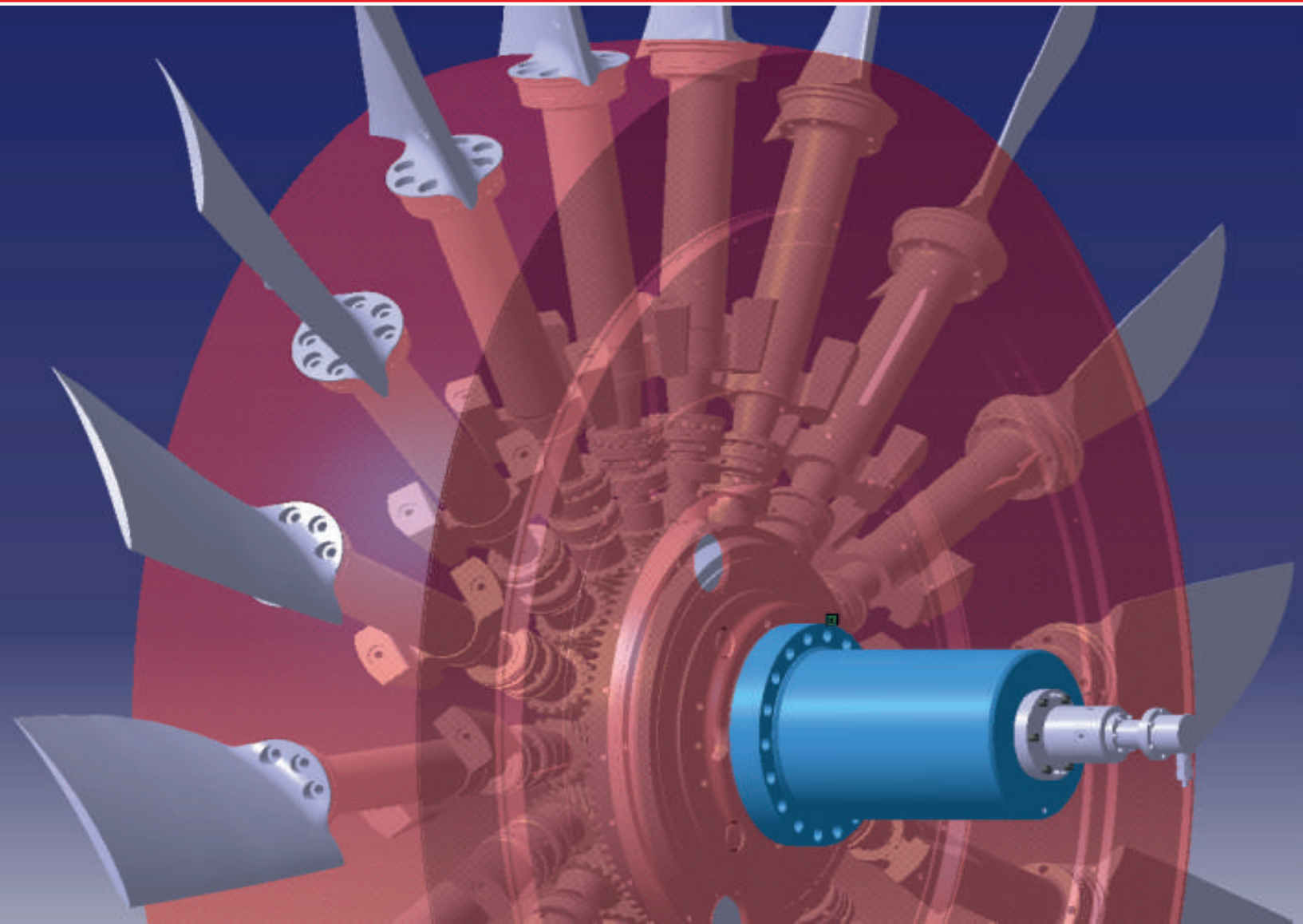




CFE Technology GmbH



PRODUCTS & SERVICE

CFE - Technology GmbH - abbreviated CFE - markets various types of axial flow fans and compressors to serve air and gas moving requirements in all sizes, applications, and environments. The company also has a complete engineering line of acoustic products that efficiently attenuate noise emitted from fans or other rotating machinery.

THE COMPANY

CFE is a privately owned company located in Germany. The company is a supplier of advanced technology for axial flow fans and compressors, and noise abatement equipment for utility and industrial boilers, pollution control systems, wind tunnels, subway tunnels and process applications. It also supplies mine fans, tunnel fans and jet fans with forward flow and reversed flow capabilities.

THE PRODUCTS

- High capacity axial flow fans and compressors with inflight variable pitch control
- Axial flow fans for forward and reversed operation
- Resonant silencers
- Absorption silencers
- Acoustic insulation and lagging
- Installation and service
- Fan repair and rebuild

Induced draft fan at site for coal-fired power plant



Picture 01

THE APPLICATIONS

- **Boilers and flue gas pollution control systems for utility, with**
 - forced draft fans
 - primary air fans
 - induced draft fans
 - booster fans
 - silencers
- **Windtunnel-systems, with**
 - High capacity fans
 - High performance compressors
- **Mining industry, with**
 - surface exhaust fans
 - surface downcast fans
 - underground exhaust fans
 - silencers
- **Tunnel ventilation, with**
 - fresh air fans
 - exhaust air fans
 - exchange air fans
 - jet fans
 - silencers

Surface exhaust fan for coal mine during workshop assembly



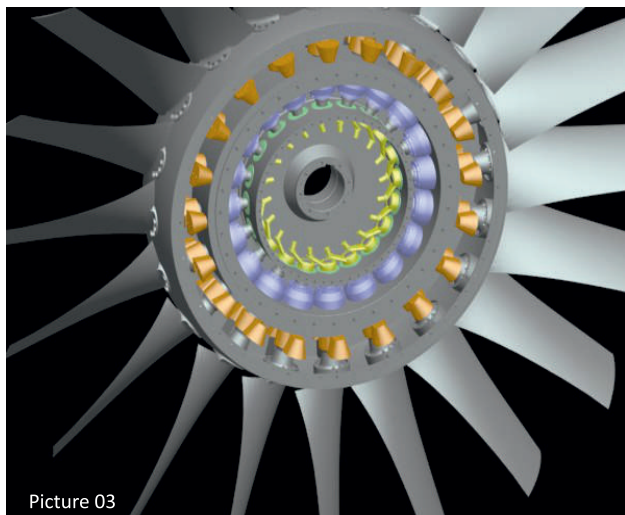
Picture 02

ENGINEERING AND DESIGN

The factor that sets CFE apart from other fan manufacturers is engineering and design. Our engineering staff has effectively applied the outstanding technology from Mr. Hans Schilder a leading chief engineer for high performance fans for virtually all applications. Our engineering staff has been successfully in applying „State of the Art“ German technology to further enhance the performance and reliability of CFE products. These enhancements include:

STRUCTURAL ANALYSIS

By using the advanced technology of finite element analysis, the vibrational characteristics of a fan can be determined prior to the final design stage. This capability allows any problem areas to be identified, simulated, and redesigned, if necessary. The technique is also used to calculate detailed stress analyses that predict the natural frequency and mode shapes of the entire fan and its individual components. As a final check, the results of the finite element analysis are correlated with static and dynamic field measurements.



Picture 03

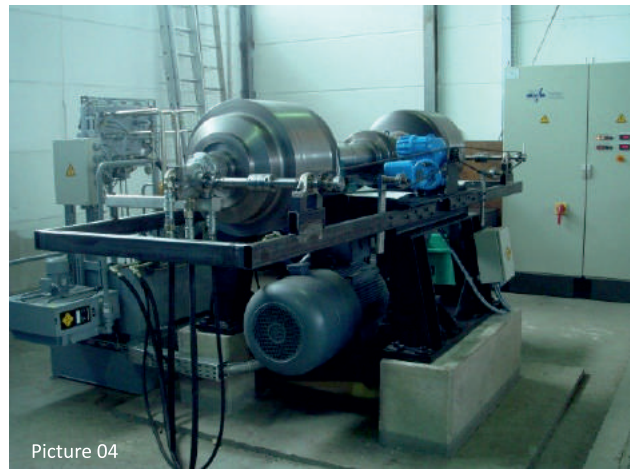
3D-model of impeller assembly for FGD-booster fan

Tip dia.:	5000 (mm)
Hub dia.:	2500 (mm)
No. of blades	24 (1)
Power:	6200 (KW)
Speed:	595 (rpm)

AFTER SALES SERVICE

All rotating equipment will require service from time to time during its operational life. In order to assure the continued satisfaction of its customers, CFE maintains experienced field service engineers to handle start-up and maintenance requirements. In addition, our partner Lakatos & Söhne GmbH is serving us for manufacturing and testing of our components at their workshops.

Stationary test bench for mechanical running test of hydraulic actuator



Picture 04

SPARE PARTS

To complement its service capabilities, the company's manufacturing facility also serves individual spare parts for axial fans. This capability enables CFE to expedite new fan orders and quickly supply replacement parts for operating units.



CFE Technology GmbH

Special Design of deep groove ball bearings and manufacturing and delivery of customized parts



Picture 05

ERECTION

Supervision for field erection of our fans is available through our engineers with long-term experience, which has been gained worldwide over decades by involvement in site erection of fans and attenuation systems. Incorporating this service enables CFE to offer customers a full range of capabilities from initial product design to complete erection.



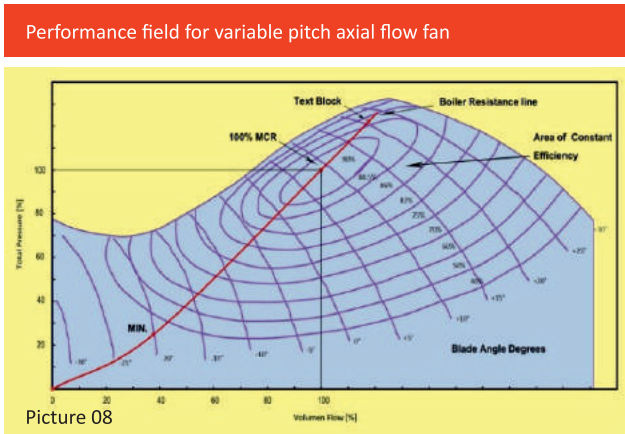
AXIAL FANS WITH VARIABLE PITCH CONTROL

The CFE variable pitch axial flow fan has three distinct benefits that make its use desirable in today’s environment of high energy and capital costs:

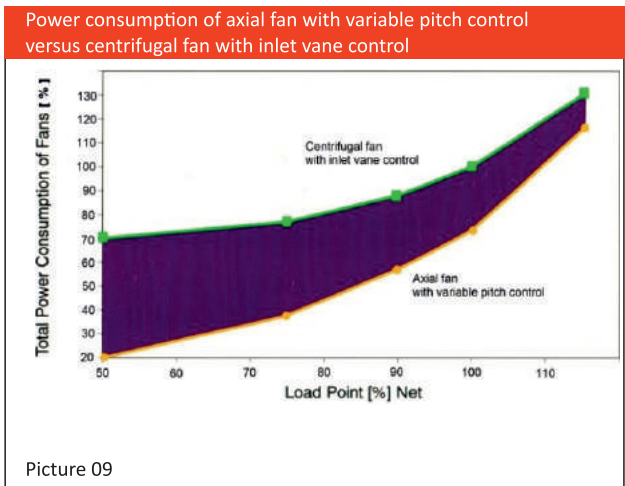


LOW OPERATING COST

Our axial fan’s high efficiency over the operating range reduces power requirements and helps cut operating costs.



Picture 08 is a typical performance field of a variable pitch axial flow fan showing the shape of the efficiency curves relative to a system resistance line. Areas of constant efficiency have their longest dimension parallel to the resistance line providing efficient performance across a range of load points. The resulting benefit is that net system operating power requirements will be minimized. Maximum design conditions or test block conditions remain within the control range of the performance field.



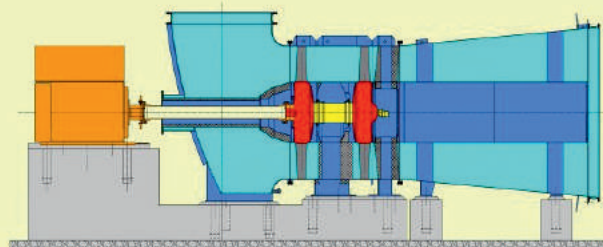
Picture 09 illustrates the advantages of the performance characteristics inherent in our axial fan design. This relative comparison was developed using actual operating data of fossil-fired boilers and calculating the power requirements for an axial flow fan versus a centrifugal fan with inlet vane control. With axial flow fans, high savings result as well at part load as full load of boiler.

FLEXIBILITY IN PLANT DESIGN

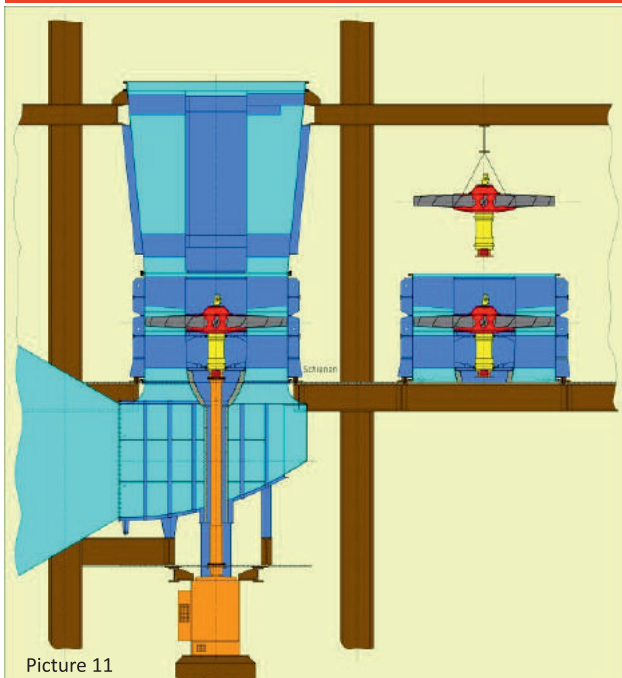
CFE - Technology GmbH axial flow fans may be mounted either horizontally or vertically to fit any plant design (Picture 10 & 11). This feature is especially important when plants are retrofitted with pollution control equipment and space is at a premium

Horizontal mounting of 2-stage axial flow fan

Picture 10



Vertical mounting of 1-stage axial flow fan



Picture 11

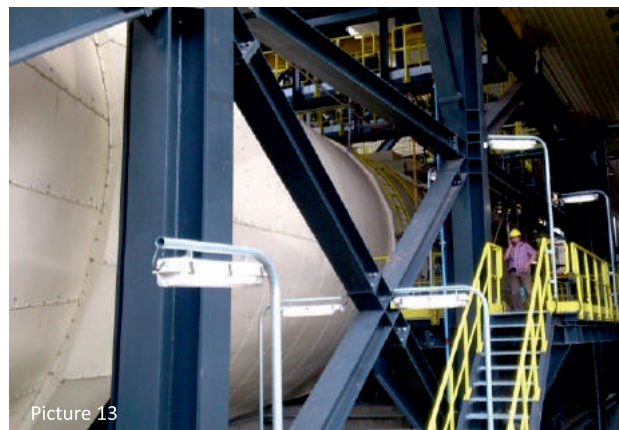
APPLICATION FOR VARIABLE PITCH FANS



Picture 12

Upgrade of forced draft fan for utility boiler

Fan Size FD2-300IN-VHP-2stage
Unit Size 660 (MW)
Motor Size 5225 (KW)



Picture 13

Booster fan for flue gas desulphurization plant with variable speed and variable pitch control during operation

Fan size	FD 1-500XD-VHP /S - 1 stage
Motor size	6900 (K W)
Max. speed	595 (rpm)
Flow rate	1222 (m³/s)
Temperature	170 (°C)
Pressure rise	4660 (Pa)

AXIAL FLOW FANS WITH REVERSIBLE OPERATION

Our ability to design ventilation systems that meets present and future needs is partly the result of our special make-up. Individual designs of axial flow fans are available for reversed operation by applying special asymmetric airfoils with excellent efficiencies and highest performance for forward and reversed operation. This principle at speed reversal supports to save human life in case of fire, explosion and firedamp in underground mines and subway tunnels or metro stations. Our advanced design allows changing pitch angle of blade by more than 180° by using our special development in conjunction with hydraulic adjustment. The fans react in case of these incidents quickly and can be switched short time for reversed operation. In particular this design is applicable for:

- Mine ventilation
- Highway and railroad tunnels
- Metro stations
- Industrial process systems



CFE Technology GmbH

Application for Reversed Flow Fans



Picture 14

Surface exhaust mine fan with reversed operation and simultaneously adjustable at standstill for iron ore plant

Fan size	MA2-212YQ -DHR - 2 stage
Motor size	1000 (KW)
Speed	990 (rpm)
Flow rate	120 (m ³ /s)
Temperature	10 (°C)
Pressure rise	4842 (Pa)



Picture 15

Surface exhaust mine fan with inflight reversible operation and hydraulically adjustable during operation for coal mine

Fan size	ME1-315YQ -DHR - 1 stage
Motor size	1200 (KW)
Speed	745 (rpm)
Flow rate	200 (m ³ /s)
Temperature	25 (°C)
Pressure rise	4500 (Pa)

Application for Aerospace

In this market segment CFE participated in the development and planning of transonic wind tunnels for aerospace applications in the sound speed range up to 1.6 Mach.

Further, CFE has developed different versions of multi-stage compressors to test the aerodynamic properties for aircraft at extremely high power ratings.

Currently, CFE is involved in a number of transonic wind tunnel projects at high speed range, ambient temperature and low temperature for international architects and engineers as well as end-users from Europe, North America and Asia.

Latest technology supplied by CFE includes a 4-stage axial compressor of a transonic wind tunnel for AVIC Aerodynamic Research Institute in Shenyang, P. R. China.



Picture 16

Stator housing of 4-stage compressor for transonic wind tunnel during workshop assembly

Application for Automotive

CFE has consolidated a lot of its accumulated technology for multi-stage compressors and transferred for high capacity fans in the automotive industry.

These fans are used as well in climatic wind tunnels as aero acoustic wind tunnels with closed circuit and further to this for large subsonic wind tunnels for aerodynamic measurements of resistance figures.

The system is controlled by variable speed or in-flight variable pitch adjustment or by a combination of both.

CFE -Axial Flow Fan Features

- **Blade design to meet operating conditions:**
 - Cast aluminium alloy for normal temperature and clean air applications
 - Cast spherical iron material for high temperature and low ash concentrations
 - Forged steel material for high temperature and high ash concentrations
 - Coating as an option to protect against sliding erosion
- **Blade shaft design to extend intervals for maintenance:**
 - Two-chamber oil lubrication without leakage problems
 - Individual design of thrust ball bearings with high load rating
 - Counter weights to compensate centrifugal moment of blade
- **Compact design of main bearing to minimize maintenance:**
 - Ball and roller antifriction bearings for horizontal and vertical installation
 - Sleeve bearings with split housing for easy exchange of internal bearings
- **Blade adjustment mechanisms**
 - Hydraulically adjustable during operation:
 - High operating pressure
 - High setting accuracy
 - Low energy control signals
 - Simultaneously adjustable at standstill
 - Individually adjustable at standstill
- **Horizontally split housings to provide ease of maintenance and accessibility**
- **Overall Economy**
 - Moderate capital costs
 - Low energy costs
 - Low maintenance costs

- **Simple service**

- Entire rotor can be installed and removed
- Accessibility through split housing and manholes
- Servicing of blade bearings without dismantling of fan

Noise Control Products

A complete line of acoustic equipment for clean air fans, contaminated or process gas fans, and high-pressure fluid venting is available. The following is a description of CFE's noise control product line:

Resonant Silencer

For the difficult application of attenuating the noise of fans having a particulate- or moisture-laden gas stream, the CFE-resonant silencer can be the solution. This silencer utilizes an innovative design to resist fouling while maintaining excellent acoustic performance.

Absorption Silencer

Clean air fans requiring inlet or outlet noise attenuation can employ CFE's absorption silencer. This perforated baffle silencer is customized to fit the installation and the application. Designed to provide the requested attenuation at minimized pressure drop, this silencer is appropriate for a wide range of fan sizes and volumes.

Acoustic Insulation and Lagging

Attenuation of the noise from fan casings and attached ductwork is accomplished by acoustic insulation and lagging. The required dampening is considered individually for each application and may include additional acoustic material thickness or anti drumming foil for more stringent requirements.

Quality Assurance

One of the basic requirements for assured quality - in addition to good organization and motivation - is the systematic development of modern engineering methods. The CFE quality assurance system prepares clear and comprehensive documentation based upon long-term experience to meet standard in accordance with ISO 9001.

PRODUCT LINES

- High capacity axial flow fans for utility and industrial boiler applications, flue gas pollution control Systems, mine ventilation, subway tunnels and low speed wind tunnels
- High performance axial compressors for transonic and supersonic wind tunnels
- Heavy duty centrifugal fans for utility processing and industrial applications
- Engineering, manufacturing and testing of advanced components for axial flow fans
- Sound attenuation systems including components such as acoustic insulation, lagging and silencers
- Service, upgrade, repair, and replacement of all type of fans



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