AESSEAL®

ENVIRONMENTAL TECHNOLOGY

Guide to Sealing the Chocolate Confectionery Industry

- CHOCOLATE CONFECTIONERY PRODUCTION
- SEALING SOLUTIONS
- USE OF BARRIER FLUID SYSTEMS
- USE OF THE AESSEAL® MAGTECTA™

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Description **Page**

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We would like to thank the BCCCA (Biscuit, Cake, Chocolate and Confectionery Alliance) for giving us permission to use pictures Fig.1, Fig.2, Fig.3, Fig.4, Fig.5 and Fig.6.

We would like to thank the BPMA (British Pump Manufacurers Association) for giving us permission to use pictures Fig.7, Fig.9, Fig.11, Fig.13 and Fig.14.

We would like to thank JP Pumps Ltd (Johnson Pumps) for Fig.8, Howden Pumps for Fig.10 and Mono Pumps for Fig.12.

We would also like to thank Richard Smith for his hard work contributed to this brochure.

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Sealing Opportunities in Chocolate Confectionery Industry

The Chocolate Confectionery Factory;

There are many potential mechanical seal applications within the manufacture of chocolate confectionery. The many pumps transferring chocolate through the various stages of the process will all need sealing. Apart from the pumps there are various chocolate specialist-processing machines that also use seals. Additionally there may well be glucose syrup based soft fillings that are also being processed and pumped. Dough mixing and biscuit manufacture may also be present as well as milk processing. These ancillary-sealing applications may well out number the actual chocolate applications.

There are many opportunities in this industry for AESSEAL® to replace soft packed glands or upgrade OEM supplied seals that in many instances may not be giving a reasonable life. Opportunities also exist for AESSEAL® to simply supply like for like replacement seals. The industry is conservative and labour intensive. The majority of equipment is old, using inferior or out dated sealing devices. House keeping regimes are strict and many of these companies are spending a lot of money on sealing devices and not enjoying the longevity that would be expected in other process industries. The industry has historically been sold single seals by the OEM that have not proven reliable enough, so the industry has not embraced mechanical seals. Where double seals have been used water ring mains and contamination of product has proven problematical.

The industry has not woken up to modern double seal technology used in conjunction with thermosyphon units and carefully selected barrier fluids. Modern sealing practices will result in significant dividends for this industry.

In the developed world chocolate confectionery consumption exceeds 70,000 tonnes annually for every million population. Production in Europe exceeds € 36 billion & in the USA $27 billion. This is a big industry!

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A Brief History of Chocolate & The Cocoa Bean

Chocolate is a preparation made from the fruit of the cacao tree and used as a flavouring and as an ingredient of beverages and various kinds of confectionery.

The word chocolate is derived from the Aztec word for their cocoa-based drink - xocolati. The indigenous people of South America highly prized the Cocoa bean and in some societies beans were used as currency!

Chocolate was brought to Europe in the early 1600s by the Spaniards, who learned its use from the Aztecs. The conquistadors were treated to a banquet by the Aztec emperor Montezuma and were given cold chocolate to drink in sumptuous gold goblets. This was a bitter, spicy drink and completely different from the hot chocolate drink we know today. It was thickened by maize and flavoured with vanilla and ginger and often chilli and turmeric. (Today in Mexico, breakfast is still likely to be washed down with a drink of sweetened hot chocolate flavoured with spices such as cinnamon and ginger.)

When the Spanish first bought chocolate to Europe it was still served as a beverage. Chocolate soon underwent a revolution when the chilli was replaced by sugar. Chocolate houses became fashionable across Europe during the 17th century, especially among the wealthy in large cities such as Florence, Brussels and Vienna.

England was somewhat more egalitarian than the rest of Europe, chocolate was not just a preserve of the rich, the Quaker families of Britain (the Frys, Rowntrees, Terry's and Cadburys) were quick to show interest. Their primary aim was to promote drinking chocolate as a healthier alternative to gin for the working people of the country!

In 1828, a Dutchman called Van Houten invented a hydraulic press to extract the cocoa butter (fat) from the bean. Over 50% of the centre of the bean (Nib) is a naturally occurring fat. Prior to the invention of the press this process was carried out by boiling and skimming. With this removed the cocoa was reduced to a 'cake' or 'Liquor'. Treated with alkaline salts the resultant powder would mix more easily with water. The introduction of Cocoa powder not only made the creation of drinking chocolate easier but also simplified combining with sugar. After this chocolate lost some of its exclusiveness in Europe and became available to the masses.

In 1847 Joseph Fry discovered that by blending a little cocoa butter with chocolate liquor and sugar, a solid, eating chocolate could be formed, the chocolate bar was born.

In 1879 Daniel Peter a Swiss chocolate manufacturer developed the idea of using powdered milk, invented in 1867 by Henri Nestle to make a new kind of chocolate, 'milk chocolate'.

Rudolf Lindt developed Conching shortly afterwards, a process which greatly improved the quality of chocolate.

In 1922 Frank Mars, and his son, Forrest, had an original idea: to produce a malted milk bar with a chocolate covering. The Mars bar and Milky Way bar was an immediate success. This paved the way for the soft centre chocolate confectionery industry. Mars were also responsible for the invention of candy coated chocolate and in the late 30s the brand M&Ms was born.

From Bean to the Formation of Cocoa Powder & Chocolate

Cocoa Processing

The process to produce these products is relatively straight forward and the basic process is described below. This may change in different factories.

Fermentation, drying, roasting, winnowing and grinding may often be performed in the country where the cocoa was grown. Many chocolate manufacturers will purchase the raw chocolate liquor from these countries whereas the major manufacturers may well want to have control over the roasting process as it has a major bearing on the flavour.

The process of making fine chocolate hasn't changed much since the breakthroughs of the late 1800s.

Beans

Harvest, fermentation and drying.

Immediately after harvest, the seed kernels are removed from the cocoa fruit and fermented. The fermented raw cocoa is spread to dry while still in the country of origin.

Roasting

All of the beans are sorted before being roasted. Each variety of beans is roasted separately.

Winnowing

Following the roasting process, the beans are loaded into a machine known as the winnower, which removes the hard outer shell and separates the ‘nibs’ (centre) of the beans by size. The nibs are the basic product used for chocolate production.

Grinding

The nibs are then ground to produce a thick paste that is known as raw chocolate liquor.

Pressing

After the grinding process there is approximately 53% fat or cocoa butter, this is reduced to 27% by pressing. A press is used to squeeze out the fat or Cocoa butter leaving behind Cocoa ‘cake’ or ‘crumb’. Both cocoa cake and cocoa butter are used in the production of chocolate

Cocoa Powder Production Pulverising

The cocoa ‘cake’ is then pulverised to produce a very fine powder; this is then sifted to produce cocoa powder for use as drinking chocolate and as a food ingredient.

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Chocolate & Cocoa Powder Production

Mixing

The Cocoa cake is mixed in a heated kneading machine with the other ingredients. These ingredients may include, sugar, cocoa butter, milk powder or crumb, vegetable fats, lecithin, condensed milk and flavourings. Ingredients to these machines are fed by overhead hoppers or screw conveyors. Mixing machines can take many forms and can be either batch or continuous processed.

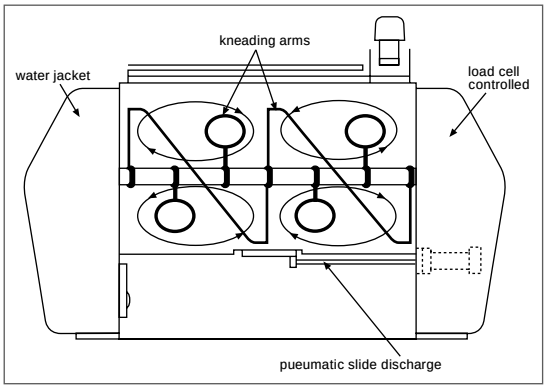

Fig.1

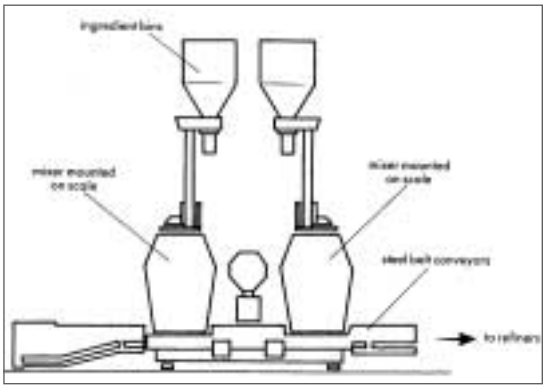

Fig.2

Refining

These machines consist of cooled metal rollers. As the chocolate passes through the refiners the particles are crushed by the pressure between the rollers. The roller successively runs at a higher speed to assist the crushing process. Two or three roll refiners are used for pre-refining followed by five roll machines for end refining.

The mixing and refining processes have generally replaced the operation that used to be performed by the Melangéur, (which uses granite rollers). These are sometimes found in small factories or for experimental batches.

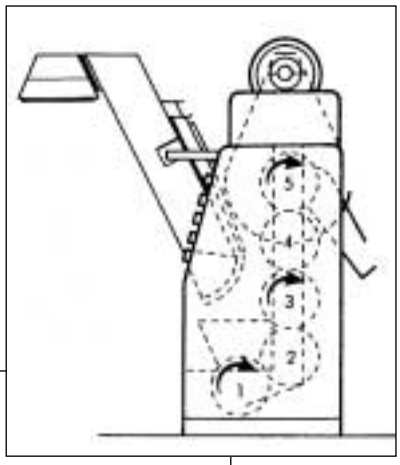

Fig.3

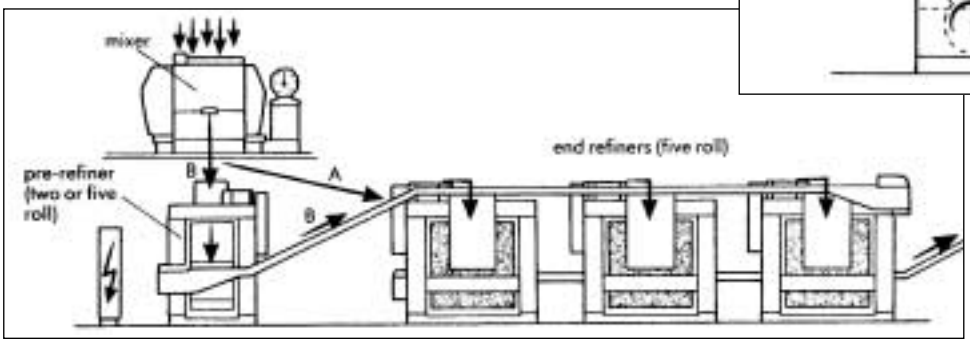

Fig.4

Conching

The 'chocolate' is transferred to the 'conche-refiner' for further processing. Heat is introduced to this process by mechanically working the mix by vigorous slapping agitation. This process takes several hours (some chocolate makers will conche for up to 72 hours). Conching ensures that the liquid is evenly blended.

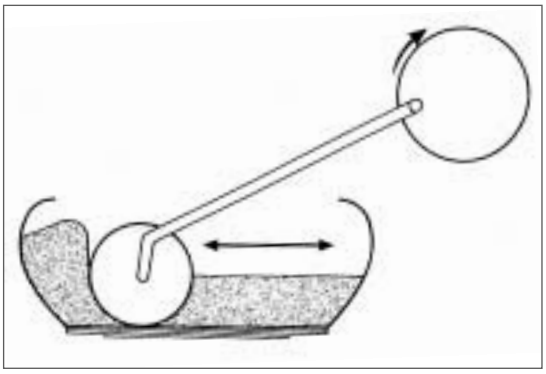

Fig.5 - Traditional Conche

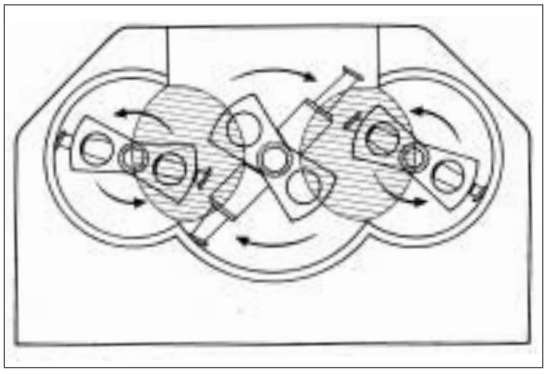

Fig.6 - Modern Conche Refiner

The modern conch refiner can be of various configuration vertical or horizontal. The paddles and rollers are often driven by several shafts. Conches are heated normally by a water jacket and can be continuous or batch design

Tempering

Following conching, the liquid chocolate is tempered for several hours. The tempering process involves heating the chocolate liquor and then cooling it in several stages. This process stabilises the cocoa butter crystals so that they become more uniform in size. It also gives the chocolate a bright lustre and a sharp snap when you break it.

Moulding and Packaging

The final steps in the process are moulding the chocolate, allowing it to cool and harden, and then finally packaging it.

Sealing Solutions and Recommendations Design & Selection Philosophy

Raw Liquor to Processed Chocolate

In both processed & raw liquor, chocolate is normally transferred using positive displacement pumps. The raw liquor is abrasive and contains the entire size spectrum (micron to sub-micron) particles. It appears that plants use the complete mixture of positive displacement pumps. Generally the raw liquor is pumped with internal gear pumps and progressive cavity pumps. As the chocolate becomes more refined it is less abrasive, however, the addition of sugar and similar ingredients at this stage adds the problem of crystallisation. In these later stages rotary lobe, screws and sliding vanes appear to be the most common pumps used.

With many of these pumps the space envelope available may dictate the seal selection and compromises from the ideal will need to be made. Experience has shown that the lower the speed of the seal, the more tolerant of compromise a seal will be.

Solid Tungsten Carbide has proven to be very successful in this industry, its proven abrasive tolerance is not the only advantage. The robust nature of this material is invaluable. Especially its ability to resist breakage in the high torque loads in start up conditions, when the face becomes glued together by the solidified chocolate or syrups,

Raw Chocolate Liquor

	Seal	Faces Materials	System	Barrier Fluid
Preferred Option	Double	TCTC TC C Viton® 316L	P2	Thermotec Velvet
	CDSA™			Rape Seed Oil*
				Palm Oil*
				Customer specified
Intermediate Option	Single Quenched	TC TC Viton® 316L	Quench Drain	Steam
	CURE™, CRCO™**			Condensate
Space Ltd Option	Single Internal	TC TC Viton® 316L	None	
	SAI™ or Convertor II™			

Processed Chocolate

	Seal	Faces Materials	System	Barrier Fluid
Preferred Option	Double	TCTC TC C Viton® 316L	P2	Thermotec Velvet
	CDSA™			Rape Seed Oil*
				Palm Oil*
				Customer specified
Intermediate Option	Single Quenched	TC TC Viton® 316L	Quench Drain	Steam
	CURE™, CRCO™**			Condensate
Space Ltd Option	Single External	TC TC Viton® 316L	None	
	NCE™ or NCM™			

Notes
* Ability of barrier fluid to thermosyphon irrelevant on slow speed positive displacement pumps.
** CRCO™ or CRCO™ H due to low speed of positive displacement pumps. Use of CRCO™ with water acceptable.

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Soft Fillings

The sealing of sugar, syrups and caramels are well documented within AESSEAL®. These applications tend to use rotary lobe pumps.

Soft Fillings

	Seal	Faces Materials	System	Barrier Fluid
Preferred Option	Double CDSA™	TCTC TC C Viton® 316L	P2	Thermotec Velvet Rape Seed Oil* Palm Oil* Customer specified
Intermediate Option	Single Quenched CURE™, CRCO™**	TC TC Viton® 316L	Quench Drain	Steam Condensate
Space Ltd Option Abrasive Predominant	Single Internal SAI™ or Convertor II™	TC TC Viton® 316L	None	
Space Ltd Option Crystalline Predominant	Single External	TC TC Viton® 316L NCE™ or NCM™	None	

Notes
* Ability of barrier fluid to thermosyphon irrelevant on slow speed positive displacement pumps.
** CRCO™ or CRCO™ H due to low speed of positive displacement pumps. Use of CRCO™ with water acceptable.

Biscuit & Doe Mix

Positive displacement pumps are predominant here.

Biscuit & Doe Mix

	Seal	Faces Materials	System	Barrier Fluid
Preferred Option	Double CDSA™	TCTC TC C Viton® 316L	P2	Thermotec Velvet Rape Seed Oil* Palm Oil* Customer specified
Intermediate Option	Single Quenched CURE™, CRCO™**	TC TC Viton® 316L	Quench Drain	Steam Condensate
Space Ltd Option	Single Internal SAI™ or Convertor II™	TC TC Viton® 316L	None	

Notes
* Ability of barrier fluid to thermosyphon irrelevant on slow speed positive displacement pumps.
** CRCO™ or CRCO™ H due to low speed of positive displacement pumps. Use of CRCO™ with water acceptable.

Cocoa Butter

The use of both positive displacement & centrifugal pumps is common.

Cocoa Butter

	Seal	Faces Materials	System	Barrier Fluid
Preferred Option	Double CDSA™	TCTC TC C Viton® 316L	P2	Thermotec Velvet Rape Seed Oil* Palm Oil* Customer specified
Intermediate Option	Single Quenched CURE™, CRCO™**	TC TC Viton® 316L	Quench Drain	Steam Condensate
Space Ltd Option	Single Internal SAI™ or Convertor II™	TC TC Viton® 316L	None	

Notes
* Ability of barrier fluid to thermosyphon irrelevant on slow speed positive displacement pumps.
** CRCO™ or CRCO™ H due to low speed of positive displacement pumps. Use of CRCO™ with water acceptable.

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AESSEAL®

Chocolate

Confectionery

L-UK/US-CHOC-01

IN 4830 - 05/2003

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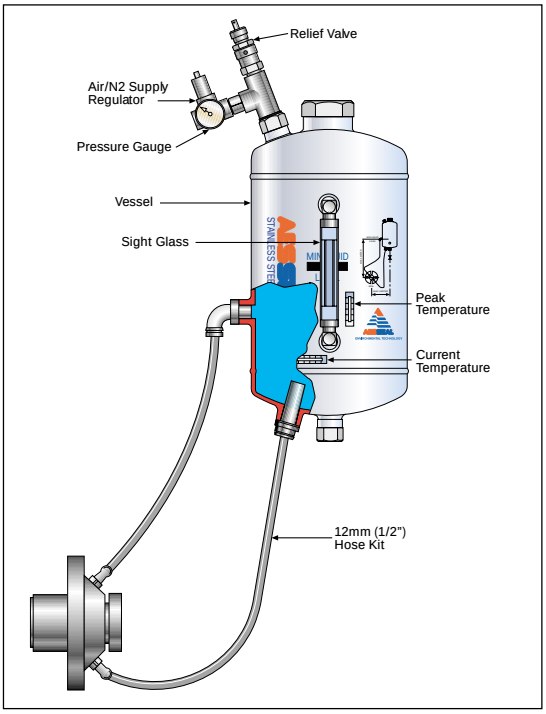
CHOCOLATE & CONFECTIONERY

Chocolate Industry Common Equipment Types

Positive displacement Pumps

Many of these pumps have potential for upgrading to double seals used in conjunction with a P type Thermosyphon System.



Internal Gear Pump

A positive displacement pump commonly used in the first stages of Cocoa powder production.

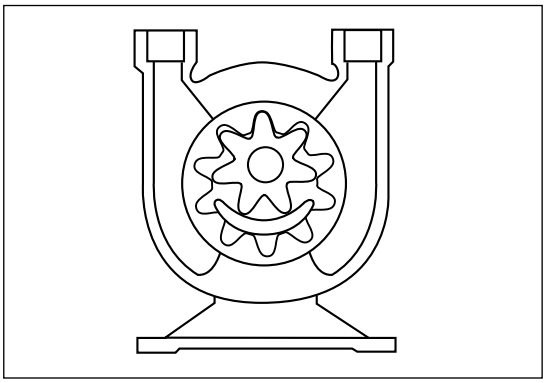


Fig.7

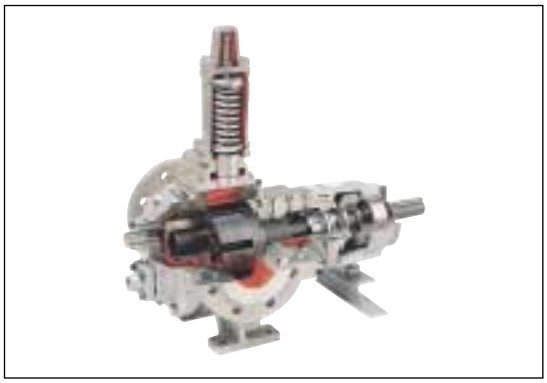
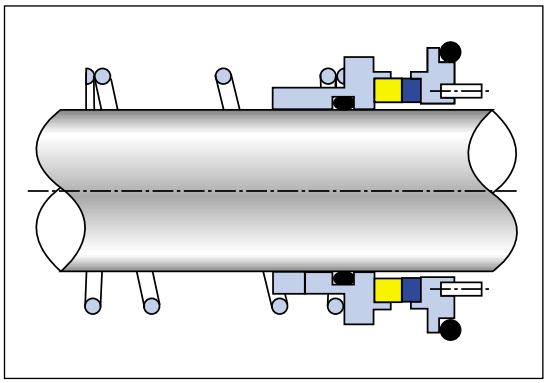


Fig.8 JP Pumps Ltd (Johnson Pumps) Top Gear H Series Pump

Viking Convertor II™ 1 1/16 AZA 4612 for CURE™ Variant



P11 Seal to suit Viking Slurry Pump

AESSEAL® solutions for JP Pumps Ltd (Johnson Pumps), Viking Rotan & many more. Seals commonly fitted to gear pumps Con II™, CURC™ and CDSA™.

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Rotary Lobe

A positive displacement pump commonly used in the latter stages of chocolate production often used for the pumping of soft filling & doe mix production.

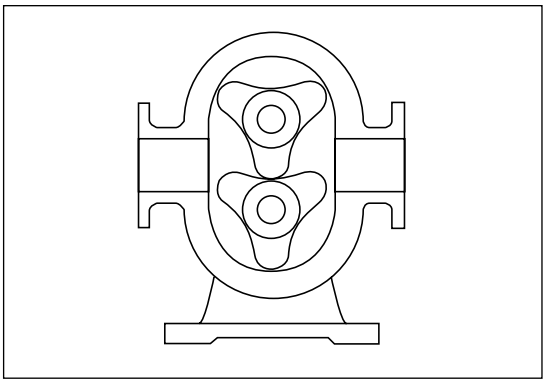


Fig.9

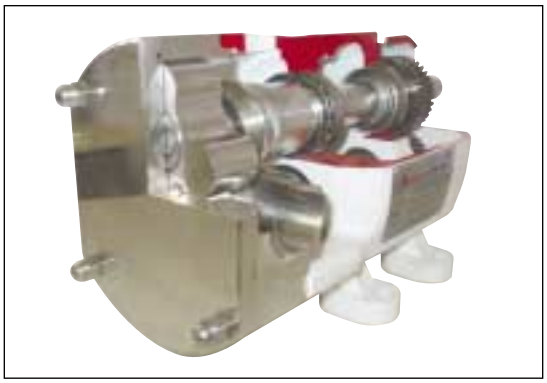
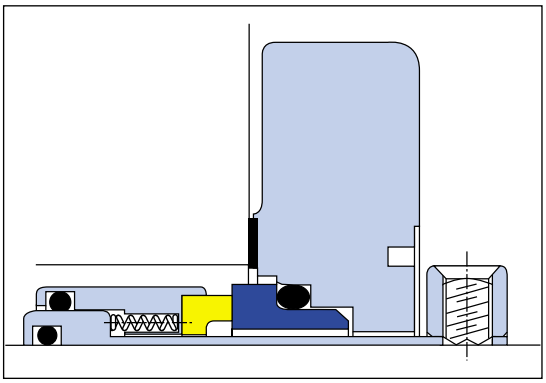
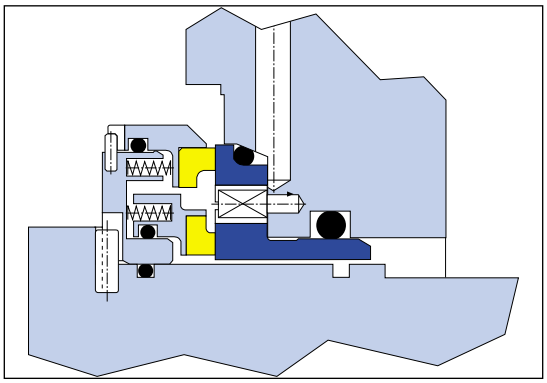


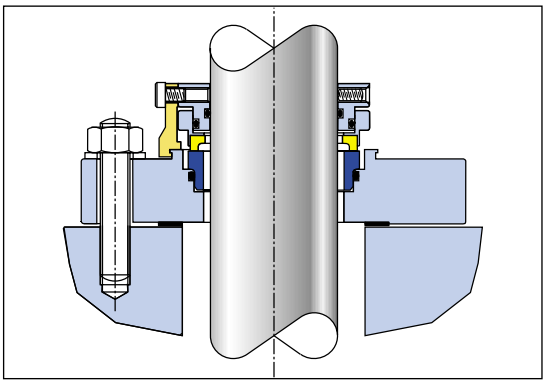
Fig.10 Howden Pumps - Rotorflo Rotary Lobe Pump



Convertor II™ SSP SR Range



WUPS™ Waukesha® Universal 30,60,120



NCM™ AZA 9083 Ibex MOG 2000

WO Range

AESSEAL® Solutions for Johnson, Alfa Laval (SSP) Waukesha®, Sihi, Inoxpa, and many more.

CHOCOLATE & CONFECTIONERY

PCP or Helical Screw

A positive displacement pump commonly used in the first stages of Cocoa powder production, however, may well often be found in later processes for pumping soft fillings.

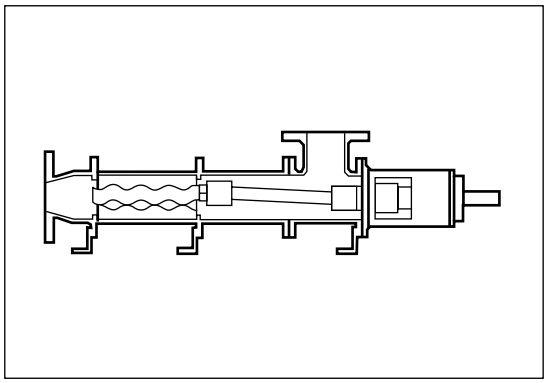


Fig.11

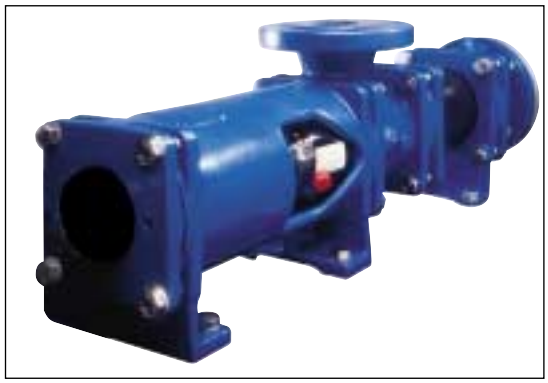
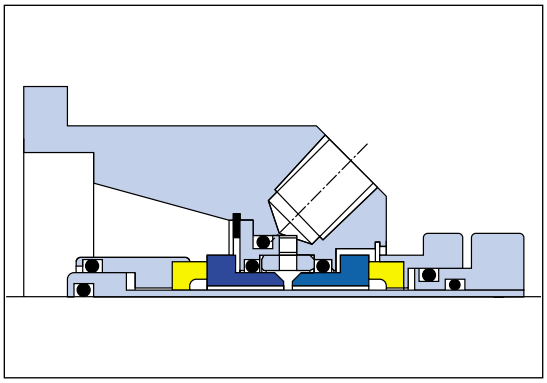


Fig.12



PCPS™

AESSEAL® Solutions for Mono, PCM, Netsch, Seepex, Orbit & many more.

Screw Pump

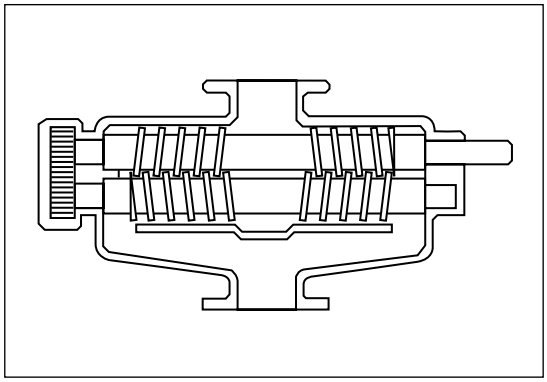
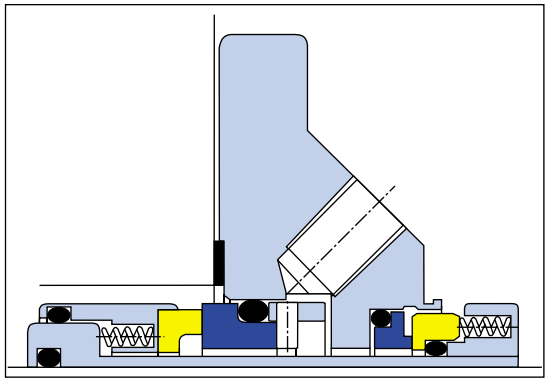


Fig.13



CURE™

AESSEAL® Solutions for SIG pumps Convertor II™, CURE™.

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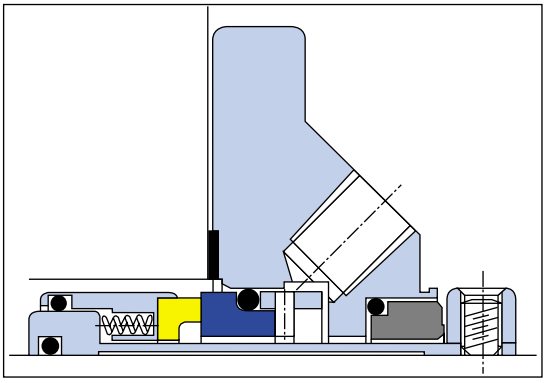
Sliding Vane



CURC™

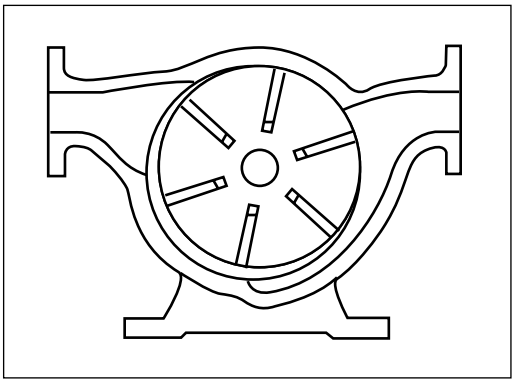
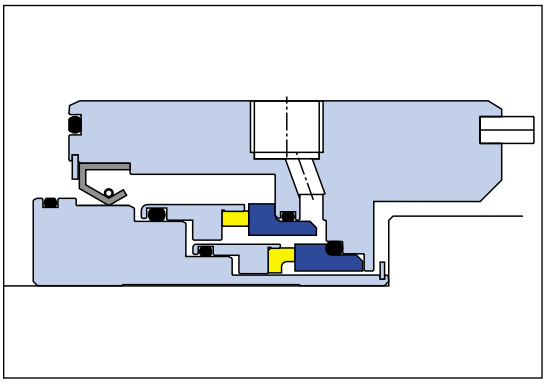


Fig.14

AESSEAL® Solutions for Mik Roverk & Blackmere Pumps CURC™ & CURE™.

Sine Pump

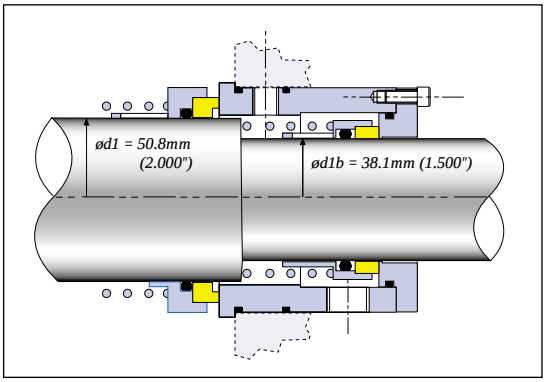


Sine Pump Seal CURCO H AZA8864 & AZA4210

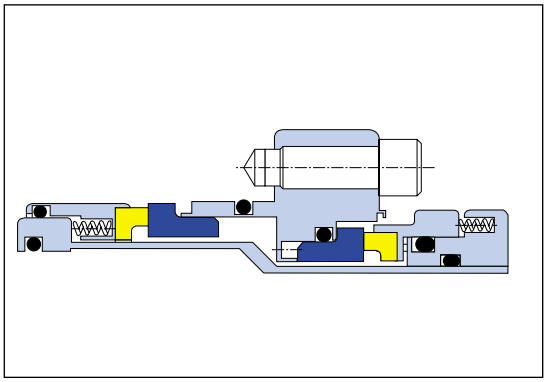
Scrapped Surface Heat Exchangers

These are used to cook ingredients for soft fillings such as caramel on a continuous process basis rather than a batch. They normally have two seals per unit.
AESSEAL® Solutions for: -

Contherm® , Thermutator®, Votator®



Contherm S0Z



Contherm Cart AZA 1623

CHOCOLATE & CONFECTIONERY

Depositors

These are used for depositing chocolate onto soft or biscuit centre. They often use mechanical seals.

AESSEAL® AZA 1534 AZA1713

Agitators

AESSEAL® Solutions for Simon Oaks, Lightnin, Plenty and Many more.

Conche Machines

A positive displacement pump commonly used in the first stages of Cocoa powder production, however, may well often be found in later processes for pumping soft fillings.

Tempering Machines

These machines gently cool the chocolate liquid slowly to promote crystal growth. They often have many rotating paddles that gently agitate the chocolate. These paddles will often have a seal or gland. The slow rotational speed lends themselves to upgrade to a single seal such as the CURC™.

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MagTecta™ Sealing Opportunities

Cocoa Production

This area of the plant is full of rotating equipment. On the primary processes of Cocoa production, such as winnowing the potential for dry contaminants to damage bearings is very real. Exclusion of these contaminants is paramount to maximize bearing life, reduce down time and reduce maintenance expenditure. Conventional bearing lip seals are often ineffective at preventing this contamination. The MagTecta™ is the ideal solution to prevent ingress of these foreign particles into the bearing. In these production areas equipment such as screw feeders, rotary valves, fans, pumps, gearboxes and motors will all be commonly found.

AESSEAL® MagTecta™

The Chocolate Confectionery Factory

The chocolate factory is a food production area and therefore stringent hygiene regimes exist. The frequent house keeping and the use of high pressure cleaning pose a serious threat of bearing contamination.

The limited life of conventional lip seals also presents the potential hazard of oil leaking into food products. The increased life of the MagTecta™ will prevent many expensive equipment removal and strip downs just to replace worn out lip seal

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

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INVESTOR IN PEOPLE

AESSEAL® produces components of the highest quality, for demanding customers across the world. To achieve customer satisfaction, upon which the future of AESSEAL® depends, we need employees who are totally equipped to handle every aspect of our business.

The Company is, therefore, committed to the Investor in People standard. We have undertaken, as part of this initiative, to train and develop all employees to the standard necessary to achieve company objectives.

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