

**Plan 02** *Single Seals*

**What**  
Dead-ended seal chamber with no flush.

**Why**  
No fluid recirculation needed.

**Where**  
Cooling jacket seal chambers in high temperature services.  
Clean fluids.  
Top-entry mixers/agitators with dry seals.  
Heating jacket seal chambers in fluids that solidify at low temperatures.

**Plan 03**

**What**  
Circulation created by the design of the seal chamber.

**Why**  
No external fluid recirculation needed.  
Solids removal from seal chamber.

**Where**  
Large bore/open throat seal chambers.  
Dirty or contaminated fluids.

**Plan 11**

**What**  
Seal flush from pump discharge through orifice.  
Default single seal flush plan.

**Why**  
Seal chamber heat removal.  
Seal chamber venting on horizontal pumps.  
Increase seal chamber pressure and fluid vapor margin.

**Where**  
General applications with clean fluids.  
Clean, non-polymerizing fluids.

**Plan 13**

**What**  
Recirculation from seal chamber to pump suction through orifice.  
Standard flush plan on vertical pumps.

**Why**  
Continuous seal chamber venting on vertical pumps.  
Seal chamber heat removal.

**Where**  
Vertical pumps.  
Seal chamber pressure is greater than suction pressure.  
Moderate temperature fluids with moderate solids.  
Non-polymerizing fluids.

**Plan 14**

**What**  
Seal flush from pump discharge and recirculation to pump suction with orifices.  
Combination of Plan 11 and Plan 13.

**Why**  
Continuous seal chamber venting on vertical pumps.  
Seal chamber heat removal.  
Increase seal chamber pressure and fluid vapor margin.

**Where**  
Vertical pumps.  
Clean, non-polymerizing fluids at moderate temperatures.

**Plan 21** *Single Seals*

**What**  
Seal flush from pump discharge through orifice and cooler.  
Cooler added to Plan 11 flush increases heat removal.

**Why**  
Seal cooling.  
Reduce fluid temperature to increase fluid vapor margin.  
Reduce coking.

**Where**  
High temperature service, typically less than 177°C (350°F).  
Hot water over 80°C (180°F).  
Clean, non-polymerizing fluids.

**Plan 23**

**What**  
Seal flush from internal pumping device through cooler.  
Standard flush plan in hot water services.

**Why**  
Efficient seal cooling with low cooler duty.  
Increase fluid vapor margin.  
Improve water lubricity.

**Where**  
High temperature service, hot hydrocarbons.  
Boiler feed water and hot water over 80°C (180°F).  
Clean, non-polymerizing fluids.

**Plan 31**

**What**  
Seal flush from pump discharge through cyclone separator.  
Centrifuged solids are returned to pump suction.

**Why**  
Seal chamber heat removal.  
Solids removal from flush and seal chamber.

**Where**  
Dirty or contaminated fluids, water with sand or pipe slag.  
Non-polymerizing fluids.

**Plan 32**

**What**  
Seal flush from an external clean source.

**Why**  
Seal chamber heat removal.  
Process and solids removal from seal chamber.  
Increase seal chamber pressure and fluid vapor margin.

**Where**  
Dirty or contaminated fluids, paper pulp.  
High temperature service.  
Polymerizing and/or oxidizing fluids.

**Plan 41**

**What**  
Seal flush from pump discharge through cyclone separator and cooler.  
Combination of Plan 21 and Plan 31.

**Why**  
Seal cooling.  
Solids removal from flush and seal chamber.

**Where**  
High temperature service, typically less than 177°C (350°F).  
Dirty or contaminated fluids, water with sand or pipe slag.  
Non-polymerizing fluids.

**Plan 52** *Dual Seals*

**What**  
Unpressurized buffer fluid circulation through reservoir.  
Fluid is circulated by a pumping ring in the dual seal assembly.

**Why**  
Outboard seal acts as a safety backup to the primary seal.  
Zero to very low process emissions.  
No process contamination is allowed.

**Where**  
Used with dual unpressurized seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Heat transfer fluids.

**Plan 53A**

**What**  
Pressurized barrier fluid circulation through reservoir.  
Fluid is circulated by a pumping ring in the dual seal assembly.

**Why**  
Isolate process fluid.  
Zero process emissions.

**Where**  
Used with dual pressurized seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Heat transfer fluids.  
Dirty/abrasive or polymerizing fluids.  
Mixers/agitators and vacuum service.

**Plan 53B**

**What**  
Pressurized barrier fluid circulation with bladder accumulator.  
Fluid is circulated by a pumping ring in the dual seal assembly.

**Why**  
Isolate process fluid.  
Zero process emissions.  
Higher pressure than Plan 53A.

**Where**  
Used with dual pressurized seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Heat transfer fluids.  
Dirty/abrasive or polymerizing fluids.

**Plan 53C**

**What**  
Pressurized barrier fluid circulation with piston accumulator.  
Fluid is circulated by a pumping ring in the dual seal assembly.

**Why**  
Isolate process fluid.  
Zero process emissions.  
Higher pressure than Plan 53A.  
Dynamic tracking of system pressure.

**Where**  
Used with dual pressurized seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Heat transfer fluids.

**Plan 54 & 55**

**Plan 54**  
**What**  
Unpressurized buffer fluid circulation by external system.  
**Why**  
Isolate process fluid.  
Zero process emissions.  
**Where**  
Used with pressurized dual seals.

**Plan 55**  
**What**  
Unpressurized buffer fluid circulation by external system.  
**Why**  
Outboard seal acts as a safety backup to the primary seal.  
Zero to very low process emissions.  
No process contamination is allowed.  
**Where**  
Used with unpressurized dual seals.

**Plan 62** *Quench Seals*

**What**  
External quench on atmospheric side of seal.  
Quench fluids typically steam, nitrogen, or water.  
Drain connection to be larger than inlet connection.

**Why**  
Prevent solids buildup on atmospheric side of seal.  
Prevent icing.

**Where**  
Used with single seals.  
Oxidizing fluids or fluids that coke, hot hydrocarbons.  
Crystallizing fluids or fluids that salt out.  
Caustic.  
Cold fluids less than 0°C (32°F).

**Plan 65A**

**What**  
External drain with leakage detection on atmospheric side of seal.

**Why**  
Safety indicator for primary seal detects failure.

**Where**  
May be used alone or with Plan 62 quench.  
Used with close clearance throttle bushing.  
Useful with single seals in remote locations and critical services.

**Plan 65B**

**What**  
External drain with leakage detection on atmospheric side of seal.

**Why**  
Leakage collection to detect for process leakage.  
Safety indicator to detect seal failure.  
Continuous monitoring of leakage rates to atmosphere.

**Where**  
Used with close clearance throttle bushing.  
Used with non-flashing, condensing fluids.  
Useful with seals in remote locations and critical services.

**Plan 66A**

**What**  
Leakage detection on atmospheric side of seal utilizing two throttle bushings in series.

**Why**  
Safety indicator for primary seal to detect failure.  
Minimize leakage from seal gland in case of seal failure.

**Where**  
May be used alone or with Plan 65A or Plan 65B.  
Used with flashing or non-flashing fluids.  
Useful with single seals in remote locations and critical services.  
Used with close clearance throttle bushings.

**Plan 66B**

**What**  
Leakage detection on atmospheric side of seal utilizing a throttle bushing and orifice plug.

**Why**  
Safety indicator for primary seal detects failure.

**Where**  
May be used alone or with Plan 65A or Plan 65B.  
Used with close clearance throttle bushing.  
Used with flashing or non-flashing fluids.  
Useful when adding atmospheric side leakage detection to an existing seal.  
Useful with single seals in remote locations and critical services.

**Plan 72** *Gas Seals*

**What**  
Unpressurized buffer gas control system.  
Containment seal support typically with nitrogen buffer gas.

**Why**  
Zero to very low process emissions.  
Safety backup to primary seal.

**Where**  
Used with dual unpressurized containment seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Clean, non-polymerizing, non-oxidizing fluids.  
Used in combination with Plan 75 and/or Plan 76.

**Plan 74**

**What**  
Pressurized barrier gas control system.  
Gas seal support typically with nitrogen buffer gas.

**Why**  
Isolate process fluid.  
Zero process emissions.

**Where**  
Used with dual pressurized gas seals.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Services that do not tolerate liquid barrier seals.  
Clean, non-polymerizing fluids.  
Moderate temperature fluids.

**Plan 75**

**What**  
Drain from containment seal cavity to liquid collector and vapor recovery.

**Why**  
Leakage collection for zero to very low process emissions.  
Safety indicator for primary seal.

**Where**  
May be used alone or with Plan 72 on containment seals.  
Fluids that condense at ambient temperature.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Clean, non-polymerizing, non-oxidizing fluids.

**Plan 76**

**What**  
Vent from containment seal cavity to vapor recovery.

**Why**  
Leakage collection for zero to very low process emissions.  
Safety indicator for primary seal.

**Where**  
May be used alone or with Plan 72 on containment seals.  
Fluids that do not condense at ambient temperature.  
High vapor pressure fluids, light hydrocarbons.  
Hazardous/toxic fluids.  
Clean, non-polymerizing, non-oxidizing fluids.

**Good Piping Practices**

**Plan 53A example**

- Minimize line losses
- Use large diameter tubing
- Only upward sloping lines. Slope shall be 40 mm/m (0.5 in/ft)

**Plan 23 example**

- Use long radius bends
- Minimize component losses
- Optimize for thermosiphon
- Check rotation direction
- Test for leaks

Dimensions: 0.91 m (3 ft) normal liquid level, 0.45 - 0.60 m (1.5 - 2 ft) high point vent, 1.2 m (4 ft) max low point drain, 0.9 m (3 ft) max low point drain.