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1. Preface

Thank you for your purchase of the Nikken CNC Table.

The Nikken CNC Table is designed and manufactured on basis of our spirit of "everyday research", which wards are the origin of our company name, and customers intention is incorporated in the design to a Maximum practical extent.

We are sure that this CNC Table will satisfy you with its high performance, high quality and easy operation.

Nikken CNC Table withstands long-term and full operation, however, in order to ensure its proper handling and full utility for intended purpose, please read through the instruction manuals attached hereto.

**Please keep " Inspection Certificate ",
" Common Instruction Manual ",
and " Individual Instruction Manual " in your file.**

If there should happen any trouble on the CNC Table, please inform us details of trouble as well as all letters engraved on its name plate.



2. Dimensions and Specifications

Please see separate sheets in this file.

3. Preparation for operation

The following preparations and trial running are required before the CNC Rotary Table is fully running:

- 1) Unpacking, transfer and installation
- 2) Installation onto the M/C
- 3) Filling lubrication oil
- 4) Electrical connection
- 5) Supplying hydraulic pressure for clamping
- 6) Trial Running
- 7) Setting grid shift amount for zero return

3-1. Unpacking , transfer and installation



1) Unpacking and transfer

Careful attention should be paid to the transfer of the CNC Rotary Table after it is unpacked.

Hook a wire through the eye bolts and carefully move the CNC Rotary Table while keeping the balance.

After the transfer please detach the eye bolts.

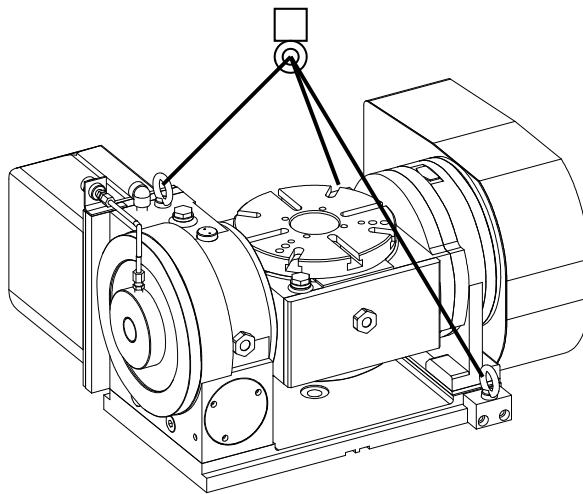


Fig. 1

2) Wiping off rust-preventive oil

Carefully wipe off the rust-preventive oil applied on the whole surface of the CNC Rotary Table when shipped by using waste cloth.

Do not use benzene or gasoline which would produce rust.

3-2. Installation onto the M/C

Please see Common Instruction Manual.

3-3. Filling lubrication oil

The entirely enclosed CNC Rotary Table body will not permit the ingress of cutting oil or permit lubrication oil to leak out. Check lubrication oil and the oil pots every week, and supply a proper amount of oil if it is insufficient.

Oil should be changed at least once a year.

There are 2 oil ports for lubrication on each rotary axis & tilt axis body.

The proper amount of oil has been filled in the CNC Rotary Table when shipped.

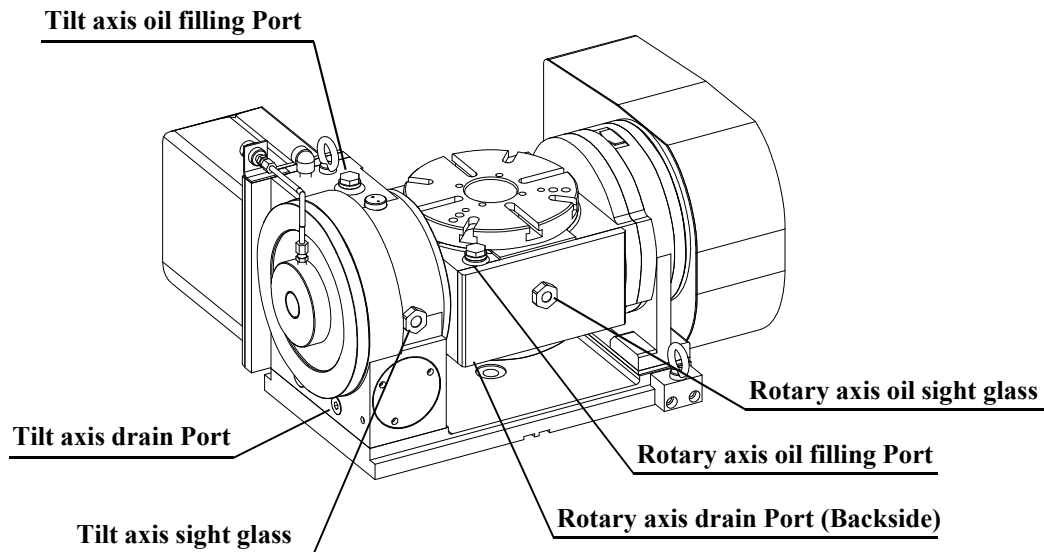


Fig. 2

3-4. Electrical connection

Always make sure that the electrical connection between the CNC Rotary Table and the machine controller

Is done according to the attached electrical circuit diagram.

Starting the CNC Rotary Table with the brake clamped would damage the CNC Rotary Table.

Note 1) The cable connection and checking must be done when the main power of the machine tool is switched off.



Note 2) Ensure that the cables and the hydraulic hose are located safely without causing any interference against the movement of the machine table.

Note 3) Ensure that the over travel detection limit switches on the tilt axis activates emergency stop with enforced over travel operation.

After the checking, make sure that the over travel release operation (in case of the table controlled by the Nikken Alpha21 Controller, it can be executed by pressing reset button on to release the over travel and return the rotary table to the opposite direction by jog mode.)

If the table controlled by the machine side NC unit, the unit has to be turned the power off once after the emergency stop, and turned on again to release the emergency stop, thus ensure that the over travel bypass switch is turned on after the unit is turned off, and finally the power is turned on.

3-5. Supplying pneumatic pressure for the brake

The brake clamp on this table is activated by pneumatic pressure.

The solenoid valve and confirmation switches for clamp/unclamp are provided inside the motor cover. Please connect air supply hose to the specified port.

- 1) Please refer the attached drawing details about location of pneumatic connection port.
- 2) Always make sure that the brake clamp requires 0.49MPa constant pneumatic supply pressure.
- 3) The applicable pneumatic pressure range is between 0.40MPa – 0.70MPa.
However, if the pressure is below 0.49MPa, the sufficient brake torque in the specifications can not be obtained, and if the pressure is over 0.70MPa, it might damage the solenoid valve, switches for clamp/unclamp confirmation, and the air hose
- 4) Always make sure that the pure clean air is supplied for brake clamp system.

3-6. Trial Running (For pneumatic)

- 1) Make sure that the air hose is connected and the pressure is supplied correctly.
- 2) Do not load any component on the CNC Rotary Table.
- 3) Execute the brake clamp (M10, M68 etc) and unclamp (M11, M69 etc) commands repeatedly
from NC unit to check the brake works properly.

When the CNC Rotary Table is controlled by the Nikken Alpha 21, use G10 (Unclamp command) and G11 (Clamp command) signal instead.

N000	G10 G13	(Unclamp, Single Drive Mode)
N001 J000	G11	(Clamp and then Jump to N000)

- 4) Rotate the CNC table rotary axis clockwise and counter-clockwise about twice at low speed (F300) for the first time, and make sure that the CNC Rotary Table rotates smoothly, then gradually increase the speed up to the rapid speed.
- 5) Drive the CNC table tilt axis to + & - directions about twice at low speed within over travel limitation ranges, and make sure that the table tilts smoothly, then gradually increase the speed up to the rapid speed.

3-5. Supplying hydraulic pressure for clamping

The table clamps operate entirely on hydraulics. Moreover, the solenoid valve is not built into the table. For details, see the attached hydraulic circuit diagram.

- 1) See the diagram below for the standard locations of the hydraulic connections. The connection port uses an Rc 3/8 female screw. (For a non-standard location, see the separate specifications sheet.)
- 2) Supplied hydraulic pressure for clamping should be between 3.0MPa and 3.5MPa.
- 3) If the hydraulic pressure source is 3.5MPa or greater, provide a reducing valve.
- 4) Set the back pressure (cracking pressure) to 0.05MPa or lower.

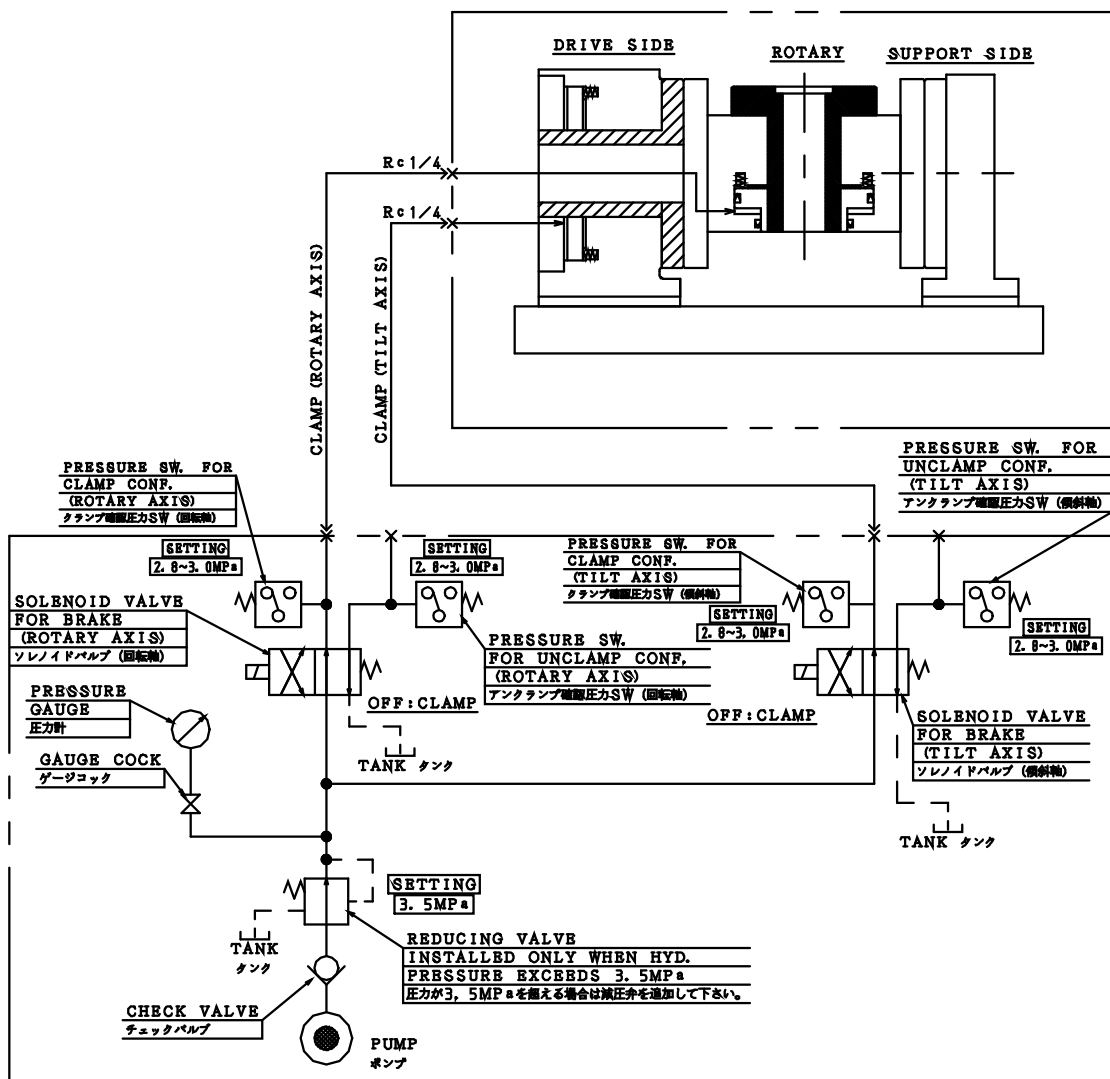


Fig. 3

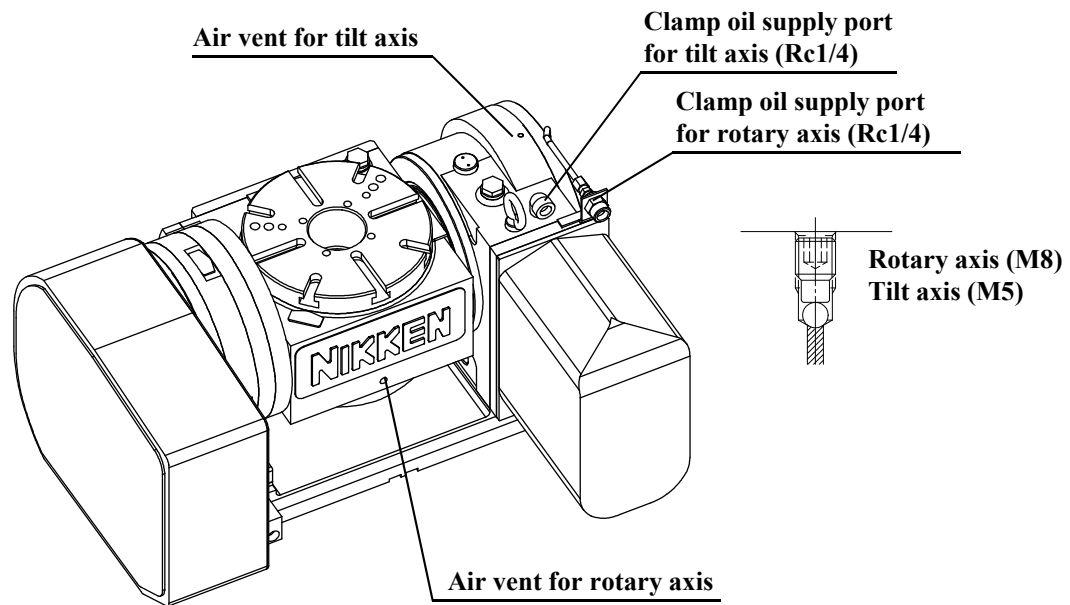


Fig. 4

After completion of hydraulic connection, slightly loosen the air vent bolts for both axis and activate the brake clamp and unclamp several times until the oil starts to come out through vent hole then tighten the bolts completely.

Male sure that the above air venting operation is done completely or it might cause less powerful brake force than the specified figures.

3-6. Trial Running (For hydraulic)

- 1) Make sure that the hydraulic hose is connected and the pressure is supplied correctly.
- 2) Do not load any component on the CNC Rotary Table.
- 3) Execute the brake clamp (M10, M68 etc) and unclamp (M11, M69 etc) commands repeatedly from NC unit to check the brake works properly.

When the CNC Rotary Table is controlled by the Nikken Alpha 21, use G10 (Unclamp command) and G11 (Clamp command) signal instead.

N000	G10 G13	(Unclamp, Single Drive Mode)
N001 J000	G11	(Clamp and then Jump to N000)

- 4) Rotate the CNC table rotary axis clockwise and counter-clockwise about twice at low speed (F300) for the first time, and make sure that the CNC Rotary Table rotates smoothly, then gradually increase the speed up to the rapid speed.
- 5) Drive the CNC table tilt axis to + & - directions about twice at low speed within over travel limitation ranges, and make sure that the table tilts smoothly, then gradually increase the speed up to the rapid speed.

3-7. Setting grid shift amount for machine zero return (only for additional axis control)

The machine zero point of each rotary and tilt axis is as follows:

The machine zero point of tilt axis on the CNC Table is located at the position where the rotary axis table surface becomes parallel position.

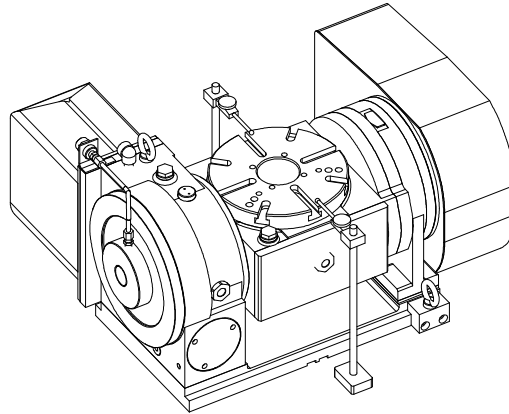


Fig. 5

The machine zero point of the CNC Rotary Table is located at the position where the CNC Rotary Table reference T-slot becomes parallel with the CNC Rotary Table bottom surface and the base line plate indicates “0” position.

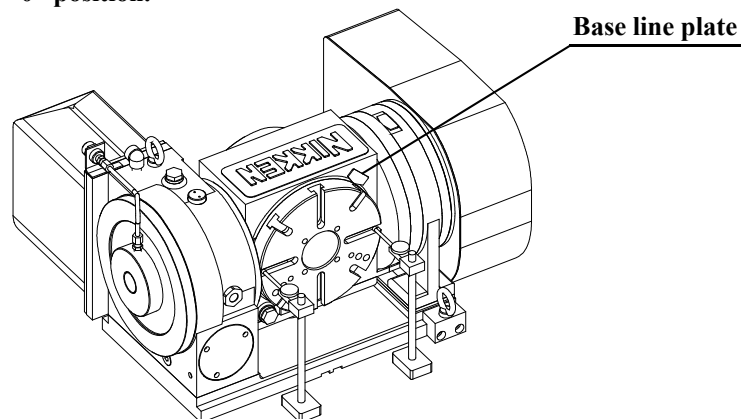


Fig. 6

The grid shift amount is described at the individual parameter list. And regard this amount as the compensation amount.

1) Input the compensation amount at the grid shift amount.

2) By Jog mode,

For Rotary Axis, Rotate the CNC Table a few degrees to the machine zero return direction,

For Tilt Axis, tilt nearby 45° at absolute position, then carry out the machine zero return.

3) Adjust the compensation amount with checking the CNC Rotary Table zero position by dial gauge reading.

Repeat 1) ~ 3) operation to obtain the correct grid shift amount.

4. Mechanism and Maintenance for main parts

4-1. Mechanism location for main parts

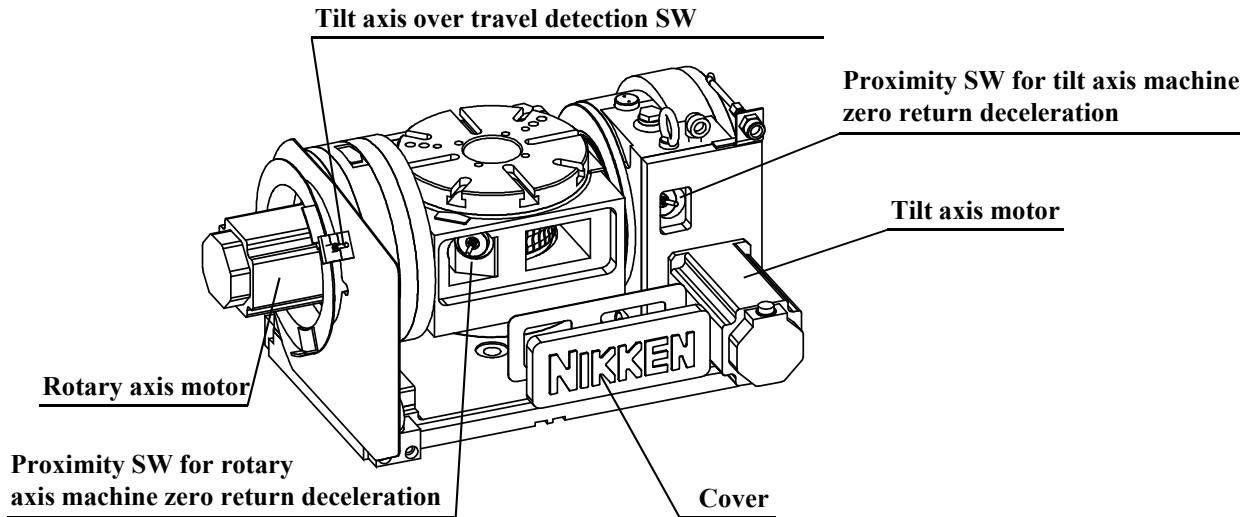


Fig. 7

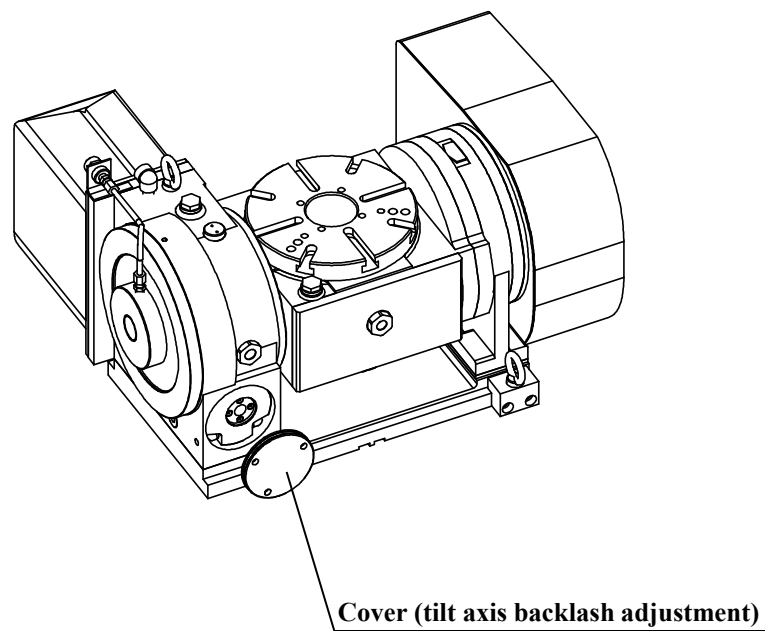


Fig. 8

4-2. Backlash adjustment

4-2-1. Backlash adjustment (Rotary Axis)

The worm screw rotates in the totally-enclosed oil bath and the reduction mechanism is composed of a combination of the special ion-nitrided worm gear and the hardened worm screw, so that it is not necessary to adjust the backlash until 4 ~ 5 years have elapsed after the rotary table is put in service.

However, if it's necessary, the backlash can be simply adjusted according to the following procedures.

- 1) Unclamp the brake (Shut the hydraulic supply and detach the hydraulic hose off the table.)
- 2) Tilt the table by 90°
- 3) Confirming the backlash

Read a deflection of the dial gauge (a) by inserting the flat plate (H) into a T-slot and manoeuvre the faceplate clockwise and anticlockwise through the plate by hand. A backlash of within 0.005mm to 0.015mm is normal, and the adjustment should be done in the event when a backlash of 0.050mm or more is observed. The confirmation is to be done on four spots of every 45° of table.

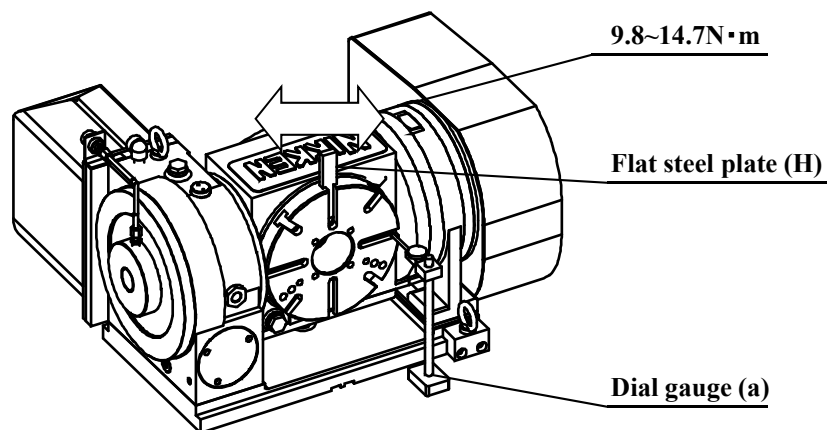


Fig. 9-1

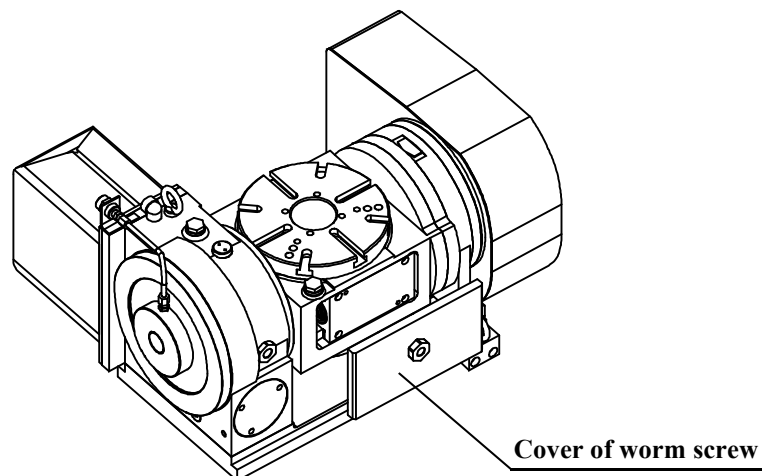


Fig. 9-2

4) Backlash adjustment

The adjustment of backlash for rotary axis can be carried out by minimizing the meshing pitch between the table (worm wheel) center and the worm screw center.

Locate the tilt axis at 0° and the cover of worm screw of Fig. 9-2 is removed.

The adjusting mechanism is illustrated by Fig. 10. In order to minimize the meshing pitch, remove the shim plate and thin it by a surface grinder etc. To minimize the backlash by 0.010mm, it is necessary to thin the shim plate by about 0.019mm.

Be sure to thin the shim plate gradually so as not to thin it excessively.

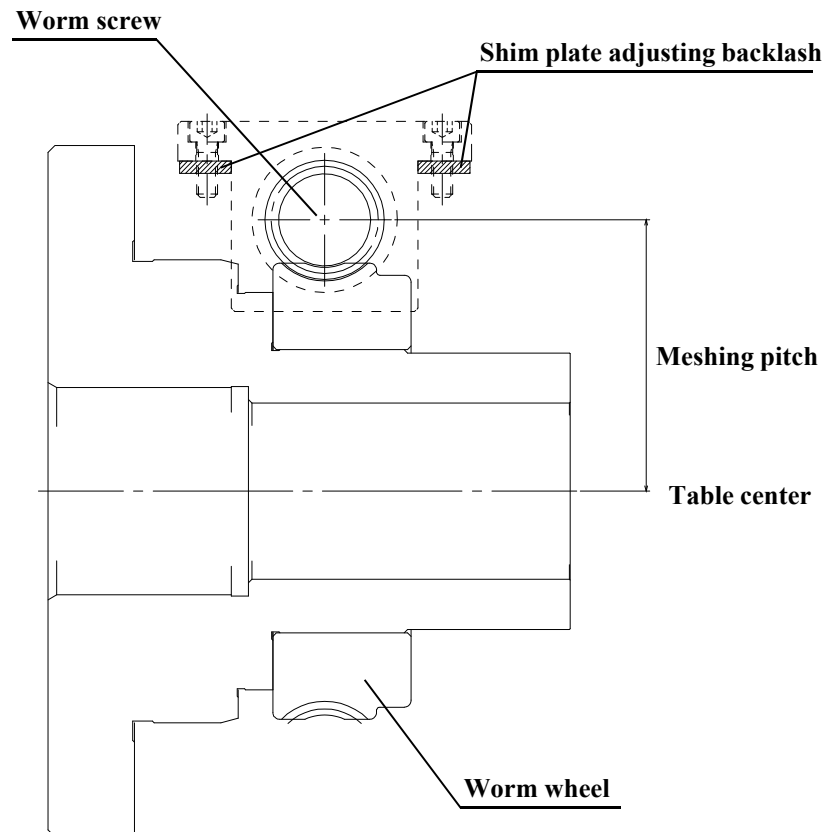


Fig. 10 Rotary axis backlash adjustment mechanism

After completion of the adjustment, make sure that it has been adjusted to about $5\mu\text{m} \sim 15\mu\text{m}$ besides be sure to rotate the table at the low speed (2 rpm) for running first, then turn at the rapid speed.

4-2-2. Backlash adjustment for Tilt axis

The worm screw rotates in the totally-enclosed oil bath and the reduction mechanism is composed of a combination of the special ion-nitrided worm gear and the hardened worm screw, so that it is not necessary to adjust the backlash until 4 ~ 5 years have elapsed after the rotary table is put in service.

However, if it's necessary, the backlash can be simply adjusted according to the following procedures.

- 1) Execute machine zero return on rotary axis and clamp the brake (brake on)
- 2) Locate the tilt axis at 0° and unclamp the brake (Shut the pneumatic supply and detach the hydraulic hose off the table.)
- 3) Confirming the backlash

Put the dial gauge (a) on the table surface (rotary axis center line).

Read a deflection of the dial gauge (a) by inserting the flat plate (H) into a T-slot and manoeuvre the faceplate by hand at 9.8 ~ 14.7Nm force as per Fig.11.

A backlash of within 5 μ m ~ 15 μ m is normal, and the adjustment should be done in the event when a backlash of 50 μ m or more is observed.

The confirmation is to be done on 4 spots by indexing 30° increment. (at 0, 30, 60 & 90).

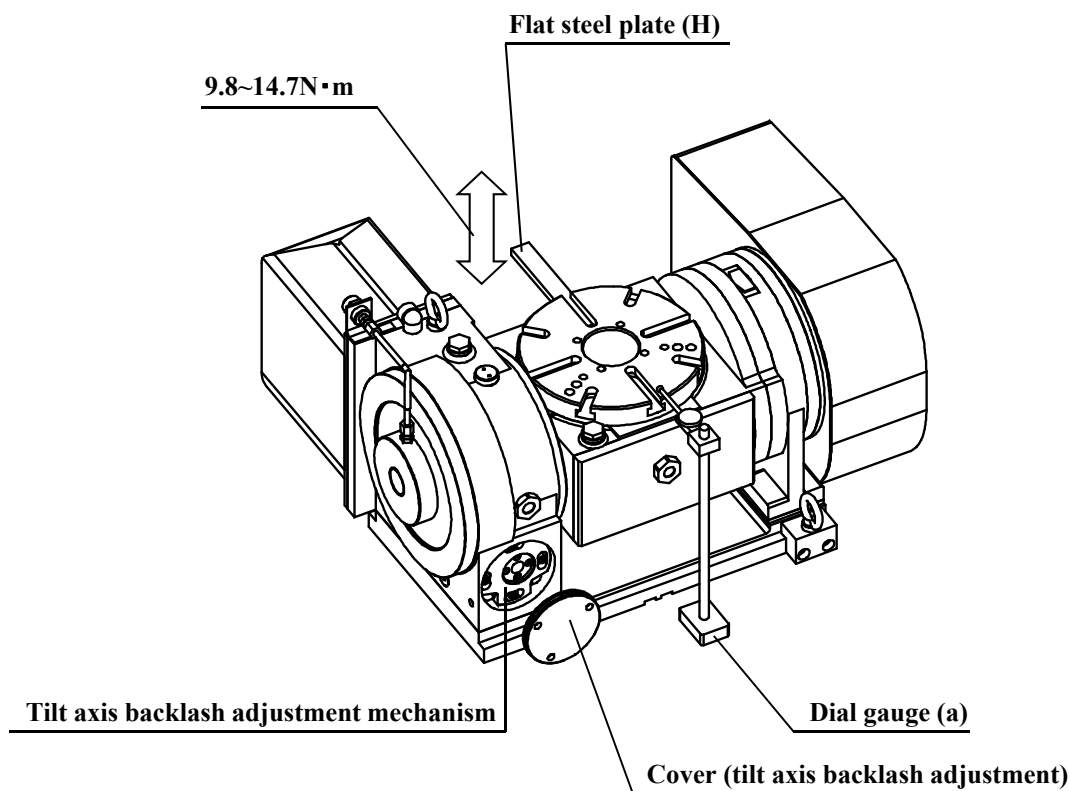


Fig. 11

4) How to adjust backlash

1. Locate the tilt axis at 90° . (Fig.9-1)
2. Slightly loosen 4 bolts (a) which fixing the eccentric housing.
3. Remove the plug (b)
4. There are bolts (c) for fixing the eccentric housing behind the plugs, loosen the bolts 2 ~ 3 turns.

Thus, the clamping of eccentric housing will be released and now it's ready to adjust the backlash.

5. Here, reset the dial gauge probe (a) as shown in Fig.13, and loosen the backlash adjust bolt (d) to counter clockwise and tighten the backlash adjust bolt (e) to clockwise, then the eccentric housing will turn and the backlash between the worm screw and worm wheel will get near to 0 (zero).

Adjust the backlash to 0.005 ~ 0.015mm by watching the deflection of the dial gauge (a) while maneuvering the outer periphery of CNC Rotary Table.

6. After completion of above adjustment, put (a), (c), and (b) back in this sequence as they were.
7. Measure the backlash again and confirm to that it has been adjusted to 0.005 ~ 0.015mm.

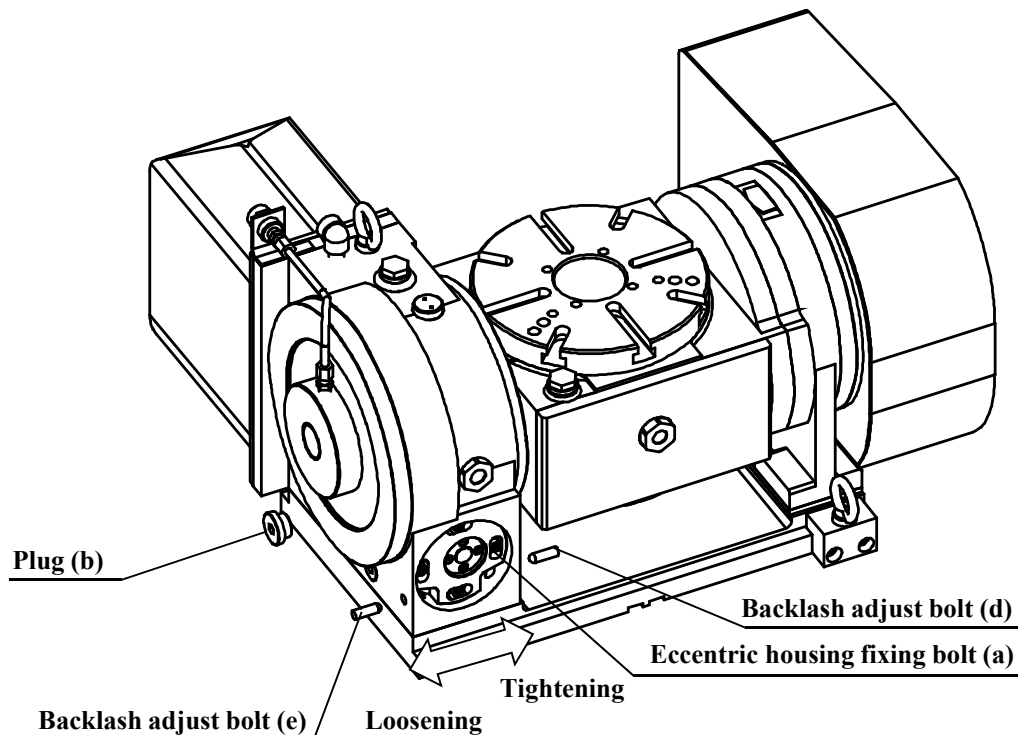


Fig. 12

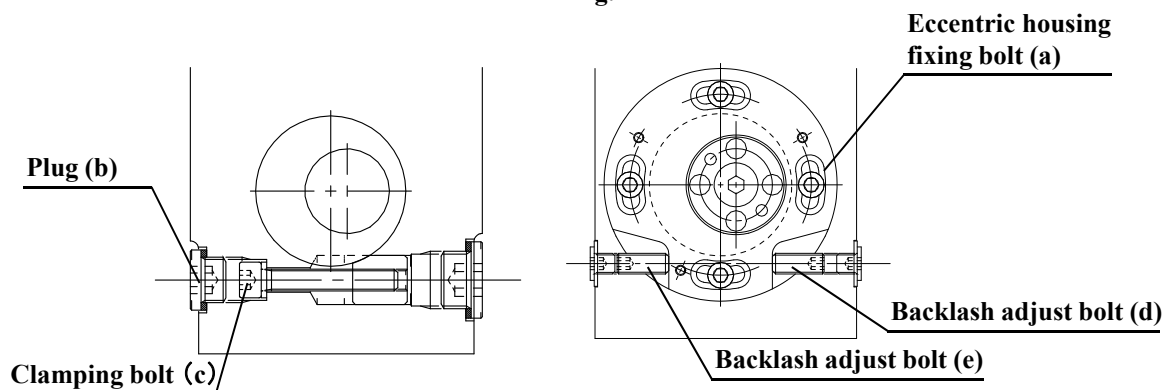
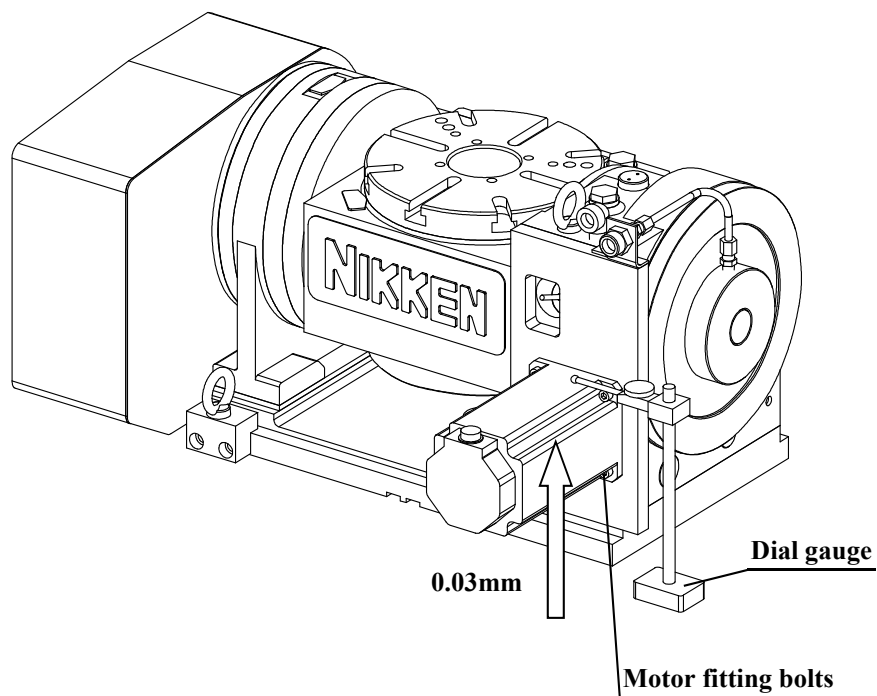


Fig. 13

Fig. 14

5) Backlash adjustment between main gear and motor gear

1. Loosen four motor fitting bolts.
2. Slightly push the motor toward the main gear.
3. Slightly tighten the motor fitting bolts.
4. Apply the probe of dial gauge at the flange of the motor.
5. Push the motor away from the main gear by 0.03mm.
6. Tighten the motor fitting bolts thoroughly.
7. Make sure that it's not making any unusual noise by driving the motor.
8. If so, adjust the position of the motor as per the procedure 5. to suit.

**Fig. 15**

4-3. Machine Zero Return deceleration mechanism

There is a proximity switch for zero point return on rotary axis as per Fig 16, on tilt axis as per Fig 17.

If the Machine zero position on the CNC Rotary Table is out of position by shift amount per one rotation of the motor (4° for rotary axis or 3° for tilt axis) or more, adjustment of dog ring location is required.

Note 1) When changing the proximity switch on rotary axis, locate the switch to get the length of 22mm from flange to the front end. (If the adjustment is not made, it might cause the interference against the dog ring or the zero positioning might not be done properly.)

Note 2) When changing the proximity switch on rotary axis, locate the switch to get the length of 18mm from flange to the front end. (If the adjustment is not made, it might cause the interference against the dog ring or the zero positioning might not be done properly.)

Note 3) When installing to a dedicated device, a proximity switch for zero point return deceleration might not be available depending on the specifications. See the specifications for details.

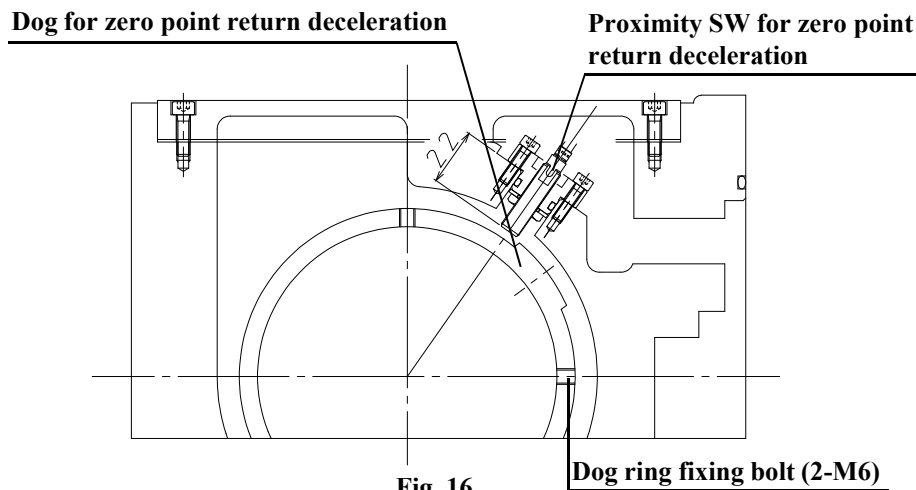


Fig. 16

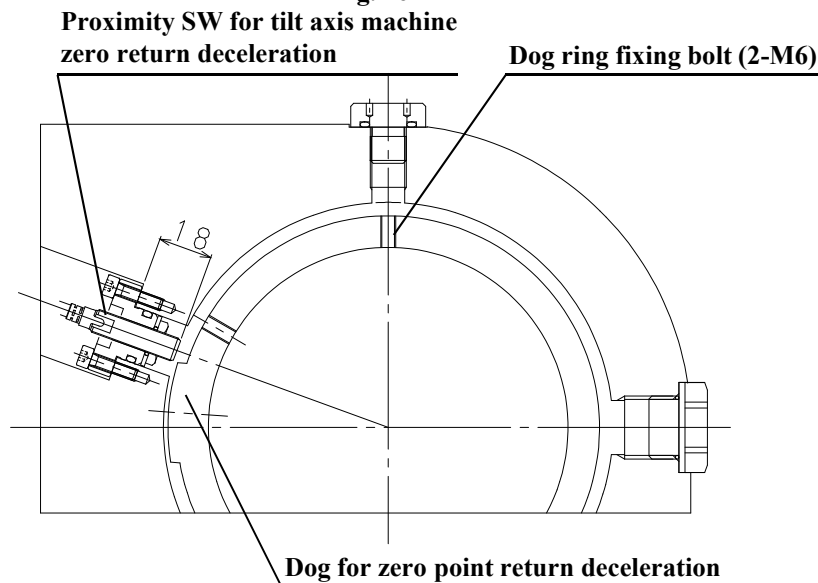


Fig. 17

4-4. Over travel detection mechanism (for Tilt axis only)

The dog ring and limit switches (Normally closed Contact) for over travel detection mechanism is located at the rear side of the tilting axis. Standard range of tilting is 0~105° but can be change in consultation.

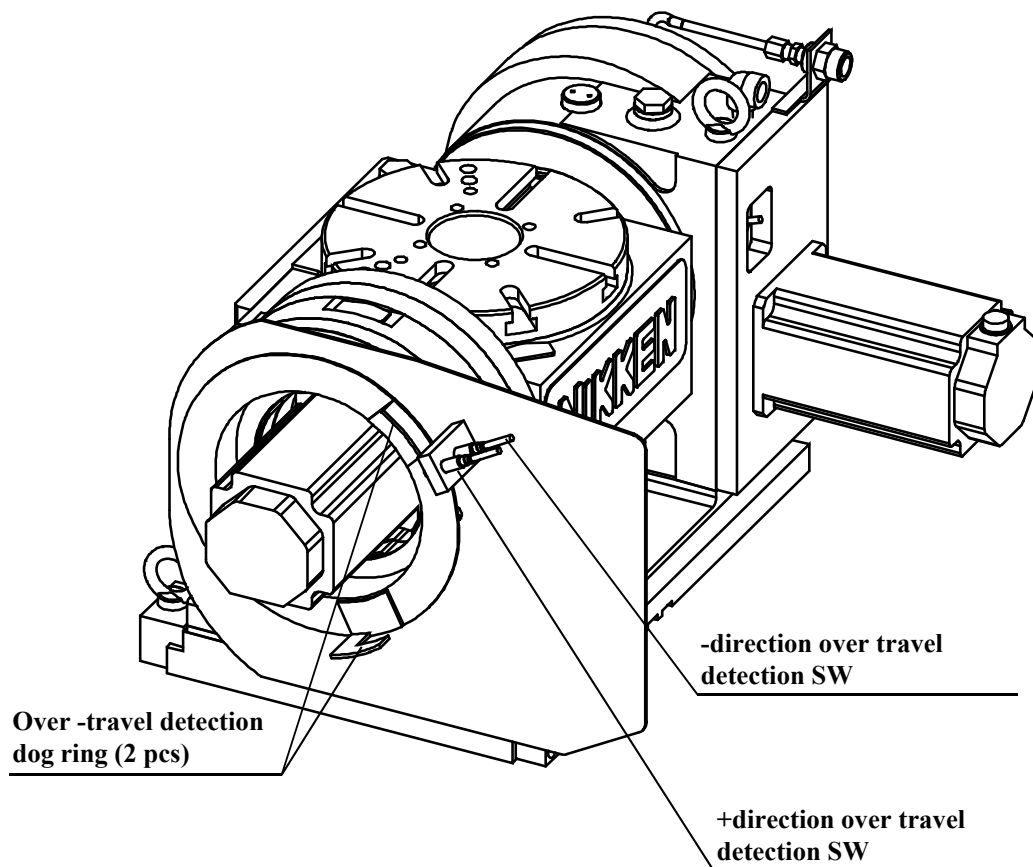
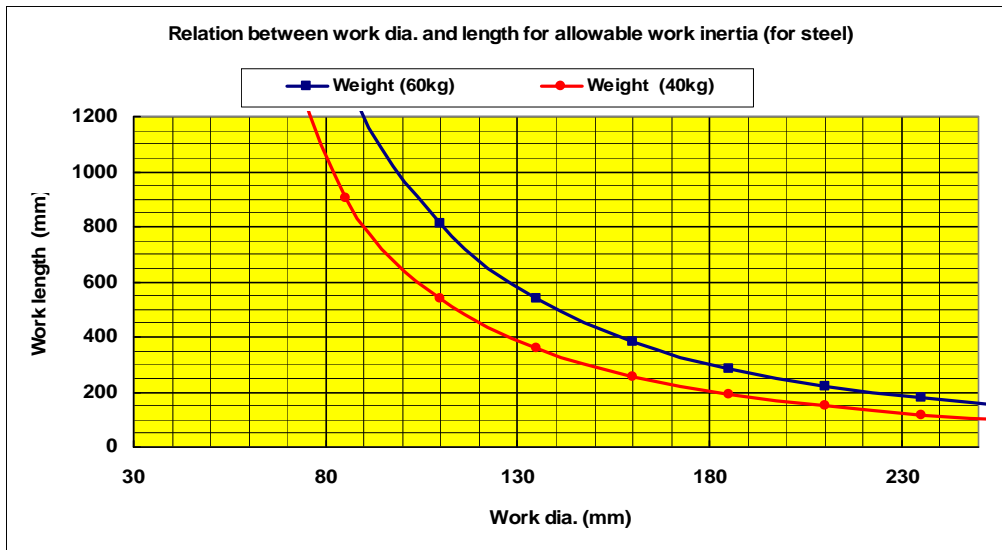


Fig. 18

5. Appendix

5-1. Relation between work diameter and length for allowable Maximum load (for steel)

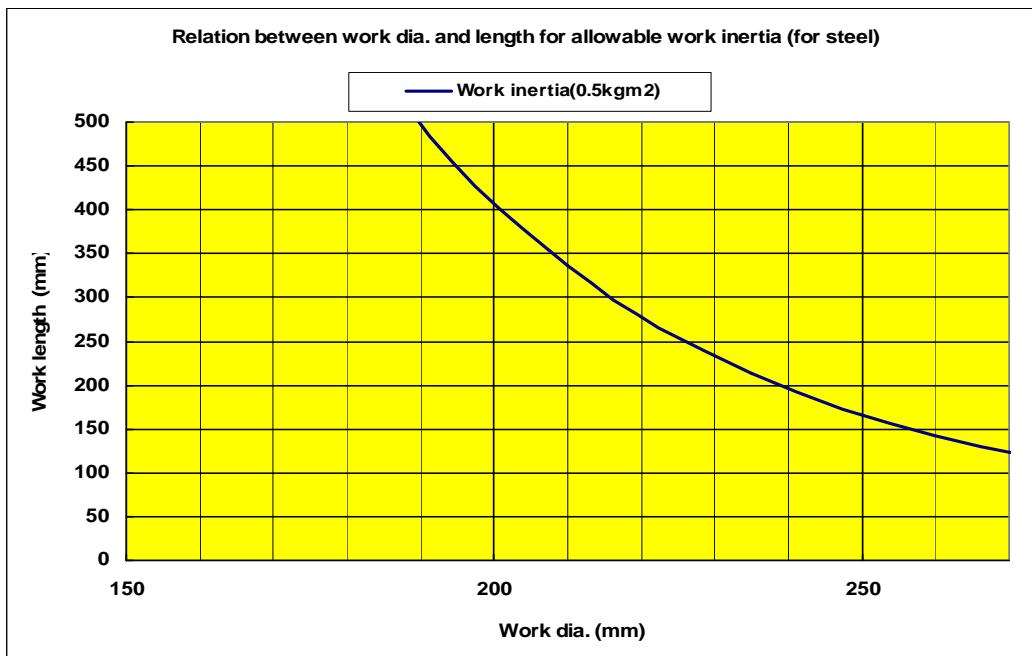


How to use above chart

A work piece of 200mm diameter and its length of less than 163mm is within the allowable load of 40kg from above chart.

Note) In case of the work piece diameter of more than 200mm, please make sure that its work inertia is within the specification, even if the work piece weight is within the allowable load.

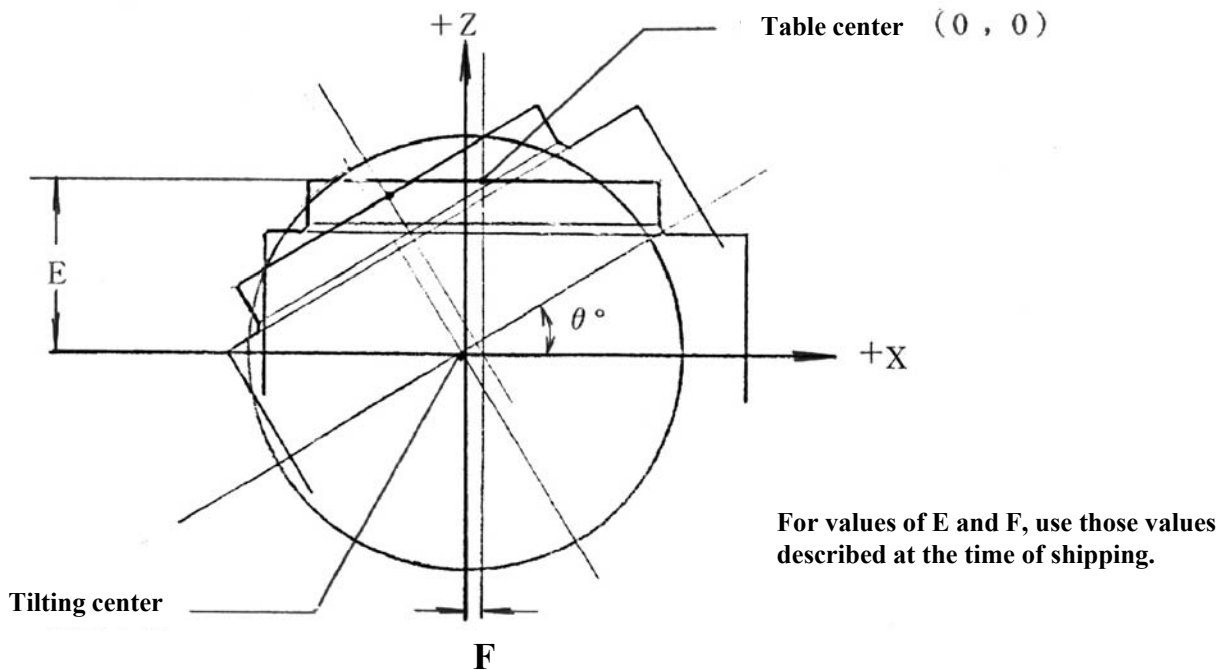
5-2. Relation between work diameter and length for allowable work inertia.(for steel)



How to use above chart

A work piece of 200mm diameter and its length of less than 407mm is with the allowable work inertia of 0.5kgm².

5-3. Coordinate calculating equation for table center in relation to tilting angle



$$X = F \cos \theta - E \sin \theta - F$$

$$Z = E \cos \theta + F \sin \theta - E$$

When E=80 and F=0, these values become as follows:

$$X = -80 \sin \theta$$

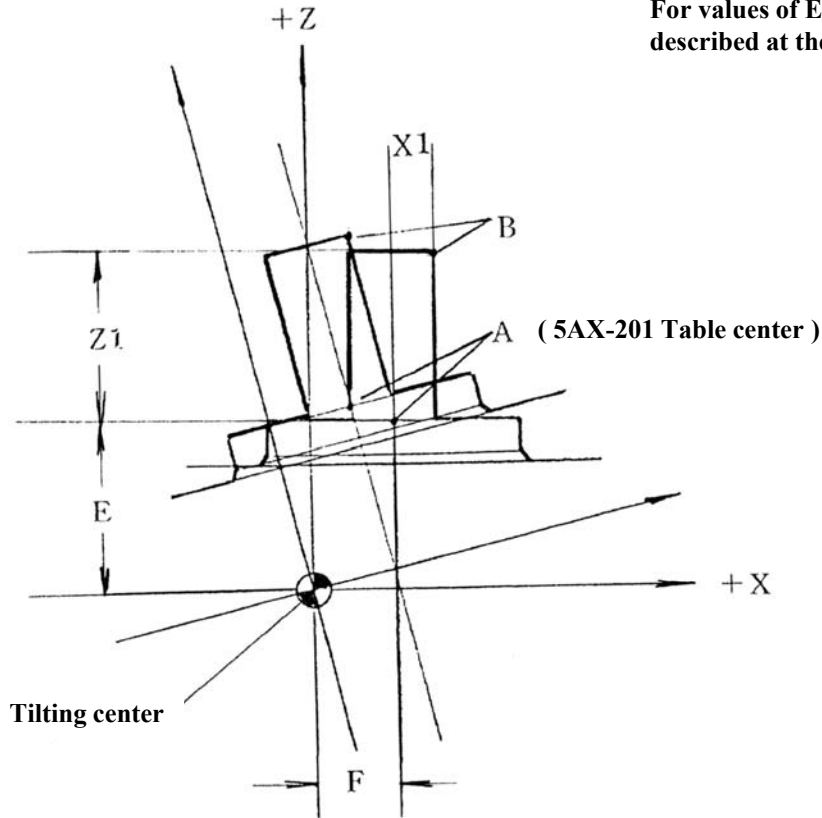
$$Z = 80 \cos \theta - 80$$

Relation between θ and X & Z coordinates is shown in the table of next page.

Coordinate calculating equation for table centre in relation to tilting angle			
E=	80		
F=	0		
Tilting angle		Table center	
(θ°)	(rad)	X	Z
0	0	0	0
5	0.087	-6.972	-0.304
10	0.175	-13.892	-1.215
15	0.262	-20.706	-2.726
20	0.349	-27.362	-4.825
25	0.436	-33.809	-7.495
30	0.524	-40.000	-10.718
35	0.611	-45.886	-14.468
40	0.698	-51.423	-18.716
45	0.785	-56.569	-23.431
50	0.873	-61.284	-28.577
55	0.960	-65.532	-34.114
60	1.047	-69.282	-40.000
65	1.134	-72.505	-46.191
70	1.222	-75.175	-52.638
75	1.309	-77.274	-59.294
80	1.396	-78.785	-66.108
85	1.484	-79.696	-73.028
90	1.571	-80.000	-80.000
95	1.658	-79.696	-86.972
100	1.745	-78.785	-93.892
105	1.833	-77.274	-100.706

5-4. Relation between tilting angle and X & Z coordinate value

For values of E and F, use those values described at the time of shipping.



Assuming that the tilting center is at coordinate values (0, 0), coordinate values of respective Points become as follows:

When the tilting angle is 0, the coordinate values of A-point is:

$$X_{a0}=F$$

$$Z_{a0}=E$$

When the tilting angle is θ , the coordinate values of A-point is:

$$X_{A\theta}=F\cos\theta - E\sin\theta$$

$$Z_{A\theta}=E\cos\theta + F\sin\theta$$

When the tilting angle is 0, the coordinate values of B-point is:

$$X_{B0}=F+X1$$

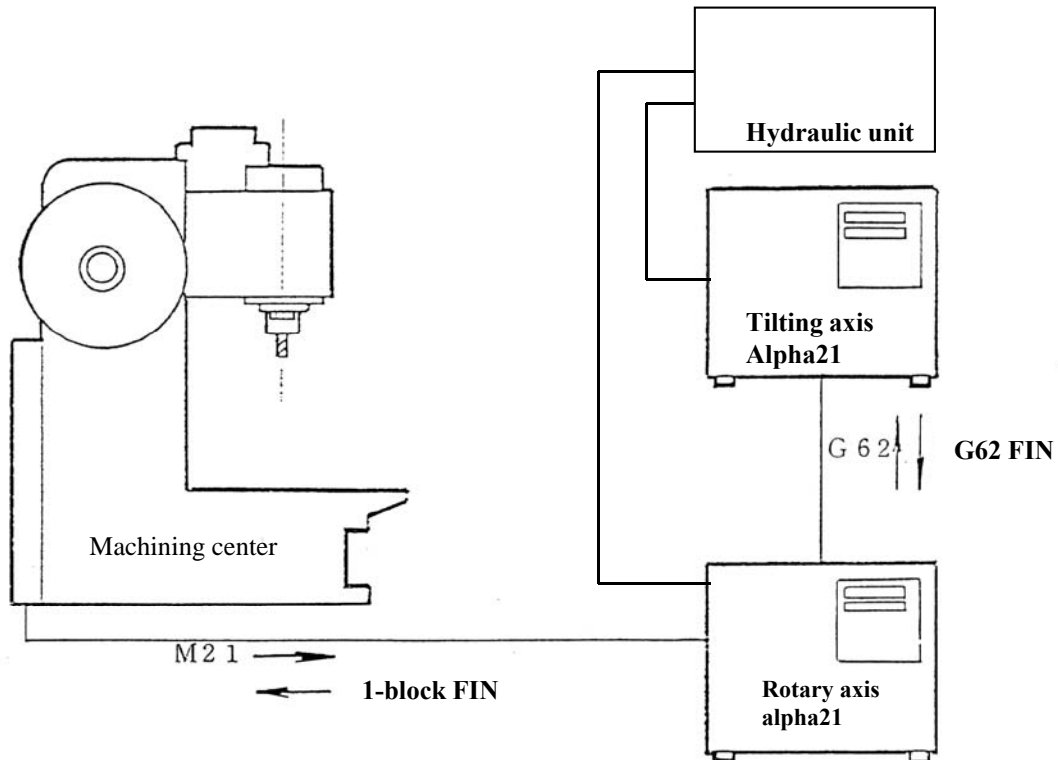
$$Z_{B0}=E+Z1$$

When the tilting angle is θ , the coordinate values of B-point is:

$$X_{B\theta}=(F+X1)\cos\theta - (E+Z1)\sin\theta$$

$$Z_{B\theta}=(E+Z1)\cos\theta + (F+X1)\sin\theta$$

5-5. Composition of 5AX-201WA21(Standard Specifications)



The emergency stop signal to the Alpha21 controller for rotary axis can be entered only through B-contact.

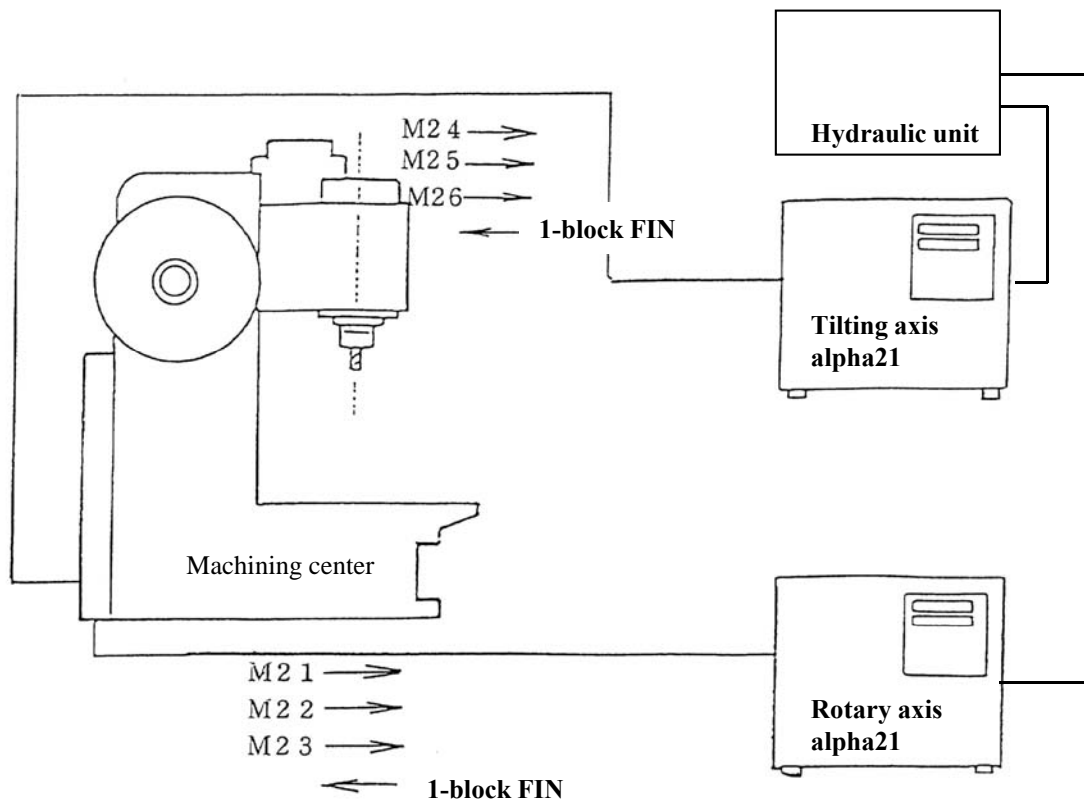
M21: Any number will do for M-signal of M/C, however, it should be valid only for the relevant block under the DISTRIBUTION END mode.

1 Block Fin: Finish signal for M21

G62: G62 signal on the rotary axis Alpha21 get the tilting axis Alpha21 start. When the rotary axis movement instruction and G62 instruction are given in the same block, the both axis move almost simultaneously. Viewing from the tilt axis Alpha21 side, the G62 signal is same type of signal as M21(start signal)

G62 Fin: Viewing from the tilt axis Alpha21 side, G62 Fin signal is same type of signal as 1-block Fin signal.

5-6. Composition of 5AX-201WA21(Special Specifications)



Both emergency stop signal for rotary and tilt axis Alpha21 Controllers are given to B-contact.

M21: Rotary axis Program start

M22: Rotary axis Program Jump to program executed address

M23: Rotary axis Reset to machine zero point and N000

M24: Tilt axis Program start

M25: Tilt axis Program Jump to program executed address

M26: Tilt axis Reset to machine zero point and N000

1 block Fin: For rotary axis, Finish of M21 ~ M23

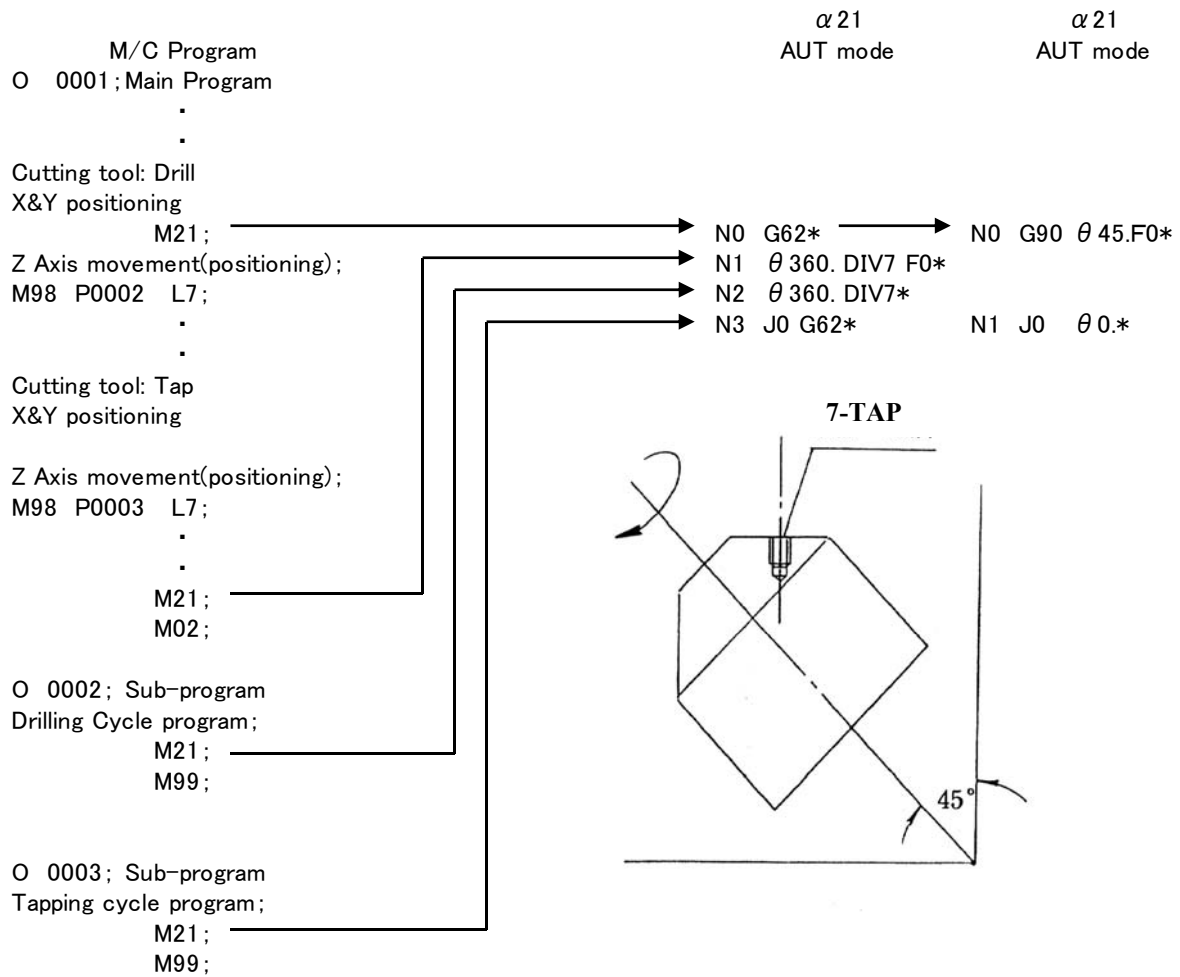
For tilt axis, Finish of M24 ~ M26

5-7. Program example

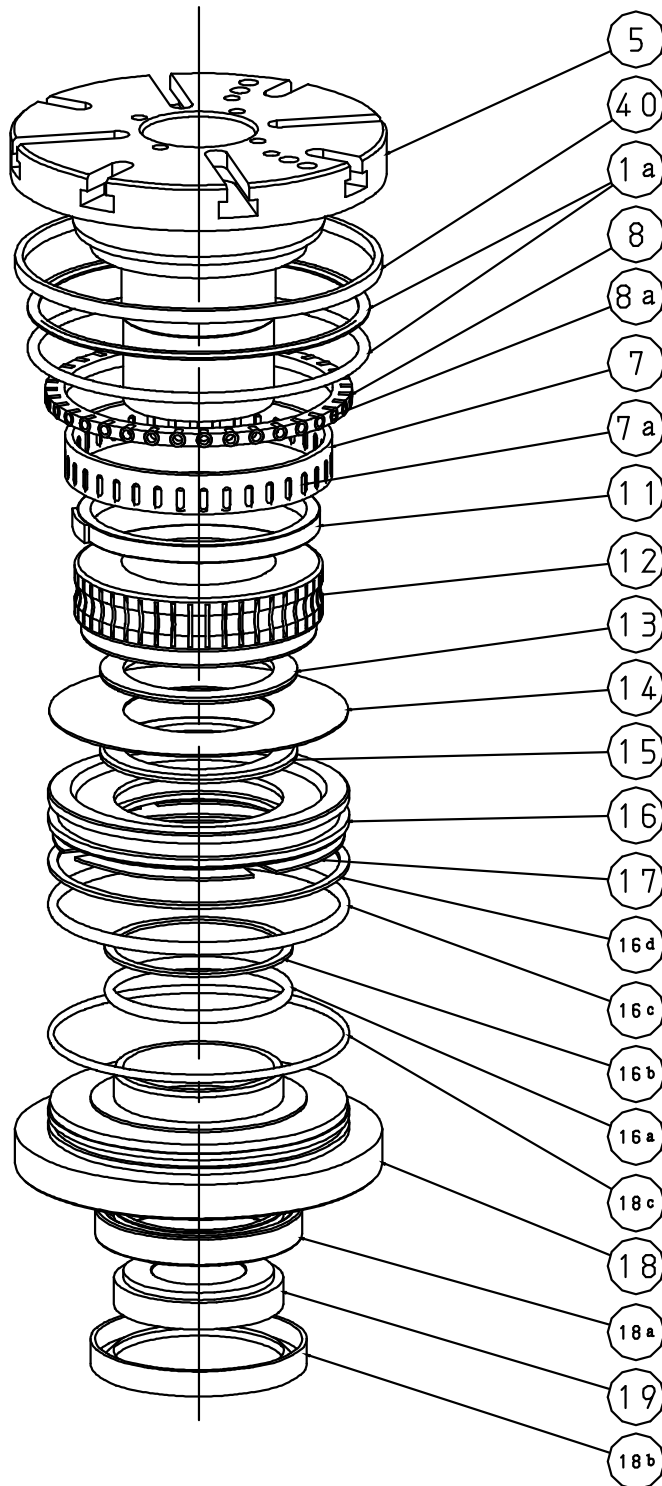
The following shows the program example on 5AX-201WA21

Operation	M/C	Rotary Axis α 21	Tilting Axis α 21
Rotary Axis movement	M21;	θ 90.F0*	
Tilt Axis movement	M21;	G62*	θ 30.F0*
Rotary & Tilt Axis movement	M21;	θ 90.F0 G62*	θ 30.F0*

G62 : Tilting Axis movement command.

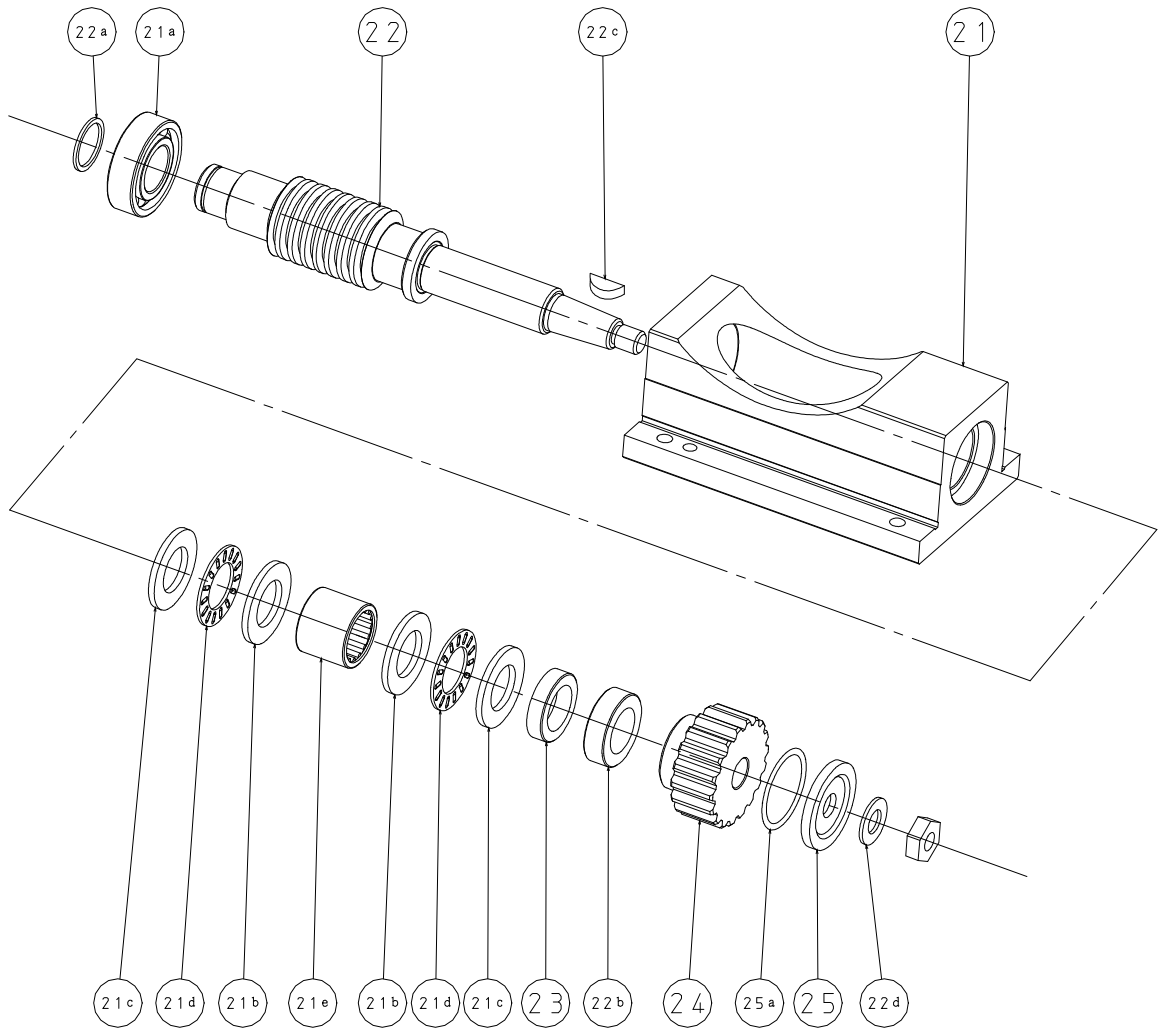


5-8. Spare Parts List
5AX-201 Rotary Axis Spindle



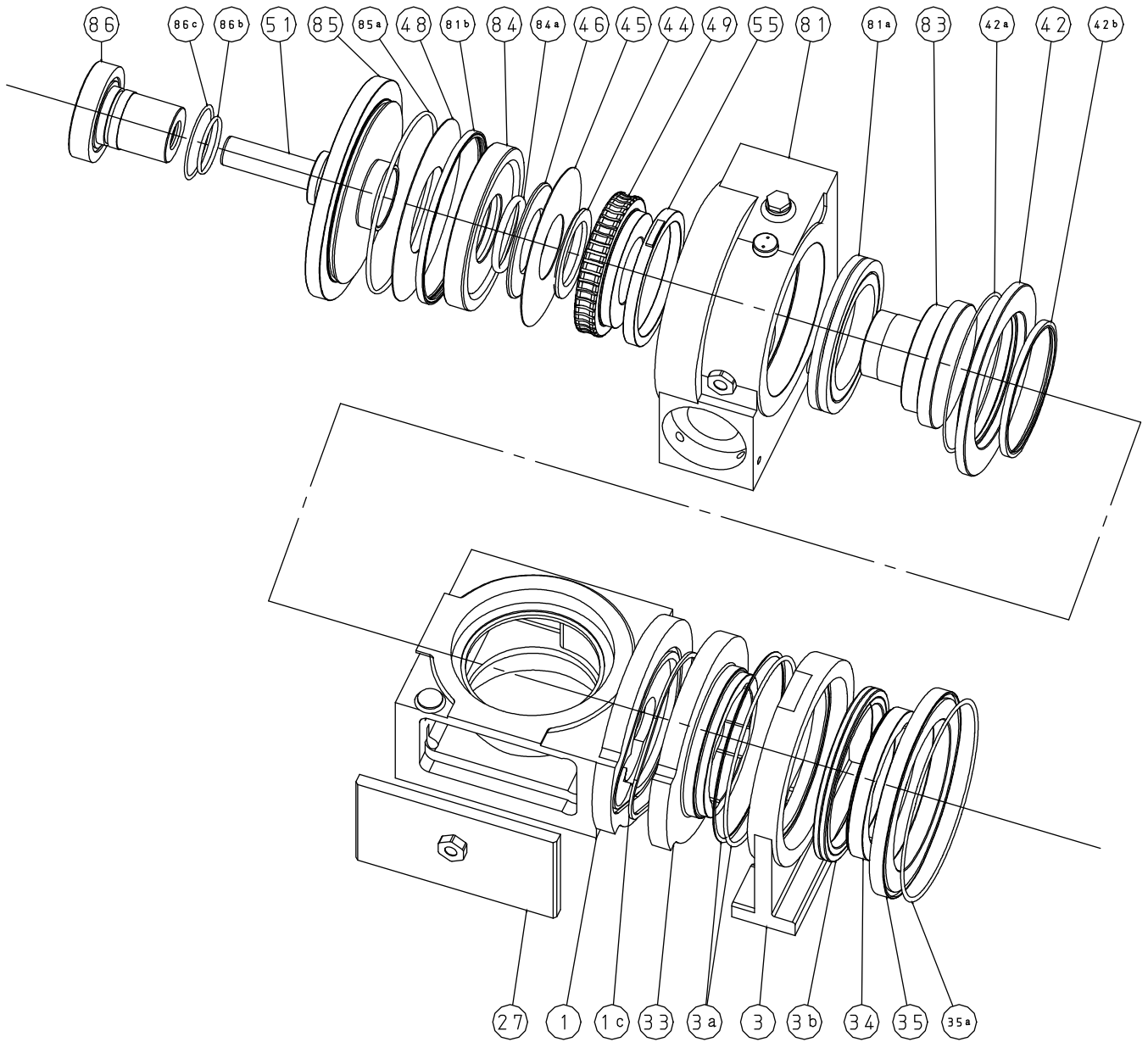
TCZ-E6001

5AX-201 Rotary Axis Worm Screw



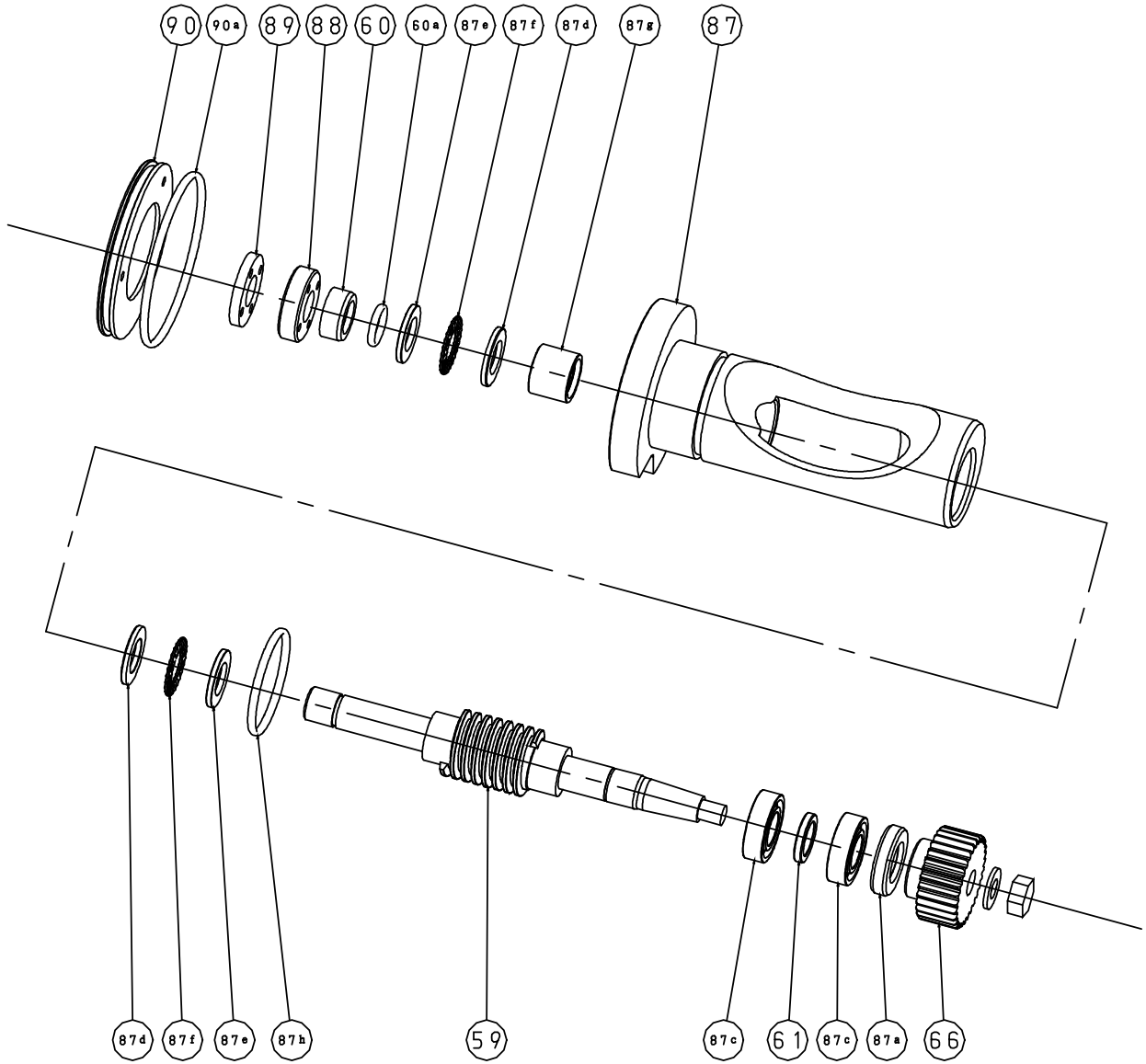
TCZ-E6002

5AX-201 Tilting Axis Spindle & Tail Stock



TCZ-E6003

5AX-201 Tilting Axis Worm Screw



TCZ-E6004

Reference	No.	Part No.	Item	Qty.	Remarks
TCZ-E6001	1a		Face Seal	1	Dia.170mm with O Ring (MITSUBISHI)
	5	AX204R005	Circular Table	1	
	7	CN202R005	Radial Retainer	1	
	7a		Needle Roller	30	Dia.4mm x 11mmL
	8	CN202R006	Thrust Retainer	1	
	8a		Tubular Roller	24	Dia.8mm x 8mmL
	11	AX203R011	MZR Dog Ring	1	
	12	WW-AX203R012	Worm Wheel	1	
	13	AX203R013	Spacer Ring	1	
	14	AX203R014	Brake Disk	1	
	15	AX203R015	Brake Disk Set Ring	1	
	16	AX203R016	Piston	1	
	16a		O Ring	1	P-90
	16b		Back Up Ring	1	SUN-2BP-90(MITSUBISHI)
	16c		O Ring	1	P-150
	16d		Back Up Ring	1	SUN-2BP-150(MITSUBISHI)
	17	AX203R017	Return Plate	4	
	18	AX204R018	Cylinder Cover	1	
	18a		Angular Bearing	1	#7916(NTN)
	18b		Oil Seal	1	TC9011513(NOK)
18c		O Ring	1	AS568-258(MITSUBISHI)	
19	AX203R019	Holder For Bearing	1		
40	AX204R040	Seal	1		
TCZ-E6002	21	AX204R021/1	Worm Screw Housing	1	
	21a		Ball Bearing	1	#6004(P5)(NTN)
	21b		Outer Ring	2	GS2035(IKO)
	21c		Inner Ring	2	WS2035(IKO)
	21d		Thrust Needle Bearing	2	NTB2035(IKO)
	21e		Needle Bearing	1	RNA6902(NTN)
	22	WS-AX204R022	Worm Screw	1	
	22a		Snap Ring	1	ISTW-20(Ochiai)
	22b		Lock Nut	1	ZM20S
	22c		Key	1	5 x 16
	22d		Diethread	1	DT-1-10(MITSUBISHI)
	23	AX204R023	Spacer Ring	1	
	24	GR-AX201R024	Main Gear	1	
	25	AX201R067	Washer	1	
	25a		O Ring	1	S-30(NOK)

Reference	No.	Part No.	Item	Qty.	Remarks
TCZ-E6003	1	AX204R001/1	Rotary Axis Main Body	1	
	1c		O Ring	1	AS568-260
	3	AX204R003/4	Tail Stock	1	
	3a		Face Seal	1	Dia.190mm with O Ring (MITSUBISHI)
	3b		Cross Roller Bearing	1	RB-15013UUCO(THK)
	27	AX204R027/1	Cover for Worm Screw	1	
	33	AX204R033/2	Tail Stock Flange	1	
	34	AX204R034/1	Inner Ring Holder	1	
	35	AX204R035/2	Outer Ring Holder	1	
	35a		O Ring	1	AS568-266
	42	AX204R042/3	Holder For Bearing	1	
	42a		O Ring	1	AS568-164
	42b		Oil Seal	1	BE3908E01X2
	44	AX204R044/2	Spacer Ring	1	
	45	AX204R045/2	Brake Disk	1	
	46	AX204R046/2	Brake Disk Set Ring	1	
	48	AX204R048/2	Return Plate	4	
	49	AX204R049/2	Worm Wheel	1	
	51	AX204R051/2	Center Shaft	1	
	55	AX204R055	MZR Dog Ring	1	
	81	AX204R081	Tilting Axis Main Body	1	
	81a		Cross Roller Bearing	1	CRBH11020AT1(IKO)
	81b		T Ring	1	170 x 180 x 7.5
	83	AX204R083/2	Tilting Axis Spindle	1	
	84	AX204R084	Piston	1	
	84a		O Ring	1	P-70(NOK)
	85	AX204R085	Cylinder Cover	1	
	85a		O Ring	1	AS568-263
	86	AX204R086	Joint Sleeve	1	
	86b		O Ring	1	G-55
	86c		O Ring	1	G-70
TCZ-E6004	59	WS-CN180R055	Worm Screw	1	
	60	AX123R059	Seal Collar	1	
	60a		O Ring	1	WP-13
	61	CN180R026	Bearing Collar	1	
	66	GR-AX204R066	Main Gear	1	
	87	AX204R087	Eccentric Housing	1	
	87a		Oil Seal	1	SC17 35 8
	87c		Ball Bearing	2	#6003(P5)
	87d		Outer Ring	2	GS81103
	87e		Inner Ring	2	WS81103
	87f		Thrust Needle Bearing	2	AXK1103
	87g		Needle Bearing	1	NK17/20R
	87h		O Ring	1	G-50
	88	AX204R088	Nut A for Worm Screw	1	
	89	AX204R089	Nut B for Worm Screw	1	
90	AX204R090	Eccentric Cover	1		
90a		O Ring	1	G-85	

NIKKEN CNC ROTARY TABLE
5AX-201 Series
Instruction Manual
VER 2.0

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