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# LOSS OF THE INTEGRITY IN BEER ALUMINIUM CANS

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***Abstract***

*Canned beer samples obtained from Romania factories were analyzed for the double sealed parameters like body hook and seam gap. Sampling location was Bucharest (Romania). Deviant variation from standard was found in 12 from 18 samples analyzed. Also several measurements showed how standard cans look like and were compared with the other ones. The results of previous studies showed that the defective values of double seam may conduct to leakage of liquids or vapors into or out of the can or to the bacteria contaminations. The double seam, then, is an interlocked metal-to-metal joint that provides the hermetic seal. The small voids that naturally occur in this metal-to-metal joint are filled by the sealing compound when it is under proper compression (seam tightness). The experiments revealed that voids can become larger and more apt to cause leakage through the double seams when these common conditions exist.*

***Keywords:*** *body hook, beer, ending, chemical contamination, seam*

## INTRODUCTION

Double seamer problems are very common in the process of filling and ending Aluminum cans for beer and beverages. Several parts of the tin plate can are influential in the canning process, but most relevant discuss is about seam and its most common defects. The development of double seam is the result of two separate operations precisely related in timing.

In the first part of the seaming process, the end curl is clinched to the body flange. The end is made of three thickness, while the can is made of two thickness. The purpose of the second operation during the process is to complete the closing by pressing this thickness tightly. The sealing compound, previously applied to the end, will form an elastic gasket to compensate the imperfections and ensure an hermetic closure can. Measurements, visual inspections and tests can be used in order to note variations in the finished seam (Bill Armsden, 1999).

Part of researches tries to underline some of the visual defects that can be evident in the general aspect of the can. The visual aspect of the closing is very important for the quality and it may conduct to serious defect that can affect the innocuity of the filled beverage (Seam control, IMETA, 2014).

Many common seamer problems are not handled accurately due to the inadequacy of operators to find the correct cause. This can be time consuming as fabricating is shut while the specialist efforts to adjust the difficulty on the seamer. In some cases, a corner of the chuck or roll can be damaged in one area, which can cause scuffing, wrinkle (tightness issue), sharp seam or various other problems. A cracked chuck can cause the double seam thickness to vary and even cause a bump that can compromise the integrity of the can's vacuum hermetic seal (BCME, 2005).

There are abundant systems of controlling the seam but one method is the use of a special projector. This system only serves to check one cut section of the seam. In case a incomplete seam takes place in one head, it is compulsory to control a second one from the same head before conducting to the adjustment (Bill Armsden, 1999). In case of a sizable defect the seamer has to be carefully examined before additionally controls. On high speed lines hundreds or thousands of scraps can pass if the machine is not instantly inspected and an action is not taken (Ferrum Can Seaming Machine, 2007).

In order to obtain good results from the control tests it is important to take note of all the measurements taken and to consider the results as a definite rule.

## MATERIALS AND METHODS

All the measurements were taken in more than fifty aluminum cans with beer bottled in.

METOP Seam System GT is a portable double seam control system for beverage cans. For measuring of all internal properties of the seam METOP has built in video measuring abilities into a powerful computer. Combine the Seam Computer, the Mini Desk and the Winseam software results safe seam quality inspection (Metop Manual, 2014).

Figure 1: can section
Source: Beverage Can Makers Europe Double Seam Reference Manual

Measurement process is starts with typical seam section saw who sectioned seamed area that includes the can flange and the ending combined. External measurements are to be recorded before cans are sectioned. These measurements are countersink depth and seam thickness. Can sectioned at two diametrically opposed points (Seam control, IMETA, 2014).

There are some limitations of this method that does not allow for tightness rating evaluation and therefore should always be used in conjunction with the full teardown method. When using the section method a second set of numbered cans are required to evaluate the tightness rating. To maintain seam integrity the critical parameters must be achieved at all times. The Double Seam parameters are measured on the screen shown using the cursor lines.

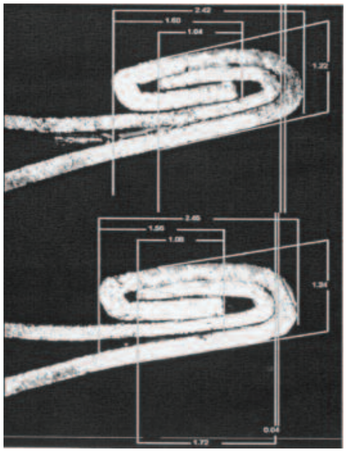


Figure 2: Cursor lines limits

Source: Metop portable Seam System report

Preprogrammed software enables calculations to be made to complete the Double Seam measurement.

Teardown Method

Measurements are to be taken (internal) for end hook (operating parameter). The End Hook is measured using a micrometer ensuring the Hook is perpendicular to the micrometer anvils.

Another operating parameter is body hook. The Body Hook is measured as shown in the photo.

Figure 3: Body Hook measure

Source: Beverage Can Makers Europe Double Seam Reference Manual

Actual Overlap

The actual overlap refers to the amount by which the body Hook and the end Hook overlap each other within the double seam. The Actual Overlap is calculated from the following formula.

Actual Overlap = EH + BH + (1.1 x te) – SL

EH = End Hook

BH = Body Hook

SL = Seam Length

te = End Thickness

Critical Parameters:

Body Hook Butting (BHB)

The length of the Body Hook in relation to the internal length of the Seam must be sufficient to ensure that it is embedded into the lining compound. This is calculated by the formula shown and is the primary sealing area.

Body Hook Butting = BH – 1.1 tb x100

SL – 1.1(2 te+tb)

BH = Body Hook

SL = Seam Length

tb = Body Thickness

te = End Thickness

Sample preparation and measurements

Samples were taken from the production beer line as the line worked in good parameters. Also when the line had issues that conduct to defective sealing of cans multiple batches were taken for measurement. All the samples were double cut with the saw and manually, also Metop machine, measured for all causeless parameters.

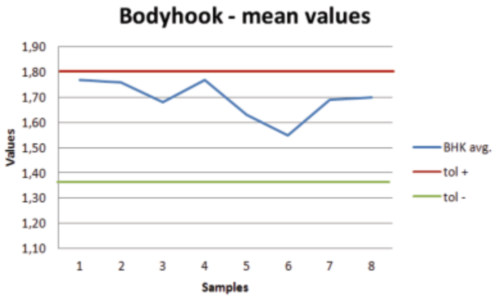
## RESULTS AND DISCUSSIONS

Below are presented the results for a set of analysis conducted on cans, which had the results within the normal specifications, together with a set of the used terminology.

Table 1: Double seam control analysis – batch 1

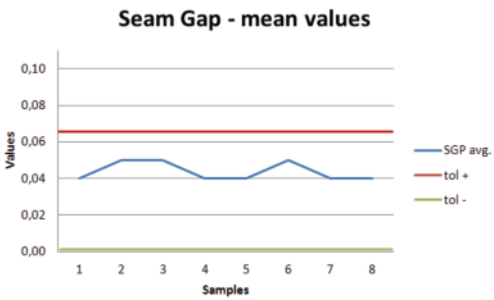
| Head no. | CHT mean | CSK mean | SHT mean | STH mean | BHK mean | OL mean | CHK mean | SGP mean | BHB min | Tightness |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 168,09 | 6,78 | 2,46 | 1,22 | 1,77 | 1,28 | 1,67 | 0,04 | 90 | 99 |
| 2 | 167,91 | 6,79 | 2,43 | 1,24 | 1,76 | 1,27 | 1,66 | 0,05 | 92 | 99 |
| 3 | 168,31 | 6,91 | 2,41 | 1,19 | 1,68 | 1,23 | 1,64 | 0,05 | 90 | 99 |
| 4 | 168,12 | 6,73 | 2,46 | 1,23 | 1,77 | 1,29 | 1,72 | 0,04 | 88 | 99 |
| 5 | 168,22 | 7 | 2,48 | 1,18 | 1,63 | 0,96 | 1,55 | 0,04 | 81 | 99 |
| 6 | 168,29 | 6,89 | 2,42 | 1,19 | 1,55 | 1,06 | 1,64 | 0,05 | 80 | 99 |
| 7 | 168,14 | 6,81 | 2,46 | 1,22 | 1,69 | 1,18 | 1,66 | 0,04 | 85 | 99 |
| 8 | 168,12 | 6,79 | 2,46 | 1,24 | 1,7 | 1,08 | 1,58 | 0,04 | 85 | 99 |
| tol + | 168,4 | 7 | 2,7 | 1,24 | 1,8 | 1,35 | 1,8 | 0,07 | 92 | 100 |
| tol - | 167,6 | 6,7 | 2,4 | 1,12 | 1,4 | 0,75 | 1,4 | 0 | 72 | 99 |

Out of the 8 samples, all registered values within the tolerance limits for all the parameters.




Graph 1: Body Hook mean values, batch 1

The body hook values were close to the upper limit of 1.8, but did not exceed it, while the seam gap values registered median values.

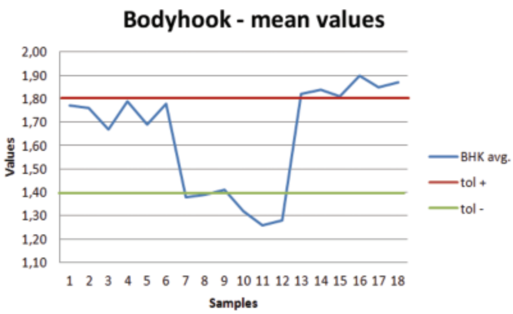



Graph 2: Seam Gap mean values, batch 1

Next was performed the analysis of a batch which implied more damaged cans and were presented the values of two main parameters.

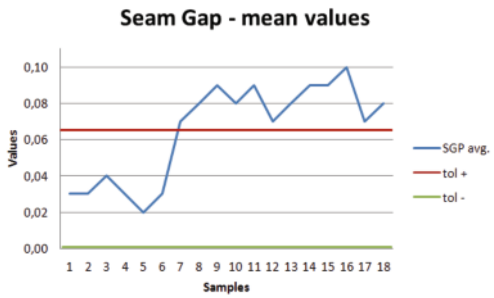
| Head no. | BHK avg. | SGP avg. |
|---|---|---|
| 1 | 1,77 | 0,03 |
| 2 | 1,76 | 0,03 |
| 3 | 1,67 | 0,04 |
| 4 | 1,79 | 0,03 |
| 5 | 1,69 | 0,02 |
| 6 | 1,78 | 0,03 |
| 7 | 1,38 | 0,07 |
| 8 | 1,39 | 0,08 |
| 9 | 1,41 | 0,09 |
| 10 | 1,32 | 0,08 |
| 11 | 1,26 | 0,09 |
| 12 | 1,28 | 0,07 |
| 13 | 1,82 | 0,08 |
| 14 | 1,84 | 0,09 |
| 15 | 1,81 | 0,09 |
| 16 | 1,9 | 0,1 |
| 17 | 1,85 | 0,07 |
| 18 | 1,87 | 0,08 |
| tol + | 1,8 | 0,07 |
| tol - | 1,4 | 0 |

Table 2: Double seam control analysis – batch 2




Graph 3: Body Hook mean values, batch 2

From the 18 cans analyzed, 12 had values of the body hook outside the tolerance levels (1.40-1.80). the lowest value was 1.26, the highest was 1.9, while the average reached 1.64.




Graph 4: Seam Gap mean values, batch 2

Regarding the Seam Gap analysis, 12 cans out of 18 registered values outside the tolerance levels (0.00-0.07), with a maximum measured value of 0.10, a minimum of 0.02 and an average of 0.65 .

## CONCLUSIONS

It is important to follows a number of factors which give constant attention to double seams of high quality. The seam dimensions, the degree of wrinkle in the cover hook, and the position and shape of the body and cover hooks must satisfy pre-determined specifications.

Metal pick-up is where metal from the can or end has dissolved into the product after this could be iron or aluminum depending on the substrate used for the can and end production. metal pick-up will occur at significant sites of exposed metal which are in contact with the product. If good seam quality is not maintained, metal pick-up can occur anywhere on the can or end. Experience and test pack monitoring (under variable double seam conditions) shows that the most likely source is from the internal body hook radius of the double seamed can.

The metal pick-up is caused by the product reacting with the metal substrate at a site of exposed metal. In particular the forming of the body hook during seaming can cause a degree of lacquer cracking in this region, which results in potential exposure of the metal substrate.

The quantity of dissolved metal will determine if flavour issues become detectable and subsequent consumer complaints arise. There are industry guidelines for levels of iron and aluminum which are considered acceptable. many cases customers have created their own specifications which may be more stringent, particularly if their products are sensitive to taints. Dissolved iron is much more likely to give a taint as this is detected by the average consumer at much lower threshold levels.

If the product is in contact with exposed metal then dissolution of the metal will start immediately. The levels of dissolved metal will increase the longer the storage period. The levels achieved in a given time will depend on the amount of exposed metal and the temperature storage conditions. Cans which are stored inverted or horizontally will be affected more so than those stored upright for a similar time period. It is essential that good seam control is maintained and the seams are centered within the industry specification. The primary objective of the compound within the double seam is to provide a hermetic seal at all points of the seam .

The compound will effectively protect any exposed metal on the body hook radius created during seaming if the seam thickness values are centered on nominal and seam gap is minimized. When the seam thickness is centered on nominal then the compound will prevent product access to the body hook radius area. If the seam gap is high and/or in combination with a loose double seam then there is a potential path for the product to gain access to the exposed metal. Good seam control (in particular seam gap and seam thickness) will prevent product ingress to the body hook radius which is the most common source of metal pick-up. Additionally good control of filling conditions, in particular the headspace air content, will help to reduce the risk of metallic of flavor issues. The corrosion rates will be accelerated if there is more oxygen present. Undercover gassing at the point of seaming is used by most fillers to reduce the level of air/oxygen in the headspace.

The hermetic seal performs several functions. It keeps bacteria out of the can, probably its most important function. It prevents seepage of the pack from the can, leakage of liquids or vapors into or out of the can, and maintains the desired vacuum or pressure in the can.

**REFERENCES**

1. Bill Armsden, Evaluating and Controlling Double Seams, Darex Container Products 1999
2. Seam control, IMETA, www.imetasrl.com, 2014 February
3. Beverage Can Makers Europe, Double Seam Reference Manual, BCME 2005
4. Borza, V., et al., Journal of Labelled Coumpound and Radiopharmaceuticals 53, (5-6), 2010, p. 406
5. Dragolici, C. A., et al., Maintenance Program for a Safe Prolonged Wet Storage of Spent Fuel at IFIN-HH, Bucharest-Magurele Site, Proc. of International Conference on Research Reactor (Utilization, Safety, Decommisioning, Fuel and Waste Management), Santiago, Chile, 10-14 Nov. 2003, p. 282
6. Fontana, M.G, Corrosion Engineering, 3rd edn, McGraw-Hill, New York 1986.
7. Howell, J. P., Burke, S. D., The corrosion of aluminium-clad spent fuel in wet basin storage, Proc. Embedded Topical Mtg. on DOE Spent Nuclear Fuel and Fissile Material Management, Reno, 1996, American Nuclear Soc., La Grand Park, IL, 1996, p. 49
8. Luca, A., et. al., Assessment of the Radioactivity levels în Soil Around VVR-S Nuclear Reactor of IFIN-HH by Gamma-Ray Spectrometry, IRPA Regional Congress for Central and Eastern Europe(IRPA 2007), Brasov, Romania, 24-28 Septembrie 2007
9. Luca, A., Spectrometrie gamma de nivel redus prin metoda coincidenţelor şi anticoincidenţelor. Aplicaţii., Teză de doctorat, Bucureşti, 2005
10. Matei, L., Postolache, C., Neacşu, E., Evaluation of relationship between conductivity and radioactive concentration în tritiated water, Eighth International Conference on Methods and Applications of Radioanalytical Chemistry, MARC VIII, Kailua-Kona, Hawai'I, USA, April 5- 10, 2009
11. Neacşu, E., et al., Aspects related to spent nuclear fuel wet storage management: the water chemistry, IRPA Regional Congress for Central and Eastern Europe (IRPA 2007), Brasov, Romania, 24-28 Sept., 2007
12. Neacşu, E., et al., Experience on Safe Wet Storage Spent Nuclear Fuel at VVR-S Reserch Reactor of IFIN "Horia Hulubei", International Conference of Physical Chemistry, ROMPHYSCHEM 13, Bucharest – ROMANIA, 3 - 5, Sept., 2008
13. Neacşu, E., et al., Romanian experience on wet storage spent nuclear fuel at VVR-S research reactor of IFIN "Horia Hulubei",Workshop on Neutron Measurement, Evaluation and Applications, NEMEA-2, Bucharest, Romania, 20-23 Oct., 2004
14. Rowe, L.C., Walker, M.S., Corrosion, 17, 1961, p. 353t
* * Metop Manual, 2014
* * Ferrum Can Seaming Machine, Training Documentation, Ferrum Ltd. , 2007
* * Corrosion of Research Reactor Aluminium Clad Spent Nuclear Fuel în Water, Technical Reports Series

No.418, IAEA, Vienn, 2003, ISSN 0074-1914, ISBN 92-0-113703-6
* * EURACHEM, Quantifying Uncertainty în Analytical Measurement. Laboratory of the Government Chemist, London 1995. ISBN 0-948926-08-2
* * Standards Methods for the Examination of Water and Wastewater, 18th Edition, 5120B, 1992
* * Metals Handbook, 9th edn, Vol. 13,ASM International, Metals Park, OH,1987
* * Beverage Can Makers Europe Double Seam Reference Manual