Wear protection for centrifugal fans

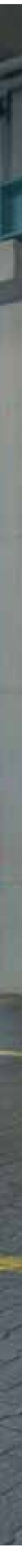
We make air work for you

Venti Oelde

Wear protection – an economically sound decision

Damaged impeller
without wear protection

Impeller with wear
on the centreplate

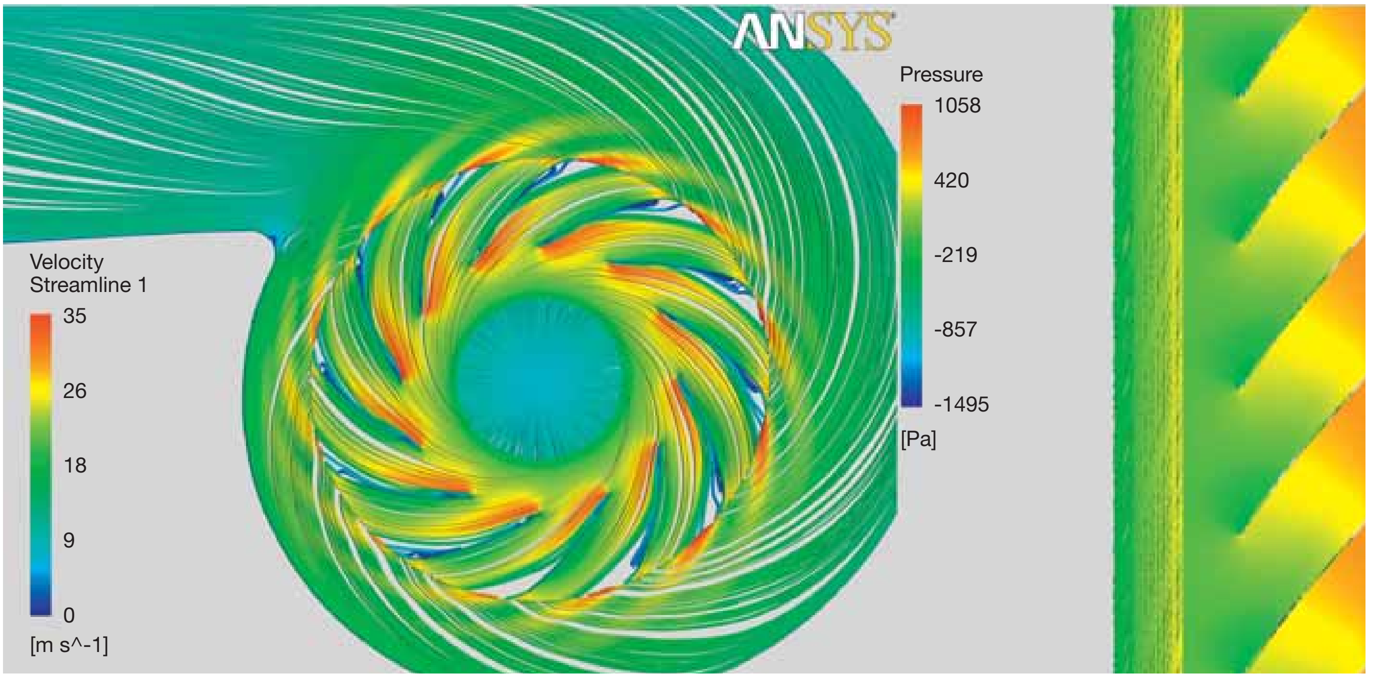


Extreme demands
Large and special fans are often exposed to the harshest wear attacks. Irrespective of the sector, they have to withstand enormous stresses in the production process.
In the cement and steel industries in particular, the fans are subject to extreme demands. Abrasive media that are carried in the air flow (e. g. clinker dust, quartz and also corundum, wood and plastic shavings) assault the material. The particles which enter strike all structural elements of the fan – the impeller blades and the casing as well as the impeller shroud and impeller back-plate. This attack can cause considerable damage.

Wear causes a reduction in material thickness and an associated reduction in the service life of the fan. Wear abrasion can lead to reduced performance or may cause imbalances that prevent further operation. The resulting costs are considerable. Investment in preventive measures is economically sound.

A science in itself
Venti Oelde possesses experience, gathered over decades, in the design and construction of industrial centrifugal fans and is a technological leader in wear protection. The company constantly promotes research and development in this sector. Together with a reputable German technical university Venti Oelde has meticulously examined wear on industrial fans. Experience from many field studies – some involving industrial plant manufacturers – has been incorporated into the development of measures to provide wear protection.

Virtual test runs –
optimal planning for development and refurbishment



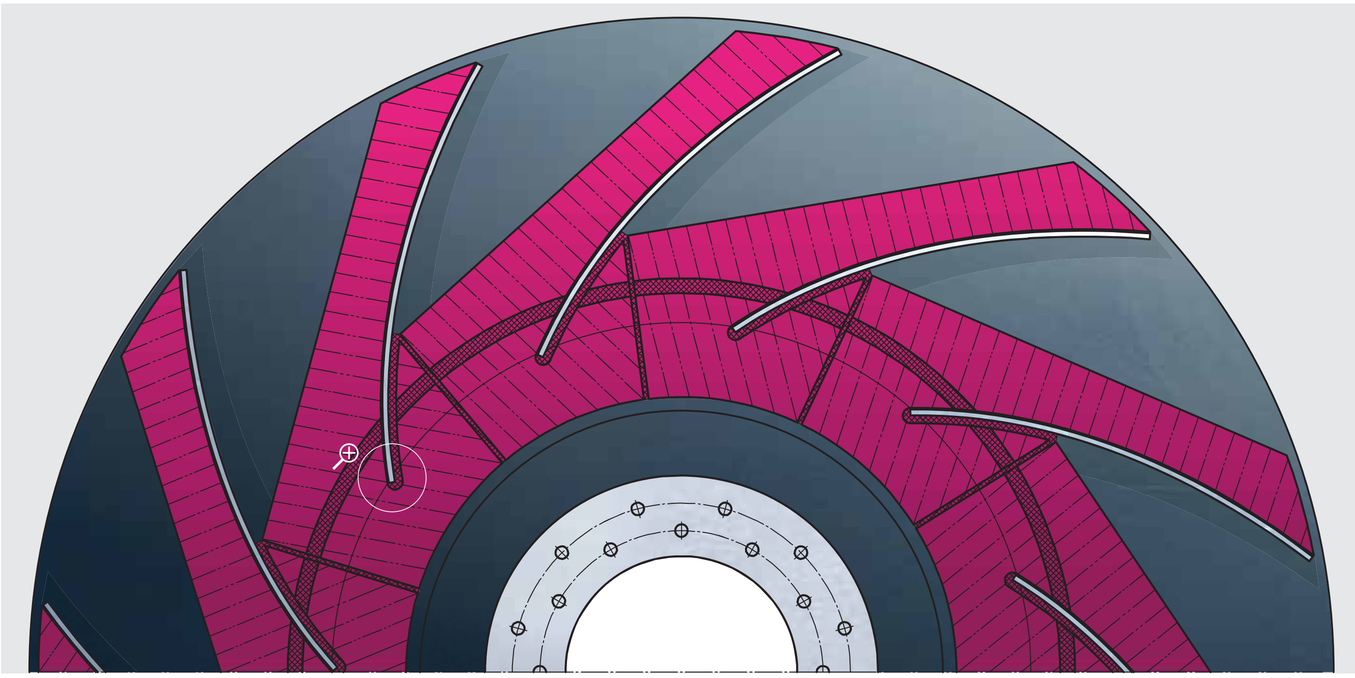
Fan flow simulation

Effective protection – right from the start
At the beginning of the planning phase, the first question to be asked is: what flow medium is to be handled? If it contains abrasive or corrosive substances then some protection of the fan against wear is highly recommended. Ultimately, this will increase the service life of the fan in a profitable manner.

To determine the optimal wear protection and its positioning and design, the fan's load is digitally simulated using computational fluid dynamics (CFD).

Taking into account the specific properties of the abrasive material, we can, for example, calculate the load on the blade's leading edge, which would be technically impossible or disproportionately costly to capture using measurement technology. Thanks to our in-depth knowledge of the fluid-dynamic processes in the impeller and housing, fans which are robust and highly efficient are created.

Initial visual inspection and information-gathering for a damage report

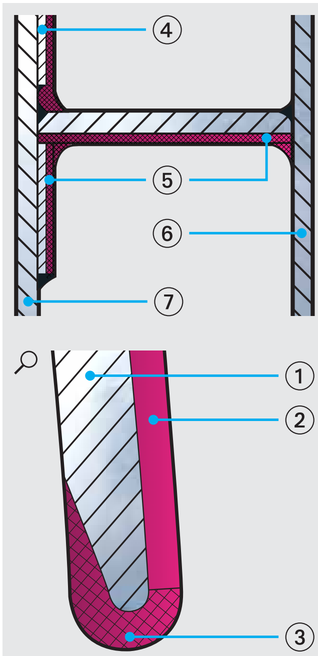


Hard shell – even retrospectively
However, this technology is not only used in new constructions. It is also an essential component in the optimisation or reconditioning of fans currently in use. The impellers or fans are dismantled by Venti Oelde on site and transported to Oelde. After cleaning the steel parts, an initial visual inspection is performed, as well as technical fault detection using the ultrasound method and dye penetrant testing. Parallel to fault detection, the fan may also be the subject of a flow simulation – customised to its operation – to determine how the fan may best be protected against wear.

All these measurements, tests and simulations form the basis on which Venti Oelde proposes necessary repairs and sensible improvements – such as wear protection.

Mean particle sizes of typical abrasives in the fan industry

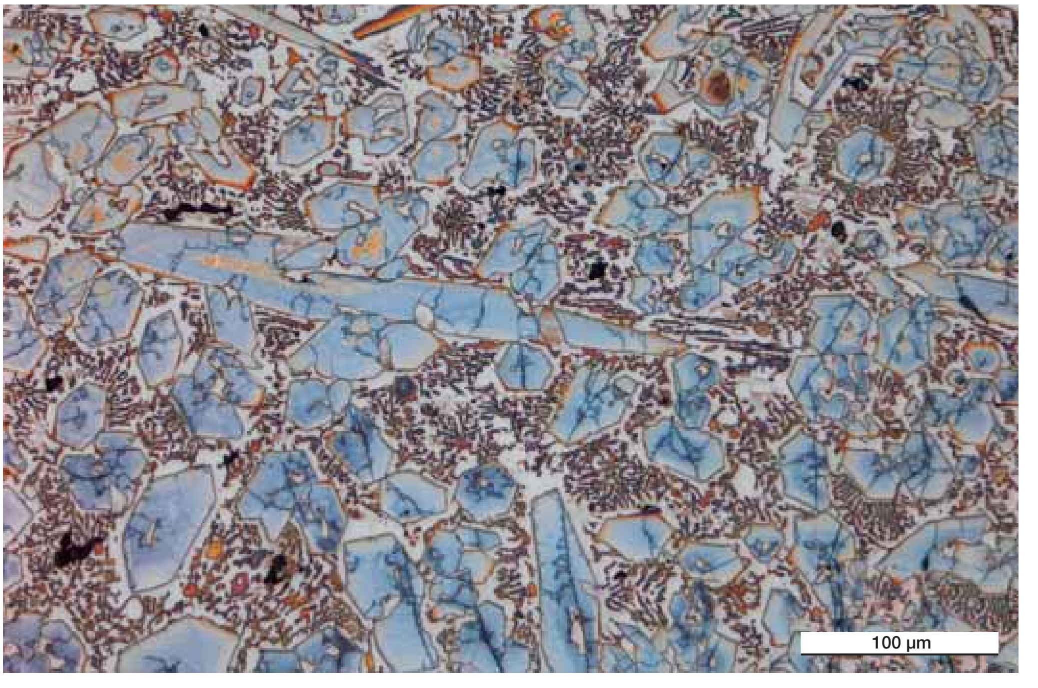
Abrasive elements	Mean particle size in microns
Raw meal dust	~ 8
Sinter dust	5 – 15
Dusts from steelmaking	< 20
Cement raw meal	8 – 15
Cement dust	10 – 20
Dust from chipboard production	1 – 35
Iron-ore-pellet dust	> 100 – 770
Blast furnace slag	25 – 150
Quartz sand	> 1

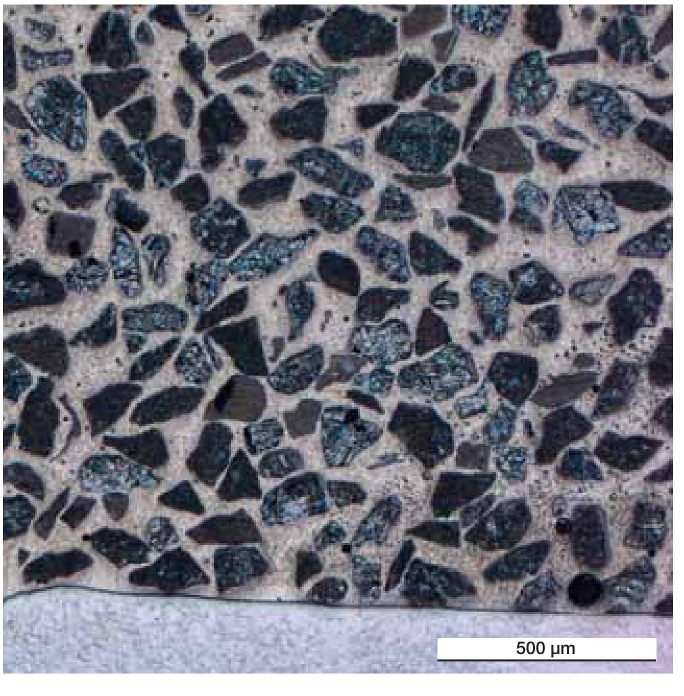


① Blade base metal
② Hardfacing
③ Hardfacing
④ Wear strip on impeller backplate
⑤ Hardfacing
⑥ Impeller shroud
⑦ Impeller backplate

Robust protective layer – intelligent mix of materials against aggressive dust particles

Photomicrograph material chromium carbide





Photomicrograph material fused tungsten carbide

Hard surfaces are not the sole solution
The statement „A lot helps a lot" can only be applied to wear protection with reservations. The essential thing is to take the correct measures.

Using harder hardfacing does not necessarily provide the wished-for result, especially as it is usually considerably more expensive and more complicated to apply. Furthermore, wear protection materials such as fused tungsten carbide are becoming more and more difficult to obtain and their price on the world markets is continuously climbing.

Venti Oelde's aim is to select a wear protection system appropriate to the process. A parameter for the selection of the best wear protection is the composition of the dust in the air-stream causing the wear. In this process, as well as quantity and hardness, the particle size distribution and particle geometry of the dust play an important part.

VentiWear	Hard phase	Matrix	Operating temperature	Surface hardness RT	Special
100	Chromium carbides	Fe	250 °C	59 HRc	
150	Chromium and niobium carbides	Fe	250 °C	61 HRc	
170	Chromium carbides, Bor	Fe	250 °C	62 HRc	
200	Chromium carbides, Mo	Fe	500 °C	62 HRc	Hot hardness 61 HRc at 450 °C
210	Chromium carbides, Mo	Fe	350 °C	59 HRc	Hot hardness 50 HRc at 350 °C
300	Chromium carbides and borides	Fe	250 °C	57 HRc	Minimum cracking
310	Chromium carbides	Fe	600 °C	68 HRc	Hot hardness 65 HRc at 500 °C
500	Fused tungsten carbides	NiBSi	500 °C	50 HRc	Corrosion-resistant under certain conditions
600	Chromium carbide	Fe	250 °C	55 HRc	Corrosion-resistant under certain conditions
800	Fused tungsten carbides, tungsten carbides	NiCrBSi	250 °C *	55 HRc	Minimum cracking, corrosion-resistant under certain conditions
1000	Tungsten carbides	Co	250 °C**	1350 HV1	Special design hot gas up to 450 °C

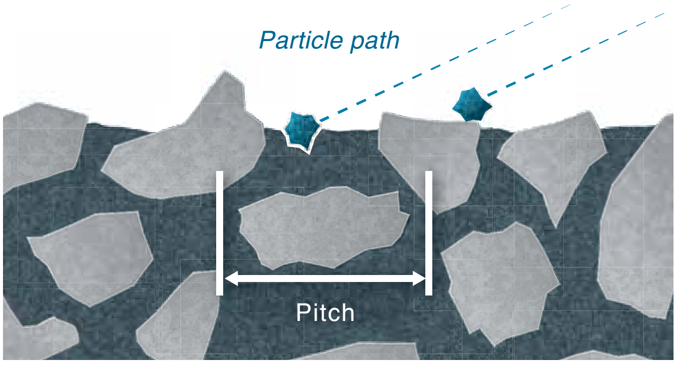
* conditional on base material, as sintered at 1100 °C
** conditional on the bonding

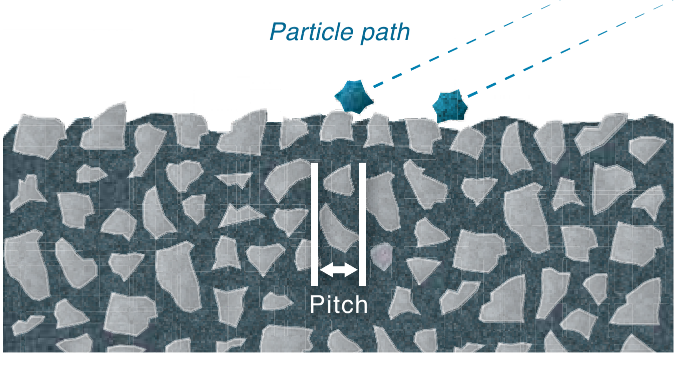
For example, when the dust is very fine and abrasive a wear protection system where the carbides are evenly distributed and as close together as possible must be selected. This prevents too great an erosion of the carbides. The structure of a wear protection layer consists generally of hard carbide particles embedded into a binder matrix phase.

Offering no room for attacks
If the so-called pitch, i. e. the distance between the carbides, is too great, the dust particles directly hit the soft binder matrix; this is then worn away relatively quickly and can no longer bind the carbides. As a consequence the carbides are eroded and break away from the matrix. Any advantage provided by the hard and tough carbides is negated. The service life of the wear protection layer is comparatively short.

On the other hand, if the pitch is smaller than the diameter of the dust particles, the dust particles are more likely to come into contact with the hard carbides, and the softer matrix is protected. Use is made of the toughness of the carbides. Service life is clearly increased.

Diagram of two alloys with coarse and fine fraction hard phases





Knowing where – proper positioning

Protecting the right places
Beside selecting the appropriate anti-wear material, its positioning and the implementation of measures to protect the centrifugal fan against wear are of equal importance.

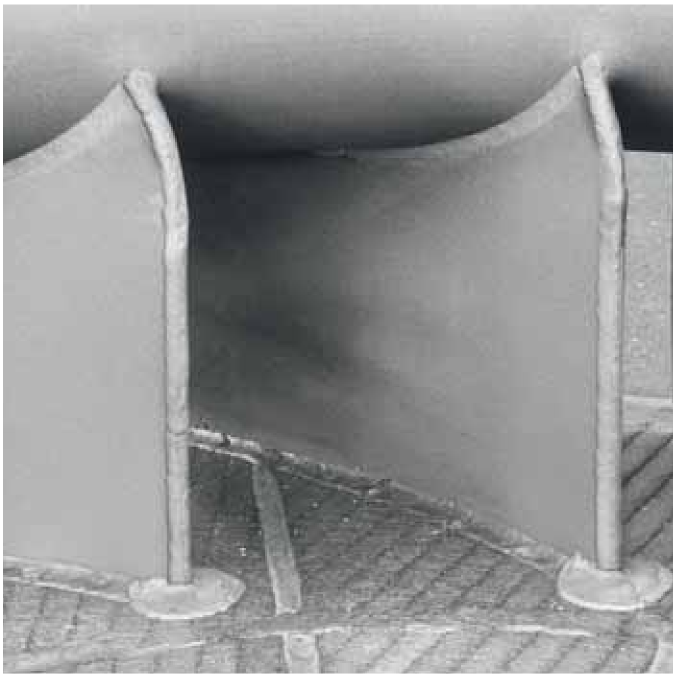
Wear protection helps to increase the service life of a fan, and in particular that of the impeller. But it is also a significant cost factor. For this reason, it is necessary to first define which areas are to be protected and which do not require to be protected against wear.

Empirical data combined with flow analysis gives an indication of the areas of an impeller which are likely to suffer wear. These areas can be given more significant protection against wear.

This frequently applies to the blade's leading edge, areas of the impeller blade and the blade root.

In addition, however, the impeller centreplate and impeller shroud, the drive shaft, bolts on the connection between impeller and shaft, the casing as well as dampers and inlet vane control are exposed to varying degrees of wear.

Easy to identify
The correct positioning of wear protection is easier when reconditioning already-worn impellers, whose service life is to be increased. In such cases, identification of the heavily stressed areas is easily done by looking at wear pattern, and then equipping them with higher-quality protection against wear.



Special wear protection on the blade leading edge and the surrounding area of the impeller

Special wear protection
on the critical areas of the impeller

Specific protection against wear
in areas of the impeller blade

Wear-resistant cover
for flanged connection

Welded or bolted. Zigzag or straight. The precise design type for each process.

Costs at a glance
Alongside the selection of the appropriate material and its positioning, correct designing of the wear protection system is of great importance. Firstly, because it needs to be adjusted precisely to the different process parameters. For example, not every wear protection system can be used at higher temperatures. Secondly, because the design selected will influence costs significantly.

It is the combination of different wear protection systems which helps to reduce costs without reducing the life span – a solution which gives an excellent cost-benefit ratio.

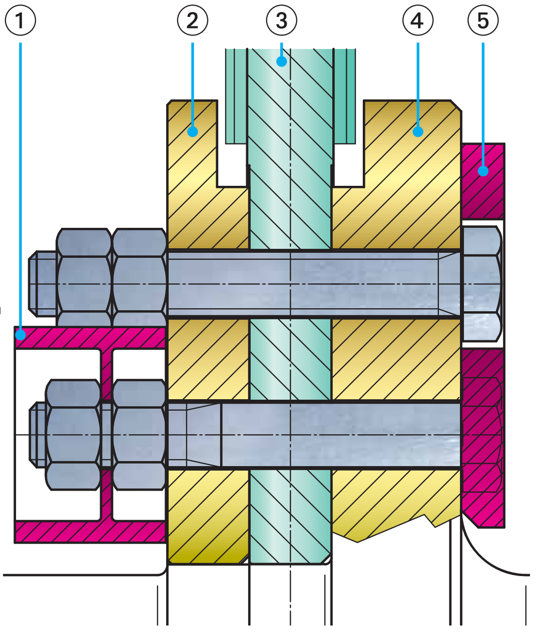
The right surface finish
The surface properties of the individual wear protection materials are also evaluated, while considering the flow pattern and properties of the particles (particularly their sizes), travelling through the fan and causing wear. This will have, for example, an effect on the geometry of the wear protection or on the technique used to apply the wear protection coating.

In the case of fine dusts, in order to minimise an erosion of the cracks in the wear-resistant layer – impossible to avoid in some materials used to protect against wear, due to their high hardness levels – the weld bead is laid contrary to the direction of flow or else a zigzag geometry is chosen. By selecting a wear protection system in conjunction with an appropriate technique for the application of the wear-resistant coating, a virtually crack-free surface can be created.

Bolted/welded connection of wear plates on the impeller

Impeller with fully welded wear protection

Bolted connection impeller – shaft



① Wear protection sleeve for each screw
② Counterflange
③ Impeller
④ Shaft flange
⑤ Divided wear plate

Welded and bolted

Wear protection for blades, offered by Venti Oelde, is available in welded and bolted variants. In the welded variant, the wear-resistant coating is applied directly to the blade or, alternatively, wear plates are welded on. This variant can be serviced by means of repair welding.

In the bolted version, the wear plates are fastened to the blade with through bolts. In addition, they are welded to the centreplate and impeller shroud with a seal weld. For repairs, the seal weld is ground down, and the bolt connections are loosened. The wear plate can then be replaced with a new one.

Zig-zag geometry on wear protection on an impeller blade

Combination of different wear-resistant materials on the impeller blade

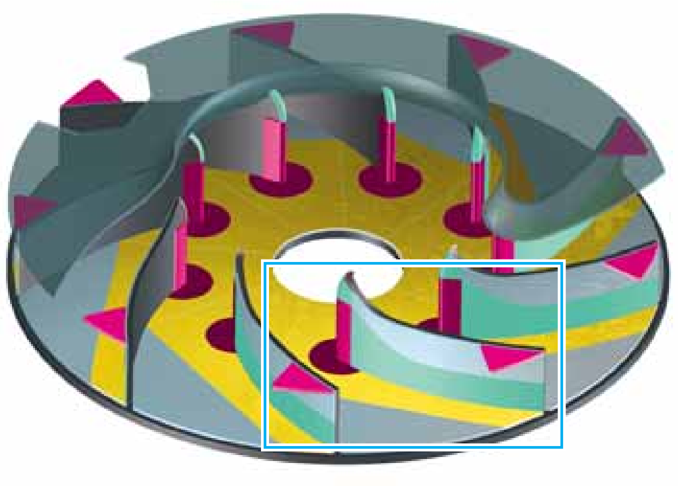
Protection against wear in a modular format – modular, replaceable, cost-effective

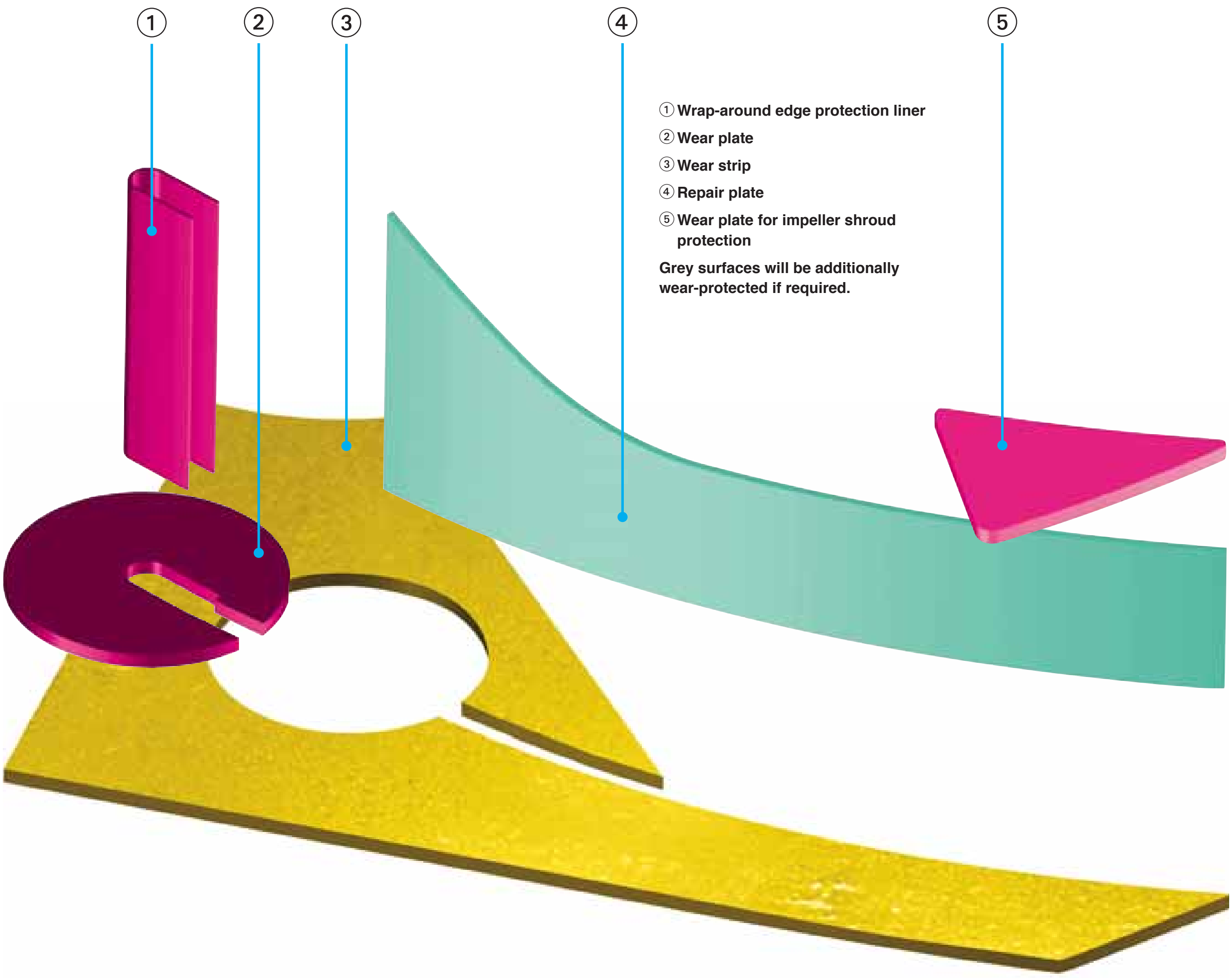
Modules for combining
Venti Oelde offers, as well as conventional wear protection, a sort of modular system. This includes in particular six modules:

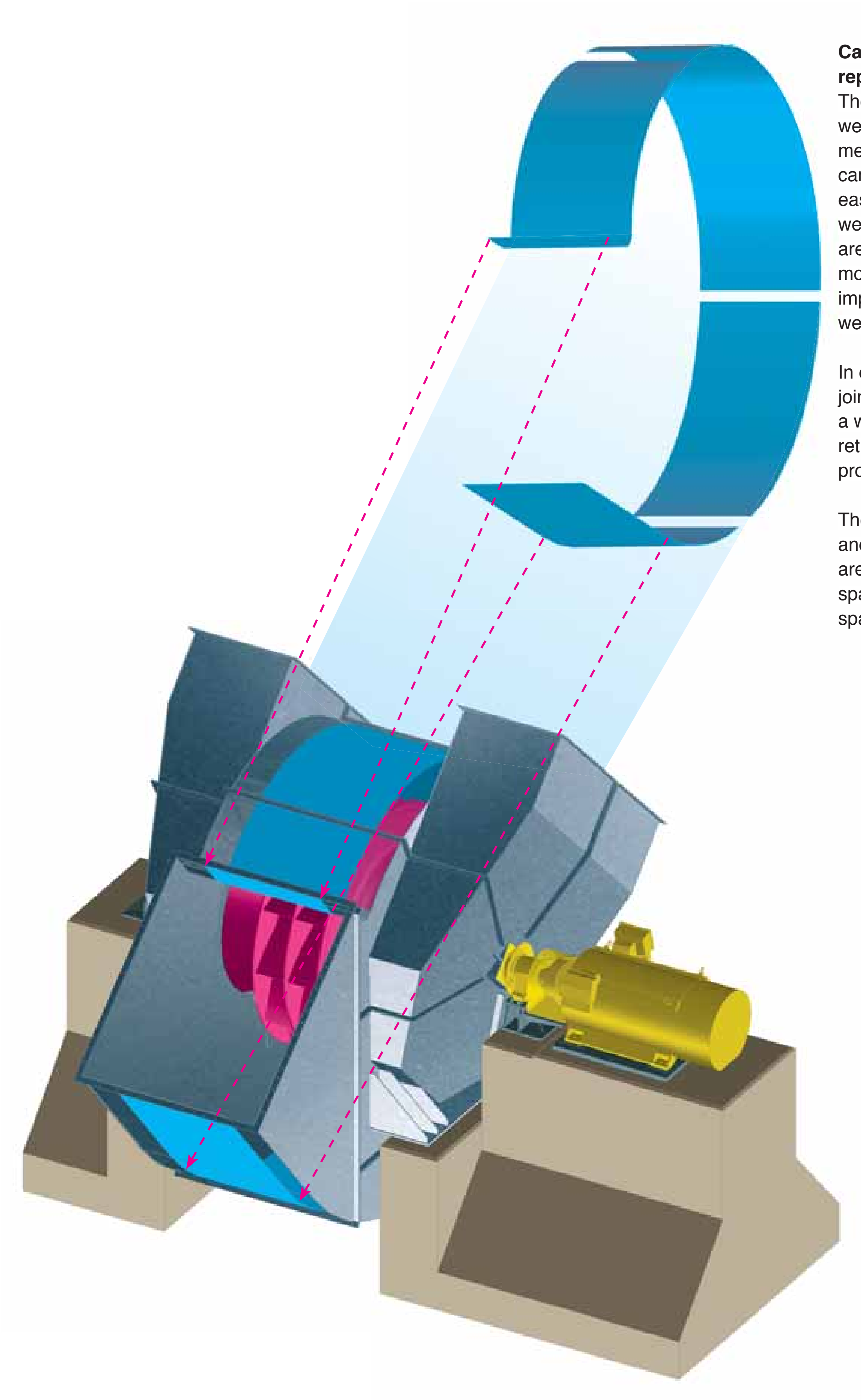
1. Wrap-around edge protection liners for blade inlet edges
2. Wear plates on blade inlet edge
3. Wear strips for the impeller centreplate
4. Wear plates for the blades
5. Wear plates for impeller shroud protection
6. Protective caps and plates for the threaded connections impeller – shaft

The Venti Oelde modular system makes it possible to use wear protective materials of varying quality in the different areas, depending on the load. The particularly endangered areas have been marked in colour.

Wear protective measures on the impellers of centrifugal process fans







Can be quickly and easily replaced

The modular design of the wear-protection system means that the worn modules can be replaced quickly and easily. When the connection weld has been parted, they are removed and the new modules welded onto the impeller according to the welding specifications.

In carbide modules, solder joints may also be used. Even a worn impeller can be easily retrofitted with the wear-protection modules.

The modules can be quickly and easily replaced if repairs are needed. Warehousing spare modules saves on space and costs.

Regular servicing – ensures continued operation and reduces costs

Early diagnosis saves on costs
Even with the best wear protection, the critical areas on the rotors of centrifugal process fans must be regularly checked after a period of service. Reliable vibration monitoring, regular visual inspection of the impellers and monitoring of the bearing temperature are appropriate safeguards in this respect. If necessary, the worn areas of the rotor must be re-hardfaced.

Early detection of wear in centrifugal fans and the corresponding repair measures are very cost effective.

Venti Oelde carries out preventive maintenance and services fan impellers. These services and any necessary cleaning is done at the customer's premises or at our factory. This applies to our own products and those of other manufacturers.

Cleaning a double-inlet impeller before damage analysis

Surface crack check (MP) on the weld after the repair has been carried out

Balancing a double-inlet rotor

Subject to alterations B/1/09/10/8.Stu

- Industrial fans
- Dust collection and process air cleaning plants
- Exhaust air treatment plants
- Ventilating, heating and air conditioning plants
- Recycling and waste processing plants
- Surface technology

Venti Oelde

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