Keep those motors running: electric motor maintenance preventing downtime

The motors driving the tunnel furnace fans are exposed to harsh environments because of the high furnace temperatures. The mechanical conditions are also demanding because the furnace construction requires motor shaft extensions with couplings to the fans. These two factors were accelerating the wear of the motor components.

Keeping the motors running is down to CNP Myszkow's electrical maintenance team: three people working on a three-shift schedule. Increasingly, frequent downtime of the tunnel furnace prompted us to use condition-based motor maintenance.

Aside from the motor lifetimes, two of the most useful measures are temperature and vibration. Most mechanical components emit some heat and vibration in the normal course of operation. We measured these using Fluke's TiS45 thermal camera and 805 FC vibration tester.

Set-up for machine measurements

Before starting diagnosis, we needed to set up test points up on the machine. Once these were fixed, it was necessary to stick with them for all further measurements. Table 1 shows that the meter measured different vibration levels depending on the axis being measured. Following good maintenance practice, we defined a test point for each axis on the motor. These had to be as close to the bearing plates as possible.

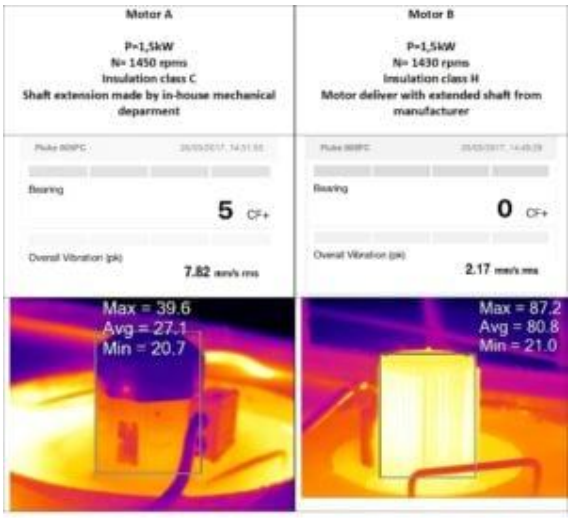

Table 1. Different vibration levels were measured for the different axes

Condition-based maintenance requires proper data acquisition. Paper records can be lost, or become unreadable because of contamination in a harsh environment. Connecting to a PC, though, can cause driver problems with USB connections. Instead, we used smartphones and cloud data storage. Both the Fluke TiS45 and 805 FC can connect to a unit under test with the Fluke Connect mobile application. This is a kind of hub between measurement tools and the cloud, where all data is stored. The app automatically drew trends for us from the measurements.

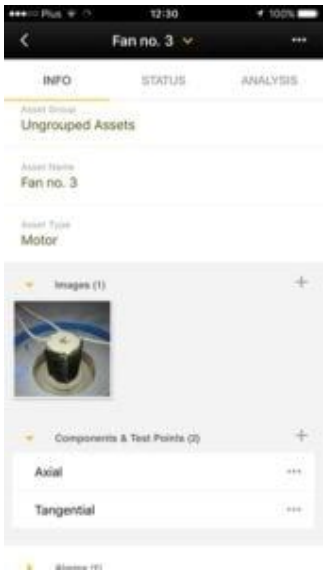

Figure 1. Test points were defined in the Fluke Connect app

Fluke Connect lets us define all the motors installed in the furnace as well as the test points in it. We defined the test points by adding the name and image in the app, as shown in Figure 1.

Thermal and vibration diagnoses

Table 1 again shows the data from the vibration tester and thermal camera. Motor A was primarily installed on the furnace as a typical general-application induction motor. We had installed an additional shaft extender (Figure 2) to connect to a fan. Motor B has a special design for heat treatment. It works at ambient temperatures up to 100°C and has enclosed rolling bearings. The thermal measurements showed that Motor A ran cooler than motor B because of the fan on its shaft. Motor B has no additional mechanical ventilation, leading to a high average temperature of 80.8°C.

Figure 2. A shaft extender connects the motor to a fan

The high insulation class (Class H) of Motor B meant that it could easily deal with this high temperature. Despite the higher temperature, we found it exhibited low vibration compared with Motor A. We tracked the root cause of this problem to unbalance of the rotor and fan attached to the motor shaft.

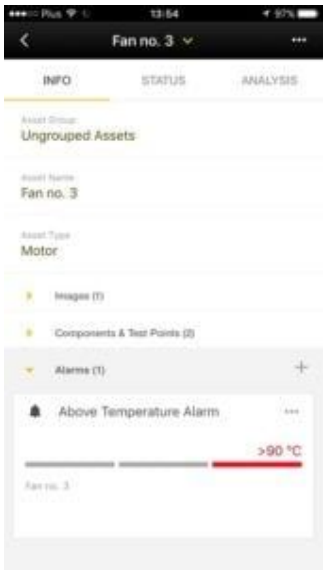

Figure 3. Fluke Connect can generate temperature alarms

Besides collecting data from instruments, Fluke Connect can generate alarms (Figure 3) to any device listed in the app. Temperature alarms can be set for electrical motors, for example when the temperature exceeds a value defined in the app. Either an e-mail can be sent automatically with alarm notification, or a pop-up message shown on your Smartphone. For Motor B, we set a temperature alarm at a value higher than 90°C. That was on the safe side since this motor had no additional mechanical ventilation. Any temperature changes above normal operating temperature could therefore lead to insulation stress.

External sensor mounted on motor body

Some electrical motors may be located in inaccessible places. For instance, we have a motor that runs a ventilation fan located 3m above ground level. Even more extreme is measuring vibrations close to motors that are installed on a hot rolling mill line. There, you don't want to go near the meter, so the Fluke 805 FC connects to an external sensor. This was mounted using a magnet on the motor body. We used a Fluke 805EX for this, but any type of accelerometer with sensitivity 80-120 mV/g would do the job.

Figure 4. The vibration tester can use an external sensor to measure overall vibration values

Using an external sensor (Figure 4) limits the vibration tester's measurements to just the overall vibration value. That is because the magnetic mounting could be considered as an additional vibration damper, reducing the instrument's bandwidth. So, CF+ (Crest Factor +) which is measured in the 4-20kHz range, is then automatically switched off.

Optimized motors, reduce maintenance

In the end, these instruments helped our maintenance team optimize the electrical motors that drive fans installed in the tunnel furnace. They also reduced the maintenance downtime to a minimum. Fluke Connect's capabilities made data acquisition easy. But most importantly, they allowed us to improve maintenance so we can deliver high-quality products to our customers.