SERVICE MANUAL

6-Axis Manipulator

VT Series Manipulators

EPSON
EXCEED YOUR VISION

Confidential

Rev.1

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REVISION HISTORY

After first release of this manual, the parts and mechanism may be subject to change for improvement of their performance and the manual may be revised. Be sure to always keep this manual up to date.

Revision	Date	Page of change	Detail of change
Rev.1	2020.1.7	All	First Release

	Contents	Example
Level 1	Material anyone can see	Catalog, Presentation
Level 2	Detailed information (Potential Customers)	Maintenance Manual
Level 3	Training Level Information (Customers and non-contract partners)	Parts information, Structure of Robot
Level 4 (Confidential)	Only for SEC, ESC and contract partners	Detailed Specifications, Service Information
Level 5 (Strictly Confidential)	Only for SEC and ESC internal use	Epson Encoder, Epson Motor Specifications, Hidden Commands

Contents

CHAPTER

1

Maintenance Procedures

Level 3

1.1 Maintenance Tables

BOLTS/SCREWS USED IN THIS SECTION

Screw / Bolt Type	Details	Size	Tightening Torque (N.m)
S01	Silver: Hex socket head cap bolt (F/NI)	M2.5	1.0 +/- 0.1
		M3	2.0 +/- 0.1
		M4	4.0 +/- 0.2
		M5	8.0 +/- 0.4
		M6	13.0 +/- 0.65
		M8	32.0 +/- 1.6
S02	Black: Hex socket head cap bolt (F/B) (Important / Reduction Gear)	M3	2.4 +/- 0.1
		M4	5.5 +/- 0.25
		M5	10.0 +/- 0.5
		M6	18.0 +/- 0.9
		M8	44.4 +/- 2.2
S03	Cross recessed bind screws (General)	M2.5	0.36 +/- 0.1
		M3	0.45 +/- 0.1
		M4	0.45 +/- 0.1
S04	Cross recessed bind screws (Brackets)	M3	0.6 +/- 0.1
		M4	0.9 +/- 0.1
S05	Hex bind screws	M3	0.7 +/- 0.1
		M4	2.4 +/- 0.1
		M5	4.0 +/- 0.2

LUBRICANTS USED IN THIS SECTION

Type	Part/Amount
SK-1A	Reduction Gear J1,J2,J3,J4
SK-2	Reduction Gear J5, J6, Bevel Gear
Krytox GPL-224	Internal Cables at Joint 1,2,3,4 Sleeves
LOCTITE 641,242	Reduction Gear, Bearing Fixing

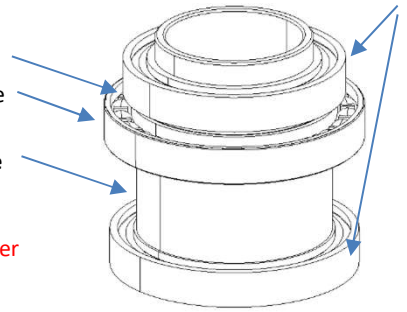
Level 3

Bearing Outer Surface

①Waveform Generator Bearing Surface

Waveform Generator Bearing Outer Surface

②Waveform Generator Inner Surface



Caution: No grease is applied to Bearing Outer Surface

GREASE AMOUNT MAINTENANCE VALUES

Area	Part	Grease Type	Amount	Diagram Ref.	Note
J1	SHF-25-120-2SH-SP	SK-1A	①:2±0.2g	GR 1-1	Apply with syringe
			②:24±1.0g	GR 1-2	Apply 12g inside Flexspline 1 2g to Waveform Generator
J2	SHF-25-120-2SH-SP	SK-1A	①:2±0.2g	GR 2-1	Apply with syringe
			①:24±1.0g	GR 2-2	Apply 12g inside Flexspline 1 2g to Waveform Generator
J3	SHF-20-100-2SH-SP	SK-1A	①:1.5±0.5g	GR 3-1	Apply with syringe
			②:11.0±0.5g	GR 3-2	
J4	SHF-20-100-2SH-SP	SK-1A	①:1.5±0.5g	GR 4-1	Apply with syringe
			②:11.0±0.5g	GR 4-2	
J5	SHD-17-80-3SH-SP	SK-2	①:1.25±0.25g	GR 5-1	Apply with syringe
			②:3.5±0.3g	GR 5-2	
J6	SHD-17-80-3SH-SP	SK-2	①:1.25±0.25g	GR 6-1	Apply with syringe
			②:4.2±0.3g	GR 6-2	
J5 / J6	Bevel Gear (J6 side)	SK-2	1～1.5g	GR 6-3	Apply with syringe
	Bevel Gear (J5 side)	SK-2	1～1.5g	GR 5-3	
	ARM5 inside bottom surface	SK-2	5～6g	GR 5-4	
J6	Oil Seal (AC1213P1)	SK-1A	-	GR 6-4	Applied for lubrication only when pressed into flange

GREASING EXAMPLES

The below examples shows grease place on the outside surface of the Waveform Generator.
The red circles indicate no good compared to the blue circles being good.

Fig.1

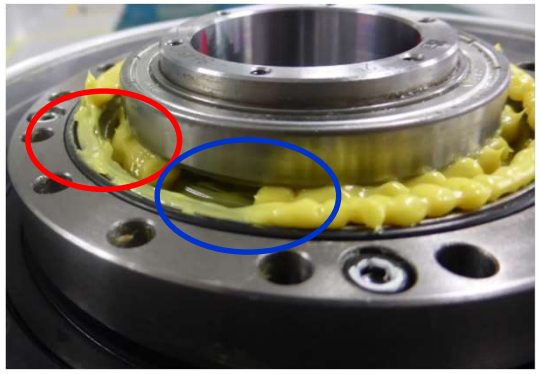


Fig.2

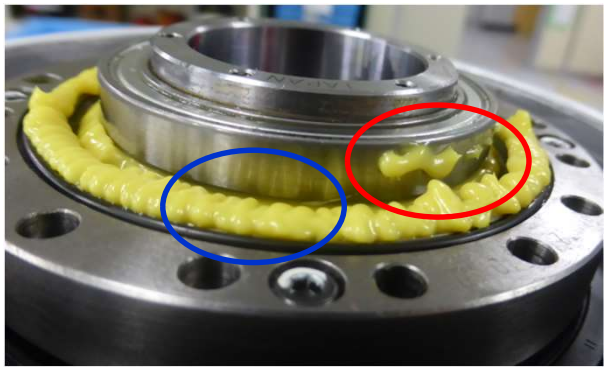


Fig.3

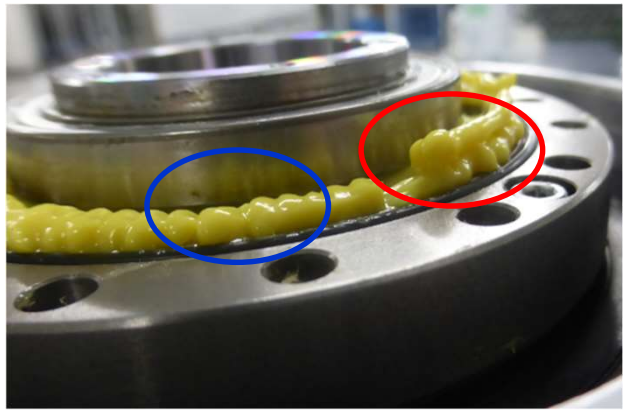


Fig.4

Major Points to be careful of:

1. Grease is only applied on the inside of the O-ring. Refer to fig 1. and fig 3.
2. No grease is applied under the bearing. Refer to Fig 2.
3. No grease is allowed on the outside surface of the bearing. Refer to Fig 3.
4. Make sure grease is applied evenly. Refer to Fig 4

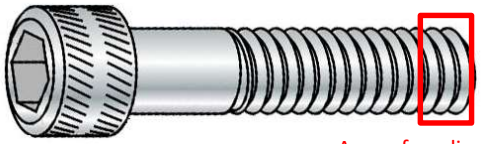
Example: Waveform Generator Inner Surface

Example: Flexspline Inner Surface

Level 3

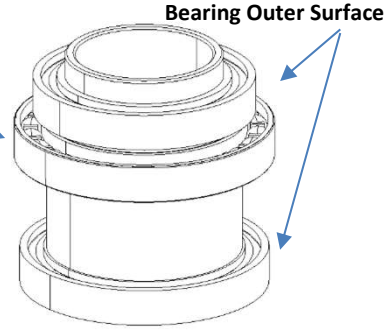
LOCTITE/GASKET AMOUNT MAINTENANCE VALUES

Caution: Make sure bolt is cleaned before reapplication of Loctite.



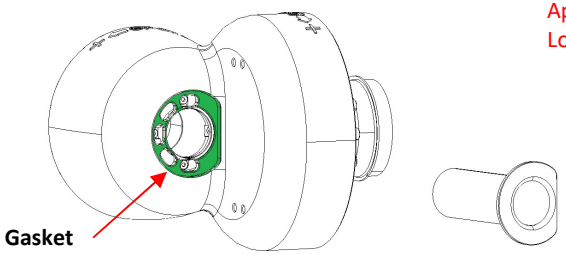
Area of application

Waveform Generator Bearing Outer Surface



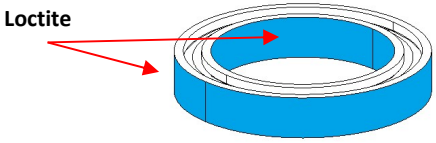
Caution: Make sure no grease is applied to Bearing Outer Surface or Loctite will not hold.

Loctite Type	Parts	Part Type No.	Application/Amount	ASP Diagram Ref. No
LOCTITE 641	J1 & J2 Bearing	6808	Apply to all of bearing outer surface only	025
	J1 & J2 Bearing	6807		026
	J3 & J4 Bearing	6807		026
	J3 & J4 Bearing	6806		027
	J5 Bevel Gear Bearing	6803		028
	J5 Pulley Bearing	6807		026
	J5 Pulley Bearing	6803		028
	J6 Bevel Gear Bearing	6807		026
LOCTITE 242	J6 Output Pulley Fixing Bolt	M4x15	Apply to tip of Bolt (3 threads and below)	049
	J4,J5,J6 Motor Pulley Fixing Bolt	M4x12		043
	J1、J2, J3 Motor pully Fixing Bolt	M5x12		042
LIQUID GASKET	J6 Sleeve	1207B	0.2～0.3g	LT6-1

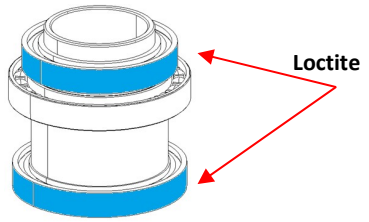


Example: J6 Sleeve

Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



Example: Standalone ASP



Example: Pressed ASP

Level 3

BELT TENSION SONIC METER SETTING VALUES

	J1	J2	J3	J4	J5	J6
Diagram Ref	BT1-1	BT2-1	BT3-1	BT4-1	BT5-1	BT6-1
MASS (g/m)	2.5	2.5	2.5	2.5	2.5	2.5
WIDTH (mm/R)	9.0	9.0	9.0	6.0	6.0	6.0
SPAN (mm)	60	172	169	45	184	184

BELT TENSION VALUES

	J1	J2	J3	J4	J5 (With Cover)	J5 (Without Cover)	J6 (With Cover)	J6 (Without Cover)
Diagram Ref	BT1-1	BT2-1	BT3-1	BT4-1	BT5-1	BT5-1	BT6-1	BT6-1
Design Tension [N]	34~70	34 ~ 58	34 ~ 58	23 ~ 36	23 ~ 36	22~29 (Guide Only)	23 ~ 36	15~20 (Guide Only)
Service Tension[N]	60 ~ 70	50 ~ 58	50 ~ 58	30 ~ 36	30 ~ 36	22~25 (Guide Only)	30 ~ 36	15~20 (Guide Only)
Measure Point (Pulley Rotation)	1point fixed	1point fixed (4x90°)	1point fixed (4x90°)	1point fixed	1point fixed	1point fixed (4x90°)	1point fixed	1point fixed (4x90°)

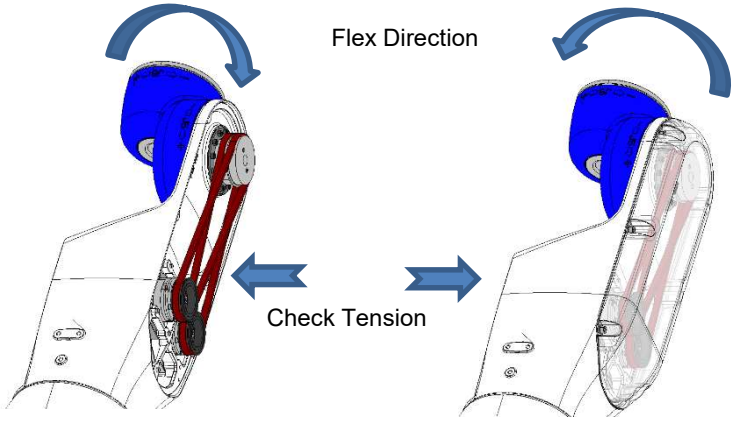
Note: Service Tension is the recommended value when replacing with new belt. The belt will tend to stretch in the first period of aging. Therefore setting the belt to a higher value will reduce the need for adjusting after aging.

Note: The J5 belt is tightened first then the J6 belt. The J5 belt tension will slightly decrease when J6 is tensioned. When cover is replaced belt tension will increase **1.5 times**.

How to tension J5 & J6 belts
Step 1. Adjust J5 Belt Tension
Step 2. Check J5 belt tension using without cover tension

Step 3. Adjust J6 Belt Tension
Step 4. Check J5 belt tension using without cover tension

Note: Arm 4 will slightly flex by tension of belts



Step 5. Attach Arm 4 Cover
Note: Arm will flex back to original position which will tighten the belt by about 1.5 times

Step 6. Check Belt Tension from opposite side using with cover tension when cover is attached.

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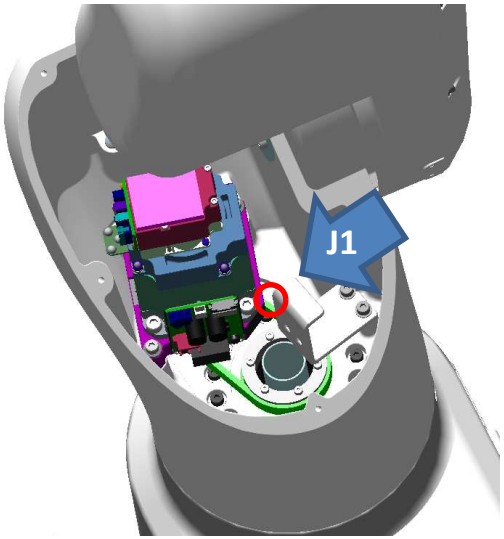
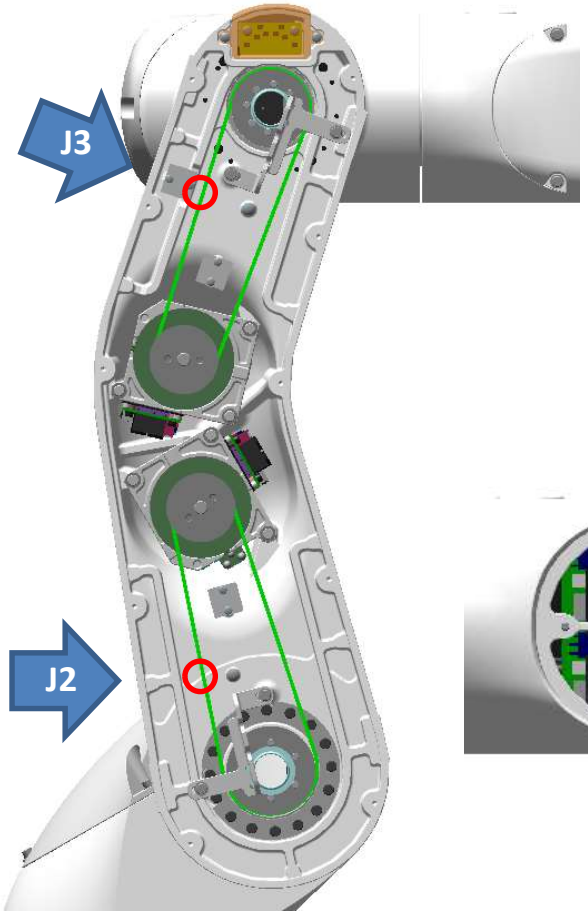
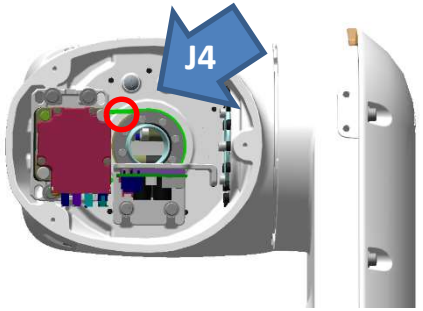
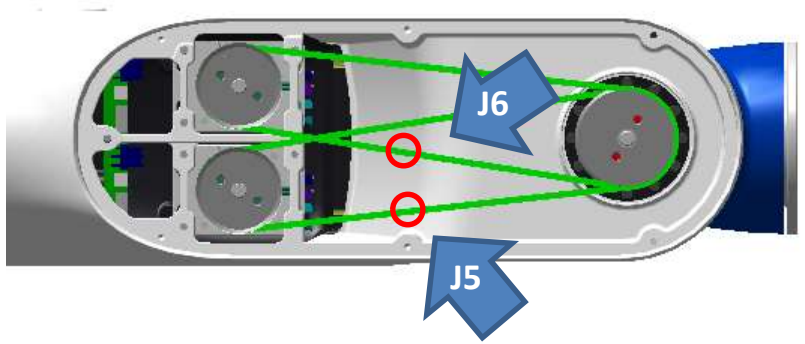
BELT TENSION MEASURMENT POINTS









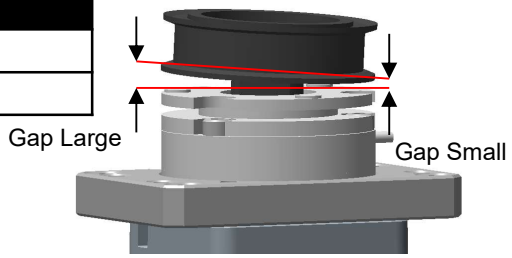
Level 3

MOTOR PULLEY/ BRAKE CLEARANCE

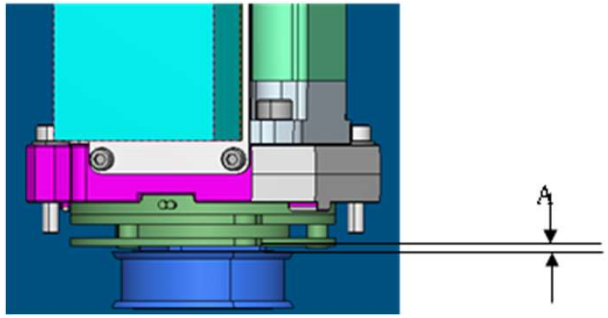
If the pulley is not even on all sides then it is on an angle. The values below are a guide only.

Parts Clearance	A（mm）
J1/ J2/ J3 Motor Pulley/ Brake	1.3±0.5
J4/ J5/ J6 Motor Pulley/ Brake	3.0±0.5

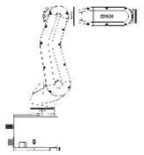
The pulley must be even on all sides or the fixing bolt and brake hub will be misaligned causes damage when fixed by the belt.



Misaligned Pulley
(Incorrect)

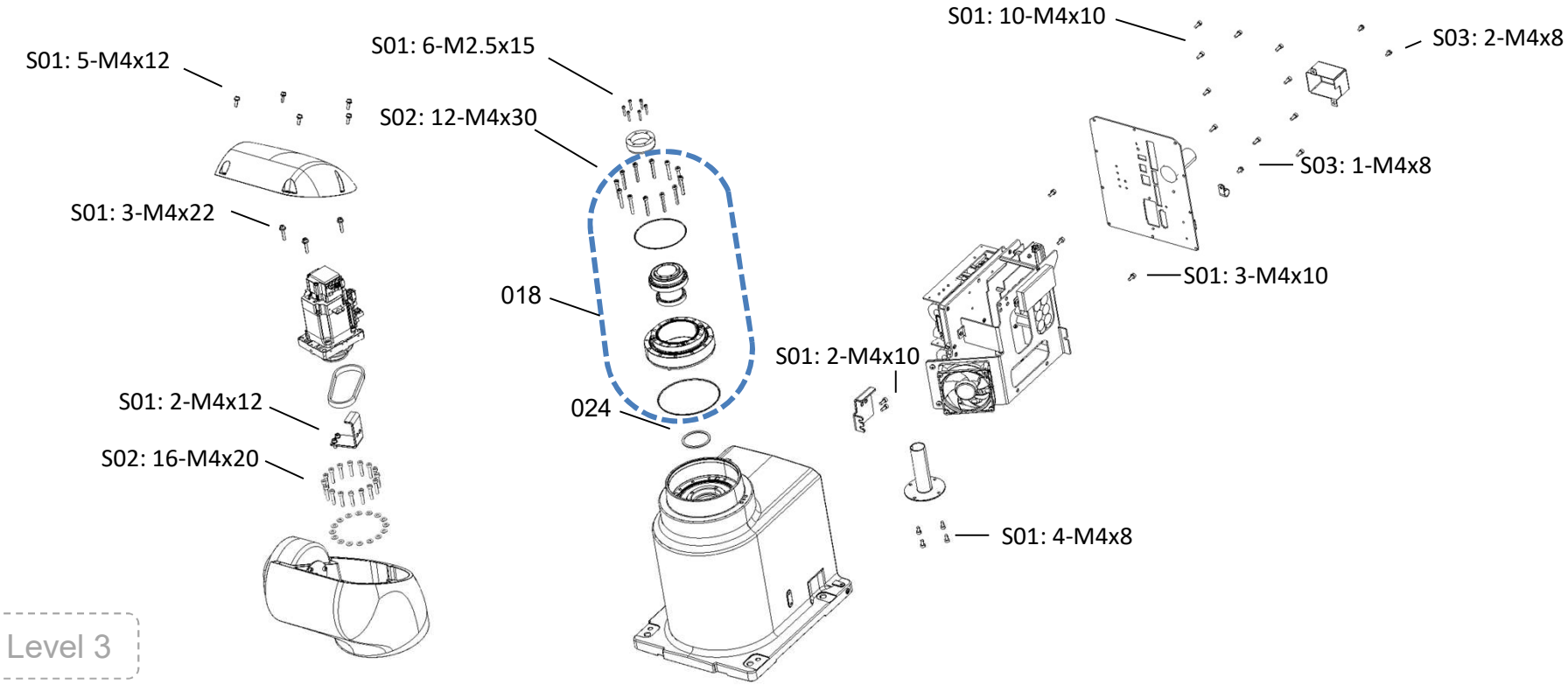


1.2. Joint #1 Reduction Gear



VT6 Series Joint #1 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
018	LP_J1_J2_RG_UNIT	1759296	b	J1, J2 Reduction Gear Unit (1768640), Bearings already pressed(1656178 & 1566573), O-Rings(1773890 & 1773897), M4x30 bolts incl.
024	WAVE WASHER	1843132	d	For J1/J2/J3/J4/J6 (No need for centering jig)



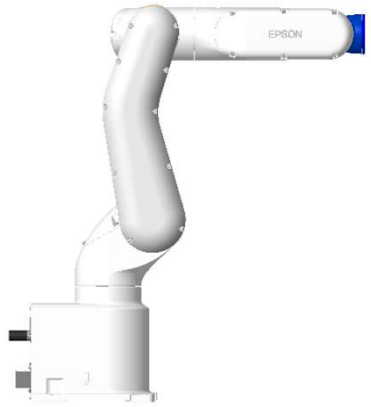
Level 3

Level 3

2-1 Removing Joint #1 Reduction Gear Unit

Note: Replacing the Joint #1 Reduction Gear will require at least 2 ~ 3 engineers to replace. It is recommended to remove the manipulator from the line and perform replacement at a workbench.

1. Move the manipulator to 0 pulse position
   Command: Pulse 0,0,0,0,0,0



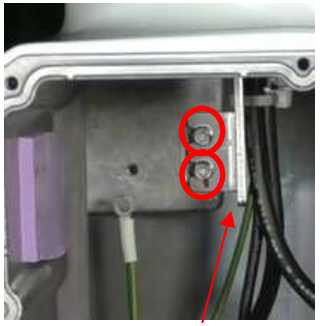
0 Pulse Position

2. Remove the Controller Unit

   For Details, refer to Manipulator Manual Maintenance: 18.1 Replacing Controller Unit.

Earth Cable Screw

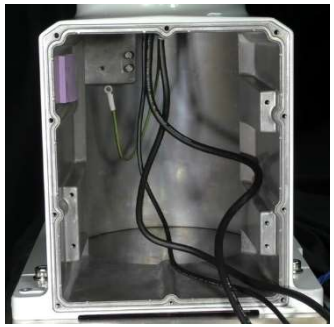
3. Remove the earth cable fixing screw
   Cross-recessed Bind Screw: 1-M4x6



Base Side Cable Plate

4. Remove the cable fixing plate
   Hexagon socket head cap : 2-M4x10
   Note: Loosen the 2-M4 bolts to allow the plate to be removed

5. Remove the cable tie from the base side Cable Fixing Plate



2-1 Removing Joint #1 Reduction Gear Unit

6. Remove the Joint # 1 Motor Unit and Joint #1 Timing Belt

   For Details, refer to Manipulator Manual Maintenance: 9.3 Replacing Joint #1 Motor.

7. Remove the Joint #1 side cable fixing plate from Arm #1 by loosening the 2-M4x12 bolts to allow the fixing plate to be released.
   Hexagon socket head cap bolts with captive washer: 2-M4x12

8. Pull the cables from the base through to Arm #1 .
   Caution: Be careful of the connectors catching on the Arm #1 sleeve.

9. Remove the Arm #1 sleeve from the Base
   Hexagon socket head cap : 4-M4x8

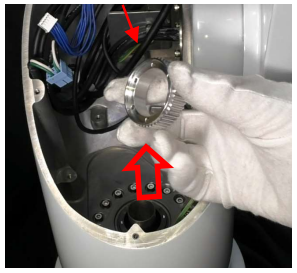
10. Remove the Arm #1 pulley
    Hexagon socket head cap : 6-M2.5x15

    Note: Use a flat head screw driver to help remove the pulley

Arm #1
Cable Fixing Plate

Arm #1 Sleeve

Pulley



Level 3

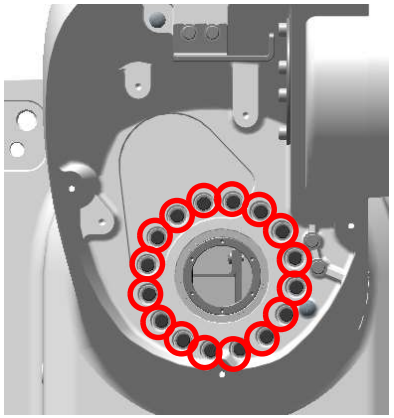
2-1 Removing Joint #1 Reduction Gear Unit

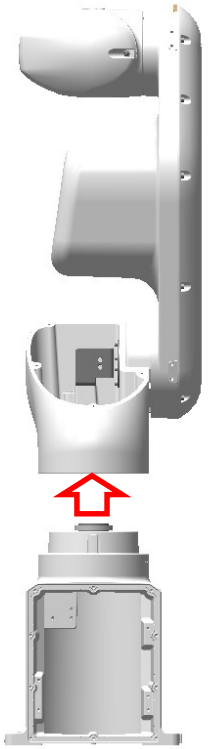
11. Remove the Arm #1 fixing bolts
    Hexagon socket head cap with washer: 16-M4x20

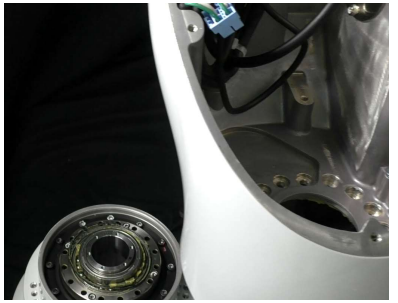
12. Remove Arm #1 from the base. *This will require two engineers at minimum.*
    Caution: Arm #1 is heavy so use at least two persons when lifting.

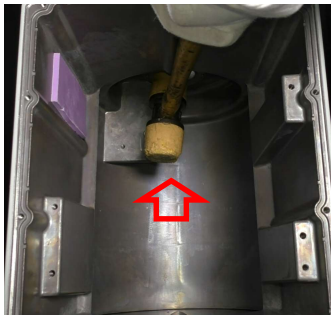
13. Remove the O-ring from the Circularspline side

14. Remove the Waveform Generator from the base.
    Note: Loctite is holding the bearing firmly in place.
    Use a soft hammer to help loosen the Loctite holding the bearing by tapping the Waveform Generator from the base side.
    Note: Use two M2.5 bolts to help lift the Waveform Generator from the arm.









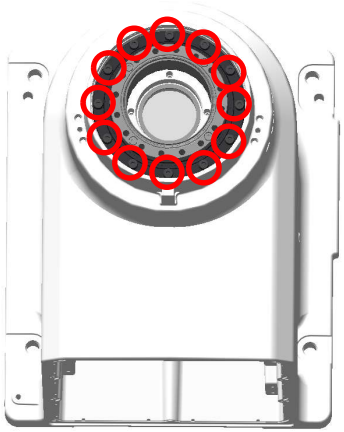
Level 3

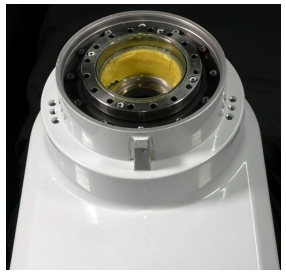
2-1 Removing Joint #1 Reduction Gear Unit

15. Remove the Reduction Gear Unit from the base
    Hexagon socket head cap: 12-M4x30

    Note: Two M4 bolts can be used to help lift the reduction gear from the base

    Caution: Be careful of the O-ring underneath the cross-roller bearing when removing

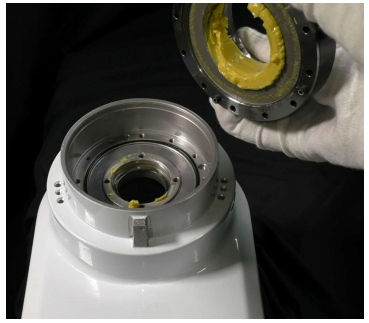


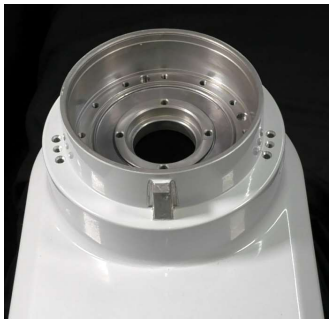


16. Remove the O-ring
    Note: Be careful not to damage the O-ring.
    Any small damage may cause oil leakage.

17. Remove the Wave washer

18. Clean Arm #1 of grease and unwanted particles





Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

Note: Replacing the Joint #1 Reduction Gear will require at least 2 ~ 3 engineers to replace. It is recommended to remove the manipulator from the line and perform replacement at a workbench.

1. Before replacing with the new reduction gear please check the serial numbers match each of the parts and are the same numbers.

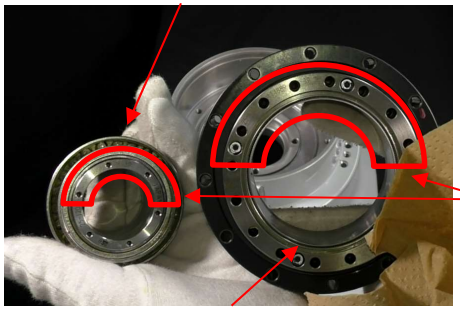
2. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

3. Make sure Arm #1 is clear of dust or unwanted particles. These may enter the reduction gear causing extra heat which may lead to damage of the reduction gear.

4. Place the O-ring into Arm #1.
   Note: Applying a little grease (SK-1A) will help stick the O-ring in the arm groove.

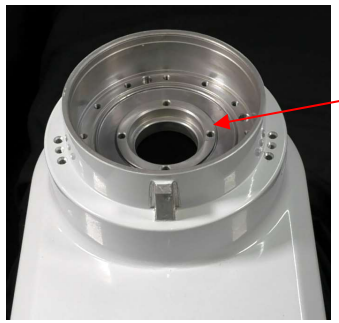
   Caution: Be careful of the O-ring when replacing it into the Base. Any damage to the O-ring will cause oil leakage.

Waveform Generator



Serial Numbers

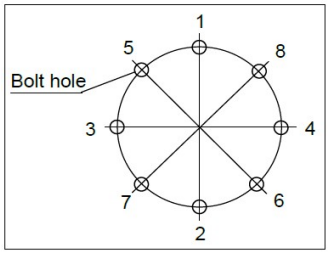
Circularspline/Flexspline



Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

5. Place the Reduction Gear (Circularspline/Flexspline unit) into the Base. Make sure to place with cross-roller bearing fixing bolts facing in the four inset holes in the arm.
   Note: 2-M4 bolts can be used to help place the unit into the arm.



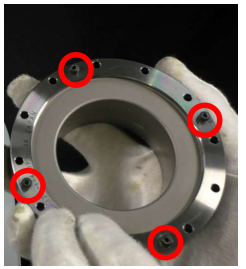
Crisscross Example

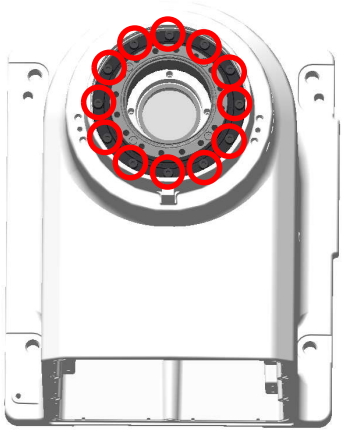
6. Replace the reduction Gear fixing bolts
   Note: Tighten in a crisscross pattern
   Hexagon socket head cap: 12-M4x30
   Tightening Torque: 5.5 ±0.25N・m

7. Place the wave washer into Arm #1

Note：Steps 8 to 11 Wave washer centering is not required for wave washer parts code: 1843132 or manipulators manufactured after March 13th 2020.


Placement Holes


Cross-roller Bearing Fixing Bolts



Level 3

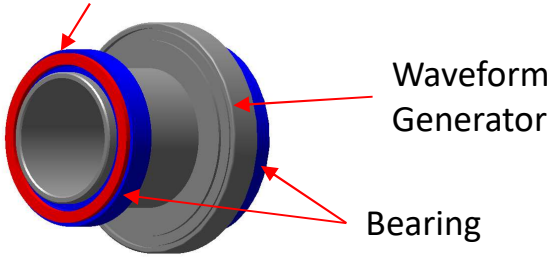
2-2 Replacing Joint #1 Reduction Gear Unit

8. Place the wave washer centering jig to the base and tighten the bolts to hold in place.

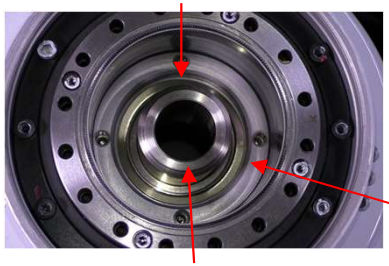
   Hexagon socket head cap: 4-M4x12

9. Place the wave washer into Arm #1 using the wave washer centering jig to help center the washer in the arm.

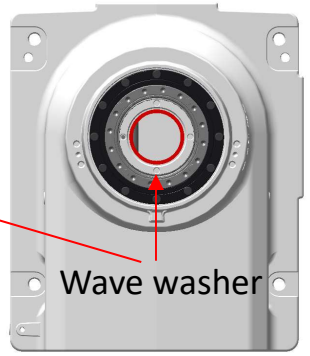
   Caution: Centering of the wave washer is very important. If the wave washer is not centered correctly the Arm will not move smoothly and may cause torque errors during operation. The wave washer will sit in the center of the bearing attached to the Waveform Generator and the center of the arm. If out of alignment the bearing may be damaged.



10. Make sure the wave washer is centered around the centering jig ring



11. Remove the wave washer centering jig from the Base
    Caution: Make sure to remove the jig without touching or moving the wave washer. If the wave washer is moved it will need to be centered again.



2-2 Replacing Joint #1 Reduction Gear Unit

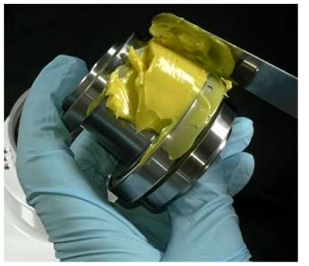
12. Prepare the Waveform Generator unit and apply SK-1A grease to the Waveform Generator surface

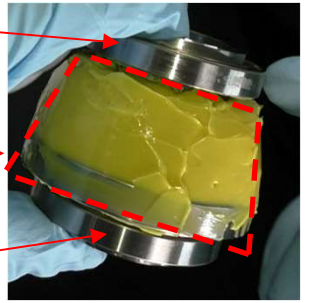
    Note: Make sure the grease is applied evenly around the inside surface of the Waveform Generator unit.

    Grease: 24±1.0g SK-1A
    - **Apply 12g to Waveform Generator**
    - **Apply 12g inside Flexspline**

    Caution:
    Do not apply grease to the outer side bearings.
    These bearings need to have Loctite applied in the next step

    Note: Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



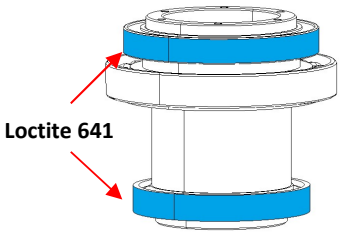


13. Next apply Loctite 641 to the outer rim of bearing①

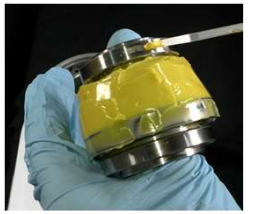
    Note: Apply evenly to center of bearing. When bearing is placed in the Base the Loctite will evenly disperse.

    Note: Loctite requires approx. 8 hours to firmly bond.

    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer surface the Loctite will not bond correctly.



Example: Waveform Generator Unit



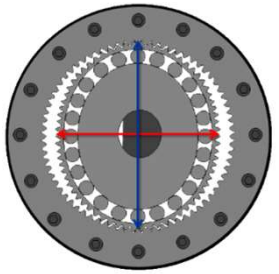
Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

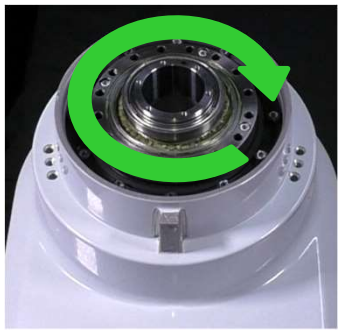
13. Place Waveform Generator into Flexspline.
    Note: Make sure the longside of the Waveform Generator and Flexspline match when placing.
    Caution: Do not allow the Loctite to touch the inside of the Flexspline.

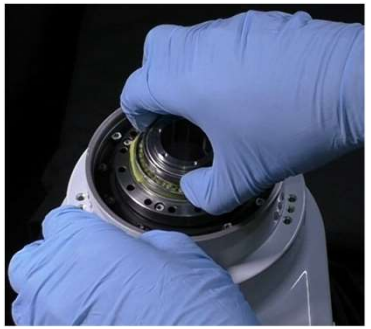
14. Confirm that the wave washer is centered. Turn the Waveform Generator to check if the wave washer is centered correctly. If the Waveform Generator cannot turn smoothly, remove and center the wave washer again. The wave washer can also be viewed from the Base.

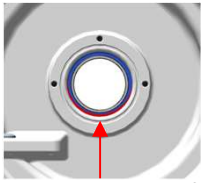
Shortside



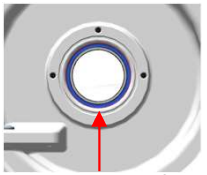
Longside







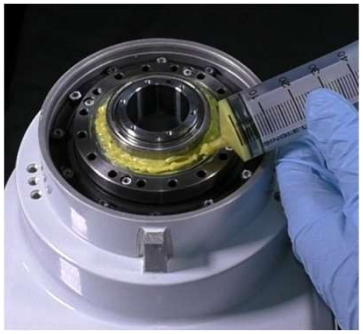
Not Centered



Centered

2-2 Replacing Joint #1 Reduction Gear Unit

15. Apply SK-1A grease to the Waveform Generator surface.
    Caution: Make sure the grease is applied evenly and on the inside of the O-ring groove. Applying with a syringe is recommended.
    Grease: 2±0.2g SK-1A

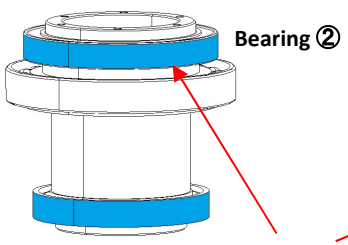


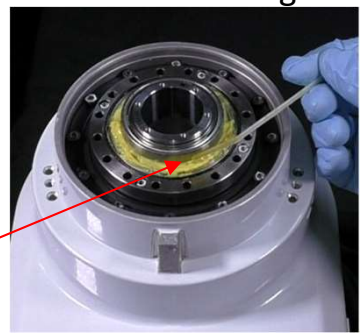
17. Apply a little SK-1A grease to the O-ring and replace the O-ring onto the Circularspline groove.

    Caution: Be careful not to stretch the O-ring when replacing. Minor damage to the O-ring will cause oil leakage.

    Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.

18. Apply Loctite 641 to the outside of bearing②
    Note: Apply evenly to center of bearing. When Arm #2 is placed on the bearing the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer rim surface the Loctite will not bond correctly.



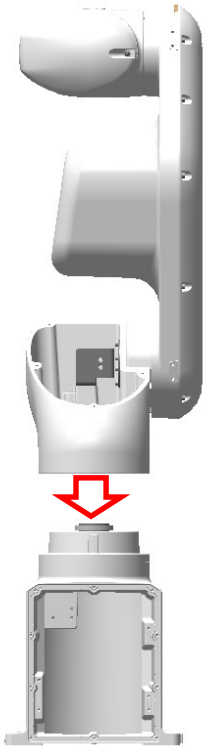


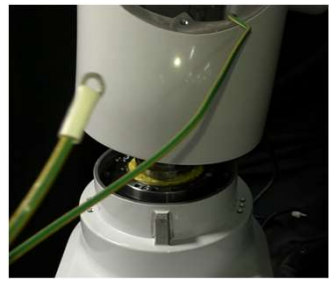
Level 3

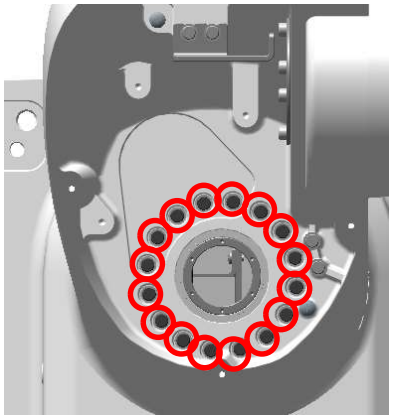
2-2 Replacing Joint #1 Reduction Gear Unit

19. Place Arm #1 onto the Base making sure the Arm #1 bolt holes are aligned with the Circularspline bolt holes. *This will require two engineers at minimum.*

    Caution: Be careful of the O-ring when replacing Arm #1 to the Base. Make sure to replace Arm #1 as straight as possible onto the Base. Always use at least two people when replacing the arm.



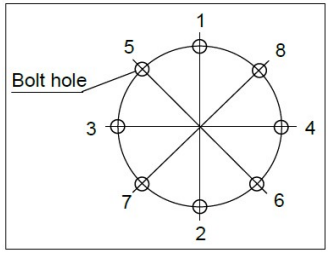




20. Replace the Arm #1 16 fixing bolts

    Note: Tighten in a crisscross pattern
    Hexagon socket head cap bolts: 16-M4x20
    Tightening Torque: 5.5±0.25N･m

    Note: Pre-tighten one bolt to allow the arm to be temporarily fixed in place.

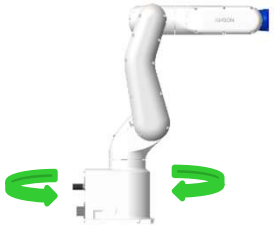


Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

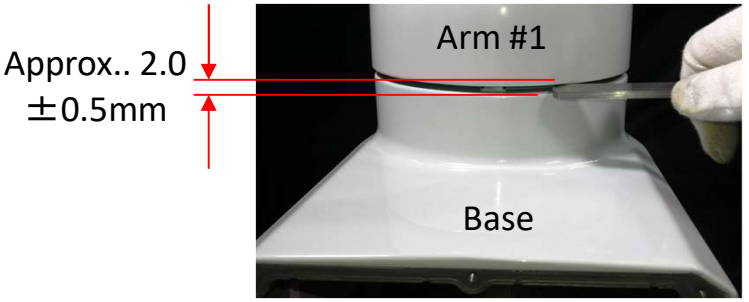
21. Turn Arm #1 manually back and forth to feel if the arm moves smoothly

    Caution: If the arm does not move smoothly check the centering of the wave washer or the reduction gear again



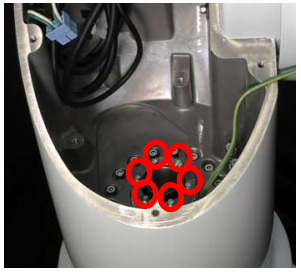
22. Make sure the gap between Arm #1 and the Base is even around the entire arm. Approx. 2.0 ±0.5mm

    Caution: If Arm #1 is at a slight angle the accuracy of the robot cannot be assured. Arm #1 or the Waveform Generator will need to be adjusted again.



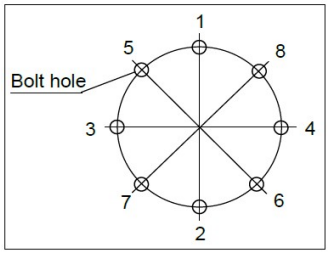
23. Replace the pulley onto the Joint #1 Waveform Generator unit

    Note: Tighten in a crisscross pattern
    Hexagon socket head cap bolts: 6-M2.5x15
    Tightening Torque: 1.0±0.1N・m



    Note: Gradually tighten the bolts in a crisscross pattern to allow the pulley to be levelly attached

    Note: The pulley can be held firmly in place using the timing belt to allow the correct tension to be applied to the bolts



24. Move the pulley to check for smooth movement

Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

25. Place the Arm #1 sleeve between the Base and Arm #1

26. Replace the 4 sleeve fixing bolts

    Hexagon socket head cap bolts: 4-M4x8
    Tightening Torque: 4.0±0.2N・m

    Note: Gradually tighten the bolts in a crisscross pattern starting with the top bolt. The sleeve must be centered correctly.

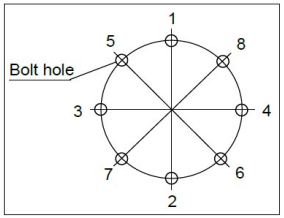
27. Place the Joint #1 timing belt over the pulley.
    Note: This will make sure the cable threaded through the timing belt.

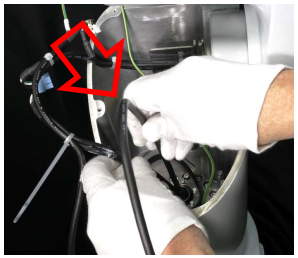
28. Push the cables through to the base from Arm #1 one at a time.
    Caution: Be careful of the connectors catching on the Arm #1 sleeve.

29. Replace a cable tie to the Arm #1 Cable Fixing Plate

30. Replace the cable fixing plate to Arm #1 by tightening the 2-M4x12 bolts which hold the fixing plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0±0.2N・m

Arm #1 Sleeve





Arm #1 Cable Fixing Plate & Cable Tie

Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

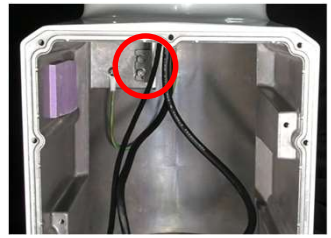
31. Fix the cables to the Arm #1 Cable Fixing Plate.
    Note: The white markings on the cables can be used as a guide for placement.


32. Replace the Joint # 1 Motor Unit and Joint #1 Timing Belt

    For Details, refer to Manipulator Manual
    Maintenance: 9.3 Replacing Joint #1 Motor.

33. Replace the earth cable fixing screw
    Cross-recessed Bind Screw: 1-M4x6

34. Replace the cable fixing plate to the base by tightening the 2-M4x12 bolts which hold the fixing plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0±0.2N・m

35. Replace the cable tie to the base side Cable Fixing Plate

36. Fix the cables to the Arm #1 Cable Fixing Plate.
    Note: The white markings on the cables can be used as a guide for placement


Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

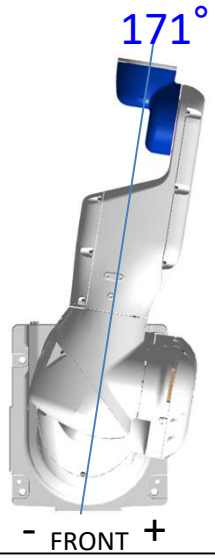
37. Replace the Controller Unit

    For Details, refer to Manipulator Manual
    Maintenance: 18.1 Replacing Controller Unit.

38. Next rough calibration must be performed on Joint #1.

39. Joint #1 will need to be moved mechanical stopper position(171°).
    From this position the robot can be calibrated.
    This can be performed by releasing the Joint #1 brake and moving the joint manually in the + direction until the arm is stopped by the mechanical stopper.

40. Next using RC+ Command Window calibrate the manipulator accordingly.
41. Reset the Joint #1 encoder.
    Command: Encreset 1
42. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
43. Output the current Calpls value.
    Command: Calpls
44. Copy the Calpls value to Calpls command and make sure Joint #1 is **8538405** and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
45. Execute Calib to calculate HOFs
    Command: Calib 1



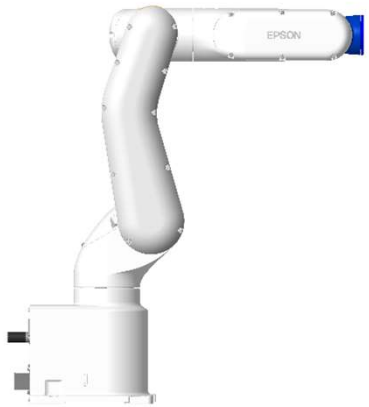
Level 3

2-2 Replacing Joint #1 Reduction Gear Unit

46. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

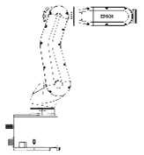
47. Move the Manipulator to the 0 pulse position (origin position).
    Command: Pulse 0,0,0,0,0,0

48. Next test Joint #1 in low power and high power mode. Check for any abnormalities. If there are none you are finished.



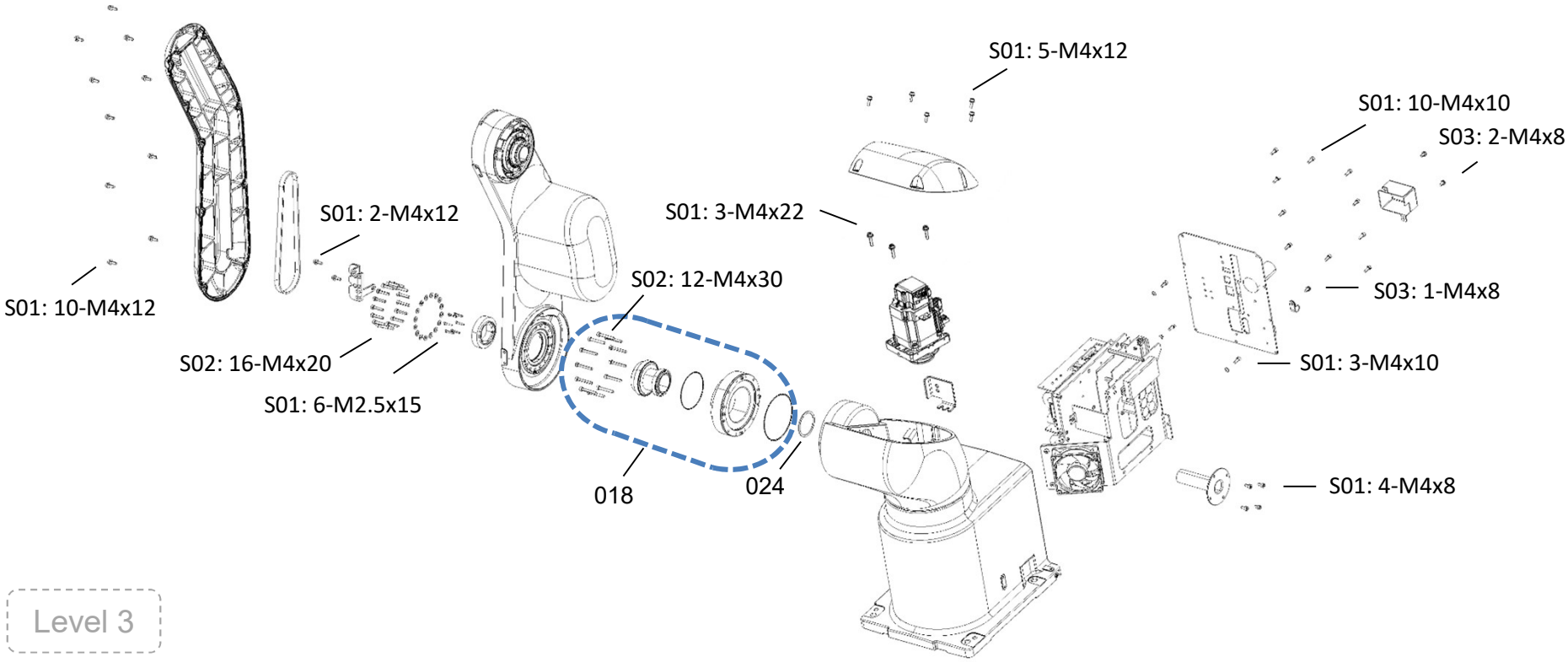
0 Pulse Position

1.3. Joint #2 Reduction Gear



VT6 Series Joint #2 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
018	LP_J1_J2_RG_UNIT	1759296	b	J1, J2 Reduction Gear Unit (1768640), Bearings already pressed(1656178 & 1566573), O-Rings(1773890 & 1773897), M4x30 bolts incl.
024	WAVE WASHER	1843132	d	For J1/J2/J3/J4/J6 (No need for centering jig)

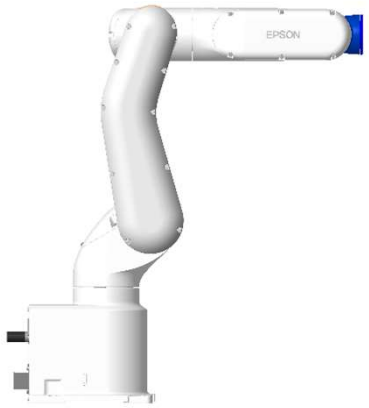


Level 3

Level 3

3-1 Removing Joint #2 Reduction Gear Unit

Note: Replacing the Joint #2 Reduction Gear will require at least 2 ~ 3 engineers to replace. It is recommended to remove the manipulator from the line and perform replacement at a workbench.



0 Pulse Position

1. Move the manipulator to 0 pulse position
   Command: Pulse 0,0,0,0,0,0

2. Remove the Controller Unit

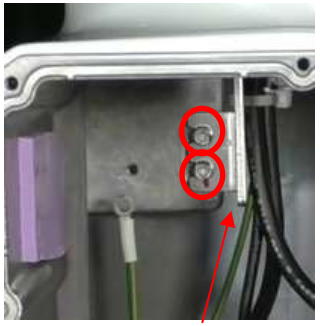
   For Details, refer to Manipulator Manual Maintenance: 18.1 Replacing Controller Unit.

3. Remove the earth cable fixing screw
   Cross-recessed Bind Screw: 1-M4x6

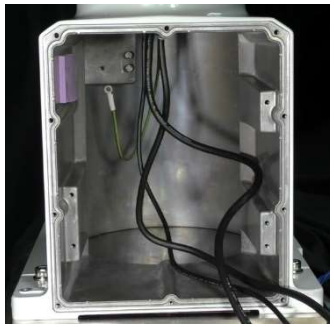
4. Remove the cable fixing plate
   Hexagon socket head cap : 2-M4x10
   Note: Loosen the 2-M4 bolts to allow the plate to be removed

5. Remove the cable tie from the base side Cable Fixing Plate

Earth Cable Screw



Base Side Cable Plate



Level 3

3-1 Removing Joint #2 Reduction Gear Unit

6. Remove the Joint # 1 Motor Unit and Joint #1 Timing Belt

   For Details, refer to Manipulator Manual
   Maintenance: 9.3 Replacing Joint #1 Motor.

7. Remove the Joint #1 side cable fixing plate from Arm #1 by loosening the 2-M4x12 bolts to allow the fixing plate to be released.
   Hexagon socket head cap bolts with captive washer: 2-M4x12

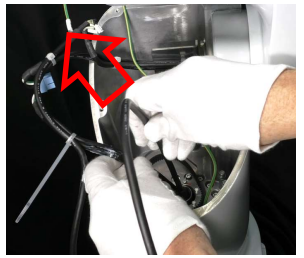
8. Pull the cables from the base through to Arm #1 .
   Caution: Be careful of the connectors catching on the Arm #1 sleeve.

9. Remove the cable tie from Arm #1 Front Cable Fixing Plate.

10. Loosen 2-M4x12 bolts which hold the fixing plate then remove the Arm #1 Front Cable Fixing Plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12

11. Remove the earth cable fixing screw
    Cross-recessed Bind Screw: 1-M4x6

Arm #1
Cable Fixing Plate



Cable Tie

Arm #1 Front
Cable Fixing Plate

1-M4x6

2-M4x12

Level 3

3-1 Removing Joint #2 Reduction Gear Unit

12. Remove the Arm #2 Cover
    Hexagon socket head cap bolts with captive washer: 10-M4x12

13. Remove the Arm #2 cable fixing plate (Joint #2 side) fixing bolts
    Hexagon socket head cap with captive washer : 2-M4x12

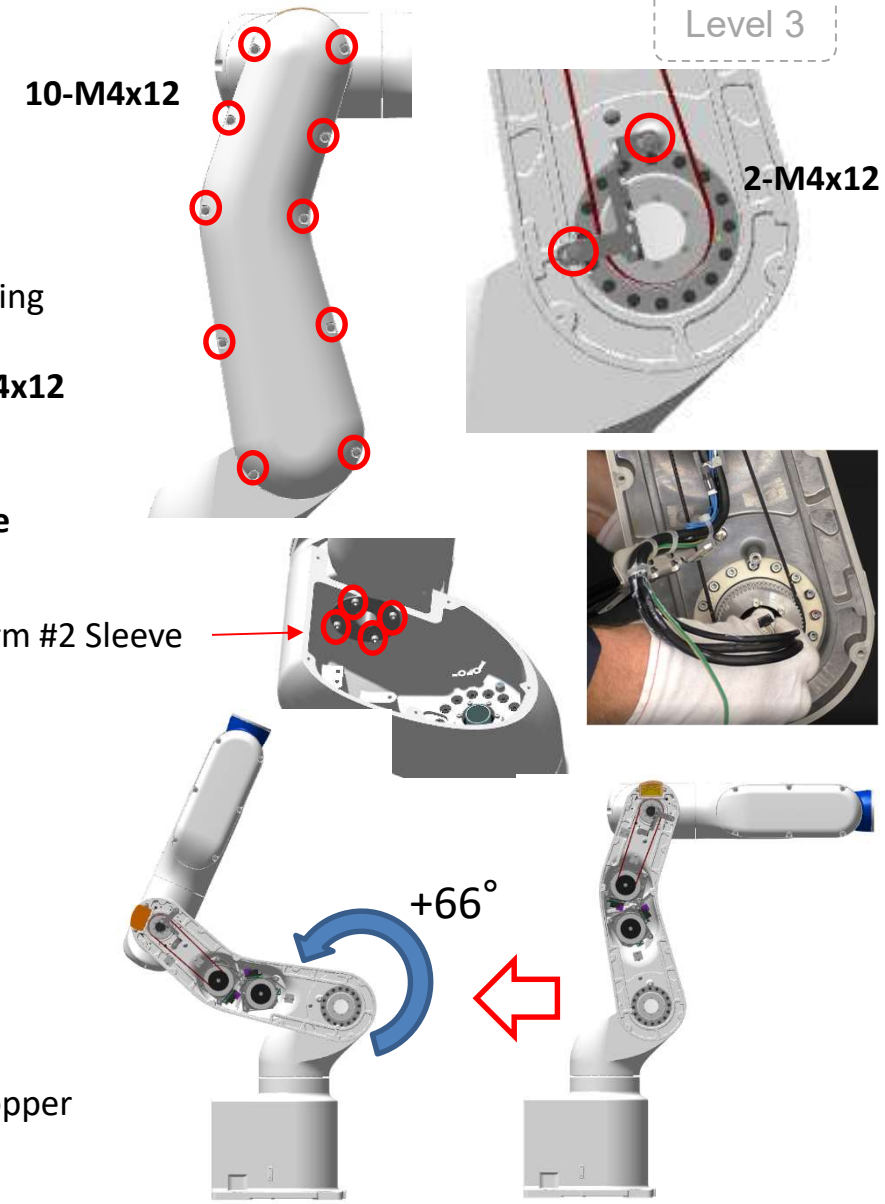
14. Pull the cables from the Arm #1 through to Arm #2.
    Caution: Be careful of the connectors catching on the Arm #2 sleeve

15. Remove the Arm #2 Sleeve
    Hexagon socket head cap : 4-M4x8

16. Loosen the Arm #2 Motor plate fixing bolts
    Caution: Arm #2 may fall. Be sure to have another person holding Arm #3 and #4.
    Hexagon socket head cap with washer : 3-M4x22

17. Remove the Joint #2 Timing Belt

18. Move Arm #2 until the arm stops at the mechanical stopper at +66° deg



Level 3

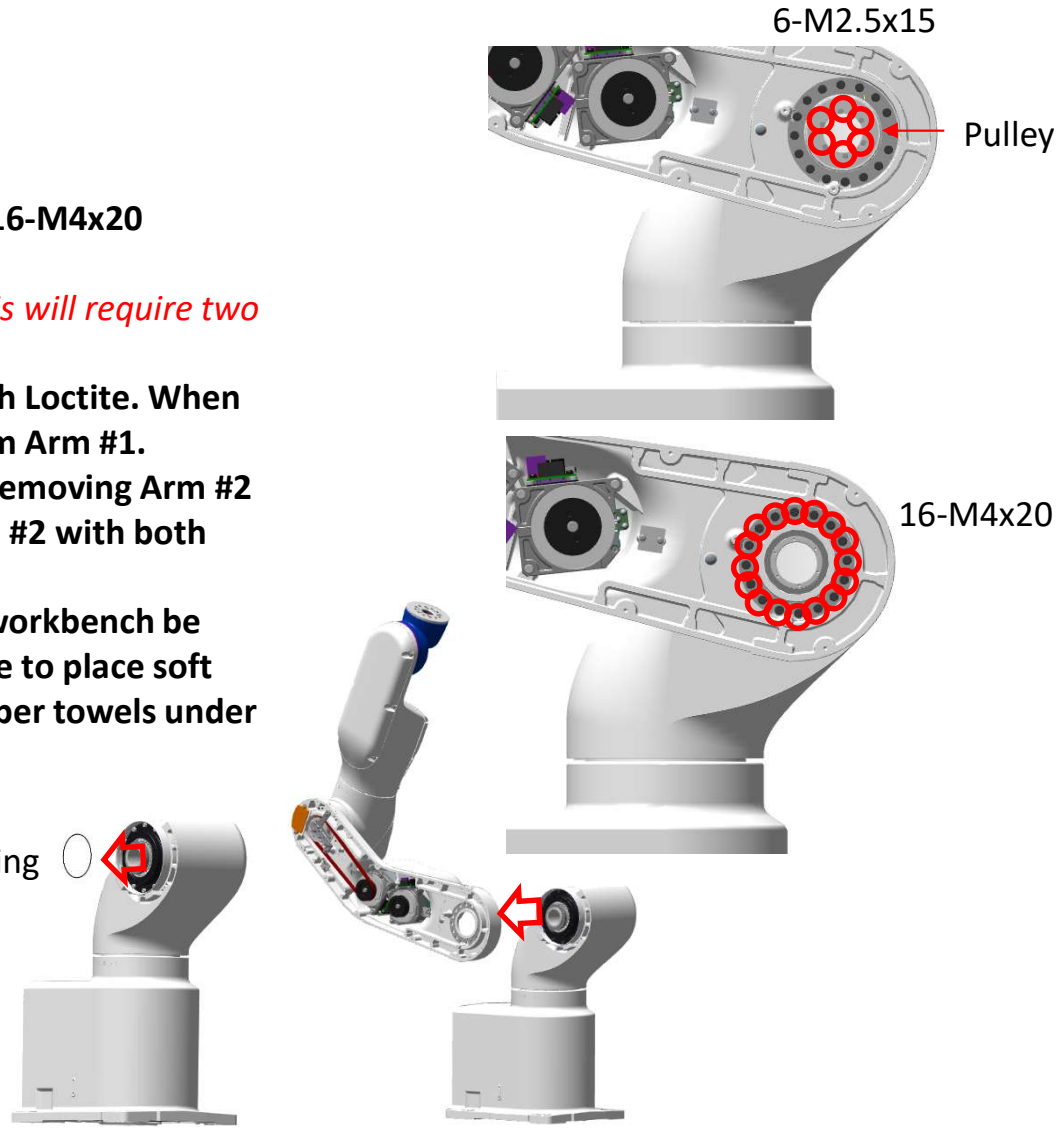
3-1 Removing Joint #2 Reduction Gear Unit

18. Remove the Arm #2 pulley
    Hexagon socket head cap : 6-M2.5x15

19. Remove the Arm #2 fixing bolts
    Hexagon socket head cap and washer : 16-M4x20

20. Carefully remove Arm #2 from Arm #1. *This will require two engineers at minimum.*
    Note: The bearing is held in the arm with Loctite. When removing Arm #2 move straight out from Arm #1.
    Caution: Be careful of the O-ring when removing Arm #2 from Arm #1. Make sure to remove Arm #2 with both hands and with at least two persons.
    Caution: When placing the arm on the workbench be careful of the internal cables and be sure to place soft material such as bubble wrapping or paper towels under the arm.

21. Remove the O-ring from the Circularspline



Level 3

3-1 Removing Joint #2 Reduction Gear Unit

22. Tap the rear of the Waveform Generator from Arm #1 with a soft hammer to remove the Waveform Generator.
    Caution: The wave washer may fall out when removing

23. Remove the Joint #2 Reduction Gear fixing bolts and then the remaining Reduction Gear.
    Hexagon socket head cap : 12-M4x20

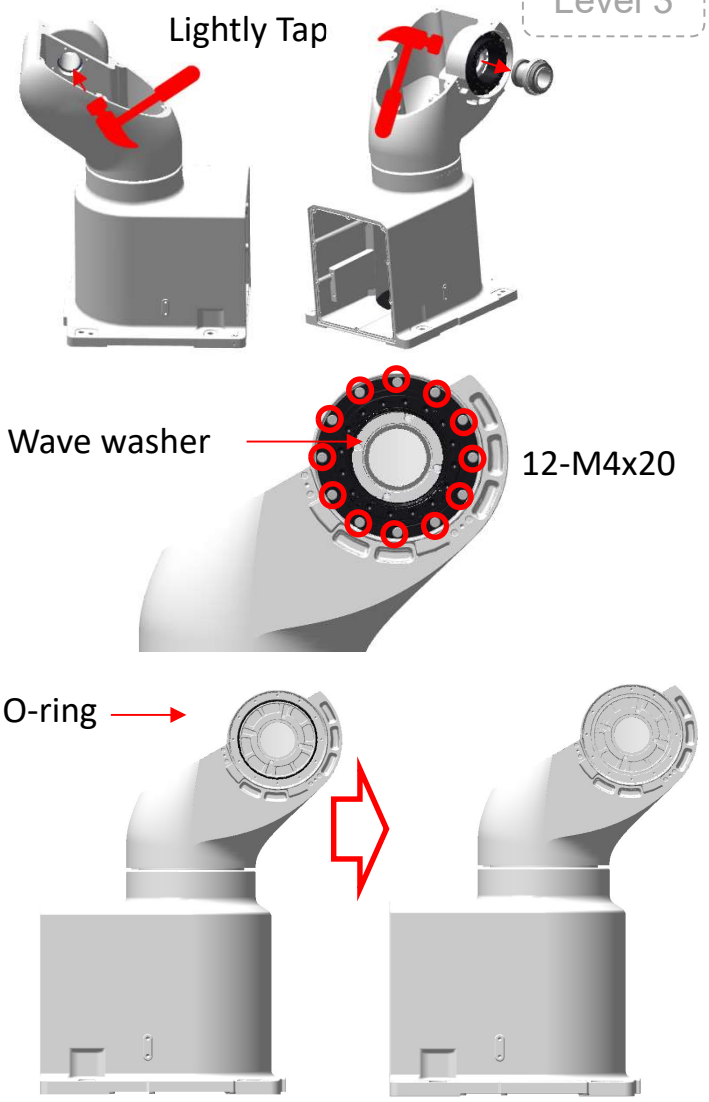
    Note: Two M4 bolts can be used to help lift the reduction gear from Arm #1

    Caution: Be careful of the O-ring underneath the cross-roller bearing when removing

24. Remove the O-ring
    Note: Be careful not to damage the O-ring.
    Any small damage may cause oil leakage.

25. Remove the Wave washer

26. Clean Arm #1 and Arm #2 of grease and unwanted particles



Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

Note: Replacing the Joint #2 Reduction Gear will require at least 2 ~ 3 engineers to replace. It is recommended to remove the manipulator from the line and perform replacement at a workbench.

1. Make sure Arm #1 is clear of dust or unwanted particles. These may enter the reduction gear causing extra heat which may lead to damage of the reduction gear.

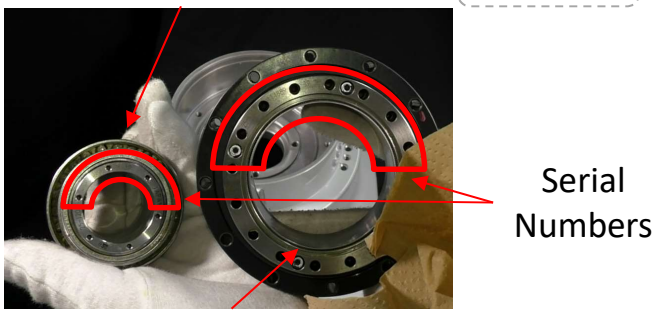
2. Before replacing with the new reduction gear please check the serial numbers match each of the parts and are the same numbers.

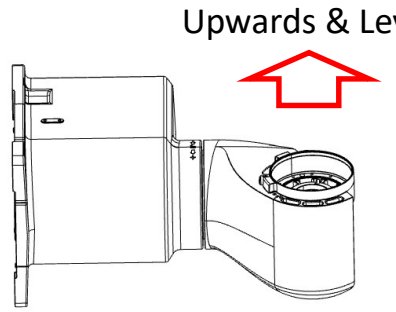
3. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

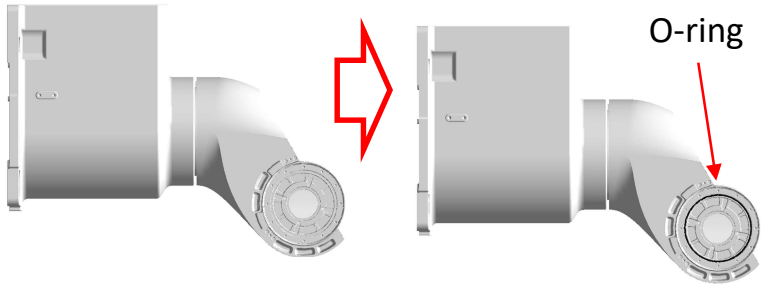
4. Place Arm #1 (incl. Base) on its side with the Arm #2 joint facing upwards.

5. Place the O-ring into Arm #2 joint.
   Note: Applying a little grease (SK-1A) will help stick the O-ring in the arm groove.

   Caution: Be careful of the O-ring when replacing it into the Arm. Any damage to the O-ring will cause oil leakage.



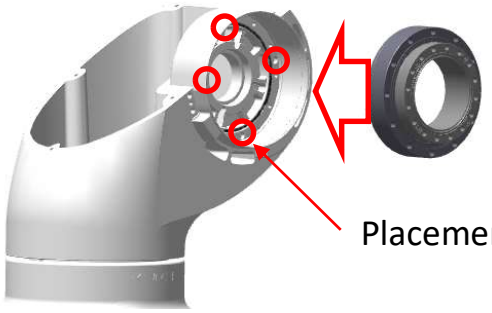




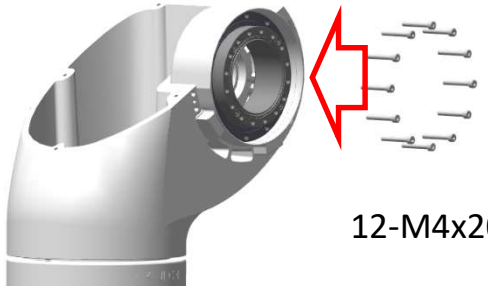
Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

6. Place the Reduction Gear (Circularspline/Flexspline unit) into the Arm. Make sure to place with cross-roller bearing fixing bolts facing in the four inset placement holes in the arm.
   Note: 2-M4 bolts can be used to help place the unit into the arm.

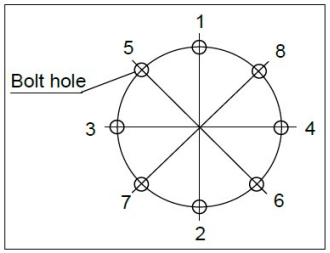


7. Replace the reduction Gear fixing bolts
   Note: Tighten in a crisscross pattern
   Hexagon socket head cap: 12-M4x20
   Tightening Torque: 5.5 ±0.25N・m

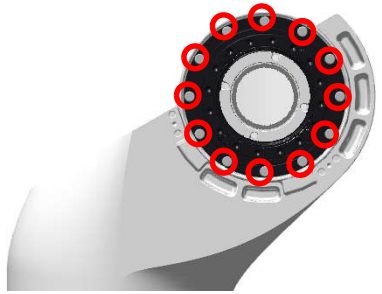


8. Place the wave washer into Arm #1

Note : Steps 7 to 10 Wave washer centering is not required for wave washer parts code: 1843132 or manipulators manufactured after March 13th 2020



Crisscross Example



Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

9. Place the wave washer centering jig into Arm #1 and tighten the bolts to hold in place.

   Hexagon socket head cap: 4-M4x12

10. Place the wave washer into Arm #1 using the wave washer centering jig to help center the washer in the arm.

    Caution: Centering of the wave washer is very important. If the wave washer is not centered correctly the Arm will not move smoothly and may cause torque errors during operation. The wave washer will sit in the center of the bearing attached to the Waveform Generator and the center of the arm. If out of alignment the bearing may be damaged.

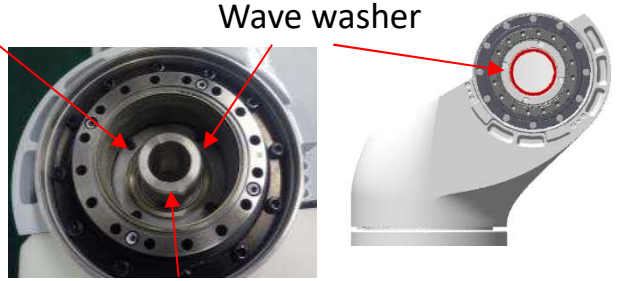
11. Make sure the wave washer is centered around the centering jig ring

12. Remove the wave washer centering jig from the Base
    Caution: Make sure to remove the jig without touching or moving the wave washer. If the wave washer is moved it will need to be centered again.

Centering Jig

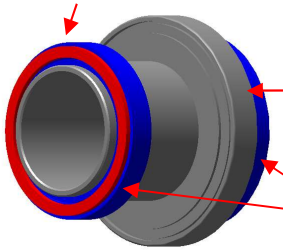
Centering Jig Ring

Wave washer



Centering Jig

Wave washer



Waveform Generator

Bearing

Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

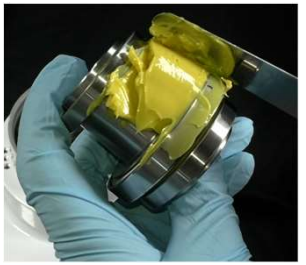
13. Prepare the Waveform Generator unit and apply SK-1A grease to the Waveform Generator surface. Leave a 5mm gap between top bearing and grease.
    Note: Make sure the grease is applied evenly around the inside surface of the Waveform Generator unit.

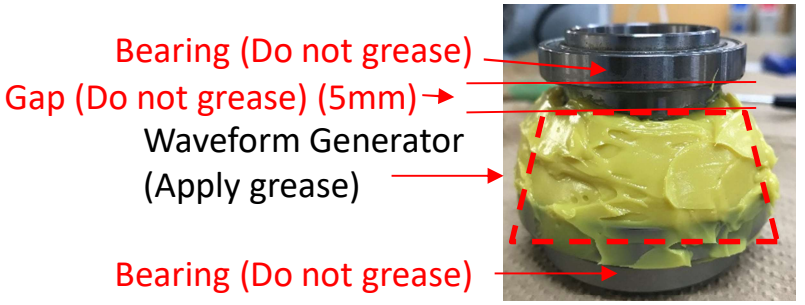
    Grease: 24±1.0g SK-1A
    - **Apply 12g to Waveform Generator**
    - **Apply 12g inside Flexspline**

    Caution:
    Do not apply grease to the outer side bearings.
    These bearings need to have Loctite applied in the next step

Flexspline

Waveform Generator



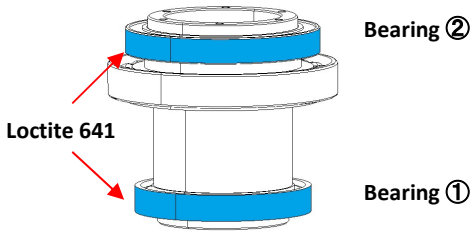


Level 3

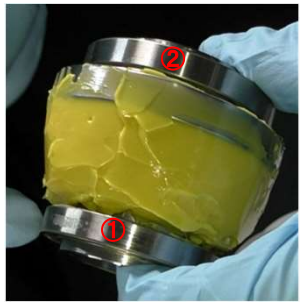
3-2 Replacing Joint #2 Reduction Gear Unit

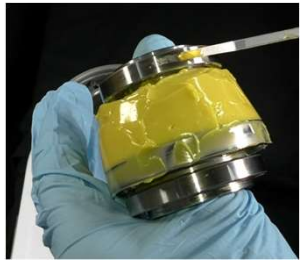
Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.

14. Next apply Loctite 641 to the outer rim of bearing①
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #1 the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer surface the Loctite will not bond correctly.

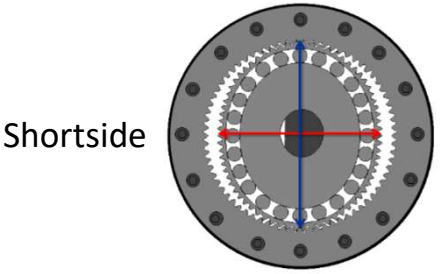


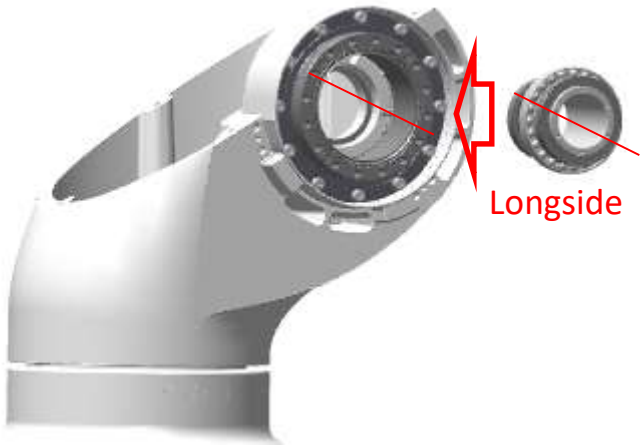
Example: Waveform Generator Unit





15. Place Waveform Generator into Flexspline.
    Note: Make sure the longside of the Waveform Generator and Flexspline match when placing.

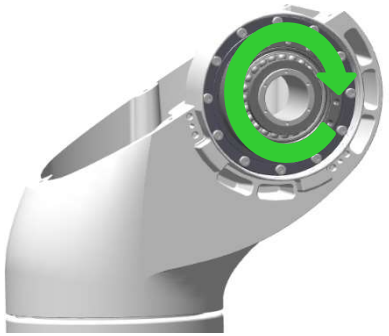




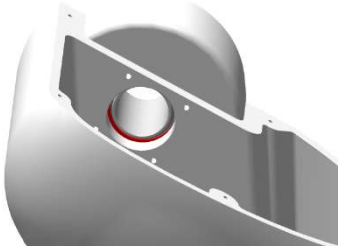
Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

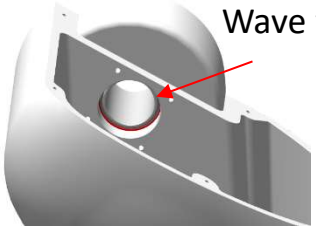
16. Confirm that the wave washer is centered. Turn the Waveform Generator to check if the wave washer is centered correctly. If the Waveform Generator cannot turn smoothly, remove and center the wave washer again. The wave washer can also be viewed from Arm #1.



17. Apply SK-1A grease to the Waveform Generator surface.
    Caution: Make sure the grease is applied evenly and on the inside of the O-ring groove. Applying with a syringe is recommended.
    Grease: 2±0.2g SK-1A



Not Centered



Centered

18. Apply a little SK-1A grease to the O-ring and replace the O-ring onto the Circularspline groove.

    Caution: Be careful not to stretch the O-ring when replacing. Minor damage to the O-ring will cause oil leakage.

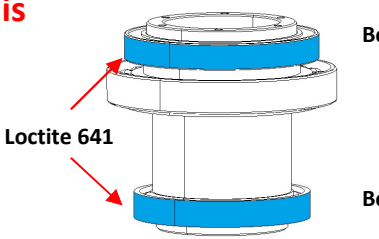
O-ring

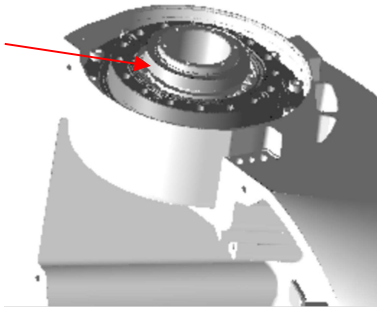
SK-1A

Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.





Example: Waveform Generator Unit

19. Apply Loctite 641 to the outside of bearing②
    Note: Apply evenly to center of bearing. When Arm #2 is placed on the bearing the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer rim surface the Loctite will not bond correctly.

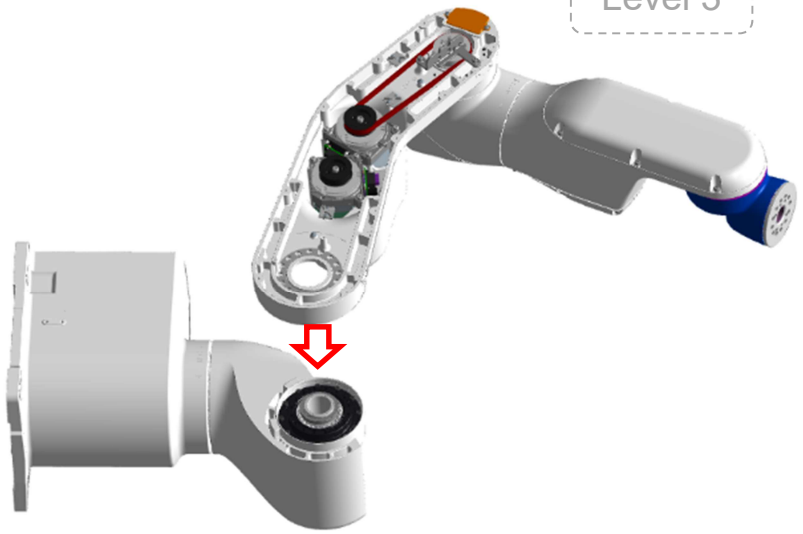
Apply Loctite to outer rim only

Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

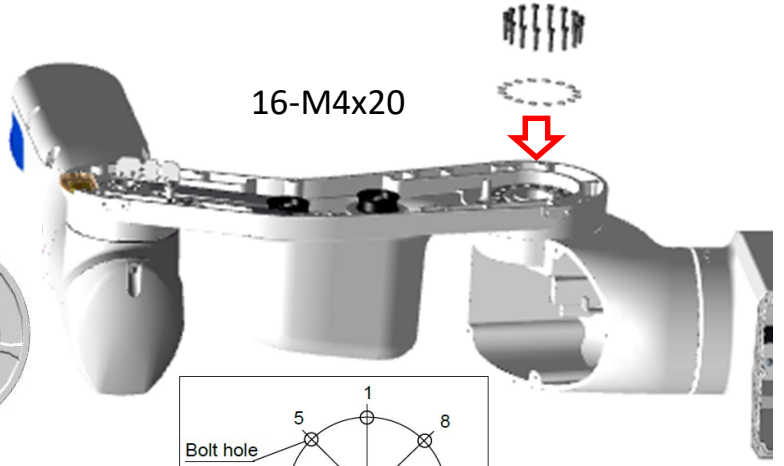
20. Carefully replace Arm #2 to Arm #1. *This will require two engineers at minimum.*
    Note: Align the bolt holes of Arm #1 and Arm#2 and place levelly together.

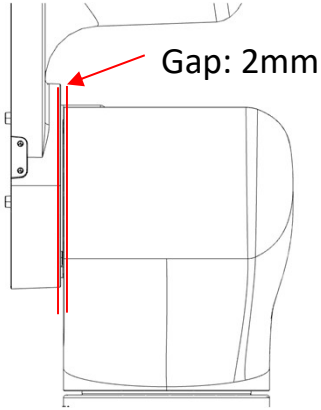
    Caution: Be careful of the O-ring when placing the arms. Minor damage to the O-ring will cause oil leakage.

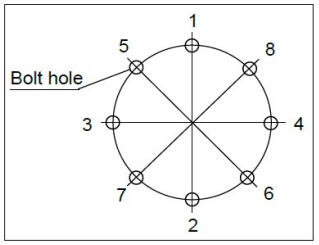


21. Replace the Arm #2 fixing bolts
    Hexagon socket head cap and washer: 16-M4x20
    Tightening Torque: 5.5 ±0.25N・m

    Note: The gap between Arm #1 and Arm #2 should be evenly spaced around the entire joint. Approx. 2mm







Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

22. Move Arm #2 manually back and forth to feel if the arm moves smoothly.
    Note: The manipulator can now be placed upright. Move the arm until it is resting against the mechanical stopper at +66°

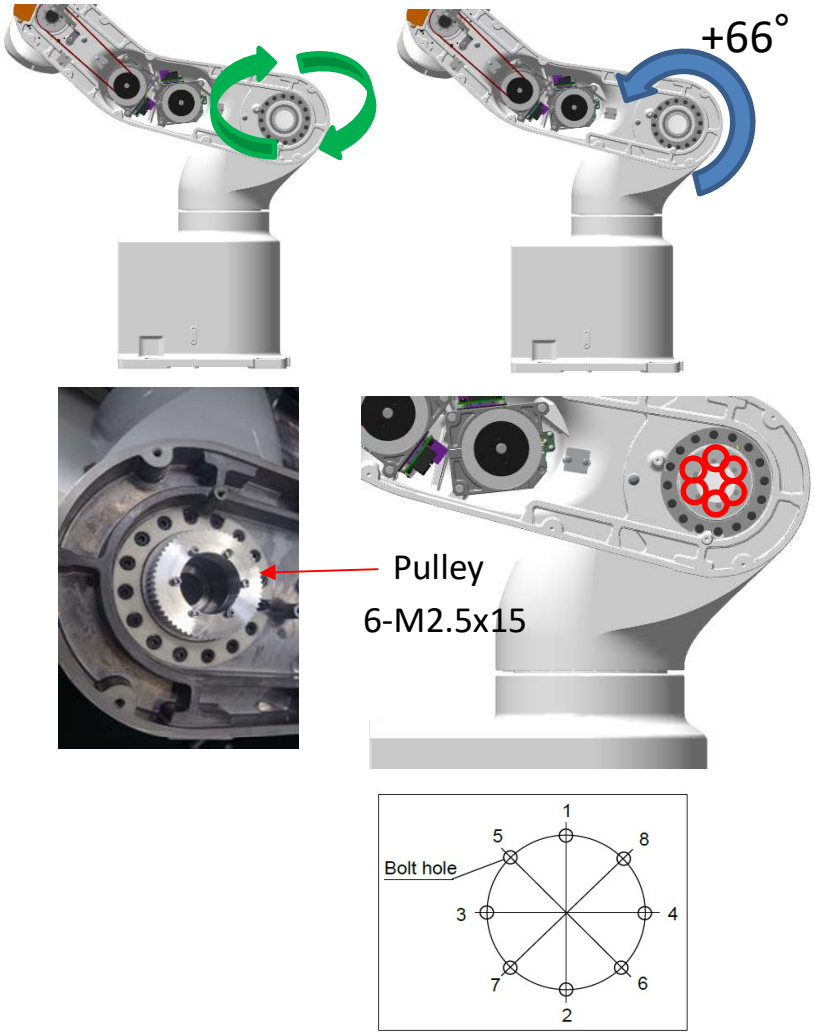
    Caution: If the arm does not move smoothly check the centering of the wave washer or the reduction gear again

23. Replace the Arm #2 pulley
    Hexagon socket head cap : 6-M2.5x15
    Tightening Torque: 1.0 ±0.1N・m

    Note: Gradually tighten the bolts in a crisscross pattern to allow the pulley to be levelly attached

    Note: The pulley can be held firmly in place using the timing belt to allow the correct tension to be applied to the bolts

24. Move the pulley to check for smooth movement



Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

25. Replace the Joint #2 Timing Belt

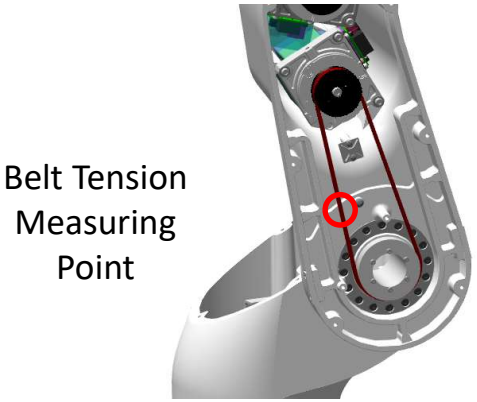
26. Tighten the Arm #2 Motor plate fixing bolts
    Hexagon socket head cap with washer : 3-M4x22
    Tightening Torque: 4.0 ±0.2N・m

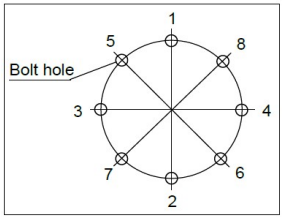
    Joint #2 Timing belt tension: 34 - 58 N
    Belt tension meter setting values
    Weight: 2.5g
    Width: 9.0mm
    Span: 172mm

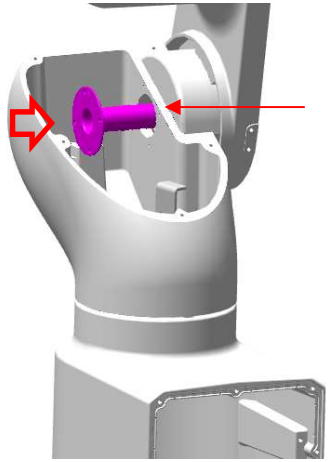
    For Details, refer to Manipulator Manual
    Maintenance: 10.3 Replacing Joint #2 Timing Belt

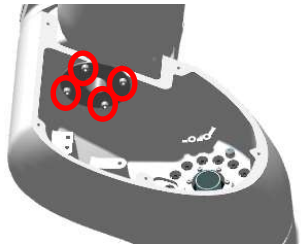
27. Replace the Arm #2 Sleeve
    Hexagon socket head cap : 4-M4x8
    Tightening Torque: 4.0 ±0.2N・m
    Note: Gradually tighten the bolts in a crisscross pattern starting with the top bolt. The sleeve must be centered correctly.

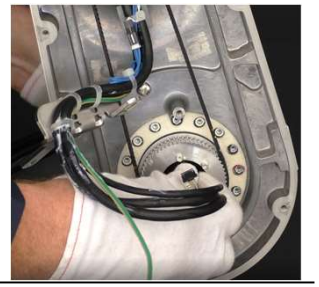
28. Thread and push the cables from the Arm #2 through to Arm #1.
    Caution: Be careful of the connectors catching on the Arm #2 sleeve









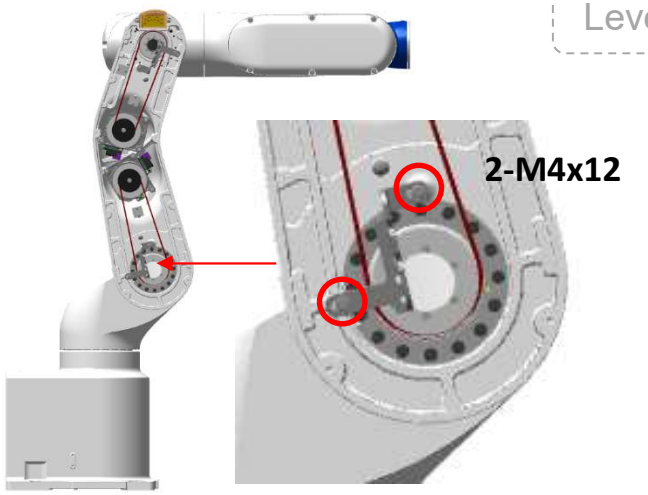


Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

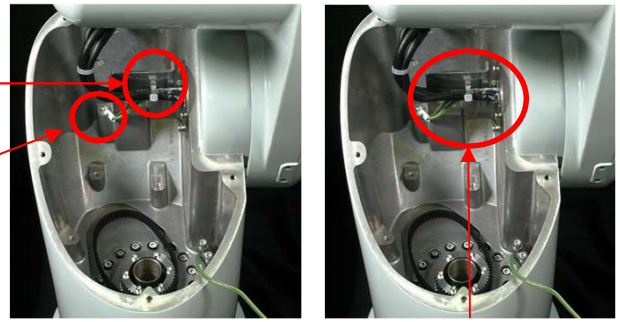
29. Attach the Arm #2 cable fixing plate (Joint #2 side) fixing bolts
    Hexagon socket head cap with captive washer : 2-M4x12
    Tightening Torque: 4.0 ±0.2N・m

    Note: Apply Krytox grease around the cabling in the sleeve.



30. Replace the cable tie to Arm #1 Front Cable Fixing Plate.

31. Replace the Arm #1 Front Cable Fixing Plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0 ±0.2N・m



32. Replace the earth cable fixing screw
    Cross-recessed Bind Screw: 1-M4x6

33. Replace the Arm #2 Cover
    Hexagon socket head cap bolts with captive washer: 10-M4x12
    Tightening Torque: 4.0 ±0.2N・m

Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

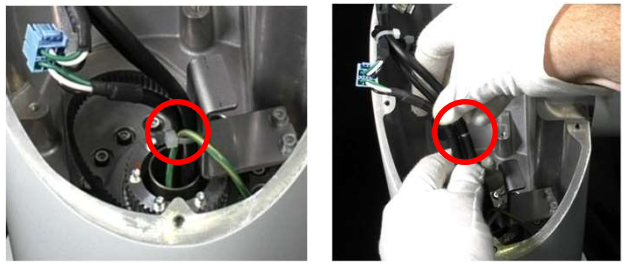
34. Push the cables through to the base from Arm #1 one at a time.
    Caution: Be careful of the connectors catching on the Arm #1 sleeve.

35. Replace a cable tie to the Arm #1 Cable Fixing Plate

36. Replace the cable fixing plate to Arm #1 by tightening the 2-M4x12 bolts which hold the fixing plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0±0.2N・m

Arm #1 Cable Fixing Plate & Cable Tie

37. Fix the cables to the Arm #1 Cable Fixing Plate.
    Note: The white markings on the cables can be used as a guide for placement.



38. Replace the Joint # 1 Motor Unit and Joint #1 Timing Belt

    For Details, refer to Manipulator Manual Maintenance: 9.3 Replacing Joint #1 Motor.

Level 3

3-2 Replacing Joint #2 Reduction Gear Unit

39. Replace the earth cable fixing screw
    Cross-recessed Bind Screw: 1-M4x6

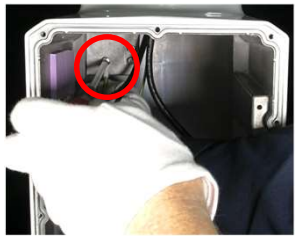
40. Replace the cable fixing plate to the base by tightening the 2-M4x12 bolts which hold the fixing plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0±0.2N・m

41. Replace the cable tie to the base side Cable Fixing Plate

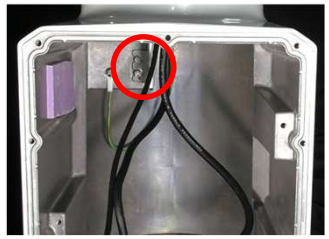
42. Fix the cables to the Arm #1 Cable Fixing Plate.
    Note: The white markings on the cables can be used as a guide for placement

43. Replace the Controller Unit

    For Details, refer to Manipulator Manual Maintenance: 18.1 Replacing Controller Unit.



Earth Cable Screw



Base Side Cable Plate

Cable Tie

Level 3

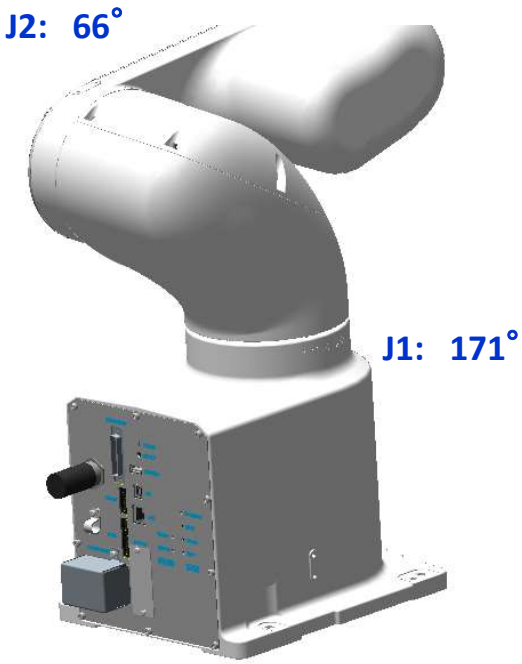
3-2 Replacing Joint #2 Reduction Gear Unit

44. Next rough calibration must be performed on Joint #1 and Joint #2.

45. Joint #1 will need to be moved mechanical stopper position(171˚). This can be performed by releasing the Joint #1 brake and moving the joint manually in the + direction until the arm is stopped by the mechanical stopper.

46. Joint #2 will need to be moved mechanical stopper position(66˚). This can be performed by releasing the Joint #2 brake and moving the joint manually in the + direction until the arm is stopped by the mechanical stopper.

47. Next using RC+ Command Window calibrate the manipulator accordingly for Joint #1.
48. Reset the Joint #1 encoder.
    Command: Encreset 1
49. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
50. Output the current Calpls value.
    Command: Calpls
51. Copy the Calpls value to Calpls command and make sure Joint #1 is **8538405** and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
52. Execute Calib to calculate HOFs
    Command: Calib 1



For Details, refer to VT6 Service Reference Calibration (J1,J2,J3 and J5) for more details

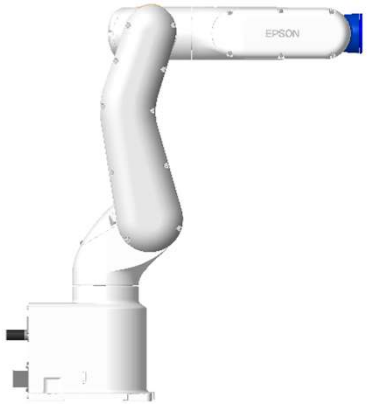
3-2 Replacing Joint #2 Reduction Gear Unit

53. Next using RC+ Command Window calibrate the manipulator accordingly for Joint #2
54. Reset the Joint #2 encoder.
    Command: Encreset 2
55. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
56. Output the current Calpls value.
    Command: Calpls
57. Copy the Calpls value to Calpls command and make sure Joint #2 is **4119406** and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
58. Execute Calib to calculate HOFs
    Command: Calib 2

59. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

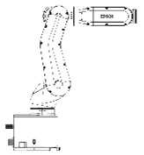
60. Move the Manipulator to the 0 pulse position (origin position).
    Command: Pulse 0,0,0,0,0,0

61. Next test Joint #1 and Joint #2 in low and high power mode. Check for any abnormalities. If there are none you are finished.



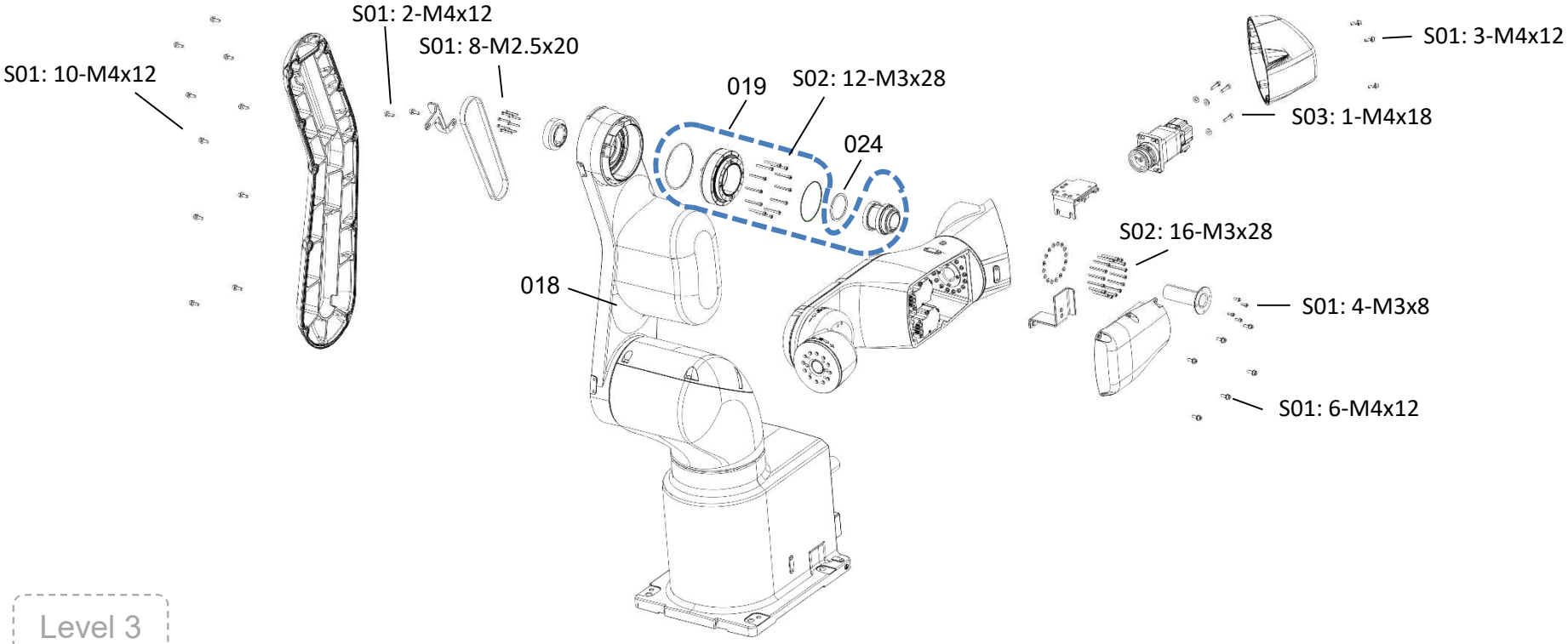
0 Pulse Position

1.4. Joint #3 Reduction Gear



VT6 Series Joint #3 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
019	LP_J3_J4_RG_UNIT	1759298	b	J3, J4 Reduction Gear Unit (1768641), Bearings already pressed(1566573 & 1656177), O-Rings(1670639 & 1773891), M3x28 bolts and washers incl.
024	WAVE WASHER	1843132	d	For J1/J2/J3/J4/J6 (No need for centering jig)



Level 3

Level 3

4-1 Removing Joint #3 Reduction Gear Unit

1. Move the manipulator to 0 pulse position
   Command: Pulse 0,0,0,0,0,0

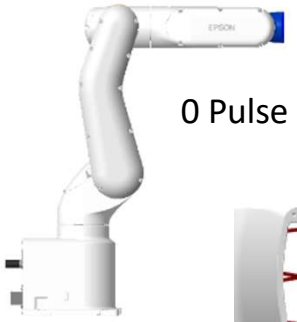
2. Remove the Joint # 4 Motor Unit and Timing Belt
   For Details, refer to Manipulator Manual
   Maintenance: 12.3 Replacing Joint #4 Timing Belt.

3. Remove the cable fixing plate from Arm #4 by loosening the 2-M4x12 bolts to allow the fixing plate to be released.
   Hexagon socket head cap bolts with captive washer: 2-M4x12

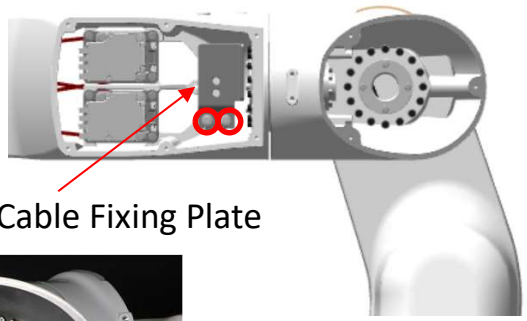
4. Pull the cables from Arm #4 through to Arm #3.
   Caution: Be careful of the connectors catching on the Arm #4 sleeve

5. Remove the Arm #2 Cover
   Hexagon socket head cap bolts with captive washer: 10-M4x12

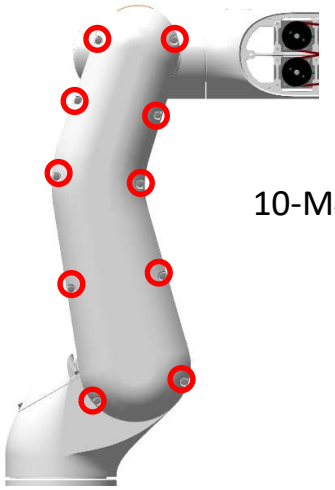
   Note: Leave the top bolts until last to stop the cover from falling.
   Caution: Be careful of the cables and motor units when removing.



0 Pulse Position



Arm #4 Cable Fixing Plate



10-M4x12

Level 3

4-1 Removing Joint #3 Reduction Gear Unit

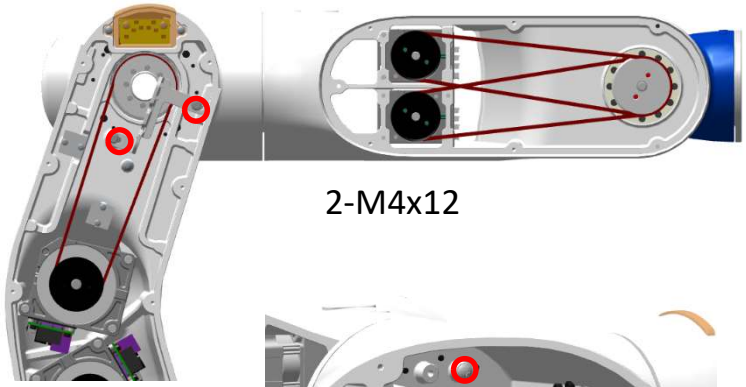
6. Remove the Arm #2 cable fixing plate (Joint #3 side) fixing bolts
   Note: Leave the fixing plate attached to the cables
   Hexagon socket head cap : 2-M4x12

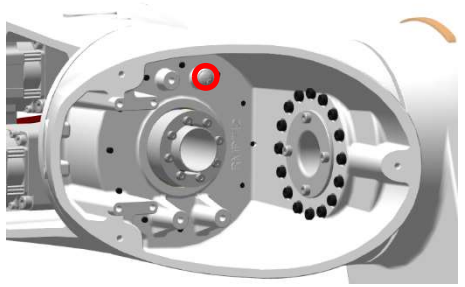
7. Remove the earth cable fixing screw
   Cross-recessed Bind Screw: 1-M4x6

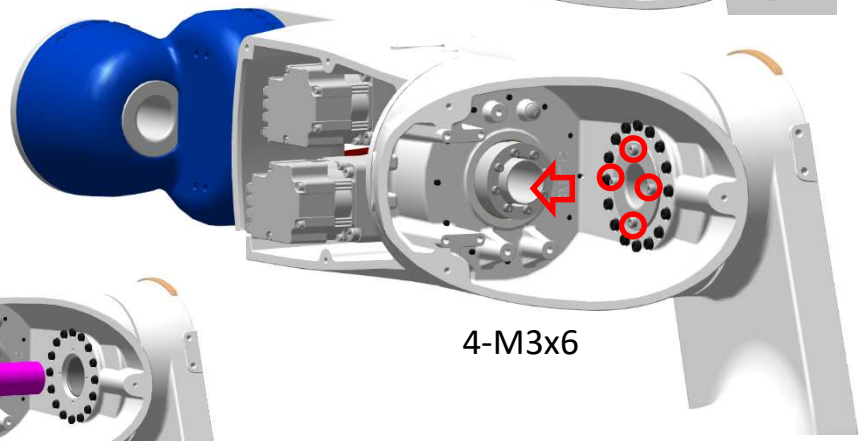
8. Pull the cables from Arm #3 through to Arm #2 and place to one side.
   Caution: Be careful of the connectors catching on the Arm #3 sleeve

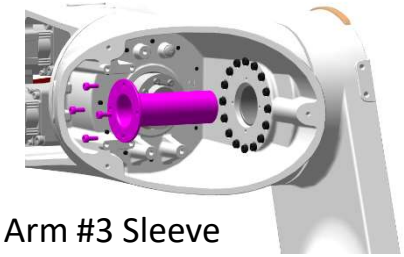
9. Remove the Arm #3 sleeve fixing bolts
   Hexagon socket head cap : 4-M3x8

10. Remove the Arm #3 sleeve









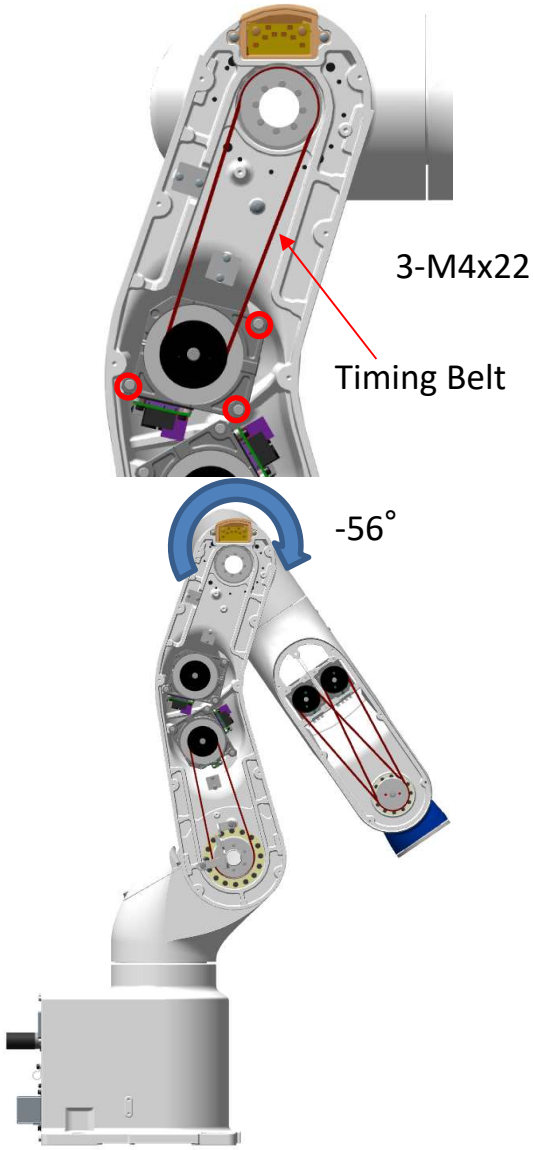
Level 3

4-1 Removing Joint #3 Reduction Gear Unit

10. Loosen the Arm #3 Motor plate fixing bolts
    Caution: Arm #3 may fall. Be sure to have another person holding Arm #4.
    Hexagon socket head cap with washer : 3-M4x22

11. Remove the Joint #3 Timing Belt

12. Move Arm #3 until the arm stops at the mechanical stopper at -56°



Level 3

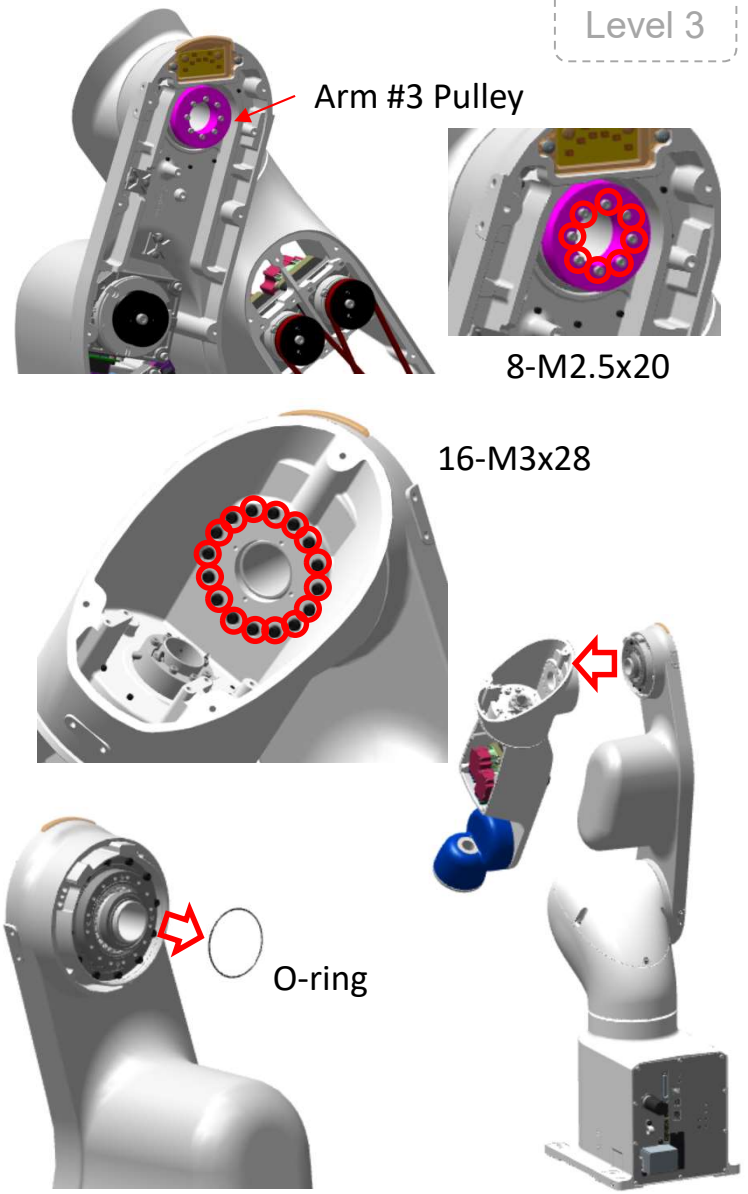
4-1 Removing Joint #3 Reduction Gear Unit

13. Remove the Arm #3 pulley
    Hexagon socket head cap : 8-M2.5x20

14. Remove the Arm #3 fixing bolts
    Hexagon socket head cap and washer : 16-M3x28

15. Carefully remove Arm #3 from Arm #2. *This may require two engineers.*
    Note: The Waveform Generator unit bearings are held in the arm with Loctite. When removing Arm #3 move straight out from Arm #2.
    Caution: Be careful of the O-ring when removing Arm #3 from Arm #2. Make sure to remove Arm #3 with both hands.
    Caution: When placing the arm on the workbench be careful of the internal cables and be sure to place soft material such as bubble wrapping or paper towels under the arm.

16. Remove the O-ring from the Circularspline



Level 3

4-1 Removing Joint #3 Reduction Gear Unit

17. Tap the rear of the Waveform Generator from Arm #2 with a soft hammer to remove the Waveform Generator.
    Caution: The wave washer may fall out when removing

18. Remove the Joint #3 Reduction Gear fixing bolts and then the remaining Reduction Gear.
    Hexagon socket head cap : 12-M3x28

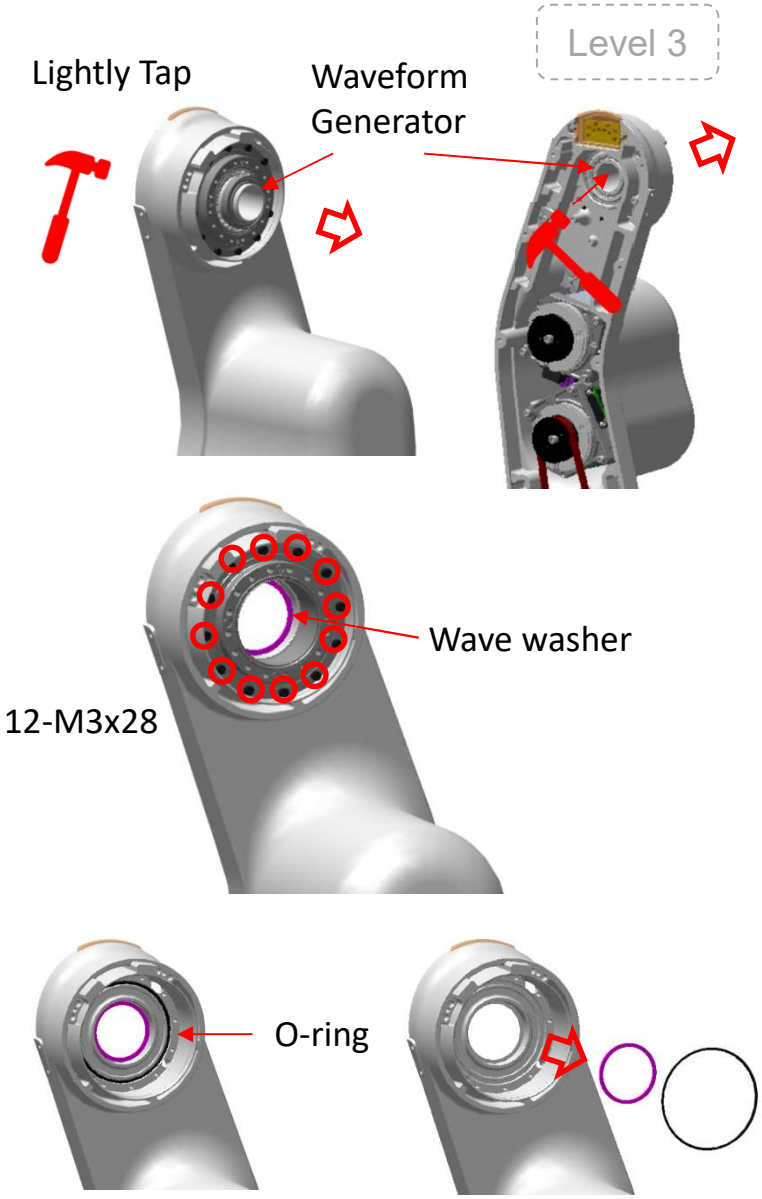
    Note: Two M3 bolts can be used to help lift the reduction gear out from Arm #3

    Caution: Be careful of the O-ring underneath the cross-roller bearing when removing

19. Remove the O-ring
    Note: Be careful not to damage the O-ring.
    Any small damage may cause oil leakage.

20. Remove the Wave washer

21. Clean Arm #2 and Arm #3 of grease and unwanted particles



Level 3

4-2 Replacing Joint #3 Reduction Gear Unit

Note: Replacing the Joint #3 Reduction Gear will require at least 2 engineers to replace. It is recommended to remove the manipulator from the line and perform replacement at a workbench.

1. Make sure Arm #2 is clear of dust or unwanted particles. These may enter the reduction gear causing extra heat which may lead to damage of the reduction gear.

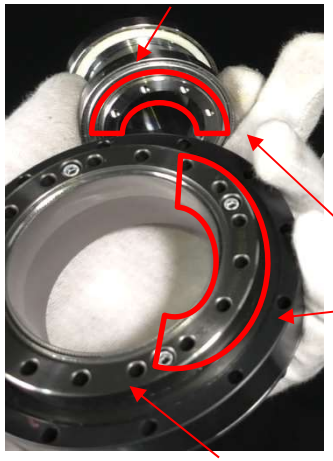
2. Before replacing with the new reduction gear please check the serial numbers match each of the parts and are the same numbers.

3. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

4. Place manipulator on its side with the Arm #3 joint facing upwards. Leave a gap underneath the arm for the internal cable to sit.
5. Place the O-ring into Arm #3 joint.
   Note: Applying a little grease (SK-1A) will help stick the O-ring in the arm groove.

   Caution: Be careful of the O-ring when replacing it into the Arm. Any damage to the O-ring will cause oil leakage.

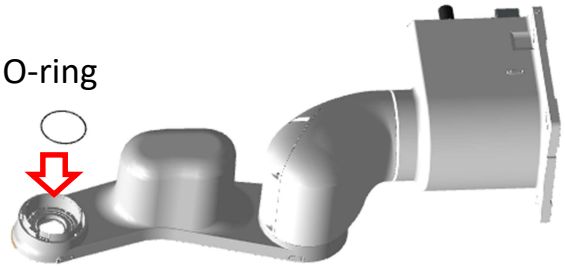
Waveform Generator



Serial Numbers

Circularspline/Flexspline

O-ring

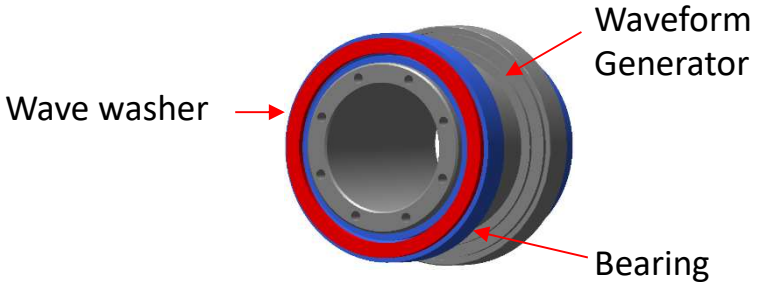


Level 3

4-2 Replacing Joint #3 Reduction Gear Unit

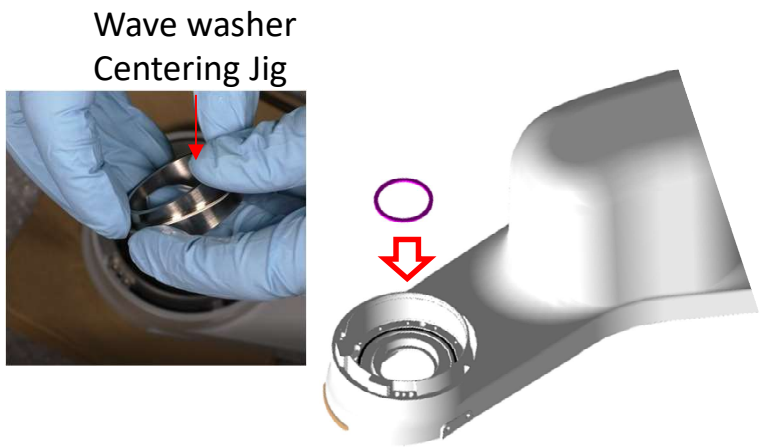
6. Place the wave washer into Arm #1

Note : Steps 7 to 10 Wave washer centering is not required for wave washer parts code: 1843132 or manipulators manufactured after March 13th 2020



7. Place the wave washer into Arm #3 using the wave washer centering jig to help center the washer in the arm.

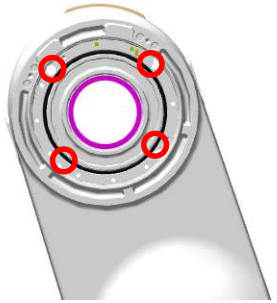
Caution: Centering of the wave washer is very important. If the wave washer is not centered correctly the Arm will not move smoothly and may cause torque errors during operation. The wave washer will sit in the center of the bearing attached to the Waveform Generator and the center of the arm. If out of alignment the bearing may be damaged.



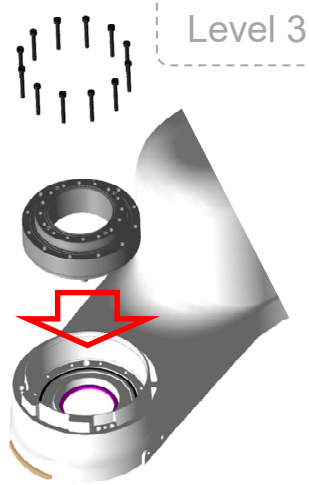
Level 3

4-2 Replacing Joint #3 Reduction Gear Unit

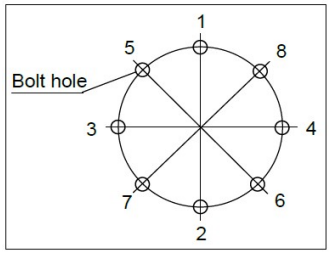
8. Place the Reduction Gear (Circularspline/Flexspline unit) into the Arm. Make sure to place with cross-roller bearing fixing bolts facing in the four inset placement holes in the arm.
   Note: 2-M3 bolts can be used to help place the unit into the arm.



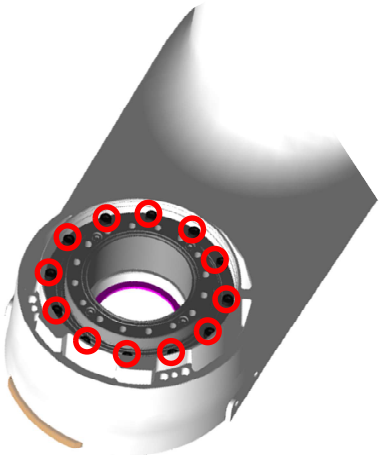
Placement Holes



9. Replace the reduction Gear fixing bolts
   Note: Tighten in a crisscross pattern
   Hexagon socket head cap: 12-M3x28
   Tightening Torque: 2.4±0.1N･m



Crisscross Example



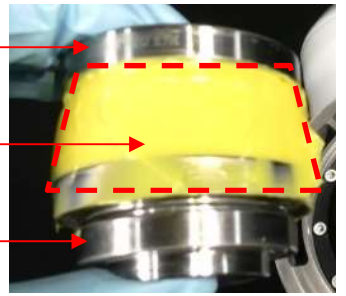
12-M3x28

4-2 Replacing Joint #3 Reduction Gear Unit

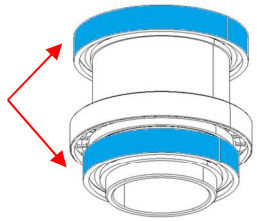
10. Apply SK-1A grease to the wave form generator.
    Note: Make sure the grease is applied evenly around the inside surface of the Waveform Generator unit.

    Grease: 11.0g ±0.5g SK-1A

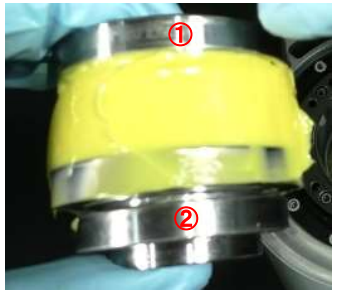
    Caution:
    Do not apply grease to the outer side bearings. These bearings need to have Loctite applied in the next step.
    Note：Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



11. Next apply Loctite 641 to the outer rim of bearing①
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #3 the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer surface the Loctite will not bond correctly.

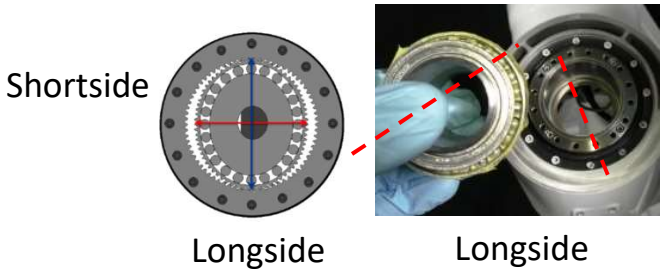


Example: Waveform Generator Unit

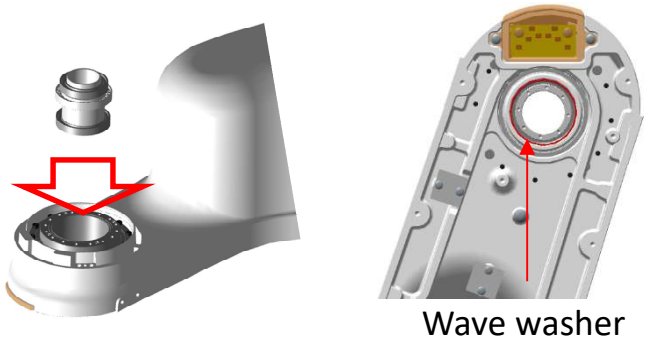


4-2 Replacing Joint #3 Reduction Gear Unit

12. Place Waveform Generator into Flexspline.
    Note: Make sure the longside of the Waveform Generator and Flexspline match when placing.
    Caution: Do not allow the Loctite to touch the inside of the Flexspline.



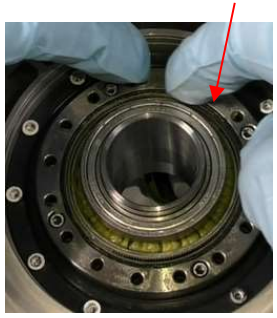
13. Confirm that the wave washer is centered. This can be viewed from Arm #2.

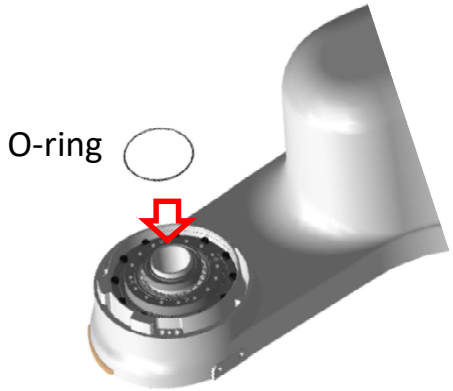


14. Apply a little SK-1A grease to the O-ring and replace the O-ring onto the Circularspline groove.

15. Apply SK-1A grease to the Waveform Generator surface.
    Caution: Make sure the grease is applied evenly and within the O-ring. Applying with a syringe is recommended.

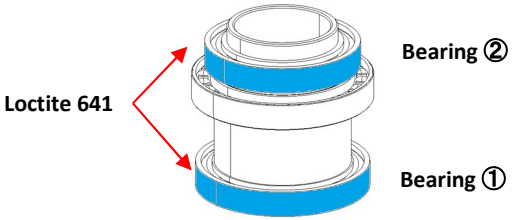
    Grease: 1.5g SK-1A





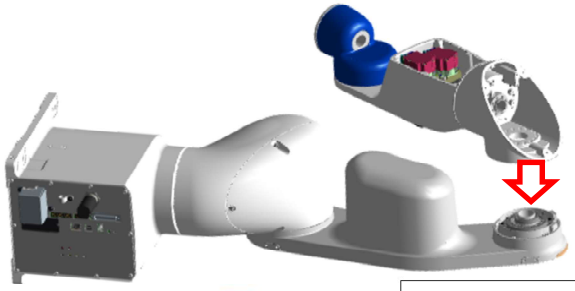
4-2 Replacing Joint #3 Reduction Gear Unit

Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



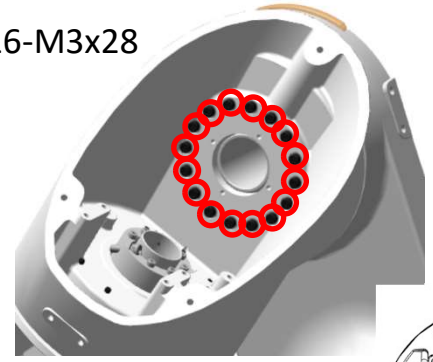
Example: Waveform Generator Unit

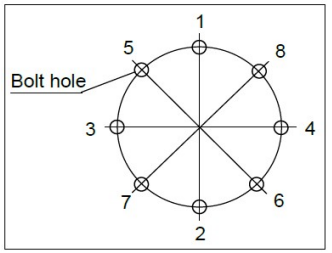
16. Apply Loctite 641 to the outside of bearing②
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #4 the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer rim surface the Loctite will not bond correctly.



17. Place Arm #3 onto Arm #2 making sure the Arm #3 bolt holes are aligned with the Circularspline bolt holes.
    Caution: Be careful of the O-ring when replacing Arm #3 to Arm #2. Make sure to replace Arm #4 with both hands.

16-M3x28

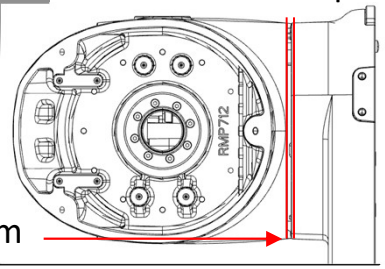




Crisscross Example

18. Replace the Arm #4 16 fixing bolts
    Hexagon socket head cap bolts with washer: 16-M3x28
    Tightening Torque: 2.4±0.1N・m

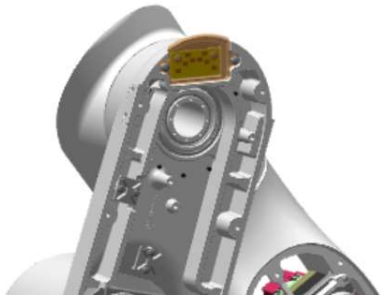
    Note: The gap between Arm #2 and Arm #3 should be evenly spaced around the entire joint. Approx.: 2mm



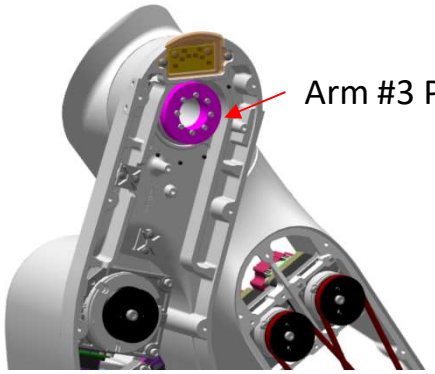
Gap: 2mm

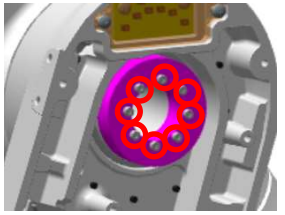
4-2 Replacing Joint #3 Reduction Gear Unit

19. Replace the pulley on to the Joint #4 Waveform Generator unit. Align the pulley holes to the Waveform Generator unit's bolt holes.



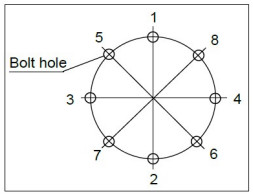
20. Replace the 8 pulley fixing bolts
    Hexagon socket head cap bolts: 8-M2.5x20
    Tightening Torque: 1.0±0.1N・m





8-M2.5x20

    Note: Gradually tighten the bolts in a crisscross pattern to allow the pulley to be levelly attached



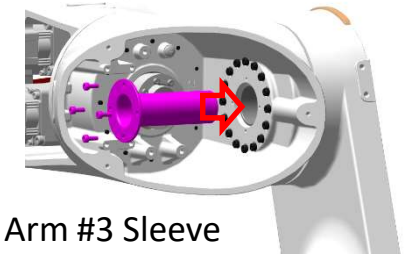
Crisscross Example

    Note: The pulley can be held firmly in place using the timing belt to allow the correct tension to be applied to the bolts

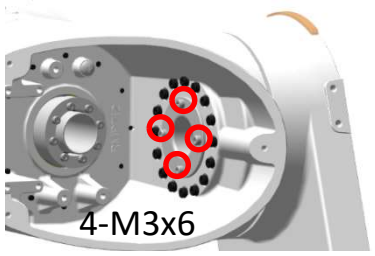
21. Place the Arm #3 sleeve between Arm #4 and Arm #3

22. Replace the 4 sleeve fixing bolts

    Hexagon socket head cap bolts: 4-M3x8
    Tightening Torque: 2.0±0.1N・m



Arm #3 Sleeve



4-M3x6

    Note: Gradually tighten the bolts in a crisscross pattern starting with the top bolt. The sleeve must be centered correctly.

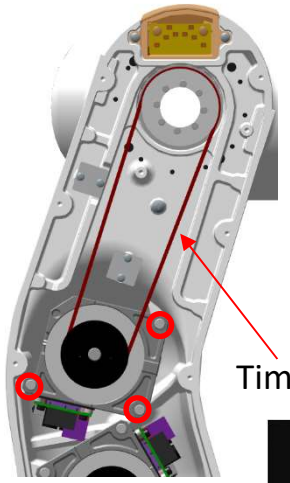
4-2 Replacing Joint #3 Reduction Gear Unit

23. Replace the Joint #3 Timing Belt

24. Tighten the Arm #2 Motor plate fixing bolts
    Hexagon socket head cap bolts with washer : 3-M4x22
    Tightening Torque: 4.0 ±0.2N・m

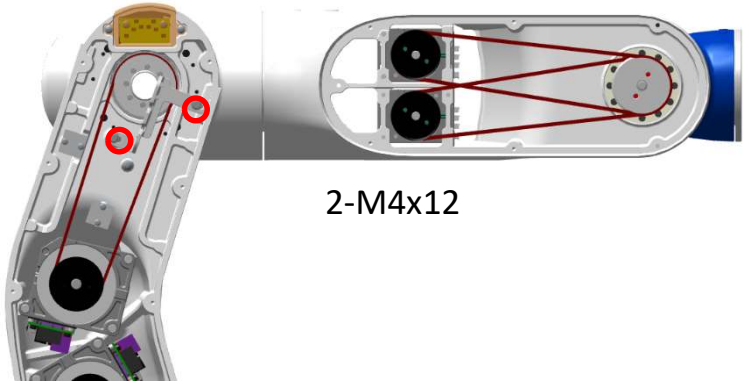
    Joint #3 Timing belt tension: 34 - 58 N
    Belt tension meter setting values
    Weight: 2.5g
    Width: 9.0mm
    Span: 169mm

    For Details, refer to Manipulator Manual
    Maintenance: 10.3 Replacing Joint #2 Timing Belt



25. Thread and push the cables from the Arm #2 through to Arm #3.
    Caution: Be careful of the connectors catching on the Arm #2 sleeve

26. Replace the Arm #2 cable fixing plate (Joint #3 side) fixing bolts
    Hexagon socket head cap with captive washer : 2-M4x12
    Tightening Torque: 4.0 ±0.2N・m



Level 3

4-2 Replacing Joint #3 Reduction Gear Unit

27. Replace the earth cable fixing screw
    Cross-recessed Bind Screw: 1-M4x6
    Tightening Torque: 4.5 ±0.5kgf･cm

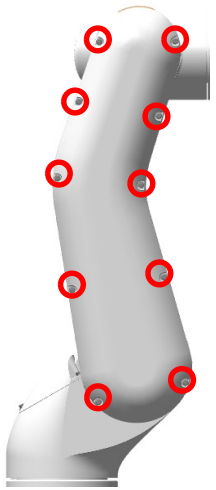
28. Replace the Arm #2 Cover
    Hexagon socket head cap bolts with captive washer: 10-M4x12
    Tightening Torque: 4.0 ±0.2N･m

29. Pull the cables from Arm #4 through to Arm #3.
    Caution: Be careful of the connectors catching on the Arm #4 sleeve

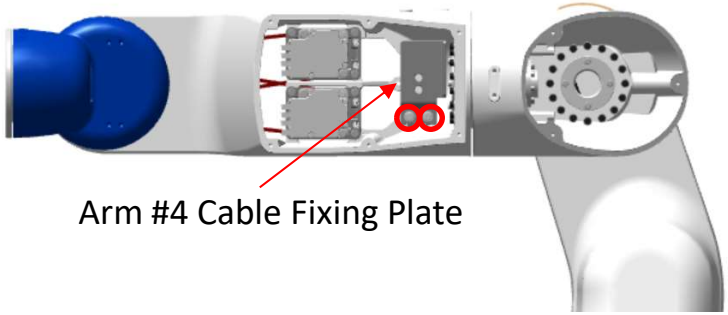
30. Replace the cable fixing plate from Arm #4 by loosening the 2-M4x12 bolts to allow the fixing plate to be released.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0 ±0.2N･m

31. Replace the Joint # 4 Motor Unit and Timing Belt
    For Details, refer to Manipulator Manual
    Maintenance: 12.3 Replacing Joint #4 Timing Belt.

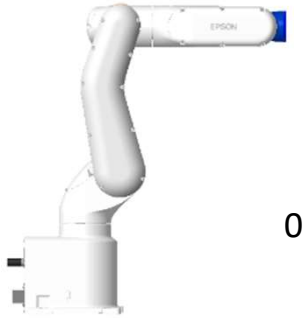
32. Move the manipulator to 0 pulse position
    Command: Pulse 0,0,0,0,0,0



10-M4x12



Arm #4 Cable Fixing Plate



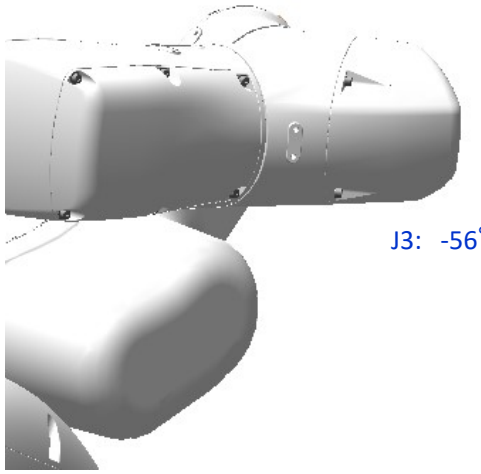
0 Pulse Position

Level 3

4-2 Replacing Joint #3 Reduction Gear Unit

33. Next rough calibration must be performed on Joint #3.

34. Joint #3 will need to be moved mechanical stopper position(-56°). This can be performed by releasing the Joint #3 brake and moving the joint manually in the + direction until the arm is stopped by the mechanical stopper.



35. Next using RC+ Command Window calibrate the manipulator accordingly for Joint #3.
36. Reset the Joint #3 encoder.
    Command: Encreset 3
37. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
38. Output the current Calpls value.
    Command: Calpls
39. Copy the Calpls value to Calpls command and make sure Joint #3 is **-2598624** and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
40. Execute Calib to calculate HOFs
    Command: Calib 3

For Details, refer to VT6 Service Reference Calibration (J1,J2,J3 and J5) for more details

4-2 Replacing Joint #3Reduction Gear Unit

41. Next rough calibration must be performed on Joint #4.

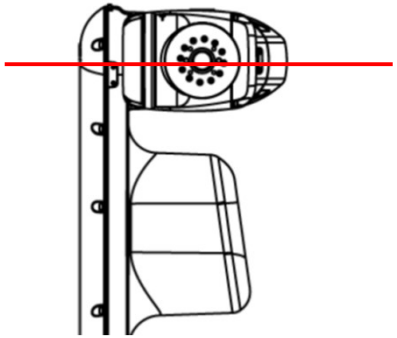
42. Move Joint #5 +90˚

43. Joint #4 will need to be moved back to the 0 pulse position (origin position). This can be performed by releasing the Joint #4 brake and moving the joint manually.
    For Details, refer to Manipulator Manual
    Setup & Operation: 3.9 Checking the Basic Orientation.

44. With the Joint #4 brake released place a level on the Joint #6 flange. **(Level Accuracy: 0.5mm/m)**

45. Move Joint #4 until the level bubble is centered.
    Caution: Make sure the table the manipulator on is also level.

Out of Alignment



0 pulse position

Level

Level 3

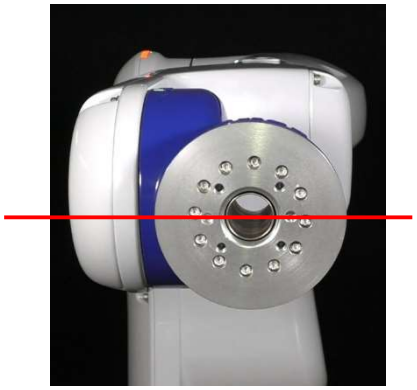
4-2 Replacing Joint #3 Reduction Gear Unit

46. Once leveled turn the Joint #4 brake ON and remove the Level.

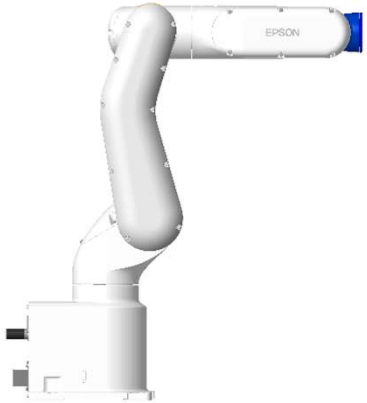
47. Next using RC+ Command Window calibrate the manipulator accordingly.

48. Reset the Joint #4 encoder.
    Command: Encreset 4
49. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
50. Output the current Calpls value.
    Command: Calpls
51. Copy the Calpls value to Calpls command and make sure Joint #4 is 0 and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
52. Execute Calib to calculate HOFs
    Command: Calib 4
53. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

54. Move the Manipulator to the 0 pulse position (origin position).
    Command: Pulse 0,0,0,0,0,0
55. Next test Joint #3 and Joint #4 in low power and high power mode. Check for any abnormalities. If there are none you are finished.

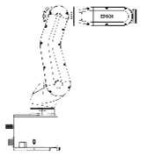


Correct 0 pulse position



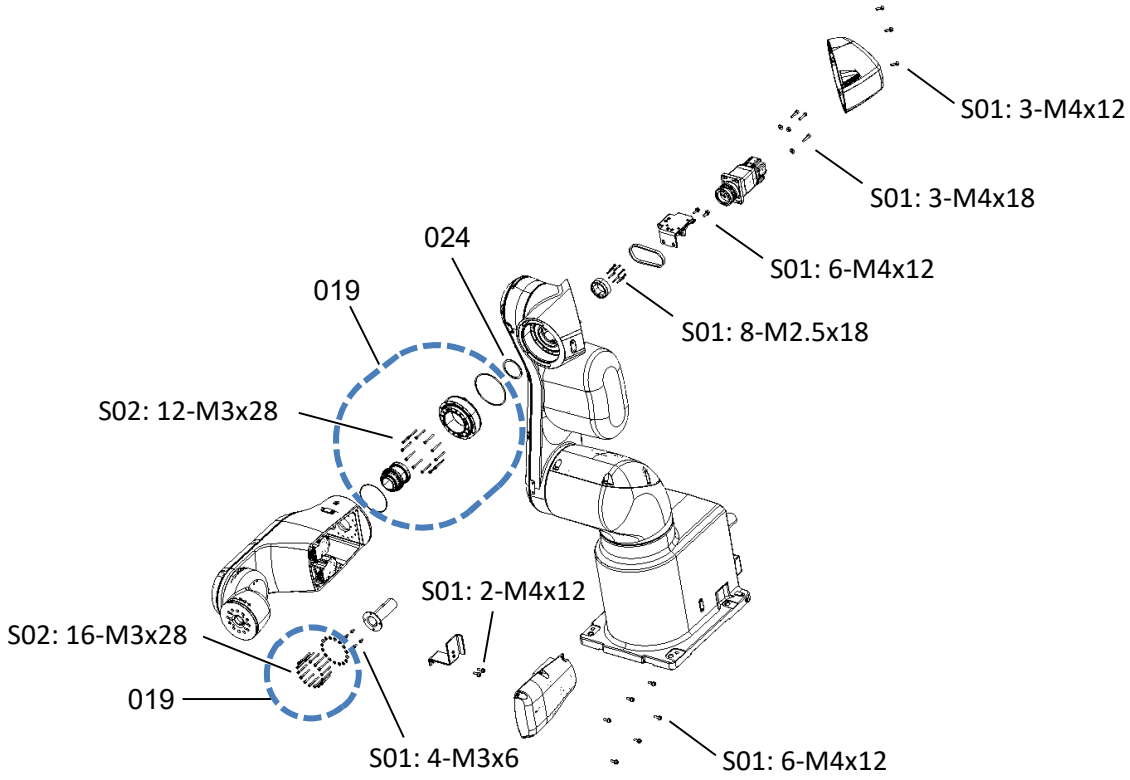
0 Pulse Position

1.5. Joint #4 Reduction Gear



VT6 Series Joint #4 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
019	LP_J3_J4_RG_UNIT	1759298	b	J3, J4 Reduction Gear Unit (1768641), Bearings already pressed(1566573 & 1656177), O-Rings(1670639 & 1773891), M3x28 bolts and washers incl.
024	WAVE WASHER	1843132	d	For J1/J2/J3/J4/J6 (No need for centering jig)

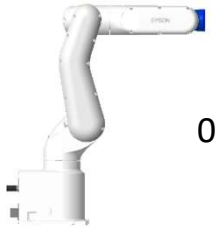


Level 3

Level 3

5-1 Removing Joint #4 Reduction Gear Unit

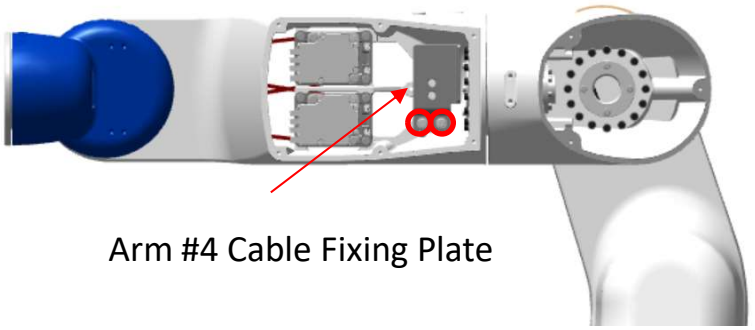
1. Move the manipulator to 0 pulse position
   Command: Pulse 0,0,0,0,0,0



0 Pulse Position

2. Remove the Joint # 4 Motor Unit and Timing Belt
   For Details, refer to Manipulator Manual
   Maintenance: 12.3 Replacing Joint #4 Timing Belt.

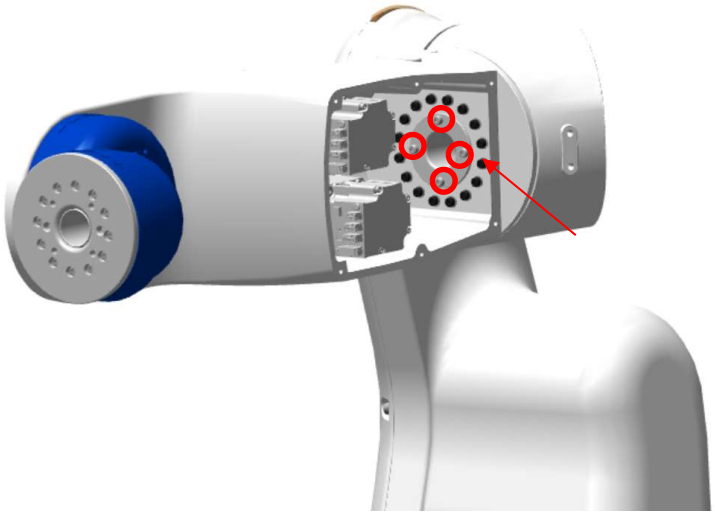
4. Remove the cable fixing plate from Arm #4 by loosening the 2-M4x12 bolts to allow the fixing plate to be released.
   Hexagon socket head cap bolts with captive washer: 2-M4x12



Arm #4 Cable Fixing Plate

5. Pull the cables from Arm #4 through to Arm #3.
   Caution: Be careful of the connectors catching on the Arm #4 sleeve

6. Remove the Arm #4 sleeve fixing bolts
   Hexagon socket head cap : 4-M3x6



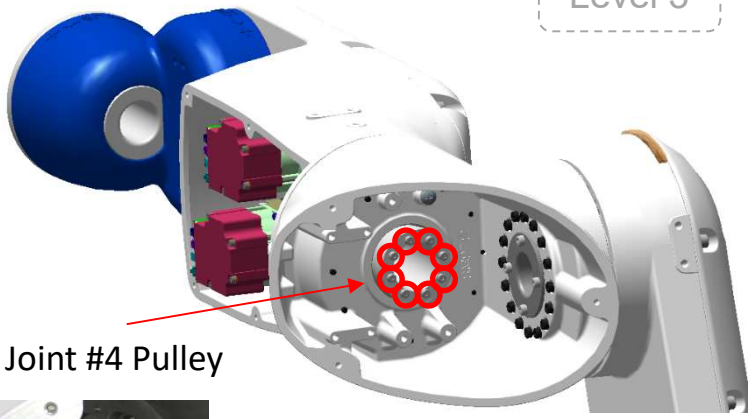
7. Remove the Arm #4 sleeve

Level 3

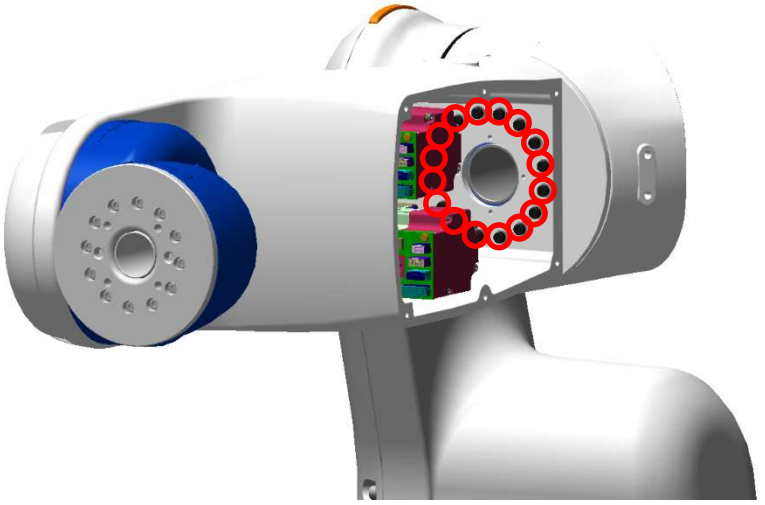
5-1 Removing Joint #4 Reduction Gear Unit

8. Remove the Joint #4 pulley fixing bolts and then the pulley.
   Hexagon socket head cap bolts: 8-M2.5x18

   Note: The pulley may be difficult to remove in this case use a flat head screw driver to gently pry the pulley off. Move the pulley a little at a time to wedge free.



9. Remove the Arm #4 fixing bolts
   Hexagon socket head cap with washer: 16-M3x28



Level 3

5-1 Removing Joint #4 Reduction Gear Unit

10. Remove Arm #4 from Arm #3

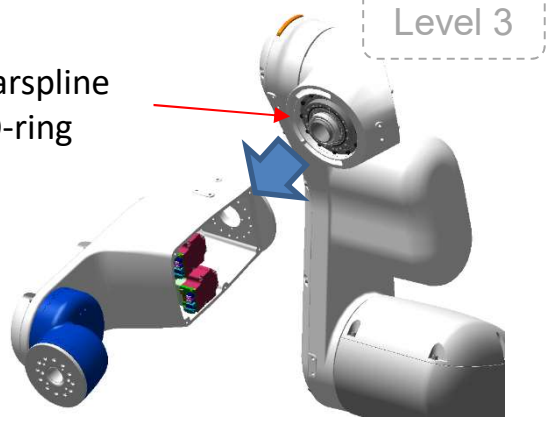
    Caution: Be careful of the O-ring when removing Arm #4 from Arm #3. Make sure to remove Arm #4 with both hands.

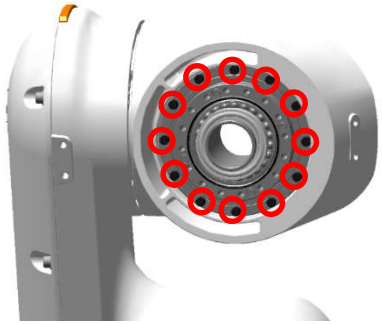
11. Remove the O-ring from the Circularspline

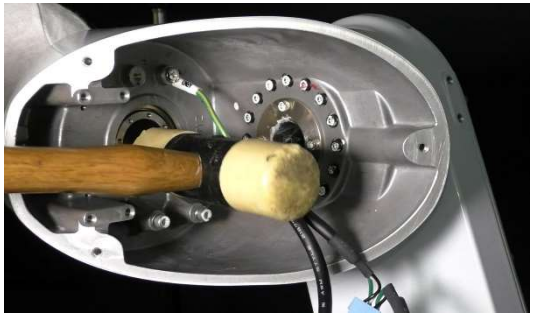
12. Tap the rear of the Waveform Generator from Arm #3 with a soft hammer to remove the Waveform Generator.
13. Remove the Joint #4 Reduction Gear fixing bolts and then the remaining Reduction Gear.

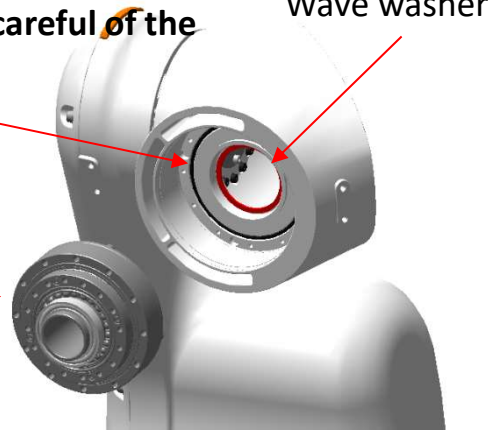
    Hexagon socket head cap: 12-M3x28

    Caution: Be careful of the O-ring when removing the Reduction Gear from Arm #3. Also be careful of the wave washer falling out of Arm #3.









Level 3

5-2 Replacing Joint #4 Reduction Gear Unit

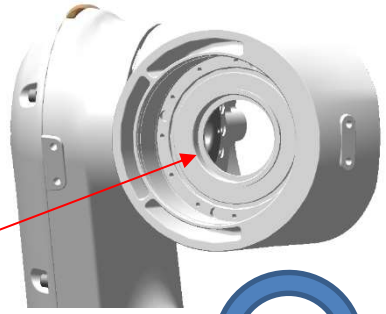
1. Before replacing with the new reduction gear please check the serial numbers match each of the parts and are the same numbers.

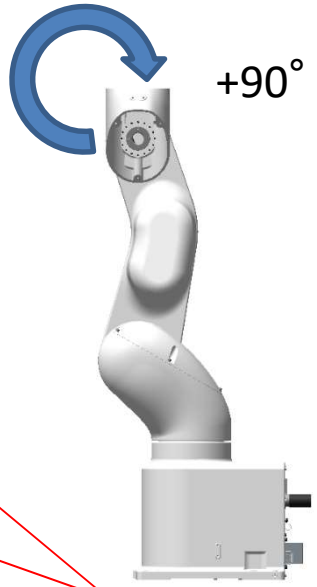
2. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

3. Make sure the Arm #3 is clear of dust or unwanted particles. These may enter the reduction gear causing extra heat which may lead to damage of the reduction gear.

4. Move Arm #3 to a +90° position.
   Note: Use either of the below methods
   1. Release the Joint #3 Motor Unit brake by connecting a 24V power supply directly to the brake connector
   2. Loosen the fixing bolts of the Joint #3 motor unit and remove the Timing Belt.

   Caution: Method 2 will require re-tensioning of the Joint #3 timing belt and calibration of Joint #3





Level 3

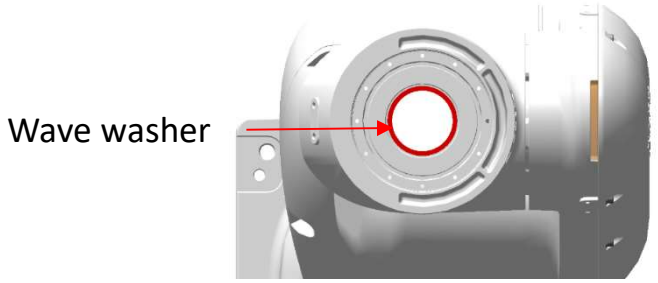
5-2 Replacing Joint #4 Reduction Gear Unit

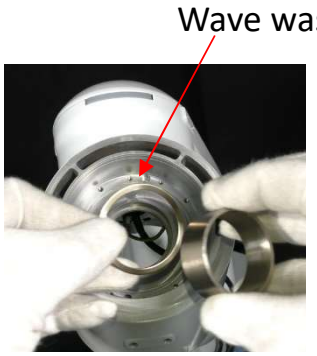
5. Place the wave washer into Arm #3

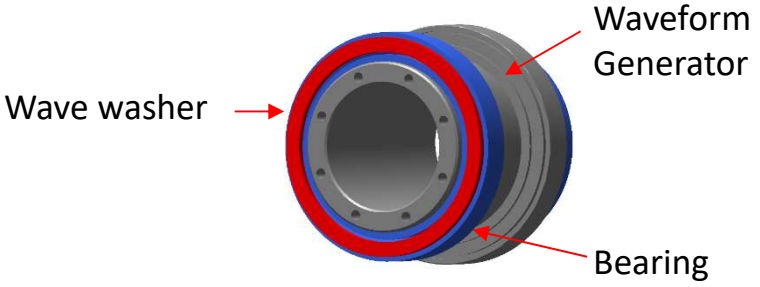
Note : Step 6 Wave washer centering is not required for wave washer parts code: 1843132 or manipulators manufactured after March 13th 2020

6. Place the wave washer into Arm #3 using the wave washer centering jig to help center the washer in the arm.

Caution: Centering of the wave washer is very important. If the wave washer is not centered correctly the Arm will not move smoothly and may cause torque errors during operation. The wave washer will sit in the center of the bearing attached to the Waveform Generator and the center of the arm. If out of alignment the bearing may be damaged.





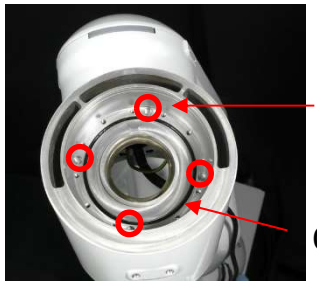


Level 3

5-2 Replacing Joint #4 Reduction Gear Unit

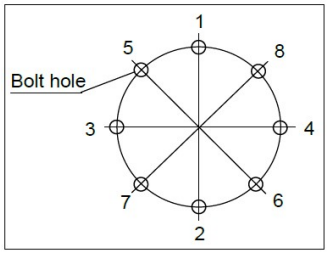
7. Place the O-ring into Arm #3.
   Note: Applying a little grease (SK-1A) will help stick the O-ring in the arm groove.

8. Place the Reduction Gear (Circularspline/Flexspline unit) into Arm #3. Make sure to place with cross-roller bearing fixing bolts facing in the four inset holes in the arm.
   Note: 2-M3 bolts can be used to help place the unit into the arm.



5-2 Replacing Joint #4 Reduction Gear Unit

9. Replace the reduction gear 12 fixing bolts
   Note: Tighten in a crisscross pattern
   Hexagon socket head cap bolts: 12-M3x28
   Tightening Torque: 2.4±0.1N･m

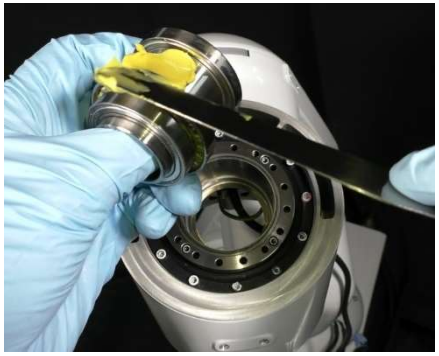


Crisscross Example

10. Apply SK-1A grease to the wave form generator.
    Note: Make sure the grease is applied evenly around the inside surface of the Waveform Generator unit.

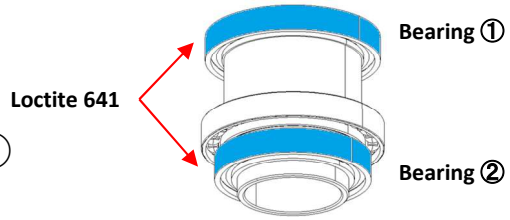
    Grease: 11.0g ±0.5g SK-1A

    Caution:
    Do not apply grease to the outer side bearings. These bearings need to have Loctite applied in the next step.



5-2 Replacing Joint #4 Reduction Gear Unit

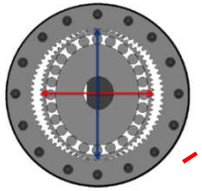
Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



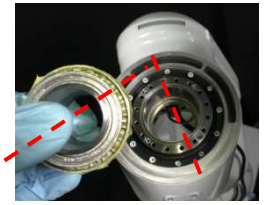
Example: Waveform Generator Unit

11. Next apply Loctite 641 to the outer rim of bearing①
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #3 the Loctite will evenly disperse.
    Note: Loctite requires approx.. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer surface the Loctite will not bond correctly.

12. Place Waveform Generator into Flexspline.
    Note: Make sure the longside of the Waveform Generator and Flexspline match when placing.
    Caution: Do not allow the Loctite to touch the inside of the Flexspline.

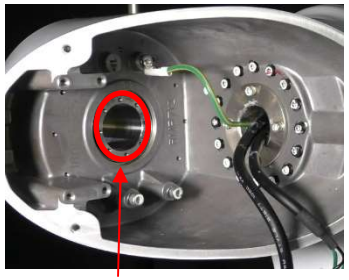


Shortside



Longside Longside

13. Confirm that the wave washer is centered. This can be viewed from Arm #3.



Wave washer confirmation point

Level 3

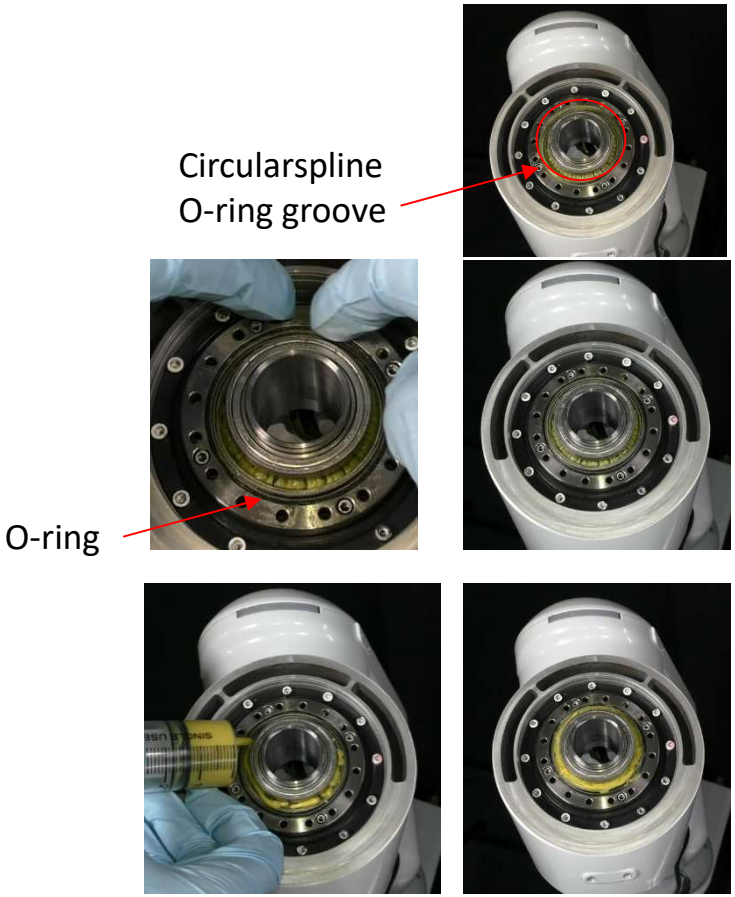
5-2 Replacing Joint #4 Reduction Gear Unit

14. Apply a little SK-1A grease to the O-ring and replace the O-ring onto the Circularspline groove.

15. Apply SK-1A grease to the Waveform Generator surface.

    Caution: Make sure the grease is applied evenly and within the O-ring. Applying with a syringe is recommended.

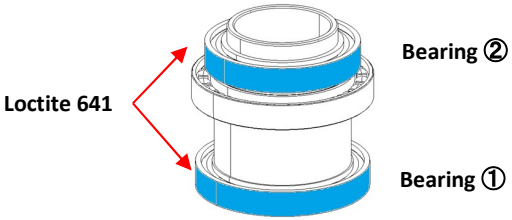
    Grease: 1.5g SK-1A



Level 3

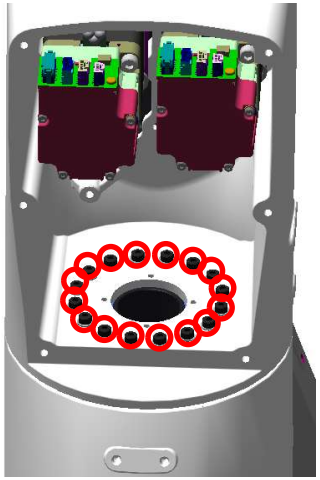
5-2 Replacing Joint #4 Reduction Gear Unit

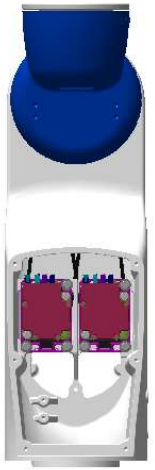
Note : Applying Loctite 641 to the bearing outer surface is required. Without Loctite fletching will occur leading to reduced life of the bearings.



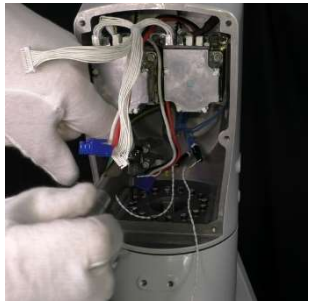
Example: Waveform Generator Unit

16. Apply Loctite 641 to the outside of bearing②
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #4 the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.
    Caution: Do not allow grease to mix with the Loctite. If grease is on the bearing outer rim surface the Loctite will not bond correctly.





17. Place Arm #4 onto Arm #3 making sure the Arm #4 bolt holes are aligned with the Circularspline bolt holes.
    Caution: Be careful of the O-ring when replacing Arm #4 to Arm #3. Make sure to replace Arm #4 with both hands.



18. Replace the Arm #4 16 fixing bolts
    Hexagon socket head cap bolts: 16-M3x28
    Tightening Torque: 2.4±0.1N・m

Level 3

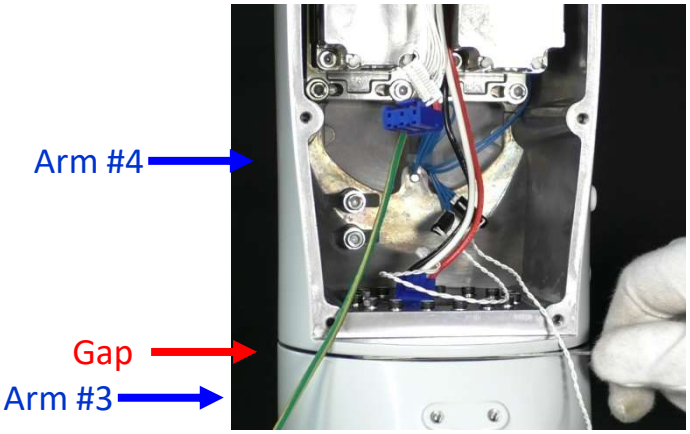
5-2 Replacing Joint #4 Reduction Gear Unit

19. Turn Arm #4 manually back and forth to feel if the arm moves smoothly

    Caution: If the arm does not move smoothly check the centering of the wave washer or the reduction gear again

20. Make sure the gap between Arm #3 and Arm #4 is even around the entire arm. Approx. 1.5 ±0.8mm

    Caution: If Arm #4 is at a slight angle the accuracy of the robot cannot be assured. Arm #4 or the Waveform Generator will need to be adjusted again.

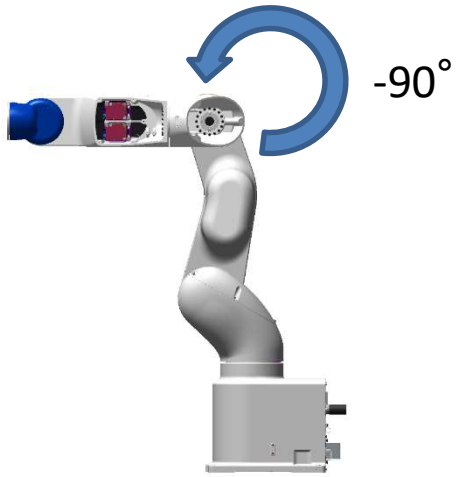


Level 3

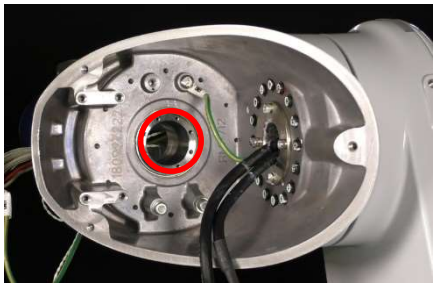
5-2 Replacing Joint #4 Reduction Gear Unit

21. Move Arm #3 -90° to the 0 pulse position.
    Note: Use either of the below methods
    1. Release the Joint #3 Motor Unit brake by connecting a 24V power supply directly to the brake connector
    2. Loosen the fixing bolts of the Joint #3 motor unit and remove the Timing Belt.

    Caution: Method 2 will require re-tensioning of the Joint #3 timing belt and calibration of Joint #3



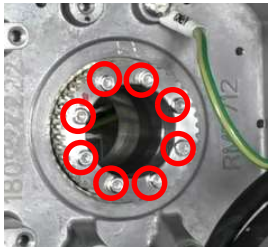
22. Replace the pulley on to the Joint #4 Waveform Generator unit. Align the pulley holes to the Waveform Generator unit's bolt holes.

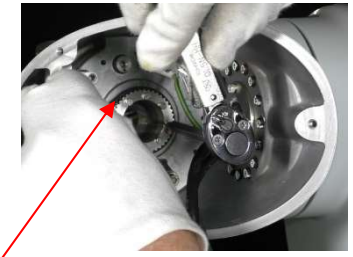


23. Replace the 8 pulley fixing bolts
    Hexagon socket head cap bolts: 8-M2.5x18
    Tightening Torque: 1.0±0.1N·m

    Note: Gradually tighten the bolts in a crisscross pattern to allow the pulley to be levelly attached

    Note: The pulley can be held firmly in place using the timing belt to allow the correct tension to be applied to the bolts





5-2 Replacing Joint #4 Reduction Gear Unit

24. Place the Arm #4 sleeve between Arm #4 and Arm #3

25. Replace the 4 sleeve fixing bolts

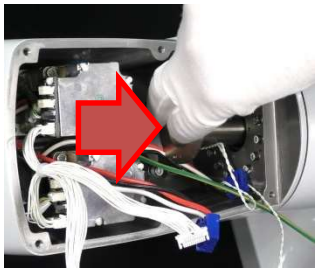
    Hexagon socket head cap bolts: 4-M3x6
    Tightening Torque: 2.0±0.1N·m

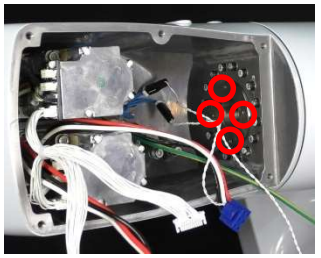
    Note: Gradually tighten the bolts in a crisscross pattern starting with the top bolt. The sleeve must be centered correctly.

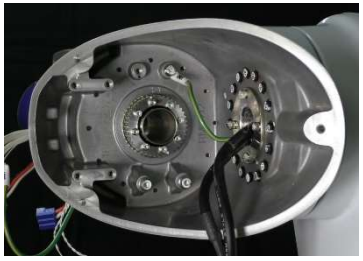
26. Replace the cable fixing plate to Arm #4 by tightening the 2-M4x12 bolts which hold the fixing plate.
    Hexagon socket head cap bolts with captive washer: 2-M4x12
    Tightening Torque: 4.0±0.2N·m

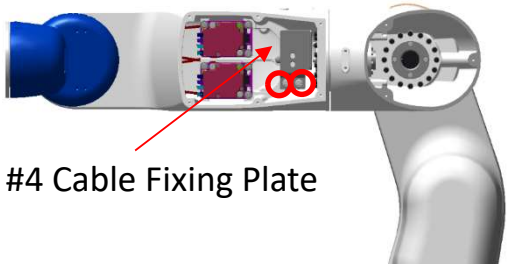
27. Replace the Joint # 4 Motor Unit and Joint #4 Timing Belt

    For Details, refer to Manipulator Manual Maintenance: 12.3 Replacing Joint #4 Timing Belt.









5-2 Replacing Joint #4 Reduction Gear Unit

28. Next rough calibration must be performed on Joint #4.

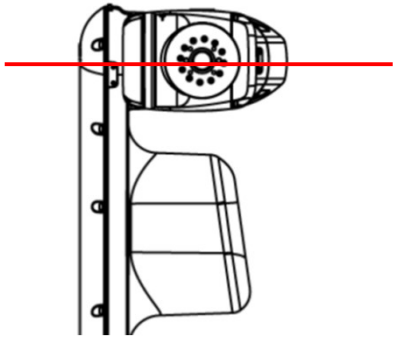
29. Move Joint #5 +90˚

30. Joint #4 will need to be moved back to the 0 pulse position (origin position). This can be performed by releasing the Joint #4 brake and moving the joint manually.
    For Details, refer to Manipulator Manual
    Setup & Operation: 3.9 Checking the Basic Orientation.

31. With the Joint #4 brake released place a level on the Joint #6 flange. **(Level Accuracy: 0.5mm/m)**

32. Move Joint #4 until the level bubble is centered.
    Caution: Make sure the table the manipulator on is also level.

Out of Alignment



0 pulse position

Level

Level 3

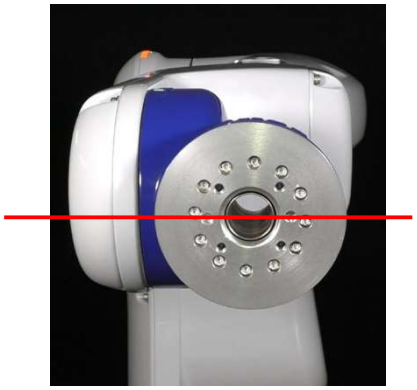
5-2 Replacing Joint #4 Reduction Gear Unit

33. Once leveled turn the Joint #4 brake ON and remove the Level.

34. Next using RC+ Command Window calibrate the manipulator accordingly.

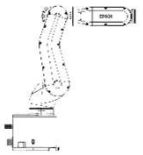
35. Reset the Joint #4 encoder.
    Command: Encreset 4
36. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
37. Output the current Calpls value.
    Command: Calpls
38. Copy the Calpls value to Calpls command and make sure Joint #4 is 0 and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
39. Execute Calib to calculate HOFs
    Command: Calib 4
40. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

41. Move the Manipulator to the 0 pulse position (origin position).
    Command: Pulse 0,0,0,0,0,0
42. Next test Joint #4 in low and high power mode. Check for any abnormalities. If there are none you are finished.



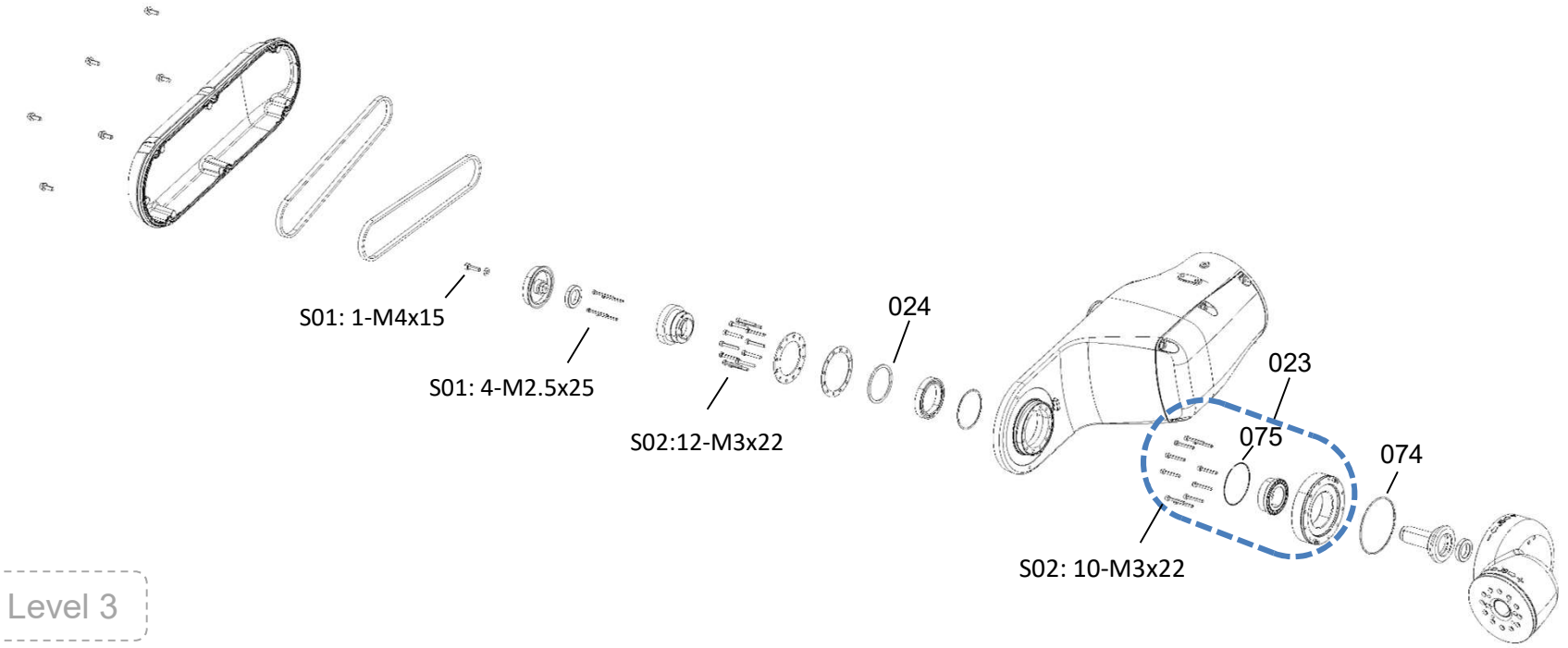
Correct 0 pulse position

1.6. Joint #5 Reduction Gear



VT6 Series Joint #5 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
023	SHD-17-80-3SH-SP	1768643	d	Reduction Gear J5/J6 included O-ring [1773892]
074	O-RING	1773892	c	64.0X1.5 J5, J6 Flexspline side
075	O-RING	1773893	c	45.4X0.80 J5, J6 Circularspline side
024	WAVE WASHER	1749486	d	For J5 (must use centering jig)



Level 3

Level 3

6-1 Removing Joint #5 Reduction Gear Unit

1. Move the manipulator to 0 pulse position
   Command: Pulse 0,0,0,0,0,0

2. Remove the Joint # 6 Motor Unit and Joint #6 Timing Belt

   For Details, refer to Manipulator Manual
   Maintenance: 14.3 Replacing Joint #6 Timing Belt.

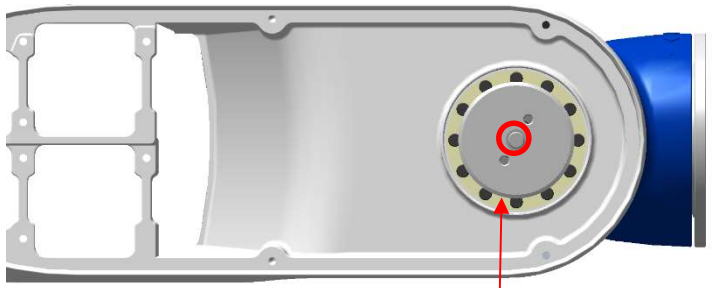
3. Remove the Joint # 5 Motor Unit and Joint #5 Timing Belt

   For Details, refer to Manipulator Manual
   Maintenance: 13.3 Replacing Joint #6 Timing Belt.

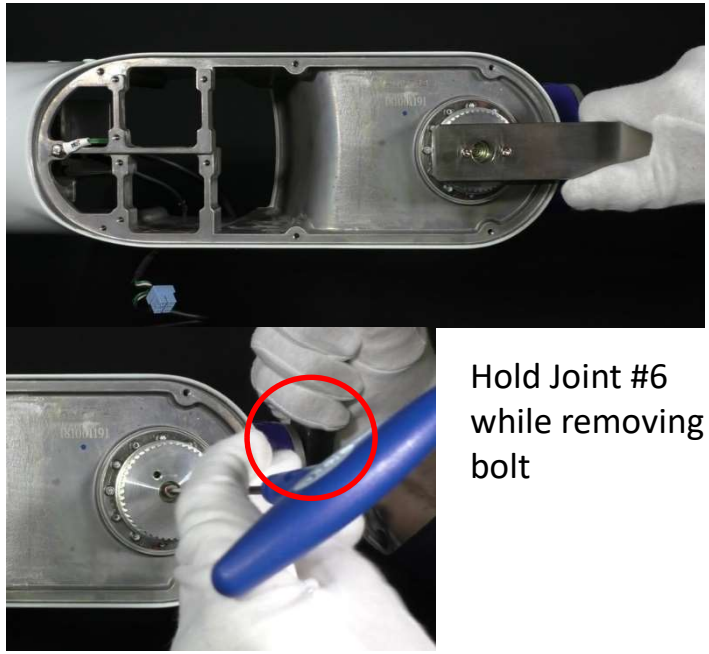
4. Remove the Joint #6 Reduction Gear side pulley
   Hexagon socket head cap bolts with washer: 1-M4x15

   Caution: The bolt is held with Loctite therefore be careful when removing not to damage the bolt, pulley or manipulator.

   Note: To stop the pulley turning the pulley holding jig can be used. However, once the bolt is initially loose Joint #6 must be held to stop turning to remove all of the bolt.



Joint #6 Reduction Gear Side Pulley



Hold Joint #6 while removing bolt

Level 3

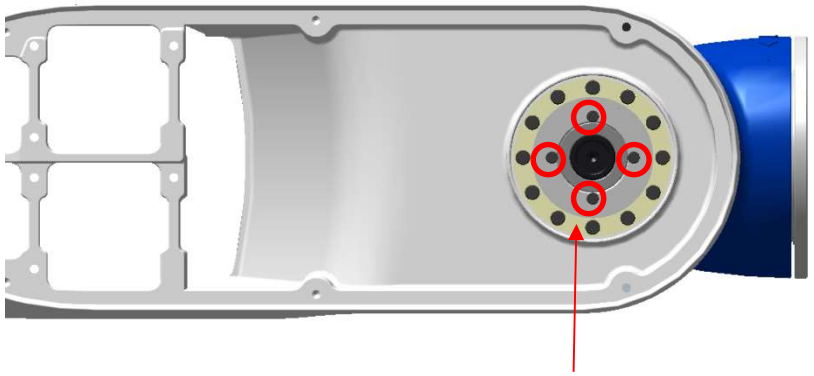
6-1 Removing Joint #5 Reduction Gear Unit

5. Remove the Joint #5 Reduction Gear side pulley
   Hexagon socket head cap bolts: 4-M2.5x25

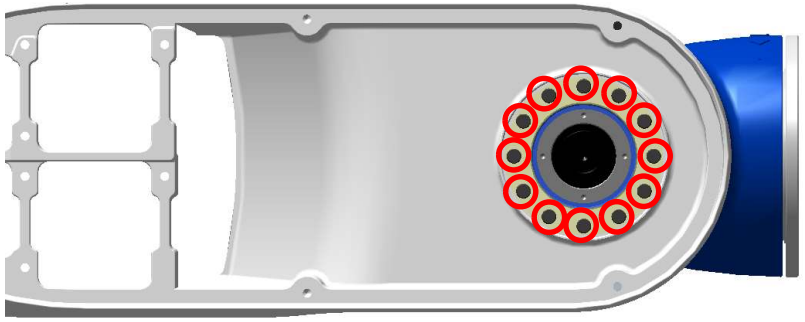
   Note: To stop the pulley turning the timing belt can be used to hold the pulley in place

6. Remove the Arm #5 fixing bolts
   Hexagon socket head cap bolts: 12-M3x22

   Caution: The bolts have marking paint which can make the bolts difficult to remove. Use a sharp object such as a flat head screw driver.



Joint #5 Reduction Gear Side Pulley



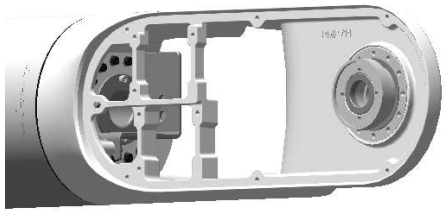
Level 3

6-1 Removing Joint #5 Reduction Gear Unit

7. Remove Arm #5
   Caution: Remove while holding Arm #5 and the Joint #5 pulley

8. Remove the Reduction Gear Circularspline side O-ring

9. Remove the Joint #5 pulley with bearings attached
   Note: The bearings are held with Loctite to Arm #4. Use of a soft hammer is recommended to allow the Loctite to be loosened in Arm #4. Softly tap/hit the unit from the Arm #5 side.
   Caution: Be careful not to damage the arm or parts when removing.



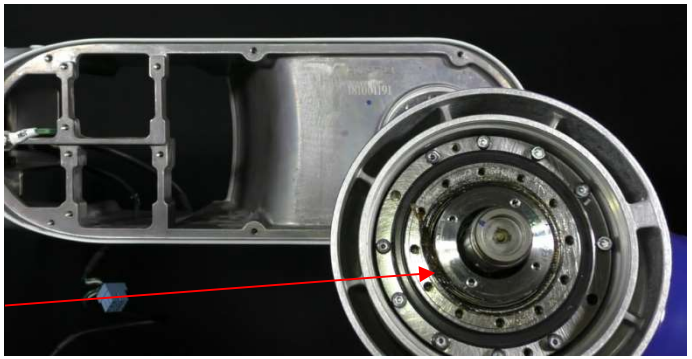
Circularspline side O-ring

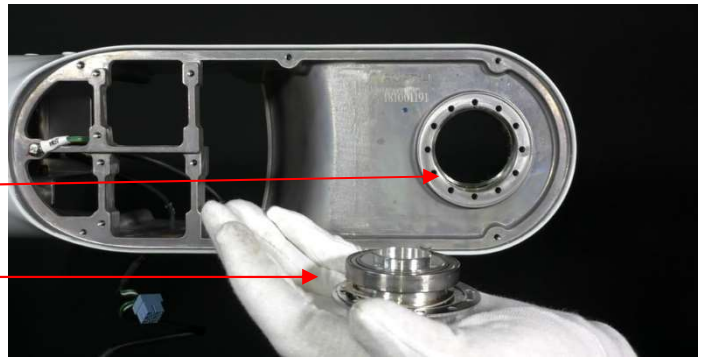
Direction to tap

10. Remove the shim from Arm #4

Shim

Joint #5 Reduction Gear Pulley & Bearing Unit

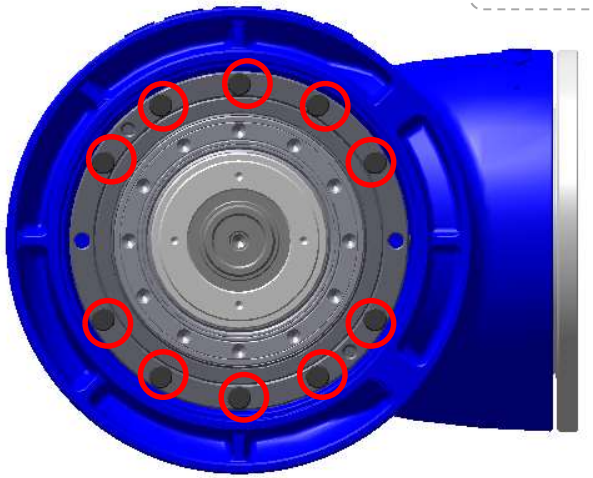




Level 3

6-1 Removing Joint #5 Reduction Gear Unit

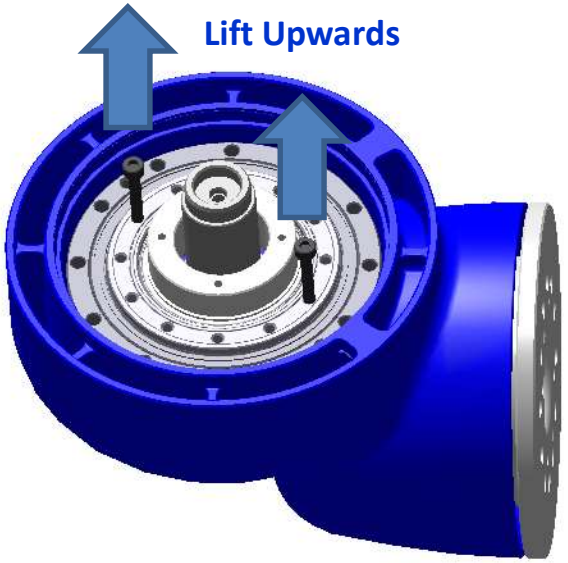
11. Remove Joint #5 Reduction Gear fixing bolts
    Hexagon socket head cap bolts: 10-M3x22



12. Remove the Joint #5 Reduction Gear Unit
    Note: Attach two bolts to the Circularspline to lift the reduction gear from the arm.

    Caution: Be careful of the cross-roller bearing side O-ring when removing.

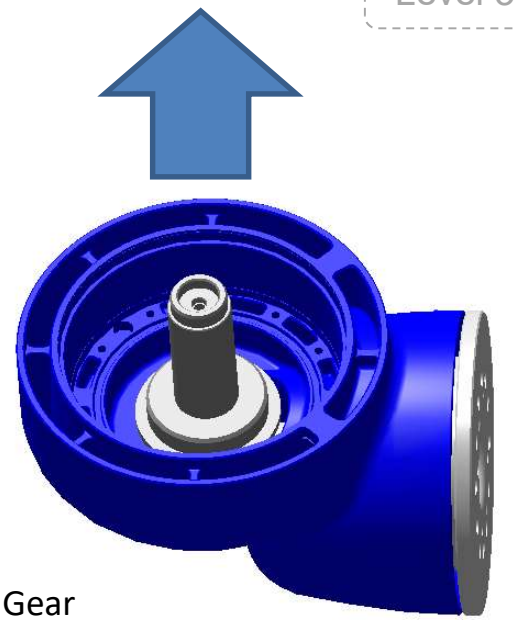
13. Remove the cross-roller bearing side O-ring



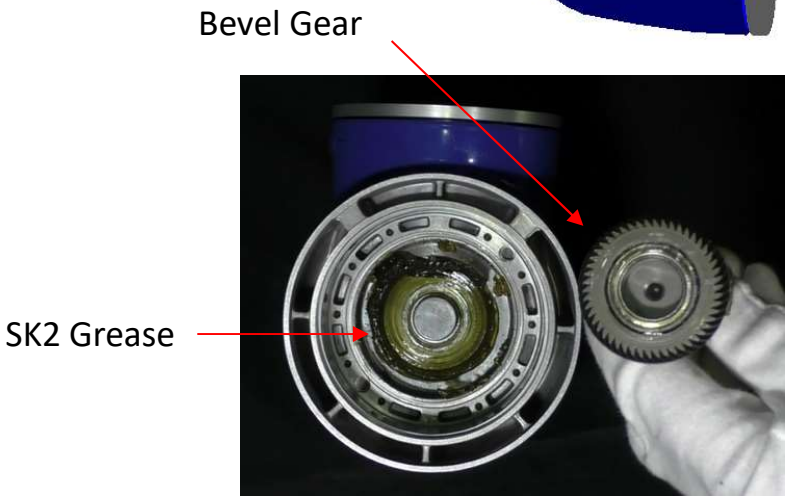
Level 3

6-1 Removing Joint #5 Reduction Gear Unit

14. Remove Joint #5 side bevel. Pull the bevel gear upwards to remove.



15. Clean Arm #5 of old grease.
    Note: New grease should be applied when replacing the reduction gear.



6-2 Replacing Joint #5 Reduction Gear Unit

1. Clean Arm #5 of old grease.
   Make sure the Arm #5 is clear of dust or unwanted particles.
   These may enter the reduction gear causing extra heat
   which may lead to damage of the reduction gear.

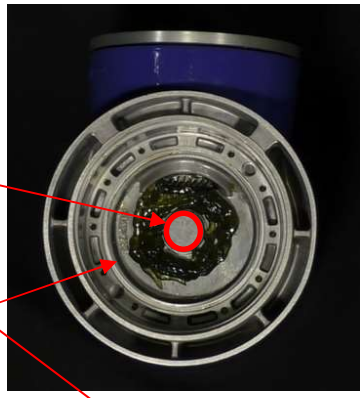
2. Apply grease to the bottom of Arm #5

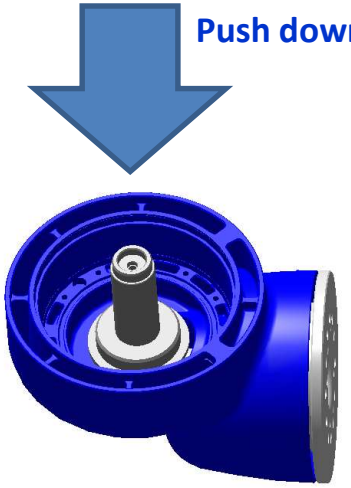
   Grease: 5～6g SK-2
   Note: Do not apply to the center of the arm where the pressed bearing in the bevel gear will sit

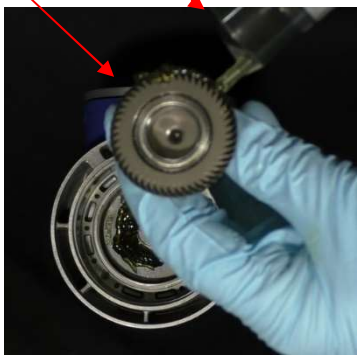
3. Apply grease to the bevel gear teeth

   Grease: 1～1.5g SK-2

4. Push the bevel gear into Arm #5



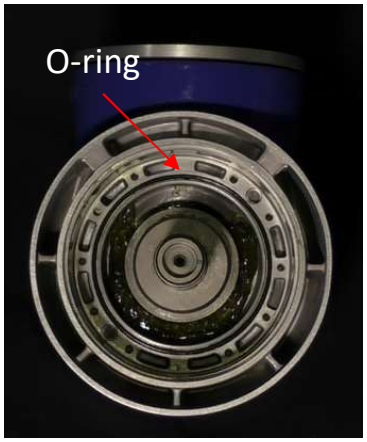




Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

6. Place the cross-roller side O-ring into Arm #5 over the bevel and into the arm groove.
   Note: Applying a little grease (SK-2) will help stick the O-ring in the arm groove.

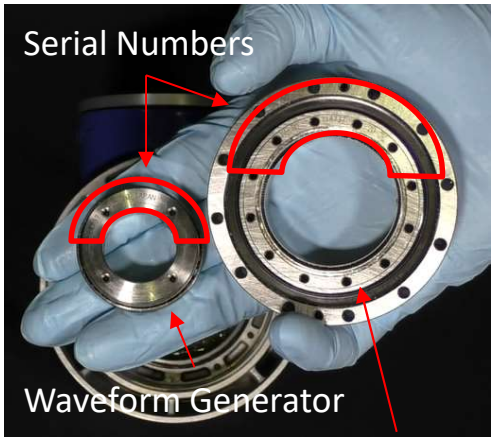


7. Before replacing with the new reduction gear please check the serial numbers match each of the parts and have the same numbers.

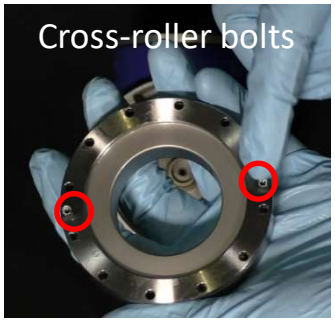
8. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

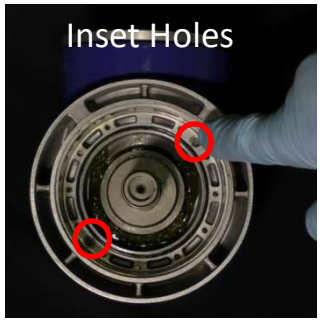
9. Place the Reduction Gear (Circularspline/Flexspline unit) into Arm #5. Make sure to place with cross-roller bearing fixing bolts facing in the two inset holes in the arm.

   Note: 2-M3 bolts can be used to help place the unit into the arm.



Circularspline/Flexspline

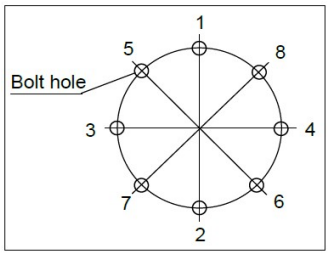




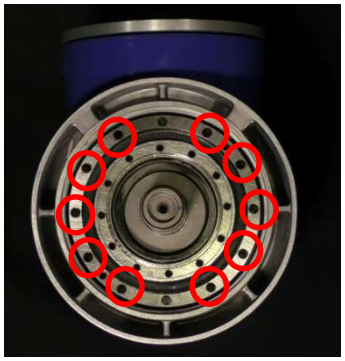
Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

10. Replace the reduction gear 10 fixing bolts
    Note: Tighten in a crisscross pattern
    Hexagon socket head cap bolts: 10-M3x22
    Tightening Torque: 2.4±0.1N・m

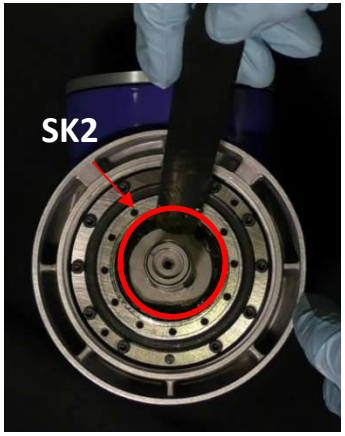


Crisscross Example



11. Apply SK2 grease to the Flexspline of the reduction gear.
    Note: c.

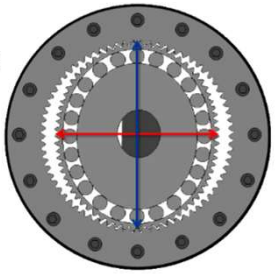
    Grease: 5.5 ± 0.5g SK-2
    Caution:
    Apply grease evenly to the inside of the Flexspline.



12. Place Waveform Generator into the Flexspline.
    Note: Make sure the longside of the Waveform Generator and the Flexspline match when placing.

    Caution: Make sure the direction of the Waveform Generator is correct and is level with the Flexspline.

Shortside



Longside

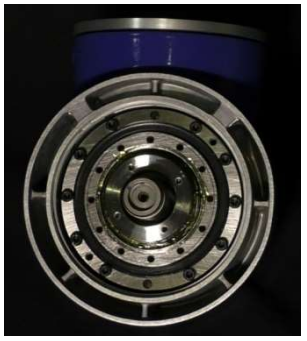
Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

13. Apply SK-2 grease to the Waveform Generator outer bearing surface.
    Note: Make sure the grease is applied evenly and within the O-ring groove. Applying with a syringe is recommended.

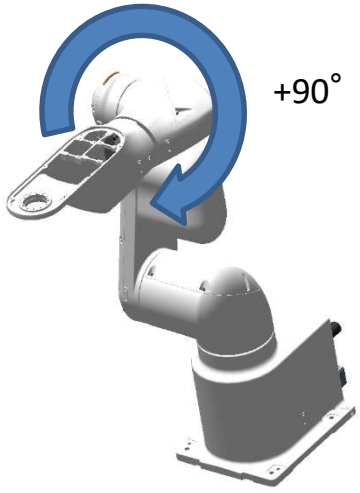
    Grease: 1~1.5g SK-2

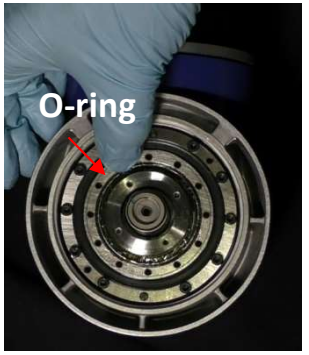
14. Place the Circularspline side O-ring onto the reduction gear. Make sure there is no grease on the outside of the O-ring.
    Note: Applying a little grease (SK-2) will help stick the O-ring in the arm groove.



15. Move Arm #4 to a +90° position.
    Note: Use either of the below methods
    1. Release the Joint #4 Motor Unit brake by connecting a 24V power supply directly to the brake connector
    2. Loosen the fixing bolts of the Joint #4 motor unit and remove the Timing Belt.

    Caution: Method 2 will require re-tensioning of the Joint #4 timing belt and calibration of Joint #4





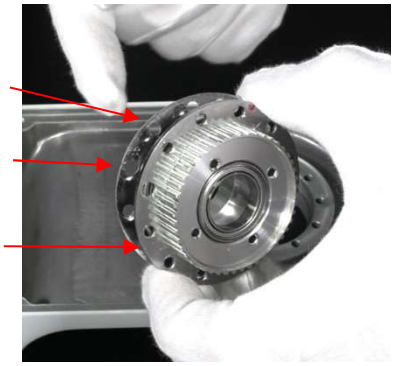
Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

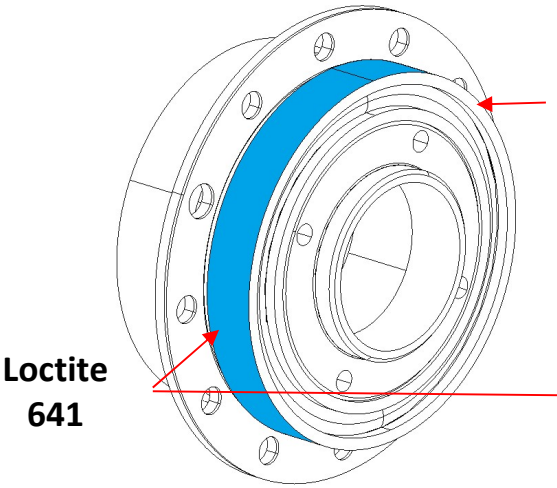
16. Place the shim into Arm #4. Make sure the shim is level and centered in the arm.

17. Align the Joint #5 Reduction Gear Pulley & Bearing unit's shim and flange two large holes.

18. Apply Loctite 641 to the outside of the pulley unit bearing
    Note: Apply evenly to center of bearing. When bearing is placed in Arm #4 the Loctite will evenly disperse.
    Note: Loctite requires approx. 8 hours to firmly bond.

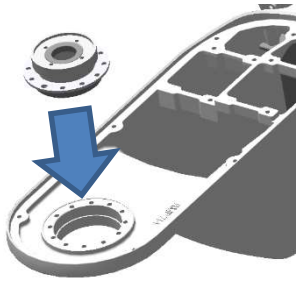


Joint #5 Reduction Gear Pulley & Bearing Unit



Level 3

6-2 Replacing Joint #5 Reduction Gear Unit



16. Place the pulley unit into Arm #4 while aligning the bolt holes with the shim and flange holes.

17. Place two M3x22 bolts into Arm #4.

18. Attach Arm #5 to Arm #4 while firmly pressing the pulley unit's bearing evenly into Arm #4
    Note: Align the bolts with the longside of the Flexspline bolt holes.
    Caution: Be careful of the O-ring. Misalignment may occur and will damage or cut the O-ring.

19. Loosely tighten the two bolts until Arm #5 is held by the bolts but the wave washer is not fully pressed and can move.

Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

20. Prepare the Joint #5 Wave Washer Centering Jigs.

21. Place the jigs on opposite sides of the bolts. The jigs should be placed inside the flange and shim to center the wave washer.

22. Pre-tighten the two M3 bolts gradually then remove the jigs once the wave washer is held in place.

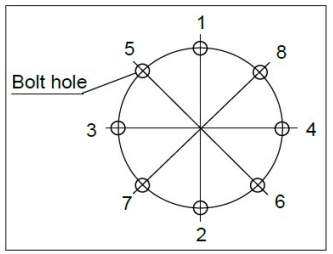
23. Pre-tighten the two more M3 bolts gradually until Arm #5 is held in place.

24. Check whether the wave washer is centered correctly. Turn the pulley and feel whether it turns smoothly. If grating or catching occurs the wave washer is not centered correctly. In this case loosen the bolts and re-center again with the jigs.

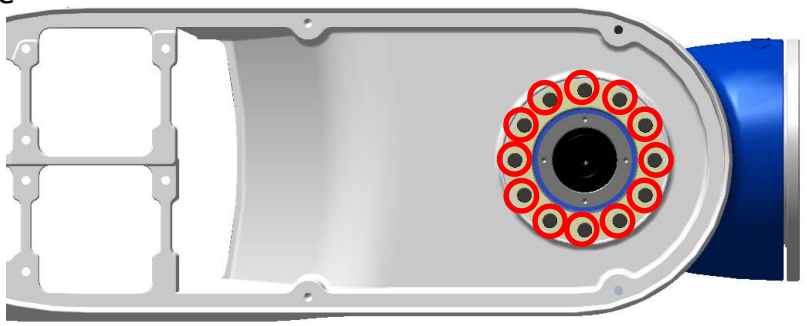
25. Replace the remaining reduction gear 12 fixing bolts
    Note: Tighten in a crisscross pattern

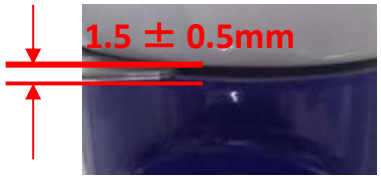
    Hexagon socket head cap bolts: 12-M3x22
    Tightening Torque: 2.4±0.1N・m

    Note: Gap between Arm #4 and Arm #5 should be even around the entire joint. (approx.. 1.5 ± 0.5mm)



Wave Washer Centering Jig





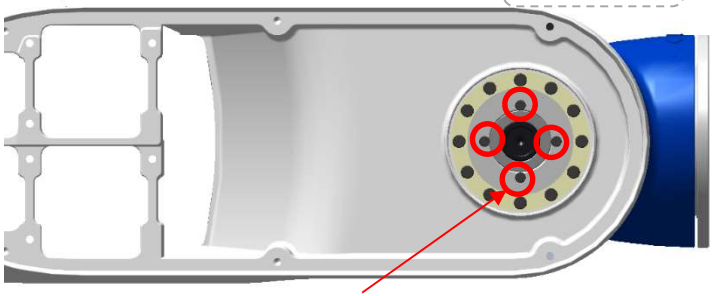
Level 3

Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

26. Replace the Joint #5 Reduction Gear side pulley. Align bolt holes with Waveform Generator bolt holes.
    Hexagon socket head cap bolts: 4-M2.5x25
    Tightening Torque: 1.0±0.1N・m

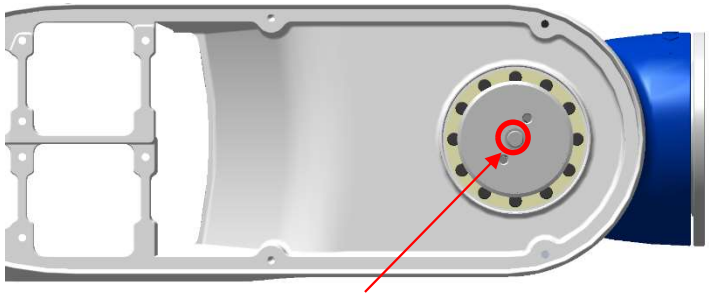
    Note: To stop the pulley turning the timing belt can be used to hold the pulley in place



Joint #5 Reduction Gear Side Pulley

27. Turn the pulley and feel whether it turns smoothly. If grating or catching occurs the wave washer is not centered correctly or the reduction gear is not centered correctly. In these case perform replacement procedure again.

28. Replace the Joint #6 reduction gear side pulley.



Joint #6 Reduction Gear Side Pulley

    Hexagon socket head cap bolts with washer: 1-M4x15
    Tightening Torque: 4.0±0.2N・m

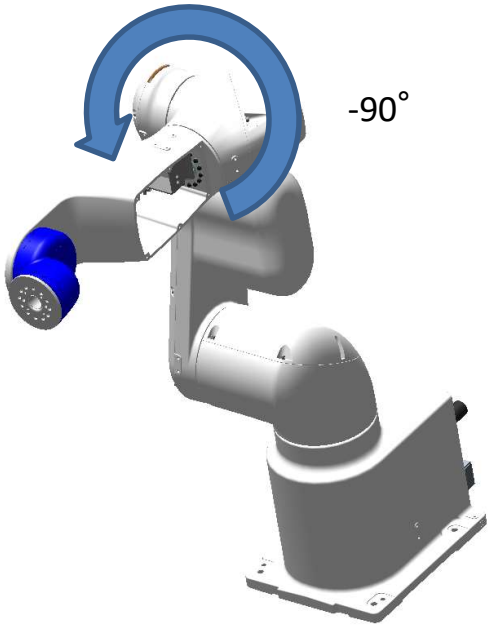
    Note: Apply Loctite 242 to the bolt end
    (Loctite Depth: 3mm from bolt tip)

    Note: Use the pulley holding jig to fix the pulley in place while tightening

6-2 Replacing Joint #5 Reduction Gear Unit

29. Move Arm #4 to a -90° to the 0 pulse position.
    Note: Use either of the below methods
    1. Release the Joint #4 Motor Unit brake by connecting a 24V power supply directly to the brake connector
    2. Loosen the fixing bolts of the Joint #4 motor unit and remove the Timing Belt.

    Caution: Method 2 will require re-tensioning of the Joint #4 timing belt and calibration of Joint #4



30. Replace the Joint # 5 Motor Unit and Joint #5 Timing Belt

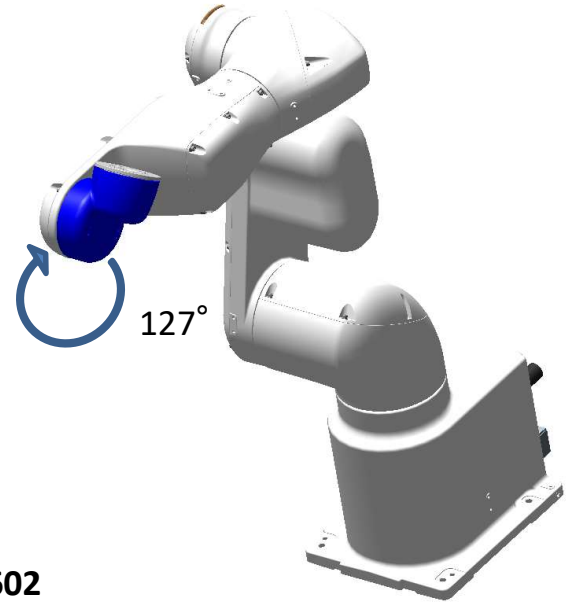
    For Details, refer to Manipulator Manual
    Maintenance: 13.3 Replacing Joint #5 Timing Belt.

31. Replace the Joint # 6 Motor Unit and Joint #6 Timing Belt

    For Details, refer to Manipulator Manual
    Maintenance: 14.3 Replacing Joint #6 Timing Belt.

Level 3

6-2 Replacing Joint #5 Reduction Gear Unit



32. Next rough calibration must be performed on Joint #5
33. Using the RC+ Command Window calibrate the manipulator accordingly
34. Release the Joint #5 brake and move it in a + direction to the mechanical stopper.
    Command: Brake off, 5
35. Apply the Joint #5 brake.
    Command: Brake on, 5
36. Next reset the Joint #5 encoder
    Command: Encreset 5
37. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
38. Output the current Calpls value.
    Command: Calpls
39. Copy the Calpls value to Calpls command and make sure Joint #5 is **4672602** and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
40. Execute Calib to calculate HOFs
    Command: Calib 5
41. Next rough calibration must be performed on Joint #6.

42. Move Joint #5 to 0 pulse position.
    Command: Pulse 0,0,0,0,0,0

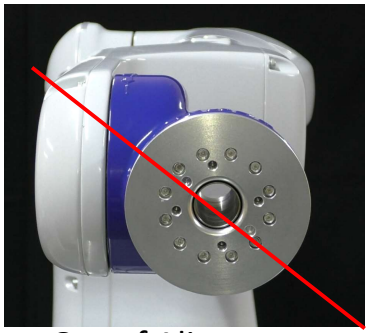
6-2 Replacing Joint #5 Reduction Gear Unit

43. Joint #6 will need to be moved back to 0 pulse position. This can be performed by releasing the Joint #6 brake and moving the joint to the 0 pulse position as shown in the maintenance manual.
    Command: Brake off, 6
    Note: Please take note of pin holes for guidance.

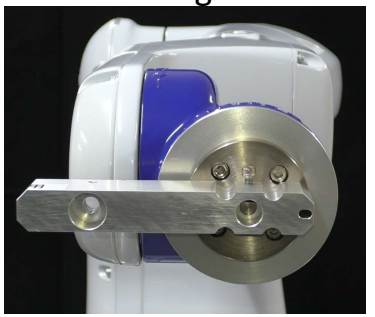
44. Attach the Joint #6 Calibration Jigs to the Flange.

45. Place a level on the jigs. **(Level Accuracy: 0.5mm/m)**

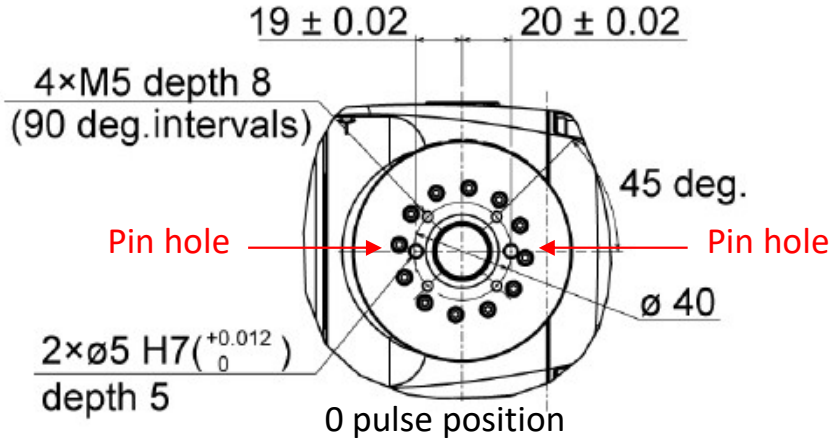
46. Move Joint #6 until the level bubble is centered.
    Caution: Make sure the table the manipulator on is also level.



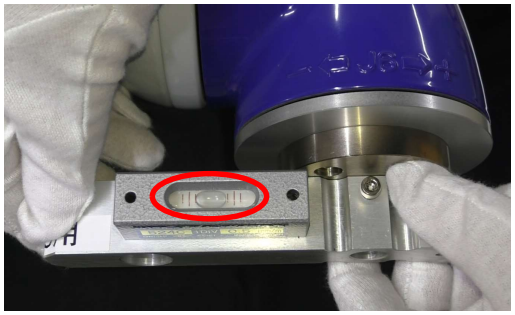
Out of Alignment



Joint #6 Calibration Jigs



0 pulse position



Joint #6 Level

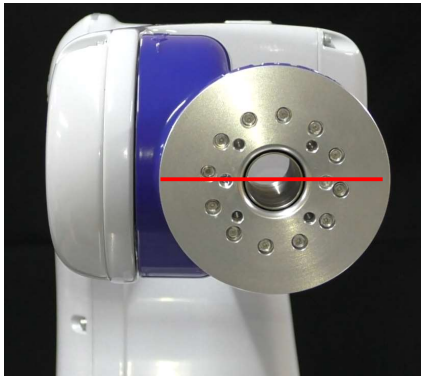
0.5mm/m Level

Level 3

6-2 Replacing Joint #5 Reduction Gear Unit

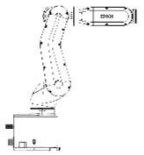
47. Once leveled turn the Joint #6 brake ON and remove the Level and Joint #6 jigs.
    Command: Brake On, 6
48. Reset the Joint #6 encoder.
    Command: Encreset 6
49. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
50. Output the current Calpls value.
    Command: Calpls
51. Copy the Calpls value to Calpls command and make sure Joint #6 is 0 and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
52. Execute Calib to calculate HOFs
    Command: Calib 6
53. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

54. Next test Joint #5 and Joint #6 in low and high power mode. Check for any abnormalities. If there are none you are finished.



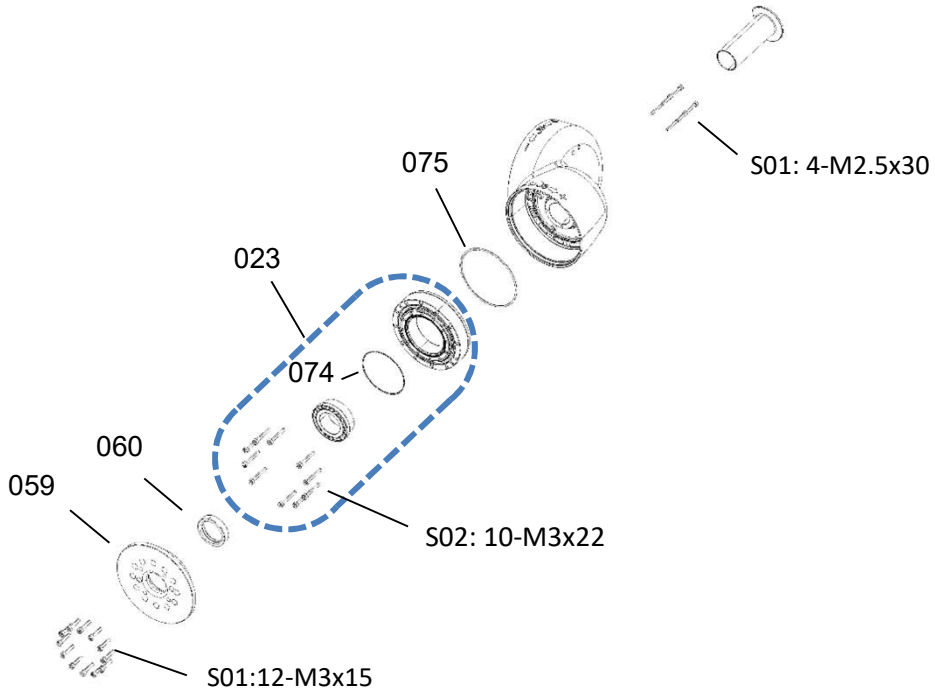
Correct 0 pulse position

1.7. Joint #6 Reduction Gear



VT6 Series Joint #6 Reduction Gear ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
023	SHD-17-80-3SH-SP	1768643	d	Reduction Gear J5/J6 included O-ring [1773892]
074	O-RING	1773892	c	64.0X1.5 J5, J6 Flexspline side
075	O-RING	1773893	c	45.4X0.80 J5, J6 Circularspline side
059	FLANGE_J6_LP	1749510	c	J6 Flange
060	Oil Seal	1739284	c	AC1213P1 for J6

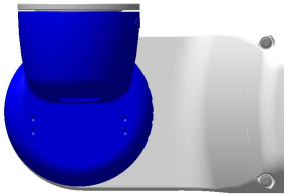


Level 3

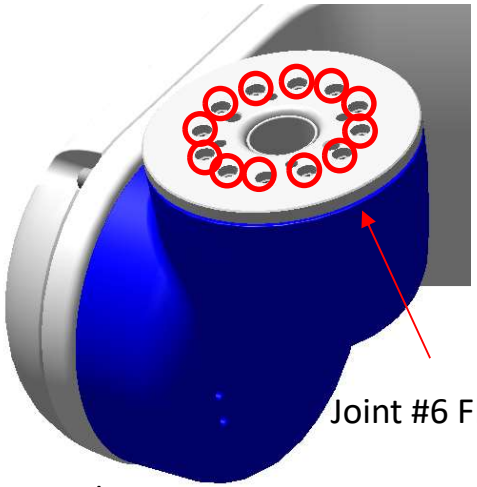
7-1 Removing Joint #6 Reduction Gear Unit

1. Move Joint #5 to a +90° position
2. Remove the Joint #6 Flange
   Hexagon socket head cap bolts: 12-M3x15

   Caution: Be careful of the oil-seal coming away from the flange.



Joint #5 90°



Joint #6 Flange

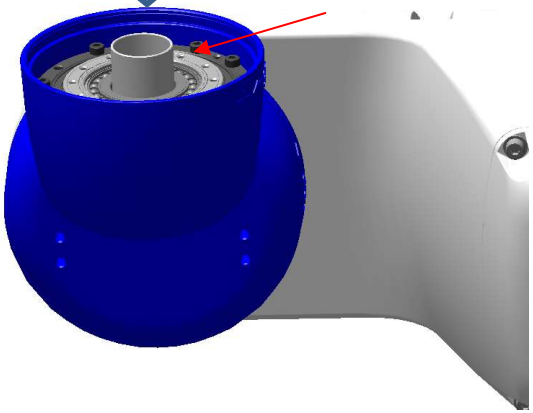
3. Remove the Sleeve from the rear of the J5J6 Unit

   Caution: the Sleeve is held on by liquid gasket and may need extra force to remove.

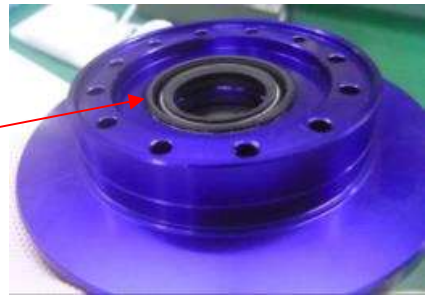
   To remove push with flat of hand from front of Joint #6
   Note: Before replacing clean the old gasket from the Sleeve

Push

Joint #6 Sleeve



Oil-Seal

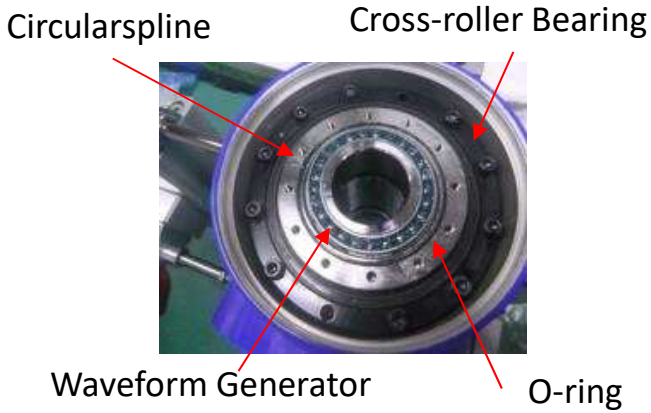


Joint #6 Flange

Level 3

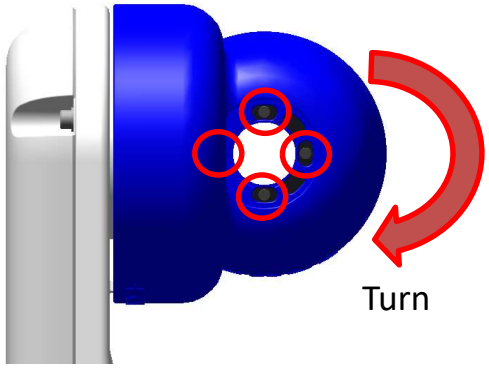
7-1 Removing Joint #6 Reduction Gear Unit

4. Remove the O-ring on the Circularspline
   Caution: The O-ring maybe damaged when removing the reduction gear. When replacing always use the new O-ring included with the new reduction gear unit.



5. Remove the 4 bolts from rear of the J5J6 unit
   Hexagon socket head cap bolts: 4-M2.5x30

   Note: To remove all bolts the joint #6 reduction gear will need to be turned. This can be performed by either of the following:
   1. Apply power to the manipulator and from RC+ use the “Brake Off, 6” command to release the brake to allow the reduction gear to be moved.
   2. If power cannot be applied to the manipulator then removal of the Joint #6 timing belt will allow the reduction gear to be moved via the pulley.



Rear View J5J6 unit

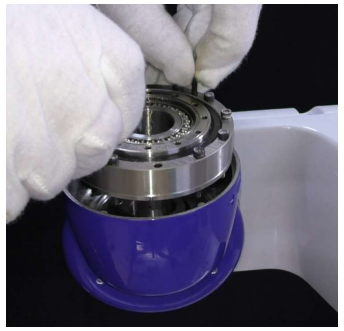
6. Remove the Reduction Gear 10 fixing bolts holding the unit in the arm.
   Hexagon socket head cap bolts:10-M3x22

Level 3

7-1 Removing Joint #6 Reduction Gear Unit

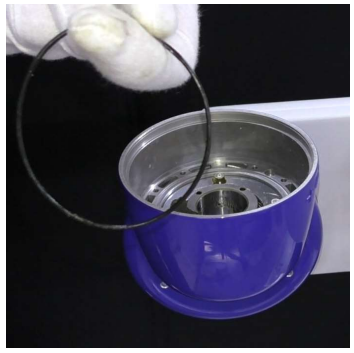
7. Remove the Reduction Gear Unit from the J5J6 unit.
   Caution: Be careful of the O-ring underneath on the cross-roller bearing side when removing. The O-ring can be re-used when replacing the unit.

   Note: The reduction gear unit can be pulled out by attaching two bolts to the two M3 bolt holes in the cross-roller bearing allowing the unit to be leveraged out.



8. Remove the O-ring from on the J5J6 unit
   Caution: The O-ring maybe damaged when removing the reduction gear. When replacing always check the O-ring for damage or stretching.

9. Clean the old grease from the J5J6 unit.



Level 3

7-2 Replacing Joint #6 Reduction Gear Unit

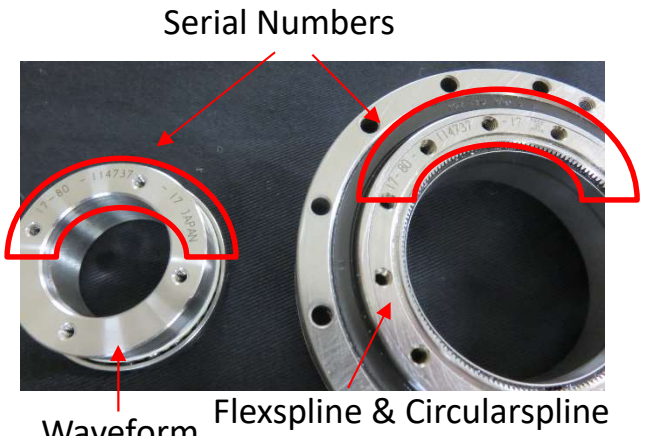
1. Before replacing with the new reduction please check the serial numbers match each of the parts and are the same numbers.

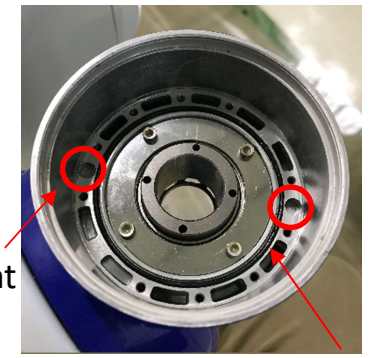
2. New reduction gears have rustproof oil applied to them. Please clean the reduction gear before applying new grease.

3. Make sure the J5J6 unit is clear of dust or unwanted particles. These may enter the reduction gear causing extra heat which may lead to damage of the reduction gear.

4. Place the O-ring into the J5J6 unit
   Caution: The O-ring maybe damaged when removing the reduction gear. When replacing always check the O-ring for damage or stretching.

5. Attach to M3 bolts to the cross-roller bearing . This will allow easy replacement of the reduction gear. Also the bolts will allow alignment of the placement holes in the J5J6 unit.
   Caution: Be careful of the O-ring when placing the reduction gear. Be sure it does not catch or move from placement position.

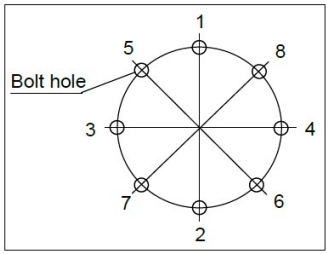




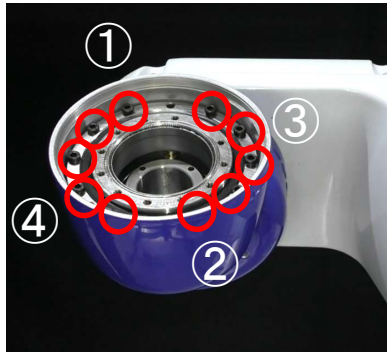
Level 3

7-2 Replacing Joint #6 Reduction Gear Unit

6. Replace the reduction gear 10 fixing bolts
   Note: Tighten in a crisscross pattern
   Hexagon socket head cap bolts: 10-M3x22
   Tightening Torque: 2.4±0.1N･m

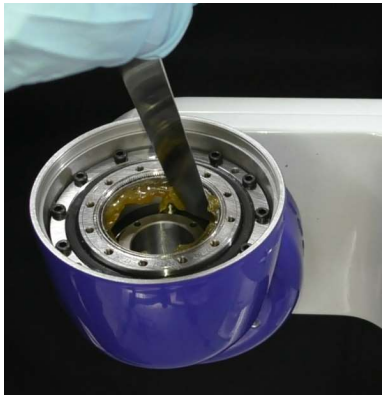


Crisscross Example



7. Apply SK-2 grease to inside of Flexspline.
   Note: Make sure the grease is applied evenly around the inside surface of the Flexspline.

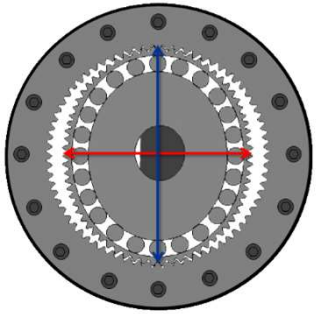
   Grease: 5~6g SK-2

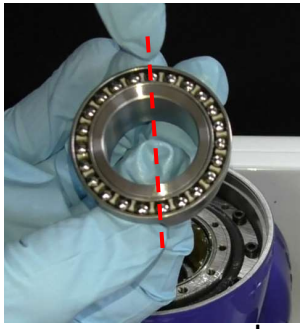


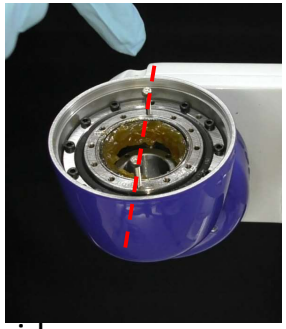
8. Align the 4 bevel gear bolt holes and the 4 Waveform Generator fixing holes.

9. Place Waveform Generator into Flexspline.
   Note: Make sure the **longside** of the Waveform Generator and Flexspline match when placing.

Shortside


Longside

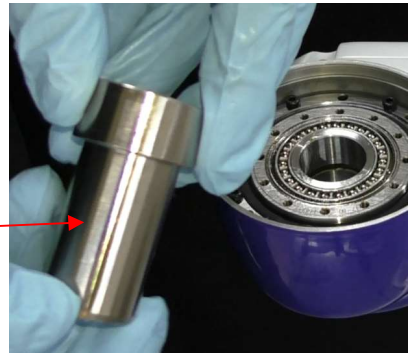



Longside

Level 3

7-2 Replacing Joint #6 Reduction Gear Unit

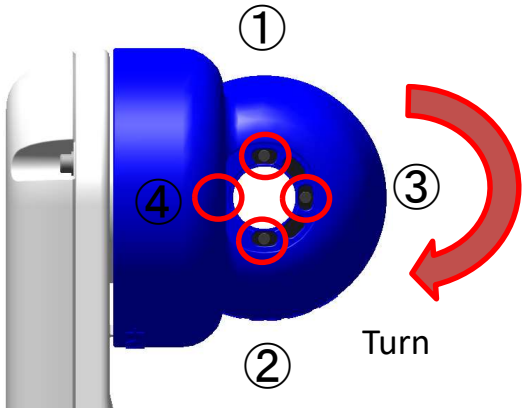
10. Place Joint #6 Centering Jig to center Waveform Generator and bevel gear.



Joint #6
Centering Jig

11. Replace the 4 fixing bolts to rear of J5J6 unit.
    Caution: Tighten each bolt in crisscross pattern to ensure the Waveform Generator is centered correctly.
    Note: The bevel gear will need to be turned to allow correct alignment. This can be performed by either releasing the Joint #6 brake or by moving the Joint #6 pulley.

    Hexagon socket head cap bolts: 4-M3x30
    Tightening Torque: 1N±0.1N・m



Level 3

7-2 Replacing Joint #6 Reduction Gear Unit

12. Apply a little SK-2 grease to the O-ring and replace the O-ring onto the Circularspline.

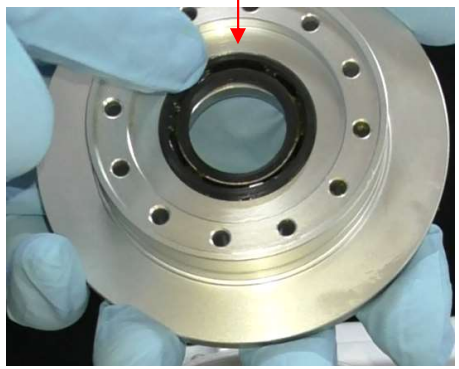
13. Apply SK-2 grease to the Waveform Generator surface.
    Caution: Make sure the grease is applied evenly and within the O-ring. Applying with a syringe is recommended.

    Grease: 1~1.5g SK-2

Note: In the case the oil-seal is not in the flange. Apply SK-2 grease to Oil Seal outside to help press back into flange.

Grease: A small amount SK-1A

Oil Seal

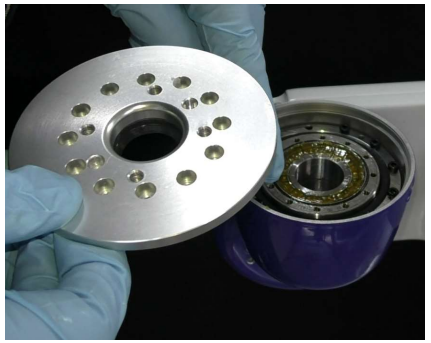


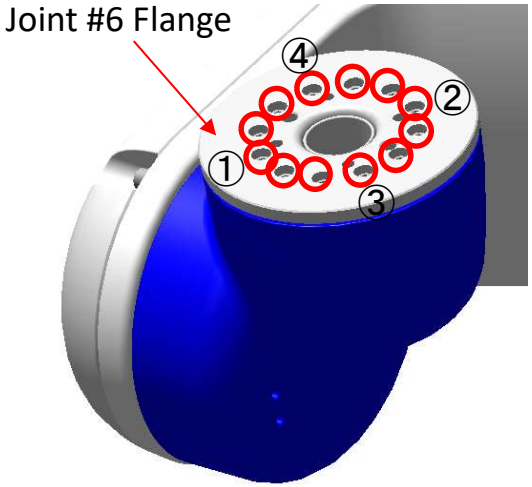
Level 3

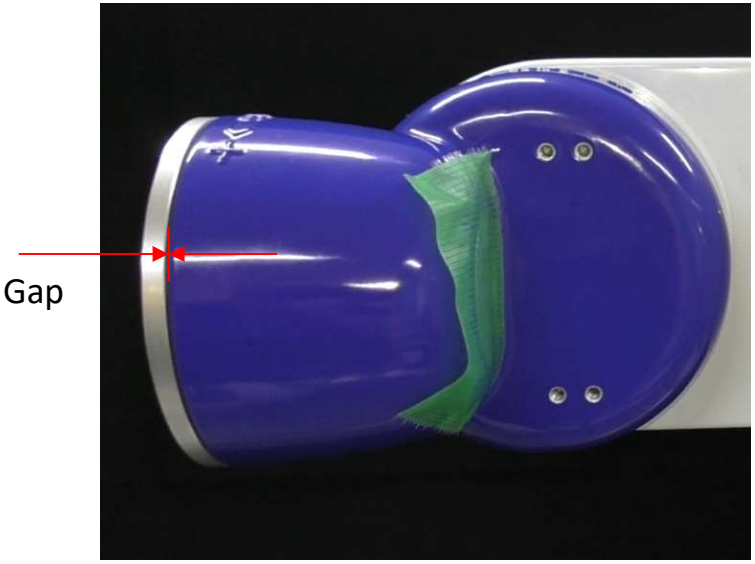
7-2 Replacing Joint #6 Reduction Gear Unit

15. Attach the Joint #6 Flange onto the J5J6 unit.
    Caution: Be careful of the O-ring when attaching. Make sure the flange bolt holes are aligned correctly when placing.
16. Replace the 12 fixing bolts to the flange and tighten with a crisscross pattern.
    Hexagon socket head cap bolts: 12-M3x15
    Tightening Torque: 2N±0.1N

    Note: The gap around the Joint #6 Flange and the J5J6 unit should be even and **1.0 ± 0.5mm.** Check at 4 points 90° each for levelness.



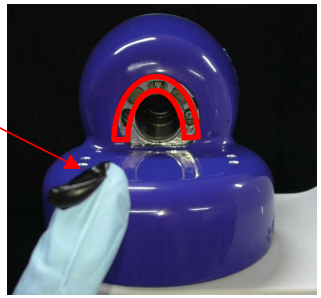




7-2 Replacing Joint #6 Reduction Gear Unit

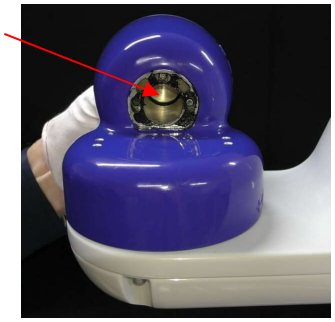
17. Apply Liquid Gasket 1207B to the rear of the J5J6 unit where the Joint #6 Sleeve will sit.
    Caution: Wipe away any excess gasket from the surface of the manipulator before it dries.
    Liquid Gasket: 0.2 ~ 0.3g 1207B

Liquid Gasket



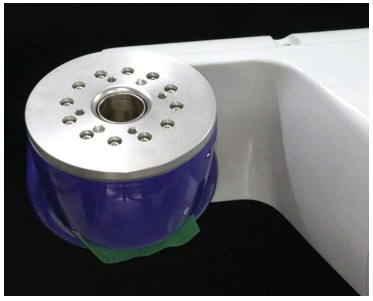
18. Insert the Joint #6 Centering Jig into the front of the flange. Push until the Oil Seal is open.

Centering Jig



19. Next insert the Joint #6 Sleeve into the rear of the J5J6 unit. Push the firmly until it is attached to the J5J6 unit and the Centering Jig is pushed out from the flange by the Joint #6 Sleeve. The Joint #6 Sleeve should be centered within the oil seal

20. Clean any excess gasket from the manipulator and tape the back of the rear of the J5J6 unit. Liquid Gasket will require approx.. **8 Hours** to be completely dry. However the manipulator may be tested and calibrated after **approx.. 1 hour.**



Level 3

Level 3

7-2 Replacing Joint #6 Reduction Gear Unit

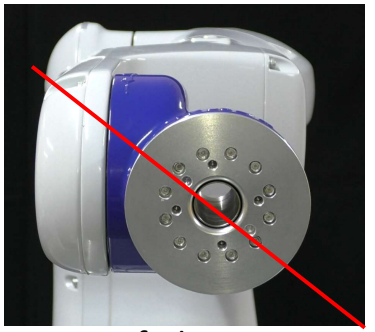
21. Next rough calibration must be performed on Joint #6. Return J5 to 0 pulse position.

22. Joint #6 will need to be moved back to 0 pulse position. This can be performed by releasing the Joint #6 brake and moving the joint to the 0 pulse position as shown in the maintenance manual.
    Note: Please take note of pin holes for guidance.

23. Attach the Joint #6 Calibration Jigs to the Flange.

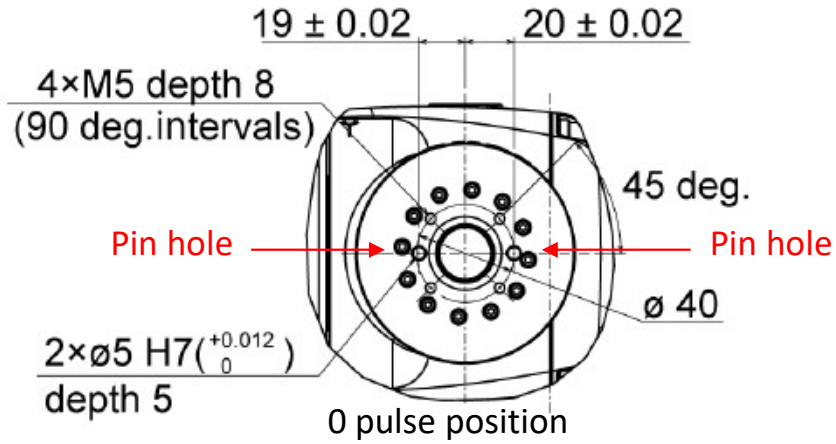
24. Place a level on the jigs. **(Level Accuracy: 0.5mm/m)**

25. Move Joint #6 until the level bubble is centered.
    Caution: Make sure the table the manipulator on is also level.

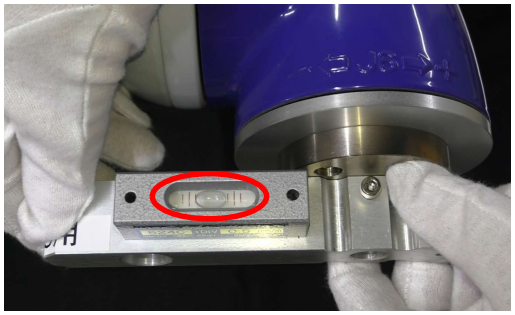


Out of Alignment

Joint #6 Calibration Jigs



0 pulse position



Joint #6 Level

0.5mm/m Level

Level 3

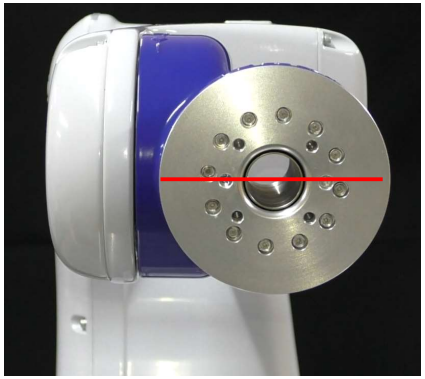
7-2 Replacing Joint #6 Reduction Gear Unit

26. Once leveled turn the Joint #6 brake ON and remove the Level and Joint #6 jigs.

27. Next using RC+ Command Window calibrate the manipulator accordingly.

28. Reset the Joint #6 encoder.
    Command: Encreset 6
29. Reset the controller from RC+ Tools⇒Maintenance⇒Reset Controller
30. Output the current Calpls value.
    Command: Calpls
31. Copy the Calpls value to Calpls command and make sure Joint #6 is 0 and execute Calpls. *(Example at Shipment)*
    Command: Calpls 8538405, 4119406, -2598624, 0, 4672602, 0
32. Execute Calib to calculate HOFs
    Command: Calib 6
33. The manipulator is calibrated. For Advanced calibration please follow the procedure in the Maintenance Manual using a customer's teaching point.

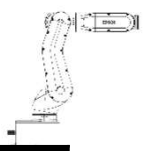
34. Next test Joint #6 in low and high power mode. Check for any abnormalities. If there are none you are finished.



Correct 0 pulse position

1.8. Motor Unit Parts Replacement

Level 4

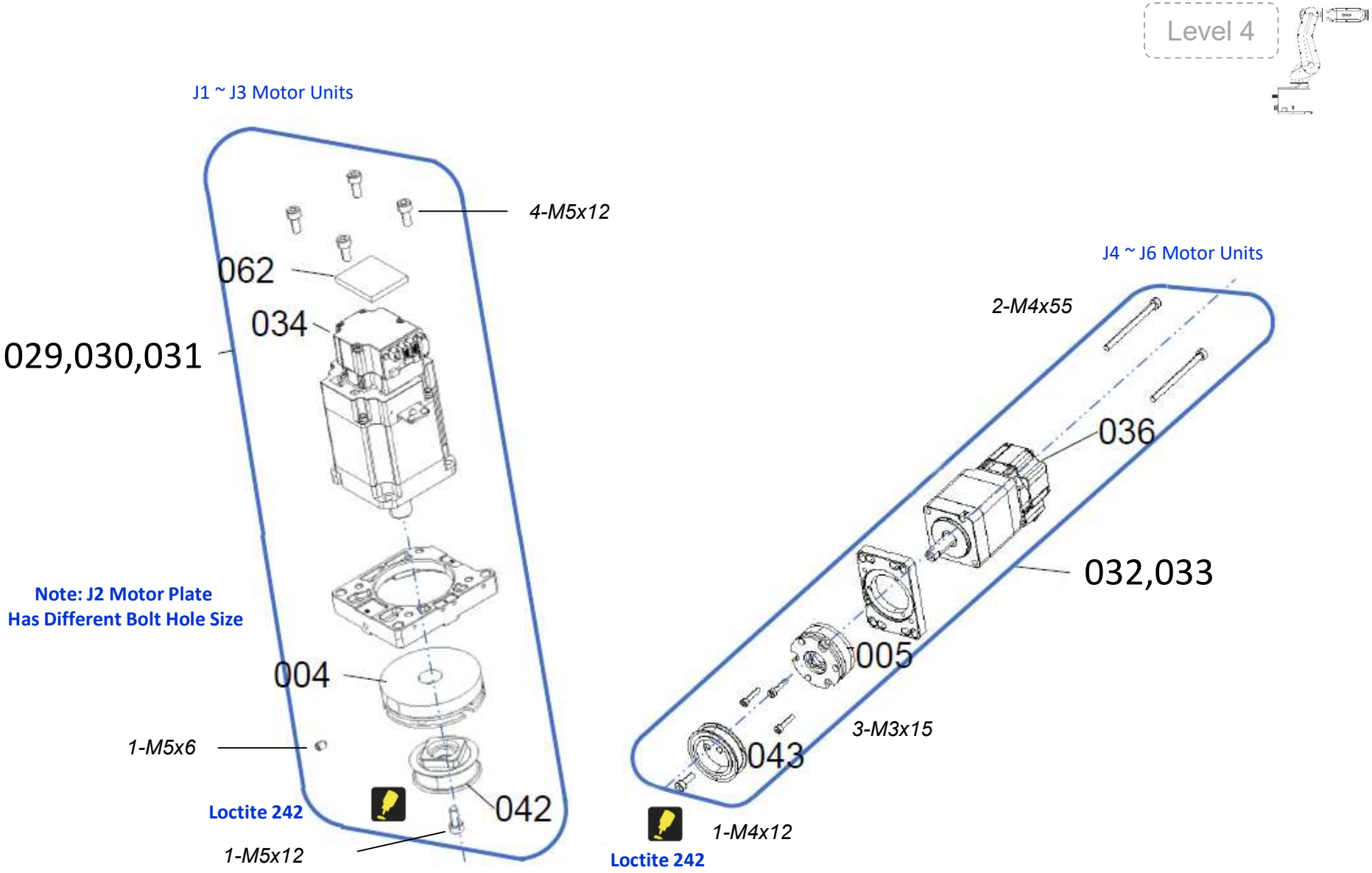


VT6 Series Motor Unit ASP:

VT6 Diagram Ref No.	Parts Name	Code	Replacement Rank	Notes
029	LP_J1_MOTOR_UNIT	2194596	b	Incl. Pulley, Brake, Motor 300W, Motor plate
030	LP_J2_MOTOR_UNIT	2194597	b	Incl. Pulley, Brake, Motor 300W, Motor Plate
031	LP_J3_MOTOR_UNIT	2194598	b	Incl. Pulley, Brake, Motor 200W, Motor Plate
032	LP_J4_MOTOR_UNIT	2194599	b	Incl. Pulley, Brake, Motor 100W, Motor Plate
033	LP_J5_MOTOR_UNIT	2194600	b	Incl. Pulley, Brake, Motor 100W, Motor Plate, Terminator Switch OFF
	LP_J6_MOTOR_UNIT	2194601	b	Incl. Pulley, Brake, Motor 100W, Motor Plate, Terminator Switch ON
034	AC_SERVO_MOTOR_300W_Y/SE-301-722V	2193760	c	Motor Only
035	AC_SERVO_MOTOR_200W_Y/SE-201-622	2188570	c	Motor Only
036	AC_SERVO_MOTOR_100W_Y/SE-101-522	2188571	c	Motor Only
042	J123_MOTOR_PULLEY_LP	1749493	c	Pulley for J1, J2, J3 Motor Unit
043	J456_MOTOR_PULLEY_LP	1749501	c	Pulley for J4, J5, J6 Motor Unit
004	Electromagnetic Brake	1654165	c	MCNB10-59 Brake for J1, J2, J3
005	ASP/Brake	1670649	c	MCNB3-45 Brake for J4, J5, J6
062	HEAT CONDUCTIVE SHEET2 LP	1755573	c	For J1,J2,J3 Encoder

	Jig	Parts Name	Code	Replacement Rank	Total Parts
3-9	J6 Pully Fixing Jig	Rotation Preventing JIG for J6 Pulley	1829116	c	1

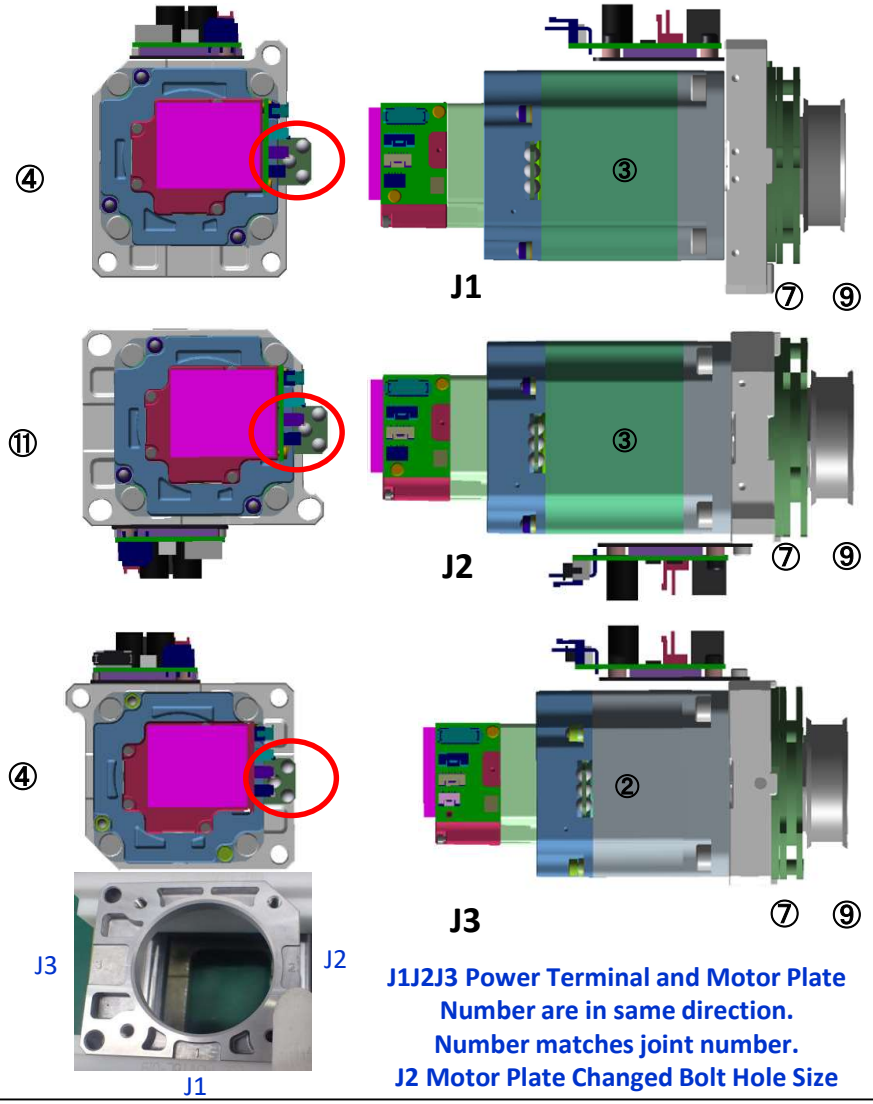
Level 4


J1 ~ J3 Motor Units
4-M5x12
062
034
029,030,031
Note: J2 Motor Plate
Has Different Bolt Hole Size
004
1-M5x6
Loctite 242
042
1-M5x12
J4 ~ J6 Motor Units
2-M4x55
036
032,033
005
3-M3x15
043
1-M4x12
Loctite 242

Level 4

VT6 Series Motor Unit:

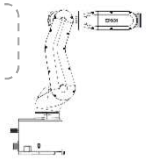
Refer to table on following page part reference number.



J1J2J3 Power Terminal and Motor Plate Number are in same direction.
Number matches joint number.
J2 Motor Plate Changed Bolt Hole Size

J5J6 Power Terminal and Motor Plate groove are in same direction.
J4 motor plate groove is in the opposite direction.

Level 4



Motor Unit Shared Parts List:

Ref. No.	Parts	Parts Name	J1	J2	J3	J4	J5	J6	Same As
①	Motor 100W	SE-101-522	-	-		✔	✔	✔	T3/T6
②	Motor 200W	SE-201-622	-	-	✔	-	-	-	T3/T6
③	Motor 300W	SE-301-722V	✔	✔	-	-	-	-	T6
④	Motor Plate	J123_MOTOR_PLATE_LP	✔	△	✔	-	-	-	
⑪		MOTOR_PLATE_LP	-	✔	-	-	-	-	Fixing Bolt hole diameter changed (larger)
⑤		J456_MOTOR_PLATE_LP	-	-	-	✔	✔	✔	
⑥	Brake	MCNB10-59	✔	✔	✔	-	-	-	C8
⑦		MCNB3-45				✔	✔	✔	C8
⑧	Pulley	J123_MOTOR_PULLEY_LP	✔	✔	✔	-	-	-	
⑨		J456_MOTOR_PULLEY_LP				✔	✔	✔	
⑩	THERMAL SHEET	HEAT CONDUCTIVE SHEET2 LP	✔	✔	✔	-	-	-	

✔ Utilizes Part
\- Does not utilize part
△ Part Changed

Level 4

8-1 Removing Joint #1 ~ #3 Motor Unit Parts

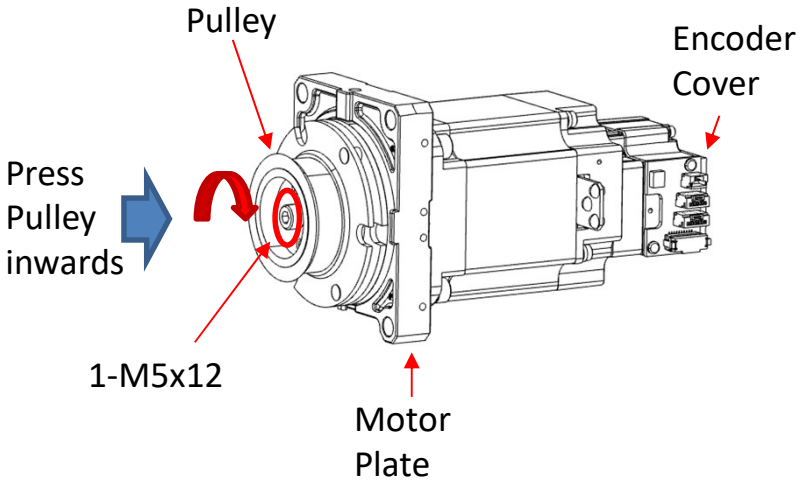
1. Remove the pulley.

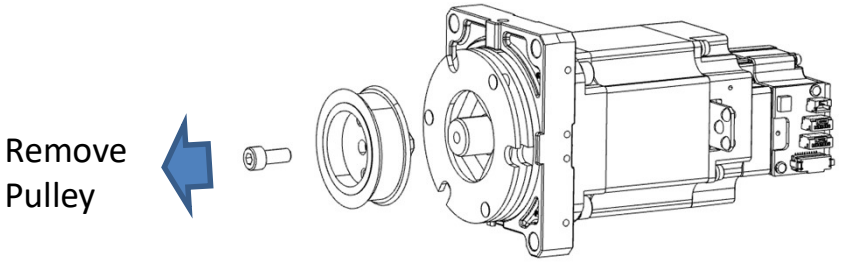
Hexagon socket head cap bolts: 1-M5x12

Note: The pulley is attached to the motor shaft. When the fixing bolt is turned the motor shaft will also turn. The motor must be held in place by the Motor Plate. Use of the Pulley Fixing Jig should be used to stop the pulley from turning. However pressure must be applied to the pulley to lock the motor shaft and allow the fixing bolt to be fully removed.

Caution:
The bolt is held with Loctite and may damage when removing.

Caution:
Do not apply pressure to the Encoder cover or damage will be caused to the motor unit.



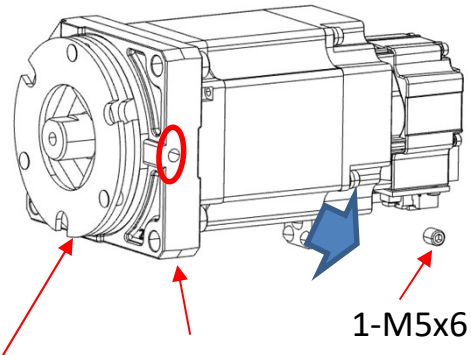


Level 4

8-1 Removing Joint #1 ~ #3 Motor Unit Parts

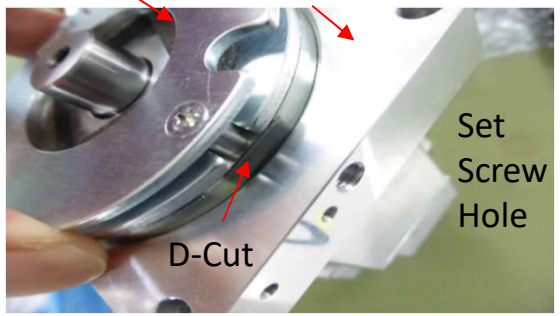
2. Remove the Brake set screw.

   Hexagon socket set screw: 1-M5x6
   Caution: The bolt is held with Loctite and may damage when removing.

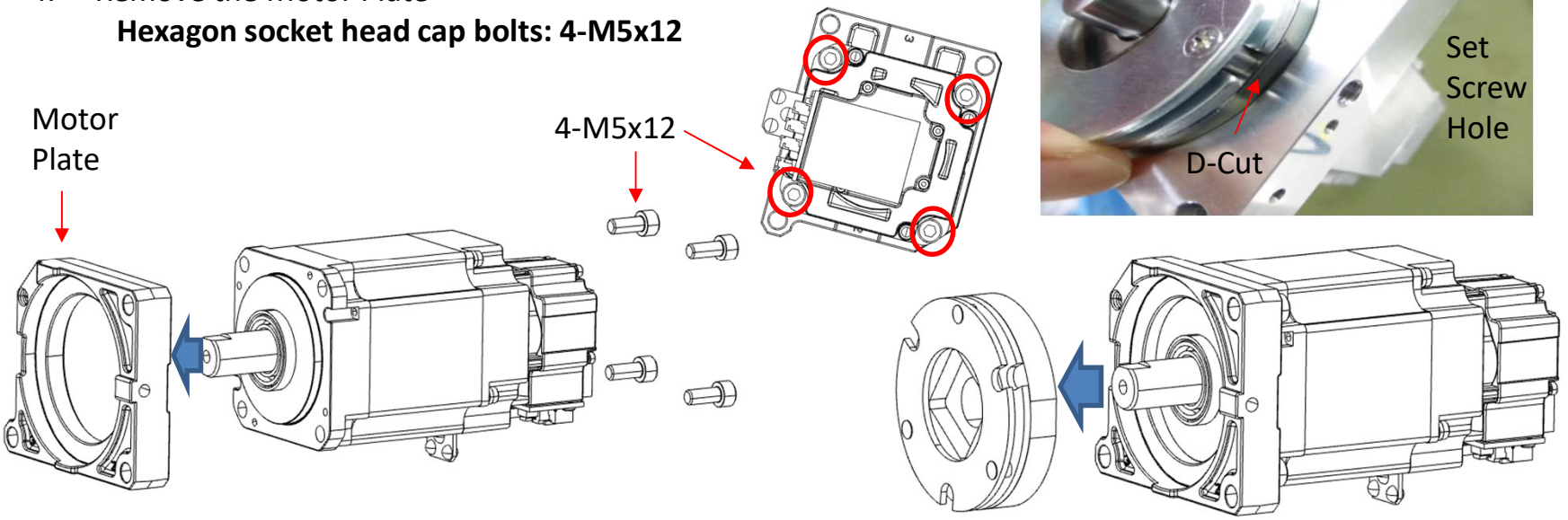


3. Remove the brake

   Note: The brake hub is part of the Pulley. Once the set screw is removed the brake should be easily removed.



4. Remove the Motor Plate
   Hexagon socket head cap bolts: 4-M5x12



Level 4

8-2 Removing Joint #4 ~ #6 Motor Unit Parts

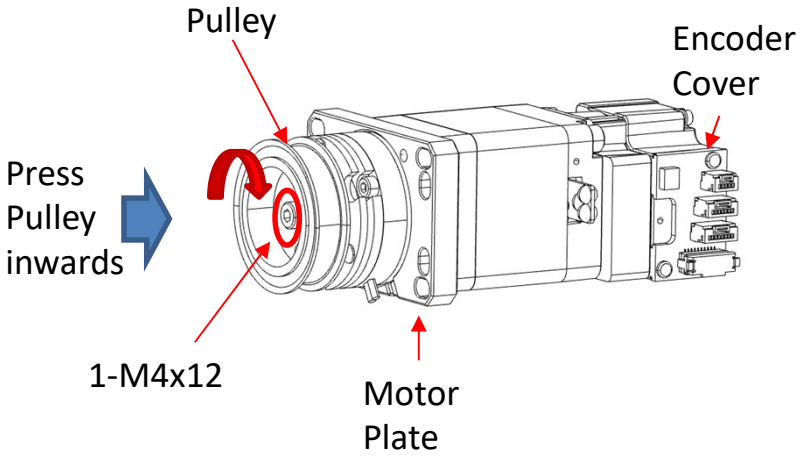
1. Remove the pulley.

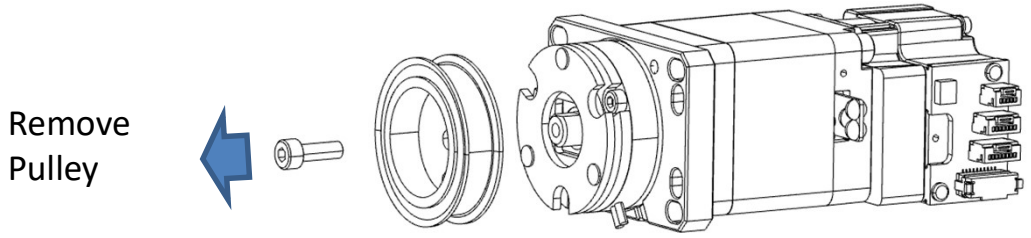
Hexagon socket head cap bolts: 1-M4x12

Note: The pulley is attached to the motor shaft. When the fixing bolt is turned the motor shaft will also turn. The motor must be held in place by the Motor Plate. Use of the Pulley Fixing Jig should be used to stop the pulley from turning. However pressure must be applied to the pulley to lock the motor shaft and allow the fixing bolt to be fully removed.

Caution:
The bolt is held with Loctite and may damage when removing.

Caution:
Do not apply pressure to the Encoder cover or damage will be caused to the motor unit.





Level 4

8-2 Removing Joint #4 ~ #6 Motor Unit Parts

2. Remove the Brake fixing bolts.

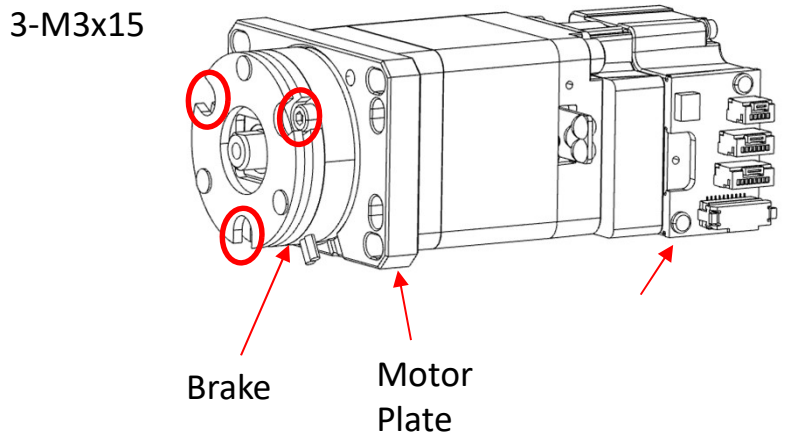
   Hexagon socket set screw: 3-M3x15

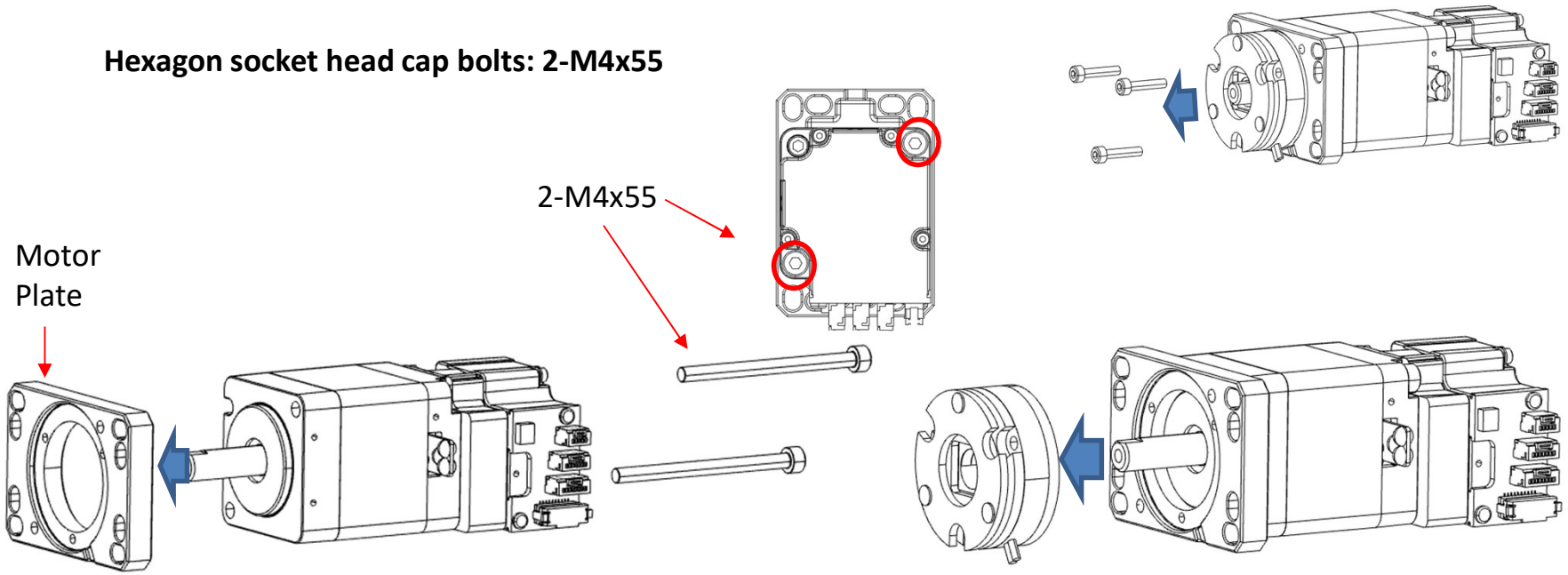
3. Remove the brake

   Note: The brake hub is part of the Pulley. Once the set screw is removed the brake should be easily removed.

4. Remove the Motor Plate

   Hexagon socket head cap bolts: 2-M4x55





Level 4

8-3 Replacing Joint #1 ~ #3 Motor Unit Parts

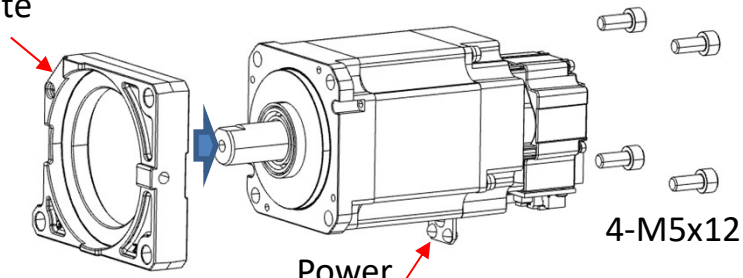
1. Replace the Motor Plate
   Note: Each motor plate position is different depending on the joint. Refer to number on motor plate for motor position.

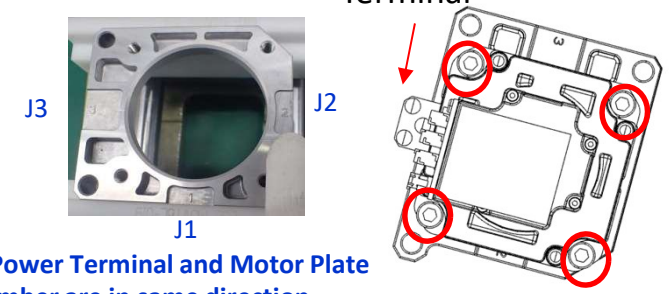
2. Replace the Motor Plate fixing bolts

   Hexagon socket head cap bolts: 4-M5x12
   Tightening Torque: 8.0 ±0.4N·m

3. Replace the brake
   Note: The brake D-Cut should be aligned with the Motor Plate Set screw hole.

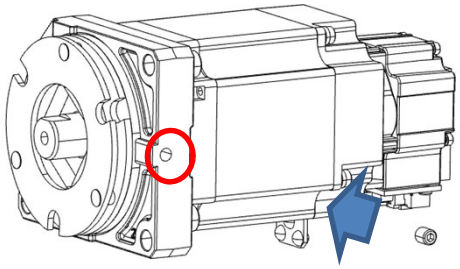
4. Replace the Brake set screw.
   Hexagon socket set screw: 1-M5x6
   Tightening Torque: 4.0 ±0.2N·m
   Apply Loctite 242 to end of set screw

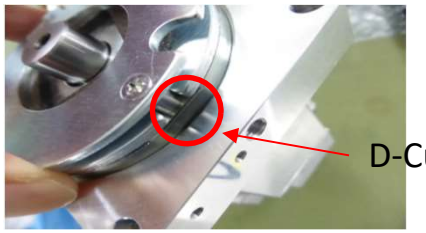




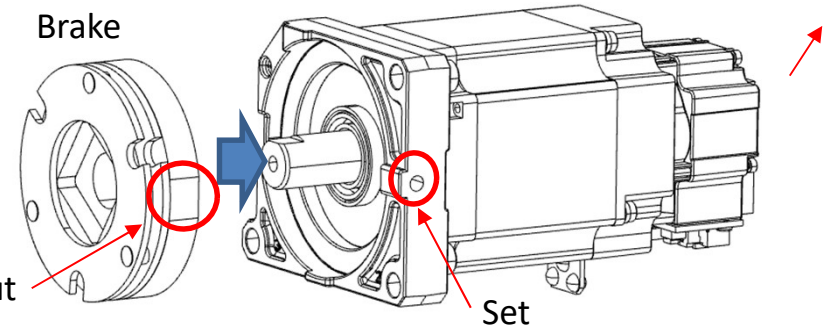
J1J2J3 Power Terminal and Motor Plate Number are in same direction.
Number matches joint number.

Area of Loctite 242 application





1-M5x6 Set Screw



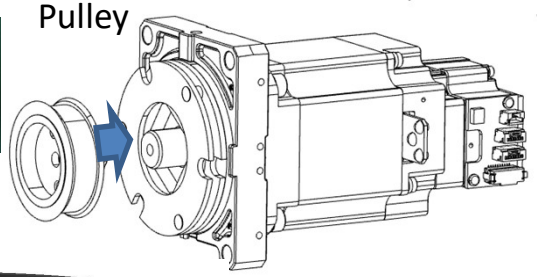
Level 4

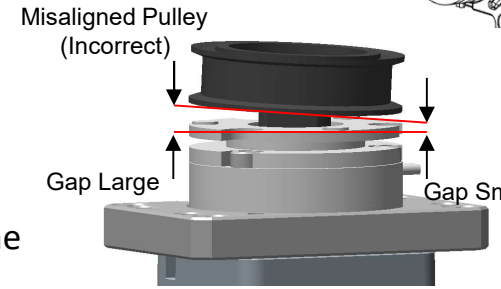
8-3 Replacing Joint #1 ~ #3 Motor Unit Parts

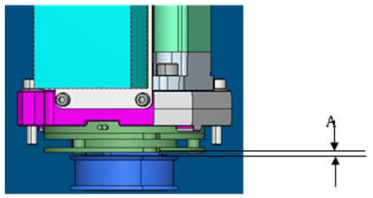
5. Replace the pulley.

   Note: the pulley hub will fit in the brake disc.
   The pulley must be even on all sides or the fixing bolt and brake hub will be misaligned causes damage when fixed by the timing belt.

Parts Clearance	A(mm)
J1/ J2/ J3 Motor Pulley/ Brake	1.3±0.5







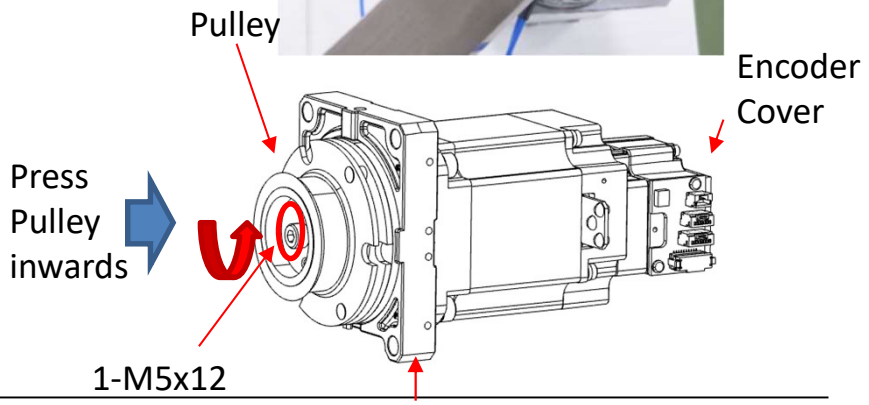
6. Replace pulley fixing bolt

   Note: ***Loctite 242*** needs to be applied the end of the bolt before replacing.

   Hexagon socket head cap bolts: 1-M5x12
   Tightening Torque: 8.0 ±0.4N・m

   Note: The pulley is attached to the motor shaft. When the fixing bolt is turned the motor shaft will also turn. The motor must be held in place by the Motor Plate. Use of the Pulley Fixing Jig should be used to stop the pulley from turning. However pressure must be applied to the pulley to lock the motor shaft and allow the fixing bolt to be fully removed.

   Caution: Do not apply pressure to the Encoder cover or damage will be caused to the motor unit.



8-4 Replacing Joint #4 ~ #6 Motor Unit Parts

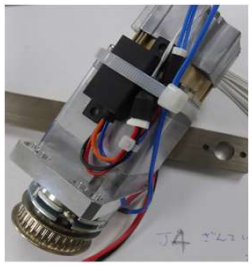
1. Replace the Motor Plate
   Note: Each motor plate position is different depending on the joint. Refer to number on motor plate for motor position.

2. Replace the Motor Plate fixing bolts

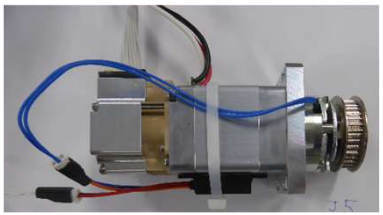
   Hexagon socket head cap bolts: 4-M4x55
   Tightening Torque: 4.0 ±0.2N·m

3. Replace the brake

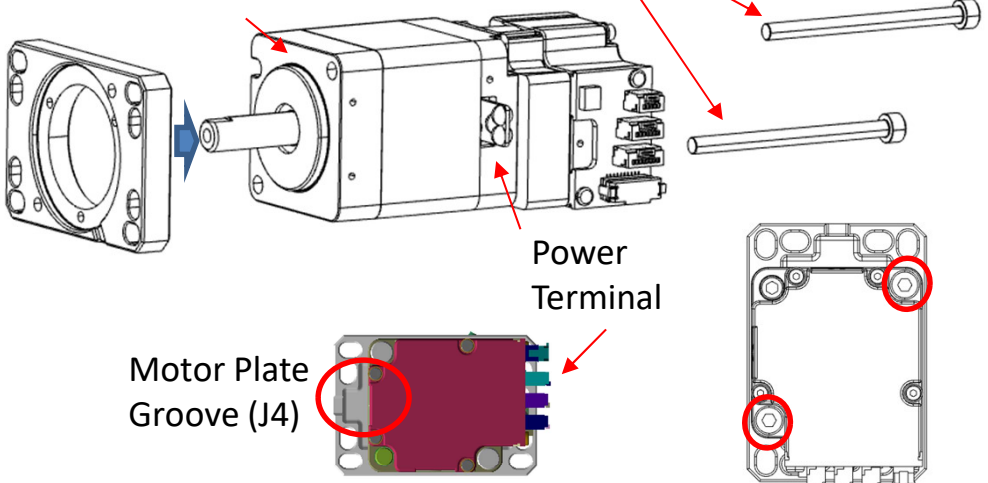
   Note: The J4 brake cable is aligned with the brake cable groove.
   The J5 and J6 cable is aligned in same orientation. However the motor plate is in the opposite direction and the cable does not follow the groove.



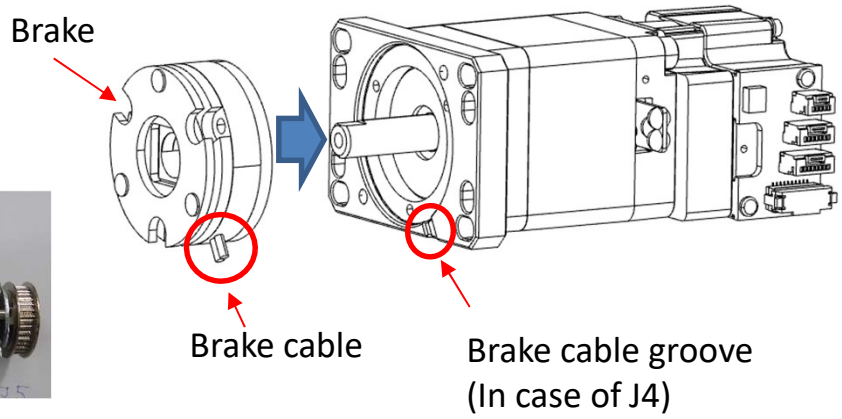
Brake cable J4



Brake cable J5/J6



J5J6 Power Terminal and Motor Plate groove are in same direction.
J4 motor plate groove and Power Terminal is in the opposite direction.

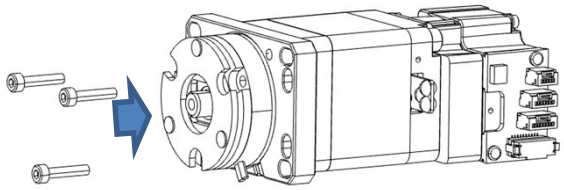


Level 4

8-4 Replacing Joint #4 ~ #6 Motor Unit Parts

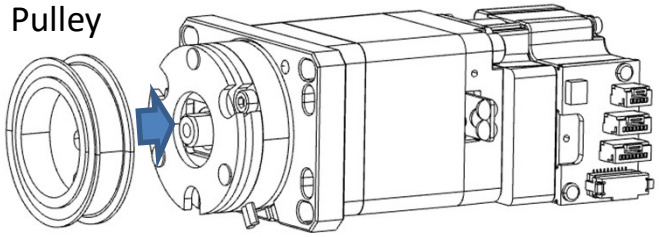
4. Replace the Brake fixing bolts.
   Hexagon socket set screw: 3-M3x15
   Tightening Torque: 2.0 ±0.1N・m

3-M3x15

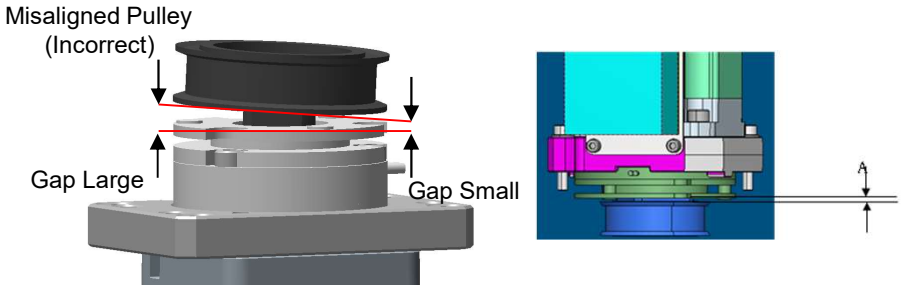


5. Replace the pulley.
   Note: the pulley hub will fit in the brake disc.
   The pulley must be even on all sides or the fixing bolt and brake hub will be misaligned causes damage when fixed by the timing belt.

Replace Pulley



Parts Clearance	A（mm）
J4/ J5/ J6 Motor Pulley/ Brake	3.0±0.5



Level 4

8-4 Replacing Joint #4 ~ #6 Motor Unit Parts

6. Replace pulley fixing bolt

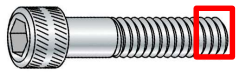
   Note: ***Loctite 242*** needs to be applied the end of the bolt before replacing.

   Hexagon socket head cap bolts: 1-M4x12

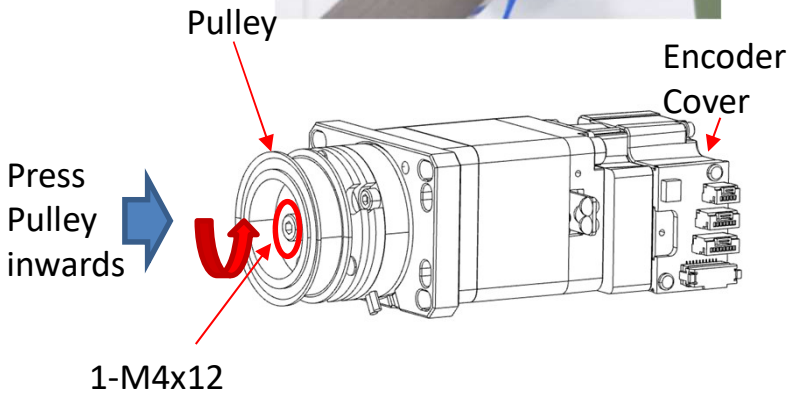
   Tightening Torque: 4.0 ±0.2N・m

   Note: The pulley is attached to the motor shaft. When the fixing bolt is turned the motor shaft will also turn. The motor must be held in place by the Motor Plate. Use of the Pulley Fixing Jig should be used to stop the pulley from turning. However pressure must be applied to the pulley to lock the motor shaft and allow the fixing bolt to be fully removed.

   Caution: Do not apply pressure to the Encoder cover or damage will be caused to the motor unit.



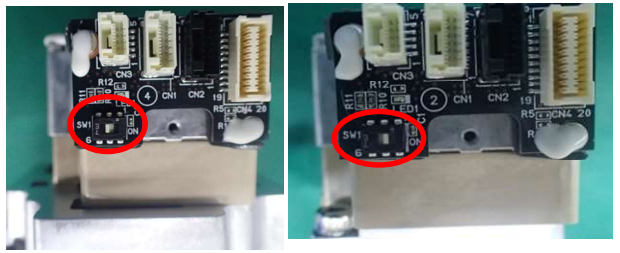
Area of Loctite 242 application



Caution: Depending on whether the motor unit is used for Joint #5 or Joint #6 the Terminator Switch position will change. Please check the switch position is correct for the motor joint.

SW No.	Motor Unit	Switch Setting
1	J1～J5	OFF
2	J6	ON

Terminator Switch



Off On