



Operation and Maintenance Manual

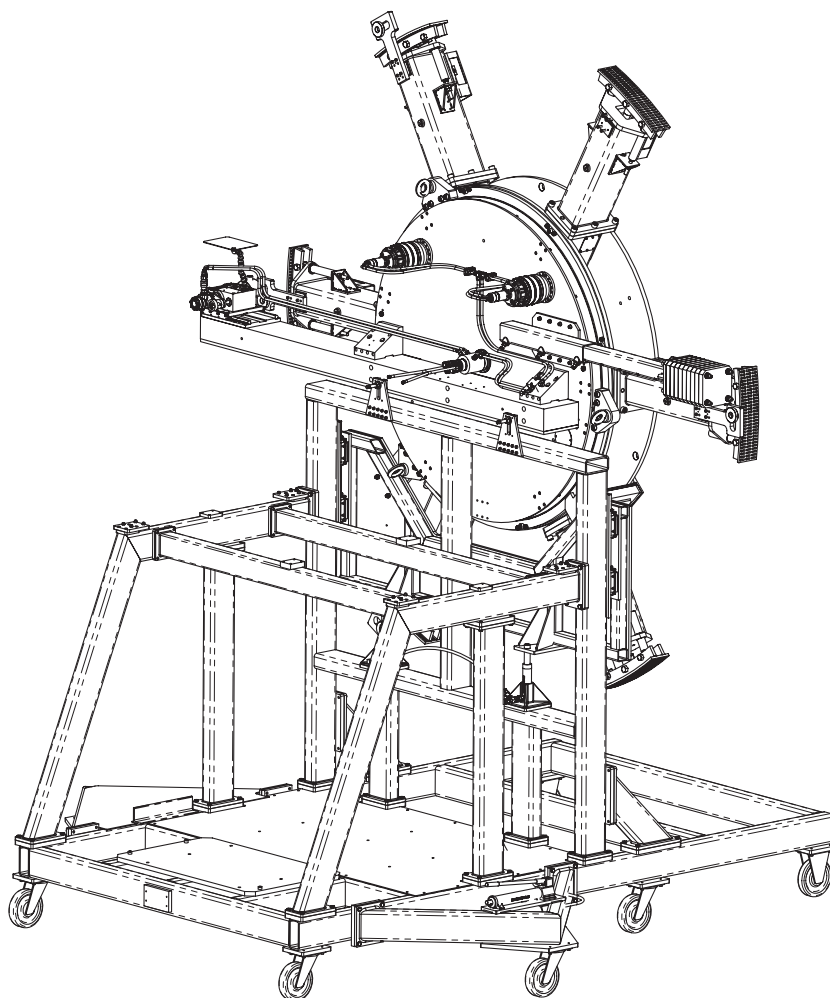
WP4600-H Orbital Milling Machine with WP4700-2 Base and WP4600-14 Trolley

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To reduce the risk of injury, user must read and understand this document before use.

ABOUT US

Enerpac is a global market leader in high pressure hydraulic tools, controlled force products, portable machining, on-site services and solutions for precise positioning of heavy loads. As a leading innovator with a 110-year legacy, Enerpac has helped move and maintain some of the largest structures on earth. When safety and precision matters, elite professionals in industries such as aerospace, infrastructure, manufacturing, mining, oil & gas and power generation rely on Enerpac for quality tools, services and solutions. For additional information, visit www.enerpac.com.



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WARRANTY

Refer to the Enerpac Global Warranty document for terms and conditions of the product warranty. Such warranty information can be found at www.enerpac.com.

NAMEPLATE

MIRAGE AN ENERPAC BRAND	MACHINE TYPE:	
MIRAGE MACHINES LTD	SERIAL NUMBER:	
8-10 ENTERPRISE WAY	YEAR OF MANUFACTURE:	
JUBILEE PARKWAY	SUPPLY:	
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CE		

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1. Introduction

1.1 Overview

The WP4600-H Orbital Milling Machine has been designed for 'out of the manufacturing mould' material removal of wind turbine blade root diameters.

The WP4600-H uses a hydraulic base, with three manually set Clamping Feet and three hydraulically operated Clamping Feet, to clamp inside the blade with minimal setting time and operation.

Once the WP4600-H is positioned within the root diameter, the hydraulic feet are activated securing the WP3500-H in position.

The common "Out of the manufacturing mould" root diameter flatness error is generally in the region of 3 – 5mm, however larger manufacturing flatness errors have been experienced. It is the responsibility of the manufacturer to achieve the best possible flatness within the mould which will reduce the root diameter machining durations.

The operation of the WP4600-H is to contact the root diameter with the face milling cutter and carefully power the WP4600-H milling arm around the root diameter to identify the high point of the root diameter. Once the high point of the root diameter is identified, the recommended depths of cut can be applied until the complete 360° surface is machined to a flat plane that achieves the common industry flatness of 0.3mm.

Upon completion of the machining operation, and the WP4600-H made safe for removal, the clamping base can be de-energised and the WP4600-H removed from the root diameter.

1.2 Personnel

As a specialist portable machine the minimum standard for an operator is to be:

- The operator must be trained and conversant with the Enerpac WP4600-H.
- The operator to be able to identify the correct and incorrect use of static or portable machines.
- Comply with all local and internationally recognised safe use of powered machines

1.3 Manual information

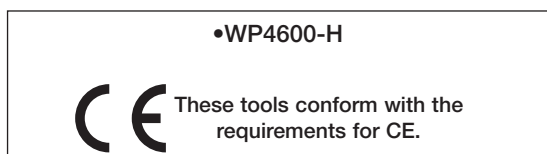
This manual refers to specific manuals for the Hydraulic Power pack, the hydraulic pump, and the Milling Head assembly. Ensure that each manual is read and understood before attempting to use the machinery.

1.4 Delivery Instructions

Upon delivery, all components must be inspected for damage incurred during shipping. If damage is found, the carrier should be notified at once. Shipping damage is not covered by the Enerpac warranty.

2. Compliance Statement

2.1 EU Declaration of Conformity



Enerpac declares that this product has been tested and conforms to applicable standards and is compatible to all CE Requirements.

A copy of an EU Declaration of Conformity is enclosed with each shipment of this product.

3. Safety

Read all instructions carefully. Follow all recommended safety precautions to avoid personal injury as well as damage to the product and / or damage to other property. Enerpac cannot be responsible for any damage or injury from unsafe use, lack of maintenance, or incorrect operation. Do not remove warning labels, tags, or decals. In the event that any questions or concerns arise, contact Enerpac or a local Enerpac distributor for clarification.

Save these instructions for future use.

If you have never been trained on high-pressure hydraulic safety, consult your distributor or service center for information about Enerpac Hydraulic Safety Courses.

This manual follows a system of safety alert symbols, signals, words, and safety messages to warn the user of specific hazards. Failure to comply with these warnings could result in death or serious personal injury, as well as damage to the equipment or other property.



The Safety Alert Symbol appears throughout this manual. It is used to alert you to potential physical injury hazards. Pay close attention to Safety Alert Symbols and obey all safety messages that follow this symbol to avoid the possibility of death or serious injury.

Safety Alert Symbols are used in conjunction with certain Signal Words that call attention to safety messages or property damage messages and designate a degree or level of hazard seriousness. The Signal Words used in this manual are DANGER, WARNING, CAUTION, and NOTICE.

DANGER Indicates a hazardous situation that, if not avoided, will result in death or serious personal injury.

WARNING Indicates a hazardous situation that, if not avoided, could result in death or serious personal injury.

CAUTION Indicates a hazardous situation that, if not avoided, could result in minor or moderate personal injury.

NOTICE Indicates information considered important, but not hazard related (e.g. messages related to property damage).

Please note that the Safety Alert Symbol will not be used with the signal word.

3.1 Safety Precautions

The manufacturer has made every effort to ensure that the information given in this Operation & Maintenance manual, and other publications relating to this machine is correct and understandable. However, it is acknowledged that there may be errors or omissions in this publication.

The company also reserves the right not to provide updates, corrections or amendments to this publication but will endeavour to keep its customers up to date with all changes that may affect the machine operation or safety.

Mandatory Safety Signs

ISO 7010 SYMBOL	SAFETY DESCRIPTION
	EYE PROTECTION MUST BE WORN
	EAR PROTECTION MUST BE WORN
	HARD HATS MUST BE WORN
	PROTECTIVE GLOVES MUST BE WORN
	PROTECTIVE FOOTWEAR MUST BE WORN
	OVERALL MUST BE WORN
	MACHINE GUARDS MUST BE USED

3.1.1 Handling

Customers, users and operators of the machines must be aware of the nature of the equipment supplied.

Although inherently robust, the machine is a precision tool and may be damaged by poor handling, tipping and falling, inadequate transport arrangements over e.g. rough terrain, misuse by operators and use outside its design specification.

Such poor handling may result in either broken or damaged parts or disturbance to fine settings resulting in an inability to meet the specified machining tolerances and capabilities.

3.1.2 Safety Procedures

Detailed in this chapter is a list of good Health and Safety practices that the manufacturer advise users to adhere to. Due to the nature of portable machine tools, not every eventuality can be catered for and the following is not exhaustive, as such the manufacturer strongly advise that the user carries out their own risk assessments based on the machining and environment in which they intend to use the machinery.

Machine Hazards /signs

ISO 7010 SYMBOL	HAZARD DESCRIPTION
	DANGER HIGH VOLTAGE
	WARNING MOVING MACHINERY
	CAUTION MOVING MACHINERY
	WARNING KEEP HANDS CLEAR

3.1.3 Pre-Operational Safety Checks

1. Always read safety signs / labels.
2. Ensure no slip / trip hazards are present in workspaces and walkways.
3. Locate and ensure you are familiar with the operation of the ON / OFF starter and E-Stop (if fitted). Do not leave equipment on top of the machine.
4. Ensure each tool is in good condition and securely mounted.
5. Secure / Remove loose items.

Faulty equipment must not be used.

Immediately report any suspect machinery.

3.1.4 Operational Safety Checks

1. Operator is fully conversant and trained in use of equipment.
2. Keep clear of moving machine parts.
3. Never leave the machine running unattended.
4. Follow correct clamping procedures - keep overhangs as small as possible and check work piece is secure.
5. Set the correct speed to suit the tool, the depth of cut and the material.
6. Before making adjustments and measurements or before cleaning swarf accumulations switch off and bring the machine to a complete standstill.
7. The lighting in the machine working environment shall be a minimum of 500 lumen.

3.1.5 Housekeeping

1. Switch off the machine.
2. Remove milling cutters, drill attachments and tap attachments and store them safely (if applicable).
3. Leave the machine and work area in a safe, clean and tidy state.



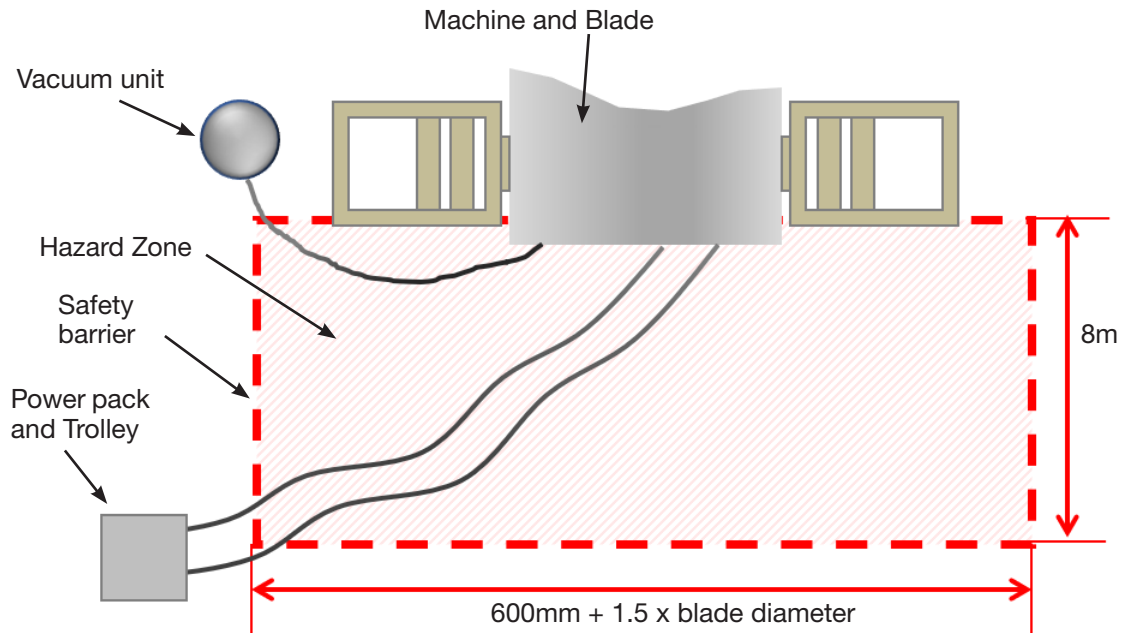
3.1.6 Potential Hazards

1. Sharp cutters. Use protective gloves when handling cutters.
2. Moving components – hair / clothing entanglement.
3. Skin irritation. Overalls and gloves should be worn stop direct contact with swarf and lubricants.
4. Metal splinters and burrs. Wear gloves when handling the machine or any sharp object. Swarf should be removed with pliers as well as protective gloves.
5. Flying debris. Keep clear of hazard zone when the machine is in operation. Eye protection should be worn to prevent eye injuries.
6. Fumes. Continuous cutting of metal can create fumes, therefore the machine must be used in a well ventilated area.
7. Hydraulic fluid leaks.

3.1.7 Machine Hazard Zone



When positioning and operating the machine, observe the hazard zones as shown below.



Attention: The Power pack and Trolley should be positioned outside of the hazard area of the machine.

It is considered that all persons in the vicinity of the machine have a good awareness of the hazards of the machine.

3.1.8 General Principles Concerning Operator Safety for All Portable Machine Tools

Adjustments

1. M Beware of obstructions that prevent complete tightening of all parts.
2. M Correctly locate tools and tool-holders.
3. M Do not use other machine parts, without confirming compatibility with the machine.
4. M Be sure that the work piece and machine are securely held together.
5. M Always select the correct tool/tip for the job.
6. M Beware of where you leave tools during set up and remove from close to the machining area
7. P Know how to set/attach protective guards - do not adjust while the machine is running.
8. P Never use the wrong protective guard.
9. P Secure all tools, nuts, bolts and supports.
10. P Know the proper procedure for applying loads - never apply force from an awkward position.

Operation

11. P Do not rush work.
12. P Never take cuts beyond the machine's capability.
13. P Beware of accidentally moving levers, or turning the power on.
14. P Do not allow distractions to interfere with machining operations.
15. P Never use a mobile phone while operating the machine
16. P Always check the machining area for loose items.
17. P Allow machine to stop before any adjustments to it.
18. P Never place hands on a machine or work piece to stop rotation.
19. P Beware of hands resting on operating levers.
20. P Do not wear rings, watches, ties or loose sleeved clothing or loose long hair.
21. M Do not use broken, chipped or defective tools.
22. M Do not run the machine unattended.
23. P Beware of moving machine parts that can fall.
24. P Be aware of where you are moving your hand or body in relationship to the machine.
25. P Be aware of hands or other parts of the body that may be hit by rotating machine parts.
26. P Know the function of each and every control.
27. P Make sure power has been turned off when the machine is unused for some time.
28. P Beware of performing another operation while

close to rotating parts of the machine.

29. P Beware of material, swarf and tools/tips flying from the machine.
30. P Never reach over, under or around a rotating machine to retrieve anything.
31. P Never reach over, under or around a rotating machine to make an adjustment.
32. P Never reach over, under or around a rotating machine to remove swarf.

Housekeeping

33. P Always attend to filing and de-burring operations.
34. P Beware of large burrs on work-pieces.
35. P Be sure to clean oil or grease from hand tools, levers and handles.
36. P Always use the proper hand tool to remove swarf.
37. P Never hurry to remove swarf.
38. P Beware of swarf wrapped around the tool or work piece.
39. P Do not touch any electric equipment or operating panel with wet hands.

Manual Handling

40. P Do not grip a component with grease or oil on it.
41. P Do not attempt to hold components that are too awkward or too difficult to hold.
42. P Know how to hold components properly when lifting, get assistance if necessary.
43. P Do not use hand tools or lever handles in an awkward position.
44. P Do not apply excessive force.
45. P Beware of irregular shaped work-pieces or machine parts.
46. P Never mount a machine too large for the operator to handle alone or without lift gear.
47. P Wear protective clothing and essential PPE.

Maintenance

48. M Always maintain the equipment in accordance with manufacturer's recommendations
49. M Always use the recommended or equivalent hydraulic oil, lubricant oil and grease.

AND

50. Carry out all operations in accordance with good engineering practice

3.1.9 User Responsibilities

Enerpac can only recommend that suitable Risk Assessments and precautions are made and taken, by the Customer, as it has no control over the actual use of the equipment by the Customer.

It is the responsibility of the Customer and Machine User to ensure that detailed Risk Assessments are carried out and Safe Systems of Work are developed for the particular tasks to be carried out using this equipment.

Typical Assessments relevant to this Safe System of Work are shown below.

Users of this equipment should ensure that equivalent assessments are in place and that they are familiar with them and all risks associated with the task.

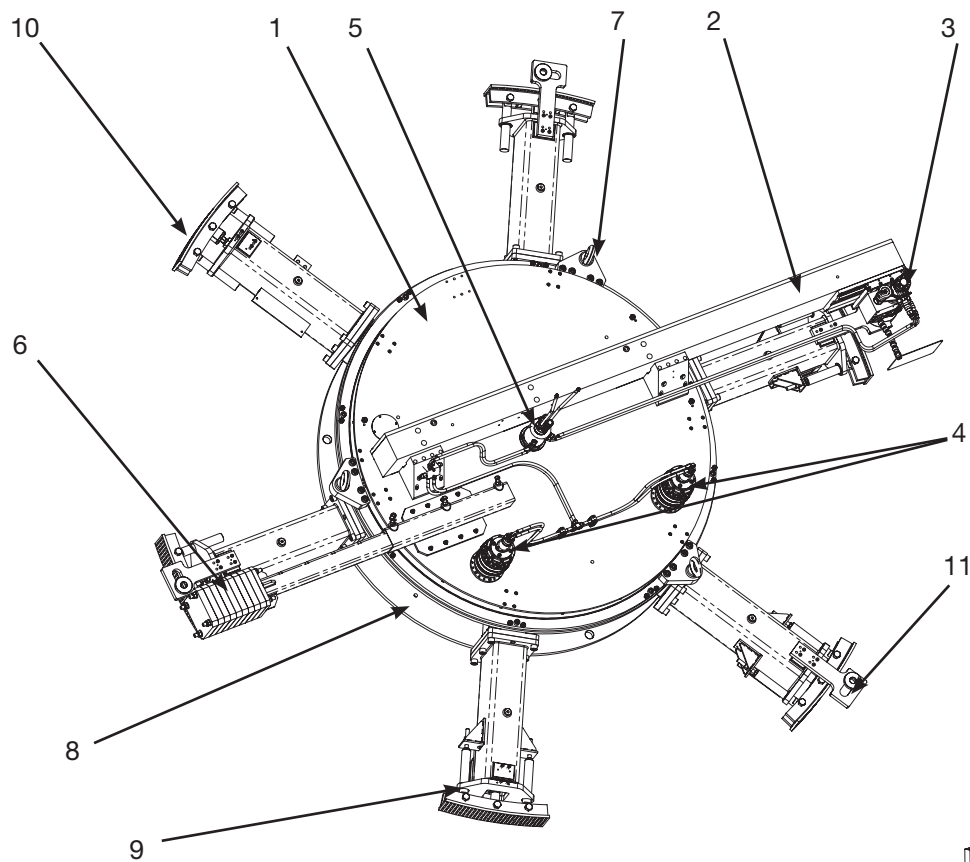
It is the responsibility of the Customer / Operator to ensure that:

- any necessary Permits to Work have been authorised
- relevant Machine Lock Out procedures are adhered to
- any other restrictions to working times / conditions are identified and adhered to

Risk Assessments	
Site Safety	
Transport of the equipment	Machine Support
Machine Location	Installation of the equipment
Pedestrian segregation	Moving vehicles
Air / Electricity / Hydraulic Services	Lifting Operations
Noise Control	Working at Height
Machine Operation	
Portable Machine Tools - Detailed Operation	Use of Hydraulic Power Drive Units
Use of Airlines	Moving 25L Coolant Hydraulic Oil etc Drums
Flying Swarf	Swarf Bin Handling
Cleaning Swarf From Machines	Manual Handling
General Handling	General Lifting-Carrying-Placement of Items 0-18Kg
Housekeeping	General Lifting-Carrying-Placement of Items 18-50kg
	Consumption of Food and Drink in the Working Area
Personal Protective Equipment (PPE)	
Coveralls and Coats	Safety Footwear - Various Styles
Safety Spectacles	Safety Over-Spectacles
Safety Goggles	Protective Face Guard
Hearing Protectors	Ear Plugs
Rigger Gloves	Pigskin Gloves
High Grip Kevlar Lined Latex Gloves	Nitrile Disposal Gloves
Control of Substances Hazardous to Health (CoSHH)	
Coolants	Metal Cutting Fluids
Degreasers - Water Based	Degreasers - Solvent Based
Hydraulic Oils	Water Dispersants
General Oils and Greases	

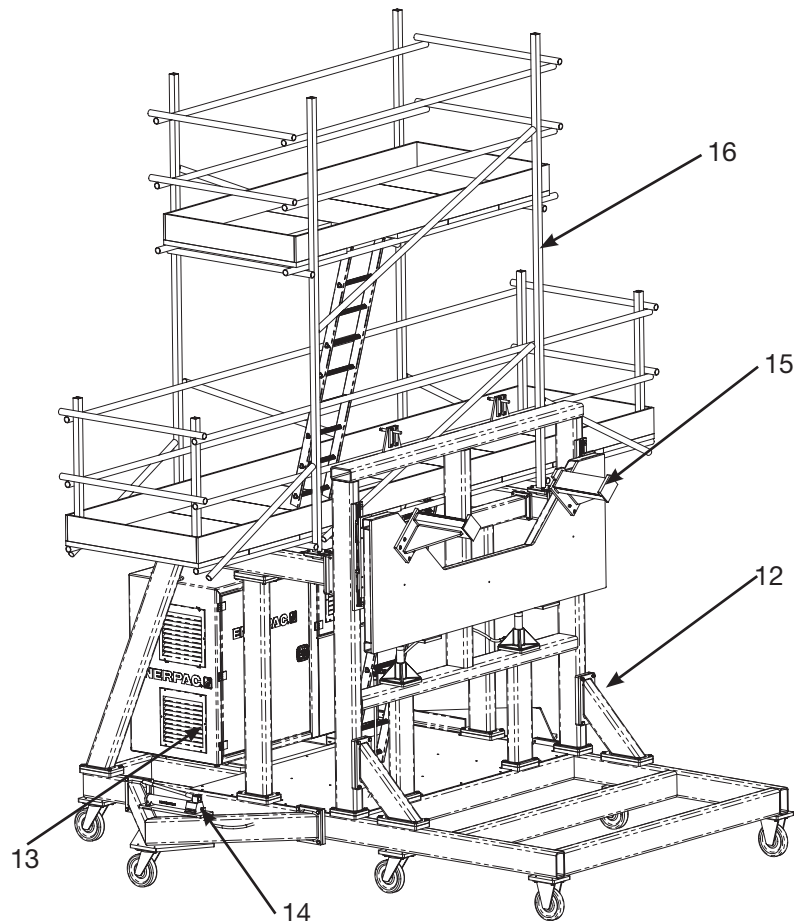
4. Features & Components

4.1 Feature Diagram



Features

1. Rotating Drive Ring
2. Milling Arm
3. Cutting Head Assembly & Carriage
4. Hydraulic Motors
5. Distributor
6. Balancing Weight
7. Lifting Point
8. Base Assembly
9. Hydraulic Feet
10. Manual Feet
11. Setting Strap
12. Trolley Assembly
13. Powerpack
14. Trolley Hydraulic Hand Pump
15. Trolley Carriage Assembly
16. Trolley Platform



5. Technical Product Data

5.1 Dimensional Art

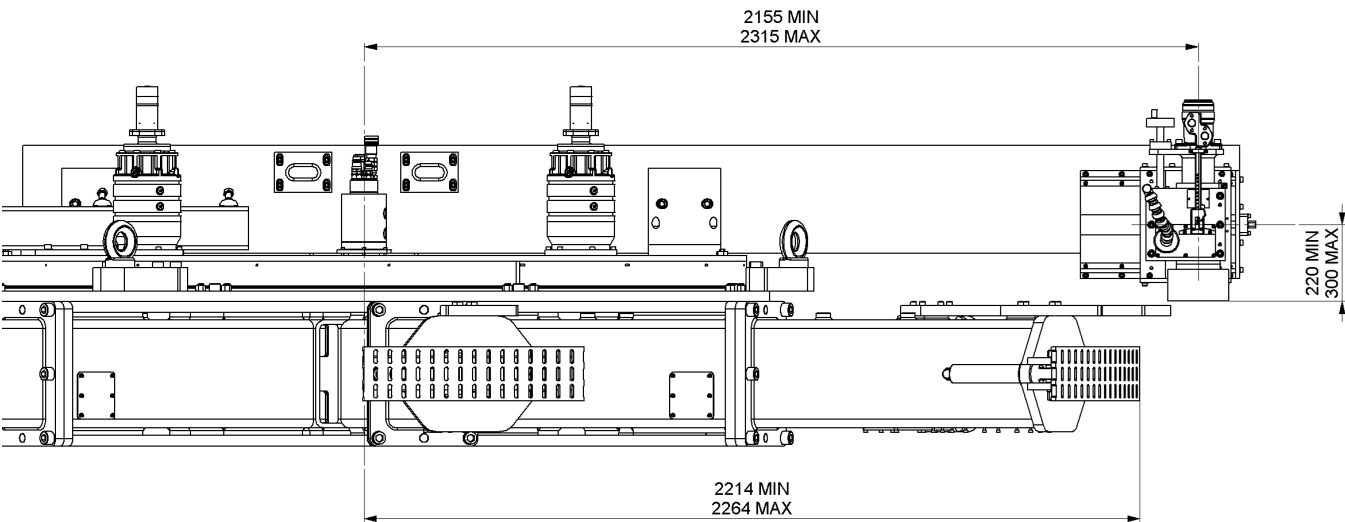


Figure 1: Machine Dimensional information

5.2 Technical Data

Technical Details		
Max Clamping Diameter	4520mm	178.0"
Min Clamping Diameter	4428mm	174.3"
Max Machining Radius	2315mm	91.1"
Min Machining Radius	2155mm	84.8"
Rotating Motors 2x	1.8kW (3.2kW Intermittent Use*)	2.4Hp (4.3Hp Intermittent Use*)
Milling Spindle (Hydraulic)	3.73kW	5.0Hp
Machine RPM	2 RPM MAX	-
Standard Cutting Speed (160mm Facing Cutter)	300-400 mm/min	12-16 inches/min
Milling Spindle RPM	25 RPM MIN	265 RPM MAX
Flatness Tolerance Achievable	0.3mm	0.011"
Milling Head Travel	68mm	2.6"
Hydraulic Supply at 1050 psi (70 bar)	60 L/min	13.2 Gal/min
Complete Machine Weight	7370 kg	16248 Lbs

*Intermittent Operation is a maximum of 10% of every minute

6. Installation

6.1 Lifting

The WP4600 is supplied with a lifting trolley to help installation and removal from the turbine blade. Lifting the machine to the blade should be facilitated using the trolley, however, if for any reason the machine is required to be lifted then the following instructions apply.

Before lifting ensure that:

- A lifting plan has been generated and is adhered to.
- Lifting equipment is suitable for the job.
- All lifting equipment is properly certified and in date.
- Lifting equipment is inspected for any damage.
- All necessary safety procedures are followed.

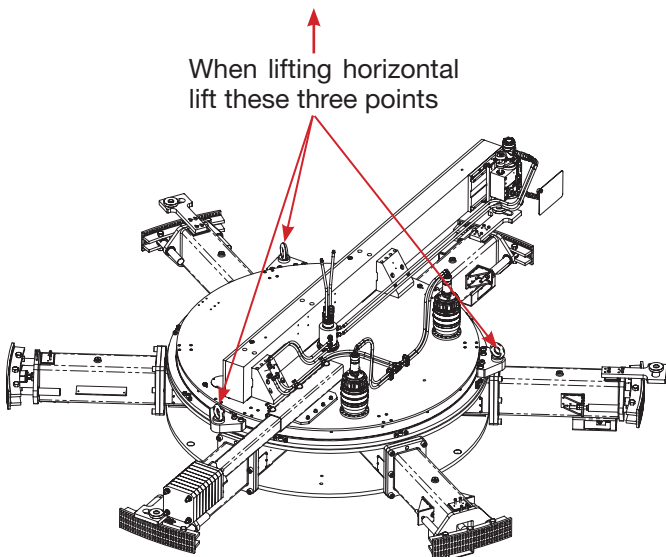


Figure 2: Machine and Base Horizontal Lift

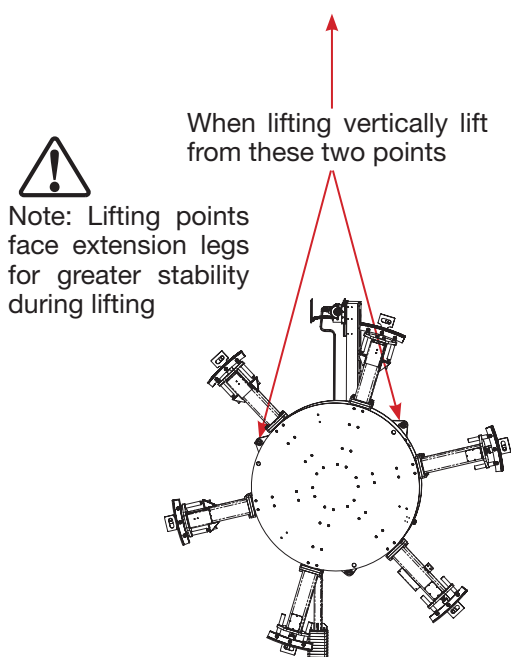


Figure 3: Machine and Base Vertical Lift

6.2 Installing WP4600 machine to clamping base

If the drive assembly needs re-assembling to the base following maintenance or any other reason the following instructions should be followed.

1. Position the hydraulic base in the horizontal position.
2. Using suitable lifting equipment, lift the Drive Ring Assembly (WP4700-7) onto the Hydraulic Base Assembly (WP4700-2). Ensure the mounting bolt holes within the Drive Ring Assembly align with the securing holes within the hydraulic clamping base.

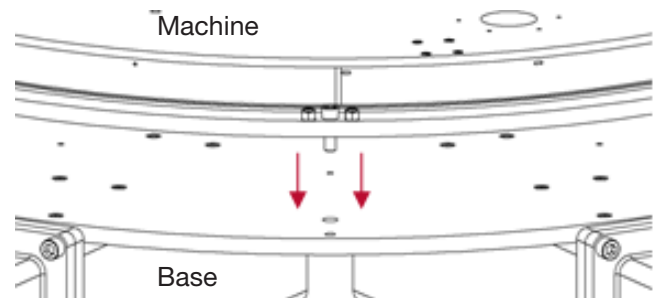


Figure 4: Attach Machine to Base

3. Install mounting bolts to secure the Drive Ring Assembly to the Hydraulic Base Assembly.
4. Now the machine will require setting, see section 6.3.



Note: When assembling the base legs ensure that the M24 socket head cap screws are tightened to a torque figure of 140N/m (100ft/lbs)

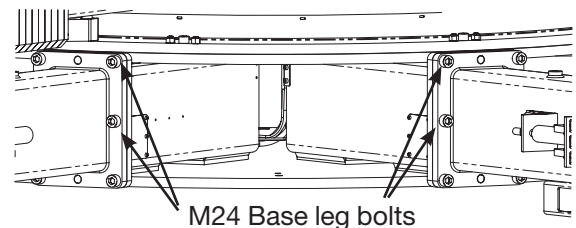


Figure 5: Base Leg Bolts

6.3 Setting the machine parallel

Your WP4600 Orbital Milling machine has been set at Enerpac & under normal circumstances should not require any further adjustment. However, if these factory settings are lost during transit, whilst carrying out maintenance or just through normal 'settling' of the machine then the Setting Straps will need re-setting to the machining plane.

The instructions below detail the approved method of how to re-set the 'Machining Plane'.

Note: No laser measuring equipment is supplied with the machine as standard.

Note: The following instructions assume that the machine has been separated from the Base assembly.

1. Ensure all M16 grub screws are retracted so they do not protrude beneath the 'Baseplate'. See Figure 6

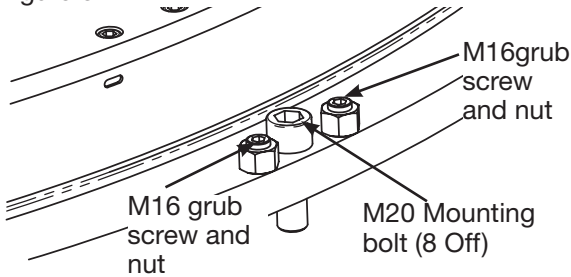


Figure 6: Machine plane adjusting screws

2. Lower the machine assembly, complete with Milling arm onto its base ensuring all bolts line up with their corresponding holes in the base & the machine sits flat onto its Base assembly.
3. When the machine is seated onto its base land all M16 grub screws & lightly tighten 8off M20 mounting bolts to secure the machine in position.
4. Install a laser target to the end of the Milling arm that is furthest away from the centre of the machine.
5. Rotate the Milling arm & survey the laser target plane/path.
6. If the target plane/path requires any adjustment carry this out now by releasing any relevant M20 mounting bolts & adjusting the M16 grub screws & lock nuts. Re-survey & repeat the above process until the machining plane is flat. Fully tighten the M20 mounting bolts & ensure all M16 lock nuts are tight.
7. Measure between the Milling Arm & each Setting Strap. Measurements should not deviate more than +/- 0.1mm, if they do then remove the Setting Strap and install an appropriate shim (supplied) & then re-assemble. Adjust all Setting Straps in this way until all are within tolerance.

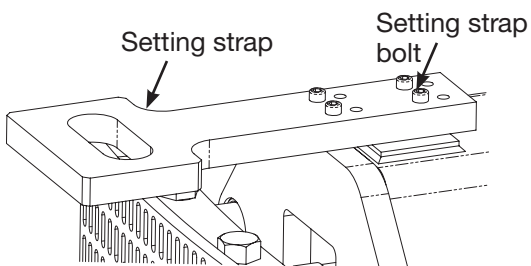


Figure 7: Setting Strap on Base Leg

8. Mark each Setting Strap and any shims to the corresponding place on the machine base to ensure that they are always replaced in the same position.



Ensure the four setting strap bolts shown in fig. 7 are torqued to the recommended value given in section 12.1

6.4 Preparing to Install the Assembly to the Work-piece

The construction of the hydraulic base (WP4700-2) is such that there are 3 manual clamping feet and 3 hydraulic feet.

The 3 manual feet must be set prior to installation of the complete assembly into the work piece.

1. Using a tape measure record the inside diameter of the work piece.
2. Divide the inside diameter by 2 to give the required clamping radius. Now measure from the centre of the Base to the outer middle of the fixed feet and adjust until the correct radius is achieved as detailed below.
3. Set the manual clamping foot by releasing the M36 half nut and rotating the M36 threaded bar clockwise to advance the fixed clamping foot to the dimension calculated above.
4. Re-lock the M36 half nut once the required dimension has been confirmed.
5. Repeat for the remaining two fixed clamping feet.

The WP4600-H machine and WP4700-2 hydraulic base assembly are now ready for installation into the work piece.

6.5 Installing machine into the work piece

6.5.1 Securing the machine to the trolley

The WP4600-H Orbital Milling Machine is supplied with an Installation Trolley (WP4600-14) to enable the machine to be installed into the blades without the need for cranes or overhead winches.

When you take initial delivery of your WP4600-H Orbital Milling Machine, it will require installing into the Installation Trolley. (Note: the machine should be attached to the base, refer to section 6.2).



Do NOT move the trolley when Personnel is on the Trolley Platform



Do not operate the machine when it is on the trolley



Appropriate PPE should be worn when manoeuvring the WP machine on the WP4600 trolley.

The WP4600 should be installed to the blade using the WP4600 Trolley (WP4600-14), 3 x Setting Straps (WP4700-3-005) and 3 x work specific bolts.

1. Lift the machine assembly in a vertical position using a crane or overhead winch.
2. Orientate the base so that the clamping feet are not at 12 & 6 o'clock but the hydraulic feet are at the top of the machine. Move the milling arm so it's parallel with the floor & lower the machine onto the machine support arms. See Figure 8 and 9.

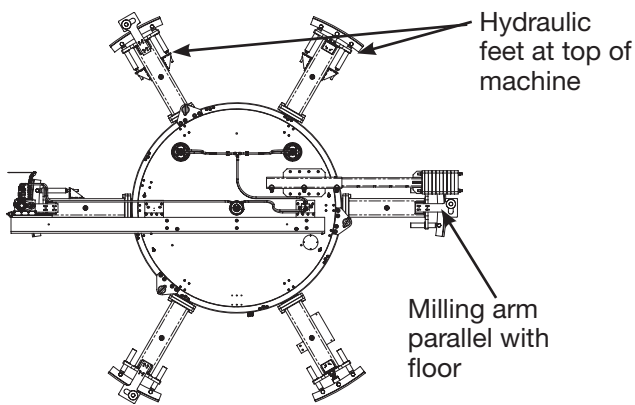


Figure 8: Front view of machine & base assembly before installing to trolley

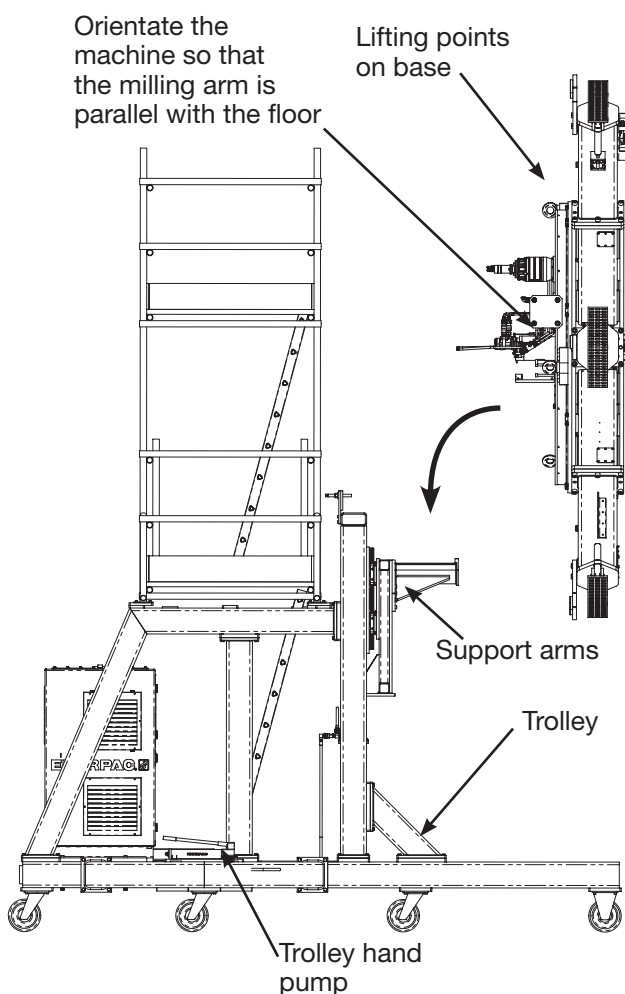


Figure 9: Machine and trolley

3. Whilst still supporting the machine with a crane/overhead winch secure the machine to the trolley by engaging the 'Machine Top Brace'. These bolt to the milling arm. See figure 10.

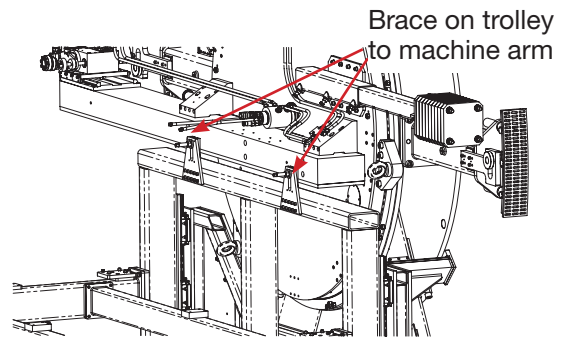


Figure 10: Secure machine to trolley

4. The machine is now secure in the trolley & can be installed into the work piece.

Note: Ensure all M16 frame assembly bolts are tightened to a torque figure of 125 N/m (90 ft/lbs)

6.5.2 Moving and securing the machine to the work-piece

1. Connect the machine **Base Assembly** to the Enerpac hydraulic hand pump (P/N P842-100) using the 'Quick Release' fittings available. Information on the Enerpac Hydraulic Manual Hand Pump can be found at www.enerpac.com
2. Ensure that the hydraulic clamping feet are fully retracted. Refer to Section 10 for the Hydraulic parts list.

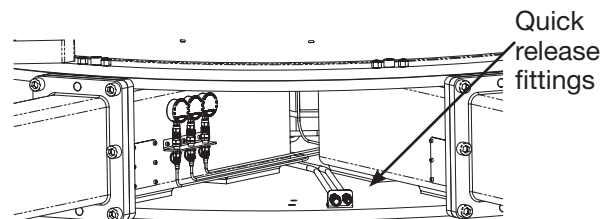


Figure 11: Hydraulic base pump connection.

3. To install the machine into the work piece, manoeuvre the trolley until the machine is perpendicular to the work piece.
4. The **Installation Trolley** features a hydraulic jack that allows the height of the machine to be altered in the trolley. This allows the centre heights of the 'Blade Root' & machine to be aligned. (See figure 9 for pump location on trolley).
5. Using the hand operated hydraulic pump fitted to the WP4600 trolley (PN P392), raise the machine until the WP machine will fit into the work piece if driven forwards.

Refer to Section 10 for the WP4600-14 Trolley parts list. Information on the Enerpac Hydraulic Manual Hand Pump can be found at www.enerpac.com



There is an additional safety valve (PN V66) on the P392 hand pump supplied. See Figure 12. To extend the cylinder, turn valve closed (turn Clock-Wise) before pumping the hand pump. To retract cylinders, turn pump open (turn Counter-Clock-Wise), only then turn the safety valve lever CCW to slowly lower the machine.

Further information Information on the V66 valve can be found at www.enerpac.com.

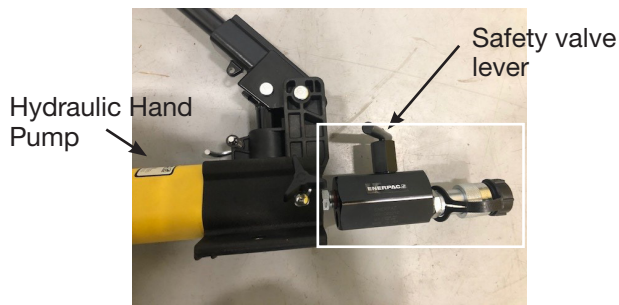


Figure 12: Safety Valve Trolley Hand Pump

6. Drive the trolley forwards until the 3 x setting straps make contact with the work piece.
7. The slot within the setting straps should line up with holes on the face of the work piece, the work specific bolts should be used to go through the setting straps and into the work piece to orient the machine only and not to hold the machine to the work piece, this is done by the clamping feet.

Note: Excessive tightening of the work specific bolts is not needed.

8. Connect the manual hydraulic pump for expanding the base legs (P842-100) and pump until there is an indicated 80 bar of pressure on each of the three pressure gauges that are mounted inside the machine base.

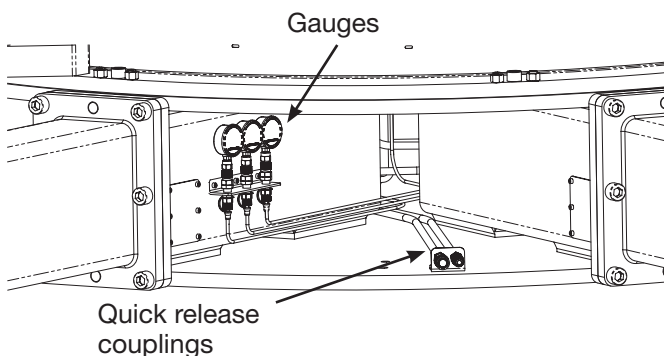


Figure 13: Gauges in Base assembly

9. Move the hydraulic shut off valve located on the manual hydraulic pump to the neutral position and disconnect it via the two quick release connections.

NOTICE

Once the hydraulic rams have been activated with the introduced 80 bar of pressure the hydraulic rams will maintain pressure within the hydraulic rams as check valves are incorporated into each one.

⚠ DANGER

Note: The pressure reading on the gauges should be monitored to ensure the hydraulic pressure does not drop below 40 bar, if it does, stop the machine immediately & re-pressurise base.

10. Wind the 4 x M20 Nuts on each hydraulic clamping foot (2 on each side) to lock the hydraulic rams in place. See figure 14.

⚠ DANGER

Ensure that each hydraulic clamping foot is secured with 4x M20 nuts. This will prevent the base extension legs from retracting if there is sudden pressure loss.

When the mechanical locks are applied there may be a minimal visible drop in pressure on the hydraulic gauges. This is due to the mechanical lock activation. If the mechanical locks are overtightened the gauge pressure will drop further.

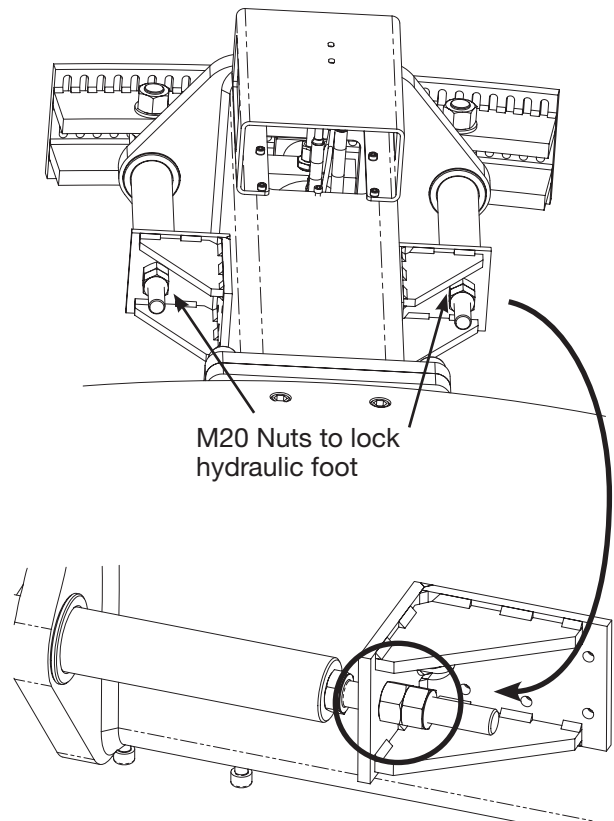


Figure 14: Hydraulic clamping locks on base

11. The trolley can now be removed by disengaging the 'Machine Top Brace' & lowering the 'Support Arms' on the trolley by releasing the hydraulic pressure in the trolley jack. The trolley can now be pulled away from the machine.
12. With the machine now in place and a full 80bar (8MPa) reading on all the pressure gauges, disconnect the hand pump hydraulic hoses & remove the 'Setting Straps'.
13. The WP4600 is now installed into the work piece.

6.6 Hydraulic base de-activation



The hydraulic base must not be de-activated without the WP4600 machine being fully supported by both the setting straps and WP4600 Trolley or overhead crane.

To release the contained pressure within the hydraulic rams, to remove the machine assembly, or to reverse the machine installation process, the hydraulic hoses which connect the manual hydraulic pump to the WP machine base have to be re-connected via the quick release connection.

1. Ensure the machine assembly is fully supported.
2. Connect pump (P842-100) quick release connection to Base assembly.
3. On the manual hydraulic pump move the directional control valve lever to the Release position. Information on the Enerpac Hydraulic Manual Hand Pump can be found at www.enerpac.com
4. Using the hand pump apply hydraulic pressure.
5. When enough pressure has developed the check valves will lift and the feet will start to retract. Keep pumping until the feet are fully retracted.

6.7 Connecting the WP4600 to the power pack

The Hydraulic Power Pack's specification and technical detail is within the supplied Hydraulic Power Pack Manual.

1. The hydraulic hoses from the hydraulic power pack are constructed and sized for one configuration onto the WP4600 hydraulic distributor. The connection ports are located at the top of the distributor.

Distributor feed and return ports

Rotation feed and return 3/8" ports

Spindle feed and return 1/2" ports

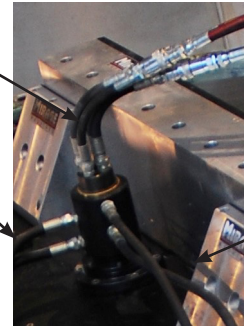


Figure 15: Hydraulic distributor on WP machine

2. WP4600 spindle hydraulic hose size 1/2" supply and return.
3. WP4600 rotational feed hydraulic hose size 3/8" supply and return.
4. Using the quick release fittings on the WP4600 and on the supply/return hydraulic hoses connect the hydraulic hoses to the machine distributor.
5. Refer to the power pack manual for the starting up procedure.

7. Operation

7.1 NEG milling head

For information regarding the operation and maintenance of the NEG milling head please refer to the separate 'NEG0100 Milling Head' manual.

7.2 Hydraulic Power Pack Pendant Control

The directions of use for the pendant control is given in Enerpac Hydraulic power pack manual.

7.3 Hydraulic power pack controls

Guidance for the power pack control panel is given in the Enerpac Hydraulic power pack manual.

7.4 Machine Balancing

When machining in any position other than horizontally flat, the 'Counterweight Assembly' will need to be set to help the machine maintain a constant rotational speed when cutting. Failure to balance the machine correctly will result in poor surface finish, out of tolerance machining, over stressed components or possible failure

Balancing can only be carried out when the machine is set in the position that it will be operating in.

1. Ensure that an appropriate tool is fitted in the NEG milling head & the carriage is positioned in its average facing position for the machining you intend to carry out.
2. Start by rotating the machine under its own power for several rotations taking note of its rotational speed as the 'Counterweight Assembly' passes both the 2 & 7 o'clock positions.
3. If the highest point of the machine is considered as 12 o'clock & the counterweights accelerate as they pass the 2 o'clock position & decelerate when passing the 7 o'clock position then either, weight needs to be removed or the assemblies position needs adjusting inwards radially. If the counterweights decelerate as they pass the 2 o'clock position & accelerate when passing the 7 o'clock position then either, weight needs to be added or the assemblies position needs adjusting outwards radially.

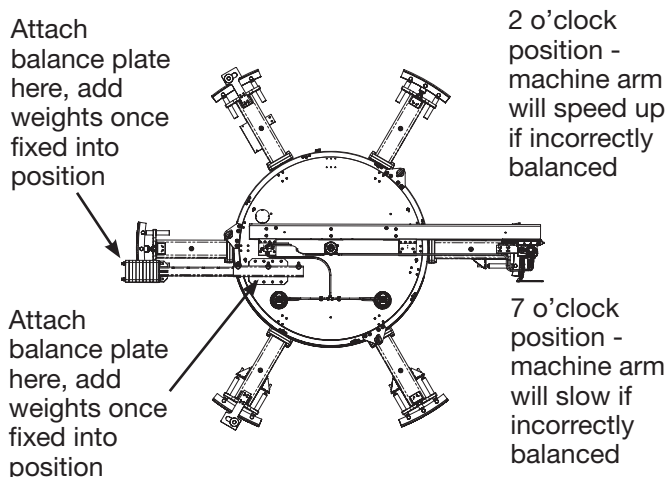


Figure 16: Balancing machine

4. To add or remove weights, simply unscrew & remove the four 20mm AF nuts along with their washers. The weights can now be added or removed as necessary.

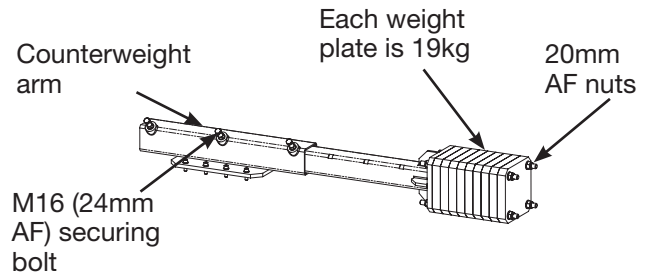


Figure 17: Counter balance assembly

5. To adjust the assembly's position, unscrew the three M16 securing bolts that lock the 'Counterweight Arm' into the 'Counterweight Base' & adjust as necessary. Note that there are three different positions available.
6. When the appropriate adjustments have been made ensure that all the securing/locking nuts & bolts are re-fitted & tightened correctly. Also ensure that the three M16 bolts used to lock the 'Counterweight Arm' within the 'Counterweight' base are located in one of the appropriate adjustment slots and NOT sitting directly onto the 'Counterweight Arm'.
7. Repeat steps 1 to 5 until the machine rotates at a smooth & constant speed.

7.5 Restart Procedure

1. In the event that the machine stops during a machining operation firstly identify the reason for the stop and resolve as required. In the event of a power loss to the hydraulic power pack, investigate the cause and amend.
2. If the emergency stop activation was activated whilst machining, the milling spindle cannot be re-started in the 'as stopped' condition. You will have to:
 - A. Unlock the 'Spindle Lock'.
 - B. Turn the 'NEG milling head' hand wheel to retract the cutter away from the work piece.
 - C. Inspect the carbide tool inserts for damage and replace as required.
3. Cancel the emergency stop command by re-setting the 'Emergency Stop' button on the front of the 'Power Pack' or 'Pendant'.
4. Re-set your cutting depth & continue to machine.

8. Storage

Activity	Duration				
	<1week	1week>	4weeks>	12weeks>	1year>
Remove all production cutting debris from the WP4600 and the hydraulic base.	•	•	•	•	•
Cover the WP4600 and the hydraulic base with a suitable tarpaulin to protect from the production environment.	•	•	•	•	•
Confirm that the maintenance schedule is current			•	•	•
Store the WP4600 and the hydraulic base in a temperature controlled environment of no less than 20° C.		•	•	•	•
Coat all non painted parts with an approved rust inhibitor. End user to identify the rust inhibitor that complies with their HS&E.				•	•
Place Silica Desiccant sachets with the stored/covered WP4600 and hydraulic base.				•	•

9. Maintenance

9.1 General Maintenance



NO MACHINE ADJUSTMENTS SHOULD BE MADE WHILE THE MACHINE IS IN OPERATION. TURN AND LOCK OFF THE POWER SUPPLY BEFORE MAKING ANY ADJUSTMENTS.

General wear and tear items should be replaced with like for like components as per the machine general assembly drawings detailed in this manual. Failure to do so may result in a machine that is not fit for purpose and is outside the design intent it was supplied for. Items that require specific maintenance regimes and products will be detailed here in.

General Maintenance Schedule		
Time Period (of machine use)	Action	Recommended Lubricant
After every use	Clean all cutting debris from machine. Pay particular attention to lead screws, pivots, sealing, sliding & rotating faces. Perform a visual check for any leaks and change fittings if required	General water displacing / cleaning oil.
As required	Replace cutting tool/cutting tool inserts.	N/A
Every 10 hours	Apply a small amount of low viscosity oil to all lead screws, pivots, sliding & rotating faces.	Mineral based SAE 10 oil.
	Check all securing nuts & bolts are tight.	N/A
Every 6 Months	Damper block setting should be reviewed.	
Every 12 months	Remove the guards covering the machine gears and bearing race to check for grease / swarf. Check landing feet with a laser and correct if needed.	
Before long term storage (12 months minimum)	Protect machine, components & accessories from corrosion.	General, oil based, rust inhibitor.

For maintenance regarding the Milling Head, please refer to separate NEG0100 Milling Head manual.

For maintenance regarding the powerpack, please refer to the separate hydraulic powerpack manual.

9.2 Corrective



ENSURE TO DISCONNECT ALL POWER CONNECTIONS PRIOR TO START

9.2.1 Milling head spindle

1. Loosen clamping screws and loosen spindle adjuster screws – check slide of spindle up and down and re tighten.
2. Once clamped check spindle movement prior to use.

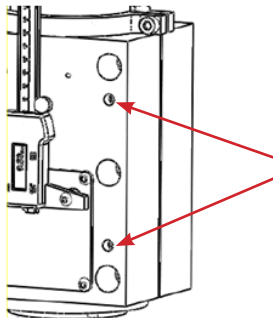


Figure 18: Milling head

9.2.2 Spindle bearings Adjustment

1. Loosen motor clamping screws and remove motor. The locknut and tab washer are now accessible.
2. One clamped check spindle movement prior to use

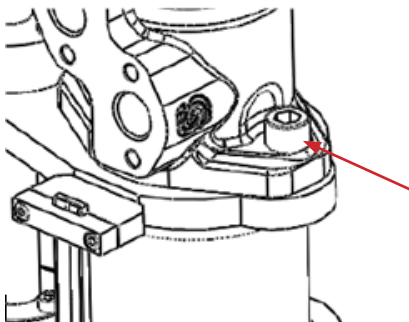


Figure 19: Motor drive assembly

9.2.3 Carriage

1. Loosen carriage rail retainer plate screws and tighten fully.
2. Back off one quarter of a turn and tighten the lock nuts.
3. Check slide operation and that there is no movement sideways in the carriage assembly

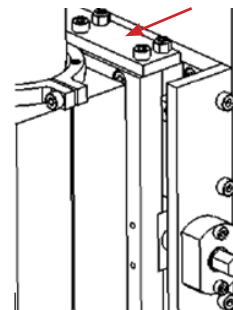


Figure 20: Carriage on milling rail

9.2.4 Damper Block Setting

The WP4600-H Drive Ring [WP4700-7] is fitted with 4 off damper blocks with an intended function of reducing/removing potential frequency within the machine.

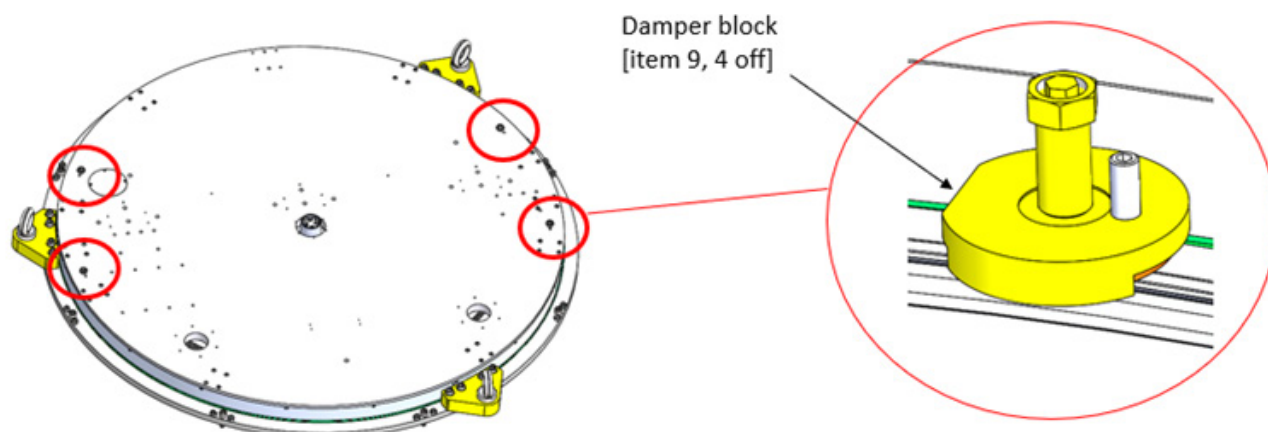


Figure 21: damper block locations

The setting of the damper blocks is to be carried out in the horizontal position and not within an installation trolley, machine holding frame or mounted within a blade. The complete machine can be on or off the hydraulic base when in the horizontal position.

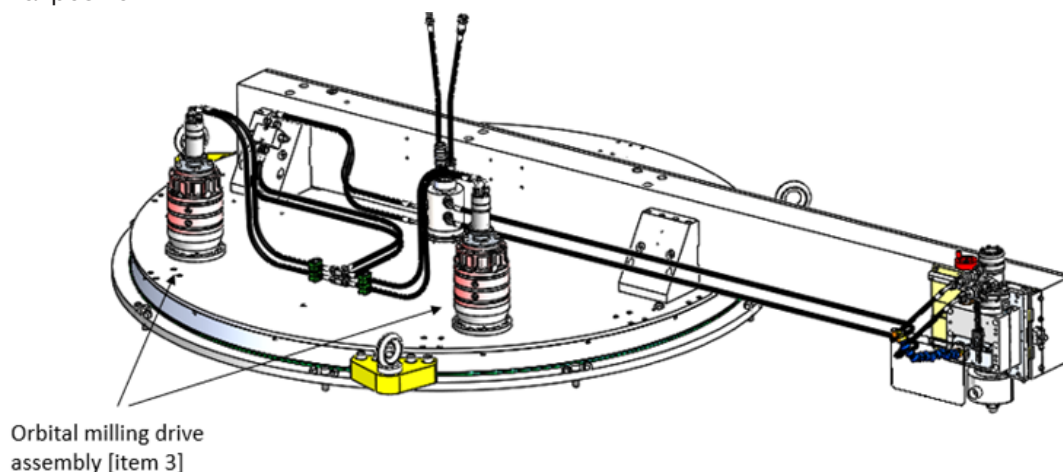


Figure 22: Orbital milling drives

1. Remove the two Orbital milling drive assemblies [item 3] above, and green strip, to allow manual rotation of the WP machine. The motors are engraved with a number. This needs to be recorded so that the motors are placed back in the same position when reassembled.
2. Unlock/ release the damper lock nuts OD 0172 [item 27] and release the damping block steady screw WP6000-30-012 [item 2], 4 off in total. The damping blocks MMIE 1877 [item 9] will now be in a contact free state.

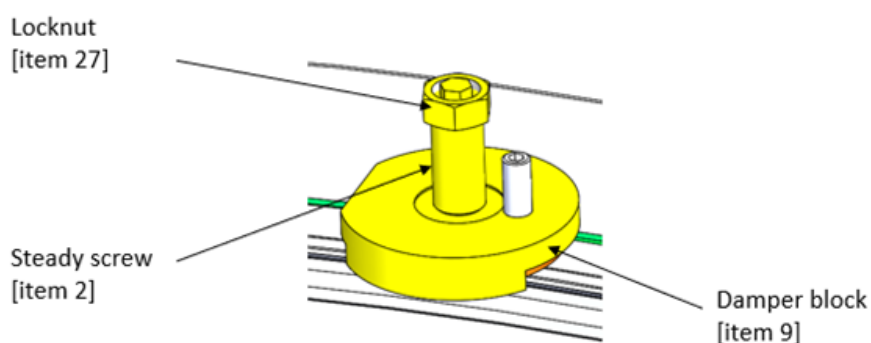


Figure 23: Damper block

3. Rotate the machine a full 360° with all damper blocks in a free state to appreciate the free state manual rotation of the machine.

4. Concentrating on one damper only and in no particular 360° rotational position, land the damper block [item 9] onto the internal linear rail by turning the steady screw [item 2] in a clockwise rotation. Stop as soon as contact is made. Do not apply any further force to the steady screw [item 2]. Apply the locknut [item 27].
5. Using a marker, record the position that the damper has landed onto the internal linear rail 'Damper Landing'.
6. Manually rotate the machine turntable. If any manual rotational force is noted, stop the manual rotation. This step identifies any tight spots during rotation.
7. In this position, where the machine rotation has been stopped at the tight spot, release the damper block which is currently 'landed' and reset as step 4 above: "land the damper block [item 9] onto the internal linear rail by turning the steady screw [item 2] in a clockwise rotation. Stop as soon as contact is made. Do not apply any further force to the steady screw [item 2]. Apply the locknut [item 27].
Using a marker record the new position that the damper has landed onto the internal linear rail.
Erase the previous 'damper landing' position.
8. Repeat steps 6 and 7 until a full 360° rotation, without any tight spots, has been achieved. The 'Damper Landing' position will now be identified.
9. Set the other 3 off Damper blocks at the now known 'Damper Landing' position.
10. Replace the previously removed Drive Gear Ring within step 1



Note: Damping Blocks are not to be used as brakes.

Damper Block Maintenance Recommendations

It is recommended that the damper block setting is reviewed every 6 months.

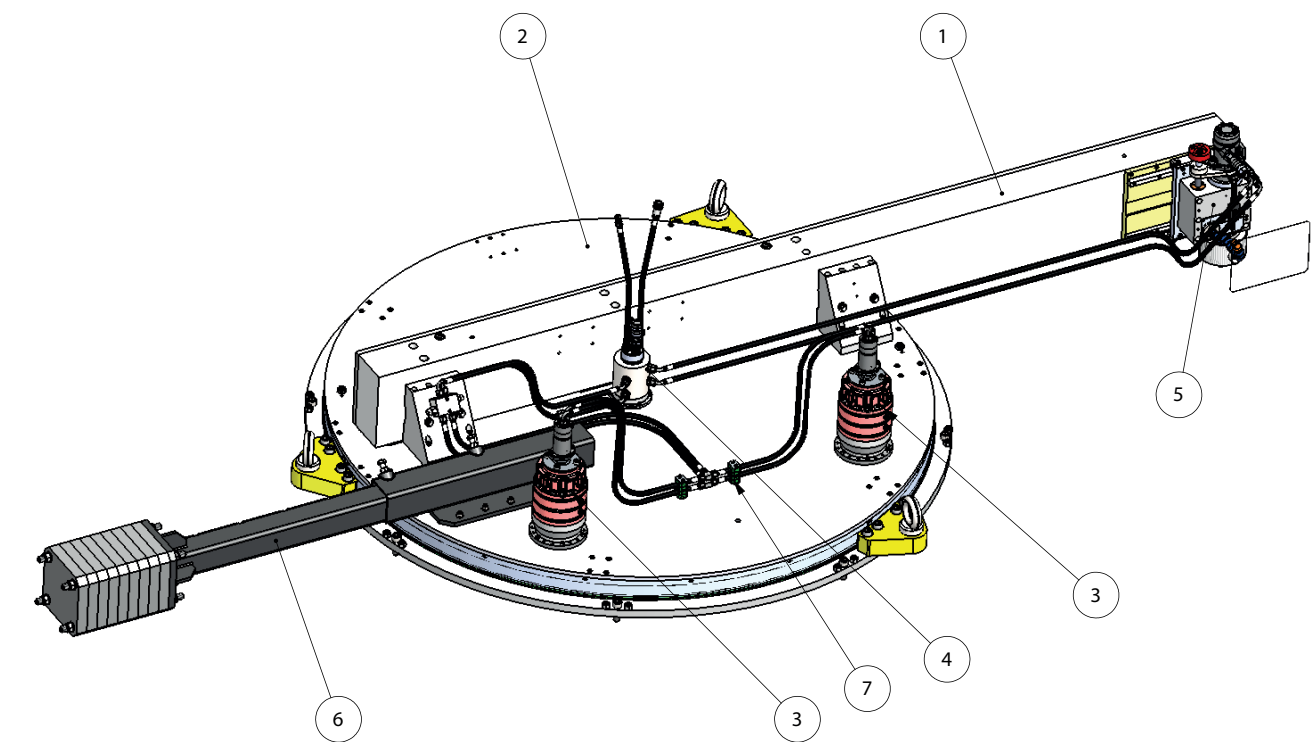
The 'Damper Landing' position will be known from the initial setting of the damper blocks;

- Position each damper at the known 'damper landing' position.
- Before releasing the lock nut OD 0172, record the damping block steady screw WP6000-30-012 [item 9] using a marker or similar.
- Release the lock nut and retract the damping block steady screw by ½ a turn in a counter clockwise rotation. Then rotate the damping block steady screw in a clockwise rotation until contact is made.
- Compare the retracted counter clockwise rotation to the contact clockwise rotation. This will identify if any wear has been encountered.
- Tighten the locknut OD 0172 to maintain the landing contact.

10. Parts List

10.1 WP4600-H - Machine Assembly

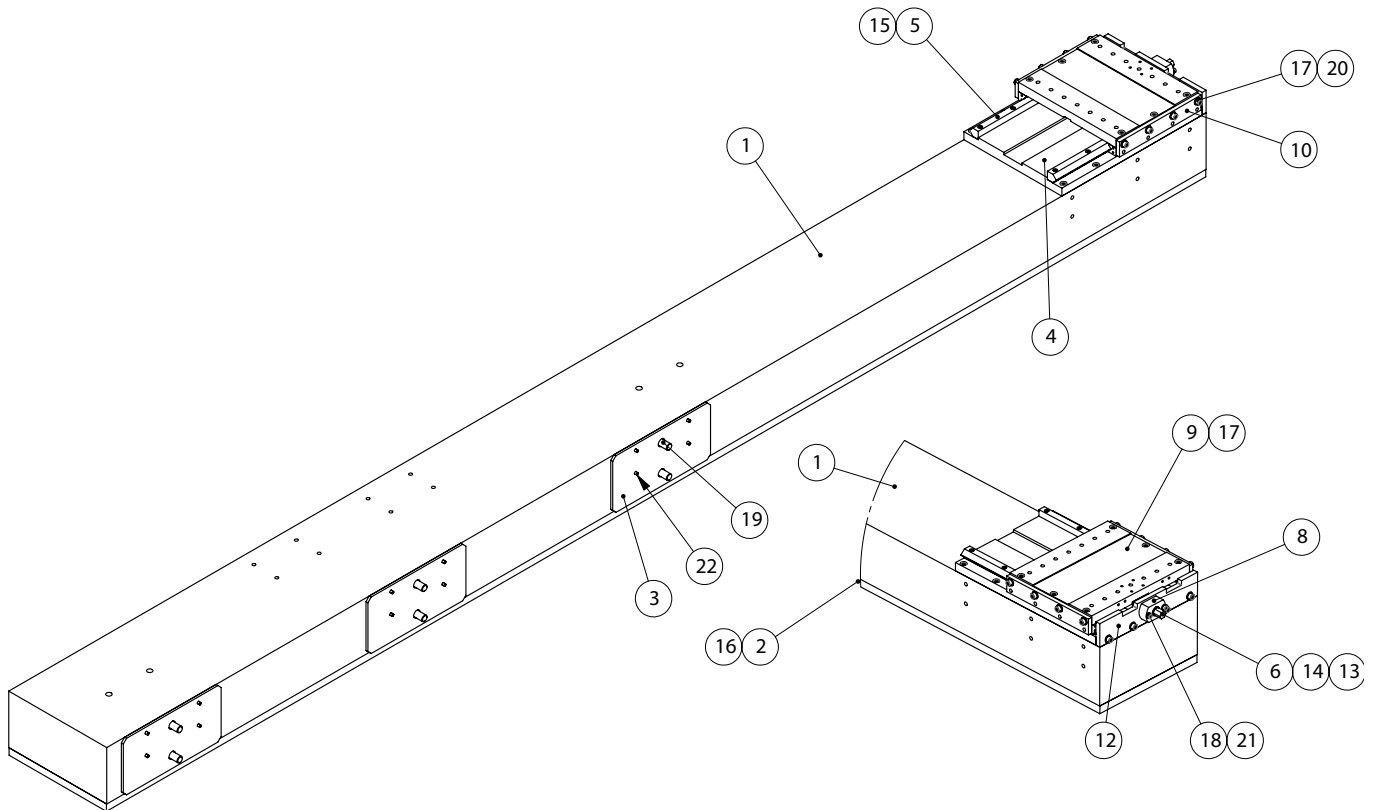
Revision D, Weight 3365kg



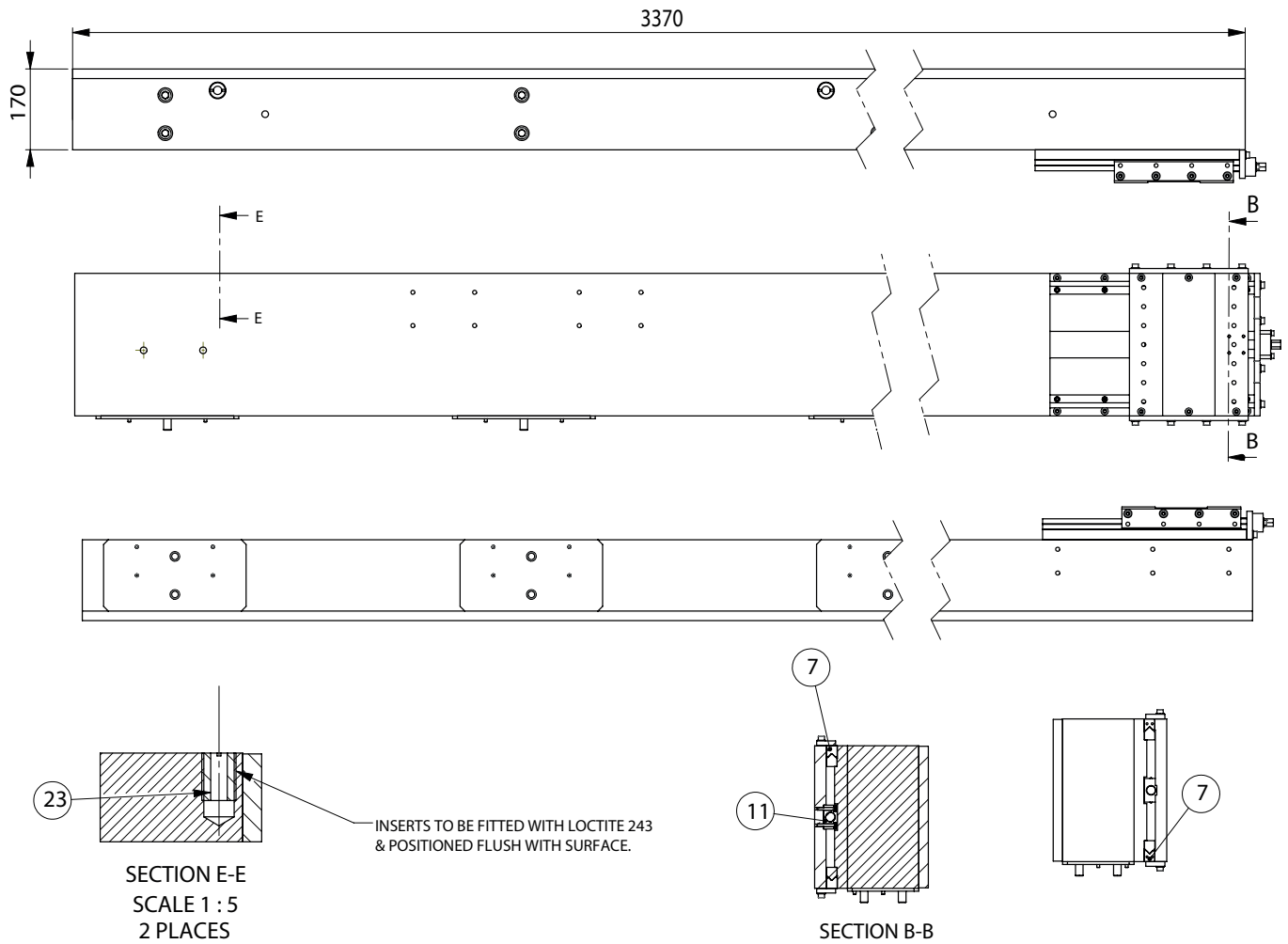
Item	Part Number	Description	QTY
1	WP4700-1	MILLING ARM ASSEMBLY	1
2	WP4700-7	DRIVE RING ASSEMBLY	1
3	WP6000-32	ORBITAL MILLING DRIVE ASSEMBLY	2
4	MMI3000-2	DISTRIBUTOR	1
5	NEG 0100-1	WP2500 SPINDLE ASSEMBLY	1
6	D32-11-040	COUNTERWEIGHT ASSEMBLY	1
7	03934.19.01.03	WP4600-H HYDRAULIC KIT	1

10.2WP4700-1 Milling Arm Assembly

Revision E, Weight 580kg

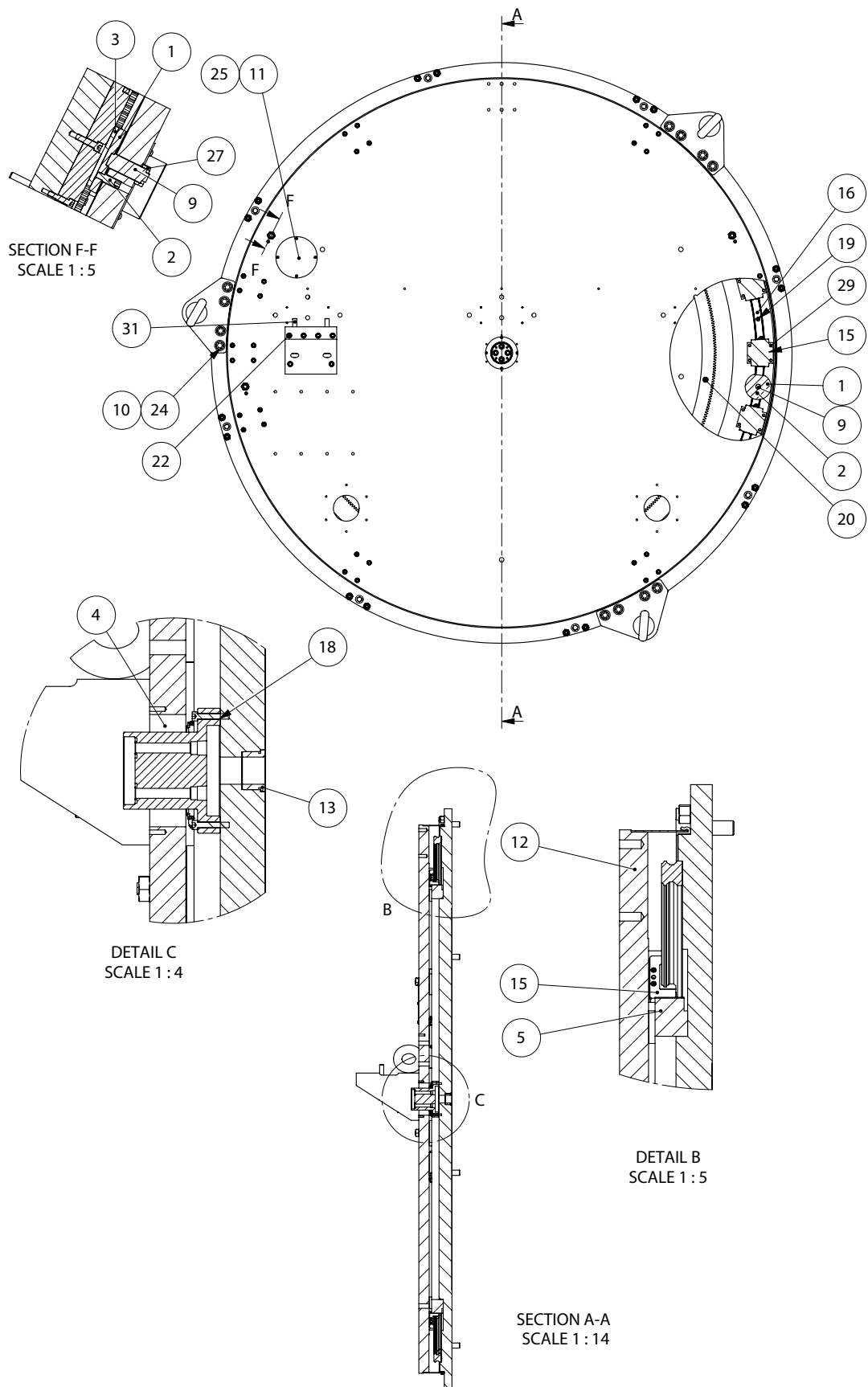


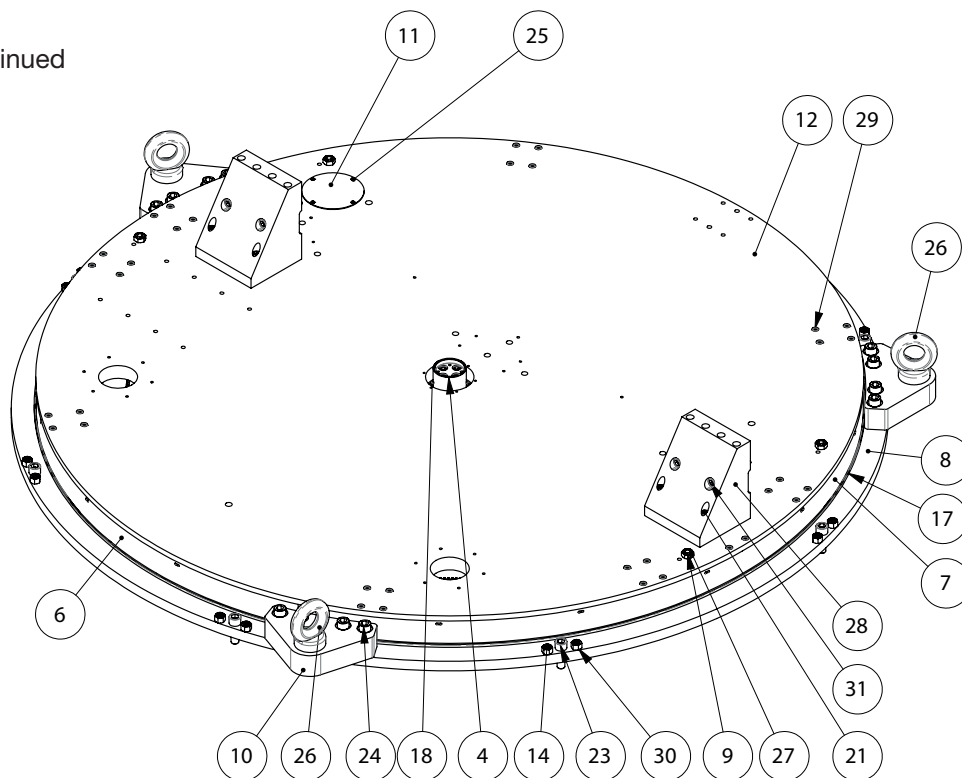
Item	Part Number	Description	QTY
1	WP4700-1-001	MILLING ARM	1
2	WP4700-1-002	MILLING ARM BACKPLATE	1
3	WP4700-1-003	PACKER	3
4	WP3500-3-003	CROSS SLIDE SUPPORT	1
5	WP3500-3-004	RAIL	2
6	WP3500-3-006	FEED SCREW	1
7	WP2500-3-003	MODIFIED LWRPM9 SKF RAIL x 250 LONG	2
8	HTD 0416	THRUST BEARING HOUSING	1
9	NEG 0107	CARRIAGE	1
10	NEG 0108	CARRIAGE RAIL PLATE	2
11	NEG 0121	FEED NUT	1
12	NEG 0122	THRUST PLATE	1
13	AMF202615	OILITE BUSH	1
14	WC18DU	THRUST WASHER	1
15	MMI8388A	MODIFIED M8 BUTTON HEAD SCREW	10
16	M8 x 25	Hex Socket Head	24
17	M8 x 30	Hex Socket Head	28
18	M6 x 55	Hex Socket Head	6
19	M16 x 160	Hex Socket Head	6
20	M8	WASHER (FORM A)	12
21	M6	WASHER (FORM A)	2
22	M6 X 12	HEX COUNTERSINK HEAD	12
23	WP4700-1-006	M20 INSERT	2



10.3WP4700-7 Drive Ring Assembly

Revision - Weight 2670kg

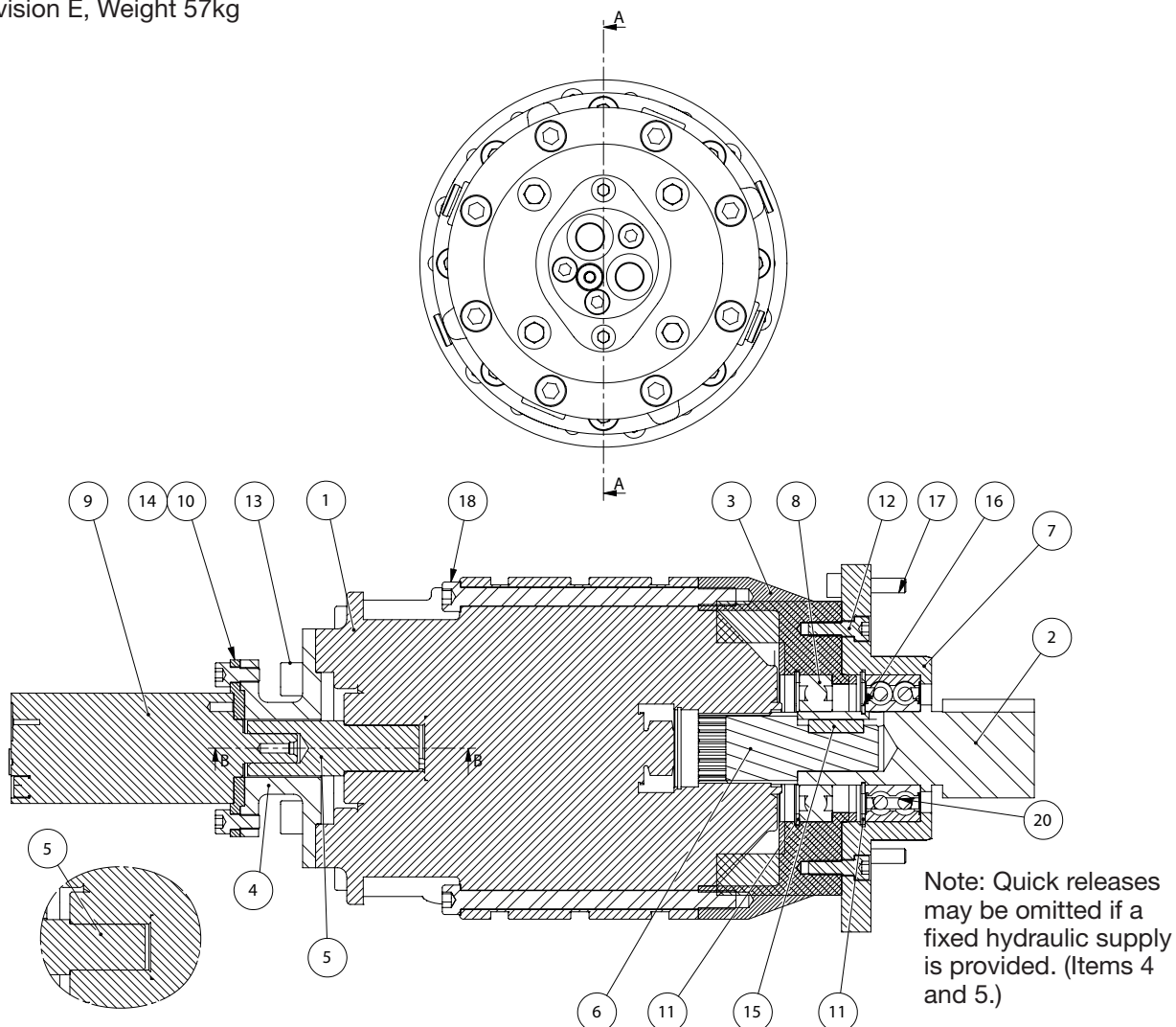




Item	Part Number	Description	QTY
1	MMIE 1877	DAMPER BLOCK	4
2	MMIE 1879	MODIFIED SOCKET SET SCREW	4
3	MMIE 1880	DAMPER	4
4	MMI3000-1-017	DISTRIBUTOR POST EXTENSION	1
5	OM430102	520 TOOTH EXTERNAL RING GEAR	1
6	OM430110	OD SEAL STRIP EXTENDED SECTION	1
7	OM430114	OD SEAL STRIP STD SECTION	2
8	WP6000-30-005	BASEPLATE	1
9	WP6000-30-012	STEADY SCREW	4
10	WP6000-30-013	LIFTING BRACKET	3
11	WP6000-30-023	COVER PLATE	1
12	WP6000-30-024	TOP PLATE	1
13	PH42J 30 (30 bore 25 long)	HEADED BUSH (BONEHAM & TURNER)	1
14	GN.14368	M16 X 50 BTSS GRUB SCREW	16
15	HCR35A	HCR35A BLOCK	10
16	HCR35A R1000 RAIL	RAIL	6
17	MARBETT CODE 2779	40 METRES 251-63631 SEAL STRIP	1
18	M6 x 55	HEX SOCKET HEAD	4
19	M8 x 30	HEX SOCKET HEAD	72
20	M12 x 55	HEX SOCKET HEAD	8
21	M12 x 80	HEX SOCKET HEAD	4
22	M12 x 200	SOCKET HEAD CAP SCREW	8
23	M20 x 60	HEX SOCKET HEAD	8
24	M20 x 90	CAP HEAD SCREW	12
25	M5 x 10	HEX SKT HD BUTTON ISO7380 STST	4
26	M36	EYEBOLT	3
27	OD 0172	LOCKNUT	4
28	WP4700-7-001	SUPPORT BRACKET	2
29	M10 x 50	HEX SOCKET HEAD - BS EN ISO 4762	40
30	M16	HEX NUT GRADE C	16
31	M16 x 120	HEX SOCKET HEAD - BS EN ISO 4762	4

10.4WP6000-32 Orbital Milling Drive Assembly

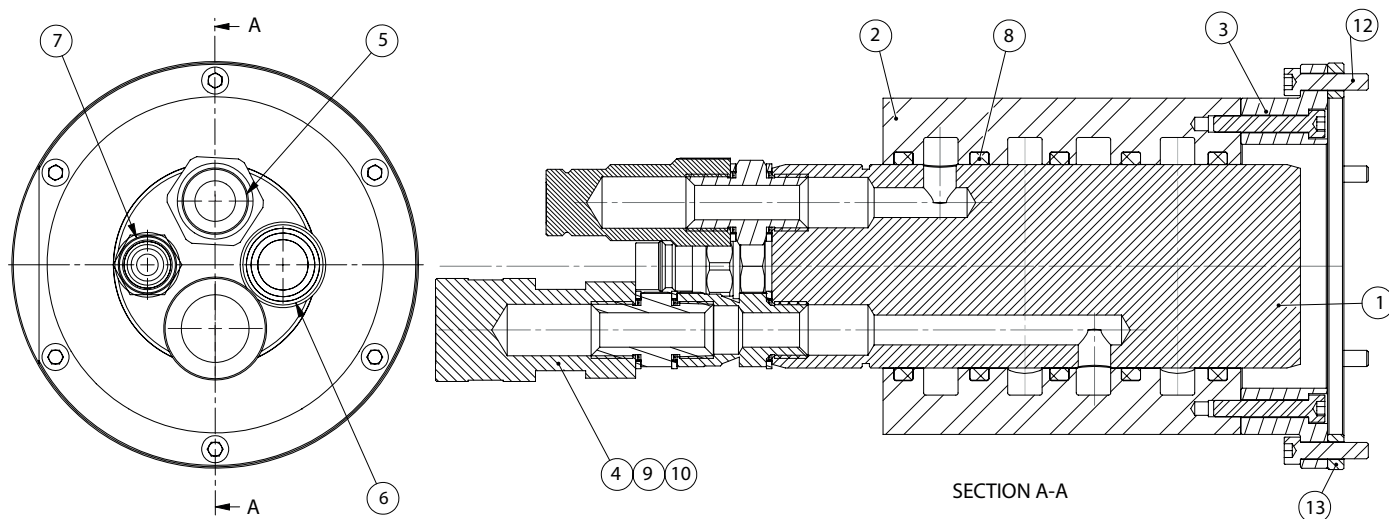
Revision E, Weight 57kg



Item	Part Number	Description	QTY
1	EX-103-FS-CA04	177.09:1 PLANETARY GEARBOX	1
2	WP6000-32-001	15t drive pinion	1
3	WP6000-32-002	STM GEARBOX MOUNT	1
4	WP6000-32-003	HYDRAULIC MOTOR MOUNT	1
5	WP6000-32-004	ADAPTER SHAFT	1
6	MMIE 1875502	20t GEAR STUB SHAFT	1
7	OM430202	BEARING CAP	1
8	6208 2RS1	SINGLE ROW RADIAL BALL BEARING	1
9	151 G 0037	OMM 50 MOTOR END PORT	1
10	151 G 0211	OMM 50 MOTOR FLANGE	1
11	D1300 0800	INTERNAL CIRCLIP	2
12	M8 x 25	HEX SOCKET HEAD - BS EN ISO 4762	6
13	M12 x 25	HEX SOCKET HEAD - BS EN ISO 4762	4
14	M8 x 16	HEX SOCKET HEAD - BS EN ISO 4762	2
15	KK8-7-30A	TYPE A KEY	1
16	D1400-0400	DIN 471 EXTERNAL CIRCLIP	1
17	M8 x 35	HEX SOCKET HEAD - BS EN ISO 4762	6
18	M10 x 150	HEX SOCKET HEAD - BS EN ISO 4762	8
19	KK8-7-20B	TYPE B KEY	1
20	3208-2RS1	-	1
21	NEG 0110	28:1 BOX MOUNTING BLOCK	1

10.5 MMI3000-2 Distributor

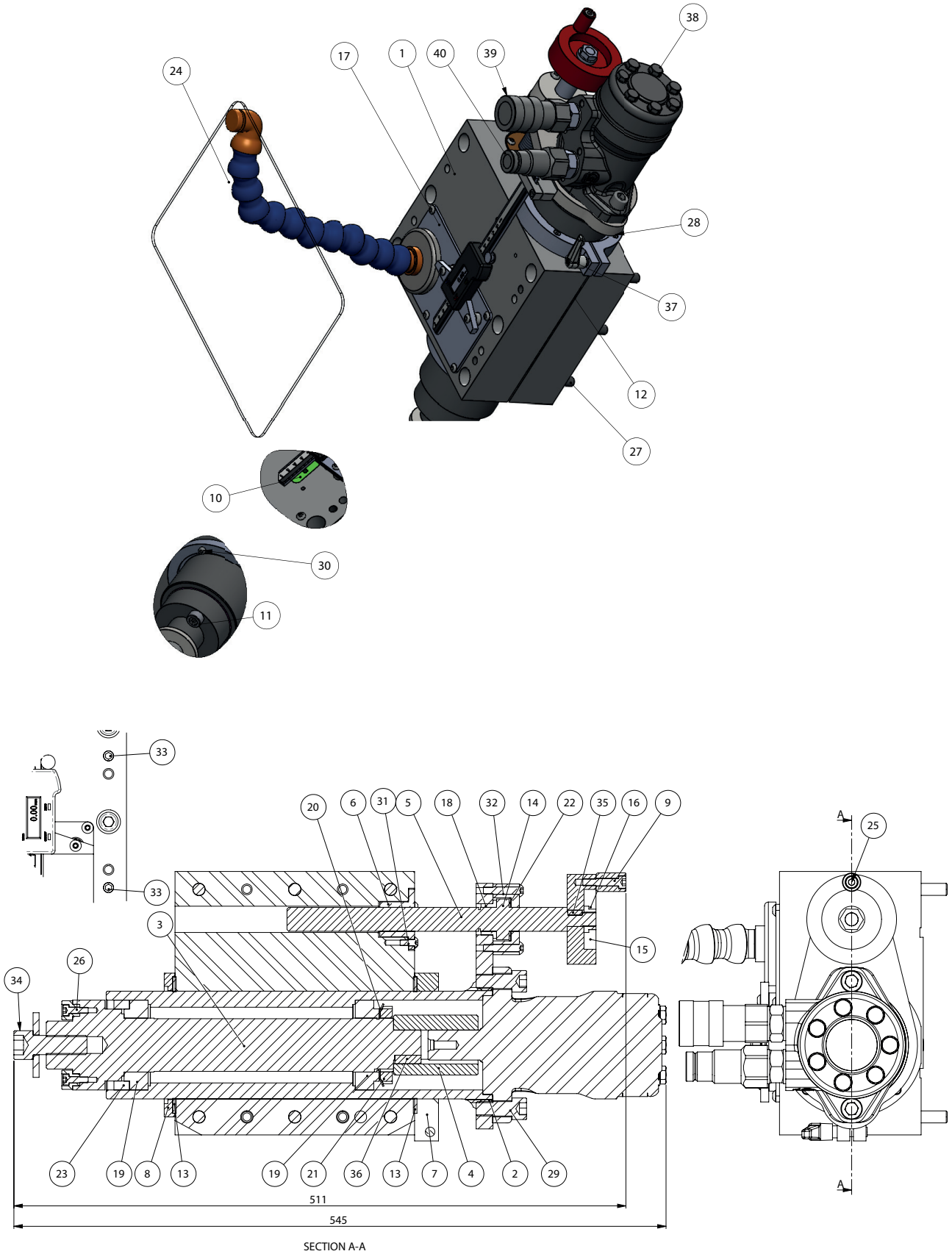
Revision B, Weight 16kg



Item	Part Number	Description	QTY
1	WP4300-1003	DISTRIBUTOR POST	1
2	WP4300-1004	DISTRIBUTOR	1
3	SRB3000-H-9-002	DISTRIBUTOR MOUNTING PLATE	1
4	1/2" QRCOUPPING-FEMALE	1/2" QUICK RELEASE COUPLING FEMALE	1
5	1/2" QRCOUPPING-MALE	1/2" QUICK RELEASE COUPLING MALE	1
6	3/8" QRCOUPPING-FEMALE	3/8" QUICK RELEASE COUPLING FEMALE	1
7	3/8" QRCOUPPING-MALE	3/8" QUICK RELEASE COUPLING MALE	1
8	S/55403/0750/S	DOUBLE DELTA SEAL	5
9	AAMP-08-08	BSPP MALE X BSPP SWIVEL FEMALE	1
10	D400 025 08	1/2" DOWTY WASHER	1
11	M6 x 35	HEX SOCKET HEAD - BS EN ISO 4762	4
12	M6 x 25	HEX SOCKET HEAD - BS EN ISO 4762	6
13	OM4500-H-0-001	SPACER RING	1

10.6 NEG 0100-1 WP2500 spindle assembly

Revision J, Weight 37kg

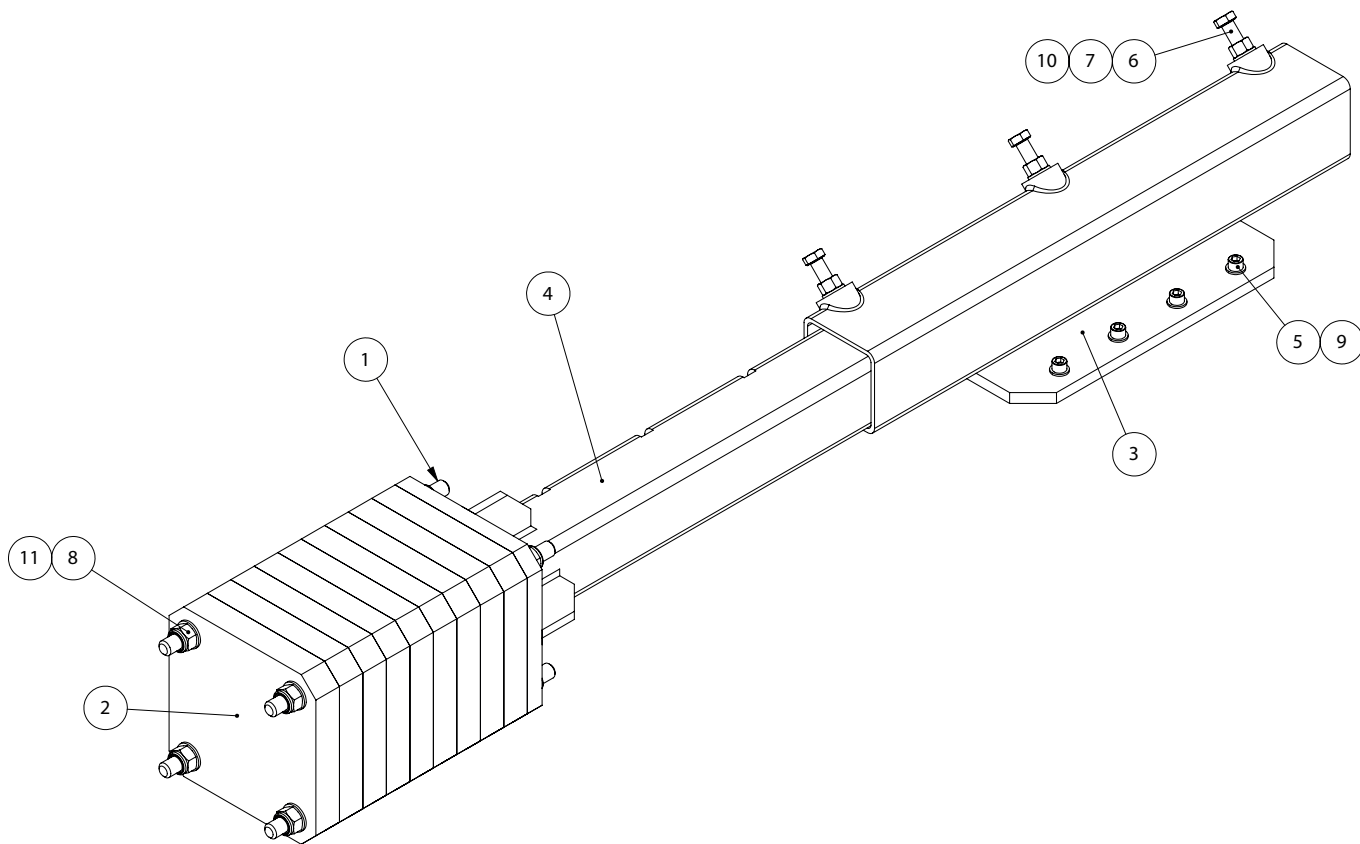


NEG 0100-1 continued

Item	Part Number	Description	QTY
1	NEG 0126	SPINDLE HOUSING	1
2	NEG0125	DRIVE COLUMN	1
3	NEG 0127	DRIVE SPINDLE	1
4	NEG 0129	DRIVE COUPLING	1
5	NEG 0124	SPINDLE HOUSING FEED SCREW	1
6	NEG 0130	SPINDLE HOUSING FEED NUT	1
7	NEG 0133	DEPTH STOP	1
8	NEG 0135	LOWER FELT RING	1
9	MMI 8359	HANDWHEEL HANDLE	1
10	NEG 0140	SPINDLE HOUSING KEY	1
11	NEG 0176	CUTTER DRIVE KEY	2
12	NEG 0126 A	SPINDLE HOUSING GIB	1
13	NEG 0161	FELT SEAL RING	2
14	HTD 0416M	THRUST BEARING HOUSING	1
15	NEG 0170	MILLING HEAD HANDWHEEL	1
16	NEG 0174	MODIFIED WDS 404-203 COLLAR NUT	1
17	DRO-6	6 INCH SPINDLE DIGITAL READ OUT KIT	1
18	AMF202615	OILITE BUSH	1
19	32009	TAPER ROLLER BEARING	2
20	MB9	LOCKWASHER	1
21	KM9	LOCKNUT	1
22	WC18DU	THRUST WASHER	1
23	60 x 75 x 13	OIL SEAL	1
24	IND4470250K	MACHINE GUARD	1
25	M6 x 30	HEX SOCKET HEAD - BS EN ISO 4762	1
26	M5 x 16	HEX SOCKET HEAD - BS EN ISO 4762	2
27	M10 x 100	HEX SOCKET HEAD - BS EN ISO 4762	6
28	M4 x 25	HEX SOCKET HEAD - BS EN ISO 4762	4
29	M12 x 30	HEX SOCKET HEAD - BS EN ISO 4762	2
30	M4 x 20	HEX SOCKET HEAD - BS EN ISO 4762	4
31	M5 x 12	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	3
32	M6 x 30	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	2
33	M10 x 50	SOCKET SET SCREW FLAT POINT	2
34	M16 x 45	HEX SOCKET HEAD - BS EN ISO 4762	1
35	KK4-12A	TYPE A KEY	1
36	KK8-7-22C	TYPE C KEY	1
37	WDS8189-20525	INDEXING CLAMPING HANDLE, ZINC DIECAST	1
38	151-0314	OMP 160	1
39	1/2" QRCOUPPING-FEMALE	1/2" QUICK RELEASE COUPLING FEMALE SET	1
40	1/2" QRCOUPPING-MALE	1/2" QUICK RELEASE COUPLING MALE SET	1

10.7 D32-11-040 Counterweight Assembly

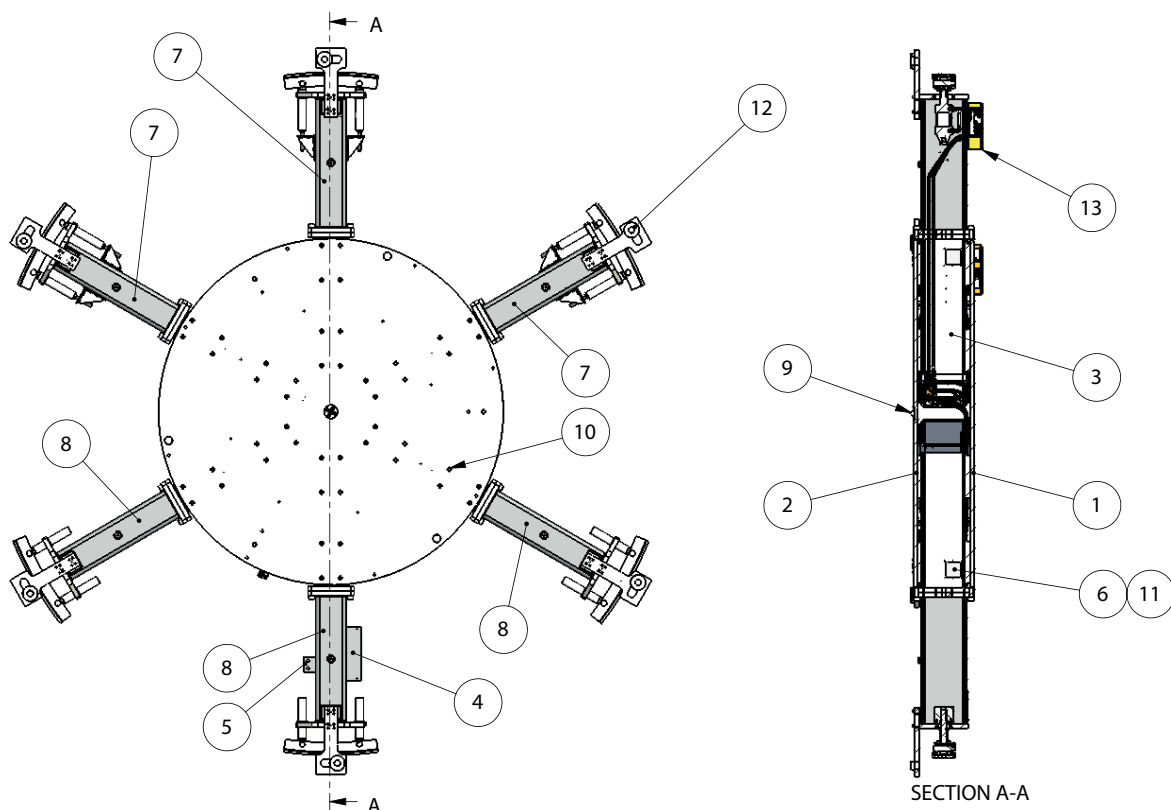
Revision A, Weight 250kg



Item	Part Number	Description	QTY
1	D32-11-105	COUNTERWEIGHT THREADED BAR	4
2	D32-11-109	COUNTERWEIGHT WEIGHT	9
3	D32-11-110	COUNTERWEIGHT BASE	1
4	D32-11-111	COUNTERWEIGHT ARM	1
5	M12 x 40	Hex Socket Head	8
6	M16 x 70	Hex Screw Grade AB	3
7	M16	HEXAGON NUT	3
8	M20	Metric Nyloc Nut	8
9	Bright washer BS 4320 - M12	WASHER (FORM A)	8
10	M16	WASHER (FORM A)	3
11	M20	WASHER (FORM A)	3

10.8 WP4700-2 Hydraulic Base Assembly

Revision F, Weight 3770kg



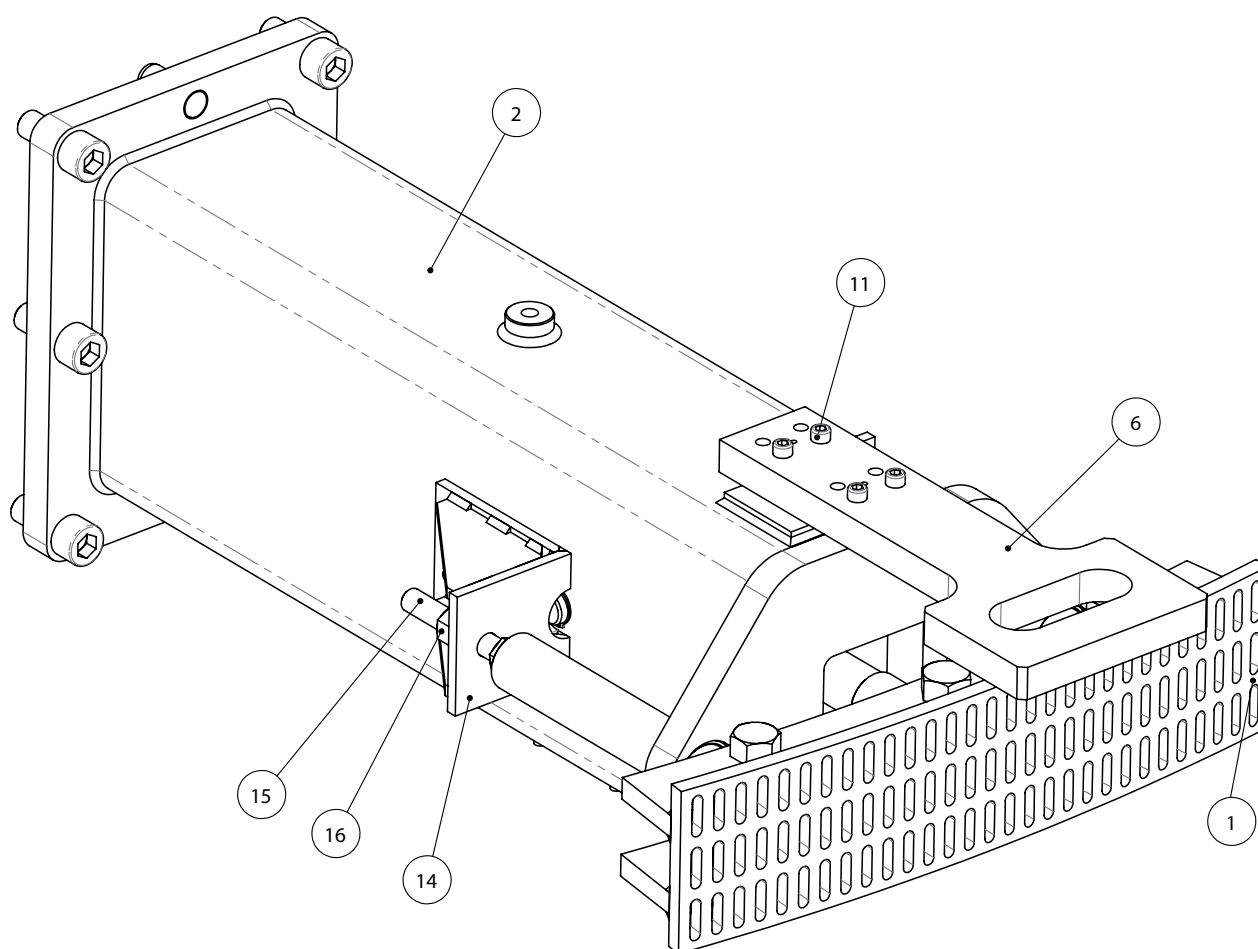
NOTES:

1. ITEMS 14, 15, 16 & 17 NOT SHOWN

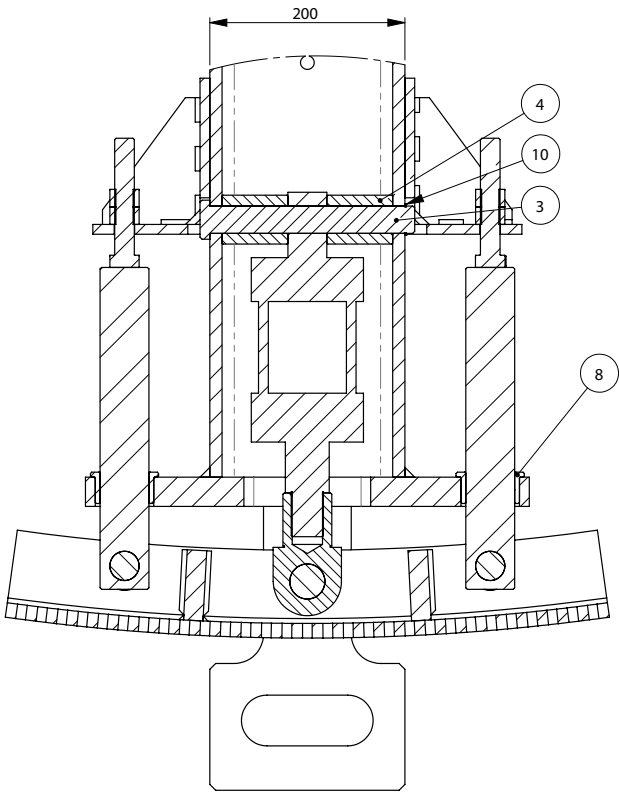
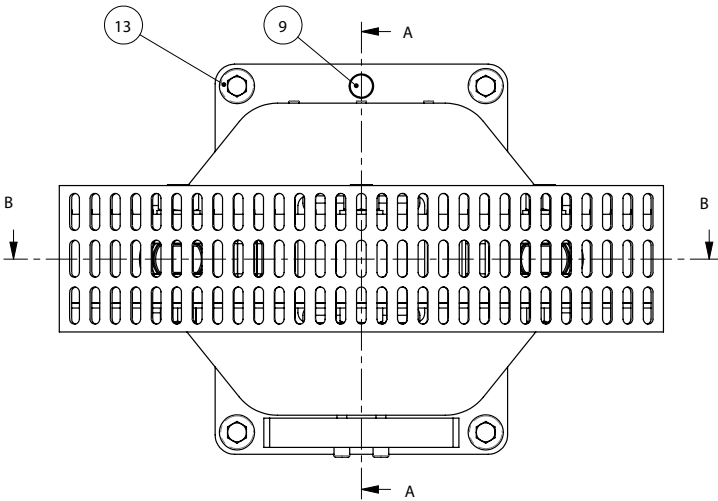
Item	Part Number	Description	QTY
1	WP4700-2-001	BASE BOTTOM PLATE	1
2	WP4700-2-002	BASE TOP PLATE	1
3	WP4700-2-003	BASE SPACER BLOCK	6
4	WP4700-2-004	GAUGE MOUNTING BRACKET	1
5	WP4700-2-005	HOSE MOUNTING BRACKET	1
6	WP4700-2-006	COVER PLATE	12
7	WP4700-3	HYDRAULIC CLAMP ASSY	3
8	WP4700-4	WP4700 MANUAL CLAMP ASSY	3
9	WP6000-33-008	LOCATING SPIGOT	1
10	M16x45	CAP SCREW	96
11	M6 x 12	Hex Socket Head - BS EN ISO 4762	72
12	WP3500-6-028	SETTING STRAP WASHER	6
13	03934.19.01.01	WP4700-2 HYDRAULIC KIT	1
14	WP4700-3-007	6mm SHIM COVER PLATE	2
15	WP4700-3-008	4mm SHIM COVER PLATE	3
16	WP4700-3-009	5mm SHIM COVER PLATE	2
17	M6 X 16	Hex Socket CTSK Head - BS EN ISO 10642	6

10.9 WP4700-3 Hydraulic Clamp Assembly

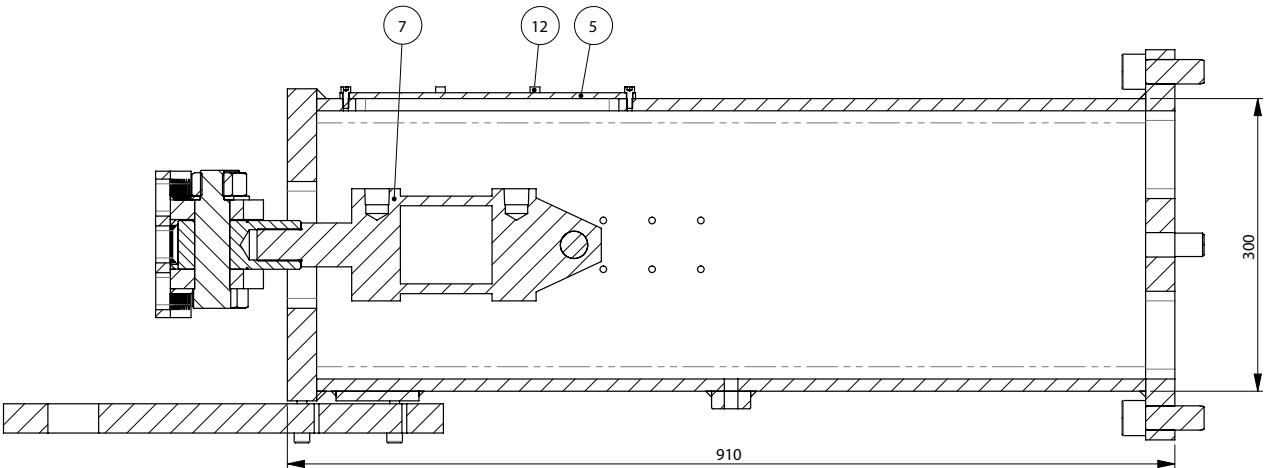
Revision B, Weight 185kg



Item	Part Number	Description	QTY
1	WP4700-5	WP4700 CLAMP FOOT ASSY	1
2	WP4700-3-001	HYDRAULIC CLAMP LEG	1
3	WP4700-3-002	PIVOT PIN	1
4	WP4700-3-003	SPACER	2
5	WP4700-3-004	COVER PLATE	1
6	WP4700-3-005	SETTING STRAP	1
7	MP3-SR80-50-NC-45-2-U-BSP	HYDRAULIC CYLINDER	1
8	AMF506032	Flanged Oilite Bush	2
9	25MM X 60LG	Parallel Pin (Unhard)	2
10	D1400-0280	External Circlip	1
11	M10 x 50	Hex Socket Head - BS EN ISO 4762	4
12	M6 x 16	Hex Socket Head - BS EN ISO 4762	10
13	M24 x 60	Hex Socket Cap Head	6
14	WP4700-3-006	BRACKET	2
15	M20 x 120	Hex Screw Grade AB - BS EN 24017	2
16	M20	Hex Nut Style 1 - BS EN 24439	2



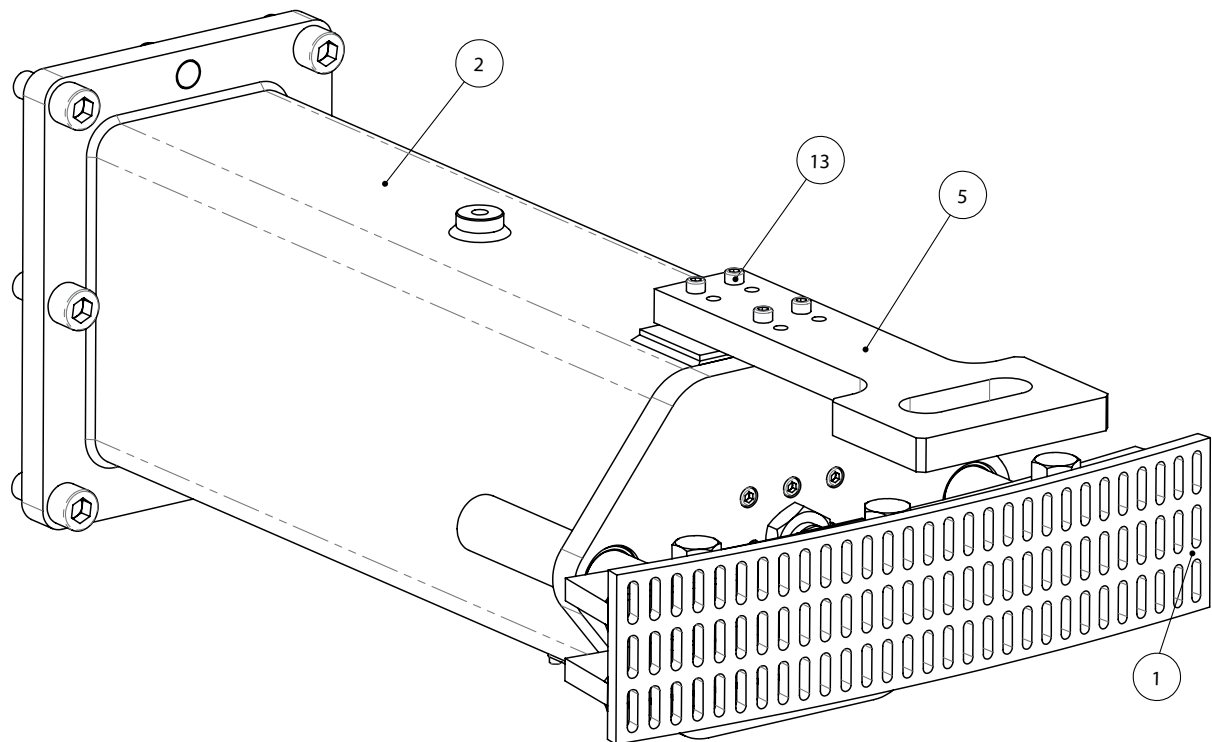
SECTION B-B



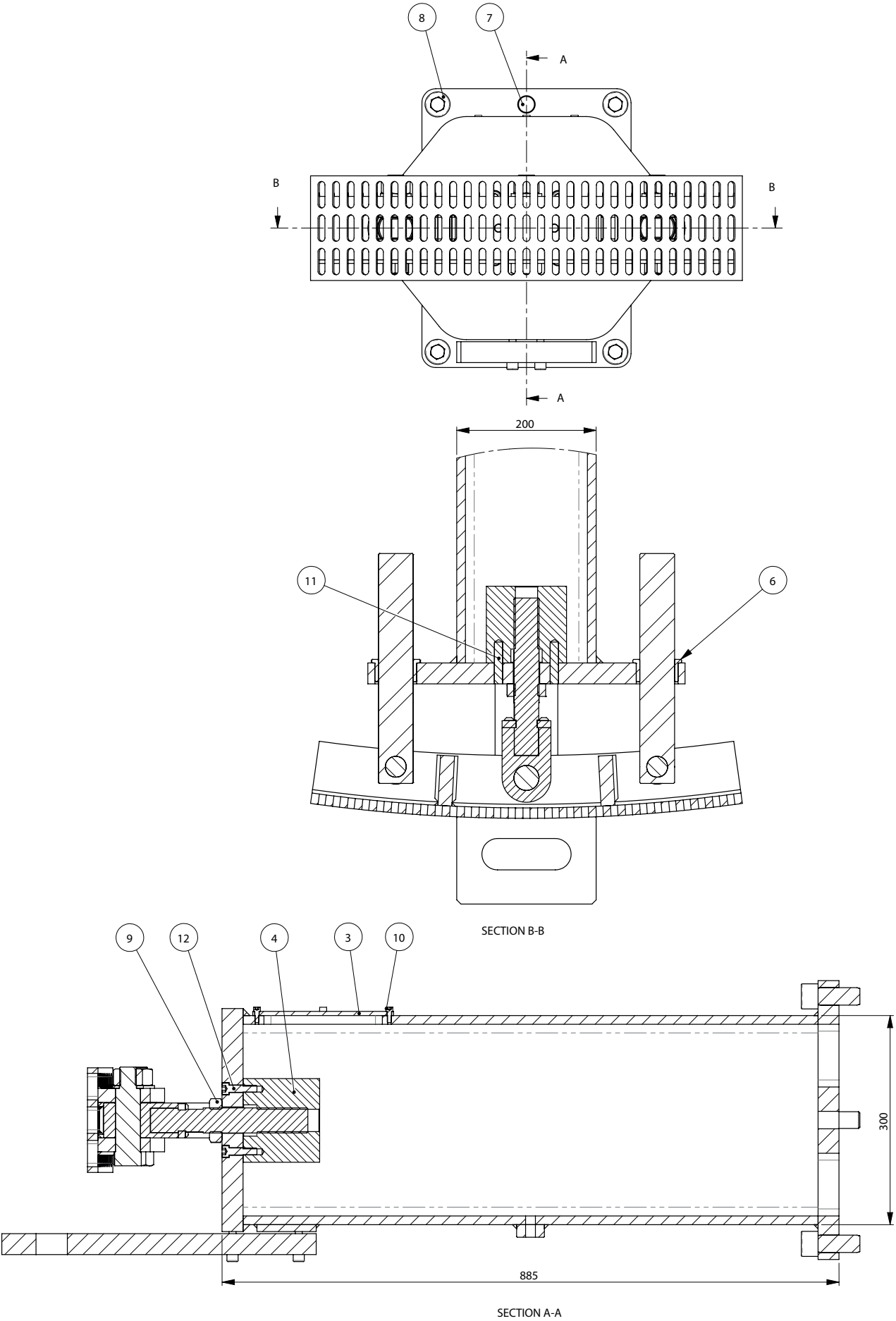
SECTION A-A

10.10 W4700-4 Manual Clamp Assembly

Revision -, Weight 188kg

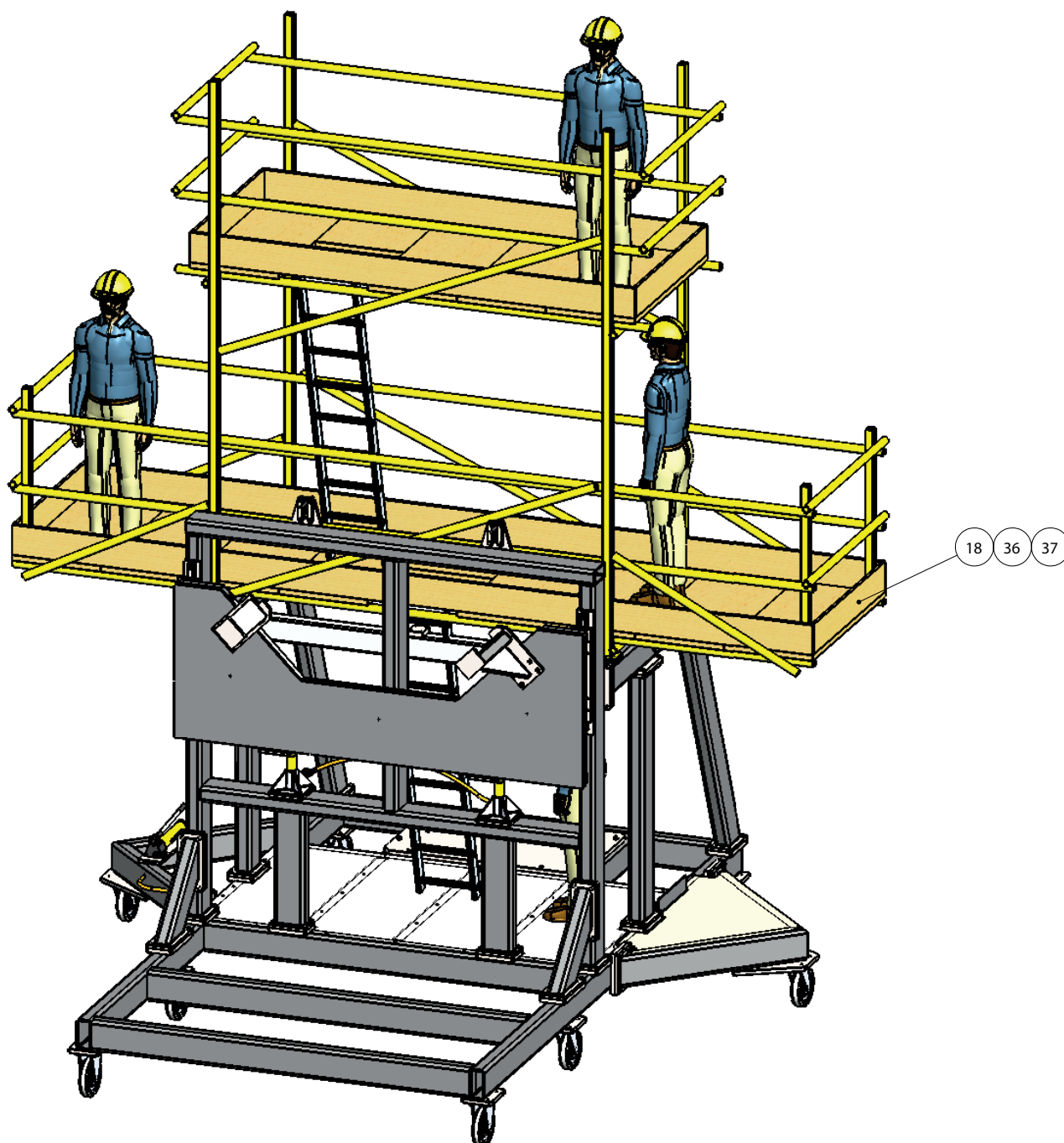


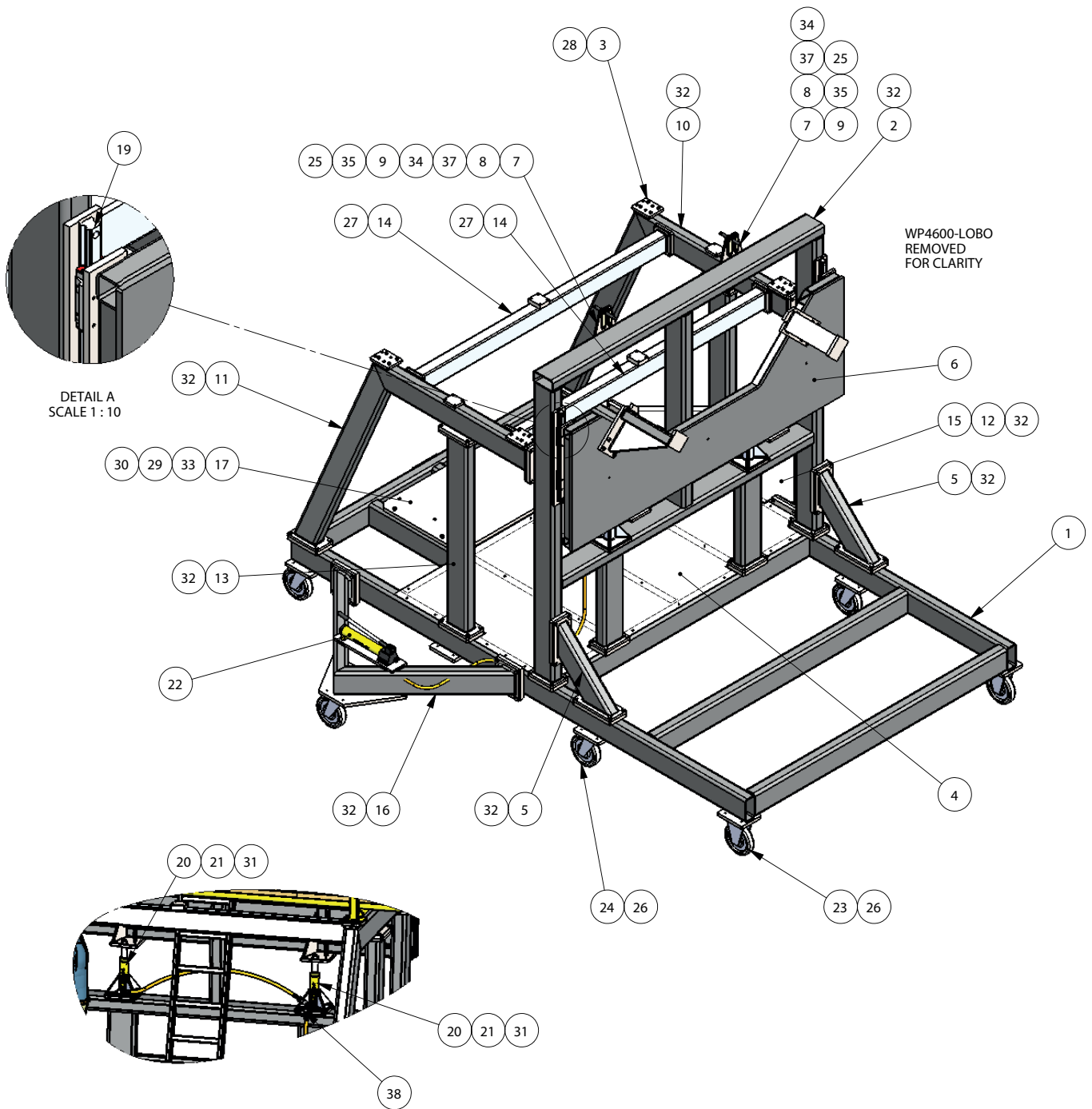
Item	Part Number	Description	QTY
1	WP4700-6	WP4700 CLAMP FOOT ASSY	1
2	WP4700-4-001	MANUAL CLAMP LEG	1
3	WP4700-4-002	COVER PLATE	1
4	WP4700-4-003	THREADED BLOCK	1
5	WP4700-3-005	SETTING STRAP	1
6	AMF506032	Flanged Oilite Bush	2
7	25MM X 60LG	Parallel Pin (Unhard)	2
8	M24 x 60	Hex Socket Cap Head	6
9	M36 THIN NUT	Hex Thin Nut Grade AB	1
10	M6 x 16	Hex Socket Head - BS EN ISO 4762	8
11	Ø12 x 60	PARALLEL PIN	2
12	M10 x 40	Hex Socket Head - BS EN ISO 4762	6
13	M10 x 50	Hex Socket Head - BS EN ISO 4762	4



10.11 WP4600-14 Trolley (LOBO)

Revision B, Weight 4950kg



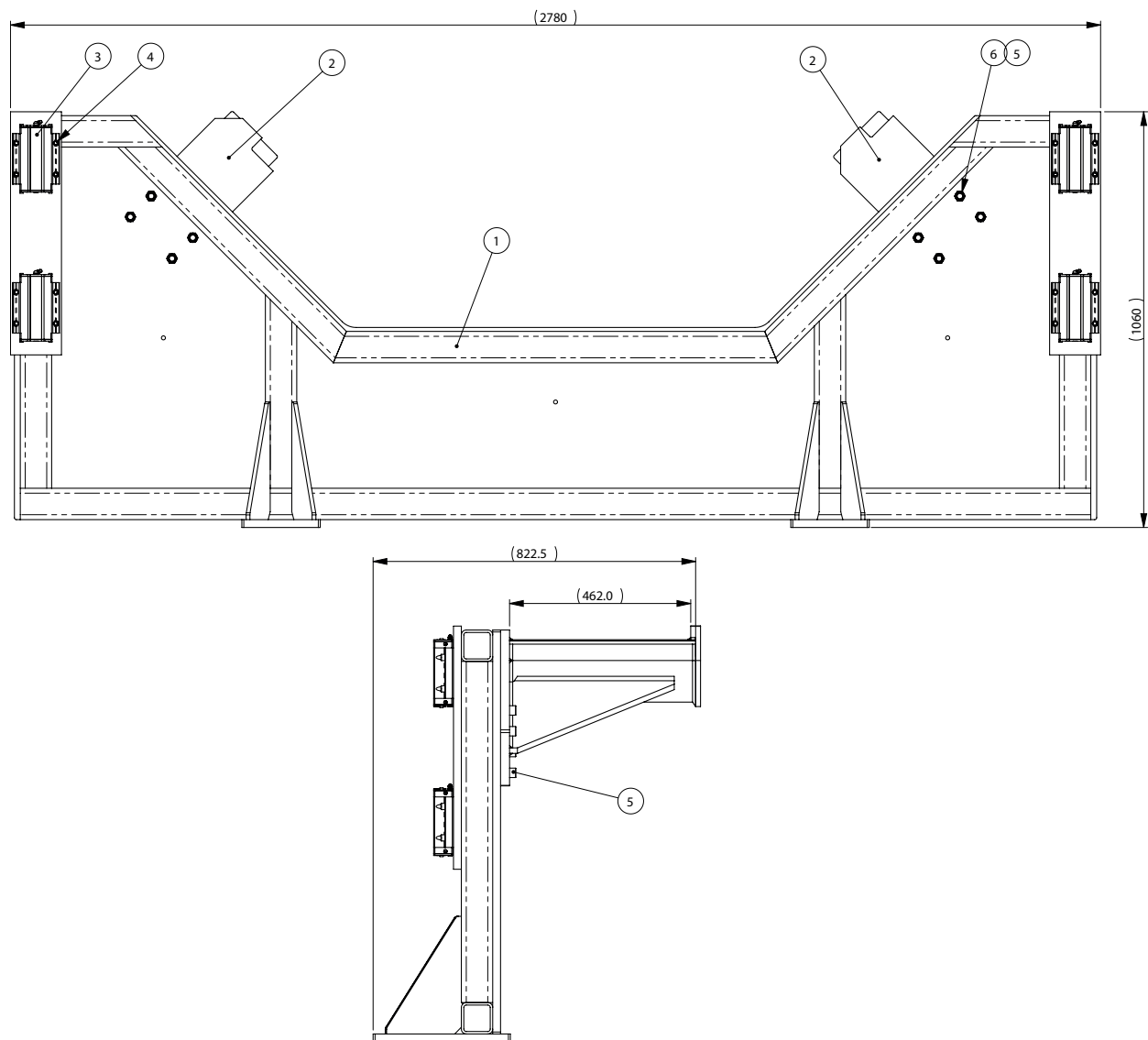


WP4600-14 continued

Item	Part Number	Description	QTY
1	WP4600-14-001	TROLLEY BASE FRAME	1
2	WP4600-14-002	BASE FRAME UPRIGHT	1
3	WP4600-14-003	LOBO INTERFACE PLATE	4
4	WP4600-14-004	FLOOR PLATE	1
5	WP4600-10-004	SHORT SUPPORT	2
6	WP4600-10-005	CARRIAGE ASSEMBLY	1
7	WP4600-10-018	Location Plate	2
8	WP4600-10-019	Nylon Packer Strip	4
9	WP4600-10-023	WP4600-10 STUD	2
10	WP4600-11-003	LH SIDE SUPPORT	1
11	WP4600-11-004	RH SIDE SUPPORT	1
12	WP4600-11-005	LH OUTRIGGER FABRICATION	1
13	WP4600-11-006	UPRIGHT SUPPORT	2
14	WP4600-11-007	LOWER SUPPORT	2
15	WP4600-11-010	SIDE FOOT PLATE	1
16	WP4600-11-027	RH OUTRIGGER FABRICATION	1
17	WP2500-71-004	HPU MOUNT	1
18	WP4600-LOBO	LOBO PLATFORM	1
19	HGR45R885	LINEAR RAIL (HIWIN)	2
20	RC-106	SINGLE ACTING CYLINDER	2
21	JB1-10 (ENERPAC)	BASE PLATE	2
22	ENERPAC P-392 + FZ1616	HAND PUMP +90 ELBOW	1
23	2BZQXFL250NYBJ	CASTOR WHEEL (FIXED) - 5000Kg	2
24	2BZQXL250NYBJ	CASTOR WHEEL (SWIVEL) - 5000Kg	6
25	25700.W0120	M20 CONICAL WASHER	2
26	M12 x 30	Hex Socket Head - BS EN ISO 4762	32
27	M8 x 25	Hex Socket Head - BS EN ISO 4762	16
28	M12 x 25	Hex Socket Head - BS EN ISO 4762	16
29	M16	WASHER (FORM A)	4
30	M16	HEXAGON NUT	4
31	1" - 8 UNC x 1 1/2" LONG	HEX SOCKET CAP SCREW	2
32	M16 x 50	Hex Screw Grade AB - BS EN 24017	80
33	M16 x 250	Hex Socket Head	4
34	M8x20	Hex Socket Head - BS EN ISO 4762	12
35	M20	Hex Nut Style 2 - BS EN 24033	2
36	M10	WASHER (FORM A)	16
37	M10 x 25	Hex Socket Head - BS EN ISO 4762	36
38	03934.19.01.02	WP4600-14 HYDRAULIC KIT	1

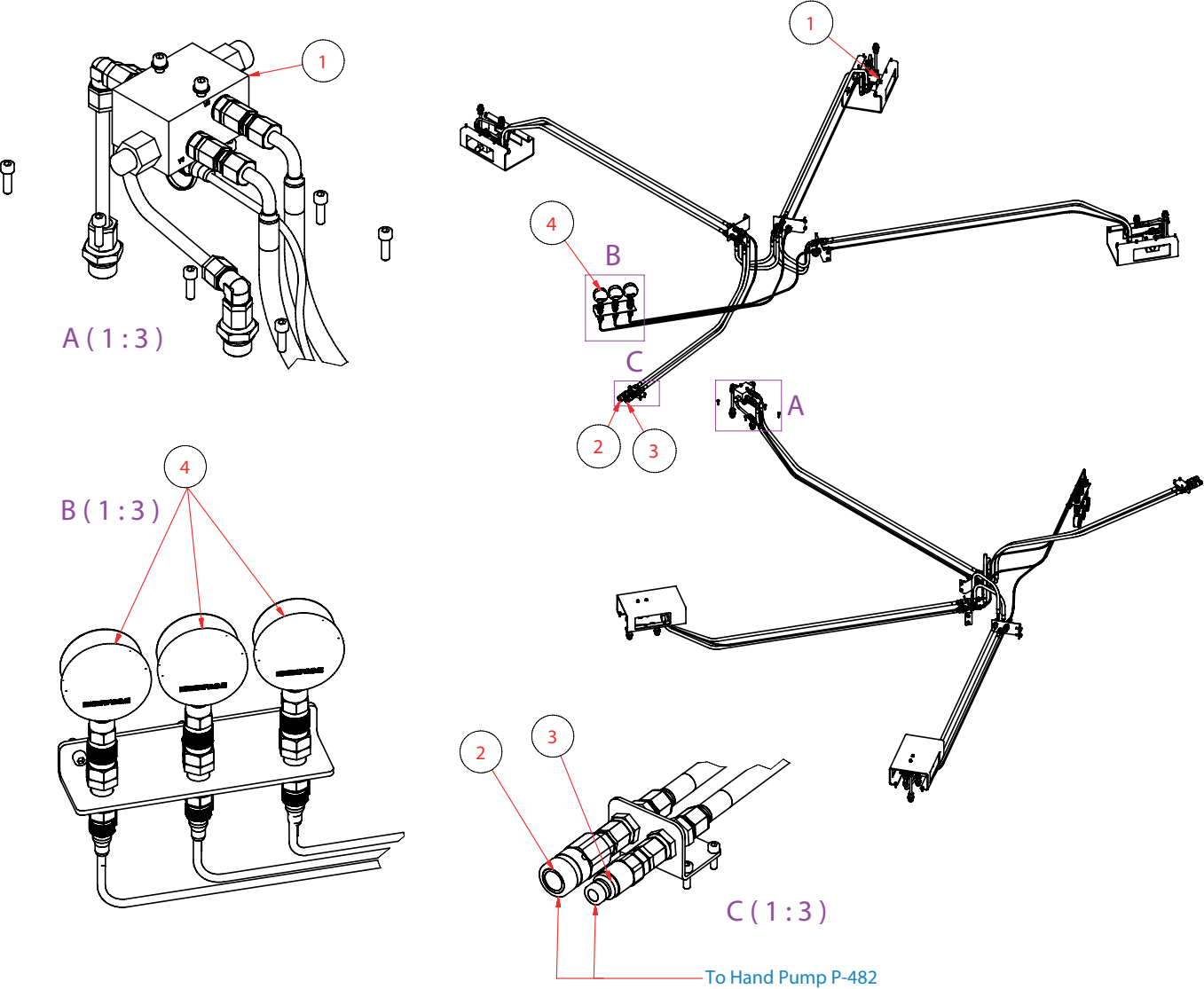
10.12 WP4600-10-005 Carriage Assembly

Revision -, Weight 575kg



Item	Part Number	Description	QTY
1	WP4600-10-006	CARRIER	1
2	WP4600-10-007	SUPPORT BAR	2
3	HGW45HC	RAIL BLOCK	4
4	M10 x 40	Hex Socket Head - BS EN ISO 4762	16
5	M16 x 65	Hex Socket Head - BS EN ISO 4762	8
6	M16P	Metric Nyloc Nut	8

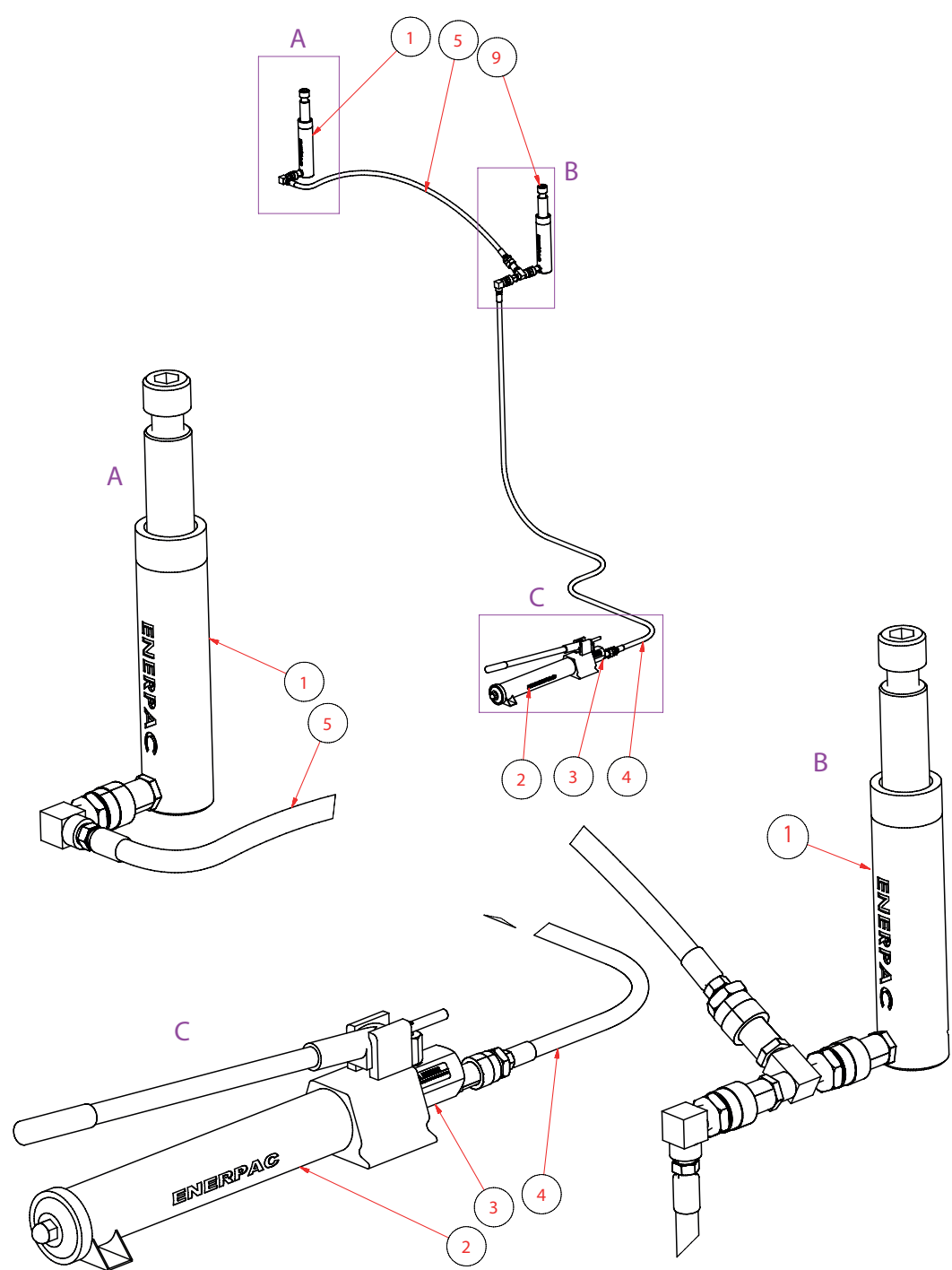
10.13 03934.10.01.01 Hydraulic Kit WP-4600 (on Base assembly) Revision 0



Item	Part Number	Description	QTY
1	07004032	Dual Overcenter Valve	3
2	801300005	FLAT FACE NIPPLE 3/8"	1
3	801300006	FLAT FACE COUPLER 3/8"	1
4	12000250	PRESSURE GAUGE 0-250 D63 1/4OA	3
5	P-842-100	HAND PUMP P-842-100	1
6	801301005	FLAT FACE NIPPLE 3/8"NPT	1
7	801301006	FLAT FACE COUPLER 3/8"NPT	1
8	H-7210	HOSE L=3.0 M H-7210	2

10.14 03934.10.01.02 Hydraulic kit for Lift Cylinders (on Trolley assembly)

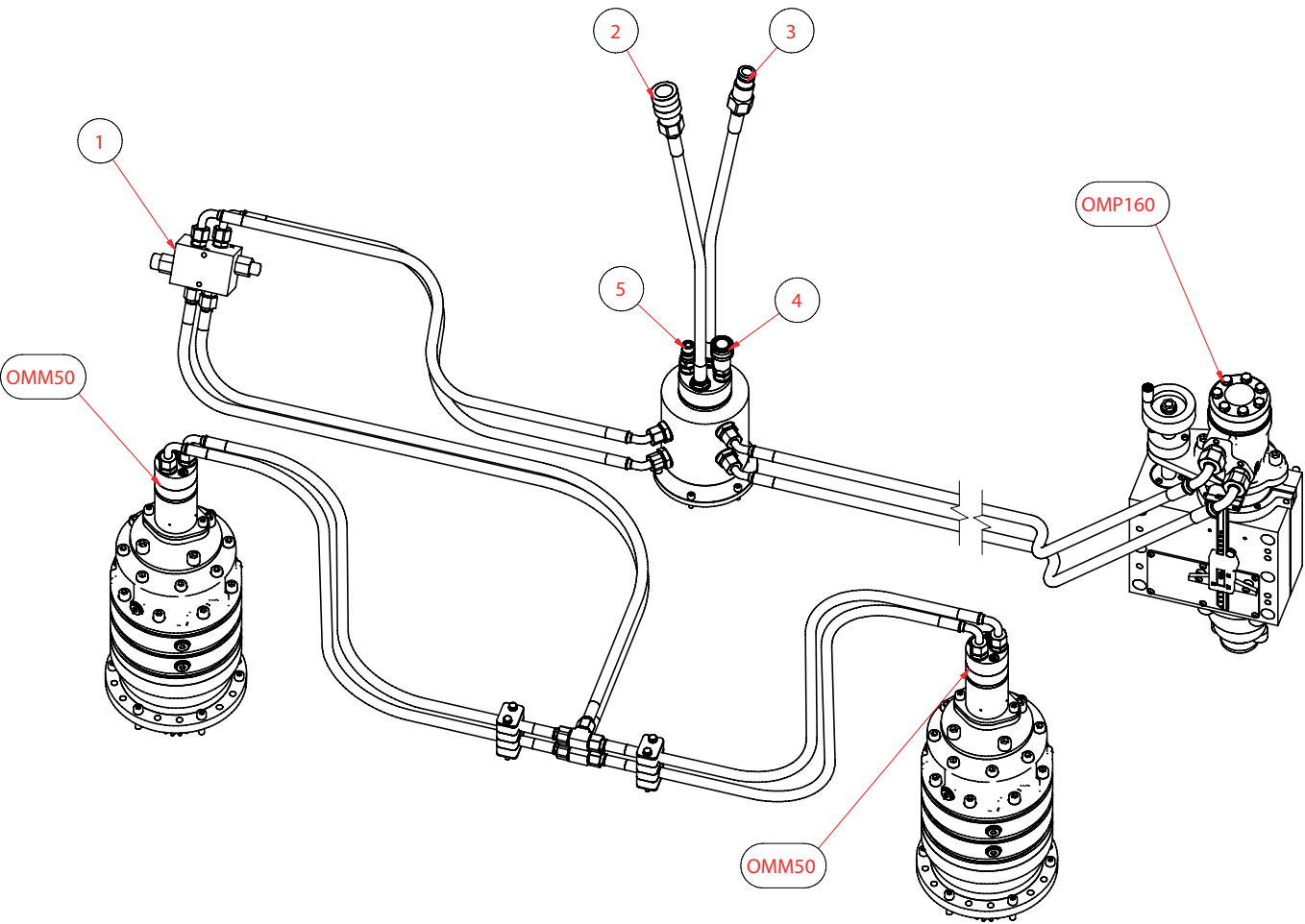
Revision 0



Item	Part Number	Description	QTY
1	RC-106	RC-106 Cylinder 10Te	2
2	P-392	Hand Pump Two Speed	1
3	V66	Valve Control Check	1
4	HC7210	Hose 10 FT3/8 NPT + CH-604	1
5	HC-7206	HOSE L=1.8 M HC-7206	1

10.15 03934.10.01.03 Hydraulic for Hydromotors (on Machine assembly)

Revision 0



Item	Part Number	Description	QTY
1	07004033	Dual Overcenter Valve	1
2	801300014	FLAT FACE COUPLER 1/2"	1
3	801300013	FLAT FACE NIPPELE 1/2"	1
4	801300006	FLAT FACE COUPLER 3/8"	1
5	801300005	FLAT FACE NIPPLE 3/8"	1

10.16 WP4600-TK Toolkit

Part Number	Description	QTY
KEN5801550K	55MM OPEN ENDED SPANNER	1
KEN5803900K	24MM/27MM DOUBLE ENDED SPANNER	1
KEN5822640K	12MM COMBI SPANNER	1
KEN5822700K	17MM COMBI SPANNER	1
KEN5822830K	32MM COMBI SPANNER	1
KEN5822840K	36MM COMBI SPANNER	1
KEN5822860K	38MM COMBI SPANNER	1
KEN5930520K	POCKET PLAIN CHISEL ROLL	1
KEN6015140K	14MM ALLEN KEY LONG ARM	1
KEN6025500K	BALL DRIVER L WRENCHES	1

11. Troubleshooting

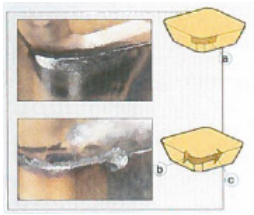
11.1 Troubleshooting



NO MACHINE ADJUSTMENTS SHOULD BE MADE WHILE THE MACHINE IS IN OPERATION. TURN AND LOCK OFF THE POWER SUPPLY BEFORE MAKING ANY ADJUSTMENTS.

Symptom	Possible Cause	Corrective Action
The machine will not rotate	1. Hydraulic supply not available	Check supply
	2. Hydraulic supply is below the minimum required to operate the machine	Check supply
	3. Drive motor faulty	Remove motor and check operation
	4. Damage to drive gear train	Remove motor and check free rotation
	5. Faulty valve or emergency shut off operational	Check supply to motor
The machine does not traverse	1. Drive gear problem	Remove and check drive assembly operation
	2. Depth of cut too deep	Remove cutting tool and check rotation
Poor surface finish on the face	1. Machine out of balance	Check balance
	2. Machine base incorrectly installed	Check installation
	3. Tool inserts worn or damaged	Check tool & replace
	4. Depth of cut too deep	Reduce depth of cut
	5. Worn drive motor	Check motor
	6. General poor machine condition	Refer to the manufacturer

Cutting Tip Wear

Issue	Reason for wear		
Thermal cracks 	Small cracks perpendicular to the cutting edge causing frittering and poor surface finish.	Thermal cracks due to temperature variations caused by: Intermittent machining	Select a tougher grade with better resistance to thermal shocks
Built up edge (B.U.E) 	Built up edge causing poor surface finish and cutting edge frittering when the B.U.E. is torn away	Work piece material is welded to the insert due to : Low cutting speed	Increase cutting speed
		Low feed	Increase feed
		Negative cutting geometry.	Select a positive geometry
Vibrations	Machine vibrates badly causing poor surface finish/accelerated machine wear.	Wrong cutting data	Reduce cutting feed
		Bad stability	Increase cutting feed
			Change cutting depth
Flank & notch wear 	a) Rapid flank wear	a) Cutting speed too high or insert has insufficient wear resistance.	Reduce cutting speed. Select more resistant grade of insert.
		a) Feed too low	Increase feed rate
	b)/c) Notch wear causing poor surface finish & risk of edge breaking.	b)/c) Material work hardens	Reduce cutting speed.
		b)/c) Skin & scale	Select tougher grade
			Increase cutting speed.
Frittering 	Small cutting edge fractures (frittering) causing poor surface finish and excessive flank wear.	Grade too brittle.	Select tougher grade.
		Insert geometry too weak.	Select insert with tougher geometry
		Built up edge	Increase cutting speed or select a positive geometry.
			Reduce feed at beginning of cut.
Poor Surface finish 	Wavy, rough or inconsistent finish on work piece.	Feed too high	Reduce feed.
		Wrong insert position	Change position
		Deflection	Check overhang
		Bad stability	Check stability

12. Appendices

12.1 Recommended General Torque Settings for Fasteners

Thread Ø	Tensile Strength		Torque Setting	
	kN	lbs	Nm	in-lbs
M3	6.54	1470	2.1	19
M4	11.4	2560	4.6	41
M5	18.5	4160	9.5	85
M6	26.1	5870	16	140
M8	47.6	10700	39	350
M10	75.4	17000	77	680
M12	110	24700	135	1200
M14	150	33700	215	1900
M16	204	45900	330	2900
M20	306	68800	650	5750
M22	374	83950	875	7725
M24	441	99100	1100	9700
M30	701	158000	2250	19900
M32	860	193500	3050	27000
M36	1020	229000	3850	34100

12.2 Cutting Feed and Speed Calculations

To find	Using	Metric		English	
Cutting speed	RPM, Dia	m/min	$V = \text{RPM} \times 0.00314 \times \text{Dia}$	Ft / min	$V = \text{RPM} \times \text{Dia} \times 3.82$
RPM	V , Dia	Revs/min	$\text{RPM} = \frac{V}{3.14 \times \text{Dia}} \times 1000$	Revs /min	$\text{RPM} = \frac{V}{\text{Dia} \times 3.82}$
Feed rate	RPM, FPT, NT	mm/min	$\text{FR} = \text{RPM} \times \text{FPT} \times \text{NT}$	Inches/min	$\text{FR} = \text{RPM} \times \text{FPT} \times \text{NT}$
Feed per Tooth	FR, RPM, NT	mm/tooth	$\text{FPT} = \frac{\text{FR}}{\text{RPM} \times \text{NT}}$	Inches/tooth	$\text{FPT} = \frac{\text{FR}}{\text{RPM} \times \text{NT}}$
Feed / Rev	RPM, FR	mm/Rev	$\text{FRR} = \frac{\text{FR}}{\text{RPM}}$	Inches/Rev	$\text{FRR} = \frac{\text{FR}}{\text{RPM}}$
Metal removal	DC, RC, FR	cm ³ /min	$\text{MR} = \text{DC} \times \text{RC} \times \text{FR} \times 1,000$	Inches ³ /min	$\text{MR} = \text{DC} \times \text{RC} \times \text{FR}$
Horse Power	MR, C, WC, PC	HP	$\text{HP} = \frac{\text{MR} \times \text{C} \times \text{WC}}{\text{PC} \times 0.015}$	HP	$\text{HP} = \frac{\text{MR} \times \text{C} \times \text{WC}}{\text{PC}}$

V = cutting speed (m/min or Ft/min)

Dia = Diameter of cutting tool

RPM = spindle revs /min

FPT = Feed per tooth (mm or Inches)

NT = Number of teeth

FR = Feed rate (mm/min or inches/min)

FRR = Feed rate per revolution

DC = axial depth of cut

RC = radial engagement of cut (mm or inches)

MR = Metal removal rate (cm³/min or inches³/min)

HP = horse power (estimate of the power required at the motor assumes 75% efficiency)

C = cutting edge constant (from table 1)

WC = wear constant (from table 2)

PC = power constant (from table 3)

Table 2 (Determine the type of operation to obtain constant W)

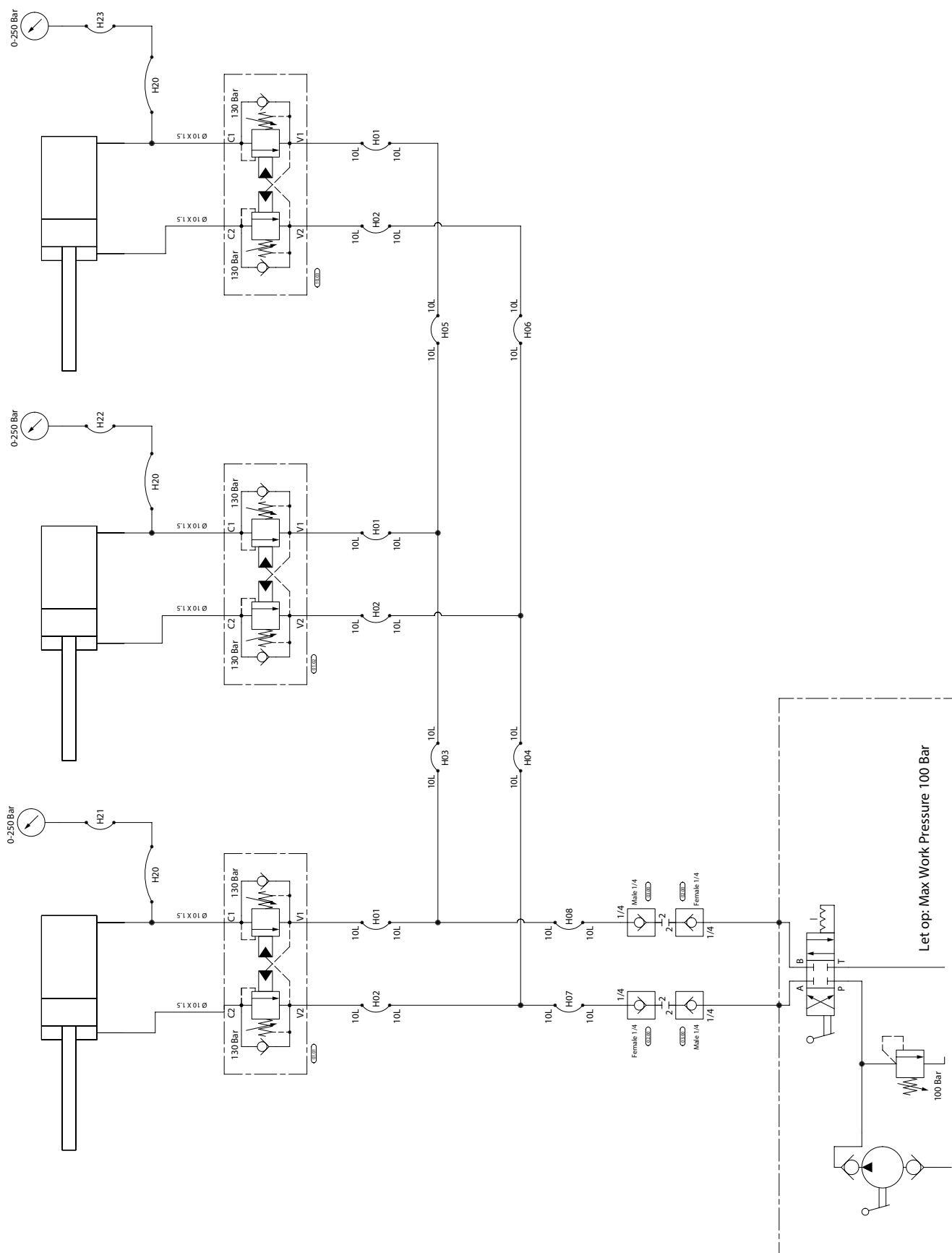
Type of operation	W
Turning – finishing cuts	1.00 – 1.10
Turning – roughing cuts	1.60 – 2.0
Milling – finishing cuts	1.10 – 1.25
Milling – Heavy metal removal face milling	1.30 – 1.60
Drilling – normal to hard to drill materials	1.30 – 1.50

Table 3 (Determine material to obtain constant PC)

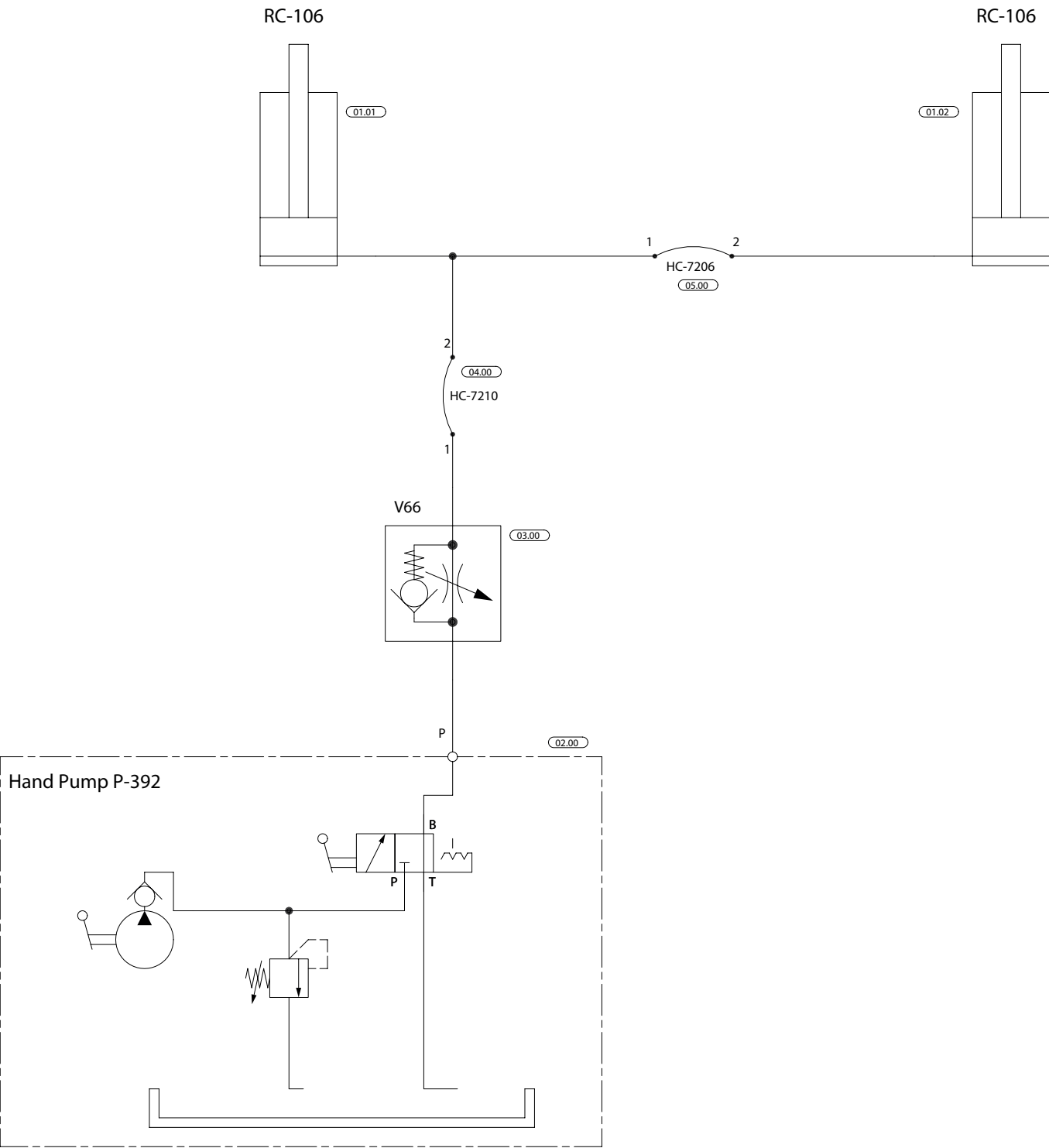
Material Type	Hardness - HB	Tensile Strength – n/mm ²	PC	
(inch)	PC			
(metric)				
Plain carbon steels	<200	< 700	0.51 – 0.62	1.39 – 1.69
Free machining and stainless steels	< 260	< 850	0.74 – 0.92	2.02 – 2.51
Alloy steels	< 340	< 1200	0.80 – 1.00	2.18 – 2.73
High alloy steels and castings	< 450	< 1500	1.00 - 1.20	2.73 – 3.28
Aluminium		< 300	0.25 – 0.33	0.68 – 0.90
Cast iron	< 300		0.63 – 0.86	1.72 – 2.35
Stainless steel	< 340	< 1200	0.80 – 1.00	2.02 – 2.51
Heat resistant super alloys		< 1250	1.00 – 1.10	2.73 – 3.00

12.3 Schematic Diagrams

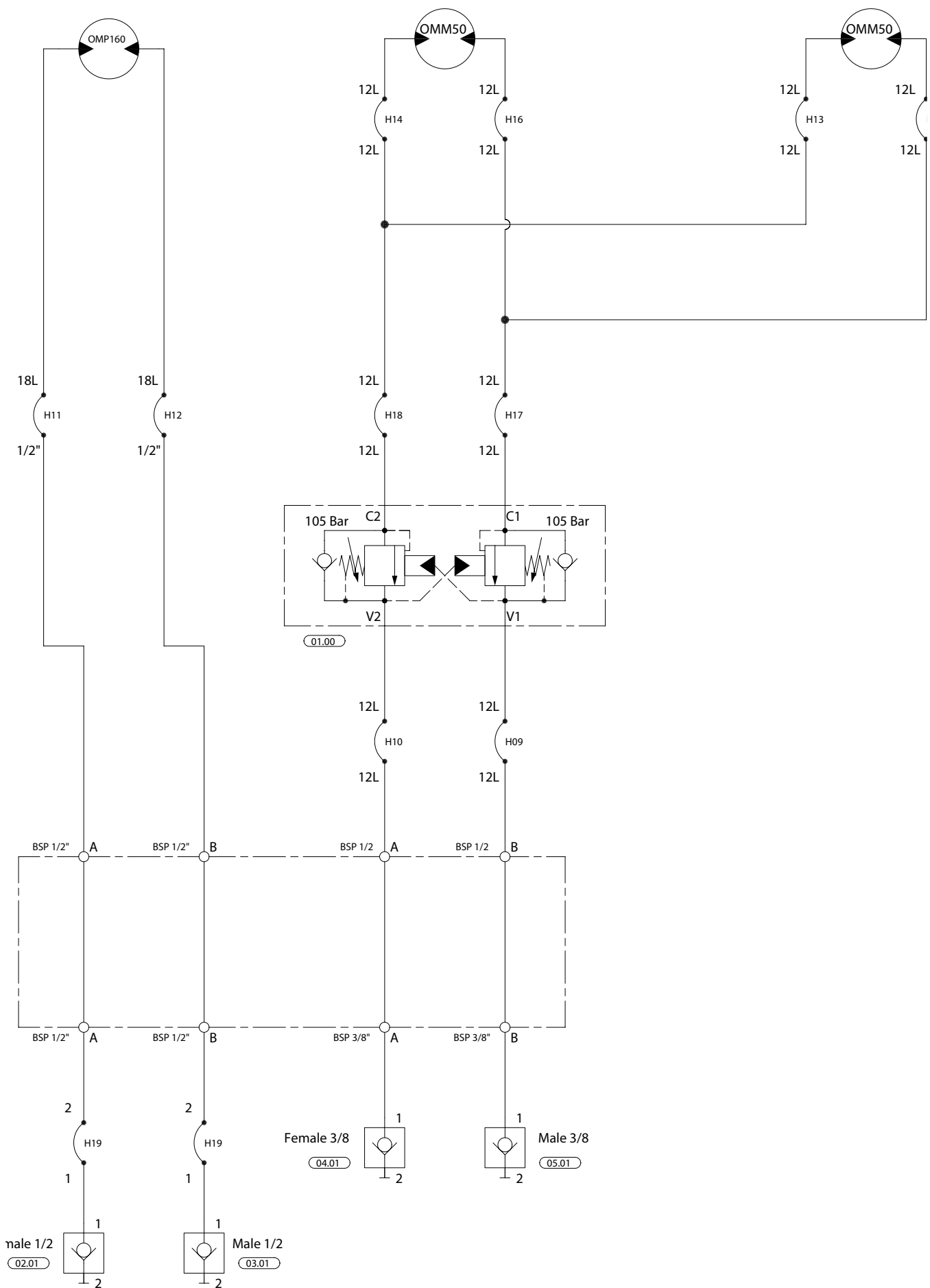
12.3.1 Hydraulic schematic for 03934150101 - Hydraulic Kit WP4600



12.3.2 Hydraulic schematic for 03934150102 - Hydraulic Kit for Lift Cylinders



12.3.3 Hydraulic schematic for 03934150103 - Hydraulic kit for Hydromotors



LOBO Systems CODE OF SAFE PRACTICES

It shall be the responsibility of all users to read and comply with the following common sense guidelines which are designed to promote safety in the erecting, dismantling and use of the LOBO System. These guidelines are not inclusive nor do they replace other additional safety and precautionary measures to cover usual or unusual conditions. If these guidelines in any way conflict with any law, government statute or regulation, then the said law, statute or regulation shall supersede these guidelines and it shall be the responsibility of each user to comply.

1 GENERAL GUIDELINES:

- a FOLLOW ALL LAWS & REGULATIONS, local or otherwise and Federal Codes and Regulations.
- b SURVEY THE JOB SITE. A survey shall be made of the job site by a competent person for hazards, including but not limited to uneven or soft earth, ditches, debris, high voltage tension wires, unguarded openings, and other hazardous conditions created by other trades. These conditions should be corrected or avoided as noted in the following sections.
- c PERFORM A RISK ASSESSMENT TO IDENTIFY WHAT COULD CAUSE HARM TO USERS. Take precautions to prevent harm or injury. Example risk assesment:
Identify the hazards.
Decide who might be harmed and how.
Evaluate the risks and decide on precautions.
Record and implement findings.
Review and update Risk Assessment if necessary.
- d INSPECT ALL EQUIPMENT BEFORE USING. Never use any equipment that is damaged or defective in any way. Mark it or tag it as defective and remove it from the job site.
- e THE SYSTEM MUST BE ERECTED IN ACCORDANCE WITH LOBO SYSTEMS ASSEMBLY INSTRUCTIONS.
- f DO NOT ERECT, DISMANTLE OR ALTER THE SYSTEM. Unless under the supervision of a trained and competent person.
- g DO NOT ABUSE OR MISUSE LOBO SYSTEMS PRODUCTS AND EQUIPMENT.
- h ERECTED SYSTEMS SHOULD BE REGULARLY INSPECTED. Users need to be sure that they are maintained in a safe condition. Report any unsafe condition to your supervisor and/or Health & Safety Representative.
- i NEVER TAKE ANY RISKS! If in doubt about the safety or use of the LOBO System, consult LOBO Systems.
- j NEVER USE EQUIPMENT FOR PURPOSES OR IN WAYS FOR WHICH IT WAS NOT INTENDED.
- k PHYSICAL CONDITION. Do not work on the LOBO System if you feel dizzy or unsteady in any way.
- l INFLUENCE. Do not work under the influence of alcohol or drugs, including prescription drugs, which may affect your ability to work safely.

- m ALWAYS FIT HANDRAILS . Where ever there is a risk of injury due to a fall, a handrail must be fitted.

2 GUIDELINES FOR ERECTION AND USE OF LOBO SYSTEMS:

- a TRESTLE LEGS OR BASE PLATES. The system must be constructed on trestle legs or base plates to prevent slipping or sinking and fixed where required. Any part of a building or structure used to support the system shall be capable of supporting the maximum intended load to be applied.
- b LEVELLING. Adjust to level on uneven floors and surfaces.

3 BRACING, LEVELLING & PLUMBING OF THE LOBO SYSTEM

- a PLUMB AND LEVEL . All systems need to be plumbed and level as they are constructed. Do not force the trestle legs, extensions, handrails or sway braces to fit. Level the system until a proper fit can be easily made.
- b BRACING. Each trestle leg or extension piece shall be braced by horizontal tubes, diagonal bracing using sway braces or combination of both to secure the vertical pieces together. All tube and sway braces shall be made secure by using top clamps, side bracing clamps or lobands, in accordance with LOBO Systems' recommendations.
- c ASSEMBLY. Fasten all clamps, thumb screws and loband couplers securely before assembly of the next level.

4 ERECTING A FREE STANDING LOBO TOWER SYSTEM.

When erecting the system you must never exceed a height of three (3) times the minimum base dimension. Use outriggers to increase the base dimension and ensure stability.

5 DO NOT ERECT THE SYSTEM NEAR ELECTRICAL POWER LINES.

Consult a qualified person for advice.

6 LADDER ACCESS SHOULD BE PROVIDED TO ALL PLATFORMS.

Do not climb the cross brace tubes or diagonal sway braces, ensure all ladders are clamped in position.

7 CONSTRUCT A HANDRAIL SYSTEM, AND /OR FALL PROTECTION SYSTEM AND USE TOE BOARDS WHERE REQUIRED.

HAND TIGHT MEANS
5 Nm / 45 Inch-lbs



ERECTING WORK PLATFORMS USING the LOBO System.		Assessment Number:
Generic Risk Assessment Guidance.		Date:
Persons Exposed:	Operatives undertaking the work, and others in the vicinity.	

Hazards	Risks	Initial Assessment			Control Measures to Reduce Risks	Re-Assessment			Remarks
		S	L	R		S	L	R	
Work at Height, Poor Ground conditions, Inclement weather, Heavy equipment.	Falls, Falling Objects, Collapse of Structure, Trapped fingers –Significant injuries or Fatality, Bruising, Grazes and cuts.	4	4	HR	- Select and plan the process, where possible, to avoid unnecessary work at height. - Ensure your emergency rescue plan provides a safe method of recovering an injured person from the platform. - Inspect the equipment before its use. - Always ensure the system is erected by trained and competent persons. - Issue and ensure personnel wear suitable protective clothing i.e. Gloves, Hard Hats and Protective footwear. - Check the ground bearing capabilities before work commences. - Do not exceed the stated loads and working height restrictions of the system. - Level the system and ensure legs are vertical/plumb and the system is square before fitting the extensions. - Apply castor/wheel brakes as soon as they are fitted to the system and ensure they are applied during any work activities. - Prevent falls by collective protection measures i.e. fit guardrails and secure ladders as you progress and erect horizontal rails at all openings or edges where falls are likely. - Get assistance to lift heavier components. - Fit Toe Boards securely on all working platforms. - Check temperature to ensure ice and/or snow does not create a slip risk. - Clear Loboards in icy conditions. - Secure system in high winds i.e. over Beaufort Scale - Force 4.	4	2	MR	Don't forget to consider risk to others who may be close by.

Hazards	Risks	Initial Assessment			Control Measures to Reduce Risks	Re-Assessment			Remarks
		S	L	R		S	L	R	
					- Only fit debris netting on systems used indoors, unless wind loads have been calculated, the system is designed for the additional load, and the system is tied to a suitable structure. - Never raise heavy items (e.g. platform decks) outside the system's base dimension. - Do not secure harnesses or other fall arrest devices to the structure unless it has been designed specifically for that purpose. - Ensure platform decks are secured from being lifted. - Prevent access to the working area by erecting signs, warning tape or barriers as necessary. - Remove ladder to first platform when system is not in use or prevent access/use of ladder by other means.				

Assessment Legend: S: Severity of Injury L: Likelihood of Occurrence R: Risk Rating PR Prohibitive Risk HR High Risk MR Medium Risk LR Low Risk Severity ranking multiplied by Likelihood value to determine the Risk Rating.									
Likelihood Severity	Likely (5)	Probable (4)	Possible (3)	Remote (2)	Improbable (1)				
Death (4)	20-PR	16-HR	12-HR	MR	4-LR				
Major Injury / Permanent Disability (3)	15-HR	12-HR	MR	6-LR	3-LR				
Minor Injury (2)	10-MR	MR	6-LR	4-LR	2-LR				
No Injury (1)	5-LR	4-LR	3-LR	2-LR	1-LR				

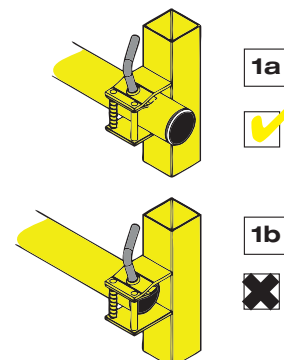
do's & don'ts

The LOBO System Side Clamp

The side clamp refers to any clamp located on the front face of any LOBO System component. Ensure that the L-Bolt is fully tightened during assembly.

Fig 1a: Shows the correct use of the LOBO System side clamp. You must ensure that the tube is level with the end of the side clamp or protruding at least through the side clamp. You must pay particular attention to ensure that the tube itself is level with the edge of the side clamp and not the end caps as this would mean that the tube itself is 5mm short of being flush with the edge.

Fig 1b: Clearly shows that the tube is not fully inserted into the side clamp and this is not acceptable under any circumstances.

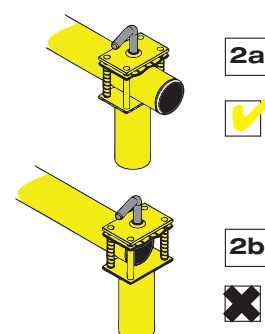


The LOBO System Top Clamp

The top clamp refers to any clamp located on the top of the leg inserts of any LOBO System component. Ensure that the L-Bolt is fully tightened during assembly.

Fig 2a: Shows the correct use of the LOBO System top clamp. You must ensure that the tube is level with the end of the top clamp or protruding at least through the top clamp. You must pay particular attention to ensure that the tube itself is level with the edge of the top clamp and not the end cap as this would mean that the tube itself is 5mm short of being flush with the edge.

Fig 2b: Clearly shows that the tube is not fully inserted into the top clamp and this is not acceptable under any circumstances.

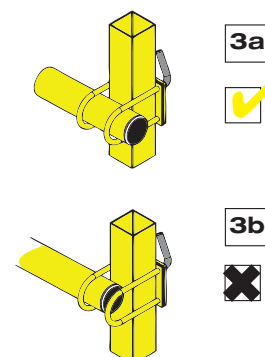


The LOBO System Loband

The Loband is available with a round (LC1) or square (LC3) end. These instructions apply to both varieties. Ensure that the L-Bolt is fully tightened during assembly.

Fig 3a: Shows the correct use of the LOBO System Loband clamp. You must ensure that the tube is protruding a minimum of 5mm through the Loband clamp to ensure a safe and strong fit and to prevent damage to the end cap.

Fig 3b: Clearly shows that the tube is not fully inserted into the Loband clamp and this is not acceptable under any circumstances.



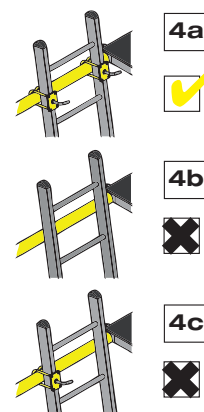
The LOBO System Ladder Clamp

The LOBO Ladder clamp must only be used to secure a ladder and has no other uses on the LOBO System. Ensure that the L-Bolt is fully tightened during assembly.

Fig 4a: Shows the correct use of the LOBO Ladder clamp. You must ensure at least 2 ladder clamps are used per ladder.

Fig 4b: Clearly shows no ladder clamps in use and this is not acceptable under any circumstances.

Fig 4c: Clearly shows only one ladder clamp in use and this is not acceptable under any circumstances.



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HAND TIGHT MEANS
5 Nm / 45 Inch-lbs

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Safety checks, periodic checks and maintenance

Whilst building the system ensure the following are checked:

Check L-Bolts and thumb screws on ALL system components are fully tight and are undamaged.
 Check to ensure that all height adjustment pins are present and that the wire spring is present and undamaged.
 Check ALL welds for signs of cracking. This check must also be carried out on the aluminium Loboards as well.
 Check for dents in all system components including the round tubes and the aluminium Loboards.
 Check the compression springs and their condition, the side clamp has 1 spring and the top clamp has 2 springs.

After 5 days of the system being erected:

Check to ensure that the L-Bolts and thumb screws are fully tight and are undamaged.
 Check general condition of system and Loboards.

After 28 days of the system being erected:

Check L-Bolts and thumb screws on ALL system components are fully tight and are undamaged.
 Check to ensure that all height adjustment pins are present and that the wire spring is present and undamaged.
 Check ALL welds for signs of cracking. This check must also be carried out on the aluminium Loboards as well.
 Check for dents in all system components including the round tubes and the aluminium Loboards.
 Check the compression springs and their condition, the side clamp has 1 spring and the top clamp has 2 springs.

Maintenance

Every 12 months:

Ensure that all L-Bolts and thumb screws are greased to ensure maximum durability of the product.

If any parts are missing or damaged, do not use the LOBO System until it is either repaired or replaced.

HAND TIGHT MEANS
5 Nm / 45 Inch-lbs

