GASTOPS

Making Machinery More Effective

GEARBOX PROBLEMS WITH YOUR WIND TURBINE?

MetalSCAN

MS3000

RELIABLE
COST EFFECTIVE
CONDITION MONITORING
FOR GEARBOXES

windpower
renewable solutions

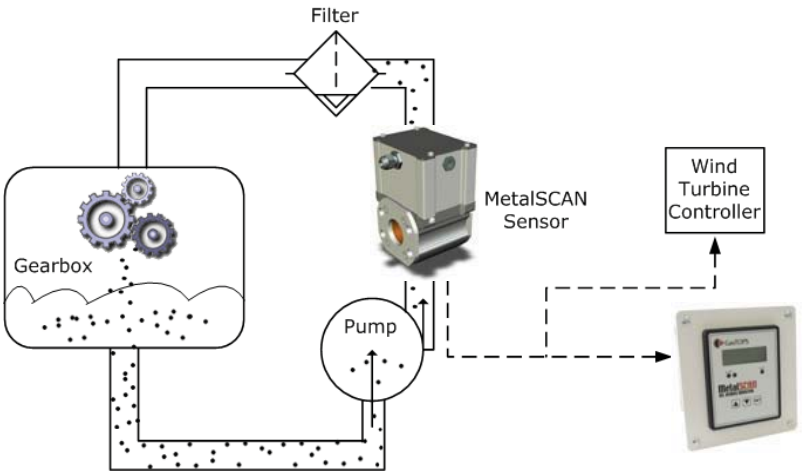
Gearbox condition monitoring is a recognized requirement for geared wind turbines.

Based upon the proven MetalSCAN technology, GasTOPS has introduced a MetalSCAN sensor designed specifically for the wind turbine gearbox application that:

- provides reliable damage indication (no false alarms & no missed indicators)
- is easy to install
- is easy to interpret data
- is low cost

WHAT IS METALSCAN?

MetalSCAN is a full flow in-line sensor that identifies and quantifies component damage by detecting the presence of damage particles as they pass through the lubrication system.



WHAT IS IT?

MetalSCAN is **NOT** an oil condition sensor.

A class of products referred to as “particle counters” are available on the market which indicate the cleanliness of the oil by measuring the transmissibility of light through the oil. Monitoring the condition of the oil using “particle counters” can be valuable for triggering oil changes, however cleanliness cannot be readily correlated to component damage, particularly in the early stages of damage.

- MetalSCAN monitors **COMPONENT DAMAGE** by detecting metallic particles produced from surface fatigue damage from bearings and gears, which are characteristically LARGER than 200 microns

- Other technologies known as "particle counters" monitor oil cleanliness that is affected by large distributions of contamination, very fine, particles much smaller than 200 microns (typically below 15 microns)

IS METALSCAN A NEW TECHNOLOGY?

MetalSCAN has been in the marketplace for over 10 years for the following applications:

Industrial Gas Turbines

More than 300 gas turbines fitted with MetalSCAN are in operation worldwide. MetalSCAN has proven time and again to save engine operators hundreds of thousands, and often millions of dollars in reduced repair and maintenance costs.

LM2500 Gas Turbine

Aerospace

MetalSCAN is fitted to the engines of the most advanced aircraft in the world.

F22 engines

Sikorsky S61 engines and transmission

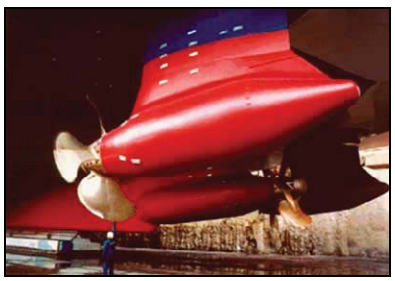
Eurofighter

Pilatus PC12

F35 engines and Liftfan

Marine

MetalSCAN has become standard equipment on large cruise ship propulsion pods (Azimuthing pods) and on naval vessel propulsion engines.



Propulsion Pods

Aegis Destroyer engines

MetalSCAN is a **MATURE** technology, well proven in the most demanding and harshest environments.

ARE THERE ANY WIND TURBINE APPLICATIONS?

MetalSCAN is proven in the wind turbine industry. After several years of testing it has been demonstrated on the following wind turbines and wind turbine test cells:

NREL (DoE)	-	Test cells for wind turbine gearboxes (Cincinnati, GE Transportation Systems, Flender, Clipper, Eickhoff…)
Vestas	-	V47
	-	V44
	-	V80
GE Wind	-	1.5MW
	-	2.5MW
	-	3.2MW
	-	3.6MW
Nordex	-	N43
Acciona	-	AW-1500
	-	AW-3000
AAER	-	A-1500
Clipper	-	Liberty 2.5MW
Gamesa	-	G47
	-	G80
REpower	-	MM70
	-	MM82
	-	MM90
	-	5M
	-	6M
NEG Micon	-	NM750
	-	NM900
Suzlon	-	S64
	-	S88
WinWinD	-	WWD-1
	-	WWD-3
Siemens (Bonus)	-	600kW
	-	850 kW
	-	3.6MW

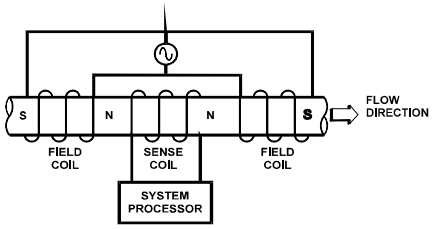
…and the list is growing daily.

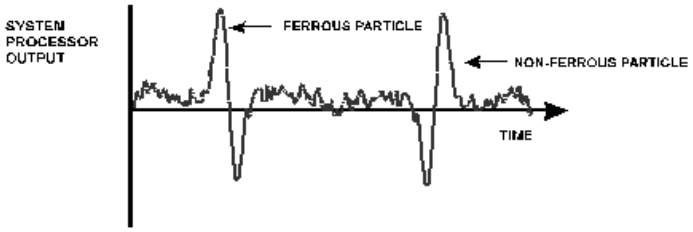
MetalSCAN has also been officially endorsed by the turbine manufacturer REpower.

HOW DOES METALSCAN WORK?

Principle

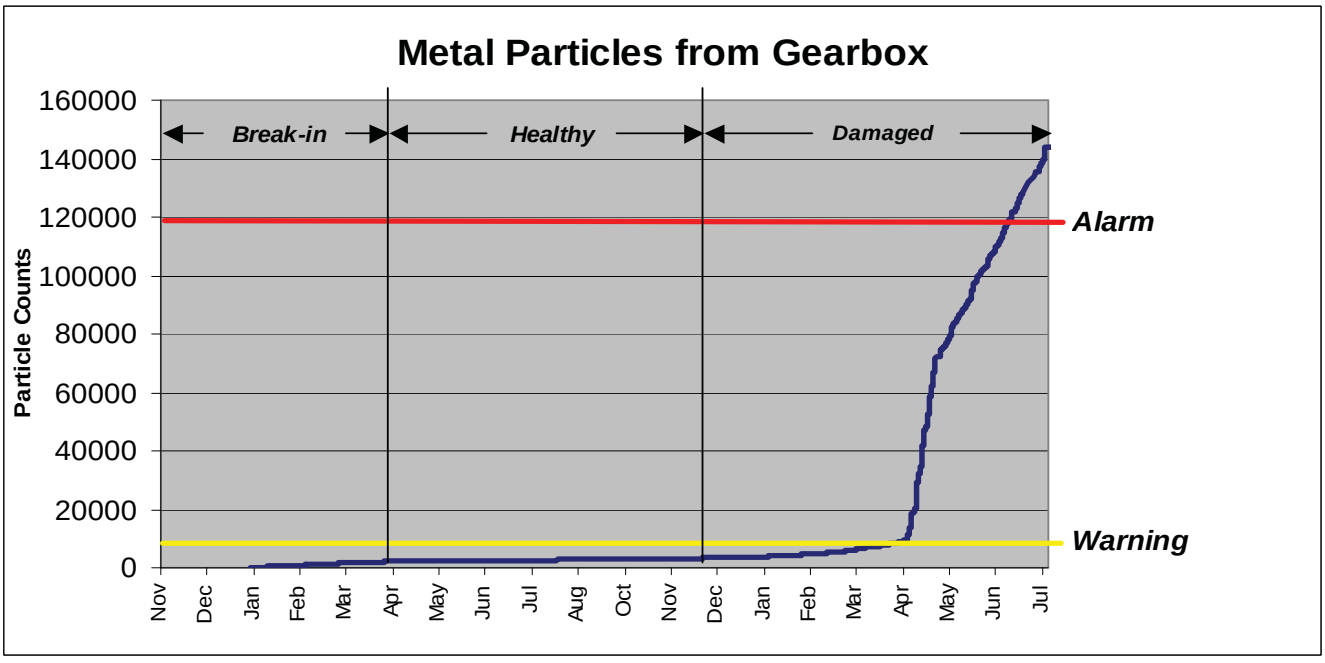
The MetalSCAN MS3000 sensor is designed to be installed in-line in the gearbox lubrication system, before or after the pump but before the filter. Oil flows through the sensor without restriction. A balanced alternating magnetic field in the sensor is disturbed by the passage of metallic particles, either ferrous or non-ferrous. A sense coil measures the disturbance and generates an output signal for each particle detected.





Gearbox Failure Characteristics

Damage to gears and bearings are generally a result of surface fatigue, which produces increasing quantities of metallic particles as the damage progresses. Even at the initiation of the damage large particles (>200 microns in size) are produced. On one wind turbine gearbox damage event, MetalSCAN detected 150,000 particles over a period of 8 months before the damage was sufficient to warrant gearbox removal. In the later stages of the damage progression, about 1500 particles were detected each day!



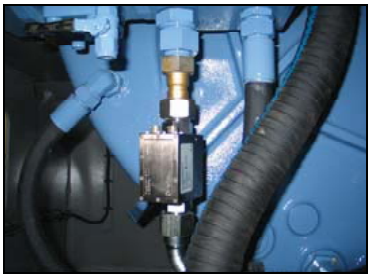
Note: 3 months after the warning limit was crossed, off-line vibration still did not indicate any damage.

How is METALSCAN installed?

The sensor is installed in-line in the lubrication system between the pump and the filter.

Vestas

GE Wind



REpower

The sensor outputs a 24V pulse for every particle detected. There are several ways to integrate this information:

- Interface to existing wind turbine, or controller
- Interface to a third party SCADA
- Interface to stand-alone MetalSCAN Alarm Module (locally or remotely)
- Interface to fully independent remote accessible GPRS
- Use GasTOPS monitoring service

WHY SHOULD I INSTALL METALSCAN?

For Retrofit:

On older wind turbines, the cost of complex vibration based condition monitoring and expert analysis is very high and establishing reliable operating limits (to ensure early warning without false alarms) is very challenging.

In comparison, MetalSCAN is low cost and easy to install including simple reliable alarm limits that can be readily interpreted by maintainers (no experts required or lengthy training) providing the earliest detection of damage possible.

New Wind Turbines:

Many new generation wind turbines are equipped from the factory with vibration-based condition monitoring systems. These systems have not proven to be effective at reliable detection of early gearbox damage, particularly without false alarms and universally require expensive expert interpretation of data. The superior reliability and earliest indication of gearbox damage detection provided by MetalSCAN, simplicity of data interpretation (no experts required), and its low cost makes MetalSCAN a natural addition to all existing condition monitoring systems.

For all Applications MetalSCAN:

- Provides for data collection and mining to help detect failures for individual wind turbines or for a fleet of wind turbines.
- Provides a qualitative gearbox health condition.

- Provides capability to increase operational knowledge as time progresses on the gearbox and limit the damage.
- Provides for data collection capability for a single wind turbine or a fleet of wind turbines with many different types and configurations.
- Provides an intuitive insight into the trade-off between two extremes “run-to-failure” verses “tear-it down” and possible “fix in-situ” strategies to limit damage repair.
- Provides more comprehensive insight for OEMS when units are under warranty.
- Provides operators and maintainers a tool to understand and manage their gearbox assets.

Benefits:

- Data-collection
- Archiving
- Integration into control room
- Easy to interpret
- "Real time decision aid”
- Reduce gearbox repair costs
- Reduce downtime

IN SUMMARY

Fact 1 - A damaged gearbox will release metallic particles into the oil system.

Fact 2 - MetalSCAN has proven that it will detect metallic particles in the oil system.

Fact 3 - The extent of damage can be managed before repair.

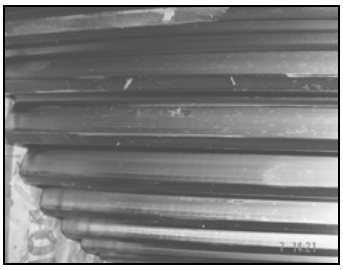
CONCLUSION

The MetalSCAN MS3000 allows operators/owners to:

- manage the problem
- minimize the financial risk

WHICH REPAIR WOULD YOU RATHER FACE?

With MetalSCAN: No damage beyond planetary stage Gearbox is easily repaired **~ $35k**



Without MetalSCAN: Damage spread through gearbox, Gearbox requires full overhaul **~ $100k+**

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