

# Rotating Equipment Support

A photograph of an industrial facility at night, featuring several tall, cylindrical distillation columns and a complex network of pipes. The scene is illuminated by bright artificial lights, creating a high-contrast image against the dark sky. The columns are made of metal and have various ladders and walkways attached. The overall atmosphere is industrial and technical.

Presenter: Sean Hunsicker  
Sean.hunsicker@swagelok.com  
Product Line Leader – Smart Solutions

Swagelok®

# Why Pumps Fail

- Pump failures are a major cause of unplanned outages

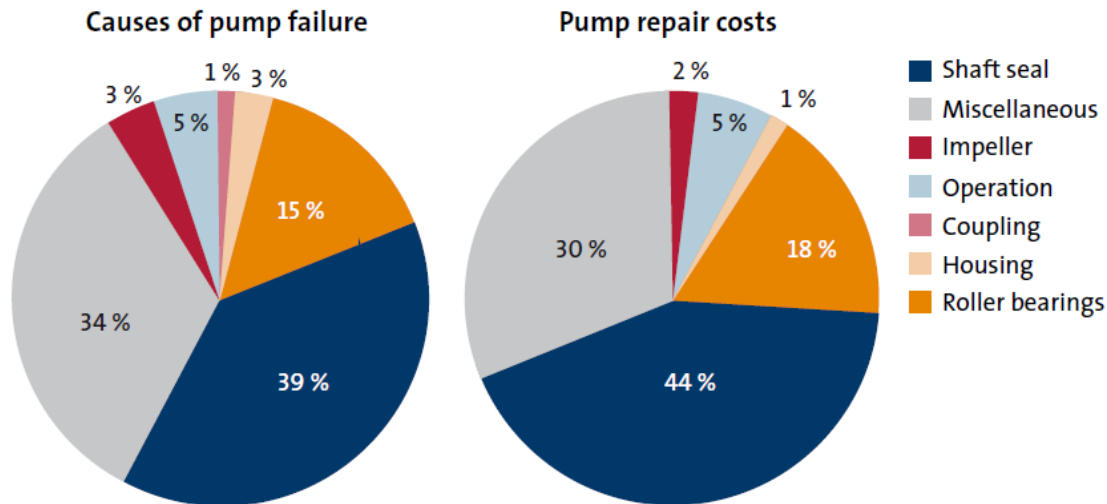


Fig. 5.1: Analysis of pump failure.  
Mechanical seals account for 39 %  
of pump failures. [1]

Fig. 5.2: Analysis of pump repair costs.  
Mechanical seals account for  
44 % of pump repair costs. [1]



# Pumps Metrics

**Table I. Pump MTBFs**

ANSI pumps, average, USA:	2.5 years
ANSI/ISO pumps average, Scandinavian P&P plants:	3.5 years
API pumps, average, USA:	5.5 years
API pumps, average, Western Europe:	6.1 years
API pumps, repair-focused refinery, developing country:	1.6 years
API pumps, Caribbean region:	3.9 years
API pumps, best-of-class, U.S. Refinery, California:	9.2 years
All pumps, best-of-class petrochemical plant, USA (Texas):	10.1 years
All pumps, major petrochemical company, USA (Texas):	7.5 years

**Table II. Suggested Refinery Seal Target MTBFs**

Target for seal MTBF in oil refineries	
Excellent	>90 months
Very good	70/90 months
Average	70 months
Fair	62/70 months
Poor	<62 months

**Table III. Realistic Target Pump & Component Lives**

*(Note that "target" is less than "best actually achieved")*

		Refineries	Chemical and other plants
SEALS	Excellent	90 months	55 months
	Average	70 months	45 months
COUPLINGS	All plants	Membrane type	120 months
		Gear type	> 60 months
BEARINGS	All plants	Continuous operation:	60 months
		spared operation	120 months
PUMPS	Based on series system calculation		48 months



# Bad Actor Pumps

## Pump P20143

- service: reduced crude
- Total repairs in last 5 yrs: 12
- Average life in 5 yrs (mnths): 4.61
- Total seal cost: \$94,313
- Status: in progress
- Root cause/corrective action: loss of seal flush/  
will install Plan 54 circulator

The image shows a large, multi-page document titled "BAD ACTOR PUMPS - PROJECT LIST". The document is a detailed table listing various pump repair projects. The table has multiple columns, including "PUMP ID", "SERVICE", "REPAIR DATE", "REPAIR DESCRIPTION", "REPAIR COST", and "TOTAL COST". The table is filled with rows of data, and several rows are highlighted in yellow and blue. The document is placed on a dark surface, and a small "S" logo is visible in the bottom right corner.



# Mechanical Seal Support Systems

- Swagelok Distributors are offering a product, panel or skid for the Piping Plan specified by the customer
  - 3 categories:
    - Process Side – Flush Plans
    - Between Seal – Seal Pots, Gas Seal Plans
    - Atmospheric – Quench, Leakage Collection





# Old Pipe systems

- Piping systems- ½" schd. 80 common
- Leak points, 90 degree elbows provide flow restriction
- Carbon steel has replacement schedule



# First Versions of Gas Panel seal provider designs

- Design of panels was extremely basic
- Little consideration given to quality of individual components
- Reliability and maintenance of panel not given sufficient consideration



# Plan 72 & 74 – Swagelok Design

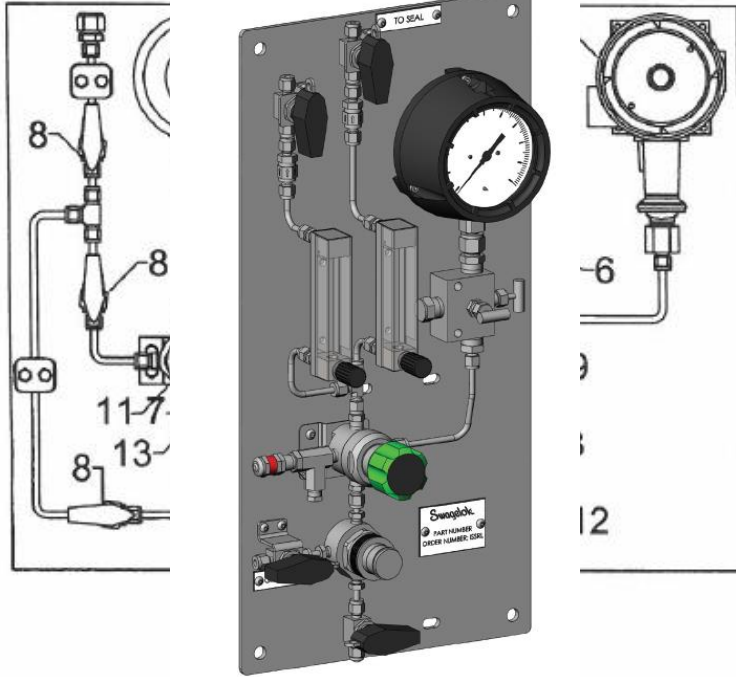


Fig. 41 API Plan 72 Panel  
Panel shown with some optional components.

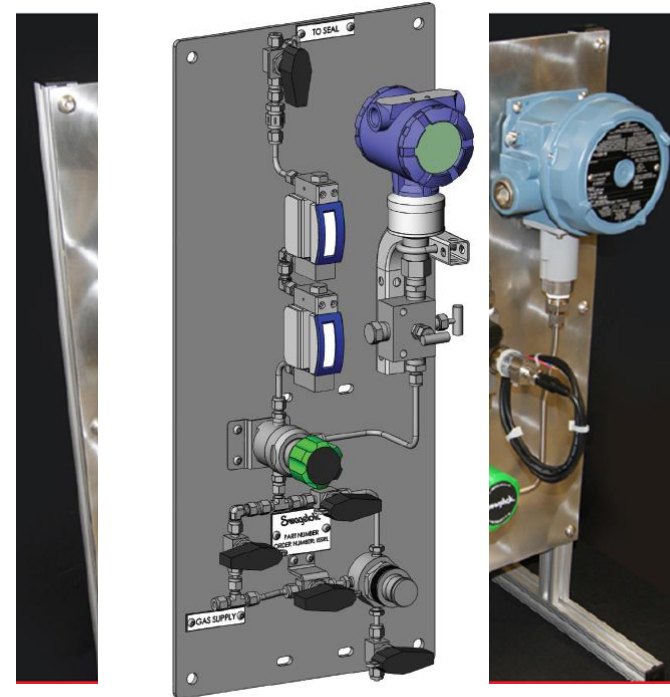


Fig. 44 API Plan 74 Panel  
Panel shown with some optional components.





## Atmospheric Side Plans

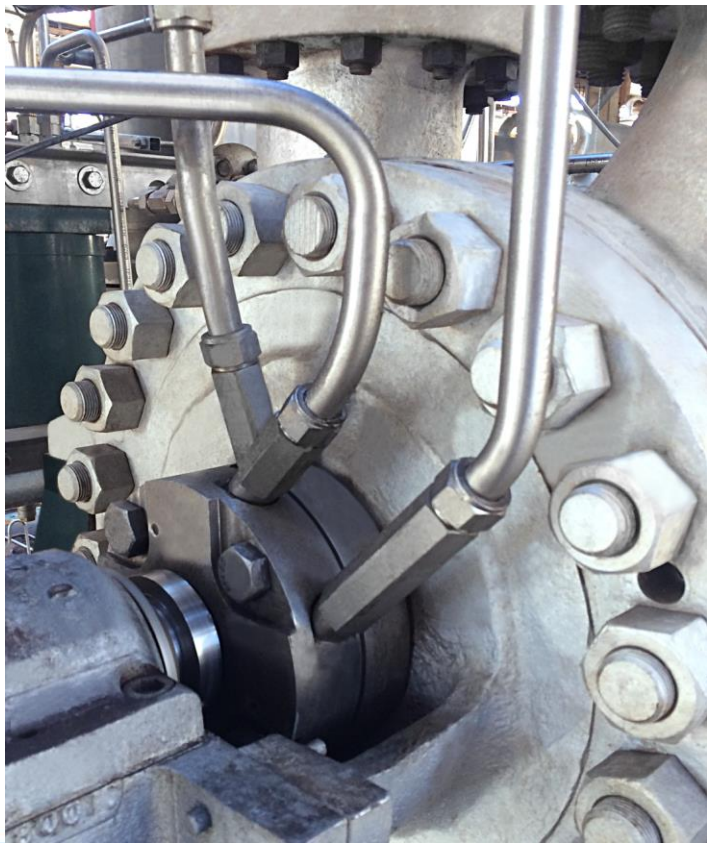


# Seal Flush System

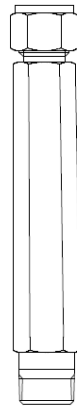
- Nipple is generally 4" to 6" in length
- Potential leak point at first fitting
- Carbon steel instead of stainless
- Low quality threads can cause gland port damage



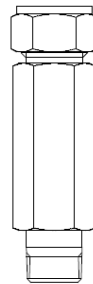
# Extended Male Connector



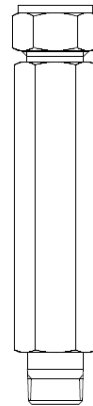
SS-810-1-8-50553  
 $\frac{1}{2}$ " Tube x  $\frac{1}{2}$ " MPT  
4" OAL



SS-810-1-8-49485  
 $\frac{1}{2}$ " Tube x  $\frac{1}{2}$ " MPT  
6" OAL



SS-1210-1-8-50553  
 $\frac{3}{4}$ " Tube x  $\frac{1}{2}$ " MPT  
4" OAL



SS-1210-1-8-49485  
 $\frac{3}{4}$ " Tube x  $\frac{1}{2}$ " MPT  
6" OAL



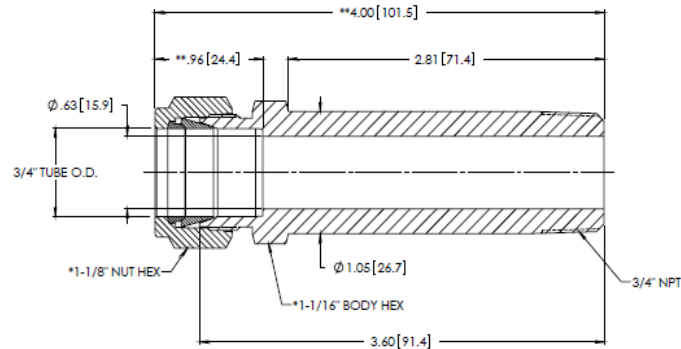
# Recessed Port Flush Connections





# Machined Shank Extended Male Connector

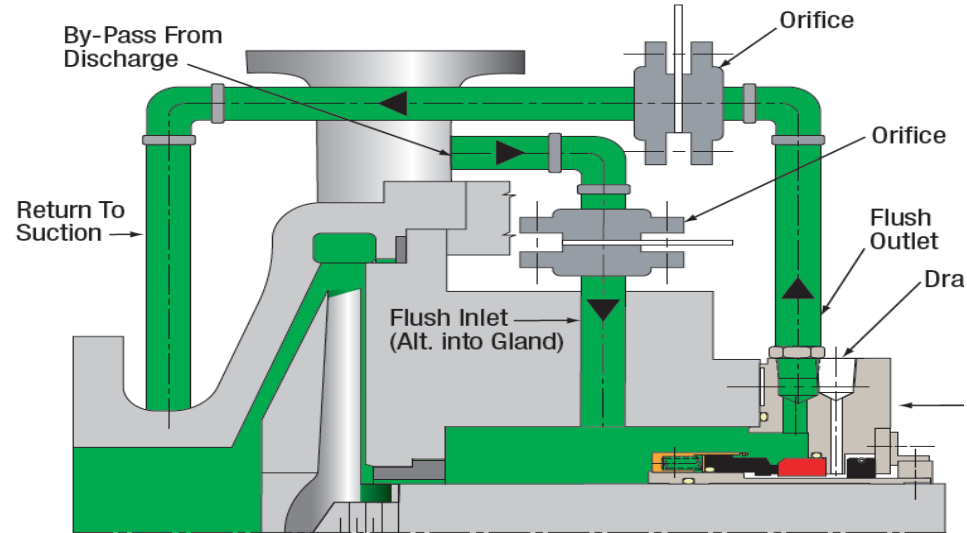
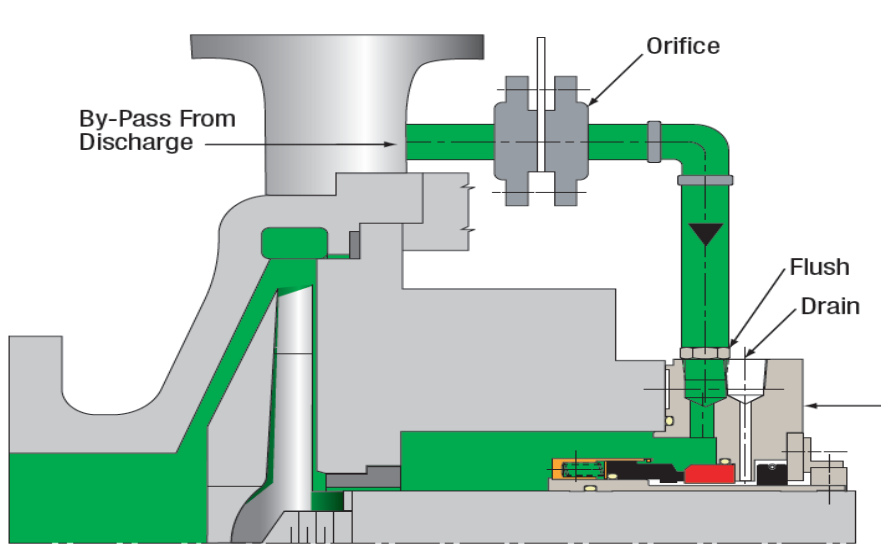
- SS-810-1-8-52166 (4" OAL)
- SS-810-1-8-52167 (6" OAL)
- SS-1210-1-12-52166 (4" OAL)
- SS-1210-1-12-52167 (6" OAL)



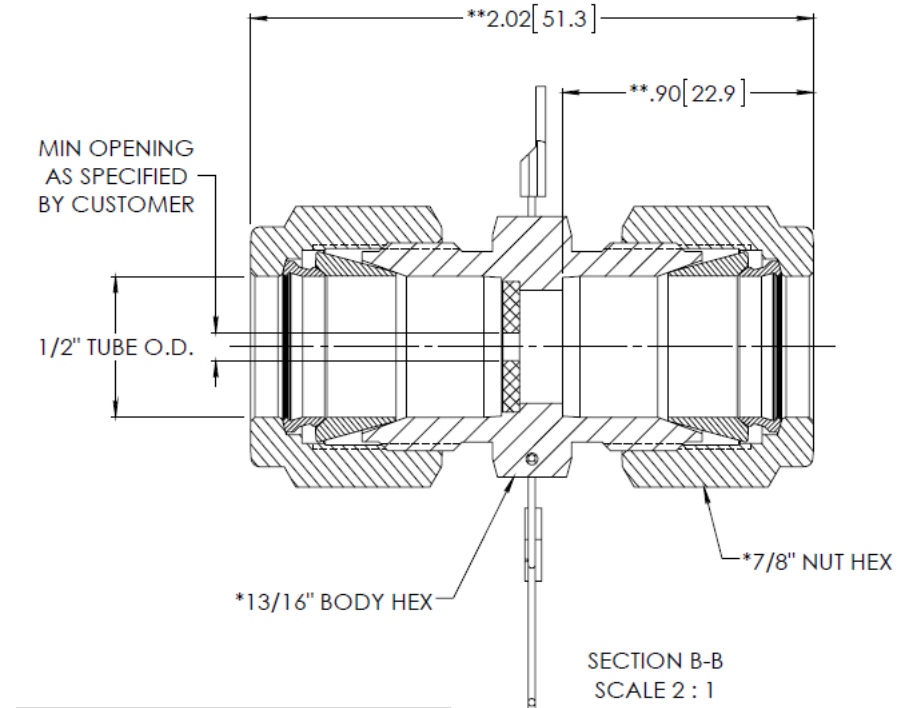
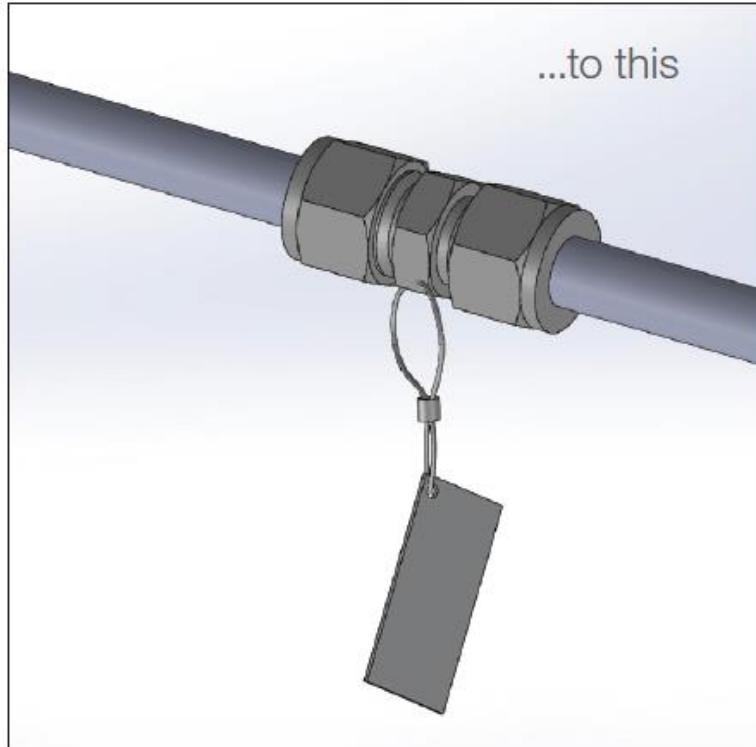
# Even new installs need help



# Flush Plans

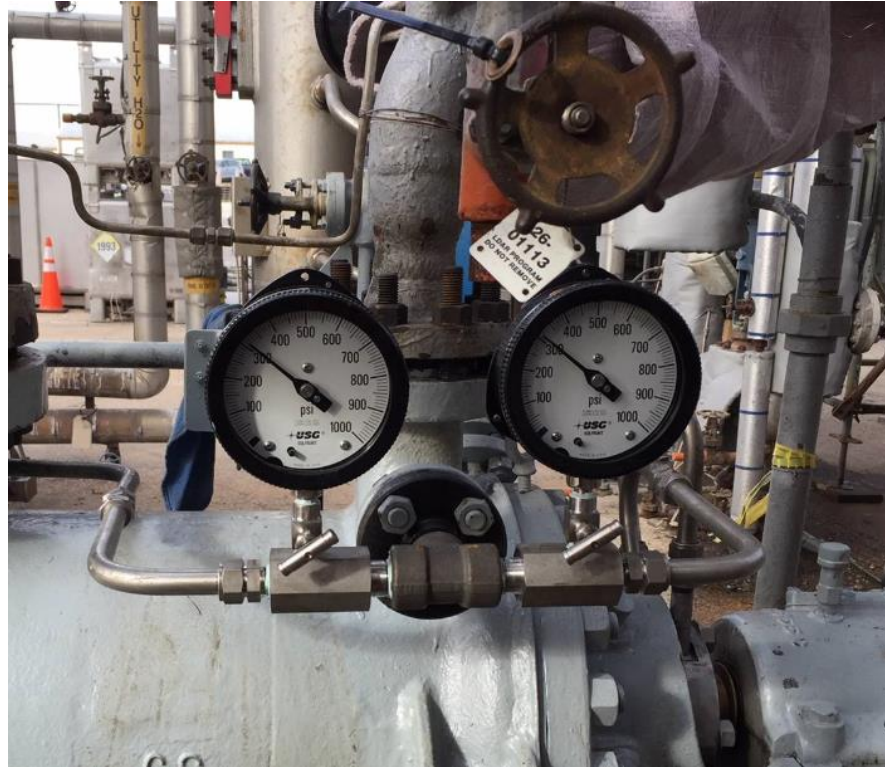


# Orifice Fittings





# Between Bearing Pumps

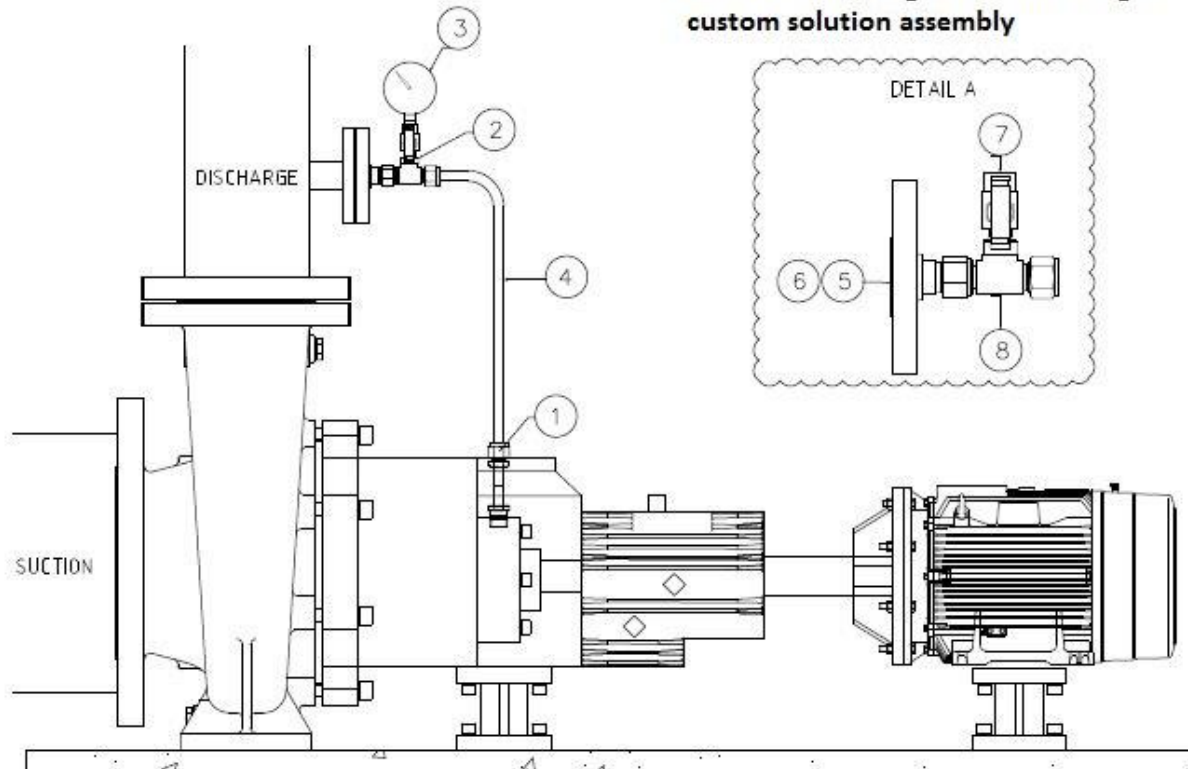


# Flanged Orifice Fittings

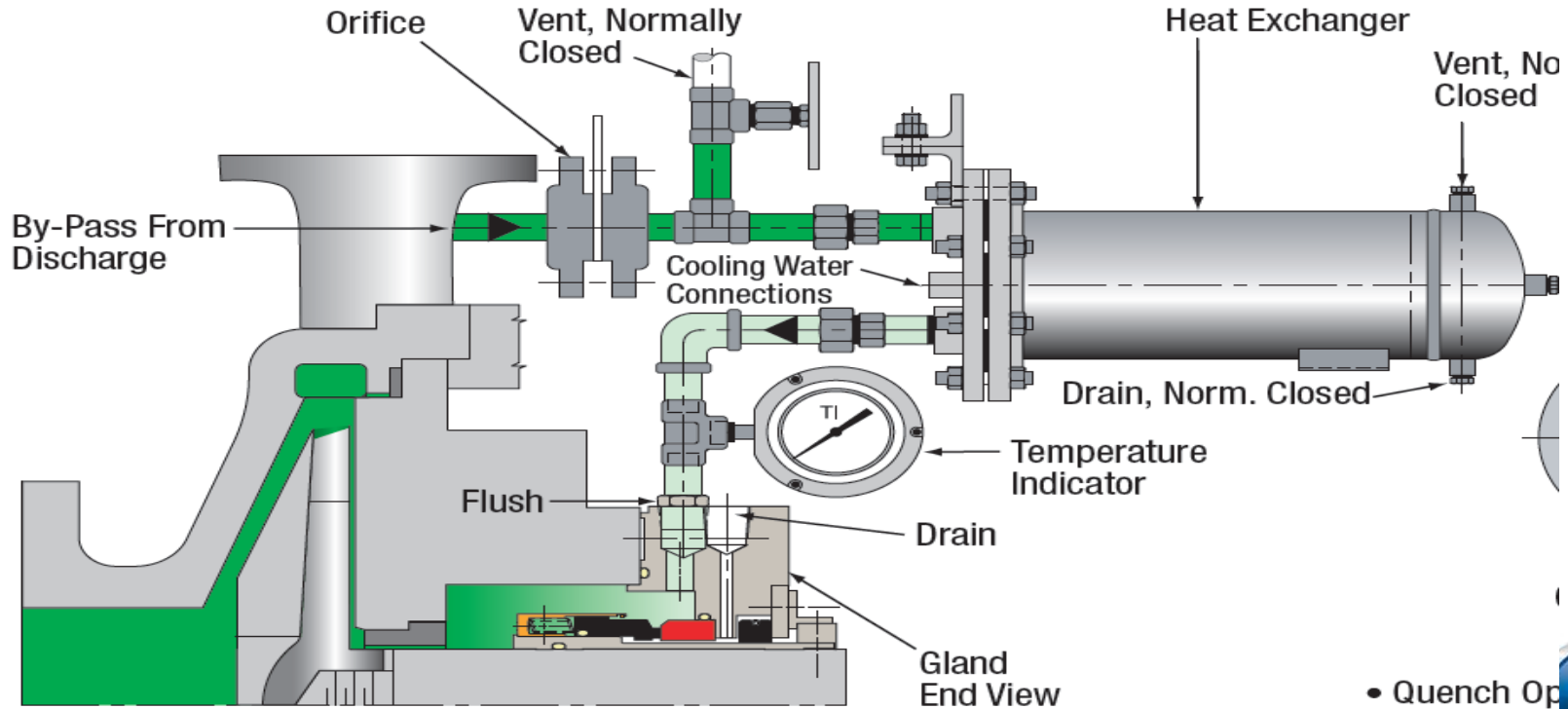


# API 682 – Orifice Fitting Assemblies

**Plan 11 with Swagelok orifice flange  
custom solution assembly**



# Cooled flush plans



• Quench Op

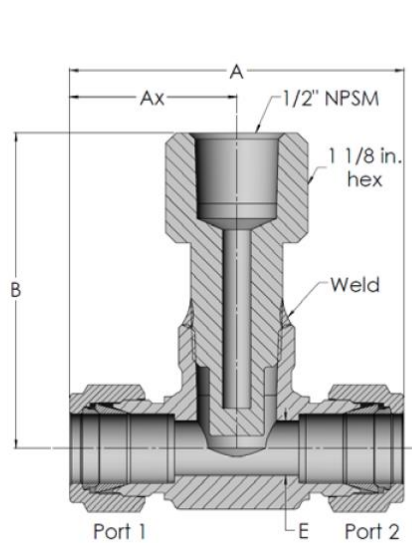




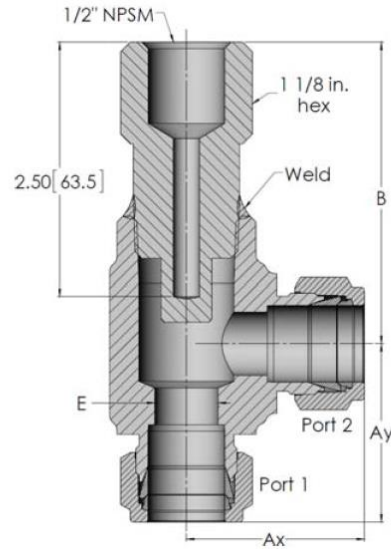


# Thermowell Tee

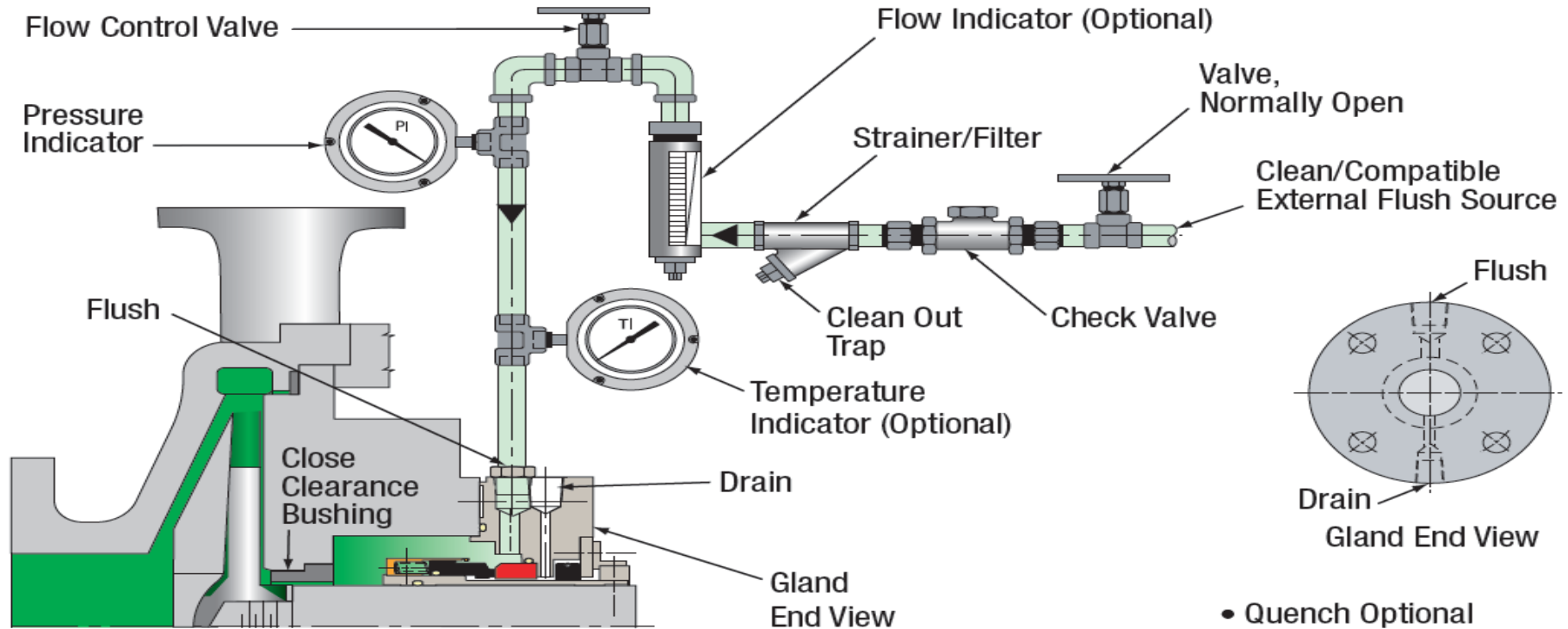
**Straight  
Pattern**



**Angle  
Pattern**



# Flush Plan

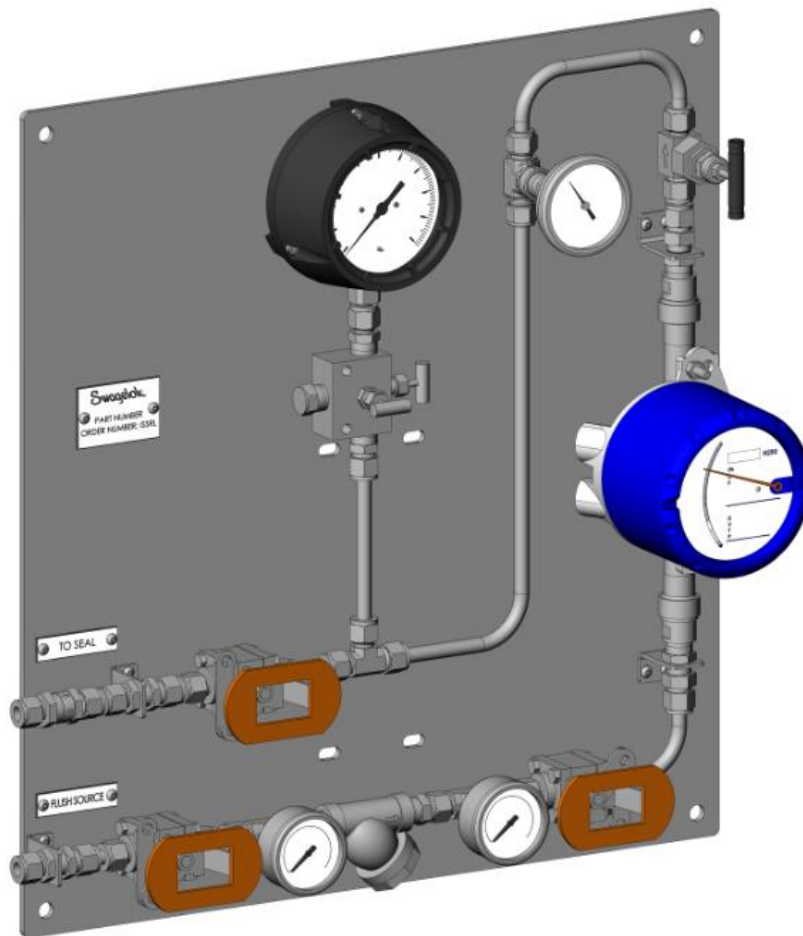


# Flush Plan

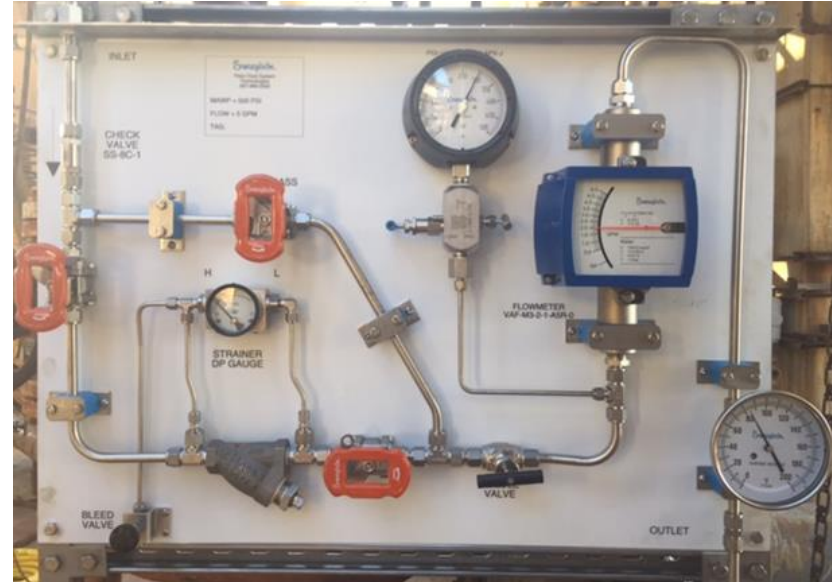




# Flush - Plan 32



# Flush Panel

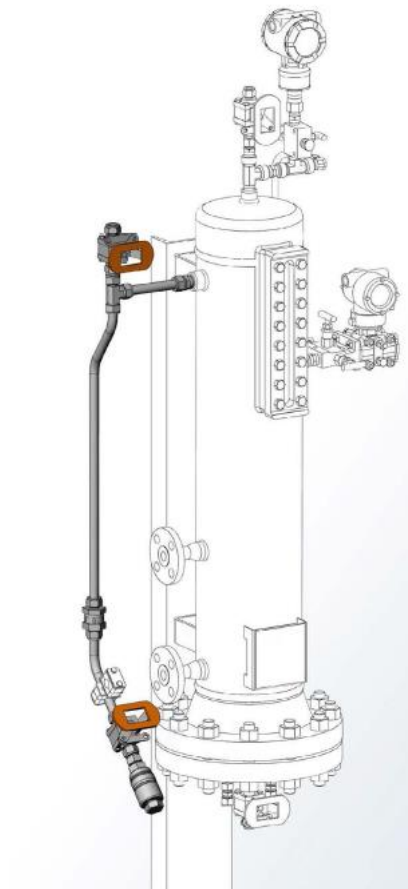
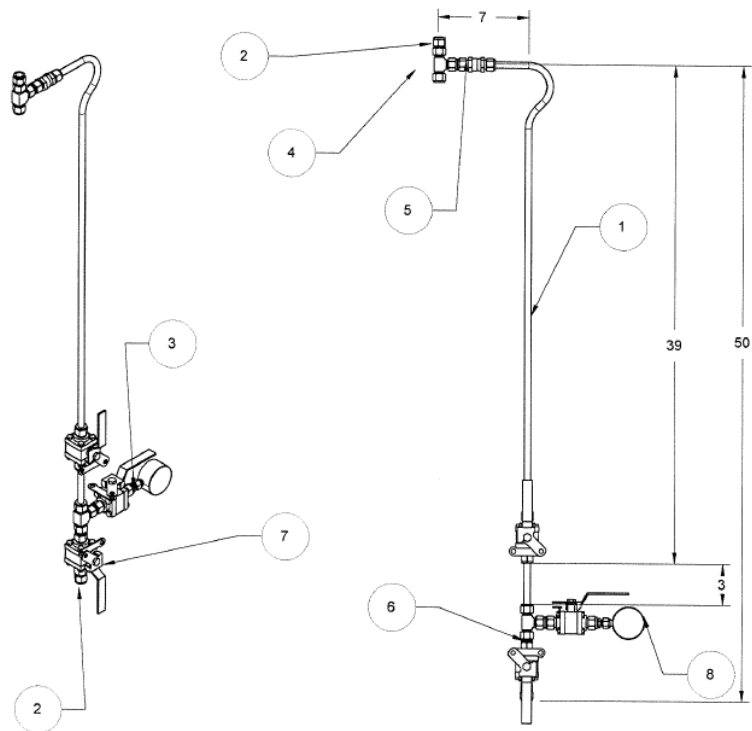


# Safety improvements

- Application Overview:
  - Refilling seal pots
- Previous method to refill seal pot:
  - Refill procedure is cumbersome, inefficient and costly (4hrs)
    - Shut down and cool equipment
    - Health and safety issues
      - Use of ladder or climb on equip
      - Exposure to hot / hazardous vapors (up to 300 psi & 350F)



# Safe Fill Assembly





# Seal Pot Fill Tube Application

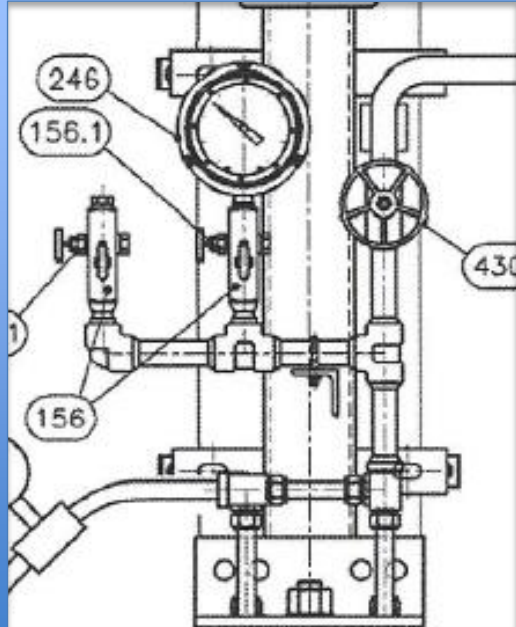
- New method to refill seal pot:
  - Provides for online refill
    - Each seal pot has a fill tube
    - Check valve provides online refill
      - Reduced cost / no downtime
    - Standardized design
      - Use of tube adapters
  - Safe operation
    - Operator works from ground level
    - Gauge indicates pressure in line
    - No exposure to vapors
    - Single method to fill all seal pots on site







# Plan 53B



TEMPERATURE INDICATORS FOR INLET AND OUTLET OF COOLER ARE RECOMMENDED

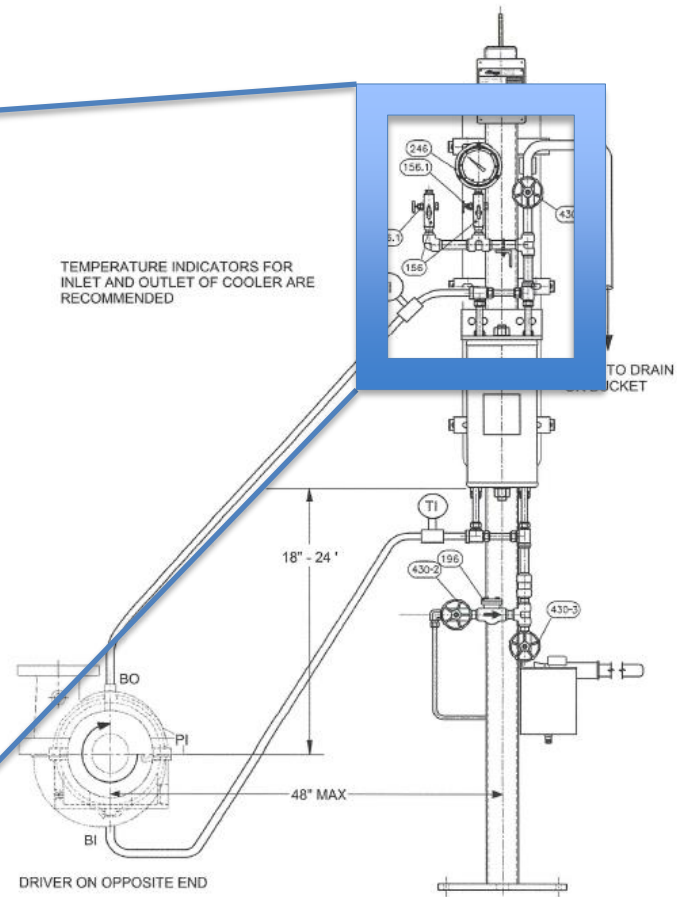
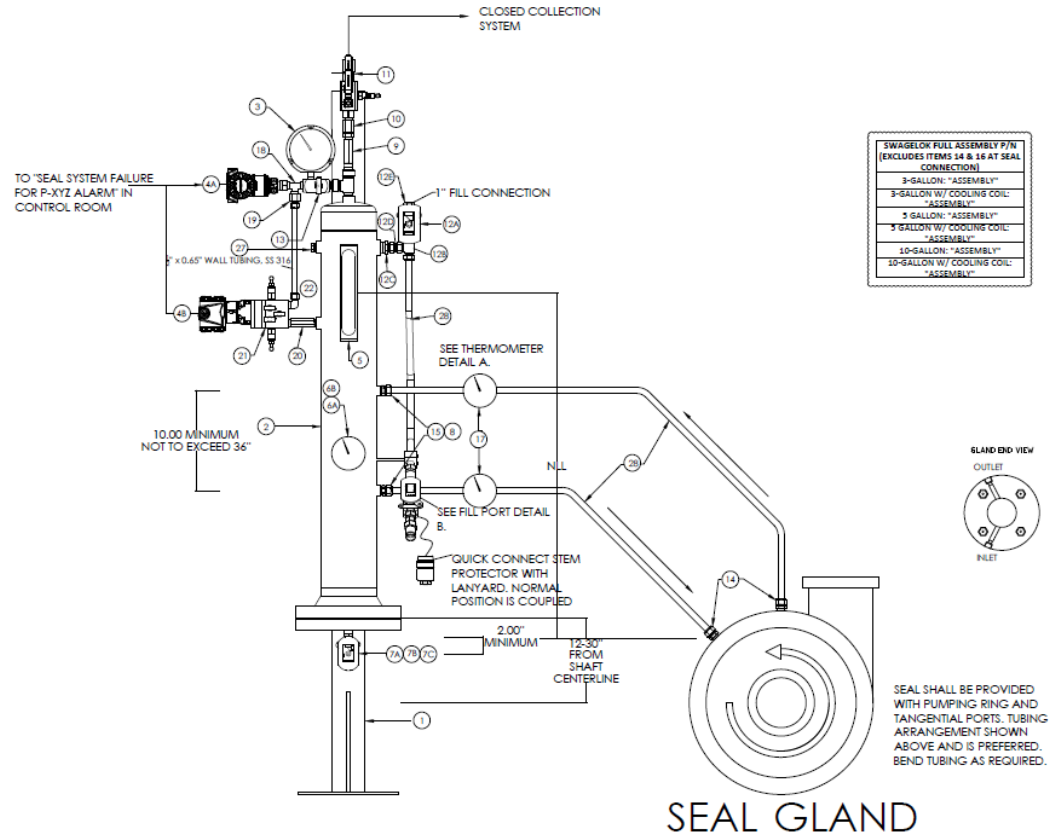


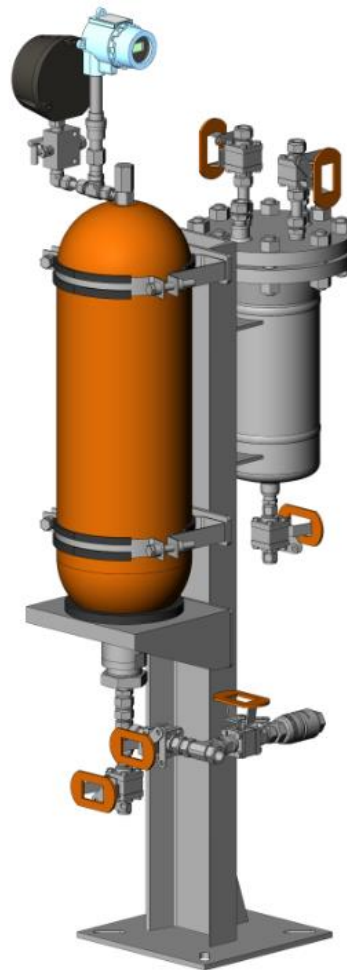
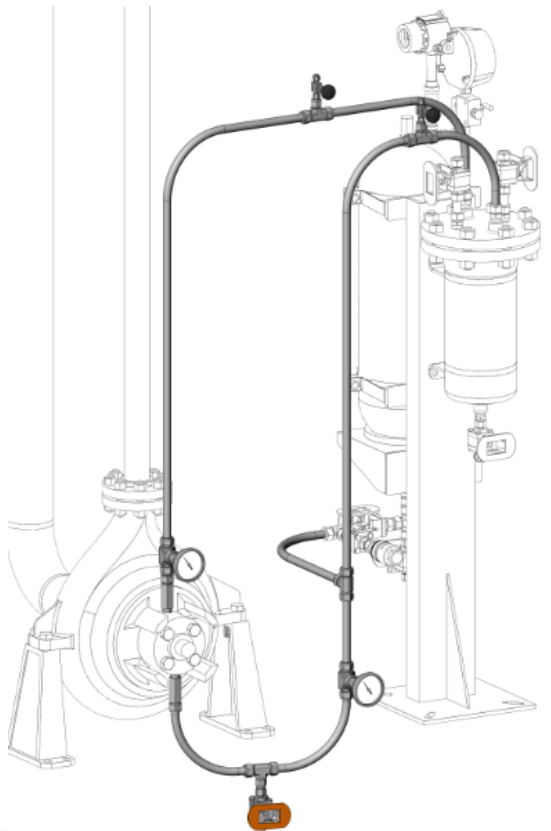
Figure 1 Plan 53B Assembly



# Seal Pot System



# Connection Kits



# Circulating Systems







# Application Guide

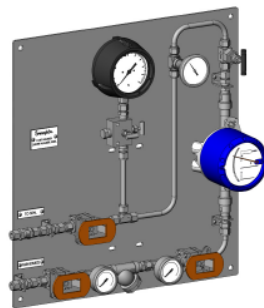
## API Plan 32

API Plan 32 delivers a clean flush fluid into the seal chamber from an external source. Typically used with a close-clearance throat bushing, this arrangement can be used to ensure a higher pressure in the seal chamber. Flush fluid will migrate past the bushing so it is important to ensure the flush stream is chemically compatible with the process fluid and that process fluid dilution is not a concern.

### Plan 32

- Provides clean flush fluid to the seal chamber when the process media is unsuitable to be used as the flush fluid
- Increases the seal chamber pressure and fluid vapor margin

Plan 32 is available as an assembled panel. The associated field installation kit for use in connecting the panel to your system is also available.

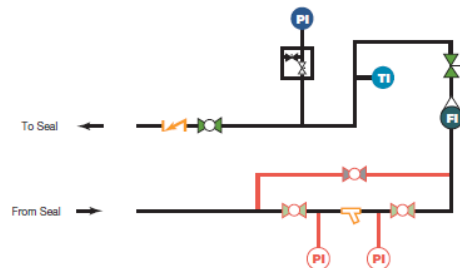


**Fig. 18 API Plan 32 Panel**  
Panel shown with optional components.

### Panel contents:

- Swagelok tube fittings
- 63 series ball valves
- CH series check valve
- V series 2-valve manifold
- M4 model flowmeter
- N series needle valve
- Bimetal thermometer
- TTW series thermowell tee
- PGI series gauges
- Swagelok pipe fittings
- Pressure transmitter
- Mounting panel
- Brackets/miscellaneous hardware

See page xx for additional information on individual components.



**Fig. 19 API Plan 32 P&ID**

Optional components shown in red.

Contact your authorized sales and service center for information on optional components.



# Kits & Assemblies

## Plan 11 Kit

### Ordering Information

Build an ordering number by combining the designators in the sequence shown.

#### Plan 11 Kit

SPK11 -  -  -  -  -  -  - 

#### 1 Primary Tubing Size

C = 1/2 in.  
K = 12 mm

#### 2 Seal Connection (Flush)

B = 3/8 in. female NPT  
C = 1/2 in. female NPT  
D = 3/4 in. female NPT  
H = G 3/8  
J = G 1/2  
K = G 3/4

#### 3 Seal Connector Type (Flush)

1 = Standard female connector  
2 = Standard male connector  
3 = 4 in. extended male connector, hex  
4 = 6 in. extended male connector, hex  
5 = 4 in. extended male connector, machined  
6 = 6 in. extended male connector, machined

Ⓢ Installation will require use of pipe nipple (included in kit when female connector selected).

#### 4 Seal Connection Instrumentation (Flush)

1 = None  
2 = Pressure gauge  
3 = Pressure transmitter

#### 5 Pump Discharge Connector Type

C = 1/2 in. female NPT  
D = 3/4 in. female NPT  
M = 1/2 in. Class 150 ANSI flange  
N = 1/2 in. Class 300 ANSI flange  
P = 3/4 in. Class 150 ANSI flange  
Q = 3/4 in. Class 300 ANSI flange

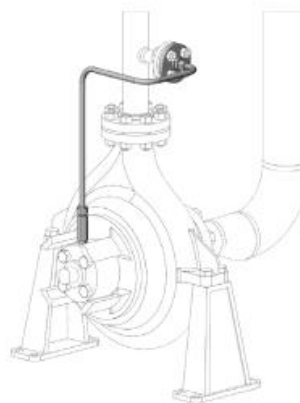
#### 6 Pump Discharge Instrumentation

1 = None  
2 = Pressure gauge  
3 = Pressure transmitter  
4 = Thermometer  
5 = Pressure gauge and thermometer  
6 = Pressure transmitter and thermometer

#### 7 Flow Control Orifice

1 = None  
2 = Tube fitting union  
3 = Integral to flange adapter  
4 = Orifice plate

Ⓢ Not compatible with pump discharge instrumentation pressure gauge or pressure transmitter. Must select an ANSI flange pump discharge connector with this option.



**API Plan 11**  
Kit components shown solid  
and include optional  
components.



# Configurable CAD File

Easy to use:

1. Select system
2. Select Part Number
3. Click Configure

Outputs:

- Bill of materials
- Description
- Estimated processing time
- Assumptions / notes
- Configured CAD File

Swagelok

1 2 3 4 5 6 7 8 9  
SPK 21 - C - C 3 1 - 1

**General**

**1 Product Type**  
SPK = Seal Plan Kit

**2 Seal Plan**  
21 = Seal Plan 21

**3 Primary Tubing Size**  
C = 1/2 Inch  
K = 12mm

1. Not compatible with Pump Discharge Connection gauge or transmitter. Must select flanged Pump Discharge Connection.

**Seal Connection (Flush)**

**4 Connection Size/Type**  
B = 3/8" FNPT  
C = 1/2" FNPT  
D = 3/4" FNPT  
H = G 3/8  
J = G 1/2  
K = G 3/4

**5 Connector Style**  
1 = Standard Female Connector  
2 = Standard Male Connector  
3 = 4" Extended Male Connector, Hex  
4 = 6" Extended Male Connector, Hex  
5 = 4" Extended Male Connector, Round  
6 = 6" Extended Male Connector, Round

**6 Instrumentation**  
1 = None  
2 = Pressure Gauge  
3 = Pressure Transmitter  
4 = Thermometer  
5 = Gauge and Thermometer  
6 = Transmitter and Thermometer

**Large Connection**

**7 Connection Size/Type**  
1 = 1/2" FNPT  
D = 3/4" FNPT  
M = 1/2" 150# ANSI Flange  
N = 1/2" 300# ANSI Flange  
P = 3/4" 150# ANSI Flange  
Q = 3/4" 300# ANSI Flange

**8 Instrumentation**  
1 = None  
2 = Pressure Gauge  
3 = Pressure Transmitter  
4 = Thermometer  
5 = Gauge and Thermometer  
6 = Transmitter and Thermometer

**9 Orifice**  
A = No Orifice  
B = Tube Fitting Union  
C = Integral to Flange Adapter<sup>1</sup>  
D = Orifice Plate<sup>1</sup>

Expert Mode Configure Clear Help Back

