



CASE STUDY – FEBRUARY 2023



CDI

**ENERGY
PRODUCTS®**

A Michelin Group Company

Preventing Catastrophic Failure of a Boiler Feed Water Pump with dures® XPC-2



PROBLEM IDENTIFIED

Application: BB3 Horizontal Axially Split Multistage Pump operating as a Boiler Feed Water Pump in a Chemical Plant

Issue: Premature Pump Radial Bearing Failure

Solution: Retrofitting the pump with dures® XPC-2 for all and stationary wear components extended the life cycle of the pump and prevented catastrophic damage to the pump rotor assembly components



When a potentially catastrophic issue with a boiler feed pump in a Texas Chemical Plant arose, one of our customers, a pump repair service provider, contacted us to find a solution. The chemical plant in question is a producer of products that are crucial ingredients - like Amines, Ethanolamines, and Propylene Glycol - vital to a number of global industries such as electronics, cosmetics, energy production, and construction. Failure at the chemical plant could not only result in a costly plant shutdown causing potential shortages of chemicals required by these critical markets, but it might also put people at risk, raise health and safety concerns, and cause environmental issues.



APPLICATION ENVIRONMENT

The plant was running a boiler feed water pump using an API 610 5-Stage BB3 Horizontal Axially Split Multistage Pump. A high-pressure boiler system like this is essential to the success of any chemical processing plant. Boilers are the unsung heroes of chemical processing operations, and they have a substantial effect on the productivity and efficiency of operations. Boilers are pressurized tanks used to heat and evaporate water to produce steam. The steam produced is utilized for a variety of applications including heating and cooling chemical reactors, disinfecting and sanitation procedures, heating and cooling of the plant itself, and power generation. Boilers require fresh feed water to produce steam, requiring boiler feed pumps for the process. Condensation in boiler systems is normally recycled and returned to the boiler via condensate return pumps.

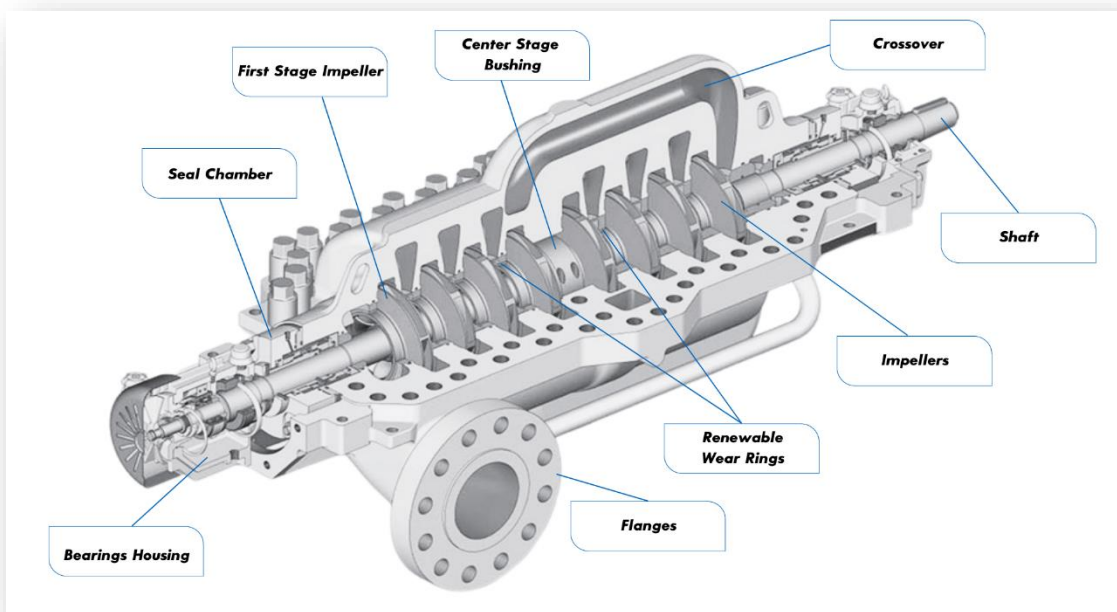


Due to the high temperatures of the feed water, boiler feed water pumping applications often necessitate high pressures to keep the water liquid. At 212° Fahrenheit (100° Celsius) and atmospheric pressure, water transforms into a gas. However, boiler feed water temperatures range from 225° to 250° Fahrenheit (107° - 121° Celsius), with some even reaching 400° Fahrenheit (204° Celsius).



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A 5-Stage BB3 Horizontal Axially Split Multistage Pump like this is a true workhorse for any plant, with a flow capacity up to 8,500 GPM (1930 m³/h handling pressures of up to 4,000 PSIG (275 bar) and temperatures up to 400° Fahrenheit (204° Celsius). With the optimized pump structure including a balanced rotor assembly with back-to-back impeller arrangement to minimize residual axial thrust, this pump was the superior option to increase production efficiency. For this application, the pump was operating at temperatures around 240° Fahrenheit (116° Celsius) and differential pressures of 817 PSIG (56 bar). A pump like this typically has a five to seven (5-7) year Mean Time Between Repair (MTBR), but this pump was prematurely removed from service after only 10 months due to rolling-element radial bearing failure.



*Example of API 610 BB3 Horizontal Axially Split Multistage Pump with Key Stationary and Active Components
Pump Shown is an 8-Stage Pump*

Bearing failure is the second leading cause of pump breakdowns, after fluid contamination. Bearings are one of the components in the mechanical assembly of the pump (including the shaft, impellers, mechanical seals, wear rings, bushings, and pump casing). The pump bearings support the mechanical load imposed by the mass of the rotor assembly while the stationary composite wear rings and bushings support the hydraulic loads imposed by the impeller, the mass of the rotor assembly, and the loads due to the shaft coupling or belt drive. (See visual above to identify some of the stationary and active components in a typical axially split, multistage horizontal pump.) The most common causes of early bearing failure include static overload, wear, static vibration, corrosion, lubrication failure, contaminant buildup, or overheating. Radial Bearings are essential within the pump system because a bearing failure frequently causes a failure due to excessive wear on the shaft at the mounting location, leading to the entire pump being taken out of operation. Failure like this ultimately increases plant downtime, requires expensive maintenance expenses, can drive lost deliveries and revenue loss, and, in very extreme circumstances, worker injury.

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TECHNICAL SOLUTION

When the radial bearing failed prematurely, our customer reached out to CDI for support. We had a long-standing relationship with the pump repair service company, with our technical experts collaborating on numerous ambitious projects. For the 5-Stage BB3 Horizontal Axially Split Multistage Pump in question, CDI had previously upgraded all the stationary components to a polymer composite with CDI’s dures® XPC-2 to increase the rotor stability, MTBR, and efficiency. Specifically, the components upgraded using dures® XPC-2 included the 1st stage case wear rings, series suction eye case wear rings, series hub case wear rings, center stage bushing, throat bushing, and throttle bushing. Delivering the chemical resistance, physical strength, and flexibility, the API 610 recognized material was the perfect solution for this pump. CDI’s dures® XPC-2 also has exceptional resistance to wear during slow roll start-up and shut down. These components were exceeding expectations and our customer trusted our engineers and material scientists to help deliver a solution. We understood that quick action was critical for this project. As such a vital part of the operations, the boiler feed pump needed to be back in action as quickly, but as safely as possible.

We conducted a series of calls with our customer’s Sales Engineer to better understand what was happening at the plant. From those discussions, the CDI engineering team and service line managers were able to diagnose the issue and make a recommendation to the pump repair service company. Our customer was able to take that information with confidence back to the end user’s Plant Supervisor and Maintenance Engineering Team to discuss options and next steps. This is a fundamental aspect of our customer approach at CDI. Much of our work is focused on OEMs and service companies who supply equipment and services to end users. Our products have to work for our customers today and for our customers’ customers tomorrow with optimal results. Our goal is to build solid relationships with our customers which in turn strengthens their relationships and confidence with end users.

Having worked on the stationary components for this 5-Stage BB3 Horizontal Axially Split Multistage Pump, we were fortunate to have all the pump specifications, measurements, and load requirements. During the initial consultations, we learned that the pump’s radial bearing failure (which was a third-party component) resulted in an ~.125” (3.2 mm) drop in the rotating assembly creating a hard rub condition between the rotating and stationary components at all wear ring and bushing locations.



Case Wear Ring: Evidence dures® XPC-2 components acted as sacrificial components protecting the pump from total loss



Impeller Wear Ring: Minimal damage after running against dures® XPC-2 case wear ring

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With metal-on-metal parts, this could have been so much worse than a temporary pause in pump operation. This could have resulted in a catastrophic failure leading to the frictional welding of the rotating and stationary components requiring the complete rotating assembly to be replaced.

During the assessment, we were able to see the performance of the retrofitted parts provided by CDI and clearly see the positive impact seen with dures® XPC-2. It was clear from the visual inspection that the CDI components acted as sacrificial components protecting the pump from total loss. The pump impellers, which optimize flow while minimizing turbulence and maximizing efficiency, were salvaged with a minimal skim cut to bring all impeller wear rings to a nominal dimension and surface finish.

CUSTOMER RESULTS

Due to the strength of our partnership with the pump service repair company, and our collaboration, we were able to find a solution that mitigated lost time and reduced repair costs. We were able to deliver the new parts with minimal lost time at the plant while preventing complete pump failure. Although the pump shaft had to be replaced due to radial bearing failure, the pump itself could be brought back online with minimal maintenance and a considerable cost savings to full pump replacement. The actualized savings were quite substantial. Since the customer trusted dures® XPC-2, we were able to deliver a solution with significant savings to our customer. Our offering came in at 50% of the costs of traditional pump case work (welding and machining) and impeller repair. In a plant, every minute counts and every minute costs money. On this project, we were also able to deliver significant time savings. We were able to complete the repairs in 1/3 the time typically allocated for pump case work (welding and machining) and new impeller castings.

IMPACT FOR CDI

When it comes to serving a quick-turn market like the pump repair business, having material on hand is mission critical. In this market, every hour a project is delayed equates to both a major cost and a major loss of production value. This project reinforced the need for CDI's internal stocking program which is managed specifically to support our customers' in-service repair. After extensive research and collaboration with our customers, we have initiated stage one of our new stocking program launching with materials in our dures® line including XPC-2 and dures® 250. Stay tuned for more information on our program as we expand and please contact us if you would like to learn more about the lead times for billets and finished parts.

FURTHER INFORMATION

To learn how CDI Energy Products can improve performance in your operations, please visit cdiproducts.com.

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