

Apparatus And Method For Measuring Static Pressure In An Aircraft

FIELD OF INVENTION

The invention relates broadly to an apparatus and method for measuring static pressure in an aircraft. In particular, the invention relates to an apparatus and method for measuring static pressure in an aircraft utilising vertical take-off and landing (VTOL) as well as fixed-wing aircraft.

BACKGROUND

Accurate static pressure measurements are important for maneuvering an aircraft. Figure 1 is a schematic block diagram of a conventional pitot-static system 100 of an aircraft. The pitot-static system 100 generally consists of a pitot tube 101, a static port 109, and pitot-static instruments 103, 105, 107.

An altimeter 107 measures the height of the aircraft with respect to a fixed reference level. A vertical speed indicator 105 measures the rate of ascent or descent of the aircraft.

The altimeter 107 and the vertical speed indicator 105 are operated by the aircraft's static pressure system comprising a static port 109 and an alternate static source 111. The static port 109 is an opening on the exterior of the aircraft for sensing the static pressure i.e. the atmospheric pressure at an altitude at which the aircraft is flying. The static port 109 is often a flush-mounted hole on the fuselage of an aircraft and located such that it can sense the local static pressure in a relatively undisturbed area.

An airspeed indicator 103 measures the dynamic pressure of the air through which the aircraft is flying. The airspeed indicator 103 is operated by the aircraft's static and pitot pressure system. The pitot pressure system consists of a pitot tube 101 for measuring the dynamic pressure.

Figures 2a, 2b, 2c are sketches of conventional devices used in the pitot-static system 100. Figure 2a is a simple pitot tube 201 with an opening 203 for admitting

air for dynamic pressure measurement. Figure 2b is a static source 205 comprising an opening 207 for allowing static air flow. Figure 2c is a pitot-static tube comprising an opening 211 for allowing dynamic air flow and another opening 213 for allowing static air flow.

Figure 3 is a perspective view of a conventional fixed wing unmanned aerial vehicle (UAV) 300 and Figure 4 is a perspective view of a flight control computer (FCC) board 407 used in the UAV of Figure 3. Figure 3 shows a pitot tube 305 attached to a leading edge of a wing 303 and connected to the dynamic pressure sensor 401 (Figure 4) of the FCC board 407. The FCC board 407 is embedded to the middle segment of the fuselage 301. Since the fuselage 301 is not a pressurized cabin, a static pressure sensor 403 located on the FCC board 407 is able to sense the atmospheric pressure.

Figure 5 is a perspective view of a conventional FanTail VTOL UAV 500. The FCC board 407 is integrated into the middle segment of the upper fuselage 501 sitting on a circular shroud 503. Unlike the conventional fixed-wing UAV 300, static pressure measurements are influenced by propeller down-wash 510. The propeller down-wash 510 is unsteady even at a constant throttle setting. As a result, static pressure measurements fluctuate even at a fixed flying altitude or with engine operating at a constant RPM. This causes the aerial vehicle 500 to resonate at its operating height. This phenomenon is encountered even when the aerial vehicle 500 is hovering in a gusty environment or moving at a constant height. This phenomenon also occurs when there is a change in angle of attack (AoA) or heading direction.

During flight, the air pressure is slightly different at different positions around the exterior of an aircraft. There is no position on the exterior of an aircraft at which the air pressure, for all angles of attack, is identical to the atmospheric pressure at the altitude at which the aircraft is flying. The difference in pressure causes an error in the altitude indicated on the altimeter 107, and the airspeed indicated on the airspeed indicator 103. This error is known as position error. Position errors in a pitot-static system can be extremely dangerous to the flight of the aircraft.

As explained above, position errors can be caused when the static pressure of an aircraft is different from the free-stream pressure remote to the aircraft. Therefore, it is critical to position the static port in a position where the local air pressure in flight is always equal to the pressure remote from the aircraft

Position errors can be of two types namely "fixed errors" and "variable errors". Fixed errors are errors that are specific to a particular make of an aircraft. Variable errors are caused by external factors, such as deformed panels that may obstruct the flow of air, or situations which may overstress an aircraft.

Position errors may be positive or negative, depending on factors, such as airspeed, angle of attack, aircraft weight, acceleration, aircraft configuration, and in the case of helicopters, rotor downwash.

There is thus a need to provide an apparatus and method for measuring static pressure in an aircraft that seek to address one or more of the above disadvantages.

SUMMARY

In one aspect of the present invention, there is provided a system for measuring static pressure of an aircraft comprising: a plurality of static ports mounted on the fuselage of the aircraft, wherein outputs of each of the static ports are connected to a pressure stabilizer, and the pressure stabilizer is operable to provide average pressure from the plurality of the static ports to a static pressure sensor located on a flight control computer (FCC) board of the aircraft, and wherein each of the static port comprises a static port valve comprising: a receptacle operable to be inserted into a through-hole of payload adaptor; and a valve cap co-operable with the receptacle, wherein the valve cap is operable to regulate static pressure entering into the stabilizer.

The receptacle may comprise a cylindrical head and a base, the base comprising a through-hole along its length, wherein the base is operable to be inserted into a through-hole of the payload adaptor.

The receptacle may have a through-hole and comprises an annular head with sharp edges, and a truncated conical base connected by recessed portions, wherein the annular head is operable to receive the valve cap.

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The conical base may have a 90° undercut for gripping a flexible tube, wherein the flexible tube connects the output of the static port valve to the input of the stabilizer.

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The valve cap may comprise a substantially flat head with substantially sharp edges and a cylindrical shaft, wherein the receptacle is operable to receive the shaft of the valve cap.

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The inner surface of the valve cap head and the shaft may have a plurality of channels that lack material, wherein said channels are operable to control the static pressure input. The channels may be spaced at 120°.

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The pressure stabilizer may comprise a pressure reservoir for receiving static pressure from the plurality of static port valve; and an accumulator valve positioned at the base pressure reservoir for directing the average static pressure output to the static pressure sensor located on the FCC.

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The pressure reservoir may have a cylindrical wall, a base and an annular cap, the inner surface of the cylindrical wall and the outer surface of the cap having screw-threads whereby an enclosed space is formed when the cap is fitted onto the pressure reservoir.

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The pressure reservoir may comprise a plurality of inlet ports communicating with a corresponding static port valve, wherein the inlet ports are mounted radially and at equal distance on the outer surface of the wall.

The inlet port may comprise a base and an arm, the arm comprising a truncated conical head connected by a recessed portion, wherein the head has a 90° undercut for receiving and gripping a flexible tube connecting a respective static port valve.

The base of the inlet port head may comprise internal screw-thread for receiving corresponding screw-thread on the recessed portion of the arm.

The base of the pressure reservoir may have a through-hole for receiving the accumulator valve. The accumulator valve may have a through-hole along its length, the accumulator valve comprising an annular head; and a hollow shaft, wherein adjacent to the head the shaft has a threaded portion, a recessed portion, and a truncated conical base for inserting a flexible tube, the flexible tube terminating above the static pressure sensor on the FCC board.

The system may further comprise an adaptor bar for positioning the pressure stabilizer to the FCC; and a fastener for locking the assembly of pressure reservoir, the accumulator valve and the adaptor bar.

The adaptor bar may comprise a through-hole on either side for mounting the pressure stabilizer to the FCC board; a through-hole at the center for receiving the pressure reservoir and the accumulator valve.

The adapter bar may have a recessed portion for co-operating with an oval shaped emboss on the outer surface of the base of the pressure reservoir.

The aircraft may be an unmanned aerial vehicle (UAV). The aircraft may be capable of vertical take-off and landing (VTOL). The aircraft may be a FanTail VTOL UAV. The payload adaptor may be integral to the fuselage.

In another aspect of the present invention, there is provided a method for measuring static pressure of an aircraft comprising: mounting a plurality of static ports on the fuselage of the aircraft, connecting the outputs of each of the static ports to a pressure stabilizer, providing average pressure from the plurality of the static ports to a static pressure sensor located on a flight control computer (FCC) board of the aircraft, providing a static port valve for each of the static port, inserting a receptacle into a through-hole of payload adaptor, and providing a valve cap to the receptacle for regulating static pressure entering into the stabilizer.

BRIEF DESCRIPTION OF THE DRAWINGS

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

5 Figure 1 is a schematic block diagram of a conventional pitot-static system of an aircraft;

 Figure 2a is a sketch of a conventional pitot tube;

 Figure 2b is a sketch of a conventional static source;

 Figure 2c is a sketch of a conventional pitot-static tube;

10 Figure 3 is a perspective view of a conventional fixed wing UAV;

 Figure 4 is a perspective view of a flight control computer (FCC) board used in Figure 3;

 Figure 5 is a perspective view of a conventional FanTail VTOL UAV;

 Figure 6 is a perspective view of the FanTail VTOL UAV of Figure 5 with a
15 static pressure stabilizer assembly in accordance with an embodiment of the present invention;

 Figure 7a is a perspective view of the static pressure stabilizer assembly of Figure 6 integrated into the FCC module;

 Figure 7b is a perspective view of a complete static pressure stabilizer system
20 of Figure 6;

 Figure 8 is a top view of the static pressure stabilizer assembly of Figure 6;

 Figure 9a is an exploded perspective view of a static port valve in accordance with an embodiment of the present invention;

 Figure 9b is a perspective view of the components of the static port valve of
25 Figure 9a;

 Figure 9c is another perspective view of an assembled static port valve of Figure 9a;

 Figure 10a is a perspective view of a pressure reservoir assembly in accordance with an embodiment of the present invention;

30 Figure 10b is an exploded perspective view of Figure 10a;

 Figure 11 is an exploded perspective view of a pressure reservoir and an adaptor bar used Figures 10a and 10b.

Figure 12a is a perspective view of the pressure reservoir of Figure 11 with an accumulator valve;

Figure 12b is a sectional view of the pressure reservoir of Figure 12a;

Figure 13 is a front view of Figure 7 to illustrate the flow of free-stream when an aircraft moves vertically;

Figure 14 is another front view of Figure 7 to illustrate the flow of free-stream when an aircraft moves horizontally;

Figure 15 is a partial cross-sectional view of the static port valve mounted on the payload adaptor;

Figure 16 is a cross-sectional view of the static port valve subjected to frontal free stream;

Figure 17a shows actual plots obtained using the aircraft of Figure 5 the without a static pressure stabilizer; and

Figure 17b shows actual plots obtained using the aircraft of Figure 5 with the static pressure stabilizer according to an embodiment of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention provide a plurality of static port valves positioned on the fuselage of an aircraft so that an average pressure is measured for improving the accuracy during specific flight maneuvers. The static port valves advantageously assist in collecting localized static pressure at respective positions on the fuselage while minimizing errors. The output of the static port valves are connected to a static pressure stabilizer, which accumulates all the local static pressure. Any differential pressure reading will be balanced within an enclosed space of the static stabilizer to channel the average pressure to a static pressure sensor located on the FCC board through a flexible tube

Embodiments of the present invention provide a system for measuring static pressure in an aircraft independent of airspeed, aircraft weight, acceleration, angle of attack (AoA), rotor downwash or heading direction.

Embodiments of the present invention minimize position errors by eliminating fixed errors i.e. calibrating each individual model noting that all identical models of an aircraft will have the same calibration factor.

- 5 Embodiments of the present invention provide a system for measuring static pressure that can minimize position errors by eliminating variable errors to a tolerable value by introducing static port valves and a pressure stabilizer to the existing static pressure sensor.
- 10 Embodiments of the present invention provide a system for measuring static pressure that can be deployed in both fixed-wing aircrafts and helicopters.

Embodiments of the present invention provide a system for measuring static pressure that has the flexibility to be adapted to a fuselage of any profile.

- 15 Embodiments of the present invention provide a system for measuring static pressure that can be integrated into any preferred location on the aircraft.

- Embodiments of the present invention provide a system for measuring static pressure that is adaptable to any static pressure sensor
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Figure 6 is a perspective view of the FanTail VTOL UAV of Figure 5 including a static pressure stabilizer system 700 (refer Figure 7b) in accordance with an embodiment of the present invention.

- 25 The static pressure stabilizer system 700 is integral with the circular shroud 503 and is mounted co-axially to the middle section of the upper fuselage 501. The static pressure stabilizer system 700 is integrated to the payload adaptor 605. The payload adaptor 605 has a plurality of through-holes for receiving a respective static port valve 601 or pitot 603.
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Figure 7a is a perspective view of the static pressure stabilizer system of Figure 7b integrated into the FCC module 600 located at the middle section of the upper

fuselage 501 showing static port valves 601, and a pressure reservoir 701. The static port valves 601 are connected to the pressure reservoir by flexible tubes 703. The pressure reservoir 701 is cylindrical in shape and consists of four inlet ports 705 that are mounted radially and at equal distance on the surface of the cylindrical wall 707. Each inlet port 705 is adapted to receive one end of a respective flexible tube 703. The other end of each flexible tube 703 is connected to a respective static port valve 601 so that the static port valve 601 and the pressure reservoir 701 are in fluid communication. The pressure reservoir 701 in the embodiment has four static port valves 601. An adaptor bar 750, partly seen below the pressure reservoir 701, and pillars 760 are used to mount the pressure reservoir 701 to the FCC board 407.

Figure 7b is a perspective view of a complete static pressure stabilizing system 700 comprising four sets of static port valves 601, flexible silicon tubes 703 connected to a pressure reservoir 701 that is rigidly mounted onto an adaptor bar 750.

Figure 8 is a top view of the static pressure stabilizer assembly 600 of Figure 7 clearly showing four flexible tubes 703 at an angle of 90° and connecting a respective inlet port 701 and static port valve 601. Also seen are the dynamic pressure sensor 401 and static pressure sensor 403 on the FCC board 407. One end of a flexible tube 801 connects an inner end of the pitot 603 (not shown) while the other end terminates above the dynamic pressure sensor 403. Similarly, one end of a flexible tube 730 connects the output of the pressure reservoir 701 (not shown) while the other end terminates above the static pressure sensor 401.

The pressure reservoir 701 normalizes the static pressure from the static port valves 601 by obtaining an average of pressure received from the static port valves 601. The pressure reservoir 701 also acts as a buffering reservoir to prevent sudden changes in pressure caused by abrupt movements of an aircraft.

The flexible tubes 703 enable adaption of the static pressure stabilizer system 700 to any fuselage. The pressure reservoir 701 need not be positioned at the center of the payload adaptor 605. Rather, the pressure reservoir 701 can be located away from

the center of the payload adaptor 605 or anywhere in the fuselage 503 and the length of the flexible tubes 703, 730, 801 can be appropriately altered.

The pressure reservoir 701 may not be limited to only four static port valves 601.

- 5 Accuracy of static pressure readings can be increased by increasing the number of static port valves 601. Accordingly, suitable holes are drilled at desired positions on the payload adaptor 605 to allow adaption of the static port valves 601.

- 10 The static port valve 601 is generally made of a material that is light-weighted and having chemical resistance e.g, delrin or aluminium. The flexible tubes, 703, 730, 801 may be made of soft silicon. The pressure reservoir 701 is made of delrin.

- 15 Figure 9a is an exploded perspective view of a static port valve 601 in accordance with an embodiment of the present invention. The static port valve 601 can help in eliminating errors that are induced by movements of an aircraft and rotor downwash.

- 20 The static port valve 601 consists of a valve cap 901 and a receptacle 909. The cap 901 is in form of a rivet comprising a button-shaped head 902 and a cylindrical shaft 904. The inner surfaces of the cap head 902 and the shaft 904 have three channels 903 at an angle of 120° . These channels 903 act as pressure inlet ports. The receptacle 909 has an annular head 911 and a truncated conical base 907. The head 911 and base 907 are connected by two recessed portions 906, 908. The conical base 907 helps in easy insertion of the flexible tubes 703. Furthermore the base 907 has a 90° undercut for gripping the flexible tubes 703. The head 911 of the
25 receptacle 909 has sharp inner and outer edges. Similarly, the head 902 of the cap 901 has sharp edges.

- 30 Figure 9b is a perspective view of the components of the static port valve 901 revealing the inner areas of the cap 901 and the receptacle 909. A through-hole 913 is seen at the center of the receptacle 909. This through-hole 913 has receives the shaft 904 of the cap 901. The receptacle 909 and the cap 901 are so designed that upon assembly a flat surface of the head 902 of cap 901 is flush with an outer surface of the head 911.

Figure 9c is another perspective view the receptacle 909 with the cap 901 inserted into the head 911 clearly showing the conical base 907, the actuator 901 and the head 911.

Figure 10a is a perspective view of a pressure reservoir assembly 1000 in accordance with an embodiment of the present invention. The pressure reservoir assembly 1000 consists of an accumulator valve 1001, a fastener 1003, an adaptor bar 750 and a pressure reservoir 701.

The accumulator valve 1001 helps in delivering normalized static pressure from each of the static port valves 601 to the static pressure sensor 403. The pressure reservoir 701 and the adaptor bar 750 are fastened with the fastener 1003 e.g. a nut.

The adaptor bar 750 is used for positioning the pressure reservoir 701 to the pressure sensor system on the FCC board 407. The elongate adaptor bar 750 has a pair of through-holes 1015, 1017 on either side for mounting the pressure stabilizer 1000 on the FCC board 407. The adaptor bar 750 has another through-hole 1013 (refer figure 10b) at the center for receiving the accumulator valve 1001.

When assembled, the pressure reservoir 701 forms an enclosed space with a controlled environment. The pressure reservoir 701 has a cylindrical wall 707, a flat base 1008 and an annular cap 1007. The base 1008 has a through-hole 1019 (refer Figure 10b) for receiving the accumulator valve 1001. The outer surface of the cap 1007 is flat while the inner surface has an annular ring 1010. The annular ring 1010 has screw thread on its outer surface for mating with a corresponding screw thread found on the inner surface 1103 of the base 1008.

The pressure reservoir 701 consists of four inlet ports 705 that are mounted radially and at equal distance on the outer surface of the cylindrical wall 707. The inlet port 705 has a rectangular base 1011 and a truncated conical head 1009. The base 1011 and the head 1009 are connected by a recessed portion 1012. The conical head

1009 aids in easy insertion of the respective flexible tube 703. Furthermore, the head 1009 has a 90° undercut 1014 for gripping the flexible tube 703.

Figure 10b is an exploded perspective view of the pressure stabilizer 1000 of Figure 10a showing the cap 1007 and the accumulator valve 1001. The outer surface of the base 1008 of the pressure reservoir 701 has an oval-shaped emboss 1020, around the through-hole 1019, for co-operating with a corresponding oval-shaped recessed portion 1101 (refer Figure 11) surrounding the through-hole 1013 of the adaptor bar 750. The thickness of the adaptor bar 750 is the same or more than the height of the recessed portion 1101.

Figure 11 is an exploded perspective view of the pressure reservoir 701 and adaptor bar 750 of Figures 10a and 10b. The pressure reservoir 701 is shown without the cap 1007 revealing screw threads on the inner surface 1103 of the pressure reservoir 701 for receiving the cap 1007. Through-holes 1105 connect the pressure reservoir 701 and the static ports 601. Through-hole 1019 is for receiving the accumulator valve 1001. An oval-shaped recess 1101 surrounding the through-hole 1013 aids in receiving and holding the oval-shaped emboss 1020.

The emboss 1020 protruding from the base 1008 of the pressure reservoir 701, in conjunction with the adaptor bar 750, helps in aligning and locking the pressure reservoir 701 to the pressure sensor system of the FCC board 407.

Alternatively, the stabilizer 600 can be directly mounted to the pressure sensor system of the FCC board 407, without the adaptor bar 750. In case of direct mounting, an undercut of appropriate size can be made to mate with another part of the FCC board 407.

Figure 12a is a perspective view of the pressure reservoir 701 of Figure 11 with the accumulator valve 1001 installed into the through-hole 1019.

Figure 12b is a sectional view of the pressure reservoir 701 of Figure 12a, in a direction 1200 with the accumulator valve 1001 and the cap 1007 installed into their respective positions.

5 In the embodiment, the base 1011 of the inlet port 705 and the head 1009 are shown as discrete parts. The base 1011 has internal screw-threads 1212 at its center. A recessed portion 1012 adjacent to the head 1009 also has screw-thread on its outer surface to enable installation of the head 1009 to its respective base 1011. Each of the inlet port 705 has through-holes 1201 for connecting the pressure
10 reservoir 701 with respective static port valve 601.

The accumulator valve 1001 is in the form of a hollow-bolt having a through-hole 1203. The accumulator valve 1001 consists of a head 1213 and a hollow shaft. Adjacent to the head 1213, the shaft has a threaded portion 1030, a recessed
15 portion 1207 and a truncated conical base 1209. The base 1209 aids in easy insertion of the flexible tube 730 that terminates above the static pressure sensor 403.

In order to assemble the static pressure stabilizer 700, the static port valves 601 are
20 inserted into respective through-holes on the payload adaptor 605. One end of a flexible tube 801 is inserted and positioned to the output of the pitot 603.

Meanwhile, the accumulator valve 1001 is inserted and positioned into the through-hole 1019 of the pressure reservoir 701 and the cap 1007 is fitted onto the pressure
25 reservoir 701 to form an enclosed space. The conical head 1009 is inserted and positioned into the respective base 1011 of the inlet port 705. The adaptor bar 750 is fitted to the pressure reservoir 701 such that the embossing 1020 of the base 1008 mates with the recessed portion 1101 on the adaptor bar 750. A fastener 1003 locks the adaptor bar 750 and the pressure reservoir 701.

30 One end of each of the flexible tubes 703 is inserted and positioned on the respective head 1009. Similarly, one end of the flexible tubes 730 is inserted and positioned on the accumulator valve 1001.

The assembly of the pressure reservoir 701 and the adaptor bar 750 with the flexible tubes 703, 730 is positioned and fastened to the FCC board 407.

- 5 The other end of each flexible tube 703 is inserted and positioned to the respective heads 907 of the static port valve 601.

The other end of the flexible tube 730 is bent and positioned above the static pressure sensor 403 of the FCC board 407. Likewise, the other end of the flexible tube 801 is bent and positioned above the dynamic pressure sensor 403 of the FCC board 407.

Figure 13 is a front view of Figure 7 to illustrate the flow of free-stream when an aircraft moves vertically i.e. in a direction 1301. As the aircraft moves in the direction of 1301, an induced free-stream 1303 flows around the skirting of the static port valve 601 instead of ingesting into the static port valve 601. If the aircraft moves downwards, the induced free-stream 1303 flows in the opposite direction. This helps in achieving accurate static pressure measurements during upward and downward movement of the aircraft.

20 Figure 14 is a front view of Figure 7 to illustrate the flow of free-stream when an aircraft moves horizontally i.e. in a direction 1401. As the aircraft moves in the direction of 1401, an induced free-stream 1403 flows around the skirting of the static port valves 601 instead of ingesting into the static port valve 601. This helps in achieving accurate static pressure measurements during horizontal movement of the aircraft.

30 Figure 15 is a partial cross-sectional view of the static port valve 601 mounted on the pay-load adaptor 605 to illustrate the flow of free-stream 1503 in a direction 1501. As the free-stream 1503 flows past the head 911 of the static port valve 601, most of it flows around the skirting of the static port valves 601. A portion of the free-stream 1503 e.g. at an entry position 1505, may flow over the flat surface of the actuator 901 of the static port valve 601. Under normal circumstances, the pressure above

entry position 1505 of static port valve 601 will reduce, causing a vacuum effect over the cap opening, thus introducing error into the system. In order to prevent this phenomenon, the inner and outer edges of the receptacle head 911 and the cap 901 have sharp edges to retard flow of free-stream over the static port valve opening.

5 The sharp edges induce a separating flow of free-stream at the entry position 1505. This helps in minimizing the errors induced by the fast moving free stream over the entry position of the static port valves.

When the static port 601 is subjected to rotor downwash, a similar phenomenon as explained in Figure 15 will be encountered. The sharp edges of the head 911 and anchor 901 can assist in inducing a separating flow of free-stream at the entry position 1505 of the static port valve 601 whereby accurate static pressure measurements are possible during rotor downwash.

15 Figure 16 is a cross-sectional view of the static port valve of Figure 15 to illustrate the effect of frontal pressure on the static port valve 601. Often, a static port valve 601 may be subjected to direct frontal free-stream 1601 whereby the valve cap 901 may completely block the through-hole 913 causing positional error. To minimize such errors, the inner surfaces of the cap head 902 and the shaft 904 have three channels 903 that are at an angle of 120° . Since the free-stream 1603 bends twice at 90° before reaching the flexible tube 703, the pressure build-up because of orientation of the free-stream can be reduced thereby increasing the accuracy of static pressure measurements. This deficiency is further compensated by pressure obtained at the remaining static port valves which is not subjected to the frontal pressure buildup.

Figure 17a shows the actual plots obtained without the static pressure stabilizer 700. The data was collected at 0.6m altitude as indicated by the chart 1701. Depending on the rotation speed (RPM) of the rotor of the engine (as per chart 1703), the propeller downwash or suction also varies (as per chart 1705). As seen in the plot, an error in the height (between 15m to 22.5m) was recorded. This demonstrates the negative impact of propeller downwash 510 on a conventional static pressure sensor 401.

Figure 17b shows the actual plots obtained with the static pressure stabilizer 700 of the present invention. The data was again conducted at 0.6m altitude as indicated by the chart 1707. For various rotation speeds (RPM) of the rotor (as per chart 1709), the rotor downwash or suction was measured (as per chart 1711). It can be clearly seen that the error in static pressure is reduced sharply within a resolution of $\pm 1\text{m}$. This can be a breakthrough in measuring static pressure under adverse conditions. Accurate measurement of data can assist in deciding the appropriate location of the static ports on the fuselage.

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 scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

For instance, the static pressure stabilizer 700 can comprise components that are integrally made. The pressure reservoir 701 comprising, the base 1008, the wall 70, the cap 1007 and the inlet ports can be integrally made. The payload adaptor 605 can be tailored to match the shape of the fuselage.

The number of the static port valves 601 can be altered with appropriate provisions made on the payload adaptor 605 for insertion of the static port valve 601.

The number of the channels 903 can be more than three.

CLAIMS

1. A system for measuring static pressure of an aircraft comprising:
a plurality of static ports mounted on the fuselage of the aircraft, wherein
5 outputs of each of the static ports are connected to a pressure stabilizer, and
the pressure stabilizer is operable to provide average pressure from the
plurality of the static ports to a static pressure sensor located on a flight control
computer (FCC) board of the aircraft, and
wherein each of the static port comprises a static port valve comprising:
10 a receptacle operable to be inserted into a through-hole of payload adaptor;
and
a valve cap co-operable with the receptacle, wherein the valve cap is
operable to regulate static pressure entering into the stabilizer.
- 15 2. The system of claim 1, wherein the receptacle comprises a cylindrical head
and a base, the base comprising a through-hole along its length, wherein the base is
operable to be inserted into a through-hole of the payload adaptor.
3. The system according to claim 1 or 2, wherein the receptacle has a through-
20 hole and comprises an annular head with sharp edges, and a truncated conical base
connected by recessed portions, wherein the annular head is operable to receive the
valve cap.
4. The system according to claims 1, 2 or 3, wherein the conical base has a 90°
25 undercut for gripping a flexible tube, wherein the flexible tube connects the output of
the static port valve to the input of the stabilizer.
5. The system according to any one of the preceding claims, wherein the valve
cap comprises a substantially flat head with substantially sharp edges and a
30 cylindrical shaft, wherein the receptacle is operable to receive the shaft of the valve
cap.

6. The system according to any one of the preceding claims, wherein the inner surface of the valve cap head and the shaft have a plurality of channels that lack material, wherein said channels are operable to control the static pressure input.

5 7. The system according to claim 6, wherein the channels are spaced at 120°.

8. The system according to any one of the preceding claims, wherein the pressure stabilizer comprises:

10 a pressure reservoir for receiving static pressure from the plurality of static port valve; and

an accumulator valve positioned at the base pressure reservoir for directing the average static pressure output to the static pressure sensor located on the FCC.

15 9. The system according to claim 8, wherein the pressure reservoir has a cylindrical wall, a base and an annular cap, the inner surface of the cylindrical wall and the outer surface of the cap having screw-threads whereby a enclosed space is formed when the cap is fitted onto the pressure reservoir.

20 10. The system according to claim 9, wherein the pressure reservoir comprises a plurality of inlet ports communicating with a corresponding static port valve, wherein the inlet ports are mounted radially and at equal distance on the outer surface of the wall.

25 11. The system according to claim 10, wherein the inlet port comprises a base and an arm, the arm comprising a truncated conical head connected by a recessed portion, wherein the head has a 90° undercut for receiving and gripping a flexible tube connecting a respective static port valve.

30 12. The system according to claim 11, wherein the base of the inlet port head comprises internal screw-thread for receiving corresponding screw-thread on the recessed portion of the arm.

13. The system according to any one of claims 8 to 12, wherein the base of the pressure reservoir has a through-hole for receiving the accumulator valve.

14. The system according to claim any one of claims 8 to 13, wherein the accumulator valve has a through-hole along its length, the accumulator valve comprising:

an annular head; and

a hollow shaft, wherein adjacent to the head the shaft has a threaded portion, a recessed portion, and a truncated conical base for inserting a flexible tube, the flexible tube terminating above the static pressure sensor on the FCC board.

15. The system according to claim any one of claims 8 to 14, further comprising:

an adaptor bar for positioning the pressure stabilizer to the FCC; and

a fastener for locking the assembly of pressure reservoir, the accumulator valve and the adaptor bar.

16. The system according to claim 15, wherein the adaptor bar comprises:

a through-hole on either side for mounting the pressure stabilizer to the FCC board;

a through-hole at the center for receiving the pressure reservoir and the accumulator valve.

17. The system according to claim 15 or 16, wherein the adapter bar has a recessed portion for co-operating with an oval shaped emboss on the outer surface of the base of the pressure reservoir.

18. The system according to any one of the preceding claims, wherein the aircraft is an unmanned aerial vehicle (UAV).

19. The system according to any one of the preceding claims, wherein the aircraft is capable of vertical take-off and landing (VTOL).

20. The system according to any one of the preceding claims, wherein the aircraft is a FanTail VTOL UAV.

21. The system according to any one of the preceding claims, wherein the
5 payload adaptor is integral to the fuselage.

22. A method for measuring static pressure of an aircraft comprising:
mounting a plurality of static ports on the fuselage of the aircraft,
connecting the outputs of each of the static ports to a pressure stabilizer,
10 providing average pressure from the plurality of the static ports to a static
pressure sensor located on a flight control computer (FCC) board of the aircraft,
providing a static port valve for each of the static port,
inserting a receptacle into a through-hole of payload adaptor, and
providing a valve cap to the receptacle for regulating static pressure entering
15 into the stabilizer.

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