CLAIMS

We claim:

1. A method for monitoring seal life comprising:

providing a valve assembly movable from an open position to a closed position and comprising a seal having elastomeric properties seated within the valve and in contact with a surface of the valve assembly, wherein when the seal is in operation the seal is subject to degradation;

placing at least one sensor for measuring micro strain and at least one sensor for measuring at least one other property related to an ambient condition of operation or related to degradation of the seal on a surface of the valve assembly or within the valve assembly;

placing the valve assembly in an operation wherein the seal is subject to degradation and initiating the operation of the valve assembly;

at a time after the operation is initiated, recording micro strain data and data related to the at least one other property;

creating baseline data by initially measuring micro strain and the at least one other property at 100% seal life and measuring micro strain and the at least one other property again at one or more percentages of seal life to create an adjusted range of baseline data; and

analyzing the recorded data against baseline data associated with 100% seal life to evaluate seal life at the time after the operation is initiated as a percentage of seal life less than 100%.

2. The method according to claim 1, wherein the valve assembly is one of a valve assembly with a door, a pendulum valve assembly, and an isolation valve assembly.

3. The method according to claim 2, wherein the valve assembly is the valve assembly with a door and the door is configured for covering an opening in a process chamber, and the valve assembly further comprises a valve for operating the door from the open position to the closed position and the seal contacts the door.

4. The method according to claim 3, further comprising placing at least one of the at least one micro strain sensor on an exterior surface of the door.

5. The method according to claim 4, wherein initiating operation of the valve assembly comprises initiating a vacuum process when the door is in the closed position.

6. The method according to claim 4, further comprising evaluating the seal life at the time after the vacuum process is initiated as a percentage of seal life less than 100%.

7. The method according to claim 3, wherein the movable valve door is a bonded slit valve or gate valve.

8. The method according to claim 7, wherein the moveable valve door is a bonded slit valve.

9. The method according to claim 3, wherein the seal is mechanically affixed to a surface of the door.

10. The method according to claim 3, wherein there are two or more sensors for measuring micro strain that are each positioned at different locations on the door.

11. The method according to claim 10, wherein the sensors are bonded to an exterior surface of the door.

12. The method according to claim 10, wherein one or more strain gage rosette pattern is positioned on the door.

13. The method according to claim 12, wherein there are two or more strain gage rosette patterns and they are positioned in different locations.

14. The method according to claim 3, wherein the baseline data is measured after calibrating the door.

15. The method according to claim 3, wherein the baseline data is measured when a load is applied to the door and then removed, based at least in part on initial micro strain data.

16. The method according to claim 1, wherein the baseline data is saved and incorporated into a database for predicting seal life for a type of door and seal in a specific process.

17. The method according to claim 1, wherein the at least one sensor is a strain gage.

18. The method according to claim 1, wherein the at least one other property is selected from one or more of temperature, humidity, and vibration, and monitoring of such condition of operation is used to compensate for ambient noise.

19. The method according to claim 1, wherein at least one sensor is placed to measure each of the at least one other property.

20. The method according to claim 1, wherein the strain gage micro strain data is converted to a digital signal through use of a circuit including a Wheatstone bridge to convert micro strain to data to a change in voltage, conditioning an analog signal from the measured change in voltage, and converting the analog signal to the digital signal, wherein the Wheatstone bridge incorporates high precision resistors having a tolerance of no greater than 0.25%.

21. The method according to claim 20, wherein the circuit is incorporated into a printed circuit board.

22. The method according to claim 20, wherein the circuit comprises an amplifier.

23. The method according to claim 1, wherein the baseline data is measured after calibrating the valve assembly.

24. The method according to claim 1, wherein the baseline data is measured after the valve assembly is in operation and the valve is under pressure, based in part on initial micro strain data.

25. The method according to claim 1, wherein the baseline data is measured when a load is applied to the valve and then removed, based at least in part on initial micro strain data.

26. A system for analyzing seal life, comprising:

at least one memory for storing computer-executable instructions; and

at least one processing unit for executing the instructions stored in the memory, wherein execution of the instructions programs the at least one processing unit to perform operations comprising:

engaging a valve assembly movable from an open position to a closed position, to place the valve assembly in operation, wherein the valve assembly comprises a seal having elastomeric properties and the seal is seated within the valve and in contact with a surface of the valve assembly, and wherein pressure is applied to the valve assembly in operation and the seal is subject to degradation;

receiving from a circuit a signal from a change in voltage, wherein the circuit is in communication with at least one sensor for measuring micro strain and with at least one sensor for measuring at least one other property related to an ambient condition of operation or related to degradation of the seal on a surface of the valve assembly or within the valve assembly;

recording micro strain data and data related to the at least one other property at a time after operation of the valve assembly is initiated;

measuring micro strain and the at least one other property at 100% seal life to create baseline data and measuring micro strain and the at least one other property again at one or more percentages of seal life to create an adjusted range of baseline data; and

analyzing the recorded data against the baseline data and/or the adjusted range of baseline data associated with 100% seal life to evaluate seal life at the time after the operation of the valve assembly is initiated as a percentage of seal life less than 100%.

27. The system according to claim 26, wherein the valve assembly is one of a valve assembly with a door, a pendulum valve assembly, and an isolation valve assembly.

28. The system according to claim 27, wherein the valve assembly is the valve assembly with a door and the door is configured for covering an opening in a process chamber, and

the valve assembly further comprises a valve for operating the door from the open position to the closed position and the seal contacts the door.

29. The system according to claim 28, wherein at least one sensor is placed on an exterior surface of the door for measuring micro strain.

30. The system according to claim 29, wherein operation of the valve assembly is initiated by initiating a vacuum process when the door is in the closed position.

31. The system according to claim 30, wherein the seal life is evaluated at a time after the vacuum process is initiated as a percentage of seal life less than 100%.

32. The system according to claim 28, wherein the movable valve door is a bonded slit valve or gate valve.

33. A self-sensing valve assembly, comprising:

a valve assembly movable from an open position to a closed position, comprising a seal having elastomeric properties which is seated within the valve assembly and is in contact with a surface of the valve assembly, wherein in operation of the valve assembly, the seal is under pressure and is subject to degradation; and

at least one sensor for measuring micro strain on a surface of the valve assembly or within the valve assembly, and at least one sensor for measuring at least one other property related to an ambient condition of operation or related to degradation of the seal in operation, wherein the sensors are in communication with a circuit capable of sending a signal from a change in voltage, wherein the assembly is capable of recording micro strain data and data related to the at least one other property at a time after operation of the valve assembly is initiated, and of analyzing the recorded data against base line data and/or an adjusted range of baseline data associated with 100% seal life to evaluate seal life at a time after operation of the valve assembly is initiated as a percentage of seal life less than 100%, and wherein the baseline data is measured at 100% seal life and again at one or more percentages of seal life to create an adjusted range of baseline data.

34. The self-sensing valve assembly of claim 33, further comprising a thermocouple in communication with one of the sensors measuring micro strain on an exterior surface of the valve assembly.

35. The self-sensing valve assembly of claim 33, wherein the valve assembly is one of a valve assembly with a door, a pendulum valve assembly, and an isolation valve assembly.

36. The self-sensing valve assembly of claim 35, wherein the valve assembly is the valve assembly with a door and the door is configured for covering an opening in a process chamber, and the valve assembly further comprises a valve for operating the door from the open position to the closed position and the seal contacts the door.

37. The self-sensing valve assembly of claim 36, wherein the at least one sensor for measuring micro strain is placed on an exterior surface of the door.

38. The self-sensing valve assembly of claim 36, wherein operation of the valve assembly is initiated by initiating a vacuum process when the door is in the closed position.

39. The self-sensing valve assembly of claim 38, wherein the seal life is evaluated at a time after the vacuum process is initiated as a percentage of seal life less than 100%.

40. The self-sensing valve assembly of claim 36, wherein the movable valve door is a bonded slit valve or gate valve.