Brüel & Kjær Vibro

Application Note

Monitoring strategy – Condition Monitoring of Jet Fans

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Scope

The machine monitoring strategy described in this document is applicable for all types of direct-drive jet fans with rolling element bearings. They are typically powered by an integrated fully reversible variable speed motor. The most common application for jet fans are for ventilation and smoke control in case of a fire in tunnels for road, rail and metros.

Machine Operation and Maintenance Requirements

The amount and type of maintenance required for jet fans is highly dependent on the environmental conditions such as temperature, amount of pulsation pressure, dust, etc. There is consequently a wide range of different failure modes that can occur. Typical faults include unbalance (due to blade deposits), misalignment, bent shaft and damaged bearings and damaged motor.

If unchecked, these potential failure modes can consequently result in reducing operating efficiency and provoke excessive loading on components leading to premature bearing failure, stator/rotor rub, component damage or even a catastrophic failure. A catastrophic failure of a jet fan in certain cases could require tunnel closure.

Monitoring Strategy

A condition monitoring strategy is intended to detect most developing faults at an early enough stage such that maintenance can be cost-effectively planned ahead of time without stopping the machine.

The monitoring strategy for this particular machine is focused on the Brüel & Kjær Vibro **VDAU-6000** system (all monitoring and analysis techniques are built in) and described in the following pages.

The VDAU-6000 data can be exported to the control system via OPC, Modbus and Brüel & Kjær Vibro's proprietary database protocol. The data can be imported to existing software platforms via http request.

Monitoring configuration and techniques

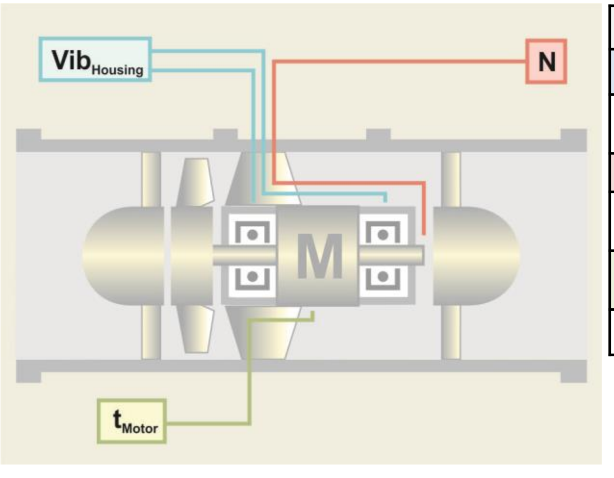

Figure 1. Monitoring inputs .

Symbol	Signal
Absolute Vibration Monitoring Sensors	
$Vib_{Housing}$	2x Bearing housing radial vibration (accelerometer)
Relative Vibration Monitoring Sensors	
N	Shaft speed, phase referencing, tracking
Process Values (Imported from DCS or by installed sensors)	
t_{Motor}	Motor temperature

Table 1. Input signal symbols.

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Monitoring configuration and techniques (cont.)

Sensor Location (type)	**Measurements**	**Plots**	**Faults that can be detected and diagnosed**
Shaft (Tacho)	• **Speed, phase**	• Trend vs. time	Phase, tracking and triggering used in other measurements
Bearing housing (Absolute radial vibration)	• **Overall** (ISO:1Hz/10Hz - 1kHz) • **Autospectrum** (FFT) • **Cepstrum** • **Envelope spectrum** • **Blade passing frequency** • **Bearing fault frequencies**	• Trend vs. time/speed • Spectrum (FFT, Cepstrum, Envelope) • Waterfall (FFT, Cepstrum, Envelope) • Time waveform	Unbalance, misalignment, bent shaft, resonances, bearing faults, blade faults, motor faults, structural faults
Motor (Process)	• **DC** (motor temp.)	• Trend vs. time/speed	Motor damage due to excess heat, lack of lubrication, overload, wear

Table 2. Monitoring techniques.

Sensor Location (type)	**Analysis techniques**	**Purpose**	**Faults that can be detected and diagnosed**
Bearing housing (Absolute radial vibration)	• **Event analysis** (complete data download during an event or by request)	Root cause analysis	Unbalance, misalignment, bent shaft, resonances, bearing faults, blade faults, motor faults, structural faults
	• **Automatic machine diagnostics** (two or more descriptors set up to identify specific faults)	Automatic diagnostics	

Table 3. Analysis techniques.

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