



air filters for gas turbines

Camfil Farr Power Systems	Segment brochure	
Gas Turbine Aftermarket		
Camfil Farr - clean air solutions for turbomachinery		

camfil farr is a world leader in clean air technology and air filter production



Our organization specializes in the field of Air Filtration Solutions. We are focused on research and development, state-of-the-art manufacturing, and marketing of air filtration products and services on a global basis. The Camfil Farr group of companies is the world's largest designer and manufacturer of air filters for many applications with 24 manufacturing facilities around the globe. We offer the strength and expertise of the group. As well as the advantage of local presence.

For the past forty years, we have supplied filtration solutions and services to a large number of gas turbine installations around the world.

Camfil Farr takes great pride in the fact that our products and systems offer superior engine protection while minimizing degradation due to fouling and erosion. Our products offer high efficiency, extended service life, low pressure drop and high quality thus providing our customers with the lowest possible operating and maintenance costs.

Our efforts have thus been focused on the ability to offer our clients an extensive range of products and services which cater to a broad range of requirements, whether based on technical or commercial criteria.

Strength factors

An international leader in the field of air filtration, Camfil Farr offers its customers the security of long-term partnership, backed by the documented capability to analyze needs and supply total air filtration solutions.

Our product range will meet your demands, from solutions to common filtration problems to highly specialized filtration techniques for applications that are extremely sensitive to air pollution. We provide the best possible clean air solutions, customized and optimized for cost and performance.

Raising air filtration to a new level of excellence, we thrive to set the standards of the filter industry's major trade groups and organizations.



we have been supplying
filters for gas turbines for
over 40 years



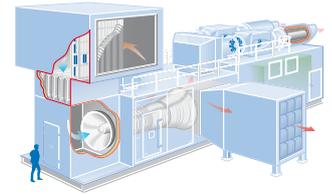
Camfil Farr operates 24 manufacturing facilities around the world. As illustrated on the map shown above, our gas turbine business units, located in Sweden, Belgium, Canada, the USA, Germany, India and the UAE, span the globe. Information on our gas turbine filtration solutions can be obtained from any of

these six locations or via any of the other direct sales offices or authorized representatives.

Camfil Farr designs and manufactures complete gas turbine air intake and acoustic packages for all types of applications and environments.

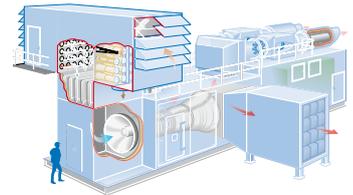


**We offer five
system solutions**



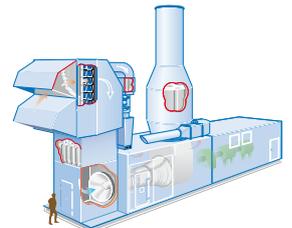
Static Filter Systems

Air filtration for power generation, industrial and oil & gas installations in a large part of land-based environments.



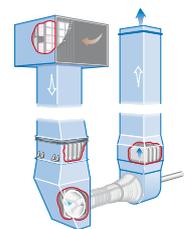
Pulsejet Filter Systems

Air filtration for power generation, industrial and Oil & Gas installations with highly polluted environments.



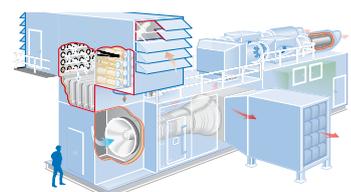
Offshore Filter Systems

Air filtration for installations on drilling and production platforms and ships exposed to marine and industrial environment.



Marine Filter Systems

Air filtration for marine and naval installations.



Acoustic Systems

Enclosures, Inlet and Exhaust Silencers for stationary and mobile turbomachinery.

camfil farr air filtration systems are often the choice of the gas turbine OEM manufacturer

A properly designed filter system gives the user:

Reliability,

The engine will be protected from risk of damage from erosion, fouling and hot corrosion.

Economy,

High filtration efficiency results in less fouling and less degradation, which is the key to maintaining maximum efficiency and power production. Low pressure drop provides high power output and high dust holding capacity increases filter service life.



OEM REFERENCES

Siemens

General Electric

Nuovo Pignone

MAN Turbomaschinen

Rolls Royce

Dresser-Rand

Pratt & Whitney

Wärtsilä NSD

Hitachi

Trans Canada

Camfil Farr has a long history of supplying systems to the gas turbine industry. Our engineers work closely with the gas turbine OEM's to develop optimum solutions in terms of performance, reliability and economy.

With our broad range of products, we have delivered systems to all types of turbine installations: industrial, desert, offshore, arctic and marine. Our expertise in system design for various environments is an asset that all our customers can benefit from.

The expertise, product range in addition to the fact that Camfil Farr is the world leader in air filtration combined with our global capability makes us often a preferred partner for many of the gas turbine OEM's.

User benefits

The prime function of the inlet filter system is to protect the gas turbine from pollutants in the inlet air. Particles entering the gas turbine can cause erosion or fouling of the turbine internals. Erosion is mainly caused to relatively coarse particles above 5 µm in size. Smaller particles in the sub micron size, cause fouling of turbine blades and cooling coils which rapidly reduces performance and becomes a serious threat to the turbine. Hot corrosion is an accelerated corrosion of metal surfaces that results

from the combined effect of oxidation and reactions with sulfur compounds and other contaminants such as chlorides. Effective capture of small particulate and airborne salt is therefore of vital importance for long and efficient operation.

LCC – Life Cycle Cost is the key to the future

End customers are requesting more and more that filter systems be optimized, not only in terms of price but also with regard to the total cost for the intake system, including filters usage, compressor cleaning, CO₂-emission costs, energy costs and other factors. The LCC programme developed by Camfil Farr for gas turbine inlet systems takes into account such factors as engine sensibility, energy cost, running time, filter price, cleaning cost, different environments and filter characteristics.

It is a well-known fact amongst gas turbine operators that high efficiency filters in combination with low pressure drop results in low operating and maintenance cost while ensuring high power output from the turbine.

For example:

100 Pa less operating pressure drop at the intake system will increase the turbine output by approximately 0.2 % and reduce the fuel consumption by approximately 0,1%. Camfil Farr can run calculations to determine the optimum combination of filters needed for the lowest totalcost over a given time period. Camfil Farr's calculations are based on real life testing data from a large number of sites.

camfil farr has extensive testing capability

With air filters it is difficult to judge their performance just by looking at them and the particles they should catch are very often not visible to the human eye. Since the filters typically last for a very long time laboratory testing is currently used to compare filters. In order for this laboratory testing to be fair, industry standards are established to define the method of testing for an air filter.

Currently in Europe and North America there are different laboratory filter test standards utilized for determining how an air filter should be measured and classified as well as a European test method for in situ testing.

The present standards are:

- EN 779:2002 (Europe)
- Eurovent 4/9 (Europe)
- ANSI/ASHRAE Standard 52.1-1992 (North America)
- ANSI/ASHRAE Standard 52.2-1999 (North America)

The latest revisions and/or proposed revisions to the laboratory test standards bring them closer together.

Eurovent 4/9 and ASHRAE 52.1 both utilize the same efficiency test methodology. EN 779:2002 and ASHRAE 52.2-1999 are the latest test methods and both utilize particle count efficiency measurements.

EN 779:2002

This standard classifies a filter's performance by the average efficiency at 0.4 μm . In addition the new revision to this standard requires tests to include information about the filters efficiency when all electrostatic charge has been eliminated to give the user a true minimum efficiency value.

ASHRAE 52.2.1999

This standard reports a filters performance across a range of particle sizes for 0.3 μm to 10.0 μm .

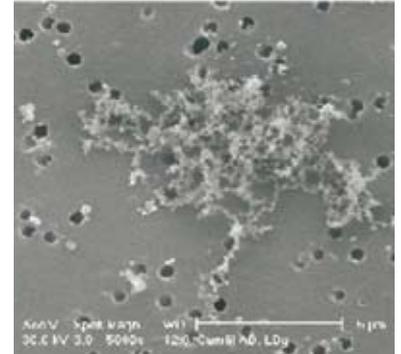
The minimum measured efficiency during the test is reported, but this standard does not require dicharging to give a true minimum efficiency. Particle size efficiency will be the new test method "world wide". Camfil Farr has played a very active part in setting the new standards for air filters.

Camfil Farr has several test rigs around the world

We were the first company to our own Eurovent 4/9 / EN 779:2002 test rigs. The rigs have been testing according to round robin tests so that they give the same results as the independent test labs. We were the first filter manufacturer to own their own ASHRAE 52.2-1999 test rig according to the new US standard.

By having a number of our own test rigs we can test new filters as well as used filters from the field to build up our own database how filters work and perform in real life. Standards have so far been concentrating on finding fast, economical methods to classify filters.

In gas turbine applications, it is important to understand that small particles of less than 1 μm in size can form clusters that cause wear and damage to the turbine blades. It is for this reason that air filters must maintain their nominal efficiency throughout their useful life.



Small particles <1 μm forming a cluster of 9 μm in size.

INDEPENDENT LABORATORIES

All our final filters used in gas turbine applications undergo in-house testing as well as independent laboratory testing to certify efficiency, pressure drop, dust holding capacity and burst pressure.



VTT testing protocols.

camfil farr gas turbine air intake filtration products

DYNA VANE



A compact, virtually self-cleaning, inertial separator. Designed to handle large volumes of air at high velocities, while operating at a constant air-flow resistance. The Dynavane incorporates inertial separation, providing high dust removal efficiency of airborne particulate matter.

The Camfil Farr Dynavane is self-cleaning and does not require any routine maintenance. It is designed to provide long lasting, trouble-free service under the most rigorous conditions. The blade packs are removable facilitating inspection or service.

CAMVANE



A high efficiency droplet separator using vertical separation vanes. Ideal when high droplet separation efficiency is required in combination with low operating pressure drop.

Typical applications include air intake filtration for turbo machinery and ventilation intakes which experience high humidity and/or heavy rainfall.

The CamVane housing is made of extruded marine grade aluminum. The droplet separator profiles are available in black polypropylene or extruded marine grade aluminum.

64 MZ



A low velocity, high performance, panel type moisture separator comprised of alternative layers of flat and herringbone crimped galvanized screen. Enclosing frame is also galvanized and complete with drain holes.

For maximum performance, panels should be installed vertically.

Also available in stainless steel for offshore, tropical or coastal applications.

30/30 GT



An extended area pleated filter which has long been established as the industry standard prefilter for gasturbines. Its favorable efficiency ratings, low initial pressure drop, extended service life, and ease of handling have made the 30/30 GT the prefilter of choice for those seeking both economy and proven performance.

The 30/30 GT is rated as a medium efficiency, totally disposable filter offering extended service life to final filters.

RADIAL PLEAT DESIGN - Unique "radial pleat" design assures total usage of the filter media, maximum dust holding capacity and extended service life. The 30/30 GT is rated as a class G4 filter per CEN EN 779:2002 and a MERV 7 filter according to ASHRAE 52.2.

filtration products

R30/30 WR



A filter that has been specifically developed for wet conditions. When subjected to water testing at a feed rate equivalent to 11 inches (280 mm) per hour of rain – the R30/30 WR test filters allowed no water penetration on the downstream side. The filter combines high efficiency removal of water and mist with medium removal of airborne particulate.

The R30/30 WR is rated as a class G4 filter per CEN EN 779:2002 and a MERV 7 filter according to ASHRAE 52.2.

HI-CAP



A pocket filter made of synthetic media. It has a large filter area, good collection efficiency on atmospheric dust and is widely used as a prefilter and coalescer in 2 and 3 stage systems offering extended service life to final filters. Produced in the following filter classes: G4 per CEN EN 779:2002 and MERV 6 according to ASHRAE 52.2.

CAMCLOSE



The Camfil Farr CamClose is specially design to be fitted directly – close coupled to Camfil Farr final filters, such as CamGTs and Opakfil GTs. It's major strength is that it makes it possible to add an extra filter stage to the filter system without the need for an extra filter bank.

The CamClose's structural integrity is maintained by the use of a high strength ABS frame. Downstream pleat separators are used to ensure optimum operation.

For humidity applications, it is preferable to use the CamClose filter. Designed for humid conditions, the Camclose filter is ideal for tropical or coastal installations. Produced in filterclass: G4 per CEN EN 779:2002.

HI-FLO



These bag filters are the first choice for thousands of satisfied customers who have found that HI-FLO bag filters represent the most economical filter choice for a variety of applications. The filter pockets are manufactured using the proprietary CMS (Controlled Media Spacing) method. Each pocket is thus formed into a perfect V-Shape, inhibiting contact between bags and optimizing the airflow profile.

The Hi-Flo is constructed with pockets made of glass fibre media and available with galvanized or plastic headers.

Produced in the following filter classes: F5, F6, F7 and F8/F9 per CEN EN 779:2002 and MERV 9, 11 and 13 per ASHRAE 52.2.

S-FLO



A synthetic bag filter which meets the high demands for efficiency, dust loading capacity, low pressure drop, extended service life and high mechanical strength.

The filter pockets are manufactured using the proprietary CMS (Controlled Media Spacing) method. Each pocket is thus formed into a perfect V-Shape, inhibiting contact between bags and optimizing the airflow profile.

S-Flo is available with galvanized or plastic headers.

Produced in the following filter classes: F5, F6, F7 and F8 per CEN EN 779:2002 and MERV 9, 11, 13 and 14 per ASHRAE 52.2.

HP GT



A high performance, extended area, rigidly supported, disposable filter. Totally supported design results in performance not being affected by changes of airflow or turbine shutdown. Filter configuration is not altered by the accumulation of dust.

Produced in the following filter classes: F5, F6, F7 and F8 per CEN EN 779:2002 and MERV 9, 11 and 13 per ASHRAE 52.2.

filtration products

RIGA-FLO GT



This high efficiency, heavy-duty air filter is designed for application on gas turbines in any location. The Riga-Flo GT rigid construction results in the Riga-Flo GT not being affected by changes in air velocity or equipment shutdown, and its configuration is not altered by the accumulation of dust.

Specifically designed for gas turbine applications, the sturdy Riga-Flo GT has a welded wire media support grid, corrosion resistant contour stabilizers, a galvanized steel enclosing frame and protective wire mesh screens on both the upstream and downstream sides. All these characteristics contribute to the filter's structural integrity throughout its service life. The filter pack is continuously bonded to the inside of the enclosing frame and the filter itself is able to withstand a 6220 Pa (25" w.g.) pressure drop without any noticeable distortion.

Produced in the following filter classes: F6, F7 and F8 per CEN EN 779:2002 and MERV 11, 13 and 14 per ASHRAE 52.2.

CAM GT



The market leader and state of art, high-capacity filter for turbo machinery. Its unique design with vertical pleats assures that performance is maintained in humid or wet conditions, guaranteeing a long service life and an economical filtration solution.

Combined with its sturdy and heavy duty design, the Cam GT's high efficiency and low pressure drop guarantee optimum protection and engine performance under the most demanding operating conditions. The Cam GT is suitable for both onshore and offshore installations where its exceptional performance is maintained during periods of high humidity and extensive fog.

To ensure high mechanical resistance towards blast risks and filter integrity protection during handling and installation, each pleated pack is protected by an integrally sealed mesh on air outlet.

Produced in the following filter classes: F7 and F9 per CEN EN 779:2002. H10 and H12 per EN 1822. Cam GT exists also in Reverse Airflow configuration in order to allow any kind of filter fitting.

Improve your installation service costs with Cam GT-XL: **+ 26% filtering area in the same external dimensions.** Available for Cam GT class F9 and H10.

CAM GT BOX



A totally new high-capacity filter for turbo machinery. Based on the same unique filter pleat design as the standard Cam GT, the box type version is set into a rigid enclosing plastic frame. It is therefore very suitable for upgrading existing filter systems from older box type filters to a modern high performance filter product. Just as the std Cam GT, its performance is maintained in humid or wet conditions, making it suitable for operation also in salty environments.

Combined with its sturdy and heavy duty design, the Cam GT's high efficiency and low pressure drop guarantee optimum protection and engine performance under the most demanding operating conditions.

Produced in the following filter classes: F7 and F9 per CEN EN 779:2002. H10 per EN 1822.

TURBOPAC



TurboPac is a box type filter designed to withstand the high pressures and surging airflows associated with gas turbine operation. The filter casing consists of a galvanized steel frame with headers on both sides. Media pack with vertical pleats protected by face guards on air entering and air leaving sides.

Produced in the following filter classes: F6, F7 and F8 per CEN EN 779:2002 and MERV 11, 13 and 14 per ASHRAE 52.2.

filtration products

OPAKFIL GT



A turbomachinery version of Camfil's well known Opakfil compact filter. The Opakfil GT offers a cost effective solution in areas with dry environments and where considerations for high humidity and hygroscopic dust are less important. The Opakfil is designed with horizontal pleats and is, just as the CamGT, fully incinerable.

To ensure no risk of filter damaging during handling and installation, external exposed pleated packs are equipped with protective integrated sealed mesh.

Produced in the following filter classes: F7, F8 and F9 per EN779:2002. H10 per EN1822.

TENKAY



Vertically hung self-cleaning air filter cartridge providing high performance in a single stage of filtration. Camfil Farr's dimple pleat design ensures uniform pleat spacing and maximum utilization of the filtration media. In turn, this results in improved air distribution through the filter, lower pressure drop and longer service life.

Offering leak-free performance, the filter media is factory bonded to a closed steel bottom pan and to a top clamping plate. A triple helical cord is bonded to the outer surface to prevent media distortion during back flushing. A wide variety of models are available with header, gasket and media options to meet your particular needs.

The water repellent media is composed of a resin-impregnated mixture of cellulose and synthetic fibers and is available in four different grades: standard cellulose, blended Polytech, the ultra high efficiency Polytech HE and fire retardant media

Tenkay filter elements maintain pleat stability and overall performance even under high humidity conditions. See also HEMIPLEAT below

CAMPULSE



Pulse filter elements used in automatic, self-cleaning air filter systems providing high performance in a single stage of filtration. Each set consists of a cylindrical element of type CY-2612 and a conical element of type CO-2612. Top and bottom caps are made of pressed or spun galvanized steel. A rigid expanded metal inner core supports the media pack and prevents the element from collapsing under conditions of extreme differential pressure. An outer expanded metal wrap protects the media from damage during handling and from large foreign objects during operation.

The filter media is water repellent and is corrugated perpendicularly to the pleat direction to ensure even spacing of pleats and prevent their collapse. Composed of a resin-impregnated mixture of cellulose and synthetic fibers, our filter media is available in four different grades: standard cellulose, blended Polytech, the ultra high efficiency Polytech HE and fire retardant media.

Polytech media is manufactured to Camfil Farr's specifications and provides improved performance under conditions of high humidity and abundant water. Mounting gasket is permanently glued to the end cap. Efficiency is tested in accordance with ASHRAE Standard 52.1-1992 (AC-Fine test dust). Test data can be provided upon request. See also HEMIPLEAT below

NEW HEMIPLEAT TENKAY HEMIPLEAT & CAMPULSE HEMIPLEAT



HEMIPLEAT, state-of-the-art in pleating technology is the key to the superior performance in operating and maintenance for pulse cleaning cartridges. Techniques used to manufacture the media packs of the cartridge are unique and have never been applied to pulse filter cartridge for turbomachinery before. Synthetic beads hold the pleats more open and the wider spacing in the HEMIPLEAT design gives greater media utilization and more effective filtration providing enhanced performance such as considerably lower pressure drop and longer service life. The new PolyTech media is the most advanced pulse-cleaned media ever made, and is available in two different grades: PolyTech HE ultra high efficiency and blended PolyTech both as standard with silicone impregnation for high humidity resistance. The HEMIPLEAT type cartridges are available in both the Tenkay and the Campulse filtersystems as upgrades or as original supply.

R research & development



At Camfil Farr, we are deeply committed to R&D and quality control, performing rigorous laboratory testing and field trials under controlled conditions.

We design, develop and build our own production equipment to maximize our control over the quality and performance of the filtration products that we manufacture.

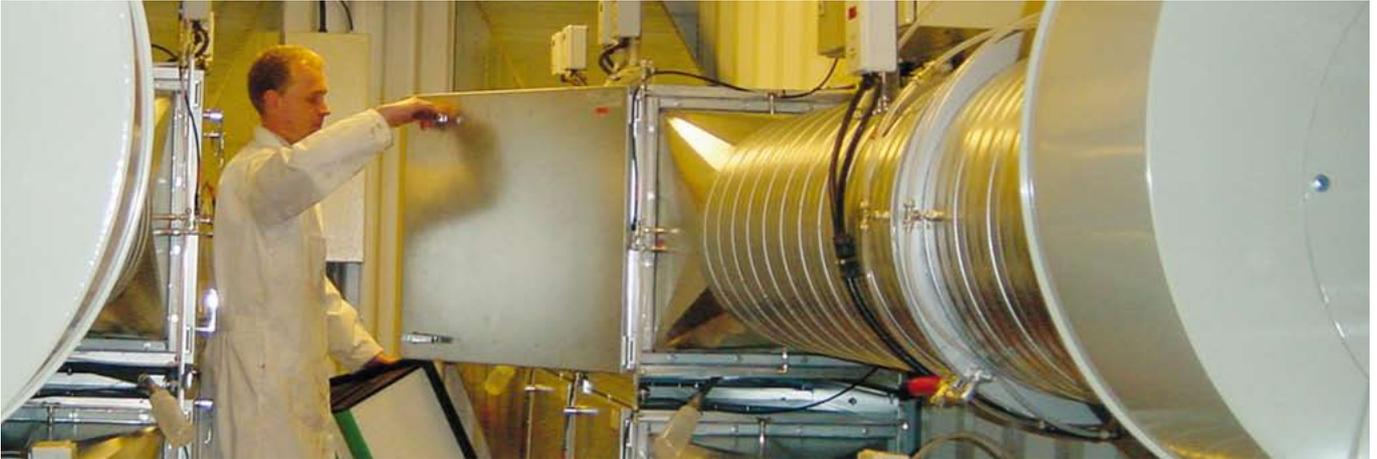
Our software packages assist in reviewing our customer's needs and provide the optimum air filter product for each application.

Our main R&D center is located at our

corporate headquarters in Trosa, Sweden and is well equipped with a myriad of sophisticated instruments including, but not limited to, an SEM (Scanning Electron Microscope) and particle testing devices.



new materials and equipment



Always at the forefront of emerging technologies, Camfil Farr is a recognized filtration leader and is continuously developing new materials to optimize our clean air solutions.

We work closely with media suppliers to obtain products that meet our very high quality standards.

We are constantly introducing new products such as the Cam GT box, Opakfil GT and HemiPleat technology for pulsjet filters.

All new products which incorporates our patented media pleating technique for the GT market.

Climate chamber

One of Camfil Farr's latest investments is our full scale test device used to evaluate filtration needs under difficult circumstances.

Using this apparatus, we can modify all of the important parameters such as airflow, relative humidity, temperature and salt content.

The device can be used with air or other gases and will allow rapid prototyping, product validation, evaluation of competitive products and for research and development testing.

Mobile test rig

Another new investments is Camfil Farr's mobile approach to filter tests consists of a mobile test rig installed in standard 20-foot container. Tests can be performed on eight different filters simultaneously in four different air ducts.

The mobile test laboratory documents the actual performance of filters in the application they are intended for, with complete control over the operating parameters. Customers see, right on their site, what the most cost-efficient and effective filtration solution will be for their gas turbine system, building or process. Customers can also participate in monitoring the results.

Accelerated tests are also possible to test filters at a higher air flow, with the exact same dust load, to shorten the test period and simulate a long-term test.

Airaudit service

The airaudit service of Camfil Farr have as main objective to verify, maintain or improve the quality of filtration of your installation. Sampling of air is made before and after the

filter house or individual filter stages and a qualitative and/or quantitative analysis of the air will be reported.

Qualitative analysis is an electronic microscope analysis of particles collected in the air.

Quantitative analysis is a counting of individual particles per volume of air.

Camfil Farr report will include recommendations and advise on possible solutions to reduce operating cost by improving the efficiency and reliability of your installation.



On Camfil Farr's website www.camfilfarr.com all the technical data about our products can be downloaded.

On world standards...

...Camfil Farr is the leader in clean air technology and air filter production. Camfil Farr conducts its own product development and R&D, and has worldwide local representation.

Our overall quality goal is to develop, produce and market top-quality products and services that always exceed our customers' expectations.

We see our activities and products as an expression of our quality.

To achieve overall high quality, it is necessary to establish an internal work environment where all Camfil Farr's employees can succeed together. This means an environment characterised by openness, confidence and always doing what's right for our customers.

www.camfilfarr.com
info.gt@camfilfarr.com

Camfil Farr Power Systems

Europe:	Americas:	Middle East:	Asia:
Borås, Sweden tel: +46 33 17 85 00	Laval, Canada tel: +1 450 629 30 30	Dubai tel: +971 4 887 1796	India tel: +91 124 43 24 100
Bremen, Germany tel: +49 421 47886 0	tel: +1 800 976 93 82		Japan tel: +81 6361 38 36 (Tominaga & CO Ltd)
Kreuzau, Germany tel: +49 2421 22 49 80			
Brussels, Belgium tel: +32 2 68 80 520			