

Pointing the way towards the future



Brüel & Kjær, Schenck Condition Monitoring Systems' ingenuity has pioneered the way into new terrain in machine management systems for many years now. As we look toward the future, we intend to remain the front-runners in this exciting and rapidly developing field. With our state-of-the-art technology and commitment to individualized service and delivery of scalable systems, Brüel & Kjær, Schenck will continue to lead the way in the new millennium.

COMPASS is our commitment to continuously developing scalable solutions that will...

- Reduce your machinery downtime
- Improve the performance of your machines
- Lower the cost of ownership *life-cycle cost* of the monitoring system
- Provide you with advanced measurement tools for tracking changes in your machinery and for analysis of machine faults.

You are on your way

Give us a call. One of our sales professionals in our international sales group will contact you to make an appointment for evaluating your particular needs. Based on your actual problems and the configuration of your production line, we will work out a proposal that allows your company to be more competitive by increasing the availability of your assets.

**You will find us nearby
anywhere around the globe.**

www.bkscms.com

Brüel & Kjær CMS A/S

DK-2950 Nærum

Tel.: +45 45800500

Fax: +45 45802937

E-mail: cmsinfo@bkcms.com

Internet: www.bkscms.com

SCHENCK VIBRO GmbH

D-64273 Damstadt

Tel.: +49 (0) 61 51-32-33 55

Fax: +49 (0) 61 51-32-13 70

E-mail: schenck_vibro@csd.de

Internet: www.bkscms.com



Brüel & Kjær, Schenck
Condition Monitoring Systems



**On Course...
with COMPASS**

COMPASS points the way



For more than 50 years, Brüel & Kjær, Schenck Condition Monitoring Systems has been leader in the design and manufacture of instrumentation for vibration measurement and analysis. We are dedicated to the production and implementation of machine maintenance management solutions, and we are proud of our role at the frontier of state-of-the-art technology in this field.

When we first launched COMPASS in 1992, it created nothing short of a revolution in the world of machinery management systems. Since then, we have continued our role as trailblazers and continually updated and enhanced COMPASS.

COMPASS is a modular machine management system that is designed to fit your company's particular needs. COMPASS provides fully integrated machine protection-, condition- and performance monitoring capability. COMPASS can bring all the data from the various machine information systems and present it as usable information.

Brüel & Kjær, Schenck Condition Monitoring Systems offers our customers international service in addition to unprecedented on-time, on-budget delivery of system solutions.

- We assist customers in the selection, procurement, design, planning, implementation, training and support of systems.
- We leverage the best-of-breed applications that allow for flexible customization and rapid deployment.
- Brüel & Kjær, Schenck Condition Monitoring Systems has a unique system and application house that offers a full-circle service approach. This radically alters the way in which front and central monitoring technology solutions are deployed and integrated in order to provide true integral machine monitoring solutions.

In addition to COMPASS, we also offer a complete range of machine management products consisting of -

- A standard range of safety systems, compact safety monitors, data collectors and balancing equipment
- Advanced diagnostic systems as well as integrated condition monitoring systems.
- Products all supported by market standard software - for example Windows, UNIX, and Linux. This enables us to secure the best solution for our customers.



Setting the course



Our customers all share the immense responsibility of keeping their production running. They recognize that lower maintenance costs and increased uptime are the only ways of staying ahead in today's competitive environment. We know that in order to stay ahead of the competition, our customers need to tailor their workflow. With COMPASS, we can offer a solution that fits their needs.

Each customer is unique. In the oil & gas industry, the petrochemical industry, the power industry, and in heavy process industry, no two plants are equipped and run the same way. Setting the course depends in part on the machines and production tools and in part on the objectives for the maintenance function.

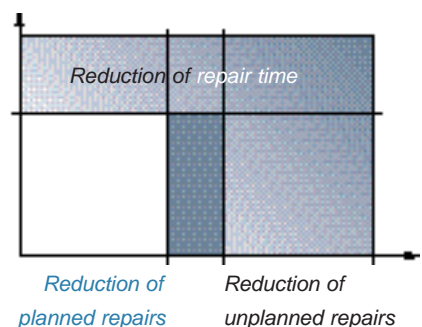
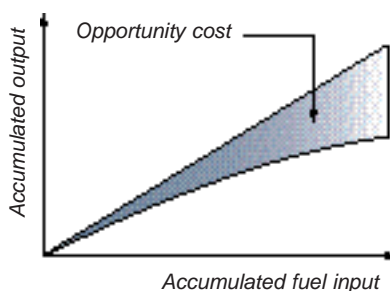
A tremendous improvement in operational effectiveness can be achieved by adopting our automated maintenance strategy.

This strategy is quite basic:

- **Save time by reducing the length of unexpected repairs.** The COMPASS system gives you the information you need to know about what went wrong and what you need to do to fix it.
- **Reduce the number of machine stoppages.** Using COMPASS allows you to extend the time between planned maintenance operations and reduces the number of unplanned stoppages.

- **Improve the efficiency and performance of your machines** - which allows you either to improve throughput or reduce the cost of energy and raw materials.

Saving for a single event can pay for a management system several times over. The end result is fewer false alarms, less time needed for maintenance, greater time between overhauls, and better operating efficiency of machines - in short, optimal operating effectiveness.



COMPASS keeps you on course



COMPASS collects, stores, and analyses data, and presents it as clear, accurate information, allowing you to evaluate the current status, condition, and performance of your machines all the time.

Intelligent Monitoring

COMPASS uses Intelligent Monitoring (Adaptive Monitoring Strategy, Profile Monitoring, CPB Spectral Comparison). You get earlier alarms than with any other system, and you can trust the alarms. COMPASS can even automatically detect changes in complex data.

COMPASS has an Expert System (ADVISOR) that automatically analyses and assesses all the measurements made all of the time, thus improving the speed accuracy and reliability of diagnosis.

Lower the Life-Cycle Cost

All systems claim to cut maintenance costs and reduce downtime, and the fact is that they all probably do. But it's a question of degree. How much cost can be cut? How much downtime can be saved? The key difference with COMPASS is that its automated techniques ensure that it has low life-cycle cost and returns savings fast.

Life-cycle costs of systems are critically important when measuring return on investment in condition monitoring systems.





Life-cycle cost is made of up of several elements:

- The capital investment cost of the system itself
- The cost of integrating that system into the other plant systems
- The cost of running the system, day to day. This is linked to the hours spent "driving" the system
- The cost of educating personnel and maintaining the expertise required for running the system

There are some hidden costs, which are rarely included, but which ought to be:

- The cost of the system giving a false alarm or false trip
- The cost of the system not detecting a fault early enough in its development so that proper maintenance can be planned

All things considered, COMPASS reduces maintenance costs and downtime, thus returning savings faster.

Increased machine efficiency

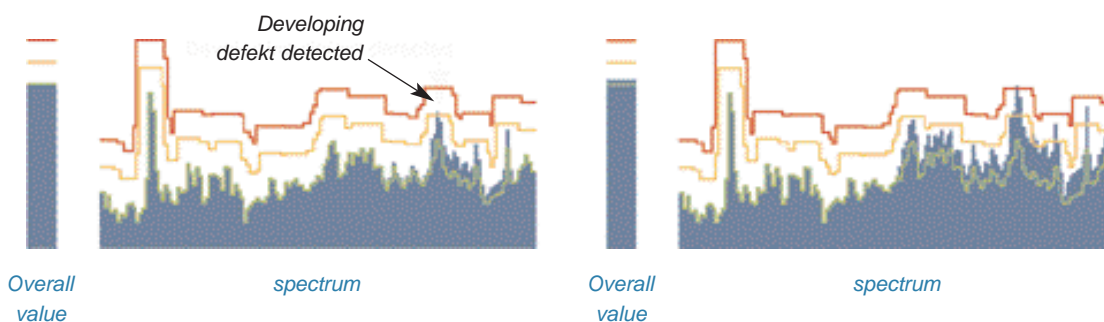
Increasing your machine efficiency by only a few percent will yield millions a year in saved fuel and increased production. But achieving a measurement accuracy of just a few percent places large demands on the monitoring techniques and the diagnostic techniques.

The performance monitoring capability of COMPASS has achieved unprecedented end-user acceptance, partly because it was designed and developed together with major oil & gas end-users. Moreover, the thermodynamic expertise needed to design an accurate and reliable performance monitoring system comes from well-respected consultants in this field.

Proactive versus reactive

COMPASS is designed with a Proactive Condition-Based Maintenance Strategy at the heart of its design concept. This is opposed to the reactive strategy found in many systems where the users are not alerted until they already know that they have a problem (a trip, a high vibration, or a temperature alarm on the DCS or local monitoring system). COMPASS automatically detects telltale changes in complex data, such as S_{max} for detecting changes in the orbit, FFT's and CPB's. These changes give significantly earlier warnings of potential trouble long before the overall levels

(scalars) begin to rise. Any changes in any measurements are indicated via a traffic light alarm system. Furthermore, the expert system ADVISOR can automatically print out a report every morning of what COMPASS found the day before when it examined the millions of complex measurements it made. It makes great reading with the first coffee of the day! In short, a proactive system delivers the benefits of a predictive maintenance strategy at lower cost.



Monitoring changes in a spectrum gives earlier warning than monitoring changes in an overall value.

Confidence logged

ABB • Aker • Alcoa • Allen-Bradley • Alstom • Bailey

BASF • Borealis • Brown & Root • CEMIG • Chiyoda • COPEL

COPEL • Donaukraftwerke • Dresser Rand • ECNZ • EGAT

Electropaulo • Elf • Enzo

EPON • Exxon • Fortum

Foster Wheeler • Foxboro

GE • GHH Borsig • Honeywell

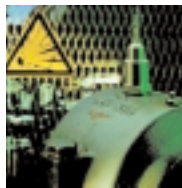
Illwerke • IPEN • Jersey

Kalinin NPP • Lafarge

Leningrad NPP

Mærsk Oil & Gas

Niagara Mohawk



Huntsman
Electric
Kvaerner

M.W.Kellogg • MHI

Mitsubishi • NAM

NSW • Nuovo Pignone

By taking a serious approach to our business and providing competent, technological solutions over the years, we have gained the confidence of our customers in the solutions we offer. We are proud to say we have a long track record of working with the most innovative operating companies around the world. Together with our customers we have developed several unique applications. Here are some examples:

Reduce scheduled testing of emergency shutdown valves

COMPASS was set up to generate an alarm if the ESD valves did not depressurize the system to at least 50% within a given time in the event of a trip. This simple solution was easy to implement with the advanced logic processing of COMPASS, and the data needed was already available in the DCS. Now, instead of expensive scheduled testing, the ESD system can be tested during any spurious trip.

UK sector North Sea gas production platform

Major responsibility

“We have 5 compressors exporting 100 MSm³/day to the European market. It is our responsibility to keep the machinery running. With COMPASS we can plan our maintenance in a way that avoids production stoppages.”

Norwegian onshore gas terminal

Heat exchanger monitoring

Intercooler efficiency vastly improves the overall efficiency of a compressor. Gains in efficiency are possible if early warning of lost heat exchanger efficiency can be detected.

Australian offshore platform

Ontario Hydro

Pacific Power • PDO

Petrokemia Ploč

Petronas

Rovno NPP

Shell



Simrad • Slovnaft

Snamprogetti

Solar Turbines

SOLAC • Statoil • TCS TEAS

UFA United Illuminating • UNA

Woodside • Yokogawa



Combined monitoring techniques offered

The open architecture of COMPASS allowed cavitation, flow, and other data to be imported and stored from the DCS and various stand-alone systems for monitoring and alarming. Diagnostic tools offered by COMPASS allow this data to be correlated in a single plot together with vibration data, so developing faults can be more reliably diagnosed.

Brazilian hydroelectric power station

Fast, reliable operation and maintenance decisions require relevant information

If there is a machine trip in a liquified natural gas (LNG) plant, you only have a few hours to decide whether to put it back in service or do a complete shutdown with purging for a couple of days before starting it again. Therefore you need all the necessary information you can get on the condition of the machines. The integrated vibration, process and performance monitoring capability of COMPASS together with its diagnostic tools gives you those answers and avoids the machine tripping in the first place.

Middle East LNG plant

Optimized machine uptime by monitoring both upstream and downstream companies

Machine uptime cannot always be individually optimized from one plant to the next in the olefin industry, since these plants are all so dependent on one another. A maintenance service contract was therefore made by the olefin plant with several of the downstream plants that use their products. All maintenance planning and management for these plants is centralized, including the COMPASS monitoring system. This gives each plant high machine availability at minimal expense. The plants are now operating well above the benchmark uptime for the industry, and a whole year has been added between plant shutdowns.

Brazilian olefin plant.

COMPASS



COMPASS is an evolutionary platform on which we have been building solutions for our customers since 1992. This latest release of COMPASS - offers an exciting range of new solutions in direct response to the needs of our key customers.



Web-enabled COMPASS

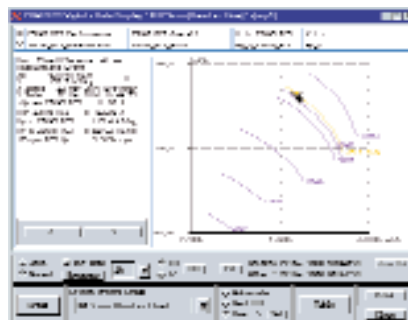
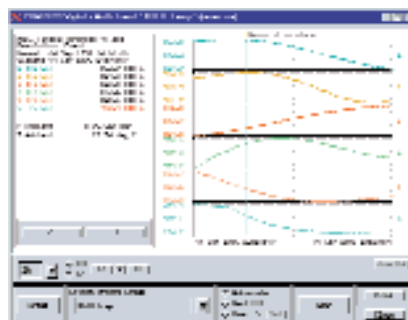
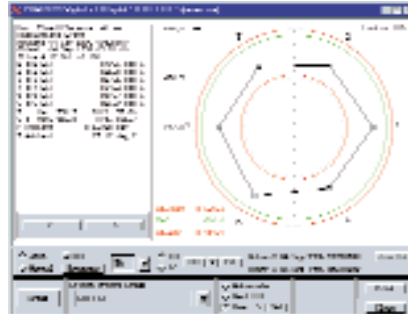
We've always believed in moving the information to the expert rather than flying the expert to the data. Remote access to COMPASS has always been a standard feature. With web- and browser-based access to the COMPASS Server you can access the information from any computer in your organization using a standard Web browser without having to install any extra software. With remote access on a modem or ISDN line the performance feels as fast as that obtained by sitting at the COMPASS monitor itself! The Web enabling of COMPASS is just the start of a new era of products and services that are emerging from our company.

ADVISOR™ - The expert system that evolves with you

You do not need to be an expert to run a condition monitoring system. Using the COMPASS Web interface, you can connect to any expert around the world. For on-site diagnostics, the ADVISOR™ software is a powerful ally. It will pinpoint any problem when prompted, or you can set it up to perform round-the-clock diagnosis of all your machines. It will report machine problems in plain language and justify its finding in a report containing both the evidence and a trend of the certainty of the diagnosis. Most of today's simple expert systems have been limited by both the number of rules in their databases, and their rigidity. ADVISOR™ offers as standard a user knowledge-base facility that allows you to add your own knowledge and experience to the expert system, continuously improving the breadth and accuracy of the diagno-



The COMPASS graphs are also available in 'classic' black color.



Machine	Manufacturer	Model	Year	Capacity	Unit
1-1000	1-1000	1-1000	1-1000	1-1000	1-1000
1-1000	1-1000	1-1000	1-1000	1-1000	1-1000
1-1000	1-1000	1-1000	1-1000	1-1000	1-1000
1-1000	1-1000	1-1000	1-1000	1-1000	1-1000

ses. ADVISOR™ is based on neural network technology, and it can quickly "learn" completely new diagnosis from observed historical data. ADVISOR™ does not need the presence of an expert to answer tedious questions prompted by the software. After the initial setup period, ADVISOR™ is fully automatic, receiving all of its measurement data from the monitoring system at time intervals preset by the user.

Performance monitoring

The performance monitoring package in COMPASS is a product with standard packages for pumps, compressors, gas turbines, steam turbines, hydro turbines, and liquid expanders, all of which can be customized to cover the actual measurement configurations of the individual on-site machines. The performance monitoring system formulae and setups are fully transparent. Changing a gas composition or even a thermodynamic calculation can be done very easily. The system is so flexible that we have even been able to take on challenges beyond rotating equipment. The performance monitoring replay function allows you to see all relevant high-resolution process data

before and after a machine trip, an operation upset, or by manual request, thus giving you a more complete diagnostic picture of your machine. The use of customized yet standard performance packages allows us continuously to live up to our reputation of delivering large monitoring systems on time and on budget and exceeding the customers' expectations. With the COMPASS system, you will be able to analyze the performance of most of the machines in your plant.

"Reciprocating" agreement gives compressor monitoring results

We have cooperated with a major reciprocating compressor manufacturer to specify, develop, test, mutually market, and support a more effective method for monitoring rider-ring wear on reciprocating compressors. Piston-rod geometry, as well as compressor crank angle measurements, are fully configurable, and alarms can be set for exceeded wear limits. Wear can be automatically trended against alarm limits to give extended lead-time in maintenance planning.



Scaling into a plant-wide system

The COMPASS system is a well-tested platform using the technology that allows for scaling into a plant-wide monitoring system. These are the main benefits of the COMPASS system:

The user interface in COMPASS can be completely customized. It offers an at-a-glance summary of the condition and performance of all your machines. You can integrate monitoring information from anywhere in your plant into a single screen.



Traffic light navigation gives you indication of the state of all your machines at any time and makes it easy to go straight to the problem.

The human ear - One of our major innovations in machine condition systems, the CPB (Constant Percentage Bandwidth analysis) works in a manner very similar to the oldest analysis system in the world - the human ear. CPB spectrum is a tool to detect a machine fault in its early stages of development, long before any overall vibration measurement indicates a problem. CPB allows for reliable trending and alarming of the problem.

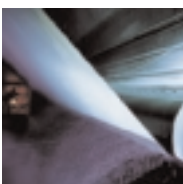


COMPASS uses all known, proven analysis techniques

- from vector plots to shaft center-line positions, from bodé plots to cepstral analysis, from FFT analysis to Zoom analysis, from Envelope Analysis to CPB - giving you a vast selection of techniques to set up measurements for analysis and comparison automatically.



Monitoring to specific process conditions eliminates the variations in the vibration measurements caused by different operating conditions of the machine.



It is possible to set up alarm limits on all advanced measurements to give the earliest possible warning.

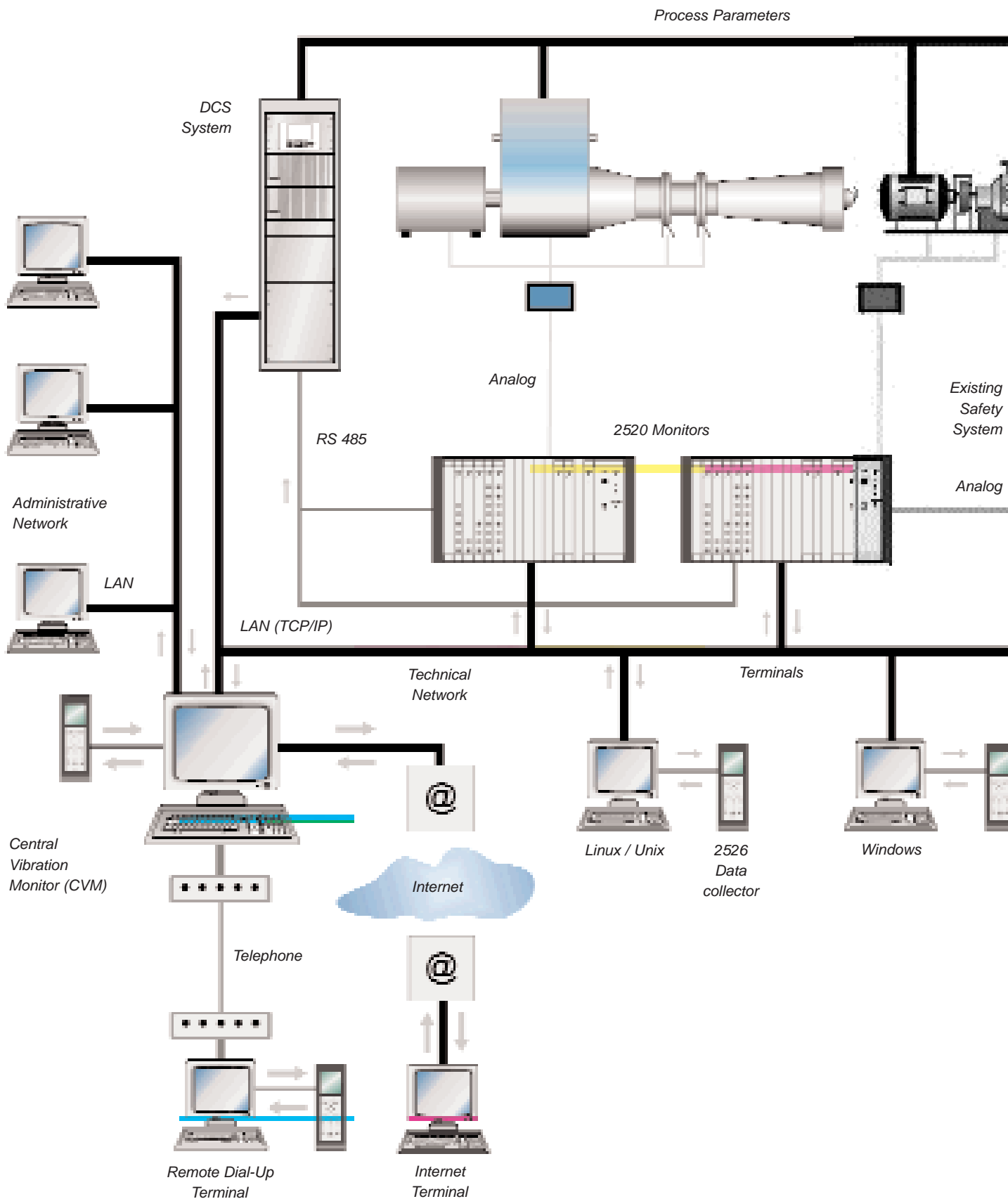
All measured changes are stored in an Oracle relational database. This allows you to trend a specific fault development, and to go back quickly in time to find similar events that have occurred on your machinery. The COMPASS database is capable of storing up to 30 years of data without significant loss.

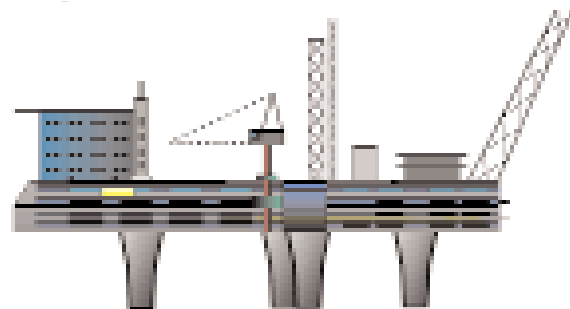
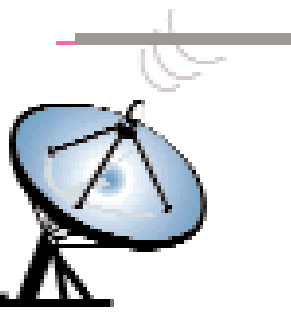
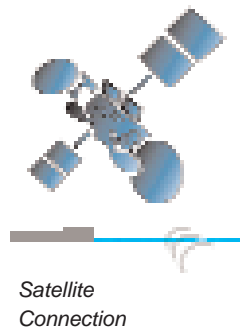
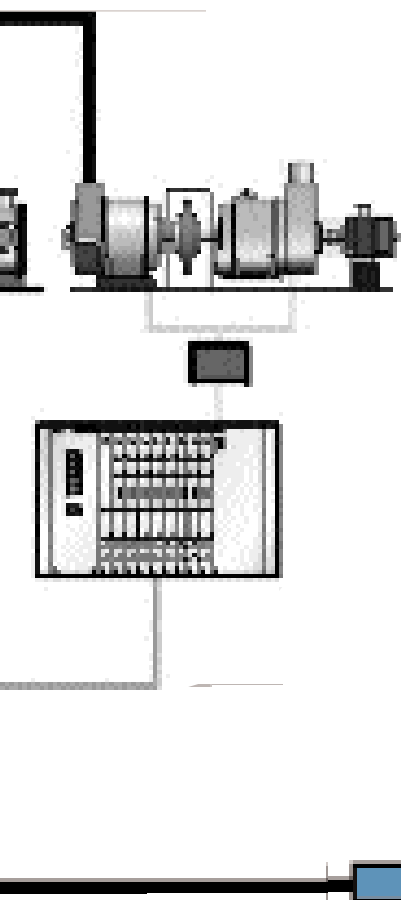
To enable a Best Practice RCM (Reliability Centred Maintenance) strategy fully, our monitoring system techniques are selected and tailored to fit the Potential Failure Modes (PFM's) of your machines.

In summary the COMPASS system provides -

- Integrated online and offline monitoring.
- Integrated safety and predictive monitoring.
- Integrated vibration and performance monitoring for improved support for making decisions.
- Plant-wide integration of machine information by interfacing to the distributed control system
- Monitoring at remote locations via modem, local area network (LAN) or the Internet.
- Rack-mounted monitoring and analysis modules that can be configured to meet almost any application, as well as off-the-shelf hardware that can be reconfigured by software to perform a multitude of different tasks from one moment to the next.
- An extensive range of optional application software packages allowing you to pick and choose the measurements that you require and lower the cost per application.

The COMPASS system





COMPASS integrates data from various systems into one central location

Brüel & Kjær, Schenck Condition Monitoring Systems can deliver a complete front end for vibration measurement including transducers, junction boxes, charge amplifiers, barriers, and a wide range of cables connectors and mounting plates.

1. Alternatively if the machines are already fitted with a safety system that provides adequate protection for the machinery, COMPASS can easily be interfaced to these systems to provide extensive predictive monitoring capabilities.
2. Temperature, pressure, and other process related measurements are transferred digitally from the Distributed Control System (DCS) at regular intervals into the COMPASS Database for calculating, monitoring, trending and alarming of the machines' performance.
3. COMPASS measurement data can be transferred to the DCS via the local area network (LAN).
4. Critical data such as alarms, relay positions, and overall vibration measurements can be transferred directly from the local Vibration Monitors (VM) to the DCS via MODBUS.
5. With browser technology, COMPASS can be fully operated from any terminal on the plant's technical or administrative network using almost any operating system. The specialist can sit anywhere in the world and connect via modem, ISDN or the Internet.
6. The 2526 Data collector can be downloaded and unloaded remotely over the network.
7. For offshore installation, the COMPASS system is connected via satellite, or in some cases, via direct cables. The latter solution allows the Central Vibration Monitor with database to be placed onshore, providing better IT support.