

A System And Method For Calibrating A Pressure Gauge

FIELD OF INVENTION

- The invention relates broadly to a system and method for calibrating a pressure gauge.
- 5 In particular, the invention relates to a system and method for calibrating a hydraulic pressure gauge.

BACKGROUND

- In order to perform calibration tests in a laboratory, a unit under test (UUT) e.g. a pressure gauge, a check valve, a relief valve etc. is usually hooked to a test pump that generates a high static pressure. This usually requires the UUT to be physically transported to the laboratory. Conventionally, the laboratory technicians use a dead weight tester for calibrating a UUT. The dead weight tester should be used under a controlled environment to simulate the on-site environment, (e.g. temperature, pressure, humidity etc) to achieve accurate results. It is not possible to carry out on-site pressure calibration. Pressure calibration using a dead weight tester is not only time consuming, but also requires additional manpower.
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- Furthermore, since many types of hydraulic fluids [e.g. Skydrol (BMS3-11), Red Oil MIL-H-83282, Lubrication Oil MIL-PRF-23699, Calibration Fluid MIL-PRF-7024, etc.] are used for testing a UUT, thorough flushing is required to prevent cross contamination.
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There is thus a need to provide a method and system for calibrating a pressure gauge that seeks to address one or more of the above disadvantages.

25 SUMMARY

- According to a first aspect of the present invention, there is provided a system for calibrating a pressure gauge, the system comprising: a hand pump positioned on a mobile platform, the hand pump operable to pressurize a fluid to a predetermined pressure and the mobile platform operable to be moved proximate to the pressure gauge; a regulator valve to regulate a fluid-flow of the pressurized fluid into a pipe system, the pipe system including a transducer coupled to a totalizer for providing a reference measure of fluid pressure in the pipe system; and a hose for connecting the pressure gauge in fluid communication with the pipe system for comparing a reading of the pressure gauge with the reference measure.
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The system may further comprise a relief valve on a hand pump side of the regulator valve for controlling the predetermined pressure.

The mobile platform may comprise a tray located below the relief valve for collecting the excess fluid for disposal. The regulator valve may comprise a needle valve.

5 The hand pump may be operable to generate a pressure of up to 10,000 Psi (703.07 kg / cm²).

The system may comprise a plurality of hand pumps, each hand pump having an associated regulator valve and pipe system, wherein each hand pump is provided for exclusively handling one hydraulic fluid type.

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The plurality of hand pumps and associated regulator valves and pipe systems may be separated by one or more partitions. Each partition may have a label to identify the hydraulic fluid used for one of the hand pumps.

15 The hose may be flexible. The colour of the hose may be chosen to correspond with the hydraulic fluid used.

The hydraulic fluid may be selected from a group consisting of Skydrol (BMS3-11), Red Oil MIL-H-83282, Lubrication Oil MIL-PRF-23699, Calibration Fluid MIL-PRF-7024, etc.

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The mobile platform may be made of a corrosion resistant material.

According to a second aspect of the present invention, there is provided a method for calibrating a pressure gauge, the method comprising the steps of: providing a hand
25 pump positioned on a mobile platform proximate to the pressure gauge; pressurizing a fluid to a predetermined pressure using the hand pump; regulating a fluid-flow of the pressurized fluid into a pipe system using a regulator valve, wherein the pipe system includes a transducer coupled to a totalizer and a hose for connecting the pressure gauge in fluid communication with the pipe system; obtaining a reference measure of
30 fluid pressure in the pipe system from the display; and comparing a reading of the pressure gauge with the reference measure.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better-understood and readily apparent to one of
35 ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 is a block diagram of a system for calibrating a pressure gauge in accordance with an embodiment of the present invention;

Figure 2 is a partial perspective view of a mobile calibration apparatus in accordance with an embodiment of the present invention;

5 Figure 3 is another partial perspective view of the mobile calibration apparatus of Figure 2;

Figure 4 is another partial perspective view of the mobile calibration apparatus of Figure 2;

Figure 5 is a front view of the mobile calibration apparatus of Figure 2;

10 Figure 6 is a top view of the mobile calibration apparatus of Figure 2; and

Figure 7 is a flow chart to illustrate a method for calibrating the pressure gauge of Figure 2.

DETAILED DESCRIPTION

15 Embodiments of the present invention can provide a system and method for calibrating a pressure gauge that is mobile, accurate in pressure calibration and prevents cross contamination.

20 The calibration system and method according to embodiments of the present invention can be used for calibrating pressure gauges with one or more hydraulic fluids. In addition, embodiments can also provide an all-purpose high static pressure source for on-site testing of inlet check valves, high-pressure relief valves, etc. In addition, proof pressure testing can be carried out to verify the structural integrity of cast component casings.

25 Embodiments of the invention can provide a calibration apparatus suitable for outdoor measurements. The mobility of the calibration apparatus can facilitate the calibration of, for example, pressure gauges at different locations.

30 Embodiments of the invention provide a calibration apparatus that can be advantageously serviced even while calibration (e.g. of a pressure gauge) is being carried out.

Embodiments of the invention can be used to calibrate, for example, a pressure gauge using a corrosive hydraulic fluid, such as Skydrol (BMS3-11).

35 Embodiments of the invention provide a calibration apparatus that can reduce manpower as well as man-hours needed for calibrating e.g. a pressure gauge, which, in turn, can reduce costs.

Figure 1 is a block diagram of a system 100 for calibrating a pressure gauge in accordance with an embodiment of the present invention.

5 The calibration system 100 consists of a hand pump 101 for pumping a hydraulic fluid to generate a predetermined pressure. The pressurised hydraulic fluid from the hand pump 101 flows out to a fluid pipe 113. The pressure generated by the hand pump 101 is controlled or limited by a relief valve 103, which is integral to the hand pump 101. The relief valve 103 is operable to relieve excess pressure by releasing the pressurised fluid through an auxiliary passage (not shown).

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The pressurized fluid from the hand pump 101 is directed to a fluid pipe 117 via a needle valve 105. The needle valve 105 regulates the flow of the pressurized fluid. The regulated hydraulic fluid from the fluid pipe 117 is also directed to a transducer 109. The transducer 109 converts the pressure variations into electrical signals that can be measured, for example, by a totalizer 111, which is electrically connected to the transducer 109 by electric cables 121. The pressure variations act on a diaphragm of the transducer 109, which converts its displacement into corresponding electrical voltages. The totalizer 111 converts the electrical voltages into corresponding pressure values. The reading on the digital display of the totalizer 111 provides a precise measurement of the predetermined pressure.

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The regulated hydraulic fluid flowing through the pipe 117 is also directed to a unit under test (UUT) 107, for example, a pressure gauge via an elongated and flexible hose 119. The flexible hose can be made of a material, such as polyethylene.

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The calibration system 100 is assembled on a mobile trolley (refer Figure 2) and moved proximate to the actual site where the pressure gauge 107 is utilized. An operator connects the distal end of the hose 119 directly to the pressure gauge 107 and the necessary calibration measurements are made. The operator takes corrective action to ensure that the predetermined pressure readings on the display of the totaliser 111 are in substantial conformity with those of the pressure gauge 107.

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Figure 2 is a partial perspective view of a mobile calibration apparatus 200 (in the direction of the hand pump 101) in accordance with an embodiment of the present invention.

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The apparatus 200 is built on a trolley 201 having wheels (not shown). The body of the trolley 201 is preferably made of stainless steel (e.g. of the type SS304) frames in order to avoid corrosion and degradation caused by hydraulic fluids. A hand pump 101 for pumping a hydraulic fluid is mounted on horizontally mounted rails 217 and affixed to the trolley 201 by e.g. a plurality of nuts and bolts (not shown). The hand pump 101 can contain sufficient volume of a hydraulic fluid and operable to generate a static pressure of up to 10,000 psi (703.07 kg/ cm²). The hydraulic fluid can be filled into a container (not shown) through an inlet (not shown). The hand pump 101 consists of a handle 205 for manually pumping the hydraulic fluid stored in the container to produce a fluid flow of a predetermined pressure.

The pressurized fluid from the hand pump 101 is controlled or limited by a relief valve 103. The relief valve 103 is operable to relieve excess pressure by releasing the pressurised fluid through an auxiliary passage (not shown). The released hydraulic fluid is collected in a stainless steel tray 219 (e.g. of the type SS304) for disposal. The pressurized fluid from the hand pump 101 is regulated and directed to an inlet of a pressure gauge 107 that needs to be calibrated (refer Figure 1) via an elongated and flexible hose 119.

A needle valve 105 attached to the end of the hand pump 101 regulates the flow of the fluid into the pressure gauge 107. The regulated fluid is also directed via a junction 218 to a transducer 109 mounted on a frame 220. The transducer 109 converts the pressure variations into electrical signals that can be measured, for example, by a totalizer 111 .

A fluid pipe 251 connects the regulated fluid from the junction 218 to a precision pressure hydraulic adjuster 250, which is mounted to the trolley 201, above the steel tray 219.

The precision pressure hydraulic adjuster 250 is the subject matter of the Singapore patent application no. 200704536-2 entitled "A Device, System And Method For Hydraulic Pressure Testing", which is incorporated herein by reference.

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The Device is a precision pressure hydraulic adjuster 250 comprising a housing; a fluid orifice extending through said housing for providing a connection to an external fluid reservoir; and an adjustment mechanism comprising a threaded section having a first end threaded into an adjustment mechanism chamber within said housing and a second end extending outwardly from said housing, and a plunger coupled to said first end of said threaded section, said threaded section extending into a fluid chamber within said housing and defining an effective volume within said fluid chamber, said fluid chamber

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having a smaller cross-sectional area than said adjustment mechanism chamber and being connected to said fluid orifice; wherein rotating said threaded section with respect to said housing provides a linear movement of said plunger in said fluid chamber to change said effective volume for adjusting and maintaining a pressure in the external
5 fluid reservoir.

The height of the trolley 201 is chosen such that the hand pump 101 may be at the waist level of an operator. In addition, the digital display of the totalizer 111 may be positioned at about the eye level of an operator for easy reading and cross-referencing with the
10 corresponding reading on the pressure gauge.

Figure 3 is another partial perspective view of the mobile calibration apparatus 200 (in the direction of the needle valve 105) showing the components adjacent to the hand pump 101 including the junction 218, the fluid pipes 117, 119, the transducer 109 etc.
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Figure 4 is another partial perspective view of the mobile calibration apparatus 200 of Figure 2 in the direction of the needle valve 105. The trolley 201 can house a plurality of calibration apparati 200 in this embodiment. The plurality of calibration apparati 200 is separated by a partition 215. A foldable cover 216 is mounted on the partition 215 and operable to cover a hand pump 200 that is not in use. Each of the calibration apparati 200
20 may be dedicated to use only a particular hydraulic fluid. Depending on the hydraulic gauge that needs to be calibrated, the hydraulic fluid can be chosen from the group consisting of Skydrol (BMS3-11), Red Oil MIL-H-83282, Lubrication Oil MIL-PRF-23699, Calibration Fluid MIL-PRF-7024, Air, Nitrogen etc.

25 Figures 5 and 6 are respectively the front and top views of the mobile calibration apparatus showing the hand pump 101, the relief valve 103, the relief valve 105, the junction 218, the fluid pipes 117, 119, the transducer 109, totalizer 111 etc.

30 The modular construction of the calibration system can also assist in the interchangeability between the hydraulic fluids used. Since the totalizer 111 is isolated from contacting any hydraulic fluids, by selectively connecting it to the transducers 109 of respective apparati 200, rapid verification may be possible. As there is no need to flush the calibration unit, cross contamination of hydraulic fluid is significantly reduced. Furthermore, the modular construction
35 of the calibration system can help in easy isolation of a faulty component thereby minimising costs.

The pressure transducers 109 used in conjunction with the totaliser 111 can provide pressure readings with an accuracy of 0.05% of full scale compared with a 1% accuracy of a unit under test of full scale. As a result, the calibration apparatus 200 can deliver pressure readings from 1 Psi (0.0703 kg / cm²) to 10,000 Psi (703.07 kg / cm²) with an accuracy of 0.01% of full scale.

In order to visually identify the hydraulic fluid used in a calibration apparatus 200, labels indicating the name of the hydraulic fluid may be appropriately affixed to the partition 215. This can assist the operators in reducing mistakes of using a wrong hydraulic fluid or using a wrong calibration apparatus 200.

Furthermore, the colour of each hose 119 used in a calibration apparatus 200 is chosen to correlate with the colour of the hydraulic fluid used. For example, a red hose may be used for a red oil (MIL-H-83282), while a yellow hose be used for Skydrol (BMS3-11). This also can assist the operators in reducing mistakes of using a wrong hose and hence prevent cross contamination.

The hydraulic fluid released from the relief valve 103 is collected in a respective stainless steel tray 219 and is then disposed.

The portability of the apparatus makes it possible to move closer to a site wherein a hydraulic gauge 107 is located, for on-site testing.

Figure 7 is a flow chart to illustrate a method for calibrating the pressure gauge of Figure 2. The method comprises a step 701 of providing a hand pump positioned on a mobile platform proximate to the pressure gauge; a step 702 of pressurizing a fluid to a predetermined pressure using the hand pump; a step 703 of regulating a fluid-flow of the pressurized fluid into a pipe system using a regulator valve, wherein the pipe system includes a transducer coupled to a totalizer and a hose for connecting the pressure gauge in fluid communication with the pipe system; a step 704 of obtaining a reference measure of fluid pressure in the pipe system from the totalizer; and a step 705 of comparing a reading of the pressure gauge with the reference measure.

In order to calibrate a unit under test (UUT), e.g. a pressure gauge, the calibration apparatus 200 is moved proximate to the location of the pressure gauge of e.g. an aircraft. The distal end of the hose 119 is connected to a pressure gauge 107. Using the

handle 205 of the hand pump 101, an operator generates a predefined hydraulic pressure, which is regulated by a needle valve 105. The regulated fluid pressure is precisely measured by the totalizer 111. As the regulated hydraulic fluid is also directed to the pressure gauge 107, a corresponding pressure reading is also reflected on the dial of the pressure gauge 107. Necessary corrective action is taken by the operator to ensure that the readings shown on the pressure gauge 107 substantially correspond with the predetermined pressure readings shown on the digital display of the totalizer 111.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A system for calibrating a pressure gauge, the system comprising:
a hand pump positioned on a mobile platform, the hand pump operable to pressurize a fluid to a predetermined pressure and the mobile platform operable to be
5 moved proximate to the pressure gauge;
a regulator valve to regulate a fluid-flow of the pressurized fluid into a pipe system, the pipe system including
a transducer coupled to a totalizer for providing a reference measure of fluid pressure in the pipe system; and
10 a hose for connecting the pressure gauge in fluid communication with the pipe system for comparing a reading of the pressure gauge with the reference measure.
2. The system as claimed in claim 1, further comprising a relief valve on a hand
15 pump side of the regulator valve for controlling the predetermined pressure.
3. The system as claimed in claim 2, wherein the mobile platform comprises a tray located below the relief valve for collecting the excess fluid for disposal.
- 20 4. The system as claimed in any one of the preceding claims, wherein the regulator valve comprises a needle valve.
5. The system as claimed in any one of the preceding claims, wherein the hand pump is operable to generate a pressure of up to 10,000 Psi (703.07 kg / cm²).
- 25 6. The system as claimed in any one of the preceding claims, comprising a plurality of hand pumps, each hand pump having an associated regulator valve and pipe system, wherein each hand pump is provided for exclusively handling one hydraulic fluid type.
- 30 7. The system as claimed in any one of the preceding claims, wherein the plurality of hand pumps and associated regulator valves and pipe systems are separated by one or more partitions.
8. The system as claimed in claim 7, wherein each partition has a label to identify
35 the hydraulic fluid used for one of the hand pumps.

9. The system as claimed in any one of the preceding claims, wherein the hose is flexible.

10. The system as claimed in any one of the preceding claims, wherein the colour of the hose is chosen to correspond with the hydraulic fluid used.

11. The system as claimed in any one of the preceding claims, wherein the hydraulic fluid is selected from a group consisting of Skydrol (BMS3-11), Red Oil MIL-H-83282, Lubrication Oil MIL-PRF-23699, Calibration Fluid MIL-PRF-7024, etc.

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12. The system as claimed in any one of the preceding claims, wherein the mobile platform is made of a corrosion resistant material.

13. A method for calibrating a pressure gauge, the method comprising the steps of:
15 providing a hand pump positioned on a mobile platform proximate to the pressure gauge;

pressurizing a fluid to a predetermined pressure using the hand pump;
regulating a fluid-flow of the pressurized fluid into a pipe system using a regulator valve, wherein the pipe system includes a transducer coupled to a totalizer and a hose
20 for connecting the pressure gauge in fluid communication with the pipe system;

obtaining a reference measure of fluid pressure in the pipe system from the totalizer; and

comparing a reading of the pressure gauge with the reference measure.

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