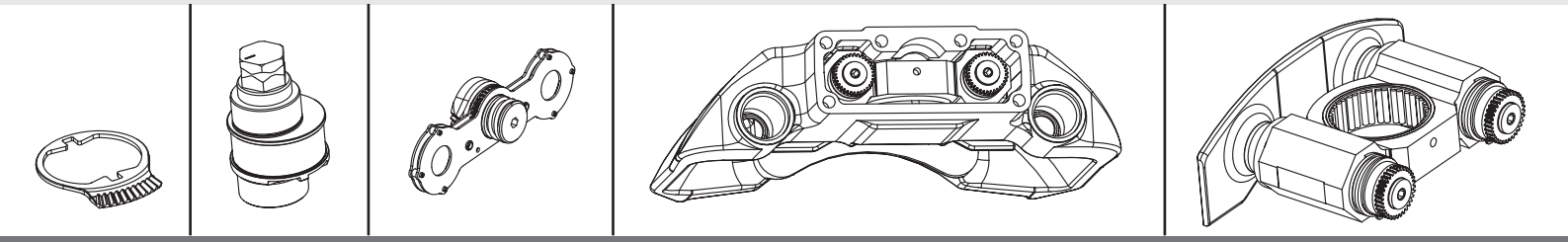
AIR DISC BRAKE

Maintenance manual no. DX/1/E



MERITOR™

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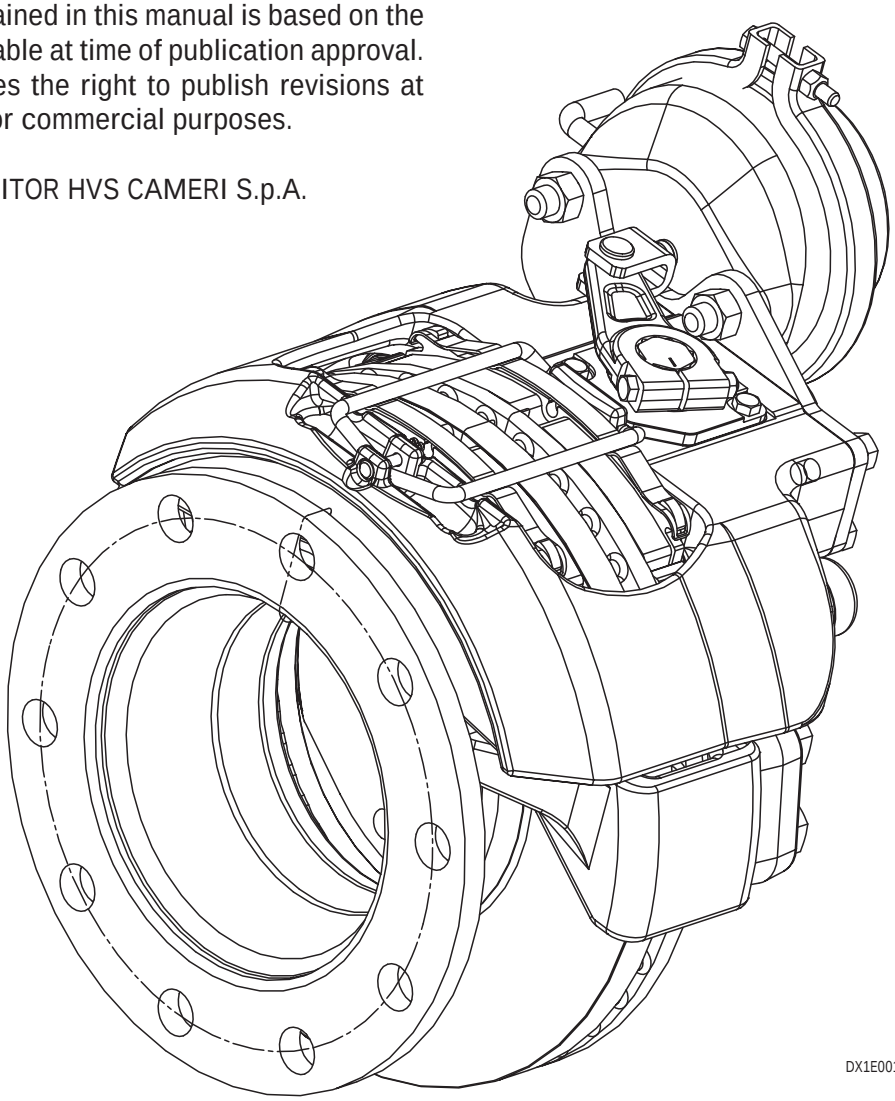


DX1E001

APPLICABLE PAGES

The following table lists the applicable pages of this manual and the date of relative revisions.

CHAPTER	PAGES		1st EDITION	REVISION
	from	to		

INTRODUCTION

This manual covers MERITOR HVS CAMERI S.p.A. air disc brakes of the DX series.

LIABILITY

In no event shall MERITOR HVS CAMERI S.p.A. be liable for any damages arising from incorrect service, use of non-original spare parts and tampering of components.
The workshop manager is responsible for the enforcement of all safety precautions outlined in this manual. The manager must be qualified to carry out all operations, must be aware of and must meticulously observe all general and applicable safety rules and regulations described in this manual. Failure to observe safety precautions can result in personal injury or damage to components.

This manual must be considered as an integral part of the device and must be carefully read by all qualified personnel working on brake maintenance.

PURPOSE OF THIS MANUAL

This manual has been compiled essentially for workshop personnel.
It gives all necessary technical information regarding the caliper with the purpose of assuring safe working conditions for maintenance personnel and to guarantee perfect, long-life efficiency of the caliper. However, personnel involved should be adequately trained.
To guarantee correct maintenance procedures, the workshop must comply with all regulations in force regarding safety and hygiene.
The manual covers all information necessary for technicians to be able to correctly carry out brake modifications and adjustments, service and repair work.
Please read this manual carefully before proceeding to work on the device.
By following the enclosed instructions and by using the appropriate special tools, guarantee of correct repair work is given. At the same time, personnel are safeguarded from possible accidents.

STRUCTURE

This manual is divided into five chapters.

CHAPTER 1 – GENERAL INFORMATION

This chapter explains the meaning of symbols used in this manual and gives a description of terms. Technician safety measures are also discussed.

CHAPTER 2 - DESCRIPTION

This chapter gives a general description of the caliper, its field of application and a list of its components. Operation and operating procedures are described herein.

CHAPTER 3 - MAINTENANCE

This chapter covers some of the scheduled and unscheduled maintenance operations. You will find listed torque specifications, special tools, recommended consumables and technician safety warnings and cautions.

CHAPTER 4 - TROUBLESHOOTING

This chapter covers the main possible failures and their causes, as well as the corresponding remedies.

CHAPTER 5 - CONVERSION TABLES

Measurement values, their conversion formulas to obtain their equivalent English units and standard torque specifications are herein listed.

GENERAL INFORMATION

SYMBOLS: MEANING AND USE

Various symbols are used to remind the reader of their meaning and to underline certain important aspects of the operation. They also indicate the type of operation to be carried out.
The following table lists and describes the meaning of these symbols.

SYMBOL	MEANING	DESCRIPTION
	Warning: risk of personal injury	Indicates danger with risk of serious or even fatal injuries. Very careful attention should be paid to the text where this symbol is used.
	Warning: environmental risk	Indicates danger with risk of environmental pollution. Very careful attention should be paid to the text where this symbol is used.
	Caution	Indicates a warning of possible deterioration on the device or operator's accessories.
	Note	Points out or gives useful information on key functions.
	Additional information	Indicates that text has been inserted to give supplementary information. This information does not directly relate to the description of a function or to the development of a procedure. It can refer the reader to other complementary publications or to other sections in this manual.
	Avoid damaging parts	Indicates a serious risk of damaging a part due to use of a wrong tool or incorrect assembly procedure.
	Special tool	The use of a special tool is necessary for this operation.
	Visual inspection	A visual inspection is necessary. The technician should read a measurement, check a warning signal, etc...
	Audible inspection	An audible inspection is necessary. The technician should listen to a particular noise during operation.

SYMBOLO	MEANING	DESCRIPTION
	Removal Detachment	Removal of a unit or of a complex device from a main assembly.
	Installation Attachment	Installation of a unit or of a complex device onto a main assembly.
	Disassembly	Disassembly into main components of a unit or of a device.
	Assembly	Assembly of main components of a unit or of a device.
	Tightening torque setting	Symbol associated with one value: use of a torque wrench is required, suitable for the specific value.
	Tightening torque and angle setting	Symbol associated with two values: use of a torque wrench is required, suitable for the specification value and for measuring tightening angle.
	Setting / adjustment	Operation carried out to obtain accurate specification values (pressure, preloading, relative distance, etc.).
	Measurement / observation	Operation carried out to obtain a value needed to restore optimum operating conditions.
	Topping up	Restoring of the correct fluid level in a device.
	Change	Change of fluid in a device.
	Lubrication	Lubricating operation (oiling, greasing, etc.) of a part / device.
	Sealing gluing	Use of sealant needed in the mating of two components.
	Positioning	Mating operation with relative position markings.
	MERITOR spare parts	Indicates that only original MERITOR spare parts should be used.

TERMS USED IN THIS MANUAL

Manufacturer: MERITOR HVS CAMERI S.p.A.

Manual: Maintenance manual, DX/1/E series

Device: Air disc brake, DX series

Technician: Qualified personnel working on brake maintenance and servicing.

Maintenance and servicing: Maintenance and servicing refer to periodical checks and/or replacement of device parts or components. It also refers to the determining of the cause of a malfunction in order to restore the initial operating conditions.

Operator: Any person who will use the device as part of a more complex device.

WARRANTY

Meritor guarantees DX Series brakes components listed below.
Warranty applies to brakes installed on vehicles for which they have been designed.

Warranty is void in the following conditions:
- Improper use of vehicle in which brakes are installed (usage conditions, overloading, etc.)
- Tampering with vehicle components that may affect brake performance
- Use of non-original spare parts
- Improper installation, adjustment, repair or modification
- Poor or improper maintenance (including consumables other than those specified).

Component	Warranty period:	Note
Brake Rotors	1 year	Warranty covers only manufacturing defects but does not account for faults due to wear.
Caliper	1 year or 100,000 Km, whichever comes first.	
Brake Pads	1 year or 100,000 Km, whichever comes first.	Warranty covers only manufacturing defects but does not account for faults due to wear.
Leaf Springs	1 year or 100,000 Km, whichever comes first.	

SAFETY PRECAUTIONS

The purpose of these safety precautions is to define a line of conduct and obligations to follow during operations listed herein with the aim of guaranteeing safe working conditions with regard to personnel, the environment and equipment.
The workshop manager is responsible for warning all personnel against accident risks, informing them about safety devices to be adopted and general rules referring to accident prevention in accordance with EEC Directives and standing legislation.

Maintenance operations must be carried out by qualified technicians.

Operations on device installed on vehicle should be performed in accordance with vehicle manufacturer's safety precautions and standing legislation.

Technicians must read this entire manual.

Tampering or unauthorized replacement of one or more parts of the device, installation of accessories which modify its use, and the use of non-recommended products can cause personal injury.

Operations on device installed on vehicle should be performed in accordance with vehicle manufacturer's safety precautions and standing legislation.

The device should be moved using appropriate hoisting and transportation devices.

Do not use compressed air to clean brakes or rotor. Linings are non-asbestos but lining dust is an irritant if inhaled and is harmful to health.

INDIVIDUAL PROTECTION SYSTEMS

All qualified maintenance personnel involved must adhere to individual protection systems. Safety glasses, suitable shoes and gloves must be worn in order to eliminate all possible risks during operation performance.

Clothing worn by maintenance personnel must be in accordance with fundamental safety requirements outlined in EEC Directives 89/656 and 89/868 and standing legislation.

To prevent accidents, technicians must wear suitable overalls during maintenance operations.

OTHER RISKS

There should be no further risks during servicing / replacement of calipers if the proper procedures are followed. Particular attention should be paid to the following cases:

Risk during handling of components:

During assembly / disassembly of components, technicians should wear suitable gloves.

Risk of abrasions or crushed hands during handling or assembly of components:

During the disassembly / inspection of components the caliper is free to slide on the saddle. Extreme care should be taken to avoid inadvertently trapping fingers.

INTRODUCTION

PURPOSE OF THIS CHAPTER

This chapter covers the field of application, the composition and the operation of the device, and lists components and their terminology.

GENERAL DESCRIPTION

The MERITOR DX series of air disc brakes is a family of high performance, low weight, high efficiency brakes designed for trucks, coaches, buses and other commercial vehicles requiring between 10,000 and 23,000 N•m of braking torque at each wheel.
Clamping force is produced by a globular cast iron caliper located above the rotor and housing two lining pads. The pads are pushed against the rotor by a dual piston actuating block connected to an eccentric shaft, which is in turn driven by a lever operated by a standard air actuator (rotation chamber).
The caliper is carried on a saddle which is a fixed support bolted to the axle flange.
Equalised clamping action both on the inner and outer pads is generated by allowing the caliper to float on the two slide pins fixed to the saddle. Clamping force generated by the primary actuation is applied to the inner pad which forces it into contact with the rotor. Reactive force through the caliper body applies equal clamping force to the outer pad applying a balanced clamping force to the rotor.
The slide pins also allow the caliper to freely position itself on the saddle to compensate for the reduction in lining pad thickness due to wear.
An automatic self-adjuster mechanism is incorporated in order to maintain constant clearance between pads and rotor.
The automatic adjuster operates on each clamping action to sense excessive pad-rotor clearance, and reduces excessive clearance by a fixed proportion with each actuation.
For brake adjustment and new lining installation, the brake incorporates provision for manual adjustment, easily performed by using a standard hexagonal wrench.
Brake actuation can be either clockwise or counterclockwise, depending on how the rotation chamber has been installed on brake unit.

Regardless of which side the brake unit is installed on vehicle, the brake is referred to as:

RIGHT when actuation is clockwise (Fig. 2-2 a) and b))

LEFT when actuation is counterclockwise (Fig. 2-2 c) and d))

Clockwise actuation (Fig. 2-2 a) and b)) will always require left-hand threaded adjuster sleeves and pistons (actuation pistons marked on the bottom with the letter L) and its related right housing (R.H.). The opposite applies for brakes with counterclockwise actuation (Fig. 2-2 c) and d)).

KEY

Ref.	Description	Quantity
1	Stabilizer bar retaining pin	1
2	Pin clip	1
3	Caliper	1
4	Anti-rattle spring **	2
5	Stabilizer bar	1
6	Cover plate gasket	1
7	Eccentric shaft	1
8	Cover plate / housing of eccentric shaft support bearing and seal gasket	1
9	Cover plate screws	2
10	Eccentric shaft seal	1
11	Eccentric shaft seal boot	1
12	Clamp bolt (lever)	1
13	Lever	1
14	Clamp bolt nut (lever)	1
15	Eccentric shaft bearing unit	2
16	End plate gasket	1
17	Slide pin bushing	2
18	Eccentric shaft support bearing	1
19	Actuation block	1
20	Damping spring	2
21	Snap ring	2
22	Bevel gear / torque limiter	1
23	Adjustment box (preinstalled unidirectional bearing)	
24	Damping ring	2
25	Compression spring	1
26	Air actuator end plate and bracket	1
27	Flathead screw	2
28	End plate cap	1
29	Plug (of adjuster port)	1
30	Copper washer	1
31	Hexagonal head screw	4
32	Adjuster device screw	1
33	Adjuster gear segment	1
34	Adjuster sleeve gear *	2
35	Slide pin protective cap	2
36	Adjuster sleeve ***	2
37	Slide pin locking screw	2
38	Actuating piston ***	2
39	Slide pin	2
40	Identification label	1
41	Slide pin seal boot	2
42	Actuating piston seal boot	2
43	Roll pin	2
44	Thrust plate	1
45	Saddle	1
46	Actuating piston screw	2
47	Brake pads	2

* Gear is shown separately since it is an integral part with adjuster screw.

** New leaf springs are supplied preinstalled with new pads.

*** These components are different according to actuation direction (clockwise or counter – clockwise) (Fig. 2-2).

BRAKE PAD WEAR INDICATOR

Brakes can have different types of wear indicators according to vehicle manufacturer's requirements.
Follow vehicle manufacturer's instructions for proper installation and connecting procedures.

NOTE:
Parts shown refer to standard configuration and may differ according to brake version and model. Use data on identification label (40) to order proper spare parts.

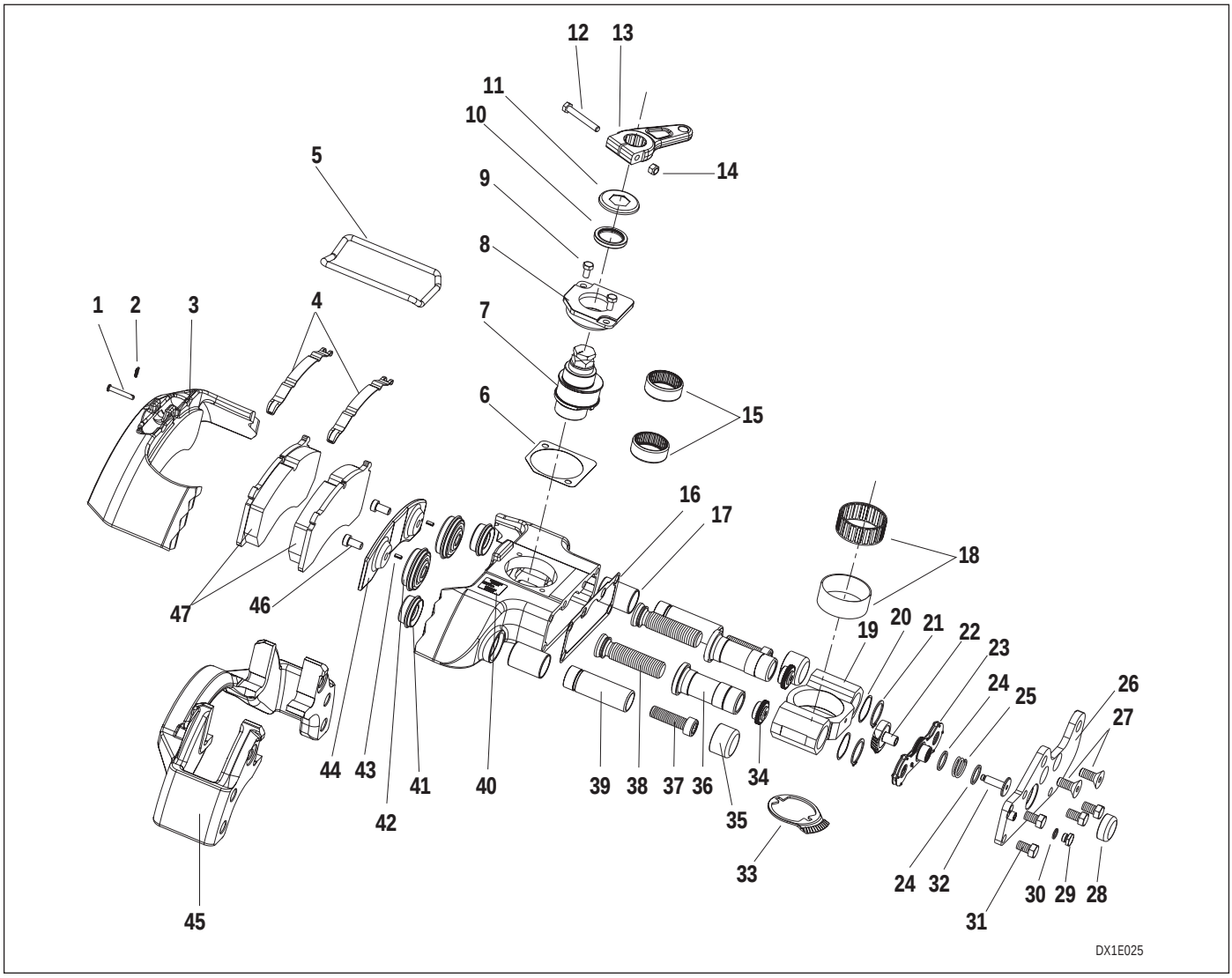
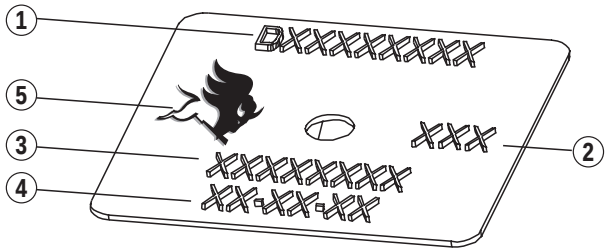


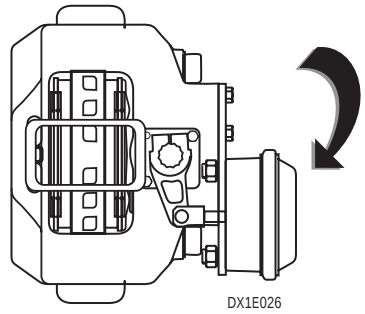
Fig. 2-1 Main components

IDENTIFICATION LABEL

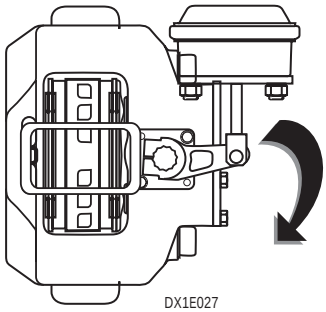
See the identification label attached on brake for suitable spare part and note down all spare part data indicated.

1 Brake Identification Number (Meritor)
2. Manufacturing Date
3. Brake Identification Number (Customer)
4. Brake Serial Number
5. Meritor Logo




DX1E026

a)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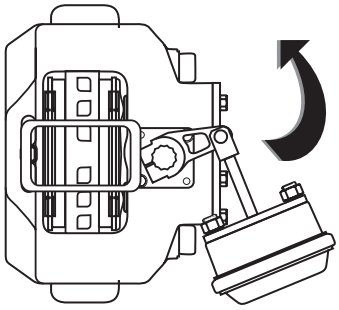
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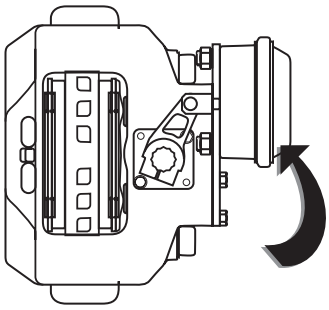
c)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d)

Fig. 2-2 Installation configuration

OPERATING PRINCIPLES

ACTUATION

Linear force from the air chamber (actuator) is converted by lever action to rotary torque on the main eccentric shaft.

Rotation of the shaft, supported by two roller bearings, causes the block to move towards the inside of the caliper. The reduction ratio between torque force on rotor and air-chamber clamping force is between 12,5 and 16,2 depending on brake model. All radial loads in the eccentric shaft are absorbed by two supporting roller bearings maintaining an efficiency of around 95% because of total absence of sliding friction in the system.

CLAMPING

The caliper assembly is free to float on the slide pins attached to the saddle. This exerts clamping force on the inner pad and determines a reaction through the caliper body, ensuring that both pads are loaded onto the rotor by an equal force.

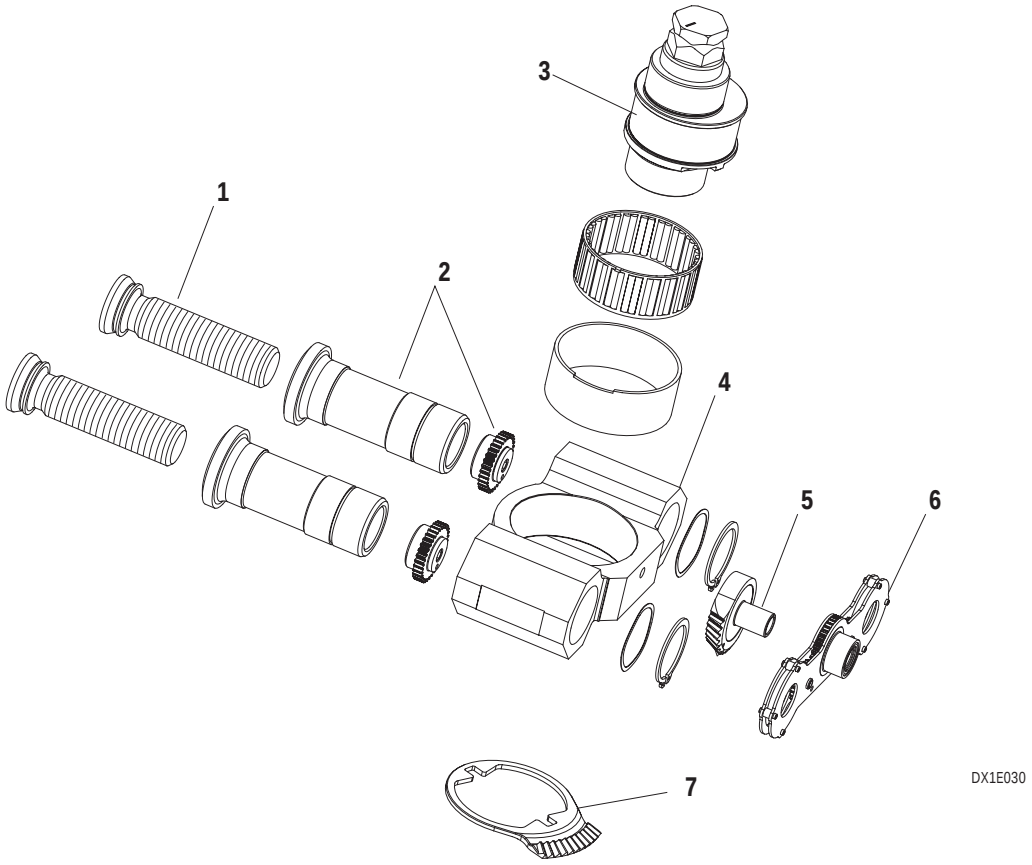


Fig. 2-3 Automatic self-adjuster mechanism

AUTOMATIC SELF-ADJUSTER MECHANISM

KEY

1	Actuating piston
2	Adjuster sleeve gear
3	Eccentric shaft
4	Actuation block
5	Bevel gear
6	Box (adjuster gear train)
7	Adjuster gear segment

AUTOMATIC CLEARANCE COMPENSATION

This mechanism, located inside the caliper, allows control of clearance caused by continuous wear of the brake pads.
The action is automatic and occurs during normal brake application.
Clearance compensation is performed as indicated in the following four steps.

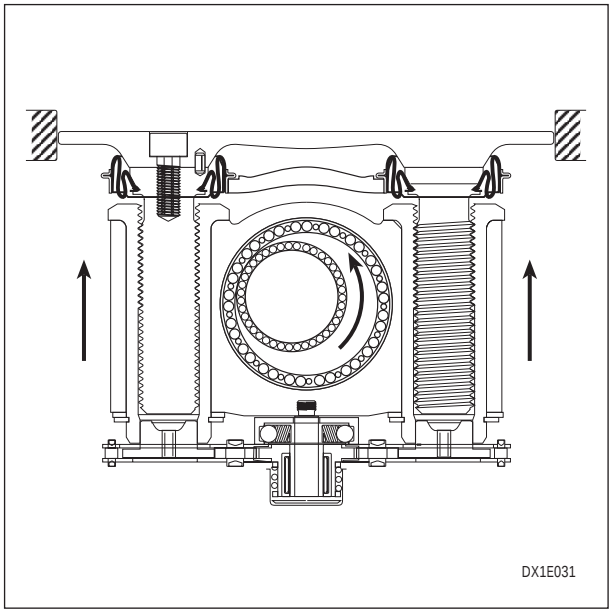


Fig. 2-4 Step 1

STEP 1 (ACTUATION OF ECCENTRIC SHAFT)

a) Actuating lever moves and eccentric shaft rotates.

b) Block lifts and begins to move forward, carrying the adjuster sleeves and pistons with it (Fig. 2-4).

c) Eccentric shaft A begins turning within the gear plate segment, eliminating clearance “h” between the adjuster gear section slot B and the shaft integral tab sides (Fig. 2-5).

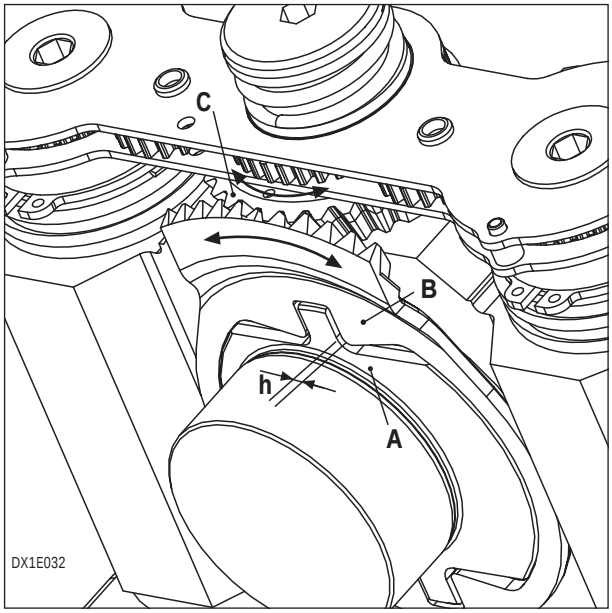


Fig. 2-5 Step 2

STEP 2 (CLEARANCE COMPENSATION DEVICE)

d) Adjuster gear segment begins to turn causing the rotation of bevel gear adjuster C (Fig. 2-5).

e) Bevel gear rotation causes the adjuster shaft to rotate by means of the ball torque limiter and the rotation is transmitted to the box central gear through the unidirectional bearing.

f) Central gear rotation, through the box gear train, causes the two adjuster sleeves to rotate.

At this stage, depending on the amount of wear of the brake pads, one of the following two conditions will occur:

condition A: No adjustment is required as clearance between pads and rotor is correct.

condition B: Adjustment is required as clearance between pads and rotor is excessive.

STEP 3 (CONDITION A)

g) At this point, when the adjusters begin to turn, the pads contact the rotor before the sleeves begin to turn and clamping force F (braking) begins to build up.

h) Clamping force generates friction in the screw threads between the adjuster sleeves B and pistons A, and friction under the flanged head of the adjuster sleeves (Fig. 2-6).

i) The friction build-up prevents rotation of the adjuster sleeves whilst the torque limiter allows the adjuster shaft to rotate with respect to the bevel gear. The adjuster drive train is locked by the friction in the system and no adjustment takes place. The main gear turns but does not transmit motion due to the torque limiter blocking.

STEP 3 (CONDITION B)

g) During the first stroke stage, before the pads come into contact with the rotor, the adjuster sleeves are turned by the gear box.

h) Sleeve rotation, due to the threaded coupling with pistons, causes pistons to be unscrewed. This determines the length 'L' of the extracted part of the pistons to increase and the pads approaching stroke towards the rotor to reduce (Fig. 2-7).

i) When the pads come into contact with the rotor the conditions mentioned above in step 3 A (g-i) are repeated, thus halting the movement.

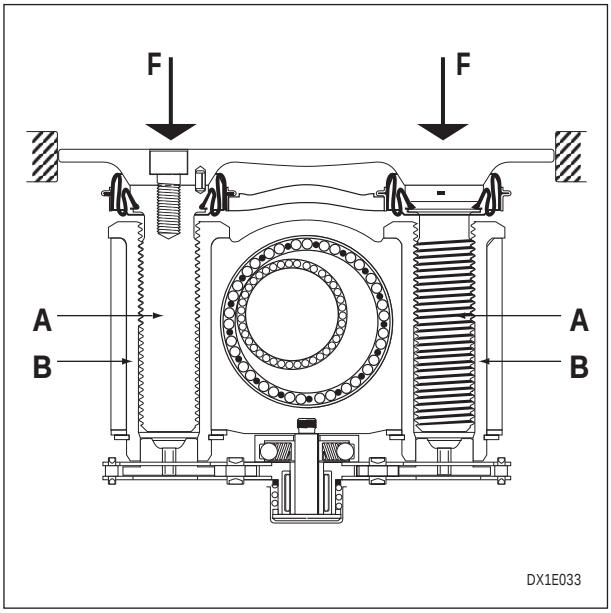


Fig. 2-6 Step 3A

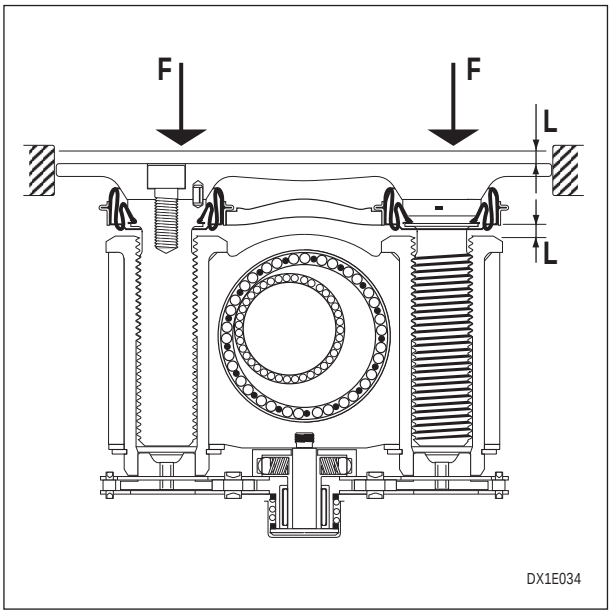


Fig. 2-7 Step 3B

STEP 4 (BRAKES RELEASED)

j) When the brake pedal is released, pressure is discharged from the air actuator and the brake actuating lever returns to its rest position pulled by the returning action of the internal air actuator spring. The eccentric shaft and the adjuster gear segment rotate in reverse direction together with the bevel gear.

k) The unidirectional bearing free-wheels without transmitting motion to the gear housing, thus avoiding brake adjustment. The relative piston / sleeve adjustment position does not vary. Therefore, clearance compensation of pre-existing rotor and pads remains unchanged. (Fig. 2-8).

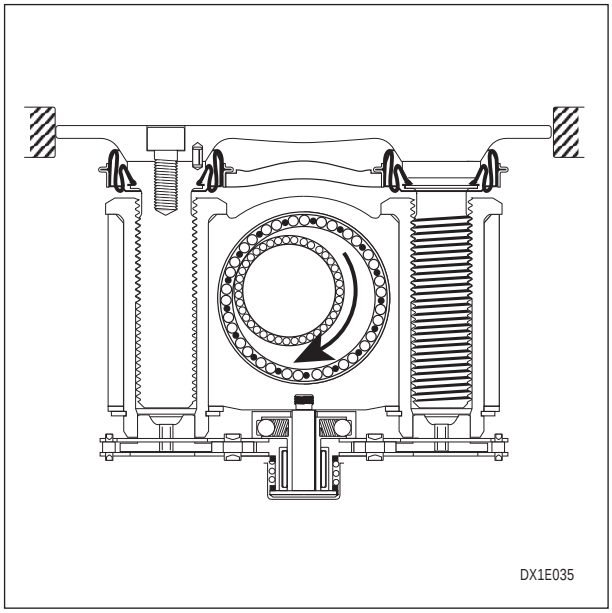


Fig. 2-8 Step 4

DAMPING

Compression springs are mounted in front of and behind the gear box in order to dampen vibration caused by vehicle movement. This prevents induced vibrations from occurring which could modify the clearance setting between rotor and pads (Fig. 2-9).

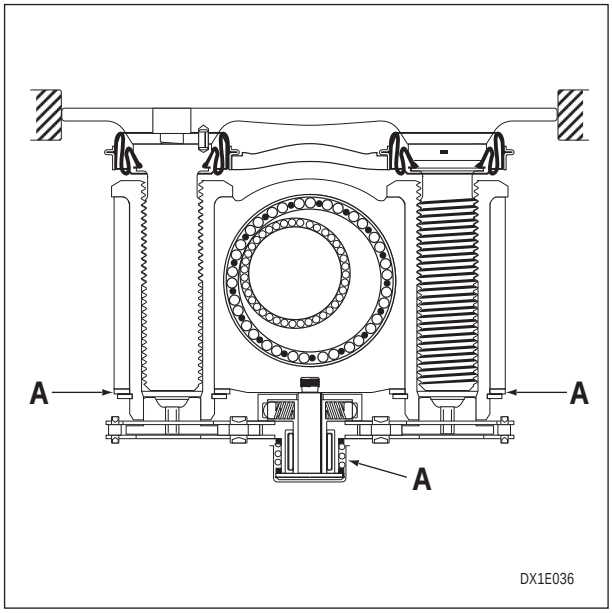


Fig. 2-9 Damping

INTRODUCTION

In order to ensure reliable and efficient brake operation, recommended maintenance intervals, lubricants and correct procedures should be followed carefully.

Only original Meritor spare parts should be used.

RECOMMENDED LUBRICANTS

MERITOR recommends the use of two lubricating greases (available as spare parts):

Code	Use
DXSK 0001	Use on all actuation and adjustment system components (pistons, sleeves, block, bearings, etc.).
DXSK 0002	Use only for slide pin plain bearings (bushings).

Use of non-recommended lubricants shall adversely affect performance and service life.

SPARE PARTS

Warranties shall be null if non-original Meritor spare parts are used.

Use of non-original parts could seriously affect brake performance.

TECHNICAL SPECIFICATIONS

Below are the technical specifications of the DX series of disc brakes.

Model		DX175	DX195	DX225	DX225/21
Type		Disc brakes	Disc brakes	Disc brakes	Disc brakes
Caliper		Floating, with pad lining compensation device.			
No. pistons per caliper		2	2	2	2
Weight (Kg)		28	38	48	41
Lining thickness (mm):	*new*	19	20	23	22
	min.	2	2	2	2
Rotor type		Self-ventilated	Self-ventilated	Self-ventilated	Self-ventilated
Rotor, outside diameter (mm)		336	378	436	420
Rotor, inside diameter (mm)		178	218	234	251
Rotor thickness (mm):	*new*	34	45	45	45
	min.	28	39	39	39

MAINTENANCE OPERATIONS

Listed below are the principal maintenance operations which apply to the DX family of brakes.
These operations will be discussed and described in detail in the following paragraphs.
In some cases, it is possible to carry out operations with brake unit mounted on vehicle. However, MERITOR recommends that all operations (with the exception of pad replacement and operating tests) be carried out with the brake unit removed from vehicle and installed on bench. This guarantees safer working conditions and better results.

Operation	No. Technicians	Special Tools	Working Position	Page
Pad replacement	1	NO	On vehicle	3
Manual clearance adjustment	1	NO	On vehicle / On bench	6
Rotor inspection	1	YES	On vehicle / On bench	7
Caliper overhaul	1	YES	On bench	11
Operating tests	2	NO	On vehicle	9

MAINTENANCE INTERVALS

The following maintenance intervals are the maximum recommended times under normal operating conditions. Extreme temperatures or adverse conditions (e.g. dusty or severe environments, frequent uphill driving, very low temperatures) will require more frequent servicing. It is the responsibility of the vehicle operator to schedule these intervals, with technical support from Meritor if necessary.

Frequency	Component	Operation
50,000 km / 6 months	Pads	Inspection
100,000 km / 12 months	Rotor	Cleaning and inspection
500,000 km / 3 years	Caliper	Complete overhaul

PAD REPLACEMENT

Brake pad replacement is necessary when the friction lining is worn down to a thickness of 2 mm (total thickness inclusive of support plate, is 9 mm).

Depending on vehicle operating conditions, pad lining wear can often be uneven (about 1 mm in tangential and radial wear).

With the vehicle on a hard level surface, fit anti-roll chocks under the road wheels to prevent it from moving either forward or backwards.

Carefully follow the manufacturer's instructions when jacking the vehicle and removing the road wheel.

PRELIMINARY PROCEDURES:

If necessary, disarm the parking spring following the air actuator manufacturer's instructions very carefully. Remove dirt and debris from caliper.

Do not use compressed air to clean brakes or rotor. Linings are non-asbestos but lining dust is an irritant if inhaled and is harmful to health.

The use of a vacuum cleaner is highly recommended to eliminate build-ups of dust. Otherwise, remove dust with water-dampened shop towels.

Remove the pin clip A and the pin B allowing the stabiliser bar C to rotate and be hinged to the caliper on the lever's side.

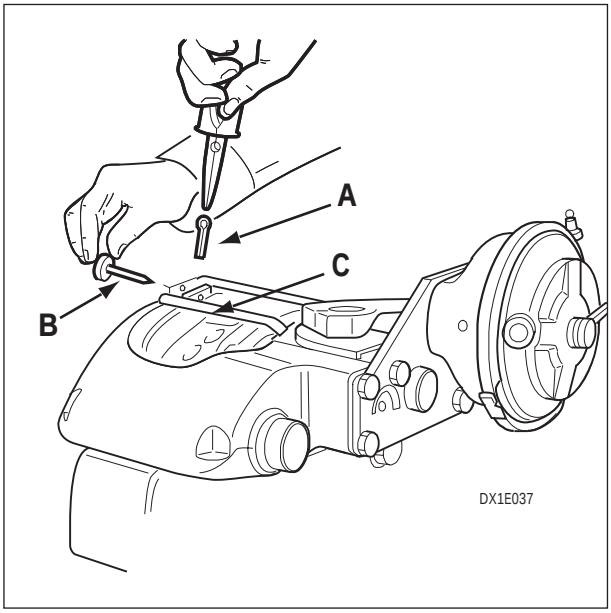


Fig. 3-1

(Fig. 3-2) Pull out the inner brake pad. If pad removal is difficult due to rotor wear (a ridge build-up on the outer diameter of the rotor) then manually de-adjust the brake (see page 6, Manual clearance adjustment).

Pull the caliper axially outwards (towards the road wheel) to free the outboard pad A and pull it out.

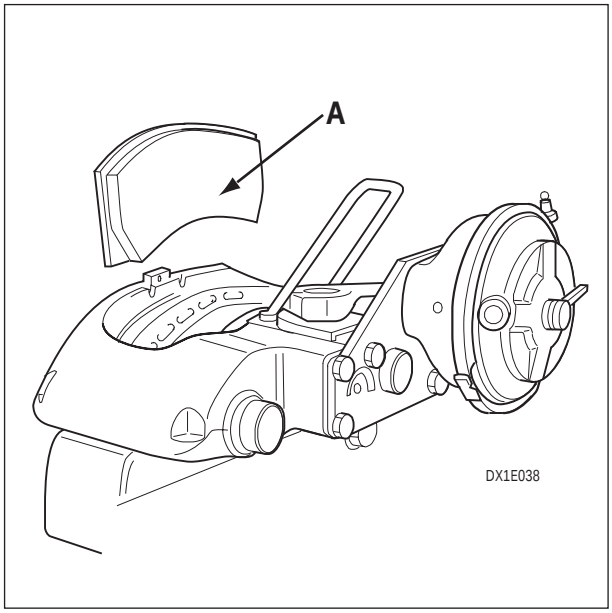


Fig. 3-2

Discard the worn pads and the leaf springs. Visually inspect the rotor for signs of excessive corrosion, physical damage, scoring on braking surfaces or signs of cracking (see page 7, Rotor inspection).

This operation requires the caliper to be moved on its slide pins. Extreme care must be taken to avoid trapping fingers.

Light surface crazing of the rotor is normal and acceptable.

Using an emery cloth, remove light surface rust from the rim of the rotor. If unsure of rotor integrity, replace it with a new one.

(Fig. 3-3) Clean the 8 pad support plates in the saddle with a wire brush removing any build-up of debris or rust. This allows the new pads to be correctly seated in position.

Inspect the pad stabiliser bar for signs of damage, distortion or corrosion.
If in doubt of bar integrity, replace it.

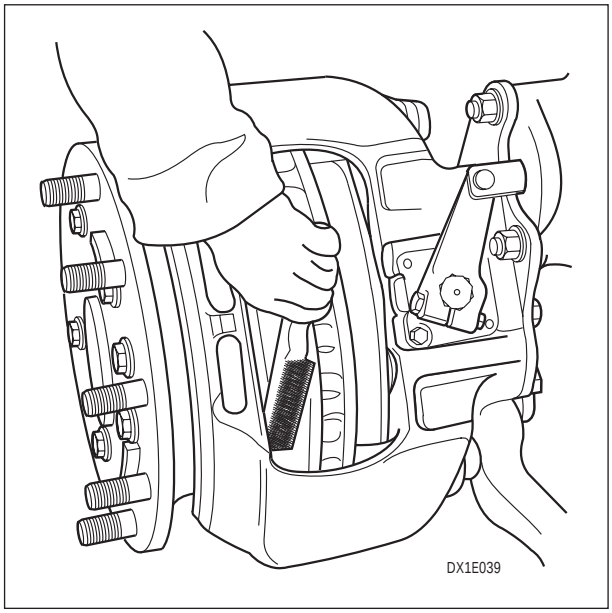


Fig. 3-3

If in doubt of bar integrity, replace it.
(Fig. 3-4) Completely de-adjust the automatic clearance compensation device (see page 6, Manual clearance adjustment).

Install new pads (which are supplied assembled with new springs anti-rattle).

Check that pads are correctly fitted with friction material in contact with rotor.

Hinge down the stabilizer bar onto the springs anti-rattle and retain in position with pin and new pin clip.

Manually adjust the brakes (see page 6, Manual clearance adjustment).

If necessary, release the parking brake spring on the air actuators.

Verify correct operation by actuating brakes about ten times.

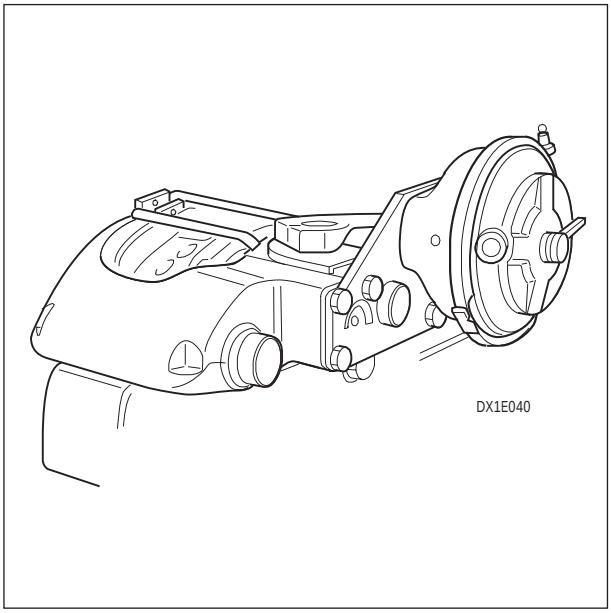


Fig. 3-4

The actual position of brake unit on vehicle can vary from one model to another.

Use only approved pad units complying with original specifications.
Use of non-approved units could adversely affect brake performance and pad life, as well as rotor life and efficiency.

MANUAL ADJUSTMENT

It is possible to manually adjust pad to rotor clearance. Under the following conditions it is necessary to operate manually:

1 - During inspection of pad to rotor clearance.
2 - During fitting of new pads.

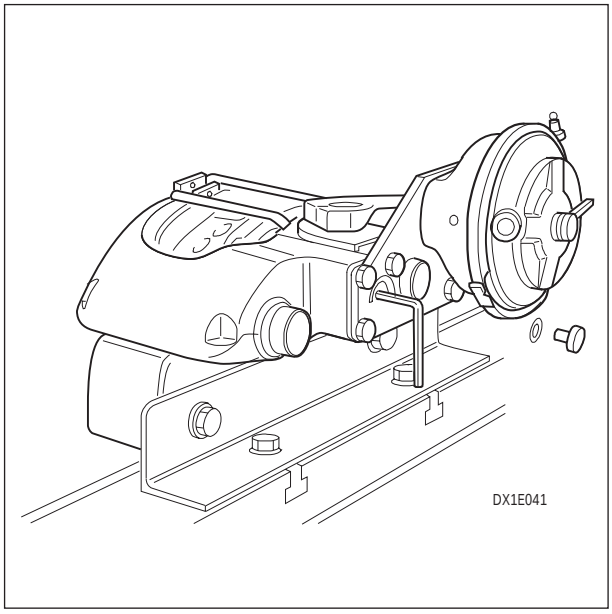


Fig. 3-5

(Fig. 3-5) To manually adjust the brake first remove the manual adjustment port plug and then rotate the mechanism using a 6 mm Hex wrench. The gear train will ensure that the adjuster sleeves will be turned equally.
The operation which allows pistons to be extracted, thus reducing pad to rotor clearance is called adjustment. The opposite operation is called de-adjustment.
De-adjustment direction depends on eccentric rotation direction. Wrench should be turned counterclockwise on brakes with clockwise lever actuation (de-adjustment rotation direction is indicated with an arrow on end plate near the plug).

Rotate the adjustment mechanism in the direction in which clicking is not heard.
Continue rotation until both pads come into contact with rotor. Then turn 180° in the opposite direction, i.e. 6 torque limiter notches.

Remove the Hex wrench, replace the port plug and washer and tighten to 14 Nm.

In general, de-adjustment or back-adjustment is achieved when the wrench is turned in the direction which produces loud clicking.
(This indicates that the torque limiter is slipping).
Turning the wrench in the opposite direction will result in a much smoother and quieter action, which will give positive adjustment and reduce pad to rotor clearance.

During brake de-adjustment, stop turning the wrench if resistance is felt. This indicates that the adjuster pistons are fully retracted.
Further turning of the wrench could lock the adjuster pistons in the sleeves, thus preventing auto-adjustment operation.

Do not use automatic unscrewing devices during manual adjustment. If used by mistake, breakage of adjuster box gears could occur. Max. adjustment torque is 6 N•m.

ROTOR INSPECTION

Rotors should be inspected whenever the brakes are serviced or new pads are fitted, or else immediately if erratic braking performance is perceived. The rotor condition should be visually inspected. Check braking surface conditions in order to determine if the rotor needs to be replaced.

Accurate cleaning of the rotor is necessary at 100,000 km (or 12 months) intervals. Remove all rust or debris caused by wear from rotor rim, from support points of the pads in the saddle and from all caliper actuation surfaces.

See below a list of conditions often detected on rotors:

Condition	Description	Tolerance	Operation
Surface crazing	Light short random crazing of braking surfaces (Fig. 3-6 A)		None
Radial cracks	Small slight cracks (Fig. 3-6 B)	Max. width 0.5 mm Max. depth 1.0 mm Radial extension of braking surface less than 75%.	None if tolerance levels are not exceeded. If one of the tolerance levels is exceeded, replace rotor.
Tangential scoring	Light circular grooves (Fig. 3-6 C)	Max. groove depth 0.5 mm	None if tolerance levels are not exceeded. Machine if tolerance levels are exceeded (*) (see Rotor resurfacing)
Heat spotted rotor	This condition indicates that the rotor has been subjected to extremely high temperatures that have caused a structural change in the rotor material and have caused the rotor to be more susceptible to cracking. Residual internal tension could lead to permanent rotor distortion (Fig. 3-6 D).	Max. axial run-out 0.3 mm Max. radial run-out 0.8 mm Max. rotor thickness variation 0.05 mm	None if tolerance levels are not exceeded. Machine if tolerance levels are exceeded (**) (see Rotor resurfacing)

((*) Wear and grooves must be approx. the same on both surfaces. If wear is considerably different, brakes will not operate properly and need to be inspected.

(**) If resurfacing does not remove the spots then the rotor must be replaced.

Use a dial test indicator (DTI) to check both axial and radial run-out as illustrated in Fig. 3-6.

Excessive runout may be due to incorrect rotor assembly on the hub, excessive tightening torques or incorrectly adjusted wheel bearings. Ensure that these conditions are avoided when reassembling.

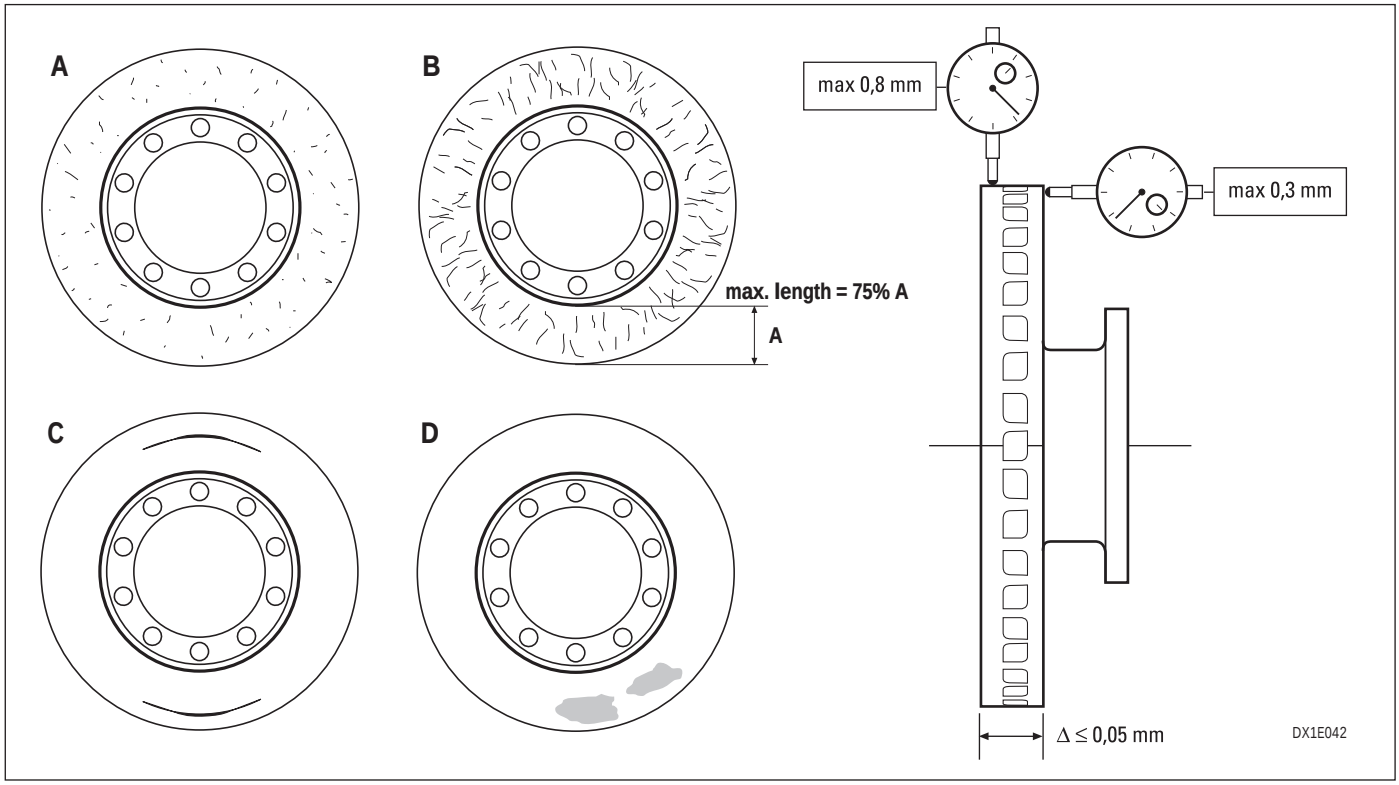


Fig. 3-6 Rotor inspection

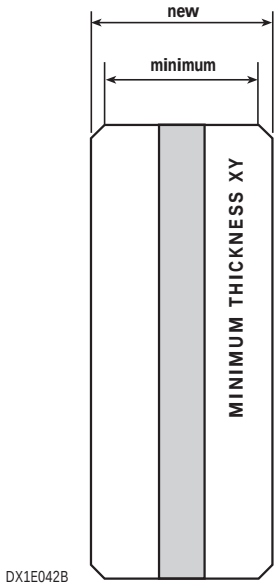
ROTOR RESURFACING

Remove rotor as described in vehicle's service manual.
Position rotor on grinder.
Eliminate all traces of defects found on rotor.
Resurfacing must be done on both sides of rotor.

During resurfacing move the grinding wheel gradually until all grinding swarf is removed.
Surface finish after machining should be max. 5 microns.

WEAR LIMITS

Wear limits for rotor are visually indicated by the bevel corner 3 x 30° on each outer diameter of both braking surfaces. Limits are 3 mm for each side. Minimal total thickness allowed for the worn rotor is hobbed on rotor outer edge **(minimum thickness XY mm).**



Rotors may be resurfaced up to the minimal thickness allowed (41 mm for DX225 and DX195; 30 mm for DX175 after resurfacing).

Minimal total thickness allowed for the worn rotor is:
- 39 mm for DX225 and DX195
- 28 mm for DX175

In order to guarantee total braking efficiency and safety, it is recommended, when replacing one rotor, to replace the other rotor on the same axle.

OPERATING TESTS

PAD WEAR COMPENSATION DEVICE (ON VEHICLE)

The operation must be performed on vehicle. Follow all safety precautions and abide by standing regulations concerning vehicle hoisting and workshop conditions. The vehicle must be hoisted and the relative wheel of the device to be tested should be removed.

Clean the area where the operation will be performed.

Do not use compressed air.
Linings are non-asbestos but lining dust is an irritant if inhaled and is harmful to health.

The use of a vacuum cleaner is highly recommended to eliminate build-ups of dust. Otherwise, remove dust with water-dampened shop towels.

1. Reset the manual adjuster (see page 6, Manual adjustment) in order to have a total clearance of 2 mm between pad and rotor (for rotors without wear ridge). The clearance should be measured with a feeler gauge once the internal pad touches the rotor (pull the gauge outwards). Should the rotor have a wear ridge, 2 mm clearance could be achieved as follows:

   - Rotate adjustment device towards the position in which clicking is no longer heard so that both pads are in contact with rotor
   - Rotate the Hex wrench 360° in the opposite direction, i.e. 12 torque limiter notches.
     By leaving a Hex wrench in the adjuster port, device operation can be observed during test.
   - For this purpose, be sure that the wrench does not interfere with brake components all around (360°).

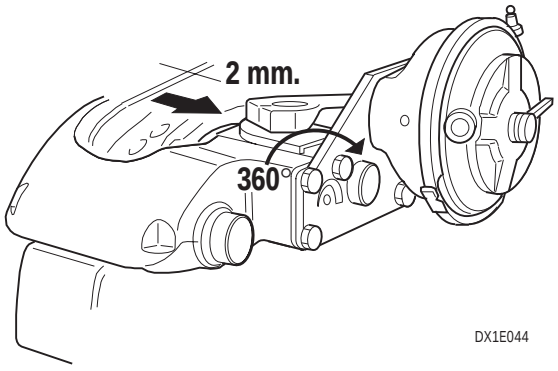


Fig. 3-7

2. Actuate the brakes 50 times.

If a wrench has been left in the device, at the end of this operation it should have rotated 180° ÷ 270° from starting point in normal conditions. If this is so, the next step could be skipped.

3. The automatic adjuster device operates correctly if measured clearance (with a feeler gauge) is between 0.6 and 1.0 mm, or if Hex wrench rotation needed to make the pad be in contact with the rotor is between 90° and 180°. Should this be the case, it should be remembered that the brake should be de-adjusted as in the above step.

4. The automatic adjuster device must be replaced as a complete unit if the clearance is not within these

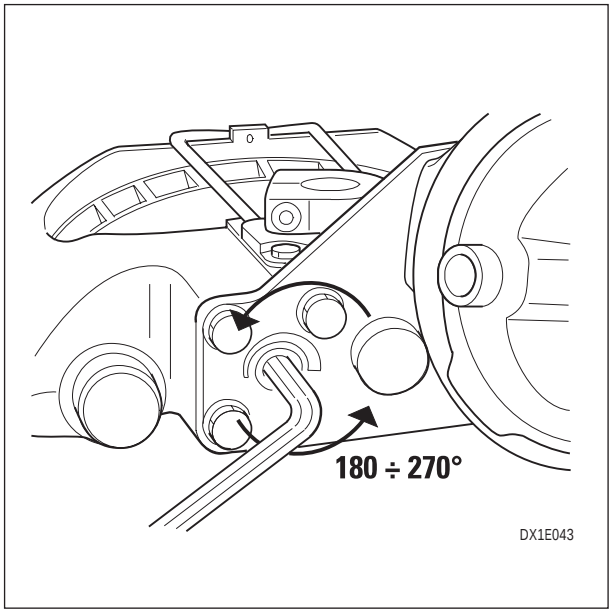


Fig. 3-8

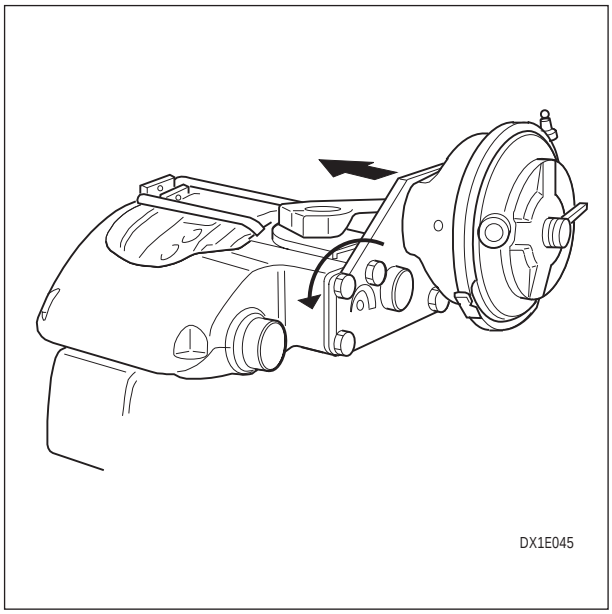


Fig. 3-9

CALIPER GUIDE SYSTEM (ON VEHICLE)

1 Remove the two pads.

2 With brake on vehicle check manually the movement of the caliper on the saddle by sliding it on slide pins along all of the allowed stroke.

3 If the movement is not smooth, and with judder or binding, and excessive clearance is noted between slide pins and bushings the brake unit should be disassembled and the caliper guide system inspected.

Fig. 3-10

BRAKE SERVICING (ON BENCH)

REMOVAL OF BRAKE UNIT FROM VEHICLE

1 Refer to vehicle manufacturer's workshop instructions for safe jacking of the vehicle and removal of road wheels.

2 Before proceeding with brake removal, cage any parking brake springs fitted on air actuators and disconnect air lines and all electrical connections (ABS and wear sensors).

3 Remove pin clip A and pin B allowing the pad stabiliser bar to swing up. Remove the inner pad first and then the outer one.

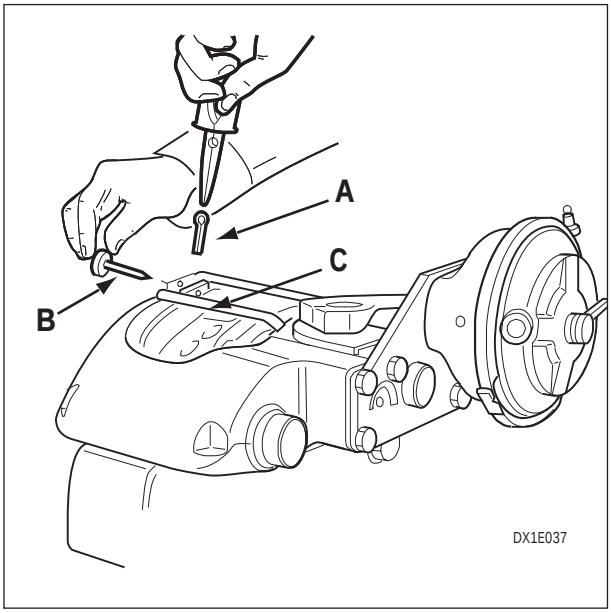


Fig. 3-11

At this stage the caliper is free to slide on the saddle. Care should be taken to avoid inadvertently trapping fingers.

In extreme cases of rotor wear it could be difficult to remove pads because of rotor ridges. Manual de-adjusting of the brakes shall be necessary.
(See Manual Adjustment page 6)

For normal servicing, Meritor recommends removal of complete brake unit and that operations be performed on bench.

1 Remove saddle to axle / flange retaining screws.

2 Remove brake from vehicle and secure it to a bench mounted bracket using the same fixings as on the vehicle (**DXT17**).

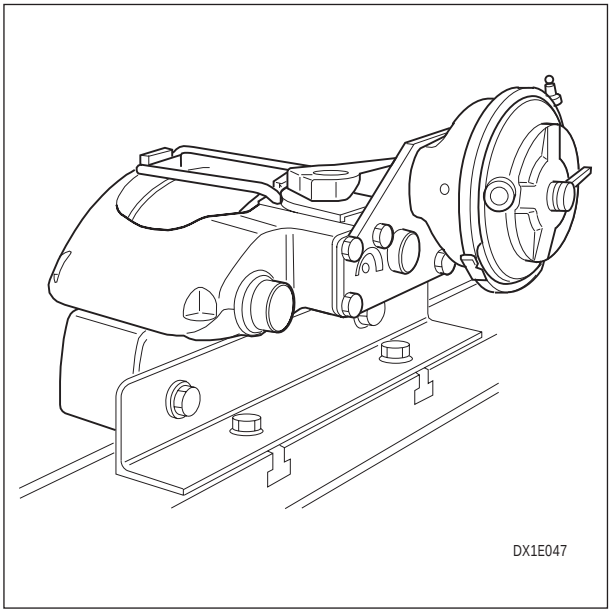


Fig. 3-12

As very high torques are required, the mounting device should be clamped onto a sturdy workbench.

DISASSEMBLY OF ACTUATING SYSTEM

For a correct reassembly, note or mark relative rotation chamber position with respect to end flange.

1. Remove pin clip A and clevis pin B connecting the air actuator (rotation chamber) pushrod to the brake actuating lever.

2. Remove the two retaining nuts C attaching the rotation chamber to the end plate.

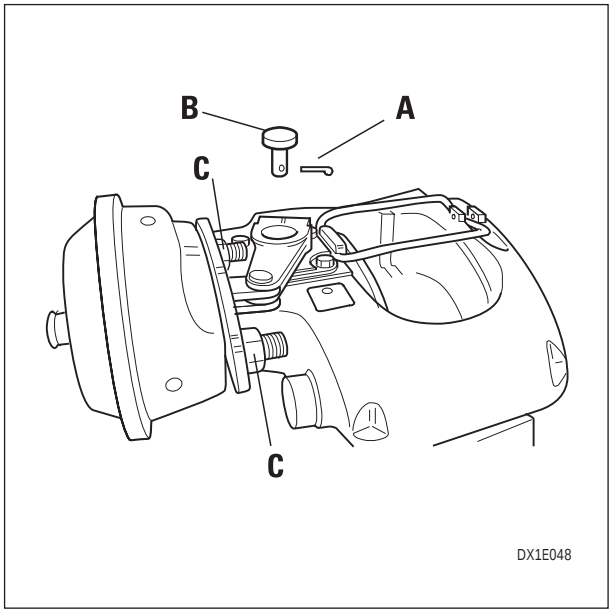


Fig. 3-13

3. Remove air actuator.

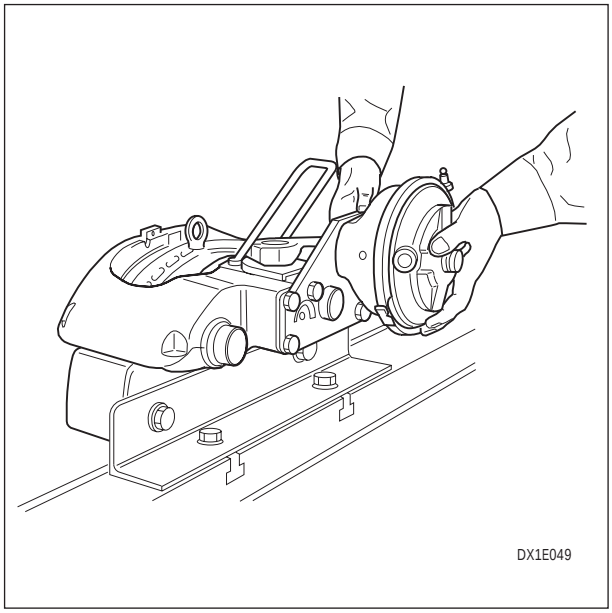


Fig. 3-14

4. Remove the two socket head screws A and then remove the inner pad thrust plate B.

Attention should be paid since a high starting torque will be required due to thread locking compound applied to screws.

New screws must be used when reassembling.

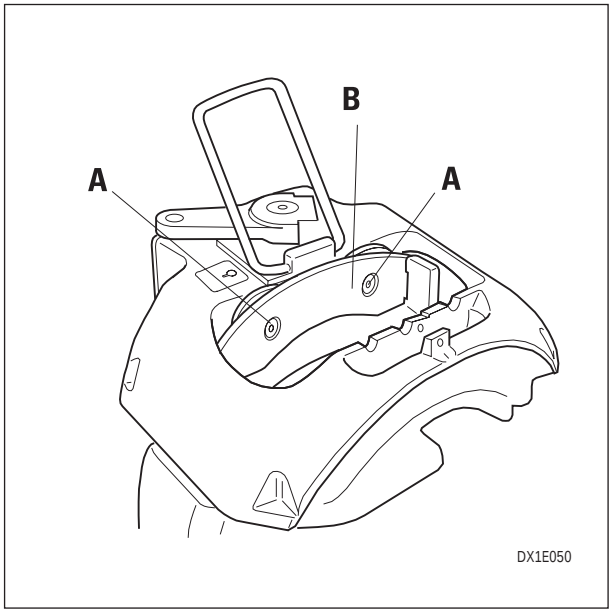


Fig. 3-15

5. Remove the 6 end plate screws A, then remove plate from caliper.

6. Remove and discard gasket and clean any possible debris from metal surfaces.

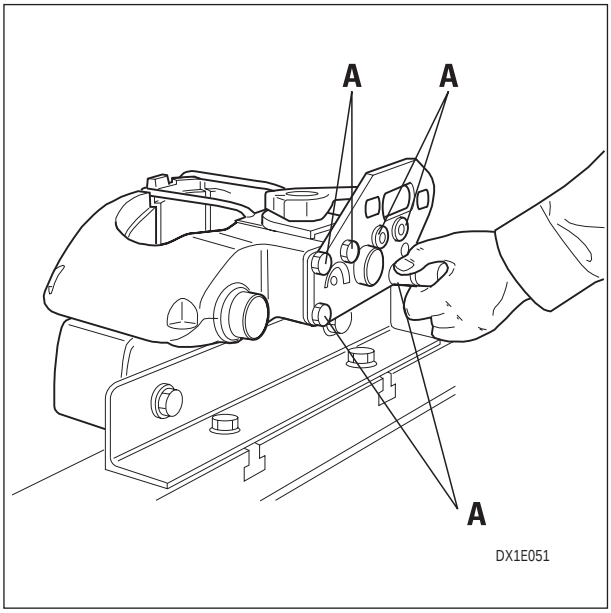


Fig. 3-16

7. Remove and discard central screw B from automatic adjuster device and remove compression spring C and damping rings D.

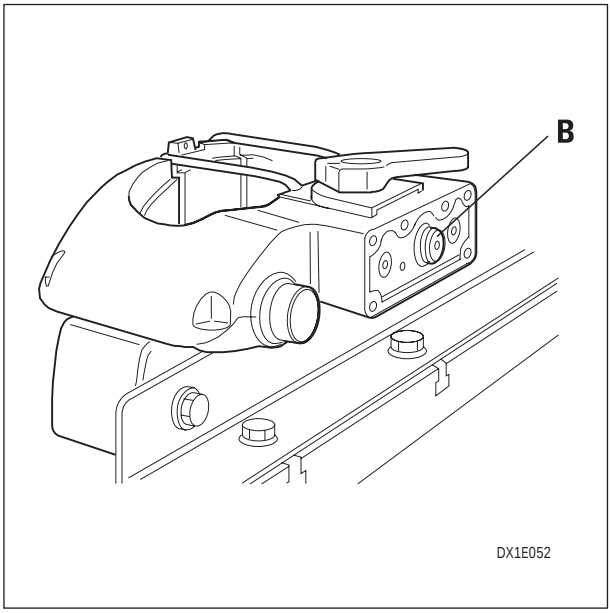


Fig. 3-17

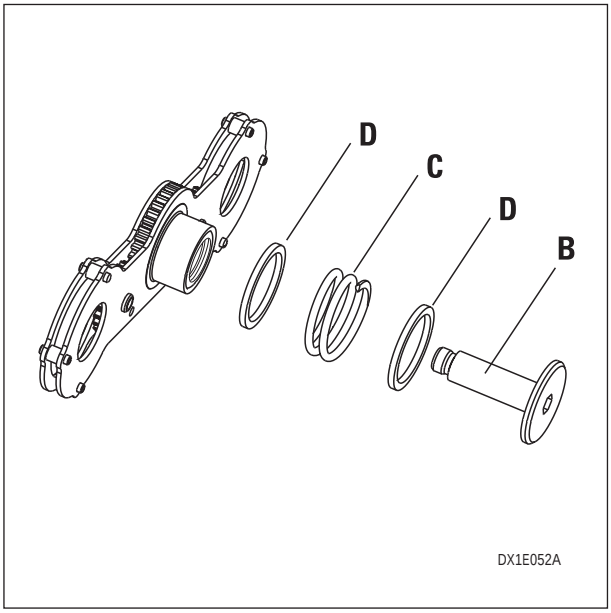


Fig. 3-18

8. Remove gear train box and torque limiter assembly together with bevel gear.

For a correct reassembly note or mark relative lever position with respect to eccentric shaft.

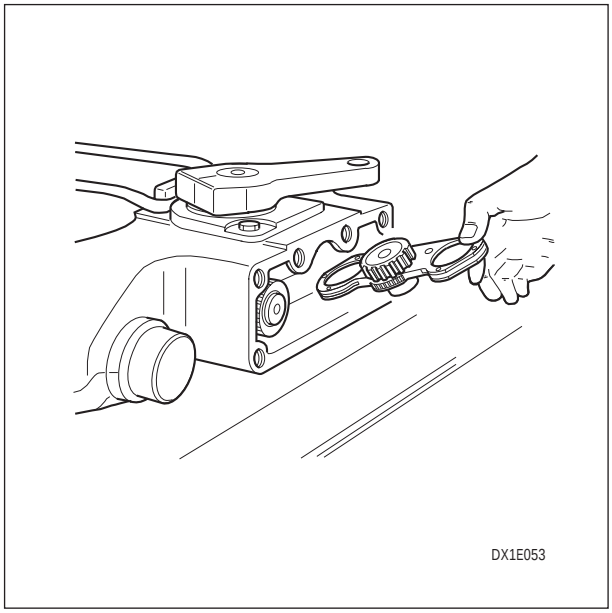


Fig. 3-19

9. Remove lever clamp bolt.

10. Should the lever interfere with the eccentric shaft, insert an appropriate wedge (screwdriver's blade) in the groove in order to facilitate disassembly and remove lever.

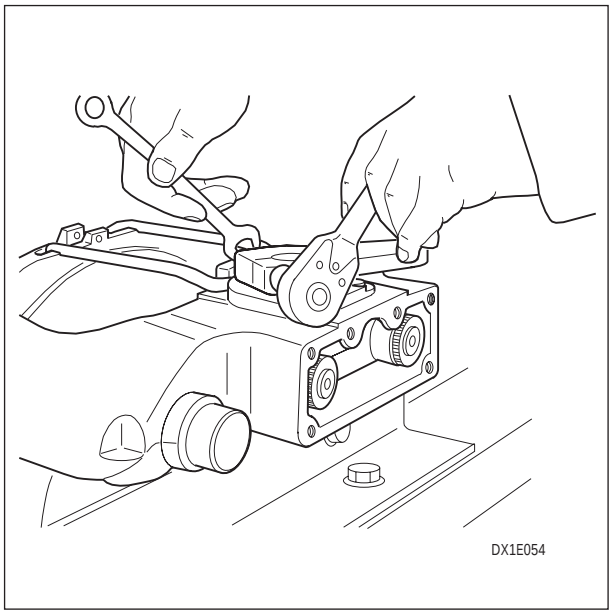


Fig. 3-20

11. Remove the rubber dust seal.

12. Remove and discard the two cover plate screws A.

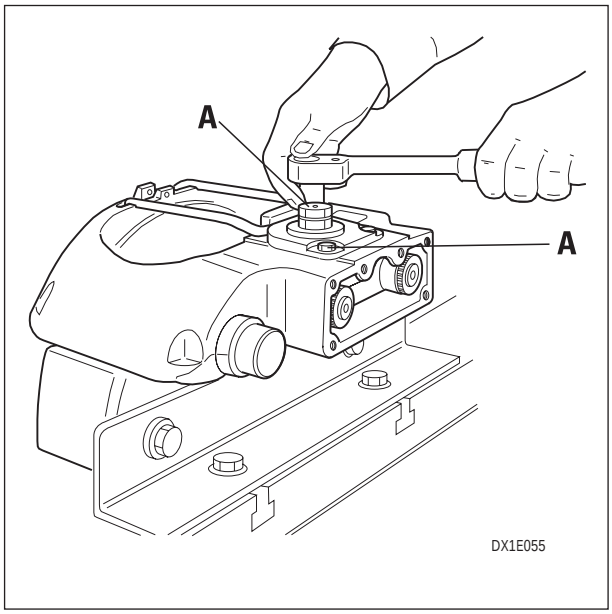


Fig. 3-21

13. Pull out the cover plate on which the eccentric shaft upper bearing is positioned.

The bearing is an uncaged, needle roller bearing assembly. Care must be taken not to drop or jar the cover plate in order to avoid displacement or loss of rollers.

14. Remove and discard cover plate gasket.

15. Thoroughly clean contact surfaces between plate and caliper.

16. Remove the stabiliser bar A secured in position by the cover plate.

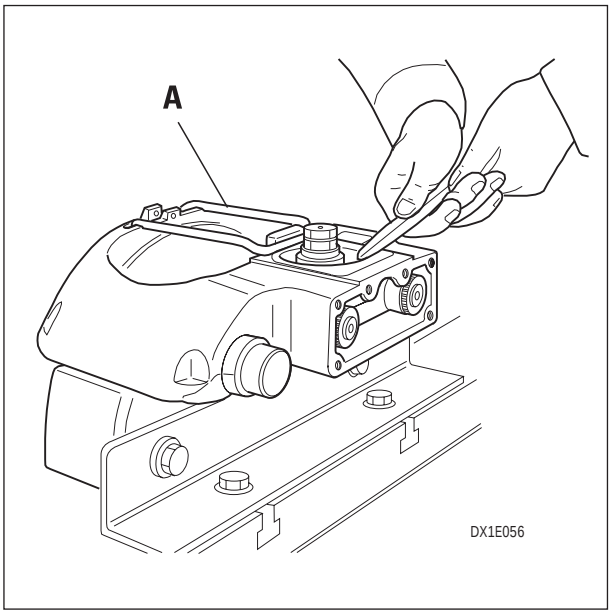


Fig. 3-22

17. Remove eccentric shaft B from upper caliper opening. Rotate the shaft slightly to disengage the adjuster gear segment.

18. Remove the cage C together with bearing needle roller assembly from the eccentric shaft.

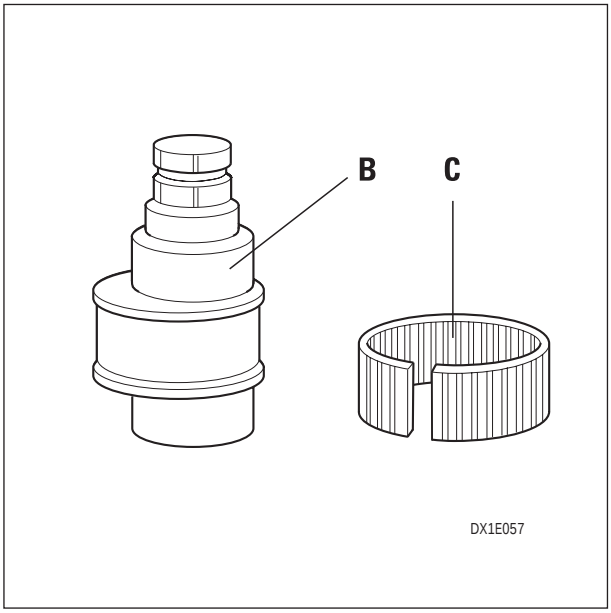


Fig. 3-23

19. Remove adjuster gear segment.

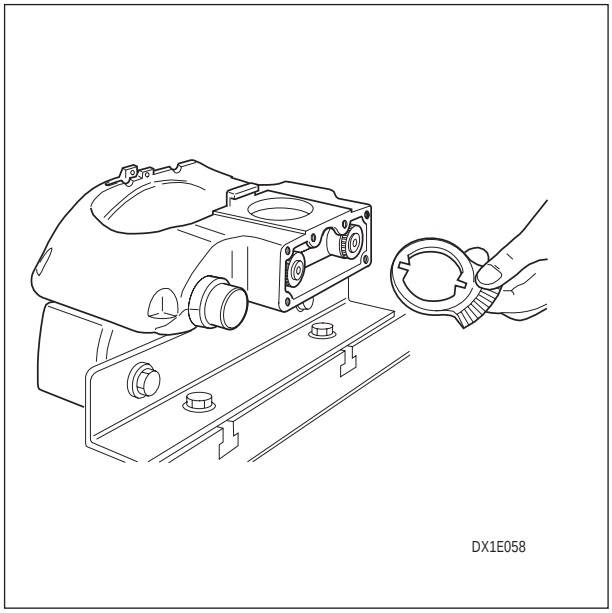


Fig. 3-24

20. Pull out the block from caliper body, disengaging the two pistons from the boot seals C.

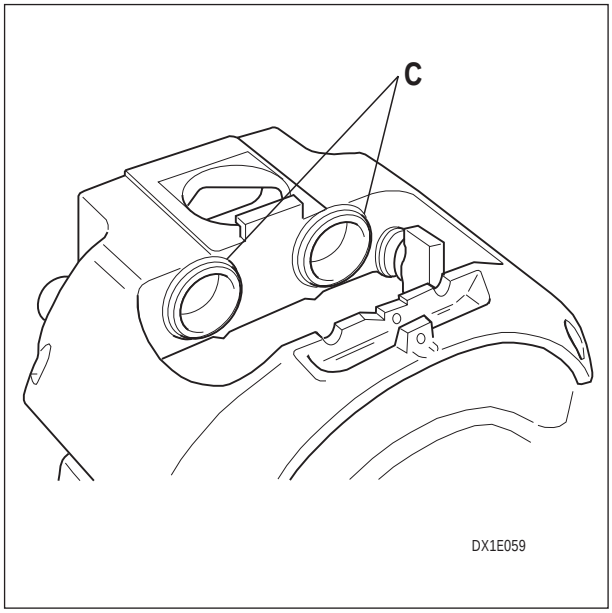


Fig. 3-25

21. Open and remove circlips between sleeves and actuating assembly.

22. Remove sleeve springs.

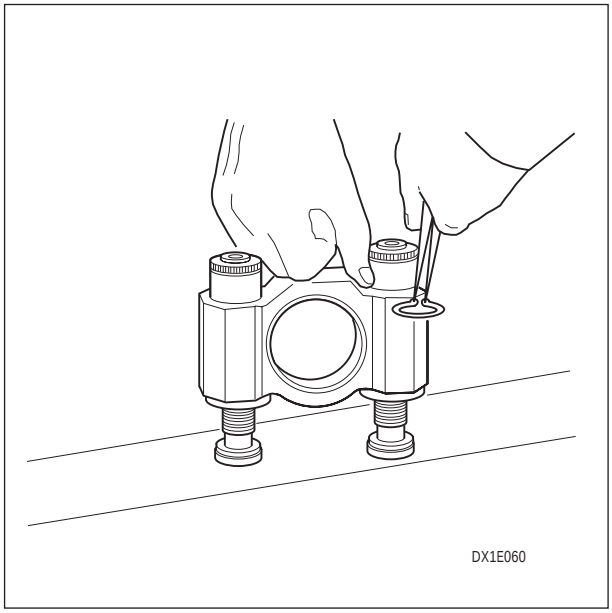


Fig. 3-26

23. Pull out the two sleeve assemblies A and manually unscrew pistons B.

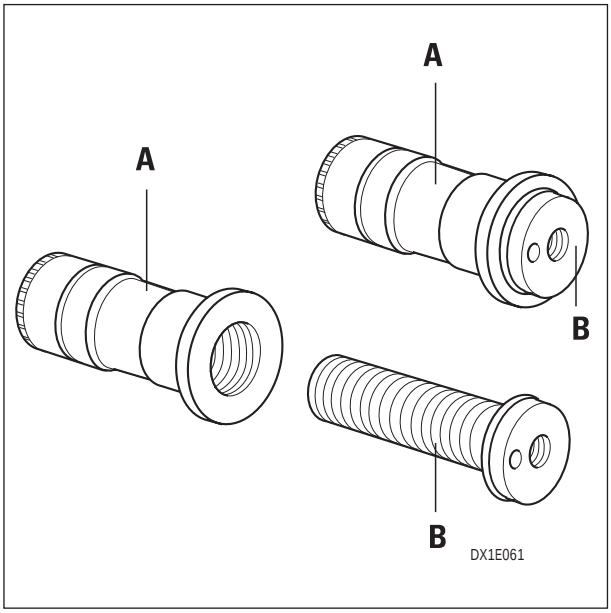


Fig. 3-27

24. Remove and discard the two seals from within the caliper body using a suitably sized drift.

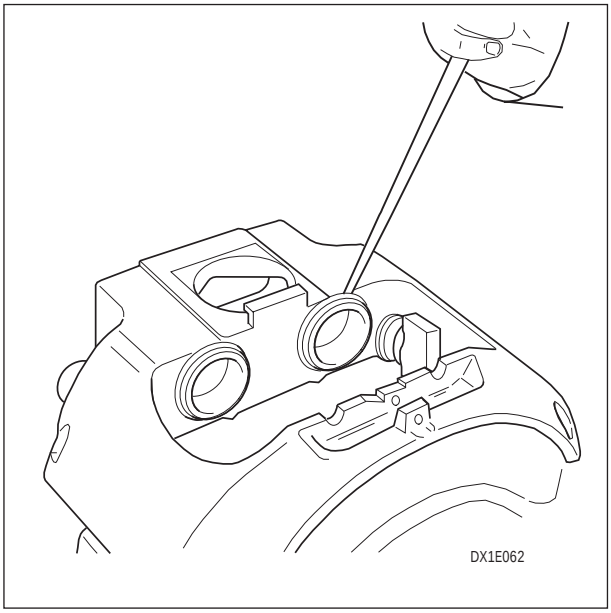


Fig. 3-28

25. Remove lower eccentric shaft bearing from caliper using a suitable bearing puller.

If the bearing is not removed, in order to avoid the risk of rollers being dislodged or lost, it is recommended that the eccentric shaft be temporarily filled with paper and held in position with tape.
The latter precaution should be taken just in case maintenance is to be performed with caliper removed from saddle.

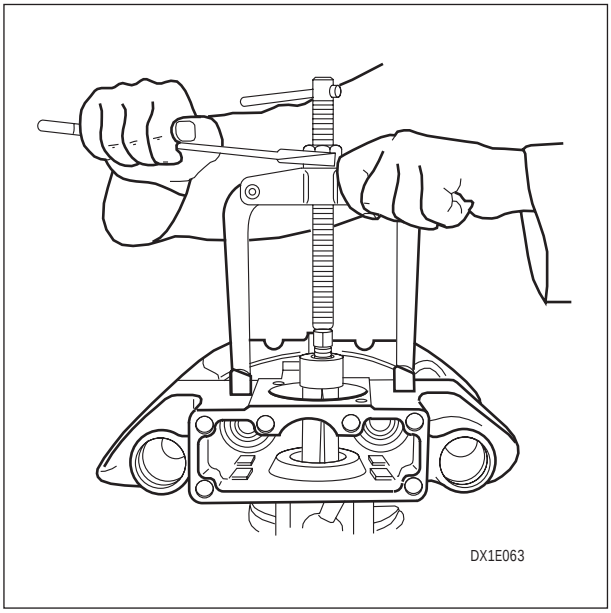


Fig. 3-29

DISASSEMBLY, INSPECTION AND REASSEMBLY OF CALIPER GUIDE SYSTEM

DISASSEMBLY

1. With the help of a hammer and a screwdriver, remove and discard the two slide pin covers A.

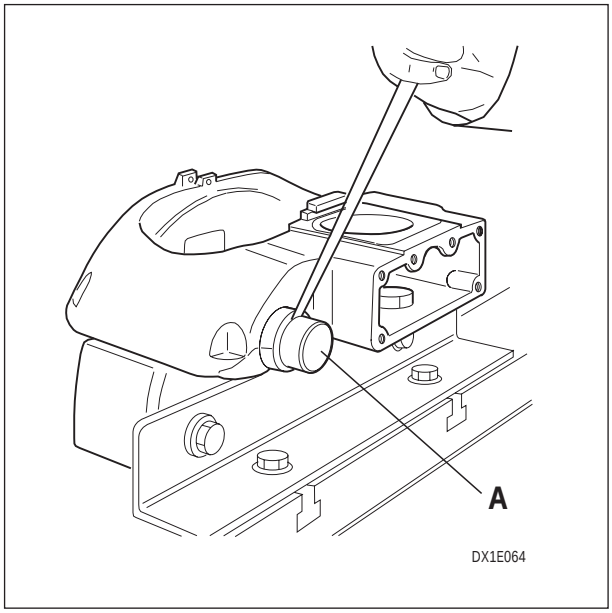


Fig. 3-30

2. Remove and discard the 2 slide pin clamp bolts.

Slide pin retaining screws are different in length. Make a note or mark the caliper body in order to identify the screw positions.

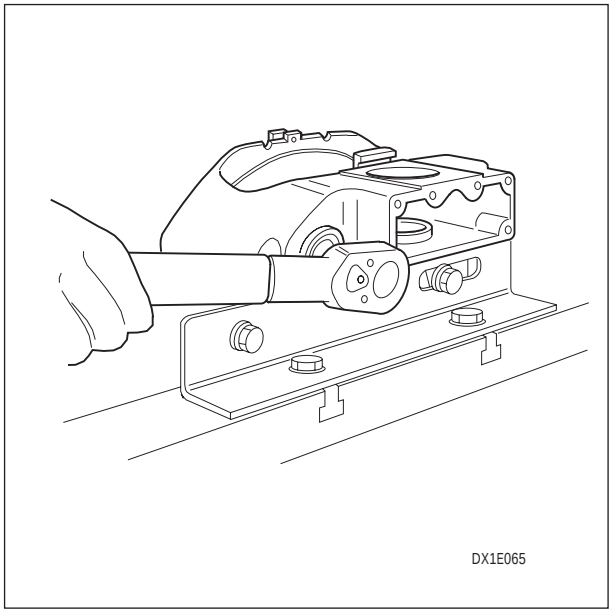


Fig. 3-31

Due to the high tightening torque, use wrench with required adapter or extension.

3. Remove caliper from saddle.
4. Remove slide pins from caliper.

Mark the correct positions of the slide pins on caliper since they are both different.

5. Remove and discard the two slide pin rubber seals from the caliper.

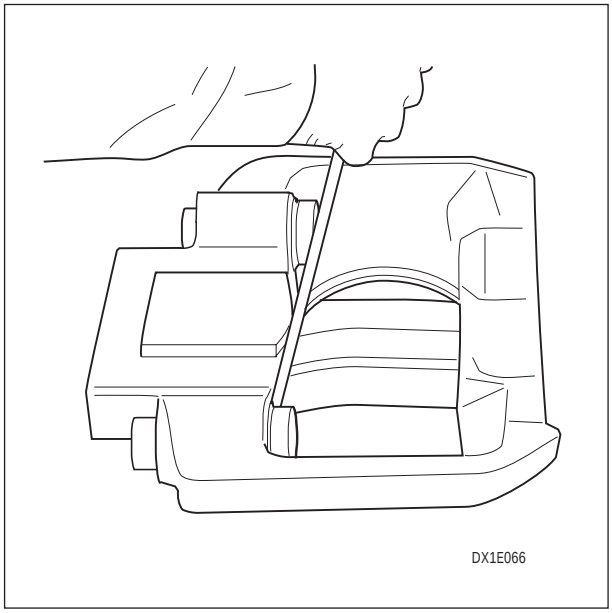


Fig. 3-32

INSPECTION AND REASSEMBLY OF SLIDE PINS

1 Inspect both slide pin bushings. These bushings have a low friction coating which must be checked for wear or damage.

2 Check for any signs of coating detachment of the bushing shell. If in any doubt about serviceability, replace both bushings.
For removal use a bar with an outer diameter smaller than the bushing and long enough to push it out of its housing **(**use special tool).

Code	Model
DXT01	DX225
DXT02	DX195 DX225/21
DXT03	DX175

3. Inspect both slide pins. The bearing surfaces must be smooth, polished and undamaged with no trace of scratches or wear.
If in any doubt about serviceability replace both bushings.

4. Fit bushings in caliper body using special tool:

Code	Model
DXT04	DX225
DXT05	DX195 DX225/21
DXT06	DX175

5. Fit new rubber boot seals, pushing them into position with special tool:

Code	Model
DXT09	DX225
DXT010	DX195 DX225/21
DXT011	DX175

Before reassembly, apply sealant DXSK 0003 on the outside of metal ring.

6. Fit new actuation piston seals, pushing them into position on caliper with special tool:

Code	Model
DXT07	DX225
DXT07	DX195 DX225/21
DXT08	DX175

Before reassembly, apply sealant DXSK 0003 on the outside of metal ring.

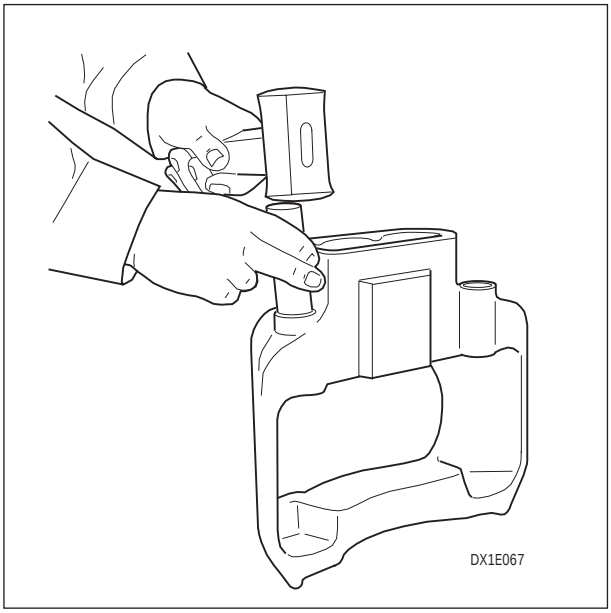


Fig. 3-33

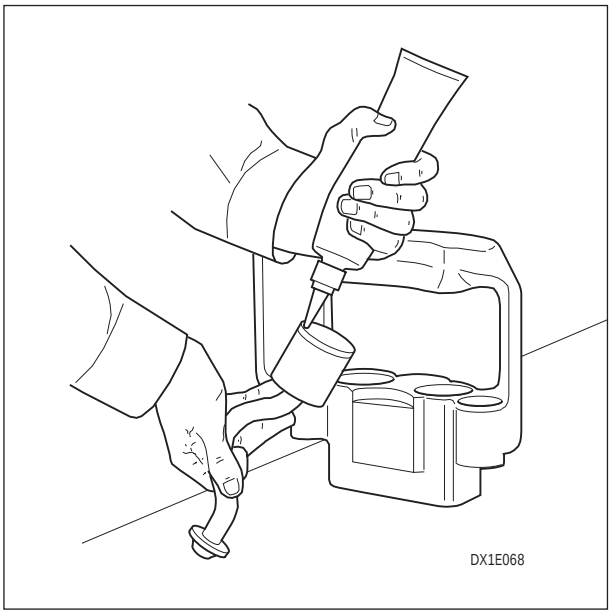


Fig. 3-34

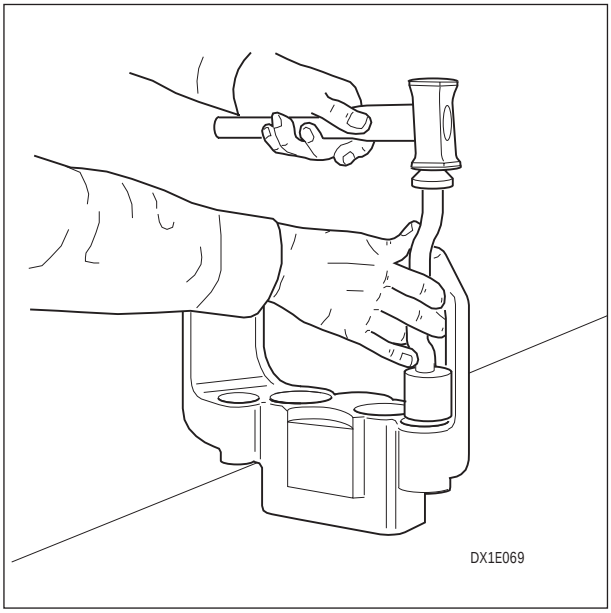


Fig. 3-35

7. Fit slide pins in bushings, applying lubricant DXSK 0002 on the surface and inside the slot.

The slide pin with the short screw (and outer diameter slightly oversized) should be installed on the right side (looking at the brake from the end plate) on brakes with clockwise lever actuation. The opposite applies for brakes with counterclockwise lever actuation.

8. Position the collar of the rubber seal in the appropriate slot A on the slide pin body.

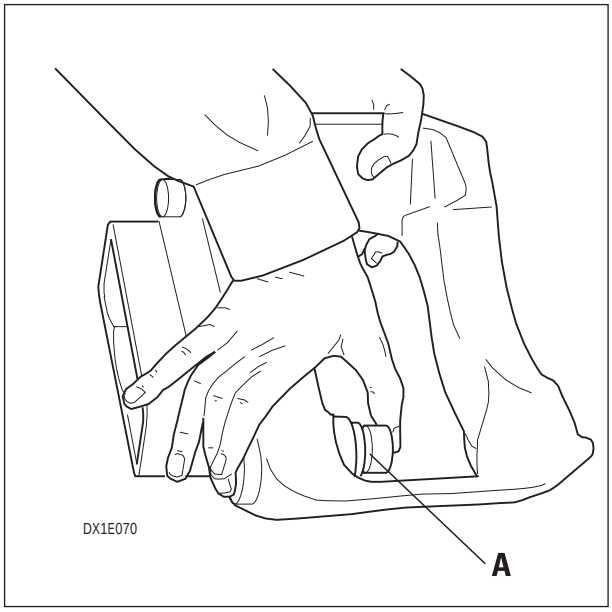


Fig. 3-36

Clean any traces of thread tightening compound from all inner threads of brake components. Use only new screws and bolts during maintenance. The use of old screws and bolts is very dangerous and can seriously affect brake performance.

9. Clean all 8 saddle pad mounting surfaces using a metal brush and a suitable vacuum cleaner.

10. Position the caliper on the saddle by aligning slide pins with the corresponding seats in the saddle.

11. Insert the new screws, with pre-applied thread locking compound and tighten to the specified torque:

Type	Torque (N•m)
DX225	500
DX195	340
DX175	240
DX225/21	340

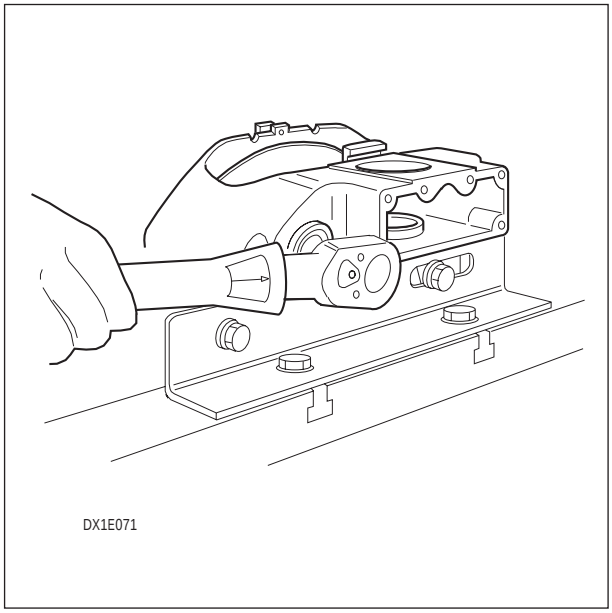


Fig. 3-37

12. Install new slide pin cap, pushing them into position with special tool **DXT12** (**DXT18** for DX175).
Before reassembly, apply DXSK 0003 sealant to cap.

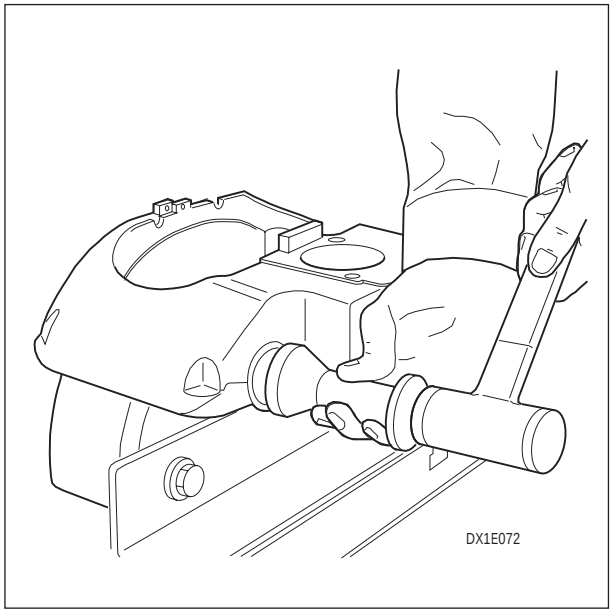


Fig. 3-38

INSPECTION OF ACTUATING AND ADJUSTING COMPONENTS

Clean and degrease all brake actuating and adjusting system components.

Never use solvents to clean brake components. Use only detergents conforming to standing regulations.

2. Inspect all bearing components and replace them if there are signs of damage, corrosion or wear.

3. Visually inspect threaded section of pistons and its corresponding adjuster sleeve.
Check for damage on flanged head of adjuster sleeve.

4. Manually check that the tightening / loosening of screws is smooth, with no jamming. If in any doubt, replace the piston / sleeve unit.

5. Inspect all gears for damage and wear. If in any doubt, replace the complete gear train box.

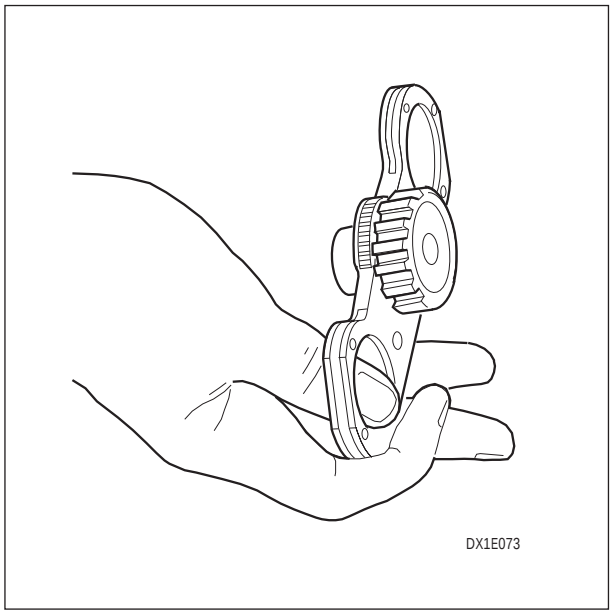


Fig. 3-39

Replacement of any damaged or worn gear should be done along with the replacement of all brake gears.

6. Check conditions and operation of unidirectional bearing mounted on the box central gear. This should be done once bevel gear (and its corresponding torque limiter) has been mounted within unidirectional bearing. Rotate bevel gear in both directions keeping box secured. All gears shall rotate only in the direction set by the unidirectional bearing.

Fig. 3-40

REASSEMBLY OF ACTUATING / ADJUSTING UNIT

1. Thoroughly lubricate adjuster plungers and then screw them into the adjuster sleeves with cylindrical gear, leaving approximately 10 loose threads.

2. Using a suitable depth gauge ensure that both sleeve / piston assemblies are equally extended. Rotate the piston inside the sleeve in order to modify the length. Use indistinctly one of the two assemblies as reference.

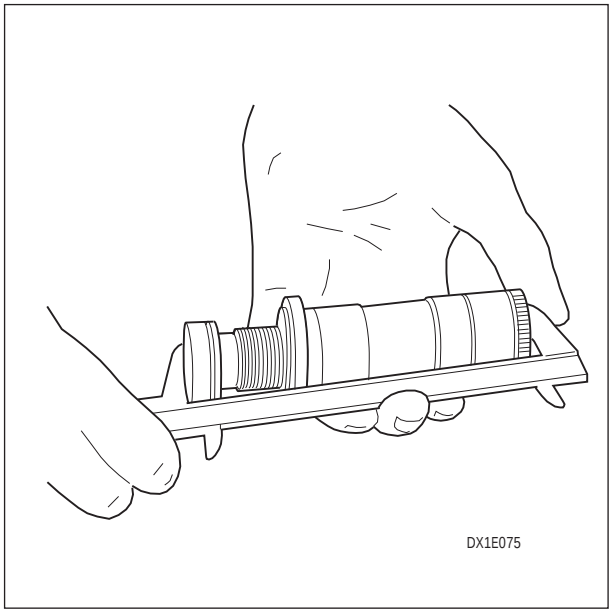


Fig. 3-41

3. Apply lubricant grease DXSK 0001 to the outside surface of both adjuster sleeves and install them on actuation block.

4. Install springs in retaining circlips.

5. Manually rotate the sleeves operating on the bevel gear, which is clamped onto them, without touching the pistons. Align the two holes on the piston head (elastic pin seat) located on the right and on the actuation block centerline (as seen from adjuster gear).

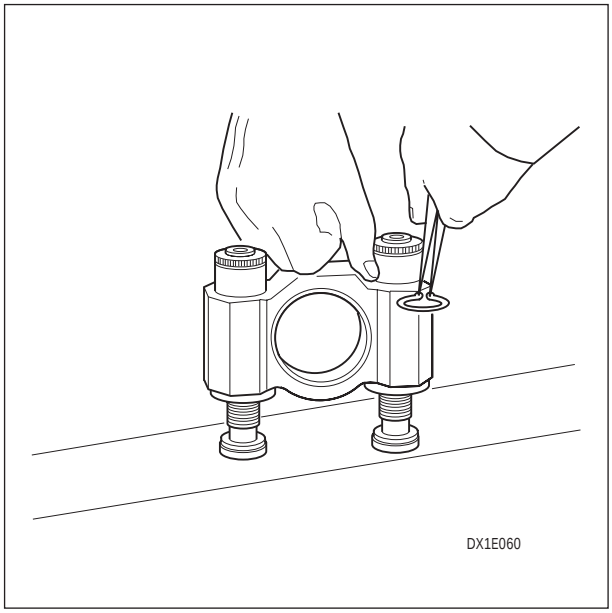


Fig. 3-42

6. Apply lubricant grease DXSK 0001 to all external surfaces of actuation block.

7. Apply lubricant grease DXSK 0001 to all 8 block mounting surfaces within the caliper.

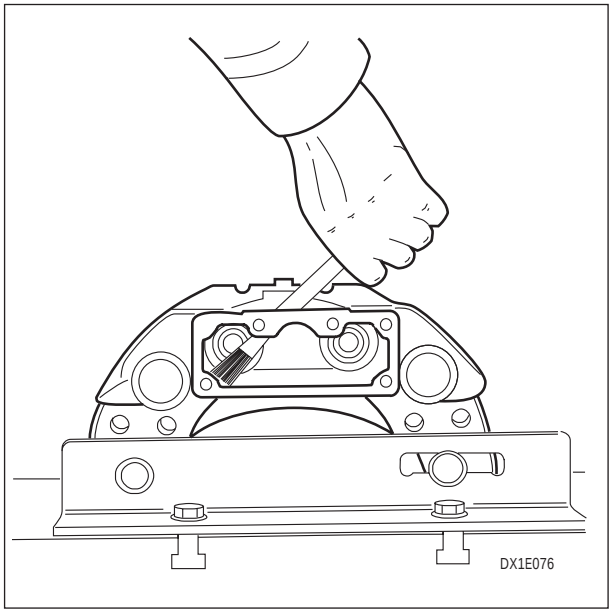


Fig. 3-43

8. Apply lubricant grease to the lower needle roller bearing, taking care not to allow the loose needle rollers to become displaced.

9. Thoroughly apply lubricant grease DXSK 0001 to all surfaces of the adjuster gear segment and position it within caliper body, supporting it against the upper edge of the roller bearing seat.

10. Install adjuster block within caliper body, making sure that threaded hole is uppermost. At this stage intervene manually in order to make sure that the collar of each boot seal is seated in the groove at the end of each piston.

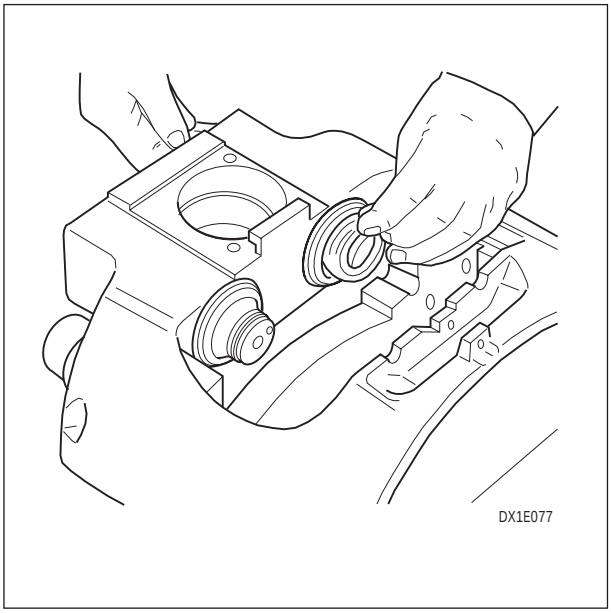


Fig. 3-44

During above steps, avoid changing pin seat locations on pistons so as not to modify previously measured calibration length.

11. Position thrust plate with its two pins and insert them in their seats on end of actuator pistons.

12. Apply thread locking compound DXSK 0004 on the two new socket head screws. Manually tighten screws in the pistons supporting thrust plate against it. Specified torque tightening shall be carried out after thrust plate has been aligned.

13. Apply lubricant grease DXSK 0001 to all surfaces of eccentric shaft. Open up and position roller bearing in seat on eccentric shaft and thoroughly lubricate rollers.

14. Insert the eccentric by passing it through the block and the adjuster gear segment. Assembly is correct when eccentric tongue is seated and engages in adjuster gear segment. Failure to fully engage it may be due to a displaced needle roller in the lower shaft bearing. Check that parts are correctly engaged by ensuring that the adjuster gear segment rotates together with the eccentric.

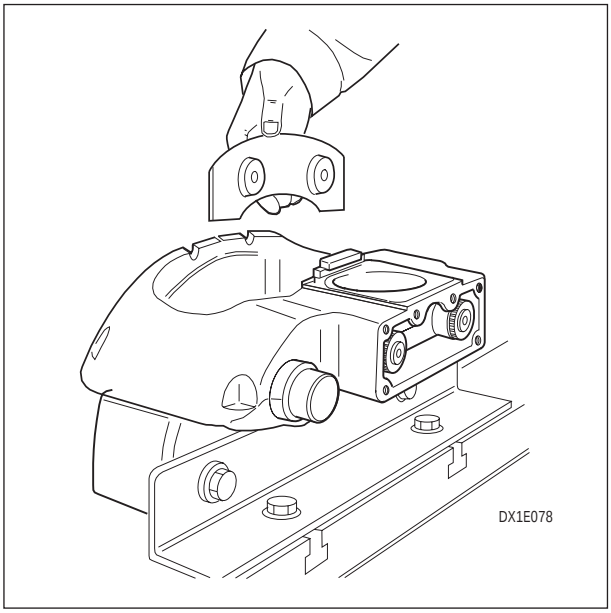


Fig. 3-45

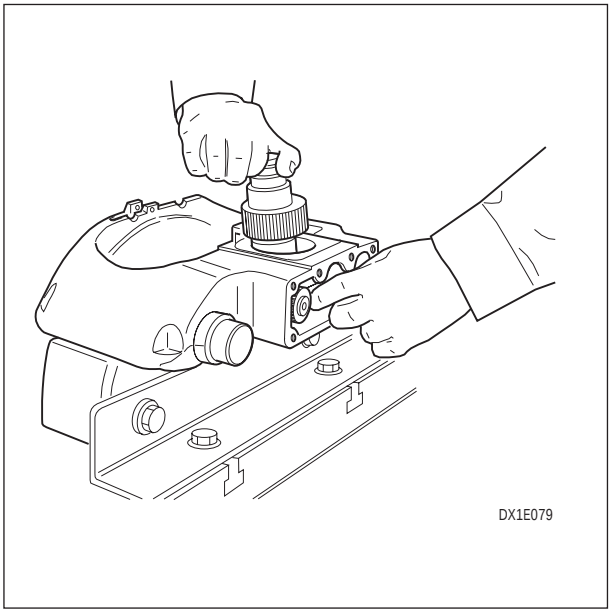


Fig. 3-46

15. Position the stabilizer bar on the caliper.

16. Thoroughly apply lubricant grease DXSK 0001 to needle roller bearing in the cover plate, taking care not to allow needle rollers to become displaced.

17 Fill grooves between cover plate seal lips with grease.

18 Apply sealant DXSK 0003 on both sides of new seal. Position seal and install cover plate securing it with two new screws (with thread locking compound previously applied) and tighten to a torque of 35 N•m.

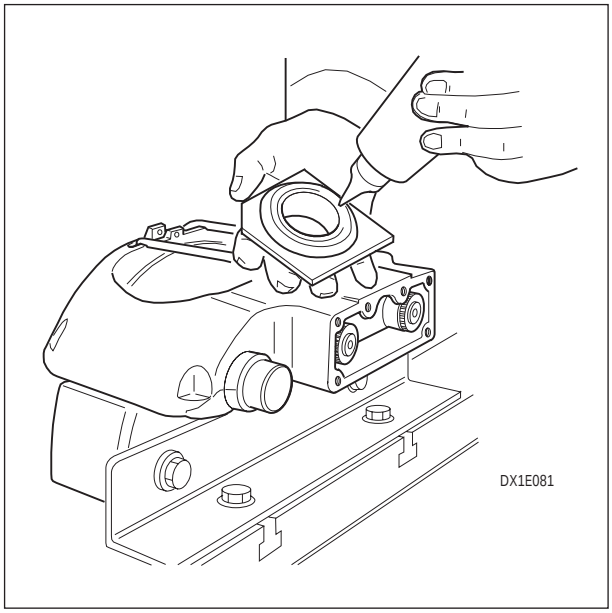


Fig. 3-47

19. Position segment adjuster gear so that the aligning notch on the middle tooth is in the central position. Proceed with the alignment positioning the mark on the base of the grooves of the two central teeth of the bevel gear at the aligning notch on the middle tooth of the gear segment.

20. Apply lubricant grease DXSK 0001 to box gear train and fit bevel gear and torque limiter assembly into it.

21. Insert box engaging loose wheel teeth to cylinder gear. If necessary, coupling is achieved by rotating cylinder gear clockwise or counterclockwise.

22. Insert first damping ring and compression spring on box central gear collar. Position second damping ring on the new screw of the adjusting device. Align and tighten to 10 N•m torque.

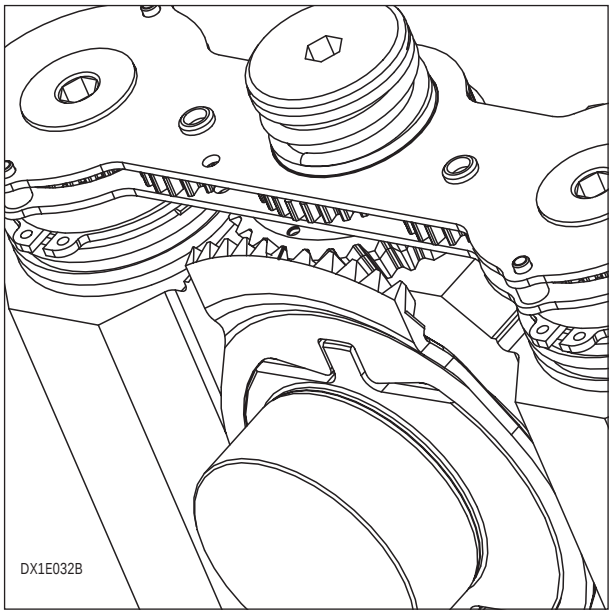


Fig. 3-48

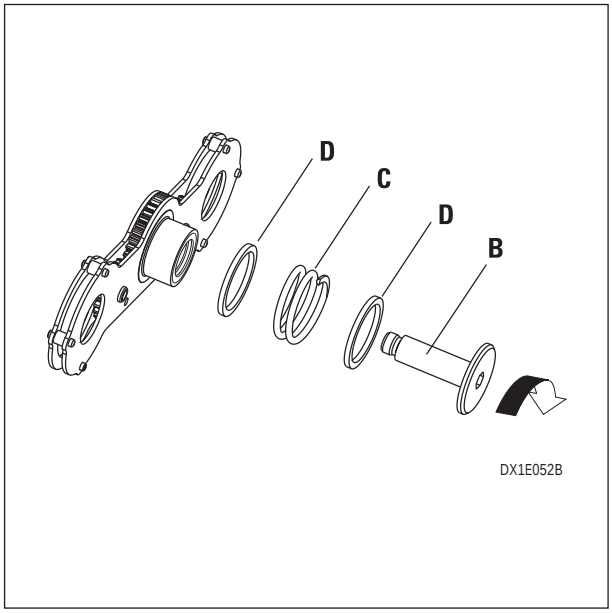


Fig. 3-49

The rubber damping rings must not come into contact with grease as this will impair efficiency.

23. Position the dust seal A on the hexagonal section of the eccentric shaft.

24. Install lever (as for disassembly, use a wedge or screwdriver if necessary) making sure that the marks on lever and eccentric are aligned.

Lever is in correct position when it completely engages in the hexagonal section of the eccentric shaft.

25. Fit clamping bolt in its seat on lever, insert nut and tighten to 30 N•m torque.

Nut location should be near the air actuator.

26. Manually engage lever several times in order to check adjustment and actuating device operation. The block should move back and forth and the gear train should turn in one direction only.

Actuating pistons should be extracted. Otherwise check that adjusting unit components are appropriate for the brake's actuating direction.

Follow diagram B when applying sealant DXSK 0003 to the end section of caliper (with or without seal). (Fig. 3-51)

27. Apply sealant DXSK 0003 on both sides of end plate's new seal. Position seal and install on end plate. Secure end plate using a set of new screws (with thread locking compound pre-applied) and using a cross diagonal sequence, tighten gradually to a final torque of:

Model	Torque (N•m)
DX225 DX195 DX225/21	100
DX175	70

28. Tighten the two countersunk screws before the others if following the standard configuration.

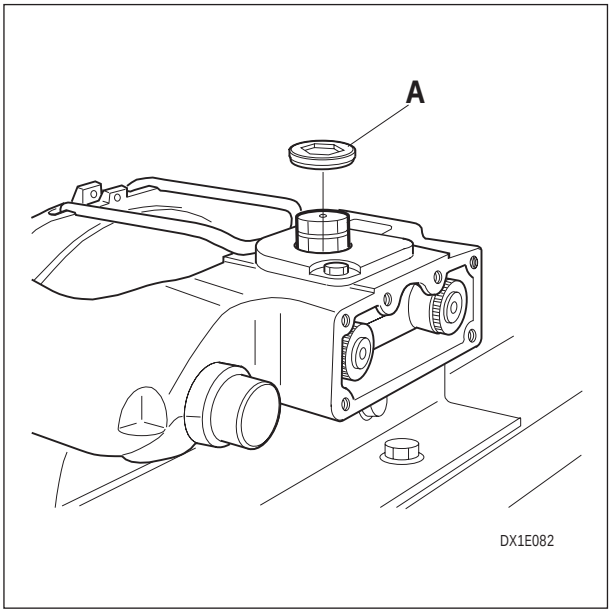


Fig. 3-50

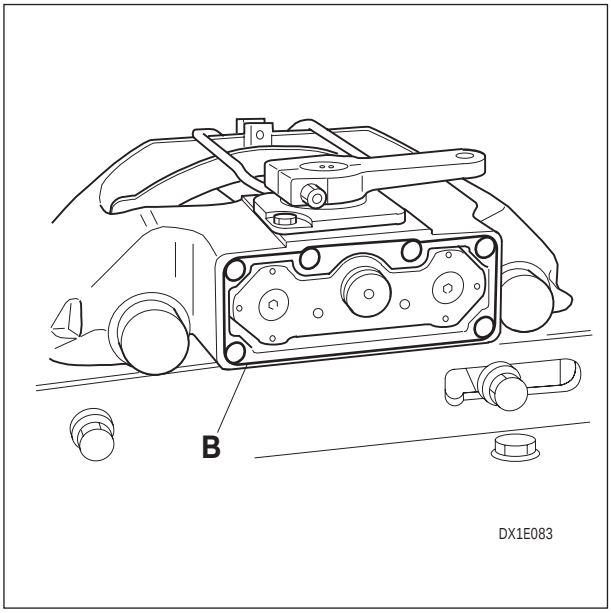


Fig. 3-51

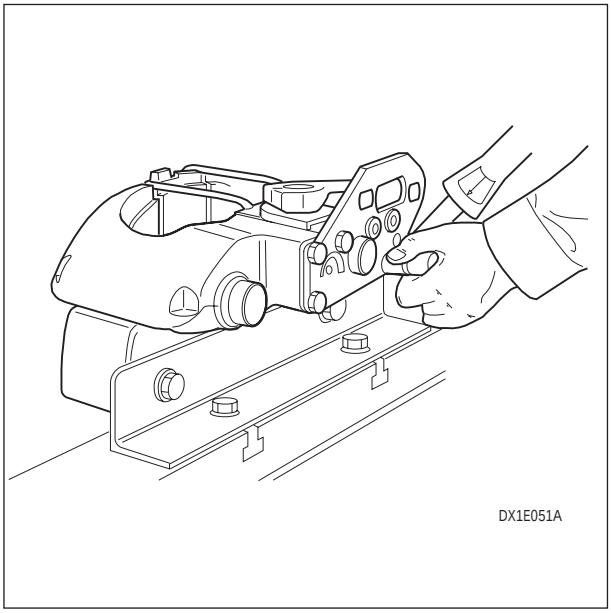


Fig. 3-52

29. Fit air chamber ensuring correct port orientation and secure it with two nuts. Follow manufacturer's recommended torque values.

30. Install clevis pin in the push rod and lever, and lock with new split pin.

Screws and bolts must not be reused. It is of vital importance that only new screws and bolts be used for reassembly.

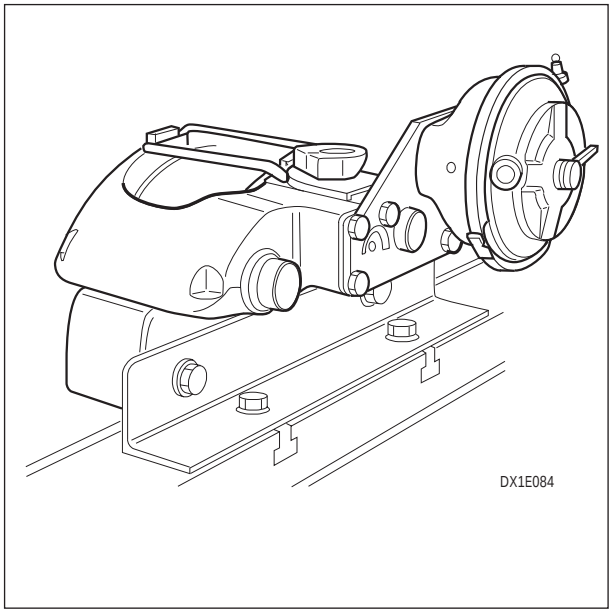


Fig. 3-53

THRUST PLATE CENTERING IN SADDLE

1. Install metal block to check parallelism between thrust plate and opposite caliper reaction surface. Push the thrust plate against metal parallelism block manually rotating adjusting system. Use 6 mm Hex wrench through adjusting hole on end plate.

Model	Tool
DX175	DXT15
DX195	DXT14
DX225	DXT13
DX225/21	DXT16

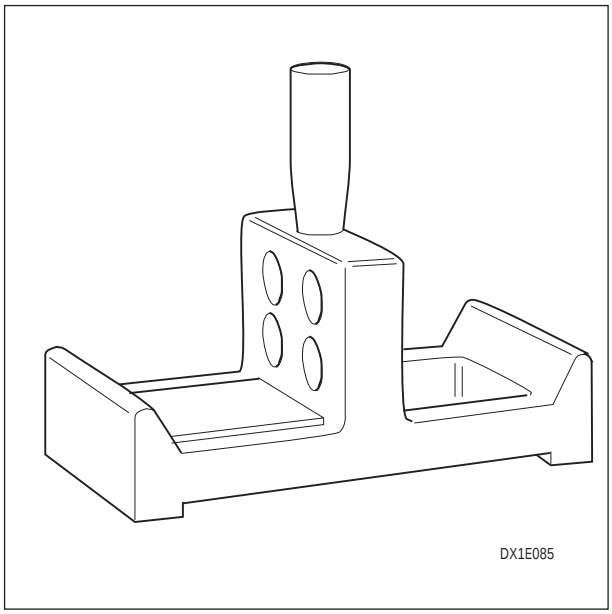


Fig. 3-54

2. Due to the eccentric actuating system the thrust plate should be positioned on a longitudinal axis with respect to the two saddle vertical axes which support the inner pad during braking. Positioning is carried out with the lever in rest position and air chamber mounted. A 0.1 mm feeler gauge should be placed between the saddle's vertical support face and the thrust plate rim in order to manually support it against the shim.

The 0.1 mm shim should be placed on the left if actuation is counterclockwise or on the right if actuation is clockwise. For further inspection insert a 0.5 mm shim from the opposite end in order to check correct thrust plate positioning.

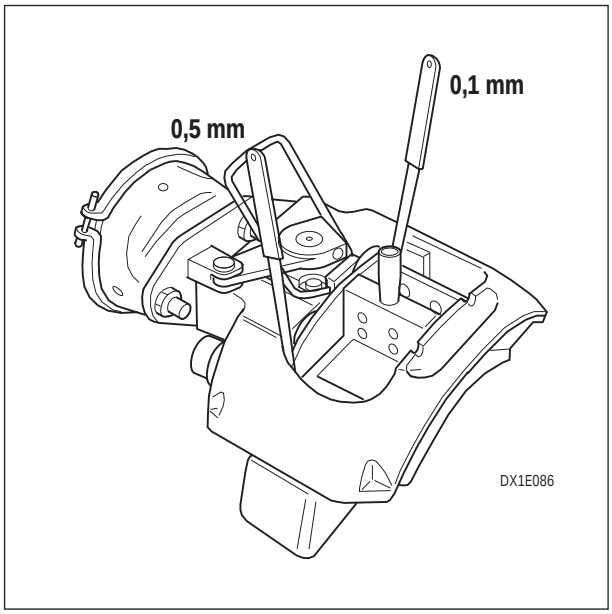


Fig. 3-55

3. Tighten one of two piston screws just enough to keep thrust plate in the calibrated position.

4. Remove feeler gauges and parallelism block, de-adjusting the brake slightly.

5. Tighten piston screws to a final torque of 85 N•m

Model	Torque (N•m)
DX225 DX195 DX225/21	85
DX175	45

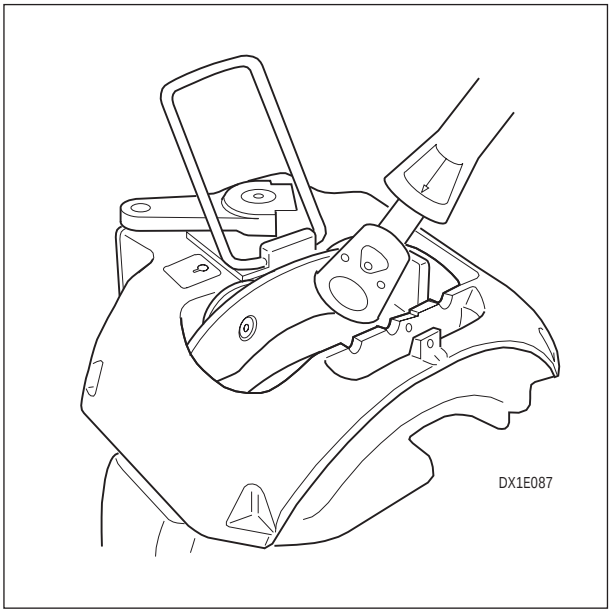


Fig. 3-56

REASSEMBLY OF BRAKE UNIT ON VEHICLE AND PAD REFITTING

1. Reassemble brake unit on vehicle securing it to the appropriate flange. Tighten screws to specified torque (values refer to standard brake configuration):

Model	Torque (N•m)	Screw
DX225	600 N•m	M20x1.5
DX195 DX225/21	290 N•m	M16x2.0
DX175	200 N•m	M14x1.5

2. For non-standard brake configurations apply specified torque for the corresponding type of screw or follow manufacturer's instructions.

3. Due to the rotor's presence, brake should be de-adjusted completely in order to position brake pads (see chapter Maintenance – Manual Adjustment, page 6).

4. Pull caliper manually outwards to position outboard pad assembly with leaf spring.

5. Push caliper manually inwards to position inboard pad assembly with leaf spring.

6. Tighten pad stabilizer bar and secure it in position with clamping pin and pin clip.

7. Adjust brake (see chapter Maintenance – Manual Adjustment, page 6).

8. Refit all air and electrical connections following vehicle manufacturer's recommendations and uncage any parking brake springs on air actuators.

9. After reassembly of brakes check for proper operation by actuating them ten times.

TORQUE CHART

Part Ref. (fig. 2-1)	Description	DX175	DX195	DX225	DX225/21
32	Adjuster device screw	10	10	10	10
27-31	End plate screws	70	100	100	100
46	Piston screws	45	85	85	85
12-14	Lever clamp bolt	30	30	30	30
37	Slide pin locking screws	240	340	500	340
9	Cover plate screws	35	35	35	35

SPECIAL TOOLS

Description	DX175	DX195	DX225	DX225/21
Puller, slide pin bushing	DXT03	DXT02	DXT01	DXT02
Installer, slide pin bushing	DXT06	DXT05	DXT04	DXT05
Installer, piston boot seal	DXT08	DXT07	DXT07	DXT07
Installer, slide pin protective cover	DXT18	DXT12	DXT12	DXT12
Installer, slide pin boot seal	DXT11	DXT10	DXT09	DXT10
Metal parallelism block	DXT15	DXT14	DXT13	DXT16
Brake support (universal)	DXT17	DXT17	DXT17	DXT17

SEALANTS AND THREAD LOCKING COMPOUNDS

Code	Description
DXSK 0003	Sealant for seals
DXSK 0004	Thread locking compound for piston screws.

TROUBLESHOOTING

Below there is a chart showing the most common faults occurring to DX family brakes.

CONDITION	POSSIBLE CAUSES	CHECKS	REMEDIES
1. Unbalanced braking	Incorrect clearance between brake pads and rotor	Check clearance	Replace caliper / saddle unit
	Incorrect initial clearance		Perform new adjustment
	Vehicle air circuit malfunction		Repair or replace any faulty components
2. Short lifetime of external pad	Caliper seized or slide pins jammed	Check for damaged slide pin boots/caps	Replace caliper/saddle unit
		After removingpads, check manually if caliper can freely move back and forth	
3. Short lifetime of pads	See 1 and 2	See 1 and 2	See 1 and 2
	Too much usage of braking system	Improper vehicle driving	Train driver
	Rotor surface	Check for cracks or signs of exposure to over-temperature	See page 7 of chapter Maintenance for rotor inspection
	Vehicle overload	Check for maximum load permitted on identification label of vehicle	Follow vehicle manufacturer's specifications on maximum load permitted
	Incorrect brake operation	Check all other brakes and air circuits on vehicle	Perform registrations or repairs, as necessary
4 Smoke coming from brakes	Brakes over-temperature	See 1, 2, and 3	See 1, 2, and 3
	Brake pads contamination	Grease, oil, or other substances on pad friction material	Inspect hub seal. Replace with a new one, if necessary. Clean rotor /caliper unit. Replace brake pads as described in Section 1.7
	Locking of actuating system	Check clearance and rubber seals	Replace caliper / saddle unit

CONDITION	POSSIBLE CAUSES	CHECKS	REMEDIES
5. Poor braking: **- braking distance too long;** **- negative driver impressions;** **- abnormal response;** **- unbalanced braking.**			
	Vehicle air circuit malfunction	Check for correct air pressure at chamber inlet	Have air circuit inspected by a qualified technician
	Brakes de-adjustment	Check if chamber actuating stroke is longer than value specified by manufacturer	Replace caliper / saddle unit See Section 1.9
	Vehicle overload	Check maximum load permitted on the identification label of vehicle	Follow vehicle manufacturer's specifications on maximum load permitted
	Brake pads contamination	Grease, oil or other substances on pad friction material	Inspect hub seal. Replace with a new one, if necessary. Clean rotor / caliper unit. Replace brake pads
	Incorrect brake operation	Check all other brakes and air circuits of vehicle	Perform registrations or repairs, as necessary
6. Oscillating or unbalanced braking	See 1 and 5	See 1 and 5	See 1 and 5
	Rotor runout and thickness variation		Replace hub / rotor unit

MEASUREMENT VALUES

MEASUREMENT VALUES (INTERNATIONAL SYSTEM)

Force in N (Newton):	Conversion:	1 N	=	0.1019 kg	
		1 kg	=	9.81 N	
Power in kW (kilowatt)	Conversion:	1 kW	=	1.36 CV	Other measurement values used:
		1 kW	=	1.34 HP	CV (Metric horsepower)
		1 CV	=	0.736 kW	HP (Horsepower)
		1 CV	=	0.986 HP	
		1 HP	=	0.746 kW	
		1 HP	=	1.014 CV	
Torque in N•m (Newton metre)	Conversion:	1 N•m	=	0.1019 kgm	
		1 kgm	=	9.81 N•m	
		1 kgm	=	10 N•m *	
Specific consumption in g/kWh (grams per kilowatt hour)	Conversion:	1 g/kWh	=	0.736 g/CVh	Other measurement values used:
		1 g/CVh	=	1.36 g/kWh	g/CVh (Grams per metric horsepower hour)
Pressure in kPa (kilopascal)	Conversion:	1 kg/cm^2	=	1 Atm	Other measurement values used:
		1 kg/cm^2	=	98.1 kPa	kg/cm^2 (Kilogram/square centimeter)
		1 kg/cm^2	=	0.981 bar	Atm (Metric atmosphere)
		1 kg/cm^2	=	1 bar *	psi (Pounds per square inch)
		1 kg/cm^2	=	14.22 psi	
		1 bar	=	100 kPa	
		1 bar	=	1.02 kg/cm^2	
		1 bar	=	14.51 psi	
		1 psi	=	6.9 kPa	
		1 psi	=	0.069 bar	
		1 psi	=	0.0703 kg/cm^2	
		1 kPa	=	0.145 psi	
		1 kPa	=	0.0102 kg/cm^2	
		1 kPa	=	0.01 bar	

* * For practical reasons N•m and bar units are converted according to 10:1 and 1:1 ratios.

CONVERSION VALUES PER ENGLISH UNITS

0.1 mm	=	3.937 mils
1 mm	=	0.039 inch
1 m	=	3.281 ft
1 km	=	0.621 miles
1 cm3	=	0.061 cu.in.
1 l	=	1.759 pts (0.88 imp. qts)
1 bar	=	14.5038 psi
1 g	=	0.035 oz. (0.564 dr.)
1 kg.	=	2.205 lbs.
1 t	=	1.102 short ton (0.9842 long ton)
0° C	=	32° F
(in case of temperature differences 1° C = 1.8° F)		

STANDARD TORQUE SPECIFICATIONS

Metric-thread nuts

Max torque for metric thread in kgm

Diam. x pitch d x p (mm)	Galvanized standard nuts		Galvanized down-sized nuts		Diam. x pitch d x p (mm)	Galvanized standard nuts		Galvanized down-sized nuts	
	MAT. 5S	MAT. 8G	MAT. 5S	MAT. 8G		MAT. 5S	MAT. 8G	MAT. 5S	MAT. 8G
5 x 0.8	0.55	-	0.35	-	**18 x 2.5**	27.00	39.00	17.00	24.50
6 x 1	0.95	1.30	0.60	0.80	**18 x 1.5**	30.50	42.50	19.00	26.50
8 x 1.25	2.30	3.20	1.40	2.00	**20 x 2.5**	30.50	54.00	19.00	34.00
8 x 1	2.50	3.50	1.60	2.20	**20 x 1.5**	42.50	60.00	26.00	37.50
10 x 1.5	4.60	6.40	2.90	4.00	**22 x 2.5**	51.00	72.00	32.00	45.00
10 x 1.25	4.90	6.80	3.10	4.20	**22 x 1.5**	57.00	80.00	36.00	50.00
12 x 1.75	8.00	11.00	5.00	6.90	**24 x 3**	66.00	93.00	41.00	58.00
12 x 1.25	8.80	12.50	5.50	7.80	**24 x 2**	72.00	100.00	45.00	63.00
14 x 2	12.50	18.00	7.80	11.00	**27 x 3**	98.00	140.00	61.00	88.00
14 x 1.5	14.00	19.50	8.80	12.00	**27 x 2**	105.00	150.00	66.00	94.00
16 x 2	19.50	27.50	12.00	17.00	**30 x 3.5**	135.00	185.00	85.00	116.00
16 x 1.5	21.00	29.50	13.00	18.50	**30 x 2**	145.00	205.00	91.00	128.00

STANDARD TORQUE SPECIFICATIONS

Metric-thread nuts

Max torque for metric thread in kgm

Diam. x pitch d x p (mm)	Screw 8.8 (8,8)			Screw 10.9 (10,9)			Screw 12.9 (12,9)		
	Standard	Galvanized	Cadmium plated	Standard	Galvanized	Cadmium plated	Standard	Galvanized	Cadmium plated
3 x 0.5	0.153	0.137	0.122	0.193	0.173	0.15	0.234	0.21	0.187
4 x 0.7	0.316	0.284	0.252	0.438	0.394	0.35	0.53	0.477	0.424
5 x 0.8	0.612	0.55	0.49	0.87	0.78	0.69	1.03	0.93	0.82
6 x 1	1.06	0.95	0.85	1.48	1.33	1.18	1.78	1.60	1.42
8 x 1.25	2.51	2.25	2.00	3.54	3.18	2.83	4.24	3.02	3.39
8 x 1	2.65	2.38	2.12	3.73	3.35	2.98	4.47	4.03	3.57
10 x 1.5	5.11	4.60	4.08	7.19	6.47	5.75	8.63	7.76	6.90
10 x 1.25	5.34	4.81	4.27	7.51	6.75	6.00	9.02	8.11	7.21
12 x 1.75	8.65	7.78	6.02	12.14	10.92	9.71	14.59	13.13	11.67
12 x 1.25	9.24	8.32	7.39	12.95	11.66	10.36	15.61	14.05	12.48
14 x 2	13.77	12.39	11.01	19.38	17.44	15.50	23.26	20.93	18.60
14 x 1.5	14.59	13.13	11.67	20.61	18.55	16.48	24.69	22.20	19.75
16 x 2	20.91	18.82	16.72	29.38	26.44	23.50	35.30	31.77	28.24
16 x 1.5	21.83	19.65	17.46	30.81	27.73	24.64	36.93	33.24	29.54
18 x 2.5	28.87	25.98	23.09	40.61	36.55	32.48	48.77	43.69	39.00
18 x 1.5	31.42	28.28	25.13	44.28	39.85	35.42	53.06	47.75	42.44
20 x 2.5	40.81	36.73	32.64	57.34	51.61	45.87	68.77	61.89	56.00
20 x 1.5	43.97	39.58	35.17	61.93	55.74	49.54	74.28	66.25	59.42
22 x 2.5	54.23	48.85	43.42	76.32	68.69	61.05	91.53	82.37	73.22
22 x 1.5	58.26	52.43	46.60	81.93	73.74	65.54	98.36	88.53	78.68
24 x 3	70.51	63.45	56.40	99.08	89.17	79.26	119.33	107.44	95.50
24 x 2	74.53	67.13	59.67	105.10	94.59	84.08	125.51	112.95	100.40
27 x 3	103.60	92.75	82.44	144.89	130.40	115.91	173.46	156.12	138.76
27 x 2	109.18	98.26	87.34	153.06	137.75	122.44	183.67	165.30	140.97
30 x 3.5	130.79	125.81	111.03	198.93	177.24	157.54	235.71	212.14	183.60
30 x 2	151.02	135.91	120.81	212.24	191.02	169.79	254.08	228.67	203.26