

A Guide to Sealing ETHANOL PLANTS



- ETHANOL PRODUCTION
- SEAL SUPPORT SYSTEMS
- SEALING GUIDE
- MECHANICAL SEAL SELECTION

Types of Ethanol Produced

There are several different types of Ethanol being produced today. The main one is Grain-Ethanol which has grown in production from 200 million gallons per year in 1979 to 1.9 billion gallons per year in 2000. Feed Stocks for this are corn, wheat, barley, Sorghum and Milo. Another major type of Ethanol is Cellulosic-Ethanol for which feed stocks include forest residues, waste paper and municipal solid waste.

Background

The primary ingredients of Ethanol are 199.9 proof Anhydrous Ethanol (Grain Alcohol) and a Denaturing liquid such as Gasoline. Ethanol production recently has under gone a resurgence due to the demand for low emissions vehicles and alternative fuel vehicles. Currently, new vehicles are being manufactured which can utilize an 85% Ethanol 15% Gasoline blend (E85).

To meet this growing demand for Ethanol, many existing Ethanol plants are modernizing and expanding their production. There were approximately 60 Ethanol production facilities in the USA in 2003. There are also numerous cooperative owned and operated ethanol production facilities that are coming on line and more are under construction. Current Ethanol production in the USA is 1.9 billion gallons annually and the demand is expected to exceed 3.0 billion gallons annually by 2010 and 4.5 billion gallons annually by 2015.

Grain Ethanol Production

Currently most Anhydrous Ethanol is distilled from cornstarch, which can be produced by the dry milling or wet milling process. In the wet milling process the corn kernel is steeped or soaked to allow it to be separated into germ, fiber and gluten, which are recovered and processed as by-products of the process. In dry milling the corn is ground into flour (meal) and processed without the separation of the component parts. Both processes produce similar yields of Ethanol (2.5-2.75 gallons per bushel of corn), though most modern plant designers prefer the wet milling process.

Note: Information on wet corn milling can be found in the AESSEAL® "Corn Wet Milling and Refining" brochure (L-UK/US-CORN-03), though Ethanol production plants are usually smaller than wet corn milling plants producing corn syrup.

The corn starch is broken down even further in the Liquifaction and Saccharification processes to form fermentable sugars. This process takes place with the addition of steam and enzymes and requires 10-20 gallons of water at 12 pounds of steam per bushel of corn.

The fermentable sugars are then mixed with yeast to begin the fermentation process. The mash passes through several fermentation phases and is then cooled and mixed with more enzymes before proceeding with the fermentation process. CO₂ gas is a byproduct of this process and can be captured and sold or processed through a scrubber system to recover all residual alcohol and then released to the atmosphere.

When the fermentation process is complete the mash alcohol content is between 10-13%. The beer mash is transferred to holding tanks called "beer wells". The mash is stored in the beer wells and is metered into the distillation columns (beer columns) where the solids and water are removed to form 95% purity (190 proof) alcohol. During the distillation process, the mash is passed through reboilers to separate the water from the Ethanol. The solids (stillage) fall to the bottom of the distillation column and are collected and processed and sold as Distillers Wet Grain (DWG) for use as animal feed.

In order to mix the alcohol with Gasoline the remaining 5% of the water must be removed. Modern plants pump the alcohol through molecular sieves, which remove the remaining water and bring the alcohol to 198.6-199.9 proof (Anhydrous Ethanol). Other processes used to remove the remaining water are Grits Dehydration and Azeotropic Dehydration.

The Anhydrous Ethanol is then mixed with a denaturing liquid such as Gasoline to provide the composition required by the government for the typical properties of fuel Ethanol. Usually the percentage of Anhydrous Ethanol to Gasoline is 95.3% Fuel Ethanol to 4.7% Gasoline.

Grain Ethanol Wet Milling Process



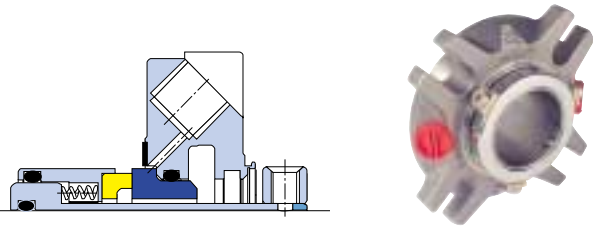
Guide to Sealing Ethanol

Mechanical Seal Selection for Ethanol Production Plants

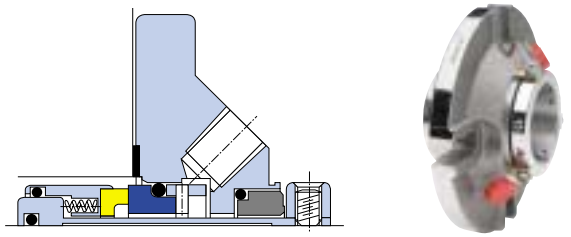
Description	Fluid	Solids %	Temp (F)	Specific Gravity	AESSEAL® Seal Design	Metallurgy	Suggested Seal Faces and Elastomers	API Plan/Seal Support System
Wet Corn Milling								
Cook Water Pump	Grain Mash/Water	1.0%	90	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Slurry Pump	Thin Stillage Mash	30.0%	185	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW02
Flash Vessel Pump	Thin Stillage Mash	30.0%	185	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW02
Starch Conversion								
Liquifaction Feed Pump	Thin Stillage Mash	32.0%	185	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW02
Yeast Feed Pump	Thin Stillage Mash/Yeast Slurry	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Alpha Amylase Mix Pump	Enzyme	0.0%	80	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Gluco Amylase Mix Pump	Enzyme	0.0%	80	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Fermentation								
Fermenter Feed Pump	Thin Stillage Mash	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Fermenter Drain Pump	Thin Stillage Mash/Water	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIP Fermenter Pump	5% NaOH	2.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW02
CO2 Scrubber Pump	Water	0.0%	85	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Fermenter Recirculation Pumps	Thin Stillage Mash	12-29%	95	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Berwell Discharge pump	Thin Stillage Mash	12-29%	90	1.06	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE10 SW02
Distillation								
1st Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-13%		212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
2nd Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-13%		212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
3rd Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-13%		212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Steam Condensate Receiver Pump	Water	0.0%	212	0.96	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
4th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 3.0%		212	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
5th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-38%		200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
6th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-38%		200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
7th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-38%		200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
8th Effect Evaporation Pump	Beer Stillage / Thin Stillage Syrup 7-38%		200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Evap. Process Condensate Pump	Water	0.0%	200	0.97	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
Evaporator Drain Pump	Thin Stillage Syrup	0-38%	200	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Evaporator Syrup Pump	Thin Stillage Syrup	1.0%	188	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
EtOH (Ethanol) Evaporation Pump	Syrup	1.0%	183	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Beer Bottoms Pump	Ethanol/Water/Solids	12.0%	183	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 25 SW03
Side Stripper Bottoms Pump	Water	0.0%	183	0.97	SMSS	AISI 316L	ANT CB/TC/AFLAS	Plan 11 + Finned Tubing
Rectifier Bottoms Pump	Ethanol/Water/Solids	30.0%	183	0.80	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW03
Dehydration								
Reflux Pump (Distillation Pump)	95% Ethanol	0.0%	130	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Molecular Sieve Regen Pump	199.9 Proof Ethanol	0.0%	77	0.90	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
200 Proof Product Pump	Anhydrous Ethanol	0.0%	200	0.80	CDSA/CDPN	AISI 316L	CB/TC//TC/CB/AFLAS/VITON	52/SSE 10 SW02
Separation								
Whole Stillage Discharge / Centrifuge Feed Pump	Thin Stillage Mash	15.0%	180	1.20	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Evaporator Transfer Pump	Syrup	4.5%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Centrate Pump	Thin Stillage Mash	7.0%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Syrup Pump	Thin Stillage Syrup	7.0%	180	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Evap Feed Pump	Thin Stillage Mash	7.0%	180	1.00	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Final Product								
Denaturant Pump	Gasoline	0.0%	80	0.67	CURC/CSSN	AISI 316L	CB/TC/VITON	11
Ethanol Loadout Pump	Denatured Ethanol / Gas	0.0%	80	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Ethanol Transfer Pump	Anhydrous Ethanol	0.0%	80	0.80	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Utilities								
CIP Make-up	5% NaOH	2.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIPS Pump	5% NaOH	1.0%	140	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
CIPS Fermenter Pump	5% NaOH	1.0%	140	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Raw Water Pump	Water	0.0%	50	1.00	CURC/CSSN	AISI 316L	TC/TC/AFLAS	11
Chiller Pump	Water	0.0%	70	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
RO Product Pump	Water	0.0%	55	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Process Water Pump	Water	0.0%	70	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
50% NaOH Pump	50% NaOH	1.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
50% NaOH Unload Pump	50% NaOH	1.0%	70	1.53	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Waste NaOH Meter Pump	5% NaOH	1.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Acid Wash Pump	Sodium Bisulfite	1.0%	170	1.10	CDSA/CDPN	AISI 316L	TC/TC//TC/CB/AFLAS/VITON	53/SSE 10 SW02
Cooling Tower Pump	Water	0.0%	90	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Optional								
Methanator Product Pump	Water	0.0%	120	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11
Methanator Recycle Pump	Water	0.0%	120	1.00	CURC/CSSN	AISI 316L	CB/TC/AFLAS	11

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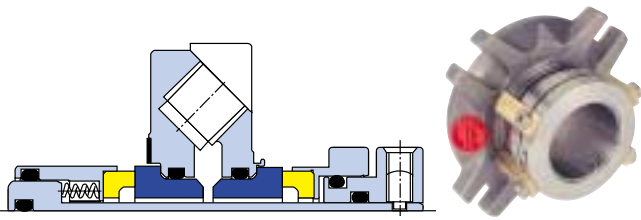
CSSN™ - Cartridge Mounted Single Seal



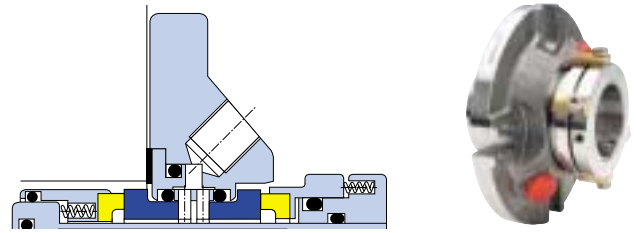
CURC™ - Cartridge Mounted Single Seal with Self-Aligner



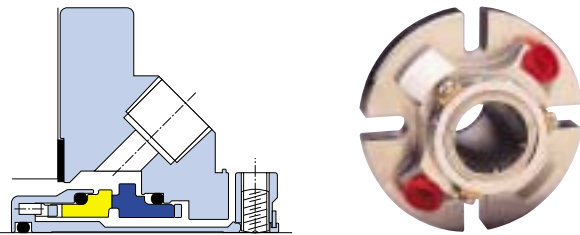
CDPN™ - Cartridge Mounted Double Seal



CDSA™ - Cartridge Mounted Double Seal with Self-Aligner

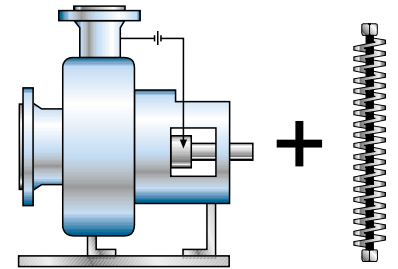


SMSS™ - Single Monolithic Stationary Seal

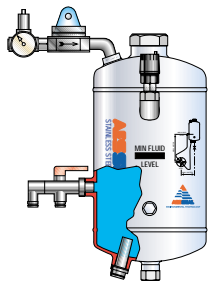


API Plan 11 and Finned Tubing

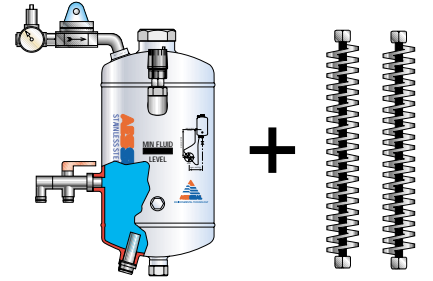
API Plan No.11
Product Recirculation
from Pump Discharge
to Seal using
Finned Tubing



**API Plan 52/53
SSE10™ / SWO2™**



SSE10™ / SWO3™



THIS DOCUMENT IS DESIGNED TO PROVIDE DIMENSIONAL INFORMATION AND AN INDICATION OF AVAILABILITY.
FOR FURTHER INFORMATION AND SAFE OPERATING LIMITS CONTACT OUR TECHNICAL SPECIALISTS AT THE LOCATIONS BELOW.

WINNER OF THE
NATWEST
SUNDAY TIMES
COMPANY OF
TOMORROW
AWARD



INVESTOR IN PEOPLE

USE DOUBLE MECHANICAL SEALS
WITH HAZARDOUS PRODUCTS.
ALWAYS TAKE SAFETY
PRECAUTIONS:

- GUARD YOUR EQUIPMENT
- WEAR PROTECTIVE CLOTHING



WARNING

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