

SECTION 6 MAINTENANCE STANDARD

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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 HD Hyundai Construction Equipment spec.

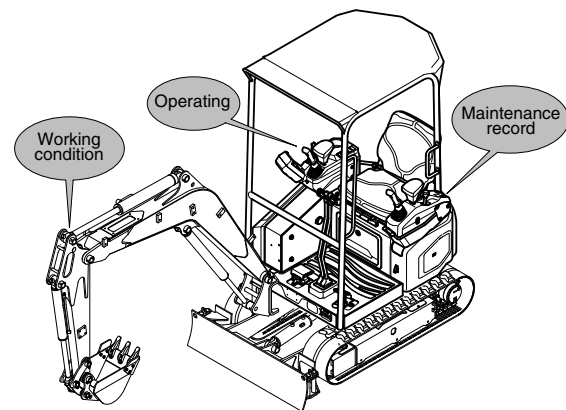
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

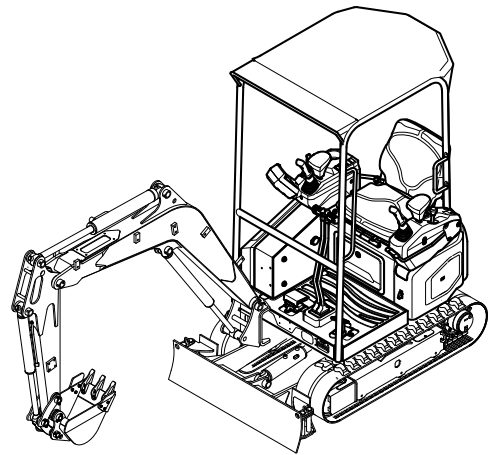


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2. TERMINOLOGY

1) STANDARD

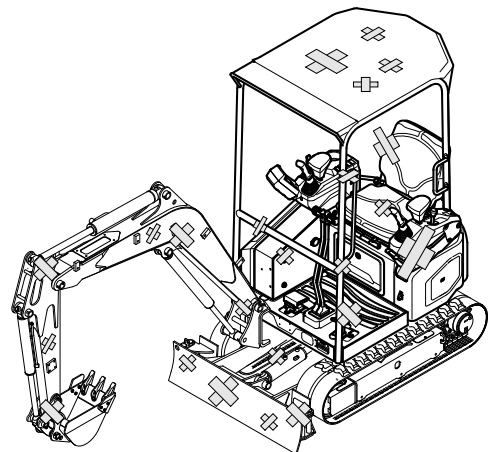
Specifications applied to the brand-new machine, components and parts.



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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

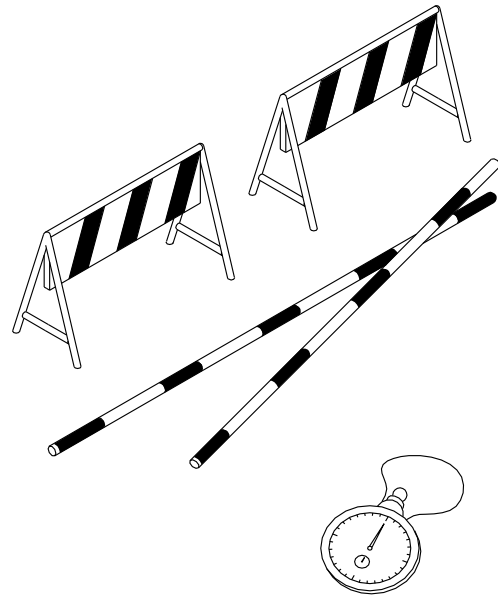
- ① Select a hard, flat surface.
- ② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
- ③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(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.

(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.



7-3 (140-7)

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

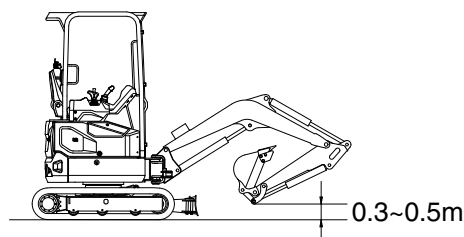
| Model | Engine speed | Standard | Remarks |
|---------|--------------|----------------|---------|
| HX17A Z | Low idle | 1450 ± 100 | |
| | High idle | 2400 ± 50 | |

3) TRAVEL SPEED

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

(2) Preparation

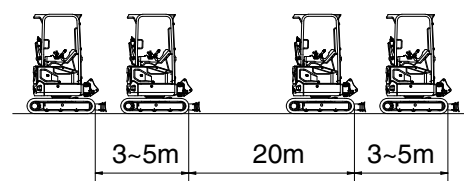
- ① Adjust the tension of both tracks to be equal.
- ② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil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



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(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

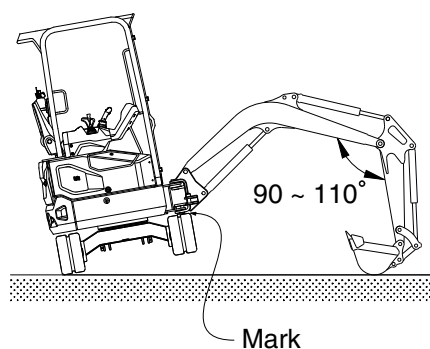
| Model | Travel speed | Standard | Remarks |
|---------|--------------|----------------|---------|
| HX17A Z | 1 Speed | 31.3 ± 2.0 | |
| | 2 Speed | 17.1 ± 1.0 | |

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



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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

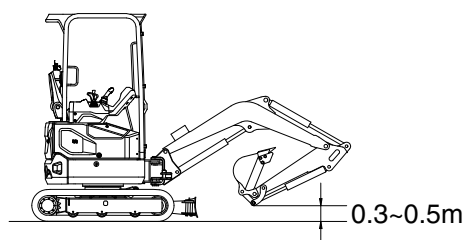
| Model | Travel speed | Standard |
|---------|--------------|----------------|
| HX17A Z | 1 Speed | 16.5 ± 2.0 |
| | 2 Speed | 8.6 ± 2.0 |

5) TRAVEL DEVIATION

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

(2) Preparation

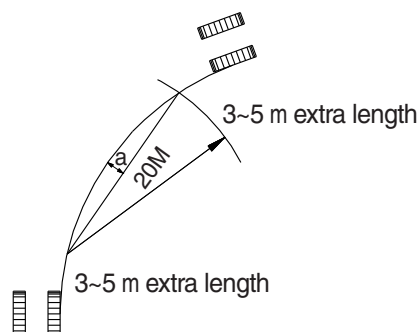
- ① Adjust the tension of both tracks to be equal.
- ② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
- ③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
- ④ Keep the hydraulic oil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

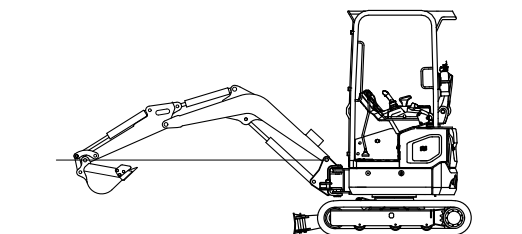
| Model | Standard | Maximum allowable | Remarks |
|---------|-----------|-------------------|---------|
| HX17A Z | 200 below | 240 | |

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

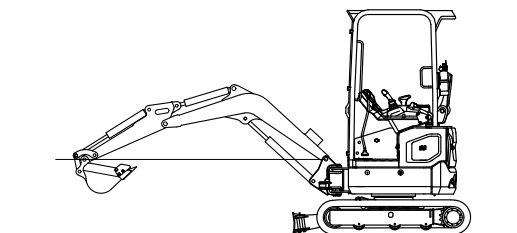
| Model | Standard | Remarks |
|---------|----------------|---------|
| HX17A Z | 13.1 ± 1.0 | |

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

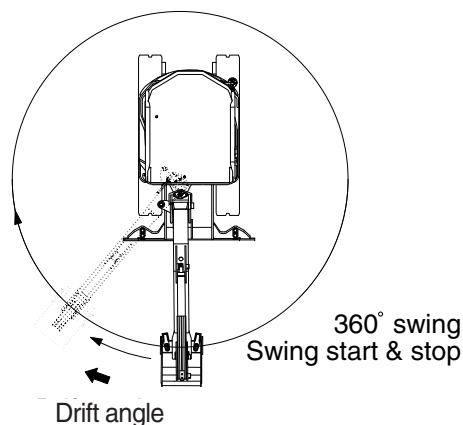
- ① Check the lubrication of the swing gear and swing bearing.
- ② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
- ③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom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

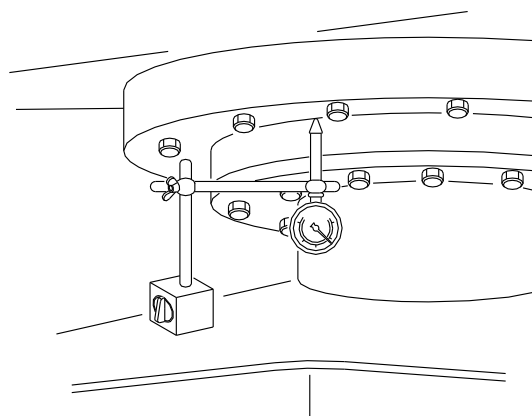
| Model | Standard | Maximum allowable | Remarks |
|---------|----------|-------------------|---------|
| HX17A Z | 40 below | 50 | |

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.



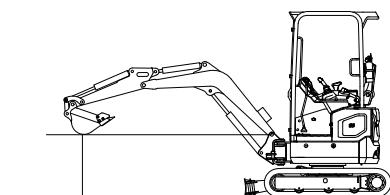
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(3) Measurement

- 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.

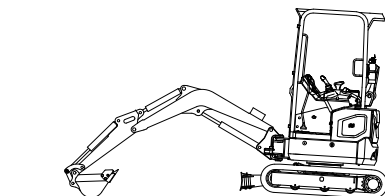
$$H = h2 - h1$$

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 |
|---------|-----------|-------------------|---------|
| HX17A Z | 0.5 ~ 1.2 | 2.4 | |

9) HYDRAULIC CYLINDER CYCLE TIME

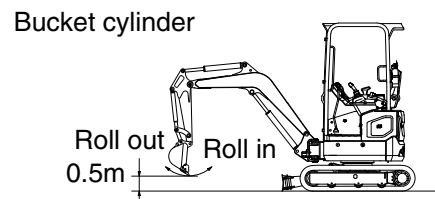
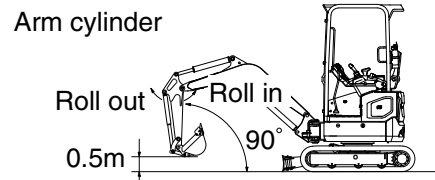
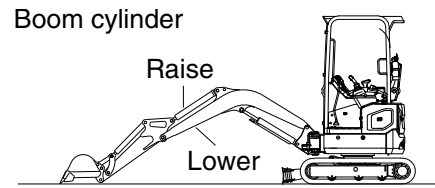
- (1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

(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.



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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

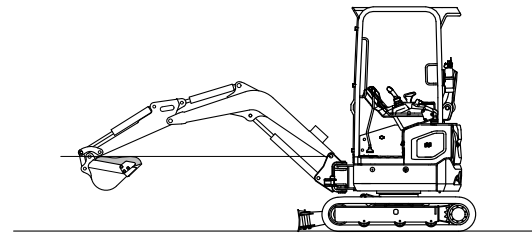
| Model | Function | Standard | Remarks |
|---------|--------------------------|---------------|---------|
| HX17A Z | Boom raise | 2.5 ± 0.4 | |
| | Boom lower | 2.1 ± 0.4 | |
| | Arm in | 3.8 ± 0.4 | |
| | Arm out | 2.3 ± 0.4 | |
| | Bucket load | 3.0 ± 0.4 | |
| | Bucket dump | 1.9 ± 0.4 | |
| | Boom swing (LH) | 4.6 ± 0.4 | |
| | Boom swing (RH) | 3.4 ± 0.4 | |
| | Dozer up (raise) | 1.5 ± 0.3 | |
| | Dozer down (lower) | 1.8 ± 0.3 | |
| | Angle dozer up (raise) | 2.1 ± 0.3 | |
| | Angle dozer down (lower) | 1.9 ± 0.3 | |

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 |
|---------|----------------------|----------|-------------------|---------|
| HX17A Z | 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 |
|---------|---------------|--------------|-------------------|---------|
| HX17A Z | 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 |
|---------|---------------|-------------|-------------------|---------|
| HX17A Z | 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

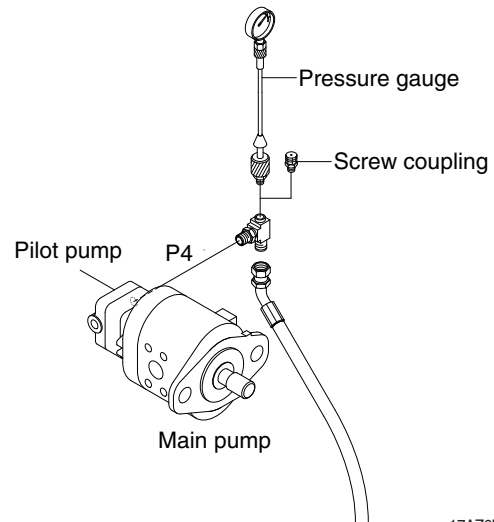
- ① Measure the primary pilot pressure.

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

| Model | Standard | Remarks |
|---------|------------|---------|
| HX17A Z | 36 ± 5 | |

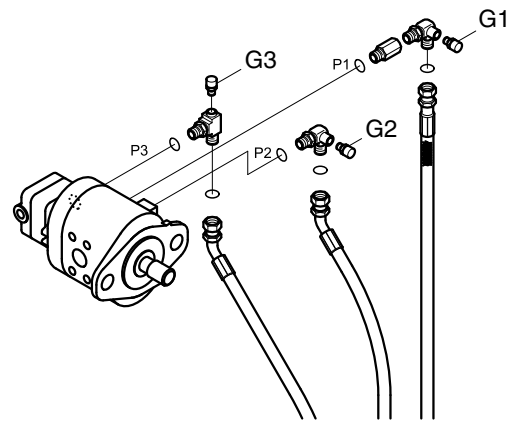


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15) MAIN PUMP DELIVERY PRESSURE

(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.

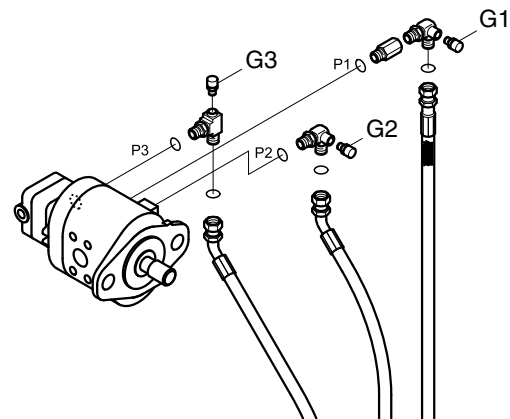
Unit : kgf / cm^2

| Model | Engine speed | Standard | Allowable limits | Remarks |
|---------|--------------|------------|------------------|---------|
| HX17A Z | 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.

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(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

| Model | Function to be tested | Standard |
|---------|-----------------------|--------------|
| HX17A Z | Boom, Arm, Bucket | 210 ± 10 |
| | Travel | 210 ± 10 |
| | Swing | 190 ± 10 |

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

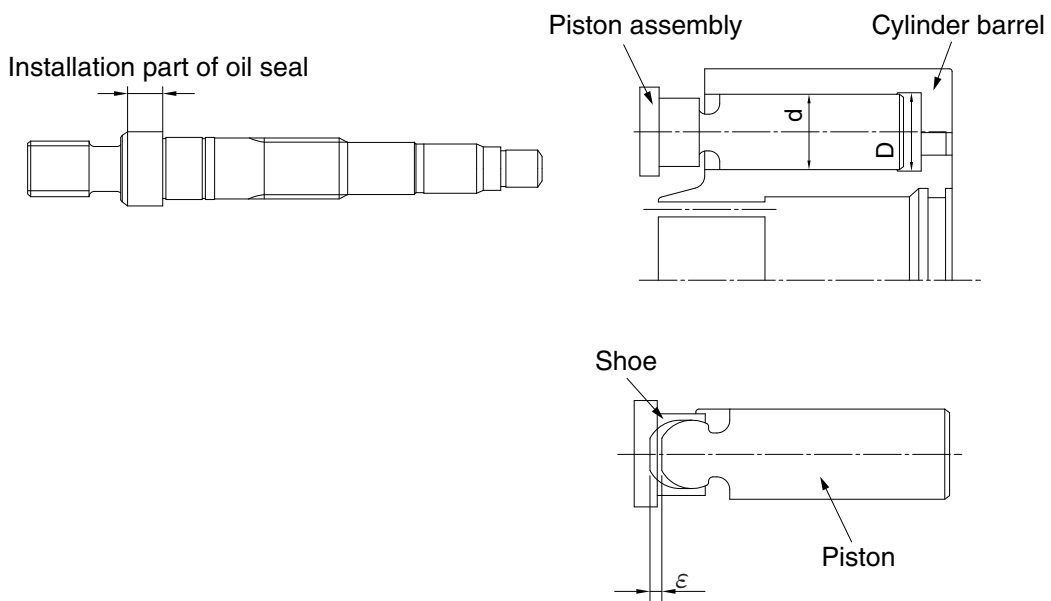
Before inspection, wash the parts well and dry them completely.

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 | Excessive wear on the seal surface. | Worn depth : 0.025 mm or more | Replace the shaft. |
| Valve plate | Excessive wear or damages on the sliding surface. | Worn depth : 0.020 mm or more | Replace the cylinder barrel kit. |
| Cylinder barrel | Excessive wear or damages on the sliding surface. | Worn depth : 0.020 mm or more | Replace the cylinder barrel kit. |
| | Clearance between the pistons (D-d) | 0.030 mm or more | Replace the cylinder barrel kit. |
| Piston and shoe | Wear of joint section | Check play (ϵ) between the shoe and the piston ϵ : 0.2 mm or more by hand operation. | Replace the cylinder barrel kit. |
| Seals (O-rings, gasket, etc.) | Damage, excessive rust | - | Replace each part. |



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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"> The level of oil in the tank is low 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"> Replenish a tank with oil 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

| Condition | Cause | Correction |
|--------------------------------|---|--|
| Motor will not turn | <ul style="list-style-type: none"> · No oil · Pump broken · Relief valve stuck open or set too low | <ul style="list-style-type: none"> · Fill reservoir to proper oil level. · Replace pump. · Clean and free relief valve spool and adjust to proper setting. |
| Slow operation | <ul style="list-style-type: none"> · Low oil viscosity · Worn pump · Extremely high fluid temperatures · Relief setting too low | <ul style="list-style-type: none"> · Use proper viscosity oil. · Repair or replace pump. · Increase reservoir size or add oil cooler. · Set relief valve for proper pressure. |
| Erratic motor operation | <ul style="list-style-type: none"> · Relief setting too low · Air sucked in inlet side of pump | <ul style="list-style-type: none"> · Set relief valve for proper pressure. · Tighten pipe fitting on pump inlet side. |
| Motor turns in wrong direction | <ul style="list-style-type: none"> · Wrong piping · The valve timing is incorrect due to a disassembling error. | <ul style="list-style-type: none"> · Reverse the piping · Disassemble and reassemble the unit and correct valve timing. |
| Fluid leakage | <ul style="list-style-type: none"> · Loose bolts or plugs. · Scratched or abraded O-ring · Scratched or abraded X-ring | <ul style="list-style-type: none"> · Tighten bolts and plugs by the correct torque. · Replace the O-ring with a new one. · Replace the X-ring with a new one. <p>Lower the drain pressure until it is within the allowable range.</p> |
| Abnormal sound | <ul style="list-style-type: none"> · Air is remaining in the circuit and motor. · Pump cavitation. | <ul style="list-style-type: none"> · Bleed air completely. · Remove substance clogging the suction filter. Enlarge the diameter of the suction pipe of the pump. · Raise the boost pump pressure. |

※ In case of, caused from life, torque or revolution declined or increase of noise, repair the motor or replace for new one.

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

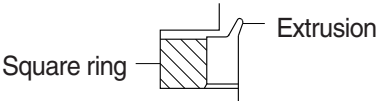
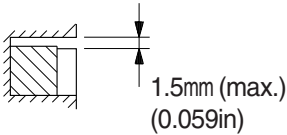
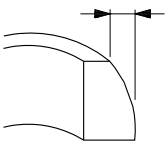
| No. | Part name | Point to be checked | Standard | Action |
|-----|---|---|---|------------------------------------|
| 12 | Body 1 | Spool sliding contact surface | No abnormal damage, wear | Replace whole body 1 kit |
| 13 | Counter valve spool Two-speed spool Shuttle spool | Body 1 sliding contact surface | No abnormal damage, wear | Replace 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 installation 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 plate sliding contact surface | No abnormal damage, wear (0.020 mm or greater) | Lap or replace cylinder barrel kit |
| 17 | Valve plate | Cylinder barrel sliding contact surface | No abnormal damage, wear (0.020 mm or greater) | Lap or replace cylinder 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 cylinder 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. | Remove the foreign object. In case of much leakage, replace the body 1 kit. |
| | Choke is clogged | 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. | Remove the foreign object. In case of much leakage, replace the body 1 kit. |
| | Choke is clogged. Spring is damaged. | Remove the foreign object. Replace the body 1 kit. |
| | - 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. |
| Rotating speed is slow | Prescribed flow rate is not supplied to the motor due to operating defect in the pump. | Inspect and repair or replace the pump. |
| | Volumetric efficiency declines due to defect in the motor. - Abnormal wear of sliding parts | Replace the worn part (kit). |
| | Volumetric efficiency declines due to defect in the hydraulic valve. - Abnormal wear of main spool and two speed spool sliding part | Replace body 1 kit. |

| 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 |

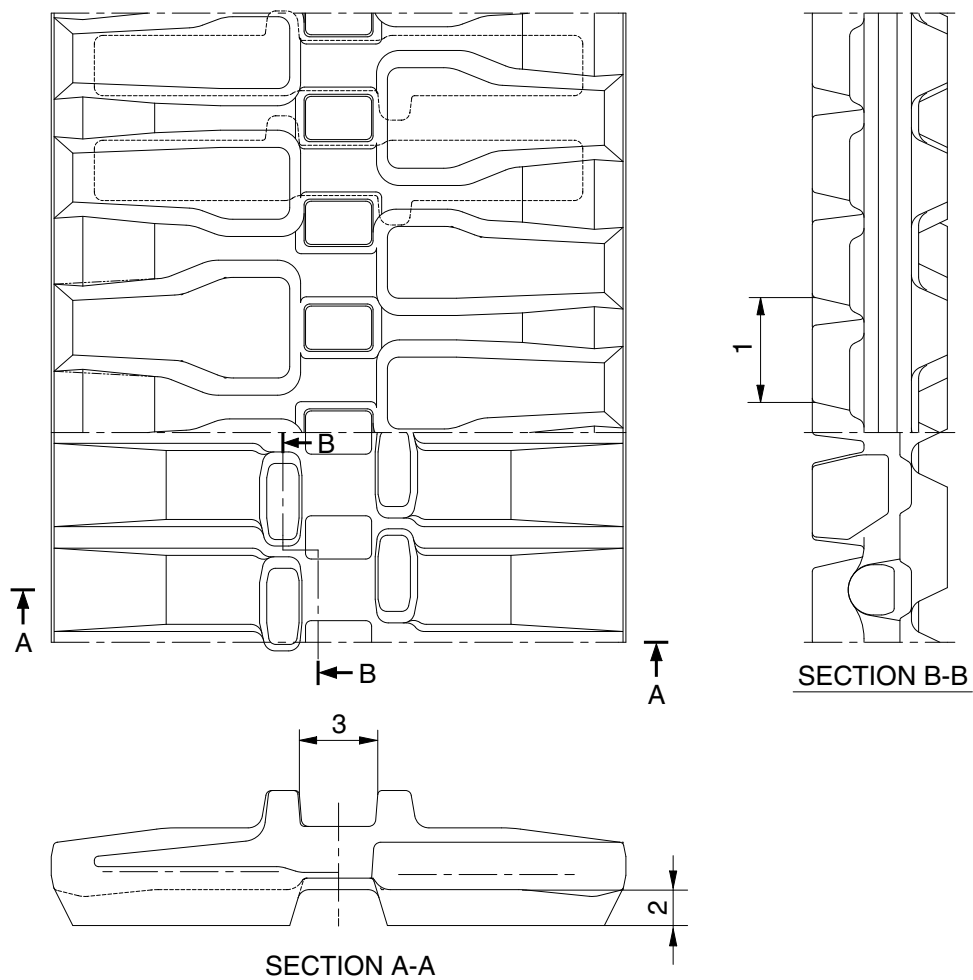
6. CYLINDER

| 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. | · Replace or replate |
| | | · Scratches are not present. | · Recondition, replate or replace |
| Cylinder tube | · Rod | · Wear of O.D. | · Recondition, replate or replace |
| | · Bushing at mounting part | · Wear of I.D. | · Replace |
| | · Weld on bottom | · Presence of crack | · Replace |
| | · Weld on head | · Presence of crack | · Replace |
| | · Weld on hub | · Presence of crack | · Replace |
| Gland | · Tube interior | · Presence of faults | · Replace if oil leak is seen |
| | · Bushing at mounting part | · Wear on inner surface | · Replace |
| | · 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

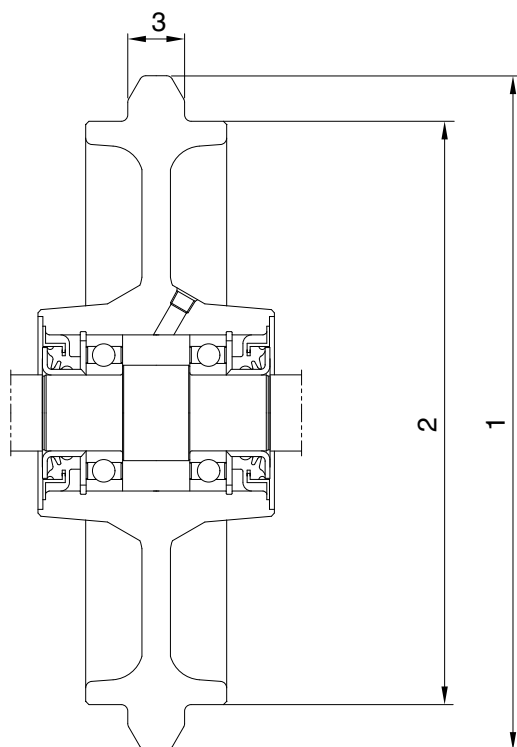


R5576MC17

Unit : mm

| No | Check item | Criteria | | Remedy |
|----|-------------------|---------------|--------------|---------|
| | | Standard size | Repair limit | |
| 1 | Link pitch | 48 | 50 | Replace |
| 2 | Height of grouser | 20 | 5 | |
| 3 | Width of link | 34 | 44 | |

2. IDLER

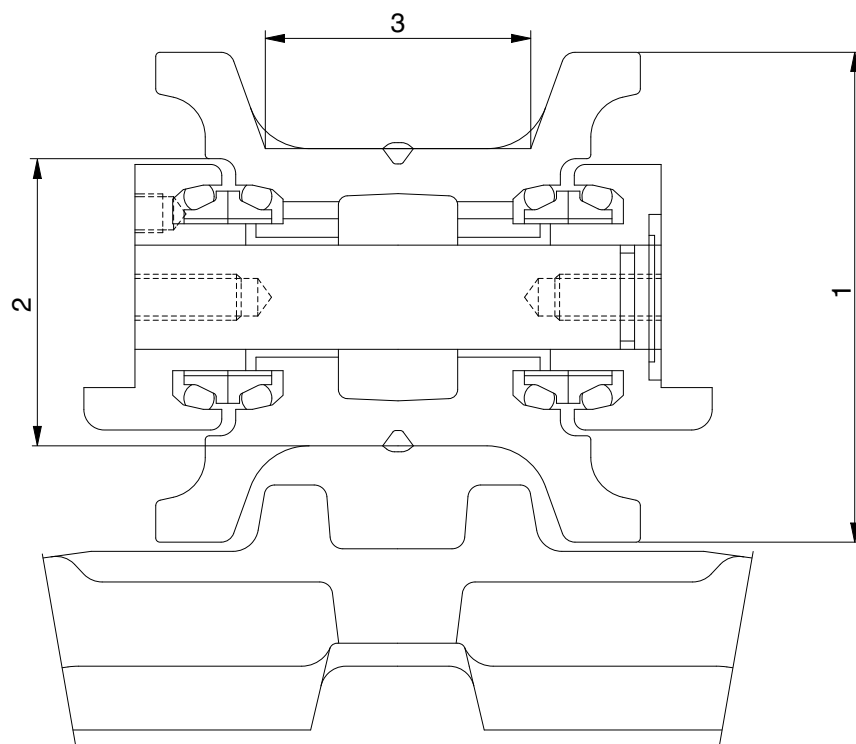


R27Z96MC23

Unit : mm

| No | Check item | | Criteria | | Remedy |
|----|----------------------------|--------|---------------|--------------|--------------------|
| | | | Standard size | Repair limit | |
| 1 | Outside diameter of flange | Rubber | 249 | - | Rebuild or replace |
| 2 | Outside diameter of thread | Rubber | 216 | 210 | |
| 3 | Width of flange | | 25 | 19 | |

3. TRACK ROLLER

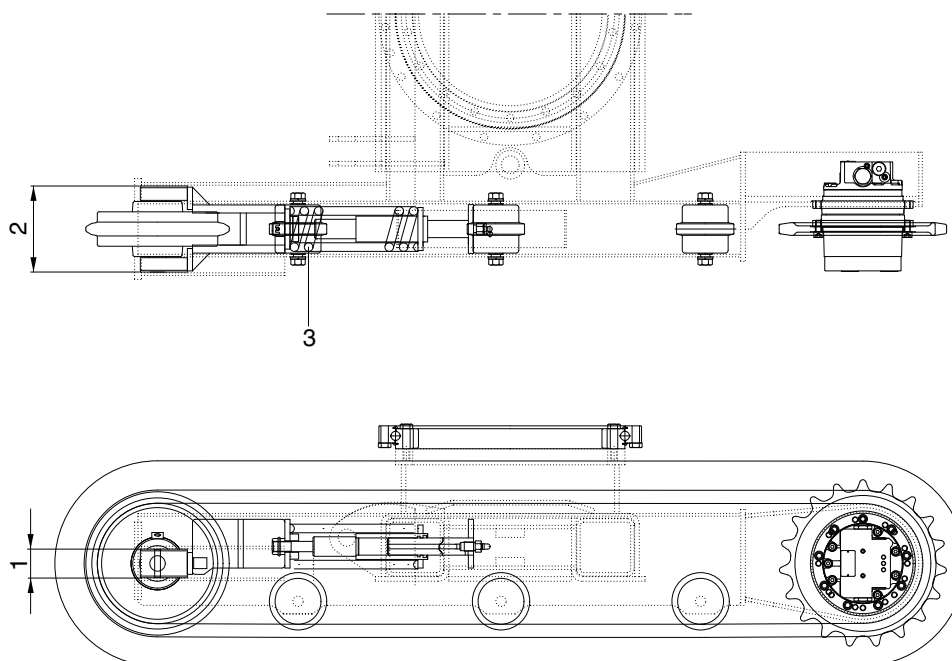


17Z9A6MC13

Unit : mm

| No | Check item | | Criteria | | Remedy |
|----|----------------------------|--------|---------------|--------------|--------------------|
| | | | Standard size | Repair limit | |
| 1 | Outside diameter of flange | Rubber | 118 | 112 | Rebuild or replace |
| 2 | Outside diameter of thread | Rubber | 72 | - | |
| 3 | Width of flange | | 64 | 70 | |

4. TENSION CYLINDER

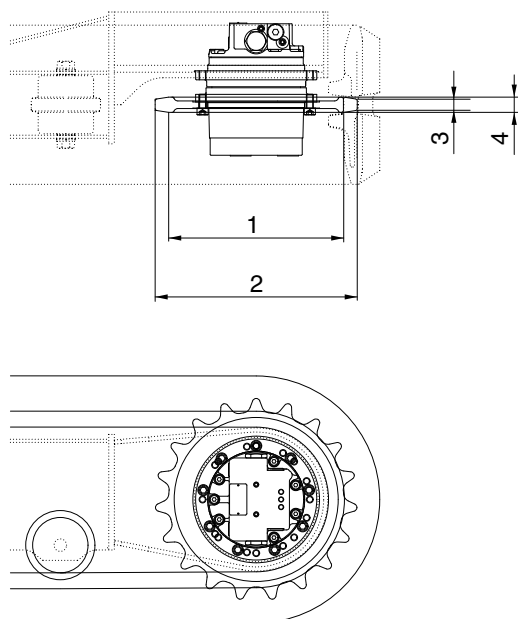


17Z9A6MC16

Unit : mm

| No | Check item | Criteria | | | | | Remedy |
|----|---------------------------------|---------------|------------------|----------------|--------------|----------------|--------------------|
| | | | Standard size | | Repair limit | | |
| 1 | Vertical width of idler guide | Track frame | 51 | | 53 | | Rebuild |
| | | Idler support | 49 | | 47 | | Rebuild or replace |
| 2 | Horizontal width of idler guide | Track frame | 151 | | 155 | | Rebuild |
| | | Idler guide | 149 | | 145 | | Rebuild or replace |
| 3 | Recoil spring | Standard size | | | Repair limit | | Replace |
| | | Free length | Installed length | Installed load | Free length | Installed load | |
| | | 261 | 188 | 1785 kg | - | 1540 kg | |

5. SPROCKET

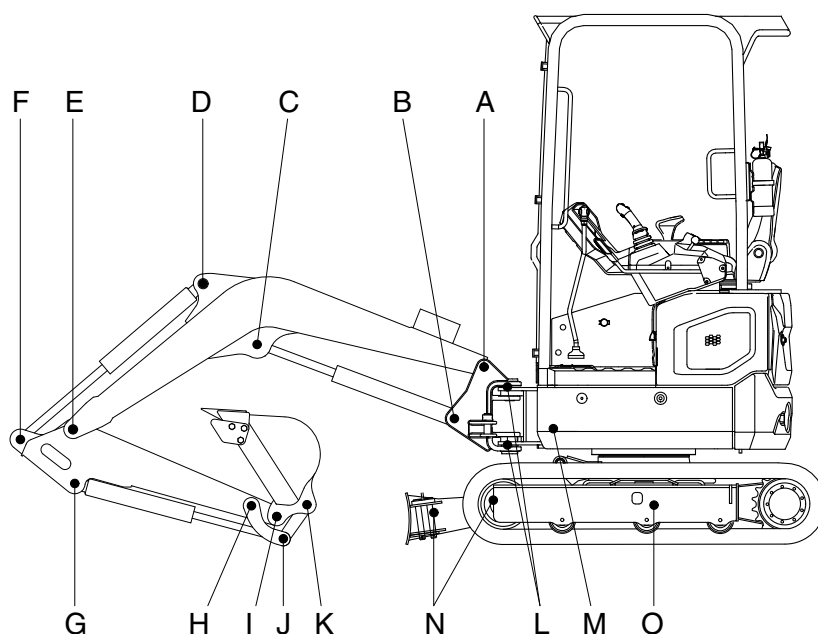


17Z9A6MC22

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



17AZ6MC17

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 | " |