

KITAGAWA

**NC ROTARY TABLES
OPERATION MANUAL**

MODEL : TM(H)160
TM(H)180
TM(H)200
TM(H)250
TR(L)250
TR(L)320
TR400
TR500

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(!) 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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1. For Your Safety

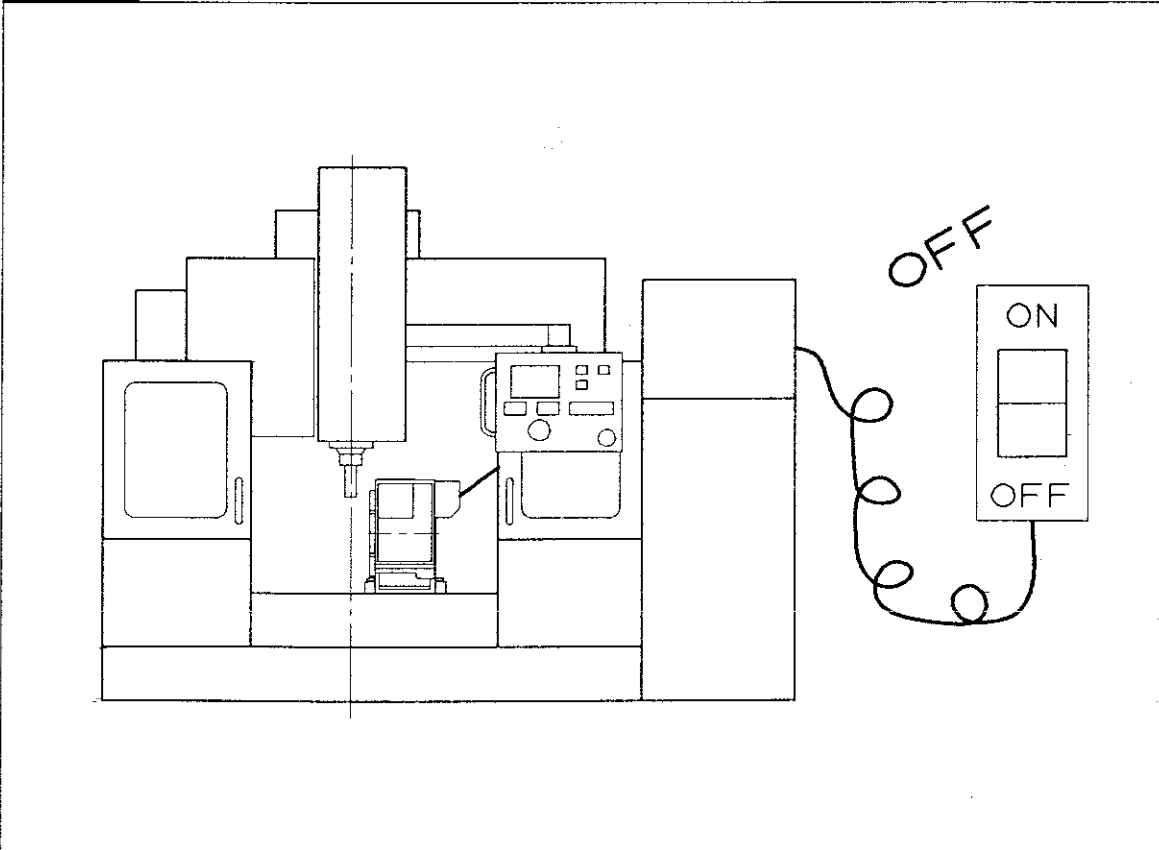
Basic Safety Tips

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.



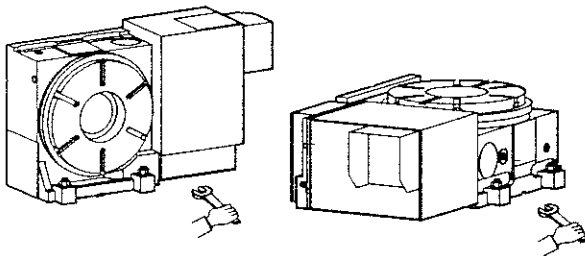


WARNING



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

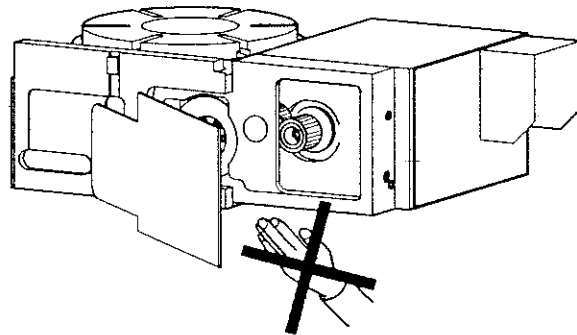
Please refer to the chart below for the recommended tightening torque of the bolts.



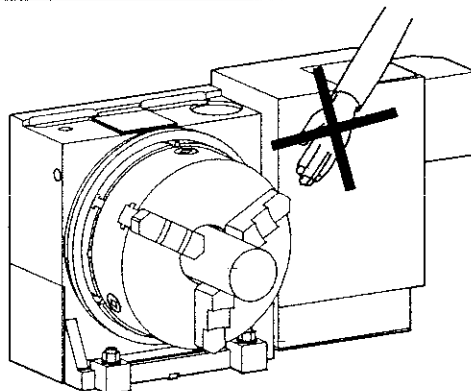
Hex Bolt Size	Torque Nm(kgfm)
M10	73 (7.4)
M12	108 (11.0)
M16	250 (25.5)
M20	402 (41.0)



Do not operate the unit dismantled or partially disassembled as internal parts such as gears, may cause serious accident and/or injury.



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

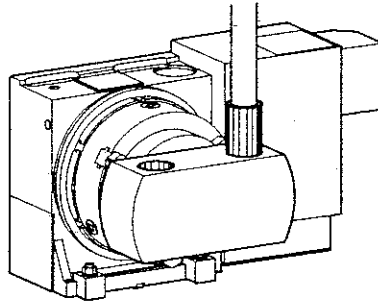




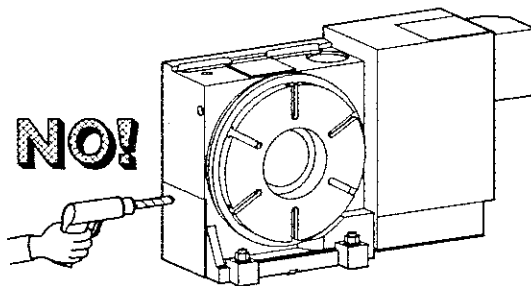
WARNING



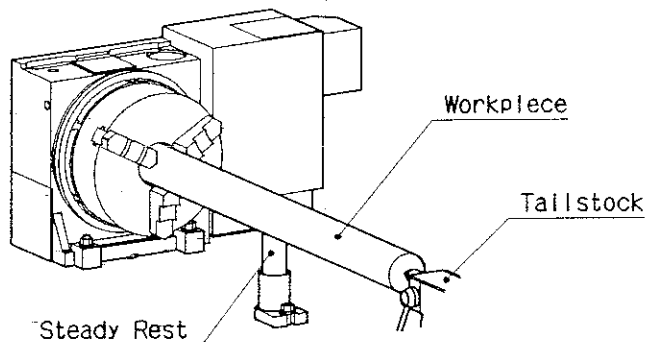
Do not apply cutting force which exceeds the specification in this manual. Failure to do so may cause severe damage to the unit and/or injury.



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)



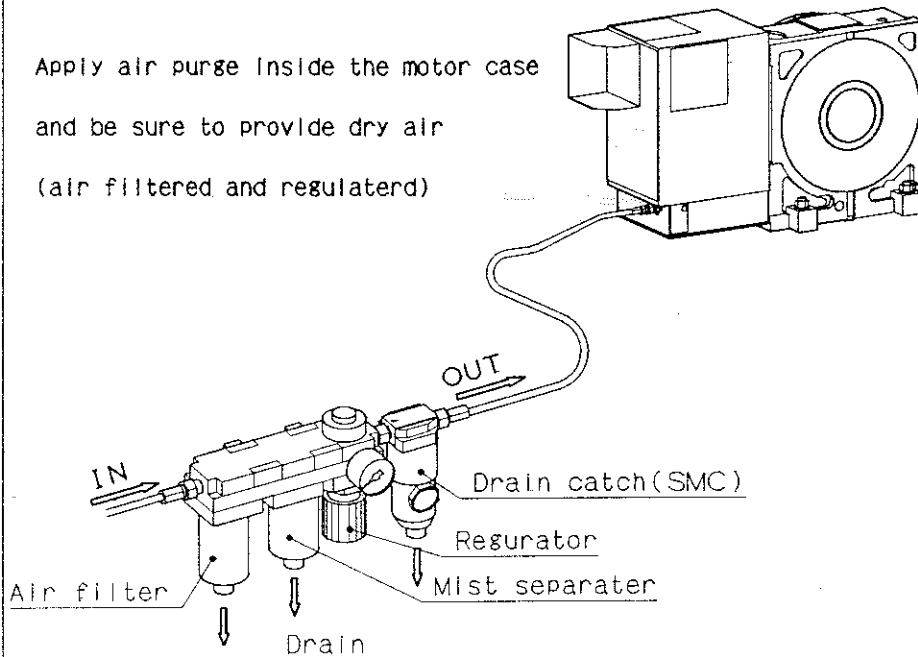


CAUTION



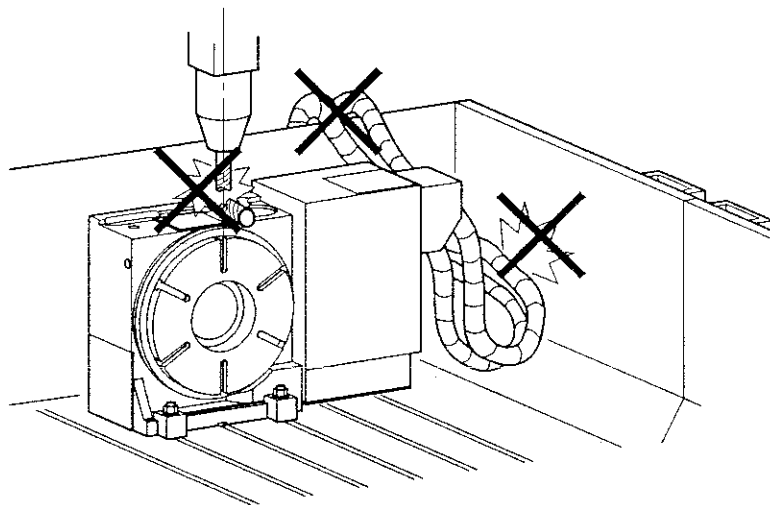
Supply air through Air regulator unit (Air filter, Mist separator, regulator, Drain catch) (see page 10)

Apply air purge inside the motor case
and be sure to provide dry air
(air filtered and regulated)



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

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

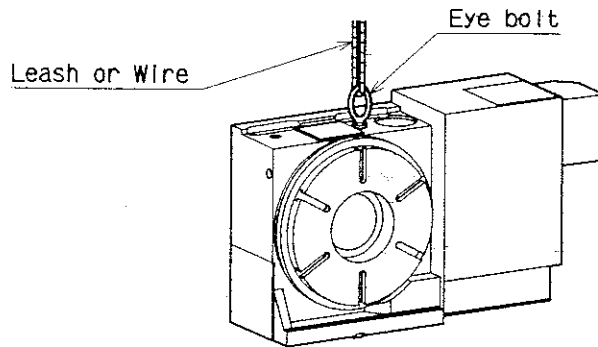




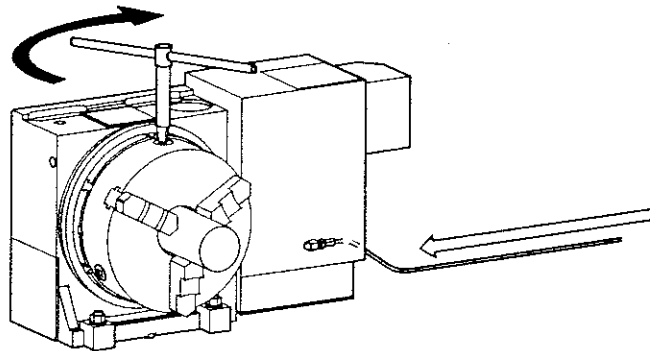
CAUTION



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. (See P.12)

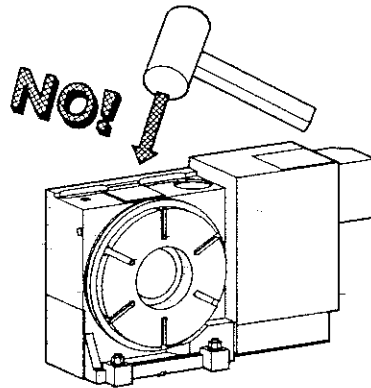




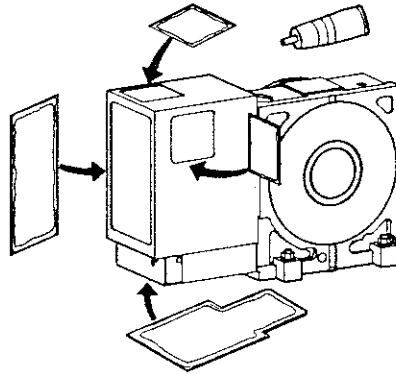
CAUTION



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



When removing the covers under any circumstances, make sure to strip existing sealing compound and uniformly apply new sealing compound before re-assembling for the prevention of coolant leakage into the unit caused the malfunction of the unit. (See P23)



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		TM(H)160	TM(H)180	TM(H)200	TM(H)250	TR(L)250	TR(L)320	TR400	TR500
Table Diameter (mm)		φ160	φ180	φ200	φ250	φ250	φ320	φ400	φ500
Center Height In Vertical (mm)		120	140	140	180	180	225	255	310
Table Height In Vertical (mm)		145	176	176	210	210	225	250	278
Overall Height In Horizontal (mm)		254	268	283	332	370	430	500	595
Center Hole (mm)		φ50	φ65	φ65	φ100	φ100	φ130	φ150	φ170
Thru. Hole Diameter (mm)		φ40	φ40	φ40	φ70	φ70	φ100	φ150	φ200
Guide Block (mm)		18h7	18h7	18h7	18h7	18h7	18h7	18h7	18h7
Width of T-Slot (mm)		12	12	12	12	12	14	18	18
AC Servo Motor	FANUC	1-0S, α2	1-0S, α2	0S, α3	5S, α6	5S, α6	5S, α6	10S, α12	10S, α12
	MELDAS	HA33NC-TS	HA33NC-TS	HA40NC-S	HA80NC-S	HA80NC-S	HA80NC-S	HA100NC-S	HA100NC-S
	YASNUC	USAFED-03 C21S	USAFED-05 C21S	USAFED-05 C21S	USAFED-09 C21S	USAFED-09 C21S	USAFED-09 C21S	USAFED-20 C22S	USAFED-20 C22S
	OSP	BL-MC25E-20T	BL-MC25E-20T	BL-MC25E-20T	BL-MC50E-20T	BL-MC50E-20T	BL-MC50E-20T	BL-MC100E-20S	BL-MC100E-20S
	NEDAC	DFSM-0420-252A	DFSM-0420-252A	DFSM-0520-502A	DFSM-1020-502A	DFSM-1020-502A	DFSM-1020-502A	DFSM-2020-502A	DFSM-2020-502A
Total Reduction Ratio		1/90	1/90	1/90	1/90	1/90	1/180	1/180	1/180
Max. Table Revolution [min ⁻¹ (rpm)]		22.2	22.2	22.2	22.2	22.2	11.1	11.1	11.1
Min. Resolution (degree)		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Indexing Accuracy (second)		20	20	20	20	20	20	20	20
Repeatability (second)		±2	±2	±2	±2	±2	±2	±2	±2
Clamping Torque [N·m(kgf·m)]	Air Press 0.5MPa(5.1kgf/cm ²)	100(10.1)	100(10.1)	100(10.1)	250(25.5)	250(25.5)	500(51.0)	—	—
	Hyd Press 3.5MPa(35.7kgf/cm ²)	350(35.5)	350(35.5)	350(35.5)	900(91.8)	900(91.8)	1600(163)	2500(255)	3200(326)
Allowable Mass (kg)	Horizontal	160	160	200	250	250	350	500	600
	Vertical	80	80	100	125	125	180	250	300
Max. Work Inertia [kg·m ² (kgf·cm·s ²)]		0.51 (5.2)	0.73 (6.6)	1.00 (10.2)	1.95 (19.9)	1.95 (19.9)	4.48 (45.7)	10.0 (102)	19.5 (191)
Machine Inertia [kg·m ² (kgf·cm·s ²)] (Reduced To Motor Shaft)		0.000167 (0.00170)	0.000317 (0.00323)	0.000318 (0.00324)	0.000557 (0.00568)	0.000695 (0.00709)	0.000418 (0.00426)	0.002767 (0.02822)	0.002820 (0.02876)
Mass (kg)		56	58	60	101	110	196	350	550

IMPORTANT

Table clamping force are measured 0.5MPa(5.1kgf/cm²) pneumatic pressure and 3.5MPa(35.7 kgf/cm²) hydraulic pressure. Max. Table Revolution is at 2000min⁻¹(rpm) of motor rotation.



Although the weight of the workpiece is within Allowable Mass. Max. Work Inertia must stay within the specification.



A tall stock may be required depending upon the weight and shape of the workpiece or the cutting conditions.



The cutting conditions are to be within the specifications above.

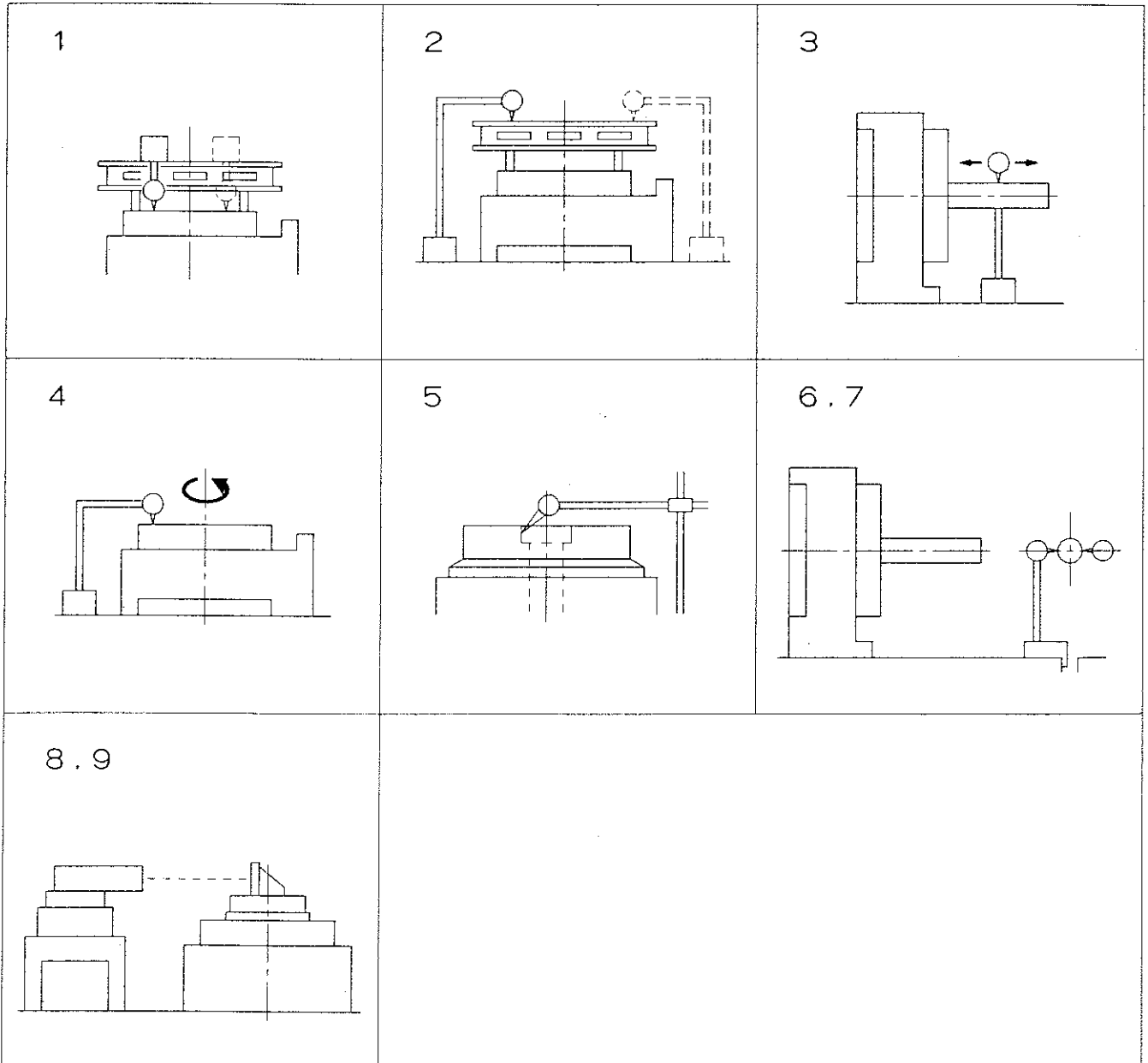
3. Accuracies

GUARANTEED ACCURACIES

ITEM	DESCRIPTION OF INSPECTION	UNIT	GUARANTEED ACCURACY
1	Flatness of Table Face	(mm)	0.01
2	Parallelism Between Table Face and Base	(mm)	0.02
3	Parallelism Between Center of Table and Base	(mm)	0.02
4	Run-out of Table Face in Rotation	(mm)	0.01
5	Concentricity of Center Hole	(mm)	0.01
6	Parallelism Between Center of Table and Center of Guide Blocks	(mm)	0.02
7	Deviation Between Center of Table and Center of Guide Blocks	(mm)	0.02
8	Indexing Accuracy	(second)	20
9	Repeatability	(second)	±2

Note: Measurement is taken at 300mm length from either face or center of the table.

Accuracies are measured with the auto-collimator.



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 a vertical unit, 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 interference 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 lubrication 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 which will cause severe damage to the internal mechanism. Use recommended oil shown 4-4.

4-3 Required Oil Quantity

MODEL	TM(H)160	TM(H)180	TM(H)200	TM(H)250	TR(L)250	TR(L)320	TR400	TR500
QTY. (l) at Horizontal	0.6	0.9	0.9	1.8	3.1	3.8	4.5	5.7
QTY. (l) at Vertical	0.4	0.7	0.7	1.4	2.4	3.1	4.1	5.1

4-4 Recommended Lubricating Oil

For TM(H)160, TM(H)180, TM(H)200

MANUFACTURER	PRODUCT NAME
Mobile	Vactra Oil No.1
Shell	Shelltona Oil K32

·Grade of Viscosity: ISO VG32

For TM(H)250, TR(L)250, TR(L)320, TR400

MANUFACTURER	PRODUCT NAME
Mobile	Vactra Oil No.2
Shell	Shelltona Oil K68

·Grade of Viscosity: ISO VG68

4-5 Inlet Pressure for Table Clamp

The unit is available both of Pneumatic and Hydraulic for Table Clamp.

4-5-1 Pneumatic Clamping

- 1) Use an appropriate filtration system. (Air Filter, Mist separator, Regulator, Drain catch set)
- 2) Connect the hose to the Pneumatic Inlet (Rc1/4), and supply 0.5~0.6MPa (5.1~6.1kgf/cm²) of Pneumatic pressure.

Recommendation for Air Unit. (Air Filter Unit) AC2000 (SMC) (or Similar).

4-5-2 Hydraulic Clamping

- 1) Connect the hose to the Hydraulic Inlet (Rc1/4), and supply 3.5~3.7MPa (35.7~37.7kgf/cm²) of Hydraulic pressure.

IMPORTANT

Hydraulic hose should be used 3/8 Size or Equivalent.

4-6 Air purge



(Pneumatic Clamping)

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 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.

(Hydraulic Clamping)

In the hydraulic pressure specification, since the exclusive air supply port for air purge is provided, be sure to supply the clean air as well as air specification (Service air pressure: 5kgf/cm²).

If the air purge is not performed because there is no air source, be sure to replace the silencer mounted to the air exhaust port as shown in the outline drawing with the plug 1/8 or 1/4 with the hexagon socket head attached.

5. Table Clamp and Unclamp

5-1 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 pressure remains when it is unclamped, the unit is operating under a half-clamp situation. This may cause severe damage to the internal mechanism. Especially when unclamped using the hydraulic system, make sure the back pressure is less than 0.2MPa (2.0kgf/cm²)

Do not operate the pneumatic clamp system under hydraulic pressure, and the hydraulic clamp system under pneumatic pressure.

5-2 Confirmation of Clamp and Unclamp

The unit is equipped with two built-in pressure switches for clamp/unclamp detection as shown in Fig. 1.

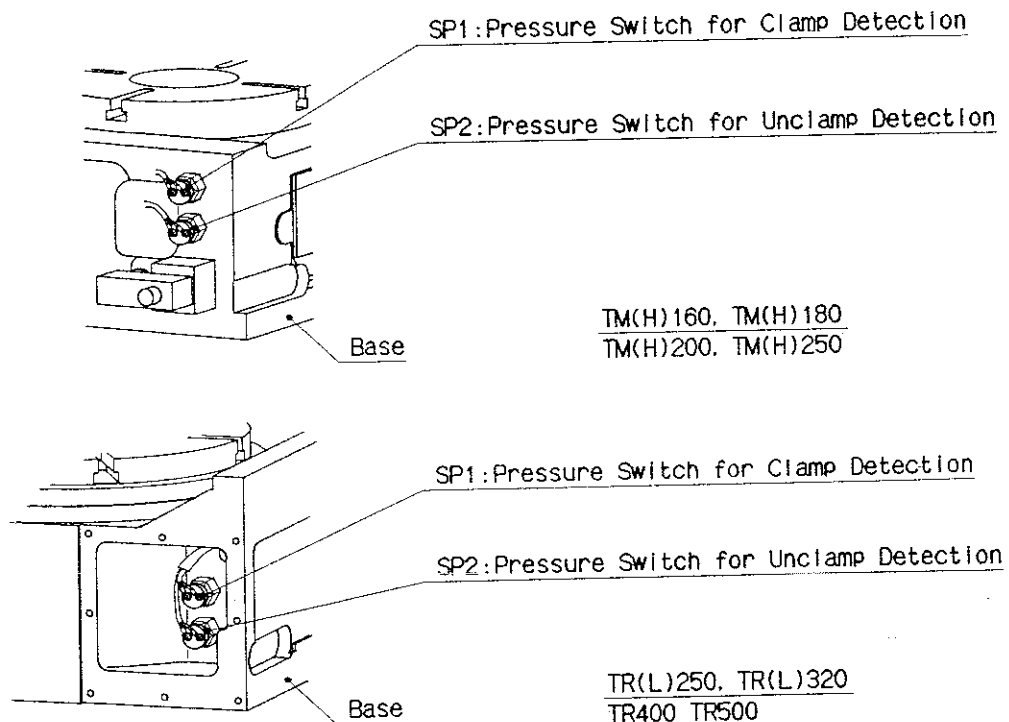


Fig. 1

The set up pressure of the switch for both pneumatic and hydraulic systems are as follows:

Signal	Clamp Signal (SP1)	Unclamp Signal (SP2)
Hydraulic	2.7 MPa (28 kgf/cm ²)	0.2 MPa (2 kgf/cm ²)
Pneumatic	0.3 MPa (3 kgf/cm ²)	0.05 MPa (0.5 kgf/cm ²)

5-3 Solenoid Valve for Clamp and Unclamp

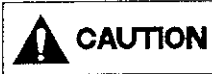
For Pneumatic Clamping, a solenoid valve is equipped inside.

The piping is arranged as follows as a standard set up.

Be sure to arrange electrical wiring accordingly.

Solenoid ON — Unclamp

Solenoid OFF — Clamp



For Hydraulic Clamping, the solenoid valve of the hydraulic unit shall have the same piping and electrical wiring as in the pneumatic clamping above.

6. Mounting the Workpiece



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



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.



If the workpiece is off-centered, it may cause inaccurate indexing.

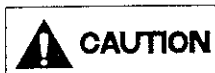


Mount or dismount the workpiece to or from the unit while the unit is clamped to avoid damage to the internal mechanism and diminished indexing accuracy of the unit.

7. 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 reduced 3~5 seconds due to 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.

Model	Backlash In Circular Length of Table O.D. (mm)	Backlash In Seconds
TM(H)160	0.010 - 0.026	34 - 101
TM(H)180	0.012 - 0.031	28 - 71
TM(H)200	0.013 - 0.032	28 - 71
TM(H)250	0.014 - 0.042	23 - 69
TR(L)250	0.014 - 0.042	23 - 69
TR(L)320	0.015 - 0.045	19 - 63
TR400	0.013 - 0.038	13 - 39
TR500	0.012 - 0.038	9.8 - 29

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

7-1 Measuring Backlash (See Fig. 2)

- 1) Place a dial indicator close to the table circumference on one of the T-Slot.
- 2) Insert a steel rod into another table T-Slot and move it in a clockwise direction with approximately 150 N·m (15.3 kgf·m) of force. 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 above.
If the amount of backlash is not within the appropriate range, adjust the amount using following procedures.

7-2 Procedure for Backlash Adjustment (See Fig. 3)



Be sure to shut off the main power of the machine when the cover of the gear case is removed.

Failure to do so may cause severe injury and/or accident.

7-2-1 Backlash Adjustment for TM Type Unit

- 1) Completely drain the lubrication oil from the drain port.
- 2) Remove the motor cover (8).
- 3) Remove the cover (1) at the opposite side of the motor cover (8).
- 4) Remove the adaptor (11) and the servo motor (10) together by loosening the socket head cap screws (12) mounting the adaptor (11).
- 5) Remove the pressure flange (9) and the clamp ring (7) by loosening the socket head cap screws (13). Then remove the gear (6).
- 6) Loosen the socket head cap screws (14) mounting the bearing case (4). Then, slowly rotate the worm shaft (5) with the lock nut (2) hole to remove the worm shaft (4) together with the entire bearing case (4).
- 7) Remove the worm shaft (5) from the casting body, then remove the spacer (3).
- 8) The backlash can be adjusted by altering the spacer (3) thickness.

7-2-2 Backlash Adjustment of TR Type Unit

- 1) Completely drain the lubrication oil from the drain port.
- 2) Remove the cover (3) at the gear case.
- 3) Remove the pressure flange (2) and the clamp ring (4) by loosening the socket head cap screws (9). Then remove the gear (1).
- 4) Loosen the socket cap screws (10) mounting the bearing case (5). Then, slowly rotate the worm shaft (8) with the lock nut (7) hole to remove the worm shaft (8) together with the entire bearing case (5).
- 5) Remove the worm shaft (8) from the casting body, then remove the spacer (6).
- 6) The backlash can be adjusted by altering the spacer (6) thickness.

IMPORTANT

The distance of grinding to reduce the backlash by 0.01mm is as follows:

MODEL	TM(H)160	TM(H)180	TM(H)200	TM(H)250	TR(L)250	TR(L)320	TR400	TR500
Amount of Grinding (mm)	0.314	0.314	0.314	0.466	0.466	0.466	0.548	0.548



Both faces of the spacer should be precisely ground to keep accurate parallelism. The adjustment of the backlash should be achieved gradually and cautiously. Repeat the procedure if necessary.

Re-assemble the worm gear by reversing the above procedure after adjusting the spacer thickness and lubricate it. Bolts are to be tightened with care and when the cover is to be attached. Please make the pressure of sealing with care.

Remove the existing sealing compound well and uniformly apply with new sealing compound (Three Bond Company Seal Compound 1215 or similar).



For gear assembly, tighten the hex. bolts with very uniform pressure to eliminate any gear wobbling motion.

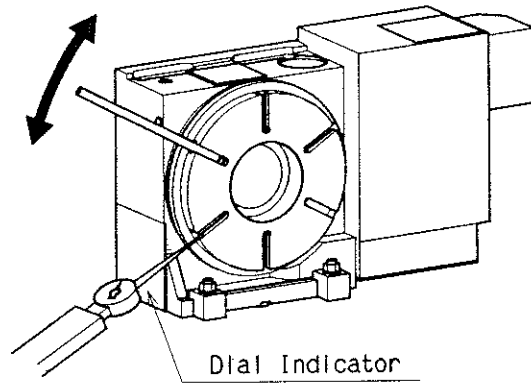
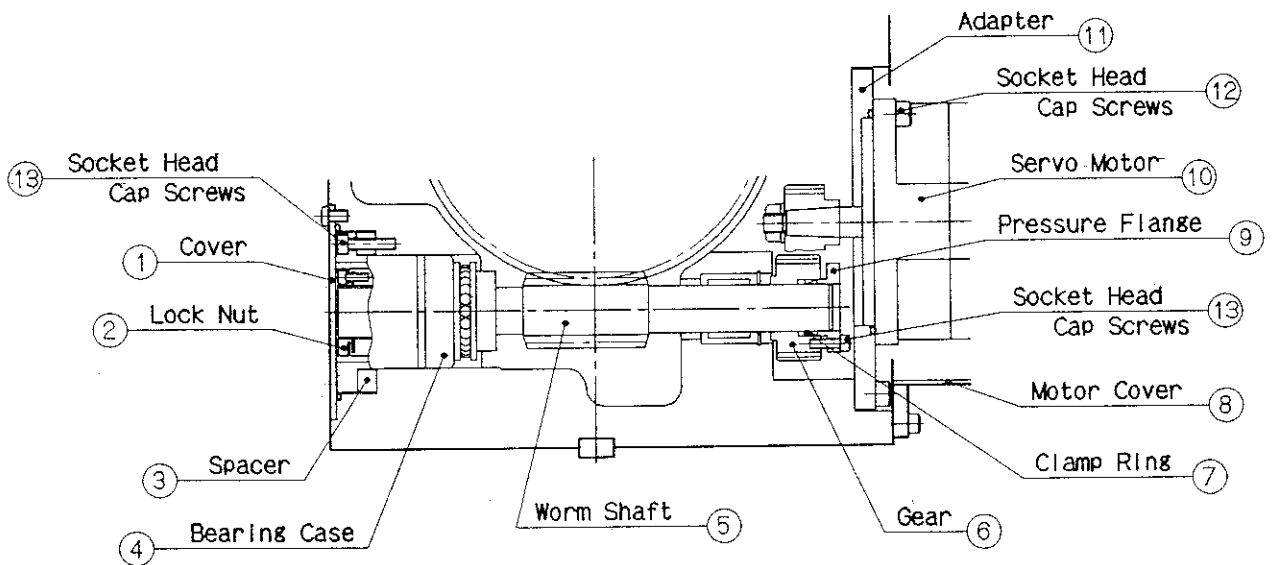
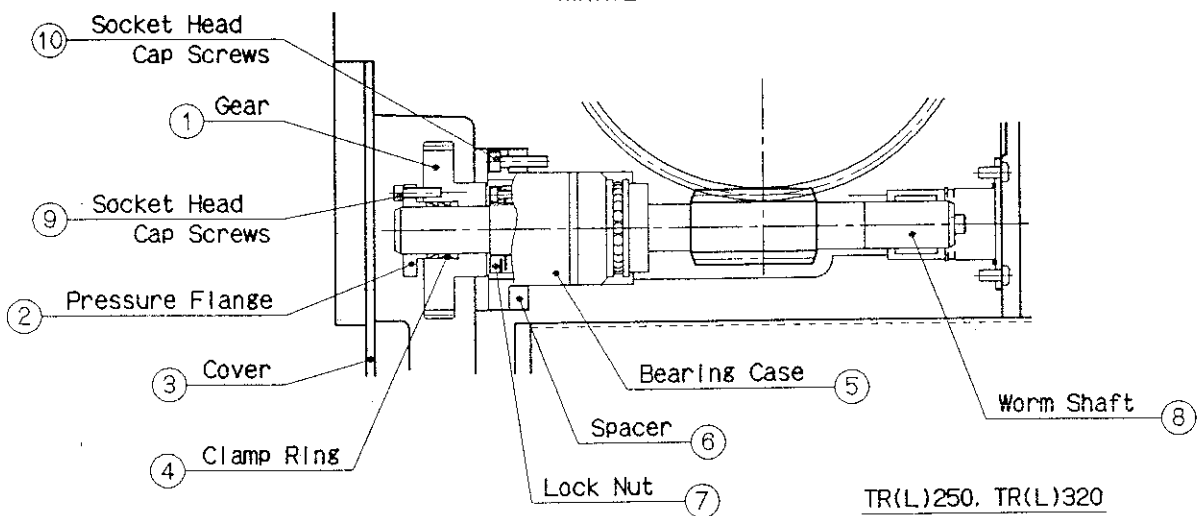


Fig. 2



TM(H)160. TM(H)180
 TM(H)200. TM(H)250



TR(L)250. TR(L)320
 TR400 TR500

Fig. 3

8. Zero-Return and Dog

8-1 Dog Position

The dog position is adjusted for zero-return in a clockwise rotation at the factory. 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. However, the dog can be exposed if the adjustment of the dog position is required. Fine adjustment of the dog position may be required at the customer at the time of interface with the NC controller of the machine.



The zero return dog is not provided on the unit for both the SUPER MAC and the OSP controller, in which the zero return position is programmed in their own software.

8-2 Dog Position Adjustment (See Fig. 4 & 5)

- 1) Drain the lubrication oil.
- 2) Remove the cover (1).
- 3) Loosen set screw (3) on the dog (2).
- 4) Relocate dog to the appropriate position.
- 5) Make sure to tighten set screw after the position is adjusted.



When putting the cover back, remove the existing sealing compound and uniformly apply with new sealing compound (Three Bond Company Seal Compound 1215).

8-3 Sensor Mechanism

- 1) Proximity Switch (See Fig. 4 & 5)

The gap between the dog (2) and the proximity switch (4) should be adjusted to approximately 1.5mm by the 1.00mm pitch thread provided on the proximity switch.

- 2) Limit Switch (See Fig. 4 & 5)

A roller plunger actuator (7) is provided between the dog (2) and the limit switch (6). Loosen the socket head cap screw (8) for fine adjustment of the limit switch position.

TM(H)160, TM(H)180
 TM(H)200, TM(H)250

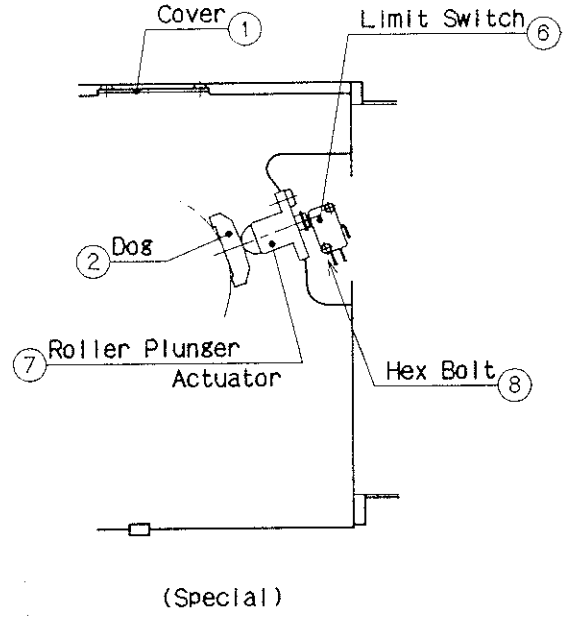
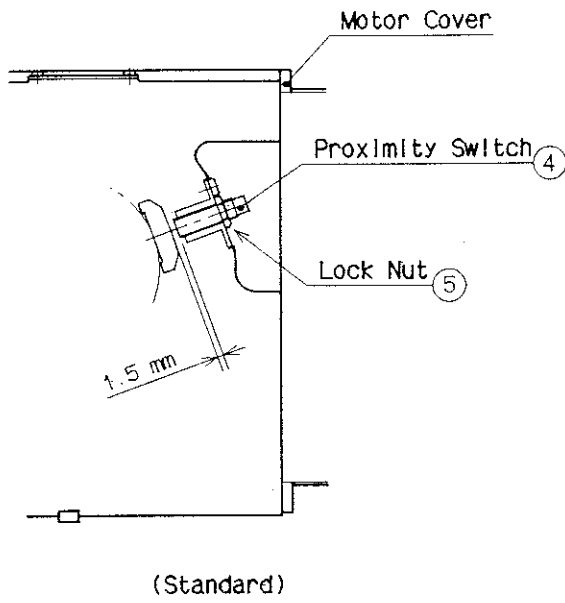
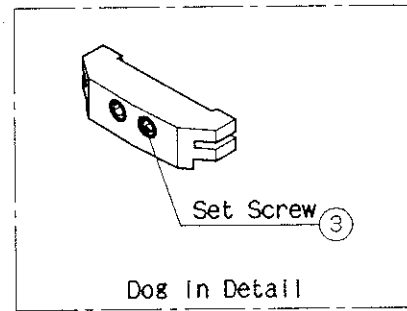


Fig. 4



TR(L)250, TR(L)320
 TR400

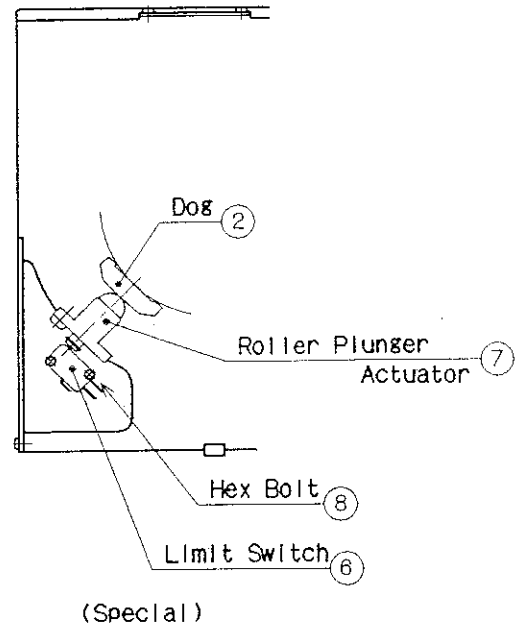
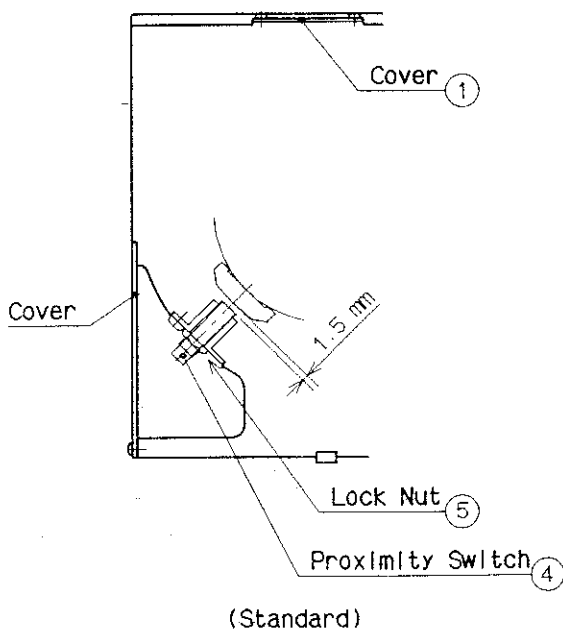


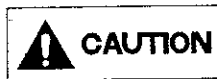
Fig. 5

9. Adjustment of Backlash of the Spur Gears

9-1 Measuring Backlash for TM Type Unit (See Fig. 6)

- 1) Completely drain the lubrication oil through the drain port.
- 2) Remove the hex. plug (2), then lock the movement of the spur gear Z1 (13) with an appropriate tool such as a screw driver through this opening.
- 3) Remove the hex. plug (8), and set a dial indicator at the pitch circle on the tooth face of the spur gear Z2 (14).
- 4) Remove the cover (12). Read the total movement of the dial indicator by slowly rotating the worm shaft (9) in both clockwise and counterclockwise directions. Use a hole on the lock nut (11) to rotate the worm shaft (9). This total movement of the dial indicator will be the backlash.

Backlash should be between 0.02 and 0.04mm. Backlash adjustment is required if the measurement is much larger or smaller than these figures.



Place the O ring (10) properly when putting the cover (12) back on the unit.

9-2 Adjustment of Backlash of the Spur Gears for TM Type Unit (See Fig. 6)

- 1) Measure the backlash by following the procedure in section 9-1.
- 2) Remove the motor cover (6).
- 3) Loosen the hex. bolt (1).
- 4) Loosen the four hex. bolts (3) mounting the servo motor (4), then eliminate the backlash of the spur gears to nearly zero by slowly tightening the hex. bolt (1).
- 5) Loosen and adjust the position of the hex. bolt (1) to have the flange of the motor sit against the hex. bolt (1) with sufficient amount of backlash. The position of the motor can be adjusted by utilizing a rod inserted in the hole provided on the adaptor (7).

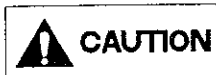
IMPORTANT

The hex. bolt (1) has 1.0mm pitch thread.

Therefore, backlash can be adjusted approximately 0.033mm by turning the hex. bolt (1) by 10 degrees.

- 6) Securely tighten the hex. bolts (3), and measure the backlash by following the procedure in section 9-1.

Repeat the procedure 2) through 6) if the backlash measurement above is not between 0.02 and 0.04mm.



Avoid any damage such as nicks and dents to the tooth face of the spur gear when backlash measurement or adjustment are performed.

Damage on the tooth face may prevent smooth rotation resulting in poor indexing accuracy and abnormal gear noise.

9-3 Measuring Backlash for TR Type Unit (See Fig. 6)

9-3-1 Measuring the Backlash of the Spur Gears Z2 (13) and Z3 (12)

- 1) Completely drain the lubrication oil through the drain port.
- 2) Remove the cover (6).
- 3) Lock the movement of the spur gear Z3 (12) with an appropriate tool such as a screw driver.
- 4) Set a dial indicator at the pitch circle on the tooth face of the spur gear Z2 (13).
- 5) Read the total movement of the dial indicator by manually rotating the spur gear Z2 (13) in both clockwise and counterclockwise directions. This total movement of the dial indicator will be the backlash.

9-3-2 Measuring the Backlash of the Spur Gears Z1 (11) and Z3 (12)

- 1) Completely drain the lubrication oil through the drain port.
- 2) Remove the cover (6).
- 3) Lock the movement of the spur gear Z3 (12) with an appropriate tool such as a screw driver.
- 4) Set a dial indicator at the pitch circle on the tooth face of the spur gear Z1 (11).
- 5) Read the total movement of the dial indicator by manually rotating the spur gear Z1 (11) in both clockwise and counterclockwise directions. This total movement of the dial indicator will be the backlash.

Backlash between each gear engagement should be between 0.02 and 0.04mm.

Backlash adjustment is required if the measurement is much smaller or larger than these figures.

9-4 Adjustment of Backlash of the Spur Gears for TR Type Unit (See Fig. 6)

9-4-1 Backlash Adjustment of the Spur Gears Z2 (13) and Z3 (12)

Backlash can be adjusted by rotating the eccentric ring which has a maximum of 0.3mm of eccentricity.

- 1) Measure the backlash by following the procedure in section 9-3-1.
- 2) Set and leave a dial indicator at the pitch circle on the tooth face of the spur gear Z2 (13) for further backlash measurement needed.
- 3) The eccentric shaft (7) is positioned securely by the hex. bolt (10) and the steel ball (9). Remove the hex. bolt (8). Then, adjust the amount of eccentricity as measuring the backlash with a dial indicator by slowly turning the hex. screw (10) in either clockwise or counterclockwise directions.

Backlash can be increased by rotating the eccentric shaft (7) in clockwise direction, and decreased in counterclockwise direction.

Alignment marks indicating the proper backlash position is engraved at the factory on both the eccentric shaft and the gear box for your convenience.

9-4-2 Backlash Adjustment of the Spur Gears Z1 (11) and Z3 (12)

- 1) Measure the backlash by following the procedures in section 9-3-2.
- 2) Loosen the hex. bolt (4).

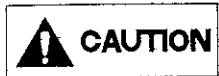
3) Loosen the four hex. bolts (2) mounting the servo motor, then eliminate the backlash to nearly zero by slowly tightening the hex. bolt (4).

IMPORTANT

4) Loosen and adjust the position of the hex. bolt (4) to have the flange of the motor sit against the hex. bolt (4) with sufficient amount of backlash. The hex. bolt has 1.00mm pitch thread. Backlash can be adjusted approximately 0.033mm by turning the hex. bolt (4) by 10 degrees.

5) Securely tighten the four hex. bolts (2), and measure the backlash by following the procedure in section 9-3-2.

Repeat the procedure 2) through 5) if the backlash measurement is not between 0.02 and 0.04mm.



Avoid any damage such as nicks and dents to the tooth face of the spur gear when backlash measurement or adjustment are performed.

Damage on the tooth face may prevent smooth rotation resulting in poor indexing accuracy and abnormal gear noise.

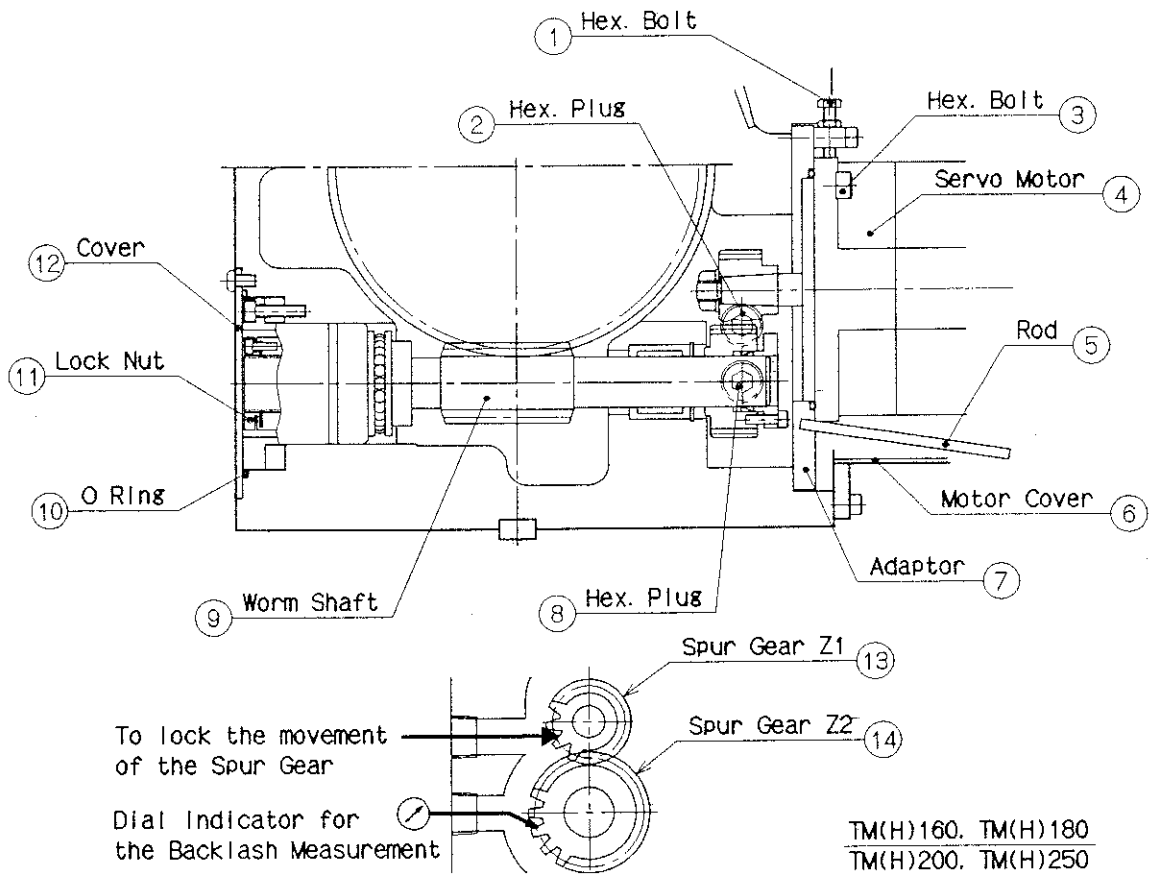
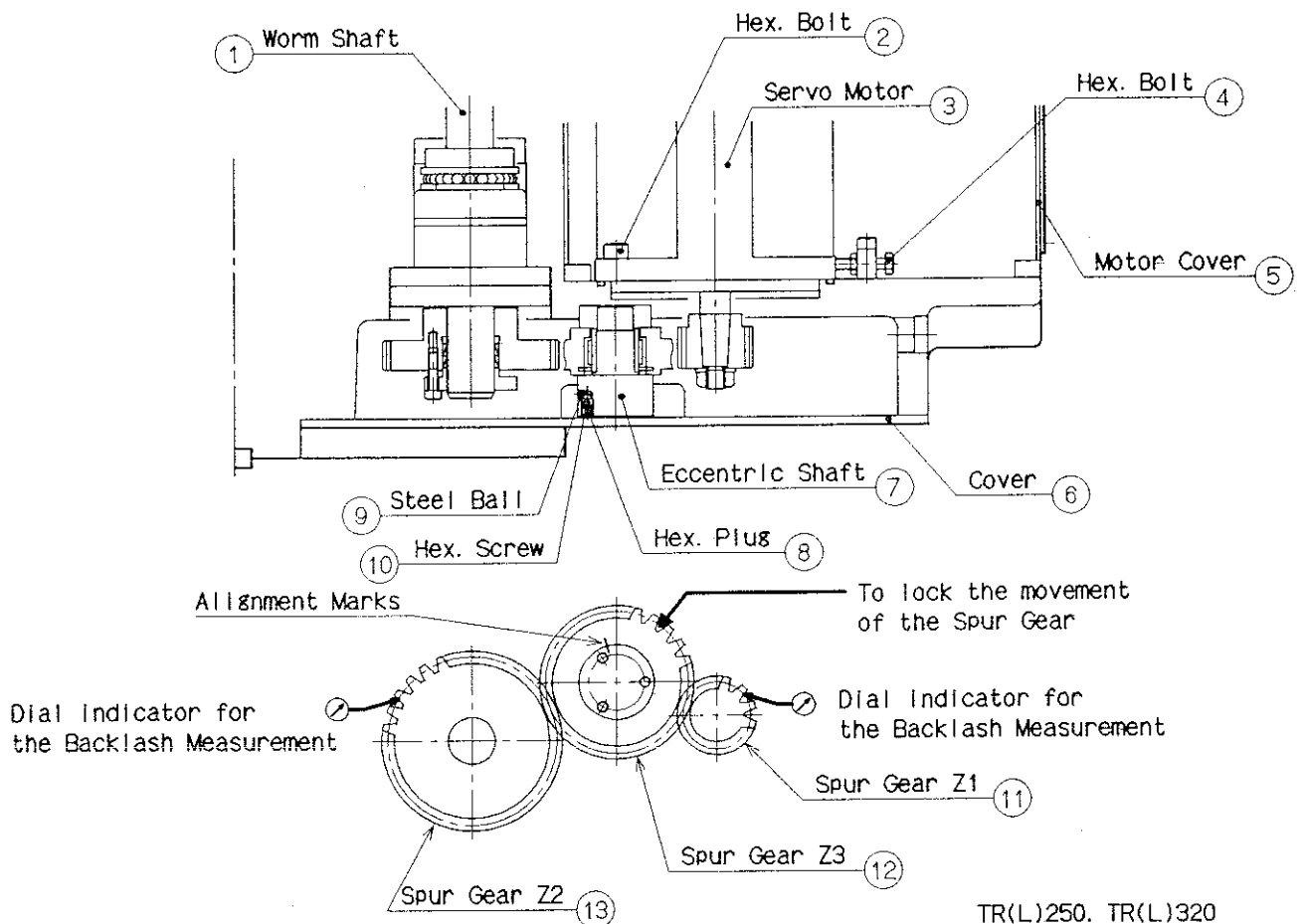


Fig. 6



TR(L)250. TR(L)320
 TR400 TR500

Fig. 6

10. Motor Cover

10-1 Dismount

Please follow the procedure below for removing the motor cover. (See Fig. 7)

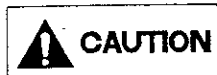
- 1) Remove the cover (1) at the motor cover (5), disconnect wires from the terminal box (3), and disconnect the cannon connectors (2) from the servo motor.
- 2) Loosen the hex. bolts (7), then remove the motor cover slowly by lifting upward.

10-2 Waterproofing

For the prevention of coolant leakage into the unit, all attached elements such as lids and covers are coated with sealing compound, and an oil seal is used on the rotating element. When removing the covers under any circumstances, make sure to strip the existing sealing compound and uniformly apply with new sealing compound before re-assembling. A drain port is provided to drain the coolant out. In the event of coolant leakage into the unit. However, avoid shooting coolant around the motor cover area and the drain port area as much as possible.



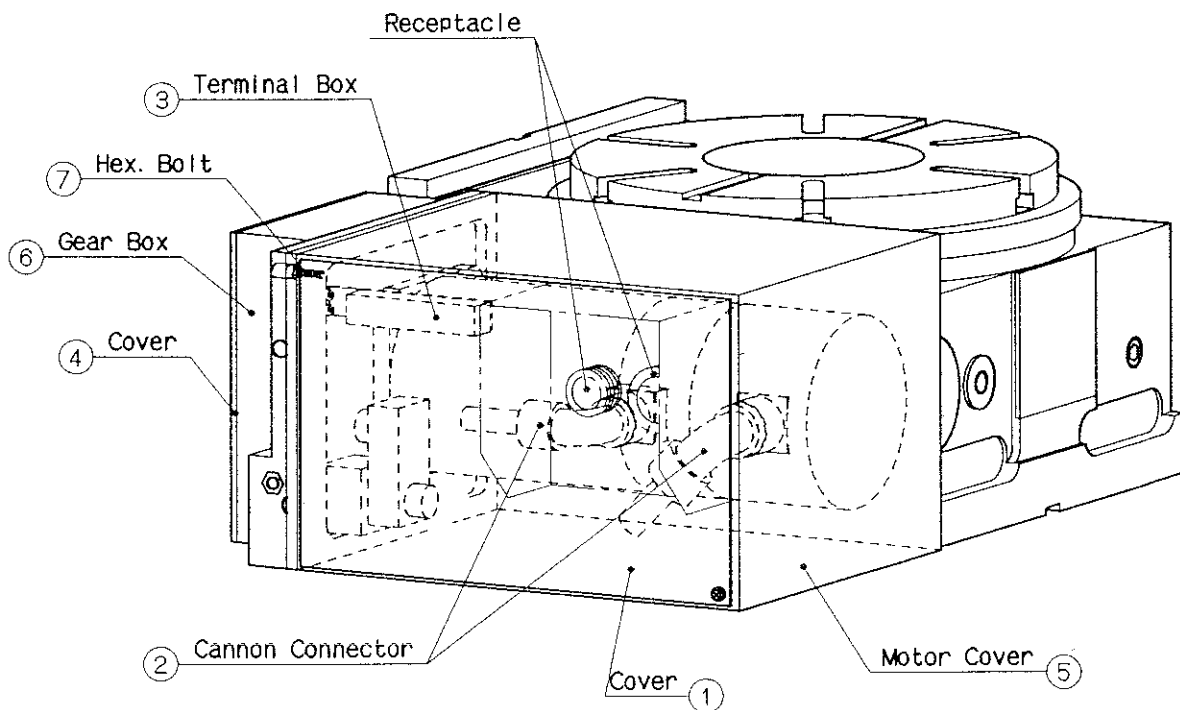
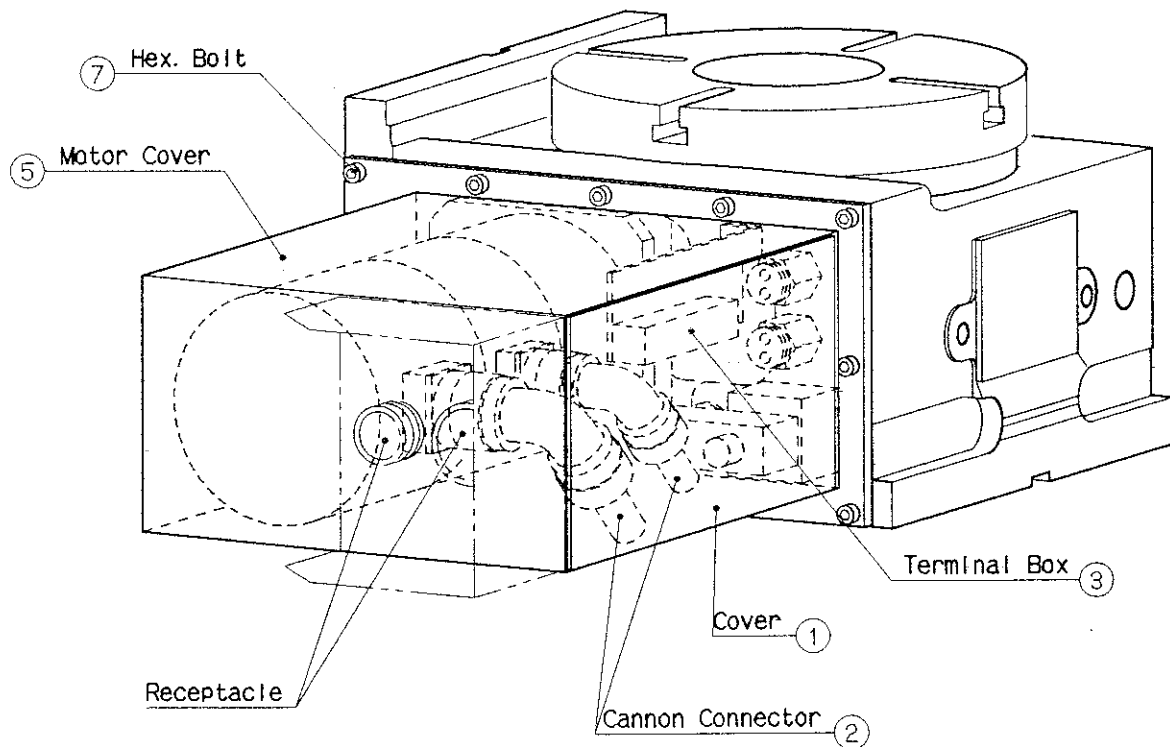
When putting the motor cover back on the unit, remove the existing sealing compound and uniformly apply with new sealing compound (Three Bond Company Seal Compound 1215 or similar).



Drain the lubrication oil before starting the procedure to remove the motor. The drain port at the motor cover is provided for unexpected coolant leakage into the motor cover.

TM(H)160. TM(H)180
TM(H)200. TM(H)250

Fig. 7



TR(L)250. TR(L)320
TR400 TR500

Fig. 7

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 30 seconds cumulative indexing accuracy ?*

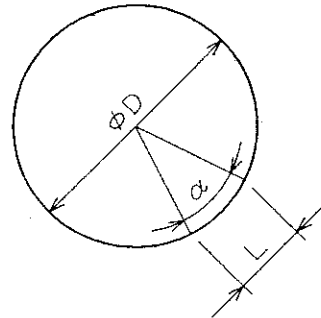
* What is the angle with a cumulative pitch error of 0.05mm ?*

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 4 inches, and by using formula (3), the cumulative indexing accuracy of 30 seconds as linear length at table circumference will be:

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

Therefore, the length is approximately 0.0073mm.

And converting the cumulative pitch error of 0.05mm to an angle, use formula (2):

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

Therefore, the angle is approximately 206.25 seconds equal to 3 minutes 26 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. Maintenance

In order to maintain a unit with the best condition, clean up and check with the following points.

- 1) Check the fixed condition of NC Rotary indexing table (Jig: If Jig is mounted onto the table).
- 2) Check electric and air connection cables and air hose. (Whether serious damage or air leakage from hose can be found or not.)
- 3) Confirmation of lubricant (Lubricant must be filled at the center level of oil-leakage. In general, lubricant should be changed newly every 6 months though soil of lubricant will be depend on frequency of use. Please refer to item 4-2.)
- 4) Confirmation of pressure for clamping. [Air clamp method: Air pressure 0.5~0.6MPa (5.1~6.1kgf/cm²) Hydraulic method: Hydraulic pressure 3.5~3.7MPa (35.7~37.7kgf/cm²) Please refer to 4-5.]
- 5) After use, it is important to clean the rotary table. Remove all metal chips from the unit since the surfaces of the unit are precisely ground for accurate positioning and metal chips could damage those surfaces. When clean up, do not dash water on-unit directly. Apply a coat of rust preventative.

14. Trouble and Countermeasure

Investigate the causes of the trouble of NC Rotary Table by using the self-diagnosis function of machining center controller.



Countermeasure must be done only the skilled service-man.

Trouble	Possible Reason	Countermeasure
Wrong signal for returning to machine origin.	Signal is not "off" because of wrong adjustment of attachment position of proximity switch.	Adjust the stroke of proximity switch. (See Item 8-3)
	Malfunction of proximity switch.	Change proximity switch. (See item 8-3)
	Disconnection of cable.	Check proper connection of cable. (A6, A7) (See drawing of wiring)
Wrong confirmation signal for clamping /unclamping.	Shortage of pressure source for clamping.	Check the pressure source for clamping. (See Item 4-5)
	Malfunction of solenoid valve.	Change solenoid valve.
	Malfunction of pressure switches for clamping/unclamping.	Investigate wrong signal by using the function of self-diagnosis of controller. If it is wrong, change it newly. (See Item 5-2)

Please contact the distributors or following KITAGAWA agent in Europe referring to the troubles except above or actual countermeasures:

Agent : KITAGAWA EUROPE LTD.

DOLPHIN INDUSTRIAL ESTATE
SOUTHAMPTON ROAD SALISBURY
WILTSHIRE SP1 2NB ENGLAND

TEL (01722) 421155
FAX (01722) 421071