



Doosan Infracore
Machine Tools

VMC Maintenance Manual

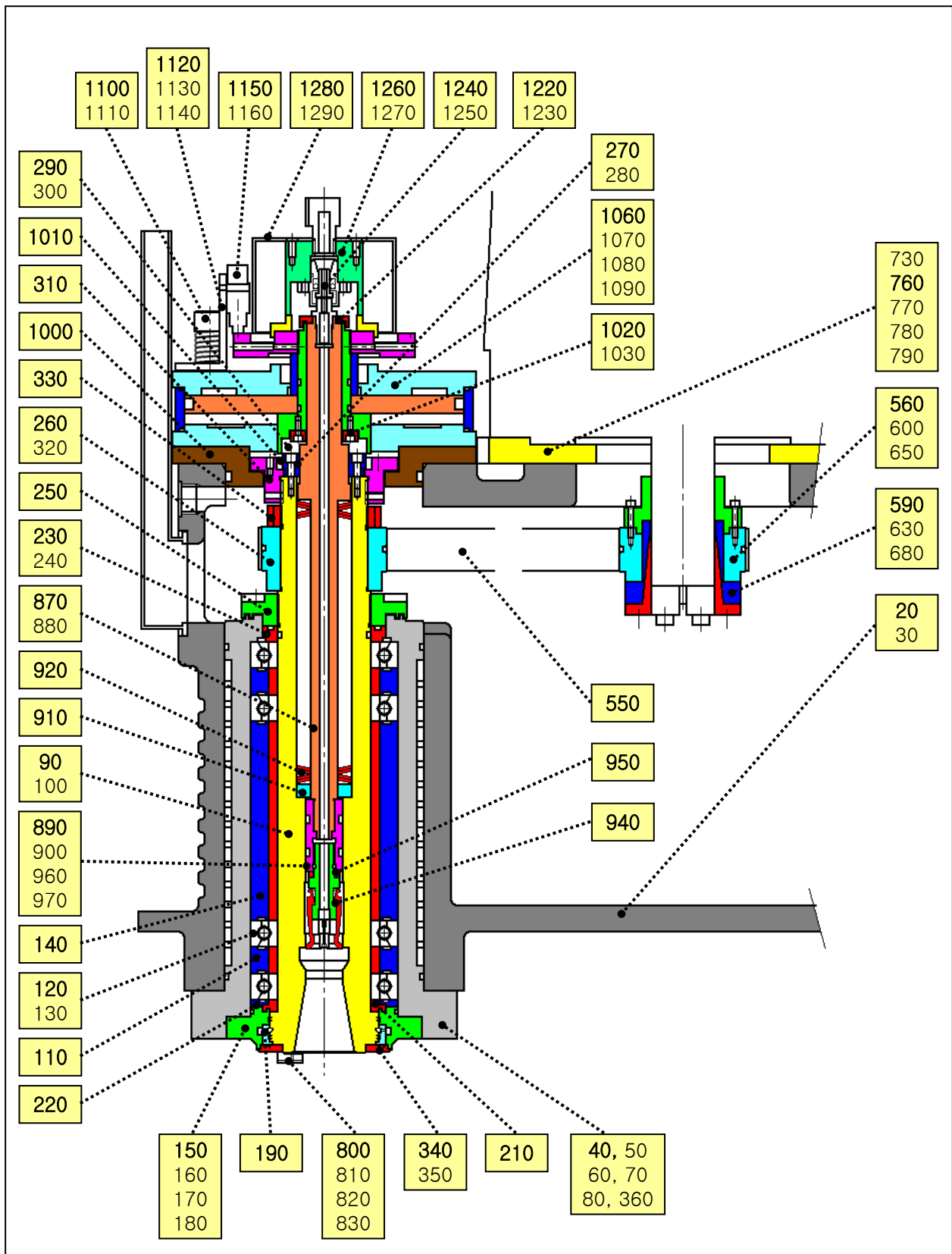
(DNM 500)

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1. Assembling/disassembling the spindle cartridge



No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
20	C72041011A	Head Body	GC300	1	
30	S221561	Bolt → S2215561	BB12×45	16	
40	C72041031A	Bearing Housing	SM45C	1	
50	S8011450	O-Ring	G145	1	
60	S8000090	O-Ring	P9	2	
70	S2215561	Hex. Socket Head Bolt	BB12×45	8	
80	S7035010	Plug	FP1/4	2	
90	C72041061A	Main Spindle	SCM415-F	1	
100	S8010650	O-Ring	G65	1	
110	C72041083	Bearing Spacer	SM45C	2St	
120	R10861	Ang. Contact Ball Bearing	HAR014CA-6DBBCY4	1St	8,000rpm
130	R10862	Ang. Contact Ball Bearing	3NCHAR014CA-6DBBCS10	1St	12,000rpm
140	C72041053B	Long Spacer	SM45C	1St	
150	C72041073C	Bearing Cap	SM45C	1	
160	P80300105	O-Ring	S105	1	
170	S2205661	Hex. Socket Head Bolt	BB8×20	6	
180	C68012064D	Hex. Socket Plug	NPT1/16	1	
190	C72041114C	Air Supply Ring	SM45C	1	
210	C72041244A	Bearing Spacer	SM45C	1	
220	C72041234A	Bearing Spacer	SM45C	1	
230	C72041104A	Bearing Spacer (3)	SM45C	1	
240	P80300080	O-Ring	S80	1	
250	C72041093A	Lock Nut	SM45C	1	
260	C72041343	Spindle Pulley	R65097	1	
270	C72041164A	Rod Guide	SM45C	1	
280	S2203361	Hex. Socket Head Bolt	BB5×20	6	
290	C72041224A	Rod Stopper	SM45C	2	
300	S2201661	Hex. Socket Head Bolt	BB4×12	2	
310	C72041643	End Stopper	SM45C	1	
320	P64016045	Parallel Key (W/Tap)	KSP16×10×45	1	
330	R03044	Lock Nut	DZM65×2	1	
340	C72041723	Coolant Protect	SCM445	1	

No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
350	R00359	Flat Head Cap Screw	BNH4×8	1	
360	S3520136	Set Screw	BQ3×4	1	
550	R61335	Eagle PD Belt	W-800	1	
560	C72041353A	Pulley Ass'y		1	Fanuc Φ12
590	R08155	Span Ring	SWLE100(48×62)	1	Fanuc Φ12
600	C72041673A	Pulley Ass'y		1	Fanuc Φ18
630	R08195	Motor Pulley	W-28S-MPB	1	Fanuc Φ18
650	C72048163	Pulley Ass'y for QAN200U		1	Heidenhain
680	R08203	Span Ring for QAN200U	SWLE100 (38×50)	1	Heidenhain
730	C72048153	Motor Plate	SS400	1	Heidenhain
760	C72041183A	Motor Plate	SS400	1	Fanuc
770	S2215461	Hex. Socket Head Bolt	BB12×40	4	
780	S5100701	Spring Washer	ZS12	4	
790	S5000701	Plain Washer	ZP12	4	
800	C72041264A	Drive Key (2)	SCM440	2	BT
810	C72041254A	Drive Key (1)	SCM440	1	Din
820	C72041264A	Drive Key (2)	SCM440	1	
830	S2203161	Hex. Socket Head Bolt	BB5×16	2	
870	C72041043A	Push Rod	SMC415	1	
880	P80300010	O-Ring	S10	1	
890	C72041123A	Rod Connector	SCM445	1	
900	S3522286	Set Screw	BQD5×6	2	
910	C72041134	Spring Spacer	SCM445	1	
920	C72041733	Disk Spring	Approved	1St	
940	R76739A	Collet(DIN40)	DIN#40	1St	
950	C72041204	Collet Spacer	SM45C	1	
950	R55449	Quad Ring	QRAR04212	2	
960	R54363	Backup Ring	BP3200216 [≡]	2	
1000	C72041633A	Cylinder Stopper	SM45C	1	
1010	S8001400	O-Ring	P140	1	
1020	C72041214	Spring Pusher	SM45C	1	
1030	S2201661	Hex. Socket Head Bolt	BB4×12	4	

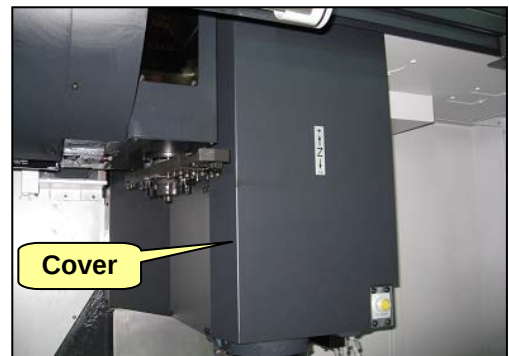
No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
1060	C72041193A	Unclamp Cylinder	SM45C	1	
1070	S2216161	Hex. Socket Head Bolt	BB12×75	4	
1080	S5100701	Spring Washer	ZS12	4	
1090	S5000701	Plain Washer	ZP12	4	
1100	C72041174	Spring Bolt	SM45C	4	
1110	C72041413B	Unclamp Spring	PW2	4	
1120	C72041564A	Switch Bracket	SS400	1	
1130	S2203061	Hex. Socket Head Bolt	BB5×14	2	
1140	S5000201	Plain Washer	ZP5	2	
1150	ESWLM0053	Limit Switch	SHL-D55-01	1	
1160	S2201661	Hex. Socket Head Bolt	BB4×12	1	
1220	C72041314A	Rod Cap	SM45C	1	TSC
1230	P80300018	O-Ring	S18	1	TSC
1240	R27273	Rotating Union	1151-030-137	1	TSC
1250	S2201861	Hex. Socket Head Bolt	BB4×16	4	TSC
1260	C72041303B	Rotating Union Connector	SM45C	1	TSC
1270	S2201661	Hex. Socket Head Bolt	BB4×12	4	TSC
1280	C72041394A	Rotating Union Cover	SCP1	1	TSC
1290	S2201561	Hex. Socket Head Bolt	BB4×10	2	TSC

1.1 Disassembling the tool unclamp cylinder

※ Preparations for disassembling the tool unclamp cylinder

- (1) Keep the machine and work area clean and away from dust or oil residues.
 - In particular, the surface of the table should be oil-less at all times to prevent slippery.
- (2) If the spindle has a tool inserted, pull it out to empty the spindle.
- (3) If you intend to remove the draw bar, first remove the collet from the spindle.
 - To remove the collet, first manually perform the tool unclamping. With the 8mm hex wrench, turn the collet inside the spindle to remove it. Then, perform the tool clamping.

- 1) Move the Z axis while lifting up the spindle head assembly cover to remove it.

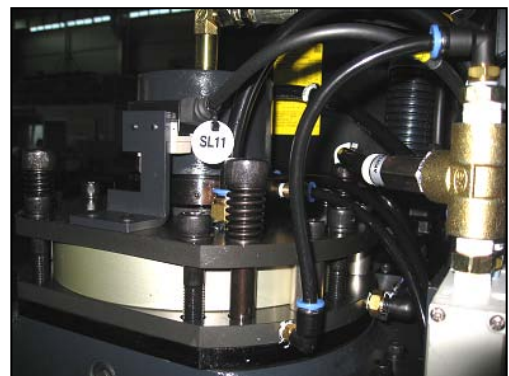


- 2) Close the valve (as shown) to block air inflow from the air supply unit.



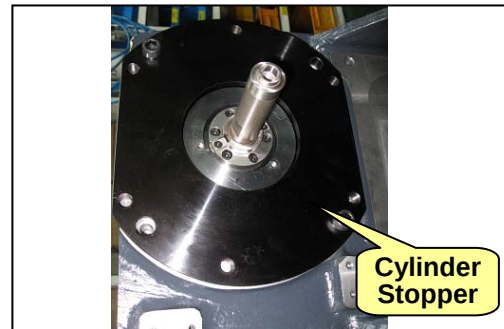
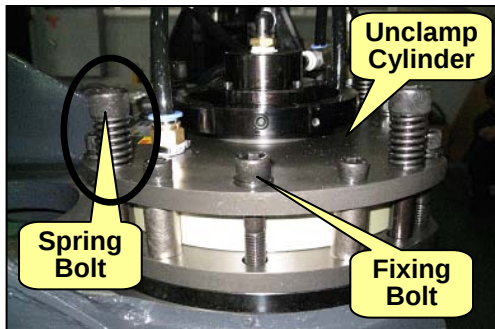
- 3) Remove the component parts such as coolant hose, air tube, bracket, micro switch bracket, air solenoid valve, and C50019133A rotating union assembly before you can disassemble the tool unclamp cylinder.

- 4-BB5×55



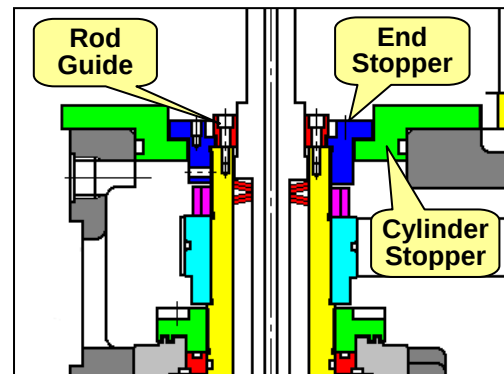
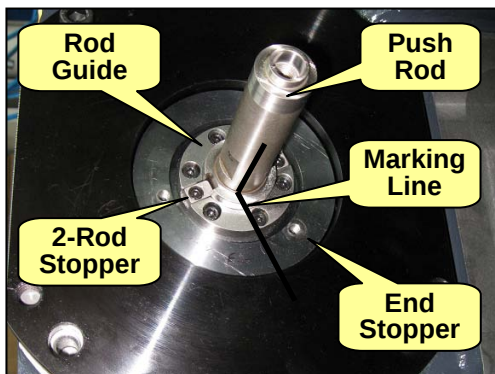
4) Remove the unclamp cylinder.

- ① Loosen the unclamp cylinder fixing bolts (4-BB12×75).
- ② Loosen C49041174 spring bolts (x4) and remove the cylinder with C49041413B unclamp spring. (x4)
- ③ Remove the whole unit of C72041193 unclamp cylinder while lifting it up.



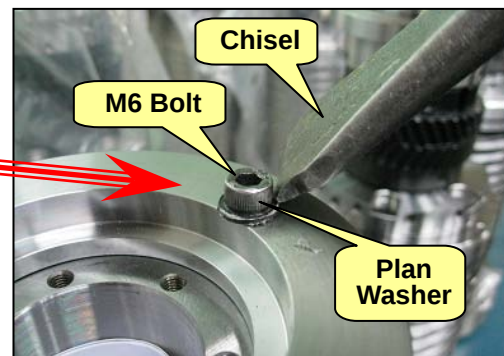
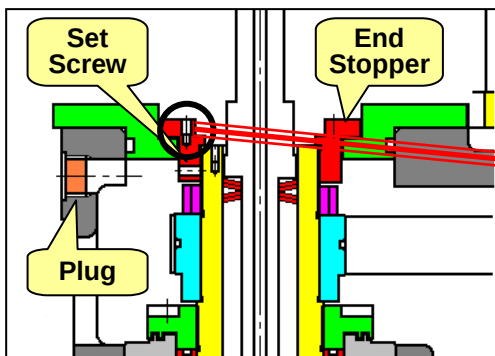
5) Remove the rod guide.

Draw a marking line on C72041164A rod guide, push rod, end stopper and cylinder stopper before removing each of them with care.

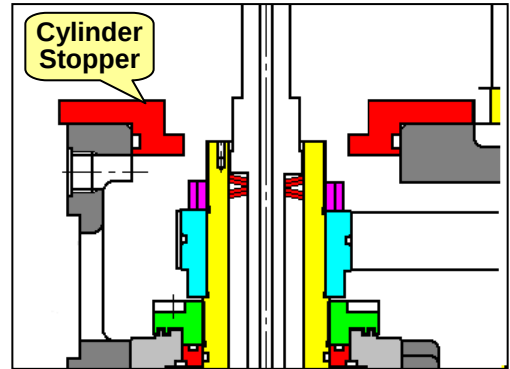


6) Remove the end stopper.

- ① Disconnect the plug (FT1/2) from the front of spindle body. While rotating the spindle, loosen C72041643 end stopper's set screws (3-BQ8×8) one at a time through the hole of the disconnected plug.
- ② Insert one M6 bolt with the plain washer into one of 3 M6 taps on the top of end stopper. With the chisel and hammer, impact on the M6 bolt to remove the end cap.



- 7) Remove the cylinder support.
Insert the bolt (coming from the removed cylinder) diagonally into C72041633A cylinder support, and lift up to remove it.

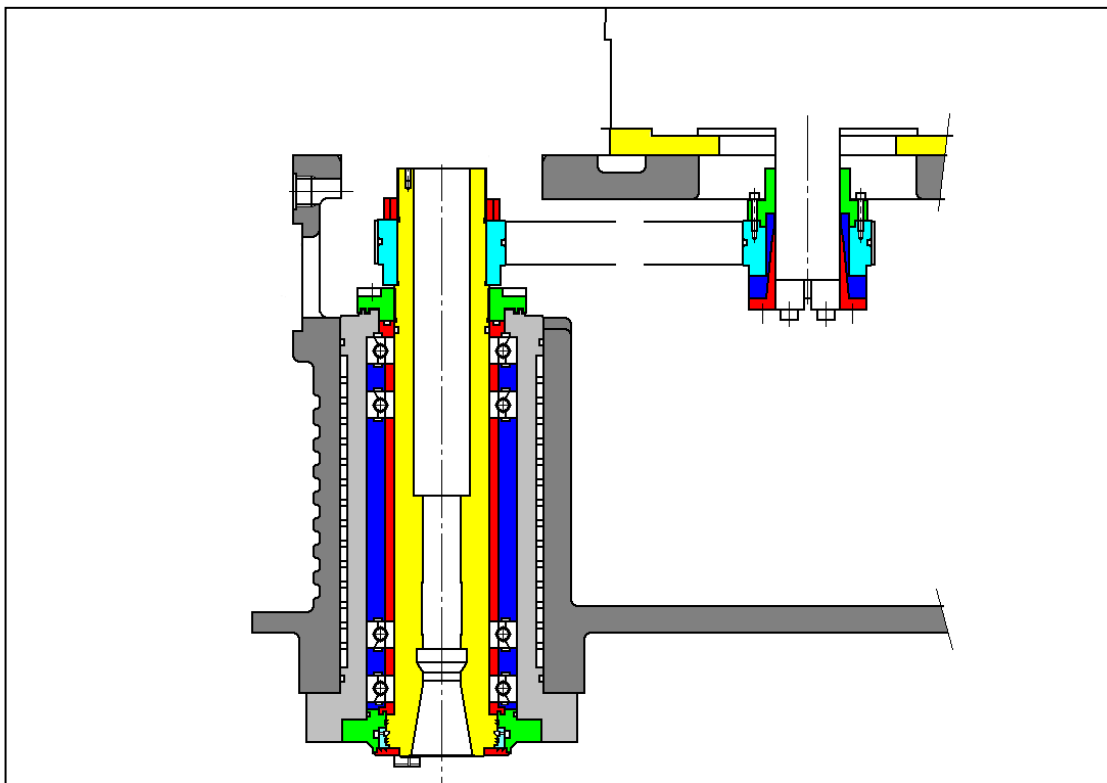


- 8) Remove the push rod assembly.
Pull up to remove C72041713 push rod assembly.



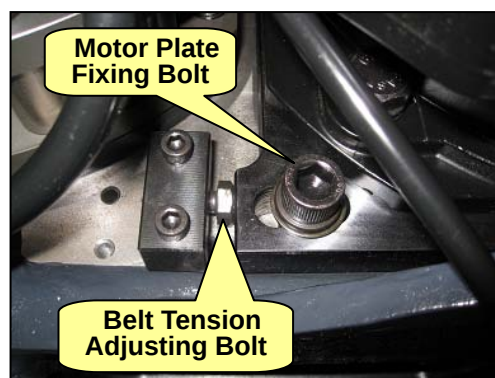
1.2 Disassembling the spindle cartridge

- ※ If you have the necessity to disassemble the spindle cartridge for the reason of repairing any damaged parts such as main spindle or spindle bearing, remove the spindle tool unclamp cylinder as instructed above before proceeding.

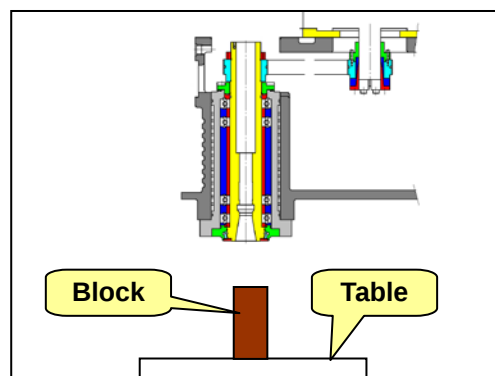


1) Loosen the timing belt.

- ① Loosen the fixing bolts (4-BB12×40) on C72041183A motor plate.
- ② Loosen 2 spindle motor belt tension adjustable bolts to the end in order to move the motor as closer to the spindle as possible.

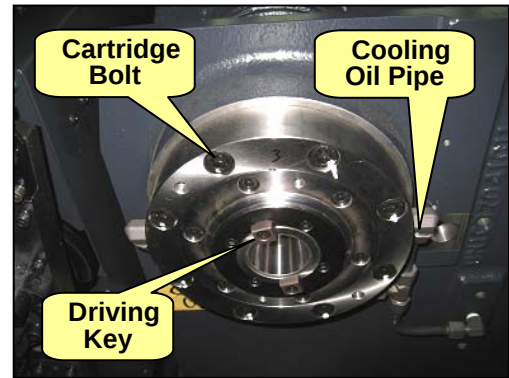


- ### 2) Prepare the block for removing the cartridge.
- Place a block in sizes of between 200mm and 250mm under the spindle as shown.



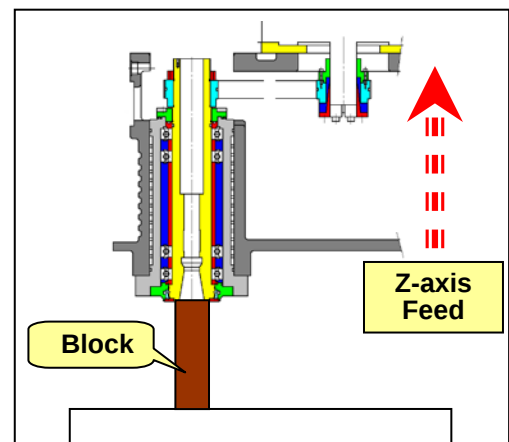
3) Remove the component parts on the bottom of the spindle.

- ① Move the Z axis to lift up the spindle head so that you can remove the component parts with ease.
- ② Remove the spindle cooling oil pipe and driving key from the spindle.
- ③ Loosen all spindle cartridge fixing bolts (8-BB12×45) excluding one that is easily removable.



4) Loosen the cartridge fixing bolts.

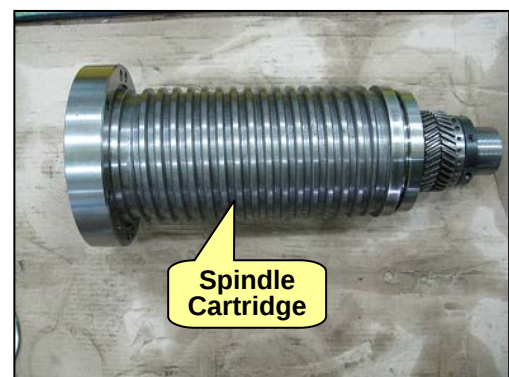
- ① Lower the spindle along the Z axis to the verge of the block on the table.
- ② Loosen the remaining one of the spindle cartridge fixing bolts.
 - In most cases, the spindle will lower itself to contact the block due to its weight if all the fixing bolts on the spindle cartridge are loosened.



5) Move up the z axis in handle mode slowly, which will accordingly lift up the spindle head alone with the spindle cartridge staying in contact on the block.

- While the spindle head is slowly moving up, remove the already-loosened spindle timing belt from the pulley.
- If the spindle cartridge does not easily get loose from the spindle head, use a plastic hammer to slightly impact on the upper side of the spindle.

6) When the spindle cartridge is completely loose from the spindle head, pull out the cartridge.



1.3 Replacing the spindle bearing (removal)

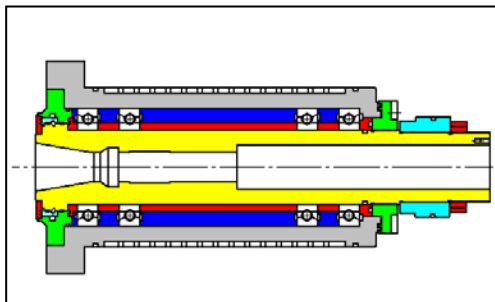
- ※ You may need to replace the spindle bearing if you encounter an abnormal noise, overheat or incorrect precision of the spindle during its operation, mostly due to such a reason as an external impact on the spindle.

In principle, replacement of the spindle bearing should be done under our control in our workplace where all necessary fixtures and tools are equipped.

However, if an inevitable situation makes you replace the bearing in your workplace or on the site, prepare at least the following requirements before replacing the bearing on your own.

- (1) Take a clean place free of dust particles or impurities with a constant temperature.
- (2) Precision grapple (surface plate) and indicator that enables you to measure the height and parallelism of the collar.
- (3) Precision tools for measuring including outer-diameter micrometer (0 ~ 25mm), depth micrometer (0 ~ 25mm), and vernier calipers
- (4) Cleaning oil (at least 2ℓ) such as thinner for removing the bearing grease and impurities, and clean, dehydrated, compressed air
- (5) Special grease for high speed, and grease injector (ex: Large syringe)
- (6) Common tools that are required for repairing the machine tool

- 1) Put the spindle cartridge on a clean worktable.

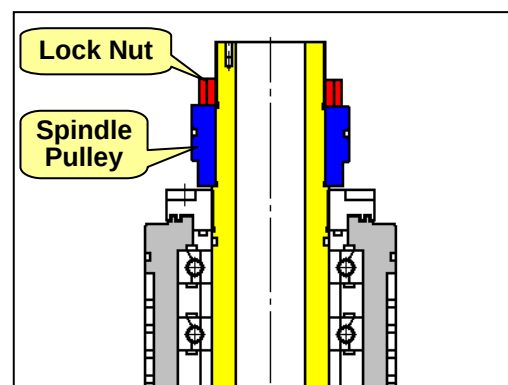


- 2) Remove the spindle pulley.

- ① Loosen R03044 lock-nut.

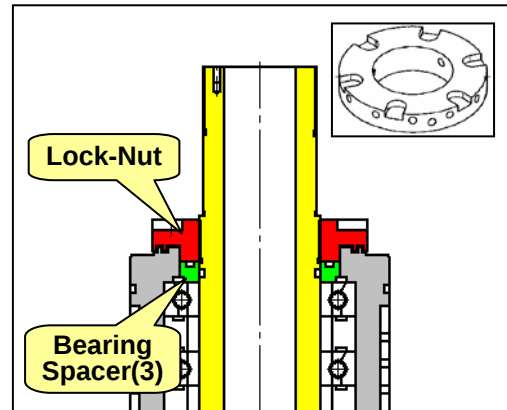
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.

- ② Remove C72041343 spindle pulley.
- ③ Use a 6mm pin puller or M6 bolt to pick out P64016045 parallel key.



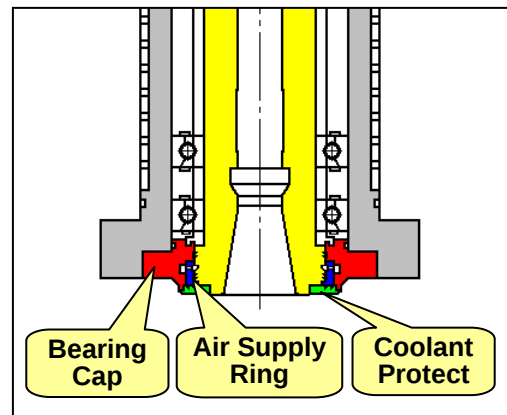
3) Remove the lock-nut.

- ① Loosen the set-screws (3-BQ8×12) from C72041093A lock-nut.
- ② Use the chisel and hammer to impact on the lock-nut while loosening it.
 - ※ If the lock-nut is not loose well, gently impact on the set-screw while loosening the set-piece contacting the spindle screw inside the set-screw.



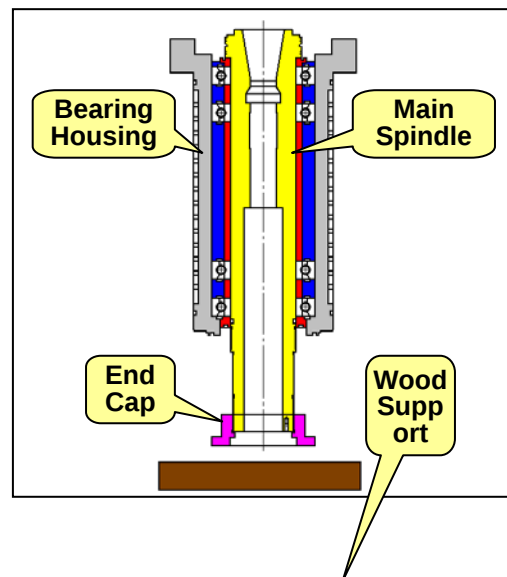
4) Remove the bearing cap.

- ① Remove C72041723 coolant protection.
 - 4-BNH4×8
- ② Remove C72041073C bearing cap where the air supply ring is installed.
 - 6-BB8×20

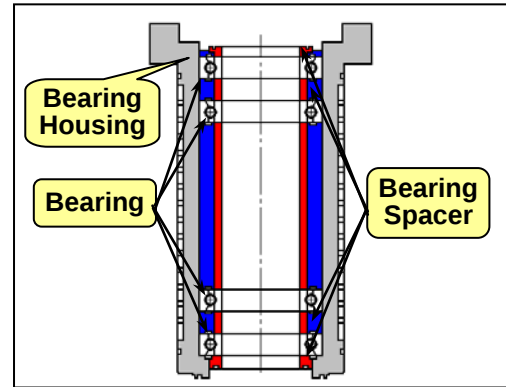


5) Remove the main spindle from the bearing housing.

- ① Insert the end cap to the original position, which is used to protect the distal screw on the spindle.
- ② Place a hard wood support.
- ③ Lower the spindle cartridge upside down until the end cap contacts on the wood support.
- ④ Repeat the steps above until the bearing housing is separated from the spindle due to its own weight.



- 6) Remove the remaining parts inside the bearing housing such as spacers and bearings.



1.4 Replacing the spindle bearing (installation)

※ Preparations for installing the spindle bearing

- (1) Clean up all the component parts that were removed for this process until no oil or grease (impurities) should remain.
 - (2) Fit the bearing spacers to use.
Check if there remains rust or spot on the surface, and, if any, use a fine whetstone or sandpaper #1000 to grind them. If necessary, measure the difference between inner spacer and outer spacer, as well as the parallelism of each component part.
 - Put the indicator on the grapple, and measure the difference between inner and outer spacers. If the difference or the parallelism is above 0.002mm, place sandpaper #1000 on the grapple and grind the component part manually until the measured value falls into the allowance (0.002mm).
 - (3) Completely remove oil from the main bearing (no oil or grease is allowed to remain). To do this, use thinner or a strong cleansing solvent to clean it up before drying with compressed air for more than 1 hour.
 - (4) Inject the special grease for a higher RPM into the oilless bearing.
 - Injection Amount: The amount of injection is between 10% and 15% of the applicable volume. For details, refer to the table below.
 - Injection Instruction: Inject the grease evenly along the circumference of the bearing until the grease permeates the bearing ball to its bottom.
 - Storage: When completed, wrap up the bearing with a clean paper and keep it away from dust and water.
- ※ Note that excessive grease may cause overheat of the bearing as the surplus grease leaks outside of the bearing and blocks the air inflow.

※ Standard Amount of Grease for Main-Spindle Bearing

UOM: cm³/item Note: NTN

NO.	Inner Diameter (mm)	Double-row Roller Brg. NN30	Single-row Roller Brg. 10	Thrust Ang. Ball Brg.		Ang. Contact Brg.	
				AB, BT Family	TAC Family	70 Family	72 Family
14	70	3.2	2.4	3	3.2	3.6	3.3
15	75	3.5	2.5	3.2	3.5	3.8	3.6
16	80	4.7	3.5	4.2	4.7	5.1	4.4
17	85	4.9	3.7	4.4	4.7	5.3	4.7
18	90	6.5	4.5	6	6.5	6.9	6.2
19	95	6.6	4.7	6.3	6.6	7.2	6.5
20	100	6.8	4.9	6.5	6.8	7.4	6.8

* Inject the grease 12% to 15% of the spatial volume for the angular contact bearing, and 10% for the cylindrical roller bearing.

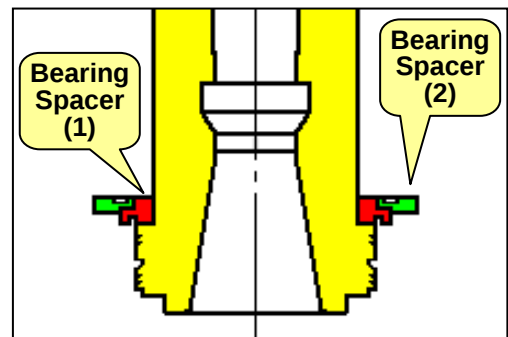
1) Assembly Preparations

- ① Put the oilless C72041061A main spindle and C72041011A bearing housing on a clean worktable.
- ② Clean up the fit bearing spacers with a cloth before storage.
- ③ Apply heat to the main bearing (with grease already applied) at about 45°C.



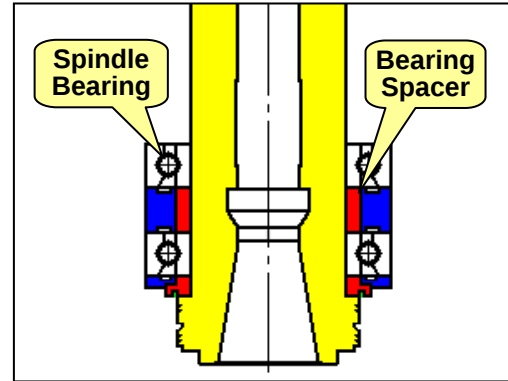
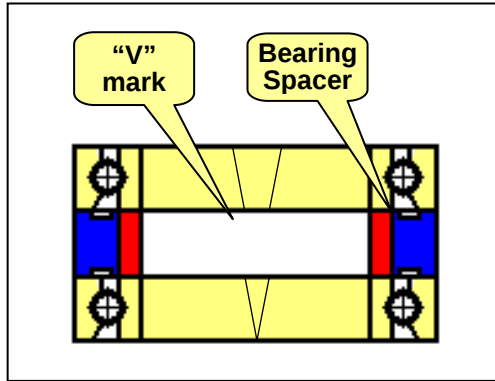
2) Install the bearing spacer

- ① Apply the special grease thinly to C72041244A Bearing Spacer (1) and C72041234A bearing spacer (2) as well.
- ② Fit the bearing spacers into the main spindle in the right direction.

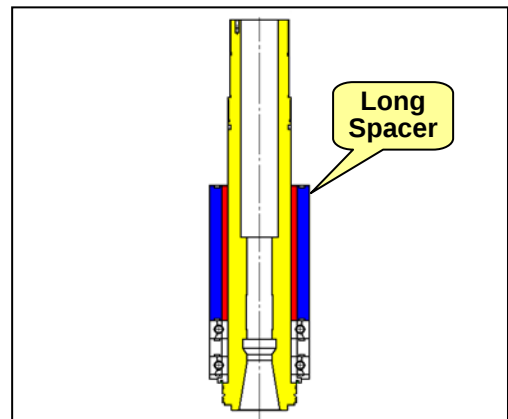


3) Install the spindle bearing

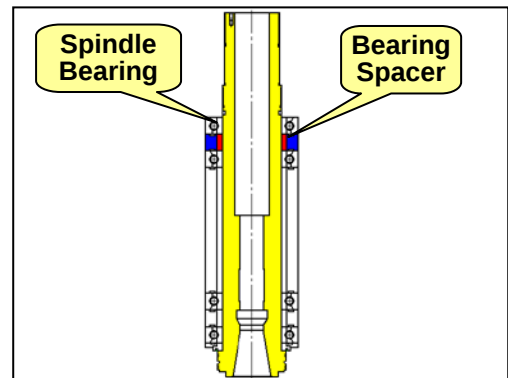
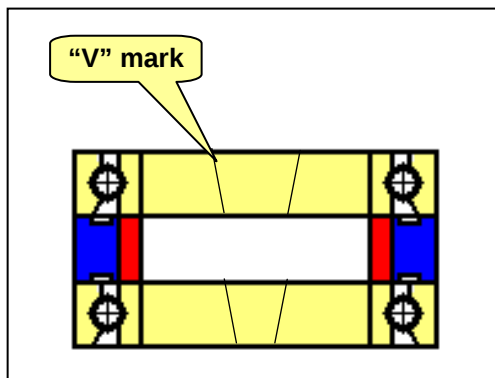
- ① Insert a pair of C72041083 bearing spacers (with the special grease applied) between the two most narrow "V" marked ones of R10861 angular contactor ball bearings, and put them together with the main spindle.
 - If you have a heating device available, apply heat to the main bearing at about 45°C to facilitate the installation work.



- ② Apply the special grease thinly to the front of C72041053B long spacer before putting it together with the spindle.

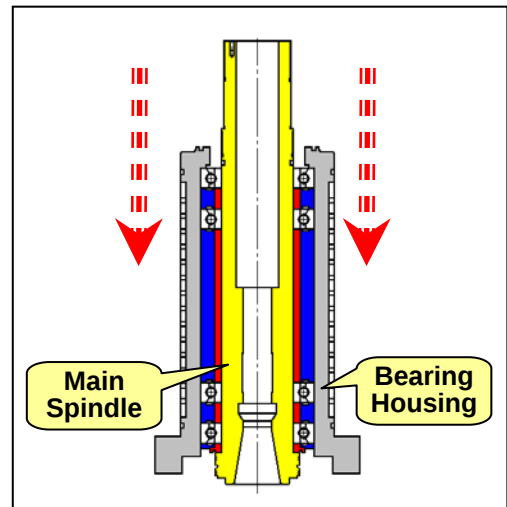


- ③ Insert a pair of C72041083 bearing spacers (with the special grease applied) between the other two "V" marked ones of the angular contactor ball bearings, and put them together with the main spindle.
 - If you have a heating device available, apply heat to the main bearing at about 45°C to facilitate the installation work.



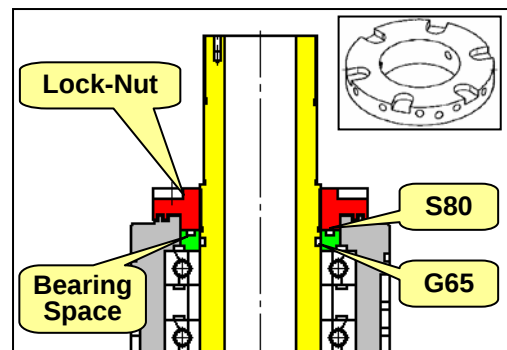
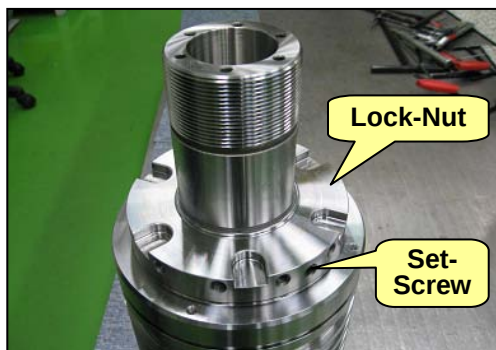
4) Fix the bearing housing

- ① Apply the special grease thinly to the inner side of C72041031A bearing housing that is already cleansed up.
- ② Place vertically both main spindle and bearing assembly.
- ※ If you have heated the bearing, wait as long as needed until it cools down before installation.
- ③ Gently Insert the bearing housing into the main spindle in the arrow direction (top down) as shown until the distal hole of the bearing housing fits into the top bearing.
 - If you have a heating device available, apply heat to the main housing at about 40°C to facilitate the work.



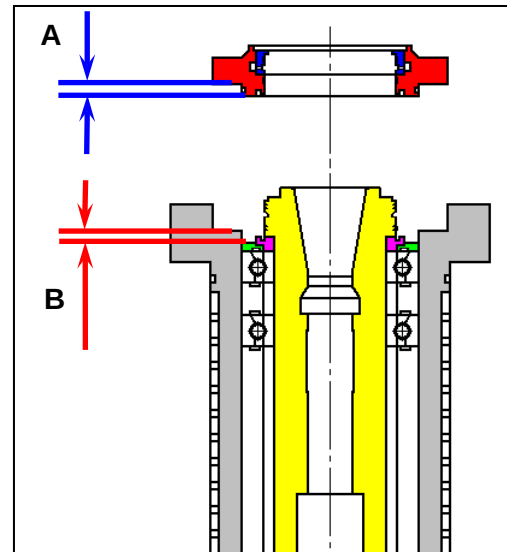
5) Fit the lock-nut

- ① Insert the O-ring (1-G65) into the main spindle and apply grease.
- ② Insert C72041104A bearing spacer (3) into the spindle (be careful not to damage the O-ring) and apply grease to the top O-ring hole before inserting 1-S80 O-ring.
- ③ Tighten C72041093A lock-nut.
 - While gently rotating the bearing housing, fix the lock-nut as tight as possible by impacting on it with the chisel and hammer.



6) Install the bearing cap

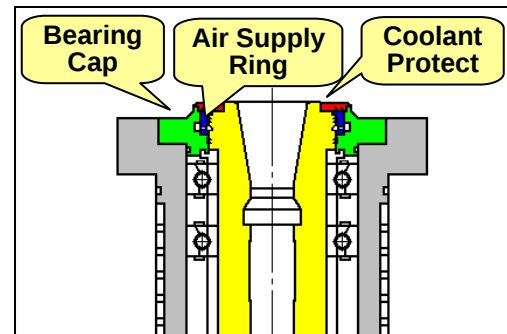
- ① Measure the depth between bearing housing section and C72041234A bearing spacer. ("**B**")
 - ② Calculate the target size of the sectional depth of C72041073C bearing cap before fitting it on-site.
 - Sectional target size of the bearing cap
"A" = "B" + 0.03mm
 - ③ Install the completed bearing cap in the bearing housing by putting force as even as possible.
 - 6-BB8×20, O-Ring : 1-S105
- ※ If you want to use a new one, insert C72041114C air supply ring into the bearing cap after fitting the air hole.



7) Install the coolant protection

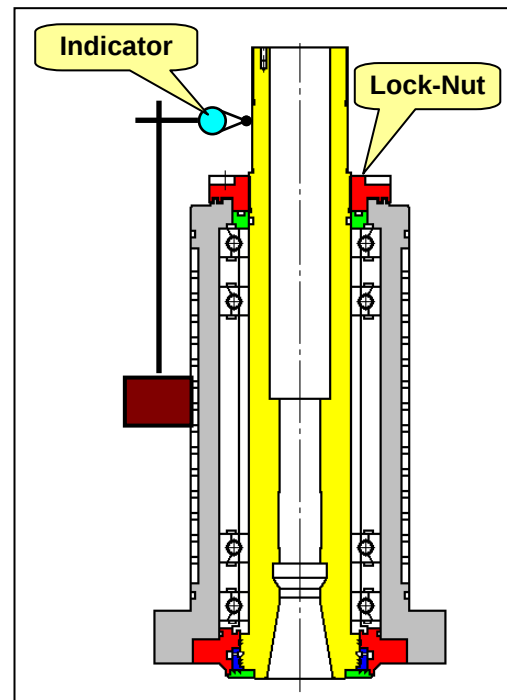
When the bearing cap is installed properly, go on with C72041723 coolant protection.

- 4-BNH4×8



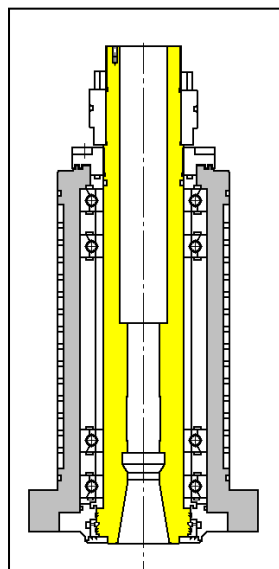
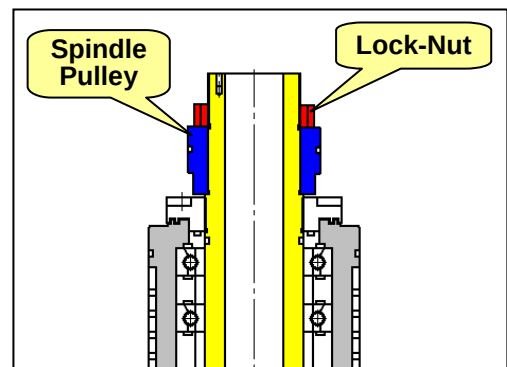
8) Adjust the runout of the main spindle

- ① Put the indicator on the bearing housing and install the gage on an appropriate area of the spindle (avoid the key hole or screw) to facilitate the runout measuring.
- ② While gently rotating the bearing housing, measure the runout of the spindle.
- ③ With the chisel and hammer, impact on the lock-nut showing a higher measurement so that it is tightened accordingly.
- ④ Repeat the steps above to set the runout tolerance below 0.002mm.
- ⑤ When completed, fix the set-screws (2-BQ5×12) as tight as possible.



9) Install C72041343 spindle pulley

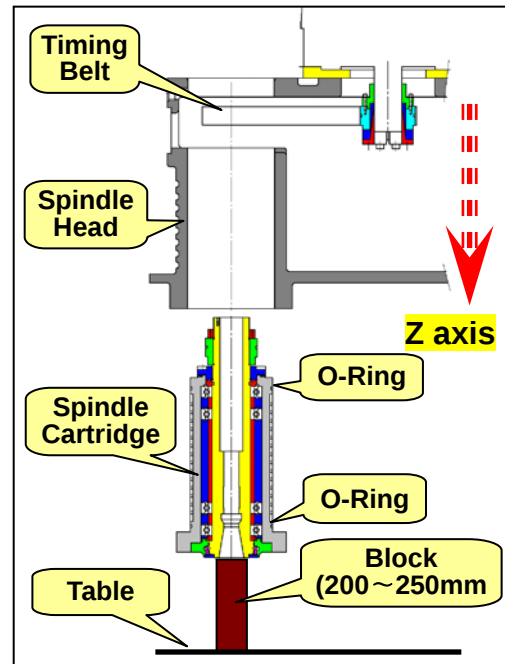
- ① Insert KSP16×10×45 parallel key into the spindle.
 - If the key gets even a slightest loose, replace it with a new one.
- ② Install C72041343 spindle pulley.
- ③ With the chisel and hammer, impact on R03044 lock nut to tighten it up, and fix the set-screws (4-BQ6×6) as tight as possible.



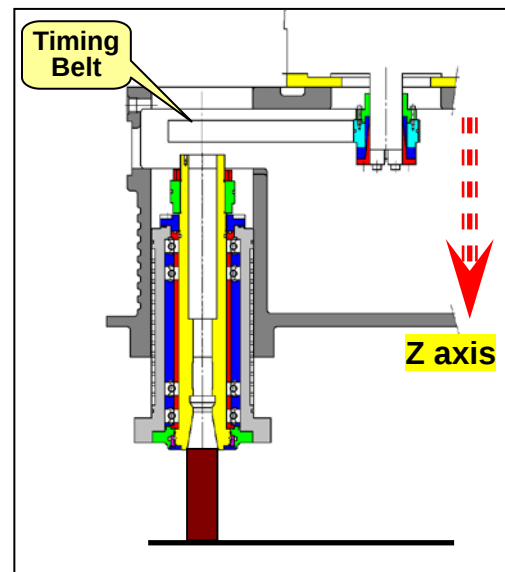
1.5 Installing the spindle cartridge

1) Insert the spindle cartridge.

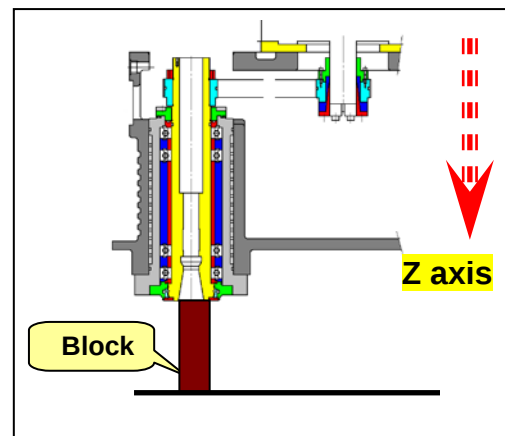
- ① Before installing the spindle cartridge, cleanse up the spindle head and apply grease thinly to the installation area.
- ② Insert the O-rings (2-G145, 2-P9) into the bearing housing and apply grease.
- ③ Hang the timing belt onto the installation area inside the spindle head.
- ④ Put a 200mm ~ 250mm block on the table, and place the spindle cartridge over the block. Then, move the table until the center of the cartridge aligns with the installation position of the spindle head.



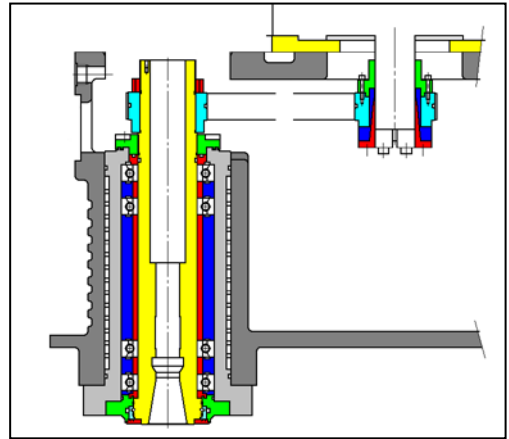
- ⑤ While gently lowering the Z axis, insert the cartridge to the spindle head.
 - To ensure correctness, repeat moving the Z axis up and down while refining your installation work on the cartridge and spindle head. (If the cartridge does not easily get loose when you move up the Z axis, the cartridge does not align with the spindle head. If this is the case, replace the block with a new parallel block and try again.)



- ⑥ While inserting the cartridge to the spindle head, guide the timing belt into the timing pulley so that it fits to the intended position. However, leave a small space (approx. 1-2mm) at the end.

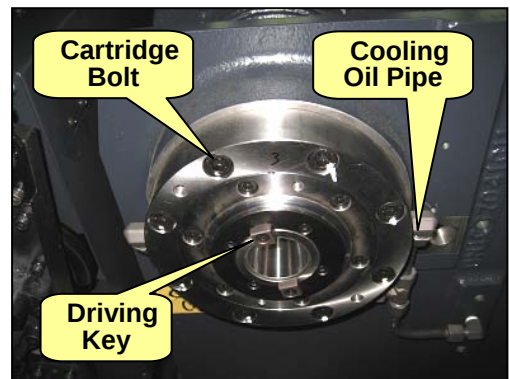


- ⑦ Tighten a couple of bolts first, move up the Z axis as appropriate, and tighten up the remaining bolts with even torque.
- 8-BB12×45



2) Install the component parts on the bottom of the spindle.

- ① Move the Z axis to lift up the spindle head so that you can install the component parts with ease.
- ② Install the spindle cooling oil pipes and driving key onto the spindle.

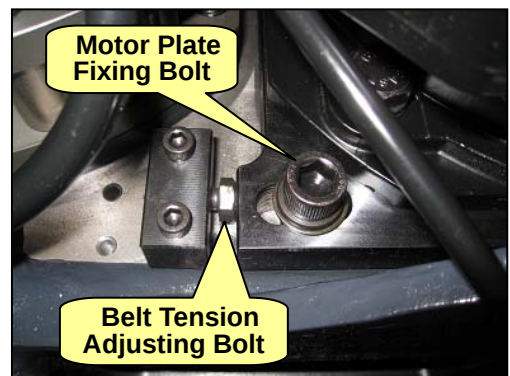
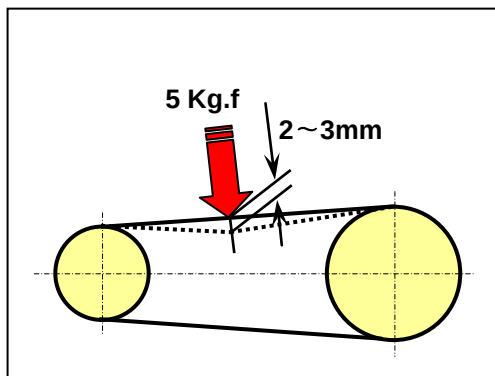


3) Adjust the tension of the spindle motor timing belt.

- ① Slightly tighten the fixing bolts (4-BB12×40) for C72041183A motor plate.
- ② Adjust the belt tension by evenly tightening two tension bolts gradually.

Correction : Tension is properly adjusted if the midway of the timing belt is pressed down 2mm~3mm by a force of about 5 kgf. However, this is not an easy work. So set the tension when you feel the least noise and vibration in spindle rotation mode.

- ※ If the timing belt is too loose or too tight, this may cause excessive heat, deformation or noise of the belt. To avoid this, adjust the tension properly.
- ③ When the tension is properly adjusted, tighten up the motor plate fixing bolts (4-BB12×40).



1.6 Assembling the tool unclamp cylinder

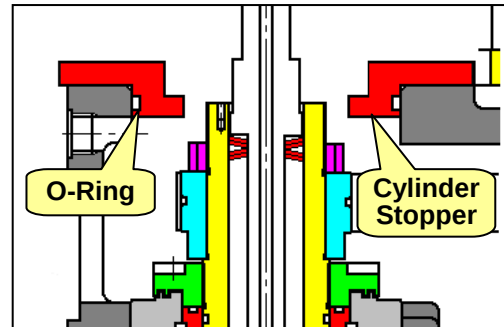
1) Install the push rod assembly

Apply grease to C72041713 push rod assembly before inserting the whole assembly into the spindle.



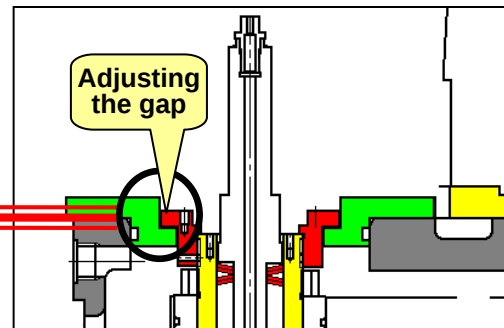
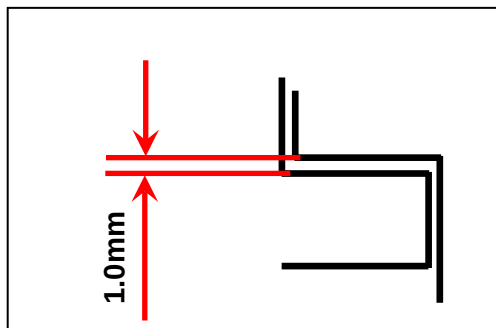
2) Install the cylinder support.

- ① Insert the O-ring (1-P140) into C72041633A cylinder support, and apply grease.
- ② Insert the bolts (coming from the removed cylinder) diagonally into the cylinder base, and tighten them with care to fix the cylinder support.

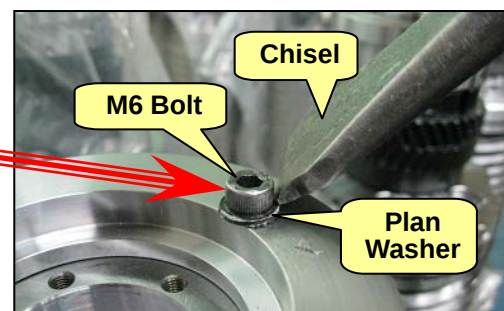
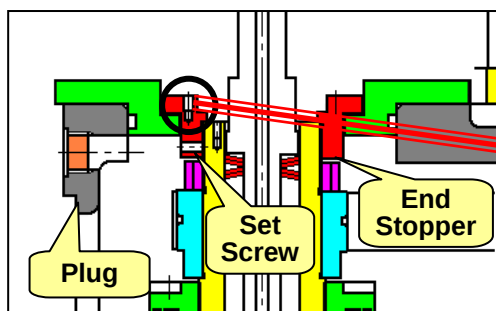


3) Adjust the gap of and install the end stopper

- ① Install C72041643 end stopper manually, and measure the gap from the cylinder base. If out of the tolerance, fit the end stopper on site.
 - Target: $1.0\text{mm} \pm 0.2$

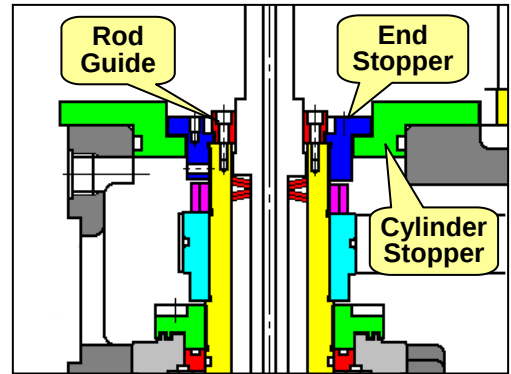
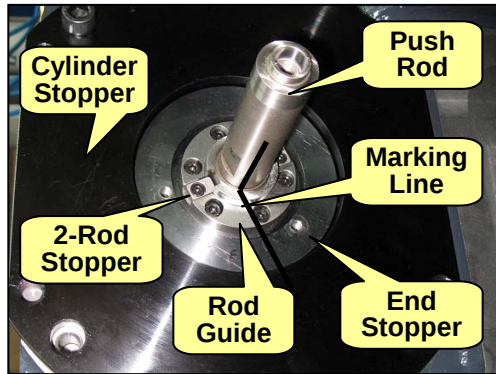


- ② Insert a M6 bolt with the plain washer into the M6 tap on the top of end stopper. With the chisel and hammer, impact on the M6 bolt to remove the end cap.
- ① Tighten up C72041643 end stopper's set screws (3-BQ8×8) one at a time through the hole of the disconnected plug (FT 1/2) in the front of spindle body.

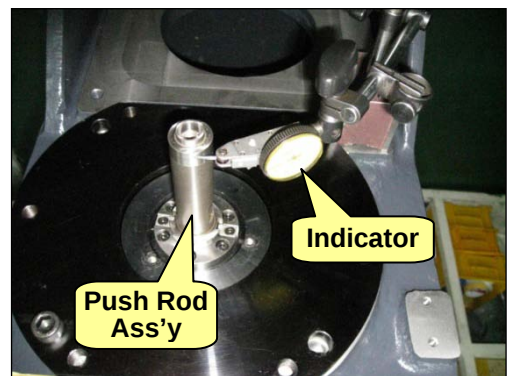


4) Install the rod guide

- ① Check the marking line that you draw when removing C72041164A rod guide and insert it back to original. Then, tighten the fixing bolts loosely.
 - 6-BB5×20
- ② Fit two rod stoppers into the push rod holes, one per each.
 - 2-BB4×12

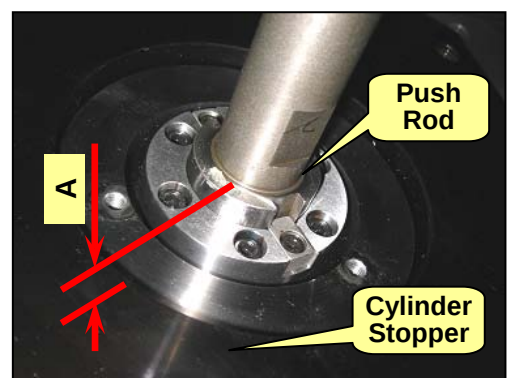
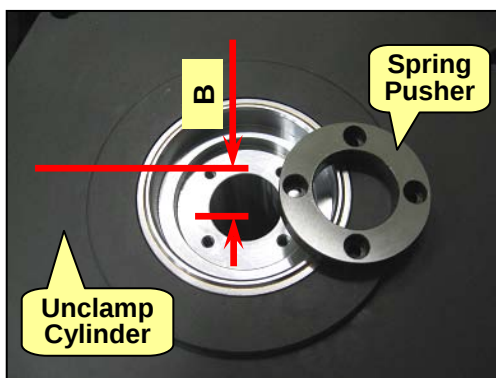


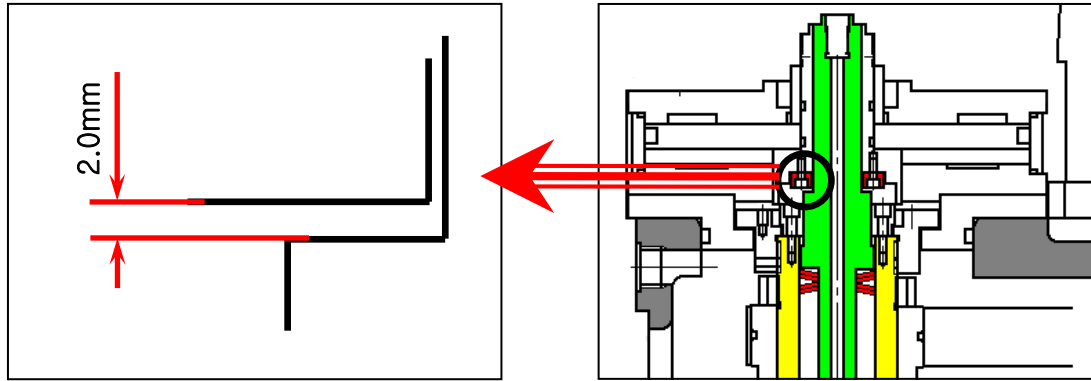
- ③ Present the indicator needle to the push rod assembly and measure the runout value. Correct the runout until it falls below 0.02mm.
- ④ When done, tighten up the loosely-fixed bolts on the rod guide.



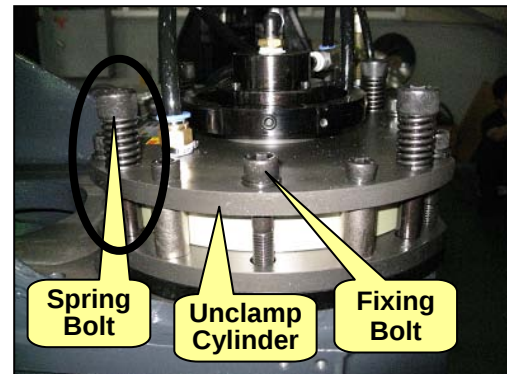
5) Install the unclamp cylinder

- ① Check the gap of C72041214 spring pusher. Put the unclamp cylinder upside down, and measure the distance between cylinder stopper and distal end of the spring pusher ("B") as well as the distance between cylinder stopper and push rod ("A"). Fit the spring pusher on-site until the gap falls 2.0 ± 0.2 mm.



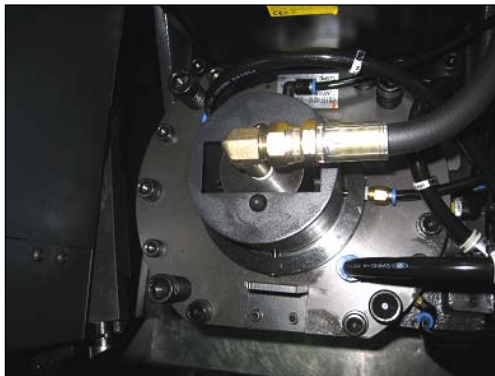


- ② Mount the unclamp cylinder onto the cylinder stopper.
- ③ Tighten 4 C49041174 spring bolts (with C49041413B unclamp spring inserted) as well as the unclamp cylinder fixing bolts.
 - 4-BB16×130, 4- BB12×75



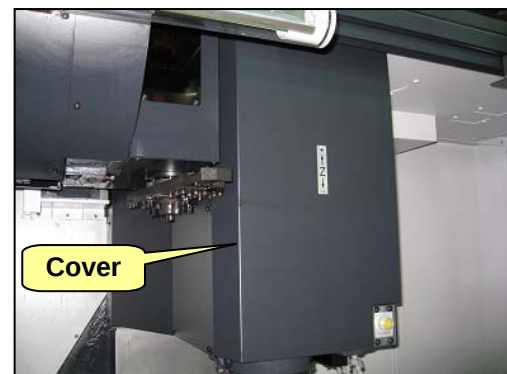
6) Others

Put together the component parts such as coolant hose, air tube, bracket, micro switch bracket, air solenoid valve, and R27273 rotating union (all of which were removed for the disassembly of the tool unclamp cylinder) back in the original position.



6) Finishing

When done, resume the air supply that was stopped for the disassembly of the cylinder, make necessary steps according to a new installation of the spindle, and close the spindle head assembly cover.



- ※ You must take the steps below according to a new installation of the spindle.
 - (1) Turn the spindle forward or backward to check for any noise or interference.
 - (2) Run-in the spindle bearing
 - (3) Reset the spindle orientation.
 - (4) Adjust the tool kick distance

1.7 Running-in the spindle bearing

- ※ When installation is done, check again if there is no further problem with the installation. If not, turn on the machine and set the reference point of each axis before running-in the spindle bearing.
 - (1) The purpose of the running-in is to apply grease evenly to the spindle bearing so that the bearing settles down.
 - (2) For the rotary RPM and the running-in time, refer to the program sample below:
 - (3) If you hear an abnormal sound (interruption noise) during the process, take an appropriate action.
 - (4) The allowable temperature range is the room (air) temperature + (40℃ ~ 50℃).

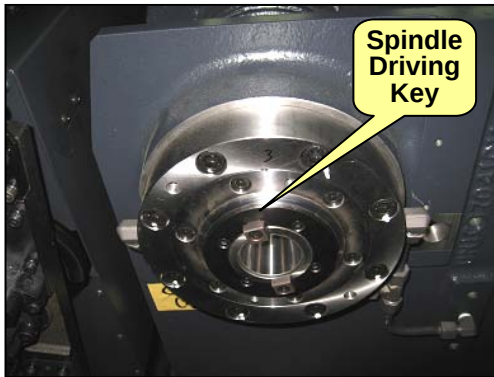
▪ Sample running-in program for the spindle bearing (at 8,000 RPM)

M03 S1000 ;	M03 S4000 ;	M03 S7000 ;	M30 ;
G04 X300. ;	G04 X300. ;	G04 X180. ;	
M04 ;	M04 ;	M04 ;	
G04 X300. ;	G04 X300. ;	G04 X180. ;	
M03 S2000 ;	M03 S5000 ;	M03 S8000 ;	
G04 X300. ;	G04 X300. ;	G04 X180. ;	
M04 ;	M04 ;	M04 ;	
G04 X300. ;	G04 X300. ;	G04 X180. ;	
M03 S3000 ;	M03 S6000 ;	M03 S1000 ;	
G04 X300. ;	G04 X300. ;	G04 X300. ;	
M04 ;	M04 ;	M04 ;	
G04 X300. ;	G04 X300. ;	G04 X300. ;	

1.8 Positioning the spindle orientation

- ※ The purpose of spindle orientation is to determine the regular stop position of the spindle when replacing the tools automatically. The tolerance is $\pm 0.25^\circ$. If you re-assemble the position coder or spindle, you must check and reset the spindle orientation.

- 1) Remove the driving key of the spindle, and the key of the ATC changer arm.



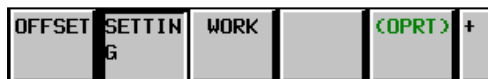
- 2) By manipulating the ATC arm, move it up to the spindle position.
 - Keep rotating the ATC changer arm forward until the arm is moved out, and rotate it backward to move up to the top position before stopping it.
- 3) Correct the value of Keep Relay K7.6 (ATC Used) from "1" to "0".

(Note) To change the Keep Relay setting

- ① Set the mode switch on the main OP to "MDI".

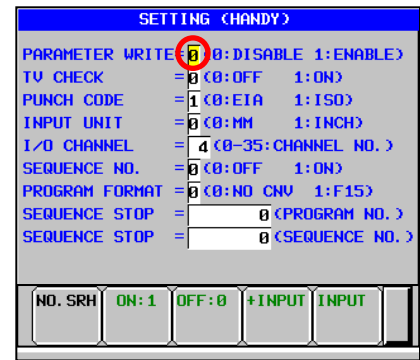


- ② Press the "OFFSET/SET" button in the right side of the main OP monitor.
- The following options will be displayed in the soft key menu.



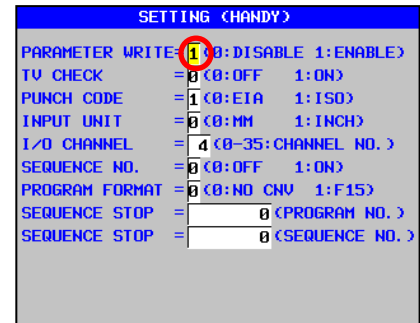
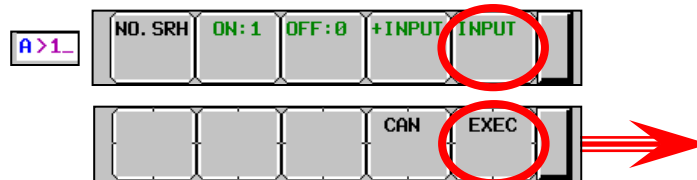
③ Press the [SETTING] button.

- The Setting menu appears where the cursor will be positioned to "PARAMETER WRITE" on the top.

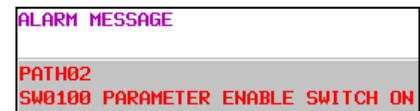


- ※ If the screen is not displayed as shown in the right picture, move to the first page of the Setting Parameter menu ("0" → "NO.SRH") and press the Page Up button three times. Then, you will see the right screen properly.

④ Enter a numeric of "1" and keep pressing the INPUT and EXEC buttons.

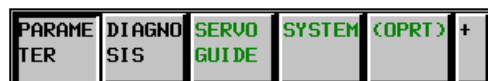


- ★ The "SW0100 Parameter Enable Switch ON" alarm will occur.

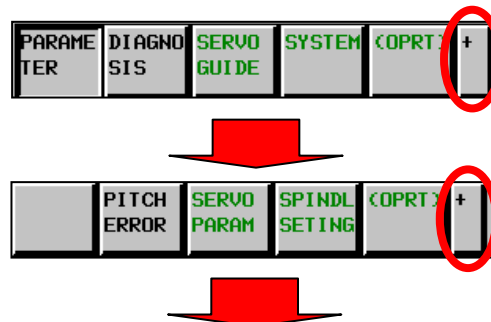


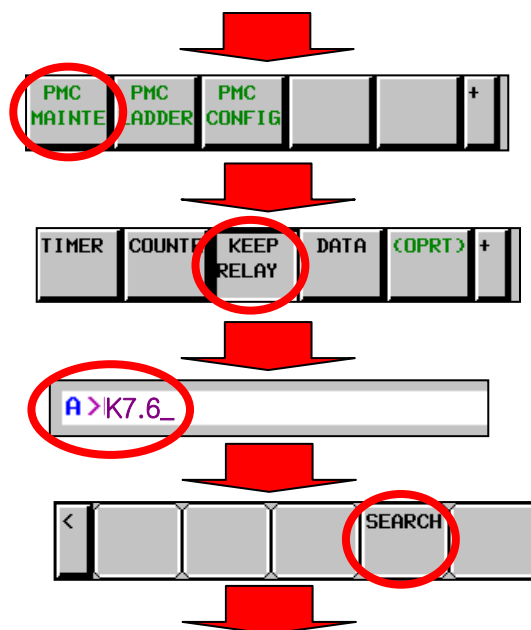
⑤ Press the "SYSTEM" button in the right side of the main OP monitor.

- The following options will be displayed in the soft key menu.



⑥ Press the soft keys one after another to move to the Keep Relay screen.





- ⑦ Enter a desired Keep Relay number and press [SEARCH], or move the cursor to the Keep Relay item and enter 1 or 0. Then, press the INPUT button.
- ⑧ When done, move back to **"SETTING"** and turn off **"PARAMETER WRITE"** ("1" → '0'). Then, press the **"RESET"** button to release the alarm.

ADDRESS	7	6	5	4	3	2	1	0	HEX	ADDRESS	7	6	5	4	3	2	1	0	HEX
K0000	0	0	0	0	0	0	0	0	00	K0014	0	0	0	0	0	0	0	0	00
K0001	0	0	0	0	0	0	0	0	01	K0015	0	0	0	0	0	0	0	0	01
K0002	0	0	0	0	0	0	0	0	02	K0016	0	0	0	0	0	0	0	0	02
K0003	0	0	0	0	0	0	0	0	03	K0017	0	0	0	0	0	0	0	0	03
K0004	0	0	0	0	0	0	0	0	04	K0018	0	0	0	0	0	0	0	0	04
K0005	0	0	0	0	0	0	0	0	05	K0019	0	0	0	0	0	0	0	0	05
K0006	0	0	0	0	0	0	0	0	06	K0020	0	0	0	0	0	0	0	0	06
K0007	0	0	0	0	0	0	0	0	07	K0021	0	0	0	0	0	0	0	0	07
K0008	0	0	0	0	0	0	0	0	08	K0022	0	0	0	0	0	0	0	0	08
K0009	0	0	0	0	0	0	0	0	09	K0023	0	0	0	0	0	0	0	0	09
K0010	0	0	0	0	0	0	0	0	0A	K0024	0	0	0	0	0	0	0	0	0A
K0011	0	0	0	0	0	0	0	0	0B	K0025	0	0	0	0	0	0	0	0	0B
K0012	0	0	0	0	0	0	0	0	0C	K0026	0	0	0	0	0	0	0	0	0C
K0013	0	0	0	0	0	0	0	0	0D	K0027	0	0	0	0	0	0	0	0	0D

- 4) Instruct the machine to perform spindle orientation (M19) in MDI mode.
 - ※ The spindle is very close to the changer arm by now. So check for any interruption before operating the machine for your safety.
- 5) Refer to the driving key hole of the spindle and the key hole of the ATC changer arm before correcting the position.
 - ① Find the orientation result -> check the error
 - If the error is significant, check the angle with bare eye, and compare between the two key holes based on the spindle driving key.
 - ② Adjust the parameter settings -> Increase or decrease the default value while checking the orientation position by instructing M19.
 - Target : Inserted in the key hole of the spindle, the spindle driving key fits into the key hole of the changer arm with no interruption.
 - ※ Orientation Adjusting Parameter No. : NC Parameter #4077
 - Description of Parameter Value: 0.08789° per 1 pulse (range: ±4096),
4069 on the basis of 360° for the spindle (90° = 1024)
- 6) When completed, change the value of Keep Relay K7.6 (ATC Used) to "1", and manipulate the ATC changer arm to move to the home position.

(Note) To change the parameter setting

- ① Set the mode switch on the main OP to "MDI".



- ② Press the "OFS/SET" button in the right side of the main OP monitor.

- The following options will be displayed in the soft key menu.

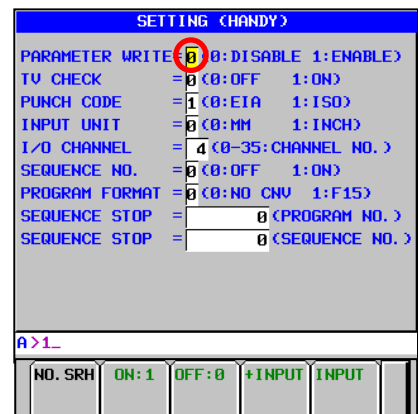


- ③ Press the [SETTING] button.

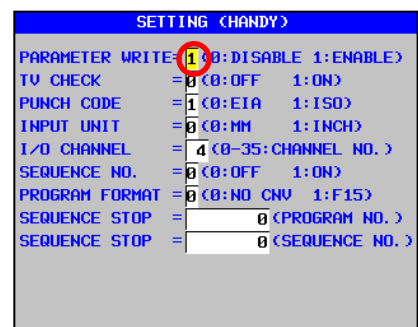
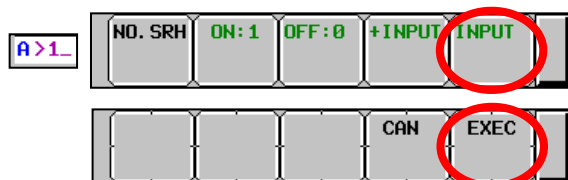
- The Setting menu appears where the cursor will be positioned to "PARAMETER WRITE" on the top.



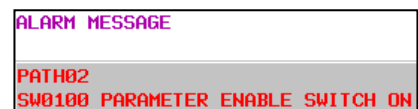
- ※ If the screen is not displayed as shown in the right picture, move to the first page of the Setting Parameter menu ("0" → "NO.SRH") and press the Page Up button three times. Then, you will see the right screen properly.



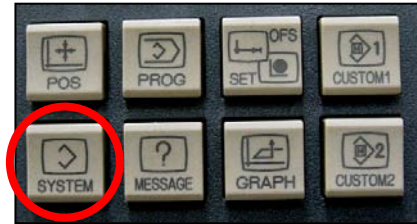
- ④ Enter a numeric of "1" and keep pressing the INPUT and EXEC buttons.



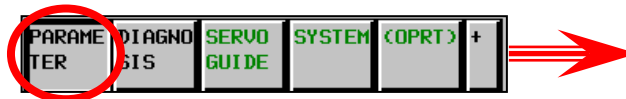
- ★ The "SW0100 Parameter Enable Switch ON" alarm will occur.



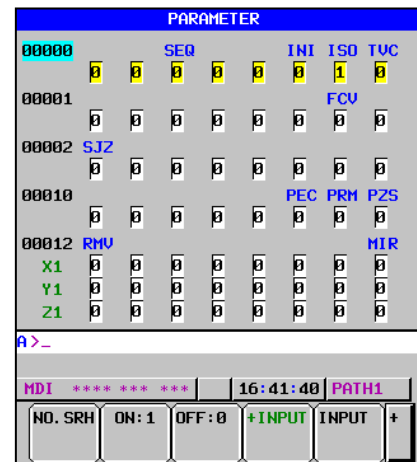
- ⑤ Press the "SYSTEM" button in the right side of the main OP monitor.
- The following options will be displayed in the soft key menu.



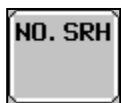
- ⑥ Press the [PARAMETER] button in the bottom navigation bar.



- You will see the Parameter setting screen.

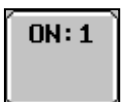


About Navigation Bar



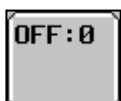
Find a desired parameter number.

Ex) If calling parameter no.4175: Enter the numeric numbers of "4175" and press the [NO.SRH] button in the navigation bar to move to the Parameter N4175 screen with the cursor positioned at the number.



Used to turn ON (1) the BIT-format parameter.

Ex) Press this to turn ON (1) only the highlighted BIT-format parameters.



Used to turn OFF (0) the BIT-format parameter.

Ex) Press this to turn OFF (0) only the highlighted BIT-format parameters.



Used to increase or decrease a word-format parameter by adding or subtracting data.

Ex) If you want to add to or subtract from the existing data included in the parameter, enter a data value to add or subtract (In subtraction, add "-" in front of the data value.) and press this button to perform the operation (addition or subtraction).



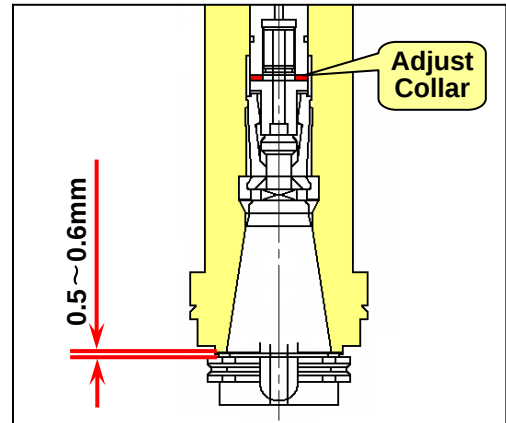
Used to enter a parameter value in the word format.

Ex) Regardless of the existing data, enter a data value and press this button. The data value will be entered immediately and properly.

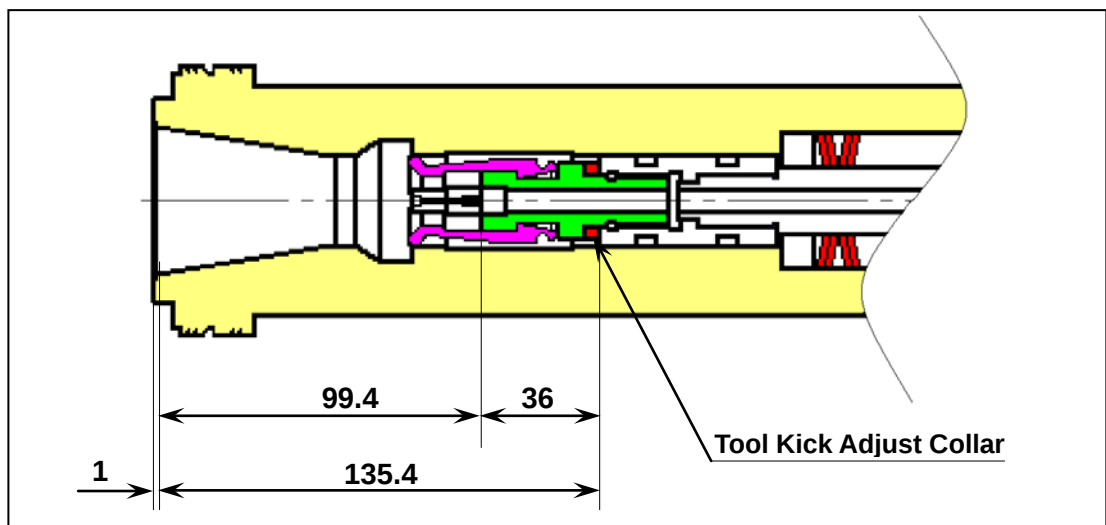
- ⑦ Select a navigation button that is suitable to your needs, and use it to adjust the value as necessary.
- ⑧ When done, move back to “**SETTING**” and turn off “**PARAMETER WRITE**”(“1”→ ‘0’). Then, press the “**RESET**” button to release the alarm.

1.9 Adjust the tool kick distance

Bind a tool to the spindle. While repeating the spindle tool clamping/unclamping in manual mode, measure the distance between one position of the tool and the spindle section while clamping/unclamping the tool. The tolerance is between 0.5mm and 0.6mm. (Adjust the adjustable collar)

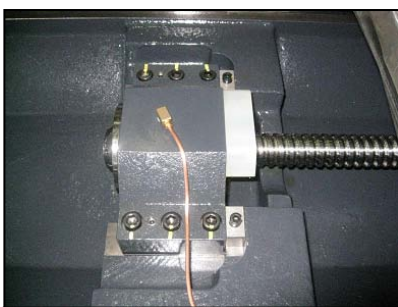
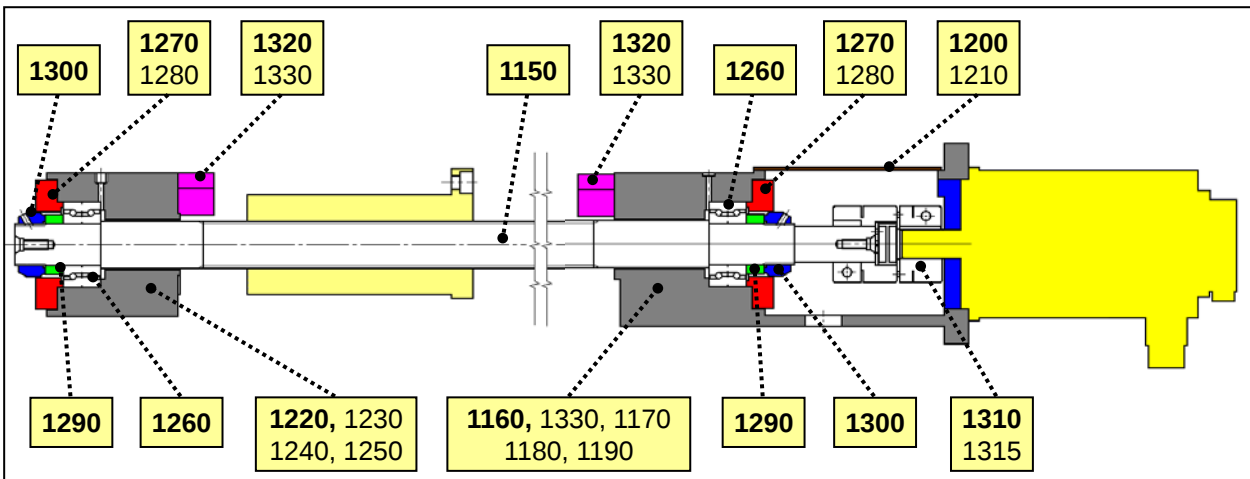
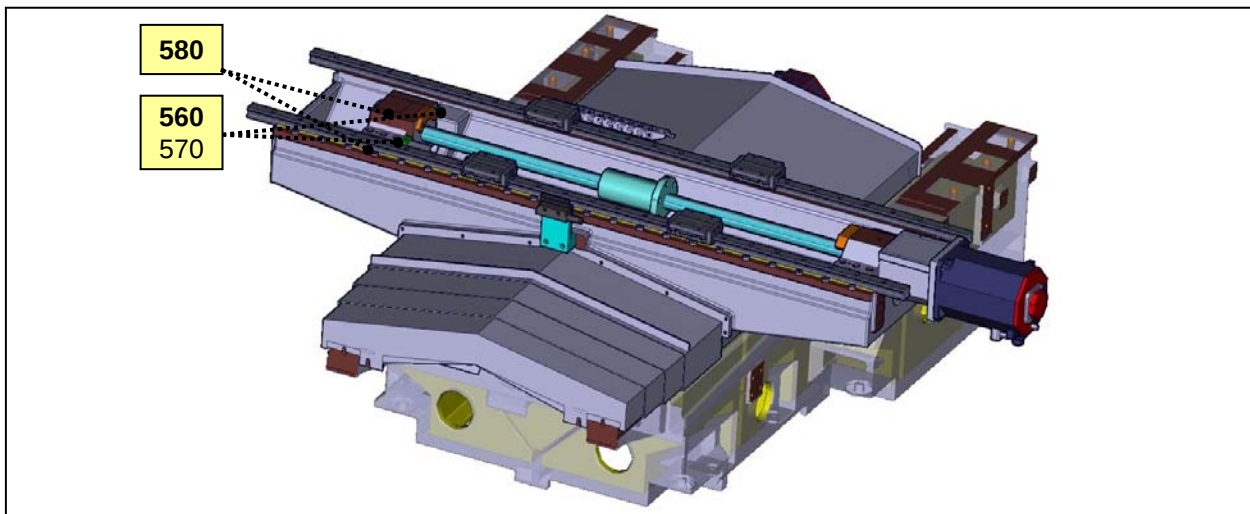


※ Figure below: Distance between spindle section and collet



2. Assembling & disassembling the ball screw

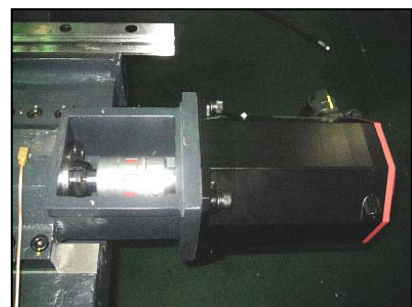
※ Parts List of the X Axis



Support housing of the X axis



Ball screw nut of the X axis

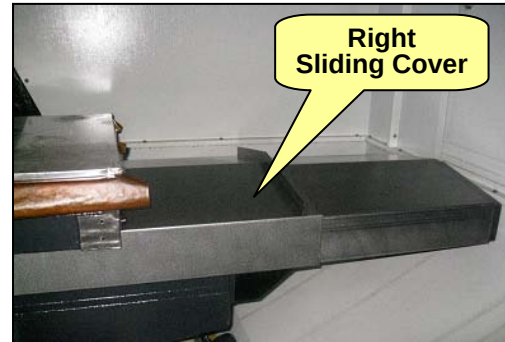


Motor housing of the X axis

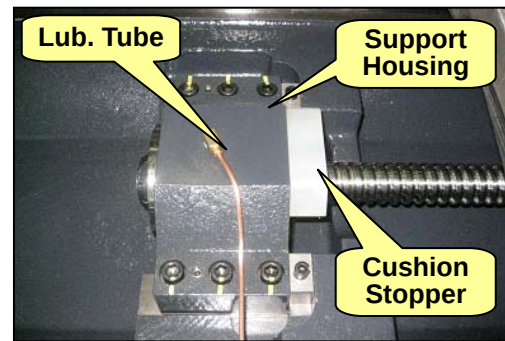
No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
560	C46021074	Spacer Key	SM45C	2	
570	S2209361	Hex. Socket Head Bolt	BB8×35	2	
580	C72021094A	Spacer	SS400	2	
1150	C72022033B	Ball Screw (DNM500.X)	R40-12E2-FSWE-1275-1663-0.008	1St	
1160	C72021052B	Motor Housing	GC250	1	Fanuc
1165	C72028112	Motor Housing	GC250	1	Heidenhain
1170	S2215861	Hex. Socket Head Bolt	BB12×60	6	
1180	P51400012	Conical Washer	ZC12	6	
1190	P57210063	Taper Pin (W/Tap)	TPB10×63	4	
1200	C72021104A	Motor Housing Cover	SCP1	1	
1210	R01023	Machine Screw	BC5×12 (PICR3)	2	
1220	C72021043A	Support Housing	GC250	1	
1230	S2215861	Hex. Socket Head Bolt	BB12×60	6	
1240	P51400012	Conical Washer	ZC12	6	
1250	P57210063	Taper Pin (W/Tap)	TPB10×63	4	
1260	R10090	Ang. Thrust Ball Bearing	35TAC72BDBC10PN7A	2	
1270	C72021083	Bearing Cap	SM45C	2	
1280	S2209261	Hex. Socket Head Bolt	BB8×30	12	
1290	C72021114A	Bearing Spacer	Sm45C	2	
1300	R02124	Lock Nut	DKMT35	2	
1310	R15275	Coupling (R15275)	Rolex GS 20 (30/24)	1St	Fanuc
1315	R15314	Heidenhain Coupling	Rolex GS 20 (32/30)	1St	Heidenhain
1320	C72021483A	Cushion Stopper	Urethane	2	
1330	S2203761	Hex. Socket Head Bolt	BB5×30	4	

2.1 Disassembling the ball screw on the X axis

- 1) To loosen the ball screw on the X axis, remove the sliding covers on both sides of the saddle.

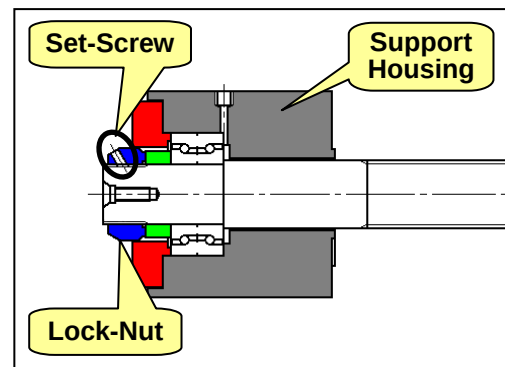


- 2) Move the X axis to the reference point as appropriate to secure room for work on the right support housing. Then, remove the oil pipes and cushion stopper from the support housing.



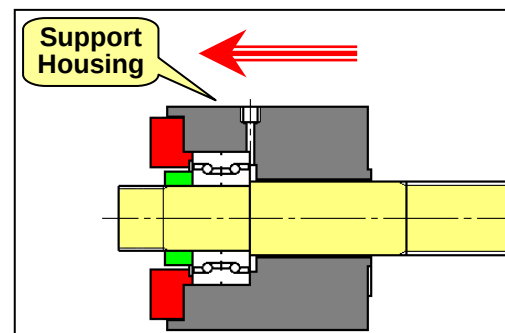
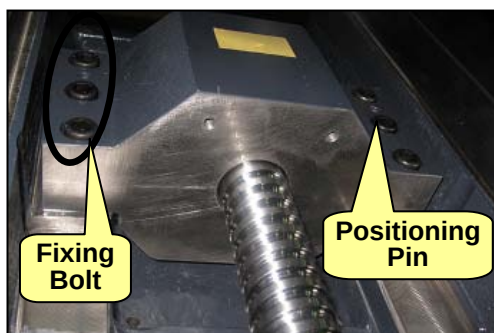
- 3) Remove the lock-nut from C72021043A support housing.

※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.

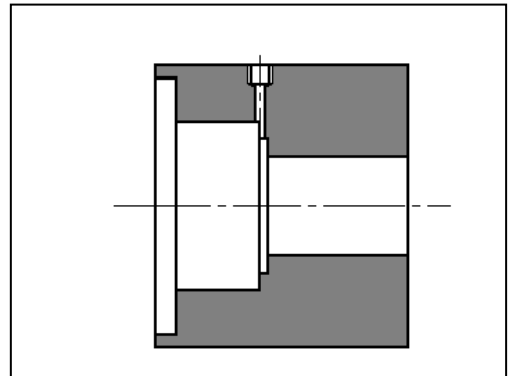
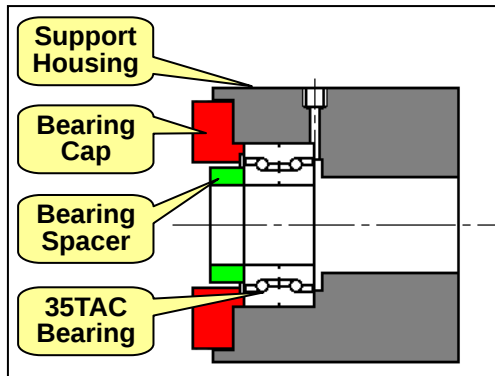


- 4) Remove the support housing.

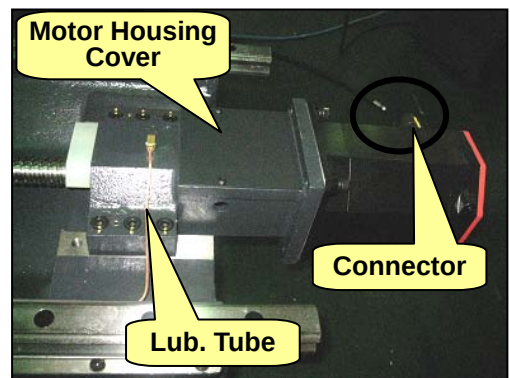
- ① Pull out the positioning pins (2-TPB10×63), and loosen the fixing bolts (6-BB12×60).
- ② With a plastic hammer, gently impact on the support housing to remove it from the ball screw.



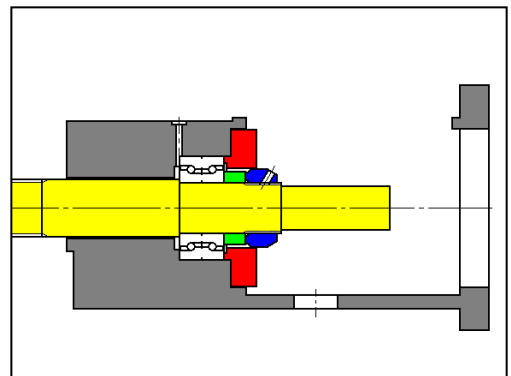
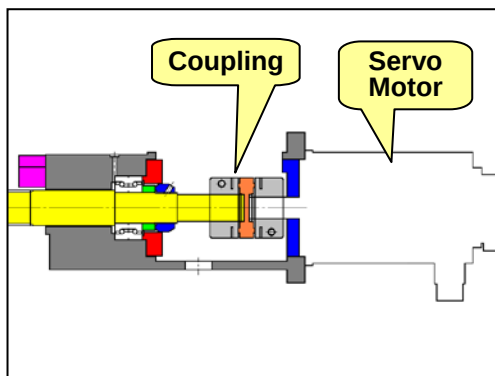
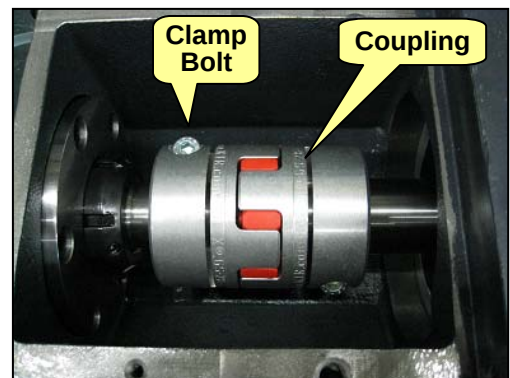
- 5) Remove C72021083 bearing cap fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer, R10090 35TAC angular thrust ball bearing from the support housing.



- 6) Turn the X axis slowly in the reverse direction to secure enough room for work on the motor housing where the X-axis servo motor is installed, and remove C72021104A motor housing cover and lubricant pipe from C72021052B motor housing. Then, disconnect the cable connectors (power & feedback cable) of the servo motor.

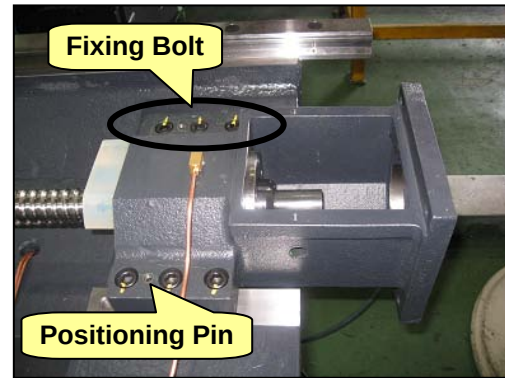


- 7) Loosen R15275 coupling clamp bolt that is closer to the ball screw, loosen the fixing bolts of the servo motor, and remove the motor with care.

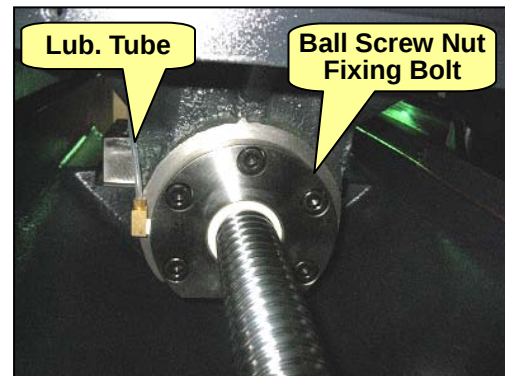


8) Remove the coupling housing.

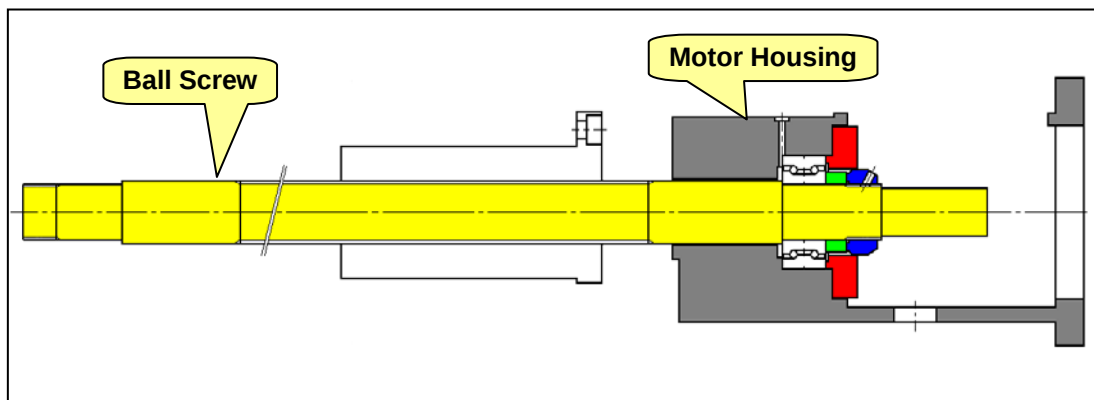
- ① Use the pin puller to remove the positioning pins (2-TPB8×63).
- ② Loosen and remove the fixing bolts (6-BB12×60).



9) Remove the ball screw lubricant tube under the table, and loosen the fixing bolts (5-BB10×40) on the ball screw nut.

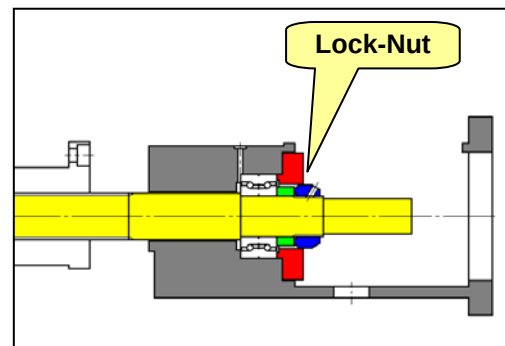


10) Pull out the whole assembly of motor bracket and ball screw from the machine.

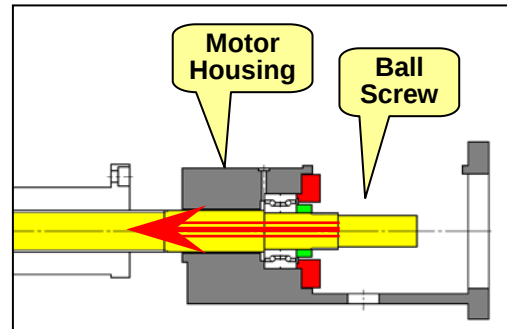


11) Loosen the lock-nuts on the assembly of ball-screw and coupling housing.

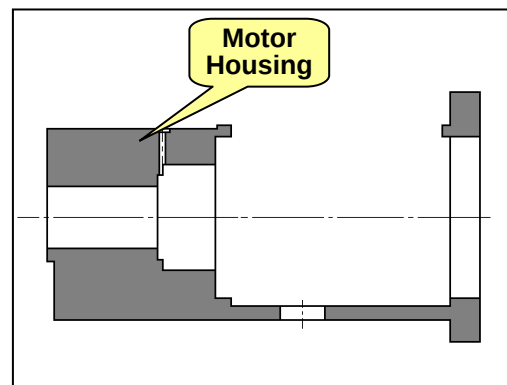
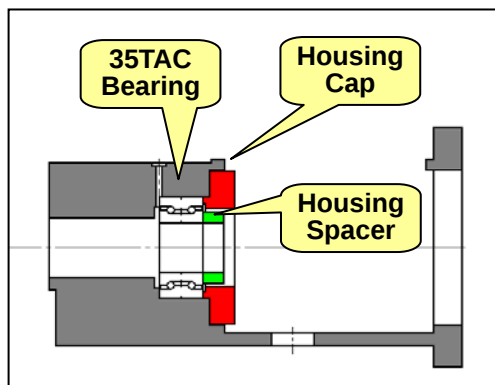
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.



- 12) Remove the ball screw from the motor housing with care.



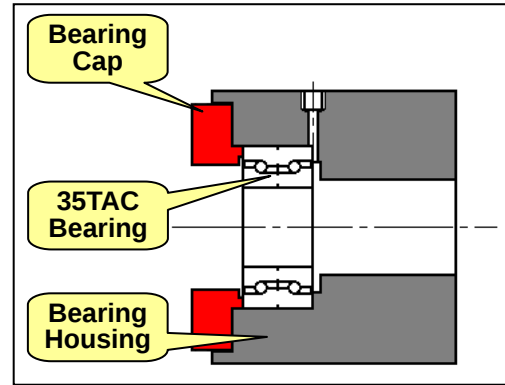
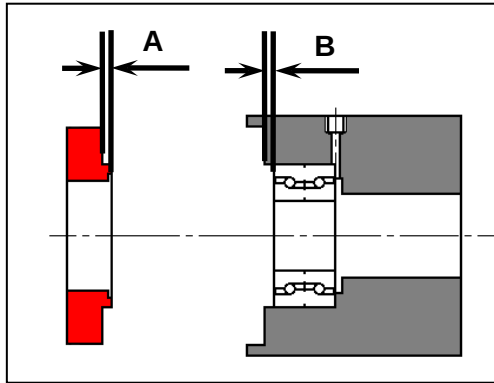
- 13) Remove C72021083 bearing cap fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer, R10090 35TAC angular thrust ball bearing from the motor housing.



2.2 Installing the ball screw on the X axis

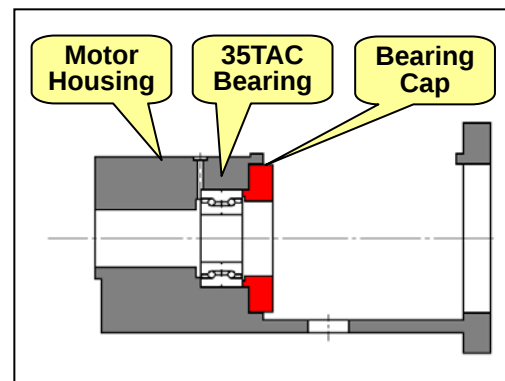
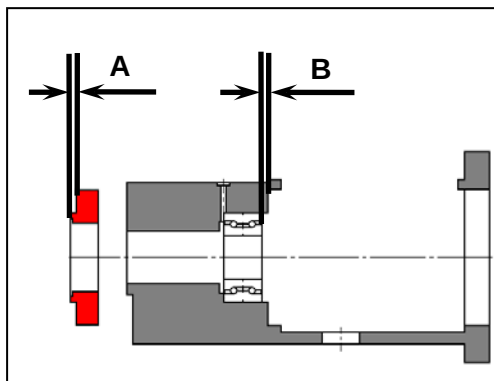
- 1) Fit the bearing cap of the support housing on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021043A support housing in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
- ② Measure the depth between end point of the bearing and top section of the bearing housing. ("**B**")
- ③ Calculate the target size of the sectional depth of C72021083 bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "**A**" = "**B**" + 0.05mm
- ④ Insert the completed bearing cap into the bearing housing.
 - ※ Put force as even as possible to each of the fixing bolts.
 - 6-BB8×30



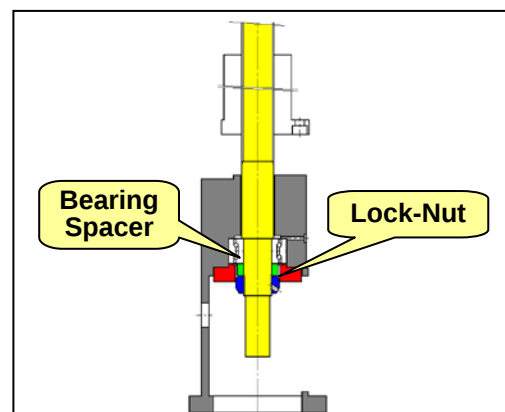
2) Fit the bearing cap of the motor housing on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021052B motor housing in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
- ② Measure the depth between end point of the bearing and top section of the coupling housing. ("B")
- ③ Calculate the target size of the sectional depth of C72021083 bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "A" = "B" + 0.05mm
- ④ Insert the completed bearing cap into the motor housing.
 - ※ Put force as even as possible to each of the fixing bolts.
 - 6-BB8×30

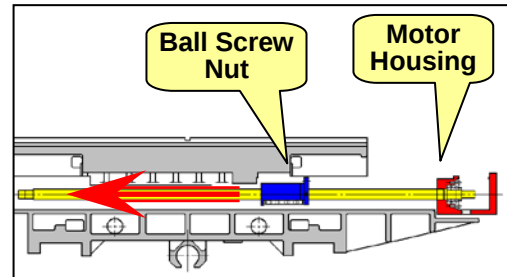


3) Install the ball screw

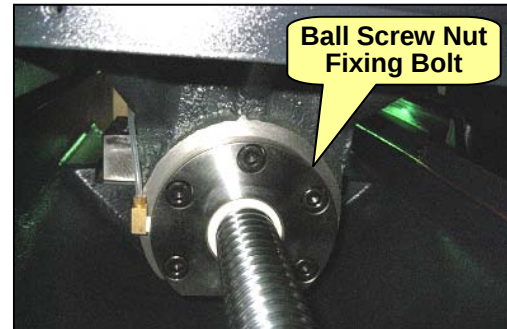
- ① Place C72021052B motor housing (with the bearing inserted) vertically, into which you insert a new ball screw and C72021114A bearing spacer. Then, tighten the lock-nut.
 - To the end, you must solve the runout problem with the ball screw so you just tighten the nut to the full length at this moment.



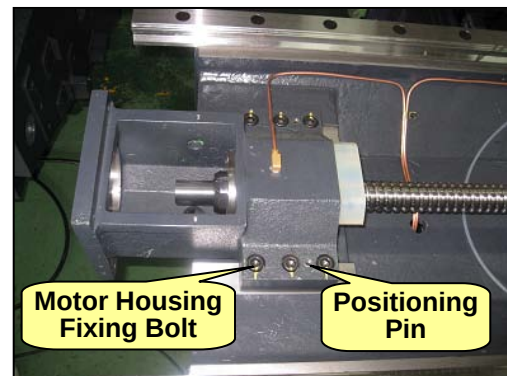
- ② Insert the assembly of motor housing and (combined with) the ball screw through the place of the ball screw on the X axis. Care must be taken here.



- ③ Tighten the fixing bolts of the ball screw nut loosely.
- 5-BB10×40

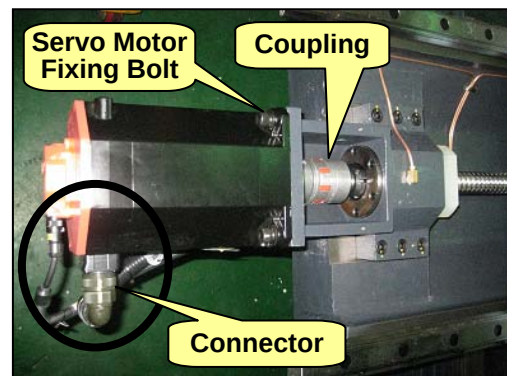


- ④ Tighten the motor housing bolts and insert the positioning pins.
- 6-BB12×60, 2-TPB8×63



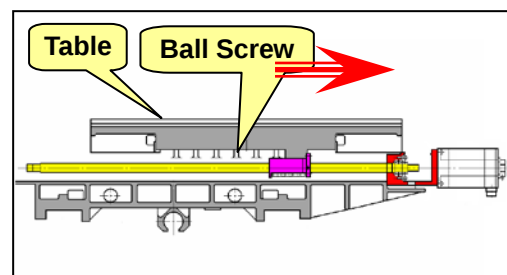
4) Install the servo motor

- ① Insert the X-axis servo motor (where R15275 coupling is installed) into the ball screw, and tighten the motor fixing bolts.
- ② Turn the ball screw manually to check if the bearing fits. Then, tighten up the clamp bolt of the coupling.
- ③ Connect the power cable and feedback cable of the servo motor.



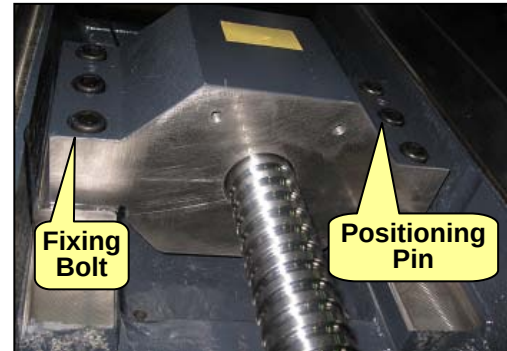
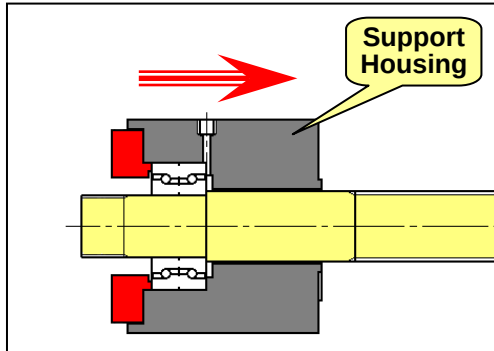
5) Move the table

When the servo motor connectors are connected properly, apply power and manipulate the X axis to move the table slowly to the reference point so that you can work on the support housing.



6) Install the support housing

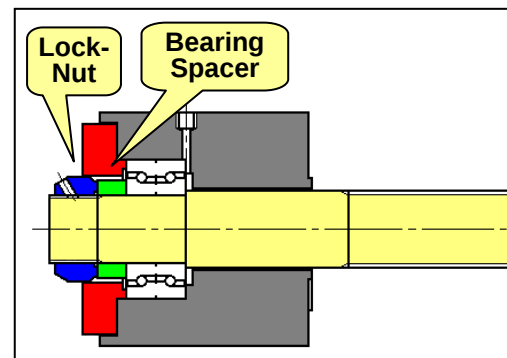
- ① Insert the support housing assembly carefully from the end of the ball screw into the body.
- ② Mount the support housing onto the saddle body.
 - 6-BB12×60, 2-TPB8×63



7) Fix the ball screw lock-nut

Insert C72021114A bearing spacer into the end of the ball screw on the support housing, and tighten the lock-nut.

- ※ To the end, you must do the pre-tension work and solve the run-out problem with the ball screw so you just tighten the screw to the full length at this moment.



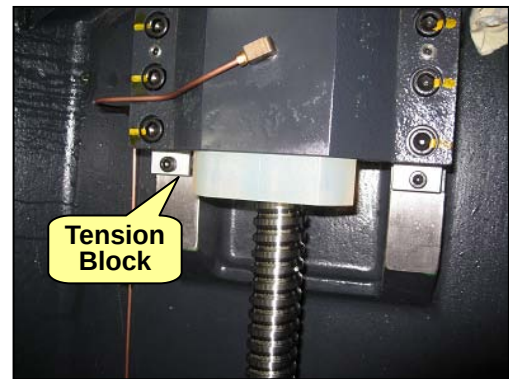
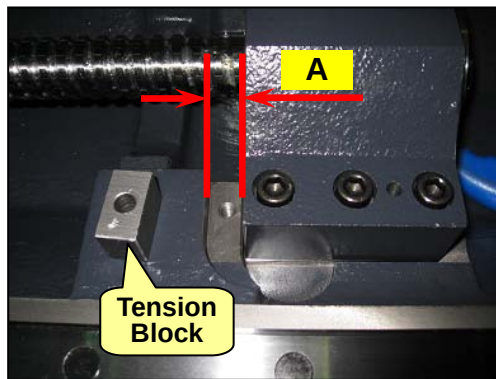
8) Pre-tension on the ball screw

- ① Loosen the lock-nut and use the indicator to set the end of the ball screw and set it to "0".
- ② To minimize the impact, use the spanner. If it is not available, use the chisel and hammer to impact on and tighten up the lock-nut. Then, measure the extended length of the ball screw.
- ③ The target extended length of the ball screw is 0.05 mm, which can be corrected by adjusting C46021074 spacer key in the front of bearing housing.



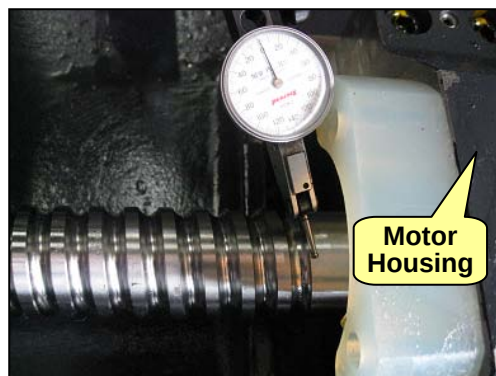
※ How to adjust the tension

- (1) Present another indicator to the ball screw section and set it to "0".
- (2) Loosen the support housing bolts and pull out the positioning pin.
- (3) Refer to the indicator that is installed in the side of the ball screw, and measure the gap of the tension block installation area (gap between section of the support housing and raised spot of the support housing installation area) using the block gauge. ("A")
- (4) Fit the tension block on site.
 - **Target size of the tension block = measurement ("A") + 0.05mm**
- (5) With the lock nut loose, insert the tension block to the end and tighten the support housing bolts.
- (6) Refer to step 8) above to check if you can get the right pretension value.
- (7) If you get the right result, perform reaming again of the place of the bearing housing positioning taper pin before inserting the taper pin.



9) Runout on the ball screw

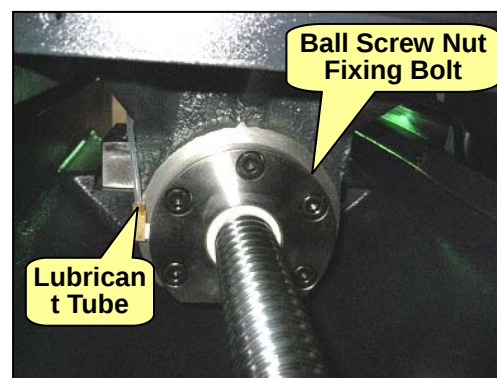
- ① Install the indicator and present the gauge to the top area (free of the screw thread) of the ball screw.
- ② While rotating the ball screw, read the runout value of the indicator, and impact on and fix the lock-nut using the chisel at the highest value of the run-out.
- ③ If the runout value of the ball screw goes below 0.005 mm, tighten up the set-screw for locking the lock-nut.



10) Install the ball screw nut

Complete installing the ball screw nut that were attached temporarily for alignment.

- ① Move the X axis to the "X0" coordinates.
- ② Put force as even as possible to each bolt until you tighten them up finally.
 - Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.
- ③ Connect the lubricant tube back to the original.

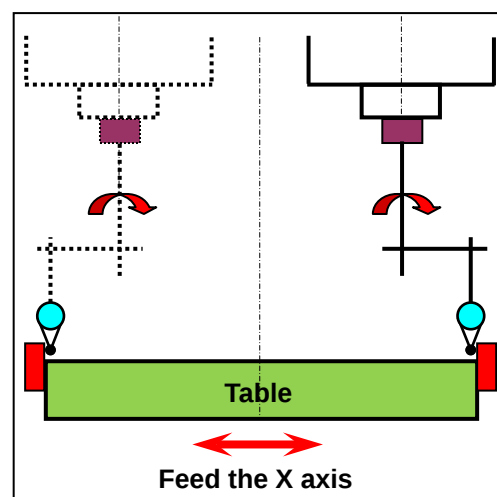


※ If you had loosened the X-axis ball screw or removed the servo motor and re-installed either one, you must reset the reference point of the X axis.

※ **Resetting the reference point for the X axis**

As DNM 500 is not equipped with the center bush on the center of table, figure out the center of either ends of the table and set it as reference point.

- 1) Install the indicator on the spindle and move it to one end of the X-axis approximate stroke. Place the block and set the gauge at the end of the table. While manually rotating the spindle left or right little by little, check the highest point along the way the indicator contacts on the block, and set the indicator to "0".



- 2) From the main OP, press **[POS.] → [RELATIVE] → [(OPRT)] → [ORIGIN] → "X" → [EXEC]** in sequence and switch the X-axis relative position to "0.000".

- 3) Rotate the spindle by 180 degrees manually so that the indicator faces the opposite side and contacts the block on the opposite side of the table. While manually rotating the spindle left and right little by little, move the X axis in the opposite direction until the highest point along the way the indicator contacts on the block is set to "0".

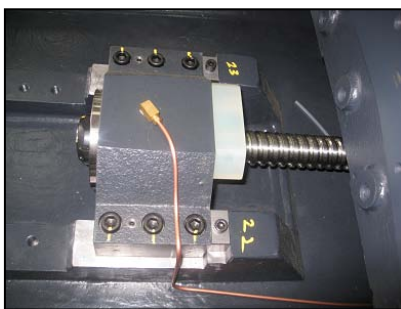
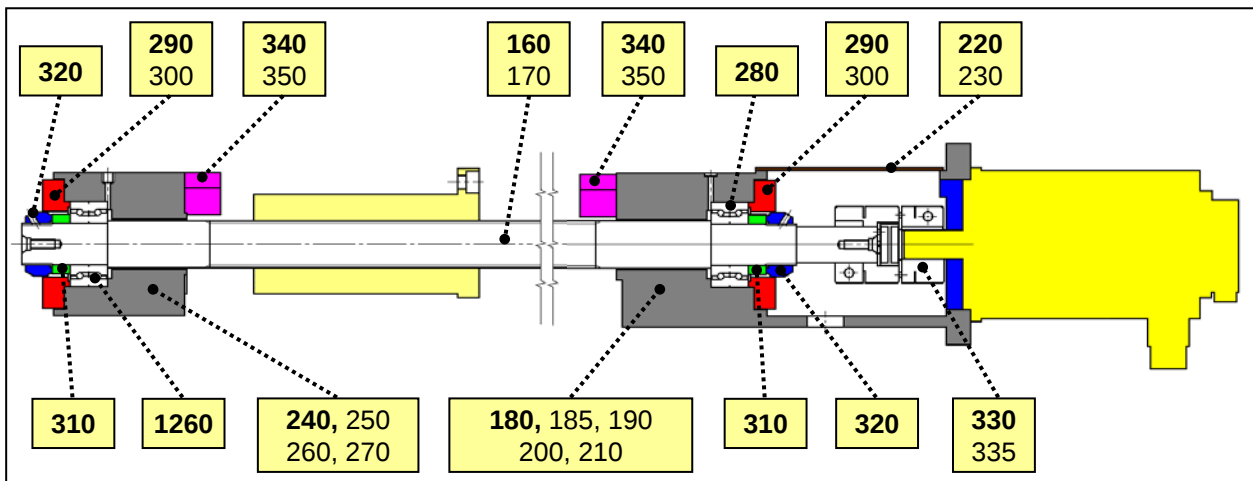
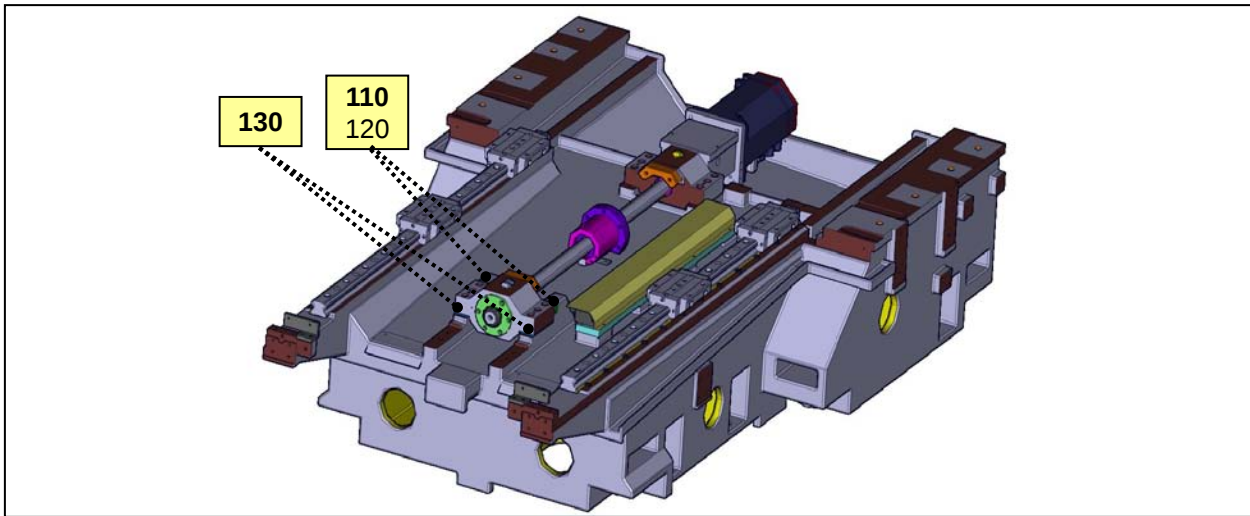
- 4) From the main OP, check the X-axis relative position and move the X axis, in handle mode or MDI, to the center as much as half of the relative position.
 - Now the final position is the center of the table.

5) Check the machine position (coordinates) on the CRT monitor, and move the X axis by 510mm (half of the X-axis stroke) in "-" direction in handle mode, or instruct "G91 X-510." in MDI mode.

- From the main OP, press [POS.] → [RELATIVE] → [(OPRT)] → [ORIGIN] → "X" → [EXEC] in sequence and switch the X-axis relative position to "0.000". It is convenient for you to move the X axis to the point of "-510.000".

6) Switch b4(APZ) of parameter #1815 X from "1" → "0". (The **"PW0000 POWER MUST BE OFF"** alarm will occur on the screen) Then, switch b4(APZ) of parameter #1815 X from "0" back to → "1" and turn Power Off → Power On. This is the completion of resetting the X-axis reference point.

※ Parts List of the Y Axis



Support housing of the Y axis



Ball screw nut of the Y axis

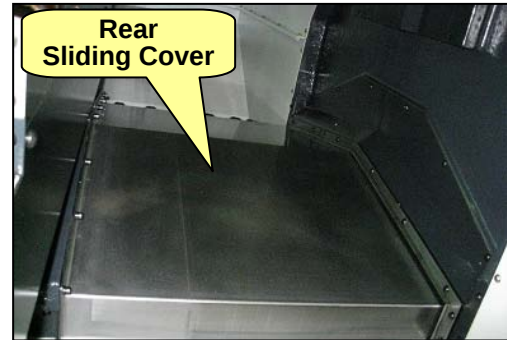
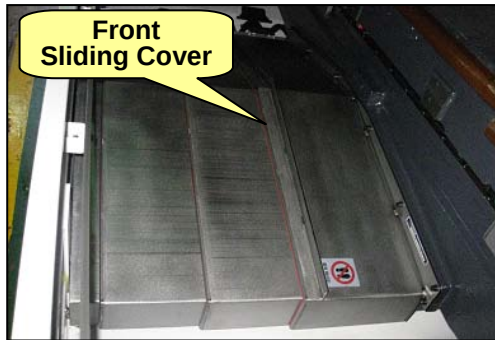


Motor housing of the Y axis

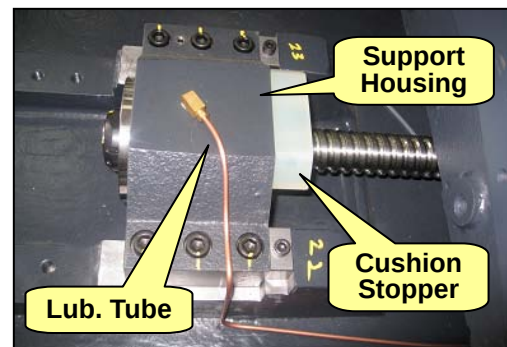
No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
110	C46021074	Spacer Key	SM45C	2	
120	S2209361	Hex. Socket Head Bolt	BB8×35	2	
130	C72021094A	Spacer	SS400	2	
160	C72021033B	Ball Screw (DNM500.Y)	R40-12E2-FSWE-795-1183-0.008	1St	
180	C72021052B	Motor Housing	GC250	1	Fanuc
185	C72028112	Motor Housing	GC250	1	Heidenhain
190	S2215861	Hex. Socket Head Bolt	BB12×60	6	
200	P51400012	Conical Washer	ZC12	6	
210	P57210063	Taper Pin (W/Tap)	TPB10×63	4	
220	C72021104A	Motor Housing Cover	SCP1	1	
230	R01023	Machine Screw	BC5×12 (PICR3)	2	
240	C72021043A	Support Housing	GC250	1	
205	S2215861	Hex. Socket Head Bolt	BB12×60	6	
260	P51400012	Conical Washer	ZC12	6	
270	P57210063	Taper Pin (W/Tap)	TPB10×63	4	
280	R10090	Ang. Thrust Ball Bearing	35TAC72BDBC10PN7A	2	
290	C72021083	Bearing Cap	SM45C	2	
300	S2209261	Hex. Socket Head Bolt	BB8×30	12	
310	C72021114A	Bearing Spacer	SM45C	2	
320	R02124	Lock Nut	DKMT35	2	
330	R15275	Coupling (R15275)	Rolex GS 20 (30/24)	1St	Fanuc
335	R15314	Heidenhain Coupling	Rolex GS 20 (32/30)	1St	Heidenhain
340	C72021483A	Cushion Stopper	Urethane	2	
350	S2203761	Hex. Socket Head Bolt	BB5×30	4	

2.3 Disassembling the ball screw on the Y axis

- 1) To loosen the ball screw on the Y axis, remove the sliding covers on both (front, rear) sides of the saddle.

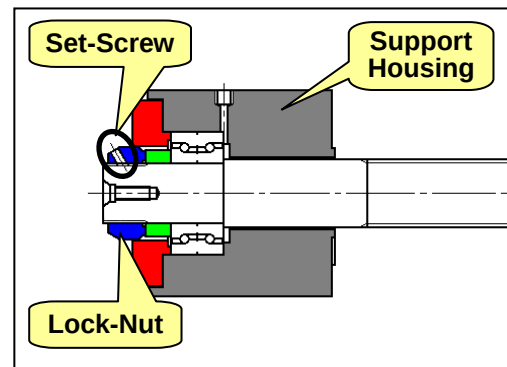


- 2) Move the Y axis in "-" direction as appropriate to secure room for work on the front support housing. Then, remove the lubricant tube and cushion stopper from the support housing.



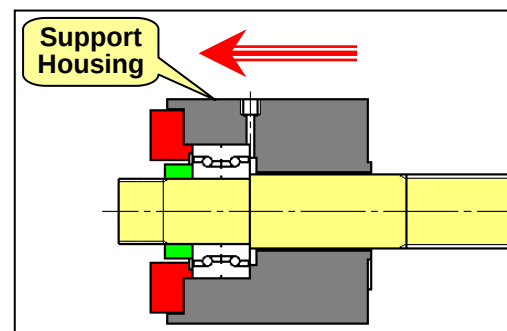
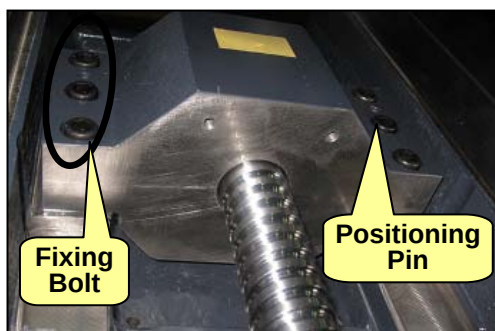
- 3) Remove the lock-nut from C72021043A support housing.

※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.

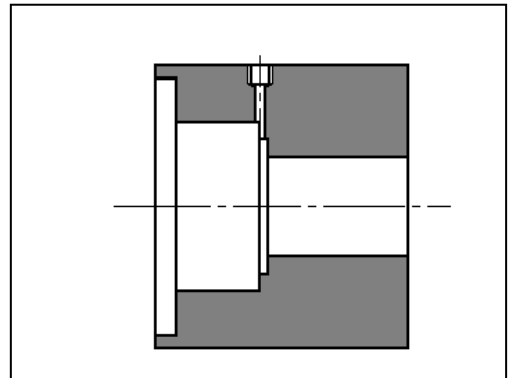
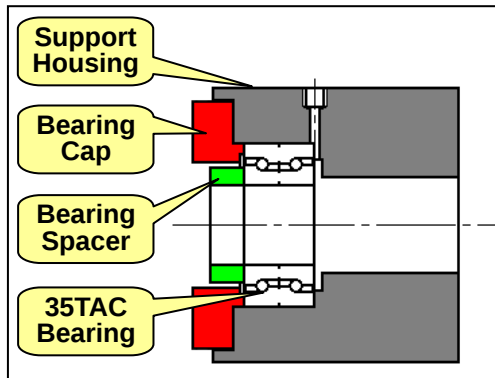


- 4) Remove the support housing.

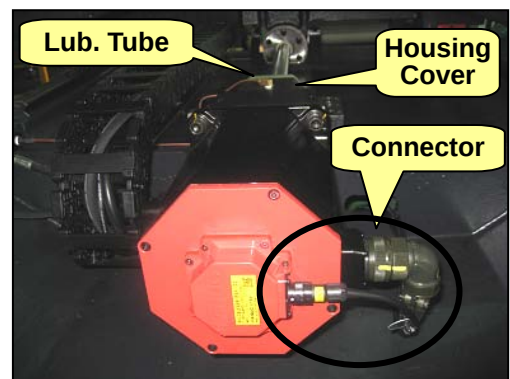
- ① Pull out the positioning pins (2-TPB10×63), and loosen the fixing bolts (6-BB12×60).
- ② With a plastic hammer, gently impact on the support housing to remove it from the ball screw.



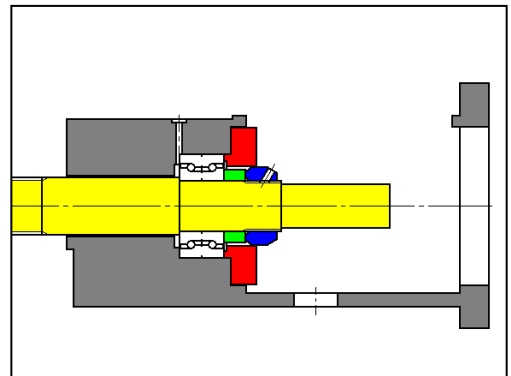
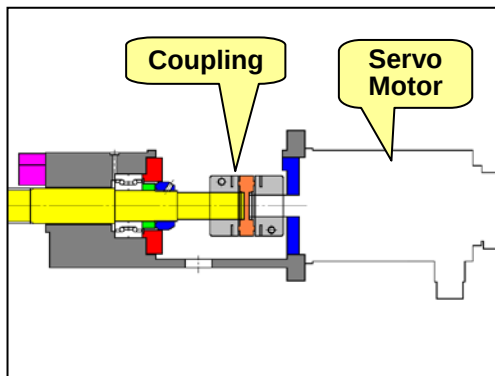
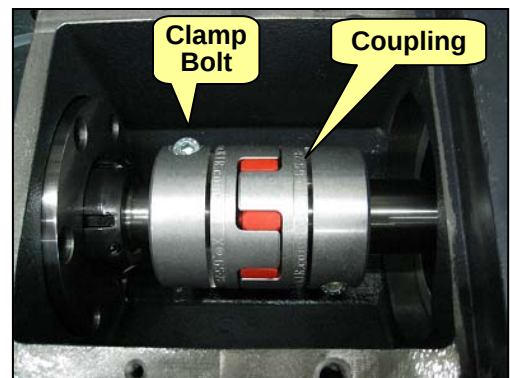
- 5) Remove C72021083 bearing cap, fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer, R10090 35TAC angular thrust ball bearing from the support housing.



- 6) Turn the Y axis slowly in the reverse direction to secure enough room for work on the motor housing where the Y-axis servo motor is installed, and remove C72021104A motor housing cover and lubricant tube from C72021052B motor housing. Then, disconnect the cable connectors (power & feedback cable) of the servo motor.

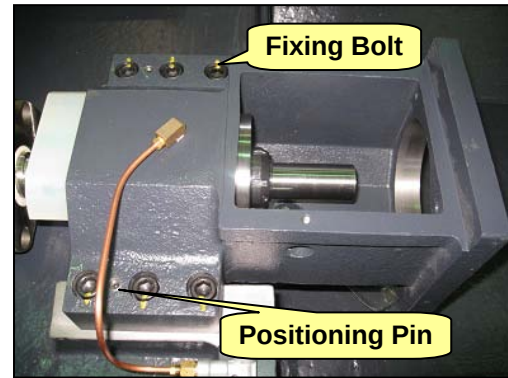


- 7) Loosen R15275 coupling clamp bolt that is closer to the ball screw, loosen the fixing bolts of the servo motor, and remove the motor with care.

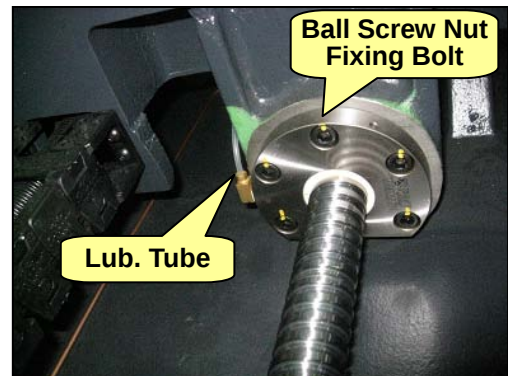


8) Remove the coupling housing.

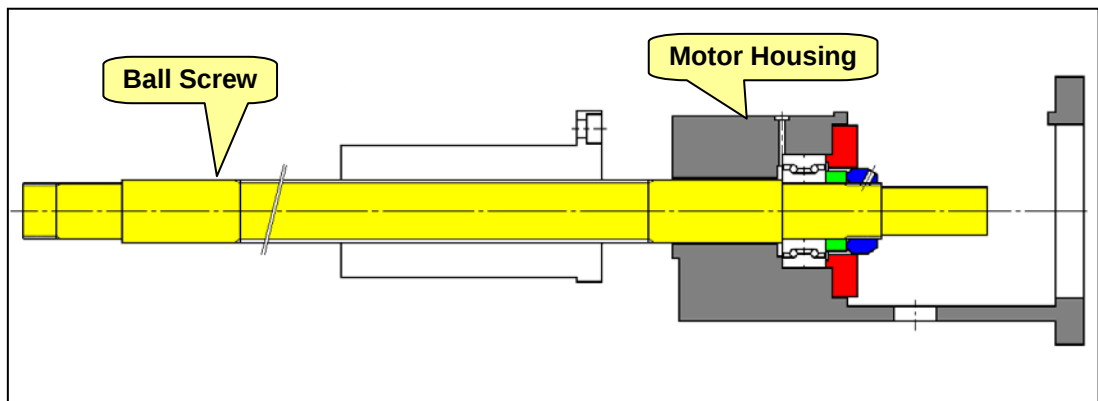
- ① Use the pin puller to remove the positioning pins (2-TPB8×63).
- ② Loosen and remove the fixing bolts (6-BB12×60).



9) Remove the ball screw lubricant tube under the saddle, and loosen the fixing bolts (5-BB10×40) of the ball screw nut.

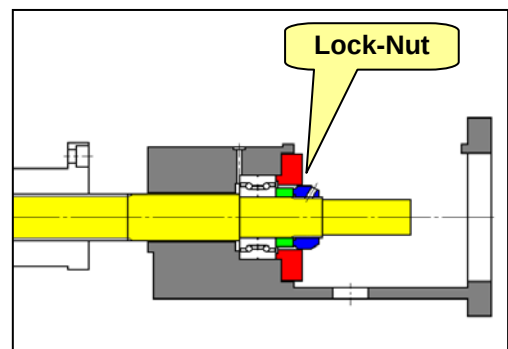


10) Pull out the whole assembly of motor bracket and ball screw from the machine. Care must be taken here.

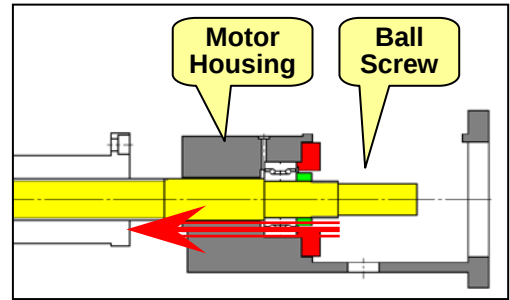


11) Loosen the lock-nuts from the assembly of ball screw and motor housing.

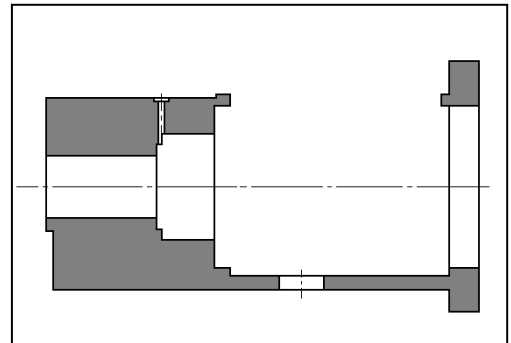
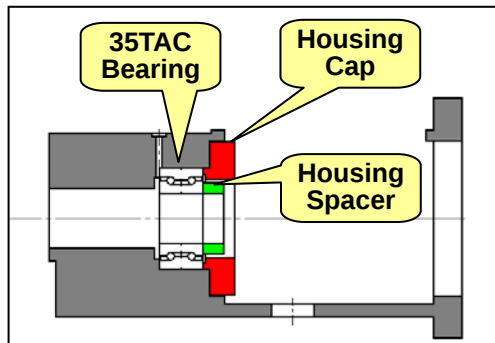
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.



- 12) Remove the ball screw from the motor housing with care.



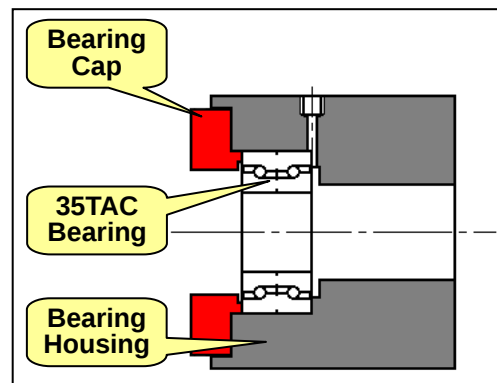
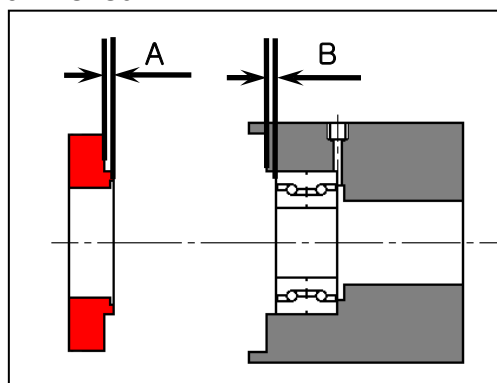
- 13) Remove C72021083 bearing cap fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer, R10090 35TAC angular thrust ball bearing from the motor housing.



2.4 Installing the ball screw on the Y axis

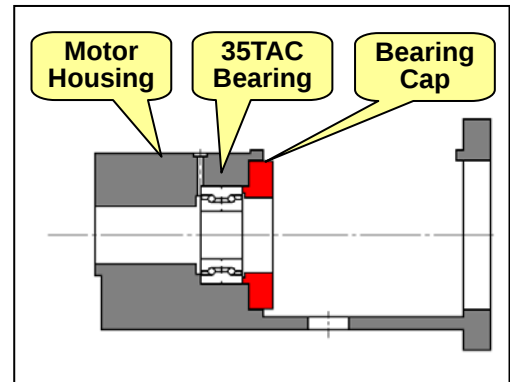
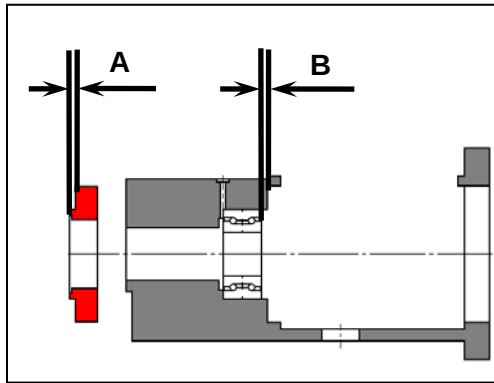
1) Fit the bearing cap of the support housing on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021043A support housing in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
 - ② Measure the depth between end point of the bearing and top section of the bearing housing. ("**B**")
 - ③ Calculate the target size of the sectional depth of C72021083 bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "**A**" = "**B**" + 0.05mm
 - ④ Insert the bearing cap into the bearing housing (where the bearing is inserted).
 - ※ Put force as even as possible to each of the bearing cap bolts.
- 6-BB8×30



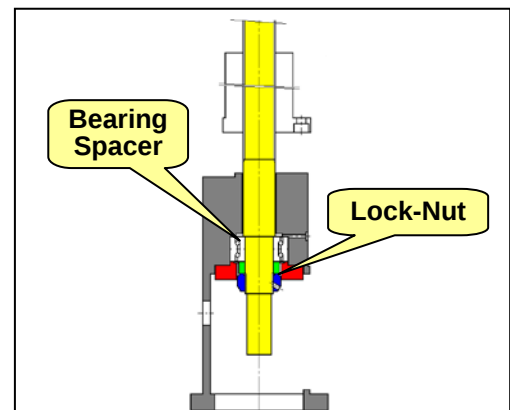
2) Fit the bearing cap of the motor housing on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021052B motor housing in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
 - ② Measure the depth between end point of the bearing and top section of the coupling housing. ("**B**")
 - ③ Calculate the target size of the sectional depth of C72021083 bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "**A**" = "**B**" + 0.05mm
 - ④ Insert the completed bearing cap into the motor housing.
 - ※ Put force as even as possible to each of the bearing cap bolts.
- 6-BB8×30



3) Install the ball screw

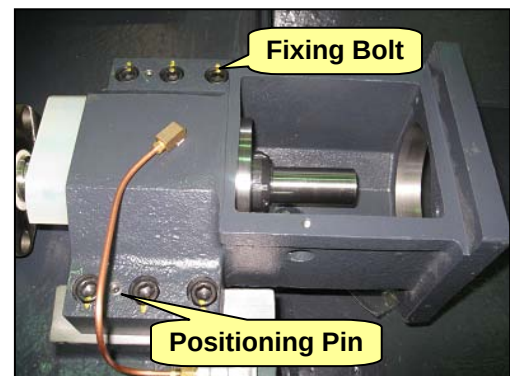
- ① Place C72021052B motor housing (with the bearing inserted) vertically, into which you insert a new ball screw and C72021114A bearing spacer. Then, tighten the lock-nut.
 - To the end, you must solve the runout problem with the ball screw so you just tighten the nut to the full length at this moment.



- ② Insert the assembly of the motor housing combined with the ball screw through the position of the ball screw on the X axis. Care must be taken here.
- ③ Tighten the fixing bolts of the ball screw nut loosely.
 - 5-BB10×40

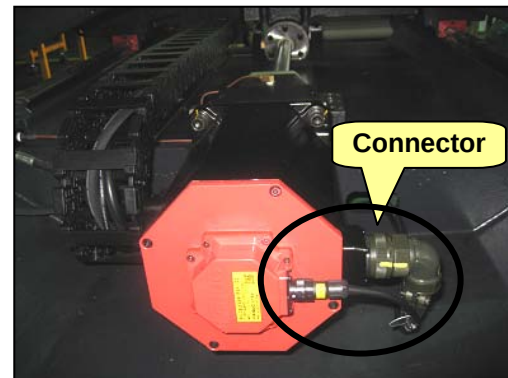


- ④ Tighten the motor housing bolts and insert the positioning pins.
 - 6-BB12×60, 2-TPB8×63



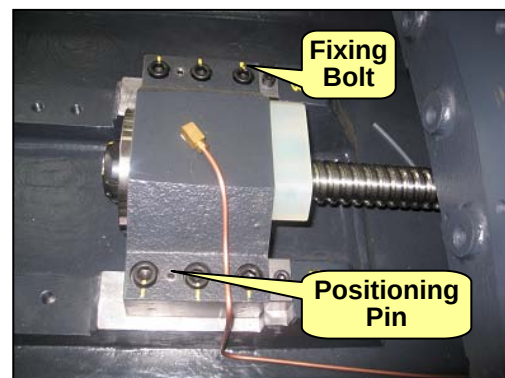
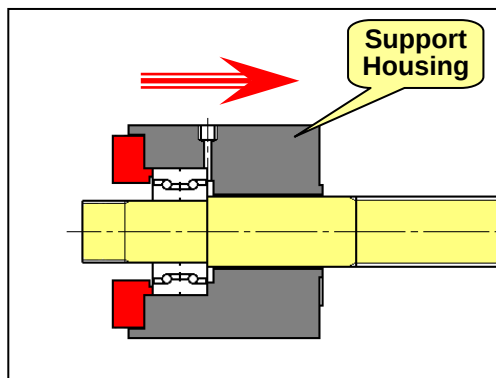
4) Install the servo motor

- ① Insert the Y-axis servo motor (where R15275 coupling is installed) into the ball screw, and tighten the motor fixing bolts.
- ② Turn the ball screw manually to check if the bearing fits. Then, tighten up the clamp bolt of the coupling.
- ③ Connect the power cable and feedback cable of the servo motor.



5) Install the support housing

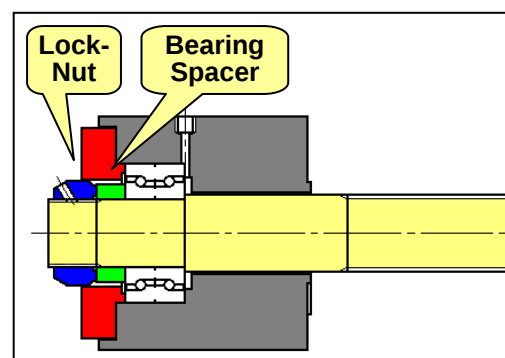
- ① When the servo motor connectors are connected properly, apply power and manipulate the Y axis to move it slowly to the rear of the machine so that you can work on the support housing.
- ② Insert the support housing assembly carefully from the end of the ball screw into the body.
- ③ Install the support housing in the saddle body.
 - 6-BB12×60, 2-TPB8×63



6) Fix the ball screw lock-nut

Insert C72021114A bearing spacer into the end of the ball screw on the support housing, and tighten the lock-nut.

- ※ To the end, you must do the pre-tension work and solve the run-out problem with the ball screw so you just tighten the screw to the full length at this moment.



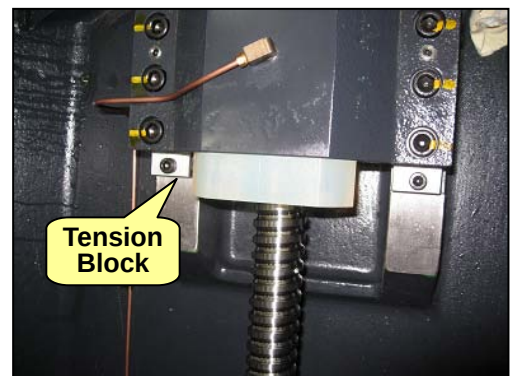
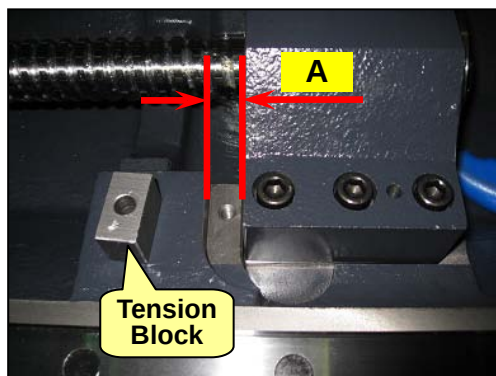
7) Pre-tension on the ball screw

- ① Loosen the lock-nut and use the indicator to set the end of the ball screw and set it to "0".
- ② To minimize the impact, use the spanner. If it is not available, use the chisel and hammer to impact on and tighten up the lock-nut. Then, measure the extended length of the ball screw.
- ③ The target extended length of the ball screw is 0.05 mm, which can be corrected by adjusting C46021074 spacer key in the front of bearing housing.



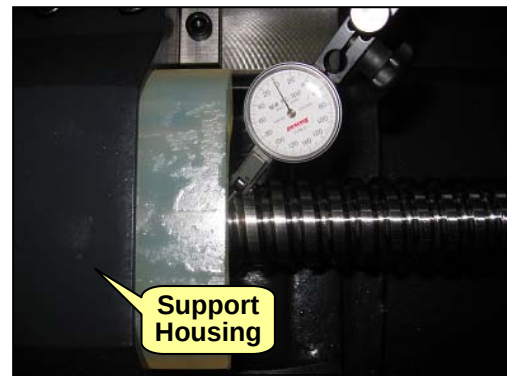
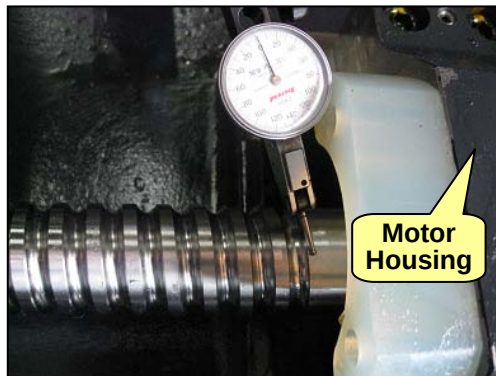
※ How to adjust the tension

- (1) Present another indicator to the ball screw section and set it to "0".
- (2) Loosen the support housing bolts and pull out the positioning pin.
- (3) Refer to the indicator that is installed in the side of the ball screw, and measure the gap of the tension block installation area (gap between section of the support housing and raised spot of the support housing installation area) using the block gauge. ("A")
- (4) Fit the tension block on site.
 - **Target size of the tension block = measurement ("A") + 0.05mm**
- (5) With the lock nut loose, insert the tension block to the end and tighten the support housing bolts.
- (6) Refer to step 7) above to check if you can get the right pretension value.
- (7) If you get the right result, perform reaming again of the place of the bearing housing positioning taper pin before inserting the taper pin.



8) Runout on the ball screw

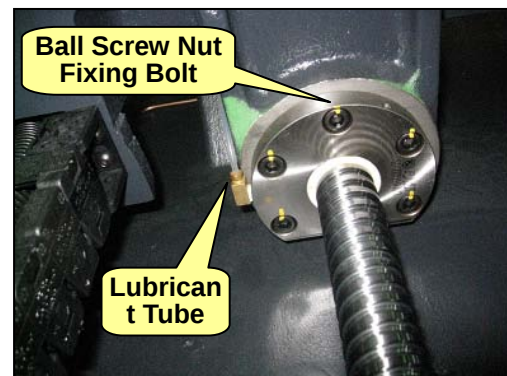
- ① Install the indicator and present the gauge to the top area (free of the screw thread) of the ball screw.
- ② While rotating the ball screw, read the runout value of the indicator, and impact on and fix the lock-nut using the chisel at the highest value of the run-out.
- ③ If the runout value of the ball screw goes below 0.005 mm, tighten up the set-screw for locking the lock-nut.



9) Fix the ball screw nut

Complete installing the ball screw nut that were attached temporarily for alignment.

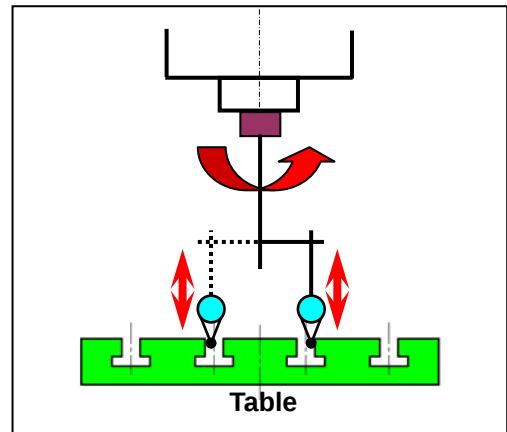
- ① Move the Y axis to "Y0".
- ② Put force as even as possible to each bolt until you tighten them up finally.
 - Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.
- ③ Connect the cooling lubricant tube back to the original.



※ If you had loosened the Y-axis ball screw or removed the servo motor and re-installed either one, you must reset the reference point of the Y axis.

※ Resetting the reference point for the Y axis

Since DNM 500 table has no center bush at the center and the number of T holes is even, use two T holes in the center to figure out the center of the Y axis.

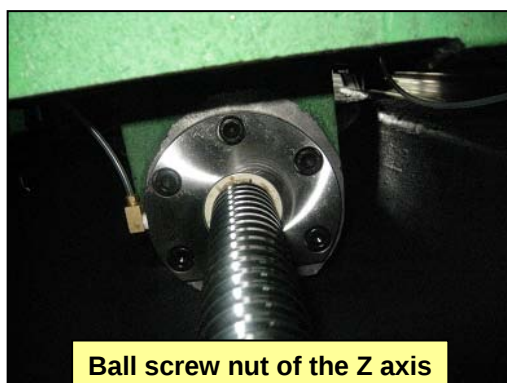
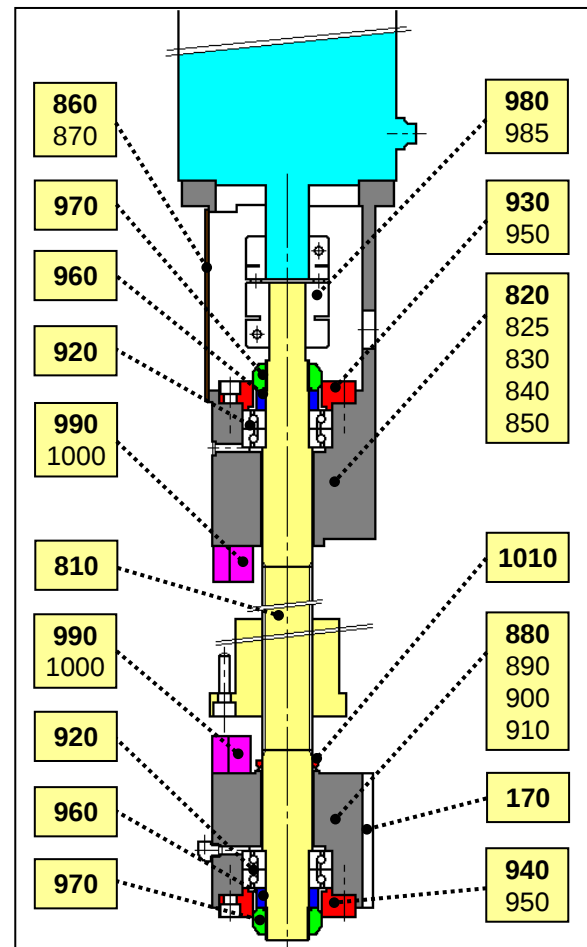
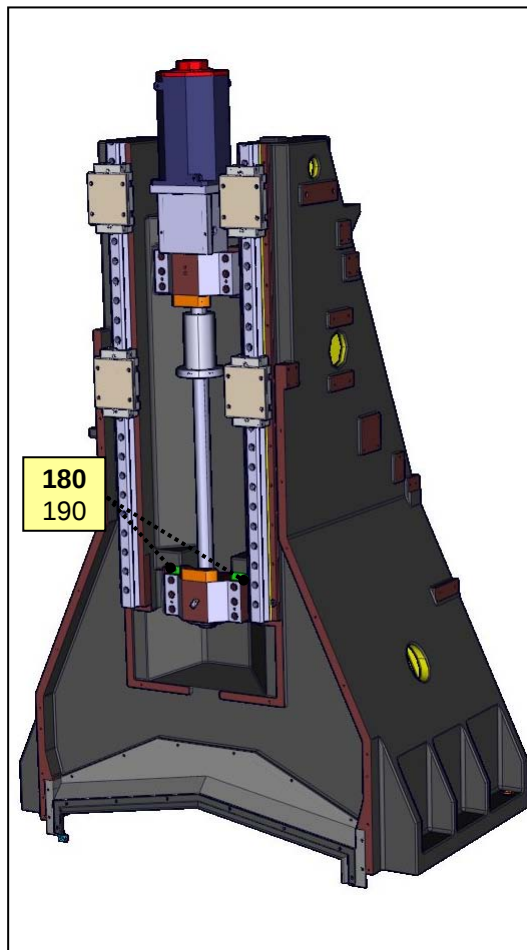


- 1) Install the indicator on the spindle and move it to the approximate center (Y270.) of the Y-axis stroke. Set the gauge at the side of T hole. While manually rotating the spindle left or right little by little, check the highest point along the side line of T hole that the indicator contacts, and set the indicator to "0".
- 2) Move up the Z axis in handle mode to get out from T hole. Rotate the spindle by 180 degrees with one hand to position the indicator to the opposite T hole. Then, move down the Z axis to enter the T hole.
- 3) While manually rotating the spindle left or right, move the Y axis little by little to check the highest point along the side line of T hole that the indicator contacts, and set the indicator to "0".
- 4) Check the Y-axis machine position (coordinates) on the main OP, calculate the difference from 270.000 (median of Y-axis stroke) and move the Y axis by half of the difference in handle mode.
- 5) Then again, while manually rotating the spindle left or right little by little (after adjusting the indicator), check the highest point along the side line of T hole that the indicator contacts, and set the indicator to "0".
- 6) Move up the Z axis in handle mode to get out from T hole. Rotate the spindle by 180 degrees with one hand to position the indicator to the opposite T hole. Then, move it down to enter the T hole. While manually rotating the spindle left or right little by little, check if the highest point along the side line of T hole that the indicator contacts is set to "0" on the indicator.
 - If it fails, repeat the steps above to rotate the spindle by 180 degrees so that both sides of the Y axis should be set to "0".
- 7) Check the machine position (coordinates) on the CRT monitor, and move the Y axis by 270mm (half of the Y-axis stroke) in "-" direction in handle mode.

- From the main OP, press **[POS.] → [RELATIVE] → [(OPRT)] → [ORIGIN] → “Y” → [EXEC]** in sequence and switch the Y-axis relative position to "0.000". It is convenient for you to move the Y axis to the point of "-270.000".

8) Switch b4(APZ) of parameter #1815 Y from “1” → “0”. (The **“PW0000 POWER MUST BE OFF”** alarm will occur on the screen) Then, switch b4(APZ) of parameter #1815 Y from “0” back to → “1” and turn Power Off → Power On. This is the completion of resetting the Y-axis reference point.

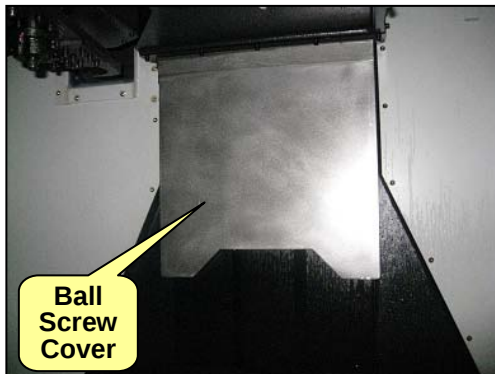
※ Parts List of the Z Axis



No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
170	C72021094A	Spacer	SS400	2	
180	C46021074	Spacer Key	SM45C	2	
190	S2209361	Hex. Socket Head Bolt	BB8×35	2	
810	C72031033B	Ball Screw (DNM500.Z)	R40-12E2-FSWE-726-1193-0.008	1St	
820	C72031072B	Coupling Box	GC250	1	Fanuc
825	C72028112	Coupling Box	GC250	1	Heidenhain
830	S2215861	Hex. Socket Head Bolt	BB12×60	6	
840	P51400012	Conical Washer	ZC12	6	
850	P57210063	Taper Pin (W/Tap)	TPB10×63	2	
860	C72021104A	Motor Housing Cover	SCP1	1	
870	R01023	Machine Screw	BC5×12 (PICR3)	2	
880	C72021043A	Support Housing	GC250	1	
890	S2215861	Hex. Socket Head Bolt	BB12×60	6	
900	P51400012	Conical Washer	ZC12	6	
910	P57210063	Taper Pin (W/Tap)	TPB10×63	4	
920	R10090	Ang. Thrust Ball Bearing	35TAC72BDBC10PN7A	2	
930	C72031083A	Bearing Cap	SM45C	1	
940	C72021083	Bearing Cap	SM45C	1	
950	S2209261	Hex. Socket Head Bolt	BB8×30	12	
960	C72021114A	Bearing Spacer	SM45C	2	
970	R02124	Lock Nut	DKMT35	2	
980	R08158A	Coupling (R08158)	Rolex GS 28 (35/30)	1St	Fanuc
985	R15314	Heidenhain Coupling	Rolex GS 20 (32/30)	1St	Heidenhain
990	C46021483A	Cushion Stopper	Urethane	2	
1000	S2203761	Hex. Socket Head Bolt	BB5×30	4	

2.5 Disassembling the ball screw on the Z axis

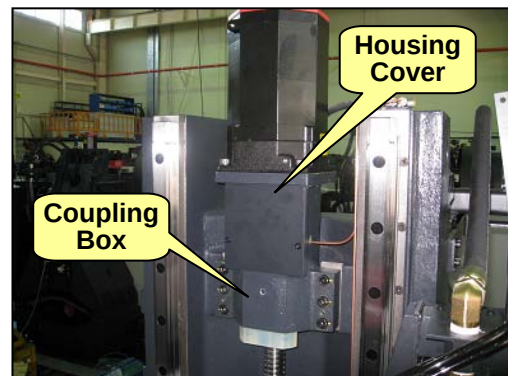
- 1) While moving up and down the Z axis in handle mode, remove the Z-axis ball screw cover as well as head cover.



- 2) Move the Z axis as down as possible to secure room for work on the bearing housing, and insert a hard wood support between spindle head and table lest that the spindle head falls down when disassembling the ball screw. Turn off the power.

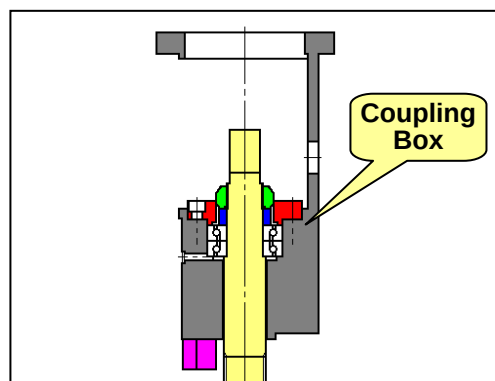
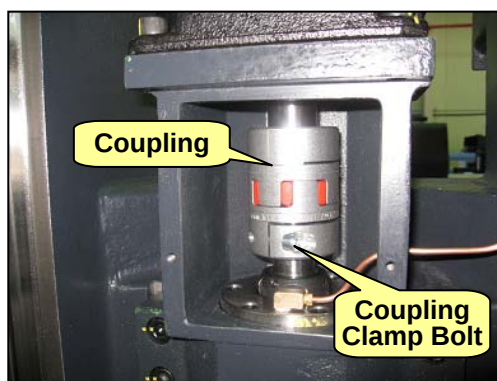


- 3) Remove C72021104A motor housing cover from C72031072B coupling box.
 - 2-BC5×12

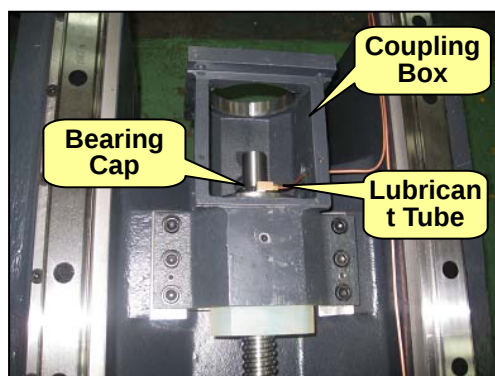


- 4) Remove the Z-axis servo motor.

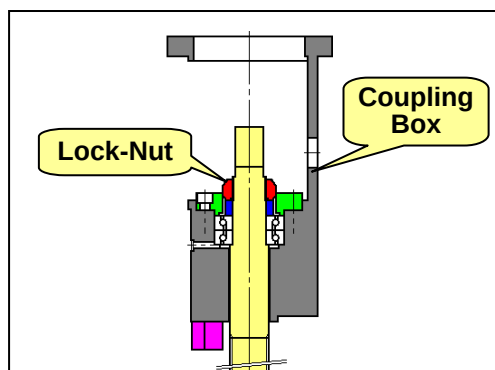
- ① Unplug all connectors (such as feedback cable and brake cable) from the Z-axis servo motor. Put them aside.
- ② Loosen R08158A coupling fixing bolts closer to the ball screw.
 - Before loosening all of the coupling fixing bolts, you must ensure that the wood support is securely inserted between spindle head and table.
- ③ Loosen the bolts on the servo motor, and remove the motor with care, which is mounted on the coupling.



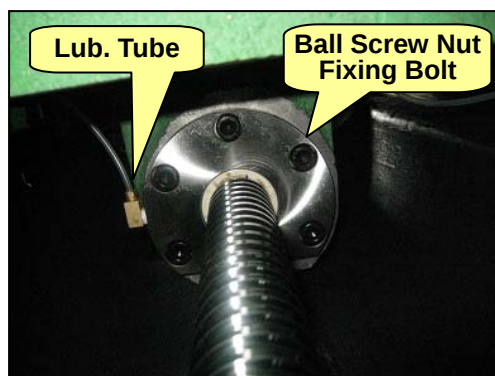
- 5) Disconnect the lubricant tube from the bearing cap of the coupling box.



- 6) Remove the lock-nut from C72021043A support housing.
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.

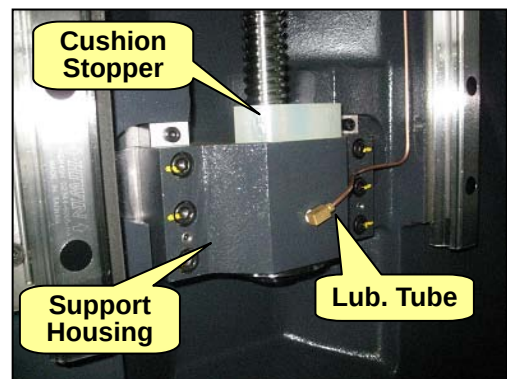


- 7) Remove the lubricant tube from the ball screw nut, and loosen the fixing bolts (5-BB10×40) on the ball screw nut.

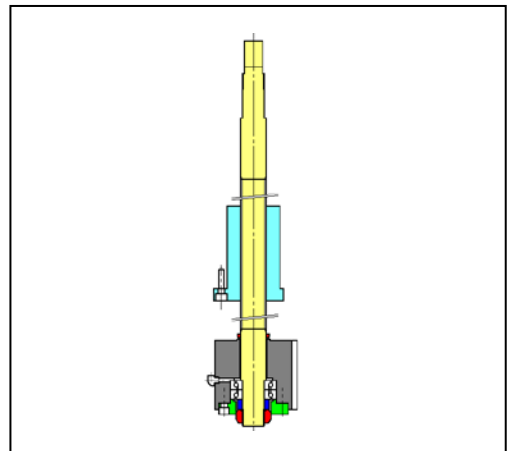


8) Remove the support housing.

- ① Disconnect the lubricant tube from the support housing.
- ② Use the pin puller to remove the positioning pins (2-TPB8×63).
- ③ Loosen and remove the fixing bolts (6-BB12×60).
 - ※ Hold tight the ball screw when loosening bolts on the ball screw because it may hang loose due to its weight.

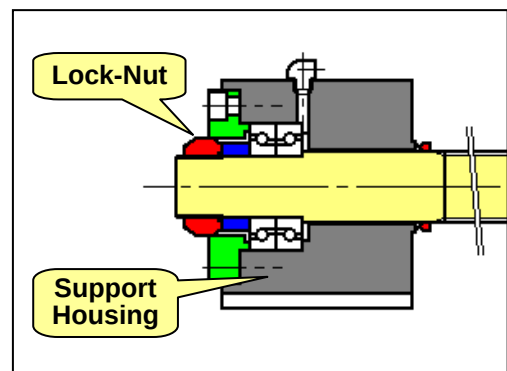


9) Remove the ball screw assembly through under the spindle head with care and take it out from the machine.

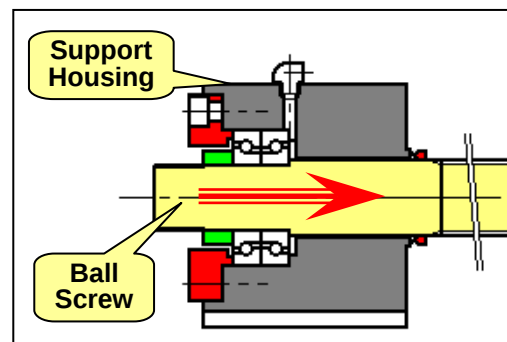


10) Remove the ball screw lock-nut from the assembly of ball-screw and C72021043A support housing (already taken out).

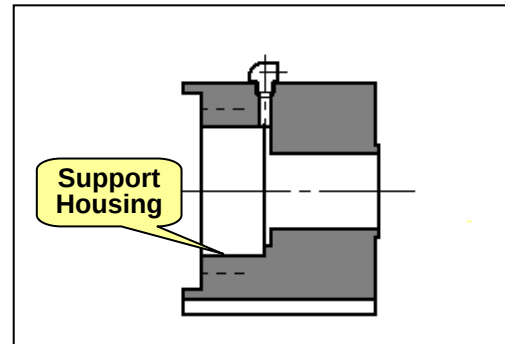
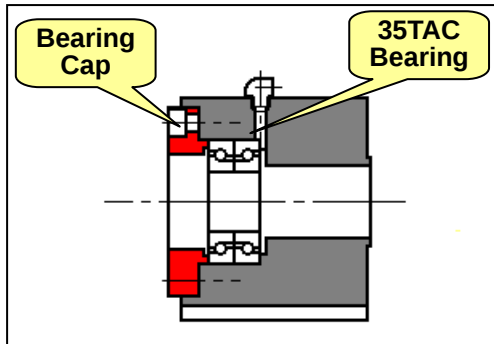
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the hook spanner that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. Be careful not to damage the lock-nut.



11) Remove the ball screw from the support housing with care.

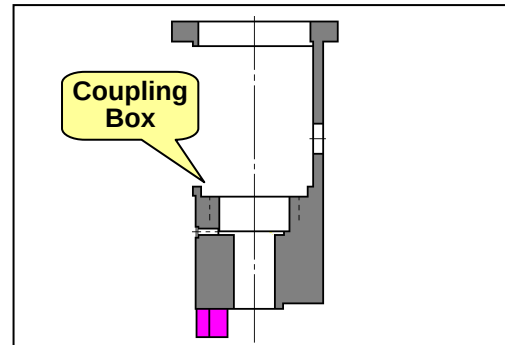
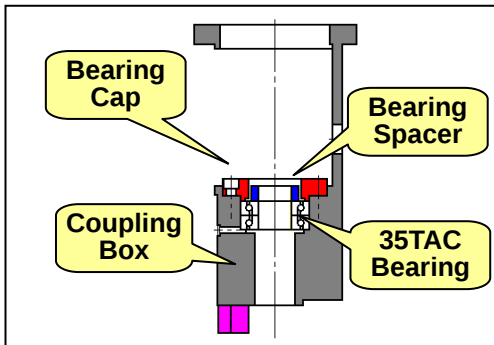


- 12) Remove C72021083 bearing cap fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer, and R10090 35TAC ball bearing from the support housing.



- 13) Remove C72021083 bearing cap fixing bolts (6-BB8×30), bearing cap, C72021114A bearing spacer and R10090 35 bearing from the coupling box.

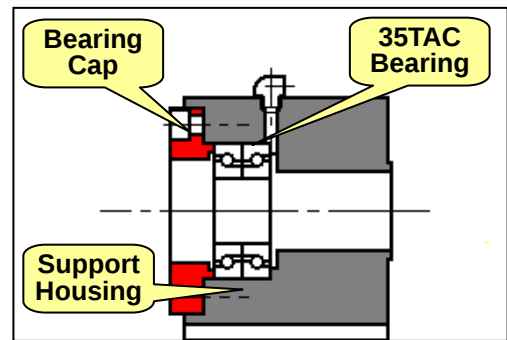
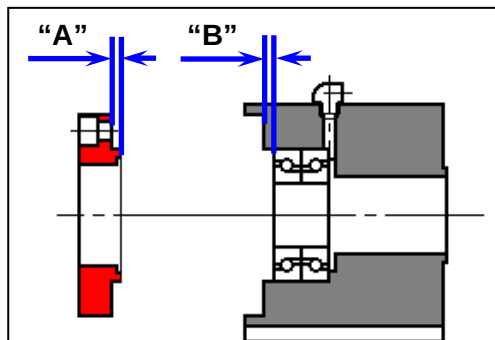
※ It may be easier to remove the bearing as a whole without removing the coupling box from the column.



2.6 Install the ball screw on the Z axis

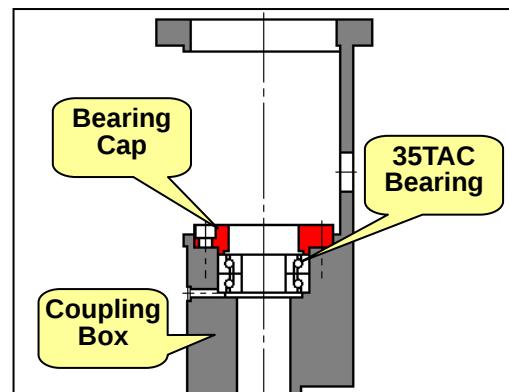
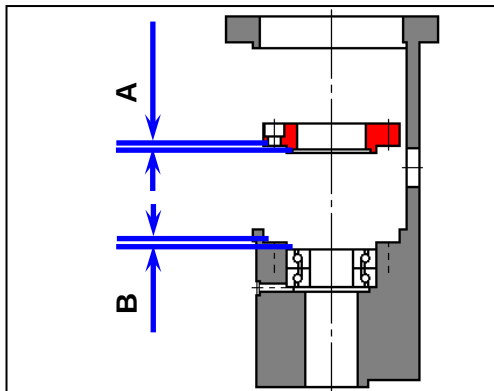
1) Fit the bearing cap of the support housing on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021043A support housing in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
 - ② Measure the depth between end point of the bearing and top section of the bearing housing. ("**B**")
 - ③ Calculate the target size of the sectional depth of C72021083A bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "**A**" = "**B**" + 0.05mm
 - ④ Insert the bearing cap into the bearing housing (where the bearing is inserted).
 - ※ Put force as even as possible to each of the bearing cap bolts.
- 6-BB8×30



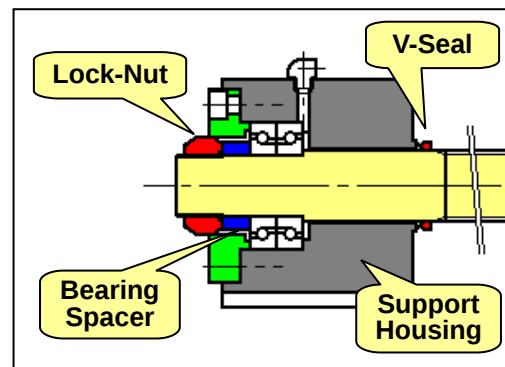
2) Fit the bearing cap of the coupling box on site

- ① Install R10090 angular thrust ball bearing (35TAC72BDBC10PN7A) into C72021072B coupling box in the right direction.
 - ※ Align with the "V" line in the outer race of the bearing.
 - ② Measure the depth between end point of the bearing and top section of the coupling box. ("B")
 - ③ Calculate the target size of the sectional depth of C72021083 bearing cap before fitting it on-site.
 - ※ Sectional target size of the bearing cap "A" = "B" + 0.05mm
 - ④ Install the completed bearing cap into the bearing-installed coupling box.
 - ※ Put force as even as possible to each of the bearing cap bolts.
- 6-BB8×30

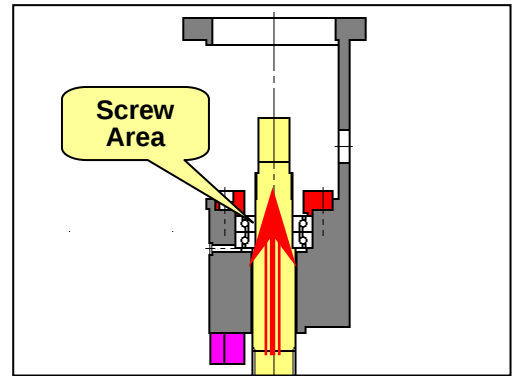
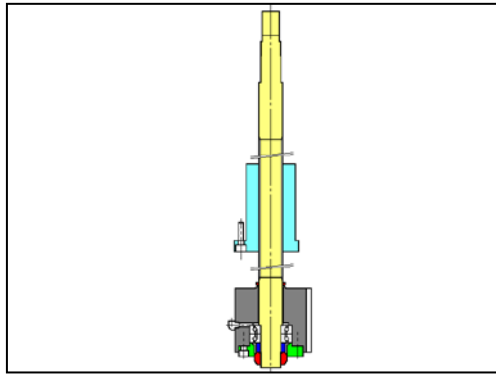


3) Install the ball screw

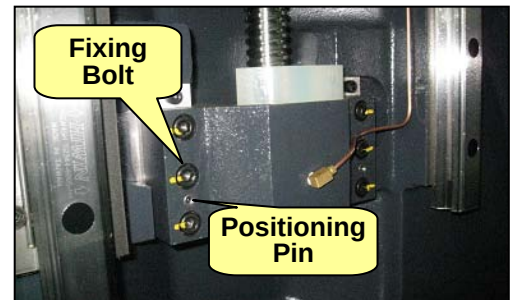
- ① Insert the bearing-installed C72021043A support housing into a new ball screw (with R55420 V-seal already applied) with care. Then, insert C72021114A bearing spacer and tighten the lock-nut.
 - To the end, you must solve the runout problem with the ball screw so you just tighten the nut to the full length at this moment.



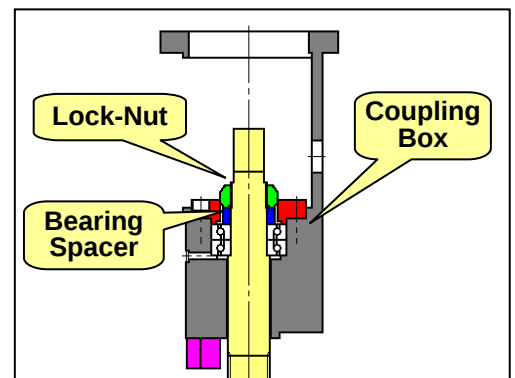
- ② With care, push in the assembly of ball screw and support housing from under the spindle head through the Z-axis ball screw place.
 - ※ When installing the ball screw in the upper coupling box, take caution lest that either end (screw places) of the ball screw get scratched.



- ③ Tighten the support housing bolts and insert the positioning pins.
- 6-BB12×60, 2-TPB10×63



- ④ Insert C72021114A bearing spacer into the end of the ball screw on the upper coupling box, and tighten the lock-nut.
- ※ To the end, you must solve the run-out problem with the ball screw so you just tighten the screw to the full length at this moment.



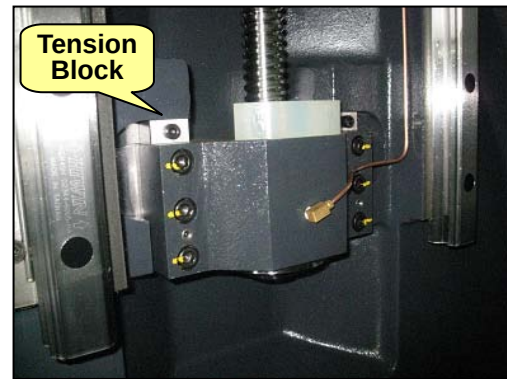
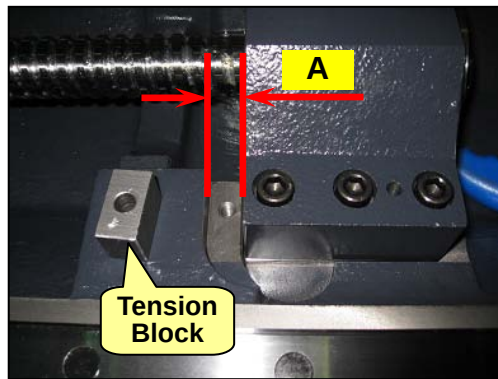
4) Pre-tension on the ball screw

- ① Loosen the lock-nut and use the indicator to set the end of the ball screw and set it to "0".
- ② To minimize the impact, use the spanner. If it is not available, use the chisel and hammer to impact on and tighten up the lock-nut. Then, measure the extended length of the ball screw.
- ③ The target extended length of the ball screw is 0.05 mm, which can be corrected by adjusting C46021074 spacer key in the front of bearing housing.



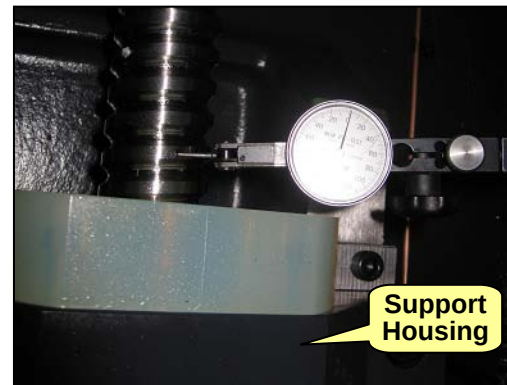
※ How to adjust the tension

- (1) Present another indicator to the ball screw section and set it to "0".
- (2) Loosen the support housing bolts and pull out the positioning pin.
- (3) Refer to the indicator that is installed in the side of the ball screw, and measure the gap of the tension block installation area (gap between section of the support housing and raised spot of the support housing installation area) using the block gauge. ("A")
- (4) Fit the tension block on site.
 - **Target size of the tension block = measurement ("A") + 0.05mm**
- (5) With the lock nut loose, insert the tension block to the end and tighten the support housing bolts.
- (6) Refer to step 4) above to check if you can get the right pretension value.
- (7) If you get the right result, perform reaming again of the place of the bearing housing positioning taper pin before inserting the taper pin.



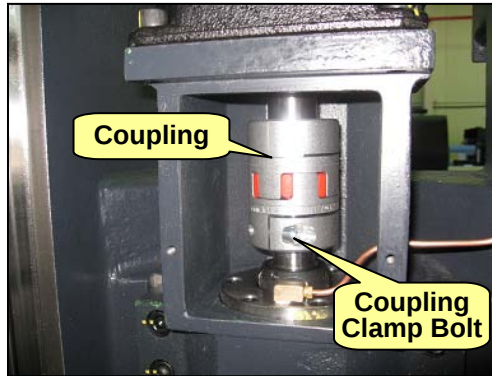
5) Runout on the ball screw

- ① Install the indicator and present the gauge to the top area (free of the screw thread) of the ball screw.
- ② While rotating the ball screw, read the runout value of the indicator, and impact on and fix the lock-nut using the chisel at the highest value of the run-out.
- ③ If the runout value of the ball screw goes below 0.005 mm, tighten up the set-screw for locking the lock-nut.



6) Install the servo motor

- ① Insert the Z-axis servo motor (where R15275 coupling is installed) into the ball screw.
- ② Manually turn the servo motor left and right to check if the coupling fits into the ball screw. Then, tighten the motor fixing bolts.
- ③ Tighten up the clamp bolt on the coupling.
- ④ Connect the power cable and feedback cable of the servo motor.



7) Fix the ball screw nut

- ① Turn the Z-axis ball screw nut manually, or apply power and move up the Z axis in handle mode to the installation area of the spindle head. Then, tighten the fixing bolts loosely.
- ② Move up the Z axis in handle mode to remove the wood support under the spindle head.
- ③ Complete installing the ball screw nut.

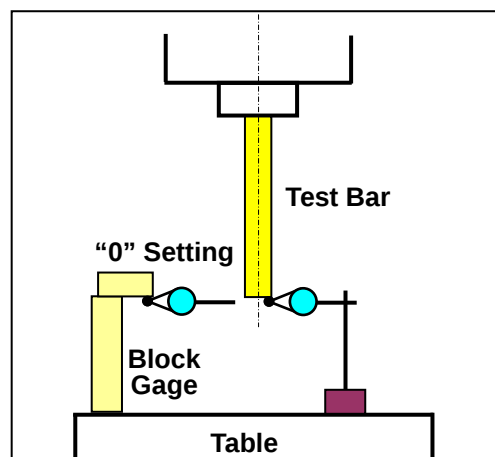
※ **Ball screw nut completion**

- (1) Move up the Z axis to the end of the Z-axis stroke (Z510.).
- (2) Put force as even as possible to each bolt until you tighten them up finally.
 - Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.
- (3) Connect the cooling lubricant tube back to the original.

- ※ If you had loosened the Z-axis ball screw or removed the servo motor and reassembled either one, you must reset the reference point of the Z axis.

※ Resetting the reference point for the Z axis

- 1) Insert the test bar in the spindle, place the block gauge (approx. 100mm) down the bar and set the indicator to 0.
- 2) In handle mode, move the Z axis so that the end of the test bar contacts on the indicator (this will set the indicator to 0).
- 3) Refer to the following formula to calculate the difference from "Z0".



▪ **Length of Test Bar + Height of Block Gauge - 150**

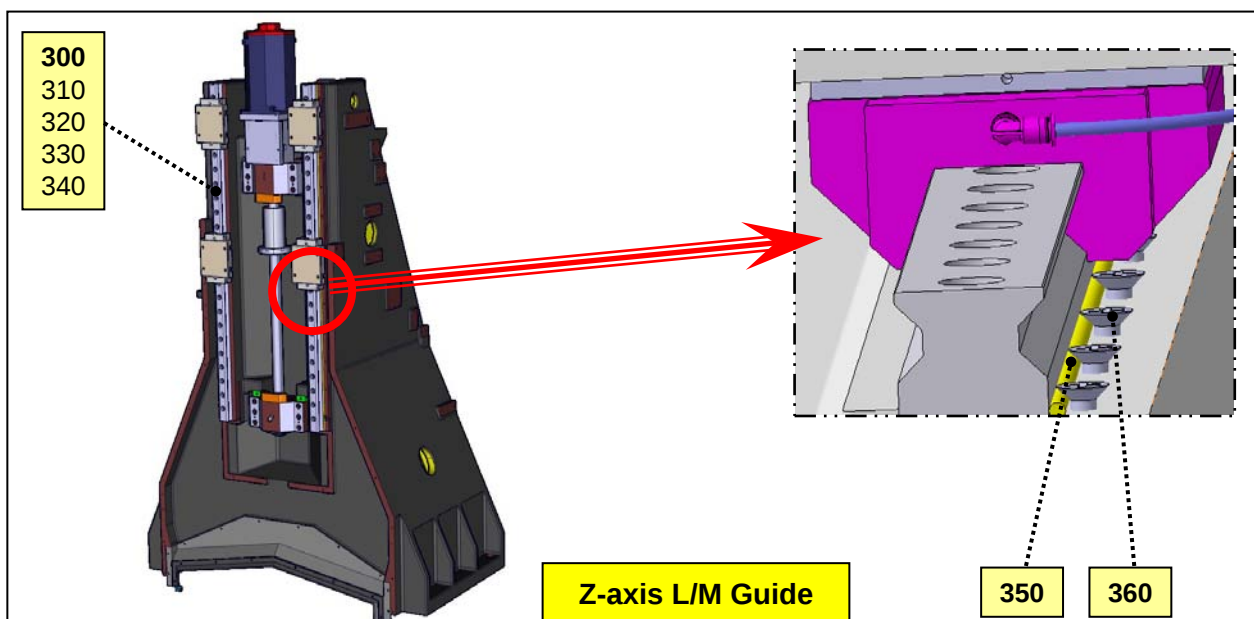
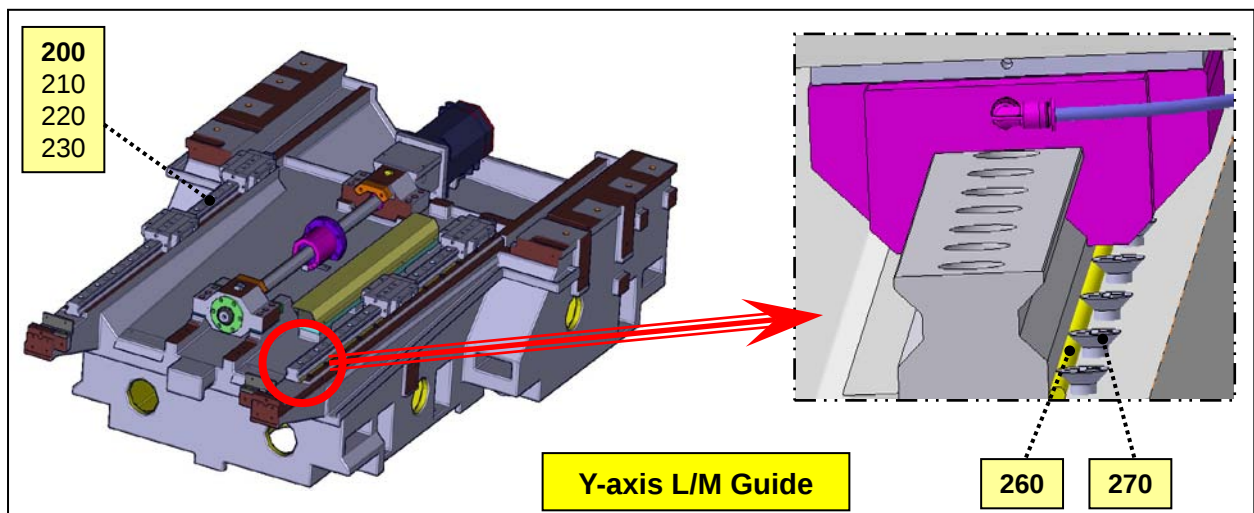
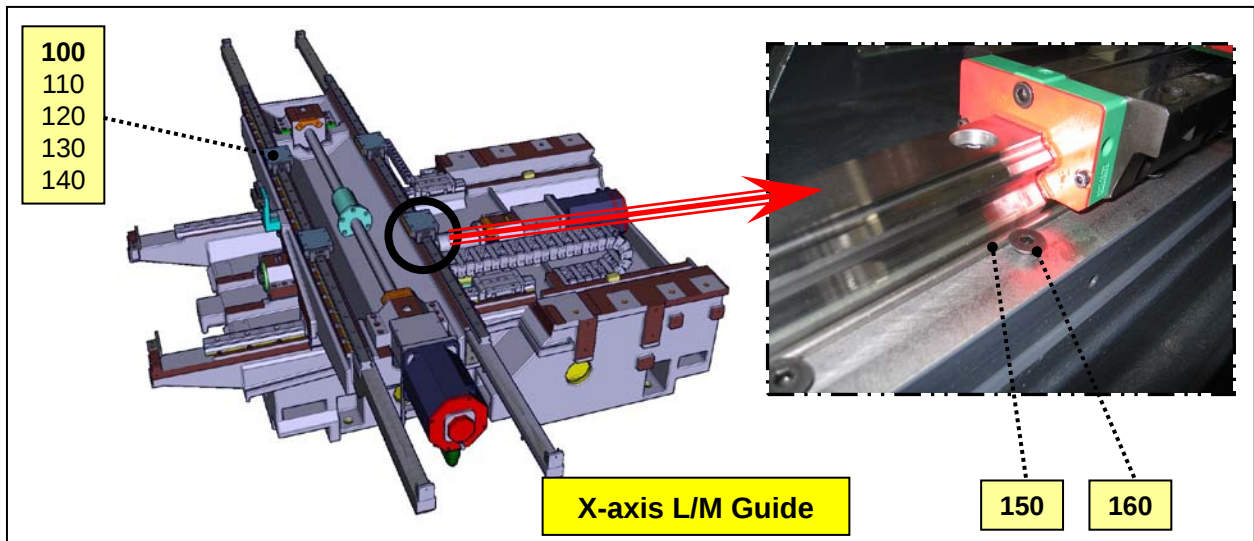
- DNM 500 will settle at "Z0" if the distance between table deck and spindle tool gauge line is 150mm.

Ex) If block gage : 100mm and test bar : 310mm, then $310 + 100 - 150 = 260$

In this case, the current Z-axis machine position PLUS -260.000 shall be the "Z0" position.

- 4) Check the machine position (coordinates) on the CRT monitor, and move down the Z axis by the above calculation in handle mode.
 - From the main OP, press **[POS.] → [RELATIVE] → [(OPRT)] → [ORIGIN] → "Z" → [EXEC]** in sequence and switch the Z-axis relative position to "0.000". It is convenient for you to move the Z axis down to a desired position.
- 5) Switch b4(APZ) of parameter #1815 Z from "1" → "0". (The **"PW0000 POWER MUST BE OFF"** alarm will occur) Then, switch b4(APZ) of parameter #1815 Z from "0" → back to "1" and turn Power Off → Power On. This is the completion of resetting the Z-axis reference point.

3. Aligning LM guide



No.	Parts No.	Description	Material / Specification	Q'ty	Remarks
100	C72022011A	LM Guide(DNM500 X)	HGW35HB2R1980ZBH II	1PR	
110	S2212061	Hex. Socket Head Bolt	BB10×25	16	
120	S2209461	Hex. Socket Head Bolt	BB8×40	48	
130	C46021103A	Spacer	SS41	4	
140	C46021154	Spacer	SS41	2	
150	C72022203	Guide Bar	SS400	2	
160	R00332	2.Tone.Co.Machine Screw	BNH8×15	44	
200	C72021073	LM Guide(DNM500 Y)	HGW45HB2R1250ZAH II	1PR	
210	S2215561	Hex. Socket Head Bolt	BB12×45	26	
220	S2212061	Hex. Socket Head Bolt	BB10×25	16	
230	C46021174	Spacer	SS41	2	
240	C72031133	Guide Bar	SS400	2	
250	R00332	2.Tone.Co.Machine Screw	BNH8×15	24	
260	C72031133	Guide Bar	SS400	2	
270	R00332	2.Tone.Co.Machine Screw	BNH8×15	24	
300	C72031043	LM Guide(DNM500 Z)	HGW45HC2R1250ZAH II	1PR	
310	S2215561	Hex. Socket Head Bolt	BB12×45	26	
320	S2212061	Hex. Socket Head Bolt	BB10×25	16	
330	C46021093B	Spacer	SS41	4	
340	C46021174	Spacer	SS41	2	
350	C72031133	Guide Bar	SS400	2	
360	R00332	2.Tone.Co.Machine Screw	BNH8×15	24	

3.1 Assembling LM guide

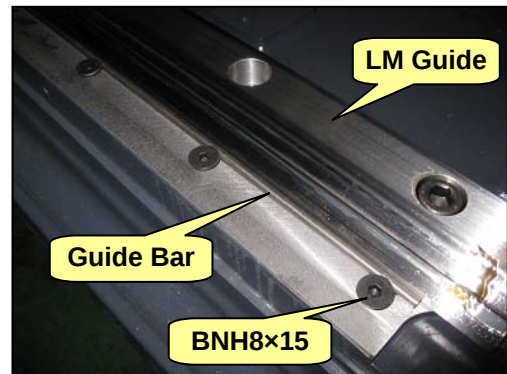
1) Smooth the installation area of LM guide

- ① Use the sandpaper or oilstone to smooth the installation area (bottom and side reference line) of LM guide. Get rid of rust, uneven surface areas, scratches, etc.
- ② Use the compressed air to blow away the dust inside the tap place.
- ③ Thoroughly remove residues with a cloth and apply oil thinly to the surface.



2) Install LM guide

- ① Remove the protective plastic from a new LM guide.
- ② Check the mark on the deck of LM guide, and place it down along the side reference line.
- ③ Insert a fixing bolt into the bolt hole in either end, and slightly move the guide left and right to fit the center of both bolts. Then, tighten them loosely.
- ④ Place C72022203 guide bar in the opposite side of the side reference line before aligning with each other. Insert and tighten all of BNH8×15 bolts loosely.
- ⑤ Insert and tighten all fixing bolts of LM guide loosely.



3) Fix the reference LM guide

- ① Tighten the LM guide fixing bolts with 1/3 of full torque.
 - ※ Tighten the center bolt at first and proceed with next ones one after another, from center to endmost. The bolts in either ends will be the last in line.
- ② Follow the instruction above to tighten up the guide bar fixing bolts.

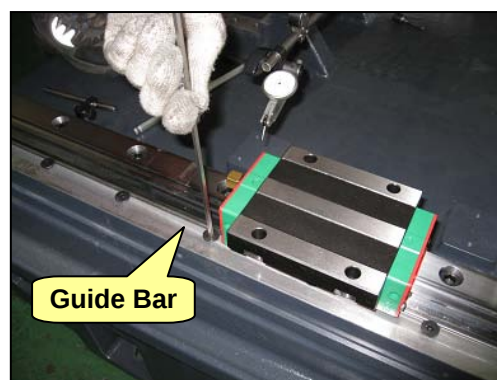
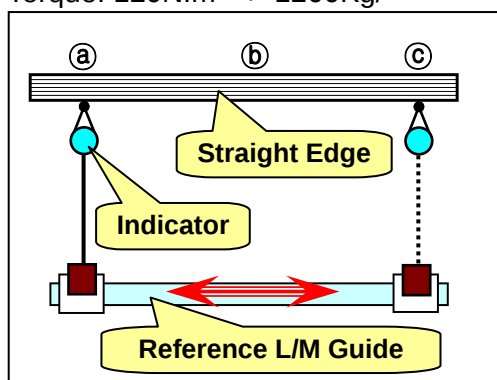


- ③ Use a torque wrench to apply even force to each of the bolts.
 - Torque: $120\text{N.m} \div 1200\text{Kg/cm}^2$

3.2 Aligning LM guide

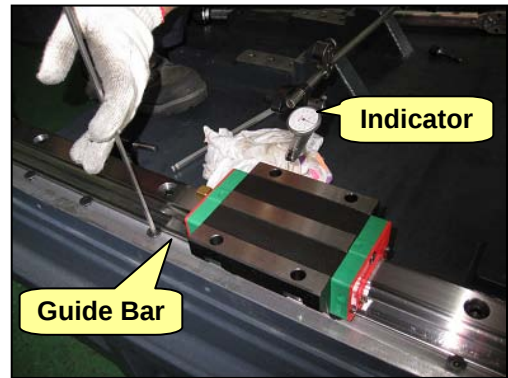
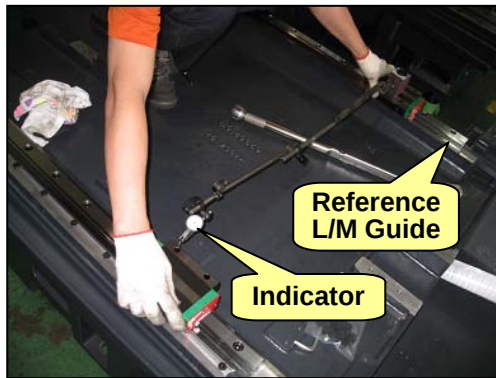
1) Align the reference L/M guide (check and correct the straightness)

- ① Place the straight edge on the reference L/M guide and set the indicator (installed on the reference L/M guide block) to "0" at either ends (a - c) of the straight edge based on the reference L/M guide.
- ② While moving the L/M guide block to measure the straightness of the reference L/M guide based on the straight edge. If the measurement is more than 0.01mm/full stroke, loosen the L/M guide bolt slightly and use the guide bar bolt to correct the straightness of L/M guide.
 - Target straightness : 0.01mm / full stroke
- ③ If the straightness of L/M guide falls below the target in full stroke, use the torque wrench to tighten all the fixing bolts with even force.
 - Torque: $120\text{N.m} \div 1200\text{Kg/cm}^2$



2) Align L/M guide (check and correct the parallelism)

- ① Install the indicator on the reference L/M guide block (with the straightness corrected) and set it to "0" at a side of the relative L/M guide block.
- ② While moving both L/M guide blocks simultaneously, measure the parallelism between the two L/M guides. If the measurement is more than 0.01mm/full stroke, loosen the opposite L/M guide bolts slightly and use the guide bar fixing bolt to correct the parallelism between the two.
 - Target parallelism: 0.01mm / full stroke
- ③ If the parallelism between two L/M guides falls below the target, use the torque wrench to tighten all the fixing bolts with even force.
 - Torque: $120\text{N.m} \div 1200\text{Kg/cm}^2$



3.3 Insert the L/M guide bolt cap

When L/M guide is installed completely, insert the L/M guide bolt cap.

- 1) Insert only the specified cap into each bolt hole.



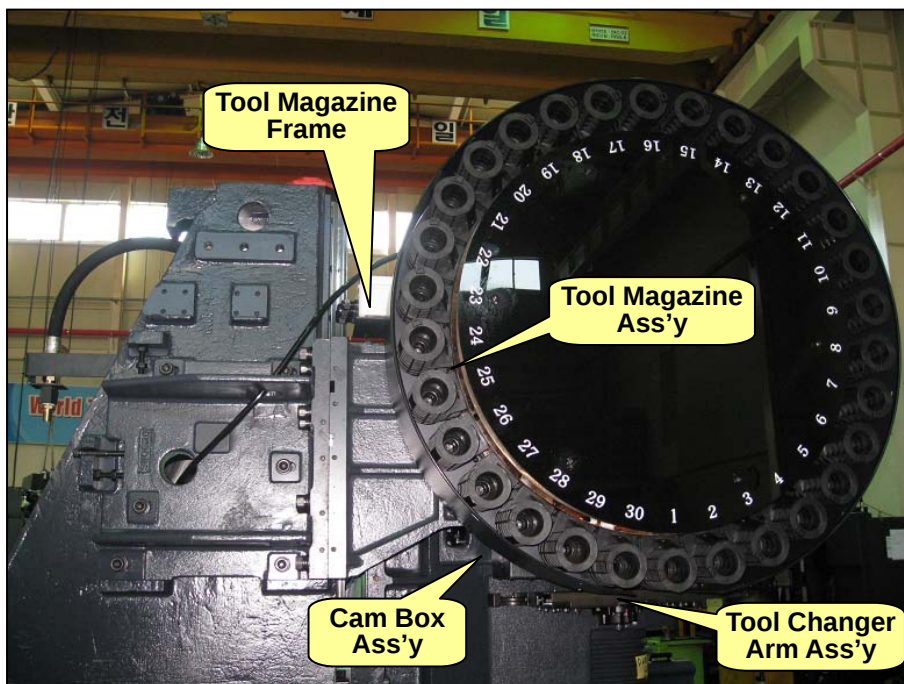
- 2) Place a plastic or acrylic block on the caps in parallel with L/M guide. Gently impact on the block until the cap heads align with L/M guide.



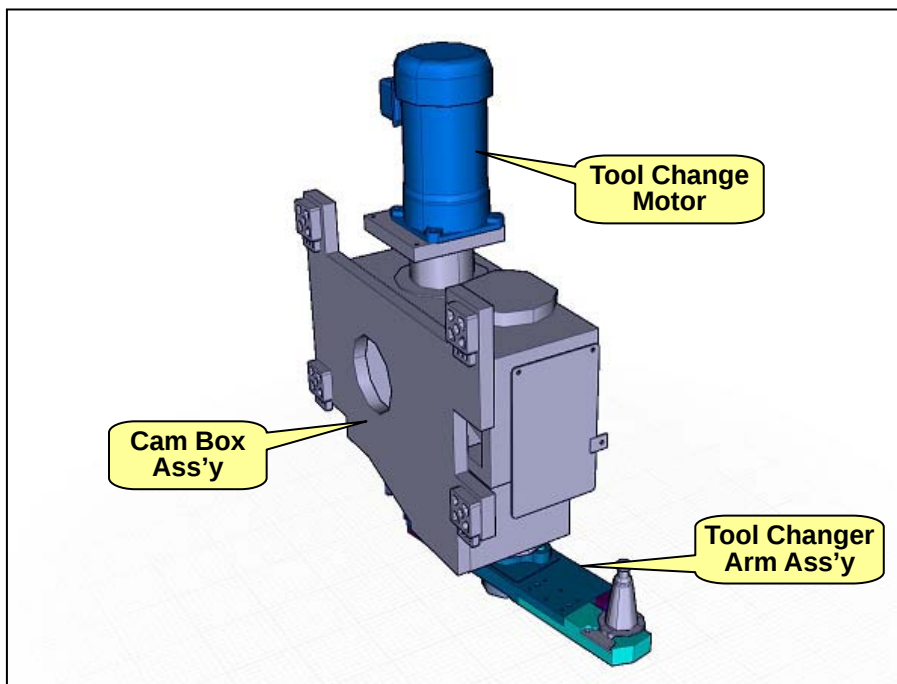
4. ATC (Automatic Tool Changer)

4.1 ATC Components

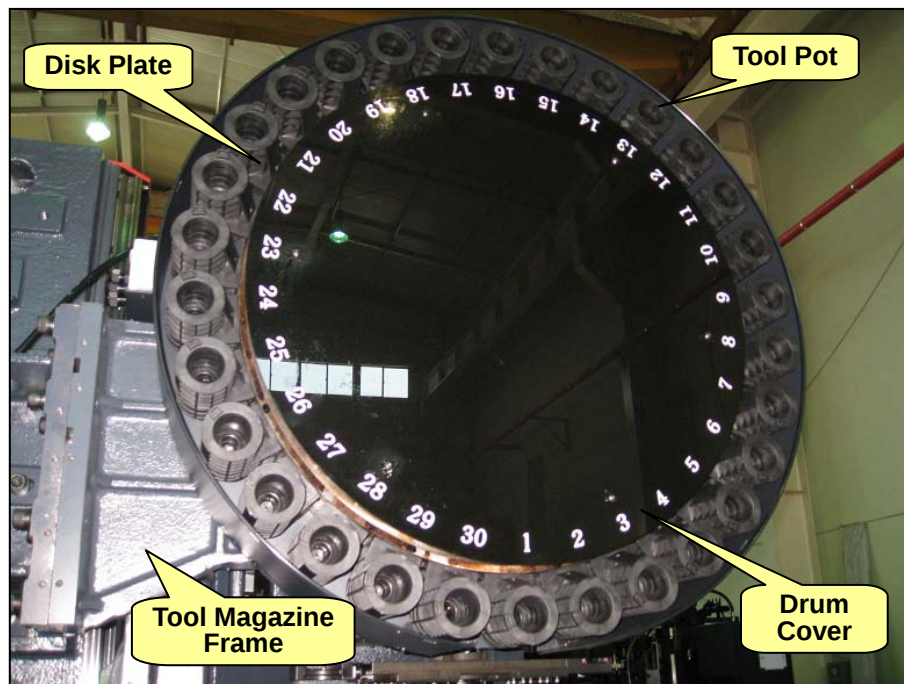
1) Overall structure



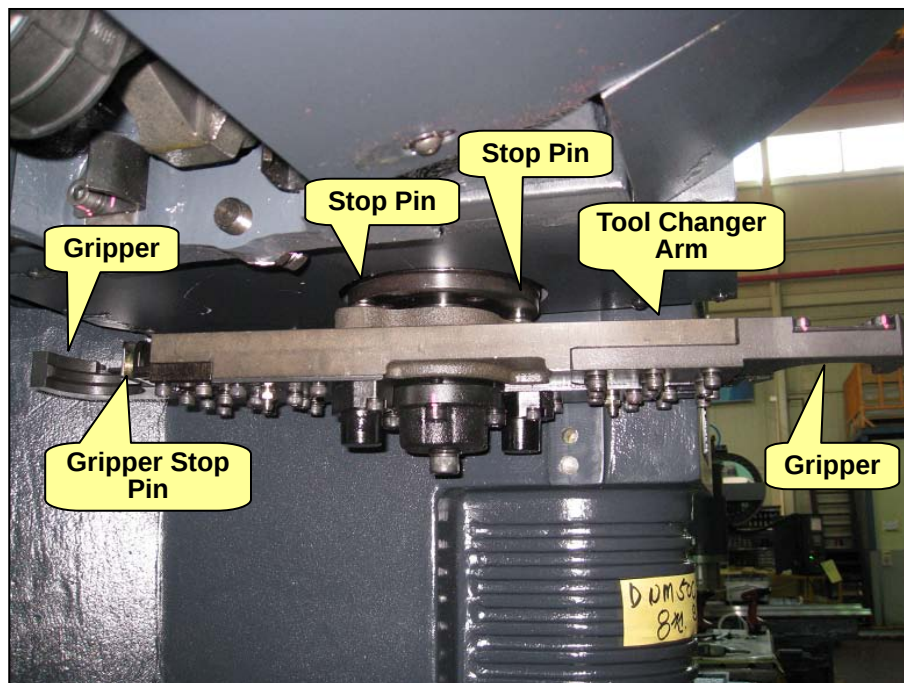
2) Cam Box Assembly



3) Tool Magazine Ass'y



4) Tool Changer Ass'y

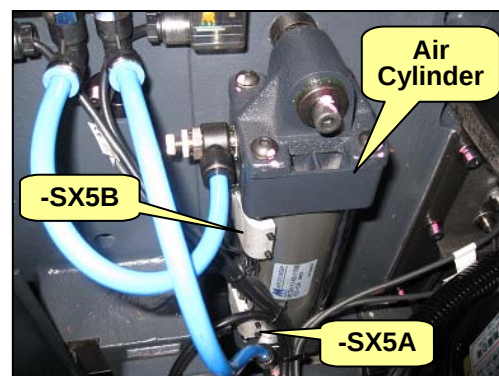


4.2 Waiting Pot Up/Down Device of ATC

1) Waiting Pot Up/Down Driving Units

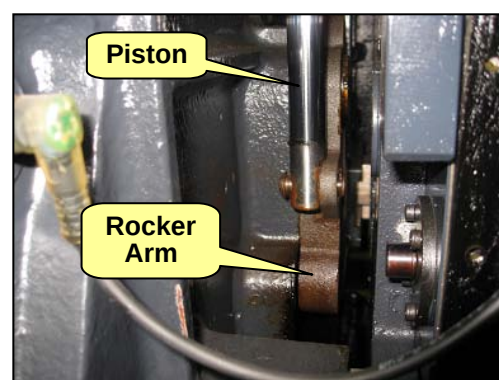
① Air Cylinder

- YM509050657 Air Cylinder



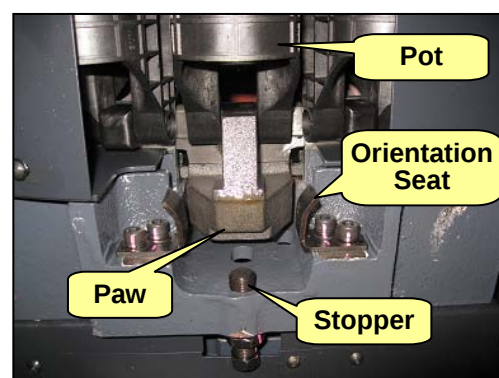
② Rocker Arm

- YM509050537 Rocker Arm



③ Paw

- YM509050637 (30T) Paw
- YM509050647 (40T) Paw



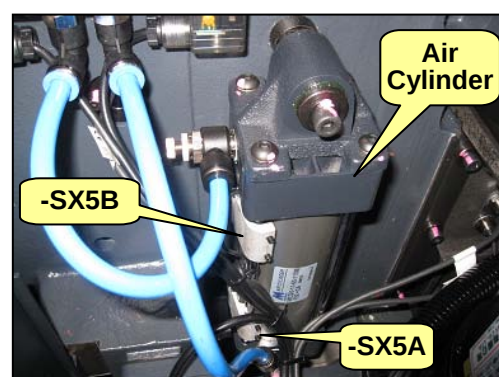
2) Waiting Pot Up/Down Sensor

① Waiting Pot Magazine Side Sensor

- YM509050737 Magnetism Reed Switch
- SX5B, X2.6(WPMS.M)

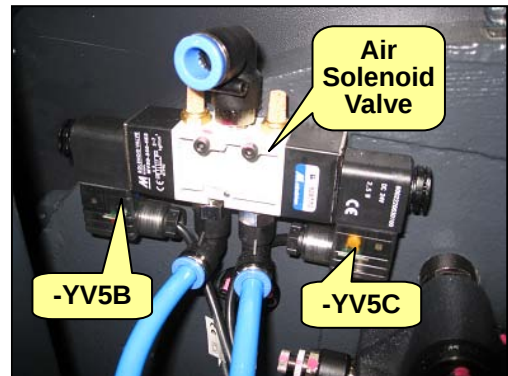
② Waiting Pot Spindle Side Sensor

- YM509050737 Magnetism Reed Switch
- SX5A, X2.5(WPSS.M)

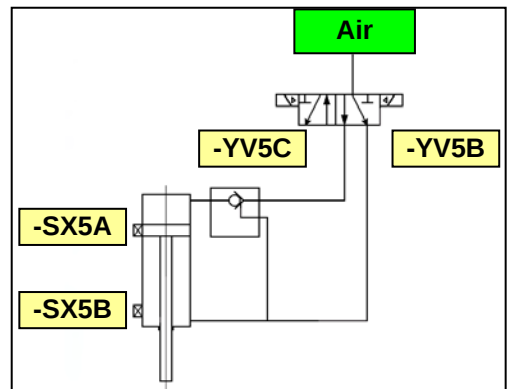


3) Air-pressure Supply Unit

- ① Waiting Pot Up Air Solenoid Valve
- YV5C, Y1.6 (WPU.R)
- ② Waiting Pot Down Air Solenoid Valve
- YV5B, Y1.5 (WPD.R)



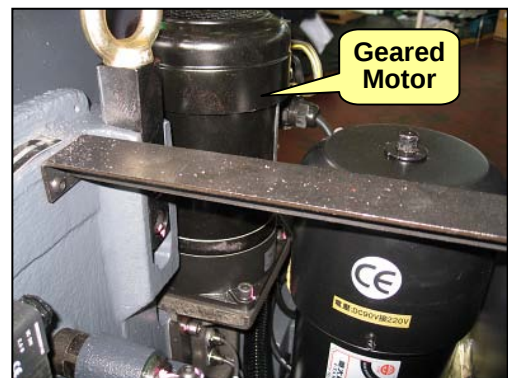
4) Air-pressure Circuit Diagram



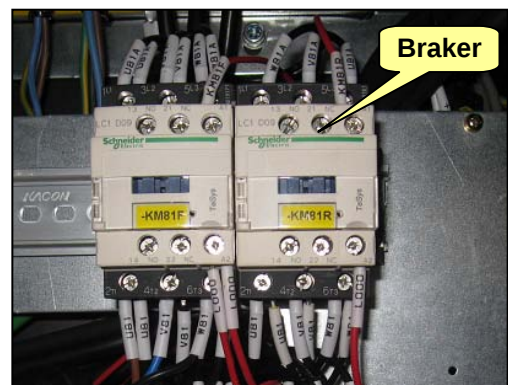
4.3 Tool Magazine Rotator

1) Tool Magazine Driving Unit

- ① Geared motor for rotating the tool magazine
- 300504-00063 Decelerator of Gear Motor
- M81 (0.2KW)

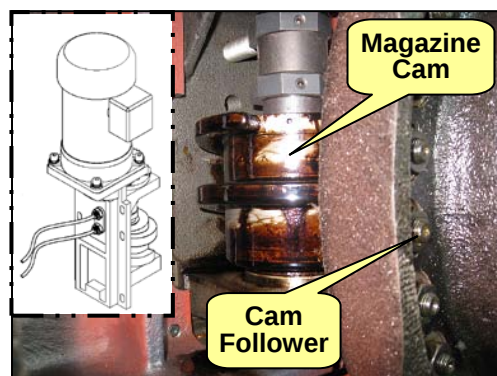


- ② Braker for driving the tool magazine motor
- ENFBX0255R Circuit Braker (1.1 ~ 1.6A)
- QM81 (CW : Y1.0, CCW : Y1.1)



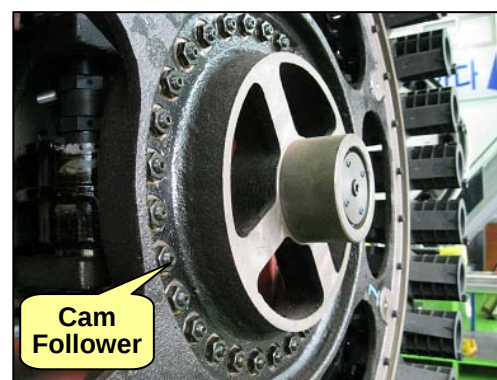
③ Magazine Cam

- Y509050777 Magazine Cam (30T)
- Y509050787 Magazine Cam (40T)



④ Cam Follower

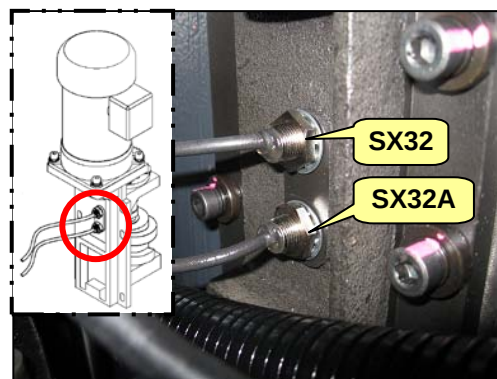
- R18293 Cam Follower



2) Tool Magazine Driving Unit Sensor

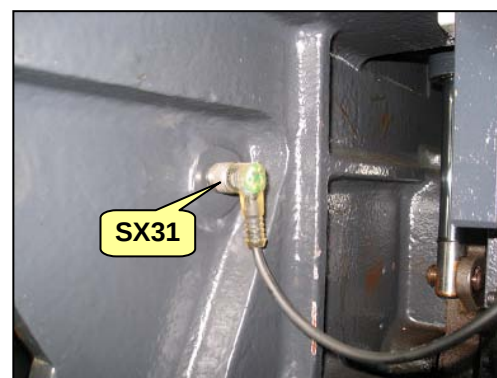
① Tool Pot Count

- ESWPX0307 Proximity Switch
- SX32 : X2.1 (TPCD.M) Tool Pot Counter
- SX32A : X2.7 (TPC1.M) Tool Pot Counter



② 1st Tool Pot Detection

- ESWPX0307 Proximity Switch
- SX31 : X2.0 (TPT1.M)



4.4 Tool Changer

1) Tool Changer Driving Unit

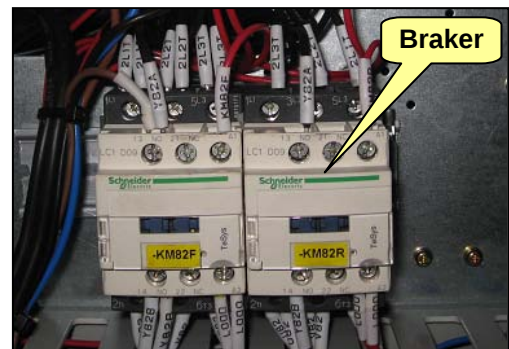
① Tool Change Motor

- 300504-00064 Geared Motor (1/2Hp)
- M82 (0.4KW)

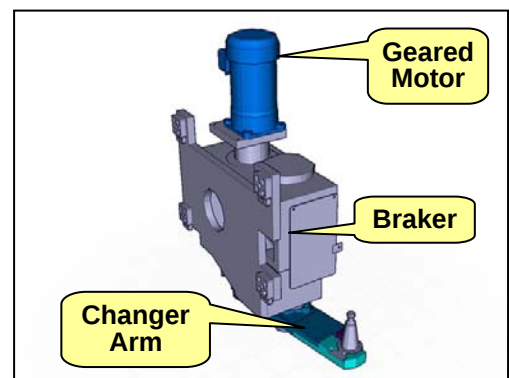
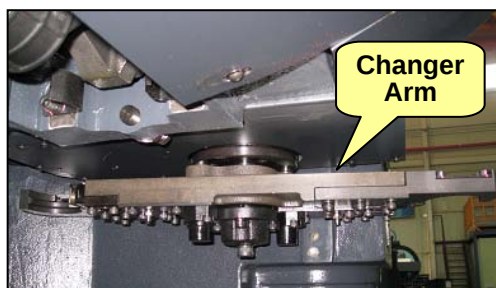


② Braker for driving the tool magazine motor

- ENFBX0257R Circuit Braker (2.8~4.0A)
- QM82 (+ : Y1.2, - : Y1.3)

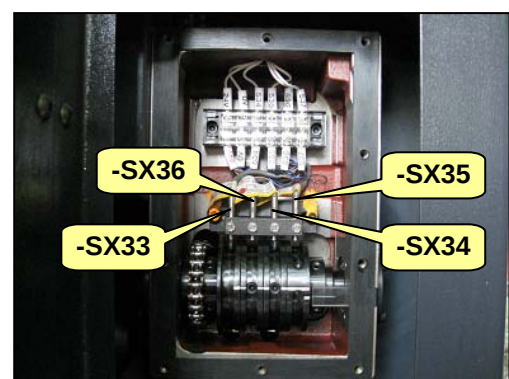


③ Cam Box & Changer Arm

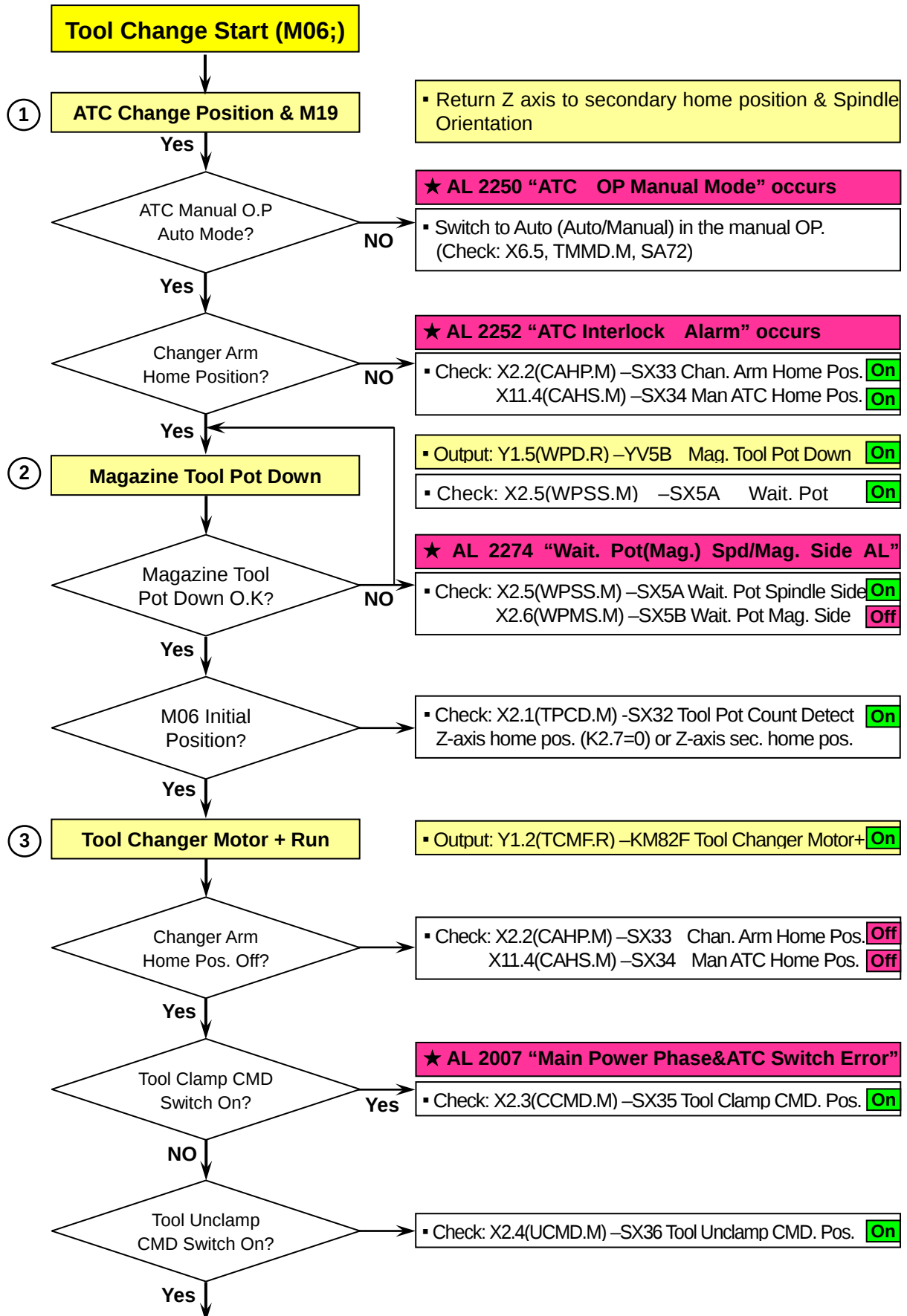


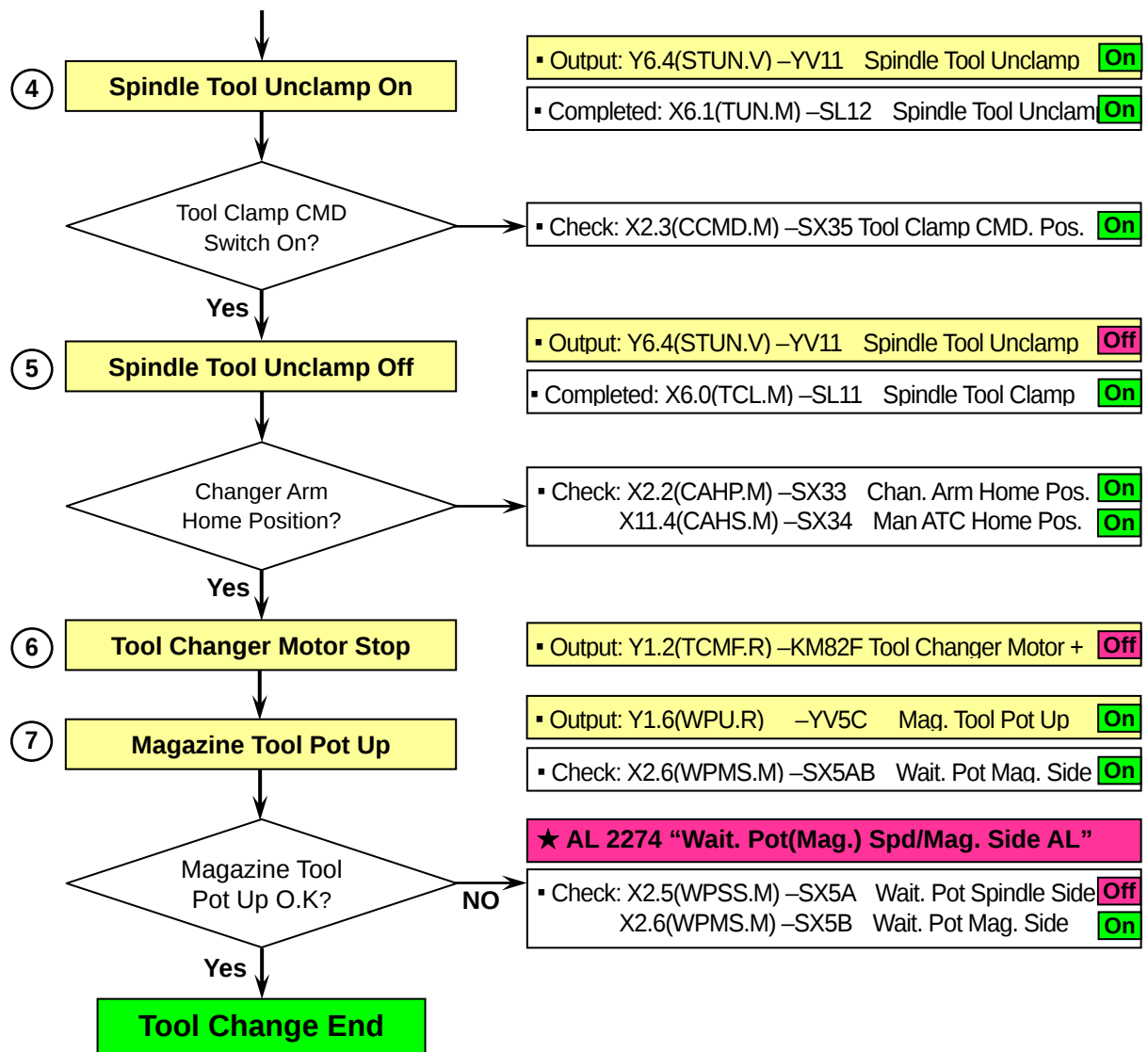
2) Command Sensor

- SX33 : X2.2 (CAHP.M) Changer Arm Home Position
- SX34 : X11.4 (CAHS.M) Manual ATC Home Position
- SX35 : X2.3 (CCMD.M) Tool Clamp Command
- SX36 : X2.4 (UCMD.M) Tool Unclamp Command



4.5 Tool Changing (M06;) Sequence Chart (F-0i)





Note 1) Since step 3 above "Tool Changer Motor + Run" starts, the motor keeps running irrelevantly to the sensor signal in steps 3 through 6 above, which may cause a mechanical conflict due to inappropriate air pressure, or defective air solenoid valve or switches.

Note 2) The operation by the Tool Change instruction (M06) may differ depending on the following conditions:

- (1) If instructed to change a tool without calling it
 -  The machine changes the tool in the current changing position.
- (2) If instructed to change a tool in the spindle after calling it
 -  The machine completes the instruction without changing the tool.
- (3) If instructed to call a called tool again before changing it
 -  The machine change the tool but the second calling command will be ignored.
- (4) If instructed to change a called tool after calling a different tool

- ☞ The first calling command will be ignored; only the last called tool will be changed.

4.6 ATC Troubleshooting

- ☞ If the changer arm is stopped for any reason while changing the tools (M06), you must return the changer arm to the home position manually.
However, the countermeasures may differ according to the cause of trouble. So please find out the exact cause before restoring or repairing the machine.

(1) If the changer arm is stuck while trying to pull out a tool from the spindle

In most cases, this happens when the changer arm is stuck in the spindle while trying to pull out a tool after tool unclamping is performed, causing to trigger the " 2062 M06 Command Over Time" alarm.

(2) If the changer arm is stuck in the spindle after changing a tool

In most cases, this happens when the changer arm gripper is stuck in a tool after the changer arm changed the tool and performed the tool clamping, causing to trigger the " 2062 M06 Command Overtime" alarm.

(3) If the changer arm has stopped operation irrelevantly to the spindle

This happens if the machine is emergency stopped or there occurs a power failure while performing the tool changing.

- 1) If this happens due to the emergency stop or power failure, take an appropriate measure to solve the problem and turn power back on before entering Machine Ready.



- 2) From the main OP, set the mode switch to "ATC Changer".



3) Check how ATC changer arm is stopped for what reason and set the mode switch to either "ATC CW" or "CCW" accordingly.

- ① If the changer arm is stuck while trying to pull out a tool from the spindle

From the main OP, set the mode switch to "CCW".

☞ If the machine is in the state of tool unclamping, manually perform the tool clamping before proceeding.

- How to confirm the state of tool unclamping

Check if the spindle emits the collet air (in MDI or Auto mode), or check if the button indicator of Unclamp on the spindle head turns on.



- ② If the changer arm is stuck in the spindle after it changed a tool

From the main OP, set the mode switch to "ATC CW".

☞ If the machine is in the state of tool unclamping, manually perform the tool clamping before proceeding.



- ③ If the changer arm has stopped operation irrelevantly to the spindle

If the changer arm or tool is not interrupted by the spindle or workpiece, pull out the tool from the spindle and set the mode switch to "CCW".

- How to pull out a tool from the spindle: Hold the tool with hand and press the Tool Unclamp button on the spindle head to pull it out. Then, press the button again to perform the tool clamping again.



4) As selected above, press and release the "ATC CCW" or "CCW" button repeatedly until the changer arm moves to the home position.

- (1) In case of ① above : In this case, the changer arm is stuck in the spindle for a reason while changing a tool. Return the changer arm to the home position and find the cause by performing the tool unclamping manually.

☞ If the manual tool unclamping does not work at all, gently impact on the tool to remove it with the hammer. Then, check the tool kick distance, the state of the

unclamp cylinder, collet, and the tapering side of the spindle or tool to find out the cause of trouble and take a necessary measure.

(2) In case of ② above : This happens when the gripper of the changer arm is stuck in the tool. If the problem persists after following the steps below, use a rubber hammer to impact on the end of the changer arm so that the gripper can be removed. Then, pull out the changer arm and return it to the home position. Find out the cause of trouble and take a necessary action. (it happens mostly while realigning ATC)

(3) In case of ③ above : This kind of trouble shooting will be made manually while the tools are inserted in the changer arm. Just in case of a fall of the tool, prepare a shock absorber such as wood palette under the machine, so that it can protect the machine from the possible fall.

5) The changer arm will not move further when it reaches the home position.

☞ Changer Arm Home Position Check

X2.2 (CAHP.M) : Changer Arm Home Position, -SX33

X11.4 (CAHS.M) : Manual ATC Home Position, -SX34

6) Select [SYSTEM] => [+] => [+] => [PMC MAINT] => [STATUS] => [DATA] in sequence and check the tool number (D450) in the spindle as well as the tool number (D452) in the waiting pot. Make correction if necessary.

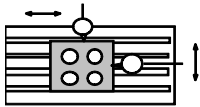
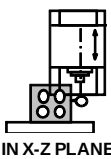
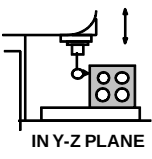
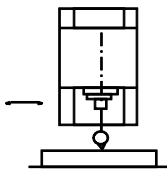
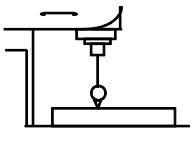
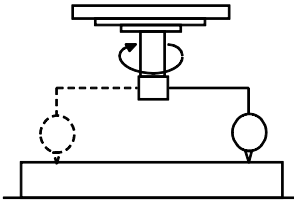
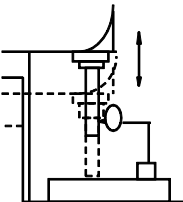
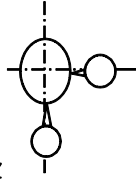
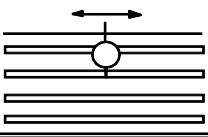
D450 : Tool number in the spindle

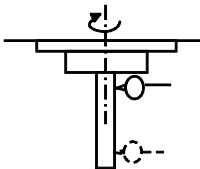
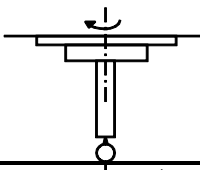
D452 : Tool number in the waiting pot

7) When each axis returns to their respective home position, ATC troubleshooting will be completed.

5. Machine Precision

※ V-MC Inspection Report Sample

V-MCT		GEOMETRICAL TEST			2/4
NO	TEST ITEM	TOLERANCE			READING
1	▶ SQUARENESS OF X-AXIS MOVEMENT TO Y-AXIS MOVEMENT 	0.010/300			0.002
2	▶ SQUARENESS OF Z-AXIS MOVEMENT TO THE PALLET SURFACE PALLET  IN X-Z PLANE  IN Y-Z PLANE	X-Z 0.015/300			PALLET#1 0.010
					PALLET#2 —
		Y-Z 0.015/300			PALLET#1 0.012
					PALLET#2 —
3	▶ PARALLELISM OF AXIAL MOVEMENTS TO THE PALLET SURFACE PALLET  X AXIS  Y AXIS	UPT0 500	500~ 1000	OVER 1000	PALLET#1 0.014
		0.02	0.03	0.04	PALLET#2 —
		X AXIS			—
		UPT0 500	500~ 1000		PALLET#1 0.014
		0.02	0.03		PALLET#2 —
		Y AXIS			—
4	▶ SQUARENESS OF THE SPINDLE CENTER TO THE PALLET SURFACE Pallet 	X-Z 0.010/300			PALLET#1 0.008
					PALLET#2 —
		Y-Z 0.015/300			PALLET#1 0.010
					PALLET#2 —
5	▶ PARALLELISM OF Z-AXIS MOVEMENT TO THE SPINDLE CENTER   Y-Z X-Z	X-Z 0.010/300			0.008
		Y-Z 0.015/300			0.012
6	▶ PARALLELISM OF X-AXIS MOVEMENT TO THE REFERENCE T-SLOT 	0.010/300			PALLET#1 0.010
		0.040/FULL STROKE			PALLET#2 —

V-MCT	GEOMETRICAL TEST		3/4
NO	TEST ITEM	TOLERANCE	READING
7	▶ RUN-OUT OF SPINDLE INTERNAL TAPER 	AT SPINDLE NOSE 0.005	0.002
		AT 300 DISTANCE 0.012	0.007
8	▶ SPINDLE AXIAL MOVEMENT 	0.003	0.001

M.DMF-Q7210-2(1990.4.23)

A4(210 × 297mm)

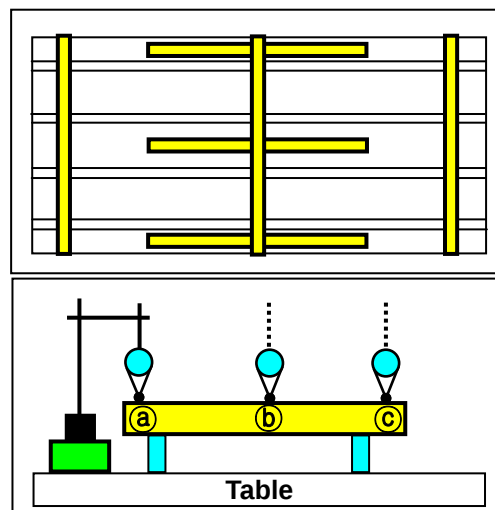
Doosan Infracore Co., Ltd.

5.1 Straightness of Pallet Deck

1) How to measure

Install the straight edge on the pallet deck and install the indicator on the block. Use the indicator to measure the parallelism from the table deck. Move the indicator to set either ends of the straight edge to "0". The greatest center value is the measurement.(3 points in X direction, 3 points in Y direction)
(measuring points: both ends and center)

- Tolerance; 0.015mm/500mm, 0.04mm/ front side



(The center of the table should not be the highest value.)

- Note) Calculating the taper value

If one of either ends on the straight edge does not measure "0", add or deduct the difference to set it to "0". As a result, the center value will increase by half of the difference.

Ex) If (a) is "0", (b) is "+5," and (c) is "-20", set (c) to "0" (by adding "20"). Then, (b) will increase by half of the addition ("10"). As a result, the value of (b) becomes "+15". This is the taper value.

2) Correction

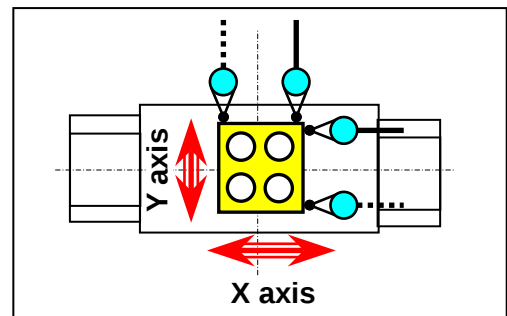
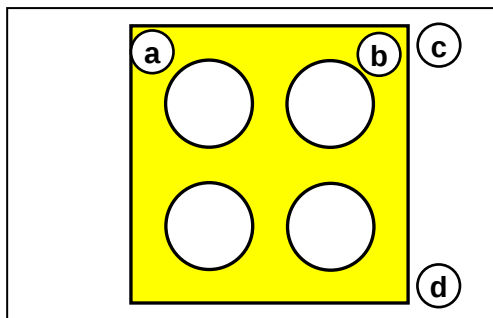
Correction is not possible as the straightness is attributed to the physical table itself.

- If the difference is as significant as to require correction, grind the deck again.

5.2 Squareness Between X-axis and Y-axis Movements

1) How to measure

- ① Place the square horizontally on the table deck.
 - ② Install the indicator on the spindle head and present the gauge to the Y-axis direction of the square.
 - ③ While moving the X axis, set either ends of the square to "0".
 - To correct the parallelism, use the handle of a screwdriver to impact on any high positions on the X axis as necessary.
 - ④ Measure the Y-axis parallelism; the highest difference will be the measurement. Set the parallelism between ① and ② to "0", against which the difference on parallelism between ③ and ④ will be the measurement.
- Tolerance : 0.01mm / 300mm

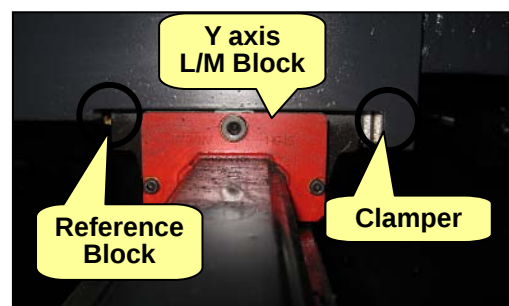
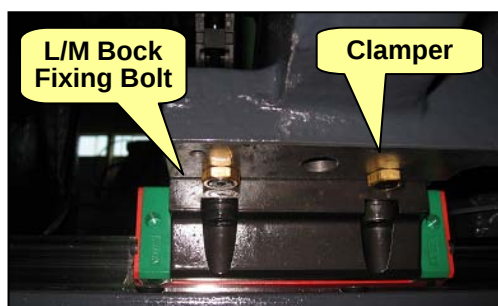


2) Correction

In general, the L/M guide machine has an extremely low possibility of having a squareness problem. However, if you encounter a problem with the squareness, you must correct the squareness and realign the L/M guide block.

- How to realign the L/M guide block

- ① Loosen the fixing bolts (4-BB10×25) of the Y-axis L/M guide block that needs correction.
- ② Loosen the clamber bolts on the L/M guide block.
- ③ Remove the spacer that is inserted in the grinding side.
- ④ Calculate the grinding value of C46021154 spacer before fitting it onsite. Insert it back to original and tighten up the clamber bolts so that the spacer gets tightened up.
 - Target size = measurement between ③ and ④ × 2
- ⑤ If you get a satisfactory result, tighten the L/M guide block fixing bolts (4-BB10×25).



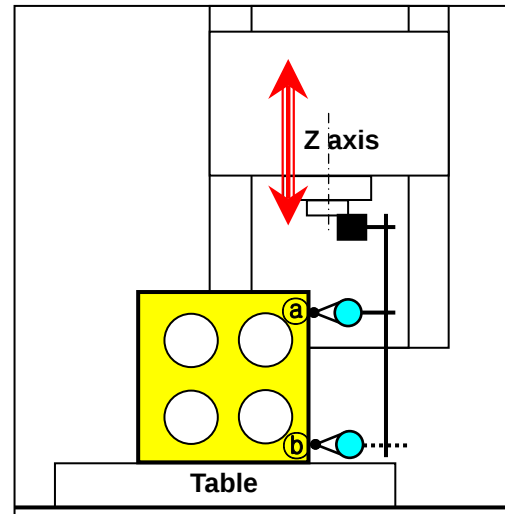
5.3 Squareness between pallet deck and Z-axis movement

► X - Z

1) How to measure

Place the square on the table deck in the X-axis direction and install the indicator on the spindle head. While moving the Z axis, measure either vertical ends (a, b) of the square. The greatest difference is the measurement.

▪ Tolerance : 0.01mm / 300mm



2) Correction

This is a matter of squareness between table deck and column. so you can correct the error using machine leveling.

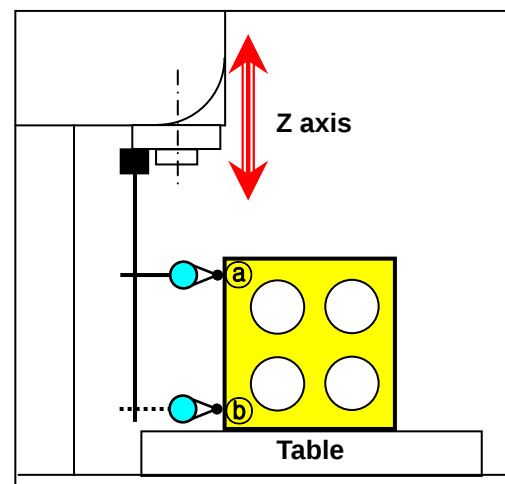
If the squareness error is way beyond the mechanical leveling, scrape the bed under the column or insert a shim as wide as the error between column and bed. However, the squareness is well fit by factory default so the mechanical leveling will do in most cases.

► Y - Z

1) How to measure

Place the square on the table deck in the Y-axis direction and install the indicator on the spindle head. While moving the Z axis, measure either vertical ends (a, b) of the square. The greatest difference is the measurement.

▪ Tolerance : 0.01mm / 300mm



2) Correction

This is a matter of squareness between table deck and column. so you can correct the error using machine leveling.

If the squareness error is way beyond the mechanical leveling, scrape the bed under the column or insert a shim as wide as the error between column and bed. However, the squareness is well fit by factory default so the mechanical leveling will do in most cases.

5.4 Parallelism between pallet deck and X/ Y-axis movement

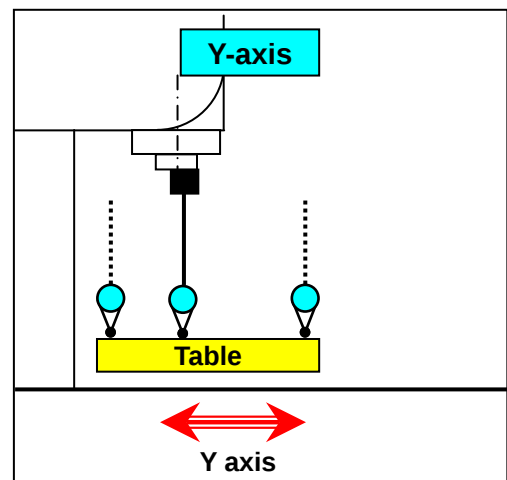
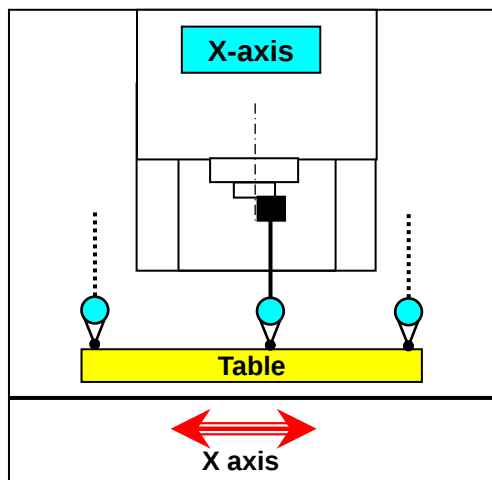
1) How to measure

Install the indicator on the spindle, put the gauge on the pallet deck, and move the X axis. The greatest difference is the measurement.

- Tolerance : X-axis direction: 0.04mm
Y-axis direction: 0.03mm

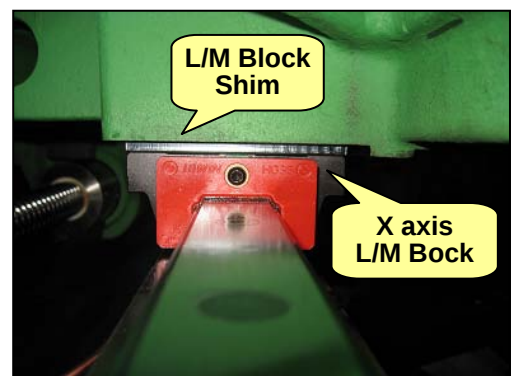
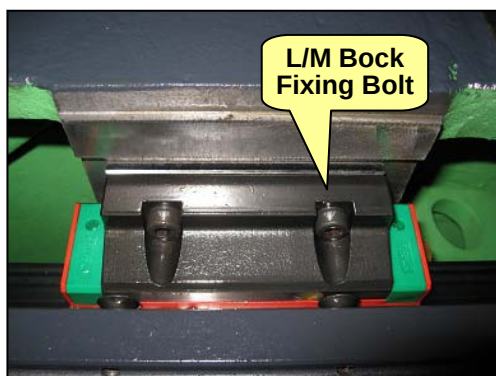
2) Correction

As the height of the table deck can be measured differently depending on the mechanical leveling, do the leveling work first and, then, correct the table height only if the problem persists.



- To correct the height of the table

- ① Select an area to correct.
- ② Loosen the fixing bolts (4-BB10×25) of the X-axis L/M guide block that needs correction.
- ③ Loosen the fixing bolts (5-BB10×25) of the X-axis ball screw nut.
- ④ Insert the screw jack between bed and table before lifting up the table slightly.
- ⑤ Pull out the spacer between bottom of table and L/M block. Grind it as much as measured above and insert it back to original.
- ⑥ If you get a satisfactory result, tighten the L/M guide block fixing bolts (4-BB10×25).
- ⑦ Move the X axis to "X0" and tighten the fixing bolts of the X-axis ball screw nut.

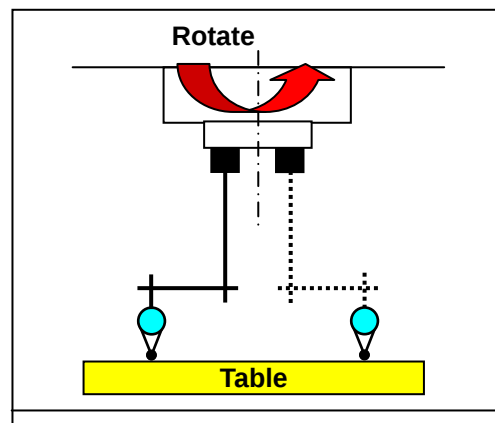


5.5 Squareness between pallet deck and center line of main spindle

1) How to measure

Install the indicator on the spindle and put the gauge on a point about 150mm away from the spindle center. While manually moving the spindle in the X- and Y-axis directions, measure the difference between highest and lowest values.

- Tolerance : X- direction: 0.010mm / 300mm
Y- direction: 0.015mm / 300mm



2) Correction

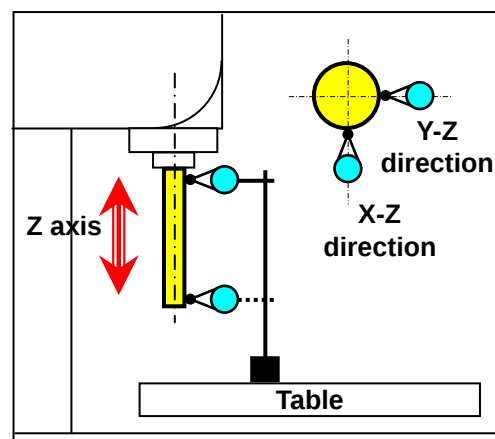
The squareness between spindle center and table deck is affected by several factors: squareness between Z axis and table deck, parallelism between axial movement and pallet deck, parallelism between spindle center and Z axis, and the mechanical leveling condition. The squareness between spindle center and table deck should be the last process after completing other precision work as mentioned above.

5.6 Parallelism between center line of main spindle and Z-axis movement

1) How to measure

Insert the test bar to the spindle, install the indicator on the table, and put the gauge on the highest point of the test bar. While moving the spindle, measure the runout on the spindle and stop moving the spindle at the middle position between runout highest and lowest points, then move the Z axis and measure the difference between mouth and end of the test bar.

- Tolerance : X-Z direction: 0.010mm / 300mm
Y-Z direction: 0.015mm / 300mm



2) Correction

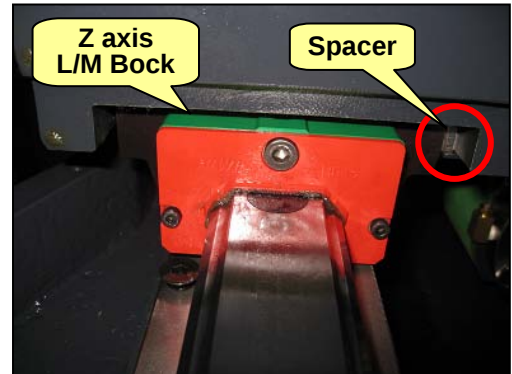
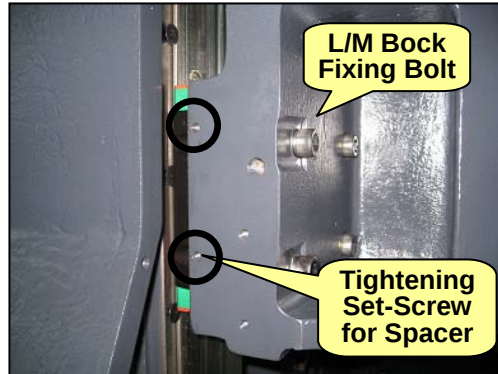
Correction can be made by realigning the Z-axis L/M guide block.

- How to realign the Z-axis L/M guide block (X-Z)
 - ① Loosen the fixing bolts (4-BB10×25) of the Z-axis L/M guide block that needs correction.
 - ② Loosen the tightening set-screws of the spacer.
 - ③ Pull out C46021174 spacer that is inserted in the grinding side.
 - ④ Calculate the grinding value of the spacer before fitting it onsite. Insert it back to

original and tighten up the set screws so that the spacer gets tightened up.

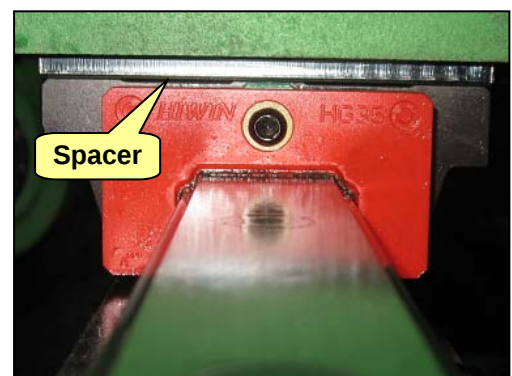
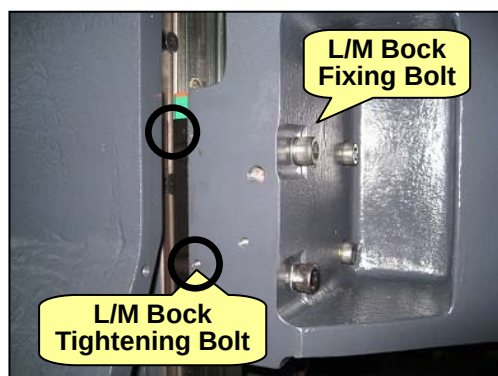
▪ Target size = measurement $\times$ 2

- ⑤ If you get a satisfactory result, tighten the L/M guide block fixing bolts (4-BB10 $\times$ 25).



▪ How to realign the Z-axis L/M guide block (Y-Z)

- ① Select an area to correct. (2 places among a total of 4 in upper and lower sides)
- ② Loosen the fixing bolts (4-BB10 $\times$ 25) of the L/M guide block that needs correction.
- ③ Loosen the fixing bolts (5-BB10 $\times$ 25) of the Z-axis ball screw nut.
- ④ Pull out C46021023B spacer between bottom of spindle head and L/M block. Grind it twice as much as measured above and insert it back to original.
- ⑤ Tighten the L/M guide block fixing bolts (4-BB10 $\times$ 25). Repeat the steps above until you get a satisfactory result.
- ⑥ Move the Z axis to the home position and tighten the fixing bolts of the Z-axis ball screw nut.

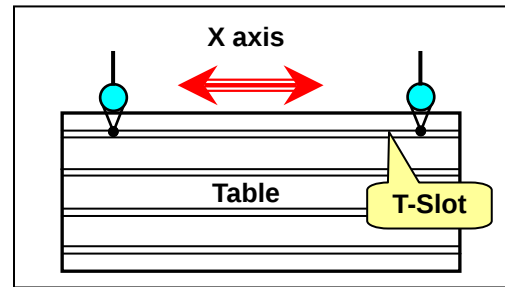


5.7 Parallelism between T slot and X-axis movement

1) How to measure

Install the indicator on the spindle, present the gauge to one side of the T slot, and move the X axis while measuring the parallelism. Where, the greatest parallelism is the measurement.

- Tolerance : 0.01mm / 300mm,
0.04mm / full stroke

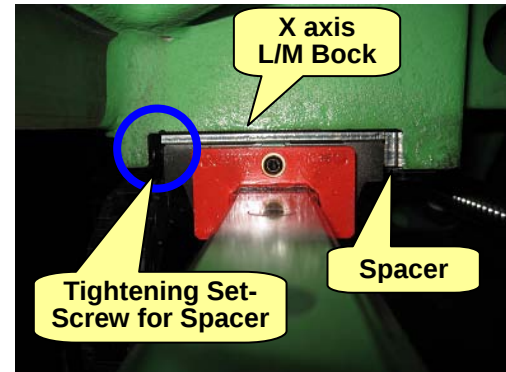


2) Correction

Correction can be made by realigning the X-axis L/M guide block.

- How to realign the X-axis L/M guide block

- ① Loosen the fixing bolts (4-BB10×25) of the X-axis L/M guide block that needs correction.
- ② Loosen the tightening set-screws of the spacer.
- ③ Pull out C46021154 spacer that is inserted in the grinding side.
- ④ Calculate the grinding value of the spacer before fitting it onsite. Insert it back to original and tighten up the set screws so that the spacer contacts the block.
 - Target size = measurement
- ⑤ If you get a satisfactory result, tighten the L/M guide block fixing bolts (4-BB10×25).

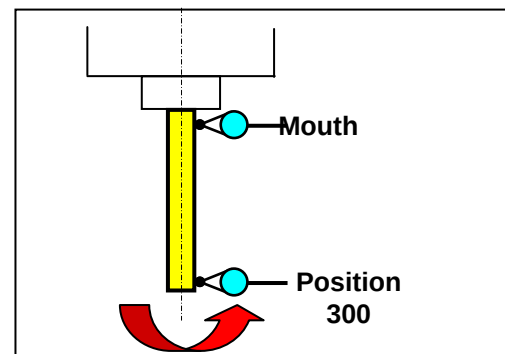


5.8 Shaking inside the main spindle hole

1) How to measure

Insert the test bar into the spindle and present the indicator to the mouth of the test bar, and to a point 300mm away from the mouth. While turning the spindle in a low speed, measure the greatest shaking value.

- Tolerance : Mouth of the test bar: 0.005mm
Position 300mm: 0.012mm



2) Correction

As the taper side of the spindle is exposed to a high risk of scratch during the precision work, remove the pull stud from the test bar or a new tool before applying minium or stamp ink to the taper side, and use the sandpaper to grind the contact area of the taper.

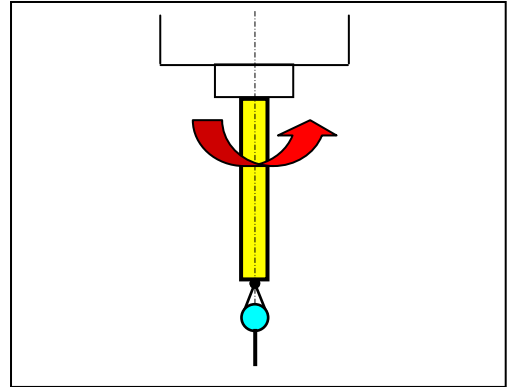
- ※ Using the grinder is strictly prohibited. If the taper side is badly damaged, re-grind the spindle itself.

5.9 Z-directional displacement of the main spindle

1) How to measure

Insert the test bar into the spindle, insert the steel ball into the end center of the test bar, and present the indicator to each of X and Y highest points. While rotating the spindle, measure the greatest shaking value. (For a test bar whose end section is already grinded, measure the runout on the grinded section)

- Tolerance : 0.003mm



2) Correction

If the spindle moves in the Z-axis direction, this may be caused by a problem with the spindle main bearing. If this is the case, replace the bearing.

6. Regular Checkpoints

6.1 Spindle Head

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Tool Unclamp Device	Test and correct it if necessary.			○	
	Spindle Orientation	Adjust the stop angle	○		○	
	Spindle Drive Key	Check for any abnormal abrasion			○	
	Grinding Section of Spindle Taper				○	
	Spindle Driving Belt	Check the tension and correct it if necessary.			○	
	Orientation Belt				○	
	RPM	Test and correct it if necessary.				○
	Power Supply to Spindle Motor	±10%			○	
	Bolts and Connectors	Check if properly fixed or connected.	○			○
Operation	Rotate Spindle	Operate it manually	○	○		
	Spindle Orientation	MDI manipulation	○	○		
	Tool Clamp / Unclamp	Operate it manually	○	○		
	Position Sensor	Check if detecting the RPM properly				○
	Each sol. valve operation	Check DGN				○
	Operation of Each Switch					○
Oil Supply	Driving Components	Apply grease				○
Cleaning	Grinding Section of the Spindle Taper	Remove impurities		○		
	Inside the cover					○

6.2 Table

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Table Deck	Remove impurities		○		
	Table T-Slot			○		○
	Inside the cover					

6.3 Axes System

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Mechanical reference point	Test and correct it if necessary.				○
	Shaking of each axis					○
	Static accuracy					○
	Positioning accuracy					○
	Feed Accuracy					○
	Check the wiper for any abnormal abrasion				○	
	Power supply to servo motor	±10%			○	
	Bolts and Connectors	Check if properly fixed or connected.	○			
Operation	Axial Feeding	Operate it manually	○	○		
Oil Supply	Driving Components	Check if properly supplied with lubricant.			○	
Cleaning	Covers in the axes system	Remove impurities		○		
	Inside splash guard				○	
	Inside the guideway cover				○	

6.4 Auto Tool Changer (ATC)

1) Armless Type ATC

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	ATC centering	Check using the fixture	○		○	
	Gripper	Check for any abnormal abrasion			○	
	Power supply to each driving motor	±10%			○	
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Tool changing operation	Operate it manually	○	○		
	Tool magazine operation		○	○		
	Each sol. valve operation	Check DGN			○	
	Operation of each switch				○	
Cleaning	Tool used	Remove Impurities		○		
	Inside the cover					○

2) Cam Type ATC

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	ATC centering	Check using the fixture	○		○	
	Home position of Waiting Pot	Check with bare eye	○		○	
	Waiting position of Waiting Pot		○		○	
	Gripper	Check for any abnormal abrasion			○	
	Taper of the pot				○	
	Key of the pot				○	
	Switch-dog driving chain	Check and correct the tension if necessary.			○	
	Power supply to each driving motor	±10%			○	
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Tool changing operation	Operate it manually	○	○		
	Tool magazine operation		○	○		
	Pot Up/Down		○	○		
	Each sol. valve operation	Check DGN			○	
	Operation of each switch	Remove impurities			○	
Oil Supply	Cam Box	CC320 Oil				○
	Magazine Cam-Follower	Apply grease			○	
	Pot Up/Down area				○	
	Tool Arm Gripper				○	
	End of tool clamping rod				○	
Cleaning	Changer Arm Griper	Remove impurities		○		
	Inside Tool Pot			○		
	Pot Up/Down area			○		
	Tools used			○		
	Inside the cover					○

6.5 Air Service Unit

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Manometer	5.5Kgf/cm ²	○	○		
	Oiler flow	5 drops/min.	○	○		
	Pressure switch	4Kgf/cm ²	○	○		
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Emit Cleaning Air	Operate ATC	○	○		
	Regulator	Check if working properly			○	
	Oiler	Check if working properly			○	
	Pressure switch				○	
Oil Supply	Oiler ullage scale	Check with bare eye Drain water	○	○		
Cleaning	Filter Unit Tank		○	○		
	Filter in filter unit	Check/clean/replace			○	

6.6 Lubrication Unit

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Manometer (in working condition)	16 ~ 20Kgf/cm ²	○	○		
	Power supply to pump motor	±10%			○	
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Pump	Check the operational sound	○	○		
	Supply lubricant to each axis	Check with bare eye	○	○		
	Pressure switch operation	Check DGN				○
	Plotter switch operation					○
Oil Supply	Ullage scale	Check with bare eye	○	○		
Cleaning	Oil Supply Filter	Check/clean/replace		○		

6.7 Oil Cooler – Option

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Temperature	Operation Panel (SV=03)	○	○		
	Power supply to terminal board	±10%			○	
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Device	Check the operational sound	○	○		
	Operation Panel	Check with bare eye			○	
Oil Supply	Ullage scale	Check DGN	○	○		
	Replace oil				○	
Cleaning	Filter	Check/clean/replace		○		

6.8 Splash Guard

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Check for any leakage	Check with bare eye	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Doors	Check if properly open and close	○			
	Door safety switch	Check DGN	○	○		

6.9 Name Plates

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Attachment of each label	Check with bare eye	○	○		

6.10 Coolant & Chip Devices

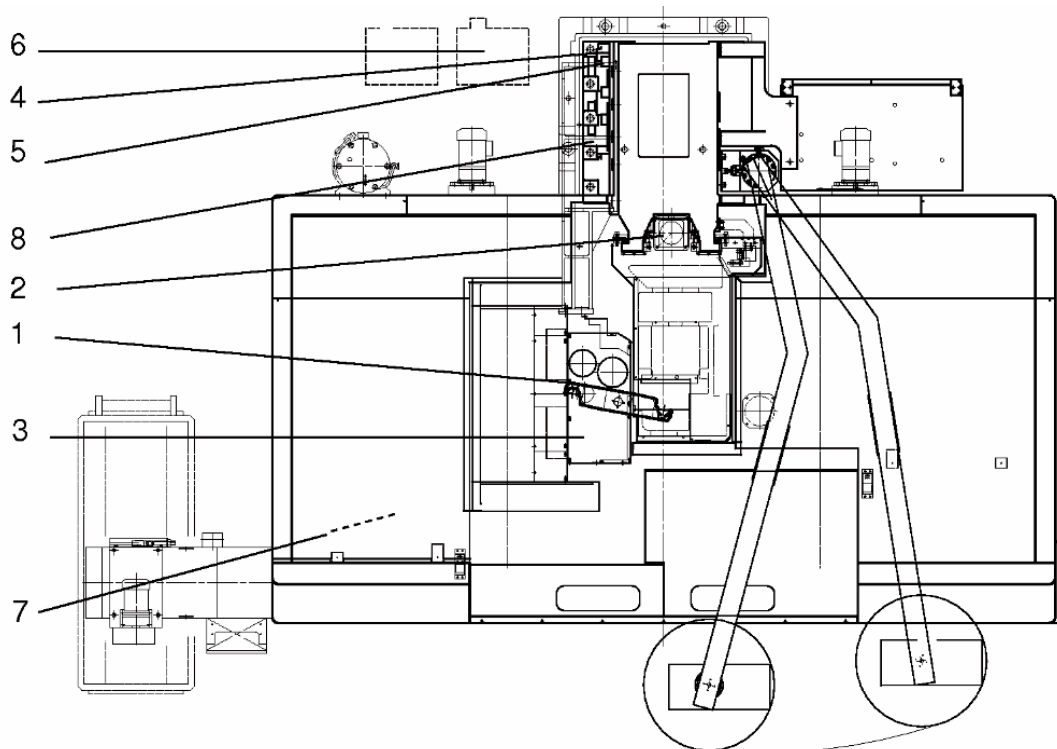
Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Power supply to each pump	±10%			○	
	Coolant flux	Control flux		○		
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Pumps	Check the operational sound	○	○		
	Chip conveyor	Check if properly working	○	○		
Oil Supply	Oil Priming	Check with bare eye	○	○		
	Ullage scale		○	○		
	Replace oil				○	
	Chip conveyor chain	Apply grease				○
Cleaning	Inside tank	Clean inside the tank			○	
	Strainers and Filter	Check/clean/replace			○	
	Inside the chip pan	Dispose chips		○		
	Dispose of chips inside chip conveyor	Use a cloth, and drive reverse		○		
	Inside chip conveyor	Dismantle the conveyor for cleaning				○

6.11 Electric Devices

Item	Checkpoint	Note	Upon Install.	Daily	Semi-annually	Annually
State	Power supply	±10%	○		○	
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Emergency stop buttons	Check DSN and check if working properly	○	○		
	Operation panels	Check if working properly	○	○		
	Operator call lamp	Check if turning on/off properly	○	○		
	Work light		○	○		
	Electric cabinet ventilator	Check if properly working	○	○		
Cleaning	Inside electric cabinet	Clean inside			○	

6.12 Check Oil Supply

1) Oil Supply Line



Symbol	Oil Supply Position		Oil Type	Tank Capacity(L)	Check Interval(HR)	Supply or Change	
	Unit	Position				Interval(HR)	Quantity(L)
1	Cam ATC	Driver Chain	XM2, Grease	5		2,400	0.02
		Changer	XM2, Grease			1,000	0.01
		Cam Follower	XM2, Grease			1,000	0.02
		Pot Up/Down	XM2, Grease			1,000	0.01
	Armless ATC	Geneava Gear	XM2, Grease			1,000	0.02
2	Axes System	Moving Parts	XM2, Grease			1,000	0.02
3	Spindle Head	Moving Parts	XM2, Grease			1,000	0.02
4	Air Service Unit	Oiler	FD22 Oil	0.05	8	50	0.05
5	Lub. Unit	Tank	G68 Oil	1.9	8	50	1.5
6	Oil Cooler	Tank	FC10, Oil	20	8	1,000	20
7	Coolant& Chip Device	Tank	*	300	8	*	300
		Chip Conveyor	XM2, Grease			1,000	0.02
8	Lub.Unit for Spindle	Tank	HM32, Oil	1.9	8	500	1.5

*) Optional specifications according to the workpiece

2) Oil Analysis Table (by oil maker)

Maker Symbol	Mobil Oil	Shell Oil	Esso Oil	Caltex Oil	BP Oil	Sun Oil
FC10	Velocite No.6	Tellus C10	Spinesso 10	Spindural 10	Energol HP 10	Solnus 55
FD22	DTE22 22	Tellus 22				
FC10	DTE Oil Light	Tellus 32	Teresso 32	Rando 32	Energol HP 32	Sunvis 916
HM32	DTE 24	Tellus 32	Nuto H 32	Rando HD 32	Energol HLP 32	Sunvis F.
HG32	Vacuoline 1405	Tonna T 32	Febis K 32		Energol GHL 32	Sun Lubrway
HM46	DTE 25	Tellus 46	Nuto H 46	Rando HD 32	Energol HLP 46	Sunvis 821WR
HM68	DTE 26	Tellus 68	Nuto H 32	Rando HD 68	Energol HLP 68	Sunvis 831WR
HG68	Vacuoline 1409	Tonna T 68	Febis K 68	Way Lubricant 68	Energol HHL 68	Sun Lubrway 1754
G68	Vactra No.2	Tonna T 68	Febis K 68	Way Lubricant 68	Maccurat 68	Sun Lubrway 80
CB150	DTE Oil Extra Heavy	Tellus C 150	Teresso 150	Rando Oil 150	Energol GR-XP 150	Sunvis 975
G220	Vactra No.4	Tonna T 220	Febis K 220	Way Lubricant 220	Maccurat 220	Sun Lubrway 90
CC320	Mobilux 632	Omala 320	Spartan EP 320	Meropa 320	Energol GR-XP 320	Sunep 1090
XM2	Mobilux 2	Alavnia Grease EP2	Beacon 2	Multifak EP2	Ener Grease LS 2	Prestige 42 Grease
XMP0	Mobilux 2	Alavnia Grease EPR0	Neacon EP0	Multifak EP0	Ener Grease MM-EP0	Prestige 740EP Grease

Mixing with different oil types (even if they are in the same family) is strictly prohibited as oil mixing can cause deteriorated performance of lubrication, leading to a physical damage.

Revision History
VMC Maintenance Manual DNM 500

Version	Year/Month	Revision history	Created by
01	2010. 10	Official draft(DNM500MTE0A)	Jeong, Sam Young
02			
03			
04			
05			
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