

# **KITAGAWA**

## **NC ROTARY TABLES OPERATION MANUAL**

**MODEL : RS250RAE10**

**IMPORTANT**

Please ensure that these instructions are read and understood by machine operators before using the NC Rotary Indexing Table.

**Please Read and Save This Manual**



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(1) 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.



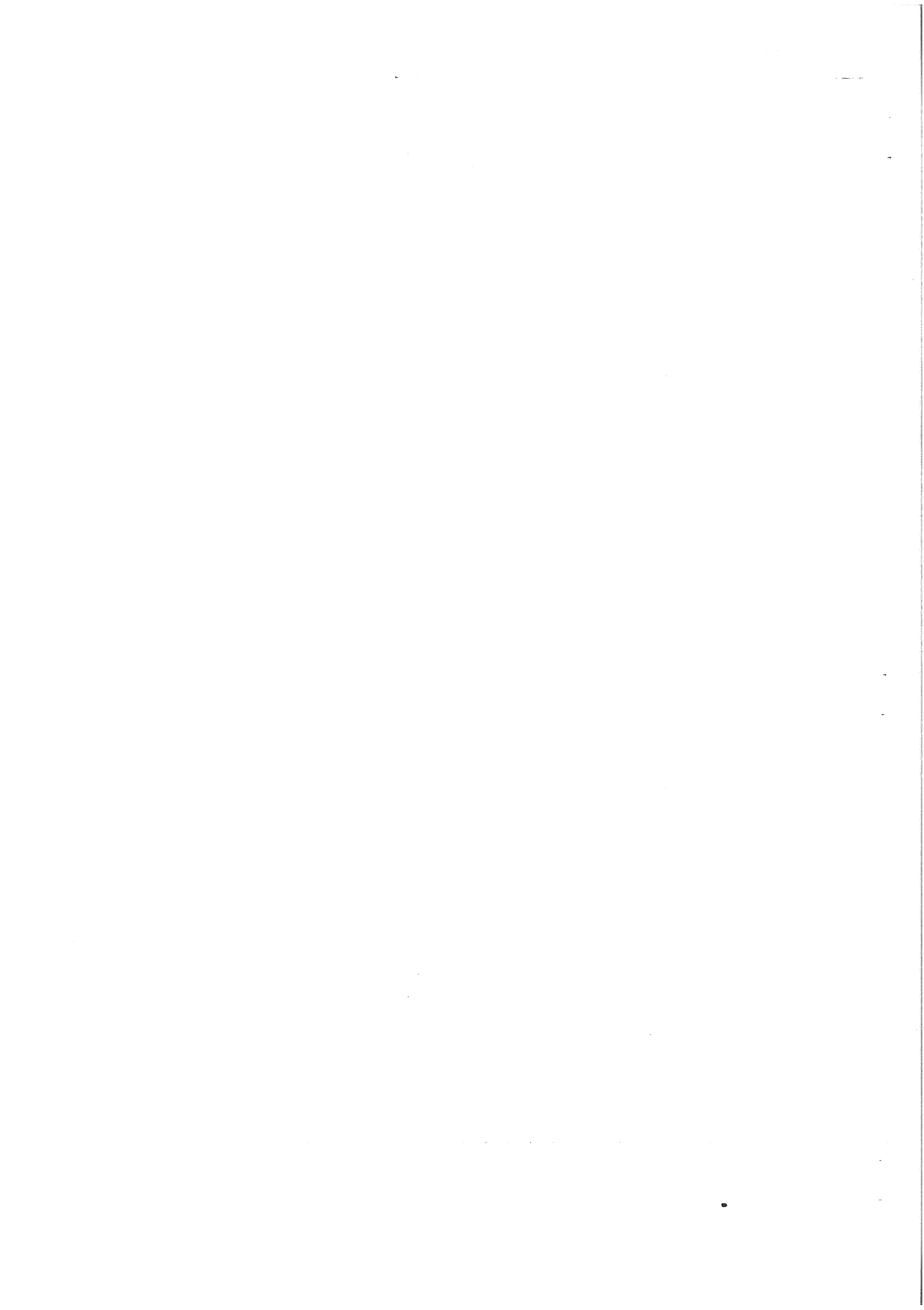
**CAUTION**

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.



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## TABLE OF CONTENTS

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	Page
1. For Your Safety-----	1
2. Specifications-----	6
3. Accuracies-----	7
4. Prepare for operation-----	8
4-1 Carry and mounting onto the machine tool	
4-2 Lubrication	
4-3 Air supply for clamp	
4-4 Referring to Air-purge	
5. Table Clamping-----	11
5-1 Precautions of table clamp	
5-2 Clamp/unclamp check device	
5-3 Solenoid Valve for Clamp/unclamp	
6. Workpiece clamping-----	12
7. Daily Inspection-----	12
8. Backlash adjustment of worm gear-----	12
8-1 Measuring method of backlash	
8-2 Adjustment method of backlash	
9. Built-in zero return device-----	16
9-1 Dog position of zero return reduction	
9-2 Adjustment method of dog position	
10. Motor Case-----	16
10-1 Removing	
10-2 Waterproof	
11. Storage-----	17
12. Conversion of circumference length and angle-----	17

# 1. For Your Safety

## Basic Safety Tips

Please read this manual and follow instructions carefully.

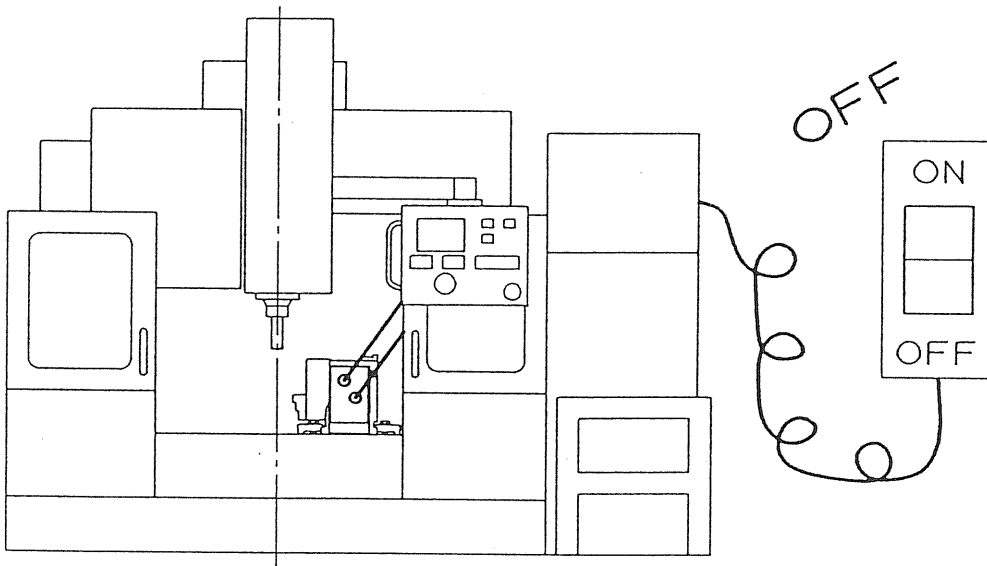
We cannot assume responsibility for damage or accidents caused by misuse of the NC Rotary indexing tables, through non-compliance with the safety instructions.



**DANGER**



**SWITCH OFF** power before setting, inspecting and repairing NC rotary indexing table.



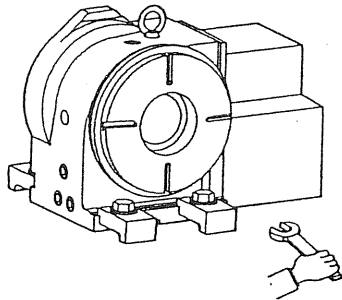
Failing to do so could cause bodily harm to the operator.



**WARNING**



**Secure clamp bolts to correct torque.**



There is a danger of disturbance of NC rotary table and release of work piece.

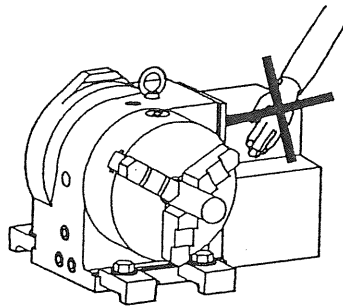
Tighten to correct torque

Bolt size	Clamping torque [N·m(kgf·m)]
M8	38(3.9)
M10	73(7.4)
M12	108(11.0)
M16	250(25.5)



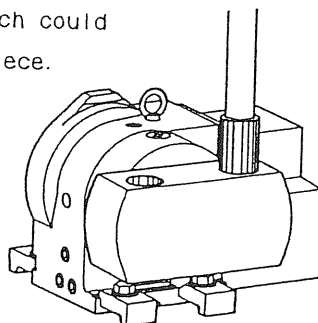
**When rotating the table, ensure your hand is out of the rotating area.**

Failing to do so could cause injury.



**Never apply excessive cutting force.**

Failing to do so could result in damage to the NC rotary table, which could cause release of the workpiece.



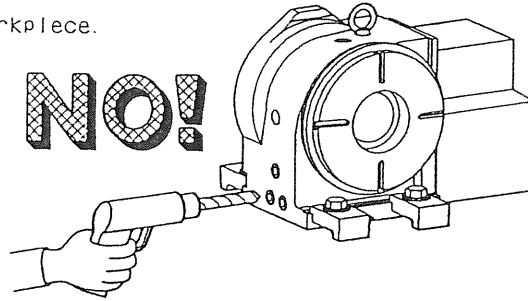


**WARNING**



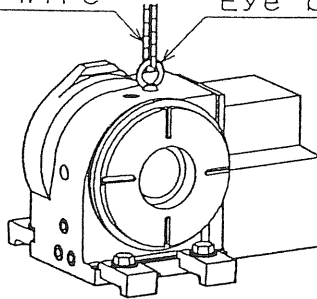
Do not attempt to modify the NC rotary indexing table.

Failing to do so could result in damage to the NC rotary table, which could cause release of the workpiece.

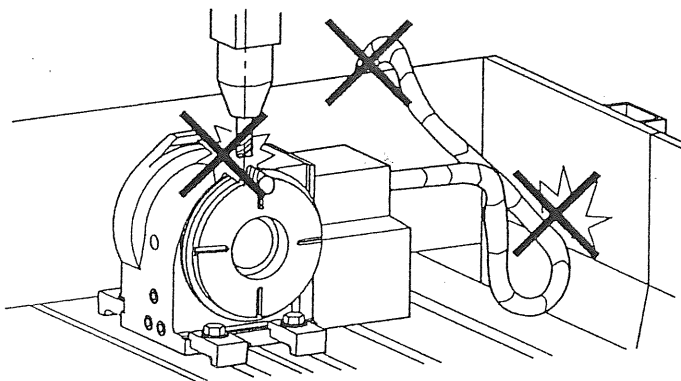


When lifting the NC rotary table, use an eyebolt and wire. (See page 8)

Leash or Wire      Eye bolt



Avoid interference between NC rotary indexing table and surrounding equipment. (See page 8)



Interference and extreme bending of cable and hose should be avoided.

There is a possibility that you receive an electric shock in case of damaging the cable.

Minimum bending radius of the cable (CB1)

Fixed portion: R65

Movable portion: R150



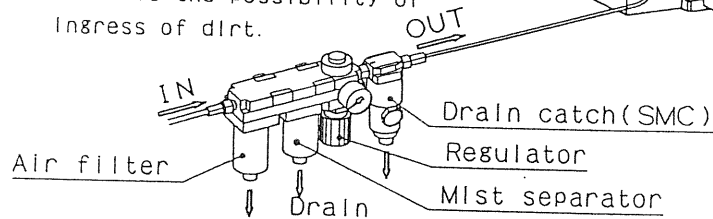


## CAUTION



Air must be supplied clean air through air control unit (Air filter, Mist separator, Regulator)+Drain catch. (See page 10)

There is a danger of release of the workpiece when the clamping force of NC rotary table is reduced and also there is the possibility of ingress of dirt.

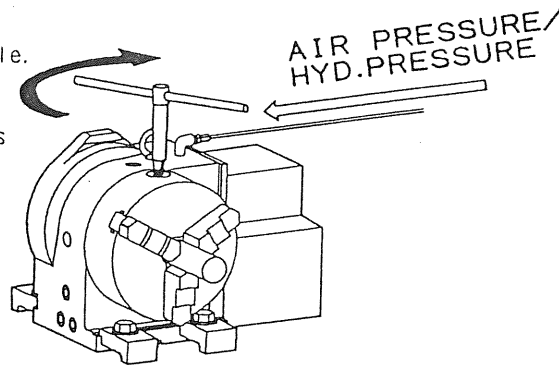


Periodically drain water collected in the air filter section.



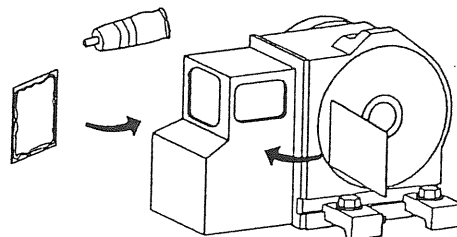
When clamping or unclamping workpieces ensure the table is properly clamped to the machine table.

Failing to do so could result in damage to the NC rotary table, which could cause release of the workpiece and also there is a possibility of deterioration of accuracy.



The cover plate should be sealed with a silicon rubber compound. (See page 17)

Failing to do so could cause release of the workpiece and miss-operation of the table by ingress of oils.

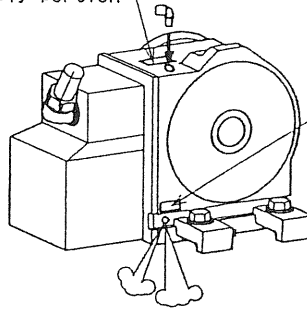




Air for clamping and also air for air-purge should be supplied to the specified portion with specified pressure, and portion of exhaust should not be blocked up. (See page 10)

A motor case may be damaged in case that air is supplied to the other portion except for the specified portion or an air pressure beyond the specified air pressure is supplied or the portion of an air-exhaust is closed.

Name plate of  
air supply portion



Name plate of  
exhaust portion



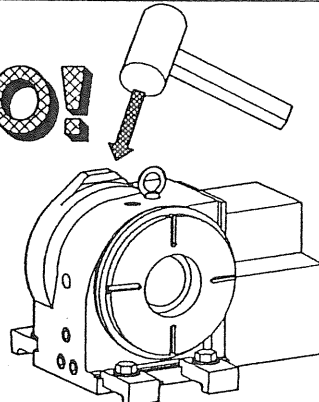
**CAUTION**



Never use a hammer on the NC rotary indexing table or the clamped workpiece.

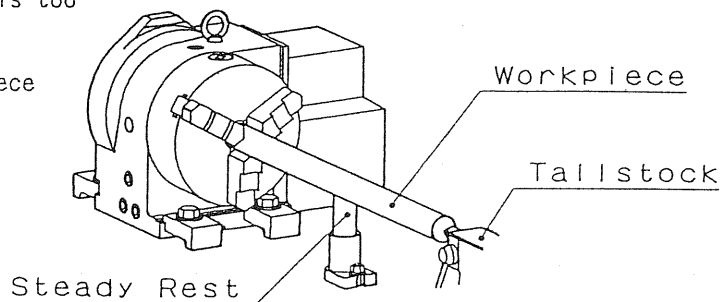
Failing to do so could result in damage to the NC rotary table, which could cause release of the workpiece.

**NO!**



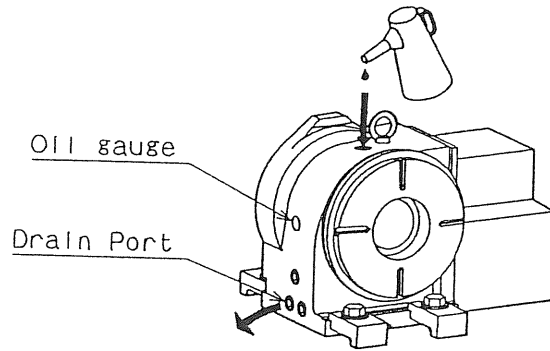
When machining a long or heavy workpiece, support with a tallstock or steady rest. (See page 6)

In case that workpiece is too long or too heavy, it is dangerous as the workpiece may release.





Replace lubricating oil every 6 months. (see page 9)



## 2. Specifications

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

Specifications are as follows.

MODEL		RS100	RS250	RS320	
Table Diameter	(mm)	φ105	φ250	φ320	
Table Height in vertical	(mm)	140	210	φ225	
Center height	(mm)	110	180	225	
Center hole	(mm)	φ50	φ70	φ130	
Thru. Hole Diameter	(mm)	φ32	φ51	φ90	
Width of T-Slot	(mm)		12	14	
Guide block width	(mm)	14h7	18h7	18h7	
Clamping torque (Air Press at 0.5 Mpa (5.1kgf/cm <sup>2</sup> ))	N·m(kgf·m)	80(8.2)	450(46)	900(92)	
Allowable work diameter	(mm)	φ105	φ250	φ320	
Allowable work weight	In vertical position	kg	30	125	180
	In vertical position with tailstock	kg	60	250	350
	In horizontal position	kg	60	250	350
Allowable workpiece inertia	kg·m <sup>2</sup> (kgf·cm·sec <sup>2</sup> )	0.08(0.8)	1.95(19.9)	4.49(45.7)	
Total reduction ratio		1/36	1/90	1/120	
Maximum table speed	min <sup>-1</sup>	83.3	33.3	25	
Motor	(W)	400	750	750	
Body weight	(kg)	23	92	170	
Tailstock weight	(kg)	9	20	24	

### IMPORTANT

Max. Table Revolution is at 3000min<sup>-1</sup>(rpm) of motor rotation.



### CAUTION

Be sure to remain within Allowable workpiece inertia even though workpiece weight is within the maximum quoted.



### CAUTION

A tailstock may be required according to the weight, shape and cutting conditions on the workpiece.



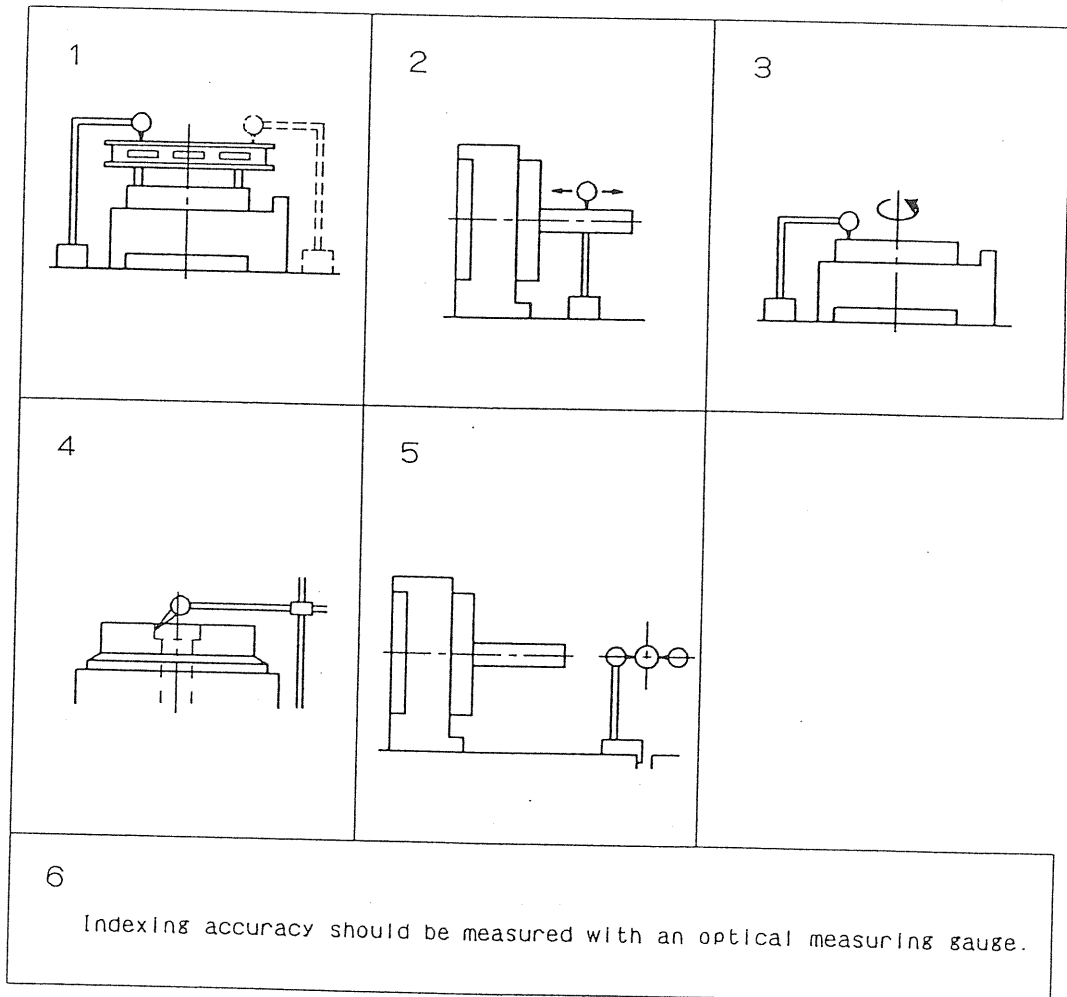
### CAUTION

See above specification and precautions for operation. Set each machining condition so as not to exceed allowable value.

### 3. Accuracies

(Unit: mm)

Inspection items			Allowable value
1	Parallelism Between Table Face and Base	Per 150mm	0.015
2	Parallelism Between Center of Face and Base	Per 150mm	0.02
3	Run-out of Table Face In Rotation		0.02
4	Concentricity of Center Hole		0.01
5	Parallelism Between Center of Table and Center of Guide Blocks	Per 150mm	0.02
6	Indexing accuracy		30sec
7	Repeatability		±2.5sec

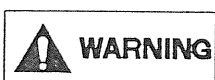


## 4. Prepare for operation

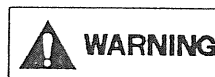
The following procedures are recommended for preparing the NC rotary indexing table and for the trial run.

### 4-1 Carry and mounting onto the machine tool

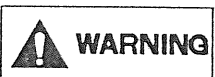
- 1) Carefully carry the table with a strong wire rope through the attached eye bolt.
- 2) Ensure mounting surface of machine tool is clean and free of burrs. If burrs or flaws are found, repair them with oil stone, etc., before mounting.
- 3) Install the table to the optimum position for work. Fit the guide block bottom face into T-groove on the machine tool table. If the clearance between T-groove and the guide block is large, move the table aside before installing.
- 4) Securely fix the NC rotary indexing table onto the machining tool with the attached clamp device.



Check mounting space before mounting NC rotary indexing table on the machine tool. Take care so that the NC rotary indexing table body, cable and air hose do not interfere with the splash guard or ATC device, spindle head, etc., of the machine tool when the machine tool table, spindle head, etc., are moved.



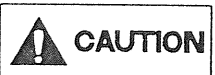
Do not scratch nor give stress nor load a heavy matter nor pinch a cable. There is a possibility that you may receive an electric shock in case of damaging the cable.



Use the mounting seat effectively and tighten the bolts of clamp equipment to correct torque. (See page 2)

### 4-2 Lubrication

The NC rotary indexing table has already been filled with lubrication before shipping. Check that the lubricant is filled to center level of the oil gauge.



Normally the lubricant should be replaced every six months. Drain the old oil thoroughly before replacing with clean oil. Clean the oil supply port so that no swarf or foreign matter can enter during re-filling. Should any foreign matter enter, the unit may seize or be severely damaged. The following lubricants are recommended.

### Recommended lubricant (viscosity grade ISO VG32)

Maker	Brand	Maker	Brand
MOBILE OIL	BACTRA OIL NO.1	COSMO OIL	DAINAWAY S32
NIPPON OIL	UNIWAY32	IDEMITSU KOSAN	DAFUNIMULTIWAY 32C
KYODO OIL	KYOUSEKISLIDUS32	ESSO STANDARD OIL	FABIS K32
MITSUBISHI OIL	DIAMOND SLIDEWAY 32	SHOWA SHELL OIL	SHELLTUNA OIL T32

Necessary oil quantity is 0.3 (RS100)

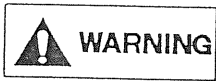
Necessary oil quantity is 3.1 (RS250)

Necessary oil quantity is 3.2 (RS320)

BACTRA OIL No.1(MOBILE) is provided in the unit before shipping.

### 4-3 Air supply for clamp

- 1) Clean air which is removed moisture and dust should be supplied through three-point unit consisting of filtration unit of air filter, mist separator, regulator and drain catch. (See page.4)
- 2) The air connection port of Rc1/4 is as shown in Fig.3. Connect the air hose to this port.
- 3) The air supply pressure used is within 0.5~0.6MPa(5.1~6.1kgf/cm<sup>2</sup>)



### 4-4 Referring to 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 parts.

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 catch) 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 exhaust is 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.

## 5. Table Clamping

### 5-1 Precautions of table clamp

**CAUTION** Always turn the table with the brake unclamped. Always ensure table has the brake clamped prior to machining except when milling.

**CAUTION** never subject the table to more than the recommended braking force. Such action will cause excessive wear to the clamp and also damage the wormwheel.

**CAUTION** It is important to ensure no residual pressure remains in the unit during unclamping as this can result in damage of the worm gear and clamping parts.

### 5-2 Clamp/unclamp check device

To perform correct procedure, be sure to check clamp/unclamp. These clamp/unclamp check signals are input NC control system MAC mini A. (See Fig.4)  
RS100 have only unclamp detection.

The check signal for clamp/unclamp is generated by the pressure switches. These pressure switches have been set as follows.

Clamp check (SP1) ————— 0.3 MPa ( 3 kgf/cm<sup>2</sup>)  
Unclamp check (SP2) ————— 0.05 MPa ( 0.5 kgf/cm<sup>2</sup>)

### 5-3 Solenoid Valve for Clamp/unclamp

The solenoid valve is incorporated as shown in Fig.3.  
Standard specification is as follows.

Solenoid ON ————— Table Unclamp  
Solenoid OFF ————— Table Clamp

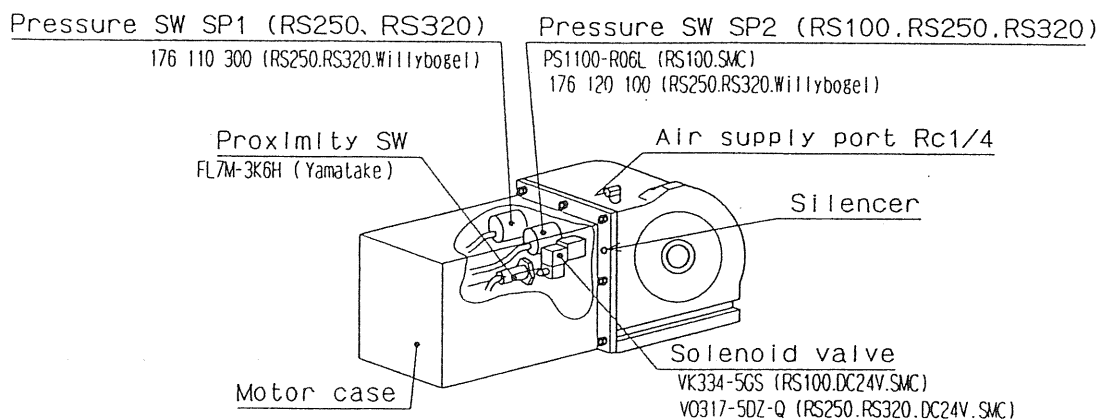


Fig. 3



## 6 Workpiece clamping

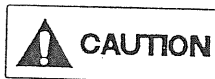
Clamp the workpiece securely to ensure high accuracy and precision.



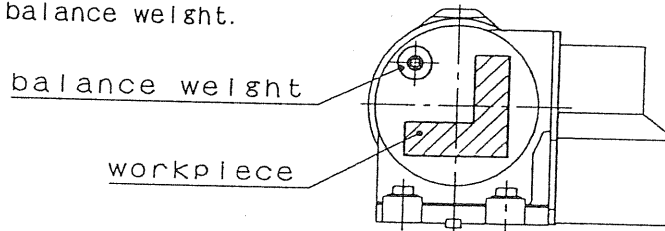
Always ensure that the workpiece is firmly clamped. Failure to do this will cause damage and accidents.



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.



Set the work so as there is no eccentric load for the table rotation center by compensating with balance weight.



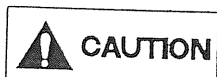
## 7 Daily Inspection

The following procedures are recommended before operation.

- 1) Check the fixed condition of NC rotary indexing table (jig: if jig is mounted onto the face plate).
- 2) Check electric and air connection cables and air hose.
- 3) Check air supply pressure.
- 4) Check zero return, indexing and position.

## 8 Backlash adjustment of worm gear

The worm and worm wheel are made of special material and designed to maintain excellent accuracy. The backlash has been already adjusted before shipping. However, adjustment may be required when operating your unit over long periods. To obtain the optimum values of backlash the unit must be properly cool. If the unit is continuously operated over long periods the backlash will be smaller due to thermal expansion.



If the backlash is too small, the worm gear may seize.

○ Optimum values of backlash

Model	Measuring position	Angle(sec)	Circular length( $\mu\text{m}$ )
RS100	Face plate periphery( $\phi 105$ )	69~138	18~35
RS250	Face plate periphery( $\phi 250$ )	31~92	19~56
RS320	Face plate periphery( $\phi 320$ )	14~52	13~40

Measure backlash with the following methods before adjusting.

8-1 Measuring method of backlash (See Fig 4)

- 1) Please a dial indicator close to the table circumference on one of the T-Slot.  
(In case of RS100, block put on the table surface near OD in stead of T-slot would be used for backlash measurement.)
- 2) Insert a steel rod into another table T-Slot and move it in a clockwise direction. Release and read the dial indicator.  
Next, apply force in a counter-clockwise direction on the steel rod. Release and read the dial indicator. The amount of backlash is the difference between the two dial indicator readings.
- 3) Check the amount of backlash at eight equally divided positions by repeating the procedures avobe. If the amount of backlash is not within the appropritate range, adjust the amount using following procedures.

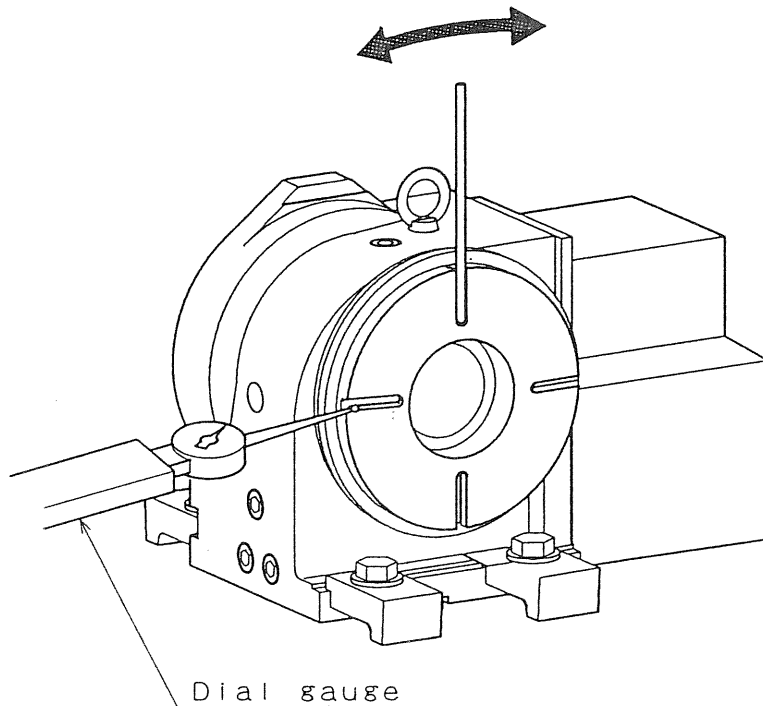


Fig.4

## 8-2 Adjusting method of backlash (See Fig.3)

The worm is supported by the worm housing. Also, the motor is fixed by this worm housing. The backlash is adjusted by varying the engagement of the worm and the worm wheel, moving the worm housing along body mounting face.

- 1) Remove the motor case and drain hydraulic oil in the table from the drain port. (See page 16 to remove the motor case.)
- 2) Slightly loosen the hexagon head bolt ① for the stopper.
- 3) Slightly loosen three hexagon socket head cap screws ③ little which fix the worm housing ②.
- 4) Insert the round bar ④ (about  $\phi 6$  or bar spanner) into  $\phi 8$  hole of body through  $\phi 7$  hole of the worm housing.
- 5) Approach the worm wheel side carefully to return the backlash to almost zero(0), operating the round bar.
- 6) Tighten the hexagon head bolt for the stopper and move the worm away from the worm wheel. Since the thread pitch of this bolt is 0.8 the backlash becomes larger by 0.036 with each  $1/12$  turn ( $30^\circ$ degrees).
- 7) Securely tighten the hexagon socket head cap screws ③ before measuring the backlash as indicated in 8.1.
- 8) If optimum value isn't found, repeat items 2) to 7).

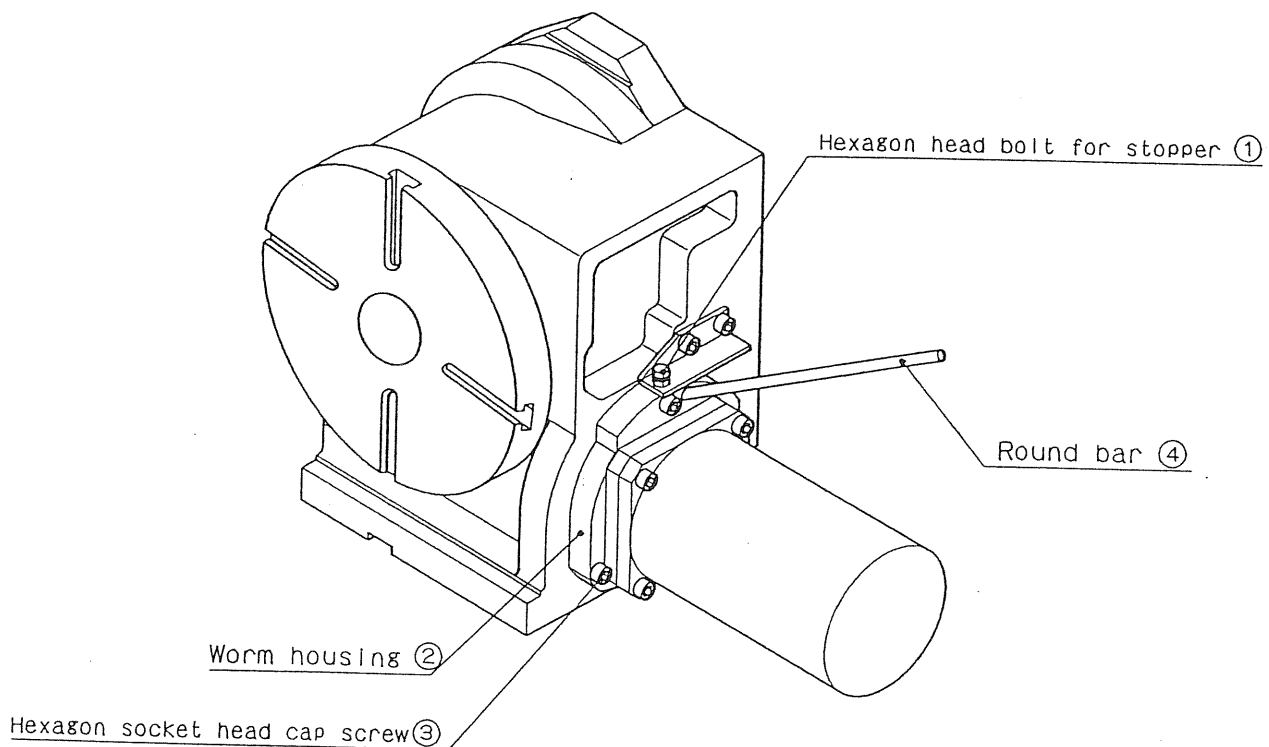


Fig. 3

## 9 Built-in zero return device

The proximity SW ① detects the zero return.

### 9-1 Dog position of zero return reduction

On standard specification the zero return device turn clockwise (CW).

The ring type dog is set to the table spindle and it is possible to fix to optional periphery position. It is set where T-groove is horizontal before shipping.

To change the home position and dog position when marking return rotary direction counterclockwise, the following procedures are recommended.

### 9-2 Adjusting method of dog position(See Fig 6.)

- 1) Remove hexagonal hole plug ② located on the lubricant supply oil port and loosen two hexagon socket head cap screws ④ (RS250) or hexagon socket head cap setscrews ④ (RS100) which fix the dog ③ to the table spindle through this oil supply port.
- 2) Move the dog ③ to proper position.
- 3) Securely tighten the hexagon socket head cap screws ④ after adjusting position.

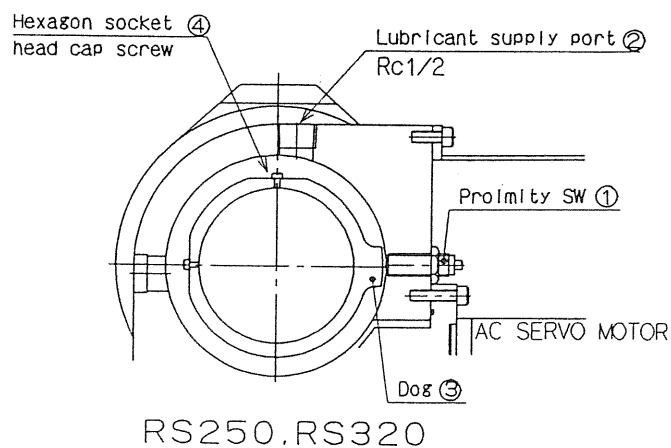
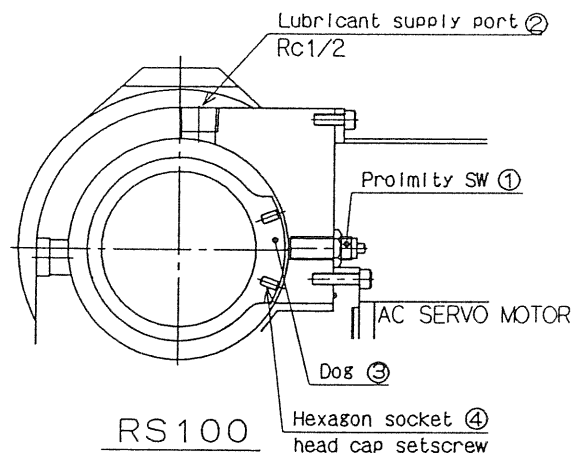


Fig. 6

## 10 Motor case

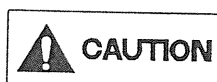
### 10-1 Removing

When removing the motor, the following procedures are recommended only when the motor case must be removed. (See Fig.7)

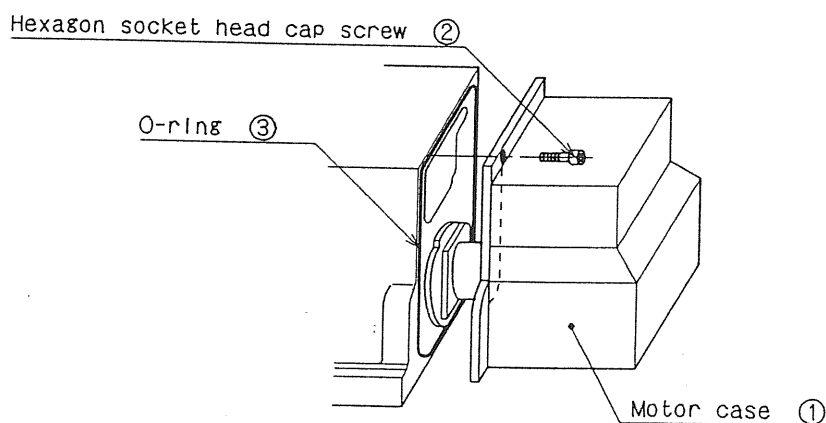
- 1) Remove screws② for the motor case① is fixed with four (RS100) or six (RS250, RS320) hexagon socket head cap screws ②.
- 2) Though the motor case ① can be removed under this condition, the motor case ① should be removed from the body with care in order not to be damaged so that it is needed to remove with connecting cable.

### 10-2 Measures for waterproof

In order to prevent the entering of coolant from the outside, O-ring ③ is used at the portion of connection between motor case ① and the body.



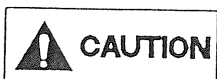
If cutting oil etc. is to be invaded into the motor case because of the break of a cable etc. It is urgently needed to be replaced a new cable so that electricies (motor, solenoid valve etc.) are to be damaged.



RS100, RS250, RS320 Type

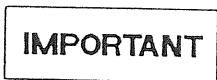
Fig. 7

## 11 Storage



When removing the NC rotary indexing table from the machine for storage, remove swarf and foreign matter before placing it on stable wooden base to maintain table accuracy. Also, coat it with rust-prevention oil and provide a wooden box or cover to protect from water and dust. Never use green fresh cut wooden case or box. Use treated timber.

## 12 Conversion of circumference length and angle

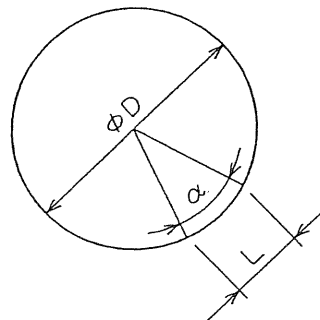


To calculate the circumference length when accumulated indexing accuracy is 30 sec or what is the angle when the accumulative pitch error is 0.05° use the following formula from relationship of the angle to the circumference length.

D: Work diameter (mm)

$\alpha$ : Angle (seconds)

L: Circumference length (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)

Regard the work diameter as 100mm and use previous "for cumulative index accuracy, the time of 30 seconds is indicated as circumference length." and formula (3). As a result, the following is found.

$$L = 2.424 \times 30 \times 100 \times 10^{-6} = 0.007272\text{mm} \approx 0.0073\text{mm}$$

Consequently, circumference length is about 0.0073mm.

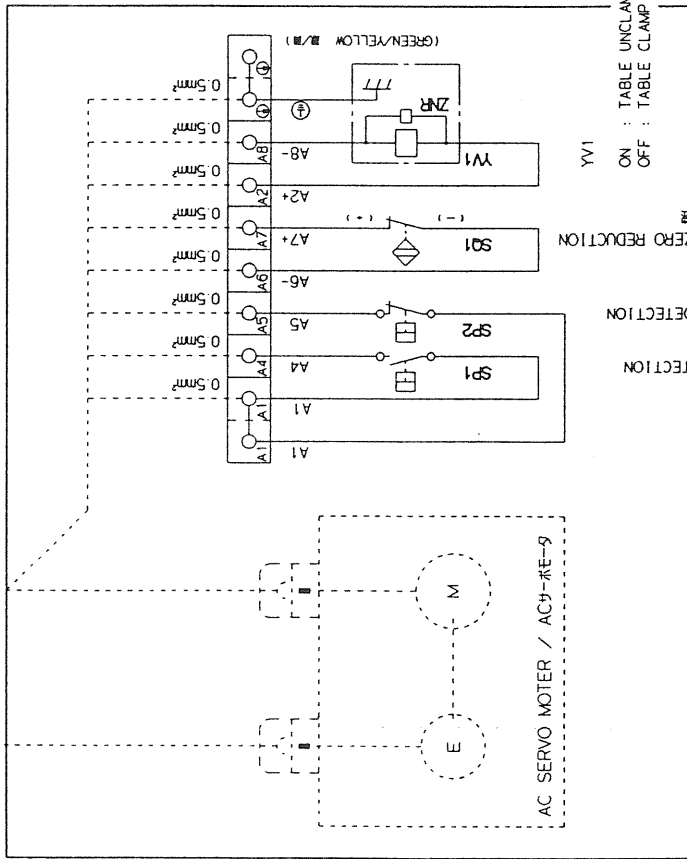
Also, use "Cumulative pitch error is indicated with angle of 0.05." and formula (2), the following is found.

$$\alpha = \frac{4.124 \times 0.05 \times 10^5}{100} = 206.25''$$

Therefore, the angle is 206 seconds or 3 min., 26 sec. As shown above, the circumference length and angle can be converted by formulas (2) and (3).

# Appendix 2 Wiring Diagram

61E3583640



MARK 記号	NAME 品名	MAKER メーカー	TYPE 型式	Qty 数量	REMARKS 備考
SP1	PRESSURE SWITCH 圧力スイッチ	WILLY VOGEL	176 110 300	1	0.2913MPa(kgf/cm <sup>2</sup> ) 1a
SP2	PRESSURE SWITCH 圧力スイッチ	WILLY VOGEL	176 120 100	1	0.0510.5MPa(kgf/cm <sup>2</sup> ) 1b
SQ1	PROXIMITY SWITCH 近接スイッチ	YAMATAKE	FL7M-3K6H-Z	1	DC10-30V
YV1	SOLENOID VALVE ソレノイドバルブ	SVC	VO317-1DZ-Q	1	AC100V
XT1	TERMINAL BLOCK 端子台	WAGO	264-701	6	
	TERMINAL BLOCK 端子台	WAGO	264-727	1	
	TERMINAL BLOCK 端子台	WAGO	264-721	1	
	END PLATE エンドプレート	WAGO	264-368	1	
	END STOP エンドストップ	WAGO	249-101	2	
	CARRIER RAIL キャリアレール	WAGO	210-111	1	

近接スイッチ接続仕様  
CONNECTION OF PROXIMITY SWITCH

(BROWN)	A7+	電源電圧	POWER SUPPLY	DC10-30V
(BLUE)	A6-	負荷電流	LOAD CURRENT	3~100 mA
		漏れ電流	LEAK CURRENT	max.0.55 mA
		残圧電圧	RESIDUAL VOLTAGE	max.3.0 V
		出力電圧	OUT PUT TYPE	NC

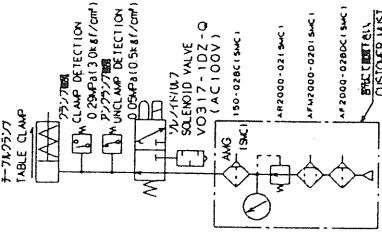
NOTE 注意  
1) \* ⊕ IS EARTH.  
⊙ ⊕ 接地アース電圧。

ソレノイドバルブ仕様  
SOLENOID VALVE SPEC

INRUSH 起動	50HZ	19VA
HOLDING 保持	60HZ	16VA
	50HZ	11VA
	60HZ	7VA

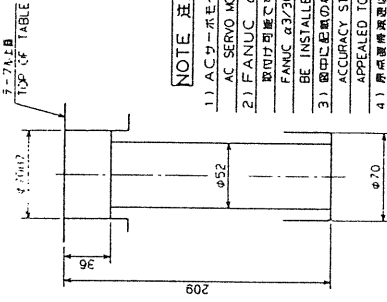
Model : RS250RAE10

仕 様 規 定 値	
回転速度 (REV/ACMIN)	30 30CPM
反復性 (REPEATABILITY)	5 34CPA
サーボモータの回転速度 (SERVO MOTOR REV/ACMIN)	33 3 33RPM
最大トルク (MAX. TORQUE)	3000 3000ACT(N)
サーボモータのトルク (SERVO MOTOR TORQUE)	45N・M (4.02LBM)
クランプの寸法 (CLAMPING TORQUE)	10.000046 (10.0001)
許容質量 (ALLOWABLE MASS)	250 2.5
クランプの径 (CLAMPING DIA.)	250 2.5
総長 (TOTAL LENGTH)	190
質量 (WEIGHT)	105 1.1
製造番号 (MANUFACTURE NO.)	00003925P
検査番号 (INSPECTION NO.)	10.00.00046 (10.0001)

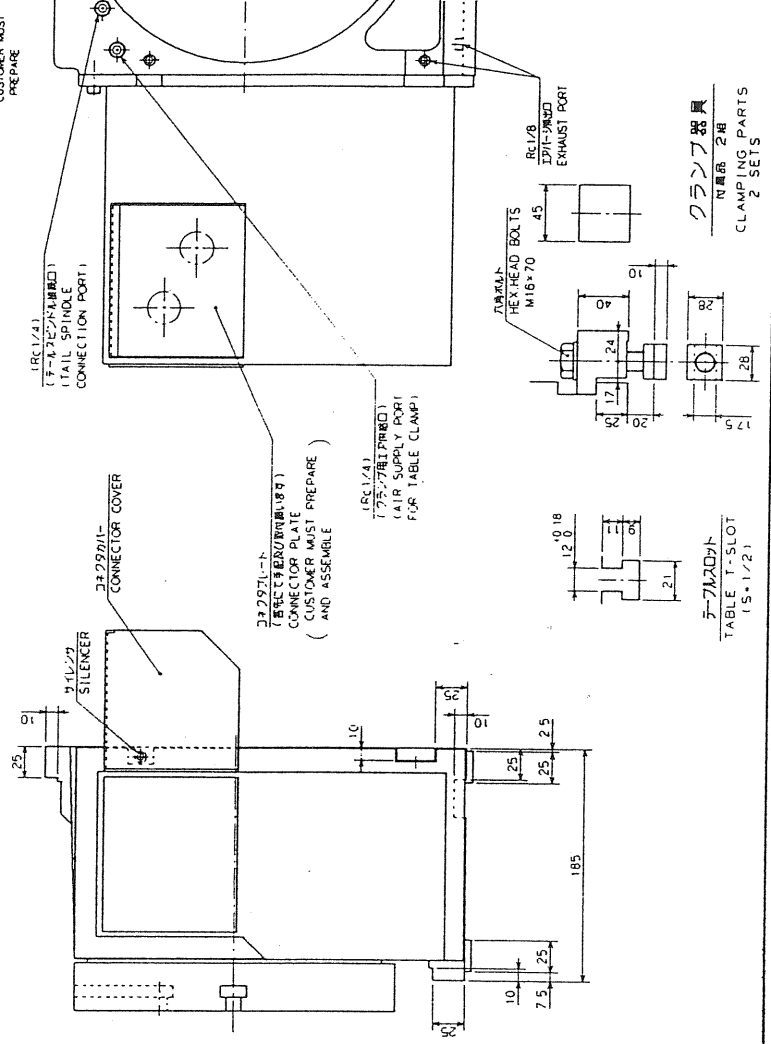
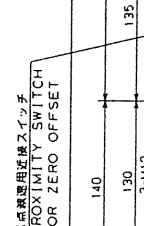
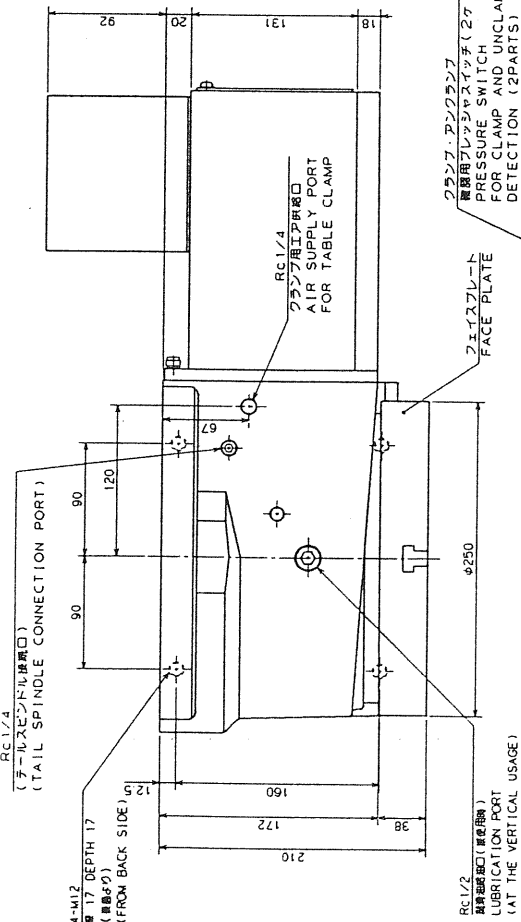


NOTE 注記

- 1) ACサーボモータ: 各部に手配され取り付けられています。AC SERVO MOTOR: CUSTOMER MUST PREPARE AND ASSEMBLE.
- 2) FANUC α3/3000/β21-HC53T1, このモーターは取り付け可能です。FANUC α3/3000 AND MITSUBISHI HC53T1 ARE POSSIBLE TO BE INSTALLED IN THIS MOTOR CASE.
- 3) 表中に記述のない精度標準値は、カタログ記載の値とします。ACCURACY STANDARDS EXCEPT STATED IN THIS DRAWING SHOULD BE APPEALED TO THAT IN CATALOGUE.
- 4) 所定速度標準値は、33.3min<sup>-1</sup>以下、クロック速度は、0.6min<sup>-1</sup>以下に設定して下さい。ZERO OFFSET SHOULD BE SET LESS THAN 33.3min<sup>-1</sup> AND ITS CREEP SPEED SHOULD BE SET LESS THAN 0.6min<sup>-1</sup>.
- 5) 駆動の後にカバーを開放する場合は、必ずシリコン系液状グリスを塗布して下さい。AFTER COVERS ARE REMOVED, TO ASSURE WATERTIGHTNESS, A LIQUID SILICON GASKET MUST BE APPLIED BEFORE REPLACING COVERS.
- 6) ケーブルは両向きケーブルとして接続 (前後) 可能です。CABLE CAN BE CONNECTED FROM ALL (2) DIRECTIONS (SIDE, BACK.) OF MOTOR CASE.
- 7) 本機は左右に設定できます。クランプは右向きに設定下さい。THIS ROTARY TABLE IS DESIGNED UNDER THE CONDITION OF AIR PURGE ACCORDINGLY CLEAN AIR FROM AIR SUPPLY PORT HAVE TO BE SUPPLIED.



SPINDLE THRU-HOLE



クランプ器具  
 潤滑油 2箱  
 CLAMPING PARTS  
 2 SETS

NOTE 注記

WHEN DIRECTION OF MOTOR SHAFT REVOLUTION IS CW THAT OF TABLE REVOLUTION IS CW  
 モーターの回転方向と、出力軸の回転方向はC/Wのときサーボ回転方向は、C.W.





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