CLAIMS

1. A system for protecting a cryostorage bag, said system comprising:

a protective interface cushion device, comprising:

an upper half having a first interior surface configured to receive a first side of a cryostorage bag, said upper half further comprising a first outer surface;

a lower half having a second interior surface configured to receive a second side of a cryostorage bag, wherein said first side is opposite said second side, said lower half further comprising a second outer surface, wherein said upper and lower halves are secured together to provide an exterior dimension;

a cutout forming an opening through at least one of the first interior surface, the first outer surface, the second interior surface, and the second outer surface, wherein said cutout is configured to restrict a first fill volume of a cryostorage bag during a freezing procedure; and

a recessed surface provided on at least one of the first interior surface and the second interior surface, wherein said recessed surface is configured to restrict a second fill volume of the cryostorage bag during a freezing procedure; and

an exclusion region between the first interior surface and the second interior surface, the exclusion region configured to displace liquid contents of the cryostorage bag into the first fill volume and/or the second fill volume;

a protective shell, comprising:

a lid having an upper interior surface configured to compatibly receive the first outer surface; and

a tray having a lower interior surface configured to compatibly receive the second outer surface, wherein when the lid and tray are secured together an interior dimension of the protective shell is approximately equal to the exterior dimension of the protective interface cushion device.

2. The system of claim 1, wherein a proximity between the cutout and at least one of the upper interior surface and the lower interior surface is configured such that a portion of a cryostorage bag expands through the cutout and contacts at least one of the upper interior surface and the lower interior surface during a freezing procedure.

3. The system of claim 1, wherein the protective interface cushion device comprises a

thermoinsulative material.

4. The system of claim 3, wherein the thermoinsulative material remains flexible or deformable over a range of temperatures from ambient to cryogenic temperatures.

5. The system of claim 3, wherein the thermoinsulative material is configured to absorb at least one of impact, shock, and acceleration forces a cryogenic temperatures.

6. The system of claim 1, wherein the protective shell comprises a polymer material that is cryogenically stable.

7. The system of claim 1, wherein the protective shell comprises a polymer material that is radiotransparent.

8. The system of claim 1, wherein the cutout comprises a cutout shape, and wherein the cutout shape is imparted to the first fill volume portion of the cryostorage bag when the first fill volume portion of the cryostorage bag expands through the cutout during a freezing procedure.

9. The system of claim 1, wherein the recessed surface comprises a recess shape, and wherein the recess shape is imparted to the second fill volume portion of the cryostorage bag when the second fill volume portion of the cryostorage bag expands into the recessed surface during a freezing procedure.

10. The system of claim 1, wherein at least one of the upper half and the lower half comprises a plurality of layers in a laminated configuration.

11. The system of claim 1, wherein the upper half is hingedly coupled to the lower half.

12. The system of claim 1, wherein the upper half is coupled to the lower half along at least two edges.

13. The system of claim 12, wherein the upper and lower halves comprise an envelope or bi-layer sleeve configuration.

14. The system of claim 1, wherein the cutout provides at least one region selected from the group

consisting of a fill region, an overflow region, and an exclusion region.

15. A protective interface cushion device, comprising:

an upper half having a first interior surface configured to receive a first side of a cryostorage bag, said upper half further comprising a first outer surface;

a lower half having a second interior surface configured to receive a second side of the cryostorage bag, wherein said first side is opposite said second side, said lower half further comprising a second outer surface, wherein said upper and lower halves are secured together to provide an exterior dimension;

a cutout forming an opening through at least one of the first interior surface, the first outer surface, the second interior surface, and the second outer surface, wherein said cutout is configured to restrict a first fill volume of the cryostorage bag during a freezing procedure;

a recessed surface provided on at least one of the first interior surface and the second interior surface, wherein said recessed surface is configured to restrict a second fill volume of the cryostorage bag during a freezing procedure; and

an exclusion region between the first interior surface and the second interior surface, the exclusion region configured to displace liquid contents of the cryostorage bag into the first fill volume and/or the second fill volume.

16. The device of claim 15, wherein the cutout comprises a cutout shape, and wherein the cutout shape is imparted to the first fill volume portion of the cryostorage bag when the first fill volume portion of the cryostorage bag expands through the cutout during a freezing procedure.

17. The device of claim 15, wherein the recessed surface comprises a recess shape, and wherein the recess shape is imparted to the second fill volume portion of the cryostorage bag when the second fill volume portion of the cryostorage bag expands into the recessed surface during a freezing procedure.

18. The device of claim 15, wherein at least one of the upper and lower halves comprise a plurality of layers in a laminated configuration.

19. The device of claim 15, wherein the upper half is hingedly coupled to the lower half.

20. The device of claim 15, wherein the upper half is coupled to the lower half along at least two edges.

21. The device of claim 18, wherein the cutout provides at least one region selected from the group consisting of a fill region, an overflow region, and an exclusion region.

22. A method for handling a liquid sample, comprising:

placing a cryostorage bag within a protective interface cushion device of any of claims 1 to 21;

inserting a liquid sample into the cryostorage bag;

contacting an outer surface of the protective interface cushion device with a first confinement structure; and

freezing the liquid sample while the protective interface cushion device is contacted by the first confinement structure.

23. The method of claim 22, further comprising a step for encasing the protective interface cushion device, and cryostorage bag placed therein, in a protective shell of any of claims 1, 6 or 7, prior to the step of contacting the outer surface of the protective interface cushion device with the first confinement structure.

24. The method of claim 22, wherein the first confinement structure is a freezing device.

25. The method of claim 22, further comprising a step for removing the cryostorage bag comprising the frozen liquid sample and protective interface cushion device from the first confinement structure.

26. The method of claim 25, further comprising a step for removing the cryostorage bag comprising the frozen liquid sample from the protective interface cushion device.

27. The method of claim 25, further comprising a step for thawing the frozen liquid sample, wherein the step for thawing comprises contacting the cryostorage bag comprising the frozen liquid sample and the protective interface cushion device with a second confinement structure, wherein the second confinement structure is a heating device.

28. The method of claim 27, further comprising a step for heating the frozen liquid sample by contacting a portion of the cryostorage bag through a cutout of the protective interface cushion device.