STEELWRIST

Service manual for Tiltrotators

X04 - X32

700504USC v.2
2019-02-25

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Introduction

General Maintenance

It is important to carry out regular inspections and maintenance to ensure that the tiltrotator functions without problems during its entire service life. All safety instructions must be followed during the maintenance work.

NOTE

When in contact with your supplier or Steelwrist regarding maintenance, service or spare parts it is always good to have the serial number of your tiltrotator available. The serial number is found in EG-försäkran om överensstämmelse 2016 and on the machine plate that is mounted on the tiltrotator.

WARNING

The person who shall carry out inspection, maintenance and service must have sufficient knowledge for carrying out the work in question.

WARNING

Always switch off the machine and pressure-relieve the hydraulic system before maintenance and repair work.

CAUTION

When using spare parts, original Steelwrist spare parts should be used. Steelwrist is not responsible for non-original spare parts and their impact on other parts of the product.

Table 1. Intervals for maintenance and lubrication

Time	Carried out by	Documented in the service protocol
On delivery of the machine	Installer	-
Daily	Operator	-
Weekly	Operator	-
At 250 hours	Operator	Yes
At the first machine service or at the latest at the 500th operating hour, then periodically every 500 hours	Professional	Yes

After each service is completed, the service protocol that is found in the tiltrotator's user manual is filled in. Download the user manual on its QR website. The page is accessed via the QR code found on the QR document as well as on the QR decals (2 pieces are sent with the tiltrotator, one mounted on the tiltrotator and one loose for mounting in the excavator's cab). Contact Steelwrist or your dealer in case of any uncertainty.

Steelwrist Support Structure

Our goal is to give you as an installer of Steelwrist products the best support possible. You can reach the Steelwrist Support line at telephone number +46 8 6260712, weekdays 07.00-16.00 (GMT + 1).

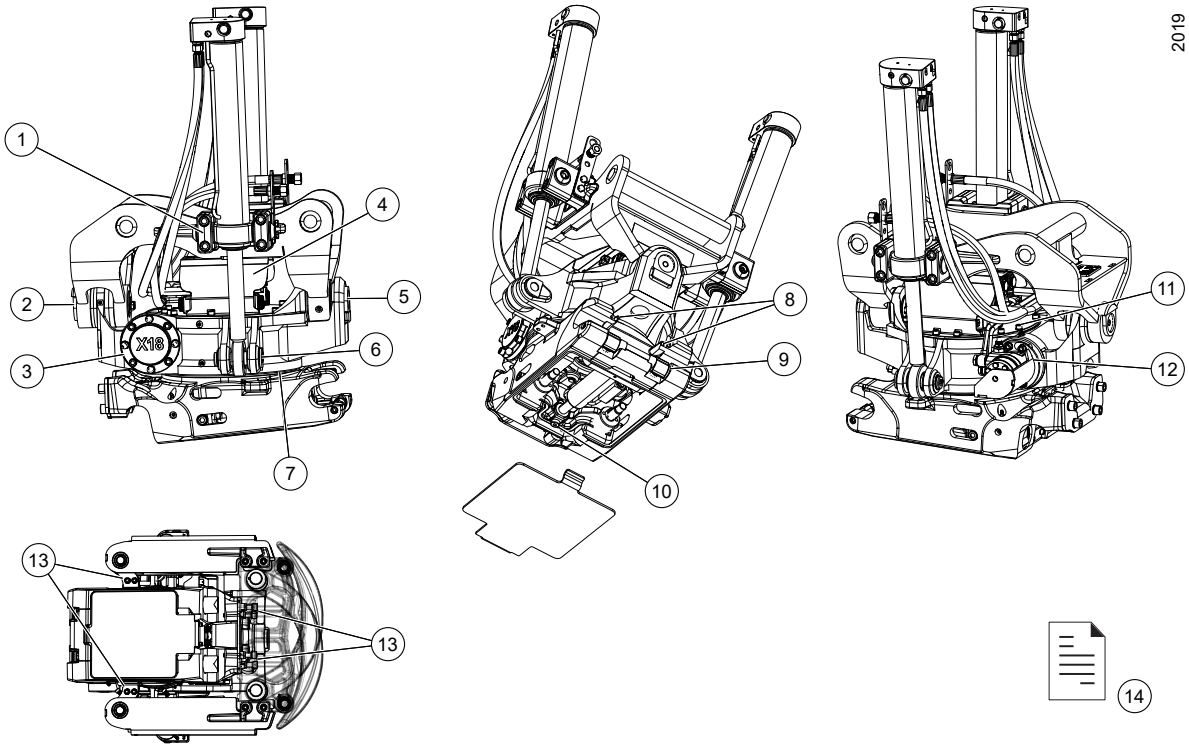
In addition there is the documentation you might need even at Steelwrist Supportweb

If you do not already have a login on the Support web you can sign up for login on the website by clicking the "Distributor Login" and then "Register".

Maintenance

Maintenance schedule

Figure 1. Checkpoints

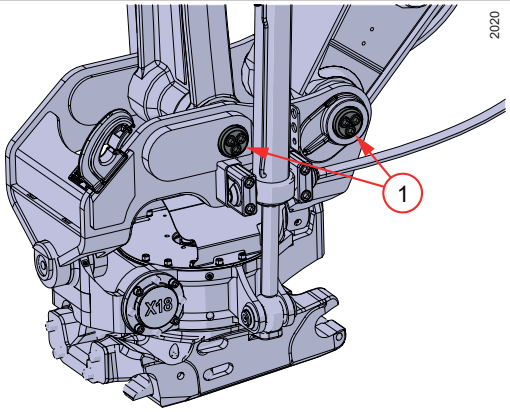
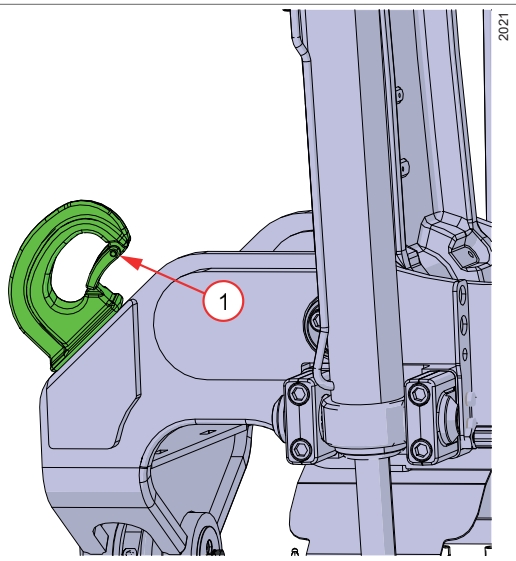


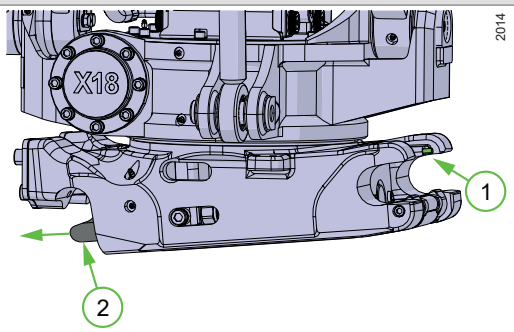
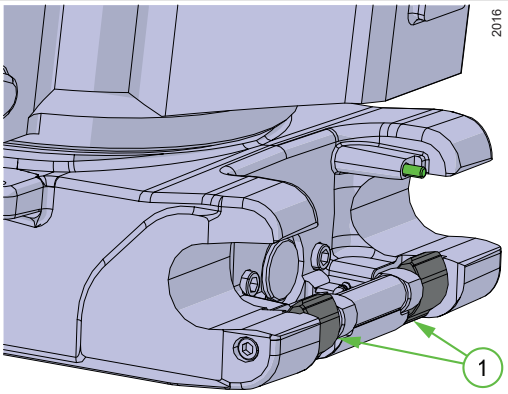
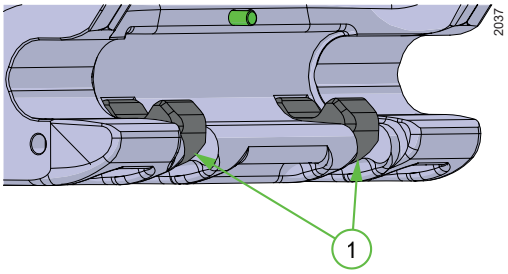
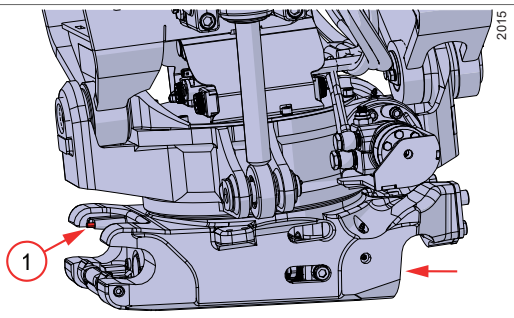
1. Tilt cylinder holder
2. Rear tilt shaft
3. Worm cover
4. Valves, manifolds, connectors and hydraulic hoses
5. Front tilt shaft
6. Tilt cylinder shaft
7. Axial and radial play
8. Indicator bars (red and green)
9. Front pin lock parts
10. Locking cylinder
11. Top cover
12. Hydraulic engine mounting
13. Gripper cassette mounting
14. General Condition: seals, labels and piston rods

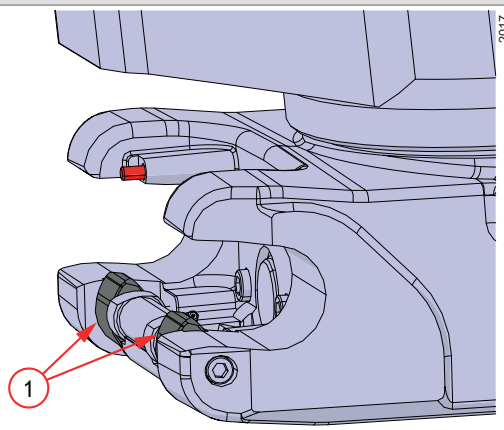
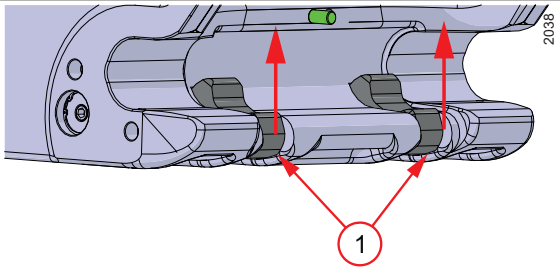
Table 2. On delivery of the machine

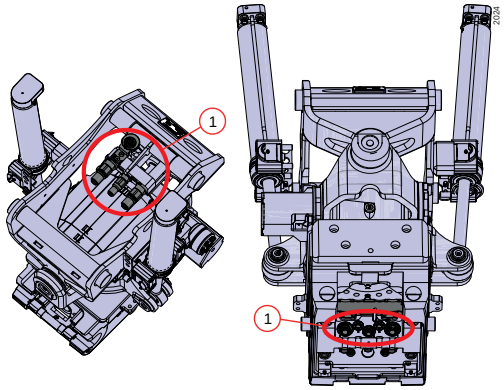
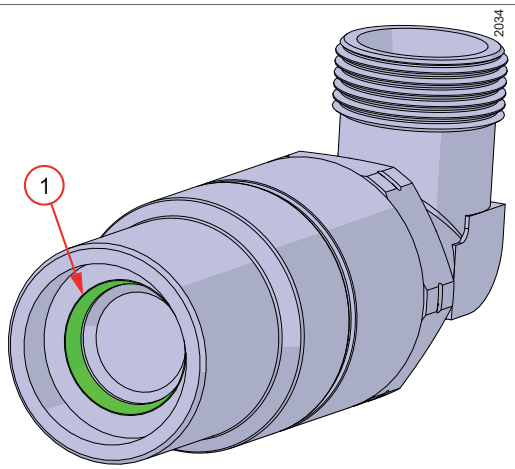
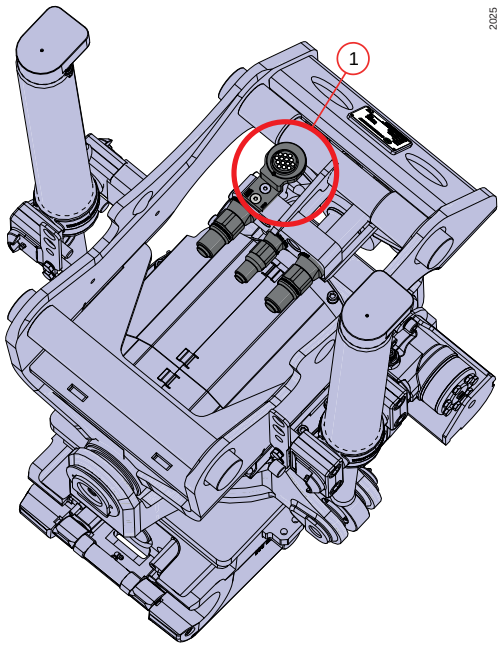
	Checkpoints
☐	Check that the product complies with the type plate and instruction manual.
☐	Make sure the feeder hoses are the right length, that is, you can run the break cylinder from full indentation to full extension without stretching the hoses or them being unnecessarily long.
☐	Check that the tiltrotator cable is securely attached to a hose and not pinched when you tilt the tiltrotator fully.
☐	Check the tilt cylinder hoses and the hydraulic block hoses so that they are not pinched between the upper section and the gearbox when you tilt the tiltrotator fully.
☐	Check the functionality of all functions.
☐	Ensure that the tiltrotator moves freely in all positions over the bucket cylinder’s stroke, even when tilted.

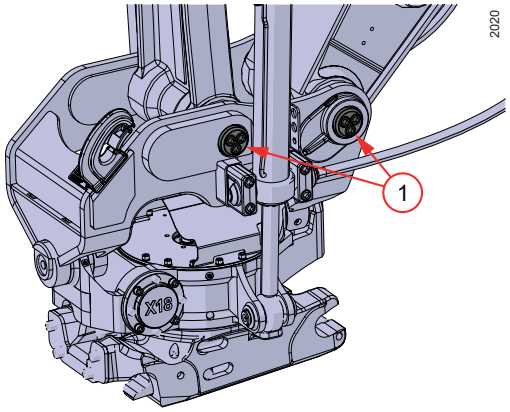
Table 3. Maintenance schedule

Daily	Weekly	250 hours	500h/ 1500h	Checkpoints	Visual description
X				Check that no cracking has occurred on the product.	[sv]
X				**Directly attached tiltrotator:** Check that all screws in the expansion shaft end washers are securely in place and that the expansion shafts are in position (1).	
X			X	**Directly attached tiltrotator:** Inspect the locking mechanism on the lifting hook (1) before each occasion of use.	
X	X	X	X	Check that the locking of the tilt shafts are intact and undamaged.	See points 2 and 5 in the picture under Checkpoints above.
X	X	X	X	Check that the locking of the tilt cylinder shafts are intact and undamaged.	See point 6 in the picture under Checkpoints above.
X	X	X	X	Check that the lock function on the attachment coupler and the machine's quick coupler lock properly.	See points 8 and 9 in the picture under Checkpoints above.

Daily	Weekly	250 hours	500h/ 1500h	Checkpoints	Visual description
X	X	X	X	**FPL 1 and 2:**Check that only the green indicator pin (1) is visible when the attachment coupler is in the locked position and that the locking pins (2) are intact and fully extended.	
X	X	X	X	**FPL 1:** Check that the front pin lock is undamaged and that the attachment coupler is locked, without connected work tool; that the locking wings (1) block the opening of the front grip and that they are intact.	
X	X	X	X	**FPL 2:** Check that the front pin lock is undamaged and that the attachment coupler is locked, without work tool connected; that the latches (1) block the opening of the front grip and that they are intact.	
X	X	X	X	**FPL 1 and 2:** Make sure that only the red indicator pin (1) is visible when the attachment coupler is in the unlocked position.	

Daily	Weekly	250 hours	500h/ 1500h	Checkpoints	Visual description
X	X	X	X	**FPL 1:** Check with the attachment coupler unlocked, with no work tools connected that the locking wings (1) can move both outwards and inwards.	
X	X	X	X	**FPL 2:** Unlock the attachment coupler without a work tool attached and then lock the attachment coupler; it should be possible to fold up the latches (1) by hand to locked position.	
X	X	X	X	Check that the indicator bars are intact.	See point 8 in the picture under Checkpoints above.
X	X	X	X	**FPL 1:** Check that the locking bolt for lock cylinder is intact and tight.	See point 10 in the picture under Checkpoints above.
X	X	X	X	Make sure the mounting screws for tilt cylinder brackets, worm flange, top cover and gripper cassette are intact and tight See the tightening torque table.	See points 1, 3, 11 and 13 in the picture under Checkpoints above.
	X	X	X	Check that the screw joints for attaching the hydraulic motor are intact and tightened. See table for tightening torque.	See point 12 in the picture under Checkpoints above.
X		X		Check that hydraulic hoses and connections are intact without oil leaks.	[sv]
X	X	X	X	Make sure the cable harness is intact and undamaged	[sv]

Daily	Weekly	250 hours	500h/ 1500h	Checkpoints	Visual description
X	X	X	X	Check that warning labels are present and readable.	See point 14 in the picture under Checkpoints above.
	X	X	X	Check all shaft bearings for wear and tear.	See points 2 and 5 in the picture under Checkpoints above.
	X		X	Cleaning the tiltrotator	[sv]
X				**Tiltrotator with SQ upper and / or attachment coupler:** a) Clean SQ couplings and electrical connector (1). b) Check that all SQ couplings are fault free.	
X				**Tiltrotator with SQ attachment coupler:** Check that all seals (1) are in place and are intact in all SQ female couplings.	
X				**Tiltrotator with SQ upper coupler:** a) Check that the vertical electrical connector male (1) is in the correct position and in the correct orientation. b) Spray contact spray on the vertical electrical connector (1) to avoid interference due to moisture and / or annoyance.	

Daily	Weekly	250 hours	500h/ 1500h	Checkpoints	Visual description
		X	X	Check whether the tilt shafts need shimming.	See points 2 and 5 in the picture under Checkpoints above.
			X	**Directly attached tiltrotator:** Tighten the expansion shafts (1) screws / nuts with tightening torque according to Tightening torque [71].	
			X	Check radial and axial play	See point 7 in the picture under Checkpoints above.
			X	Check that the product complies with the type plate and instruction manual.	[sv]

Lubrication

Grease and hydraulic oil

NOTE

Do not over lubricate.

Maximum five pumps / week in total in the grease nipples that are on the tiltrotator's gearbox. It corresponds to about 7.5 cm^3/ 40 hours.

The tiltrotator is filled at the factory with a grease type EP2. Steelwrist's recommendation is that you continue to use a grease-type EP2/NLGI 2 with base oil viscosity greater than 180 cSt at 40 degrees Celsius. If central lubrication is installed please follow the lubrication system supplier's recommendations.

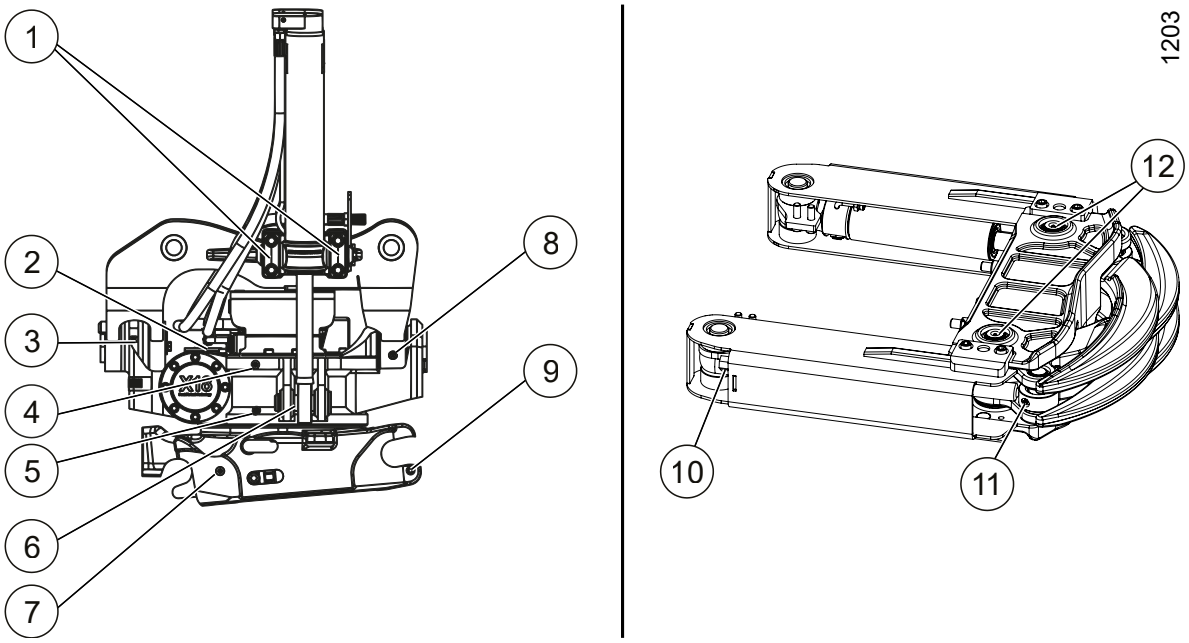
Oils must be approved for use with O-rings in material NBR70.

Before delivery, the tiltrotator is tested with hydraulic oil.

Manual lubrication

Figure 2. Lubrication points

NOTE
Follow our recommendations regarding lubrication volumes, particularly regarding the gearbox. Otherwise the O-ring between the gearbox and lower section can jump out of position and/or the rotation function may stop working due to over pressure in the gearbox.



Wipe the grease nipple before connecting the grease gun. Some tiltrotators have lubrication-free bearings on certain lubrication points.

1. Tilt cylinder holder
2. Gearbox - worm bushing motor side *
3. Rear tilt shaft
4. Gearbox - gear wheel *
5. Gearbox - gear wheel and axial bearing *
6. Tilt cylinder shaft
7. Locking pins - bushings
8. Front tilt shaft with bushings
9. Front pin lock
10. Gripper cylinder shaft
11. Gripper cylinder lug
12. Gripper shaft

* Max. one pump stroke in total in these three (X04-X07)/four (X12-X32) grease nipples/24 operating hours, i.e. 1/3 or 1/4 pump strokes/24 operating hours per grease nipple. One pump stroke corresponds to approx. 1.3 - 1.5 cm^3.

Other lubrication points:

- Max. one pump stroke/24 operating hours at each grease nipple.

Lubrication schedule

Table 4. Lubrication schedule

Daily	Weekly	250 hours	500h/1500h	Lubrication point
X	X	X	X	Lubricate the grease nipples on the tilt cylinder yoke.

Daily	Weekly	250 hours	500h/1500h	Lubrication point
X	X	X	X	Lubricate the grease nipples on the tilt shafts (2 pcs)
X	X	X	X	Lubricate the grease nipples on the tilt cylinder shafts (2 pcs)
	X	X	X	Lubricate the shaft pins in accordance with the lubrication diagram for the machine if the quick coupler has lubrication through the shafts.
	X	X	X	Lubricate all grease nipples on the gearbox housing (3 or 4 pcs. depending on model, see Manual lubrication [13]).
	X	X	X	Lubricate the grease nipples on the locking pins' bushings (2 pcs)
	X	X	X	Lubricate grease nipple in front pin lock (FPL) (1 pc).
X	X	X	X	Lubricate all grease nipples on the gripper cassette (6 pcs)

Central lubrication (CLS) (option)

Ensure that the tiltrotator is equipped with central lubrication for automatic lubrication of all grease points.

The system consists of a distribution block with progressively controlled pistons, which distribute the right amount of grease to all lubrication points. The system can be connected to the excavator's central lubrication pump that delivers grease via the excavator arm to the connection point on the tiltrotator and onto the distribution block.

Table 5. Technical data centralised lubrication

Technical data	Value
Working pressure	max. 300 bar (4350 psi)
Temperature range	-35 °C - 80 °C (-31 °F - 176 °F)
Lubricant	Oil - liquid grease - grease up to NLGI cl. 2
Number of revs	max. 180 rpm
Grease amount total **X04-X07**	max. 5 cm^3/16 operating hours (max. 0.3 in^3/16 hrs) * **approx. 3 pump strokes/16 operating hours**
Grease amount total **X12-X32**	max. 10 cm^3/16 operating hours (max. 0.6 in^3/16 hrs) * **approx. 6-7 pump strokes/16 operating hours**

* (1000 cm^3 = 1 litre) (231 in^3 = 1 US gal)

Touch-up painting

Touch-up painting can be carried out on steel surfaces according the Steelwrist painting instruction 720008.

NOTE

Do not paint contact surfaces, holes, threads, grips or bushes!

Colours:

- RAL 9005 (Black)
- RAL 6018 (Green for lifting hooks)

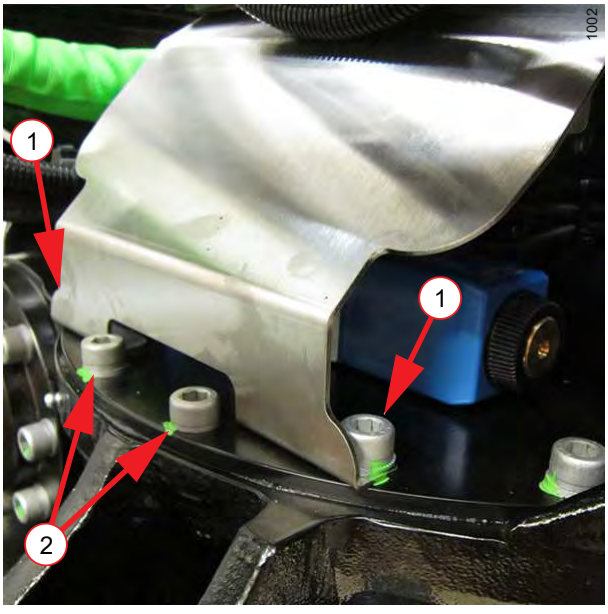
Installation of G2 module

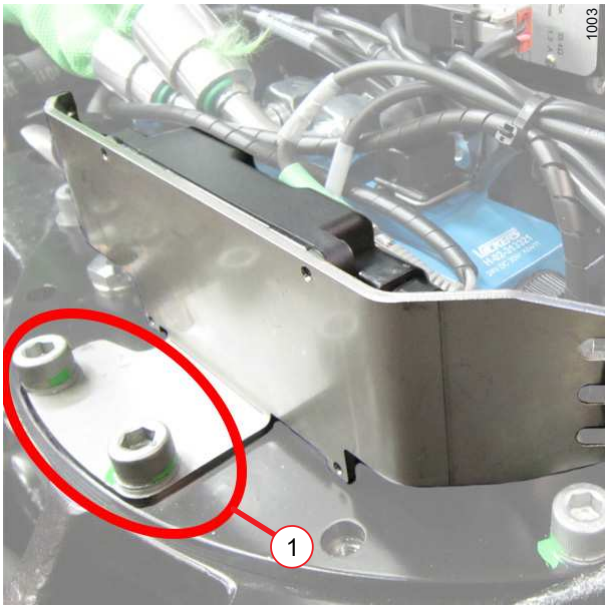
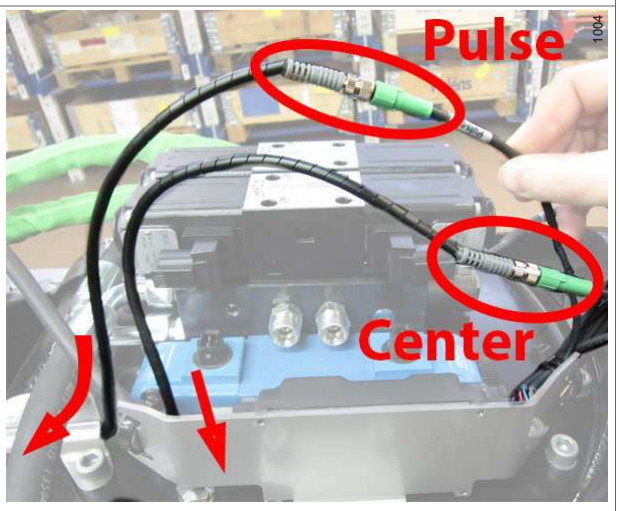
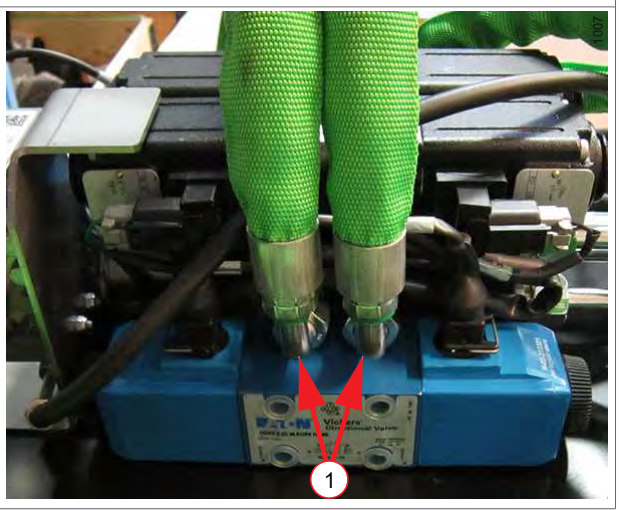
Instruction installation of G2 module

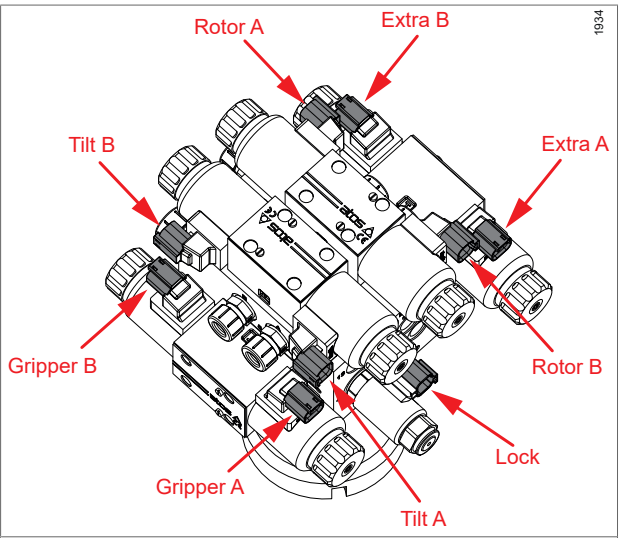
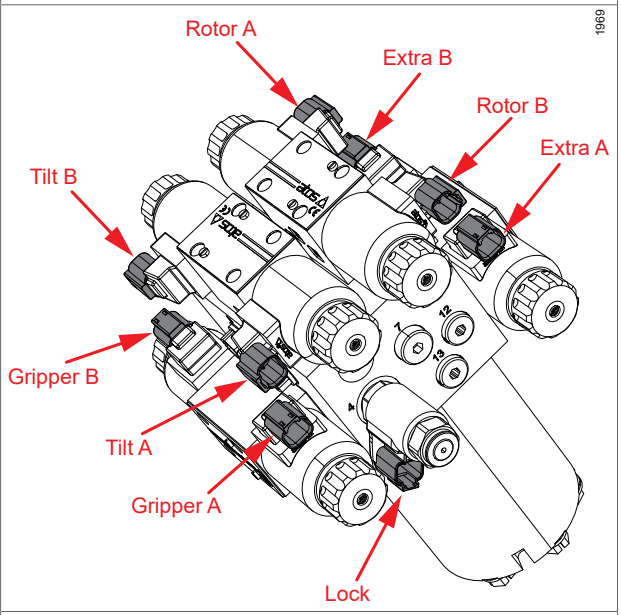
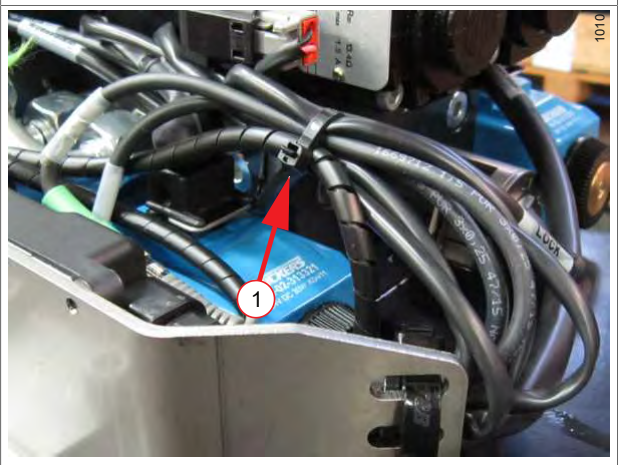
This instruction goes through how to install the G2 module for control system 10 / XCG2 on the X12-X32.

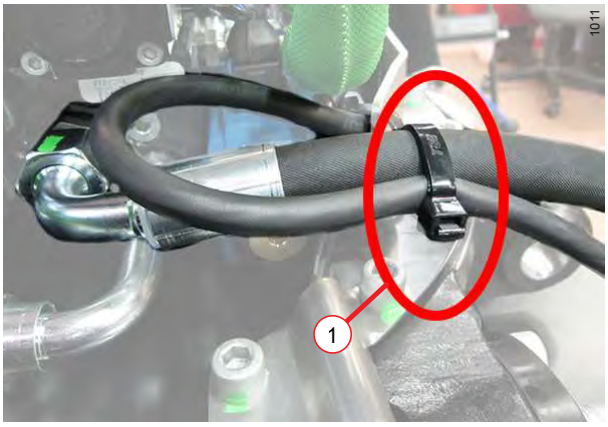
NOTE

- Cables and hoses must not be pinched or strangled. Use cable ties.
- Before removing previously installed cables, compare how this instruction connects the cables. If there is a difference, mark how the cables were inserted earlier and mount after that.
- Make sure the connectors are properly seated.
- If possible, test run before mounting the protective plate.
- If there is no cut in the bottom of the protective plate, the protective plate must be replaced to allow installation.

1. Make sure the G2 module is mounted and the cables are fastened with cable ties.	
2. Remove the protective plate (1) and the screws and washers (2) where the G2 module should be located.	

3. Mount the plate with the G2 module (1).	
4. Connect the Pulse and Center cables as shown. The pulse cable is easily identifiable as it goes down under a small protective plate.	
5. If the hydraulic hoses are in the way, it is possible to release the sleeves of the hoses (1) in order to temporarily angle the hoses.	

6.1. Installation of cabling on hydraulic block for XCG2 on X14-X32, CS10, 12 / 24V, HF (high flow). The picture shows where the cables should be connected. All cables are marked.	
6.2. Installation of cabling on swivel blocks for XCG2 / CS10 X12-X32 12 / 24V. The picture shows where the cables should be connected. All cables are marked.	
7. Assemble all cables on the same side as the G2 module is mounted and use cable ties to bundle them together.	

8. The cable from the G2 module to be attached to the excavator arm should be attached with a cable tie (1) to the hydraulic hose which should also be attached there.	
9. Reinstall the cover plate.	

Replacing the worm

These instructions go through how to remove the worm and reinstall it. This may be necessary if the worm gear needs removing for example.

Removing the worm

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1. Slacken off the 3 screws holding the motor's protective cover.
2. Unscrew the last screw holding the motor. At the same time, tilt the motor slightly so that the screw can be unscrewed, see image 1023. Remove the motor.
3. Slacken off all screws from the worm cover, see image 1024.

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4. Use the worm gear/screw gear to push the worm cover out. Do this by turning the entire gear housing by hand. A special tool (part no. 209874) can also be used to screw the worm on.
5. Remove the worm cover, see image 1026. If it cannot be removed by hand, use a jimmy bar.

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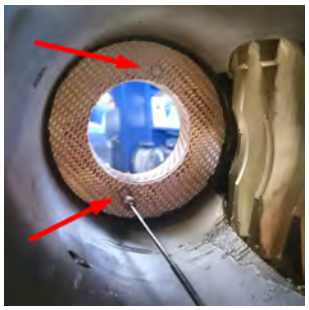
6. Ensure that the notch at the end of the worm is turned to the 3 o'clock position (see image 1027) and then continue to rotate the entire gear housing until the worm can be removed, see image 1031.

Installing the worm



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1. Check that the slide washers are correctly positioned. The sliding surface must be towards the worm. Ensure that any pins are correctly positioned. Push them in again if necessary, see image 1028.
2. Insert the worm and ensure that the marking at the end is turned to the 3 o'clock position, see image 1027.
3. Rotate the entire gear housing and simultaneously feed in the worm. Ensure that the worm still protrudes slightly to facilitate installation of the worm cover, see image 1030.

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4. Before installing the cover, shims can be added (see image 1029) if there is play in the rotational movement. (Testing can be carried out if special tool with part no. 209874 is used. Test by rotating the worm gear when the cover and shims are installed. There should be very little movement.) Do not forget to slide the sliding bearing onto the worm's shaft first. Screw the cover on (see image 1024) to the correct torque, see chapter regarding Tightening torques.

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5. Push the motor back and screw it into place (see image 1023), also install the protective cover for the motor (see image 1033).

Replacing a grab arm

These instructions show how to remove and install a grab arm and check whether the grab arms need shims.

CHECK THE PLAY OF A GRAB ARM

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Check whether the grab arm has too much play by pushing a jimmy bar or similar under the grab arm, see image 1015. Use the jimmy bar as a lever to see how much play there is. If there is too much play, install spacers, see image 1040.

Removing a grab arm

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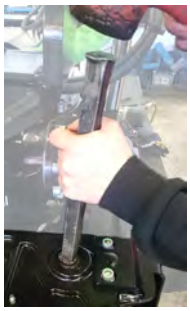

1019

1. Ensure that the grab is open slightly to make removal easier, see image 1041.
2. Remove the circlip that locks the shaft and unscrew the nipple to prevent damaging it, see image 1034.
3. Tap out the shaft from above, see image 1019.

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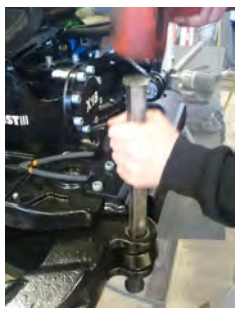

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4. Pull the arm outside the protective panel to gain access to the other shaft, see image 1035.

5. Remove the circlip and tap out the other shaft, see image 1036.
6. The grab arm is now loose and can be removed.

Installing a grab arm

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1. Ensure that the sliding bearing is correctly positioned and the sliding surface is towards the grab arm, see image 1037.
2. Install the grab arm onto the grab cylinder first to make installation easier. Do not forget to install the spacer under the grab cylinder lug, see image 1038.
3. Lubricate the shaft and install from underneath. Lock with the circlip.
4. Ensure that the nipple on the lug points outwards so that it can be used, see image 1039.

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5. Push in the grab arm so that it lies against the shaft hole.
6. Insert the slide washer with the slide surface downwards towards the grab arm, see image 1040. Insert shims if necessary.
7. Lubricate and install the shaft from underneath. Ensure that the notch in the shaft head is correctly positioned so it can be inserted all the way.
8. Lock with the circlip, see image 1034.

Replacing the locking valve

These instructions go through how to replace or clean the lock valve. This may be necessary if there is a problem with the locking function for the tools.

TESTING THE LOCKING VALVE

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Test that the lock valve works when it is removed. Turn on the magnet and connect to the power source. Lock as usual from the cab. If the lock valve works, it should click, the slide (1) should move and a few drops of oil will usually come out.

Removing the locking valve

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1. Remove the protective panel.
2. Disconnect the contact from the lock valve, see image 1043.
3. Undo the nut on the lock valve that locks the magnet and remove the magnet, see image 1044.

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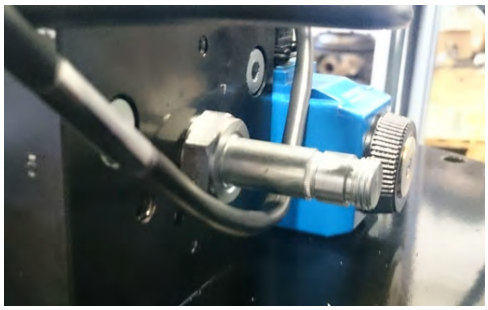
4. Remove the lock valve from the block, see image 1016 and 1055.

Installing the locking valve



1016

1044

1. Screw the lock valve onto the block, see image 1016. Ensure that the valve is clean beforehand.
2. Thread the magnet on and lock in place with the nut, see image 1044.

1043

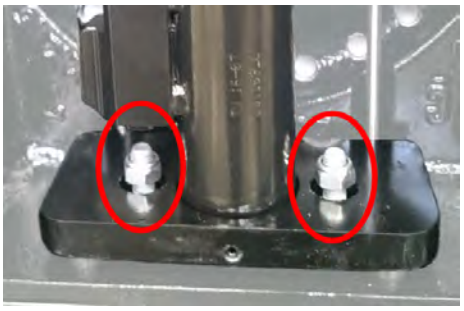
3. Connect the contact for the lock valve, see image 1043.
4. Install the protective panels. Use the standard torque for the screws.

Replacing the locking cylinder, FPL 1

These instructions go through how to remove and install the lock cylinder. This may be needed if the machine's hydraulic oil is contaminated.

Removing the locking cylinder

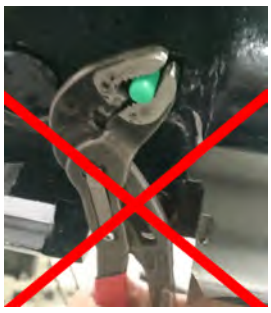
1047



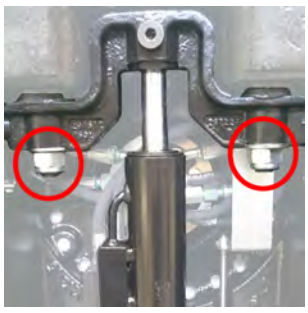
1049

1052

1. Slacken off the screws on the side of FPL and remove FPL, see image 1047.
2. Turn the tiltrotator so that it can be accessed from underneath. Remove the protective panel.
3. Remove the two smaller nuts by the thick support plate, see image 1049.
4. Unscrew the screws enough so that the support plate releases, see image 1052.



1051



1048

1050

5. Remove the green indicator pin. Do not hold the green plastic part as it will come off, see image 1051.
6. Undo the two large nuts securing the locking wedges, see image 1048.
7. Remove the screw and nut at the top of the locking wedge, see image 1050.

1053

1054

8. Unscrew the check valve and hoses. Ensure that the location of each hose is noted to make reinstallation easier, see image 1053.
9. Pull out the locking wedges and use a jimmy bar or similar to pry off the lock cylinder and support plate, see image 1054.

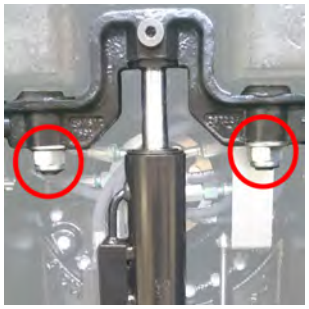
Installing the locking cylinder

1054

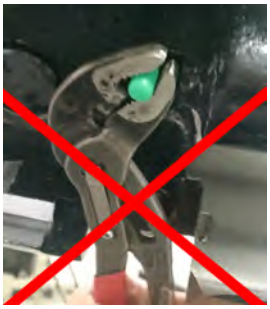
1053

1050

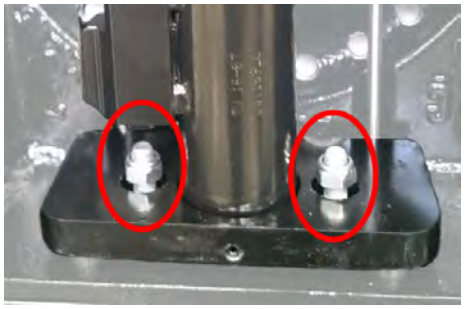
1. Insert the locking wedges, see image 1054.
2. Reinstall the lock cylinder with the support plate, see image 1054.
3. Connect the hoses as before and screw the lock valve back into position, see image 1053.
4. Tighten screw and nut at the top, see image 1050.



1048



1051



1049

5. Mount the nuts and washers in the locking pin, see Fig. 1048. The nuts should only sit so hard that the plate holding the red indicator pin is loose, see Fig. 1048.
6. Reinstall the green indicator pin. Do not hold the green plastic when tightening as it will brake, see image 1051.
7. Screw back the screws through the support panel. Install the nuts. Only tighten slightly, see image 1049.

1047

1098

1097

8. Reinstall FPL, see image 1047.

9. Test operate and ensure the lock function operates correctly.

a) The locking wedges must be completely withdrawn, see image 1098.

b) The screw that is secured in the locking pins' yoke must not catch on the end of the slit in the side of the cast body when the cylinder is in the withdrawn position.

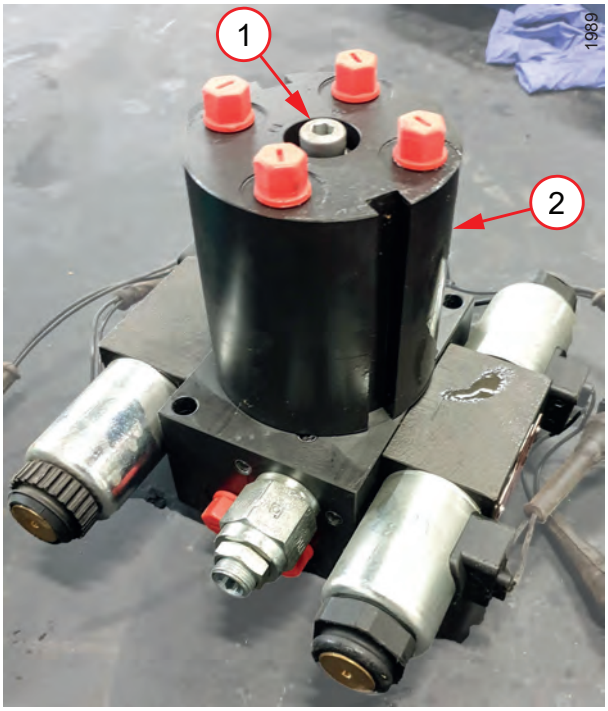
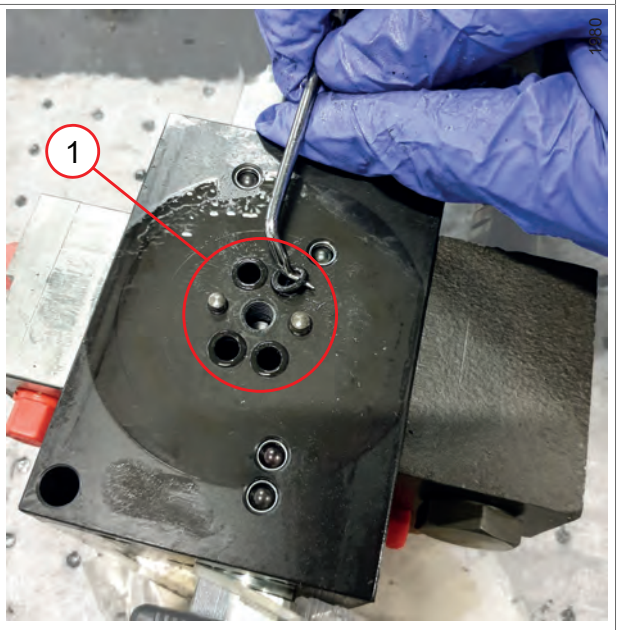
c) The green indicator pin must be fully withdrawn when the mounting is in the unlocked position. The screw must be adjusted so that all the criteria are fulfilled, see image 1049.

10. Verify that the front pin lock mechanism functions.

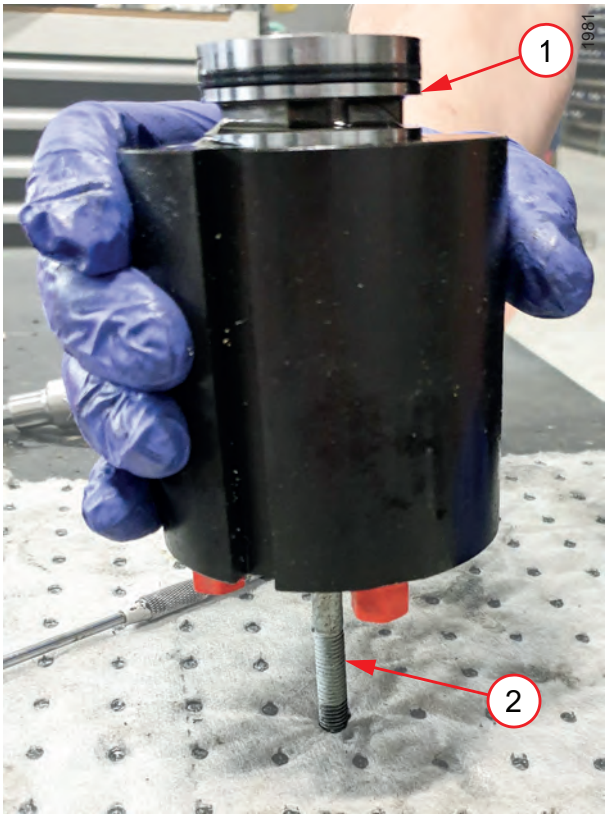
11. Reinstall the protective panel.

Replacing o-rings and gaskets in the swivel

X04-X07

1. a) Loosen the swivel bolt (1). b) Remove the swivel (2) from the block.	
2. Replace the o-rings (1).	

3. Turn out the center unit (1) using the swivel bolt (2). Position the swivel bolt so that its skull lies against the center unit.

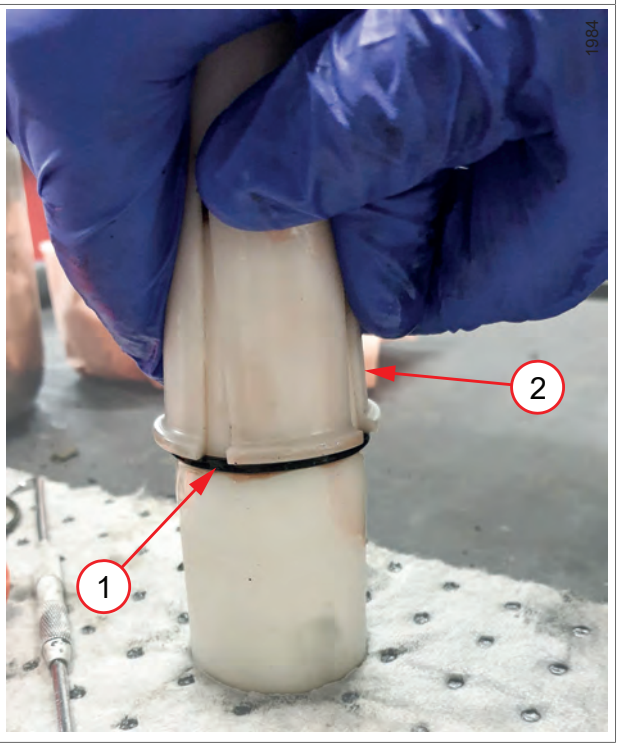


4.

a) Remove the seals x5 (1).

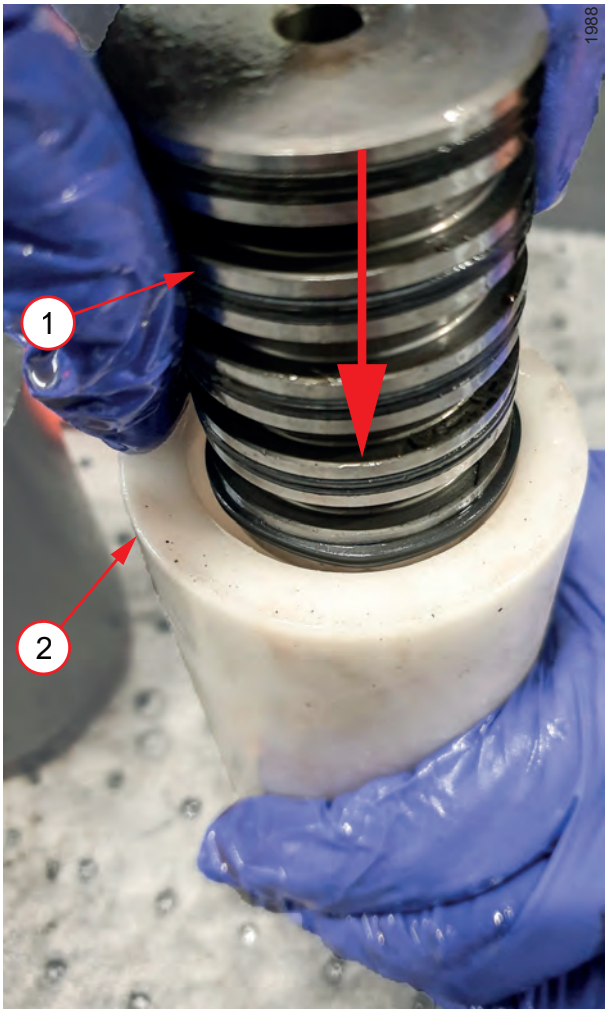
b) Remove the o-rings x5 (2).

c) Install new o-rings x5.

5. Seal fitting with auxiliary tool kit 203395. a) Oil the seal (1) and apply it to the conical auxiliary tool (2) to expand it.	
6. Push the seal (1) from the conical end down to the cylindrical with the flexible auxiliary tool (2).	

7. Press the seal (1) to the outer part of the cylindrical end with the cylindrical tool (2).	

8. Feed the seal from the cylindrical tool into the groove on the center unit on top of the o-ring.	
9. Massage the seal (1).	

10. Press the center unit (1) through the cylindrical auxiliary tool (2) to compress the seal.	
11. Repeat steps 5-10 for the remaining 4 seals.	
12. Assemble the swivel and then screw it to the swivel block. For torque see Tightening torque [71].	

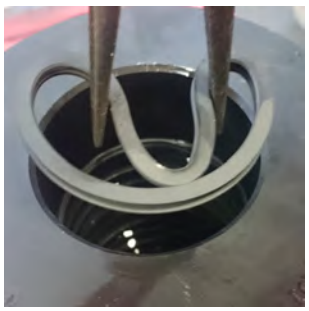
X12-X32 not HF

1060

1061

1. Slacken off the swivel bolt so that the swivel can be removed together with the washer, see image 1060.
2. Reinstall the swivel bolt and use it to tap out the centre part of the swivel, see image 1061.

1062



1063

1064

3. Remove all gaskets and O-rings. Depress the gaskets to remove them according to image 1062.
4. Clean everything and install new O-rings and gaskets. To insert the gasket, bend it as per image 1063.
5. Tap in the centre part of the swivel housing. Use something soft between the centre part and the hammer so prevent damage, see image 1064.

1065

1018

1060

6. Remove the small O-rings on the base plate and replace with new ones, see image 1065.
7. Reinstall the swivel housing and ensure that the locating pins are correctly positioned, see image 1018.
8. Secure the swivel bolt into place and the large washer. Use a Nordlock washer and tighten to the correct torque, see image 1060.

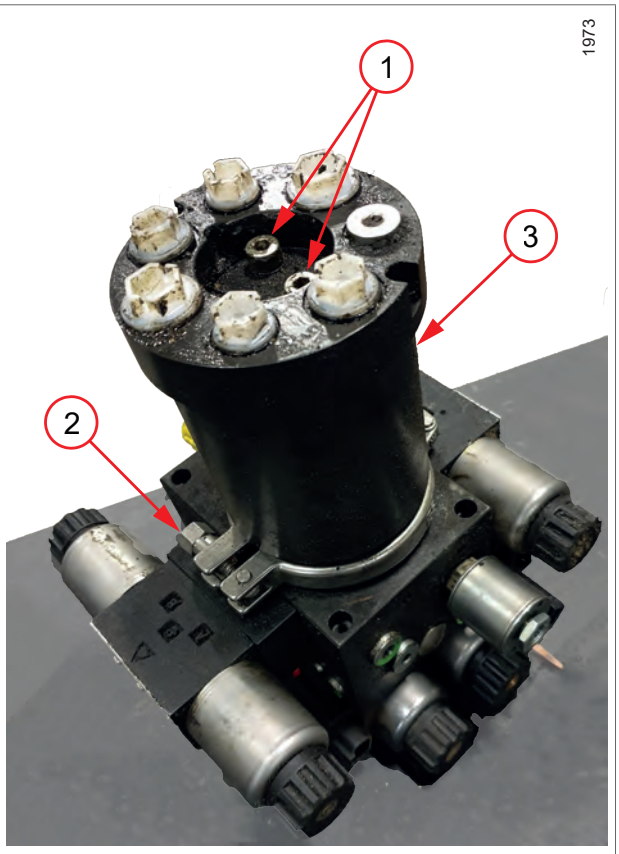
X12-X32 HF

1.

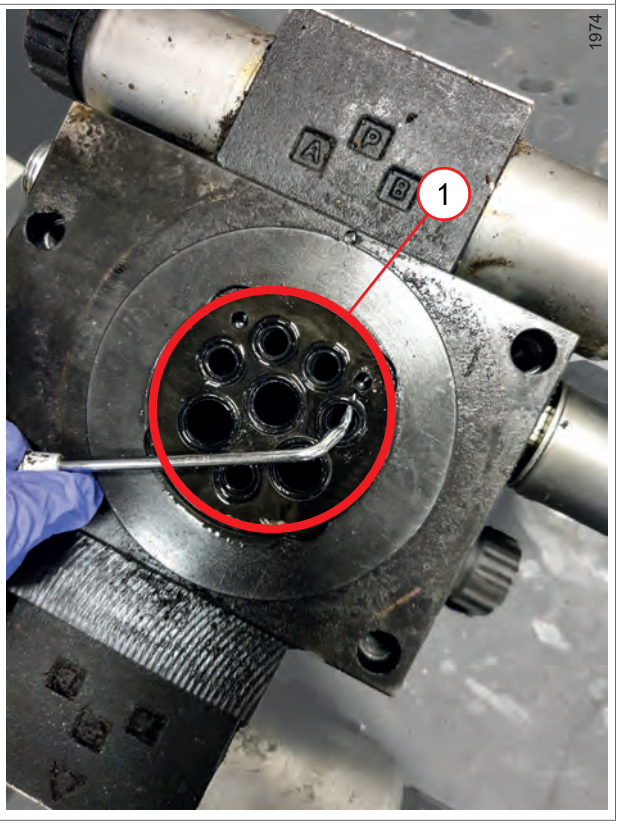
a) Loosen the swivel bolts (1).

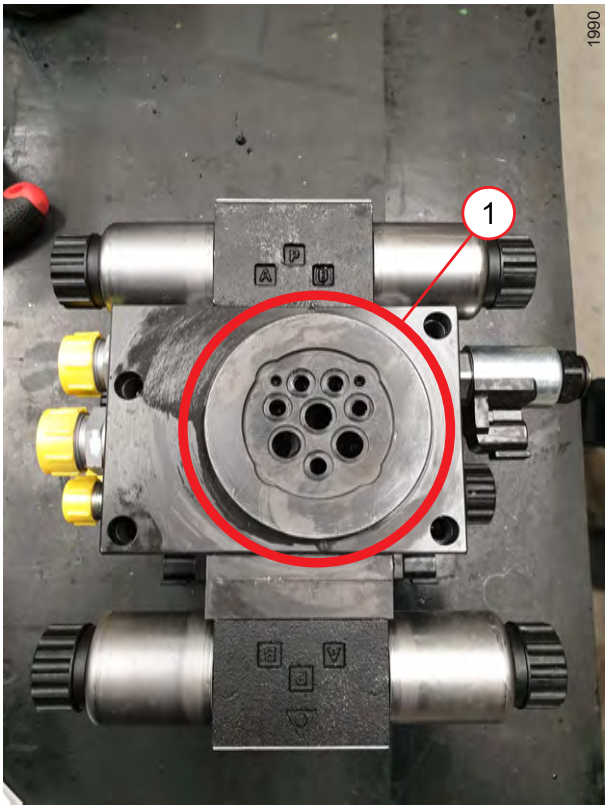
b) Remove clamp (2).

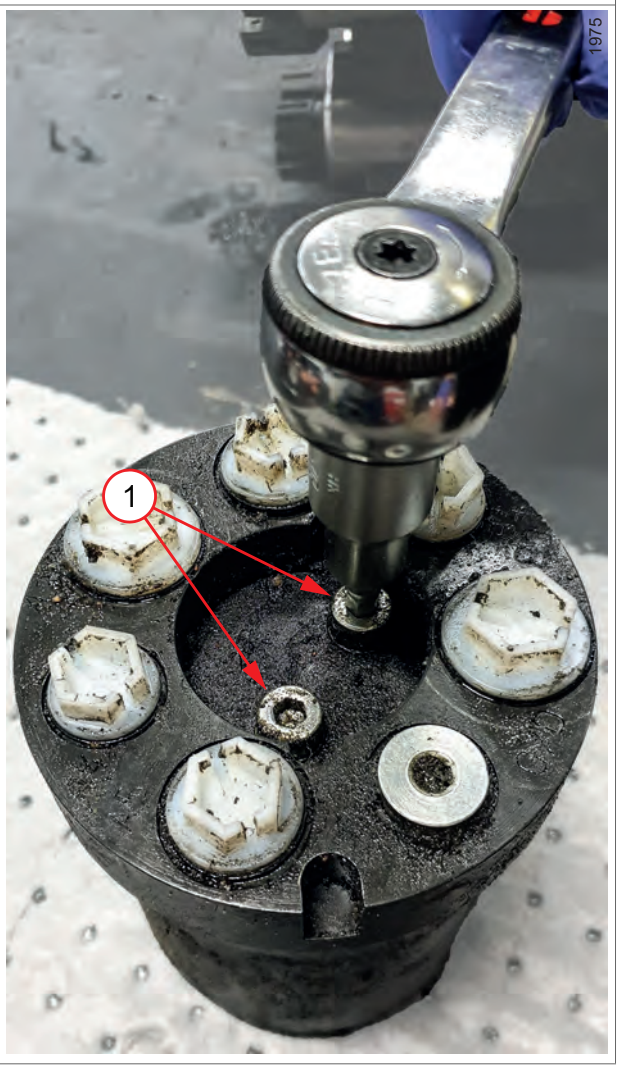
c) Remove the swivel (3) from the block.

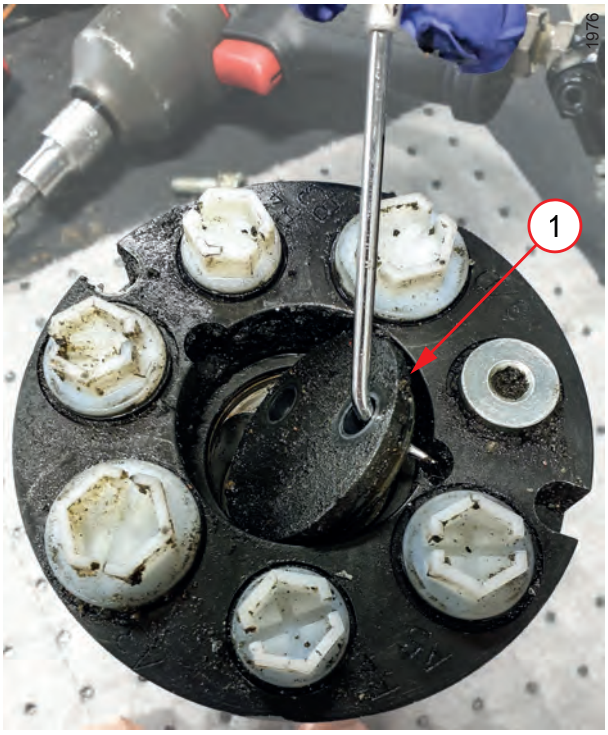


2. Remove the o-rings (1).



3. Clean the swivel contact surface (1) thoroughly with Breakclean or similar detergent on the block.	
4. Lubricate all o-rings (1, article no. 905096 and 905097, NBR90) with clean grease, do not use brush or grease container where a brush is dipped, this to avoid brush hair.	

5. Install the new o-rings (1) after grease lubrication.	
6. Unscrew the swivel bolts (1).	

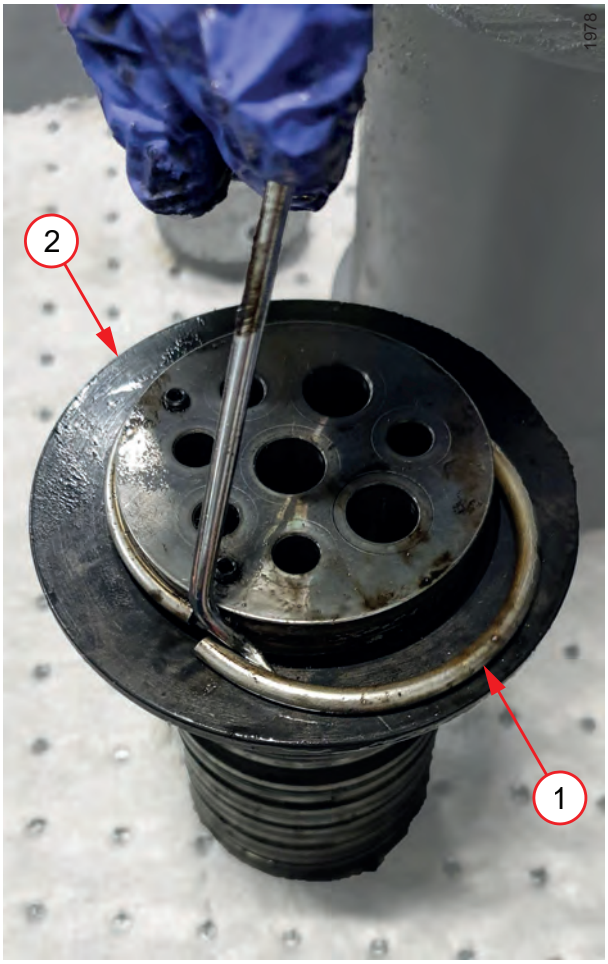
7. Remove the washer (1).	

8. Turn the swivel and knock out the center unit (1), for example a plastic hammer (2). If you use a steel tool to knock out the center unit, place something soft between the center unit and the tool.

9.

a) Remove steel locking ring x2 (1).

b) Remove flange (2).



10.

a) Remove all seals on the center unit (1).

b) Remove all o-rings (2).

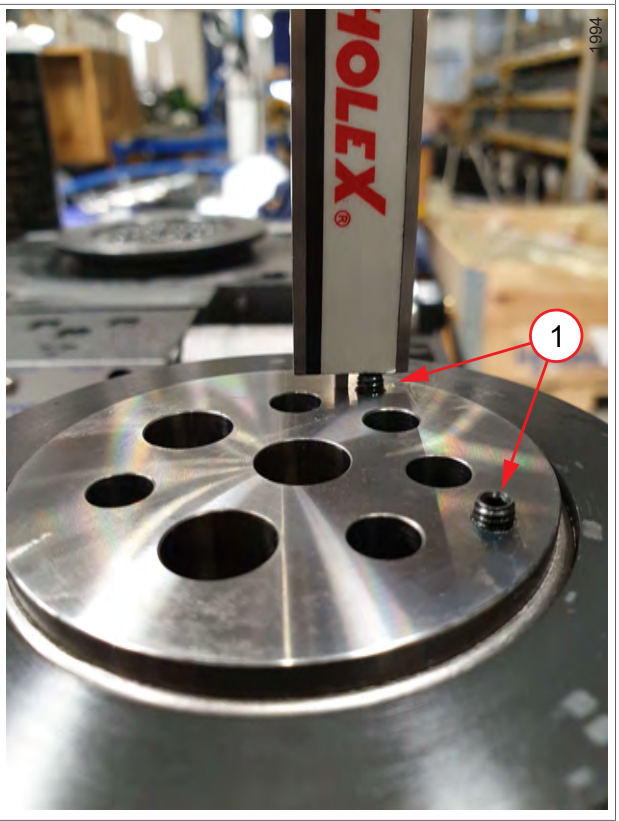
c) Insert new o-rings (innermost) and seals (on top of o-ring) on the center part.

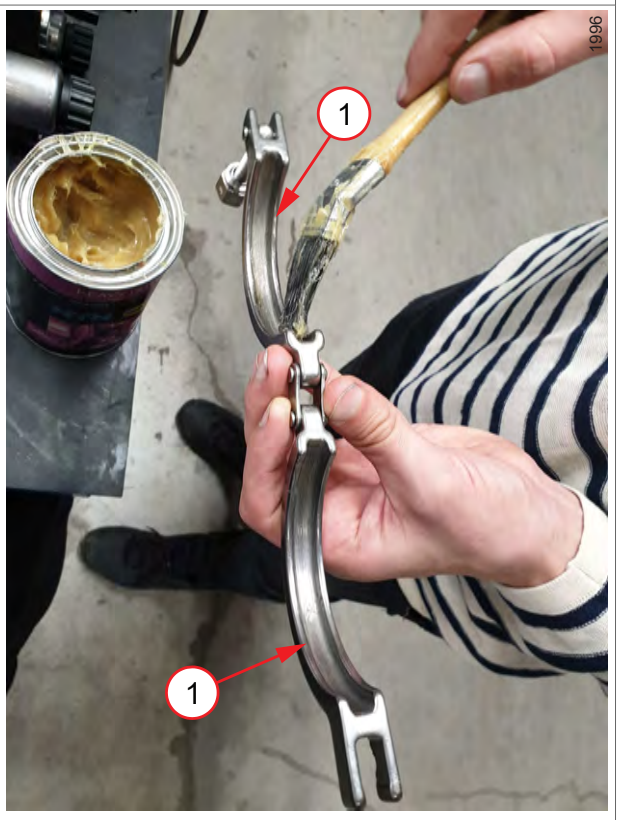
11.

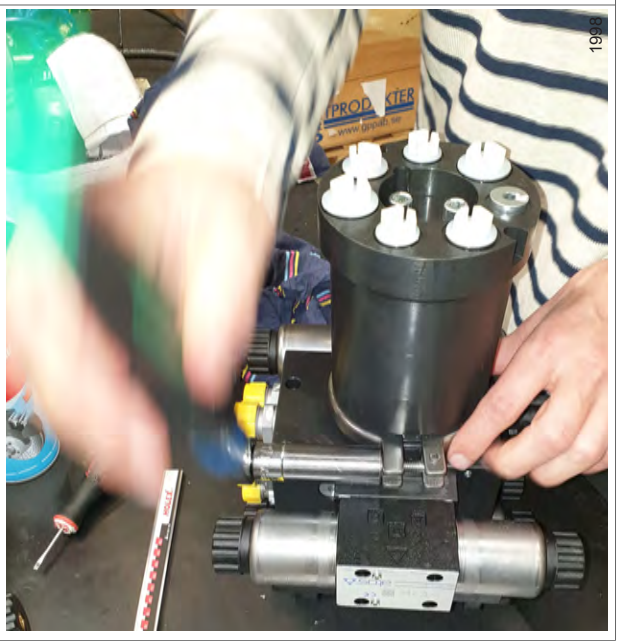
a) Mount the center unit in the swivel.

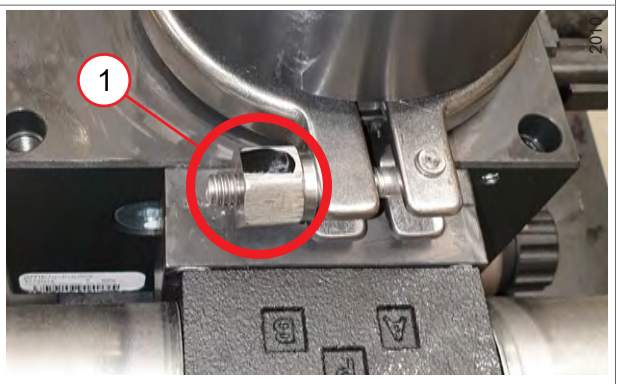
b) Thoroughly clean the swivel contact surface (1) against the block with Brakeclean or similar cleaning agents.

12. Measure how much the stop screws (1) protrude from the center unit, it should be 3 mm, +/- 1 mm. Adjust if needed.



13. Mount the swivel (1) on the block.	
14. Lubricate the inside of the clamp (1) with grease.	

15. Mount the clamp, the screw bracket should be centered over the cutout (1) in the block.	
16. Tighten the clamping screw with torque wrench to 20 Nm.	
17. Gently tap the clamp with plastic hammer on all four sides (related to the block).	

18. Tighten the clamp screw again with a torque wrench to 20 Nm.	
19. Mark the clamp screw with black marking colour to mark that the o-rings have been replaced with the new version and that the clamp is correctly attached.	
20. Tighten the swivel bolts. For torque see Tightening torque [71].	

Radial play and axial play

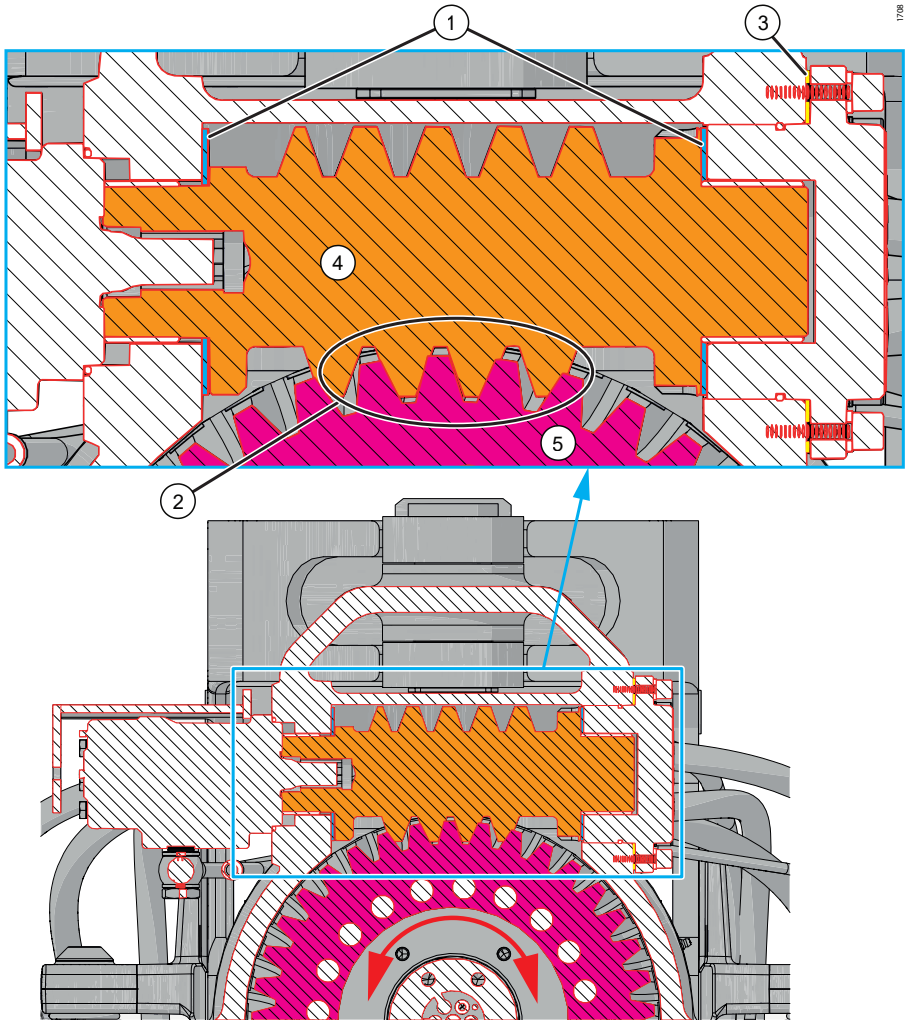
The tiltrotator is designed with as little play as possible on both axial and radial axes. This is necessary because the friction between sliding surfaces generates heat and as this affects the various metals differently there would otherwise be a risk of the tiltrotator "pinching". After a certain time in operation, the gap will increase slightly as the tiltrotator is run-in. Wear is influenced by high break out forces and general driving style but mainly neglected lubrication.

It is very important that you lubricate and clean the tiltrotator periodically. Hydraulic breakers can significantly increases the wear so that tiltrotator over time may exhibit excessive play. It is important to monitor development over time and ensure that neither the axial nor radial play become too large. Play above that specified should be adjusted as soon as possible.

After prolonged use, it may be worth submitting the tiltrotator to your local service workshop or Steelwrist for review. Normally, all wear details such as slide washers, bushings, grease, broken hoses, etc. is exchanged. For more information see Steelwrist website: www.steelwrist.com

Radial play

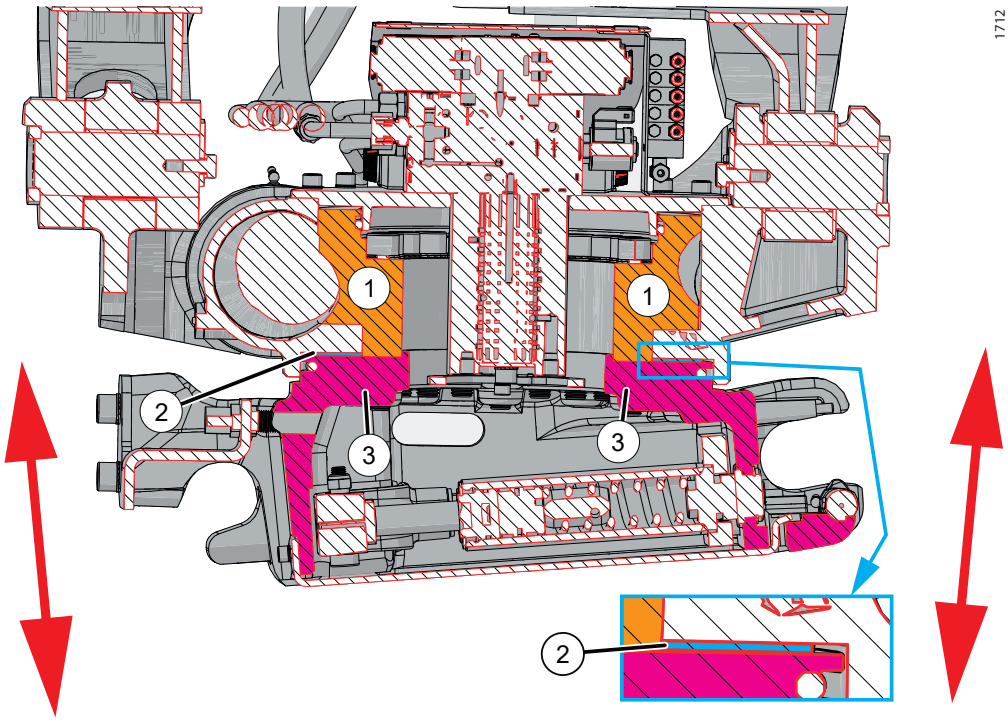
Radial play occurs in two places (direction of rotation, red arrow):



1. Between axial bearings (x2), screws and their mountings in the gearbox's frame as well as motor housing. Corrected by removing shim (3).
2. Between worm and worm gear. Corrected by rotating worm gear (5) or replacing worm gear and/or worm (4).

Axial play

Axial play occurs in the event of wear between the gearbox, axial bearings and the tiltrotator's lower section.



1. Gearbox
2. Axial bearing
3. Lower section/attachment mounting

Table 6. Permitted play for Tiltrotators

Checkpoints	X04	X06	X07	X12	X14	X18	X20	X26	X32
Max permitted radial play [mm]	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.0	2.0
Max permitted radial play [in.]	0.06	0.06	0.06	0.08	0.08	0.08	0.08	0.08	0.08
Max permitted axial play [mm]	0.6	0.6	0.6	0.8	0.8	0.8	0.8	0.8	0.8
Max permitted axial play [in.]	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03

Measurement of radial play X04-X32

To measure tiltrotator radial play, a dial indicator and magnetic hub are needed, (Stelwrist part number XXXXXX).

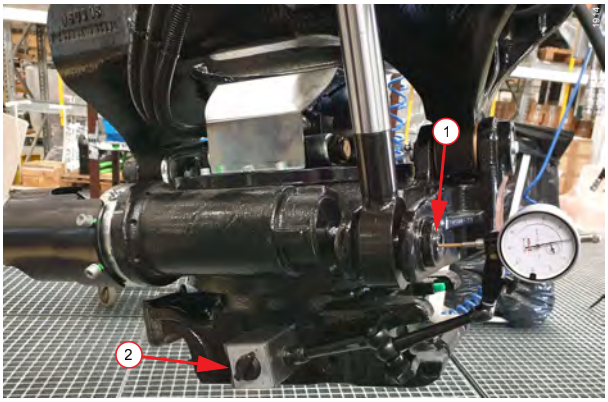
See allowed play in Radial play and axial play [47].

No other special tools are needed.

WARNING

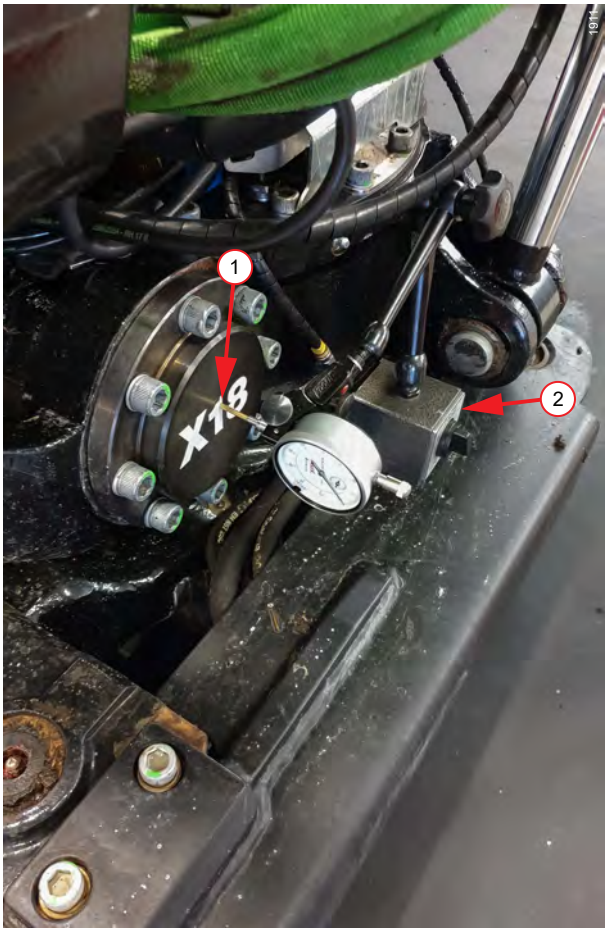
Always turn off the machine and its main electrical switch before maintenance and repair work.

Measuring points:

X04-X07 Place the measuring stick of the dial indicator (1) on the outer edge of the tiltcylinder shaft attachment on the same side as the worm. The magnetic hub (2) is placed on the vertical side of the attachment coupler, if the tiltrotator has a gripper cassette the magnetic hub is placed on top of it.	

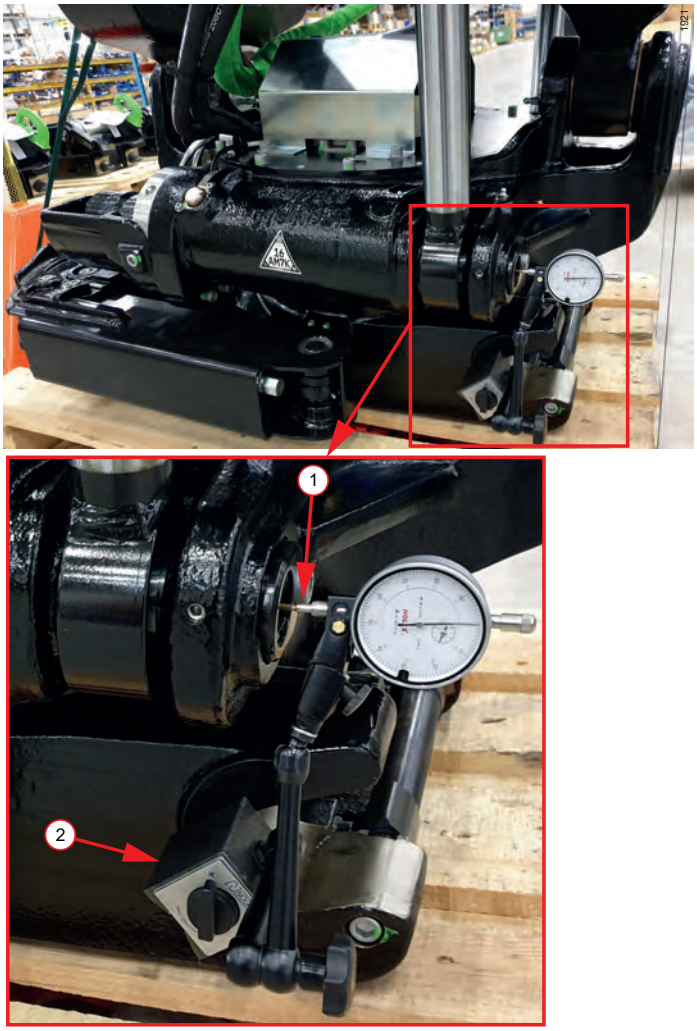
X12-26

Place the measuring stick of the dial indicator (1) on the centre of the worm cover. The magnetic hub (2) is to be placed on the gripper cassette, if the tiltrotator do not have a gripper cassette the magnetic hub is placed on the vertical side of the lower coupler.



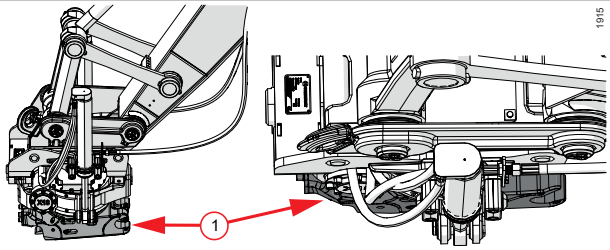
X32

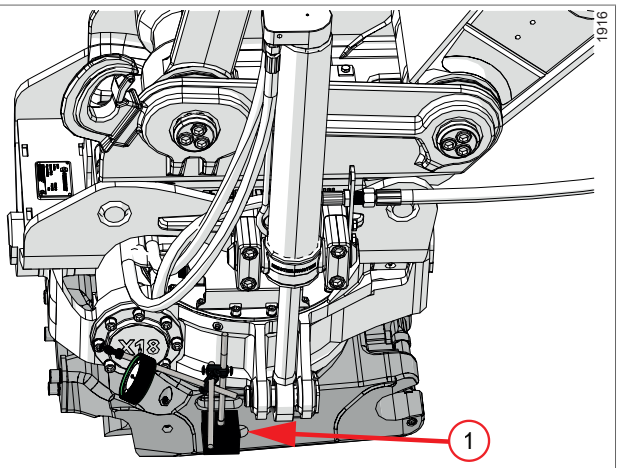
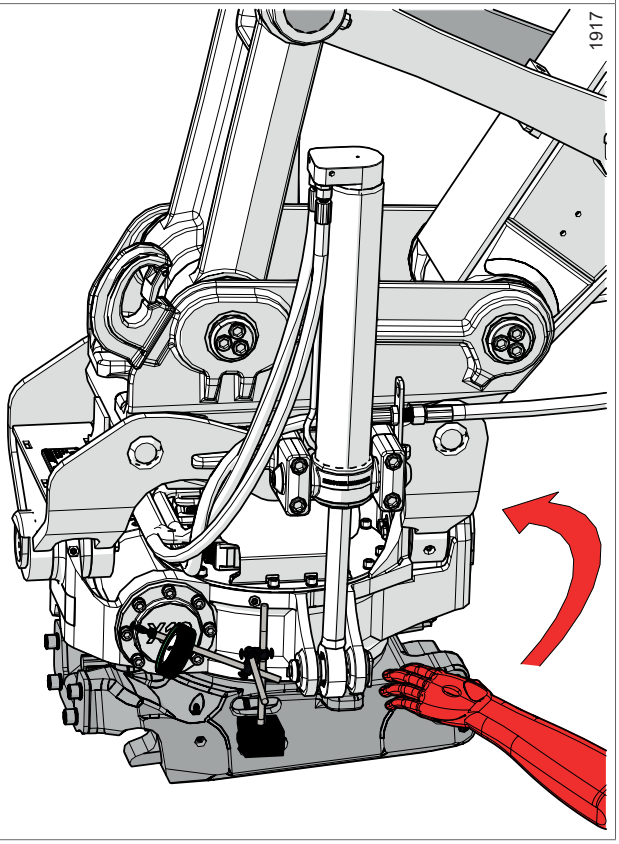
Place the measuring stick of the dial indicator (1) on the outer edge of the tiltcylinder shaft attachment on the same side as the worm. The magnetic hub (2) is placed on the vertical side of the attachment coupler, if the tiltrotator has a gripper cassette the magnetic hub is placed on top of it in certain postions, see below.

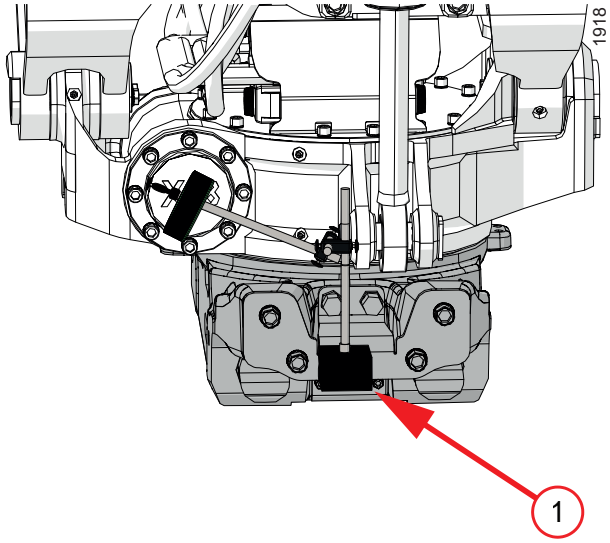
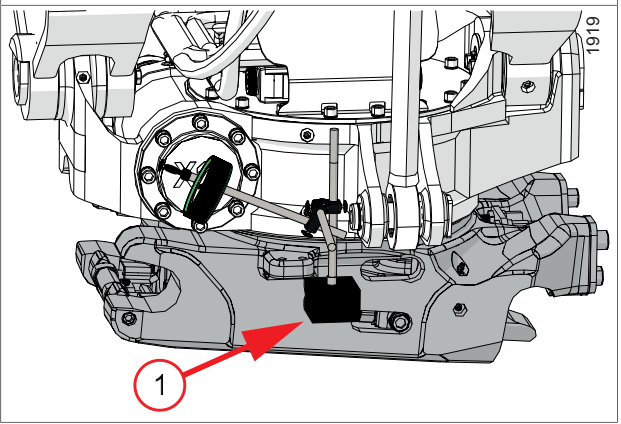


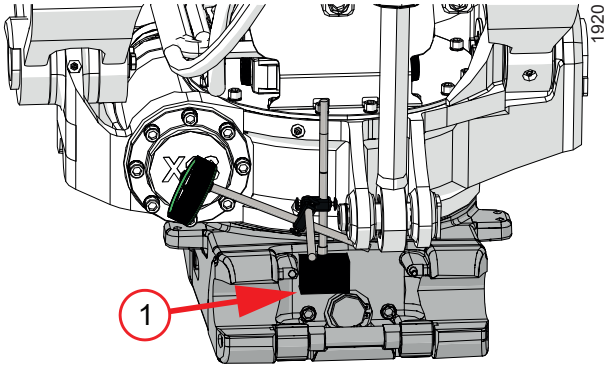
Measuring procedure:
(X18 S60/S60 without gripper cassette)

1. Position the attachment coupler (1) as in the picture (digging position).



2. Position the dial indicator (1) depending on model as described in Measuring points above. Zero the dial indicator.	
3. Tiltrotator mounted on excavator (picture right): Rotate the attachment coupler of the tiltrotator in one direction as far as you can. Which direction do not matter. Tiltrotator on service table: Rotate the upper part (gearbox and upper coupler) of the tiltrotator in one direction as far as you can. Which direction do not matter.	

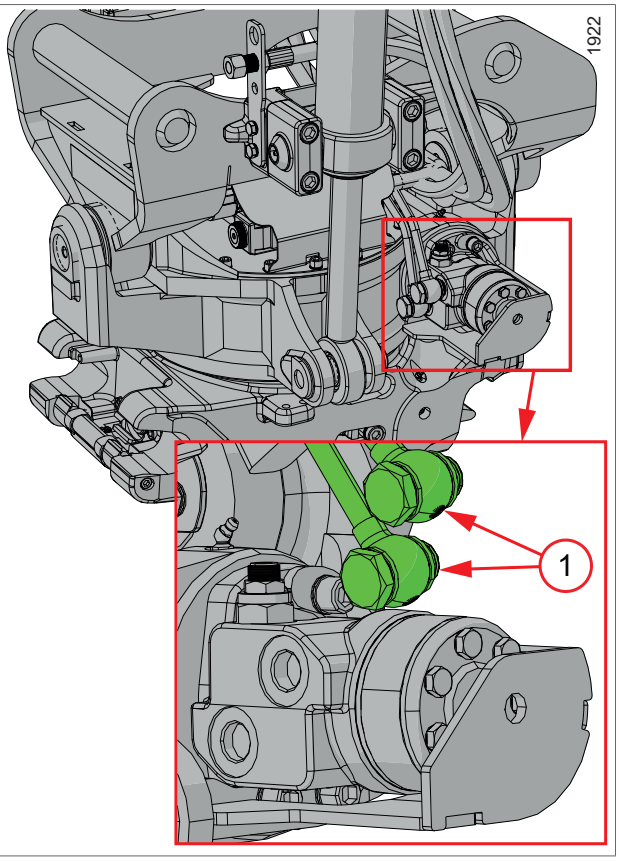
4. Check the reading on the dial indicator.	
5. Start the excavator, rotate the attachment coupler (1) 90 degrees. Turn off the excavator. Repeat the measuring process. Always place the dial indicator meauring stick in the same place on the gearbox see Measuring points above.	
6. Start the excavator, rotate the attachment coupler (1) 90 degrees. Turn off the excavator. Repeat the measuring process. Always place the dial indicator meauring stick in the same place on the gearbox see Measuring points above.	

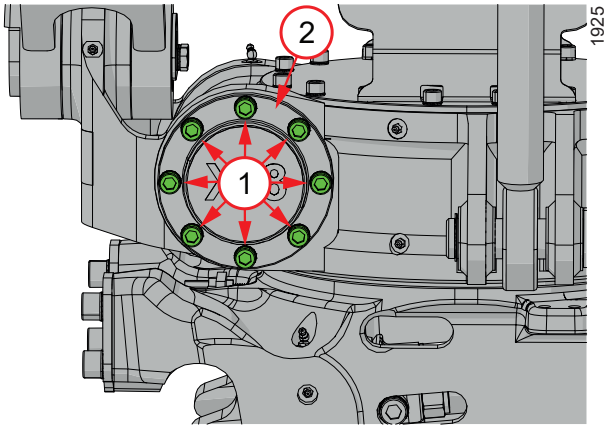
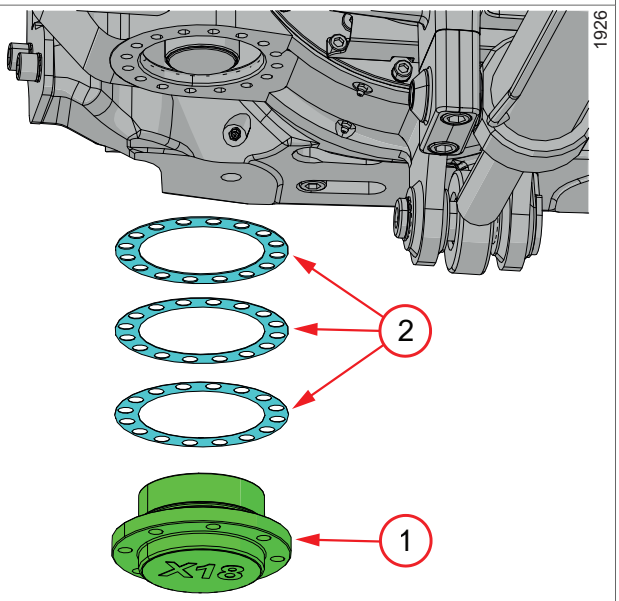
7. Start the excavator, rotate the attachment coupler (1) 90 degrees. Turn off the excavator. Repeat the measuring process. Always place the dial indicator meauring stick in the same place on the gearbox see Measuring points above.	
8. Check your play measurements, if the play is similar in all four measuring positions shims need to be removed from under the worm cover, see Radial shim adjustement/replacement [48]. If the play is larger in digging position (step 3) the worm gear or the screw can be in need of replacement. Contact your Steelwrist dealer.	

Replacement / adjustment of shims that affect radial play

WARNING
Always turn off the excavator and its main electrical switch and relieve the pressure from the hydraulic system before maintenance and repair work.

Work process:

1. Remove hydraulic couplings (1) from the hydraulic motor.	

4. Remove screws (1) hodling the worm cover (2).	
5. Remove worm cover (1). a) Remove shims (2).	
6. Replace shims that look worn / Remove shims if the radial play is to large.	
7. Remount everything, step 5-1. For torque see, Tightening torque tiltrotator.	
8. Check radial play, see Meausurement of radial play X04-X32 [48].	

Measurement of axial play X04-X07

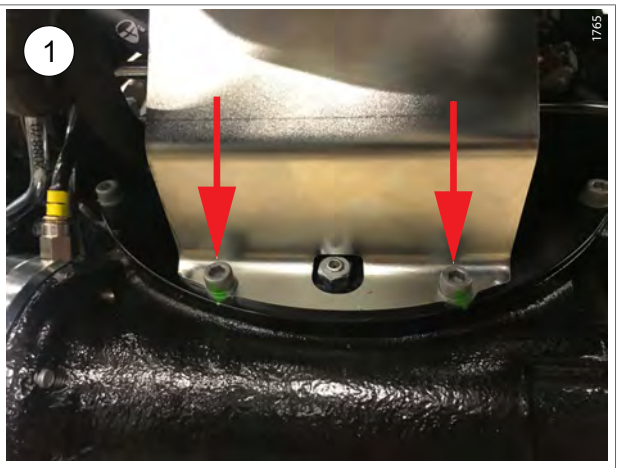
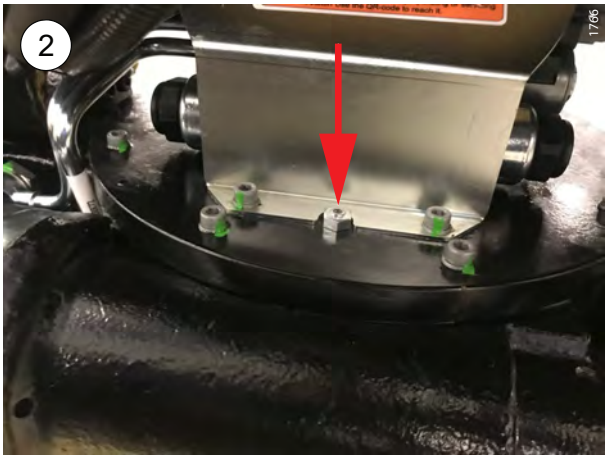
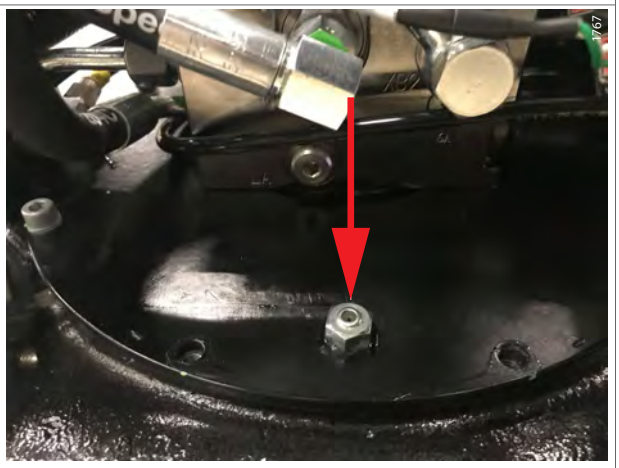
To measure tiltrotator axial play, a dial indicator and hub are needed, (Stelwrist part number 604680).
See allowed play in Radial play and axial play [47].

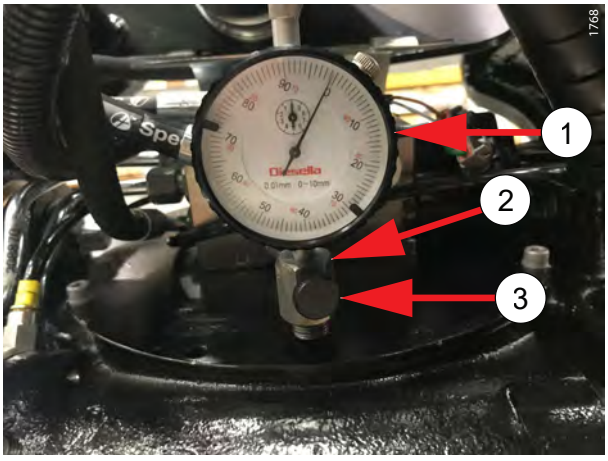
No other special tools are needed.

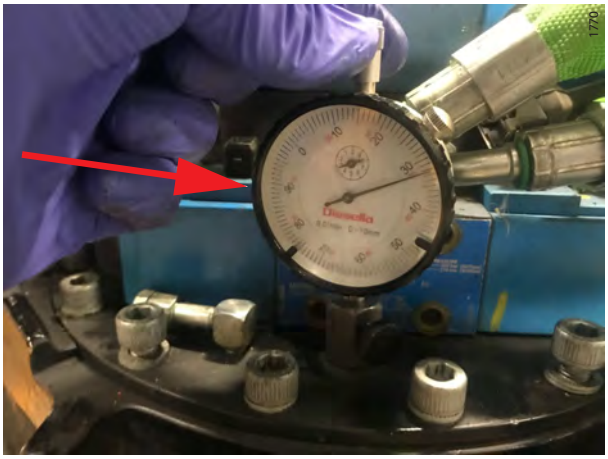
Measuring procedure:

WARNING

Always turn off the machine and its main electrical switch before maintenance and repair work.

1. On X04 and X06, remove the cover over the valves by removing the 2 bolts, see picture 1. On X07, it is possible remove the relief valve with the cover in place, see picture 2.	 
2. Remove the relief valve.	

3. a) Dial indicator (1) b) Hub (2) c) Lock screw (3)	
4. Mount the dial indicator.	
5. Use a crowbar to create leverage between the attachment coupler unit and the gearbox. Pry as much as the play allows.	

6. Read the dial indicator to see what the play was.	

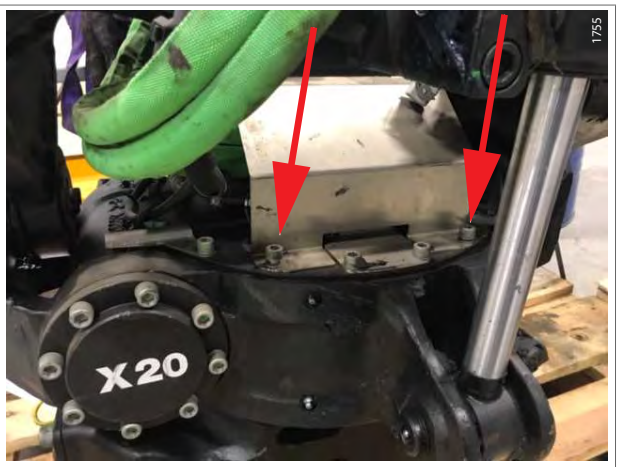
Meausurement of axial play X12-X32

To measure tiltrotator axial play, a dial indicator and hub are needed, (Stelwrist part number 604680).
See allowed play in Radial play and axial play [47].

No other special tools are needed.

Measuring procedure:

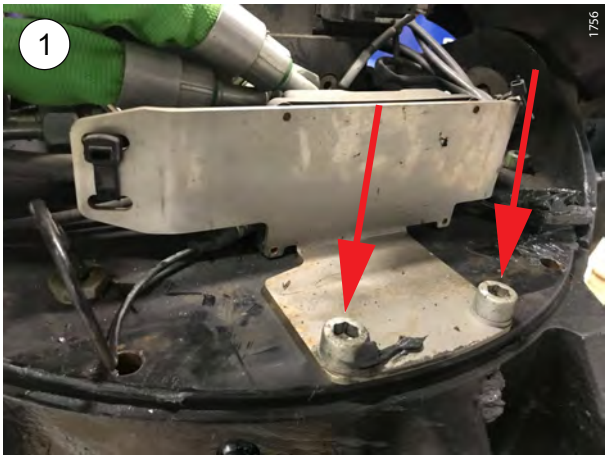
> **WARNING**
> Always turn off the machine and its main electrical switch before maintenance and repair work.

1. Remove the cover over the valves by loosening the 2 screws at the red arrows.	

2. Remove the screws that secure the TR module:

X12-X26, see Figure 1.

X32, see Figure 2.



3. Move the bracket to the side and disconnect the sensor connector.

4.

Tiltrotators configured for XCG2 have a gear sensor (picture 1, location on X14-X32), tiltrotators configured for CS9 have no gear sensor and there is instead a plug in the same hole (picture 2, location on X12).

XCG2: Remove the gear sensor, take care not to damage the cable, picture 1.

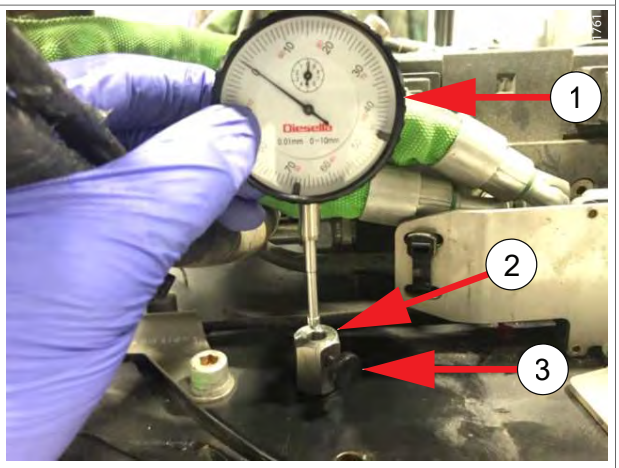
CS9: Remove plug, picture 2.

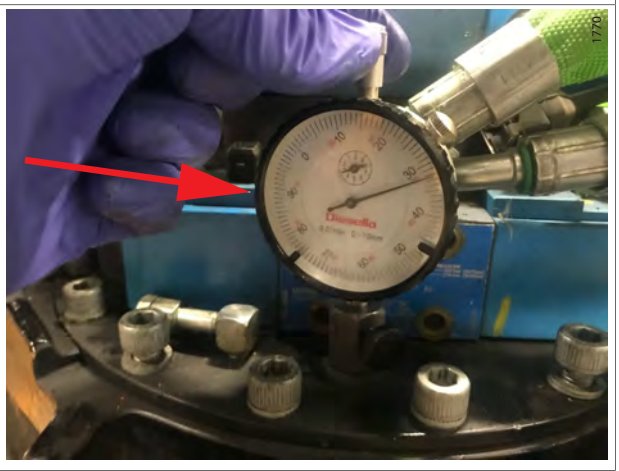
5.

a) Dial indicator (1)

b) Hub (2)

c) Lock screw (3)

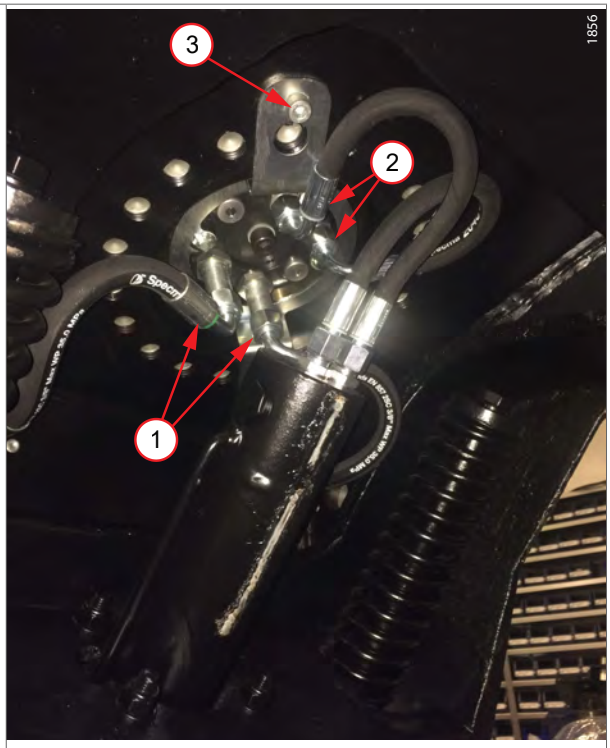
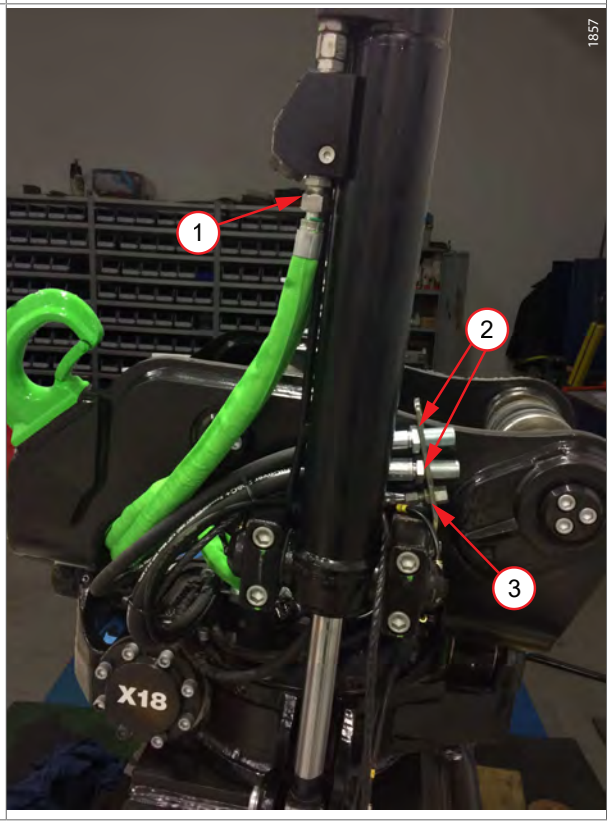


6. Mount the dial indicator.	
7. Use a crowbar to create leverage between the attachment coupler unit and the gearbox. Pry as much as the play allows.	
8. Read the dial indicator to see what the play was.	

Replacement of axial bearings / shims affecting axial play

If the tiltrotators' axial play is too large, shims (X04-X07) or axial bearings (X12-X32) need to be replaced between the gearbox and the attachment coupler. For more information on axial play see Radial play and axial play [47].

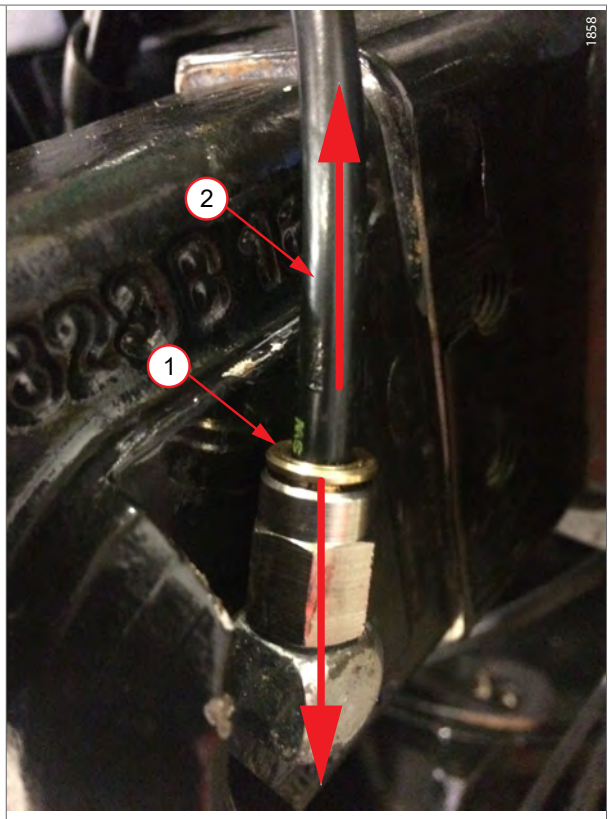
Work process:

1. Get access to the underside of the tiltrotators attachment coupler and remove the following from the swivel: a) extra hydraulics (1) b) lock hydraulics (2) c) swivel lock (3) d) if there is is a gripper cassette its hydraulic connections also need to be removed from the swivel.	
2. Remove: a) the tiltcylinder hoses (x4) from the tiltcylinder on each side (1) b) Pressure and Tank hoses (2) (two hoses on XCG2, four hoses (two on each side) on CS9) c) if the tiltrotator is equipped with CLS that hose also needs to be removed (3).	

3. Remove all the CLS hose connections from the gearbox:

a) press the copper part (1) towards the connection/downwards

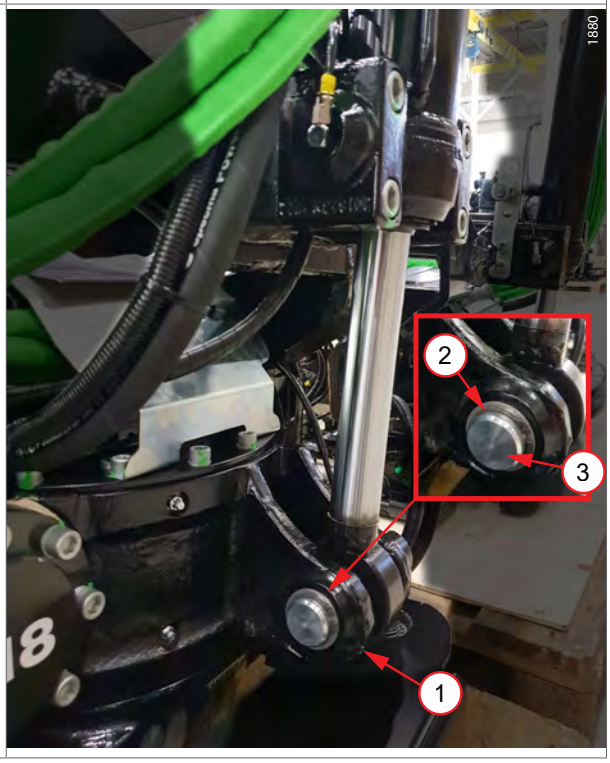
b) pull the CLS-hose (2) away from the connection into the gearbox to remove it.



4. Remove both tiltcylinders from their mounts (1) on each side of the gearbox:

a) remove circlip (2)

b) knock out the shaft holding the piston rod (3).

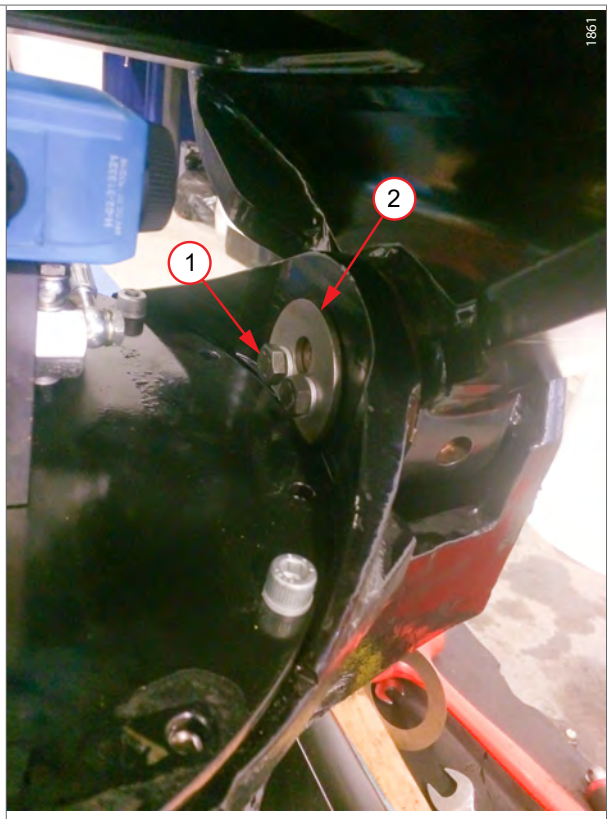


5. Start disconnecting the upper coupler from the gearbox.

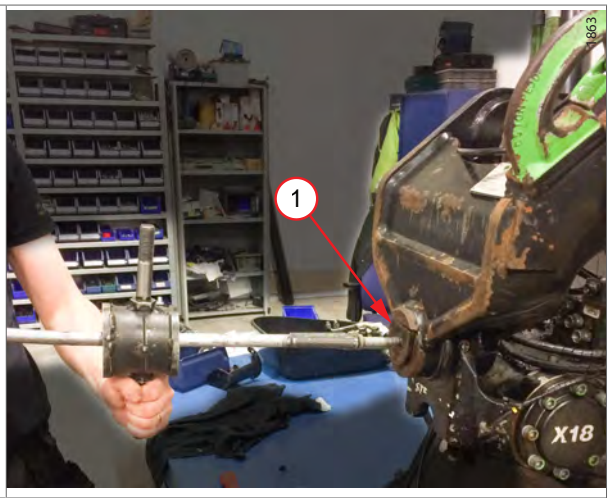
For removal on each side on the inside of the tilt shaft:

a) two screws (1).

b) one lock bracket (2).



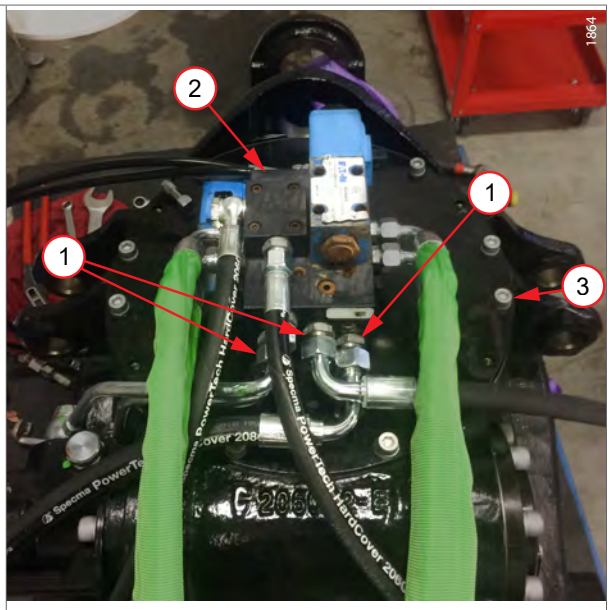
6. Remove the plastic plugs (1) on the outside of the tilt shaft, one plug per side.

7. Ensure that the upper coupler is suspended in a suitable lifting device; Remove front and rear tilt shaft (1), use a impact hammer if necessary, see picture.	
8. Remove the upper coupler (1) by lifting it with appropriate lifting gear.	

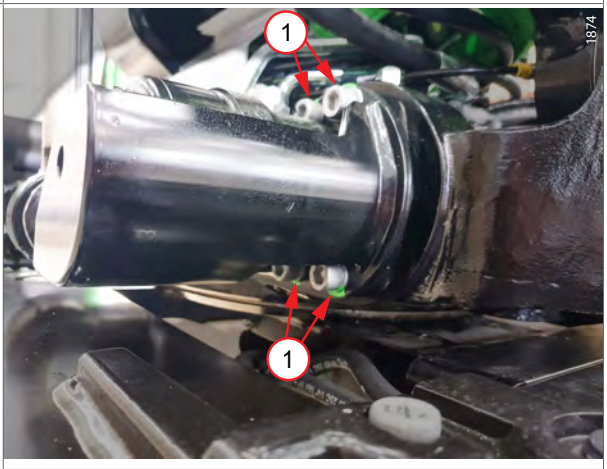
9. Remove:

a) all hydraulic pipes and hoses connected to the gearbox (1) from the hydraulic block (2) on the gearbox cover

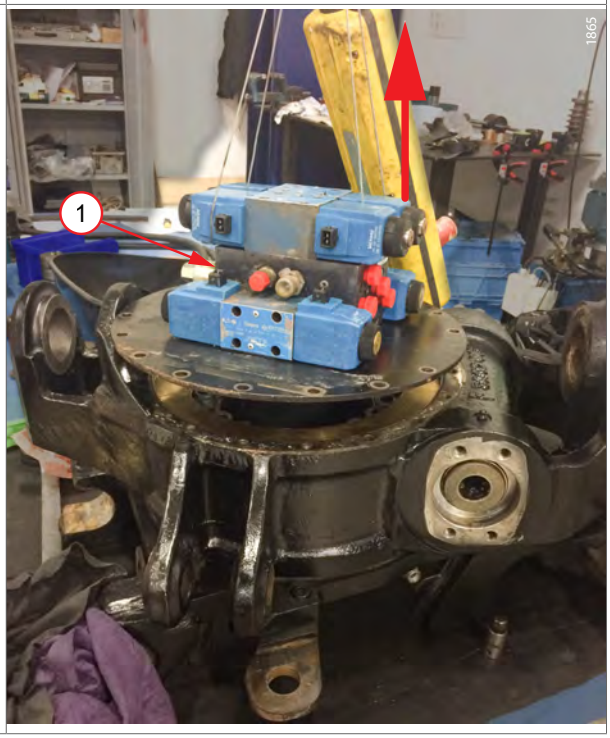
b) all screws holding the cover (3).



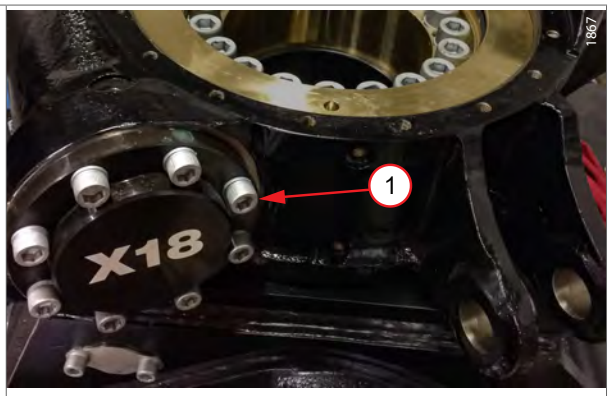
10. Remove the screws (1) holding the hydraulic motor and remove the motor.



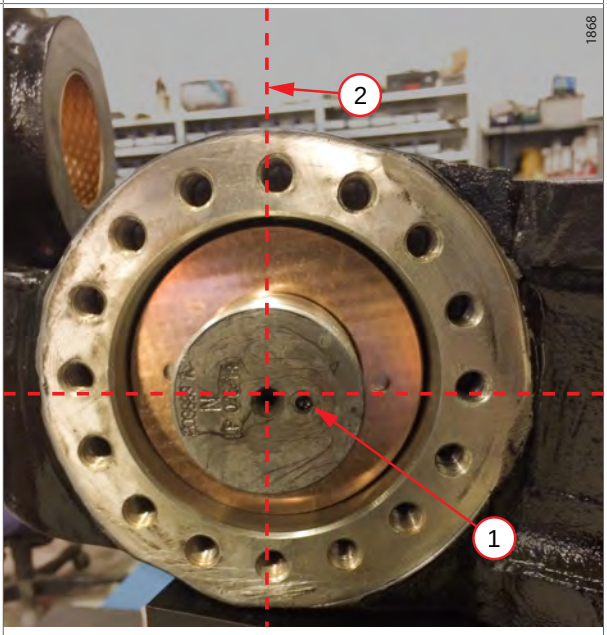
11. Lift out the hydraulic block and the cover (1).



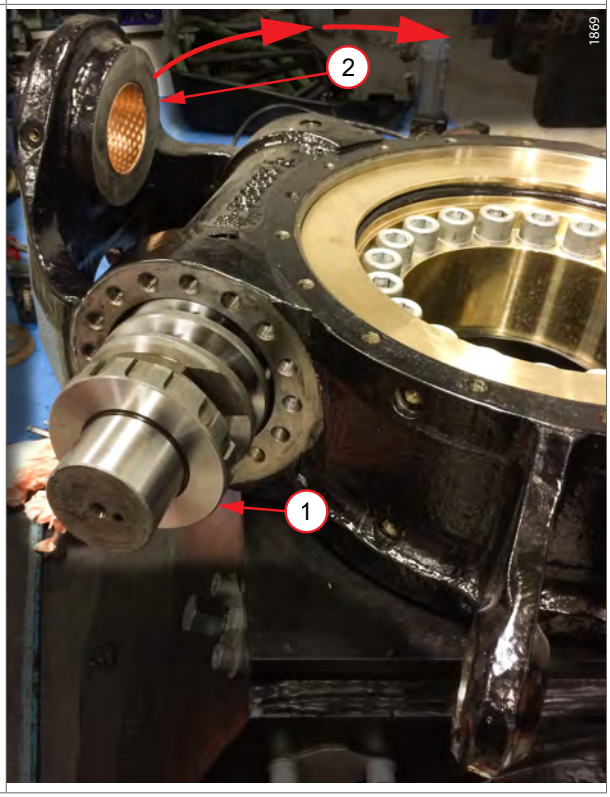
12. Remove all screws (1) holding the worm cover and then remove the cover.



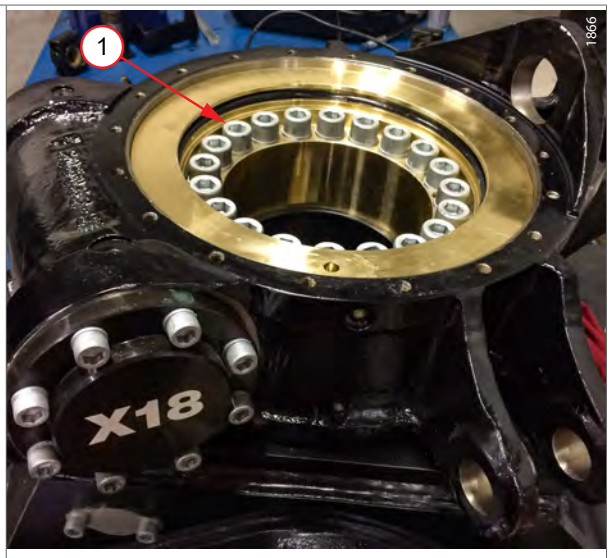
13. Place hole marking (1) on the worm at three o'clock in relation to the vertical plane (2). The hole marking needs to be in the same position (three o'clock) when remounting tiltrotator.



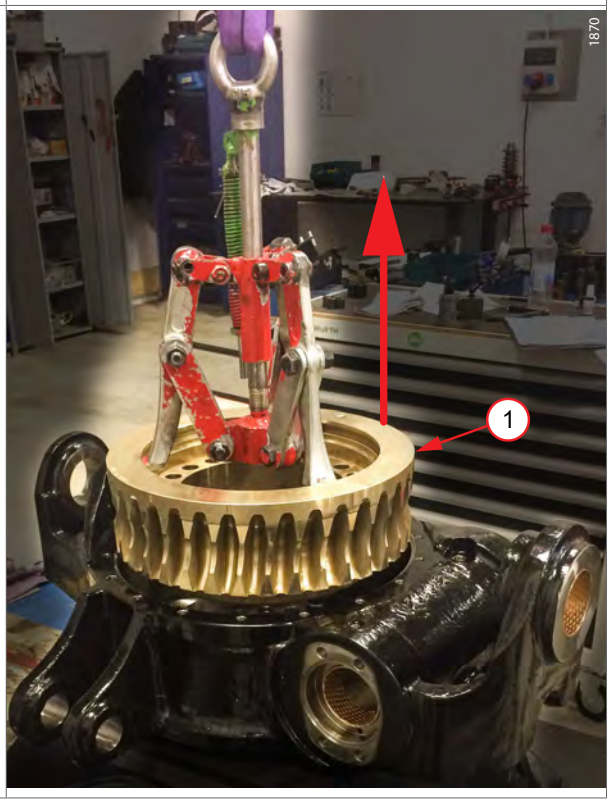
14. To remove the worm, hold it (1) while pushing the gearbox (2) clockwise.



15. Remove all screws (1) holding the worm gear.



16. Remove worm gear (1) by lifting it with appropriate lifting gear.



17. Remove gearbox (1) by lifting it with appropriate lifting gear.

18.

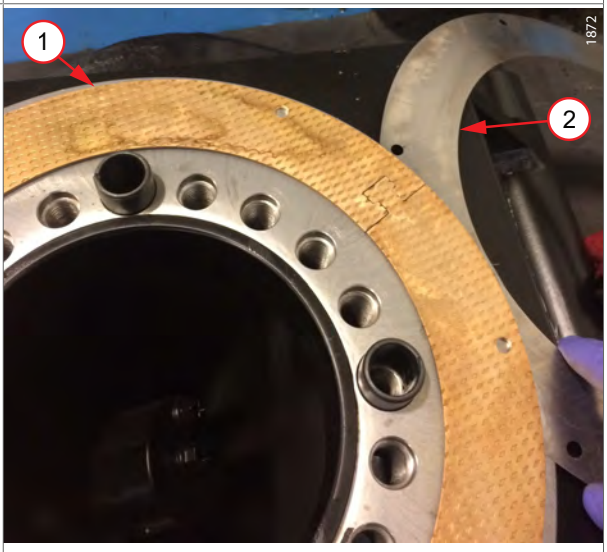
X04-X07:

a) Remove axial bearing (1), replace axial bearing if worn.

b) Place shims (2) under the axial bearing. Replace the shaft bearing over the shim with the side with grease pockets facing up (1).

X12-X32:

a) Change axial bearings, if necessary to an oversized bearing (2.8 mm) (1), alternatively replace shims (2).



19. Change all O-rings for new ones before remounting the tiltrotator. There are five O-rings:

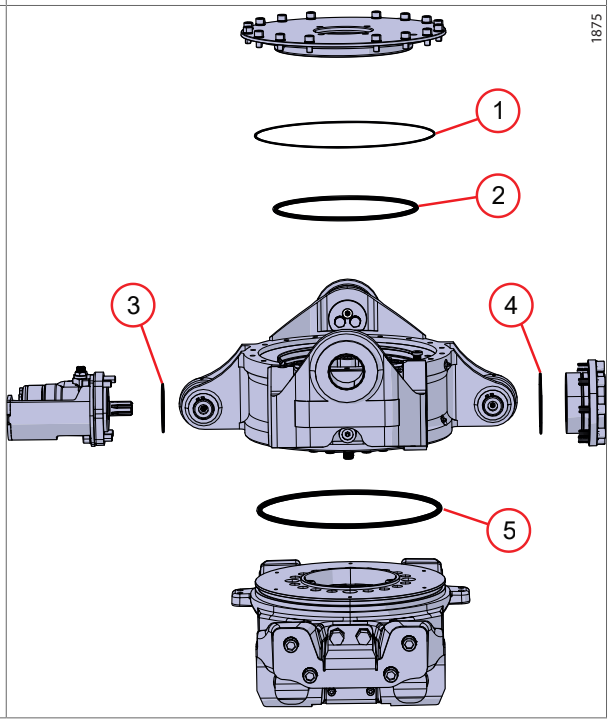
- 1. Gearbox cover.

- 2. Inner gearbox.

- 3. Hydraulic motor.

- 4. Worm cover.

-5. Attachment coupler.



20. Assemble gearbox (1) (step 17) and worm gear (2) (step 16, with only four screws).

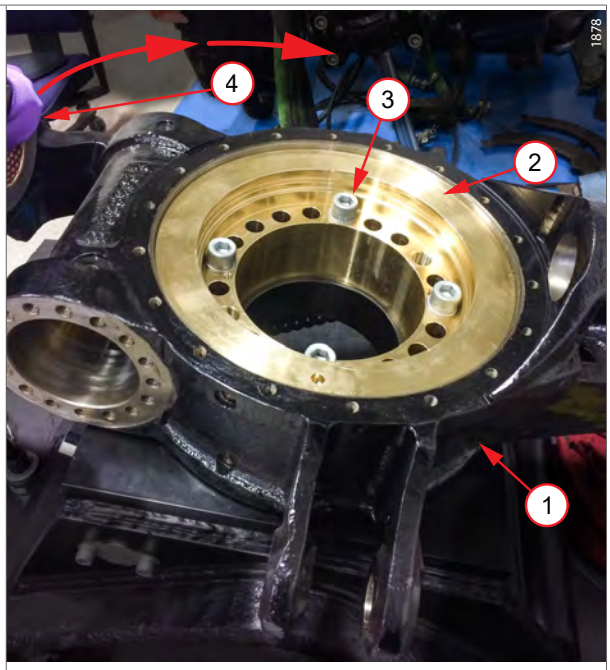
a) Mount the worm gear (2) with four screws (3) as shown. For steps see Tightening torque [71].

b) Turn the gearbox by hand (4). If possible, you are on the right track.

c) If it is not possible to rotate the gearbox by hand:

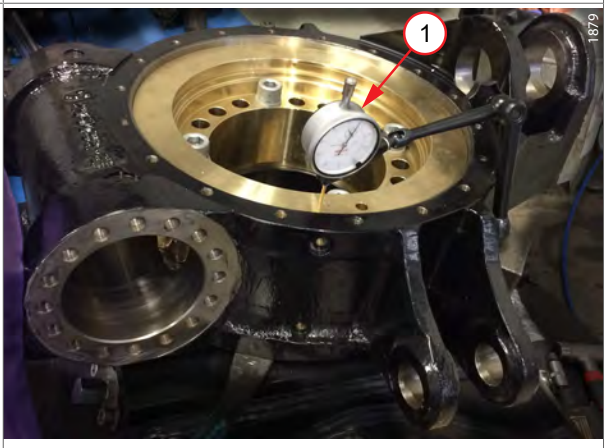
X04-X07; Switch to a thinner shim.

X12-X32; Change to a thinner axial bearing.

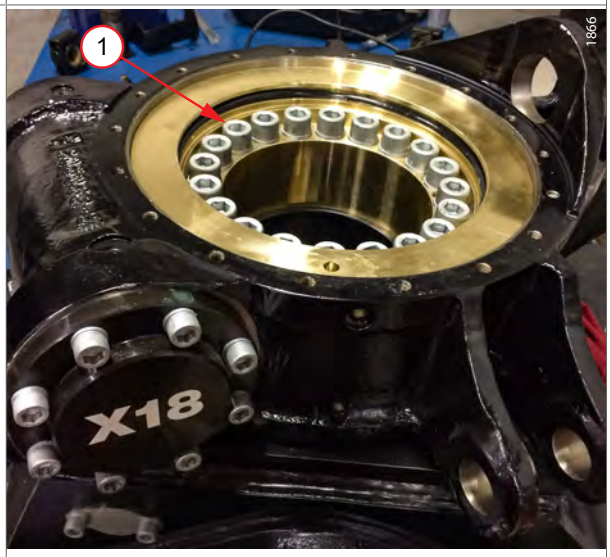


21. Measure the play with a dial indicator (1). The play must be at least 0.2 mm (0.008 in.) In this measuring position. NOTE! The gearbox must be rotated by hand as above (step 20).

If the play is large despite the fact that either axial bearings or shim have been replaced, the flatness of the sliding surfaces should be checked between gearbox and attachment coupler.



22. Remount all the screws (1) and tighten to torque. For torque see Tightening torque tiltrotator.



23. Remount the rest of the tiltrotator and fill the gearbox with grease.

Tightening torque

Tightening torque for the tiltrotator

Table 7. Recommended tightening torques for different mounting screws (USC).

Size	Bolted joint	Dimensions	Quality	Torque
X04/X06/X07	Top cover	M6	12.9	12 lbf-ft
	Worm flange	M8	12.9	28 lbf-ft
	Hydraulic motor	M8	12.9	28 lbf-ft
		M10	12.9	55 lbf-ft
	Tilt cylinder holder	M12	12.9	94 lbf-ft
	Gear wheel	M16	12.9	229 lbf-ft
	Gripper cassette	M16	12.9	229 lbf-ft
X12	Top cover	M10	12.9	55 lbf-ft
	Worm flange	M12	12.9	94 lbf-ft
	Hydraulic motor	M12	12.9	55 lbf-ft
	Tilt cylinder holder	M16	12.9	229 lbf-ft
	Gear wheel	M16	12.9	229 lbf-ft
	Gripper cassette	M16	12.9	229 lbf-ft
X14	Top cover	M10	12.9	55 lbf-ft
	Worm flange	M12	12.9	55 lbf-ft
	Hydraulic motor	M12	12.9	55 lbf-ft
	Tilt cylinder holder	M16	12.9	229 lbf-ft
	Gear wheel	M18	12.9	322 lbf-ft
	Gripper cassette	M16	12.9	229 lbf-ft
X18/X20/X26	Top cover	M10	12.9	55 lbf-ft
	Worm flange	M12	12.9	55 lbf-ft
	Hydraulic motor	M12	12.9	55 lbf-ft
	Tilt cylinder holder	M16	12.9	229 lbf-ft
	Gear wheel	M18	12.9	322 lbf-ft
	Gripper cassette	M16	12.9	229 lbf-ft
X32	Top cover	M10	12.9	55 lbf-ft
	Worm flange	M12	12.9	55 lbf-ft
	Hydraulic motor	M12	12.9	55 lbf-ft
	Tilt cylinder holder	M16	12.9	229 lbf-ft
	Gear wheel	M20	12.9	450 lbf-ft
	Gripper cassette	M16	12.9	229 lbf-ft

Tightening torque shafts locked with expander cones

NOTE

Important, the bolts for shaft pins with expander cones must be retightened with a torque and at intervals set out below:

- After 1 hr
- After 3 hrs
- After 1 day of use
- After 4 days of use
- During service

Table 8. Tightening torque for shafts with expander cones (USC)

Type	Dimensions	Quality	Torque
Screw	M12	12.9	94 lbf-ft
Screw	M16	12.9	229 lbf-ft
Nut	M20	-	148 lbf-ft
Nut	M24	-	203 lbf-ft
Nut	M27	-	221 lbf-ft
Nut	M30	-	258 lbf-ft

Table 9. Tightening torque generally for screws (USC)

Dimensions	Quality	Torque
M8	12.9	28 lbf-ft
M10	12.9	55 lbf-ft
M12	12.9	94 lbf-ft
M16	12.9	229 lbf-ft

Tightening torque for the hydraulic adapter and hose couplings

All ports in blocks and cylinders have BSPP G threads according to ISO 228, ISO 1179-1.

We recommend adapters with ED seals against the blocks according to ISO 1179-2.

Our recommended torque for adapters, see the table.

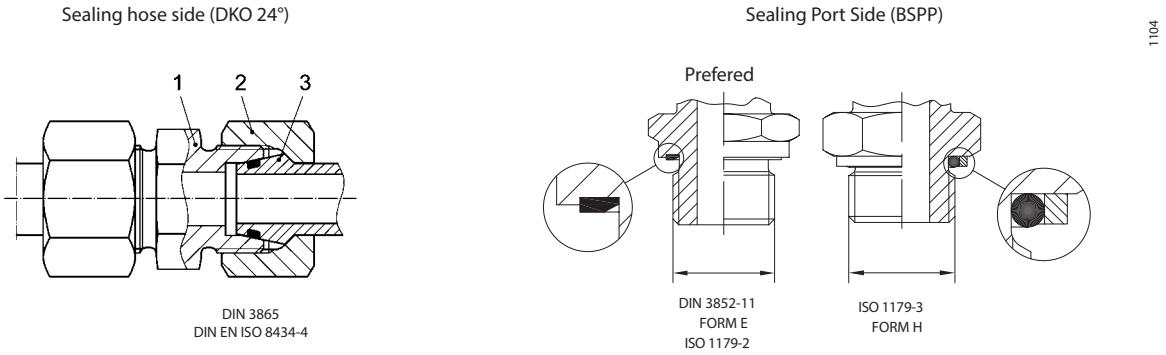
Table 10. Tightening torque for the hydraulic adapter

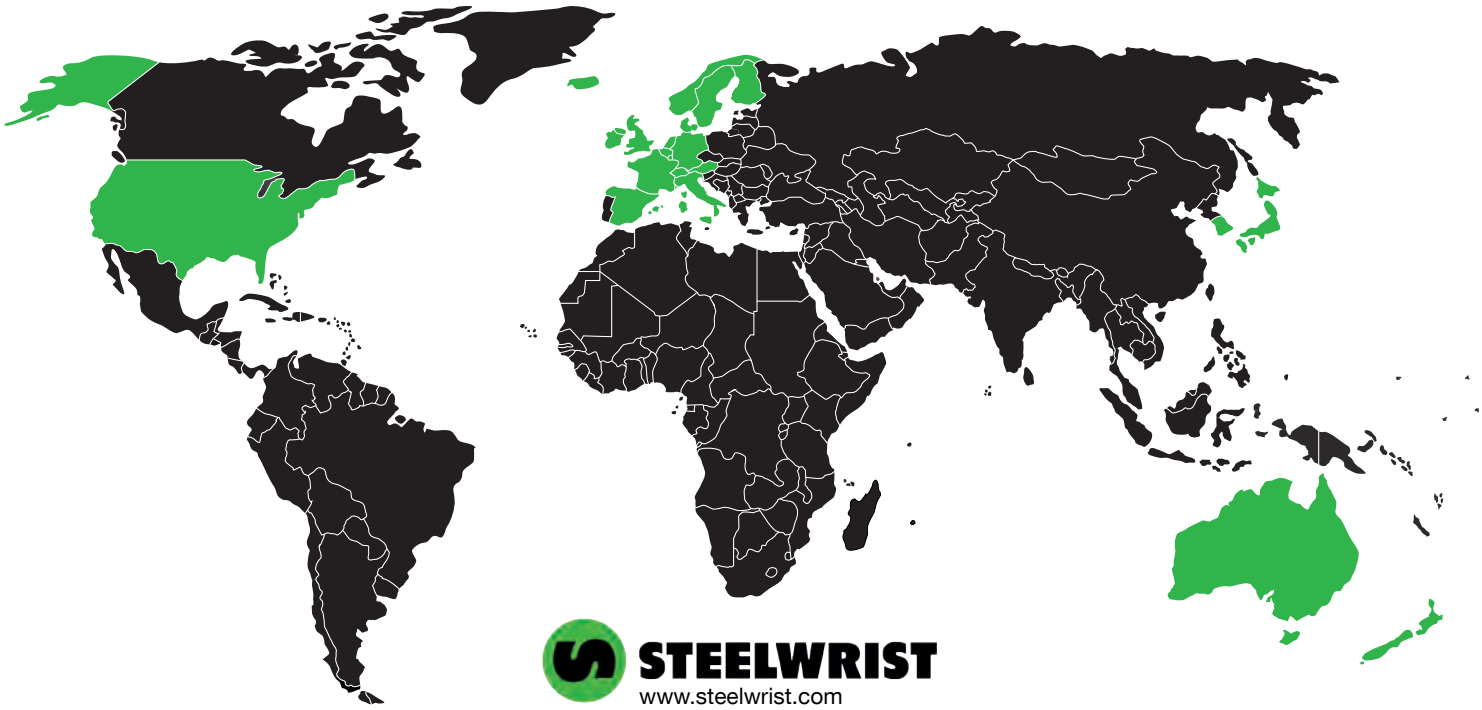
Block adapter		Hose couplings			Weo cartridge	
Thread	Torque	Coupling	Thread	Torque	Thread	Torque
1/8" BSPP	12 lbf-ft	6L	M12x1.5	15 lbf-ft	-	-
1/4" BSPP	26 lbf-ft	8L	M14x1.5	22 lbf-ft	1/4”	22 lbf-ft
-	-	10L	M16x1.5	30 lbf-ft	-	-
3/8" BSPP	44 lbf-ft	12L	M18x1.5	44 lbf-ft	3/8"	26 lbf-ft
1/2" BSPP	59 lbf-ft	15L	M22x1.5	74 lbf-ft	1/2"	33 lbf-ft
-	-	18L	M26x1.5	74 lbf-ft	-	-
3/4" BSPP	111 lbf-ft	20S	M30x2	89 lbf-ft	3/4"	55 lbf-ft
-	-	22L	M30x2	89 lbf-ft	-	-

The adapters in our tiltrotators have connections on the hose side according to DIN 3861/ISO 8434-1.

The hoses in our tiltrotators have compression ring couplings with soft seals according to DIN 3865/DIN EN ISO 8434-4.

Figure 3. Compression ring coupling (metric connection)

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