

CLAIMS

What is claimed is:

1. An apparatus for characterizing downhole fluid handling systems, comprising:
 - 5 a hollow cylindrical housing arranged to selectively receive a multiphase fluid containing a gas and a liquid therein, the hollow cylindrical housing constructed at least partly of a transparent or translucent material;
a gas separator positioned within the hollow cylindrical housing at a specified location;
 - 10 a multistage pump positioned upstream of the gas separator at a specified location within the hollow cylindrical housing;
a first chamber supply line coupled to the hollow cylindrical housing between the gas separator and the multistage pump and arranged to transport gas separated by the gas separator and any liquid away from the hollow
15 cylindrical housing;
a second chamber supply line coupled to the hollow cylindrical housing upstream of the multistage pump and arranged to transport liquid and any gas unseparated by the gas separator from the multistage pump away from the hollow cylindrical housing;
 - 20 at least one first chamber coupled to the first chamber supply line and arranged to receive the gas and any liquid transported by the first chamber supply line;
at least one second chamber coupled to the second chamber supply line and arranged to receive the liquid and any gas transported by the second
25 chamber supply line;
a liquid flow meter coupled to each of the at least one first and second chambers, each liquid flow meter arranged to measure a flow rate of liquid at the at least one first and second chambers, respectively; and
a gas flow meter coupled to each of the at least one first and second
30 chambers, each gas flow meter arranged to measure a flow rate of gas at the at least one first and second chambers, respectively.

2. The apparatus of claim 1, further comprising a mechanical separator positioned downstream of the gas separator within the hollow cylindrical housing, the mechanical separator arranged to induce a vortex in the hollow cylindrical housing.

3. The apparatus of claim 1, wherein the hollow cylindrical housing has one or more resealable holes formed therein, the one or more resealable holes allowing a sensor to be inserted in the hollow cylindrical housing.

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4. The apparatus of claim 1, further comprising a gas supply line coupled to the hollow cylindrical housing and arranged to selectively inject gas into the hollow cylindrical housing.

15 5. The apparatus of claim 1, wherein each of the at least one first and second chambers includes a gas outlet and each gas flow meter is coupled to a respective each gas outlet.

6. The apparatus of claim 1, wherein each of the at least one first and second chambers includes a liquid outlet and each liquid flow meter is coupled to a respective liquid outlet.

7. The apparatus of claim 6, further comprising a holding tank and a liquid supply line coupling the holding tank to the hollow cylindrical housing, the liquid supply line arranged to selectively supply liquid from the holding tank to the hollow cylindrical housing.

8. The apparatus of claim 7, further comprising a return line coupled to each liquid flow meter, the return line arranged to return liquid exiting from the at least one first and second chambers to the holding tank.

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9. The apparatus of claim 8, wherein the first chamber supply line and the at least one first chamber form a first closed test loop together with the return line, the holding tank, the liquid supply line, and the hollow cylindrical housing, and/or wherein the second chamber supply line and the at least one second
5 chamber form a second closed test loop together with the return line, the holding tank, the liquid supply line, and the hollow cylindrical housing.

10. The apparatus of claim 1, further comprising a plurality of chamber valves coupled to the first and second chamber supply lines, each chamber valve
10 individually operable in conjunction with one another to selectively control fluid flow into the at least one first and second chambers.

11. The apparatus of claim 1, further comprising an isolation valve coupled to the first chamber supply line and operable to selectively isolate the at least one
15 first chamber from the at least one second chamber.

12. The apparatus of claim 1, wherein the gas separator has a transparent or translucent outer housing, and/or the multistage pump has a transparent or translucent outer housing.
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13. The apparatus of claim 1, wherein the first chamber supply line, the second chamber supply line, the at least one first chamber, and/or the at least one second chamber is constructed of a transparent or translucent material.

14. A method for testing fluid handling equipment used in oil and gas production, comprising:
- supplying a liquid to a hollow cylindrical housing at a selected supply flow rate from a liquid supply line, the hollow cylindrical housing constructed at least partly of a transparent or translucent material;
 - injecting a gas into the hollow cylindrical housing at a first injection rate from a gas supply line;
 - mixing the gas and the liquid to create a multiphase fluid;
 - increasing injection of gas into the hollow cylindrical housing from the first injection rate to a second injection rate;
 - separating the gas in a gas separator positioned within the hollow cylindrical housing, wherein the gas separator separates all the gas injected at the first injection rate from the multiphase fluid, and wherein the gas separator fails to separate all the gas injected at the second injection rate from the multiphase fluid;
 - transporting gas separated by the gas separator and any liquid to at least one first chamber through a first chamber supply line coupled to the hollow cylindrical housing;
 - transporting liquid and any gas unseparated by the gas separator from a multistage pump to at least one second chamber through a second chamber supply line coupled to the hollow cylindrical housing;
 - measuring a liquid flow rate and a gas flow rate at the at least one first and second chambers; and
 - comparing the liquid flow rate and the gas flow rate at the at least one first chamber to the liquid flow rate and the gas flow rate at the at least one second chamber.
15. The method of claim 14, wherein mixing the gas and the liquid to create a multiphase fluid is performed by a mechanical separator positioned downstream of the gas separator within the hollow cylindrical housing, the mechanical separator arranged to induce a vortex in the hollow cylindrical housing.

16. The method of claim 14, further comprising inserting a sensor into the hollow cylindrical housing through one or more resealable holes formed therein.
- 5 17. The method of claim 14, wherein the liquid is supplied to the hollow cylindrical housing from a holding tank, the holding arranged to receive liquid from the at least first and second chambers through a return line.
- 10 18. The method of claim 17, wherein the first chamber supply line and the at least one first chamber form a first closed test loop together with the return line, the holding tank, the liquid supply line, and the hollow cylindrical housing, and/or wherein the second chamber supply line and the at least one second chamber form a second closed test loop together with the return line, the holding tank, the liquid supply line, and the hollow cylindrical housing.
- 15 19. The method of claim 14, wherein the gas separator has a transparent or translucent outer housing, and/or the multistage pump has a transparent or translucent outer housing.
- 20 20. The method of claim 14, wherein the first chamber supply line, the second chamber supply line, the at least one first chamber, and/or the at least one second chamber is constructed of a transparent or translucent material.