

Customer Technical Information Manual

Zelvalve[®] dispensing closures



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Introduction

Zelvalve® is a sophisticated silicone valve dispensing system. It is vital for technical, production and marketing managers alike to understand that dispensing and seal performances depend on the choice of valve specification, product formulation, and container size/shape and material. Failure to appreciate this will undoubtedly result in a less than optimum dispensing performance.

Unless the product being filled is very fluid (low viscosity) such as a sports drink, the optimum pack design in all cases is a 'head stand' presentation. The reason for this is that all packs perform well when the container is full; however the real measure is how the pack performs when it is nearly empty.

If head stand designs are not specified when higher viscosity formulations are used such as ketchups, the product (when the pack is partially empty) takes longer to reach the valve than the consumer is prepared to wait for before trying to squeeze the pack. In this case the valve 'spits' and dispenses a mixture of product and air. This results in poor dispensing and failure of the valve to 'stay clean'. If the pack is head stand then it is always 'primed' for optimum dispensing.

Valves can be provided in a number of standard variants, and therefore the choice of valve is important. There are three main design variables help to achieve optimum dispensing/sealing performance:

- valve slit length & design
- valve head thickness
- valve head diameter

The combination of container design/material and product formulation of these valve design variables needs careful selection with Zeller Plastik UK to determine the best option for the customer/consumer pack. An example of good container design is a flat oval profiled PET bottle as it produces excellent recovery of the container wall after squeezing and this in turn defines the efficiency of 'suck back' through the valve slits. An example of poor container design is a cylindrical LDPE cosmetic tube. Such tubes cannot normally be used with silicone valves where vent back is desired.

It should not be assumed that re-launching a product using a silicone valve system allows utilising existing product formulations. It is sometimes necessary to adjust the formulation in combination with valve choice and container design/material. Checking of all product formulations for compatibility with the silicone is always advised.

Whilst every care has been taken in the preparation of this manual, no statement made herein is to be taken to be a representation, warranty, undertaking or contractual condition, Zeller Plastik UK accepts no liability by reason of any loss or damage suffered by any third party arising out the use thereof. Customers are responsible for ensuring that any closures and containers supplied are acceptable with, and suitable for, the purpose for which it is intended to use them.

Zelvalve[®]: Closure Types

1. Hinged closures

A common application for valved closures is shower gel dispensing where the closures can be left permanently once the pack is hung upside down in the shower.

A feature of the closure design can be a centre-opening lid, which snaps in to a feature at the back of the closure body. This allows the lid to be kept out of the way during use; and for the closure to be stable enough to stand-up whilst open if required.

The lid seals differently to a conventional dispensing cap in that the valve is 'self sealing'. The lid feature is designed primarily to prevent the valve moving forward which is the action that allows the valve slits to separate and the product to be dispensed.

2. Screw on closures

Where filling head stand packs is often more demanding than conventional upright pack presentations, customers may elect to fill in the normal way.

In this instance shower hooks or travel caps with the relevant feature to prevent valve activation in distribution can be used.

In the case of shower hooks the container is designed to allow the hook to be detached from the closure (or bottle) and with the aid of a snap fit feature on the container to achieve sufficient retention to suspend the pack effectively in the shower.

Development of Valve Technology

The original valve designs were launched over 20 years ago and these valves are large in diameter and assembled to the closure body as three separate components i.e. closure, valve & retaining ring. Some disadvantages existed in that use of the valve in very small closures was not possible and the ability to assemble the valve at speed because of its inherent 'sticky' properties was limited.

Smaller valves such as the Z21, Z25, Z150 & Z77 are more recent innovations, with no loss of dispensing performance. These valves were developed in order to offer high volume production particularly in Food and Beverage applications. Zeller Plastik UK have designed and patented a Valve Sub Assembly. This valve assembly inserts the valve into its retaining ring at high speeds, and by crimping the top section of the ring provides a positive method of holding the valve during handling and high-speed feeding/assembly to the closure body.

This sub-assembly is currently used in a variety of closure designs and allows for the closure to be designed for use with and without valves by providing simple tooling change parts in the closure mould design.

Valve Development Options

If the standard valve options are not entirely suitable, custom slit configurations are possible and certain investment and M.O.Q. criteria are applicable.

The potential for a custom valve development also exists. As this involves investment in valve design/capacity, and assembly equipment, a significant volume opportunity would be required to justify such a development.

Recycling Limitations

As the valve silicone materials are a chemically inert thermoset polymer, every care should be taken to eliminate any contamination into the recycling stream especially PET.

The “recyclable” or “swimming”® material as used on the V143-200-SF-R and the Z25-200-R VSAs have been specifically developed to allow an easy separation from the PET recycling stream float tanks.

It should be noted that not all standard silicone valves can be made utilizing the swimming® silicone material, for technical advice and availability please contact Martin Bull.

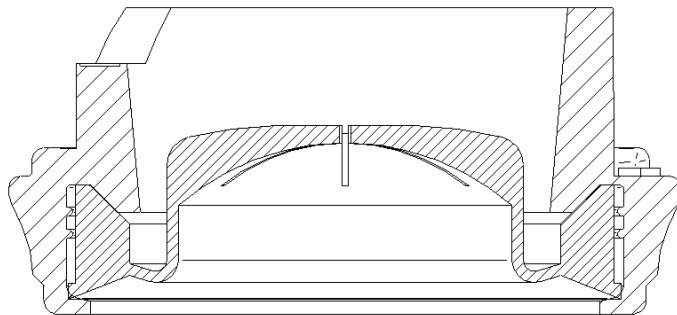


Swimming Silicone © is a TM of **Aptar** group

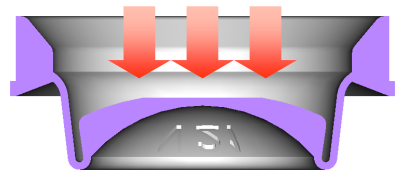
Valve Orientation

The valves have been developed to operate in only one direction to dispense, and therefore, the Valve Sub Assembly has been designed to function in one orientation only.

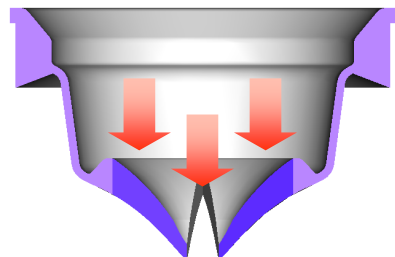
Direction of Product Flow



Slits sealed in relaxed position



Pressure applied to valve



Head moves improving seal

Increased pressure rolls valve head

Valve petals open and product flows

Container Design Recommendation

The container shape, size, wall thickness and material are all critical to a successful valve dispensing system. As a result, Zeller Plastik UK is pleased to offer, as a free service, closure & container recommendations, and testing facilities to assist in developing the optimum valve, product, and pack design solution.

Features that make up good container design include:

SHAPE

The container acts as an engine or pump for the system. As a result, the shape is very important to a container design and will determine how easy or hard the consumer will have to press or squeeze the pack in order to dispense the product. The container shape will also determine how easily and quickly the system will recharge or recover for the next dispense. Past experience has shown that an oval shaped profile, or as close to oval as possible, with minimal small radii or aggressive geometry changes works best.

Rectangular or square container profiles do not work as well because:

- (1) the panels are too flat and do not allow for easy squeezing (compression) of the package
- (2) they do not spring back to shape as quickly after dispensing, which would allow the system to recharge for the next dispense.

If a customer's design specifies a rectangle or square shape, it will be very important to recommend rounded front and back panels and large radii in the corners.

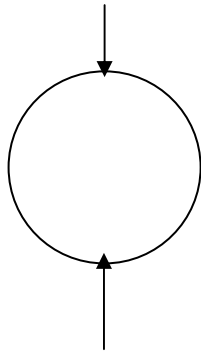
Round containers can fail if the overall size gets too large, or the material choice is incorrect, or the wall sections are too thin. With round containers, as the product level decreases, the consumer needs to compress the container more and eventually the container goes past the "spring back" or recovery point and the container walls collapse or crease. The end result is a poorly functioning system.

Corners also affect a container design. If a container must have corners, the radii should be as large as possible. Some containers also have recessed panels, creases, or sharp geometry direction changes. These can be potential weak points that reduce dispensing performance.

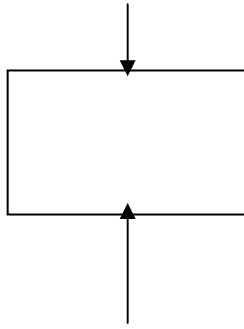
An oval shape container works best because it creates the least amount of resistance when squeezed to dispense product; whilst maintaining good spring-back qualities even when product level decreases.

Container Design Recommendation (continued)

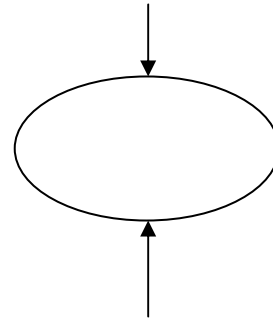
We have found that oval containers meet this delicate balance best.



Could collapse



Hard to squeeze
Slow recovery



Easy squeeze
Fast recovery

SIZE

Size is another factor when designing containers. As explained earlier, a container becomes harder to squeeze as the product level decreases. A larger container will only magnify this affect.

Our experience shows that a container up to 150mm tall and up to 600ml function the best. Larger containers will work, but be aware as the size of the bottle increases, the performance will decrease.

MATERIAL

Material selection is very important. We have found that PET works best followed by PP and then HDPE. We do not recommend MDPE or LDPE, as they are too weak and do not spring back well.

WALL THICKNESS

For guidance we recommend a wall thickness of 0.65mm – 0.75mm for PET, 0.75mm – 0.90mm for PP and 0.90mm – 1.00mm for HDPE but the container capacity and shape consideration will have a bearing on the final decision for optimum performance.

Product Compatibility

We recommend, as with any closure system that our customers conduct compatibility tests with the closure assembly containing the valve to ensure that effective sealing/dispensing is not impaired when in contact with the product formulations.

For new product launches we offer a comprehensive testing service to confirm optimum dispensing performance of the pack.

If the product formulation is changed, or a new variant added, to an existing pack it is essential to confirm the valve function and compatibility.

There are currently under development a number of valve materials potentially suitable for automotive sundry products containing silicone as conventional silicone materials are not compatible.

Through rigorous testing, it has been evaluated that certain products and chemicals may react with the silicone material(s), and subsequently, can have an effect upon the dispensing performances of the valves:

Not Compatible:

- Silicone based products i.e. polishes
- Methicones
- Hydrocarbons

Impact / Affect Performance:

- Perfumes
- Hydrogen Peroxide
- Sodium Hypochlorite
- Monoethanolamine

The aforementioned list is not exhaustive and is intended as a guide. However, in some instances, through design or material choice, some of the adverse effects upon the valve performance can be minimised.

Zeller Plastik UK can advise upon likely chemical compatibility and suitability, and can also perform chemical compatibility tests. However, the customer must satisfy themselves on the suitability of the consumer pack.

Food Approval

The silicone valves used meet current FDA, EC and BGVV legislation for plastics in contact with food. This compliance extends to the talcum powder used post moulding to allow the product to be effectively slit and handled during the assembly process into the closure.

The European PET Bottle Platform (EPBP) concludes that “Swimming”® silicone will have no negative impact on current European PET recycling.

Our closures and components are designed, manufactured and delivered in compliance with our certified Integrated Management Standard which encompasses current Quality (ISO 9001), Environmental (ISO 14001) and Occupational Health & Safety (OHSAS 18001), and the current BRC Global Standard for Packaging & Packaging Materials

Capping and Filling

As the valves are housed within a non-critical area inside the closure design, capping and filling considerations should be no different to conventional closure designs.

As indicated earlier in this manual, to achieve an optimum dispensing design a head stand pack is essential for most products considered. This will impact on both filling and capping lines if the existing packaging is not already in this format.

It is strongly advised not to compromise on the need for a head stand pack, as undoubtedly customer satisfaction will suffer as the pack becomes partially empty.

We also highly recommend that the bottle “pucks” which hold the containers during the filling process are designed to apply a small degree of compression to the container sides. This will ensure that the container is held firmly within the puck, but also as the cap is applied and the bottle released, the pack will try to recover or “suck back” which in turn “presets” the valve and ensures an optimum seal.

Storage

Care must be taken to ensure every aspect of the transportation and storage of the finished components will not adversely affect the constituent valve materials or features.

A clean & moisture free environment must be maintained to ensure that the talc ingredient does not coagulate or alter the valve dispensing properties.

It is recommended that after transportation or storage, the closures are permitted to acclimatise to the assembly ambient temperature for a minimum of 24 hours before capping or filling. If any extremes of temperatures have been experienced during the transportation or storage of the components, this may affect the performance of the feeding and/or capping equipment.

Valve Options








Variant	Currently Available	Available with Investment	Recommended for	
			Low viscosity Products	High viscosity Products
Z21-200	✓		✓	
Z21-200-3	✓			✓
Z21-200-SF	✓			✓
Z21-200x070x070	✓		✓	
Z25-200	✓		✓	
Z25-200-R	✓		✓	
Z77XD-220-SF	✓		✓	✓
Z77XD-220-SF-R		✓	✓	✓
Z150-200x070x070	✓		✓	
V143-200-SF-R	✓		✓	
R13AAH-300-2	✓		✓	✓
R13AAH-355-3	✓		✓	✓

	VSA & Valve Options											
	Z21-200	Z21-200-SF	Z 221-200-3	Z21-200x070x070	Z25-200	Z25-200-R	Z77XD-220-SF	Z77XD-220-SF-R	Z150-200x070x070	V143-200-SF-R	R13AAH-355-3	R13AAH-355-3
EXAMPLES OF USE FOR CURRENT PRODUCTS												
KETCHUP/SAUCES	✓		✓							✓	✓	✓
MAYONNAISE/MUSTARDS		✓	✓							✓	✓	✓
DRINKS (NON CARBONATED)	✓		✓		✓	✓	✓	✓				
DRINKS (CARBONATED)					✓	✓	✓	✓				
SHOWER GELS	✓									✓		
SHAMPOOS	✓									✓		
POWDERS (e.g. TALC)		✓	✓								✓	✓
PARTICLE PRODUCTS (e.g. RELISH)		✓				✓					✓	✓
SYRUPS/JAMS		✓	✓								✓	✓
CLEANING PRODUCTS	✓		✓	✓						✓		
LIQUID CONCENTRATES				✓					✓			

Standard Zelvalve® Closure Options

		VSA	R13	Recommended for	
				<u>Low viscosity Products</u>	<u>High viscosity Products</u>
	X0136	✓			✓
	X0149	✓		✓	✓
	X0212	✓		✓	✓
	X0178	✓		✓	✓
	X0206		✓		✓
	X0207	✓		✓	✓
	1283	✓		✓	✓



Standard Zelvalve Closure Options - continued

		VSA	R13	Recommended for	
				<u>Low viscosity Products</u>	<u>High viscosity Products</u>
	1283	✓		✓	✓
	1803	✓		✓	✓
	1804	✓		✓	✓
	2882	✓		✓	✓
	1801		✓		✓
	1959		✓		✓
	1961		✓		✓

Standard Zelvalve Closure Options - continued

		VSA	R13	Recommended for	
				<u>Low viscosity Products</u>	<u>High viscosity Products</u>
	3222	✓		✓	✓
	4170 (To be used with 4124 Hook)		✓		✓
	4933		✓		✓
	4967	✓		✓	✓
	4981	✓			✓
	5058		✓		✓
	5238	✓		✓	✓

Standard Zelvalve Closure Options - continued

		VSA	R13	Recommended for	
				<u>Low viscosity Products</u>	<u>High viscosity Products</u>
 <p>global closure systems</p>	8981	✓		✓	
 <p>global closure systems</p>	8938		✓	✓	

Customer & container neck drawings available upon request.



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