

# SHOP MANUAL



## **GUIDANCE FOR REUSABLE PARTS**

# **BRAKE DRUMS (FOR DUMP TRUCKS)**



GUIDANCE FOR REUSABLE PARTS  
**KOMATSU**

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# INTRODUCTION

Brake drums are used together with brake shoes and have an extremely important role to play in machine braking systems. For this reason, if the user does not take proper care of the machine operating conditions or carry out repairs of sufficiently high quality, there is a possibility that a fatal accident might occur. Accordingly, special care is needed to ensure that inspections and repairs are carried out so that the optimum braking performance will be available at all times.

Taking as examples the brake drums of internally expanding type brakes (excluding caliper disc brakes and multidisc brakes) used on dump trucks, this Guide to Reusable Parts describes the causes and symptoms of various kinds of damage and provides photographs to help you judge whether the parts can be reused. The examples of damage give emphasis to the wear surface between the drums and brake shoes. For details about the allowable wear limits, see the shop Manual.

We hope that this Guide to Reusable Parts will be actively used by persons involved in the troubleshooting and repair of brake drums and that they will not only give careful consideration to daily preventive maintenance but also endeavor to discover potential failures at an early stage. We will be pleased if this booklet makes it possible to prevent recurrence of failures by helping you make correct judgements of the causes of failures and if it leads to reduced repair costs through the proper replacement and repair of component parts.

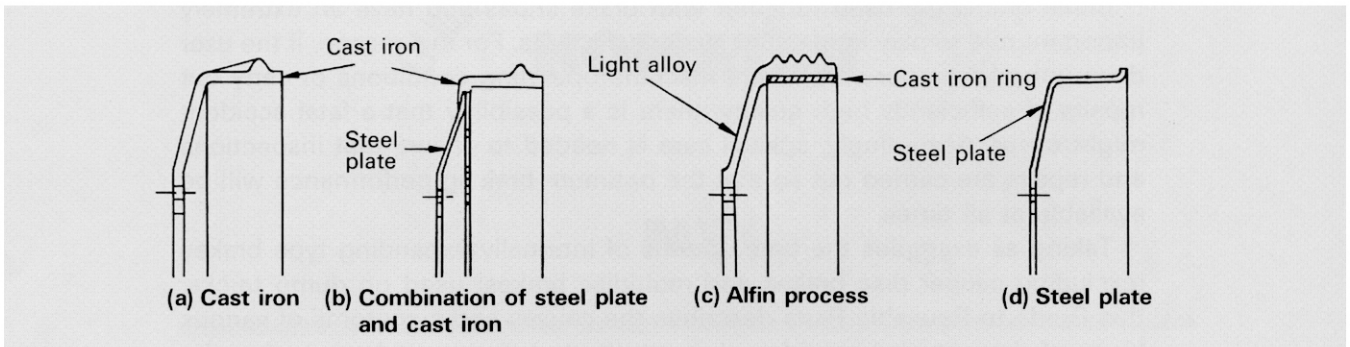
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# SHAPE AND MATERIAL OF BRAKE DRUMS

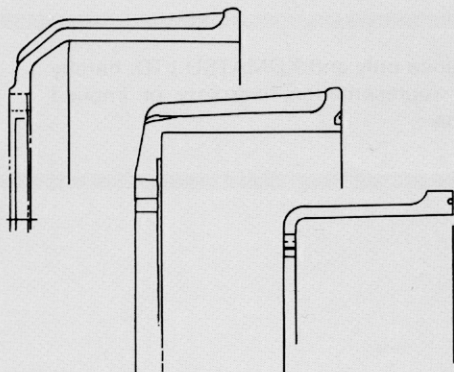
Generally, the brake drums used on passenger cars are made of cast iron, though sometimes the contact surface is made of steel plate and sometimes gilled aluminum is metallurgically bonded to the cast iron contact surface. The structural portion of the brake drum not only has strength and rigidity, but also good friction characteristics, heat resistance, wear resistance, heat capacity and heat radiation. In terms of friction characteristics, the brake drums are made to have a high and stable coefficient of friction.



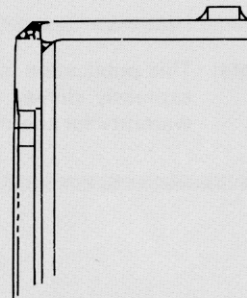
Structure of Brake Drums on Komatsu Dump Trucks

Machine Model	HD180	HD200	HD320 HD325	HD460 HD465	HD680	HD785	HD1200	HD1200M	HD1600M
Cast iron	Parking: front-rear	Parking: front-rear	Parking	Parking	Parking	Parking	Parking	—	Parking
Steel plate welded structure	(Option)		Front	Front	Front	Front	—	Parking	—
	○	○	○	○	○	○	○	○	○

Shape of Cast Iron Brake Drum (Example)



Shape of Steel Plate welded Structure Brake Drum (Example)



# CAUSES AND SYMPTOMS OF BRAKE DRUM DAMAGE

## 1. Service brakes

The service brakes are used at ordinary times and involve the simultaneous action of both front and rear brakes. Damage to the brake drums occurs not only because of mechanical failure, but also because of inappropriate operation of the brake which can lead to overheating and repeated heating and cooling of the brake drums.

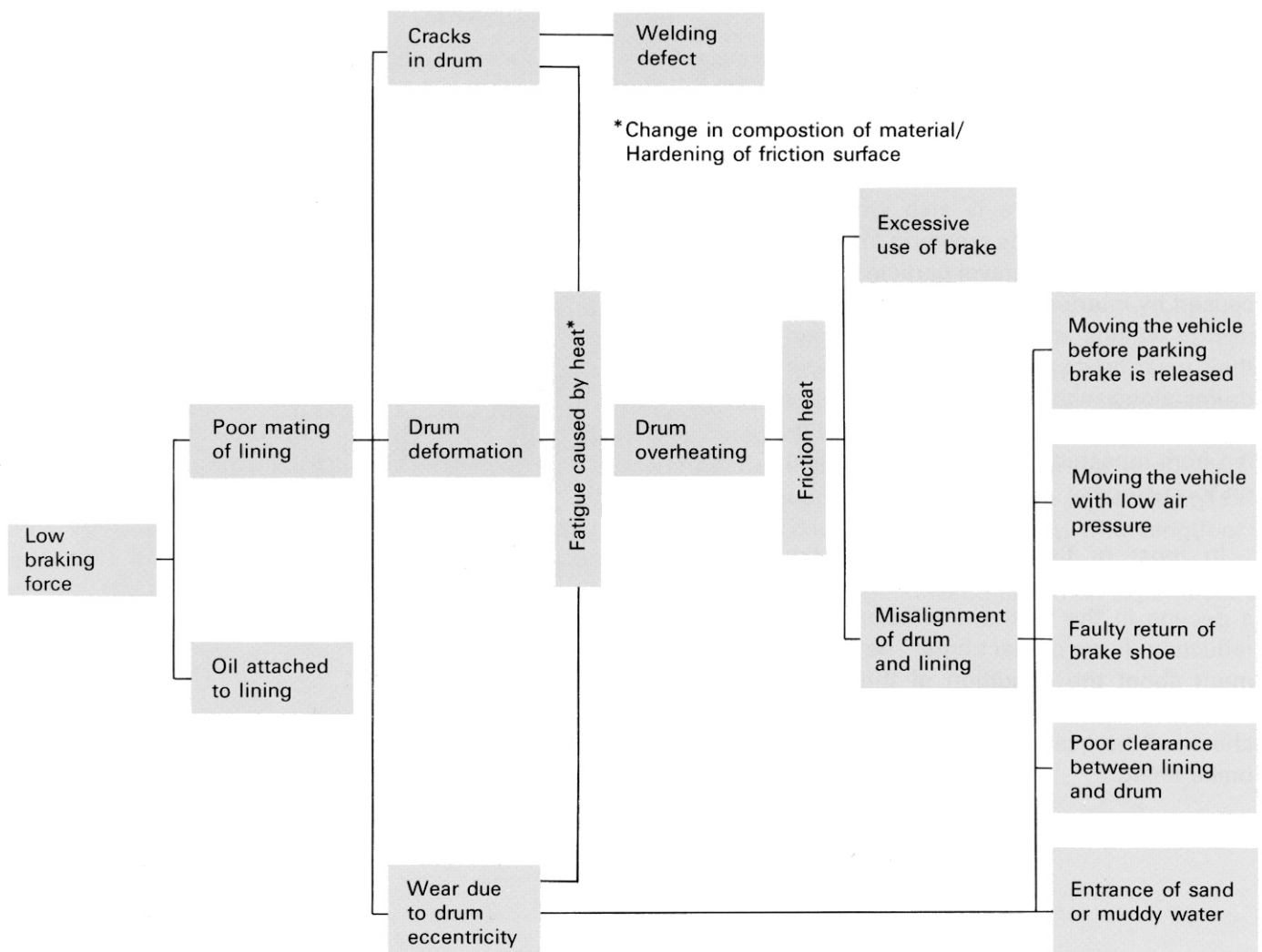
## 2. Parking brake

The parking brake is applied after the vehicle has been brought to a stop and is used to prevent it from moving, so the main causes of damage to the brake drums are mechanical (such as eccentricity of the drum) or inappropriate operation of the parking brake, for example:

- Actuating it before the vehicle has come to a complete stop,
- Moving the vehicle while the parking brake is applied,
- Moving the vehicle even though the air pressure is low.

(The parking brake is provided with a function to actuate automatically while the air pressure is low.)

## Causes of Brake Drum Damage

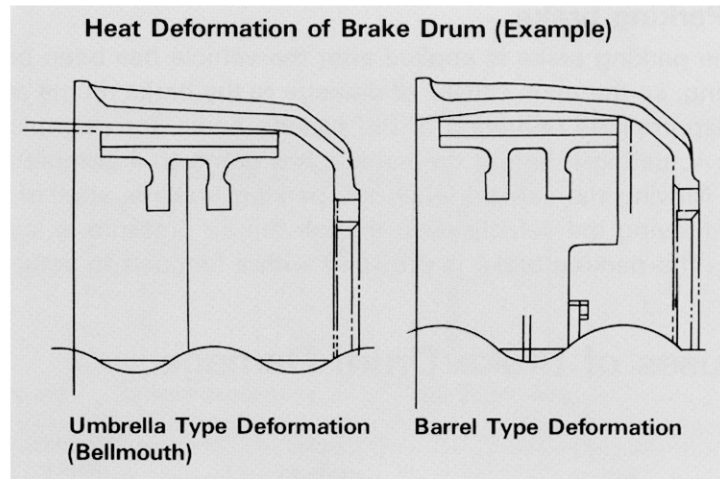


## Symptoms of Damage

The symptoms of drum damage can be divided into strain or deformation caused by the influence of heat inside the drum, discoloration or cracks of the friction surfaces, cracks in welded portions, and abnormal wear due to scratches.

### Causes of Strain Deformation, Discoloration, and Cracks

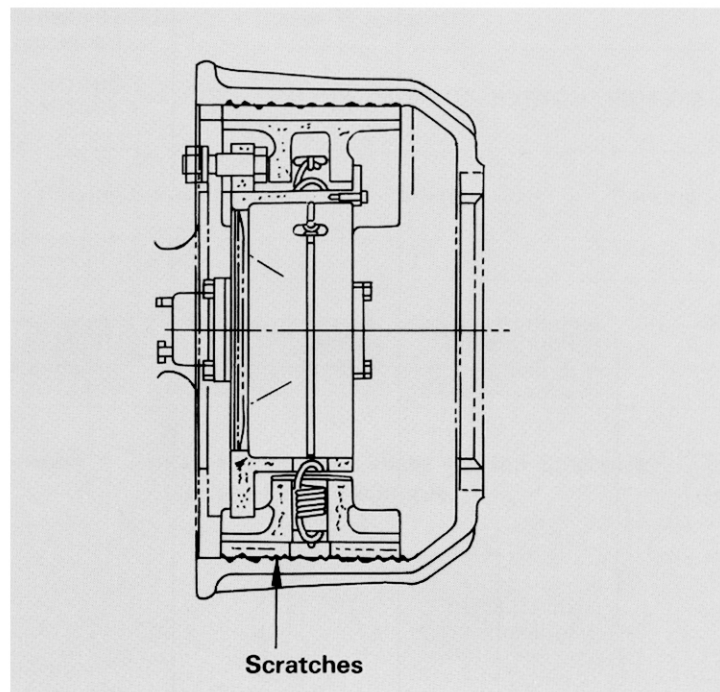
The surface temperature of a brake drum's friction sliding surfaces is ordinarily 250-300°C, but if the brake is operated frequently, the temperature can go as high as 600-900°C. In such cases, the repeated heating and cooling of the brake will lead to repeated expansion and contraction. The resulting cycle of changes in volume is likely to lead to deformation and cracks.



### Causes of Promotion of Wear

Aside from ordinary wear which progresses evenly, there is also wear accompanying scratches resulting from the entrance of sand or gravel particles, wear caused by interference with rivets due to use of linings after they have passed their wear limits, and wear of the brake drums along with carbonization of lining surface due to rising temperatures resulting from repeated braking when traveling on long slopes.

In most of the above cases, brake performance will deteriorate because of a decline in the friction coefficient or a reduction in the contact area. The judgment about the condition of the brake drum should be made together with a check on the quality of the mating of the brake lining.



# LEVEL OF FAILURE AND JUDGEMENT ON REUSE

When deciding whether the brake drum can be reused, search for the cause of the damage by considering the daily maintenance and the operating conditions in order to find out why the damage occurred. Then, relying on your knowhow and experience, make a judgement on reusability by referring to the photographs in this booklet which rank failures into categories A, B and C.

Category	Level of failure	Action
A	This category indicates slight or minor damage which creates no problem for the performance of the machine. There is no risk of this damage causing secondary damage.	Can be used as it is
B	This category indicates medium damage which at present is no problem to the performance of the machine, but there is a risk of secondary damage, so replacement is preferable if the part is used for heavy duty work.	Repair and reuse
C	This category indicates serious or critical damage, or that the part has reached the end of its life. If this part is used it may break and cause serious damage, so it must be replaced.	Can not be reused

Damage to parts does not simply consist of one type of damage; it often consists of several types of damage occurring together. In such cases, take the most dangerous form of damage as a guide when making judgement, and always take the overall safety of the machine into consideration.

If the level of damage is ranked between category A and category B as shown in the photographs, the damage should be ranked at the more dangerous category, that is, category B.

This judgement frequently depends on the user's needs (does the part still have the demanded residual life?), so it is impossible to make an unconditional judgement. However, it is necessary to consider what kind of operation it will be used in, what level of capacity it must display, what length of time it will be used and if it can be used continuously.

Therefore, judgement on the harmful effects or danger of the damage must be based on experience, so when ranking the damage, use the photographs as reference.

## Criteria for Determining Reusability of Brake Drums

Check points		Category		
		A	B	C
1	Strain or deformation of drum inner diameter	No strain or deformation	Strain or deformation, but within allowable limits ; can be corrected by machining.	Strain or deformation in excess of allowable limits ; can not be corrected by machining.
2	Cracks in friction surface	No cracks	Hair cracks which can be removed by machining to reduce the cracks to the allowable limits.	Cracks in excess of allowable limits
3	Weld cracks in steel-plate types of drums	No cracks		Cracks
4	Scratches or abrasion in friction surface	Very small scratches or abrasions, but the mating of the lining is still in good condition.	The wear surface is not smooth because of the scratches, but can be corrected to within allowable limits by machining	Significant scratches which can not be corrected to within allowable limits by machining
5	Wear in friction surface	Even wear within allowable limits; friction surface is still smooth. Mating between wear surface and lining is good.	Uneven wear or lack of smoothness in friction surface, but can be corrected to within allowable limits by machining	* Can not be corrected to within allowable limits by machining. * Wear exceeds the allowable limits.

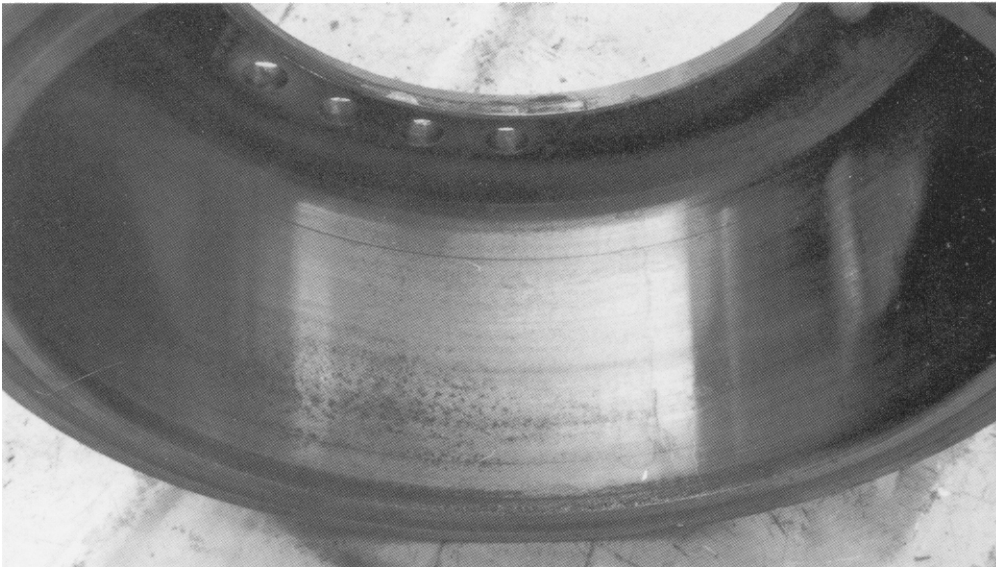
- For items in Category B, see the shop Manual for details about changing the linings of the brake shoes. (method of adhesion, bolt tightening torque).
- Ensure that at least 80% of the area of the friction surface is in contact with the lining.
- When machining the drum friction surface, ensure a roughness height ratings-microinches of 125.



# EXAMPLES OF DAMAGE

## Cast Iron Brake Drums

1



**Category: A**

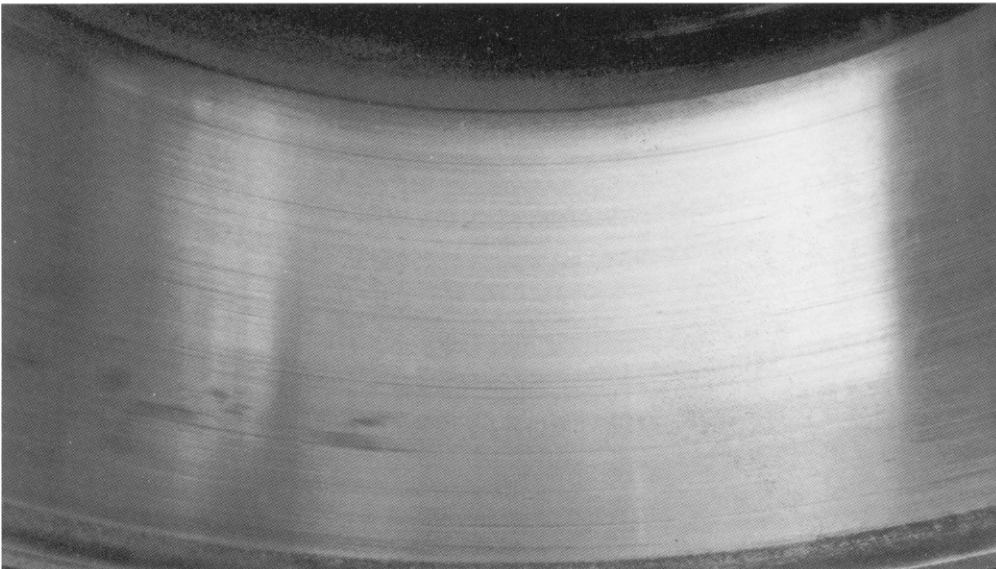
**Condition**

- There is rust on the near side of the friction surface and a shallow, single-line scratch on the inside, but the contact of the lining is still good and the overall wear conditions are good.

**Cause**

- Normal

2



**Category: A**

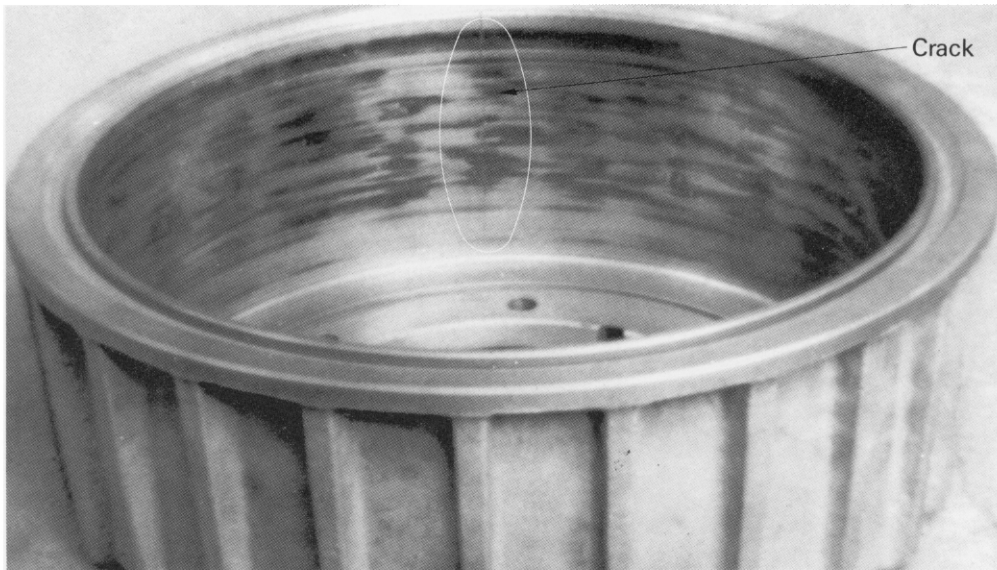
**Condition**

- There is a slight amount of heat discoloration and, although there are very light scratches on the surface, there is no roughness due to scratches. The contact with the lining is still in good condition and the wear is not particularly advanced.

**Cause**

- Normal

3



**Category: C**

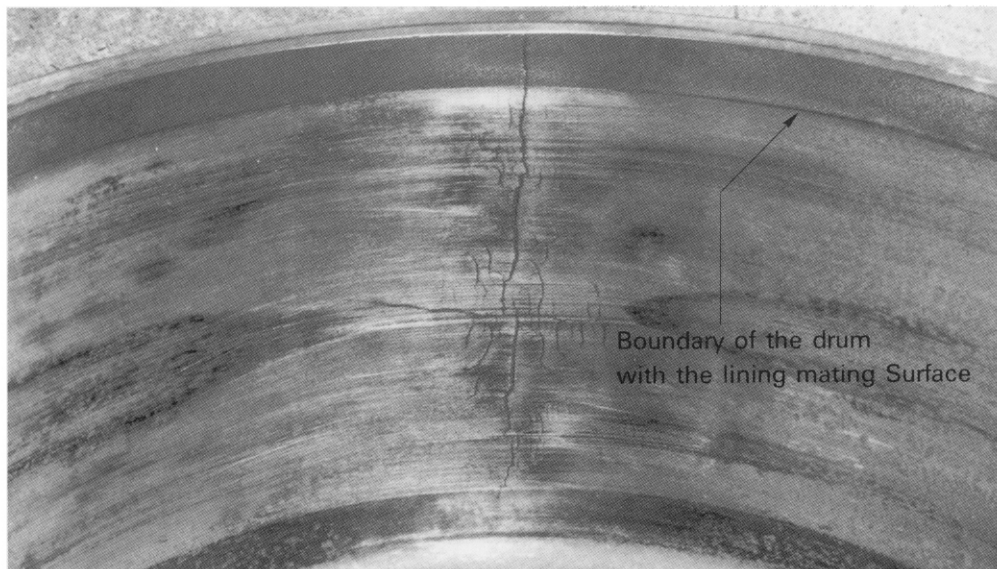
**Condition**

- Heat discoloration and scratches.  
Conspicuous heat discoloration over the entire periphery of the contact surface and a thread-like scratch in the vertical direction in the central portion.

**Cause**

- The scratches occurred as a result of heat fatigue of the material, which was excessively heated because of frequent application of the brake.

4



**Category: C**

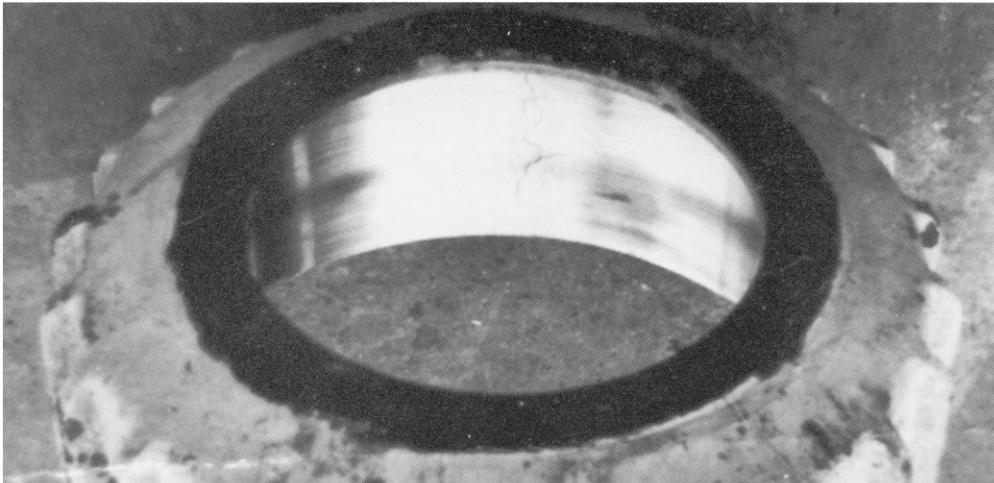
**Condition**

- Heat discoloration, cracks, and advanced wear.
  - \*The contact surface has become discolored and there are not only prominent cracks, but also hair cracks in the periphery.
  - \*The material shows signs of heat fatigue.
  - \*There are traces of stepped wear at the boundary of the drum with the lining mating surface; the contact surface lacks luster and there are signs of defects and rapidly accelerating wear in the lining mating face.

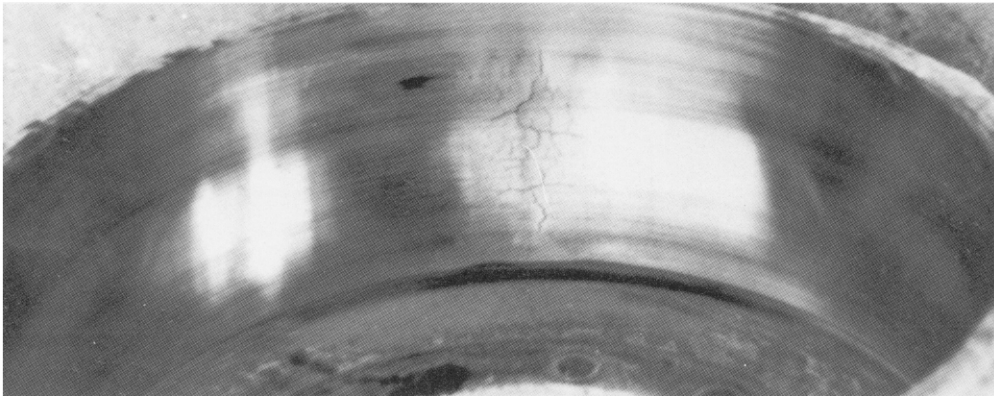
**Cause**

- Excessive heated of the drums.

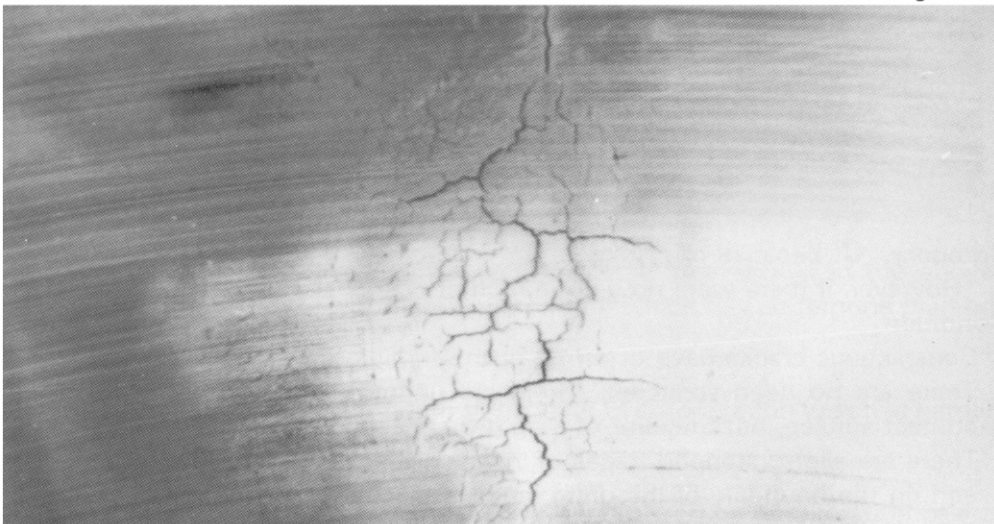
5



Enlargement



Enlargement



**Category: C**, because of the cracks

\* However, if there were no deformations or cracks, the category would be **A**.

**Condition**

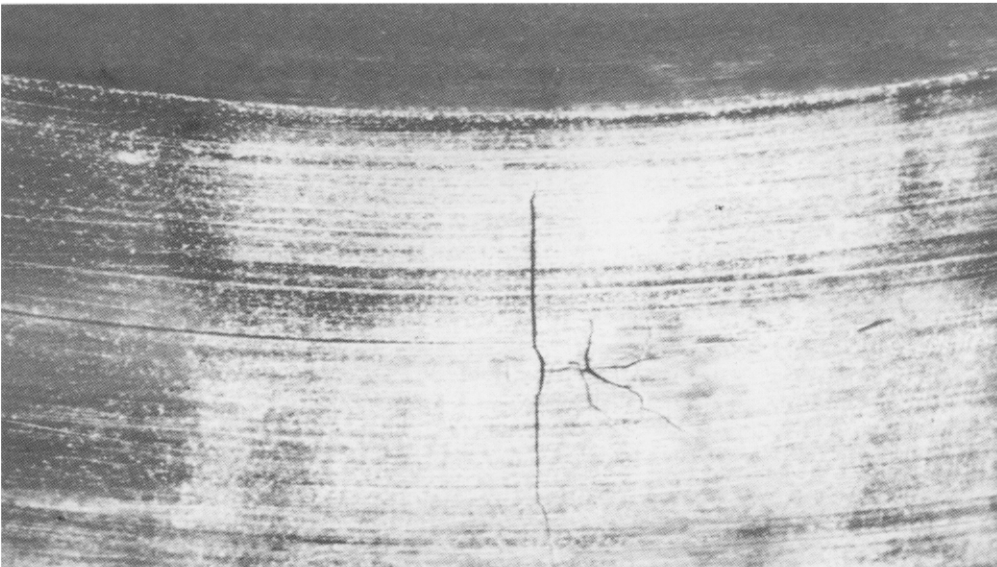
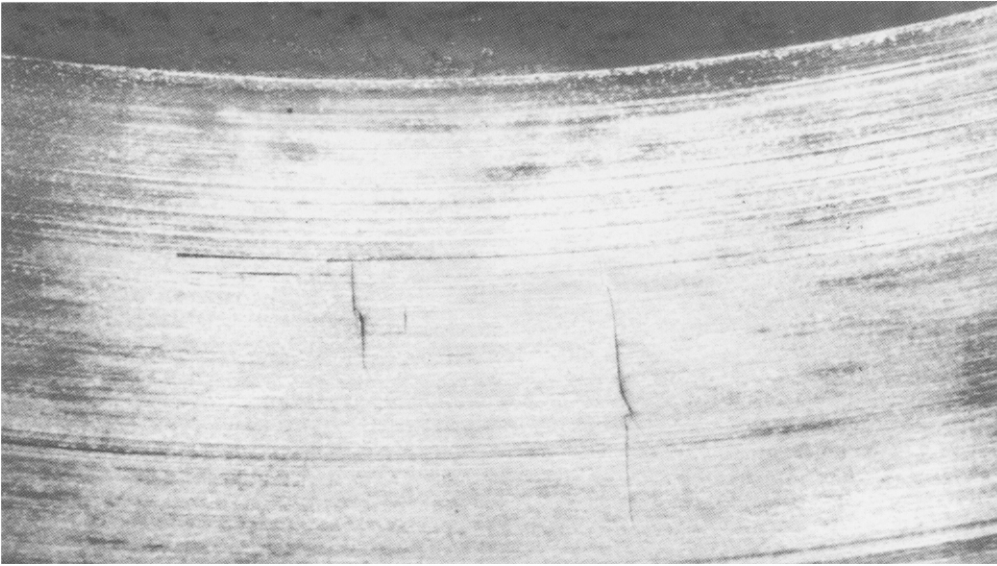
- Cracks and scratches are present. There are major cracks as well as numerous hair cracks in the vicinity of the major cracks as well as light scratches.
- Wear has not progressed significantly, as a visual inspection.

**Cause**

- The cracks occurred because of heat fatigue produced by excessive heat following repeated and frequent application of the brakes, probably when traveling down long slopes.

## Steel Plate Brake Drums

6



**Category: C**, because of cracks

\* However, if there were no deformation or cracks, the category would be **B**.

### **Condition**

- Conspicuous cracks have occurred in the friction surface.
- There are no deep scratches. There are uniform scratches over the entire contact surface, but they are of a light degree.
- There are slight, stepped traces of wear on the mating surface of the lining and on the boundary of the drum inner face, but this wear is only of a light degree. The wear condition is even over the entire surface and there is no extreme roughness.

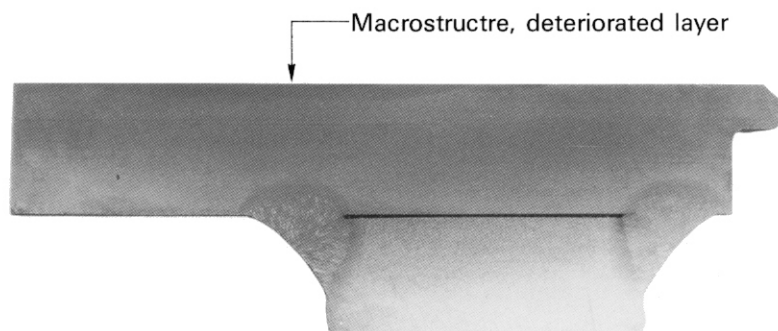
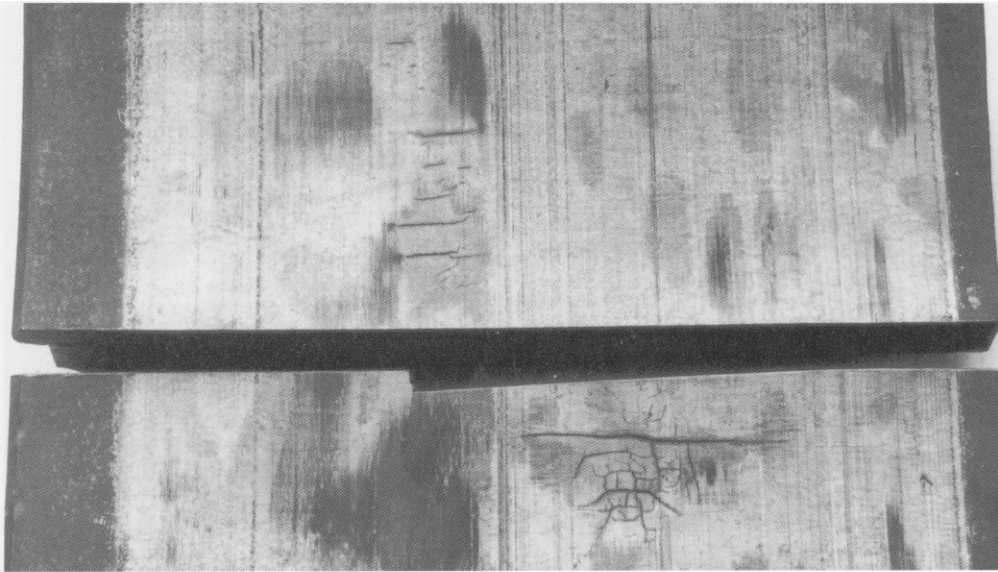
### **Cause**

- The cracks occurred because of heat fatigue as a result of excessive heat.

Note: As a result of the cracks and scratches, the mating of the lining is in slightly poor condition.

## (Reference) Actual Examples of Cracks in Steel Plate Brake Drums

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### Explanation of Photographs

To confirm the condition caused by the influence of heat in a cracked friction surface, these photographs show portions of micro-etched drums. The blackened areas on the contact surface indicate the portions of the material which have deteriorated.

This photograph shows a cut cross-section of the area shown in the above photograph. The blackened portion is the portion which has undergone marked deterioration.

### Results of Analysis

- The surface of the cracked portion has a layer of deterioration which is harder than the base material.

### Cause

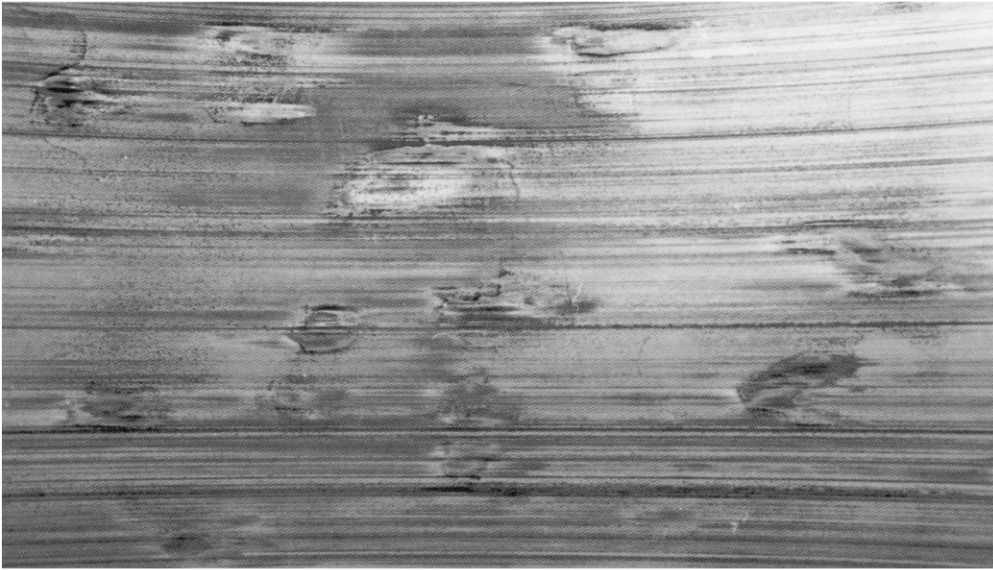
- The cracked occurred because of heat fatigue caused by deterioration of the contact surface after it was subjected to excessive friction heat.

### Method of Making Inspection through Use of Etching

This is a method of checking the deteriorated condition of the material structure of surface areas which are subject to the influence of heat or seizing—such as brake drums and engine crankshafts—by making a visual inspection on the basis of oxidation of steel. The deteriorated portion (the seized condition) is indicated by black corrosion.

**Method:** After the surface to be inspected is thoroughly cleaned, a 4% solution of nitric acid is applied to the surface. Absorb the nitric acid with a cotton and apply it with a pair of stainless steel tweezers. Let the acid stand for 1—2 minutes, then wash with water and dry.

8



**Category: C**

\* However, If machining can be carried out to bring the dimensions to within the allowable limits, B

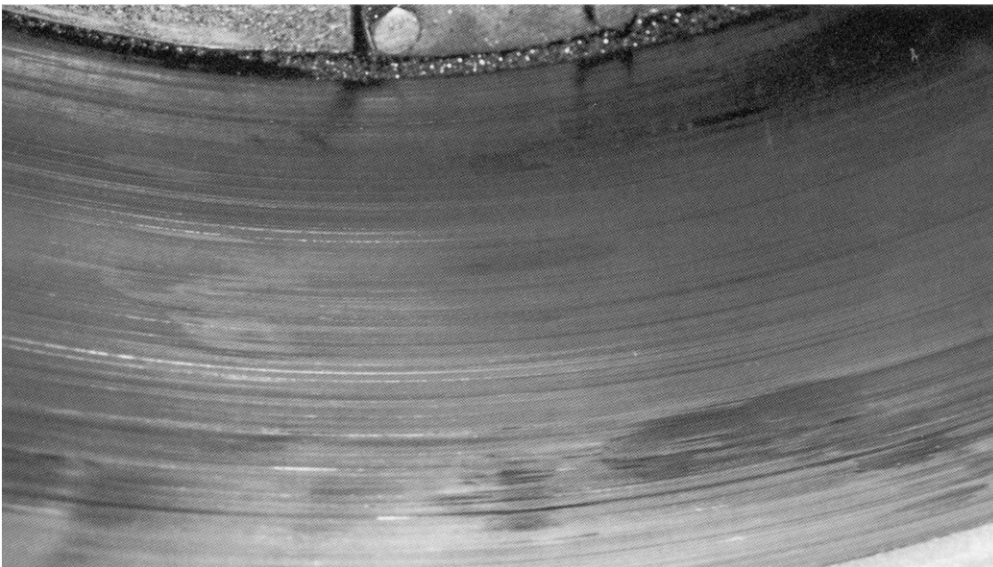
**Condition**

- Along with the heat discoloration, there are extremely fine hair cracks in the central portion, indicating the early stage of heat fatigue.
- \* There are marked scratches as well as linear deep scratches from below the central portion.

**Cause**

- A combination of heat due to excessive friction heat, entrance of sand into the brake chamber, inclusion of flaked-off particles of the brass tips in the brake lining material and biting of wear particles.

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**Category: B**

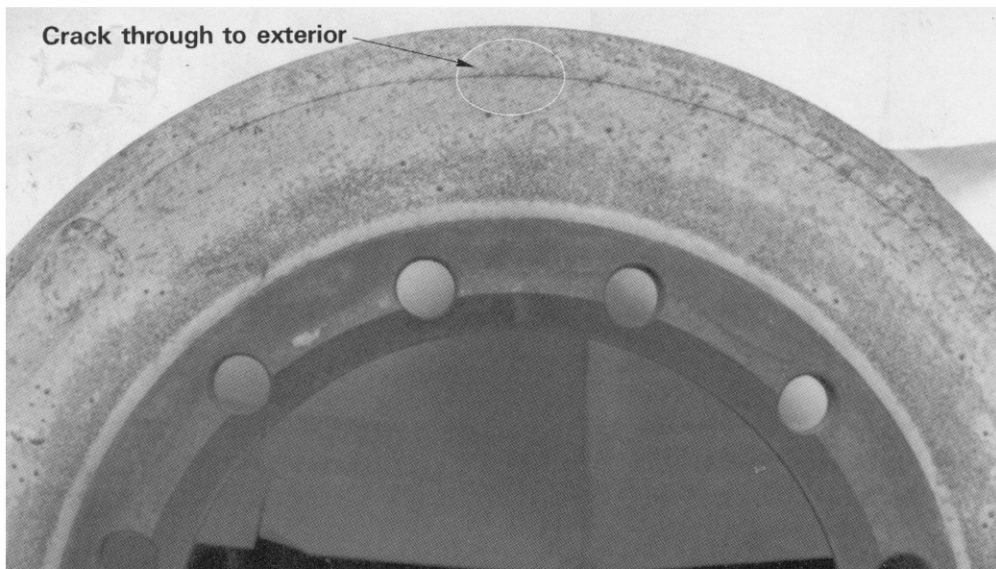
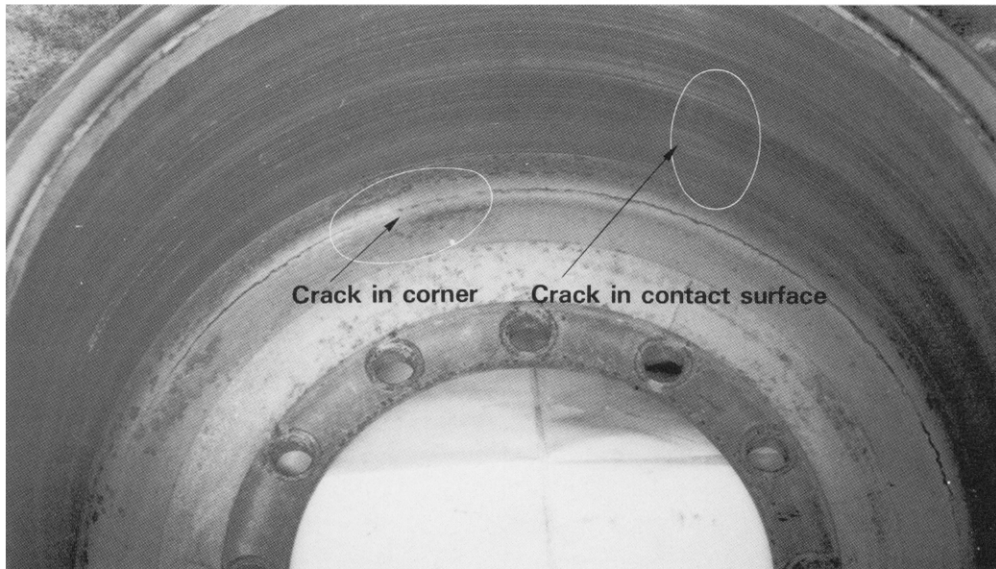
**Condition**

- A light degree of heat discoloration in the friction surface caused by heat.
- There is a light degree of wear and virtually uniform scratches; the mating with the lining lacks luster and is slightly faulty.

**Cause**

- A combination of excessive friction heat, sand, and lining wear particles.

10



**Category: C**

**Condition**

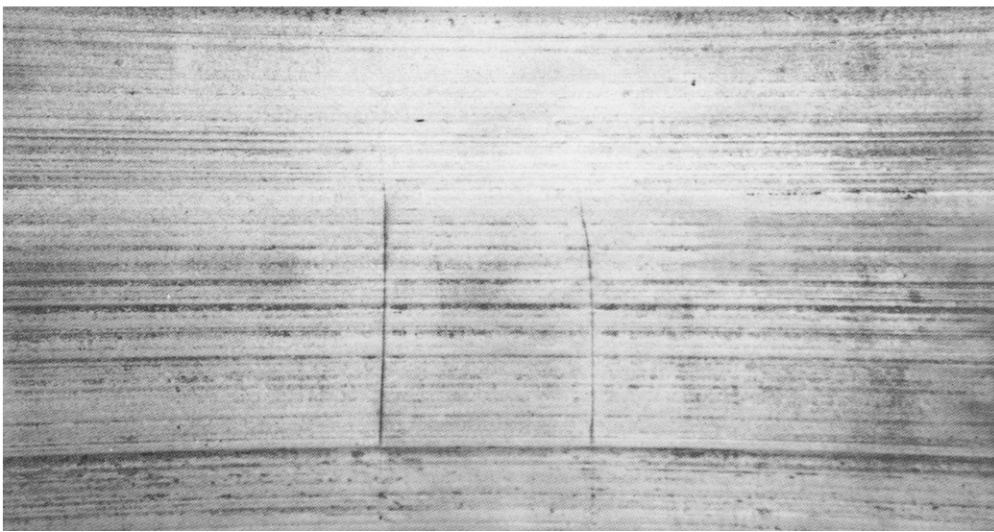
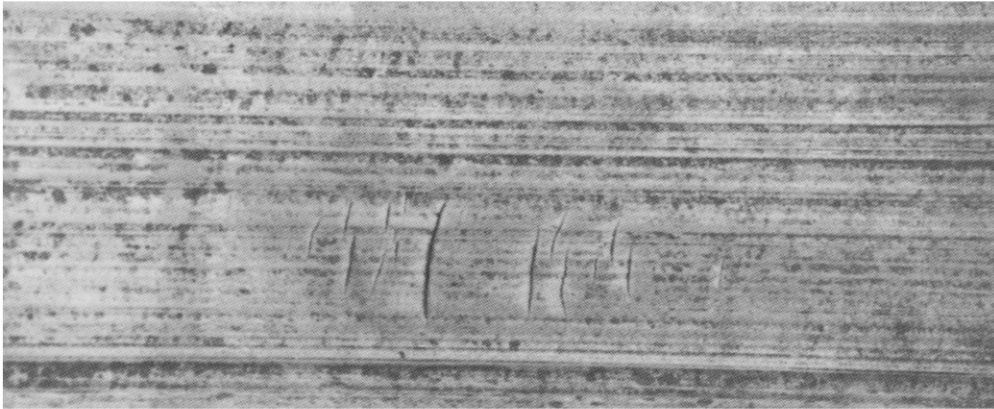
- Cracks have occurred in the friction surface and corner welded structure; the crack in the welded portion has pierced through the wall.

**Cause**

- The cracked in the friction surface were produced by heat fatigue as a result of the friction heat created by excessive braking.
- The crack in the corner welded section occurred because of insufficient weld penetration, which led to advanced crack damage because of crack deformations in the friction surface and high stress when braking loads were applied.

## Details of the cracks

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### Category: C

#### Condition

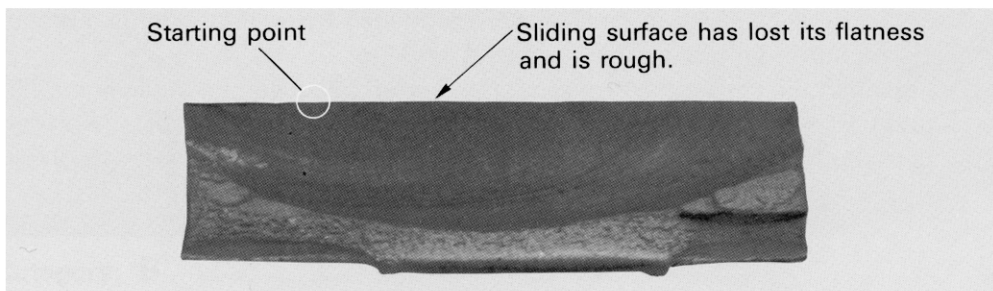
- Cracks have occurred at several places on the friction surface.  
(Top photo) A concentration of short hair cracks  
(Lower photo) Marked linear cracks

Mating condition of contact surface—The surface is rough and worn due to scratches, indicating poor mating with the lining.

#### Cause

- Brittleness due to heat fatigue.

Reference: Condition of cracked, damaged surface



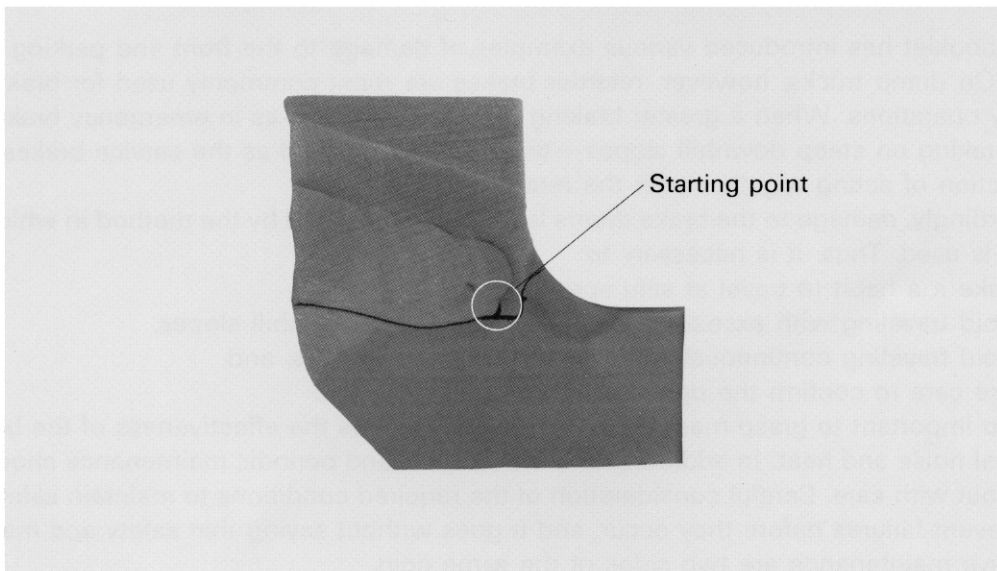
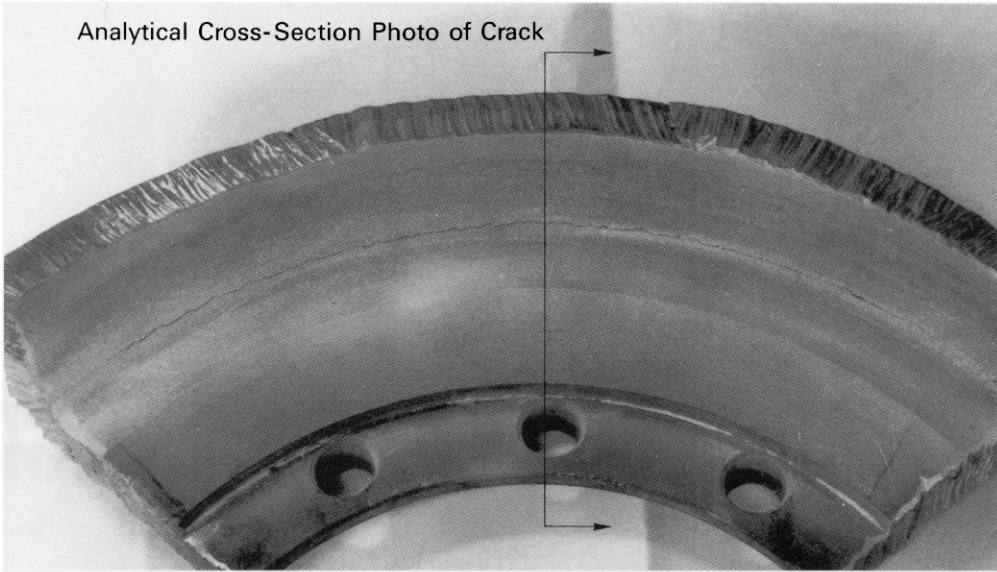
- The damaged surface is pitted and shows signs of heat fatigue ruptures.



**(Reference) Example of Crack in Welded Structure**

12

Analytical Cross-Section Photo of Crack



**Condition and Cause**

- The crack in the corner welded section started from the internal part of the weld which lacked sufficient penetration and the crack developed until it pierced through between the inside and outside of the brake drum.

# PREVENTIVE MAINTENANCE

This booklet has introduced various examples of damage to the front and parking brake drums. On dump trucks, however, retarder brakes are most commonly used for braking in ordinary operations. When a greater braking force is required—as in emergency braking or when braking on steep downhill slopes—the front brakes used as the service brakes have the function of acting together with the retarder brakes.

Accordingly, damage to the brake drums is largely determined by the method in which the vehicle is used. Thus, it is necessary to:

- make it a habit to travel at safe speeds,
- avoid traveling with excessive loads, particularly on downhill slopes,
- avoid traveling continuously over long downhill distances, and
- take care to confirm the operation of the parking brake.

It is also important to grasp mechanical conditions such as the effectiveness of the brakes, abnormal noise and heat. In addition, daily inspections and periodic maintenance should be carried out with care. Careful consideration of the required conditions to maintain safety will help prevent failures before they occur, and it goes without saying that safety and machine preventive maintenance are two sides of the same coin.

