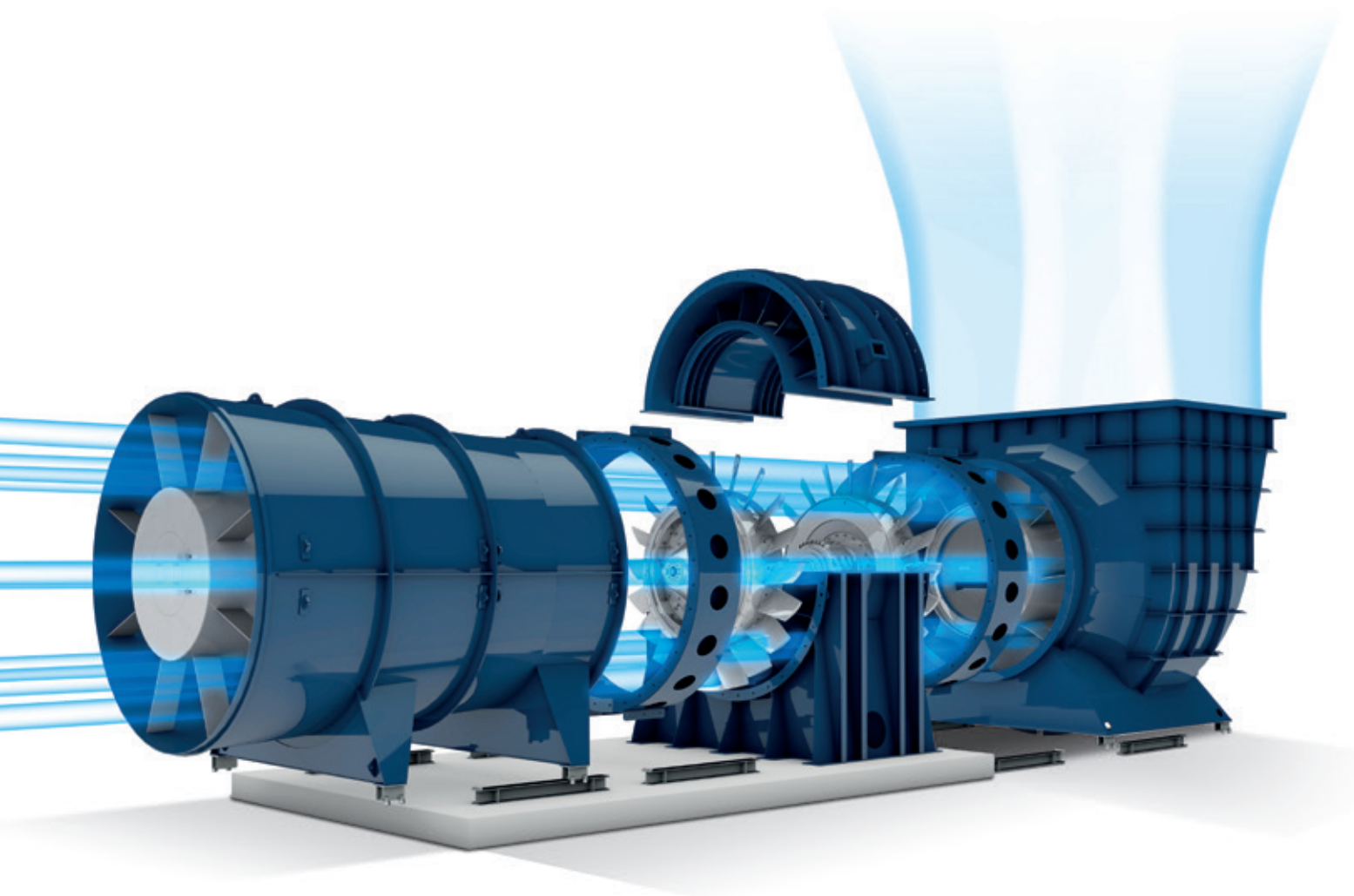


# VARIAX<sup>®</sup> Axial Flow Fans

Continually setting new standards





**The VARIAX® variable pitch axial fan combines one of the highest efficiency levels available today with an exceptionally flexible, customer focused design, manufacturing and aftermarket service.**



The VARIAX® is designed and engineered by Howden Axial Fans, part of Howden's Heavy Fans and Heaters Division, and Howden's centre of excellence for variable pitch axial flow fan technology.

For around 60 years, we have been pushing the boundaries of both quality and performance, researching both the design of VARIAX® fans and their applications.

We have accumulated an enormous reservoir of expertise and experience covering all kinds of fan installations.

With locations in Denmark, Sweden and Germany, Howden Axial Fans is a subsidiary of Howden Global, an acknowledged world leader in air and gas handling equipment. Howden Global produces heavy fans and blowers, rotary heat exchangers and some of the world's largest compressor packages.

Revolving Around You™





# Serving the world – the VARIAX® advantage

With more than 3200 units sold worldwide, the VARIAX® fan is the proven, reliable and robust choice across a wide range of applications.

## The benefits of a global presence

Howden is, in both geographical reach and culture, a global company. Every part of the organisation, in every country and across all products and markets, has access to truly international resources and world-class research and development. The experience we build in one area is applied and shared across all divisions. One of the most important advantages this brings is our ability to pass on the benefits of our global sourcing policy.

Global sourcing is an essential part of our procurement strategy, and we have several dedicated teams strategically placed throughout the world to monitor conditions, industries and markets.

We have built, over many decades, a reputation for the highest quality, reliability, service and value. We demand the same standards from our suppliers.

Our specialist teams of dedicated staff combine a full understanding of Howden products with considerable expertise in sourcing, specifying and quality assuring our materials and components.

We can deliver full documentation according to local standards and demands, and our global presence enables us to be available locally for our customers worldwide.

### North America

400+ installations

### Europe

1200+ installations

### Asia

1400+ installations

### South America

26 installations

### Oceania

100+ installations

### Africa

40 installations

#### Map key

- Sales office
- Site with no manufacturing
- Site with manufacturing

## More than 3200 installations worldwide



Ensted Power Station, Denmark.



Oak Creek Power Plant, Wisconsin.



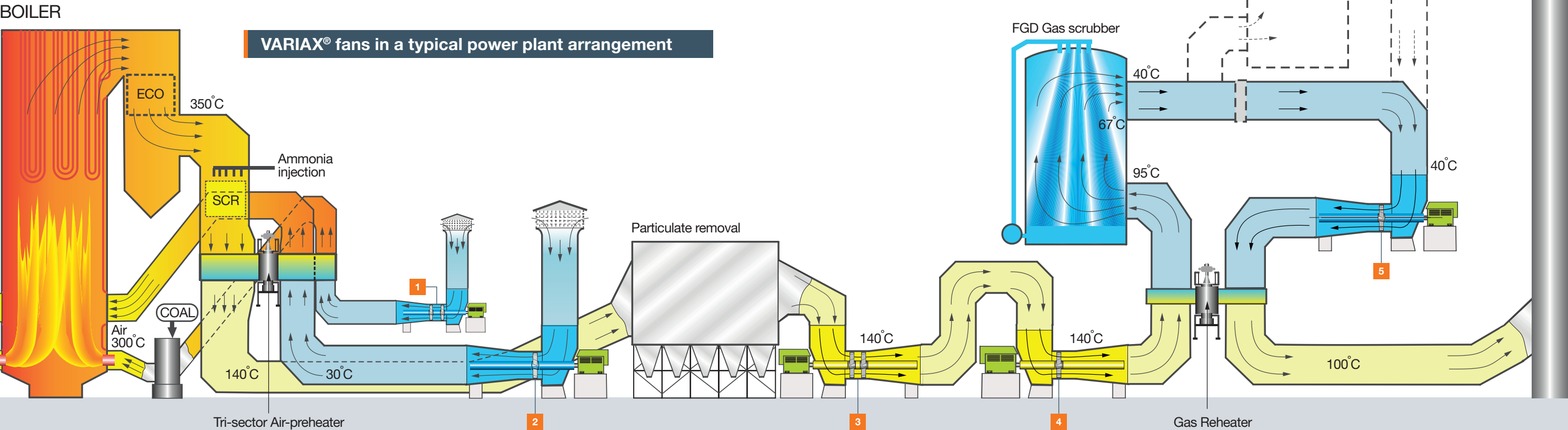
Grums, Sweden.



Two stage ID Fan: Trial assembly of casing

# Built on experience

The principle of adjusting the pitch of the blade to govern aerodynamic performance is the proven route to optimum efficiency, enabling the fan performance to be accurately matched to its duties in real time while allowing the drive motor to run constantly at its recommended speed and power consumption.



## The right choice for all applications

VARIAX® fans are found in a wide spectrum of situations where high volumes, high pressures and precise flow control are required, and where reliability and continuous running for months on end are demanded. They are the fans of choice in critical applications within the power industry, where they are used in both primary air, forced draught and induced draught positions including boiler draught and FGD and SCR booster applications.

### 1 PA fan



Power Station Avedøreværket, Denmark 2002. 580 MW(e) boiler. 2 stage fan with aluminium blades

### 2 FD fan



Kogan Creek Power Station, Australia 2006. 750 MW(e) boiler. 1 stage fan with aluminium blades

### 3 ID fan



John E. Amos Power Plant, Unit 3, West Virginia, USA, 2006-2007. 1300 MW(e) boiler. 2 stage fan with nodular cast iron blades

### 4 A-position booster fan



Uong Bi Power Plant, Vietnam 2004. 300 MW(e) boiler. 1 stage fan with nodular cast iron blades

### 5 C-position booster fan



Elektrenai Power Plant, Lithuania, 2007. 150 MW(e) boiler. 1 and 2 stage fans with cast nickel alloy blades and rubber lined hubs and casings

## Custom-built technology

Every fan we supply is designed and built to unique specifications. In the initial planning of the project, in consultation with the customer, we carry out a full analysis of the duties of the equipment and the performance required. We have comprehensive knowledge of power plant design covering both new and

revamped installations, and will offer advice and proposals based on our wide-ranging expertise. Each customer is thus assured of a fan engineered precisely to their requirements of the individual application both now and in the future.



## Lifetime commitment

Importantly, for every VARIAX® installation we maintain a complete, detailed record of specification and any subsequent maintenance or retrofits, to allow us to offer a guaranteed spares and service programme. We can carry out regular monitoring and inspections as well as offer a troubleshooting and emergency service.





# Key features and benefits

All VARIAX® fans are designed to work within an operational temperature range up to 200°C/392°F. They are available in single and two-stage versions to suit a wide range of pressures and volumes.

## 1 Blades



Design adaptability: VARIAX® fan blades can be supplied in a wide range of lengths, profiles and materials including aluminium, nodular cast iron and steel.

Blade attachment: The blade is attached to its pivot by a single threaded connection with a key, and the fit between blade and hub is superbly designed and engineered to the most exacting standards. In addition to facilitating blade replacement, the design reduces the risk of corrosion. The use of a single pawl into the blade root also helps to keep the airstream smooth and brings a measurable increase in efficiency.

Tip clearance: The clearance between the blade tip and the fan casing has a dramatic effect on performance and efficiency, and the clearance at normal running temperature in a VARIAX® fan approaches just 1% of the total diameter of the rotor.

## 2 Blade bearings



The oil lubricated blade bearings, designed especially for VARIAX® fans, incorporate oversized balls for increased contact area and greater load bearing capacity.

## 3 Hub



The VARIAX® hub has a spherical surface designed to minimise the gaps between the blade root and hub surface throughout the whole range of blade movement. This offers the best aerodynamic performance and contributes to the exceptional overall efficiency of the VARIAX® fan.

## 4 Hydraulic cylinder



The unique VARIAX® hydraulic cylinder uses a continual flow of oil through the system even when the blade position is constant, operating like a servo and transmitting changes instantaneously. The large volume of oil circulating through the system moderates the temperature of the hub both while the fan is operating and at standstill.

## 5 Guide vanes



Guide vanes before and after the impeller are custom designed for the unique combination of fan size and blade profile. The vanes smooth the air flow, reduce vibration and noise and raise overall efficiency.

## 6 Diffuser



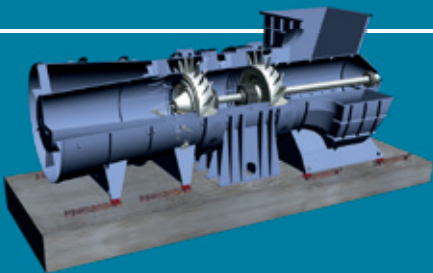
In both single and two-stage VARIAX® fans, the whole diffuser assembly is mounted on a roller mechanism. It can be slid away for maintenance, allowing full access to the rotor without the need for removing it from its casing. All maintenance can thus be carried out easily on site.

## Single stage

Designed for pressures of 300Pa/1 InWG to 15,000Pa/60 InWG at volumes between 25m³ and 1600m³ per second /50,000 ACFM and 3,400,000 ACFM.

## Two stage

Designed for pressures 1500Pa/6 InWG to 30,000Pa/120 InWG at volumes between 15m³ and 1600m³ per second /32,000 ACFM and 3,400,000 ACFM. In two-stage VARIAX® fans, the inlet box is also mounted on rollers and tracks to allow access to the first stage impeller unit while the moving diffuser gives access to the second stage.



## 7 Lubrication system

We recommend that separate oil systems are used for lubrication and hydraulic control. We do, however, offer a combined system as an alternative.

## 8 Separately balanced impeller units

In all VARIAX® fans, not only is the whole impeller unit precisely balanced, the hub and the blades that make up the unit are separately balanced before the unit is assembled. This means that replacement blades of a different material or profile can be fitted to the fan without removing and rebalancing the impeller unit.

## 9 Main bearings

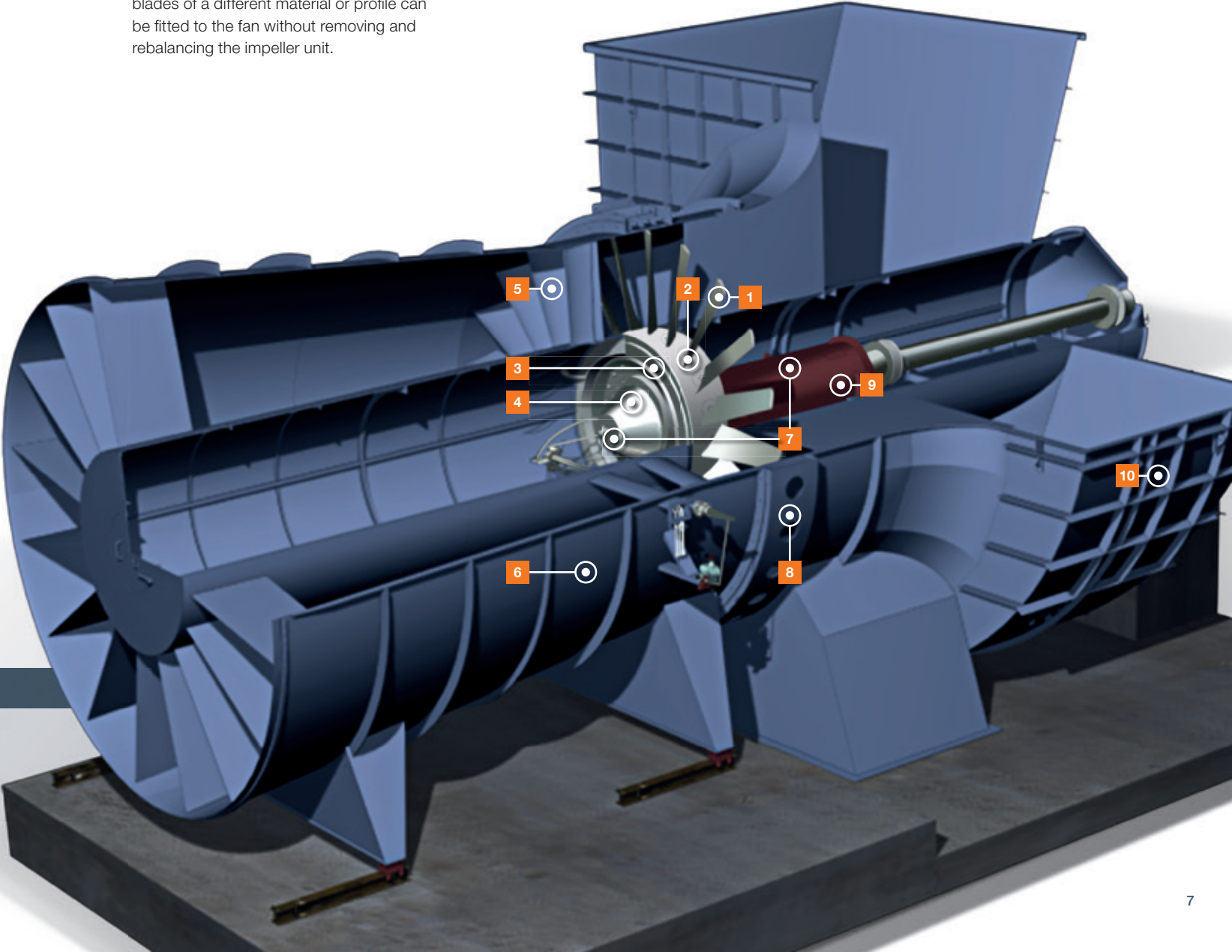


In VARIAX® fans, we can supply either roller bearings or sleeve bearings as standard. The bearings are chosen to suit each individual project.

## 10 Inlet box



The enlarged inlet box leads to lower flow velocity and thus brings a significant documented reduction in inlet losses and a marked increase in efficiency.



## Thousands of possible configurations

Our possible combinations of blade profile, impeller diameter and material, hub design and size produce a choice of many thousands of configurations. In addition, we can design VARIAX® fans for vertical as well as horizontal alignments, and turn the inlet box to suit particular installations. Specific challenges, such as the complex C-position fans required for flue gases with temperatures close to the acid dew point, are well within our experience.



# Continual improvement

The VARIAX® fan is the subject of continual research and development, and the interchangeability of parts makes it possible to retrofit, adapt and upgrade with ease.

The recent super high pressure blade profile brought a pressure increase of up to 30% while raising the flow by up to 15% and allowing a smaller hub. In 2009 we introduced a new hub design which makes it possible to design smaller primary air fans and forced draught fans, and to upgrade existing fans to cope with higher pressure.

## Fabricated hubs for better strength



B-type for heavy duty fans (ID/Booster fans)



C-type for clean air applications (PA fans and FD fans)

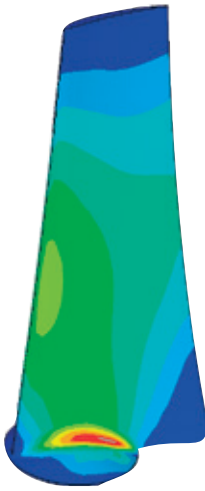
## Blade profiles and pivot connection



Variety of different blade profiles



Single threaded connection



Stress analysis by finite element method

## Quality assurance

VARIAX® fans meet all major industry standards, and all of the equipment we supply is backed by an absolute commitment to customer satisfaction. Our quality assurance procedures are underpinned by **ISO 9001** accreditation, our environmental standards are certified to **ISO 14001**, and we have a health and safety programme certified to **OHSAS 18001** criteria covering all VARIAX® staff.



## Test facilities

At Howden Axial Fans, we have a state-of-the-art aerodynamic research laboratory with a capacity of up to 100m³ per second/ 212,000 ACFM, enabling us to carry out the most stringent testing. The laboratory places our capabilities for model testing amongst the largest in the world, and by using large-scale models we can achieve the highest degree of accuracy available.

Designed and built to meet the US AMCA 210 registration for model testing to establish Aerodynamic Power Ratings, the laboratory is a major advantage in our quest for improved fans with more efficient designs for blades and other components. The laboratory facilities are also used to generate performance curves, carry out acoustic tests for new fans and allow customers to witness acceptance tests.

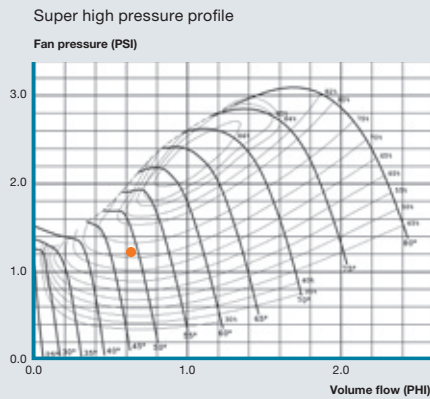
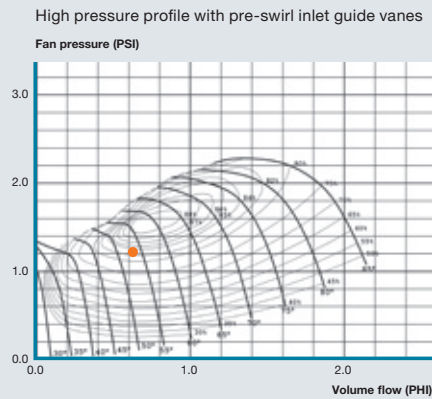
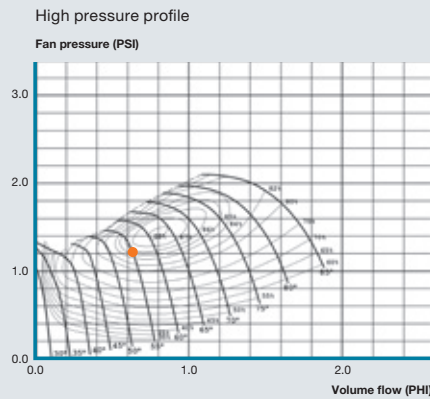
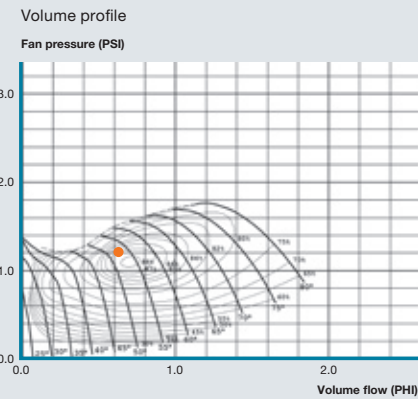
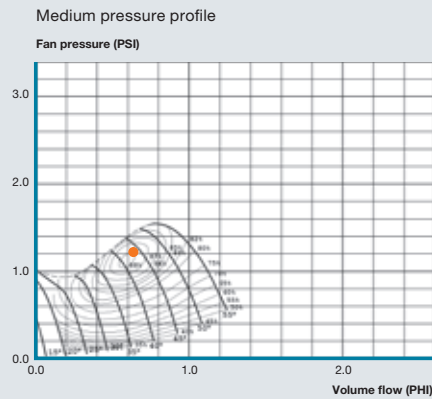
The performance curves produced in the laboratory are verified to US Standard AMCA 802, which requires that the outer diameter of the fan model is at 900mm/36 inches, and does not permit the results to be scaled up. The German standard VDI 2044 allows a fan diameter of 400–500mm to be used, and results can be scaled up. This means that the German standard will give a higher efficiency rating, by a factor of 2–3% depending on the size of the fan, than the US one. It is worth noting, however, that validation tests of our full-scale products showed their performance was even better than the figures produced by our model tests.



## The VARIAX® curve programme

Our blade performance programme presents some wide ranges of both pressure and volume, always making it possible to select the best fan to meet the client's performance and efficiency requirements for new plants and upgrades. By indicating the placement of the same operation point (orange dot), the figures show the development of the ranges for our different profiles step by step.

These figures show curves for an impeller/hub ratio of 2.0. The curve programme includes performance curves for each of the many impeller/hub ratios.





## At the heart of your operations

Howden people live to improve our products and services and for over 160 years our world has revolved around our customers. This dedication means our air and gas handling equipment adds maximum value to your operations. We have innovation in our hearts and every day we focus on providing you with the best solutions for your vital operations.



### Howden Axial Fans ApS

Industrivej 23  
DK-4700 Næstved  
Denmark

**Tel:** +45 5577 6262  
**Fax:** +45 5572 3343  
**Email:** [howdenaxialfans@howden.com](mailto:howdenaxialfans@howden.com)

### Howden Axial Fans GmbH

Habsburgerstr. 7  
DE-73432 Aalen-Ebnat  
Germany

**Tel:** +49 7321 55049 00  
**Fax:** +49 7321 55049 49  
**Email:** [howdenaxialfans@howden.com](mailto:howdenaxialfans@howden.com)

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