Plan 11

Flush Plan

Single Seal / Double Seal (Inboard)

Plan Overview:

API Plan 11 is the most commonly used flush plan for mechanical seals as part of seal support systems. It **bypasses** the process fluid from the **pump discharge** back into the seal chamber through a flow **control orifice**, ensuring regulated recirculation of the process fluid for cooling, lubrication, and contaminant removal for optimal seal performance.

The primary objective of Plan 11 is to **prevent** excessive heat buildup and solid accumulation in the seal chamber. By maintaining a steady flow of process fluid recirculation, it **minimizes** the risk of dry running, enhances lubrication, and reduces wear and coking tendencies.

Additionally, Plan 11 helps regulate seal chamber pressure by maintaining a controlled pressure differential, preventing vaporization, minimizing pressure fluctuations across the seal faces, and ensuring stable operating conditions for improved seal reliability and longevity.

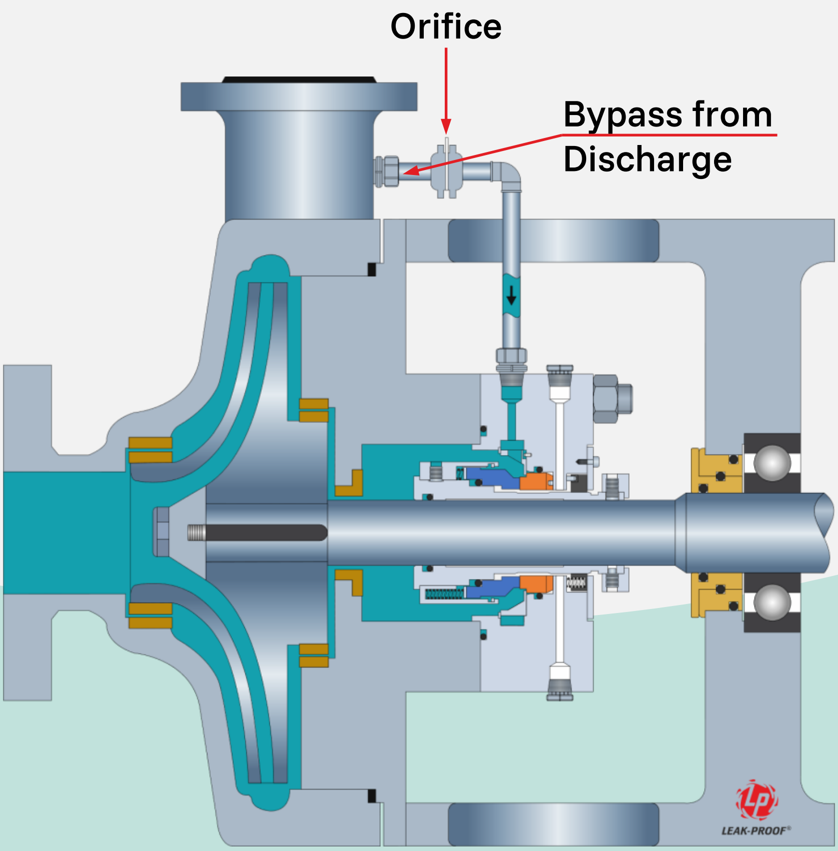

Image: Pump c/s with API Plan 11

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Features

1. **Effective Heat Dissipation:** Circulates process fluid through the seal chamber, carrying away heat from seal faces to prevent thermal distortion, wear, and premature failure. The calibrated orifice ensures efficient heat transfer without excessive energy loss.

2. **Positive Pressure Maintenance:** Maintains a controlled pressure differential between the pump discharge and seal chamber, ensuring a higher-pressure margin to prevent vaporization. This minimizes cavitation risks, which cause seal instability and face damage. By keeping the process fluid in a liquid state, it prevents dry running— a major cause of seal failures.

3. **Minimized Contamination:** Prevents solid buildup at seal faces in clean fluid applications. Continuous flushing removes potential contaminants, reducing abrasive wear and clogging. This is particularly beneficial for clean, non-polymerizing fluids like light hydrocarbons, chemicals, and water-based fluids, enhancing seal reliability.

4. **Self-Venting in Horizontal Pumps:** Automatically removes entrapped air and gases, reducing vapor lock and improving lubrication. In horizontal pumps, where air pockets form due to flow patterns, this feature ensures continuous liquid contact with seal faces, reducing wear and improving reliability.

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Applications

1. Ideal for clean, non-polymerizing fluids.
2. Suitable for pumps with sufficient discharge-to-seal chamber pressure differential to drive effective recirculation.
3. Applicable for moderate-temperature services where process fluid can efficiently dissipate seal-generated heat.

Precautions

1. **Sufficient Pressure Differential:** Maintain an adequate pressure difference between the pump discharge and the seal chamber to generate the **required flow rate** for effective cooling and lubrication. If the differential pressure is insufficient, consider using **Plan 13** to facilitate controlled flow from the seal chamber back to the pump suction.
2. **Orifice Sizing:** The orifice must be carefully sized based on flow rate, pressure differential, and fluid properties to ensure optimal performance while preventing clogging, with a minimum diameter of **3 mm (1/8")** recommended by **API 682**. High flow rates through an orifice can generate **excessive noise**, making orifice sizing also crucial for noise reduction.
3. **Pressure Control:** In high-pressure applications, **multiple orifices in series** may be used to achieve the required pressure drop while minimizing excessive turbulence and energy loss.

4. **Throat Bush Clearance:** Throat Bush clearance should be carefully sized in accordance with **orifice** dimensions to maintain the desired pressure differential and ensure effective seal flush flow. Proper clearance helps balance seal chamber pressure, optimize recirculation, and prevent excessive leakage or flow restriction.

5. **Fluid Compatibility:** Avoid using Plan 11 with solid-laden or polymerizing fluids, as suspended particles can clog the orifice, and polymerization can restrict flow, leading to ineffective recirculation. **Plan 31** (cyclone separator) is recommended when solid particles have a specific gravity at least twice that of the process fluid; otherwise, **Plan 32** (external clean flush) should be used to ensure reliable seal performance.

6. **Temperature Limitation:** Plan 11 is not recommended for high-temperature applications, as excessive heat can cause seal face degradation and thermal distortion, leading to increased wear, loss of lubrication, and premature failure. For elevated temperatures, **Plan 21** can be used, as it incorporates a heat exchanger to improve cooling. For even higher temperatures or when more efficient cooling is required, **Plan 23** is preferred, as it provides a closed-loop system with a dedicated heat exchanger to maintain optimal seal performance.