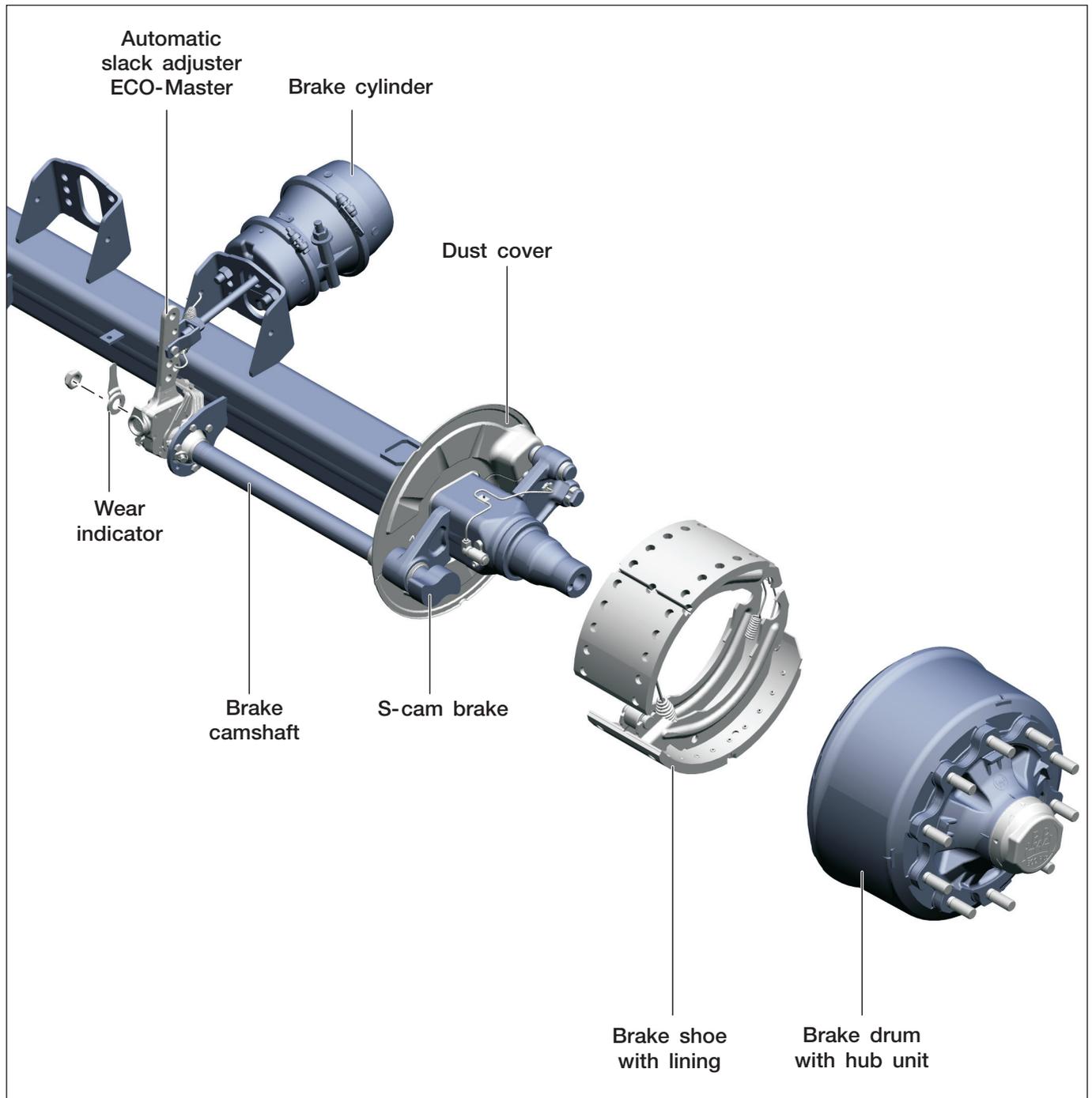


## Wear and damage characteristics on friction brakes

- Drum brake -

## Overview



## Foreword

The purpose of this publication is to explain wheel brakes for drum-braked commercial vehicles.

It is aimed at vehicle manufacturers, haulage contractors, workshops, testing centres, drivers and, in general, anyone interested in commercial vehicles.

The document serves as a guide in the assessment of possible cases of wear and damage. The objective is to provide decision aids which can be used to distinguish between normal wear and misuse of brakes.

Typical wear and damage profiles to drum brakes and their components are summarised in this catalogue. The findings, causes and repercussions of each case of damage are explained in detail.

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# Wear and damage characteristics on friction brakes

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## Introduction

Until the mid-1990s, the Simplex cam brake, which was operated with compressed air, represented the standard for heavy commercial vehicles and trailers. Whilst the disc brake has replaced the drum brake as the standard brake in the towing vehicle to a very large extent in Western Europe, the drum brake still maintains a considerable share of the market in trailers, particularly outside Western Europe.

This difference can essentially be attributed to the robustness of the brake. The closed design, which is accessible by means of dust covers, is not vulnerable to contamination by dirt even during off-road use. What makes the drum brake stand out not least of all is the low operating and spare part costs. It is less sensitive to different towing vehicles and an unfavourable tractor/trailer synchronisation.

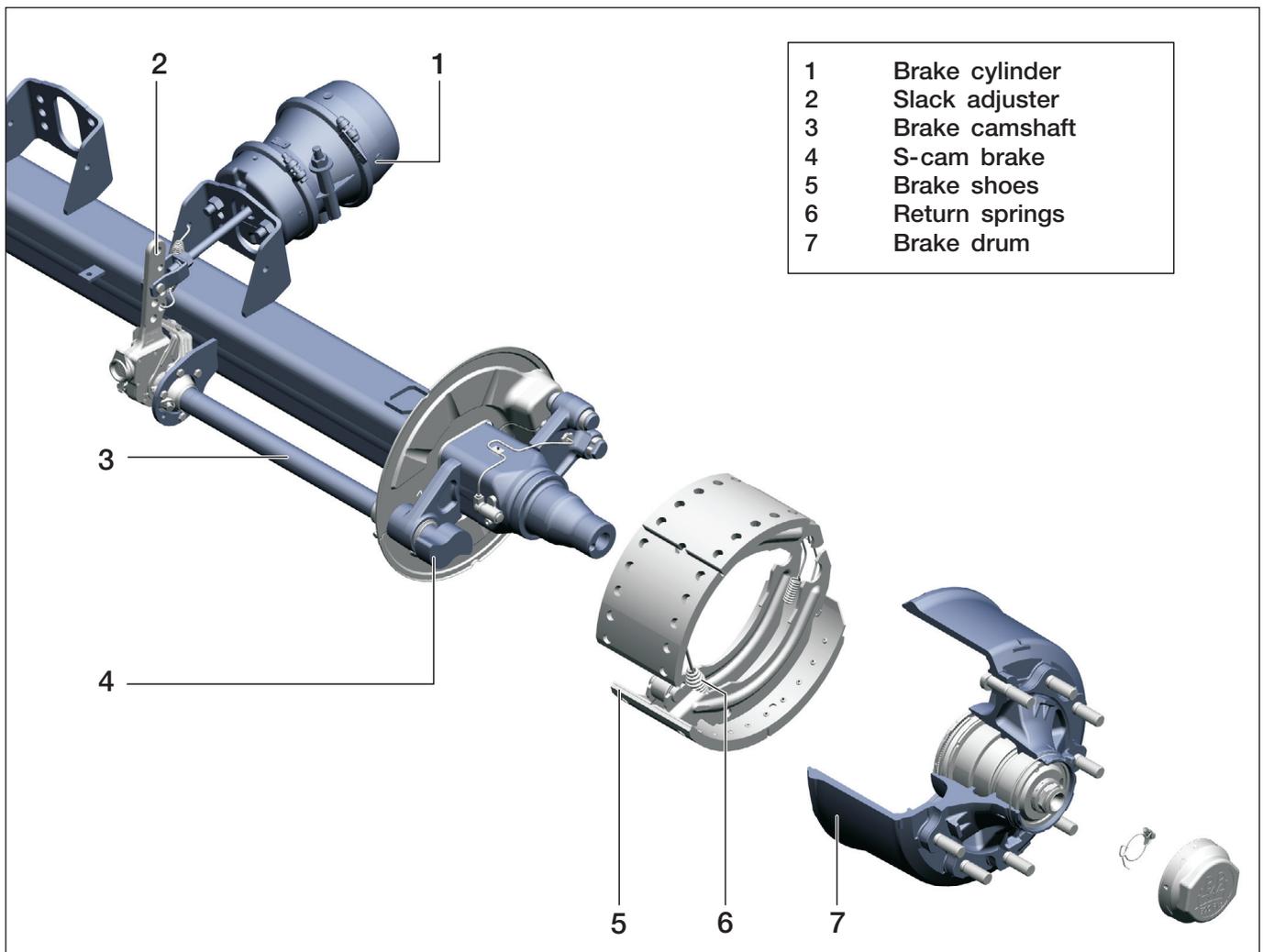
The S-cam brake offers a greater amount of wear and a constantly high braking action over the entire service life of the brake linings, compared with other drum brakes.

# Wear and damage characteristics on friction brakes

## Operation / construction

The exploded view shows a typical S-cam drum brake which is operated with compressed air for heavy trailers.

The force acting from the brake cylinder (1) makes the camshaft (3) rotate via the slack adjuster (2). The S-cam (4) expands the brake shoes (5) and presses them against the inner face of the brake drum (7). When the brake is released, the camshaft rotates the S-cam back into the neutral position. The brake shoes are returned to their starting position by the return springs (6) and external pull-off springs (if used).



## Comparison between disc and drum brakes

The choice of brake is very much dependent on its operating conditions. Both systems have appropriate advantages and disadvantages depending on the application and demands. However, if a brake is not used appropriately, it will rapidly be overloaded or underused. Optimum performance, weight, wear behaviour and service life are obtained by observing all the relevant requirements.

It is an inherent feature of its design that a drum brake is better protected against contamination by dirt than a disc brake, thanks to the former's closed design. For the same reason it is also better suited to off-road use, poor road conditions and tipper vehicles.

Tractor/trailer synchronisation is essential for optimum performance and a longer brake service life.

The operating temperatures of the drum brake are considerably lower at the same load compared with the disc brake. As a result, adjacent components, such as wheel bearings and tyres are not subject to such high thermal loads. In the event of overstressing, the brake has a tendency towards what is known as fading at very high temperatures. The brake drum expands due to the resulting temperatures and the braking power is reduced.

BPW's commercial vehicle catalogue and the relevant workshop manuals contain additional explanations or information.

## Inspection and maintenance

In order to maintain the operating and road safety of the vehicle, the maintenance work specified by the vehicle or component manufacturer must be carried out at the intervals indicated. During this, particular attention is to be paid to the condition of the braking system.

BPW components should always be maintained in accordance with the information contained in the relevant workshop manual.

Maintenance work must be carried out in specialist workshops or on the vehicle owner's premises by trained personnel in suitably equipped workshops.

Components should only be renewed by genuine components, as even tested and cleared generic products can display undesired effects when they interact with genuine components. In individual cases, using generic products can result in undesired and very costly repairs.

# Wear and damage characteristics on friction brakes

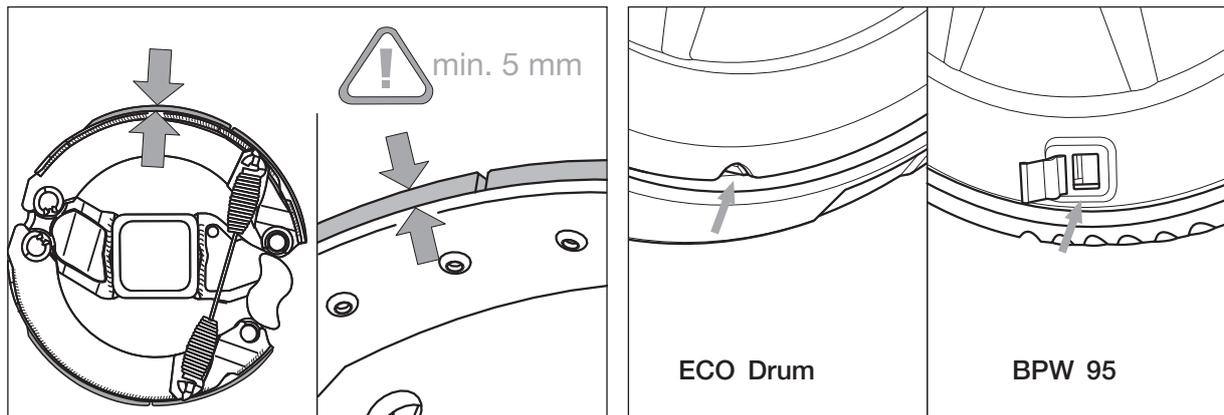
## Assessment of wear

Brake linings and brake drums are wearing parts and must be subjected to a visual examination at regular intervals.

Components which have reached their wear limit must be renewed. This is the only way to ensure that the brake has sufficient braking power in reserve for emergency braking.

### State of wear of the brake linings:

Brake linings must be renewed once the residual lining thickness coincides with the lower edge of the wear indicator. This corresponds, for example, to a residual lining thickness of at least 5 mm in the case of BPW S-cam brakes.

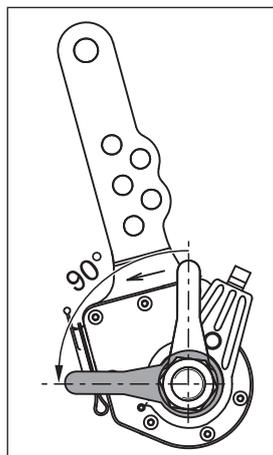


The state of wear of the brake linings can be assessed by means of the inspection holes of the dust covers.

### IMPORTANT:

It is difficult to assess the residual lining thickness, if the brake linings project laterally over the edge of the brake drum and thin wear edges are formed. In order to prevent this, BPW brake linings are equipped with wear indicator pockets. In the case of brake linings without wear indicator pockets or a similar feature, a correct assessment is only possible by measuring the residual lining thickness after having first dismantled the brake drum.

In the case of BPW's drum brake axles, which are equipped with the AGS ECO-Master with wear indicator, the state of wear of the brake linings can be easily detected. If the wear indicator has rotated by approximately 90° with respect to its starting position, the brake linings have almost reached their wear limit and must be renewed.



### IMPORTANT:

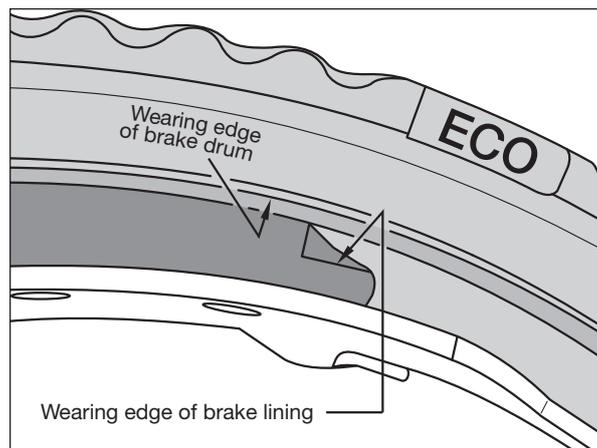
If the wear indicators of the individual wheel brakes differ considerably, the state of wear of the brake linings must be checked via the inspection holes of the dust covers, and the position of the wear indicators must be corrected if necessary.

BPW drum brake axles can be equipped with an electronic wear sensor. This allows the EBS system or the BPW Brake Monitor to indicate when the brake lining wear limit has been reached. To this end, the BPW Brake Monitor is mounted in a very visible location on the vehicle.

**State of wear of the brake drum:**

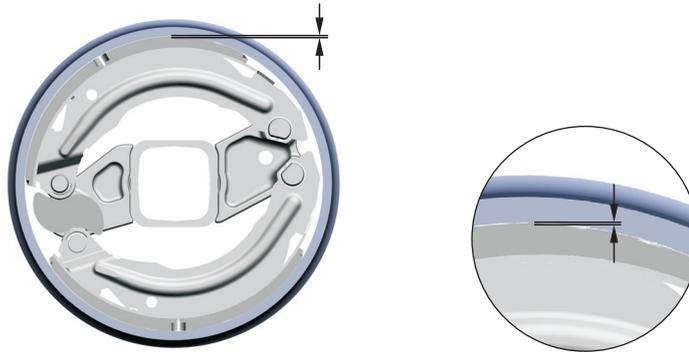
In order to assess the state of wear of the brake drum, the dust covers must be removed and the wear edge assessed. If the wear edge has almost been reached or it can no longer be clearly seen, the hub/drum assembly should be withdrawn and the inside diameter measured at the point with the greatest amount of wear.

Refer to the workshop manual for the permissible degrees of wear.



# Wear and damage characteristics on friction brakes

<b>Component:</b>	Entire brake
<b>Damage profile:</b>	Clearance of the brake too small



## Findings:

Even when the brake is not being operated, the brake lining drags on the brake drum. As a result, the brake is permanently under stress. The components can have the damage described in the damage cases on page 16 (brake drum) and page 21 (brake shoe/brake linings).

## Causes:

1. If, during the re-line of a vehicle, the surfaces of the brake drum and brake lining are not synchronised, increased elasticity of the brake can occur. This can result in over adjustment of the slack adjuster.
2. When brake linings are thermally stressed for the first time, these expand due to the liberation of organic constituents (see page 21).
3. The basic adjustment of the slack adjuster has not been carried out correctly (adjustment too narrow).

## Repercussions:

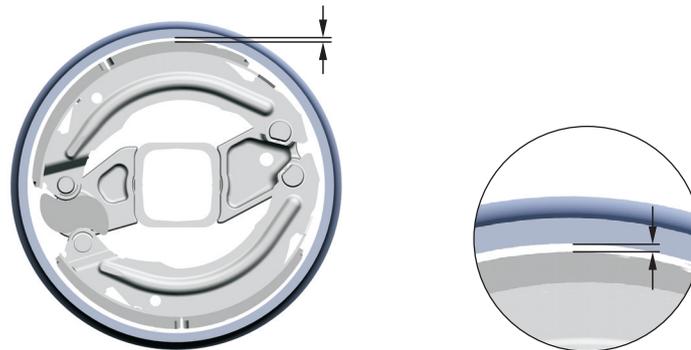
The brake lining continually drags on the brake drum, resulting in the brake increasingly heating up, so that the brake components are thermally overloaded and damaged. In extreme cases, this can result in thermal damage to the wheel bearings and the tyres.

## Remedial action:

Thermally overloaded components must be renewed. It is recommended that genuine components be used.

- For 1: It must be ensured that there is a correct contact pattern between the brake lining and the brake drum. The brake linings and brake drum may require machining, in order to achieve optimum contact with the brake contact surface of the brake drum.
- For 2: Wearing parts should in general only be renewed by tested and approved quality components. You are strongly advised not to use cheap products of a similar design but which have not been tested. In individual cases, using them can result in undesired and very costly repairs. In individual cases, using them can result in undesired and very costly repairs.
- For 3: The slack adjuster is to be adjusted and maintained in accordance with the information provided by the manufacturer.

Component:	Entire brake
Damage profile:	Excessive clearance of the drum brake



### Findings:

The clearance between the brake lining and the brake drum is excessive.

### Causes:

If the brake linings and brake drum wear, this increases the brake's clearance.

1. Automatic slack adjuster  
If the automatic slack adjuster is not adjusted or not adjusted correctly, this always results in excessive clearance.  
There can be various causes for this:
  - a) Due to the incorrect basic adjustment during assembly, correct adjustment is not possible.
  - b) After changing a lining, the clutch mechanism of the automatic slack adjuster has not been depressed correctly on resetting the brake, resulting in the destruction of the slack adjuster's adjusting device.
  - c) Bent or non-affixed auto-adjuster reaction/fixed point holders adversely affecting the function of the adjusting device.
  - d) The worm gear of the adjusting device is defective.
  - e) The bearings of the brake camshaft are worn or worn out.
  - f) The adjusting mechanism of the slack adjuster is corroding due to a lack of lubricant or the penetration of moisture, making adjustment no longer possible.
2. Manual slack adjuster  
If, in the case of a manual slack adjuster, the adjustment is not made at the right time, the wear of the brake lining and brake drum results in too large a clearance.

### Repercussions:

Excessive clearance has a negative effect on the braking power and can even result in the complete failure of the brake in question, if the travel of the brake cylinder is no longer adequate.

### Remedial action:

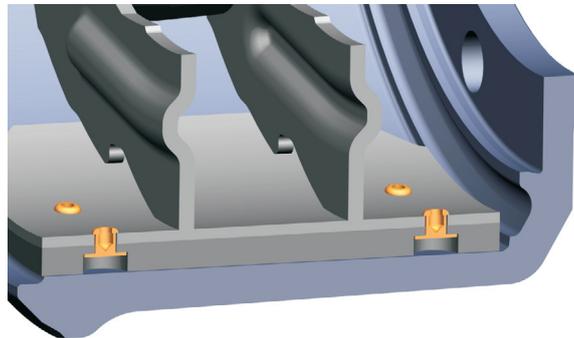
Vehicle owners and vehicle operators are obliged to carry out maintenance and services in accordance with the stipulations of the vehicle manufacturer and, in particular, are to regularly check the operational safety of braking systems.

The function of the automatic slack adjuster is to be checked in accordance with the information provided by the manufacturer. It is to be ensured that the sealing cap is correctly mounted.

In the case of vehicles with manual slack adjusters, the clearance must be regularly checked and corrected by adjusting as appropriate.

# Wear and damage characteristics on friction brakes

<b>Component:</b>	Entire brake
<b>Damage profile:</b>	Low drum wear relative to lining wear / mileage



## Findings:

The graphic shows a cross-section of a drum brake. The brake shoe is in contact, with the lining, with the brake contact surface of the drum.

The brake drum only shows a small amount of wear. The wear edge is still almost completely in place (see fig.). On the other hand, the brake lining is already considerably worn. The mileage of the entire brake is low.

## Causes:

The brake is equipped with fast-wearing brake linings.

## Repercussions:

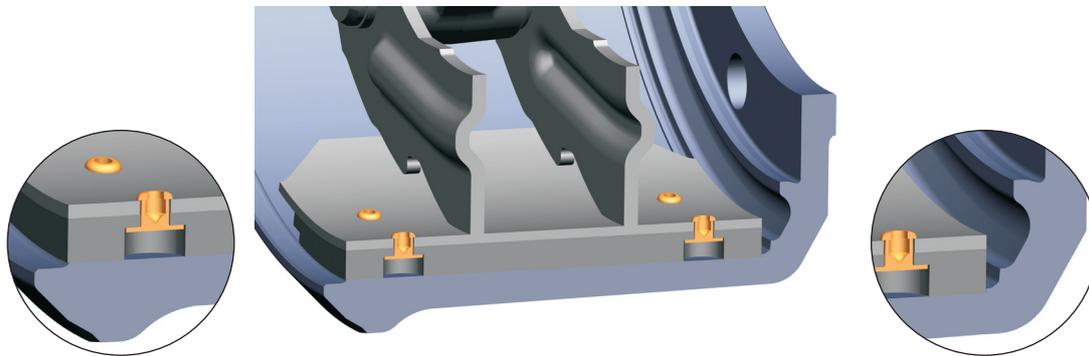
Brake linings that are not correctly matched to the drum may wear much more quickly than genuine linings. In addition, the modified friction (coefficient) pairing can have a negative effect on the braking power.

## Remedial action:

Wearing parts should in general only be renewed by tested and approved quality components. You are strongly advised not to use cheap products of a similar design but which have not been tested. In individual cases, using them can result in undesired and very costly repairs.

The combination of the genuine equipment brake drum and brake lining is selected by manufacturers to guarantee a balanced wear ratio.

Component:	Entire brake
Damage profile:	High wear of the brake drum relative to lining wear / mileage



**Findings:**

The graphic shows a cross-section of a drum brake. The brake shoe is in contact, via the lining, with the brake contact surface of the drum.

The brake linings only have a small amount of wear, while the brake drum is already considerably worn. It can be clearly seen that the linings have ground themselves into the contour of the drum (fig. on the right). The wear edge (fig. on the left) is also abraded to a large extent. The mileage of the entire brake is relatively low.

**Causes:**

The brake is equipped with brake linings which act aggressively on the drum.

**Repercussions:**

The brake linings are too aggressive and are wearing the drum brake contact surface too quickly. This will therefore reach its wear limit earlier. In addition, the modified friction (coefficient) pairing can have a negative effect on the braking power.

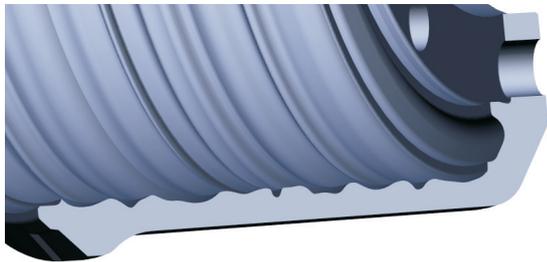
**Remedial action:**

Wearing parts should in general only be renewed by tested and approved quality components. You are strongly advised not to use cheap products of a similar design but which have not been tested. In individual cases, using them can result in undesired and very costly repairs.

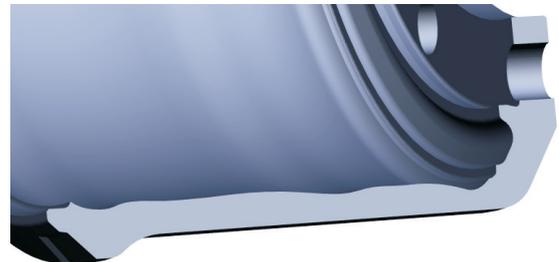
The combination of the genuine equipment brake drum and brake lining is selected by manufacturers to guarantee a balanced wear ratio.

# Wear and damage characteristics on friction brakes

<b>Component:</b>	<b>Brake drum</b>
<b>Damage profile:</b>	<b>Scoring and uneven wear due to dirt penetration</b>



a) Scoring due to coarse dirt



b) Uneven wear due to abrasive dust



## Findings:

The damage profile shows very pronounced scoring on the entire brake contact surface of the brake drum and on the brake lining. In addition, the wear of the brake drum is very high in relation to that of the brake linings. The wear limit has already been achieved and even exceeded after covering a relatively short distance.

## Causes:

The cause of such damage is generally driving on sandy and dusty roads with damaged or missing dust covers. The dirt whirled up can get into the brakes and lodge itself between the brake linings and brake drum.

Sand and dust particles cannot penetrate the hard steel of the drum, but remain on the surface and wear it down. The brake lining, on the other hand, is made of softer material. The sand particles become embedded in the surface of this material. If the lining is in contact with the drum wall during braking, it acts like sandpaper on the brake contact surface, so that the brake drum wears relatively quickly, resulting in greater wear of the brake drum and in scoring.

## Repercussions:

As the wear increases an edge is formed on the outer edge of the brake drum, which keeps the sand in the brake, thus further increasing the abrasion.

## Remedial action:

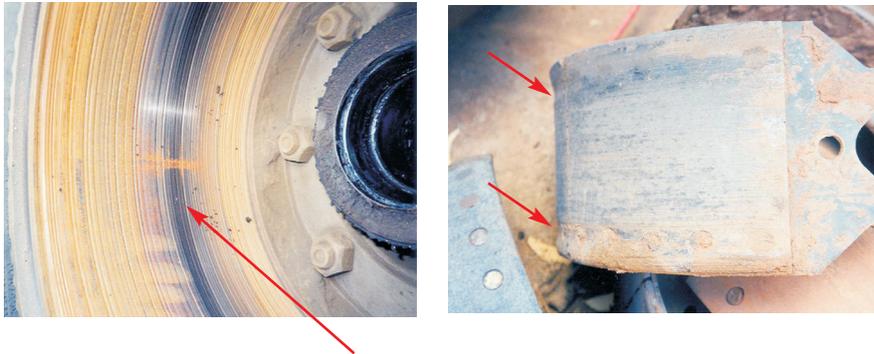
Badly uneven worn brake drums must be renewed. It is recommended that genuine components be used.

It is crucially important that the dust covers are in perfect condition, particularly when operating on unpaved roads.

Stone chips can result in deformations and damage to covers, through which dirt is able to penetrate and damage the brakes.

The condition of the dust covers must be regularly checked.

<b>Component:</b>	Brake drum
<b>Damage profile:</b>	Scoring at rivet hole intervals



**Findings:**

The damage profile shows the inner face of a brake drum. Unusually, the scoring which is pronounced to varying degrees is on the brake contact surface. The brake drum is particularly worn in the area of the brake linings' rivet holes.

**Causes:**

If dirt and moisture penetrate the brake as a result of defective or missing dust covers, the action of pressure and temperature can result in the formation of a wear-resistant compound similar to clay brick in the rivet holes. As the wear of the brake linings increases, this compound works its way into the brake drum and causes the severe scoring in the area of the rivet holes.

**Repercussions:**

If the permitted wear limit of the brake drum is exceeded, this can have the effect of weakening the brake drum.

**Remedial action:**

A brake drum which is damaged in this way must be renewed. It is recommended that genuine components be used.

It is crucially important that the dust covers are in perfect condition, particularly when operating on unpaved roads.

Stone chips can result in deformations and damage to covers, through which dirt is able to penetrate and damage the brakes.

The condition of the dust covers must be regularly checked.

# Wear and damage characteristics on friction brakes

<b>Component:</b>	Brake drum
<b>Damage profile:</b>	Scorches (heat spotting) and heat cracks



Scorches and temper colours with heat cracks starting to form



Severe heat crack formation

## Findings:

The figures show brake drums which have scorches and heat cracks with varying degrees of severity. These scorches and heat cracks are on the brake contact surface and are caused by thermal stress or overloading. The top figure shows the white colouration of the burnt coating, and the lower figure shows an extremely reddish layer of corrosion, on the outer surface of the drum.

## Causes:

Heat cracks and scorches are signs of a thermally highly loaded or overloaded brake.

Such overloading often occurs as a result of severe braking from high speeds. This occurs particularly frequently during inappropriate and aggressive driving. The brake contact surface is heated up considerably and very rapidly, whilst the outer area of the brake drum is still relatively cold. These high temperature differences result in a plastic deformation of the inner surface, resulting in visible cracks occurring during cooling.

## Repercussions:

Surface cracks which do not extend right up to the edge area of the brake drum are normal signs of a brake which is being subjected to considerable stresses for short periods of time.

The edges of the heat cracks projecting from the brake contact surface wear the brake linings considerably, so that the latter reach their wear limit much more quickly.

Deeper cracks extending into the edge area of the brake contact surface or which connect together to form longer cracks reduce the stability of the brake drum. Such cracks can, in extreme cases, lead to the fracture of the brake drum.

## Remedial action:

Brake drums with severe heat crack formation must be renewed. It is recommended that genuine components be used.

Appropriate and foresighted driving can help to avoid this type of overloading.

<b>Component:</b>	Brake drum
<b>Damage profile:</b>	Cold fracture of a brake drum



**Findings:**

The figure shows a fractured brake drum. The original coat of paint is still in place, which shows that the brake drum has not experienced any thermal loads or has only experienced slight thermal loads. The mileage is low.

**Causes:**

Hairline cracks can occur in the brake drum as a result of poor handling, severe impacts or other use of force during the transportation of the axle. If these are only very small or inside the structure, it is possible for them to be overlooked when the brake drums are fitted on the vehicle.

**Repercussions:**

The scarcely visible hairline crack expanded in the material during heavier braking and resulted, in the end, in the destruction of the brake drum.

**Remedial action:**

If such damage exists the brake drum is to be immediately renewed.

If there is any suspicion of damage prior to installation of the brake drum, it should not be used for safety reasons.

Despite their robust construction, it is essential that axles and brake drums are handled carefully, in order to avoid causing prior damage to them.

# Wear and damage characteristics on friction brakes

**Component:** Brake drum

**Damage profile:** Brake drum with radial run-out (ovality), eccentricity or impact



a) Brake drum with radial run-out



b) Brake drum with eccentricity or impact

## Findings:

The graphics show deformed brake drums. The contact of the brake shoes with the drum brake contact surface is uneven as a result of the shape deviations.

## Causes:

Brake drums running out of true may be the consequence of improper wheel assembly, during which the wheel nuts have been incorrectly tightened, or the mounting faces on the rim or hub side are not level or are heavily contaminated. The resulting strains are transmitted to the brake drum.

Oval deformation can occur if a vehicle is parked with extremely hot brakes. The brake drum warps under the pressure of the parking brake, cools and retains the oval form even after the brake is released.

Radial run-out and eccentricity can also be the consequence of unstable production processes or too large production tolerances being selected during brake drum production.

## Repercussions:

Deformations of brake drums manifest themselves during driving through a considerably vibrating, pulsating braking action. In addition, uneven tyre wear as well as increased wear of the brake linings may be the consequence. High thermal localised stresses can also occur giving rise to brake drum fracture.

## Remedial action:

The wheels should be dismantled, the mounting surfaces checked and, if they are very contaminated, these should be cleaned. The wheels are then to be expertly assembled.

In the event of a continued pulsating braking action, the brake drum must be renewed. It is recommended that genuine components be used.

<b>Component:</b>	Brake drum
<b>Damage profile:</b>	Brake contact surface corrosion



**Findings:**

The brake drum has slight surface rust on the brake contact surface. The contact area of the brake linings with the brake drum can be clearly seen.

**Causes:**

If moisture penetrates the brake as a result of cleaning with high-pressure cleaners or during wet weather, particularly near the sea, surface rust may possibly form on the brake contact surface within a matter of only a few hours.

**Repercussions:**

The surface rust does not have any detrimental effect on the braking power and the component service life, as this slight rusting is worn away during subsequent braking operations.

**Remedial action:**

No particular remedial measures are required in the case of the formation of surface rust.

In the case of more severe corrosion, e.g. following long laid-up periods, the brake drum must be renewed. It is recommended that genuine components be used.

# Wear and damage characteristics on friction brakes

<b>Component:</b>	Brake shoe
<b>Damage profile:</b>	Scoring and uneven wear due to dirt



## Findings:

The linings shown are considerably worn and scored. The scoring runs over the entire surface of the brake lining. The average lining thickness still has a large amount of wear left.

## Causes:

The cause of such damage is generally driving on unpaved or dirty roads with damaged or missing dust covers. The dirt whirled up can get into the brakes and lodge itself between the brake linings and brake drum. The rotating motion causes the sand and grit particles to be ground between the brake contact surfaces of the brake drum and the brake lining and causes the scoring which can be seen. (Please also see page 14).

## Repercussions:

The particles of dirt in the brake wear the brake drum and brake lining very quickly and unevenly. In addition, the formation of friction carbon on the lining surface is prevented. The layer of friction carbon increases the friction between the brake drum and brake lining and therefore also the braking power. Without friction carbon, the brake loses effect. In the worst case, all of the brakes of the vehicle provide different braking power.

## Remedial action:

In the case of severe scoring, the components affected are to be repaired or renewed. It is recommended that genuine components be used.

It is crucially important that the dust covers are in perfect condition, particularly when operating on unpaved roads. Stone chips can result in deformations and damage to covers, through which dirt is able to penetrate the brakes and cause damage.

The condition of the dust covers must be regularly checked.

**Component:** Brake shoe

**Damage profile:** Thermal overloading of the brake linings



### Findings:

The damage profiles show a thermally overloaded brake lining. It has incipient cracks and tears in particular in the area of the rivet holes. The breaks are no longer within the permissible range. The brake lining has not yet reached its wear limit.

### Causes:

Thermal overloading is responsible for the damage to the brake lining. There may be various causes for this: If all the brakes of the vehicle observed have a similar wear profile, a defective tractor/trailer synchronisation or inappropriate and aggressive driving may be the cause of the thermal overloading of the brake. If only one wheel brake shows signs of thermal overloading, a defect in the adjusting device or in the brake circuit may have prevented the brake from being released, resulting in the brakes overheating (see page 10). If, when the linings were changed, substandard products were fitted, High thermal stresses and, as a consequence, thermal overloading or even overheating can occur. Excessively oversized linings can also result in 'brake drag' in the brake drum during initial running, giving a similar effect.

### Repercussions:

The overheating causes the lining binding materials to decompose, so that the lining structure changes and the lining wears more quickly. In addition, the lining becomes porous and cracks and breaks, which can in extreme cases, result in the total failure of the brake. The extreme heat in the brake quickly extends to the wheel bearings and the tyres. If such damage is not detected in good time, this may result in damage to the wheel bearings and tyres and, in extreme cases, even in a vehicle fire.

### Remedial action:

Brakes with such a damage profile should be renewed including the wheel bearings and seals. It is recommended that genuine components be used. If the damage affects all of a vehicle's brakes, the compressed air braking system is to be checked and the tractor and trailer are to be synchronised. Appropriate and foresighted driving can help to avoid thermal overloading of the brakes. If the damage only affects one of a vehicle's brakes, all of the braking-related components and valves of the braking circuit in question must be checked. The use of an anti-jack-knife brake is never recommended, even if this is permissible in some countries.

# Wear and damage characteristics on friction brakes

<b>Component:</b>	Brake shoe
<b>Damage profile:</b>	Brake lining with projecting lining edge



## Findings:

This brake lining has reached its wear limit. The lining edge projects upwards into the drum recess. The lining is evenly worn and does not have any excessive scoring, heat cracks or material breaks, leading to the conclusion that the brake has been subjected to normal stresses.

## Causes:

The brake lining is projecting slightly laterally over the drum brake contact surface.

## Repercussions:

The braking action and the component service life are not adversely affected by this brake lining edge. However, when the brake is merely checked via the inspection holes, it is impossible to make correct judgements about the amount of wear, if the visible outer edge is attributed to the usable residual lining thickness.

## Remedial action:

The drum must be removed in order to be able to make a reliable assessment of the state of wear of brake linings which do not have wear pockets or a wearing edge.

In order to exclude the possibility of an incorrect judgment as described above, genuine linings made by BPW are equipped with wear pockets in the area of the inspection holes.

<b>Component:</b>	Brake shoe
<b>Damage profile:</b>	Brake lining below the permissible minimum thickness



**Findings:**

This brake shoe has been worn beyond the wear limit. The surface of the brake lining shows an even wear pattern without any signs of thermal or mechanical overloading. The rivet heads are considerably ground down. Parts of the brake lining have been torn off.

**Causes:**

The cause of such a damage profile is failure to comply with the brake lining wear limit.

**Repercussions:**

The brake is no longer road safe in this condition, as it no longer has the necessary amount of braking power in reserve. There is a risk of a total failure of the brake as a result of the S-cam rotating over-centre. The brake drum is also damaged or even destroyed by means of the friction contact with the rivets.

**Remedial action:**

Brake linings which have reached their wear limit must be renewed. This is the only way to ensure that the brake still has sufficient braking power in reserve for emergency braking. It is recommended that genuine components be used.

Vehicle owners and vehicle operators are obliged to carry out maintenance and services in accordance with the stipulations of the vehicle manufacturer and, in particular, are to regularly check the operational safety of braking systems.

BPW drum brake axles can be equipped with an electronic wear sensor. This allows the EBS system or the BPW Brake Monitor to indicate when the brake lining wear limit has been reached. To this end, the BPW Brake Monitor is mounted in a very visible location on the vehicle.

## Wear and damage characteristics on friction brakes

**Component:** Brake shoe

**Damage profile:** Detached half of brake lining as a result of too high rivet forces or incorrect rivet sequence



### Findings:

The figure shows a brake shoe with a completely detached lining half. The bases are torn out in the area of the lining's rivet holes, the rivets are still in the brake shoe's holes.

### Causes:

If brake shoes are fixed to the brake shoe using rivet forces which are too high, the base of the rivet is crushed by excessively high rivet forces.

An incorrect riveting sequence may also lead to the damage profile shown above due to distortion of the lining.

### Repercussions:

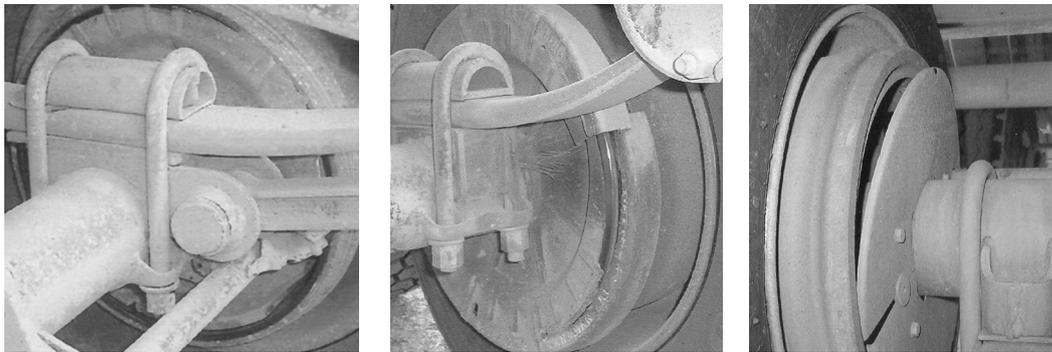
In both cases, the lining material sustains prior damage so that the rivet connection between the brake lining and the brake shoe loosens. The braking forces then lead to ruptures in the lining material in the area of the rivet holes. The brake linings break or become completely detached from the brake shoe.

### Remedial action:

Brake linings which have sustained prior damage due to too high rivet forces or distortion must be renewed. If the holes in the brake platform have also been distorted, then the whole brake shoe must be renewed.

The tightening of the rivets of the brake linings, when changing linings, must be carried out exactly in accordance with the stipulations of the manufacturer. It is recommended that genuine components be used.

<b>Component:</b>	Dust covers
<b>Damage profile:</b>	Bent and damaged dust covers



**Findings:**

The damage profiles show bent and damaged dust covers, from which parts have been broken off partly due to rubbing.

**Causes:**

In particular, during use of the vehicle on unpaved roads, foreign bodies, such as stones or pieces of wood can bend, damage or completely tear off the dust covers. As a result of these deformations and damage to the plates, dirt can penetrate the brake and damage it.

**Repercussions:**

There is then nothing to prevent road dust and foreign bodies from penetrating the brake and then rubbing between the drum and brake lining - increasing the wear of the brake drum and brake lining (see pages 14, 15 and 20).

In addition, in the case of snow, mud, etc. penetrating the brake, it must be expected that the braking effect will be adversely affected.

**Remedial action:**

Damaged or missing dust covers must be renewed. The remaining components of the wheel brake in question must be checked and, if they are damaged, these must also be renewed. It is recommended that genuine components be used.

It is crucially important that the dust covers are in perfect condition, particularly when operating on unpaved roads.

The condition of the dust covers must be regularly checked.

## Wear and damage characteristics on friction brakes

**Component:** Brake cylinder

**Damage profile:** Brake cylinder mounting face torn out due to loose screw connection



### Findings:

The screw fixing stud(s) of the brake cylinder are torn out. Signs of a fatigue fracture can be seen on the fracture surfaces of the brake cylinder.

### Causes:

Brake cylinders are able to handle running gear movements and road bumps without damage. In the case of poor road conditions or during off-road use, impacts can be transmitted to the brake cylinder, which can ultimately lead to fatigue fractures in the housing. This process is accelerated in particular if the screw connections on the brake chamber bracket are loose. Defective shock absorbers can also result in extremely high axle accelerations, which can result in the damage profile indicated.

### Repercussions:

The movement of the piston rod pushes the brake cylinder away from the brake chamber bracket, instead of controlling the slack adjuster and brake camshaft. This cylinder is no longer able to operate the brake.

### Remedial action:

Damaged parts must be renewed. It is recommended that genuine components be used.

When driving on poor road surfaces and off-road, the firm seating of the screw connection, as well as the condition of the brake cylinder and the chamber bracket must be regularly checked.

Vehicle owners and vehicle operators are obliged to comply with the stipulations of the vehicle manufacturer for off-road use and to have the vehicles regularly maintained and repaired by a specialist workshop.

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