

CLAIMS

1. A stopper for a syringe assembly, the stopper comprising:
a lower portion;
a roof portion, the roof portion having a first thickness; and
a shear element configured to enable molding of the stopper in an open gate system,
the shear element disposed adjacent the roof portion, the shear element having a second thickness, wherein the second thickness of the shear element is less than 52% and greater than 36% of the first thickness of the roof portion.
2. The stopper of claim 1, wherein the second thickness of the shear element is approximately 44% of the first thickness of the roof portion.
3. The stopper of claim 1, further comprising a catch can element having a receiving volume.
4. A stopper for a syringe assembly, the stopper comprising:
a lower portion;
a roof portion, the roof portion having a first thickness;
a shear element disposed adjacent the roof portion, the shear element having a second thickness, wherein the second thickness of the shear element is less than 52% and greater than 36% of the first thickness of the roof portion; and
a catch can element having a receiving volume, the catch can element having a volume that is configured to receive a volume of residual material remaining from a previous shot during a gate molding operation.

5. A stopper for a syringe assembly, the stopper comprising an elastomeric body, wherein the compression set of the elastomeric body is $\leq 50\%$ when measured at 25% compression for 22 hours at 70 degrees C, wherein the hardness of the elastomeric body is 40-70 Shore A, wherein the viscosity of the elastomeric body at 205 degrees C is $\geq 115 \text{ Pa}\cdot\text{s}$ at $1,000 \text{ s}^{-1}$ shear rate, $\geq 25 \text{ Pa}\cdot\text{s}$ at $10,000 \text{ s}^{-1}$ shear rate, and $\geq 5 \text{ Pa}\cdot\text{s}$ at $50,000 \text{ s}^{-1}$ shear rate, and wherein the elastomeric body comprises at least an olefin block copolymer.

6. The stopper of claim 5, wherein the compression set of the elastomeric body is $\leq 45\%$ when measured at 25% compression for 22 hours at 70 degrees C.

7. The stopper of claim 5, wherein the compression set of the elastomeric body is 35% - 45% when measured at 25% compression for 22 hours at 70 degrees C.

8. The stopper of claim 5, wherein the hardness of the elastomeric body is 51-61 Shore A.

9. The stopper of claim 5, wherein the viscosity of the elastomeric body is 115 - 210 $\text{Pa}\cdot\text{s}$ at $1,000 \text{ s}^{-1}$ shear rate.

10. The stopper of claim 5, wherein the viscosity of the elastomeric body is 165 $\text{Pa}\cdot\text{s}$ at $1,000 \text{ s}^{-1}$ shear rate.

11. The stopper of claim 5, wherein the viscosity of the elastomeric body is 25-35 $\text{Pa}\cdot\text{s}$ at $10,000 \text{ s}^{-1}$ shear rate.

12. The stopper of claim 5, wherein the viscosity of the elastomeric body is 30 Pa·s at 10,000 s⁻¹ shear rate.

13. The stopper of claim 5, wherein the viscosity of the elastomeric body is 5-9 Pa·s at 50,000 s⁻¹ shear rate.

14. The stopper of claim 5, wherein the viscosity of the elastomeric body is 7 Pa·s at 50,000 s⁻¹ shear rate.

15. A stopper for a syringe assembly, the stopper comprising an elastomeric body, wherein the compression set of the elastomeric body is $\leq 45\%$ when measured at 25% compression for 22 hours at 70 degrees C, wherein the hardness of the elastomeric body is 40-70 Shore A, and wherein the viscosity of the elastomeric body at 205 degrees C is ≥ 115 Pa·s at 1,000 s⁻¹ shear rate, ≥ 25 Pa·s at 10,000 s⁻¹ shear rate, and ≥ 5 Pa·s at 50,000 s⁻¹ shear rate.

16. The stopper of claim 15, wherein the compression set of the elastomeric body is 35% - 45% when measured at 25% compression for 22 hours at 70 degrees C.

17. The stopper of claim 15, wherein the viscosity of the elastomeric body is 115 - 210 Pa·s at 1,000 s⁻¹ shear rate.

18. The stopper of claim 15, wherein the viscosity of the elastomeric body is 165 Pa·s at 1,000 s⁻¹ shear rate.

19. The stopper of claim 15, wherein the viscosity of the elastomeric body is 25-35 Pa·s at 10,000 s⁻¹ shear rate.

20. The stopper of claim 15, wherein the viscosity of the elastomeric body is 30 Pa·s at 10,000 s⁻¹ shear rate.

21. The stopper of claim 15, wherein the viscosity of the elastomeric body is 5-9 Pa·s at 50,000 s⁻¹ shear rate.

22. The stopper of claim 15, wherein the viscosity of the elastomeric body is 7 Pa·s at 50,000 s⁻¹ shear rate.

23. A syringe assembly, comprising:

a syringe barrel having a proximal end, a distal end, and a sidewall extending therebetween and defining a chamber having an interior;

a stopper disposed within the interior of the syringe barrel, the stopper comprising an elastomeric body, wherein the compression set of the elastomeric body is $\leq 50\%$ when measured at 25% compression for 22 hours at 70 degrees C, wherein the viscosity of the elastomeric body at 205 degrees C is ≥ 115 Pa·s at 1,000 s⁻¹ shear rate, ≥ 25 Pa·s at 10,000 s⁻¹ shear rate, and ≥ 5 Pa·s at 50,000 s⁻¹ shear rate, and wherein the elastomeric body comprises at least an olefin block copolymer; and

a plunger rod having a first end engageable with a portion of the stopper.

24. The syringe assembly of claim 23, wherein the compression set of the elastomeric body is $\leq 45\%$ when measured at 25% compression for 22 hours at 70 degrees C.

25. The syringe assembly of claim 23, wherein the compression set of the elastomeric body is 35% - 45% when measured at 25% compression for 22 hours at 70 degrees C.

26. The syringe assembly of claim 23, wherein the hardness of the elastomeric body is 51-61 Shore A.

27. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 115 - 210 Pa·s at 1,000 s⁻¹ shear rate.

28. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 165 Pa·s at 1,000 s⁻¹ shear rate.

29. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 25-35 Pa·s at 10,000 s⁻¹ shear rate.

30. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 30 Pa·s at 10,000 s⁻¹ shear rate.

31. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 5-9 Pa·s at 50,000 s⁻¹ shear rate.

32. The syringe assembly of claim 23, wherein the viscosity of the elastomeric body is 7 Pa·s at 50,000 s⁻¹ shear rate.

33. A stopper for a syringe assembly, the stopper comprising an upper portion, a lower portion, and a middle portion extending between the upper portion and the lower portion, the upper portion, the lower portion, and the middle portion defining an interior cavity, wherein at least one arm element is provided within the interior cavity in the upper portion of the stopper, the stopper further comprising an elastomeric body, wherein the compression set of the elastomeric body is $\leq 45\%$ when measured at 25% compression for 22 hours at 70 degrees C, wherein the viscosity of the elastomeric body at 205 degrees C is $\geq 115 \text{ Pa}\cdot\text{s}$ at $1,000 \text{ s}^{-1}$ shear rate, $\geq 25 \text{ Pa}\cdot\text{s}$ at $10,000 \text{ s}^{-1}$ shear rate, and $\geq 5 \text{ Pa}\cdot\text{s}$ at $50,000 \text{ s}^{-1}$ shear rate, and wherein the elastomeric body comprises at least an olefin block copolymer.

34. The stopper of claim 7, comprising an upper portion, wherein the upper portion comprises the roof portion, the shear portion, and a core portion, the roof portion extending from a perimeter of the stopper to the shear element, the shear element having a perimeter defining a transition portion extending from the roof portion to the core portion and wherein the core portion comprises an inwardly extending angular design.

35. The stopper of claim 14, wherein the catch can element comprises a semi-ellipsoidal shape.

36. The stopper of claim 14, wherein the shear element is configured to create a gap adjacent to a mold gating point that is configured to prevent any residual molding material from passing out of the catch can element.