

ENGINEERING
TOMORROW



Case story | VLT® HVAC Drive FC 102 with CBM technology

Driving maximum uptime in aseptic pharmaceutical production

The situation

There's no room for error in the world of pharmaceuticals. And that means there's certainly no room for downtime within the mechanical systems of a continuous production cycle.

For these aseptic environments, HVAC plays a critical role in maintaining the highly controlled temperature and air quality. And while it may only take an hour to repair a potential system breakdown, it takes many more to reestablish the aseptic environment—which means many costly hours of lost production time.

Hence, a leading global pharmaceutical company was determined to find an intelligent HVAC solution that prevents downtime with real-time system monitoring and customizable instant alarms. Plus, the solution needed to fit within the organization's ambitious digitalization strategy.

Fortunately, the Danfoss VLT® HVAC Drive FC 102 with integrated condition-based monitoring has done exactly that.

24/7/365

**real-time monitoring,
alarms, and control
with intelligent
condition-based
monitoring**

The challenge

Maintaining an aseptic environment is critical to pharmaceutical production. And for a Denmark-based pharmaceutical company, integrated digital solutions are the key to achieving its ambition for safe and continuous production processes backed by its mechanical systems.

In this case, the focus was on the HVAC system. An HVAC breakdown could instantly contaminate the production—regardless of how minor the issue is. And that could cost the company millions in lost revenue due to lost production for every hour it takes to reestablish the aseptic environment.

“For us, predictability is essential to maintaining 24/7 production—which is why the monitoring and control of our HVAC system is key to preventing downtime,” explained the project’s Utility Engineer.

So, that called for an intelligent solution giving on-site technicians real-time monitoring of the vibration inside an air handling ventilation system—calibrated to send alarms precisely before a breakdown occurs.

Danfoss was brought in to collaborate on a digital solution that could help the pharmaceutical company:

- Prevent downtime with real-time monitoring
- Instantly react to system irregularities with warnings and alarms integrated into their production SCADA system and their Building Management System
- Increase overall production reliability and safety
- Support an ambitious digitalization agenda

With a zero-tolerance for bacterial contamination and the ambition for zero downtime—the challenge was defined.

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Utility Engineer responsible for the pharmaceutical company’s project.



The solution

The search for intelligent and predictable performance

Because the pharmaceutical company had such unique specifications, they decided to test three different vibration solutions for the HVAC system.

The purpose of the experiment was to find the solution that met their special requirements. Specifically, instant, actionable insights that enable preventative maintenance. The project's Utility Engineer explained, "Data empowers us to make informed decisions previously based on gut feelings." With that objective in place, the experiment began.

Testing the solutions

We proposed the **VLT® HVAC Drive FC 102 with integrated condition-based monitoring (CBM)** for the pharmaceutical company's HVAC system.

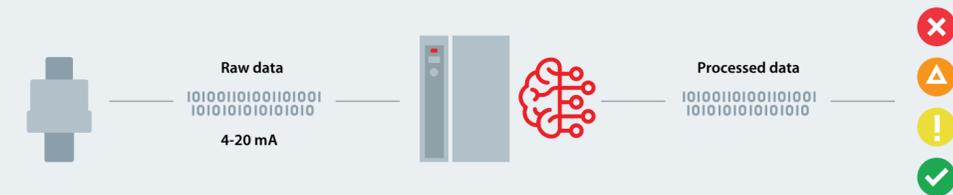
A CBM solution empowers the drive to act as a smart sensor, monitoring the condition of a motor and application for early detection of potential problems—such as mechanical vibration inside an Air Handling Unit (AHU). That means the intelligent drive not only produces data—it interprets data into actionable insights for preventative maintenance.

Specifications for the experiment

- ✓ The vibration system must:
 - Immediately send warnings when the vibration approaches a critical level
 - Immediately send alarms when the vibration exceeds critical levels
 - Be mounted directly on mechanical systems
 - Provide an online overview of the mechanical system's condition
 - Enable on-site technicians to access data in real-time
- ✓ Easy installation and commissioning
- ✓ The implemented sensor must detect mechanical vibrations triggered by imbalance, misalignment, or looseness of components, as well as ball bearings in the motor, from the lowest to the maximum application speed
- ✓ It must be possible to make initial measurements to ensure a sufficient dynamic range and capture the required vibration amplitude
- ✓ Data must be sent to the production system (SCADA) via fieldbus network or via email to specified recipients

Danfoss VLT® HVAC Drive FC 102 CBM Solution (Wired)

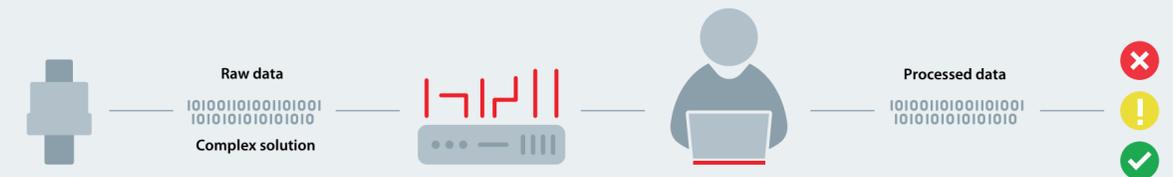
Uses an intelligent drive to monitor and instantly detect a specified application in all operating modes, from minimum to maximum speed.



- ✓ Simple wired sensor connection to the drive
- ✓ Easily establish the application baseline to receive warnings and alarms
- ✓ Warnings and alarms integrated with SCADA and BMS system
- ✓ ISO 10816/20816-compliant

Advanced Frequency Analysis Solution (Wired)

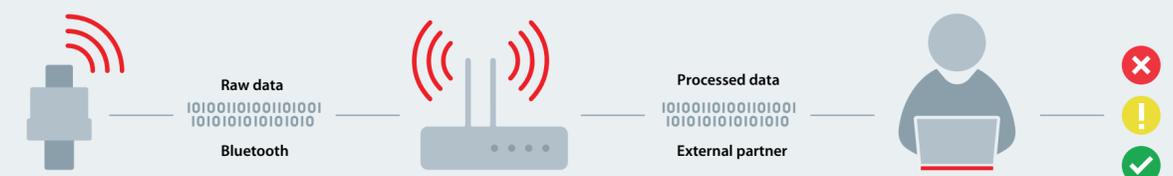
Monitors and detects a specified application, covering the entire frequency spectrum.



- ✗ Complex wired solution requires specific expertise to operate and evaluate raw system data for actionable conclusions
- ✗ Complex software, tools, and operation
- ✗ An offline solution only used for troubleshooting

Simple Vibration Sensor (Wireless)

Provides monitoring and detection via an external partner who routes the application's operating status to the end user for further action.



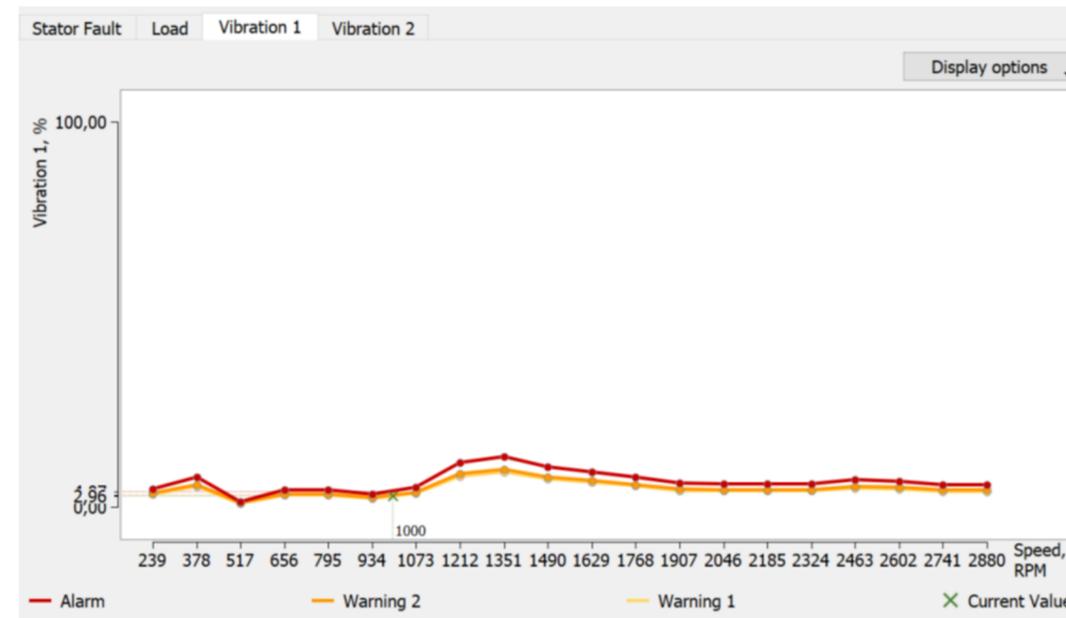
- ✗ Wireless sensor had coverage and modem configuration challenges
- ✗ Third party monitoring and detection that requires interpretation and an annual service fee for evaluation
- ✗ Wireless sensor requires periodic evaluation and replacement caused by discharged battery

Testing the Danfoss CBM Solution on an AHU application

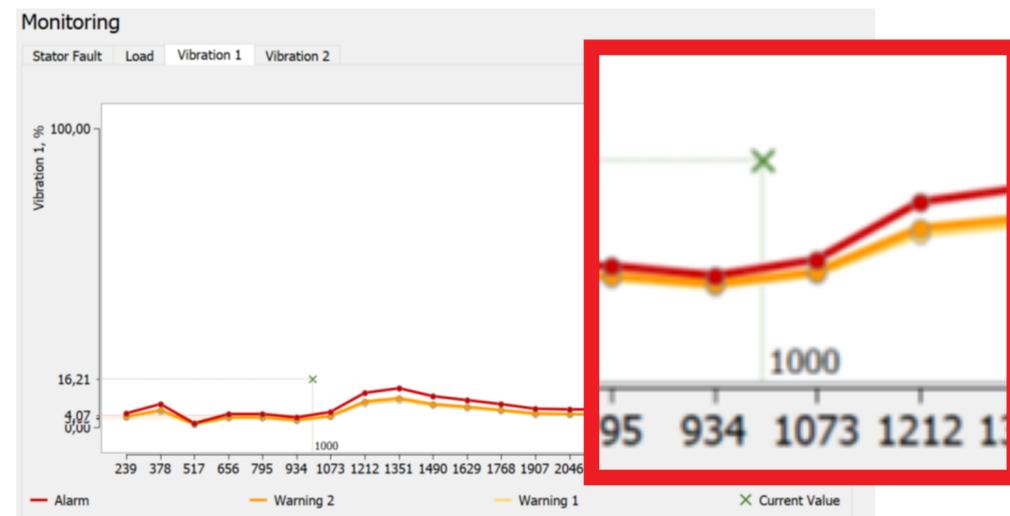
The pharmaceutical company's engineering team built an AHU fan system to evaluate the different vibration solutions. Vibration irregularities were built in to simulate real-time changes in the AHU and monitor the detection solutions' performance using two controlled factors: a damaged ball-bearing and motor imbalance.

Before implementing the fault conditions, the engineers defined a healthy system baseline in the Danfoss CBM solution—collected in an intuitive App. The baseline and its warning and alarm thresholds reflects how the CBM will react to changes in the specified application and document the real-time accuracy of the CBM.

The CBM baseline is the first indication of a stable working application and is often used as handover documentation from a contractor to the end-user in a new application. Plus, the baseline is an effective troubleshooting tool because it instantly reflects improvement during the process.



1. In the experiment, the trigger levels for Warning 1 and Warning 2 are defined on the application baseline. The intelligent drive monitors and detects the application's operation values from the lowest to the highest speed.



2. During operation, the actual vibration value, represented by the X, is monitored in real-time against the defined trigger levels. Here, the X vibration value exceeded the warning levels after the fault was introduced into the AHU test rig.

Maximum uptime backed by predictable maintenance

Out of the three systems, the **Danfoss CBM solution was the only one to succeed in capturing the damage** to the AHU test rig at the exact moment the faults were introduced into the application.

Because the CBM solution succeeded in reporting real-time warnings and alarms, it proved that the on-site technicians could prevent costly downtime—instead of reacting to an automatic shutdown.



The outcome

The pharmaceutical company's simulated AHU vibration test proved that the VLT® HVAC Drive FC 102 with integrated condition-based monitoring (CBM) technology supported the factory's aseptic operating conditions and aligned with their digitalization strategy.

With intuitive commissioning, easy installation, and real-time monitoring and alarms, the Danfoss CBM solution effectively erased the threat of downtime and contamination.

"There are some things even scheduled maintenance can't detect—such as a worn-down ball-bearing. With the Danfoss CBM solution, we get an intelligent drive that prevents costly downtime," concluded the Utility Engineer.

The pharmaceutical company now has the confidence to implement CBM on an industrial scale in their operations with the knowledge that their production facility can operate safely and reliably.

"With the Danfoss CBM solution, we get an intelligent drive that prevents costly downtime."

Utility Engineer responsible for the pharmaceutical company's project.

Why the Danfoss CBM solution was chosen

- ✓ Detects application changes with warnings and alarms to prevent a breakdown
- ✓ Simplifies the implementation with and upgrade of existing drives with broadly compatible edge CBM intelligence
- ✓ Records the actual application baseline to indicate real-time operating conditions and stability
- ✓ Vibration sensors connect directly to the converter for real-time application monitoring (from lowest to maximum speed of the application) and easy installation
- ✓ Changes in operating conditions requiring inspection are indicated by simple color codes on the drive
- ✓ Changes in operating conditions are sent via fieldbus to the SCADA production system, Building Management System (BMS), and/or via cloud connection and emails to the defined service team

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hours of downtime
with smart condition-
based monitoring

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