

Measurements

Stork Optimization Services can perform various sorts of measurements on your installation; a summary of the commonest measurements is given below:

Vibration measurements:

Stork Optimization Services has two systems to perform vibration measurements: CSI portable spectrum analysers or the multi-channel real-time analysers of Bently Nevada.

Stork Optimization Services is able to carry out the measurements below at short notice anywhere in the world in order to demonstrate the dynamic behaviour of your installation.

Portable Spectrum analyser

This data collector performs and records vibration measurements on various sorts of rotating equipment. The measurements can be sub-divided into 3 categories on the basis of the customer's wishes, viz.:

- *Zero measurements:* a one-time only measurement is performed shortly after an overhaul or new construction.
- *Trend measurements:* These measurements are performed periodically, in which slight rises can be noticed at an early stage.
- *Troubleshooting:* These measurements are performed in the event of deviating behaviour of the installation in order to identify the cause within a short time.

Considering the short time needed to prepare this equipment, we are adequately able to perform vibration measurements at our clients' premises. This spectrum analyser can detect the errors/ defects below:

- Gear damage
- Bearing defects, sub-divided into: inner ring damage, outer ring damage, roller elements damage, cage fractures
- Alignment errors
- Looseness and play
- Imbalance (including on-site balancing)
- Resonance areas (using impact test)

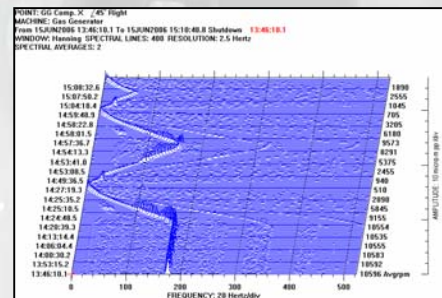
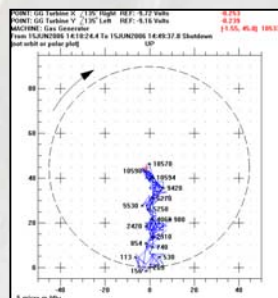
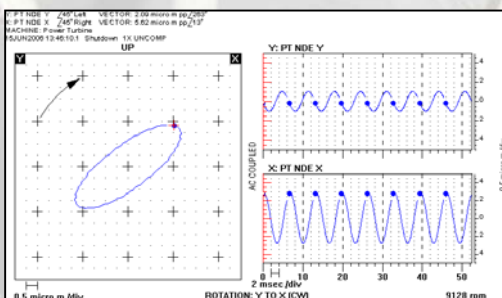
A possible cause determined during the measurements is discussed with the client, and Stork Gears & Services may take direct action. Any further analysis needed can be carried out at short notice and recorded in a report.



Multi-channel real-time analyser

The multi-channel real time analyser is used to determine the dynamic behaviour of your turbo machinery simultaneously with several housing vibration, axle displacement recorders and key phasers.

Several of the data presentation techniques, which can be used to give a correct analysis, are showed below:



Torque measurements:

Stork Optimization Services performs torque measurements on location using stretch strips. This is usually done on gearboxes and screw axles. We can perform measurements continually using our advanced RMC-sensor telemetric system.

This system can send current static and dynamic (torsion vibration) torque of the stretch strip on the axle via an amplifier to the RMC-unit. The volt signal can be converted proportionally to the elasticity to a torque value. The measured values are recorded in a data logger. The measured values are not influenced by bending or temperature changes due to the 'full bridge' stretch strip application.

The RMC unit can be used to measure several parameters:

- Torque (static and dynamic)
- Power
- Pressure
- Temperature
- Acceleration

Advantages of the RMC-unit:

- Short set-up time
- No more solder resistance needed on amplifier unit
- Freely adjustable measurement range and zero setting measurements
- High resolution of measurement signals due to variable measurement range
- Integrated rpm recorder



Infrared measurements:

Stork Optimization Services performs thermographic infrared measurements on location on both mechanical and electrical equipment. The Raytek ThermoView™ Ti30 of Stork Optimization Services measures temperatures between 0 and 250° C (32 to 482° F) of metals and non-metals.

Uses of Infrared Thermography

Stork Optimization Services usually uses this technique to determine the critical parts, such as bearings, in gearboxes. However, the thermographic infrared camera is also used in:

- Detection of blockage in pipelines, e.g. air fan banks
- Condition monitoring of rotating equipment
- Inspection of electrical installations such as switch rooms and transformers
- Detection of leaks of gases and liquids

The thermographic infrared camera can localise 'hotspots'. The photos made by the camera can be filed in a database. The advantage is that the camera can be used for 'troubleshooting' and periodic measurements. The trends in installations can be followed and beginning problems can be noticed at an early stage. This can save you expenses.

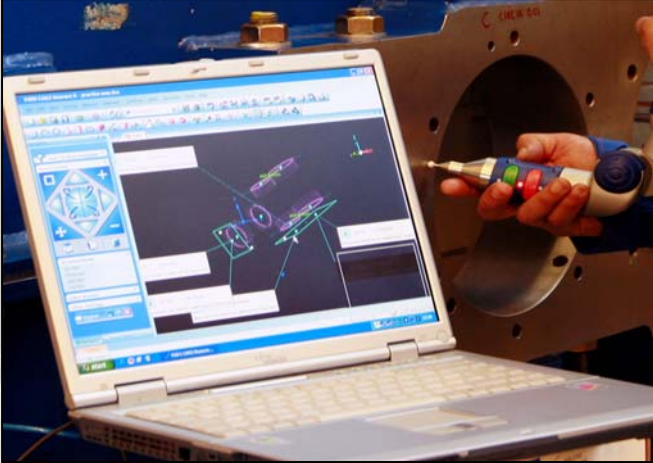
Technical specifications:

- | | |
|---------------------|----------------------------|
| • Temperature range | 0 to 250° C (32 to 482° F) |
| • Accuracy | ± 2% |
| • Laser | class 2 |
| • Storage capacity | 100 photos |



Geometric measurements:

For geometric measurements Stork Optimization Services has a Faro measurement arm. This measures on-site installations with great accuracy. These can be measurements for the determination of the geometry or the reverse engineering of parts. The measured values are directly imported into a 3D-CAD programme. Our own engineering department analyses the 'measured drawing' for you.



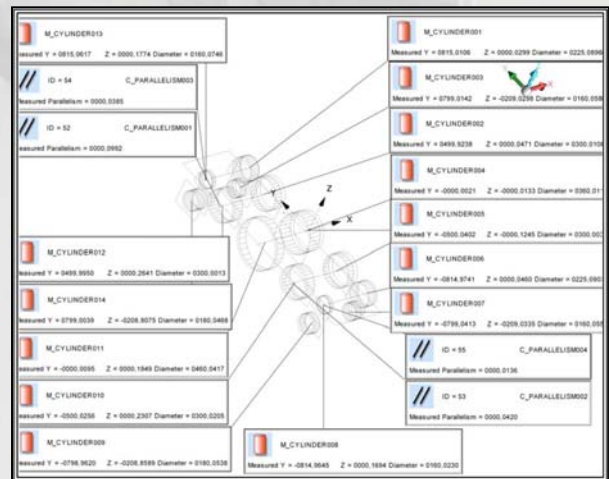
Uses

- Alignment of gearboxes, turbines, engines, Bogies, etc.
- Reverse engineering of various parts, such as turbine blades, ships propellers, rotation shafts, etc.

The possibilities of this Faro measurement arm are countless. You are free to contact us if you have any queries about the uses of this measurement arm on your installation.

Data Faro measurement arm

| | |
|-----------------------|----------------------------------|
| Accuracy: | +/- 0,025 mm |
| Operating temperature | 10 tot 40 °C |
| Certification | CE Conform |
| Standard | EN 50081-1 : 1991 Class B |
| Standard | EN 50082-1 : 1991 (ESD, RI, EFT) |



Visual inspections:

Stork Optimization Services recently invested in an advanced new videoscope system: the Everest XLG3 VideoProbe. This portable visual inspection tool speeds up gearbox inspections significantly. The downtime is minimised and the gearbox system is quickly up and running again. The Everest XLG3 VideoProbe system is especially built to inspect difficult to reach environments such as the epicyclical part of a wind-turbine gearbox.

Wind-turbine gearbox inspections are technically demanding and physically challenging. The Everest XLG3 VideoProbe is a complete, portable workstation for onsite wind-turbine inspections. A high-output illumination probe sheds light into the darkest and smallest corners of the gearbox system, delivering sharp and clear images. Our highly skilled diagnostic engineers will analyse these images with high accuracy and are able to identify possible defects with high precision.

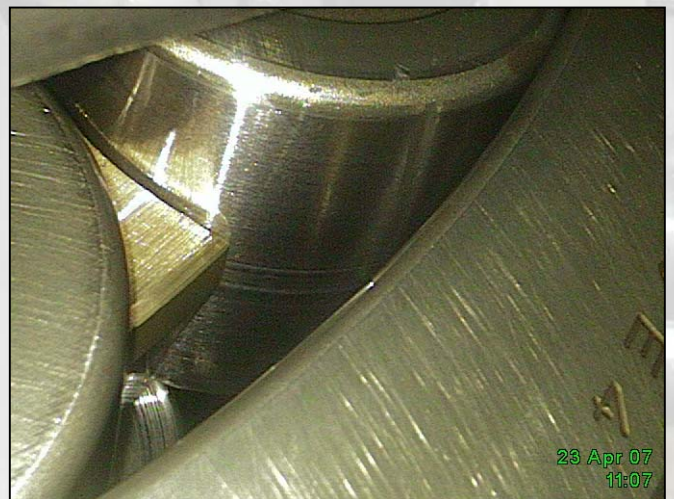


Advantages of the Everest XLG3 Videoscope:

- A complete, portable workstation for onsite visual inspections.
 - Inspection time of the gearbox is minimised.
 - Provides high quality images for accurate diagnosis.
 - The high-output light source illuminates the darkest corners.
 - The XLG3 is able to navigate to difficult to reach environments such as the epicyclical part of a wind-turbine gearbox.
 - Visual inspections are often combined with oil analysis and vibration measurements in order to obtain a complete overview of the condition of the gearbox.
- Our highly skilled engineers have an extensive knowledge of wind-turbine gearboxes, like for example Jahnel & Kestermann, Flender Winergy, Hansen and Valmet gearboxes.

The Everest XLG3 VideoProbe is suitable for:

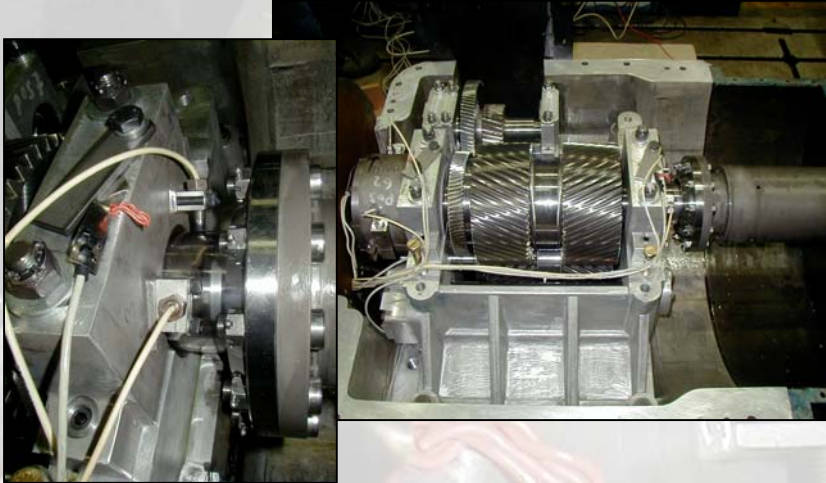
- Gearbox troubleshooting.
- End of Warranty- inspections.
- Time-based preventive maintenance.



Online monitoring

Stork Optimization Services' latest development is to expand its activities to include a system whereby industrial installations can be monitored 24/7 'on-line', anywhere in the world.

This On-line Monitoring System consists of several sensors, which are attached to various sorts of rotating equipment to measure various parameters. The data is sent to a central control box via one or more intermediate stations called 'Multiplexers'. The control box processes data and sends it via the Internet to our home base in Rotterdam.



The measured data is stored in the PC. This data is compared with earlier analysed data for a trend analysis. The On-line Monitoring System works with alert levels. It monitors the gearbox 24 hours a day and warns the home base with an e-mail or SMS if an alert level is exceeded. Our diagnosis specialist will take direct action.

The diagnosis specialist makes contact with the local measurement system to analyse the stored parameters and to determine the cause of the alert from the home base. More detailed measurements are also performed at local level from the home base.

The Online Monitoring System scans the sensors regularly for data processing. This can vary from streaming every two minutes to once a day. The above measurements can also be used for trend analysis, in which gradual increase in for example vibration levels can indicate increasing wear of bearings and/or gears. This sort of wear can therefore be noticed at an early stage, so that maintenance can be easily planned, depending on the situation.

The communication of the Online Monitoring System proceeds via a satellite connection, a fixed telephone line or GSM network. It is simultaneously possible to use a router to connect various PCs on location via a LAN ether network. It will be obvious that this system has no exceptions regarding placement locations.

Alert levels are set at a warning alert and a shut-down alert, depending on rpm and power. An SMS or e-mail is sent immediately in the event of a warning alert. The installation can also be immediately shut down in the event of a shut-down alert, in addition to this dispatch being sent.

The parameters that are determined with the Online Monitoring System are given below:

- vibrations
- axle displacements
- temperature
- pressure
- oil level
- rpm
- power
- noise
- torsion

The Online Monitoring System is powerful:

- Works fully stand-alone
- Warns if alert values are exceeded
- Can be used in places that are difficult to reach
- Online monitoring of your equipment 24 hours a day, 7 days a week.
- Alert values are set depending on input rpm and power
- Analysis options from the home base
- Early warnings ensure cost saving, less subsequent damage and planned maintenance
- Data can be stored periodically in a database
- Measurement settings can be changed from the home base



Equipment Management System

Stork Optimization Services has developed an Internet application for the management of your installation, e.g. your gearboxes and/or electrical motors. You can access this application anywhere via Internet. The information that the application gives you about your installation contains the following:

**UW INSPECTIERAPPORTAGES
ALTIJD ONLINE BEREIKBAAR**

**EEN ACTUEEL OVERZICHT VAN UW
EQUIPMENT, 24 UUR PER DAG ONLINE**

- Technical state of your installation
- List of maintenance activities
- Technical specifications of your installation
- Inspection reports
- Machine drawings

The great advantage of this system is that it transforms your maintenance system from a preventive or corrective maintenance system into a situation-dependent maintenance system. You take action when a registration is made that this is really necessary. This means no unnecessary stoppage or early replacement of oil or parts. Your installation is more reliable and you can see when which maintenance has to be done. This increases the continuity of your installation. You will need to make fewer unplanned stops, so that the maintenance system is more attractive from an insurance and technical viewpoint. You have all the information about your installation neatly documented and available everywhere at all times. Contact us for more information.

**UW EQUIPMENT SPECIFICATIES
ONLINE RAADPLEGEN**

**ONLINE BEHEER VAN UW EQUIPMENT
VIA UW EIGEN PLATTEGRONDEN**