MC-L SERIES
FANUC 0iMF+ CONTROL
MAINTENANCE MANUAL

MADE IN USA

TABLE OF CONTENTS

5.0 – CAROUSEL & ARM STYLE ATC OPERATION

6.0 – DRAWINGS AND PARTS LIST

READ BEFORE INSTALLING OR OPERATING

NOTE: THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME.

All CNC machines contain hazards from rotating parts, belts and pulleys, high voltage electricity, noise, and compressed air. When using CNC machines and their components, basic safety precautions, including all appropriate LOTO procedures must always be followed to reduce the risk of personal injury and mechanical damage.

It is the machine owner's responsibility to make sure all personnel who are involved in installation and operation of this machine are thoroughly acquainted with the procedures and safety instructions provided herein *BEFORE* they perform any actual work.

Only Fryer factory-trained service personnel should troubleshoot and repair the equipment.

Do not modify or alter this equipment in any way without first consulting Fryer Machine. Any modification or alteration of this equipment could lead to personal injury and/or mechanical damage and could void your warranty.

EMERGENCY STOP (E-STOP) BUTTON

PRESSING THE EMERGENCY STOP BUTTON WILL STOP ALL MOTION OF THE MACHINE, AND THE COOLANT PUMP.

1. Keep machine and area around it clean and well lit. Never allow chips, coolant, or oil to remain on the floor. Do not leave loose objects on or around machine.

2. Use appropriate eye and ear protection while operating the machine. ANSI-approved impact safety goggles and OSHA-approved ear protection are recommended to reduce the risks of eye injury and hearing loss.

3. Keep all loose clothing, hair, and jewelry away from the machine at all times.

4. Gloves are easily caught in moving parts. Take them off before using the machine.

5. Always wear safety shoes with steel toes and oil-resistant soles.

6. Do not paint, alter, deface, or remove any warning plates from the machine. Replacement plates are available from Fryer Machine Systems.

7. Keep flammable liquids and materials away from the work area and hot chips.

8. Coolant and oils can make surfaces on the machine slippery. They can also present an electrical hazard if the machine has power on. Therefore, do not stand on any part of the machine at any time.

9. Keep vises, clamps, fixtures, or work pieces from extending beyond the back edge of the table.

10. Check for damaged parts and tools before operating the machine. Any part of a tool that is damaged should be properly repaired or replaced. Do not operate the machine if any component does not appear to be functioning correctly.

11. Improperly clamped parts machined at high speeds/feeds may be ejected and puncture the safety door. Machining oversized or marginally clamped parts is not safe.

12. To avoid tool changer damage, ensure that tools are properly aligned with the spindle drive lugs when loading tools.

13. Windows must be replaced immediately if damaged or severely scratched – contact the factory for replacement panels.

14. Do not attempt to operate the machine before all the installation instructions have been completed.

15. Be sure to review the maintenance section of this manual for instructions to keep your machine running properly.

1.01 Mechanical Safety

1. Always press Emergency Stop when the machine is not in use.

2. Never operate the machine with any cover or shield open or removed.

3. Never reach into the work area when the spindle is turning or if the machine is in automatic mode.

4. Put the machine in manual mode and be sure last programmed function has been completed before reaching inside of the work area.

5. The functions of the machine make it impossible to eliminate all pinch points. Be particularly aware of the following pinch points:

a. Spindle and tool rotation

b. Indexing of ATC and tools

c. Table, saddle, and head.

6. Do not operate machine without axis motor covers or axis waycovers in place.

7. Report any loose, worn, or broken parts to your supervisor. The same action should be taken if any unusual noise or machine action occurs.

8. The electric components are protected from normal moisture resulting from humidity or use of water-based coolants. **DO NOT** however, use a water hose to clean the machine or the area around it.

9. Never touch a machine control device or electrical component when your hand is wet.

10. Never clean up chips while the machine is running or is in automatic mode.

11. Do not file workpieces being rotated under power.

12. At the end of the workday the machine should be placed in "EMERGENCY STOP MODE"

13. When restarting a machine after it has been shut down always assume it has been altered. Recheck all phases of the job as though you were running the first piece.

14. Never run the spindle until hands, feet, and body are well clear of the work area.

1.02 Electrical Safety

1. **WARNING**: Electrical enclosures contain high voltage. Disconnect equipment from power source before opening cabinets.

2. **Before replacing a fuse, switch off the machine.**

3. *Immediately turn off power if:*

- Power problems develop

- In the event of electrical storms.

- Ambient temperatures exceed 105 degrees Fahrenheit (40 degrees C)

4. The electrical power must meet the specifications in this manual. Attempting to run the machine from any other source can cause severe damage and will void the warranty.

5. The electrical panel should always be closed and locked except during service.

6. When the main circuit breaker is on, there is high voltage throughout the electrical panel and some components operate at high temperatures, therefore extreme caution is required.

7. Do not reset a circuit breaker until the reason for the fault is investigated.

8. Never service the machine with the power connected.

2.0 BASIC INSTALLATION

2.1 WHERE TO PLACE YOUR MACHINE

Thank you for choosing Fryer Machine Systems. You have purchased a high quality, custom crafted machine tool designed and built to provide years of trouble-free service. To ensure that your machine is properly installed we ask that you review the following information prior to the shipment of your machine.

2.11 Foundation

Your foundation must be a minimum 6"(150mm) thick concrete slab floor and should be placed on a single slab with no seams. Be sure to leave space around the machine for leveling components and access to the electrical cabinet.

If your floor does not meet these specifications, contact the factory for further recommendations.

Install the machine on the first or second floor. Take the stress of ceiling and foundation into careful consideration to ensure that the machine load can be offset.

2.12 Environmental Conditions

Generally, the machine will be installed in the following conditions. However, these may change over a period of time or in response to seasonal changes.

- Supply voltage: +/- 10% of voltage listed on serial number tag.

- Source frequency: ±2 Hz of frequency listed on serial number tag

- Temperature effects dimensional accuracy, therefore, ambient temperatures should not exceed 105 degrees Fahrenheit. Also avoid exposing the machine to direct sunlight or heat rays which can change the environmental temperature.

- Relative Humidity: Less than 80% (Temperature changes should not cause condensation)

- Atmosphere: Free from excessive dust, fumes, corrosive gases, and salt

- Avoid exposing the machine to abnormal vibration.

2.2 Unloading Your Machine

Fryer machines are shipped on skids designed for forklift offloading. Be sure your forklift is rated for the proper weight of the machine.

Note: If you are using a crane for offloading, please contact the factory in advance for instructions as damage can occur if supported in the wrong locations.

2.3 RECEIVING YOUR MACHINE

NOTE: If you have a door that is less than 8' wide x 10' high, please contact the factory prior to shipment so that we can make sure your machine is packaged to fit into your door openings.

1. Fryer machines are carefully packed to avoid damage in transit; however, we ask that you ***UNWRAP AND INSPECT YOUR MACHINE AS THOROUGHLY AS POSSIBLE PRIOR TO SIGNING THE BILL OF LADING***. If a digital camera is available, pictures should be taken before the machine is moved further. Pictures should be sent to service@fryermachine.com.

2. Place the machine in its location and complete inspection. If there is any damage to your machine, Fryer should be notified immediately. This will enable us to provide replacement parts before the service technician arrives install the machine.

3. If you have any questions about any of these installation instructions or other questions about your new Fryer Machine Systems machine, please call the Fryer Service Department and one of our trained technical staff will be happy to assist you.

2.4 Unpack and Place Your Machine

To make certain that your machine installation goes smoothly, it is important that the following items are completed **prior** to the arrival of the Fryer authorized service technician. This will ensure that our technician is able to provide you with the maximum amount of training during his allocated time with you.

1. Have your rigger move the machine to the operating location, remove it from the skid and install on ALL leveling pads.

2. Remove all packaging material and thoroughly clean the machine and inspect for hidden damage.

3. Remove all large assemblies from skids and stage next to machine to facilitate ease of assembly.

4. Install leveling pads and level machine. Level with a precision level, using the leveling screws and pads provided with the machine.

2.5 Prior To The Arrival of The Technician

2.51 Installation Safety Instructions

Initial start-up of the machine must be performed by a Fryer Machine Systems authorized service technician.

2.52 Cleaning & Lubricating Machine

- All protective coatings (cosmoline) must be removed before using the machine.

- Be cautious when selecting a suitable cleaning agent. Paraffin applied with a clean brush will soften the protective coating. The protective coating can then be removed with clean rags.

- WD-40 or a similar product is recommended for cleaning the machine. Do not use gasoline or any other flammable solution to clean the machine.

- Clean all exposed ways of the bed and saddle.

2.53 Line Voltage Check

Line voltage must be ± 10% of the voltage listed on the serial number tag.

> ### INITIAL POWER-UP SHOULD ONLY BE PERFORMED BY
> ### A FRYER TECHNICIAN OR FACTORY AUTHORIZED REPRESENTATIVE.

2.54 Electrical Precautions

ELECTRICAL SCHEMATICS FOR YOUR MACHINE ARE LOCATED IN THE ELECTRICAL CABINET AND IN THIS MANUAL.

Wiring

1. Ensure that all local electrical codes are met.

2. Do not connect to the power distribution panel any power cables for devices that can cause line noise, such as welders and high frequency quenching machines.

Grounding

You should always refer to your local electrical code to be sure you are grounding to code. Generally, use a grounding wire with a cross section of more than 14 mm and a resistance to ground of less than 100 ohms. This wire size should be greater than AWG (American Wire Gauge) No. 5 and SWG (British Legal Standard Wire Gauge) No.6.

Generally, the machine should be grounded to a separate grounding rod. If an independent ground cannot be provided for the machine, prepare the ground connection as follows:

1. Connect a single conductor to its own grounding terminal. This will avoid possible serious accidents resulting from ground currents that might otherwise flow in the NC machine if a peripheral device should malfunction.

2. Be careful when using concrete reinforcing rods as grounding points. These reinforcing rods often are used to ground equipment because they usually offer a resistance to ground of less than 100 ohms. In doing so, make the connection as follows: (This also applies to connecting ground wires to regular grounding terminals)

3. Do not use the same grounding reinforcing rod or grounding terminal for other devices since this could lead to line noise such as produced electric welders and high frequency quenching machines.

4. Use a grounding terminal with an adequate electrical performance rating and which is durable.

5. A separate grounding wire should be used, one whose length is as short as possible.

6. Check the resistance to ground by actual measurement.

7. This should measure less than 100 ohms if the single device is connected to its own grounding rod.

Desirable Independent Grounding: Earth resistance: Less than 100 ohms

Common Grounds: Resistance to ground = 100/the number of devices connected to the grounding (Ω)

NEVER GROUND EQUIPMENT IN SERIES!

Connection of Power Line

NOTE: Electrical installation should only be completed by a qualified electrician.

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1. Make sure that the incoming power is compatible with the requirements of the machine tool (voltage, amperage, phasing). All this information can be found on the machine's serial number tag.

2. Power wires, grounding and over-voltage protection should comply with the local electrical code.

3. **DO NOT** connect if the incoming power is different from the power requirements of the machine. Contact a qualified electrician.

2.6 Leveling the Machine

Before attempting to use the machine, it will be necessary to accurately level it.

- Screw the leveling bolts (with nut) into the holes in the base of the machine. Set a leveling pad under.

- Please prepare the following tools to adjust machine level:

  o Precision level (0.0005"/ft. or 0.013mm/1000mm accuracy)

  o Two adjustable wrenches

- Clean the bed way and cross slide surfaces thoroughly and set one of the precision levels on the flat bed way in the longitudinal direction, and the other on the cross slide, perpendicular to the first (if there is only one level available, then use it on both directions alternately).

- Adjust the leveling bolts located the bottom of the machine base until the machine is leveled to within 0.001"/ft. (0.08mm/1000mm) in both directions.

- Lock the nuts on the leveling bolts, and re-check to see whether the level of machine is still correct. Repeat as necessary until machine level is obtained with leveling bolts locked.

- After initial installation, check the level once a week for the first month, then check monthly thereafter.

2.61 Leveling Procedure

Step 1

- Set up your precision level in the middle of the machine table parallel to the X-axis.

- With the table centered in the X and Y-axis, adjust the machine's four outside leveling studs to achieve level.

- Be sure that the center leveling pads are not touching and that all four outside pads have load.

- Also check to make sure that the machine casting is not touching the floor.

Step 2

- Now rotate the level 90 degrees so it is parallel to the Y-axis and again check level.

- Adjust the four outside leveling studs as needed.

- If any adjustments are required to achieve level, you must go back and re-check level with the level parallel to the X-axis.

- Repeat the adjustment process until the machine is perfectly level with the level parallel to both axes without further adjustment.

Step 3

- Adjust the center leveling studs until they are just touching.
- Again, verify the machine is level with the level parallel to both axes without further adjustment.

Step 4

- With the level parallel to the X-axis, slowly move the table back and forth over full Y-axis travel check to see that the level does not change. Make any required adjustments to achieve level.

Step 5

- Re-center the table in the Y-axis and again verify that the machine is level with the level parallel to both axes.
- Check that all leveling pads have some degree of load.
- Lock the nuts on the studs once the correct level is achieved.

Step 6

- The final check is "tramming" of the head. This is accomplished by mounting the indicator base on the spindle nose and setting the indicator tip on the tabletop at position "0" shown below. Properly load the indicator tip and zero the indicator at position "0". Sweep the indicator tip by rotating the spindle manually over a 12" diameter circle. The indicator should show no more than .0005" total indicator reading. Record the values found at positions 1, 2, and 3.

	TABLE SWEEP	3 1 2 0	**.0005"** **OVER 12" DIAMETER** **IN X-Y AXIS**	1
				2.
				3.

3.0 GENERAL INFORMATION

3.1 Maintenance Schedule Chart

*FOR FURTHER MAINTENANCE DETAIL, REFER TO THE MACHINE COMPONENT SECTIONS IN THE MANUAL LISTED BELOW.

CAUTION! Always follow all Lock Out / Tag Out procedures before performing any maintenance

MAINTENANCE ITEM	RECOMMENDED	Daily	Weekly	6 Mo	As Required
Check air pressure gage	90 – 125 PSI	X			
At the end of the day remove and dispose of chips	Use of brush or vacuum is recommended. Do not use air as it can push chips into waycovers and ballscrews.	X			
Check axis lubrication pump oil level	See Section 3.201 – Use Mobil Vactra #2 (ISO 68) or equivalent	X			
Clean chips from interior of ATC	See Section 3.204 for details		X		
Check pneumatic (air) lubrication oil	Add Mobil ALMO break free synthetic air tool oil (5W-10W)		X		
Check coolant level	Complete a visual inspection		X		
Check machine level	See Section 2.61 for details			X	
Check axis backlash	See procedure in Section 3.43			X	
Remove and clean underside of waycovers / check sliders and bumpers for wear and/or damage	See Section 3.44 for details			X	
Check wipers for adjustment / damage	See Section 3.44 for details			X	
Check ballscrew endplay	See procedure in Section 3.45			X	
Check axis motor belts	See procedure in Section 3.46			X	
Grease ATC cam pockets	See Section 3.24 for details			X	
Change coolant	Blasocut BC40 NF-PL or equivalent				X
Check and change electrical cabinet air filters	Use Purolator A23465 air filters				X
Change ATC gearbox oil	Mobilgear 600XP 150, Shell Omala EP 150-220 or equivalent				Yearly
Chiller fluid	Oil Chiller: VG-32 Oil				Yearly

3.21 Axis Lubrication System

- The automatic way lube system is controlled by the PLC in the control. The system only pumps way oil when the axes are moving. If there is no machine movement the pump will not pump unnecessary oil. This method greatly reduces way lube usage and keeps oil out of the machine coolant sump and prevents fouling.

*For illustrative purposes only. Your specific
machine's lubrication pump may be different.*

- If the machine has been unused for more than 48 hours press the blue pushbutton on the side of the lube tank for approximately 30 seconds to pump oil to the ways. The pressure gage on the tank will indicate if it is working properly.

- If the system detects low way lube it will display the following message in the control:

    A003.12001   LOW WAY LUBE

3.22 Electrical System
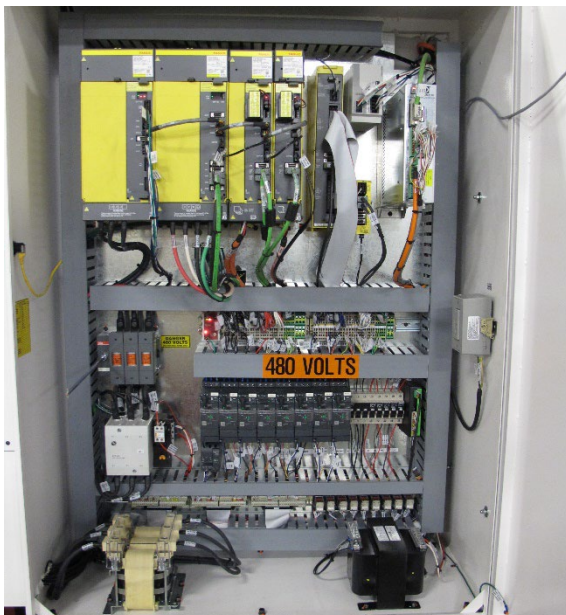
- Schematics– The Electrical and Pneumatic Schematics are inside electrical cabinet

- Cabinet Filter Type – Purolator A23465 or equivalent

- Check Filter Interval - Weekly

- Change Filter Interval – As Required (depending on environment)

- Pneumatic Schematics for your machine are located in electrical cabinet door pocket(see previous page)

- A list of the different solenoids and pressure settings is located on a sticker where the solenoids are located.

- Some of the basic solenoids are listed below:

  - Air Gun

  - Air Pressure Switch

  - ATC Tool Pot Up

  - ATC Tool Pot Down

  - Drawbar Solenoid

  - Spindle Air Blast (Option)

  - Spindle Bearing Purge (Option)

  - 4th Axis Brake (Option)

  - Spray Mist (Option)

  - Glass Scale Air Purge (Option)

  - Programmable Air Blast (Option)

  - 4th Axis Tailstock Brake (Option)
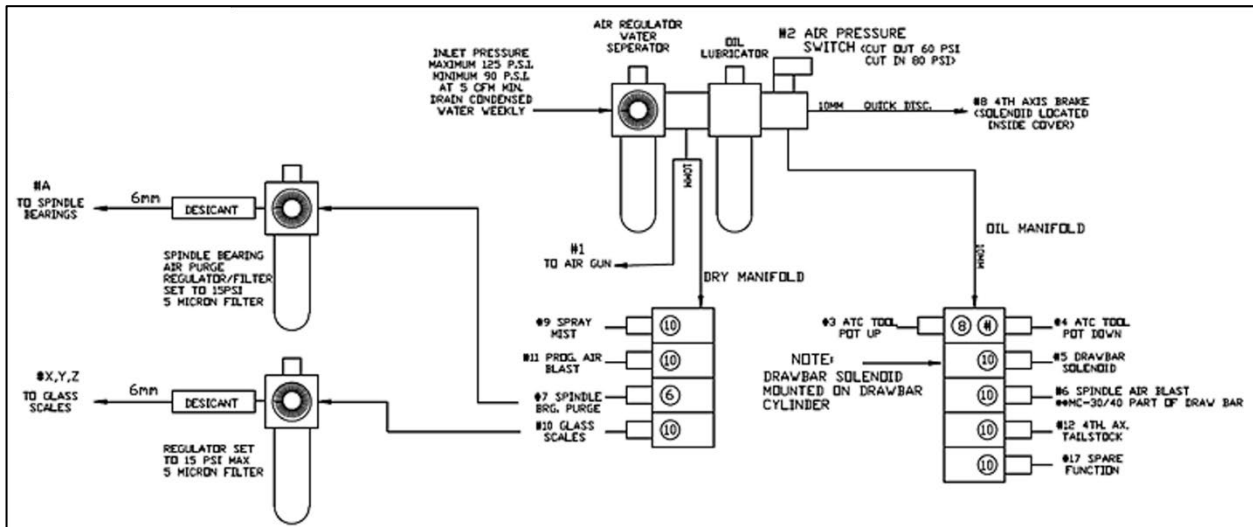
- Lubrication Requirements – Mobil Almo break free synthetic air tool oil 5W-10W or equivalent

- Check Lubrication Interval – Weekly – Add as needed

40 Taper 20-Position, Carousel Style Tool Changer

- Maximum Tool Diameter – 4.10"
- Maximum Tool Diameter with adjacent positions empty – 7.90"
- Maximum Tool Length – 15.00"
- Maximum Tool Weight – 16.5 lbs.

40 Taper 24-Position Arm Style Tool Changer

- Maximum Tool Diameter – 3.2"
- Maximum Tool Diameter with adjacent positions empty – 5.5"
- Maximum Tool Length – 11.8"
- Maximum Tool Weight – 15.4 lbs.
- Tool Change Time: 3 seconds

40 Taper 40 & 60-Position Arm Style Tool Changer

- Maximum Tool Diameter – 3.55"
- Maximum Tool Diameter with adjacent positions empty – 6"
- Maximum Tool Length – 11"
- Maximum Tool Weight – 17.5 lbs.
- Tool Change Time: 3 seconds

50 Taper 24 & 40-Position Arm Style Tool Changer

- Maximum Tool Diameter – 5"
- Maximum Tool Diameter with adjacent positions empty – 8.9"
- Maximum Tool Length – 11.8"
- Maximum Tool Weight – 35.25 lbs.
- Tool Change Time: 4 seconds

3.25 Spindle Information

Thermal expansion of the machine components can jeopardize machining accuracy. To prevent this condition always warm the machine up.

SPINDLE WARM UP – Use the chart below for daily startup

	10 minutes @ 25% of maximum speed
Warm Up Cycle	10 minutes @ 50% of maximum speed
	10 minutes @ 75% of maximum speed

*SPINDLE DUTY RATING – Follow the duty rating outlined below for **6K, 8.5K & 10K RPM Spindles***

- If it is required for the spindle to run continuously (24 hours a day), the spindle must not run above 80% of the maximum RPM.

- If it is required for the spindle to run at maximum RPM, the spindle must not run more than 2 hours straight. After 2 hours of run time at maximum RPM, the spindle must be slowed down to 50% of the maximum RPM for at least 30 minutes before running at the maximum RPM again.

- ***For 12K, 15K & 21K RPM Spindles run at 100% Duty Cycle.***

3.26 Coolant Systems

Flood Coolant - Standard

The standard flood coolant system consists of a submersible flood pump mounted on the coolant tank, generally at the rear of the machine. The flood line runs up the back of the column and through the Z-axis cable track. It splits at a y-fitting in the headstock where it runs to two separate lengths of loc-line. It flows a maximum of 9 GPM.

Coolant Thru Spindle Systems (optional)

- Available for 40 or 50 taper spindles.

- The 350 PSI System has an adjustable range of 100 to 350 PSI. Features full pressure even with tool coolant holes up to .200" diameter.

- The 1,000 PSI System has an adjustable range of 300 to 1,000 PSI. Features full pressure even with tool coolant holes up to .100" diameter.

- Both systems includes high volume 8 gallon / minute pumps and a 10-micron replaceable filter cartridge.

- Machines with this option include a top cover on the machine.

High Pressure Washdown System & Washdown Hose (optional)

- Washdown system consists of one high volume submersible pump. For larger machines, may use two of these pumps.

- On the output of the pump is a T-fitting one line feeds the washdown hose and the other line feeds the washdown nozzles inside the enclosure.

- A ball valve is located between the line that feeds the hose and the line that feeds the nozzles so volume of flow can be adjusted when using both the nozzles and the hose at the same time.

Do not deadhead the pump by shutting off the pump's ability to discharge fluid. Components in the pump can heat to the point that they will severly damage the pump.

3.27 Optional Tool Probe Calibration

Note the Fryer probe will only work with conductive tools.

The following variables are set automatically during complete calibration. It is not necessary for you to preset the values. You can just use this for reference.

NOTE: Variables marked * are distances in the machine co-ordinate system, and not the program cordinate system.

SETTING VARIABLE		INTERNAL VARIABLE
#520	* Z calibration value (non-rotating tools)	#107
#521	* Z calibration value (rotating tools)	#113
#522	Stylus size for diameter setting	#110

Manually set the following:

#523	* X axis stylus centre position	#111
#524	* Y axis stylus centre position	#112

Make sure none of these variables are used in other macros or programs.

Tool Probe Calibration

To test that the probe is functioning properly:

- Move the Z axis to the middle of its travel, at least 6" from the probe.

- Command in MDI the following probe Z axis calibration cycle: G65P9851K1

    The Z axis should move towards the table by the default amount of .56" then move up and display a probe fault.

    If it does not do this check all of the above parameter settings.

    If the probe operates as explained above, then issue the Z axis calibration cycle again.

    As soon as you press cycle start to execute the command deflect the probe. This should cause the Z axis to move up.

    It will then move down again deflect the probe again, it will move up. This means the probe is operating correctly.

- Use a ½" dowel pin in a tool holder (collet) as a master, move dowel to top of table, record machine Z-axis position. This will be used as K in the probe calibration cycle.

- Now move dowel above and centered over tool probe. It must be less than .500 inch above probe.

    -Run this probe length calibration cycle: G65P9851K_____ (K is the Z value you obtained above). This will set the Z probe calibration value. Refer to Renishaw manual for more details.

- In order to test the operation of the probe, first set the approximate tool length offset in the offset table. (The tool length is the distance from the tip of the tool at Z home position to the tabletop.)

- Use a tape measure to set this within an 1/8".

- An MDI or a Program can be used to set tool length offsets.

    In the example below we are using H1 and T1.

    G65P9853B1T1;

    The B1 means only set length offset, the T1 will use tool 1 offset and set it correctly.

- In order to activate the tool offset, set the machine to incremental mode G91 in MDI. Then G91G43H2Z0 will cause the offset for tool 2 to be active and the machine to move Z incrementally 0". If you handwheel the Z axis the tabletop should read 0". Anything above the table will be a positive value.

- Now you can put in the distance from the top of the part to the table a fixture offset in Z, this must be typed into the Z fixture offset you plan on using in your program.

- Now you will have all your offsets set correctly.

3.28 Optional Part Probe Calibration

1. Macro 9810 is a protected probe move; this should be used whenever the probe is in the spindle to position it. Here is a program example to test probe operation: Bring the probe alongside a piece of steel on the table, about ¼" away. Do the following in MDI to test the p[protected move works: Note the x position must be beyond the obstruction.

   G91 G65 P9810 X-1 F10

2. Once the probe starts to move towards the table, deflect the probe and the axis should stop moving. An alarm should be generated stating 3086 path obstructed. This will test the function of the probe.

3. Now the ring gage should be mounted to the table and indicated in to find the center, and a fixture offset should be set for the exact center location (use G54). Set a tool offset and radius for the probe.

4. Calibrating the Stylus X and Y offset (9802)

   O0402(PROBE STYLUS CAL)
   G20G40G80G90
   G1F50G43H2Z5.0
   G55
   G0X0Y0
   G65P9810Z-.25F20
   G65P9802D2
   G65P9810Z2F20
   M30

5. Calibrating the vector stylus ball radius (9804)

   O0403(PROBE BALL CAL)
   G20G40G80G90
   G1F50G43H2Z5.0
   G55
   G1F200X0Y0
   G65P9810Z-.25F20
   G65P9804D2
   G65P9810Z2F20
   M30

6. Program to test to make sure probe can set a G55 at center of ring gauge:

   G65 P9814D2S2

   This will calibrate fixture offset #2 G55 in a 2" bore.

3.3 BASIC MACHINE PROCEDURES

3.31 FANUC Machine Reference Procedure after Absolute Encoder Alarm

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure must be followed after the encoder is disconnected or battery for the absolute encoder goes dead or if parameters are reloaded.

The machine normally remembers the position of the table due to the absolute encoder tracking. If this is lost the machine home position is also lost. Each axis should be positioned at the home position and the alignment marks lined up. The home position is always within an inch of the positive travel of each axis. The alignment marks are red or black painted button head screw that is marked as the home position marker and align it with scribed line or pointer on the axis to be set.

Follow the procedure below to reset this home position.

Referencing the axis: The X, Y and Z-axis have battery backed up encoder's, (absolute encoders). The control will give advance notice of a weak battery so it can be changed before position loss occurs. If the encoder is disconnected an error will occur, you will have to reference the axis follow this procedure:

To change parameter, write enable must be in MDI (push MDI hard key).

1. Press-offset setting-parameter-write enable (OFS/SET hard key twice) set parameter bit to a 1. The "key" needs to be switched to the [0] position, the key cannot be removed, this enables the write capability.

2. Press system (hard key)- type 1815 -press -no. Search (this will find parameter 1815 which is the reference position parameter setting- set APZ bits for axis wishing to reference to 0. If you already have an alarm about lost encoder position the troubled axis will have a zero set in this bit, you can go to step 4.

3. Power down completely.

4. Power up, drives on and jog the axis requiring referencing to align with scribe marks on red painted washer. Be very careful you do not crash the machine!

5. Change 1815 APZ bit to 1 for axis wishing to reference. Change the parameter write enable bit to 0

6. Power down completely.

7. Power up, drives on, the axis display should read 0 and there should be no alarms.

3.32 Check Axis Backlash

Tools Required: 0.0001" resolution dial indicator, remote handwheel (manual pulse generator)

- Set the indicator along the axis which is being measured. The needle should be in contact with a flat machined surface and the base on a stable, fixed point. See the pictures below which illustrate the setup for the X, Y, and Z axes.

- Using the remote handwheel, move the axis in one direction either positive or negative until the indicator is loaded by 0.002".

- Zero the indicator.

- Move the axis in the same direction by 0.005".

- Reverse the direction of the axis by 0.005".

- The additional amount that is needed to reach zero after the 0.005" reverse in direction is the backlash measured.

- This shows the loss of motion in the axis from the ballscrew and linear guide rails. Backlash compensation can be adjusted according to the procedure outlined below in *Section 3.33*.

X-Axis	Y-Axis	Z-Axis

3.33 Adjusting Backlash Compensation

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY
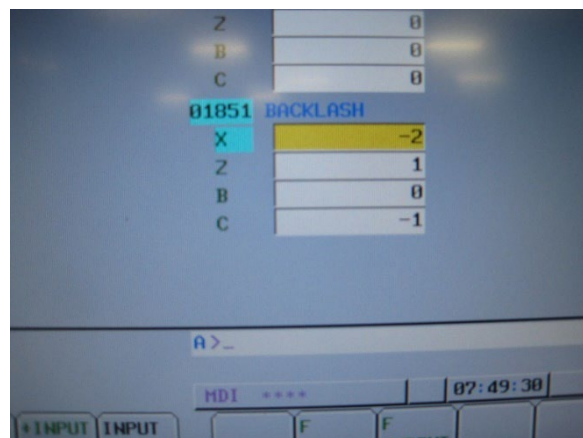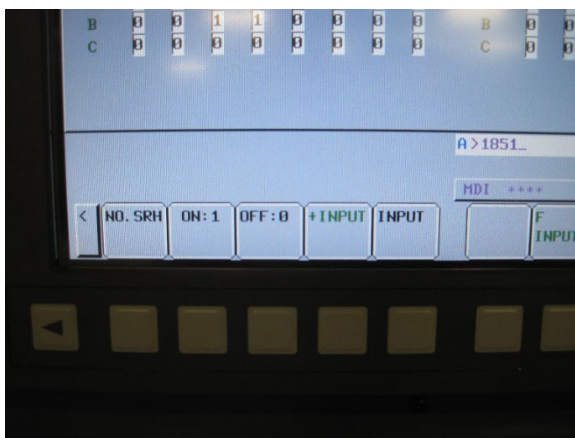
3.34   Working With Waycovers

- When working with steel waycovers, several precautions must be taken:

- Do not put excessive weight on the waycovers (50lbs. max.)

- Protective gloves should be worn while handling waycovers, as the metal edges can be sharp.

- Covers should be cleaned regularly to avoid any build-up of chips or debris. It is recommended that the underside of the covers be thoroughly cleaned at least every 6 months.

To remove the waycovers for service:

- Jog the axis being worked on so that the cover to be removed is in the fully compressed position.

- Next, remove the cap head screws attaching the cover to the moving axis and to the waycover standoff (if applicable).

- The waycover can now be removed by simply pulling it off the way surface.

To check waycovers for wear and/or damage:

- Make sure the covers slide open and closed freely and that there are no dents or visible damage that would impair free movement of the covers.

- Inspect the plastic sliders and rubber bumpers under the waycover to make sure they are in place and not damaged or worn.

To reinstall the waycovers on the machine:

- Slide the cover on the appropriate way surface making sure that it is clear of debris.

- Insert the cap head screws to the moving axis and the standoffs (if applicable) and **hand tighten only**.

- To properly align the waycover, jog the axis to the position where the waycover is in full extension, and then full compression.

- With the waycover fully compressed, all cap head screws can now be tightened.

- Run the axis back and forth slowing over full travel check for any visual signs of misalignment.

- Now rapid the axis back and forth over full travel again check for any signs of misalignment.

3.35 Check / Adjusting Ballscrew Endplay

* It is important to read and understand the procedure *3.34 Working with Waycovers*, before executing this procedure.

- Tools Required: 0.0001" resolution dial indicator, remote handwheel (manual pulse generator), metric allen key set, spanner wrench.

- Check Endplay: You will need to access the pulley end of the ballscrew for the axis being worked on. To do this, remove the left side waycover and the belt cover for the X-axis. Remove the front waycover and belt cover for the Y-axis. The top end of the z-axis ballscrew is accessible by just moving the head down. Place a dial indicator needle on the end of the ballscrew. Load and zero the indicator appropriately. Using the remote handwheel set to x100 for the appropriate axis, change axis direction back and forth and observe any axial motion shown on the indicator. Endplay should be no more than .0001". This can also be accomplished by jogging each axis using the manual panel buttons or manually by using an allen wrench on the end of the ballscrew.

- Adjusting Endplay: If ballscrew endplay is greater than 0.0001", it must be adjusted. To do so, loosen the 3 set screws on the ballscrew spanner nut adjacent to the motor coupling. Using a spanner wrench, tighten the nut. The ballscrew will have to be held stationary with an allen key on the opposite end. Tighten the set screws and recheck the endplay. Repeat the tightening procedure if necessary. Once the ballscrew endplay is .0001" or less, re-install any sheet metal or motor covers and re-install the waycover(s) as applicable.

3.36 Check Axis Motor Belts

- The axis motors are connected to the ballscrews via pulley driven belts. Belts should be checked for excessive wear and proper tension at least every 6 months.

- To access the belts, remove left side belt cover for the X-axis and the front belt cover for the Y-axis.

- The Z-axis belt is located on the top of the column

- Once you have gained access to the belts, inspect them for any visible signs or wear or damage. Once the belts are considered acceptable, check each belt for proper tension.

- Belt tension is adjusted by loosening the slotted motor plate and sliding the motor-plate assembly to tighten or loosen the belt as required. Double check all hardware is properly tightened once the belt tension is correct.

- After the inspection is complete and any adjustments made, re-install the belt covers.
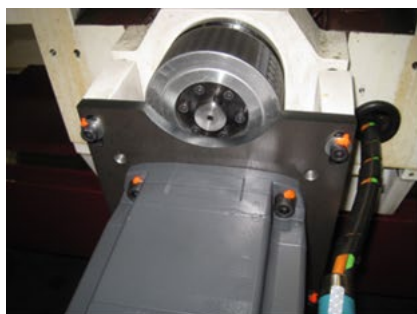
X-AXIS

Y-AXIS
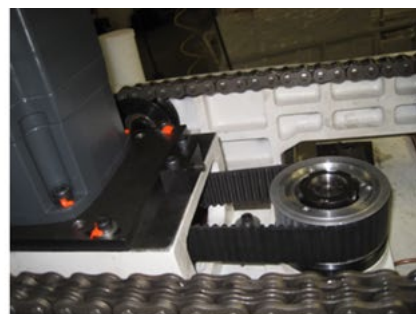
Z-AXIS

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

> ⚠ **WARNING**
>
> **Malfunctions of the machine as a result of incorrect or changed parameter settings**
>
> As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.
>
> - Protect the parameterization (parameter assignments) against unauthorized access.
> - Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

Setting Parameter Write Enable (PWE)

- Make sure drives are enabled (E-stop out)

- Press MDI

- Press "OFF/SET" hard key

- Press "setting" soft key (may have to press "+" softkey to see the soft key button)

- See below screen will appear:

- Change Parameter write =1 (this should be changed back 0 to prevent parameter changes)
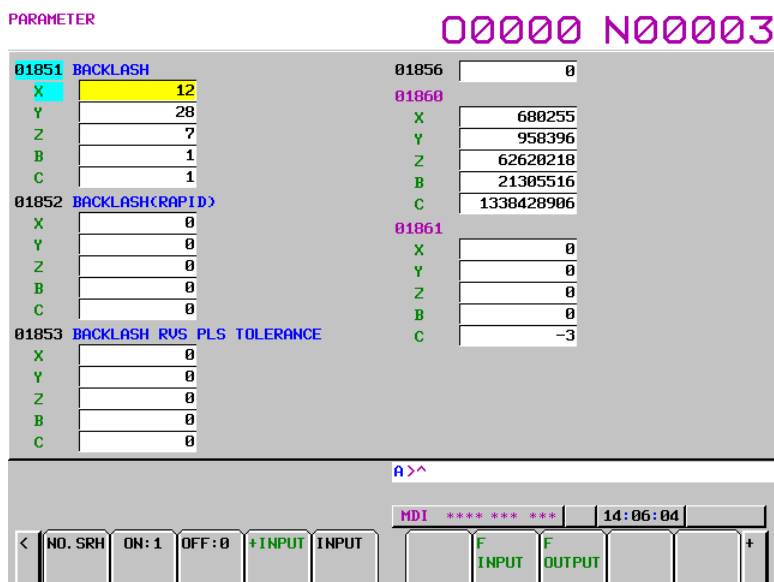
- Getting to the machine parameters
- Press "SYSTEM" Hard key
- Press "+" soft key until "parameter" soft key is visible.
- Press "parameter" soft key
- Press "oprt" soft key
- Type in desired parameter number
- Press "No. SRCH" soft key

- See below screen shot where parameter 1815 is displayed. Cursor can be moved about, and data changed with numeric keys and input button.


```
PARAMETER                               O0000 N00003

01851 BACKLASH              01856          0
    X          12           01860
    Y          28               X      680255
    Z           7               Y      958396
    B           1               Z    62620218
    C           1               B    21305516
01852 BACKLASH(RAPID)            C  1338428906
    X           0           01861
    Y           0               X          0
    Z           0               Y          0
    B           0               Z          0
    C           0               B          0
01853 BACKLASH RVS PLS TOLERANCE C         -3
    X           0
    Y           0
    Z           0
    B           0
    C           0

                              A>^

                              MDI  **** *** ***    14:06:04

< NO.SRH  ON:1  OFF:0  +INPUT  INPUT      F      F              +
                                          INPUT  OUTPUT
```
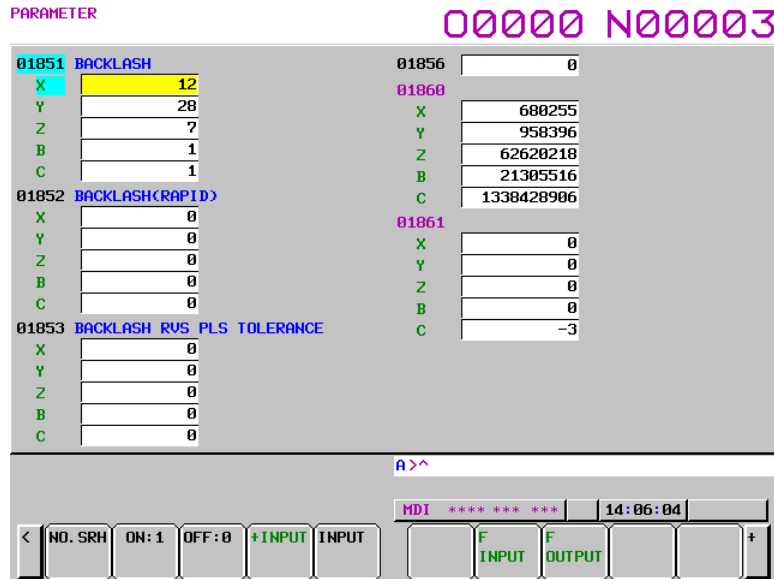
4.02 Parameter Write Enable + USB

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure will allow editing and copying machine parameters from the USB stick.

Setting Parameter Write Enable (PWE) and USB stick for I/O

1. Make sure drives are enabled (E-stop out)
2. Press MDI
3. Press "OFF/SET" hard key
4. Press "setting" soft key (may have to press + softkey to see the soft key button)
5. See below screen will appear:
6. Change Parameter write =1
7. Change I/O Channel =17 Make a note if there is a different value in there as this how the programs are put into the control could be RS-232, Network, USB, or PCMCIA.

4.03 Saving Parameters to USB

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure will allow the parameter file to be saved a USB stick.

**Before these procedures can be performed make sure Parameter write enable is on and the I/O channel is set to the USB (see *4.02 Parameter Write Enable + USB*)

Saving Parameters

1. Reset drives
2. Position machine to machine zero (all axis)
3. Insert USB stick
4. Press edit

5. Press system

6. Press "parameter" soft key

7. Press "oprt" soft key

8. Press "+" soft key

9. Press "F output" soft key

10. -press "exec" soft key (output should be flashing on lower right corner of screen)

Now you will have a file called "CNC-PARA.TXT" you should rename this on a pc to another name for future use. **Do not overwrite an existing file on the memory card.**

4.04 Loading Parameters From USB

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure will allow the parameter file to be loaded from a USB stick.

**Before these procedures can be performed make sure Parameter write enable is on and the I/O channel is set to the USB (see *4.72 Parameter Write Enable + USB*)

Reloading Parameters

1. Make sure all axes are at machine zero

2. Press EDIT

3. Press system

4. Press "parameter" soft key

5. Press "oprt" soft key

6. Press "+" soft key

7. Press "F input" soft key

8. Press "exec" soft key (input will flash in lower right-hand corner of screen)

9. Power down including main disconnect wait 1 minute before powering up again.

Once the drives are turned on you may have to zero return the machine, make sure all axes are at machine zero then change parameter **1815 APZ bit=1 for all axes**.

This can be done with the following keystrokes:

-param-1815-no.srh, this will get you to edit the correct parameter. Use the arrow keys and the 1 soft key to set the proper bit.

4.05 FANUC PLC Installation Procedures USB

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure will explain how to save the current PLC and install a newer version with a USB stick If the new PLC is sent to you by e-mail note the name of the file and put on the USB stick.

Important Notes: Make sure your program protect key is off. Make sure your i/o channel=17 to be able to use the USB stick (see screen below, it is set to a 4). If you have the smaller screen, the right arrow may have to be pressed to see the rest of the soft keys available.

4.06 Saving Current PLC

1. Move the machine to machine zero in all axes. And set the MDI mode

2. Press the E-stop button in

3. Confirm that parameter write enable is on:

    a. Press "offset/setting" hard key several times (this will scroll you through menus) until you find parameter write enable

    b. Set this to a 1 to allow editing parameters, use soft keys.

Below is the Setting Screen:
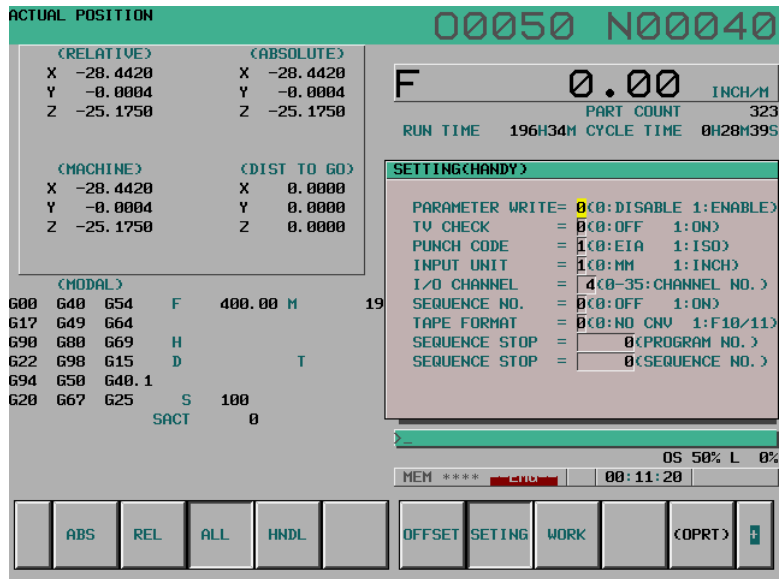
4. Press "system" hard key.

5. Press "+" soft key on the bottom of the screen which is the > arrow key below it. Until you see the softkey "pmc config"

6. Press "Pmc config" soft key.
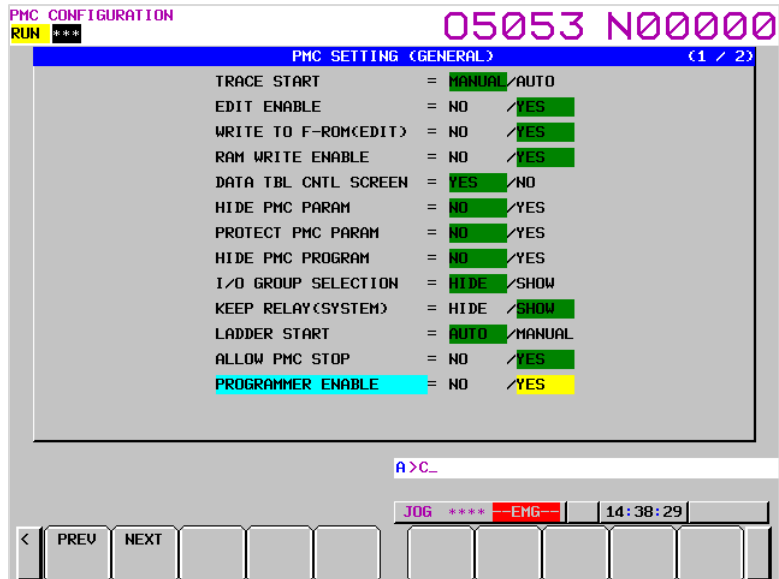
7. Press "Setting" softkey. The following screen is what you will have to change in the next step:

8. The yellow square is the cursor, navigate using the arrow keys on the keyboard to replicate your screen as above.

9. Once the above parameters are set use the left arrow soft key"<" to go back to the PMC soft key menu.(May have to press two times to see the "PMC mainte" soft key)

10. Press "PMC mainte" soft key
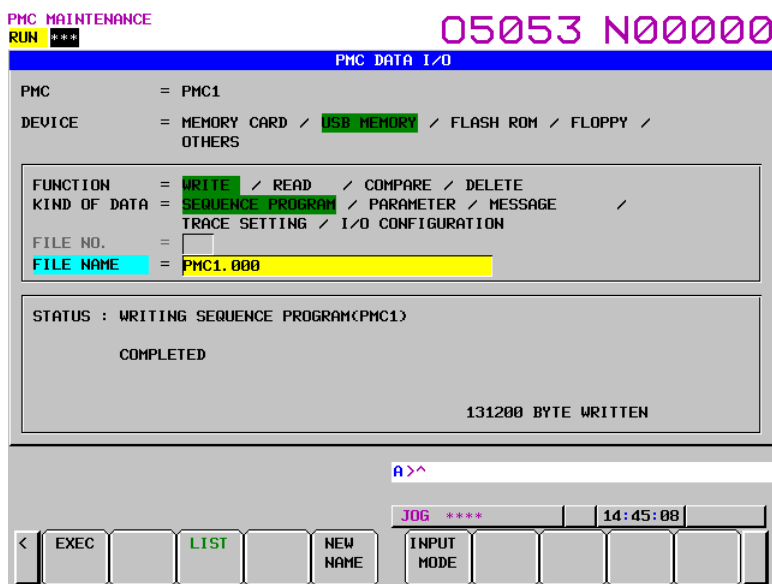
11. Press the + ">" softkey until you see the "I/O" softkey and press it. The screen below will be displayed.

```
PMC MAINTENANCE
RUN ***                                    05053 N00000
                        PMC DATA I/O
PMC           = PMC1

DEVICE        = MEMORY CARD / USB MEMORY / FLASH ROM / FLOPPY /
                OTHERS

  FUNCTION    = WRITE  / READ   / COMPARE / DELETE
  KIND OF DATA = SEQUENCE PROGRAM / PARAMETER / MESSAGE       /
                 TRACE SETTING / I/O CONFIGURATION
  FILE NO.    = 
  FILE NAME   = 

  STATUS : USB MEMORY => PMC




                              A>^

                              JOG  **** --EMG--     14:42:09
                        STATUS  I/O   PMC   I/O  <OPRT> +
                                DEVICE ALARM
```
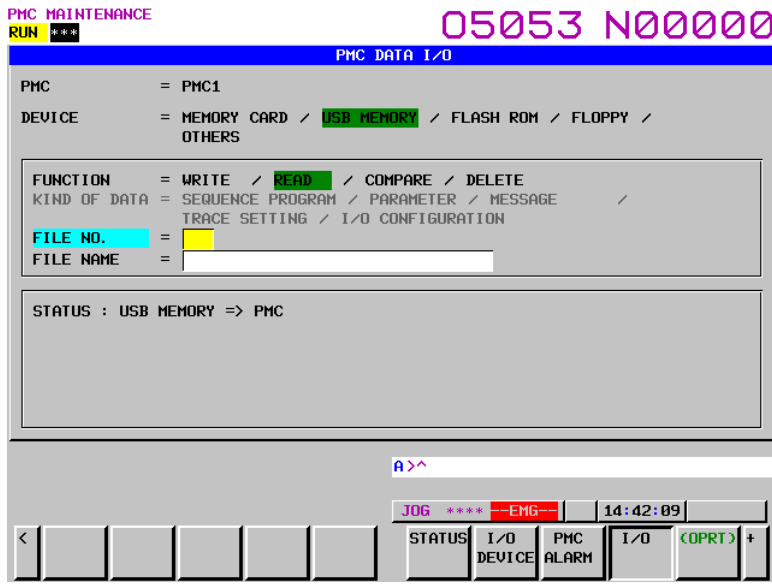
4.07 Saving the Existing PLC

1. Insert USB stick(must have new version of PLC on this card)

2. Make sure the following is set correctly on the screen. The values can be changed by scrolling to highlighted field with the arrow keys

   a. Device: USB Memory

   b. Function = Write

   c. Kind of Data = Sequence Program

3. Cursor down to File No. and press softkey "oprt"

   4. Press soft key "new name" This will enter a file name for the existing PLC loaded into your machine. It will back up your old ladder onto the USB stick in the next step. You can use this if the new PLC does not work.

```
PMC MAINTENANCE
RUN ***                                    05053 N00000
                        PMC DATA I/O
PMC           = PMC1

DEVICE        = MEMORY CARD / USB MEMORY / FLASH ROM / FLOPPY /
                OTHERS

  FUNCTION    = WRITE  / READ   / COMPARE / DELETE
  KIND OF DATA = SEQUENCE PROGRAM / PARAMETER / MESSAGE       /
                 TRACE SETTING / I/O CONFIGURATION
  FILE NO.    = 
  FILE NAME   = PMC1.000

  STATUS : WRITING SEQUENCE PROGRAM(PMC1)

            COMPLETED


                              131200 BYTE WRITTEN


                              A>^

                              JOG  ****           14:45:08
        EXEC      LIST      NEW    INPUT
                            NAME   MODE
```

5. Press "exec" soft key This will output the PLC to the USB stick make a note of the filename.

26

1. When the cursor (yellow box) is to the right of File name= Press softkey "list"

2. Scroll and highlight new PLC on USB stick press softkey "input"

3. Move the highlighted cursor to set the following fields

    a. Device: USB Memory

    b. Function = Read

    c. Kind of Data = Sequence Program

    d. File Name= "new plc e-mailed to you'

4. Press "exec" soft key, this will load the new plc into the machine.

5. Now use the arrow keys to highlight the following fields:

    a. Device: Flash ROM

    b. Function = Write

    c. Kind of Data = Sequence Program

6. Press "exec" soft key

7. Now we must turn off the parameters that were enabled to load the new PLC.

8. Press "<" soft key, twice until you see the softkey "pmc config"

9. Press "pmc config" softkey.

10. Press the "setting" soft key, use the cursor keys to reset the fields back to "no" as in the screen shot #2

11. Confirm that parameter write enable is off:

    a. Press "offset/setting" hard key several times (this will scroll you through menus) until you find parameter write enable

    b. Set this to a 0 to not allow editing parameters, use soft keys.

12. Re-boot control, you are done. Make sure to save the new PLC in a safe place in case you have to reload it to the machine.

4.09 M-Codes

An M code in CNC programming controls miscellaneous machine functions, including starting and stopping specific actions or programs.

M00	PROGRAM STOP
M01	OPTIONAL PROGRAM STOP
M02	END OF PROGRAM
M03	SPINDLE CLOCKWISE
M04	SPINDLE COUNTERCLOCKWISE
M05	SPINDLE STOP
M06	TOOL CHANGE REQUESTED
M07	MIST COOLANT OUTPUT OR PROGRAMMABLE AIR BLAST
M08	FLOOD COOLANT (SPINDLE MAY HAVE TO BE ON)
M09	COOLANT (M7,M8 COOLANT OFF)
M10	INDEXER CYCLE START WAIT FOR COMPLETION
M11/M12	MISC. MCODE ON/OFF
M17	HIGH PRESSURE THRU SPINDLE COOLANT ON
M18	HIGH PRESSURE THRU SPINDLE COOLANT OFF
M19	SPINDLE ORIENT
M20	CHIP AUGER ON (CHIP WASHDOWN. PRIME PUMP FIRST)
M21	CHIP AUGER REVERSE
M22	CHIP AUGER OFF
M23/M24	2ND PROGRAMMABLE AIRBLAST ON/OFF
M40	SHIFT GEARBOX INTO LOW RANGE
M41	SHIFT GEARBOX INTO HIGH RANGE
M50	DISABLE SPINDLE DRIVE FOR INDICATING PURPOSES
M51	ENABLE SPINDLE DRIVE FOR OPERATION
M52	ATC CAROUSEL IN (ARM ATC POT DOWN)
M53	ATC CAROUSEL OUT (ARM ATC POT UP)
M54	DRAWBAR ON
M55	DRAWBAR OFF
M58	ATC CAROUSEL CW 1 POSITION
M59	ATC CAROUSEL CCW 1 POSITION
M61	HOME ATC CAROUSEL TO POCKET 1, ASUMES TOOL 0 IN SPINDLE
M62	ARM ATC GRAB TOOL(ON ELECTRIC ATC ALSO SWAPS TOOLS AND GOES UP)
M63	ARM ATC ARM ORIGIN
M64	PNEUMATIC ARM ATC ARM DOWN AND SWAP TOOLS
M65	PNEUMATIC ARM ATC ARM UP

Note: M-codes may change depending on options the machine is equipped with.

4.10 Alarms

An alarm will be displayed once a fault occurs.

> **! Warning**: If you do not heed an alarm that is issued and do not resolve the cause of the alarm, it can present a hazard to the machine, the work piece, the saved settings, and in certain circumstances, may cause injury.

4.11 FRYER PLC Alarms and Descriptions

These are **FRYER** Machine specific alarms that are for optional equipment installed on the machine. The alarms are listed below:

NO.	ADDRESS		MESSAGE
0.0009	A001.0	1001	LOW WAY LUBE
0.0010	A001.1	1002	LOW AIR PRESSURE
0.0011	A001.2	2001	ATC HOME REMOVE TOOL FROM SPINDLE
0.0012	A001.3	2002	TOOL NUMBER [I220, D110] IS IN SPINDLE
0.0013	A001.4	1003	ERROR TOOL CODE NOT ALLOWED
0.0014	A001.5	1005	SPINDLE CHILLER ALARM
0.0015	A001.6	1006	HIGH PRESS. COOLANT FAULT
0.0016	A001.7	1007	GEARSHIFT FAULT
0.0017	A002.0	1008	OUT OF GEAR FAULT
0.0018	A002.1	1009	ATC ARM OUT OF POS 1010PROBE FAULT
0.0019	A002.2	1010	PROBE FAULT
0.0020	A002.3	1011	ATC CAR. MISCOUNT-DO M61! ! ! !
0.0021	A002.4	1012	ATC E-STOP ALARM-CHK TOOLS
0.0022	A002.5	1013	ATC ABORTED BY RESET-CHK TOOLS
0.0023	A002.6	1014	DOOR INTERLOCK OPEN
0.0024	A002.7	1015	PROBE BATTERY LOW
0.0025	A003.0	1016	DOOR CLOSE OBSTRUCTION-TIMED OUT
0.0026	A003.1	2001	WAY LUBE PRESSURE FAULT

4.12 Clearing an Alarm

1. Press **RESET**
2. Certain alarms will require a reboot of the control to clear.

4.63 Set Up the Network Drive in the FANUC

> **! NOTE:** *It is recommended that this procedure be performed by an experienced network administrator.*

The transfer of programs can be achieved by mapping a soft- key to a networked computer.

5.1 - CAROUSEL STYLE ATC OPERATION

5.2 Safety Rules -- READ BEFORE OPERATING CAROUSEL ATC

CAUTION! Always follow all Lock Out Tag Out procedures before performing any maintenance

- Due to the complexity and timing of the ATC, it should only be operated with the **M6** command.
- ***Never interrupt the tool changer in the middle of cycle, wait for it to complete the tool change***.
- The carousel motor is a 3-phase motor and must be phased correctly for proper direction. The machine is phased properly at the factory before shipment, so if the carousel rotates in the wrong direction, switch any two incoming power wires at the disconnect. ***Make sure the main power breaker is off!***
- **M58** moves carousel position CW one position, **M59** moves carousel position CCW one position.
- If the T code is programmed on the same line as the M6 command, make sure the M6 is before the T code (example: M6T4).

5.3 Manual Operation of the Carousel Tool Changer

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY
The following is the process to manually step through the tool change operation in **MDI**.

> **NOTE*: Make sure you follow these steps in sequence to prevent damage to the ATC or machine.***

The proper sequence of a tool change and the respective M-codes are as follows:

1. T-code executes to move carousel to pending tool.
2. **M19** orient, and **G0Z&P#1130**, move z axis to tool change position.(Fanuc uses G91 G30 Z0, to move z axis to tool change position)
3. **M52** – Tool change carousel in position.
4. **M54 -** Drawbar open to unclamp tool.
5. **M55** Drawbar close to clamp tool in spindle.
6. **M53** Tool change carousel out position.

5.4 - ARM STYLE ATC OPERATION

5.5 Safety Rules -- READ BEFORE OPERATING ARM STYLE ATC

CAUTION! Always follow all Lock Out Tag Out procedures before performing any maintenance

- Due to the complexity and timing of the ATC, it should only be operated with the **M6** command.
- ***Never interrupt the tool changer in the middle of cycle, wait for it to complete the tool change.*** If a low air alarm sets and the tool gets stuck in the spindle, then go to the ***Recovering from Tool Change Failure*** section of this document.
- This is a random-access tool changer to reduce tool change time. The machine will always keep track of the correct tool even though it may not agree with the bin #.
- **M58** moves carousel position CW one position, **M59** moves carousel position CCW one position.
- If the T code is programmed on the same line as the M6 command, make sure the M6 is before the T code (example: M6T4).
- Most tools have a deeper notch on one side of the tools v-flange. The ATC carousel will only allow this deeper notch to fit into the carousel key. Make sure when installing tools in spindle this orientation is verified.

  After spindle orientation the key slot on the v-flange of the tool furthest from the operator will align with the key on the carousel.

5.6 Manual Operation of the Arm Style Tool Changer

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

The following is the process to manually step through the tool change operation in MDI.

> **NOTE***: Make sure you follow these steps in sequence to prevent damage to the ATC or machine.*

Manual operation of tool change solenoid valves

If the tool changer gets hung up the solenoid valves can be operated manually to reset the tool changer.

Access the air solenoid valves for the tool changer behind the door on the front of the ATC.

There is a diagram of the operation of each solenoid. These can be run manually by depressing the blue manual override buttons.

Here is a description of the operation of the valves.

Make sure you push the buttons in sequence otherwise damage could be done to the ATC.

- There are three two-way solenoid valves mounted horizontally.
- The top solenoid valve controls the carousel tool pot; left button returns tool pot to up position; right button drops pot down.
- The middle solenoid controls the arm movement 60° under the spindle and to normal rest position. The right button moves the arm under the spindle nose to grab a tool, left button moves the arm back to its normal clearance position.
- The bottom solenoid controls the arm down and 180° and arm up. The right button moves the arm down and then 180°, the left button returns the arm up.

The proper sequence of a tool change and the respective M-codes is as follows:

T-code to move carousel to pending tool

1. **M52** tool pot down
2. **M19** orient, and **G0Z&P#1130**, move z axis to tool change position.(Fanuc uses G91 G30 Z0, to move z axis to tool change position)
3. **M62** Arm moves under spindle to grab tool and carousel pot
4. **M54** turns drawbar on
5. **M64** Arm removes tool from spindle and carousel tool pot and swaps them
6. **M65** Arm up to install pending tool in spindle and old tool into carousel pot.
7. **M55** Drawbar off to grab tool in spindle.
8. **M63** Arm origin
9. **M53** carousel tool pot up

5.7 Setting Tool Change Height

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

The proper tool change height must be set for the ATC to perform correctly. The tool change height (machine coordinates from home position) is stored in parameter MC_1130 in the machine setup (Fanuc parameter P1241).

This will have to be checked if the home position is different due to removing the z motor or home switch or dog. Here is a procedure to set this height correctly: There is some allowance (play) allowed for the tool change height (about .03") This is the difference between the v flange groove of the tool and the v location of the arm. You will see this vertical play if you install a tool into the arm when the machine is in e-stop. **Make sure you do not leave the tool there!**

1. Home the machine.
2. Move the Z-axis to the tool change height specified in parameter MC_1130 (Fanuc parameter P1241). In the Fanuc Oi-M push "System" hard key several times until one of the soft keys at the bottom says "Parameter", enter soft key and go to "Parameter (co-ordinates) enter. Type in 1241 and enter, to go to P1241- Tool Change Height is in the Z- Reference Point #2 (typically -6XXXX) negative number always.

The number is derived from the distance from home position (machine zero) to the proper height for tool change.

3. That number is in MM (millimeters) and is a negative value. Change display to read in MM to get a direct read out in the Machine Coordinates box in Z =(ex. -62.408 MM) drop the decimal point when entering the new number. Enter -62408 for this example. Make sure you are in MDI and the key is switched to [0] to enable changes.

4. Orient the spindle with an M19 command.

5. Install a tool in the spindle.

6. Press the middle right solenoid manual button to grab the tool, see the description of manual solenoid operation.

7. Using the hand wheel at its finest setting or jog .001" increments move the Z axis, so the v flange groove of the tool is in the center of the arm v notch. Be careful not to put stress on the ATC arm. This is "play" as described above. This is the correct Z axis tool change position, record the machine coordinate value and retain for entry into parameter MC_1130 (step 8).

8. Press the middle left solenoid manual button to remove the arm from the tool in the spindle. At this time, you can alternate the middle left and middle right button to check for smooth engagement of the arm into and away from the tool. If the arm doesn't respond smoothly then further Z axis height adjustment may be required.

9. Remove tool from spindle. Update parameter MC_1130 (Fanuc parameter P1241) with the new tool change height as described in step 2 above.

5.8 Recovering from a Tool Change Failure

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

- If the tool changer fails you may get an alarm "timeout in spindle sequence", this means that after 30 seconds of waiting a function did not get its proper finish signal.

- You must look to see what function did not complete. It most likely had to do with movement of the arm.

- Look at the solenoid valves, the solenoid valve that is illuminated is the operation that failed.

- Press emergency stop.

- If the arm did not complete grabbing the tool, make sure the pot is down and then press the arm return manual button. Refer to manual operation of tool changer pneumatic solenoid valves.

- After the arm is returned to normal resting position, tool is removed from the spindle and carousel pot returned manually, the carousel pots may have to be reset.

- If the carousel does not rotate check the fuses in the electrical cabinet. Refer to electrical schematics in maintenance manual.

5.9 ATC Carousel Home Position and Tool Bin# Reset

To reset all of the tool bin locations, follow this procedure:
- Remove tool from spindle
- In MDI command M6T0, press cycle start
- Remove any tool in spindle
- In MDI command M61, cycle start (this will cause the carousel to index to bin#1)
- Press system hard key
- PMC soft key
- Params soft key
- Data soft key
- Dtble soft key

- The data table bins 0-24 or the number of carousel positions will have to agree with the proper tool numbers. Make sure there are no duplicates included the number 0
- Remove all tools from the spindle

5.10 Spindle Orient Adjustment

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

This procedure will outline how to adjust the spindle orient position when an **M19** is commanded to perform a tool change. Read all instructions carefully and do not skip steps.

1. With Z axis at maximum positive limit and ATC arm under spindle nose (manual solenoid button 2nd on right). Make sure spindle can be spun without spindle keys hitting ATC arm.

2. Orient spindle with M19.

3. Look to see if spindle keys are in alignment with notch in the arm. Command M5 cycle start. This will turn off the orient command. Fanuc machines you will have to change the orient position parameter P4031.

4. Repeat steps 2 and 3 and change P4031.

5.11 Arm Alignment

PROCEDURE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY

If the arm no longer moves in the proper angular alignment an adjustment may be required. The arm is held in place on the arm shaft with a compression clamp. In order to adjust this, follow this procedure:

1. Install tool in spindle

2. Orient spindle **M19**

3. Install tool in carousel pot

4. Drop carousel pot down with manual button(top right)

5. Move Z axis to tool change height

6. Move arm to grab tools with manual button.(middle right)

7. Loosen socket head cap screws at bottom center of arm and align arm to grab tools fully. Once completed adjustment tighten screws.

8. Move arm back to origin location with manual button (middle left)

9. Remove tools

10. Reset carousel pot back up with manual button. (top left)

11. Turn off orient with **M5** command

A Gradient Structure Motor 1
B Sensor Switch 2
C Sensor Switch 3
F Tool Change Structure Motor 6
D Reed Sensor 4
Reed Sensor 5
G Sensor Switch 7
H Sensor Switch 8
I Sensor Switch 9
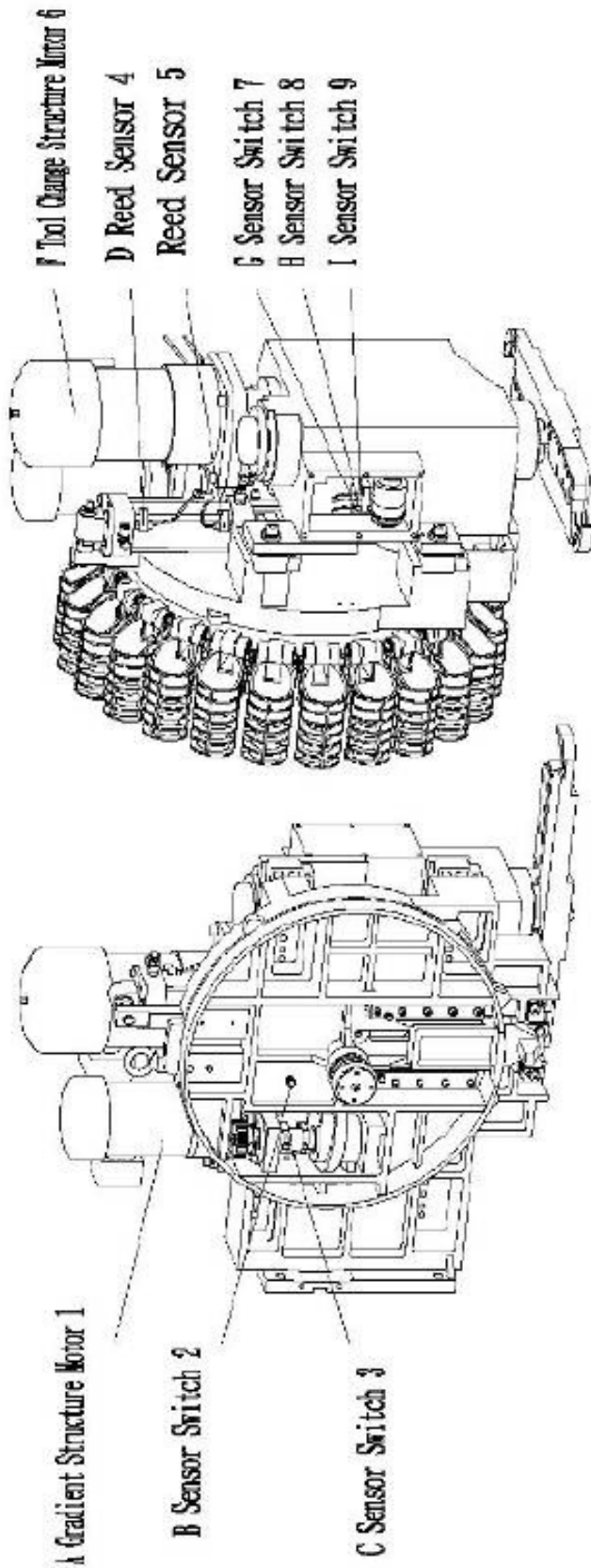
NO	CONTROL ELEMENT	FUNCTION	SPECIFICATION DISK TYPE 40-24DV	QTY	REMARK
A	Gradient Structure Motor 1	Control tool disk position reverse turn	1/4HP*4P	1	3Ø220V/60Hz
B	Proximity Sensor 2	Tool change structure origin point number one tool signal	Balluff PS(24)F-iSV00-002	1	Ø12 DC24V(PNP)
C	Sensor Switch 3	Stop signal of disk gradient motor	Balluff PS(24)F-iSV00-002	1	Ø12 DC24V(PNP)
D	Reed Sensor 4	Positioning signal of tool dropping (contracting of cylinder)	LSD-B2	1	DC24V
E	Reed Sensor 5	Positioning signal of tool receeding (protruding of cylinder)	LSD-B2	1	DC24V
F	Tool Change Structure Motor 6	Tool change structure power source	3/4 HP*4P	1	3Ø220V/60Hz
G	Proximity Sensor 7	Stop signal of motor (tool change)	OMRON E2E-CF8B1	1	Ø4 DC24V(PNP NO)
H	Proximity Sensor 8	Tool clamp signal (tool change)	OMRON E2E-CF8B1	1	Ø4 DC24V(PNP NO)
I	Proximity Sensor 9	Origin point confirmation signal (tool change)	OMRON E2E-CF8B1	1	Ø4 DC24V(PNP NO)

Signal form machine (columns 1–16)

Action	Signal	State
Cylinder Action / Gradient Motor	Motor Action 1	ON / OFF
	Sensor Switch Signal 3	ON / OFF
Sensor Switch	Reed Sensor Signal 5	ON / OFF
	Reed sensor Signal 4	ON / OFF
ATC Action	ATC Motor Action	ON / OFF
	Home Confirmation 9	ON / OFF
	Tool Clamp Signal 8	ON / OFF
	Motor Stop Signal 7	ON / OFF
	Feed back signal to machine	
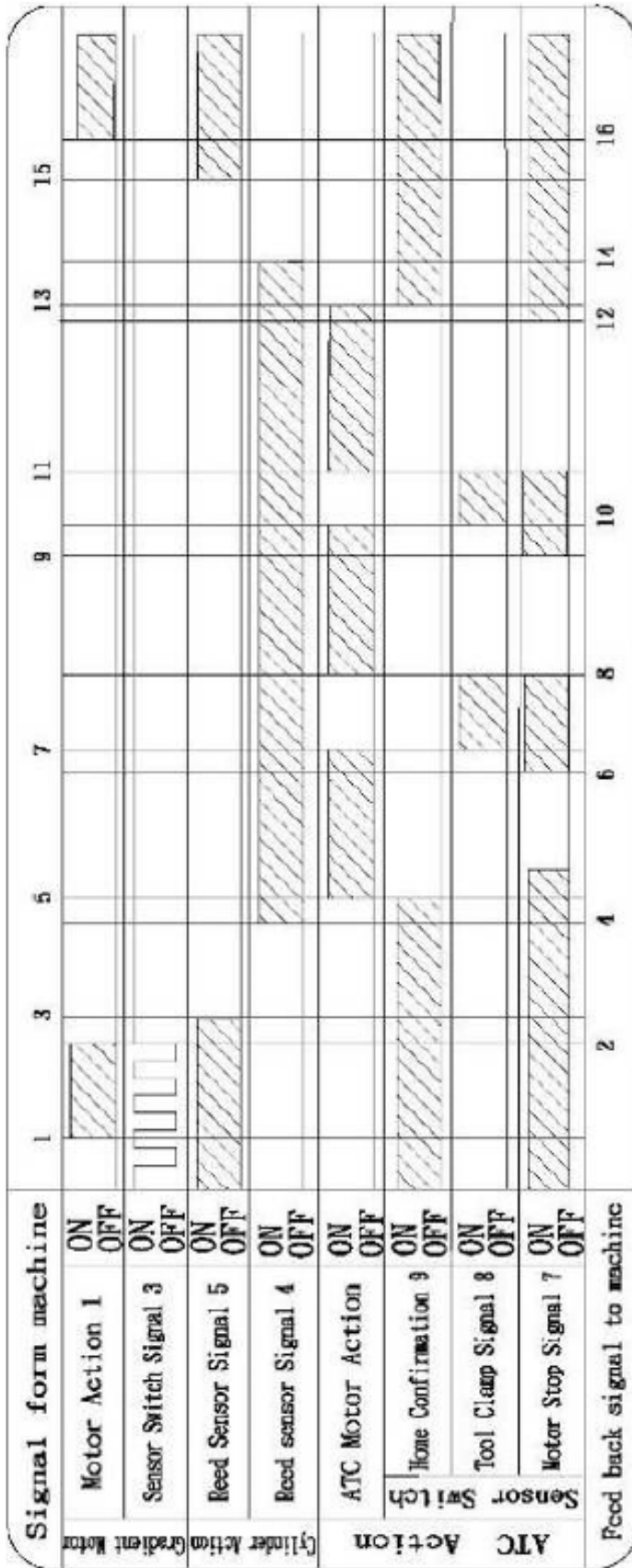
1. Tool selection (Tool selection power for CW or CCW)
2. Tool counter and positioning signal (to stop indexing motor)
3. Power on for tool pot up-down
4. Positioning signal of tool falling (contracting of cylinder)
5. Tool change motor start from home
6. ATC motor start to stop
7. Tool clamping confirmation, tool release signal, motor stop
8. Tool release finish, motor power on
9. ATC motor start to stop
10. Tool change confirmation, tool clamping signal, motor stop
11. Motor power on and arm to home position
12. ATC motor start to stop
13. Motor stop & home confirmation
14. Protruding of cylinder starts to position, tool pot home position
15. Protruding of cylinder position signal (Tool change finish)
16. Indexing motor rotating to new order - pot

Voltage DC24V(Please choose positive or negative output voltage by PNP or NPN)

Proximity sensor 3	—	Magazine tool counting signal
Proximity sensor 2	—	Magazine positioning signal
Reed sensor 5	—	Positioning signal of tool returning (protruding of cylinder)
Reed Sensor 4	—	Positioning signal of tool falling (contracting of cylinder
Proximity sensor 7	—	Stop signal of motor (tool change)
Proximity sensor 8	—	Tool clamp signal (tool change)
Proximity sensor 9	—	Home confirmation signal (tool change)

Voltage 220V 60HZ   DC24V

Motor for magazine
C.W. rotating — (Mc1) — Control sprocket wheel C.W.&C.C.W. rotating
C.C.W. rotating — (Mc2)

Motor for tool change — (Mc3) — Tool arm action

Tool clamping cylinder, MAR80BI60-CA, Solenoid valve depending on customer's request

Sensor Switch

DC24V PNP

(+) Positive Output

Signal Line Output

(-) Negative Output

BROWN

BLACK

BLUE

Output

3Ø Motor Wiring Diagram

X Y Z

U V W

3Ø AC220V

BRAKE

DC90V

Cylinder
MCQV-11-63-110M

3/8X∅8 Valve for cylinder speed

3/8X∅8 Valve for cylinder speed

a

SOL

b

F.R.L.

AIR

The solenoid valve shown within the dotted lines is shown for reference only and is not included as a standard accessory.

CONNECTOR WAGO231-620

Terminal	Signal
24V	Reed sensor positive voltage 24V brown
3	Tool pot up - Reed sensor blue
4	Tool pot down - Reed sensor blue
24V	Proximity sensor - positive voltage - 24V brown
0V	Proximity sensor – negative voltage – 24V blue
5	
6	Home position proximity sensor black
15	
16	Counter & position proximity sensor black
17	Arm proximity sensor – positive voltage 24V – white
24V	Arm proximity sensor – negative voltage 24V – blue
0V	Stop signal of motor (tool change) black
7	Tool clamp signal (tool change) black
8	Home configuration signal (tool change) black
9	Option signal (tool change) black
10	
34	Tool pot up – solenoid valve black
35	Tool pot down – solenoid valve black
36	Solenoid valve Negative 0V White
0V	

CONNECTOR WAGO231-612

Terminal	Signal
U1	Magazine motor power black
V1	Magazine motor power white
W1	Magazine motor red
G	Magazine motor power green
U2	Arm motor power red
V2	Arm motor power white
W2	Arm motor power black
G	Arm motor power green
X	
Y	
Z	
G	

CAM DEGREE	65°		
UP-DOWN STROKE	115mm		
SIGNAL SPEC.	PNP×4-Ø4		
TOOL CHANGE TIME	50Hz=1.5sec		
	60Hz=1.2sec		
MOTOR SPEC.	1/2HP		
	BREAKE DC-90V		
	GEAR RATIO 1:8		

DEX-2 TIME CHART

Return knife angle

holding knife angle

360° (input shaft turn one cycle)

180°

7.5°

15°

50°

15°

60°

20°

MS

125°

20°

60°

15°

50°

7.5°

72.5°

65°

85°

65°

72.5

115mm

MCS2S L.H
MS R.H
MS
MS
MCY2S R.H

*ATC time chart

*raising stroke

*original position confirmation

*holding knife angle
knife angle confirmation

*for brake

OFF
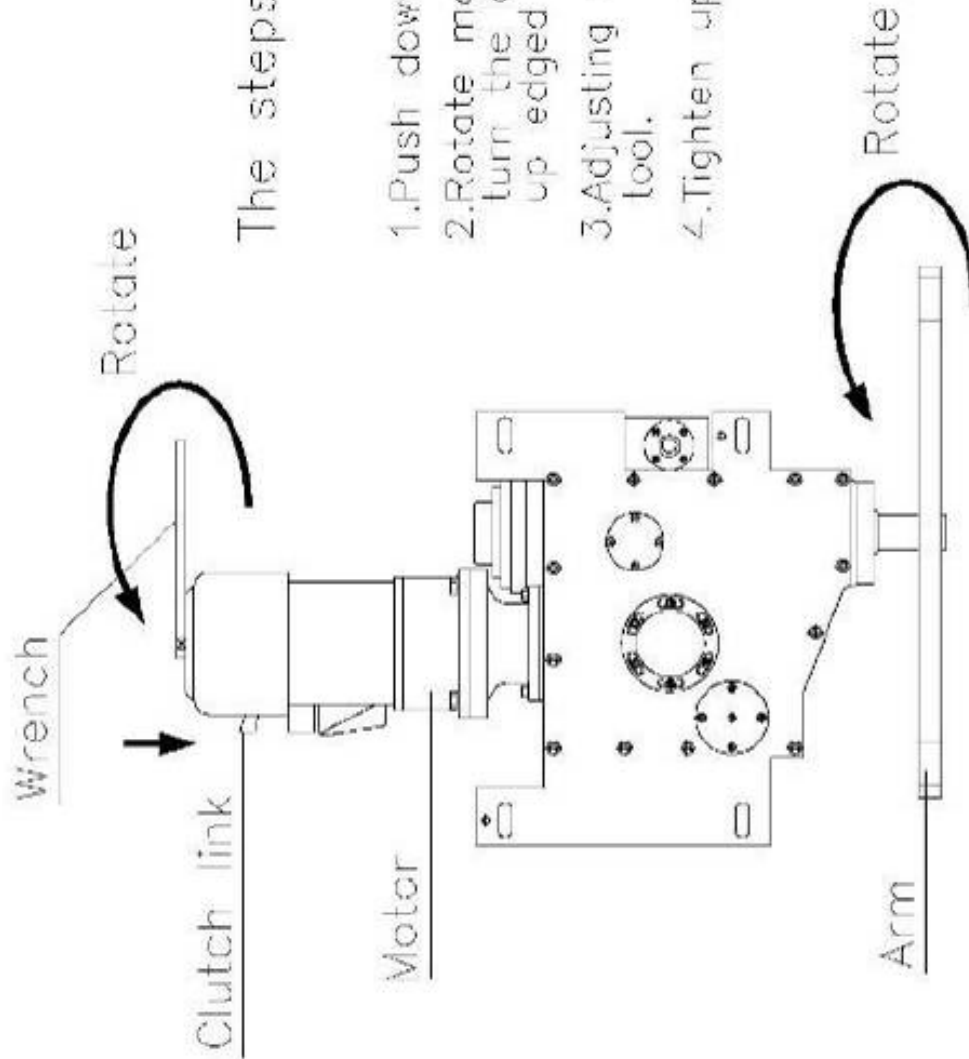
The steps of arm adjustment

1. Push down clutch link.
2. Rotate motor by using the wrench and turn the arm to the angle of setting up edged tool.
3. Adjusting the arm to hold the edged tool.
4. Tighten up the setup screws.

Rotate

Wrench

Clutch link

Motor

Rotate

Arm
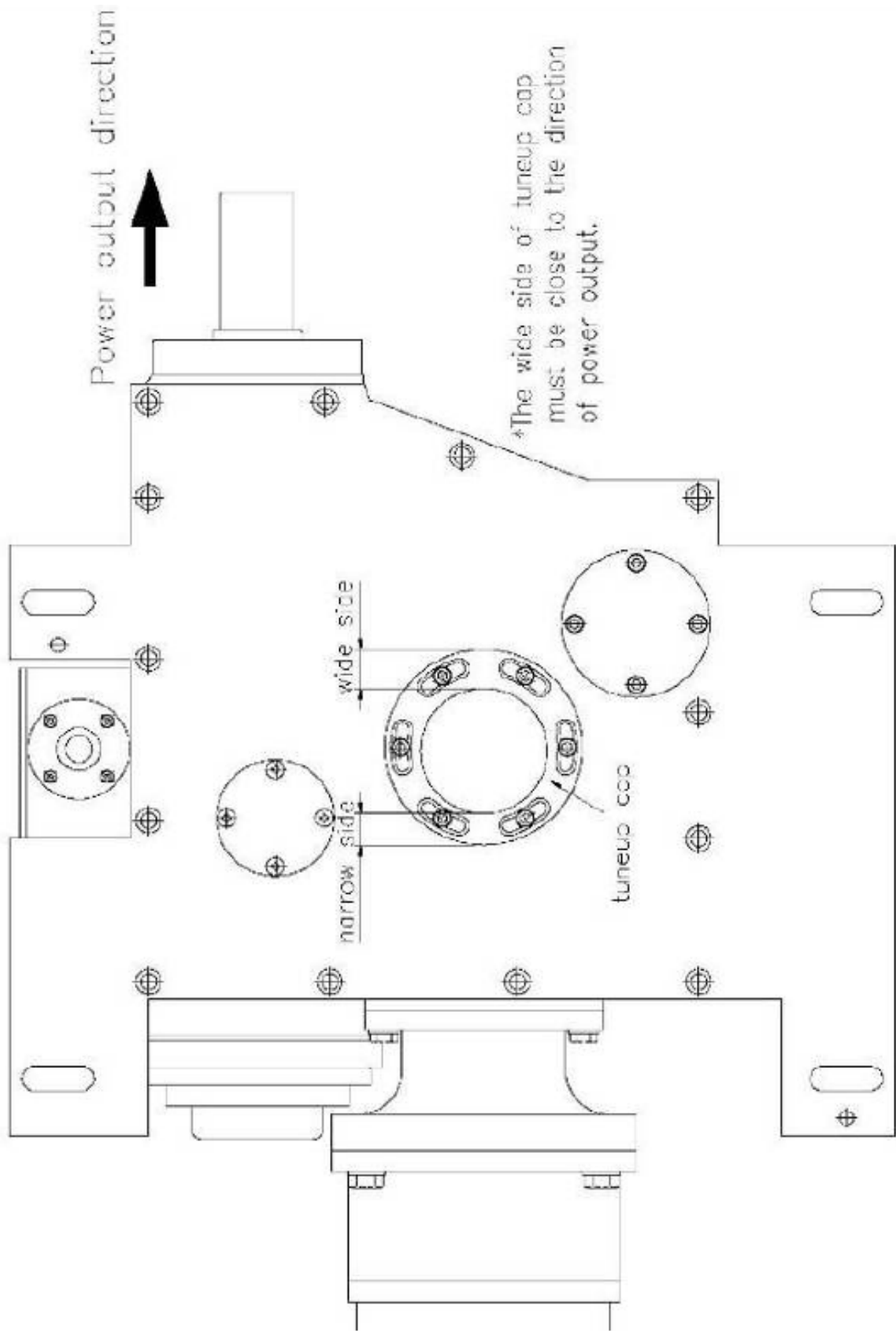
5.23 ELECTRIC ARM TYPE ATC – GEAR OIL SPECIFICATIONS

BRAND NAME	SPEC(VISCOSITY GAGE ISO VG)
SHELL	Omala EP 150-220
TOTAL	Garter EP 150-220
MOBLE	Mobil gear 150-220
ESSO	Spartan EP 150-220
CASTROL	ALPHA SP(EP) 150-220
CPC	*85W/90*

NOTES:
1. Check oil level before running equipment
2. Change oil after 2,400 hours of use
3. Use new oil with the proper viscosity

5.24 ELECTRIC ARM TYPE ATC – REPAIR PROCEDURES

1. To dismantle and reinstall the splined output shaft:
   - Turn to origin position, remove the taper pin (246) and M8 bolt (227) on the case cap.
   - Remove the case cap (101B).
   - Loosen hexagonal screw (225) and remove the front fix cap (111).
   - Remove the splined output shaft (106), and transmit wheel (107), suns nut (208) suns gasket (210) and remove the shaft.
   - Reassemble in reverse order.

2. To change the bearings on bearing tube: :
   - Turn to origin position, remove the case cap of taper pin (246) and M8 bolt (227) on the case cap.
   - Remove the case cap (101B).
   - Rotate the bearings tube (108) to the standby position.
   - Remove the side set screw (233).
   - Use the special tool to remove the bearings 4)20 (134), reinstall the new bearings, use the no air rubber to fastener the settled screw (233).
   - Reassemble in reverse order.

3. To take rocker apart: :
   - Turn to origin position, remove the case cap of taper pin (246) and M8 bolt (227).
   - Remove the case cap (101B)
   - Then remove the rocker of settled screw down (224)
   - Use the teardown tool, removed the rocker shaft (116)
   - Remove the thrust bearings AXK1108 (206), thrust bearing pad AS1108 (227) and needle bearings HK3516 (205).
   - The needle bearings 4)22(135) and needle bearings 4)24(136) taken apart the rocker is now replaced new product.
   - Reassemble in reverse order.

Condition	Reason	Trouble Shooting
Tool disk stops in mid position.	1.Brake failed to work or was overloaded 2.Carousel count proximity switch too far from target.	1. Check that the electronic brake wiring is correct. If part failed to work 2. Move sensor switch closer to target
Tool disk rotates continuously.	1.Counting sensor switch failed. 2. Carousel count proximity switch too far from target.	1. Replace sensor switch 2. Move sensor switch closer to target.
Tool pot broken.	1. Tool disk rotated while tool pot down 2. Tool arm out of adjustment	1. Check operation of tool pot up/down proximity switches. 2. Adjust tool arm position.
Tool disk stuck.	Tool disk rotated while tool pot down	1. Check operation of tool pot up/down proximity switches.
Vibration during arm movement.	1.Oil level low. 2.Cylinder speed out of balance.	1. Fill lubricant oil. 2. Adjust cylinder pressure & speed with throttle valve.
Tool disk does not work during tool selection.	1. Induction switch does not work. 2. Reed switch broken. 3. Motor failure. 4. Electronic connection open. 5. Fuse opened.	1. Adjust reed switch to normal position. 2. Replace reed switch. 3. Repair/replace motor. 4. Check wiring & repair. 5. Check sensor switch. 6. Replace fuse.
Cylinder does not work during tool change.	1. Proximity switch for tool counter positioning broken. 2. Tool disk not in position. 3. Cylinder has no air. 4. ATC arm is not at origin position.	1. Replace proximity switch. 2. Check tool disk positioning. 3. Check air cylinder by manually operating solenoid valve. 4. Rotate motor manually to put ATC arm back to original position.
ATC motor over-heat	1. Break not working. 2. Motor short circuit.	1. Replace the brake. 2. Replace the motor.
ATC arm fails to move after tool is clamped. ATC fail to work after 180° degrees tool change. ATC home stop & home sensor switch do not work.	1. Proximity switch is in wrong position. 2. Proximity switch is broken.	1. Adjust proximity switch. 2. Replace proximity switch.
ATC arm stops out of position.	1. Proximity switch is in wrong position. 2. Positioning ring of proximity switch is at wrong angle	1. Adjust 3 switches at the same time to proper angle. 2. Rotate set ring, adjust 3 proximity switches to proper angle.
ATC tool arm not fully engaging tools.	ATC arm not aligned.	Loosen arm & align it.

5.27 TOOL POT REPLACEMENT PROCEDURE

|	
1. Remove the 2 carousel covers as shown.	2. Remove the 8mm bolt and loosen but do not remove the 10mm bolt on the shaft cover. (Note: do not remove the 4 attachment bolts)
3. Pull out the plate to the M10 screw bolt position as shown.	4. Remove the 6mm bolt next to the tool pot as shown.
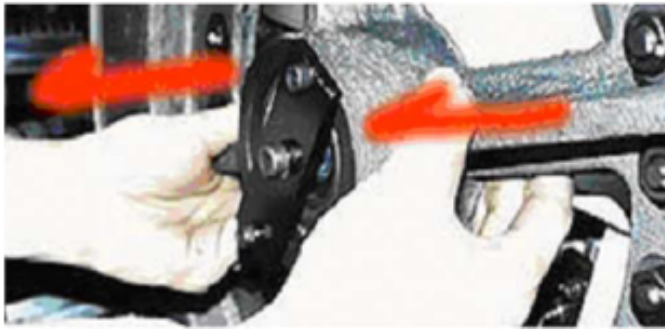
5. Remove the broken pot by pushing the pot forward, rotating it upward, then extract it.
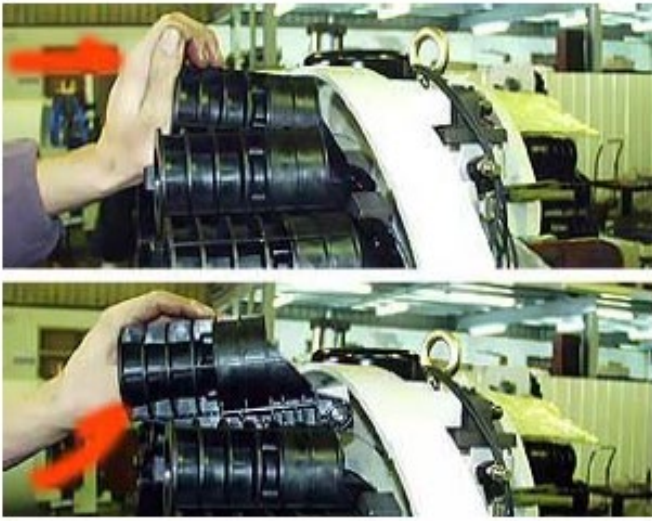
6. Confirm the attachment bolt and knob are correct by comparing to broken pot.
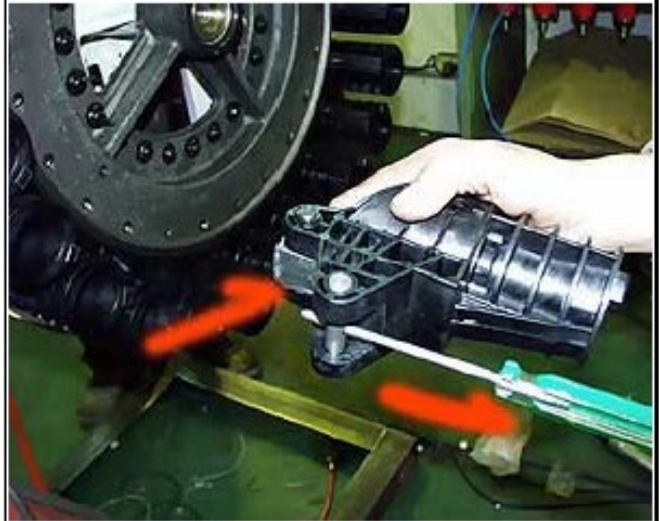
7. Install the new pot in reverse order of step 5.
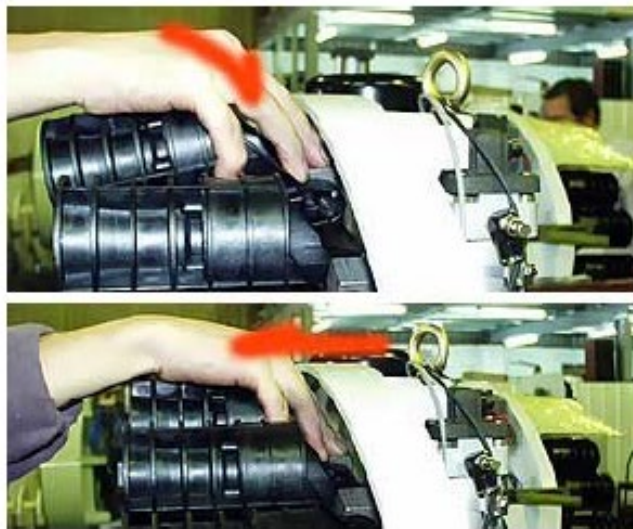
8. Replace the 6mm bolt next to the tool pot as shown.

9. Push the plate to the original position and replace/tighten the screws

10. Check that the tool disk is fully seated so it does not move in/out.

11 Check that the tool pot drops at the correct 90 degree angle by manually operating solenoid valve.

5.28 REPLACE ATC MAGAZINE MOTOR

1. Turn power off.
2. Disconnect the wires for the magazine motor in the junction box.
3. Remove the M8 bolts (4pcs) on motor seat, and then remove the motor.
4. Remove the S18 ring & M6 bolt from the damaged motor & install the parts on the new motor.
5. Please make sure the motor specification is correct before you replace it.
6. Reconnect the wires in the junction box.

5.29 REPLACE ARM MOTOR

1. Power off.
2. Disconnect the wires for the arm motor in the junction box.
3. Remove the M10 bolts (4pcs) on motor seat, and then the motor.
4. Please make sure the motor specification is correct before you replace it.
5. Reconnect the wires in the junction box.

5.30 CYLINDER REPLACEMENT

1. Turn off the power & cylinder air pressure source.
2. Take off 08 air pipe.
3. Take off induction switch & mark original position before removing it.
4. Remove the M8 bolt on the cylinder and the S12 ring on joint "I".
5. Make sure to the cylinder specifications are correct before you install. Install the induction switch to the original position.

5.31 INDUCTION SWITCH REPLACEMENT

1. Power off.
2. Disconnect the wires for the induction switches in the junction box.
3. Please loosen the seat of reed switch & take it out.
4. Replace new part & take care of the sensor position, push it to upward & downward until to end of both sides.
5. Follow the steps to set up wires in electric box.

5.32 REPLACING THE PROXIMITY SWITCH FOR THE TOOL MAGAZINE

1. Power off.
2. Disconnect the wires for the induction switches in the junction box.
3. Remove the front cover & outer metal cover.
4. Remove the M12 bolt on the proximity switch.
5. Replace the switches & make sure the gap distance is 4 mm.
6. Reconnect the wires in the junction box.

5.33 REPLACING THE PROXIMITY SWITCH FOR THE ARM

1. Power off.
2. Disconnect the wires for the induction switches in the junction box.
3. Remove the acrylic cover plate.
4. Replace the switch & make sure the gap distance is 4 mm.
5. Reconnect the wires in the junction box.

5.34 NOTES

1. Be sure to use the proper tools during maintenance & repair.
2. Take care to match the part specifications before replacement. Specifications are listed in the parts list.
3. Make sure the gap for the proximity switch & reed switch 4 mm.
4. Be sure to note the wire numbers & locations before disconnecting.

G. Magazine maintenance main points

#	Category		Item	Maintenance main point	Tool	Frequency	Material
1	Lubrication	A	Carousel pot guideway	Take off number cover, fill oil manually	Grease Gun	Half year	Grease
		B	Pot slide	Take off sheet metal, fill	Grease Gun		Grease
		C	Arm slide block & position pin	Take off sheet metal cover, clean & fill oil manually			Grease
		D	Cam Slide	Take off ATC cover, fill lubrication oil manually	Grease Gun		Grease
		E	Motor Gear	Take off front cover & outer sheet	Grease Gun		Grease
2	Cleaning	A	Inner taper face of pot	Clean pot			
		B	Change ATC oil	Drain the old oil, and fill		Once a month	SHELL TELLUS 32
3	Loosen Check	A	Sensor switch for magazine	Check manually		Half year	
		B	Sensor switch for ATC	Check manually		year	
		C	Sensor switch for cylinder	Check manually			
		D	Limit switch	Check manually & optically			
		E	Bolts	Check manually			
		F	Bolts on arm	Check manually			
		G	Shake the arm to decide if backlashes too big	Check manually & inaccuracy can't ...			
		H	Check the carousel body	Check manually			
		I	Check tool magazine	Check manually			
4	Other check	A	Pot ball is falling down	Check manually			
		B	Excessive noise or heat from motor	Check manually			
		C	Check the air pressure for the cylinder solenoid valve	Check manually			
		D	Oil leak from ATC output shaft	Check manually			
		E	V shape flange of ATC arm to wear and tear	Check manually			
		F	The oil level lower of ATC oil tank	Check manually		Before power	

6.1 FANUC CONTROL ELECTRICAL PANEL LAYOUT & PARTS LIST
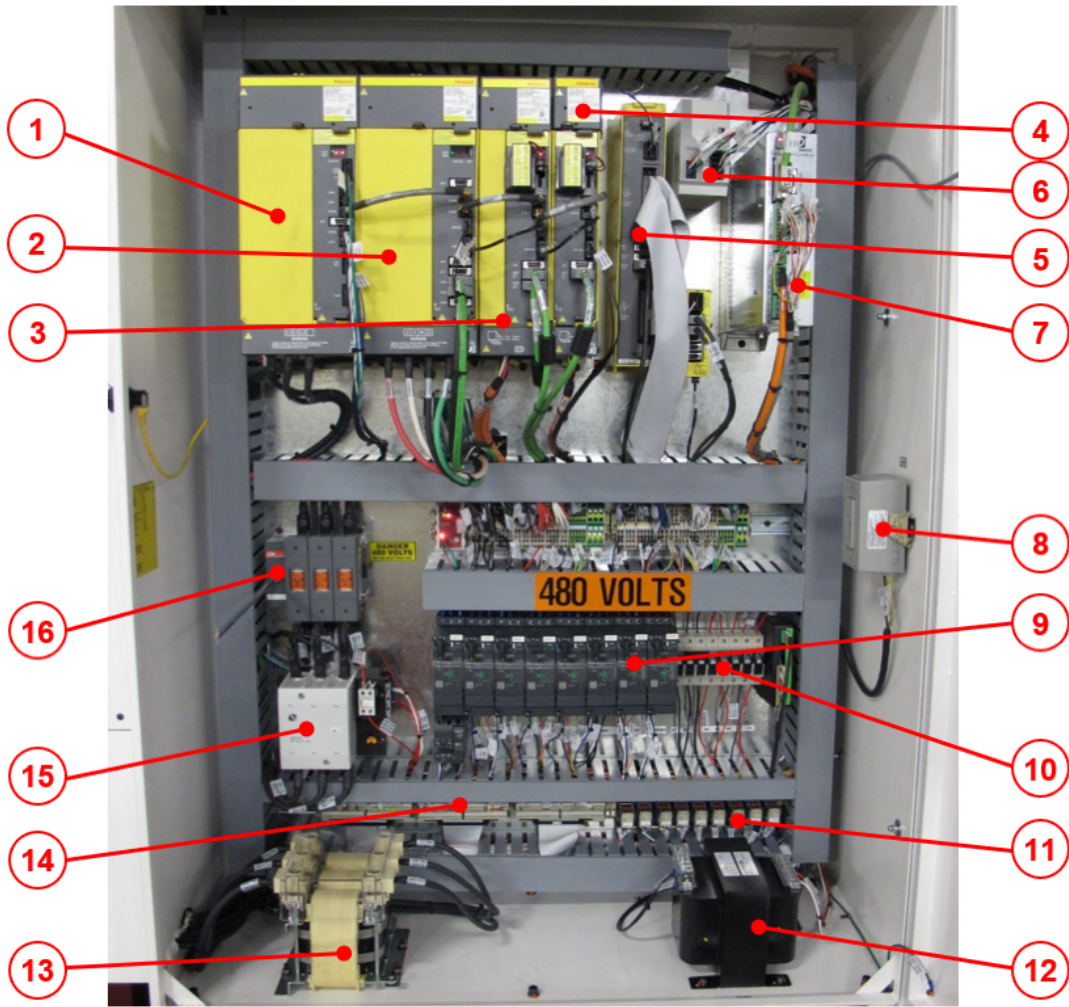
REF	PART NO.	DESCRIPTION	QTY
1	A06B-6252-H045	FANUC POWER SUPPLY	1
2	A06B-6272-H045#H610	FANUC SPINDLE DRIVE	1
3	A06B-6290-H209	FANUC DOUBLE AXIS DRIVE	1
4	A06B-6290-H125	FANUC SINGLE AXIS DRIVE	1
5	A16B-2204-0240/10A	FANUC I/O BOARD	1
6	MSE-2946	POWER SUPPLY 20 AMP	1
7	TMC-14-400-8-20-5.0/11	DUPLOMATIC TORQUE MOTOR CONTROLLER	1
8		110 VOLT POWER OUTLET	1
9	MSE-6620	CONTACTOR	1
10	MSE-6549	SINGLE POLE FUSE HOLDER	1
11	MSE-1185 / MSE-1195	RELAY & BASE	1
12	MSE-1610	3 / 4 KVA TRANSFORMER	1
13	A81L-0001-0191	FANUC REACTOR	1
14	MSE-1330	TERMINAL BLOCK	1
15	MSE-1403	MAIN CONTACTOR	1
16	SWT-5106	DISCONNECT SWITCH	1

REF	PART NO.	DESCRIPTION	QTY
1	A02B-0338-H140	Oi-F 10.4" COLOR LCD UNIT	1
2	A02B-0323-C125#T	MDI UNIT	1
3	A02B-0338-C243	Oi-F MACHINE OPERATOR PANEL	1
4	A02B-0236-C239	MACHINE OPERATOR'S PANEL – SUB PANEL CCI	
5	A56L-0001-0134#2A2B	E-STOP SWITCH	
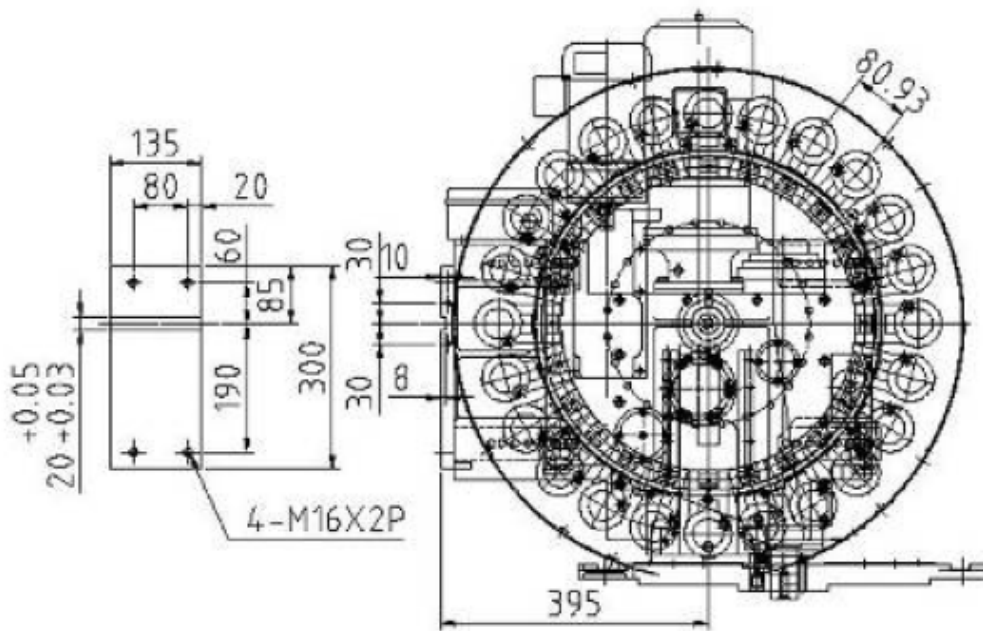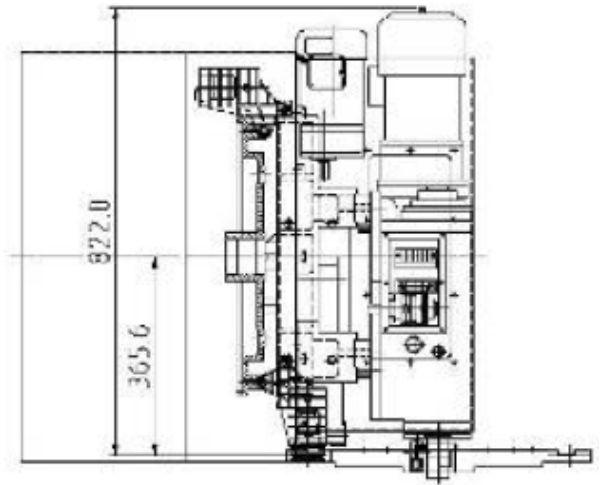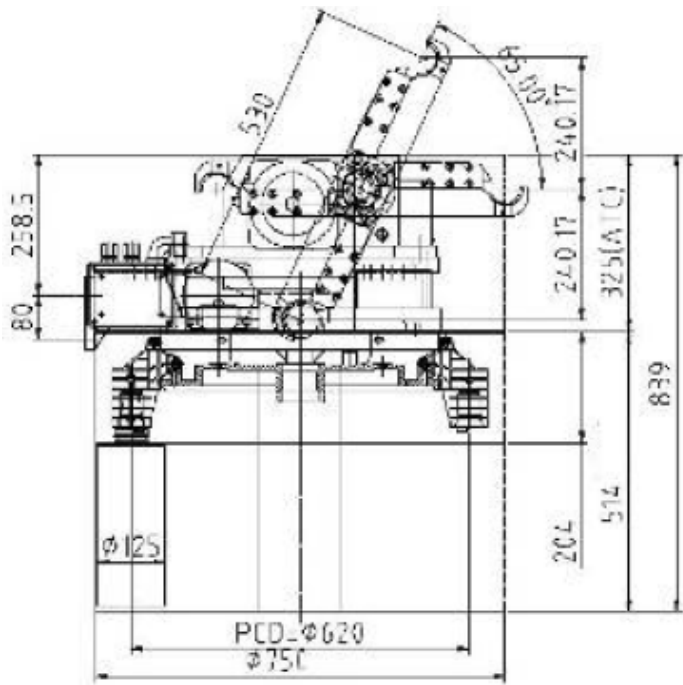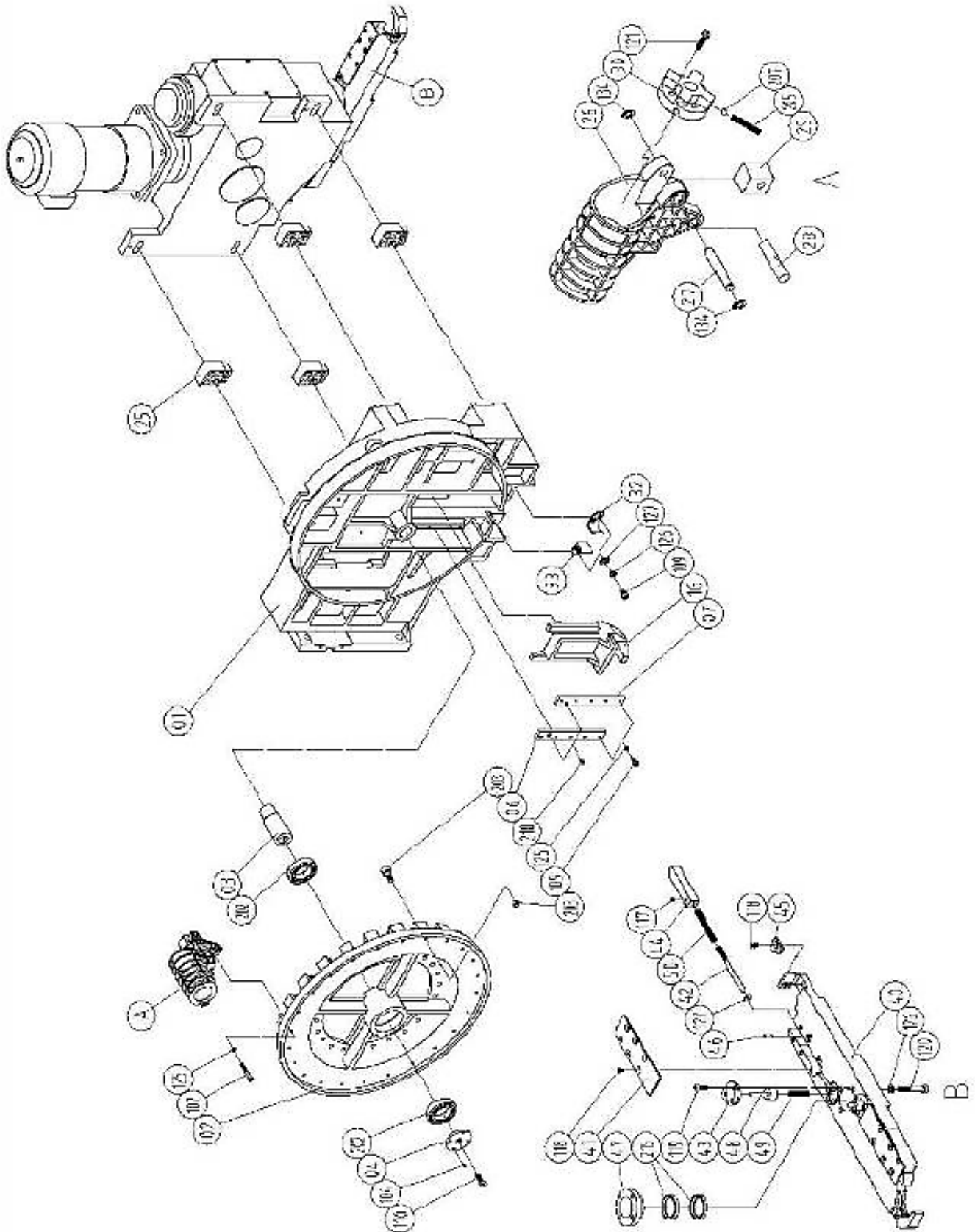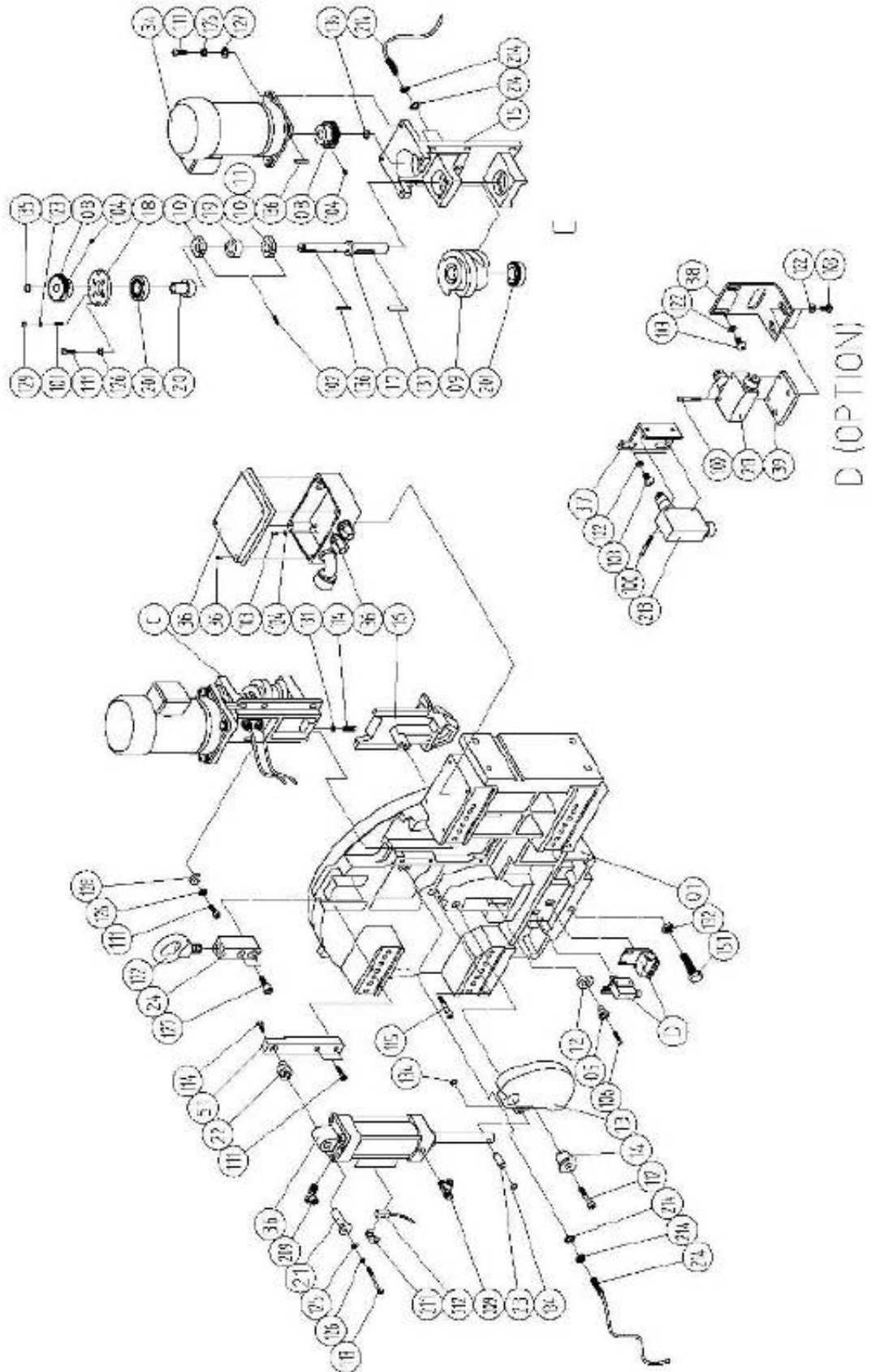
6.3 ELECTRIC ARM TYPE ATC - PARTS LIST

No.	Part No.	Part Name	Material / Spec.	QTY	Remark
01	MBX420200	New case	FC-25	1	24T
02	MBX420080	24T Disk plate	FC-25	1	
03	MBX410010	Disk rotate shaft	S45C	1	
04	MBX410030	Fixed cover of rotate shaft	S45C	1	
05	MBX410070	Sleeve of rocker arm	S45C	1	
06	MBX410090	Lock plate right slide seat	S45C	1	
07	MBX410100	Fixed plate of left slide seat	S45C	1	
08	MBX410150	Gear	S45C	2	
09	MBX410220	24 divide up turntable of cam	SCM435	1	
10	MBX410250	Single reaction block (On)	Powder metallurgy	1	
11	MBX411000	Single reaction block (Off)	Powder metallurgy	1	OPTION
12	MBX410290	Rotor of tool upside down	SC45	1	
13	MBX410740	A rocker arm of tool upside down	FCD55	1	
14	MBX410750	A rocker arm's arbor	S45C	1	
15	MBX410760	A cam seat	FCD50	1	
16	MBX410770	24T Tool upside down paw	FCD55	1	
17	MBX410780	An axle center of cam	S45C	1	
18	MBX410790	Bearing cover	S45C	1	
19	MBX410800	Collar	S45C	1	
20	MBX410810	Sleeve of bearing	S45C	1	
21	MBX410850	Fixed shaft of cylinder	S45C	1	
22	MBX410870	Eccentric shaft of cylinder	S45C	1	
23	MBX410880	Connect shaft of piston rod	S45C	1	
24	MBX411010	Fixed block of flying rings	S45C	1	
25	MBX450630	Interface board	AL-6061-T6	4	Ref (DEX65°× 530 L)
26	MBX460010	Tool pot (60°)	POM	24	
27	MBX460020	Rotate shaft of tool pot	S45C	24	
28	MBX460030	Lock shaft of tool pot	S45C	24	
29	MBX460040	Pull block of tool pot	Powder metallurgy	24	
30	MBX460240	Fixed block of pull stud	POM	24	
31	MBX460180	Spring	Piano wire	96	
32	MCX410230	Orientation seat of left pot	SPHC	1	
33	MCX410240	Orientation seat of right pot	SPHC	1	
34	MBX480140	Decelerator of gear motor	Hardware	1	
35	MBX480150	Cylinder of tool pot up & down	Hardware	1	
36	MBX480190	Wiring connect box	Hardware	1	
37	MBX411200	Limit switch fixed seat 1	SPHC	1	
38	MBX411210	Limit switch fixed seat 2	SPHC	1	
39	MBX411220	Limit switch fixed seat 3	SPHC	1	
40	MBX470130	Arm-530L	FCD-50	1	
41	MBX470340	Fixed plate	SPHC	2	
42	MBX470420	Slide block of stop tip	S45C	2	
43	MBX470460	Sleeve of stop tip	S45C	2	
44	MBX470480	Slide & fixed block	S45C	2	
45	MBX470490	Lock key	SS41	2	

46	MBX410280	ψ8 Stop tip	S45C	2	
47	MBX470690	Fixed collar	S45C	1	
48	MBX470720	Stop tip	SCM415	2	
49	MBX470740	Spring ψ1.2×9od×14T×41L	Piano wire	2	For stop tip
50	MBX470750	Spring ψ1.2×11od×20T×78.5L	Piano wire	2	For Slide block of stop tip
51	MBX410860	Cylinder fixed block	S45C	1	
100		Hexagonal bolt	M4×0.7P-25L	4	For limit switch
101		Stop bolt	M5×0.8P-20L	4	
102		Stop bolt	M5×0.8P-25L	2	
103		Hex. socket head screw	M5×0.8P-12L	4	Limit switch (OP)*10 PCS
104		Stop bolt	M6×1P-8L	6	
105		Hexagonal bolt	M6×1P-20L	10	
106		Hexagonal bolt	M6×1P-25L	1	
107		Hexagonal bolt	M6×1P-40L	24	Compose with 20T Disk*20PCS
108		External Hexagonal bolt	M6×1P-20L	1	Origin point reaction
109		Hexagonal bolt	M8×1.25P-16L	4	
110		Hexagonal bolt	M8×1.25P-20L	1	
111		Hexagonal bolt	M8×1.25P-25L	14	
112		Hexagonal bolt	M8×1.25P-45L	1	
113		Hexagonal bolt	M8×1.25P-65L	1	
114		External Hexagonal bolt	M8×1.25P-30L	1	
115		Hexagonal bolt	M10×1.5P-65L	1	
116		Hexagonal bolt	M12×1.75P-20L	1	
117		Stop bolt	M6×1P-6L	2	For arm
118		Shallow head screw	M6X1P-10L	14	For arm
119		Hexagonal bolt	M6×1P-16L	6	For arm
120		Hexagonal bolt	M8×1.25P-55L	4	For arm
121		Self-tap screw	3/16 × 1"	96	
122		An eye ring	M16	1	
123		Spring washer	M5	4	
124		Flat washer	M5	4	
125		Spring washer	M6	34	Compose with 20T
126		Spring washer	M8	20	
127		Flat washer	M8 × 2T	14	
128		Flat washer	M8 × 5T	6	
129		Nut	M5 × 0.8P	4	
130		Nut	M6 × 1P	2	
131		Nut	M8 × 1.25P	1	
132		Nut	M16 × 1.5P	1	
133					
134		C Ring (External)	S-10	50	Compose with 20T Disk* 42 PCS
135		C Ring (External)	S-18	2	
136		Single side round key	5 × 5 × 28L	2	
137		Double side round key	8 × 7 × 40L	1	
201	GKW030205	Angular ball bearing	30205JR(HIC)	2	
202	GKW006008	Deep groove ball bearing	6008 ZZ	2	
203	GKWCF0010	Bearing for cam (With M10 nut)	CF-10	24	20T- 20 PCS

204					
205	MBX460180	Spring	ψ1.2×7.8od×10T×25L	96	20T- 80 PCS
206					
207		Steel ball	ψ8	96	
208					
209	EDWN00001	Air throttle	1/4 × ∮8	2	
210	FEWN10002	Oil filler joint	1/8 PT	2	
211	MBX480450	Sensor fixed jig	PM-10	2	
212	EAWC00001	Magnetism reed switch	LS-BD2	2	
213	EAWA00001	Micro limit switch	YAMATAKA SL1-A	2	
214	EAWB00001	Proximity switch	BALLUFF-PSC40B	3	Sensor+Nut+Washer
215	GLW040045	Taper cone Collar	40 × 45	2	

INPUT SHAFT

No.	Parts No.	Specification	Q'ty	No.	Parts No.	Specification	Q'ty
101A	A402C3C000A1	Case	1	216	007KX*3*20	Double circle keru 3*3*20	1
101B	A402C3C000B1	Case cap	1	219	007KX*6*55	Dustin circle keys 6*6*55	1
102	A402A01C0001	Cam shaft	1	224	HI-M5*16L	Anti hexgool screw M5*16L	12
103	A102A02C0003	Tuneup cap	2	225	HI-M5*20L	Anti tsugai screw M5*20L	2
104	A402A02C0001	Tuneup screw cap	2	227	HI-M5*25L	Anti tsugai screw M5*25L	12
105	A402A04C0001	Cam shaft sprocket	1	226	HI-M8*95L	Anti tsugai screw M8*95L	2
11'	A402C0100000C	Case	1	241	PTL/2'	Oil plugger PTL/2"	4
127	A402FD1DK001	Big umbrella gear	1	242	C1-26	Oil plugger(A26mm)	1
201	1DR30008	Taper roller bearing 32KM	2	248	P7M-T-3*32L	Taper pin 49*32(±80)	3
218	O-SS42	O ring 6/SS42	2	249	P7M-P-8*32M	Tandlizer pin 49*32M	2
214	C70	O ring C70	2				

OUTPUT PARTS

No.	Parts No.	Specification	Q'ty
101A	A402DSC000A1	Case	1
106	A402301000001	Spline(output) shaft	1
107	A402302000I0H	Transmit wheel	1
105	A402303030001	Bearing tube	1
109	A402304-0000	Bearing tube fixture	1
110	A402305000I04	Bearing tube pusher	1
111	A402306000I0H	Front fix cap	1
112	A402307000001	Back fix cap	1
154	RS00020000AL	Bearing ø50	8
203	FR62111	Speed adjustment	2
208	AN08	Sun's nut AN08	1
209	AN11	Sun's nut AN11	1
210	AW08	Sun's gasket AW08	1
211	AN11	Sun's gasket AN11	1
215	G60	O ring G60	1
218	G100	O ring G100	1
224	M8*16L	bolt (socket cap M8)	4
225	M5*10L	bolt socket screw M5	6
228	M8*16L	bolt socket screw M8	6
233	FS-V6M18L	Solid screw M18	6
240	PT 1/8"	oil plugger PT/8	1
244	CBR 609003	OBR type oil seal	1

MOTOR PARTS

No.	Parts No.	Specification	Q'ty
128	A402F02C0001	Small umbrella gear	1
129	A402F02D0001	Motor fixture	2
130	A402F02C0001	Adjustment sheet	1
206	2URSCC09	Taper roller bearing 30R	2
205	AN08	Sun's nut AN08	1
210	AW08	Sun's gasket AW08	1
229	M10*30L	bolt socket screw M10L	4
230	M-M10*30L	bolt socket screw M10L	4
232	MR 1/2HP	Motor 1/2HP	1

SIGNAL PARTS

No. Parts NO.	PART NO.	Specification	Q'ty
101A	A-0205000TA1	Case	1
118	AV-0440100CA0	Brake signal wheel	1
119	AV-02R010DCS	Cam signal wheel	1
120	A-02R020S001	Signal fixture	1
121	A-02R030001	Signal shaft	1
122	A-02R040C00X	Dust-proof cap	1
123	A-02R050S001	Signal cap	1
124	A-02R06002001	Signal cap(been lock)	1
125	A-02R070001	Signal sprocket	1
126	A-02R080T001	Signal key up parcel	1
204	H2R8202	Bag press ball bearing 6202	4
217	HTRX4*4*10	Parfen circle key A4*4*10	2
220	HL-M4*10L	Inbus hexagon screw 4*10L	8
121	HL-M6*6L	Inbus hexagon screw 6*6L	8
222	HT-M6*6L	Inbus hexagon screw 6*6L	8
231	ES-M6*76L	Bottion sensor M6*76L	1
232	ES-M5*10L	Settled sensor M5*10L	2
239	PF-1906	Plastics screw 1906(R28)	4
243	TW13*2*5	W type oil seal 13*2*5	1
249	AG-1R	Wire strobe(KR6)	1
250	TB-10A000Y	Terminal friction	1

Item No.	Description	Part Name	Q'TY	Remark
31	01.01.01-3002	Leveling Nut	6	
30	01.01.01-3001	Leveling Bolt	6	
29	01.01.01-0002	Leveling Pad	6	
28	12.9 GB/T 70.1 M8×30	SCREW	4	
27	GB/T 118-2000 6×30	PIN	2	
26	01.01.02-0004	motor plate	1	LV955
25	XHW-64C	Coupling	1	NBK
24	YSF-M25x1.5P	Lock Nut	1	
23	01.01.02-3002	XY Collar	1	
22	01.01.02	XY Motor Bracket	1	
21	12.9 GB/T 70.1 M8×20	SCREW	5	
20	R36-16K4-FSDC-701-850-0.008	Y Ballscrew	1	V8Y
19	01.01.04	XY Seal	2	
18	GB/T 276-1994	Bearing 6205	1	02
17	GB/T894.1-1986	Ring	1	
16	12.9 GB/T 70.1 M6×20	SCREW	4	
15	01.01.02-7001	Plastic	2	LV955
14	01.01.03	XY Bearing Ass.	1	
13	12.9 GB/T 70.1 M12×50	SCREW	12	
12	GB/T 118-2000 8×65	PIN	4	
11	01.01.03-3002	Bracket	4	L650
10	12.9 GB/T 70.1 M10×25	SCREW	8	
9	GB/T 95-2002 10	washer	8	
8	GB/T 118-2000 6×20	SCREW	4	
7	12.9 GB/T 70.1 M8×20	SCREW	4	
6	GB/T 95-2002 8	washer	4	
5	01.01.05-3001	Y Front waycover support	2	
4	M30	Eye Bolt	2	
3	12.9 GB/T 70.1 M8×30	SCREW	28	
2	HGR35HA2R1080ZAPII	Y axis linear Guideway	2	
1	01.01.01-0001	Base	1	
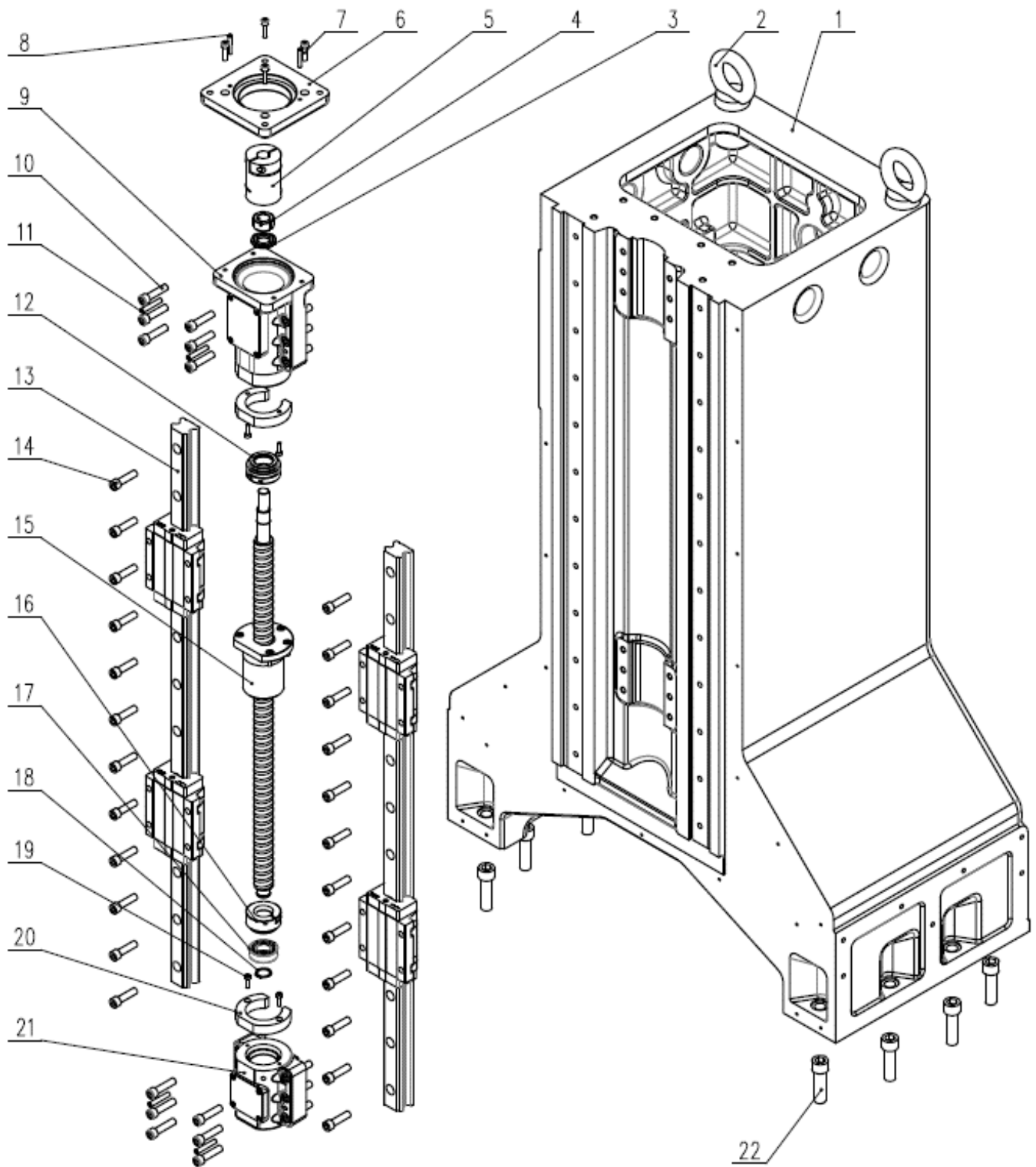
Item No.	Description	Part Name	Q'TY	Remark
22	12.9 GB/T 70.1 M20×70	Screw	8	
21	01.04.03	Z Bearing Ass.	1	
20	01.01.02-7001	Plastic	2	LV955
19	12.9 GB/T 70.1 M6×20	Screw	4	
18	GB/T 276-1994	Bearing 6205	1	02
17	GB/T894.1-1986	Collar	1	
16	01.04.04	Z Lower Seal	1	
15	R36-16K4-FSDC-751-900-0.008	Z Ballscrew	1	V8Y
14	12.9 GB/T 70.1 M12×40	Screw	24	
13	HGR45HA2R1235ZAPII	Z Linear Guideway	2	
12	01.01.04	XY Seal	1	
11	GB/T 118-2000 8×65	PIN	4	
10	12.9 GB/T 70.1 M12×50	Screw	12	
9	01.04.02	Z Motor Bracket	1	
8	GB/T 118-2000 6×30	PIN	2	
7	12.9 GB/T 70.1 M8×30	Screw	4	
6	01.01.02-0004	Motor Plate (Ø110-Ø130-24)	1	LV955
5	XHW-64C	Coupling	1	
4	YSF-M25x1.5P	Lock Nut	1	
3	01.04.02-3001	Z Collar	1	
2	M30	Eye Bolt	2	
1	01.04.01-0001	Column	1	
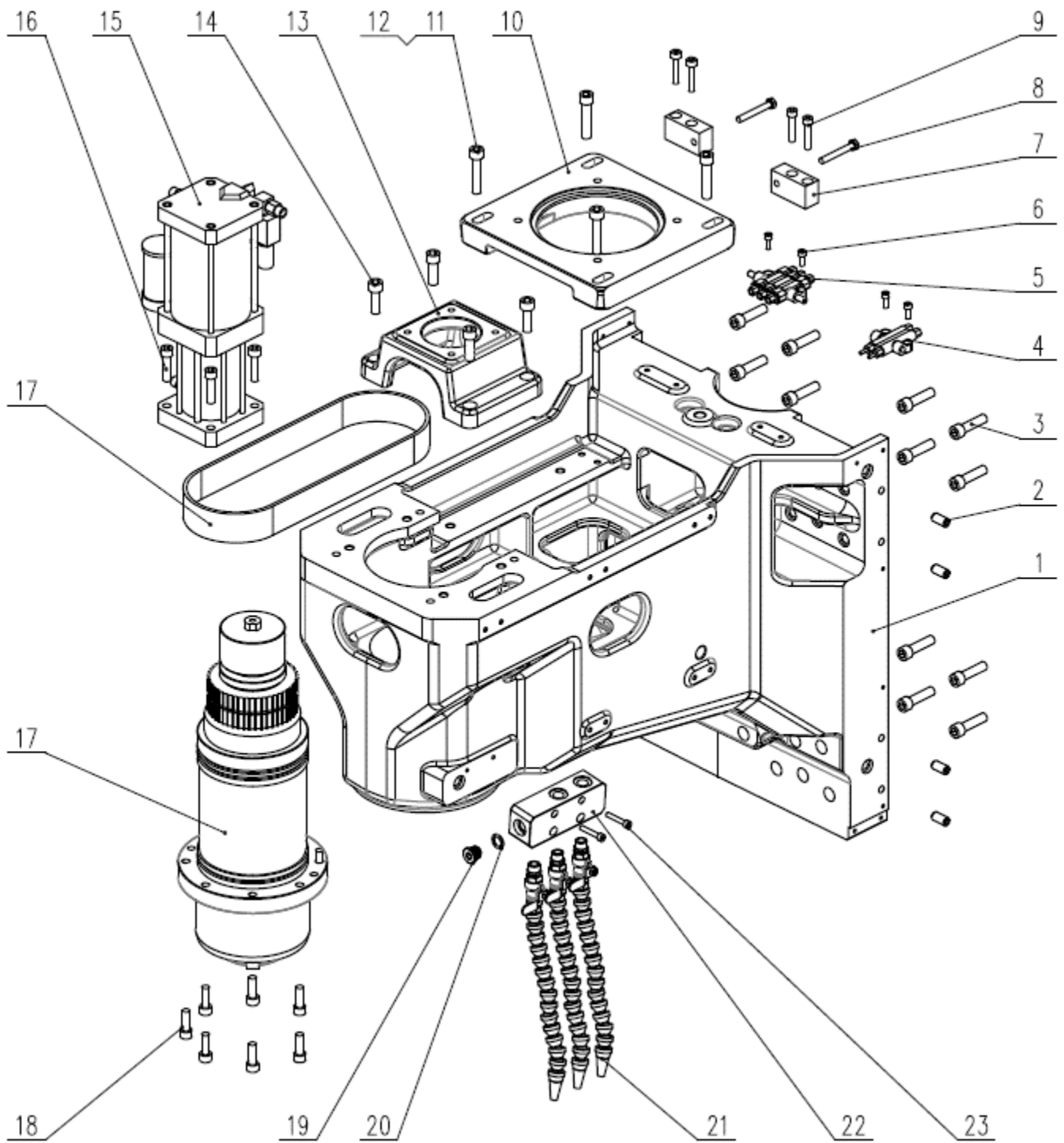
Item No.	Description	Part Name	Q'TY	Remark
23	12.9 GB/T 70.1 M6×35	Screw	2	
22	01.05.01-3002	Distributor	1	
21	GB/GQ0627-88 3/8	Tube	3	
20	OR3001500(ø15×ø3)	O Seal	1	
19	GB/T70.1-2000 3/8	Plug	1	
18	12.9 GB/T 70.1 M10×30	Screw	8	
17	RB4002 BT40-ø150	Spindle	1	
16	12.9 GB/T 70.1 M10×40	Screw	4	
15	HchBz(4.5TX13)	Booster Cylinder	1	
14	12.9 GB/T 70.1 M12×35	Screw	4	
13	01.05.01-0002	Booster Cylinder Bracket	1	LV955
12	12.9 GB/T 70.1 M12×55	Screw	4	
11	GB/T 95-2002 12	Washer	4	
10	01.05.01-0003	Motor Plate (ø180-ø215-35)	1	
9	12.9 GB/T 70.1 M8×40	Screw	4	
8	GB/T 5783-2000 M8×60	Screw	2	
7	01.05.01-3001	Adjusting Block	2	
6	12.9 GB/T 70.1 M6×16	Screw	4	
5	rh-33	Distributor	1	
4	rh-32	Distributor	1	
3	12.9 GB/T 70.1 M12×45	Screw	16	
2	GB/T 77-2000 M12×25	Screw	4	
1	01.05.01-0001	Ram	1	
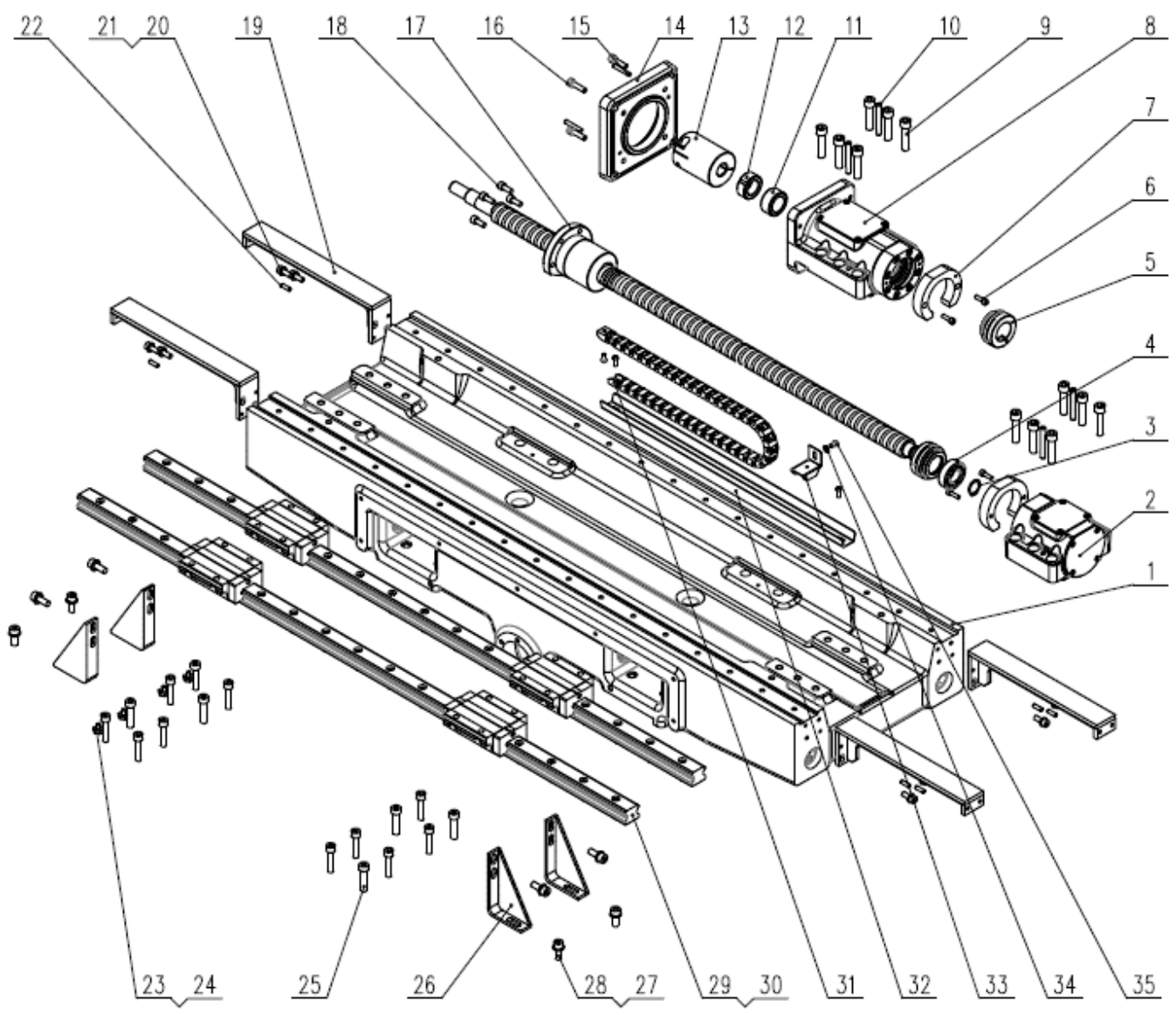
Item No.	Description	Part Name	Q'TY	Remark
35	12.9 GB/T 70.1 M6×12	Screw	4	
34	GB/T 95-2002 6	Washer	2	
33	01.02.01-3004	Bracket	1	LV955
32	01.01.01-3005	Guide Plate	1	LV955
31	10×10	Cable Track	1	
30	12.9 GB/T 70.1 M8×30	Screw	26	
29	HGR35HA2R1360ZAPII	X Linear Guideway	2	
28	12.9 GB/T 70.1 M10×25	Screw	8	
27	GB/T 95-2002 10	Washer	8	
26	01.01.03-3002	Bracket	4	L650
25	12.9 GB/T 70.1 M10×45	Screw	16	
24	M6-16mm	Screw	4	
23	M6	Washer	4	
22	GB/T 118-2000 6×20	PIN	4	
21	12.9 GB/T 70.1 M8×20	Screw	4	
20	GB/T 95-2002 8	Washer	4	
19	01.02.03-3001	X Waycover Support	4	
18	12.9 GB/T 70.1 M8×20	Screw	5	
17	R36-16K4-FSDC-1001-1150-0.008	X Ballscrew	1	借用V8Y丝杆
16	12.9 GB/T 70.1 M8×30	Screw	4	
15	GB/T 118-2000 6×30	PIN	2	
14	01.01.02-0004	Motor Plate	1	LV955
13	XHW-64C	Coupling	1	NBK
12	YSF-M25x1.5P	Lock Nut	1	
11	01.01.02-3002	XY Collar	1	
10	GB/T 118-2000 8×65	PIN	4	
9	12.9 GB/T 70.1 M12×50	Screw	12	
8	01.01.02	XY Motor Bracket	1	
7	01.01.02-7001	Plastic	2	LV955
6	12.9 GB/T 70.1 M6×20	Screw	4	
5	01.01.04	XY Seal	2	
4	GB/T 276-1994	Bearing 6205	1	02
3	GB/T894.1-1986	Collar	1	
2	01.01.03	XY Bearing Ass.	1	
1	01.02.01-0001	Saddle	1	
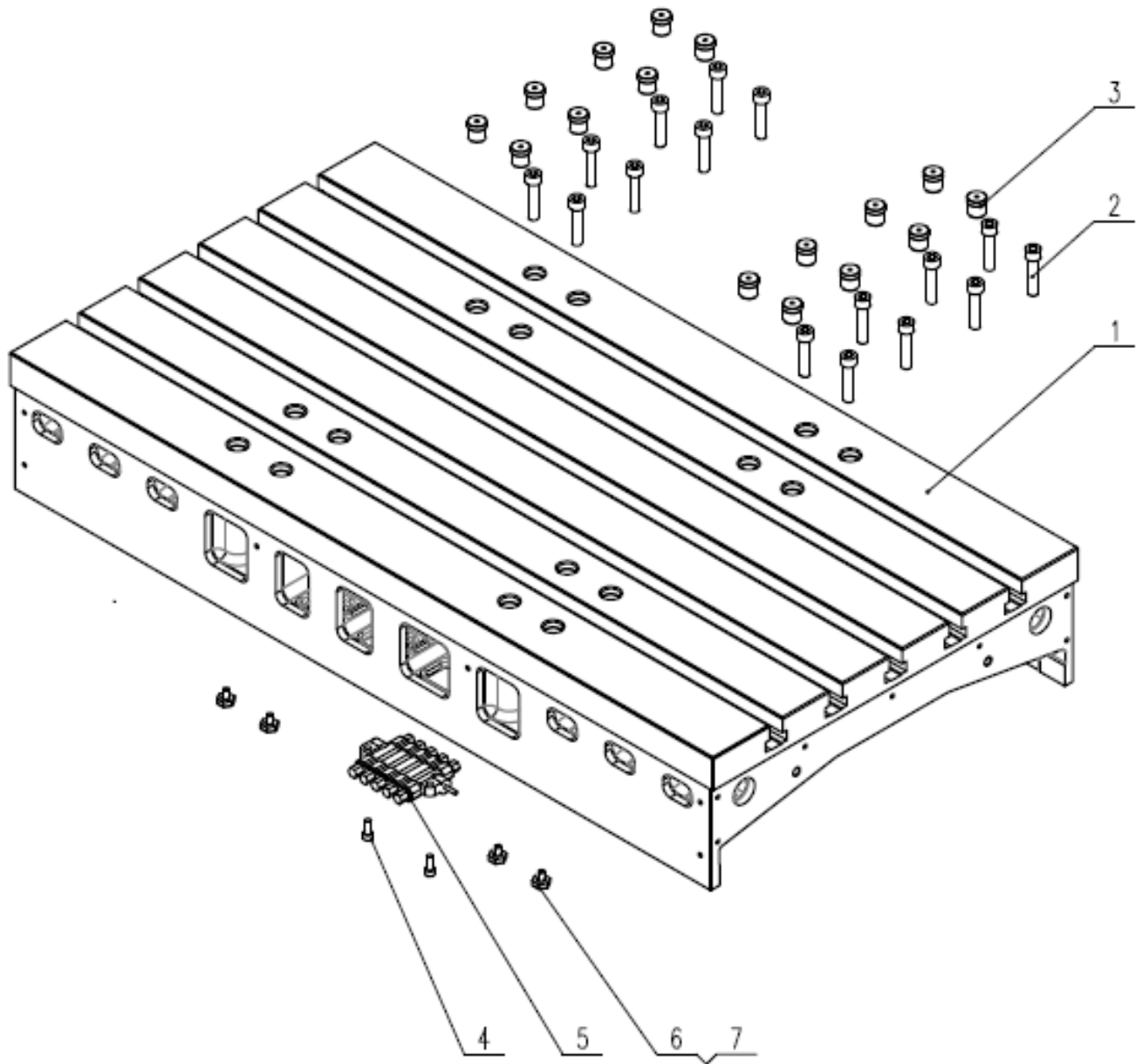
Item No.	Description	Part Name	Q'TY	Remark
7	M6–16mm	Screw	4	
6	M6	Washer	4	
5	RHYJ	Distributor	1	
4	12.9 GB/T 70.1 M6x16	Screw	2	
3	01.03.01–3002	plug	16	L850/L650
2	12.9 GB/T 70.1 M10×45	Screw	16	
1	01.03.01–0001	Table	1	
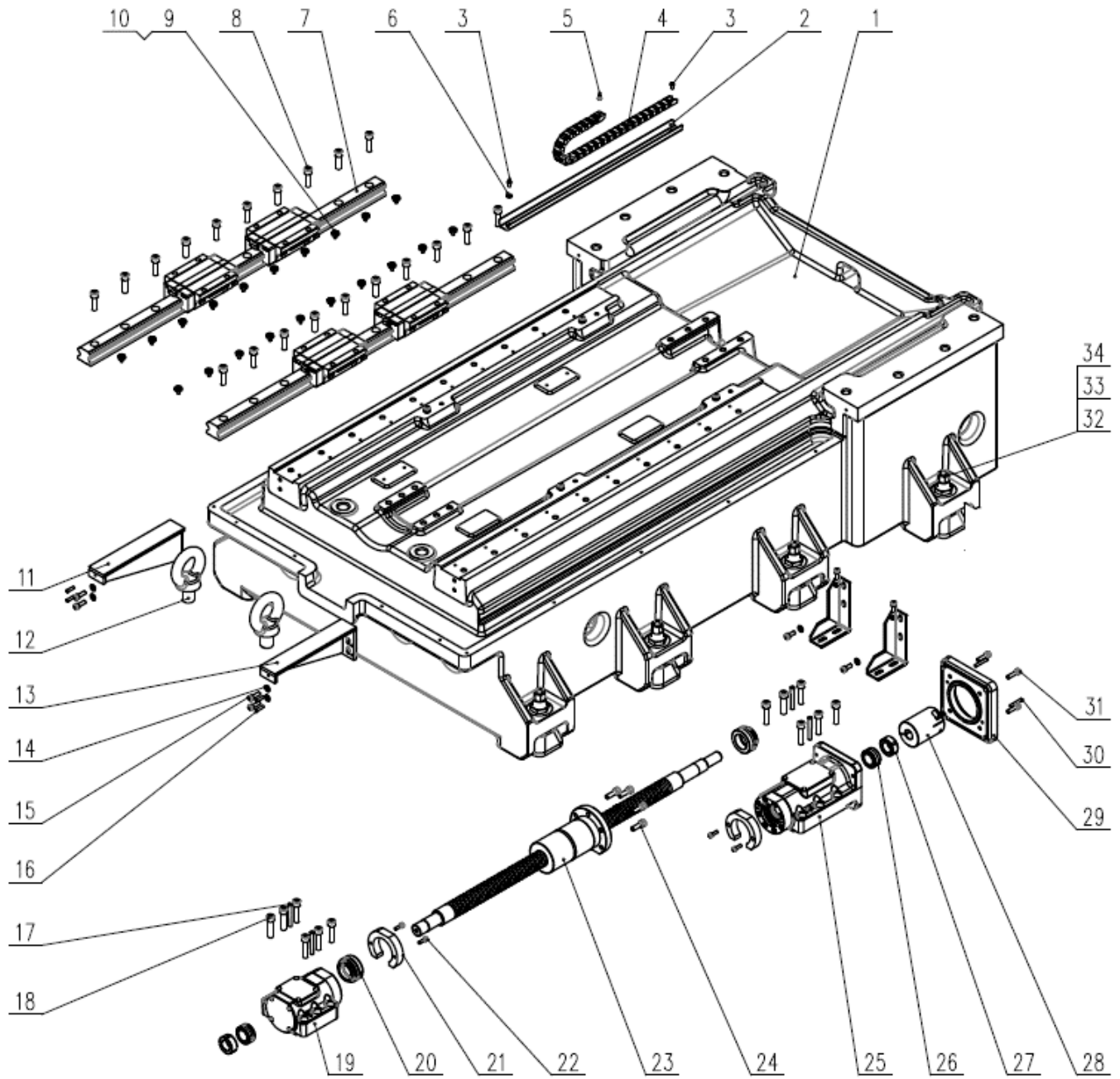
Item No.	Description	Part Name	Q'TY	Remark
34	01.01.01-3001	Leveling Nut	8	
33	01.01.01-3001	Leveling Bolt	8	
32	01.01.01-0002	Leveling Pad	8	
31	12.9 GB/T 70.1 M8×30	Screw	4	
30	GB/T 118-2000 6×30	PIN	2	
29	01.01.02-0004	Motor plate (Ø110-Ø130-24)	1	
28	XHW-64C	Coupling	1	NBK
27	YSF-M30x1.5P	Lock Nut	2	
26	01.01.02-3002	Collar	2	
25	01.01.02	Motor Bracket	1	
24	12.9 GB/T 70.1 M10×25	Screw	5	
23	R40-12K5-FDC-745-1040- 0.008	Y Ballscrew	1	L850Y
22	12.9 GB/T 70.1 M6×20	Screw	4	
21	01.01.02-7001	Plastic	2	
20	01.01.04	XY Seal	2	
19	01.01.03	Bearing Ass.	1	
18	12.9 GB/T 70.1 M12×50	Screw	12	
17	GB/T 118-2000 8×65	PIN	4	
16	GB/T 118-2000 6×20	PIN	4	
15	12.9 GB/T 70.1 M8×20	Screw	4	
14	GB/T 95-2002 8	Washer	4	
13	01.01.01-3004	Y Right waycover support	1	
12	M30	Eye Bolt	2	
11	01.01.01-3003	Y Left waycover support	1	
10	M6-16mm	Screw	20	
9	M6	Washer	20	
8	12.9 GB/T 70.1 M12×45	Screw	20	
7	HGR45HA2R1015ZAPII	Y Linear Guideway	2	
6	GB/T 95-2002 5	Washer	1	
5	12.9 GB/T 70.1 M5×10	Screw	1	
4	15×15	Cable Track	1	L850
3	12.9 GB/T 70.1 M6×12	Screw	2	
2	01.01.01-3005	Guide Plate	1	
1	01.01.01-0001	Base	1	
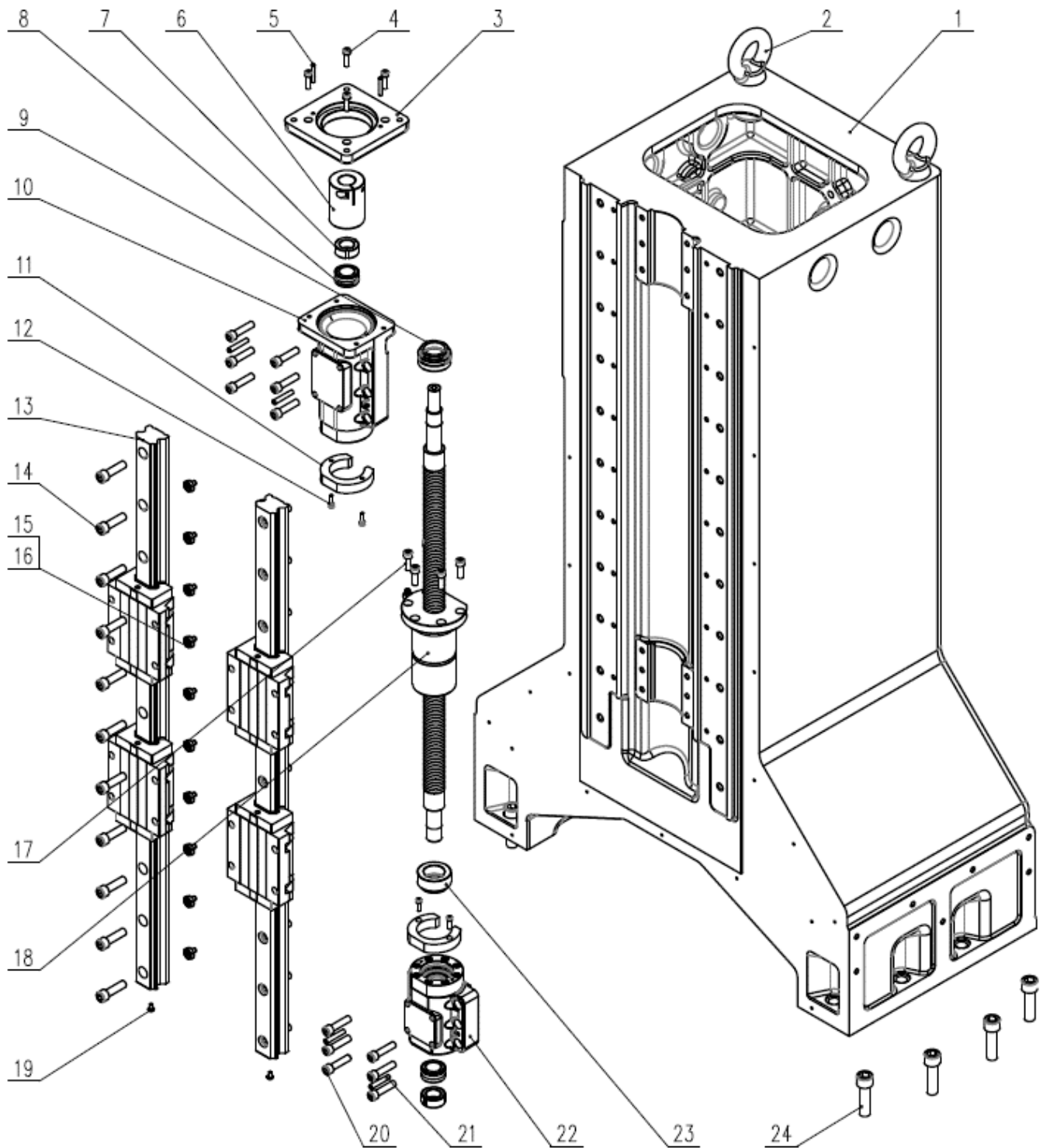
Item No.	Description	Part Name	Q'TY	Remark
24	12.9 GB/T 70.1 M20×70	Screw	8	
23	01.04.04	Z Seal	1	
22	01.04.03	Z Lower Bearing Ass.	1	
21	GB/T 118-2000 8×65	PIN	4	
20	12.9 GB/T 70.1 M12×50	Screw	12	
19	GB/T 70.2-2008 M6×12	Screw	2	
18	R40-12K5-FDC-745-1040- 0.008	Y Ballscrew	1	L850Y
17	12.9 GB/T 70.1 M10×25	Screw	5	
16	M8-16mm	Screw	20	
15	M8	Washer	20	
14	12.9 GB/T 70.1 M14×50	Screw	22	
13	HGW55HA2R1280ZAPII	Z Linear Guideway	2	
12	12.9 GB/T 70.1 M6×20	Screw	4	
11	01.01.02-7001	Plastic	2	
10	01.01.02	Bearing Ass.	1	
9	01.01.04	XY Seal	1	
8	01.01.02-3002	Collar	2	
7	YSF-M30x1.5P	Lock Nut	2	
6	XHW-64C	Coupling	1	
5	GB/T 118-2000 6×30	PIN	2	
4	12.9 GB/T 70.1 M8×30	Screw	4	
3	01.01.02-0004	Motor Plate (Ø110-Ø130-24)	1	
2	M30	Eye Bolt	2	
1	01.04.01-0001	Column	1	
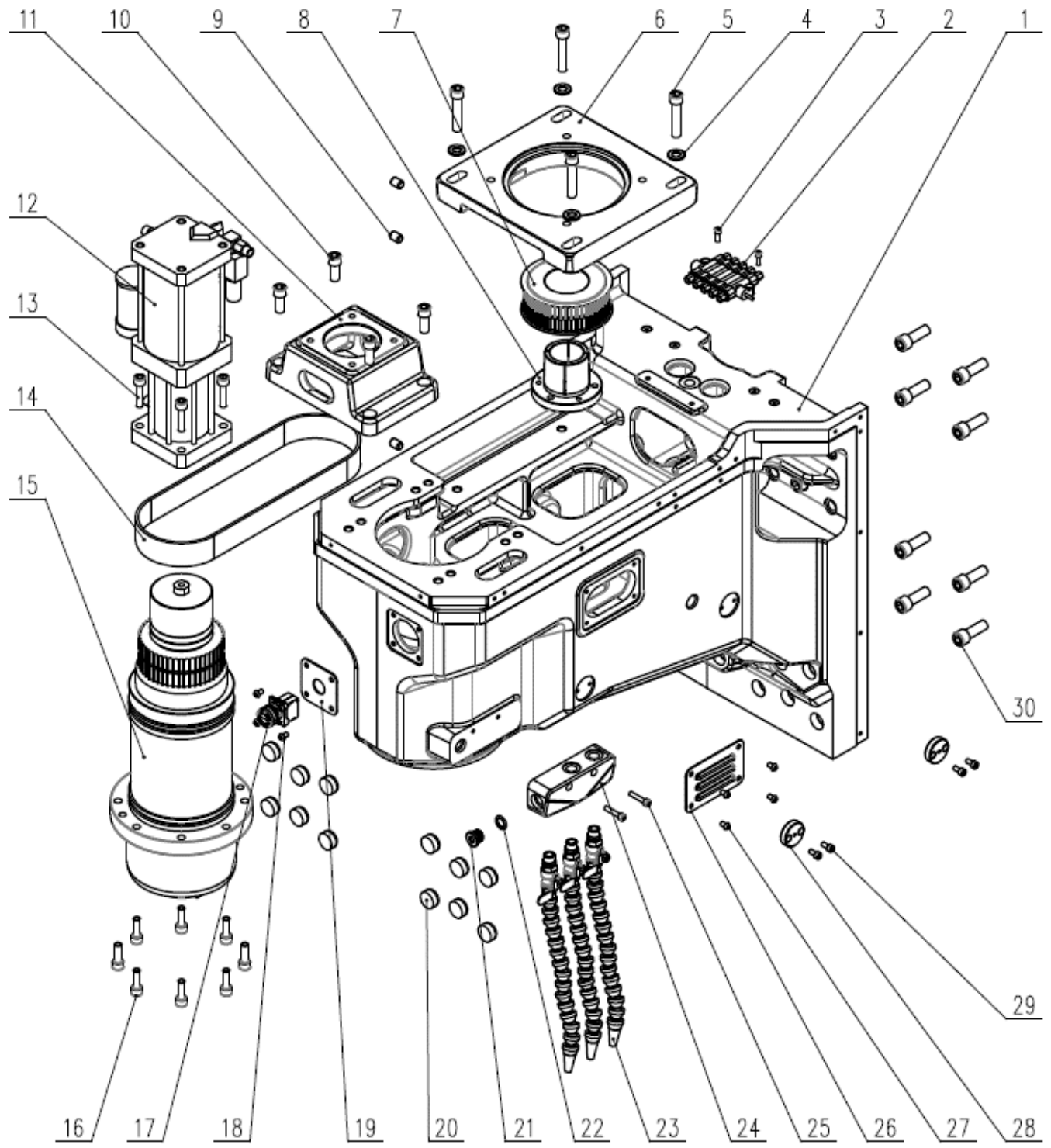
Item No.	Description	Part Name	Q'TY	Remark
30	12.9 GB/T 70.1 M14×40	Screw	16	
29	12.9 GB/T 70.1 M6×12	Screw	8	
28	01.05.01-3003	Plate	4	
27	GB/T 70.2-2008 M6×12	Screw	8	
26	01.05.01-3002	Ram window	2	
25	12.9 GB/T 70.1 M6×35	Screw	2	
24	01.05.01-0004	Distributor	1	
23	GB/GQ0627-88 3/8	Tube	3	
22	OR3001500(ø15×ø3)	O Seal	1	
21	GB/T70.1-2000 3/8	Screw	1	
20	01.05.01-0008	Plug	24	
19	01.05.01-3001	Switch Plate	1	
18	GB/T 70.2-2008 M6×12	Screw	4	
17	01.05.01-7010	Booster Cylinder Switch	0	
16	12.9 GB/T 70.1 M10×30	Screw	8	
15	RB4002 BT40-ø150	Spindle (8000r)	1	
14	920-8YU-40	Belt	1	
13	12.9 GB/T 70.1 M10×40	Screw	4	
12	HchBz(4.5TX13)	Booster Cylinder	1	
11	01.05.01-0002	Booster Cylinder Mount	1	
10	12.9 GB/T 70.1 M12×35	Screw	4	
9	GB/T 77-2000 M12×16	Screw	4	
8	(ø48)	Tapper Lock	1	
7	(8YU-48T)	Pulley	1	
6	01.05.01-0003	Motor Plate (ø180-ø215-35)	1	
5	12.9 GB/T 70.1 M12×55	Screw	4	
4	GB/T 95-2002 12	Washer	4	
3	12.9 GB/T 70.1 M6×12	Screw	2	
2	rh-35	Distributor	1	
1	01.05.01-0001	Ram	1	
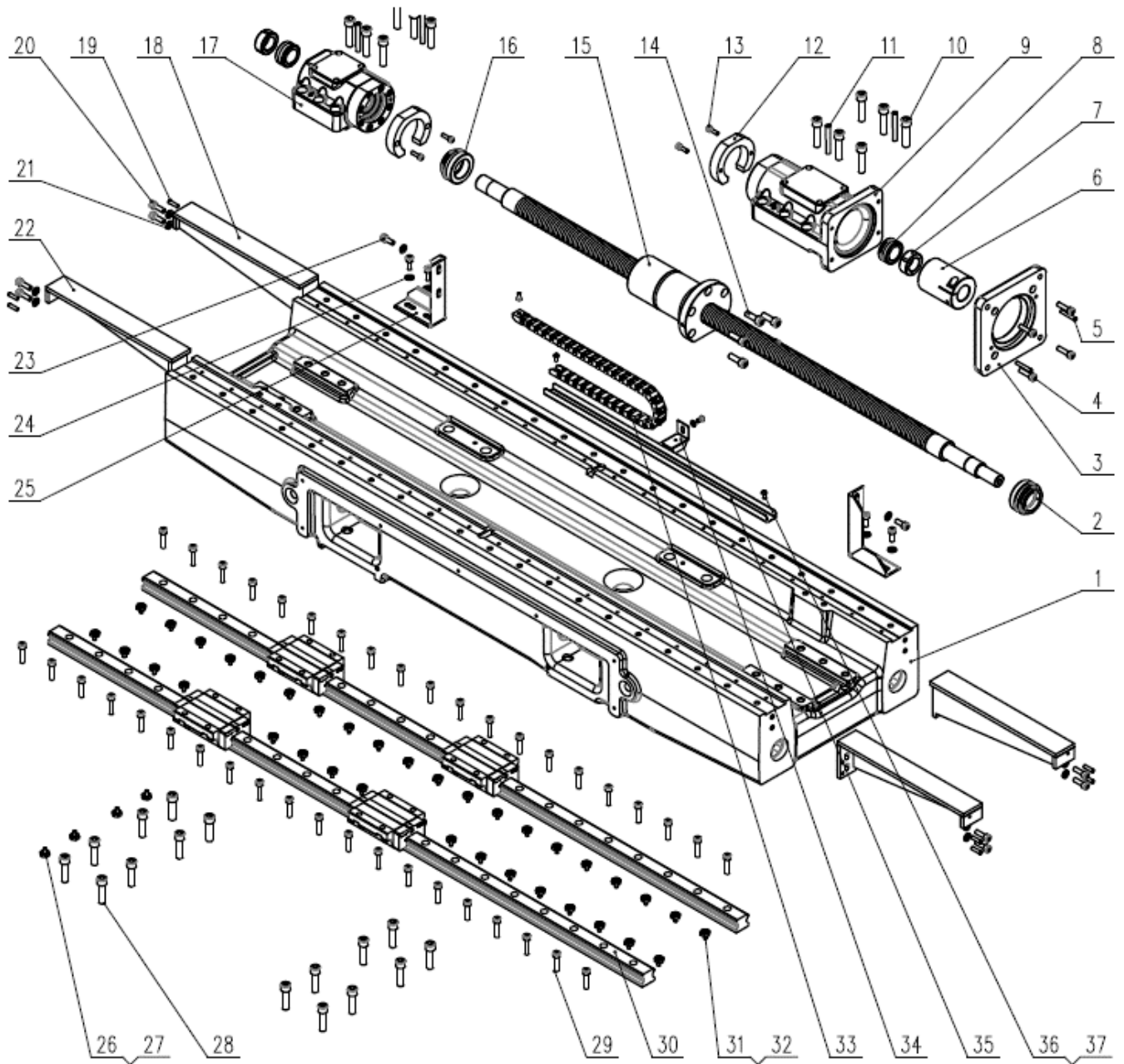
Item No.	Description	Part Name	Q'TY	Remark
37	GB/T 95–2002 5	Washer	2	
36	12.9 GB/T 70.1 M6×12	Screw	4	
35	01.01.01–3005	Guide Plate	1	LV955
34	01.02.01–3004	Track Bracket	1	LV955
33	10×10	Cable Track	1	
32	M6–16mm	Screw	42	
31	M6	Washer	42	
30	HGR35HA2R1600AZPII	X Ballscrew	2	
29	12.9 GB/T 70.1 M8×30	Screw	42	
28	12.9 GB/T 70.1 M12×45	Screw	16	
27	M6–16mm	Screw	4	
26	M6	Washer	4	
25	01.01.01–3006	Fastening Bracket	2	LV955
24	GB/T 95–2002 8	Washer	4	
23	12.9 GB/T 70.1 M8×20	Screw	4	
22	01.02.01–3002	X Right waycover Support	2	LV955
21	GB/T 95–2002 8	Washer	8	
20	12.9 GB/T 70.1 M8×20	Screw	8	
19	GB/T 118–2000 6×20	PIN	8	
18	01.02.01–3001	X Left waycover support	2	
17	01.01.03	Bearing Ass.	1	LV955
16	01.01.04	XY Seal	1	LV955
15	R40-12K5-FDC-1102-1470- 0.008	X Ballscrew	1	
14	12.9 GB/T 70.1 M10×25	Screw	5	
13	12.9 GB/T 70.1 M6×20	Screw	4	
12	01.01.02–7001	Plastic	2	LV955
11	GB/T 118–2000 8×65	PIN	4	
10	12.9 GB/T 70.1 M12×50	Screw	12	
9	01.01.02	Motor Bracket	1	LV955
8	01.01.02–3002	Collar	2	LV955
7	YSF–M30x1.5P	Lock Nut	2	
6	XHW–64C	Coupling	1	NBK
5	GB/T 118–2000 6×30	PIN	2	
4	12.9 GB/T 70.1 M8×30	Screw	4	
3	01.01.02–0004	Motor Plate (ø110–ø130–24)	1	LV955
2	01.02.02	32 Seal	1	
1	01.02.01–0001	Saddle	1	
Item No.	Description	Part Name	Q'TY	Remark
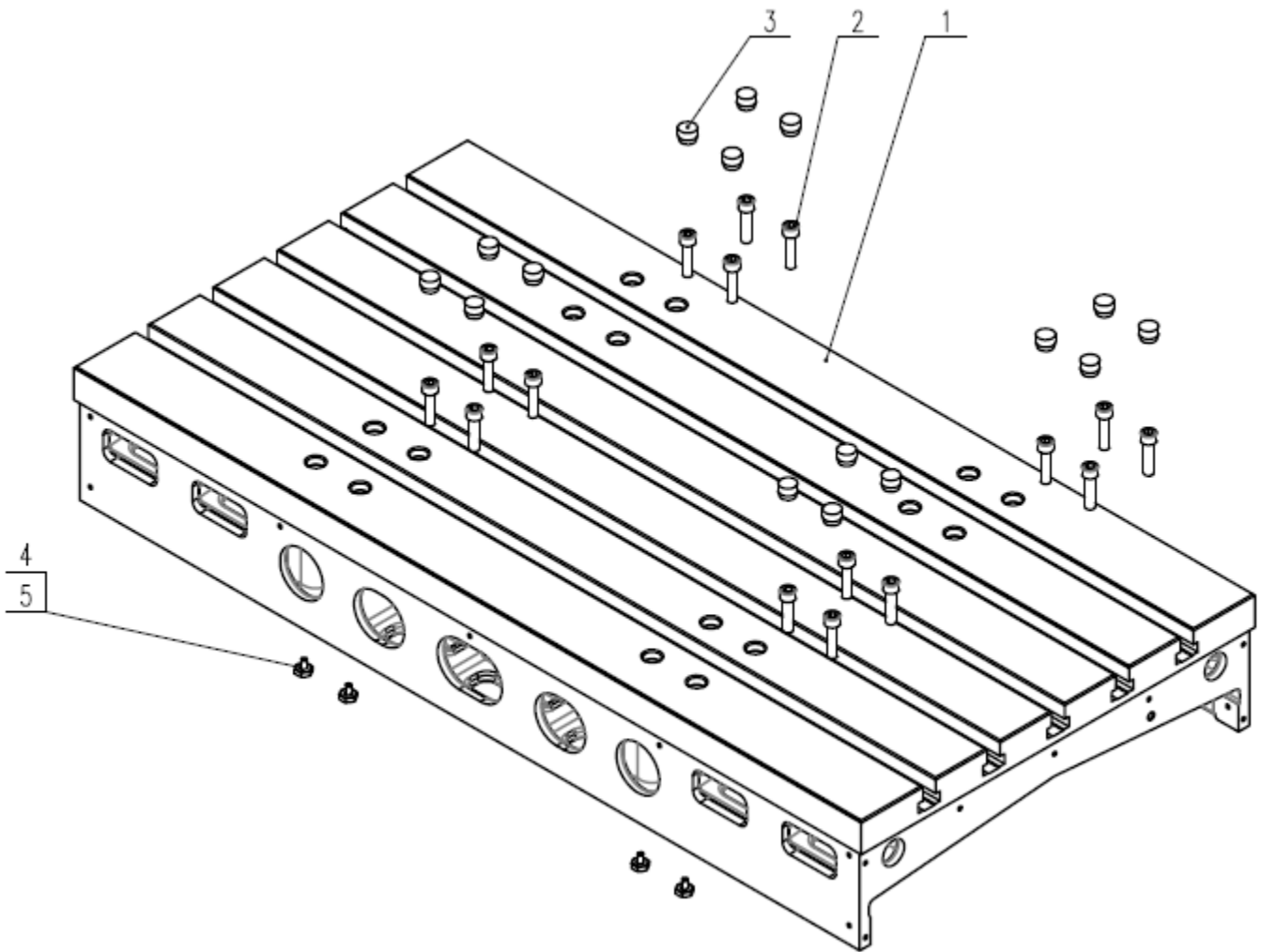
Item No.	Description	Part Name	Q'ty	Remark
5	M6–16mm	Screw	4	
4	M6	Washer	4	
3	01.03.01–3002	Plug	16	L850/L650
2	12.9 GB/T 70.1 M10×40	Screw	16	
1	01.03.01–0001	Table	1	