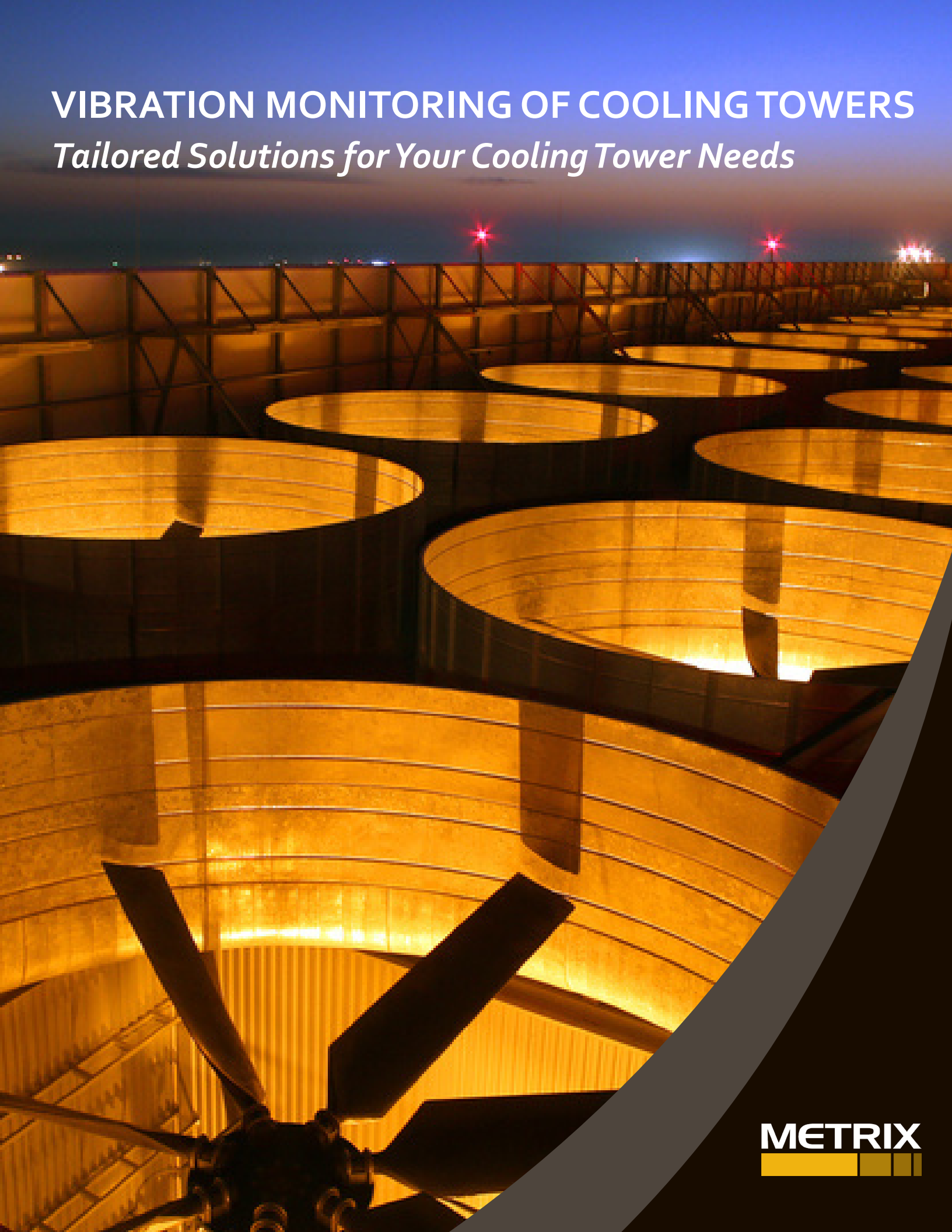
VIBRATION MONITORING OF COOLING TOWERS

Tailored Solutions for Your Cooling Tower Needs



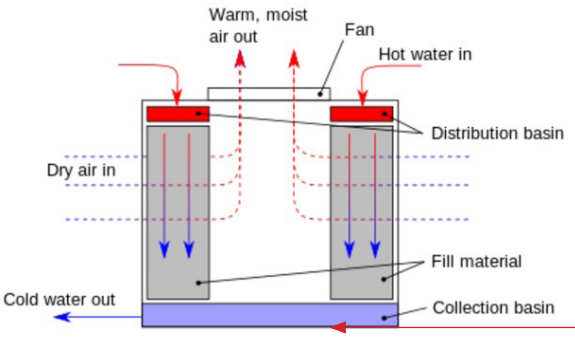
METRIX

Applications

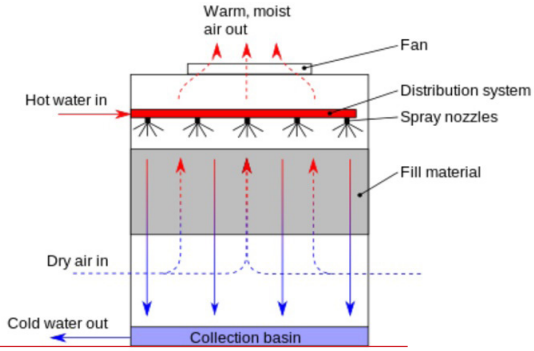
Cooling towers are commonly used in petroleum refineries, power generation plants, natural gas processing plants, petrochemical plants, and other industrial processing facilities. Cooling towers act as a special type of heat exchanger that cools down water heated up by industrial equipment and processes. In the cooling tower, heat is rejected from the working fluid (water) into the atmosphere (air) by means of evaporation (wet) and convection (dry) cooling.

For evaporative cooling towers, hot water from an industrial process is pumped up to the top of the cooling tower, then gets distributed to the wet deck, and then flows down through the fill material (lattice structure). At the same time, air is being drawn through the air-inlet louvers forcing water to evaporate. Evaporation causes the heat to be removed. Finally, cold water circulates back into the industrial process. With respect to the air-to-water flow pattern, cooling towers can be categorized into two families: cross-flow cooling towers and counterflow cooling towers.

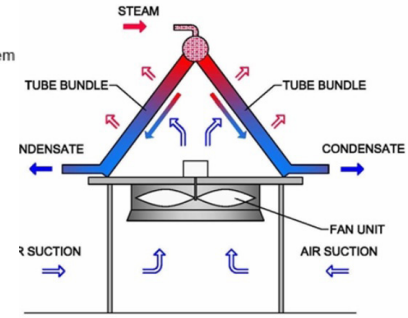
In the dry cooling tower there is no evaporation in the process. The hot working fluid flows inside the tube bundles. The tube bundles have a very large convection surface area. The lower temperature ambient air flow is blown from outside tube bundles. As a result, the hot fluid is cooled. The diagram is shown below.



Cross-Flow Cooling Tower



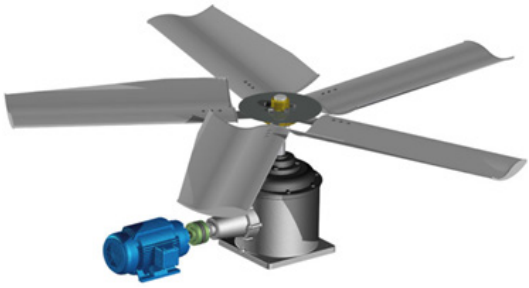
Counterflow Cooling Tower



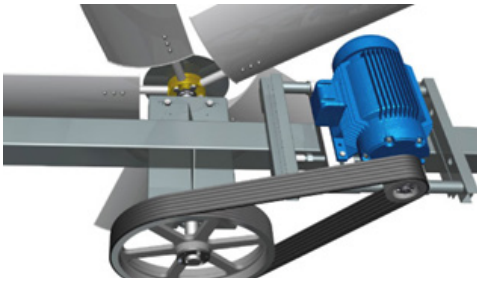
Dry Cooling Tower

On the other hand, induced draft systems use fans at the top discharge area to pull air up through the tower and forced draft systems use fans at air intake louvers to push the air into the tower.

In induced / forced draft cooling towers, fans play a critical role in the air circulation. Two types of cooling tower fan drive designs are commonly used, gearbox driven fans and belt driven fans.



Gearbox Driven Fan



Belt Driven Fan

A gearbox driven fan has the motor mounted to the side of the fan's cell and drives the fan using a shaft. In the belt driven fan case, a motor drives the fan using a belt. A belt driven fan is typically used in smaller cooling towers while the gearbox driven fan can be used in larger towers. The difference of these two types of fans can be seen from the previous graphics.

Failures and Causes

Catastrophic failure of a cooling tower can bring serious consequences to plant business operations, such as failure of other equipment, safety hazards, downtime, lost production revenue, expensive repairs, and health issues. Common causes of failure in cooling tower components can often be linked to either the misalignment or imbalance of components. Studies have shown that the most common failures in cooling tower components were related to the motor (60%), the gearbox (30%), the fan (2%) and others (8%).

Assets Protection

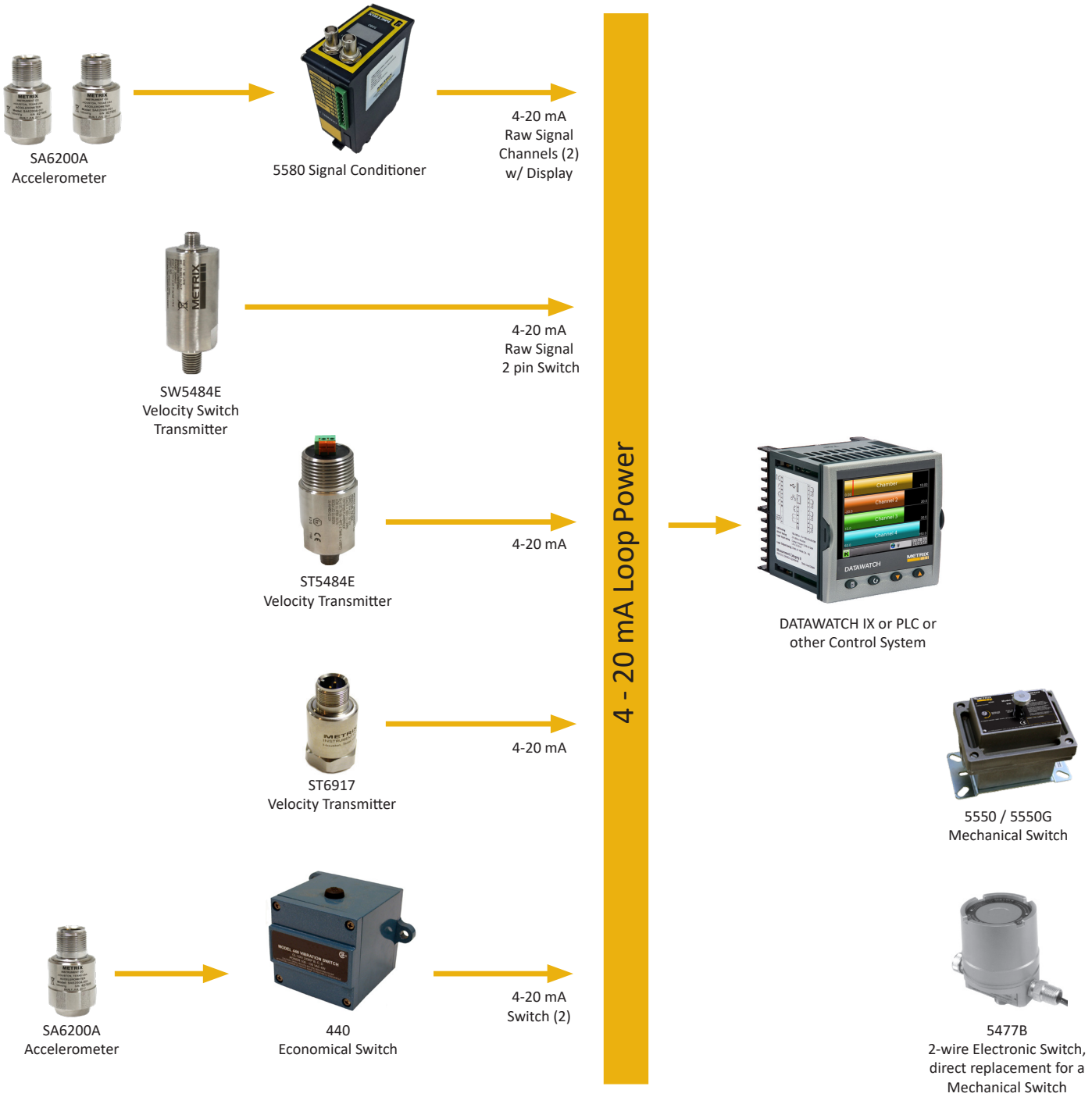
As the cooling tower failure consequences are understood and the causes of failures are analyzed, priority to prevent the catastrophic disaster occurs, which leads to asset protection. Measuring the key vibration parameters and analyzing vibration data from a cooling tower are the most important actions to be taken.

The OEM recommends to install at least one vibration sensor on the gearbox and /or fan bearing. The sensor installation positions are described as following:

- To collect vibration data on gearbox driven fans, one has to monitor both the motor and the gearbox.
- To collect vibration data on belt driven fans, one must monitor the fan inboard pillow block bearing, the motor inboard bearing, and intermediary bearings on the fan shaft.

In general, most cooling tower fans run at a speed somewhere between 90 and 300 revolutions per minute (rpm) while motors for cooling towers generally run at speeds around 1,500 to 1,800 rpm. Two organizations have developed vibration standards for cooling tower fans. The Cooling Technology Institute (CTI) Vibration Standards are presented in units of displacement (mils pk-pk, µm pk-pk) and are dependent on both construction type (steel, fiberglass, wood, or concrete) and frequency. No overall vibration standards are given by CTI. The Technical Associates (TA) Machine Specific Standards concern overall vibration levels and are dependent on the drive type (close coupled direct drive, close coupled belt drive, or long hollow drive shaft). The TA Standards are presented in units of velocity (ips-pk, mm/s-pk).

Metrix has a broad range of product options to meet various cooling tower applications. Select one of the following system solutions that works best for your application.



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