M41

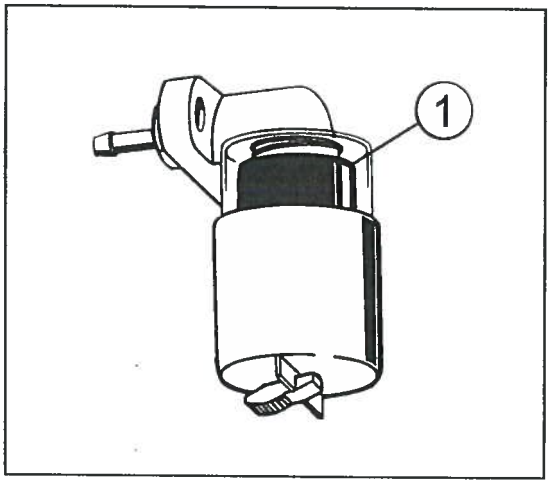


4L42C and 4M42



Pos.	Designation
5	Air filter maintenance display

Mechanical air filter maintenance display



Pos.	Designation
1	Red field

Procedure

Step	Activity
For the electrical air filter maintenance display:	

Step	Activity
1	Briefly let the engine run at maximum speed and watch for the indicator (5) to light up for a short period – depending on the version. In the engines **4L42C and 4M42**, the following flash code indicates that maintenance work is required on the air filter ▪ 7 short flashes (approx. 0.5 seconds) and ▪ 1 long flash (approx. 1.5 seconds) (see the chapter *8.2.10 Maintaining the dry air filter, page 74*).
With mechanical air filter maintenance display:	
1	Briefly let the engine run at maximum speed and watch for the visible red field (1) in the mechanical air filter maintenance display. The visible red field (1) indicates that maintenance work is required on the air filter (see the chapter *8.2.10 Maintaining the dry air filter, page 74*).

8.2.4 Checking the cooling air area

Safety notes

⚠ CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

⚠ CAUTION

Danger of injury.

When working with compressed air, foreign bodies may fly into your eyes.

- Wear safety goggles.
- Never direct the compressed air jet toward people or toward yourself.

CAUTION

Danger of engine damage from overheating.

The engine temperature display (option) lights up as soon as the engine becomes impermissibly hot.

- Switch off the engine immediately and eliminate the cause.

NOTICE

In case of heavy contamination, shorten the maintenance intervals accordingly (see the chapter *8.2.2 Maintenance plan, page 58*).

Procedure

Step	Activity
1	Check the supply and exhaust air areas for coarse contamination such as leaves, heavy dust deposits, etc., and clean if necessary (see the chapter *8.2.6 Cleaning the cooling fan, cooling fins and oil cooler, page 66*).

8.2.5 Change the engine oil

Safety notes

CAUTION

Danger of burns.

When working on the engine there is a danger of burns from hot oil.

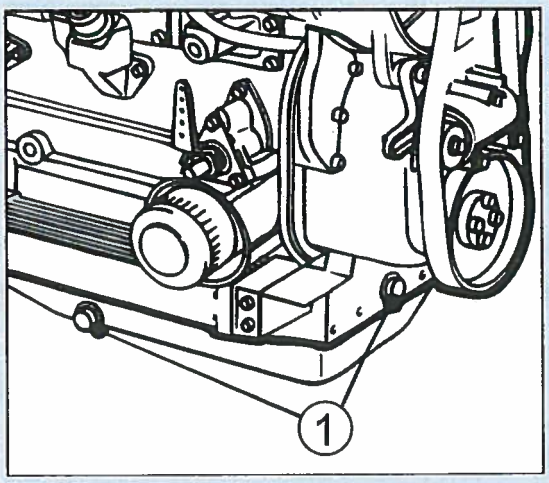
- Wear personal protective equipment (gloves).
- Collect the used oil and dispose of it according to local environmental regulations.

NOTICE

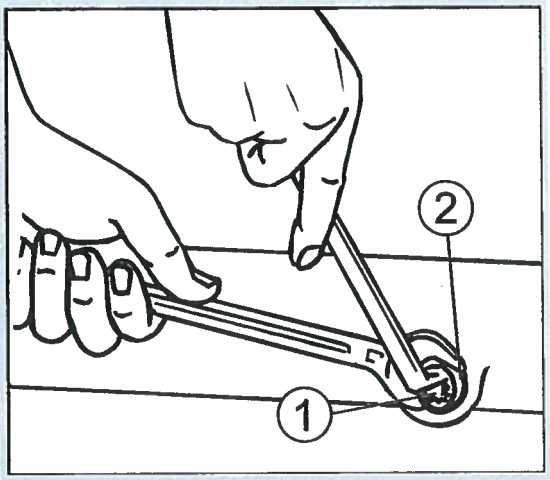
- The engine must be level.
- The engine must be switched off.
- Only drain engine oil while it is warm.
- The engine oil should be changed when the oil filter is changed.

Overview

M41



L41

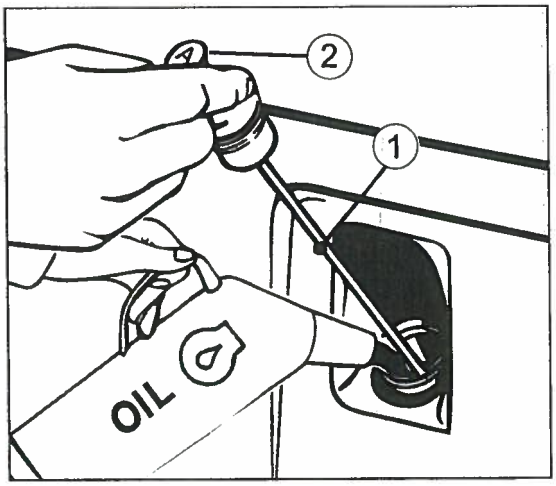


Pos.	Designation
1	Oil drain screw
2	Drain pipe

Draining the oil

Step	Activity
1	Unscrew the oil drain screw (1) and drain the oil entirely. When unscrewing the oil drain screw (1) on engines of type **2-4L41C** and **4L42C**, ensure that the drain pipe (2) is not loosened. Hold it with an open-end wrench.
2	Screw in the cleaned oil drain screw (1) with the new gasket and tighten.

Overview



Pos.	Designation
1	Dipstick
2	Mark on the dipstick

Adding oil

Step	Activity
1	Add engine oil to the **max.** mark on the dipstick (1). ▪ For the specification and viscosity, see the chapter *4.3 Engine oil, page 24*. ▪ The mark of the dipstick (2) indicates whether the engine is equipped **with** an oil sump or **not** (see the chapter *4.1 Engine, page 22*).
2	Reinsert the dipstick (1).
3	Check the oil level after a short test run and correct if necessary.

8.2.6 Cleaning the cooling fan, cooling fins and oil cooler

Safety notes

DANGER

Danger of explosion from flammable cleaning agents.

Cleaning with benzene is an explosion hazard. It is highly flammable, can become electrostatically charged and can generate an explosive gas-air mixture.

- Use halogen-free, cold cleaners with a high flashpoint for cleaning.

CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

CAUTION

Danger of injury.

When working with compressed air, foreign bodies may fly into your eyes.

- Wear safety goggles.
- Never direct the compressed air jet toward people or toward yourself.

CAUTION

Danger of engine damage from overheating.

The engine temperature display (option) lights up as soon as the engine becomes impermissibly hot.

- Switch off the engine immediately and eliminate the cause.

CAUTION

Danger of damage to the machine from incorrect engine cleaning.

- Do not spray components of the electrical equipment with a water jet or high pressure jet during cleaning.
- Do not use gasoline or acid-based cleaning agents.

CAUTION

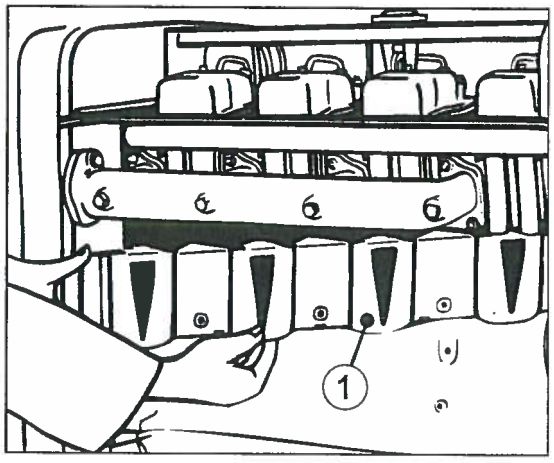
Damage from inadequate engine cooling.

Only run the engine when all covers are installed.

NOTICE

In case of heavy contamination, shorten the maintenance intervals accordingly (see the chapter *8.2.2 Maintenance plan, page 58*).

Overview

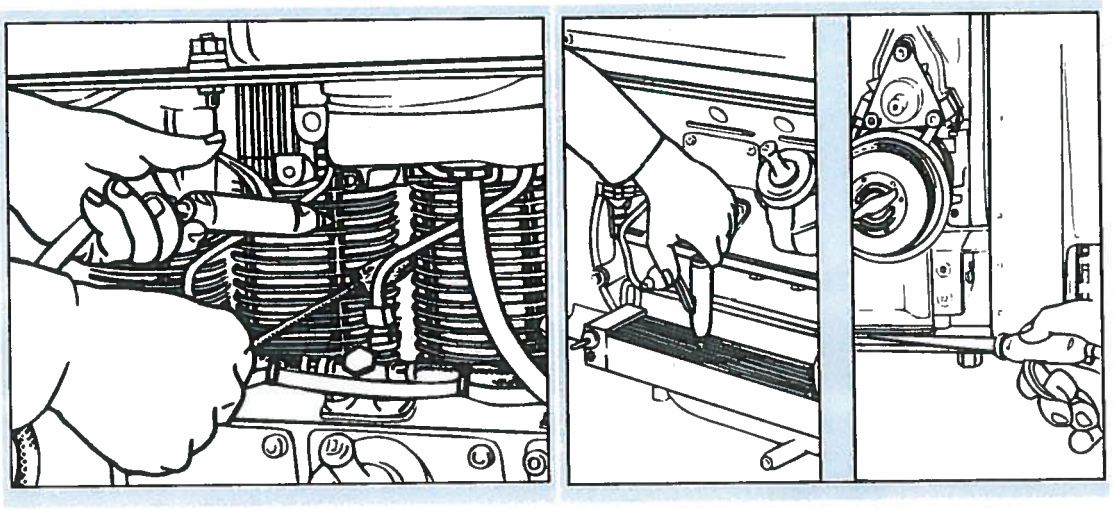


Pos.	Designation
1	Baffle plate

Preparation

Step	Activity
1	**Unscrew the following on encapsulated engines:** ▪ Hood ▪ Side wall with speed control lever ▪ Cover plate on operating side ▪ Exhaust air duct ▪ Cover plate on exhaust side (see the chapter *5 Engine design, page 25*).
1	**Remove the following on engines without a capsule:** ▪ Side trim panel ▪ Cooling air guide for lubrication oil cooler
2	Unscrew the baffle plate (1)

Overview



Procedure

Step	Activity
Cleaning in case of dry dirt contamination	
1	Clean the cooling fan, cylinder head and cylinder with a suitable brush.
2	Blow out the entire cooling air area with compressed air.
3	Blow out the oil cooler with compressed air only. *NOTE:* ▪ Do not place the compressed air gun against the sensitive radiator fins.
4	On encapsulated engines, also clean the area between the floor plate and crankcase.
5	Mount the capsule and air guide parts again.
Cleaning of wet or oily dirt contamination	
1	Disconnect the negative terminal of the battery.
2	Manually clean the alternator and regulator.
3	Cover the alternator with the installed regulator and do not spray directly.
4	Spray the entire area with a suitable cleaning solution according to manufacturer instructions and then clean off with a strong jet of water. Do not spray components of the electrical equipment with a water jet or high pressure jet during cleaning.
5	Blow dry the engine with compressed air.

Step	Activity
6	Determine the cause of the oil contamination and have leaks corrected by the **HATZ service station.**
7	Mount the capsule and air guide parts again.
8	Let the engine run warm to prevent rust formation.

8.2.7 Check the screw connections

NOTICE

- Do not retighten the screws for attaching the cylinder head.
- The adjustment screws on the speed regulator and the injection system are secured with locking varnish and are not permitted to be tightened or adjusted.

Procedure

Step	Activity
1	Check the condition of all screw connections and ensure that they are tight (for exceptions, see note).
2	Tighten any lose screw connections.

8.2.8 Cleaning the screen insert in the exhaust pipe (additional equipment)

Safety notes

⚠ CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

⚠ CAUTION

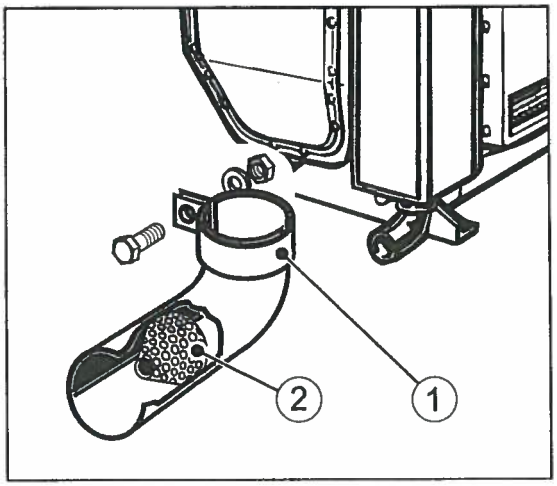
Danger of injury

There is a danger of injury when performing cleaning work at the exhaust screen.

- Wear safety gloves.

NOTICE	
	Operation of the engine for a lengthy period without a load or with only a small load can result in premature deposits on the screen insert. Shorten the maintenance interval accordingly.

Overview



Pos.	Designation
1	Pipe clamp
2	Screen insert

Procedure

Step	Activity
1	Release the pipe clamp (1) and remove it with the exhaust pipe.
2	Remove deposits on the screen insert (2).
3	Check the screen insert for cracks or breakage, and replace if necessary.

8.2.9 Changing the fuel prefilter

Safety notes

DANGER

Fire hazard from fuel.

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Never refuel in the vicinity of open flames or sparks that can cause ignition.
- Do not smoke.
- Do not spill fuel.

CAUTION

Danger of injury

Repeated contact with diesel fuel can cause chapped and cracked skin.

- Wear safety gloves.

CAUTION

Danger of environmental damage from spilled fuel.

When the filter is removed, a small amount of fuel is drained as well.

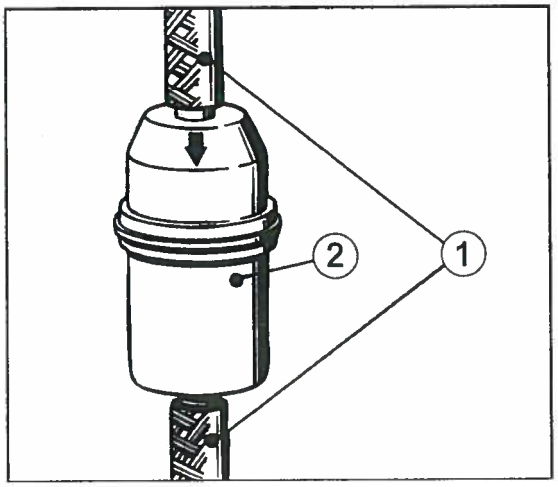
- Collect emerging fuel and dispose of it in an environmentally compatible manner.

CAUTION

Dirt particles can damage the injection system.

- Maintain clean conditions to ensure that dirt does not enter the fuel line.

Overview



Pos.	Designation
1	Fuel lines
2	Fuel prefilter

Procedure

Step	Activity
1	Place a suitable container under the filter to collect emerging fuel.
2	Close the fuel feed line.
3	Pull the fuel lines (1) off of the fuel prefilter (2) on both sides.
4	Dispose of the old filter in accordance with local environmental regulations.
5	Insert a new fuel prefilter. Note the following: ▪ Arrow for flow direction ▪ Position of the fuel tank: HIGH or LOW ▪ Installation position/flow-through direction should be as vertical as possible
6	Open the fuel feed line.
2-4L41C and 2-4M41	
7	To simplify the starting procedure, it is recommended that you pre-pump the fuel using the manual lever at the fuel feed pump until you hear fuel flow back through the return line into the fuel tank (see the chapter *7.3.1 Pumping fuel with the manual lever, page 34*).
8	Perform a leak tightness test by activating the manual lever.

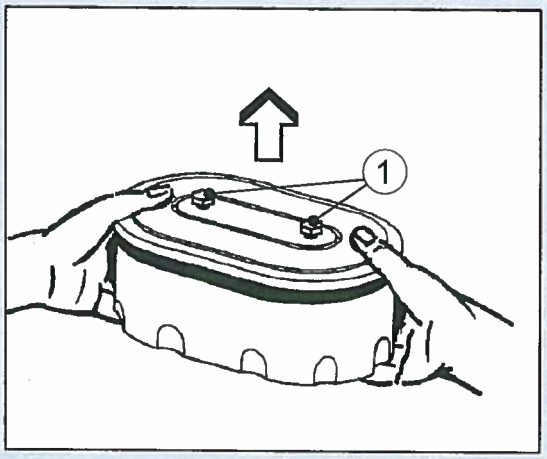
Step	Activity
9	After completion, insert the access cover to the fuel feed pump back in the side wall.
4L42C and 4M42	
7	If you have difficulties starting the engine, bleed the injection system with the aid of the manual fuel pump (see the chapter *7.3.2 Pumping fuel with the manual fuel pump, page 35*).

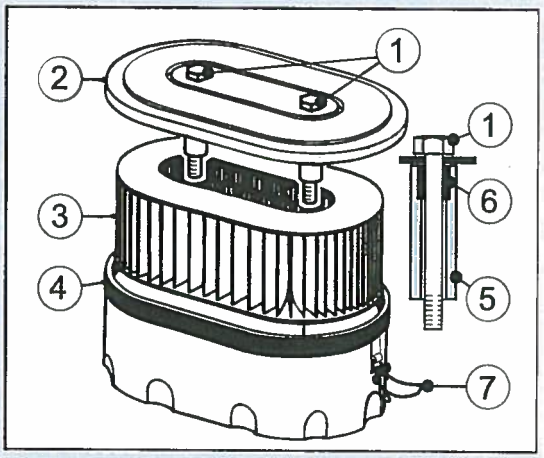
8.2.10 Maintaining the dry air filter

NOTICE

- Immediately clean the filter cartridge if the maintenance display appears at maximum speed.
- The air filter cartridge either needs to be replaced, or cleaned or checked depending on the degree of contamination.
- Renew the filter cartridge after a use period of 500 operating hours.
- Four cylinder engines have two filter cartridges.

Overview of engines 2-4 L41C and 4L42C





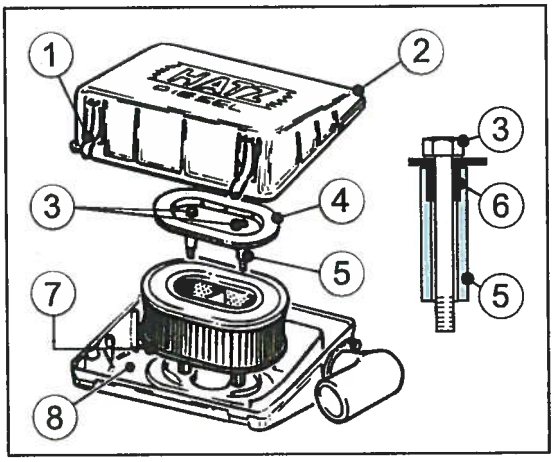
Pos.	Designation
1	Screw
2	Cover
3	Filter cartridge
4	Air filter housing
5	Spacer
6	Bushing

Pos.	Designation
7	Clamp

Removing the air filter cartridge - engines 2-4L41C and 4L42C

Step	Activity
1	Remove the capsule hood.
2	Remove adherent dirt in the area of the air filter housing (4).
3	Only loosen the screws (1) to the point where you can lift off the complete air filter housing (4).
4	Cover the opening in the intake pipe to prevent ingress of dirt and other foreign bodies.
5	On three cylinder engines, open the clamp (7). ▪ On three cylinder engines, the cover (2) is additionally held by a clamp (7).
6	Open the air filter housing (4).
7	Take out the filter cartridge (3).
8	Clean the air filter housing (4) and cover (2).
9	Renew the bushing (6) if the spacer (5) is loose. ▪ The spacer (5) is connected with the screw (1) by the elastic bushing (6) to ensure that it cannot fall into the intake pipe during disassembly and assembly.

Overview of the engines 2-4M41. and 4M42



Pos.	Designation
1	Clamp
2	Air filter housing cover
3	Screw

Pos.	Designation
4	Filter cover
5	Spacer
6	Bushing
7	Filter cartridge
8	Air filter housing

Removing the air filter cartridge - engines 2-4M41. and 4M42

Step	Activity
1	Release the clamps (1) and remove the cover of the air filter housing (2).
2	Remove adherent dirt in the air filter area.
3	Only loosen the screws (3) to the point where the filter cover (4) can be removed with the filter cartridge (7).
4	Cover the opening in the intake pipe to prevent ingress of dirt and other foreign bodies.
5	Clean the air filter housing cover (2), filter cover (4) and air filter housing (8).
6	Renew the bushing (6) if the spacer (5) is loose. ▪ The spacer (5) is connected with the screw (3) by the elastic bushing (6) to ensure that it cannot fall into the intake pipe during disassembly and assembly.

8.2.11 Checking and cleaning the air filter cartridge

Safety notes

⚠ CAUTION

Danger of injury.

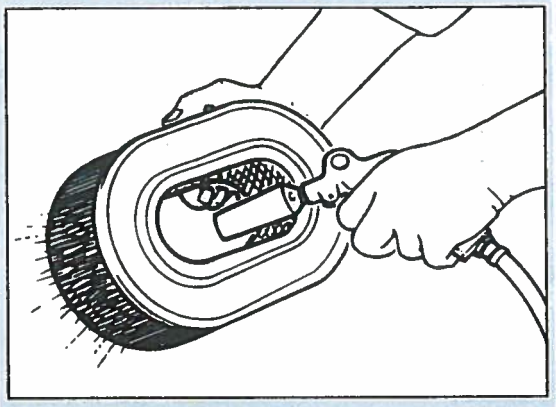
When working with compressed air, foreign bodies may fly into your eyes.

- Wear safety goggles.
- Never direct the compressed air jet toward people or toward yourself.

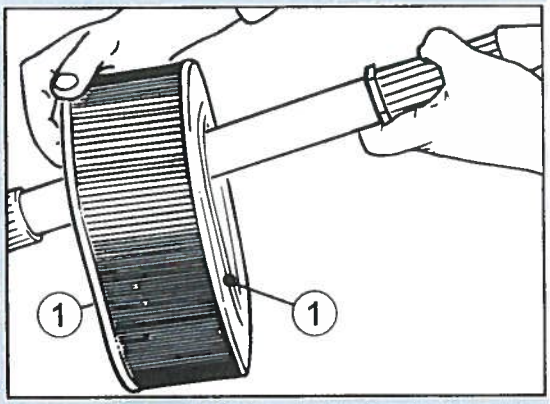
NOTICE	
	▪ The pressure must not exceed 5 bar. ▪ A distance of approx. 150 mm must be maintained between the filter cartridge and the compressed air gun. ▪ Even minor damage in the areas of the sealing surface, filter paper or filter cartridge makes it impossible to reuse the filter cartridge.

Overview

Clean the filter cartridge



Check the air filter cartridge

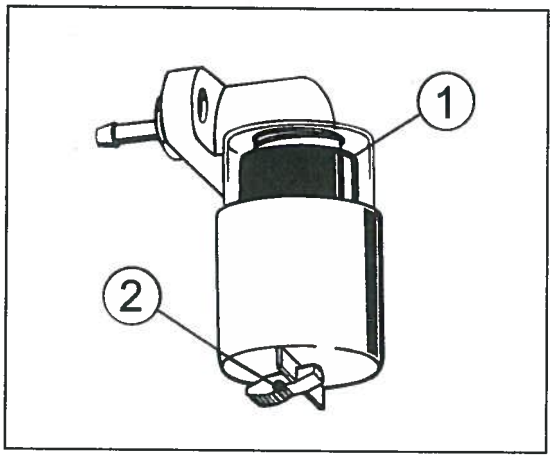


Pos.	Designation
1	Sealing surface

Procedure

Step	Activity
Dry contamination	
1	Blow out the filter cartridge with dry compressed air from the inside to the outside until dust no longer emerges.
2	Check the sealing surfaces (1) of the filter cartridge for damage.
3	Check the filter cartridge for cracks in the filter paper and other damage by holding it against the light at a slant or letting light from a lamp shine through it.
4	Replace the filter cartridge if necessary (see note).
Moist or oily contamination	
1	Renew the filter cartridge.

Mechanical air filter maintenance display



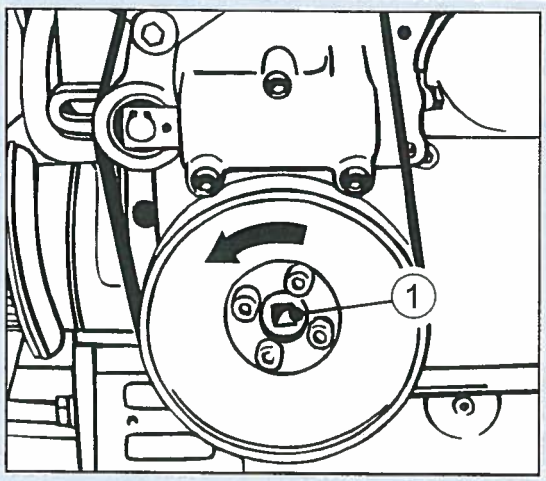
Pos.	Designation
1	Red field
2	Reset button

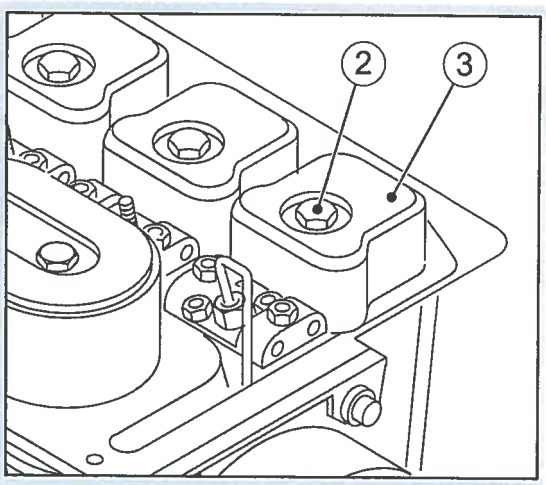
Mounting the air filter cartridge

Step	Activity
1	When assembling, mount the parts individually one after the other to make sure they are correctly seated and to ensure leak tightness.
2	After the filter is mounted, unlock the visible red field (1) in the maintenance display by pressing the reset button (2).

8.2.12 Check and set the tappet clearance

Overview





Pos.	Designation
1	Square opening

Pos.	Designation
2	Hex nut
3	Cylinder head cover

Preparation

Step	Activity
1	On encapsulated engines, remove the hood of the capsule (see the chapter *5 Engine design, page 25*).
2	Remove the hex nut (2) and remove the cylinder head cover (3).
3	Remove the air guide housing cover (see the chapter *5 Engine design, page 25*) or the belt guard.
4	Insert the ratchet or T-piece 1/2" with the required extension (1) into the square opening.

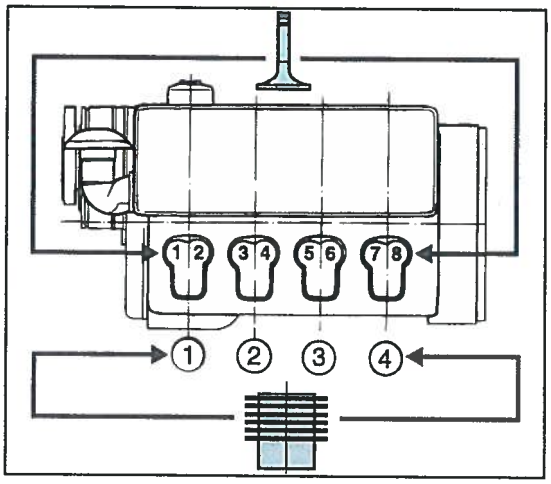
	NOTICE
	**Turn the engine in the sense of rotation.** Clockwise in both cases - flywheel side or timing cover side.

Setting method for two cylinder engine

Step	Activity
1	Set the valve of the 1st cylinder – fan side – to overlap (outlet valve not yet closed, intake valve begins to open).
2	Turn the crankshaft by 180° in the sense of rotation and check the valves of the 2nd cylinder.
3	Continue turning the crankshaft by 180° in the sense of rotation and check the valves of the first cylinder.

Setting method for three and four cylinder engines

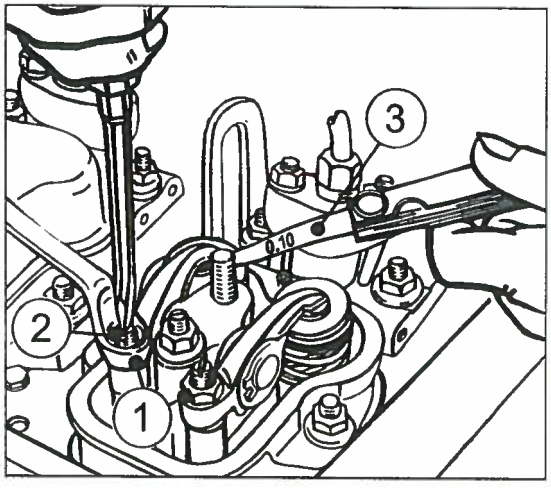
Numbering of the valves and cylinders from the fan side



Setting method for three and four cylinder engines

Type	Valve no. ... fully opened	Check the valves of the ... cylinder
3-cylinder	1	3rd cylinder
	5	2nd cylinder
	3	1st cylinder
4-cylinder	1	3rd cylinder
	5	4th cylinder
	7	2nd cylinder
	3	1st cylinder

Overview



Pos.	Designation
1	Hex nut

Pos.	Designation
2	Adjusting screw
3	Feeler gauge

Procedure

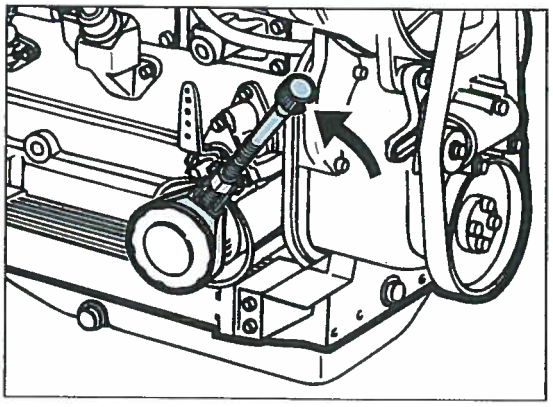
Step	Activity
1	Check the tappet clearance with the feeler gauge (3). For the setting, see the chapter *4.1 Engine, page 22*
2	If the tappet clearance needs to be corrected: ▪ Release the hex nut (1). ▪ Turn the adjustment screw (2) so the feeler gauge (3) can be pulled through with a barely perceptible resistance after the hex nut (1) is tightened again.
3	Repeat the above procedure for the entire valve area, taking special care to use the described adjustment method.
4	Mount the cylinder head cover again: ▪ Always renew the gaskets. ▪ Use the fixing nuts for the cylinder head cover no more than twice before renewing them. ▪ Tightening torque: **10 Nm**.
5	Mount all covers. *NOTE:* ▪ Under no circumstances is the engine permitted to be operated if not all covers are mounted.
6	After a brief trial run, check the cylinder head cover for tightness.

8.2.13 Changing the oil filter

Safety notes

⚠ CAUTION	
 	**Danger of burns.** When working on the engine there is a danger of burns from hot oil. ▪ Wear personal protective equipment (gloves). ▪ Collect the used oil and dispose of it according to local environmental regulations.

Overview



Procedure

Step	Activity
1	Release the oil filter with a strap wrench and quickly unscrew and remove it. ▪ HATZ order no. for strap wrench: 620 307 01.
2	Dispose of the old filter in accordance with local environmental regulations.
3	Wipe spilled engine oil out of the oil baffle.
4	Lightly oil the sealing lip of the new oil filter.
5	Screw in the oil filter and tighten it by hand.
6	Add engine oil to the **max.** mark on the dipstick. ▪ For the specification and viscosity, see the chapter *4.3 Engine oil, page 24*. ▪ The mark of the dipstick indicates whether the engine is equipped **with** an oil sump or **not** (see the chapter *4.1 Engine, page 22*).
7	Reinsert the dipstick.
8	Check the oil level after a short test run and correct if necessary.
9	Check the oil filter for tightness and retighten by hand if necessary.

8.2.14 Change the fuel filter

Safety notes

DANGER

Fire hazard from fuel

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Do not spill fuel.
- No open flames when working on the fuel system.
- Do not smoke

CAUTION

Danger of injury

Repeated contact with diesel fuel can cause chapped and cracked skin.

- Wear safety gloves.

CAUTION

Danger of environmental damage from spilled fuel.

When the filter is removed, a small amount of fuel is drained as well.

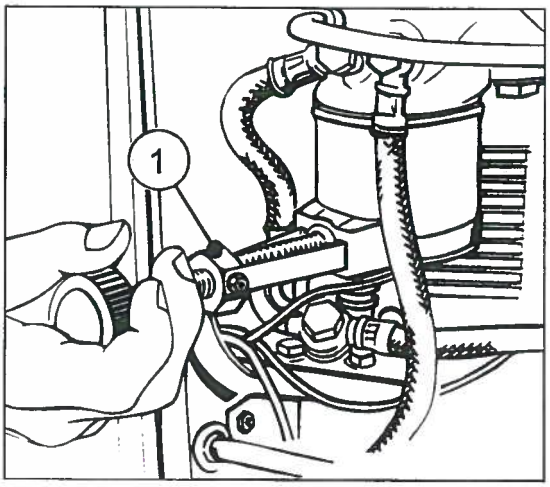
- Collect emerging fuel and dispose of it in an environmentally compatible manner.

CAUTION

Dirt particles can damage the injection system.

- Maintain clean conditions to ensure that dirt does not enter the fuel line.

Overview 2-4L41C and 2-4M41.



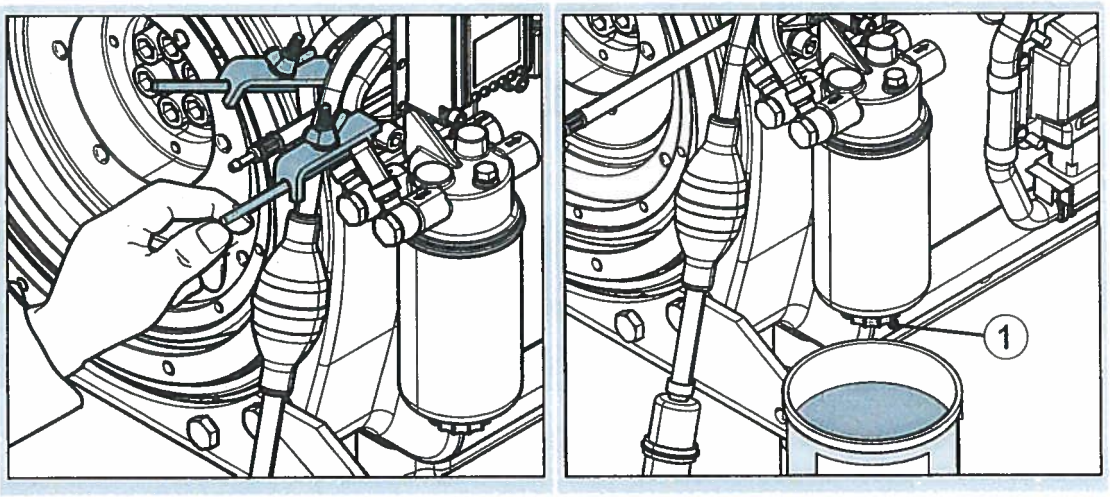
Pos.	Designation
1	Strap wrench (HATZ order no.: 620 307 01)

Procedure 2-4L41C and 2-4M41

Step	Activity
1	**On encapsulated engines:** ▪ Lift off the capsule hood (see the chapter *5 Engine design, page 25*).
	On engines without a capsule: ▪ Remove the side trim panel (see the chapter *5 Engine design, page 25*).
2	Place a suitable container under the filter to collect emerging fuel.
3	Close the fuel feed line.
4	Slide on the strap wrench (1) and unscrew the fuel filter counter-clockwise.
5	Dispose of the old filter in accordance with local environmental regulations.
6	Lightly oil the gasket of the new fuel filter.
7	Mount the fuel filter and tighten it **by hand**.
8	Open the fuel feed line.
9	To ease the starting procedure, it is recommended that you pre-pump the fuel using the manual lever at the fuel feed pump until you hear fuel flow back through the return line into the fuel tank (see the chapter *7.3.1 Pumping fuel with the manual lever, page 34*).

Step	Activity
10	Perform a leak tightness test by activating the manual lever.
11	After completion, insert the access cover to the fuel feed pump back in the side wall.
12	Mount the capsule and air guide parts again.

Overview 4L42C and 4M42

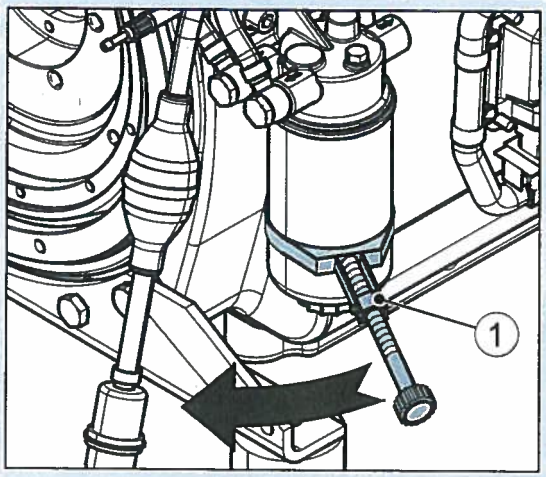


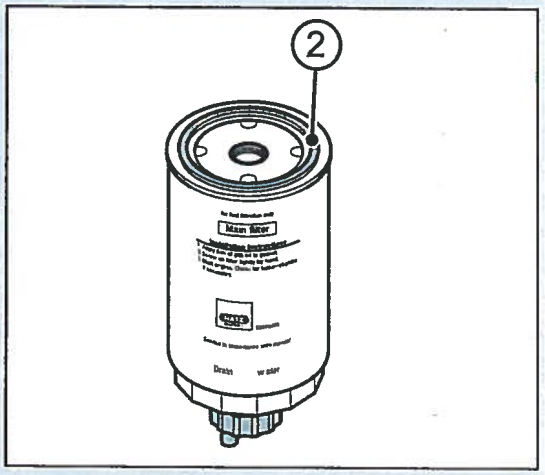
Pos.	Designation
1	Drain plug

Preparation 4L42C and 4M42

Step	Activity
1	Close the fuel lines on the filter housing.
2	Place a suitable container under the filter to collect emerging fuel.
3	Release the drain screw (1) and drain the fuel.

Overview 4L42C and 4M42





Pos.	Designation
1	Strap wrench (HATZ order no.: 620 307 01)
2	Gasket

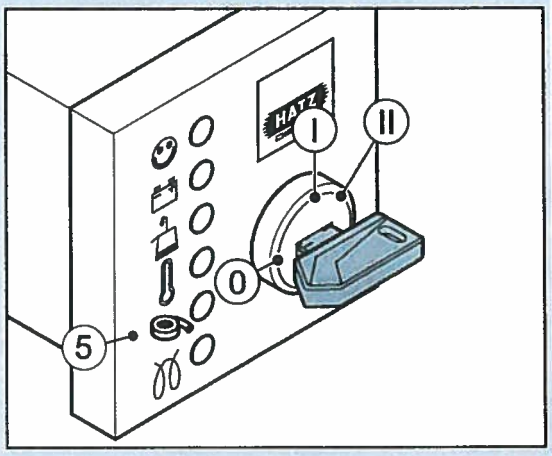
Procedure 4L42 C and 4M42

Step	Activity
1	Slide on the strap wrench (1) and unscrew the fuel filter counter-clockwise.
2	Dispose of the old filter in accordance with local environmental regulations.
3	Lightly oil the gasket (2) of the new fuel filter.
4	Mount the fuel filter and tighten it **by hand**.
5	Open the fuel feed line.
6	Bleed the injection system with the aid of the manual fuel pump (see the chapter *7.3.2 Pumping fuel with the manual fuel pump, page 35*).
7	After a brief trial run, check the fuel filter for leak tightness and retighten by hand.

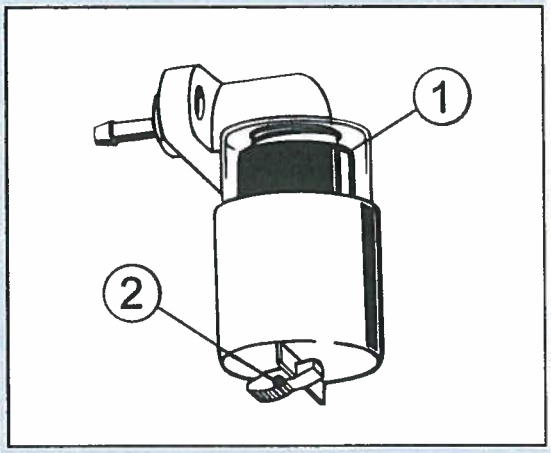
8.2.15 Checking that the air filter maintenance indicator is working properly

Overview

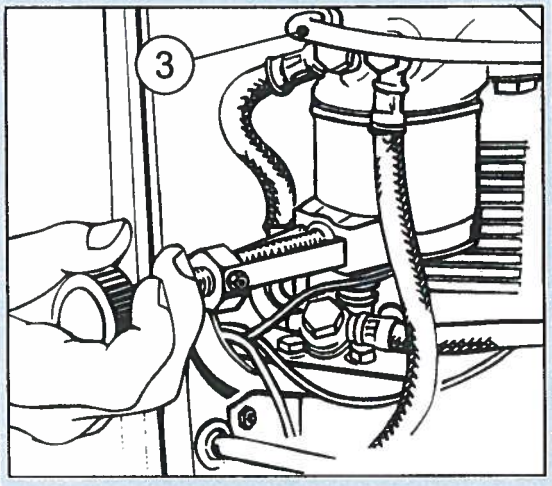
Electrical
air filter maintenance display



Mechanical
air filter maintenance display



Hose of air intake pipe



Pos.	Designation
1	Red field
2	Reset button
3	Hose
5	Air filter maintenance display
Ignition lock	
0	Off
I	Operation
II	Start

Procedure

Step	Activity
1	Remove the capsule hood and the side panel trim (see the chapter *5 Engine design, page 25*).
2	Turn the starting key to position I.
3	Pull the hose (3) off of the exhaust manifold.
Electrical air filter maintenance display	
	NOTE: On engine types **4L42** and **4M42**, this function test cannot be performed.
4	Generate a vacuum by sucking forcefully at the hose end. The indicator (5) lights up.
5	If there is no reaction, check the following: ▪ Electrical part; cable connections, etc. ▪ Indicator ▪ Function of the maintenance switch.
Mechanical air filter maintenance display	
4	Generate a vacuum by sucking forcefully at the hose end. The red field (1) engages.
5	After the function test, unlock the red field (1) by pressing the reset button (2).
After the function test	
6	Replace the faulty parts.
7	Reattach the hose (3) of the exhaust manifold.
8	Mount the capsule and air guide parts again.

8.2.16 Renewing the poly v belt and checking the function of the switch-off unit

NOTICE	
	When changing the belt: ▪ Always check the function of the switch-off unit. The switch-off pin must emerge by spring force, or else the machine will not switch off automatically if the belt tears. ▪ If the grooves are broken off or bent, renew the damaged pulley. ▪ To be absolutely sure that you order the right poly v belt – in terms of the length – it is recommended that you measure the diameter of the fan-side pulley and use this as the basis for your selection.

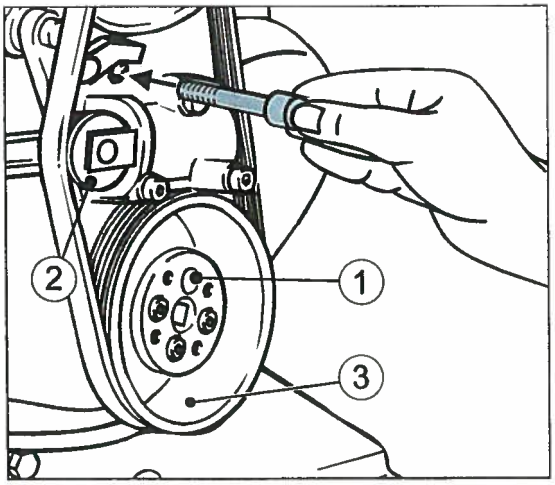
Belt types

Because of the different diameters of the fan-side pulleys, in combination with different engine types and versions, various lengths of poly v belts are used.

Type and engine version	ID number	Belt length mm	Fan pulley Ø mm
2L41C	502 031 00	920	72
All remaining types and versions	501 415 00	910	64

Removing the poly v belt

Overview



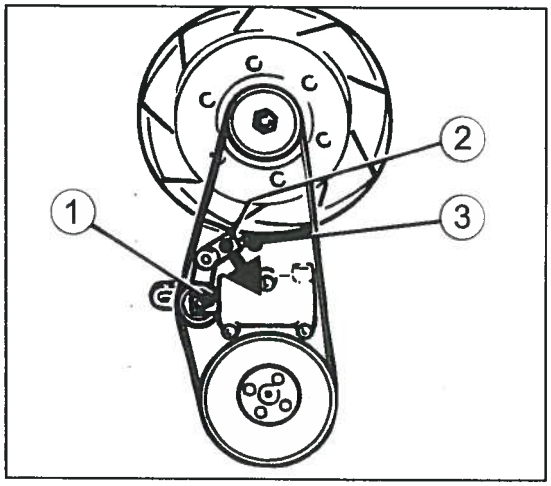
Pos.	Designation
1	Cylinder screw
2	Tension pulley
3	Pulley

Procedure

Step	Activity
1	Unscrew one cylinder screw (1) from the pulley (3).
2	Push back the tension pulley (2) and lock it using the cylinder screw (1).
3	Unscrew the pulley (3).
4	Check the pulley (3) for broken or bent grooves.
5	Remove the poly v belt.

Checking the function of the switch-off unit of the belt monitoring system

Overview



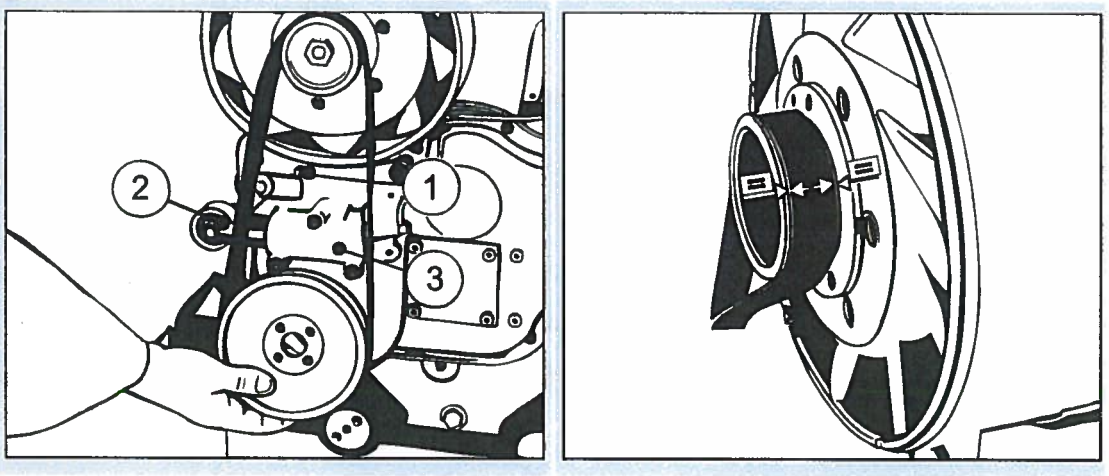
Pos.	Designation
1	Tension pulley
2	Angle lever
3	Switch-off pin

Procedure

Step	Activity
1	Release the piston with the tension pulley (1) by removing the cylinder screw. ▪ The piston with the tension pulley is pushed out of the housing by spring pressure. ▪ The angle lever (2) turns downward and releases the switch-off pin (3). ▪ The switch-off pin (3) must emerge by spring force, or else the machine will not switch off automatically if the belt tears.
2	If there is no reaction, please contact the nearest **HATZ service station**.

Mounting the poly v belt

Overview



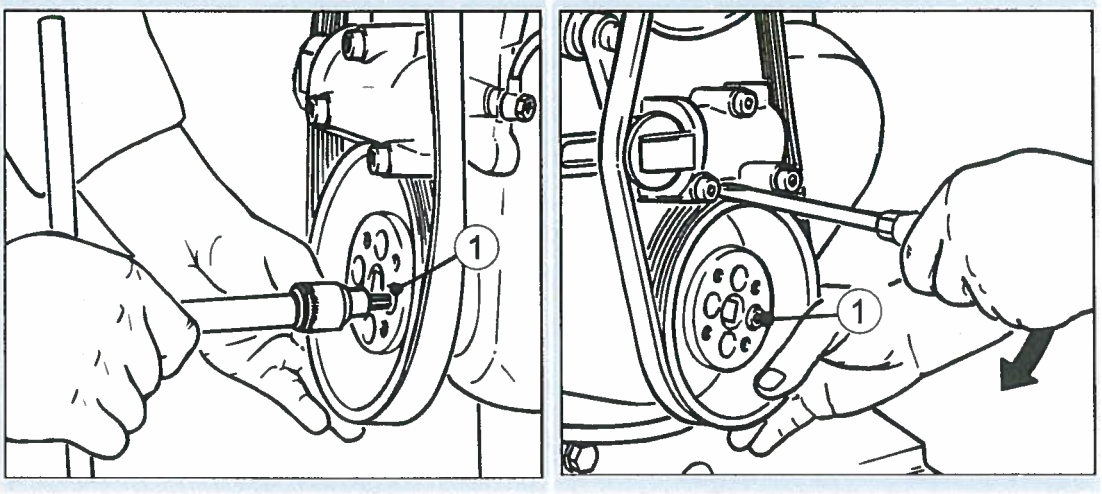
Pos.	Designation
1	Switch-off pin
2	Tension pulley
3	Housing

Procedure

Step	Activity
1	Slide in the switch-off pin (1).
2	Slide the piston with the tension pulley (2) into the housing (3) and lock it using the cylinder screw.
3	Position the poly v belt centrally on the pulley of the fan wheel, the tension pulley (2) and the pulley at the bottom.

Centering the pulley

Overview



Pos.	Designation
1	Cylinder screw

Procedure

Step	Activity
1	Lightly secure the pulley with a cylinder screw (1) without placing the pulley fully on the centering.
2	Insert a large screwdriver between the hydraulic belt tensioner and pulley and push down until it slides fully into the centering.
3	Insert the remaining cylinder screws (1) and tighten.

SECTION 7

GEARBOX

MAINTENANCE INSTRUCTIONS

DANDO DRILLING INTERNATIONAL LTD

OLD CUSTOMS HOUSE, WHARF ROAD,
LITTLEHAMPTON, WEST SUSSEX,
BN17 5DD, ENGLAND

E-MAIL: info@dando.co.uk
WEB: www.dando.co.uk
TEL: +44(0)1903 731312 FAX: +44(0)1903 730305

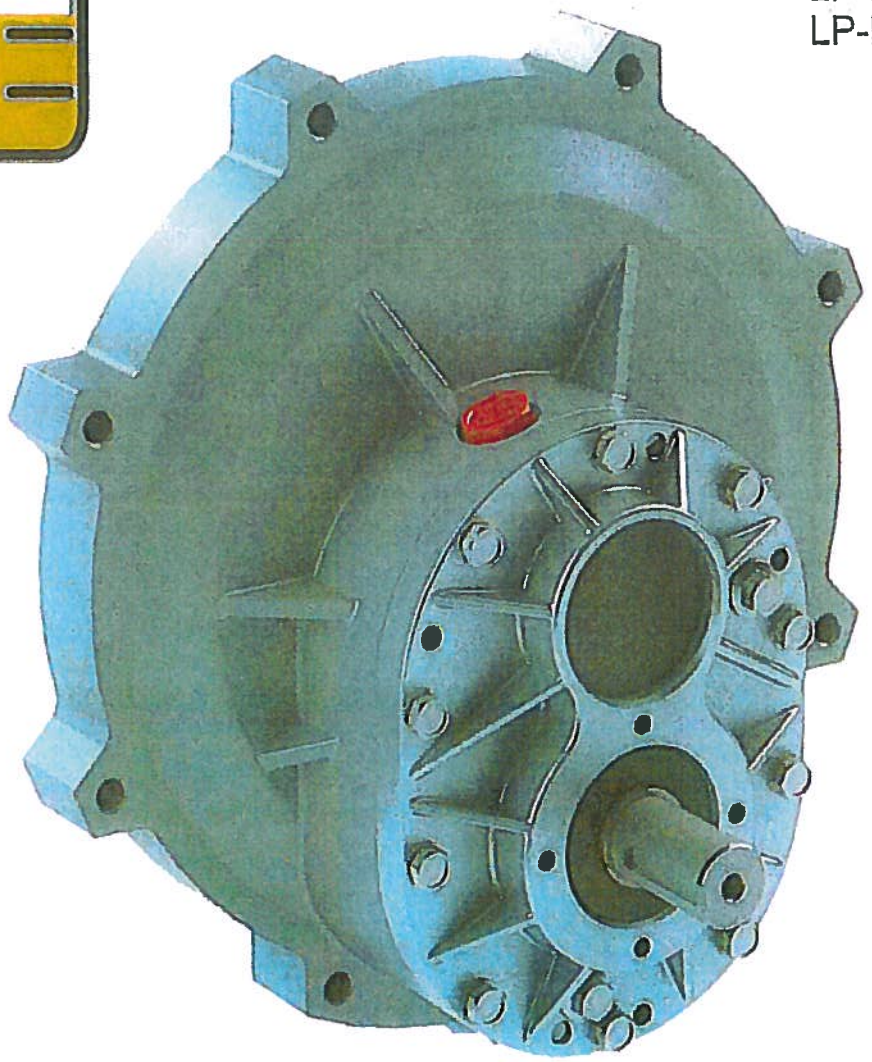
Energold DRILLING CORP

Made in England since 1867

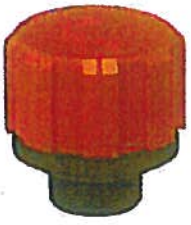
Gearbox Service Information

Models:- As List:-

HZ-BGBX2-M/L
HZ-BGBX2.5D
HZ-BGBX3-M/L
LP-BGBX2-TR
LP-BGBX3-TR



Once mounted replace the uppermost red filler plug with the orange breather plug supplied



This gearbox is supplied pre-filled with oil

Oil Type:

Synthetic PG 220 Extreme Pressure Gear Oil.

Please do not mix with mineral based oils.

When changing the oil please follow the below instructions:

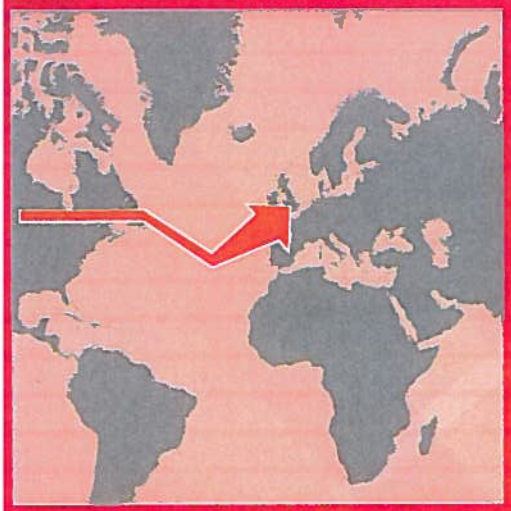
Intervals of Maintenance:

First oil change after 50 operating hours.
Further intervals as prescribed for the engine, but at the latest after 500 operating hours

Oil Change:

Always change oil when gearbox is warm.
Position the gearbox so that one of the two oil filler/drain plugs is located at the lowest point.
Loosen the lower oil filler/drain plug, when draining remove the top filler/drain plug also to aid the draining of the unit.
Once drained refit the red filler plug and tighten with approx. 15Nm.

Measure and add 0.089 litres of the above specification oil to the gearbox through the uppermost filling port.
Once filled with the correct amount of oil refit the orange breather plug in the upper most filler hole.



DANDO DRILLING
INTERNATIONAL

Dando Drilling International Limited
Old Customs House, Wharf Road
Littlehampton, West Sussex
United Kingdom BN17 5DD

tel: +44 (0)1903 731312
fax: +44 (0)1903 730305

www.dando.co.uk