

FULL APERTURE BEVERAGE CAN END

Technical Field

[0001] The present invention relates generally to beverage cans and more particularly to the size of drinking aperture that is created in a beverage can end. There is increasing pressure by consumers to increase the size of such drinking apertures to increase the pleasure of drinking the beverage contained within the can, directly from the can.

Background Art

[0002] Conventional full aperture can ends include a score that extends around a major portion of the end's centre panel and defines a removable panel. A tab is attached to the removable panel by a rivet. The tab has a tail or handle end on one side of the rivet and a nose end on the opposite side of the rivet and the tab is positioned so that its nose end lies adjacent to or touching the score. To open the can end, a user lifts the tail or handle end of the tab, which causes the tab to pivot about the rivet and presses the nose end adjacent to the score, propagating fracture of the score until the removable panel is detached from the remainder of the end. Typically, full aperture ends are attached to food can bodies by conventional seaming techniques.

[0003] Full aperture food can ends are designed primarily to allow full product release of the foodstuff contained within the food can. Often, this foodstuff is packed under slight negative pressure. However, where pressurised food cans are proposed having positive internal pressure, the internal pressures are relatively low and merely determined by the internal pressure required to maintain the structural rigidity of the food can, which is often relatively "thin-walled".

[0004] In conventional beverage cans the beverage product, such as carbonated soft drinks or beer, typically is held under much higher pressures than the internal pressures in food cans, resulting in concerns related to "blow-off" of the ends upon initial opening by a user or when subjected to adverse handling. *For these reasons, the conventional beverage can has an end defining a restricted aperture, which can be safely opened by a consumer.*

- [0005] US 5711448 A (REYNOLDS METALS CO) 27.01.1998 describes a conventional "large opening end"(that is an end having a relatively large opening), as currently used on some beverage cans. This patent describes a "standard size opening" of about 322.58 square mm (0.5 square inches) and a "larger opening" of about 322.58 – 483.87 square mm (0.5 to 0.75 square inches), which represents a relatively small fraction of the area of the centre panel.
- [0006] Full aperture beverage can ends have been sold in the past but these had serious safety issues and have now been withdrawn from the market. 'Spiral scored' ends were produced for Sapporo beer, where the can end was vented in its centre and then the score propagated to the edge of the can end panel and then around the periphery thereof. Venting was critical because the end was relatively large, 66mm diameter with a 52mm centre panel size. If the end was opened without being vented the panel would explode and missile towards the consumer. Thus a vent was used to provide safe venting and release the internal pressure in the can before opening. However the resulting spiral geometry of the opened end panel was very dangerous having several long exposed cut edges and for this reason, this can end configuration was withdrawn.
- [0007] Conventional beverage cans are often banned from being sold at festivals and events, because the restricted aperture prevents the contents of the can being from being discharged quickly if an opened beverage can is thrown. Thus, even if a conventional beverage can is opened at the point of sale at a festival or event, it may still provide a dangerous missile if thrown.

Summary of invention

- [0008] Accordingly, the present invention provides a full aperture beverage end having a centre panel, a countersink surrounding the centre panel, a main score arranged in proximity to the countersink to define a removable aperture panel and a vent score, characterised in that the beverage end is adapted for use with products held under pressure exceeding 207 kPa (30 psi) when opened and during opening the vent score is adapted to sever first, controlling the pressure differential between the external surface and

internal surface of the centre panel. In this way, the pressure differential between the external surface and the internal surface of the centre panel reaches equilibrium gently. This allows the main score to tear in a controlled and reliable manner. The can may also be rated for internal pressures of at least 483 kPa (70 psi), 586 kPa (85 psi), or 621 kPa (90 psi).

- [0009] Additionally, the main score may have an outer wall proximate the drinking lip of the end (once the aperture panel is removed), an inner wall proximate the aperture panel and a land at the base of the main score. The land has a thickness that is smaller proximate the main score outer wall than the land thickness proximate the main score inner wall. This configuration ensures that the land remains affixed to the aperture panel after the aperture panel is removed.
- [0010] Preferably, the centreline of the main score is located between 0.000 and 0.508 mm (0.020 inches), more preferably between 0.000 and 0.254 mm (0.010 inches), more preferably between 0.000 and 0.152 mm (0.006 inches), more preferably between 0.000 and 0.102 mm (0.004 inches), and most preferably between 0.000 and 0.051 mm (0.002 inches) from a centre of a transition radius between the countersink and the centre panel.
- [0011] A nose of the tab in its rest state is radially inwardly spaced apart from an inner edge of the main score by between 0.000 and 0.203 mm (0.008 inches), more preferably between 0.000 and 0.127 mm (0.005 inches), measured horizontally. In its partially actuated state, in which the tab nose contacts the centre panel, the nose of the tab is approximately between the centreline of the main score and 0.127 mm (0.005 inches) radially inboard from an inner edge of the main score – more preferably within 0.051 mm (0.002 inches) of an inner edge of the main score. Among the benefits for consumers are that after opening, the beverage can becomes more like a drinking glass. Consumers can drink from the can from any orientation and the can contents can be sipped rather than poured into the mouth. Furthermore, the contents of the can is visible after opening, showing the colour, level of carbonation, and head (with widgeted beers).
- [0012] One of the benefits for fillers is that the cans may be sold at festivals and

events, as they can no longer be used as missiles. The larger, full aperture ensures that once opened, the majority of the beverage does not remain in the can if it is thrown. Furthermore, sealed beverage cans are preferable to glasses as they can be freshly opened immediately upon serving and thus many drinks can be freshly served in the interval periods during events.

Brief description of drawings

[0013] The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

[0014] Figure 1 shows a plan view of can having a beverage end (tab not shown) according to a first embodiment of the present invention;

[0015] Figure 2 shows a 3-dimensional view of a container incorporating the beverage end according to the invention, including a tab in a vented position (after the vent score has been severed);

[0016] Figure 3 shows a 3-dimensional view of the container and beverage end shown in Figure 2, from a rear angle;

[0017] Figure 4 shows a 3-dimensional view of the container and beverage end shown in Figures 2 and 3 (from the same angle as shown in Figure 2) after the vent score has been broken and as the main score starts to sever;

[0018] Figure 5 shows a 3-dimensional view of the container and beverage end shown in Figures 2 and 3 (from the same angle as shown in Figure 3) after the vent score has been broken and as the main score starts to sever;

[0019] Figure 6 shows a 3-dimensional view of the container and beverage end after the main score has completely severed allowing the aperture to be exposed and the aperture panel to be removed;

[0020] Figure 7A (Prior Art) is a cross sectional sketch showing a standard (symmetrical) score profile used on conventional beverage ends;

[0021] Figure 7B is a cross sectional sketch showing the (asymmetric) score profile used for the main score on ends according to the invention;

[0022] Figure 8 is a cross section view of a portion of the can end according to the invention fixed to a can body;

[0023] Figure 9 is a plan view of the can shown in Figure 2;

[0024] Figure 10A is a cross section view of a can illustrating a can end with the

removable aperture panel removed according to a second embodiment of the present invention;

[0025] Figure 10B is a cross section view of a can illustrating a can end with the removable aperture panel removed according to a third embodiment of the present invention;

[0026] Figure 10C is a cross section view of a can illustrating a can end with the removable aperture panel removed according to a fourth embodiment of the present invention; and

[0027] Figure 10D is a cross section view of a can illustrating a can end with the removable aperture panel removed according to a fifth embodiment of the present invention.

Description of embodiments

[0028] A beverage can 10 includes a can body 12 and a can end 14 that are joined together at a seam 16. Preferably, can body 12 and seam 16 are conventional according to commercial carbonated beverage standards.

[0029] Figure 1 illustrates a first embodiment can end 14 with the tab omitted for clarity. Can end 14 includes a wall portion 20, a countersink 22, and a centre panel 30. The shell configuration (that is, the can end without the tab as it leaves the shell press) has a configuration, including wall 20, countersink 22, and centre panel 30. In the embodiment shown in Figure 1, the can end is preferably a conventional SuperEnd® beverage can end as supplied by Crown Cork & Seal.

[0030] Countersink 22 extends from the lower part of wall 20 and includes a curved bottom portion 24 and an inner wall 26 that extends up from bottom portion 24. Inner wall 26 has a straight portion that merges into centre panel 30 via transition 28 having a radius R. The origin of radius R is point C, as best shown in Figure 8. For embodiments having a curved transition that does not have a single radius and a single origin, averages may be used.

[0031] Centre panel 30 includes a rivet 34, a moustache score 46, a main score 50, and an anti-fracture score 52. Rivet 34 is preferably conventional. A tab 36 is attached to centre panel 30 by rivet 34. Tab 36 is preferably a solid tab – that is, without an integral hinge. Centre panel 30 is preferably

substantially planar in its unseamed or unpressurized state.

- [0032] Moustache score 46 is configured to enable venting of the pressurized, filled can 10. For internal pressures greater than 207 kPa (30 psi), the vent score described in the applicant's co-pending patent application no. US 12/796972 is preferred. As tab 36 is lifted by its handle or heel 38, moustache score 46 is designed to break before main score 50 to vent the internal pressure in filled can 10.
- [0033] Main score 50 extends about the periphery of centre panel 30 and defines a removable aperture panel 54. As shown in Figure 6, tab 36 is attached to the aperture panel 54. A conventional anti-fracture score 52 is also located on aperture panel 54, radially inside the main score 50 to reduce stress and take up slack metal as the main score 50 is severed. Upon removal of aperture panel 54, a lip 32 is left behind. Lip 32 is the portion of can end 14 that protrudes radially inwardly from the inside edge of the seam 16. Additionally, aperture panel 54 may include debosses and embosses, as explained more fully below.
- [0034] The inventors have identified the importance of configuring the can end 14 in such a way that main score 50 is in a location on the can end 14 that is sufficiently stiff to promote initial rupture of score 50 upon actuation of tab 36. Figure 8 is an enlarged view of a first embodiment of the can end 14 and illustrates the relationship between the main score 50 and the transition 28 from the countersink 22 to the centre panel 30, which stiffens the can end 14 in the region of the main score 50.
- [0035] Preferably, the centreline of main score 50 is near the countersink 22 at the point where the tab nose 40 contacts the centre panel 30, such that the structural stiffness of countersink 22 prevents excessive panel deflection to promote initial score fracture. For example, the horizontal distance between transition curve origin C and the vertical centre of the main score 50 may be as low as 0.000 inches (i.e. falling on the same vertical axis). Preferably, the centreline of main score 50 does not extend radially outside point C so that the main score does not interfere with the structural performance of countersink 22. In the embodiment of Figure 1, the centreline of main score 50 is preferably within 0.508 mm (0.020

inches), more preferably within 0.254 mm (0.010 inches), more preferably 0.152 mm (0.0060 inches), more preferably 0.102 mm (0.004 inches), and even more preferably 0.051 mm (0.002 inches) measured horizontally of point C to get the benefit of countersink stiffening. The upper limit of distance between the main score centreline and point C may also be determined by aesthetics or the functional aspects of drinking.

- [0036] Alternatively, main score 50 may be spaced apart from the countersink 22, but is preferably located near a structural stiffener, such as an emboss, deboss, or like ridge. The configuration and distance of the main score and countersink may be chosen according to parameters that will be understood by persons familiar with beverage can end engineering and design upon considering this specification.
- [0037] Figure 7A illustrates a symmetrical score profile 130 currently used for the aperture score of conventional beverage ends. Symmetric score 130 has a generally trapezoidal shape that includes a pair of identical but oppositely oriented sidewalls 130a and 130b and a generally flat land 130c. In practice, it is difficult to control or predict exactly where (in its cross section) score 130 severs. Land 130c, when severed and extending at the base of either sidewall 130a or 130b, makes the edge sharp. This edge is more likely to cut a user than the fillet. The fillet is the score sidewall from which land the score residual of land 130c breaks cleanly (that is, the part of the score sidewall to which no portion or an insignificant part of the score residual of land 130c remains attached).
- [0038] Figure 7B illustrates the asymmetrical main score 50 used in the can end 14 according to the present invention. Asymmetric main score 50 has a pair of sidewalls 51x and 51y that extend to two different depths X and Y relative to the external surface of centre panel 30. Main score 50 has a land 56. In this specification, the term "land" refers generally to top surface or width and the term "score residual" refers to the thickness. Ends of the land 56x and 56y (in cross section as shown in Figure 7B) are defined as the points at which the land merges into the score sidewalls 51x and 51y. In its opened state, the thickness at land ends 56x and 56y have score residual thicknesses T_a and T_b .

- [0039] Thicknesses T_a and T_b may be chosen according to the desired parameters of can end 14, such as proximity of main score 50 to the countersink 22, thickness and material of the can end, desired pressure rating, tab configuration, and the like. For the embodiment shown in Figure 1, the thickness of centre panel 30 is between 0.191mm (0.0075 inches) and 0.330 mm (0.013 inches), the width of score 50 at its top is approximately 0.178 mm (0.007 inches), the width of score land 56 is between 0.025 mm (0.001 inches) and 0.076 mm (0.003 inches). T_a is between 0.051 mm (0.002 inches) and 0.102 mm (0.004 inches) and T_b is between 0.064 mm (0.0025 inches) and 1.143 mm (0.045 inches).
- [0040] The score residual at thinner end 56x of score land 56 tends to fracture more readily than that at thicker end 56y. This tendency is an advantage in controlling the location of the fracture within main score 50. In this regard, the cross sectional structure of score 50 is configured such that the score residual of land 130c remains attached to aperture panel 54 rather than to lip 32 (that is, because the score residual at land outer end 56x is thinner than that at land inner end 56y), therefore leaving lip 32 having a smoother configuration.
- [0041] Also, the inventors have found that for a given score, the structure and operation of the tab affects the reliability and predictability of the main score fracture. In this regard, if tab nose 40 is too far from main score 50, end 14 may fracture between the main score 50 and the anti-fracture score 52 or within anti-fracture score 52, rather than solely in the main score 50. Measured upon actuation of tab 36, when the tab nose 40 first contacts can end 14 (before main score fracture), tab nose 40 preferably does not span across main score 50 to touch the outer score wall 51x. Preferably, tab nose 40, upon contact with can end 14, is at the centreline of main score 50 or on the aperture panel 54, within 0.127 mm (0.005 inches) radially inboard of the inner edge 60 of main score 50 (see Figure 7B). More preferably, tab nose 40 is within 0.051 mm (0.002 inches) radially inboard of the inner edge 60.
- [0042] A user may also measure the location of tab nose 40 with the tab in its at-rest state before actuation. In this regard, tab nose 40 preferably is

between 0.000 and 0.203 mm (0.008 inches) from the inner edge 60 of main score 50, and more preferably between 0.000 and 0.127 mm (0.005 inches), as measured radially inwardly from edge 60. The difference in location of tab nose 40 relative to main score 50 between its initial contact state and its at-rest state is due to shunting during the tab actuation process. Tab 36 shunts forward in the end shown in Figure 1 during the actuation and opening process by about 0.76 mm (0.003 inches), mostly because of deflection of panel 30 near rivet 34 and opening of vent score 46. The magnitude of tab nose shunting is also dependant on internal can pressure. In general, a higher internal pressure creates shunting of a corresponding greater magnitude. For simplicity, the dimensions provided for tab nose location relative to main score 50 are measured with a microscope looking straight down on end 14, as shown for example in Figure 9.

- [0043] The location of the tab nose 40 relative to the main score 50 may be chosen according to the design parameters of the particular can end, for example main score configuration, tab design, vent score design, internal pressure, and other factors that will be understood by persons familiar with can end engineering and design upon considering the present specification.
- [0044] Figures 2 through 6 show different 3-dimensional views of the first embodiment beverage end 14 applied to a filled can 10 (product level not shown). Figures 2 and 3 illustrate the operation of end 14. A user first lifts heel 38 of tab 36, which pivots around the rivet 34. The force and moment applied to rivet 34, and the corresponding local deflection of centre panel 30, severs the vent score 46 creating a vent hole 48 (see Figure 3). Preferably, vent score 46 takes the form of a flap, such that internal pressure in the can causes the fracture of vent score 46 to rupture without arresting, thereby deflecting the flap to vent pressures of greater than 207 kPa (30 psi), such as 483 kPa (70 psi), 586 kPa (85 psi), and 621 kPa (90 psi) and above.
- [0045] As illustrated in Figures 4 and 5, the user then continues to lift the tab 36, which causes the tab nose 40 to press on the centre panel 30 close to the

main score 50, as described above. Tab nose 40 severs main score 50 at the land outer end 56x. The user then pulls up on the tab 36 to break the remainder of the main score 50. Preferably, the fracture propagates around aperture panel 54 at land outer end 56x such that the score residual of land 56 is attached to aperture panel 54. Lip 32 remains part of the can assembly 10 and ideally has the cross sectional structure of a fillet (that is, a cross-sectional structure wherein a significant portion of the score residual associated with land 56 does not remain attached).

[0046] Once the main score 50 has completely severed the resulting aperture panel 54 can be discarded and a user can drink directly from aperture 58.

[0047] Figure 8, described above, shows the relative height and configuration of countersink 22 and the centre panel 30, and the relative positions of the main score 50 and the anti fracture score 52. The present invention is not limited to the particular embodiment of the end shown in Figure 8. For example, Figures 10A, 10B, 10C, and 10D illustrate additional embodiments of end structures 14a, 14b, 14c, and 14d on which the present invention may be employed. To describe the embodiments shown in Figures 10A through 10D, reference numerals of the structure described above with respect to the first embodiment will be reused, but appended with a letter designation.

[0048] Each of ends 14a, 14b, 14c, and 14d are seamed onto a can body 12a, 12b, 12c, 12d. Figures 10A, 10B, 10C, and 10D illustrate the cans having the aperture panel removed and ready for a user to drink from. The main scores, aperture panels, tabs, and all parts of the aperture panels for end embodiments 14a, 14b, 14c, and 14d are as described above for first embodiment can end 14.

[0049] End 14a of Figure 10A is a variation of the SuperEnd® beverage can end described with respect to the first embodiment end 14. The location of the centre C of the radius of transition wall 28a is illustrated in Figure 10A.

[0050] End 14b of Figure 10B is cross sectional view of an end supplied commercially by Container Development Limited. End 14c of Figure 10C is a cross sectional view of an end referred to as LOF supplied by Metal Container Corporation. Each of ends 14b and 14c have an inner wall

portion 29b and 29c, respectively, at the base of transition 28b and 28c.

The present invention encompasses locating main score 50b, 50c radially outside of transition radius centre Cb and Cc, such that the main score is located within portions 29b or 29c.

[0051] End 14d of Figure 10D is a cross sectional schematic view of a conventional B64 end. The location of the centre C of the radius of transition wall 28d is illustrated in Figure 10D.

Claims

1. A full aperture beverage end having a centre panel, a countersink surrounding the centre panel, a main score arranged in proximity to the countersink to define a removeable aperture panel and a vent score, characterised in that the beverage end is adapted for use with products held under pressure of at least 70psi (483 kPa) and during opening the vent score is adapted to sever first, controlling the pressure differential between the external surface and internal surface of the centre panel, thereby allowing the main score to tear in a controlled and reliable manner.
2. A full aperture beverage end according to claim 1, adapted for use with products held under pressure of at least 85psi (586 kPa).
3. A full aperture beverage end according to claim 1 or claim 2, adapted for use with products held under pressure of at least 90psi (621 kPa).
4. A full aperture beverage end according to any one of the preceding claims, wherein the beverage end includes a tab having a nose and a handle, which is lifted by a user to initiate sequential rupture of the vent score and then the main score.
5. A full aperture beverage end according to claim 4, wherein the tab is solid and has no hinge.
6. A full aperture beverage end according to claim 4 or claim 5, wherein the tab is positioned so that the tab nose is within the main score or proximate the main score upon initial actuation of the tab.
7. A full aperture beverage end according to any one of the preceding claims, wherein the aperture panel further includes a second anti-fracture score positioned radially inside the main score.
8. A full aperture beverage end according to any one of the preceding claims, wherein the centreline of the main score is located between 0.000 and 0.508 mm (0.020 inches) from the centre of the transition radius (2R, R) between the countersink and the centre panel.
9. A full aperture beverage end according to any one of the preceding claims, wherein the nose of the tab in its rest state, is spaced radially inwardly from the inner edge of the main score by between 0.000 and

0.203 mm (0.008 inches), measured horizontally.

10. A full aperture beverage end according to any one of the preceding claims, wherein the main score has an asymmetric score profile.
11. A full aperture beverage end according to claim 10, wherein the main score has an outer wall (51x) proximate a lip and an inner wall (51y) proximate the aperture panel, the inner and outer walls (51x, 51y) separated by a land and the score residual thickness (Ta) of the land adjacent to the outer wall (51x) is less than the score residual thickness (Tb) of the land adjacent to the inner wall (51y), whereby upon detachment of the aperture panel from the centre panel of the end, the land remains attached to the aperture panel.
12. A full aperture beverage end according to any one of the preceding claims, wherein the centre panel further includes a second, anti-fracture score positioned radially inside the main score.
13. A full aperture beverage end according to any one of the preceding claims, wherein the height from the base of the countersink to the centre panel is greater than 1.5 mm.
14. A full aperture beverage end according to any one of the preceding claims, wherein after opening, the aperture is positioned to within 0.5mm radially of the panel fillet, to maximise cut edge safety.
15. A sealed container comprising a container body with a product contained therein, and a full aperture beverage end according to any one of the preceding claims connected thereto by a seam.