CLAIMS

1. A gasket for actuating a pump cassette,

the gasket having a first side configured for placement against a pressure delivery block and having an opposing second side configured for placement against a flexible cassette membrane overlying the pump cassette, the gasket having a main body and an elastomeric valve actuation region that moves outward toward the cassette under positive pressure and inward toward the pressure delivery block under negative pressure;

the valve actuation region configured to be positioned adjacent a valve actuation portion of the cassette membrane overlying a cassette valve of the pump cassette;

the valve actuation region comprising:

a central portion configured to align with and to be pressed against a valve seat defining an orifice of the cassette valve;

a peripheral portion configured to extend over a valve chamber of the pump cassette surrounding the valve orifice;

a vacuum channel forming a perimeter around at least a portion of the peripheral portion of the actuation region, the vacuum channel defined by an inner wall contiguous with the peripheral portion of the actuation region, a floor, and an outer wall contiguous with or formed from the main body of the gasket, the vacuum channel being open to the second side of the gasket;

the vacuum channel fluidically connected to a vacuum port in the gasket that penetrates from the second side to the first side of the gasket, the vacuum port configured to communicate with a corresponding pressure delivery block vacuum port when the gasket is positioned against the pressure delivery block;

wherein the inner wall of the vacuum channel is configured to flex toward the pressure delivery block when the gasket valve actuation region is placed under negative pressure, at least partially collapsing the inner wall of the vacuum channel while the valve actuation region moves inward and is pulled away from the cassette valve orifice when the pump cassette is present against the gasket.

2. The gasket of claim 1, wherein the seat of the cassette valve seat comprises a raised circumferential wall, and wherein the gasket valve actuation region is configured to press

o

the cassette membrane against the circumferential wall to occlude or close the cassette valve.

3. The gasket of claim 2, wherein the vacuum channel of the valve actuation region is configured to be positioned outside the circumferential wall of the valve seat and over a well or chamber of the cassette valve.

4. The gasket of claim 3, wherein the inner and outer walls of the vacuum channel are configured to apply pressure between the valve actuation region and the valve seat when the first side of the valve actuation region is exposed to atmospheric pressure and the pump cassette is placed against the gasket.

5. A fluid pumping system comprising:

a pump cassette comprising a flexible membrane and a membrane based valve;

a base pumping unit comprising a source of positive or negative pressure, a pressure distribution manifold, and a pressure delivery block configured to be positioned adjacent the cassette membrane and valve;

a gasket configured for placement between the pressure delivery block and the cassette membrane, a first side of the gasket positioned against the pressure delivery block and a second opposing side of the gasket positioned against the cassette, the gasket comprising an elastomeric valve actuation region for positioning against the cassette membrane and valve;

the pressure delivery block comprising a control port for delivering positive pressure to the valve actuation region to move the cassette membrane against a valve seat of the cassette valve, and for delivering negative pressure to the valve actuation region to move the cassette membrane away from the valve seat of the cassette valve;

the gasket comprising a vacuum channel forming a perimeter around at least a portion of the valve actuation region, the vacuum channel defined by an inner wall contiguous with the valve actuation region, a floor, and an outer wall contiguous with or formed from a non-actuation region of the gasket surrounding the valve actuation region;

the vacuum channel in communication with a vacuum port in the gasket that penetrates from the second side to the first side of the gasket and that is aligned with a pressure delivery block vacuum port;

o

wherein the inner wall of the vacuum channel is configured to flex toward the pressure delivery block when negative pressure is applied to the valve actuation region via the control port, and patency of the vacuum channel is maintained.

6. The fluid pumping system of claim 5, wherein the positive or negative pressure is pneumatic pressure.

7. The fluid pumping system of claim 5, wherein the vacuum channel is positioned circumferentially around the periphery of the gasket valve actuation region.

8. The fluid pumping system of claim 5, wherein the cassette valve seat comprises a raised circumferential wall, and wherein the gasket valve actuation region is configured to press the cassette membrane against the circumferential wall to occlude or close the cassette valve.

9. The fluid pumping system of claim 8, wherein the vacuum channel of the valve actuation region is positioned outside the circumferential wall of the valve seat and over a well or chamber of the cassette valve.

10. The fluid pumping system of claim 9, wherein the inner and outer walls of the vacuum channel are configured to apply pressure between the valve actuation region and the valve seat when the first side of the valve actuation region is exposed to atmospheric or ambient pressure.

11. A method of opening or closing a pump cassette membrane valve comprising a flexible membrane overlying a valve seat of the pump cassette and using an elastomeric valve actuation region of a gasket placed between the flexible membrane of the pump cassette and a pressure delivery block, the method comprising:

the pressure delivery block applying negative pressure through a vacuum port in the gasket to an outer side of the gasket valve actuation region facing the cassette membrane, said negative pressure being applied via a vacuum channel located along a periphery of the valve actuation region and open to the outer side of the gasket valve actuation region;

the pressure delivery block applying negative pressure to an inner side of the gasket valve actuation region facing the pressure delivery block to open the membrane valve;

the pressure delivery block applying pressure through the vacuum port sufficient to flex an inner wall of the vacuum channel toward the pressure delivery block and away from

pump cassette valve seat, the inner wall being contiguous with the valve actuation region of the gasket; and

the pressure delivery block limiting the pressure applied through the vacuum port to maintain patency of the vacuum channel during the opening of the membrane valve so that the negative pressure applied to the outer side of the gasket valve actuation region is uninterrupted.

12. The method of claim 11, wherein applying negative pressure comprises applying negative pneumatic pressure.

13. The method of claim 11, wherein applying negative pressure to an outer side of the gasket valve actuation region comprises delivering negative pressure via the vacuum channel circumferentially around the valve actuation region.

14. The method of claim 11, further comprising closing the pump cassette membrane valve by applying positive pressure via the pressure delivery block to the inner side of the gasket valve actuation region against a raised wall of the valve seat surrounding an orifice of the pump cassette membrane valve.

oo