Technical training.
Product information.

M Carbon Ceramic Brake System

Edited for the U.S. market by:
BMW Group University
Technical Training
ST1302 3/1/2013

BMW Service

General information

Symbols used

The following symbol/schematic diagram is used in this document to facilitate better comprehension or to draw attention to very important information:

Contains important safety information and information that needs to be observed strictly in order to guarantee the smooth operation of the system.

Information status and national-market versions

BMW Group vehicles meet the requirements of the highest safety and quality standards. Changes in requirements for environmental protection, customer benefits and design render necessary continuous development of systems and components. Consequently, there may be discrepancies between the contents of this document and the vehicles available in the training course.

This document basically relates to the European version of left-hand drive vehicles. Some operating elements or components are arranged differently in right-hand drive vehicles than shown in the graphics in this document. Further deviations may arise as a result of the equipment specification in specific markets or countries.

Additional sources of information

Further information on the individual topics can be found in the following:

- Owner's Handbook
- Integrated Service Technical Application.

Contact: conceptinfo@bmw.de

The information contained in this document forms an integral part of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the current respective information systems of the BMW Group for any changes/additions to the technical data.

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BV-72/Technical Training

M Carbon Ceramic Brake System

Contents

M Carbon Ceramic Brake System

1. Introduction

Starting in March production of 2013, M Carbon ceramic brakes are available as an option (2NK) on the M6 Coupe, M6 Convertible and F06 M Gran Coupe vehicles. M Carbon ceramic brakes will also be available as an option in the future with the F10 M5.

The M Carbon ceramic brake system is also called BMW C/SiC brake system (see chapter entitled "Design").

Depending on the situation, this offers a further increase in active safety compared to the standard M Compound brakes. In a direct comparison it also offers:

- Even more direct/spontaneous use of brake force
- Higher fading stability
- Significantly reduced wear
- 19.4 kg / 42.7 lb weight reduction of rotating wheel masses
- Increased reliability for winter driving conditions thanks to corrosion resistance.

M Carbon ceramic brake, front axle

M Carbon Ceramic Brake System

1. Introduction

As a visible distinguishing feature to the M Compound brake system the brake calipers are painted in gold.

The M Carbon ceramic brake system can only be installed with 20" M wheels due to the larger brake discs at the front. The 20" M wheels must also be ordered as an option in conjunction with the Carbon ceramic brake option 2NK.

The brake discs are manufactured by Brembo SGL Carbon Ceramic Brakes GmbH.

M Carbon Ceramic Brake System

2. Technical Data

2.1. Comparison of the M Compound to M Carbon Ceramic Brake System

Designation	Unit	M Compound brake system	M Carbon ceramic brake system
Front brake		6 pistons, fixed caliper	6 pistons, fixed caliper
Diameter x Thickness, brake disc	[mm]	400 x 36	410 x 38
Friction path/Friction ring width	[mm]	76.0	88.8
Weight of brake disc	[kg / lbs]	13.9 / 30.6	7.8 / 17.1
Weight of brake caliper and pads	[kg / lbs]	7.0 / 15.4	7.4 / 16.3
Rear brakes		1 piston, floating caliper	1 piston, floating caliper
Diameter x Thickness, brake disc	[mm]	396 x 24	396 x 26
Friction path/Friction ring width	[mm]	64	64
Weight of brake disc	[kg / lbs]	9.3 / 20.5	5.4 / 11.9
Weight of brake caliper and pads	[kg / lbs]	6.7 / 14.7	6.6 / 14.5

M Carbon Ceramic Brake System

3. Design of Brake

3.1. Introduction

3.1.1. C/SiC brake disc

Currently carbon fibers are generally used in the development and application of composite ceramics such as the M Carbon ceramic brake disc. The abbreviation "C/SiC" is used for carbon fiber reinforced silicon carbide.

In addition to the intended load, which impacts the brake disc upon braking, this material cannot be subject to any mechanical or thermal mechanical deviating load (see also chapter entitled Service instructions).

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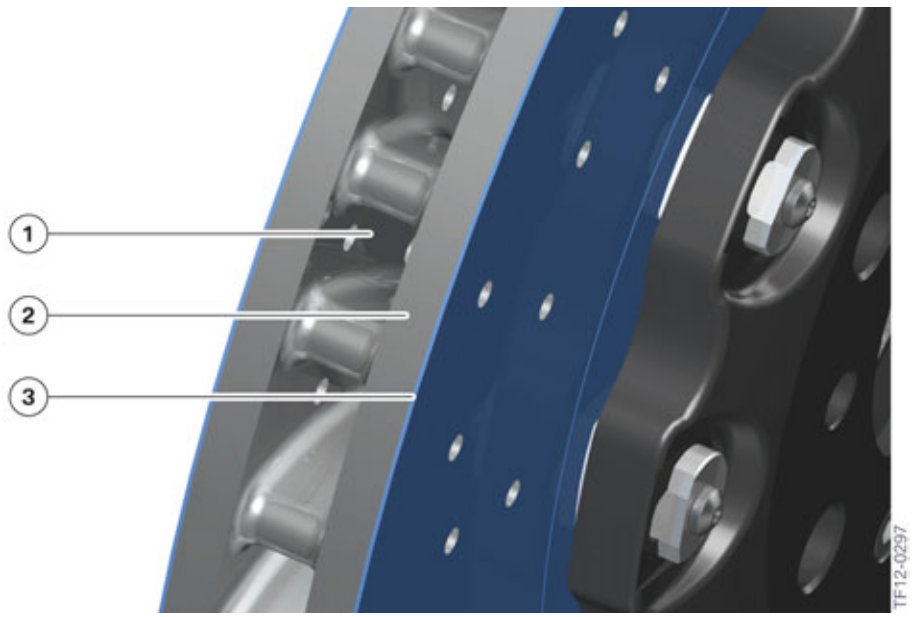
Due to the special feature of the material, the current information and specifications in the documents in the Integrated Service Technical Application must be observed in each case.

3.2. Brake Disc

3.2.1. Design and special feature

The composition of the M Carbon ceramic brake disc is made up of two different materials. The support body (2) with the cooling ducts (1) have a sintered silicon carbide ceramic base that is reinforced with a high content of carbon fiber direction oriented strands. The inner and outer friction coating (3) has a much a higher ceramic content.



M Carbon ceramic brake design

M Carbon Ceramic Brake System

3. Design of Brake

Index	Explanation
1	Cooling duct
2	Support body with cooling ducts and ribs
3	Outer friction coating

The brake disc body is designed using a special shaped part. The fibers (also called "rovings") are set down, aligned and fixed similar to the process observed for the manufacturing of fiber-reinforced plastic. They have a high carbon content. This forms the support body with the cooling ducts and ribs. A thin outer and inner friction coating with high ceramic content is fixed to the support body. The braking surface blank, comprising the support body and the two friction coatings, is then baked in a special oven at a high temperature, whereby the shaped part is then dissolved.

Sanding, boring, lapping or milling can take place as part of the finishing work; as is customary for all ceramics, only with diamond tools, water jet or laser.

During cooling a visible cracked pattern is formed on the friction coating, this is called the relaxed microstructure. The relaxed microstructure also remains visible after the final finishing process.

This is normal for this Carbon ceramic brake disc and also remains visible to varying degrees when driving.

M Carbon ceramic brake, relaxed microstructure

This surface structure formed by the relaxed microstructure has no influence on the performance of the brakes.

3.2.2. Wear characteristics

The M Carbon ceramic brake disc has a much longer service life than the M Compound brake disc as a result of its special friction coating. In an ideal scenario (everyday driving) these brakes can last the service life of the vehicle.

Thanks to the design with the hard friction coating, this technology only shows very minimal signs of heavy wear on the brake disc.

Depending on the thermal load, there can be a slow, continuous loss of strength. This is primarily through oxidation of the carbon fibers of the support body at very high temperatures like in sport driving usage. The brake disc also loses weight in the process.

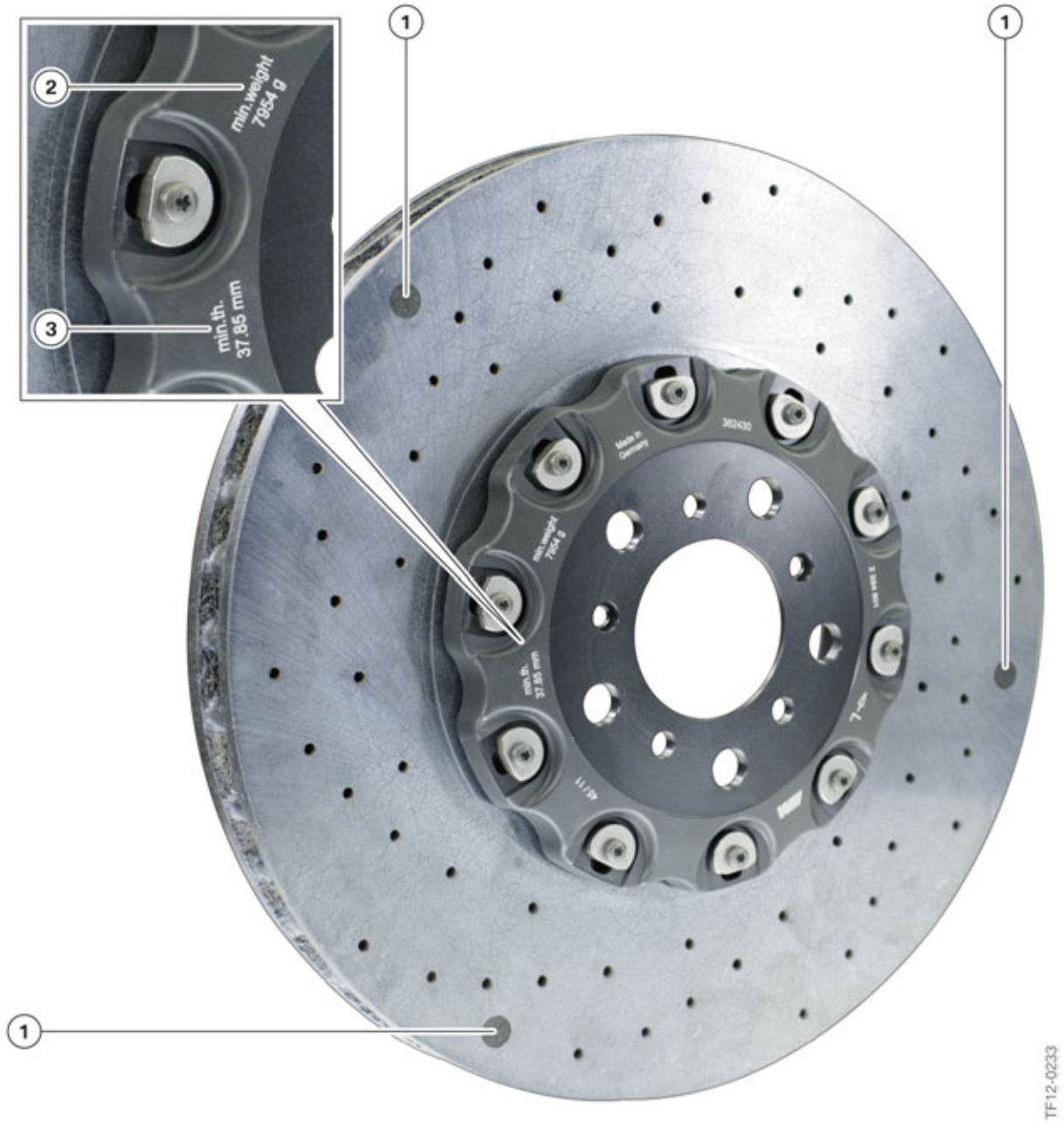
It is a service-specific wear measuring procedure in the development phase which is used at a later stage.

There are currently three wear indicators for the M Carbon ceramic brake disc in addition to checking the surface for damage:

- Three wear indicators per friction surface located every 120°. (1)
- Minimum brake disc weight. (2)
- Minimum brake disc thickness. (3)

M Carbon Ceramic Brake System

3. Design of Brake



M Carbon ceramic brake wear indicators

Index	Explanation
1	Wear indicators
2	Min. weight
3	Min. thickness

M Carbon Ceramic Brake System

3. Design of Brake

As part of a brake service the wear indicators are the primary factors when determining disc wear.

New brake disc showing no wear as indicated by the wear indicator.

New disc, no wear

M Carbon Ceramic Brake System

3. Design of Brake

Brake disc showing partial wear by a portion of the wear indicator being exposed.

Disc with partial wear

M Carbon Ceramic Brake System

3. Design of Brake

Wear indicator is greater than 50% exposed, brake disc is considered worn beyond limits and should no longer be used.

Disc must be replaced, total wear

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For necessary service work the current information and specifications in the documents in the Integrated Service Technical Application must be observed in each case.

M Carbon Ceramic Brake System

3. Design of Brake

3.3. Brake Pads

3.3.1. Overview

The brake pad structure of all brake pads is adapted to the surface of the friction coating of the M Carbon ceramic brake discs. The brake pads do not have their own special friction coating like the brake discs.

The size of the friction surface and the thickness of the friction pad are adapted to the parameters of the M Carbon ceramic brake discs.

3.3.2. Wear characteristics

The wear characteristics of the M Carbon ceramic brake pads are better than that of a M Compound brake pad.

Roughly double the service life of a M compound brake pad can be expected.

3.4. Protective Plate

The front brake disc protective plates at the swivel bearing have been modified and are specific to the M Carbon ceramic brake.

M Carbon Ceramic Brake System

4. Function

4.1. Braking Performance/Braking Effect

4.1.1. Cold brake and cold tires

The spontaneously greater braking effect can reduce the stopping distance slightly depending on the situation, caused by the spontaneously higher friction between tires and roadway at the start of braking and the resulting quicker heating-up of the tires.

4.1.2. Warm brake and warm tires

The braking effect in a warm state could be considerably higher, but will be roughly the same as the M Compound brake system, as it is restricted by the adhesion of the tires.

High braking frequency and heavy usage such as braking from maximum speed to standstill are no problem. Also for extreme loads there is no direct material destruction by overheating or fading tendency.

4.1.3. Wet conditions

Without a dry brake function, for example after washing wheels, a slight deceleration of the higher braking effect can be felt, similar to the wet M Compound brake system.

Through the high braking effect of the M Carbon ceramic brake system the contact force of the brake pads in the dry brake function is withdrawn as otherwise it would be noticeable for the passengers. This is done by updated software to the Dynamic Stability Control.

At low speed and cautious braking an audible sound may occur with wet M Carbon ceramic brakes or in the case of high humidity. This is due to the current design of the M Carbon ceramic brakes.

In the case of complaints the current information and specifications in the documents in the Integrated Service Technical Application must be observed in each case and a PuMA case created if necessary.

4.1.4. Winter operation

A big winter advantage of the M Carbon ceramic brake disc in comparison to the M Compound brake disc is its corrosion resistance.

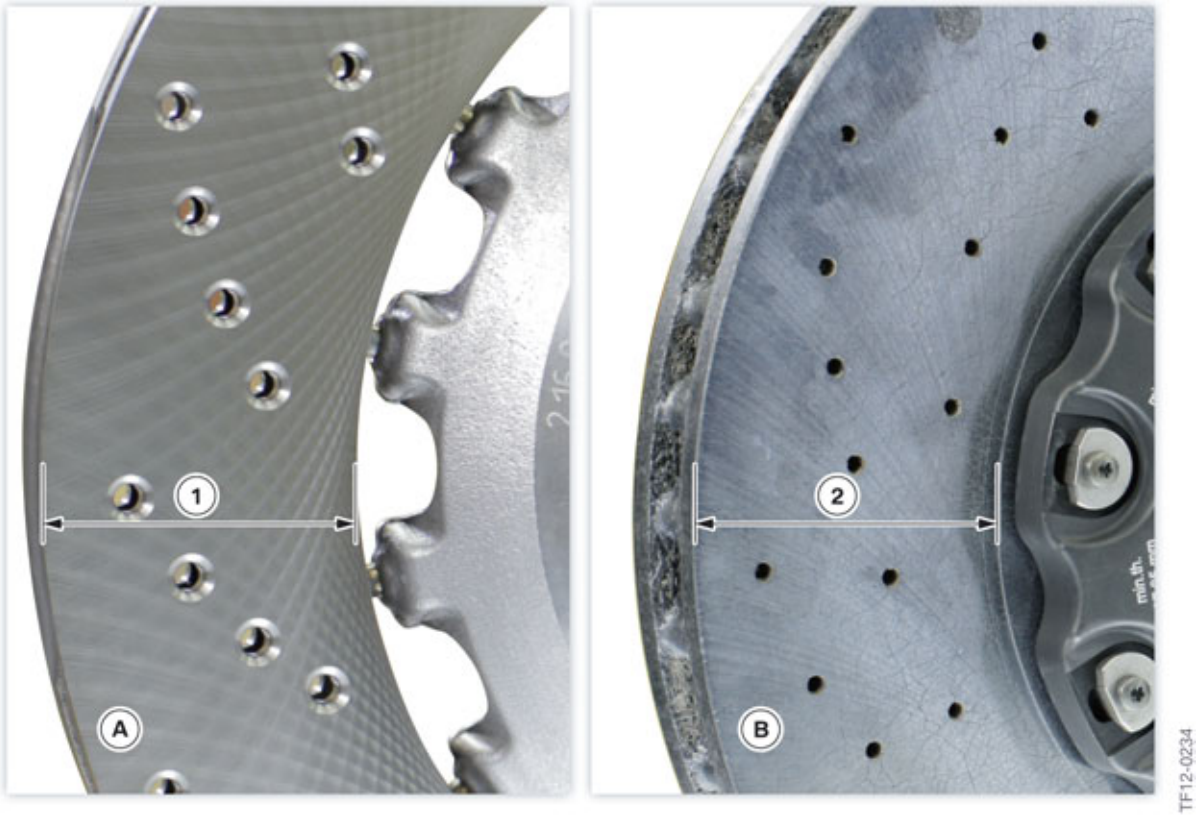
M Carbon Ceramic Brake System

5. Comparison to M Compound Brake

5.1. Front Axle Brake

5.1.1. Brake disc

The friction ring width (swept area) of the front M Carbon ceramic brake disc is 12.8 mm / 0.5 inches larger than the M Compound brake disc at 88.8 mm / 3.5 inches.



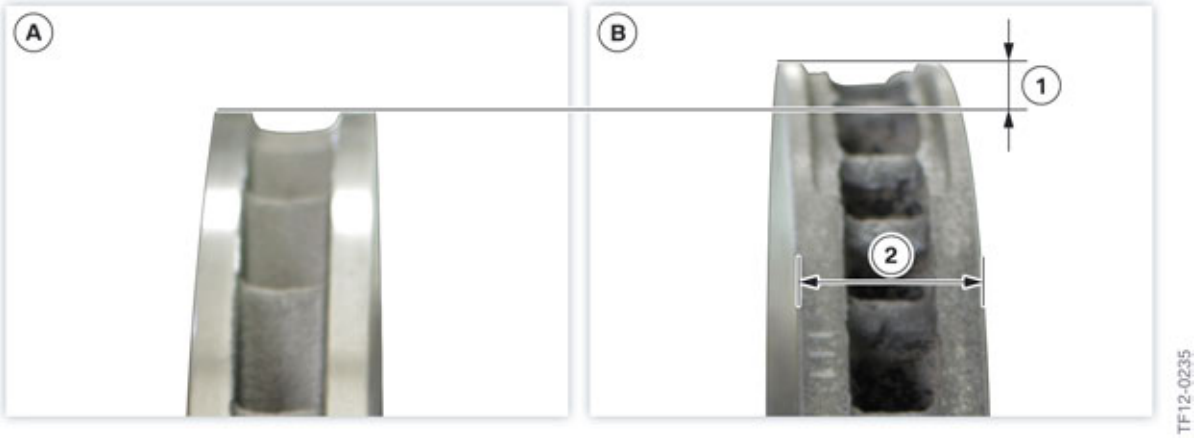
M Carbon ceramic brake, friction surface width

Index	Explanation
A	M Compound friction surface
B	M Carbon ceramic friction surface
1	76.0 mm / 3.0 inches
2	88.8 mm / 3.5 inches

The diameter of the M Carbon ceramic brake disc is 10 mm bigger and its thickness 2 mm greater.

M Carbon Ceramic Brake System

5. Comparison to M Compound Brake



M Carbon ceramic brake disc, front Dimension comparison

Index	Explanation
A	Front M compound brake disc
B	Front M Carbon ceramic brake disc
1	410 mm / 16.14 inches diameter, 10 mm / .39 inches larger
2	38 mm / 1.5 inches thick, 2 mm / .078 inches larger

5.1.2. Brake disc hub

The brake disc hub is made up of a high-strength aluminium alloy. Important information is engraved on it. This information is:

- Serial number
- Part number
- Direction of travel
- Min. weight (wear weight)
- Min. thickness (wear thickness)
- Week/Year of manufacture.

As the Carbon ceramic friction ring is exposed to alternating temperatures during driving, it uses a floating brake disc hub with a unique connection. This allows for expansion and contraction of the friction ring.

M Carbon Ceramic Brake System

5. Comparison to M Compound Brake

M Carbon ceramic brake, float-mounted

Index	Explanation
1	Friction ring connection at brake disc hub

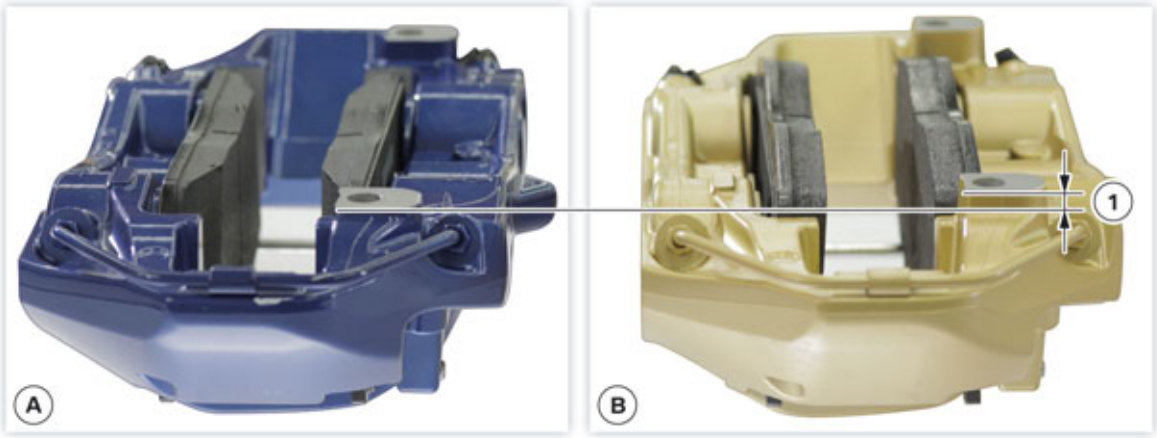
The bolts of the friction ring connection at brake disc hub should never be removed, loosened or tightened.

M Carbon Ceramic Brake System

5. Comparison to M Compound Brake

5.1.3. Brake caliper/pad

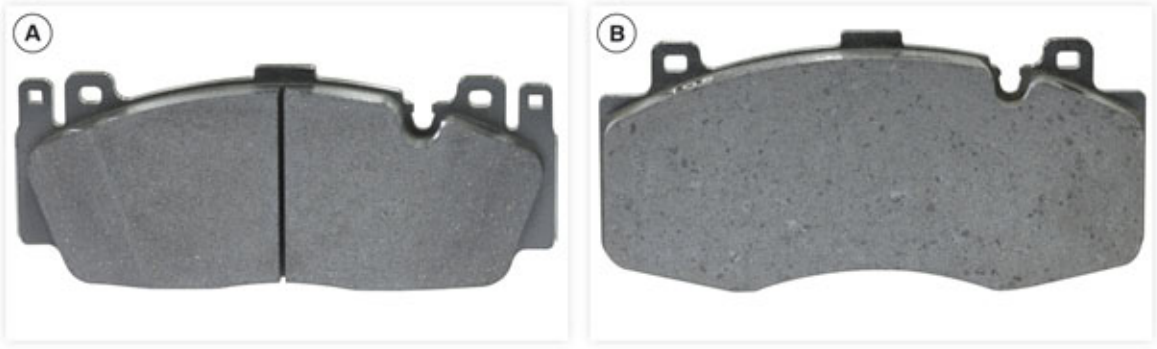
The front brake caliper housing corresponds to the F1x M Compound brake system. Only the contact surface (1) at the swivel bearing is machined 5 mm less than for the M Compound brake caliper as the front M carbon ceramic brake disc has a 5 mm larger radius and a larger friction ring.



M Carbon ceramic brake, brake caliper adaptation, front axle

Index	Explanation
A	Front M compound brake caliper
B	Front M Carbon ceramic brake caliper
1	Contact surface at swivel bearing, 5 mm taller

The size of the brake pad friction surface is adapted to the larger friction surface of the front brake disc.



M Carbon ceramic brake, brake pad, front axle

Due to the 2 mm thicker brake disc, the thickness of each brake pad is reduced by 1 mm.

M Carbon Ceramic Brake System

5. Comparison to M Compound Brake

M Carbon ceramic brake, brake pad, front axle

Index	Explanation
A	M Compound brake pad
B	M Carbon ceramic brake pad

Due to the larger brake pads the weight of the front brake caliper including the pads is 0.4 kg / 0.88 lbs heaver than the M Compound brake caliper.

5.2. Rear Axle Brake

5.2.1. Brake disc

The rear M Carbon ceramic brake disc has the same diameter as the M Compound brake disc.

The brake disc is 2 mm / .078 inches thicker.

Similar to the front brake disc, the Carbon ceramic friction ring is float-mounted at the brake disc hub using a specific connection.

5.2.2. Brake disc hub

This brake disc hub is also made from a high-strength aluminium alloy and the same information as for the front brake disc applies.

- Serial number
- Part number
- Direction of travel
- Min. weight (wear weight)
- Min. thickness
- Week/Year of manufacture.

M Carbon Ceramic Brake System

5. Comparison to M Compound Brake

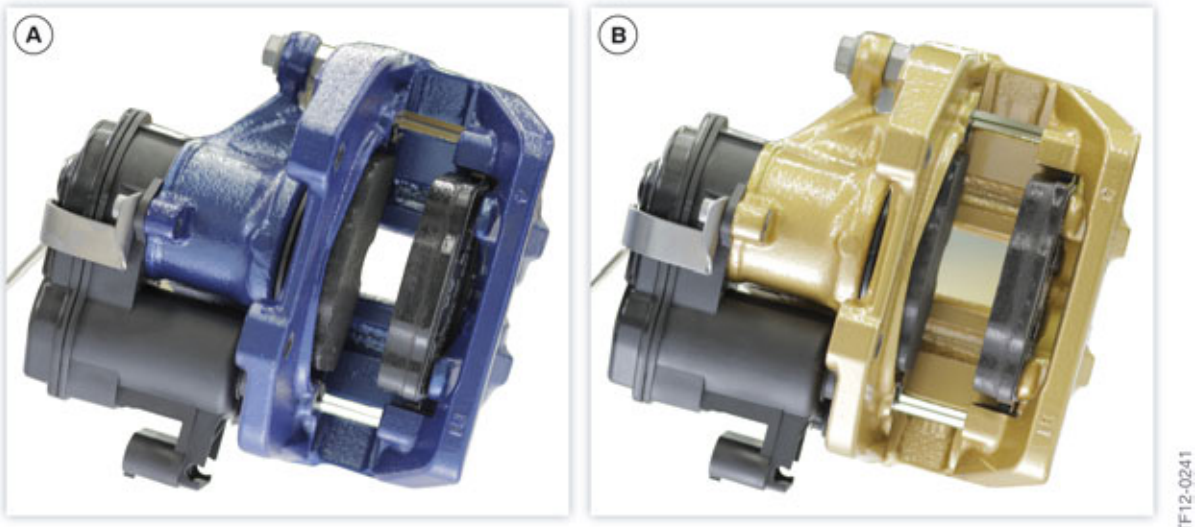
M Carbon ceramic brake, rear axle

5.2.3. Brake caliper/pad

The rear brake caliper is identical to the M Compound brake caliper, the size of the brake pads are also the same .

M Carbon Ceramic Brake System

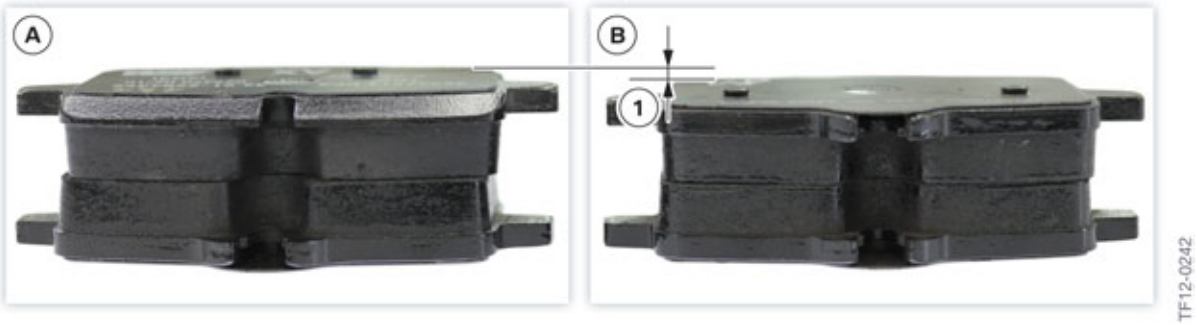
5. Comparison to M Compound Brake



M Carbon ceramic brake, brake caliper, rear axle

Index	Explanation
A	Rear M compound brake caliper (Blue)
B	Rear M Carbon ceramic brake caliper (Gold)

Due to the 2 mm thicker brake disc, the thickness of each brake pad is reduced by 1 mm.



M Carbon ceramic brake, brake pad, rear axle

Index	Explanation
A	Rear M Compound brake pads
B	Rear M Carbon ceramic brake pads
1	Pad thickness difference 2x –1 mm, i.e. total of –2 mm

5.3. Brake Booster

The brake booster is specifically designed for the increased coefficient of friction of the M Carbon ceramic brake. This is why it has its own part number. Without this adaptation, the behavior of the M Carbon ceramic brakes would be rated as disproportionately aggressive.

M Carbon Ceramic Brake System

6. Service Information

6.1. General Information

Every impact and collision with hard materials can cause damage to the ceramic surfaces and edges.

Chipping (1) of the disc surface may mean the brake disc is no longer suitable for installation and driving.

Max permissible width/depth of chip = 2 mm

Max permissible length = 10 mm

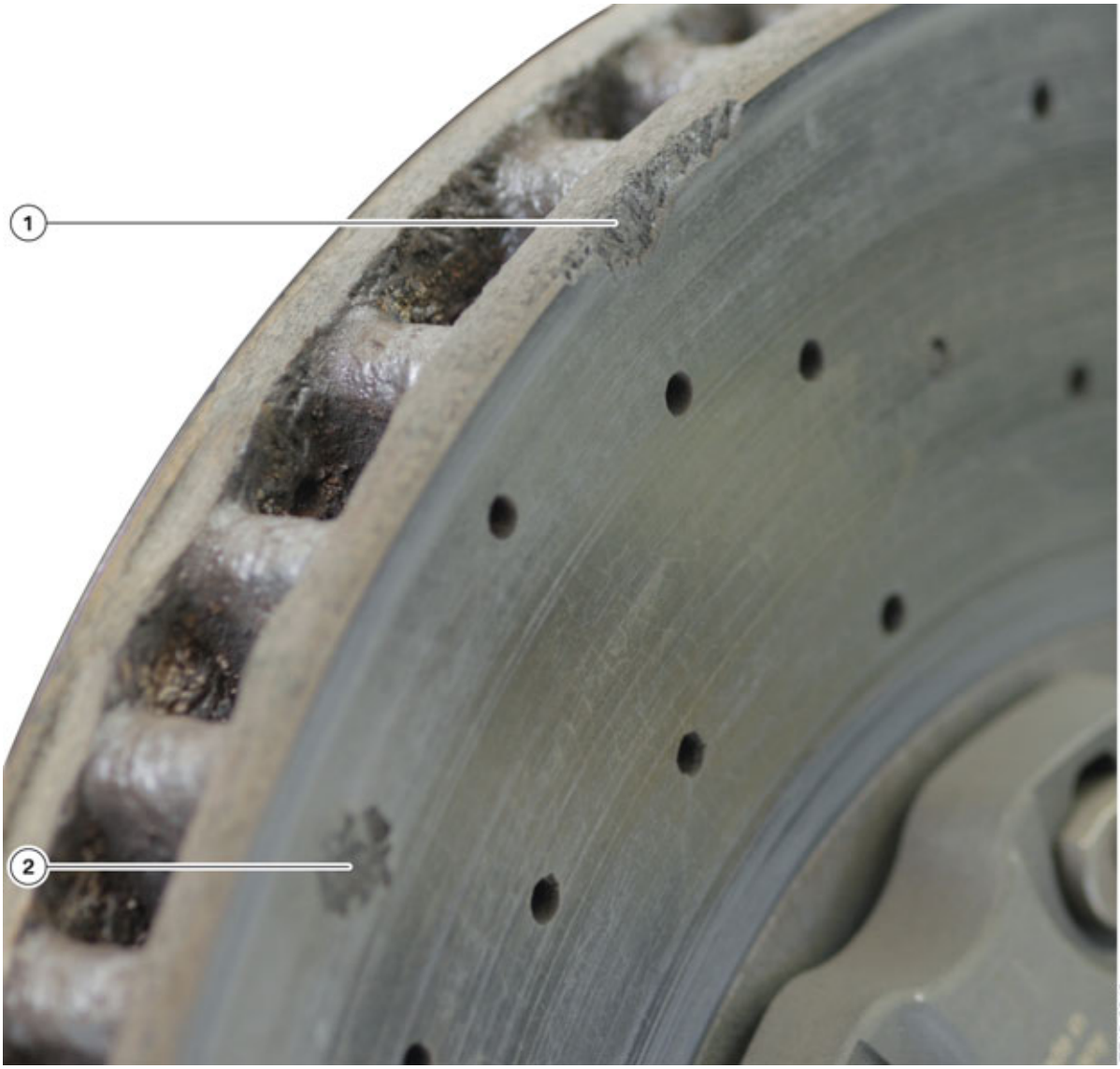
As a result, a professional check of the brake discs for visible damage must be performed during inspection and servicing. Damage may also occur during driving by stone chipping or accident.

If any of the wear indicators (2) on the disc surface are worn greater than 50% of the entire area, the disc requires replacement.

For more information about assessing the Carbon Ceramic brakes (C/SiC) for wear, Refer to ISTA 34 11 667.

M Carbon Ceramic Brake System

6. Service Information



M Carbon ceramic brake disc damaged and worn

Index	Explanation
1	Chipping after accident
2	Wear indicator after racing-style continuous load or high mileage

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Each time for performing the check, in the event of uncertainty or assumed borderline values as a result of damage and for necessary work, the current information and specifications in the documents in the Integrated Service Technical Application must be observed and, if necessary, a PuMA case created.

No machining can be made to the brake disc surfaces. The bolts of the friction ring connection at brake disc hub should never be removed, loosened or tightened.

M Carbon Ceramic Brake System

6. Service Information

6.2. Dismantling/Installation

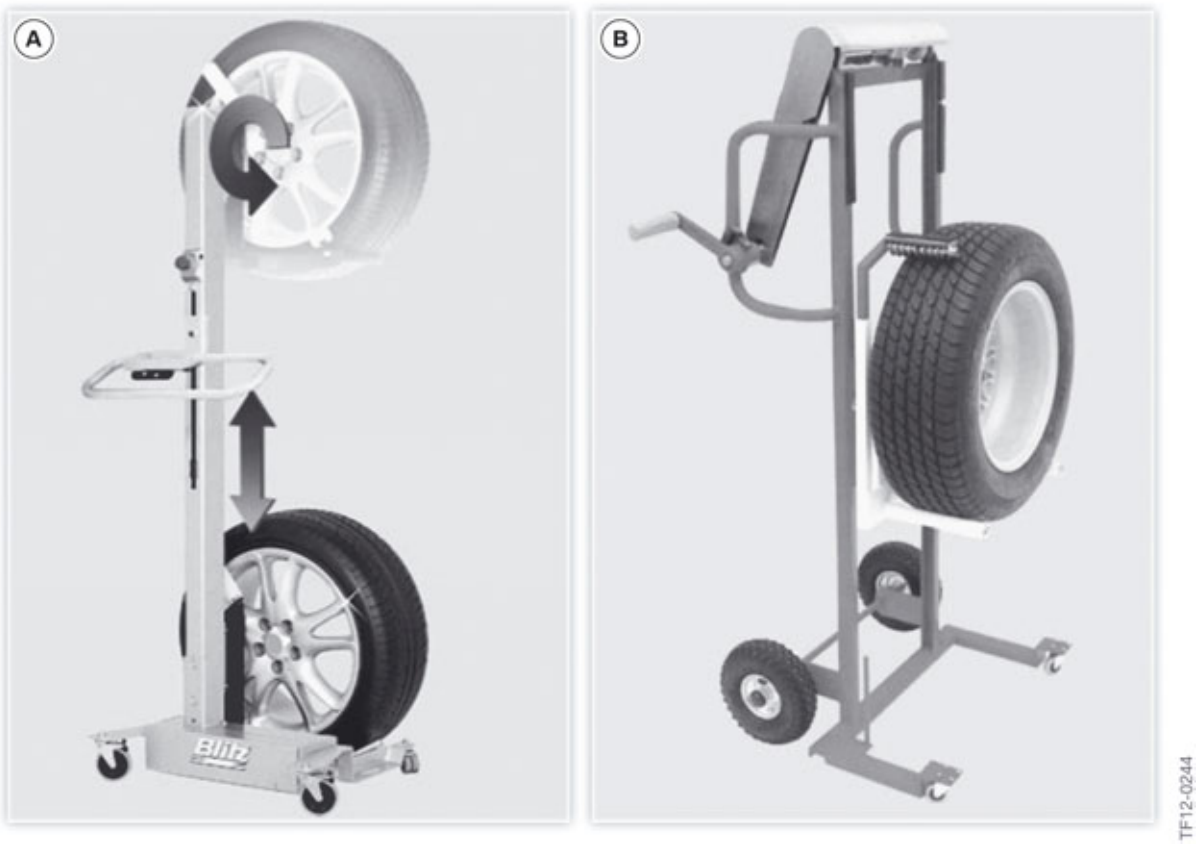
During dismantling/installation of the brake disc there is a risk that the wheel rim or add-on parts such as brake caliper, brake pads, heat shield, mounting tools, etc. may cause chipping on the ceramic through contact.

For dismantling and installation of the wheel the use of a jack or tire lifting device is the preferred method.

Tire lifting device

M Carbon Ceramic Brake System

6. Service Information

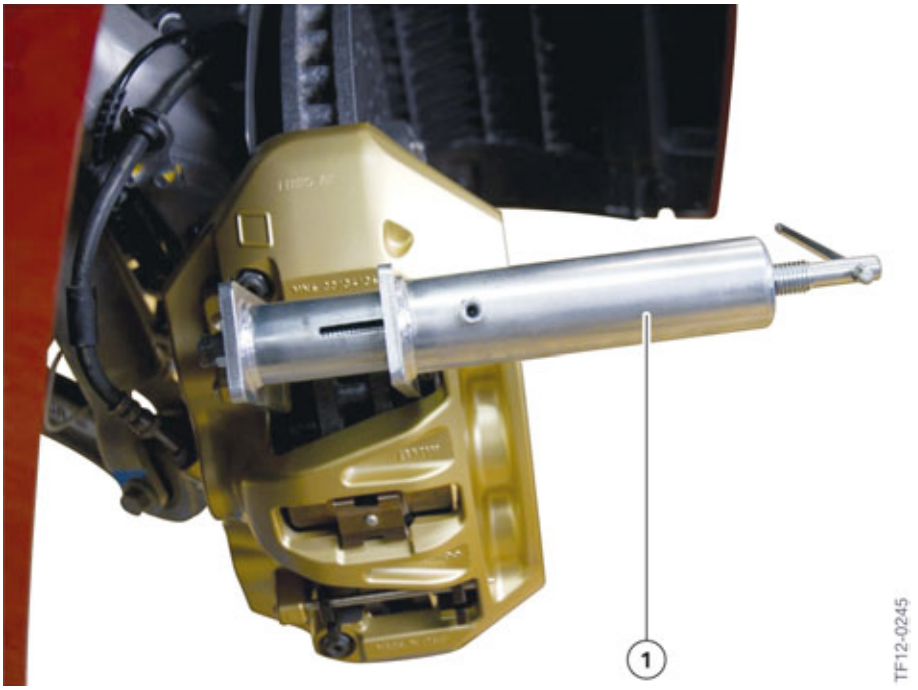


M Carbon ceramic brake, tire lifting devices

Index	Explanation
A	Tire lifting device 81 25 0 392 908
B	Tire lifting device 81 25 0 301 746

M Carbon Ceramic Brake System

6. Service Information



M Carbon ceramic brake, special tool

Index	Explanation
1	Special tool 34 1 050

The brake pads must have the maximum spreading distance and can only be opened using the BMW special tool (no other tools).

The brake caliper must be removed and installed carefully and without contact with the M Carbon ceramic brake disc. After dismantling the brake caliper must be secured with a suitable tool away from the brake disc.

M Carbon Ceramic Brake System

6. Service Information

S hook for supporting caliper.

During removal/installation there must be no force applied to the brake disc.

The brake disc should only be set down on the hub side, never place the surface of the disc on a work bench or floor.

A brake disc which has been dropped or experiences a heavy impact can no longer be used. The brake disc is no longer to be used due to visible and invisible damage.

For cleaning the M Carbon ceramic brake no brake cleaner or safety cleaner can be used as it has an aggressive effect on the friction ring.
Alcohol can be used as an alternative for cleaning when a brake has cooled down to room temperature.

Do not use any brake cleaner or safety cleaner!

If no wheel is mounted, extra caution against contact must be taken. The brake disc should be protected against external hazards using suitable measures.

Transport of the brake discs from the parts counter to the workbay should always be done in the original packaging. If no original packaging is available for transporting a brake disc, the brake disc must be properly packed to protect the disc from collision and damage.

M Carbon Ceramic Brake System

6. Service Information

6.3. Breaking in New Brake Pads/discs

After completing repair work:

- Perform functional check on brake test stand to ensure compliance with statutory guidelines.
- Carry out test braking while driving at low speed, the effectiveness of the brakes may be reduced during the initial braking operation.
- Brake pads do not have the optimal wear and contact pattern before approx. 1000 km / 600 miles.
  Drive cautiously during this period.
- Advise the customer not to perform any drastic braking in the first 200 km / 120 miles after brake replacement.

Refer to ISTA group 34 for additional information.

M Carbon Ceramic Brake System

7. Sample Boundary Catalog

7.1. General Information

BMW has developed a catalog to assess the appearance of new Carbon Ceramic Brake Discs. This document describes in detail what is considered normal and abnormal appearance of these new discs.

Please refer to ISTA group 34 to view the Sample Boundary Catalog.

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