CLAIMS

1. An unseamed can end capable of withstanding 90 psi internal pressure after seaming onto a can body, the can end being formed of an aluminum alloy, the can end comprising:

a curl structure adapted for being seamed together with a flange of a can body;

a chuck wall extending radially inwardly from the curl structure, the chuck wall is adapted for contact with a chuck during the seaming process;

an inwardly domed panel radially inwardly from the chuck wall, wherein a slope of a tangent of a curve defined by the can end at every point of the chuck wall and the domed panel is non-zero except at the center;

a score formed on the panel; and

a tab attached to the panel and adapted for rupturing the score in response to actuation of the tab by a user to form a pour opening.

2. The can end of claim 1, wherein the panel extends from a lower end of the chuck wall into the panel with no countersink bead therebetween.

3. The can end of claim 2, wherein a diameter of the can end is less than 10 times a height of the dome at a center of the end, preferably the diameter of the can end is between 4 and 8 times a height of the dome at a center of the end; or

   wherein the can end has a stacking height S of between 1.7 and 3.0 mm, preferably the stacking height S is at least 1.8 mm.

4. The can end of claim 2, wherein the can end is formed of an aluminum alloy that is less than 0.20 inches thick, preferably the aluminum alloy is less than 0.18 inches thick, more preferably the aluminum alloy is less than 0.16 inches thick.

5. The can end of claim 2, wherein the curl structure has a curl width of less than 3.5 mm measured radially and horizontally between the outboard most point of the curl structure and a point on the curl at which a seaming panel of the curl structure yields to a relatively straight portion of a chuck wall of the end, preferably the curl width is less than 3.0 mm.

6. The can end of claim 2, wherein the can end is any one of a beverage can end and a food can end.

7. The can end of claim 2, wherein the panel in cross section is formed by multiple radii that decrease with radial position from the panel center.

8. The can end of claim 2, wherein the panel radius R1 inboard and proximate the chuck wall is between 0.5 mm and 4 mm, preferably the panel radius R1 inboard and proximate the chuck wall is between 0.5 mm and 2 mm, more preferably the panel radius R1 is between 0.7mm and 2.0 mm, and more preferably the panel radius R1 is approximately 1.0 mm, the panel radius R2 inboard and proximate radius R1 is between 7 mm and 20 mm, preferably the panel radius R2 is between 10 mm to 16 mm, more preferably the panel radius R2 is approximately 13 mm, the panel radius R3 inboard and proximate to radius R2 is between 28 mm and 41 mm, the panel radius R4 at the center of the panel is between 35 mm and 55 mm, the can end diameter is between 38 and 52mm, preferably the panel radius R4 is between 40 mm and 50 mm, more preferably the panel radius R4 is approximately 44 mm.

9. The can end of claim 2, wherein the panel has a diameter of between 38 mm and 52 mm

10. The can end of claim 2, wherein the pour opening defined by the score has a straight line dimension measured radially by a line that is inclined at an angle defined by opposite points of the pour opening of between 14 mm and 19 mm, preferably the pour opening of between 15 mm and 17 mm.

11. The can end of claim 2, wherein a horizontal clearance defined between an innermost part of the chuck wall and an outboard-most portion of the score is between 0.6 mm and 3.0 mm, preferably the score is between 1.0 mm and 2.0 mm, and more preferably the score is between 1.0 mm and 1.4 mm.

12. The can end of claim 2, wherein the tab is concavely curved.

13. The can end of claim 12, wherein a finger clearance F defined between an innermost part of the chuck wall and distal-most portion of the tab heel measured on an incline is between 6 mm and 15 mm, preferably the incline is between 7 mm and 10 mm.

14. The can end of claim 2, wherein the unseamed end has a panel depth of between 5 mm and 16 mm, preferably the panel depth is between 6 mm and 10 mm, more preferably the panel depth is approximately 8 mm.

15. The can end of claim 2, wherein the score extends around a perimeter of the panel proximate the wall, such that the end is a full aperture end, and preferably the end is approximately a 30 mm size.

16. An unseamed can end and can body combination comprising:
a drawn and ironed can body including a base, a sidewall, and a flange; and

an unseamed can end including:

a curl structure engaged with the flange;

a chuck wall extending radially inwardly from the curl structure, the chuck wall is adapted for contact with a chuck during the seaming process;

an inwardly domed panel radially inwardly from the chuck wall, wherein a slope of a tangent of a curve defined by the can end at every point of the chuck wall and the domed panel is non-zero except at the center;

a score formed on the panel; and

a tab attached to the panel and adapted for rupturing the score in response to actuation of the tab by a user to form a pour opening.

17. The combination of claim 16, wherein radial clearance between the flange proximate a neck of the can and the curl is at least 0.5mm; or

wherein the clearance is measured at a chuck wall of the end.

18. The combination of claim 16, wherein the thickness of the can end measured at the curl structure is at least than 10% less than the thickness of the flange, preferably the curl structure is at least than 20% less than the thickness of the flange.

19. The combination of claim 16, wherein the flange width is less than 1.8 mm, measured radially from an inboard side of a vertical portion of a neck of the can to an outermost lip of the flange, preferably wherein the flange width is less than 1.6 mm, more preferably the flange width is less than 1.5 mm.

20. The combination of claim 16, wherein the height of the curl is greater than the width of the flange by at least 0.5 mm, preferably the height of the curl is greater than the width of the flange by at least 0.2 mm, more preferably the height of the curl is greater than the width of the flange.

21. The combination of claim 16, wherein a curl clearance dimension measured horizontally between an outermost tip of the flange and an innermost tip of the curl is between 0.4 to 1.2 mm.

22. The combination of claim 16, wherein the panel extends from a lower end of the chuck wall into the panel with no countersink bead therebetween.

23. The combination of claim 16, wherein a diameter of the can end is less than between 4 and 8 times a height of the panel at a center of the end.

24. The combination of claim 16, wherein the end has a stacking height S of at least 1.8 mm.

25. The combination of claim 16, wherein the combination is any one of a beverage can package and a food can package.

26. The combination of claim 16, wherein the panel in cross section is formed by multiple radii that decrease with radial position from the panel center.

27. The combination of claim 16, wherein the can end has a diameter of between 38 mm and 52 mm.

28. The combination of claim 16, wherein the can end is formed of a 5000 series aluminum alloy and the can body is formed of a 3000 series aluminum alloy.

29. A container for holding a comestible product, the container comprising:
a drawn and ironed can body including a base, a sidewall, and a neck;
a can end including:
a chuck wall extending radially inwardly from a curl structure, the chuck wall is adapted for contact with a chuck during the seaming process;
an inwardly domed panel radially inwardly from the chuck wall, wherein the domed panel in cross section is formed by multiple radii that decrease with radial position from a panel center to a curved portion inboard and proximate the chuck wall;
a score formed on the panel; and
a tab attached to the panel and adapted for rupturing the score in response to actuation of the tab by a user to form a pour opening; and
a terminal portion of the can body and a terminal portion of the can end being joined together by a double seam having a seam height that is less than approximately 2.2 mm.

30. The container of claim 29, wherein a thickness of a terminal portion of the end is no more than a thickness of the terminal portion of the can body.

31. The container of claim 29, wherein a seam thickness is no more than 1.1 mm, preferably the seam thickness is no more than 0.96 mm, and more preferably the seam thickness is between 0.85 and 0.93 mm.

32. The container of claim 29, wherein a seam length is no more than 2.2 mm, preferably the seam length is approximately 2.0 mm; or

wherein a seam radius is no more than 0.6 mm, preferably the seam radius is no more than 0.55 mm.

33. The container of claim 29, wherein the double seaming includes: (i) a cover hook, an end hook, a seaming panel, and a chuck wall of the terminal portion of the can body and (ii) a bod wall and a body hook of the can end; an overlap between the body hook and the cover hook is between 0.65 and 1.2 mm, preferably the overlap between the body hook and the cover hook is approximately 0.9 mm.

34. The container of claim 29, wherein the panel extends from a lower end of the chuck wall into the panel with no countersink bead therebetween.

35. The container of claim 29, wherein a diameter of the can end is less than between 4 and 8 times a height of the panel at a center of the can end.

36. The container of claim 29, wherein the can end is any one of a beverage can end and a food can end.

37. The container of claim 29, wherein the can end has a diameter of between 38 mm and 52 mm.

38. The container of claim 29, wherein the can end is formed of a 5000 series aluminum alloy and the can body is formed of a 3000 series aluminum alloy.

39. The container of claim 29, wherein a vertical height between liquid contents of the container and the underside of the can end at its center is between 13 mm and 18 mm; or wherein a vertical height between liquid contents of the container and a top of the can seam is between 10 and 30 mm.

40. A container for holding a comestible product, the container comprising:
a can body;
a can end including:
a chuck wall extending radially inwardly from a curl structure, the chuck wall is adapted for contact with a chuck during the seaming process;
an inwardly domed panel radially inwardly from the chuck wall, wherein the domed panel in cross section is formed by multiple radii that decrease with radial position from a panel center to a curved portion inboard and proximate the chuck wall;

a terminal portion of the can body and a terminal portion of the can end being joined together by a double seam having a seam height that is less than approximately 2.2 mm.

41. The container of claim 40, wherein the can end is formed of an aluminum alloy that is less than 0.20 inches thick, preferably the aluminum alloy is less than 0.18 inches thick, more preferably the aluminum alloy is less than 0.16 inches thick.

42. A method of forming a can end shell capable of withstanding 85 psi after seaming to a can body, the method comprising the steps of

(a) clamping an end shell metal blank between an upper sleeve having a concave surface and a lower sleeve having a convex surface near a periphery of the blank;

(b) deforming the blank by engaging an upper surface of the blank with a dome-shaped punch and moving the punch relative to blank; and

(c) engaging an underside of the blank with a pressure sleeve assembly opposite a portion of the dome-shaped punch upon deformation of the blank in deforming step (b);

whereby the steps (b) and (c) resisting wrinkling, wherein steps (a)-(c) form an inwardly domed panel radially inward from a chuck wall, wherein a slope of a tangent of a curve defined by the can end shell at every point of the chuck wall and the domed panel is non-zero except at a center of the can end shell.

43. The method of claim 42, wherein the pressure sleeve assembly of the engaging step (c) includes an outer pressure sleeve and an inner pressure sleeve, and in the engaging step (c) the inner pressure sleeve contacts an underside of the blank in response to relative movement by the punch, and the outer pressure sleeve contacts an underside of the blank after the inner pressure sleeve contacts the blank.

44. The method of claim 43, wherein the inner pressure sleeve has a contact surface having a shape that matches the shape of an opposing local portion the dome-shaped punch, and the outer pressure sleeve having a contact surface that matches the shape of an opposing portion of the dome-shaped punch.

45. The method of claim 44, wherein the inner pressure sleeve and outer pressure sleeve are independently depressible such that during a first phase of the engaging step (c) the inner pressure sleeve is depressed by the relative downward movement of the punch while the outer pressure sleeve stays relatively stationary and spaced apart from the

blank and during a second phase of the engaging step (c) each one of the inner pressure sleeve and outer pressure sleeve contact the underside of the blank and each one of the inner pressure sleeve and the outer pressure sleeve are depressed by the relative downward movement of the punch.

46. The method of claim 44, wherein the clamping step (a) includes forming a pre curl near the periphery of the blank by forced applied between the upper sleeve and the lower sleeve, wherein optionally the method further comprises the step of curling the periphery of the blank to form a finished curl capable of being seamed onto a can body flange.

47. The method of claim 44, further comprising the steps of transporting the domed shell to a curling press and, in the curling press, forming a pre-curl near the periphery of the blank by forced applied between an upper tool and a lower tool, wherein optionally the method further comprises the step of curling the pre-curl by vertical movement of a curling die.

48. The method of claim 43, wherein the metal blank is formed of a 5000 series aluminum alloy.

49. A shell press for forming a can end shell capable of withstanding 85 psi after seaming to a can body, the shell press including:

a central dome-shaped punch;

a pressure sleeve assembly located opposite a portion of the dome-shaped punch, the pressure sleeve having a contact surface that matches a corresponding opposite portion of the dome-shaped punch, the pressure sleeve being adapted for movement in response to movement of the dome-shaped punch such that the pressure sleeve contact surface and the corresponding opposite portion of the dome-shaped punch are adapted to deform a metal blank into a dome in response to downward movement of the dome-shaped punch, wherein the dome is radially inward from a chuck wall, wherein a slope of a tangent of a curve defined by the can end shell at every point of the chuck wall and the dome is non-zero except at a center of the can end shell;

an upper sleeve concentrically located outboard of the dome-shaped punch, the upper sleeve having a concave contact surface;

a lower sleeve concentrically located outboard of the pressure sleeve, the lower sleeve having a convex contact surface; the lower sleeve contact surface and the upper sleeve contact surface are adapted for curling a portion of a periphery of the blank;

a punch sleeve concentrically located outboard of the upper sleeve; and

a pressure pad concentrically located outboard of the lower sleeve.

50. The shell press of claim 49, wherein the pressure sleeve assembly includes an outer pressure sleeve and an inner pressure sleeve, the inner pressure sleeve being concentrically located inboard of the outer pressure sleeve, the inner pressure sleeve having a contact surface that matches a corresponding opposite portion of the dome-shaped punch, the outer pressure sleeve having a contact surface that matches a corresponding opposite portion of the dome-shaped punch, wherein optionally the shell press further comprises a blanking tool concentrically located outboard of at pressure pad, wherein the punch sleeve and the lower pressure pad are adapted for vertical movement relative to the blanking tool to cut the blank from a metal sheet.

51. The shell press of claim 50, wherein each one of the inner pressure sleeve and the outer pressure sleeve is downwardly moveable in response to downward movement of the dome-shaped punch, the inner pressure sleeve and the outer pressure sleeve being independently moveable downwardly.

52. The shell press of claim 50, wherein the inner pressure sleeve and the outer pressure sleeves are configured such that the inner pressure sleeve contacts a deformed portion of the blank before the outer pressure contacts a deformed portion of the blank.

53. The shell press of claim 50, wherein the shell press is adapted for forming a can end shell from a blank of a 5000 series aluminum alloy without significant wrinkling.