



Operation and Maintenance Manual

Enerpac MM200e

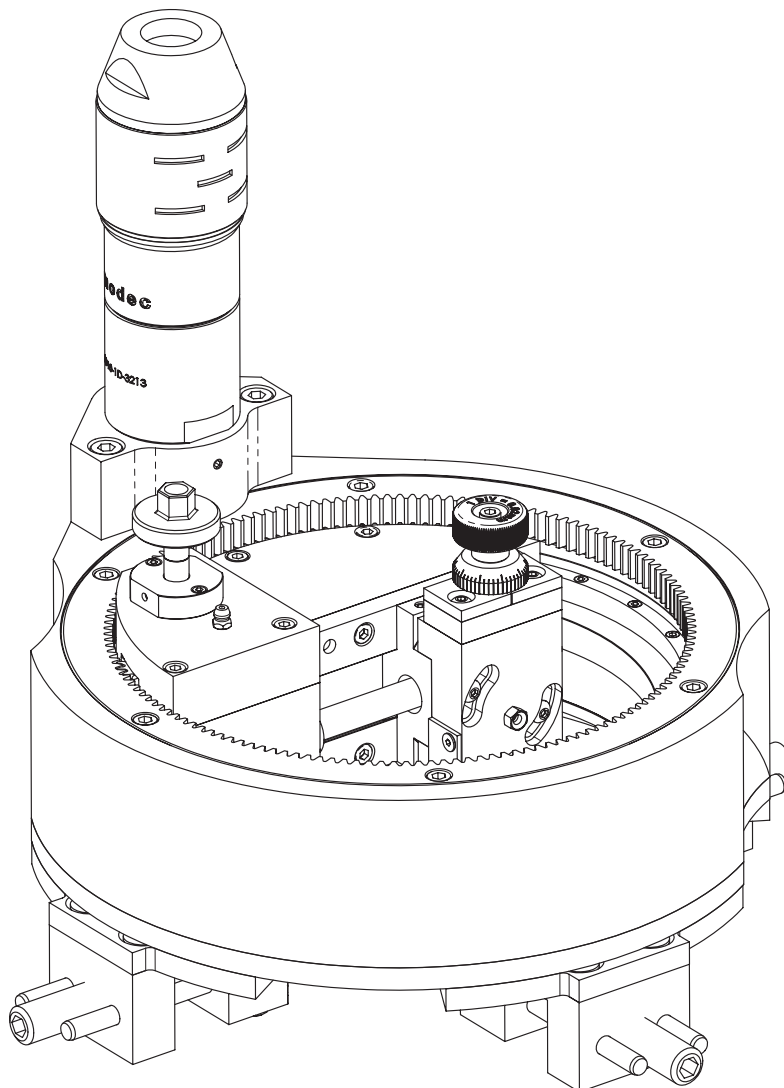
Flange Facing Machine (0-8" External Mounted Flange Facing Machine)

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

ABOUT US

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



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WARRANTY

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

NAMEPLATE

MIRAGE AN ENERPAC BRAND	MACHINE TYPE:	
MIRAGE MACHINES LTD	SERIAL NUMBER:	
8-10 ENTERPRISE WAY	YEAR OF MANUFACTURE:	
JUBILEE PARKWAY	SUPPLY:	
DERBY DE21 4BB	MAX SWP:	
UNITED KINGDOM	WEIGHT:	
TEL: +44 (0) 1332 291767		
WWW.MIRAGEMACHINES.COM		
CE		

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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). 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.
6. 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.

⚠ WARNING

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.

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. See section 1.2.4.

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

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.

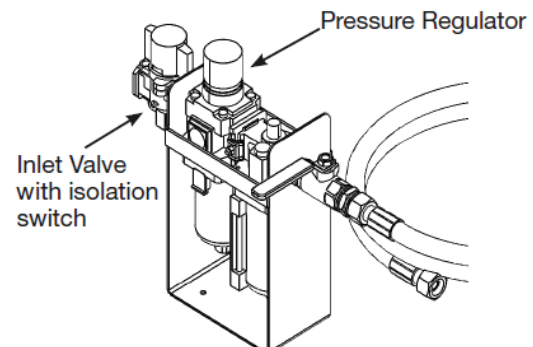


Figure 1: Air Lubrication unit

Isolation Switch on the Air Lubrication Unit

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.

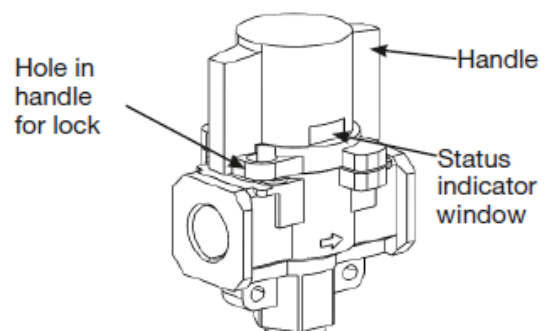


Figure 2: isolation switch

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.

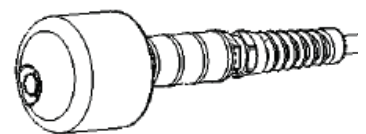


Figure 3: Hold to Run handle

1.3 Machine Hazard Zone

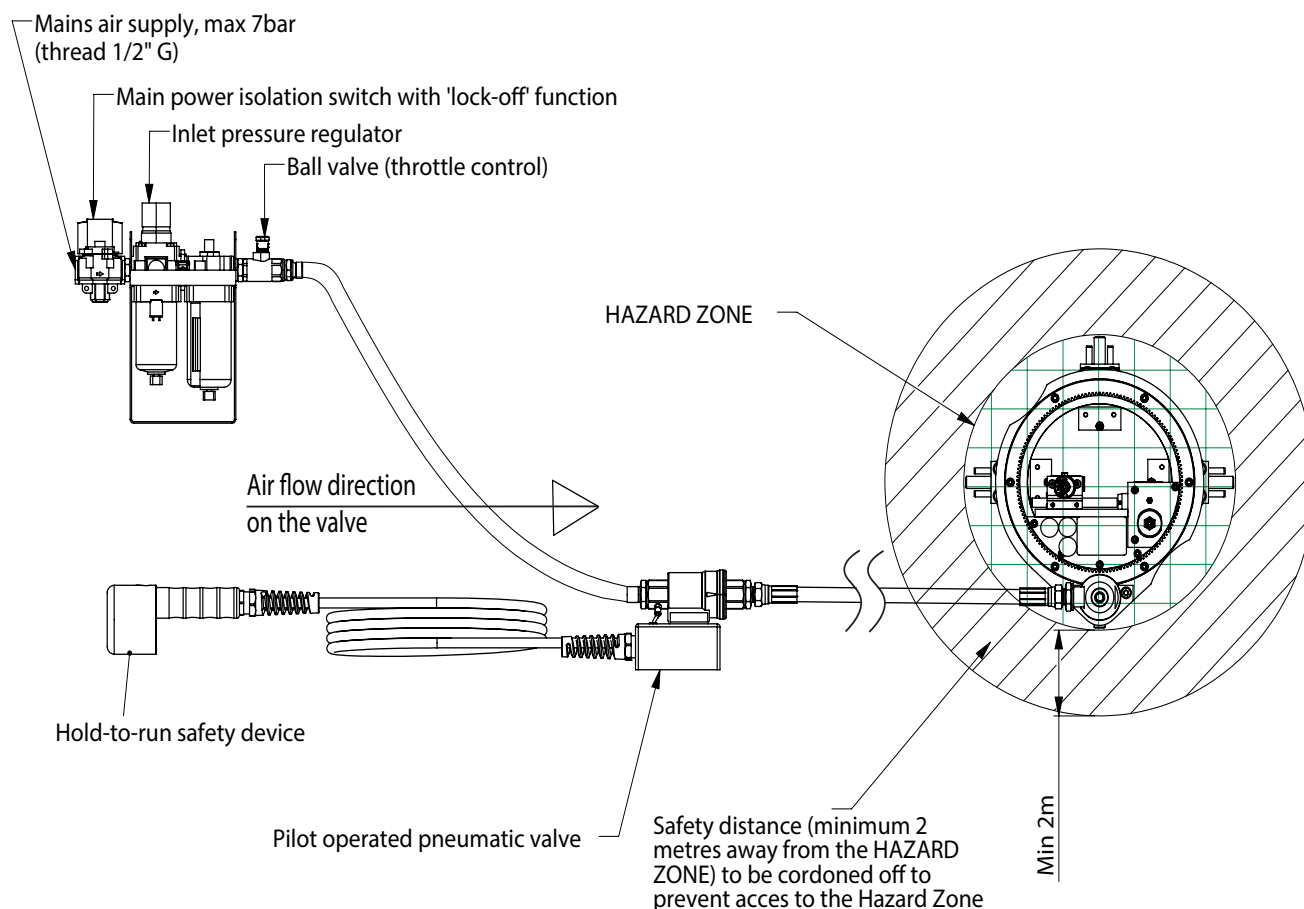


Figure 4: Supplied system layout drawing showing hazard area to be cordoned off

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.

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 MM200e 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 5: 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 6: 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 Feature Diagram

1. Pneumatic Motor
2. D-Section (Gearbox and Carriage Slide Assembly)
3. Clearance Cutaway
4. Toolpost Assembly
5. Carriage locking Screw
6. Main Drive Assembly
7. Machine Mount Assembly (clamping Jaws)
8. Hold-to-run Device
9. Air Lubrication Unit

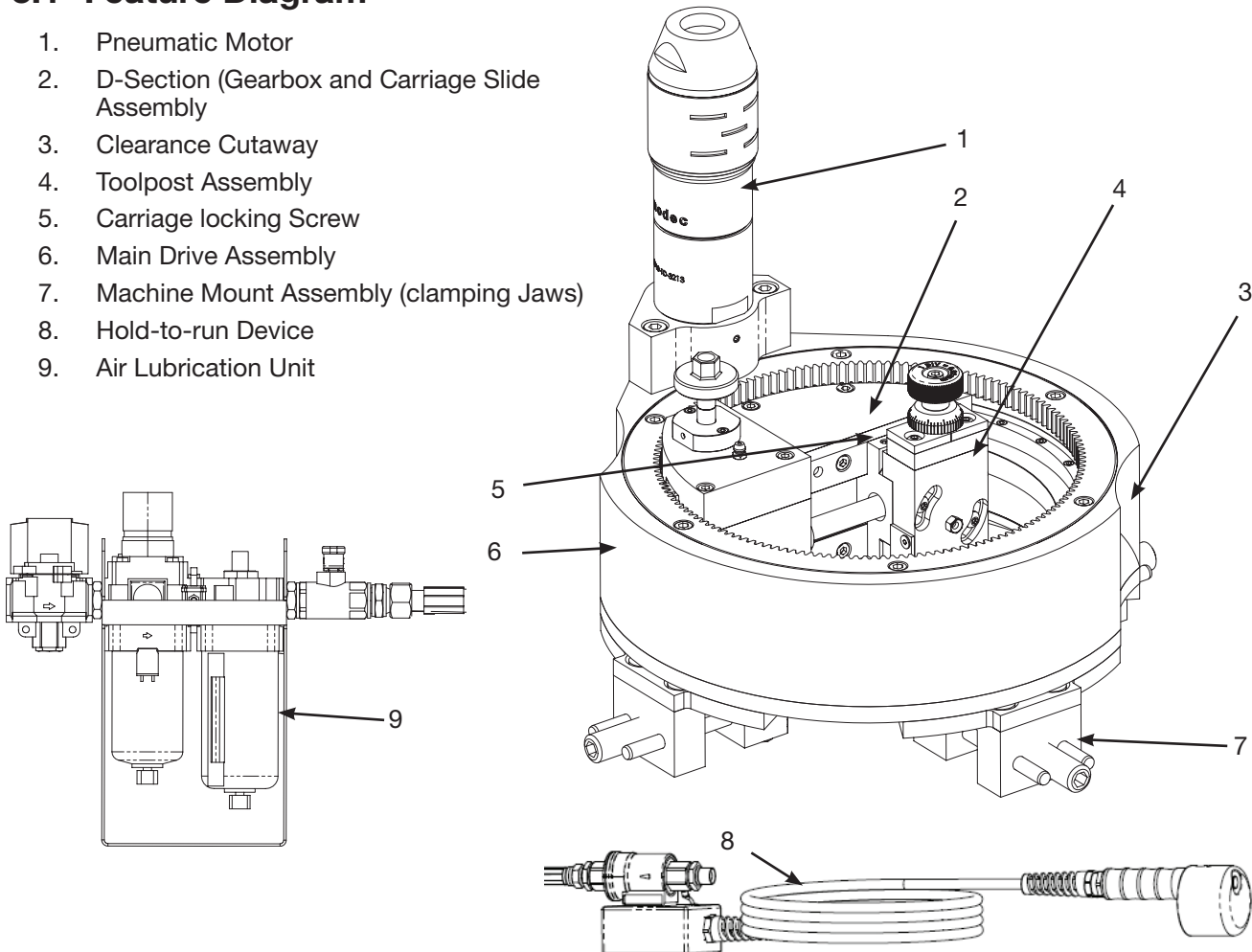


Figure 5: Major features and components

3.2 Feature Description

This machine has been designed for performing facing operations on flanges. It can be used for seal groove machining. The machine is manually fixed and levelled to the flange using the clamping Jaws. 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.

The MM200e has been predominantly designed for the facing of 'Pipeline' coupling flanges but can also be used for any application that suits its externally mounting base.

It features

- An 800 watt (1.1hp) pneumatic motor which is powered from an external power source.
- An optional range of lead screws to allow a choice of surface finishes.

4. Technical Product Data

4.1 Dimensional Art

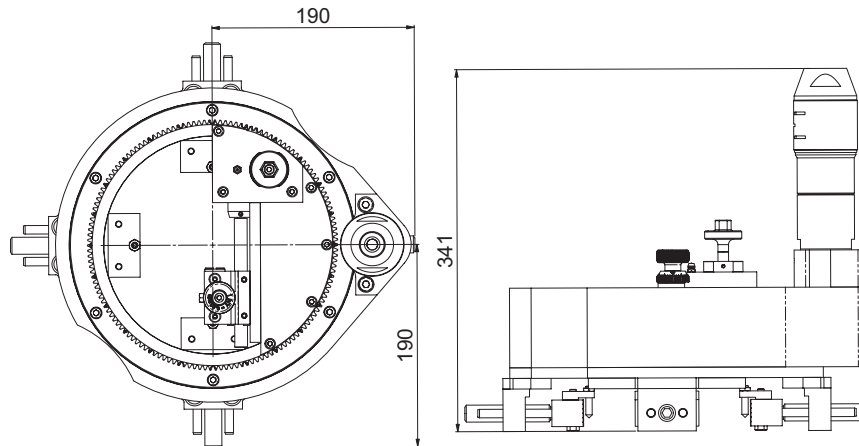


Figure 6: Dimensional Information

4.2 Specification Table

The Enerpac MM200e Machine has been modularly designed for accurate in-situ machining of work surfaces, to this end the constituent parts are easily manipulated by hand or crane.

Description	Value	
Clamping Range	90mm - 205mm	3.5" - 8"
Machining Range		
STD Tooling for facing	0 - 130mm Ø	0 - 5.125"
Tool post Stroke		
X - Axis	0 - 67mm	0 - 2.6"
Z - Axis	0 - 25mm	0 - 1"
Feed Rates (per machine rev)		
1.75mm Lead screw	0 - 0.484mm	0 - 0.019"
Other		
Machine RPM	15 - 80	
Supply at 6 bar [87 psi]	1.42m³/min	50ft³/min
Operational Weight	20kg	44 lbs
Shipping Weight	30kg	66lbs
Designed for General Use		

4.3 Service and Supplies

4.3.1 Services

The MM200e Facing Machine uses a 1.1hp motor that requires a pneumatic supply capable of supplying 1.415 M³ of air per minute [50 CFM] at a pressure of 6 Bar [87 Psi].

4.3.2 Personnel

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

- The operator must be trained and conversant with the Enerpac MM200e.
- 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

5. Installation

The MM200e has been designed to fit onto a circular work piece, for example a pipe or flange. It can be fitted onto work pieces that range in size from 90 to 205mm (3.5-8in) diameter. Manually adjustable, clamping Jaws (M/C Mount Assemblies) are used to secure the machine to the work piece.

5.1 Installation to work-piece

1. Record the diameter of the work piece & ensure it falls within the working envelope of the machine. See 'Section 4.2' for machine details.
2. Adjust the four 'M/C Mount Assemblies' using an 8mm hex key until the distance between opposing clamping jaws is approximately 10mm larger than the recorded diameter from point 1. Be aware that all four jaws should be adjusted equally to ensure the machine is mounted concentrically to the diameter of the work piece.
3. Ensure each 'M/C Mount Assembly' has a 'Setting Strap' fitted to it.
4. Lift the machine safely over the work piece & lower it until all four setting straps are in contact with the work piece. Make use of the clearance cutaway on the outside diameter of the machine if necessary.
5. Screw in each of the four jaws until they start to grip the work piece.

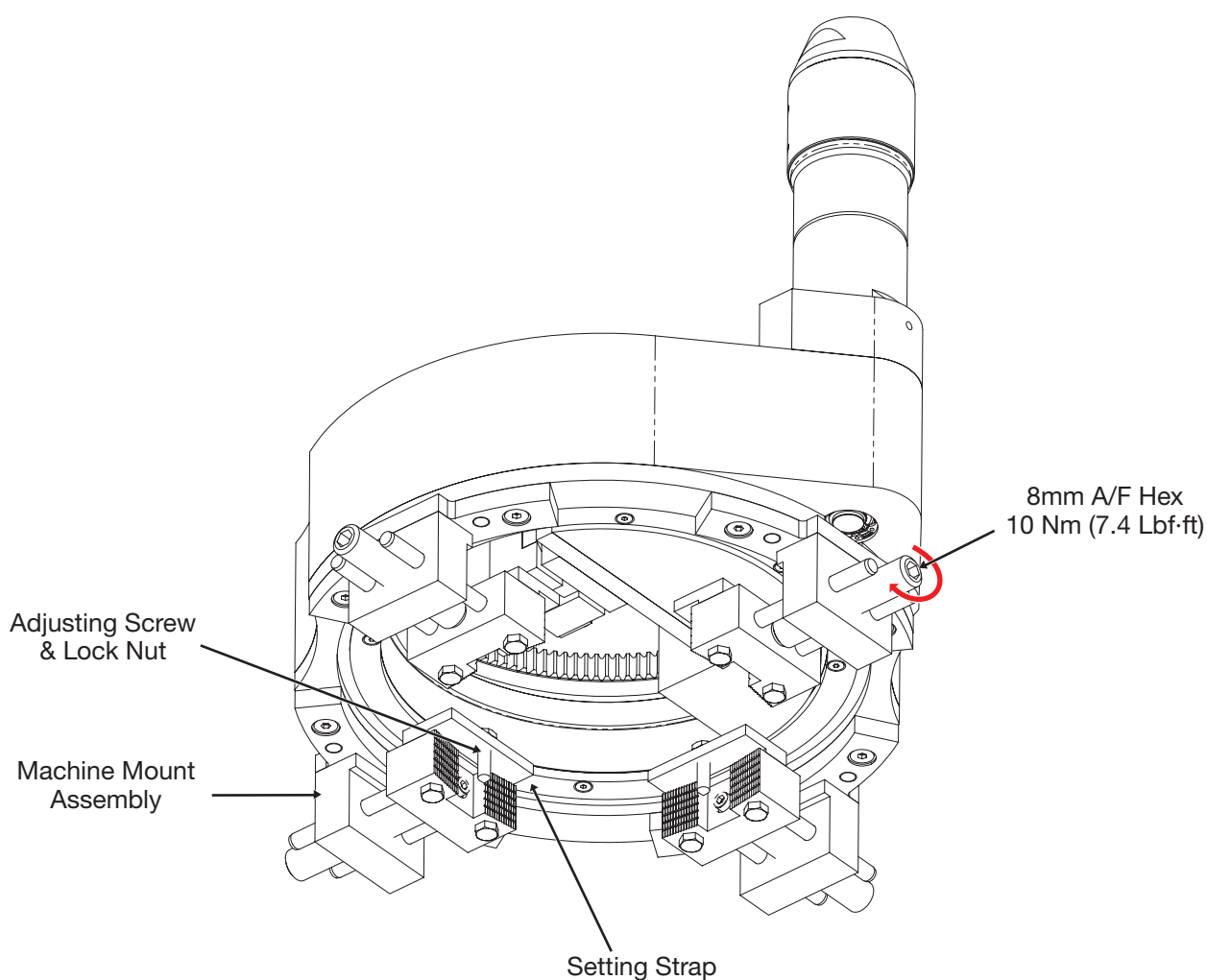


Figure 7: M/C Mount Assemblies

6. Adjust the machines perpendicularity to the work piece by adjusting the four adjusting screws & lock nuts located on each of the four 'Setting Straps'.

5.2 Lifting



The machine weight is approximately 20kg, care should be taken when lifting the unit.

Ensure that adequate Personal Protection Equipment (for example, hand, eye and feet protection) is worn when handling the assemblies.

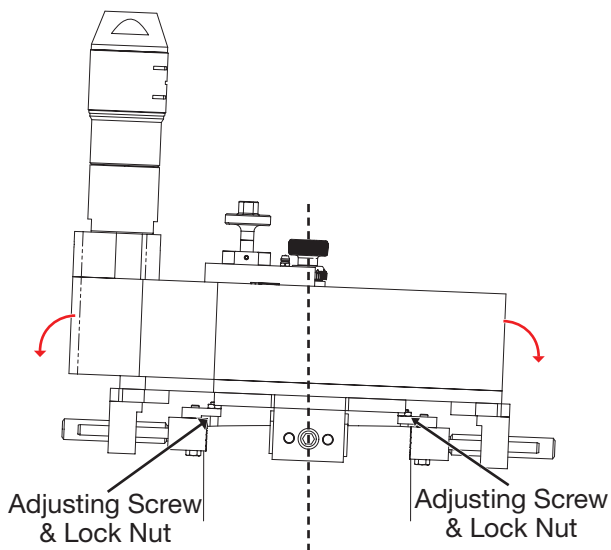


Figure 8: Levelling the machine

7. Whilst maintaining contact between 'Setting Straps' & the work piece tighten each of the four 'M/C Mount Assemblies' to a minimum torque figure of 10 Nm (7.4 Lb ft).
8. Now the machine is correctly fixed, the 'Setting Straps' can be removed.

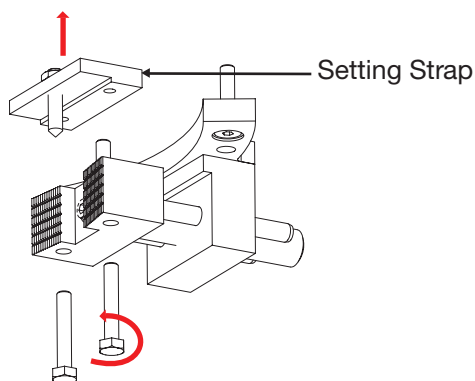


Figure 9: Removing Setting strap

9. If any adjustments are required following the initial installation ensure that the setting straps are re-fitted to the 'M/C Mount Assemblies' before releasing the four 'Clamp Screws'. This will prevent the machine slipping or falling down the work piece when the screws are released.



Following any adjustments & be sure to re-torque the four 'Clamp Screws' to a figure of 10 Nm (7.4 Lb ft).

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.

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 unit to the pilot operated pneumatic valve from the hold to run unit.

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

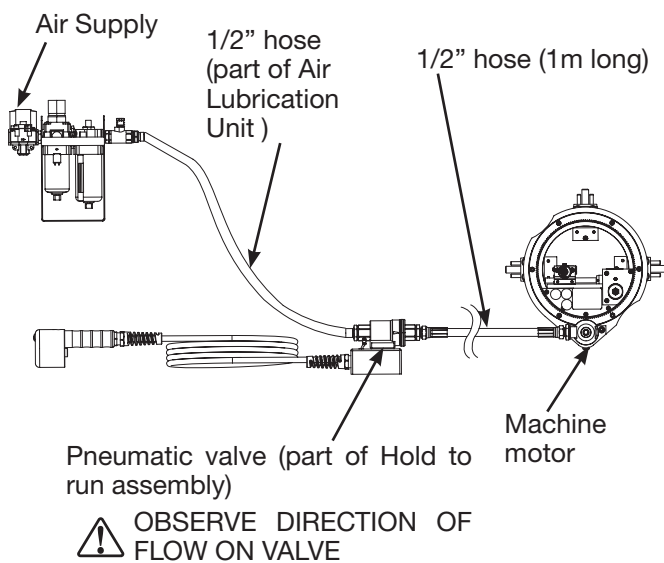


Figure 10: Connection system diagram

Schematic diagrams are located in the appendix.

6.2 Air Lubrication Unit

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

⚠ 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.

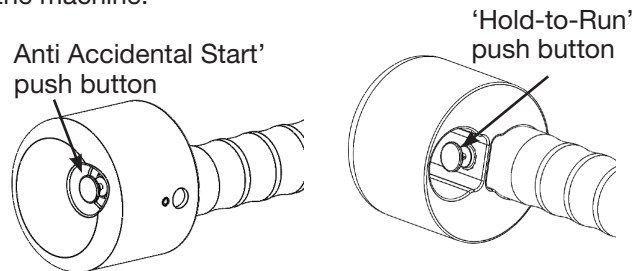


Figure 11: Hold-to-run handle

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

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 Lubrication unit.
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 .

6.5 Tool Post Setting

Setting the Tool Post Position

Move the Tool Post assembly along the leadscrew to an approximate position at the start of the required cut. To do this, ensure that the 'selector knob' is pushed down and rotate the 'selector knob' to move the toolpost along the leadscrew to the required position.

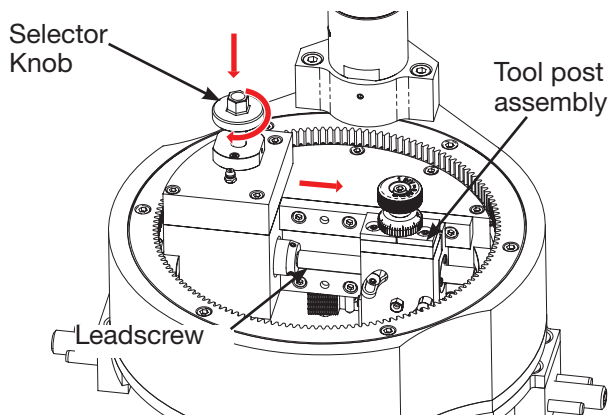


Figure 12: Setting toolpost location using selector knob

Note that the tool post can be locked in position at the carriage by tightening the pair of grub screws located behind the toolpost on the top face of the carriage.

Setting the Tool Post Angle

To adjust the angle of the tool post, release the two M5 locking bolts $\frac{1}{2}$ - 1 turn each and move the tool post to the desired position. Re-tighten the locking bolts once in position.

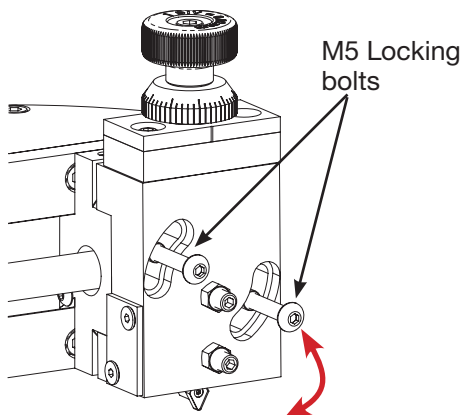


Figure 13: Setting angle of tool post

To set the tool in a vertical position, place a straight edge across both the side faces of the "Tool Post" and the "Tool Post Carriage", set the faces flush with each other and tighten the shoulder screws.



After setting up the toolpost, but before operation, the operator must, by hand, wind the carriage and toolpost to the minimum and maximum stroke on the arm to check for crashes.

Setting the Depth of cut

To alter the depth of cut, turn the Tool Post Hand Wheel. One rotation of the Hand Wheel equals 1mm feed of the cutting tool & each division equals 0.02mm feed.

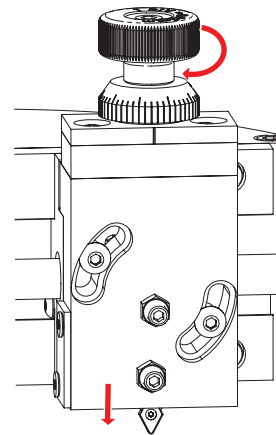


Figure 14: Setting Tool Post Depth

6.6 Operating the Machine

1. Ensure the 'Selector Knob' is pushed downwards to terminate drive to the feed gear.
2. Introduce power to the pneumatic motor (see sections 6.1 to 6.3) to start driving the 'Gearbox & Carriage Slide Assembly' around. Note that the assembly should rotate in a clockwise direction when viewed from above & the 'Tool Post' should not be feeding in any direction.
3. If the direction of rotation is correct, then the power to the motor can be turned off & the drive to the feed gear can be engaged by pulling the 'Selector Knob' up. Note that the 'Gearbox & Carriage Slide Assembly' may need rotating slowly to help engage the drive gear.

4. Finally check that the cutting tool is positioned correctly & then re-introduce power to the pneumatic motor to start driving the cutting tool. Note that the cutting tool should always feed out radially when cutting.
5. When the required cut has been completed terminate power to the pneumatic motor before it clashes with the clamping feet/machine housing.

NOTICE

The MM200e has not been designed to machine to its clamping diameter. Due to the design of the 'M/C Mount Assemblies' if the tool was allowed to cut all the way to the circumference of the work piece there is a danger that the 'M/C Mount Assemblies' will also be machined in the process.

6.7 Leadscrew Clutch System

The MM200e lead screw incorporates a clutch mechanism to stop feeding the tool carriage if it encounters an obstruction or excessive torque is required to achieve the cut.

If the clutch system operates during machine operation, stop machine immediately, remove obstruction or reset the tool path. If it is found that the clutch system is operating frequently, ensure that the three grub screws on the outside of the clutch mechanism are tightened to a torque figure of 4 Nm (3 Lb/ft).

If the clutch mechanism operates excessively it may become worn, if so remove the three grub screws, remove the leadscrew & inspect the tapered end. If it is noticeably worn, is 'glazed' or shiny replace the leadscrew & grub screws. When refitting the Leadscrew ensure the three grub screws are tightened to 4 Nm (3 Lb/ft).

The machine will come installed with a 1.75mm pitch leadscrew.

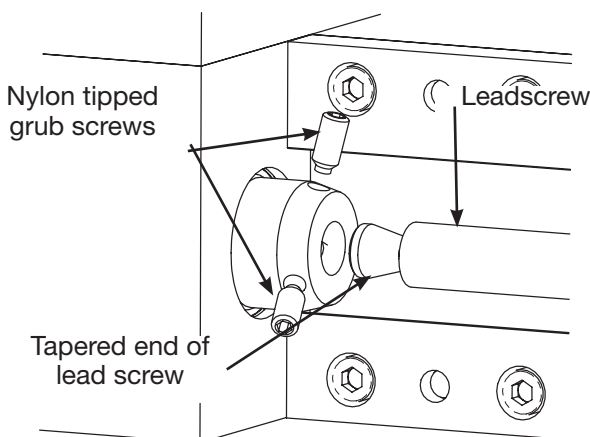


Figure 15: Leadscrew Clutch

6.8 Restart procedure

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 Lubrication unit.
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

6.9 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.

Wear protective gloves before commencing the below clearing procedure.

Release button on the hold-to-run handle.

Use a metal brush and pliers to remove swarf build-up.

Before re-starting the machine, re-assess safety, then once out of the cordoned off area start the hold to run device.

6.10 Machine Disassembly

To remove the machine from the work-piece, ensure all power is disconnected from the machine before safety attaching lifting equipment to the Drive Assembly. Once the machine is secured to the lifting equipment, loosen the base jaw assemblies and lift off the machine from the work-piece.

7. Recommended 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:



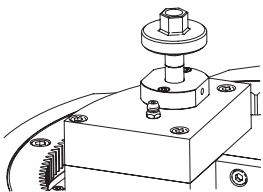
Figure 16: Storage box

8. Maintenance

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.

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.	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 100 hours	Check for backlash in lead screw/lead screw nut & correct if necessary.	N/A
Before long term storage (12 months minimum)	Protect machine, components & accessories from corrosion. Store all machine components securely in original packing box.	General, oil based, rust inhibitor.

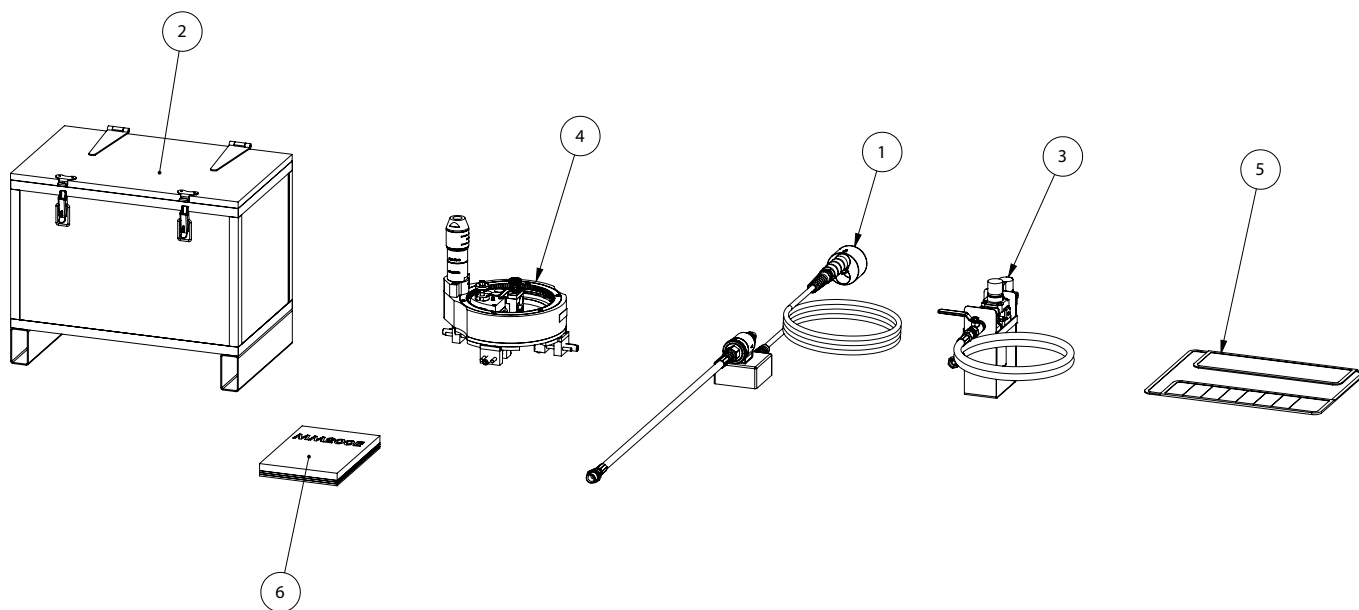
Machine Specific Maintenance Schedule		
Time Period (machine use)	Action	Recommended Lubricant
Every 25 hours	Grease gearbox via grease nipple, 2 shots. 	Lithium based 'Extreme Pressure' Grease (EPL)

8.2 Safely maintaining hydraulic/pneumatic system

- Never work on a hydraulic/pneumatic system unless fully trained.
- Carefully review the manuals before beginning work. Ask questions about anything you do not fully understand.
- Maintain a clean work area free of slipping hazards and debris.
- Use all required safety equipment.
- Always use safety glasses.
- Block, secure or lower to the ground components that may move, rotate or fall.
- Relieve system pressures. (Note: Some systems use accumulators that store pressure. Identify the system before working on it.)
- Use extreme caution when disconnecting lines. Severe burns from hot fluid can result.
- Use test equipment designed for higher pressures than the system being repaired. Use of gauges, lines, connectors, etc., designed for lower pressures can result in bursting or equipment damage. (Note: A good rule is to use equipment rated at twice what is expected. Example: For a 2500 psi system, use a 5000 psi gauge.)
- DO NOT USE HANDS OR FINGERS to find leaks. Fluid under high pressure can be injected into skin causing extreme injury and serious infection. "Note: High-pressure hydrocarbon injection injuries may produce substantial necrosis of underlying tissue despite an innocuous appearing external wound. These injuries often require extensive emergency surgical debridement and all injuries should be evaluated by a specialist in order to assess the extent of injury. Early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury."
- Clean up spills immediately. Hydraulic fluid is an oily substance which can cause slipping, falling and resulting injuries.
- Do not work under equipment/apparatus being supported by hydraulics. Stops, safety pins, etc. must be in place prior to beginning repairs.
- Review the Material Safety Data Sheets (MSDSs) for all chemicals used

9. Parts List

9.1 MM200E Assembly (MM200E, Revision G) View

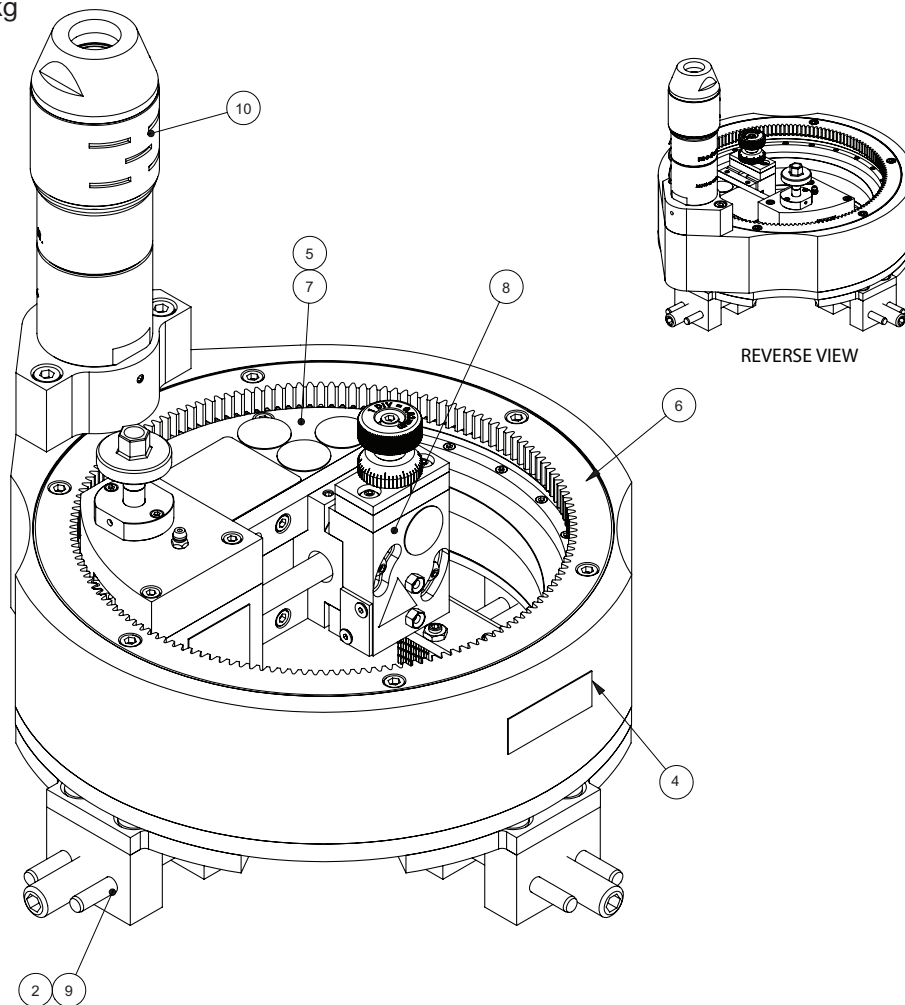


9.2 MM200E Assembly (MM200E, Revision G) Table of Parts

Item Number	Part Number	Description	QTY
1	DMH-PNEUMATIC	PNEUMATIC DEAD MANS HANDLE	1
2	MM200E-BOX-005	MM200E WOOD BOX ASSEMBLY	1
3	LARGE-ALK	LARGE FILTER LUBRICATOR KIT	1
4	MM200E-P-M	EXTERNAL MOUNTED FLANGE FACING MACHINE - PNEUMATIC	1
5	MM200e-TK	MM200E TOOLKIT	1
6	DOC-MM200E	DOCUMENT PACK FOR MM200E	1

9.3 MM200E Machine Assembly (MM200E-P-M, Revision E) View

Weight 21.4kg



NOTES:

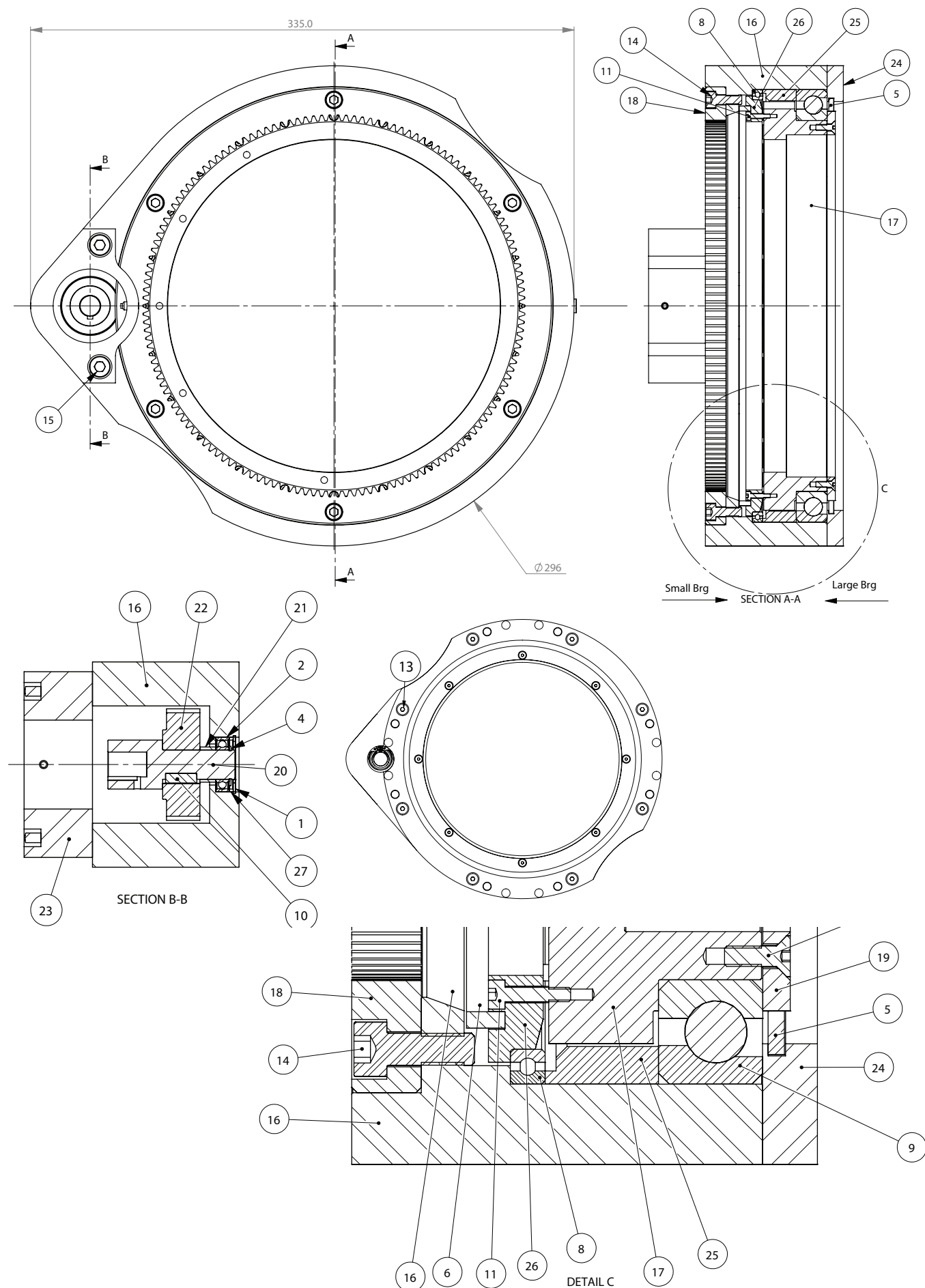
1. MACHINE TO BE SUPPLIED WITH 1.75mm LEADSCREW AND NUT FITTED.
2. IT IS RECOMMENDED TO USE ALL CLAMPS AT THE SAME TIME FOR MAXIMUM SECURING STRENGTH.

9.4 MM200E Machine Assembly (MM200E-P-M, Revision E) Table of Parts

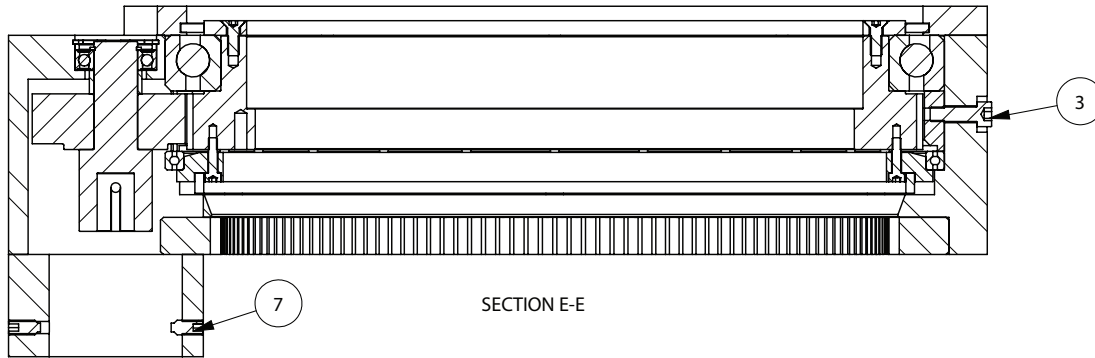
Item Number	Part Number	Description	QTY
1	1/2-3/4MALEMALE	3/4" BSPP MALE X 1/2" BSPP MALE	1
2	Ø8 x 40	PARALLEL PIN ISO 8734	8
3	3-4DOWTY	3/4" DOWTY WASHER	1
4	LABEL-PACK-1	LABEL PACK FOR MM200E, MM305I & MM610I	1
5	CCZ523028-1A	M5X25 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	4
6	MM200e-1	MAIN DRIVE UNIT ASSY	1
7	MM200e-2	G/BOX & C/SLIDE ASSY	1
8	MM200e-3	TOOLPOST ASSY	1
9	MM200e-5	M/C MOUNT ASSEMBLY	4
10	MTS10LT023FCL1-00	AIR MOTOR, 1.1KW,336RPM (@6 BAR), 12.7MM KEYED SHAFT, LEFT TURN	1

9.5 Main Drive Unit Assembly (MM200e-1, Revision M) View

Weight 11kg



Main Drive Unit Assembly (MM200e-1, Revision M) View

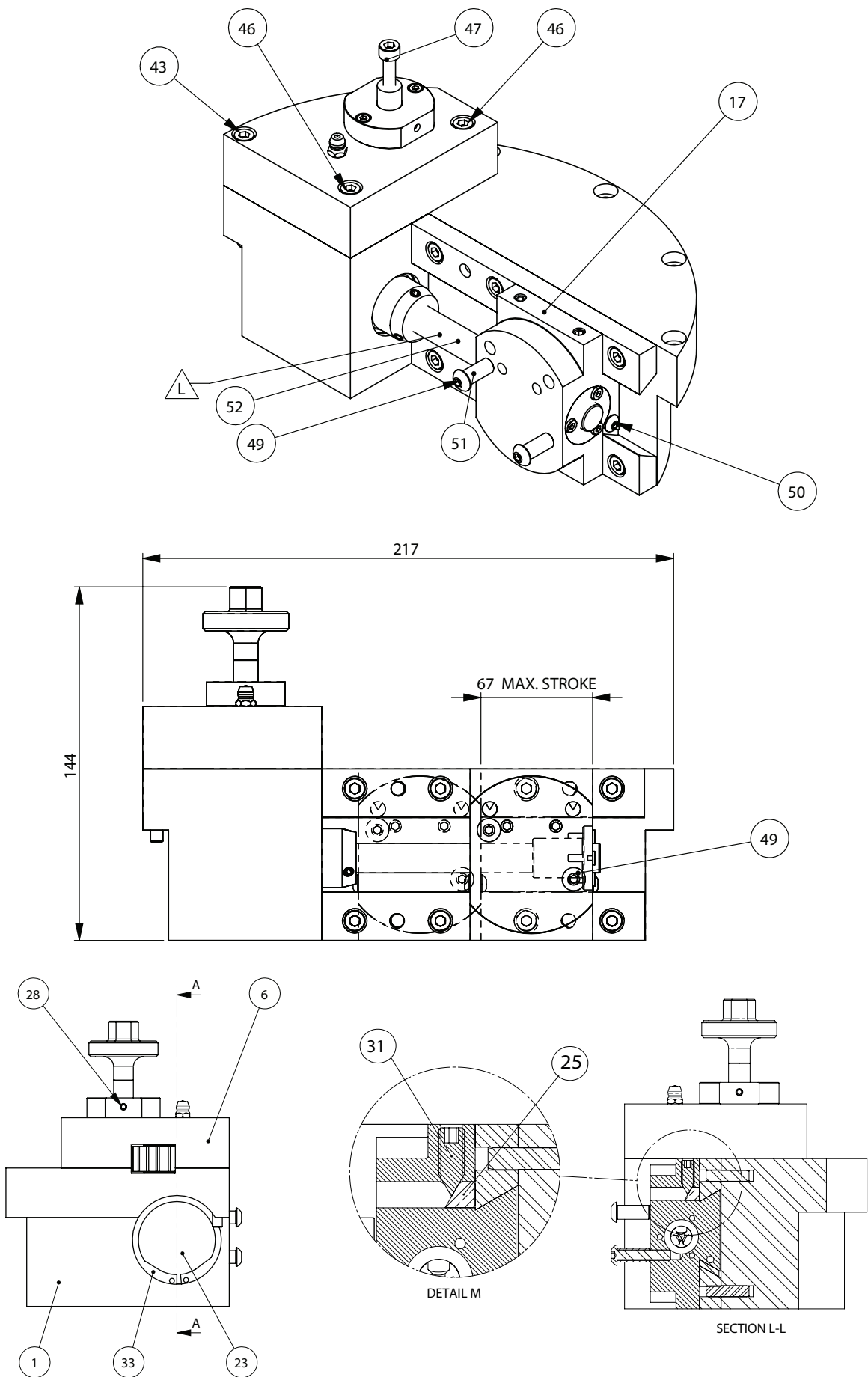


9.6 Main Drive Unit Assembly (MM200e-1, Revision M) Table of Parts

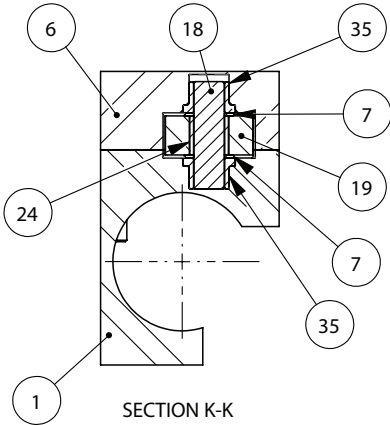
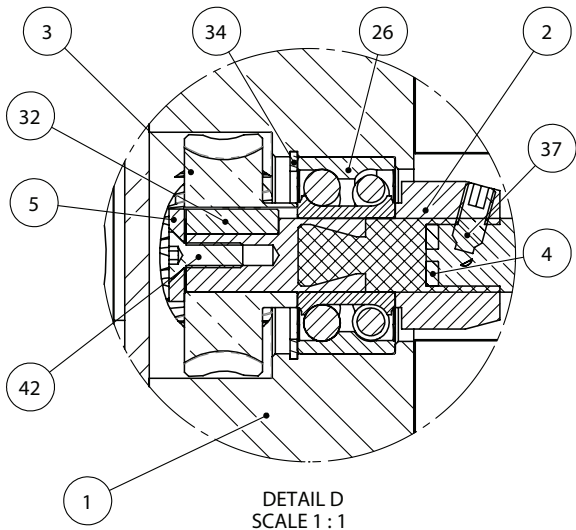
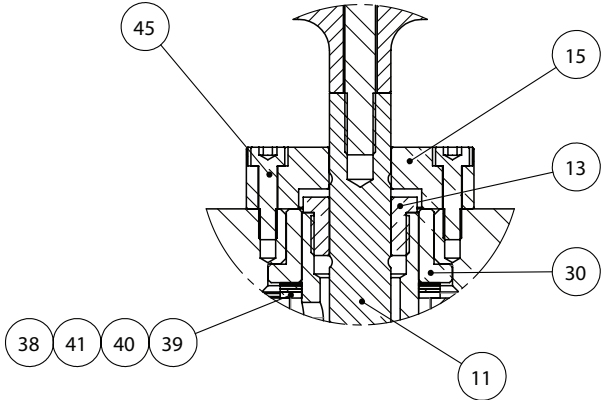
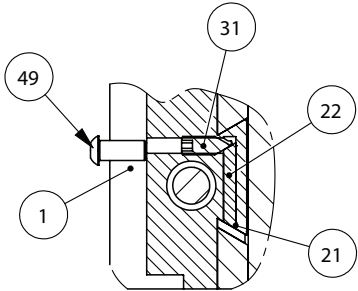
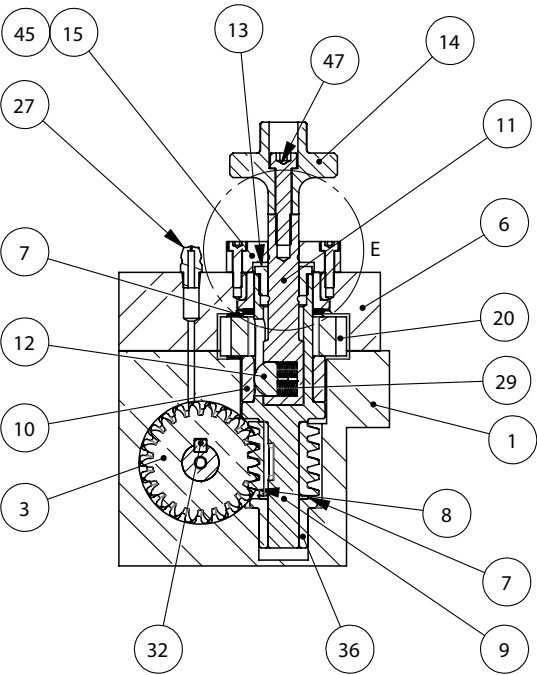
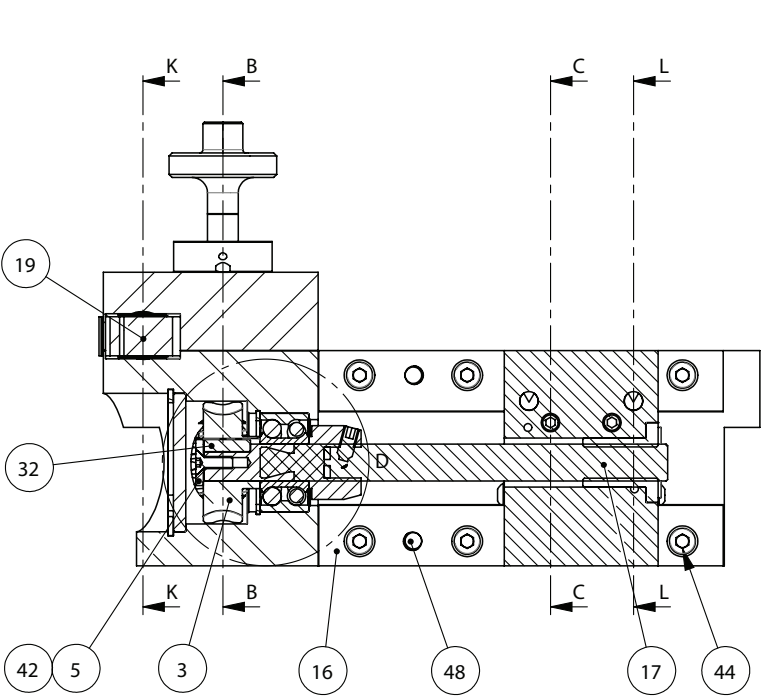
Item	Part Number	Description	QTY
1	28 X 1.2	DIN 472 INTERNAL CIRCLIP	1
2	61902-2RS	SINGLE ROW DEEP GROOVE BALL BEARING	1
3	CCZ519028-1A	M5X16 GR12-9 SOCKET HEAD CAP SCREW COARSE ISO 4762 (BZP)	1
4	D1400 0150	EXTERNAL CIRCLIP	1
5	ECOFLON 1 240 x 256 x 3	R14 ROTARY SEAL	1
6	ECOFLON 1 240.3 x 246.3 x 7	R14 ROTARY SEAL	1
7	GN.13711	SOCKET SET SCREW DOG POINT	2
8	KA100CP0*RBC	10.5" OD X 10" ID X 1/4" THK THIN SECTION BRG	1
9	KF090CP0*RBC	10.5"OD X 9"ID X 3/4" THK THIN SECTION BRG	1
10	KK5-16A	TYPE A KEY	1
11	M3 x 12	HEX SOCKET HEAD - BS EN ISO 4762	24
12	M4 X 12	HEX SOCKET CTSK HEAD - BS EN ISO 10642	8
13	M6 X 20	HEX SOCKET CTSK HEAD - BS EN ISO 10642	8
14	M6 x 16	HEX SOCKET HEAD - BS EN ISO 4762	6
15	M8 x 45	HEX SOCKET HEAD - BS EN ISO 4762	2
16	MM200e-1-001	MAIN M/C HOUSING	1
17	MM200e-1-002	117T MAIN DRIVE GEAR	1
18	MM200e-1-003	146T FEED RING GEAR	1
19	MM200e-1-004	DRIVE RETAINING RING	1
20	MM200e-1-006	MOTOR DRIVE ADAPTOR	1
21	MM200e-1-007	GEAR SPACER	1
22	MM200e-1-008	MOTOR PINION 25T	1
23	MM200e-1-009	MOTOR MOUNT	1
24	MM200e-1-010	MAIN BEARING RETAINING RING	1
25	MM200e-1-011	BEARING SPACER RING	1
26	MM200e-1-012	BEARING TRAPPING RING	1
27	MM200e-1-013	SPACER SHIM	1

9.7 G/Box & C/Slide Assembly (MM200e-2, Revision L) View

Weight 4kg



G/Box & C/Slide Assembly (MM200e-2 Revision L) View



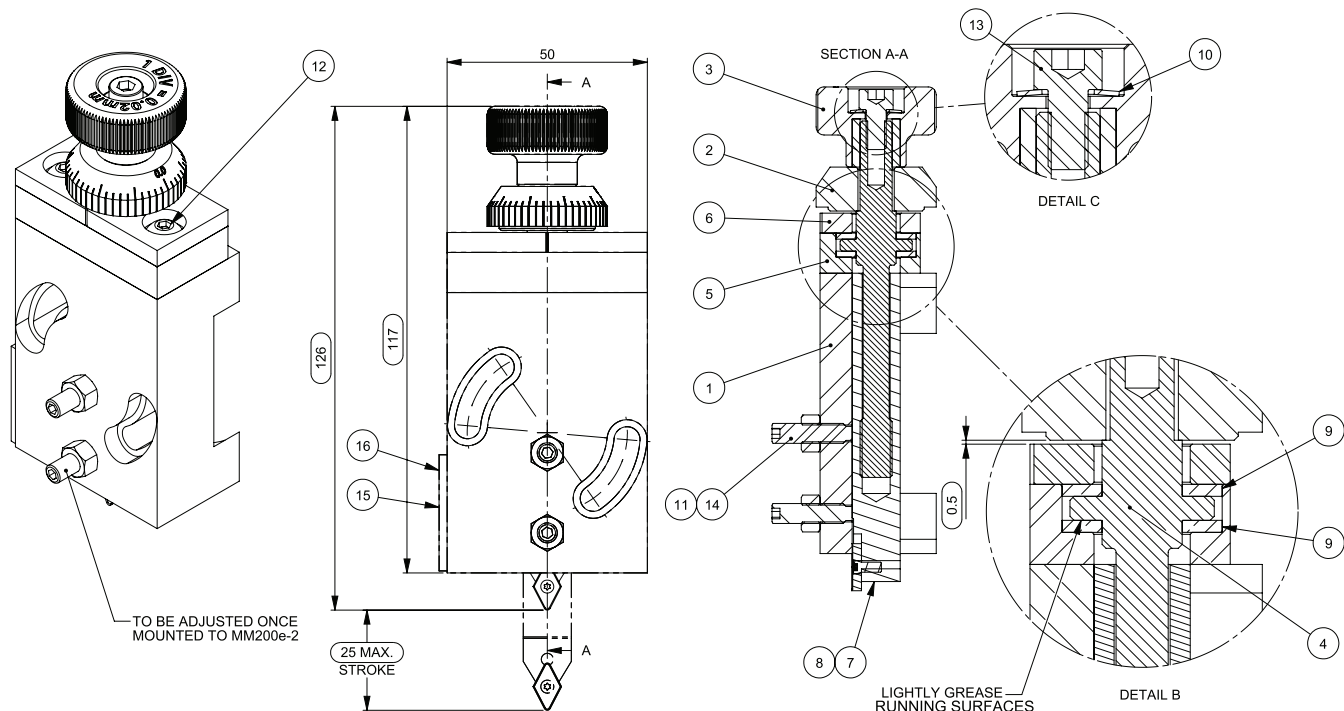
9.8 G/Box & C/Slide Assembly (MM200e-2, Revision L) Views Table of Parts

Item	Part Number	Description	QTY
1	MM200e-2-001	MAIN M/C BODY	1
2	MME 3259	DRIVE COUPLING	1
3	MM200e-2-008	1 START WORMWHEEL R/H	1
4	MM300E-2-008	NYLON AXIAL THRUST WASHER	1
5	MME 3239	CAPTIVE WASHER	1
6	MM200e-2-006	G/BOX LID	1
7	MM300e CF- 3-004	GEAR SPACER	3
8	MM200e-2-014	1 START WORM	1
9	MM300e CF- 3-006	FEED SHAFT	1
10	MMI 7680	SELECTOR KEY PARKING SLEEVE	1
11	MM300e CF- 3-026	SELECTOR SHAFT	1
12	MMI 7632	SELECTOR KEY	1
13	MMI 7637	SELECTOR END CAP	1
14	MM300E CF- 3-033	SELECTOR KNOB	1
15	MM200e-2-007	RR CLIP HOUSING	1
16	MM200e-2-003	GUIDE RAIL	2
17	MM200e-2-002	TOOLPOST CARRIAGE	1
18	MM200e-2-005	16T IDLE LAYSHAFT	1
19	MM200e-2-009	16T IDLE GEAR	1
20	MM200e-2-010	24T DRIVE GEAR	1
21	MM200e-2-004	GIB STRIP	1
22	MM200e-2-011	GIB STRIP PUSHER	2
23	MM200e-2-012	D-SECTION DUST COVER	1
24	MM200e-2-013	16T GEAR BUSH	1
25	MM200E-2-017	CARRIAGE STOP	2
26	3201-2RS	ANGULAR CONTACT BEARING	1
27	M6	STRAIGHT GREASE NIPPLE	1

Item	Part Number	Description	QTY
28	3150.W004	SPRING PLUNGER	2
29	5	COMPRESSION SPRING	2
30	MM860LT - 2 - 017	OILITE BUSH	1
31	MMI 2305 A	GIB STRIP GRUB SCREW	4
32	KK4-15C	TYPE C KEY	1
33	D1300-45	DIN 472 INTERNAL CIRCLIP	1
34	D1300-0320	DIN 472 INTERNAL CIRCLIP	1
35	AMF101310	FLANGED OILITE BUSH	2
36	AMF101616	FLANGED OILITE BUSH	1
37	GN.13711	SOCKET SET SCREW DOG POINT	3
38	CPS19x26x0.1	PRECISION SHIM	1
39	CPS19x26x1	PRECISION SHIM	1
40	CPS19x26x0.5	PRECISION SHIM	2
41	CPS19x26x0.2	PRECISION SHIM	2
42	M4 x 12	HEX SOCKET CTSK HEAD - BS EN ISO 10642	1
43	M5 x 50	HEX SOCKET HEAD - BS EN ISO 4762	1
44	M5 x 50	HEX SOCKET HEAD - BS EN ISO 4762	8
45	M3 x 12	HEX SOCKET HEAD - BS EN ISO 4762	2
46	M5 x 30	HEX SOCKET HEAD - BS EN ISO 4762	2
47	M5 x 25	HEX SOCKET HEAD - BS EN ISO 4762	1
48	6 X 20	Ø6 DOWEL	4
49	M5 x 25	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	2
50	M4 x 8	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	2
51	MM200e-2-015	M5 CAP HEAD SPACER	2
52	MM200e-6	STD MM200E LEAD- SCREW & NUT ASSY	1

9.9 Toolpost Assembly (MM200e-3, Revision G) View

Weight 0.4kg



FITTING NOTE:

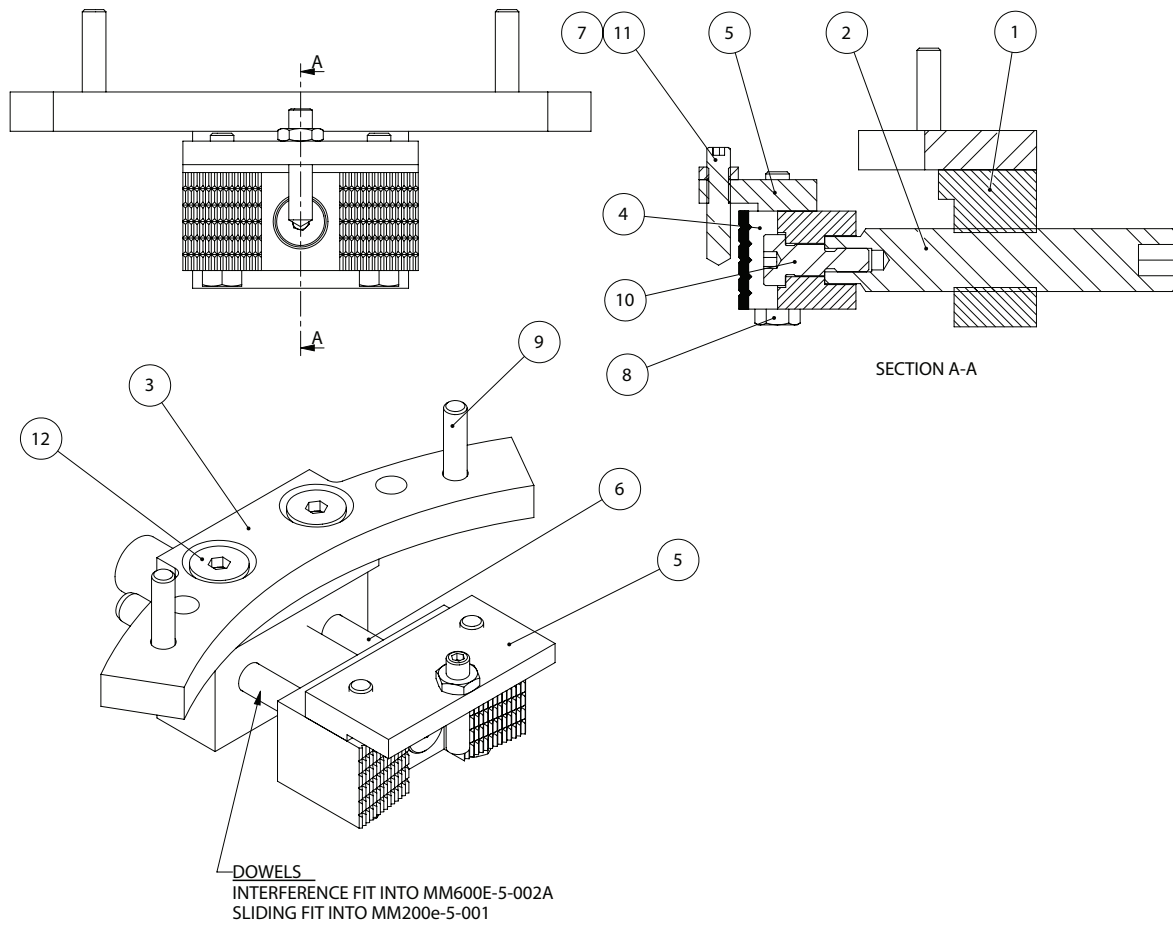
WHEN FITTING THE M5 CAP HEAD TO MM200E-3-003, MAKE SURE THAT BELLEVILLE WASHER IS NOT FULLY DEFORMED, THIS WASHER SHOULD ONLY BE TIGHTENED UNTIL SUFFICIENT FRICTION HAS BEEN CREATED BETWEEN MM200E-3-002 & MM200E-3-003 SO THAT THEY BOTH TURN TOGETHER. THE REMAINDER OF THE BELLEVILLE WASHERS DEFORMATION WILL ACT AS A METHOD TO DIS-ENGAGE THESE PARTS, MAKING ZEROING OF THE GAUGE POSSIBLE.

9.10 Toolpost Assembly (MM200e-3, Revision G) Table of Parts

Item	Part Number	Description	QTY
1	MM200e-3-001	TOOLPOST BODY	1
2	MM200e-3-002	AXIS SCALE (0.02mm inc.)	1
3	MM200e-3-003	AXIS SCALE (0.02mm inc.)	1
4	MM200e-3-004	TOOLPOST FEED SCREW	1
5	MM200e-3-005	MOUNTING PLATE	1
6	MM200e-3-006	REACTION PLATE	1
7	MM200e-3-007	FACING TOOL HOLDER	1
8	5513020-03	INSERT SCREW	1
9	WC08DU	DU THRUST WASHER	2
10	P12765506	BELLEVILLE WASHER	1
11	M5	HEX NUT STYLE 1 - BS EN 24241	2
12	M5 x 20	HEX SOCKET BUTTON HEAD - BS EN ISO 7380	2
13	M5 x 10	HEX SOCKET HEAD - BS EN ISO 4762	1
14	M5X0.8X20DPGS 14-9	M5X20 GR14-9 SET SCREW,DOG COARSE ISO 4028 (BZP)	2
15	MM200e-3-008	DTI PLATE	1
16	M3X0.5X8CSK10-9	M3X8 GR10-9 SOCKET HEAD CSK SCREW COARSE ISO 10642 (BZP)	2

9.11 M/C Mount Assembly (MM200e-5, Revision H) View

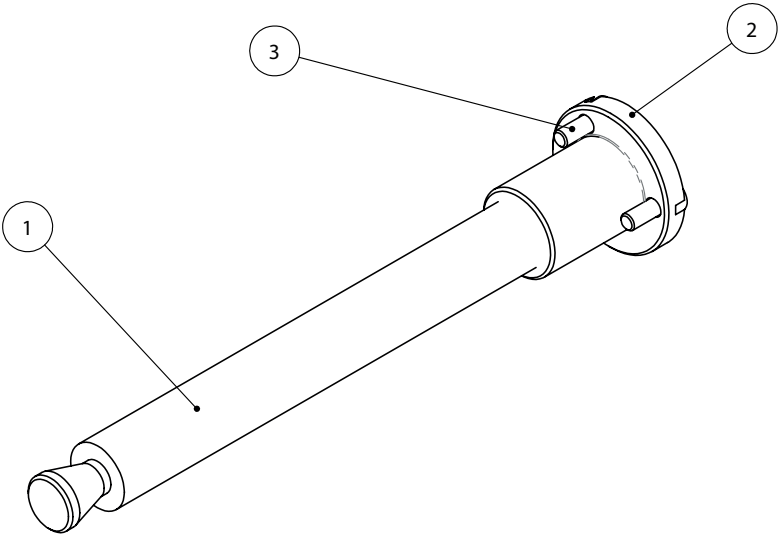
Weight 1kg



9.12 M/C Mount Assembly (MM200e-5, Revision H) Table of Parts

Item	Part Number	Description	QTY
1	MM200e-5-001	CLAMP MOUNTING BLOCK	1
2	MM200e-5-002	CLAMP SCREW	1
3	MM200e-5-003	MOUNT SPACER	1
4	MM600E-5-002A	GRIPPER BLOCK	1
5	MM600e-5-005	SETTING STRAP	1
6	8 x 80	TYPE B PLAIN DOWEL	6
7	M6	HEX THIN NUT GRADE AB - BS EN 24149	1
8	M6 x 35	HEX SCREW GRADE B - BS EN 24015	2
9	M6 x 30	HEX SOCKET CTSK HEAD - BS EN ISO 10642	2
10	M6X10SHSB	M6(DIA8X10) GR12-9 SKT HEAD SHOULDER BOLT ISO 7379 (PLAIN)	1
11	M6X1X30CPGS14-9	M6X30 GR14-9 SET SCREW, CONE COARSE ISO 4027 (BZP)	1
12	CCA821028-1B	M8X20 GR10-9 SOCKET HEAD CSK SCREW COARSE ISO 10642 (BZP)	2

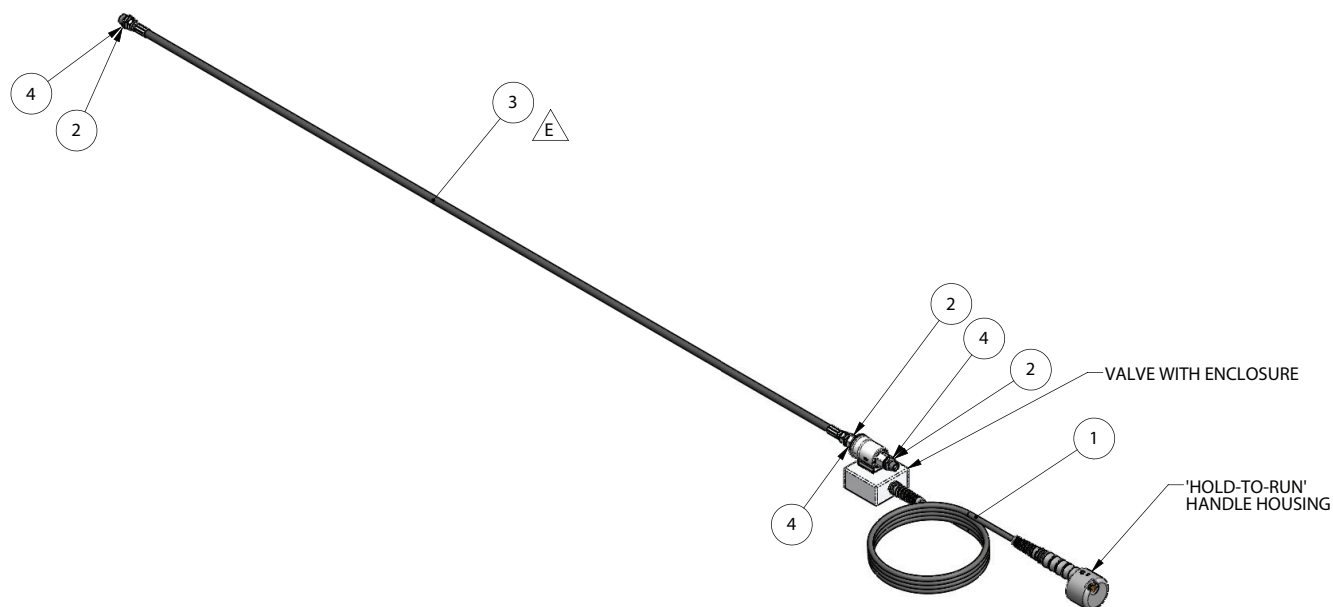
9.14 STD MM200e Leadscrew & Nut Assembly (MM200e-6, Revision C) View
Weight 0.2kg



9.15 STD MM200e Leadscrew & Nut Assembly (MM200e-6, Revision C)
Table of Parts

Item	Part Number	Description	QTY
1	MM200e-6-001	M12 x 1.75 LEADSCREW	1
2	MM200e-6-002	M12 x 1.75 LEADSCREW NUT	1
3	M3 x 8	HEX SOCKET HEAD - BS EN ISO 4762	3

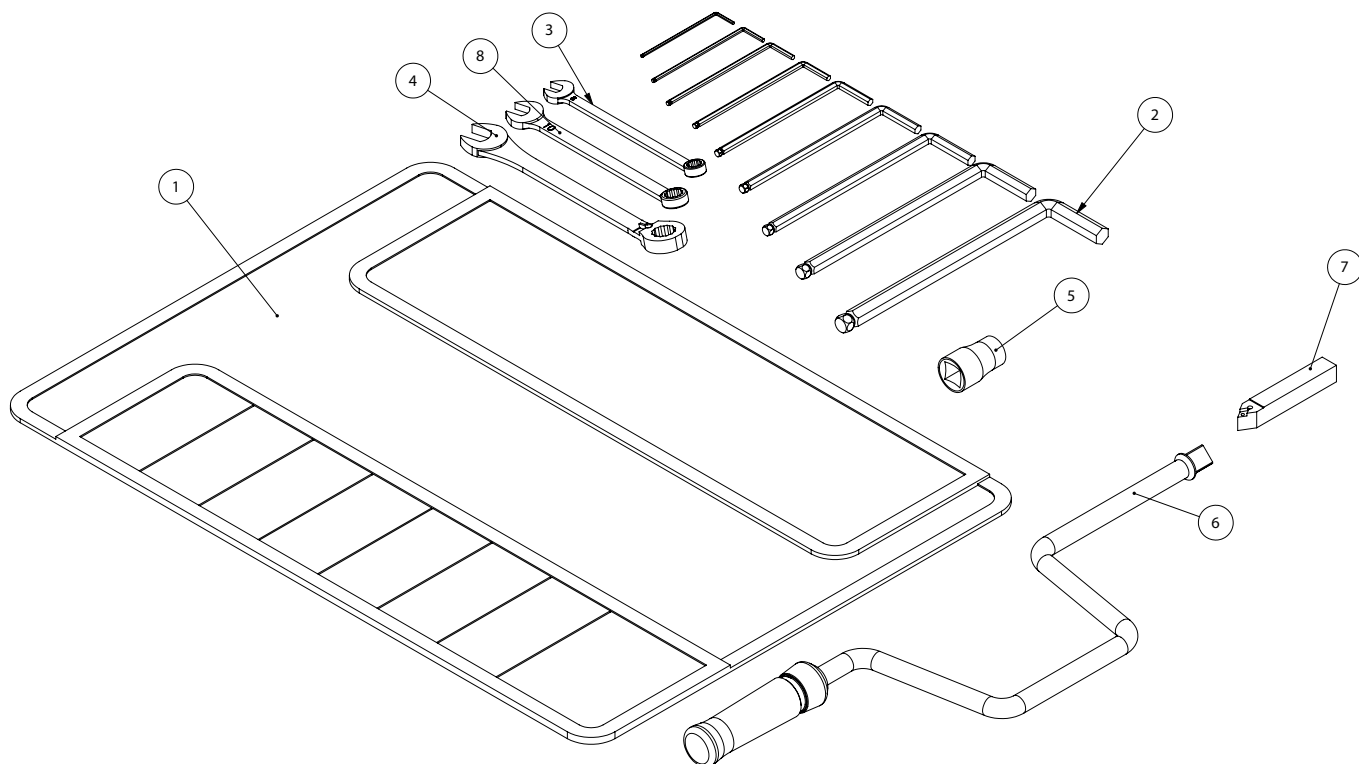
9.16 Pneumatic Deads Mans Handle (DMH-Pneumatic, Revision E) View



9.17 Pneumatic Deads Mans Handle (DMH-Pneumatic, Revision E) Table of Parts

Item	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-PIPE	1/2" BSPP FEMALE-FEMALE 2.5M HOSE	1
4	D400 027 12	3/4" DOWTY WASHER	3

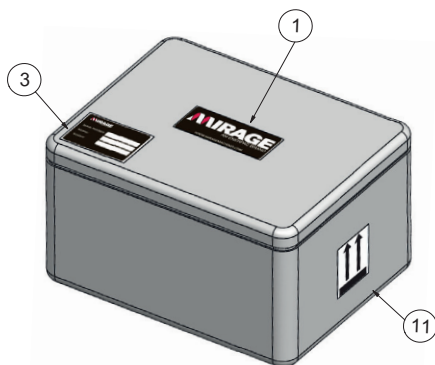
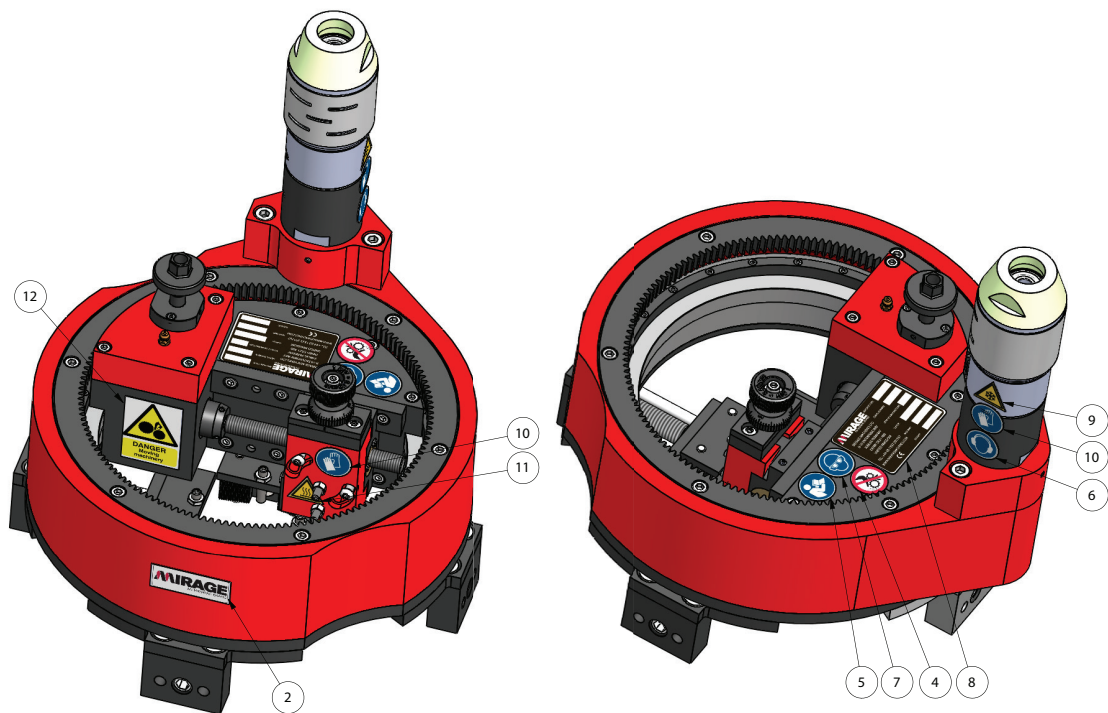
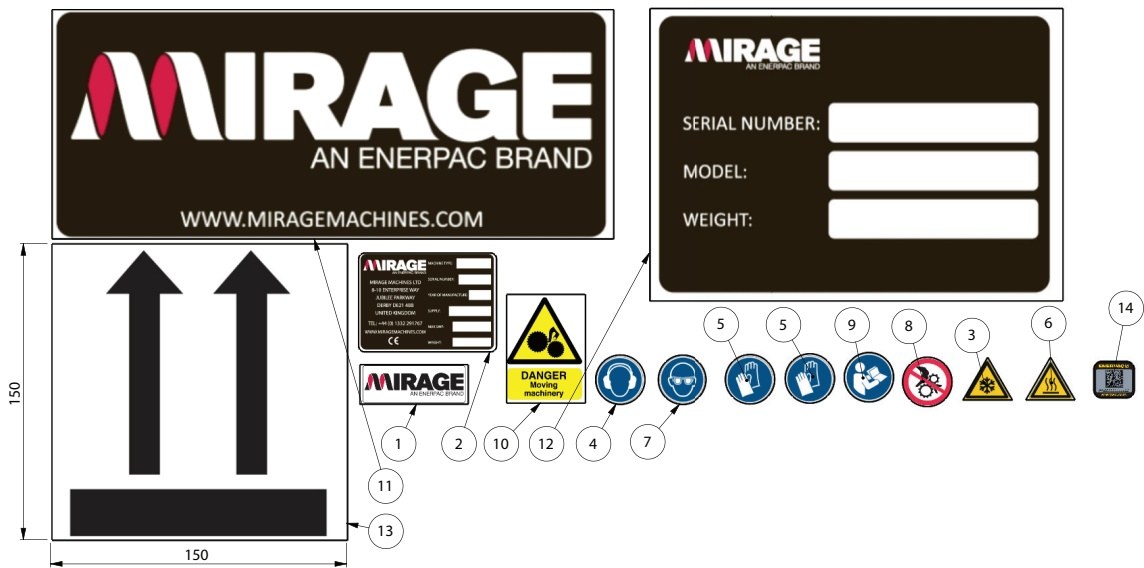
9.18 Tool Kit (MM200e-TK, Revision D) View



9.19 Tool Kit (MM200e-TK, Revision) Table of Parts

Item	Part Number	Description	QTY
1	KEN5930480K	6 POCKET PLAIN CHISEL ROLL	1
2	KEN6025500K	BALL DRIVER L WRENCHES	1
3	KEN5822590K	8mm COMBI SPANNER	1
4	KEN5822166K	13mm RATCHET COMBINATION SPANNER	1
5	KEN5826950K	13mm SOCKET ½" SQ DR	1
6	KEN5826600K	½" SQUARE DRIVE SPEED BRACE	1
7	MM200e-3-007	FACING TOOL HOLDER	1
8	KEN5822610K	10mm COMBI SPANNER	1

9.20 Label Pack (LABEL-PACK-1, revision E) Views



9.21 Label Pack (LABEL-PACK-1, Revision E) Table of Parts

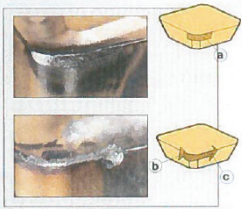
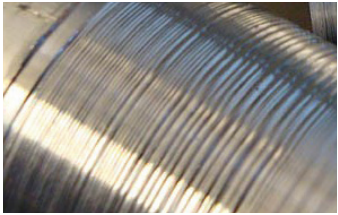
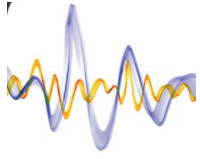
Item	Part Number	Description	QTY
1	LABEL-MM-004	MACHINE LOGO STICKER - SMALL (55 x 20)	1
2	LABEL-MM-033	CE ALUMINIUM LABEL	1
3	LABEL-MM-063	WARNING LABEL "LOW TEMPERATURE" ISO 7010 - W010 (21.5 x 25)	1
4	LABEL-MM-020	MANDATORY LABEL "WEAR EAR PROTECTION" ISO 7010 - M003	1
5	LABEL-MM-064	MANDATORY LABEL "WEAR PROTECTIVE GLOVES" ISO 7010 - M009 (Ø25)	2
6	LABEL-MM-065	WARNING LABEL "HOT SURFACE" ISO 7010 - W017 (21.5 x 25)	1
7	LABEL-MM-021	MANDATORY LABEL "WEAR EYE PROTECTION" ISO 7010 - M004	1
8	LABEL-MM-008	PROHIBITION LABEL "FINGERS OUT - ROTATING MACHINERY" ISO 7010	1
9	LABEL-MM-009	MANDATORY LABEL "REFER TO INSTRUCTIONS" ISO 7010 - M002	1
10	LABEL-MM-066	WARNING LABEL "DANGER - MOVING MACHINERY" (40 x 55)	1
11	LABEL-MM-001	BOX PACKAGING STICKER WITH WEB ADDRESS (285 x 116)	1
12	LABEL-MM-007	BOX CONTENTS STICKER (210 x 148 - A5)	1
13	LABEL-MM-087	LABEL 'THIS WAY UP' (150 x 150)	1
14	DD9012026	UIN METALPHOTO BUG DECAL	1

10. Troubleshooting

Before making adjustments and measurements or before cleaning swarf accumulations, switch off and bring the machine to a complete standstill

Symptom	Possible Cause	Corrective Action
The machine will not rotate	1. Hydraulic/Pneumatic supply not available	Check supply
	2. Hydraulic/Pneumatic 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. The feed control valve is not correctly set	Check position
	2. Drive gear problem	Remove and check drive assembly operation
	3. Depth of cut too deep	Remove cut and check rotation
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. Tool inserts worn or damaged	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 Enerpac

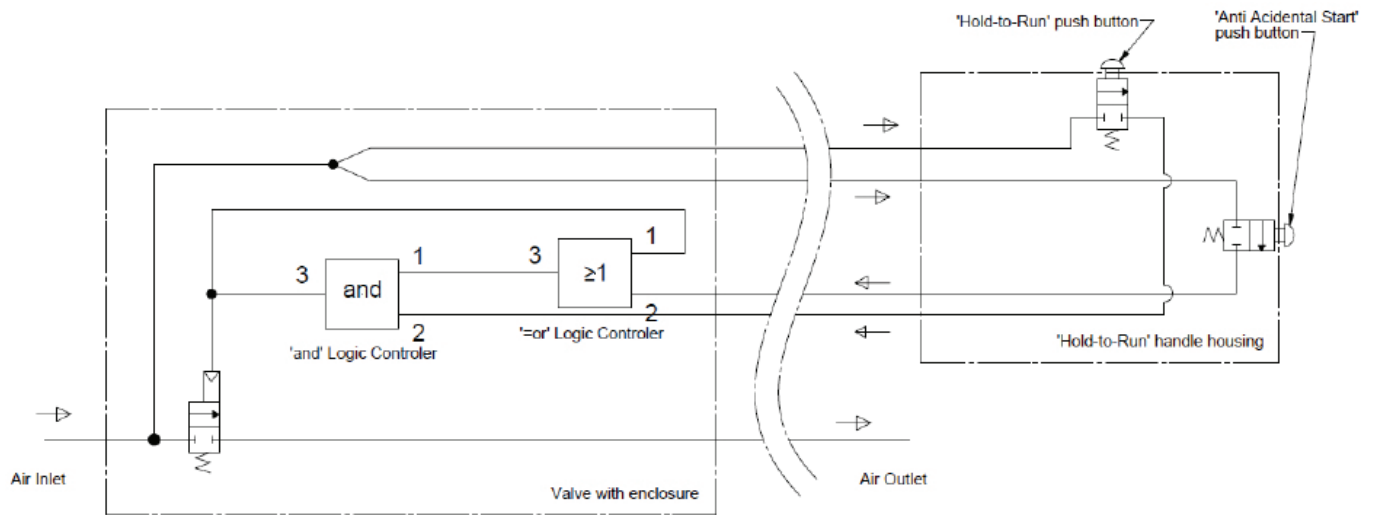
Cutting Tip Wear

Issue	Reason for wear		
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
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
		Varying coolant supply	Coolant should be applied copiously or not at all.
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

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

Thread Ø	Tensile Strength		Torque Setting	
	kN	lbs	Nm	in-lbs
M3	6.54	1470	2.1	19
M4	11.4	2560	4.6	41
M5	18.5	4160	9.5	85
M6	26.1	5870	16	140
M8	47.6	10700	39	350
M10	75.4	17000	77	680
M12	110	24700	135	1200
M14	150	33700	215	1900

Thread Ø	Tensile Strength		Torque Setting	
	kN	lbs	Nm	in-lbs
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

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	$\text{RPM} = \frac{V}{\text{Dia} \times 3.82}$
Feed rate	RPM, FPT, NT	mm/min	$\text{FR} = \text{RPM} \times \text{FPT} \times \text{NT}$	Inches/min	$\text{FR} = \text{RPM} \times \text{FPT} \times \text{NT}$
Feed per Tooth	FR, RPM, NT	mm/tooth	$\text{FPT} = \frac{\text{FR}}{\text{RPM} \times \text{NT}}$	Inches/tooth	$\text{FPT} = \frac{\text{FR}}{\text{RPM} \times \text{NT}}$
Feed / Rev	RPM, FR	mm/Rev	$\text{FRR} = \text{FR} / \text{RPM}$	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

C Optional Accessory

C1 MM200e-9 Right Angled Motor Assembly

The MM200e machine can fit a right angled gearbox (MM200e-9) as an optional extra in situations where space is an issue. The installation of this assembly is detailed below;

1. Unscrew the two M8 x 50 Socket Cap Head screws located either side of the motor mount. Remove the motor and motor mount (MM200e-1-009) from the main assembly.
2. Attach the motor mount to the right angled gearbox (MM200e-9) using the two M8 x 50 Socket Cap Head screws. Bolt the right angled gearbox to the MM200e assembly using the two M8 x 80 Socket Cap Head Screws.

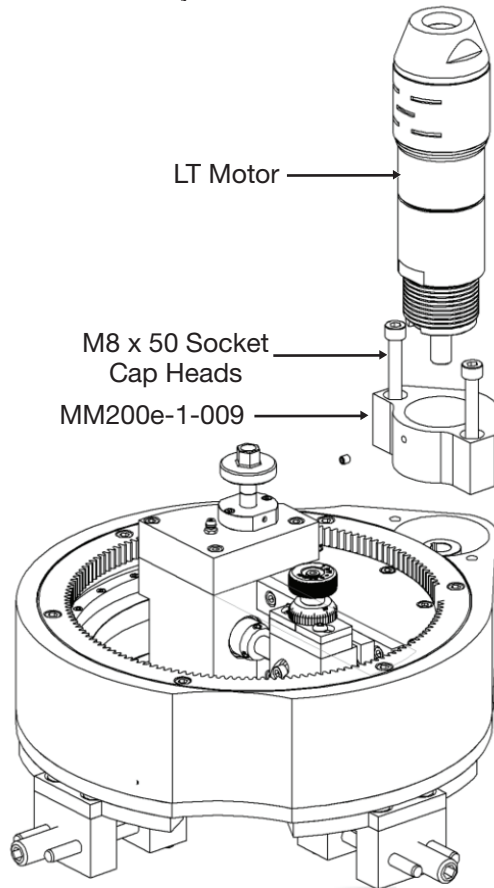


Figure 17: Normal Machine assembly

The MM200e-9 right angled gearbox also has the capacity to swap which side the motor is mounted it as shown below.

NOTE: since the MM200e is only supplied with a left turning motor, a reversible or additional right turning motor is needed if the motor has to be mounted on the left side to prevent the machine from turning backwards.

1. To swap which face the motor assembly is mounted to, remove the four M4 x 10 button head screws and the MM200e-9-007 bearing housing cap, as well as the MM200e-9-008 bearing housing cap.
2. Secure the MM200e-9-007 bearing housing cap to the other side of the assembly using the four M4 x 10 button head screws. Push the MM200e-9-008 bearing housing cap into position on the other side.

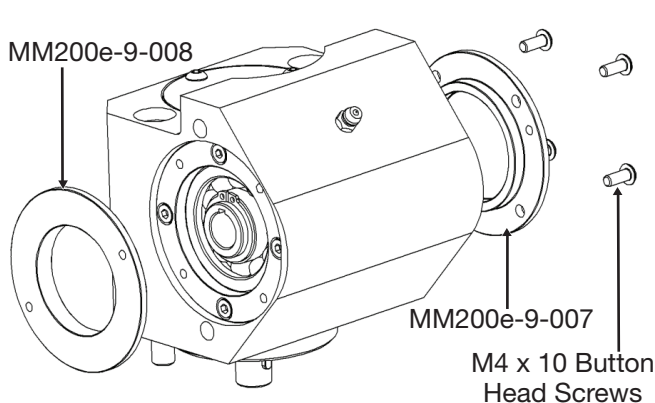


Figure 19: Gear box

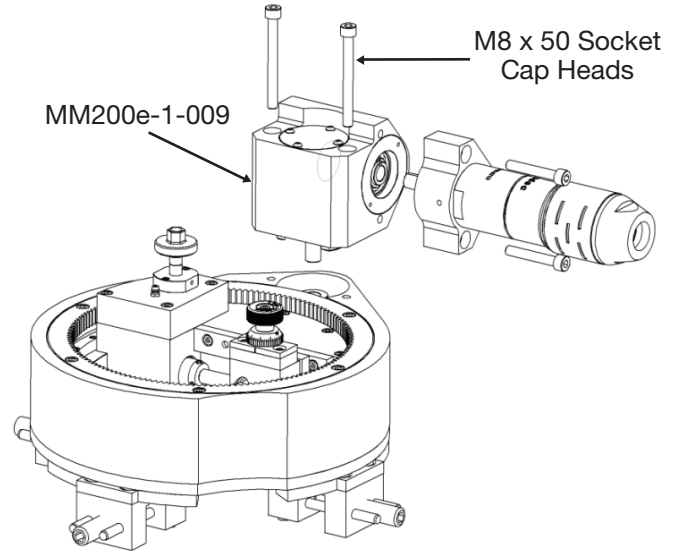


Figure 18: Right angled drive assembly

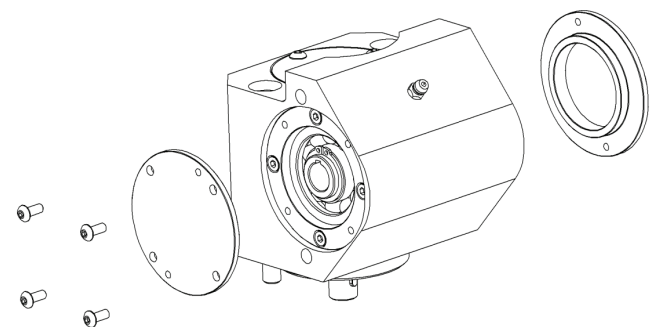


Figure 20: Gear box alternate assembly

