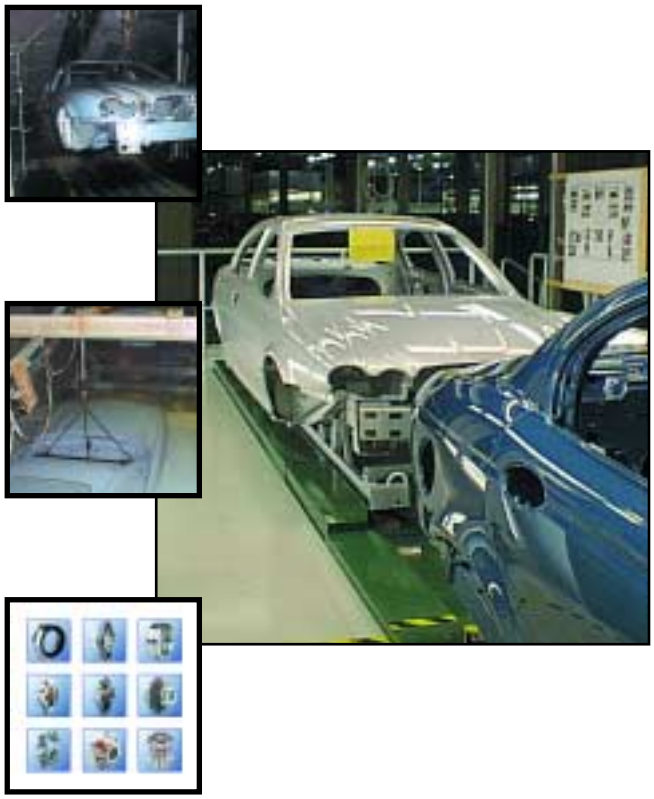
AESSEAL®

ENVIRONMENTAL TECHNOLOGY

A Guide to Seals in the

AUTOMOTIVE INDUSTRY, PRE-TREATMENT & PAINT PLANTS



- THE VEHICLE PAINT PRODUCTION LINE
- MECHANICAL SEAL SELECTION
- CASE HISTORIES

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ACKNOWLEDGMENTS

We would like to thank Richard Smith, Sales Director, for his time and commitment in producing this document.

We would also like to thank Jaguar Cars for the kind permission to use various pictures from their Halewood Production Plant.

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Introduction

The global demand for automobiles is increasing year on year. This demand is fuelling manufacturers to strive for higher quality in all aspects of automotive manufacture. As with most consumer driven industries, the quality and commercial attractiveness of the product are of paramount importance to any automotive manufacturer.

Customer demand for increased corrosion protection and variation in the vehicles' color specification dictate that the modern manufacturing line must be flexible and responsive to market changes.

The appearance of the vehicle; its shape, style and bodywork finish can go a long way to selling a vehicle. Often, if these features are not aesthetically pleasing, the consumer will not even get inside to test the technical features. The quality of the vehicle paintwork is, therefore, an essential part of the automotive production processes and one which a manufacturer ignores at his peril.

In a typical car plant, more than 1000 cars are processed in any given day. This high volume and the most exacting of standards mean that a manufacturer must invest in a modern and efficient production line.

Automotive manufacturers have taken up the challenge and now provide vehicles and products with many years of corrosion protection. Furthermore, they boast production lines which can accommodate changes in color specification from car to car.

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L-UK/US-AUTO-02

IN 4379 - 01/2002

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The Vehicle Paint Production Line

The vehicle body is generally pressed and welded and transported to a pre-clean area. Here, high pressure water spray jets are directed at the body with the purpose of cleaning off dirt and debris from previous processes. This detritus can take many forms ranging from parts of components used in the production process, to operator refuse or items of clothing such as gloves.

The vehicle is then transferred to the alkali dip rinse. The bodies are circulated through a series of dip tanks, which essentially degrease and clean the metal work. Each body is totally submerged in the caustic rinse, ensuring that no section is left untreated. Afterwards, the alkali dip excess fluid is drained from the vehicle body before the rinsing operation.

During the dip rinse the full body of the vehicle is submerged in de-ionized water. This, like so many stages in the production process, is another cleaning operation. Next, the vehicle body goes onto the conditional spray. Spray pumps direct de-ionized water onto the vehicle body, generally at ambient temperatures before the phosphate operation.

During the phosphate operation the body is completely submerged in a phosphate liquid which chemically etches the metal work and provides a layer of crystal on the surface of the steel. This enables the paint to ‘bite into’ the metal work for good adhesion.

Occasionally, some plants opt for a partial phosphate dip, instead of a full phosphate dip, which is complemented by spray jets directing phosphate solution onto the roof of the vehicle. It is not uncommon to see many re-iterations of the same process, i.e. cleaning, etching, rinsing etc. This is a safeguard against wasted efforts further along the production line.

The care and attention required in the pre-treatment makes this one of the most critical elements in the plant in obtaining a good paint finish.

The phosphate system is sometimes referred to as "the bond". This is the part of the plant which bonds the paint to the steel body frame.

Depending on the type of plant, a hot blower is sometimes employed. If the body is going into storage, the hot blower is commonly encountered. If the plant is a continuous production line then this stage is often omitted.

From the phosphate operation, the body of the vehicle is transported to the preparation deck and then onto the ELPO (Electro Coat Paint Operation), commonly referred to as the E-Coat, a water based painting operation. During the ELPO process, the body is immersed or dipped into electro-coat paint. The whole body is charged with electricity (similar to a plating process). The paint sticks to the body as the body is charged, as it effectively becomes a cathode whilst the paint becomes an anode.

After this process the body is transported to an UF-dip (Ultra Filtrate) and then onto a UF-spray.

Lastly the vehicle body goes through a DI-spray and DI-dip which is effectively a cleaning spray operation, then into an oven for approximately 20 minutes. Afterwards the body is transferred to the finishing plant where it is masked, PVC (Uniseal) sprayed, de-masked and sent to the sealer-deck for sealant to be applied between the seams and under the bonnet of the vehicle.

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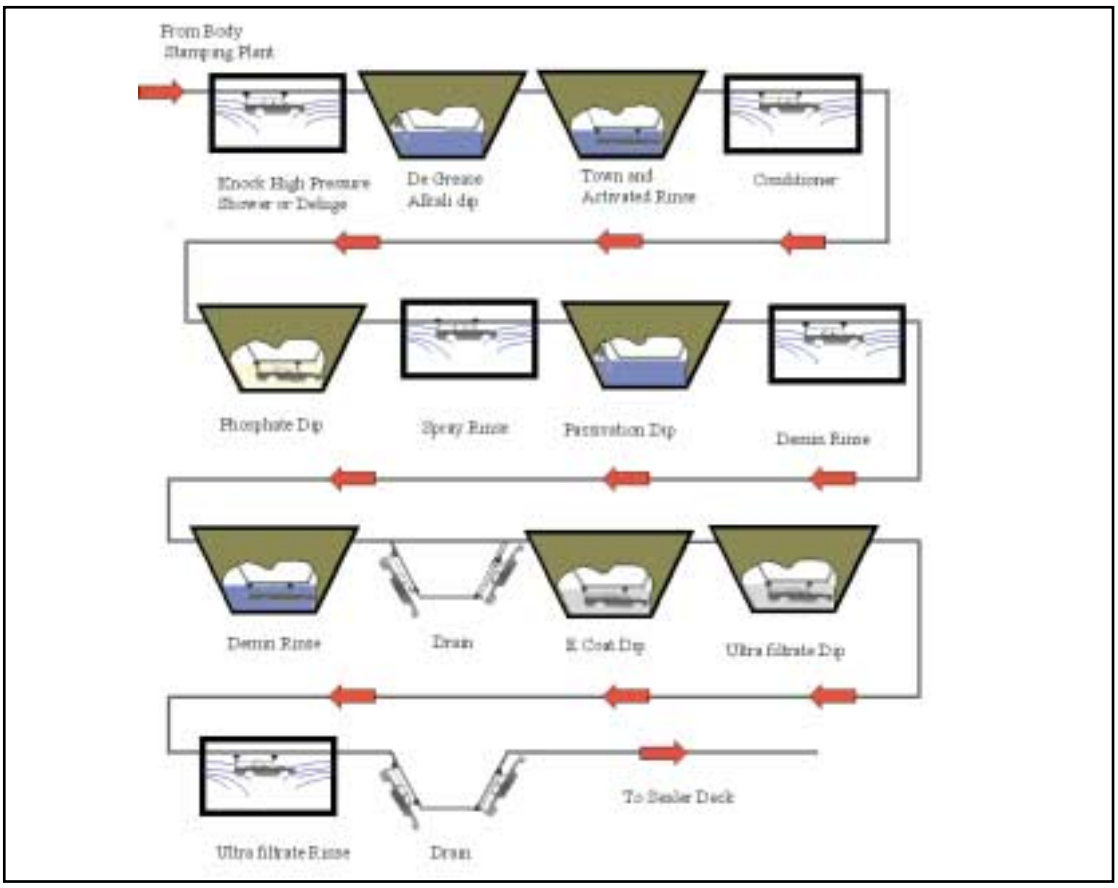
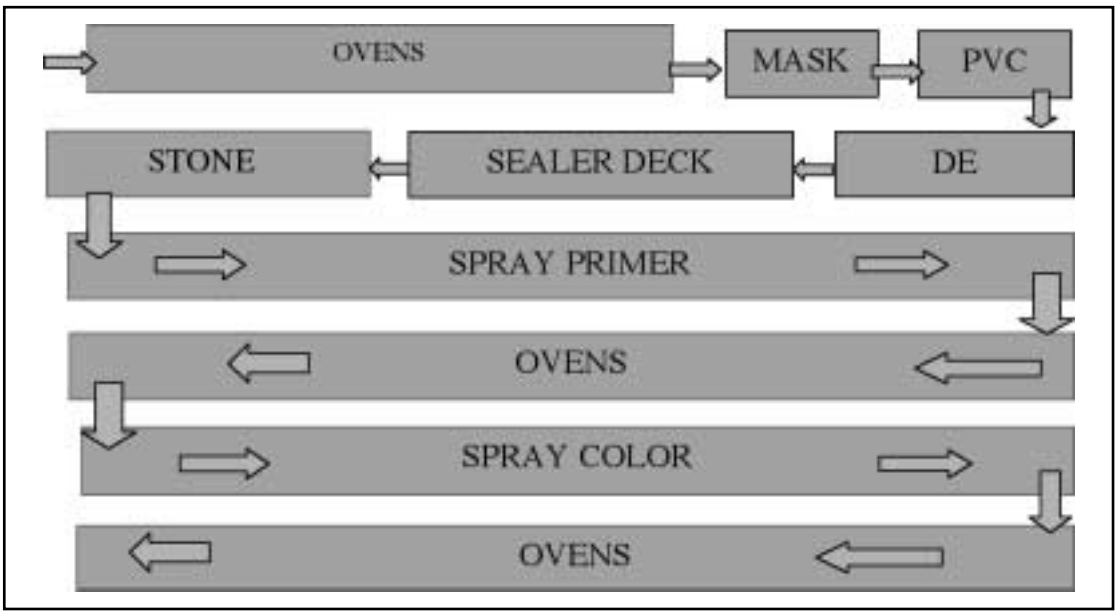
A Typical Vehicle Paint Production Line





The body is then stone chipped, which is the heavy black paint finish underneath the car, and then sent to the primer booths for either manual or robotic spraying. It is here where the flexibility of the plant is realized as atomizing bells provide the flexibility to rapidly change the color of a vehicle body in the production line.

After the primer booths, the body is then transported to the ovens, then onto the color booths, where it is once again manually or robotically sprayed using atomizing bells.

After a last oven operation the body is then sent to the trim/assembly area where the finished product is realized.

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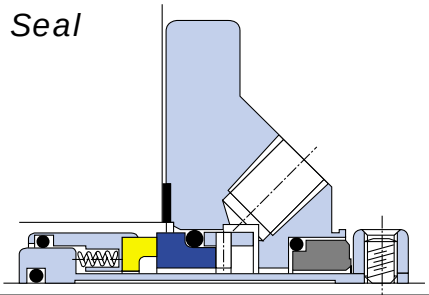
Mechanical Seals

Mechanical seals are found in many positions in the plant. This is due to the fact that the paint plant uses massive volumes of liquid, mainly during the pre-treatment operations. Centrifugal pumps and mechanical seals, therefore, play an important part in the efficient running of a modern automotive paint plant. The following text indicates the seal standardization for the respective sections of the production line.

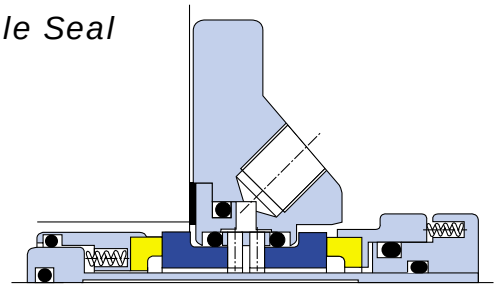
Important: Silicone grease can contaminate the whole painting system, if used during the seal assembly. The presence of silicone grease can prevent paint adhesion to the vehicle body. It is, therefore, essential that it should never be used. See Z895 grease for a suitable replacement.

Main AESSEAL® seals used in paint plants

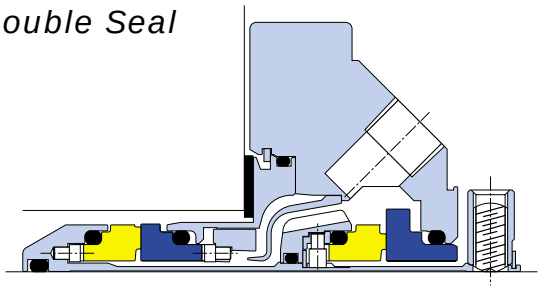
CURC™ - Single Seal



CDSA™ - Double Seal



DMSF™ - Double Seal



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Sealing at the "Pre-clean" Stage

Pre-clean is conducted by one of two methods:

Deluge: High production volume operating at low pressure.

Knock-off: High pressure sprays (Knock-off sprays), direct water towards the pressed and welded vehicle bodies.

Mechanical seals may be found on the high-pressure centrifugal pumps, which feed the sprays. These can be a multi-staged arrangement, or a bank of single stage pumps, which go from suction to discharge of the next pump in the line. Knock-off is generally set at (30 - 45 psi) 2-3 bar on single centrifugal pumps, used to throttle back the spray pressure, so that it is not too high.

Typically a hydrocyclone separator removes the lightweight contraries.

Seal Standardization

Seal Type: CURC™ single cartridge seal with Z895 grease
Seal Faces: Car/TC
Seal Elastomers: Viton®
Seal System: API Plan 13

Knock-off is sometimes "soapy" and can contain heavy deposits of swarf. Depending on the pump specification and duty, CDSA™ double seals TC/TC//Chrox/Car (Z895) with SSE10™ W2 support system, are sometimes preferred.

Sealing at the "Alkali (Caustic) Dip/Rinse" Stage

Mechanical seals may be found on the circulation centrifugal pumps, which re-circulate the dip tanks. Note: Caustic is hazardous, therefore, double seals are preferred.

Seal Standardization

Seal Type: CDSA™ single cartridge seal with Z895 grease
Seal Faces: TC/TC//Chrox/Car
Seal Elastomers: Aflas®
Seal System: SSE10™ W2

Sealing the "Conditioner Spray"

Mechanical seals may be found on the centrifugal pumps, which feed the sprays. Soilds can be present depending on the conditioner additive used (Titanium).

Seal Standardization

Seal Type: CDSA™ Double cartridge seal with Z895 grease
Seal Faces: TC/TC//Chrox/Car
Seal Elastomers: Viton®
Seal System: API Plan 13

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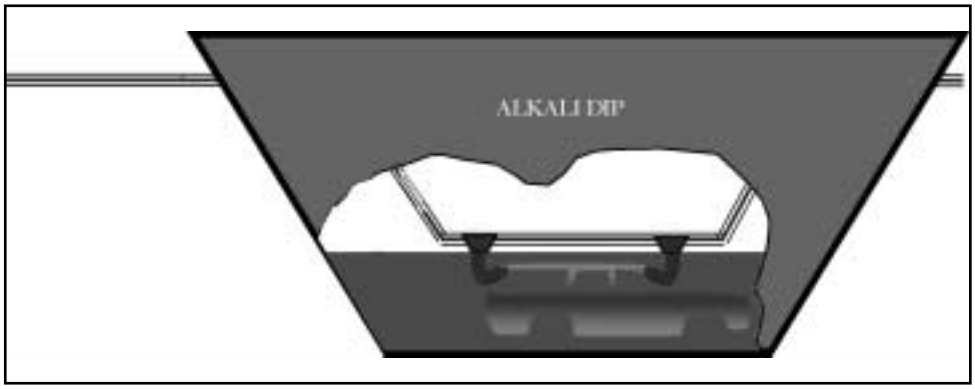
Sealing "Phosphate Dipping"

During the phosphate dip, the vehicle body is chemically etched, providing a layer of crystal on the surface of the steel, which provides a "tooth" for the paint to adhere to. Mechanical seals may be found on the phosphate circulation pumps, which circulate the liquid around the dip tank or on phosphate sludge pumps, which take the sludge away to the filtering process.

Phosphate contains DI-water and it is undesirable to leak vast quantities, however, it is difficult to seal. If one can seal the "phosphate" process, one can seal the whole paint plant. The key to successful sealing is to keep the phosphate moving and avoid dead areas in the pipework where "growth" can occur.



Sealing "E Coat" at the Halewood jaguar plant.

Seal Standardization

Seal Type:	CDSA™ double cartridge seal with Z895 grease
Seal Faces:	SiC/SiC//SiC/Car
Seal Elastomers:	Viton®
Seal System:	SSE10™ W2 or water ring main
Barrier Fluid:	DI or plant water

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Sealing the Pasivator Process

Mechanical seals will be found on the centrifugal recirculation pumps. Solids can be present depending on the conditioner additive used (Zirconium).

Seal Standardization

Seal Type:	CDSA™ double cartridge seal with Z895 grease
Seal Faces:	TC/TC//Chrox/Car
Seal Elastomers:	Viton®
Seal System:	SSE10™ W2
Barrier Fluid:	Ultra filtrate/ Di water

Sealing the "ELPO Dip/Plating or E Coat" Process

Mechanical seals may be found on the circulation, and centrifugal pumps.

Seal Standardization

Seal Type:	DMSF™ double cartridge seal with Z895 grease
Seal Faces:	TC/TC//TC/Car
Seal Elastomers:	Viton®
Seal System:	SSE10™ W2
Barrier Fluid:	Ultra filtrate/ Di water (consult AESSEAL® on application).

Alternative

Seal Type:	CDSA™ double cartridge seal with Z895 grease
Seal Faces:	TC/TC//TC/Car
Seal Elastomers:	Viton®
Seal System:	Water ring main
Barrier Fluid:	DI or Ultra filtrate

Sealing the "UF-Dip" (Ultra Filtrate)

The Ultra Filtrate dip consists of DI mineralized water and generally is found with bits of paint in it. Mechanical seals may be found on the centrifugal circulation and filter pumps.
Problems arise should the Ultra Filtrate vaporize between the seal faces and leave paint residue behind. This sticks the seal faces together which can break Silicon Carbide seal faces on equipment startup.

Seal Standardization

Seal Type:	CURC™ single cartridge seal with Z895 grease
Seal Faces:	TC/TC
Seal Elastomers:	Viton®
Seal System:	API Plan 13

*Optional: CDSA™ TC/TC//Chrox/Car-Viton® (Z895) with SSE10™ W2 seal support system.

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Sealing the Anolite

This is a conductive fluid (Citric Acid & Demin) that is circulated through the anodes in the E Coat tanks.

Seal Standardization

Seal Type:	CURC™ single cartridge seal with Z895 grease
Seal Faces:	Car/SiC
Seal Elastomers:	Viton®
Seal System:	API Plan 13

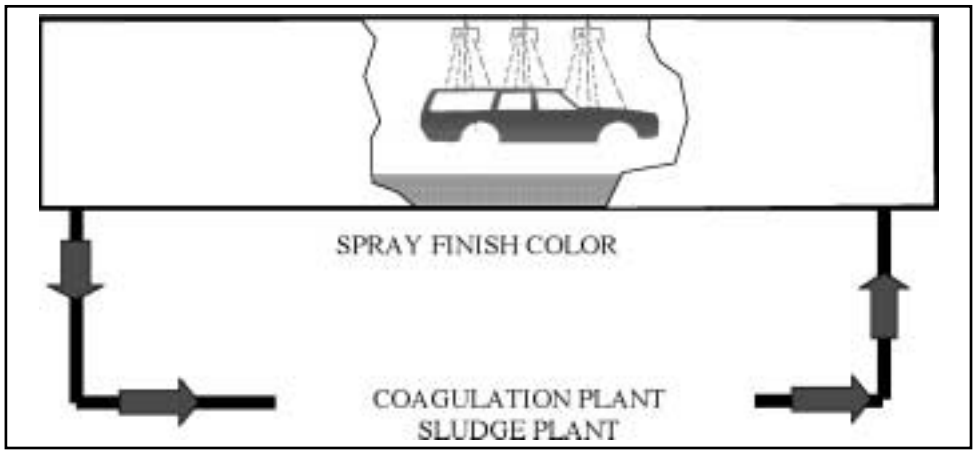
Coagulation/Sludge Plant

Air is continuously blowing through the booths to the water curtain, residing either behind or underneath the booth.

The water "river" takes all the overspray paint particles away, into the coagulation plant.

The paint particles may be removed from the water by one of several methods:

- The chemical approach: Chemicals are injected into the water, which makes the paint molecules stick together and sink. Conveyers or PCP pumps then mechanically move the paint sludge to a skip.
- The aeration system: Air is added to the water causing the paint molecules to stick to the surface of the bubbles, which then float to the top of the water. The paint sludge is then skimmed off the surface of the water and transported to skips.
- The mechanical approach: Water is pumped through filters, which screen the paint molecules, separating them from the water. The filters are then opened and the paint sludge is taken to skips.



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Seal Standardization

Seal Type:	CDSA™ double seal with Z895 grease (CDSA™ PCP for Progressing Cavity Pumps)
Seal Faces:	TC/TC//Chrox/Car
Seal Elastomers:	Viton®
Seal System:	SSE10™ W2
Barrier Fluid:	Plant water

*Optional: CURC™ TC/TC-Viton® with town water flush at 25 psi.

Finished body shells ready for assembly at the Halewood Jaguar plant.

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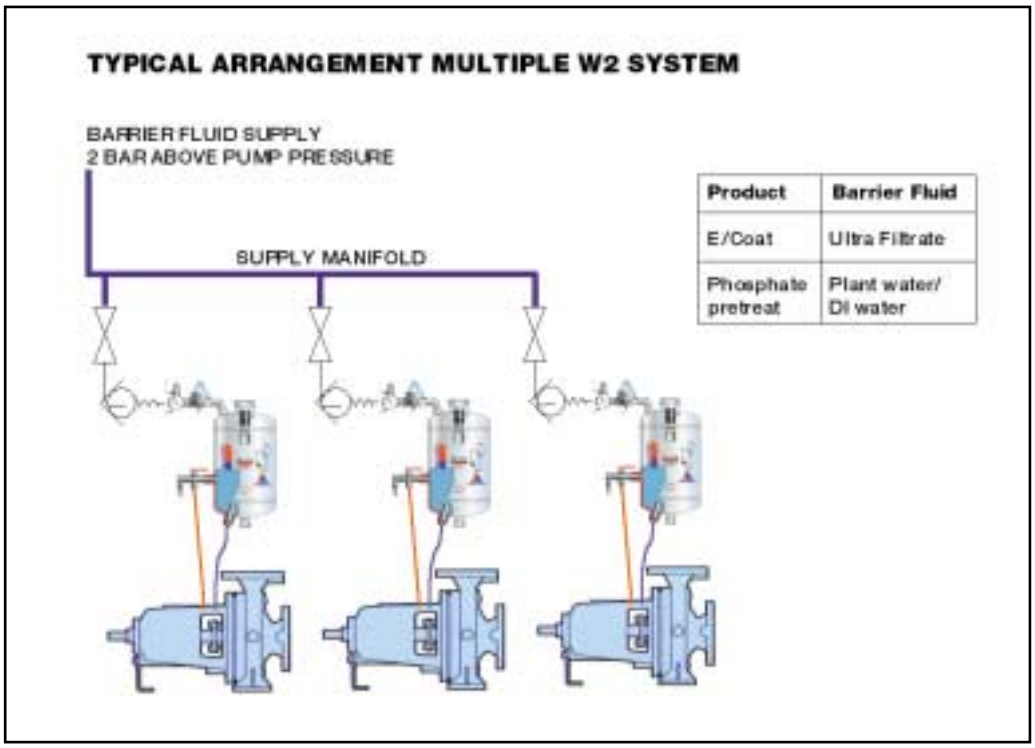
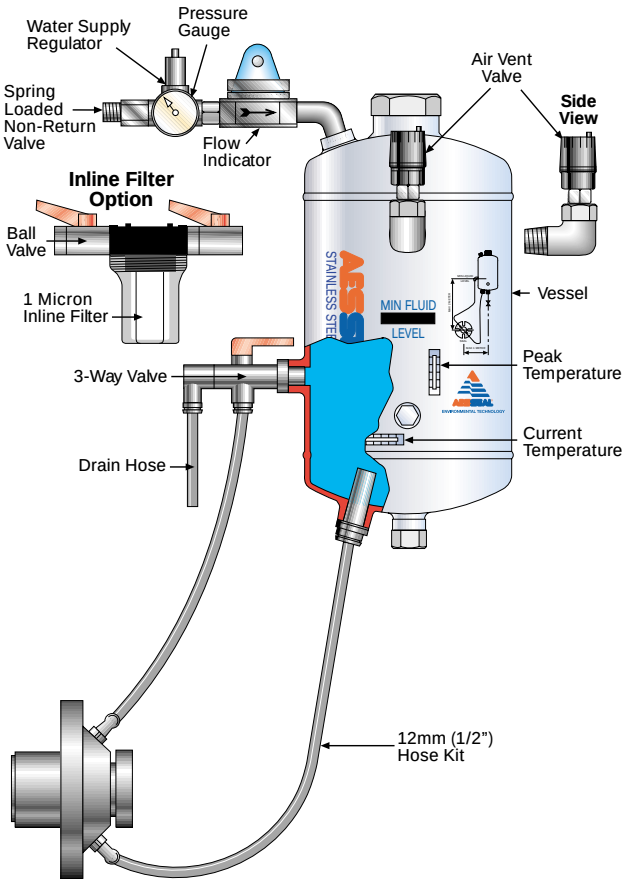
W2 SYSTEMS



SSE10™ SYSTEM W2 STANDARD WATER RETENTION VESSEL CODE VSE/SW02



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Case Histories

CASE No. 843H

In a car plant in the U.K., a 65mm CDSA™ seal was fitted to a Euramo Salmson centrifugal pump, model number M4/C4. The duty being pumped was phosphate recirculation operating at a shaft speed of 1440 rpm with inlet pressure being 5 psi (0.3 bar) and outlet pressure being 20 psi (1.4 bar). The seal faces were TC/TC//CRO2/C with Viton elastomers and 316L wetted parts. The mechanical seal operated with a SSE10™ W2 system pumping town water at 25 psi (1.7 bar). The CDSA™ and W2 system lasted 3.5 years due to the seal having to be removed because the pump failed. The customer was previously using a double back to back and sleeve with quench to drain which lasted less than 12 months.

CASE No. 845H

In a car plant in the U.K., a 48mm CDSA™ seal was fitted to a Tangie pump, model number HB-125-250. The duty being pumped was paint recirculation operating at a temperature of 104 - 122ºF (40 - 50°C). The seal faces were TC/TC//CRO2/C with Viton® elastomers and 316L wetted parts. The mechanical seal operated with a SSE10™ W2 system and lasted for 5 years.

The customer was previously using PTFE wedge back to back seals with Car/Cer seal faces, with a stuffing box adapter ring and new impeller spacer being used. The average life was less than 12 months.

See Z895 for further information.

CASE No. 846H

In a car plant in the U.K., a 50mm CDSA™ seal was fitted to a Euramo Salmson centrifugal pump model number 125/100/315 M3. The duty being pumped was electro coat operating at a temperature of 86ºF (30°C) with a shaft speed of 1440 rpm with an inlet pressure of 25 psi (1.7 bar) and outlet pressure of 90 psi (6.2 bar). The seal faces were TC/TC//CRO2/C with Viton®elastomers. The customer was previously using a back to back with a sleeve. This was difficult to install and service life was poor. They also required a new sleeve. The CDSA™ was installed directly onto the shaft and service life was more than 4 years. Stores now only need to stock a single part number and not the 5 parts of a back to back assembly.

1 - Sleeve
2 - Inboard Seal
3 - Inboard Stationary
4 - Outboard Seal
5 - Outboard Stationary

CASE No. 847H

In a car plant in the U.K., a 48mm CDSA™ seal was fitted to a Tangie pump, model number HB 125-250. The duty being pumped was electro coat operating at a temperature of 104ºF (40°C) with a shaft speed of 1450 rpm with an inlet pressure of 15 psi (1 bar) and outlet pressure 37 psi (2.5 bar). The seal faces were TC/TC//CRO2/C with Viton® elastomers and 316L wetted parts. The mechanical seal operated with a SSE10™ W2 system for 4 years.

The customer was previously using back to back PTFE wedge seals with a gland seal circulation system, with a stuffing box adapter ring and new impeller spacer being used.

See Z895 for further information.

CASE No. 848H

In a car plant in the U.K., a 55mm CURC™ seal (with API Plan 11) was fitted to an IDP centrifugal pump, bearing frame 3. The duty being pumped was Ultra Filtrate operating at ambient temperature with a shaft speed of 1550 rpm with an inlet pressure of 10 psi (0.7 bar) and outlet pressure 30 psi (2 bar). The seal faces were TC/TC with Viton® elastomers and 316L wetted parts. The mechanical seal operated with a SSE10™ W2 system pumping de-min water barrier at 22 psi (1.5 bar).
The CURC™ seal (which lasted 3 years) was fitted to a new pump, replacing a non-cartridge, TC/TC face seal, which only lasted 6 months.

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CASE No. 849H

In a car plant in the U.K., a 65mm CDSA™ seal was fitted to an IDP centrifugal pump, model Frame 4. The duty being pumped was electro paint operating with a shaft speed of 1440 rpm, with an inlet pressure of 25 psi (1.7 bar) and outlet pressure 90 psi (6.2 bar). The seal faces were TC/TC//CRO2/C with Viton® elastomers and 316L wetted parts. The mechanical seal operated with an SSE10™ W2 system.

The customer's previous seal's life was less than 12 months. The CDSA™ life was more than 3 years.

See Z895 for further details.

CASE No. 850H

In a car plant in the U.K., a 50mm CURC™ seal was fitted to a pump. The duty being pumped was effluent operating at an ambient temperature with a shaft speed of 1450 rpm with an inlet pressure of 15 psi (1 bar) and outlet pressure 44 psi (3 bar). The seal faces were TC/TC with Viton® elastomers and 316L wetted parts.

The customer has converted from packing.

See Z895 for further information.

CASE No. 851H

In a car plant in the U.K., a 48mm CDSA™ seal was fitted to a Jeumont Schneider, model number MEN/100/300. The duty being pumped was coagulant operating at a temperature of 86ºF (30°C) with a shaft speed of 1440 rpm. Inlet pressure was 10 psi (0.7 bar) and outlet pressure 75 psi (5.2 bar), quench being pressurized at 73 psi (5 bar).

The customer was previously using a hard faced single spring seal with a life of 10 minutes. The CDSA™ seal lasted more than 5 years.

CASE No. 852H

In a car plant in the U.K., a 2.125" CDSA™ seal was fitted to a Tangie pump, model number HB 150-315. The duty being pumped was paint operating at a temperature of 122ºF (50°C) with an inlet pressure of 15 psi (1 bar) and outlet pressure 37 psi (2.5 bar). The seal faces were TC/TC//CRO2/C with Viton® elastomers and 316L wetted parts. The customer was previously using a back to back single spring assembly.

A small amount of modification is required:

1. Remove existing seal housing.
2. Reduce PCD of seal housing studs.
3. Manufacture adapter ring for stuffing box.
4. Manufacture a new impeller spacer.

See Z895 for further information.

CASE No. 1316J

In an automotive paint plant in the North West of England, AESSEAL® supplied 10 off 50mm DMSF™ and bespoke SSE10™ W2 Systems via an OEM. The pump units were End Suction Isoglide Pumps model Ref HL-150-125-315 and are used to circulate Electrocoat paint around dip tanks. The seal face combination was TC/TC/TC/C/V Z895.

The barrier fluid media was UltraFiltrate and the application details are as follows:
Pump Suction Pressure - 1 Bar (g)
Pump Delivery Pressure - 3 Bar (g)
Pump Speed - 1450 rpm
Bulk Temperature - 30 to 40 Deg C

Barrier fluid pressure is 4 Bar (g) and the SSE10 systems are energized from a manifold pressurized by a small Air Operated Piston Pump.
The pumps and seal were installed in July 2000 and have been running trouble free ever since.

Important: Silicone grease can contaminate the whole painting system, if used during the seal assembly. The presence of silicone grease can prevent paint adhesion to the vehicle body. It is, therefore, essential that it should never be used. See Z895 grease for a suitable replacement.

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NOTE:

Due to AESSEAL's policy of continuous improvement the following seal types have been upgraded:

SCI	*upgraded to*	*SCUSI*
CSAI	*upgraded to*	*CURC*
CAPI	*upgraded to*	*CURC*
CAPO	*upgraded to*	*CRCO*
CMDS	*upgraded to*	*CDSA & DMSF*

The original products evolved into more modern seals which were designed to enhance application performance. The product model reference in the case study is for the most modern design, even though at the time of installation the actual installation was the predecessor model.

All information featured in these case histories has been obtained directly from Plant Engineers.

Although we have confidence in the accuracy of this information, it is not offered as a guarantee for seals manufactured by AESSEAL®.

Any prospective user of our product should verify the information stated to their own satisfaction.

Further information is available on all the case histories contained in this booklet upon request.

Issue 'A' on a case history refers to information which was current on the 31st. January, 1989.

Issue 'B' refers to information which was current on 31st. January, 1990.

Issue 'C' refers to information which was current on 31st. January, 1991.

Issue 'D' refers to information which was current on 31st. January, 1992.

Issue 'E' refers to information which was current on 31st. January, 1993.

Issue 'F' refers to information which was current on 31st. January, 1995.

Issue 'G' refers to information which was current on 31st. January, 1998.

Issue 'H' refers to information which was current on 31st. October, 1999.

Issue 'I' refers to information which was current on 31st. March, 2000.

Issue 'J' refers to information which was current on 31st. November, 2000.

Where the statement 'The seals are still working' is made, this means that the customer is or was still using AESSEAL® mechanical seals at the time the case history was updated; as denoted by either:

Issue 'A', Issue 'B', Issue 'C', Issue 'D', Issue 'E', Issue 'F', Issue 'G', Issue 'H', Issue 'I' or Issue 'J'.

For more detailed information, please contact our Applications Department.

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The AESSEAL® Group of Companies

AESSEAL plc, Rotherham, U.K.	Telephone: +44 (0) 1709 369966
AESSEAL plc, Derby, U.K.	Telephone: +44 (0) 1332 366738
AESSEAL plc, Peterborough, U.K.	Telephone: +44 (0) 1733 230787
AESSEAL plc, Scotland, U.K.	Telephone: +44 (0) 1698 849808
AESSEAL plc, Middlesbrough, U.K.	Telephone: +44 (0) 1642 245744
AESSEAL plc, Essex, U.K.	Telephone: +44 (0) 1708 256600
AESSEAL plc, Pontypridd, U.K.	Telephone: +44 (0) 1443 844330
AESSEAL (MCK) Ltd., Lisburn, U.K.	Telephone: +44 (0) 28 9266 9966
AESSEAL (MCK) Ltd., Co. Cork, Ireland.	Telephone: +353 (0) 214 633477
AESSEAL Inc., Knoxville, Tennessee, USA.	Telephone: +1 865 531 0192
AESSEAL Inc., Seneca Falls, New York, USA.	Telephone: +1 315 568 4706
AESSEAL Inc., Kingsport, Tennessee, USA.	Telephone: +1 423 224 7573
AESSEAL ESP LLC, Cedar Rapids, Iowa, USA.	Telephone: +1 319 393 4310
AESSEAL Deutschland AG.	Telephone: +49 (0) 60 74 881293
AESSEAL Italia SRL.	Telephone: +39 (0) 33 197 0556
AESSEAL Pty Ltd., Gauteng, South Africa.	Telephone: +27 (0) 11 466 6500
AESSEAL Pty Ltd., Confluid Branch, Amanzimtoti, South Africa.	Telephone: +27 (0) 31 903 5438
AESSEAL Malaysia SDN. BHD.	Telephone: +603 8062 1233
AESSEAL Nederland.	Telephone: +31 (0) 76 564 9292
AESSEAL Ibérica S.L.	Telephone: +34 977 55 43 30
AESSEAL Danmark, Køge, Denmark.	Telephone: +45 56 64 14 00
AESSEAL France S.A.R.L.	Telephone: +33 (0) 3 2017 2850
AESSEAL Turkiye, Istanbul, Turkey.	Telephone: +90 (0) 212 237 40 47
AESSEAL Canada Inc.	Telephone: +1 807 624 2727
AESSEAL China Ltd.	Telephone: +86 574 8770 1888

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INVESTOR IN PEOPLE

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

- **GUARD YOUR EQUIPMENT**
- **WEAR PROTECTIVE CLOTHING**

WARNING

AESSEAL plc
Mill Close
Templeborough
Rotherham
S60 1BZ
United Kingdom

Telephone: +44 (0) 1709 369966
Fax: +44 (0) 1709 720788
E-mail: seals@aesseal.com
Internet: http://www.aesseal.com

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Fax: 865 531 0571

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