ENERPAC

Operation and Maintenance Manual

WP3500-H Orbital Milling Machine
with WP3500-50 Base and WP3500-51 Trolley

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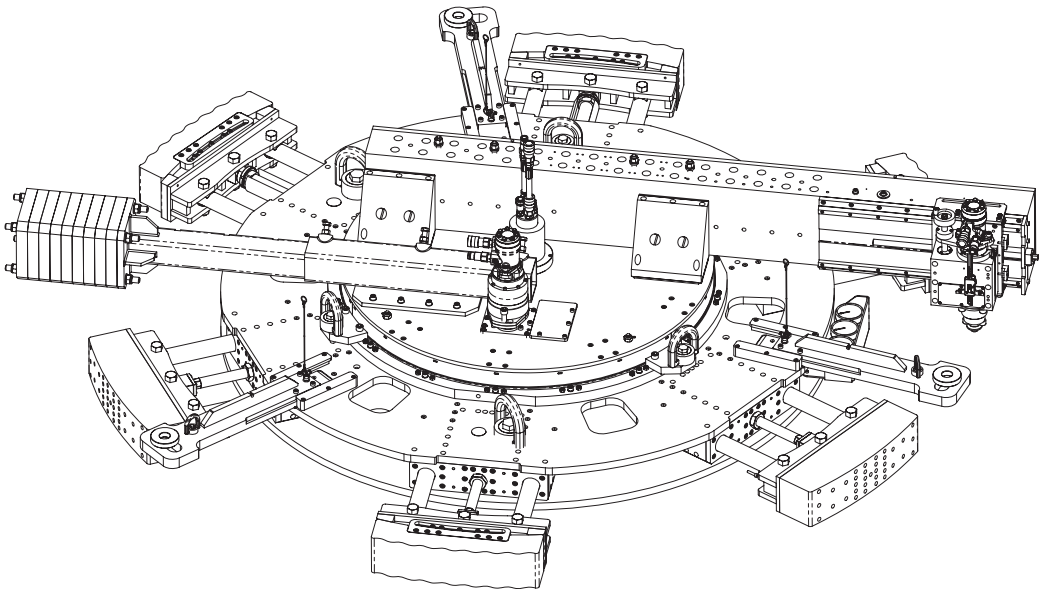

To reduce the risk of injury, user must read and understand this document before use.

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1.0 INTRODUCTION

Overview

The WP3500-H Orbital Milling Machine has been designed for 'out of the manufacturing mould' material removal of wind turbine blade root diameters.

The WP3500-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 WP3500-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 WP3500-H is to contact the root diameter with the face milling cutter and carefully power the WP3500-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 WP3500-H made safe for removal, the clamping base can be de-energised and the WP3500-H removed from the root diameter.

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 WP3500-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

Manual information

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

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.

Warranty

- Enerpac guarantees the product only for the purpose for which is intended.
- Refer to the Enerpac Global Warranty document for terms and conditions of the product warranty.

Any misuse or alteration invalidates the warranty.

- Observe all instructions as communicated in this manual.
- Modification to any part of the equipment described in this manual should not be attempted.
- When replacement parts are needed, use only genuine Enerpac replacement parts.

EU Declaration of Conformity

WP3500-H

CE These tools conform with the requirements for CE.

Enerpac declares that this/ these product(s) has/ have 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.

2.0 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.

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.

2.1 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

2.1.1 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.

2.2 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

2.2.1 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.

2.2.2 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.

2.2.3 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.

2.2.4 Potential Hazards

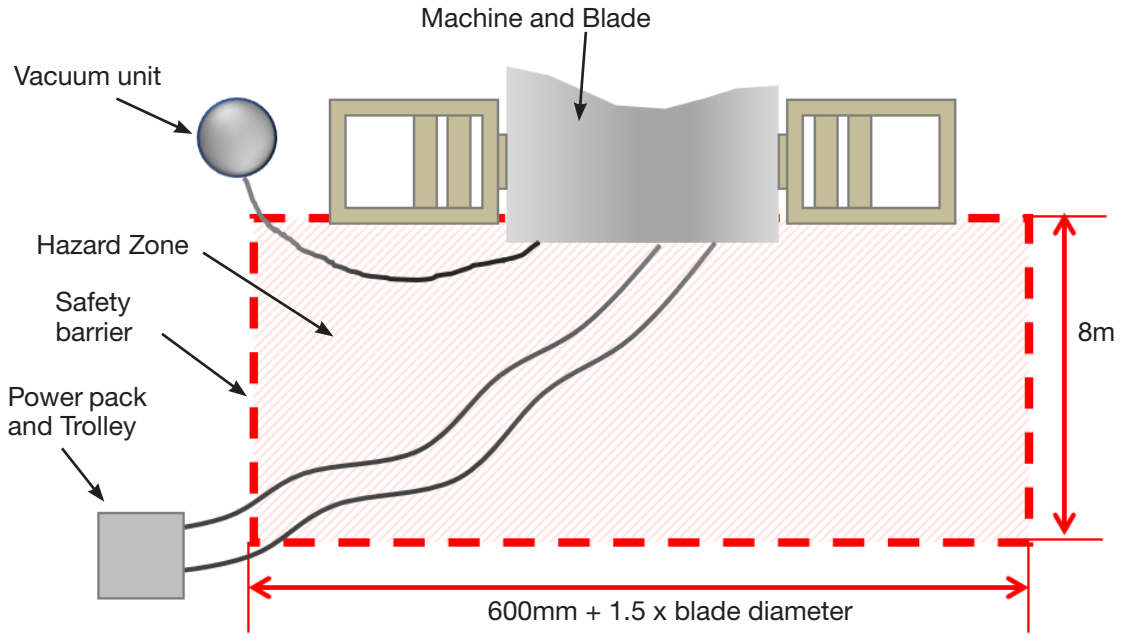
⚠ WARNING

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.

2.2.5 Machine Hazard Zone

⚠ WARNING

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

3.0 FEATURES AND COMPONENTS

1. Hydraulic Base
2. Drive Ring
3. Drive Gear Unit - Milling
4. Milling Arm
5. Spindle Assembly
6. Distributor
7. Counterweight Assembly
8. Setting Straps

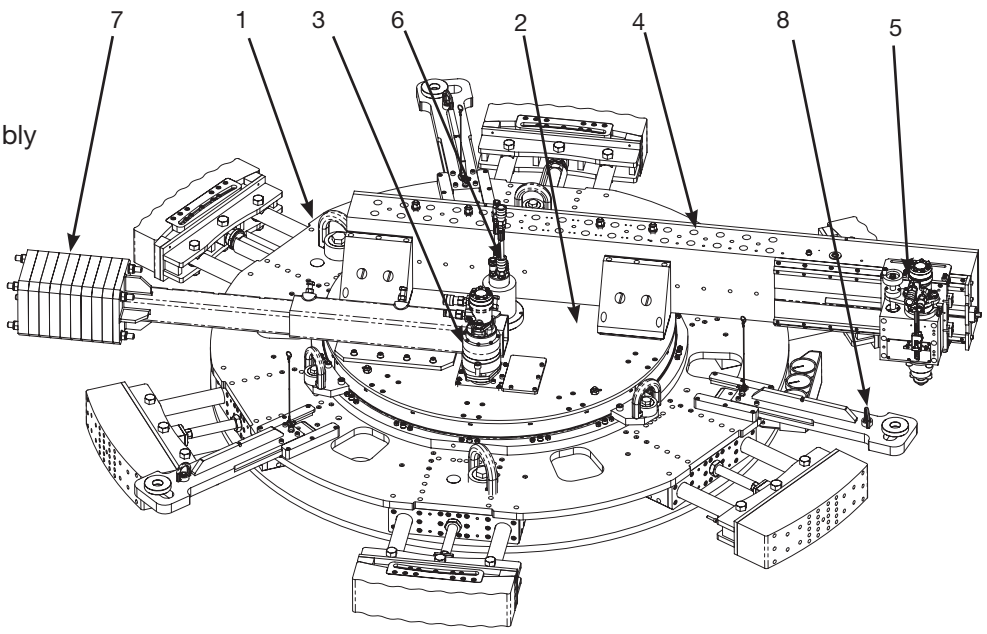


Figure 1: Major features and components of WP3500-H - Orbital Milling Machine and Base assembly

4.0 TECHNICAL DATA

4.1 Machine specification

Description	Value	
Min. Facing diameters (PCD)	2300mm	90.5”
Max. Facing diameters (PCD)	3200mm	126”
Rotational Drive – hydraulic (5.0hp)	5.0 Hp	3.78 kW
Milling spindle – Hydraulic (standard)	5.0 Hp	3.78 kW
Recommended Surface cutting speed (125mm face)	250mm/min	10” / min
Approx. Spindle R.P.M (standard)	325	
Spindle down Feed	80mm	3.125”
Hydraulic flow required (dual supply) 70bar	50L/min to the Spindle Drive & 20L/min to Rotational Drive.	
Base Weight	Dependant on base. Refer to section 10	
Machine Weight	1651kg	
Noise Pressure of Power pack	Measured at ear height at nominal loading one metre away from any Unit’s electric motor. 72 dB(A)	

5.0 INSTALLATION

5.1 Setting straps

Before securing the machine to the base, ensure that the correct setting straps have been installed on the base assembly for the blade diameter. Refer to section 10 for assembly part list on the Base (WP3500-50).

The setting strap on this base assembly features a sliding rail which allows the setting strap to be moved away from the work-piece face before the machining operation. To do this, the four M10 cap head bolts, which secure the strap to the base, need to be removed. The setting strap can now be moved back and secured in position using the pin (secured to the lanyard) and locating in the hole in the strap and base. Each strap features a lifting point due to the weight of the strap. Adequate lifting equipment must be used.

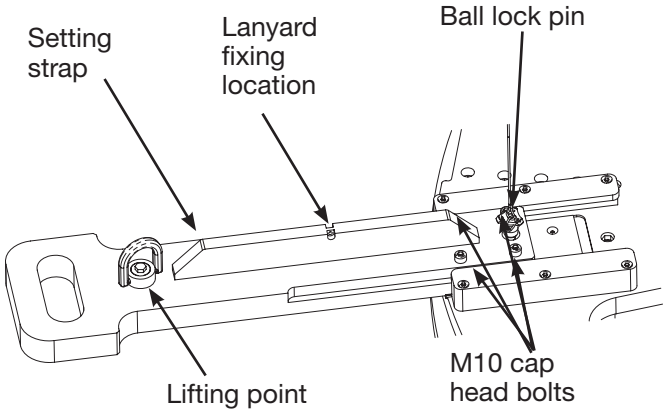


Figure 1: Setting strap bolts

Changing the setting straps

The setting strap, which is sized to fit the inside of the blade, is installed using the following procedure:

1. Disengage the lanyard from the setting strap.
2. Remove the existing setting strap by unscrewing the four M10 bolts and the middle ball lock pin which connects the strap to the base.
3. Slide out the setting strap ensuring lifting points are used.
4. Select the correct sized setting strap (see section 10 for parts list) and slide the setting strap into position using lifting points as an aid.
5. Secure using the four M10 bolts and the pin.

⚠ Ensure the four M10 bolts shown in fig. 1 are torqued to the recommended value given in section 12.7.

6. Connect the lanyard to the setting strap.

5.2 Install WP3500-H machine to clamping base

1. Upon receipt of the WP3500-H or in the event of the WP3500-H being separate from the hydraulic base. Position the hydraulic base in the horizontal position.
2. Using suitable lifting equipment, lift the WP3500-H onto the hydraulic base. Ensure the 16off mounting bolt holes (drawing number WP2500-1) within the WP3500-H align with the 16off M12 securing holes within the hydraulic clamping base. Refer to figure 2.
3. Install 16 off M12 mounting bolts and secure the WP3500-H to the hydraulic base. (Recommended torques are located in appendix-section 12.11).
4. The machine and hydraulic base assembly is now a single unit that can be positioned into the work piece.
5. The procedure for mounting the complete assembly into the work piece is reliant on the three setting straps. The setting straps are the datum points/connections to the work piece and are parallel to the WP3500-H spindle as per the general arrangement in Section 10.

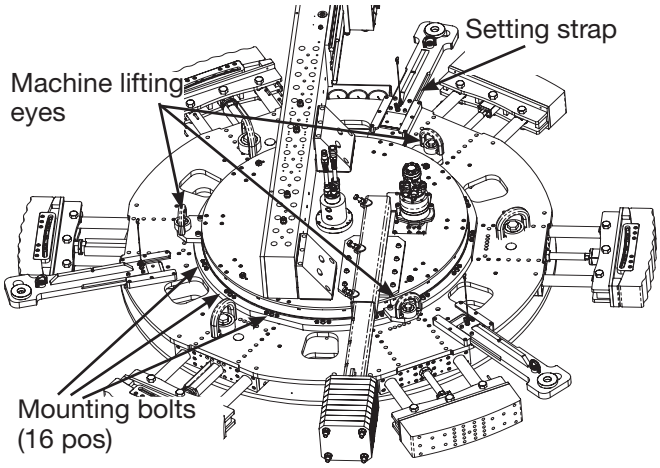


Figure 2: Machine setting features

5.3 Setting the machine parallel

Your WP3500-H 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 M10 grub screws are retracted so they do not protrude beneath the 'Baseplate'.

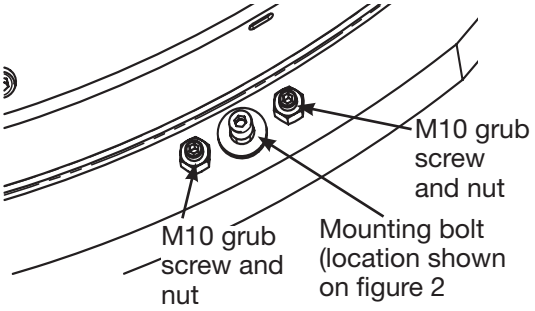


Figure 3: Machine plane adjusting screws

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 M10 grub screws & lightly tighten 16 off M12 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 M12 mounting bolts & adjusting the M10 grub screws & lock nuts. Re-survey & repeat the above process until the machining plane is flat. Fully tighten the M12 mounting bolts & ensure all M10 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 & Strap Shim, install an appropriate shim (not supplied) & then re-assemble. Adjust all Setting Straps in this way until all are within tolerance.

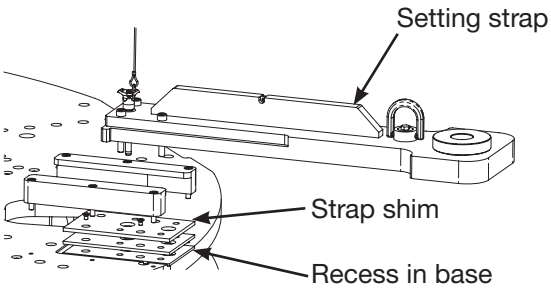


Figure 4: Setting strap and shim

8. Mark each Strap Shim, Setting Strap, any shims & the corresponding recess in the machine base to ensure that they are always replaced in the same position.

5.4 Preparing to Install the Assembly to the Work-piece

The construction of the hydraulic base is such that there are 3 fixed Clamping Feet and 3 hydraulic feet.

The 3 fixed 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 fixed 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
6. To prevent the clamping feet, located at 4 and 8 o'clock initially (see figure 5), from rotating out of position, tighten two collars in total, one on each aforementioned extension leg. The collars at positions 2 and 10 o'clock should be left loose until after the hydraulic clamping feet positions have been retracted, see section 5.7

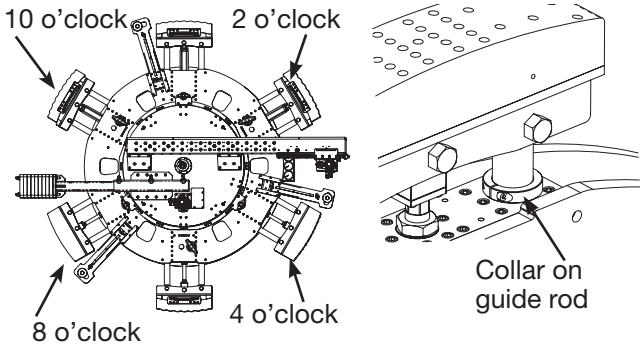


Figure 5: Guide rod collars

The WP3500-H machine and hydraulic base assembly are now ready for installation into the work piece

5.5 Installing the Assembly to the Trolley

The WP3500-H Orbital Milling Machine is supplied with an Installation Trolley (WP3500-51) 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 WP3500-H Orbital Milling Machine it will require installing into the Installation Trolley. (Note: the machine should be attached to the base, refer to section 5.2).

⚠ WARNING

The trolley hoist has a safe working load capability of 250kg and should NOT be used for lifting the machine or base assembly.
Ensure all lifting procedures have been risk assessed before commencing any lifting operations.

1. Lift the machine assembly in a vertical position using a crane or overhead winch and using the lifting eyes attached to the base assembly.
2. Orientate the base so that 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.

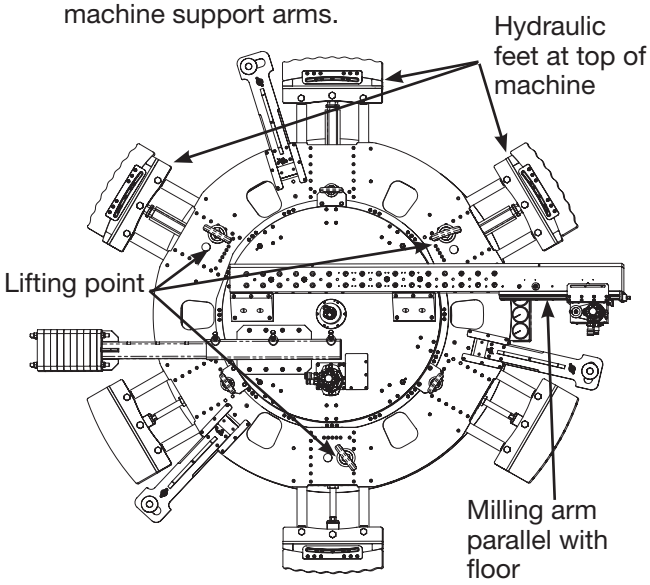


Figure 6: View of machine & base assembly

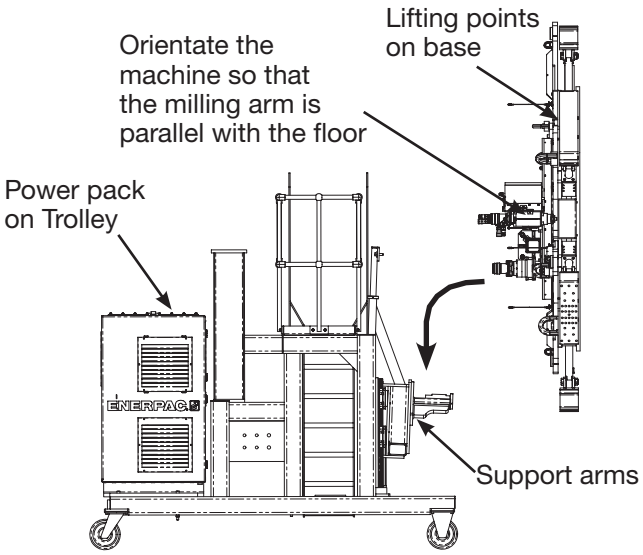


Figure 7: Machine and trolley (hoist not shown)

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. The support arms are angled 1.9º forward from the vertical plane, therefore the machine will be offered to the blade root at this angle.

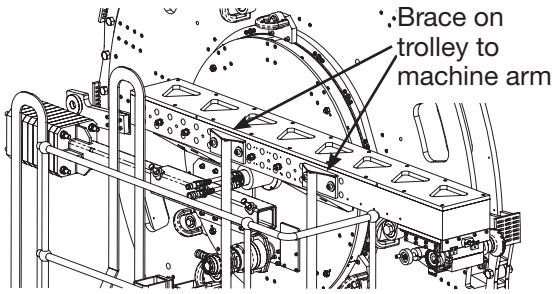


Figure 8: Secure machine to trolleyusing brace

4. The machine is now secured to the trolley.

⚠ CAUTION

Do NOT operate the Machine whilst it is on the Trolley

⚠ CAUTION

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

5.6 Setting the clamping Shoes

The machine base (WP3500-H-50) has two Clamping Feet configurations. The assembly of each configuration can be found in section 10 , WP3500-H-50 parts list.

Changing the Clamping Feet can be completed whilst the machine is secured to the trolley. Four M8 lifting points have been supplied to lift the Shoe using the hoist on the trolley. Refer to the hoist manual for directions on use of the hoist pendant. When assembling the hoist to the trolley frame, use the recommended torque values given in section 12.7.

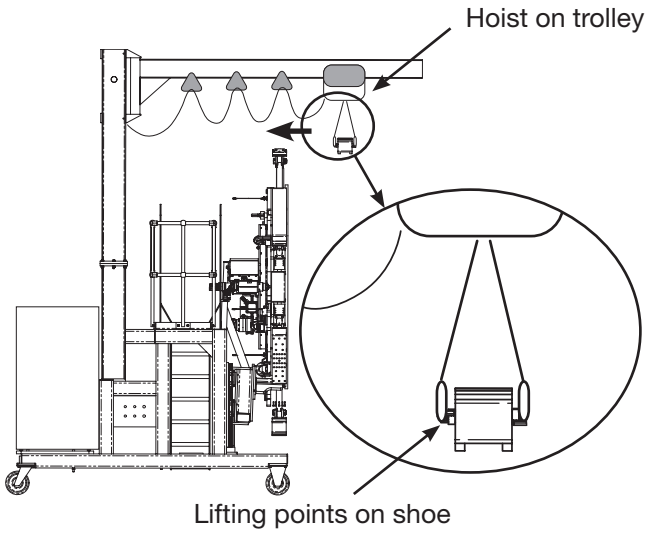


Figure 9: Trolley Hoist and Lifting Points on Shoe

Note: The lifting points must be removed before fitting the machine.

The base Clamping Feet are assembled so that the three Hydraulic Clamping Feet are fitted with the wavy edged Shoe. The Foot at 6 o'clock should also be fitted with a wavy edged Shoe. The remaining two arms are fitted with straight edged Shoes. Refer to figure 9.

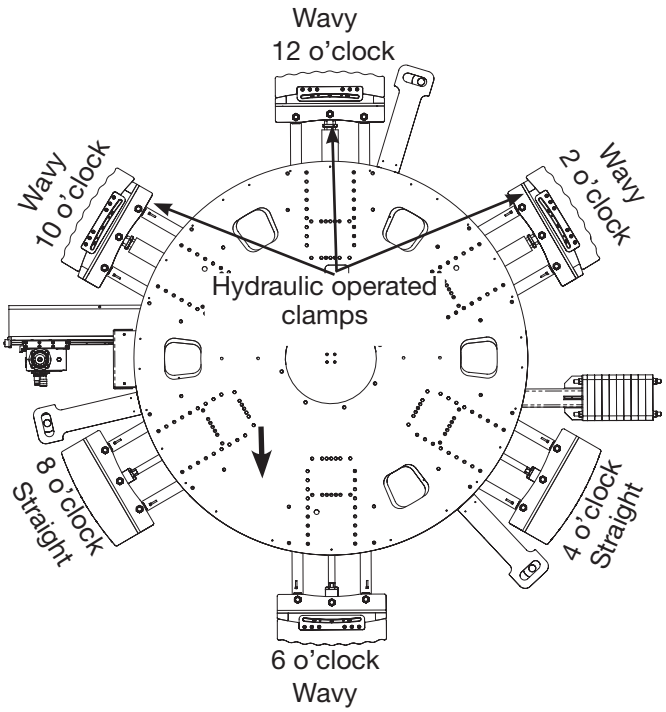


Figure 10: Clamping Feet on base

If necessary, two additional straight edged shoes have been supplied which can be fitted to the 2 o'clock and 10 o'clock positions, in place of the wavy shoes.

Connecting the clamp Shoes.

The required Shoes are slotted over the clamping foot and secured in place by three shoulder bolts on one side and five M10 bolts and washers on the other. Due to the patterned surface, it is advised to only lightly secure the shoes so that they can be moved into place

to match the pattern of the contacting surface, and then fully tightened when it is correctly located.

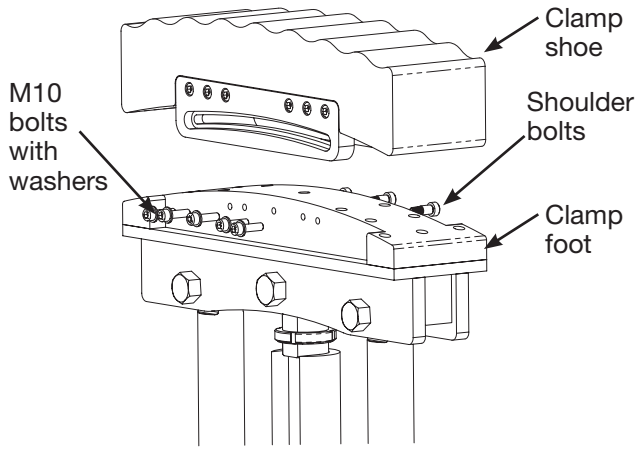


Figure 11: Fitting shoe to clamp foot

5.7 Installing the machine to the work-piece

The hydraulic clamps are activated with the use of an independent oil reservoir pump feeding three hydraulic rams within the machine base which are fitted with check valves.

1. Connect the hydraulic base pump to the hydraulic base using the 'Quick Release' fittings available.

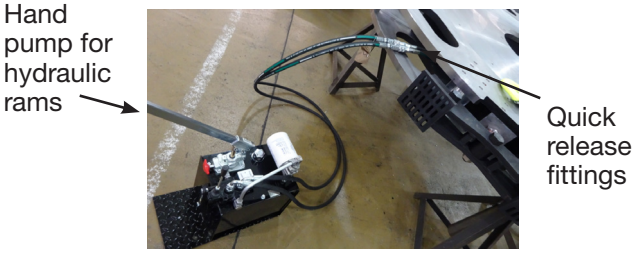


Figure 12: Hydraulic base pump connection.

2. Ensure that the hydraulic Clamping Feet are fully retracted. Do this by moving the valve lever on the hydraulic pump to 'Release' & then operate the pump lever until the feet are fully retracted.

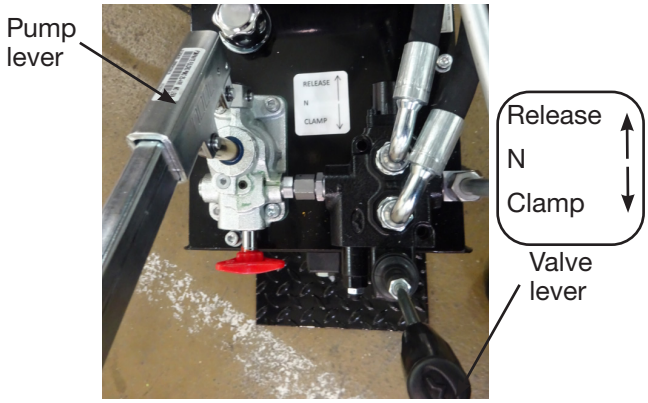


Figure 13: Hydraulic base hand pump

Note that the manually adjustable Clamping Feet have been pre-set during commission/ testing phases.

3. Now tighten two collars on the hydraulic clamping leg guide rods, located at 10 and 2 o'clock as described in section 5.4, and figure 5.

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.

5. Use the hand pump (figure 14) on the Installation Trolley to raise the height of the machine until the centre height is slightly higher than the 'Blade Root'.

The pump fitted on this trolley is a double acting hand pump. Use the hand lever to move the trolley arm higher or lower. The direction of the hydraulic flow is determined by the directional lever.

Refer to the manufacturers manual for further information. The PMD-12 pump manual can be found at www.hvhydraulic.com

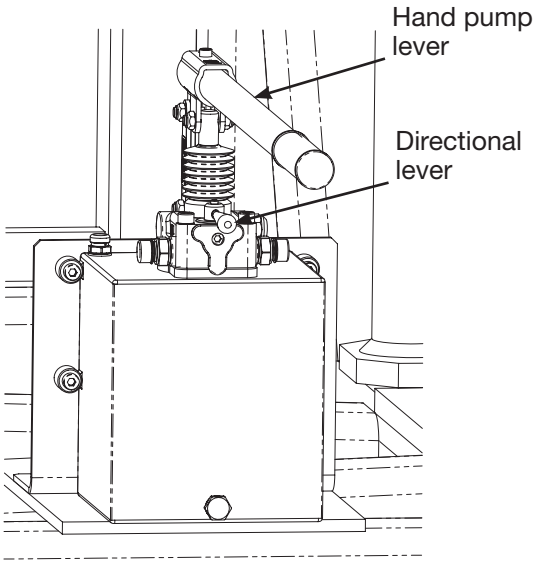


Figure 14: Pump on trolley

6. Now drive the trolley forwards into the 'Blade Root' making any vertical or horizontal adjustments as necessary. Keep driving the trolley forwards until all the 'Setting Straps' are touching the surface of the work piece.

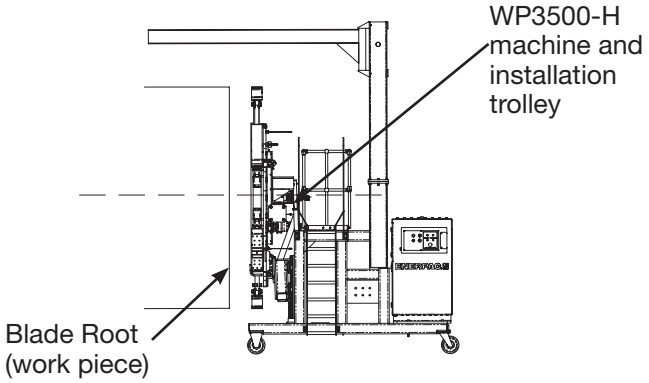


Figure 15: Moving machine to blade

7. Whilst keeping the machine pressed up to the work piece install a suitable bolt through each of the setting straps & into the threaded inserts that exist within the work piece. Excessive tightening of these bolts is not needed as they are only used for locating the machine.

8. Lower the trolley jack to allow the manually adjusted Clamping Feet to touch the inside diameter of the

blade.

9. Energise the hydraulic clamping base by moving the valve on the hydraulic pump to ‘Clamp’ and start to operate the pump handle.
10. When the machine is satisfactorily positioned within the work piece and the ‘Setting Straps’ are still in contact with the work piece, then the base can be fully engaged by continuing to pump the hydraulic base until 56 bar (5.6 MPa) of pressure is read on all the hydraulic gauges on the base.

⚠ CAUTION

Pressure above 56 bar may cause damage to the blade.

11. Now move the hydraulic valve on the pump to a neutral position. The hydraulic rams will maintain the 56 bar (5.6 MPa) of pressure as check valves are incorporated into each hydraulic ram.

⚠ DANGER

Note: The pressure reading on the gauges should be monitored to ensure that the hydraulic pressure does not drop below 40 bar during the application of the mechanical locks (or ‘C-Collars’)

12. Wind the 3 x Lock Nuts down to the mechanical locks (or ‘C-Collars’) & tighten the hex socket head grub screw to lock the hydraulic rams in place. See figure 16.

⚠ DANGER

Ensure that each hydraulic clamping foot is affixed with a C-collar. This will prevent the base extension legs from retracting if there is a reduction in pressure.

When the mechanical locks are applied there will 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.

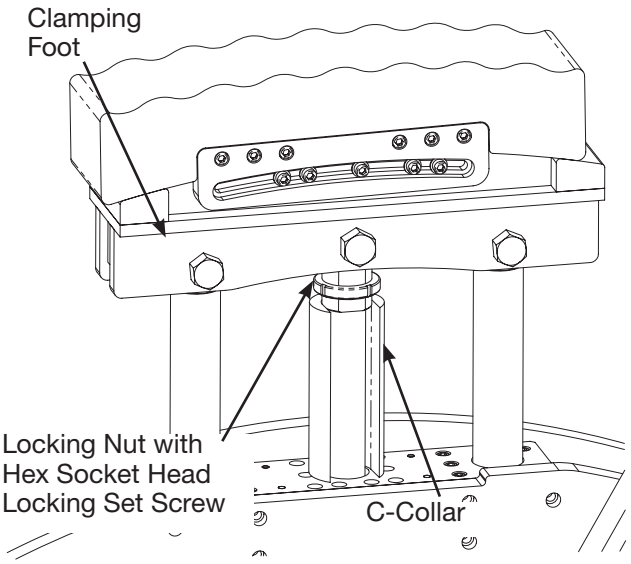


Figure 16: Clamping foot on base

13. 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.
14. With the machine now in place and a full 56bar (5.6MPa) reading on all the pressure gauges disconnect the hand pump hydraulic hoses & pivot or remove the ‘Setting Straps’.
15. The WP3500-H is now correctly installed into the work piece.

5.8 Hydraulic base de-activation

⚠ DANGER

The hydraulic base must not be de-activated without the WP3500-H machine being fully supported by both the setting straps and WP3500-H 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 connections.

1. Ensure the machine assembly is fully supported.
2. Connect quick release connections to base.
3. On the manual hydraulic pump move the directional control valve lever to the ‘Release’ position.

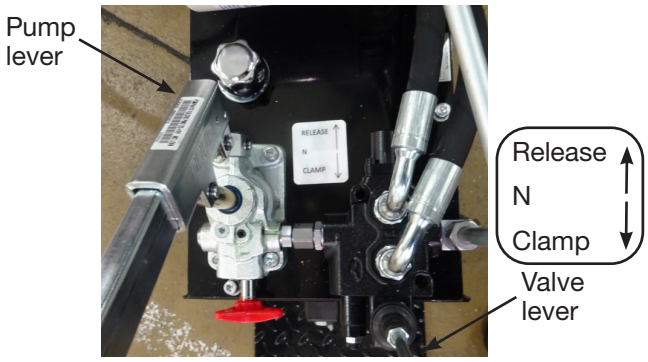


Figure 17: Hydraulic hand pump

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.

5.9 Connecting the WP3500-H to the power pack

1. The supplied Enerpac Hydraulic Power Pack's specification and technical detail is within the supplied Enerpac Hydraulic Power Pack Manual.
2. The hydraulic hoses are constructed and sized for one configuration onto the WP3500-H hydraulic distributor. The connection ports for the machine feed and cutter spindle are located at the top of the distributor.

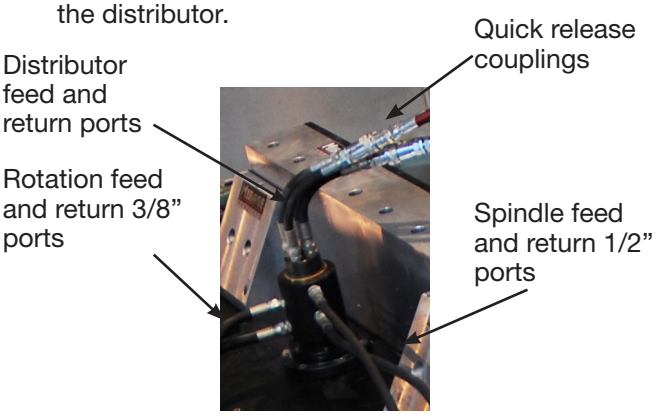


Figure 18: Hydraulic distributor on WP machine

Four hoses from the Powerpack (2 x feed and 2 x cutter ports) should be connected to the Distributor Quick Release connections shown in figure 18.

3. WP3500-H spindle hydraulic hose size ½" supply and return.
4. WP3500-H rotational feed hydraulic hose size 3/8" supply and return.
5. Using the quick release fittings on the WP3500-H and on the supply/return hydraulic hoses connect the hydraulic hoses to the WP3500-H.
6. Connect the hydraulic power pack to a 415 volt 3 phase supply. Follow the power pack instructions for connection with the assistance of a qualified electrician. Once correctly connected turn on the power pack isolation switch.
7. Follow the Enerpac Power pack manual for directions on starting the power pack.

7.0 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 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 added or the assemblies position needs adjusting outwards radially.

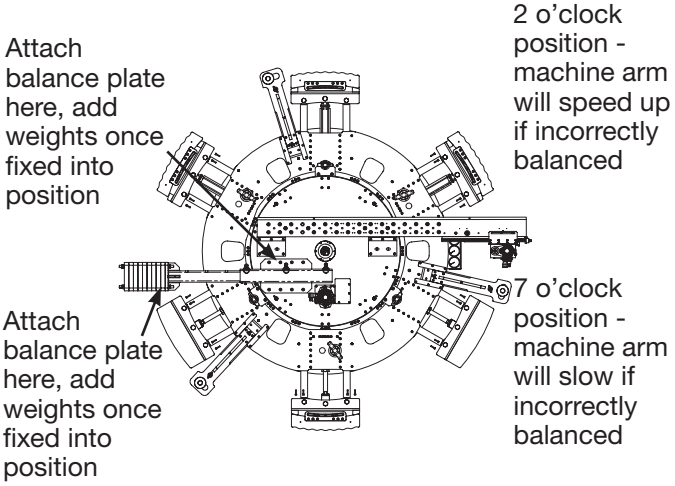


Figure 19: Balancing machine

4. To add or remove weights simply unscrew & remove the four 30mm AF nuts along with their washers. The weights can now be added or removed as necessary.

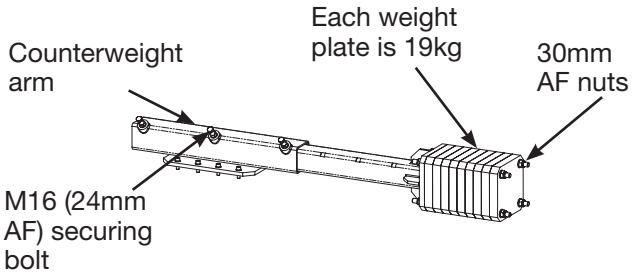


Figure 20: Counter balance assembly

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 Swarf Guards

The inner swarf guard (WP3500-H-53) limits debris from falling into the work-piece by the machining operation. It is attached to the base unit and fits inside the work piece.

The outer swarf guard (WP3500-H-52) is a stand alone structure that is placed around the outside of the work-peice to catch material removed from the work-peice during the machining operation.

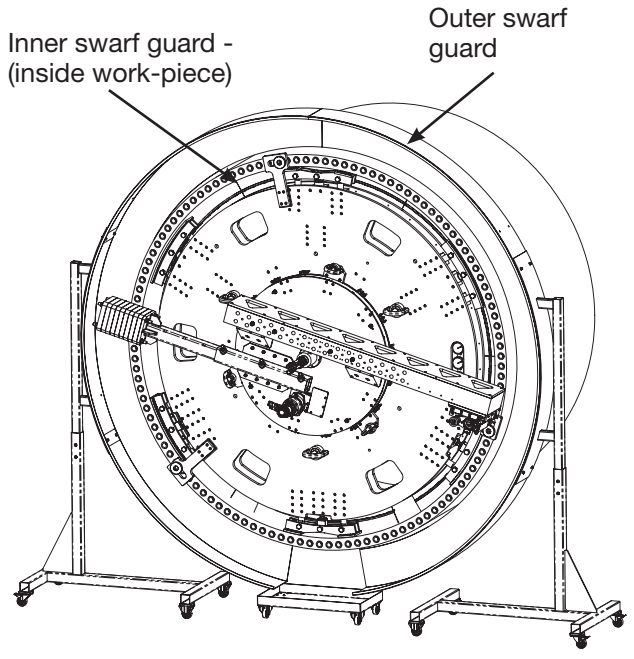


Figure 21: Swarf guards

7.6 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.

8.0 STORAGE

Enerpac machines should be stored in a cool, dry place.
Machines should always be cleaned, serviced and lubricated prior to storage.

Activity	Duration				
	<1week	1week>	4weeks>	12weeks>	1year>
Remove all production cutting debris from the WP3500-H and the hydraulic base.	●	●	●	●	●
Cover the WP3500-H and the hydraulic base with a suitable tarpaulin to protect from the production environment.	●	●	●	●	●
Confirm that the maintenance schedule is current			●	●	●
Store the WP3500-H 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 WP3500-H and hydraulic base.				●	●

9.0 MAINTENANCE

DANGER

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.

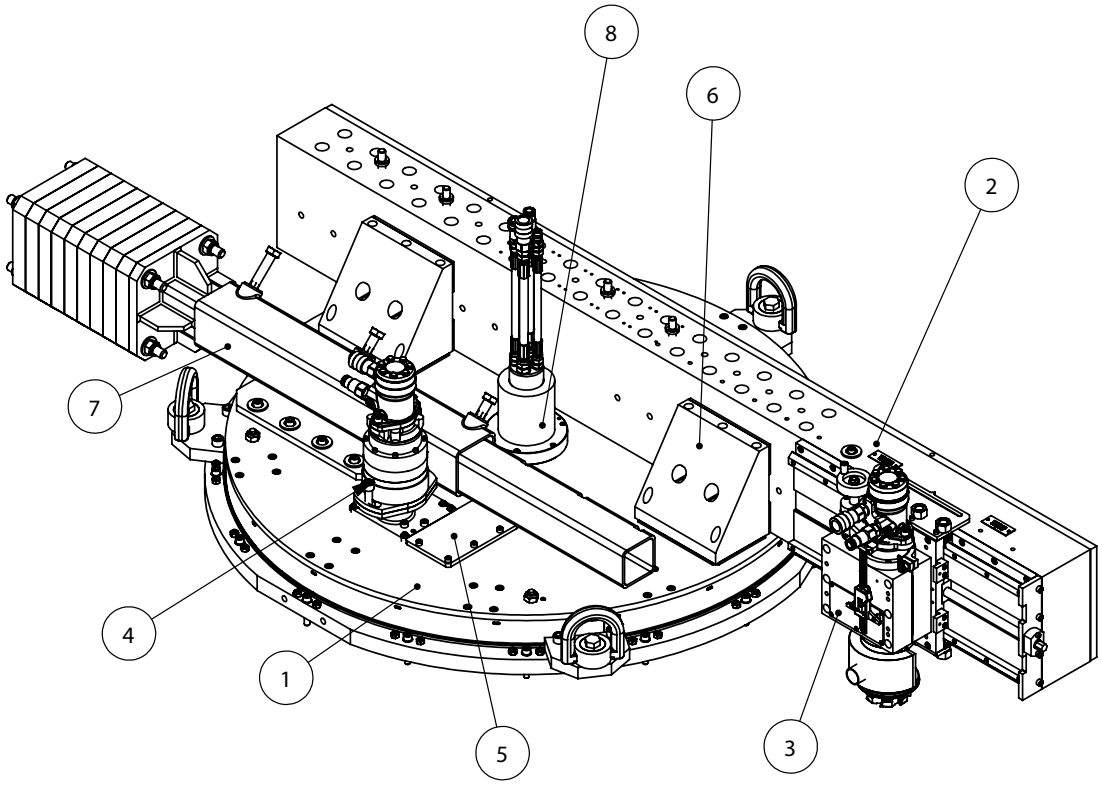
General Maintenance Schedule		
Time Period (of machine use)	**Action**	**Recommended Lubricant**
After every use	Clean all cutting debris from machine. Pay particular attention to lead screws, pivots, sealing, sliding & rotating faces. Perform a visual check for any leaks and change fittings if required	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	Anti-backlash assembly should be checked. 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.

10.0 PARTS LIST

10.1 WP3500-H - Machine Assembly

Revision D Weight 1865kg

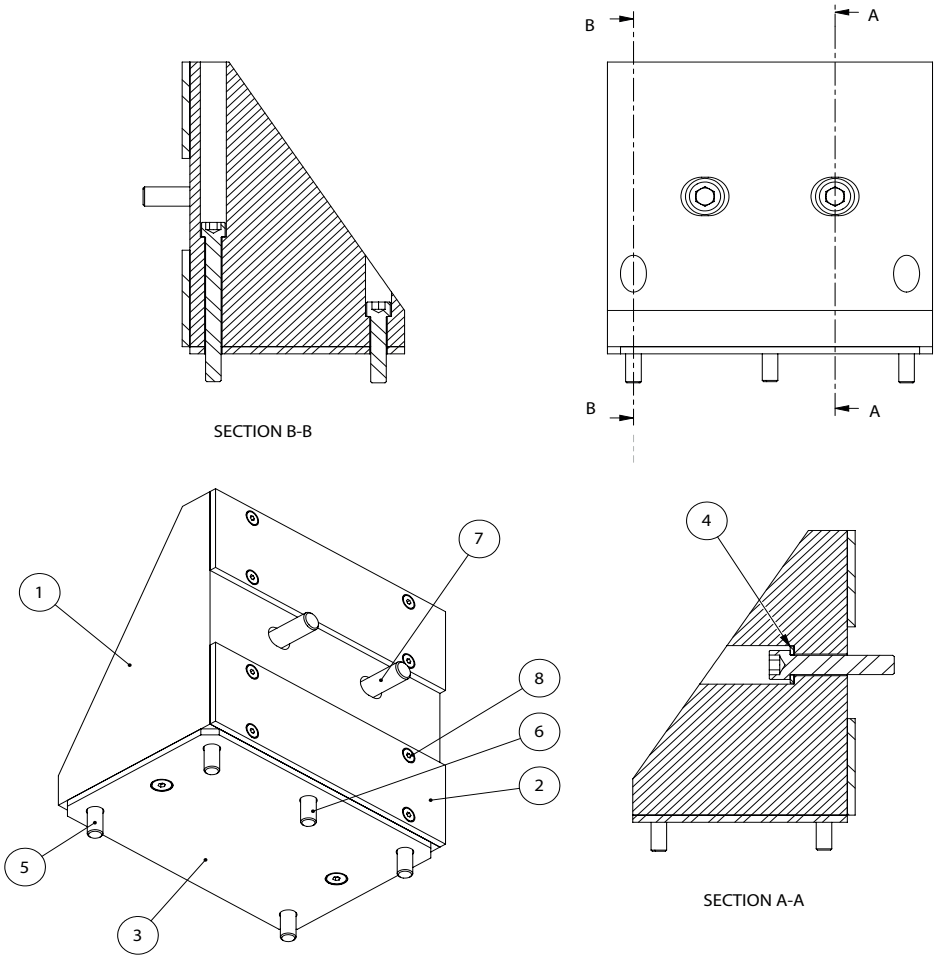


NOTE:
ITEMS 9 TO 16 NOT SHOWN ON DRAWING

Item Number	Part Number	Description	QTY
1	WP2500-1	DRIVE RING	1
2	WP2500-59	EXTENDED MILLING ARM	1
3	NEG 0100-1	WP2500 SPINDLE ASSEMBLY	1
4	WP3500-7	DRIVE GEAR UNIT - MILLING	1
5	WP2500-5	ANTI-BACKLASH ASSEMBLY	1
6	WP2500-2	SUPPORT ARM ASSEMBLY	2
7	D32-11-040	COUNTERWEIGHT ASSEMBLY	1
8	WP2500-31	WP CENTRE BEARING ASSY	1
9	HOSE-DISTRIBUTOR	HOSE ASSEMBLY	2
10	LABEL-PACK-13	WP2500-H & MM1080IE LABEL PACK	1
11	WP2500-0-002	TRAFFOLYTE LABEL - RELEASE N CLAMP	2
12	WP2500-H-TK	WP2500 TOOL KIT	1
13	WP3500-H-0-001	TOP OPENING TRANSPORTATION CASE	1
14	WP3500-HK	WP3500-H HYDRAULIC HOSE KIT	1
15	R245-125Q40-12L	125MM FACE MILL CUTTER 45 LEAD 40MM BORE 6 INSERTS	1
16	R245-12T3E-ML2030	COROMILL 245 INSERTS	1

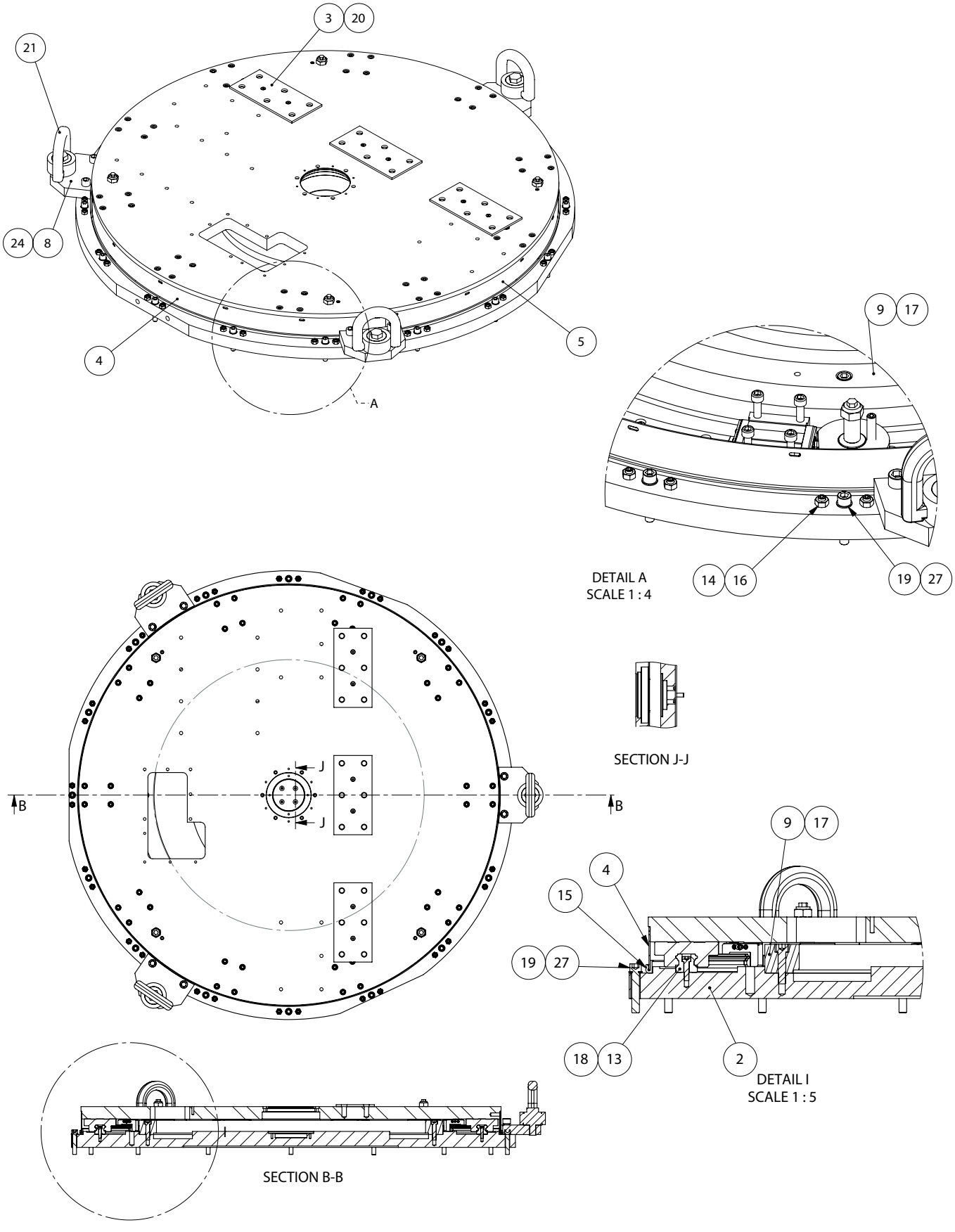
10.2 WP2500-2 - Support Arm Assembly

Revision -. Weight 21kg



Item	Part Number	Description	QTY
1	WP2500-2-001	ARM SUPPORT BRACKET	1
2	WP2500-2-002	SUPPORT ARM WEAR PLATE	2
3	MMIE 1875403	SUPPORT BRACKET SHIM PLATE	1
4	M16	WASHER (FORM A)	2
5	M12 x 55	HEX SOCKET HEAD - BS EN ISO 4762	2
6	M12 x 120	HEX SOCKET HEAD - BS EN ISO 4762	3
7	M16 x 80	HEX SOCKET HEAD - BS EN ISO 4762	2
8	M6 x 12	SOCKET HEAD C,SINK SCREW	8
9	M8x16	SOCKET HD C/SUNK SCREW	2

10.3 WP2500-1 - Drive Ring
Revision H. Weight 1021kg

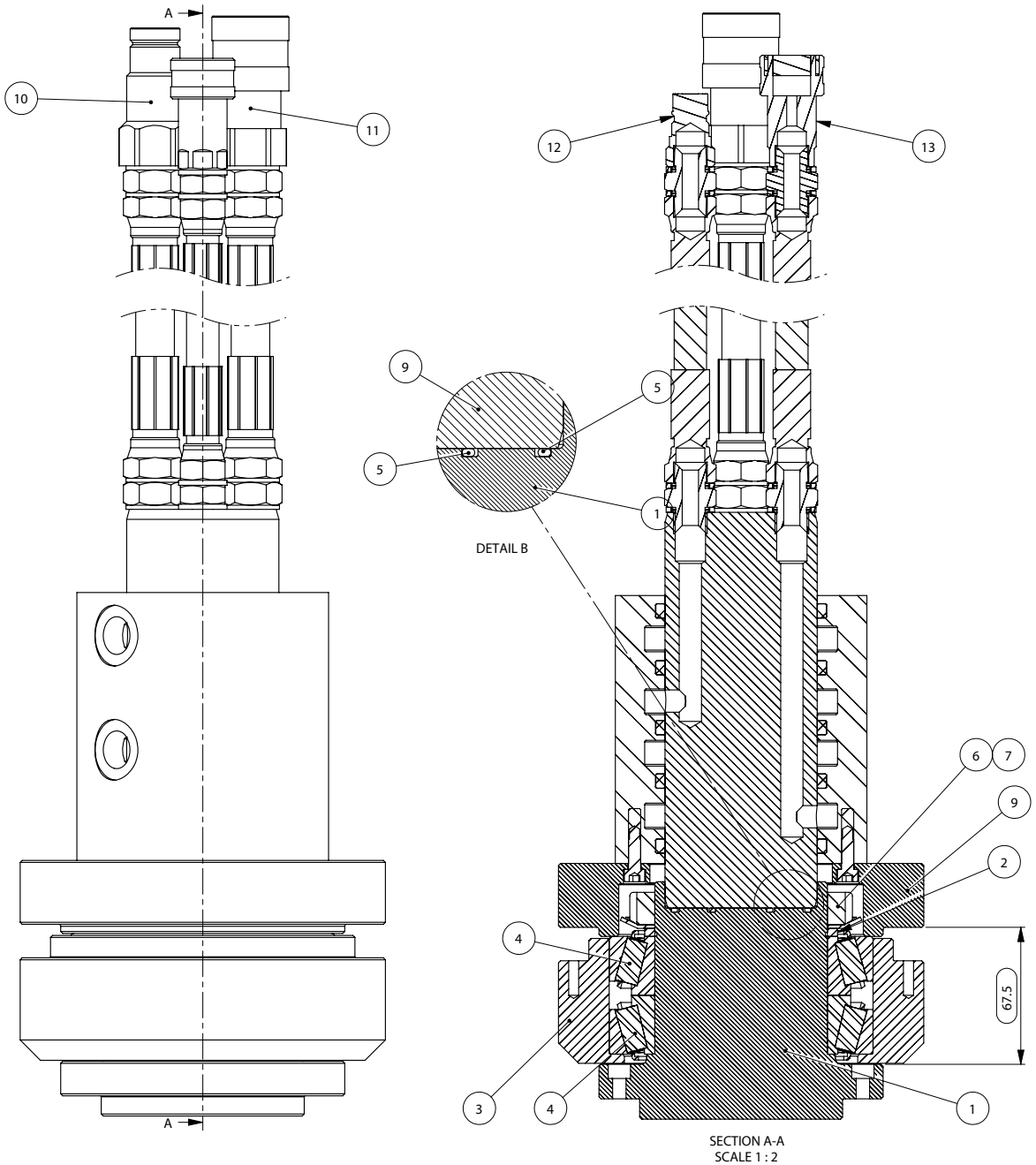


WP2500-1-Drive Ring [Continued]
Revision H.

Item	Part Number	Description	QTY
1	WP2500-1-001	TOP PLATE	1
2	WP2500-1-013	BASE PLATE	1
3	WP2500-1-003	ARM SHIM PLATE	3
4	WP2500-1-005	OD SEAL STRIP STD SECTION	2
5	WP2500-1-006	OD SEAL STRIP STD EXTENDED SECTION	1
6	WP2500-1-007	STEADY SCREW	4
7	WP2500-1-008	MODIFIED SOCKET SET SCREW	4
8	MM1080i-1-005	DRIVE RING ASSY LIFT BRACKET	3
9	NEG 0101	335T INTERNAL GEAR	1
10	OD 0172	LOCKNUT	4
11	MMIE 1877	DAMPER BLOCK	4
12	MMIE 1880	DAMPER	4
13	HCR35A10RR-C160600R6T	HCR LINEAR BEARING RAIL ASSEMBLY	1
14	GN.13986	M10 X 50 BTSS GRUB SCREW	32
15	251-63631 seal strip	MARBETT CODE 2779	1
16	M10 nut	M10 NUT	32
17	M12 x 50	HEX SOCKET HEAD - BS EN ISO 4762	8
18	M8 x 30	HEX SOCKET HEAD - BS EN ISO 4762	40
19	M12	FORM A WASHER	16
20	M6 x 12	SOCKET HEAD C,SINK SCREW	6
21	RLP-M20-10	ROTATING LIFTING POINT	3
22	M8X25	HEX SOCKET HEAD - BS EN ISO 4762	2
23	M10 x 45	HEX SOCKET HEAD - BS EN ISO 4762	40
24	M16 x 70	HEX SOCKET HEAD	6
25	S4315	DIN 2093 DISC SPRING	4
26	M6 x 6	SOCKET SET SCREW FLAT POINT - BS 4168-2	4
27	M12 x 65	HEX SOCKET HEAD - BS EN ISO 4762	16

10.4 WP2500-31 - Centre Bearing Assembly

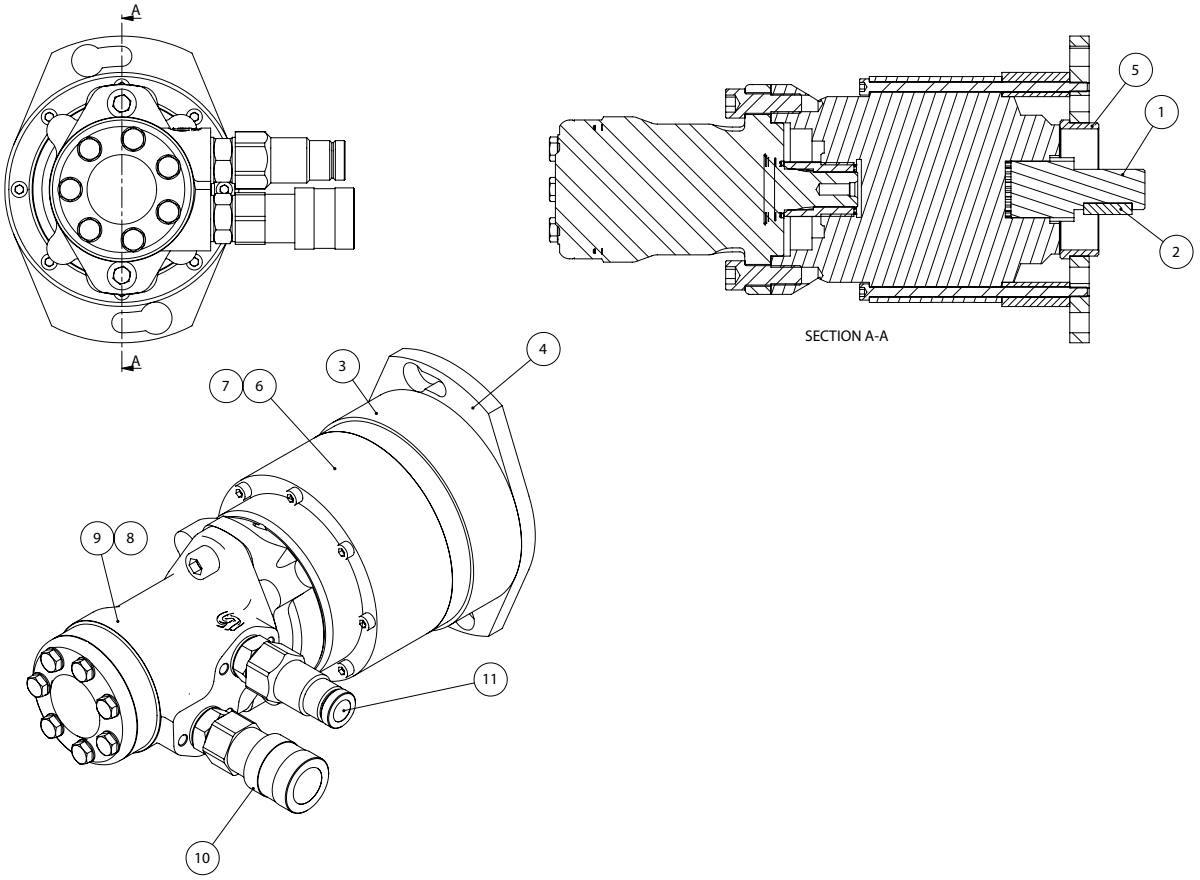
Revision C. Weight 34kg



Item	Part Number	Description	QTY
1	MM1080i-8-001	DISTRIBUTOR POST EXTENSION	1
2	MM1080i-8-002	BEARING SPACER	1
3	SRB3000-H-5-007	BEARING OUTER LOCATION	1
4	32017 X/Q	TAPER ROLLER BEARING	2
5	ORAR00114-NBR	O-RING AXIAL STATIC	4
6	KM17	LOCK NUT	1
7	MB17	LOCK WASHER	1
8	M6 x 80	SOCKET HEAD CAP SCREW	4
9	WP4300-1	WP DISTRIBUTOR ASSEMBLY	1
10	WP2500-31-001	1/2" MALE HOSE ASSEMBLY (300mm LG)	1
11	WP2500-31-002	1/2" FEMALE HOSE ASSEMBLY (300mm LG)	1
12	WP2500-31-003	3/8” MALE HOSE ASSEMBLY (300mm LONG)	1
13	WP2500-31-004	3/8” FEMALE HOSE ASSEMBLY (300mm LONG)	1

10.5 WP3500-7 - Drive Gear Unit - Milling

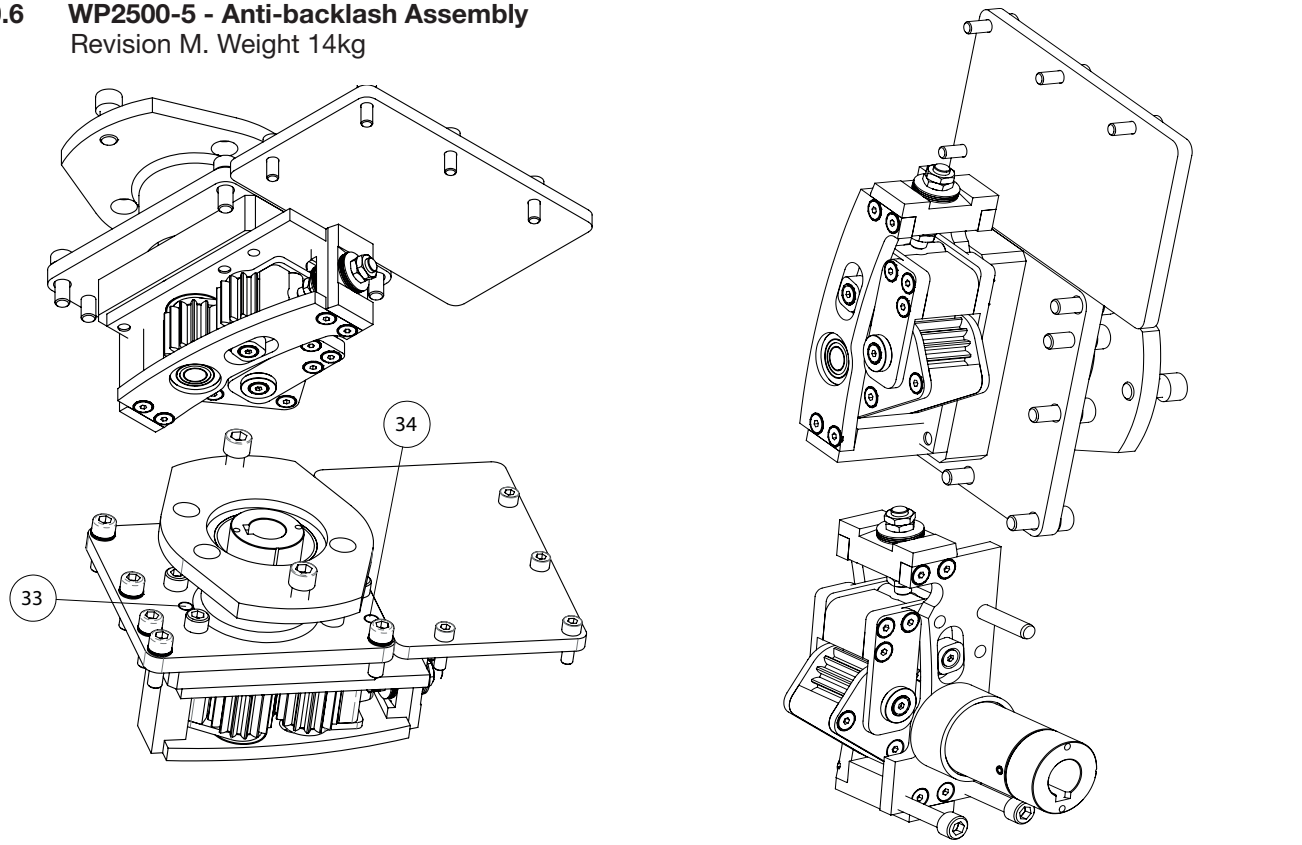
Revision A. Weight 26kg

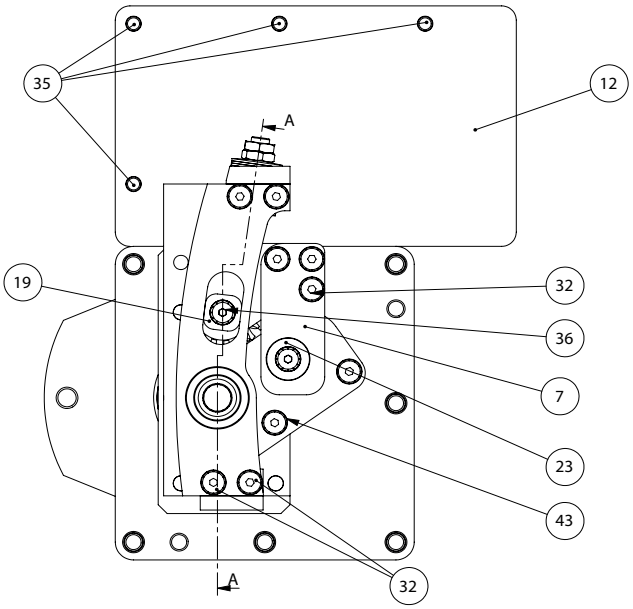


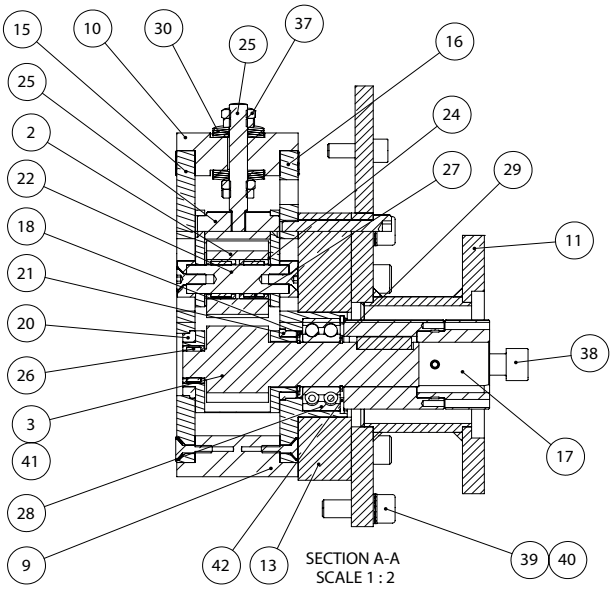
Item	Part Number	Description	QTY
1	MMIE 1875502	20t GEAR STUB SHAFT	1
2	KK8-7-30	ROUNDED END FEATHER KEY	1
3	MMI3000-7-001	QR MILLING FLANGE SPACER	1
4	MMI3000-5-002	QR TURNING FLANGE	1
5	MMI3000-7-002	QR MILLING FLANGE SPIGOT	1
6	RR65 179.32 :1 (154B5535)	3 STAGE GEARBOX	1
7	M6 x 135	SOCKET HEAD CAP SCREW	8
8	M12 x 35	HEX SOCKET HEAD - BS EN ISO 4762	2
9	151-0332	OMP 100 WITH SPLINED OUTPUT SHAFT	1
10	1/2" QRCOUPLING-FEMALE	1/2" QUICK RELEASE COUPLING FEMALE	1
11	1/2" QRCOUPLING-MALE	1/2" QUICK RELEASE COUPLING MALE	1

10.6 WP2500-5 - Anti-backlash Assembly

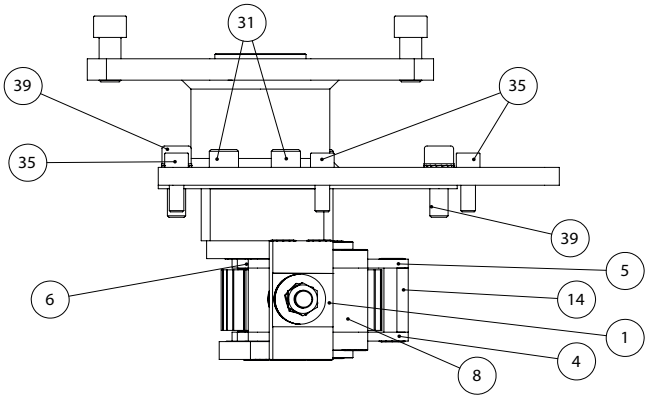
Revision M. Weight 14kg

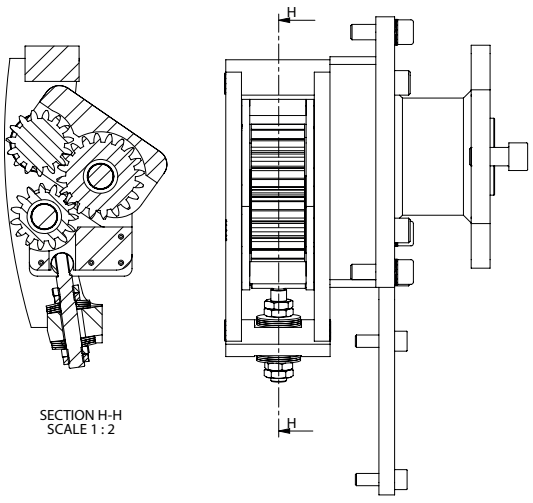






SECTION A-A
SCALE 1 : 2





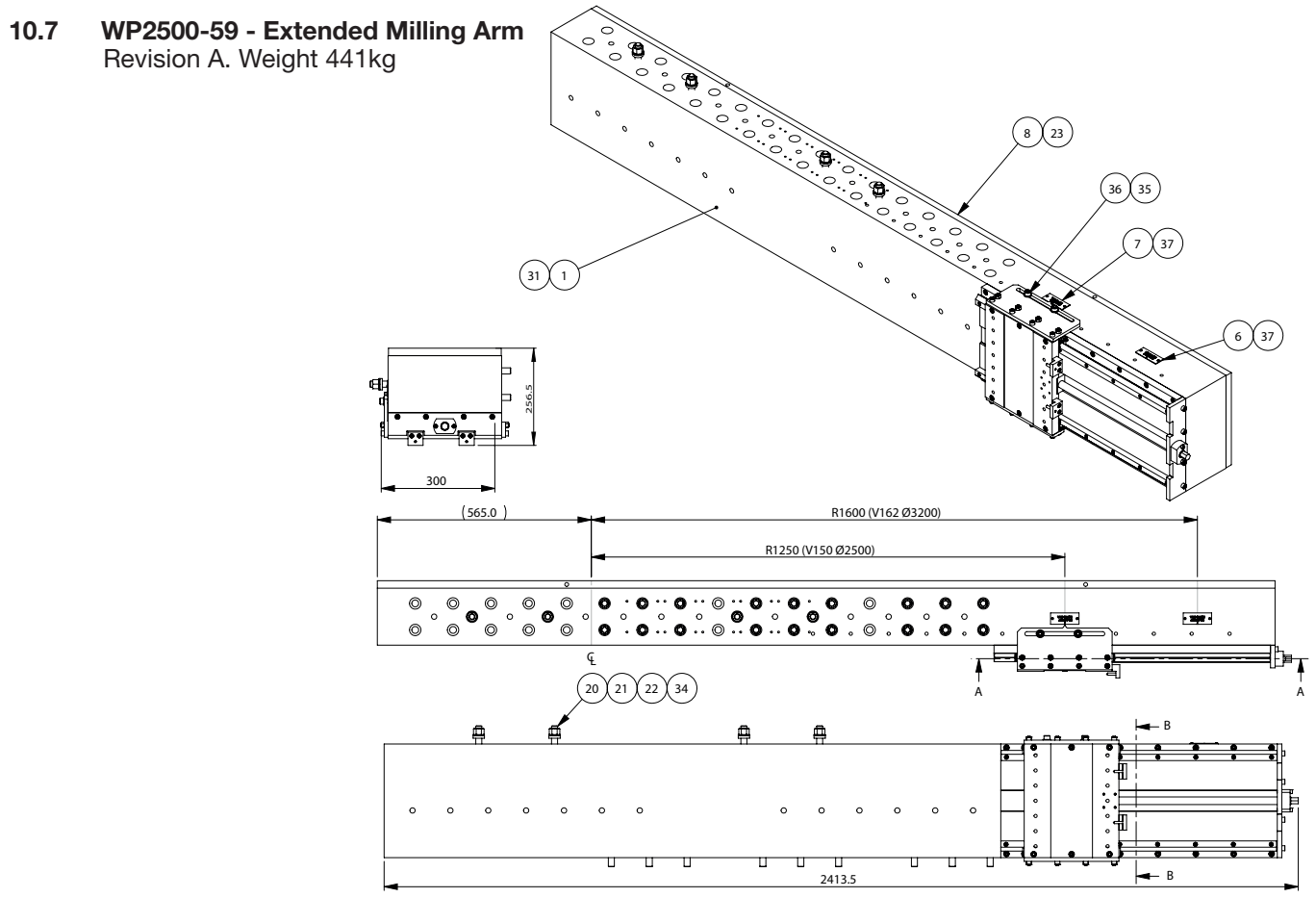
SECTION H-H
SCALE 1 : 2

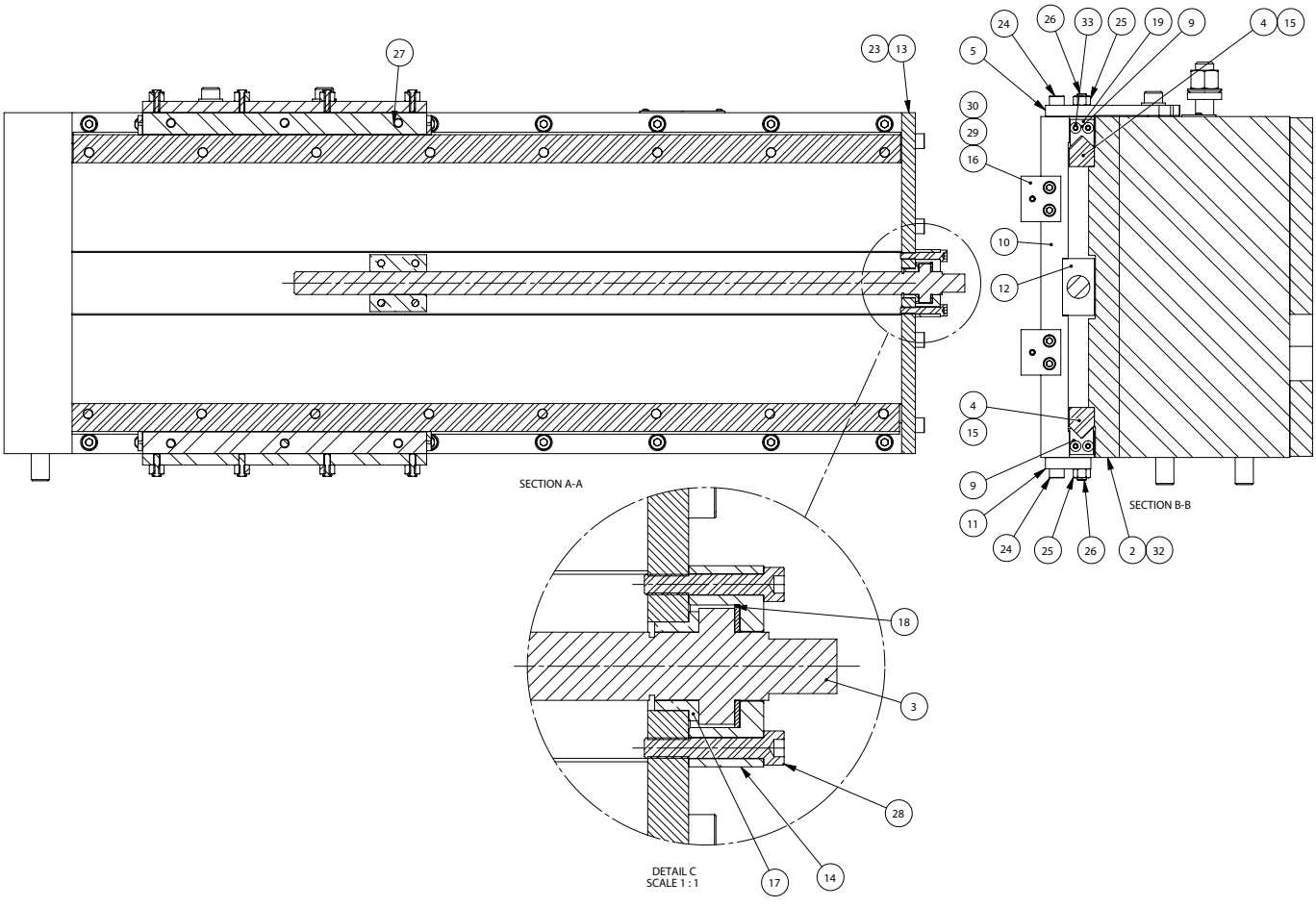
WP2500-5 -Anti-Backlash Assembly [Continued]
Revision M.

Item	Part Number	Description	QTY
1	WP2500-5-001	10DP 20T SPUR GEAR	1
2	WP2500-5-002	10DP 15T SPUR GEAR	1
3	WP2500-5-003	15 TOOTH DRIVE GEAR	1
4	WP2500-5-004	LOWER OUTER LINK PLATE	1
5	WP2500-5-005	UPPER OUTER LINK PLATE	1
6	WP2500-5-006	UPPER INNER LINK PLATE 3	1
7	WP2500-5-007	LOWER INNER LINK PLATE 2	1
8	WP2500-5-008	SPACER , SHORT 2	1
9	WP2500-5-009	END PLATE PLAIN	1
10	WP2500-5-011	END PLATE	1
11	WP2500-5-013	GEARBOX MOUNTING BASE	1
12	WP2500-5-014	INSPECTION PLATE	1
13	WP2500-5-015	ASSEMBLY SPACER	1
14	WP2500-5-016	SPACER LONG	1
15	WP2500-5-017	GUIDE BOTTOM PLATE	1
16	WP2500-5-018	GUIDE TOP PLATE	1
17	WP2500-5-029	DRIVE SLEEVE ASSEMBLY	1
18	WP2500-5-020	CIRCLIP WASHER	1
19	WP2500-5-021	RADIUSED RETAINER	2
20	WP2500-5-022	LOWER BUSH	1
21	WP2500-5-023	UPPER BUSH	1
22	WP2500-5-024	PIVOT LONG	2
23	WP2500-5-025	PIVOT RETAINER	2
24	WP2500-5-026	THRUST WASHER	4
25	WP2500-5-028	STUD BAR/ADJUSTER WELDED ASSEMBLY	1
26	HK 1512	DRAWN CUP NEEDLE ROLLER BEARING	1
27	HK 1616	DRAWN CUP NEEDLE ROLLER BEARING	4
28	3205 2RS	DOUBLE ROW ANG CON BRG	1
29	0250	EXTERNAL CIRCLIP	2
30	BELLEVILLE P28102125.	BELLEVILLE WASHERS	8
31	M10 x 50	CAP HEAD SOCKET SCREW	4
32	M6 x 20	M6 COUNTERSINK SCREW	18
33	10 x 25	PARALLEL PIN	1
34	10 x 50	PARALLEL PIN	1
35	M8 x 25	HEX SOCKET HEAD - BS EN ISO 4762	4
36	M6 X 16	HEX SOCKET CTSK HEAD - BS EN ISO 10642	4
37	M10	HEX THIN NUT GRADE AB - BS EN 24035	4
38	M12 x 25	HEX SOCKET HEAD - BS EN ISO 4762	2
39	M10 x 30	HEX SOCKET HEAD - BS EN ISO 4762	8
40	NL10SS	M10 NORD LOCK WASHER	8
41	KK8-7-30	ROUNDED END FEATHER KEY	1
42	D1300 0520	INTERNAL CIRCLIP	1
43	M6	TYPE V SERRATED LOCK WASHER	18

10.7 WP2500-59 - Extended Milling Arm

Revision A. Weight 441kg



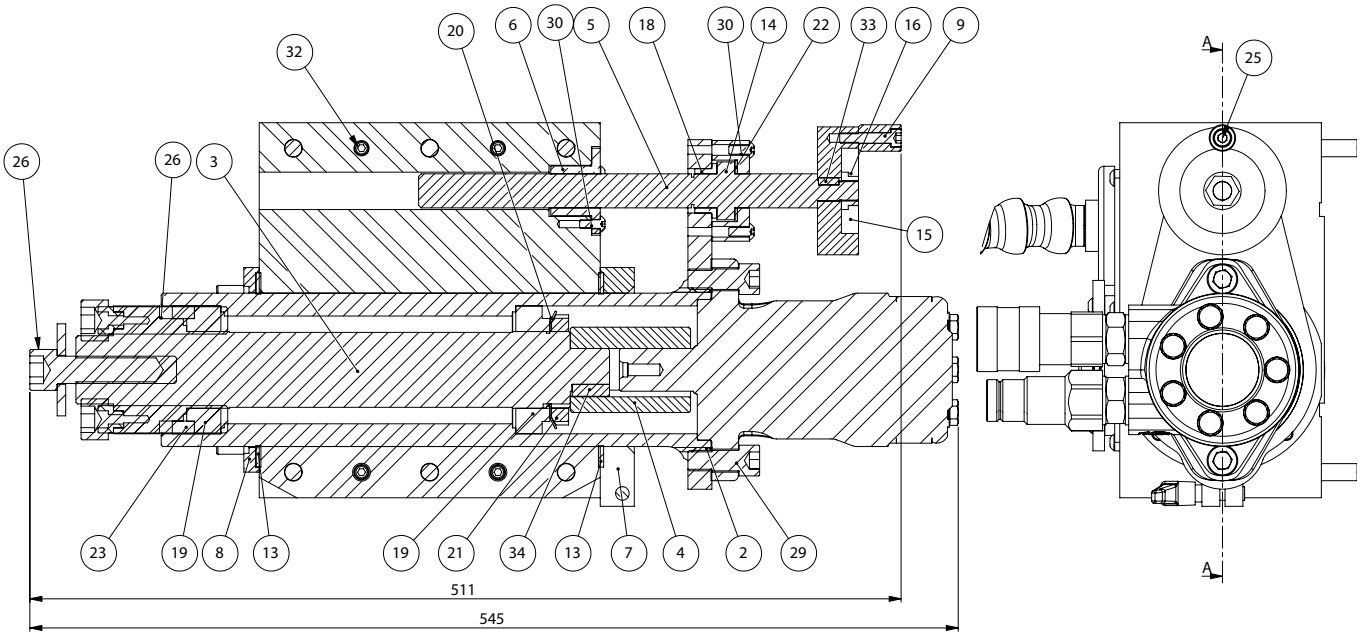


WP2500-59- Extended Milling Arm [Continued]
Revision A.

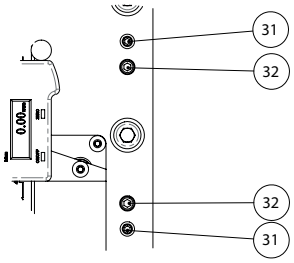
Item	Part Number	Description	QTY
1	WP2500-59-001	MILLING ARM	1
2	WP2500-59-002	CROSS SLIDE SUPPORT	1
3	WP2500-59-003	FEED SCREW	1
4	WP2500-59-004	LINEAR RAIL	2
5	WP2500-59-005	CARRIAGE RAIL PLATE	1
6	WP2500-59-007	V162 BLADE Ø3200 PCD	1
7	WP2500-59-006	V150 BLADE Ø2500 PCD	1
8	WP3500-10-002	MILLING ARM BACKPLATE	1
9	WP2500-3-003	MODIFIED LWRPM9 SKF RAIL X 250 LONG	2
10	NEG 0107	CARRIAGE	1
11	NEG 0108	CARRIAGE RAIL PLATE	1
12	NEG 0121	FEED NUT	1
13	NEG 0122	THRUST PLATE	1
14	HTD 0416	THRUST BEARING HOUSING	1
15	MMI8388A	MODIFIED M8 BUTTON HEAD SCREW	16
16	MM1080i-5-005	FINE ADJUST FOR TOOL POST	2
17	AMF202615	OILITE BUSH	1
18	WC18DU	THRUST WASHER	1
19	LWEARM9	WIPER	4
20	21150.W0662	M16 X 2.0 X 80 STUD	4
21	25400.W0116	DISHED WASHER	4
22	25100.W0116	SPHERICAL SEAT WASHER	4
23	M8 x 25	HEX SOCKET HEAD - BS EN ISO 4762	22
24	M8 x 20	HEX SOCKET HEAD - BS EN ISO 4762	8
25	M8	HEX NUT GRADE C	8
26	M8 x 20	SOCKET SET SCREW FLAT POINT	8
27	M8 x 35	HEX SOCKET HEAD - BS EN ISO 4762	6
28	M6 x 35	HEX SOCKET HEAD - BS EN ISO 4762	6
29	M6 x 25	HEX SOCKET HEAD - BS EN ISO 4762	4
30	M6 x 35	SOCKET SET SCREW CONE POINT - BS 4168-3	2
31	M16 x 220	HEX SOCKET CAP HEAD	18
32	M8 x 30	Hex Socket Head - BS EN ISO 4762	16
33	M5 x 12	Hex Socket Button Head - BS EN ISO 7380	8
34	M16	Hex Nut Style 2 - BS EN 24033	4
35	M10-WASHER	WASHER (FORM A)	2
36	M10 x 30	Hex Socket Head - BS EN ISO 4762	2
37	M3 x 6	Hex Socket Button Head - BS EN ISO 7380	4

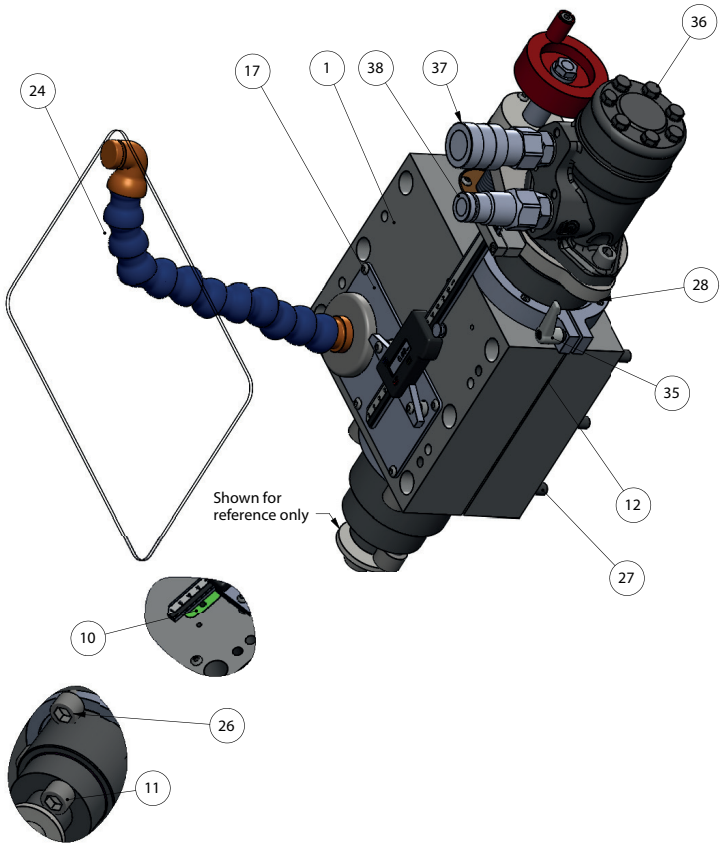
10.8 NEG 0100-1 - WP2500 Spindle Assembly

Revision I. Weight 37kg



SECTION A-A



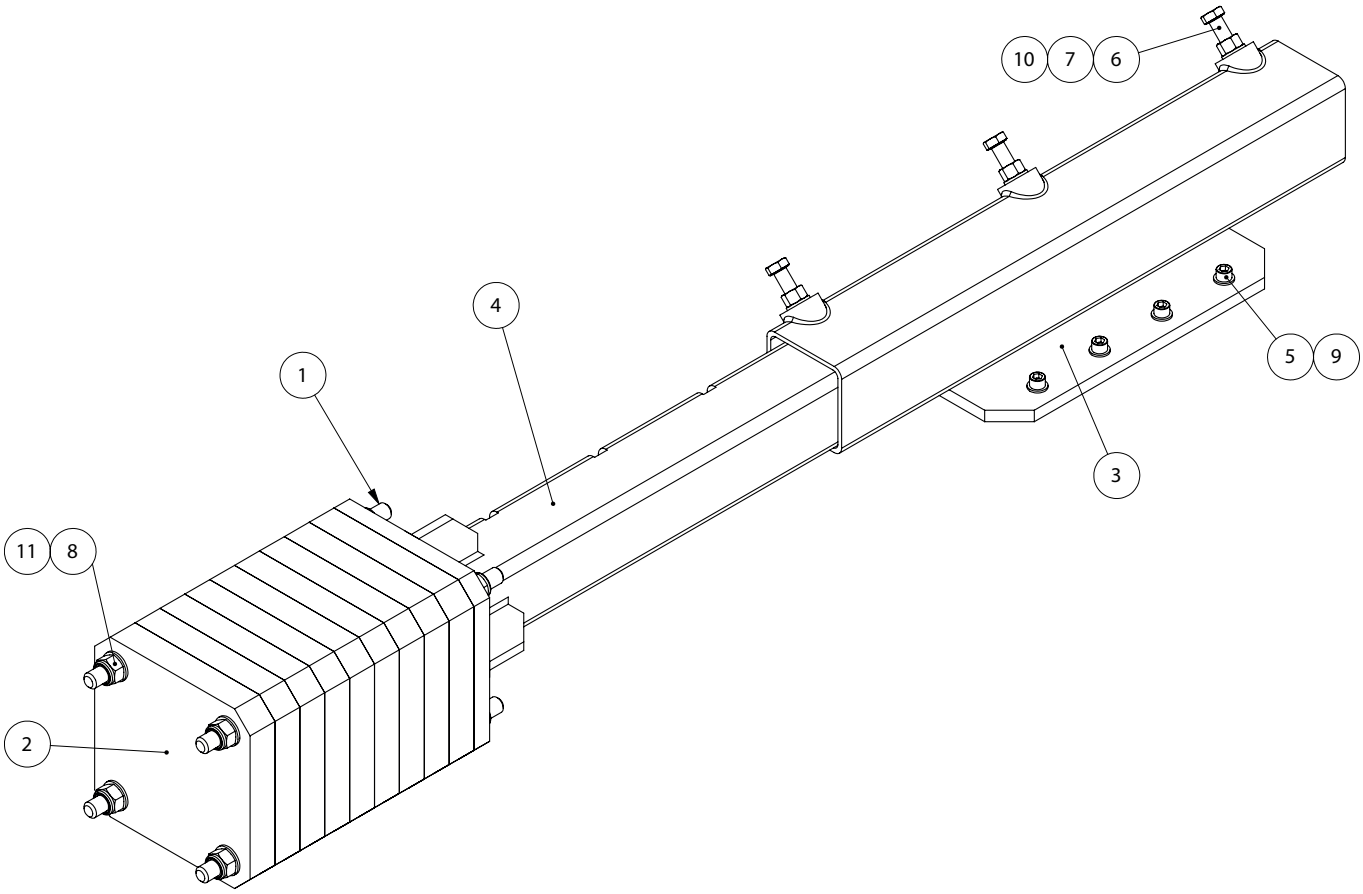


NEG 0100-1 - WP2500 Spindle Assembly [Continued]
Revision I

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	M16 x 70	HEX SOCKET HEAD	7
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	M5 x 12	HEX SOCKET BUTTON HEAD - BS EN ISO7380	5
31	M6 x 16	SOCKET SET SCREW FLAT POINT - BS 4168-2	2
32	M8 x 25-C	SOCKET SET SCREW CONE POINT	4
33	KK4-12A	TYPE A KEY	1
34	KK8-7-22C	TYPE C KEY	1
35	WDS8189-20525	INDEXING CLAMPING HANDLE, ZINC DIECAST	1
36	151-0314	OMP 160	1
37	1/2” QRCOUPLINGFE-MALE	1/2” QUICK RELEASE COUPLING FEMALE SET	1
38	1/2” QRCOU-PLING-MALE	1/2” QUICK RELEASE COUPLING MALE SET	1

10.9 D32-11-040 - Counterweight Assembly

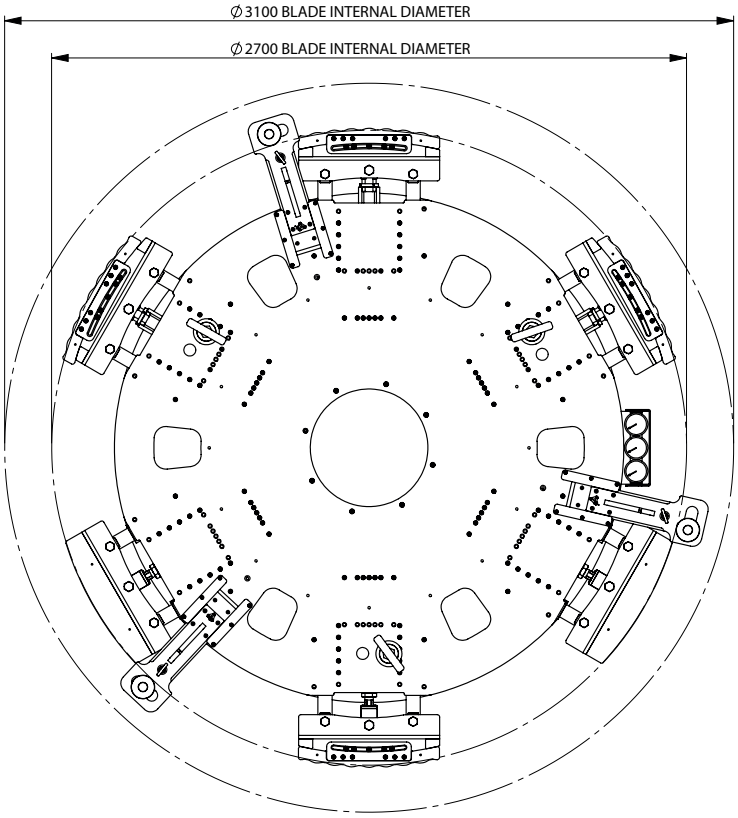
Revision A. Weight 249kg

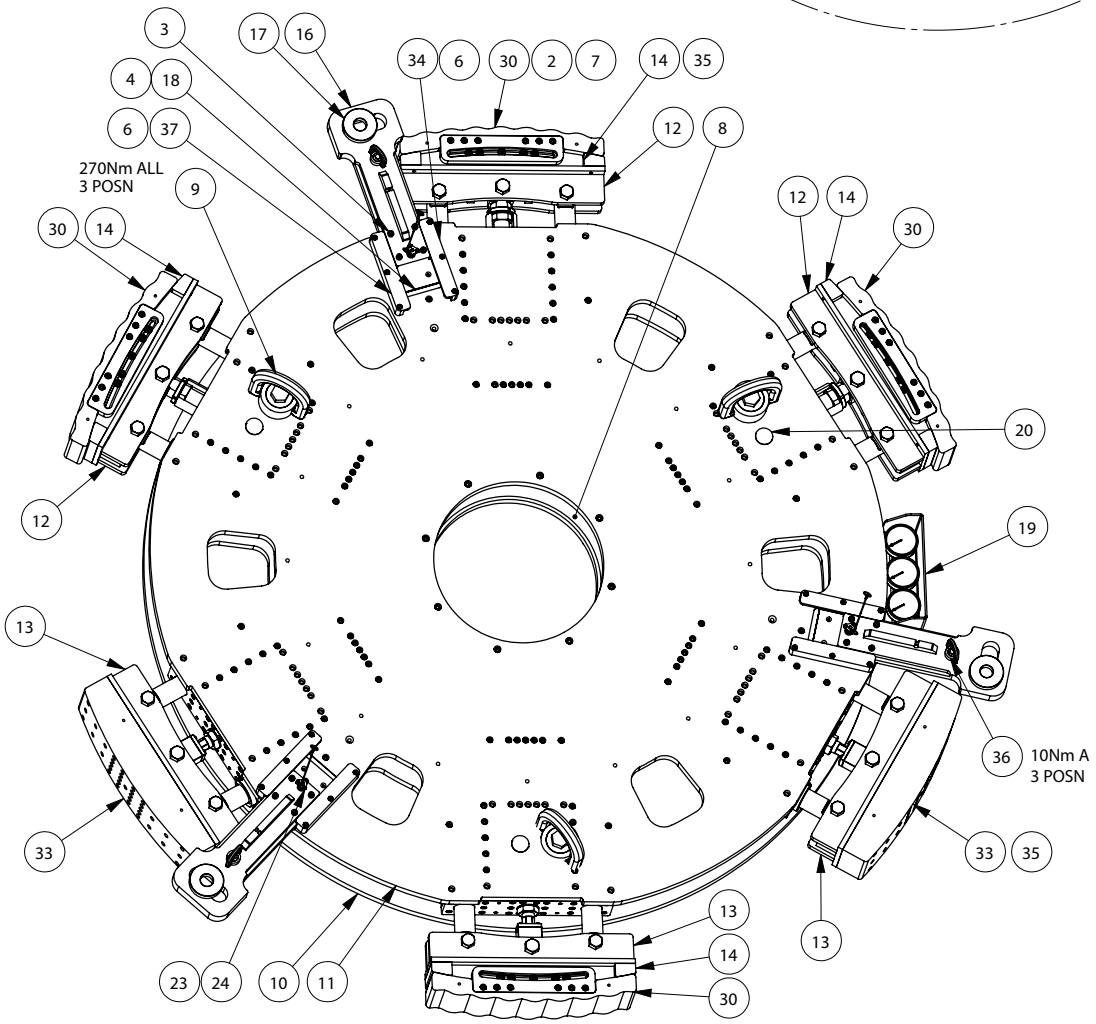


Item	Part Number	Description	QTY
1	D32-11-105	COUNTERWEIGHT THREADED BAR	4
2	D32-11-109	COUNTERWEIGHT WEIGHT	9
3	D32-11-110	COUNTERWEIGHT BASE	1
4	D32-11-111	COUNTERWEIGHT ARM	1
5	M12 x 40	HEX SOCKET HEAD	8
6	M16 x 70	HEX SCREW GRADE AB	3
7	M16	HEXAGON NUT	3
8	M20	METRIC NYLOC NUT	8
9	Bright washer BS4320 - M12	WASHER (FORM A)	8
10	M16	WASHER (FORM A)	3
11	M20	WASHER (FORM A)	8

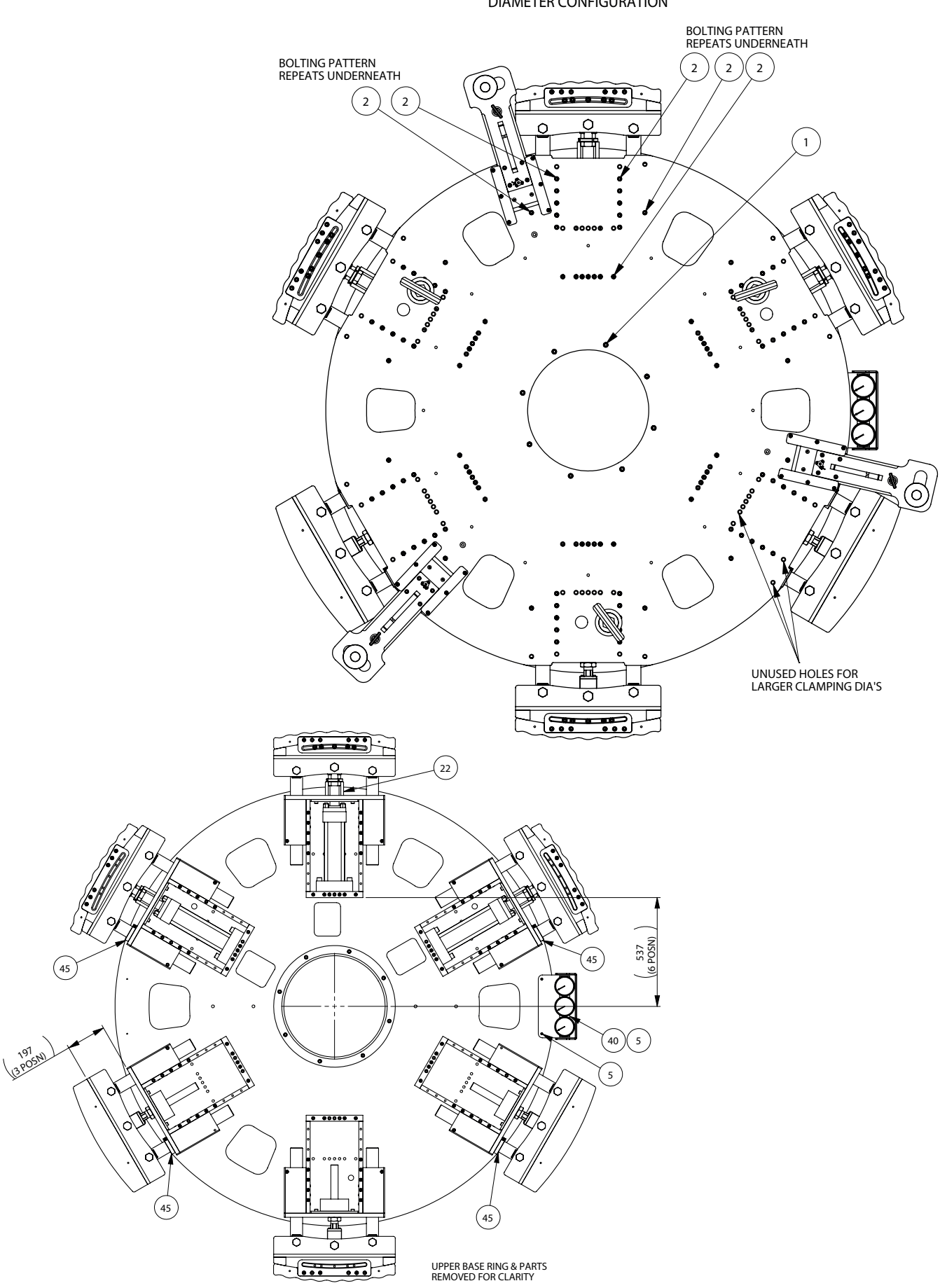
10.10 WP3500-50 - Hydraulic Base Assembly (6 LEG HYDRAULIC BASE DUAL DIA'S 2700mm & 3100mm

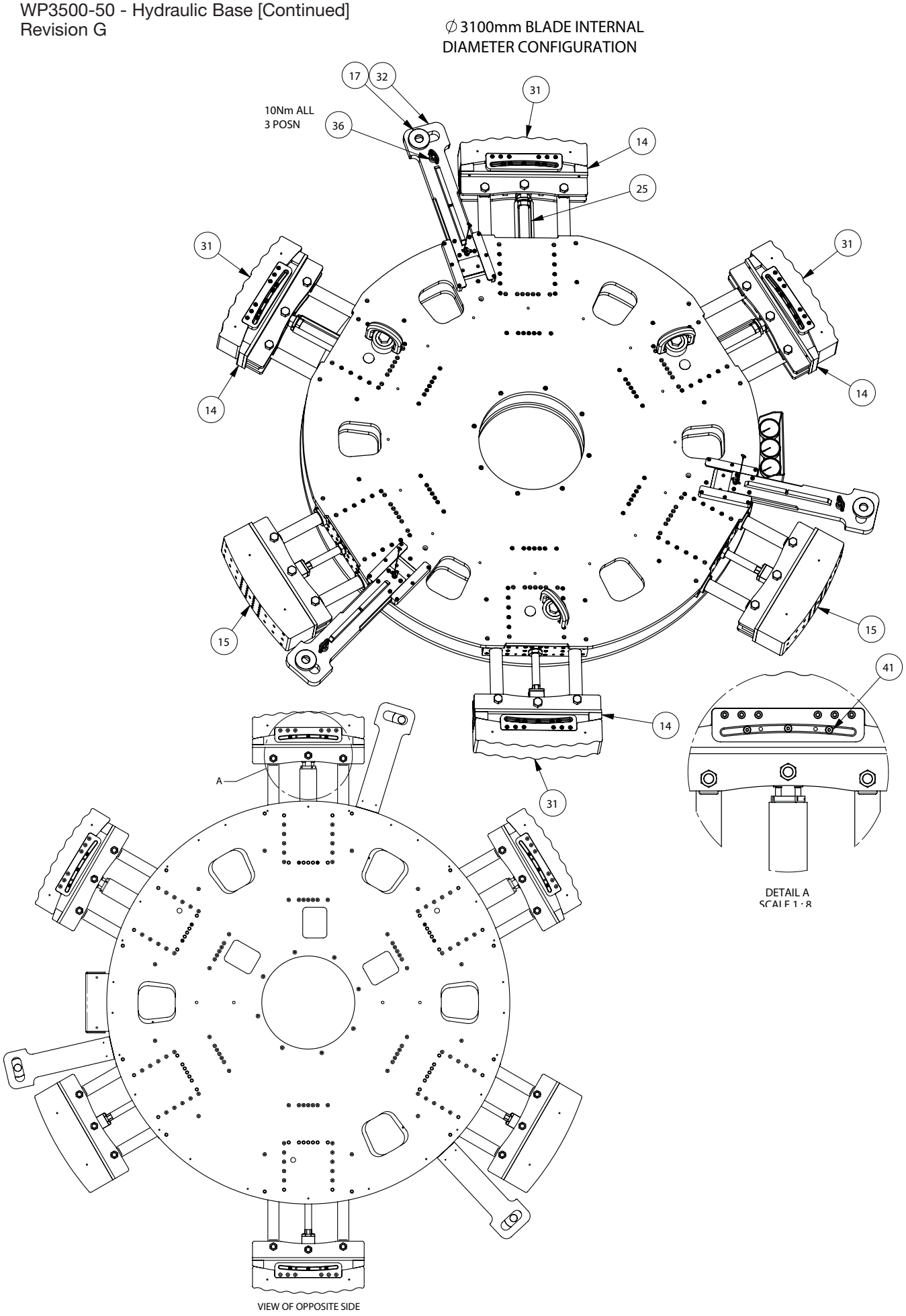
Revision G. Weight 3400kg



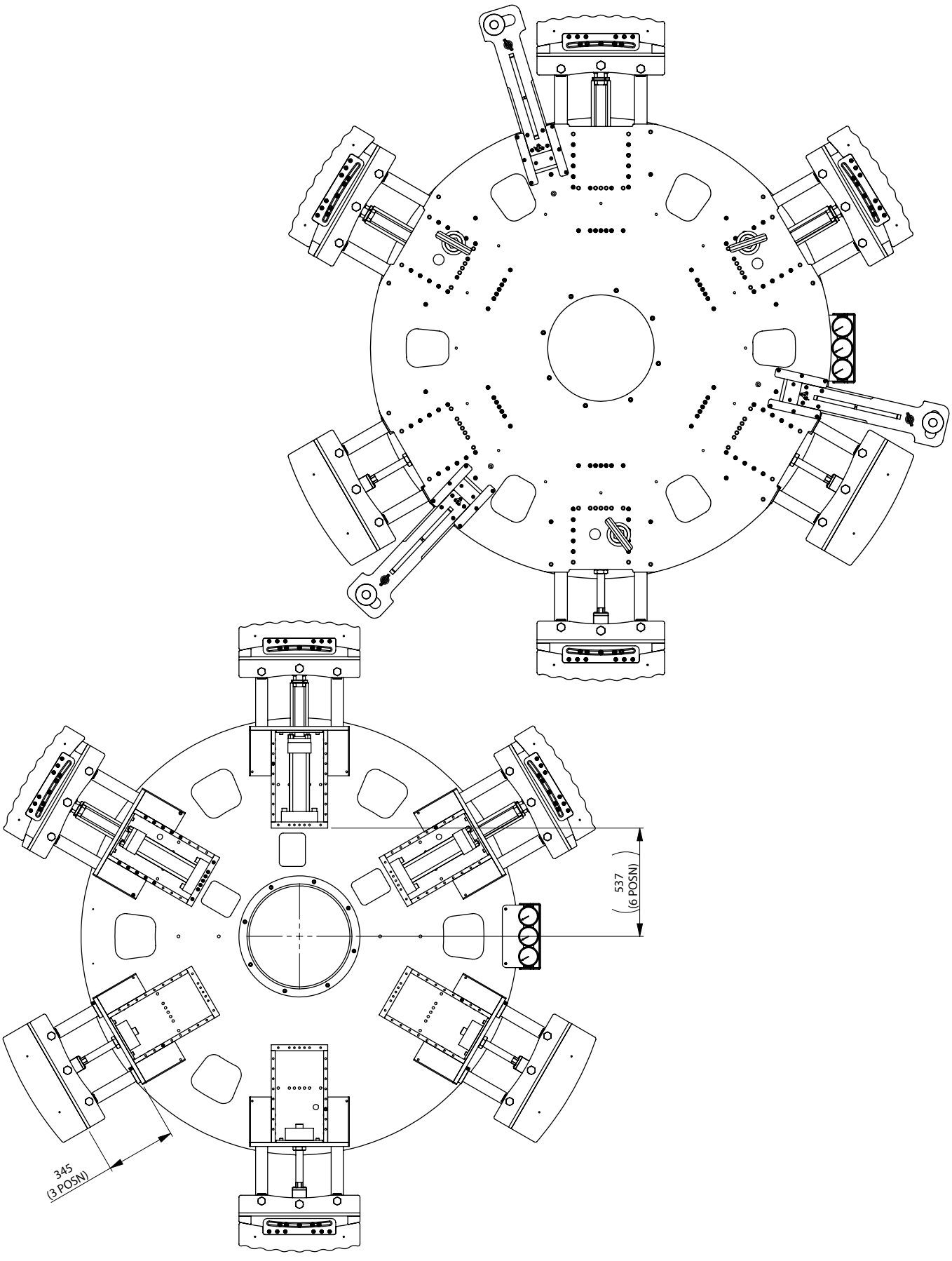


∅2700mm BLADE INTERNAL DIAMETER CONFIGURATION


∅2700mm BLADE INTERNAL
DIAMETER CONFIGURATION
BOLTING PATTERN
REPEATS UNDERNEATH
BOLTING PATTERN
REPEATS UNDERNEATH
2
2
2
2
2
1
UNUSED HOLES FOR
LARGER CLAMPING DIA'S
22
45
45
537
(6 POSN)
40
5
5
197
(3 POSN)
45
45
UPPER BASE RING & PARTS
REMOVED FOR CLARITY


∅3100mm BLADE INTERNAL DIAMETER CONFIGURATION
10Nm ALL 3 POSN
17
32
31
36
14
25
31
31
14
14
15
15
41
14
31
A
DETAIL A
SCALE 1:8
VIEW OF OPPOSITE SIDE

∅3100mm BLADE INTERNAL
DIAMETER CONFIGURATION



UPPER BASE RING & PARTS
REMOVED FOR CLARITY

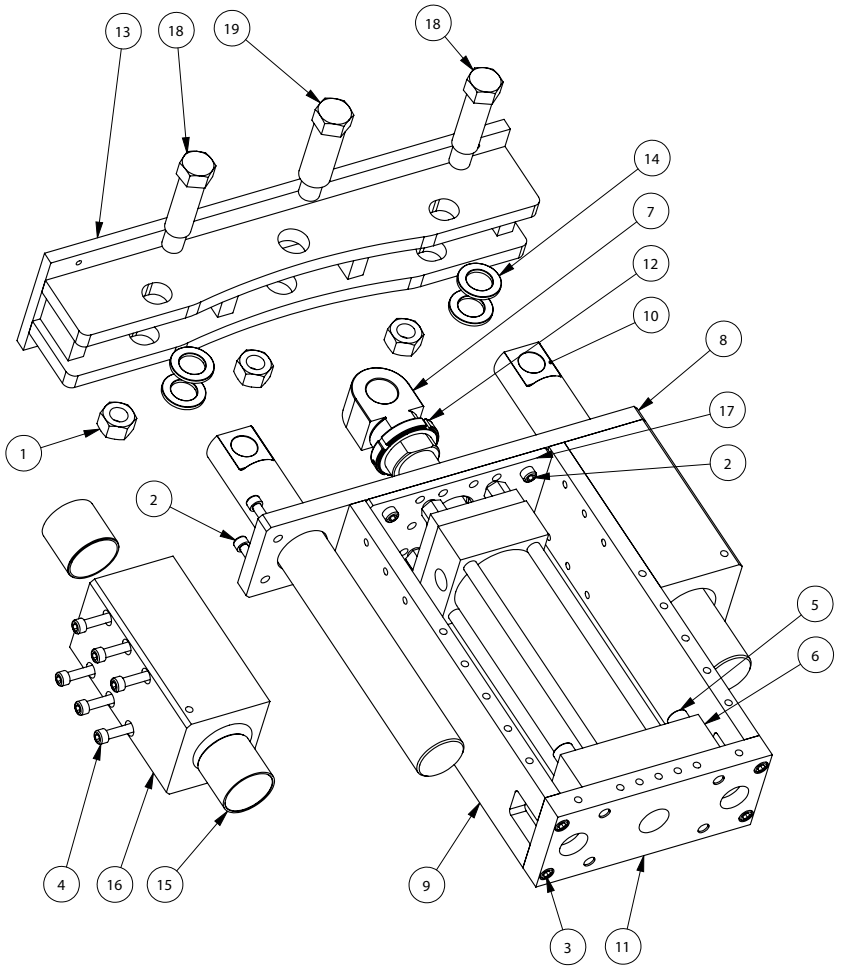
WP3500-50 - Hydraulic Base [Continued] Revision G

Item	Part Number	Description	QTY for Ø2700mm	QTY for Ø3100mm
1	M12 x 40	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	16	16
2	M10 x 35	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	228	228
3	M10 x 65	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	12	12
4	M6 x 10	HEX SOCKET CTSK HEAD - BS EN ISO 10642 BZP	12	12
5	M6 x 12	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	4	4
6	M8 x 45	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	18	18
7	M10-WASHER	WASHER (FORM A)	20	20
8	WP2500-6-003	SPACER RING	1	1
9	RLP-M30-10	ROTATING LIFTING POINT	3	3
10	WP3500-H-50-002	LOWER BASE RING	1	1
11	WP3500-H-50-001	UPPER BASE RING	1	1
12	WP3500-54	CYLINDER EXTENDING WAVY FOOT ASSEMBLY	3	3
13	WP3500-55	MANUAL EXTENDING WAVY FOOT ASSEMBLY	3	3
14	WP3500-50-004	WAVY SHOE SUPPORT	4	4
15	WP3500-50-003	SHOE CLAMPING DIA 3112MM	-	4
16	WP3500-50-006	SETTING STRAP 2800MM PCD	3	-
17	WP3500-6-028	SETTING STRAP WASHER	3	3
18	WP3500-50-012	4MM STRAP SHIM	3	3
19	WP2500-61-010	GAUGE GUARD COMPACT	1	1
20	LABEL-MM-076	Mandatory Safety Label: ‘’Lift Point’’ ISO 3864-2	3	3
21	WP3500-50-100	HYDRAULIC KIT FOR 255mm STROKE CYLINDER	1	1
22	WP3500-50-009	LOCKING SPACER 67mm	3	-
23	33250.W0956	LANYARD WITH SPLIT RINGS 300mm	3	3
24	33060.W0193	BALL LOCK PIN - SINGLE ACTING - ORANGE	3	3
25	WP3500-50-008	LOCKING SPACER 215mm	-	3
26	WP3500-50-BOX	BOX FOR 6 LEG HYDRAULIC BASE 2700-3100mm INTERNAL	1	1
27	LABEL-MM-028	Letter ‘A’ Label	1	1
28	LABEL-MM-029	Letter ‘B’ Label	1	1
29	LABEL-MM-030	Letter ‘C’ Label	1	1
30	WP3500-56	WAVY SHOE 2800mm PCD ASSLY	4	-
31	WP3500-57	WAVY SHOE 3200mm PCD ASSLY	-	4
32	WP3500-50-007	SETTING STRAP 3200mm PCD	-	3
33	WP3500-50-016	SHOE CLAMPING DIA 2704mm	4	-
34	WP3500-50-017	RAIL - SETTING STRAP	3	3
35	M8 x 35	Hex Socket Cap Head - BS EN ISO 4762 G10.9 BZP	90	90
36	RLP-M8-10	ROTATING LIFTING POINT	7	7
37	WP3500-50-020	RAIL - SETTING STRAP OPP HAND	3	3
38	WP3500-50-014	5mm STRAP SHIM	3	3
39	WP3500-50-015	6mm STRAP SHIM	3	3
40	WP2500-61-009	GAUGES MANIFOLD COMPACT	1	1
41	M10x1.5 (12mmx-16mm)	HEX SKT CAP HD SHOULDER SCREW BS 4168-7	12	12
42	LABEL-MM-033	MACHINE IDENTIFICATION STICKER	1	1
43	LABEL-MM-002	LARGE MACHINE LABEL	3	3
44	LABEL-MM-007	BOX STICKER	1	1
45	1LM060	CLAMPING COLLAR 60mm BORE	4	4

NOTES:
1. ITEMS 38 & 39 NOT SHOWN ON THE DRAWING BUT CAN BE USED INSTEAD OR WITH ITEM 18.
2. THE FOLLOWING ITEMS ARE NOT SHOWN ON THE DRAWING: 21, 26, 27, 28, 29, 42, 43, 44.
3. ITEMS 15 & 33 HAVE ONLY 2 SHOWN ON THE DRAWING AND THERE ARE 2 SPARE OF EACH (NOT SHOWN).
4. ITEM 36 HAS 3 SHOWN ON THE DRAWING AND 4 CAN BE USED AS LIFTING AIDS FOR THE CLAMPING SHOES.

10.11 WP3500-54 - CYLINDER EXTENDING WAVY FOOT ASSEMBLY

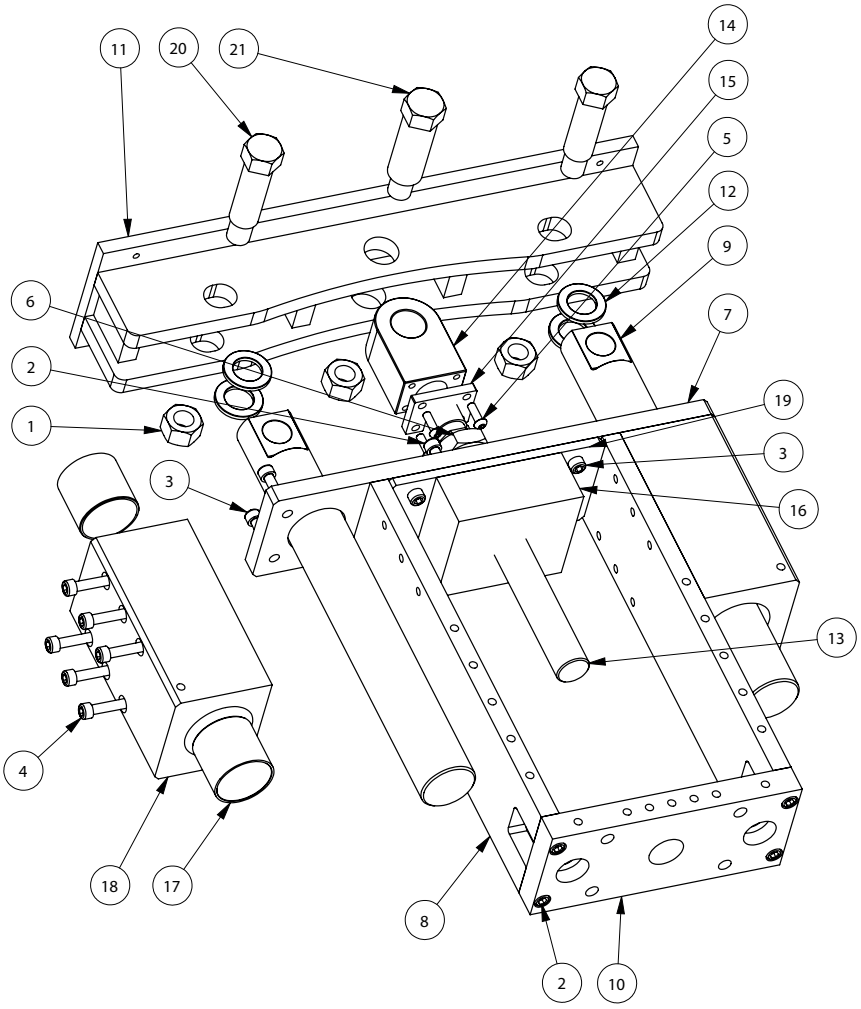
Revision A. Weight 104kg



Item	Part Number	Description	QTY
1	M24x3	HEX NUT STYLE 1 - ISO 4032 BZP	3
2	M10x1.5x 30	HEX SOCKET HEAD - BS EN ISO 4762 G10.9 BZP	14
3	M10x1.5x 40	HEX SOCKET HEAD BS EN ISO 4762 G10.9 BZP	4
4	M10x1.5x 100	HEX SOCKET HEAD - BS EN ISO 4762 G10.9 BZP	12
5	M16x2 x80	HEX SOCKET HEAD - BS EN ISO 4762 G10.9 BZP	4
6	CD8045B255S	HYDRAULIC CYLINDER, 255MM STROKE	1
7	WP2500-65-008	ROD END THREADED	1
8	WP2500-65-003	TOP PLATE CYLINDER ASSLY	1
9	WP2500-65-001	SIDE PLATE CYLINDER ASSLY	2
10	WP2500-65-007	GUIDE ROD	2
11	WP2500-65-002	CYLINDER SUPPORT PLATE	1
12	KMK 12	KMK 12 M60X2 LOCK NUT	1
13	WP3500-H-54-001	FOOT TO FIX WAVY SHOE	1
14	WP2500-65-010	SPACER	4
15	GSM-6065-60	SLEEVE BRG ID60 X60 IGLIDUR G	4
16	WP2500-65-006	SLEEVE BEARING HOUSING	2
17	WP2500-65-009	SETTING PLATE CYLINDER ASSLY	1
18	WP2500-6-011	30MM PIVOT BOLT	2
19	WP2500-6-012	36MM PIVOT BOLT	1

10.12 WP3500-55 - MANUAL EXTENDING WAVY FOOT ASSEMBLY

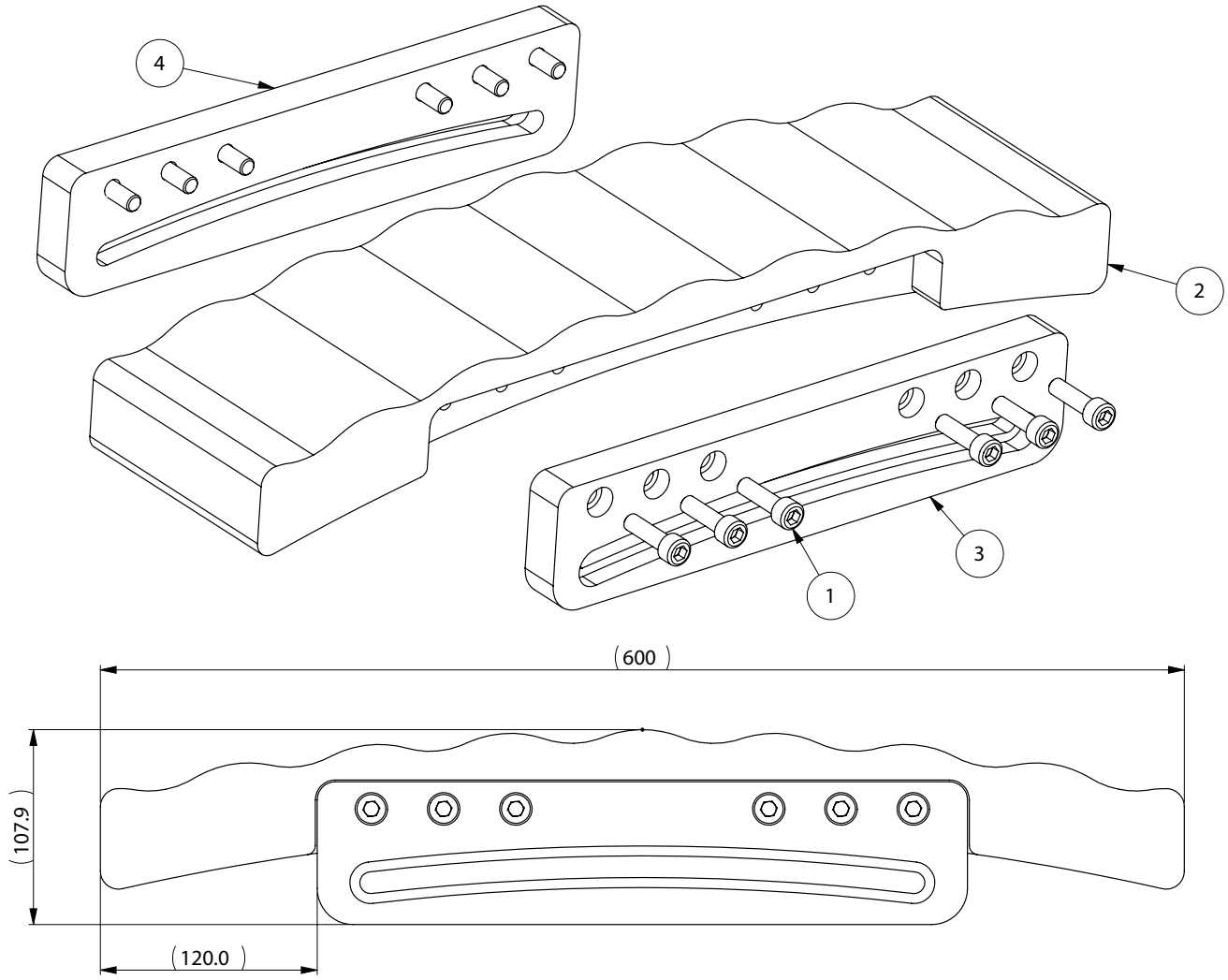
Revision A, Weight 105kg



Item	Part Number	Description	QTY
1	M24x3	HEX NUT STYLE 1 - BS EN 24493	3
2	M10x1.5 x 40	HEX SOCKET CAP HEAD - BS EN ISO 4762 G10.9 BZP	14
3	M10x1.5 x 30	HEX SOCKET CAP HEAD - BS EN ISO 4762 G10.9 BZP	14
4	M10x1.5 x 100	HEX SOCKET CAP HEAD - BS EN ISO 4762 G10.9 BZP	12
5	M8x1.25 x 25	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	4
6	M36x4 THIN NUT	HEX THIN NUT GRADE AB	1
7	WP2500-65-003	TOP PLATE CYLINDER ASSLY	1
8	WP2500-65-001	SIDE PLATE CYLINDER ASSLY	2
9	WP2500-65-007	GUIDE ROD	2
10	WP2500-65-002	CYLINDER SUPPORT PLATE	1
11	WP3500-H-54-001	FOOT TO FIX WAVY SHOE	1
12	WP2500-65-010	SPACER	4
13	WP2500-66-001	JACK SCREW MANUAL ASSLY	1
14	WP2500-6-009	ROD END PLAIN	1
15	WP2500-6-008	ROD END RETAINER	1
16	WP2500-66-002	SCREW BLOCK MANUAL ASSLY	1
17	GSM-6065-60	SLEEVE BRG ID60 X60 IGLIDUR G	4
18	WP2500-65-006	SLEEVE BEARING HOUSING	2
19	WP2500-65-009	SETTING PLATE CYLINDER ASSLY	1
20	WP2500-6-011	30MM PIVOT BOLT	2
21	WP2500-6-012	36MM PIVOT BOLT	1

10.13 WP3500-56 WAVY SHOE 2800MM PCD ASSEMBLY

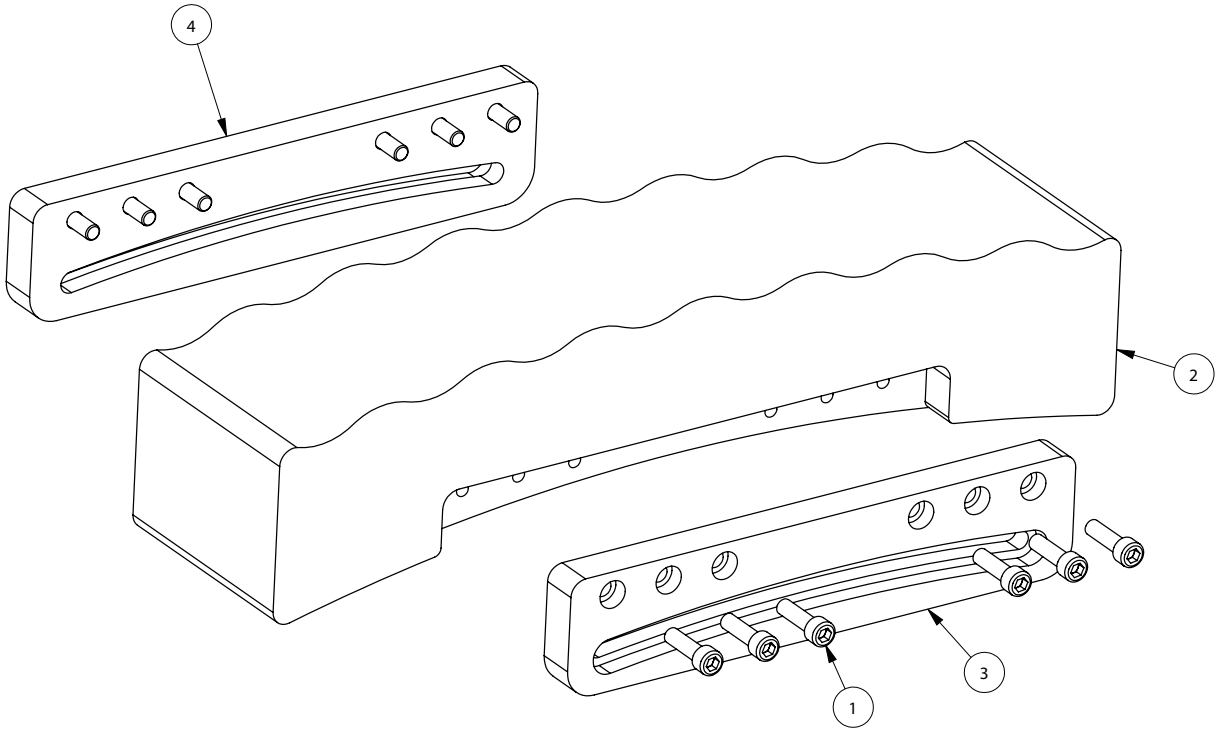
Revision A, Weight 15kg

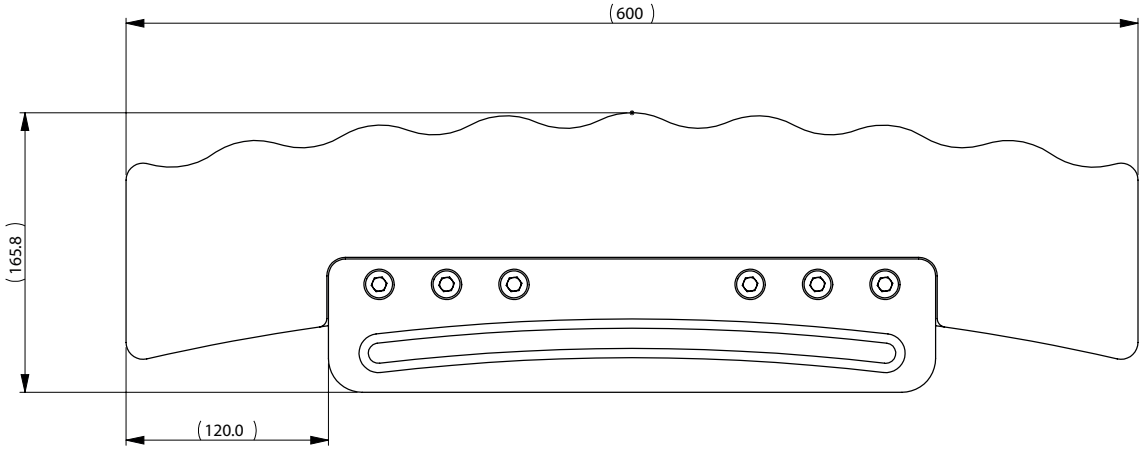


Item	Part Number	Description	QTY
1	M10 x 35	Hex Socket Cap Head - BS EN ISO 4762 G10.9 BZP	12
2	WP3500-H-50-010	WAVY SHOE 2800mm PCD - COMPENSATING	1
3	WP3500-H-50-018	SUPPORT PLATES - SHOE	1
4	WP3500-H-50-019	SUPPORT PLATE OPP HAND - SHOE	1

10.14 WP3500-57 - WAVY SHOE 3200MM PCD ASSEMBLY

Revision A. Weight 29kg

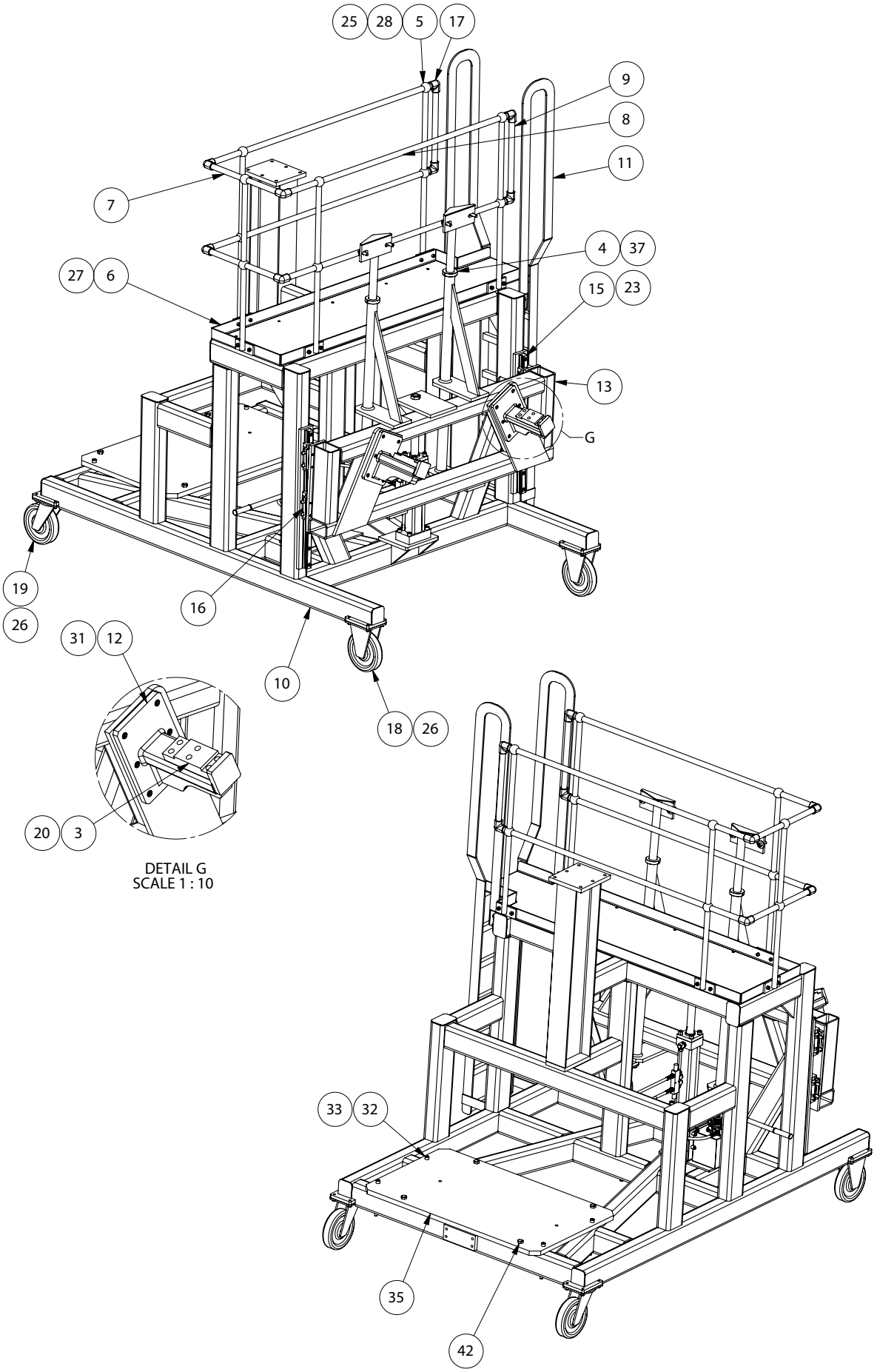


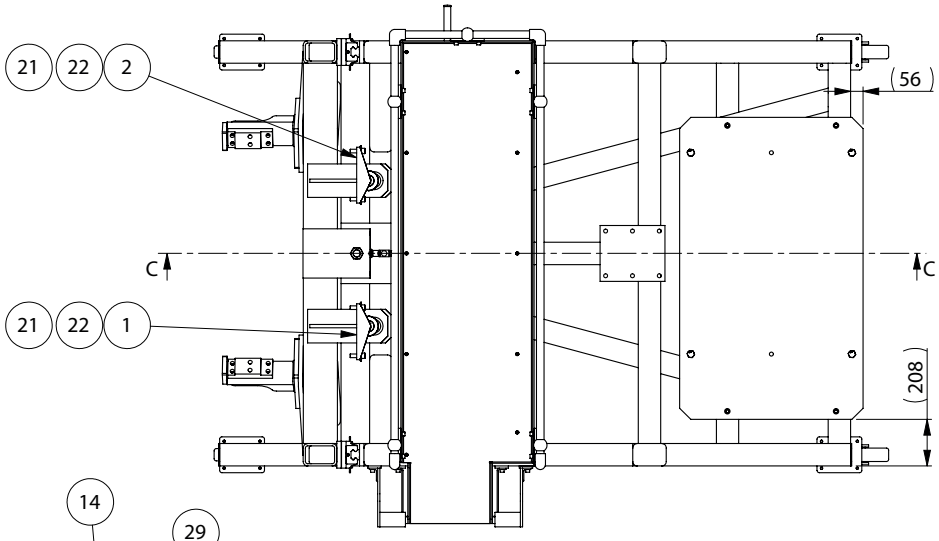


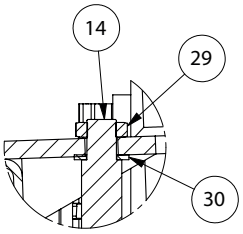
Item	Part Number	Description	QTY
1	M10 x 35	Hex Socket Cap Head - BS EN ISO 4762 G10.9 BZP	12
2	WP3500-H-50-011	WAVY SHOE 3200mm PCD - COMPENSATING	1
3	WP3500-H-50-018	SUPPORT PLATES - SHOE	1
4	WP3500-H-50-019	SUPPORT PLATE OPP HAND - SHOE	1

10.15 WP3500-51 - INSTALLATION TROLLEY WP3500-H (2200mm BLADE CR HEIGHT)

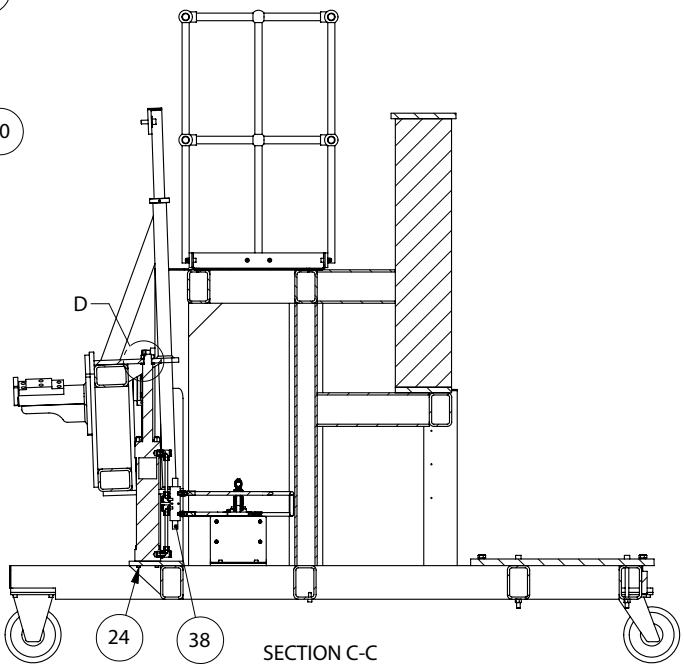
Revision D. Weight 2322kg.



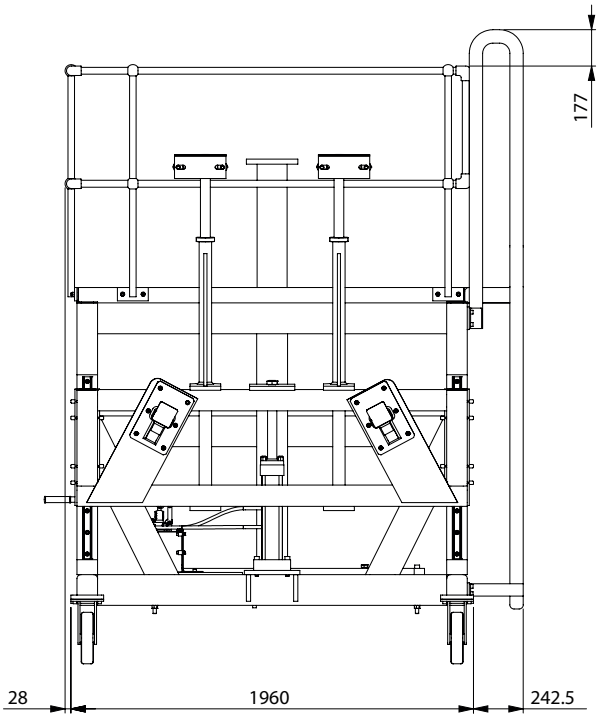


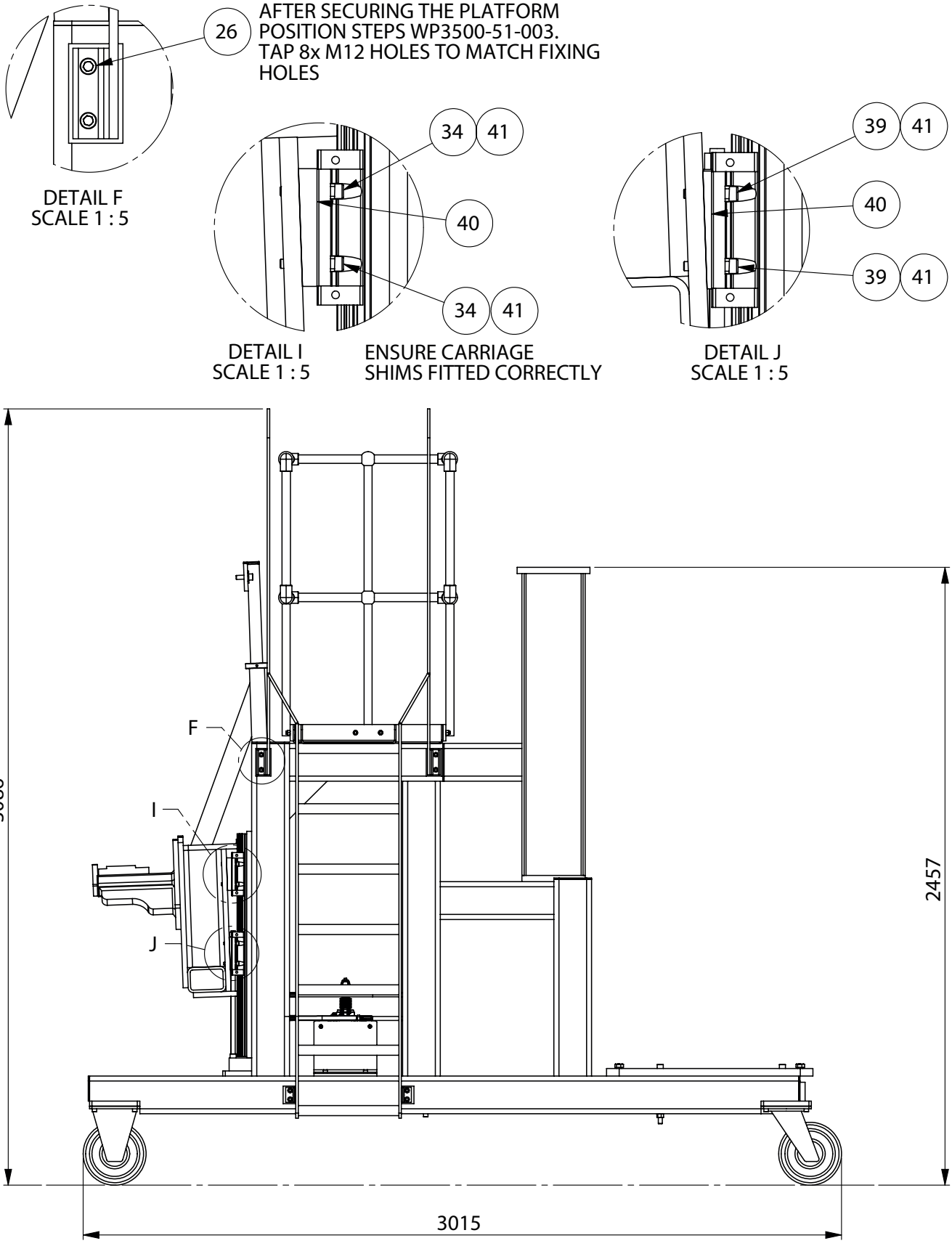


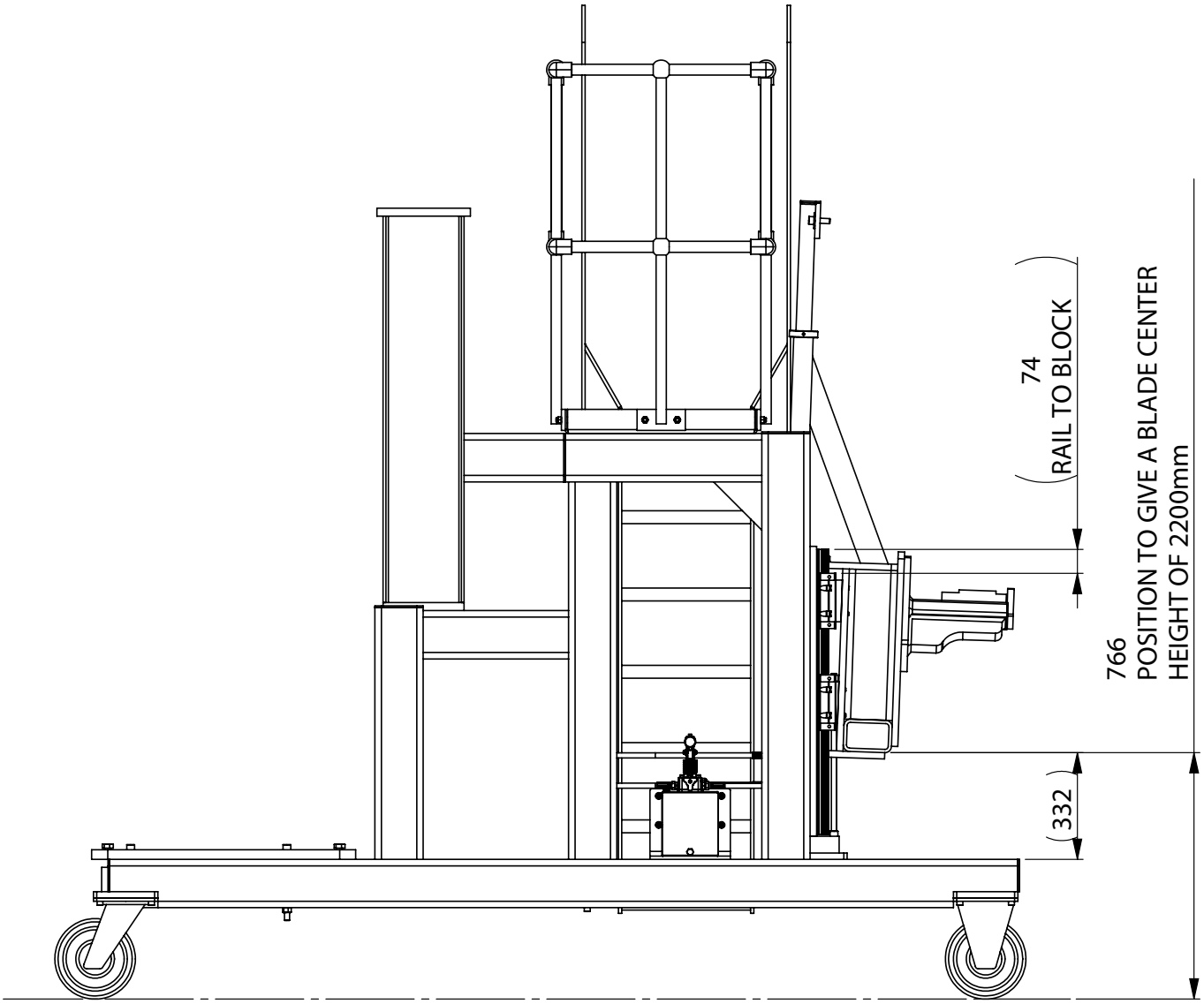
DETAIL D
SCALE 1 : 5



SECTION C-C




26
AFTER SECURING THE PLATFORM POSITION STEPS WP3500-51-003. TAP 8x M12 HOLES TO MATCH FIXING HOLES
DETAIL F
SCALE 1 : 5
34
41
40
34
41
DETAIL I
SCALE 1 : 5
ENSURE CARRIAGE SHIMS FITTED CORRECTLY
39
41
40
39
41
DETAIL J
SCALE 1 : 5
F
I
J
3086
2457
3015


74
RAIL TO BLOCK
766
POSITION TO GIVE A BLADE CENTER
HEIGHT OF 2200mm
332

WP3500-H-51 - INSTALLATION TROLLEY WP3500-H (2200mm BLADE CR HEIGHT) [Continued]
Revision D

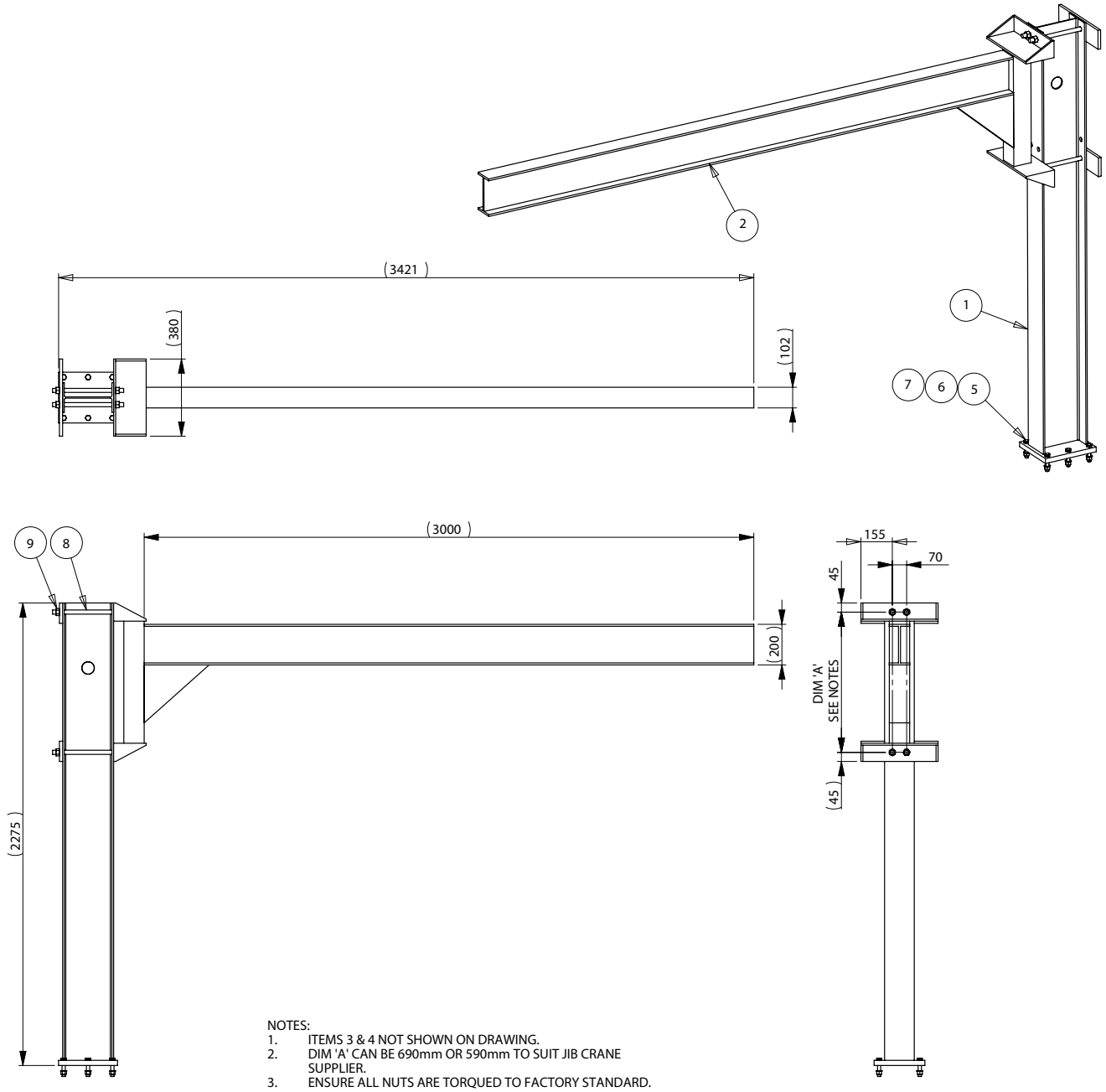
Item	Part Number	Description	QTY
1	WP3500-51-005	MACHINE TOP BRACE (L)	1
2	WP3500-51-004	MACHINE TOP BRACE (R)	1
3	WP2500-26-003	WP M/C TROLLEY FEET	2
4	WP2500-26-009	BAR STOP	2
5	WP2500-26-010	HANDRAIL STANDARD - SIDE PALM	5
6	WP2500-55-007	PLATFORM FLOOR PLATE	1
7	WP2500-55-009	GALVANISED 'B' TUBE - 605LG	2
8	WP2500-55-010	GALVANISED 'B' TUBE - 1875LG	4
9	WP2500-55-011	GALVANISED 'B' TUBE - 504LG	2
10	WP2500-71-001	BASE TROLLEY WELDMENT	1
11	WP3500-51-003	BASE TROLLEY LADDER	1
12	WP2500-67-001	M/C SUPPORT ARM	2
13	WP3500-51-002	LIFT ARM CARRIAGE	1
14	CD8045B375S	HYDRAULIC CYLINDER, 375MM STROKE	1
15	HGR45R885C	LINEAR RAIL (HIWIN)	2
16	HGW45HCZ0C	HG BLOCK	4
17	16125B	TUBECLAMP 125B 90 DEGREE ELBOW	8
18	2BZQXFL250PTBJ	CASTOR WHEEL (FIXED)	2
19	2BZQXL250PTBJ	CASTOR WHEEL (SWIVEL)	2
20	M10 x 25	HEX SOCKET BUTTON HEAD - BS EN ISO 7380 BZP	12
21	M16 x 50	HEX SOCKET HEAD - BS EN ISO 4762 BZP	4
22	M16 WASHER	WASHER - BSS4320 EXTRA LARGE FORM G	4
23	M12 x 40	HEX SOCKET HEAD - BS EN ISO 4762 BZP	18
24	M16 x 80	HEX SOCKET HEAD - BS EN ISO 4762 BZP	4
25	M12 x 35	HEX SOCKET HEAD - BS EN ISO 4762 BZP	10
26	M12 x 30	HEX SOCKET HEAD - BS EN ISO 4762 BZP	25
27	M6 x 16	HEX SOCKET CTSK HEAD - BS EN ISO 10642 BZP	10
28	M12 NUT	HEXAGON NUT STYLE 1 BS EN 24367 BZP	10
29	M33 NUT	M33X2 NUT THIN BS EN ISO 4035 (BZP)	1
30	M33 FLAT WASHER	M33 FLAT WASHER EN 14399-6 300HV	1
31	M12 x 25	HEX SOCKET HEAD BS EN ISO 4762 G10.9 BZP	12
32	M16 x 220	HEX SOCKET CAP HEAD - BS EN ISO 4762 BZP	4
33	M16 NUT	HEXAGON NUT STYLE 1 BS EN 24367 BZP	4
34	M10 x 60	HEX SOCKET HEAD - BS EN ISO 4762 BZP	8
35	WP2500-71-004	HPU MOUNT	1
36	WP3500-51-BOX	TROLLEY BOX FOR WP3500-51 & WP2500-71	1
37	M8 x 20	Socket Set Screw Cup Point BS EN ISO 4029	4
38	03927.12.01.00	COUNTER BALANCE (CYLINDER VALVE) ASSEMBLY	1
39	M10 x 50	Hex Socket Head - BS EN ISO 4762 BZP	8
40	WP2500-71-003	2° WEDGES	2
41	WP2500-71-007	2° CARRIAGE SHIM	16
42	M20 x 35	Hex Screw Grade AB - BS EN 24017	4
43	WP3500-59	HAND PUMP (TROLLEY) KIT	1

NOTES:

1. ITEM 39 NOT SHOWN ON DRAWING.

10.16 WP2500-70 - HOIST & CRANE MODULE - 220V, 50HZ, 1PH

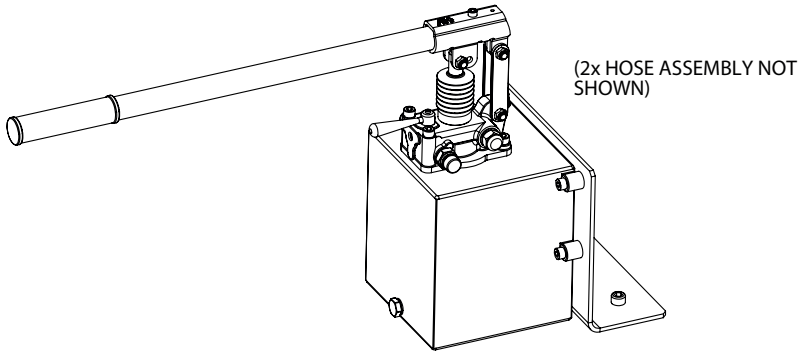
Revision A, Weight 111kg.

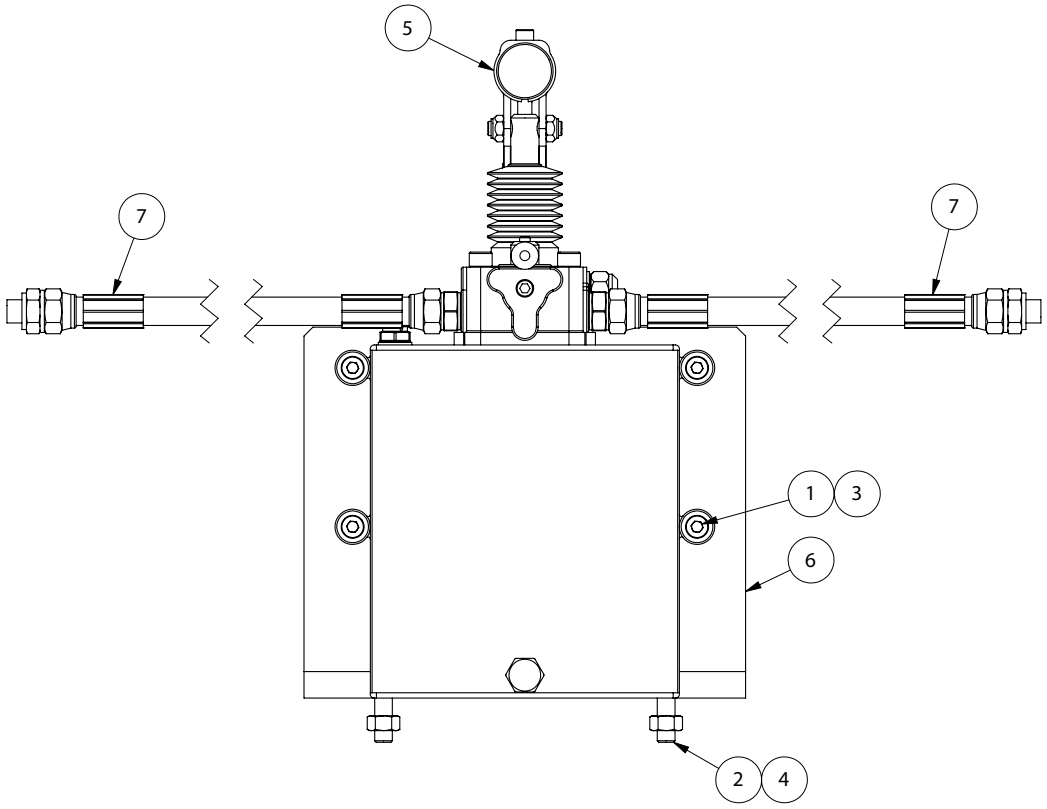


Item	Part Number	Description	QTY
1	WP2500-55-016	CRANE COLUMN	1
2	WP2500-68-001	CLAMP MOUNT JIB CRANE 250Kg	1
3	WP2500-68-002	PUSH TRAVEL TROLLEY, BEAM WIDTH 100-149mm	1
4	WP2500-68-005	ELECTRIC HOIST SWL 250Kg, 220V, 50Hz, 1PH	1
5	M16x80	Hex Screw Grade AB - BS EN 24014 - Full Thread	6
6	M16	WASHER (FORM A)	6
7	M16	Hex Nut Style 1 - BS EN 24403	6
8	WP2500-68-006	M20 HOIST TIE ROD	4
9	M20	Hex Nut Style 1 - BS EN ISO 4032, C8, BZP	8

10.17 WP3500-59- HAND PUMP TROLLEY KIT

Revision A, Weight 5kg



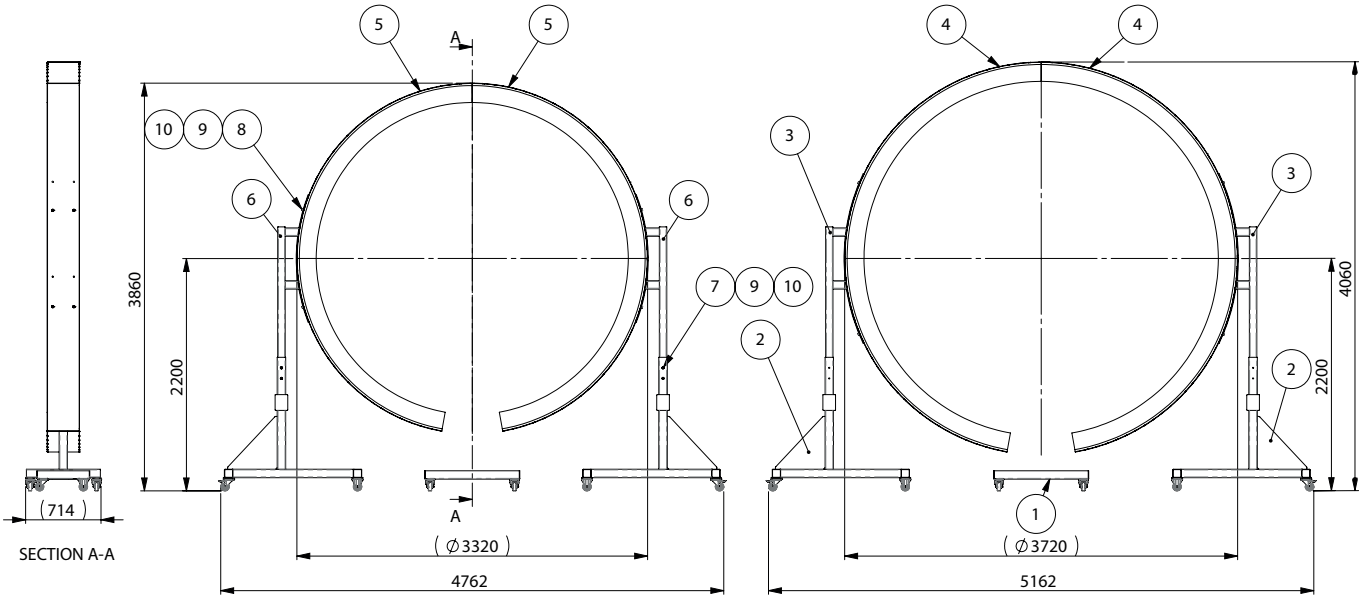


Item	Part Number	Description	QTY
1	M8 x 35	Hex Socket Head - BS EN ISO 4762	4
2	M10 x 30	Hex Socket Head - BS EN ISO 4762	2
3	M8	Hex Nut Style 1 - BS EN 24349	4
4	M10	Hex Nut Style 1 - BS EN 24349	2
5	PMD-12	PMD 12CC HAND PUMP ASSEMBLY	1
6	WP2500-62-006	BRACKET - HAND PUMP	1
7	WP2500-72-005	3/8”-1/4” HOSE ASSEMBLY (1600mm LONG)	2

10.18 WP3500-52 (2900 & 3300 OD) SWARF GUARD ASSEMBLY

Revision B, Weight 420kg

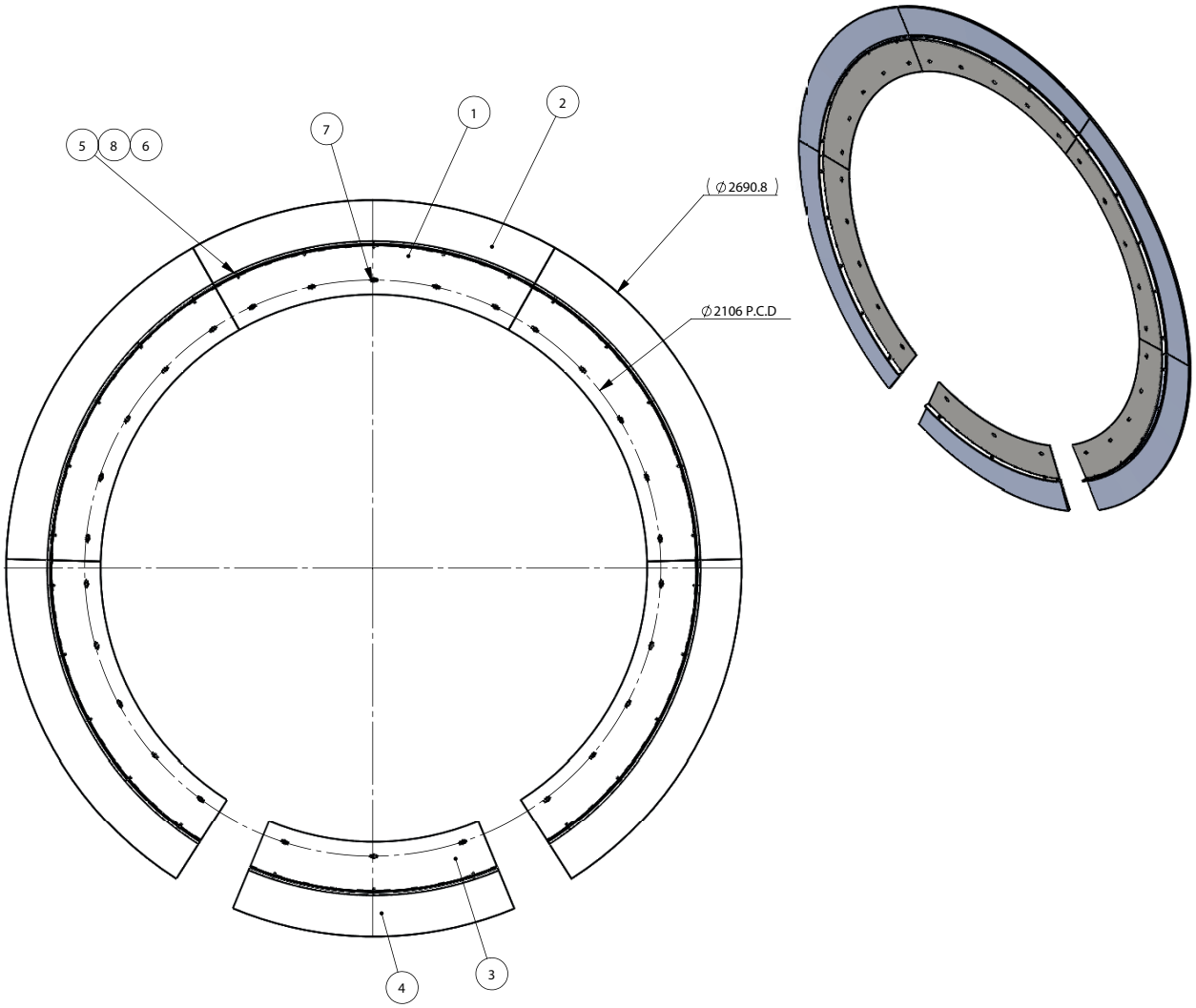
NOTE:
TWO DIFFERENT BLADE SET-UPS ARE SHOWN WITHIN THIS DRAWING.
'C' DUCT STANDS AND SWARF COLLECTION TRAY USED IN BOTH SET-UPS.
SWARF GUARDS TO FACE TOWARDS TURBINE BOLT HOLES



Item	Part Number	Description	QTY
1	WP2500-24	SWARF COLLECTION TRAY	1
2	WP3500-52-001	'C' DUCT STAND	2
3	WP3500-52-002	TOP FRAME	2
4	WP3500-52-003	SWARF GUARD (3300 OD)	2
5	WP3500-52-004	SWARF GUARD (2900 OD)	2
6	WP3500-52-005	TOP FRAME	2
7	M10 x 100	Hex Socket Head - BS EN ISO 4762	4
8	M10 x 25	Hex Socket Head - BS EN ISO 4762	16
9	M10	Hex Nut Style 1 - BS EN 24331	20
10	M10-WASHER	WASHER (FORM A)	20

10.19 WP3500-53 INTERNAL SWARF GUARD

Revision B, Weight 43kg



Item	Part Number	Description	QTY
1	WP3500-H-53-001	SWARF BRUSH BRACKET	5
2	WP3500-H-53-002	BRUSH SEAL	5
3	WP3500-H-53-003	SWARF BRUSH BRACKET	1
4	WP3500-H-53-004	BRUSH SEAL	1
5	M6 x 16	Hex Socket Button Head - BS EN ISO 7380	28
6	M6	Hex Nut Style 1 - BS EN 24277	28
7	M8 x 16	Hex Socket Button Head - BS EN ISO 7380	28
8	M6	WASHER (FORM A)	28

10.20 Parts list for Toolkit

Description	QTY
6 POCKET PLAIN CHISEL ROLL	1
14mm LONG ARM HEXAGON WRENCH	1
17mm LONG ARM HEXAGON WRENCH	1
24mm-27mm DOUBLE ENDED SPANNER	2
12mm COMBINATION SPANNER	1
16mm COMBINATION SPANNER	1
30mm COMBINATION SPANNER	2
3mm L-WRENCH BALL DRIVER	1
5mm L-WRENCH BALL DRIVER	1
6mm L-WRENCH BALL DRIVER	1
8mm L-WRENCH BALL DRIVER	1
10mm L-WRENCH BALL DRIVER	1
17mm COMBINATION SPANNER	1
32mm COMBINATION SPANNER	1
36mm COMBINATION SPANNER	1
55mm COMBINATION SPANNER	1
‘C’ HOOK SPANNER (Ø68 - Ø75)	2
22mm COMBINATION SPANNER	1
38mm COMBINATION SPANNER	1
5.0mm PIN PUNCH	1
5 x 12mm SPLIT SPRING (SELLOCK) PIN	10

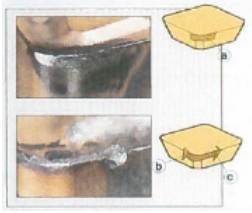
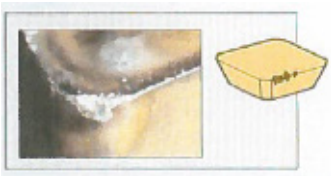
11.0 TROUBLESHOOTING

DANGER

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
			Increase cutting feed
			Change cutting depth
		Bad stability	Reduce overhang
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.
			Select tougher grade
		b)/c) Skin & scale	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

12.0 APPENDICES

DANGER

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

12.1 Spindle Column Adjustment

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.

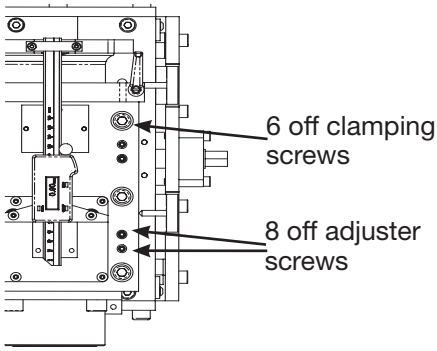


Figure 24: Milling head adjustment screws

12.2 Spindle bearings Adjustment

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

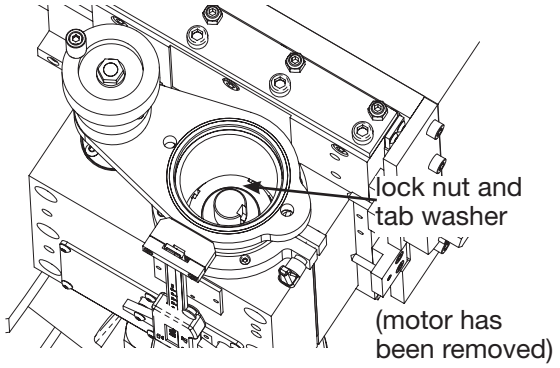


Figure 25: Milling head spindle lock nut and tab washer

12.3 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.

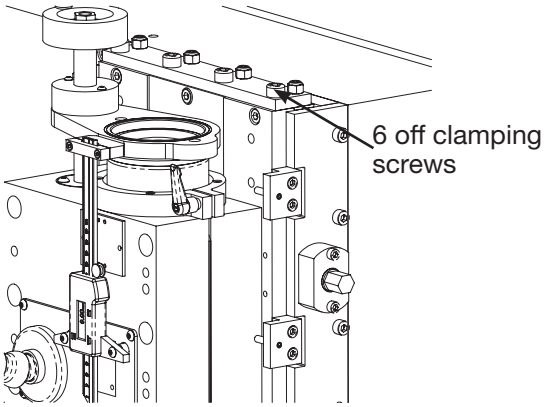


Figure 26: Carriage

12.4 Anti-Backlash assembly setting

Drawing number: WP2500-5 Anti Backlash Assembly

Note:

- Apply ‘Loctite 243’ medium strength thread locker to all M6 countersunk screws.
- Apply Nordlock washers to M10 x 30 bolts

Preparation and fitting of WP2500-5:

Prior to fitting the complete WP2500-5 to the orbital milling machine (WP3500-H)

1. Loosen the 4 off half nuts [item37] to the ends of the stud bar adjuster [item 25]; This includes 2 off half nuts to the outer extreme of their travel on the stud bar adjuster and 2 off half nuts to their inner extreme of their travel on the stud bar adjuster: -

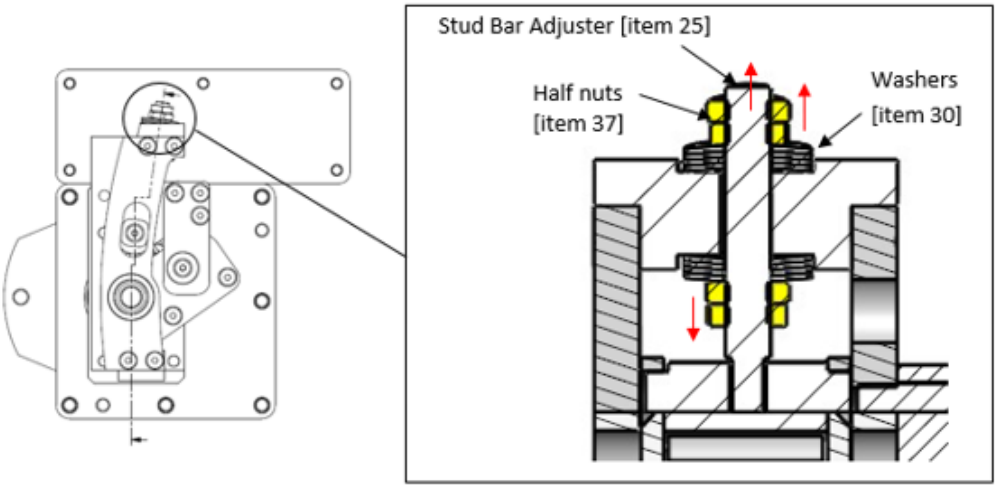


Figure 27: Stud Bar Adjuster

The Radiused retainer [item 19] should now move freely within the assembly lot.

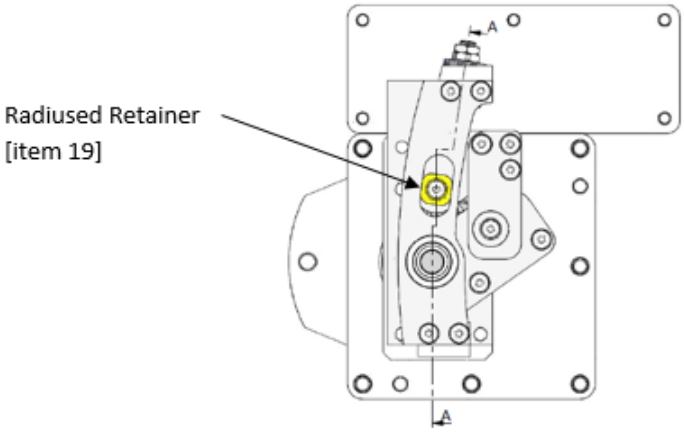


Figure 28: Radiused retainer

2. Fit the complete assembly (WP2500-5) into the WP3500-H engaging the gears into the WP3500-H main gear ring. The inspection plate [item 12] is to be removed to allow the fitting of the WP3500-H and for setting the assembly backlash
3. Fit the 6 off M10 retaining cap head bolts [item 39 & 40] into WP2500-5 and screw the cap head bolts by hand until they contact the top plate of WP2500-5 and reverse back by half a turn.

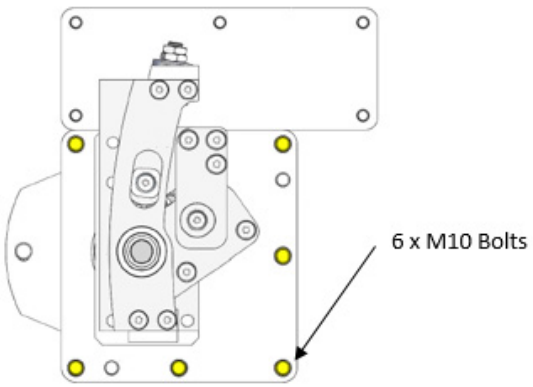


Figure 29: M10 bolts in WP2500-5 assembly

4. The complete assembly WP2500-5 will be in a loose condition. Using manual movement only pull the complete assembly WP2500-5 into the main WP3500-H gear ring applying a mesh into the gears. The required is an approximate gear 0.05mm backlash by moving the input shaft [items 3 and 17] clockwise and counter clockwise.

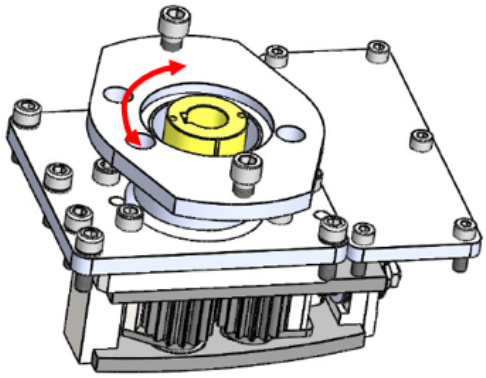


Figure 30: WP2500-5 assembly

5. Tighten the 6 off M10 retaining cap head bolts [item 39 and 40]. Check if the set backlash as within step 4 has been maintained. If not repeat until this is achieved.
6. Once the backlash is considered to be acceptable and all M10 retaining cap head bolts are tight, the following process is to be carried out: -

Note: short length open end spanners will be required to complete

- Advance HALF NUT 1 until the Belleville domed washers [item 30] are compressed flat and then back off/ return by one quarter of a turn.
- Lock HALF NUT 2 up against HALF NUT 1 (2 off short open end spanners required)
- Advance HALF NUT 3 up to the Bellville domed washers – contact only, do not compress. Advance HALF NUT 3 by one half turn to load the Bellville domed washers.
- Lock HALF NUT 4 up against HALF NUT 3 (2 off short open end spanners required)

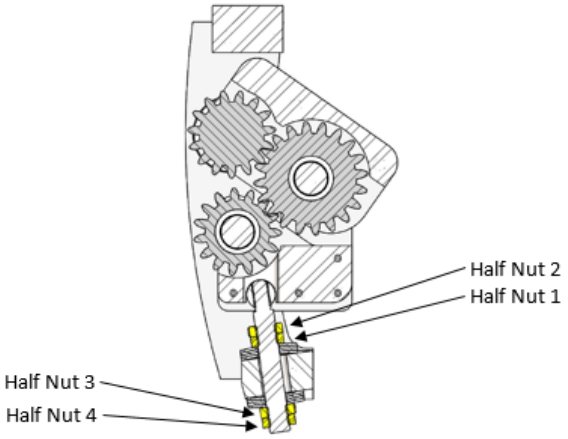


Figure 31: Half nuts on WP2500-5 assembly

7. Replace and secure the inspection Plate [item 12]

12.5 Anti Backlash Coupling Replacement

This procedure defines the replacement of a shear pin in the event of the mechanical failsafe, or for routine maintenance.

Method Overview

- Drive Gear Unit (WP3500-H-7), requires removal.
- Split Pin within Drive coupling which is a part of the Anti-Backlash assembly (WP2500-5) requires replacing.

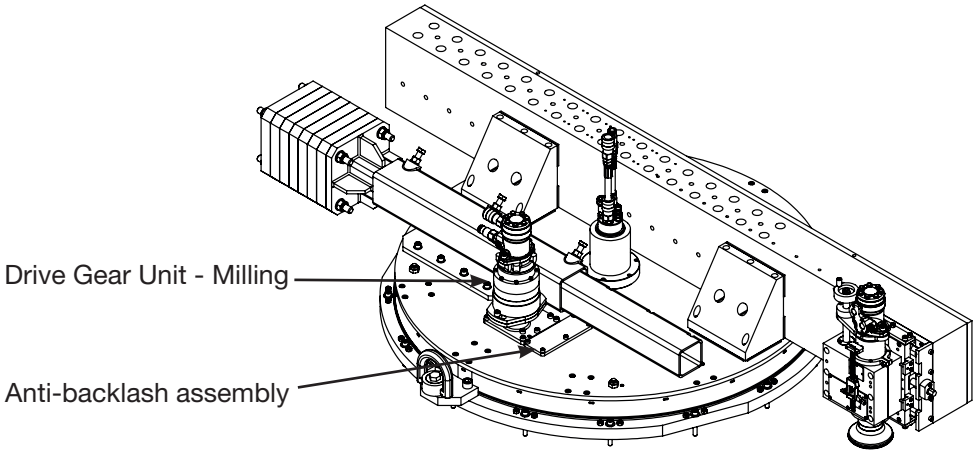


Figure 32: WP3500-H

Drive Gear Unit Removal Procedure

1. Disconnect the pressure and return hydraulic hoses that are connected to the hydraulic motor if quick release couplings are fitted [Items 10 and 11].

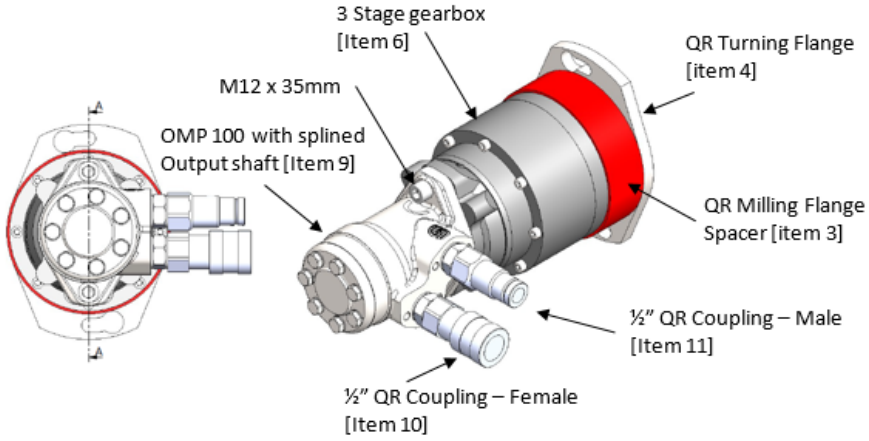


Figure 33: Drive Gear unit

If the hydraulic hoses are a direct connection to the hydraulic motor, remove the hydraulic motor [item 9] from the reduction gearbox [item 6] by removing the 2 off M12 x 35mm cap head bolts.

2. Loosen the 2 off M12 x 25 cap head bolts that secure the Drive Gear Unit to the Anti-backlash assembly

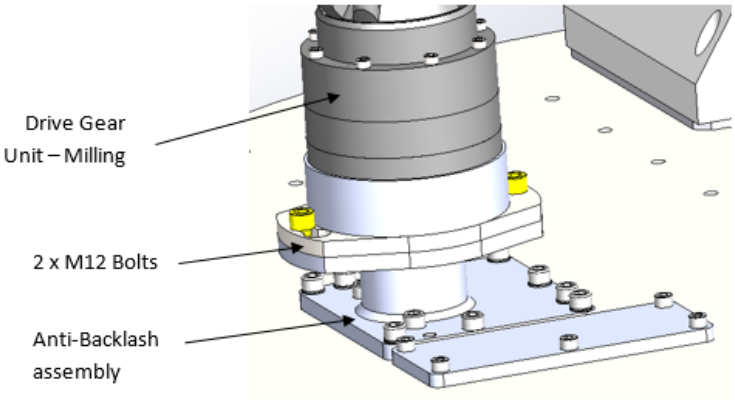


Figure 34: Disassemble motor from anti-backlash assembly

3. Safely store the removed Drive Gear Unit WP3500-H-7

Removal of Drive Coupling within Anti-Backlash Assembly

4. The now exposed drive coupling [WP2500-5-029] within the anti-backlash assembly will be clearly visible.

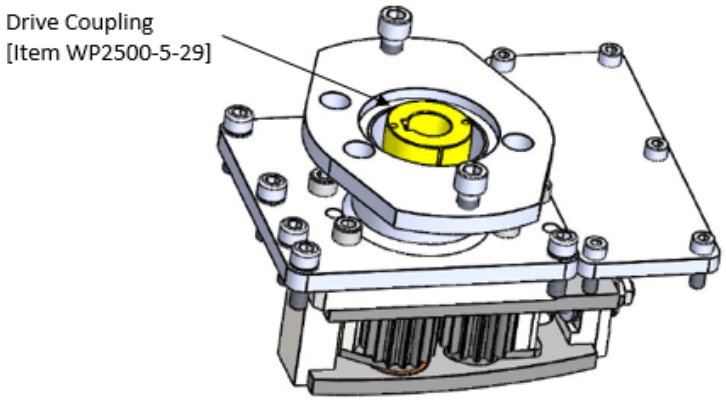


Figure 35: Drive coupling on Anti-backlash assembly.

5. Remove the drive coupling for maintenance or direct replacement.

Anti-Backlash assembly; Shear Pin Replacement.

If the shear pins have failed, removal of the sheared pins needs to be carried out within a workshop vice or alike.

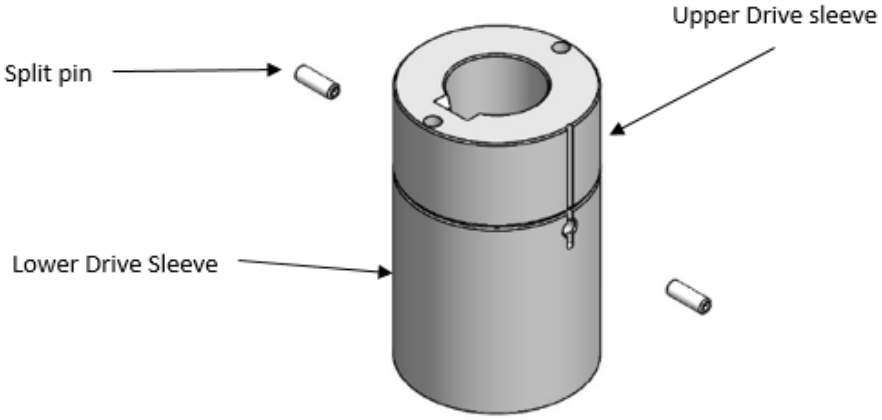


Figure 36: Dive coupling

- Align the two vertical lines with the upper and lower section of the coupling
- Using a 5.0mm pin punch remove the 2 off sheared pins
- Fit 2 off new shear pins ensuring the split line of the shear pin is per the following appreciation; at the 3 o'clock position.

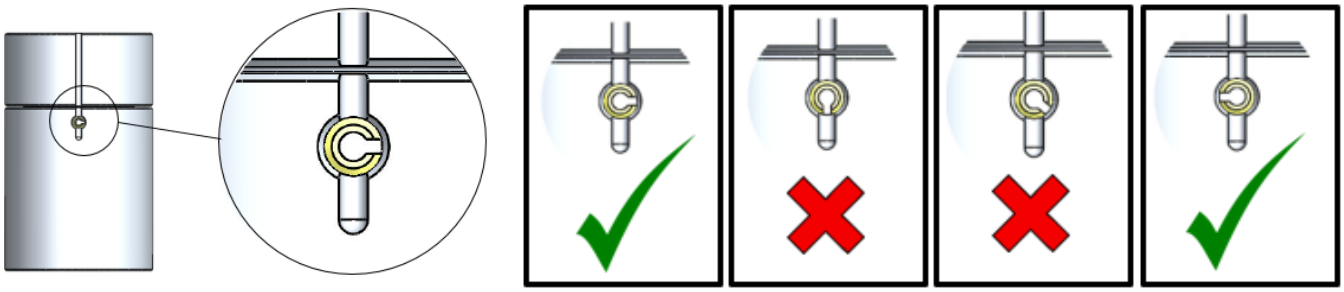


Figure 37: Shear pin placement

5. Replace the drive coupling WP2500-5-029 back into the anti-backlash assembly ensuring the drive keys are engaged correctly.
6. Replace and secure the Drive Gear onto the anti-backlash assembly ensuring the drive keys are engaged correctly and secure.

12.6 Damper Block Setting

The WP3500-H Drive Ring [WP2500-1] is fitted with 4 off damper blocks with an intended function of reducing/ removing potential frequency within the machine.

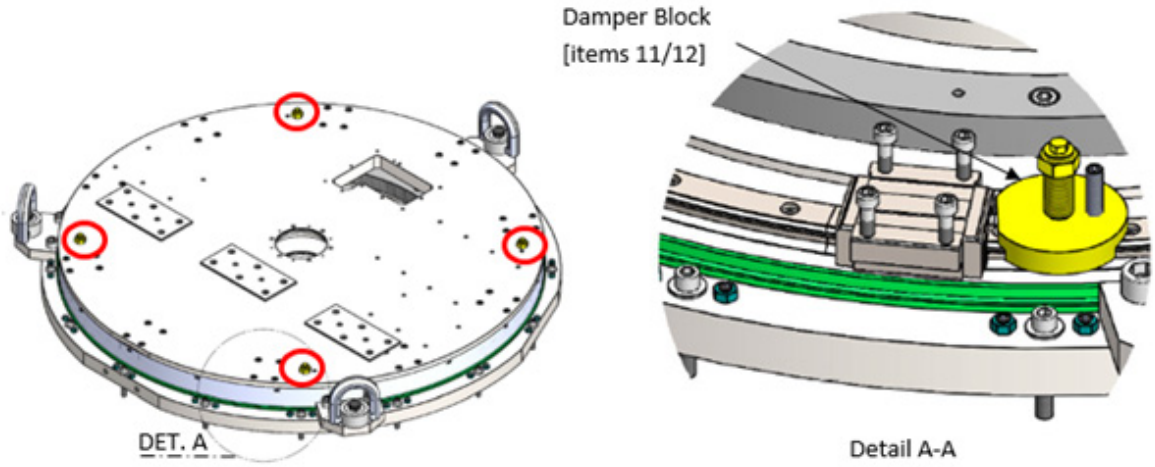
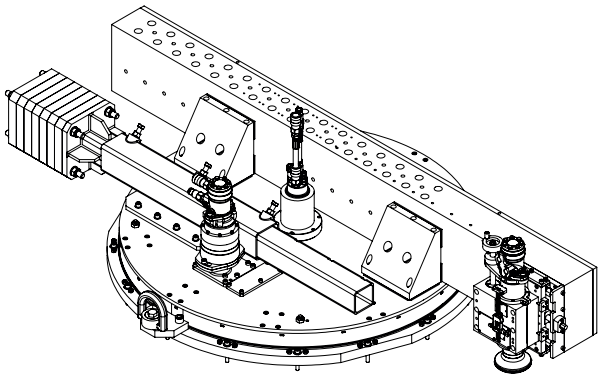


Figure 38: Damper block locations on drive ring

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.



Anti-backlash assembly

Figure 39: WP3500-H layout

1. Remove the Drive Gear Ring Unit [item 5] above, to allow manual rotation of the WP machine
2. Unlock/ release the damper lock nuts OD 0172 [item 10] and release the damping block steady screw WP2500-1-007 [item 6], 4 off in total. The damping blocks MMIE1877 [items 11/12] will now be in a contact free state.

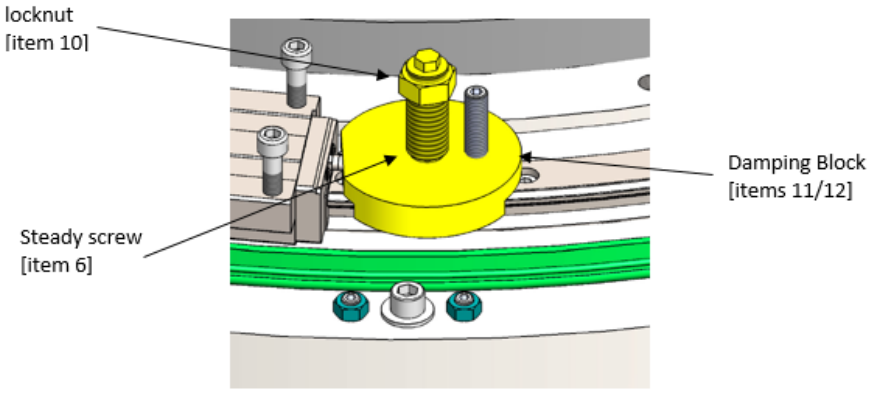


Figure 40: Damper Block

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 [items 11/12] onto the internal linear rail by turning the steady screw [item 6] in a clockwise rotation. Stop as soon as contact is made. Do not apply any further force to the steady screw [item 6]. Apply the locknut [item 10]. Using a marker record the position that the damper has landed onto the internal linear rail 'Damper Landing'.
5. Manually rotate the machine turntable and if any manual rotational force is noted stop the manual rotation.
6. Release the damper block and reset as step 4 above: ''land the damper block [items 11/12] onto the internal linear rail by turning the steady screw [item 6] in a clockwise rotation. Stop as soon as contact is made. Do not apply any further force to the steady screw [item 6]. Apply the locknut [item 10]. Using a marker record the position that the damper has landed onto the internal linear rail''. Erase the previous 'damper landing' position.
7. Repeat steps 5 and 6 until a full 360° rotation has been achieved. The 'Damper Landing' position will now be identified.
8. Set the other 3 off Damper blocks at the now known 'Damper Landing' position.
9. Replace the previously removed Drive Gear Ring within step 1

⚠ WARNING

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

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 WP2500-1-007 [item 6] using a marker or alike
- 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.

12.7 Recommended general torque settings for fasteners

Thread	Tensile Strength		Torque Setting	
Ø	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

12.8 Cutting feed and speed calculations

To find	Using	Metric		English	
Cutting speed	RPM, Dia	m/min	V = RPM x 0.00314 x Dia	Ft / min	V = RPM x Dia / 3.82
RPM	V , Dia	Revs/min	RPM = V x 1000 / 3.14 x Dia	Revs /min	RPM = V x 3.82 / Dia
Feed rate	RPM, FPT, NT	mm/min	FR = RPM x FPT x NT	Inches/min	FR = RPM x FPT x NT
Feed per Tooth	FR, RPM, NT	mm/tooth	FPT = V___ / RPM x NT	Inches/tooth	FPT = V___ / RPM x NT
Feed / Rev	RPM, FR	mm/Rev	FRR = FR / RPM	Inches/Rev	FRR = FR / RPM
Metal removal	DC, RC, FR	cm^3/min	MR = DC x RC x FR / 1,000	$Inches^3$/min	MR = DC x RC x FR
Horse Power	MR, C, WC,PC	HP	HP = MR x C x WC x PC x 0.015	HP	HP = MR x C x WC x 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 (cm^3/min or $inches^3$/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 1 (Use FPT number in feed rate calculation to obtain cutting edge constant C)							
Feed in	C	Feed in	C	Feed mm	C	Feed mm	C
0.002	1.40	0.018	0.94	0.02	1.40	0.45	0.94
0.004	1.25	0.020	0.90	0.10	1.25	0.50	0.90
0.006	1.15	0.025	0.86	0.15	1.15	0.60	0.86
0.008	1.08	0.030	0.83	0.20	1.08	0.75	0.83
0.010	1.04	0.035	0.80	0.25	1.04	0.90	0.80
0.012	1.00	0.040	0.78	0.30	1.00	1.00	0.78
0.014	0.97	0.050	0.75	0.35	0.97	1.25	0.75
0.016	0.94	0.060	0.72	0.40	0.94	1.50	0.72

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

12.9 Flange face surface finish

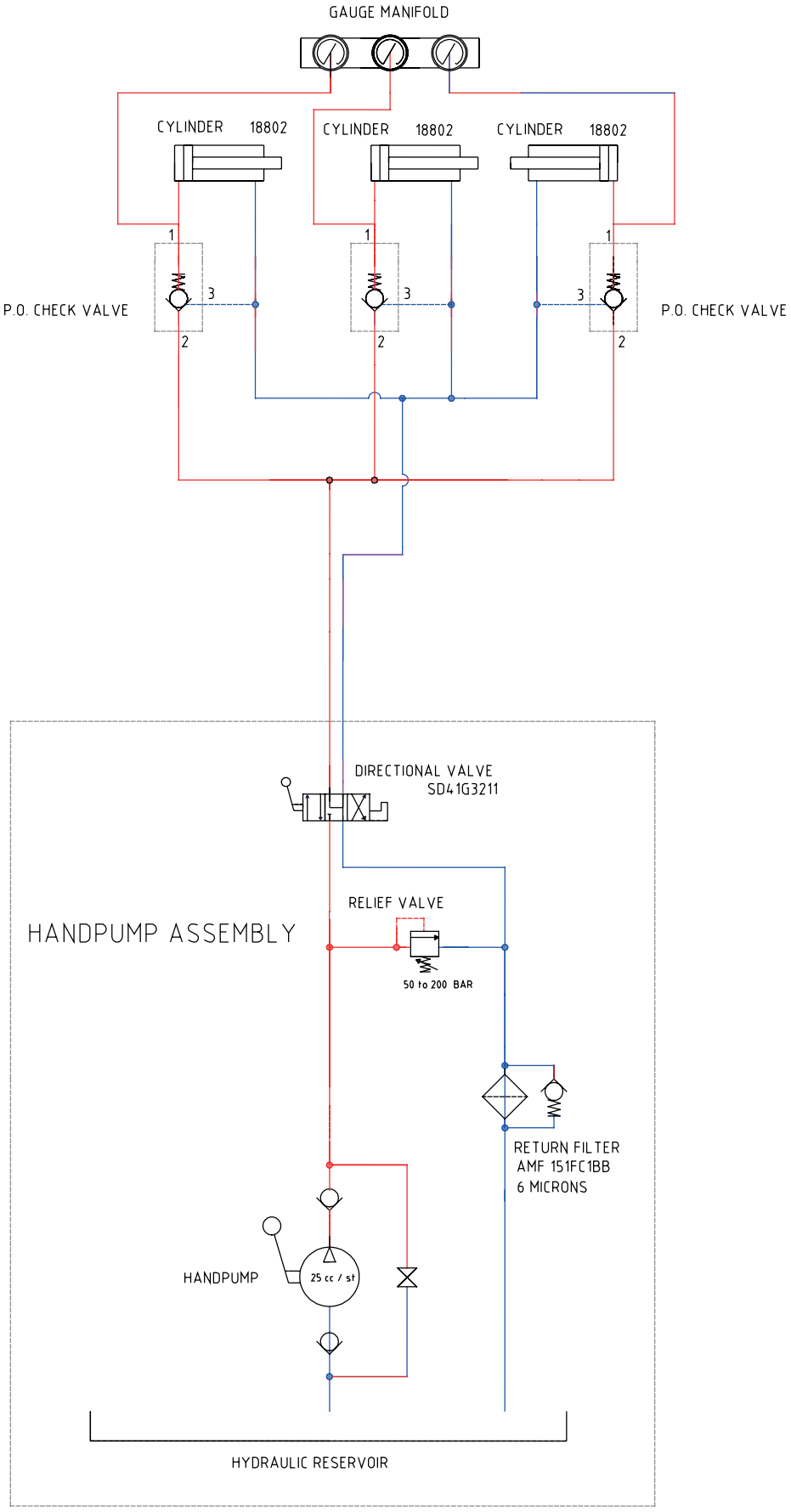
ANSI / ASME 16.5, 16.47, 16.42 - ISO 7005-1

Finish	Surface Finish	Feed Rate
RF - Stock finish	125-500µ in 3.2-12.5µ m	0.032” 0.80mm
RF - Smooth	125-250µ in 3.2-6.3µ m	0.012” 0.30mm
Hydrogen	79-125µ in 2-3.2µ m	0.008” 0.20mm
RTJ	32-63µ in 0.8-1.6µ m	0.008” 0.20mm

Micrometer µ m	Micro - inch µ in	Roughness Grade N	Roughness Grade ∇
12.5	500	N10	∇
6.3	250	N9	∇∇
3.2	125	N8	∇∇
1.6	63	N7	∇∇
0.8	32	N6	∇∇∇
0.4	16	N5	∇∇∇∇

12.10 Schematic diagrams

12.10.1 Hydraulic schematic diagram (Neilson Hydraulic Drg 18864)



NOTES

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