

Sealmatic

Delivers Robust API Plan 53B Seal Support System For A Refinery Application



The refining of crude oil is one of the most complex and demanding industrial processes in the world. Every stage of the refining process, from crude distillation and vacuum distillation to hydrocracking, catalytic reforming, hydrotreating and product blending, involves handling highly volatile, corrosive and hazardous hydrocarbons under elevated temperatures and pressures. In such an environment, even the smallest equipment failure can lead to significant production losses, environmental concerns and safety risks. Consequently, maintaining the integrity and reliability of rotating equipment is of paramount importance for ensuring continuous plant operation and achieving maximum process efficiency.

Mechanical seals are among the most critical components installed on pumps other rotating equipment throughout a refinery. Their primary function is to prevent process fluid from escaping to the atmosphere while allowing the rotating shaft to operate efficiently. However, the performance and service life of a mechanical seal are determined not only by its design but also by the effectiveness of its seal support system. A well-engineered support system provides the seal with the necessary lubrication, cooling and pressure control required to operate reliably under severe process conditions. Without adequate support, even the most advanced mechanical seal can experience premature wear, thermal damage or catastrophic failure.

Understanding these demanding operating conditions, Sealmatic recently designed, manufactured and successfully tested a robust API Plan 53B Seal Support System for a refinery application. Designed in accordance with the standards of API 682, the system has been engineered to provide continuous barrier fluid circulation, stable pressure control and efficient heat removal for dual pressurized mechanical seals operating in Arrangement 3. The project reflects Sealmatic's commitment to delivering reliable, high-performance sealing solutions that enhance operational safety, improve equipment reliability and support uninterrupted refinery operations.

Refinery applications present a unique combination of challenges for mechanical sealing systems. Process fluids often possess poor lubricating characteristics while operating temperatures may vary from sub-zero conditions to several hundred degrees Celsius. In many services, the fluids being handled contain corrosive constituents such as hydrogen sulphide, chlorides and sulphur compounds, while others exhibit high



vapour pressures that increase the possibility of flashing across the seal faces. These conditions can lead to inadequate lubrication, excessive heat generation, dry running, rapid seal face wear and ultimately process leakage if not properly managed. Since many refinery products are flammable, toxic or environmentally hazardous, even minor leakage cannot be tolerated, making the selection of an appropriate sealing arrangement and support system absolutely essential.

Among the various seal support plans specified by API 682, API Plan 53B has established itself as one of the most reliable solutions for demanding refinery services. The system is specifically intended for dual pressurized mechanical seals where complete isolation of the process fluid from the atmosphere is required. Unlike conventional sealing arrangements, API Plan 53B employs a dedicated barrier fluid circuit maintained at a pressure higher than the process pressure. This ensures that the process medium remains completely isolated from the atmosphere, while only clean barrier fluid is present within the seal cavity. The result is a highly reliable sealing arrangement capable of achieving virtually zero process emissions, significantly improving both plant safety and environmental protection.

At the heart of the API Plan 53B system is the bladder accumulator, which performs the critical function of maintaining the barrier fluid pressure throughout the operating cycle. Prior to commissioning, the accumulator is pre-charged with nitrogen gas. An elastomeric bladder separates the nitrogen from the barrier fluid, preventing direct contact between the two media. As the barrier fluid expands and contracts due to temperature variations or minor leakage, the compressed nitrogen automatically compensates for these volume changes, maintaining a stable pressure within the closed circuit. Because the nitrogen remains completely isolated from the barrier fluid, problems such as gas absorption, foaming and aeration are effectively eliminated, resulting in a highly stable hydraulic system capable of maintaining optimum sealing conditions even during fluctuating operating pressures.



While maintaining pressure is essential, effective cooling of the seal faces is equally important. During operation, the sliding contact between the rotating and stationary seal faces generates frictional heat. If this heat is not removed efficiently, the lubricating film separating the seal faces may begin to deteriorate, causing increased friction, accelerated wear and eventual seal failure. To overcome this challenge, Sealmatic's API Plan 53B system incorporates a dedicated Circulating Pump Unit (CPU), which continuously circulates the barrier fluid through a closed-loop system.

The circulating pump draws cooled barrier fluid from the reservoir and delivers it through the dual mechanical seal, where it lubricates the seal faces while simultaneously absorbing the heat generated during operation. The heated barrier fluid then flows through an efficient water cooler, where thermal energy is transferred to the cooling water before the fluid returns to the reservoir.

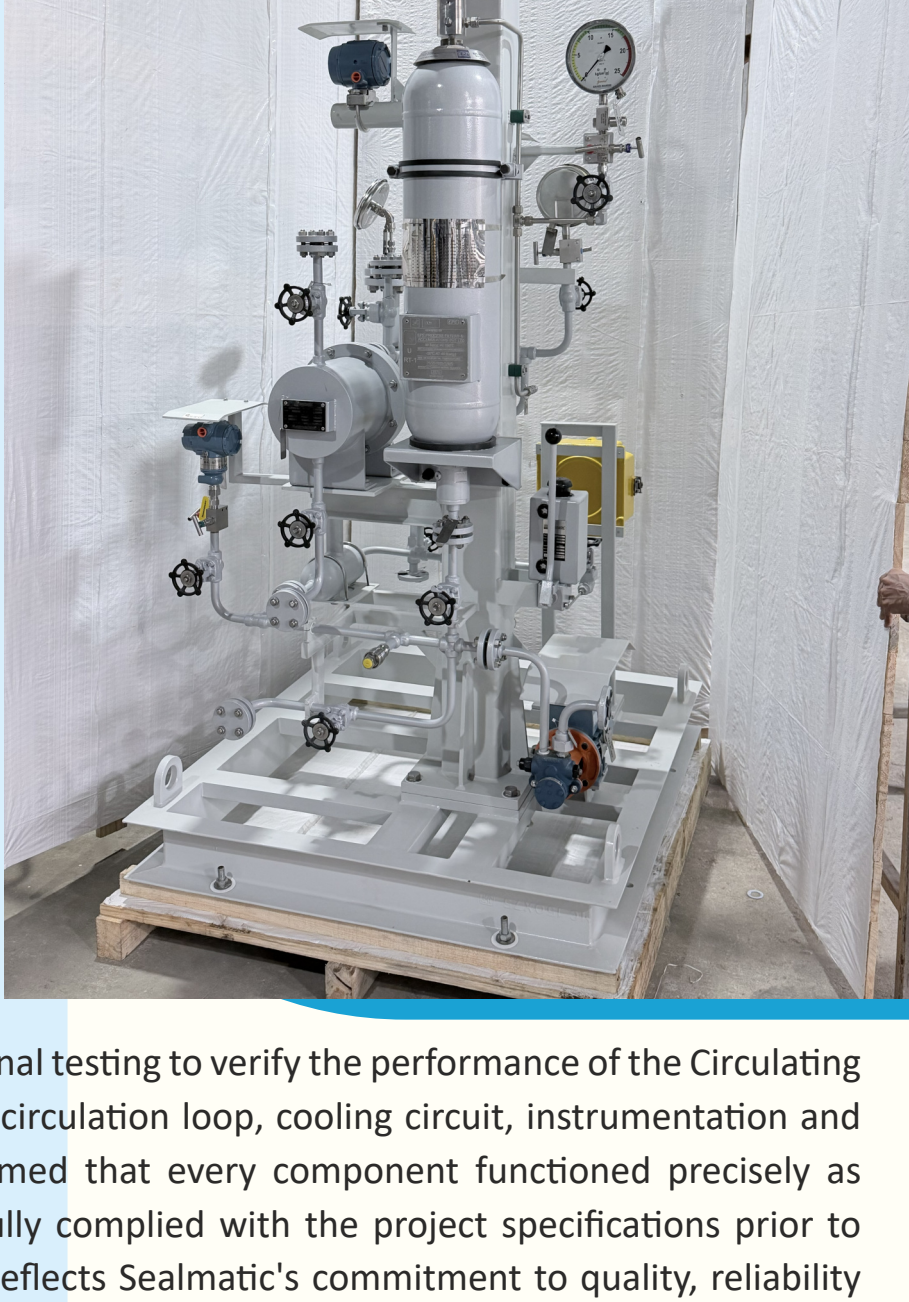
The CPU continuously recirculates the cooled barrier fluid, thereby maintaining a constant operating temperature and ensuring that the seal faces remain properly lubricated under all operating conditions. This continuous circulation of barrier fluid provides several important benefits beyond simple cooling. The fluid forms a stable lubricating film between the seal faces, reducing friction and minimizing wear. It also removes microscopic wear particles generated during normal operation, preventing their accumulation between the sealing surfaces. By maintaining consistent temperature and lubrication conditions, the system significantly improves seal face stability, minimizes thermal distortion and extends the operational life of the mechanical seal.

An equally important aspect of the system is its comprehensive monitoring and control capability. The API Plan 53B package supplied by Sealmatic incorporates a fully integrated Local Control Panel (LCP), providing operators with convenient local control and continuous monitoring of the Circulating Pump Unit. The control panel incorporates all essential operating features, including start and stop controls, status indication, electrical isolation and emergency stop functionality. This arrangement enables maintenance personnel to safely operate, isolate and troubleshoot the system whenever required, while improving overall plant safety during commissioning and routine maintenance activities.

In addition to local control, the system incorporates instrumentation for monitoring critical operating parameters such as barrier fluid pressure, barrier fluid temperature and circulation performance. Continuous monitoring of these parameters enables plant operators to identify abnormal operating conditions before they develop into equipment failures. Early detection of pressure loss, insufficient circulation or abnormal temperature trends allows corrective action to be taken during planned maintenance rather than following an unexpected shutdown, thereby improving equipment availability and supporting predictive maintenance strategies. The benefits of an API Plan 53B system extend far beyond protecting the mechanical seal itself. Stable sealing conditions contribute directly to improved reliability of the entire rotating equipment assembly. By maintaining proper lubrication and preventing leakage, the system reduces shaft vibration, minimizes bearing loading and protects critical components such as sleeves, bearings and couplings from unnecessary damage.

These improvements contribute to longer Mean Time Between Failures (MTBF), lower maintenance expenditure and increased operational availability of refinery assets. In modern refineries, where unplanned shutdowns can result in significant production losses and substantial financial impact, such improvements in equipment reliability are of considerable importance.

Environmental performance has become another key driver behind the widespread adoption of dual pressurized sealing systems. Refineries worldwide are subject to increasingly stringent regulations governing fugitive emissions and workplace safety. API Plan 53B plays a significant role in helping operators comply with these requirements by preventing hazardous hydrocarbons from escaping into the atmosphere. The barrier fluid provides an effective secondary containment system, ensuring that the integrity of the sealing arrangement is maintained even under demanding process conditions. This not only protects personnel and the environment but also contributes to improved plant sustainability and regulatory compliance. Prior to dispatch, the API Plan 53B systems successfully underwent comprehensive factory acceptance testing at Sealmatic manufacturing facility.



Each system was subjected to rigorous functional testing to verify the performance of the Circulating Pump Unit, Local Control Panel, barrier fluid circulation loop, cooling circuit, instrumentation and overall system operation. These tests confirmed that every component functioned precisely as intended and that the complete assembly fully complied with the project specifications prior to shipment. This thorough testing philosophy reflects Sealmatic's commitment to quality, reliability and engineering excellence.

The successful execution of this refinery project once again demonstrates our capability to deliver complete API-compliant sealing solutions engineered for the most demanding industrial applications. By combining advanced mechanical seal technology with intelligently designed seal support systems, Sealmatic continues to help refinery operators achieve higher equipment reliability, improved process safety, reduced maintenance costs and uninterrupted production. As the refining industry continues to pursue greater operational efficiency, enhanced environmental performance and increased asset reliability, robust seal support systems such as the API Plan 53B will continue to play an indispensable role in ensuring safe, dependable and efficient refinery operations.

