WE CLAIM:

1. A prime tube for use with a fluid injector, the prime tube comprising:

a patient tube connector having a proximal end and a distal end;

a prime cap having a proximal end and a distal end, wherein the prime cap has a sensing region configured for sensing a fluid within a second internal chamber defined in the prime cap; and

a connection interface for removably connecting the distal end of the patient tube connector to the proximal end of the prime cap, the connection interface comprising:

a first connector at the proximal end of the prime cap; and

a second connector at the distal end of the patient tube connector;

wherein the first connector comprises a releasable locking mechanism connected to a sidewall of the prime cap,

wherein the second connector comprises an engagement feature configured to engage at least a portion of the releasable locking mechanism, and

wherein disengagement of the engagement feature from the releasable locking mechanism permits removal of the patient tube connector from the prime cap.

2. The prime tube according to claim 1, wherein the releasable locking mechanism is a removable strip or a deformable or tearable ring connected to the sidewall of the prime cap by a frangible edge that extends around at least a portion of an outer perimeter of the prime cap.

3. The prime tube according to any of claims 1 to 2, wherein the patient tube connector comprises a first sidewall defining a first internal chamber between the proximal end and the distal end of the patient tube connector, and wherein the first sidewall is configured to allow sensing of a fluid content of the first internal chamber.

4. The prime tube according to claim 3, wherein the prime cap comprises a second sidewall defining the second internal chamber between the proximal end and the distal end of the prime cap, and wherein the second sidewall comprises the sensing region configured to allow sensing of a fluid content of the second internal chamber.

5. The prime tube according to claim 4, wherein second sidewall, at least in the sensing region, is configured to permit transmittance of electromagnetic energy or ultrasonic energy therethrough.

6. The prime tube according to claim 4, wherein second sidewall, at least in the sensing region, is transparent or translucent.

7. The prime tube according to claim 4, wherein second sidewall, at least in the sensing region, comprises a textured surface configured to deflect or scatter the electromagnetic energy.

8. The prime tube according to claim 4, wherein the first internal chamber is in fluid communication with the second internal chamber.

9. The prime tube according to any of claims 1 to 8, wherein the distal end of the prime cap comprises a cover.

10. The prime tube according to any of claims 1 to 9, wherein the distal end of the patient tube connector comprises a male or a female luer connector, and wherein the male or the female luer connector is at least partially surrounded by a skirt having the second connector thereon.

11. The prime tube according to any of claims 1 to 10, further comprising at least one alignment tab protruding radially outward from a sidewall of the prime cap.

12. A fluid injector system comprising:

at least one fluid container;

at least one drive member configured for delivering a fluid from the fluid container to a fluid path set;

a prime tube connected to the fluid path set, the prime tube having a patient tube connector and a prime cap, wherein the prime cap has a sensing region configured for sensing a fluid within a second internal chamber defined in the prime cap;

a sensing arrangement for sensing at least one characteristic of the prime tube, the sensing arrangement comprising at least one sensor configured to at least one of: sense a presence of the prime tube in a prime tube housing of the fluid injector system and sense at least one property of a fluid in the prime cap; and

a controller configured to control operation of the at least one drive member based on a detection status of the sensing arrangement.

13. The fluid injector system according to claim 12, wherein the at least one property of the fluid is at least one of fluid type, a transition between air and liquid, and a concentration of contrast.

14. The fluid injector system according to claim 11 or 12, wherein the at least one sensor is a through-beam sensor configured to measure intensity of infrared radiation passing through the prime cap.

15. The fluid injector system according to any of claims 12 to 14, wherein the at least one sensor comprises an optical camera configured to acquire image data of the prime cap.

16. The fluid injector system according to any of claims 12 to 15, wherein the at least one sensor comprises an optical emitter and at least one optical receiver.

17. The fluid injector system according to any of claims 12 to 16, wherein the at least one sensor comprises an ultrasonic emitter on a first side of the prime cap and an ultrasonic receiver on a second side of the prime cap or an ultrasonic receiver on the same side of the prime cap.

18. The fluid injector system according to any of claims 12 to 17, wherein the at least one sensor comprises a capacitive plate configured to contact at least a portion of the prime cap and measure a change in capacitance of the prime cap due to the at least one property of the fluid in the prime cap, detect a change in vibratory characteristics of the prime cap due to the at least one property of the fluid in the prime cap, or detect a change in outer diameter of the prime cap due to the at least one property of the fluid in the prime cap.

19. A sensing arrangement for a fluid injector system for sensing at least one characteristic of a prime tube having a patient tube connector and a prime cap, the sensing arrangement comprising:

at least one sensor configured to at least one of:

sense a presence of the prime cap in a prime tube housing of the fluid injector system; and

sense at least one property of a fluid in the prime cap.

20. The sensing arrangement according to claim 19, wherein the at least one sensor is a through-beam sensor configured to measure intensity of infrared radiation passing through the prime cap.

21. The sensing arrangement according to claim 19 or 20, wherein the at least one sensor comprises an optical camera configured to acquire image data of the prime cap.

22. The sensing arrangement according to any of claims 19 to 21, wherein the at least one sensor comprises an optical emitter and at least one optical receiver.

23. The sensing arrangement according to any of claims 19 to 22, wherein the at least one sensor comprises an ultrasonic emitter on a first side of the prime cap and an ultrasonic receiver on a second side of the prime cap or an ultrasonic receiver on the same side of the prime cap.

24. The sensing arrangement according to any of claims 19 to 23, wherein the at least one sensor comprises a capacitive plate configured to contact at least a portion of the prime cap and measure a change in capacitance of the prime cap due to the at least one property of the fluid in the prime cap, detect a change in vibratory characteristics of the prime cap due to the at least one property of the fluid in the prime cap or detect a change in outer diameter of the prime cap due to the at least one property of the fluid in the prime cap.

25. A prime cap for priming a fluid path, the prime cap comprising:

a hollow body having a proximal end configured for connecting with a patient tube connector and a distal end configured to be at least partially inserted into a priming container; and

a cover enclosing the distal end of the hollow body,

wherein the cover is configured to enclose the distal end, and

wherein the cover is configured to open when a pressure differential across the cover exceeds a predetermined threshold.

26. The prime cap according to claim 25, wherein the cover comprises an opening that is normally closed and is openable when the pressure differential across the cover exceeds the predetermined threshold.

27. The prime cap according to claim 25, wherein the cover comprises a cap movable relative to the distal end of the prime cap, and wherein the cap has a piercing element configured to pierce the membrane when the cap is moved toward the proximal end of the prime cap.

28. The prime cap according to claim 25, wherein the cover comprises a cover having a first portion connected to the distal end and a second portion connected to the distal end, and wherein the first position is configured to separate from the distal end when the pressure differential across the cover exceeds the predetermined threshold.

29. The prime cap according to claim 25, wherein the cover comprises a one-way valve.