



Operation and Maintenance Manual

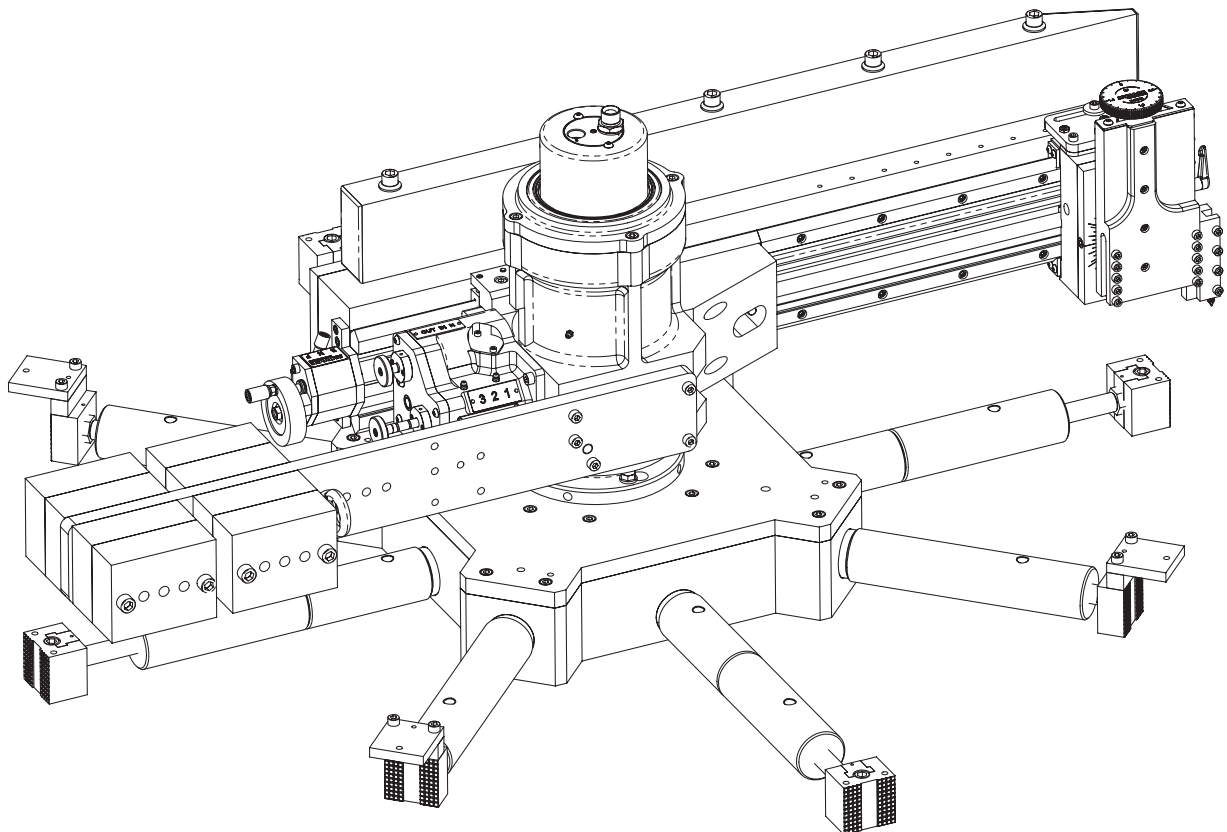
Enerpac MM1500i/ MM1500i-H Flange Facing Machine (12-60" Internal Flange Facing Machine)

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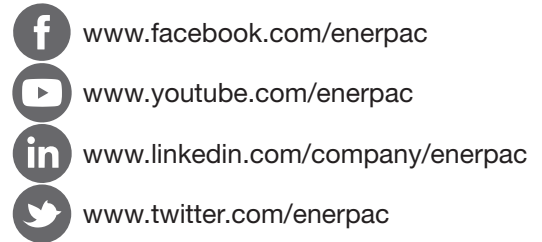
Document Language: ENGLISH EN (Original Instructions)



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:	
DERBY DE21 4BB	MAX SWP:	
UNITED KINGDOM	WEIGHT:	
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1. 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.

1.1 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 keep customers up to date with all changes that may affect the machine operation. Any updates which affect the safe use of the machine shall be communicated to the customer in a prompt and appropriate manner.

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

1.1.1 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.

1.2 Safety Procedures

Detailed in this section 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

1.2.1 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).
4. Do not leave equipment on top of the machine
5. Ensure each tool is in good condition and securely mounted.
6. Secure / Remove loose items.
7. Faulty equipment must not be used.
Immediately report any suspect machinery.

1.2.2 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.

1.2.3 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.

1.2.4 Noise Emissions

1. If this machine is driven by hydraulic motors, then airborne noise emissions of the machine will not exceed 70 db (A). For the hydraulic power pack noise emissions please refer to the hydraulic power pack manual.
2. If this machine is driven by pneumatic (air) motors, then airborne noise emissions of the machine will exceed 70 db (A). The ear protection must be worn! The exact value can be found in the 'Pre-Use Functional Checklist' which is included in the document pack.

1.2.5 Potential Hazards



1. Sharp cutters. Use protective gloves when handling cutters.
2. Moving components – hair / clothing entanglement. Keep clear of hazard zone when the machine is in operation. See section 1.3.
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. Extreme Temperatures:

Heat. The cutting tool and its surrounding areas will become hot after continuous use. Gloves should be worn when handling these components.

Frost. The pneumatic motor can become cold when used extensively. Gloves should be used when handling this component.

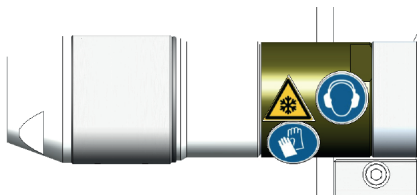


Figure 1: Motor showing safety labels



Figure 2: Frost/ ice on Motor

8. Fire or explosion. Machining aluminium, titanium, magnesium, graphite, or alkali metals can result in fire, explosion or noxious dust. If unsure, consult the manufacturer for guidance.
9. Trip hazards from hoses or other equipment at low level.
10. Hearing Loss. Use appropriate ear protection when in the vicinity of the machine in operation.

1.2.6 Foreseeable misuse

- Machining in other environments (temperature, materials, workpiece size) than what is specified in machine specification can cause damage to the machine and cause the injury.
- Do not use any other base leg extension combinations, other than what is specified in the base assembly drawings. Not enough thread engagement will have a severe effect on the stability of the machine and can cause damage to the machine and cause the injury.
- Do not use machine on poor quality and unstable workpiece (flange). The machine is clamped to the workpiece, so the workpiece structure provides the foundation and stability for the machine. If not adhered to, then this will have a severe effect on the stability of the machine and can cause damage to the machine and cause the injury.

1.2.7 Machine safety features

The following features apply to the pneumatic model only.

Pressure Regulator

The air lubrication unit comes with a pressure regulator. This limits the air pressure to 7Bar to ensure the air supply into the machine will not cause damage to the machine and its surrounding area.

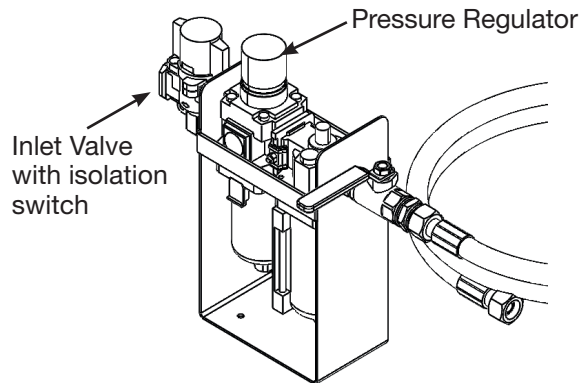


Figure 3: Air Lubrication Unit

Isolation Switch

The air lubrication unit also comes with an inlet valve with a lockable isolation switch.

The inlet valve has an indicator window to show its status;

SUP : Supply

EXH : Exhaust

To change the status of the valve, push down the handle then turn 90 degrees. Use the holes in the handle to lock the handle in position.

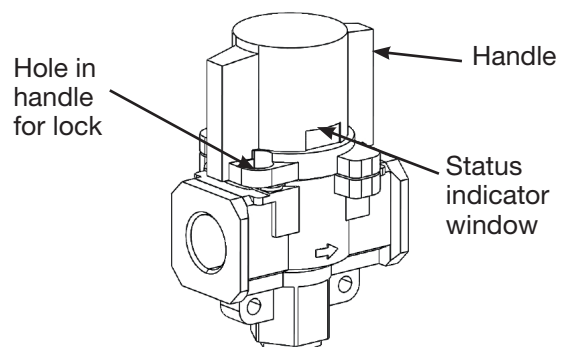


Figure 4: Inlet valve

Hold-to-Run Device

The machine is operated using a hold-to-run device which shall be located at a minimum of 2m away from the danger zone.

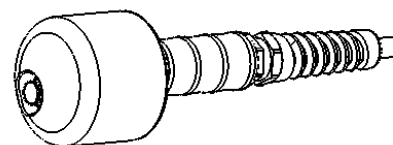


Figure 5: Hold-to-run control

1.3 Machine Hazard Zone

⚠ DANGER

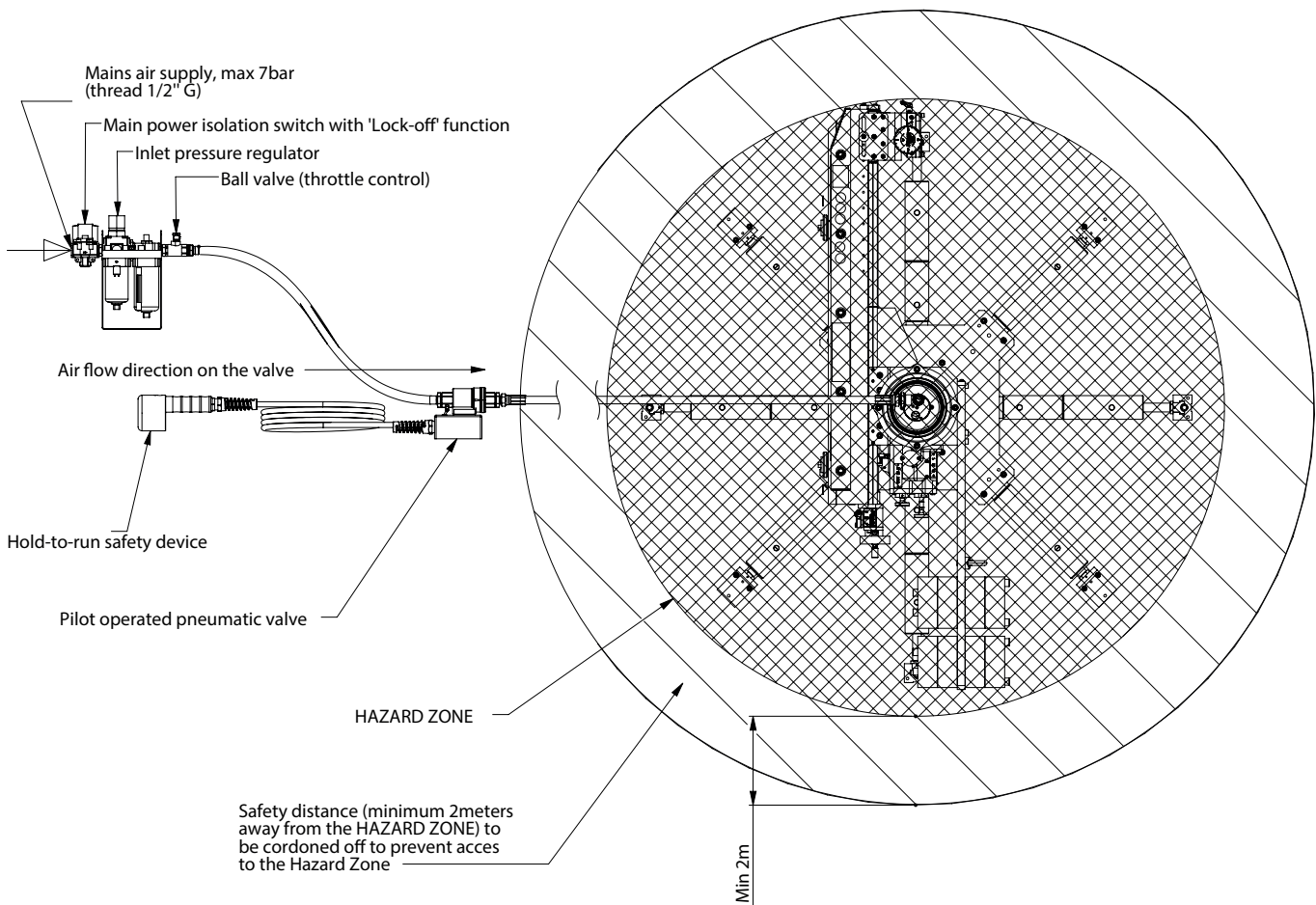


Figure 6: Supplied system layout drawing showing hazard area to be cordoned off *

⚠ DANGER

The machine mains air valve must be switched off and locked off whilst performing the below tasks:

1. Setting up the machine into the work-piece.
2. Performing any maintenance, if necessary, before cut.
3. Cordoning off the area, a minimum 2m away from hazard zone.
4. All of the controls must be placed outside of the cordoned off zone.
5. Before switching the valve on, make sure there are no personnel in cordoned off zone.

After machines mains air valve is switched on:

1. Only the operator is allowed to enter cordoned off zone, if necessary.
2. Ball valve (throttle control) should be nearly closed in order to slowly start up the machine.
3. Operator to be outside of cordoned off zone and operate the machine by using the hold to run device.
4. Whilst the machine is running, no personnel including the operator, is allowed to enter the cordoned off zone under any circumstances.

* The same hazard zone applies for the hydraulically powered models. In this case, the controls will be a part of the hydraulic power pack. The controls should be placed outside of the hazard zone. (No Air lubrication kit or hold to run assemblies are supplied for hydraulic models)

1.4 Risk Assessment Checklist

The following checklist should not be taken as a comprehensive list of things to be vigilant for when installing and operating the MM1500i/MM1500i-H flange facing machine. However these checklists are typical of the types of risks the assembler and operator should be considering. Use these checklists as part of your risk assessment.

Figure 7: Risk Assessment Checklist before installation

	<u>Before Installation</u>
☐	I understand how this machine operates and identified the best placement for the controls, cabling, and the operator (having reviewed the manual and section 1 in particular).
☐	I removed or mitigated all identified risks (such as shearing, cutting, crushing, tripping, entanglement, or falling objects).
☐	I considered the need for personnel safety protection and guarding and installed any necessary guards, if supplied.
☐	I read the Machine Assembly instructions and took inventory.
☐	I created a lift plan, for each of the setup lifts required during the setup of the machine.
☐	I located the fall paths involved in lifting. Precautions have been taken to keep workers away from the identified fall path.
☐	I have noted all the warning labels on the machine.
☐	I considered and mitigated any other potential risks specific to the working environment.
☐	I have checked that all of the ram bolts are not damaged or corroded.

Figure 8: Risk Assessment Checklist after installation

	<u>After Installation</u>
☐	I checked that the machine is safely installed and the hazard zone is cordoned off as section 1.3. If the machine is installed at an elevated position, I checked that the machine is safeguarded against falling.
☐	I evaluated and mitigated the potential risks specific to the work environment.
☐	I checked that all affected personnel understand the hazard zone (section 1.3) and are outside of it.
☐	I followed the required Maintenance Intervals with the recommended lubricants in section 8.
☐	I checked that all affected personnel have the required personal protective equipment, as well as any site-required or regulatory equipment.
☐	I identified all possible pinch points, such as those caused by rotating parts, and informed the affected personnel, noting that no other personnel are allowed in the hazard zone unless the machine is isolated and locked off.
☐	I planned the safe guarding of any chips or swarf produced by the machining process.
☐	I considered that the tool tip cutter will be sharp and have planned adequate protection for handling.

2. Compliance Statement

2.1 EU Declaration of Conformity



Enerpac declares that this product fulfils all the relevant provisions of the directives and standards written on the declaration of conformity.

A copy of the EU and UK declaration of conformity is enclosed with each shipment of this product.

3. Features & Components

3.1 MM1500i/ MM1500-H Feature Diagram

1. Manual hand wheel
2. Drive gearbox
3. Drive hub
4. Motor unit
5. Strong back
6. Tool post
7. Base assembly
8. Balance assembly

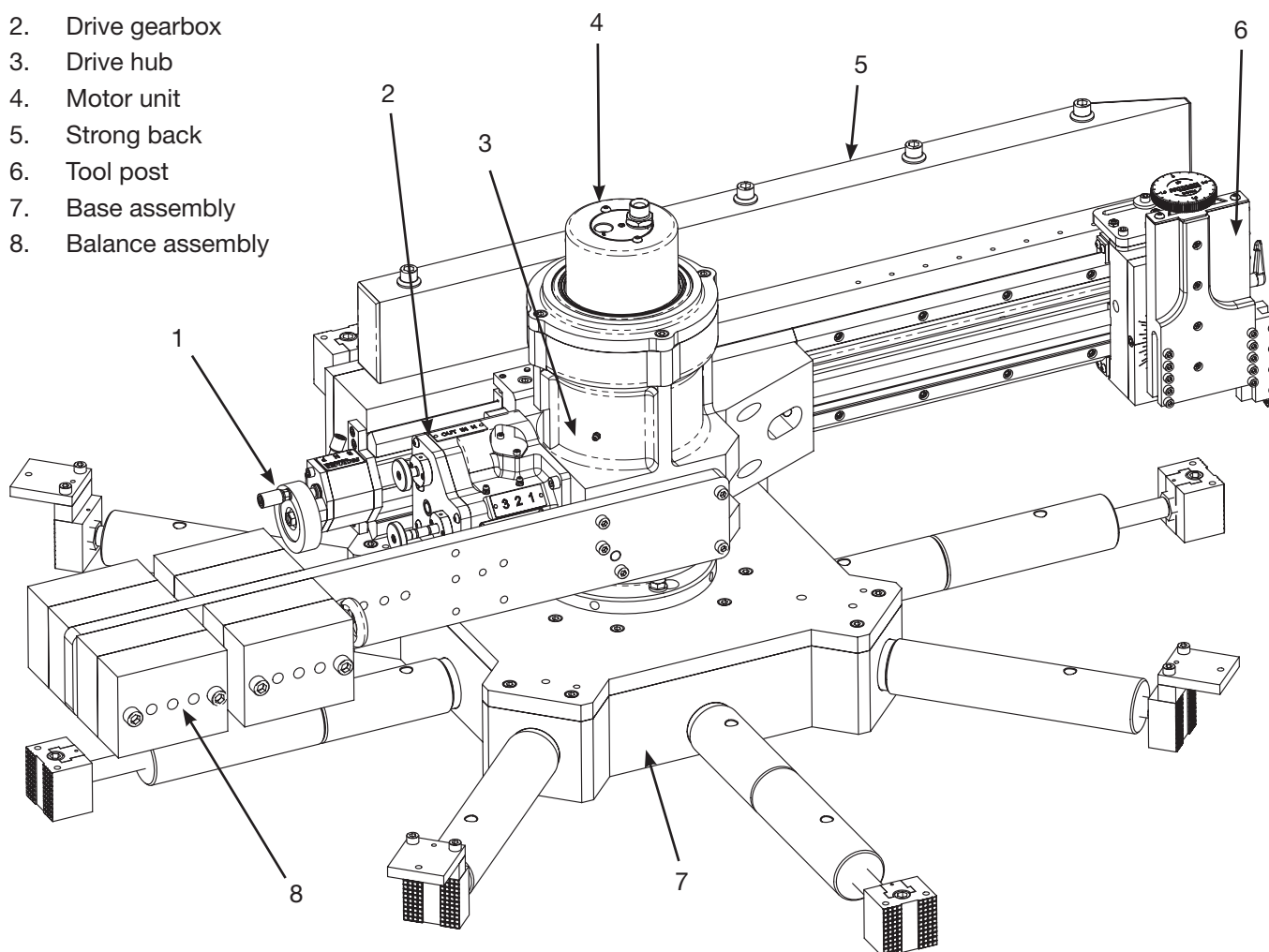


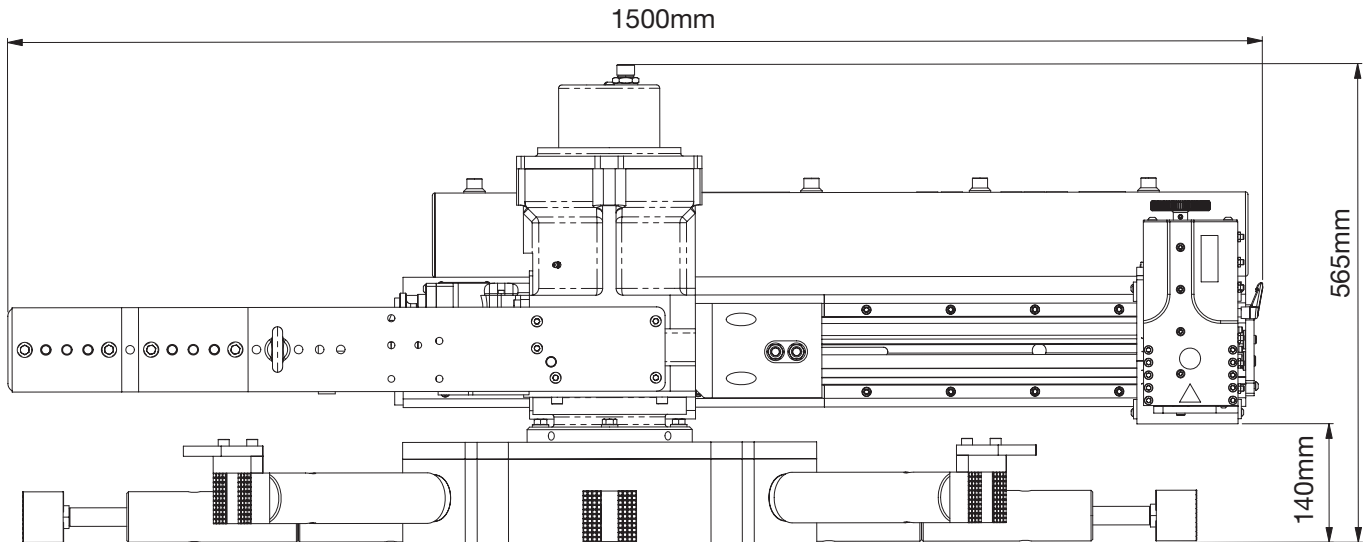
Figure 9: Major Features and Components of Flange Facing Machine (Pneumatic shown)
(For MM1500i-H refer to Parts List section)

3.2 Machine Description

This machine has been designed for performing facing and boring operations on flanges. It can be used for seal groove machining, weld preparation and counter boring. The machine is manually fixed and levelled to the flange using the Base assembly. The machine motor rotates the toolpost assembly around the flange and by using fixed gears will produce continuous feed across the flange surface for groove gramophone finishes to ASME Standard.

4. Technical Product Data

4.1 MM1500i/ MM1500i-H Dimensional Callout Art



4.2 MM1500i/ MM1500i-H Dimensional Table

Description	Value			
	Pneumatic		Hydraulic	
Minimum Clamping diameter	301mm	11.8"	301mm	11.8"
Maximum Clamping diameter	1397mm	55"	1397mm	55"
Motor	3.0 kW @ 6 bar	4.0 hp @ 87 psi	4.0 kW @ 70 bar	5.4 hp @ 1015 psi
Machine Weight (Machine & Base)	222kg	490lb	230Kg	507lb
Maximum Facing diameter	1525mm	60"	1525mm	60"
Minimum Facing diameter	305mm	12"	305mm	12"
Minimum Swing Diameter	1200mm	47.2"	1200mm	47.2"
Tool Post Vertical Travel	100mm	4"	100mm	4"
R.P.M	Min. 5	Max. 22	Min. 5	Max. 22
Supply	2.89 m ³ /min @ 6 bar	102 ft ³ /min @ 87 psi	50 L/min @ 70 bar	11 Gpm (Imp) @ 1015 psi

5. Installation

5.1 Base Assembly Installation

NOTICE Enerpac recommends that the Internal Flange Facer should not be installed as a complete assembly.

WARNING

Before installation, visually inspect all ram bolts to ensure the threads are in good working condition.

1. Measure mounting bore of the flange to be machined and ensure this is within the working parameters of the machine.
2. Using the table for 'Clamping arrangements for different diameters' in section 9.21, showing the recommended base size and parts combination, select the required components.



Note that all 4 legs must have the same arrangement.

3. Screw the base components into the correct base until they measure equally 6mm (0.25") below the bore mounting dimension.

Note that the ram bolts on the extension legs can only be moved out a certain length to ensure that enough engagement remains between the leg and bolt. There is a groove on the leg to indicate allowable full extension length.

Do not unscrew the legs any further out once the groove is visible.

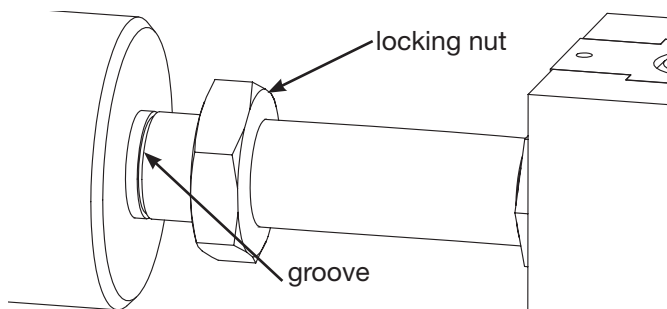


Figure 10: Groove in leg

4. Bolt the setting straps onto the base ensuring they overlap the bore dimension by at least 25mm (1.0").
5. Position the base into the flange bore and screw out the jacking bolts. Check the centralisation by measurement and adjust as necessary.
6. Adjustments can be made by tightening and loosening opposing jacking bolts, it is recommended that the setting straps are left in place until the base unit is fully installed

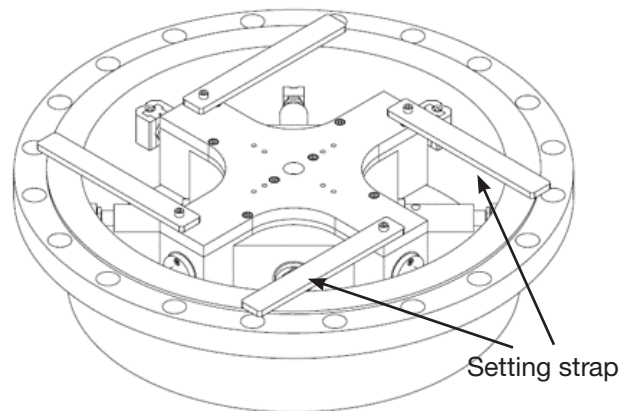


Figure 11: Base Assembly on Work-piece

CAUTION

Check that the walls of the work piece are able to withstand clamping forces without distortion. If the work piece is not able to withstand the forces, alternative means of clamping will be required. If not possible consult with the manufacturer for a custom resolution.

7. Once the base is correctly clamped to the workpiece, tighten the ram bolts to 180Nm. Then tighten the locking nut on the ram bolts to secure each leg.

WARNING

Failure to correctly torque the bolts and also tighten lock nuts may result in the clamps becoming loose from vibration.

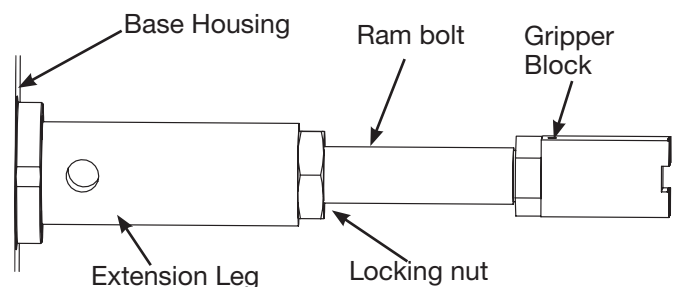


Figure 12: Example of Leg Arrangement

8. When the base is secure to the work piece, remove the setting straps and lower the main machine body onto the base. See section 5.3 for details.

5.2 Lifting

1. Refer to Figure 13 & 14 for machine lifting points and torque values.
2.  When lifting the machine, only the labelled lifting points shall be used.
3. The machine and the base are supplied in two separate assemblies. Care should be taken, and adequate PPE should be worn, when lifting the two units.
4. Do not lift the machine with the base attached.

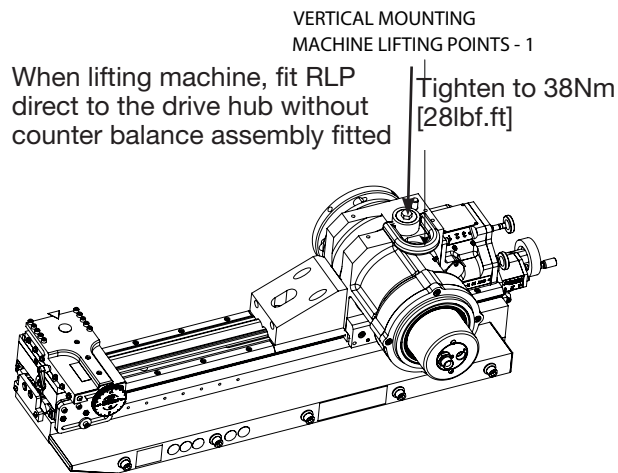


Figure 13: Vertical Lifting

When lifting the machine drive hub in the vertical plane; remove the facing arm and counter balance assemblies before using the dedicated M12 hole located on the Drive Hub, which can lift the machine with a single M12 lifting eye.

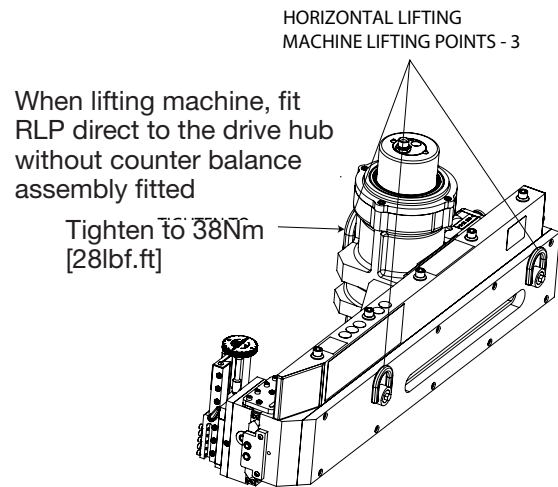


Figure 14: Horizontal Lifting

For lifting the machine in the horizontal plane; there are two points on the facing arm for M10 lifting eyes, which are used alongside the M12 lifting eye on the drive hub.

5.3 Machine installation

1. Install 4 off mounting bolts measure 20mm (0.78") of thread bolt from base plate surface to bolt head.
2. Ensure the tool post is fully retracted and the cutting tool has been removed.
3. Lift the machine carefully over the 4 off mounting bolts and align keyhole positions turn anticlockwise to lock into position and tighten the mounting bolts.
4. A central location spigot is provided for exact location of the machine to its base and this can be fixed to the centre hub of the machine.
5. A magnetic base clock is provided in the tool kit to aid radial adjustment of the machine. This can be placed on the tool post and positioned onto the flange face.
6. Survey the flange and, if required, the adjustable bolts can be used to adjust the machine parallel with the flange.

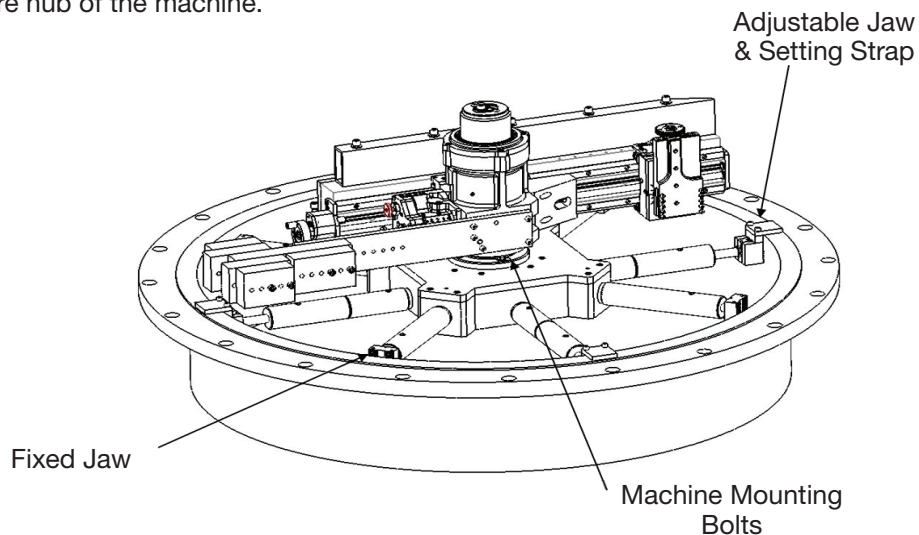


Figure 15: Machine Installation

6. Operation

⚠ DANGER

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

6.1 Connecting the machine to the power supply.

6.1.1 Pneumatic

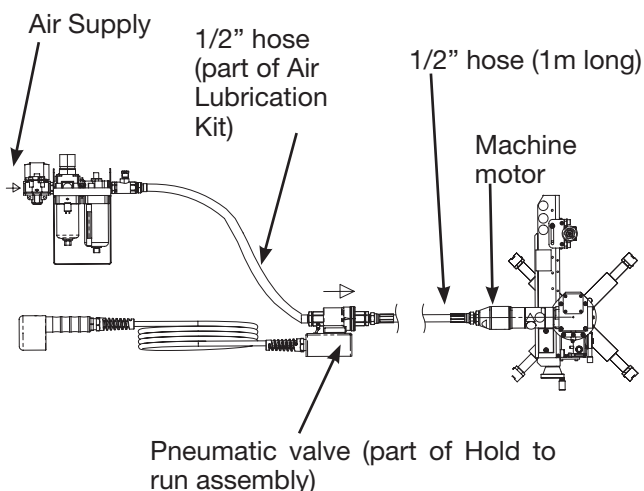
Attach the 1/2" hose to the motor coupling adapter. The free end of the 1/2" hose should be attached to the pilot operated pneumatic valve from the hold to run unit.



Ensure the directional arrow is facing the correct orientation (Flow towards the motor).

Attach the 1/2" hose from the Air Lubrication Kit to the pilot operated pneumatic valve from the hold to run unit.

The air supply should be attached to the air lubrication kit inlet valve (1/2" G port).



⚠ OBSERVE DIRECTION OF FLOW ON VALVE

Figure 16: Connection system diagram

Schematic diagrams are located in the appendix.

6.1.2 Hydraulic

The hydraulic supply from the power pack is connected to the inlet and outlet ports machine motor.

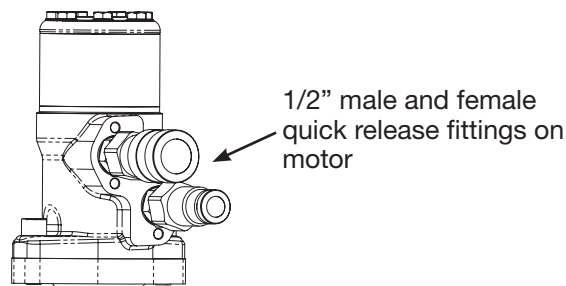


Figure 17: Hydraulic Connections

6.2 Air Lubrication Kit (Pneumatic only)

The Pneumatic machine requires an Air Lubrication Kit to prevent damage to the machine. This unit is provided as part of the machine supply. For the part number and further details of this unit, please refer to the machine General Arrangement drawing.

6.3 Operating Hold-To-Run Device (Pneumatic only)

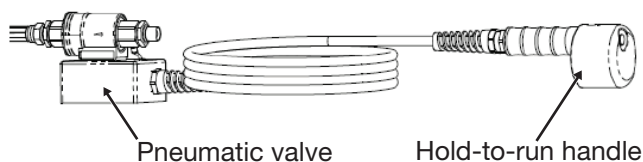


Figure 18: Hold-To-Run Assembly

⚠ WARNING

When the machine has been fully set-up and connected to the power source, go through the safety checklist before beginning the cutting operation.

To operate the hold-to-run handle, first press on the anti accidental start button. Whilst holding this down, press down the 'hold-to-run' push button. The machine should now be running.

Release the anti accidental start button, but keep down the 'hold-to-run' push button to keep running the machine.

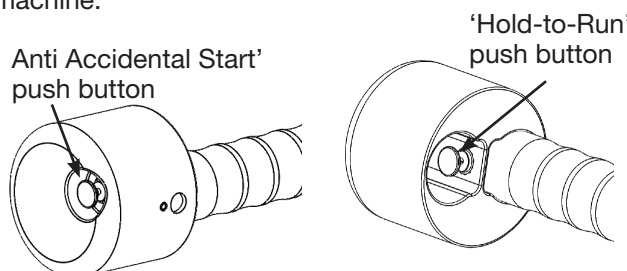


Figure 19: Hold-to-run handle

To stop the machine, and in case of emergency, release the button on the handle.

Hold-to-run device function summary:

Press 'Hold-to-run' button first, the machine **should not start**.

Press 'Anti Accidental Start' button first, the machine **should not start**.

Press 'Anti Accidental Start' button first, whilst holding this down, press 'Hold-to-Run' button, the machine **should start**.

Release 'Anti Accidental Start' button, the machine **should continue running** whilst holding down 'Hold-to-Run' button.

Release 'Hold-to-Run' button, the machine **should stop** immediately.

6.4 Restart Procedure

6.4.1 Pneumatic

If a power loss occurs during a cutting operation, follow the below procedure:

1. Release the button on the hold-to-run handle.
2. Lock off inlet isolation valve on the Air Lubrication Kit.
3. Investigate power loss.
4. When power is available, re-assess safety, then once out of the cordoned off area, unlock the isolation switch on the inlet valve.
5. Re-start the machine by operating the hold-to-run device .

6.4.2 Hydraulic

If a power loss occurs during a cutting operation, follow the below procedure:

1. Refer to power pack user manual through-out the below steps.
2. Release the run button on the power pack.
3. Lock off inlet isolation valve on the power pack.
4. Investigate power loss.
5. When power is available, re-assess safety, then once out of the cordoned off area, unlock the isolation switch on the power pack.
6. Re-start the machine by operating the controls on the power pack.

6.5 Toolpost Setting

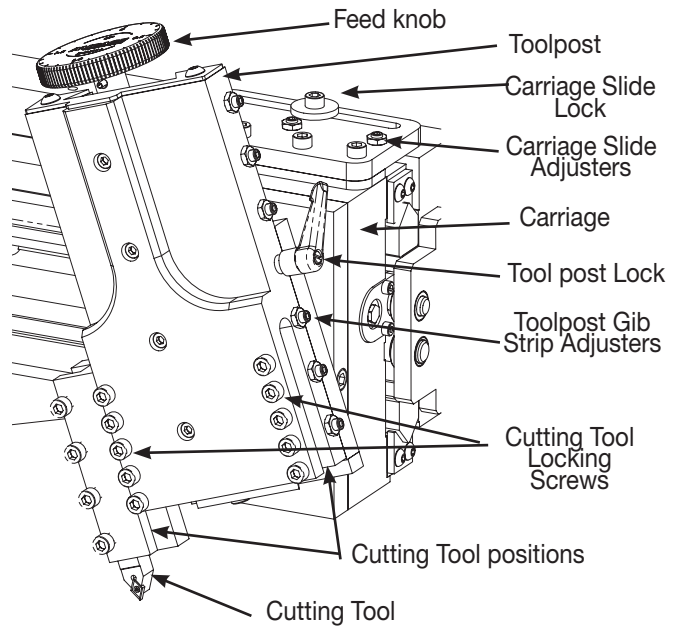


Figure 20: Toolpost Features

Installing the cutting tool

Install the cutting tool provided in either of the tool slots and tighten – over tightening of the screws could result in thread or tool post damage.

To change the insert cutting tip, refer to section 8.4

Setting the Tool Post Angle

The angle of the tool post can be altered by loosening the 2 off screws (one on each side of the carriage) as indicated in figure 21 and the tool post will swivel. Tighten the 2 off screws to lock at the required angle.

The angle guide on the carriage can be used to measure the tool post angle.

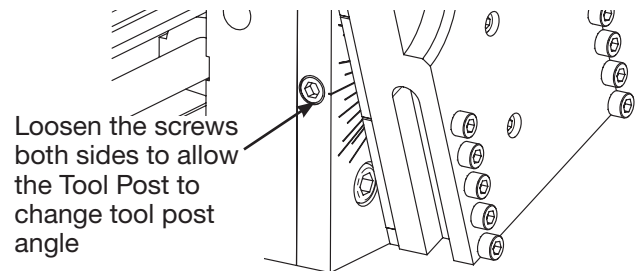


Figure 21: Setting Tool Post Angle

Setting the Depth of cut

The tool post will feed approximately 2mm (0.078") per revolution of the Feed Knob. Accurate depth of cut setting is achieved by placing the magnetic clock on the tool post zero the dial on the flange face and then add depth of cut.

Use the Tool Post Lock (shown in figure 20) to lock the depth of the tool post. Ensure this is not tight during the boring operation.

CAUTION When facing ensure the carriage slide lock is removed. When boring ensure the lock is tightened to maintain a fixed carriage position.

6.6 Selecting Facing or Boring Operation

For facing operation, push the lever away from the surfacing arm (lever should point at 'F') whilst rotating the hand wheel.

For Boring operation, push lever towards the surfacing arm (Lever should point at 'B') whilst rotating the knurled dial on the tool post.

Neutral position is selected at anytime to stop feeding. It is sometimes necessary to disengage the boring feed by stopping rotation and winding the tool post feed in the reverse direction whilst pulling the selection lever back towards the hand wheel.

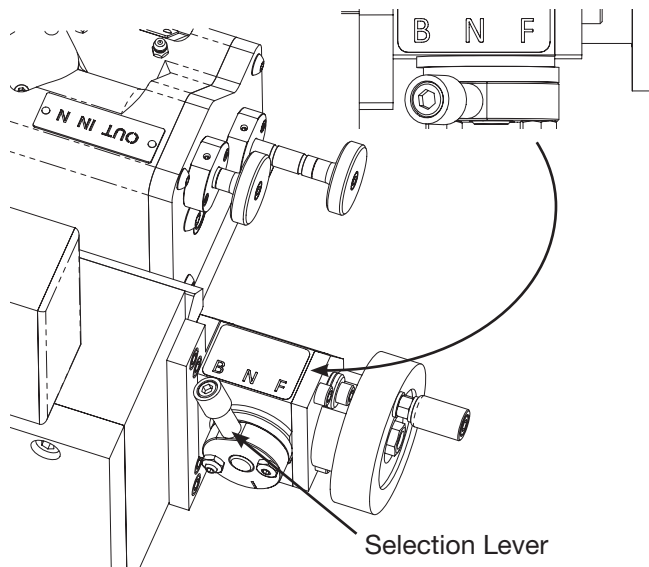


Figure 22: Select Operation

6.7 Facing Feed Gear Selection

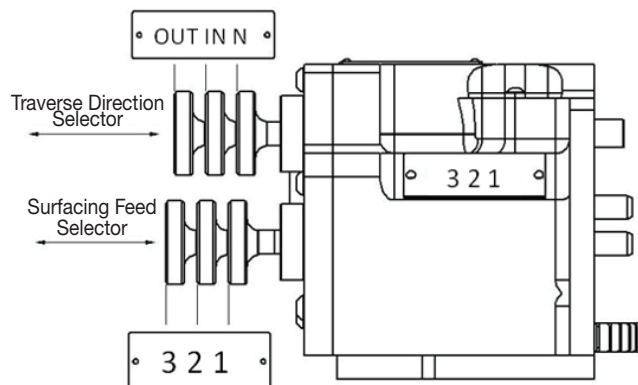


Figure 23: Feed Gear Selection

Feed Direction	Feed Gear	Feed Rate mm/rev	Feed Rate Grooves/ inch
Out	1	0.130	195
Out	2	0.203	125
Out	3	0.494	51
In	1	0.155	164
In	2	0.241	105
In	3	0.588	43

6.7.1 Selecting Feed Rate

1. Check feed rate table. (See appendix B3 Flange face surface finish)
2. Select required feed and push or pull feed selector to required position.

6.7.2 Selecting Feed Direction

1. Check required direction IN will traverse the tool towards centre – OUT will traverse the tool away from centre.
2. Select required direction and push or pull feed selector to required position.
3. The direction lever can be rotated to engage feed rate and direction gears and will not rotate when both are fully engaged.

WARNING

When using the tool post in boring mode it is advisable to lock the carriage. The plate, screw and washer are provided to do this. Its is important to remember to remove the screw before using the machine in facing mode. Failure to do so could result in damage to the machine.

6.8 Boring Feed Gear Selection

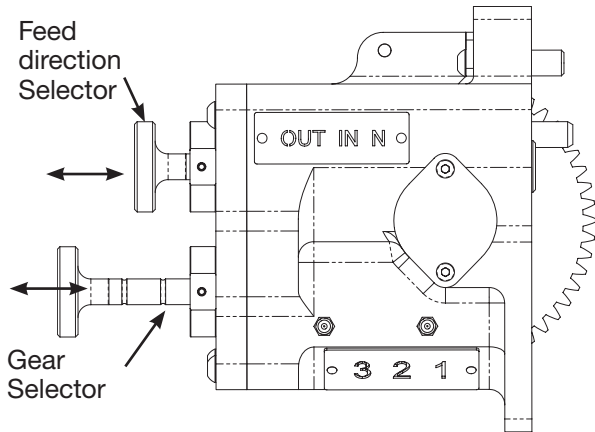


Figure 24: Boring Feed Gear Selection

Selector Position	Feed Gear	Feed Rate mm/rev	Feed Rate in/rev
Out (up)	1	0.03mm	0.001"
Out	2	0.08mm	0.003"
Out	3	0.15mm	0.006"
In (down)	1	0.05mm	0.002"
In	2	0.10mm	0.004"
In	3	0.15mm	0.007"

6.8.1 Selecting Feed Rate

1. Check feed rate table. (See appendix . B3 Flange face surface finish)
2. Select required feed and push or pull feed selector to required position: Out will feed the tool Up, In will feed the tool Down.

6.9 Surfacing Arm Setting

1. When it is necessary to move the surfacing arm, loosen the main hub to arm locking bolts.

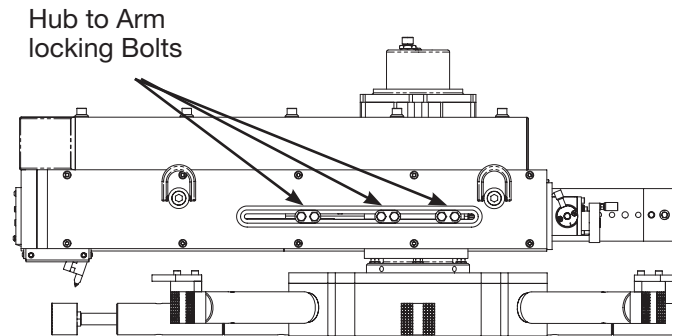


Figure 25: Hub to Arm locking bolts

2. Loosen the arm clamp plate screws and the arm should now slide. Slide to the required position.

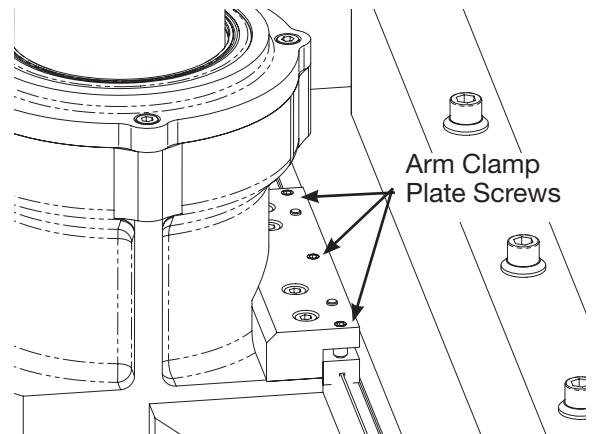


Figure 26: Arm Clamp plate screws

3. To accurately locate the arm apply finger tight pressure to the main hub arm locking bolts and then whilst supporting the arm weight tighten the clamp screws in order from centre first, the one outer, then the other, and then fully tighten the hub arm locking bolts. This will ensure the arm is located correctly and is perpendicular to the rotation drive hub.

6.10 Machine Balancing

Weights - add and remove as necessary. Position on plate to optimize machine balance

2 o'clock position – machine rotation will increase if incorrectly balanced

7 o'clock position – machine rotation will slow if incorrectly balanced

Attach balance plate here then add weights once fixed in position

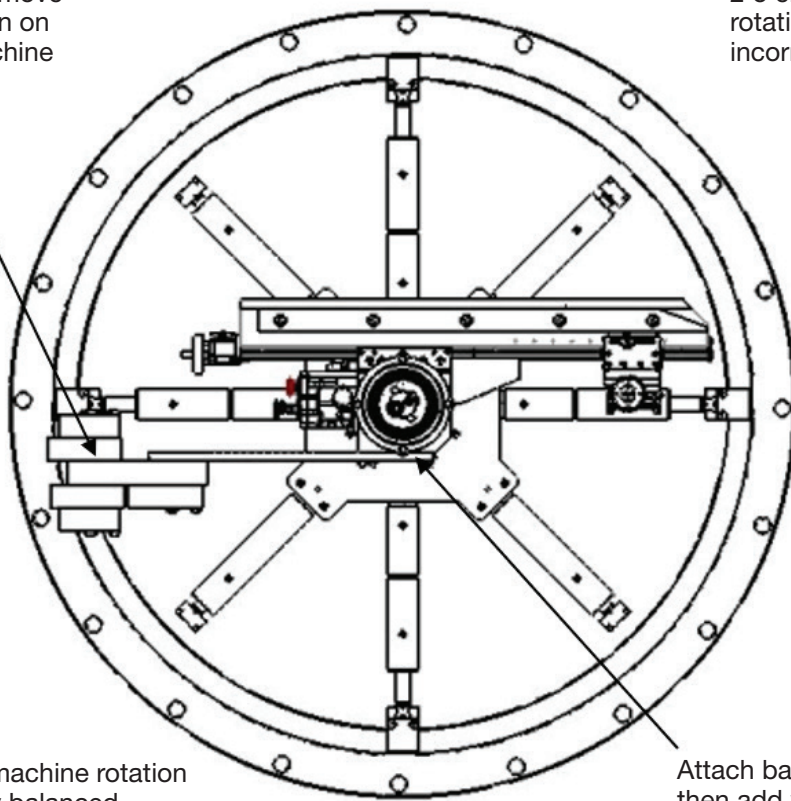


Figure 27: Machine Balancing

1. When machining in any angular position other than horizontal it is necessary to balance the machine. Attach the slide bar to the machine. Failure to balance the machine correctly will increase load on the drive components.
2. To obtain balanced rotation add or remove weights and move their position on the bar to obtain a smooth rotation. There should be no increase or decrease in rotational speed. Pay particular attention to 7 o'clock and 2 o'clock positions as this will be where the weight shift will be greatest.
3. For more accurate balancing the motor can be removed and the machine swung by hand until it rotates at an even pace with no evidence of speed increase.

6.11 Clearing Blockages

When machining, a build up of swarf can occur. Periodic clearing of the swarf around the machine tool should be carried out to prevent any blockages.

CAUTION Wear protective gloves before commencing the below clearing procedure.

1. Release button on the hold-to-run handle.
2. Use a metal brush and pliers to remove swarf build-up.
3. Before re-starting the machine, re-assess safety, then once out of the cordoned off area start the hold to run device.

6.12 Recommended Lubricants.

The air lubricating unit uses AW32 hydraulic oil. For all other lubricants refer to the maintenance schedule tables for recommended lubricants.

6.13 Machine Disassembly

To disassemble the machine follow the below procedure:

1. Switch off the inlet isolation valve before disconnecting the hoses from the machine. On the pneumatic model there should be 3 separate assemblies: the hold-to-run assembly, the lubrication kit assembly, and the machine/base assembly (still on the work piece).
2. The machine now needs to be disconnected from the base by loosening each of the 4 machine bolts on the base. The arm assembly will need to be moved around in order to gain access to each bolt.
3. Once the bolts are loosened twist the mast to the large key hole and lift off the machine assembly. Refer to section 5.2 for lifting guidance

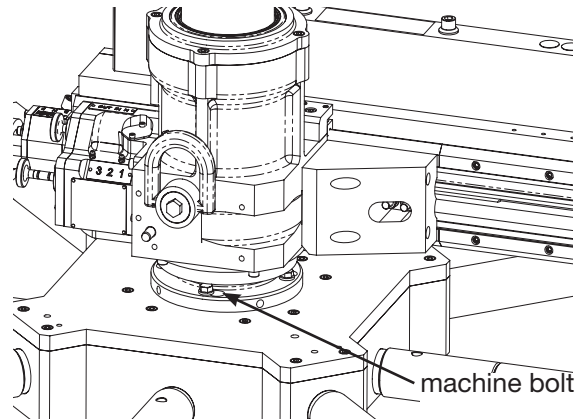


Figure 28: Mounting machine bolt

4. To safely remove the base assembly from the work piece, secure the setting straps back onto the base unit to ensure the base does not fall while loosening the ram bolts. The base can now be lifted out.

7. Storage

Storing the machine in the original box will extend the longevity of the machine. Before storing make sure the machine is clean and dry. Pay particular attention to the V grooves in the rail. Grease the leadscrew and slide ways (using WD40 or similar) before storing the machine.

Use the below images to assist with re-packing the machine.

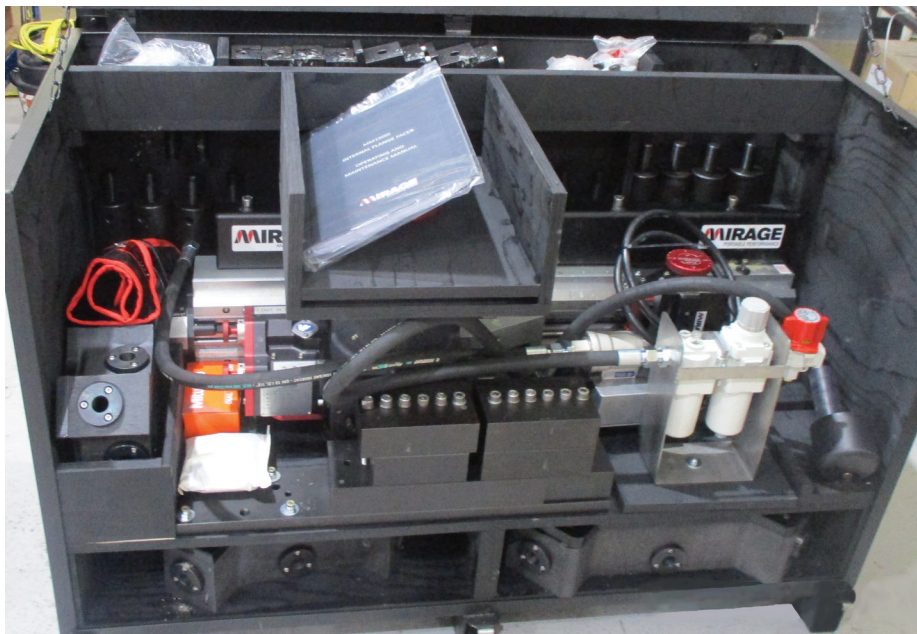


Figure 29: Storage box

8. Maintenance



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

8.1 General Maintenance

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.

Time Period (of machine use)	Action	Recommended Lubricant
After every use	1. Clean all components and lightly oil	SAE 10 oil or WD40
	2. Check all components are present and stored correctly	
	3. Check tools and regrind or reorder inserts	
	4. Check and adjust gib strip and carriage	Reference corrective maintenance section
Weekly under use	1. Grease main hub bearings – 5 shots	00 EP Lithium semi fluid grease
	2. Grease gearbox – 2 shots	00 EP Lithium semi fluid grease
	3. Grease tool post rack	00 EP Lithium semi fluid grease
	4. Lightly oil slide ways	SAE 10 oil
	5. Clean and oil base components	SAE 10 oil

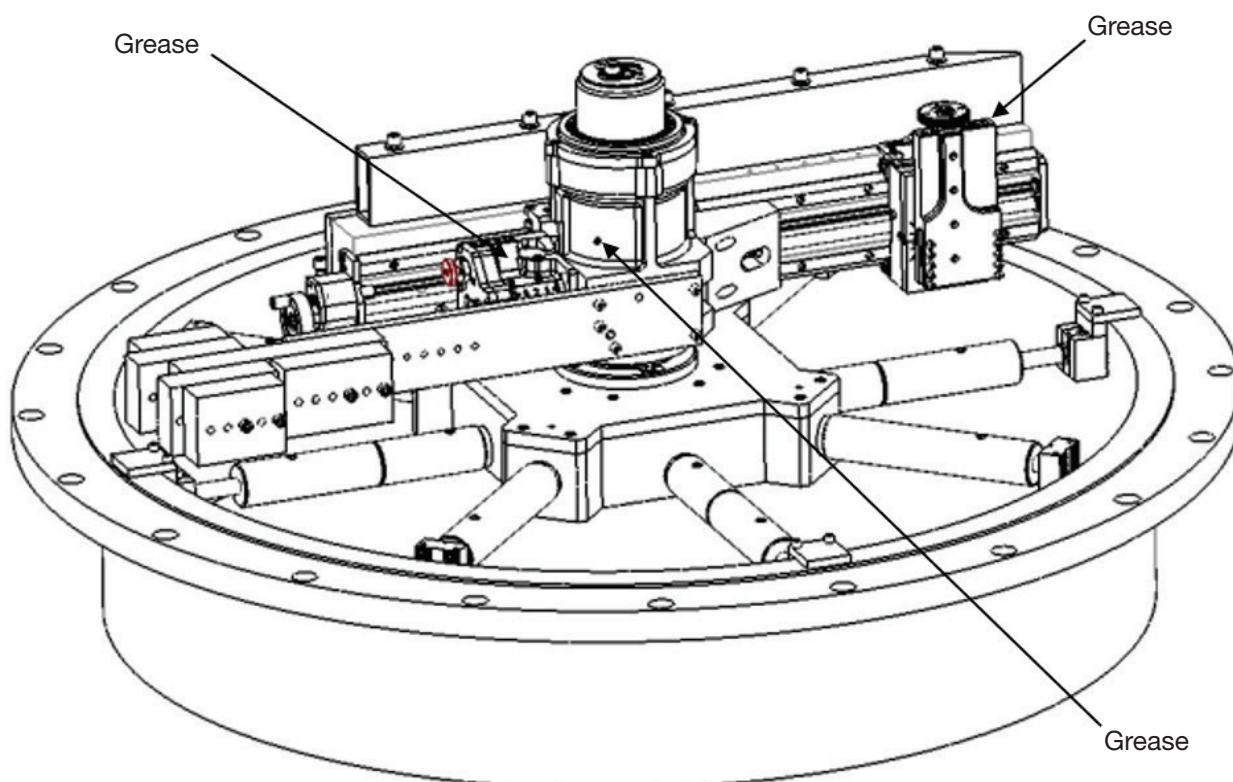


Figure 30: Grease Points During Maintenance

8.2 Corrective Maintenance

8.2.1 Air motor (ref.MM1500i-1)/

Hydraulic motor (ref. MM1500i-1H)

- Remove MMI 15112 – location spigot and Slacken 3 off screws which secure the motor to the mast.
- To remove the motor tap the drive gear MMI 15102 from the bearing MJ7/8” – 2RS.

The procedure for installation is the reverse of the removal ensuring that the motor shroud MMI 11117 is correctly seated into the seal 120 X 150 x 12.

8.2.2 Facing arm (ref MM1500i-3)

- Remove the hub – arm clamps screws and plate. Slacken off the adjuster screws which clamp the surfacing arm perpendicular to the hub on the hub assembly.
- Position the arm centrally and roll backwards and the arm will come away from the hub assembly.

The procedure for installation is the reverse of the removal ensuring that the PTO box MMI 8302 fits into the gearbox opening and it is in mesh with the output gear in the gearbox.

To check the correct installation -lift in the surfacing arm should be no more than 0.15mm (0.005”).

8.2.3 Tool post gib strip (ref MMI 8336)

- Slacken lock nuts on the gib strip adjusters and slacken grub screws.
- Working from one end adjust grub screws only when there is sufficient location on the slide way to prevent over tightening. To adjust tighten fully then back off one quarter of a turn and tighten the lock nut.
- Check the tool post movement along its stroke to ensure free sliding movement and no sideways movement.

8.2.4 Slide way Carriage (ref MM1500i-21)

- Slacken lock nuts on the gib strip adjusters and slacken grub screws (Working with the hand wheel ensure the carriage will slide whilst tightening the grub screws and then use the lock nuts to fix the the adjustment.

To check the correct installation – there should be no free play in the carriage slide assembly.

8.2.5 Main Bearings (ref MM1500i-1)

- Slacken 4 off screws and remove top cap You will now have access to the lock nut Slacken off locking screws in the lock nut and tighten to give free rotation with no bearing skid.
- Tighten the locking screws and replace the top cap.

To check the correct installation -lift in the surfacing arm should be no more than 0.15mm (0.005”).

8.2.6 Ball screw (ref MM1500i-3)

- Remove the lock nut and hand wheel You will now have access to the lock nut and washer.
- To tighten bend tab and tighten the locknut as necessary and re-bend tab back in appropriate position and re install the hand wheel and lock nut.

8.3 Replacing Shear Pin in Pick Up Gear

1. Start by removing the complete gearbox assembly from the machine.
2. Remove the Pick Up Gear Cover (Item 8 of drawing MM1500i-20) complete with the Oilite bush by first removing the series of 6 off M6 x 16 socket head cap screws.
3. Removing the 2 x M4 button head screws will give access to the retaining components of the gearbox input shaft. Referring to views A and B;
 - a) Loosen 2 x M4 cap head screws & remove the gearbox blanking plate.
 - b) 32mm internal circlip.
 - c) Remove thrust spacer.
 - d) Grip the lower end of the Worm shaft & remove the KM1 locknut and MB1 locking tab washer.
 - e) Now remove the Worm assembly complete with Pick Up Gear.

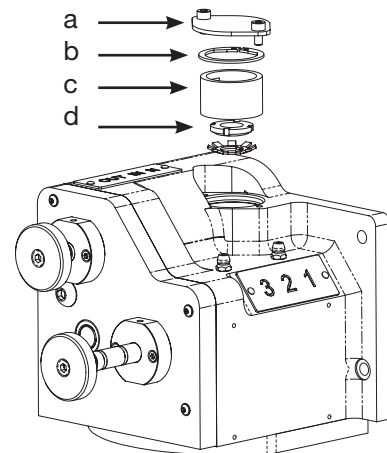


Figure 31: View A

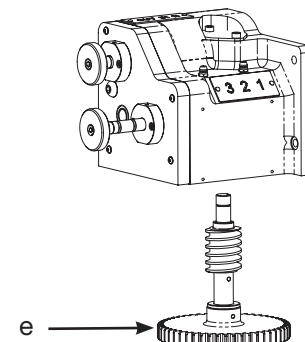


Figure 32: View B

4. Remove the spring pin and replace as necessary.

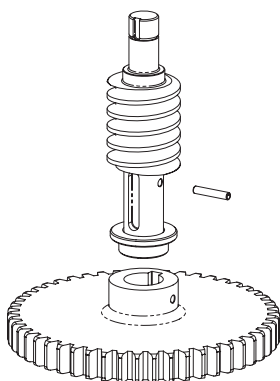


Figure 33: View C

5. Re-assemble and attach the gearbox assembly to the machine using the reverse of the process detailed above.

8.4 Changing the insert cutting tip.



When handling the insert make sure to use protective gloves.

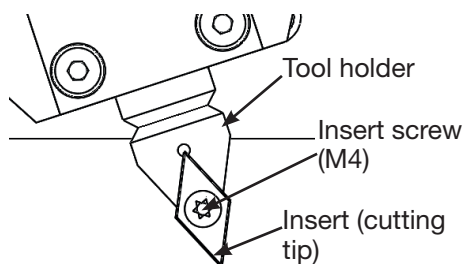
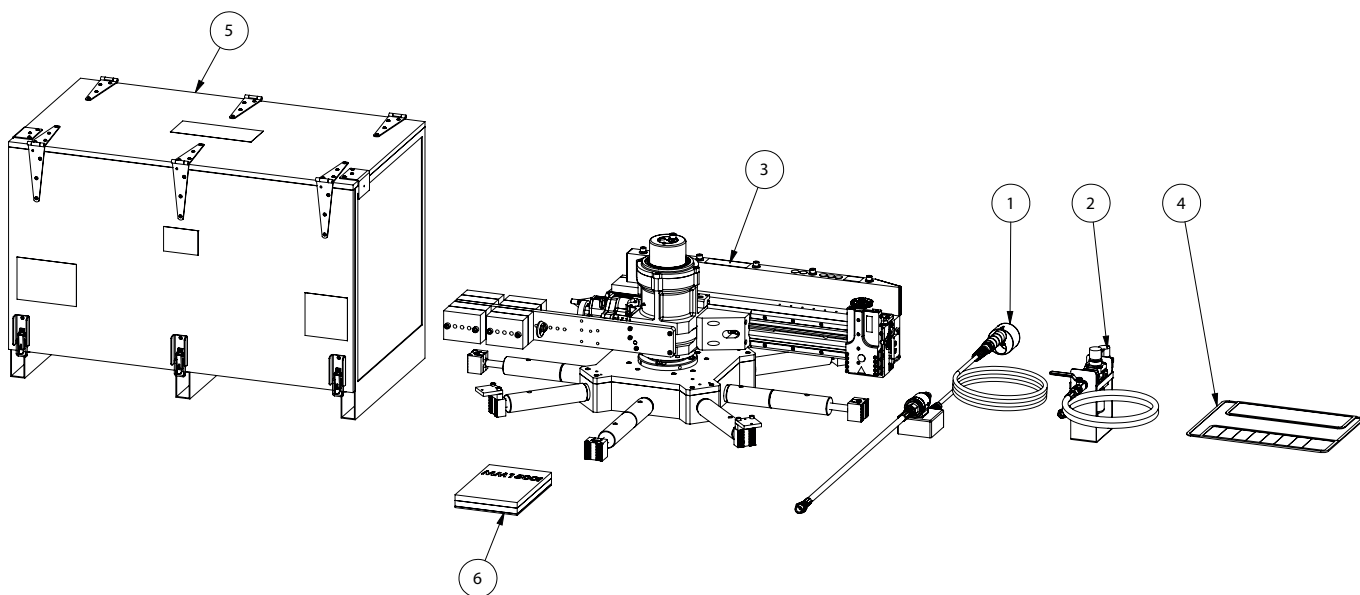


Figure 34: Insert and holder

The insert is attached to the tool holder by the screw. Ensure the screw is tight once the cutting tool insert has been changed.

9. Parts List

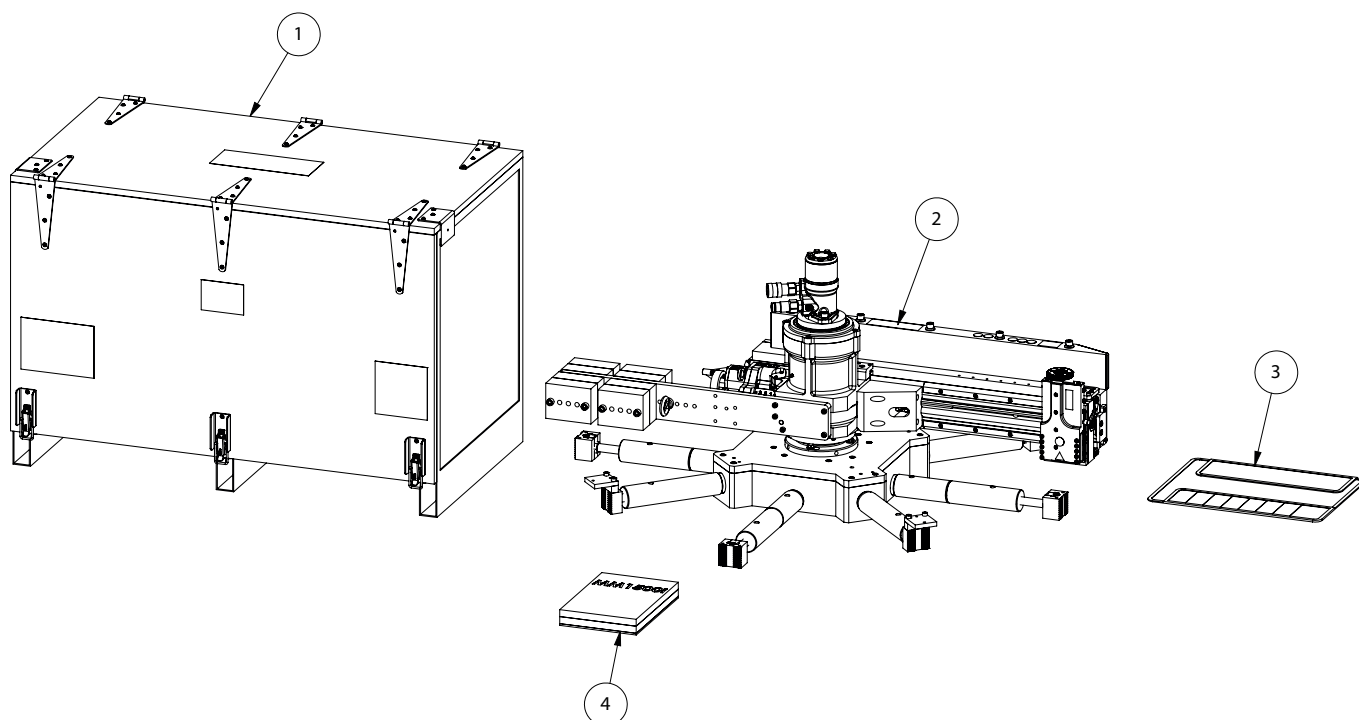
9.1 MM1500i Pneumatic Assembly (MM1500i, Revision H) Views



9.2 MM1500i Pneumatic Assembly (MM1500i, Revision H) Table of Parts

Item Number	Part Number	Description	QTY
1	DMH-PNEUMATIC	PNEUMATIC DEAD MANS HANDLE	1
2	LARGE-ALK	LARGE FILTER LUBRICATOR KIT	1
3	MM1500i-P-M	FLANGE FACING (PNEUMATIC) MACHINE	1
4	MM1500i - TK	MM1500i TOOLKIT	1
5	MM1500I-BOX	MM1500I TRANSPORTATION BOX	1
6	DOC-MM1500i	Document Pack for MM1500i	1

9.3 MM1500i-H Hydraulic Assembly (MM1500i-H, Revision B) Views

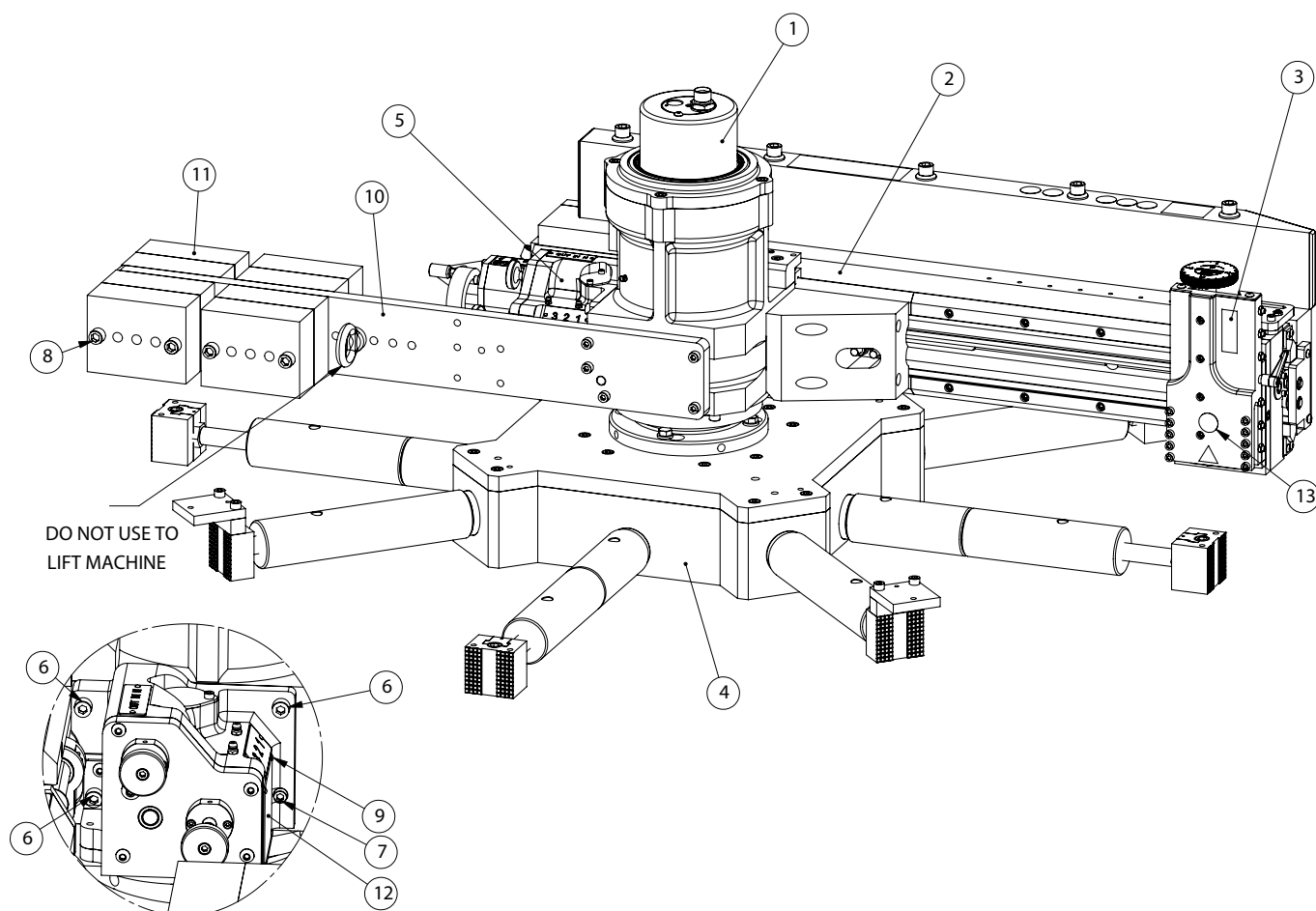


9.4 MM1500i-H Hydraulic Assembly (MM1500i-H, Revision B) Table of Parts

Item Number	Part Number	Description	QTY
1	MM1500i-BOX	MM1500i TRANSPORTATION BOX	1
2	MM1500i-H-M	FLANGE FACING (HYDRAULIC) MACHINE	1
3	MM1500i - TK	MM1500i TOOLKIT	1
4	DOC-MM1500i-H	Document Pack for MM1500i-H	1

9.5 MM1500i-P-M Pneumatic Machine Assembly (MM1500-P-M, Revision A) Views

Weight 151kg

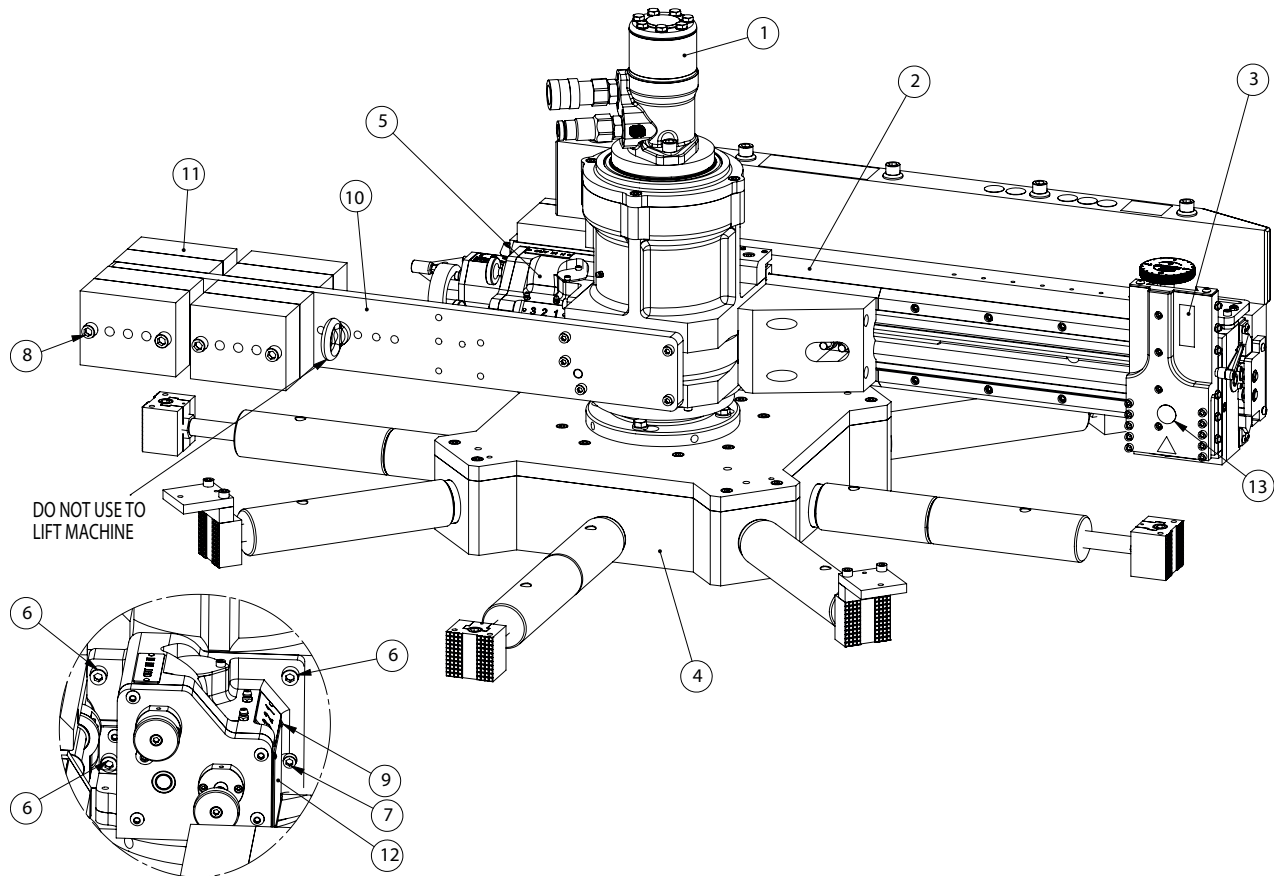


9.6 MM1500i-P-M Pneumatic Machine (MM1500i-P-M, Revision A) Table of Parts

Item Number	Part Number	Description	QTY
1	MM1500i - 1	MAST & HUB	1
2	MM1500i-3	FACING ARM & CARRIAGE	1
3	MM1500i-4	TOOLPOST & SWIVEL ASSEMBLY	1
4	MM1500i-5	MM1500i BASE ASSEMBLY	1
5	MM1500i - 20	3 SPEED GEARBOX	1
6	M8 x 35	Hex Socket Head	3
7	M6 x 20	Hex Socket Head	1
8	M12 x 120	Hex Socket Head - BS EN ISO 4762	6
9	No 2 x 3/16"	HAMMER DRIVE SCREW	4
10	MM1500i-51	COUNTER BALANCE ASSEMBLY	1
11	MM1500i-51-002	BALANCE WEIGHT 5Kg	6
12	MM1500i-20-006	3 SPEED GEARBOX LEGEND	1
13	LABEL-PACK-5	Label Pack for MM1500i	1
14	RLP-M12-10	ROTATING LIFTING POINT	1

9.7 MM1500i-H-M Hydraulic Machine Assembly (MM1500-H-M, Revision A) Views

Weight 160kg



NOTES:
1. PART RLP-M12-10 REMOVED TO FIT COUNTER BALANCE

9.8 MM1500i-H-M Hydraulic Machine (MM1500i-H-M) Table of Parts

Item Number	Part Number	Description	QTY
1	MM1500i-1H	MAST & HUB (HYDRAULIC)	1
2	MM1500i-3	FACING ARM & CARRIAGE	1
3	MM1500i-4	TOOLPOST & SWIVEL ASSEMBLY	1
4	MM1500i-5	MM1500i BASE ASSEMBLY	1
5	MM1500i - 20	3 SPEED GEARBOX	1
6	M8 x 35	Hex Socket Head	3
7	M6 x 20	Hex Socket Head	1
8	M12 x 120	Hex Socket Head - BS EN ISO 4762	6
9	No 2 x 3/16"	HAMMER DRIVE SCREW	4
10	MM1500i-51	COUNTER BALANCE ASSEMBLY	1
11	MM1500i-51-002	BALANCE WEIGHT 5Kg	6
12	MM1500i-20-006	3 SPEED GEARBOX LEGEND	1
13	LABEL-PACK-5	Label Pack for MM1500i	1
14	RLP-M12-10	ROTATING LIFTING POINT	1

Weight 47kg



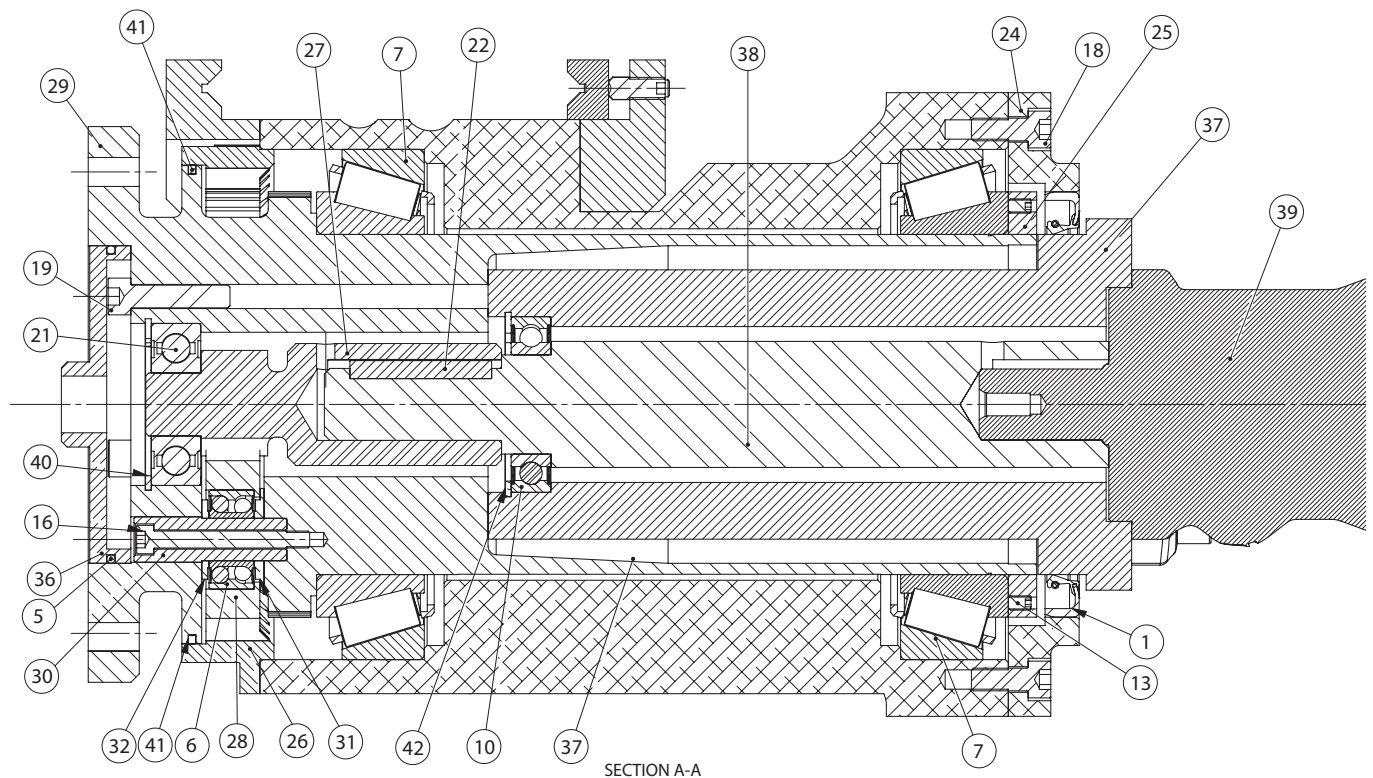
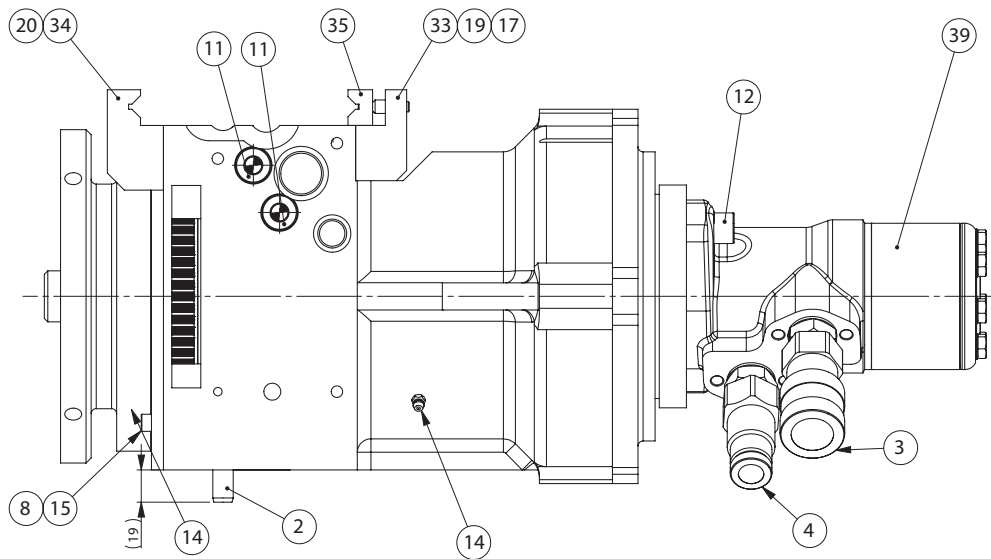
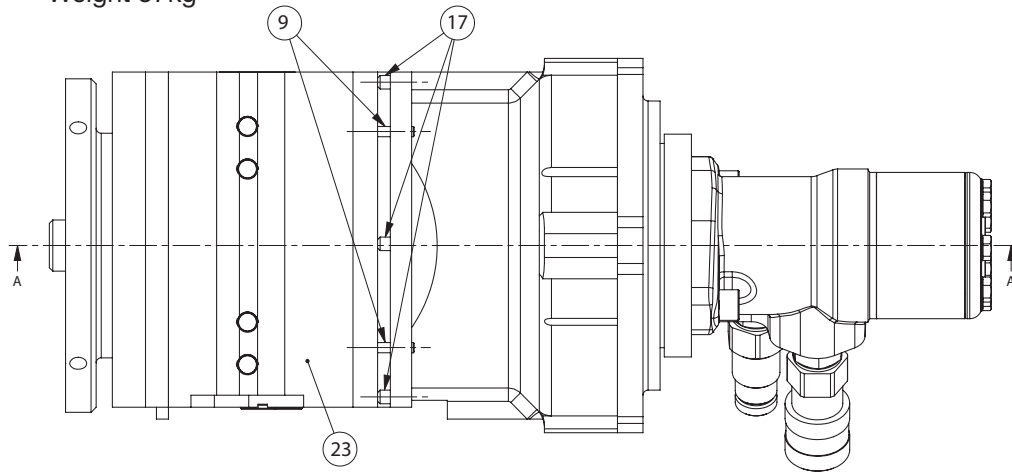
9.10 Mast and Hub Assembly - Pneumatic (MM1500i-1, Revision Q) Table of Parts

Item	Part Number	Description	QTY
1	120 x 150 x 12	METRIC OIL SEAL	1
2	12X40DOWEL	12X40 DOWEL HARD-ENED STEEL DIN 6325	1
3	3 x 106	O RING SEAL	1
4	3202-2RS	ANGULAR CONTACT BEARING	1
5	32024	SINGLE ROW TAPERED ROLLER BEARING	2
6	6 X 20	Ø6 DOWEL	2
7	6 X 30	Ø6 DOWEL	2
8	AMF101516	Flanged Oilite Bush	2
9	BMBM0808	BSP STRAIGHT MALE 1/2 - MALE 1/2	1
10	DOWTY08	1/2" DOWTY WASHER	1
11	CBE517028-1E	M5X12 GR10-9 BUT-TON HEAD CAP SCREW COARSE ISO 7380 (BZP)	2
12	M5X0.8X6F-PGS14-9	M5X6 GR14-9 SET SCREW, FLAT COARSE ISO 4026 (BZP)	2
13	M5X0.8X8F-PGS14-9	M5X8 GR14-9 SET SCREW, FLAT COARSE ISO 4026 (BZP)	4
14	M6-GREASENIP- PLE	M6 GREASE NIPPLE	1
15	CCZ619028-1A	M6X16 GR12-9 SOCK-ET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4
16	CCZ635028-1A	M6X55 GR12-9 SOCK-ET HEAD CAP SCREW COARSE ISO 4762 (BZP)	1
17	CZZ821028-5A	M8X20 GR14-9 SET SCREW, FLAT COARSE ISO 4026 (BZP)	3
18	CCZ821028-1A	M8X20 GR12-9 SOCK-ET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4
19	CCZ827028-1A	M8X35 GR12-9 SOCK-ET HEAD CAP SCREW COARSE ISO 4762 (BZP)	7
20	CCZ829028-1A	M8X40 GR12-9 SOCK-ET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4
21	MJ 7/8" - 2RS	SINGLE ROW RADIAL BALL BEARING	1
22	MM1500i-1-002	MOTOR SHROUD	1
23	MM1500i-25	HUB WITH HELICOIL IN-SERTS	1

Item	Part Number	Description	QTY
24	MMI 11102	SEAL COVER PLATE	1
25	MMI 11109	LOCK RING	1
26	MMI 15101	50t DRIVE GEAR	1
27	MMI 15102	9t DRIVE GEAR	1
28	MMI 15103	20t IDLER GEAR	1
29	MMI 15104	69t MAST	1
30	MMI 15105	IDLER SHAFT	1
31	MMI 15106	UPPER SPACER	1
32	MMI 15107	LOWER SPACER	1
33	MMI 15108	TOP CLAMP	1
34	MMI 15109	BOTTOM CLAMP	1
35	MMI 15111	CLAMP SPACER	1
36	MMI 15112	CENTERING SPIGOT	1
37	MMI 15116	MAST SEAL	1
38	MTS30LT054B- CL2-00	AIR MOTOR, 3.2kW, 93RPM (@6BAR), 25.4mm, KEYED SHAFT, LEFT TURN	1
39	N1300 0225	INTERNAL CIRCLIP	1
40	R015162.7x169 x2.5	ECOFLO 1 SEAL	1

9.11 MM1500i-H Hub and Mast - Hydraulic (MM1500i-1H, Revision G) Views

Weight 57kg

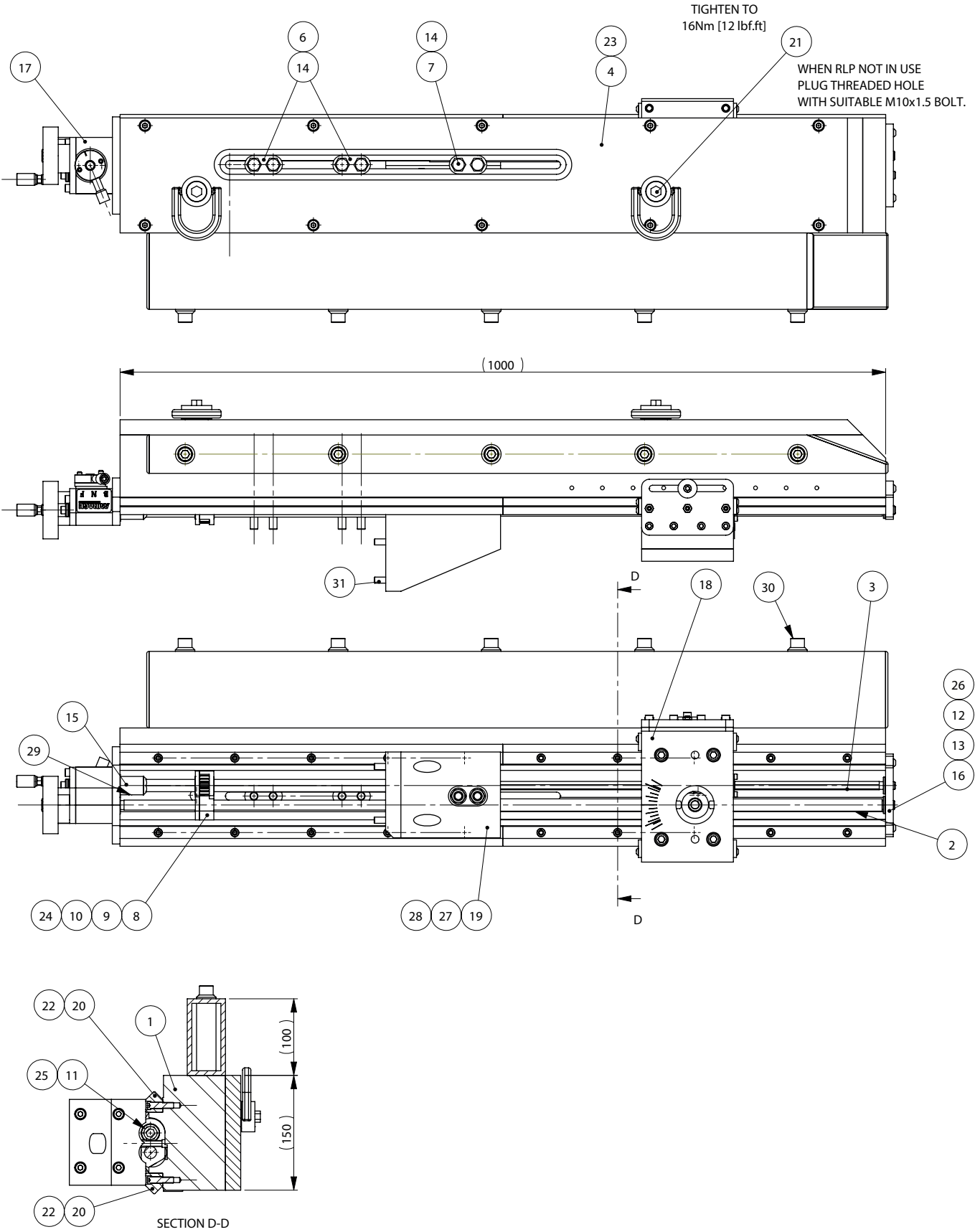


9.12 MM1500i-H Hub and Mast - Hydraulic (MM1500i-1H, Revision G) Parts List

Item	Part Number	Description	QTY	Item	Part Number	Description	QTY
1	120 x 150 x 12	METRIC OIL SEAL	1	26	MMI 15101	50t DRIVE GEAR	1
2	12X40DOWEL	12X40 DOWEL HARD-ENED STEEL DIN 6325	1	27	MMI 15102	9t DRIVE GEAR	1
3	1-2QRCOU-PLINGFEMALE	1/2" QUICK RELEASE COUPLING FEMALE SET	1	28	MMI 15103	20t IDLER GEAR	1
4	1-2QRCOU-PLINGMALE	1/2" QUICK RELEASE COUPLING MALE SET	1	29	MMI 15104	69t MAST	1
5	3 x 106	O RING SEAL	1	30	MMI 15105	IDLER SHAFT	1
6	3202-2RS	ANGULAR CONTACT BEARING	1	31	MMI 15106	UPPER SPACER	1
7	32024	SINGLE ROW TAPERED ROLLER BEARING	2	32	MMI 15107	LOWER SPACER	1
8	6 X 20	Ø6 DOWEL	2	33	MMI 15108	TOP CLAMP	1
9	6 X 30	Ø6 DOWEL	2	34	MMI 15109	BOTTOM CLAMP	1
10	6007-2RS	SINGLE ROW DEEP GROOVE BALL BEARING	1	35	MMI 15111	CLAMP SPACER	1
11	AMF101516	Flanged Oilite Bush	2	36	MMI 15112	CENTERING SPIGOT	1
12	CCZ1227028-1A	SCREW-SHCS, FLAT, HEX, M12X1.75X35, STL/12.9, ZINC	2	37	MMI 15118	HYDRAULIC MOTOR MOUNT	1
13	M5X0.8X8F-PGS14-9	M5X8 GR14-9 SET SCREW, FLAT COARSE ISO 4026 (BZP)	4	38	MMI15119	HYDRAULIC DRIVE SHAFT	1
14	M6-GREASENIP-PL	M6 GREASE NIPPLE	1	39	OMP400	DANFOSS HYDRAULIC MOTOR (151-0318)	1
15	CCZ619028-1A	M6X16 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4	40	N1300 0225	INTERNAL CIRCLIP	1
16	CCZ635028-1A	M6X55 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	1	41	R015162.7x169 x2.5	ECOFLON 1 SEAL	1
17	M8X-1.25X20CUGS 14-9	M8X20 GR14-9 SET SCREW, CUP COARSE ISO 4029 (BZP)	3	42	D1300 O620	DIN 472 INTERNAL CIRCLIP	1
18	CCZ821028-1A	M8X20 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4				
19	CCZ827028-1A	M8X35 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	7				
20	CCZ829028-1A	M8X40 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4				
21	MJ 7/8" - 2RS	SINGLE ROW RADIAL BALL BEARING	1				
22	MM1500i-1H-001	TYPE A KEY	1				
23	MM1500i-25	HUB WITH HELICOIL INSERTS	1				
24	MMI 11102	SEAL COVER PLATE	1				
25	MMI 11109	LOCK RING	1				

9.13 MM1500i / MM1500i-H Facing Arm & Carriage (MM1500i-3, Revision U) Views

Weight 99kg



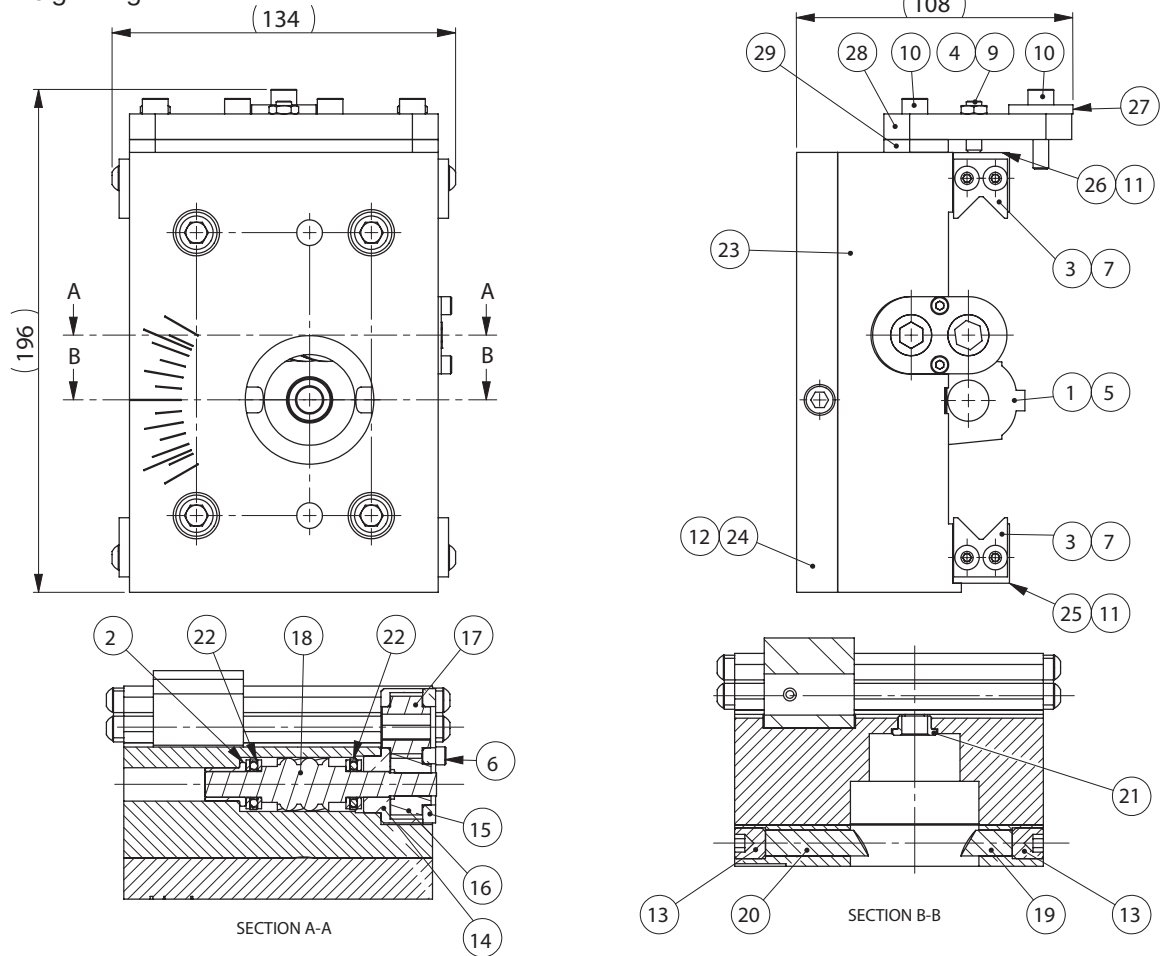
9.14 MM1500i / MM1500i-H Facing Arm & Carriage (MM1500i-3, Revision U)

Table of Parts

Item Number	Part Number	Description	QTY
1	MMI 15301	Facing Arm	1
2	MMI 15303	Leadscrew	1
3	MMI 15304	Hex Bar	1
4	MMI 15305	Backplate	1
5	MMI 15315	Strong Back	1
6	MMI 15316	Hub Bolt	4
7	MMI 15317	Hub Bolt	2
8	MMI 8302	P/T Gear Case	1
9	MMI 8303	PTO Box Case Lid	1
10	MMI 8306	20t Pick Up Gear	1
11	MMI 8347	End Stop	1
12	MMI 8393 F	MMI 8393 F	1
13	MMI 8393 H	MMI 8393 H	1
14	MMI 11318	Arm Clamp Plate	3
15	MMI 11308	Toolpost Drive Coupling	1
16	MMI 18328	Facing Arm End Plate	1
17	MM1000i-9	Selector Box Assembly	1
18	MM1500i-21	Carriage Assembly	1
19	MMI 11310	Arm Support	1
20	LWRPV 9 500	Vee Rail 9 Series	4
21	RLP-M10-10	Rotating Lifting Point	2
22	MMI8388A	Modified M8 Button Head Screw	20
23	M8 x 25	Hex Socket Head - BS EN ISO 4762	10
24	M3 x 10	Hex Socket CTSK Head - BS EN ISO 10642	2
25	M4 X 3 Flat Point	Socket Set Screw	1
26	M6 x 20	Socket Button Head Cap Screw	2
27	M10	WASHER (FORM A)	2
28	M10	NYLOC NUT	2
29	M5 x 5	Socket Set Screw Cone Point - BS 4168-3	1
30	M12 x 120	Hex Socket Head - BS EN ISO 4762	5
31	M8X35SHCSA2SS	Hex Socket Head - BS EN ISO 4762	4

9.15 MM1500i / MM1500i-H Carriage assembly (MM1500i-21, Revision K) Views

Weight 7kg

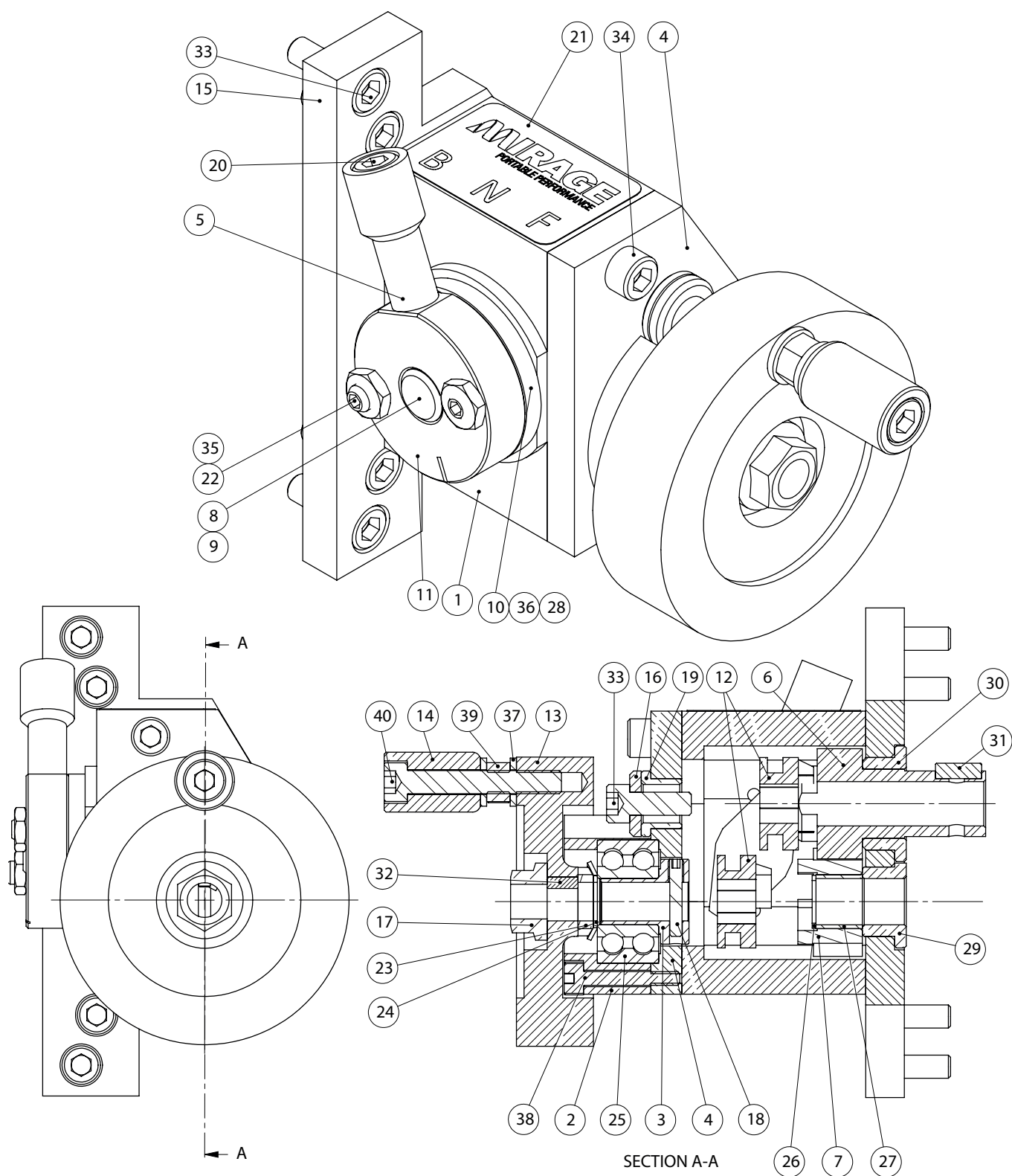


9.16 MM1500i / MM1500i-H Carriage assembly (MM1500i-21, Revision K) Table of Parts

Item	Part Number	Description	QTY	Item	Part Number	Description	QTY
1	503-165-373-14	ballscrew nut	1	16	MMI 8307	14t TRANSFER GEAR	1
2	AMF101316	FLANGED BUSH	1	17	MMI 8308	14t TRANSFER GEAR	1
3	LWEARM9	WIPER	4	18	MMI 8309	10t HELICAL GEAR TRANSFER SHAFT	1
4	M6	Jam Nut	3	19	MMI 8357	SHORT RETAINING PLUNGER	1
5	M4 x 25	Hex Socket Head - BS EN ISO 4762	4	20	MMI 8358	LARGE PLUNGER	1
6	M4 x 30	SOCKET HEAD CAP SCREW	2	21	MMI 8393 G	OILITE BUSH	1
7	M5 x 10	Hex Socket Button Head	8	22	MMI8395	MODIFIED THRUST BEARING	2
8	M6x6	Socket Set Screw Cup Point - BS 4168-5	1	23	MMI 15311	CARRIAGE	1
9	M6 x 20	Socket Set Screw Flat Point	3	24	MMI 15312	CARRIAGE PACKING PLATE	1
10	M6 x 25	Hex Socket Head - BS EN ISO 4762	5	25	MMI 15319	modified skf rail lwrp- m9x200	1
11	M8 x 55	Hex Socket Head - BS EN ISO 4762	4	26	MMI 15320	modified skf rail lwrp- m9x200	1
12	M10 x 25	Hex Socket Head - BS EN ISO 4762	4	27	MMI 15321	CARRIAGE BORING PLATE WASHER	1
13	M12 x 12	FLAT POINT GRUB SCREW	2	28	MMI 18327	CARRIAGE BORING PLATE	1
14	MMI 8304	HAND FEED GEARBOX	1	29	MMI 18334	Carriage Boring Packer Plate	1
15	MMI 8305	HAND FEED GEARBOX LID	1				

9.17 MM1500i / MM1500i-H Selector Box assembly (MM1000i-9, Revision U) views

Weight 1.5kg



9.18 MM1500i / MM1500i-H Selector Box assembly (MM1000i-9, Revision U) Table of Parts

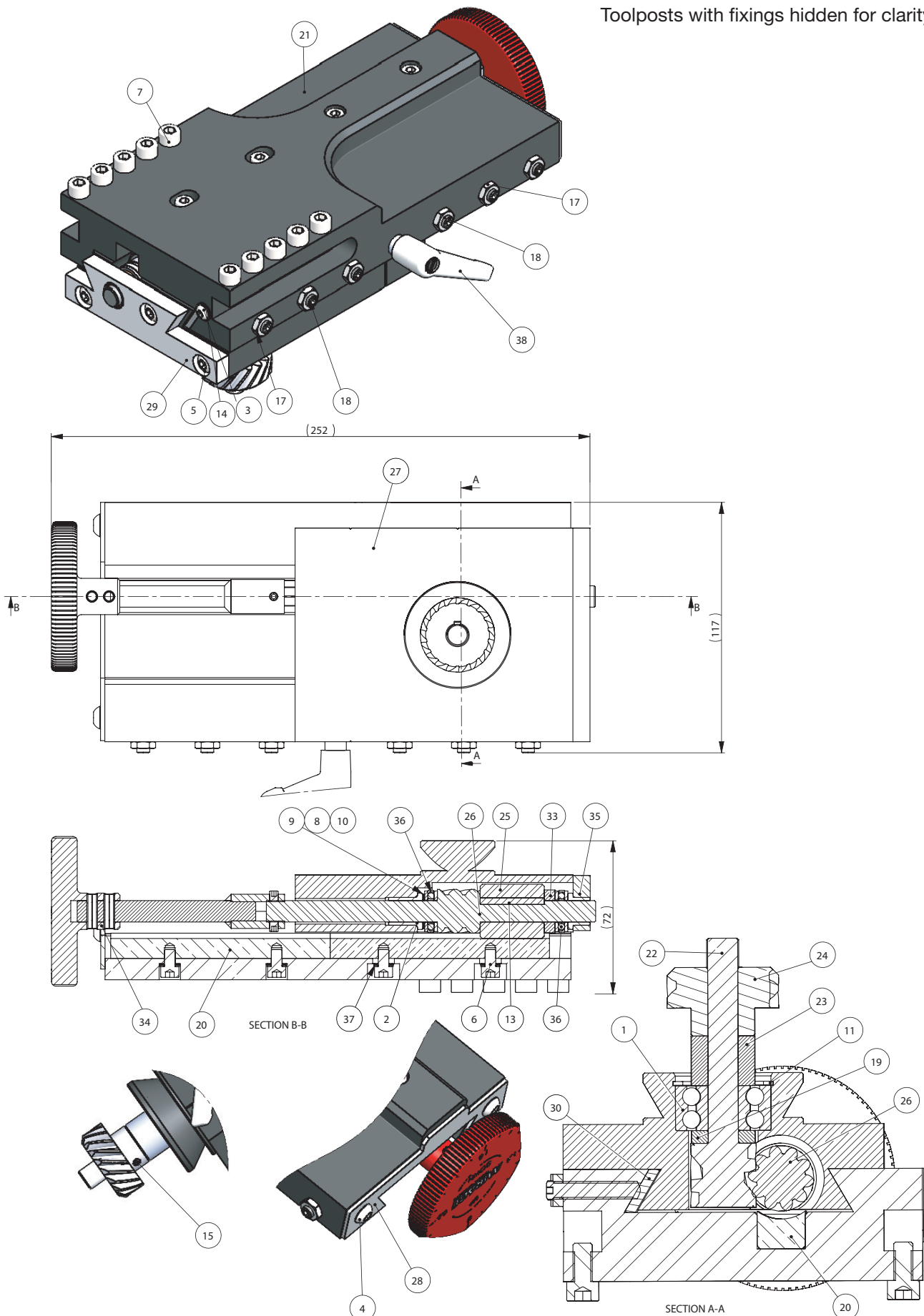
Item Number	Part Number	Description	QTY
1	MMI 15302	SELECTOR BOX	1
2	MMI 15307	BEARING HOUSING	1
3	MMI 15309	BEARING SLEEVE	1
4	MMI 15314	Selector box end cap	1
5	MMI 8239	SMALL GEAR SELECTOR	1
6	MMI 8326	16t gear on transfer shaft	1
7	MMI 8325	16t GEAR	1
8	MMI 8332	Selector	1
9	MMI 8333	SELECTOR PIN	2
10	MMI 8348	DRIVE INDENT HOUSING	1
11	MMI 8345	SURFACING ARM SELECTOR IDENT	1
12	MMI 8324	POWER SHAFT DOG	2
13	MMI 8363	Handwheel	1
14	MMI 8359	HANDWHEEL HANDLE	1
15	MMI 18326	Thrust plate	1
16	MMI 8386	Hex bar captive washer	1
17	MMI 8389	M10 x 0.75 PITCH LOCKNUT	1
18	MMI 8391	CROSS PIN	1
19	MMI 8393 A	OILITE BUSH	1
20	MMI 8450	MODIFIED M6x50 LONG SCREW	1
21	LABEL-MM-011	BNF LABEL	1
22	3160W146	Spring Plunger	2
23	KM0	locknut	1
24	MB0	lock washer	1
25	3201-2RS	double row ang con brg	1
26	M2400 0120	Snap ring	1
27	MB1212DU	DU BUSH	1
28	MMI 8393 D	OILITE BUSH	1
29	MMI 8393 C	OILITE BUSH	1
30	MMI 8393 B	OILITE BUSH	1
31	KK4-12A	TYPE A KEY	1
32	KK3-8A	TYPE A KEY	1
33	M6 x 16	SOCKET HEAD CAP SCREW	5
34	M6 x 65	Socket Head Cap Screw	2
35	M6 Nut	M6 Nut	2
36	M4 x 10	Hex Socket CTSK Head	2
37	M6	WASHER (FORM A)	2
38	M5 x 25	Hex Socket Head - BS EN ISO 4762	3
39	M6	Hex Nut Grade 8	1
40	M6X40SHCSA2SS	Hex Socket Head - BS EN ISO 4762	1

9.19 MM1500i / MM1500i-H Tool post & Swivel Assembly (MM1500i-4,Revision R) Views

Weight 7kg

Note:

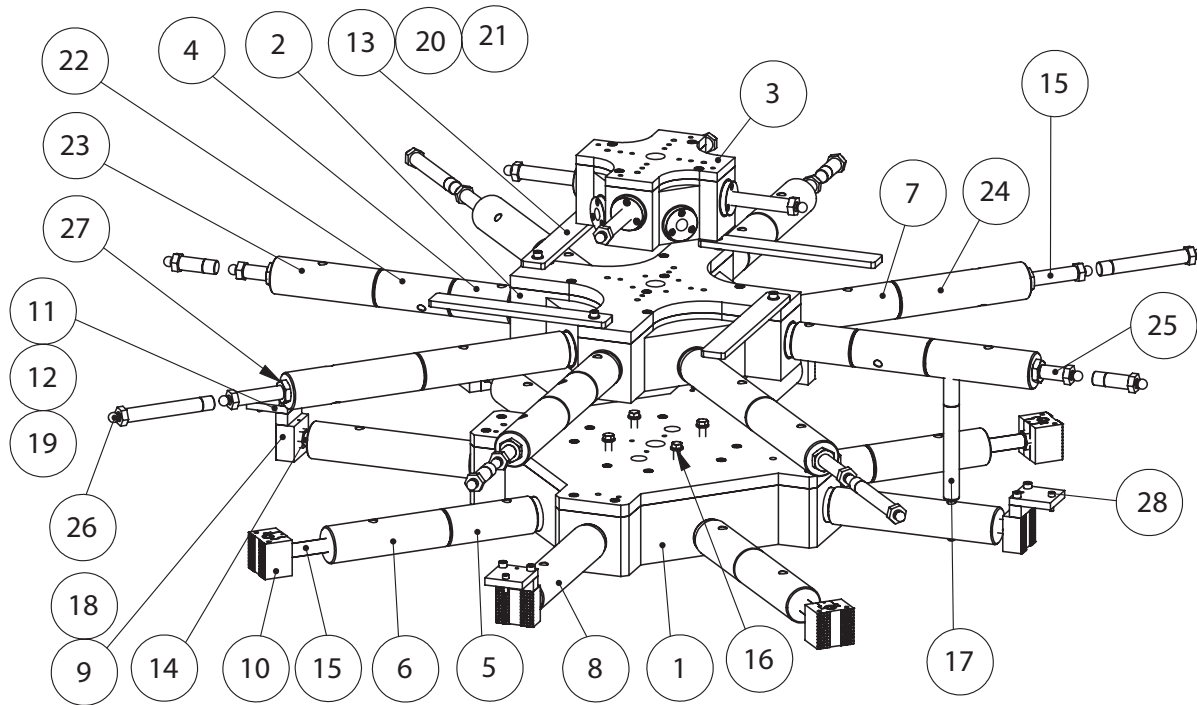
Toolposts with fixings hidden for clarity



9.20 MM1500i / MM1500i-H Tool post & Swivel Assembly (MM1500i-4, Revision R) Table of Parts

Item Number	Part Number	Description	QTY
1	3200-2RS	double row ang con brg	1
2	AMF101316	Flanged Oilite Bush	1
3	CBE413028-1E	M4X8 GR10-9 BUTTON HEAD CAP SCREW COARSE ISO 7380 (BZP)	1
4	CBE615028-1E	M6X10 GR10-9 BUTTON HEAD CAP SCREW COARSE ISO 7380 (BZP)	2
5	CBE619028-1E	M6X16 GR10-9 BUTTON HEAD CAP SCREW COARSE ISO 7380 (BZP)	3
6	M5X0.8X8SHCS12-9	M5X8 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4
7	CCZ617028-1A	M6X12 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	10
8	CPS10x16x0.1	PRECISION SHIM	2
9	CPS10x16x0.15	PRECISION SHIM	1
10	CPS10x16x0.5	PRECISION SHIM	1
11	D1300 0300	INTERNAL CIRCLIP	1
12	KK3-15A	TYPE A KEY	1
13	KK3-30A	TYPE A KEY	1
14	M4-WASHER	M4 FLAT WASHER FORM A BS 4320 (BZP)	1
15	M4X0.7X6FPGS14-9	M4X6 GR14-9 SET SCREW, FLAT COARSE ISO4026 (BZP)	1
16	M6 x 20	Hex Socket Head	4
17	M6X1TNUT	M6X1 THIN NUT COARSE ISO 4035 (BZP)	6
18	M6X1X30CPGS14-9	M6X30 GR14-9 SET SCREW, CONE COARSE ISO 4027 (BZP)	6
19	MM1000i-4-001	GEAR SPACER	1
20	MM1000i-4-002	RACK MATCHED PAIRS	2
21	MM1000i-4-003	TOOLPOST	1
22	MMI 11301	10t GEAR ON SHAFT	1
23	MMI 11313	18T BEARING SPACER	1
24	MMI 8310	18t HELICAL TRANSFER GEAR	1
25	MMI 8312	TOOLPOST FEED SCREW	1
26	MMI 8313	10t HELICAL TOOLPOST FEED	1
27	MMI 8314	TOOLPOST SWIVEL PLATE	1
28	MMI 8319	TOOLPOST TOP PLATE	1
29	MMI 8321	END PLATE	1
30	MMI 8336	TOOLPOST GIB STRIP	1
31	MMI 8339	12MM TOOLPOST EXTENSION	3
32	MMI 8340	20MM TOOLPOST ADAPTOR	2
33	MMI 8352	GEAR SPACER	1
34	MMI 8383	toolholder & handwheel assembly	1
35	MMI 8393 A	OILITE BUSH	1
36	MMI8395	MODIFIED THRUST BEARING	2
37	NL5	M5 Norid-Lock steel wedge-locking washer NL5	4
38	WDS8189-22325	INDEXING CLAMPING HANDLE, ZINC DIECAST	1

9.21 MM1500i / MM1500i-H Base Assembly (MM1500i-5, Revision H) Views



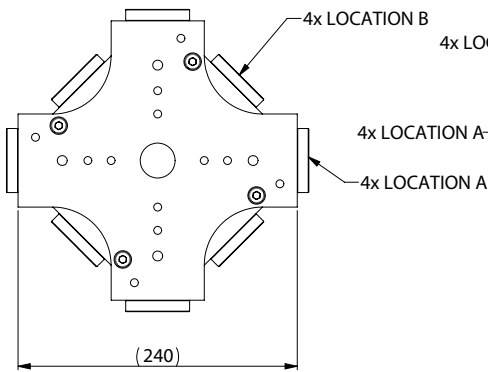
9.22 MM1500i / MM1500i-H Base Assembly (MM1500i-5, Revision H) Table of Parts

Item Number	Part Number	Description	QTY
1	MM1500i-5B	590mm Base Assembly	1
2	MM1000i-5C	460mm Base Assembly	1
3	MM1000i-5B	240mm Base Assembly	1
4	MM1500i-5-001	4" Extension	4
5	MM1500i-5-002	6" Extension	4
6	MM1500i-5-003	8" Extension	4
7	MM1500i-5-004	10" Extension	4
8	MM1500i-5-023	11" Extension	4
9	MM1500i-5-006	Plain Jaw Pad	4
10	MM1500i-5-008	Adjustable Jaw Assembly	4
11	MM1500i-5-009	Setting Strap Plate	4
12	MM1500i-5-010	Spacer Block	4
13	MMI 8415	Mounting Strap	4
14	MM1000i-5-008	Extra Long Ram Bolt	8
15	MMI 8427	Large Ram Bolt	8
16	MMI 11120	Machine Bolt	4
17	MMI 18420	Tommy Bar	1
18	3150.W004	Spring Plunger	4
19	M8 x 50	Hex Socket Head	8
20	M8	Washer (Form A)	4
21	M8 x 30	Hex Socket Head - BS EN ISO 4762	4
22	MM1500i-5-020	5" Extension	4
23	MM1500i-5-021	7" Extension	4
24	MM1500i-5-022	9" Extension	4
25	MM1000i-5-010	Ram Bolt (60mm Long)	8
26	MM1000i-5-011	Ram Bolt (150mm long)	8
27	ISO 8675 Thin Nut M22x1.5 BZP	ISO 8675 Thin Nut M22x1.5	8
28	CCZ623028-1A	M6X25 GR12-9 Socket Head Cap Screw Coarse ISO 4762 (BZP)	4

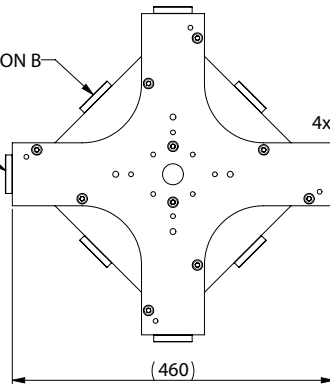
CLAMPING ARRANGEMENT FOR DIFFERENT DIAMETERS																
MIN ϕ	MAX ϕ	LOCATION	BASE	MM1500i-5-001	MM1500i-5-020	MM1500i-5-002	MM1500i-5-021	MM1500i-5-003	MM1500i-5-022	MM1500i-5-004	MM1500i-5-023	MMI 8427	MM1000i-5-008	MM1000i-5-010	MM1000i-5-011	
294mm	374mm	A	MM1000i-5B											✓		
372mm	506mm	A											✓			
452mm	554mm	A												✓		✓
550mm	610mm	B		✓												✓
602mm	634mm	B		✓		✓									✓	✓
630mm	662mm	B				✓									✓	
660mm	736mm	A		✓									✓	✓		
710mm	786mm	B				✓							✓	✓		
764mm	838mm	A				✓							✓	✓		
814mm	888mm	B					✓	✓					✓	✓		
794mm	854mm	A	MM1000i-5C	✓										✓		
852mm	930mm	A		✓		✓							✓	✓		
908mm	980mm	B											✓	✓		
960mm	1,032mm	B				✓							✓	✓		
936mm	982mm	A	MM1500i-5B	✓			✓							✓		
980mm	1,046mm	B		✓									✓	✓	✓	
1,024mm	1,096mm	B				✓							✓		✓	
1,094mm	1,160mm	A		✓		✓							✓			
1,134mm	1,210mm	A		✓			✓						✓	✓		
1,184mm	1,250mm	B		✓		✓							✓			
1,236mm	1,300mm	B		✓				✓					✓	✓		
1,286mm	1,352mm	A		✓			✓				✓		✓	✓		
1,350mm	1,400mm	B							✓				✓	✓		
		B									✓		✓	✓		

9.23 MM1500i / MM1500i-H Base Assembly (MM1500i-5, Revision H) Further Views

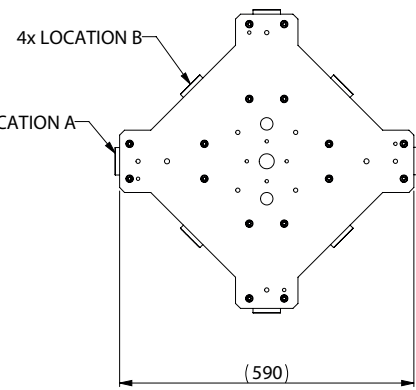
MM1000i-5B 240mm BASE ASSEMBLY



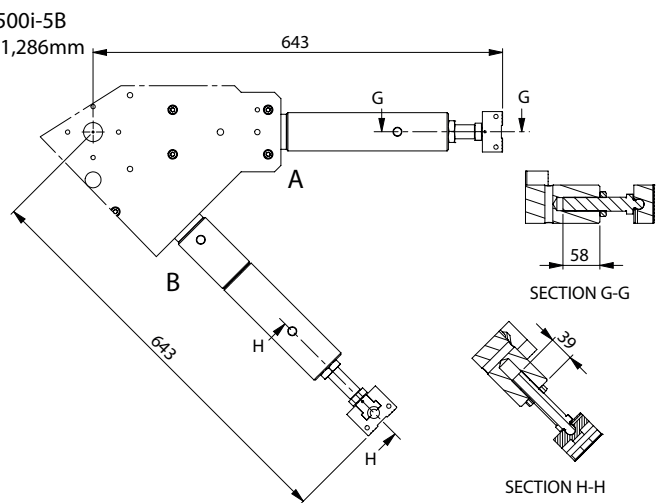
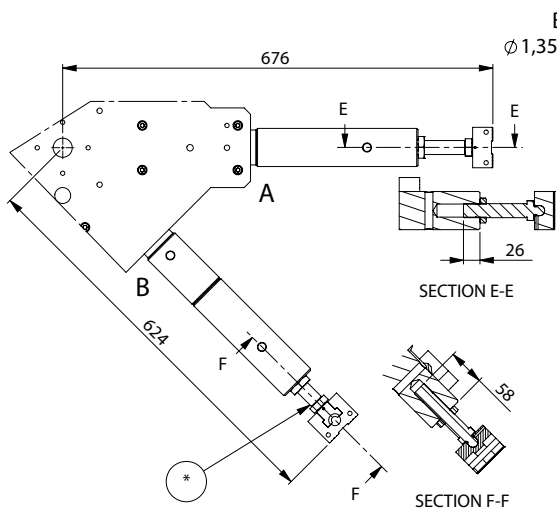
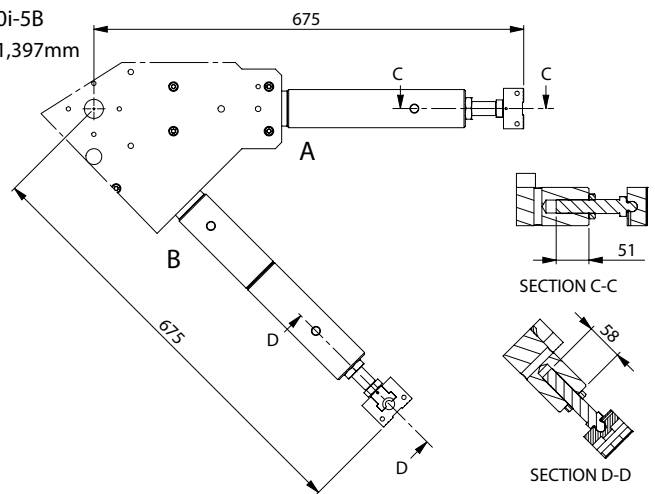
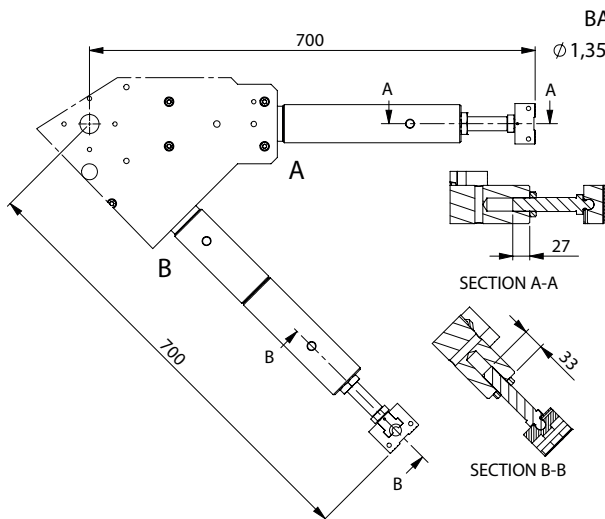
MM1000i-5C 460mm BASE ASSEMBLY

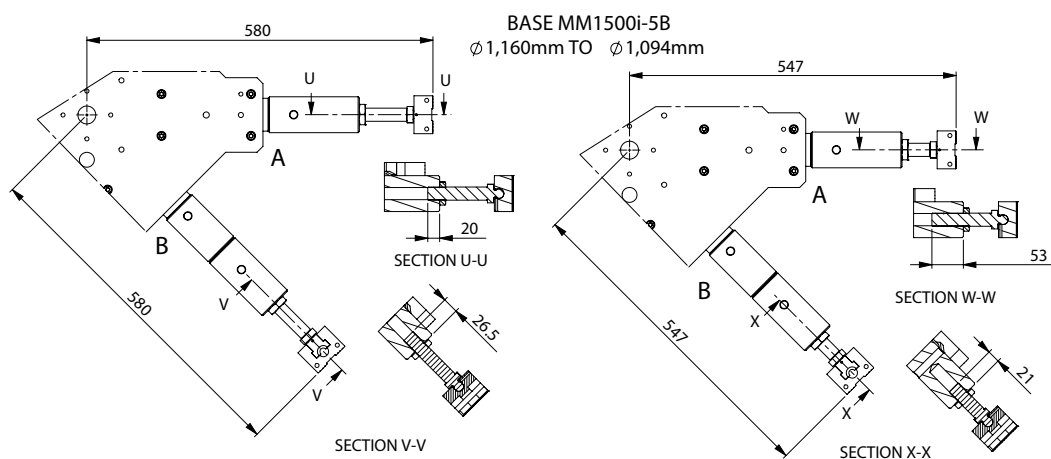
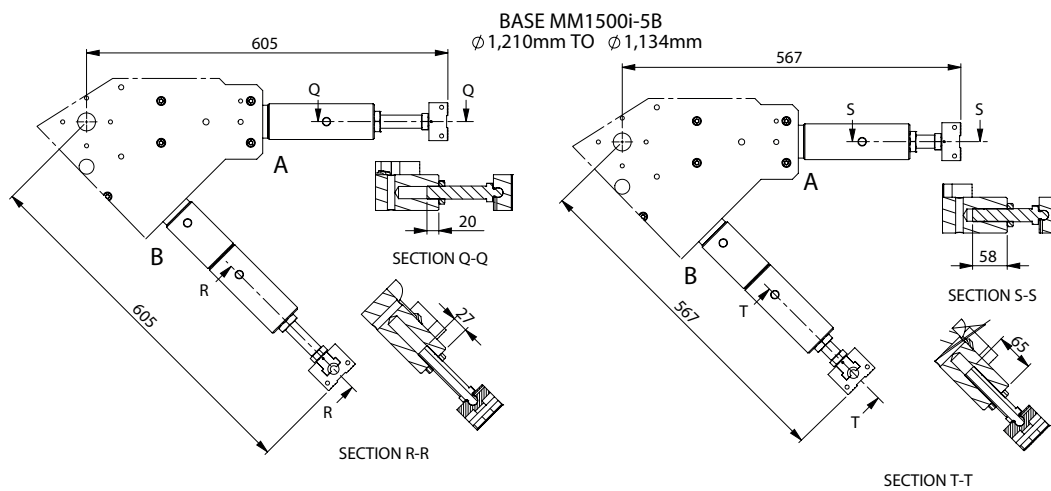
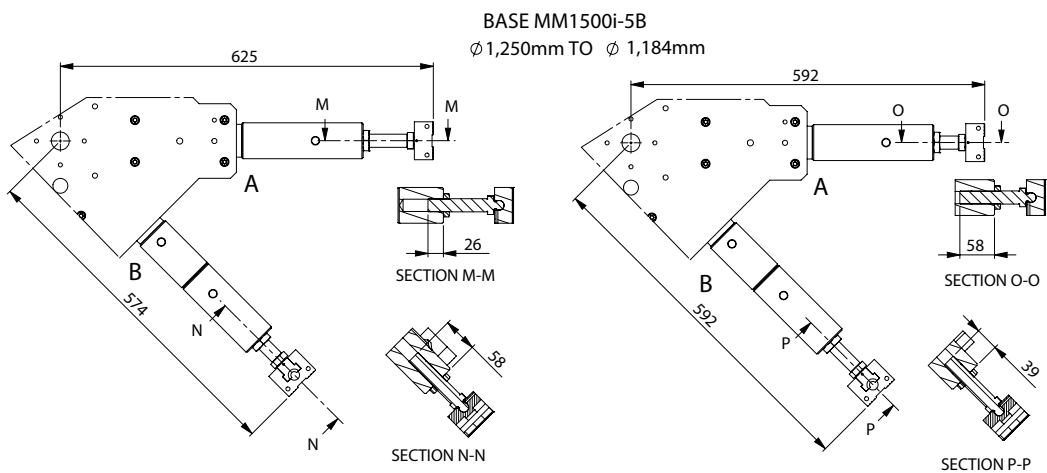
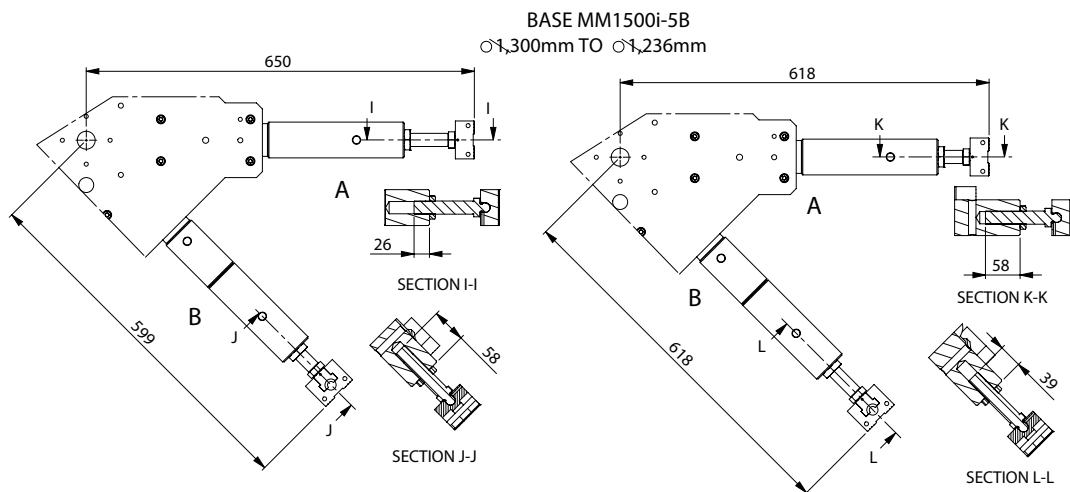


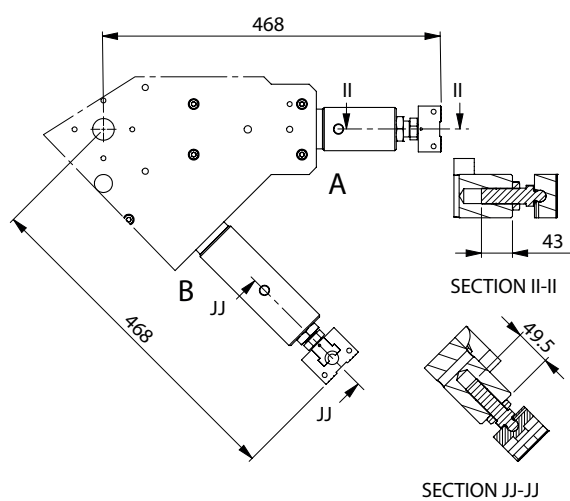
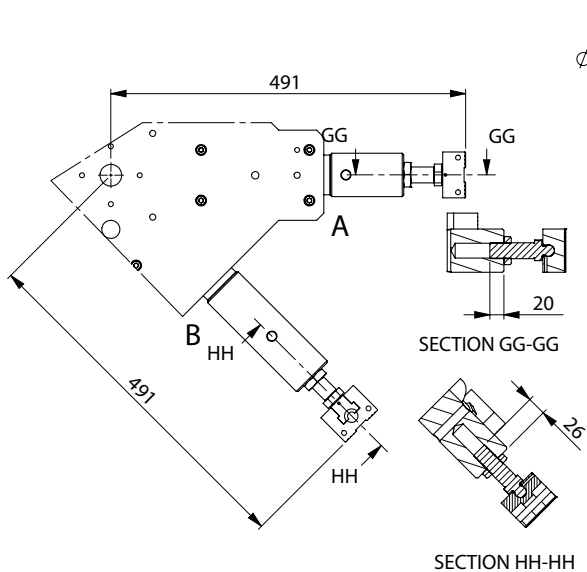
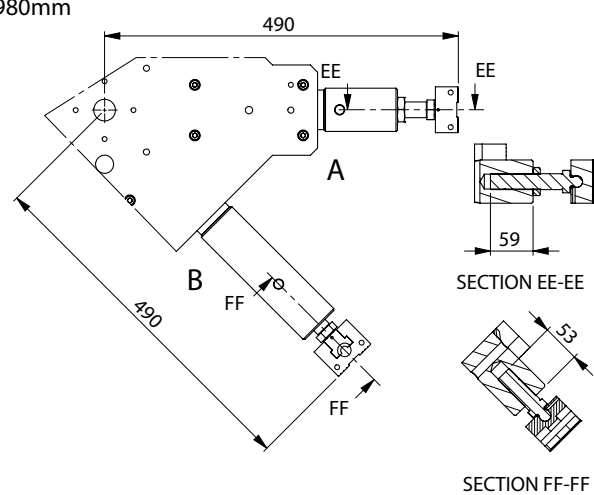
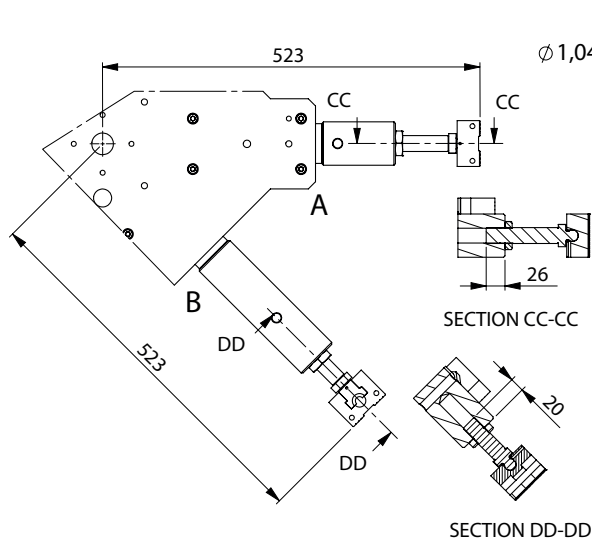
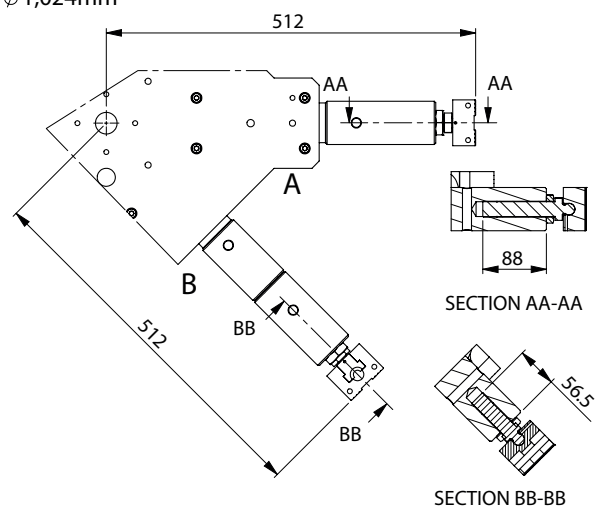
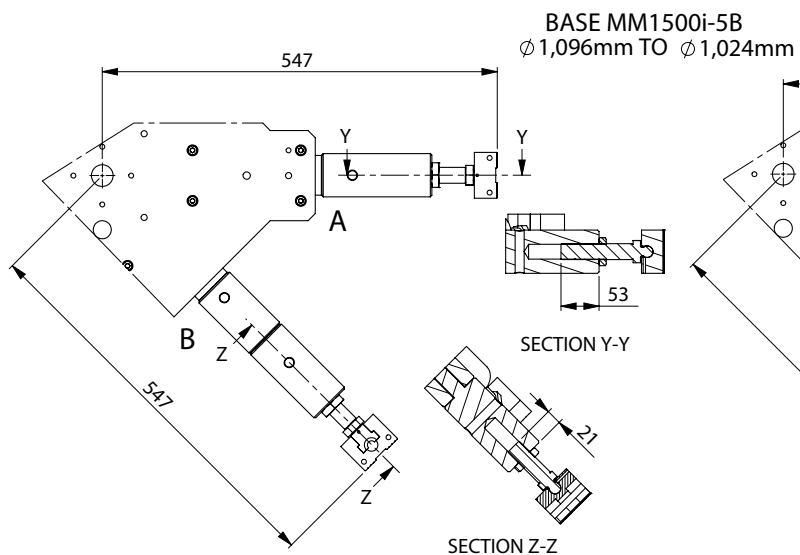
MM1500i-5B 590mm BASE ASSEMBLY

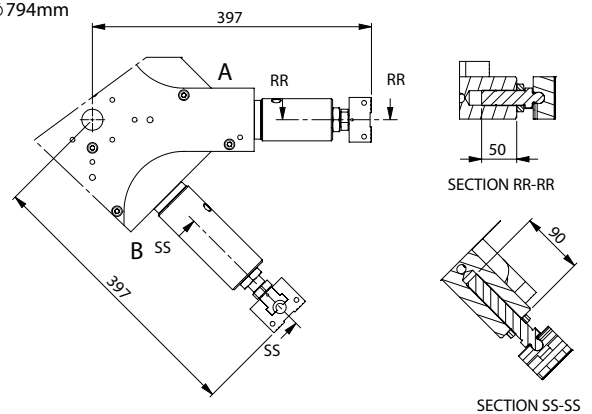
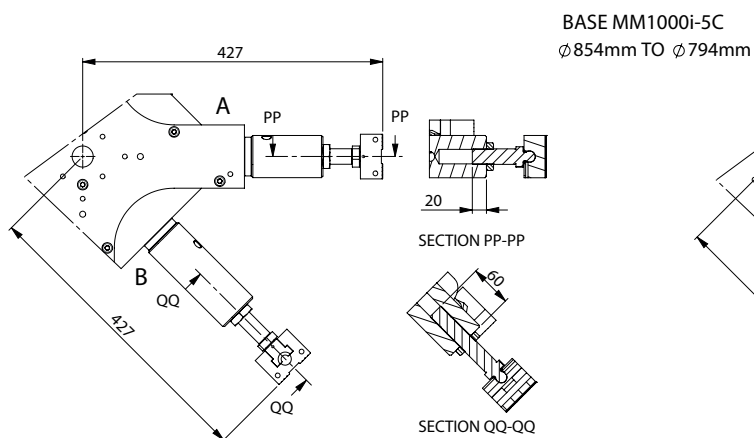
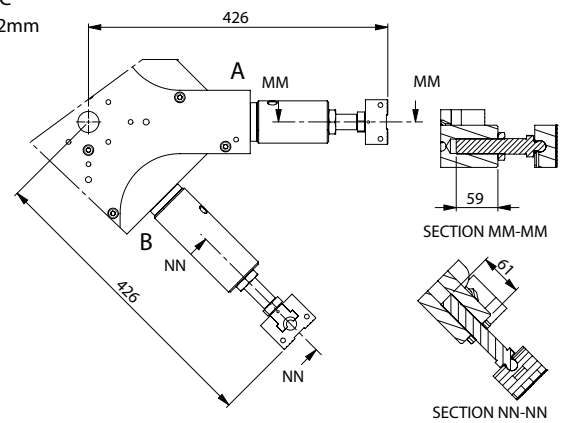
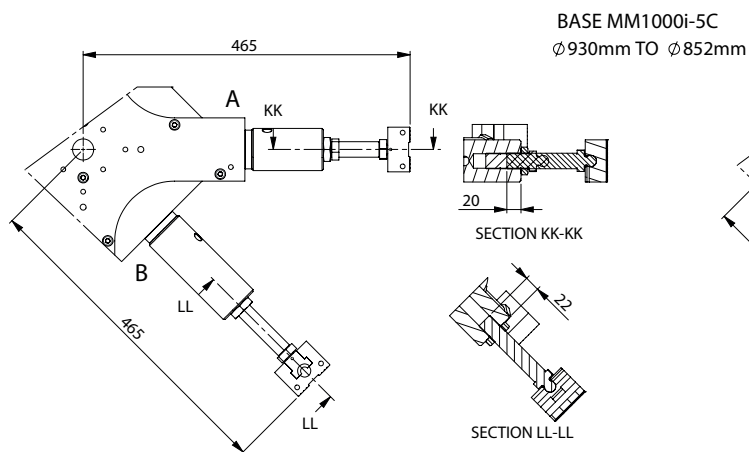
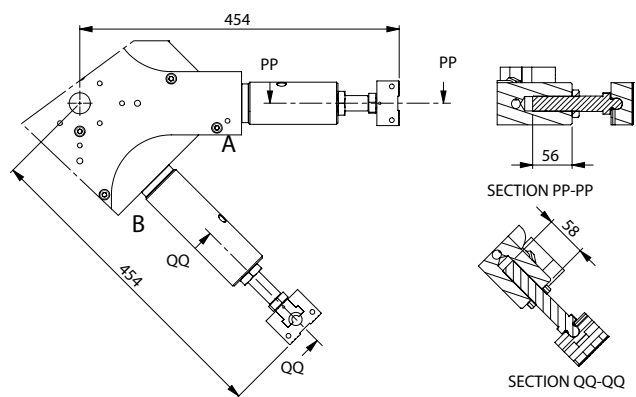
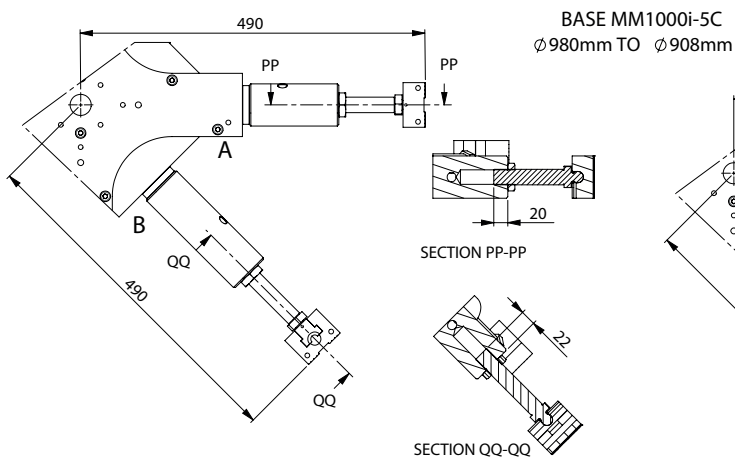
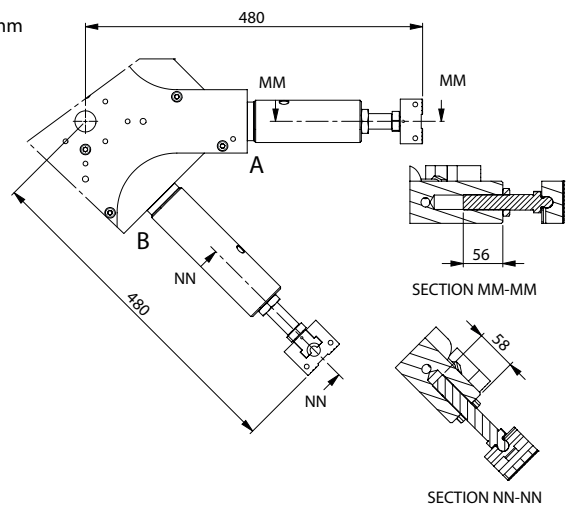
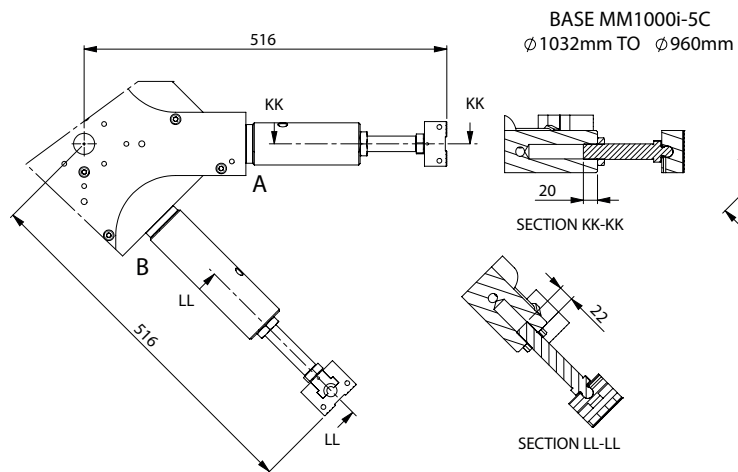


NOTES:
1. IT IS RECOMMENDED TO USE LOCATIONS 'A' AND 'B' AT THE SAME TIME FOR MAXIMUM SECURING STRENGTH.



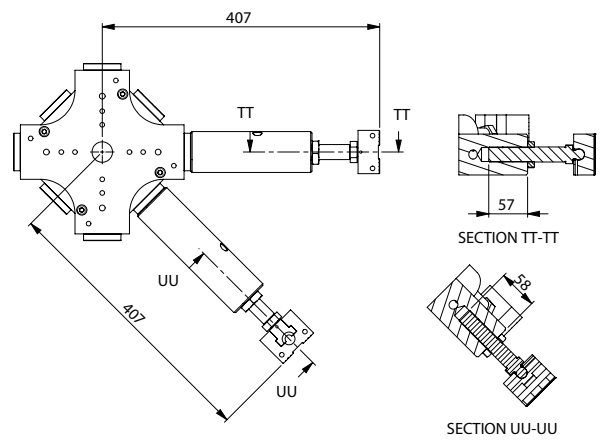
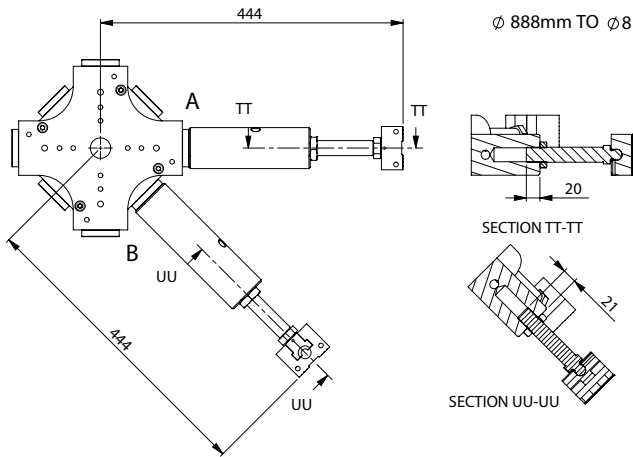






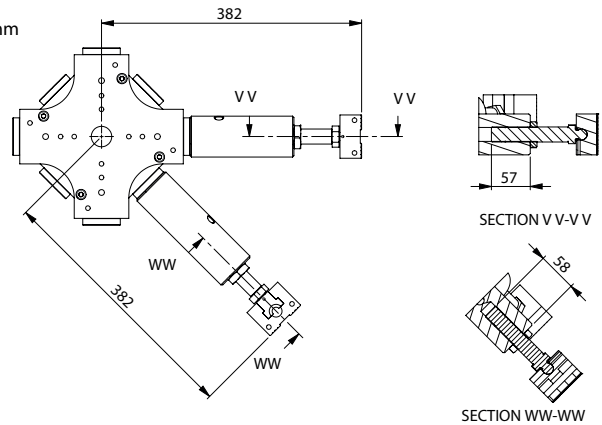
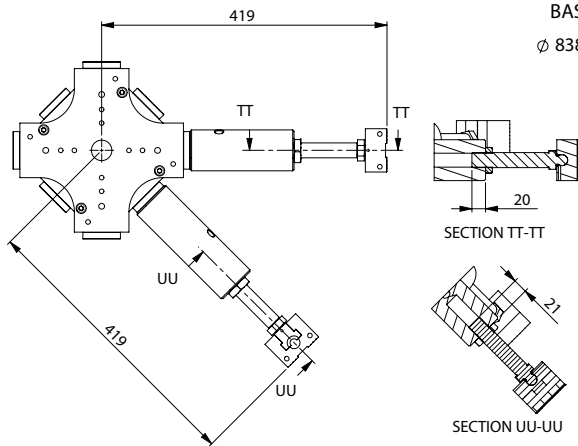
BASE MM1000i-5B

Ø 888mm TO Ø 814mm



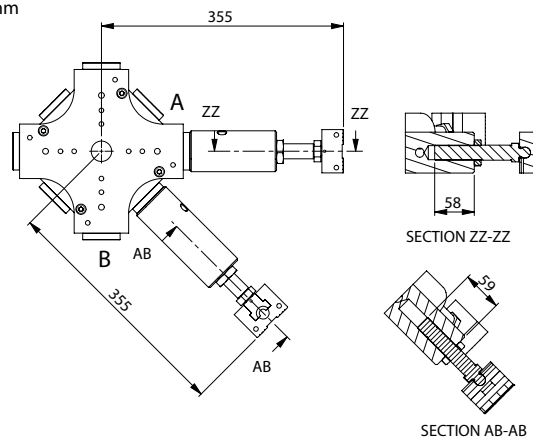
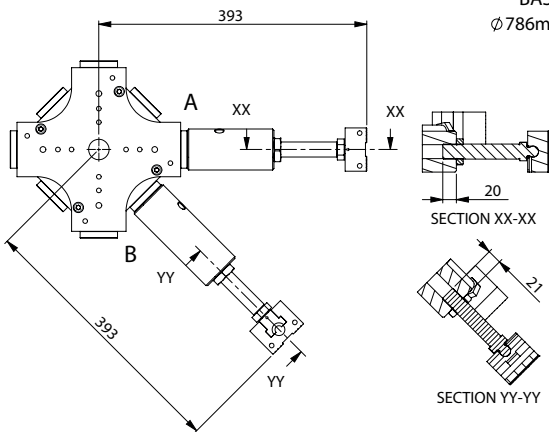
BASE MM1000i-5B

Ø 838mm TO Ø 764mm



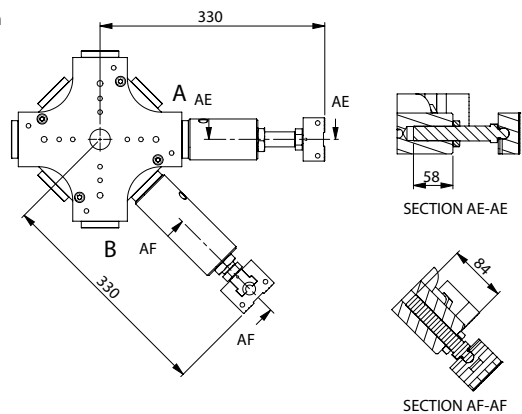
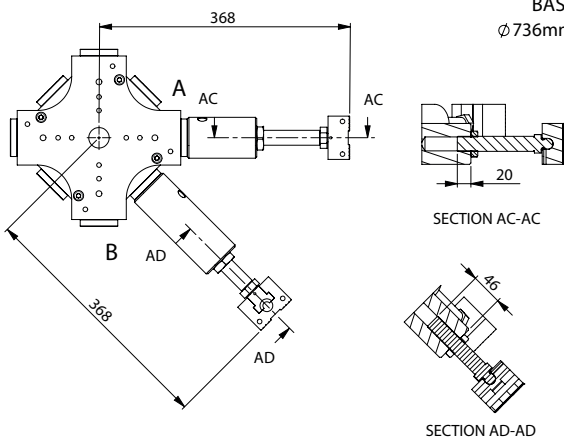
BASE MM1000i-5B

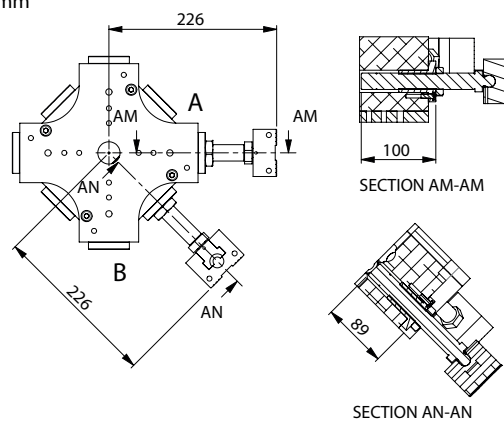
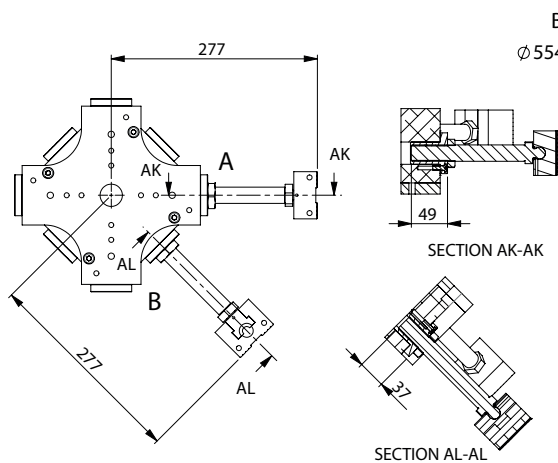
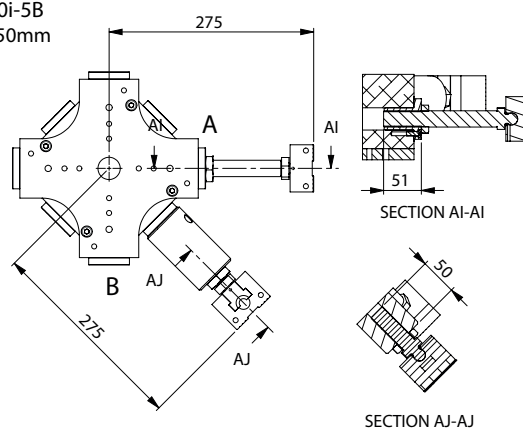
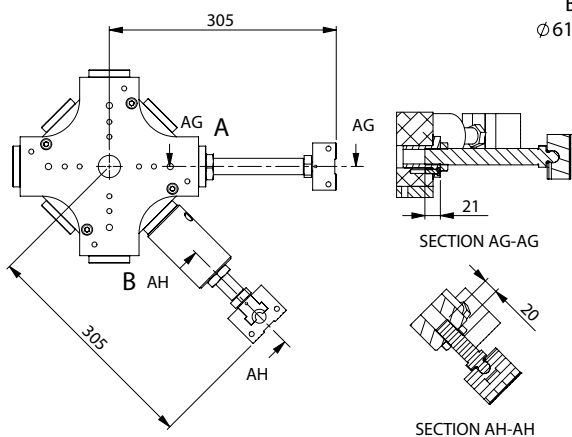
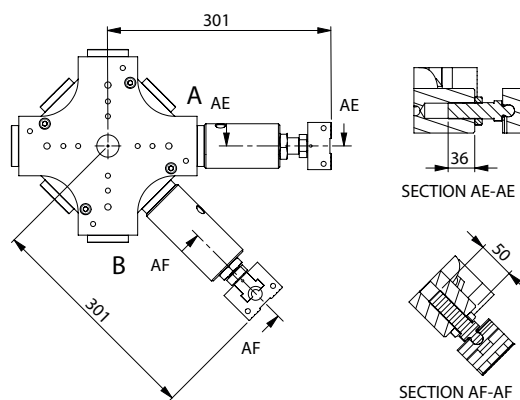
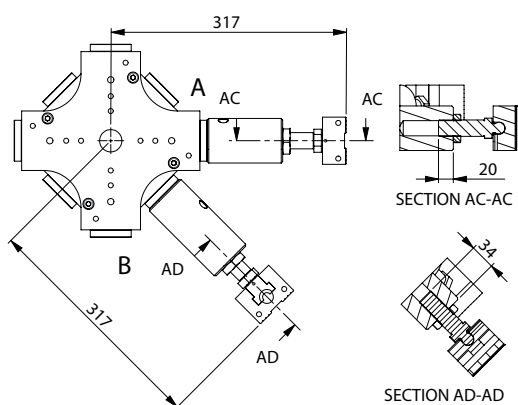
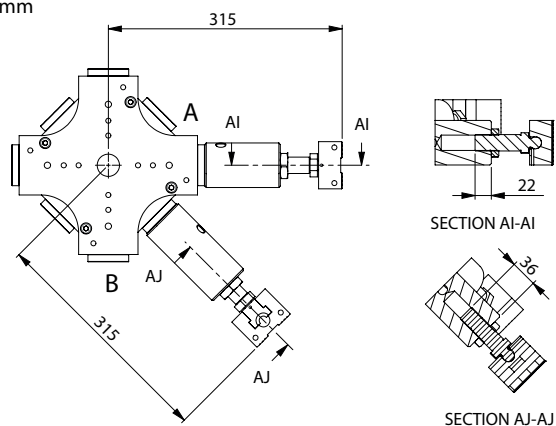
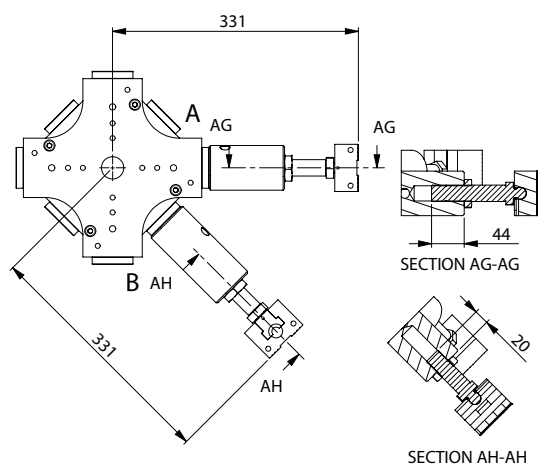
Ø 786mm TO Ø 710mm



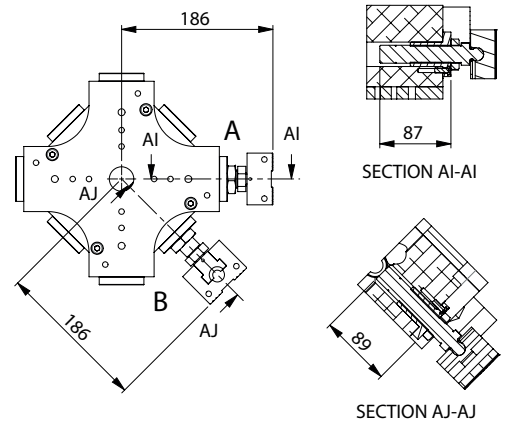
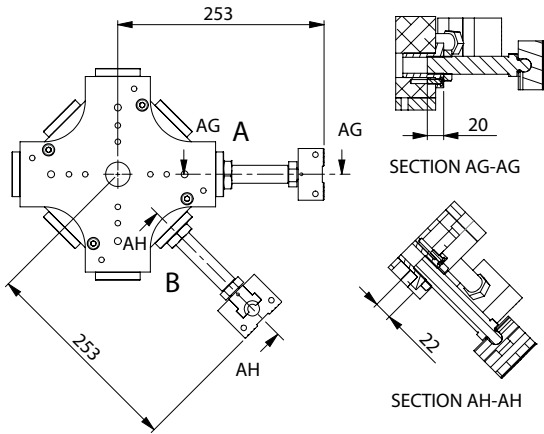
BASE MM1000i-5B

Ø 736mm TO Ø 660mm

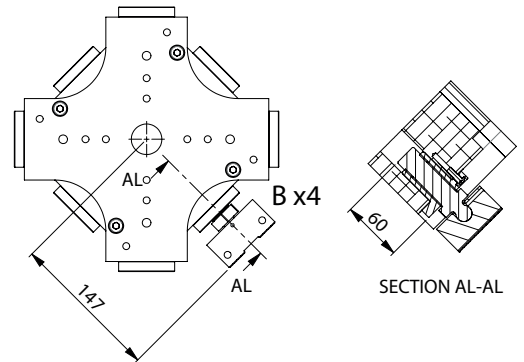
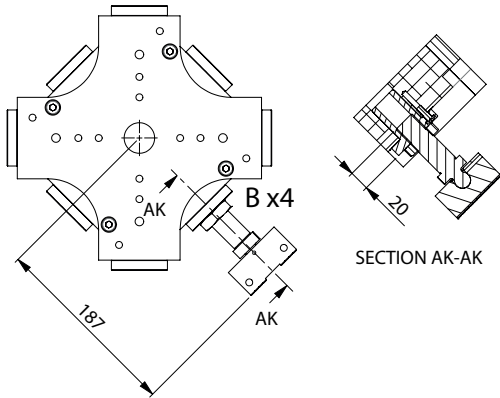




BASE MM1000i-5B
 $\phi 506\text{mm}$ TO $\phi 372\text{mm}$

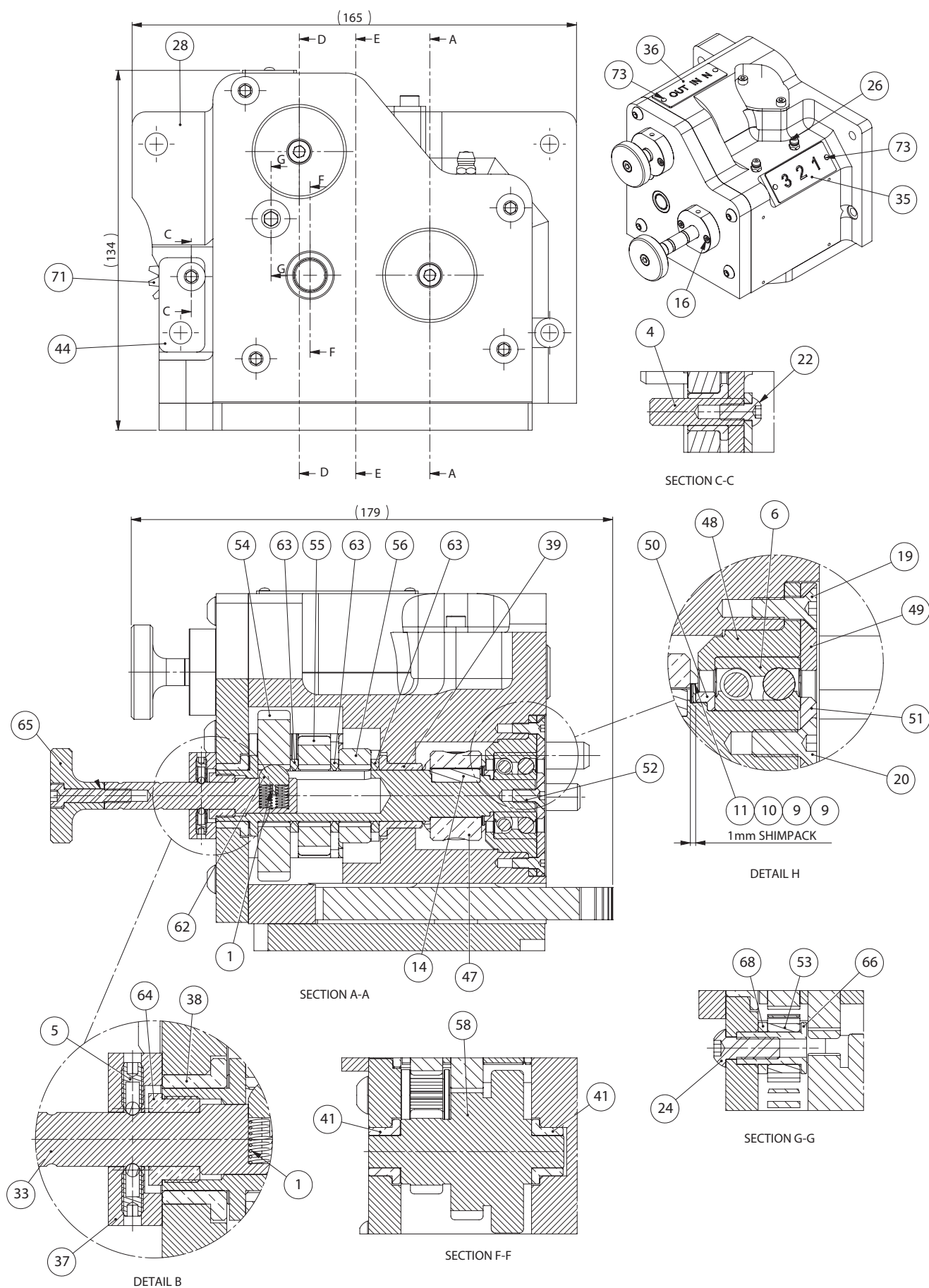


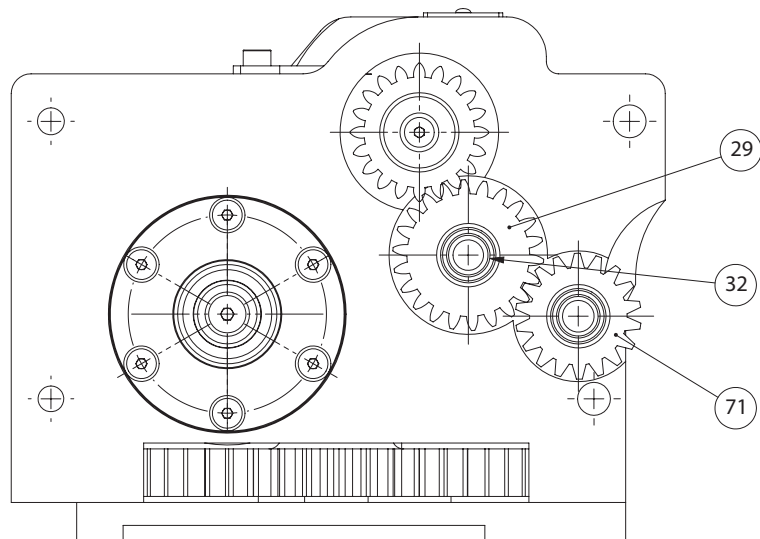
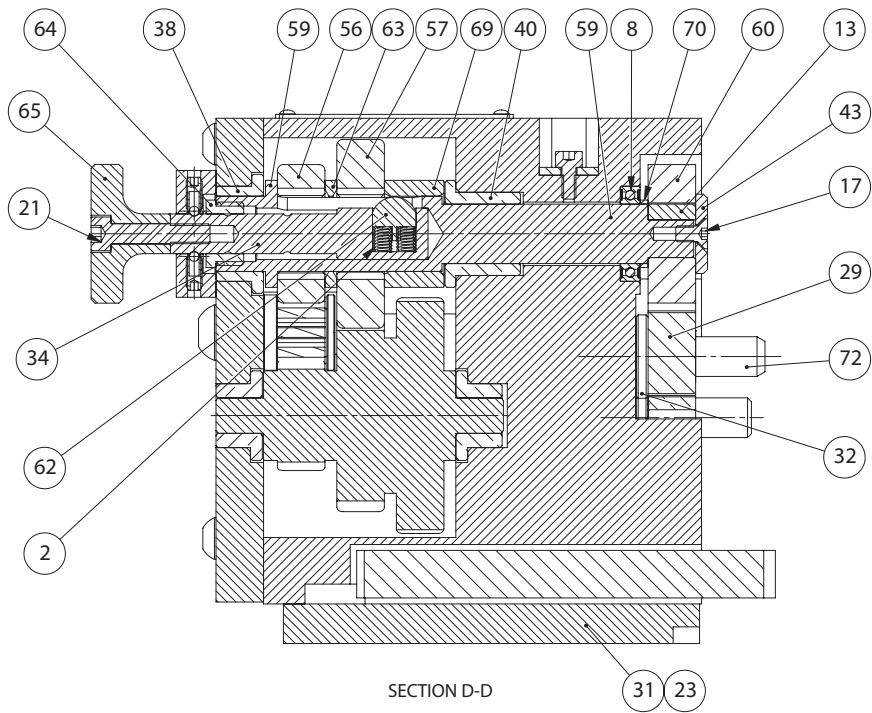
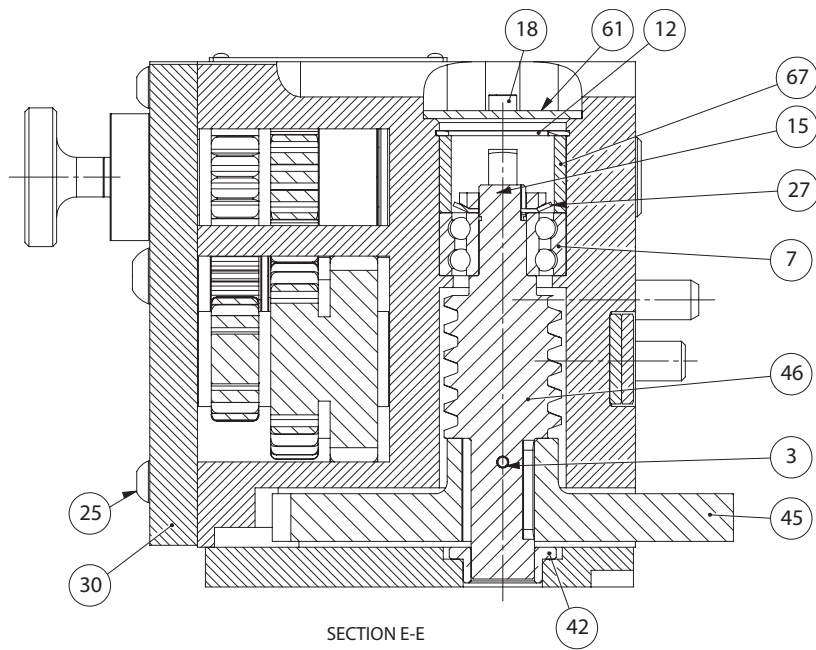
BASE MM1000i-5B
 $\phi 374\text{mm}$ TO $\phi 294\text{mm}$



9.24 MM1500i / MM1500i-H 3 Speed Gearbox (MM1500i-20, Revision L) Views

Weight 7 kg



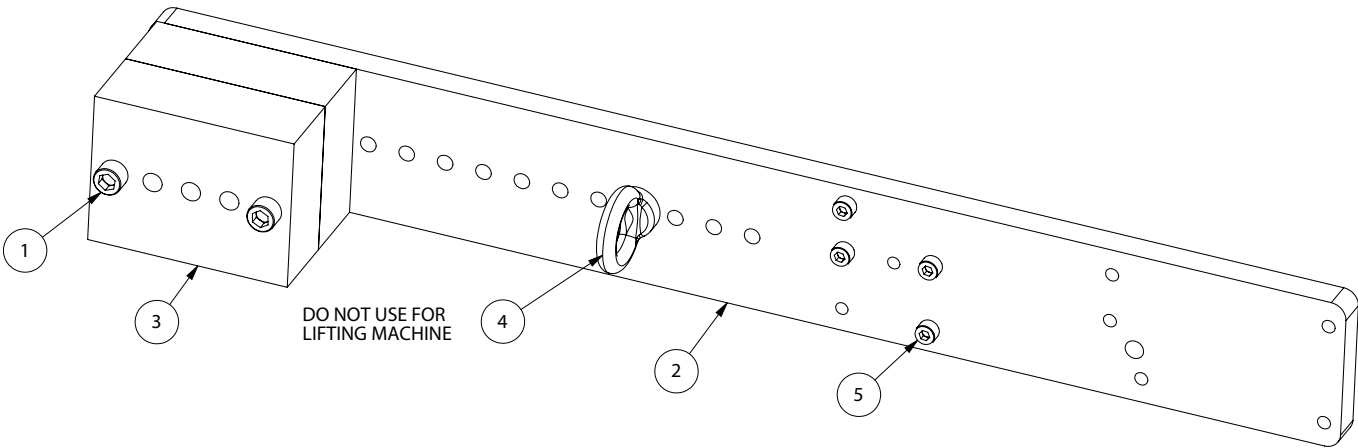


9.25 MM1500i / MM1500i-H 3 Speed Gearbox (MM1500i-20, Revision L) Table of Parts

Item No.	Part Number	Description	QTY	Item No.	Part Number	Description	QTY
1	ENTEX5	Compression Spring 5-9	2	39	MM860LT-2-018	Oilite Bush	1
2	ENTEX5	Compression Spring 5-7	2	40	MM860LT-2-019	Oilite Bush	1
3	Ø3 x 28	Spring Pin (Slotted - LD)	1	41	MM860LT-2-020	Oilite Bush	2
4	Ø10 X 35	Extractable Dowel	1	42	MM860LT-2-021	Oilite Bush	1
5	3150.W004	Spring Plunger	4	43	MM860LT-2-023	Captive Washer	1
6	3201-2RS	Angular Contact Bearing	1	44	MM860LT-2-024	Keeper Plate	1
7	3201-2RS	Double Row Ang Con Brg	1	45	MM1500i-20-001	53t 12DP Pick Up Gear	1
8	61802-2RS	Single Row Deep Groove Ball Bearing	1	46	MM1500i-20-004	1 Start 20 DP Worm	1
9	CPS15x22x0.1	Precision Shim	2	47	MM1500i-20-005	25t 20 DP 1 Start Worm-wheel	1
10	CPS15x22x0.3	Precision Shim	1	48	MM1080IE-33-001	Bearing Housing	1
11	CPS15x22x0.5	Precision Shim	1	49	MM1080IE-33-002	Bearing Cap	1
12	D1300-0320	DIN 472 Internal Circlip	1	50	MM1080IE-33-003	End Float Spacer	1
13	KK4-12C	Type C Key	1	51	MM1080IE-33-004	Retaining Washer	1
14	KK5-18A	Rounded End Feather Key	1	52	MM1080IE-33-005	Selector Sleeve	1
15	KM1	Locknut	1	53	MMI 2209	14T Idler Gear	1
16	M3 x 12	Hex Socket Head	4	54	MMI 7616	38t 16 DP Gear	1
17	M4 x 8	Socket Countersunk Head Screw	1	55	MMI 7617	26t 16 DP Gear	1
18	M4 x 8	Hex Socket Head	2	56	MMI 7618	20t 16 DP Gear	2
19	M4 x 12	Hex Socket CTSK Head	6	57	MMI 7619	28t 16 DP Gear	1
20	M5 x 12	Hex Socket CTSK Head	1	58	MMI 7620	36t 30t 18t 16 DP Gear Stack	1
21	M5 x 25	Hex Socket Head St St	2	59	MMI 7623	FR Shaft	1
22	M6 X 12	Hex Socket Button Head	1	60	MMI 7625	20t 16 DP Output Gear	1
23	M6 x 16	Hex Socket Head - BS EN ISO 4762	6	61	MMI 7627	Bearing Cover	1
24	M8 x 20	Hex Socket Button Head	1	62	MMI 7632	Selector Key	2
25	M6 x 25	Hex Socket Button Head - BS EN ISO 7380	4	63	MMI 7634	Gear Spacer	4
26	M6	Straight Grease Nipple	2	64	MMI 7637	Selector End Cap	2
27	MB1-OU	Lock Washer	1	65	MMI 7638	Selector Knob	2
28	MM860LT-2-002	Gearbox Housing	1	66	MMI 7639	Idler Post	1
29	MM860LT-2-003	22t 16DP Gear	1	67	MMI 7654	Bearing Trapping Ring	1
30	MM860LT-2-004	Gearbox Lid	1	68	MMI 7657	Idler Washer	1
31	MM860LT-2-006	50t Pick Up Cover	1	69	MMI 7680	Selector Key Parking Sleeve	1
32	MM860LT-2-007	Flanged Oilite Bush	2	70	MMI 7690	Gearbox Spacer	1
33	MM860LT-2-008	Selector Shaft	1	71	MMI 8226	18t Output Gear	1
34	MM860LT-2-010	Selector Shaft	1	72	MMI 8265	Long Location Dowel	1
35	MM860LT-2-013	Label - Speed	1	73	NO2X3-16RHHDS	Round Head Hammer Drive Screw BS 4174 TYPE U (Electro Brass Screw)	4
36	MM860LT-2-015	Label - Direction-MM3000i	1				
37	MM860LT-2-016	Rr Clip Housing	2				
38	MM860LT-2-017	Oilite Bush	2				

9.26 MM1500i / MM1500i-H Balancing Assembly (MM1500i-51, Revision A) Views

Weight 53kg

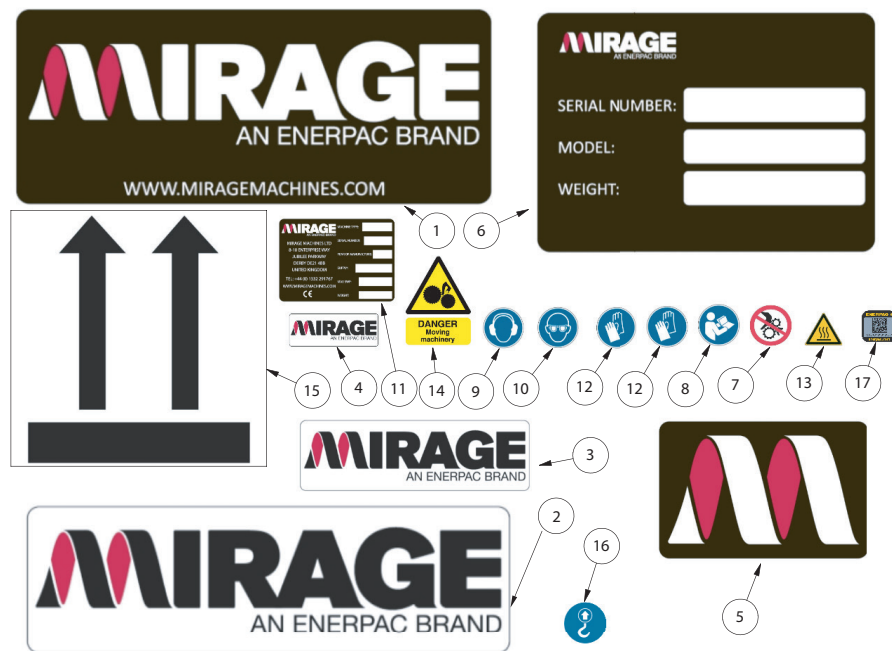
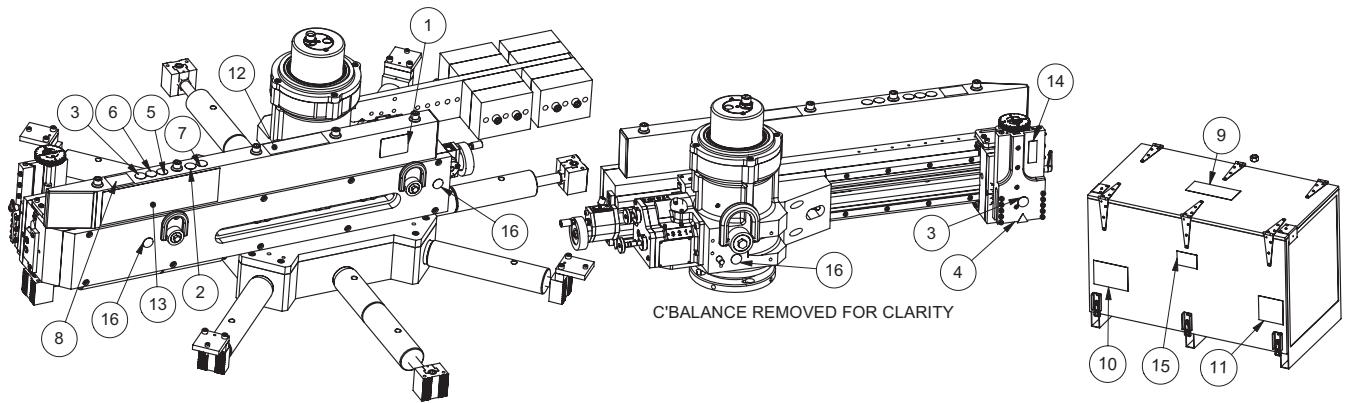


- NOTES:
- 1. 2x M12 x 70 HEX SOCKET HEAD NOT SHOWN.
 - 2. 1x MM1500i-51-002 NOT SHOWN.

9.27 MM1500i / MM1500i-H Counter Balancing Assembly (MM1500i-51, Revision A) Table of Parts

Item Number	Part Number	Description	QTY
1	M12 x 120	Hex Socket Head - BS EN ISO 4762	2
2	MM1500i-51-001	BALANCE PLATE	1
3	MM1500i-51-002	BALANCE WEIGHT 5Kg	3
4	M12	EYEBOLT	1
5	M8 x 35	Hex Socket Head - BS EN ISO 4762	5
6	M12 x 70	Hex Socket Head - BS EN ISO 4762	2

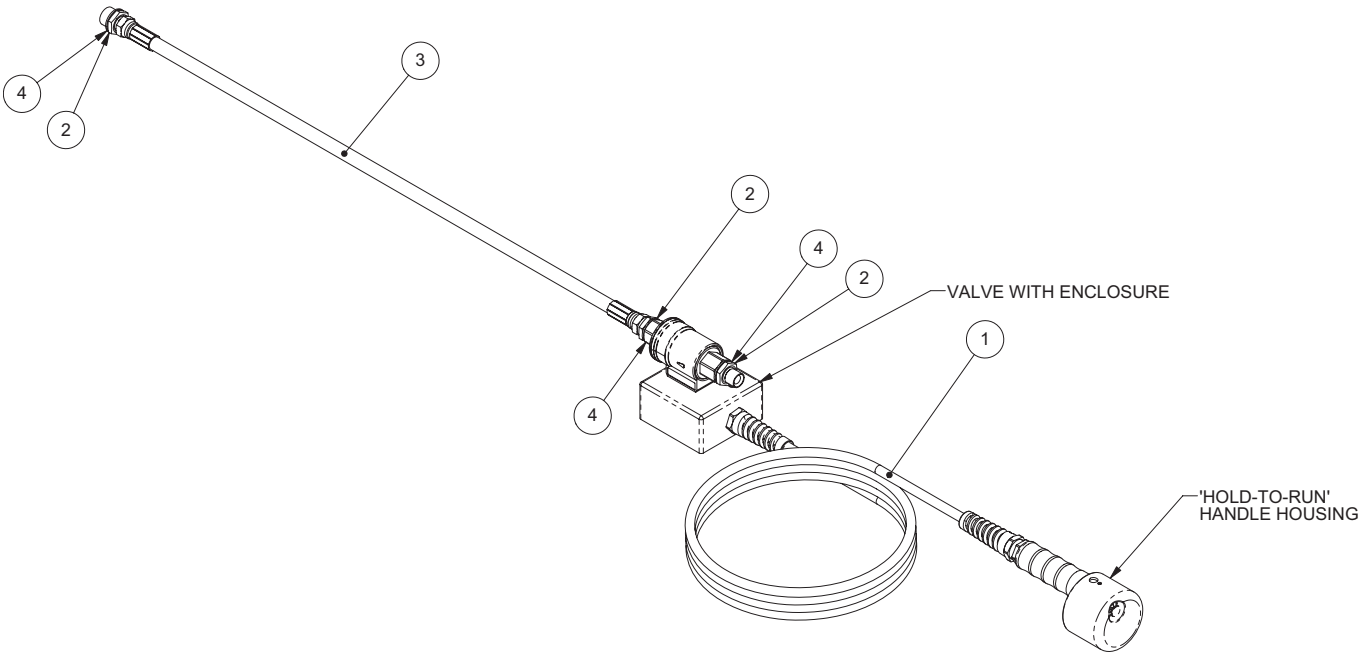
9.28 MM1500i / MM1500i-H Label Pack (LABEL-PACK-5, Revision C) Views



9.29 Label Pack (LABEL-PACK-5) Table of Parts

Item No	Part Number	Description	QTY
1	LABEL-MM-001	Box Packaging Sticker with WEB address (285 x 116)	1
2	LABEL-MM-002	Machine Logo Sticker - Large (295 x 90)	1
3	LABEL-MM-003	Machine Logo Sticker - Medium (148 x 45)	1
4	LABEL-MM-004	Machine Logo Sticker - Small (55 x 20)	1
5	LABEL-MM-005	Box Packaging 'M' Sticker (122 x 86)	1
6	LABEL-MM-007	Box Contents Sticker (210 x 148 - A5)	1
7	LABEL-MM-008	Prohibition Label "Fingers out - rotating machinery" ISO 7010 (Ø25)	1
8	LABEL-MM-009	Mandatory Label "Refer to instructions" ISO 7010 - M002 (Ø25)	1
9	LABEL-MM-020	Mandatory Label "Wear ear protection" ISO 7010 - M003 (Ø19)	1
10	LABEL-MM-021	Mandatory Label "Wear eye protection" ISO 7010 - M004 (Ø19)	1
11	LABEL-MM-033	CE Aluminium Label (70 x 50)	1
12	LABEL-MM-064	Mandatory Label "Wear protective gloves" ISO 7010 - M009 (Ø25)	2
13	LABEL-MM-065	Warning Label "Hot Surface" ISO 7010 - W017 (21.5 x 25)	1
14	LABEL-MM-066	Warning Label "Danger - Moving Machinery" (40 x 50)	1
15	LABEL-MM-087	Label 'This Way Up' (150 x 150)	1
16	LABEL-MM-088	Mandatory Safety Label: "Lift Point" ISO 3864-2	3
17	DD9012026	UIN METALPHOTO BUG DECAL	1

9.30 MM1500i Pneumatic Dead Man’s Handle (DMH-Pneumatic, Revision E)
Views



9.31 Pneumatic Dead Man’s Handle (DMH-PNEUMATIC) Table of Parts

Item Number	Part Number	Description	QTY
1	DMH1	Dead Man’s Handle	1
2	3/4" - 1/2" Adaptor M-M	3/4" BSPP Male x 1/2" BSPP Male Adaptor	3
3	12X2.5MBSP-PHOSE	1/2" BSPP FEMALE-FEMALE 2.5M HOSE	1
4	D400 027 12	3/4" Dowty Washer	3

9.32 MM1500i /MM1500i-H Toolkit Parts List

Part Number	Description	QTY
3X16-SPLITPIN	3 X 16MM SPLITPIN (SLOTTED SELLOK)	10
DCGT070204-PM2-WXN10	07 SEAT .4MM RAD INSERTS	10
KEN0101120K	RIGHT HANDED BUTT WELDED KNIFE TOOL	1
KEN0903250K	1/2"SQX3" COBALT TOOLBIT	1
KEN1001060K	44 P20/P30 BRAZED TOOL ISO DIN BHMA	1
KEN5724330K	3MM PARALLEL TIP SCREW DRIVER	1
KEN5801270K	27MM BLACK OPEN ENDED SPANNER	1
KEN5822610K	10MM COMBINATION SPANNER	1
KEN5823889K	15MM COMBI SPANNER	1
KEN5826440K	SLIDING T HANDLE 1/2" SQ DRIVE	1
KEN5826990K	17MM SOCKET 1/2" SQ DRIVE	1
KEN5930520K	POCKET PLAIN CHISEL ROLL	1
KEN6025500K	BALL DRIVER L WRENCHES	1
KEN6026200K	10MM T-HANDLE BALL DRIVER	1
MAGNETIC-BACK-900928	MAGNETIC BACK - MITUTOYO 900928	1
MIT3253587E	MITUTOYO DIGIMATIC DIAL TEST INDICATOR 2046S 58MM DIA	1
SDJCL1212F07	LEFT HAND DSTYLE TURNING TOOL	1
SDJCR1212F07	RIGHT HAND D STYLE TURNING TOOL	1
SDNCN1212F07	SDNCN 1212 F07 N EXT TOOLHOLDER	1

10. Troubleshooting



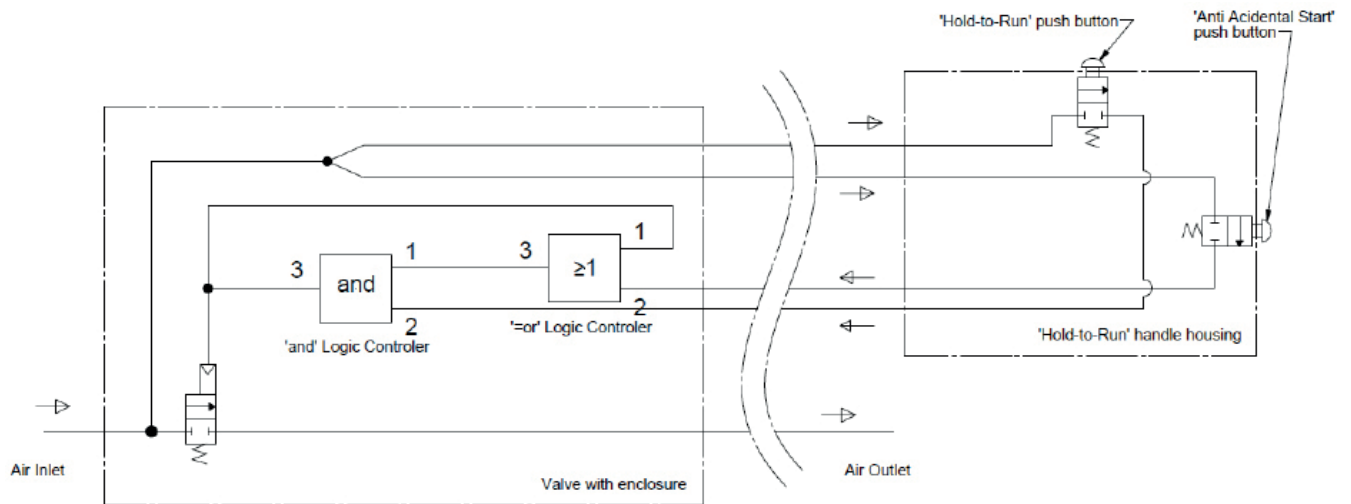
NO MACHINE ADJUSTMENTS SHOULD BE MADE WHILE THE MACHINE IS IN OPERATION. TURN AND LOCK OFF THE ISOLATION VALVE ON THE PNEUMATIC SUPPLY BEFORE MAKING ANY ADJUSTMENTS.

Symptom	Possible Cause	Corrective Action
The machine will not rotate	1. Air supply not available	Check air supply
	2. Air supply is below the minimum required to operate the machine	Check air 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. The feed selector is not correctly positioned and the facing feed gears are not engaged	Check position
	2. The direction selector is in neutral or not correctly engaged – if both gears are engaged this should not rotate	Remove and check drive assembly operation
	3. Drive key problem	Remove and check gearbox assembly operation
	4. Carriage has been run off the lead screw	Check lead screw nut and screw are engaged
Poor surface finish on the face	1. Machine out of balance	Check balance
	2. Machine base incorrectly installed	Check installation
	3. Machine installation bolts not tightened	Check bolts
	4. Turning tool not ground correctly or worn	Check tool & replace
	5. Depth of cut too deep	Reduce depth of cut
	6. Too much play in tool post gib strip or carriage	Adjust tool post & carriage
	7. Too much play in main hub bearings	Adjust bearing dampers
	8. Worn drive motor	Check motor
	9. Poorly adjusted surfacing arm	Check and adjust
	10. General poor machine condition	Refer to the manufacturer

Appendix - Additional Reference Material

A Additional Schematic diagrams

A1 Hold-to-run schematic diagram



B Additional Technical Data

B1 Recommended general torque settings for fasteners

Grade	4.8		A2-70 / A4-70		8.8		10.9		12.9	
Bolt Size	Max Torque		Max Torque		Max Torque		Max Torque		Max Torque	
	Lb ft	Nm	Lb ft	Nm	Lb ft	Nm	Lb ft	Nm	Lb ft	Nm
M3	0.5	0.7	0.8	1.1	1	1.3	1.5	2	1.5	2
M4	1	1.5	1.9	2.6	2	3	3	4.5	4	5
M5	2	3	3.8	5.1	4.5	6	6.5	9	7.5	10
M6	4	5.5	6.5	8.8	7.5	10	11	15	13	18
M8	10	13	16	21	18	25	26	35	33	45
M10	18	25	32	44	37	50	55	75	63	85
M12	33	35	55	74	63	85	97	130	111	150
M14	55	75	88	119	103	140	151	205	177	240
M16	85	115	135	183	159	215	232	315	273	370
M18	118	160	192	260	225	305	321	435	376	510
M20	166	225	273	370	321	435	457	620	535	725
M22	225	305	360	488	435	590	620	840	726	985
M24	288	390	488	608	553	750	789	1070	926	1255
M27	417	565	534	724	811	1100	1154	1565	1353	1835
M30	568	770	713	966	1103	1495	1571	2130	1837	2490

B2 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	$\text{RPM} = \frac{V}{3.82 \times \text{Dia}}$
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	$\text{FPT} = \frac{V}{\text{RPM} \times \text{NT}}$	Inches/tooth	$\text{FPT} = \frac{V}{\text{RPM} \times \text{NT}}$
Feed / Rev	RPM, FR	mm/Rev	$\text{FRR} = \text{FR} / \text{RPM}$	Inches/Rev	$\text{FRR} = \text{FR} / \text{RPM}$
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	$\text{HP} = \text{MR} \times \text{C} \times \text{WC} \times \text{PC} \times 0.015$	HP	$\text{HP} = \text{MR} \times \text{C} \times \text{WC} \times \text{PC}$

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 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

B3 Flange face surface finish

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

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

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

NOTES

[illegible]

