

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.

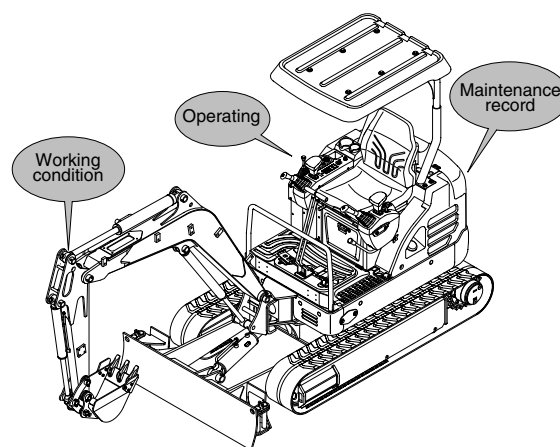
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

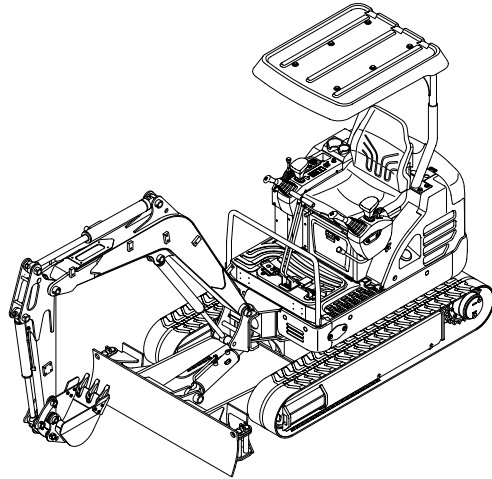


1696MS01

2. TERMINOLOGY

1) STANDARD

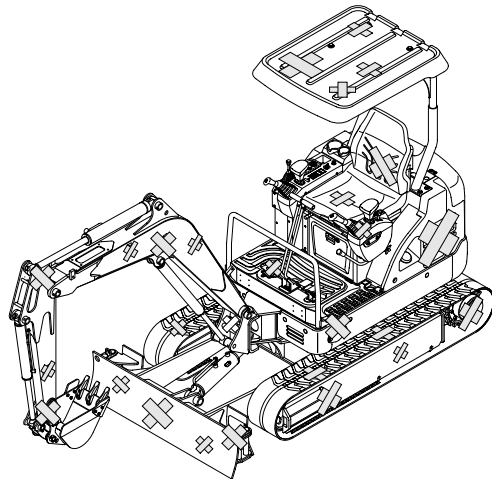
Specifications applied to the brand-new machine, components and parts.



1696MS02

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

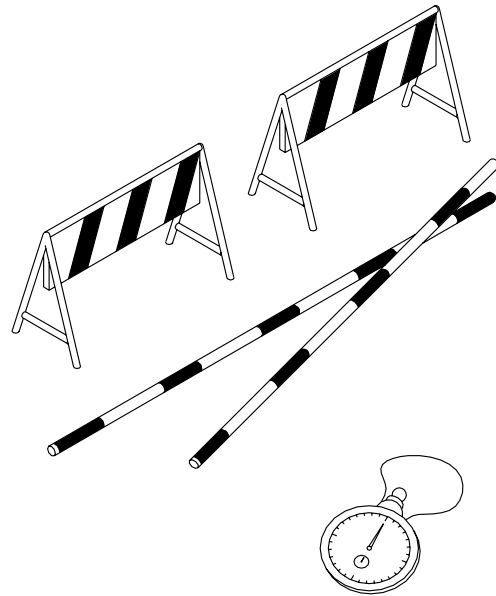
1) Observe the following rules in order to carry out performance tests accurately and safely.

(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.

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(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 the maximum RPM.

※ **The engine speed must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.**

(2) Preparation and measurement

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 lever at the maximum stroke.

③ Measure the engine RPM.

(3) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

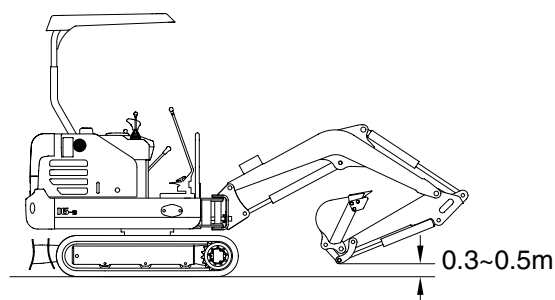
Model	Engine speed	Standard	Remarks
R16-9	Low idle	1600±100	
	High idle	2500±50	

3) TRAVEL SPEED

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

(2) Preparation

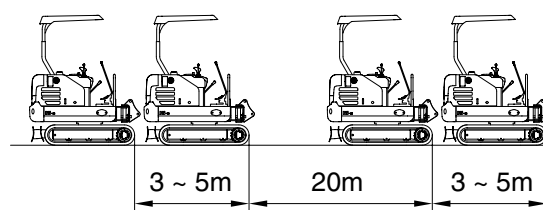
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil 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.



1696MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

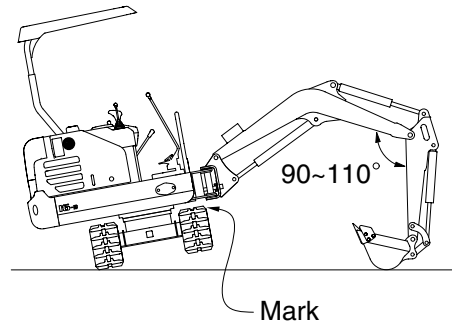
Model	Travel speed	Standard	Maximum allowable	Remarks
R16-9	1 Speed	32.7 ± 2.0	40.8	
	2 Speed	17.6 ± 1.0	22.0	

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 $50 \pm 5^\circ\text{C}$.



1696MS06

(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

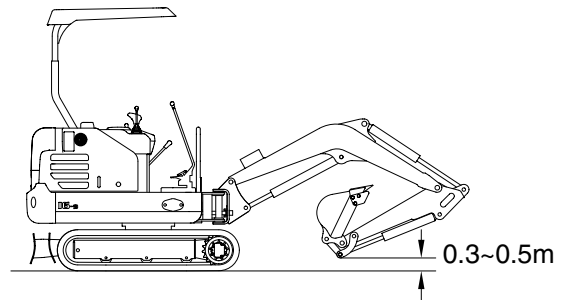
Model	Travel speed	Standard	Maximum allowable
R16-9	1 Speed	16.5 ± 2.0	20.6
	2 Speed	8.9 ± 2.0	11.1

5) TRAVEL DEVIATION

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

(2) Preparation

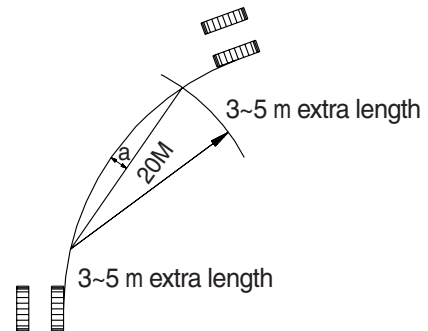
- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil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



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(3) Measurement

- ① Measure 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 / 20 m

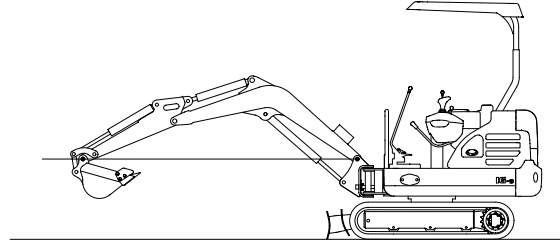
Model	Standard	Maximum allowable	Remarks
R16-9	200 below	240	

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 $50 \pm 5^{\circ}\text{C}$.



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(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 times and calculate the average values.

(4) Evaluation

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

Unit : Seconds / 2 revolutions

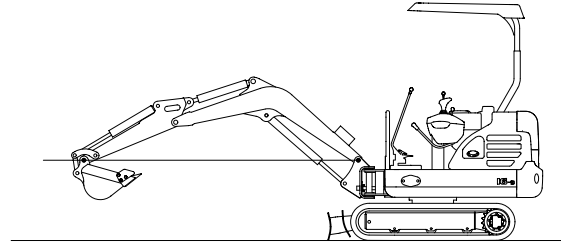
Model	Standard	Maximum allowable	Remarks
R16-9	12.9 ± 1.0	16.1	

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

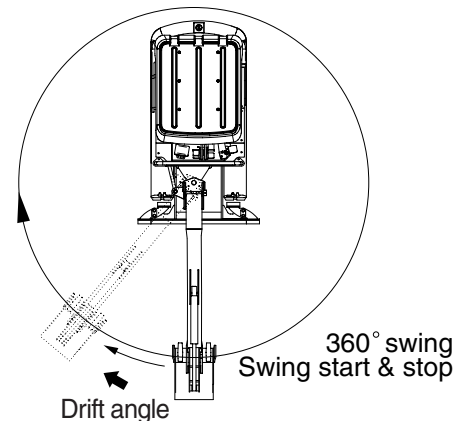
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom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



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(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

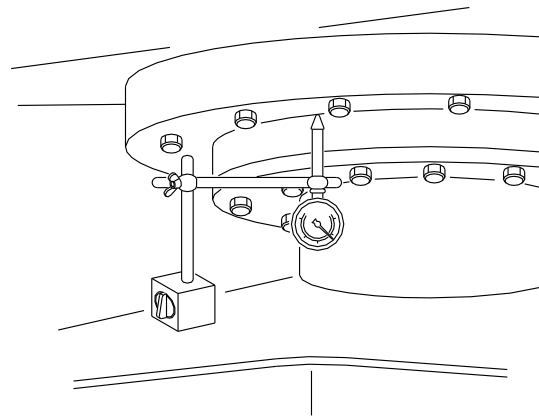
Model	Standard	Maximum allowable	Remarks
R16-9	40 below	50	

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.

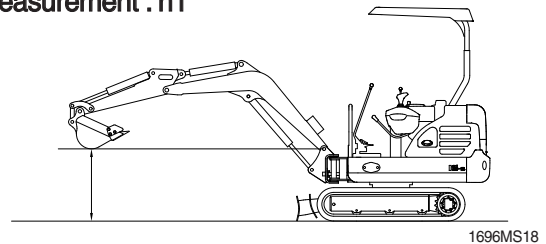


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(3) Measurement

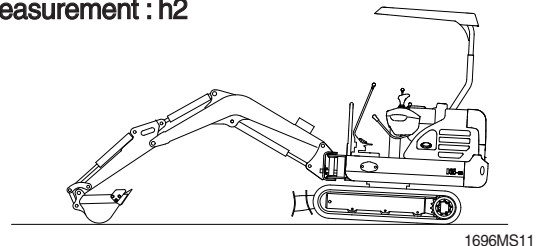
- ① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin. Record the dial gauge reading (h1).
- ② Lower the bucket to the ground and use it to raise the front idler 50 cm. Record the dial gauge reading (h2).
- ③ Calculate bearing play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

Measurement : h1



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Measurement : h2



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(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R16-9	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.

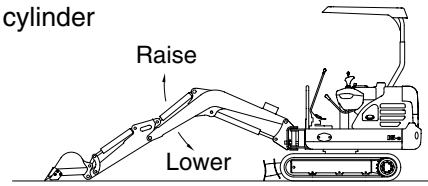
- Boom cylinders

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.

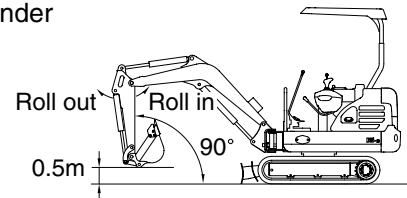
- Arm cylinder

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.

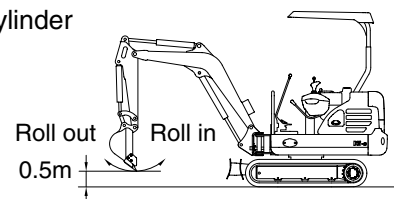
Boom cylinder



Arm cylinder



Bucket cylinder



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- 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

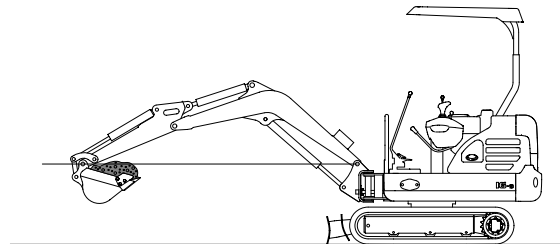
Model	Function	Standard	Maximum allowable	Remarks
R16-9	Boom raise	2.4±0.4	3.0	
	Boom lower	2.4±0.4	3.0	
	Arm in	2.4±0.4	3.0	
	Arm out	1.7±0.4	2.3	
	Bucket load	3.0±0.4	3.7	
	Bucket dump	2.2±0.4	2.8	
	Boom swing (LH)	4.8±0.4	5.9	
	Boom swing (RH)	3.5±0.4	4.3	
	Dozer up (raise)	1.6±0.3	1.9	
	Dozer down (lower)	1.9±0.3	2.2	

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 30 mm 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 $50 \pm 5^\circ C$.



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(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) Evaluation

The measured drift should be within the following specifications.

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R16-9	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
R16-9	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 : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R16-9	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 Loosen the cap of screw coupling at the fitting near pilot pump and connect pressure gauge.
- ③ Start the engine and check for oil leakage from the port.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.

(2) Measurement

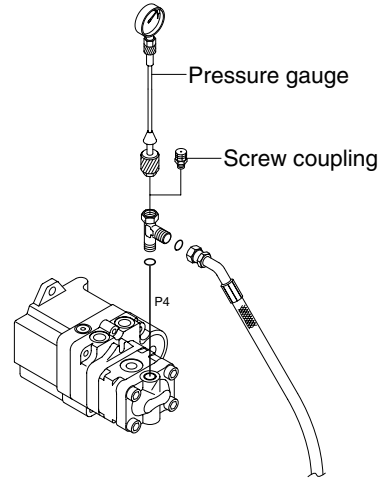
- ① Measure the primary pilot pressure.

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Standard	Remarks
R16-9	30 ± 5	

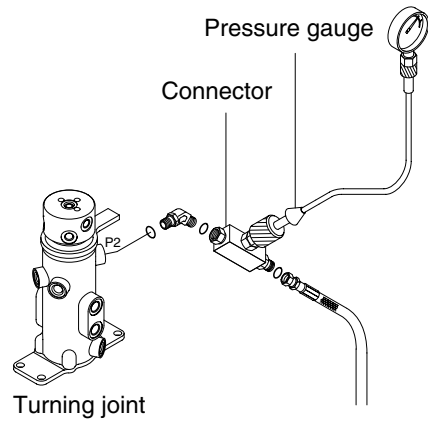


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14) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

- ① Stop the engine.
- ② To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P2 port as shown.
- ③ Start the engine and check for on leakage from the adapter.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^\circ\text{C}$.



(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.

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(3) Evaluation

The average measured pressure should be within the following specifications.

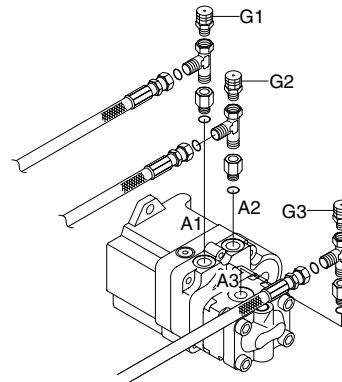
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R16-9	1 Speed	0	-	
	2 Speed	30 ± 5	-	

15) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

- ① Stop the engine.
- ② To measure the main pump pressure.
Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.
- ③ Start the engine and check for oil leakage from the port.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



(2) Measurement

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

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(3) Evaluation

The average measured pressure should meet the following specifications.

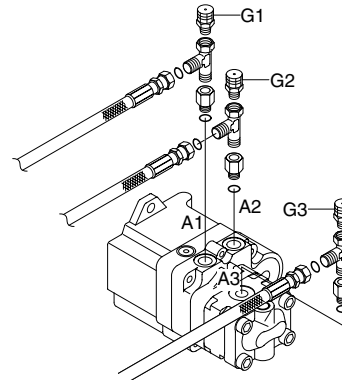
Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R16-9	High idle	20 ± 5	-	

16) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

- ① Stop the engine.
- ② To measure the system relief pressure.
Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.
- ③ Start the engine and check for oil leakage from the port.
- ④ Keep the hydraulic oil temperature at $50 \pm 5^{\circ}\text{C}$.



(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.

1696MS15

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Function to be tested	Standard
R16-9	Boom, Arm, Bucket	210 ± 10
	Travel	210 ± 10
	Swing	170 ± 10

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

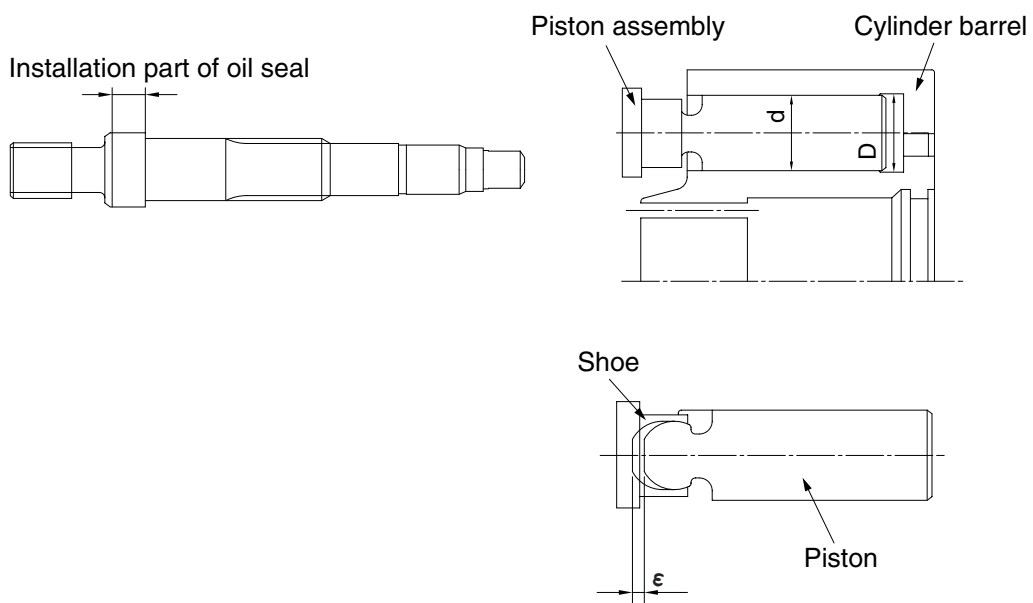
Before inspection, wash the parts well and dry them completely.

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) INSPECTION POINTS WHEN DISASSEMBLED

Part	Extent of the damage	Inspection standard	Action
Shaft (3)	Excessive wear on the seal surface.	Worn depth : 0.025 mm or more	Replace the shaft.
Valve plate (5)	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
Cylinder barrel (4)	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
	Clearance between the pistons.	0.050 mm or more	Replace the cylinder barrel kit.
Piston (6), Shoe (7)	Wear of joint section	Play between the shoe and the piston. 0.2 mm or more by hand operation.	Replace the cylinder barrel kit.
Seals (O-rings, gasket, etc.)	Damage, excessive rust	-	Replace each part.



R27Z96MC01

2) TROUBLESHOOTING AND COUNTERMEASURE

No.	Trouble	Possible cause	Countermeasure
1	Overload to engine	<ul style="list-style-type: none"> · Speed is higher than standard · Setting pressure is higher than specifications · Damage of internal parts of pump 	<ul style="list-style-type: none"> · Readjust it as standard · Readjust it as spec · Repair or replace
2	Low pump flow or low pressure	<ul style="list-style-type: none"> · Speed down of engine · Wrong coupling · Damage of internal parts of pump 	<ul style="list-style-type: none"> · Readjust of engine speed · Repair or replace · Repair or replace
3	Abnormal noise or abnormal vibration (cavitations)	<ul style="list-style-type: none"> · Air in the oil · Water in the oil · Clog of suction filter · High suction pressure · Damage of piston shoe · Installation condition is no good · Wrong coupling 	<ul style="list-style-type: none"> · Check piping Bleed the air in the hydraulic circuit · Replace oil · Clean or replace · Correction · Replace · Correction · Replace
4	Oil leakage	<ul style="list-style-type: none"> · Damage of O-ring or packing · Loosened plug · Leaking from oil seal 	<ul style="list-style-type: none"> · Replace · Tight up · Replace Replace of oil seal

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 & Anti cavitation 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.

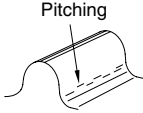
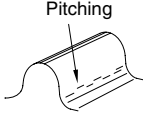
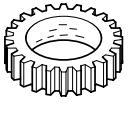


3. SWING MOTOR

1) POSSIBLE REASONS FOR THE TROUBLE AND ITS COUNTERMEASURES

Trouble	Possible reasons		Countermeasure
Motor does not move. The supplied pressure is enough.	Relief valve	Setting pressure is too low.	Replace the relief valve assembly.
		Faulty operation.	
	Hydraulic motor	Burned inner parts.	Replace the hydraulic motor assembly.
		Too much internal leakage.	
Reduction gear	Damage to the gears.	Replace the reduction gear assembly.	
Overload	-	Remove the overload.	
Insufficient torque	Relief valve	Setting pressure is too low.	Replace the relief valve assembly.
		Faulty operation.	
	Hydraulic motor	Burned sliding parts.	Replace the hydraulic motor assembly.
		Too much internal leakage.	
Reduction gear	Damage to the gears.	Replace the pinion kit, carrier kit.	
	Damage to bearings.		
Abnormal noise	Cavitation noise	Insufficient flow.	Adjust the piping.
	Hydraulic motor	Damage to sliding parts.	Replace the hydraulic motor assembly.
	Reduction gear	Damage to the gears.	Replace the pinion kit, carrier kit.
		Damage to bearings	
Pinion gear	Damage to the gear surface.	Replace the pinion kit.	
Oil leakage	Body gasket	Damage to O-rings.	Replace the O-ring
		Loose bolts.	Re-tighten the loose bolts.
	Pinion gear	Damage to oil seal.	Replace the pinion kit.
Delay in start up, or delay in stopping	Relief valve	Faulty operation.	Replace the relief valve assembly.
	Check valve	Internal leakage.	Replace the body H kit.
Excessive heat generation	Hydraulic motor	Burned or damaged sliding parts.	Replace the hydraulic motor assembly.
	Reduction gear	Damage to the gears.	Replace the pinion kit, carrier kit.
		Damage to bearings	

2) STANDARD FOR PARTS INSPECTION

(1) Reduction gear section

Part	Extent of the damage	Inspection standard	Action
A internal gear	Excessive wear of the surface	Pitching area 5% or more of the gear surface 	Replace the pinion kit.
Carrier 1	Damage to spline section	By visual	Replace the carrier kit.
S1 gear b1 gear	Excessive wear of the surface	Pitching area 5% or more of the gear surface 	Replace the carrier kit.
	Excessive wear of the bearing surface	By visual pitching, flaking 	
Ring	Excessive wear of the bearing surface	By visual pitching, flaking 	Replace the carrier kit.
Roller	Excessive wear of the bearing surface	By visual pitching, flaking 	Replace the carrier kit.
Other (screw, etc.)	Damage, excessive rust	-	Replace each part.

(2) Hydraulic motor section

Part	Extent of the damage	Inspection standard	Action
Shaft	Excessive wear of the spline section	Worn depth : 25 μ m or more	Replace the hydraulic motor assembly.
Cylinder barrel	Excessive wear to the sliding surface of the valve plate	Worn depth : 20 μ m or more	Replace the cylinder barrel kit.
Valve plate	Excessive wear to the sliding surface of the cylinder barrel	Worn depth : 20 μ m or more	Replace the cylinder barrel kit.
Piston shoe	Wear of joint section of shoe	Play of piston and shoe : 0.3 mm or more by hand operation	Replace the cylinder barrel kit.
Swash plate	Excessive wear to the sliding surface of the shoe	Worn depth : 0.1 mm or more	Replace the swash plate kit.
Other (screw, etc.)	Damage, excessive rust	-	Replace each part.

4. TRAVEL MOTOR

1) MAINTENANCE STANDARD FOR TRAVEL MOTOR

Travel motors basically don't require maintenance except changing the reducer lubricant. Don't disassemble the motor unless there are problem with it. Refer to the following standards for parts (kits) replacement.

(1) Reducer

No.	Part name	Point to be checked	Standard	Action
1	Body (internal gear)	Engaging tooth surface with B1 and B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
2	Carrier 2	Spline tooth surface	No abnormal damage, wear	Replace whole carrier 2 kit
		Loose of B2 pins	No loose by hand	
3	B1 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Needle rolling contact surface	No flaking and pitching	
4	B2 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
		Needle rolling contact surface	No flaking and pitching	
5	S1 gear	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
6	S2 gear	Engaging tooth surface with B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Spline tooth surface	No abnormal damage, wear	
7	B2 pins	Needle rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
8	Floating seals	Seat surface	No abnormal damage, wear	Replace
		O-ring surface	No damage, deformation, and hardening	
9	Angular ball bearings	Rolling contact surface	No abnormal damage, flaking	Replace
10	Needles	Rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
11	O-rings	Surface, hardness	No damage, deformation, and hardening	Replace

(2) Hydraulic valve and motor

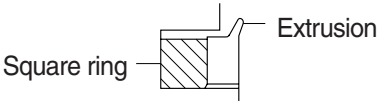
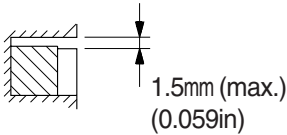
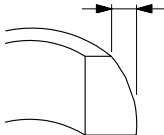
No.	Part name	Point to be checked	Standard	Action
12	Body 1	Spool sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
13	Counter valve spool Two-speed spool Shuttle spool	Body 1 sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
14	Body 2	Spline tooth surface	No abnormal damage, wear	Replace whole body 2 kit
		Control piston sliding contact surface	No abnormal damage, wear Clearance between piston and body 2 is 0.023 mm or smaller	
		Swash plate installaion surface	No abnormal damage, wear	
		Ball sliding contact surface	No abnormal damage, wear	
15	Shaft	Spline tooth surface	No abnormal damage, wear	Replace shaft kit
		Oil seal sliding contact surface	No abnormal damage, wear (0.025 mm or greater)	
16	Cylinder barrel	Piston sliding contact surface	No abnormal damage, wear Clearance between piston and cylinder barrel is 0.030 mm or smaller	Replace cylinder barrel kit
		Valve place sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
17	Valve plate	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
18	Pistons Shoes	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Replace cylinder barrel kit
		Swash plate sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
		Loose of shoe calking part	Loose is smaller than 0.3 mm	Replace cylinder barrel kit
19	Shoe holder	Barrel holder sliding contact surface	No abnormal damage, wear	Replace cylinder barrel kit
20	Barrel holder	Spline tooth surface	No abnormal damage, wear	Replace cylinder barrel kit
		Shoe holder sliding contact surface	No abnormal damage, wear	
21	Swash plate	Shoe sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace
		Ball sliding contact surface	No abnormal damage, wear	Replace
22	Control piston	Body 2 sliding contact surface	Clearance between piston and body 2 is 0.023 mm or smaller	Replace body 2 kit
23	Oil seal	Lip surface	No abnormal damage, wear and deformation	Replace
24	Ball bearing	Rolling contact surface	No abnormal damage, flaking	Replace
25	Springs	Surface	No crack	Replace
26	O-rings	Surface and hardness	No damage, deformation, and hardening	Replace

2) FAILURE DIAGNOSIS OF TRAVEL MOTOR

Failure detail	Major causes	Countermeasure
Doesn't start	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal working pressure is supplied to the motor inlet port.
	Defect in reducer - Damage of inner parts	Replace the damaged part (kit).
	Defect in hydraulic motor - Oil leakage due to abnormal wear of the sliding parts - Damage of inner parts	Replace the worn part (kit). Replace the damaged part (kit).
	Defect in hydraulic valve - Spool doesn't move Foreign object is caught in the spool sliding part. Choke is clogged	Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
Doesn't stop or stop slowly	Defect in hydraulic valve - Spool doesn't return Foreign object is caught in the spool sliding part. Choke is clogged. Spring is damaged. - Check valve doesn't close due to foreign object being caught on the seat.	Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object. Replace the body 1 kit. Remove the foreign object. In case of much leakage, replace the body 1 kit.
	Rotating speed is slow	Prescribed flow rate is not supplied to the motor due to operating defect in the pump. Volumetric efficiency declines due to defect in the motor. - Abnormal wear of sliding parts Volumetric efficiency declines due to defect in the hydraulic valve. - Abnormal wear of main spool and two speed spool sliding part

Failure detail	Major causes	Countermeasure
Doesn't change to two speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move due to foreign object being caught in the spool sliding part. - Choke in the two speed pilot line is clogged.	Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
	Defect in the hydraulic motor - Control piston doesn't move. Foreign object is caught in the piston sliding part. Oil leakage due to abnormal wear of the sliding part. Oil leakage due to damage of O-ring located between body 1 and body 2.	Remove the foreign object. In case of much leakage, replace the body 2 kit. Replace the worn part (kit). Replace the O-ring.
Doesn't change to one speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move. Foreign object is caught in the spool sliding part. Damage of spring - Choke in the two speed pilot line is clogged.	Remove the foreign object. In case of much leakage, replace the body 1 kit. Replace the body 1 kit. Remove the foreign object.
Tracking deviation	Same as No.3, 4 and 5	-
Oil leakage	Oil leakage due to damage of O-rings. - Damage of O-ring located in the reducer cover. - Damage of O-rings located between body 1 and body 2.	Replace the O-ring. Replace the O-ring.
	Oil leakage from the floating seals - Abnormal wear of the seat surface or damage of the O-ring. - Pressure in the reducer casing rises due to damage of the oil seal.	Replace the floating seal. Replace the oil seal.

5. TURNING JOINT

Parts Name		Check Points	Measures
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

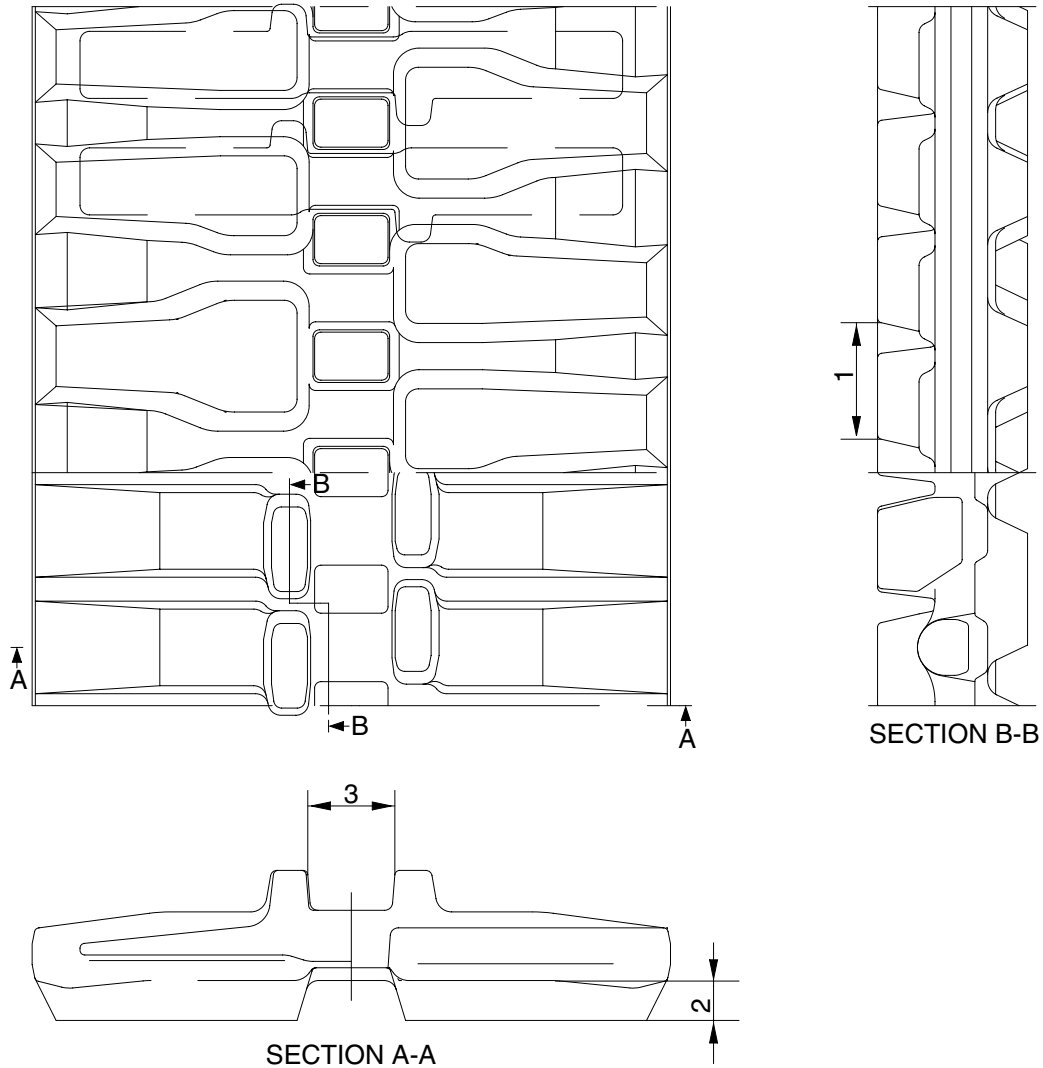
6. CYLINDER

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.	· Replace or replate
		· Rust is not present on plating. · Scratches are not present.	· 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) RUBBER SHOE SPEC

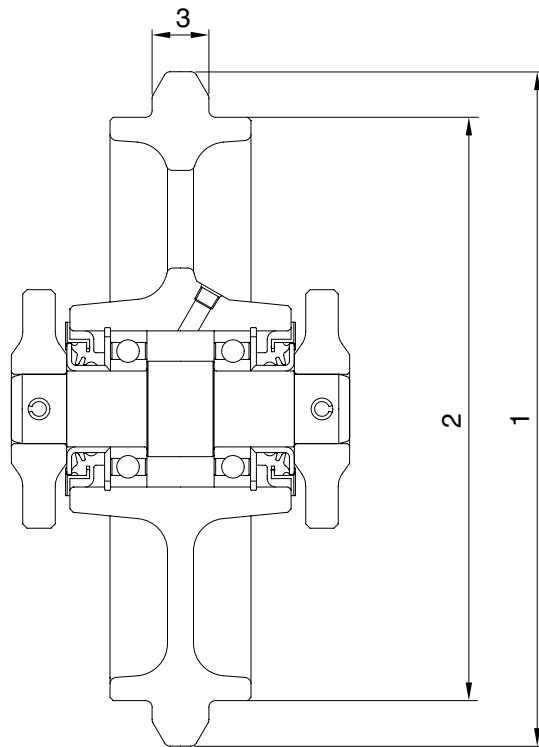


R5576MC17

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Link pitch	48	50	Replace
2	Height of grouser	25	5	
3	Width of link	30	40	

2. IDLER

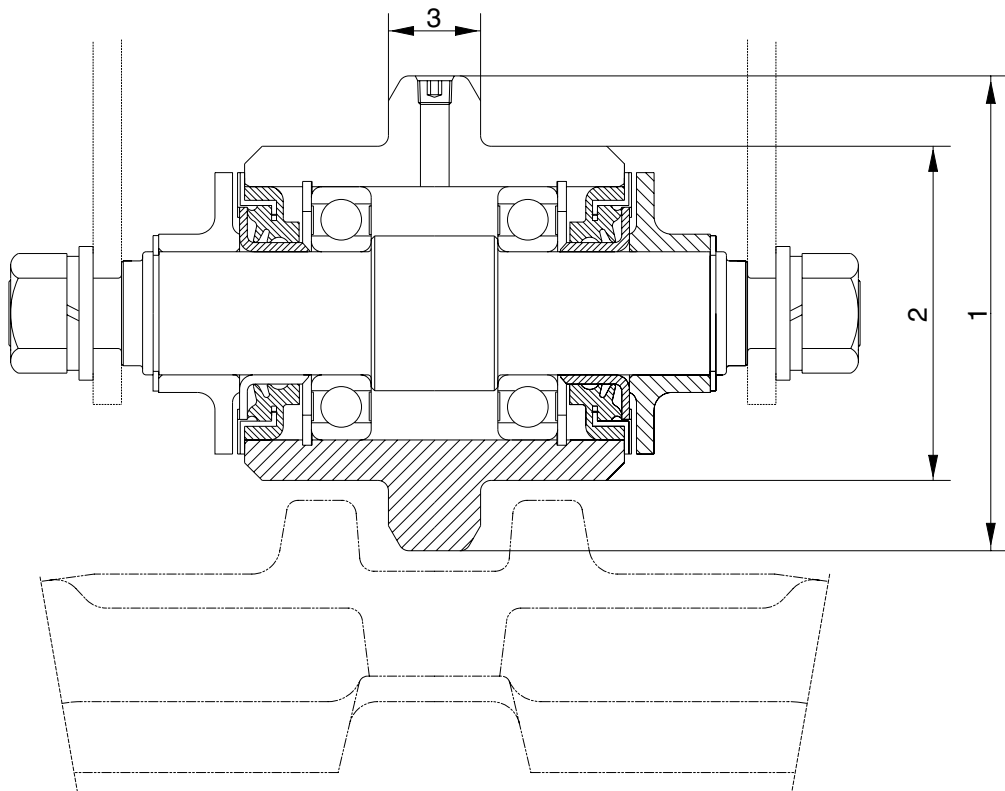


R27Z96MC23

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	250	-	Rebuild or replace
2	Outside diameter of thread	Rubber	210	204	
3	Width of flange		23	17	

3. TRACK ROLLER

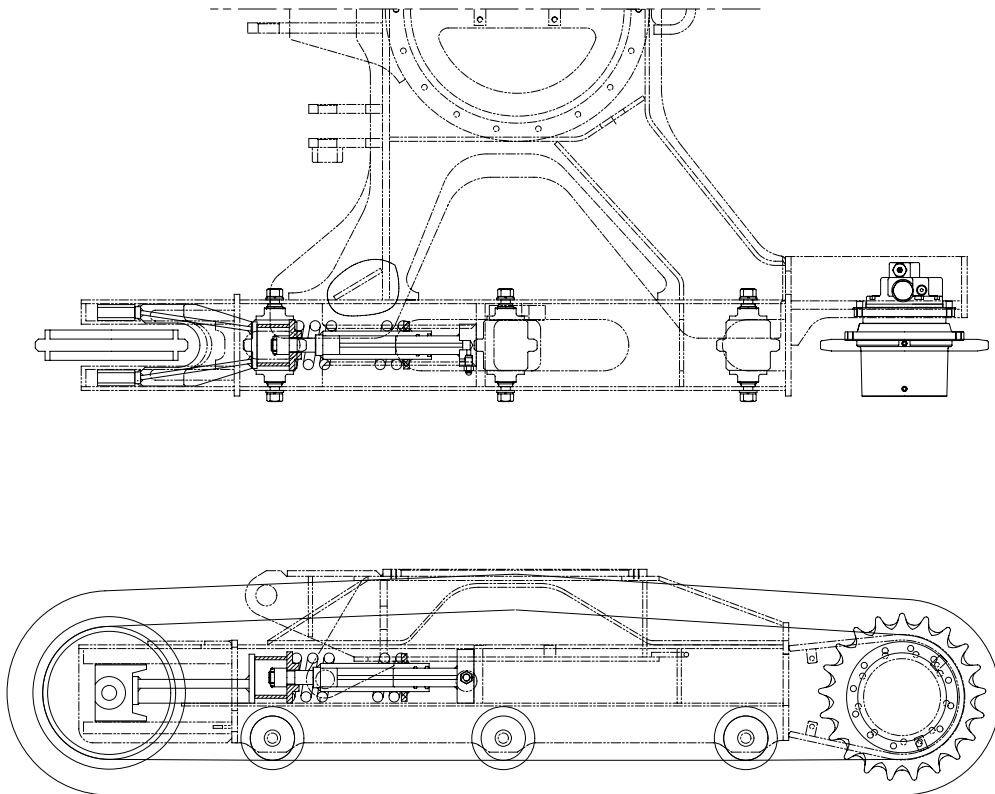


R35Z76MC19

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	100	-	Rebuild or replace
2	Outside diameter of thread	Rubber	70	64	
3	Width of flange		22	16	

4. TENSION CYLINDER

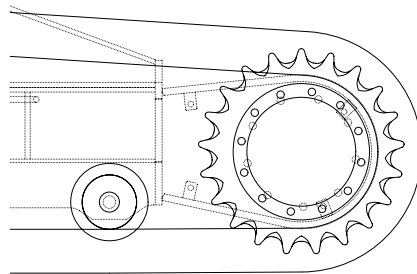
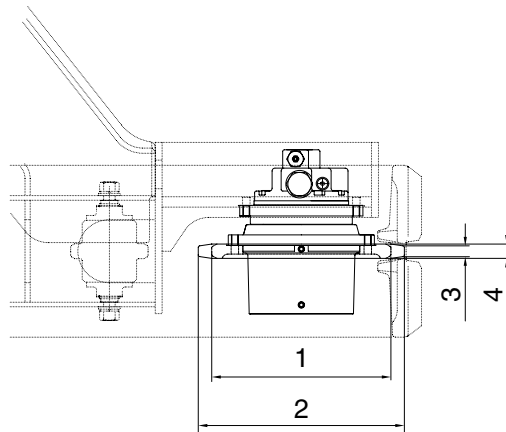


1696MS16

Unit : mm

No	Check item	Criteria				Remedy	
			Standard size	Repair limit			
1	Vertical width of idler guide	Track frame	51	53		Rebuild	
		Idler support	50	48		Rebuild or replace	
2	Horizontal width of idler guide	Track frame	151	155		Rebuild	
		Idler guide	150	146		Rebuild or replace	
3	Recoil spring	Standard size		Repair limit		Replace	
		Free length	Installed length	Installed load	Free length		Installed load
		261	223	880 kg	-		700 kg

5. SPROCKET

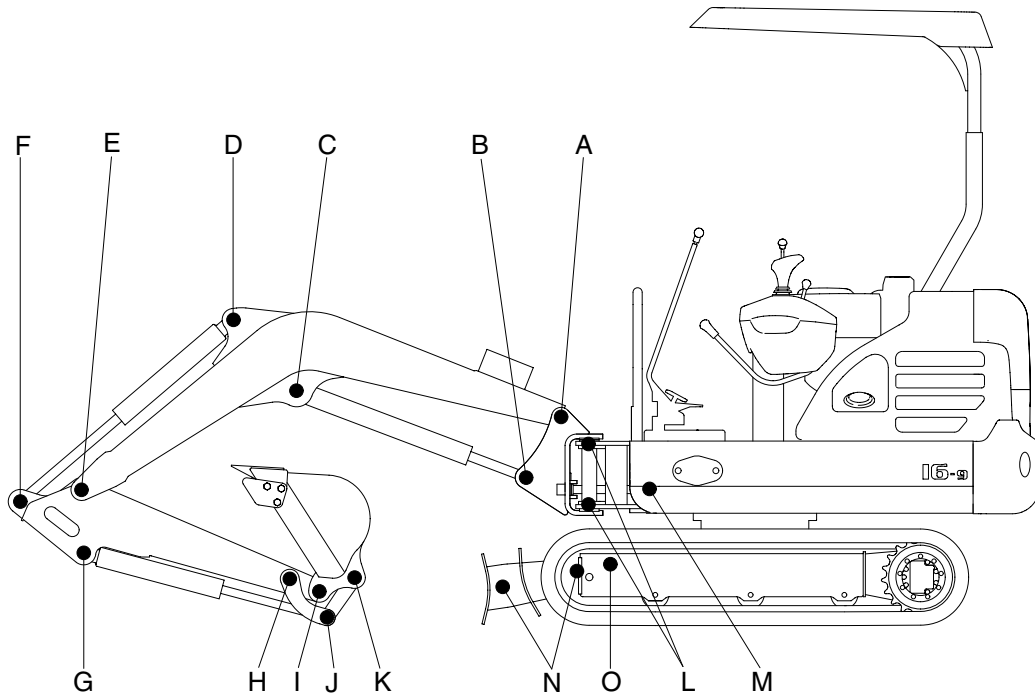


R27Z96MC22

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear out of sprocket tooth lower side diameter	253	247	Rebuild or Replace
2	Wear out of sprocket tooth upper side diameter	292	-	
3	Wear out of sprocket tooth upper side width	16	-	
4	Wear out of sprocket tooth lower side width	22	16	

6. WORK EQUIPMENT



1696MS17

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	35	34	33.5	35.5	36	Replace
B	Boom cylinder head	30	29	28.5	30.5	31	"
C	Boom cylinder rod	30	29	28.5	30.5	31	"
D	Arm cylinder head	30	29	28.5	30.5	31	"
E	Boom front	30	29	28.5	30.5	31	"
F	Arm cylinder rod	30	29	28.5	30.5	31	"
G	Bucket cylinder head	30	29	28.5	30.5	31	"
H	Arm link	30	29	28.5	30.5	31	"
I	Bucket and arm link	30	29	28.5	30.5	31	"
J	Bucket cylinder rod	30	29	28.5	30.5	31	"
K	Bucket link	30	29	28.5	30.5	31	"
L	Boom swing post	45	44	43.5	45.5	46	"
M	Boom swing cylinder	30	29	28.5	30.5	31	"
N	Blade cylinder	30	29	28.5	30.5	31	"
O	Blade and frame link	30	29	28.5	30.5	31	"