

NC ROTARY TABLE

INSTRUCTION MANUAL

Model MX160

IMPORTANT


Please read and understand DANGER / WARNING items in this manual before operating your NC Rotary Table.

Please keep this manual by your side for answers to any questions you may have and to check.

Thank you for choosing the Kitagawa NC Rotary Table.
 Kitagawa, a world-renowned precision equipment manufacturer, has developed the finest quality NC Rotary Table with emphasis in high precision and rigidity as its basic principals in design.

This NC Rotary Table has been designed to provide years of high precision performance. To ensure optimum and trouble-free performance, please read this operation manual carefully before using the unit and retain this copy for your future reference.

Please pay close attention to the procedures with the following warning marks(!) to avoid severe injury and/or accident.



SAFETY ALERT SYMBOL

This is the industry "Safety Alert Symbol". This symbol is used to call your attention to items or operations that could be dangerous to you or other persons using this equipment. Please read these messages and follow these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to assemble or use this unit.

WARNING



DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

IMPORTANT

IMPORTANT

Instructions for table performance and avoiding errors or mistakes.

TABLE OF CONTENTS

	Page
1. For Your Safety-----	1
2. Specifications-----	7
3. Accuracies-----	8
4. Preparation-----	9
4-1 Installation	
4-2 Lubrication	
4-3 Rquired Oil Quantity	
4-4 Recommended Lubricating Oil	
4-5 Inlet Pressure for Table Clamp	
4-6 Air purge	
5. Inspection-----	10
6. Table Clamp and Unclamp-----	11
6-1 General Instruction	
6-2 Confirmation of Clamp and Unclamp	
6-3 Solenoid Valve for Clamp and Unclamp	
7. Mounting the Workpiece-----	12
8. Adjustment of Backlash between Worm Wheel and Worm Gear-----	13
8-1 Measuring the Backlash of the Worm Gear	
8-2 Adjusting the Backlash of the Worm Gear	
9. ZRN device-----	16
9-1 ZRN device on table	
9-2 ZRN device Adjustment	
9-3 Sensor Mechanism	
10. Motor Cover-----	18
10-1 Dismount	
10-2 Waterproofing	
11. Storage-----	19
12. Indexing Accuracy and Pitch Error-----	19
13. Mounting Rotary Joint (Option)-----	20
13-1 Alignment of discharge opening face	
13-2 Pining to supply part	

Appendixes

- Appendix 1 Outside View
- Appendix 2 Wiring Diagram

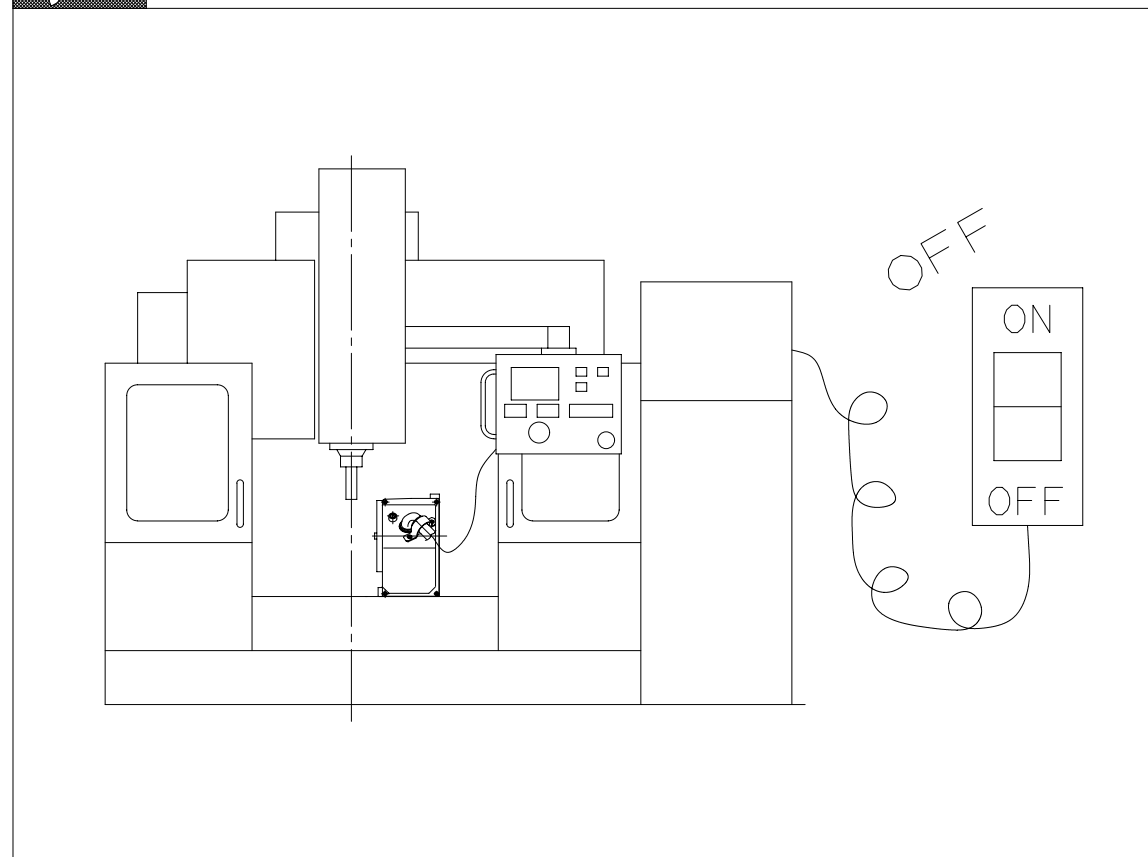
1. For Your Safety

Basic Safety Tips

Please read this manual and follow instructions carefully.
 We cannot assume responsibility for damage or accidents caused by misuse of the NC Rotary indexing tables, through non-compliance with the safety instructions.

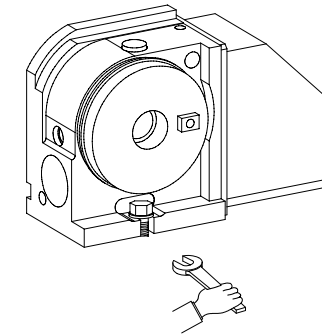


 Turn off the main power of the machine prior to maintenance, check, or repair of the unit. Failure to do so may cause severe injury and/or accident.



Tighten the bolts securely when mounting the unit on the machine table.

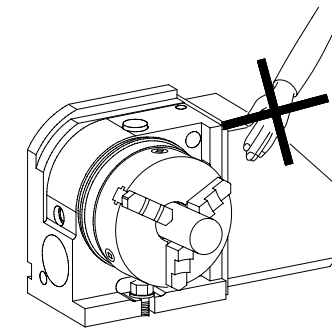
Please refer to the chart below for the recommended tightening torque of the bolts.



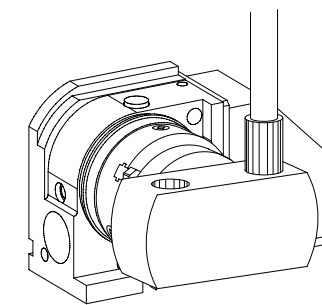
Hex. Bolt Size	Torque N·m
M10	33.8
M12	58.9
M16	146.3
M20	294.3



Make sure the working area is clear of any foreign object and/or hand when the unit is in operation to avoid any serious accident and/or injury.



Do not apply cutting force which exceeds the specification in this manual. Failure to do so may cause severe injury and/or damage to the unit.

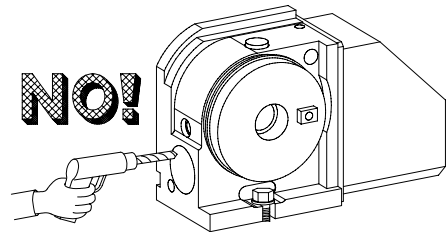




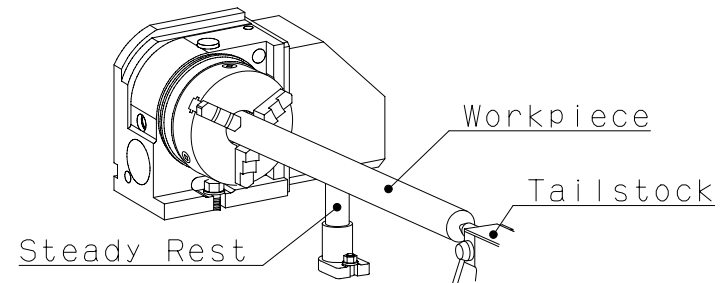
WARNING



Please consult your local distributor before attempting any modification of the unit.



Use a support, steady rest, or tailstock for heavy or long workpieces to prevent any injury and/or accident. (See P.7)

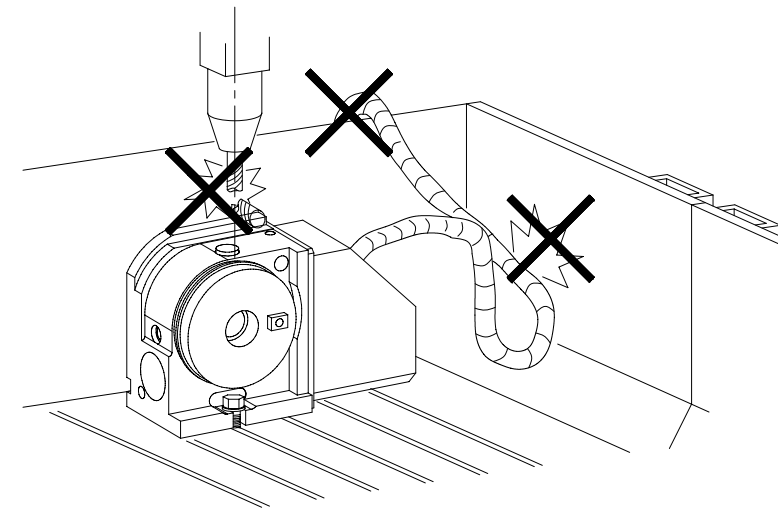


CAUTION



Maintain adequate clearance between the unit and any part of the machine.

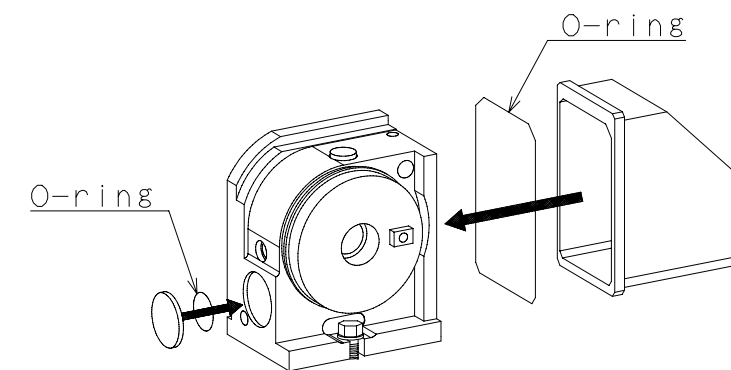
Avoid bending the external cables and air tube of the unit.



CAUTION



Mount all covers attached with O-rings. (No damages on O-rings)

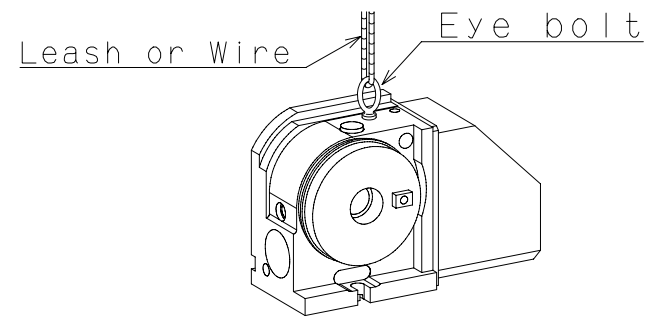




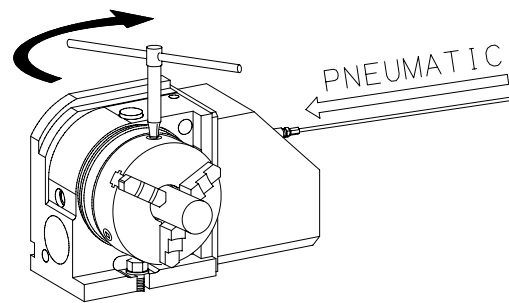
CAUTION



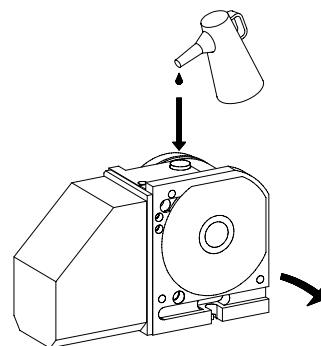
When transporting the unit, make sure to use eye bolts and a sufficient leash or wire.



Mount or dismount the workpiece to or from the unit while the unit is clamped to avoid damage to the internal mechanism and diminished indexing accuracy of the unit.



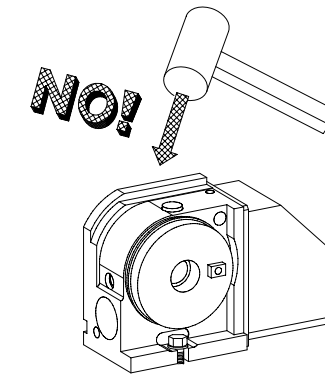
Replace lubricating oil every 6 months. (See P.9)



CAUTION

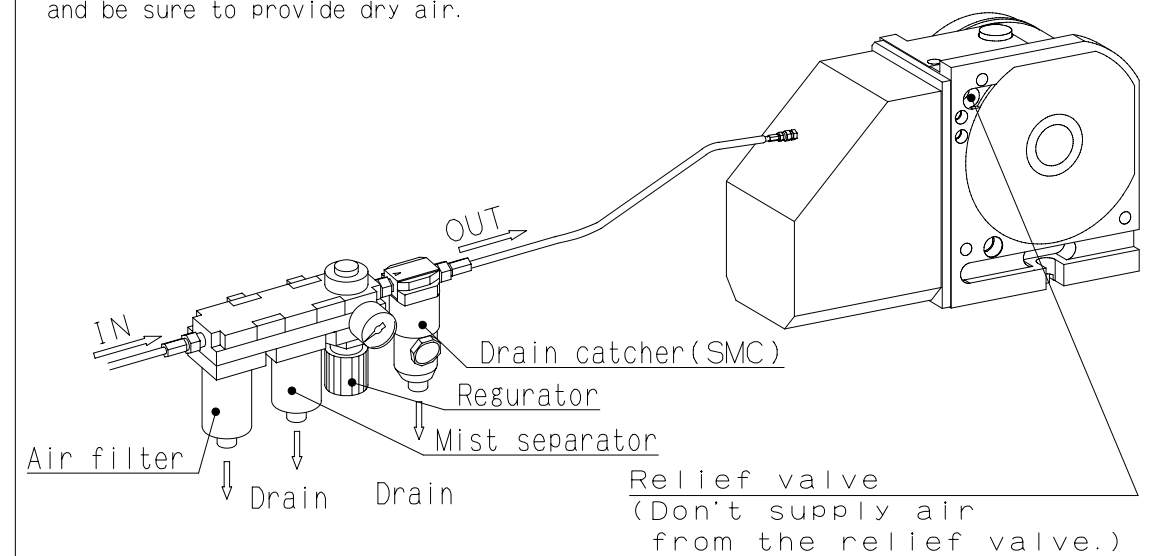


Avoid sudden impact to any part of the unit which may cause damage to the internal mechanism.



Supply air through Air combination (Air filter, Mist separator, regulator) + Drain catcher. (The air supply port is on the motor case.) (See P.10)

Apply air purge inside the motor case and be sure to provide dry air.



2. Specifications

NC Rotary Table is dividing unit for the workpiece, usually operating machines. [Machining Center.(NC) milling machine. (NC)drilling machine. etc.]

Specifications are as follows.

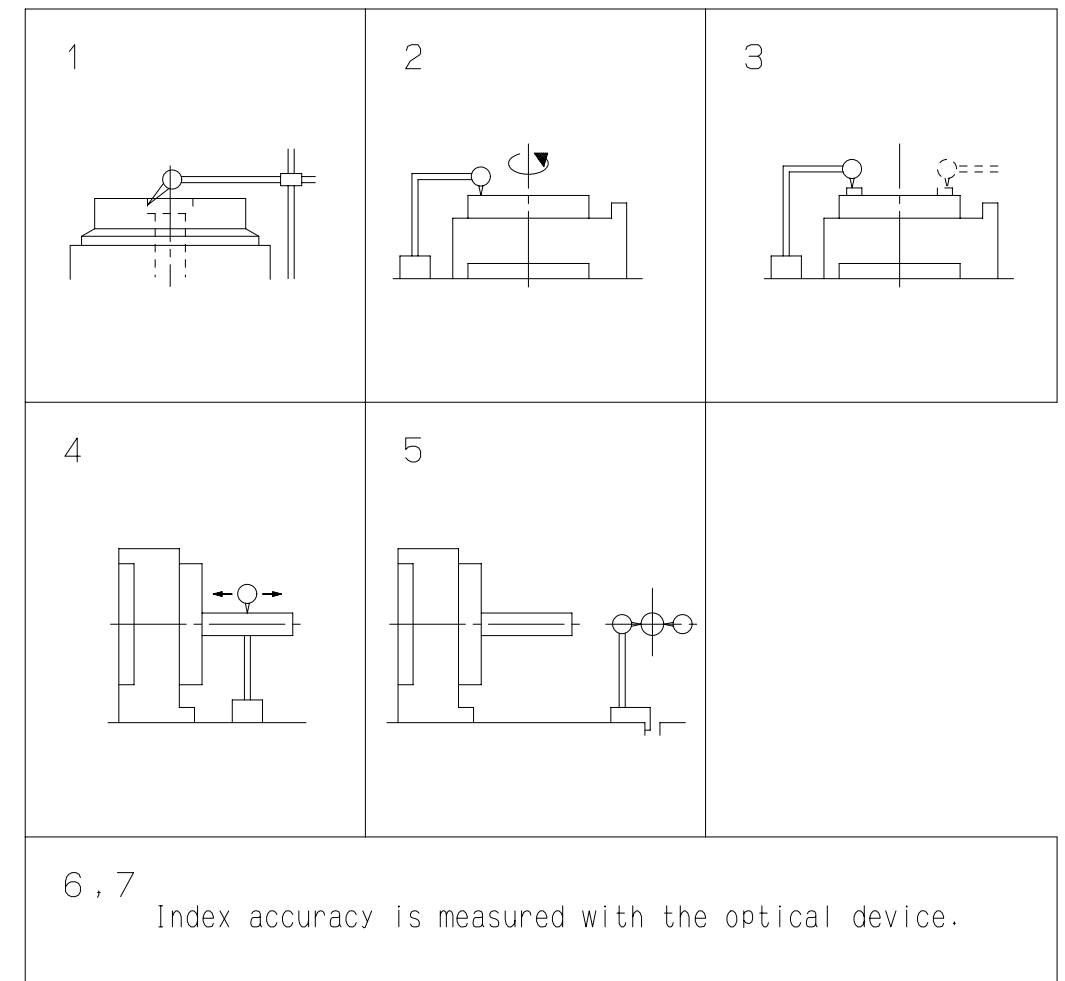
ITEM	MODEL	MX(M)160
1	Table Diameter	mm $\phi 165$
2	Table Height in Horizontal	mm 150
3	Center Height in Vertical	mm 140
4	Center Hole Diameter	mm $\phi 50$
5	Thru. Hole Diameter	mm $\phi 40$
6	Guide Block Width	mm 14h7
7	Clamping Torque [Pneumatics 0.5MPa N·m(kgf·m) (5.1kgf/cm ²)]	310(31.6)
8	Allowable Workpiece Dia.	mm $\phi 165$
9	Allowable Mass of Workpiece (kg)	Horizontal 80
		Vertical 40
10	Allowable Work Inertia Kg·m ² (kgf·cm·sec ²)	0.25(2.5)
11	Total Reduction Ratio	1/40
12	Max. Rotation Speed min ⁻¹	75
13	Mass of Rotary Table	kg 43

3. Accuracies

GUARANTEED ACCURACIES

(Unit : mm)

	DESCRIPTION OF INSPECTION		GUARANTEED ACCURACY
1	Run-out of center hole		0.01
2	Run-out of table surface		0.02
3	Parallelism of table surface and reference plane for horizontal installation	per 150mm	0.02
4	Parallelism of rotating axis center line and reference plane for vertical installation	per 150mm	0.02
5	Parallelism of rotating axis center line and guide block center	per 150mm	0.02
6	Indexing accuracy	cumulative	40sec
7	Repeatability	cumulative	8sec



IMPORTANT

The above-mentioned list shows the value in standard specification. Please refer to the outside view for details.

IMPORTANT

Table clamping torque is measured at 0.5MPa(5.1kgf/cm²) pneumatic pressure. Max. Rotation Speed is at 3000min⁻¹(rpm) of the motor rotation.

CAUTION

Be sure to observe the allowable work inertia even if the mass of work is within the allowable value.

CAUTION

There is a possibility to need the tailstock by the mass of work, shape, cutting condition, etc.

CAUTION

For conditions for using the table, refer to the above specifications and caution items. Set each cutting condition so as not to exceed the allowable value.

4. Preparation

Unpack the unit and remove the packing material.

4-1 Installation

- 1) When lifting the unit, securely screw in the eye bolts provided. Use wire loop which provided sufficient strength to lift the unit.
- 2) Clean the unit thoroughly with an adequate clean agent. When installing the unit on the machine table, make sure there is no foreign material nor damage such as nicks and burrs on the mating faces. Use an oil stone for correction if necessary.
- 3) Locate and set the unit at the most suitable location for the operation. In case of vertical installation, the guide blocks will fit into the slotted groove on the machine. If there is any play between the guide block and the T-slot, place the unit against one side of the T-slot to eliminate the gap.
- 4) Firmly clamp down the unit to the machine with the furnished clamping fixtures.



When the unit is installed on the machine, ensure to avoid any interferences with any part of the machine. Especially when the machine has a capability of X-Y-Z axis movement of the spindle head or the machine bed, the interference must be checked carefully before starting the operation.



Apply the clamping fixtures to the step of the unit provided, and clamp the bolts with the specified torque. (See P.2)

4-2 Lubrication



Change the lubricating oil every 6 months. Be sure to drain all oil from the unit first. When pouring oil into the unit, make sure to clean the area around the lubrication port so that no foreign material will enter the system. It may cause severe damage to the internal mechanism. Use recommended oil shown 4-4.

4-3 Required Oil Quantity (Unit: liter)

MODEL	MX(M)160
QTY.(l) at Horizontal installation	0.25
QTY.(l) at Vertical installation	0.25

Dafunimultiway 32MT (Idemitsu) is provided in the unit before shipping.

4-4 Recommended Lubricating Oil

Maker	Oil Name	Maker	Oil Name
Mobil	Vactra Oil No.1	Cosmo	Dynaway 32
Nippon Oil Corporation	Uniway 32	Idemitsu	Daphne Multiway 32MT
Jomo	Slidus HS32	Esso	Unipower MP32
Shell	Shell Tonna Oil S32		

·Grade of Viscosity : ISO VG32

4-5 Inlet Pressure for Table Clamp

- 1) Use an appropriate filtration system. (Air Filter, Mist separator, Regulator, Drain catcher set)
- 2) Connect the air hose to the slot. The air inlet (the slot is Rc 1/4) is located on the motor case. Be sure to refer to the outside view for air hose installation.
- 3) The air supply pressure should be range from 0.5 to 0.6 MPa (5.1 to 6.1 kgf/cm²).
- 4) Where the tailspindle is additionally used, supply air to the tailspindle via the NC Rotary Table by using either of the tailspindle slot (Rc 1/4) provided on the reverse or top surfaces of the base. (Refer to the outside view.)

4-6 Air purge



According to the circumstance of use, the dew may be occurred in the motor case. Air is exhausted from the portion of the air exhaust so that it causes the obstacle of electric parts or each part. The air purge is performed by air branched inside of NC table that uses air for clamp. Be sure to use the clean air (passing through air filter, mist separator, regulator and drain catcher) passing through the filter. If the air contains water content (moisture), oil content, etc., it is entered in the motor cover, thus causing in equipment damage. The air inside of motor case is exhausted from the air exhaust port. In case that the portion of the air closed, motor case or motor etc. may be damaged so that the dew cannot be exhausted and that air pressure is kept in the motor case. Therefore the portion of exhaust should not be closed. When exhausting, though exhaust sound occurs, there is no trouble.

5. Inspection

Daily inspection

- 1) Confirm that the NC rotary tables (including jigs, if attached) are securely fixed.
- 2) Confirm that the electric connection cables and hoses are not damaged and the penumatic pressure is appropriate.
- 3) Confirm that the machine-zero operation and indexing operation and position.
- 4) Confirm that there is no abnormal vibration or noise. (eq. Body and motor)
- 5) Confirm that there is no abnormal heating. (eq. Body and motor)

Periodic inspection (Inspect the following items every six months.)

- 1) Confirm that muddiness of the lubricating oil.
- 2) Confirm that the connectors are securely attached and there is no damage on the cables.
- 3) Confirm that corrosion and breaking of the wiring in the motor case.

6. Table Clamp and Unclamp

6-1 General Instruction



When the table is positioned, activate the table clamp. When the table is in motion, Inactivate the table clamp.

Improper procedures in table clamp and/or unclamp may cause severe damage to the internal mechanism. This unit is supplied with two pressure switches for table clamp and unclamp for added safety.



Make sure that your cutting operation on the unit does not exceed the table clamping force specified on the specification sheet. This may cause damage to the internal mechanism.



If some excessive pressures remain when it is unclamped, the unit is operating under a half-clamp situation. This may cause severe damage to the internal mechanism.

6-2 Confirmation of Clamp and Unclamp

The unit is equipped with two built-in pressure switches for clamp/unclamp detection as shown in Fig. 1. The set up pressure of each switch for pneumatic systems is as follows:

Signal	Clamp Signal (SP1)	Unclamp Signal (SP2)
Pneumatic	0.25 MPa (2.55 kgf/cm ²) PS1000-R06L-Q-X140	0.055 MPa (0.56 kgf/cm ²) PS1100-R06L-Q-X141

The pressure switches SMC CORP made are used.

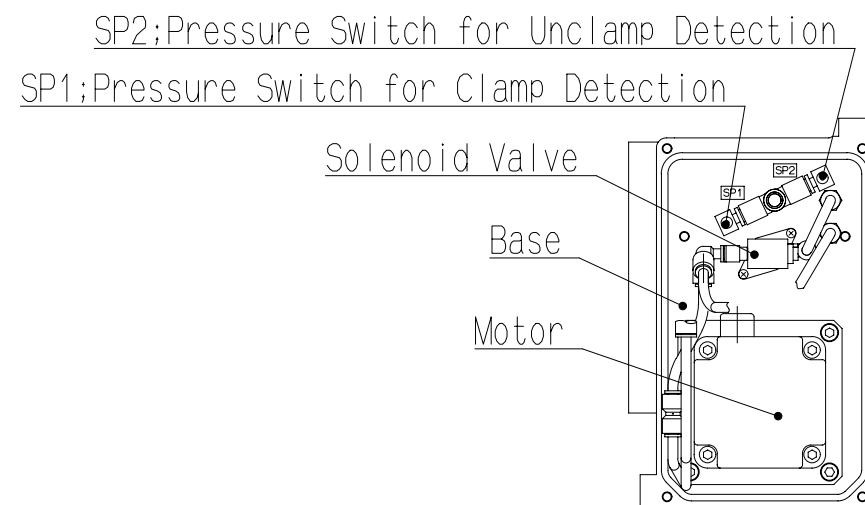


Fig. 1

6-3 Solenoid Valve for Clamp and Unclamp

For Pneumatic Clamping, a solenoid valve is equipped inside. The piping is arranged as follows as a standard set up. Be sure to arrange electrical wiring accordingly.

(Excitation Unclamp Spec.)

Solenoid ON — Unclamp

Solenoid OFF — Clamp

(Excitation Clamp Spec.)

Solenoid ON — Clamp

Solenoid OFF — Unclamp



Since there is polarity in the pressure switch by SMC CORP., a proximity switch, and a solenoid valve, please refer to the wiring diagram.

7. Mounting the Workpiece



Securely mount the workpiece to the unit. If this is not done properly, it may cause severe injury and/or accident as well as poor indexing accuracy.



Avoid mounting a workpiece which has poor flatness or perpendicularity directly to a table face. This may strain the table and prevent smooth rotation, which may result in very poor indexing accuracy. Shimming may be required to prevent this problem.



Clamp the work in equipartition on the rotary table as much as possible.

8. Adjustment of Backlash between Worm Wheel and Worm Gear

The amount of backlash has been adjusted to the appropriate range at time of the shipment from the factory. However, if it becomes necessary, excessive backlash between the precisely machined double-lead worm and worm wheel can be eliminated easily with two slightly different inclined leads provided on the worm gear. Appropriate amount of backlash between the worm and worm wheel is shown below.

The figures apply only when the unit is cold. The amount of backlash will be affected by thermal expansion when the unit warms up during operation.



If the amount of backlash is too small, it may cause a heat seizure of the worm and worm wheel.

○ Optimum values of backlash

MODEL	MX(M)160
Backlash in circular length at table guide block center(μm)	10~29
Backlash in seconds	33~98

If it is necessary to adjust the amount of backlash, measure the backlash using the following procedure:

8-1 Measuring the Backlash of the Worm Gear (See Fig.2.)

- 1) Set a dial gauge on the side face of the guide block on the top surface of the table.
- 2) Turn the table slowly by using the tap on the surface of the table as shown in fig.2. And read the value of the dial gauge when tooth of the worm wheel makes contact with a worm shaft. At this time, the rotating torque added to the table is as follows. Then, rotate the table on the same conditions to the opposite direction. The difference of these measurements is the amount of backlash.

MODEL	MX(M)160
Torque added to table T(N·m)	15

- 3) The above measurements should be conducted at four different points by rotating the table 90 degrees at a time. Compare the readings with the correct amount of backlash shown above. If the reading is out of the range specified, take the following procedures to adjust the backlash so that the minimum reading is within the correct range specified above.

$$T = F \times L$$

T:Torque(N·m)

F:Effort force(N)

L:Distance from table center to point to add power F(m)

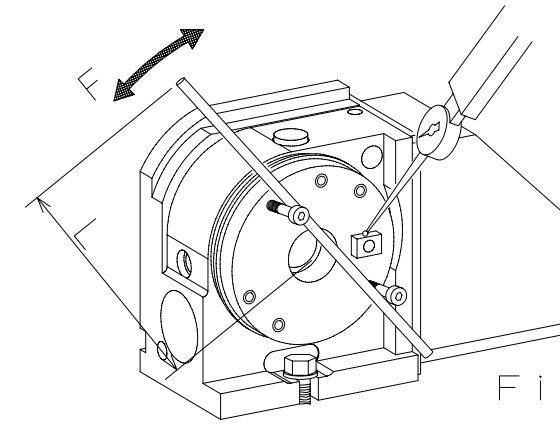


Fig. 2

8-2 Adjusting the Backlash of the Worm Gear (See Fig.3.)

This adjustment affect the indexing accuracy and worm wheel durability, thus it is strongly recommended that a skilled technician should do the adjustment.

Please consult Kitagawa distributor before the adjustment.



Before proceeding to the backlash adjustment, you must turn off the power to the control unit and set the NC Rotary Table in the 'unclamp' mode. If this caution is ignored, your hands or clothes may be caught in the gear while the gear is rotating resulting in serious injury.

- 1) For the backlash adjustment, you must discharge the lubricating oil throuht the drain
- 2) For vertical installation, remove the hexagon socket headless tapered pipe plug (3/8) ① located on the reference plane for vertical installation, and for horizontal installation, remove the same pipe plug (3/8) ② located on the reference plane for vertical installation.
- 3) You will see the coupling ⑤ through the hole after removing the screw plug in the previous step. Rotate the worm shaft to a position where you can see the hexagon socket head cap screw ③, which fixes the coupling ⑤ and the worm shaft ⑦.
- 4) Loosen the hexagon socket head cap screw ③, which is fixed on the coupling ⑤.
- 5) Then, remove the cover ⑨, which is located on the opposite side on the motor case ⑥, and slightly loosen all four hexagon socket head cap screws ⑩ which fix the bearing case ⑫. Then, slightly loosen the four adjustment screws ⑪ the same amount. Now, re-fastening the four hexagon socket head cap screws ⑩ will move the bearing case ⑫ ahead, which makes the backlash of the worm shaft ⑦ small.

IMPORTANT

Since the pitch of the adjustment screw ⑪ is set to 1.0 mm, loosening the screw by one rotation will make the backlash smaller as shown in the following table.

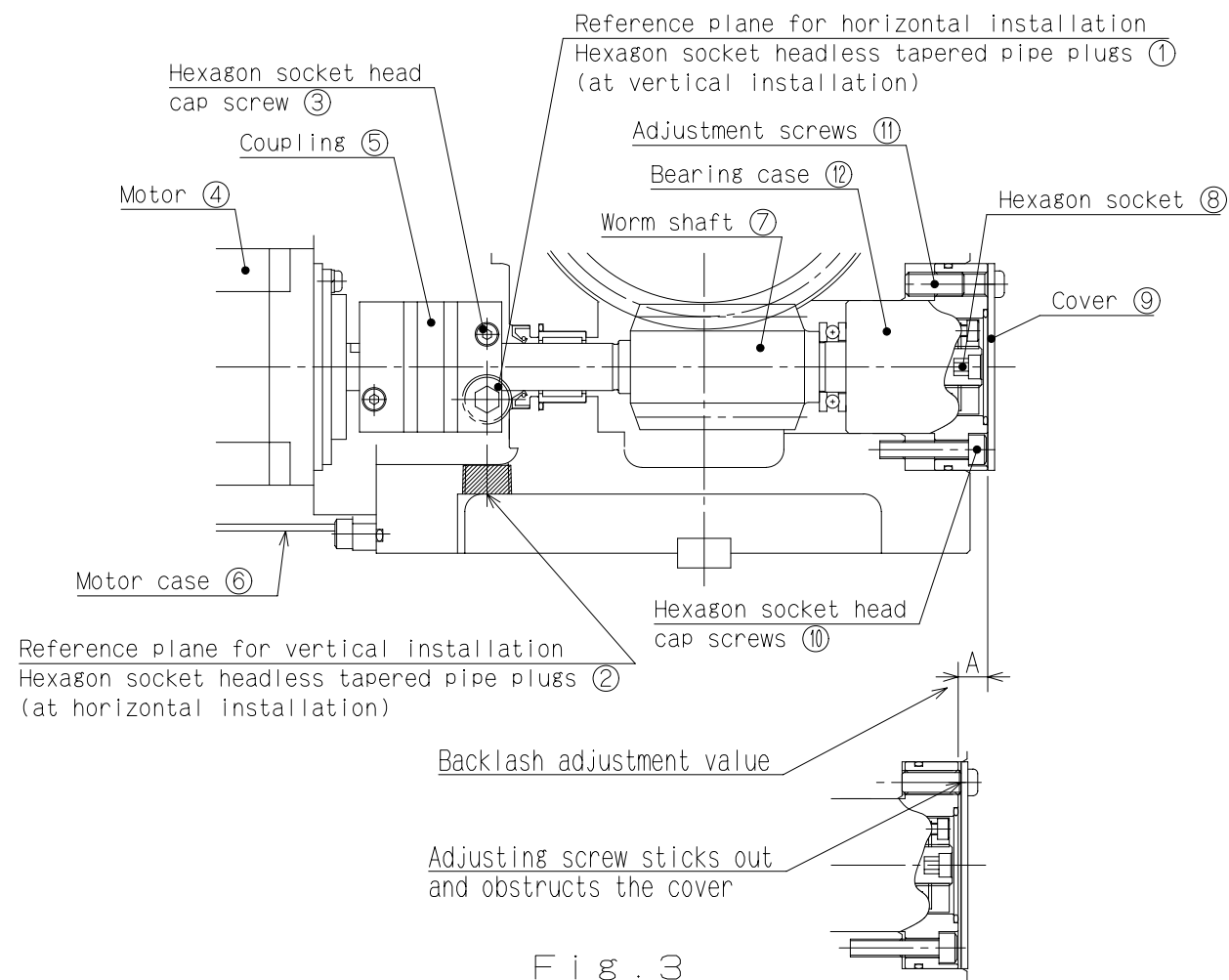
MODEL	MX(M)160
Amount of face plate O.D.(μm)	About 36

Unscrewing adjusting screws (11) of MX(M)160, adjusting screws (11) may stick out from bearing case cover (9) mounting surface and it will cause the cover (9) not to be fixed.

If this happens after backlash adjustment, replace adjusting screws to shorter ones according to the following table and adjust backlash again.

MODEL	MX(M)160	
Adjusting screw	Original screw	M8X20
	Shorter screw	M8X16

After adjusting, reassemble the worm gears by the reverse procedure of the above and securely tighten the bolts. After reassembling, measure the backlash again at outside periphery of the table and at the same position. Check that the backlash is proper. If the backlash is inadequate, adjust it again by the above method.



9. ZRN device

 The contents of this item are unnecessary for the NC rotary table of Kitagawa's controller spec. and 4th axis spec. which don't have a dog for ZRN deceleration.
 Machine zero position of this unit which set at shipment from factory is memorized due to the specification of servo motor with absolute encoder. Accordingly this unit does not have machine zero position device like as proximity SW and Dog. When changing machine zero position, instruction manual of controller (article for setting of machine zero position) would be referred.

9-1 ZRN device on table

The ZRN device rotates clockwise (CW) on the standard specification.
 The table datum groove comes to position at a right angle to the motor when connected to the NC unit. The dog, which activates the table speed reduction, is located inside the unit. The ZRN deceleration dog is mounted in the table and it can be mounted on the optional position of outer periphery. When shipping a product, the flank of the guide block fitted on the table has been positioned parallel to the reference plane for vertical installation. Fine adjustment of the ZRN position may be required at the customer at the time of interface with the NC controller of the machine.

9-2 ZRN device Adjustment (See Fig.4)

- When the zero position is changed or when the rotation direction for return is changed to counterclockwise, adjust the ZRN position through the following procedures.
- 1) Remove the flange plug ① located on the top surface of the NC Rotary Table.
 - 2) Rotate the table and, through the hole made by removing the hexagon socket flange head screw plug ①, loosen the hexagon socket headless set screw M3 ② that fixes the dog ③ to the main shaft of the Rotary Table.
 - 3) Move the dog ③ to an appropriate position.
 - 4) Upon the completion of the position adjustment, securely fasten the hexagon socket headless set screw ②. Also, securely fasten the hexagon socket headless set screw ①.

9-3 Sensor Mechanism

- 1) Proximity Switch (See Fig. 4)
 The gap between the dog ③ and the proximity switch ④ should be adjusted to approximately 0.75mm by the 1.00mm pitch thread provided on the proximity switch ④.

10. Motor Cover

10-1 Dismount

Please follow the procedure below for removing the motor cover. (See Fig.5)

- 1) Remove the cover of the motor case ① and remove wiring and air hose from the canon connector of the motor ② and from the NC Rotary Table side of the terminal block.
- 2) Loosen the hexagon socket head cap screws ⑪, which sets the motor case ① in the base ⑩ and carefully detach the motor case ① by lifting the case upward.

10-2 Waterproofing

In order to prevent the entering of coolant from the outside, O-ring ④ is used at the portion of connection between motor case ① and the body.



For detaching the motor, remove either of the hexagon socket headless tapered pipe plug, ⑤ or ⑥, and loosen the hexagon socket head cap screw ⑦ on the coupling ⑧ which connects the worm shaft ⑨ and the motor ②.

Then, remove the four hexagon socket head cap screws ③ which secure the motor ② in order to detach the motor. When re-installing the motor ②, be sure to securely tighten the bolts and plugs.



When the motor case ① is re-installed, be careful not to damage the O-ring. The damaged O-ring may allow the cutting water to enter the motor case.

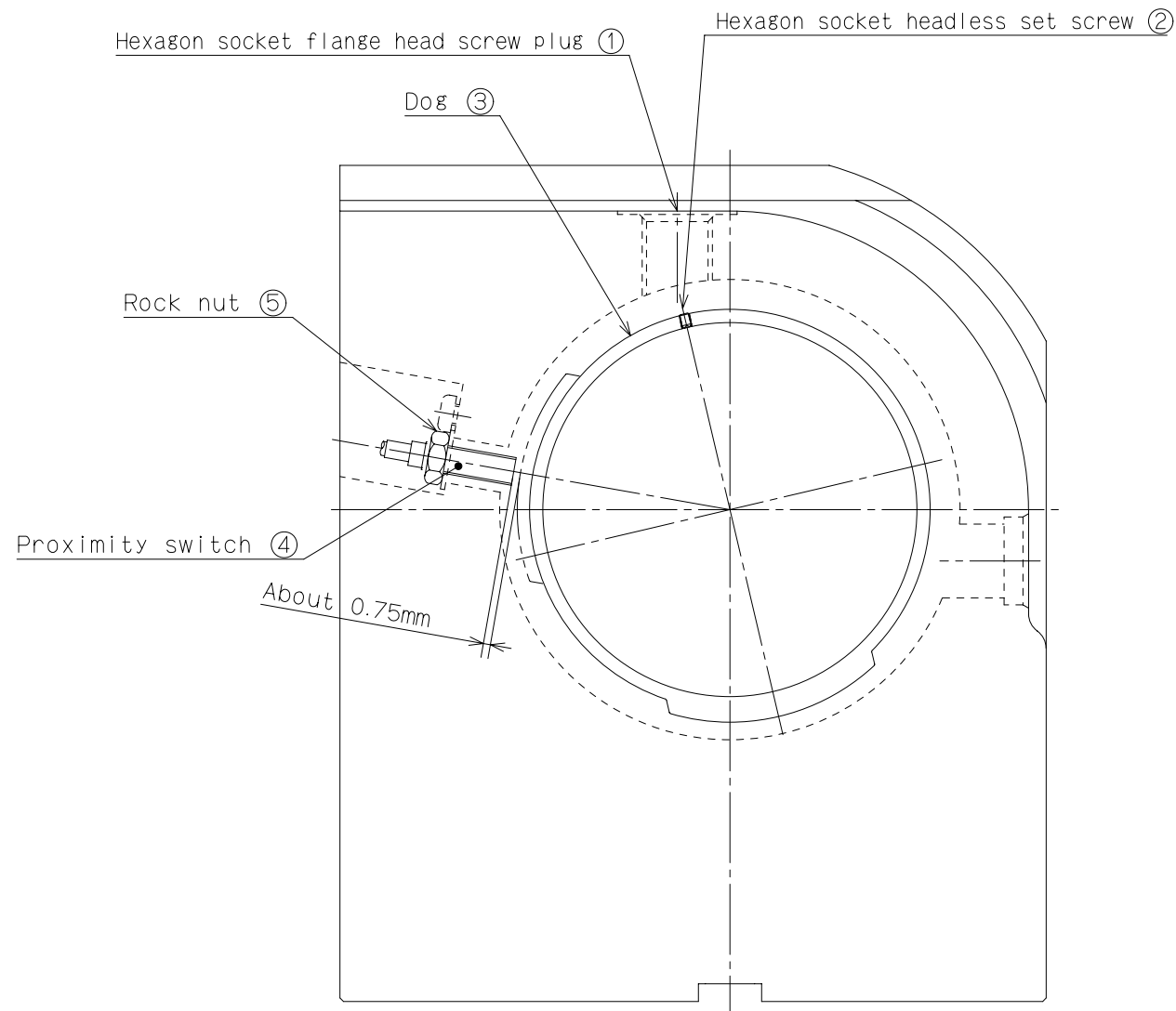


Fig. 4

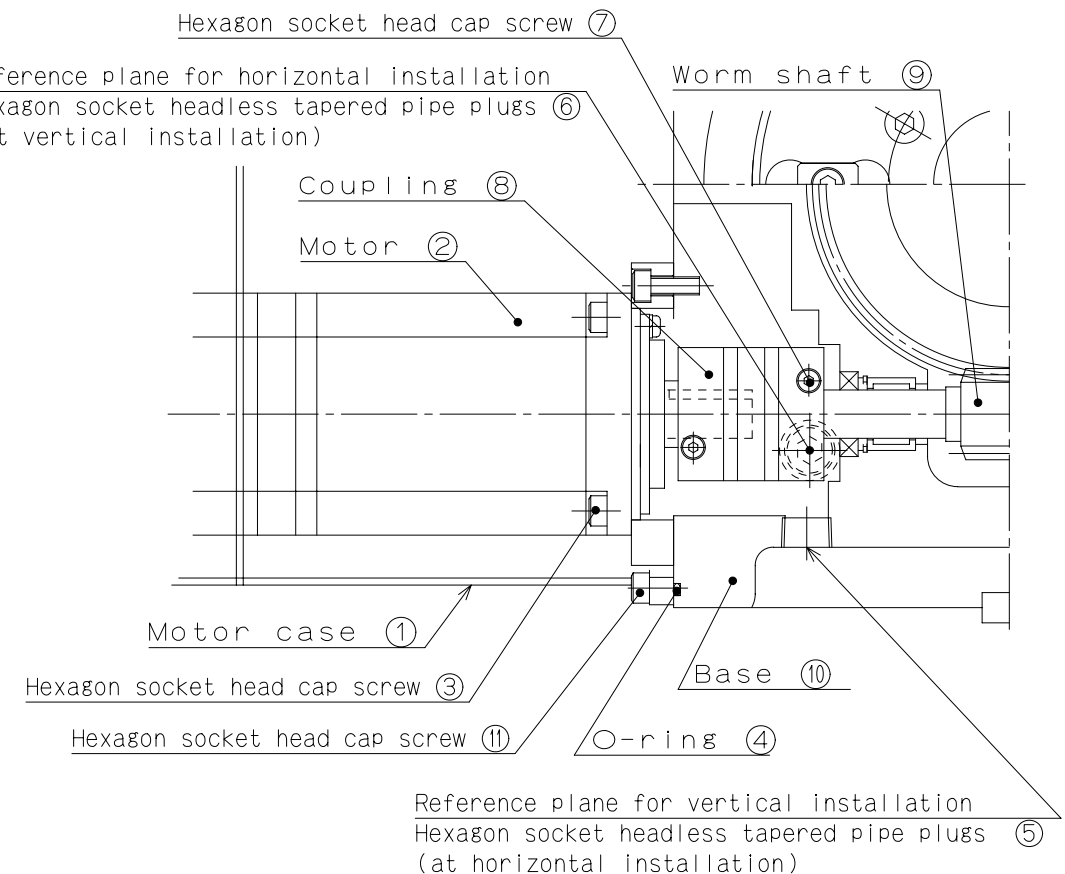


Fig. 5

11. Storage



When removing the unit from the machine table, apply oil to prevent rust and store it on a stable wooden stand or in the original crate with the appropriate cover to protect it from dust and maintain its accuracy.

Note: Some raw wood is chemically unstable and may cause rust on the unit.

12. Indexing Accuracy and Pitch Error

IMPORTANT

* What is the linear length at the table circumference with 20 seconds cumulative indexing accuracy ?*

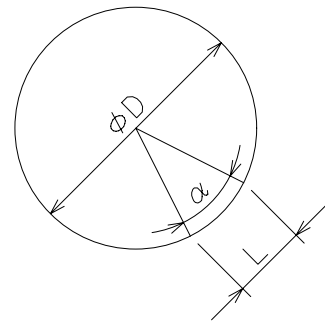
* What is the angle with a cumulative pitch error of 0.01mm ?*

To answer these questions, use the following formula representing the relationship between the angle and linear length at the table circumference.

D: Diameter of Workpiece (mm)

α : Angle (seconds)

L: Linear length at the table circumference (mm)



$$\frac{L}{\pi \times D} = \frac{\alpha}{360^\circ \times 60' \times 60''} \text{----- (1)}$$

$$\alpha = \frac{360 \times 60 \times 60 \times L}{\pi \times D} = \frac{L \times 4.125 \times 10^5}{D} \text{----- (2)}$$

$$L = \frac{\alpha \times \pi \times D}{360 \times 60 \times 60} = 2.424 \times 10^{-6} \times \alpha \times D \text{----- (3)}$$

(Examples)

Assuming the diameter of the workpiece is 100mm, and by using formula (3), the cumulative indexing accuracy of 20 seconds as linear length at table circumference will be:

$$L = 2.424 \times 20 \times 100 \times 10^{-6} = 0.004848\text{mm} \approx 0.0048\text{mm}$$

Therefore, the length is approximately 0.0048mm.

And converting the cumulative pitch error of 0.01mm to an angle, use formula (2):

$$\alpha = \frac{4.125 \times 0.01 \times 10^5}{100} = 41.25''$$

Therefore, the angle is approximately 41.25 seconds.

Thus, by using the formula (2) and (3), the indexing precision and pitch error can be converted in terms of linear length and angle.

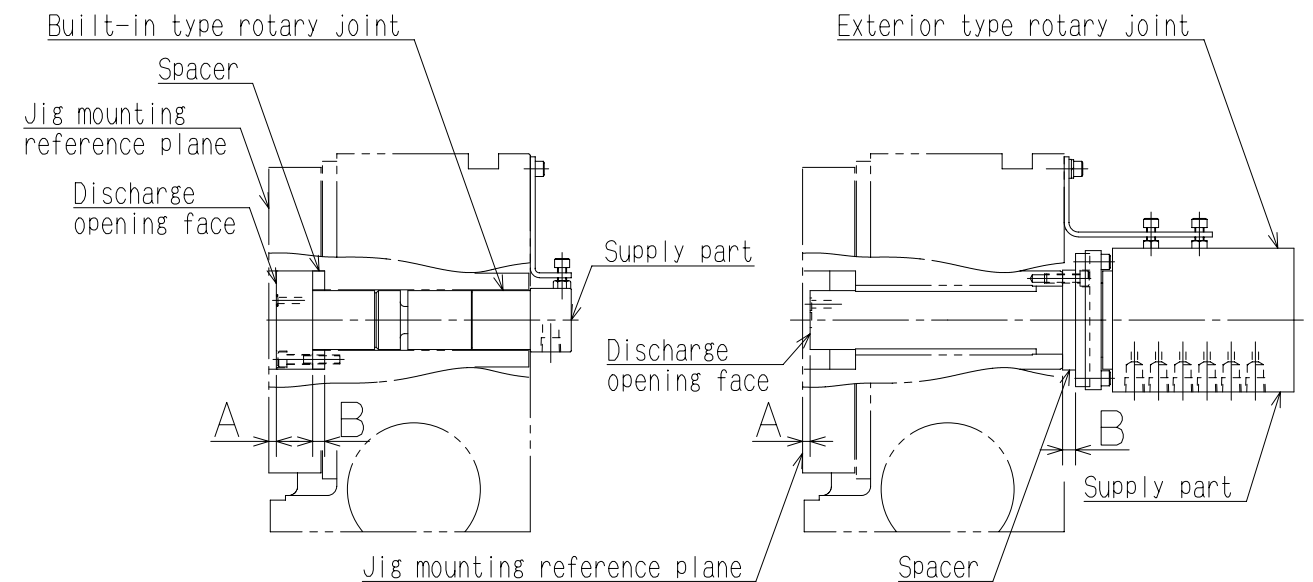
13. Mounting Rotary Joint (Option)

13-1 Alignment of discharge opening face

To mount the rotary joint, the rotary joint discharge opening face must be aligned with the jig mounting reference plane so that hydraulic oil does not leak to the jig (A-size in the following figure).

To align the position of the rotary joint discharge opening face, the thickness of the spacer attached to the rotary joint must be adjusted (B-size in the following figure).

When the rotary joint is mounted additionally or a set of rotary joint parts is replaced, check the product type and manufacturing number, and contact Kitagawa branch or your agent.



13-2 Pining to supply part

To route the pipe to the supply part of the rotary joint, determine a hose length so that the hose will not be moved by the movement of a table for a mounted machine.

Moreover, when turning a joint screw, use the tightening tool carefully so that unreasonable force will not be applied to the supply part.

KITAGAWA**Machine Tool Accessories** <http://www.mta.kiw.co.jp/>**KITAGAWA IRON WORKS CO., LTD.**

77-1 Motomachi Fuchu-shi, Hiroshima-pref., 726-8610, Japan

TEL +81-847-40-0526 FAX +81-847-45-8911

America Contact	KITAGAWA-NORTHTECH INC. http://www.kitagawa.com/ 301 E. Commerce Dr, Schaumburg, IL. 60173 USA TEL +1 847-310-8787 FAX +1 847-310-9484
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Oceania Contact	DIMAC TOOLING PTY LTD. http://www.dimac.com.au/ 61-65 Geddes Street, Mulgrave, Victoria, 3170 Australia TEL +61 3-9561-6155 FAX +61 3-9561-6705

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