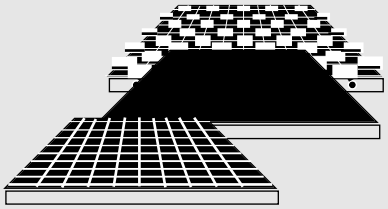
NB PARTS

Friction material



Solutions for brakes in industry sector

Standardized and customized friction materials for brake systems

Friction materials in overview

1 Roll lining materials - Universal

2 Sheet lining materials - Universal

3 Friction materials non-bonded to support - Contour conform

4 Drum brake linings

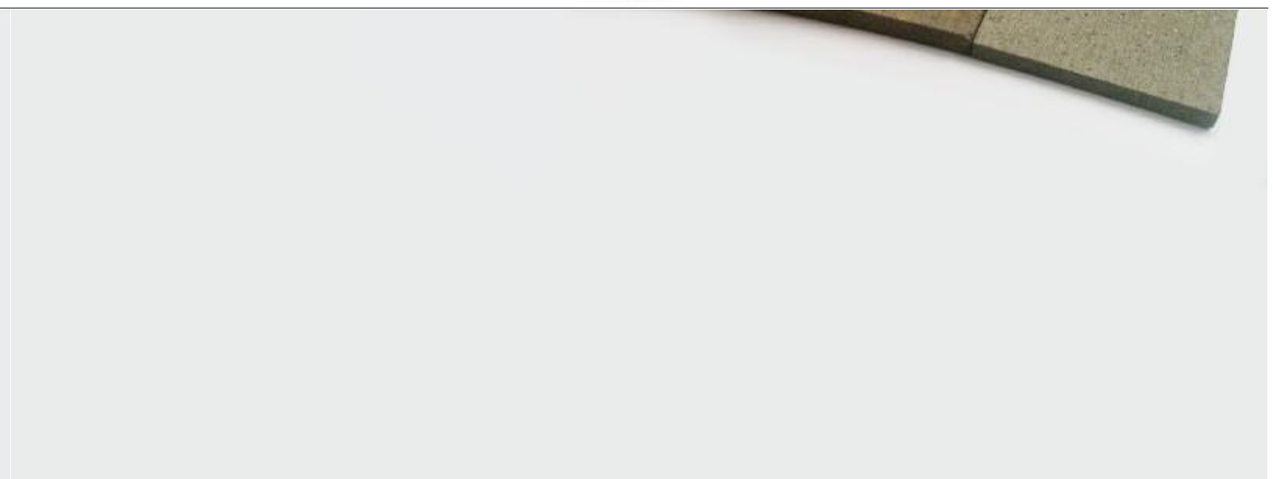
5 Friction materials bonded to support - Contour conform

6 Disc brake pads

7 Development / Production - Formulations

Company portfolio

NB PARTS is a newly established and strong partner for industrial friction materials. Focused on the optimum integration of brake linings and clutch facings into your industrial environment, the friction materials are adjusted to each particular application's requirement or developed, as the case may be. The available friction materials, reliant upon material compound and formulation, cover the whole spectrum of common applications: ranging from low to high coefficients of friction of over μ= 0,5 ; from softer lining materials for lower normal force between both friction partners up to harder friction materials like the ones for disc brake pads. The internal wearing will be suited to the requirements, with the result that glazing can be avoided. Basically the most amount of friction materials are organically bonded. Sintered compounds can be supplied as well, just ceramic friction materials do not count yet to our range of products. Organically bonded friction materials are characterized by their ingredients which are either rubber bonded or/and synthetic resin bonded – depending on required „flexibility“ and temperature resilience. The rubber type being used defines the resistance to oil, lubricants and other fluids, but certainly effects the price level as well. Best choice is to get in touch for further support and information about the variety of roll lining and flat sheet materials in universal and contour conform configurations, and whether with or without attachment to any lining support. Relying on competency in brake technical solutions and experience in developing friction materials, we will assist you and your engineering team.



Roll lining material - Universal

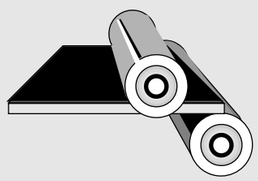
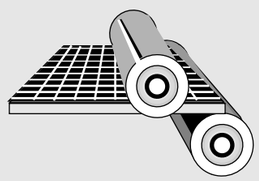
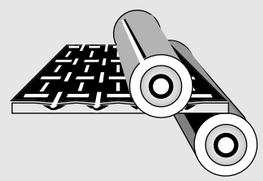
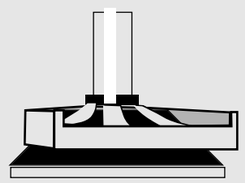
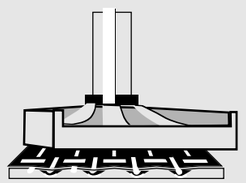
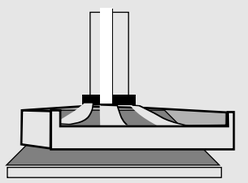
Sheet lining material - Universal

Roll lining materials
Supplied in rolls or lining segments, roll materials are being applied for relining and bonding to supports, to brake shoes and brake bands, for instance. Mostly preferred services are cutting of length and width, followed by ongoing methods of thermal adhesive bonding to join the friction material with the backing carrier. Otherwise, if brake linings need to be riveted to their supports, the lining segments go through common drilling process. To achieve sufficient strength make sure to use roll lining materials, which are reinforced by supporting wire in their rivet wall. Does the customer's applications require high strength of the friction material and great temperature resilience, the best chosen friction material should be woven roll lining material. However, to match environmental conditions, a range of roll linings can be supplied, that are resistant to oil and sea water.

Sheet lining materials
Flat sheets are certainly the best choice for customers who request complex geometries or small lot sizes, but the set up of contour conform moulding forms cannot be justified. The machining process provides a production of sheet linings in response to various custom specific requirements according to hardness grade, coefficients of friction and desired wear characteristics. Iron-free and steel-free compounds are, in addition, resistant to corrosion. Non-magnetic as well as non-magnetizable materials do not contain any metal fibers. Sheet linings provide a particular "impact and shock strength", if those flat sheets are press-moulded out of woven pre-processing fabrics.

Sliding materials
These synthetic materials perform well in low coefficients of friction, which results in low internal wearing. Furthermore they are characterized by their "shock strength" and resistance to corrosion.

1

Characteristics	**Roll material (roll moulded)** Universal non-contour conforming designs flexible	**Roll material (with wire backing)** Universal wire backing to inner or outer wall less flexible reinforced rivet wall	**Roll material (woven)** Universal non-contour conforming designs less flexible	**Sheet material (press moulded)** Universal non-contour conforming designs flexible up to rigid	**Sheet material (woven)** Universal non-contour conforming designs rigid great shock strength	**Sliding material** Universal non-contour conforming designs flexible	Characteristics
Type / Version	in scales of width 15 mm ... 330 mm up to scales of length of 15000 mm	in scales of width 15 mm ... 330 mm up to scales of length of 10000 mm	in scales of width 15 mm ... 330 mm up to scales of length of 5000 mm	in scales of width down to 30 mm in scales of length up to 760 mm	in scales of width down to 30 mm in scales of length up to 400 mm	in scales of width down to 30 mm in scales of length up to 500 mm	Type / Version
Friction material	rubber bonded	rubber bonded	synthetic resin bonded	rubber and synthetic resin bonded	synthetic resin bonded, yarn reinforced	plastics	Friction material
Applications	internal and external shoe brakes	internal and external shoe brakes	internal and external shoe brakes	industrial brakes, further processing through customer	industrial brakes, further processing through customer	guidances at transporting, contact protection	Applications
							

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Friction materials - Contour conform

non-bonded to support

Contour conforming designs
Contour shaped friction materials have to be applied, whenever high demands arise for mechanical strengths, such as edge strength or strength of adhesive joint. Due to using the method of moulding we are able to manufacture cost efficient mould cavities and tools (shaping process). Small quantities and complex geometrical contours will mostly be shaped out of sheet or roll lining materials in mechanical processing (cutting process). Furthermore contour-conform injection moulded pieces passed successfully the first testings. Friction materials should be chosen in accordance with the technical design of the brake or clutch: the greater the thermal impacts the more relevant are synthetic resin bonded friction materials (less flexible) and the less suitable are rubber bonded materials (flexible). To select the very best performing materials, temperatures under continuous operation as well as peak temperatures that eventually might come up, need to be taken into account.

Requirements on resistance to corrosion and low environmental impact, as well as electromagnetic characteristics, resistance to fluids and far more factors will be calculated and all these concerns together add a level of complexity to the application profile. In addition, further details will be examened in supporting dialogues to each application case.

Claim for quality standard
- resistant to "rotting" as a result of compact compression moulding
- highly functional solutions
- optimized for performance demands, adjusted to required load capability
- reliability

Precision in detail
- shaping of profile
- detailled shape forming of: angles, chamfers, great variety of toothings, plenty of different types of profiles
- customer tailored manufacturing

	Rings (Facings)	Discs (Facings)	Segments (Pads)	Pucks (Pads)	Cones	Friction blocks	Further applications	Custom specific solutions
Characteristics	circular partial surface	circular entire surface	partial sector of rings	solid small blocks	conical facing	solid blocks	partial sectors of blocks, sheet and roll materials	Development and production according to your specifications and requirements of the brake and clutch system
Type / Version	planar option grooved/non-grooved, option: drilled/non-drilled, profiled friction disc ring possible	planar option: grooved/non-grooved, option: drilled/non-drilled, profiled friction surface possible	planar option: grooved/non-grooved, option: drilled/non-drilled	contour conform profile machined through turning process	planar option: grooved/non-grooved option: drilled/non-drilled	planar in various shapes and configurations	great variety in shapes and configurations, profile machined	1) Measuring the item 2) Defining the friction material 3) Production of the friction material 4) Milling of the profile 5) Surface treatment 6) Final inspection and delivery
Friction material	organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings	organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings	organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings	synthetic resin bonded	organically bonded, fibre and yarn reinforced	synthetic resin bonded	rubber and synthetic resin bonded	
Applications	mechanical engineering, dry and wet running operation, drive engineering	mechanical engineering, dry and wet running operation, drive engineering	mechanical engineering, overload slip clutch, drive engineering	mechanical engineering, disc brakes, drive engineering	mechanical engineering, dry and wet running operation	mechanical engineering	mechanical engineering, drive engineering	

3

Drum brake linings - Contour conform

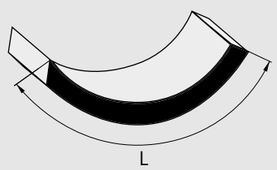
non-bonded to support

Drum brake linings
Radius-conform prepared friction linings will be applied, either riveted or adhesive bonded onto brake lining supports, in service brakes and parking (drum) brakes of commercial vehicles, truck or car trailers, busses and in industrial applications as well. The production along with single nest tools or half-shell tools is based on lot size and on custom application, or otherwise, rely on further processing of hardened roll lining materials. According to a large number of application formats we are equipped with a great quantity of friction material compounds.

Composition of lining material
Due to incoming inspection of raw materials for chemical and metallurgical criteria, we ensure that only flawless ingredients enter the manufacturing process. In ongoing process the friction material mixtures, manufactured strictly to formulation guideline, will be examined in fiber decomposition and distribution of single additives. The required flowing mixtures, that are needed for radius conform executed moulding process, will guarantee constant density distribution over the entire brake lining during shaping process under the influence of temperature, pressure, and time. On the other hand notice that poorly flowing mixtures tend to cause linings, in which strength reduces in particular in the chamfered ends. This may result into unwanted lining fractures during riveting and, even, during adhesive bonding processes of brake shoes. The rivet wall is of great concern, in order to provide a high level of adjustability onto the brake shoe through sufficient "smoothness" and a high level of strength for riveting work. Smooth flowing, but still strong, two characteristics that have to match to prevent a friction material damage. The length of time, in which drum brake linings are being used, is another criteria to be considered for composition of formulations. Neither drums nor brake shoes should seize up due to rust and linings should not be "rotting" in long lasting operation life.

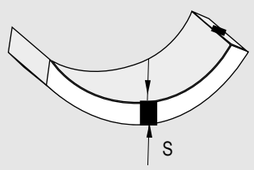
Fitted to custom application
In addition to a precise selection of formulations, which differ mainly between synthetic resin bonded "harder" linings (for higher thermal ranges) and rubber bonded more "flexible" linings, yet very fine adjusting of friction material and used lining support counts as well. Working with detailled measurement, testing and simulation series, drum linings will be developed and passed on to production facilities. In order to meet the geometrical challenges such as radius, internal arc and length, position and design of riveting holes, rivet wall included, facilities are equipped appropriate with gauges and monitorings of linings; combined with statistical checkings of these geometrical characteristics through three-dimensional measuring machine. To suit every aspect, a close dialogue between supplier and customer is absolutely necessary about details, e.g. allowed tolerances. In the end the effective transmission of braking forces inside of a brake shoe and the optimum interaction between the metal shoe and the drum brake lining, both base on full surface contact. Obviously a duo that works on best of co-operation.

Brake lining length (L)
30 mm ... 710 mm

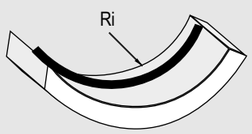


Brake lining width (B)
15 mm ... 400 mm

Brake lining thickness (S)
3 mm ... 30 mm



Brake lining inner radius (Ri)
40 mm ... 350 mm



Finishing of the brake lining

chamfering of lining ends,
option: drilled/non-drilled,
option: marking at the edges,
option: coating of inner radius

Custom specific solutions

Development and production according to your specifications and requirements of the brake and clutch system

1) Measuring the item
2) Defining the friction material
3) Generating the CAD drawing
4) Moulding process

5) Surface treatment
6) Drilling / countersinking of rivet holes
7) Final inspection and marking

Friction materials - Contour conform

bonded to support

Adhesive bonding onto support
Contour conforming friction materials will be properly joined onto support by attaching technique, since only an entire contact between the surfaces guarantees good shear levels, uniform pressure distribution and long life-time. Therefore the accurately to the millimetre trimmed brake linings and their lining supports will be coated by a thin layer of adhesive (i.e. dip coating process of special liquid adhesives) and fitted against each other in short time. Fastened by special clamping tools the workpieces will be prepared for the temper process in oven (curing). Exposed to high temperatures the adhesive layers of lining and support link together by chemical reactions that built up an optimum adhesion. After curing and cooling, the bonded item can be turned into final coating phase to protect the metal support for corrosion.

Clutch facings
Organically bonded facings secure low wear at high capacity & stress, good fading stability & comfort characteristics, extended life, stable friction coefficients even at high temperature, along with long-term strength & brake control. The use of yarn reinforcement backs up high bursting strength.

Brake shoe linings
Depending on application, the lining spectrum from which to choose varies: from soft bendable materials for exact fit, over flexible ones hardend to radius, to harder friction materials. In doing so, material consistency of counter-surfaces needs further attention.

Linings of further supports
Cones will be supplied either in glue bonded or uncoupled configuration in response to custom requirements. Pad segments could carry clutch facing material, or very specific types of friction materials can be bonded to the supports. Even friction materials in complex profiles do not cause any problem in glue bonding method.

Advantage of professional bonding
- Good adhesion to support guarantees adequate introduction of braking force.
- No interface corrosion, because of clearance-free contact to metal support.
- High adhesion, as well as temperature resilience of adhesive joint.
- Excellent noise behavior, because of strong joining of friction couple.

	Friction discs	Clutch discs	Brake shoes	Brake bands	Cones	Segments (pads, buttons)	Further applications	Custom specific solutions
Characteristics	facing on supporting disc	facing on supporting disc	lining on supporting shoe	lining on supporting band	lining on supporting cone	lining on plate or disc	friction material on support	Development and production according to your specifications and requirements of the brake and clutch system
Type / Version	riveted, glue bonded or integrally moulded, option: grooved/non-grooved	riveted, glue bonded or integrally moulded, option: grooved/non-grooved	riveted, glue bonded or integrally moulded, chamfered lining ends	glue bonded or riveted, friction material to inner wall, option: grooved/non-grooved	glue bonded or integrally moulded	glue bonded, riveted or integrally moulded	glue bonded or integrally moulded	1) Measuring the item 2) Defining the friction material 3) Production of the friction material, cutting of size, milling of the profile, finishing processes (e.g. for riveting) 4) Thermal adhesive bonding, pressing and curing in oven 5) Surface treatment 6) Final inspection and delivery
Friction material	organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings	organically bonded fibre and yarn reinforced based on PTFE / graphite / paper and aramide linings	rubber and synthetic resin bonded	rubber bonded, woven roll material	organically bonded, fibre and yarn reinforced	organically bonded fibre and yarn reinforced based on PTFE / graphite / paper and aramide linings		
Applications	drive engineering, mechanical engineering, dry and wet running operation	drive engineering, mechanical engineering, dry and wet running operation	drum brakes	band brakes	drive engineering	drive engineering, disc brakes, dry and wet running operation	drive engineering dry and wet running operation	

Disc brake pads - Contour conform

bonded to support

Disc brake pads
Placed in industrial disc brakes as well as service and parking brakes, brake pads are designed of friction material and backing plates made of steel, cast or forging.

Production of disc brake pads
At incoming raw material inspection, the components of the formulation will be checked on chemical, metallurgical and various relevant factors to ensure that only ingredients and backing plates of certain specification enter production line. Relying on strict formula guidelines, mix productions go through efficient mixing power units. In another step the preparation of the backing plates starts, wherein steel, cast or forging parts will be examined on quality criteria and material consistency. Basically, readiness of backing plates means the generating of a clean degreased and roughened surface, which will be coated by temperature resistant adhesive later on. Roughness of the contact area of the metal plate, besides layer thickness of the adhesive and its degree of dryness have to match exactly for the friction material. It is an initial part of the moulding process.

Moulding to contour
Brake pad moulding, which means joining of backing plate and friction material under pressure, time and temperature, is always carried out in contour-designed mould cavities according to defined processing instructions. Those are adapted to requirement, dimension and handled mixture.
Due to its design, the adhesive joint between friction material and backing plate prevents underlying corrosion even after extended exposure to excessive moisture. Special products (friction material mass and back plates) are optimized for applications under extreme corrosion conditions. In the last place, all required characteristics (coefficient of friction, wear etc.) of the disc brake pads will be captured through curing of friction material mass and adhesive joint.

Quality control
The testings of shear strength, density, coefficient of friction and wear behavoir with appropriate testing devices are integrated elements to assure continuous quality and underlie regular controls. The brake pads go additionally through a final visual inspection right before packaging to focus once again on painting, markings and certain characteristics that get visually viewed best evaluation results. The certification of involved factories is credited according ISO 9001.

Variation of lining in design

Several contour versions (outlines)
- parallel lining
- segment lining
- pad grinded to width
- true positive moulded

Details in friction linings
- recesses
- slots / grooves
- chamfers

Variation of metal backing

Type of metal materials
- steel
- casting
- forging

Steel processing
- pressworks
- waterjet cutting
- laser cutting

(using high-strength steel materials as well)

Applications

- Parking brake
- Hydraulic service brake
  (e.g. for passenger cars, vans and commercial vehicles)
- Air brakes
  (e.g. for heavy commercial vehicles and busses)
- Automotive brake systems
  (vehicles on road / off road)

Manufacturing process for disc brake pads is structured in following processing stages:

1) Preparing and mixing of raw materials for friction pad
2) Preparing of backing plate
3) Integrally moulding process of friction material and backing support
4) Curing (hardening) of the linings
5) Finishing, painting and marking of linings
6) Final inspection and delivery

Consulting / Development / Production

Professional support
Building on skills and experience over the years in the brake and friction lining industry we are able to guide customers according to their needs. The service includes above all qualified defining and selecting of most suitable friction materials and is well combined with expert knowledge in brake system installations, whether dealing with disc brake, drum brake or another brake mechanism. In case a braking device in long-term operation needs modifications we can call up the expert know-how of our reconditioning domain, evaluate the current condition and depending on the results we will restore and update to new standard.

Development of friction material
If circumstances or special conditions of your application might over-reach the standard portfolio of friction products, we will bring forward development & engineering of your custom specific friction materials. In dialogue with the customer we will specify and define requirements and test modalities of the new material. Samples and prototyping will be carried out by NB PARTS, and its outcome will be analyzed and rated in evaluations and discussions through both partners. After successful development, all quality relevant characteristics and the directing of their verification and inspection will be defined. In the very next and final step the newly designed products will be manufacured by quick-implementation into production process.

Production
NB PARTS is due to co-operation with ISO certified manufacturers in the position to supply a wide range of friction materials by sharing prices in line with the market. On request, products under licence can be commissioned that will be manufactured at extended workbenches. If there is no need to do so, production and delivery will base on standard friction material. NB PARTS ensures quality – corresponding contracts in conjunction with incoming & outgoing goods inspections are aimed at doing.

Distribution of raw materials
The basis of every friction compound – raw materials - they have also to be kept in mind. Our distribution of fibre and powder-formed components of formulations is focused on already treated and available raw materials, which are purchased partly from other industry sectors and have already been checked in constant quality control therein. So joining in same interests saves great expenses, offers advantages in purchasing volume and promises raw materials with competitive pricing and constant quality.

Raw Materials / Formulations

Production of mixtures
At incoming raw material inspection, the components of the formulation will be checked. It is the very first step to start with quality control by measuring chemical composition, grain-size distribution and hardness. All to ensure that only raw materials of certain specification enter production line.
The mix production is carried out through production facilities in Germany, following strict formula guidelines and being equipped with efficient mixing power units. These mixing machines do not only distribute the powder-formed components evenly, but also decompose fiber additives to realize certain attainable characteristics. Special attention is paid to repetition accuracy and "robust" attributes of the mixture, in order to remain on a high level of steady and stable quality.

Customer supporting projects
Developing of friction materials

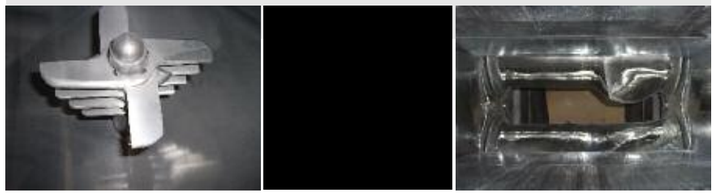
1) Consulting, analyses of the application
   Support, guidance in selecting the friction materials, brake linings, brake components

2) Development, engineering of specific friction materials
   Generating customer-tailored solutions (considering requirements, joining engineer team)
3) Defining the test modalities, preparing samples, testing and evaluation

4) Bringing the engineered lining compound into production
5) Production of mixture according to formulation settings in mixing power units
6) Preparing the pre-form of friction material at dry mixer, kneading trough, etc.
7) Manufacturing the friction materials in roll and press moulding processes (moulding nests and forms)

8) Machining and finishing processes of the friction materials
   Cutting of seize/profile, surface treatment glue bonding or riveting onto backing support

9) Final inspection, quality control, customer acceptance with a documentation to close up
   Defining quality relevant characteristics and guidelines on verification/inspection
10) Support service during certification at external test facilities



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NB PARTS GmbH
Höchstadter Straße 34
D-91325 Adelsdorf
Germany

Phone + 49 (0) 9195 92 19 50
Fax + 49 (0) 9195 92 19 520
E-Mail info@nb-parts.de
www.nb-parts.de

Register number: HRB 6248
Register court: Bamberg District Court
VAT reg. no.: DE 263 015 356