

# LAYER

Information from Sulzer Metaplas GmbH



## IONIT<sup>®</sup>-*COMPACT*

Compact and Powerful

**Productivity increase has  
a name: ALTiN-Saturn**

**New Location  
in China**

**Roundup  
Fakuma 06**

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## New Name – Same Trusted Quality

# Advancing Development

Dear Readers,

As of November 6, 2006, our name has changed from METAPLAS IONON Oberflächenveredelungstechnik GmbH to Sulzer Metaplas GmbH to better reflect our integration within the Sulzer Group. According to the motto „The total is more than the sum of its components“, the brand name of a major company is optimally utilized.

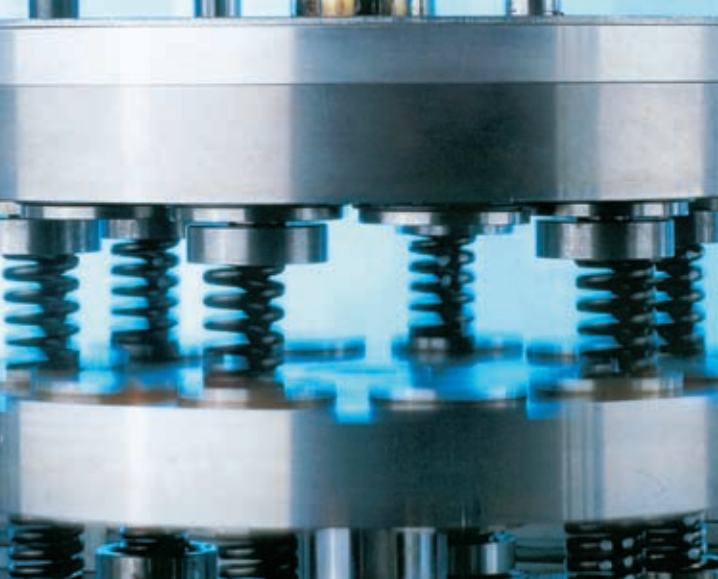
The name itself signifies our constant effort to further develop ways to serve our customers. In this edition of “Layer” we present three optimized surface treatment processes that we have developed. Here, especially, we would like to draw your attention to our new plasma nitriding system: IONIT®-COMPACT, our response to the increased demand for plasma nitriding systems. The METANIT process is a low temperature gas nitriding process that merges the advantages of gas nitriding with those of plasma nitriding. The new generation of the AlTiN-Saturn coating, deposited using the PVD-Arc process, is particularly well-suited for metal cutting operations.

Finally, we welcome the opportunity to present to you our new Sulzer Metaplas GmbH location in China.

I wish you interesting reading.

**Thomas Gutzwiller**  
Managing Director





## Springs live longer with **METANIT**

The demand for an evermore powerful and lightweight engine imposes also corresponding requirements regarding valve drive and transmission. Rotational speed and torque increase, whereas the designs are becoming even more compact in favour of the usable space.

The springs used in engines have already been optimised in view of the material and the heat treatment. By pressure blasting the surface and the thus involved residual compressive stresses has in the past met the requirements regarding the reduction of the vibrating masses and compact design.

A further increase in the residual compressive stress thereby improves fatigue limit by approximately 30% through an additional thermochemical heat treatment (nitriding). The relatively low tempering temperatures of the commonly used spring materials have, in the past, only allowed the use of a plasma nitriding treatment.

Sulzer Metaplas has developed an additional low-temperature gas nitriding process which combines the

*Fatigue limit diagram for nitrided and non-nitrided springs made of OTEVA 90, Improvement by app. 30%.*

*Nitriding is possible for spring steels with tempering temperature > 450°C.*

advantages of gas nitriding – for example, simple batching by way of bulk material and uniform all-round treatment – with the lower treatment temperatures previously only attainable through the plasma nitriding process as well as a surface structure which is almost free of white layers. The risks involved in plasma nitriding, like a plasma power density which is too low, and local overheating in the case of progressively wound springs can be excluded through the METANIT process. The sensor controller of the METANIT process ensures a uniform and reproducible heat treatment.

Manual handling required in the case of the plasma nitriding process is a thing of the past. Instead of expensive

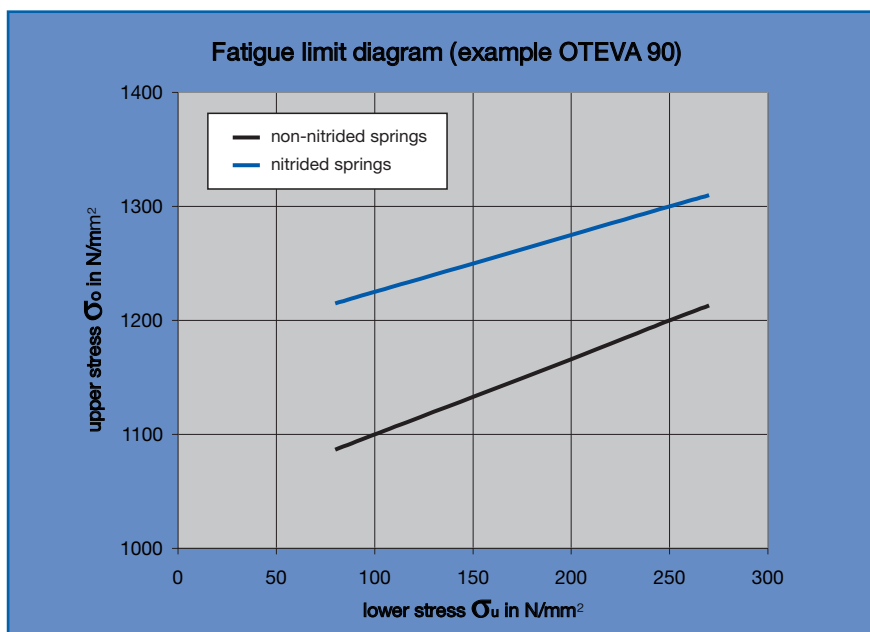
and frequently custommade batches and racks universal baskets can be used by now. The process is already being used successfully in the mass production. It has proven itself as a reliable and economic process.

### The essential advantages are:

- Fatigue limit + 30%
- Bulk treatment for cost savings
- Corrosion protection and friction reduction by additional process step

### Applications:

- Valve springs
- Torsion dampers
- Injection pumps
- Clutch springs
- Disk springs
- Door springs



## Productivity Increase Has a Name

# AlTiN-Saturn

Sulzer Metaplas has developed a PVD coating technology which provides an optimum combination of hardness and toughness. The new generation of the AlTiN-Saturn coating is applied with the PVD-arc process and offers high thermal insulation and very good oxidation protection. This coating is particularly well suited for metal cutting.

Thin-film technology has become established as an effective aid for the reduction of abrasive and adhesive wear, sticking, undesired chemical and thermal influences, and friction. Thin wear-protection coatings, for example, reduce tool costs, increase machining speeds in metal cutting, and achieve better product surface qualities. In addition, machine availability and productivity are increased. The physical vapor deposition (PVD) process is used increasingly in the industry. In the case of the PVD processes,

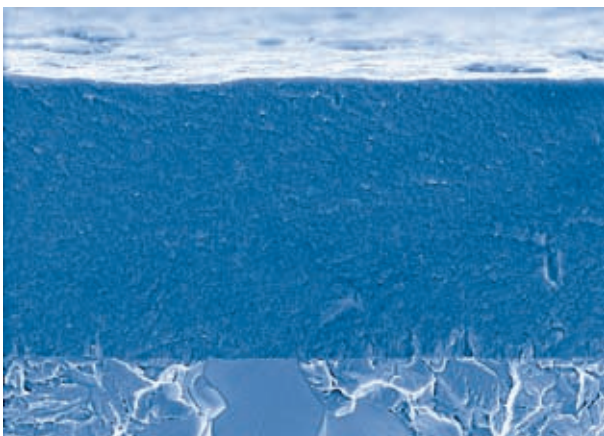
the base material, which is generally metallic, is converted from the solid state to the gaseous state and ionized by exposure to thermal (electron beam or light arc) processes or by kinetic energy (sputtering). A reactive gas, such as nitrogen, is added. At Sulzer Metaplas, two important PVD processes are used in the production of thin films: the

“  
... Better Results  
through PVD-Arc  
Processes ...  
”

universal PVD process of cathodic vacuum arc evaporation (PVD-arc process) and cathodic sputtering (PVD-magnetron sputtering process). In the sputter process, the metal atoms are driven out of the material and partially ionized by the argon ions. In the arc process, on the other hand, the metal is evaporated, ionized, and accelerated in an electric field by the arc in one step (Fig. 2). In the PVD process, typical hard material layers such as TiN, TiCN, CrN, and TiAlN are separated, in addition to special low-friction carbon

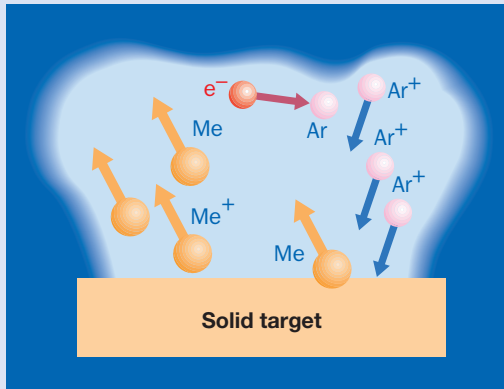
layers. The applications, here, are above all in metal cutting, metal forming, extrusion of plastics, and in production of automotive components. Sulzer Metaplas aluminum-titanium-nitride coatings that are deposited through the arc process are an example. The basic advantage of the arc process is the significantly higher energy density of the plasma during the deposition process: Degrees of ionization up to 100% ensure a far greater hardness and density and considerably better adhesion of the wear protection coatings than with the sputter process. These are vital parameters for improvement of the characteristics, for example, of metal cutting tools. While the degrees of ionization of typical sputter processes only lie between 10 and 15%, the characteristics of arc coatings cannot be attained in principle even with the most modern sputter processes, which do indeed produce degrees of ionization up to 40%.

The high aluminum content of the AlTiN-Saturn coatings leads to the formation of a thin  $Al_2O_3$  layer on the surface of the coated tool, which provides protection from oxidation and is continually renewed



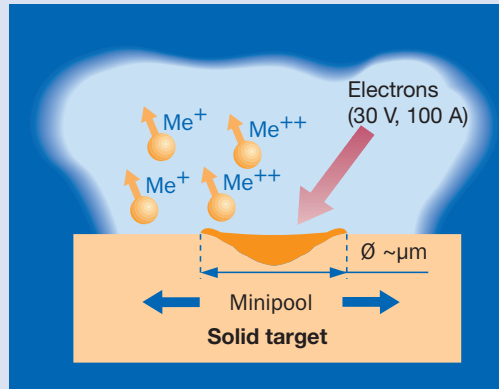
1 The dense nanocrystalline structure of AlTiN-Saturn— here in a fractured cross section magnified 20,000 times— provides a very high coating hardness with excellent fracture toughness and significantly increases oxidation resistance.

**PVD-sputter process**



The metal atoms are driven from the material by the argon ions and partially ionized.

**PVD-arc process**



The metal is evaporated, ionized, and accelerated in an electric field by the arc in one step.

2 Thin film technology helps reduce unwanted adhesive and abrasive wear and friction. In PVD processes, the base material is converted from the solid to the gaseous state and ionized by exposure to thermal (electron beam or light arc) processes or by kinetic energy (sputtering).

during operation. A further reason for the significantly better oxidation resistance compared with conventional TiAlN coatings is the high density, one of the outstanding

“*... Optimal Combination of Hardness and Toughness ...*”

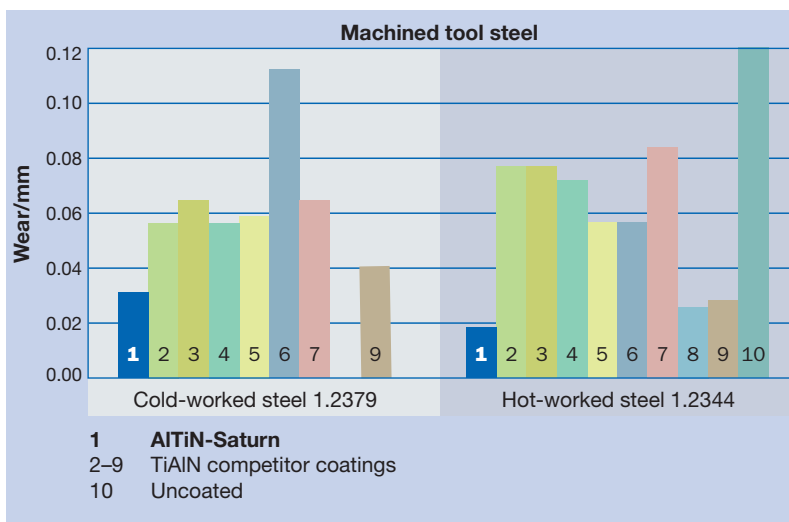
properties of AlTiN-Saturn (Fig. 1), which permits a very high coating hardness with excellent fracture resistance. In contrast to the coarse crystalline morphology, otherwise normal for PVD coatings, AlTiN-Saturn coatings are deposited in nanocrystalline structure. The significant increase in oxidation resistance occurs because the dense nanocrystalline structure further re-

duces the diffusion of oxygen. For applications in the field of heavy duty machining, compressive residual stresses are generated in the area of the coatings near the surface by systematic control of the process. AlTiN-Saturn coatings are also good electrical and thermal insulators because of their high aluminum content. They permit application temperatures up to 900 °C.

“*... Excellent Adhesion and Wear Resistance ...*”

The excellent adhesion of the AlTiN-Saturn coatings can be attributed to the plasma etching process performed on the tools immediately before the PVD separation and to

the high energy of the arc process. Sulzer Metaplas uses the patented AEGD process for this purpose (arc enhanced glow discharge); this process is unrivalled in effectiveness. For dry cutting of cold-worked steel 1.2379 and hot-worked steel 1.2344 with solid-carbide ball-nose endmills, the wear to the cutting edges of tools with AlTiN-Saturn coatings is far less than that of all TiAlN competitor coatings (Fig. 3). AlTiN-Saturn coatings also have clear advantages in the cutting of heat-treatable steel, fine steels, higher strength precipitation hardening ferritic perlitic steel, cast iron, Inconel®, and titanium alloys. The AlTiN-Saturn coating is applied today to indexable inserts and to all customary shank tools made of cemented carbide or HSS.



**Abbreviations**

Symbol	Description
Al <sub>2</sub> O <sub>3</sub>	aluminum oxide
AlTiN	aluminum titanium nitride
CrN	chromium nitride
HSS	high-speed steel
PVD	physical vapor deposition
TiCN	titanium carbo-nitride
TiN	titanium nitride
ZrN	zirconium nitride

3 For the dry machining of tool steel with solid-carbide ball-nose endmills, tools with AlTiN-Saturn coatings reveal substantially less wear than those with coatings from competitors.



## Compact and Powerful

# The New IONIT<sup>®</sup>-COMPACT

A new, fully developed and economic plasma nitriding system for the IONIT<sup>®</sup> process supplements the line of products from Sulzer Metaplas GmbH for small to medium-sized plasma nitriding systems.

Highly stressed mechanical engineering parts are subject to particularly critical loads on their surfaces or surface layers. Whereas the substrate material need only exhibit the required strength, the surface protects the component

like plasma nitriding, can impart useful properties to steel like wear resistance, frictional characteristics, endurance, corrosion resistance and fatigue characteristics. Here, the environmentally friendly plasma nitriding process offers decisive advantages compared to traditional salt bath or gaseous nitriding processes. In particular, the

... an in line solution  
with market requirements ...

layer structure, hardness transition and homogeneity can be precisely controlled independently of each other through the glow discharge parameters, the process gas conditions and the loading regime.

The Sulzer Metaplas IONIT<sup>®</sup> process, already well-established in industry, is a plasma nitriding process performed in a vacuum using a high current glow discharge. By changing the gas composition, treatment pressure, treatment temperature and pulsed plasma voltage, the structure of the surface layer can be controlled. The principal benefits of this process include the improvement of the frictional and sliding characteristics, the creation of corrosion-resistant layers and the

precision dimensional control. For this reason, rework is normally not necessary; the components grow in a controlled and calculable manner. Therefore it is generally possible to dispense with further production steps like post-grinding.

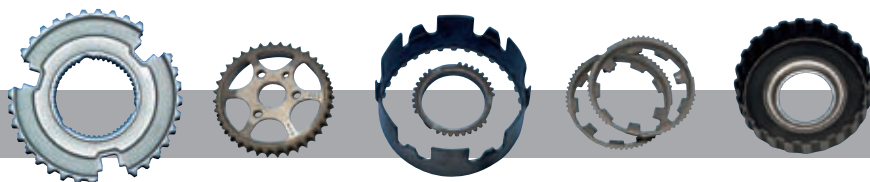
Increasingly, industrial customers demand small and medium-size plasma nitriding systems that provide economical and flexible in-house surface treatments without sacrificing quality. Sulzer Metaplas GmbH has found an answer to this challenge and after intense development has come up with a new, fully-developed and economic plasma nitriding system, IONIT<sup>®</sup>-COMPACT. This compact and flexible system excels through its extreme uniformity of the white layer and nitriding hardness depth, both in radial and vertical distribution. Through the pulse technology used by Sulzer Metaplas, higher process packing densities are attained.

Compared to conventional warm-wall furnaces, the IONIT<sup>®</sup>-COMPACT concept offers additional benefits: The furnace design offers excellent heat insulation because of the HiTec-insulation material used. Combined with the speed-controlled blowers, new ways of controlling the temperature and guidance of the cooling air can be implemented, resulting



Opening procedure of the IONIT<sup>®</sup>-COMPACT system

from corrosion and wear, provides fundamental frictional behavior and can improve fatigue limits. Because of this diversification of objectives between surface and substrate, it is possible to turn low alloyed steels into high-performance materials using appropriate surface enhancement processes. Thermochemical processes,





Plasma nitriding processes

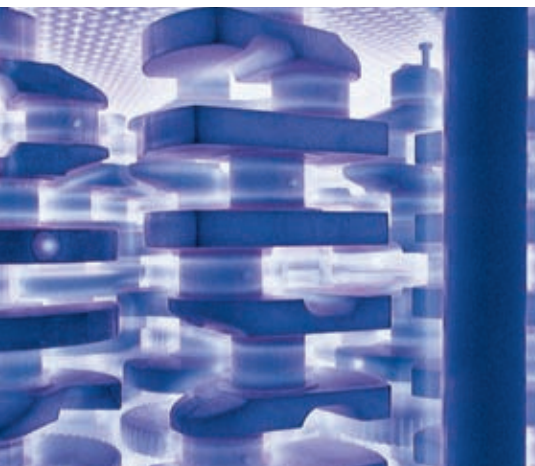


The new IONIT®-COMPACT

in significantly shorter cool down times. Temperature uniformity within the batch is at  $\pm 5^\circ \text{C}$ , accuracy previously unattainable in the market. The hydraulic lifting system, with its single button operation, allows the furnace hood to be lifted and lowered without any vibrations.

All components of the system – bell-type furnace, lifting system, controller, pulse plasma generator, pump system and gas control station – for example, are fitted to a common base. Thus, long and costly assembly and installation work at the customer's site is a thing of the past. The time from system commissioning until full production is cut and the space needed in the

standard cooling facility, an optional rapid cooling facility using an external heat exchanger can be supplied. Of course, this additional facility is fully integrated into the system. Optionally, the produced nitride coatings can also be subjected to an oxidation treatment to attain a greater degree of corrosion protection. Also, a tandem version of the IONIT®-COMPACT is available – a version with two furnace bottoms for even greater production economy. In order to be able to offer this system for a broad range of applications, pulse plasma generators of different sizes are also offered.



Plasma nitriding processing

“ ... no compromises ... ”

production facility is significantly reduced through the optimally designed system footprint.

The IONIT®-COMPACT system is customizable. For example, besides the

All these characteristics make the IONIT®-COMPACT an extremely flexible, multi-functional and user-friendly system.

With the horizontal movement the furnace bell can be removed from the working area to a parking position.

The system is equipped with the latest controllers for optimum process control, reproducibility, convenience, maintenance, troubleshooting and safety. The quick arc shutdown facility prevents damage to the work pieces that otherwise might be damaged by arc discharges, thus helping to attain an improved nitriding result.

**IONIT®-COMPACT systems are available in the following sizes:**

Usable dimensions (ø x h) in millimeters	Pulse plasma generators
ø 600 x 1000	40A/80A pulse
ø 800 x 1200	60A/120A pulse
ø 800 x 1500	60A/120A pulse
ø 1000 x 1500	80A/160A pulse



## Coating Service and System Sales

# New Location in China

The scope of the coating services offered today at the Shanghai location is expanded through the sale of coating systems and materials.

On September 21, 2005, Sulzer Metco Surface Technology (Shanghai) Co. Ltd. was founded as a platform for all Sulzer Metco activities in the Chinese market. Integrated into this facility are the product and services offered by Sulzer Metaplas GmbH.

The two buildings of this branch office located at Minhang, an urban district in the south west of Shanghai, have floor space of 3,500 square

meters. A highly motivated workforce of 25 is employed at this location, with two coming from Europe. The majority of the coating services customers are foreign companies or joint

“*... already founded in 2005 ...*”

ventures; but there are also Chinese customers who are convinced they need the quality and the products offered by Sulzer Metco.

During the start-up phase of coating services at this location, support was provided by the experts from the Sulzer Metco's worldwide organization. To date, a variety of different coating services are offered: Molybdenum coatings for synchron rings, wet carbon friction linings for synchron rings, and IONIT OX® treatment of various vehicular components. Beyond this, the branch office in China provides sales and support for thermal spray systems and materials for both customers and dealers in China, as well as field service for thermal spray facilities.

At the end of 2006, Chinese authorities granted Sulzer Metco an extended trading certificate: in addition to the initial approval for coating of components, the company can now sell systems, spare parts and materials in China. This includes import, export and the sale of coating sys-

tems, system components, coating materials and spare parts. In 2007, PVD coating services will be included in the portfolio. Further activities are planned, like direct sales to customers and new supply sources for materials and components.

All this was reason enough to celebrate this achievement at the site (see picture); but we had even more



*On December 30, 2006 an extended trading certificate was reason enough to clink glasses of sparkling wine.*

reason to celebrate! Our China facility celebrated its first birthday and successful ISO/TS 16949 certification in August 2006.

INTERNAL & EXTERNAL NEWS



*The modern building at the new site*



## International Trade Fair for Plastics Processing

# Roundup Fakuma 06

The FAKUMA 2006 – International trade fair for plastics processing – took place October 17, 2006 to October 21, 2006. In total, 1,445 exhibitors from 34 countries presented their offerings to visiting trade professionals. On the 25th anniversary of its existence, almost 40,000 visitors attended the trade fair, just a fraction below the 2005 attendance.

Since 2002, we have participated in this trade fair, and it has become highly successful for us. Conveniently accessible from three countries,

Germany, Austria and Switzerland, the new exhibition center offers an excellent platform for presentation of our surface technology for the synthetic materials industry.

For the first time in 2006, we jointly exhibited with our sister company, Sulzer Chemtech. The resulting synergistic effects were reflected by the number of visitors at the booth. Also, together we could improve the organization of the exhibition booth. And the importance of face-to-face contact should not be lightly dismissed. Next year we will surely attend again

and would be very pleased to welcome you there, too.



Professional consulting at the exhibition booth

INTERNAL & EXTERNAL NEWS

## Facts and Figures

The Sulzer Group released its annual financial statement on March 1, 2007. In many ways, 2006 was a special year: for the first time all four Sulzer divisions attained or exceeded their growth, profitability and return on investment targets.

For the first time in five years Sulzer Metco generated a surplus for its shareholders with a return on investment of over 12%. All three areas – Thermal Spray, Surface Solutions and Turbine Components – contributed to this performance. Strengthened by the success of 2006, driven by a good economy, improved customer satisfaction levels

and operational excellence projects, Sulzer Metco is well-positioned to repeat its success for a record year 2007.

Sulzer Metco has already been able to note a positive start in 2007, order intake and sales above budget for the first two months.

As before, we remain focused on:

- High customer satisfaction
- Lean and optimized processes
- Innovation

	Organic Growth 2006	Organic Growth 2005	CAGR <sup>1)</sup> Nominal Growth 2002-2006
Sulzer Pumps	30.9%	13.5%	16.8%
Sulzer Metco	10.5%	9.0%	11.3%
Sulzer Chemtech	40.2%	20.5%	19.1%
Sulzer Turbo Service	2.7%	7.5%	6.9%
<b>Divisions</b>	<b>25.0%</b>	<b>12.9%</b>	<b>15.1%</b>

<sup>1)</sup> Compound annual growth rate

In million CHF	2006	2005
Order intake	658.7	589.2
Order backlog as of Dec. 31	89.9	75.6
Sales	644.1	583.0
EBITDA	81.8	64.6
EBIT	53.4	36.1
ROS <sup>1)</sup>	8.3%	6.2%
Operating net assets as of Dec. 31	428.6	437.6
ROCE <sup>2)</sup>	12.2%	8.2%
Headcount as of Dec. 31	1928	1783

<sup>1)</sup> EBIT/sales

<sup>2)</sup> EBIT/capital employed

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