Machine Sentry®
Condition Monitoring Made Simple

- **Flexible condition monitoring system** with vibration analysis, process parameters, visual inspection, thermography and oil analysis capabilities

- **Turn any Android tablet or Smartphone** into a powerful condition monitoring data collector

- **Automatic fault diagnostic assistant** advises on common vibration problems (similar level to a Category II vibration analyst)

- **Bluetooth® 3-axis vibration and temperature sensor**

- **Available with ATEX and IECEx certification**

- **Additional support** for Category II, III and IV available from our expert condition monitoring analysts

Next Generation Condition Monitoring

We all want to get better performance from our business, and to improve performance requires good analytics.

A condition monitoring program is key to improving the performance and availability of your plant and machinery. Very often, companies are put off by the high cost and skill levels required to implement a program successfully.

Machine Sentry® is a revolutionary new approach to condition monitoring that offers a cost effective solution coupled with high level analysis support which is available to you irrespective of the size or location of your company.

Machine Sentry® is simple to use, low cost and efficient. It includes an automatic fault diagnosis assistant that can be used to help identify failure modes within rotating equipment.

Machine Sentry® unique inbuilt capabilities combined with the power and accessibility of the Internet enables efficient data acquisition to be realised by experts or inexperienced users.

AVT Reliability® can provide a full condition based maintenance service, or you can "do it yourself".

CM Competency Levels as defined by ISO 17359 and ISO 18436-2				
	Data Collection			
	Category I	Category II	Category III	Category IV
Vibration Analysis				
Experience & Training	Qualified to ISO 18436-2 >6 months practical experience	Qualified to ISO 18436-2 >3 years practical experience	Qualified to ISO 18436-2 >5 years practical experience	Qualified to ISO 18436-2 >10 years practical experience
Data Collection	Accurate repeatable data collection with single channel equipment (including tri-axial sensors)	Ability to use multi-channel devices	Multi-channel and online systems capability	As III & subject matter expert
Data Analysis	Able to identify bad readings and determine common faults	Able to detect majority of failure modes including early stage bearing defects	As II, including high-speed turbomachinery diagnostics, run-up & run-down diagnostics	As III & subject matter expert
Program design inc. building databases	N/A	Able to set-up standard CM routes using templates and ISO standard alarms	Able to analyse historical data and set-up alarm levels based on statistical information	As III & subject matter expert
Statistical alarm review and setting	N/A	N/A	Able to analyse historical data and set-up alarm levels based on statistical information	As III & subject matter expert Manages FMECA program to link failure mode with criticality
Thermography	IR Cat I Qualified IRT Standards Able to use a range of cameras and understand how to take good readings >6 months practical experience	IR Cat II Qualified IRT Standards >3 years practical experience	IR Cat II Qualified IRT Standards >5 years practical experience	IR Cat II Qualified IRT Standards >10 years practical experience
Oil Analysis	ICML MLA Level I Able to collect good samples and action data provided by an oil lab >6 months practical experience	ICML MLA Level I As CAT I plus able to establish lube-sample points / routes >3 years practical experience	ICML MLA Level II Advanced analysis capabilities including interpretation of lab results >5 years experience	Subject matter expert >10 years experience

" AVT Reliability provide Condition Monitoring services for many blue chip clients, on hundreds of sites. "

Machine Sentry®

Machine Sentry® is a unique Condition Based Maintenance (CBM) solution which integrates all condition monitoring techniques and watchkeeping data, enabling effective maintenance planning and management reporting.

Machine Sentry's vibration analysis hardware and software is compatible with standard or ATEX certified tablets and smartphones. As a web enabled system; Machine Sentry® is the most versatile, readily accessible, intuitive and cost-effective condition monitoring solution on the market today.

System Includes:

- **Modular Cloud Based Machine Sentry® Software** – Features include: action tracking, watch-keeping, process measurements, thermal imaging integration, inspections, lubrication management, intuitive dashboard and reporting
- **Vibration Analysis** – With intelligent tri-axial vibration measurement capability and temperature sensor (patent pending) plus a choice of hand held devices such as tablets or smartphones
- **Fault Diagnosis Assistant** – Automatically diagnoses potential problems and suggests verification procedures to confirm
- **Oil Analysis** – Laboratory oil analysis data is automatically* mapped and integrated into the Machine Sentry® database for easy access by all users enabling better trending and analysis
- **Key Performance Indicators (KPIs)** – To systematically measure the effectiveness of the condition based monitoring program from Schedule Compliance to Asset Health & Bad Actor Management.
- **Lubrication Management** - Plan, track and manage lubrication activities and usage.

Features

- Cost effective condition monitoring whilst suiting the needs of both expert and novice user
- IP67 rated and certified for use in hazardous areas (Zone 1 and Zone 2 certifications available)
- Up to 5 times faster than other condition monitoring systems Machine Sentry® integrates all condition monitoring techniques and watchkeeping data, enabling effective maintenance planning and management reporting
- Machine Sentry® can be used either as a stand alone tool or alongside your existing enterprise system (e.g. SAP, Maximo, PEMAC, etc)
- Access to world leading condition monitoring engineers – providing detailed diagnosis and advice
- Easily configurable and scalable solution for future expansion
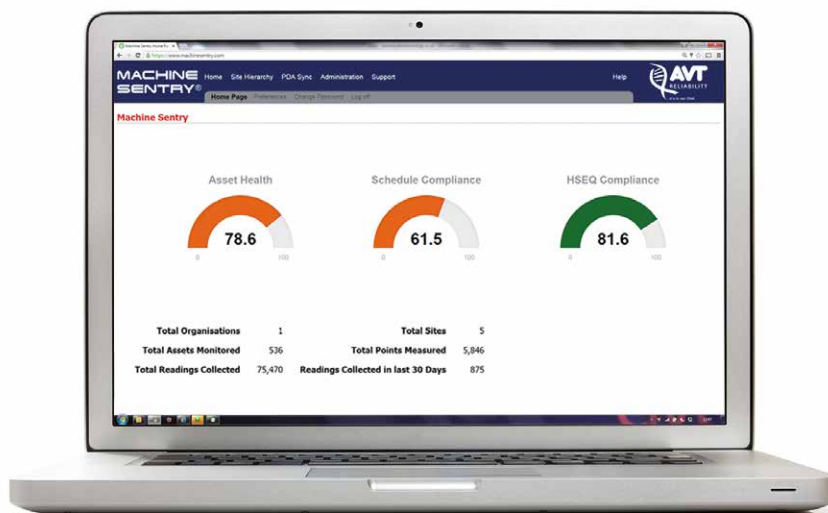
Machine Sentry® web platform provides access to detailed condition monitoring data, with no historical restriction, which can be supported by world leading condition monitoring engineers.

Secure access to the software is available from anywhere in the world via a standard web browser. In addition, the mobile software operates on industry standard Android™ tablets, smartphone or other compatible devices including ATEX certified tablets and smartphones.

Machine Sentry® can integrate and report on the following types of data:

- Vibration data using our patent pending Bluetooth® sensor with tri-axis capability
- Thermal images and temperatures
- Process parameters such as pressures and flow rates
- Visual maintenance inspection
- Lubrication usage
- Lubrication analysis results

And provide

- Visual indication of machine status
- Action tracking and follow up
- Data review and analysis
- KPIs and summary dashboards
- Management reports

" Turn any Android tablet or Windows PDA into a powerful condition monitoring data collector. "
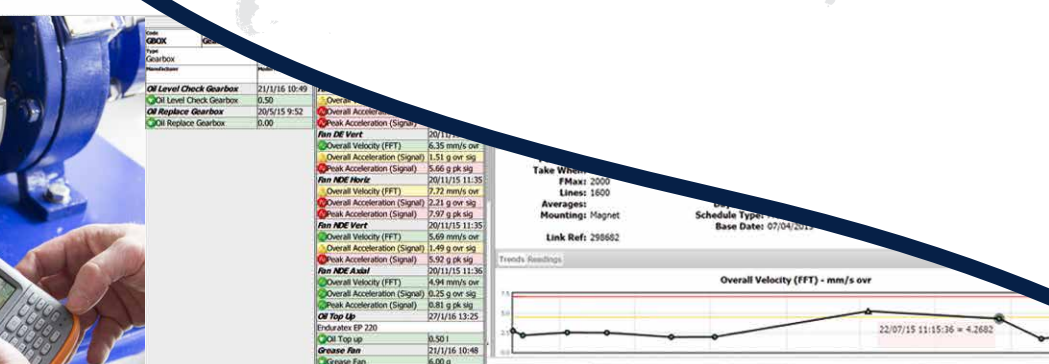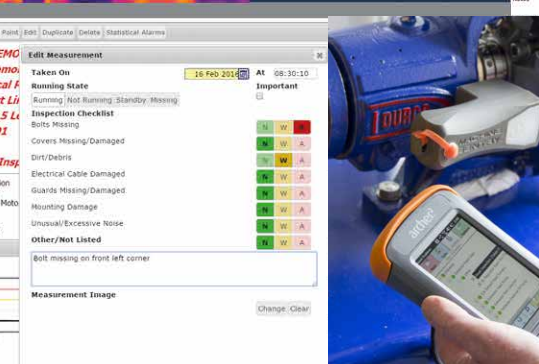
Vibration Analysis

The Machine Sentry® mobile sensor is a wireless intelligent tri-axial vibration and temperature sensor (patent pending) which connects via a Bluetooth® enabled hand held device to the Machine Sentry® software.

The sensor incorporates a quad channel multiplexed data acquisition system which utilizes 3 internal accelerometers to give full 3-axis support. An additional sensor can be connected to the 4th channel allowing simultaneous 4 channel data collection.

> ## Machine Sentry® is the CBM and Reliability tool of choice for many international blue-chip organizations.

The Machine Sentry® mobile sensor can be paired to any Android tablet or smartphone using standard Bluetooth® communications. This provides safe and efficient data collection from up to 10m away. Assets which would normally be difficult to monitor using a traditional wired accelerometer can now be measured with ease (e.g. collection points behind guards, or large, moving assets such as gearboxes on agitators).

The integral rechargeable battery offers 60 hours of continual operation between recharges allowing a full week's data collection between charges.

The sensor is available with ATEX or IECEx certification for use in Zone 1 or Zone 2 classified areas. The sensor has an inbuilt magnet which allows correct and repeatable orientation when performing multi-axis data collection.
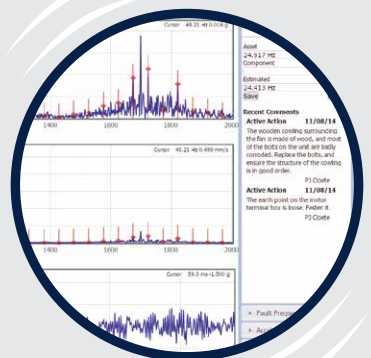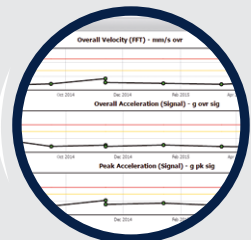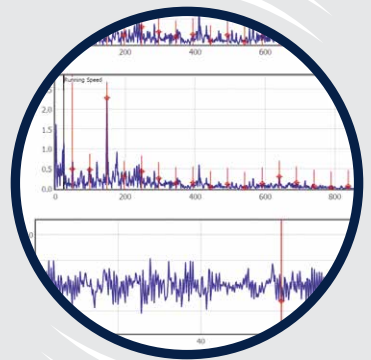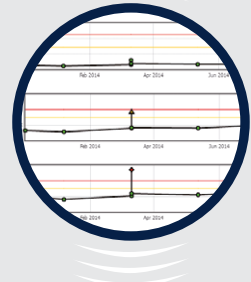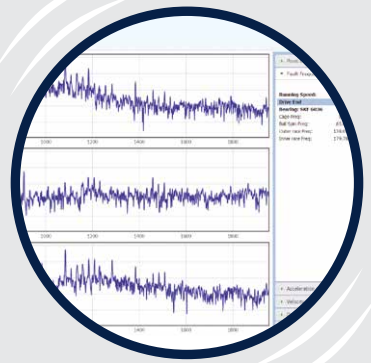
Fault Diagnosis Assistant

Machine Sentry® contains an integrated automatic fault diagnostic assistant which offers advice on many common vibration problems that would normally require the skill set of a category II vibration analyst.

Faults diagnosed include:

- Imbalance
- Bent shaft
- Resonance
- Parallel, angular, or complex misalignment
- Cocked bearing
- Structural, or rotating looseness
- Blade or vane pass issues

- Soft foot
- Cavitation
- Lack of lubrication
- Gear misalignment
- Gear backlash / eccentricity
- Gear broken tooth
- Gear tooth wear
- Bearing stage 2, 3, or 4

The fault diagnosis assistant compares and evaluates multiple vibration measurements taken on an asset in a similar time window to better evaluate the presence of different failure modes.

As well as helping the user diagnose faults which are present in the asset, the assistant also suggests verification steps which should be carried out to confirm diagnosis.

Next Steps

Unbalance

Verification

- High 1x component at running speed (rpm) of unbalanced component.
- If this is the 1st set of data then confirm resonance is not the cause.
- If this high 1x has been progressive or just appeared then carry out course of action.
- The 1x component will normally be higher in the radial direction and lower in the axial direction.
- The velocity time waveform should be very sinusoidal.
- Phase will shift 90º between the vertical and horizontal directions (If a pure static unbalance is the problem, then the phase measured across the bearings at either end of the rotating shaft will be relatively in-phase when measured in the same plane)

Course of Action

- Inspect rotating component for debris or damage.
- Clean and balance the rotating component (this could be static, couple or dynamic)

Point Info

Fault Frequencies

Acceleration Harmonics

Velocity Harmonics

Displacement Harmonics

▼ Fault Assistant

Possible faults (Non Drive End)
The following faults listed below are indicated by the measurements taken at this location. This is only to be used as an aid for a trained analyst.

Imbalance	150
Soft Foot	70
Resonance	50
Structural Looseness	50

Some faults could not be checked for due to insufficient component configuration:

Bearings not specified

Analyst Support

Need extra assistance?

For customers who do not employ experienced condition monitoring engineers, AVT Reliability provide access to a large pool of multilingual condition monitoring experts. The experts at our reliability data centre (RDC) can review clients data from anywhere in the world and deliver practical guidance that will improve plant reliability, giving further peace of mind to the decision making of a critical asset.

Wear		06/01/16 Y129464	23/12/15 Y131210	19/10/15 Y127706	27/08/15 Y122943
Silver	mg/kg	0	0	0	0
Aluminium	mg/kg	0	1	1	1
Chromium	mg/kg	0	0	0	0
Copper	mg/kg	0	7	1	0
Iron	mg/kg	2	4	2	2
Manganese	mg/kg	0	0	0	0
Molybdenum	mg/kg	0	0	0	0
Nickel	mg/kg	1	0	0	0
Lead	mg/kg	0	0	0	0
Tin	mg/kg	0	4	0	0
Titanium	mg/kg	0	0	0	0
Vanadium	mg/kg	0	0	0	0

Additives		06/01/16 Y129464	23/12/15 Y131210	19/10/15 Y127706	27/08/15 Y122943
Nitration (FT-IR)	A/cm	6	8.5	7	6
Oxydation (FT-IR)	A/cm	14	15	14	14
Phosphorus	mg/kg	1242	1304	1124	1118
Zinc	mg/kg	1352	1528	1244	1229

Contamination		06/01/16 Y129464	23/12/15 Y131210	19/10/15 Y127706	27/08/15 Y122943
Insolubles	%	0.1	0.2	0.1	0.1
Sodium	mg/kg	8	0	9	0
Silicon	mg/kg	5	4	2	2

Fluid Condition		06/01/16 Y129464	23/12/15 Y131210	19/10/15 Y127706	27/08/15 Y122943
Flash Point	°C	168	162	148	160
Water Content	ppm	0	0	0	0
Kinematic Viscosity at 40°C	mm²/s	95.4	92.6	80.2	83.2
Kinematic Viscosity at 100°C	mm²/s	13.5	13.2	12.06	12.32
PQ Index		3	19	4	8
Total Base Number	KOH/g	10.1	9	11.7	9.7
Viscosity Index		143	143	147	146

Oil Analysis

Oil analysis is performed routinely as part of a condition based maintenance strategy to provide powerful information on lubricant and therefore machine condition.

Trending oil analysis sample results over the life of a machine, can help extend Mean Time Before Failure (MTBF) and eliminate costly breakdowns.

Laboratory oil analysis data is imported automatically creating a record with all data necessary for the analysts to provide a recommendation to the maintenance team.

AVT's analysts have qualifications from the International Council for Machinery Lubrication (ICML) and are certified in compliance with ISO standards.

Training Services

AVT Reliability offer a range of accredited and internationally recognized training courses in Vibration, Lubrication and Pipework Vibration analysis.

The result is a recognized qualification and invaluable contribution towards CPD (Continued Professional Development). All our trainers are highly qualified, certified and have many years of practical experience in the application of condition monitoring technologies. Courses are delivered to international standards – ISO 18436, BINDT PCN, ICML and Energy Institute.
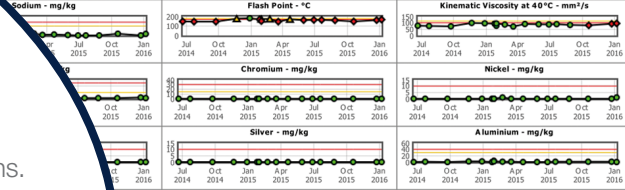
AVT Reliability are an approved training organization*

Asset
Crude Booster pump A

Site	
Area	06 - Oil Export
Manufacturer	Model	Serial No
Point Name	Oil Sample
Component Manufacturer	Component Model No 6 x 8 x 10.5 MSD-3 Stage	Component Serial No
Lubricant	Oil

| Sample No | Y129469 | Sample Taken | 06/01/2016 00:00:00 |
| Processed Date | 08/01/2016 12:00:00 | Received Date | 06/01/2016 12:00:00 |

...y is raised. Note the high level of copper and lead. Recommend change the oil and check the bearings for wear.

		06/01/16 Y129469	30/10/15 Y127666	17/12/14 Y109299	31/10/14 Y105819
	mg/kg	0	0		
	mg/kg	0	0		
	mg/kg	0			
	mg/kg	92	97		
	mg/kg	1	1		
...nese	mg/kg	0	0		
...denum	mg/kg	0	0		
	mg/kg	1	2		
	mg/kg	13	11		
...anium	mg/kg	2	0		
	mg/kg	0	0		

Additives		06/01/16 Y129469	30/10/15 Y127666	17/12/14 Y109299	
Phosphorus	mg/kg	331	300		
Zinc	mg/kg	291	272		

Contamination		06/01/16 Y129469	30/10/15 Y127666	17/12/14 Y109299	31/10/14 Y105819
...odium	mg/kg	2	15		
...ilicon	mg/kg	7	6		

Fluid Condition		06/01/16 Y129469	30/10/15 Y127666	17/12/14 Y109299	
Kinematic Viscosity at 40°C	mm²/s	36.95	36.36	32.7	
Kinematic Viscosity at 100°C	mm²/s	5.93	5.98		
PQ Index		2	5	4	
Total Acid Number	KOH/mg	0.41	0.44	0.64	
Viscosity Index		103	108		

Asset Details
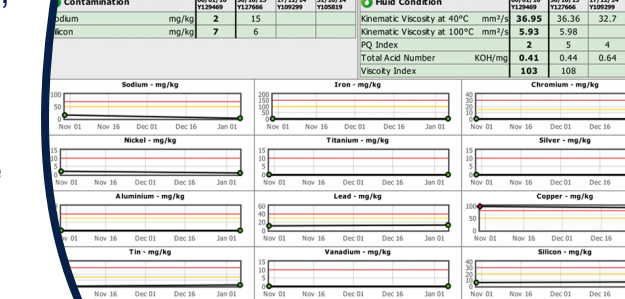
Asset Code	Asset
AVT-DEMO/FOOD/SEP/2/2	**Decanter Hydraulic Pump**

...tion	Site	Food Industry
...monstration	Area	Decanter & Dredge
Manufacturer	Model 41762	Serial No
	MCC Location	
	Power 0 kW	

Name Hydraulics		Code 09-Other	Name Inspection	
	Serial No	Type Other	Serial No	
	Model No	Manufacturer	Model No	
...0:22		Visual Inspection		17/2/16
		● Bolts Missing		
		● Damaged/Worn		

> " The most versatile and cost-effective condition monitoring and maintenance system solution on the global market. "

Specification

Tri-axial Vibration and Temperature Sensor	
Measurements	
Vibration	1Hz to 4kHz Overall velocity, -8 to 8g Amplitude Range. Maximum samples 131072. Maximum lines of resolution 51200. Sampling Frequency 10 to 20k samples per second
Temperature	-40 to 115ºC Accuracy +/-0.5ºC (0-60ºC), +/-1.5ºC (-40-115ºC)
Resolution	51,200 lines
Aux Input	ICP powered or unpowered 0 to +/- 18v
Outputs	Wireless Bluetooth® connection to Laptop / Mobile device connected to Machine Sentry® software via Windows mobile < 6.5.3 or Android v 5.0.1+
Wireless Range	~10m
Battery Type	Li-Ion 3.7v 2000mAh
Battery Life	60 Hours (continuous operation) @ 25ºC (taking readings every 15s)
Battery Recharge Time	~20hrs
Power	6v (For battery recharge only)
Environmental	
Ambient Temperature Range	-10ºC to 40ºC operating, -20ºC to 70ºC Storage
Sealing	IP67
Weight	450g
Dimensions	65mm (h) x 43mm (w) x 118mm (l)
Approvals	CE
	ATEX Certification II 2G Ex ib IIB T4 Gb Baseefa 17ATEX0066x and II 3G Ex ic IIC T4 Gc Baseefa 17ATEX0067x (certified to EN 60079-0: 2012 + A11: 2013 & EN60079-11: 2012)
	IECEx Ex ib IIB T4 Gb, Ex ic IIC T4 Gc, IECEx BAS 17.0052x (certified to IEC 60079-0:2011 Ed. 6, & IEC 60079-11:2011 Ed. 6)

AVT RELIABILITY

1975
AV Technology Ltd formed by Dr. Robin Monk, one of the first Vibration Analysis experts

2001
AVT acquired by Shell Oil

2013
AVT acquired by AESSEAL®

1976
AVT Ltd formed

2005
AVT acquired by IONIX

2015
AVT Reliability Ltd formed

AVT Reliability now has more than 100 fully employed and certified professional CBM engineers at locations in the UK and mainland Europe.

The comprehensive AVT Reliability program covers Asset Integrity, Performance Monitoring, Training, Maintenance Consultancy and Total Pump Management / Products to Manufacturers.

AVT Reliability are certified to ISO 17359 and ISO 9001. Accredited by UKAS as a Machine Directive Notified body, and are ICML and BINDT members.

COMM-CO
Communication today and tomorrow