Technical Application Report

Formed In Place Gasket (FIPG)

Gaskets can easily be overlooked when it comes to design and manufacture of many mechanical components. They may simply form a convenient seal to keep out contaminants, but more often they are critical to the function and long term reliability of the end product. In some cases they may consist of a simple 'O' ring or in other cases, form extremely complicated three dimensional shapes. They may have to withstand very high or low temperatures, large thermal cycles and be resistant to chemicals and other harsh environmental conditions. For maintenance purposes they are often required to allow for removal and reuse many times while retaining their flexibility and the ability to form an effective seal.

Major delays can be caused in the production process while the gasket is placed and held in position prior to applying any mechanical fixings. If not correctly positioned the gasket will often fail to provide a seal and result in costly product failure and reworking. To overcome these production problems many process engineers are turning to FIPG gaskets for a fast, cost effective alternative to the traditional pre-cut gasket.

FIPG: What is It?

FIPG is a relatively simple method using a liquid silicone adhesive sealant to form a gasket between two components. There are two processes: 1) The wet joint process, when the sealant is applied to one surface and immediately both components are then fixed together. This is a very fast process which has the added advantage of the sealant bonding to both components. However, it also has the disadvantage that should the components need to be taken apart again in the future, the gasket would be destroyed. 2) Post cure process, the adhesive sealant is used to form a gasket on one surface of the component which is allowed to cure prior to the final assembly process. The adhesive is therefore, bonded to one half of the assembly thus allowing for fast easy fixing during production. There is no need to position or hold the gasket in place and a perfect fit is guaranteed every time. If required the two components can be taken apart and the gasket will remain in its original position allowing for reuse.

These methods of producing gaskets have several advantages over using a pre-cut gasket:

- Fast accurate production
- Better resistance to heat differential expansion in bi-metal joints
- Reduces risk of shimmering (unwanted vibration between components)
- Better access for service or rework

Production Methods

Method 1

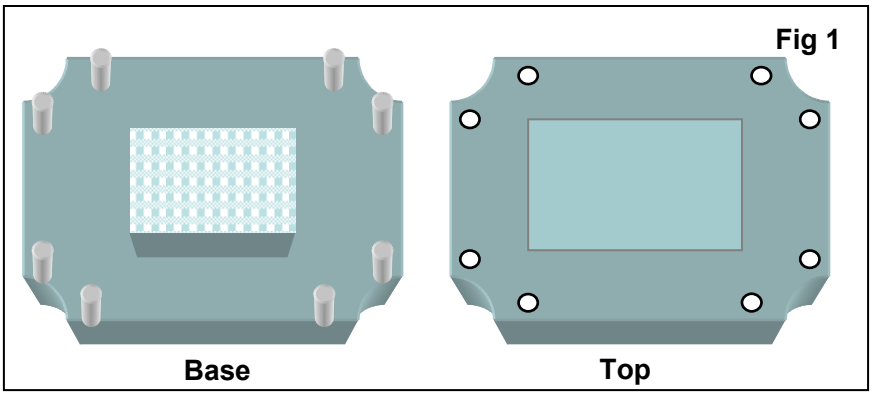
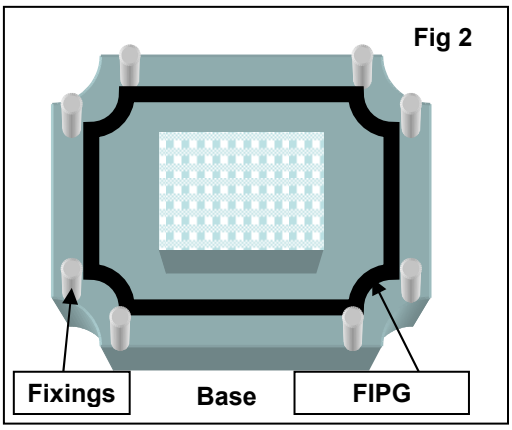
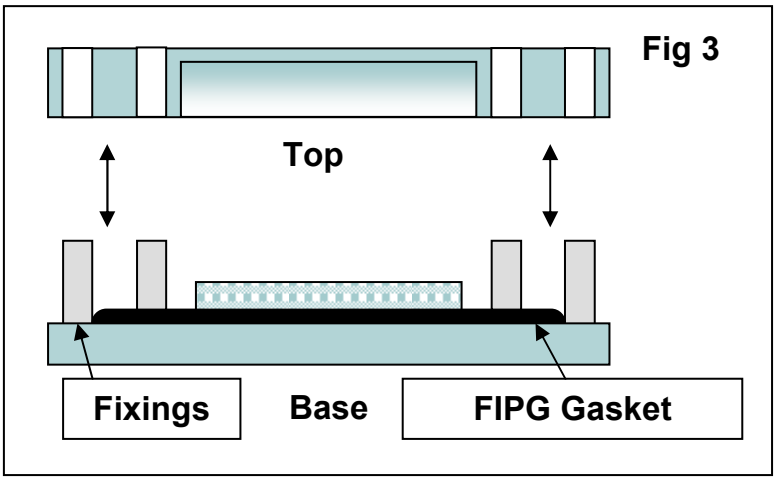


Fig1 shows a typical two component housing with a top and a bottom. A gasket seal needs to be provided between the two surfaces.



In **Fig2** a paste adhesive sealant is applied to one surface using a simple automatic dispensing system (shown below). The rheology of the sealant ensures that a raised profile is formed and this profile is maintained while curing takes place.



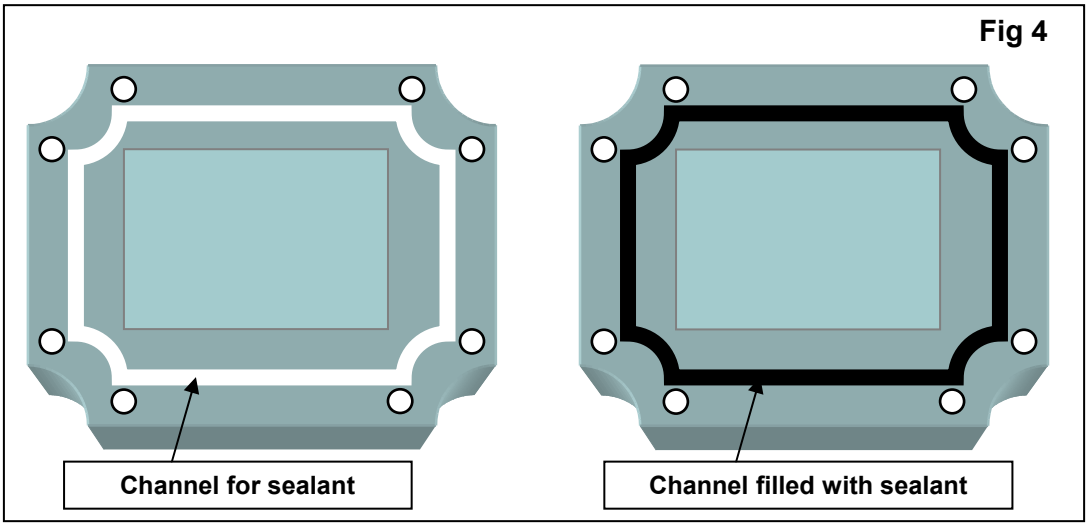
After sufficient time has been allowed for the sealant to cure the two components can then be placed together; see **Fig 3**. Mechanical fixings are used to hold the two components in place. The cured sealant is now compressed between the two surfaces to form a seal.

This method is particularly useful when the component surfaces are three dimensional. Using a three axis dispensing machine or an automated robot the sealant can be applied evenly to a three dimensional shape to provide an even and accurate gasket. Multiple gaskets can also be produced on one component where the sealing of several separate compartments or areas is required.

If the unit requires maintenance the gasket will remain in pace on one surface, allowing for easy reassembly.

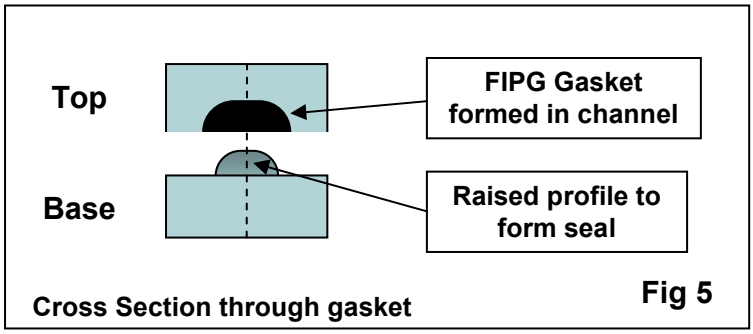
Method 2

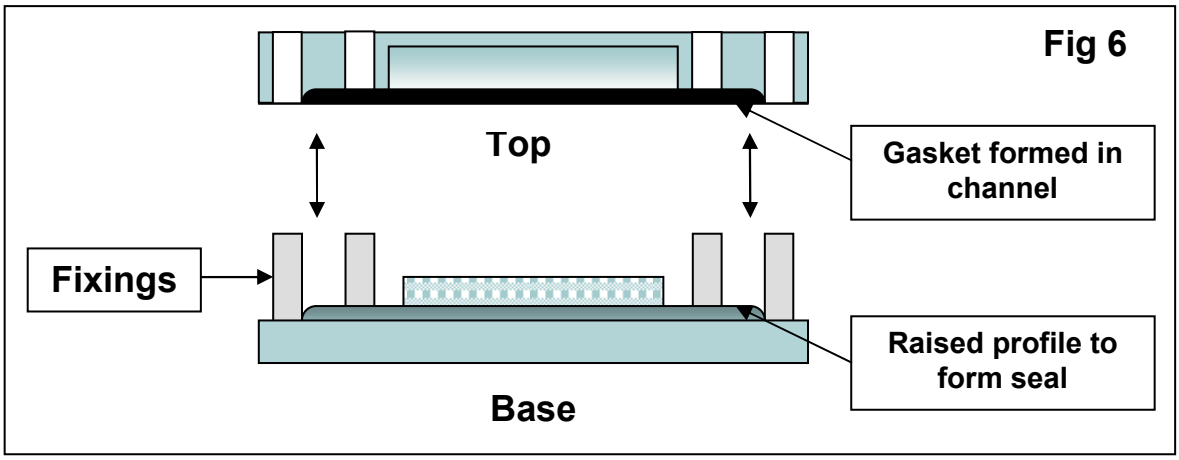
An alternative method can be employed on components that are only two dimensional; this is shown in **Fig4** below.



In the surface of one component a channel or groove is produced where the gasket is to be formed. This channel is then filled using a flowable or self levelling silicone adhesive sealant. The quantity of sealant is metered to fill the channel without overflowing onto surrounding surfaces.

On the other component a small raised profile is produced which follows the same outline as the filled channel in the first component. The centre line of the channel and raised profile would be the same. The width of the channel would be greater than that of the raised profile. See **Fig 5.** This will allow the raised profile to compress the seal evenly when the two components are assembled, using the mechanical fixings to apply pressure. See **Fig 6.**





This second method of forming the gasket has the added advantage of producing a seal which has greater mechanical strength and will therefore, be more suitable for high pressure applications.

Typical Example of FIPG

Using a recessed channel and raised profile

Top and bottom

Top section showing raised profile

Assembled unit

Bottom section with channel filled with sealant

Product Selection

Selection of the correct silicone adhesive sealant for use when making an FIPG is determined by both the method of production and the end application. The production methods will often dictate the rheology of the sealant, either a paste or flowable product. Other physical features of the sealant, such as flow rate, viscosity and extrusion rate, can affect both production speeds and the choice or design of the automated dispensing system. It is therefore, important to involve ACC Silicones and the equipment suppliers early in the design process.

Cure speeds and methods are crucial in order to maximise production efficiency. The chemical cure systems within silicone sealants produce by-products, some of which can be corrosive and harmful. These by-products can also affect the finished product and create H&S issues if they are not taken into account at an early stage.

Environmental operating conditions also affect the choice of sealant. What is the gasket providing a seal against, chemicals, oil, fuels, moisture, water etc? Silicones have proven excellent in resisting harsh operating conditions and maintaining their physical properties, but some silicone sealants are better suited to certain conditions than others. Extreme operating temperatures can degrade many gasket materials; this will result in a loss of elasticity which in turn will lead to product failures. ACC Silicones have products that will maintain their performance when exposed to very wide temperature ranges of -60^{o}C to +300^{o}C.

Other physical and electrical properties may be important and also add functionality to the gasket. Silicone is naturally electrically insulating but can be formulated to be electrically conductive. Thermal conductivity may be required to dissipate heat through the gasket into a heat sink or some other device.

ACC Silicones have a wide range of standard formulations and many more available to order. We also offer to work with our customer to create bespoke product to meet very specific design requirements. As the correct selection of product is crucial to product performance and efficient manufacturing, we encourage all our partners to involve our technicians in the design process and gain the benefit of our experience.

Some ACC Silicones Materials Suitable for Producing FIPG

Silicone Adhesive Sealants													
New Product Code	Cure Type	Rheology	Viscosity mPas	RTV or Heat cure	Colour	Min Working Temp - ºC	Max Working Temp +ºC	Duro Shore A	Tensile MPa	Elongation %	Tack Free Time mins	Max Cure 3mm Hrs@25ºC	Thermal Conductivity W/mK
1-Part Silcoset Adhesive Sealants													
Silcoset 151	Acetoxy	Self Level	210000	RTV	White	-60	300	43	2.93	180	10	<12	0.20
Silcoset 152	Acetoxy	Paste		RTV	White	-60	300	40	2.31	240	2	7	0.20
Silcoset 153	Acetoxy	Paste		RTV	Translucent	-60	250	39	2.32	280	4	7	0.20
Silcoset 158	Acetoxy	Paste		RTV	Black	-60	300	38	2.30	290	4	7	0.20
1-Part Industrial Adhesive Sealants													
AS1500	Acetoxy	Paste		RTV	White	-50	300	39	2.40	270	3	7	0.20
AS1502	Acetoxy	Paste		RTV	Silver Grey	-50	300	52	3.00	205	4	7	0.20
AS1504	Acetoxy	Paste		RTV	Red	-50	300	35	2.50	410	4	7	0.20
AS1521	Acetoxy	Flowable	49000	RTV	Translucent	-50	250	30	0.90	328	9	4	0.20
AS1522	Acetoxy	Flowable	7000	RTV	Translucent	-50	250	22	0.70	165	10	4	0.20
AS1523	Acetoxy	Flowable	70000	RTV	Translucent	-50	250	25	4.90	655	11	<14	0.20
AS1524	Acetoxy	Flowable	60000	RTV	White	-50	250	24	5.00	600	10	<14	0.20
1-Part Low Corrosive Industrial Sealants													
AS1602	Oxime	Paste		RTV	White	-50	250	38	1.60	220	4	<14	0.20
AS1603	Oxime	Paste		RTV	Translucent	-50	220	33	2.15	300	5	12	0.20
AS1604	Oxime	Paste		RTV	Black	-50	240	50	2.00	250	3	<12	0.30
AS1606	Oxime	Paste		RTV	Translucent	-50	220	25	1.50	530	8	10	0.20
AS1607	Oxime	Paste		RTV	White	-50	220	70	2.90	70	1	<9	1.58
AS1609	Oxime	Paste		RTV	Copper	-50	300	43	1.49	327	5	9	0.30
AS1620	Oxime	Flowable	26000	RTV	Translucent	-50	220	25	2.00	400	14	<24	0.20
AS1621	Oxime	Flowable	24000	RTV	White	-50	230	24	2.00	410	19	<24	0.20
AS1622	Oxime	Flowable	23500	RTV	Black	-50	275	24	1.90	390	13	<24	0.20
AS1623	Oxime	Flowable	6000	RTV	Brick Red	-65	250	24	1.20	180	19	24	0.20
AS1624	Oxime	Self Level	55000	RTV	Translucent	-50	220	23	2.00	350	13	8	0.20
1-Part Non-Corrosive Neautral Cure Adhesive Sealants (Electronic Grades)													
AS1403	Addition			Heat Cured	Black	-50	200	30	1.50	295			0.20
AS1420	Addition	Flowable	43000	Heat Cured	Grey	-50	260	67	3.10	70			1.38
AS1700	Alkoxy	Paste		RTV	Translucent	-50	200	30	2.43	545	10	36	0.20
AS1701	Alkoxy	Paste		RTV	Black	-50	220	52	2.35	200	3	24	0.60
AS1800	Acetone	Paste		RTV	White	-50	220	35	2.20	388	2	<24	0.20
AS1801	Acetone	Paste		RTV	Black	-50	220	35	2.00	320	2	<24	0.20
AS1802	Acetone	Self Level	350000	RTV	Grey	-50	220	67	3.90	103	4	<8	2.30
AS1803	Acetone	Self Level	350000	RTV	White	-50	220	65	2.80	94	4	<8	1.55
AS1804	Acetone	Paste		RTV	Black	-50	250	42	2.40	325	2	8	0.20
AS1805	Acetone	Paste		RTV	Red	-50	300	50	1.70	270	4	8	0.20
AS1806	Acetone	Paste		RTV	Black	-50	220	65	2.80	94	2	<8	1.55
AS1808	Acetone	Paste		RTV	Pink	-50	220	78	3.52	91	1	<24	1.79
AS1809	Acetone	Paste	350000	RTV	Grey	-50	220	68	2.96	85	2	8	1.55
AS1820	Acetone	Flowable	30000	RTV	White	-50	220	30	1.10	330	6	16	0.20
AS1821	Acetone	Flowable	20000	RTV	Black	-50	220	27	0.85	200	10	<24	0.20
AS1823	Acetone	Self Level	95000	RTV	Black	-50	250	29	1.70	225	4	<12	0.20
AS1825	Acetone	Paste		RTV	Black	-50	220	30	1.41	290	15	<24	0.20