

CLAIMS

We claim:

1. A fluid flow system (300), comprising:
a pipeline (301) with a flowing fluid;
5 a first pressure sensor (303) located within the pipeline (301) and determining a first pressure within the pipeline (301);
a vibrating meter (5) including:
a sensor assembly (10) located within the pipeline (301) proximate to and
in fluid communication with the first pressure sensor (303); and
10 a meter electronics (20) in electrical communication with the sensor assembly (10) and configured to receive one or more sensor signals (210) and measure one or more flow characteristics;
a system controller (310) in electrical communication with the first pressure sensor (303) and in electrical communication with the meter electronics (20) and configured to:
15 receive the first pressure measurement from the first pressure sensor (303);
receive the one or more flow characteristics from the meter electronics (20);
20 determine a static pressure of the fluid based on the pressure of the fluid within the pipeline (301) and the one or more flow characteristics;
and
determine if the fluid contains at least some gas based on the static pressure of the fluid.

25 2. The fluid flow system (300) of claim 1, wherein the system controller (310) is further configured to determine the fluid contains at least some gas if the static pressure of the fluid is outside a threshold value or band.

30 3. The fluid flow system (300) of claim 2, wherein the system controller (310) is further configured to adjust the fluid flow if the static pressure of the fluid is outside the threshold value or band.

4. The fluid flow system (300) of claim 3, wherein the adjustment can comprise increasing a pipeline line pressure.
- 5 5. The fluid flow system (300) of claim 3, wherein the adjustment can comprise decreasing a fluid flow rate.
6. The fluid flow system (300) of claim 2, wherein the threshold value or band is based upon a saturation pressure of the fluid.
- 10 7. The fluid flow system (300) of claim 6, wherein the system controller (310) is further configured to determine the saturation pressure based on a measured temperature and density of the fluid.
- 15 8. The fluid flow system (300) of claim 1, wherein the system controller (310) is further configured to determine a drive gain, compare the drive gain to a threshold value, and determine the static pressure is outside a threshold value or band if the drive gain exceeds the threshold value.
- 20 9. The fluid flow system (300) of claim 1, wherein the determined static pressure comprises the static pressure of the fluid within the sensor assembly (10).
10. A meter electronics (20) for a vibrating sensor (10) located within a pipeline (301) with a flowing fluid and in fluid communication with one or more pressure
- 25 sensors (303, 304), the meter electronics (20) configured to:
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- measure one or more flow characteristics of the fluid flowing through the sensor assembly (10);
- receive a first pressure signal (213) indicating a static pressure of the fluid in the pipeline (301);
- 30 determine a static pressure of the fluid based on the first pressure signal (213) and the one or more measured flow characteristics; and

determine if the fluid contains at least some gas based on the static pressure of the fluid.

11. The meter electronics (20) of claim 10, further configured to determine the fluid
5 contains at least some gas if the static pressure of the fluid is outside a threshold value or range.

12. The meter electronics (20) of claim 11, further configured to adjust the fluid flow
10 if the static pressure of the fluid is outside the threshold value or band.

13. The meter electronics (20) of claim 12, wherein the adjustment comprises
increasing the pipeline line pressure.

14. The meter electronics (20) of claim 12, wherein the adjustment comprises
15 decreasing a fluid flow rate.

15. The meter electronics (20) of claim 11, wherein the threshold value or band is
based upon a saturation pressure of the fluid.

20 16 The meter electronics (20) of claim 15, further configured to determine the
saturation pressure based on a measured temperature and density of the fluid.

17. The meter electronics (20) of claim 10, further configured to determine a drive
gain, compare the drive gain to a threshold value, and determine the static pressure is
25 outside a threshold value or band if the drive gain exceeds a threshold value.

18. The meter electronics (20) of claim 10, wherein the determined static pressure
comprises the static pressure of the fluid within the sensor assembly (10).

19. A method for operating a fluid flow system including a fluid flowing through a pipeline, a first pressure sensor located within the pipeline, and a vibrating meter including a sensor assembly in fluid communication with the first pressure sensor, the method comprising steps of:

5 measuring a pressure of the fluid within the pipeline using the first pressure sensor;

measuring one or more flow characteristics of the fluid using the vibrating meter;

determining a static pressure of the fluid based on the pressure of the fluid within the pipeline and the one or more flow characteristics; and

10 determining if the fluid contains at least some gas based on the static pressure of the fluid.

20. The method of claim 19, further comprising a step of determining the fluid contains at least some gas if the static pressure of the fluid is outside a threshold value or
15 band.

21. The method of claim 20, further comprising a step of adjusting the fluid flow if the static pressure of the fluid is outside the threshold value or band.

20 22. The method of claim 21, wherein the adjusting comprises increasing a pipeline line pressure.

23. The method of claim 21, wherein the adjusting comprises decreasing a fluid flow rate.

25 24. The method of claim 20, wherein the threshold value or band is based upon a saturation pressure of the fluid.

25. The method of claim 24, further comprising a step of determining the saturation
30 pressure based on a measured temperature and density of the fluid.

26. The method of claim 19, further comprising steps of:
determining a drive gain;
comparing the drive gain to a threshold value; and
determining the static pressure is outside a threshold value or band if the drive
5 gain exceeds the threshold value.
27. The method of claim 19, wherein the step of determining the static pressure
comprises determining the static pressure of the fluid within the sensor assembly.

CLAIMS

We claim:

1. A fluid flow system (300), comprising:
 - a pipeline (301) with a flowing fluid;
 - a first pressure sensor (303) located within the pipeline (301) and determining a first pressure within the pipeline (301);
 - a vibrating meter (5) including:
 - a sensor assembly (10) located within the pipeline (301) proximate to and in fluid communication with the first pressure sensor (303); and
 - a meter electronics (20) in electrical communication with the sensor assembly (10) and configured to receive one or more sensor signals (210) and measure one or more flow characteristics;
 - a system controller (310) in electrical communication with the first pressure sensor (303) and in electrical communication with the meter electronics (20) and configured to:
 - receive the first pressure measurement from the first pressure sensor (303);
 - receive the one or more flow characteristics from the meter electronics (20);
 - determine a static pressure of the fluid based on the pressure of the fluid within the sensor assembly (10) and the one or more flow characteristics;
 - determine if the fluid contains at least some gas based on the static pressure of the fluid; and
 - ~~adjust the fluid flow if the static pressure of the fluid is outside the~~ threshold value or band, wherein the adjustment is at least one of increasing a pipeline line pressure and decreasing a fluid flow rate.
2. The fluid flow system (300) of claim 1, wherein the system controller (310) is further configured to determine the fluid contains at least some gas if the static pressure of the fluid is outside a threshold value or band based upon a saturation pressure of the fluid.

3. The fluid flow system (300) of claim 2, wherein the system controller (310) is further configured to determine the saturation pressure based on a measured temperature and density of the fluid.

4. The fluid flow system (300) of claim 1, wherein the system controller (310) is further configured to determine a drive gain, compare the drive gain to a threshold value, and determine the static pressure is outside a threshold value or band if the drive gain exceeds the threshold value.

5. A meter electronics (20) for a vibrating sensor (10) located within a pipeline (301) with a flowing fluid and in fluid communication with one or more pressure sensors (303, 304), the meter electronics (20) configured to:

measure one or more flow characteristics of the fluid flowing through the sensor assembly (10);

receive a first pressure signal (213) indicating a static pressure of the fluid in the pipeline (301);

determine a static pressure of the fluid based within the sensor assembly (10) on the first pressure signal (213) and the one or more measured flow characteristics; and

determine if the fluid contains at least some gas based on if the static pressure of the fluid is outside a threshold value or range;

adjust the fluid flow if the static pressure of the fluid is outside the threshold value or band, wherein adjusting the fluid flow is the by at least one of increasing the pipeline line pressure and decreasing a fluid flow rate.

6. The meter electronics (20) of claim 5, wherein the threshold value or band is based upon a saturation pressure of the fluid.

7. The meter electronics (20) of claim 6, further configured to determine the saturation pressure based on a measured temperature and density of the fluid.

8. The meter electronics (20) of claim 5, further configured to determine a drive gain, compare the drive gain to a threshold value, and determine the static pressure is outside a threshold value or band if the drive gain exceeds a threshold value.

9. A method for operating a fluid flow system including a fluid flowing through a pipeline, a first pressure sensor located within the pipeline, and a vibrating meter including a sensor assembly in fluid communication with the first pressure sensor, the method comprising steps of:

measuring a pressure of the fluid within the pipeline using the first pressure sensor;

measuring one or more flow characteristics of the fluid using the vibrating meter;

determining a static pressure of the fluid based on the pressure of the fluid within the pipeline and the one or more flow characteristics;

determining if the fluid contains at least some gas based on the static pressure of the fluid; and

adjusting the fluid flow if the static pressure of the fluid is outside the threshold value or band by at least one of increasing a pipeline line pressure and decreasing a fluid flow rate based upon a saturation pressure of the fluid.

10. The method of claim 9, further comprising a step of determining the fluid contains at least some gas if the static pressure of the fluid is outside a threshold value or band.

11. The method of claim 9, further comprising a step of determining the saturation pressure based on a measured temperature and density of the fluid.

12. The method of claim 10, further comprising steps of:

determining a drive gain;

comparing the drive gain to a threshold value; and

determining the static pressure of the fluid within the sensor assembly is outside a threshold value or band if the drive gain exceeds the threshold value.