

Why Plan 11 Isn't Suitable for Every Application?

API Plan 11 is the most commonly used **flush plan** for mechanical seals, designed to provide continuous circulation of **process fluid** from the pump discharge to the seal chamber. It helps maintain **cooling, lubrication, and pressure stabilization** while **preventing contamination buildup**. Due to its simplicity, cost-effectiveness, and efficiency, it serves as the **baseline flush plan** in most applications.

However, no single plan can serve all applications. While effective in **clean, non-polymerizing fluids** and under moderate **temperature** and **pressure** conditions, Plan 11's limitations become evident in more challenging environments:

- 1. Contamination & Solid Handling Limitation:** In applications involving suspended solids or contaminants, Plan 11 will carry debris back into the seal chamber, leading to premature wear and clogging. To mitigate this, **Plan 12** (with a strainer) is used for **slightly contaminated fluids**, while **Plan 31** or **Plan 41** (with a cyclone separator) are preferred for fluids containing **suspended solids**, ensuring effective filtration before impurities reach the seal.
- 2. Differential Pressure Limitation:** Plan 11 relies on a **pressure differential** between the pump discharge and seal chamber, making it ineffective in pumps where this differential is insufficient or absent. This issue arises in **vertical pumps without a bleed bushing**, where the seal chamber operates at

or near full discharge pressure, and in **high-pressure pumps**, where Plan 11 may require an impractically small orifice or excessive flush flow. To overcome this, **Plan 13** routes process fluid from the seal chamber back to suction, providing controlled cooling and venting air or vapors. **Plan 14** enhances this by integrating a controlled flush injection, improving vapor removal and seal face lubrication in vertical pump applications.

3. Temperature Limitation: In high-temperature applications, Plan 11 falls short because simply recirculating process fluid does not provide **sufficient cooling**. As a result, heat buildup can lead to seal face **thermal degradation**, **increased wear**, and reduced seal reliability. To address this, **Plan 21, 22, and 23** incorporate **heat exchangers**, ensuring efficient heat dissipation and temperature regulation before the fluid reaches the seal chamber, thereby extending seal life and improving overall system performance.

Various derivatives of Plan 11 are used to address its limitations in **contamination control**, **pressure management**, and **temperature regulation**. These modifications enhance fluid conditioning, improve cooling efficiency, or redirect flow to optimize seal performance based on process requirements.

Now, let's compare them side by side to understand their key differences, from **flow paths** and **key components** to **application suitability** across different operating conditions.

Flush Plans

Derivatives of Plan 11

No Single Plan Can Serve All Applications

Table 1: API Flush Plans – Flow Path & Key Components

Plan	Flow Direction	Orifice	Strainer	Cyclone Separator	Heat Exchanger	Temp. Indicator
11	Discharge → Seal Chamber	Yes #	No	No	No	No
12*	Discharge → Seal Chamber	Yes #	Yes	No	No	No
13	Seal Chamber → Suction	Yes #	No	No	No	No
14	Discharge → Seal Chamber → Suction	Yes #	No	No	No	No
21	Discharge → Heat Exchanger → Seal Chamber	Yes #	No	No	Yes	Yes
22*	Discharge → Heat Exchanger → Seal Chamber	Yes #	Yes	No	Yes	Yes
23	Seal Chamber → Heat Exchanger → Seal Chamber (Pumping Ring required for circulation)	No	No	No	Yes	Yes
31	Discharge → Cyclone Separator → • Clean Fluid: Cyclone Separator → Seal Chamber • Dirty Fluid: Cyclone Separator → Suction	No	No	Yes	No	No
41	Discharge → Cyclone Separator → • Clean Fluid: Cyclone Separator → Heat Exchanger → Seal Chamber • Dirty Fluid: Cyclone Separator → Suction	No	No	Yes	Yes	Yes

With purchaser approval, the flow control orifice may be omitted if it is not needed to achieve the required flush flow rate.

* API Plan 12 and 22 are discouraged due to their unreliability caused by strainer choking issues.

Table 2: API Flush Plans – Suitability Across Process Conditions

Plan	Fluid Type	Temperature Suitability	Contamination Control	Pump Orientation Recommendation	Comparison with Plan 11
11	Clean, Non-polymerizing Fluids	Moderate	No	Horizontal / Vertical*	-
12	Slightly Contaminated, Non-polymerizing Fluids	Moderate	Low	Horizontal	Plan 11 + Strainer
13	Clean, Non-polymerizing Fluids	Moderate	No	Horizontal (High Pressure) / Vertical	Not Directly Comparable
14	Clean, Non-polymerizing Fluids	Moderate	No	Vertical	Plan 11 + Plan 13
21	Clean, Non-polymerizing Fluids	High	No	Horizontal / Vertical*	Plan 11 + Cooler
22	Slightly Contaminated, Non-polymerizing Fluids	High	Low	Horizontal	Plan 11 + Strainer + Cooler
23	Clean, Non-polymerizing Fluids	Extreme	No	Horizontal / Vertical*	Not Directly Comparable
31	Fluid with Suspended Solids	Moderate	Moderate #	Horizontal / Vertical*	Plan 11 + Cyclone Separator
41	Fluid with Suspended Solids	Moderate	Moderate #	Horizontal / Vertical*	Plan 11 + Cyclone Separator + Cooler

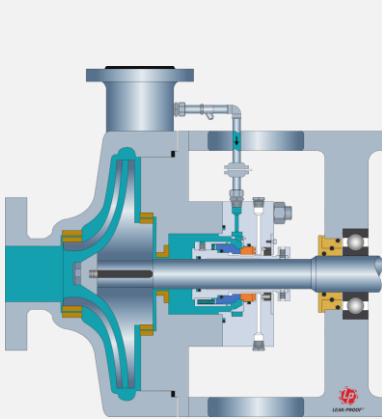
With Fluids containing solid particles with a specific gravity at least twice that of the process fluid.

* In vertical pumps, Plans 11, 21, 31, and 41 shall be provided with a separate vent connection in the piping.

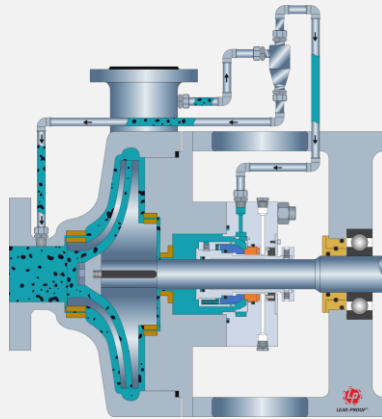
Flush Plans

Derivatives of Plan 11

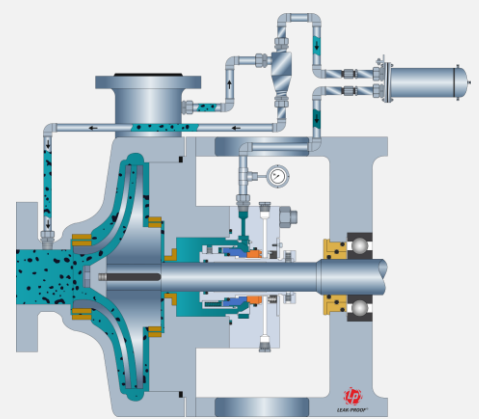
No Single Plan Can Serve All Applications



API Plan 12

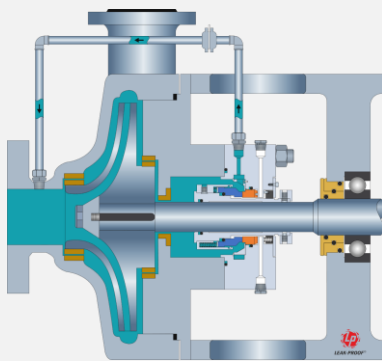


API Plan 31

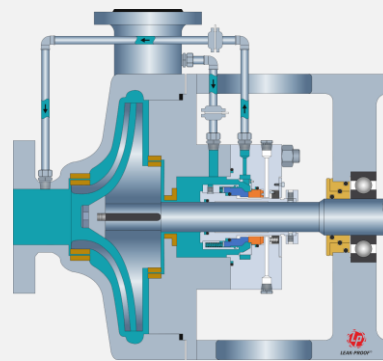


API Plan 41

Illustrations of API Plans for Contamination & Solid Handling Limitation

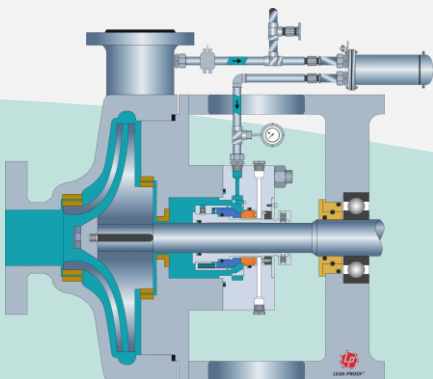


API Plan 13

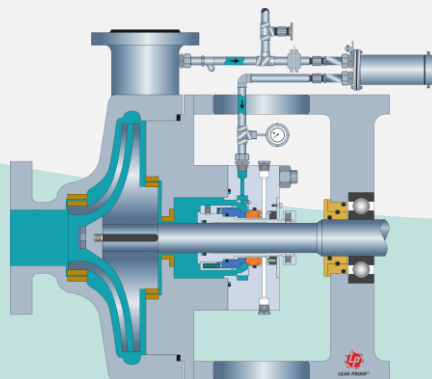


API Plan 14

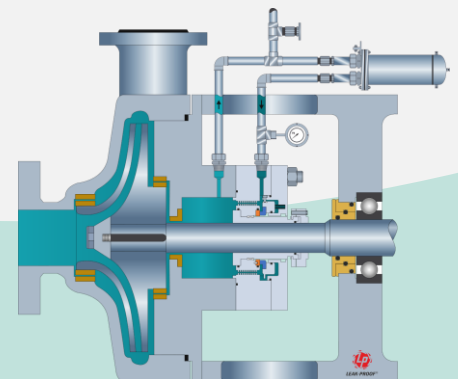
Illustrations of API Plans for Differential Pressure Limitation



API Plan 21



API Plan 22



API Plan 23

Illustrations of API Plans Temperature Limitation