CLAIMS

1. A breathing apparatus, the breathing apparatus comprising:

    a flow generator,

    a flow path, the flow path configured to provide a flow of breathable gas to a patient,

    a controller, the controller configured to control the flow generator by controlling a flow generator output to the flow generator, wherein the flow generator output is within an allowable flow generator output range, to provide the flow of breathable gas, and wherein the controller is configured to:

        determine a variable indicative of conductance of the flow path,

        determine a predicted maximum flow rate and/or a predicted minimum flow rate for the flow path based on:

            the variable indicative of conductance of the flow path,

            the allowable flow generator output range.

2. The breathing apparatus of claim 1, wherein the flow generator output is or comprises:
    i. a motor speed,
    ii. a motor current,
    iii. a motor duty,
    iv. a pressure of the gases in the flow path, or
    v. any combination of i-iv.

3. The breathing apparatus of claim 1 or claim 2, wherein the variable indicative of conductance of the flow path is, or is based on:
    i. a conductance of the flow path, or a portion of the flow path;
    ii. a resistance to flow of the flow path, or a portion of the flow path; or
    iii. a pressure drop along the flow path, or a portion of the flow path
    iv. any combination of i-iii.

4. The breathing apparatus of any one of claims 1 to 3, wherein the flow generator comprises an impeller.

5. The breathing apparatus of any one of claims 1 to 4, wherein the breathing apparatus comprises a flow sensor, wherein the flow sensor is configured to measure a flow rate of the flow of breathable gas to a patient.

6. The breathing apparatus of any one of claims 1 to 5, wherein the variable indicative of conductance of the flow path is based on a variable indicative of conductance of the flow path at a previous time step or, wherein the variable indicative of conductance of the flow path is

based on a variable indicative of conductance of the flow path over a timing window, optionally the timing window is a preceding 20 seconds.

7. The breathing apparatus of any one of claims 1 to 6, wherein the variable indicative of conductance of the flow path is based on the current flow generator output and a current flow rate.

8. The breathing apparatus of any one of claims 1 to 7, wherein the variable indicative of conductance of the flow path is based on the current flow divided by the current flow generator output.

9. The breathing apparatus of any one of claims 1 to 8, wherein the variable indicative of conductance is proportional to:

$$\frac{flow\ rate}{\sqrt{pressure}}$$

10. The breathing apparatus of any one of claims 1 to 9, wherein the variable indicative of conductance is proportional to:

$$\frac{flow\ rate}{motor\ output}$$

11. The breathing apparatus of any one of claims 1 to 10, wherein the flow path comprises one or more of:

    a humidification chamber,

    one or more breathing conduits,

    a patient interface,

    an elbow, and

    a sensor module.

12. The breathing apparatus of any one of claims 1 to 11, wherein the controller configured to control the motor to provide, or attempt to provide, the flow of breathable gas to the patient at a flow rate set point.

13. The breathing apparatus of any one of claims 1 to 12, wherein the allowable flow generator output range is an allowable motor speed range, wherein the allowable motor speed range comprises an upper motor speed limit and/or a lower motor speed limit.

14. The breathing apparatus of claim 13, wherein the predicted maximum flow rate is based on the current motor speed and/or an upper motor speed limit.

15. The breathing apparatus of claim 13 or claim 14, wherein the predicted minimum flow rate is based on the current motor speed and/or a lower motor speed limit.

16. The breathing apparatus of any one of claims 1 to 15, wherein the controller is configured to compare the predicted maximum flow rate and/or the predicted minimum flow rate, and a flow rate set point, and based on the comparison generate at least one alarm condition.

17. The breathing apparatus of claim 16, wherein the at least one alarm condition comprises one or more of:

    a cannot reach flow rate set point alarm, and

    a blockage alarm.

18. The breathing apparatus of claim 17, wherein the cannot reach flow rate set point alarm comprises:

    a cannot reach flow rate alarm associated with the flow rate set point being above the maximum predicted flow rate (i.e. a flow rate set point too high alarm), and/or

    a cannot reach flow rate alarm associated with the flow rate set point being below the minimum predicted flow rate (i.e. a flow rate set point too low alarm).

19. The breathing apparatus of claim 17 or 18, wherein the controller is configured to determine a condition where the flow rate set point cannot be reached, based on the predicted maximum flow rate and the flow rate set point, and in response, the controller is configured to generate a cannot reach flow rate set point alarm.

20. The breathing apparatus of any one of claims 16 to 19, wherein the controller is configured to generate at least one alarm condition when the flow rate set point is greater than the predicted maximum flow rate.

21. The breathing apparatus of any one of claims 16 to 20, wherein the controller is configured to generate at least one alarm condition when the flow rate set point is greater than the predicted maximum flow rate by more than an alarm threshold.

22. The breathing apparatus of claim 21, wherein the alarm threshold is a proportion of the flow rate set point.

23. The breathing apparatus of claim 22, wherein the proportion of the flow rate set point is about 5% to about 20% or about 10% of the flow rate set point.

24. The breathing apparatus of any one of claims 17 to 23, wherein the controller is configured to determine a condition where flow rate set point cannot be reached, based on the predicted minimum flow rate and the flow rate set point, and in response the controller is configured to generate a cannot reach flow rate set point alarm.

25. The breathing apparatus of any one of claims 17 to 24, wherein the controller is configured to generate at least one alarm condition when the flow rate set point is less than the predicted minimum flow rate .

26. The breathing apparatus of any one of claims 17 to 25, wherein the controller is configured to generate at least one alarm condition when the flow rate set point is less than the predicted minimum flow rate by more than an alarm threshold.

27. The breathing apparatus of claim 26, wherein the alarm threshold is a proportion of the flow rate set point.

28. The breathing apparatus of claim 27, wherein the proportion of the flow rate set point is about 5% to about 20% or about 10% of the flow rate set point.

29. The breathing apparatus of any one of claims 16 to 28, wherein in response to the generation of the at least one alarm condition, the controller controls the motor speed to a predetermined safe motor speed.

30. The breathing apparatus of claim 29, wherein the controller controls the motor speed to the predetermined safe motor speed until the predicted maximum flow rate is greater than a safe

threshold flow rate, and/or the predicted minimum flow rate is less than a safe threshold flow rate.

31. The breathing apparatus of claim 29 or claim 30, wherein the controller controls the motor speed to the predetermined safe motor speed until the flow rate set point is less than the predicted maximum flow rate, and/or the flow rate set point is greater than the predicted minimum flow rate.