MITSUBISHI ELECTRIC
Changes for the Better

Quality in Motion™

Maintenance Manual for Escalator Main Components

D55101-*
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Contents

1. Introduction

The scope of this maintenance manual covers the main components of escalators that may greatly compromise the safety of users and cause serious accidents if malfunctions or insufficiently managed.

Escalators need to be inspected and maintained periodically by competent maintenance persons. If used without proper maintenance, they may not be able to deliver the performance we expect.

The components specified in this manual are particularly critical for safety of users and maintenance persons. Please formulate the appropriate maintenance plan in accordance with this manual.

For maintenance of Mitsubishi Electric escalators, we recommend that you sign a maintenance contract with our official distributor. To contact our official distributor, please visit our website: www.mitsubishielectric.com/elevator/network/index.html.

This manual describes important items that need to be checked with particular care in performing basic maintenance.

The owner of the installation and operation manager must request the maintenance organization to perform maintenance in accordance with this manual.

2. Maintenance of escalator main components

The main components of escalators described in this manual refer to the critical parts that may cause serious accidents involving users if their functions and states are improperly maintained.

Because the way in which the state of the escalator changes varies depending on the operation time and installation environment, the maintenance activity must be performed to maintain the appropriate state at all times.

This document describes items that must be checked in performing basic maintenance for the main components of escalators mentioned above.

3. General precautions

This manual summarizes important maintenance information for competent maintenance persons who carry out basic escalator maintenance. The competent maintenance persons shall understand and observe the instructions thoroughly.

3.1 Safety symbols

Safety symbols below represent the degree of hazard that would arise should the provided instructions be neglected. The definitions of the symbols are as follows.

(1) Definitions of danger, warning, and caution symbols

Symbol	Description
Danger	Indicates an imminently hazardous situation which, if not observed, will result in death or serious injury.
Warning	Indicates a potentially hazardous situation which, if not observed, could result in death or serious injury.
Caution	Indicates a potentially hazardous situation which, if not observed, may result in injury or damage to the escalator equipment.

(2) Definitions of precaution symbols

Symbol	Description
	Indicates a mandatory action.
	Indicates a prohibited action.
	Warns of electricity. (This symbol reminds workers to take care to avoid coming into contact with live-wire portions.)

3.2 Precautions after inspection and maintenance

(1) Fault

If any fault has been found during inspection and/or maintenance, take appropriate measures immediately.

1) Take the escalator out of service until the fault is repaired. Report the state to the operation manager.
2) Record the detail of fault, replacement, and repair in the Work Log, and maintain it permanently.
3) If any abnormality has been found during inspection, and replacement, repair or adjustment by Mitsubishi Electric Corporation is required, please contact our official distributor.

Caution	**While the escalator is out-of-service, be sure to take measures to prevent anyone from entering the area.** **Use the Mitsubishi Electric's genuine parts for replacement.** **If there is any problem with the product, contact our official distributor.**

(2) Restoration

1) Restore any screws, covers, or other parts loosened or removed during inspection and/or maintenance to the original state.

2) If no abnormality has been found during inspection and/or maintenance, restore the escalator to normal operation.

Caution	**Before restoring the escalator to normal operation, conduct a test run to confirm that there is no abnormal noise, and check that all steps are securely attached with no opened areas.**

3.3 Service parts

For supply of parts, contact our official distributor.

Please note that we may not be able to supply some parts depending on when the product was produced and the condition of the equipment. In such case, we recommend modernization of your product.

Caution	**This manual is subject to change without notice. Before starting maintenance, visit the URL below to check the latest manual.** **www.mitsubishielectric.com/elevator/maintenance/index.html**

If this manual does not include the contents applicable to the component to be actually maintained, take a note of the production number of the escalator (generally an 8-digit number indicated on the component that starts with "S", such as "SEH502A1"), and contact our official distributor.

4. Maintenance and inspection of brake of escalator drive unit

4.1 Disc brake

4.1.1 Maintenance and inspection items and standard intervals

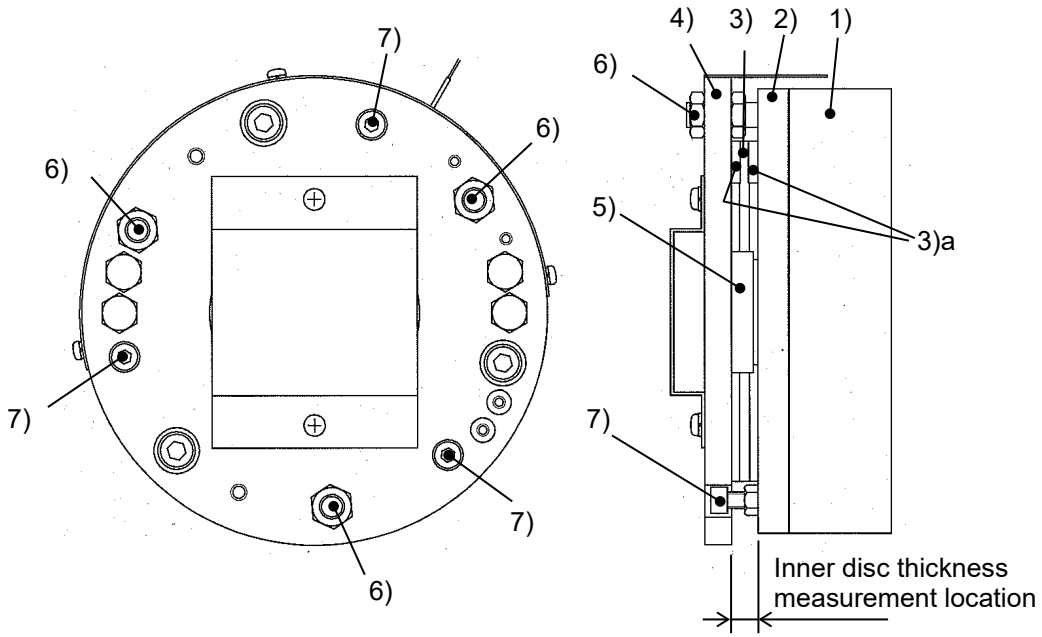
Regularly inspect the following items and promptly take measures if any abnormality is found. The inspection is to be performed based on the intervals shown in the table below. However, the intervals can be shortened depending on the installation environment, daily operation time, and changes in the actual machine.

Maintenance item	Standard interval	Section	Remarks
Brake appearance	Every maintenance (*)	4.1.3.1	
Braking, operation state		4.1.3.2	
Braking distance		4.1.3.3	
Clearance (gap) between field core and armature	6 months	4.1.3.4	
Remaining thickness of inner disc		4.1.3.5	
Cleaning		4.1.3.6	
Mounting state	12 months	4.1.3.7	

*Within 1 month

4.1.2 Brake structure

The following figure shows the structure of the brake (disc type) of the Mitsubishi Electric escalator drive unit.



1) Field core, 2) Armature, 3) Inner disc, 3)a Lining, 4) Outer disc

5) Spline hub, 6) Gap adjusting bolt (three locations), 7) Torque adjusting bolt (three locations)

4.1.3 Details on brake inspection/maintenance

Warning

Since the steps may start moving downward after the escalator is stopped possibly causing passengers on it to fall, do not continue the operation with the oil adhered to the sliding surface of the brake lining.

4.1.3.1 Brake appearance

(1) There shall be no contamination with oil or dust.
Pay particular attention to the sliding surface of the lining.

(2) Regularly clean the wear debris accumulated on the spline hub and its surroundings by blowing air and with a brush.

4.1.3.2 Braking, operation state

(1) There shall be no abnormalities when the brake is applied or released.

(2) Check for any abnormal noise during escalator operation and braking.
A squeaking noise may occur during braking, but there are no issues with the braking and holding performances of the brake if the braking distance (as specified in 4.1.3.3) remains within the standard range. If there is a squeaking noise, take the following measures.
- Repeat braking and check if the squeaking noise changes.
- If the squeaking noise does not stop even after taking the measure above, replace the brake in consideration of the level of the squeaking noise, installation environment, and use conditions.

(3) Continuous operation is to be avoided while the lining is in contact with the armature and outer disc.
If there is large amount of wear debris around the brake and the outer disc or armature generates heat only during the continuous operation without braking, check the air gap (4.1.3.4) and the state of the spline portion before performing adjustment and cleaning.

4.1.3.3 Braking distance

(1) The braking distance must be within the normal range when the escalator is stopped while operating in down direction with no load.
(Check that the moving distance is not significantly different between when the escalator is stopped while operating in up direction with no load and when stopped while operating in down direction with no load.)

How to measure the braking distance:

When a label is attached to the drive unit and the surrounding panels, follow the descriptions on it.

- For the braking distance, measure the moving distance of the handrails at the upper horizontal part of the escalator.
- Mark the spot on the handrail and the balustrade near the handrail with tape.
- Operate the escalator in down direction at the rated speed, and press the emergency stop button when the taped area is overlapped.
- Measure the distance from the tape on the balustrade to the tape on the handrail.
- Measure this two or three more times in considering that the button press timing could vary.

Standard value of braking distance:

When a label is attached to the drive unit and the surrounding panels, follow the descriptions on it. For the standard values of other braking distances, refer to the following.

System	Brake type	Brake torque	Standard braking distance
Terminal drive	MNB17-XX SCEB	Up to 137 Nm	200 ± 20 mm (Note 1) 230 ± 30 mm (Note 1)
Modular drive	MNB17-XX	Up to 137 Nm	200 ± 20 mm

*For the brake type and brake torque, refer to the nameplate attached to the brake.

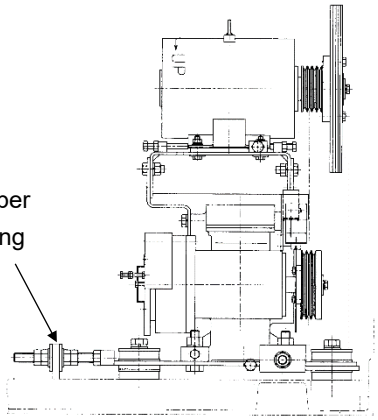
*If none of the above is applicable (e.g., the brake type is MNB30-XX), take a note of the brake type, brake torque, and production number of the escalator (generally an 8-digit number indicated on the component that starts with "S", such as "SEH502A1"), and contact our official distributor.

*Note 1: As shown in the figure on the right, determine which value to use in line with whether a rubber vibration isolator for the drive unit is present.

With a rubber vibration isolator: 200 ± 20 mm

Without a rubber vibration isolator: 230 ± 30 mm

Check the presence of the rubber vibration isolator on the adjusting bolt in BG-direction.



If the braking distance is out of the normal range, check that there is no abnormality such as V-belt slips, and then adjust the brake torque using the torque adjusting bolts. Deceleration may increase when the V-belt slips, possibly causing passengers on the escalator at the time to fall.

*If the braking distance is longer than the standard, rotate the bolt clockwise to increase the brake torque.

If the braking distance is shorter than the standard, rotate the bolt counterclockwise to decrease the brake torque.

Make sure that the torque adjusting bolts are fastened equally at three locations.

4.1.3.4 Clearance (air gap) between field core and armature

(1) When the escalator is stopped, the clearances (air gaps) between the field core and the armature must be equal and within the adjustment standard value for the entire circumference. If the gap has exceeded the adjustment standard value or is expected to exceed the standard value in the near future, or if the gap is uneven, adjust the gap to the adjustment value using the gap adjusting bolts.
Measure three locations near the gap adjusting bolts.
For each standard value, check the label on the brake main unit.

4.1.3.5 Remaining thickness of inner disc

(1) The thickness of the inner disc must be equal to or thicker than the standard. (For the measurement location, see the figure showing the structure.)
(The standard values for replacement are indicated on the label on the brake main unit.)
*When the remaining thickness has reached the following thickness, plan an early replacement.

With/without automatic operation (with an inverter)	Standard value + 0.2 mm
With automatic operation (without an inverter)	Standard value + 0.5 mm

4.1.3.6 Cleaning

(1) Dust around the brake main unit must be cleaned.

(2) No oil must adhere to the sliding surface of the lining. Because the oil adhered to the sliding surface may degrade the holding force during stop operation, stop the escalator when such adhesion is found and contact our official distributor.

4.1.3.7 Mounted state

(1) No looseness must be found in the brake mounting bolts and other adjusting bolts.

	**When a label is attached to the drive unit or the receiving junction box, strictly observe the descriptions (standard) on the label.**
	**Do not disassemble the disc brake.**

4.2 Drum brake

4.2.1 Maintenance and inspection items and standard intervals

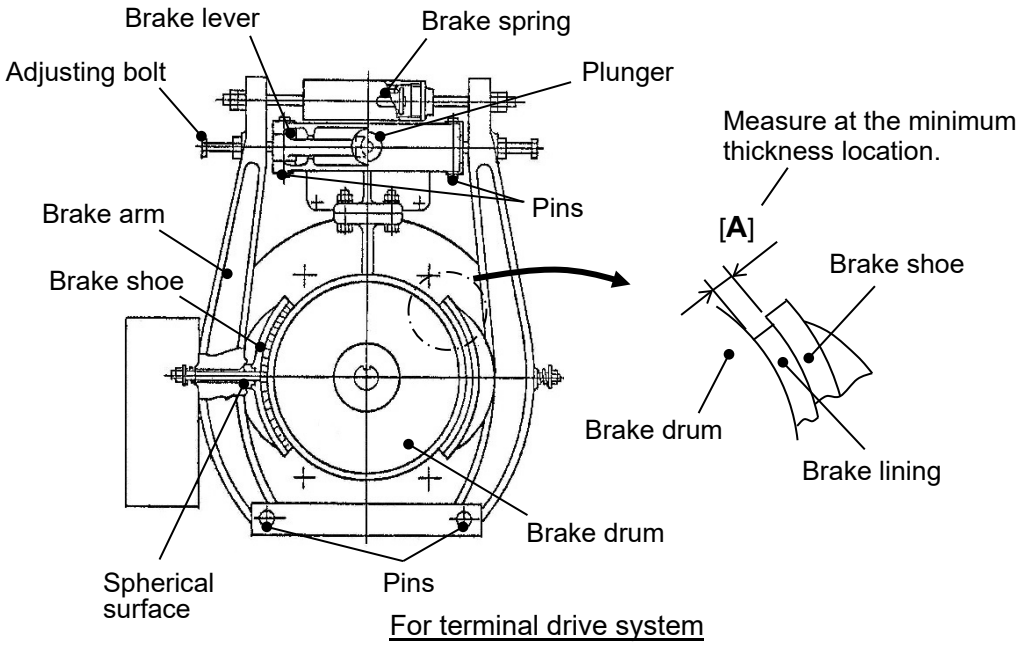
Regularly inspect the following items and promptly take measures if any abnormality is found. The inspection is to be performed based on the intervals shown in the table below. However, the intervals can be shortened depending on the installation environment, daily operation time, and changes in the actual machine.

Maintenance item	Standard interval	Section	Remarks
Brake appearance	Every maintenance (*)	4.2.3.1	
Braking, operation state		4.2.3.2	
Braking distance		4.2.3.3	
Brake plunger stroke	12 months	4.2.3.4	
Remaining thickness of brake lining		4.2.3.5	
Brake release detection device inspection (BRS: Brake Release Switch)		4.2.3.6	
Cleaning, lubrication		4.2.3.7	
Mounting state		4.2.3.8	

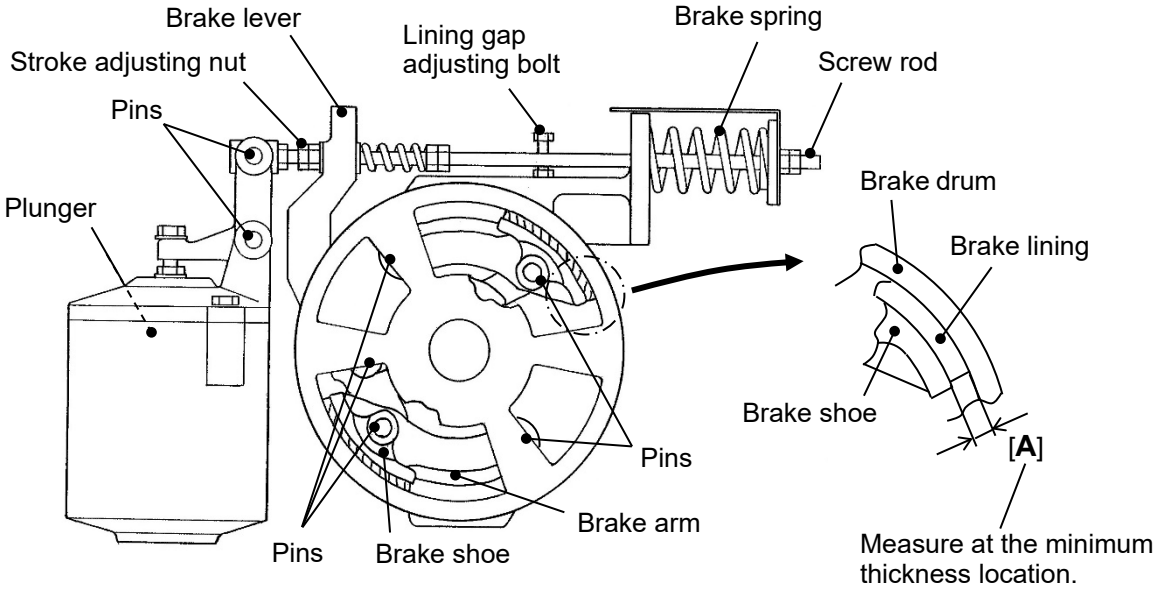
*Within 1 month

4.2.2 Brake structure

The following figure shows the structure of the brake (drum type) of the Mitsubishi Electric escalator drive unit.



For terminal drive system



For modular drive system

(The structure may differ slightly.)

4.2.3 Details on brake inspection/maintenance

Warning

Since the steps may start moving downward after the escalator is stopped possibly causing passengers on it to fall, do not continue the operation with the oil adhered to the sliding surface of the brake lining.

4.2.3.1 Brake appearance inspection

(1) There shall be no contamination with oil or dust.

*Pay particular attention to the sliding surface of the lining.

4.2.3.2 Braking, operation state

(1) There shall be no abnormalities when the brake is applied or released.

(2) Check for any abnormal noise during escalator operation and braking.

A squeaking noise may occur during braking, but there are no issues with the braking and holding performances of the brake if the braking distance (as specified in 4.2.3.3) remains within the standard range. If there is a squeaking noise, take the following measures.

- Repeat braking and check if the squeaking noise changes.
- If the squeaking noise does not stop even after taking the measure above, replace the brake in consideration of the level of the squeaking noise, installation environment, and use conditions.

(3) Continuous operation is to be avoided while the lining is in contact with the brake drum. If there is large amount of wear debris around the brake and the brake drum generates heat only during the continuous operation without braking, check the plunger stroke or the gap (clearance between the drum and the lining) (4.2.3.4) before performing adjustment and cleaning.

4.2.3.3 Braking distance

(1) The braking distance must be 200 ± 20 mm when the escalator is stopped while operating in down direction with no load.
(Check that the moving distance is not significantly different between when the escalator is stopped while operating in up direction with no load and when stopped while operating in down direction with no load.)

How to measure the braking distance:
When a label is attached to the drive unit and the surrounding panels, follow the descriptions on it

- For the braking distance, measure the moving distance of the handrails at the upper horizontal part of the escalator.
- Mark the spot on the handrail and the balustrade near the handrail with tape.
- Operate the escalator in down direction at the rated speed, and press the emergency stop button when the taped area is overlapped.
- Measure the distance from the tape on the balustrade to the tape on the handrail.
- Measure this two or three more times in considering that the button press timing could vary.

If the braking distance is out of the normal range, adjust the distance by changing the spring pressure.
In the terminal drive system, if the spring pressure is set to around 150%, the braking distance will almost reach the normal value. However, if the distance exceeds the normal range, adjust the braking force by changing the spring pressure. Note that the spring pressure must be set to 70% or more.

4.2.3.4 Brake plunger stroke

(1) For the adjustment standard values (management values) for the plunger stroke, refer to the following.

Applicable condition/type		Stroke management value	Remarks
Drum brake (Check the type from the nameplate on the drive unit.) (Note 1)	ES-300, ESB-300, ESW-300	3.0 to 4.0 mm	Terminal drive system
	ES-400, ESB-400	3.0 to 4.0 mm	
	ES-500	4.5 to 5.5 mm	
	ESB-500, ESC-500	3.5 to 4.5 mm	
	ESD-500, ESE-500	3.0 to 4.0 mm	
	ES-600, ESB-600, ESC-600, ESD-600	3.0 to 4.0 mm	
	ES-700, ESB-700	3.5 to 4.5 mm	
	ESC-700	3.0 to 4.0 mm	
	ES-800, ES-47	3.0 to 4.0 mm	
Brakes in the modular drive system whose structure is shown in the figure in 4.2.2		3.0 to 4.0 mm	Modular drive system
Brakes in the modular drive system whose structure is other than the one shown in the figure in 4.2.2		2.7 to 3.3 mm	

Note 1: The lower two digits of the number are other than 00 for some types, but the management values are the same as the types with 00.
"RB" or the like is added at the end for some types, but the management values are the same as the types without it.
For example, when the nameplate indicates ESD-501 or ESD-500RB, see the value for ESD-500 in the table above.

For the modular drive system, measure the moving distance of the plunger or screw rod when the brake release lever is used in the braking state to release the brake.
If the gap has exceeded the adjustment standard value or is expected to exceed the standard value in the near future, or if the gap is uneven, adjust the stroke to the standard value using the adjusting bolt (terminal drive system) or the stroke adjusting nut (modular drive system) of the brake arm.

(2) Check that there is no damage, wear, or stain on the plunger, and then lightly apply the Mitsubishi elevator oil No. 11.

4.2.3.5 Remaining thickness of brake lining [A]

(1) The remaining thickness must be equal to or thicker than the standard. (For the measurement location, see the figure showing the structure.)
*When the remaining thickness has reached the following thickness, perform early replacement.

Terminal drive system	Linings fixed with a screw: When the remaining thickness from the head of the screw (rivet) to the surface of the lining has reached 0.3 mm Linings fixed by an adhesive (ES-300, ESB-300, ESW-300): When the thickness of the lining has reached 3 mm
Modular drive system	When the thickness of the lining has reached 2 mm

4.2.3.6 Inspection of brake release detection device (BRS: Brake Release Switch)

Terminal drive system:

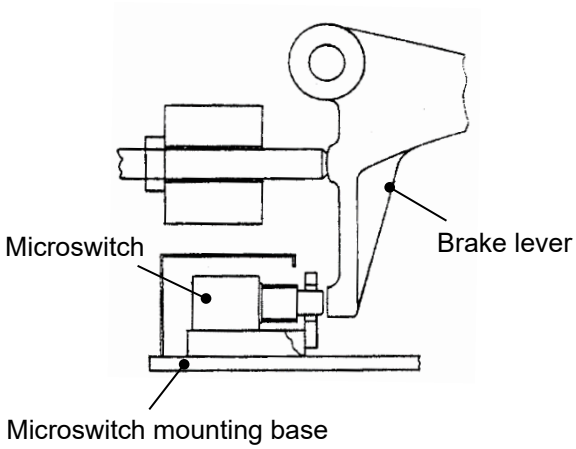
Check that the switch closes just before the plunger is completely pushed in.

1) Brake lever detection type

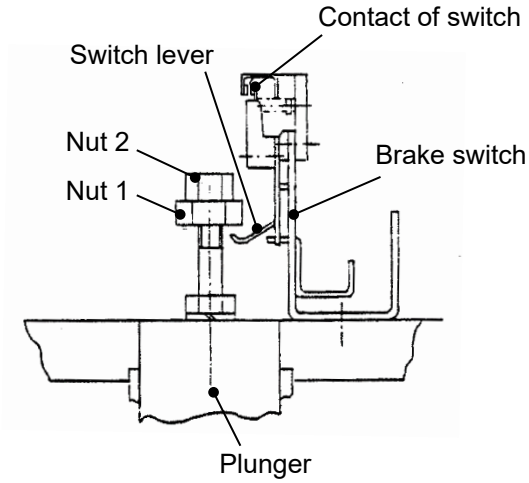
- Adjust the brake (spring pressure and plunger stroke), and then set the clearance between the microswitch and the brake lever to 1.5 mm. (Adjust the clearance using the slotted holes on the microswitch mounting base.)
- Check that the microswitch activates when the plunger is pushed in.
- If the microswitch does not activate, decrease the clearance (1.5 mm) until the switch activates.

2) Plunger detection type

- Push in the plunger and gradually tighten the nut 1. When the nut 1 presses the switch lever and the contact of the switch is closed, fix the nut 1 using the nut 2.
- Check that the contact of the switch opens during braking and closes when the plunger is pushed in (while in operation).



1) Brake lever detection type



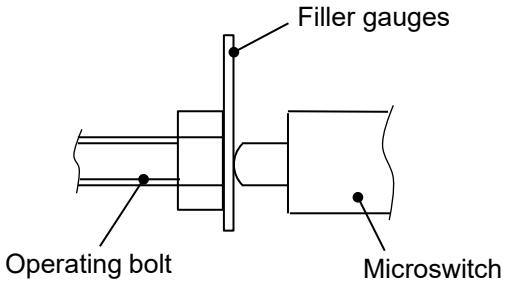
2) Plunger detection type

Modular drive system:

With the brake released, insert the filler gauges into the contact area of the operating bolt and the microswitch of the BRS to check the operation point.

The switch is not activated when the filler gauges with the thickness of 0.6 mm are inserted.

The switch is activated when the filler gauges with the thickness of 1.3 mm are inserted.



4.2.3.7 Cleaning and lubrication

(1) Dust around the brake main unit must be cleaned.

(2) No oil must adhere to the sliding surface of the lining. Because the oil adhered to the sliding surface may degrade the holding force during stop operation, stop the escalator when such adhesion is found and contact our official distributor.

(3) Lubricate as follows.

Terminal drive system:

- Lubricate the pins of the brake arm and brake lever with the Mitsubishi elevator oil No. 54.
- Clean the spherical surface, the contact surface between the plunger rod and the brake lever, and the contact surface between the brake lever and the adjusting bolt, and then apply the Mitsubishi elevator oil No. 5.

Modular drive system:

- Lubricate the lever pins of the plunger portion with the Mitsubishi elevator oil No. 5 or No. 54.
- Apply the Mitsubishi elevator oil No. 5 or No. 8 to the pin sliding portions of the brake arm and brake lever.
  (Wipe off any excess grease and be careful not to have any grease on the lining or other portions.)

4.2.3.8 Mounted state

(1) No looseness must be found in the brake mounting bolts and other adjusting bolts.

When a label is attached to the drive unit or the receiving junction box, strictly observe the descriptions (standard) on the label.

5. Maintenance and inspection of escalator drive chains and sprockets

5.1 Maintenance and inspection items and standard intervals

Regularly inspect the following items and promptly take measures if any abnormality is found. The inspection is to be performed based on the intervals shown in the table below. However, the intervals can be shortened depending on the installation environment, daily operation time, and changes in the actual machine.

Maintenance item	Standard interval	Section	Remarks
Operation state	Every maintenance (*)	5.2.1	
Lubrication state	6 months	5.2.2	
Chain tension		5.2.3	
State of chains and sprockets and their relation	12 months	5.2.4	
Chain elongation		5.2.5	

*Within 1 month

5.2 Details on inspection and maintenance of drive chains and sprockets

5.2.1 Operation state

(1) Check that there is no abnormal noise or abnormal vibration on the upper floor plate and on the drive units (terminal drive and modular drive) while the escalator is in operation (in up or down direction).

5.2.2 Lubrication state

(1) Visually check that no oil is dried, and no rust has formed on the entire chain.
If rust has formed, wipe off the oil mainly around the areas between the link plates and between the link plates and the chain rollers with a white cloth, and then check that there is no reddish-brown rust adhesion.
If the oil has dried and rust has formed, replace the chain. Also, shorten the lubrication interval and closely observe the changes in the state.

(2) Remove any dust or other accumulation on the chain.

(3) Check the position where lubrication is dropped and stains on the lubrication nozzle and correct any abnormalities.

5.2.3 Chain tension

If chain tension is too high, the service life may be reduced. And if chain tension is too loose, vibrations may occur while the escalator is in operation and a chain may jump one or more teeth possibly damaging the chain. Therefore, inspect and adjust the chain tension and make sure that it is kept in good working condition.

(1) The drive chain tension must be measured using the following steps and the tension must be as shown in the figure. If the chain tension is out of the range, adjust the tension.

Terminal drive system:

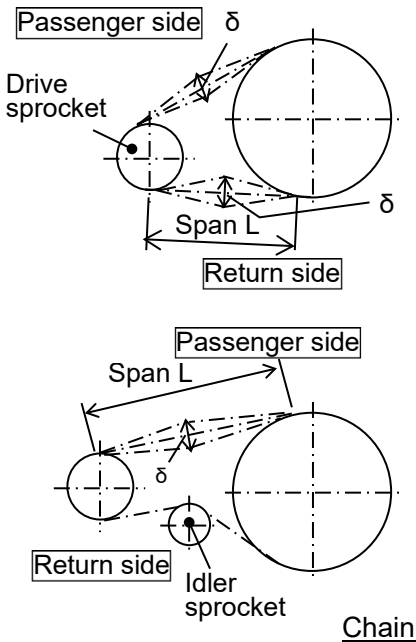
1) Perform the manual-winding operation in the direction where the chain is slack for the span to be measured.

*If no idler sprocket is on the circulation path of the drive chain, both the passenger side and return side can be measured. Loosen the chain for the span to be measured.

*If an idler sprocket is on the path, measure the maximum span.

2) Sway the drive chains to the both sides until the slack of the chains at the center of the span is eliminated, and then measure the sway width δ of that state.

3) In the same way, measure the width at three or more locations on the entire drive chain. If the width is out of the range in any location, partial elongation may have occurred. Replace the chain.



Drive chain tension standard values

Drive unit vibration isolation	Span L [mm]	Sway width δ [mm]
Provided	600 ≤ L < 1500	15 to 25
Not provided	600 ≤ L < 1500	30 ± 5
	1500 ≤ L	0.02 L ± 5

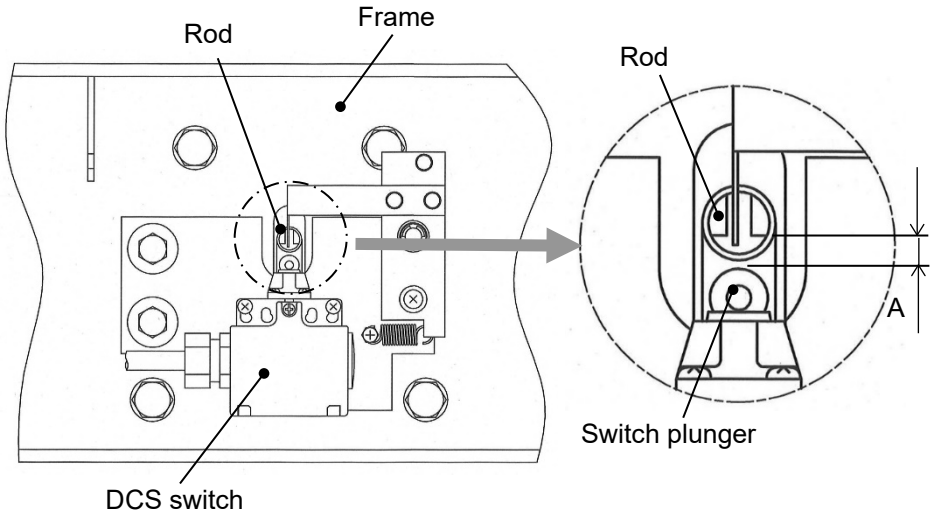
Note) The drive unit vibration isolation refers to the part mounted on the truss through the rubber vibration isolator.

Chain tension measurement locations and standard values

Modular drive system:

1) After performing the operation and up and down directions, measure clearance A between the switch of the Drive Chain Safety Device (DCS) and the rod to actuate the switch.

2) Calculate the difference between the clearance A measured after the operation in up and down directions.

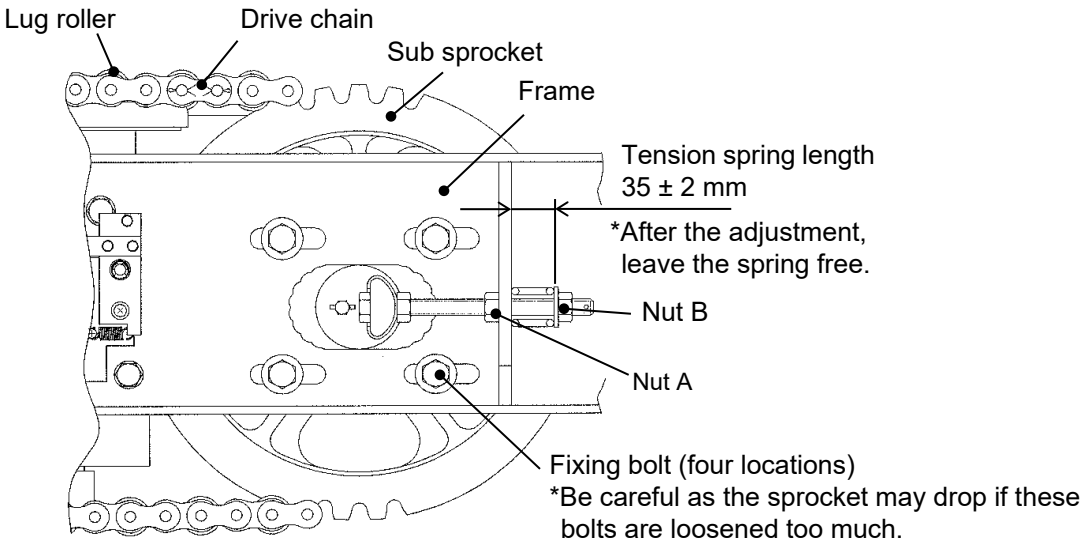


Drive chain tension standard value

Difference between clearances A after the operation in up and down directions ≤ 2 mm

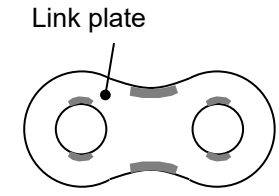
・How to adjust drive chain tension

1) Loosen the fixing bolts (at four locations) of the sub sprocket to allow the sub sprocket to move.
2) Move the nut A so that the sub sprocket can be pulled, and then tighten the nut B until the tension spring length becomes 35 ± 2 mm.
3) Fix the sub sprocket by tightening the fixing bolts.
4) Return the nut A to the original position and loosen the nut B to leave the tension spring free.
5) After the test run, follow the steps 1) and 2) to check the drive chain tension.



5.2.4 State of chains and sprockets and their relation

(1) Check that no cracks, splits, and other surface abnormalities are present on the link plates and rollers of the chain.
For the modular drive system, check that no cracks, peeling, and damage are present on the lug roller (resin roller).
If any abnormality is found, replace the chain.



Locations susceptible to crack

(2) Check that the link of the chain does not bend in the span between the sprockets.
If the link is bent, replace the chain.

(3) Check that the teeth of the sprocket are not chipped (especially the front tip).
If any tooth is chipped in each sprocket, replace the sprocket. In this case, also replace the chain.

(4) Check that there are no issues in the engagement between the sprocket and the chain.
If the engagement trace of the chain roller and sprocket has been moved in the tooth tip direction, the operation may have been continued with loose chain tension or the chain elongation including local elongation may have increased. In such case, check the details and replace the chain as needed.

(5) No interference must occur between the link plate and the sprocket of the chain.
If the interference occurs, one side of the chain may be elongated. Moreover, since the alignment between the sprockets may be displaced, check the alignment, and adjust it as needed.

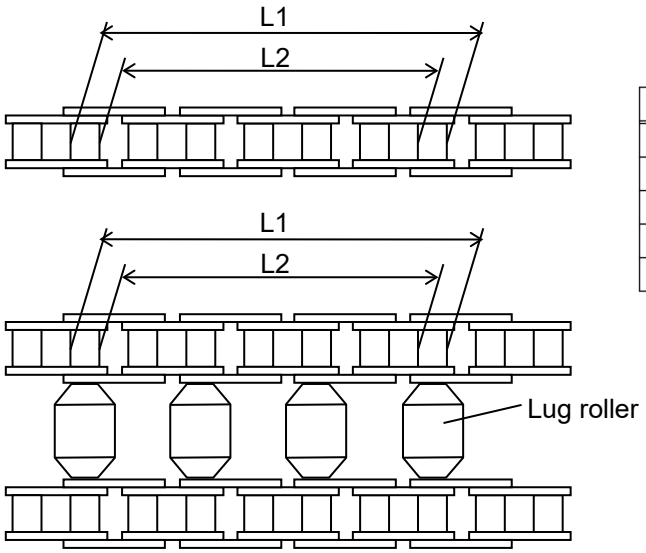
5.2.5 Chain elongation

Continuous use of an excessively elongating chain may generate noise and vibration during operation as well as gear jumping and chain damage, eventually causing the chain to break. Therefore, do not continue using the chain elongated beyond the standard and replace it properly.

(1) Measure the chain elongation using the following methods and check that the chain elongation has not exceeded 1.0%. Plan the replacement when the elongation has exceeded 0.7%, and complete the replacement before it exceeds 1.0%.
1) Perform the manual-winding operation to stretch the chain in the span to be measured.

2) As shown in the figure, measure the inner dimension (L1) and the outer dimension (L2) between the rollers for the number of links (number of pitches) to be measured using a vernier caliper, and calculate: [judgment dimension] L = (L1 + L2) / 2.
The number of links to be measured must be four or more.

3) Calculate the drive chain elongation using the following formulas.
[Chain elongation] = ([Judgment dimension] - [Standard length]) / [Standard length] × 100%
[Standard length] = [Chain pitch] × [Number of links to be measured]



Chain pitch measurement

Chain size and pitch

Size	Pitch
80	25.40
100	31.75
120	38.10
140	44.45
160	50.80

Warning

Because users may fall and be injured, keep the tension of the drive chain and the engagement with the sprocket in good condition. If the operation is continued in the improper state, the drive chain may break, resulting in a sudden stop of the escalator.

6. Maintenance and inspection of Drive Chain Safety Device (DCS) and brake (For terminal drive system)

6.1 Maintenance and inspection items and standard intervals

Regularly inspect the following items and promptly take measures if any abnormality is found. The inspection is to be performed based on the intervals shown in the table below. However, the intervals can be shortened depending on the installation environment, daily operation time, and changes in the actual machine.

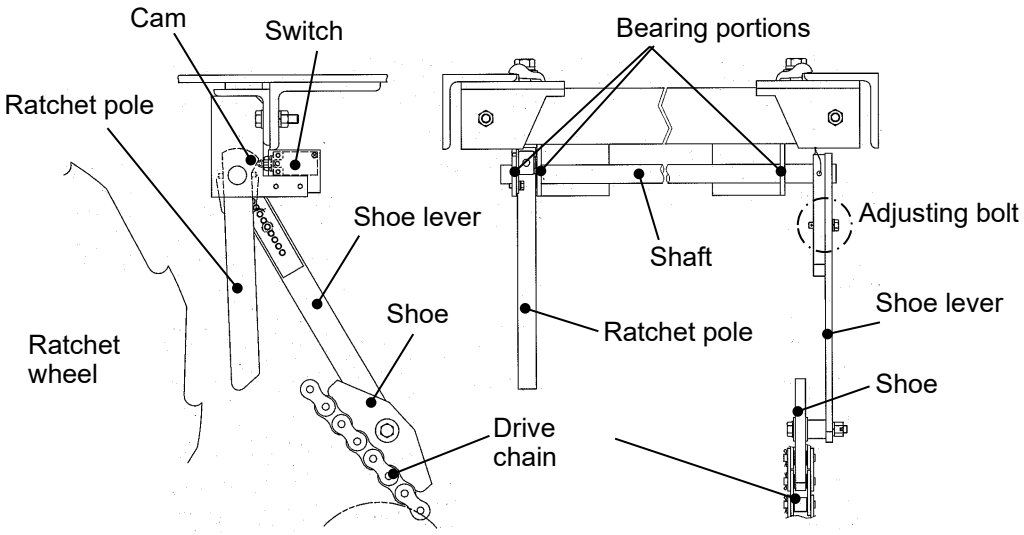
Maintenance item	Standard interval	Section	Remarks
Cleaning	6 months	6.3.1	
Operational inspection of DCS switch	6 months	6.3.2	
Inspection for looseness in shaft portions	12 months	6.3.3	
Clearance between ratchet wheel and ratchet pole	12 months	6.3.4	
DCS switch operating point	12 months	6.3.5	
Cleaning and lubrication of bearing portions	6 months	6.3.6	
Wear on bearing portions (brake replacement standard)	12 months	6.3.7	
Operational inspection of brakes	6 months	6.3.8	

6.2 Structure of Drive Chain Safety Device (DCS) and brake

The following figure shows the basic structure of the Drive Chain Safety Device (DCS) and brakes. For details on each model, see 6.4.

6.2.1 Brake operation

1) If the drive chain breaks, the shoe lever rotates around the shaft together with the shoe and the ratchet pole fixed to the shaft also rotates simultaneously.
2) The ratchet pole is fit with the ratchet wheel provided to the main shaft that circulates the steps, by which the main shaft rotation in the downward direction (the downward movement of the steps) is restrained.



Basic structure of brake

6.3 Details on inspection and maintenance of Drive Chain Safety Device (DCS) and brake

6.3.1 Cleaning

(1) Remove any dust or oil that is adhered to portions around the switch main unit, shoe, and lever with a cloth and the like.

6.3.2 Operational inspection of DCS switch

(1) Check that the escalator does not start in the switch operating state.
Check the operation while the switch is fixed in the pressed state with tape.

6.3.3 Inspection for looseness in shaft portions

(1) Check that there is no looseness for the ratchet pole and angle adjusting lever fixed to the shaft.

6.3.4 Clearance between ratchet wheel and ratchet pole

(1) Check that the shoe is not inverted and does not run on the link plate of the chain.

(2) Check that the drive chain tension is within the standard value and perform the manual-winding operation in down direction. Then, measure the clearance between the ratchet wheel and ratchet pole.

*If the drive unit has been moved during the adjustment of the drive chain tension, the clearance changes. If the clearance is out of the standard range, adjust the clearance to the standard value at the mounting position of the angle adjusting portion.

*For the clearance standard values by structure, see 6.4.

6.3.5 DCS switch operating point

(1) After removing the adjusting bolt and separating the shoe lever, move the ratchet pole, and then check that the clearance between the ratchet wheel and the ratchet pole is within the standard value when the switch is activated.

(2) Check that the switch overstroke is sufficient when the ratchet pole is moved to the root of the wheel. If any problem is found, adjust the switch position, and check the operating point again.

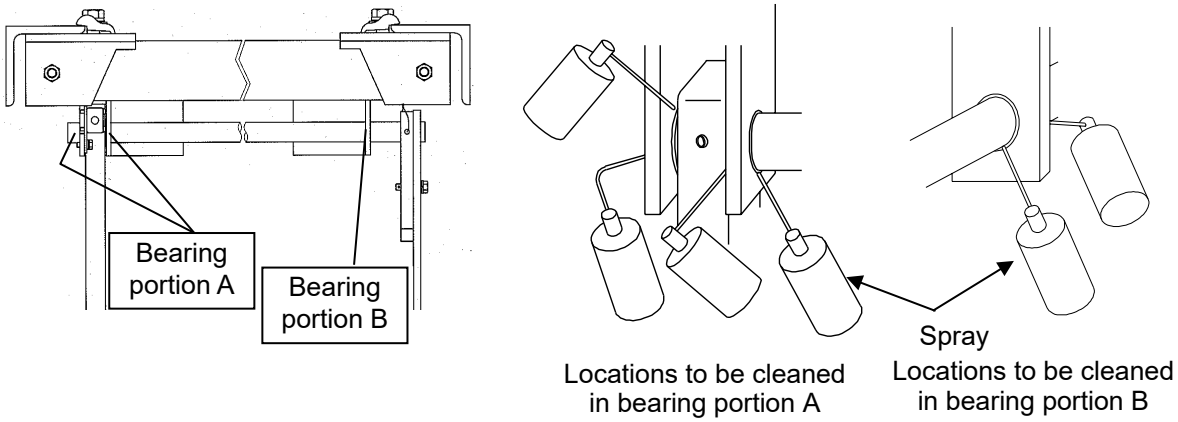
*For the standard values by model, see 6.4.

6.3.6 Cleaning and lubrication of bearing portions

Since the cleaning and lubrication of bearing portions are the most important for good brake operation, perform them regularly regardless of whether they are currently in good condition or not. The details are as follows.

(1) How to clean the bearing portions

Sufficiently spray a permeable cleaning lubricant to bearing portions A and B using a nozzle to wash away grease as well as wear debris and rust on the bearing portions.



Cleaning of bearing portions

(2) How to lubricate the bearing portions

Wipe off the detergent with a cloth, and then sufficiently lubricate the bearing portions while rotating the shaft.

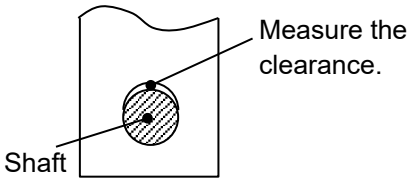
Locations with grease nipple: Mitsubishi elevator oil No. 5 [With a grease pump]

Locations without grease nipple: Mitsubishi elevator oil No. 54 [With an oil feeder]

To keep the bearing portions in good condition, clean and lubricate them at least once a year.

6.3.7 Wear on bearing portions (brake replacement standard)

Since the shaft of the brake moves slightly along with the circulation and vibration of the chain, fine wear occurs on the bearing portions. The severity of wear and the inclusion of wear debris affect the brake operation. Therefore, check for wear on the bearing portions (clearance in the bearing portions) using the following methods.



(1) How to measure the clearance in the bearing portions

In the bearing portions near the shoe lever, measure the clearance between the shaft and the shaft hole using a taper gauge.

(2) Replace the brake main unit before the following situations occur.

- A problem occurs with the brake operation due to the shaft being tilted as a result of wear.
- The ratchet pole and the ratchet wheel are disengaged, or the shoe is separated from the chain due to the shaft being tilted or rattled as a result of wear.
- If the severity of wear has exceeded the observation standard, plan the brake replacement, and replace the brake within 1 year.
- Manage the clearance in the bearing portions so that the clearance does not exceed the replacement standard after it exceeds the observation standard and before the replacement.

  Replacement standard:

  8 mm for the brake types I to III specified in 6.3.8, and 5 mm for the brake type IV

  Observation standard:

  3 mm for all types

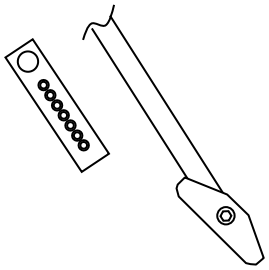
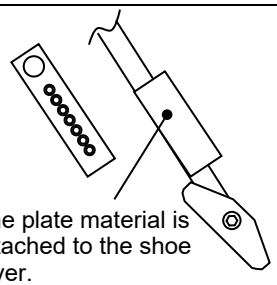
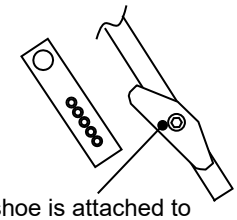
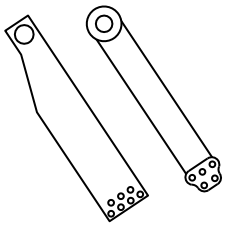
*For the standard values by model, see 6.4.

6.3.8 Operational inspection of brakes

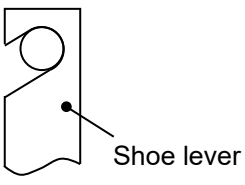
Check the operation using the following operation check methods. For the check pattern by model, see 6.4.

If a problem is found with the operation of the brake, first take the action specified at the end of this section. If the problem cannot be solved, replace the brake.

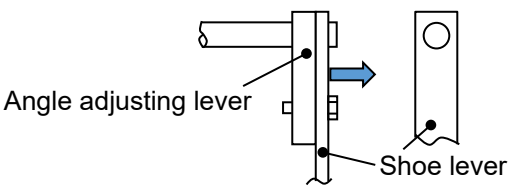
Selection of operation check methods, etc.

Type	Angle adjusting lever and shoe lever shape	Removal of shoe lever	Operation check method	Observation standard for clearance in bearing portions	Jig for operation check	Applicable model
I		Removable*	[A]	3 mm	[1] (Supplied by local)	N-type J-type Z-type
		Unremovable	[B]			
II	 The plate material is attached to the shoe lever.	Removable*	[A]	3 mm	[2] (Supplied by local)	
		Unremovable	[B]			
III	 The shoe is attached to the middle of the shoe lever.	Removable*	[A]	3 mm	[3] (Attached to the product)	SA-type
IV		Unremovable	[C]	3 mm	Not used	D-type E-type K-type G-type

*: The structure that allows removal of the shoe lever is as follows.



Shaft inserted through a hooked shape



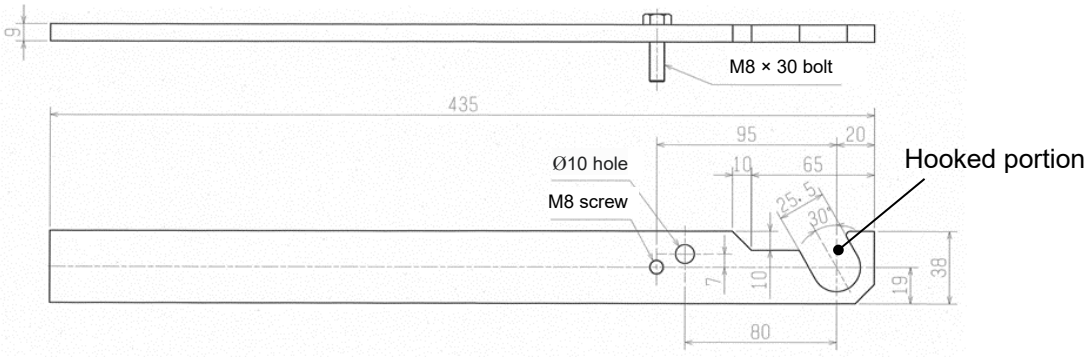
Shoe lever on the outer side of the angle adjusting lever

・Jig for operation check

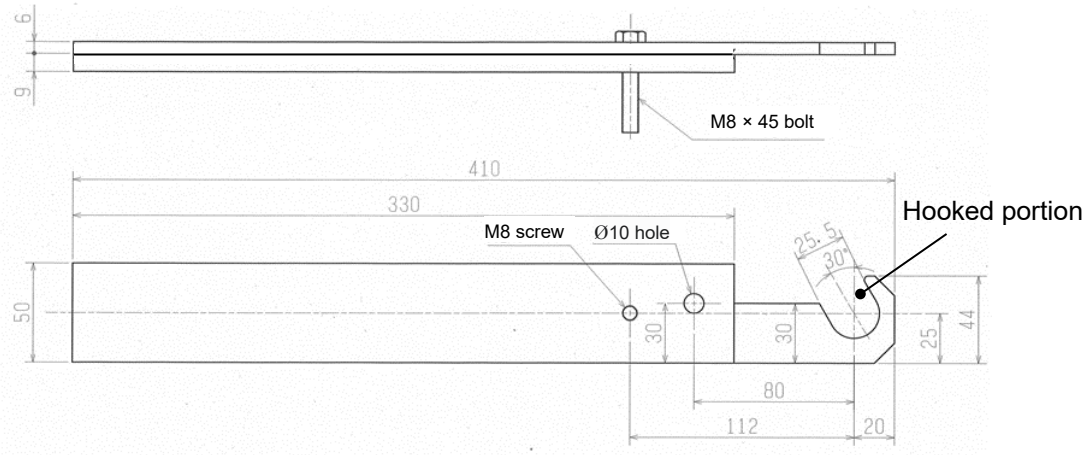
The following shows the dimensions and shape of the jig for operation check selected from the table above.

*For the jig for operation check [1] and [2], prepare those in the dimension shown in the figure below. (Material: Steel plate)

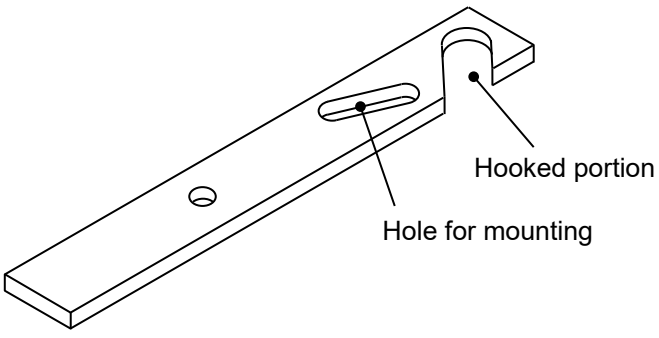
The jig for operation check [3] is attached to the product.



Jig for operation check [1]



Jig for operation check [2]



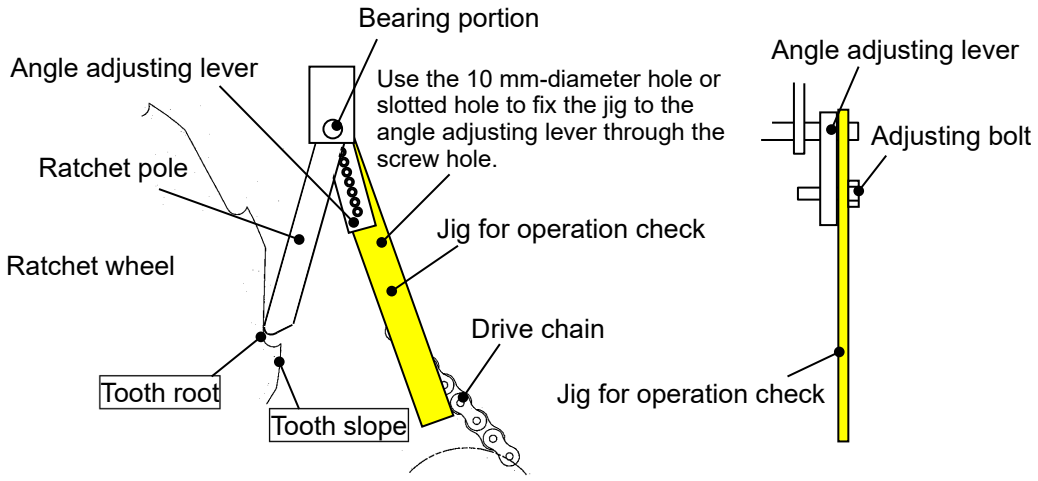
Jig for operation check [3]

・Operation check methods

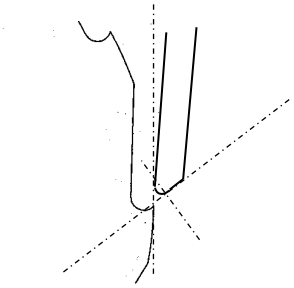
(1) Operation check method A

- Check that the bearing portion is sufficiently lubricated and no dust or the like that would hinder the operation is adhered to the bearing portion.
- After marking the mounting position of the shoe lever, remove the adjusting bolt and separate the shoe lever portion.
- Fix the jig for operation check to the screw hole of the angle adjusting lever.
  For the jigs for operation check [1] and [2], use the 10 mm-diameter hole and mount the jig to the lever through the screw hole at which the positions match.
  For the jig for operation check [3], use the slotted hole and mount the jig to the lever through the screw hole that has been used.
- Perform the manual-winding operation in up direction, and check that the ratchet pole runs over the tooth slope of the ratchet wheel and then falls to the position*1 where the ratchet pole engages with the ratchet wheel.
  If the jig for operation check interferes with the chain or other parts, perform the operation by mounting the jig on the opposite side with the angle adjusting lever in between.
- After the inspection, immediately fix the shoe lever to the original position to prevent the ratchet pole from engaging with the ratchet wheel.

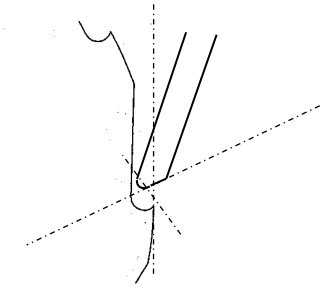
Caution	**Do not perform the electric operation (especially the operation in down direction) with the adjusting bolt removed to prevent the components from deforming and being damaged.**



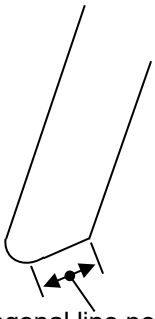
*1: The engagement positions of the ratchet pole and the ratchet wheel indicate the states shown in the figures below. (The same applies to the subsequent sections.)



Not engaged



Engaged



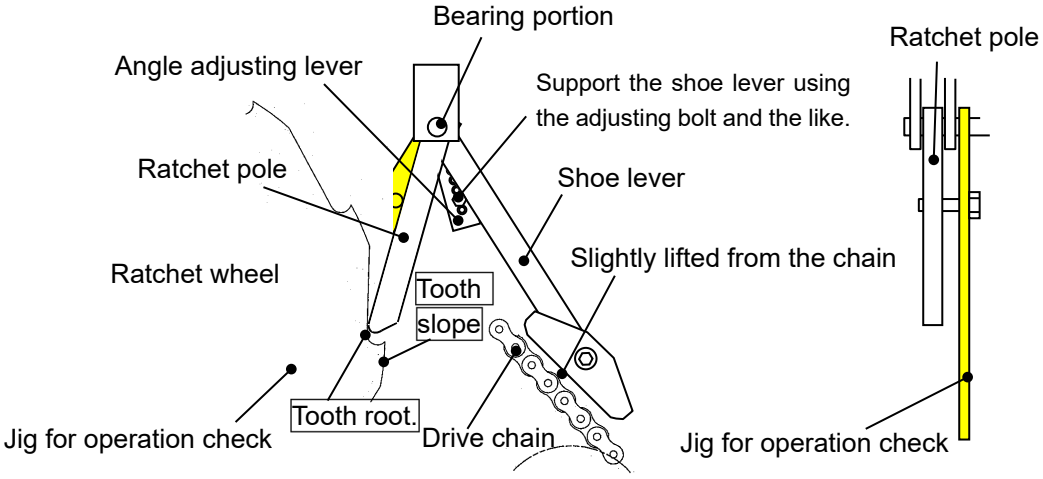
Diagonal line portion at
the tip of the ratchet pole

As shown in the figures above, the engagement is judged when the diagonal line portion at the tip of the ratchet pole is on the side closer to the center of the ratchet wheel from the vertical line that touches the tip of the ratchet wheel.

(2) Operation check method B

- Check that the bearing portion is sufficiently lubricated and no dust or the like that would hinder the operation is adhered to the bearing portion.
- After marking the mounting position of the shoe lever, remove the adjusting bolt and separate the shoe lever portion.
- Move the ratchet pole to the tooth root of the ratchet wheel and make a clearance between the shoe and the upper surface of the chain, and in that state, support the shoe lever using the adjusting bolt and the like as shown in the figure.
- Hang the hooked portion of the jig for operation check on the shaft and set up the jig to lean over the ratchet pole from the opposite side of the shoe lever as shown in the figure.
- Perform the manual-winding operation in up direction, and check that the ratchet pole runs over the tooth slope of the ratchet wheel and then falls to the position where the ratchet pole engages with the ratchet wheel. (See *1 in (1) Operation check method A.)
- After the inspection, immediately fix the shoe lever to the original position to prevent the ratchet pole from engaging with the ratchet wheel.

Caution	**Do not perform the electric operation (especially the operation in down direction) with the adjusting bolt removed to prevent the components from deforming or being damaged.**



D55101-*
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(3) Operation check method C

- Check that the bearing portion is sufficiently lubricated and no dust or the like that would hinder the operation is adhered to the bearing portion.
- After marking the mounting position of the shoe lever, remove the adjusting bolt and separate the shoe lever portion. (Check that the shoe lever and the angle adjusting lever are not stuck.)
- Perform the manual-winding operation in up direction, and check that the ratchet pole runs over the tooth slope of the ratchet wheel and then falls to the position[*1] where the ratchet pole engages with the ratchet wheel.

*In some models and settings, the angle adjusting lever may interfere with the drive chain, thereby preventing the ratchet pole from falling to the position where it engages with the ratchet wheel. In this case, perform the manual-winding operation in up direction a little and then perform the manual-winding operation in down direction to the same extent to loosen the chain on the passenger side. In that state, the operation is judged as having no problem if the pole falls to the position where the pole engages with the ratchet wheel (see *1 in (1) Operation check method A) when the chain alone is pressed down by hand.

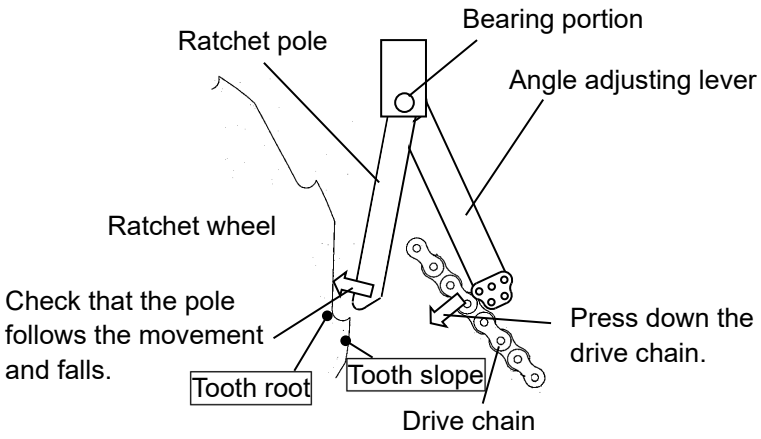
*If the operation cannot be checked even after trying the above method (special cases), check by 1) or 2) below.

1) Check any of the following when performing the manual-winding operation in down direction from the state where the angle adjusting lever runs over the drive chain in the above method.
   - The angle adjusting lever moves by following the convex and concave surface of the chain.
   - The angle adjusting lever moves by following the movement of the chain when the chain alone is pressed down.

2) Loosen the drive chain by moving the idler sprocket or drive unit on the drive chain path or by other means, and check that the pole falls to the position[*1] where the pole engages with the wheel.
   (Mark the positions of the idler sprocket and the drive unit before the inspection and restore the state immediately after the inspection to prevent the ratchet pole from engaging with the ratchet wheel.)

- After the inspection, immediately fix the shoe lever to the original position to prevent the ratchet pole from engaging with the ratchet wheel.

Caution	**Do not perform the electric operation (especially the operation in down direction) with the adjusting bolt removed to prevent the components from deforming or being damaged.**



(4) If the operation cannot be checked by any of the above methods

- Check that the bearing portion is sufficiently lubricated and no dust or the like that would hinder the operation is adhered to the bearing portion.
- Loosen the drive chain by moving the idler sprocket or drive unit on the drive chain path or by other means, and check that the ratchet pole falls to the position where the ratchet pole engages with the ratchet wheel.

*Mark the positions of the idler sprocket and the drive unit before the inspection and restore the state immediately after the inspection.

What to do when there is a problem with operation:

The possible causes and actions to be taken when there is a problem with the operating status of the brake are shown below. Examine them when investigating the cause of a problem and take measures to ensure the operation.

Factors behind brake malfunction

Possible cause	Action to be taken
High resistance on the bearing portion	Follow the steps in 6.3.6 to clean and lubricate the bearing portions.
Shaft tilted due to unbalanced wear on the bearing portions, causing operational failure	Check the wear state of the bearing portions. If the operational failure due to the tilted shaft is observed and the problem cannot be resolved by cleaning the bearing portions, replace the brake main unit.
Operational failure of the DCS switch plunger	Remove the stains on the plunger with a cloth. If the problem persists, replace the switch.
Interference with other components	Check whether the scale indicator plate is in contact with the scale plate and check for any interference with movable parts, lubricating pipes, cables, protectors, and the like, and take measures.

*If the problem persists even after taking the measures including the above, or if the operation is not smooth even if it is improved, replace the brake.

Warning

Because users may fall and be injured, clean and lubricate the bearing portions to maintain the smooth rotation of the shaft and ratchet pole. If the rotation is not smooth, the brake will not function when the drive chain breaks, and the steps will continue descending.

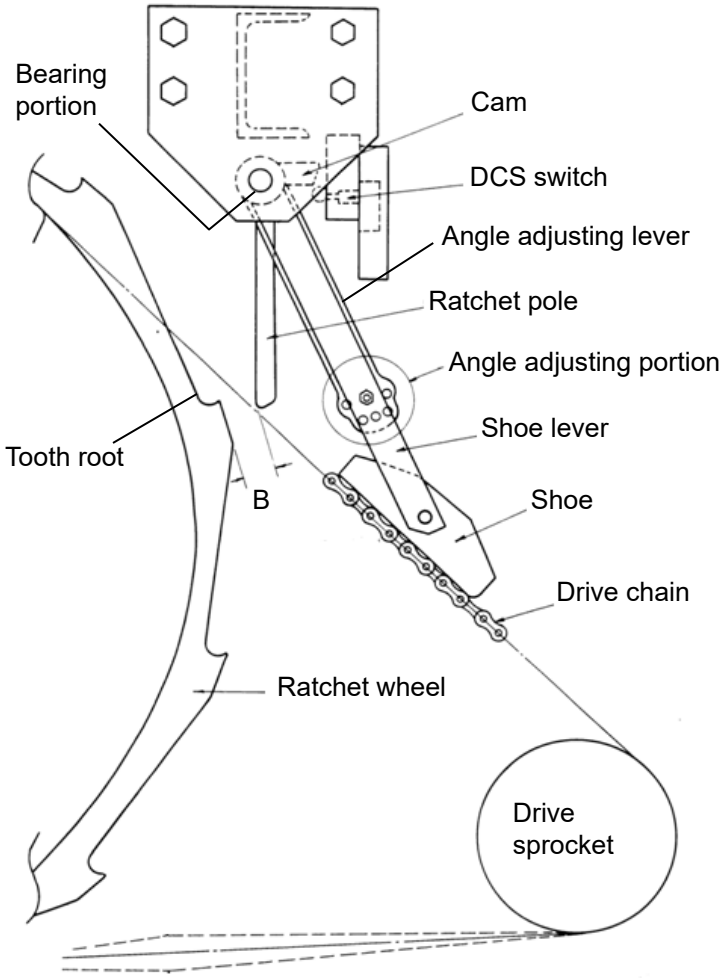
Do not perform the electric operation while the ratchet pole is in contact with the ratchet wheel. Otherwise, the component may deform or be damaged.

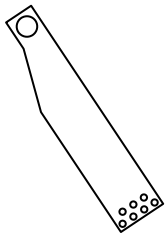
6.4 Structure and standard values by model

Model	D-type, E-type, K-type, G-type

Structure of brake:

The example of the D-type structure is shown below. For some horizontal drive units or special layouts, the layout may differ from those shown in the figure, but the basic configuration is the same. If you have any doubts, take a note of the product information, and contact our official distributor.





Angle adjusting lever for K-type and G-type

Brake operation check: (See 6.3.8.)

Check the operation using the type IV.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, stop the escalator, and immediately replace the brake.

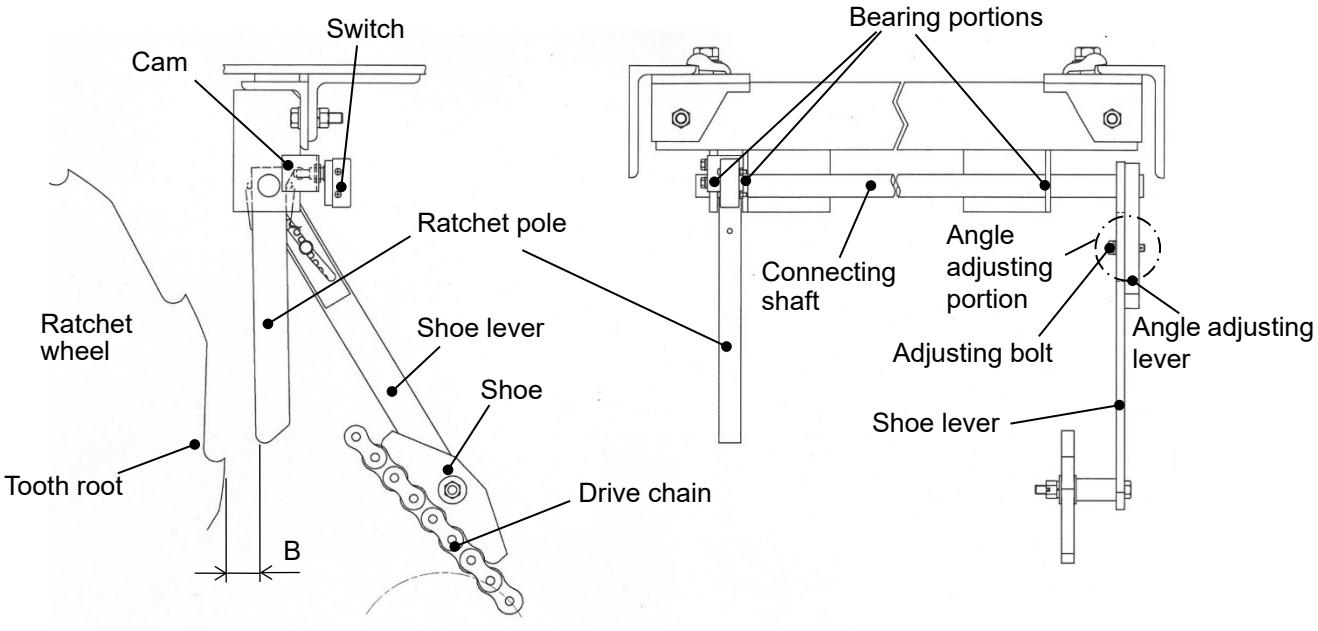
Standard values:

Item	Standard value	Reference section
Clearance between the ratchet wheel and ratchet pole	B = 35 ± 5 mm	6.3.4
DCS switch operating point	B = 10 to 20 mm	6.3.5
Bearing portion wear standard (clearance in bearing portion)	Observation standard: 3 mm	6.3.7

*If the clearance in the bearing portion exceeds 3 mm, immediately plan the brake replacement, and replace the brake within 1 year.

Model	N-type, J-type

Structure of brake:



Brake operation test: (See 6.3.8.)

<u>When no plate material is attached to the shoe lever</u>

Check the operation using the type I.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, replace the brake.

<u>When the plate material is attached to the shoe lever</u>

Check the operation using the type II.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, stop the escalator, and immediately replace the brake.

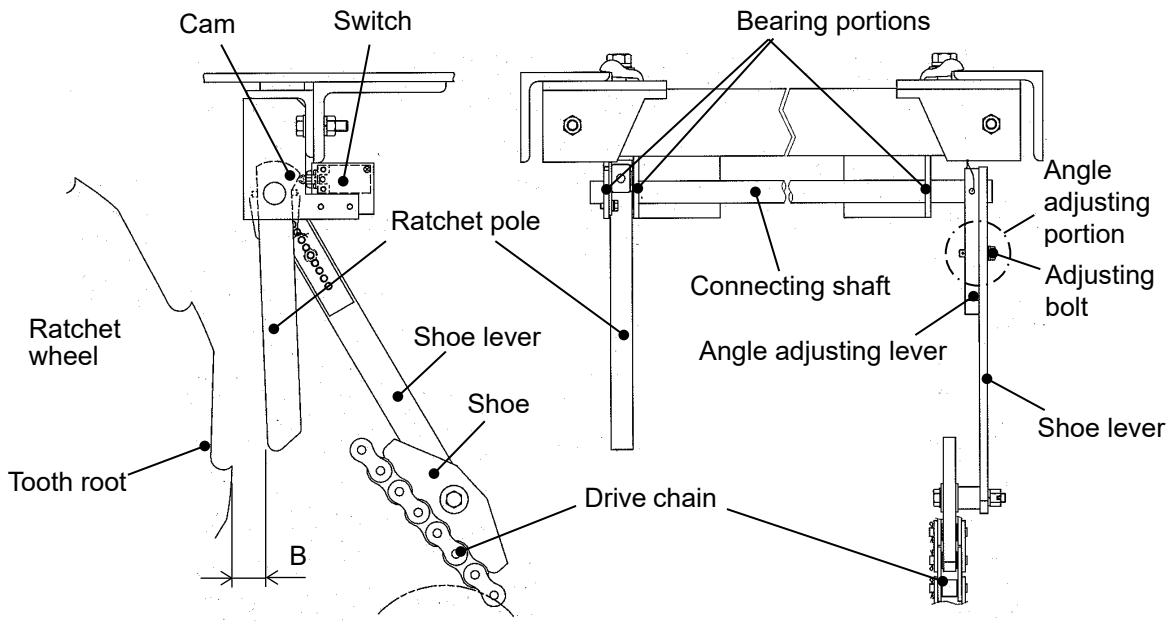
Standard values:

Item	Standard value	Reference section
Clearance between the ratchet wheel and ratchet pole	B = 35 ± 5 mm	6.3.4
DCS switch operating point	B = 10 to 20 mm	6.3.5
Bearing portion wear standard (clearance in bearing portion)	Observation standard: 3 mm	6.3.7

*If the clearance in the bearing portion exceeds 3 mm, immediately plan the brake replacement, and replace the brake within 1 year.

Model	Z-type

Structure of brake:



Brake operation test: (See 6.3.8.)

When no plate material is attached to the shoe lever

Check the operation using the type I.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, replace the brake.

When the plate material is attached to the shoe lever

Check the operation using the type II.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, stop the escalator, and immediately replace the brake.

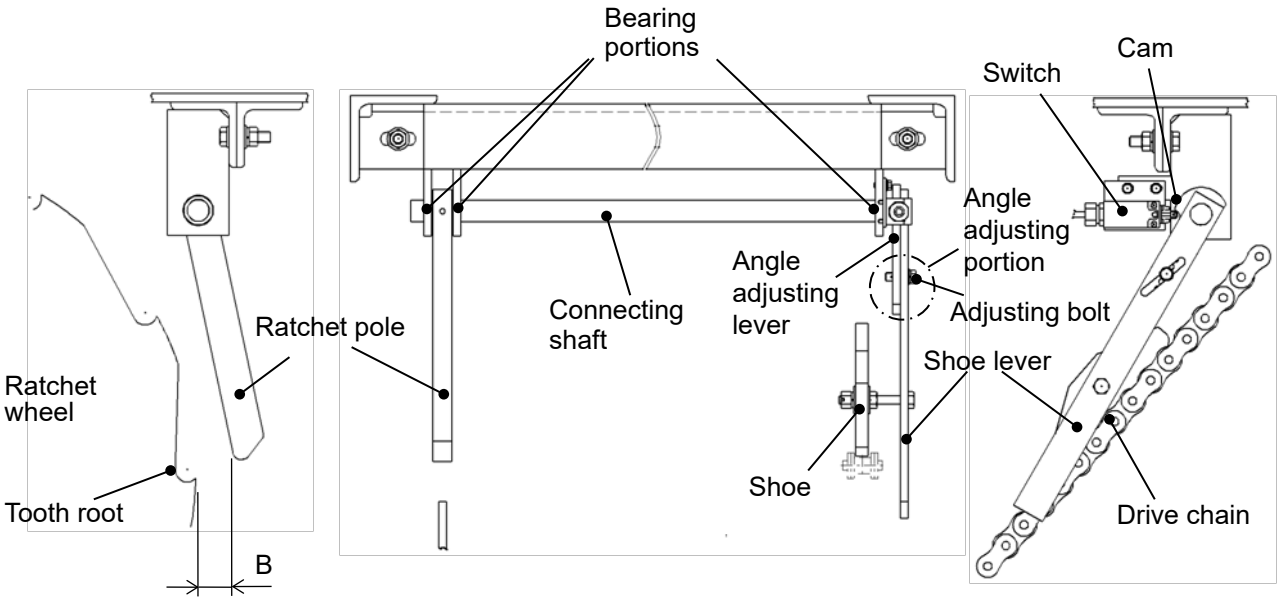
Standard values:

Item	Standard value	Reference section
Clearance between the ratchet wheel and ratchet pole	B = 40 ± 5 mm	6.3.4
DCS switch operating point	B = 10 to 20 mm	6.3.5
Bearing portion wear standard (clearance in bearing portion)	Observation standard: 3 mm	6.3.7

*If the clearance in the bearing portion exceeds 3 mm, immediately plan the brake replacement, and replace the brake within 1 year.

Model	SA-type

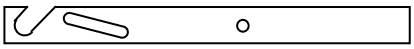
Structure of brake:



Brake operation test: (See 6.3.8.)

Check the operation using the type III.

*If the ratchet pole does not fall to the position where the ratchet pole engages with the ratchet wheel, stop the escalator, and immediately replace the brake.



Jig for operation check
(attached to the product)

Standard values:

Item	Reference value	Reference section
Clearance between the ratchet wheel and ratchet pole	B = 50 ± 5 mm	6.3.4
DCS switch operating point	B = 10 to 20 mm	6.3.5
Bearing portion wear standard (clearance in bearing portion)	Observation standard: 3 mm	6.3.7

*If the clearance in the bearing portion exceeds 3 mm, immediately plan the brake replacement, and replace the brake within 1 year.

7. Maintenance and inspection of Drive Chain Safety Device (DCS) (For modular drive system)

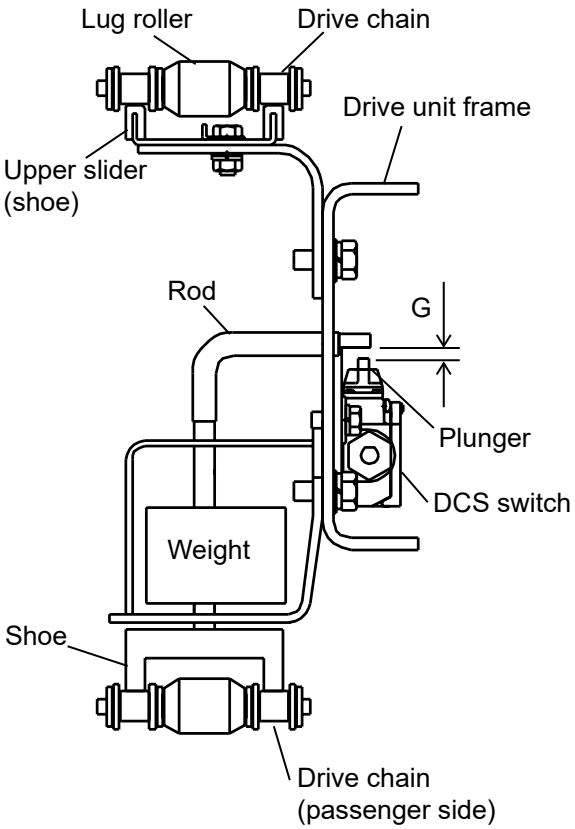
7.1 Maintenance and inspection items and standard intervals

Regularly inspect the following items and promptly take measures if any abnormality is found. The inspection is to be performed based on the intervals shown in the table below. However, the intervals can be shortened depending on the installation environment, daily operation time, and changes in the actual machine.

Maintenance item	Standard interval	Section	Remarks
Cleaning	6 months	7.3.1	
Operational inspection of DCS switch	6 months	7.3.2	
DCS switch operating point	12 months	7.3.3	

7.2 Structure and operation of Drive Chain Safety Device (DCS)

The Drive Chain Safety Device (DCS) in the modular drive system is a safety device that stops the escalator operation when a drive chain breaks or comes off the shoe. The structure is shown in the figure on the right.



Cross-section of DCS

7.2.1 Operation of Drive Chain Safety Device (DCS)

1) The rod and weight are fastened to the shoe for the drive chain on the passenger side. When the drive chain breaks, the shoe goes down.
2) When the shoe goes down, the rod goes down at the same time, and the tip of the rod activates the DCS switch.
3) The brake is activated to stop the escalator.

7.3 Details on inspection and maintenance of Drive Chain Safety Device (DCS) and brake

7.3.1 Cleaning

(1) Since the plunger part of the switch is mounted upward, oil, dirt, and dust are likely to adhere to this area possibly causing the plunger to malfunction. Carefully clean the area and ensure that the plunger operates properly.

7.3.2 Operational inspection of DCS switch

(1) Check that the escalator does not start in the switch operating state.
Check the operation while the switch is fixed in the pressed state with tape.

Warning

Be sure to get out of the truss when starting the escalator to check, as you may get caught in the steps and get injured.

7.3.3 Operational inspection of DCS switch

(1) If clearance G between the plunger of the switch and the rod tip is small, the switch may malfunction due to vibrations during the escalator operation. Since the chain tension may have decreased, inspect and adjust the tension. And then perform the inspection and adjustment to make sure that the clearance is set as shown in the table below. (See the sectional view of the DCS.)

Clearance G between the plunger and rod

Check	Switch type name and clearance G		
	BZ-, Z-	ZC-	D4D-, D4N-
After operation in down direction	7.5 ± 1 mm	6.5 ± 1 mm	6 ± 1 mm

*After the adjustment, check that the clearance is within the range even after the operation in the reverse direction.
If the clearance is not within the standard range after operation in both directions, check the drive chain tension. (See 5.2.3.)
*Check the switch type from the label on the switch main unit.

8. Maintenance and inspection of emergency stop button

8.1 Maintenance and inspection items and standard intervals

Regularly inspect the following items and promptly take improvement measures such as switch replacement if any abnormality is found.

Maintenance item	Standard interval	Section	Remarks
Operational inspection	Every maintenance(*)		Press the switch during the operation to check that the escalator stops.

*Within 1 month

9. Oil

The oil applied to each part of the escalator is as follows. Check the lubrication state of the components and replace and lubricate them as needed.

Used part	Desig-nation(*1)	Type	Product name (manufacturer)	Recom-mended interval
Bearings of step drive and follower devices Bearing unit of handrail drive main shaft [Terminal drive system]	No. 5	Grease	Epnoc Grease AP(N)2 (JXTG Nippon Oil & Energy) Shell Alvania Grease No.2 (Idemitsu Showa Shell)	2 years
Drive unit (speed reducer)	No. 51	Lubricant	Worm Gear Lube 380 (N) (JXTG Nippon Oil & Energy)	3 years
	No. 56		Bonnoc TS100 (JXTG Nippon Oil & Energy)	
Drum brake	No. 5	Grease	Epnoc Grease AP(N)2 (JXTG Nippon Oil & Energy) Shell Alvania Grease No.2 (Idemitsu Showa Shell)	1 year
	No. 8		Shell Alvania Grease No.3 (Idemitsu Showa Shell)	
	No. 11		ROCOL Paste (Sumico Lubricant)	
	No. 54	Lubricant	Diamond Chain Oil (JXTG Nippon Oil & Energy)	
Drive chain (*2)	No. 54	Lubricant	Diamond Chain Oil (JXTG Nippon Oil & Energy)	As needed (*3)
Step chain (*2) Step link (*2)				
Handrail drive chain (*2)				
Bearing portion of Drive Chain Safety Device (DCS) [Terminal drive system]	No. 5	Grease	Epnoc Grease AP(N)2 (JXTG Nippon Oil & Energy) Shell Alvania Grease No.2 (Idemitsu Showa Shell)	0.5 to 1 year
	No. 54	Lubricant	Diamond Chain Oil (JXTG Nippon Oil & Energy)	
Bearing portion of drive sprocket [Drive unit of modular drive system]	No. 5	Grease	Epnoc Grease AP(N)2 (JXTG Nippon Oil & Energy) Shell Alvania Grease No.2 (Idemitsu Showa Shell)	6 months
Bearing portion of sub sprocket [Drive unit of modular drive system]				6 months
Spline coupling portion of drive unit drive shaft [Modular drive system]				6 months
Skirt guard (*4)	-	Smoothing agent	Silicone Emulsion SM490 (Toray)	1 year

*1 Indicates Mitsubishi elevator oil number.

*2 For escalators that adopt centralized lubrication by an automatic lubrication device, refill the oil into the tank of the automatic lubrication device.

*3 For those with the automatic lubrication device, refill the oil before the oil in the tank runs out completely. If the tank is empty, refill the oil and be sure to release the air in the lubricating pipes.

*4 Apply the oil once a month under the outdoor environment and increase the number of applications under the environments where the smoothing agent can easily wear off due to exposure to rainwater.