

SECTION 6 MAINTENANCE STANDARD



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SECTION 6 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets Hyundai spec.

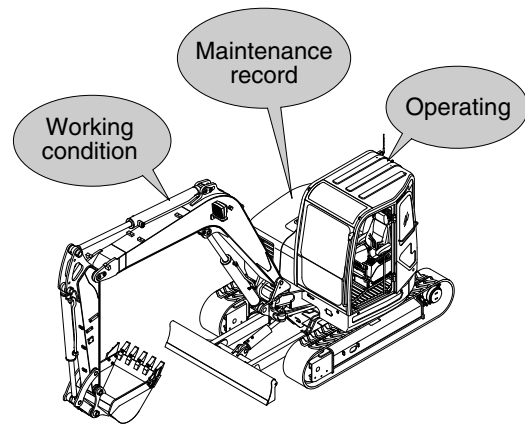
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done (by referring to the "Service Limits" in this manual).

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

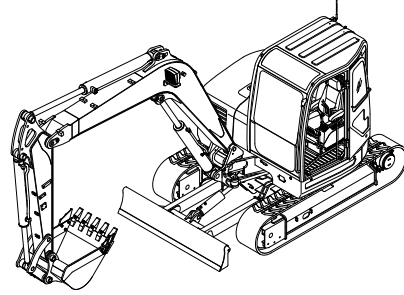


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2. TERMINOLOGY

1) STANDARD

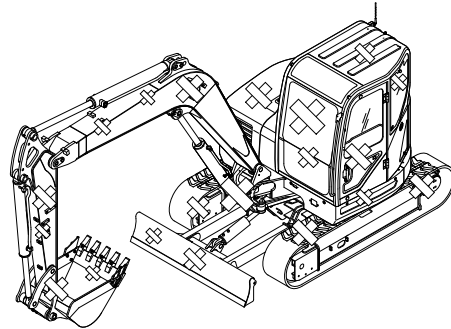
Specifications applied to the brand-new machine, components and parts.



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2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



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3. OPERATION FOR PERFORMANCE TESTS

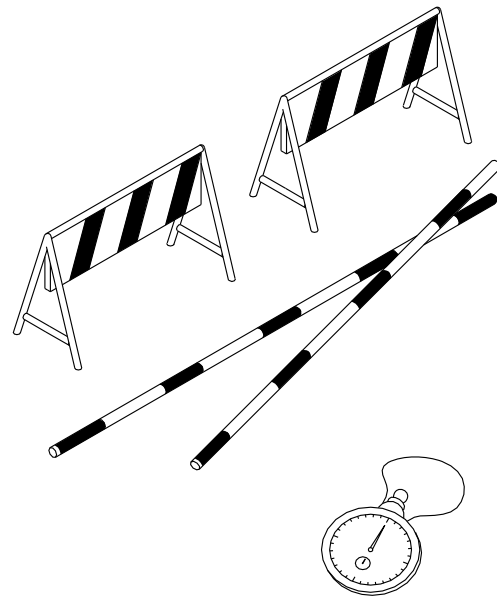
- 1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.



(3) Precautions

- ① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.
- ② Operate the machine carefully and always give first priority to safety.
- ③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.
- ④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

7-3 (140-7)

(4) Make precise measurements

- ① Accurately calibrate test instruments in advance to obtain correct data.
- ② Carry out tests under the exact test conditions prescribed for each test item.
- ③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.

2) ENGINE SPEED

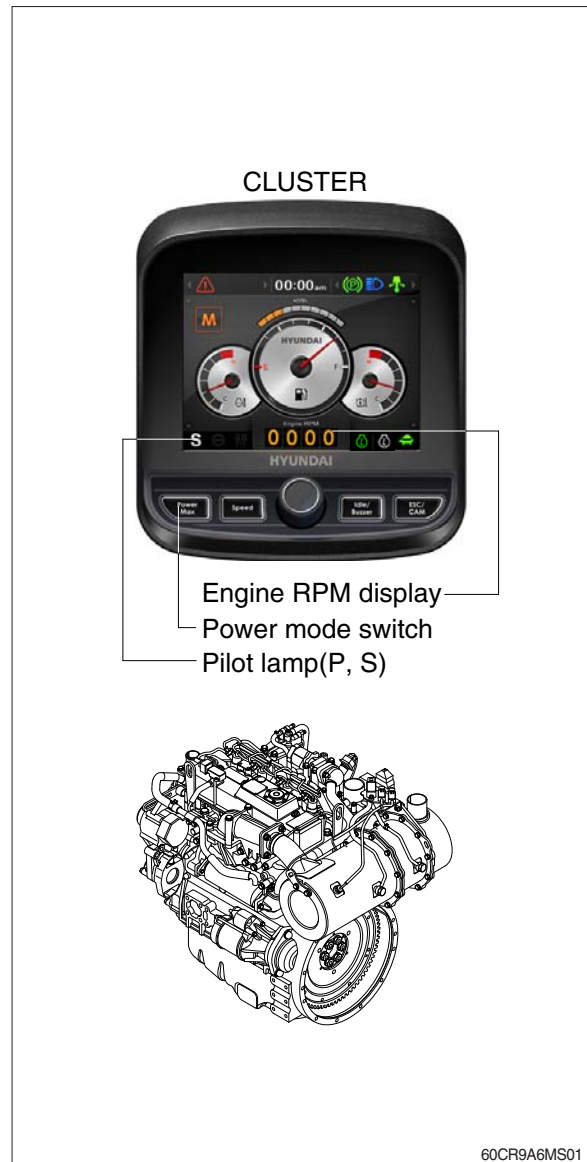
- (1) Measure the engine speed at each power mode
- ※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

- ① Warm up the machine, until the engine coolant temperature reaches 50°C or more, and the hydraulic oil is 50±5°C.
- ② Set the accel dial at 10 (Max) position.
- ③ Measure the engine RPM.

(3) Measurement

- ① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.
- ② Measure and record the engine speed at each mode (P, S).
- ③ Select the P-mode.
- ④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.
- ⑤ Measure and record the auto deceleration speed.



(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remark
R60CR-9A	Start idle	1000 ± 50	
	P mode	1900 ± 50	
	S mode	1750 ± 50	
	Auto decel	1100 ± 50	

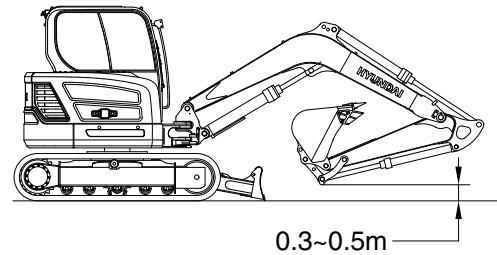
Condition : Set the accel dial at 10 (Max) position.

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20m test track.

(2) Preparation

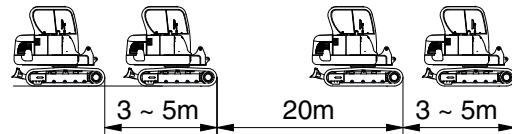
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



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(3) Measurement

- ① Measure both the low and high speeds of the machine.
- ② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested.
- ③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.
- ④ Measure the time required to travel 20m.
- ⑤ After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.
- ⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



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(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

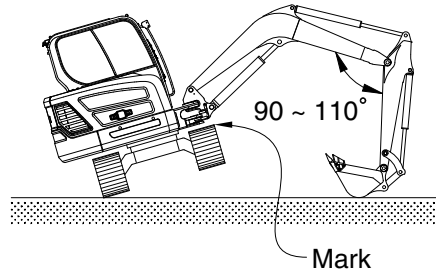
Model	Travel speed	Standard	Maximum allowable	Remarks
R60CR-9A	1 Speed	32.7 ± 2.0	41	
	2 Speed	18.0 ± 1.0	23	

4) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

(2) Preparation

- ① Adjust the tension of both side tracks to be equal.
- ② On the track to be measured, mark one shoe with chalk.
- ③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



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(3) Measurement

- ① Select the following switch positions.
 - Travel mode switch : 1 or 2 speed
- ② Operate the travel control lever of the raised track in full forward and reverse.
- ③ Rotate 1 turn, then measure time taken for next 3 revolutions.
- ④ Raise the other side of machine and repeat the procedure.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

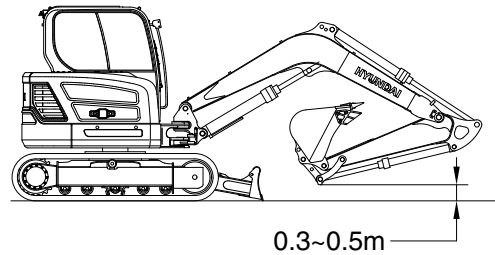
Model	Travel speed	Standard	Maximum allowable
R60CR-9A	1 Speed	26.5 ± 1.5	33.1
	2 Speed	14.6 ± 1.5	18.3

5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20m straight line.

(2) Preparation

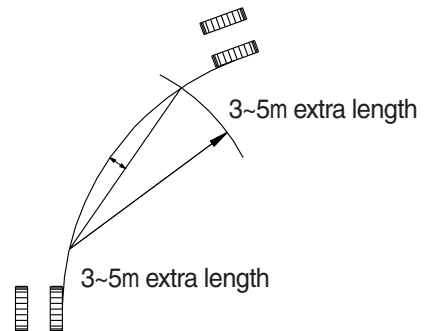
- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



55Z96MC04

(3) Measurement

- ① Measure the amount of mistracking at high and low travel speeds.
- ② Start traveling the machine in the acceleration zone with the travel levers at full stroke.
- ③ Measure the distance between a straight 20m line and the track made by the machine. (dimension a)
- ④ After measuring the tracking in forward travel, turn the upperstructure 180° and measure that in reverse travel.
- ⑤ Repeat steps ③ and ④ three times and calculate the average values.



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(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20m

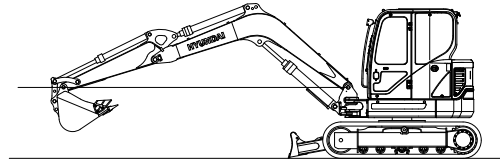
Model	Standard	Maximum allowable	Remarks
R60CR-9A	200 below	240	

6) SWING SPEED

- (1) Measure the time required to swing three complete turns.

(2) Preparation

- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



55Z96MC07

(3) Measurement

- ① Operate swing control lever fully.
- ② Swing 1 turn and measure time taken to swing next 2 revolutions.
- ③ Repeat steps ① and ② three time and calculate the average values.

(4) Evaluation

The time required for 2 swings should meet the following specifications.

Unit : Seconds / 2 revolutions

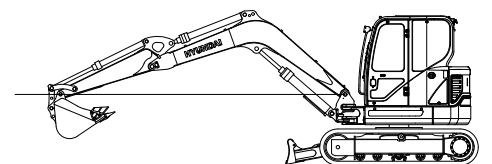
Model	Standard	Maximum allowable	Remarks
R60CR-9A	13.6 ± 0.4	17	

7) SWING FUNCTION DRIFT CHECK

- (1) Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

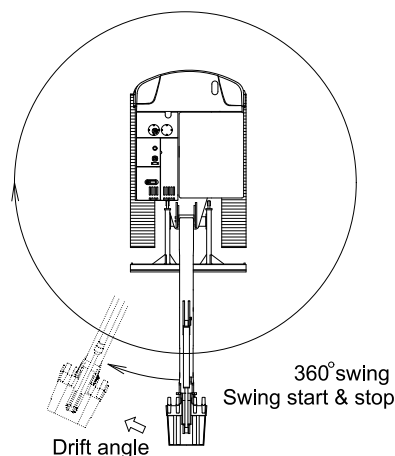
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
- ④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
- ⑤ Swing the upperstructure 360°.
- ⑥ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.



55Z96MC07

(3) Measurement

- ① Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°.
- ② Measure the distance between the two marks.
- ③ Align the marks again, swing 360°, then test the opposite direction.
- ④ Repeat steps ② and ③ three times each and calculate the average values.



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(4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

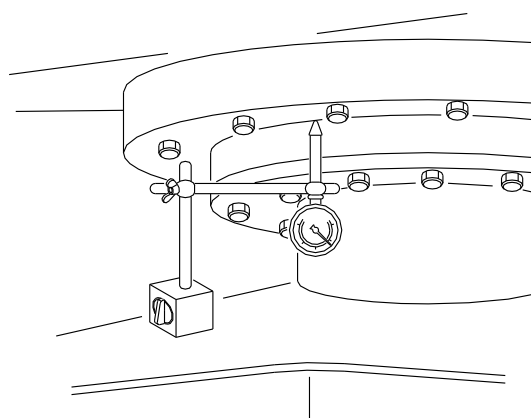
Model	Standard	Maximum allowable	Remarks
R60CR-9A	40 below	70	

8) SWING BEARING PLAY

- (1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.

(2) Preparation

- ① Check swing bearing mounting cap screws for loosening.
- ② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.
- ③ Install a dial gauge on the track frame as shown, using a magnetic base.
- ④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.
- ⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.
- ⑥ Bucket should be empty.

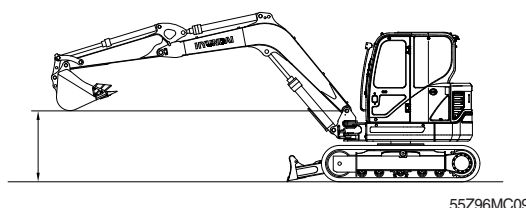


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(3) Measurement

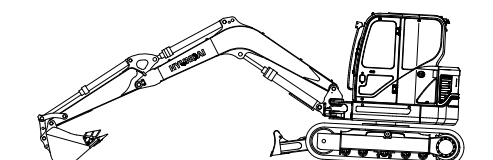
- ① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin. Record the dial gauge reading (h1).
- ② Lower the bucket to the ground and use it to raise the front idler 50 cm. Record the dial gauge reading (h2).
- ③ Calculate bearing play (H) from this data (h1 and h2) as follows.
 $H = h2 - h1$

Measurement : h1



55Z96MC09

Measurement : h2



55Z96MC10

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R60CR-9A	0.5 ~ 1.2	2.4	

9) HYDRAULIC CYLINDER CYCLE TIME

- (1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

(2) Preparation

- ① To measure the cycle time of the boom cylinders:

With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

- ② To measure the cycle time of the arm cylinder.

With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5m above the ground.

- ③ To measure the cycle time of the bucket cylinder.

The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

- ④ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.

(3) Measurement

- ① To measure cylinder cycle times.

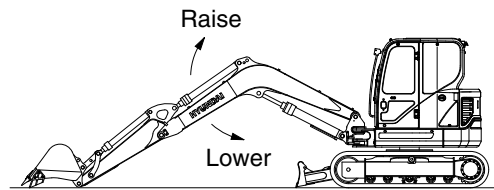
- Boom cylinders.

Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

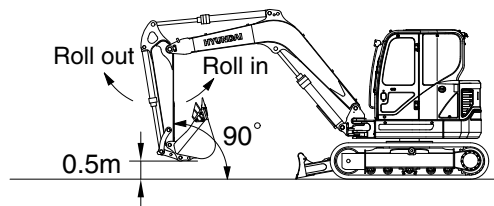
- Arm cylinder.

Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

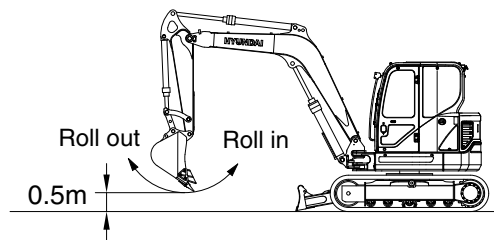
Boom cylinder



Arm cylinder



Bucket cylinder



55Z96MC11

- Bucket cylinders

Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
R60CR-9A	Boom raise	2.4 ± 0.4	3.0	
	Boom lower	2.7 ± 0.4	3.3	
	Arm in	2.3 ± 0.4	3.0	
	Arm out	2.3 ± 0.3	2.8	
	Bucket load	3.8 ± 0.4	4.4	
	Bucket dump	2.4 ± 0.3	2.9	
	Boom swing (LH)	4.9 ± 0.4	5.9	
	Boom swing (RH)	6.4 ± 0.4	7.8	
	Dozer up (raise)	2.8 ± 0.3	3.1	
	Dozer down (lower)	3.8 ± 0.3	4.2	

10) DIG FUNCTION DRIFT CHECK

- (1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

- ① Load bucket fully. Instead of loading the bucket, weight (W) of the following specification can be used.

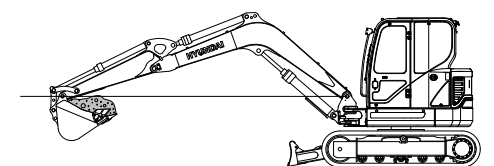
$$W = M^3 \times 1.5$$

Where :

M^3 = Bucket heaped capacity (m^3)

1.5 = Soil specific gravity

- ② Position the arm cylinder with the rod 20 to 30mm extended from the fully retracted position.
- ③ Position the bucket cylinder with the rod 20 to 30mm retracted from the fully extended position.
- ④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^\circ C$.



55Z96MC12

(3) Measurement

- ① Stop the engine.
- ② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.
- ③ Repeat step ② three times and calculate the average values.

- (4) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R60CR-9A	Boom cylinder	10 below	20	
	Arm cylinder	20 below	30	
	Bucket cylinder	20 below	30	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

① Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.

(3) Measurement

- ① Start the engine.
- ② Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
- ③ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.
- ④ Repeat steps ② and ③ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R60CR-9A	Boom lever	1.4 or below	1.9	
	Arm lever	1.4 or below	1.9	
	Bucket lever	1.4 or below	1.9	
	Swing lever	1.4 or below	1.9	
	Travel lever	2.0 or below	2.5	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.

(3) Measurement

- ① Stop the engine.
- ② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.
- ③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

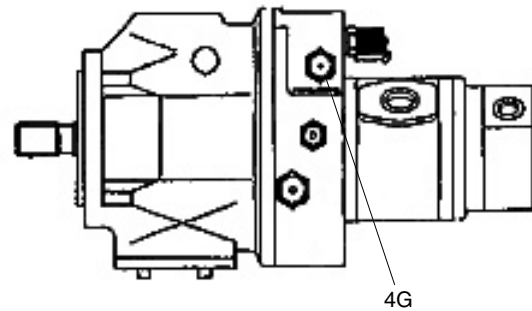
Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
R60CR-9A	Boom lever	87 ± 10	109	
	Arm lever	87 ± 10	109	
	Bucket lever	87 ± 10	109	
	Swing lever	87 ± 10	109	
	Travel lever	86 ± 10	105	

13) PILOT PRIMARY PRESSURE

(1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ Loosen and remove plug on the pilot pump delivery port (4G) and connect pressure gauge.
- ④ Start the engine and check for oil leakage from the port.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



(2) Measurement

- ① Measure the primary pilot pressure in the M mode.

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(3) Evaluation

The average measured pressure should meet the following specifications:

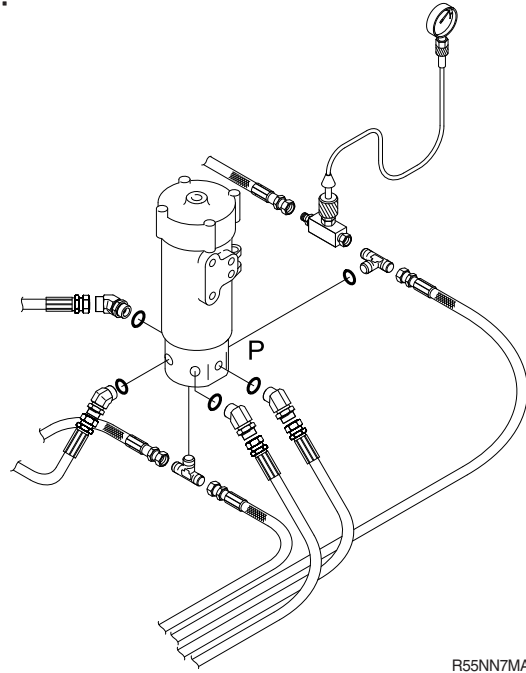
Unit : kgf / cm²

Model	Standard	Remarks
R60CR-9A	30 ± 5	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
- ④ Start the engine and check for on leakage from the adapter.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.



R55NN7MA15

(2) Measurement

- ① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
- ② Measure the travel speed selecting pressure in the Hi or Lo mode.
- ③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
- ④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

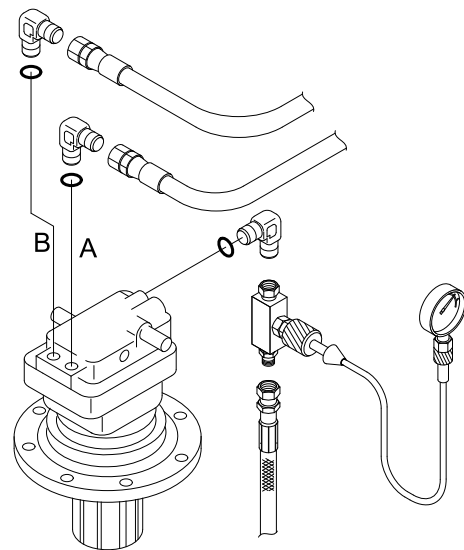
Unit : kgf / cm²

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R60CR-9A	1 Speed	0	-	
	2 Speed	30 ± 5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
- ④ Start the engine and check for oil leakage from the adapter.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.



R55NN7MA16

(2) Measurement

- ① Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
- ② Repeat three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

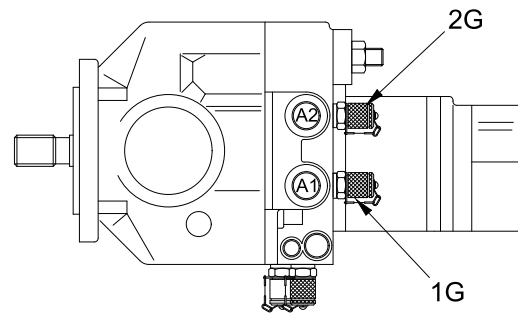
Unit : kgf / cm²

Model	Description	Standard	Remarks
R60CR-9A	Brake disengaged	30 ± 5	
	Brake applied	0	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port (1G, 2G) as shown.
- ④ Start the engine and check for oil leakage from the port.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.



(2) Measurement

- ① Measure the main pump delivery pressure at high idle.

R55NN7MA17

(3) Evaluation

The average measured pressure should meet the following specifications.

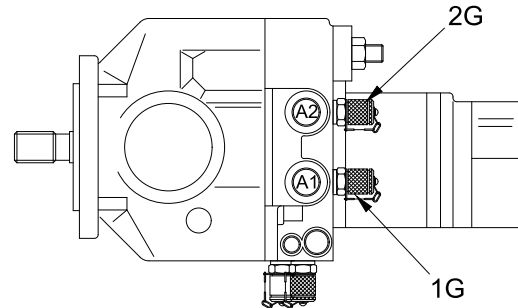
Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R60CR-9A	High idle	20 ± 5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

- ① Stop the engine.
- ② Push the pressure release button to bleed air.
- ③ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
- ④ Start the engine and check for oil leakage from the port.
- ⑤ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



R55NN7MA17

(2) Measurement

- ① Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
- ② In the swing function, place bucket against an immovable object and measure the relief pressure.
- ③ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Function to be tested	Standard
R60CR-9A	Boom, Arm, Bucket	220 ± 10
	Travel	220 ± 10
	Swing	220 ± 10

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

Before inspection, wash the parts well and dry them completely.

Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

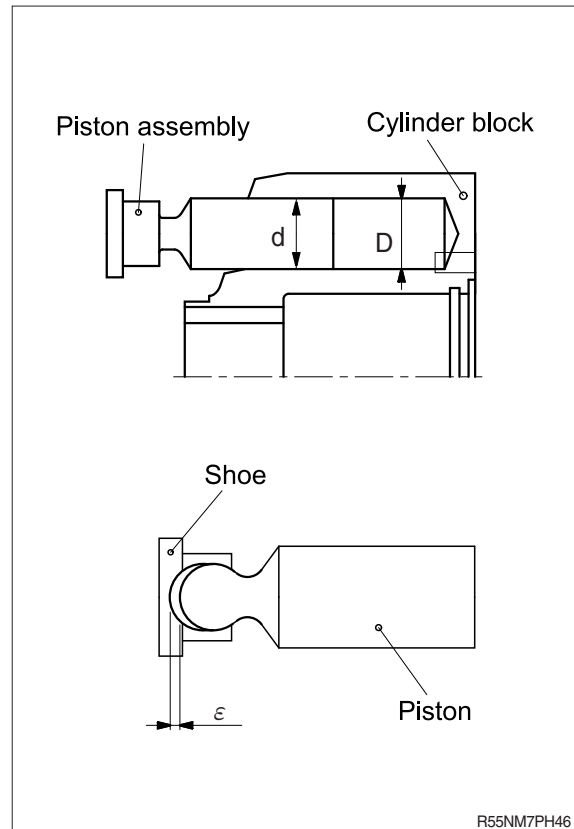
1) PISTON ASSEMBLY AND CYLINDER BLOCK

- (1) Check the appearance visually.

No damage, scouring, abnormal wear (particularly, in the slide portion) should be found.

- (2) Check the clearance between the piston outside dia and cylinder block inside dia.

$$D-d \leq 0.050 \text{ mm}$$



2) PISTON SHOE AND PISTON

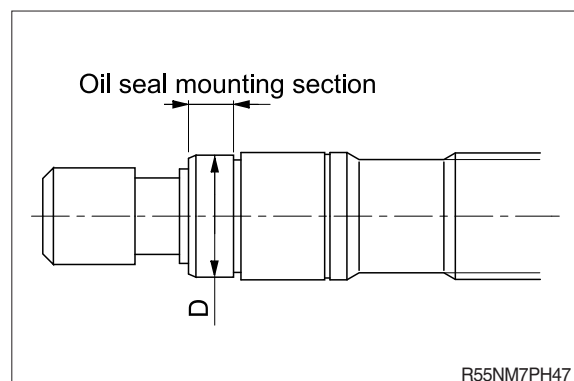
- (1) Check the axial play of the piston and piston shoe.

$$\epsilon \leq 0.2 \text{ mm}$$

3) SHAFT

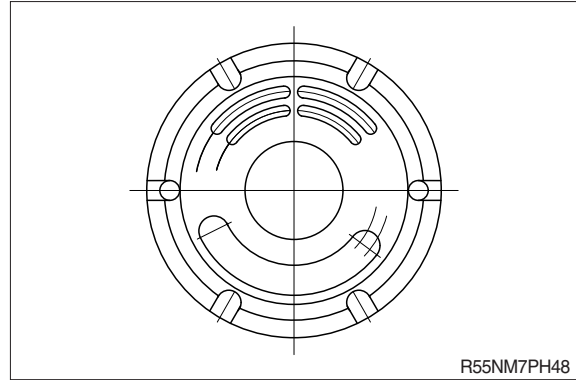
- (1) Check the wear amount of the oil seal mounting section.

$$\text{Wear amount} \leq 0.025 \text{ mm}$$



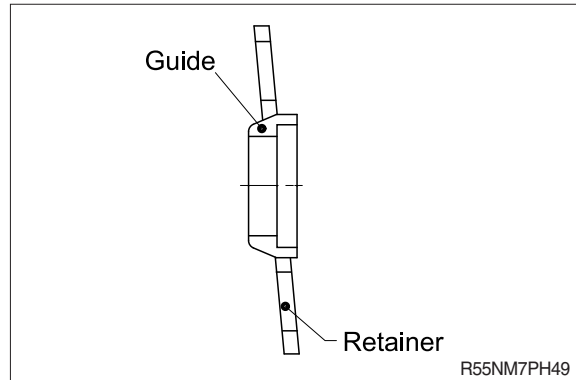
4) CONTROL PLATE

- (1) Check the slide surface for any damage.
When the damage is large, replace the plate with new one.



5) GUIDE AND RETAINER

- (1) Check for scouring or stepped wear.
If this can not be corrected, replace the guide and retainer with new full-set.
- (2) Fine scouring or damage can be corrected with lapping.
Carry out thorough washing after lapping.



2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Block	<ul style="list-style-type: none"> · Existence of scratch, rusting or corrosion. 	<ul style="list-style-type: none"> · In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	<ul style="list-style-type: none"> · Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in casing hole, rotate and reciprocate it. 	<ul style="list-style-type: none"> · Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	<ul style="list-style-type: none"> · Damage of poppet or spring · Insert poppet into casing and function it. 	<ul style="list-style-type: none"> · Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	<ul style="list-style-type: none"> · Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover. 	<ul style="list-style-type: none"> · Replacement for significant damage.
Around seal for spool	<ul style="list-style-type: none"> · External oil leakage. · Rusting, corrosion or deformation of seal plate. 	<ul style="list-style-type: none"> · Correction or replacement. · Correction or replacement.
Main relief valve & port relief valve	<ul style="list-style-type: none"> · External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals. 	<ul style="list-style-type: none"> · Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE

1) GENERAL CAUTIONS

Here, counter-measures to be taken when troubles have happened while the motor is in operation are described.

As for general precaution.

- (1) Consider a cause of the trouble before repairing
Before setting to work, think whether the same thing has happened before or not.
Also, think again whether it is the motor that is in trouble.
- (2) Be careful of dust
It is not too much to say that most troubles are ascribed to dust so that measures for dust prevention is taken into consideration with utmost care in the case of partial disassembling.
- (3) Handling part
Pay attention to the handling of parts not to injure them, especially to moving parts such as pistons, bearing and valves etc.
- (4) Pay attention to work the handling of O-ring, gasket
Once seals have been disassembled, they should be replaced even if damage is not observed.

2) INVESTIGATION MANNER OF THE MOTOR BODY

It is extremely difficult to trace trouble in the hydraulic circuits. Inspect the following items and investigation whether or not the fault is caused by the motor.

- (1) Inspection the oil in casing
Remove the drain plug and inspect the hydraulic oil in the casing. If a large amount of metallic particles come out with the oil, you should suspect a failure of internal parts.
- (2) Presence of abnormal noise
Check whether the motor emits an abnormal noise.
- (3) Pressure measurement of various points
Measure pressures at various points and check for faults, instead of disassembling parts at random.
- (4) Measurement of drain quantity
 - ① In the case of locking the swing and adding the pressure oil to motor, it's normal the drain rate would be about under 10 ℓ /min.
 - ② In normal swing mode, the drain rate would be under 1 ℓ /min.

3) CONDITION & COUNTERMEASURES OF TROUBLES

(1) Motor does not rotation

Condition	Cause	Remedy
The pressure of the circuit is not increasing	<ul style="list-style-type: none"> · Setting pressure of relief valve is incorrect · Working defectiveness of relief valve <ul style="list-style-type: none"> - Plunger stick - Close up an orifice hole of plunger · Seat defectiveness of plunger 	<ul style="list-style-type: none"> · Reset the pressure to correct value - Revise or exchange of stick face - disassembly or cleaning · Replace for damaged seat part
The pressure of the circuit is increasing	<ul style="list-style-type: none"> · Overload · Stick of motion portion · The brake dose not release · Stick of brake piston · Stick of friction plate 	<ul style="list-style-type: none"> · Load removes · Do repair or inspect the piston/shoe, cylinder block, valve plate etc. - Do repair or inspect circuit - Check for the brake valve - Disassembly and inspection - Disassembly and inspection · Replace for the stick parts · Replace for the stick parts

(2) The revolutionary direction is reverse

Condition	Cause	Remedy
The revolutionary direction is reverse	<ul style="list-style-type: none"> · The revolutionary direction of motor is reverse · The inlet and outlet in piping is reversely connected 	<ul style="list-style-type: none"> · Reassemble them after disassembling · Correct piping

(3) The number of revolution does not reach the established value

Condition	Cause	Remedy
The number of revolution does not reach the established value	<ul style="list-style-type: none"> · The volume of flowing is not sufficient · The temperature is too high and too much oil is leaking · Valves/pistons/rings etc. are worn away and broken 	<ul style="list-style-type: none"> · Check discharge volume of pump and circuit up to the motor · Reduce the oil temperature · Replace it

(4) Brake torque is not sufficient

Condition	Cause	Remedy
Brake torque is not sufficient	<ul style="list-style-type: none"> · Friction plates are worn · Brake piston is becoming stick · Brake releasing pressure is not working · Spline of friction plates are damaged 	<ul style="list-style-type: none"> · Disassembly or inspection. When it is worn more than standard, replace it · Disassembly or inspection <ul style="list-style-type: none"> - Check for the circuit - Check for the brake valve · Disassembly or inspection <ul style="list-style-type: none"> - Replace for damaged parts

(5) Motor is much slip

Investigates the DRAIN quantity for motor.

Normal : app. 200 cc/min

Condition	Cause	Remedy
Motor is much slip	<ul style="list-style-type: none"> · Working defectiveness of relief valve is the same item (1). · Seat defectiveness of plunger. 	<ul style="list-style-type: none"> · It is the same item (1). · Replace it.

(6) Oil leak

① Oil leak from the oil seal

Condition	Cause	Remedy
Oil leak from the oil seal	<ul style="list-style-type: none"> · The lip is dirty or damaged · The shaft may be damaged or worn out · The lib is damaged too high pressure in the casing · The shaft is rusty 	<ul style="list-style-type: none"> · Replace the oil seal · Replace the driving shaft or defective centering of the driving shaft · It repairs the drain piping which is closed up · Disassemble, repair, and replace the oil seal.

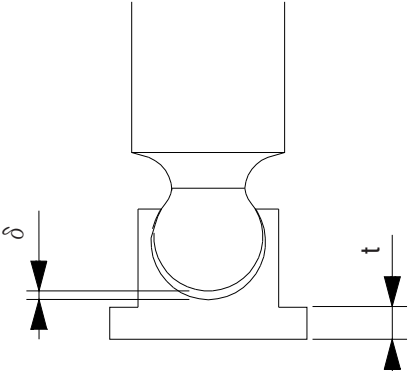
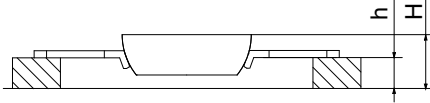
② Oil leak from the blind and union

Condition	Cause	Remedy
Oil leak from the blind and union	<ul style="list-style-type: none"> · O-ring is not in · O-ring is broken · Seal face is defective · The bolt is loose or not tightened 	<ul style="list-style-type: none"> · Insert O-ring · Replace it · Disassemble or repair · Tighten adequately or replace it.

4. MAINTENANCE STANDARDS

1) PART REPLACEMENT STANDARDS FOR HYDRAULIC MOTOR

If the various parts of the motor have been worn out beyond the following standard values, please replace them. But this shall apply only to those cases when is no remarkable outside damage.

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder bore	0.034	0.044	Replace piston or cylinder block
Gap between piston and caulked part of shoe (δ)	0.1	0.3	Replace piston or shoe
Thickness of shoe (t)	3.8	3.6	Replace piston or shoe
Assembled height of retainer plate (H-h)	13.2	12.7	Replace spherical bush and retainer as a pair
Thickness of friction plate	2.8	2.4	Replace it
 <p>Gap between piston and caulked part of shoe (δ), Thickness of shoe (t)</p>	 <p>Assembled height of retainer plate (H-h)</p>		

2) PART REPLACEMENT STANDARDS FOR REDUCTION GEAR

Item	Standard dimension (mm)	Recommended value for replacement (mm)	Remedy
Pitting or crack of gear	-	Pitting area rate : 10%	Replace if pitting or crack is found
Motor driving shaft external spline	Overpin : 28.194 (\varnothing 3.048)	27.594	Replace (Z=15)
No.1 Sun gear internal spline	Overpin : 19.767 (\varnothing 2.743)	20.367	Replace (Z=15)
No.1 Sun gear	Displacement : 23.269 (3 teeth)	22.969	Replace (Z=17)
No.1 Planet gear	Displacement : 31.876 (4 teeth)	31.576	Replace (Z=20)
No.1 Carrier internal gear	Overpin : 42.171 (\varnothing 6)	42.771	Replace (Z=17)
No.2 Sun gear	Displacement : 23.269 (3 teeth)	22.969	Replace (Z=17)
No.2 Planet gear	Displacement : 31.876 (4 teeth)	31.576	Replace (Z=20)
No.2 Carrier internal spline	Overpin : 55.255 (\varnothing 5)	55.855	Replace (Z=24)
Pinion shaft external spline	Overpin : 69.343 (\varnothing 4.5)	68.743	Replace (Z=24)
Pinion shaft gear	Displacement : 55.251 (3 teeth)	54.951	Replace (Z=13)
Ring gear internal gear	Overpin : 168.144 (\varnothing 5)	168.744	Replace (Z=58)
Crack & flaking of bearing inner/outer race & roller	-	-	Replacement if crack or flaking is found
Crack & flaking of gear & spline contact part	-	-	Replacement if crack or flaking is found

※ Z means number of teeth.

3) STANDARD FOR CORRECTING SLIDING SURFACES

If the surface roughness of the sliding surface of a part exceeds the following standards, correct it or replace the part.

Table 5. Standards

Item	Surface roughness	Roughness requiring correction
Shoe	0.8 - Z (Ra=0.2) (lapping)	3 - Z (Ra=0.8)
Shoe plate	0.4 - Z (Ra=0.1) (lapping)	3 - Z (Ra=0.8)
Cylinder block	1.6 - Z (Ra=0.4) (lapping)	12.5 - Z (Ra=3.2)
Valve plate	0.8 - Z (Ra=0.2) (lapping)	6.3 - Z (Ra=1.6)

- ※ 1. Lap each sliding surface to a standard roughness level or finer.
- 2. If the sliding surface of the cylinder block, valve plate, retainer plate or spherical bush is roughness, replace parts as sub-assemblies.

5. TRAVEL DEVICE (TYPE 1)

Disassembling and inspection of the motor must be done in strict accordance with the servicing standards described here. During servicing, handle each part very carefully not to damage them, especially for their movable or sliding sections.

1) SEALS

Once the seals (o-rings, oil seals, and floating seals) have been disassembled, they must be replaced with new ones even if no damage is observed.

2) TABLE OF MAINTENANCE STANDARD

(1) Replace all parts having a seriously damaged appearance.

(2) Replace the part if any one of the states (symptoms) listed in the table below is observed.

Item No.	Part name	Situation	Standard dimension	Maximum allowable value (criteria)
2 8 17	Spindle kit · Spindle assembly · · Spindle · · Coupling gear · Pin	· Seriously damaged in appearance. · Galling or other forms of excessive wear are observed.	-	-
3 6 9 14 25 34	Carrier assembly Carrier Cluster gear Shaft Thrust collar Needle bearing Dowel pin	· The tooth surface of the cluster gear (6) is nonuniformly worn out and damaged. · The cluster gear (6) does not move smoothly.	-	-
4	Ring gear A	· The tooth surface is nonuniformly worn out and damaged.	-	-
5	Ring gear B	· The tooth surface is nonuniformly worn out and damaged.	-	-
7	Sun gear	· The tooth surface is nonuniformly worn out and damaged. · The spline section is worn.	-	-
8	Coupling gear	· Excessive wear or pitching is observed on the tooth surface.	-	-
19	Coupling	· The spline section is worn.	-	-
20	Thrust bearing	· Worn out.	Axial clearance between coupling gear (8) and cover (13) : 0.3 mm ± 0.1 mm	-

Item No.	Part name	Situation	Standard dimension	Maximum allowable value (criteria)
22	Distance piece	<ul style="list-style-type: none"> · The sliding surface is damaged. · The sliding surface is excessively worn out. 	-	-
24	Ball bearing	<ul style="list-style-type: none"> · Dents are present. · Flaking develops. · Nonuniform wear is present. 	-	-
101	Rear flange kit Rear flange	<ul style="list-style-type: none"> · The movable section contacting the spool (123) is damaged. · The clearance against the spool (123) is too large. · The surface contacting the valve (127) is damaged. · The depth to the surface contacting the valve (127) is too large. 	Linear clearance : 10 to 20 μ	Linear clearance : 25 μ
123	Spool	<ul style="list-style-type: none"> · The outer surface is damaged. · The outer surface is nonuniformly worn out. 		
102	Shaft	<ul style="list-style-type: none"> · The surface contacting the oil seal (132) is worn out. · The spline section is worn out. 	-	-
103	Swash plate	<ul style="list-style-type: none"> · Seizure is observed. 	-	-
104	Cylinder block	<ul style="list-style-type: none"> · The spline section is worn out. · The bore inner surface is worn out too much. · The sliding surface that contacts the timing plate (109) is damaged or nonuniformly worn out. 	-	-
105 106	Piston assembly Piston shoe	<ul style="list-style-type: none"> · An axial clearance is present between the piston (105) and the shoe (106). · The shoe is excessively worn out. · The shoe is nonuniformly worn out. 	Clearance : 0.05mm	Clearance : 0.15mm
107	Retainer plate	<ul style="list-style-type: none"> · The peripheral edge is nonuniformly worn out. 	-	-

Item No.	Part name	Situation	Standard dimension	Maximum allowable value (criteria)
108	Thrust ball	· The spherical sliding section that contacts the retainer plate (107) is nonuniformly worn out.	-	-
109	Timing plate	· The sliding surface has the traces of seizure or nonuniformly wear.	-	-
115	Friction plate	· Both edges are nonuniformly worn out.	Braking torque 40.6 kgf · m or more	Braking torque 40.6 kgf · m or less
116	Mating plate	· The required torque cannot be achieved. · The traces of seizure are present.		
118	Valve seat	· The seat surface is damaged.	-	-
119	Valve	· The outer surface is damaged. · The seat surface is damaged.	-	-
136	Body kit Body	· The sliding section that contacts the spool (137) is damaged. · The clearance against the spool (137) is too large. · The outer surface is damaged. · The outer surface is nonuniformly worn out.	Linear clearance : 7 to 15 μ	Linear clearance : 20 μ
137	Spool			
149	Roller bearing	· Dents are present. · Flaking develops. · Nonuniform wear is observed.	-	-
150	Ball bearing			
163	Valve	· The outer surface is damaged. · The seat surface is damaged.	-	-
164	Stopper	· The seat surface is damaged.		
142	Valve	· The outer surface is damaged. · The seat surface is damaged.		
172	Valve seat	· The seat surface is damaged.	-	-

TRAVEL DEVICE (TYPE 2, MACHINE SERIAL NO. : #2188-)

Disassembling and inspection of the motor must be done in strict accordance with the servicing standards described here. During servicing, handle each part very carefully not to damage them, especially for their movable or sliding sections.

1) PARTS INSPECTION TIPS AND REPLACEMENT STANDARDS

(1) Sun gear, drive gear, planetary gear, housing.

Pitting and breaking appear on the tooth surface.

- ※ **When the size of the groove or cavity in one pitting is \varnothing 1mm or more or the area ratio is 5% or more for the entire area.**

(2) Oil seal

Replace when the surface of the lip is damaged or worn.

When disassembling the oil seal from the motor for inspection.

(3) Planetary gear F of needle bearing part

As the planetary gear F is assembled, check the boss and circumference direction clearance of the motor casing.

If it is 0.5 mm or more, replace it.

(4) Do not disassemble in housing and check with the following tips.

- ① Check the raceway surface, rollers or balls in the visible range, and make sure there are no pittings or cracks.
- ② Check for local corrosion and wear on the ball.
- ③ Please check again with the following tips.
 - a) Check the gear oil for excessive wear powder.
 - b) Make sure that there is excessive wear powder between the ball and cage.
 - c) When turning lightly by hand, check that it rotates smoothly.

After performing the above inspection, replace any problem.

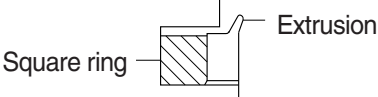
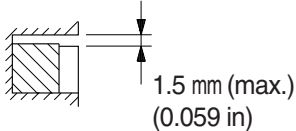
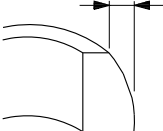
Do not use angular bearing separated from housing again.

(5) Side plate

If the drive gear and sliding surfaces are markedly damaged, they must be replaced.

- (6) Fitting on rotating surfaces of needle bearing and inner race for planetary gear R, should be replaced when broken.

6. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	· Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

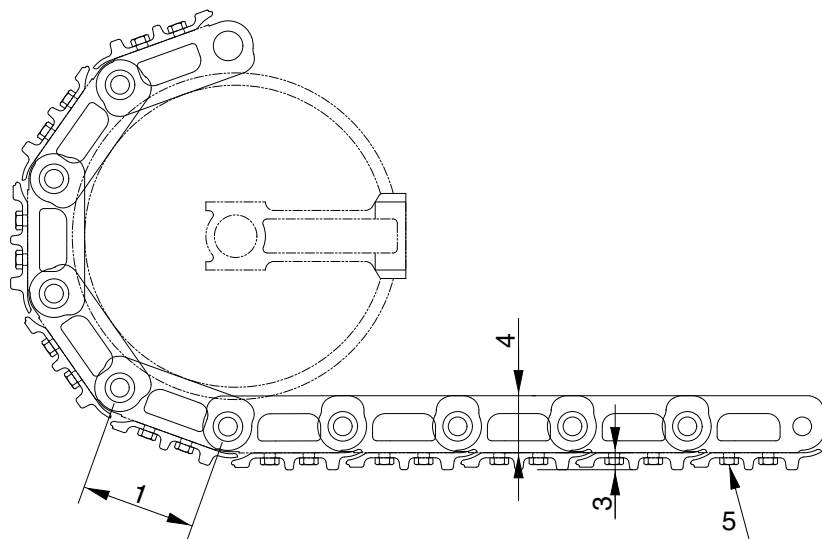
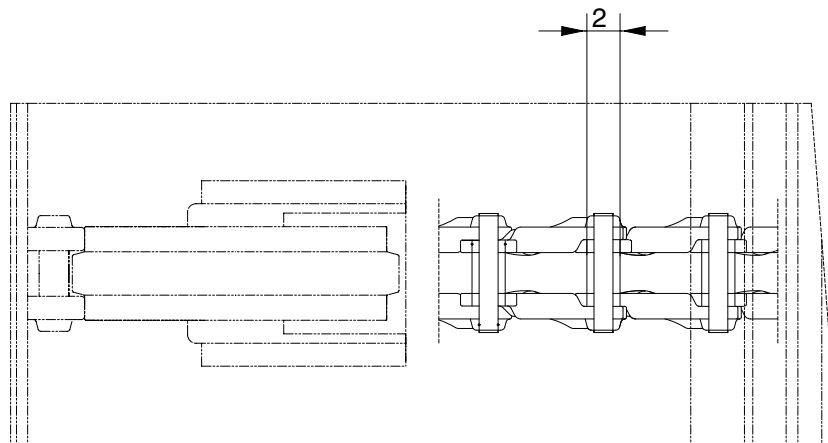
7. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal. · Rust is not present on plating. · Scratches are not present.	· Replace or replate · Replace or replate · Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK SHOE

1) STEEL SHOE SPEC

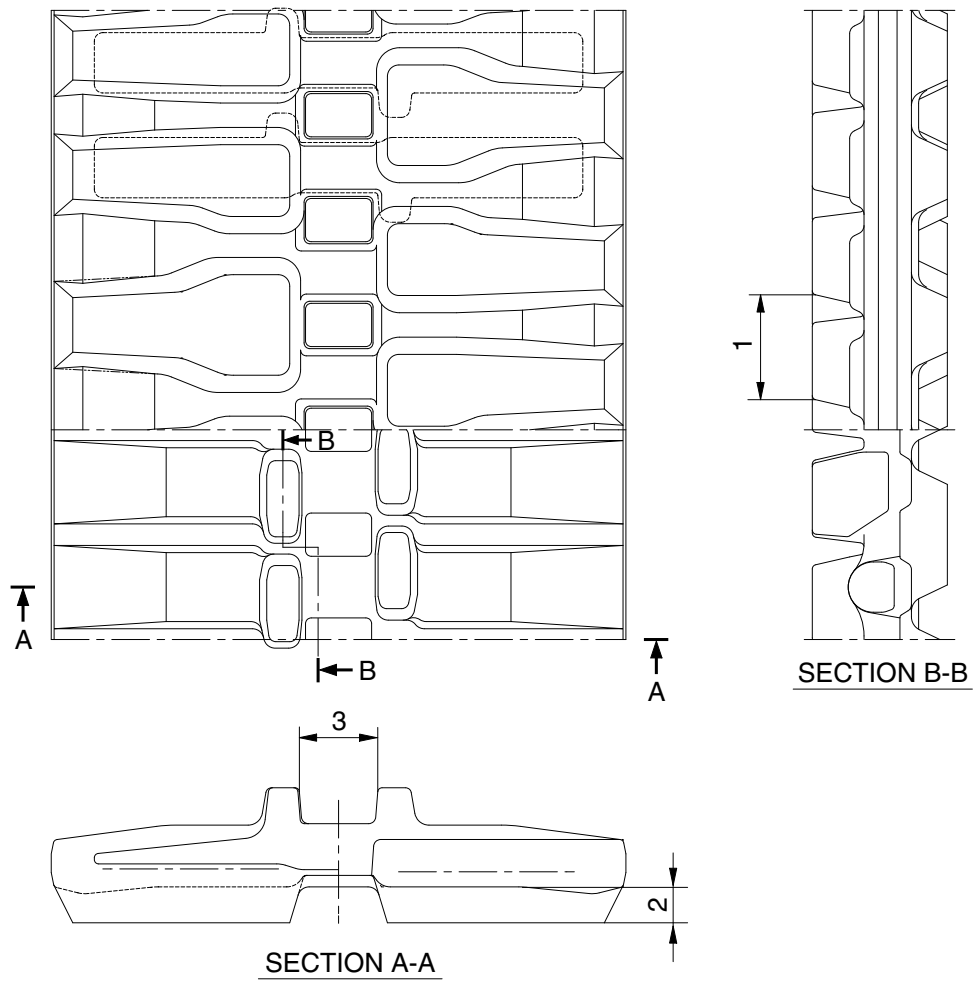


R5576MC16

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Link pitch	135	138.6	Replace bushing and pin and link assembly
2	Outside diameter of bushing	39	35.4	
3	Height of grouser	20	17	Lug welding, rebuild or replace
4	Height of link	70	64.5	
5	Tightening torque	Initial tightening torque : $19 \pm 1.0 \text{kgf} \cdot \text{m}$		Retighten

2) RUBBER SHOE SPEC

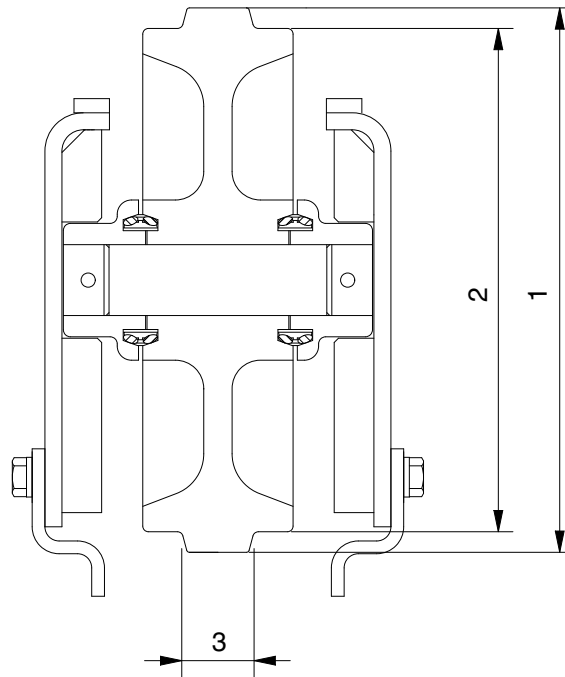


R5576MC17

Unit : mm

No	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Link pitch	73	± 1.0	76	Replace
2	Height of grouser	25	-	5	
3	Width of link	54	-	70	

2. IDLER

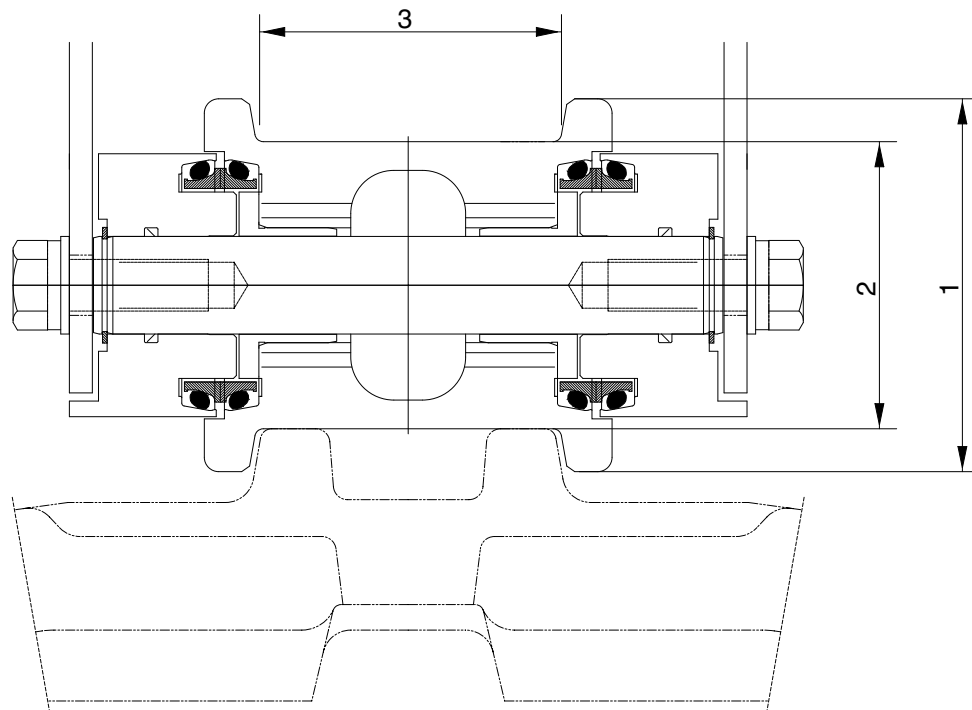


R5576MC18

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Steel	384	-	Rebuild or replace
		Rubber	398	-	
2	Outside diameter of thread		355	345	
3	Width of flange		41	-	

3. TRACK/CARRIER ROLLER



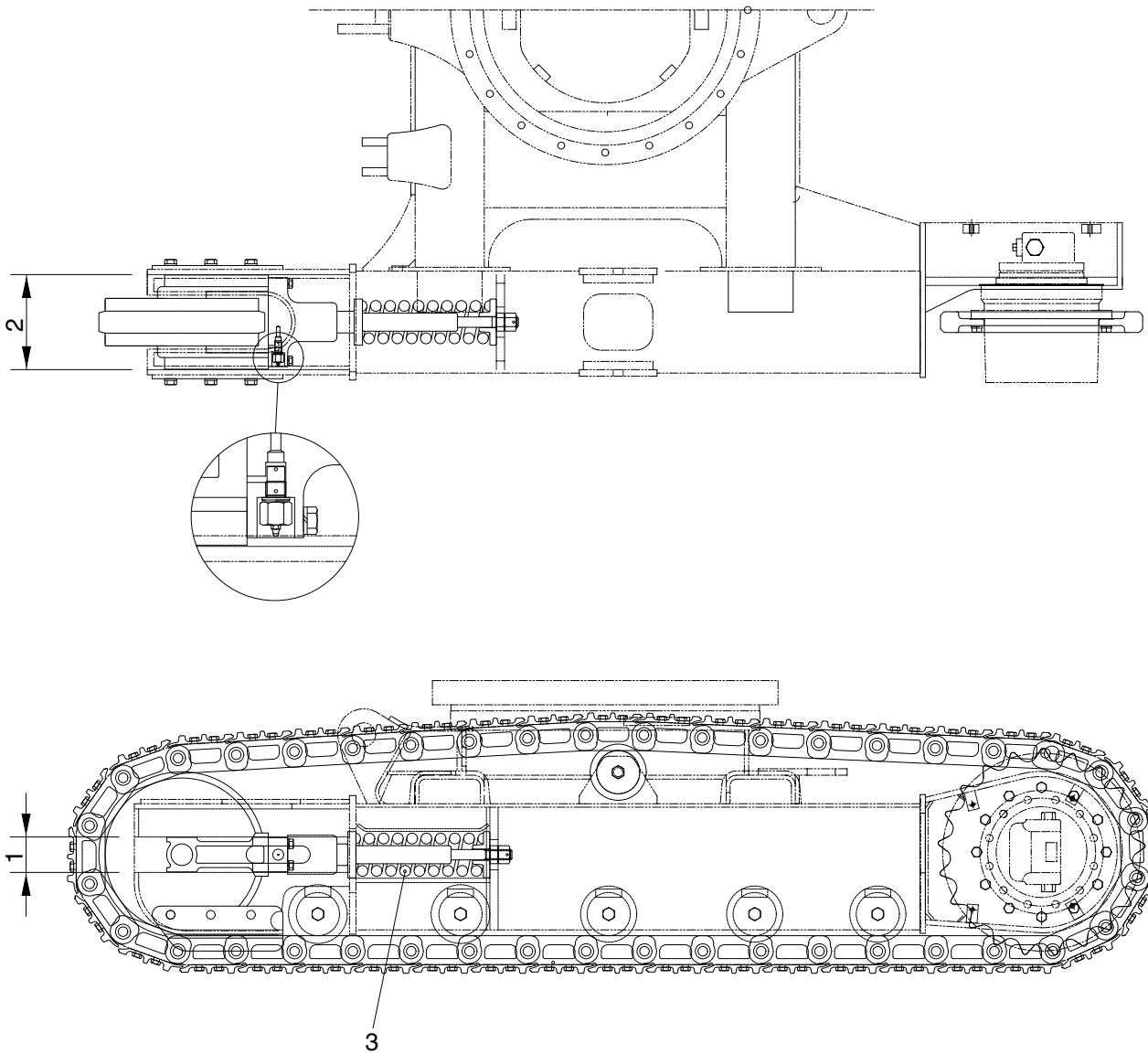
R5576MC15

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Steel	130	-	Rebuild
		Rubber	144	-	
2	Outside diameter of thread		105	95	or replace
3	Width of flange		108	114	

4. TENSION CYLINDER

1) STEEL SHOE SPEC

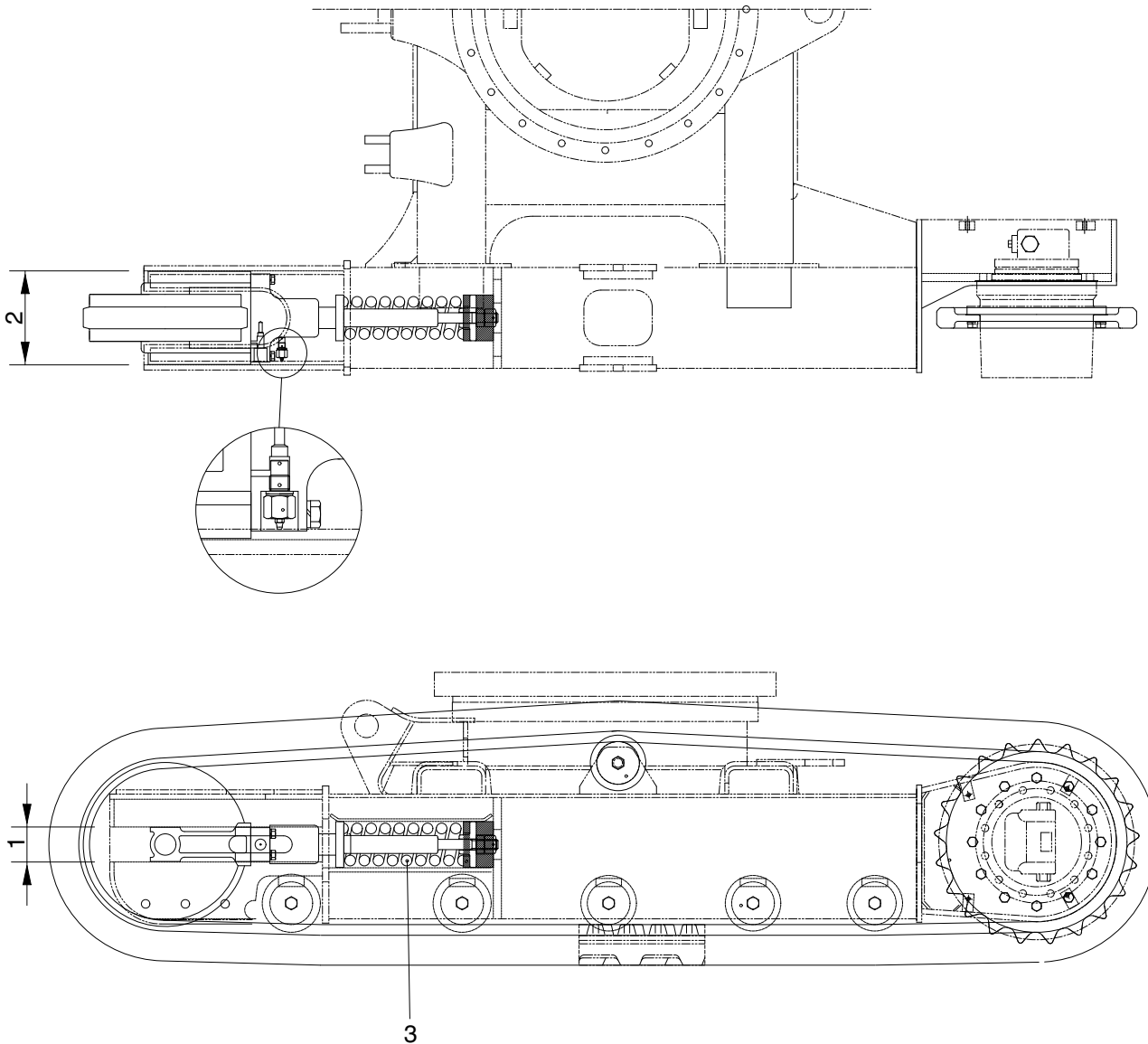


R5576MC19

Unit : mm

No	Check item	Criteria			Remedy		
			Standard size	Repair limit			
1	Outside diameter of flange	Track frame	82	86	Rebuild		
		Idler support	80	78	Rebuild or replace		
2	Outside diameter of thread	Track frame	220	222	Rebuild		
		Idler guide	218	214	Rebuild or replace		
3	Recoil spring	Standard size		Repair limit		Replace	
		Free length	Installed length	Installed load	Free length		Installed load
		∅100×330	292	3,900 kg	-		3,120 kg

2) RUBBER SHOE SPEC

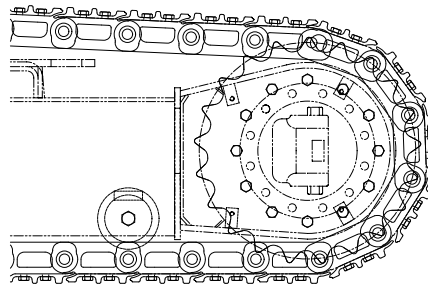
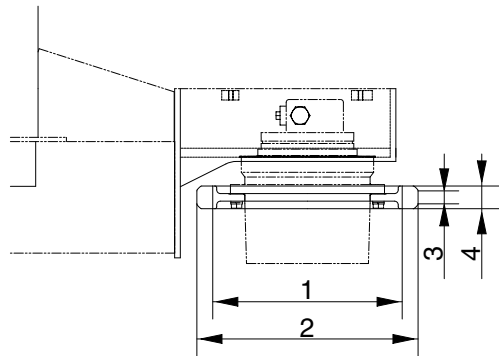


R5576MC20

Unit : mm

No	Check item	Criteria			Remedy		
			Standard size	Repair limit			
1	Vertical width of idler guide	Track frame	82	86	Rebuild		
		Idler support	80	76			
2	Horizontal width of idler guide	Track frame	220	222	Rebuild or replace		
		Idler guide	218	214	Rebuild		
3	Recoil spring	Standard size		Repair limit		Rebuild or replace	
		Free length	Installed length	Installed load	Free length		Installed load
		330	280	5,140 kg	-		4,110 kg

5. SPROCKET

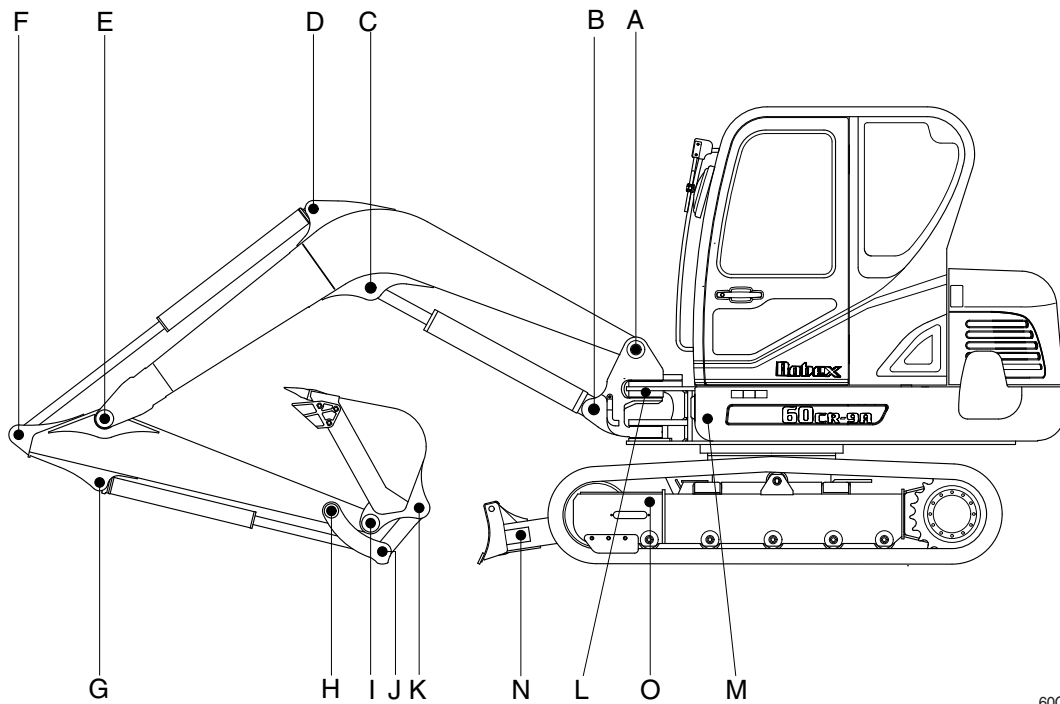


R5576MC21

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear out of sprocket tooth lower side diameter	418.6	412	Repair or Replace
2	Wear out of sprocket tooth upper side diameter	476	-	
3	Wear out of sprocket tooth upper side width	33.5	-	
4	Wear out of sprocket tooth lower side width	40	34	

6. WORK EQUIPMENT



60CR9A6MC01

Unit : mm

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	55	54	53.5	55.5	56	Replace
B	Boom Cylinder Head	60	59	58.5	60.5	61	"
C	Boom Cylinder Rod	60	59	58.5	60.5	61	"
D	Arm Cylinder Head	50	49	48.5	50.5	51	"
E	Boom Front	50	49	48.5	50.5	51	"
F	Arm Cylinder Rod	50	49	48.5	50.5	51	"
G	Bucket Cylinder Head	45	44	43.5	45.5	46	"
H	Arm Link	45	44	43.5	45.5	46	"
I	Bucket and Arm Link	45	44	43.5	45.5	46	"
J	Bucket Cylinder Rod	45	44	43.5	45.5	46	"
K	Bucket Link	45	44	43.5	45.5	46	"
L	Boom swing post	110	109	108.5	110.5	111	"
M	Boom swing cylinder	50	49	48.5	50.5	51	"
N	Blade cylinder	55	54	53.5	55.5	56	"
O	Blade and frame link	35	34	33.5	35.5	36	"