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The Art of Crimping

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Introduction

I refer to crimping as an "Art" instead of a science. As a schooled engineer, I believe that crimping, also commonly called clinching, should be a science. It is the mechanical attachment of an aerosol valve to a can and one should be able to measure the components and determine specifications. However, due to the variations in such things as the metal thickness used for the valve's mounting cup, can curl dimensions, Cup Gasket material and thickness, the effects of the product and propellant on the gasket and other numerous factors including possible liability, no one wants to provide hard fast crimping specifications. Even the valve company I work for only provides crimp diameter and depth information as guidelines.

Not only is obtaining a proper crimp difficult due to the variations in the packaging components, there are many things that can go wrong with the production equipment. When things do go wrong in the manufacturing process it is likely that you will not discover it in-house but learn of it from a customer. This is because not all crimp defects result in an instantaneous defect. Some defects, such as latent leakers, may take months to appear. I was once involved in a failure investigation where a valve had blown out of a can when the consumer tried to use the product. Investigation of the crimp showed the valve was crimped to a diameter of 1.010" (26.65mm). This was .060" (1.52mm) below the suggested crimp diameter. The applied crimp was barely large enough to keep the valve in the can. Even with this excessively undersize crimp diameter, the product made it through gassing, packaging and distribution before the undersize crimp presented a problem.

If you read texts and specifications written by experts in the aerosol field, such as "The Aerosol Handbook" written by Montfort A. Johnsen[1], you will find that they provide guidelines for determining the proper crimp depth related to variances in the components and suggest adjustments based on a set diameter. Moreover, these books do not provide hard fast crimp dimensions. Why? As I indicated above, it is the number of variables involved.

Thus, I will attempt to provide some basic quick and easy to use crimping guidelines based on my 20 years of experience working with aerosols and teaching (the art) crimping. These guidelines will provide quick ways to determine crimp dimensions, evaluate the final crimp and some pitfalls to look for when crimping.

The Goals of Crimping

There are two goals associated with crimping:

1. Securely attach the valve to the can and

2. Provide a leak proof seal between the valve and the can.

Every aerosol manufacturing plant I have visited wants to perform the crimping operation as effectively, quickly and cheaply as possible. It becomes a very costly event when collets are broken and the package leaks between the valve and can (crimp leaker). Costs escalate as a result of downtime while the crimp head is repaired. In addition, unless the defect is catastrophic enough to show leakage at the crimp, it is likely the product will end up going to a customer. That is because crimp leaks are normally extremely slow such that they are not detected during the production process. When the end user tries to dispense the product it doesn't dispense properly and reports complaints such as:

1. The product came out runny

2. There is product left in the can and I cannot get it out.

3. I went to dispense the product and nothing came out.

Not only can crimp leakers occur as the result of broken collets, they can occur as the result of improper crimp dimensions, improper selection of the cup gasket, swelling or shrinkage of the cup gasket caused by the product and other defects associated with performing the crimp

How do you prevent these types of problems? I will start my discussion on the subject by reviewing the components, terminology and equipment associated with crimping.

Components/Terminology/Crimping Equipment

There are two packaging components involved in crimping, the can and the valve.

1. Can: For the purpose of this discussion we will break the can into two parts, the body and the dome (see Figure 1).

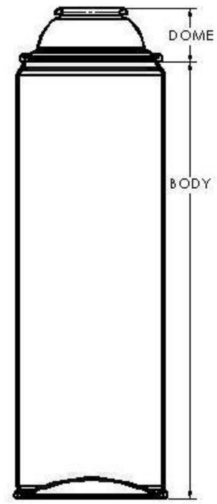

Figure 1 - Can

a. Dome: The can's dome is the top portion of the container. It may be formed as part of the can or manufactured separately and then attached. The dome contains a center opening encircled by a raised bead, also called the curl. For this paper we will be discussing only cans with a 1-inch (25.4mm) opening (see Figure 2).

   Terminology associated with the can dome:

   1. Bead (Curl): This area of the can to which the valve is attached (see Figure 2).

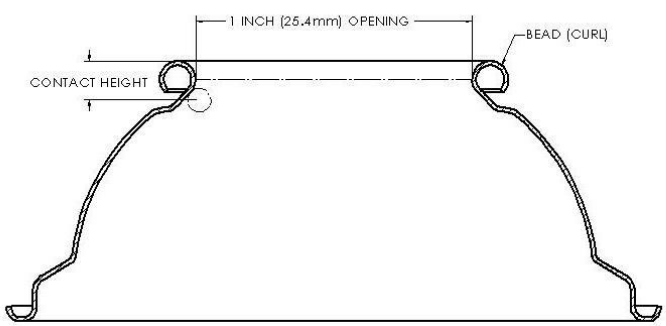

Figure 2 – Can Dome Cross-Section

   2. Contact Height (CH): The CH is the distance from the top of the can curl to the center of a ball of radius R_2 that touches the inside of the can dome tangent to the dome at the Point of Hard Contact (see Figure 3). This will be further explained in the section entitled "Establishing the Required Crimp Dimensions".

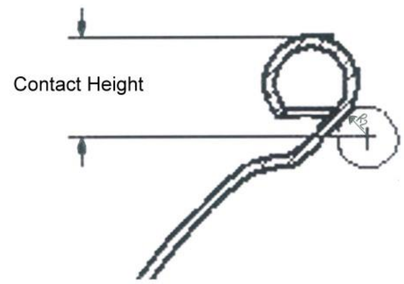

Figure 3 – Contact Height

3. Eyelashing: When an aluminum can's dome and curl are formed it is accomplished by continually reducing the diameter of the previously formed aluminum tube. As a result of this reduction in the diameter, the aluminum metal gets small wrinkles on the can curl called eyelashing (see Figure 4). This is most important because the wrinkles run from the can's inside to the outside providing a path for leakage if not properly sealed. Some manufactures machine the top of the curl to remove the eyelashing.

Figure 4: Eyelashing on the bead of an aluminum can magnified 88 times

2. Valve: For our purpose we will focus on the valve's mounting cup. This is the portion of the valve that will be attached to the can (see Figure 5).

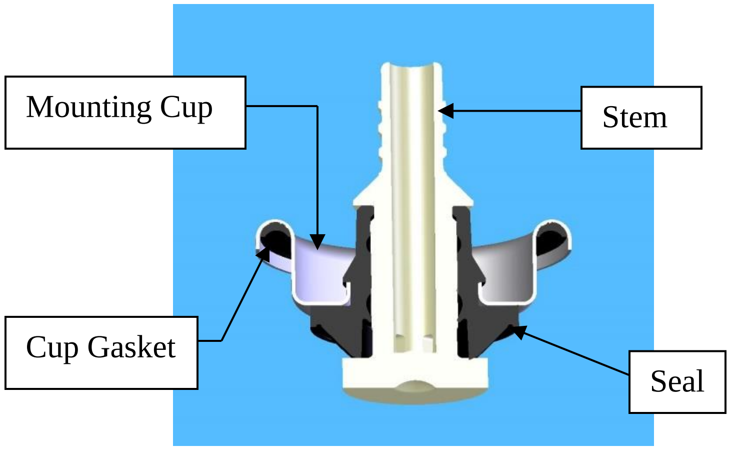

Figure 5 – Valve Cross Section

a. Mounting Cup: The valve's mounting cup is normally made from tinplate steel but can also be made from aluminum and stainless steel.

   Terminology associated with the mounting cup:

   1. Cup Curl: The area of the mounting cup that mates with the can's curl. The cup's curl is also the location of the lathe cut gasket or sleeve gasket (these items will be discussed later) (see Figure 6).

   2. Cup Skirt: The area of the mounting cup that fits over and captures the can curl. This is the area of the valve where some overcaps are attached (see Figure 6).

   3. Skirt Height: The dimension from the bottom of the cup skirt to the top of the cup curl (see Figure 6).

   4. Cup Height: The dimension from the bottom of the mounting cup to the top of the cup curl (see Figure 6).

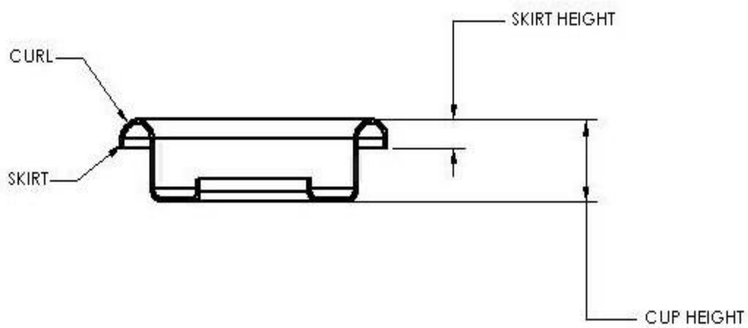

Figure 6 – Mounting Cup Cross Section

b. Cup Gasket: There are three (3) common methods used by valve manufactures to aid in obtaining a leak proof seal between the valve and container. These methods are:

   1. Lathe Cut Gasket: A rubber gasket cut from a tube of rubber dimensioned to fit inside the cup curl (See Figure 7).

   2. Laminate Gasket: A plastic film glued to the flat metal tinplate by the tinplate manufacturer. When the cup is formed the plastic side becomes the side of the mounting cup that attaches to the can (See Figure 7).

   3. Sleeve Gasket: This is a formed plastic gasket that fits inside the cup curl and extends up the side of the 1-inch (25.4mm) diameter (See Figure 7).

Lathe Cut Laminate Sleeve

Figure 7: Mounting Cup Gasket styles

3. Collet: The part of the crimp head that expands to push the metal of the valve's cup under the curl of the can. The collet is cut from bar stock into either 6 or 8 segments (see Figures 8 & 9).

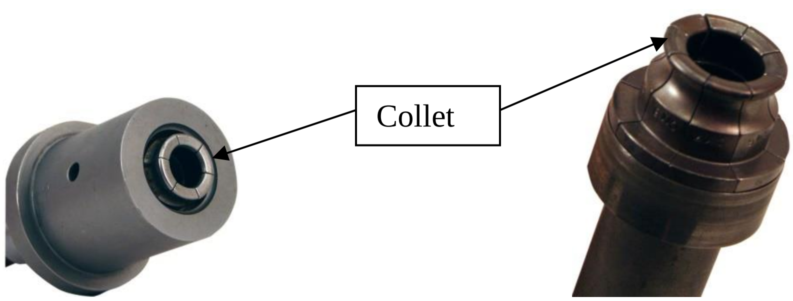

Figure 8 – Six (6) Segment Collet Figure 9 – Eight (8) Segment Collet

Terminology associated with the collet:

a. Foot (sometimes called toe): The portion of the collet that contacts the mounting cup pushing it out and under the can curl (see Figure 10).

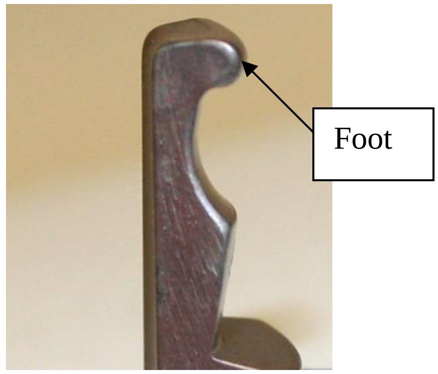

Figure 10 – Collet Section

4. Terminology associated with the crimp:

   a. Crimp Diameter: The distance between the impressions left by two collet sections 180 degrees apart (see Figure 11).

   b. Crimp Depth: The distance from the top of the cup to the center of the collet section impression (see Figure 11).

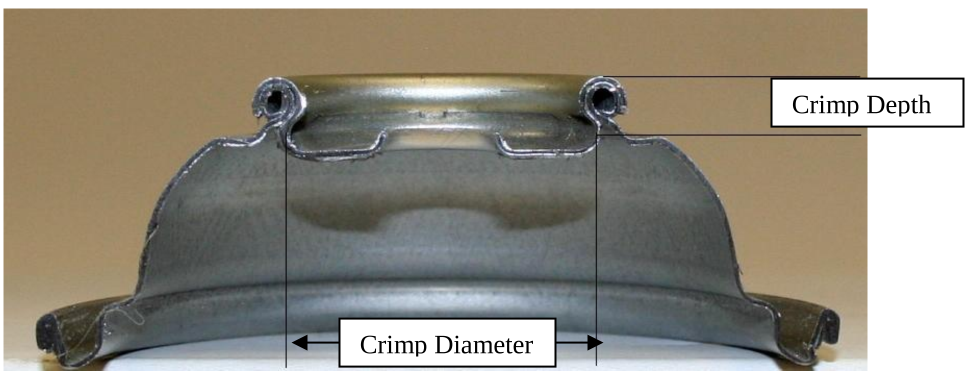

Figure 11 – Crimp Dimensions

   c. Crimp Pull: This is a condition that occurs when the metal supplied to form the crimp comes from the skirt instead of the side wall of the valve's cup.

   d. Point of Hard Contact (PHC): The location where the mounting cup contacts the can under the can curl (see Figure 12).

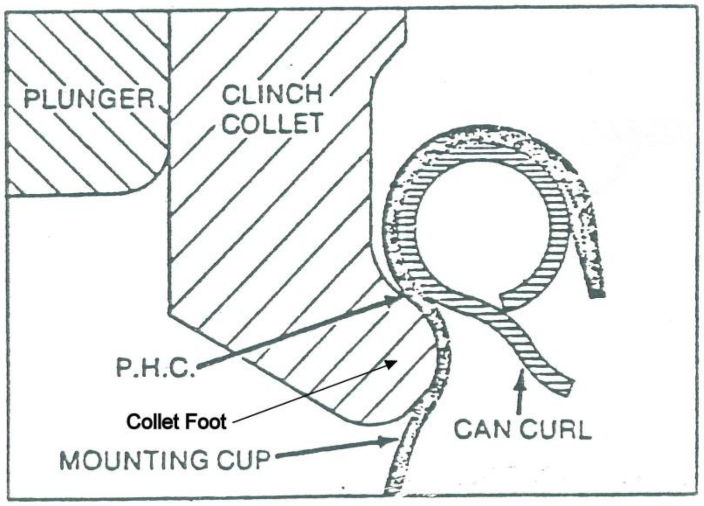

Figure 12 – Cross Section of Crimp being applied

e. Crimp Collet Section Gap: The bump formed on the crimp diameter as a result of the gap created between collet sections as they expand to crimp the valve onto the can (see Figure 13).

Figure 13 – Gap on Crimp between Collet Sections

f. Latent Crimp Leaker: Leaking between the can and valve that occurs well after packaging the product.

Selecting the proper Cup Gasket Material for the Can and Product.

This subject shall be examined from the point of obtaining a functional seal between the can and valve. As previously discussed, there are 3 major Cup Gasket materials being used:

1. Polypropylene Laminate: A thin plastic film about .008” (.20mm) thick, glued to the tinplate role stock prior to stamping the mounting cup. Generally, this is the least expensive Cup Gasket material because it does not require secondary

application operations. Laminate works well with tinplate cans but is not well suited for use with aluminum cans because it cannot compensate for the eyelashing on the can curl.

Prior to crimping, the mounting cup sits close to the can bead (see Figure 14). When the valve is crimped on the can, the laminate is put under compression from the top of the curl to the Point of Hard Contact (see Figure 15).

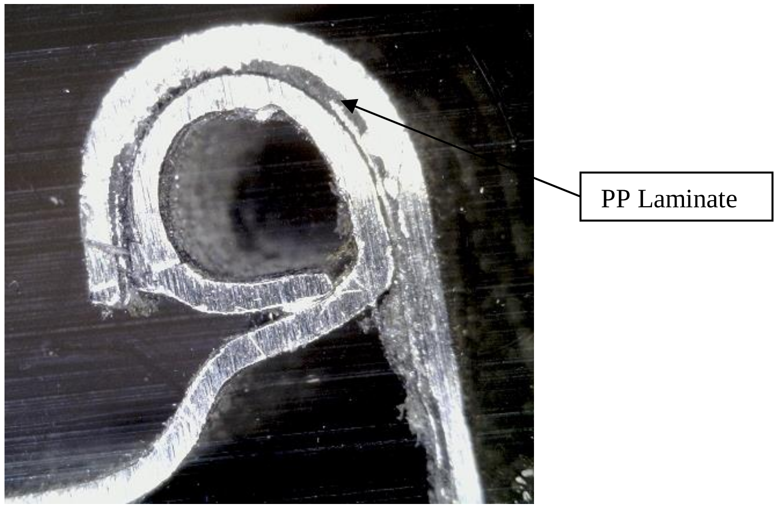

Figure 14 – Cross Section of Laminate Mounting Cup before Crimping

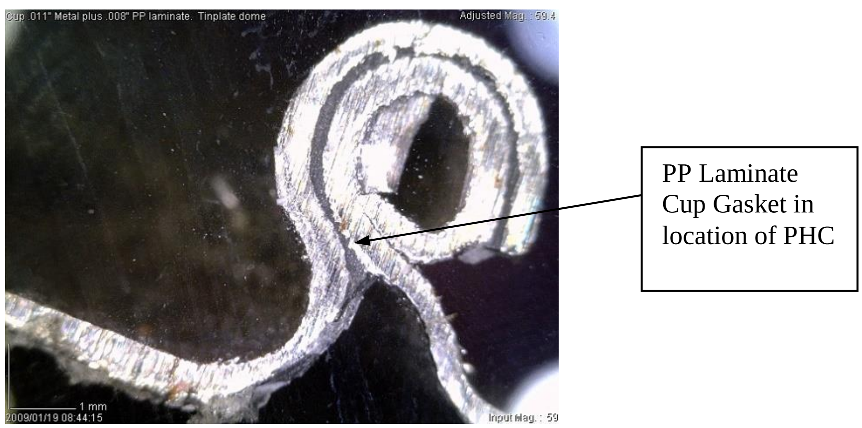

Figure 15 – Cross Section of Laminate Mounting Cup Crimped on to a Tinplate Can

2. Sleeve Gasket: Made from polyethylene, the gasket fits into a portion of the cup curl and up the sidewall and is about .015” (.38mm) thick. Note: I do not have experience with this material so I cannot provide any comment on it’s effectiveness with various can types. However, I expect that it would work similar to the polypropylene laminate gasket.

Notice the location of the sleeve gasket prior to crimping and its thickness at what will become the PHC (see Figure 16). Notice the compression of the sleeve gasket and the way it appears to be totally compressed and extruded out at the PHC (see Figure 17).

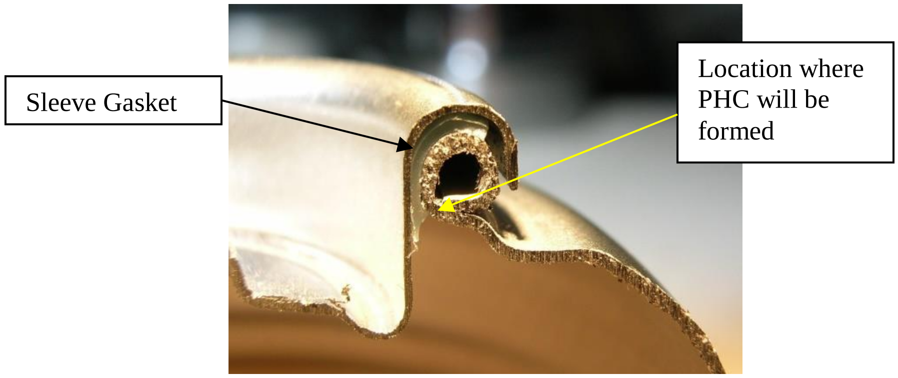

Figure 16 – Sleeve Gasket prior to Crimping

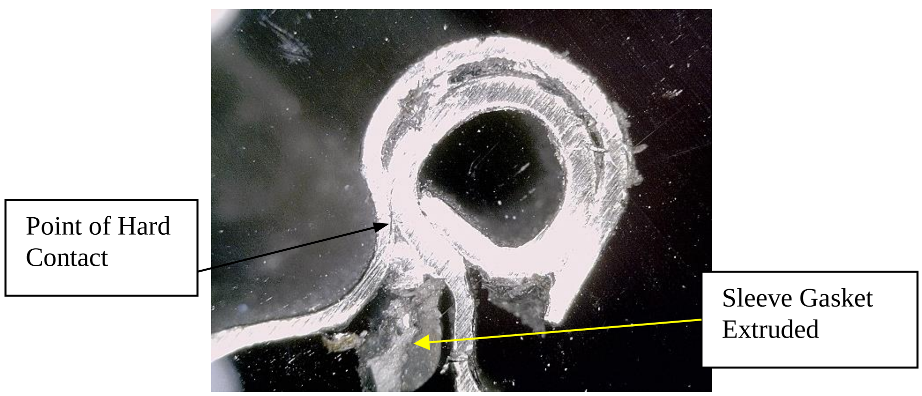

Figure 17– Sleeve Gasket after Crimping

3. Lathe Cut Gasket: This gasket comes in various materials and thicknesses however, nitrile is common. A lathe cut gasket can be used on tinplate and is well suited for aluminum cans because of its ability to conform to the irregularities in the the bead's surface.

   You will notice that prior to crimping, the lathe cut gasket sits loosely in the mounting cup curl (see Figure 18). After crimping, the lathe cut gasket is compressed between the mounting cup curl and the top of the can curl (see Figure 19). There is no gasking material at the PHC.

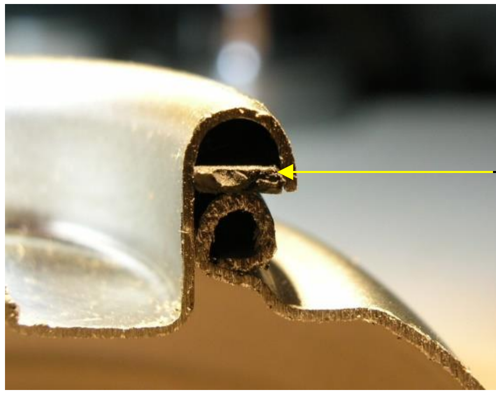

Figure 18 – Lathe Cut Gasket prior to Crimping

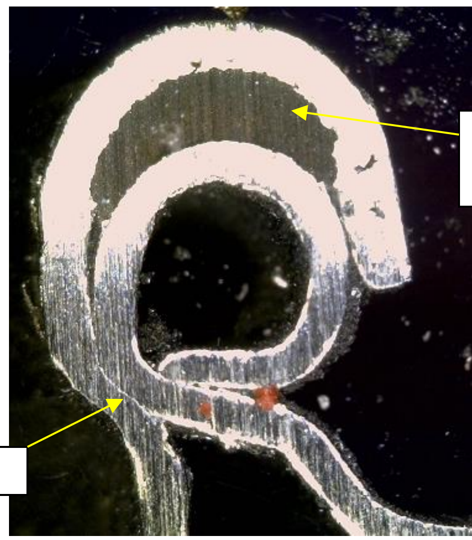

Figure 19 – Lathe Cut Gasket after Crimping

Not only must you select the proper Cup Gasket material for the can, you must also make sure that your product will not affect it. Depending on the product and propellant being used, the Cup Gasket may shrink or swell. Shrinking or swelling of the Cup Gasket may cause latent crimp leakers.

Establishing the Required Crimp Dimensions

When attempting to determine the proper crimp dimensions, several variables are involved. These variables include:

1. Can curl dimensions.
2. Collet foot radius.
3. Cup Gasket style and thickness.

4. Mounting cup metal thickness.

5. Can's 1-inch (25.4mm) diameter open dimension.

When determining the proper crimp dimensions for your system, both the diameter and the depth must be considered. A functional crimp may not be obtained if only one dimension is within specification. It takes both the crimp depth and diameter to create the Point of Hard Contact. Furthermore, the PHC is required to obtain a functional seal when using laminate and sleeve gaskets. Lets start our discussion of determining the required crimp dimensions by calculating the crimp depth. To calculate the proper crimp depth we use the equation:

$$\text{Crimp Depth} = CH_A + t + G_c + G_{phc}$$

Note: This equation is a modified version of the equation given in The Aerosol Handbook[1]. The Aerosol Handbook does not have a factor G_{phc}. G_{phc} will be zero in some cases such as when a lathe cut gasketed valve is used. In the case of a laminate mounting cup, this factor is approximately .006" (0.15mm).

Factors In The Equation (reference Figure 20):

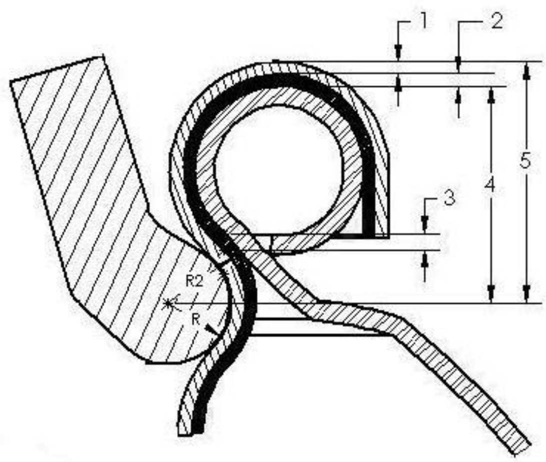

Figure 20 – Factors Involved in Determining Crimp Depth

1. t = Mounting cup metal thickness of the selected valve. Contact your valve supplier for this information.

2. G_c = Cup gasket thickness after crimping. Contact your valve supplier for this information.

3. G_{phc} = Cup gasket thickness at point of hard contact after crimping. Contact your valve supplier for this information. With Clayton's valves use .006" (.15mm) for laminate cups and zero for lathe cut gaskets.

4. CH_A = Adjusted contact height. See "Adjusting the Contact Height" below for instructions on calculating this factor.

5. Crimp Depth

R = Foot radius of the collet section forming the crimp. Contact your collet supplier for this information.

R_2 = Radius of the measuring ball used in determining the standard contact height (CH_S). You can get this information from your can supplier or from the standards.

$R_2 = R_1 + t_1$

R_1 = The foot radius of the collet section used to determine the standard contact height (standard contact heights are normally based on a foot radius of .047", 1.2mm).

t_1 = The thickness of the mounting cup metal used to determine the standard contact height (standard contact heights are normally based on a metal thickness of .010", .3mm).

Adjusting the contact height:

Standard Contact Height (CH_S): There are standards for this dimension however, they vary by can type and manufacturing location. It is best to contact your can supplier for this dimension. Furthermore, you must also ask the can supplier what size ball was used to measure the contact height. The contact height used in the equation to determine Crimp Depth above, CH_A, is the result of adjusting the stand contact height. Use the following equation to determine CH_A:

$$CH_A = CH_S + (R - R_1) + (t - t_1)$$

or

$$CH_A = CH_S + (R + t) - R_2$$

CH_A = Adjusted Contact Height

CH_S = Contact Height from standard or supplied by the can manufacturer

R = Foot radius of the collet section forming the crimp. Contact your collet supplier for this information.

R_1 = The foot radius of the collet section used to determine the standard contact height

t = Mounting cup metal thickness of the valve being used

t_1 = The thickness of the mounting cup metal used to determine the standard contact height.

The numbers used in the above equations for determining CH_A and Crimp Depth, are nominal dimensions for the components. The equations assume a crimp diameter of 1.070" (27.18mm) to achieve the proper Point Of Hard Contact. The equation takes into account all variables that effect crimp depth except for the 1-inch opening diameter. All these dimensions have tolerances and if you measured the actual dimensions on each of the components involved, the result would be the actual crimp depth for the set of components measured. The problem is you can't do this for every set of components; furthermore some of the dimensions are based on the compression of the cup gasket that is a result of the crimp. Hence, looking at the equations and the components one would think that crimping is a science. However, because of the variances in the components and the crimp, I consider crimping an art. Experience plays as much a factor in obtaining a functional crimp as the dimensions. If you use the Crimp Depth equation above, measure the crimp dimensions and assure the proper set up of the crimping equipment, experience shows a functional crimp will be obtained most of the time.

Now that we have determined the crimp depth and diameter, let me say that when it comes to lathe cut gasketed valves, you do not need to create the perfect PHC. This is because the seal between the cup and can is achieved at the top of the can curl. Your goal with a lathe cut gasketed valve is to achieve compression of the gasket and assure the valve is securely attached to the can.

Why would we want to take what we have just reviewed and throw it out the window? Lets consider one of the largest expenses associated with crimping, breaking collets. Collets can break in a number of ways but one cause is crimping too shallow a depth or too large a diameter. When you crimp shallow the collet feet are expending into the side of the can curl (see Figure21). The added stress exerted on the collet caused by the foot expanding into the can curl can cause them to break.

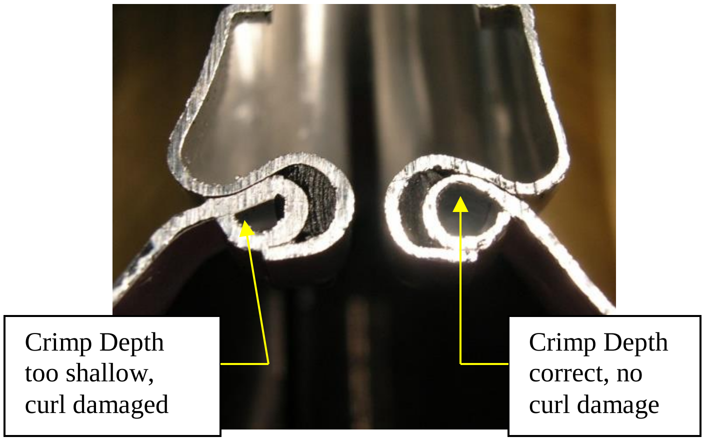

Figure 21 – Damage caused by Crimping too Shallow

If you crimp too large in diameter, the sidewall of the collet can be expanded against the sidewall of the mounting cup. This area of the mounting cup is supported from behind by the can bead resulting in added stress on the collet that could also cause breaking.

In order to reduce the risk of breaking collets and taking into account that you do not need to create a PHC; you can reduce your crimp diameter when crimping a valve that utilizes a lathe cut gasket. At Clayton, we suggest a starting crimp diameter for lathe cut gasketed valves of 1.055” +/-.010” (26.80mm +/- .25mm). I have no test data to back up the reduction in crimp diameter other than it was the crimp diameter specification I was given when I started at Clayton 20 years ago and have always used with good results.

Now that we have established the crimp diameter and depth we want to use, let’s look at some of the aspects of crimping that should be controlled in order to obtain a functional crimp. We will examine measuring/evaluating the crimp, setting up the crimper and some common problems of crimping.

Evaluating the Crimp

1. Measuring Crimp Diameter and Depth

   Let’s first review measuring the crimp diameter and crimp depth. As was shown earlier, there are two common types of crimp collets used, 6-segment and 8-segment. If we think of each collet section as an independent tool, then we have either 6 or 8 tools, depending on the number of collet sections that form the crimp.

   The first step in making your measurements is locating the collet section impressions in the mounting cup. If you look inside the cup at the crimp, you will see little bumps around the diameter (see Figure 13). These bumps are caused by the gap between the collet sections when they expand to create the crimp (see Figure 22).

Figure 22 – Expanded Collet showing Gap between Sections

Using a marker, mark the location of each of these bumps on the dome of the can (reference Figure 23). These marks indicate the edges of each collect section. Next, number each collet section between the marks, 1 to 6 or 1 to 8, depending on the number of collect sections (see Figure 23).

Figure 23 – Top of dome after Marking and Numbering Collet Sections

Now that you have located and numbered the collet sections you are ready to measure the crimp. To measure the diameter on a 6-segment collet, measure between sections 1 & 4, 2 & 5 and 3 & 6. For an 8-segment collet, measure the diameter between 1 & 5, 2 & 6, 3 & 7 and 4 & 8. The depth is then measured at each collet section.

The crimp dimensions are best measured before the can is pressurized. This is due to the phenomenon known as doming. Doming is the upward movement of the center of the valve when the can is pressurized (see Figure 24). Prior to gassing the can, the valve cup is flatter and allows easier access to the crimp (see Figure 25).

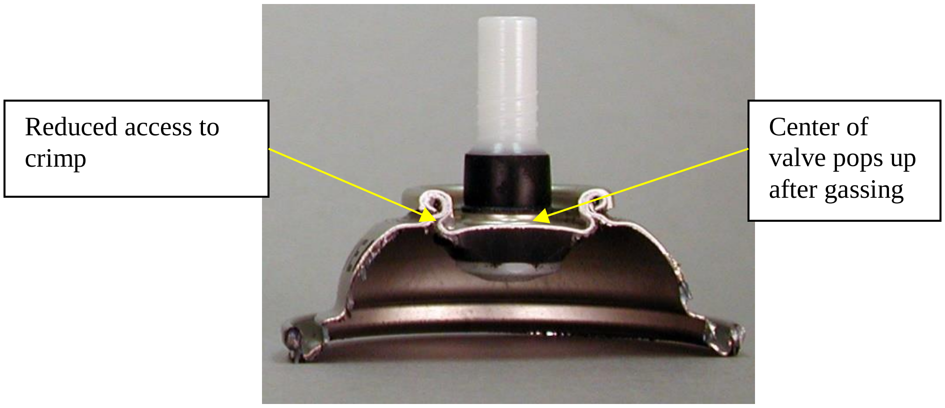

Figure 24 – Valve after Gassing

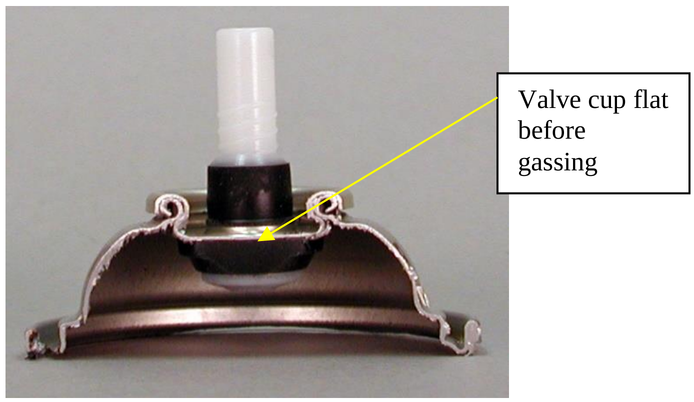

Figure 25 – Valve before Gassing

1. Crimp Pull / Crushed Dome: This measurement helps analyze the amount of pressure the can and valve are experiencing during crimping and is useful with laminate mounting cups and tinplate cans. This method doesn't work with lathe cut gasketed cups because the initial measurement would be hard to obtain due to the valves orientation on the can prior to crimping (reference Figure 18) and the gasket's compression after crimping. It is also not suited for use with round top aluminum cans due to the shape of the dome. I have not tried this method with a sleeve gasketed mounting cup but believe it would work the same as with the laminate cup.

   In order to understand why this dimension is important, lets start by looking at how the crimp is formed. When the collet expands to crimp the valve onto the can, metal from the mounting cup is pushed out under the can curl. As you can see in Figure 26, the metal required to form the crimp is supplied as the result of the upward movement of the bottom of the mounting cup. In other words, the bottom of the valves mounting cup moves up to supply the metal required to form the crimp.

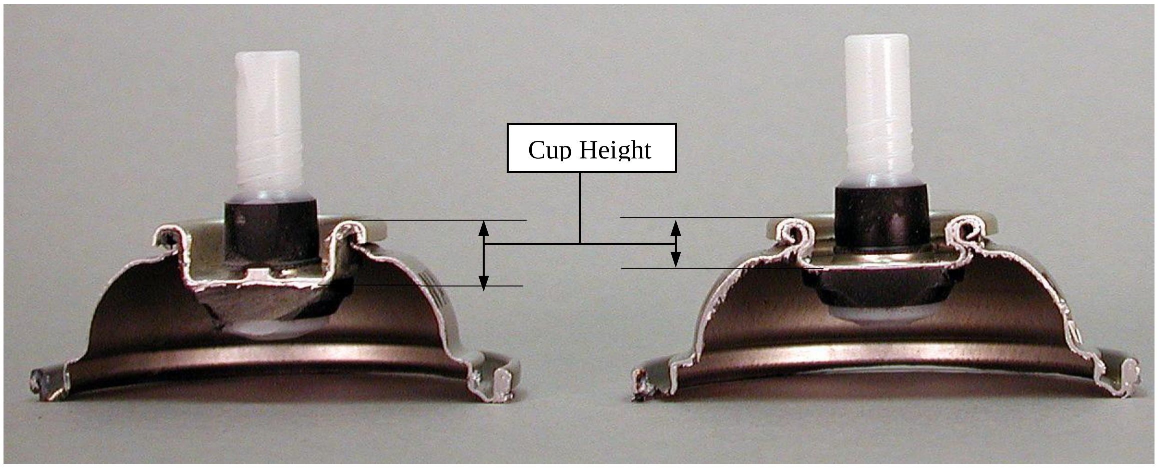

Figure 26 – Cup Height before Crimping on left and after Crimping on right

If the bottom of the mounting cup is restricted from moving upwards or the valve is not held tightly enough in the can, metal to form the crimp will come from the cup skirt. When this happens it is called a “Pulled Crimp”.

If the crimp is pulled because the bottom of the mounting cup was prevented from moving upwards, it is possible that you will damage the valve. Pulling the crimp also causes the cup diameter to increase, which may cause problems for any component that attaches to the valve such as the cover.

It is also important during crimping to hold the valve firmly against the can. This is important for two reasons:

1. To compress the Cup Gasket material.

2. To hold the mounting cup firmly against the can so the metal for the crimp is supplied by the bottom of the valve’s mounting cup moving upward, not by the skirt of the mounting cup moving toward the inside of the can.

When using a laminate mounting cup and a tinplate can prior to crimping, perform the following measurement steps to determine if you are pulling the crimp of crushing the dome.

a. Hold the valve firmly on the can.

b. Using a feeler gauges, measure the height between the bottom of the mounting cup skirt and the top of the can dome (see Figure 27). Mark the valve and can dome at the location of the measurement.

c. Keeping the marks on the valve and can aligned, run the can through the crimper.

d. Again measure the height as described in step b at the same location.

e. If the measurement has gotten smaller, then you have crushed the can dome as a result of too much downward force applied by the crimp head.

f. If the number gets larger, then you have pulled the crimp as the result of not enough pressure being applied by the crimp head.

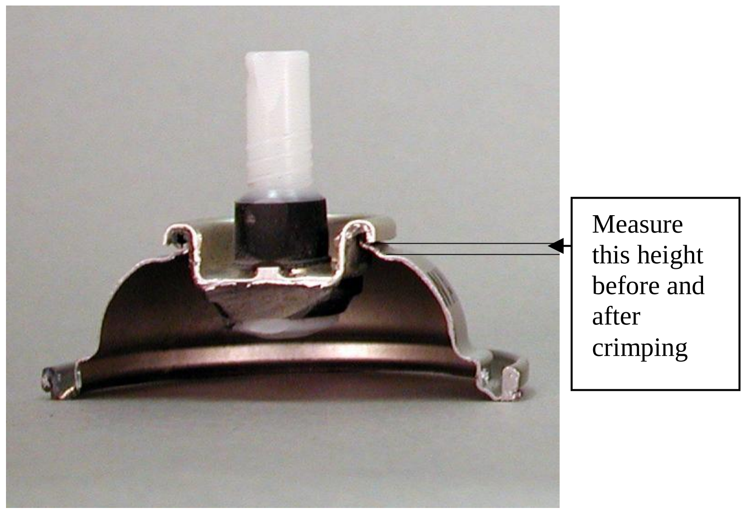

Figure 27 – Measuring Location for Crimp Pull

Although this test is not suited for aluminum cans and valve with lathe cut gaskets, there is a measurement you can make on all can styles and cup gasket types that gives information regarding a pulled crimp. Simply measure the diameter of the valve's mounting cup before and after crimping. If the diameter increases, you are pulling the crimp.

These are the standard tests used to determine the quality of the crimp. However, there are other tests, which will not be covered in this paper such as looking for leakers in a water bath, a torque test, cutting a cross section of the crimp and checking for compression of the cup gasket, damage to the can curl and location of the PHC. These tests can be found in such publications as "The Aerosol Handbook"[1] and "Aerosol Valve & Spray Pump Handbook"[2].

Setting up the Crimping Equipment

In this section, I will examine factors involving the crimping equipment that will help assure a functional crimp.

1. Air Supply: When using pneumatic crimpers, having a proper and consistent air supply is critical. It is important to control both the pressure and volume of air

available to complete the crimp. I have found that a ¾" minimum regulator and ½" minimum supply line works well (check with your crimping equipment supplier for their recommendations). Normally what I have found in plants is there is enough air pressure in a static mode however when the full plant is operating the crimper is starved for air (not enough volume of air to maintain the pressure). You can observe this by watching the pressure gauge during crimping. If the pressure drops significantly and is slow to recover, you are probably starving the crimper for air. Another sign that you are starving the crimper for air, is if the crimp is dimensionally correct and stable from can to can during the morning before the full plant is totally operational but is inconsistent after full operation is reached.

2. Crimp Head to Pressure Plate Parallelism: Make sure that your crimp head is parallel to the pressure plate (the pressure plate is the location where the cans sits during crimping). If you have a spring loaded pressure plate it can compensate for some level of out of parallelism. Out of parallelism will result in varying crimp depths around the circumference of the crimp. It can also cause breaking of collets.

3. Crimp Head to Stop Plate Parallelism: Some crimp heads travel downward until they hit a stop plate. The stop plate halts the downward travel of the crimp head allowing the rest of the cylinder stroke to push the plunger expanding the collet. As in 2, the crimp head and stop plate must be parallel.

4. Applied Downward Crimp Head Force: The force holding the valve onto the can during crimping. I have seen the force applied by 3 methods, springs, air pressure and the crimp head height setting. If you are controlling the downward pressure on the valve and can by the distance between the crimp head and pressure plate, then this setting is critical. This method results in the most variations of the crimp due to tolerances in can height and wear of the pressure plate. To make sure you are not damaging the can dome, use a test such as the Can Pull / Crushed Dome test described above. You can also visually examine the dome of the can to see if it is being crushed.

   If you are controlling the downward force by springs or air pressure, then we suggest 40 lbf to 175 lbf. Again, this is a historical suggested range given to me when I began my tenure with Clayton Corporation. The main issue is to make sure you are getting compression of the cup gasket while not crushing the dome or pulling the crimp.

Crimp Problems and Possible Solutions

1. Crimp Diameter Too Small: Check the crimper instruction manual for increasing the diameter. If this approach fails, try the following:

   a. Check air supply.

b. Check collet diameter with collet expanded. Expand the collet without a can in the crimper and measure the expanded diameter. If the expanded diameter is smaller than your requirement, then the proper diameter cannot be obtained.

c. Check to make sure the crimp head has been lubricated.

d. Increase air pressure.

e. Check crimper head cylinder for leakage.

f. Check to make sure crimp depth is not too shallow.

g. Check for broken collet section(s).

h. Try a new collet or mandrel.

2. Crimp Diameter Too Large: Check the crimper instruction manual for decreasing the diameter. If this approach fails, try the following:

   a. Reduce air pressure.

3. Crimp Diameter varies between measurement locations:

   a. Check for broken collet.

   b. Check for mismatched set of collet sections.

4. Crimp Diameter is Good Prior to Line Start up but out of Spec. after Line is Running.

   a. Check regulator for proper function and pressure.

   b. Check regulator for proper size.

   c. Check piping and hose sizes.

   d. Check compressor output.

   e. If all the above is acceptable; the unit may be starving for air. Try adding an inline accumulator.

   f. Check to make sure the crimp head has been lubricated.

5. Crimp Depth Too Shallow: Check the crimper instruction manual for increasing depth. If this approach fails, investigate the following:

a. Check the crimp head height setting. Make sure it is coming down fully onto the can.

b. Check and make sure the crimp head is free to travel completely onto the top of the can.

c. Check the crimp head for dirt.

6. Crimp Depth Too Deep: Check the crimper instruction manual for decreasing depth. If this approach fails, investigate the following:

   a. Check the crimp head height setting. Make sure it isn't crushing the can.

7. Crimp Depth Varies Evenly: If the crimp depth is measured around the circumference of the crimp and the depth changes in an organized pattern (See Figure 28) and is evident that one side of the can is lower than the other, then investigate the following:

	Sec. 1	Sec. 2	Sec. 3	Sec. 4	Sec. 5	Sec. 6
Crimp Depth	.185"	.187"	.189"	.191"	.188"	.186"

Figure 28 – Example of Crimp Depth Measurements Showing Unparallel Crimping

   a. Check to make sure the crimp head is parallel to the pressure plate.

   b. Check to make sure the stop plate is parallel to the pressure plate (if applicable).

   c. Check for uneven wear in the pressure plate.

   d. Check for dirt or foreign objects on the pressure plate or in the crimp head.

8. Crimp Depth Varies In a Specific Spot(s): If the crimp depth is measured in a circular pattern around the circumference of the crimp and the depth changes at a specific location (see Figure 29) but not in an organized pattern such that you can tell it is not a pattern as in 6 above then investigate the following:

	Sec. 1	Sec. 2	Sec. 3	Sec. 4	Sec. 5	Sec. 6
Crimp Depth	.188”	.187”	.187”	.193”	.188”	.187”

Figure 29 – Example of Crimp Depth Measurements Showing Mismatched Collet Section

a. Check for a mismatched collet section. A collet is produced from cylindrical bar stock then cut into sections farming a matched set. If one breaks and is replaced, it is possible the replacement doesn’t match the rest of the set.

9. Crimp Pull Decreasing: If the gap between the bottom of the cup skirt and can dome gets smaller after crimping then investigate the following:

   a. Crimp head may be too low.

   b. Spring-loaded pressure plate my not be depressing.

   c. Spring in crimp head may not be compressing.

10. Crimp Pull Increasing: If the gap between the bottom of the cup skirt and can dome gets larger after crimping then investigate the following:

    a. Crimp head set too high.

    b. Springs in pressure plate weak or broken.

    c. Spring in crimp head weak or broken.

    d. Mandrel extends below the bottom of the collets when crimping

11. Bottom of Valve’s Cup Damaged: If you see that the bottom of the valve’s mounting cup has been pressed down prior to gassing then investigate the following:

    a. Check crimp head mandrel to assure that it is not extending below the bottom of the collet when collet is expanded (see Figure 30).

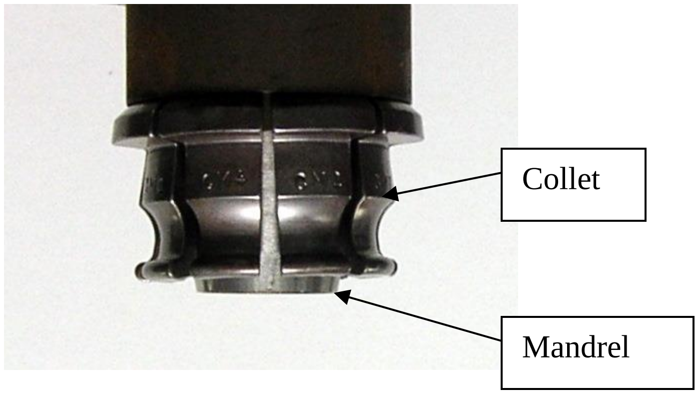

Figure 30 – Mandrel Extending Below the Bottom of Collet

12. Crimp leaker: If you find a crimp leaker after gassing then investigate the following:

    a. Check crimp diameter.

    b. Check crimp depth.

    c. Check for a broken collet section.

    d. Check for missing Cup Gasket.

References

1. The Aerosol Handbook, by Montfort A. Johnsen, Copyright 1982 by Wayne Dorland Company

2. Aerosol Valve & Spray Pump Handbook, by Jiang Guomin, Montfort A. Johnsen, Gong Baozhong, Chen Yongdi, First published in 1998 by Cosmos Books Ltd.

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