We claim:

1. A method of monitoring performance of a fluid driven actuator for a valve, the method comprising:

during a first time period, supplying pressurized fluid through an actuator supply line to an inlet port of the actuator to operate the actuator from a normal position to an actuated position;

measuring pressure changes ~~corresponding to a fluid flow condition~~ in the actuator supply line during the first time period, the measured pressure changes defining a valve cycle pressure profile including a reduction in a rate of pressure increase corresponding to movement of the actuator from the normal position to the actuated position; and

analyzing the ~~measured changes~~valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator; and

generating an output communicating the identified non-compliant condition.

~~2. The method of claim 1, wherein the fluid flow condition comprises fluid flow rate within the actuator supply line.~~

~~3. The method of claim 1, wherein the fluid flow condition comprises fluid pressure within the actuator supply line.~~

4~~2~~. The method of claim 1, wherein supplying the pressurized fluid through the actuator supply line to the actuator inlet port comprises operating a pilot valve connected with the actuator supply line.

5~~3~~. The method of claim 4~~2~~, wherein the pressure changes ~~corresponding to the fluid flow condition~~ are measured upstream of the pilot valve.

6~~4~~. The method of claim 4~~2~~, wherein the pressure changes ~~corresponding to the fluid flow condition~~ are measured downstream of the pilot valve.

~~7. The method of claim 4, further comprising providing a pressurized fluid chamber upstream of the pilot valve, wherein the changes corresponding to the fluid flow condition comprise pressure changes within the chamber during the first time period.~~

~~8~~5. The method of ~~claim 1~~any of claims 1-4, further comprising releasing the pressurized fluid from the actuator supply line during the first time period to return the actuator to ~~a~~the normal position.

~~9~~6. The method of claim ~~8~~5, wherein releasing the pressurized fluid from the actuator supply line during the first time period comprises retaining a non-actuating fluid pressure within the actuator supply line, wherein comparing the generated profile with the predetermined acceptable profile comprises identifying a decrease in the pressure within the actuator supply line consistent with leakage past the actuator.

~~10~~7. The method of ~~claim 1~~any of claims 1-6, wherein analyzing the ~~measured changes~~valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator comprises identifying a decrease in the pressure within the actuator supply line consistent with leakage past the actuator.

~~11~~8. The method of ~~claim 1~~any of claims 1-7, wherein analyzing the ~~measured changes~~valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator comprises identifying a higher than normal pressure at which the actuator is actuated, consistent with increased resistance to actuation.

~~12~~9. The method of claim 1, wherein analyzing the ~~measured changes~~valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator comprises identifying a lower than normal pressure at which the actuator is actuated, consistent with reduced resistance to actuation.

~~13~~10. The method of claim 1, wherein analyzing the ~~measured changes~~valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator comprises identifying a valve cycle pressure profile indicative of non-actuation of the actuator.

11. The method of claim 1, wherein analyzing the valve cycle pressure profile to identify the non-compliant condition in at least one of the valve and the actuator comprises identifying deviations of the reduction in the rate of pressure increase from an expected valve cycle pressure profile corresponding to expected movement of the actuator from the normal position to the actuated position.

12. The method of claim 4, wherein the valve cycle pressure profile includes a reduction in a rate of pressure drop during actuator depressurization corresponding to movement of the actuator from the actuated position to the normal position.

13. The method of claim 12, wherein analyzing the valve cycle pressure profile to identify the non-compliant condition in at least one of the valve and the actuator comprises comparing the reduction in the rate of pressure drop to an expected valve cycle pressure profile corresponding to expected movement of the actuator from the actuated position to the normal position.

14. An actuated valve system comprising:

a valve including a flow controlling valve element;

an actuator assembled with the valve and including a fluid driven actuator member operatively connected with the valve element and movable from a normal position to an actuated position in response to pressurization of an inlet port of the actuator;

a pilot valve connected with the actuator inlet port by an actuator supply line, the pilot valve being operable to supply pressurized fluid to the actuator supply line in a first position, and to exhaust pressurized fluid from the actuator supply line in a second position;

~~a pressure containment device connected with the actuator supply line to maintain a set pressure in the actuator supply line when the pilot valve is in at least one of the first and second positions;~~

a sensor connected with the actuator supply line, the sensor being configured to measure ~~a fluid condition~~pressure changes in the actuator supply line during a first time period, the measured pressure changes defining a valve cycle pressure profile including a reduction in a rate of pressure increase corresponding to movement of the actuator from the normal position to the actuated position; and~~corresponding to at least one of movement of the actuator member between the normal position and the actuated position, and leakage of pressurized fluid past the actuator member~~

a controller in circuit communication with the sensor, the controller being configured to analyze the valve cycle pressure profile to identify a non-compliant condition in at least one of the valve and the actuator, and to generate an output communicating the identified non-compliant condition.

15. The system of claim 14, wherein the sensor is configured to measure pressure changes downstream from the pilot valve.

~~15. The system of claim 14, wherein the sensor comprises a flow sensor.~~

~~16. The system of claim 14, wherein the sensor comprises a pressure sensor.~~

~~17. The system of claim 14, wherein the pressure containment device is positioned upstream from the pilot valve.~~

~~18. The system of claim 14, wherein the pressure containment device is positioned downstream from the pilot valve.~~

~~19. The system of claim 14, wherein the pressure containment device comprises a pressurized chamber.~~

~~20. The system of claim 19, wherein the pressurized chamber includes supply port for connection with a pressurized fluid source, the supply port having a flow restriction configured to delay re-pressurization of the pressurized chamber upon movement of the pilot valve to the first position.~~

~~21. The system of claim 14, wherein the pressure containment device comprises a backpressure device configured to retain a non-actuating positive pressure in the actuator supply line when the pilot valve is in the second position.~~

~~22. The system of claim 21, wherein the backpressure device comprises a check valve.~~

~~23. The system of claim 21, wherein the non-actuating positive pressure is less than about 10 psi.~~

24. The system of claim 14, wherein at least two of the pilot valve, the pressure containment device, and the sensor are integrated into a single module.

25. An actuated valve system comprising:

a valve including a flow controlling valve element;

an actuator assembled with the valve and including a fluid driven actuator member operatively connected with the valve element and movable with the valve element from a normal position to an actuated position in response to pressurization of an inlet port of the actuator;

a valve control module including an actuation port connected with the actuator inlet port, a pressurization port for connection with a source of pressurized fluid, and an exhaust port, the valve control module including a pilot valve arrangement operable between a first condition permitting flow between the pressurization port and the actuation port and blocking flow between the actuation port and the exhaust port for pressurization of the actuator inlet port, a second condition blocking flow between the pressurization port and the actuation port and blocking flow between the actuation port and the exhaust port to capture pressurized fluid in the actuator inlet port, and a third condition blocking flow between the pressurization port and the actuation port and permitting flow between the actuation port and the exhaust port for venting of the actuator inlet port;

a sensor in fluid communication with the actuator inlet port to measure a fluid condition in the actuator inlet port; and

a controller in circuit communication with the sensor and with the pilot valve arrangement for operation of the pilot valve arrangement to the first, second and third conditions, wherein the controller is configured to automatically adjust operation of the pilot valve arrangement in response to the measured fluid condition communicated to the controller from the sensor.

26. The system of claim 25, wherein the pilot valve arrangement comprises a first shutoff valve connecting the pressurization port with the actuation port, and a second shutoff valve connecting the exhaust port with the actuation port.

27. The system of claim 25, wherein the pilot valve comprises a switching valve connecting the actuation port with each of the pressurization port and the exhaust port, the switching valve

being movable between a first position corresponding with the first condition, a second position corresponding with the second condition, and a third position corresponding with the third condition.

28. The system of any of claims 25-27, wherein the sensor comprises a pressure sensor.

29. The system of any of claims 25-28, wherein the sensor is disposed in the valve module.

30. The system of any of claims 25-29, wherein the controller is disposed in the valve module.

31. The system of any of claims 25-30, wherein the actuator includes a biasing spring arrangement having a spring rate configured such that the actuator pressure required to move the actuator member and valve element from the normal position to the actuated position is at least 50% greater than the actuator pressure required to begin the actuator stroke from the normal position.

32. The system of claim 30, wherein the spring rate of the biasing spring arrangement is configured such that the actuator pressure required to move the actuator member and valve element from the normal position to the a midpoint position between the normal position and the actuated position is at least 30% greater than the actuator pressure required to begin the actuator stroke from the normal position.

33. The system of any of claims 31 and 32, wherein the biasing spring arrangement has a spring rate that is greater than about five times a spring force of the biasing spring arrangement when the valve element is in the normal position.

34. An actuated valve system comprising:

a valve including a flow controlling valve element; and

an actuator assembled with the valve and including a fluid driven actuator member operatively connected with the valve element and movable with the valve element from a normal position to an actuated position in response to pressurization of an inlet port of the actuator, and a biasing spring configured to return the actuator member and valve element from the actuated position to the normal position in response to venting of the pressurized actuator;

wherein the biasing spring arrangement has a spring rate configured such that the actuator pressure required to move the actuator member and valve element from the normal position to the actuated position is at least 50% greater than the actuator pressure required to begin the actuator stroke from the normal position.

35. The system of claim 34, wherein the spring rate of the biasing spring arrangement is configured such that the actuator pressure required to move the actuator member and valve element from the normal position to the a midpoint position between the normal position and the actuated position is at least 30% greater than the actuator pressure required to begin the actuator stroke from the normal position.

36. The system of any of claims 34 and 35, wherein the biasing spring arrangement has a spring rate that is greater than about five times a spring force of the biasing spring arrangement when the valve element is in the normal position.

37. An actuated valve system comprising:

a valve including a flow controlling valve element;

an actuator assembled with the valve and including an inlet port in fluid communication with a fluid driven actuator member operatively connected with the valve element and movable from a normal position to an actuated position in response to pressurization of the inlet port to at least a minimum actuating pressure, the actuator being configured to apply a biasing force to return the actuator member to the first position upon depressurization of the inlet port;

a pilot valve having a supply port connected with the actuator inlet port, the pilot valve being operable to supply pressurized fluid to the actuator inlet port in a first position, and to exhaust pressurized fluid from the actuator inlet port through an exhaust port in the pilot valve in a second position; and

a backpressure arrangement in fluid communication with the actuator inlet port to retain a positive pressure smaller than the minimum actuating pressure against the actuator member when the pilot valve is moved to the second position.

~~38. The actuated valve system of claim 37, wherein the backpressure arrangement comprises a backpressure device having at least a first end connection for connecting with at least one of the actuator inlet port, the pilot valve, and an actuator supply line connecting the pilot valve to the actuator inlet port.~~

~~39. The actuated valve system of claim 38, wherein the backpressure device comprises at least one of a check valve and a relief valve.~~

~~40. The actuated valve system of any of claims 38 and 39, wherein the backpressure device is assembled with the exhaust port of the pilot valve.~~

~~41. The actuated valve system of any of claims 38 and 39, wherein the backpressure device is assembled with the supply port of the pilot valve.~~

~~42. The actuated valve system of any of claims 37-41, further comprising an engineered leak path in fluid communication with the actuator inlet port, the engineered leak path being configured to reduce the non-actuating positive pressure against the actuator member while the pilot valve remains in the second position.~~

~~43. The actuated valve system of claim 42, wherein the engineered leak path is configured to eliminate the non-actuating positive pressure against the actuator member in less than 60 seconds.~~

~~44. The actuated valve system of any of claims 42 and 43, wherein the engineered leak path is integrated with the backpressure arrangement.~~

~~45. The actuated valve system of claim 37, wherein the backpressure arrangement is disposed in the actuator.~~

~~46. The actuated valve system of any of claims 37-45, wherein movement of the actuator member from the normal position to the actuated position moves the valve element from a shutoff position to a fluid flow position.~~

~~47. The actuated valve system of any of claims 37-46, wherein the non-actuating positive pressure applies a dampening force against the actuator member and counter to the biasing force to produce a net return force smaller than the biasing force.~~

48. The actuated valve system of claim 47, wherein the net return force is less than one half of the biasing force.

49. The actuated valve system of any of claims 37-48, wherein the actuator member comprises a piston.

50. The actuated valve system of any of claims 37-49, wherein the non-actuating positive pressure is about 10% - 90% of the minimum actuating pressure.

51. The actuated valve system of any of claims 37-50, further comprising a sensor connected with the actuator supply line, the sensor being configured to measure a fluid flow condition in the actuator supply line corresponding to at least one of movement of the actuator member between the normal position and the actuated position, and leakage of pressurized fluid past the actuator member.

52. The actuated valve system of claim 51, wherein the sensor comprises a flow sensor.

53. The actuated valve system of claim 51, wherein the sensor comprises a pressure sensor.

54. The actuated valve system of any of claims 37-53, further comprising an actuator supply line connecting the pilot valve supply port with the actuator inlet port.

55. A backpressure device comprising:

a body defining a passage extending from an inlet port to an outlet port;

a seat disposed in the passage;

a seal member disposed in the body and biased into sealing engagement with the seat, the seal member separating from the seat at a set pneumatic inlet pressure to release through the outlet port any excess pneumatic pressure greater than the set pneumatic pressure; and

an engineered leak path in fluid communication with the inlet port configured to provide a leak rate between about 0.25 sccm and 2.5 sccm at an inlet pressure equal to the set pneumatic pressure.

~~56. The backpressure device of claim 55, wherein the set pneumatic pressure is between about 10 psi and about 60 psi.~~

~~57. The backpressure device of claim 56, wherein the engineered leak path is defined by at least one of the body, the seat, and the seal member.~~