

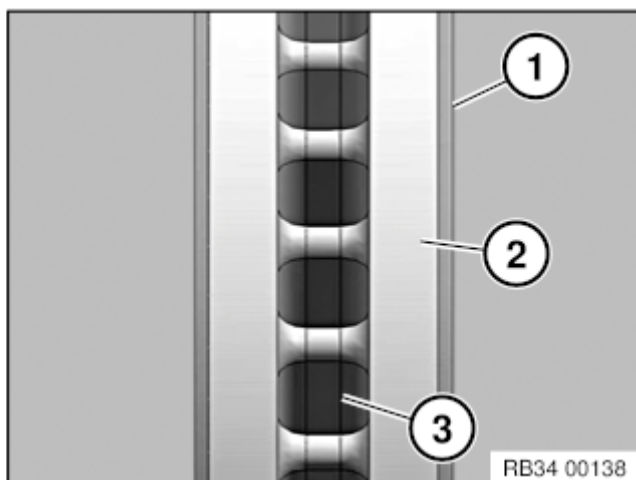
REP-REP-RAF1034-3400_CSIC_GRENZMUSTER Consult the boundary samples catalogue when assessing the appearance of carbon ceramic brake discs

VIN: Vehicle: 5' / F10 / Sedan / M5 / S63 / EUR / left-hand drive /
MANUAL / 2015 / -

System version: Data version: 3.48
1.1.8

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Consult the
boundary
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Structure of a carbon ceramic brake disc:

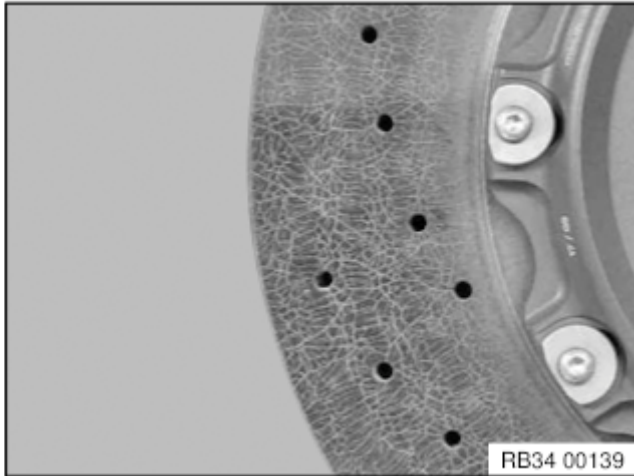
1. Ceramic friction layer
2. Carbon base
3. Coolant duct

To ensure that the ceramic brake disc has a long service life, the base is provided with a separate friction layer. The friction layer is bonded by means of a special joining paste. The siliconisation results in a bonded connection.

The base and the friction layer are made from different mixtures/recipes. For this reason, the two components differ in appearance.

Tension relief structure:

Due to the different material compositions of the friction layer and

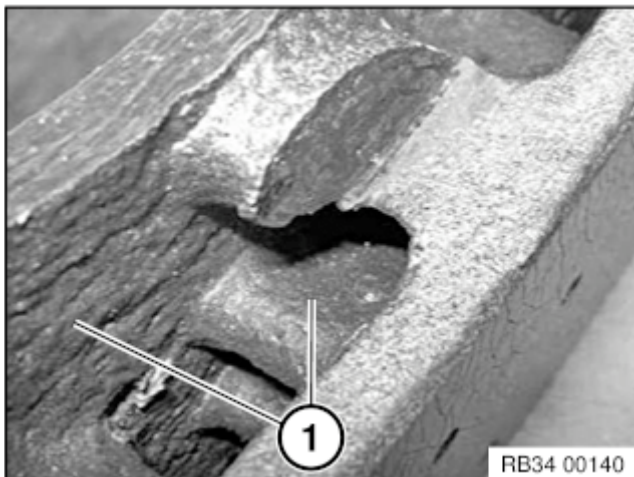


base, the friction surfaces (even when new) are characterised by a harmless tension relief structure. Some relief cracks pass along the perforation bore holes.

The tension relief structure arises during the manufacturing process, starting from the brake disc surface, and is not a safety risk. There is also no danger that the friction layers may split off the base in large pieces since because the friction layers are virtually tension free due to the tension relief structure.

The tension relief structure is partially visible on new components and may vary considerably between the two brake disc chamber sides.

Thus, a brake disc with this feature is OK.



Rough surfaces in coolant duct:

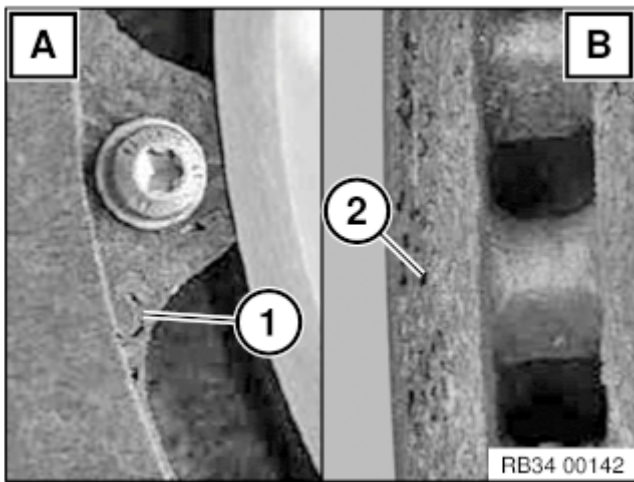
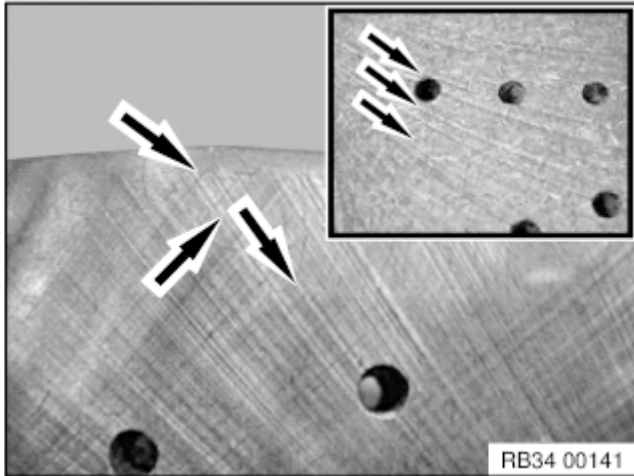
The surfaces (1) in the coolant duct have a different structure. The coolant ducts are not finished and therefore have a rough structure.

Thus, a brake disc with this feature is OK.

Processing traces:

The surface of the ceramic brake disc is characteristic of the type of grinding applied. The cross and spiral pattern (see arrows) created by the type of grinding process has no influence on the performance of the component.

Thus, a brake disc with this feature is OK.



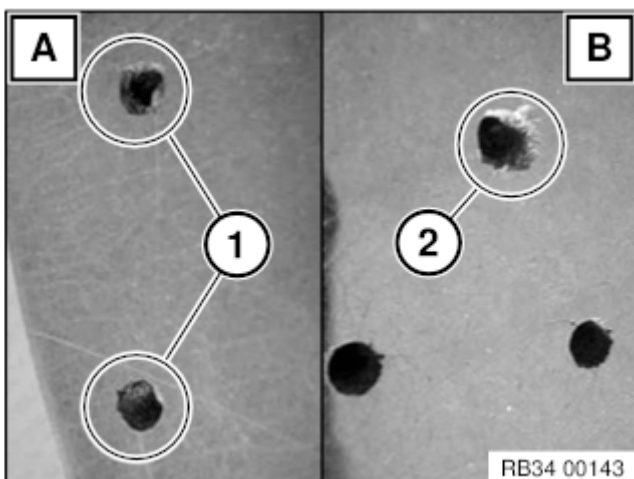
Pores in base:

Due to the carbon fibres used, with a defined length of 10 mm without a short fibre portion, visible pores arise in the base during the manufacturing process. These pores have no negative influence on the function of the ceramic brake disc.

e.g.:

(1) Pores on brake disc chamber screw connection

(2) Pores on the brake disc face



Possible surface flaws on the brake disc:

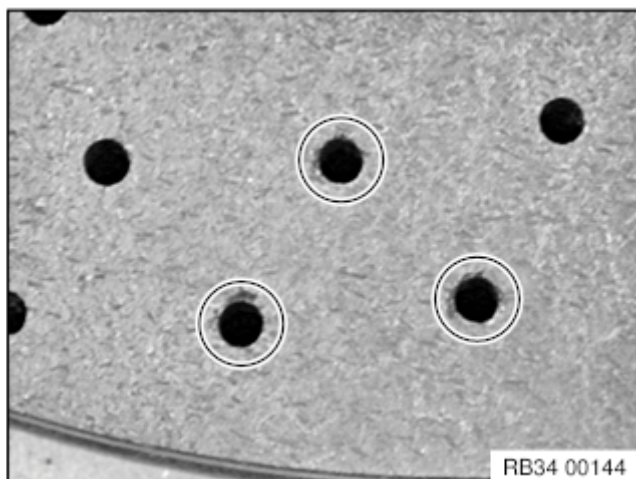
Flaws on perforation bore holes

(1) Brake disc OK

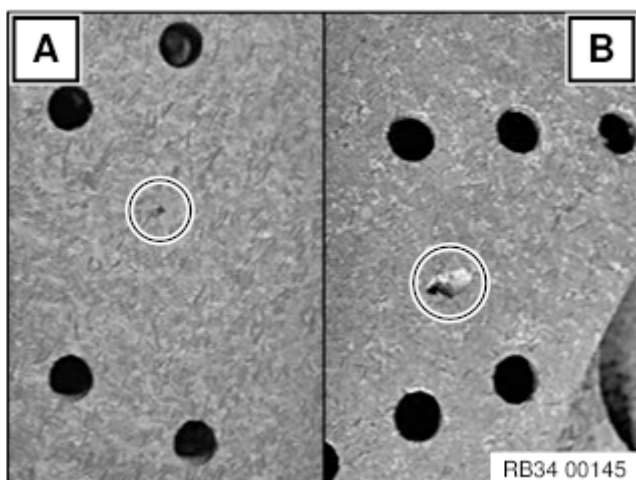
(2) Brake disc not OK -> nest-shaped pittings

Brake disc not OK

-> Nest-shaped pittings (3 or more holes on each side)



| | |
|---------------------|--|
| Nature | Perforation bore holes with edge pittings |
| Remarks | Edges widened due to edge pittings |
| Fulfilment criteria | <p>No edge pittings at perforation bore hole</p> <p>Permissible pittings are those that:</p> <ul style="list-style-type: none"> - are no larger than >3 mm starting at the hole edge - end within the friction layer - are not nest-shaped (3 or more bore holes next to each other) |
| Max. number | 20 affected bore holes on each side |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |

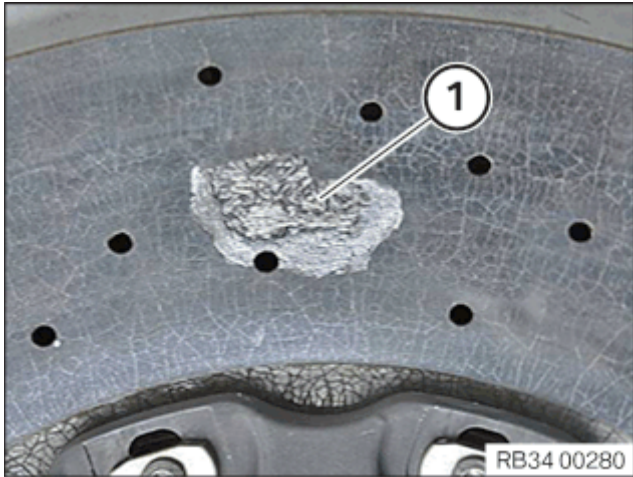


Flaws in friction layer:

Pittings in friction layer:

Image (A). Brake disc OK

Image (B): Brake disc not OK



Partial spalling (1) of the friction layer has no influence on the function or safety of the brake system (no comfort disadvantages or uneven braking force distribution).

The separation is a purely visual defect, but may cause customer disappointment and uncertainty.

If the pitting/spalling (1) has reached 2x2 mm, these ceramic brake discs can be replaced. They must be returned through the special defective parts channel, as that is the only way that a refund (applicable only to the warranty period) can be made.

Return address:

BMW AG

Sonderschadteil Gewährleistungsteile
GWTZ

Heidemannstr. 164

Werk 01.01/ Gebäude 23

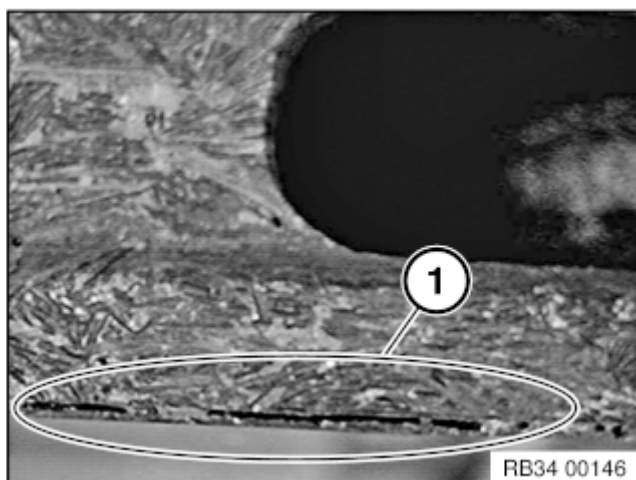
DE 80935 Munich

For Germany, returns are subject to the PuMA procedure DE4811067.

| | |
|---------------------|--|
| Nature | Pittings in friction layer |
| Remarks | None |
| Fulfilment criteria | <p>No pittings</p> <p>Permissible pittings are those that:</p> <ul style="list-style-type: none"> - end in the friction layer - if not > 2 x 2 mm |
| Max. number | 1 pitting per side |
| Evaluation | If criteria are fulfilled, OK. |

Measures

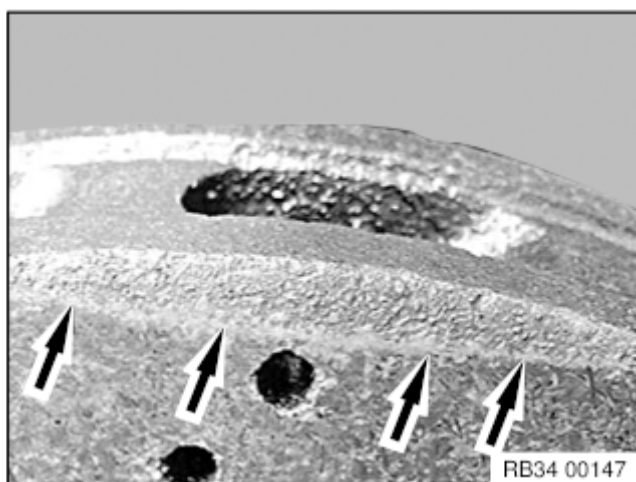
If not OK, do not install component



Friction layer detachment:

Brake disc with friction layer detachment (1) -> brake disc not OK.

| | |
|---------------------|---|
| Nature | Friction layer detachment |
| Remarks | Gap between friction layer and base |
| Fulfilment criteria | Friction layer detachment not permissible |
| Max. number | -- |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, block component |

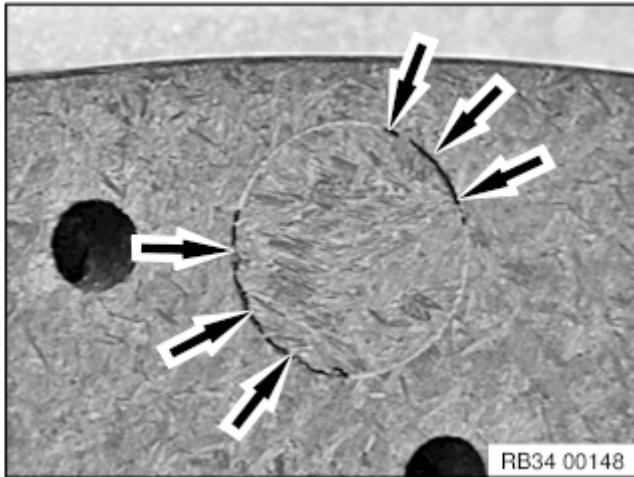


Fiction layer not fully finished:

Brake disc (see image) not OK

| | |
|---------------------|---|
| Nature | Fiction layer and edge not fully finished |
| Remarks | None |
| Fulfilment criteria | Ful, uniform finishing of surface |
| Max. number | - - |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install |

| | |
|--|-----------|
| | component |
|--|-----------|



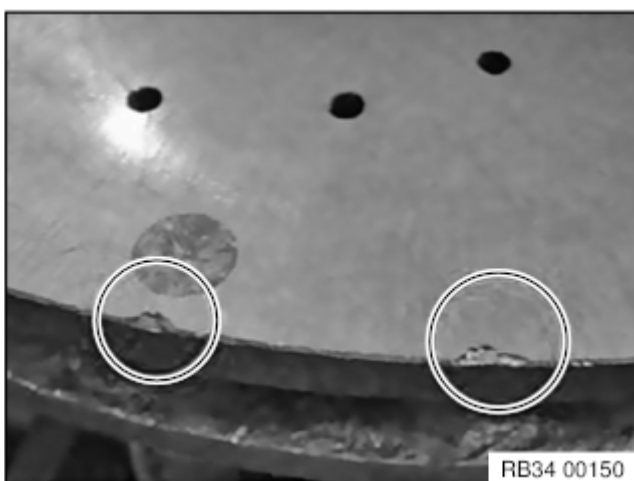
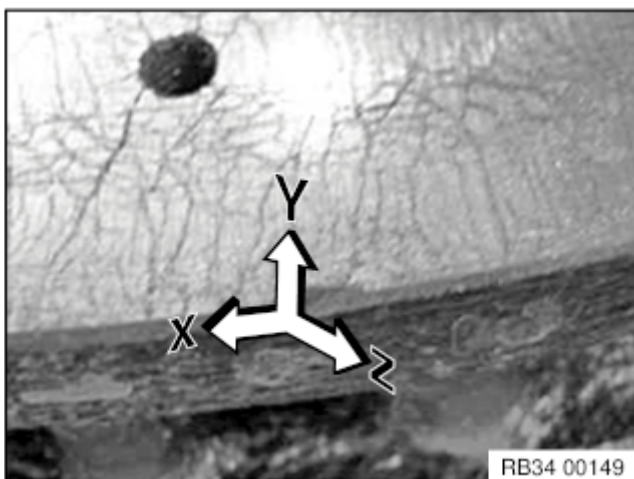
Gap between friction layer and base

Brake disc (see image) not OK

| | |
|---------------------|---|
| Nature | Bore hole in the friction layer is too large for the wear indicator with 14 mm diameter; a gap occurs between friction layer and wear indicator |
| Remarks | On friction layer 3406, only a wear indicator with a 14 mm diameter is used |
| Fulfilment criteria | No gap between wear indicator and friction layer |
| Max. number | - - |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |

Splitting off on outer edges of friction ring:

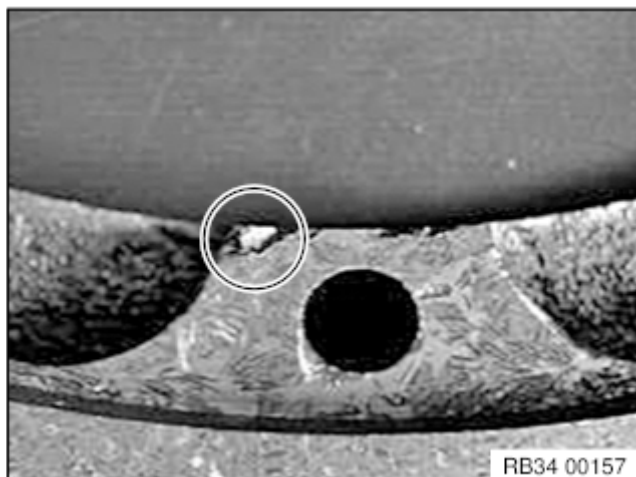
Brake disc (see image) OK



Brake disc (see image) not OK

| | |
|---------------------|--|
| Nature | Splitting off on outer edges of friction ring |
| Remarks | Irregular outer contour due to material and finishing properties of friction layer or Damage due to improper handling of brake disc |
| Fulfilment criteria | No edge damage The following is permissible: - max. damage length: 10 mm (x) - max. damage width: 3 mm (y) - max. damage depth: 3 mm (z) |
| Max. number | 1 per side |
| | |

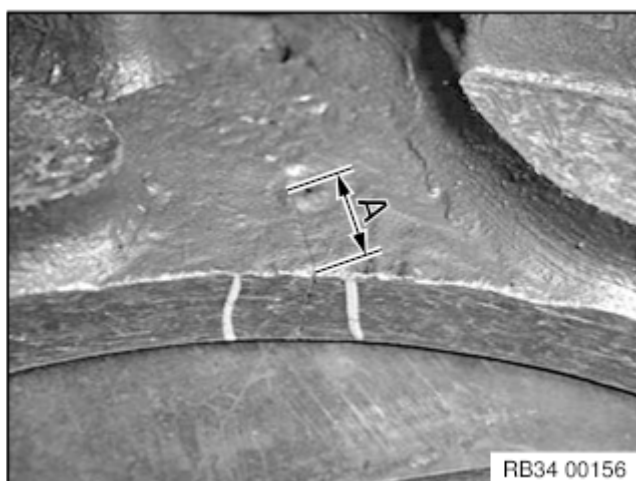
| | |
|------------|-------------------------------------|
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |



Edge pittings in rib area:

Brake disc (see image) not OK

| | |
|---------------------|---|
| Nature | Edge pittings in rib area |
| Remarks | None |
| Fulfilment criteria | No edge pittings The following is permissible: - outside of nut support with a surface $\geq 25 \text{ mm}^2$ |
| Max. number | 5 connection areas with pittings |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |

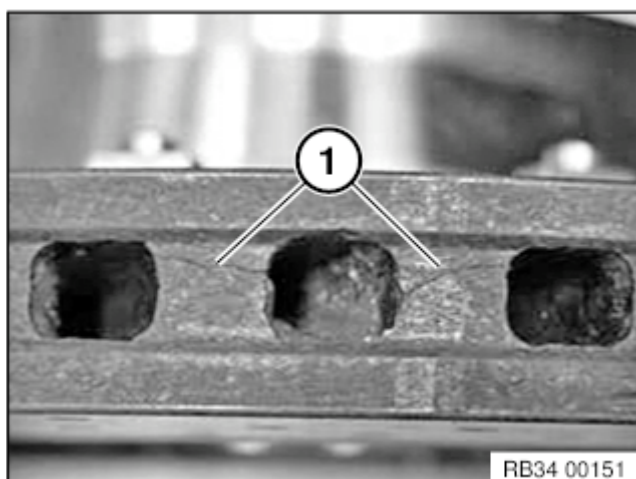


Radial cracks on inside circumference of brake disc ring

Brake disc (see image) OK

| | |
|------------|--|
| Nature | Radial crack on inside circumference of brake disc ring |
| Remarks | Due to intrinsic tension in the brake disc ring, radial cracks may occur |
| Fulfilment | The following is |

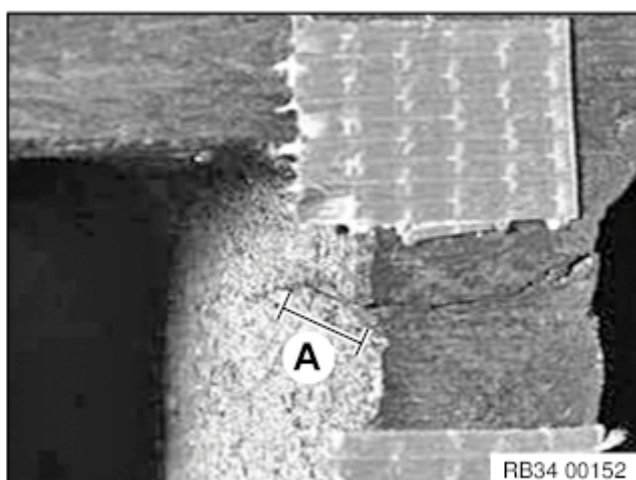
| | |
|-------------|--|
| criteria | permissible: - Cracks up to 10 mm in length |
| Max. number | 5 cracks are permissible |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |



Cracks on rib transition:

Cracks (1) in rib area of brake disc

For brake disc, see image: OK

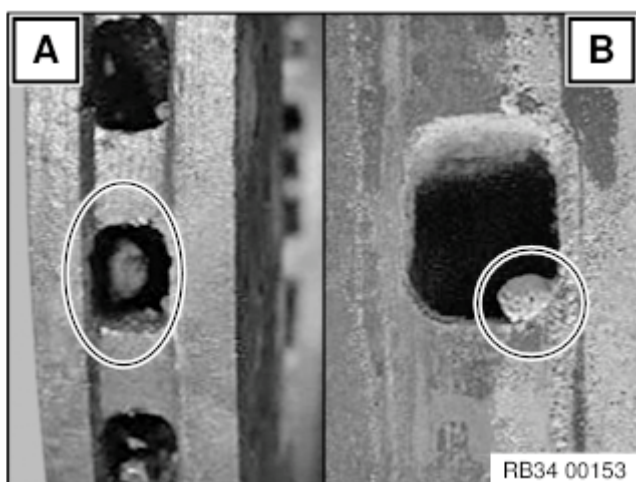


Brake disc:

Cracks (dimension A) in rib area >20 mm deep -> brake disc not OK.

| | |
|--------|-------------------------|
| Nature | Crack on rib transition |
|--------|-------------------------|

| | |
|---------------------|---|
| Remarks | Due to intrinsic tension in the brake disc ring, radial cracks may occur |
| Fulfilment criteria | The following is permissible: - Continuous cracks on rib \leq dimension [A] 20 mm deep |
| Max. number | Max. 10 cracks per component Not more than 5 cracks next to each other |
| Evaluation | If criteria are fulfilled, OK. |
| Measures | If not OK, do not install component |



Phosphate residue in coolant duct and perforation bore holes/dirt contamination on ASSY

Image (A) and (B) -> brake disc not OK.



Brake discs, see image, not OK

1 Perforation bore hole

2 Contamination of ASSY

| | |
|---------|---|
| Nature | Phosphate residue in coolant duct or perforation bore hole |
| Remarks | Coolant duct: No phosphate residue in coolant duct, perforation bore hole: - Free diameter is at |

| | |
|---------------------|---|
| | <p>least 3 mm</p> <ul style="list-style-type: none"> - Constriction is circular or crescent shaped - Constriction is 2 mm below surface <p>No contamination of ASSY</p> |
| Fulfilment criteria | <p>Coolant duct: None</p> <p>Perforation bore hole: 20 per side</p> |
| Max. number | <p>Max. 10 cracks per component</p> <p>Not more than 5 cracks next to each other</p> |
| Evaluation | <p>If criteria are fulfilled, OK.</p> |
| Measures | <p>If not OK, do not install component</p> |