We claim:

1. A method for inferring an inferred speed of sound of a flow fluid, the method being conducted by a computer system (200) having a processor (210) and a memory (220), the processor (210) configured to execute instructions from the memory (220) and store data in the memory (220), the memory (220) having a SoS inference module (202), the method comprising:

inferring, by the SoS inference module (202), the inferred speed of sound of the flow fluid based on an inferential relationship between a measured density and a heat capacity ratio of the flow fluid and the inferred speed of sound of the flow fluid.

2. A method as claimed in claim 1, wherein the inferential relationship between the inferred speed of sound of the flow fluid and the density of the flow fluid is an inverse relationship between the inferred speed of sound of the flow fluid and the square root of the measured density of the flow fluid.

3. A method as claimed in claim 2, wherein the inferential relationship between the inferred speed of sound of the flow fluid and the density of the flow fluid further accounts for a pressure of the flow fluid, wherein the pressure of the flow fluid is one or more of a measured pressure measured by a pressure sensor (20) and a pressure inferred from a density sensor (10) stiffness determination.

4. A method as claimed in claim 3, ~~the inferential relationship further based on a relationship between the inferred speed of sound of the flow fluid and a heat capacity ratio of the flow fluid,~~ wherein the inferential relationship is based on a relationship between the inferred speed of sound of the flow fluid and a square root term, the square root term having a square root of a product of the heat capacity ratio and the pressure, divided by the square root of the measured density.

5. A method as claimed in claim 4, wherein the heat capacity ratio is associated with one or more of the flow fluid and a class of flow fluids of which the flow fluid is a member and wherein the heat capacity ratio is one or more of temperature dependent and pressure dependent, such that the heat capacity ratio is determined based on a

corresponding predetermined relationship between the heat capacity ratio and one or more of the measured temperature and the pressure.

6. A method as claimed in ~~claims 1 to 5~~claim 1, wherein the computer system (200) is a density sensor meter electronics (120) of a density sensor (10) the method further comprising:

measuring, by the density sensor (10), the measured density; and

transmitting, by the density sensor (10), the inferred speed of sound of the fluid to a vibratory flow sensor (5).

7. A method as claimed in claim 6, further comprising, if the inferential relationship between a measured density of the flow fluid and the inferred speed of sound of the flow fluid accounts for a flow fluid pressure, inferring, by the density sensor meter electronics (120), an inferred flow fluid pressure based on a measured stiffness of elements of the density sensor (10) determined by the density sensor (10).

8. A method as claimed in claims 3 to 5, wherein the computer system (200) is a vibratory flow sensor meter electronics (110) of a vibratory flow sensor (5), the method further comprising:

receiving, by the computer system (200), the measured density from a density sensor (10);

receiving, by the computer system (200), the pressure of the flow fluid; and

determining, by the computer system (200), a corrected mass flowrate, based on the inferred speed of sound of the flow fluid.

9. A method as claimed in ~~claims 6 to 8~~claim 8, wherein the vibratory flow sensor (5) one or more of:

vibrates vibratory flow sensor (5) vibratory elements at a frequency that is greater than or equal to 300 hertz; and

has an inner diameter that is greater than or equal to two inches, and wherein the density sensor (10) one or more of:

vibrates density sensor (10) vibratory elements at a frequency that is less than 300 hertz; and

has an inner diameter that is less than two inches.

10. A method as claimed in claims 1 to 9, wherein the flow fluid is in a supercritical state and comprises one or more of ethylene, ethane, carbon dioxide, and argon.

11. An apparatus for inferring an inferred speed of sound of a flow fluid, the apparatus having a computer system (200), the computer system (200) having a processor (210) and a memory (220), the processor (210) configured to execute instructions from the memory (220) and store data in the memory (220), the memory (220) having a SoS inference module (202), the computer system (200) configured to:

infer, by the SoS inference module (202), the inferred speed of sound of the flow fluid based on an inferential relationship between a measured density and a heat capacity ratio of the flow fluid and the inferred speed of sound of the flow fluid.

12. An apparatus as claimed in claim 11, wherein the inferential relationship between the inferred speed of sound of the flow fluid and the density of the flow fluid is an inverse relationship between the inferred speed of sound of the flow fluid and the square root of the measured density of the flow fluid.

13. An apparatus as claimed in claim 12, wherein the inferential relationship between the inferred speed of sound of the flow fluid and the density of the flow fluid further accounts for a pressure of the flow fluid, wherein the pressure of the flow fluid is one or more of a measured pressure measured by a pressure sensor (20) and a pressure inferred from a density sensor (10) stiffness determination.

14. An apparatus as claimed in claim 13, ~~the inferential relationship further based on a relationship between the inferred speed of sound of the flow fluid and a heat capacity ratio of the flow fluid,~~ wherein the inferential relationship is based on a relationship between the inferred speed of sound of the flow fluid and a square root term, the square

root term having a square root of a product of the heat capacity ratio and the pressure, divided by the square root of the measured density.

15. An apparatus as claimed in claim 14, wherein the heat capacity ratio is associated with one or more of the flow fluid and a class of flow fluids of which the flow fluid is a member and wherein the heat capacity ratio is one or more of temperature dependent and pressure dependent, such that the heat capacity ratio is determined based on a corresponding predetermined relationship between the heat capacity ratio and one or more of the measured temperature and the pressure.

16. An apparatus as claimed in ~~claims 11 to 15~~ claim 11, wherein the computer system (200) is a density sensor meter electronics (120) of a density sensor (10), the density sensor (10) configured to:

measure the measured density; and

transmit the inferred speed of sound of the fluid to a vibratory flow sensor (5).

17. An apparatus as claimed in claim 16, wherein if the inferential relationship between a measured density of the flow fluid and the inferred speed of sound of the flow fluid accounts for a flow fluid pressure, the density sensor meter electronics (120) is configured to infer an inferred flow fluid pressure based on a measured stiffness of elements of the density sensor (10) determined by the density sensor (10).

18. An apparatus as claimed in claims 13 to 15, wherein the apparatus is a vibratory flow sensor (5), the computer system (200) is a vibratory flow sensor meter electronics (110) of the vibratory flow sensor (5), the computer system (200) further configured to:

receive the measured density from a density sensor (10);

receive the pressure of the flow fluid; and

determine a corrected mass flowrate based on the inferred speed of sound of the flow fluid.

19. An apparatus as claimed in claim 16 to 18, wherein the vibratory flow sensor (5) one or more of:

vibrates vibratory flow sensor (5) vibratory elements at a frequency that is greater than or equal to 300 hertz; and

has an inner diameter that is greater than or equal to two inches, and wherein the density sensor (10) one or more of:

vibrates density sensor (10) vibratory elements at a frequency that is less than 300 hertz; and

has an inner diameter that is less than two inches.

20. An apparatus as claimed in claims 11 to 19, wherein the flow fluid is in a supercritical state and comprises one or more of ethylene, ethane, carbon dioxide, and argon.