



NC Boring Maintenance Manual

(DBC 130)

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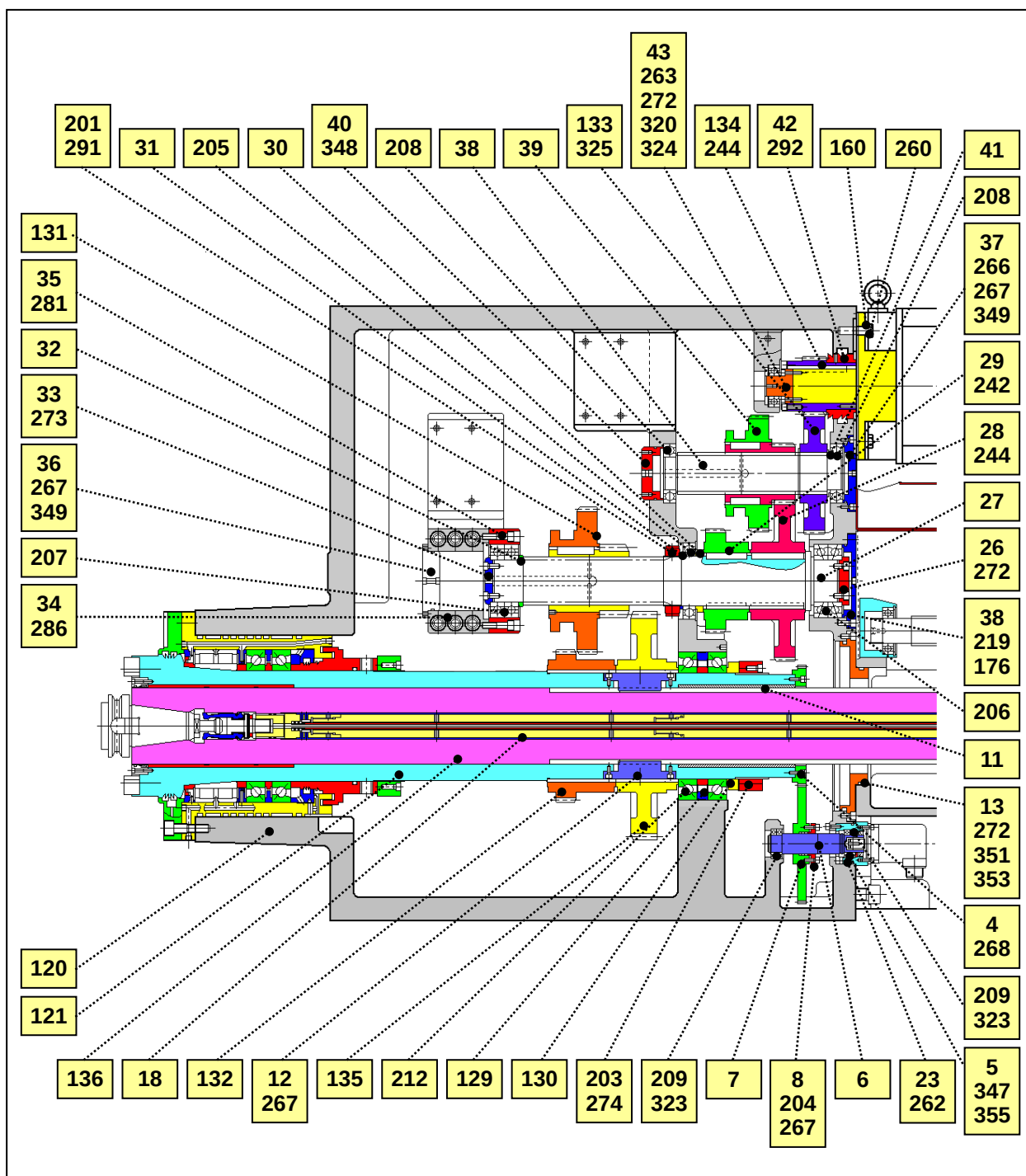
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1. Assembling/disassembling the spindle cartridge

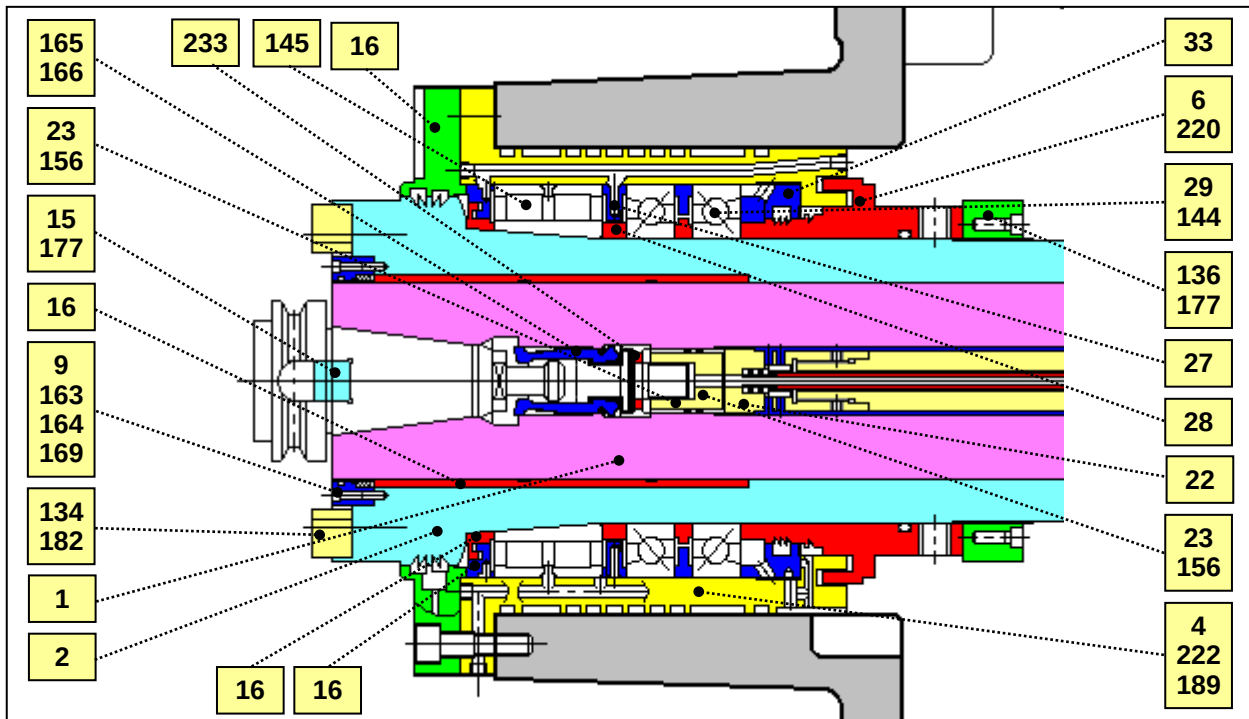
※ Spindle Head Gear Box





NO.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
4	B1411183A	Gear Position(1)	1	SNCM220	
5	B1411193C	Bracket	1	SS400	
6	B14111203A	Shaft Position	1	SCM435	
7	B14111213B	Gear. Position(2)	1	SNCM220	
8	B14111223	Bracket. Span Ring	1	SM45C	
11	B14111253A	Bush. Rear	1	AlBc3	
12	B14111263A	Key. Driving	2	SM45C	
13	B14111273A	Centering. Housing	1	SM45C	
18	B14111373A	Draw Bar(2)	2	SCM440	
23	B14111533A	Cap Bearing	1	SM45C	
25	B14112013	Cap. Bearing	1	SM45C	
26	B14112023A	Cap. Bearing	1	SM45C	
27	B14112033B	Shaft. Spline	1	SCM435	
28	B14112043C	Gear. Spur	1	SNCM220	
29	B14112053C	Gear. Spur	1	SNCM220	
30	B14112063	Collar	1	SM45C	
31	B14112073	Spacer	1	SM45C	
32	B14112123	Collar	1	SM45C	
33	B14112133	Cap	1	SM45C	
34	B14112143B	Bracket Support	1	SS400	
35	B14112153	Support. Bearing	1	SM45C	
36	B14112163	Cap. Oil	1	SM45C	
37	B14113013B	Cap. Bearing	1	SM45C	
38	B14113023A	Shaft. Spline	1	SCM435	
39	B14113063C	Ass'y Gear Shift	1		
40	B14113073A	Cap	1	SM45C	
41	B14113083	Collar	1	SM45C	
42	B14114013A	Collar. Labyrinth	1	SM45C	
43	B14114033B	Shaft. Motor	1	SM45C	
120	B14141011G	Body. Spindle Head	1	GC300	
121	B14111021C	Spindle Milling	1	SCM440	
129	B14141094	Collar	1	SM45C	
130	B14141104	Spacer	1	SM45C	
131	B14112113E	Ass'y Gear Shift	1		
132	B14111123B	Gear. Spur	1	SNCM220	
133	B14113033D	Gear. Spur	1	SNCM220	
134	B14114023B	Gear. Spur	1	SNCM220	
135	B14111133E	Gear. Spur	1	SNCM220	
136	B14111011C	Spindle Boring	1	SACM1	

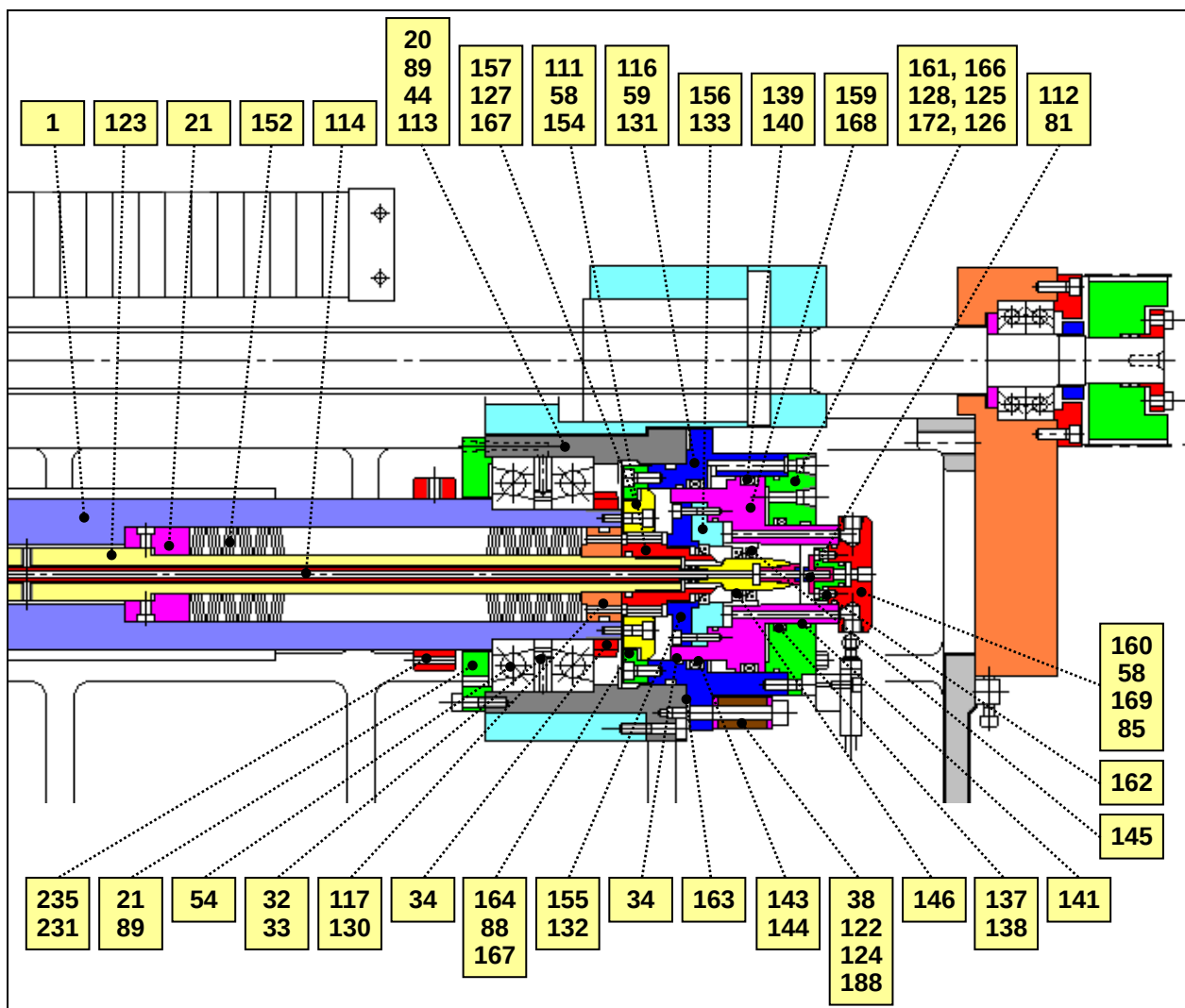
NO.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
160	C37053034	Interceptor Heat	1		VANQUA
183	EUNIE0005	Coder. Position	1	RIB-60-1024VLB	Kwang Woo
201	R03082	Nut. Lock	1	DZM85X2	K-FUKUDA/YHB
203	R02164	Nut. Lock	1	SM45C	
204	R08010	Ring. Span	2	SCE300-35X40	
205	R10114A	Bearing. Radial Ball	1	6017P5	FAG
206	R10395	Brg. Ang. Cont. Ball	1	7214T2DB/GNP5	NTN
207	R10396	Brg. Radial Ball	2	6214P5	
208	R10397	Brg. Radial Ball	2	6211P5	
209	R10401	Ball. Bearing	4	6906 P5	
212	R10751	Brg. Ang. Cont. Ball	1	71936CD/P4ADBA	SKF
242	P64016071	Key. Parallel(W/Tap)	2	KSP16X10X70	
244	P64016090	Key. Parallel(W/Tap)	3	KSP16X10X90	
260	S0060751	Bolt. Hex. Head	4	BA12X50	
262	S2203161	Bolt. Hex Socket Head	42	BB5X16	
262	S2203561	Bolt. Hex Socket Head	3	BB5X25	
266	S2204661	Bolt. Hex Socket Head	28	BB6X16	
267	S2204861	Bolt. Hex Socket Head	38	BB6X20	
268	S2205061	Bolt. Hex Socket Head	10	BB6X25	
272	S2208861	Bolt. Hex Socket Head	18	BB8X20	
273	S2209061	Bolt. Hex Socket Head	6	BB8X25	
274	S2209261	Bolt. Hex Socket Head	24	BB8X30	
281	S2212661	Bolt. Hex Socket Head	20	BB10X50	
286	S2222261	Bolt. Hex Socket Head	6	BB16X80	
291	S3520486	Screw. Set (Hex. S/Head)	9	BQ8X12	
292	S3520596	Screw. Set (Hex. S/Head)	2	BQ10X12	
320	S6002070	Bearing. Ball(Radial)	1	#6207	
323	S6500301	Ring. Retaining(Shaft)	2	RS30	
324	S6500351	Ring. Retaining(Shaft)	1	RS35	
325	S6500721	Ring. Retaining(Shaft)	1	RS72	
347	S8010650	O-Ring	1	G65	
348	S8010850	O-Ring	1	G85	
349	S8010950	O-Ring	2	G95	
350	S8011200	O-Ring	1	G120	
351	S8011600	O-Ring	1	G160	
353	S8012800	O-Ring	1	G280	
355	S8201342	Seal. Oil	1	SM30X45	

※ Spindle Housing Assembly


No.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
1	B14111011C	Boring Spindle	1	SALCrMo1(SACMI)	
2	B14111021B	Milling Spindle	1	SALCrMo1(SACMI)	
4	B14111042D	Spindle Housing	1	SCM435	
5	B14111053A	Flange	1	SM45C	
6	B14111103D	Labyrinth Spacer	1	SM45C	
9	B14111173A	Wiper Cap	1	SM45C	
15	B14110224A	Key	2	SCM435	
16	B14111243A	Front Bush	1	AlBc3	
22	B14111334	Connector	1	SM45C	
23	B14111363B	Draw Bar(1)	1	SCM440	
25	B14111394	Outer Collar(1)	1	SM45C	
26	B14111414B	Inner Collar(1)	1	SM45C	
27	B14111404A	Outer Collar(2)	1	SM45C	
28	B14111424A	Inner Collar(2)	1	SM45C	
29	B14111434A	Bearing Spacer	1	SM45C	
33	B14111483B	Rear Labyrinth	1	SM45C	
134	R00210	Set Screw	4	BQ8×55	
136	R03280	Lock Nut (1)	1	SM45C	
144	R10719	Ang, Cont. Ball Bearing	1		SKF
145	R11245	Cyl. Roller Bearing	1		SKF
156	R55374	Quad-Ring	2	QRAR04219	

No.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
163	R56101	Scraper	1	WD1701300	
164	R56103	Quad-Ring	1	Q4251	HANSUNG
165	R76628A	Collet(DIN50)	1	APPRVD DRAW	
166	R76629	Collet(BT50)	2	AS APPRVD DRAW	
169	S2203761	Hex Socket Head Bolt	6	BB5×30	
177	S2209261	Hex Socket Head Bolt	10	BB8×30	
182	S2212361	Hex Socket Head Bolt	12	BB10×35	
189	S2221861	Hex Socket Head Bolt	12	BB16×60	
220	S8012600	O-Ring	1	G260	
222	S8013000	O-Ring	2	G300	
233	B13115074	Adjusting Collar	1	SM45C	

※ Spindle Tool Unclamp Cylinder

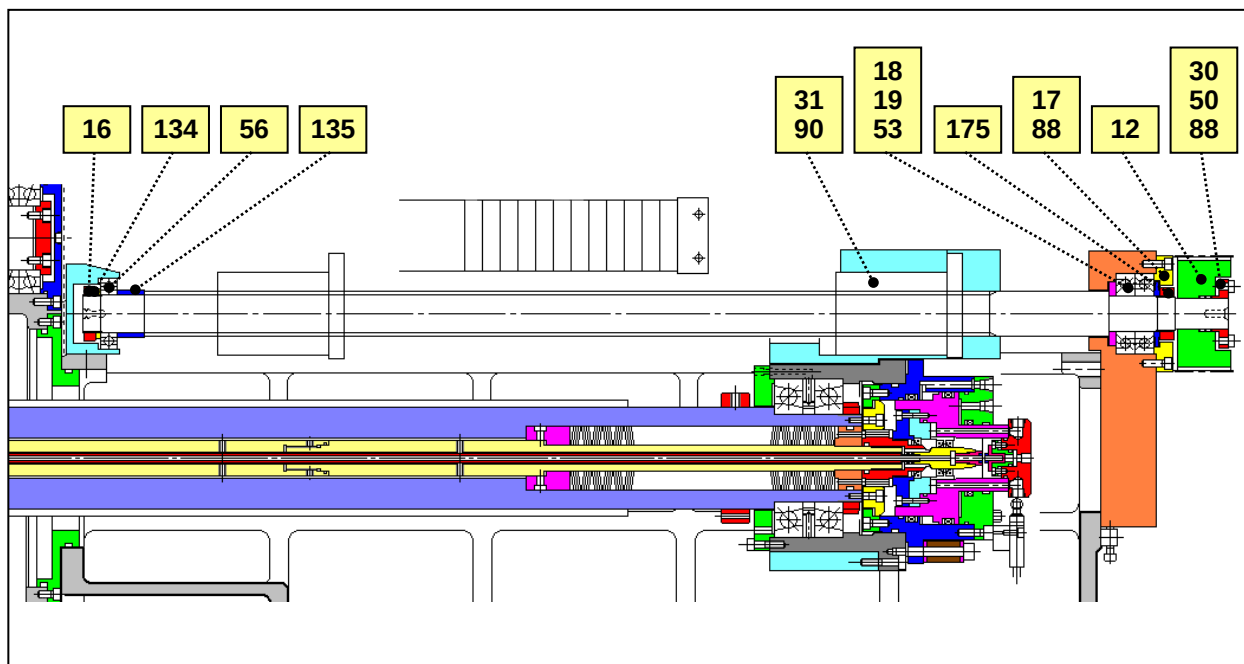




No.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
1	B14120011H	Tail Bracket Body	1	GC30	
20	B14120262	Bearing Housing	1	SM45C	
21	B14120273	Bearing Cap	1	SM45C	
32	B13120063	Inner Collar	1	SM45C	
33	B13120073	Outer Collar	1	SM45C	
34	B13120083A	Lock Nut	1	SM45C	
38	C40011684A	Disc Spring	6	S266650	
44	P57206040	Taper Pin	2	TPB6×40	
54	R10153B	Ang. Cont Ball Bearing	1	7220ATYDBC9P5	NSK
58	S8000080	O-Ring	1	P8	
59	S8000100	O-Ring	2	P10	
81	S2201761	Hex Socket Head Bolt	6	BB4×14	
85	S2205061	Hex Socket Head Bolt	12	BB6×25	
88	S2209061	Hex Socket Head Bolt	52	BB8×25	
89	S2209361	Hex Socket Head Bolt	12	BB8×35	
111	S8000280	O-Ring	1	P28	
112	R27053C	Rotating Union	1	1129-018-137	FOR TSC
113	S8000070	O-Ring	1	P7	
114	S5000301	Plain Washer	10	ZP6	
116	B14120492B	Cylinder	1	SM45C	
117	B14111314A	Collar	1	SCM415	
122	C60014104	Hex Socket Head Bolt	6	SM45C	
124	C40011704	Washer	12	SM45C	
125	P51400010	Conical Spring Washer	8	ZC10	
126	P57108040	Parallel Pin (Tap)	1	SPB8×40	
127	S2209261	Hex Socket Head Bolt	12	BB8×30	
128	S2212061	Hex Socket Head Bolt	11	BB10×25	
130	S8000630	O-Ring	1	P63	
131	S8011600	O-Ring	1	G160	
132	S2205261	Hex Socket Head Bolt	4	BB6×30	
133	S8010450	O-Ring	1	G45	
137	R53298	Quad Ring	1	QRAR04337	HANSUNG
138	R54344	Back-up Ring	2	BP4900750	HANSUNG

No.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
139	R53299	Quad Ring	1	QRAR04432	HANSUNG
140	R54343	Back-up Ring	2	BP6401372	HANSUNG
141	R53297	Wear Ring	1	GR6900750	HANSUNG
142	R53196	Wear Ring	1	GR65-408L	HANSUNG
143	R53194	Quad Ring	1	QRAR04430	HANSUNG
144	R54033	Back-up Ring	2	BP6401300	HANSUNG
145	R55362	Oil Seal	2	AD25×40×7. NBR	HANSUNG
146	S8201342	Oil Seal	1	SM30×45	
152	C68011683B	Disc Spring	1	SK5M	78EA
154	B14129023B	Rotary Shaft	1	SCM415	
155	B14129033A	Pusher	1	SCM440	
156	B14129043A	R.Shaft Housing	1	SM45C	
157	B14129053B	Stopper	1	SCM415	
159	B14129073A	Piston	1	SM45C	
160	B14129083	Adapter	1	SM45C	
161	B14129092C	Cylinder Cap	1	SM45C	
162	B14129104B	Spacer	1	SM45C	
163	B14120594	Adjusting Collar	1	SS400	
164	B14129123	Clutch	1	SM45C	
166	S8011450	O-Ring	1	G145	
167	P51400008	Conical Spring Washer	24	ZC8	
168	S8010800	O-Ring	1	G80	
169	S8010400	O-Ring	1	G40	
172	P78120818	Orifice	1	FOC1.8	
188	C68011744	Adjusting Collar	1	SS41	
231	245071	Nylon Piece	4	D4×4	
235	B13117373A	Balancing Collar	1	SM45C	

※ Ball screw on the W axis

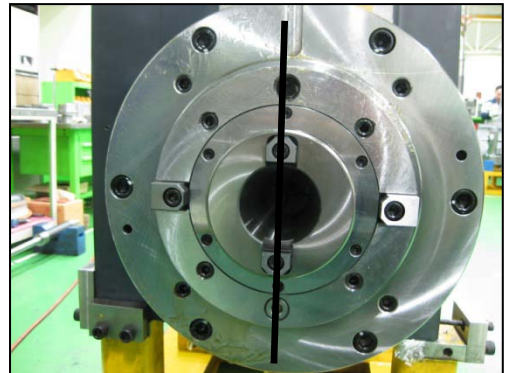


No.	Part No.	Description	Q'ty	Spec.	Mat./Remarks
12	B14120173	Timing Pulley	1	SM45C	
16	B14120223A	Lock Nut	1	SM45C	
17	B14120213A	Bearing Cap	1	SM45C	
18	B14120244	Collar	1	SM45C	
19	B14120254	Collar	1	SM45C	
30	B10121184	Span Ring Flange (2)	1	SM45C	
31	B13120022B	Ball Screw	1	50TTFJ10-12955C5	RSUBAK1
50	R08010	Span Ring	2	SCE-35x40	
53	R10024	Ang. Thrust Ball bearing	1	40TAC90BDBC10N7A	NSK
56	S6003280	Ball Bearing	1	#6208UU	
88	S2203061	Hex Socket Head Bolt	52	BB8×25	
90	S2212461	Hex Socket Head Bolt	6	BB10×40	
134	B14120524	Collar	1	SM45C	
135	B14120534	Collar	1	SM45C	
175	R03263	Lock Nut	1	M40×1.5	

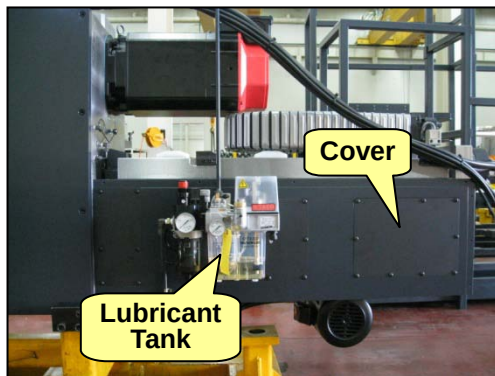
1.1 Disassembling the tool unclamp cylinder

※ Preparations for disassembling the tool unclamp cylinder

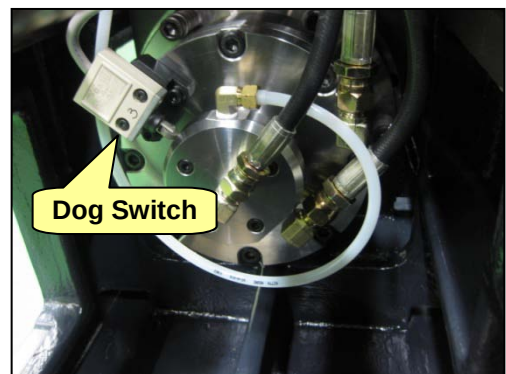
- (1) Secure room for work between front spindle head and electric cabinet and clean up the room.
- (2) Perform the spindle orientation and pull out the tool from the spindle, if any.
- (3) Manually perform the tool unclamping and use the 8mm hex wrench to remove the collet from the spindle. Then, perform the tool clamping.
- (4) Move the Z axis backward to prevent interruption by the splash guard.
- (5) Pull up the W axis forward by 300mm.
- (6) To facilitate the work on the tool unclamp cylinder, turn the spindle so that the spindle key aligns vertically.
- (7) Turn off the machine and proceed with the disassembling work.



- 1) To facilitate the disassembling of the tool unclamp cylinder, remove the spindle bearing lubricant tank on the front tail bracket as well as the cover.



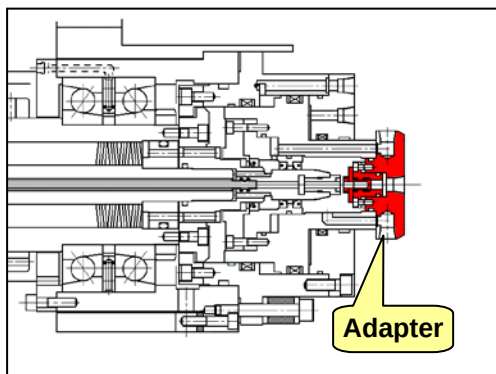
- 2) Use a marker pen to mark the position of each hose that is connected to the tool unclamp cylinder as well as the dog switch (for sensing the tool unclamping) before removing them.



3) Remove B14129083 adapter.

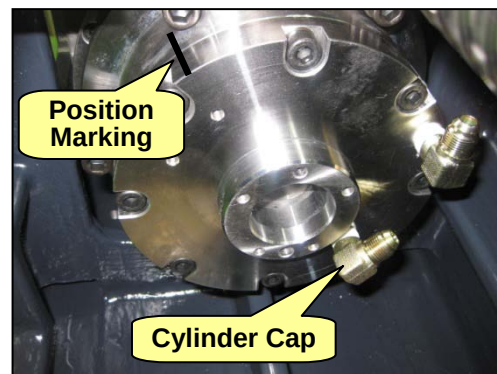
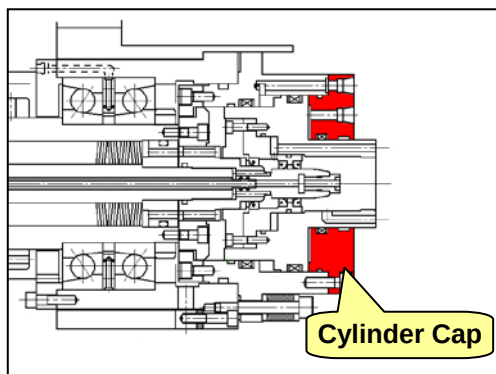
- 4-BB6×25

※ Take caution not to lose the O-ring.



4) Draw a marking line on the side of B14129092C cylinder cap before removing it.

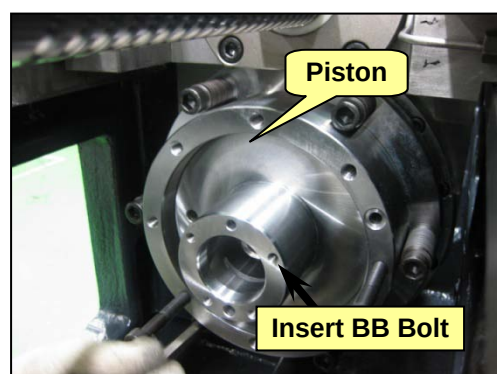
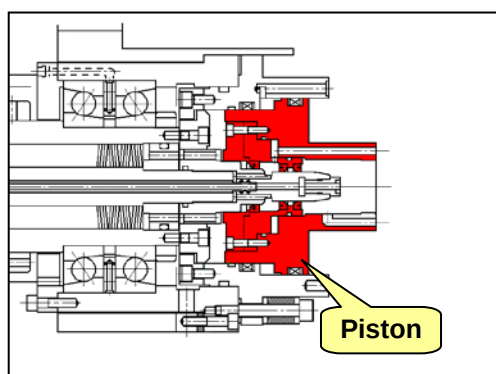
- 8-BB10×25, 8-ZCS



5) Remove B14129073A piston.

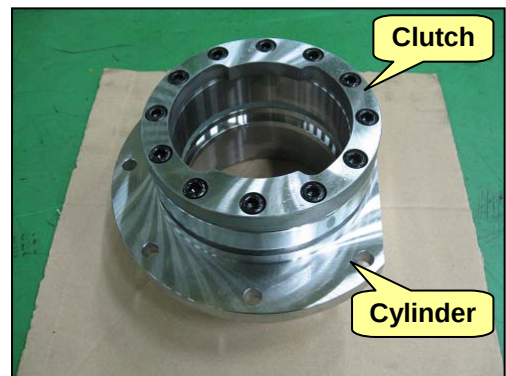
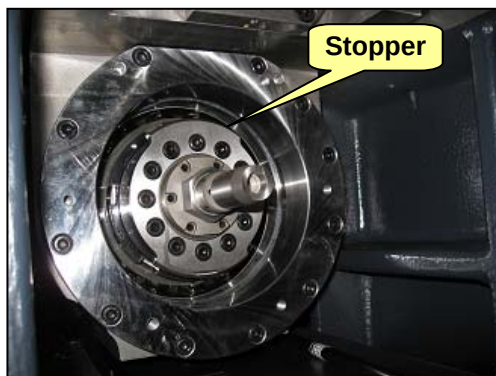
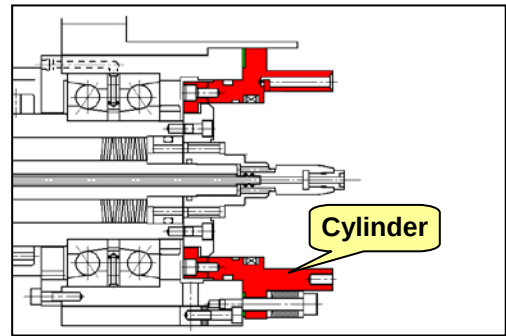
For easier removal, insert a bolt (BB6x30 or larger) into the adapter tap and use a pin puller to remove the piston. Pay attention to the balance while doing this.

※ Take caution not to lose the O-ring.



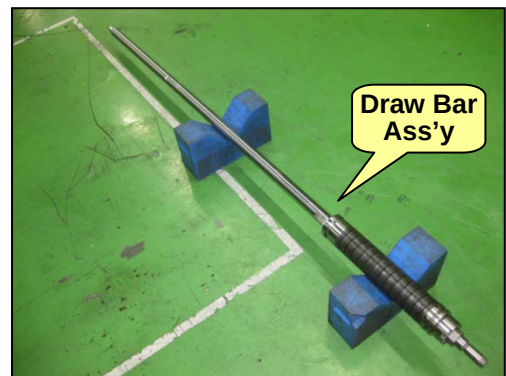
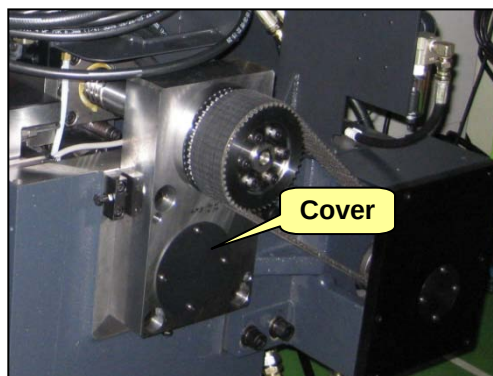
6) Check the direction of the end cap and loosen the spring bolts (x6). Then, remove B14120492B cylinder while taking caution not to lose the O-ring.

- The spindle key should align vertically so that it fits with the clutch hole in the cylinder.
- ※ Take caution not to lose the adjustable collar that is designed to control the tool unclamp stroke.



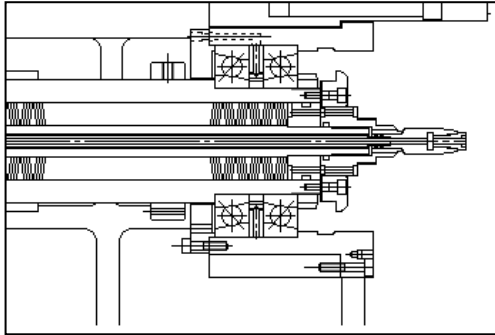
※ If you want to replace the draw bar only, remove B14129164 cover, B14129053B stopper and collet and pull out the draw bar assembly to the rear of the tail bracket.

- 4-BB6×12

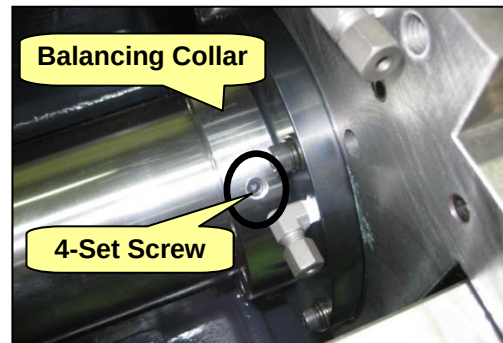
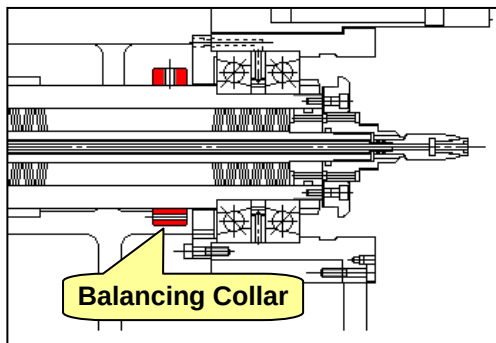


1.2 Disassembling the boring spindle

- ※ Before you can disassemble the boring spindle, the tool unclamp cylinder should be removed beforehand.

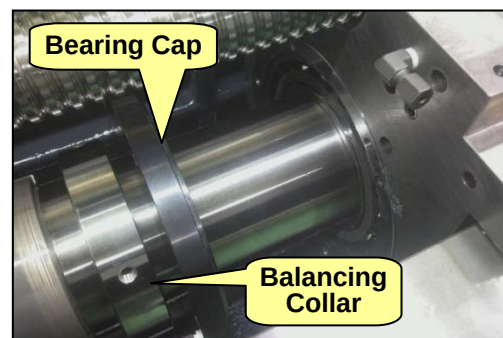
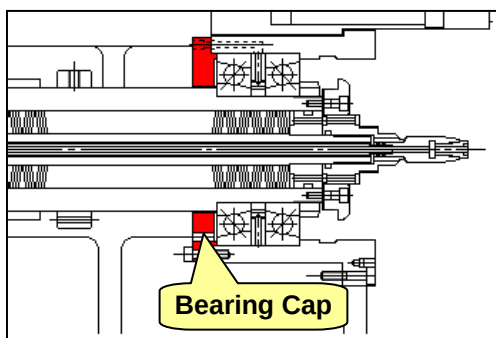


- 1) Mark the position of B13117373A balancing collar and loosen 4 set-screws slightly so that the collar can move.



- 2) Remove the bearing lubricant pipe before removing B14120273 bearing cap.

▪ 6-BB8×35

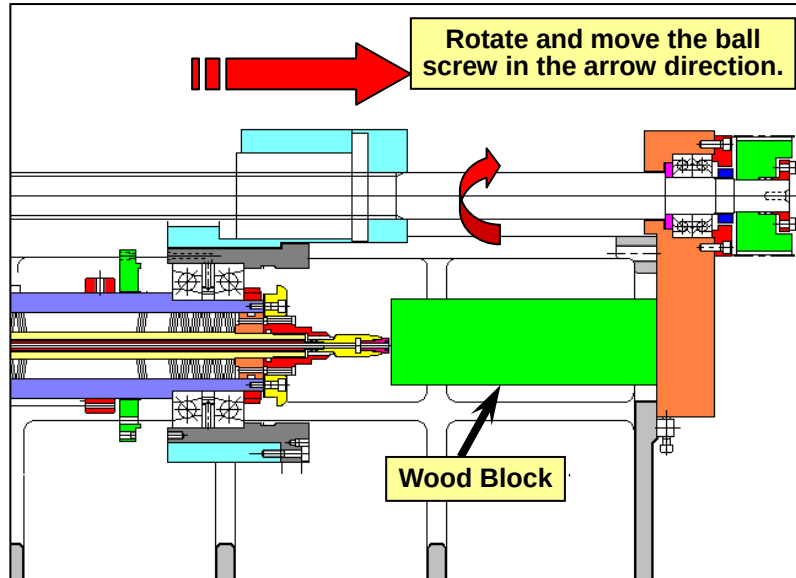


- 3) Before you can remove the bearing from the housing, the hydraulic line for the W-axis clamping device should be disconnected beforehand so that you can turn the ball screw smoothly.



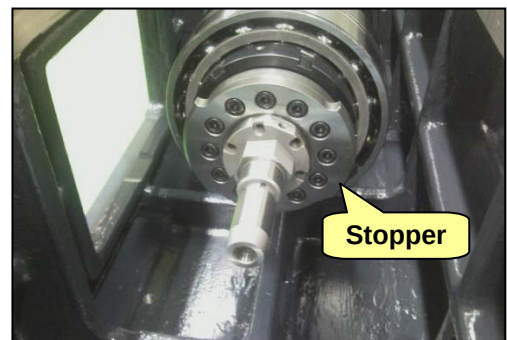
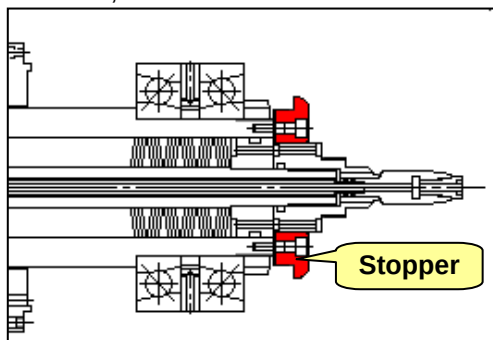
4) Place a wood block (over 200mm) inside the tail bracket and move the W axis to the rear to check if the wood block is fixed between draw bar and tail bracket. Keep turning the ball screw to move the boring spindle to the rear, which will separate the bearing from the housing gradually.

※ The bearing may be damaged while being removed from the housing. So separate the bearing with care lest that it be stuck between.



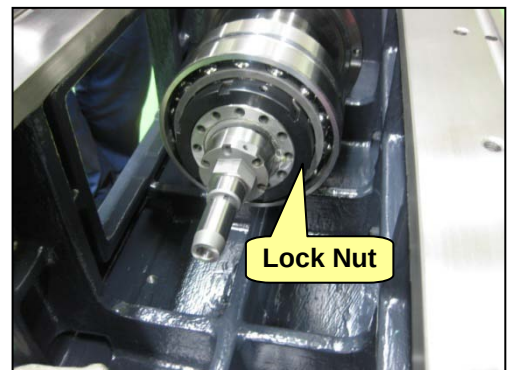
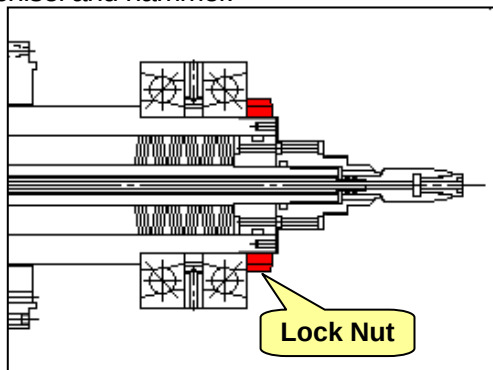
5) Remove B14129053B stopper.

▪ 12-BB8×30, 12-ZCS8



6) Loosening B13120083 lock-nut.

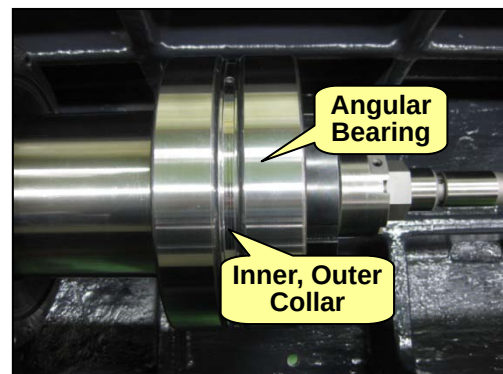
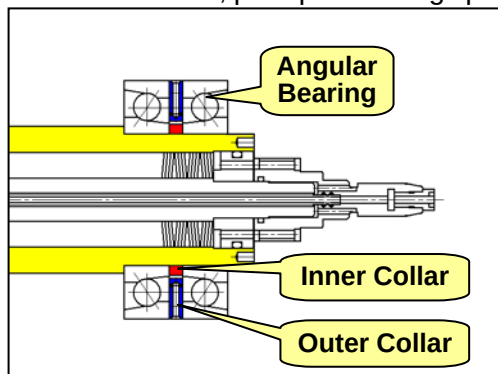
Loosen the set-screw that is designed for locking the lock-nut, and remove it by impacting with the chisel and hammer.



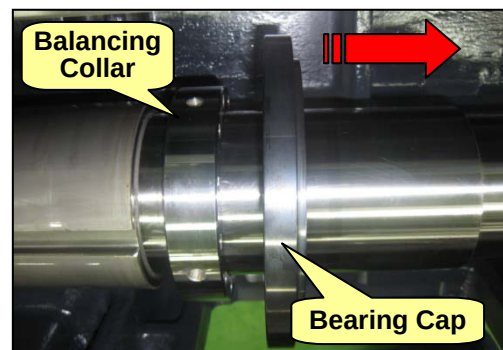
7) Removing the rear bearing

Remove R10153 angular bearing, B13120022B inner collar and B13120063 outer collar.

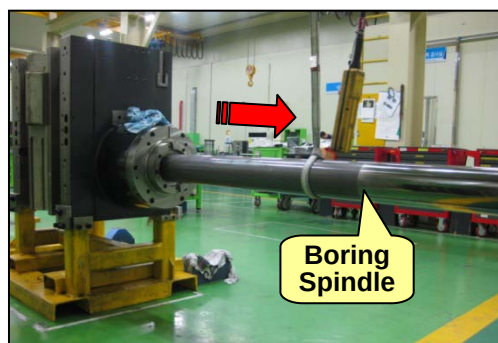
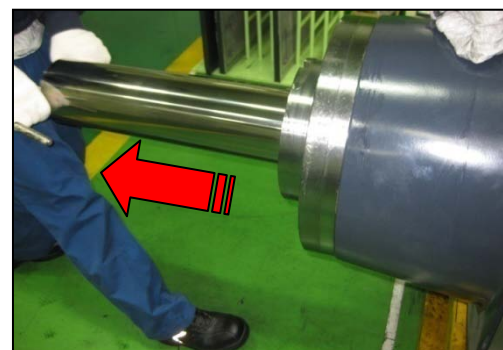
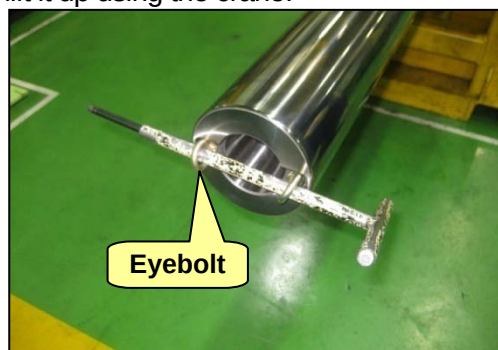
- To facilitate the work, pull up the boring spindle.



8) Remove B13117373A balancing collar and B14120273 bearing cap.

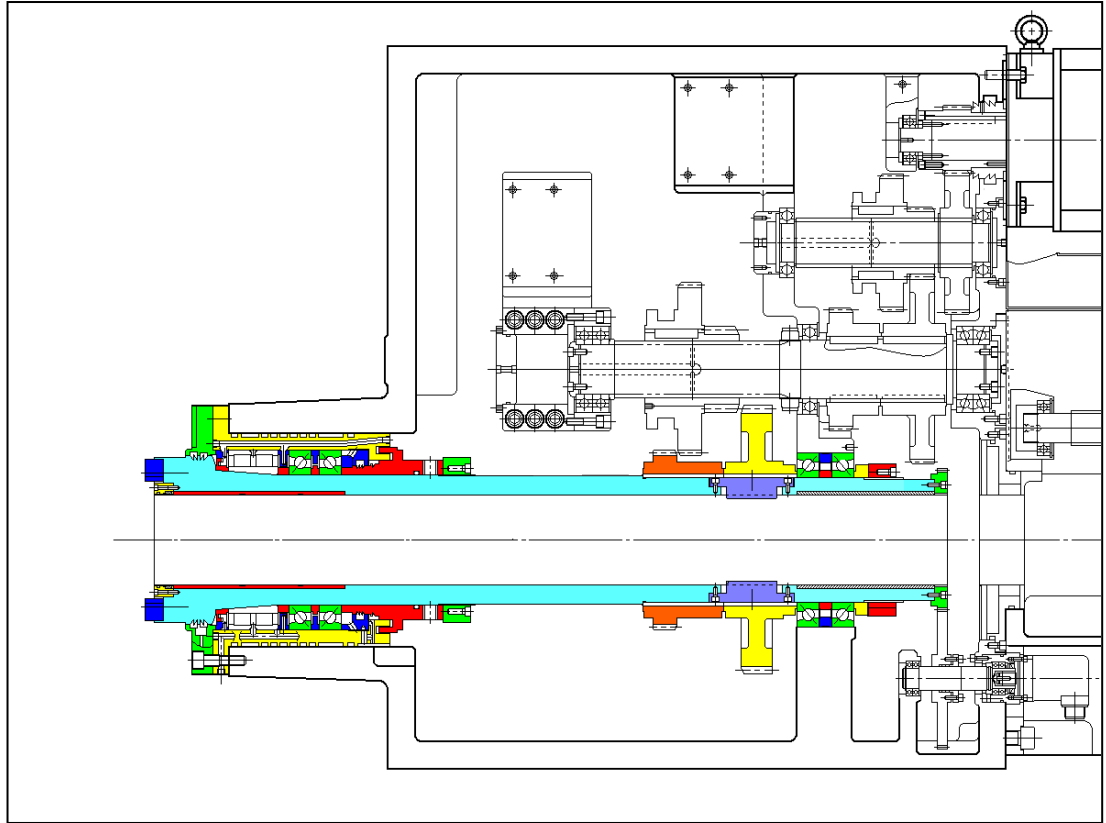


9) Insert two eyebolts in the front of the boring spindle, hook a metal pipe between the eyebolts as a handle, and use the pipe to pull out the boring spindle from the spindle. By the time it comes out about half of its length, hook a rope in the middle of the protruding boring spindle and lift it up using the crane.



1.3 Disassembling the spindle cartridge

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



1) Removing B14116012D front cover

Remove the front cover to reveal the inside of the spindle.

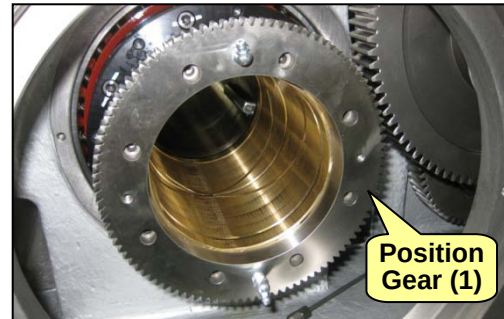
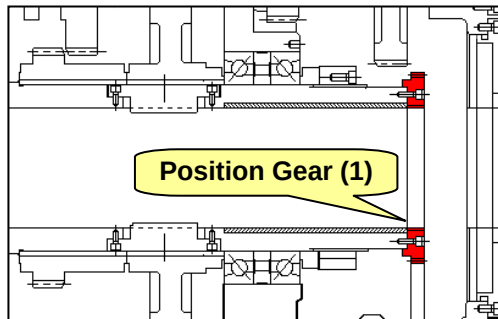
- 12-BB10×40



2) Remove B14111183A position gear (1)

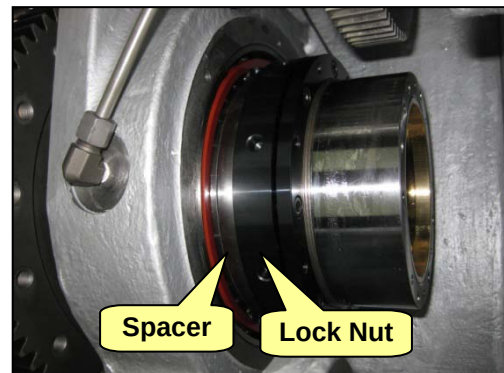
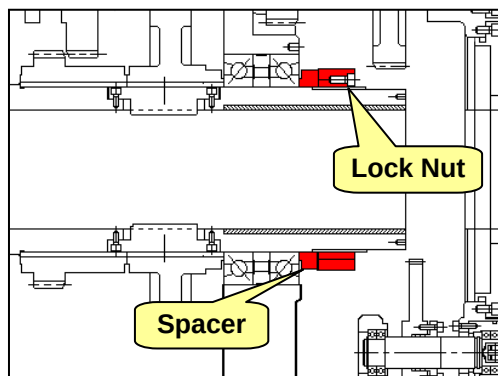
Draw a marking line between position gear (1) and milling spindle body before removing the gear.

- 8-BB6×25



3) Loosening R02164 lock-nut.

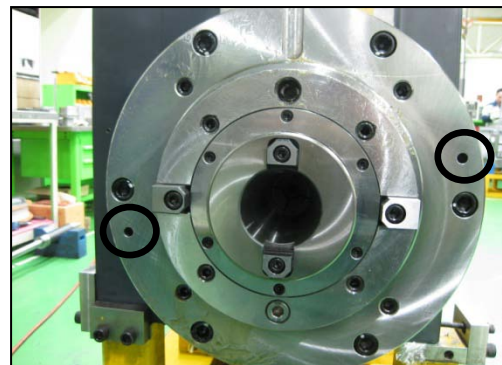
Loosen the BB bolts on the lock-nut, and remove the lock nut by impacting with the chisel and hammer. Then, pull out B14141104 spacer.



4) Removing B14111053B flange

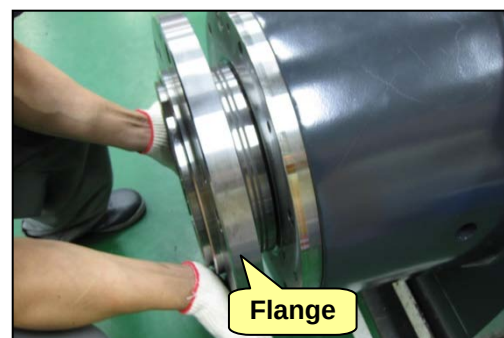
- ① Use the pin puller to pull out the taper pins in the marked positions as shown.

- 2-TPB10×56



- ② Draw a marking line on the side of B14111053B flange before removing it with care.

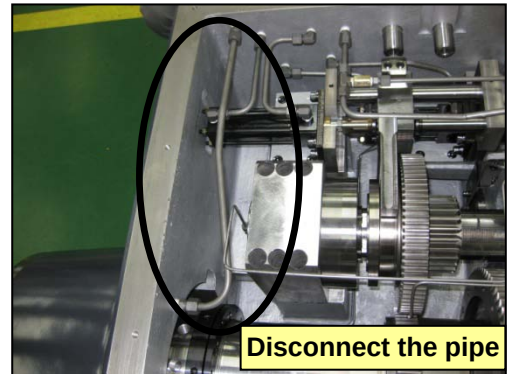
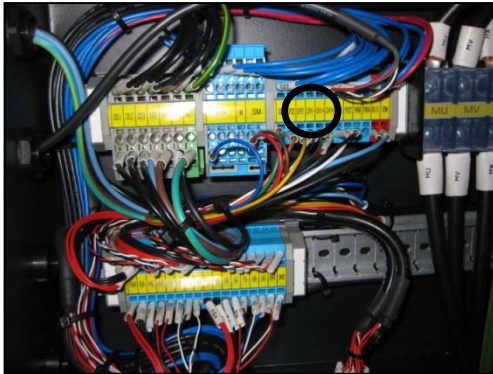
- 6-BB16×45



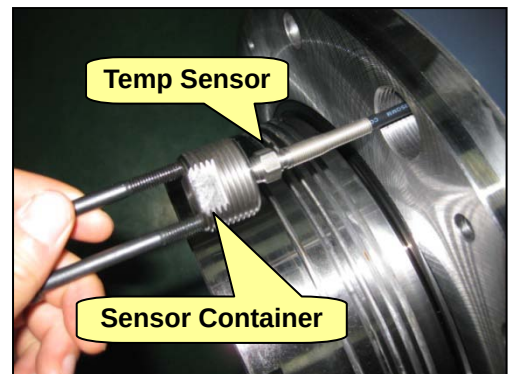
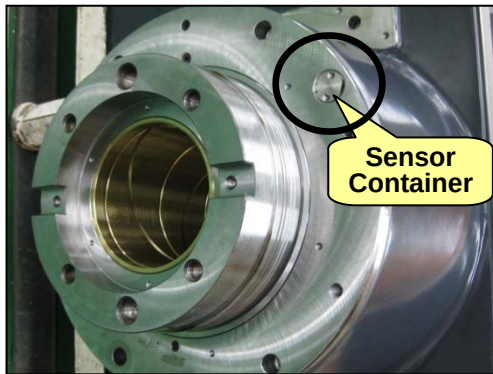
5) Removing the temperature sensor

- ① Before you can remove the temperature sensor in the front of spindle cartridge, open the terminal box in the side of the tail bracket and locate the wires with CH numbering (CH-, CH+, CH+) and unplug them from the terminal box. Then, disconnect the pipe inside the spindle head as shown.

※ If you remove the spindle cartridge without removing the temperature sensor, the sensor will be severely damaged. So ensure that the temperature sensor should be removed before you remove the cartridge.



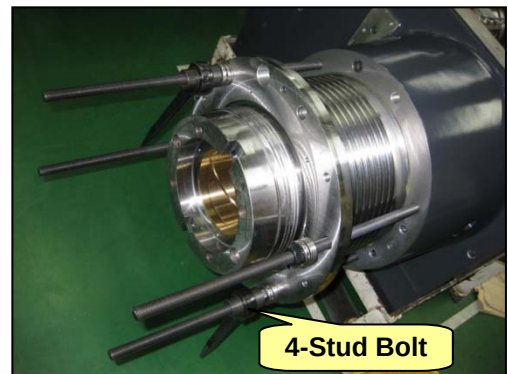
- ② Loosen B14111553 sensor container in the front of the spindle using the BB bolt, and remove the temperature sensor along with the sensor cable from the spindle head with care lest that they should be damaged.



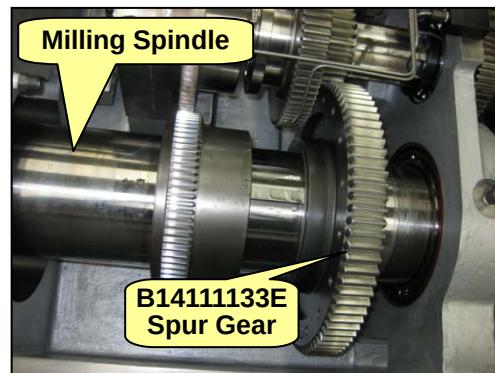
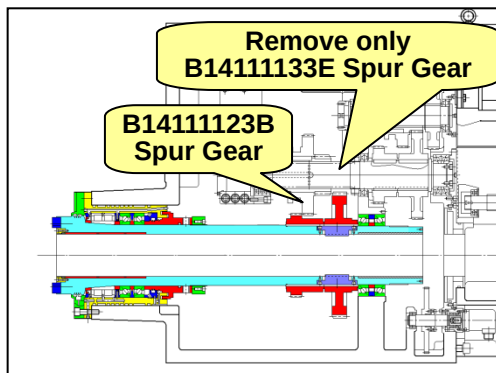
6) Removing B14111042F spindle housing

- ① Loosen the bolts (6-BB16×55) on the spindle housing, and insert 350mmmm or longer M12 stud bolts (x2) into the place of the tap (2-M12, for removing the spindle head). While adjusting the balance slowly, pull out the spindle cartridge.

▪ 6-BB16×55



- ② Remove the spindle cartridge from both head body and milling spindle with care lest that the spur gear should be damaged.
 - ※ From two spur gears, remove B14111133E spur gear alone and leave B14111123B as it is. This is enough for you to remove the spindle cartridge.

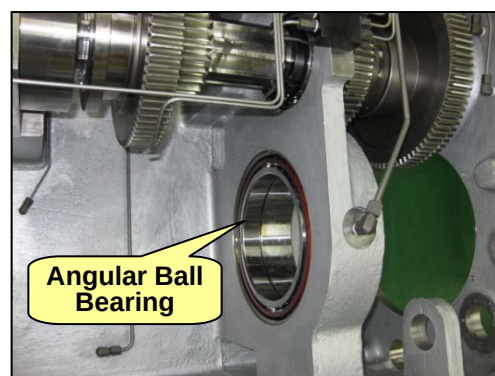
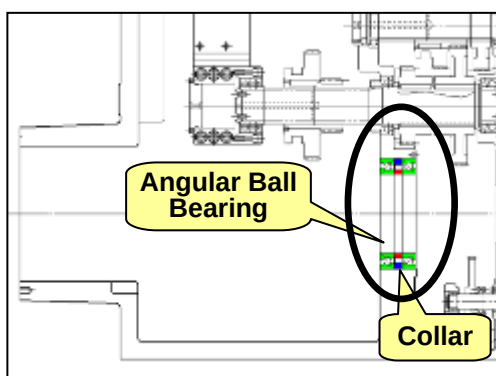


- ③ By the time the spindle housing comes out by 2/3 of its length, hook a rope between spindle housing and crane with care lest that the spindle cartridge should fall off. Insert a 1.5m or longer wood support or pipe (with a cloth wrapped) into the inner race of the spindle. Lift up the cartridge while keeping it balanced lest that the rear should sag.



7) Removing the rear bearing

Remove R10751 angular contact ball bearing and B14141094 collar from the spindle head body.



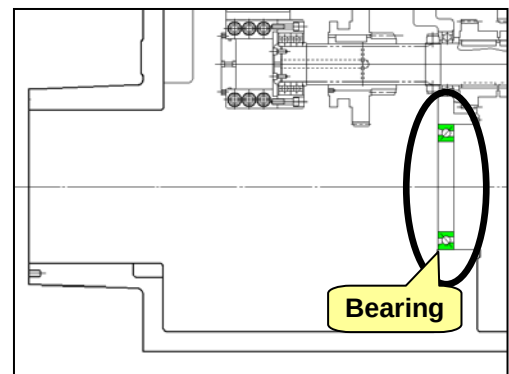
1.4 Installing the spindle cartridge

※ Preparations for installing the spindle cartridge

- (1) Clean up the spindle cartridge and other component parts to remove. (Apply grease thinly to the installation site of the spindle head body after cleaned up)
- (2) Place the spindle cartridge vertically and use the crane to lift up the boring spindle. Install it into the spindle cartridge temporarily and check if the boring spindle fits with the drive key.
 - ※ By factory default, the drive key is fitted with the boring spindle. So you just check if they fit with each other, not remove them on your site.
- (3) Install the gear into the spindle as appropriate and check if there is any problem. If you feel any interruption, use a file or sandpaper to smooth the drive key or gear. If there is no further problem, remove the parallel key and gear and clean them up for later use. Then, insert the lock-nut and check if there is any problem. If there is no problem, remove it for later use.
- (4) Insert G300 O-rings (x2) into the outer side of the spindle housing and apply grease to the installation site.

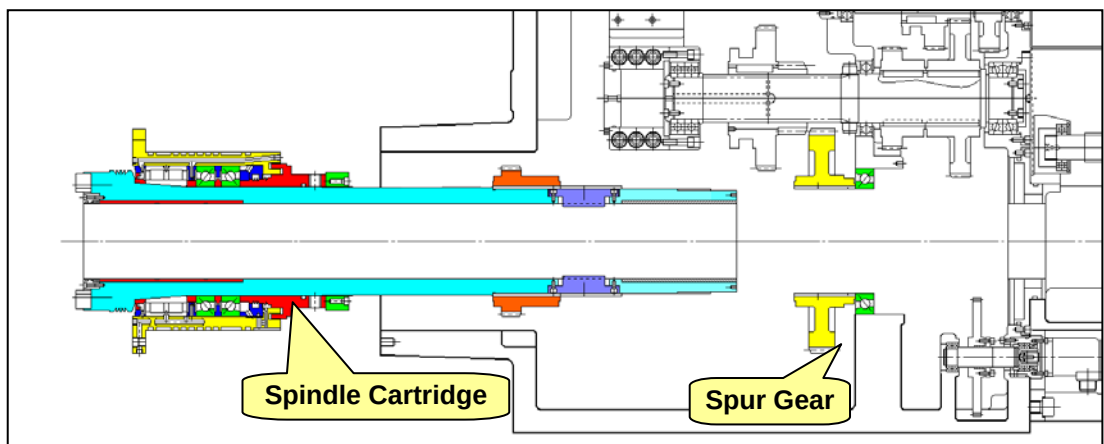
1) Installing the rear spindle bearing

Insert one of two R10751 angular contact ball bearings into the rear spindle bearing installation site to secure support for the rear spindle when installing the spindle cartridge.



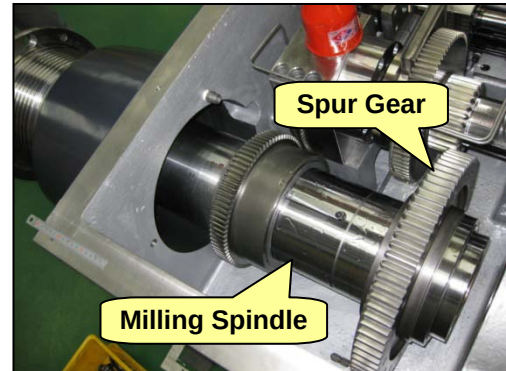
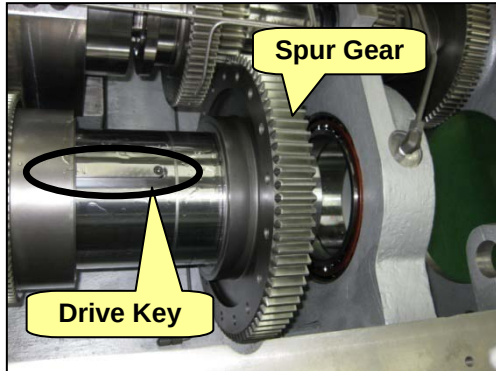
2) Installing the spindle cartridge

- ① Hook a rope between spindle cartridge and crane, and lift up the cartridge. Insert a 1.5mm or longer wood support into the spindle and keep its balance while moving it to spindle head. Then, insert the support in the exact center of the spindle head body.



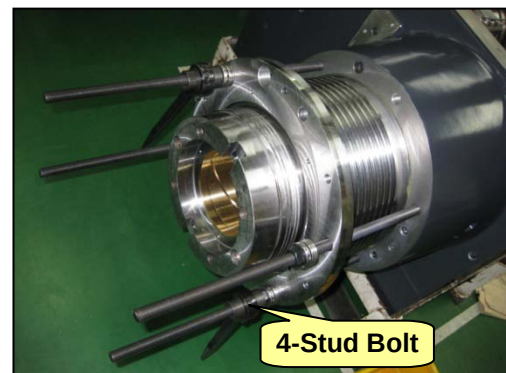
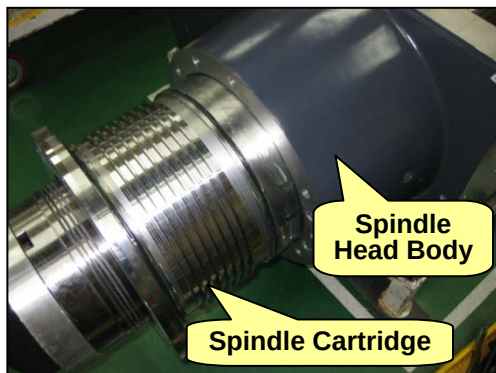
- ② Since the spindle cartridge is longer at the rear side, insert B14111133E spur gear into the spindle body so that it fits with the drive key hole before installing the bearing housing into the spindle head body.

※ Before installing the spur gear, apply lubricant or W40 to the milling spindle evenly in an attempt to facilitate the work.

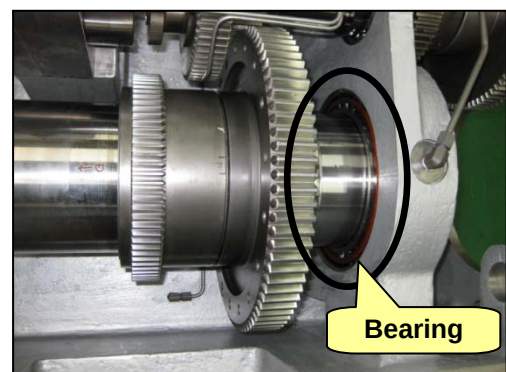


- ③ When the spindle cartridge starts inserted into the spindle body head, insert 400mm or longer M16×2.0 stud bolts (x4) into the tap place (for fixing the bearing housing) and adjust the balance by tightening the nut slowly while pushing in the cartridge.

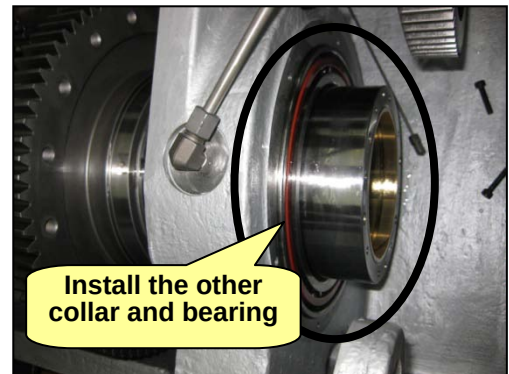
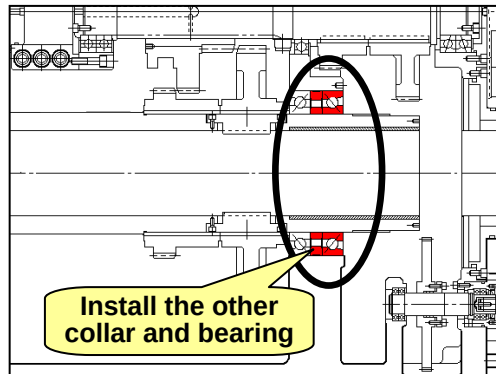
※ Care must be taken when inserting the O-ring lest that it should be damaged.



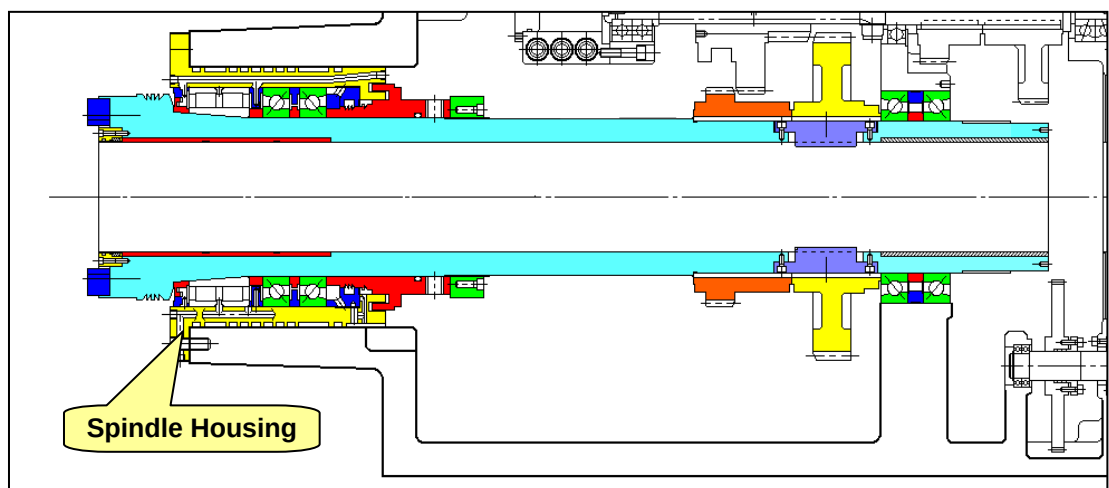
- ④ Keep pushing in the spindle cartridge along with the spur gear inch by inch. By the time the spindle cartridge starts inserted into the rear bearing on the spindle head body, keep it balanced while inserting it.



- ⑤ Just before the spindle cartridge is inserted to the end of the spindle head, put together the rear collar with the bearing and proceed.
- ※ If the spindle cartridge is inserted to the end of the spindle head body, you couldn't put together the collar with the bearing due to interruption by the gear.

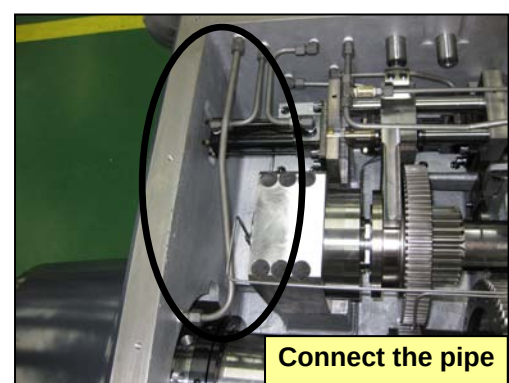
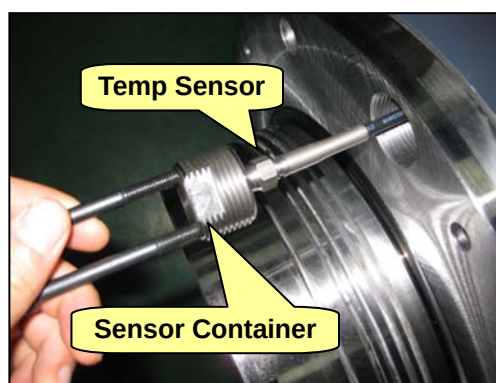


- ⑥ When the spindle cartridge is installed completely, fix it with the bolts.
- 6-BB16×55



3) Installing B14111553 sensor container and temperature sensor

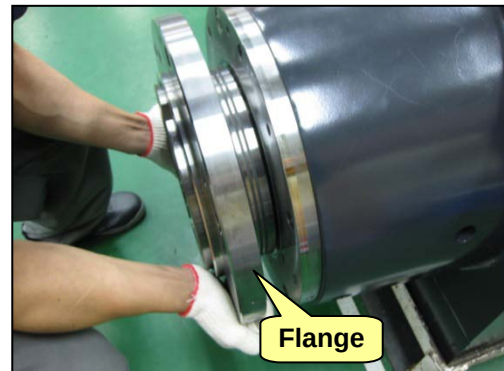
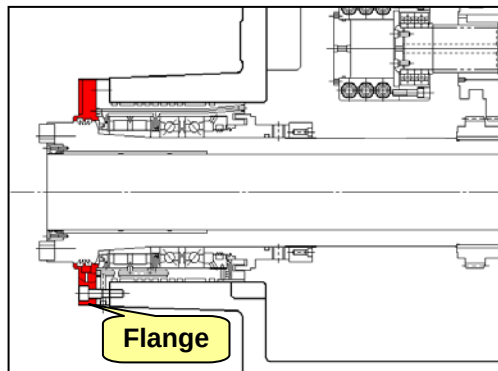
Install the sensor container and temperature sensor, and insert the sensor cable into the spindle head and into the pipe. Then, connect it to the terminal box.



4) Installing B14111053B flange

Install the flange based on the marking line that you have drawn in advance.

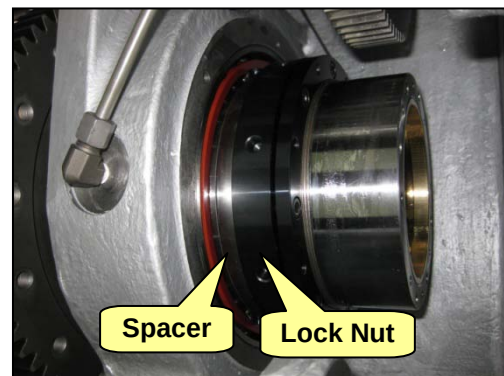
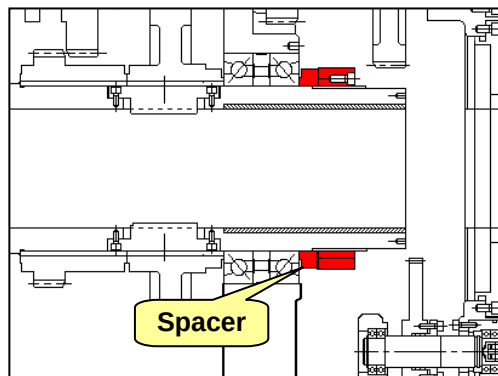
- 6-BB16×45, 2-TPB10×56



5) Installing R02164 lock-nut.

Install B14141104 spacer and lock-nut, and tighten the lock nut with the chisel and hammer. Then, tighten the bolts to fix the lock nut.

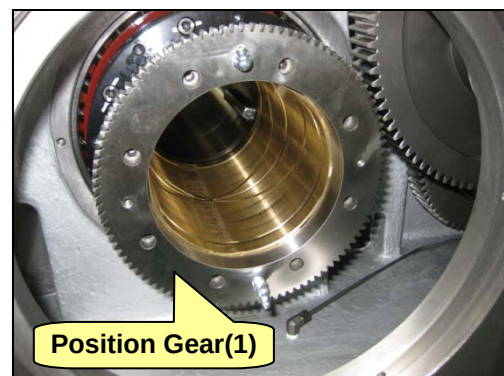
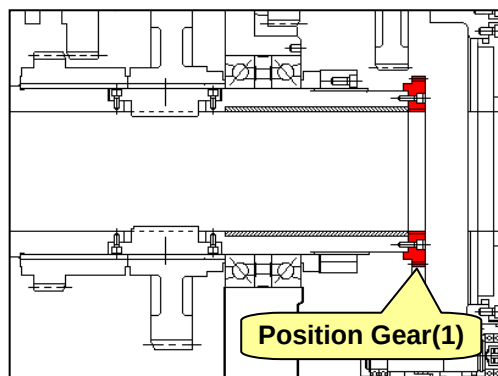
- ※ To prevent possible damage to the bearing, when you hear an impact sound indicating that the bearing contacts on the lock nut, impact on the lock nut again to fix it.



6) Remove B14111183A position gear (1)

Install B14111183A position gear (1) into the spindle body based on the marking line.

- 8-BB6×25

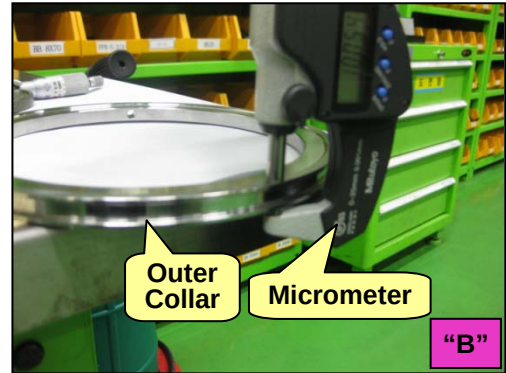


- ※ When you have re-installed the spindle cartridge, complete installing the spindle head before turning on the machine. Then, you must reset the spindle orientation.

1.5 Installing the boring spindle

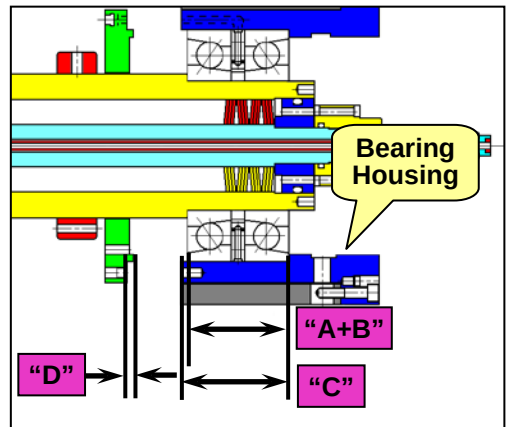
1) Fitting the bearing cap on site

- ① Before installing the boring spindle into the spindle cartridge, you must perform measuring for the fitting work on the rear B14120273 bearing cap.
- ② Measure the outer race of each bearing of R10153 angular bearing set. ("A")
- ③ Measure the outer race of B13120063 outer collar. ("B")



- ④ Measure the depth of B14120262 bearing housing. ("C")
 - ⑤ Use the formula below to calculate the target and fit the bearing cap on site accordingly. (D)
- ※ Sectional target size of the bearing cap:

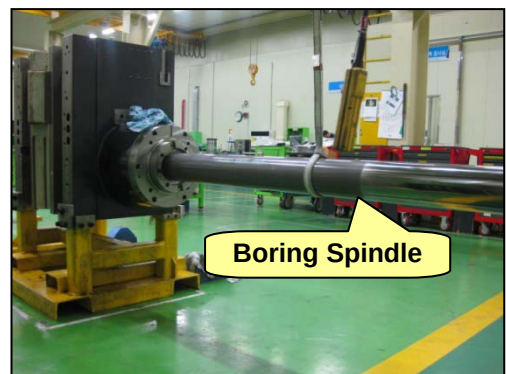
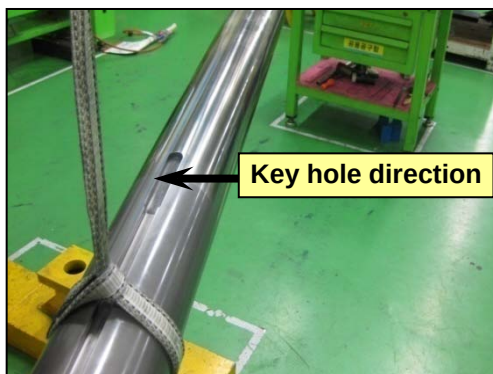
$$"D" = \{ "C" - ("A + B") \} + 0.03\text{mm}$$



2) Installing the boring spindle

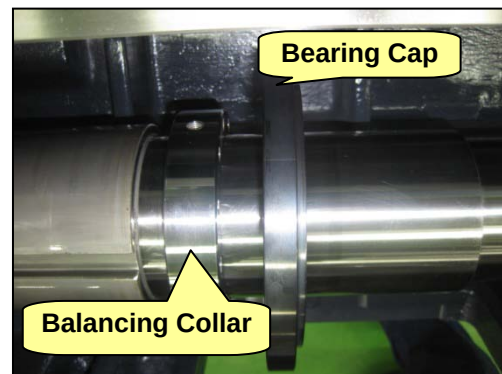
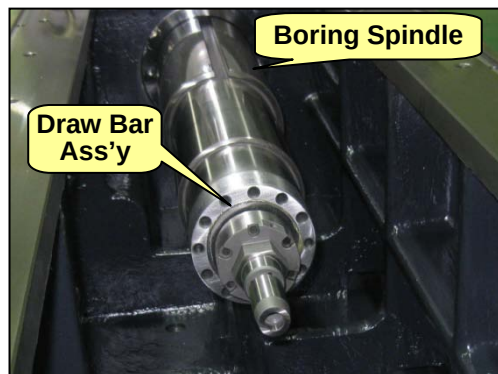
Hook a rope between B14111011C boring spindle and crane, and lift up the spindle while keeping it balanced. Then, insert it into the spindle with special care of the horizontal balance.

- ※ When inserting the spindle, the key should fit into the key hole with the applicable key number and in the right direction.



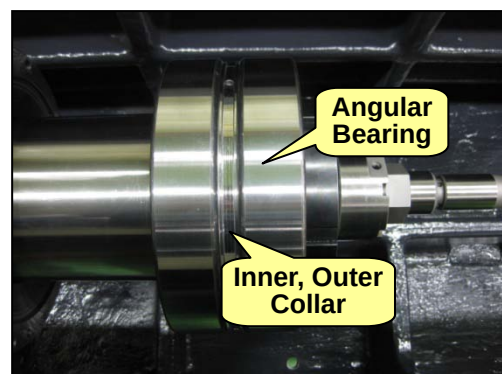
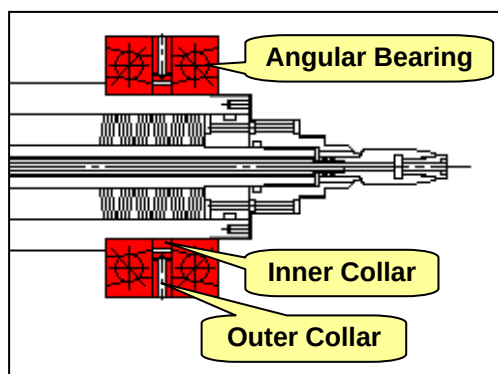
3) Inserting the balancing collar and bearing cap

Insert the draw bar if it had been removed, and insert B13117373A balancing collar as well as the completed B14120273 bearing into the boring spindle.



4) Installing the angular bearing

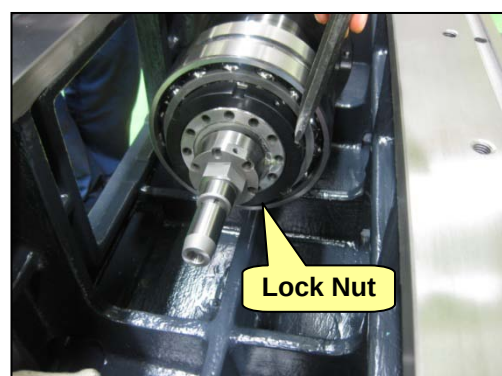
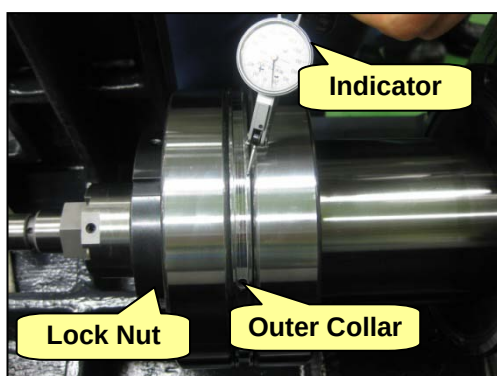
Insert R10153 angular bearing, B13120022B inner collar and B13120063 outer collar with care in sequence.



5) Installing the lock-nut

Tighten B13120083 lock nut slightly, and present the indicator to the outer collar. While adjusting the runout to below 0.03mm, impact on the lock nut using the chisel and hammer and tighten the set-screw to fix the lock nut.

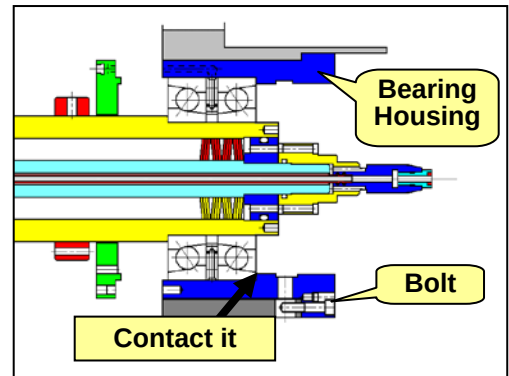
※ If you do not adjust the runout of the outer collar, installing the bearing housing may be interrupted by the outer collar.



6) Installing the bearing housing and rear bearing

While rotating the W-axis ball screw, move the bearing housing so that it contacts on the rear bearing.

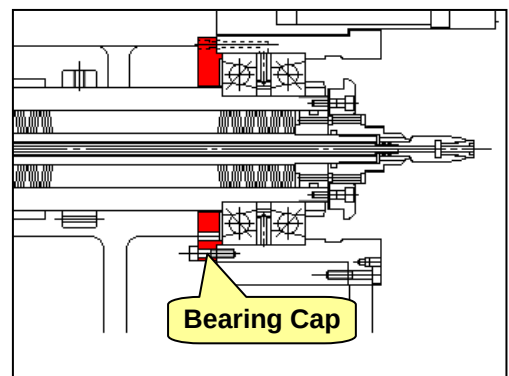
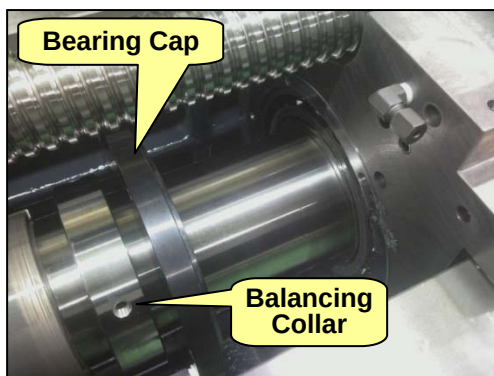
- Heat the bearing housing slightly to facilitate the installation.



7) Installing the bearing cap

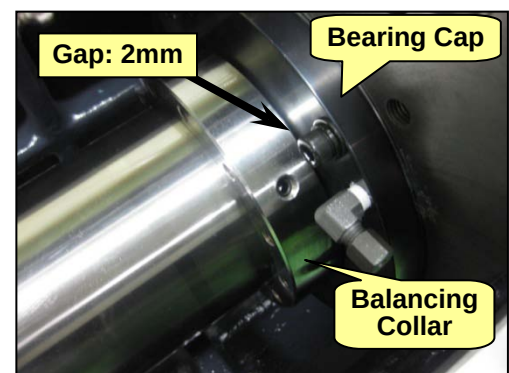
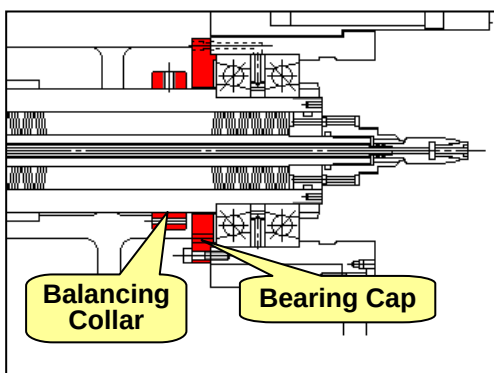
Install B14120273 bearing cap (that has been inserted in the boring spindle) into the bearing housing.

- 6-BB8×35



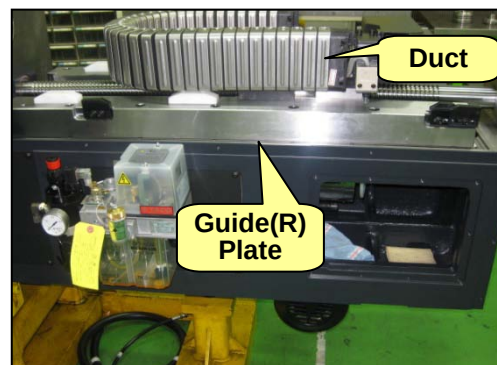
8) Fixing the balancing collar

Move up B13117373A balancing collar 2mm before the bearing cap and tighten the set-screw based on the marking line.

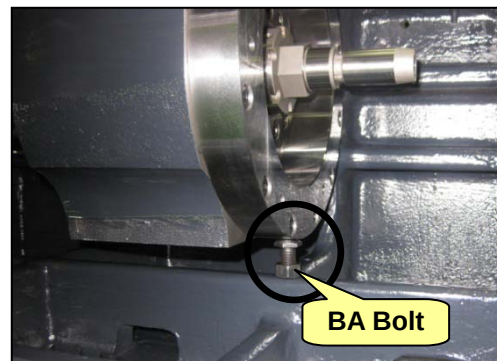


9) Adjusting the height of the boring spindle

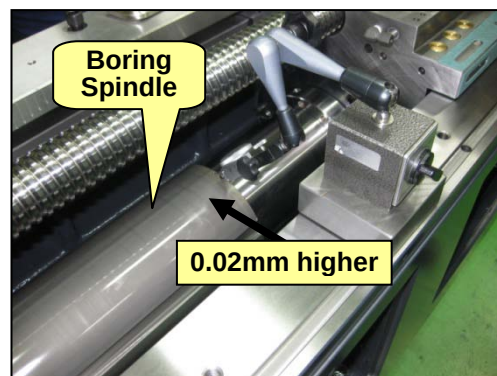
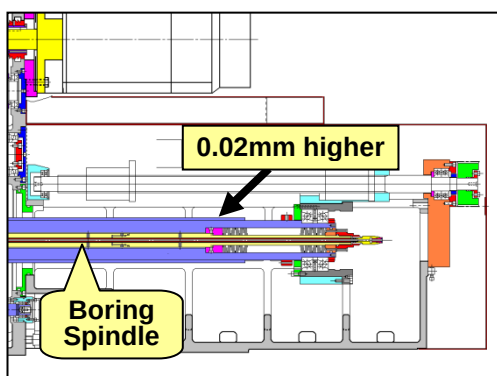
- ① Separate B14120072B guide ® plate from the wiring duct so that you can measure the height of the boring spindle.
 - 7-BB12×70



- ② Turn the ball screw to move back the boring spindle more than 540mm. Insert the bolts (B12×12) and nut to secure the bearing housing with the bolts (BA12×12).



- ③ Install the indicator on the grinded side and measure the height difference between either ends of the boring spindle. Then, Use the BA bolts to lift it up 0.02mm higher at the rear.



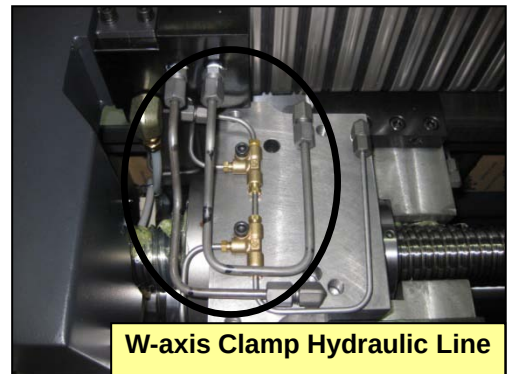
- ④ When done, tighten the bearing housing bolts while checking the height change.
 - 12-BB6×35



- ⑤ Put together B14120072B guide (R) with the duct. While rotating the ball screw manually, check if the boring spindle is installed properly.
- 7-BB12×70



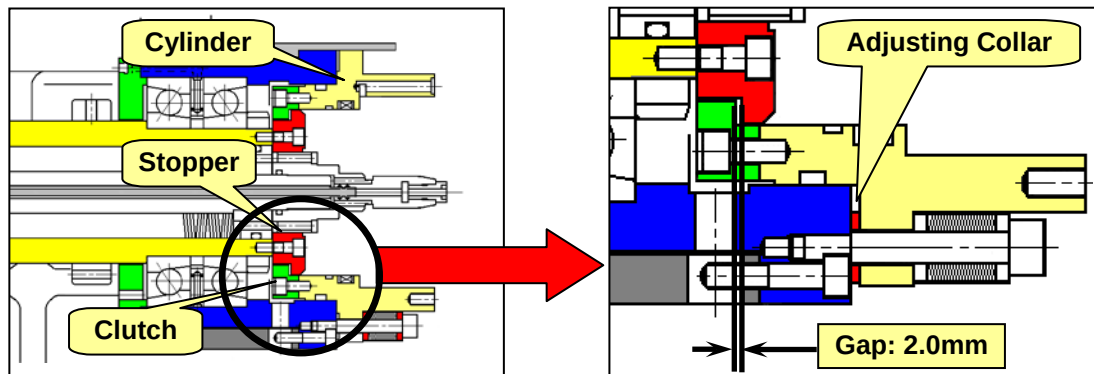
- 10) Installing the W-axis clamping hydraulic line
Connect the W-axis clamping hydraulic line back to the original.



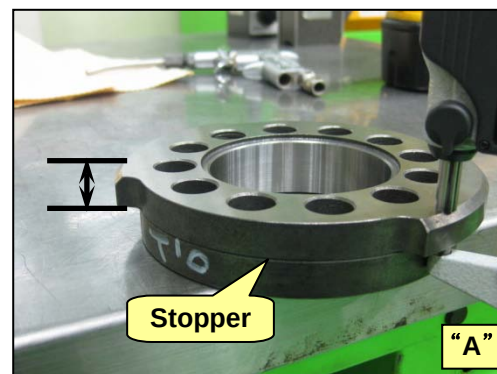
1.6 Assembling the tool unclamp cylinder

1) Fitting B14120594 adjusting collar on site

- ※ To install the tool unclamp cylinder, you must fit B14120594 adjusting collar on site before you can adjust the clutch gap between stopper and cylinder to the target (2.0mm).

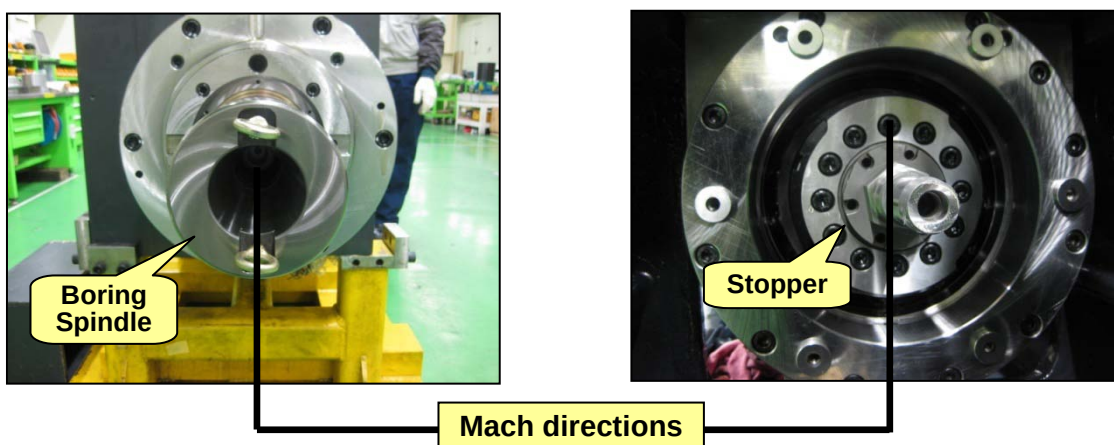


- ① Before installing B14129053B stopper, use the macrometer to measure the thickness on the cylinder contact. ("A")

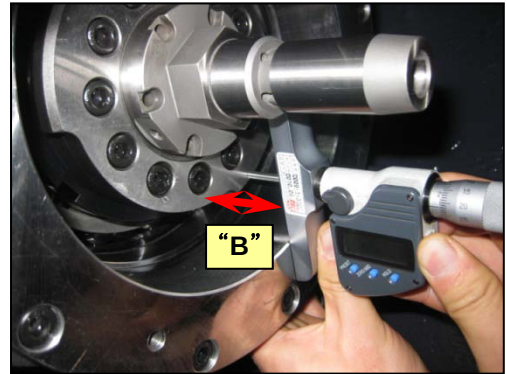
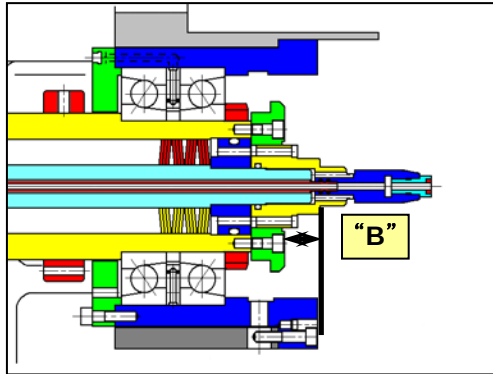


- ② Then, install the stopper into the boring spindle in the right direction.

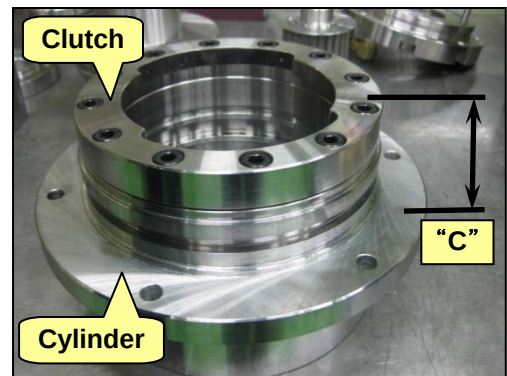
- ※ If you install in the wrong direction, the cylinder may be broken when performing the tool unclamping.



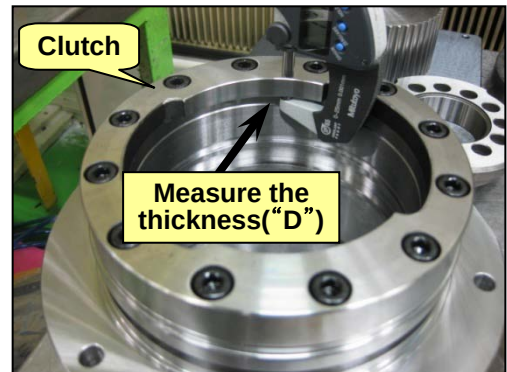
- ③ Use the macrometer to measure the sectional distance between housing and stopper. ("B")



- ④ Use the macrometer the distance from the cylinder. ("C")

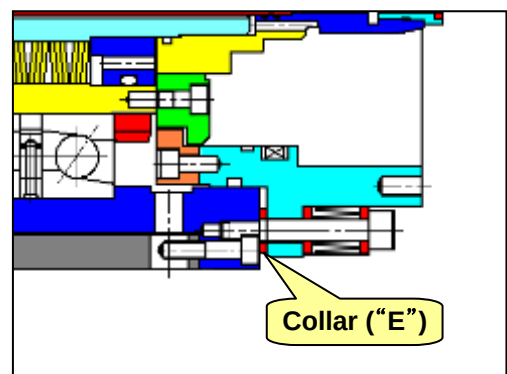
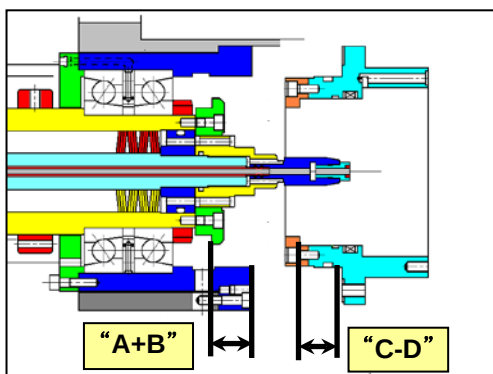


- ⑤ Measure the thickness of the clutch that is installed on the cylinder. ("D")



- ⑥ Use the formula below to calculate the target and fit the collar on site accordingly.

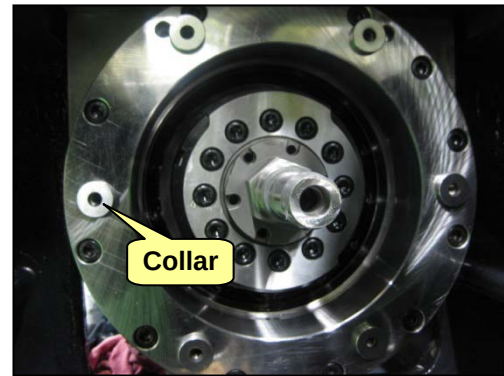
※ Target size of the collar: ("E") = {"C" - "D"} - {"A" + "B"} - 2.0mm



2) Inserting the adjusting collar

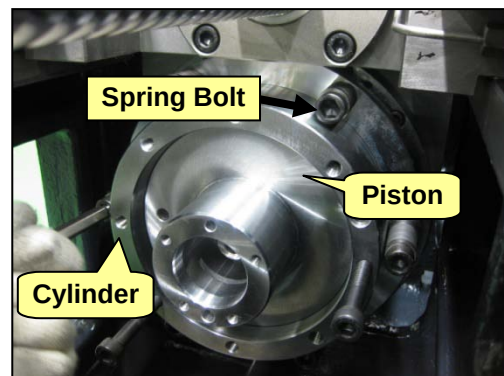
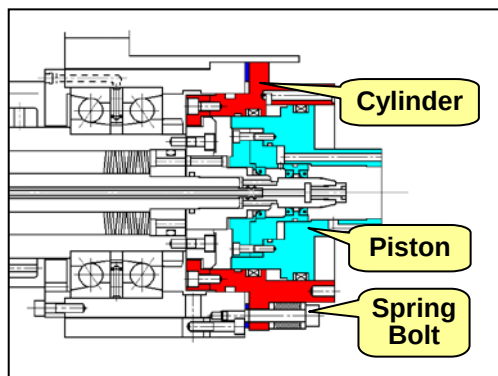
Use an adhesive to attach B14120594 adjusting collar to the bearing housing.

- ※ The collar should be installed properly at first because you feel difficulty locating and adjusting the collar once it was installed.



3) Installing the cylinder temporarily

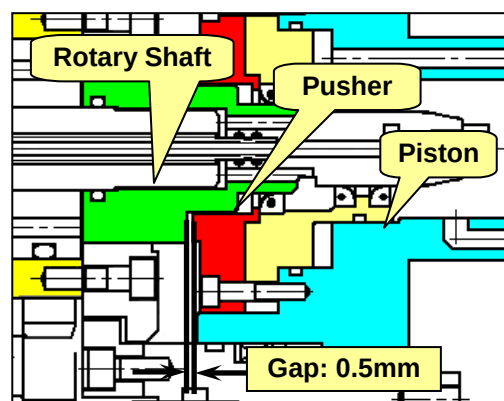
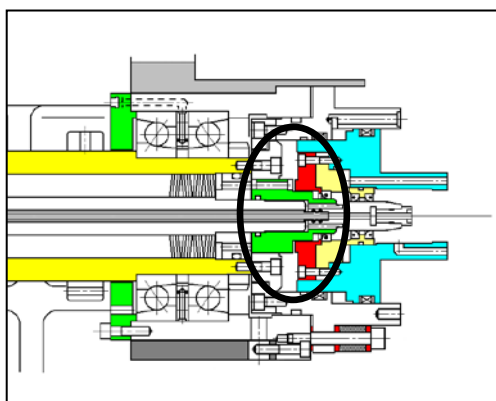
Insert the cylinder into the housing and fix it with the spring bolts (x6). Then, push in B14129073A piston temporarily so that you can perform the measuring for on-site fitting.



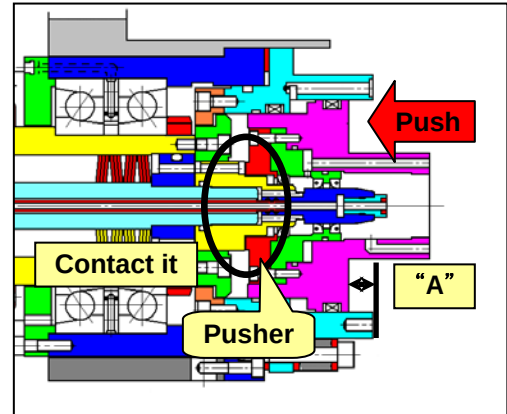
4) Fitting B14129033A pusher on site

- ① If you want to repair the tool unclamp cylinder, you must measure the gap of the rotary shaft that is installed between B14129033A pusher and draw bar before fitting the pusher on site.

- ※ Target: 0.5mm



- ② Push in the piston manually until it contacts on the draw bar. Then, use the macrometer to measure the depth. ("A")



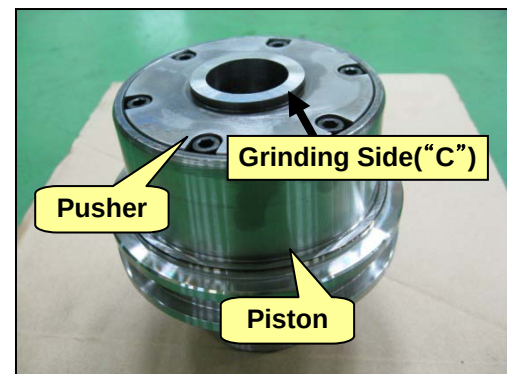
- ③ Measure the height of B14129092C cylinder cap as shown. ("B")



- ④ If B is greater than A, remove B14129033A pusher from the piston and fit the pusher on site according to the following formula.

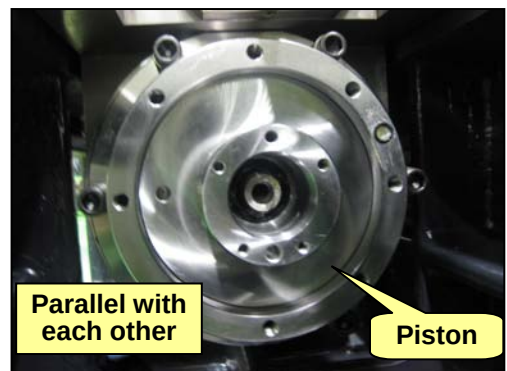
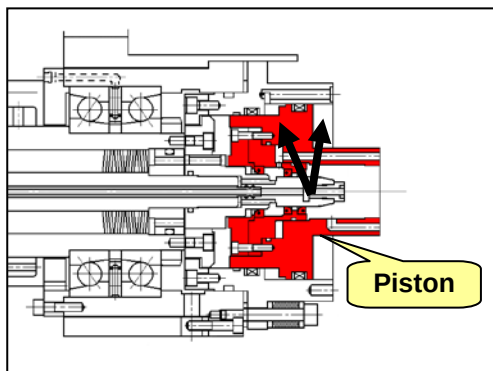
※ Fitting size:

$$"C" = ("B" - "A") + 0.5\text{mm}$$



5) Installing the piston

Insert the completed B14129033A pusher into the piston with the positioning hole in parallel with the bolt tap.



6) Installing the cylinder cap

Apply grease to the wearing ring and insert B14129092C cylinder cap into the piston so that the parallel guide pin of the cap fits into the piston hole.

- 8-BB10×25, 8-ZCS

※ Apply grease to the O-ring hole to prevent its fallout.

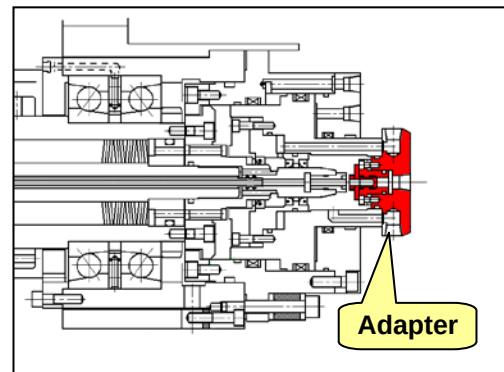


7) Installing the adapter

Install B14129083 adapter into the piston.

- 4-BB6×25

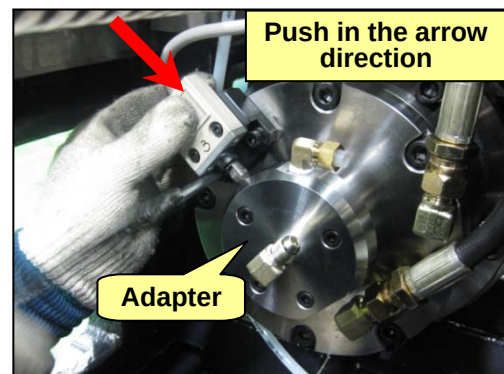
※ Apply grease to the O-ring hole to prevent its fallout.



8) Installing the dog switch

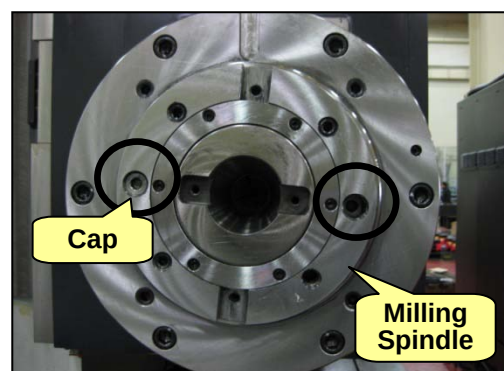
Install the dog switch based on the marking line.

- If you haven't marked the positioning line, move the dog to the adapter and push it in until you hear a click. Then, fit it with the bolts.



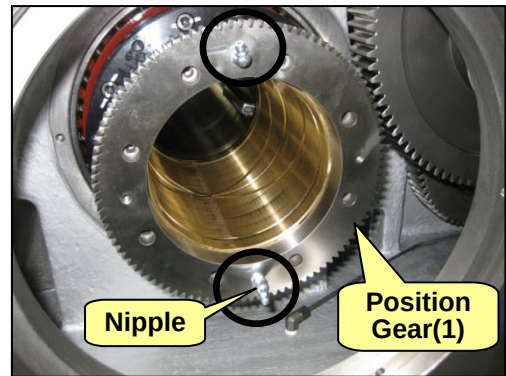
9) Applying grease to the front of milling spindle

Remove the cap from the milling spindle and use the grease gun to inject grease in the grease nipple to the full.



10) Injecting grease in the rear milling spindle

Use the grease gun to inject grease in the grease nipple on the rear of the milling spindle as appropriate.

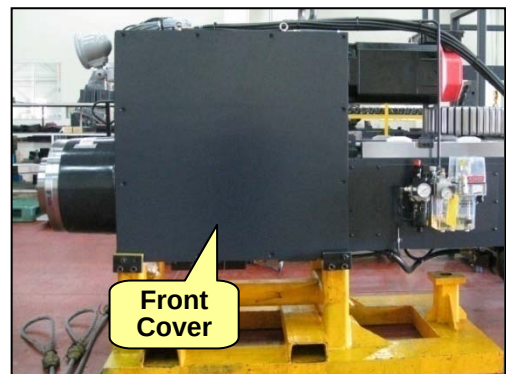


11) Installing the front cover

Install B14116012D front cover into the spindle head body.

▪ 12-BB10×40

※ During this, take caution not to damage the packing that is attached to the front cover.



12) Finishing

Connect the hoses and install the covers back to their respective position.



※ When completed, you must reset the reference point for the X axis and adjust the spindle orientation as appropriate.

1.7 Running-in the bearing

※ When the installation is completed, check for any problem regarding the installation. If no particular problem is found, turn on the machine tool and set the reference point for each axis before running-in the spindle bearing.

- 1) The purpose of the running-in is to apply grease evenly to the 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.

※ Sample running-in program for the main spindle bearing

M03 S100 G04 X600. ;

S500 G04 X600. ;

S1000 G04 X900. ;

S1500 G04 X1200. ;

S2000 G04 X1200. ;

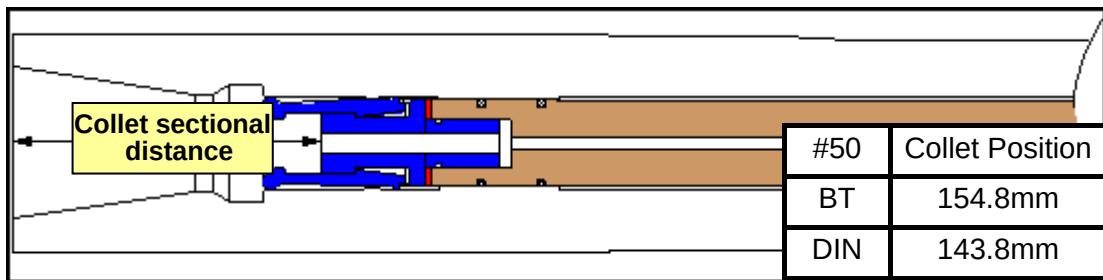
S2000 G04 X1200. ;

S2500 G04 X3600. ;

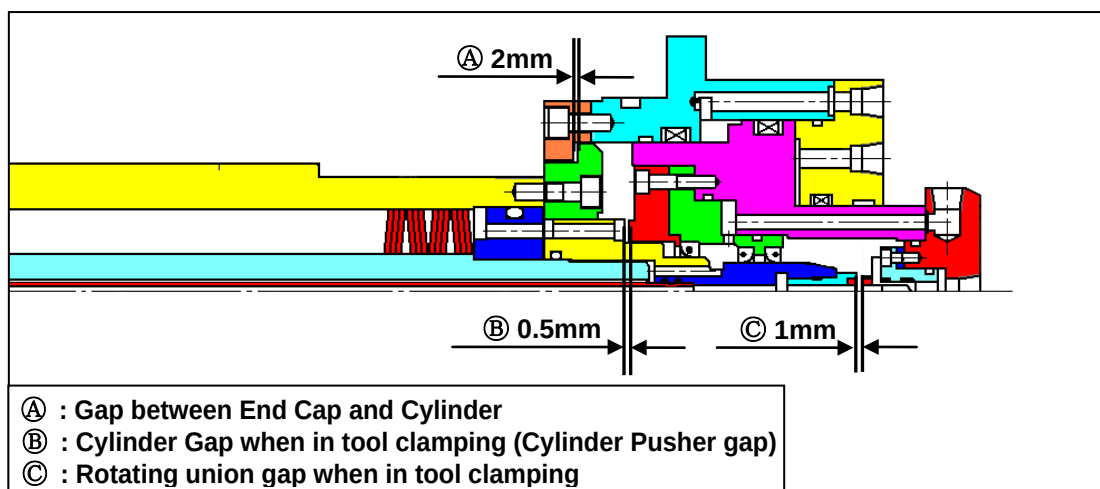
S500 G04 X1200. ;

M05 ;

※ Ref 1) Distance from the collet section

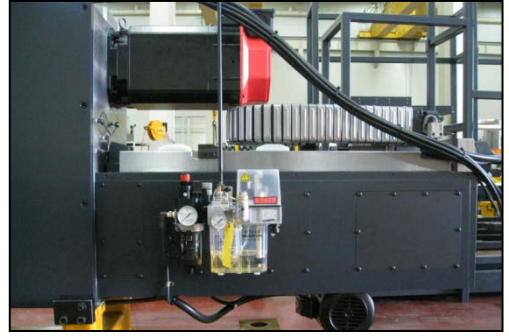


※ Ref 2) Major target sizes of tool unclamp cylinder



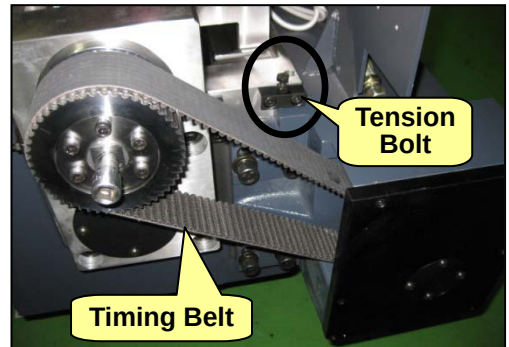
1.8 Disassembling the ball screw on the W axis

1) Remove the cover from the tail bracket.

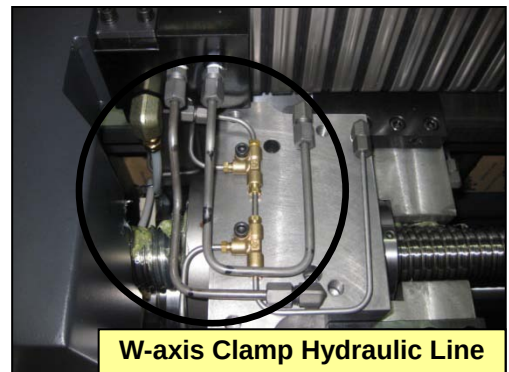


2) Removing the timing belt

Loosen the bolts on the W-axis servo motor bracket slightly to loose the tension belt. Then, loosen and remove the timing pulley in the ball screw side.



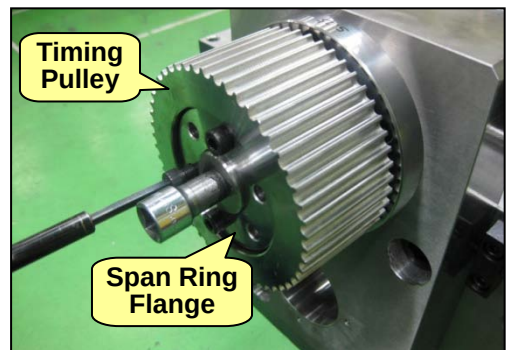
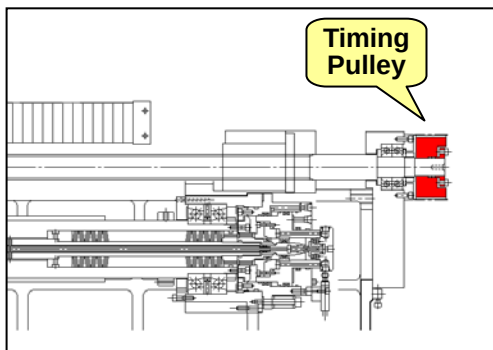
3) Before you can remove the bearing from the bearing support, the hydraulic line for the W-axis clamping device should be disconnected beforehand so that you can turn the ball screw smoothly.



4) Removing the timing pulley

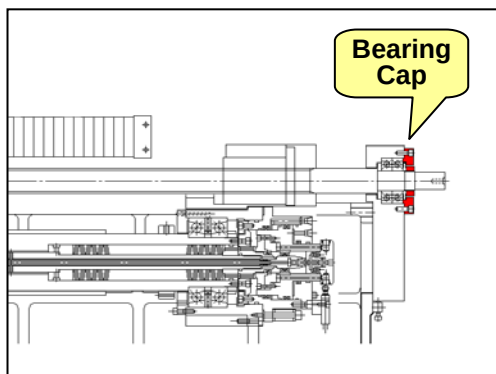
Loosen the bolts on B10121184 span ring flange and loosen and remove B14120173 timing pulley from the ball screw. You should remember the original position of the span ring for re-installation.

- 6-BB8×25

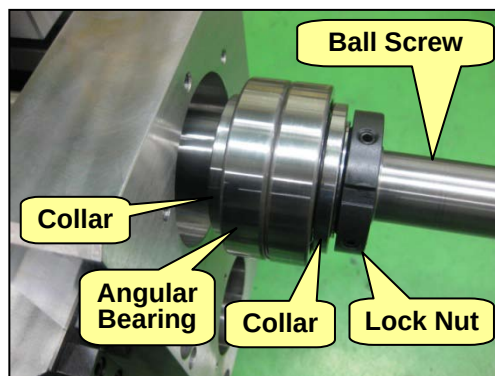
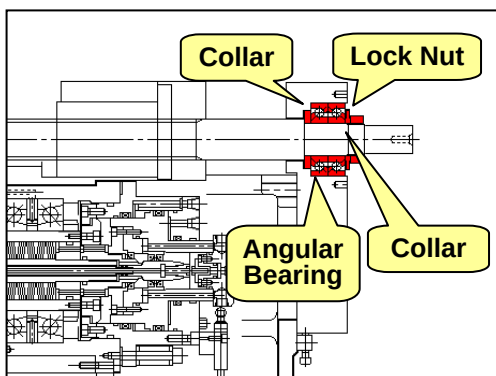


5) Loosen the bolts on B14120213 bearing cap before removing it.

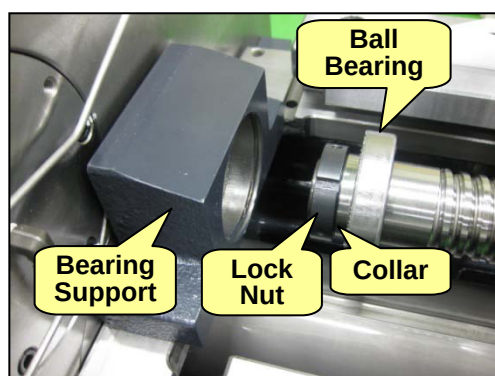
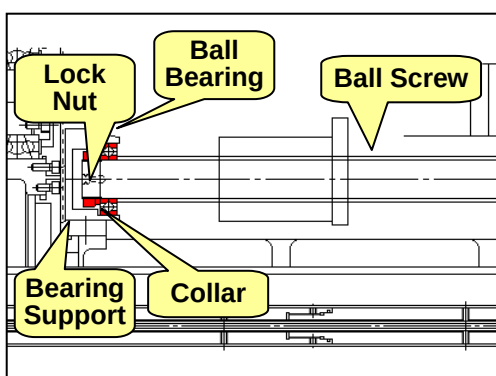
- 6-BB8×25



6) Turn the ball screw manually to pull out the bearing assembly from the housing. Loosen the lock nut set-screw and remove R03263 lock nut, B14120244 collar, B14120254 collar and R10024 angular bearing.

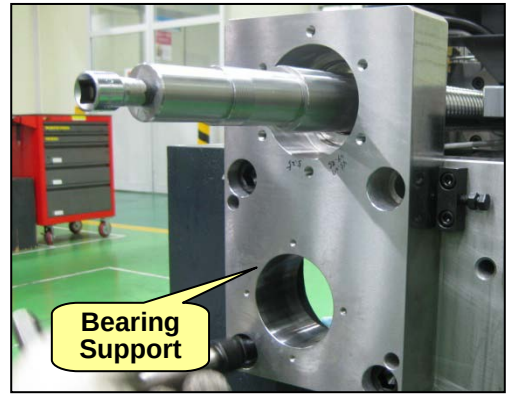


7) Remove B1420223B lock nut, B14120524 collar and S6003280 ball bearing (located in the bearing support side) from the ball screw.



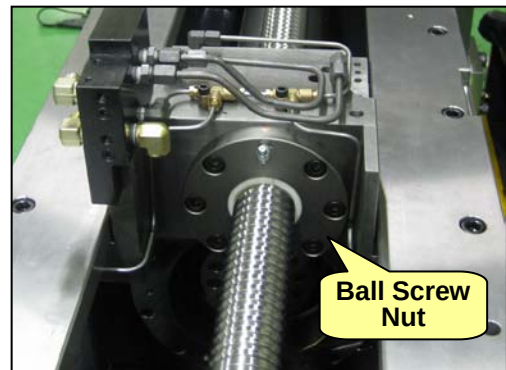
- 8) Mark the position of B14120033B bearing support and loosen the bolts before removing it.

- 4-BB20×60



- 9) To facilitate the work on the ball screw, remove the covers and disconnect the hoses. Loosen the ball nut as well as the bolts on B14120021C bearing housing before removing the ball screw.

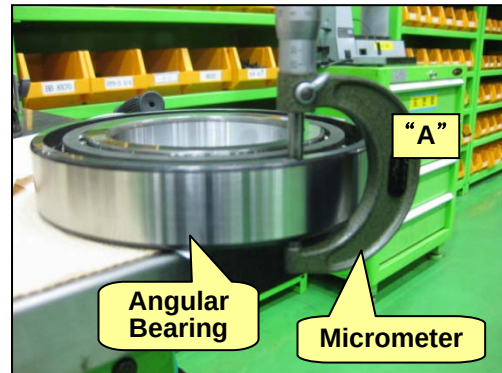
- 6-BB10×40



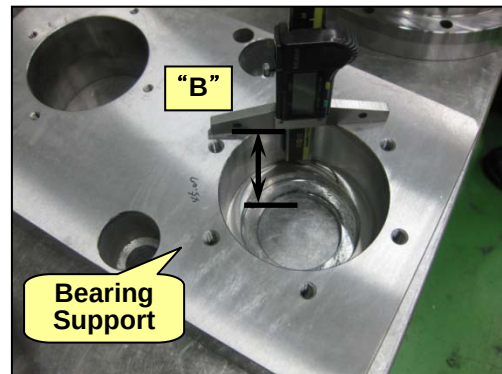
1.9 Disassembling the ball screw on the W axis

1) Fitting the bearing cap on site

- ① Measure the outer race of each bearing of R10024 angular bearing set. ("A")



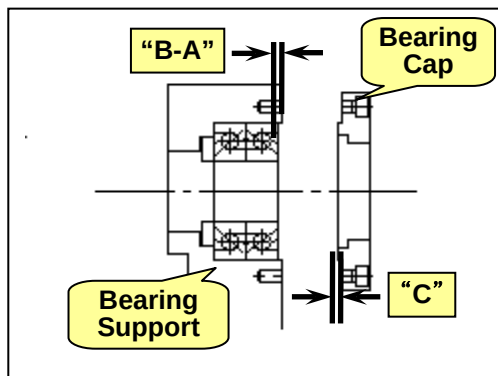
- ② Use the depth gauge to measure the depth between B14120033B bearing support and angular bearing installation section. ("B")



- ③ Calculate the target size of the bearing cap before fitting it on-site. ("C")

※ Sectional target size of the bearing cap:

$$"C" = ("B - A") + 0.03\text{mm}$$



2) Installing the ball screw temporarily

Insert the ball screw into B14120021C bearing housing with care and tighten the bolts (for fixing between ball nut and bearing housing) loosely to attach the ball screw to the bearing housing.

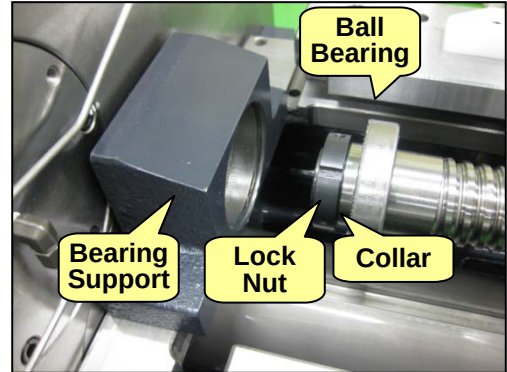
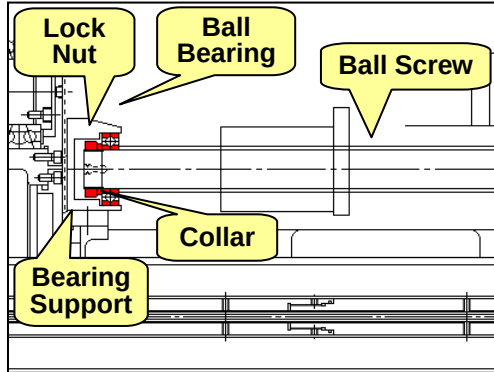
▪ 6-BB10×40

※ Do not fix the ball screw because you should adjust the parallelism of the ball screw.



3) Installing the ball bearing

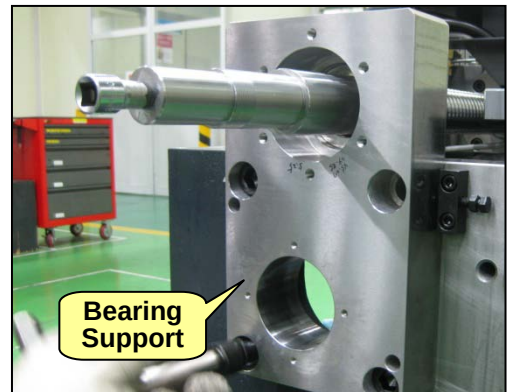
Install S6003280 ball bearing, B14120524 collar, B1420223B lock nut (all of which will be installed in the bearing support side) into the ball screw in sequence. Lock the lock nut using the chisel and hammer and tighten the set screw to fix the lock nut.



4) Installing the bearing support temporarily

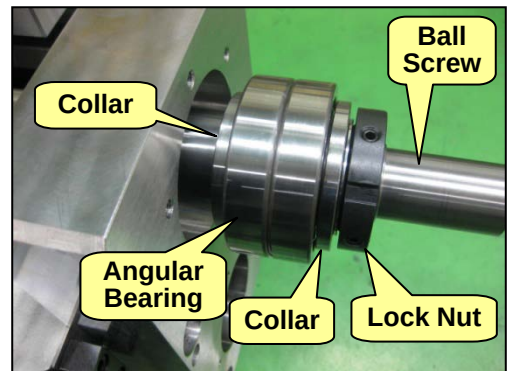
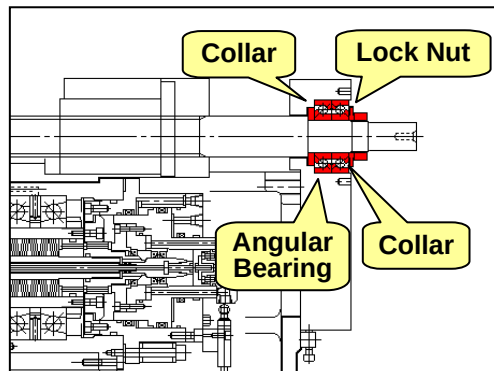
Based on the marking line, tighten B14120033B bearing support bolts loosely so that you can adjust the position of the support.

- 4-BB20×60



5) Installing the angular ball bearing

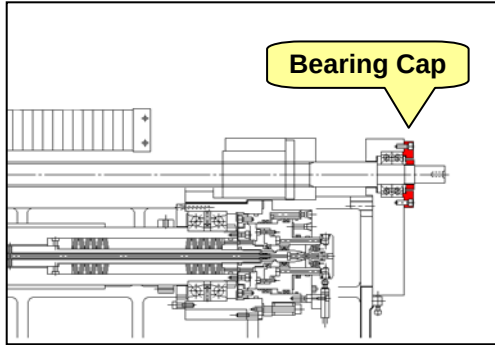
Install B14120254 collar, R10024 angular bearing, B14120244 collar and R03263 lock nut (all of which will be installed in the bearing housing side) into the ball screw in sequence. Lock the lock nut using the chisel and hammer and tighten the set screw to fix the lock nut.



6) Installing the bearing cap

To ensure that the bearing contacts on the bearing support, turn the ball screw manually so that the bearing fits into the bearing support hole. Then, install the completed B14120213 bearing cap into the bearing support.

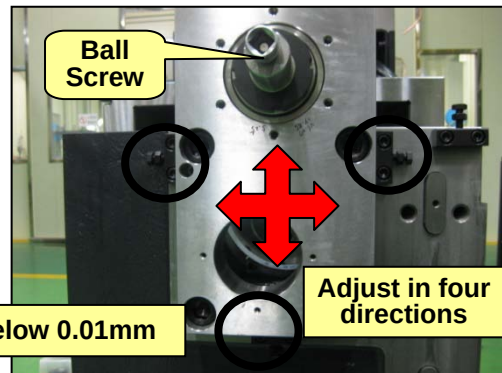
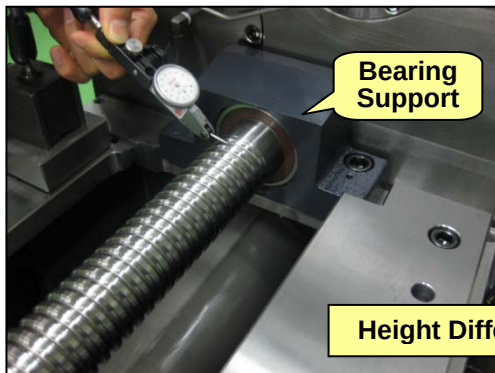
▪ 6-BB8×25



7) Positioning and fixing the bearing support

Use the positioning pins for B14120033B bearing support to adjust the horizontal and vertical position of the ball screw so that it aligns properly. Then, tighten up the bolts.

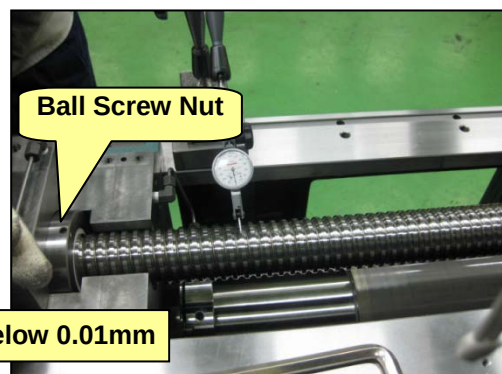
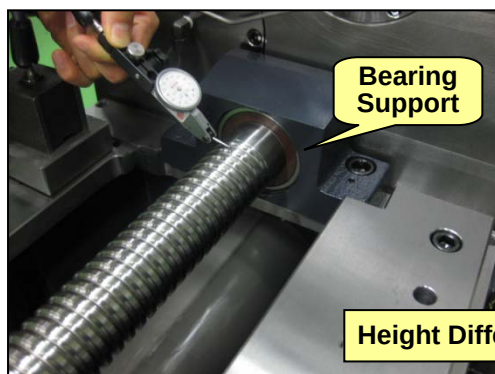
※ Target: below 0.01mm



8) Positioning and fixing the ball screw nut

Use the indicator to measure the height of the ball screw in the bearing support side as well as the height in the ball nut side. Adjust the position of the ball screw nut until two measurements becomes the same. Then, tighten up the bolts on the ball nut.

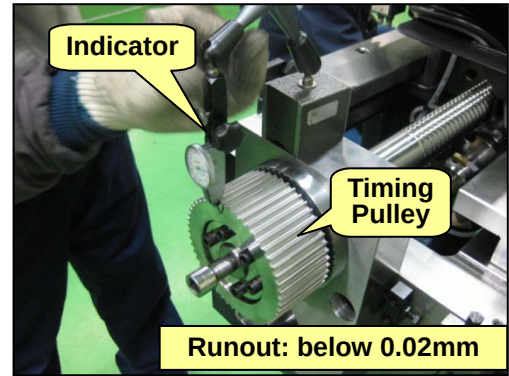
※ Target: below 0.01mm



9) Installing the timing pulley

Install B14120173 timing pulley, R08010 span ring and B10121184 span ring flange into the ball screw in sequence. Present the indicator needle to the timing pulley and adjust the runout to below 0.02mm. Then, tighten the bolts.

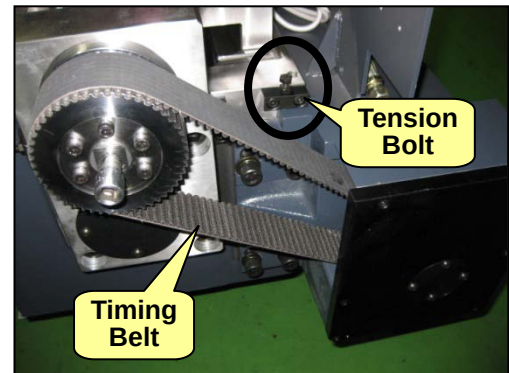
- 6-BB8×25



10) Installing the timing belt

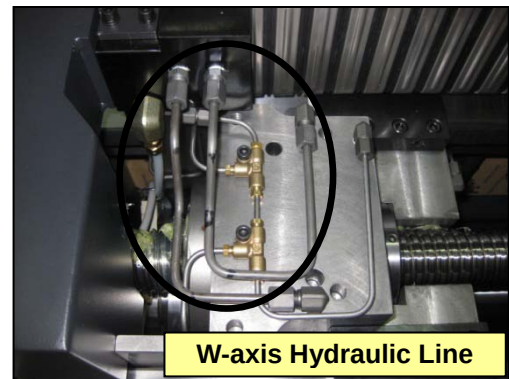
Fit the timing belt into the timing pulley and use the tension bolt to tighten the timing belt. Then, tighten up the bolts on the W-axis servo motor bracket.

- When the ball screw is installed completely, turn the ball screw manually to check if it's installed properly.



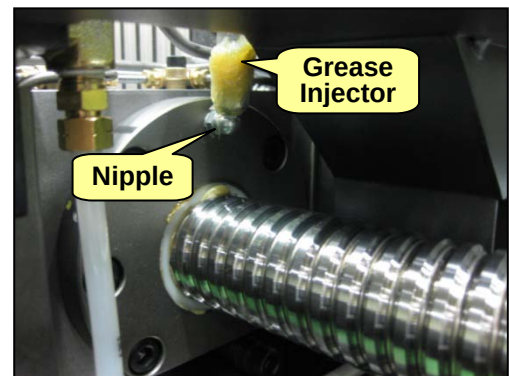
11) Installing the W-axis clamping hydraulic line

Connect the W-axis clamping hydraulic line back to the original.



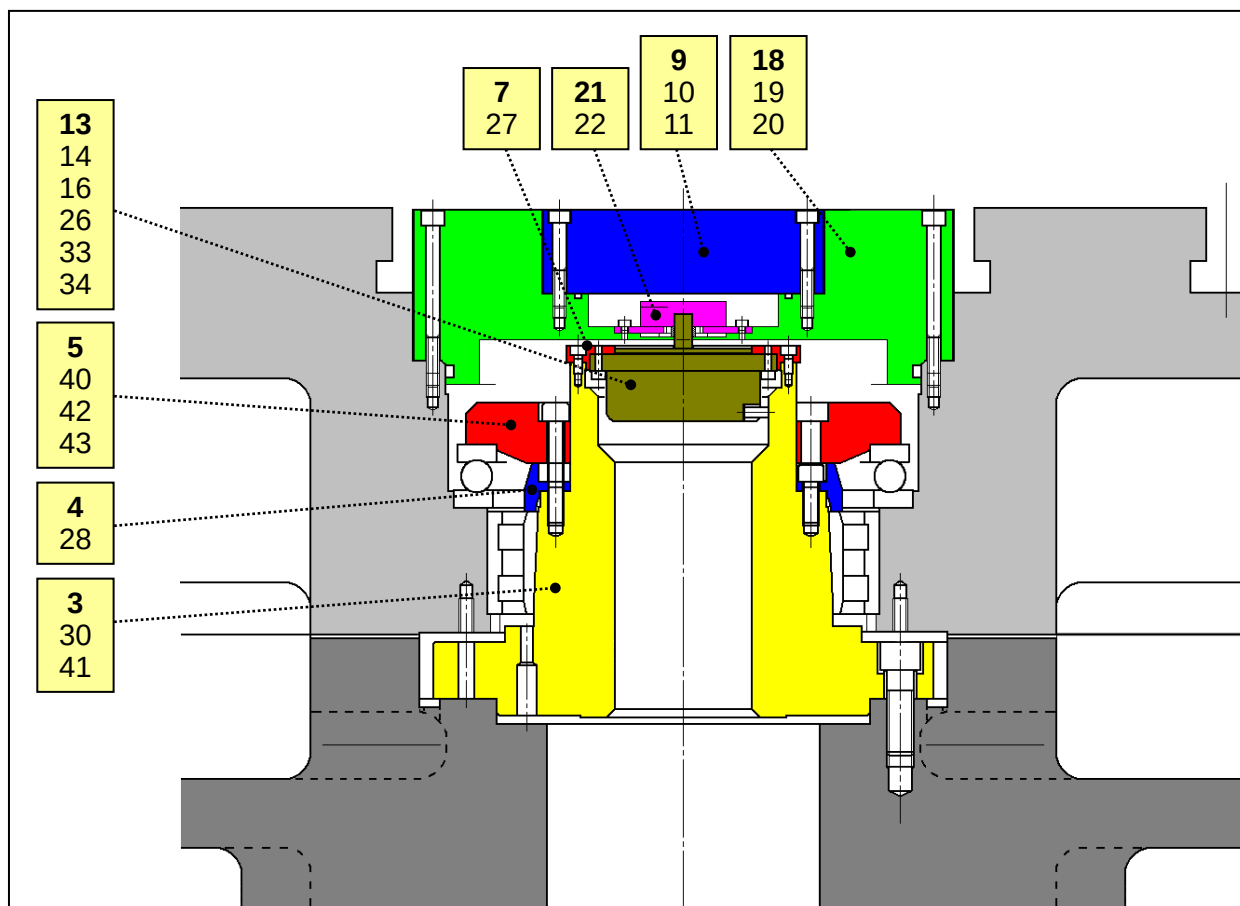
12) Finishing

Install the removed covers and hoses back to the original and use the grease gun to inject grease in the grease nipple as appropriate, which is installed on the ball nut.



2. Assembling/disassembling the table

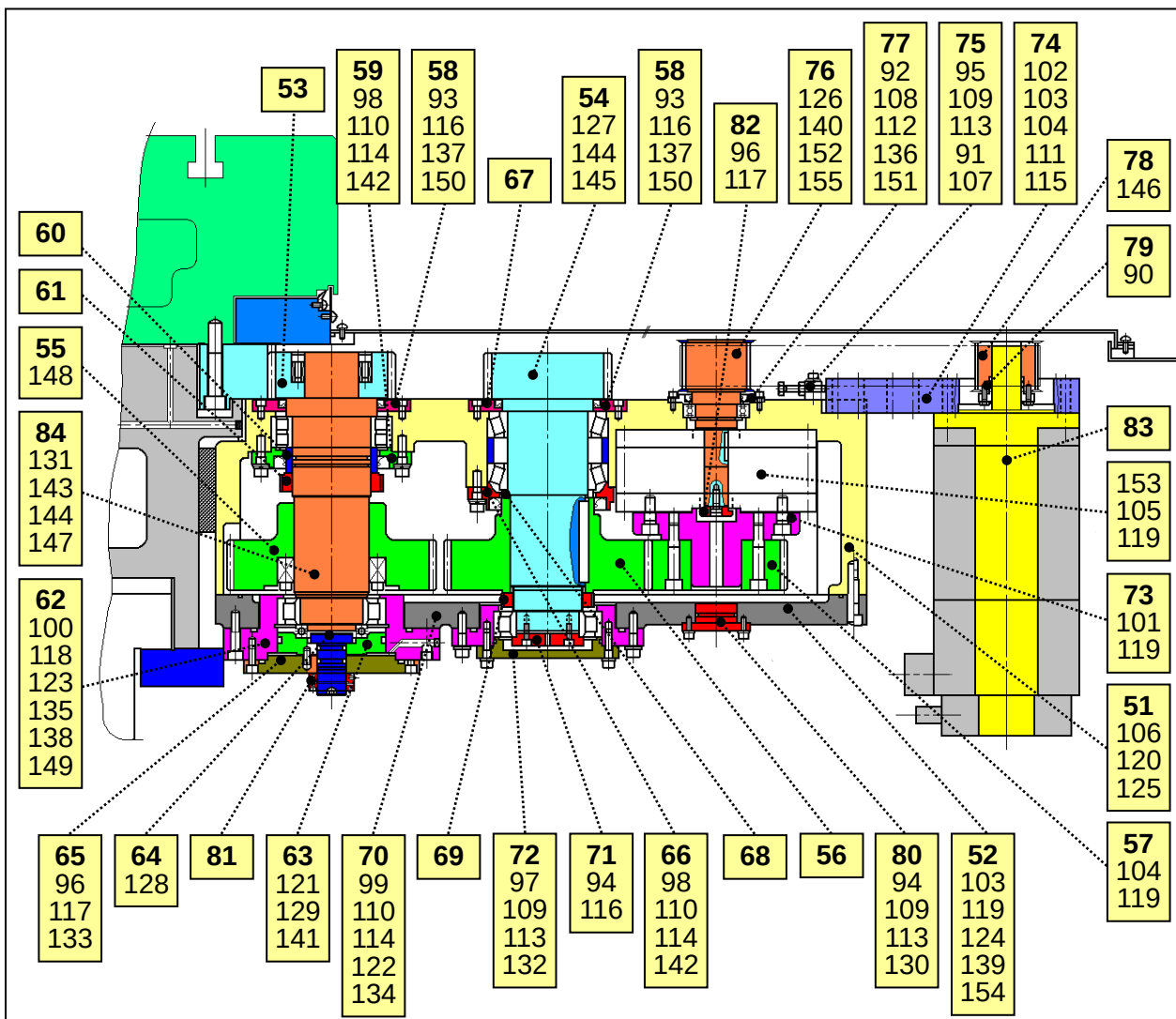
※ Table Center Post Diagram



NO.	ITEM No.	Description	Q'ty	Mat. / Spec.	Remarks
3	B14311262	Center Post	1	SCM415	
4	B14311273A	Pushing Collar	1	SM45C	
5	B14311283A	Support Collar	1	SM45C	
7	B14311293	Joint Flange	1	SM45C	
9	B14321073	Cap	1	SM45C	
10	S2209661	Hex. Socket Head Bolt	4	BB8×50	
11	S8011200	O-Ring	1	G120	
13	R83237	Rotary Encoder	1st	R00250-18000-CABL	Heidenhain
14	R833238	EXE Unit	1st	EXE 602E(5-Fold)	Heidenhain
15	R83239	Extension Cable(20M)	1st	309 774 20	Heidenhain
16	R83240	Cable/One Connector	1st	309 777 03	Heidenhain
18	B14321043B	Flange	1	SM45C	
19	S2210561	Hex. Socket Head Bolt	6	BB8×95	
20	S8012700	O-Ring	1	G270	

NO.	ITEM No.	Description	Q'ty	Mat. / Spec.	Remarks
21	R83283	Flat Coupling	1	Flat Coupling K18	Heidenhain
22	S2201461	Hex. Socket Head Bolt	4	BB4×8	
26	S2201861	Hex. Socket Head Bolt	4	BB4×16	
27	S2202961	Hex. Socket Head Bolt	6	BB5×12	
28	S2212061	Hex. Socket Head Bolt	6	BB10×25	
30	S2221661	Hex. Socket Head Bolt	8	BB16×50	
33	S5000101	Plain Washer, Plain	4	ZP4	
34	S5100101	Spring Washer	4	ZS4	
40	S6080440	Trust Ball Bearing	1	#51144	NSK
41	R10675	D/row Cyl. Roller Bearing	1st	NNU4934KCONAP5	NSK
42	S2212861	Hex. Socket Head Bolt	18	BB10×60	
43	P51400010	Conical Spring Washer	18	ZC10	

※ **Table Driver**

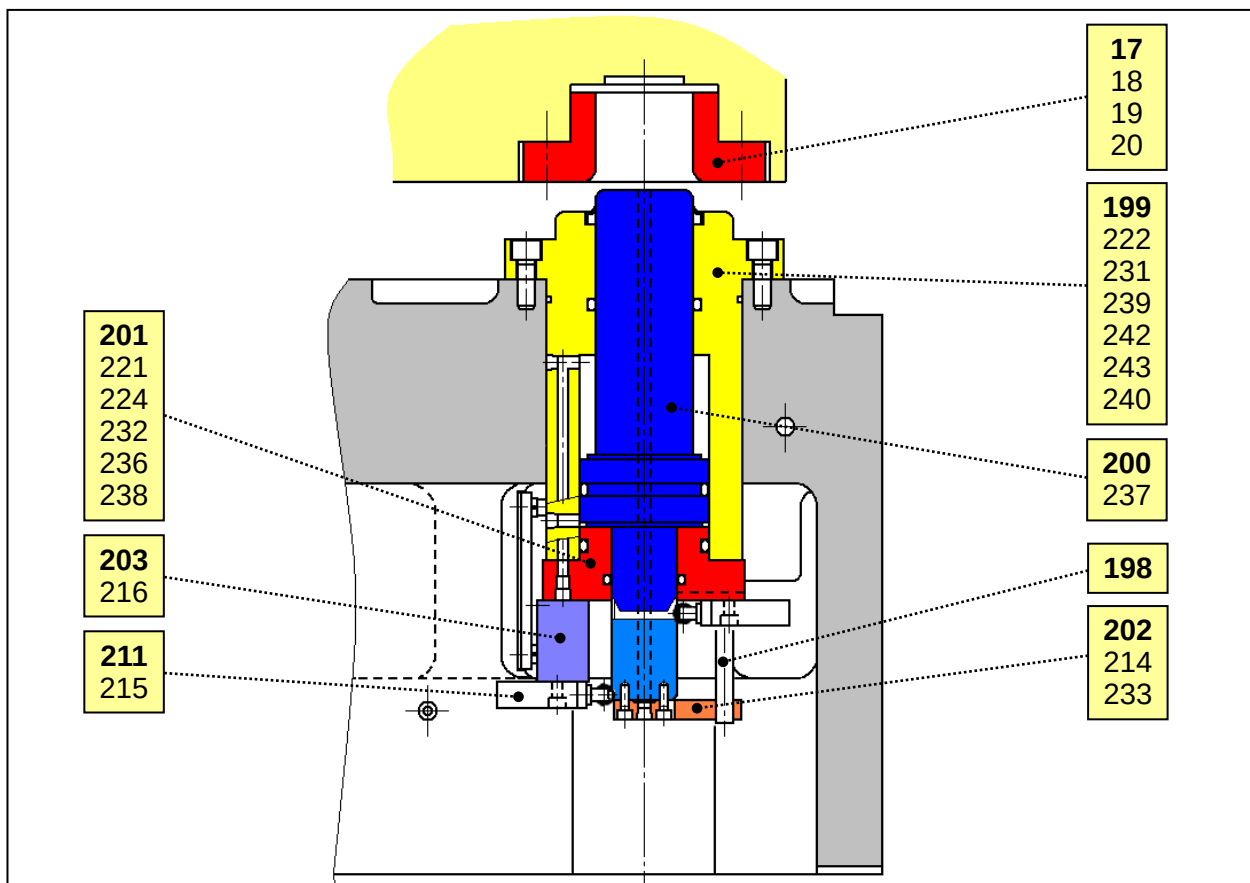




No.	Part No.	Description	Q'ty	Spec.	Mat./Remarks
51	B14312011B	Box. Table Driving	1	GC300	
52	B14312022A	Driving Cover	1	GC300	
53	B14312033A	Pinion(1)	1	SCM440	M4.5x32T
54	B14312043B	Pinion(2)	1	SCM440	M4.5x32T
55	B14312053	Helical(1)Gear	1	SNCM220	M4x60T
56	B14312063	Helical(2)Gear	1	SNCM220	M4x60T
57	B14312073	Helical(3)Gear	1	SNCM220	M4x60T
58	B14312083A	Bearing Cap (Upper)	2	SM45C	
59	B14312093A	Bearing Cap (Middle)	1	SM45C	
60	B14312104	Collar(1)	1	SM45C	
61	R03307	Lock Nut	1	DZMV 95 x 2.0	K-FUKUDA/YHB
62	B14312123A	Bearing Housing (1)	1	SM45C	
63	B14312134	Piston	1	SM45C	
64	B14312144A	Stopper	1	SM45C	
66	B14312163A	Bearing Cap (Taper Roller)	1	SM45C	
67	B14312174	Collar(2)	1	SM45C	
68	B14312184	Collar(3)	1	SM45C	
69	R03082	Nut, Lock	1	DZM 85 x 2.0	K-FUKUDA/YHB
70	B14312203A	Bearing Housing (2)	1	SM45C	
71	B14312214	Cap	1	SM45C	
72	B14312223	Bearing Cap	1	SM45C	
73	B14312233B	Connecting Shaft	1	SCM435	
74	B14312243	Motor Plate	1	SS41	
75	B14312254	Block	1	SS41	
77	B12312313A	Bearing Cap	1	SM45C	
78	B14312283	Timing Pulley (29t)	1	SM45C	8M-29T
79	B14312294	Span Ring Cap	1	SM45C	
80	B14312304A	Cap	1	SS41	
81	R02087	Lock Nut	1	MSR 35 x 1.5	K-FUKUDA/YHB
83		Servo Motor	1	A30/2000	FANUC
84	B14312323	Shaft (1)	1	SCM440	
90	S0052851	Hex Socket Head Bolt	6	BA6 x 20	
91	S0009651	Hex Socket Head Bolt	1	BAS8 x 50	
92	S2203161	Hex Socket Head Bolt	4	BB5 x 16	
93	S2204661	Hex Socket Head Bolt	12	BB6 x 16	
94	S2204861	Hex Socket Head Bolt	8	BB6 x 20	
95	S2205361	Hex Socket Head Bolt	2	BB6 x 35	
96	S2208861	Hex Socket Head Bolt	13	BB8 x 20	

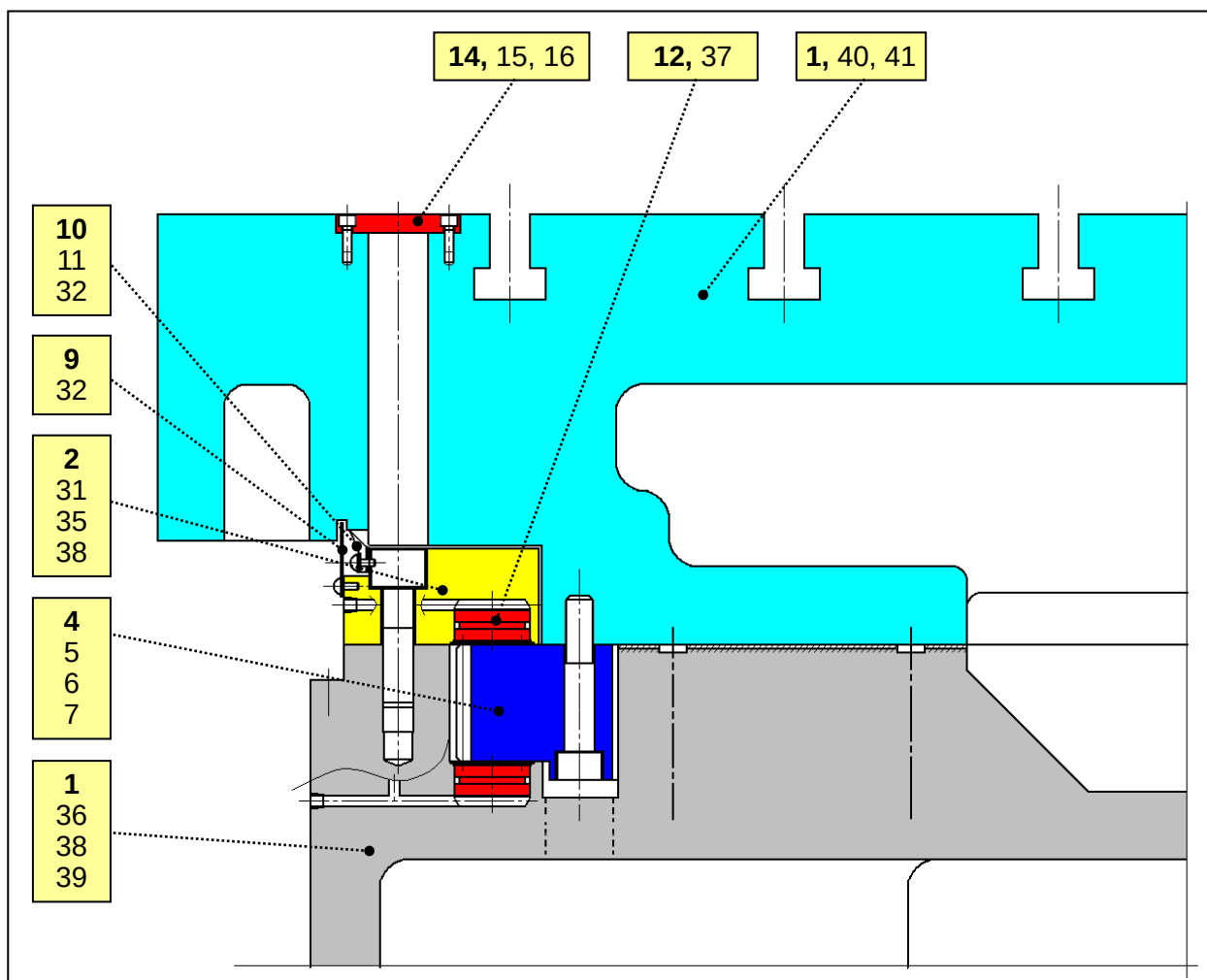
No.	Part No.	Description	Q'ty	Spec.	Mat./Remarks
97	S2209361	Hex Socket Head Bolt	6	BB8 x 35	
98	S2212461	Hex Socket Head Bolt	12	BB10 x 40	
99	S2212561	Hex Socket Head Bolt	6	BB10 x 45	
100	S2212661	Hex Socket Head Bolt	6	BB10 x 50	
101	S2215061	Hex Socket Head Bolt	14	BB12 x 25	
102	S2215561	Hex Socket Head Bolt	15	BB12 x 45	
103	S2215661	Hex Socket Head Bolt	15	BB12 x 50	
104	S2216061	Hex Socket Head Bolt	14	BB12 x 70	
105	S2217061	Hex Socket Head Bolt	12	BB12 x 120	
106	S2227961	Hex Socket Head Bolt	6	BB20 x x65	
107	S4000531	Hex Nut	1	NA8	
108	S5000201	Plain Washer	4	ZP5	
109	S5000301	Plain Washer	12	ZP6	
110	S5000601	Plain Washer	18	ZP10	
111	S5000701	Plain Washer	8	ZP12	
112	S5100201	Spring Washer	4	ZS5	
113	S5100301	Spring Washer	12	ZS6	
114	S5100601	Washer, Spring	18	ZS10	
115	S5100701	Washer, Spring	8	ZS12	
116	P51400006	Conical Spring Washer	16	ZC6	
117	P51400008	Conical Spring Washer	1	ZC8	
118	P51400010	Conical Spring Washer	6	ZC10	
119	P51400012	Conical Spring Washer	51	ZC12	
120	P51400020	Conical Spring Washer	6	ZC20	
121	P57108020	Parallel Pin (Tap)	1	SPB8 x 20	
122	P57210045	Taper Pin (Tap)	2	TPB10 x 45	
123	P57210063	Taper Pin (Tap)	2	TPB10 x 63	
124	P57213070	Taper Pin (Tap)	2	TPB13 x 70	
125	P57213090	Taper Pin (Tap)	2	TPB13 x 90	
127	P64020100	Parallel Key (Tap)	1	KSP20 x 12 x 100	
128	S8000290	O-Ring	2	P29	
129	S8001200	O-Ring	1	P120	
130	S8010450	O-Ring	1	G45	
131	S8010900	O-Ring	1	G90	
132	S8011250	O-Ring	1	G125	
133	S8011650	O-Ring	1	G165	
134	S8011750	O-Ring	1	G175	
135	S8011850	O-Ring	1	G185	

No.	Part No.	Description	Q'ty	Spec.	Mat./Remarks
136	P80300085	O-Ring	1	S85	
137	P80300150	O-Ring	2	S150	
138	P74060006	Hex Socket Plug	1	FPS-S06	
139	P74060010	Hex Socket Plug	1	FPS-S10	
141	S6001700	Thrust Ball Bearing	1	#51112	
142	S8200572	Oil Seal	2	SA100 x 140 x 14	
143	R11268	Cyl. Roller Bearing	1	NN3019C1NAP5	NTN
144	R11269	Cyl. Roller Bearing	2	NU2215	NTN
145	R11270	Taper Roller Bearing	2	#32019XUP5	NTN
146	R08010	Span Ring	2ST	SCE300-35 x 40	
147	R08136	Power Lock	1	SWLE200-65 x 95	SUNGWHA
148	R08145	Locking Element	1 ST	SWLE200-90 x 130	SUNGWHA
149	R17032	Retaining Ring	1	O-130	IWATA
150	R55373	Oil Seal	2	DS 110 130 8	KEEPER
151	R55XXX	Oil Seal	1	SB8 x 75 x 9	NOK
153	R65072	Reduction Gear	1 ST	TS240-87-SAB	SPINEAR
154	R53232	O-Ring	1	D3.1 x 3300L	

※ Table Index Pin


DBC 130
DBC130MTE04


No.	ITEM No.	Description	Q'ty	Mat. / Spec.	Remarks
17	B13320043B	Bush	4	SCM415	
18	S2215261	Hex. Socket Head Bolt	24	BB12×30	
19	P51400012	Conical Spring Washer	24	ZC12	
20	P57110050	Parallel Pin (Tap)	8	SPB10×50	
198	B13312053A	Guide Bar	1	SM45C	
199	B12311072B	Cylinder	1	SCM415	
200	B12311083	Locating Pin	1	SCM415	
201	B12311093	Cylinder Cap	1	SM45C	
202	B12311104	Plate	1	SS41	
203	B12311114	Block	1	SM45C	
211	ESWLM0099	Limit Switch	2	D4C-4233	OMRON
214	ESWLM0111	Limit Switch	2	D4C-4232	OMRON
215	ESWLM0170	Limit Switch	1	D4C-4231	OMRON
216	R00024	Hex. Socket Head Bolt	2	BB6 x 16	
221	S2212361	Hex. Socket Head Bolt	6	BB10 x 35	
222	S2215361	Hex. Socket Head Bolt	6	BB12 x 35	
224	S3520276	Set Screw (Hex Socket Head)	1	BQ5 x 5	
231	P57210056	Taper Pin (Tap)	2	TPB10 x 56	
232	S8000080	O-Ring	1	P8	
233	S8000100	O-Ring	1	P10	
236	R55345	Quad Ring	1	QRAD04326	
237	S8000700	O-Ring	1	P70	
238	S8010750	O-Ring	1	G75	
239	S8011150	O-Ring	1	G115	
240	P74060006	Hex Socket Plug	1	FPS-S06	
242	R55017A	Seal Dust	1	DK 160 x 74 x 8	NOK
243	R55312	Quad Ring	1	QRAR04332	HANSUNG

※ Table Clamping Device


NO.	ITEM No.	Description	Q'ty	Mat. / Spec.	Remarks
1	B14311011E	Base	1	GC300	
2	B14311021C	Top Ring	1	SM45C	
3	B14321011B	Rotary Table	1	GC300	
4	B14321021B	Ring Gear	1	SCM440-F	
5	S2222461	Hex. Socket Head Bolt	24	BB16 x 90	
6	P51400016	Conical Spring Washer	24	ZC16	
7	P57213080	Tape Pin (Tap)	2	TPB13 x 80	
9	B14311093	Outside Ring(1)	2	STC5(t=1.2)	
10	B14311103	Outside Ring(2)	2	STC5(t=1.2)	
11	B14311113	Ring Wiper	1	NBR-B11 807	
12	B12311124A	Clamping Piston	40	BSS	

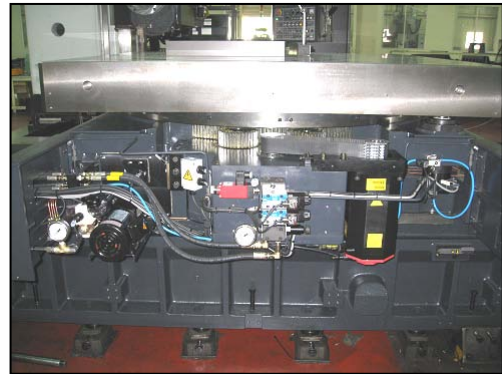
NO.	ITEM No.	Description	Q'ty	Mat. / Spec.	Remarks
14	B12321133	Cover	4	SS41	
15	S2203161	Hex. Socket Head Bolt	16	BB5 x 16	
16	S8010400	O-Ring	4	G40	
30	S2221661	Hex. Socket Head Bolt	8	BB16 x 50	
31	S2228061	Hex. Socket Head Bolt	21	BB20 x 70	
32	R01023	Machine Screw /2 Tone	40	BC5 x 12	
35	P51400020	Conical Spring Washer	21	ZC20	
36	S8000160	O-Ring	20	P16	
37	R55338	Quad-Ring	40	QRAR04222	HANSUNG
38	P74060006	Hex Socket Plug	44	FPS-S06	
39	P74060025	Hex Socket Plug	3	FPS-S25	
40	B14325031A	Rotary Table (Option)	1	GC300	2000×1800
41	B14325041	Rotary Table (Option)	1	GC300	2000×2000

2.1 Disassembling the rotary table

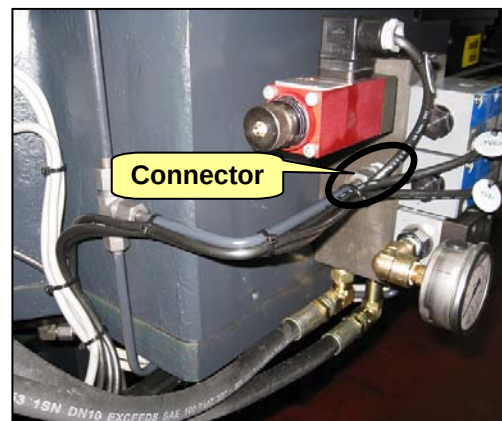
※ Preparations for disassembling the table

- (1) Keep the machine 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) Place a thick corrugated cardboard on the table deck so that you can step on it for the work.

1) Remove the outer cover of the table base.

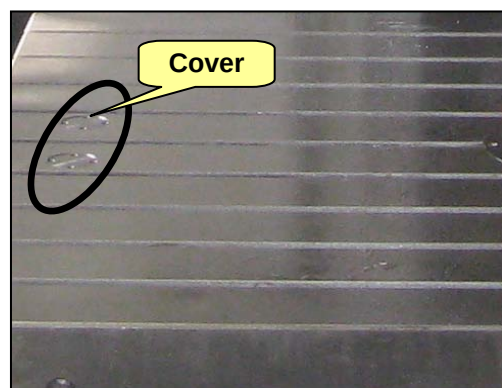
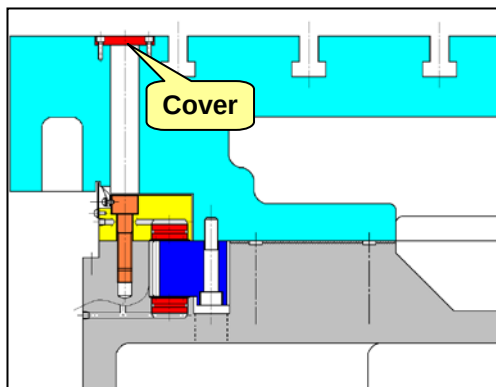


2) Turn off the machine, unplug the hydraulic line connector from the manifold and cover the connector place with the plug.



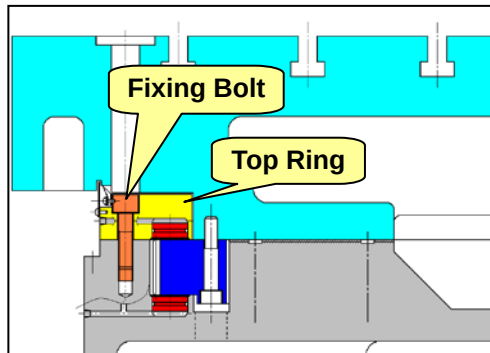
3) Remove B12321133 covers (x4) from the table deck.

- 16-BB5×16, O-Ring : 4-G40



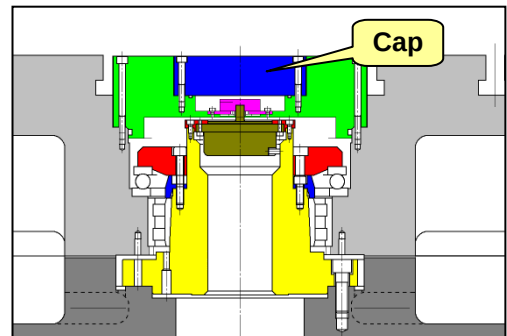
4) Loosen the top ring bolts (21-BB20×70, 21-ZC 20).

- ① From the main OP, select the B axis for the Handle Mode, and turn the handle slowly to rotate the table until B14311021C top ring bolt fits into the table hole.
- ② Use a 17mm hex T-wrench to loosen the top ring bolt one by one.
- ③ While keeping rotating the table, loosen all of 21 bolts and washers.
 - ※ Arrange the removed bolts and washers up on the table for a better view lest that you should miss any of them.
- ④ When done, turn off the machine and proceed with the next step.
 - 21-BB20×70, 21-ZC20



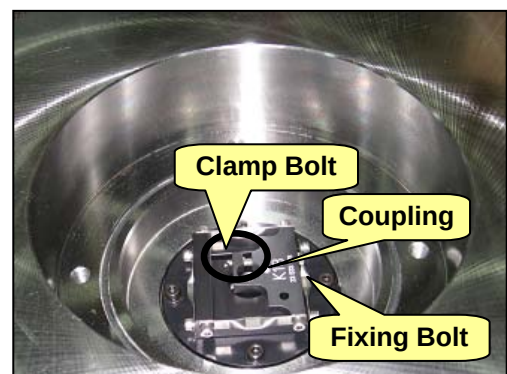
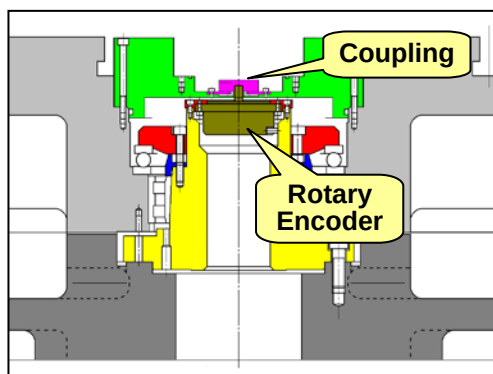
5) Remove B14321073 cap.

- 4-BB8×50, O-Ring : 1-G120



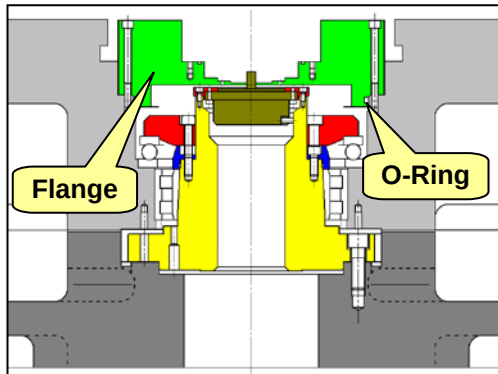
6) Remove the B-axis rotary encoder coupling.

- ① Loosen the clamp bolts on the rotary encoder coupling.
- ② Loosen the rotary encoder coupling fixing bolts.
- ③ Lift up and remove the rotary encoder coupling with care.
 - 4-BB4×8



7) Remove B14321043B flange.

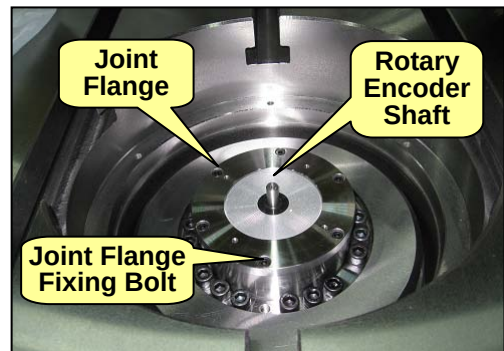
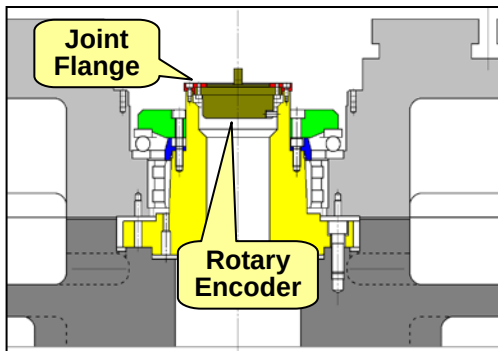
- 6-BB8×95, O-Ring : 1-G270



8) Remove B14311293 joint flange assembly where R83237 rotary encoder is installed.

- ① Open the sliding cover close to the X-axis reference point.
- ② From beneath the table, locate the rotary encoder cable connector and disconnect it.
- ③ Loose the joint flange assembly bolts and remove the assembly together with the rotary encoder cable with care.

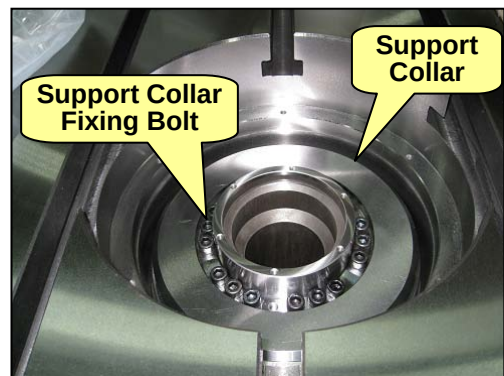
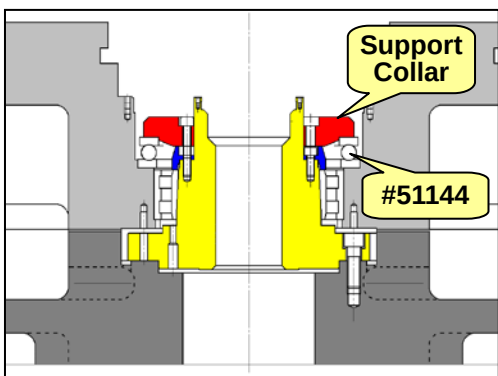
- 6-BB5×12



9) Remove B14311283A support collar.

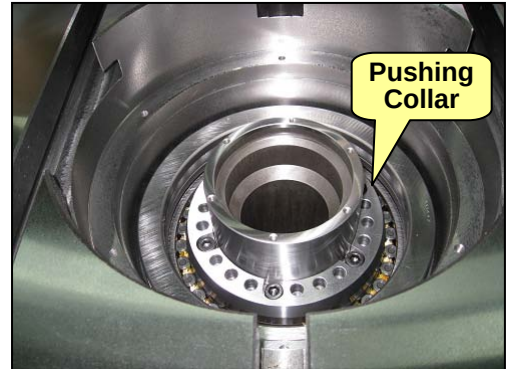
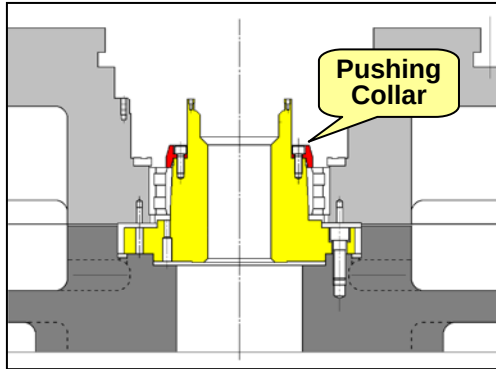
- ① Loosen the support collar bolts (18- BB10×60) and remove the support collar.
- ② Remove S6080440 #51144 thrust ball bearing.

- 18-BB10×60, 18-ZC10



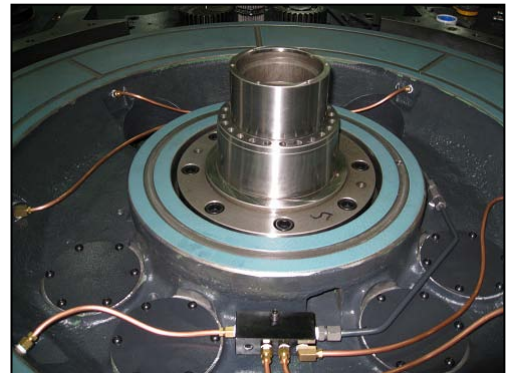
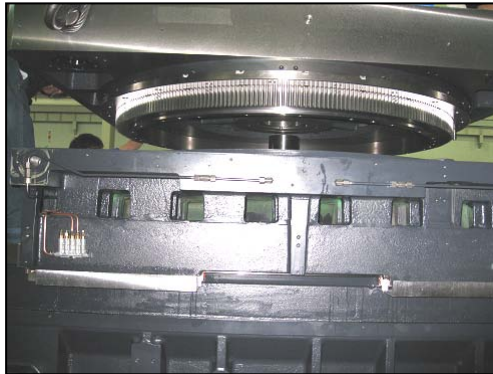
10) Remove B14311273A pushing collar.

▪ 6-BB10×25



11) Insert the eyebolts (x4) into the table and hook a rope between eyebolts and crane.

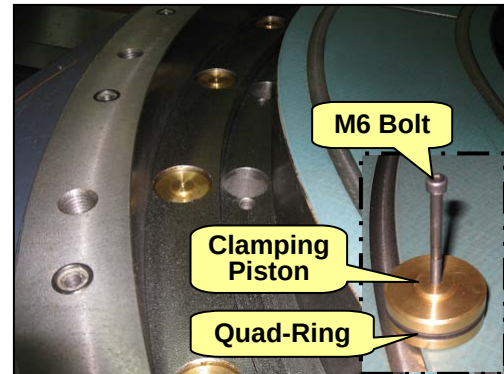
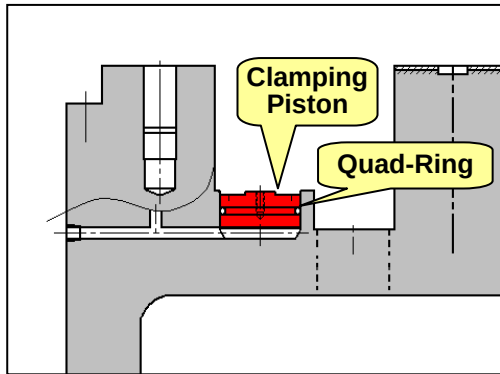
Then, lift up the table with care.



2.2 Assembling/disassembling the rotary table clamping device

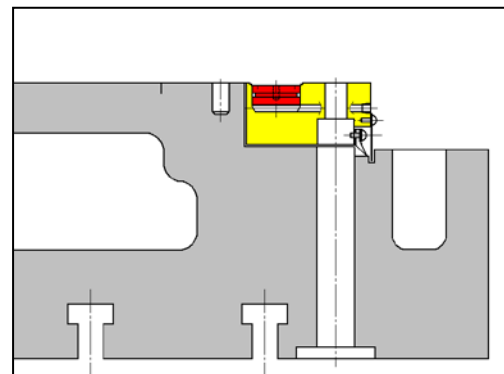
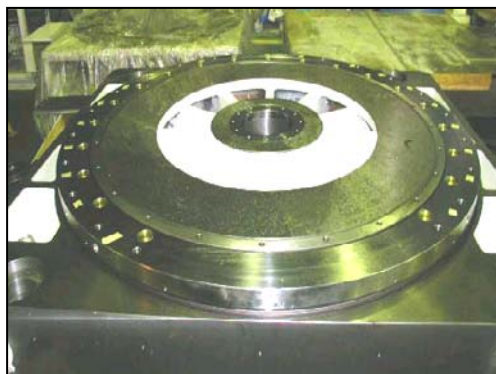
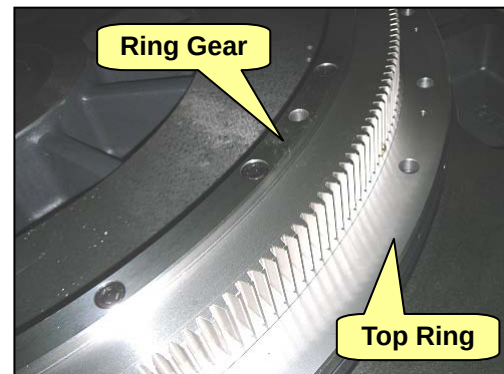
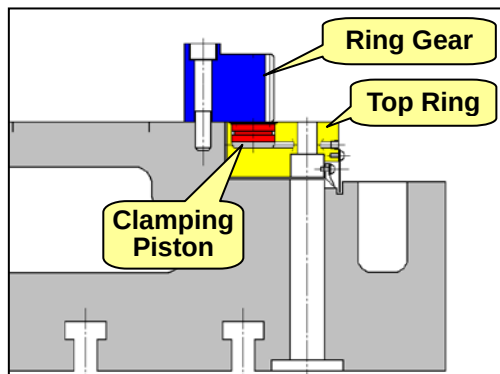
1) Installing/removing the table base clamping piston

- ① Use the pin puller to pull out the clamping piston from the table base.
- ② Check the state of ORAR04222 quad-ring and replace it if necessary.
- ③ Apply grease to the outer clamping piston as well as to the quad-ring. (this is to prevent the quad-ring from being damaged during the installation)
- ④ Insert M16 bolt into the clamping piston and gently impact on the bolt using the hammer to fix it.

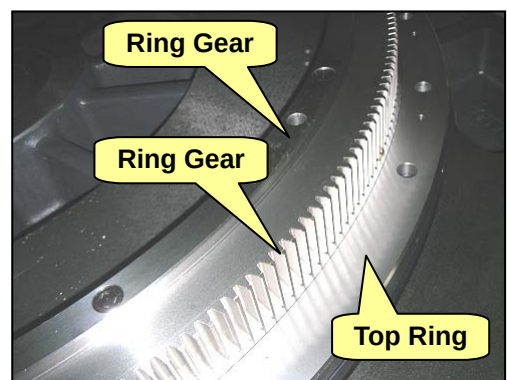
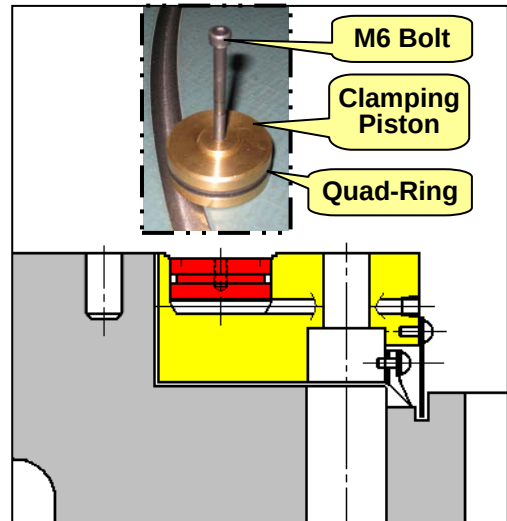


2) Installing/removing the table clamping piston

- ① Turn the table upside down and remove the ring gear.
 - 24-BB16×90, 24-ZC16, 2-TPB13×80



- ② Use the pin puller to pull out the clamping piston from the table base.
- ③ Check the state of ORAR04222 quad-ring and replace it if necessary.
- ④ Apply grease to the outer clamping piston as well as to the quad-ring. (this is to prevent the quad-ring from being damaged during the installation)
- ⑤ Insert M16 bolt into the clamping piston and gently impact on the bolt using the hammer to fix it.
- ⑥ Install the ring gear.
 - 24-BB16×90, 24-ZC16,
 - 2-TPB13×80

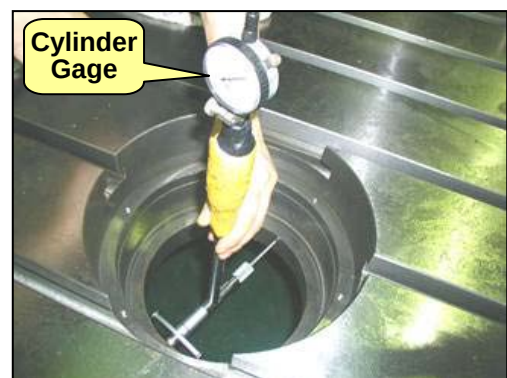


2.3 Installing the rotary table

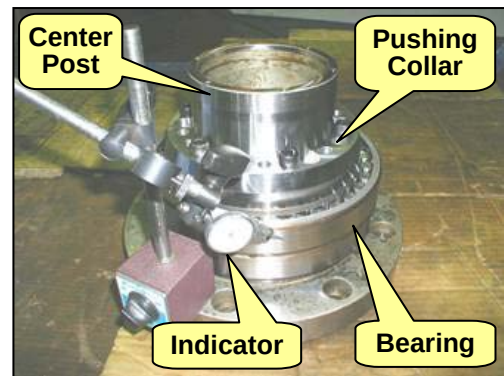
1) Fitting the pushing collar on site

Before installing the table, fit B14311273A pushing collar on site, which determines the pre-tension on the roller bearing that is installed in B14311262 center post.

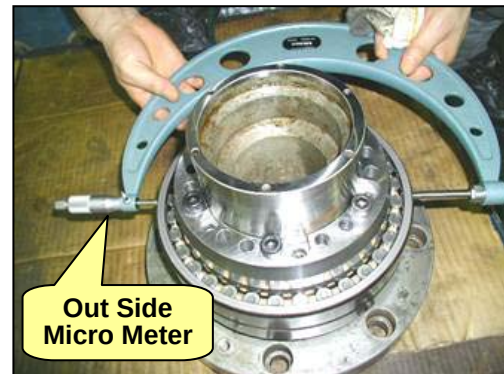
- ① Use the 230mm cylinder gauge to measure the inner diameter of the bearing installation area of the table. ("B")



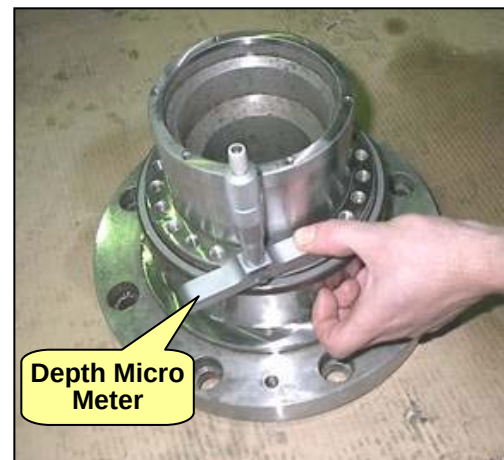
- ② Install the bearing temporarily.
 - Clean up B14311262 center post.
 - Install the inner race of NNU4934K bearing into the center post.
 - Then, install the outer race and insert B14311273A pushing collar.
 - Install the indicator on the bearing. While turning the outer race, tighten the bolts on the pushing collar until the bearing gap becomes 0 μm .



- ③ Use the outside micrometer (200mm ~ 150mm) to measure the outer diameter of the bearing. ("A")

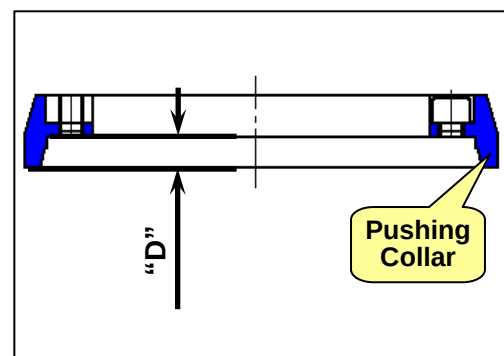


- ④ Remove the pushing collar and use the depth micrometer to measure the step height between pushing collar in the center post and inner section of the bearing. ("C")



- ⑤ Use the following formula to calculate the step height of the pushing collar before fitting it on site accordingly.

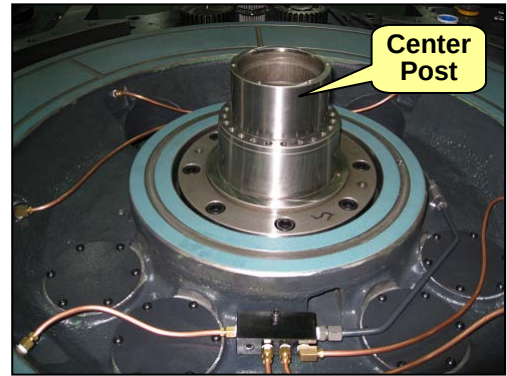
$$D = C + 15 \times \{(B - A) + 0.01\}$$



2) Installing the center post

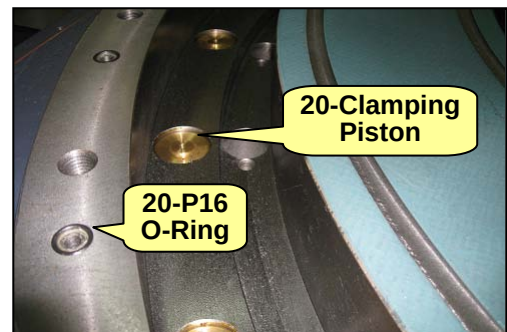
Install B14311262 center post into the table base.

- 8-BB16×50



3) Installing the clamping piston

- ① Check the state of and replace ORAR04222 quad-ring in B12311124A clamping piston of the table base, if necessary. Then, insert the ring into the corresponding place.
- ② Insert P16 O-rings (x20) around the piston.



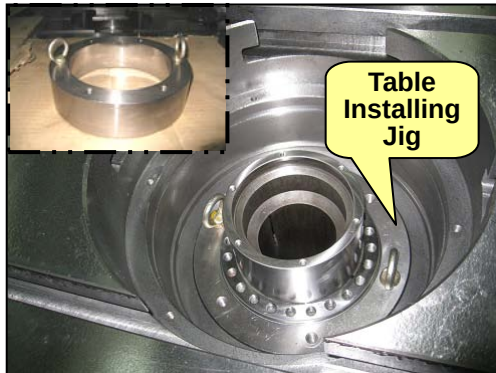
※ Apply grease to both outer side of the clamping piston and quad-ring installation site to prevent possible damage. Apply grease to the O-ring insertion holes before inserting the O-rings. Take an appropriate action not to lose the O-ring.

4) Preparations for assembling the table

- ① Clean up the table base deck and apply way lubricant (#68) on it.



- ② Clean up the center of the table and apply grease to the table jig, if available. If it's not available, apply grease to the outer race of R10675 NNU4934K bearing before installation.



5) Mount the table onto the table base.

- ① Clean up the bottom of the table.
- ② Hook a rope between table and crane. Lift up the table while keeping it balanced.
- ③ Put the table upon the table base and stop lowering the table right before it contacts on the sliding side.
 - ※ Take caution lest that the ring gear of the table contacts on the spur gear of the table base, which may cause a cut or scratch.
- ④ If you have inserted the table jig in the center of the table, just put the table down; if you have inserted the bearing just in place of the table jig, insert the inner race of the bearing just before the table contacts on the sliding side. Then, resume lowering table while keeping it balanced.



6) Installing the roller bearing

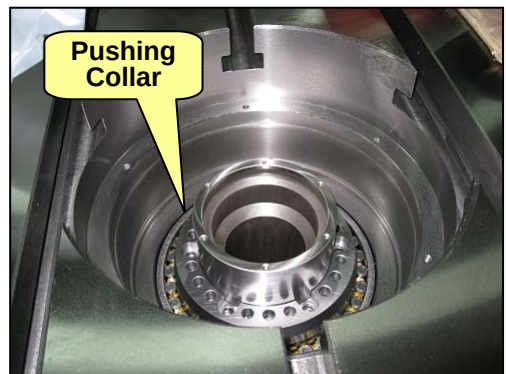
Remove the table jig if it is installed, apply grease to NNU4943K bearing as appropriate and insert the bearing with the outer race first then the inner race.



7) Inserting the pushing collar

Insert the completed B14311273A pushing collar.

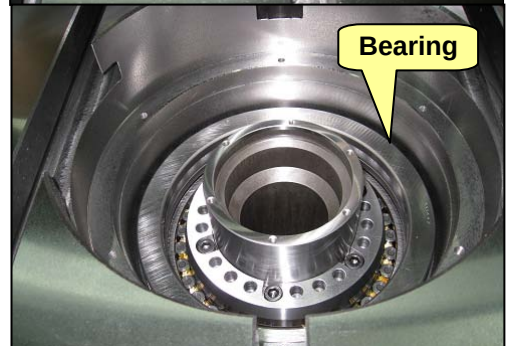
- 6-BB10×25



8) Installing the thrust ball bearing (#51144)

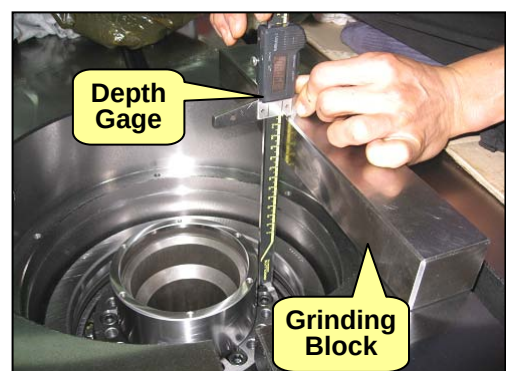
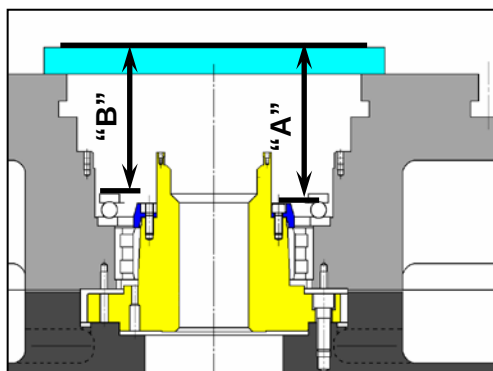
Install S6080440 thrust ball bearing (#51144) in the right direction.

- The lower bearing is inserted into the table while the upper one is for the support collar.



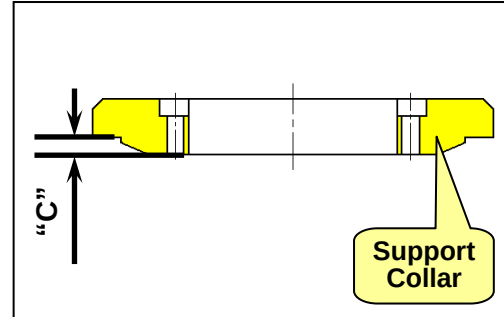
9) Fitting the support collar on site

- ① Measure the distance between table deck and pushing collar ("A"), and measure the distance between table deck and upper section of the thrust ball bearing ("B").



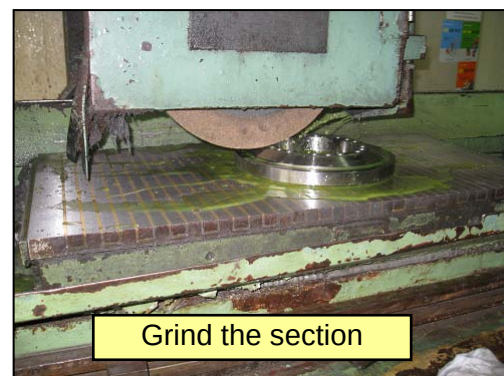
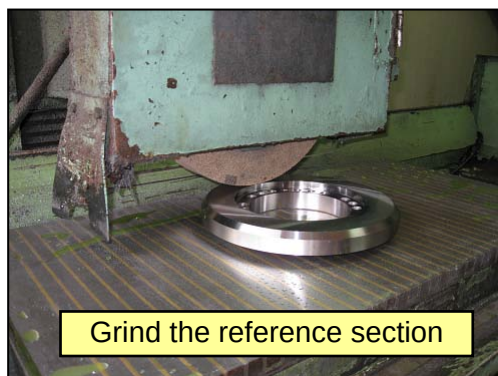
- ② Calculate the step height ("C") of B14311283 support collar.

$$"C" = "A" - "B" - 0.01\text{mm}$$



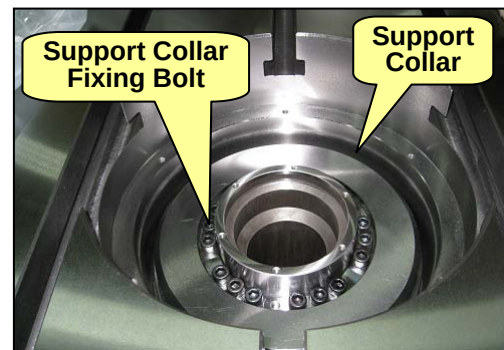
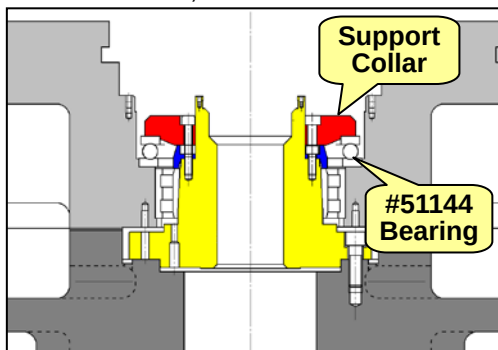
- ③ Fit B14311283 support collar on site.

※ Grind the upper side as a reference and fit the lower side according to the calculation above



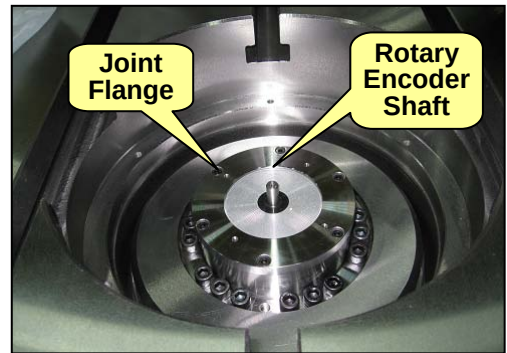
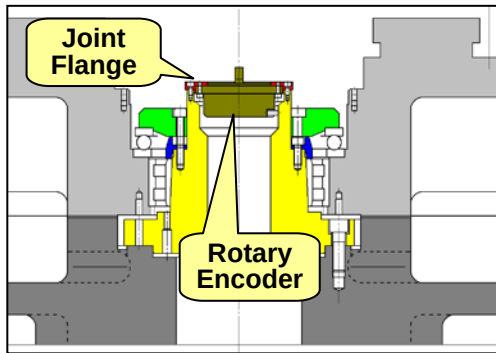
10) Inserting the support collar

- ① Apply grease to S6080440 thrust ball bearing (#51144) before inserting it.
 - ※ Pay attention to the insertion direction. (The lower bearing is inserted into the table)
- ② Insert the completed B14311283A support collar.
 - 18-BB10×60, 18-ZC10



11) Installing the rotary encoder

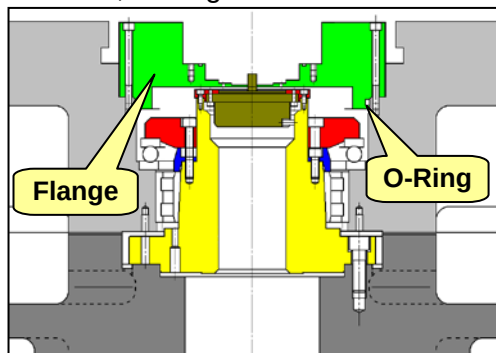
- ① Arrange the rotary encoder cable through the center post hole down to the table base.
- ② Install the joint flange assembly (where R83237 rotary encoder is installed) into the center post.
 - 6-BB5×12
- ③ From beneath the table base, locate and connect the rotary encoder cable connector and arrange the cable.



12) Installing the flange

Insert the O-ring (1-1-G270) into B14321043B flange and apply grease to the O-ring site before installing the flange into the table.

- 6-BB8×95, O-Ring : 1-G270

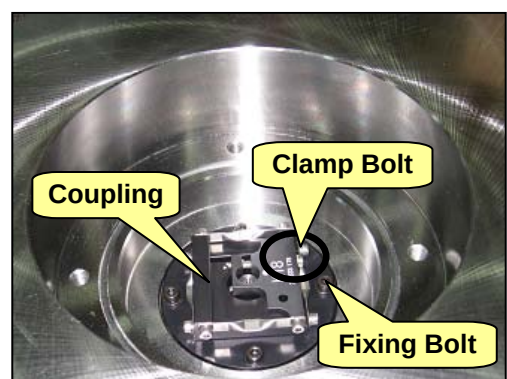
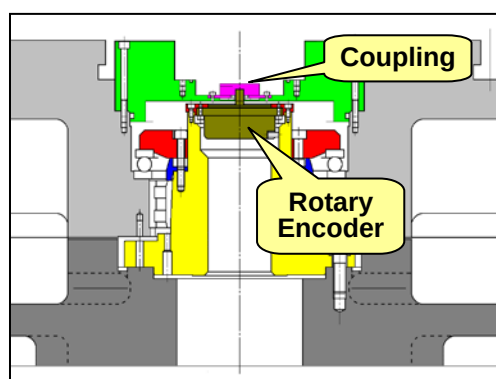


13) Installing the rotary encoder coupling

- ① Insert the rotary encoder coupling into the rotary encoder shaft with care so that it fits into the bolt holes. Then, tighten the bolts.

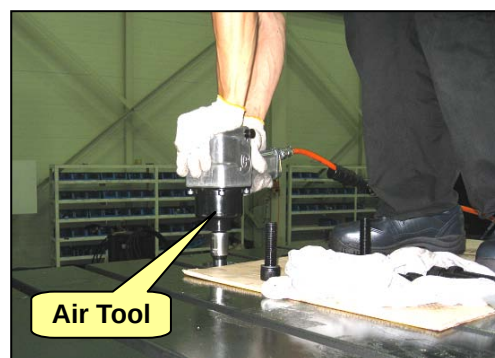
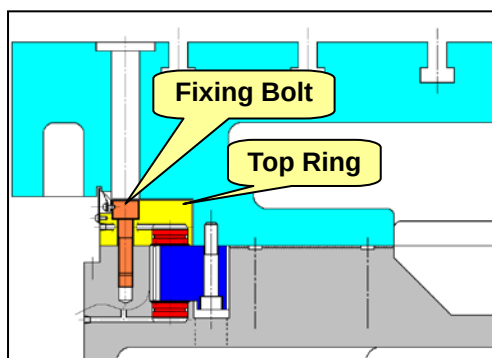
- 4-BB4×8

- ② Tighten the clamp bolts on the rotary encoder coupling.



14) Tightening the top ring bolts

- ① Turn on the machine. From the main OP, select the B axis for Handle Mode.
- ② Turn the handle slowly to rotate the table until the table holes fit with B14311021C top ring bolt holes.
- ③ Use a 17mm hex T-wrench or the air tool to tighten the top ring bolts and washers one by one.
- ④ While keeping rotating the table, tighten all of 21 bolts and washers.
 - ※ Rotate the table by another turn to ensure that no bolt hole is missing.
 - 21-BB20×70, 21-ZC20



- 15) This is the completion of installing the table. You are now ready to reset the reference point for the B axis.

※ Resetting the reference point for the B axis

1. Setting the reference-point signal position of the B-axis rotary encoder

To restore the B-axis reference point, you must go through the reference-point signal position of the rotary encoder. (If you reset the reference point without setting the ref-point signal position, alarm 90 ("can not return to the reference point") will occur.)

The reference-point signal position of the rotary encoder should be set between 0 and -7.5 degrees which is inevitably passed through when you restore the reference point.

(1) Turn on the machine and reset the reference point for the B axis manually at the "B0." coordinates. (Rotate the B axis by 360 degrees because you are not sure of the reference point for the B-axis rotary encoder yet.)

(2) When done, rotate the machine to "B180" automatically or manually.

(3) Turn off the machine and turn it back on. Then, return the B axis to the reference point in the "+" direction.

☞ If the reference point for the rotary encoder is set properly, the ref-point signal lies between 180° and 360°. If not set properly, alarm 90 ("can not return to the reference point") will occur, which means that the ref-point signal of the rotary encoder lies between 0° and 180°.

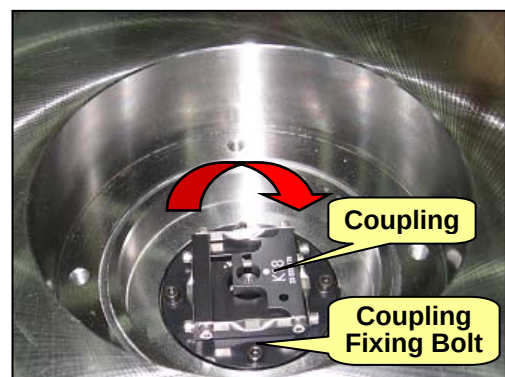
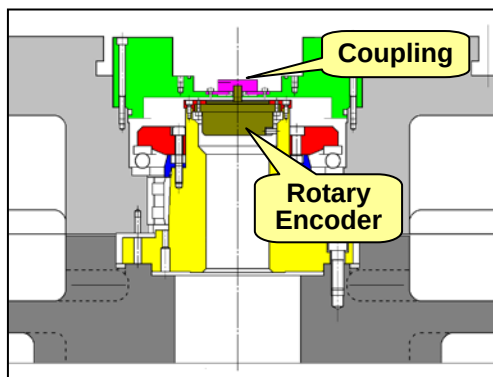
(4) If you find that alarm 90 ("can not return to the reference point") has occurred, loosen the bolts on the rotary encoder coupling and turn the coupling by 180° counter clockwise and fix it.

(5) Move the B axis to "B270." manually and restart the machine (off->on).

(6) Return the B axis to the reference point in "+" direction.

☞ If the reference point for the rotary encoder is set properly, the ref-point signal lies between 270° and 360°. If not set properly, alarm 90 ("can not return to the reference point") will occur, which means that the ref-point signal of the rotary encoder lies between 180° and 270°.

(7) If you find that alarm 90 ("can not return to the reference point") has occurred, loosen the bolts on the rotary encoder coupling and turn the coupling by 90° counter clockwise and fix it.



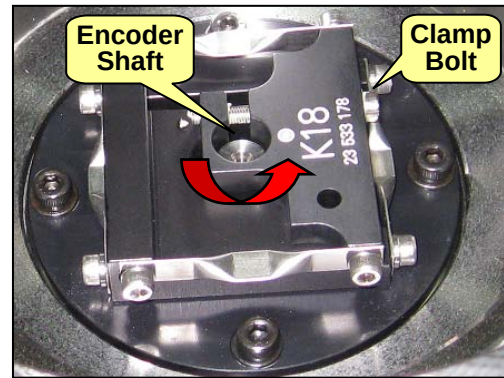
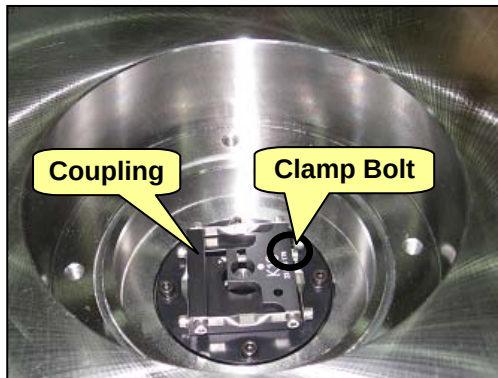
- (8) With the reference-point signal of the encoder lying between 270° and 360° , move the B axis by half of the remaining angle manually to adjust the reference-point signal position to exactly between B_0 and $B-7.5^\circ$ ($B352.5^\circ$).

☞ Set the reference point at 315° and check if set between 270° and 315° or between 315° and 360° . In the former case, turn off the machine and draw a marking line between inner coupling and encoder shaft, then loosen the coupling clamp bolts. Use the plain screwdriver to turn the encoder shaft CCW by about 45° , then tighten the clamp bolts. Repeat this step until the reference-point position lies between 0° and 352.5° .

▪ Target: 354.5° (-5.5°)

- (9) Return the B axis to the reference point in "-" direction.

☞ If the reference point is set properly, you have completed with the setting. If not, repeat these steps from the start until you set the exact "-"reference point".



2. Setting the B-axis grid shaft (reference point for the B axis)

As the overall gear ratio of the B axis is 1440: 1, the maximum degree of the B axis per one revolution of the servo motor is 0.25° . Thus, the grid shaft should be adjusted within ± 125 .

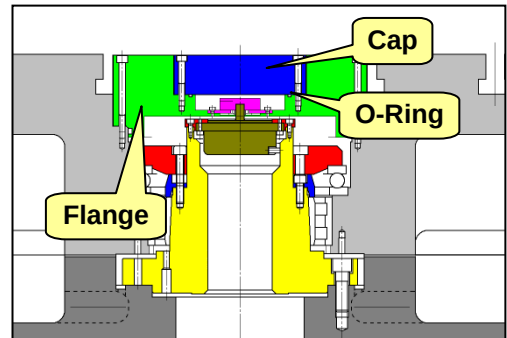
- (1) Set the reference point for the B axis manually.
- (2) Install the indicator on the spindle, present the gauge to the table T-hole or the center of the side and set it to 0.
- (3) Feed the X axis so that the gauge gets closer to the table T-hole or the distal end of the side.
- (4) Turn the B axis manually to set the gauge needle to 0.
- (5) Feed the X axis in the opposite direction and measure the error on the other side.
- (6) If the error is beyond 0.02mm, move the B axis by half of the error manually and set the gauge needle to 0. Then, feed the X axis in the opposite to measure the error on that side.

- (7) If the error is still beyond 0.02mm, move the B axis by half of the error manually and set the gauge needle to 0. Repeat this step above until the error is less than 0.02mm.
- (8) When you get a satisfactory result, check the machine position that is displayed on the screen and enter the value (coordinates) in "Parameter No. #1850 B".
 - If the item is already filled with a certain figure, just press +Input.
- (9) Restart the machine (off -> on) and set the reference point for the B axis again. Repeat these steps above until you get a satisfactory result.

16) Installing the cap

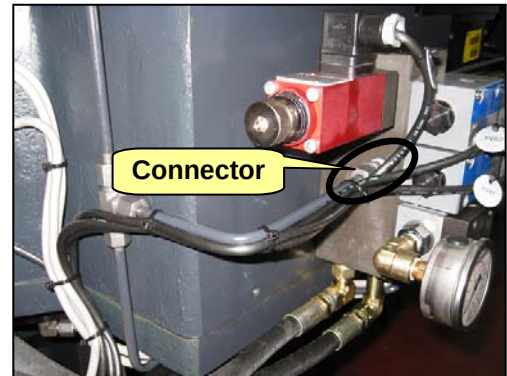
Apply grease to the O-ring hole on the bottom of the flange, insert the O-ring and install B14321073 cap.

- ※ If you install the cap without applying grease to the O-ring hole, the O-ring may be loose, causing a problem such as inflow of the coolant
- 4-BB8×50, O-Ring : 1-G120



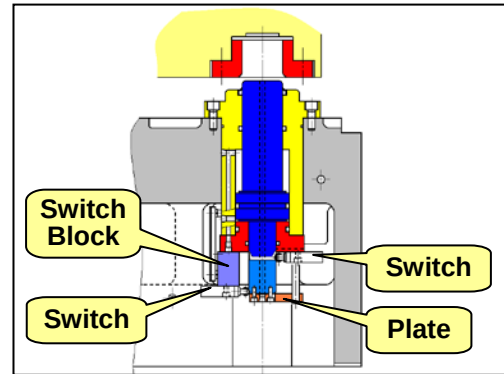
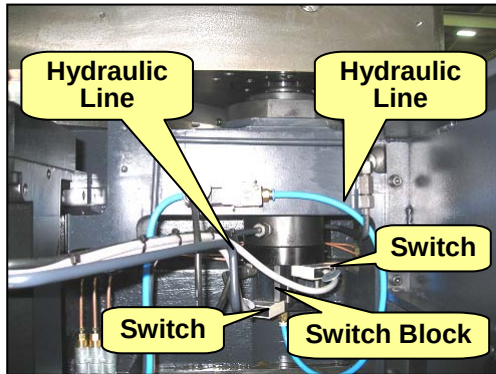
17) Finishing

- ① Remove the plug from the connector hole of the tool clamping hydraulic line in the manifold.
- ② Repeat the table clamping and unclamping manually to check if there occurs a leak of the hydraulic oil.

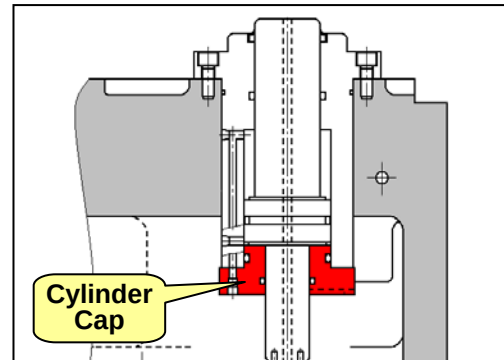


2.4 Removing the locating pin

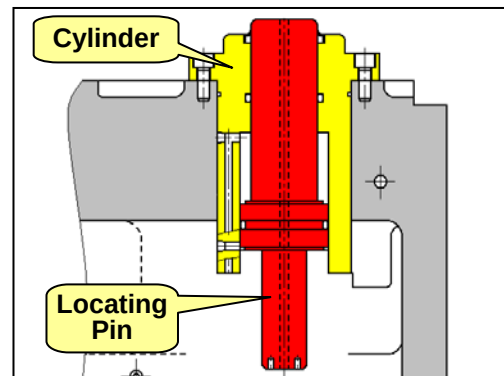
- 1) Turn the table to check if there occurs an interruption when reinstalling the locating cylinder assembly. If the table moves smoothly, turn off the machine and remove the front cover of the table. Then, remove the hydraulic piping, sensor switches, switch block and plates one by one.



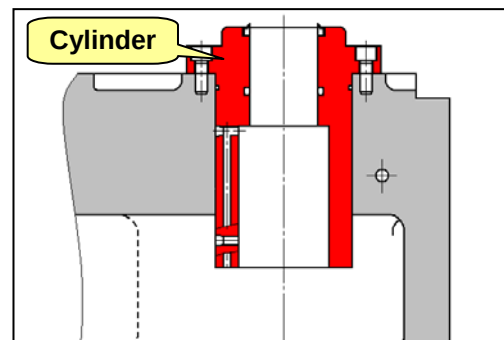
- 2) Remove B12311093 cylinder cap.
 - 6-BB10×35



- 3) Pull out B12311083 locating pin from beneath the cylinder.



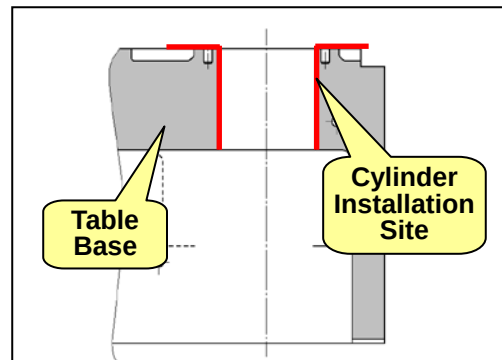
- 4) Remove B12311072B cylinder.
 - ※ To remember the original position, It is recommended to draw a marking line between one side of the cylinder and table base.
 - 6-BB12×35, 2-TPB10×56



2.5 Installing the locating pin

- 1) Preparations for installing the locating pin assembly

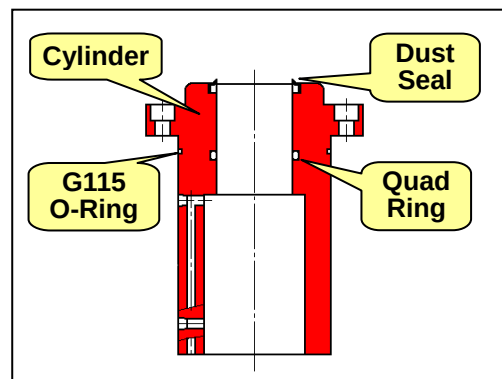
Clean up the cylinder installation area of the table base and apply grease.



- 2) Preparations for installing the cylinder

Clean up B12311072B cylinder and insert the O-ring, dust seal and quad ring. Then, apply grease to the O-ring as well as the quad ring to facilitate the work and to prevent possible damage.

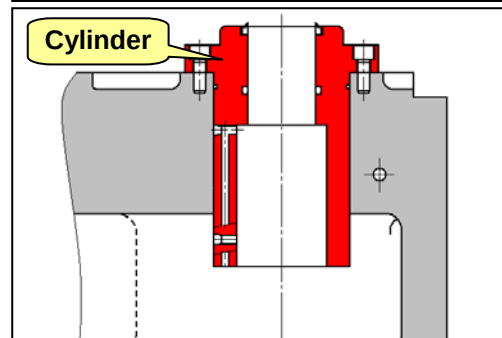
- 1- O-Ring(G119),
- 1-Dust Seal(DK160×74×8),
- 1-Quad Ring(ORAR04332)



- 3) Installing the cylinder

Install B12311072B cylinder (with the O-ring, dust seal and quad ring installed) into the table base based on the marking line.

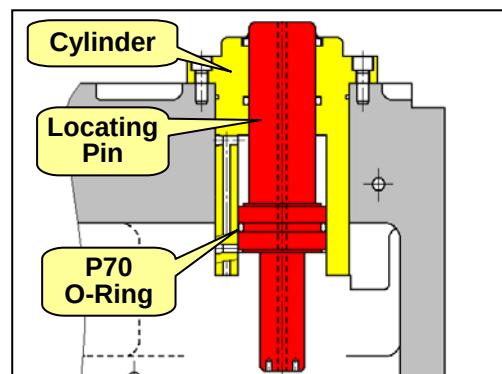
- 6-BB12×35, 2-TPB10×56



- 4) Installing the locating pin

Insert P70 O-ring into B12311083 locating pin before applying grease. Insert the cylinder bottom up with care.

- 1- O-Ring(P70)



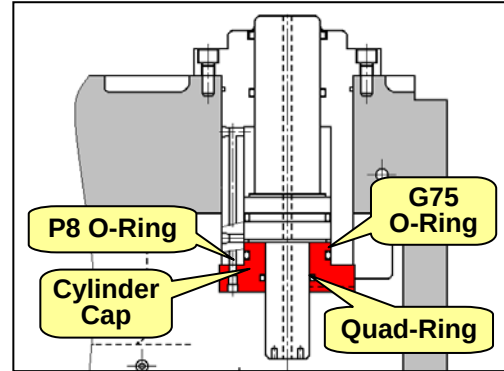
5) Installing the cylinder cap

Insert the O-rings (P8, G75) and quad ring into B12311093 cylinder cap before applying grease. Install the cap into the cylinder so that it fits into the O-ring holes.

▪ 6-BB10×35

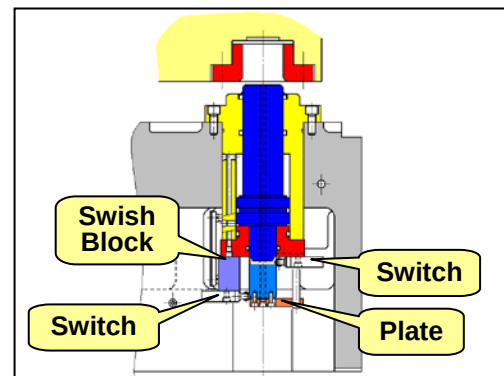
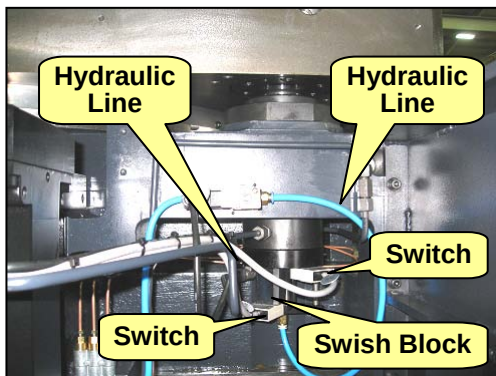
O-Ring:1-O-Ring(P8), 1-O-Ring(G75)

1-Quad Ring(ORAR04326)

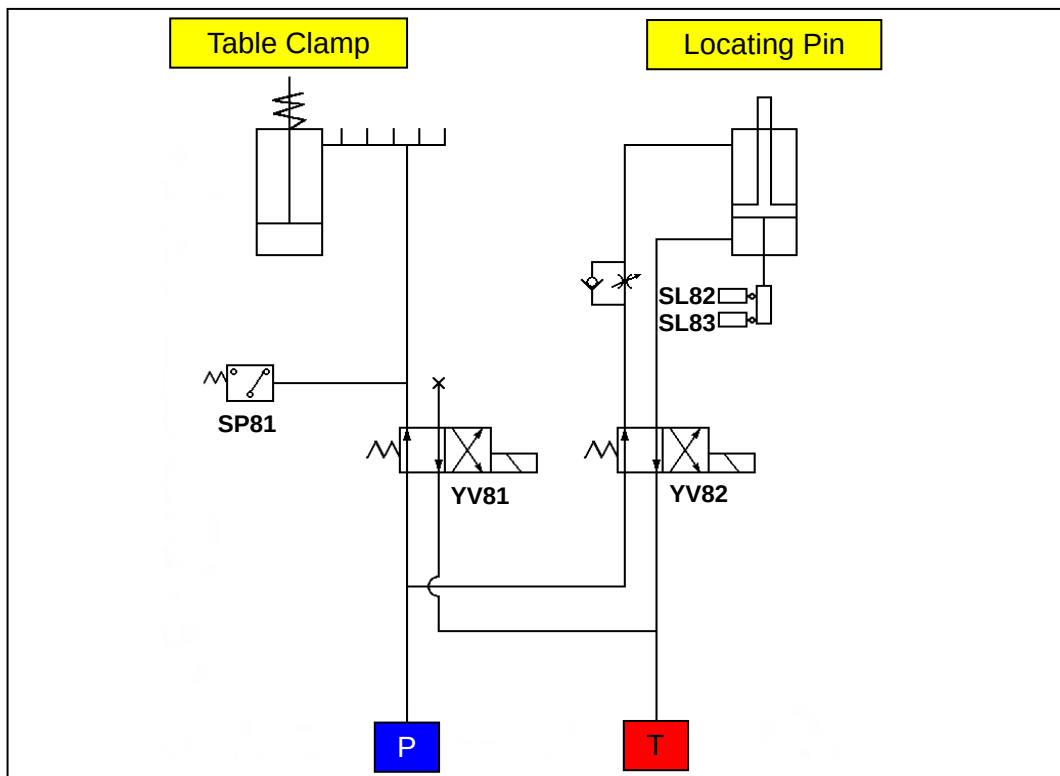


6) Finishing

Install the removed hydraulic pipes, sensor switches, switch block and plate back to the locating cylinder assembly.

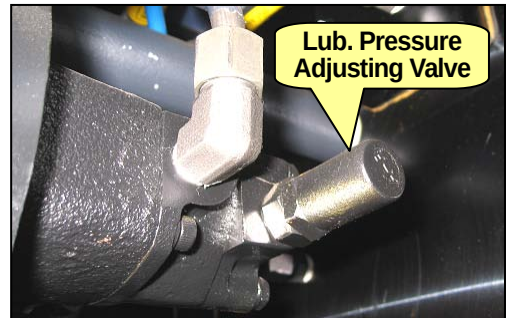
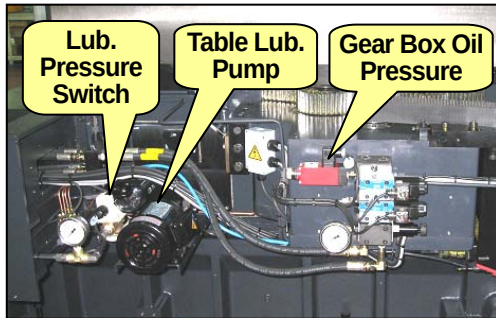


※ Ref 1) Hydraulic Circuit Line in the Table

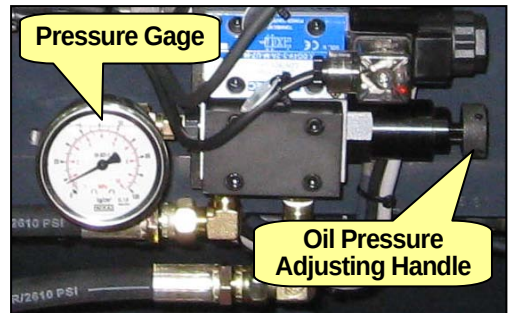
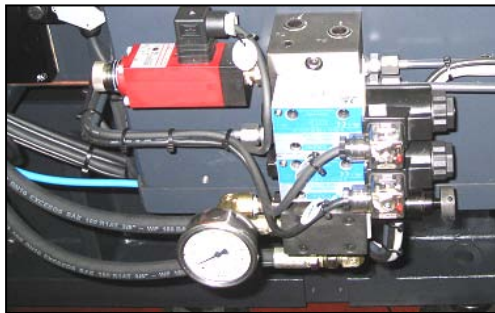


※ Ref 2) Adjusting the pressure on the table

1) Table Lubrication Pump : 1.0Kg/cm²



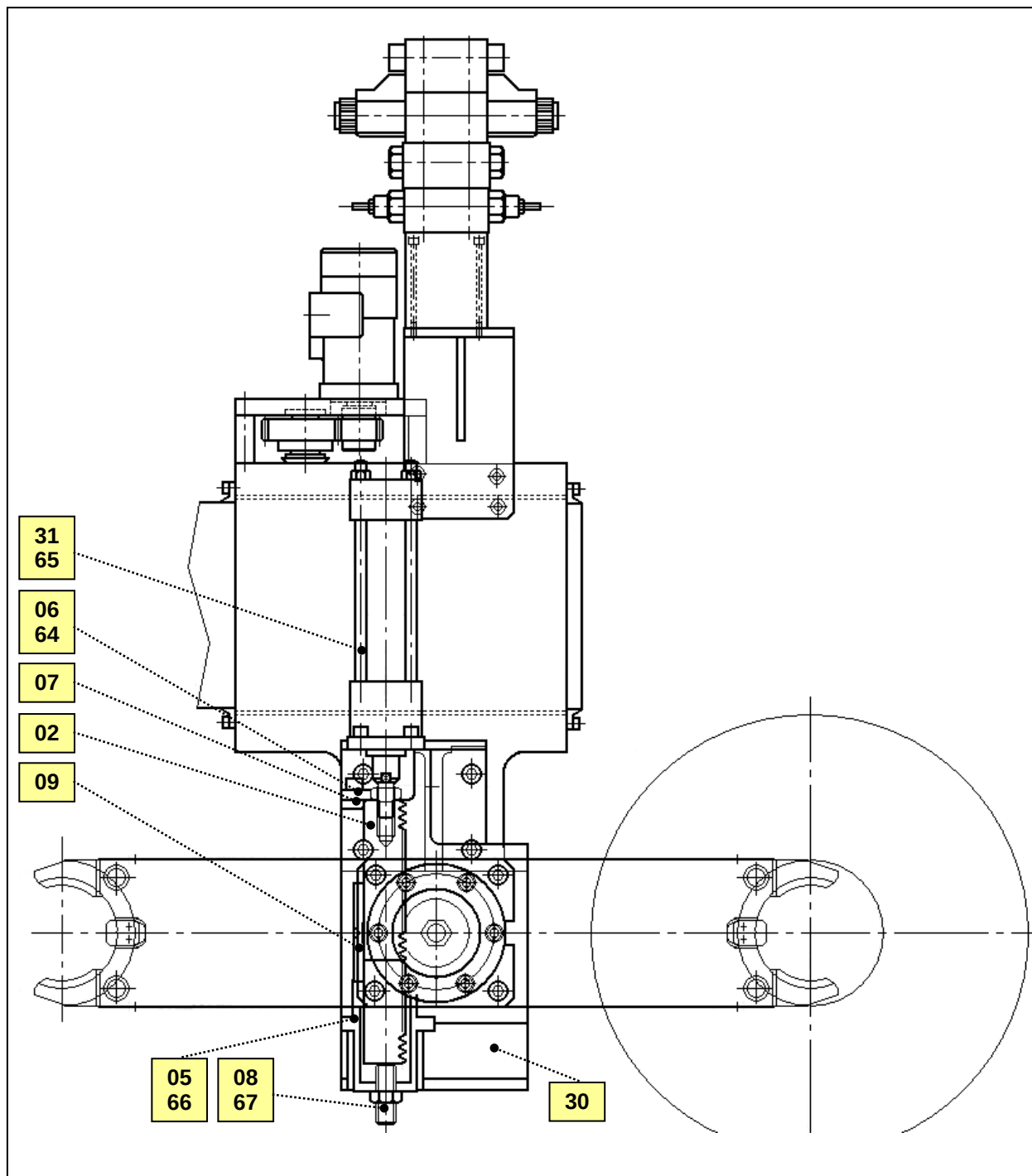
2) Oil pressure on the table gear box: 10Kg/cm²



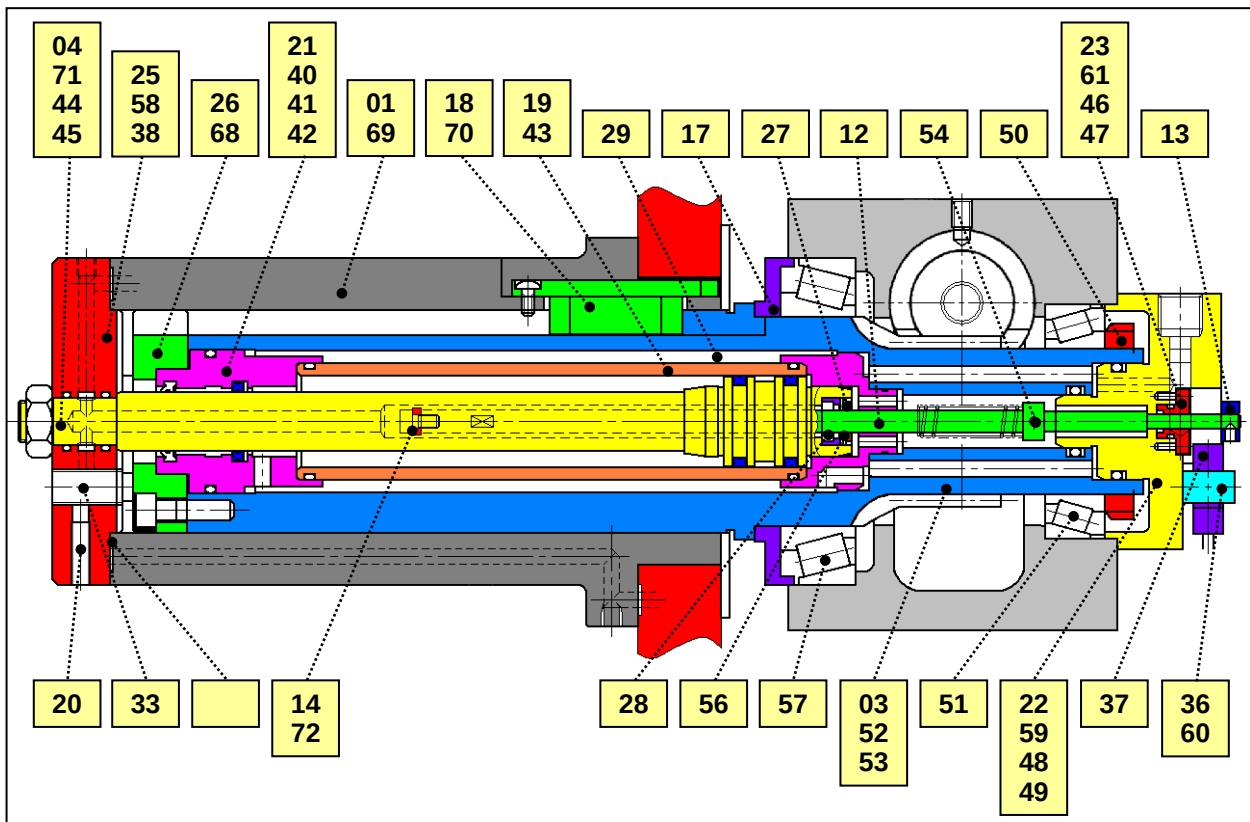
3. ATC

3.1 Learning about the changer

1) Changer assembly



2) Cross-sectional diagram of the changer

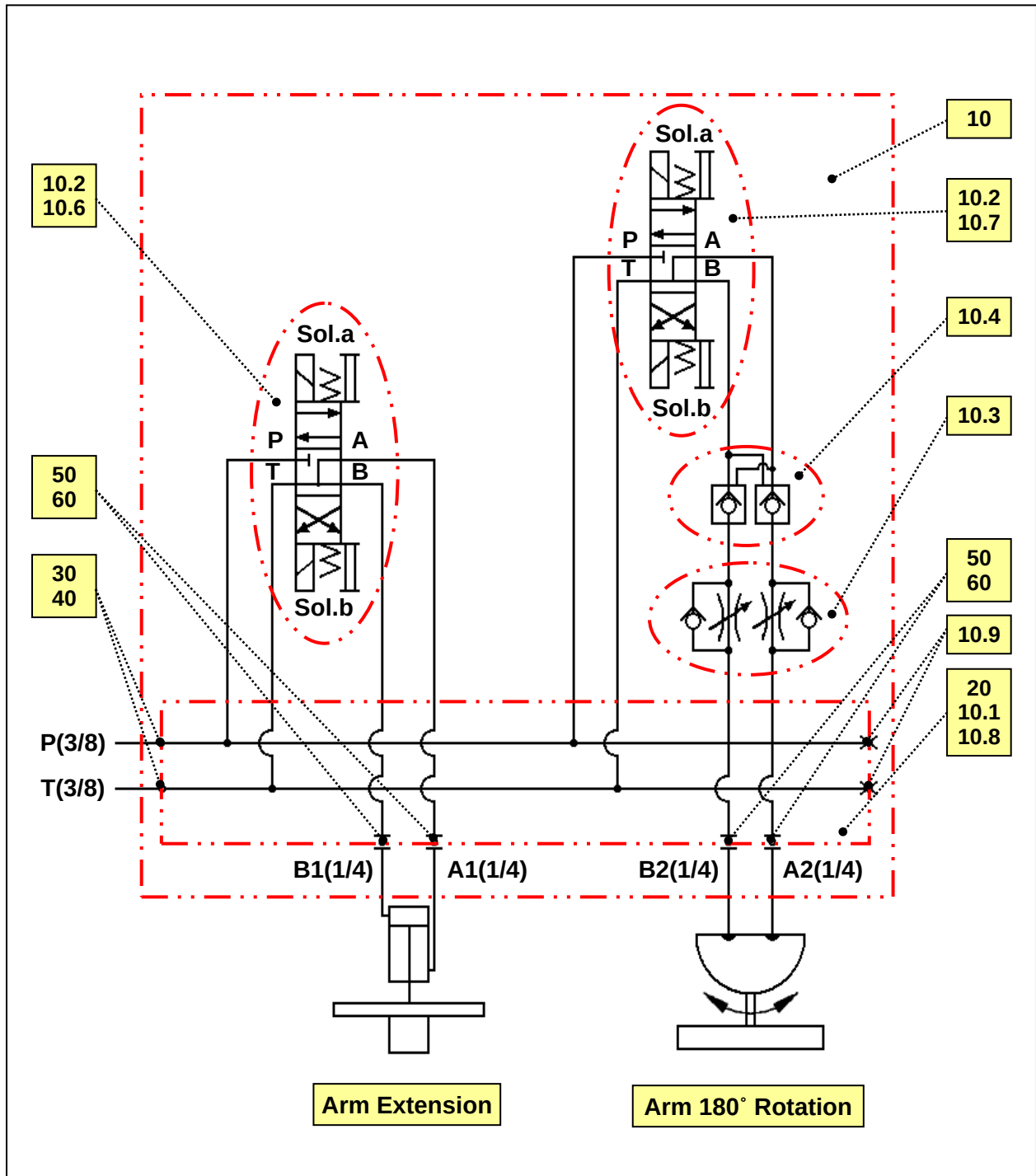


NO.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
01	B10564012A	Housing	1	FCB	
02	B10564023A	Rack	1	SCM415	
03	B10564032B	Shaft	1	SCM415	
04	B10564042	Piston	1	SCM415	
05	B10564053	Housing	1	SS41	
06	B10564064	Stopper	1	SCM415	
07	B10564074	Spacer	1	SS41	
08	B10564084	Stopper	1	SM45C	
09	B10564093	Guide Bush	1	HBSC4	
12	B10564123	Shaft	1St	SM45C	
13	B10564134	Dog	1	SS41	
14	B10564144	Washer	1	SS41	
17	B10564174	Arm Cover	1	SS41	
18	B10564184	Slide Key	1	SCM415	
19	B10564193	Piston Housing	1	STKM13A	
20	B10564204	Piece Set	1	Brc	
21	B10564213	Slide Housing	1	SM45C	
22	B10564222	Cover	1	FCB	
23	B10564134	Cover	1	SS41	
25	B10564253A	Arm Flange	1	SM45C	



NO.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
26	B10564263A	End Cover	1	SCM415	
27	B10564274	Cover	1	SCP1(t2.3)	
28	B10564284	Collar	1	SS41	
29	B10564293	Cover	1	SM45C	
30	B10564321B	Frame	1	DC500	
31	B10564323A	Hyd. Cylinder	1	SS70HL-2-FA-040-C-0097-B-C-B-N-2	Samick
33	B10564344	Stopper	1	SM45C	
36		Block Sensor	1	P90-R12	Autonics
37	ESWPX0090	Sensor	2	BES-516-325-E5-Y	Balluff
38	S8000180	O-Ring	2	P18	NOK
40	R55291	Seal	1	WRB-22.4	SKG
41	R53185	Quad-Ring	1	QRAR04327	Busak
42	R56090	Packing	1	ISI-22.4	SKG
43	R53186	O-Ring	2	1A-G40	NOK
44	R56091	Packing	2	UHS(27×35×5)	NOK
45	R56092	Wear Ring	1	SW35	SKG
46	S8000080	O-Ring	1	P10	NOK
47	S8000100	O-Ring	1	P6	NOK
48	R56093	Packing	1	4222-366Y	Busak
49	R54027	Back-Up Ring	1	S52029-222	Busak
50	S6260110	Lock Nut	1	FU11SC	Fukuda
51	S6134110	Bearing	1	4T-32011X	NSK
52	R56094	Packing	1	4211-366Y	Busak
53	R54028	Back-Up Ring	2	S52028-211	Busak
54	S5740500	Spring Pin	1	Φ3×12	
56	S6510181	Retaining Ring	1	RB18	
57	S6134160	Bearing	1	32016XU	NSK
58	S2209561	Hex. Socket Head Bolt	4	BB8×45	
59	S2209561	Hex. Socket Head Bolt	4	BB8×45	
60	S2202061	Hex. Socket Head Bolt	2	BB4×20	
61	S2203361	Hex. Socket Head Bolt	4	BB3×10	
64	S2212461	Hex. Socket Head Bolt	2	BB10×40	
65	S2212661	Hex. Socket Head Bolt	4	BB10×50	
66	S2209461	Hex. Socket Head Bolt	6	BB8×40	
67	S4000931	Nut	2	NA16	
68	S2209261	Hex. Socket Head Bolt	4	BB8×30	
69	S2215561	Hex. Socket Head Bolt	4	BB12×45	
70	S3450821	Machine Screw	2	BP5×10	
71	S4000931	Nut	1	NA16	
72	S2202861	Hex. Socket Head Bolt	1	BB5×10	
73	S8000090	O-Ring	4	P9	NOK

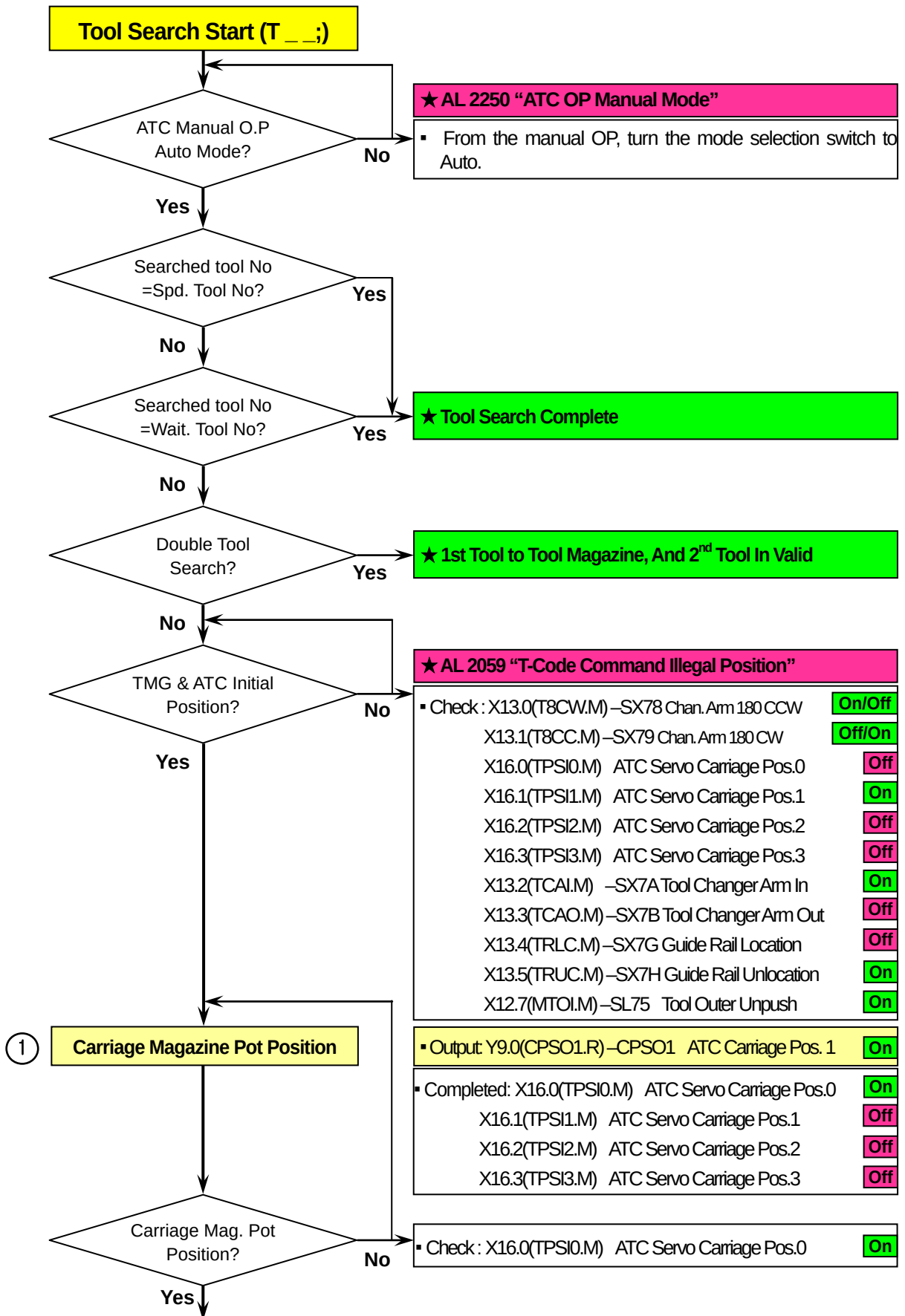
3) Hydraulic circuit line of the changer

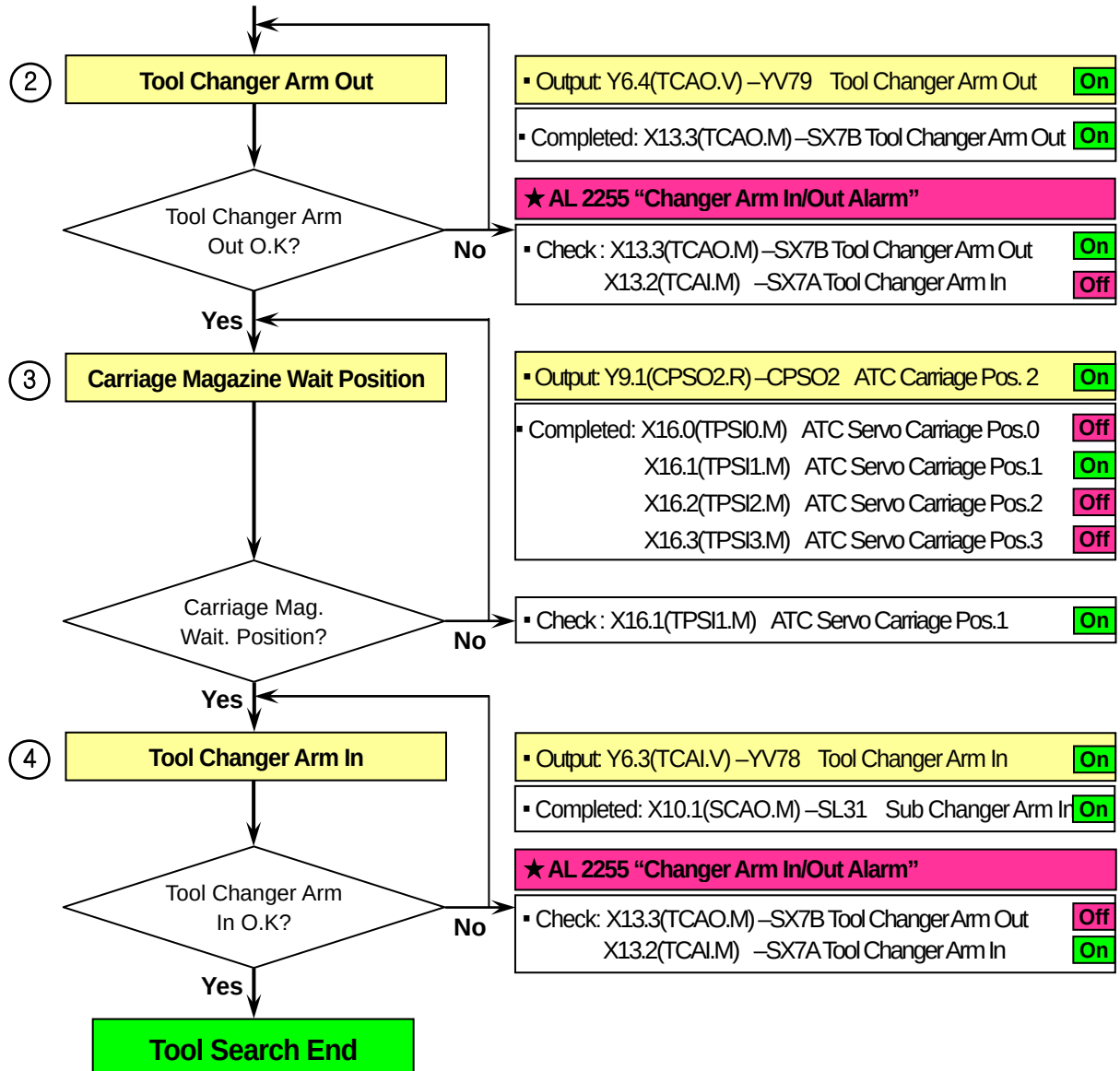




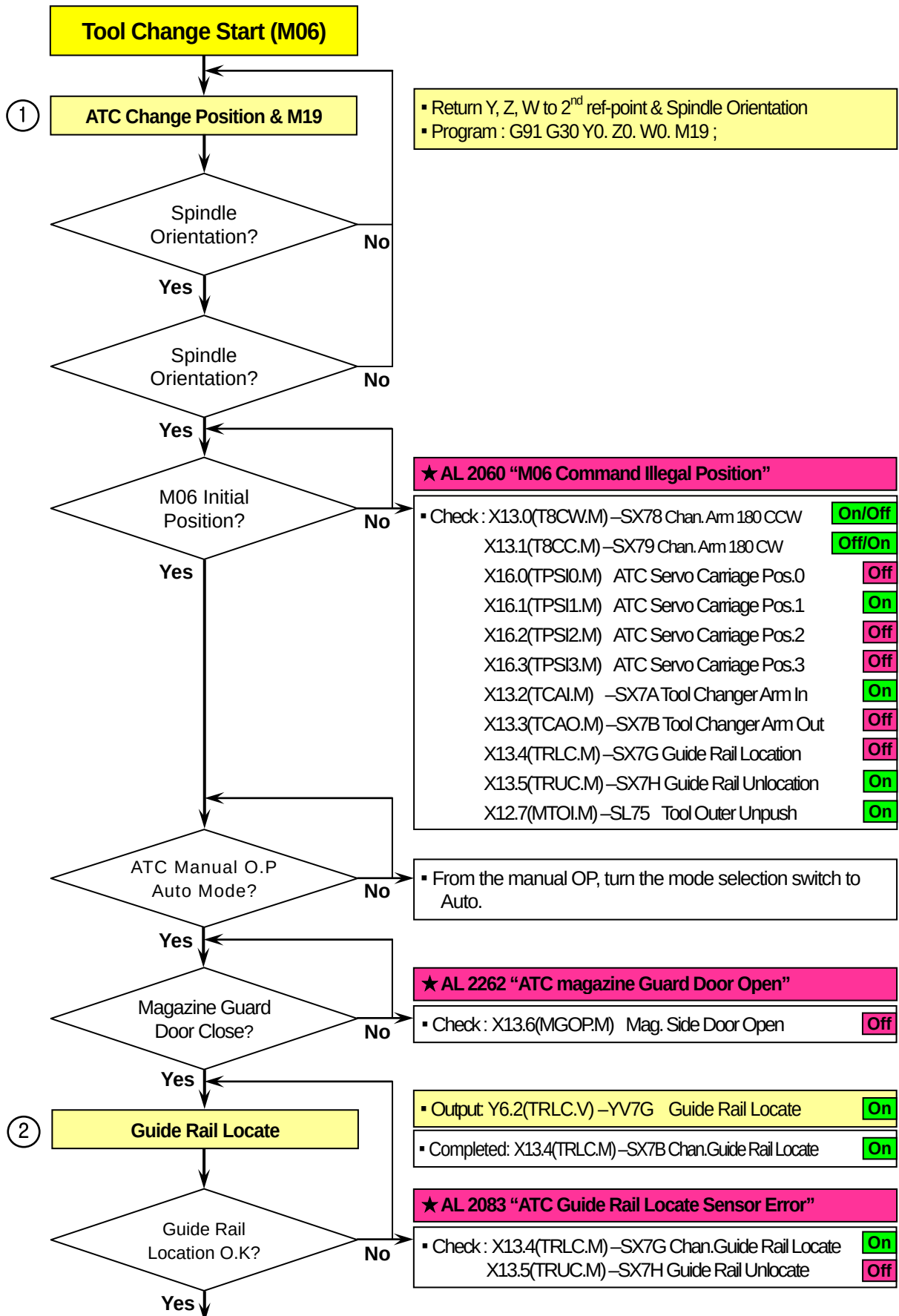
NO.	Part No.	Description	Q'ty	Mat./Spec.	Remarks
10	B26599012	Manifold Ass'y	1		
10.1	B26599021	Manifold	1	FCD450(SS400)	
10.2	R30497	Solenoid Valve	2	K-DG4V-3-M-U2t(DC24V)	
10.3	R30496	Flow Control Valve	1	TGMFN-3-Y-A2H-B2H-K	
10.4	R30500	Pilot Check Valve	1	TGMPC-3-ABK-BAK-K	
10.6	S2204061	Hex Socket Head Bolt	4	BB5×45	
10.7	R00077	Hex Socket Head Bolt	4	BB5×125	
10.8	P74060006	Hex Socket Plug	2	FPS-S(1/8")	
10.9	P74060010	Hex Socket Plug	2	FPS-S(3/8")	
20		Hex Socket Head Bolt	4	BB5×70	
30	P74421230	Mail Elbow	1	KLN12-030N	
40	P74331230	Long Mail Elbow	1	KLL12-030N	
50	P74421020	Mail Elbow	2	KLN10-020N	
60	P74331020	Long Mail Elbow	2	KLL10-020N	

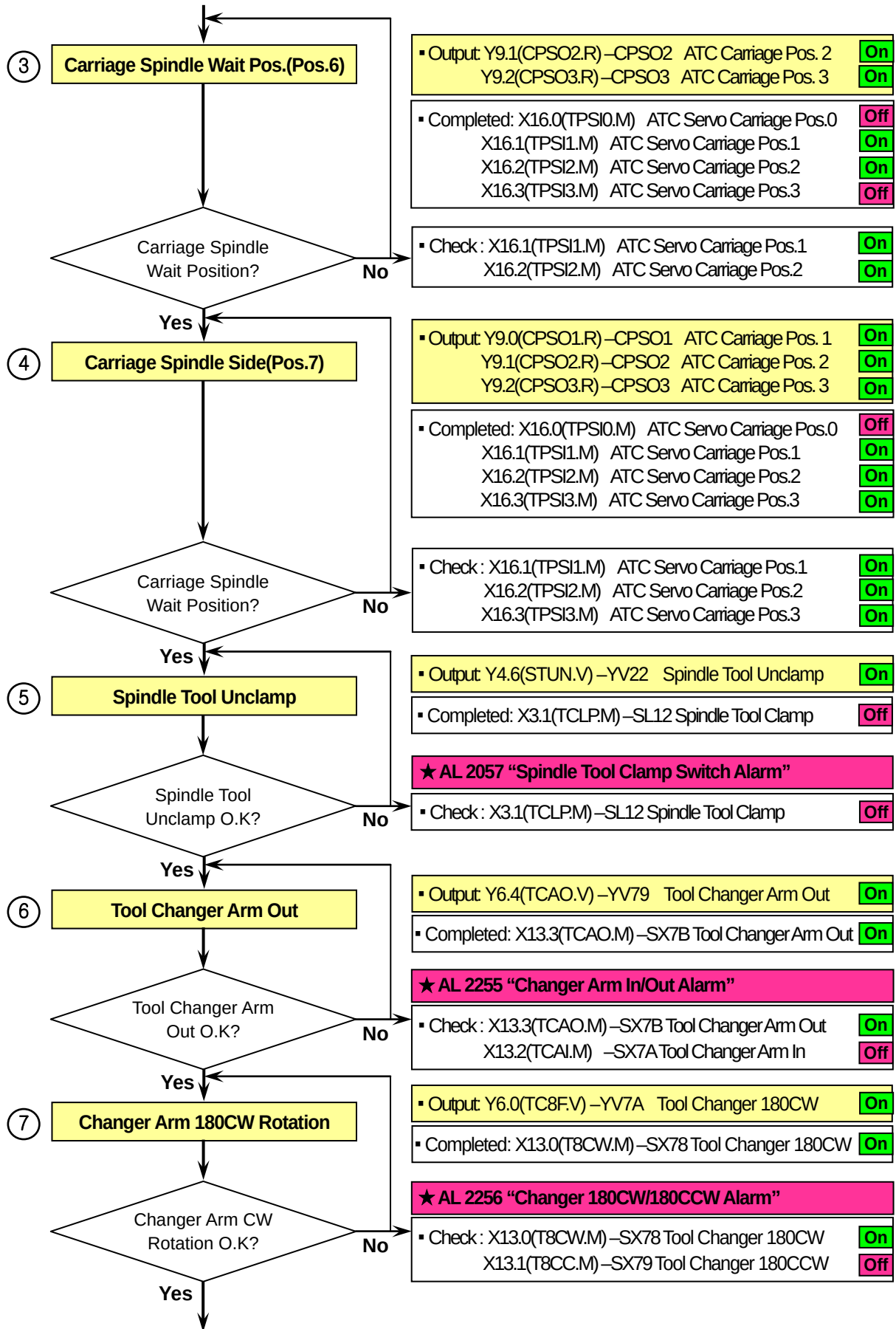
3.2 Tool Search (T __;) Sequence Chart

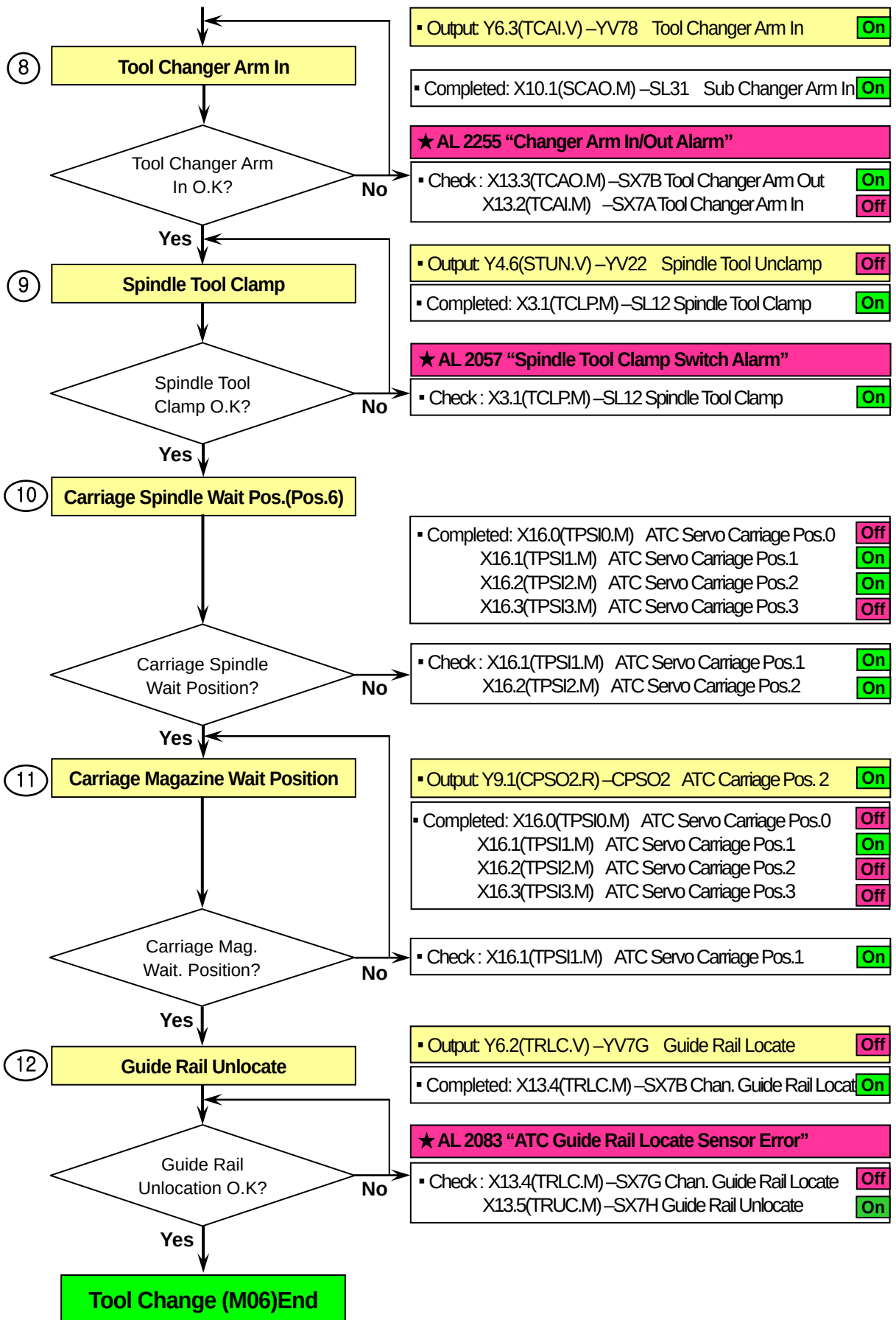




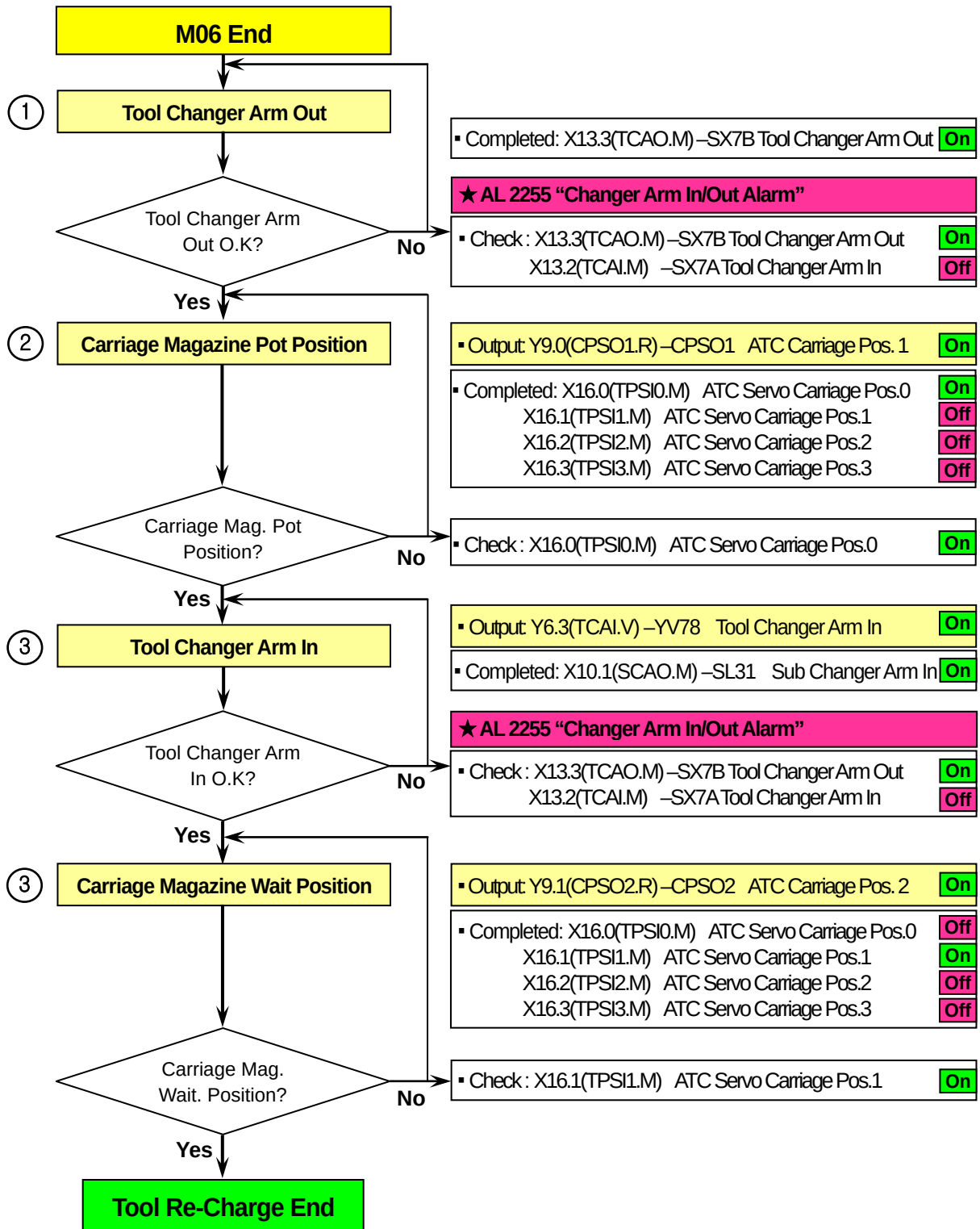
3.3 Tool Changing (M06;) Sequence Chart



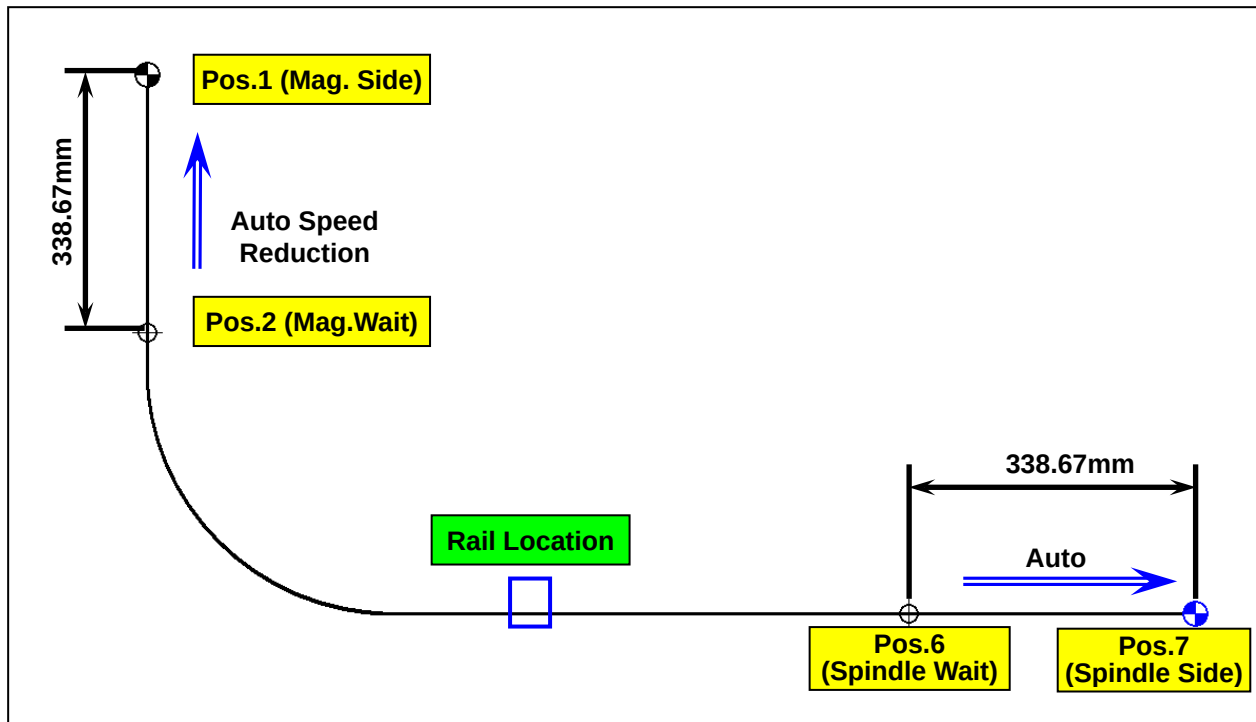




3.4 Tool Re-Charge Sequence Chart



3.5 Carriage System



- 1) Position 1 (Machine Reference Position): Tool Changer Arm Magazine Pot Position
- 2) Position 2 (Magazine Wait) : Tool Changer Arm Magazine Waiting Position (Home Position)
- 3) Position 6 (Spindle Wait) : Tool Changer Arm Spindle Waiting Position
- 4) Position 7 (Spindle Side : Tool Changer Arm Spindle Side Position

Ref) Position Signal (input)

	Pos.	X16.0	X16.1	X16.2	X16.3
Magazine Side Position	1	1	0	0	0
Waiting Position	2	0	1	0	0
Spindle Waiting Position	6	0	1	1	0
Spindle Side Position	7	0	1	1	1

Ref) Position Signal (output)

	Pos.	Y9.0	Y9.1	Y9.2
Magazine Side Position	1	1	0	0
Waiting Position	2	0	1	0
Spindle Waiting Position	6	0	1	1
Spindle Side Position	7	1	1	1



3.6 ATC Carriage Servo Motor Parameter

NC BORING		CARRIAGE. MOTOR (DOOSAN SERVO)		NC UNIT		FS16/18IM-B
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PARAMETERS FOR CARRIAGE SERVO						
NO.	CARRIAGE. SERVO		DEF.	TYPE	DB110CX/ DB130CX CARRIAGE	Method of setting parameter
	FUNCTION	RANGE				
0	MOTOR POWER CAPA.	0	0	A	0	— Note. Adjusted parameter operated as follows. A: Adjusted parameter is only valid when power is off → on B: You can adjust the parameters under the servo is off.
1	MOTOR ROTATION DIR.	0~1	1	A	1	
2	RESERVED	0~2	0	A	0	
3	JOG FUNCTION SEL.	0~1	0	A	1	Machine Home setting method When assembling the motor for the first time, set the absolute encoder zero-point to the machine Home. The setting method is as follows. (These steps should be done when the external servo 'ON' signal is OFF.) Turn the machine power supply ON. Fix parameter 2 to the POST number of the current position. ● Press the MODE key; and change operating display to parameter fixing mode. " 0.0.0000 " ● Press UP key; and change display of the first two segments to 08. " 0.8.0001 " ● Press SET key; and the dot below the first two segments will disappear. " 0.8.0001 " ● Press UP or DOWN key; to adjust the last 4 segments to the POST number of the current position. (example : if the current position number is 1, the initial POST will be set to 1.) " 0.8.0001 " ■ Set the zero-point from the zero-point display of the servo ON/OFF display mode. ● Press the MODE key; and change the display to servo ON/OFF mode. " r d - off " ● Press the DOWN key; and change the display to zero-point setting mode. " 0 r 9.5-- " ● Press SET key for 5 seconds and the display will set the parameter automatically and the tone back the display to zero-point setting mode. " 0 r 9.5-- " ■ Turn the power OFF and then ON again and the setting of the zero-point is now completed.
4	RESERVED	0~1	0	A	2048	
#5	MAX. POT NO.	2~127	12	A	15	
6	GEAR RATIO 1(MOTOR)	1~9999	33	A	2053	Carriage Position Setting Method Press the MODE key; and change operating display to parameter fixing mode. " n 0002 " => wating position Mode key for 5 seconds pushed fixing mode. " 0.10000 " Press UP key for 5 seconds pushed fixing mode. " 0.70000 " Press SET pushed fixing mode. " 0.72596 " DATA Input Press SET pushed 1mm : 432,7 , 3mm : 1298 , 5mm : 2163,7 , 7mm : 3029,2 , 2mm : 865,5 , 4mm : 1731,0 , 6mm : 2596,5 , 8mm : 3462,2 , 11mm : 4760,2 , 12mm : 5193,0 , 13mm : 5625,7 , 15mm : 6491,2 , 9mm : 3894,7 , 10mm : 4327,5 , 16mm : 6924,0
7	GEAR RATIO 2(MACH.)	1~9999	12	A	100	
8	HOME POT FOR SETT.	1~127	1	A	1	
9	RESERVED		0	A	0	
10	POSITION LOOP P GAIN	0~2048	256	B	500	
11	VELOC. LOOP P GAIN	0~2048	250	B	600	
12	VELOC. LOOP I GAIN	0~2048	1	B	110	
13	SERVO READY ON TIME	0~40	0	B	5	
14	BRAKE OFF TIME	0~40	0	B	1	
15	BRAKE ON TIME	0~40	0	B	20	
16	VEL. OR TOR. MON. OF.	-12~12	0	B	0	
17	VEL. OR TOR. MON. SE.	0~3	0	B	0	
18	INPOSITION	1~9999	100	B	100	
19	RESIDUAL PULSE ALLO.	1~6000	6000	B	6000	
20	FEEDFORW. CONT. GAIN	0~100	0	B	0	
21	FEEDFORW. TIME CONS.	0~500	0	B	0	
22	TORQUE LIMIT POSIT.	0~300	250	B	280	
23	TORQUE LIMIT NEGAT.	0~300	250	B	280	
24	TORQUE LIMIT 2 POSIT.	0~300	50	B	280	
25	TORQUE LIMIT 2 NEGA.	0~300	50	B	280	
26	VELOCITY LIMIT	0~3000	1850	B	1250	
27	JOG SPEED	0~1000	100	B	50	
28	VELOCITY COMMAND	10~2000	1800	B	1200	
29	ACC. TIME CONSTANT	0~340	50	B	340	
30	DEC. TIME CONSTANT	0~340	80	B	340	
31	MONIT. AT RATE VELO.	500~5000	3000	B	3000	
32	MONIT. AT RATE TORQ.	500~5000	1500	B	1500	
33	INITIAL STATUS DISP.	0~10	6	B	5	
34	ABS O/F OFFSET(LSW)	-32768~32767				
35	ABS O/F OFFSET(MSW)	-32768~32767				
36	HOME O/S VAL.(LSW)	-32768~32767				
37	HOME O/S VAL.(MSW)	-32768~32767				
38	CURR. LOOP P GAIN	0~2048	750	B	750	
39	CURR. LOOP I GAIN	0~2048	510	B	510	
46	RESERVED		0	B	1	
NO.	POSITION OFF SET					
1	MAGAZINE SIDE POS.			B		
2	WAITING POS.			B		
6	SPINDLE WAIT POS.			B		
7	SPINDLE SIDE POS.			B	2596	

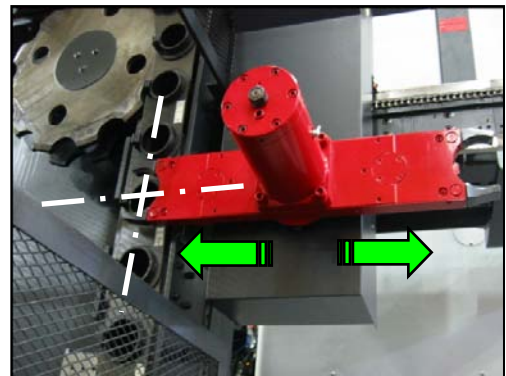
EDITION	DATE	REVISED CONTENT	PAGE
A0	2008. 01.30		M2

3.7 Setting the reference point for the carriage magazine side

- 1) Insert the centering fixture between magazine pot (③) and changer gripper (②).



- 2) Move the changer to the magazine pot manually.



- 3) Open the door of the electric cabinet and find the carriage AMP that is located in the internal front side.



- 3.1) Check the center position using the centering fixture above, and if it fits correctly

- ① Press the MODE button in the start screen [r 0000] of the servo drive to enter the diagnosis mode.



→ [rd-off] : Diagnosis mode



- ② From the [rd-off] screen, set the down arrow button as a function key to set the reference point



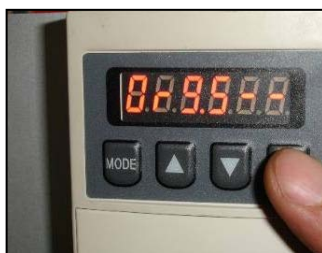
→ [Org.S - -] : Switch to ref-point setting mode



- ③ From the [Org.S - -] screen, press and hold the SET button for 10 seconds. If you press and hold the SET button for 10 seconds in the [Org.S - -] screen, the screen will blink and switch to [r 0001].



→ [r 0001] : Return to the start screen



- ④ Turn off the machine and turn it back on. This is the completion of resetting the reference point.

3.2) If you have to reset the reference point because the center of magazine pot does not match with that of the changer.

- ① Press the MODE button in the start screen [r 0000] of the servo drive.



→ [rd-off] : Diagnosis mode



- ② From the [**rd-off**] screen, set the down arrow button as a function key to set the reference point



→ [**Jog.run**] : Switch to the jog run mode



- ③ From the [**Jog.run**] screen, press the SET button.



→ [**Jr.0000**] : Jog run mode



- ④ From the [**Jr.0000**] screen, use the up/down arrow buttons to feed the changer in a desired direction. In such a way, adjust the changer position for the pot.



→ Fine-tuning the changer

- If you want to fine-tune the magazine position, set parameter #27 to a lower value.
- Use the up/down arrow buttons in the [**Jr.0000**] screen, or press the rotation button on the manual operation panel. While holding the button, insert the center bar into the centering fixture until it is inserted smoothly.

※ Feeding the changer on the manual OP

Change "K17.6" from 0 to 1 before proceeding.

- When you have completed resetting the reference point, change "K17.6" from 1 back to 0.



- ⑤ When the centering of the tool magazine's tool pot is completed, press the SET button.



→ [Jog.run] : Return to the jog run mode



- ⑥ In the [Jog.run] screen, press the MODE button.



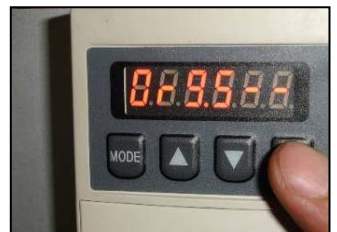
→ [rd-off] : Ready to operate the jog run



- ⑦ Back in the [rd-off] screen, press the up arrow button.



→ [Org.S - -] : Original mode



- ⑧ From the [Org.S - -] screen, press and hold the SET button for 10 seconds.
If you press and hold the SET button for 10 seconds in the [Org.S - -] screen, the screen will blink and switch to [r0001].



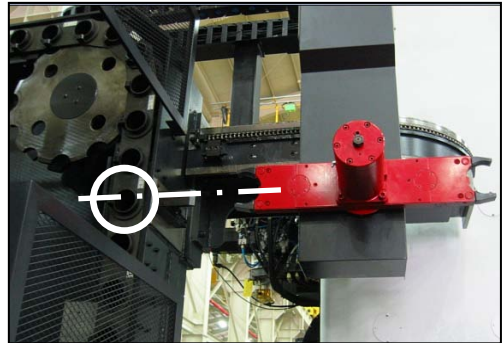
→ [r 0001] : Return to the start screen



- ⑨ Turn off the machine and turn it back on. This is the completion of resetting the reference point.
 - When you have completed resetting the reference point, change "K17.6" from 1 back to 0.

3.8 Setting the reference point for the tool magazine pot

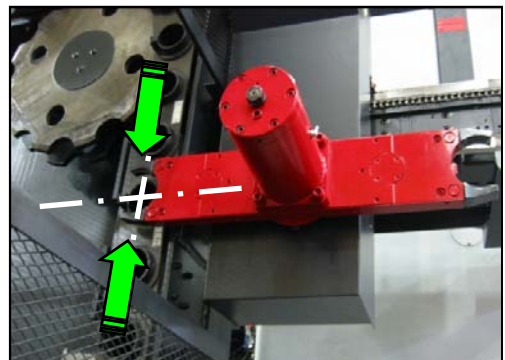
- 1) Enter the pot number (in the change position of the tool magazine) in parameter 8 on the servo AMP.



- 2) Insert the centering fixture between magazine pot (③) and changer gripper (②).



- 3) Move the changer to the magazine pot manually.



- 4) Open the door of the electric cabinet and find the magazine AMP that is located in the internal front side.



4.1) Check the center position using the centering fixture above, and if it fits correctly

- ① Press the MODE button in the start screen [r 0000] of the servo drive to enter the diagnosis mode.



→ [rd-off] : Diagnosis mode



- ② From the [rd-off] screen, set the down arrow button as a function key to set the reference point.



→ [Org.S - -] : Switch to ref-point setting mode



- ③ From the [Org.S - -] screen, press and hold the SET button for 10 seconds. If you press and hold the SET button for 10 seconds in the [Org.S - -] screen, the screen will blink and switch to [r0001].



→ [r 0001] : Return to the start screen



- ④ Turn off the machine and turn it back on. This is the completion of resetting the reference point.

4.2) If you have to reset the reference point because the center of magazine pot does not match with that of the changer.

- ① Press the MODE button in the start screen [r0000] of the servo drive.



→ [rd-off] : Diagnosis mode



- ② From the [rd-off] screen, set the down arrow button as a function key to set the reference point.



→ [Jog.run] : Switch to the jog run mode



- ③ From the [Jog.run] screen, press the SET button.



→ [Jr.0000] : Jog run mode



- ④ From the [Jr.0000] screen, use the up/down arrow buttons to feed the changer in a desired direction. In such a way, adjust the changer position for the pot.



→ Fine-tuning the changer

- If you want to fine-tune the magazine position, set parameter #27 to a lower value.
- Use the up/down arrow buttons in the [Jr.0000] screen, or press the rotation button on the manual operation panel. While holding the button, insert the center bar into the centering fixture until it is inserted smoothly.

※ Feeding the changer on the manual OP

Change "K17.6" from 0 to 1 before proceeding.

- When you have completed resetting the reference point, change "K17.6" from 1 back to 0.



- ⑤ When the centering of the tool magazine's tool pot is completed, press the SET button.



→ [Jog.run] : Return to the jog run mode



- ⑥ In the [Jog.run] screen, press the MODE button.



→ [rd-off] : Ready to operate the jog run



- ⑦ Back in the [rd-off] screen, press the up arrow button.



→ [Org.S - -] : Original mode



- ⑧ From the [Org.S - -] screen, press and hold the SET button for 10 seconds.
If you press and hold the SET button for 10 seconds in the [Org.S - -] screen, the screen will blink and switch to [r0001].



→ [r 0001] : Return to the start screen



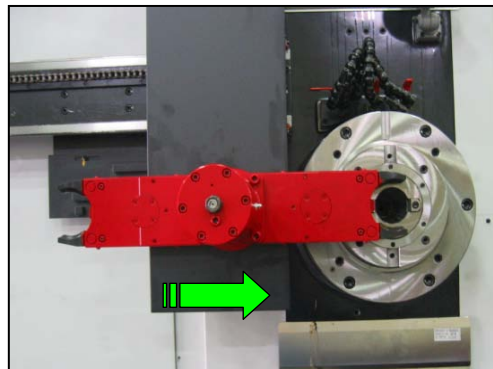
- ⑨ Turn off the machine and turn it back on. This is the completion of resetting the reference point.
- When you have completed resetting the reference point, change "K17.6" from 1 back to 0.

3.9 Fine-tuning the spindle side of the changer arm

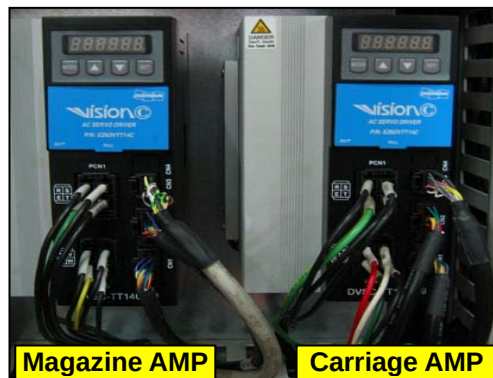
- 1) Remove the driving key from the spindle and insert the centering fixture(③) and changer gripper(②) as well.



- 2) In manual operation (jog), move the changer to the spindle side position.



- 3) Open the door of the electric cabinet and find the carriage AMP that is located in the internal front side.



- 4) From the front operation panel, make necessary settings for the work.

- ① Press the MODE button in the start screen [r0000] of the servo drive.



→ [rd-off] : Diagnosis mode



- ② In the [Jog.run] screen, press the MODE button to display [ALH - -].



→ [ALH - -] : Alarm history display mode



- ③ In the [ALH - -] screen, press the MODE button to display [0.0.0000].



→ [0.0.0000] : Parameter setting mode



- ④ In the [0.0.0000] screen, press the MODE button to display [0.0.4095].



→ [0.0.4095] : Parameter setting mode

(0.0. : Parameter 0, 4095 : setting value for Parameter 0)



- ⑤ From the [0.0.4095] screen, keep pressing the Up arrow button to display [0.7.0000].



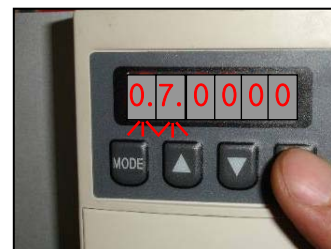
→ [0.7.0000] : Parameter #7 setting mode



- ⑥ If you press the SET button in the [0.7.0000] screen, the figure "0.7." will blink.



→ [0.7.0000] : Mode where you can change the setting of Parameter #7



- ⑦ From the [0.7.0000] screen, use the Up or Down arrow button to enter a desired parameter.



→ [0.7.3462] : Move by +8mm, [0.7.3.4.6.2.] : move by -8mm



※ Pos. 7 Data Sheet : Setting Parameter & Changer Movement

Movement (mm)	Offset (pulse)	Movement (mm)	Offset (pulse)
1mm	432.7	10mm	4327.5
2mm	865.5	11mm	4760.2
3mm	1298.2	12mm	5193.0
4mm	1731.0	13mm	5625.7
5mm	2163.7	14mm	6058.5
6mm	2596.5	15mm	6491.2
7mm	3029.2	16mm	6924.0
8mm	3462.0	17mm	7359.2
9mm	3894.7	18mm	7789.4

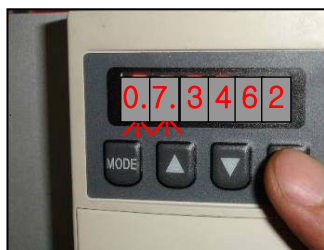
Note 1) For a negative movement such as "-8mm", add a dot to the offset value like "3.4.6.2"

Note 2) If moving by 0.1mm Enter "43" ; if moving by 0.01mm, enter "4.3".

- ⑧ When done, Press the SET button to complete the parameter setting.



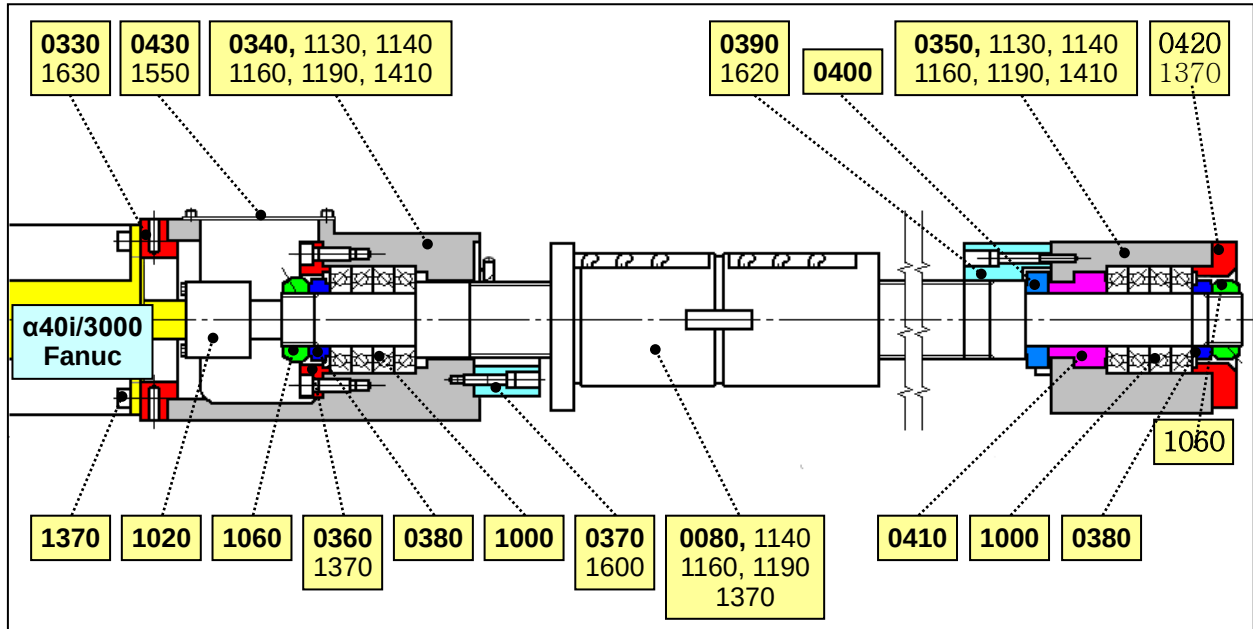
→ [0.7.3462] : The value for parameter #7 is entered successfully.



4. Assembling & disassembling the ball screw

4.1 Disassembling the ball screw on the X axis

※ Ball screw on the X axis

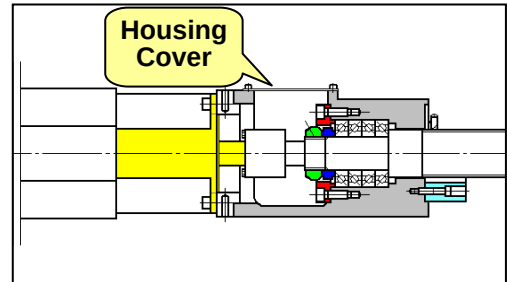
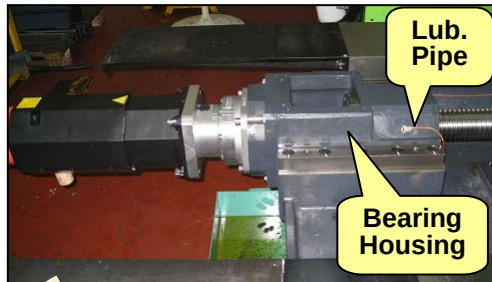




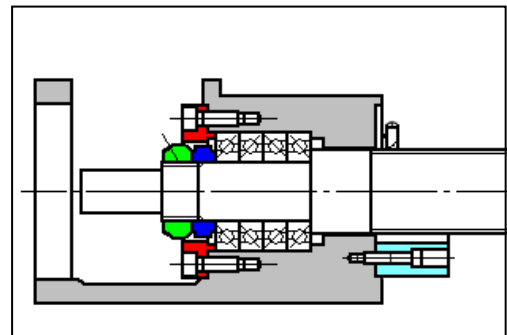
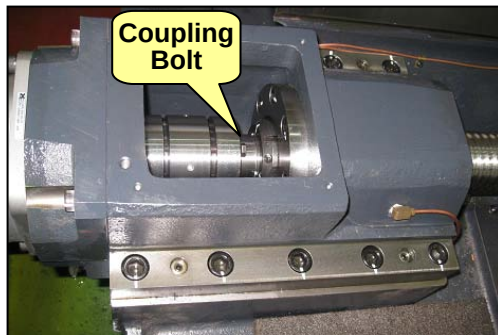
NO.	Parts No.	Description	Mat. / Spec.	Q'ty	Remarks
0080	B26270022A	Ball Screw(X)	70LLFL12-3865C3	1	Tsubaki/Supply
0330	B26220063A	Bracket, Motor	GC30	1	
0340	B26270032	Housing Bearing	GC30	1	
0360	B26220113	Cap, Bearing	SM45C	1	
0370	B26270463	Damper(1)	URETHANE RUBBER	1	
0380	B14220073	Spacer	SM45C	2	
0390	B26270063A	Damper(1)	URETHANE RUBBER	1	
0400	B26220073	Collar, Adjusting	SM45C	1	
0410	B26270104	Collar	SM45C	1	
0420	B26270053	Cap, Bearing	SM45C	1	
0430	B26220104	Cover, Housing	SCP1	1	
1000	R10713	Brg, Ang. Contact Ball	50TAC100BDBBC10PN7A	2ST	
1020	BM1200394B	Coupling	IKC-68-3535-00	1	Inkok/Supply
1060	R03284	Nut. Lock	DKMT50x1.5	2	K-Fukuda/YHB
1130	P57216056	Pin, Taper(W/TAP)	TPB16x56	8	
1140	P72000004	Plug, Connector	PA4	10	
1160	P72010004	Sleeve	PB4	10	
1190	P72130004	Adapter, Elbow	PH4	2	
1370	S2215361	Bolt. Hex. Socket Head	BB12x35	16	
1410	S2221861	Bolt. Hex. Socket Head	BB16x60	16	
1550	R01024	Bolt. Hex. Socket Head	BC6x12	48	
1600	S2205461	Bolt. Hex. Socket Head	BB6x40	3	
1620	S2206061	Bolt. Hex. Socket Head	BB6x70	3	
1630	S2209261	Bolt. Hex. Socket Head	BB8x30	11	

1) Preparations for disassembling the ball screw

- ① Move the X axis to an intermediate position to facilitate the work on the ball screw, and turn off the machine.
- ② Remove both sliding covers from the X axis and clean up the bed.
- ③ Separate B26220104 housing cover from B26270032 bearing housing, pull out the lubrication pipe, and unplug the cable (power and feedback cables) connectors of the servo motor.

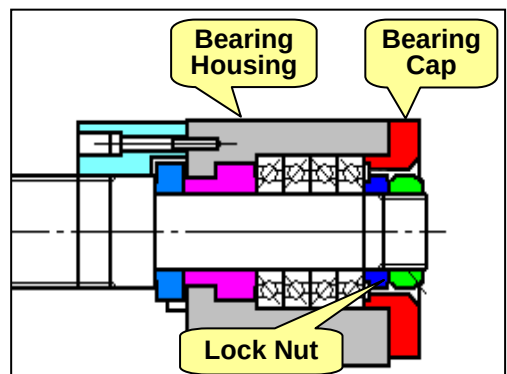
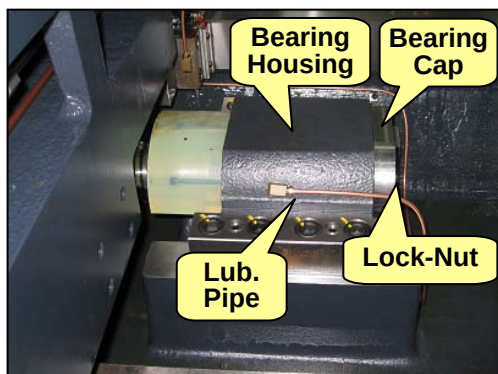


2) Loosen BM1200394B coupling fixing bolts, loosen the fixing bolts on the servo motor, and remove the motor with care.

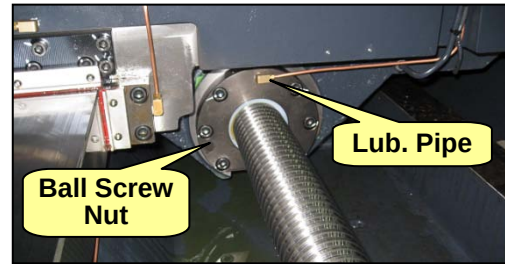


3) Disconnect the lubrication pipe from the opposite B26270042A bearing housing and loosen the lock nut.

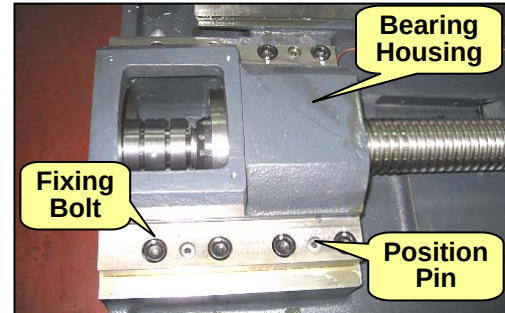
- Remove B26270053 bearing cap first. This will help loosening the lock nut.
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. (when using the chisel and hammer, care must be taken lest that the lock nut should be scratched)



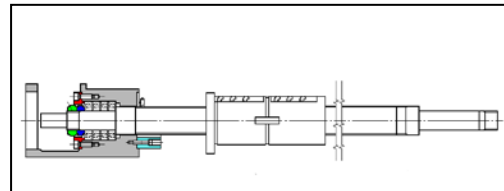
- 4) Disconnect the lubrication pipe and loosen the bolts (6-BB 12×30) from the ball screw nut (installed on the table base).



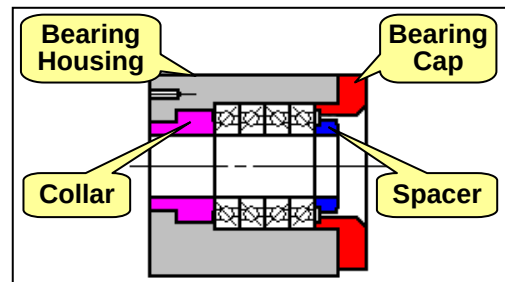
- 5) Loosen B26270032 bearing housing bolts and pull out the positioning pins.
- 8-BB16×60, 4-TPB-16×56



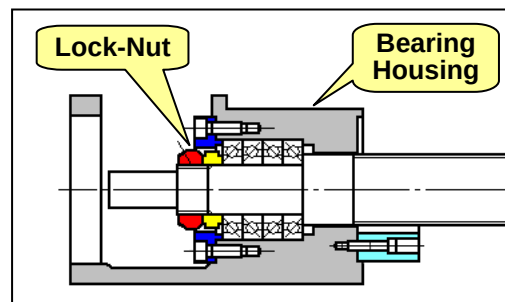
- 6) Remove the bearing housing as well as the ball screw assembly from the machine.
- ※ Use the crane to take the ball screw by the center of gravity and pull it out from the machine.



- 7) First, remove B26270053 bearing cap from B26270042A bearing housing. Then, remove B26270104 collar, R10713 50TAC angular contact ball bearing and B14220073 spacer one by one.
- 8-BB12×35

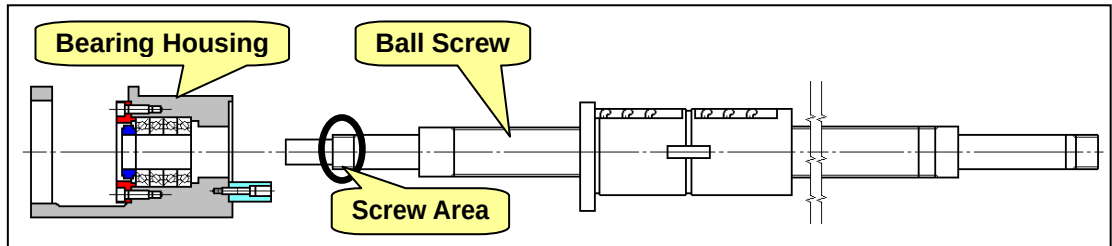


- 8) Loosen the lock-nut from the removed bearing housing.
- Remove B26270053 bearing cap first. This will help loosening the lock nut.
 - ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool that is specific to the lock-nut.
- If it is not available, use the hammer and chisel to impact on and loosen the lock-nut.(when using the chisel and hammer, care must be taken lest that the lock nut should be scratched)



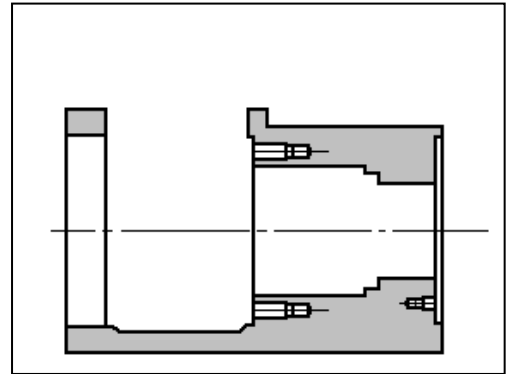
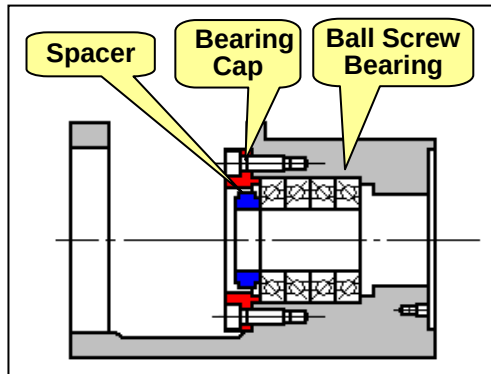
9) Separate the bearing housing from the ball screw.

- ※ When separating the ball screw from the bearing housing, take caution not to damage the lock-nut of the ball screw.



10) First, remove B26270053 bearing cap from the bearing housing. Then, remove R10713 50TAC angular contact ball bearing and B14220073 spacer.

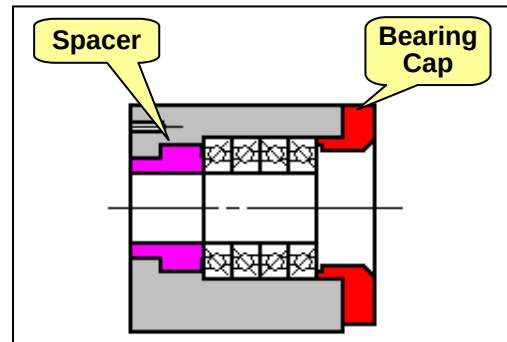
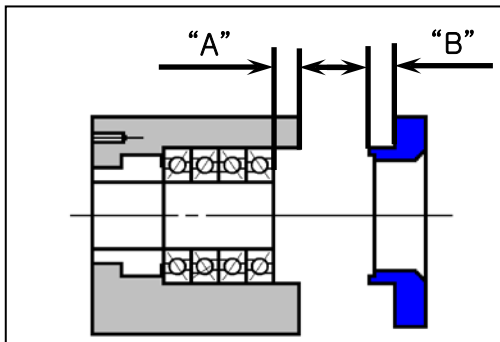
- 8-BB12×35



4.2 Installing the ball screw on the X axis

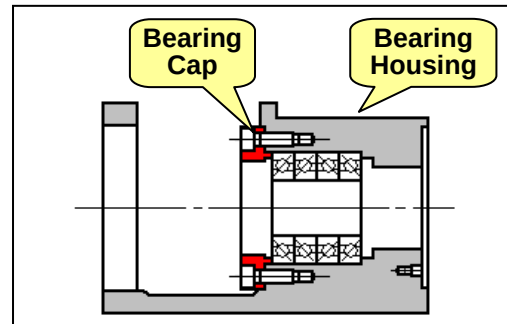
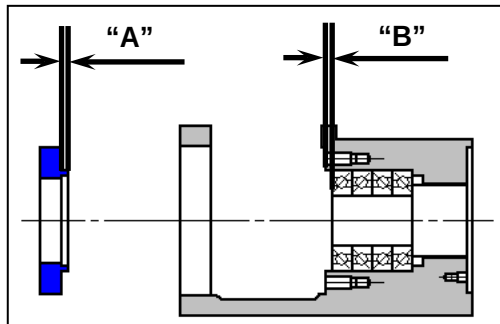
1) Fitting the bearing cap in the rear of the bearing housing on site

- ① Fit 50ATC angular contact bearing into B26270042A bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("A")
- ② Calculate the target size of B26270053 bearing cap before fitting it on-site.
※ Target size of the bearing cap "B" = "A" + 0.05mm
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).
※ Put force as even as possible to each of the fixing bolts.
▪ 8-BB12×35



2) Fitting the bearing cap in the front of the bearing housing on site

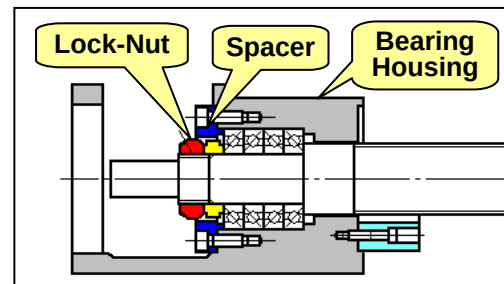
- ① Fit 50ATC angular contact bearing into B26270032 bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("B")
- ② Calculate the target size of B26270053 bearing cap before fitting it on-site.
※ Target size of the bearing cap "A" = "B" + 0.05mm
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).
※ Put force as even as possible to each of the fixing bolts.
▪ 8-BB12×35



3) Installing the ball screw

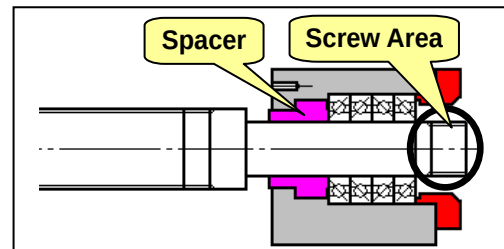
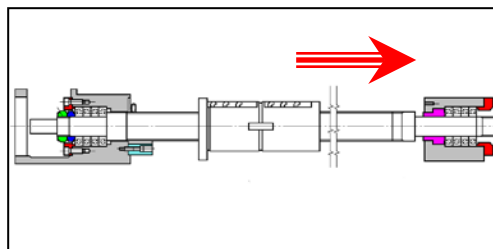
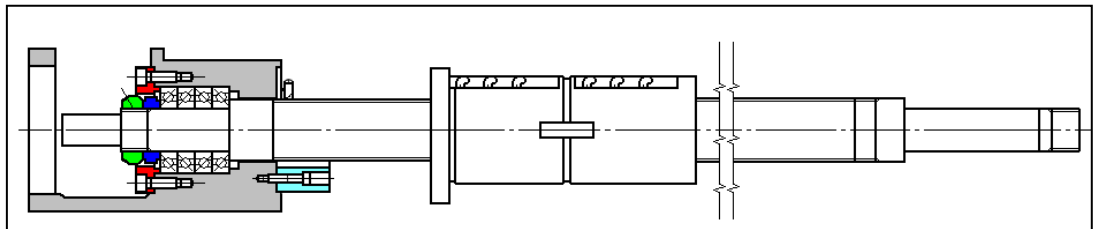
Install the ball screw into the bearing housing before inserting B14220073 spacer. Then, tighten the lock nut.

- ※ 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) Installing the bearing housing assembly

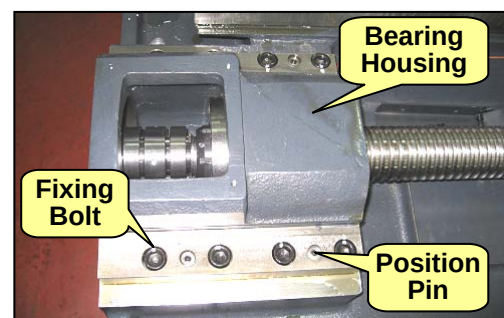
Use the crane to lift up the ball screw and bearing housing assembly with care of the center of gravity. Push it in through the X-axis ball screw place of the table with care. When installing the ball screw in the opposite bearing support, take caution lest that either end of the ball screw should get scratched.



5) Fixing the bearing housing.

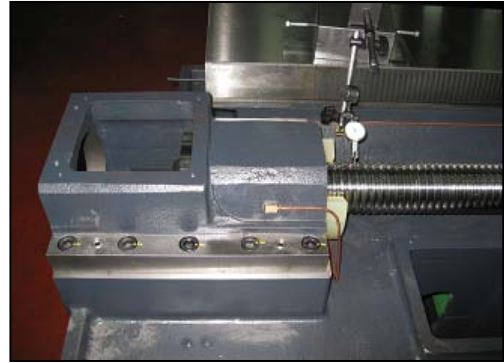
Tighten B26270032 bearing housing bolts and insert the positioning pins.

- 8-BB16×60, 4-TPB-16×56



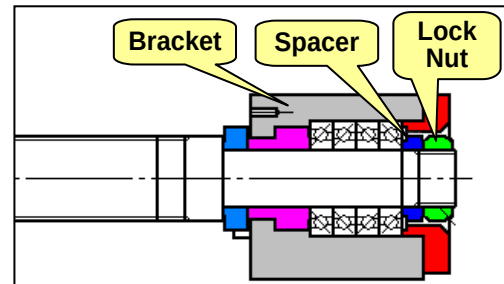
6) Runout on the ball screw

- ① Present the indicator at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout. (intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.002 mm, tighten up the set-screw for locking the lock-nut.



7) Tightening the lock nut in the rear of the bearing housing

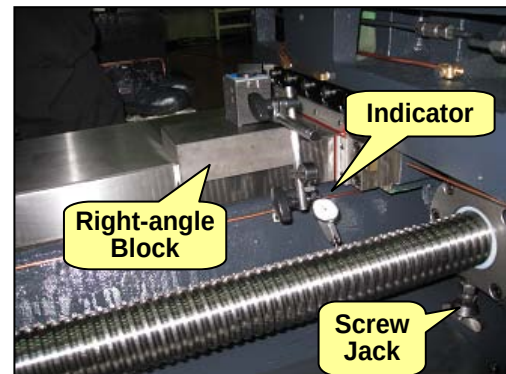
Insert B14220073 spacer at the end of the ball screw (where B26270042A bearing housing will be installed), and tighten the lock nut.



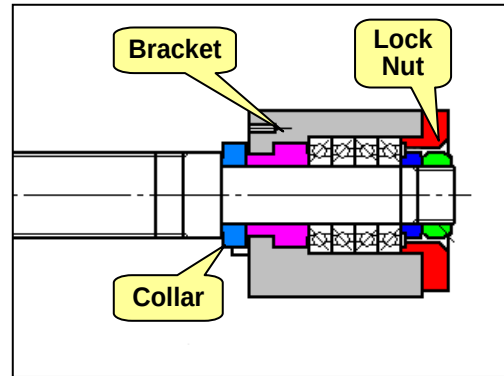
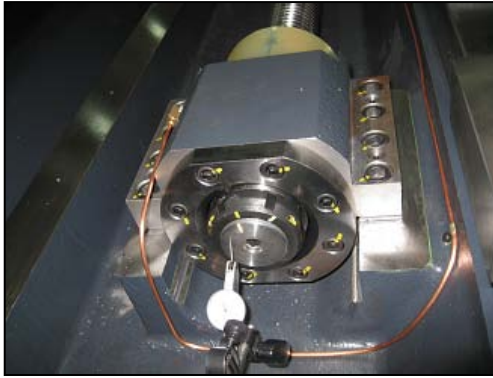
※ To the end, you must do the pre-tension work and solve the run-out problem with the ball screw so you just tighten the screw to the full length at this moment.

8) Pre-tension on the ball screw

- ① Turn the ball screw nut back to the original and tighten the fixing bolts.
 - 6-BB 12×30
- ② Install the screw jack under the ball screw nut and correct the parallelism for the ball screw (either ends, center, horizontal and vertical position)

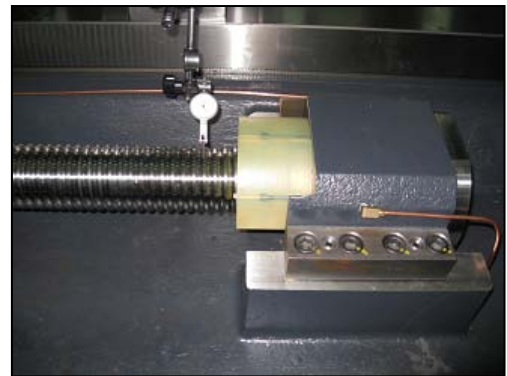


- Install the indicator on the right-angle block and present the needle at the end of the ball screw. And set it to 0. Use the screw jack to adjust the vertical and horizontal parallelism to below 0.02mm respectively.
- ③ Present the needle at the end of the ball screw and set it to 0. Use the chisel and hammer to loosen the lock nut with minimum damage, and check the gradation changes of the indicator gauge. If the measurement does not fall into the tension target, remove the collar and fit it on site.
 - The collars for adjusting the pre-tension are located on either sides so you can remove them easily by simply loosening the lock nut.
 - ※ Pre-tension on the X-axis ball screw: 0.28mm



9) Runout on the ball screw (installed in the bracket).

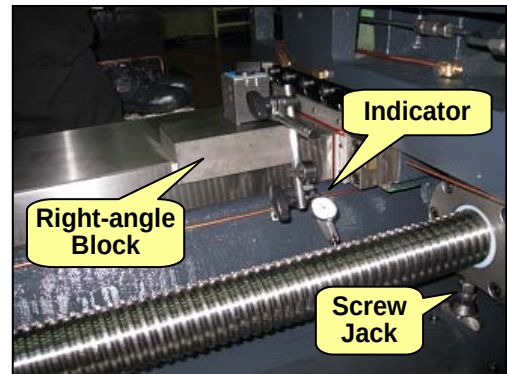
- ① Present the indicator on the block at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout. (intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.01 mm, tighten up the set-screw for locking the lock-nut.



10) Tightening the ball screw nut

Install the screw jack under the ball screw nut as instructed above and correct the parallelism for the ball screw (either ends, center, horizontal and vertical position). Then, tighten up the bolts on the ball screw nut.

- Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.

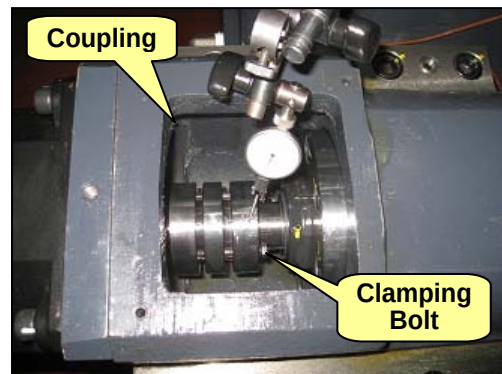
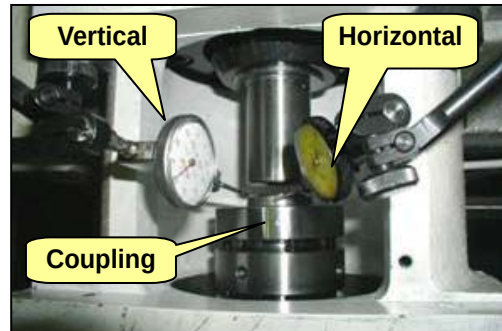


- ※ If the measuring tools are not available, turn on the machine and move the X axis to "X0". Then, apply force as even as possible to each bolt diagonally until you tighten them up finally.



11) Installing the servo motor

- ① Insert the coupling into the servo motor shaft or gear box shaft, and install the servo motor into the bearing housing.
 - Tighten the bolts slightly because you have yet to perform the alignment between servo motor and ball screw.
- ② Aligning between servo motor and ball screw
Install the indicator on the rectangle block in the X-axis bed guide way side, align the servo motor shaft with the ball screw and tighten up the bolts.
 - Target Concentricity: below 0.01 mm both horizontally and vertically
- ③ Position the coupling in the middle between ball screw and motor shaft.
- ④ While rotating the ball screw, tighten the clamping bolts and correct the runout on the coupling.
 - Runout Tolerance: below 0.01mm



12) Finishing

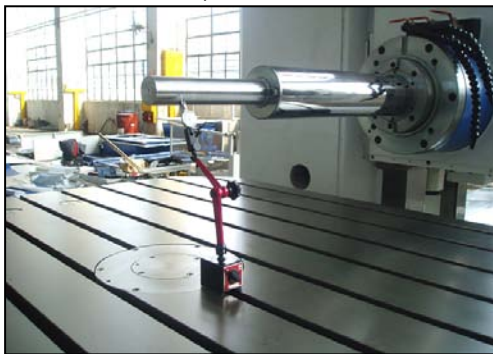
When installation is done, connect the lubrication pipe, servo motor cable (power and feedback cables) connector and various covers back to the original.



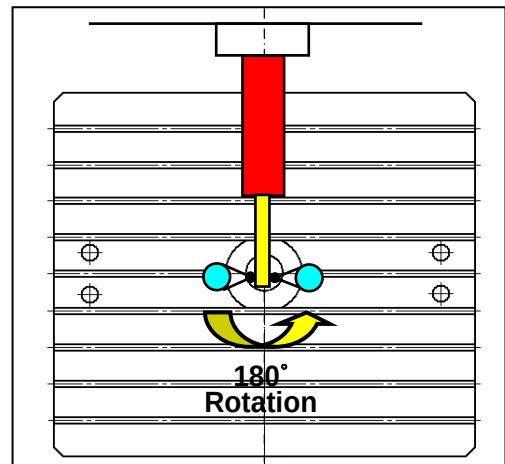
※ If you had removed and re-installed the X-axis ball screw, you must reset the reference point for the X axis.

4.3 Resetting the reference point for the X axis (X-axis stroke: 3000mm)

- 1) Return the X axis to the reference point manually. In MDI mode, move the X axis to "X1500."
- 2) Install the test bar into the spindle and move Z, W axes to "W0. Z290." respectively.
- 3) Install the indicator in the center of the table about 400mm high. In Handle mode, move the Y axis to the highest point of the test bar. (Do NEVER move the X axis.)
- 4) Rotate the spindle and stop rotating it at the intermediate point of the test bar runout. Then, set the gauge to 0.
- 5) Move the Z axis in "+" direction by 400mm, and rotate the B axis by 180 degrees. Then, move the Z axis back to the original.
- 6) Read the indicator, check the error and move the X axis by half of the error.



- 7) Repeat steps 5) to 6) above and adjust the runout until either sides of the test bar show 0.
- 8) If you get a satisfactory result, check the current position of the X axis from the "Machine Position" screen of the OP, and enter the difference between current position and "X1500." in the "parameter #1850 X" field.



- ※ To change the X-axis grid shift parameter
Read the machine position (coordinates) displayed on the OP screen. Enter the positive (+) parameter if the result of deducting half of the X stroke (1500) from the machine position is a positive value; enter the negative (-) parameter in micron (μ) if the result is a negative value.

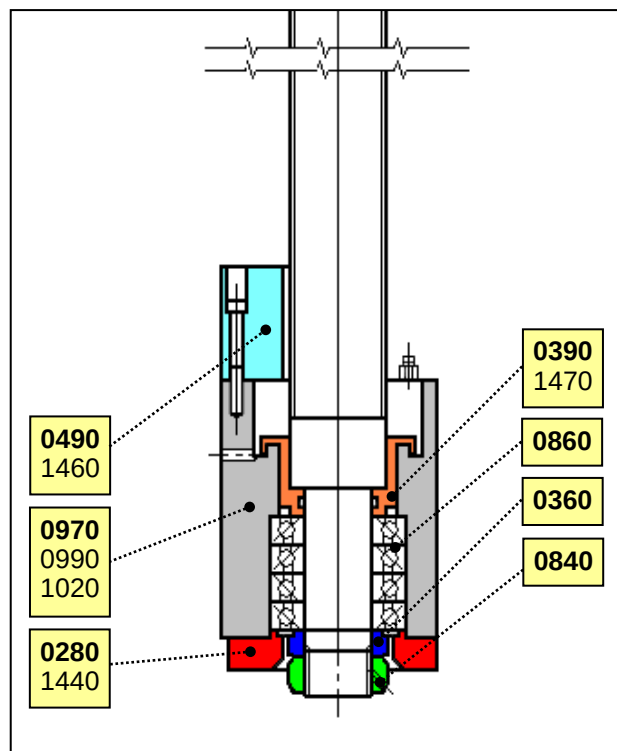
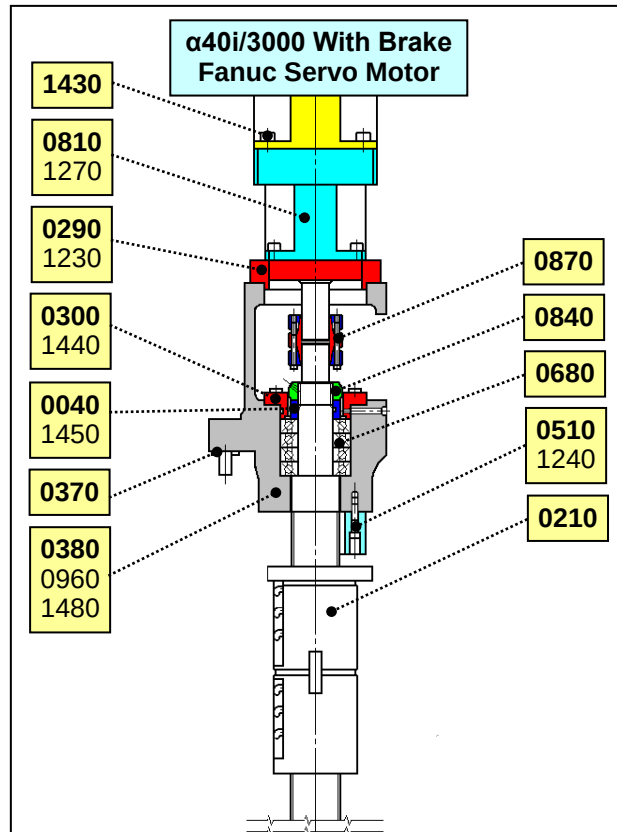
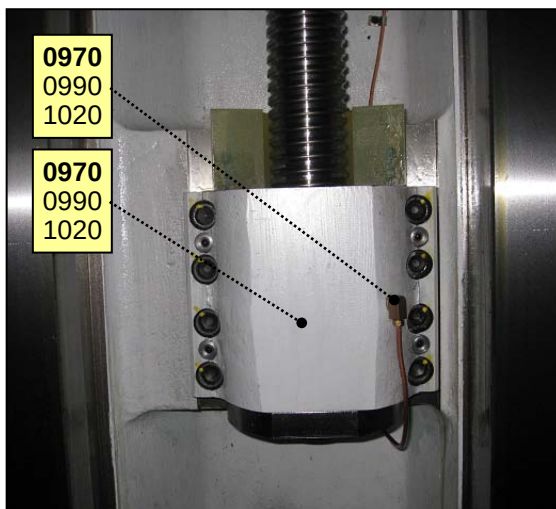
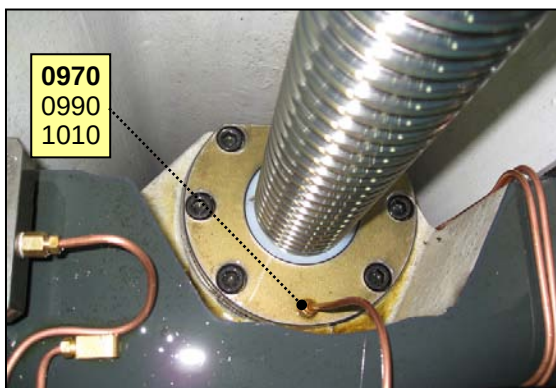
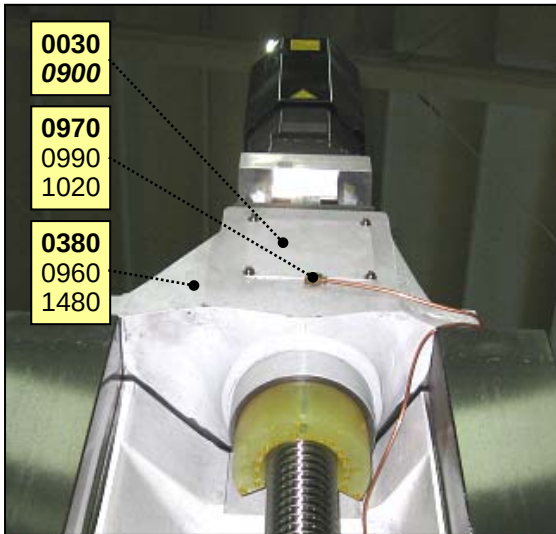
Add or deduct the above measurement to and from the existing parameter and enter "INPUT", or enter the result plus the symbol, and press "+INPUT".

- Parameter for the X-axis reference point: NO. #1850 X

- 9) Return the X axis to the reference point manually and repeat the instructions above until the result falls below 0.005mm.

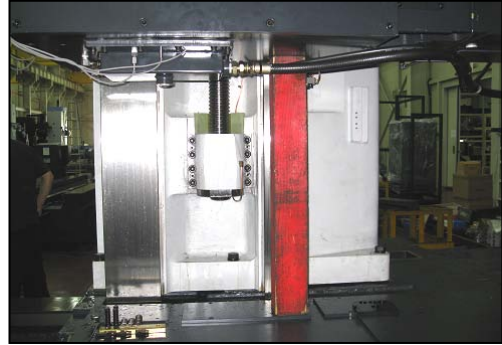
4.4 Disassembling the ball screw on the Y axis

※ Ball screw on the Y axis

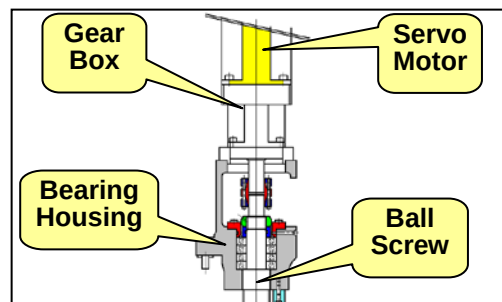
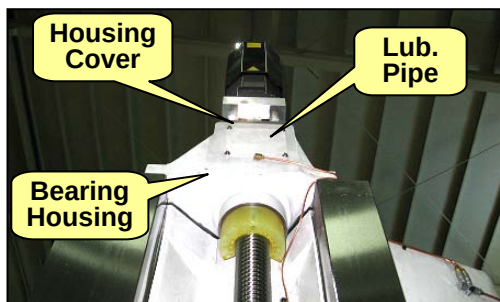


No.	Parts No.	Description	Mat. / Spec.	Q'ty	Remarks
0030	B26220104	Cover, Housing	SCP1	1	
0040	B13210113	Collar	SM45C	1	
0210	B26290022	Ball Screw(Y)	70NNFL12-2924	1	TSUBAKI/SUPPLY
0270	B26290042A	Housing. Brg	GC30	1	
0280	B26270053A	Cap, Bearing	SM45C	1	
0290	B26290053B	Bracket Motor	SM45C	1	
0300	B26290083	Cap, Bearing	SM45C	1	
0360	B14220073	Spacer	SM45C	1	
0370	B26210054	Collar	SM45C	6	
0380	B26290032	Housing, Bearing(Y)	GC30	1	
0390	B26210114A	Spacer	SM45C	1	
0490	B26290073A	Damper(2)	URETHANE	1	
0510	B26270463	Damper(1)	URETHANE	1	
0810	R65110	Gear Box	PG 050-EAE003-0AA0	1	ZF/SUPPLY
0840	R03284	Nut, Lock	DKMT50x1.5/YHB	2	
0860	R10713	Brg. Ang. Contact Ball	50TAC100BDBBC10PN7A	2ST	NSK/SUPPLY
0870	R15222	Coupling	J73-40-40	1	INKOK/SUPPLY
0900	R01024	Screw. Machine/2.Tone.Co	BC6x12, PICR3	54	
0960	P57213070	Pin, Taper(W/TAP)	TPB13x70	8	
0970	P72000004	Plug, Connector	PA4	15	
0990	P72010004	Sleeve	PB4	15	
1010	P72020004	Adapter	PD4	4	
1020	P72130004	Adapter, Elbow	PH4	11	
1230	S2209061	Bolt. Hex. Socket Head	BB8x25	8	
1240	S2209661	Bolt. Hex. Socket Head	BB8x50	6	
1270	S2212261	Bolt. Hex. Socket Head	BB10x30	20	
1280	S2221661	Bolt. Hex. Socket Head	BB16x50	8	
1430	S2215361	Bolt. Hex. Socket Head	BB12x35	4	
1440	S2215261	Bolt. Hex. Socket Head	BB12x30	12	
1450	S8000500	O-Ring	P50	1	
1460	S2209861	Bolt. Hex. Socket Head	BB8x60	3	
1470	S8010500	O-Ring	G50	1	
1480	S2221861	Bolt. Hex. Socket Head	BB16x60	6	

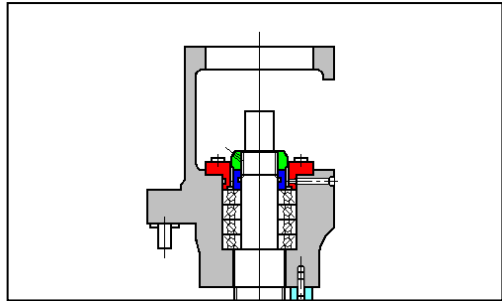
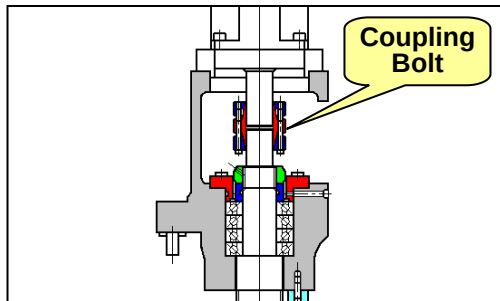
- 1) Remove the column cover.
- 2) To facilitate the disassembling work, move the Y axis to the intermediate position, and insert a wood support at an appropriate area between column base and spindle head in order to prevent the spindle head from falling off when removing the ball screw, and turn off the machine.



- 3) Separate B26220104 housing cover from B26290032 bearing housing, pull out the lubrication pipe, and unplug the cable (power and feedback cables) connectors of the servo motor.

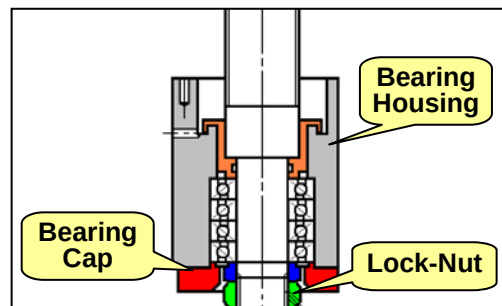
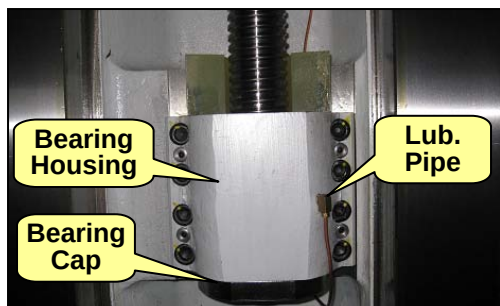


- 4) Loosen BM1200394B coupling fixing bolts, loosen the fixing bolts on the gear box, and remove the servo motor and gear box assembly with care using the crane.

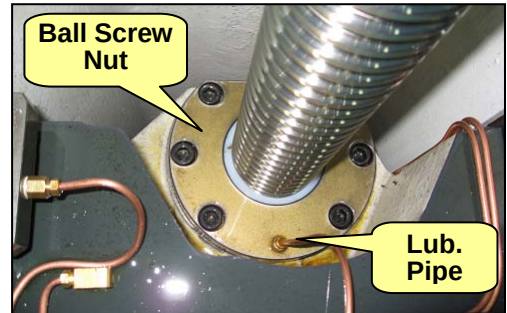


- 5) Disconnect the lubrication pipe from the bottom B26290042A bearing housing and loosen the lock nut.

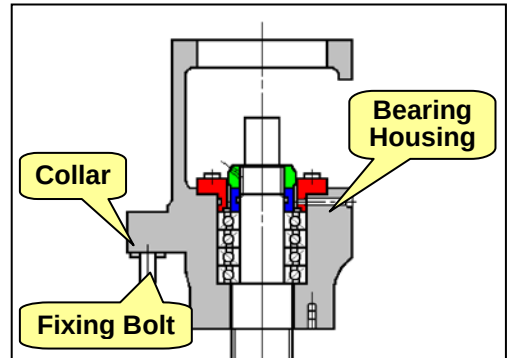
- Remove B26270053A bearing cap first. This will help loosening the lock nut.
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut.



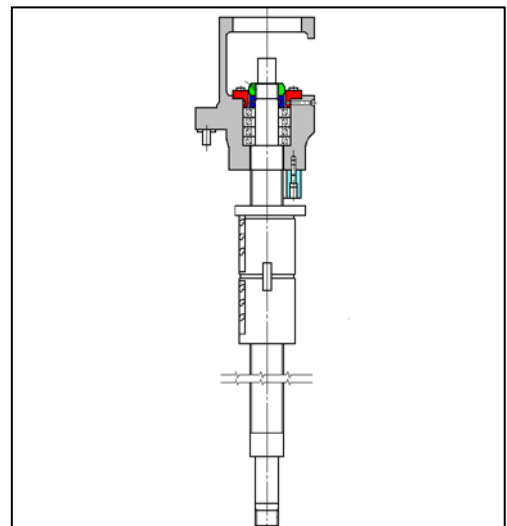
- 6) Disconnect the lubrication pipe and loosen the bolts (6-BB 12×30) from the ball screw nut (installed on the spindle head).



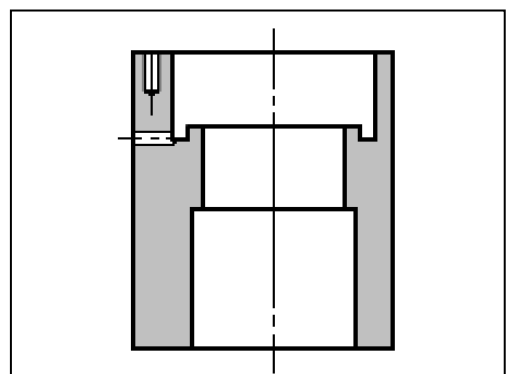
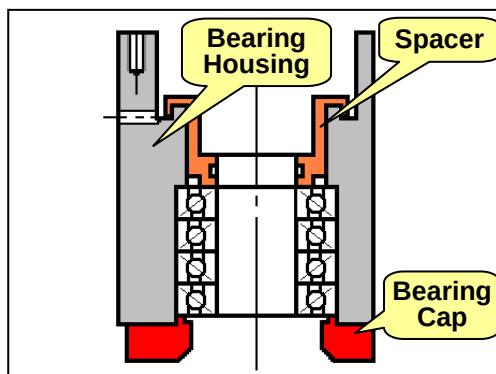
- 7) Loosen B26270032 bearing housing fixing bolts (6-BB16×60) and positioning pins (4-TPB-13×70).



- 8) Remove the bearing housing as well as the ball screw assembly from the machine.
- Use the crane to take the ball screw by the center of gravity and pull it out from the machine.
 - ※ When you remove the fixing bolts of the bearing housing, mark the position of each of the 6 adjustable collars so that you are ensured to assemble it back in the right position.

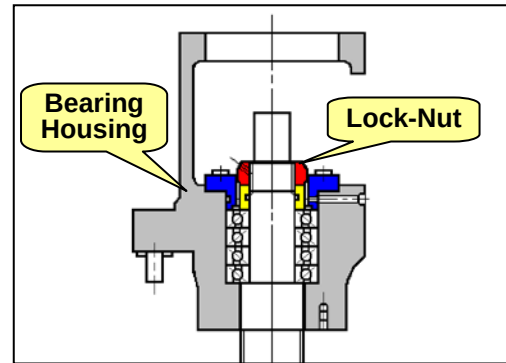


- 9) First, loosen B26270053A bearing cap fixing bolts (8-BB12×30) from B26290042A bearing housing. Then, remove R10713 50TAC angular contact ball bearing and 50TAC spacer.



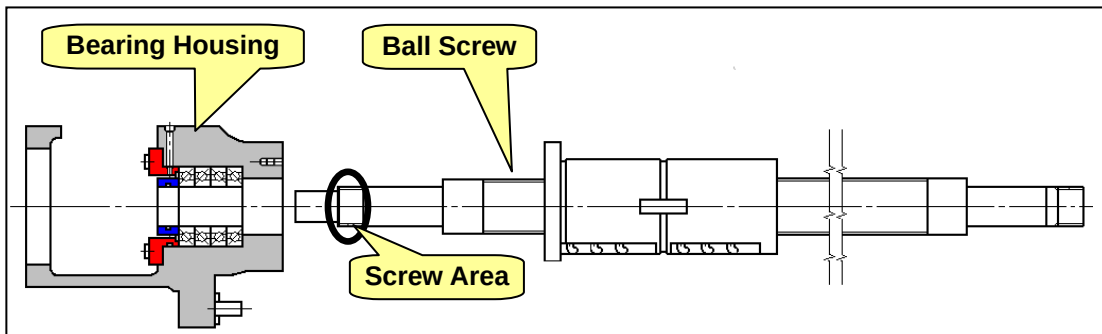
10) Loosen the lock-nut from the removed bearing housing.

- Remove B26270053 bearing cap first. This will help loosening the lock nut.
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool 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. (when using the chisel and hammer, care must be taken lest that the lock nut should be scratched)



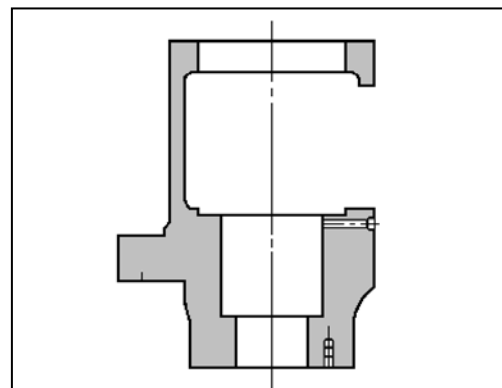
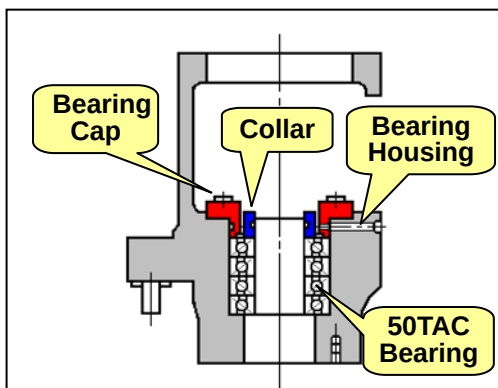
11) Separate the bearing housing from the ball screw.

- ※ When separating the ball screw from the bearing housing, take caution not to damage the lock-nut of the ball screw.



12) First, remove B26290083 bearing cap from B26290032 bearing housing(Y). Then, remove R10713 50ATC angular contact ball bearing and B13210113 collar.

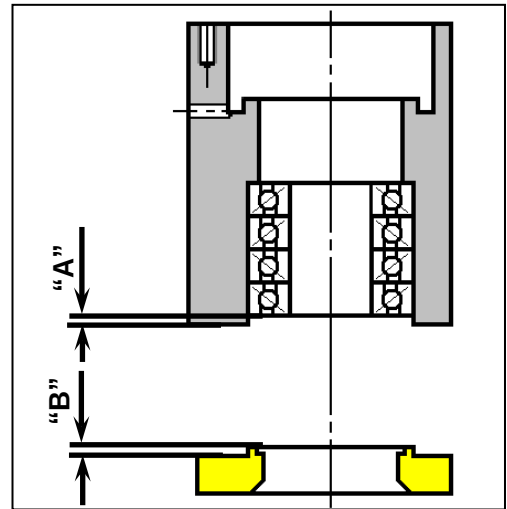
- 8-BB12×30



4.5 Installing the ball screw on the Y axis

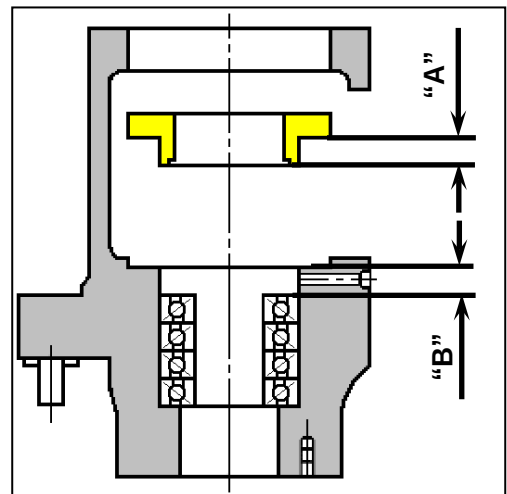
1) Installing the bearing cap in the lower bearing housing

- ① Fit 50ATC angular contact bearing into B26290042A bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("A")
- ② Calculate the target size of B26270053A bearing cap before fitting it on-site.
※ **"B" = "A" + 0.05mm**
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).
※ Put force as even as possible to each of the fixing bolts.
▪ 8-BB12×35



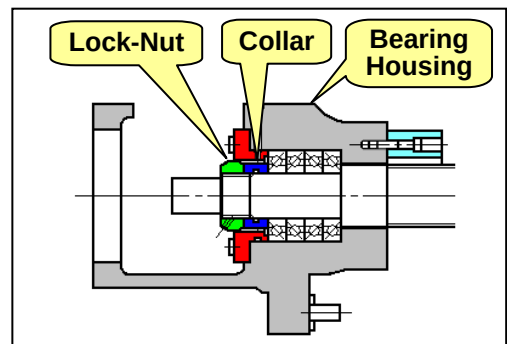
2) Installing the bearing cap in the upper bearing housing

- ① Fit 50ATC angular contact bearing into B26290032 bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("B")
- ② Calculate the target size ("A") of B26290083 bearing cap before fitting it on-site.
※ **"A" = "B" + 0.05mm**
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).
※ Put force as even as possible to each of the fixing bolts.
▪ 8-BB12×35



3) Installing the ball screw into the upper bearing housing

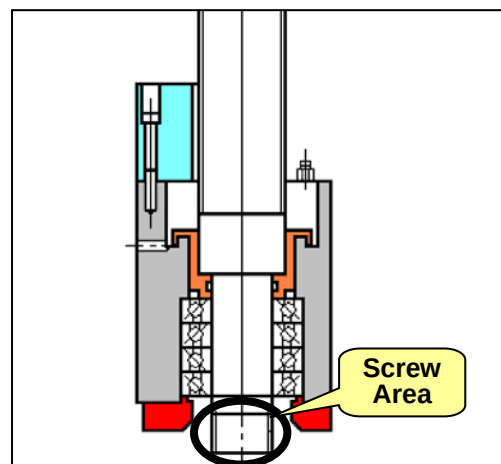
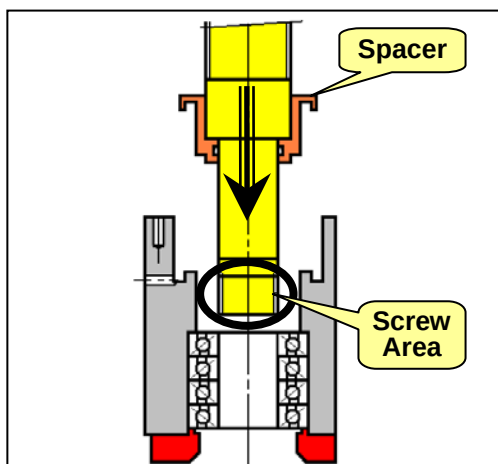
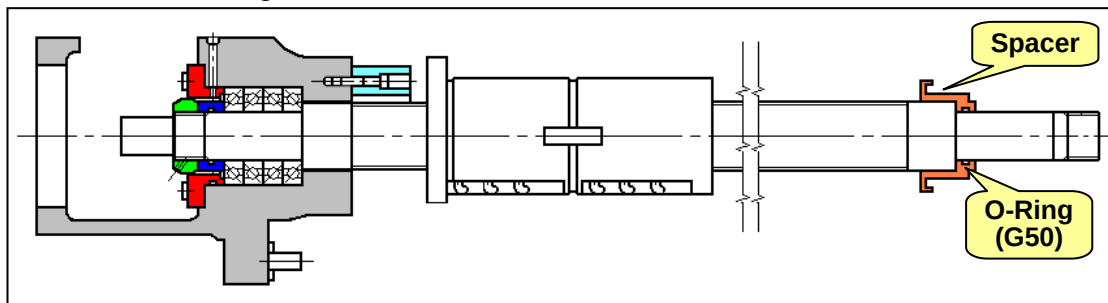
- Install the ball screw and insert B13210113 collar (with P50 O-ring inserted) into the bearing housing. Then, tighten the lock-nut.
- ※ To the end, you must solve the run-out problem with the ball screw so you just tighten the



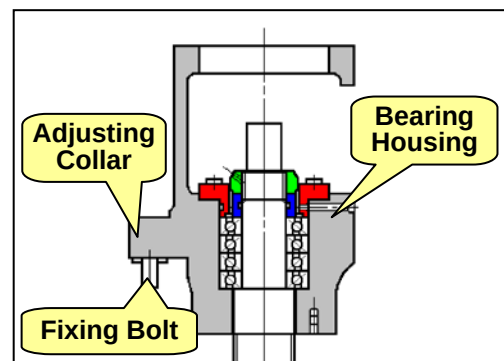
screw to the full length at this moment.

4) Installing the ball screw and bearing housing assembly

- ① Insert G50 O-ring into B26210114A spacer with grease applied, and install the spacer at the end of the ball screw.
- ② Fit the adjusting collars (x6) into the bolt holes in the bearing housing based on the marking number for each bolt.
- ③ Use the crane to lift up the ball screw and bearing housing assembly while keeping it balanced.
- ④ Push in the assembly through the Y-axis ball screw place in the spindle head.
- ⑤ When installing the ball screw in the opposite bearing housing, take caution lest that either end of the ball screw get scratched.

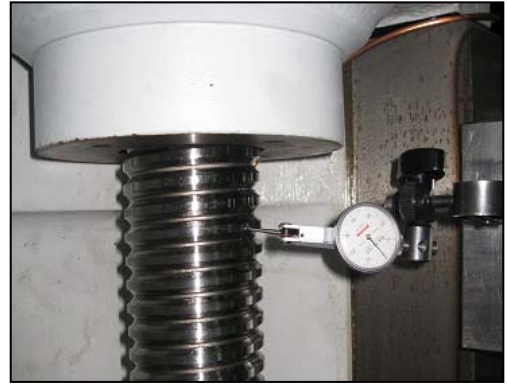


- ⑥ Right before it is inserted to the full, insert the positioning pins (4-TPB-13×70) and tighten the bearing housing bolts (6-BB16×60).



5) Runout on the ball screw

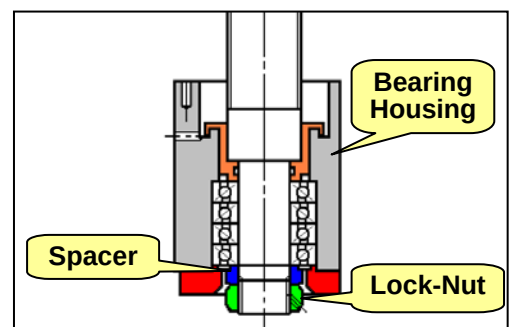
- ① Install the indicator at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout.
(intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.002 mm, tighten up the set-screw for locking the lock-nut.



6) Tightening the lock nut on the lower ball screw

Insert B14220073 spacer at the end of the ball screw (where B26290042A bearing housing will be installed), and tighten the lock nut.

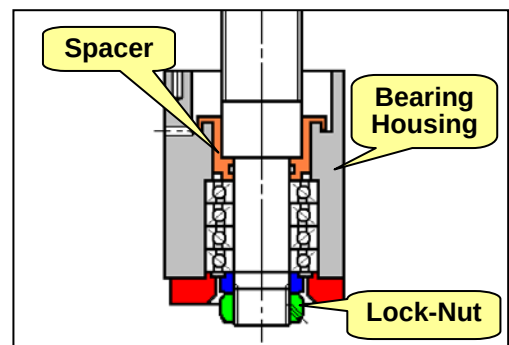
- ※ To the end, you must do the pre-tension work and solve the run-out problem with the ball screw so you just tighten the screw to the full length at this moment.



7) Pre-tension on the ball screw

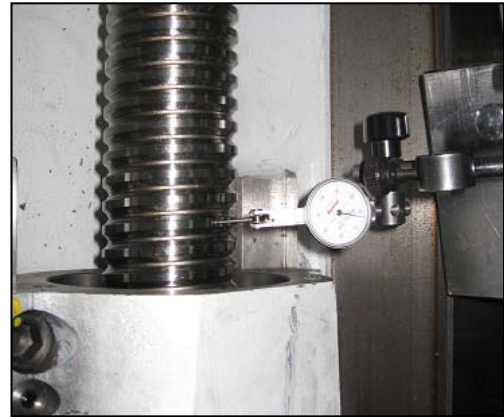
Present the needle at the end of the ball screw and set it to 0. Use the dedicated tools to loosen the lock nut with minimum damage, and check the gradation changes of the indicator gauge. If the measurement does not fall into the tension target, remove the spacer from the bearing housing and fit it on site.

- ※ Pre-tension on the Y-axis ball screw: 0.10mm



8) Runout on the lower ball screw

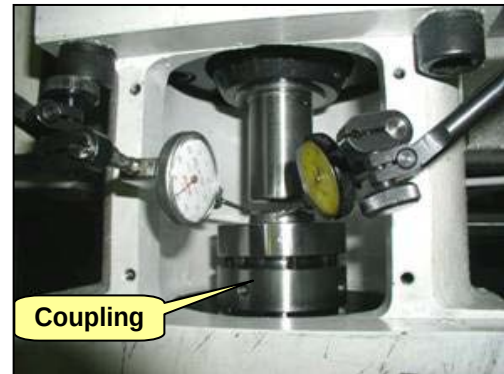
- ① Present the indicator on the block at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout.
(intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.001 mm, tighten up the set-screw for locking the lock-nut.



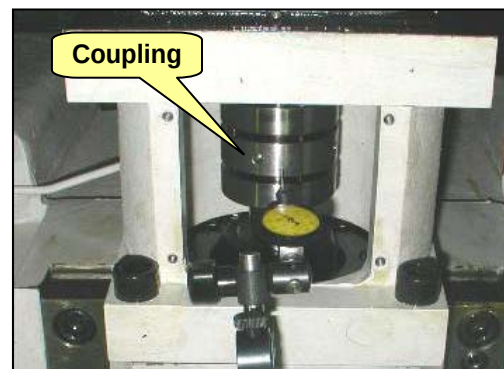
9) Installing the servo motor

- ① Insert the coupling into the servo motor shaft or gear box shaft, and install the servo motor into the bearing housing.
 - Tighten the bolts slightly because you have yet to perform the alignment between servo motor and ball screw.

- ② Install the indicator on the rectangle block in the column guide way side, align the servo motor shaft with the ball screw and tighten up the bolts.
 - Based on the horizontal and vertical positions of the ball screw, move the servo motor to adjust the concentricity of the servo motor shaft to below 0.01mm.



- ③ Position the coupling in the middle between ball screw and motor shaft.
 - If the servo motor aligns properly with the ball screw, it will be inserted into the ball screw smoothly.
- ④ While rotating the ball screw, tighten the clamping bolts and correct the runout on the coupling.
 - Runout Tolerance : below 0.01mm

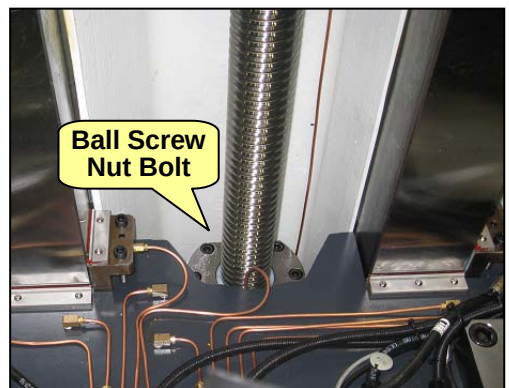


- ⑤ When installation is done, connect the lubrication pipe, servo motor cable (power and feedback cables) connector and various covers back to the original.



10) Tightening the ball screw nut

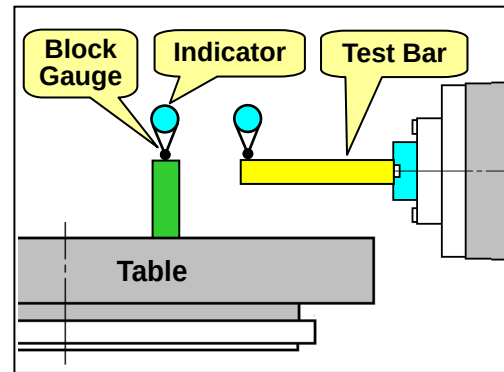
- ① Turn on the machine and move the Y axis to "Y0".
- ② Put force as even as possible to each bolt until you tighten them up finally.
 - Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.



- ※ If you had removed and re-installed the Y-axis ball screw, you must reset the reference point for the Y axis.

4.6 Resetting the reference point for the Y axis (Y-axis stroke: 2000mm)

- 1) Insert the test bar into the spindle.
- 2) Put the block gauge (over 150mm) on the pallet deck, and install the indicator on it. Then, set the height of the block gauge to "0".
- 3) Move the Y axis according to the calculation of the below formula.



**Y axis coordinates = L (height of block gauge)
– D/2 (radius of test bar)**

If the height of the block gauge is 150mm, $150 - 30 = 120$ or, Y120.

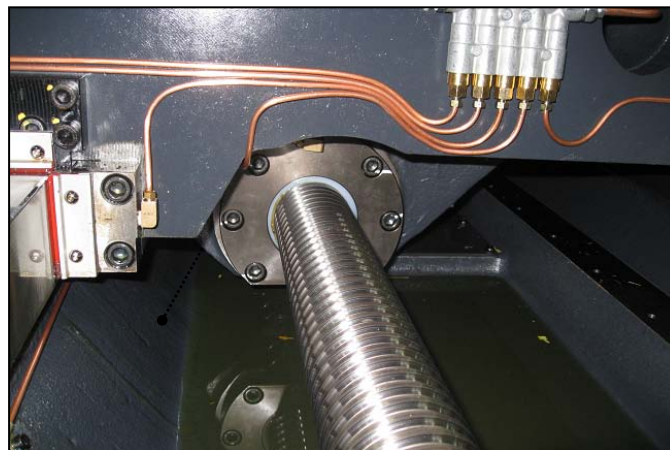
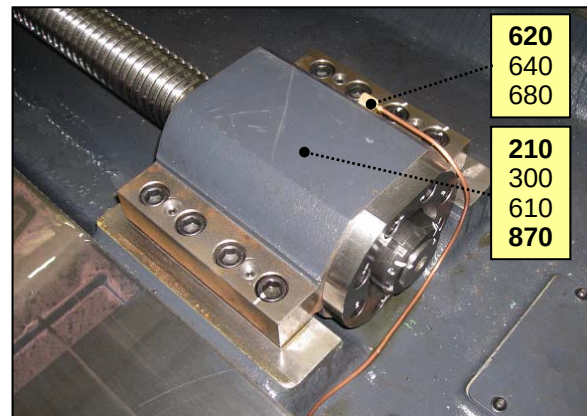
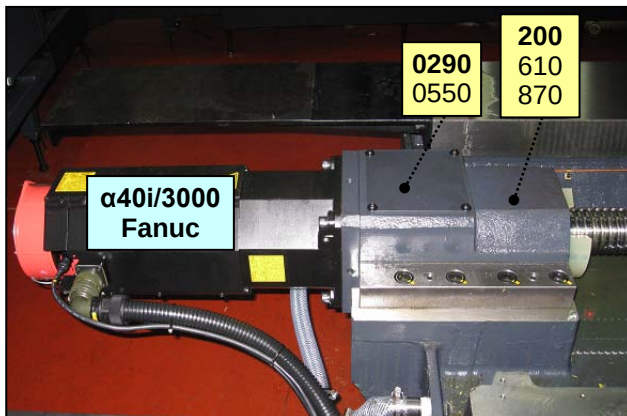
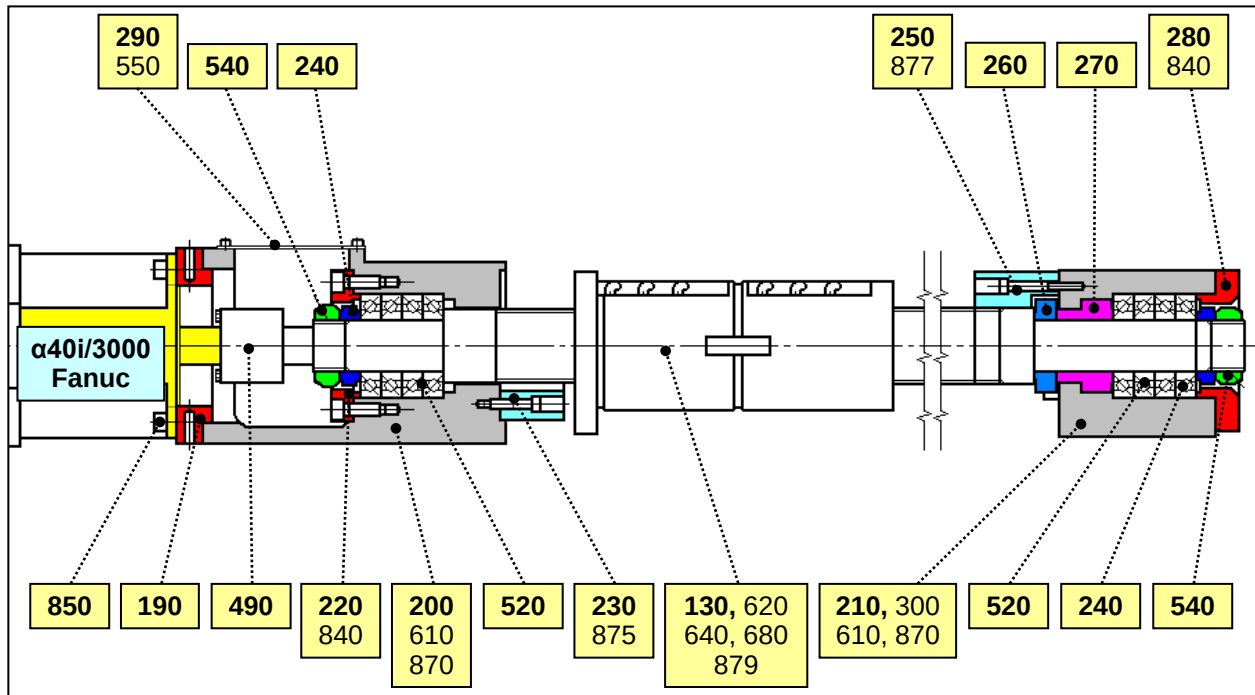
If the test bar is not available so you work directly on the boring spindle, $150 - 65 = 85$ or, Y85.

- If DB130CX is "Y.0", the spindle is positioned at the center of the table deck.
However, if APC is optionally installed, the distance between table deck and center of the spindle is 250mm. (Formula: $Y = L - (D/2 + 250)$)

- 4) Install the indicator on the top of the test bar and rotate the spindle while reading the runout on the test bar. Stop rotating the spindle at an intermediate value of the runout.
- 5) Move the Y axis to set the indicator needle to "0".
- 6) Check the measuring value of the machine position (coordinates) displayed on the main OP screen and compare it with the result of step 3) above. Enter the positive (+) parameter if it's greater than the result of step 3, or the negative (-) parameter if less.
Add the above measurement to the existing parameter and press "INPUT", or add the positive symbol (+) to the above measurement and enter "+INPUT".
 - Parameter for the Y-axis reference point: NO. #1850 Y
- 7) Adjust the reference point of the machine and repeat steps 1) ~ 6) above again until the measurement is within 0.005 mm.

4.7 Disassembling the ball screw on the Z axis

※ Ball screw on the Z axis

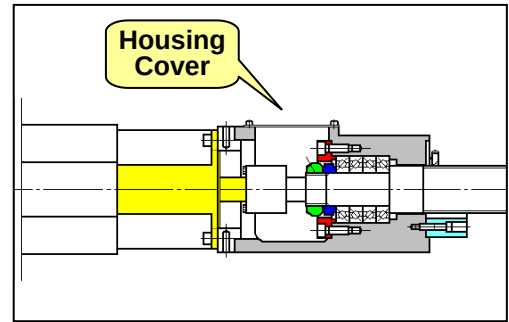
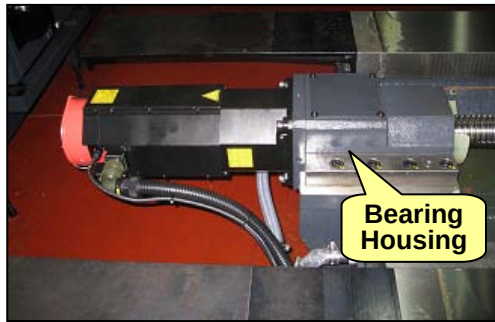




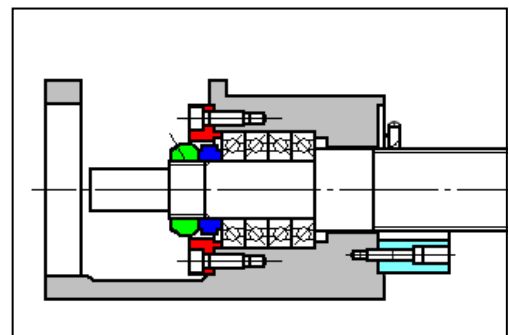
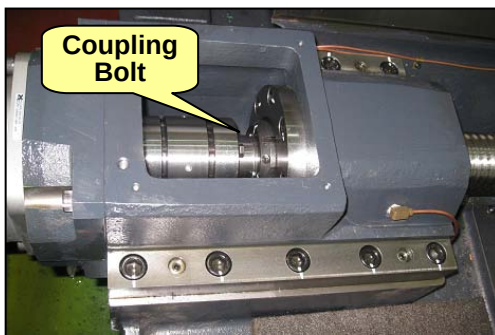
NO.	Parts No.	Description	Mat. / Spec	Q'ty	Remarks
190	B26220063B	Bracket Motor	GC30	1	
200	B26280582	Housing Bearing	GC30	1	
220	B26220113	Cap, Bearing	SM45C	1	
230	B26280633	Damper(1)	Urethane Rubber	1	
240	B14220073	Spacer	SM45C	2	
250	B26280643	Damper(2)	Urethane Rubber	1	
260	B26220073	Collar, Adjusting	SM45C	1	
270	B26270104	Collar(Φ70)	SM45C	1	
280	B26270053A	Cap, Bearing	SM45C	1	
290	B26220104	Cover_Housing	SCP1	1	
490	BM1200394B	Coupling	IKC-68-3535-00 (AS APPRVD DRAW)	1	INKOK/SUPPLY
520	R10713	Brg, Ang. Contact Ball	50TAC100BDBBC10PN7A	2	NSK/SUPPLY
540	R03284	Nut. Lock	DKMT50x1.5	2	K-FUKUDA/YHB
550	R01024	Screw. Machine/2.Tone.CO	BC6x12. PICR3	34	
610	P57216056	Pin, Taper(W/TAP)	TPB16x56	8	
620	P72000004	Plug. Connector	PA4	3	
640	P72010004	Sleeve	PB4	3	
680	P72130004	Adapter. Elbow	PH4	3	
840	S2215261	Bolt. Hex. Socket Head	BB12x30	12	
850	S2215661	Bolt. Hex. Socket Head	BB12x50	4	
870	S2221861	Bolt. Hex. Socket Head	BB16x60	16	
875	S2209361	Bolt. Hex. Socket Head	BB8x35	3	
877	S2209861	Bolt. Hex. Socket Head	BB8x60	11	

1) Preparations for disassembling the ball screw

- ① Move the Z axis to an intermediate position to facilitate the work on the ball screw, and turn off the machine.
- ② Remove both sliding covers from the Z axis and clean up the bed.
- ③ Separate B26220104 housing cover from B26270032 bearing housing, pull out the lubrication pipe, and unplug the cable (power and feedback cables) connectors of the servo motor.

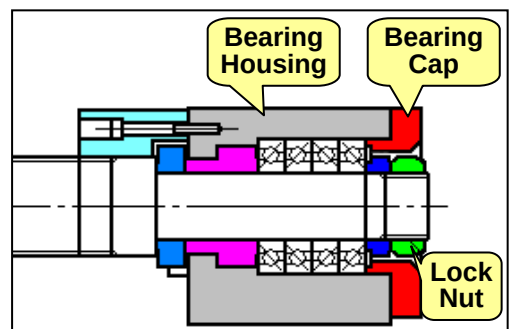
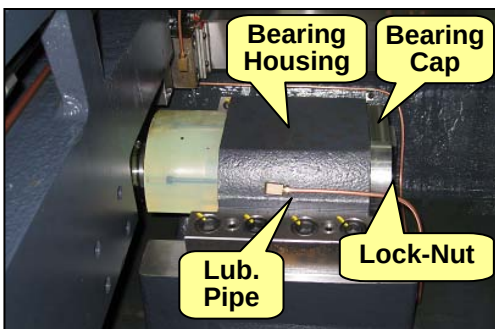


2) Loosen BM1200394B coupling fixing bolts, loosen the fixing bolts on the servo motor, and remove the motor with care.

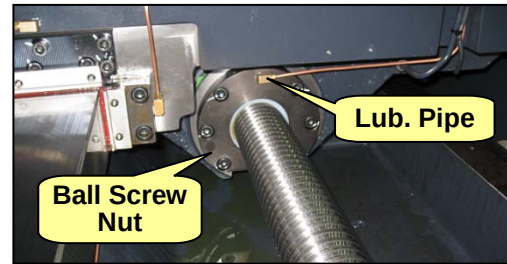


3) Disconnect the lubrication pipe from the opposite B26270042A bearing housing and loosen the lock nut.

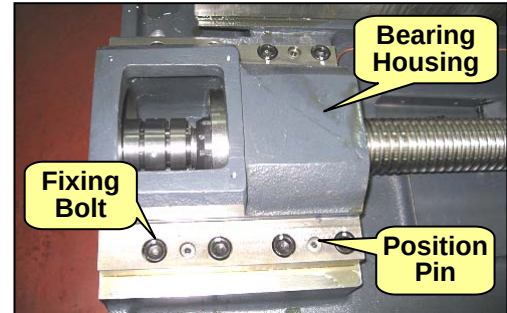
- Remove B26270053 bearing cap first. This will help loosening the lock nut.
- ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool that is specific to the lock-nut. If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. (when using the chisel and hammer, care must be taken lest that the lock nut should be scratched)



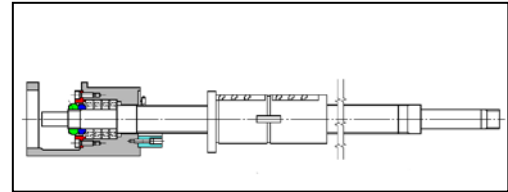
- 4) Disconnect the lubrication pipe and loosen the bolts (6-BB 12×30) from the ball screw nut (installed on the table base).



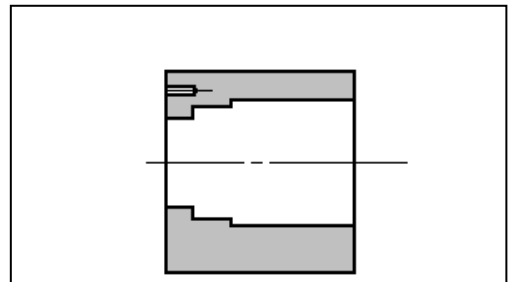
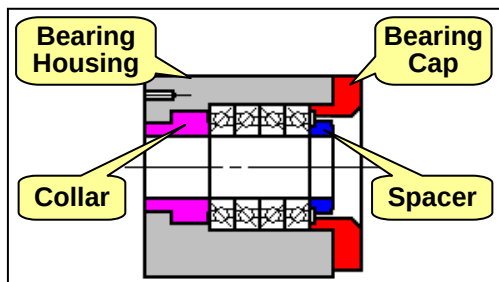
- 5) Loosen B26270032 bearing housing fixing bolts (8-BB16×60) and positioning pins (4-TPB-16×56).



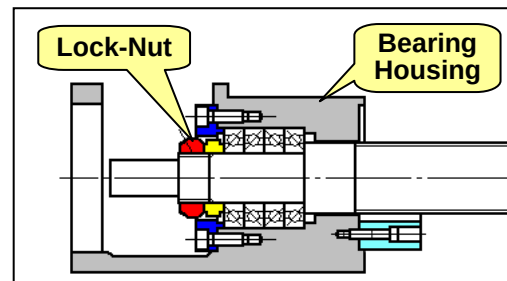
- 6) Remove the bearing housing as well as the ball screw assembly from the machine.
- Use the crane to take the ball screw by the center of gravity and pull it out from the machine.



- 7) First, loosen B26270053 bearing cap fixing bolts (8-BB12×35) from B26270042A bearing housing. Then, remove B26270104 collar, R10713 50TAC angular contact ball bearing and B14220073 spacer one by one.



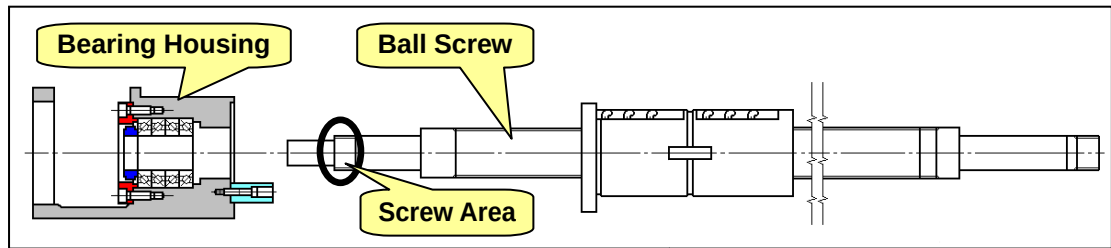
- 8) Loosen the lock-nut from the removed bearing housing.
- Remove B26270053 bearing cap first. This will help loosening the lock nut.
 - ※ Loosen the set-screws (x3) that are designed for locking the lock-nut. Then, use the tool that is specific to the lock-nut.



If it is not available, use the hammer and chisel to impact on and loosen the lock-nut. (when using the chisel and hammer, care must be taken lest that the lock nut should be scratched)

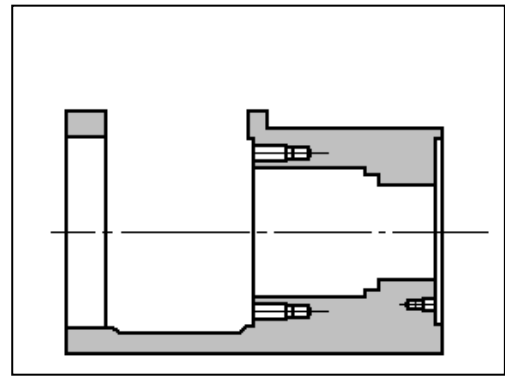
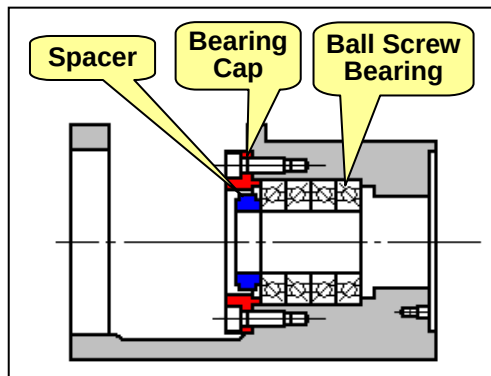
9) Separate the bearing housing from the ball screw.

- ※ When separating the ball screw from the bearing housing, take caution not to damage the lock-nut of the ball screw.



10) First, remove B26270053 bearing cap from the bearing housing. Then, remove R10713 50TAC angular contact ball bearing and B14220073 spacer.

- 8-BB12×35



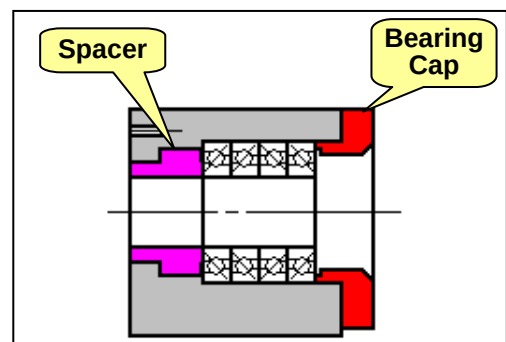
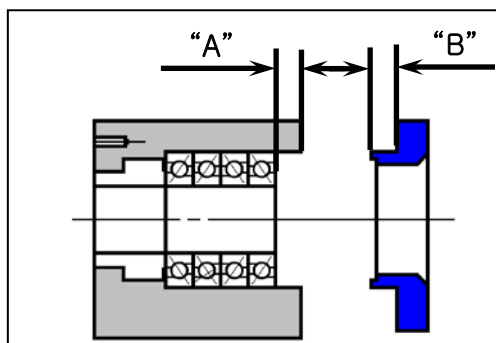
4.8 Installing the ball screw on the Z axis

1) Fitting the bearing cap on site that is located in the opposite bearing housing to the motor

- ① Fit 50ATC angular contact bearing into B26270042A bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("A")
- ② Calculate the target size of B26270053 bearing cap before fitting it on-site.
 - ※ Target size of the bearing cap "B" = "A" + 0.05mm
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).

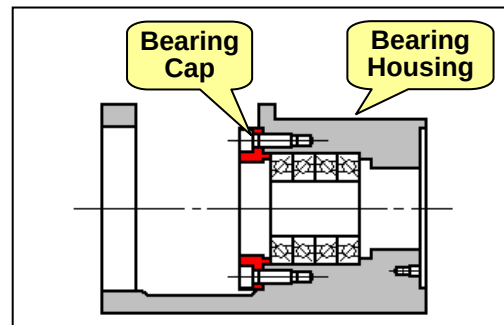
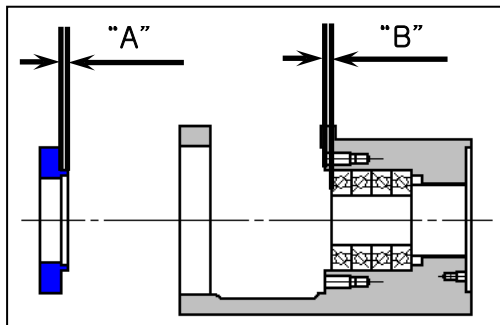
- ※ Put force as even as possible to each of the fixing bolts.

- 8-BB12×35



2) Fitting the bearing cap on site that is located in the bearing housing in the motor side

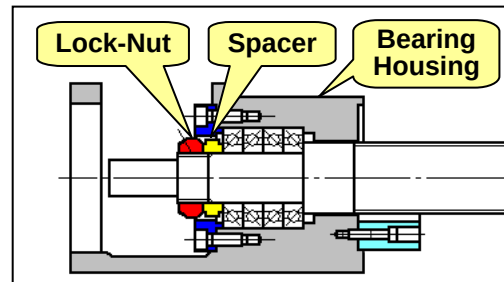
- ① Fit 50ATC angular contact bearing into B26270032 bearing housing, and measure the depth between end point of the bearing and top section of the bearing housing. ("B")
- ② Calculate the target size of B26270053 bearing cap before fitting it on-site.
※ Target size of the bearing cap "A" = "B" + 0.05mm
- ③ Insert the completed bearing cap into the bearing housing (where 50TAC bearing is installed).
※ Put force as even as possible to each of the fixing bolts.
▪ 8-BB12×35



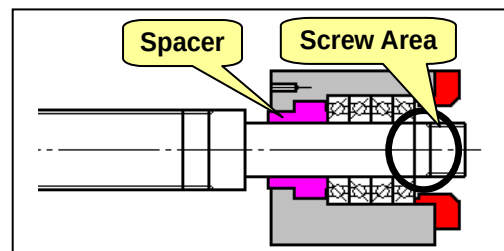
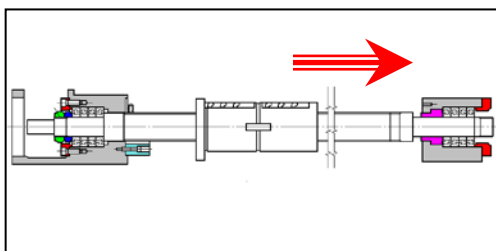
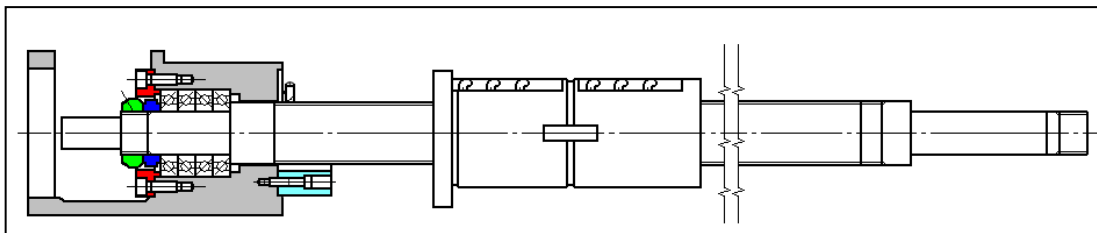
3) Installing the ball screw

Install the ball screw into the bearing housing before inserting B14220073 spacer. Then, 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.



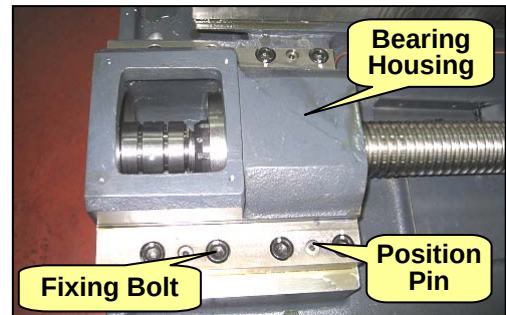
- 4) Use the crane to lift up the ball screw and bearing housing assembly considering the center of gravity. Push it in through the X-axis ball screw place of the table with care. (insert B26270104 collar at the end of the ball screw before installation)



5) Fixing the bearing housing.

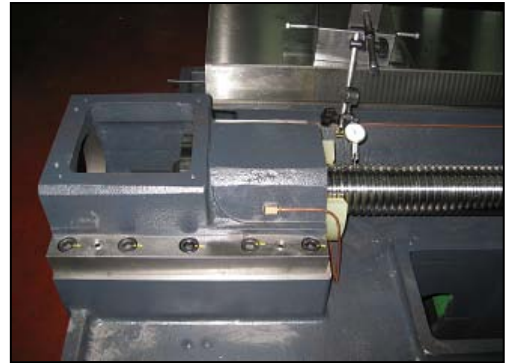
Tighten B26270032 bearing housing bolts and insert the positioning pins.

- 8-BB16×60, 4-TPB-16×56



6) Runout on the ball screw

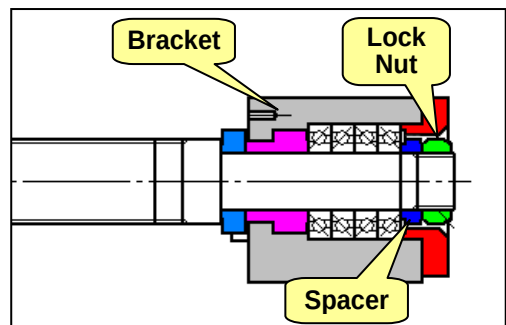
- ① Present the indicator at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout. (intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.002 mm, tighten up the set-screw for locking the lock-nut.



7) Tightening the lock nut in the rear of the bearing housing

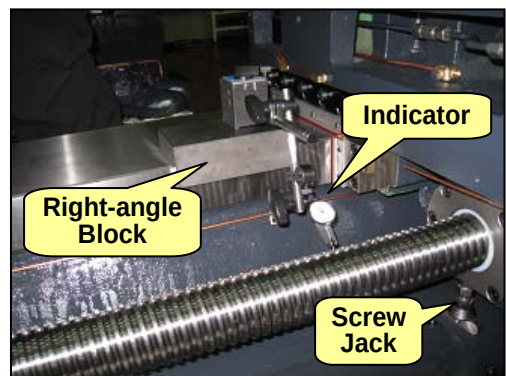
Insert B14220073 spacer at the end of the ball screw (where B26270042A bearing housing will be installed), and tighten the lock nut.

- ※ 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.

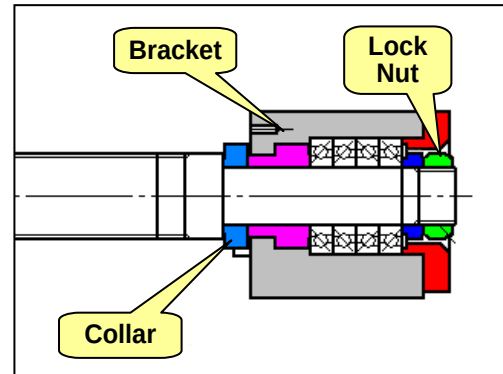
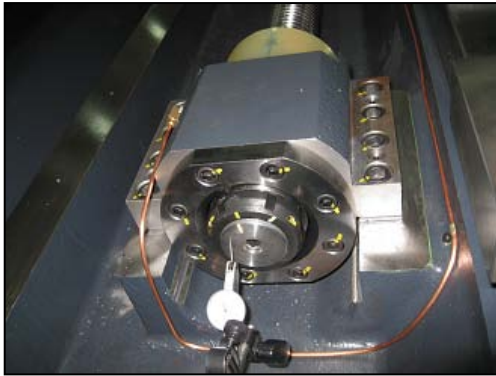


8) Pre-tension on the ball screw

- ① Turn the ball screw nut back to the original and tighten the fixing bolts.
 - 6-BB 12×30
- ② Install the screw jack under the ball screw nut and correct the parallelism for the ball screw (either ends, center, horizontal and vertical position)
 - Install the indicator on the right-angle block and present the needle at the end of the ball screw. And set it to 0. Use the screw jack to adjust the vertical and horizontal parallelism to below 0.02mm respectively.

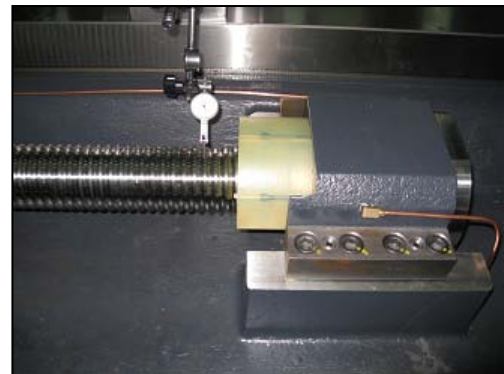


- ③ Present the needle at the end of the ball screw and set it to 0. Use the chisel and hammer to loosen the lock nut with minimum damage, and check the gradation changes of the indicator gauge. If the measurement does not fall into the tension target, remove the collar and fit it on site.
 - The collars for adjusting the pre-tension are located on either sides so you can remove them easily by simply loosening the lock nut.
 - Pre-tension on the Z-axis ball screw: 0.07mm



9) Runout on the ball screw (installed in the bracket).

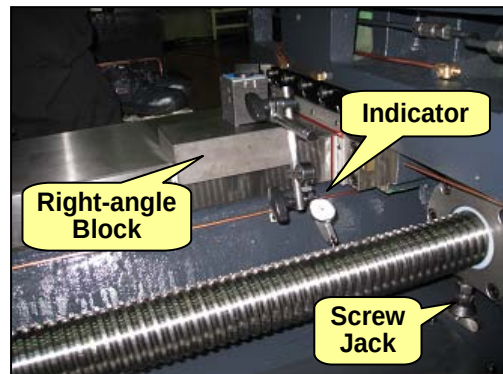
- ① Present the indicator on the block at the end of the ball screw.
- ② Turn the ball screw manually while reading the indicator, and impact and fix the lock-nut using the chisel at the highest point of the runout. (intermediate value between highest and lowest)
- ③ If the runout value of the ball screw goes below 0.001 mm, tighten up the set-screw for locking the lock-nut.



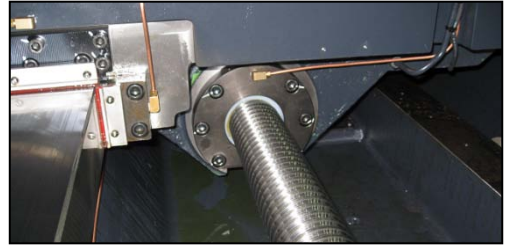
10) Tightening the ball screw nut

Install the screw jack under the ball screw nut as instructed above and correct the parallelism for the ball screw (either ends, center, horizontal and vertical position). Then, tighten up the bolts on the ball screw nut.

- Alternatively, you can tighten up two diagonal bolts first and loosen them slightly. Then, tighten them up finally.

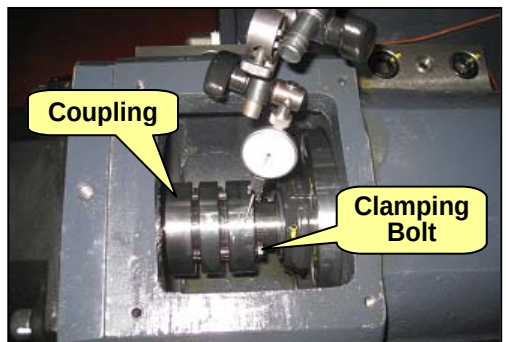
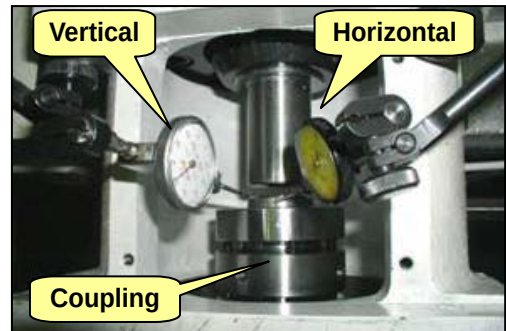


- ※ If the measuring tools are not available, turn on the machine and move the Z axis to “Z0”. Then, apply force as even as possible to each bolt diagonally until you tighten them up finally.



11) Installing the servo motor

- ① Insert the coupling into the servo motor shaft or gear box shaft, and install the servo motor into the bearing housing.
 - Tighten the bolts slightly because you have yet to perform the alignment between servo motor and ball screw.
- ② Aligning between servo motor and ball screw
Install the indicator on the rectangle block in the X-axis bed guide way side, align the servo motor shaft with the ball screw and tighten up the bolts.
 - Target Concentricity: below 0.01 mm both horizontally and vertically
- ③ Position the coupling in the middle between ball screw and motor shaft.
- ④ While rotating the ball screw, tighten the clamping bolts and correct the runout on the coupling.
 - Runout Tolerance: below 0.01mm



12) Finishing

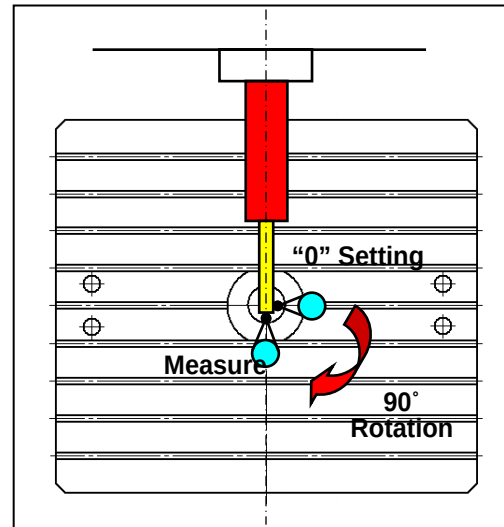
When installation is done, connect the lubrication pipe, servo motor cable (power and feedback cables) connector and various covers back to the original.



- ※ If you had removed and re-installed the X-axis ball screw, you must reset the reference point for the X axis.

4.9 Resetting the reference point for the Z axis (Z-axis stroke: 1600mm)

- 1) Refer to "Reference point for X axis" above to set the reference point of the X axis and set the indicator to "0".
 - The machine position is "X1500. Z290.W0", and around "Y400" for the Y axis.
- 2) Return the Z axis to the reference point manually.
- 3) Rotate the B axis by 90 degrees.
- 4) While moving the Z axis, set the indicator needle to "0".
- 5) Check the current position of the Z axis from the "Machine Position" screen of the OP, and enter the difference between current position and "Z290." in the "parameter #1850 Z" field.



※ To change the Z-axis grid shift parameter

Read the machine position (coordinates) displayed on the OP screen. Enter the positive (+) parameter if the result of deducting "290." from the machine position is a positive value; enter the negative (-) parameter in micron (μ) if the result is a negative value. Add or deduct the above measurement to and from the existing parameter and enter "INPUT", or enter the result plus the symbol, and press "+INPUT".

- Parameter for the Z-axis reference point: NO. #1850 Z

※ "Z290." Is the result where the test bar is 310mm long (L) and 60mm wide (D).

$$\text{i.e., } Z = L - (H - W + D/2), \quad Z = 310 - \{(750 - (700 + 30))\} = 290$$

- L : Length of the test bar 310mm

If H is "Zo.", the distance between spindle gauge line and table center is: 750mm

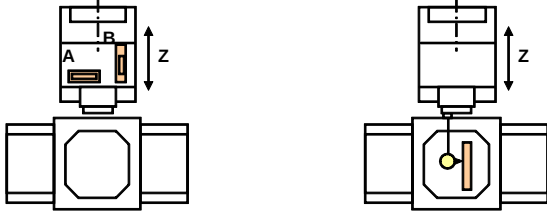
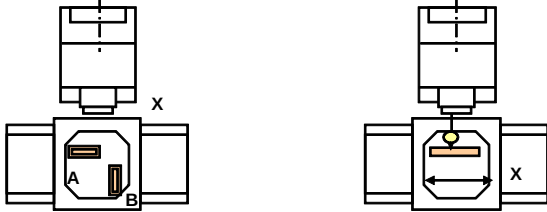
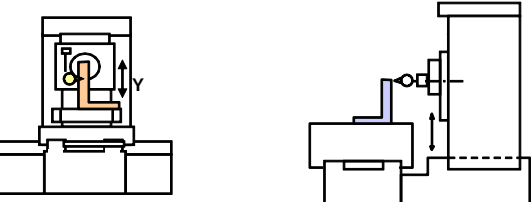
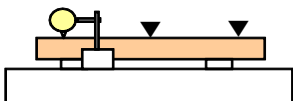
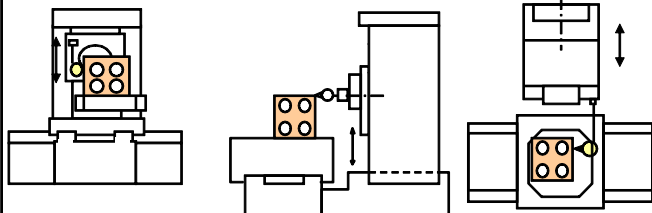
W : W-axis stroke: 700mm

D : Diameter of the test bar: 60mm ($D/2 = 30$)

- 6) Return the Z axis to the reference point manually and repeat the instructions above until the result falls below 0.005mm.

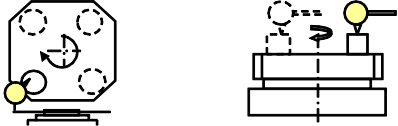
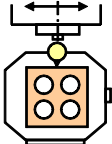
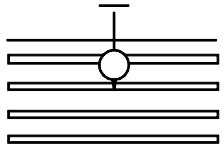
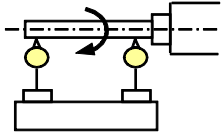
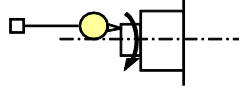
5. Precision Accuracy & Correction

※ Boring Machine Inspection Report Sample

DBC Series		GEOMETRICAL TEST		2/5
NO.	TEST ITEM	TOLERANCE		READING
1	▶ STRAIGHTNESS OF Z-AXIS MOVEMENT  A : X DIRECTION B : Z DIRECTION IN X-Y PLANE IN Y-Z PLANE Z DIRECTION IN X-Z PLANE	X-Y	0.030 / FULL STROKE	
		Y-Z	0.030 / FULL STROKE	
		X-Z	0.010 / 500	
2	▶ STRAIGHTNESS OF X-AXIS MOVEMENT  A : X DIRECTION B : Z DIRECTION IN X-Y PLANE IN Y-Z PLANE X DIRECTION IN X-Z PLANE	X-Y	0.030 / FULL STROKE	
		Y-Z	0.030 / FULL STROKE	
		X-Z	0.010 / 500	
3	▶ STRAIGHTNESS OF Y-AXIS MOVEMENT  IN X-Y PLANE IN Y-Z PLANE	X-Y	0.010 / 500	
		X-Z	0.010 / 500	
4	▶ STRAIGHTNESS OF THE PALLET SURFACE 	X-Y	0.030 / m	PALLET #1
				PALLET #2
		Y-Z	0.030 / m	PALLET #1
				PALLET #2
5	▶ MUTUAL SQUARENESS BETWEEN AXES  X-Y Y-Z X-Z	X-Y	0.020 / 500	
		Y-Z	0.020 / 500	
		X-Z	0.020 / 500	

A4(210×297mm)

Doosan Infracore Co., Ltd.

DBC Series		GEOMETRICAL TEST		3/5
NO.	TEST ITEM	TOLERANCE		READING
6	▶ PARALLELISM OF X & Z AXIAL MOVEMENT TO THE PALLET SURFACE AND RUN-OUT OF THE INDEX TABLE 	X-AXIS	0.030 / m	PALLET #1
				PALLET #2
		Z-AXIS	0.030 / m	PALLET #1
				PALLET #2
		RUN-OUT	0.025	PALLET #1
				PALLET #2
7	▶ SQUARENESS IN INDEX TABLE ANGLE DIVISION 0° POS. 90° POS. 180° POS. 270° POS. 	0.020 / 500		
8	▶ PARALLELISM OF X AXIS MOVEMENT TO T-SLOT DATUM PLANE 	0.040 / FULL STROKE		PALLET #1
				PALLET #2
10	▶ Y AXIAL MUTUAL DIFFERENCE IN PALLET CHANGE	0.020		
11	▶ PARALLELISM OF Z AXIS MOVEMENT TO THE SPINDLE CENTER 	X-Z	0.015 / 300	
		Y-Z	0.020 / 300	
12	▶ RUN-OUT OF SPINDLE INTERNAL TAPER 	AT SPINDLE NOSE	0.015	
		AT 300 mm DISTANCE	0.030	
13	▶ RUN-OUT OF MILLING SPINDLE NOSE 	0.020		

A4(210×297mm)

Doosan Infracore Co., Ltd.

5.1 Straightness of Z axis

1) X – Y

2) Y – Z

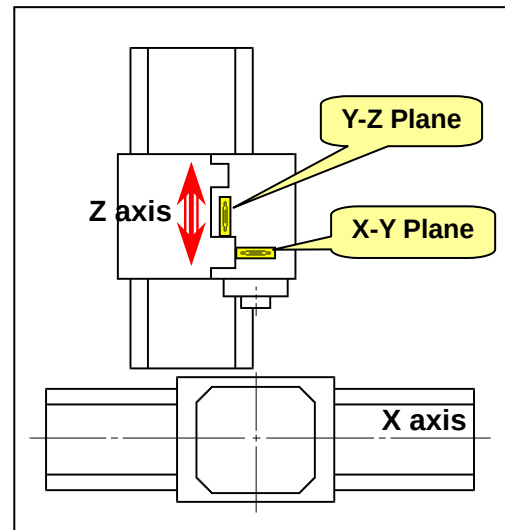
① How to measure

Install the level on the grinding side of the column in the X- and Z-axis direction and set the reference point. Feed the Z axis in 3-divided stroke and check the greatest difference of the level changes.

- Measuring position: Z0., Z800. (Z1000.), Z1600. (Z2000.)
- Tolerance: 0.030mm / full stroke

② Correction

Incorrectness of the X-Y straightness of the Z axis is thought to be attributed to an error in the machine feeding level. So refer to "Machine Leveling" later in this manual and perform the leveling again.



3) X – Z

① How to measure

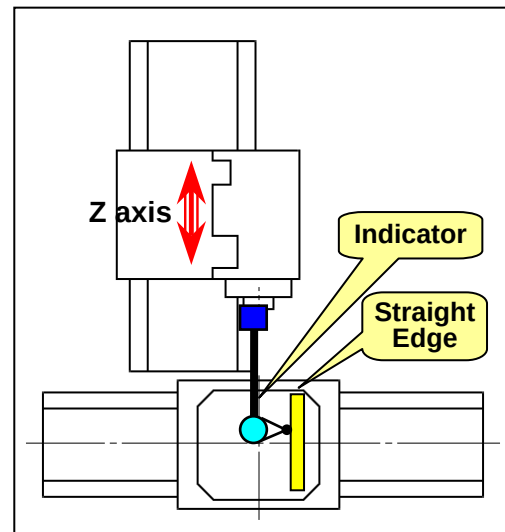
Install the straight edge horizontally on the pallet in the Z-axis direction and install the indicator on the spindle head. Set either end of the straight edge to "0" and move the Z axis to check the greatest difference (measurement in the middle of the movement).

- ※ If the straight edge is not available, use the sides of the square that is required for measuring the squareness between X and Y axes.

- Measuring position: both ends and center of straight edge
- Tolerance: 0.01mm / 500mm

② Correction

Incorrectness of the X-Z straightness of the Z axis is thought to be attributed to an error in the machine feeding level or column bed grinding. So refer to "Machine Leveling" later in this manual and perform the leveling again.



5.2 Straightness of X Axis

1) X - Y

2) Y - Z

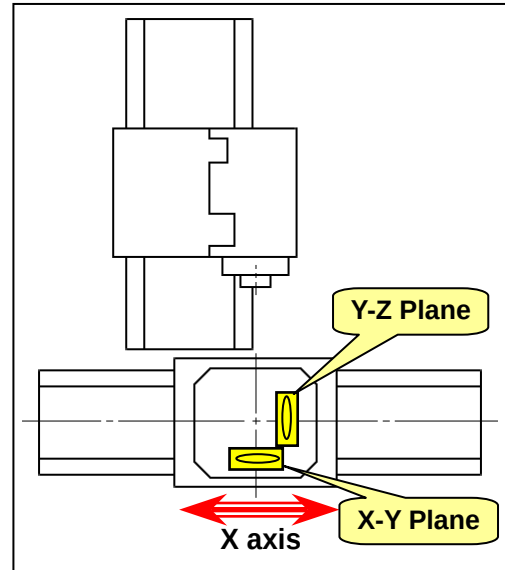
(a) How to measure

Install the level in the center of the table deck in the X- and Z-axis directions and position it so that you can read the level gradation. Feed the X axis in 3-divided stroke and check the greatest difference of the level changes.

- Measuring position: X0., X1500. (X2000.), X3000. (X4000.)
- Tolerance: 0.030mm / full stroke

(b) Correction

Incorrectness of the X-axis straightness is thought to be attributed to an error in the machine feeding level. So refer to "Machine Leveling" later in this manual and perform the leveling again.



3) X - Z

(a) How to measure

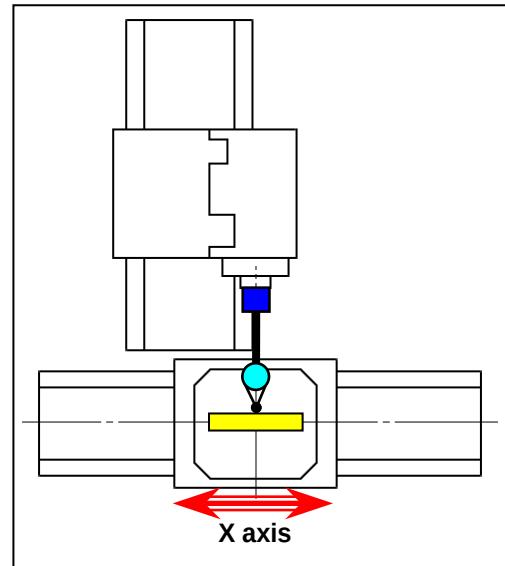
Install the straight edge horizontally on the pallet in the X-axis direction and install the indicator on the spindle head. Set either end of the straight edge to "0" and move the X axis to check the greatest difference (measurement in the middle of the movement).

- ※ If the straight edge is not available, use the sides of the square that is required for measuring the squareness between X and Y axes.

- Measuring position: both ends and center of straight edge
- Tolerance: 0.01mm / 500mm

(b) Correction

Incorrectness of the X-Y straightness of the X axis is thought to be attributed to an error in the machine feeding level. So refer to "Machine Leveling" later in this manual and perform the leveling again.



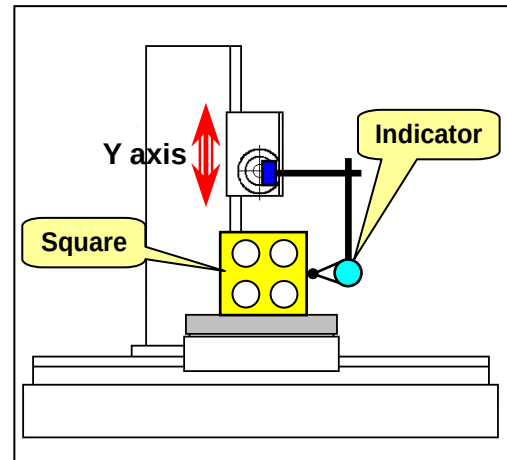
5.3 Straightness of Y Axis

1) X - Y

① How to measure

Install the square vertically on the pallet deck in the X-axis direction and install the indicator on the spindle head. Move the Y axis to measure the parallelism. Set both ends of the square to "0" and check the measurement in the middle of the square.

- Measuring position: both ends and center of square
- Tolerance: 0.01mm / 500mm



② Correction

Correction is not possible as the squareness is attributed to the physical column sliding side. However, correction is necessary as the gap of the gib in the Y axis may have a problem or the ball screw nut in the Y axis may be improperly aligned.

※ Adjusting the Y-axis gib

- (1) Loosen the bolts on the reference gib in the front and lower of the spindle head.
- (2) Loosen the set-screw (BQ bolt) of the gib-adjusting bolts completely.
- (3) Slowly tighten the BB bolt (one of the gib adjusting bolts) at first. Then tighten it up when you feel that the gib gets tightened. (this is where the gap between gib and column sliding side becomes "0")
- (4) Then, loosen the bolt (BB bolt) by a half turn (180°).
- (5) Tighten back the set-screw (BQ bolt) and pull out the gib as much as you have loosened the BB bolt (180°).
- (6) Adjust the upper and lower gibs as well as the other gibs in the same way.
 - It is recommended to adjust the back plate gib just after performing the clamping of the Y axis.

※ Aligning the ball screw nut

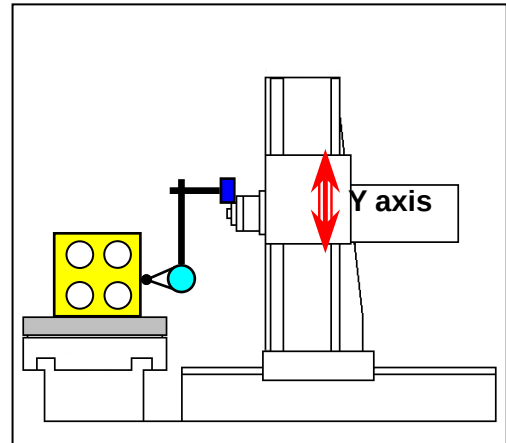
- (1) Move the Y axis to "0".
- (2) Loosen all fixing bolts on the ball screw nut.
- (3) Slightly tighten the bolts diagonally one by one at first, and then tighten them up by applying force as evenly as possible to each of them.

2) Y - Z

① How to measure

Install the square vertically on the pallet deck in the Z-axis direction and install the indicator on the spindle head. Move the Y axis to measure the parallelism. Set both ends of the square to "0" and check the measurement in the center of the square.

- Measuring position: both ends and center of square
- Tolerance: 0.01mm / 500mm



② Correction

Refer to "X-Y" above for the correction. However, this may not work as straightness of Y-Z is related to the back plate of the spindle head. If this is the case, check the gap of the back plate and try again.

5.4 Straightness of Pallet Deck

1) X – Y direction

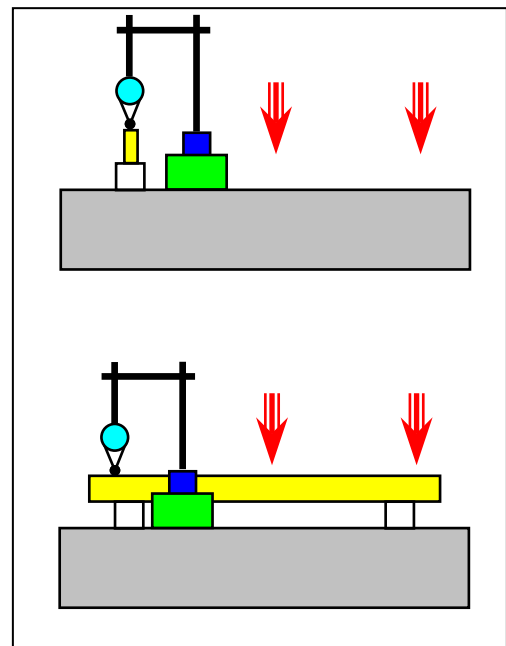
2) X – Z direction

① How to measure

Install the straight edge on the table deck in the X-axis direction (X-Y), or in the Z-axis direction (Y-Z) and install the indicator on the block. Measure the greatest difference in straightness of the top side of the straight edge.

- ※ If the straight edge is not available, you can install the indicator on the spindle head and manually move the table deck to measure the difference. Note that this may be affected by the level of the machine. So perform this just after you have completed the leveling.

- Measuring position: both ends and 9 points around the center
- Tolerance: 0.03mm/1000mm



② Correction

Correction is not possible as the straightness is attributed to the physical pallet deck itself. If the difference is as significant as to require correction, you have no option but to re-grind the deck.

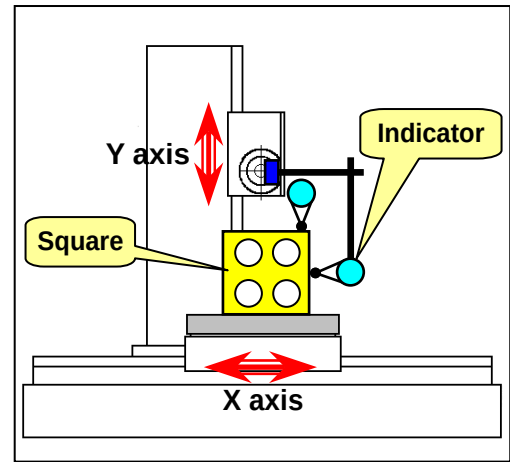
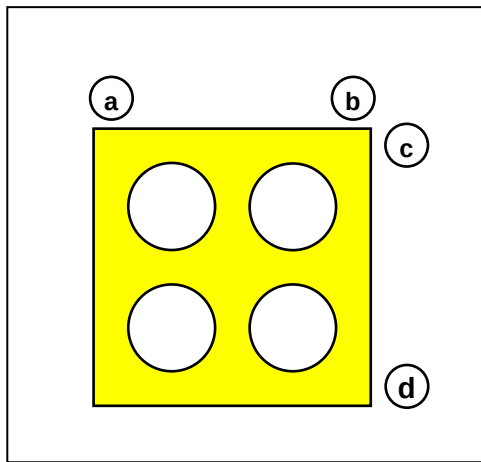
5.5 Squareness between coordinate axes

1) X – Y Squareness

① How to measure

Place the square on the table deck in the X-axis direction and install the indicator on the spindle head. Check the squareness between X and Y axes. The greatest difference is the measurement.

- Measuring: As shown below, set both ② and ③ to "0" and calculate " $② - ①$ " and " $③ - ④$ ". If ① and ④ are the same symbol (+/-), add " $② - ①$ " to " $③ - ④$ ", if not, deduct the smaller value from the greater one.
- Tolerance: 0.02mm/500mm



② Correction

- Squareness between X and Y can be corrected using the level in the column bed (Z axis).

- (1) Place the square graphplate (surface plate) vertically in the X-axis direction and install the indicator on the spindle head. Measure the parallelism between square graphplate and X axis. Take a note of the difference and direction.
- (2) Then, present the indicator to the square graphplate in the Y-axis direction and measure the overall squareness. Take a note of the difference and direction.
- (3) Set the bottom of the square graphplate to "0" and move up and stop the Y axis at the top of the square graphplate. Tighten the level block evenly on one side of the column bed. Generally, the squareness can be approximately corrected by moving the applicable axis twice as much as the changes to the indicator gradation.)
- (4) Repeat the steps above until you get the satisfactory result.
- (5) When done, check the machine level and, if it's not proper, perform the machine leveling again.

- ※ Note that the squareness takes priority over the level. So ignore the absolute level and focus on the feeding level when performing the leveling.

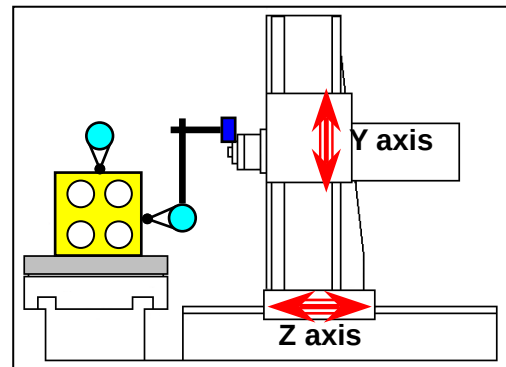
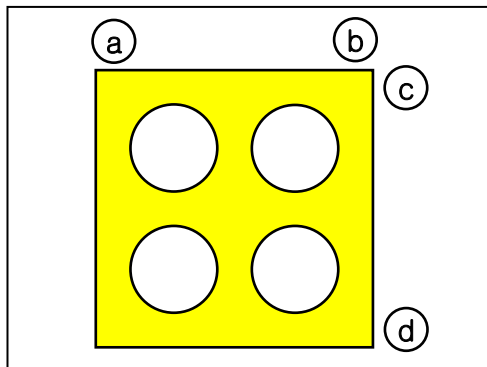
2) Y – Z squareness

① How to measure

Place the square on the table deck in the Z-axis direction and install the indicator on the spindle head. Check the squareness between Y and Z axes. The greatest difference is the measurement.

▪ How to measure: As shown below, set both ② and ③ to "0" and calculate " $b - a$ " and " $c - d$ ". If ② and ④ are the same symbol (+/-), add " $b - a$ " to " $c - d$ ", if not, deduct the smaller measurement from the greater one.

▪ Tolerance: 0.02mm/500mm



② Correction

If you fail to correct the Y-Z squareness even after the leveling (i.e., the error is over 0.01mm), perform the scraping of the sliding plate on the bottom of the column.

※ Scraping the column sliding plate is a very significant correction. Take a deep consideration before determining to do so. Try performing the leveling work, for instance. Only when you are 100% sure that the problem is caused by the plate, perform the scraping.

※ To perform the scraping of the column base sliding plate

▪ Preparations: Scraper, whetstone, minium, screw jacks (x2), cloth, other repair tools

(1) Unplug the cable that supplies power to the lubricant motor from the electric cabinet to block lubricant inflow.

※ turn off the power and unplug the secondary U51 and V51 wires from the terminal block.

(2) Remove the front sliding cover and rear cover from the Z axis.

(3) Loosen the ball screw nut fixing bolts on the rear of the column base.

(4) Remove the front and rear wiper plates from the column base.

(5) Remove the back plate from the column base.

(6) Install two screw jacks on the lubricant passage in the side of the column bed, one for each back plate place in the rear column base. Then, lift up the column base slide plate so that you can remove it.

※ Insert a thin metal plate between screw jack and back plate to prevent scratches.

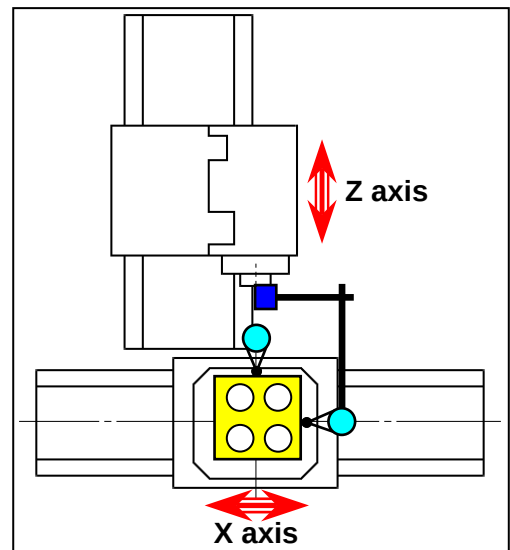
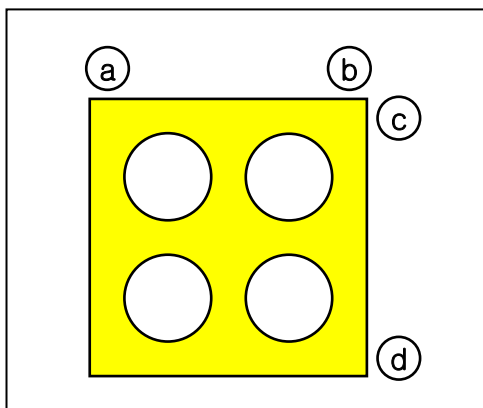
- (7) Insert the bolt (BB 12×100) in the middle of the sliding plate and use the bolt as a handle to remove the sliding plate from under the column.(one more in the rear)
- (8) Clean up the sliding plate and apply minium.
- (9) Wrap a thin tool (ex: scraper) with a clean cloth to wipe up the bottom of the column and the grinding side of the column bed.
※ Clean it up. Even a slightest lubricant is not allowed to remain.
- (10) Insert the sliding plate back to the original and remove the screw jack.
- (11) Perform the same work on the front sliding plate.
- (12) Manually move the Z axis to reveal the contact area in the bottom of the sliding plate.
- (13) Repeat the step above to reveal the contact area from the column bed and perform the scraping of the sliding plate until you get a satisfactory result. When completed, clean up the area of your work and apply grease before putting all removed parts back together.
- (14) Move the Z axis to "0". Apply force as evenly as possible to each of the ball screw nut fixing bolts until you tighten them up finally.
- (15) Put all removed parts and covers for the precision work back together.

3) X – Z squareness

① How to measure

Place the square on the table deck in the X-axis direction and move the indicator to set either ends of the square to "0". Adjust the parallelism of the X axis by impacting on higher points using the handle of a screwdriver. Measure the Z-axis parallelism of the square; the highest difference will be the measurement.

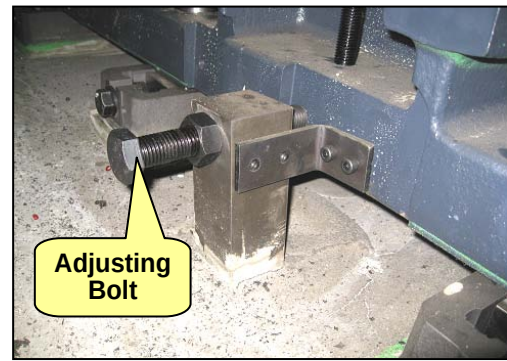
- How to measure: Set "① - ②" (see the figure below) to 0. The difference of "③ - ④" is the measurement.
- Tolerance: 0.02mm/500mm



⑥ Correction

You can use the bed positioning kicker between table bed and column bed to adjust the squareness between two beds.

- (1) Loosen the anchor nut on the column bed.
- (2) Check the mis-positioned direction and use the kicker adjusting bolt to push the bed.
- (3) Check the squareness again and repeat these steps until you get a satisfactory result.
- (4) If the error is too great to adjust the squareness only in the column bed side, repeat these steps above to adjust the squareness of the table bed using the kicker.
- (5) If you get a satisfactory result, tighten the anchor and check again.
- (6) If no error is found, measure the X- and Z-axis levels as well as the squareness of each axis again.



5.6 Parallelism of movement to X/Z axis, parallelism of pallet deck, and shaking of index table

1) X-axis direction

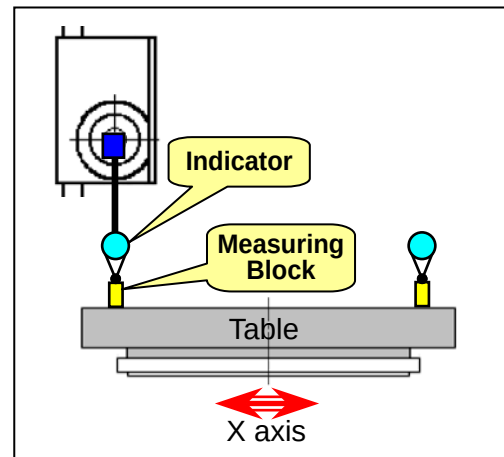
① How to measure

Install the indicator at the end of the spindle and place the height measuring block 500mm away from the table center in the X and Z directions before setting the reference point. Then, move the X axis by 1000mm and measure the difference.

- Measuring position: If the table center is set as "0"

X500.Z500., X-500.Z500.,
X500.Z0., X-500.,Z0.
X500.Z-500., X-500.,Z-500,

- Tolerance: 0.03mm / 1000mm



② Correction

If you need to adjust the precision for the X-axis direction, perform the scraping of the sliding plate under the table again for that purpose.

※ **To perform the scraping of the table base sliding plate**

- Preparations: Scraper, whetstone, minium, screw jacks (x2), cloth, other repair tools

(1) Unplug the cable that supplies power to the lubricant motor from the electric cabinet to block lubricant inflow.

- ※ turn off the power and unplug the secondary U51 and V51 wires from the terminal block.

(2) Remove the sliding covers in either sides of the X axis.

(3) Loosen the X-axis ball screw nut fixing bolts in the side of the table base.

(4) Remove the wiper plates in either sides of the table base.

(5) Remove the back plate from the table base.

(6) Install two screw jacks on the lubricant passage in the side of the table bed, one for each back plate place in the rear table base. Then, lift up the table base slide plate so that you can remove it.

- ※ Insert a thin metal plate between screw jack and back plate to prevent scratches.

(7) Insert the bolt (BB 12×100) in the middle of the sliding plate and use the bolt as a handle to remove the sliding plate from under the table base.

(8) Clean up the sliding plate and apply minium.

(9) Wrap a thin tool (ex: scraper) with a clean cloth to wipe up the bottom and the grinding side of the table base.

- ※ Clean it up. Even a slightest lubricant is not allowed to remain.

(10) Insert the sliding plate back to the original and remove the screw jack.

(11) Perform the same work on the other sliding plate.

(12) Manually move the X axis to reveal the contact area in the bottom of the sliding plate.

(13) Check the contact state on the table base and keep scraping the sliding plate until you get a satisfactory result.

(14) When you get a satisfactory result, clean up the working area and apply lubricant, then put together all the removed component parts back to the original.

(15) Move the X axis to "0". Apply force as evenly as possible to each of the ball screw nut fixing bolts until you tighten them up finally.

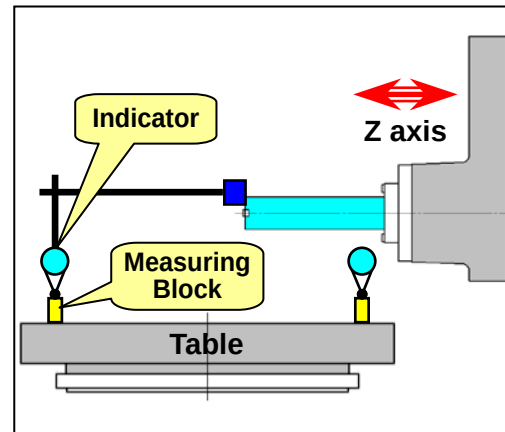
(16) Put all removed parts and covers for the precision work back together.

2) Z-axis direction

① How to measure

Move the W axis to "0". Install the indicator at the end of the spindle and place the height measuring block 500mm away from the table center in the X and Z directions before setting the reference point. Then, move the Z axis by 1000mm and measure the difference.

- Measuring position: If the table center is set as "0"
 X500.Z500., X500.-Z500.,
 X0.Z500., X0.,Z-500.
 X-500.Z500., X-500.,Z-500,
- Tolerance: 0.03mm / 1000mm



② Correction

- The Z-axis parallelism of the table can be adjusted by leveling the table bed (X axis).
 - (1) Move the W axis to "0". Install the indicator at the end of the spindle and move the Z axis to "Z0." Check the distance between indicator and table center and move the Z axis back as much as that distance. Place the measuring block on it and set the reference point.
 - (2) Then, move the Z axis back to "Z0." and use the block to measure the height.
 - (3) Adjust the level block in the front position of the table bed evenly to fit the height.
 - (4) Repeat the steps above until you get the satisfactory result.
 - (5) When done, check the machine level and, if it's not proper, perform the machine leveling again.
- ※ Note that the table parallelism takes priority over the level. So ignore the absolute level and focus on the feeding level when performing the leveling.

3) Shaking of the table

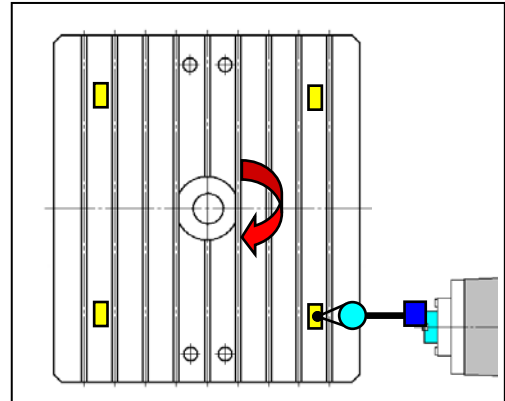
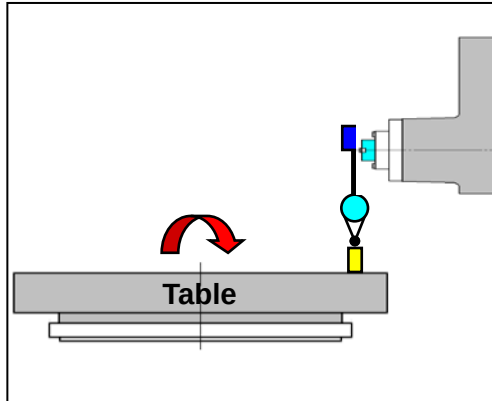
① How to measure

Install the indicator at the end of the spindle and place the height measuring block 500mm away from the table center in the X and Z directions before setting the reference point ("0"). Then, rotate the B axis by each 90 ° and measure the difference.

- Measuring position:
 If the table center is set as "0" From "X500.Z500", rotate the B axis by each 90 ° four times to measure 4 points
- Tolerance: 0.025mm

② Correction

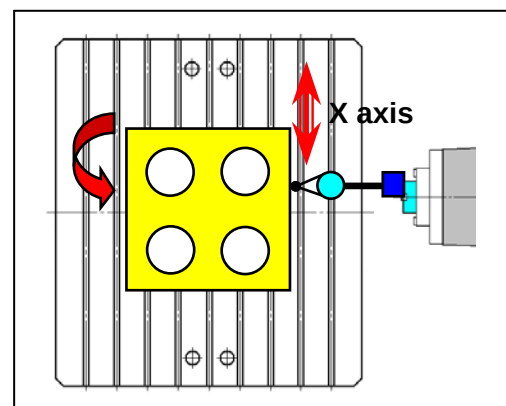
The shaking of the table is caused by a problem with the parallelism between table bottom and deck. So if you want to correct the shaking, you should scrape the bottom or grind the deck as appropriate.



5.7 Squareness in division of index table

1) How to measure

- (1) Place the square horizontally on the table deck. While moving the X axis, correct the parallelism between square and X axis.
 - To correct the parallelism, use the handle of a screwdriver to impact on certain points of the square.
- (2) While indexing the B axis, clamp the square to the table lest that it should move.



- (3) While indexing the B axis totally 4 times, one for each 90 degrees, measure the X-axis parallelism totally 4 times accordingly. The greatest difference is the measurement.
 - Measuring position: 0° Position, 90° Position, 180° Position, 270° Position
 - Tolerance: 0.02mm / 500mm

2) Correction

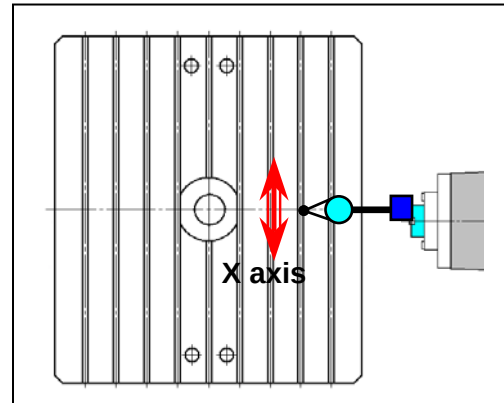
As the angle division of the index table is performed using the precise position coder and mechanical devices, it is unlikely to make an error. However, if you encounter a significant error, that's because the position coder or mechanical device inside the table is contaminated with dust and impurities, or it is defective, damaged, or worn out. If this is the case, you have no other option but to replace the position coder or the mechanical device with a new one.

5.8 Parallelism of the X-axis movement for the T-slot

1) How to measure

Set the reference point for the B axis and perform the table locating as well as the table clamping. Then, install the indicator on the spindle and present the gauge to the second T-hole of the table T-holes. While rotating the X axis, measure the parallelism.

- Measuring position: Full stroke of the table T-hole
- Tolerance: 0.04mm / full stroke



2) Correction

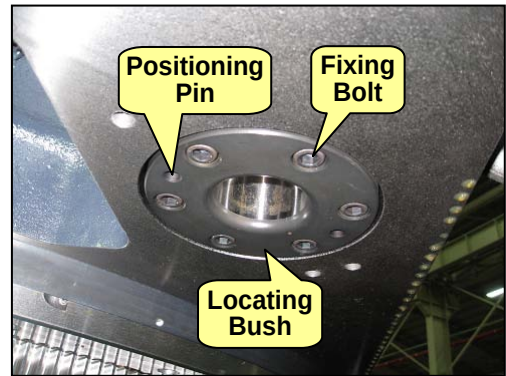
Reset the B-axis reference point and reset the locating bush position as appropriate.

※ Resetting the reference point for the B axis

- The overall gear ratio of the B axis is 1440:1. That means that the B axis rotates once when the servo motor revolves 1440 times, so the maximum degree of the B axis per one revolution of the servo motor is 0.25° . Thus, the grid shaft should be adjusted within ± 125 .
- (1) Set the reference point for the B axis.
- (2) Install the indicator on the spindle, present the gauge to the table T-hole or the center of the side and set it to 0.
- (3) Feed the X axis so that the gauge gets closer to the table T-hole or the distal end of the side.
- (4) Turn the B axis manually to set the gauge needle to 0.
- (5) Feed the X axis in the opposite direction and measure the error on the other side.
- (6) If the error is still beyond 0.02mm, move the B axis by half of the error manually and set the gauge needle to 0.
- (7) Feed the X axis in the opposite direction and measure the error on the other side.
- (8) If the error is still beyond 0.02mm, move the B axis by half of the error manually and set the gauge needle to 0. Repeat this step above until the error is less than 0.02mm.
- (9) When you get a satisfactory result, check the machine position that is displayed on the screen and enter the value (coordinates) in "Parameter No. #1850 B".
ex: 0.091 : 91, 359.937 : -63 (If the item is already filled with a certain figure, just press +Input).
- (10) Repeat these steps above until you get a satisfactory result.

※ Resetting the locating push position

- The locating pin or bush may be mis-positioned from the B-axis reference point or from the right angle (0° , 90° , 180° , 270°) due to such as an impact on the table. Even if they are correctly positioned from the reference point or each right angle, performing the locating will move the table accordingly.



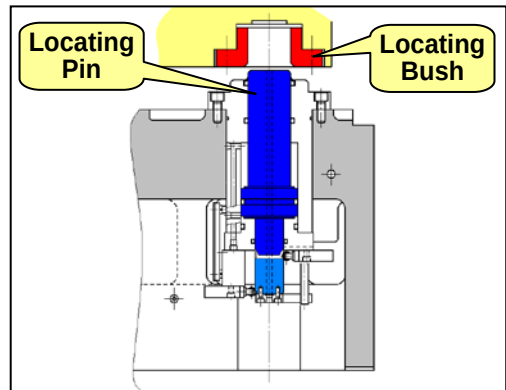
- (1) Pull out the positioning pins (2-SPB 10X50) from the problem-making locating bush and loosen the bolts (6-BB12×30).

- (2) Refer to "Resetting the reference point for the B axis" above to set the exact reference point for the table.

- (3) Perform the table locating.

- The locating bush in the table will take place in the locating pin position.

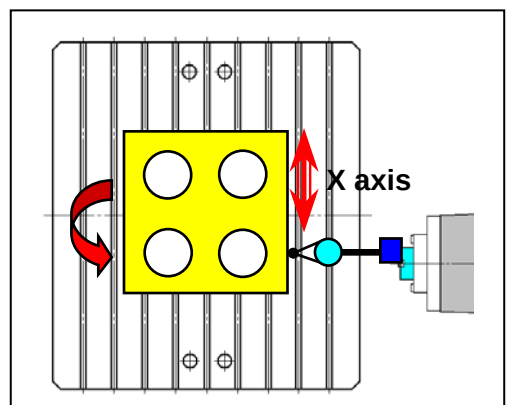
- (4) Tighten up the locating bush fixing bolts (applicable bolts only)



- (5) Perform the table unlocating and turn the table to tighten up the bush bolts. Then, reset the B-axis reference point before performing the table locating to check if there still occurs an interruption.

- (6) While indexing the B axis by each 90° , correct the positions of the other three locating bushes respectively.

- (7) When done, place the square horizontally on the table deck. While turning the X axis, adjust the parallelism between X axis and square. Clamp the square to the table so that it does not move when indexing the B axis. While indexing the B axis by each 90° , measure the parallelism



of the X-axis direction to check if the error of division squareness falls below the tolerance.

- Tolerance: 0.02mm / 500mm

- (8) When done, use the reamer to perform the reaming of the position-pin places in the locating bush before inserting the pins..

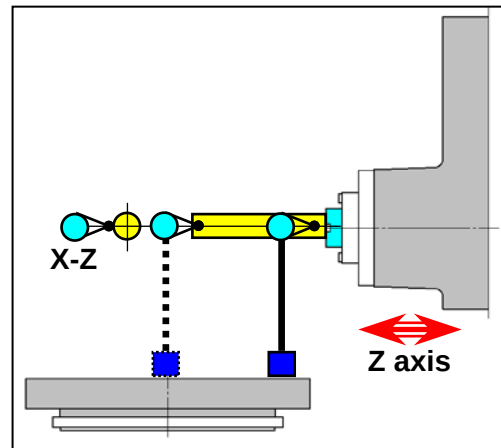
5.9 Parallelism between center line of spindle and movement of Z-axis

1) X-Z

① How to measure

Insert the test bar into the spindle and move the X axis up to 300mm away to measure the runout on the highest point (stop moving the Y axis at the highest point). Stop rotating the spindle at an intermediate point and move the Z axis to 300mm away from the mouth. The greatest difference is the measurement.

- Tolerance: X – Z: 0.015mm/300mm



② Correction

- This is to restore the accuracy of the column itself.

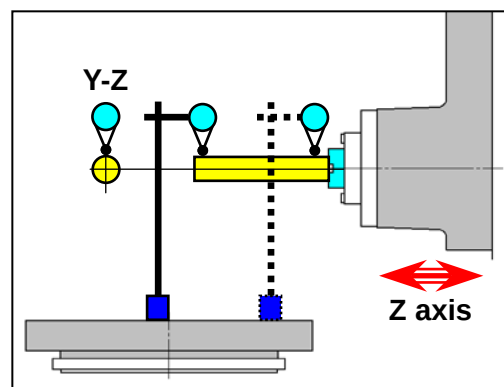
- (1) Set the indicator needle to 0 at the test bar position. Then, move the Z axis to 300mm away.
- (2) Loosen the bolts (10-BA24×100) except for the reamer bolts in the front right side of the column.
- (3) Use the adjusting bolt on the position block (under the column) to move the column in the opposite to the indicator direction about 5 times as much as the error.
- (4) Repeat these instructions above until you get a satisfactory result.
- (5) When completed, tighten the adjusting bolts (x2) evenly and tighten up the column bolts.

2) Y-Z

① How to measure

Insert the test bar into the spindle and move the Y axis up to 300mm away to measure the runout on the highest point (stop moving the X axis at the highest point). Stop rotating the spindle at an intermediate point and move the Z axis to 300mm away from the mouth. The greatest difference is the measurement.

- Tolerance: Y – Z: 0.015mm/300mm



② Correction

- As this has much to do with squareness between Y-axis column and Z-axis column bed, and squareness between center line of the spindle and Y-axis column, measure the Y-Z squareness at first. Then go on to the Y axis gib if no error is found. If the problem persists, adjust the Y-axis gib as well.

(1) Adjusting the parallel gib

- ① Remove the Y-axis cover.
- ② Loosen the ball screw nut fixing bolts on the Y axis.
- ③ Loosen the taper gib in the spindle head. (loosen the gib bolts by two turns before locking the set-screw. This will loosen the gib.)
- ④ If the measurement at the 300mm position is "+", remove the lower parallel gib; if it is "-", remove the upper one.
- ⑤ Scrape the parallel gib as much as the height of the spindle head added to the parallelism error.
⇒ Install the indicator and use the block gauge to set the thickness of the parallel gib. Then, scrape the gib according to the calculation.
(approximately 2.5 times as much as the value measured by the test bar)

(2) Adjusting the gap for the taper gib

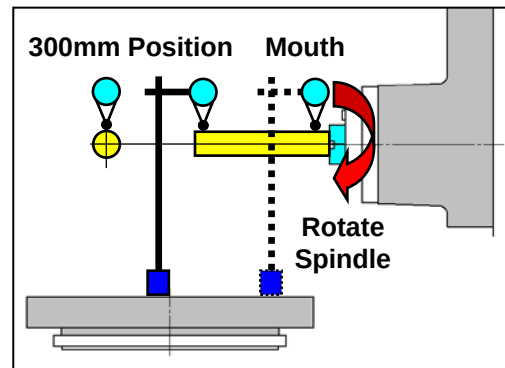
- ① Loosen the bolts on the reference gib in the front and lower of the spindle head.
- ② Loosen the set-screw (BQ bolt) of the gib-adjusting bolts as appropriate.
- ③ Slowly tighten the BB bolt (one of the gib adjusting bolts) at first. Then tighten it up when you feel that the gib gets tightened. (this is where the gap between gib and column sliding side becomes "0")
- ④ Then, loosen the bolt (BB bolt) by a half turn (180°).
- ⑤ Tighten back the set-screw (BQ bolt) and pull out the gib as much as you have loosened the BB bolt (180°).
- ⑥ Adjust the upper and lower gibs as well as the other gibs in the same way.
 - It is recommended to adjust the back plate gib just after performing the clamping of the Y axis.

5.10 Runout on the spindle

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: 0.005mm at the mouth
0.012mm at 300mm away



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.

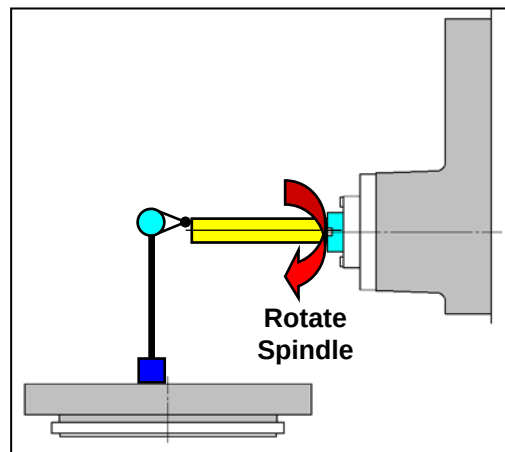
- ※ Using the grinder is strictly prohibited. If the taper side is badly damaged, re-grind the spindle itself.

5.11 Movement of spindle in the Z-axis direction

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 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 Auto Tool Changer (ATC)

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	ATC centering	Check using the fixture	○		○	
	Tool magazine	Check with bare eye.	○		○	
	Waiting pot stop position		○		○	
	Changer arm gripper				○	
	Pot taper	Check for any abnormal abrasion			○	
	Tool pot key				○	
	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		○	○		
	Changer operation		○	○		
	Solenoid valves	Check DGN			○	
	Switch operation				○	
Oil Supply	Pot chain guide	Supply and apply grease			○	
	Chain				○	
	LM guide of the guide way				○	
	Stopper & Disc Spring				○	
Cleaning	Changer arm gripper	Remove impurities	○			
	Inside the tool pot		○			
	Guide way of the changer		○			
	Tools used		○			
	Inside the cover					○

6.2 Axes System

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Mechanical reference point	Test and correct it if necessary.				○
	Static accuracy					○
	Positioning accuracy					○
	Feed system					○
	Check the sliding cover if it's abraded abnormally				○	



	Power supply to the servo motor in each axis	±10%			○	
	Bolts and connectors	Check if properly fixed or connected.	○			○
	Y, W-axis clamp	Check the clamp state.			○	
Operation	Switch that enables you to restore the reference point	Check DGN	○		○	
	Emergency Stop button		○		○	
	Return to reference point	Check if properly returned to reference point	○	○		
	Axial feeding	Operate it manually	○	○		
Oil Supply	Operating area	Apply grease			○	
Cleaning	Feed cover	Remove impurities		○		
	Inside the repair cover				○	

6.3 Spindle Head

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Tool unclamping device	Test and correct it if necessary.			○	
	Main spindle orientation	Adjust the stop angle properly	○		○	
	Main spindle driver key	Check if it's abraded.			○	
	Main spindle taper				○	
	RPM	Check and Adjust				○
	Power supply to main spindle driving motor	±10%			○	
	Bolts and connectors	Check if properly fixed or connected.				○
	Oil Mist	Check if properly supplied with lubricant.		○		
Operation	Rotation of the main spindle	Operate it manually	○	○		
	Main spindle orientation	MDI manipulation	○	○		
	Clamping/unclamping	Operate it manually	○	○		
	Position Sensor	Check if detecting the RPM properly				○
	Solenoid valves	Check DGN				○
	Switch operation					○
Oil Supply	Driving Components	Apply grease				○
Cleaning	Main spindle taper	Remove impurities		○		
	Inside the cover					○

6.4 Table

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	B-axis reference point	Test and correct it if necessary.				○
	B-axis positioning accuracy					○
	Table clamp				○	
	Pin Locating/Unlocating					
	Power supply to the B-axis servo motor	±10%			○	
	Bolts and connectors	Check if properly fixed or connected.	○			○
	Table lubrication	Check if properly supplied with lubricant.			○	
Operation	Table clamping	Operate it manually	○		○	
	Pin Locating/Unlocating	Check DGN	○		○	
	Solenoid valves		○		○	
	Emergency Stop		○		○	
	Return to reference point	Check if properly returned to reference point	○	○		
	B axis feeding	Operate it manually	○	○		
	Table Leb. Flow Switch	Check if Flow SW works properly			○	
Oil Supply	Operating area	G68 Oil	○			○
	Gear box	Level Gage	○		○	
Cleaning	Inside the cover	Remove impurities				○

6.5 Air Service Unit

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Manometer	5Kgf/cm ²	○	○		
	Oiler flowrate	5 drops/min.	○	○		
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Air pressure for cleaning	Operate ATC & APC.	○	○		
	Regulator	Check if working properly			○	
	Oiler				○	
Oil Supply	Oiler ullage scale	Check with bare eye.	○	○		



Cleaning	Filter device - tank	Drain water	○	○		
	Filter device - filter	Check/clean/replace			○	

6.6 Lubrication Unit

Item	Checkpoint	Description	Upon installation	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 operation 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		○		
	Lub. Unit	Cleanse			○	

6.7 Hydraulic Unit

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Manometer	55Kgf/cm ² (5.5Mpa)	○	○		
	Pressure switch	30Kgf/cm ² (2.8Mpa)	○	○		
	Power supply to pump motor	±10%			○	
	Tubes	Check for any leakage	○	○		
	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Pump	Check the operation sound	○	○		
	Pressure switch	Check DGN				○
Oil Supply	Ullage scale	Check with bare eye.	○	○		
	Oil replacement				○	
Cleaning	Inside the tank	Clean inside the tank.				○
	Oil supply filter	Check/clean/replace			○	
	Suction filter					○
	Return filter					○

6.8 Spindle Oil Cooler

Item	Checkpoint	Description	Upon installation	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	Operation	Check the operation sound	○	○		
	Operation panel	Check if properly working			○	
Oil Supply	Ullage scale	Check with bare eye.	○	○		
	Oil replacement				○	
Cleaning	Filter	Check/clean/replace		○		
	Oil cooler tank	Cleanse			○	

6.9 Splash Guard

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Bolts and connectors	Check if properly fixed or connected.	○			○
Operation	Doors	Check if properly open and close	○			
	Door safety switch	Check DGN	○	○		

6.10 Name Plates

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

6.11 Coolant & Chip Devices

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Power supply to each pump motor	±10%	○		○	
	Coolant flux	Adjust the flux properly.		○		



	Tubes	Check for any leakage	☐	☐		
	Bolts and connectors	Check if properly fixed or connected.	☐			☐
Operation	Each pump	Check with bare eye.	☐	☐		
	Chip conveyor		☐	☐		
Oil Supply	Oil Level	Check with bare eye.	☐			
	Ullage scale		☐	☐		
	Oil replacement				☐	
	Chip conveyor chain	Apply grease				☐
Cleaning	Inside the tank	Clean inside the tank.			☐	
	Filter	Check/clean/replace			☐	
	Disposal of the internal chip in the chip conveyor	Use a cloth and reverse rotation.		☐		
	Inside the chip conveyor	Dismantle the conveyor for cleaning				☐

6.12 Electric Devices

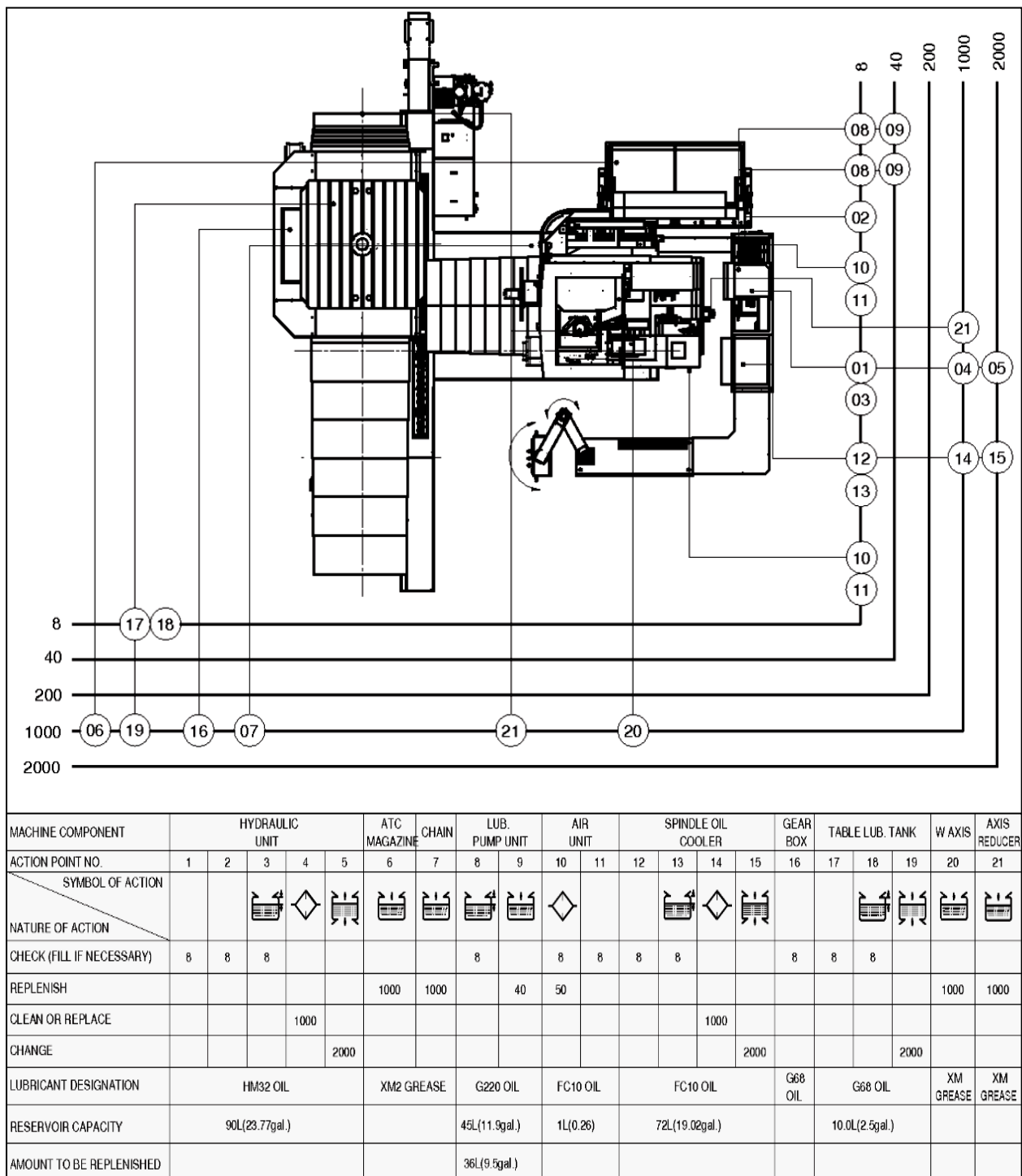
Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Power supply	±10%	☐		☐	
	Bolts and connectors	Check if properly fixed or connected.	☐			☐
Operation	Emergency stop buttons	Check DSN and check if working properly	☐	☐		
	Operation panels	Check if working properly	☐	☐		
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

6.13 Machine Leveling

Item	Checkpoint	Description	Upon installation	Daily	Semi-annually	Annually
State	Check the bed level state	Check the level and adjust it if necessary	☐		☐	

6.14 Check Oil Supply

※ Lubrication System



※ Oil Analysis Table

Maker Symbol	Mobil Oil	Shell Oil	Esso Oil	Caltex Oil	BP Oil	Sun Oil
A (FC10)	Velocite No.6	Tellus C10	Spinesso 10	Spindural 10	Energol HP 10	Solnus 55
B1 (FC32)	DTE Oil Light	Tellus 32	Teresso 32	Rando 32	Energol HP 32	Sunvis 916
B2 (HM32)	DTE 24	Tellus 32	Nuto H 32	Rando HD 32	Energol HLP 32	Sunvis F
C (HG32)	Vacuoline 1405	Tonna T 32	Febis K 32		Energol GHL 32	Sun Lubrway
D (HM46)	DTE 25	Tellus 46	Nuto H 46	Rando HD 32	Energol HLP 46	Sunvis 821WR
E (HM68)	DTE 26	Tellus 68	Nuto H 687	Rando HD 68	Energol HLP 68	Sunvis 831WR
F (HG68)	Vacuoline 1409	Tonna T 68	Febis K 68	Way Lubricant 68	Energol HHL 68	Sun Lubrway 1754
G (G68)	Vactra No.2	Tonna T 68	Febis K 68	Way Lubricant 68	Maccurat 68	Sun Lubrway 80
I (CB150)	DTE Oil Extra Heavy	Tellus C 150	Teresso 150	Rando Oil 150	Energol GR-XP 150	Sunvis 975
K (G220)	Vactra No.4	Tonna T 220	Febis K 220	Way Lubricant 220	Maccurat 220	Sun Lubrway 90
L (CC320)	Mobilux 632	Omala 320	Spartan EP 320	Meropa 320	Energol GR-XP 320	Sunep 1090
Y (XM2)	Mobilux 2	Alavniagrease EP2	Beacon 2	Multifak EP2	Ener -Grease LS 2	Prestige 42 Grease
Z (XMP0)	Mobilux 2	Alavniagrease EPR0	Neacon EP0	Multifak EP0	Ener -Grease MM-EP0	Prestige 740EP Grease

- Text in parenthesis () is the ISO symbol.
- 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
NC Boring Maintenance Manual DBC 130

Version	Year/Month	Revision history	Created by
01	2010. 04	Official draft (DBC130MTE04)	Jung, Sam Young
02	2012.10	Error correction(Page65) (DBC130MTE04)	Jung, Sam Young
03			
04			
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