Solutions for brakes in industry sector
Standardized and customized friction materials for brake systems
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 \( \mu = 0.5 \); 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.

<table>
<thead>
<tr>
<th></th>
<th>Friction materials in overview</th>
<th>Company portfolio</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Roll lining materials - Universal</td>
<td></td>
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<tr>
<td>2</td>
<td>Sheet lining materials - Universal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Friction materials non-bonded to support - Contour conform</td>
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<td>4</td>
<td>Drum brake linings</td>
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<tr>
<td>5</td>
<td>Friction materials bonded to support - Contour conform</td>
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<tr>
<td>6</td>
<td>Disc brake pads</td>
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<tr>
<td>7</td>
<td>Development / Production - Formulations</td>
<td></td>
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</table>
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.

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.

### Characteristics

<table>
<thead>
<tr>
<th>Type / Version</th>
<th>Roll material (roll moulded)</th>
<th>Roll material (wire backing)</th>
<th>Roll material (woven)</th>
<th>Sheet material (press moulded)</th>
<th>Sheet material (woven)</th>
<th>Sliding material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction material</td>
<td>rubber bonded</td>
<td>rubber bonded</td>
<td>synthetic resin bonded</td>
<td>rubber and synthetic resin bonded</td>
<td>synthetic resin bonded, yarn reinforced</td>
<td>plastics</td>
</tr>
<tr>
<td>Applications</td>
<td>internal and external shoe brakes</td>
<td>internal and external shoe brakes</td>
<td>internal and external shoe brakes</td>
<td>industrial brakes, further processing through customer</td>
<td>industrial brakes, further processing through customer</td>
<td>guidances at transporting, contact protection</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Universal non-contour conforming designs flexible</td>
<td>Universal wire backing to inner or outer wall less flexible reinforced rivet wall</td>
<td>Universal non-contour conforming designs less flexible</td>
<td>Universal non-contour conforming designs flexible up to rigid</td>
<td>Universal non-contour conforming designs rigid great shock strength</td>
<td>Universal non-contour conforming designs flexible</td>
</tr>
<tr>
<td>Type / Version</td>
<td>in scales of width 15 mm ... 330 mm up to scales of length of 15000 mm</td>
<td>in scales of width 15 mm ... 330 mm up to scales of length of 5000 mm</td>
<td>in scales of width 15 mm ... 330 mm up to scales of length of 5000 mm</td>
<td>in scales of width down to 30 mm up to scales of length up to 700 mm</td>
<td>in scales of width down to 30 mm up to scales of length up to 400 mm</td>
<td>in scales of width down to 30 mm up to scales of length up to 600 mm</td>
</tr>
</tbody>
</table>

### 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.
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 most likely 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 examined 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
- detailed shape forming of: angles, chamfers, great variety of toothings, plenty of different types of profiles
- customer tailored manufacturing

Characteristics

<table>
<thead>
<tr>
<th>Rings (Facings)</th>
<th>Discs (Facings)</th>
<th>Segments (Pads)</th>
<th>Pucks (Pads)</th>
<th>Cones</th>
<th>Friction blocks</th>
<th>Further applications</th>
<th>Custom specific solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>circular partial surface</td>
<td>circular entire surface</td>
<td>partial sector of rings</td>
<td>solid small blocks</td>
<td>conical facing</td>
<td>solid blocks</td>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>Development and production according to your specifications and requirements of the brake and clutch system</td>
</tr>
</tbody>
</table>

Type / Version

<table>
<thead>
<tr>
<th>Rings (Facings)</th>
<th>Discs (Facings)</th>
<th>Segments (Pads)</th>
<th>Pucks (Pads)</th>
<th>Cones</th>
<th>Friction blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>planar option grooved/non-grooved, option: drilled/non-drilled, profiled friction disc ring possible</td>
<td>planar option grooved/non-grooved, option: drilled/non-drilled, profiled friction surface possible</td>
<td>planar option grooved/non-grooved, option: drilled/non-drilled</td>
<td>planar conform profile machined through turning process</td>
<td>planar option grooved/non-grooved option: drilled/non-drilled planar in various shapes and configurations</td>
<td></td>
</tr>
</tbody>
</table>

Friction material

<table>
<thead>
<tr>
<th>Rings (Facings)</th>
<th>Discs (Facings)</th>
<th>Segments (Pads)</th>
<th>Pucks (Pads)</th>
<th>Cones</th>
<th>Friction blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings</td>
<td>organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings</td>
<td>organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings</td>
<td>synthetic resin bonded</td>
<td>organically bonded, fibre and yarn reinforced</td>
<td>synthetic resin bonded</td>
</tr>
</tbody>
</table>

Applications

<table>
<thead>
<tr>
<th>Rings (Facings)</th>
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<th>Segments (Pads)</th>
<th>Pucks (Pads)</th>
<th>Cones</th>
<th>Friction blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanical engineering, dry and wet running operation, drive engineering</td>
<td>mechanical engineering, dry and wet running operation, drive engineering</td>
<td>mechanical engineering, overload slip clutch, drive engineering</td>
<td>mechanical engineering, disc brakes, drive engineering</td>
<td>mechanical engineering, dry and wet running operation</td>
<td>mechanical engineering, drive engineering</td>
</tr>
</tbody>
</table>

Further applications

<table>
<thead>
<tr>
<th>Rings (Facings)</th>
<th>Discs (Facings)</th>
<th>Segments (Pads)</th>
<th>Pucks (Pads)</th>
<th>Cones</th>
<th>Friction blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>partial sectors of blocks, sheet and roll materials</td>
<td>partial sectors of blocks, sheet and roll materials</td>
</tr>
</tbody>
</table>

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
**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 detailed 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 inner radius (Ri)**

30 mm ... 350 mm

**Brake lining length (L)**

30 mm ... 710 mm

**Brake lining width (B)**

15 mm ... 400 mm

**Brake lining thickness (S)**

3 mm ... 30 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

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 lifetime. 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.

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.

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

Linings of further supports
Cone 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.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Friction discs</th>
<th>Clutch discs</th>
<th>Brake shoes</th>
<th>Brake bands</th>
<th>Cones</th>
<th>Segments (pads, buttons)</th>
<th>Further applications</th>
<th>Custom specific solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type / Version</td>
<td>riveted, glue bonded or integrally moulded, option: grooved/non-grooved</td>
<td>riveted, glue bonded or integrally moulded, option: grooved/non-grooved</td>
<td>riveted, glue bonded or integrally moulded, chamfered lining ends</td>
<td>glue bonded or riveted, friction material to inner wall, option: grooved/non-grooved</td>
<td>glue bonded or integrally moulded</td>
<td>glue bonded, riveted or integrally moulded</td>
<td>glue bonded or integrally moulded</td>
<td>Development and production according to your specifications and requirements of the brake and clutch system</td>
</tr>
<tr>
<td>Friction material</td>
<td>organically bonded, fibre and yarn reinforced, based on PTFE / graphite / paper and aramide linings</td>
<td>organically bonded fibre and yarn reinforced based on PTFE / graphite / paper and aramide linings</td>
<td>rubber and synthetic resin bonded</td>
<td>rubber bonded, woven roll material</td>
<td>organically bonded, fibre and yarn reinforced</td>
<td>organically bonded fibre and yarn reinforced based on PTFE / graphite / paper and aramide linings</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>Applications</td>
<td>drive engineering, mechanical engineering, dry and wet running operation</td>
<td>drive engineering, mechanical engineering, dry and wet running operation</td>
<td>drum brakes</td>
<td>band brakes</td>
<td>drive engineering</td>
<td>drive engineering, disc brakes, dry and wet running operation</td>
<td>drive engineering, dry and wet running operation</td>
<td></td>
</tr>
</tbody>
</table>
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 specifications 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 backing 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 behavior 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.

Disc brake pads - Contour conform

Variation of lining in design
- Several contour versions (outlines)
  - parallel lining
  - segment lining
  - pad ground 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) Integranily 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
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.

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
Friction material