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Standard instructions for leak testing the instrument system of sailplanes equipped with winter instruments. Technical bulletins No. 3/81

Leak test of the instrumentation of sailplanes

Preliminary remark:

These standard instructions are used to test for leaks in an instrument system consisting of winter devices. Since the system is designed by the respective aircraft manufacturer, its relevant instructions must be observed, whereby these standard instructions can serve as a supplement.

Leaks in the instrument system can seriously impair the display accuracy of the instruments or lead to a complete malfunction. It is therefore essential to check for leaks after every instrument installation or modification. It should also be carried out at least once a year.

Leaks in the air supply system of an instrument system can lead to persistent false reports or even to the complete failure of several aircraft instruments. One can imagine that this can lead to very uncomfortable, and under certain circumstances, dangerous situations. This is avoidable. - In the following, the measures to test an instrument system for leaks - especially using the example of a sailplane instrumentation - are to be described, although this has already happened several times in other places (see references).

The hoses that connect the aircraft instruments to one another and to the pressure tapping points should ideally be short and straight. Of course, this cannot be done strictly; however, sharp bends or kinks should be avoided when laying the hoses. The hoses are pushed several centimeters over the connecting nipples; If a PVC hose is pulled off once, it is advisable to shorten it by this piece before re-attaching it.

During the tightness tests, an overpressure or under pressure is created in the systems to be tested, which must then remain constant for several minutes with the pipes closed. A change in pressure would indicate a leak. A suitable pressure gauge is available in the form of the airspeed indicator in every aircraft.

The lines and devices for static pressure, total pressure (= "measuring pressure" for the airspeed indicator) and the pressure supplied by a compensation nozzle (hereinafter referred to as "nozzle pressure" for short) are each checked separately.

I. Check the static pressure lines with all connected instruments

Instruments connected to the static pressure can be airspeed meters, altimeters, variometers with membrane compensators, electrically compensated variometers and uncompensated variometers. With devices that are connected to the static pressure, leaks during flight are not noticeable in a drastic way, since in gliders the pressure in the fuselage and cabin differs only slightly from the static pressure in the outside air. One should not conclude from this, however, that a leak test is therefore unnecessary here. The most important instruments for flight safety are affected, namely the airspeed indicator and altimeter, the reliable functioning of which must be guaranteed in any case. In the event of a leak, unreliable large errors in the speed and altitude display could not be ruled out.

The leak test is carried out step by step.

Step 1: The openings for the static pressure reduction (on the outside of the aircraft) are closed, for example taped airtight with an adhesive strip.

Step 2: A branch piece with three connections (T-piece) is installed in the line for static pressure, whereby it is immaterial at which point this occurs. A hose line S is plugged into the free connection of the T-piece (see Figure 1a).

Step 3: The air is slowly sucked out through the hose S. It is advantageous if an aquarium air pump with a suction air connection and a fine metering valve is available for this. If necessary, suction can also be done with the mouth. –

Here, as with the following tests, it should always be noted that abrupt pressure changes can have a very damaging effect on the instruments. Orifice plate variometers, whose highly sensitive measuring mechanism can become completely inoperable due to sudden pressure surges, are particularly at risk. It is therefore very advisable to connect a connecting piece with a cross-sectional constriction to be on the safe side. (Capillaries or the "disposable cannulas" available in pharmacies are suitable.)

Attention: If a Variometer is connected to the static pressure, its display must not go beyond the full scale during the leak test!

Step 4: While the air in the static pressure lines is slowly sucked out, watch the airspeed indicator rise. At 150 km / h or another significant speed, the hose S is closed (for example, pinched off with flat-nose pliers). If the system is tight, the airspeed indicator must now remain constant for a long time. To be sure, wait at least 2 to 3 minutes. A leak becomes noticeable when the display goes back more or less quickly.

Step 5: The air is slowly let in again via the hose S. It should be noted that an abrupt increase in pressure is just as damaging to the instruments as an abrupt drop in pressure. What was said under step 3 applies here accordingly. If the system has proven to be tight, the original state is restored, i.e. the closed openings are opened again and the T-piece removed.

If a leak has been found, the task is to locate the source of the error. To do this, the lines are pulled off at various points and the free end of the line is hermetically sealed. This can be done with a suitable plug or by attaching a T-piece in which two connections are connected by a piece of hose. (Clamping with flat-nose pliers would also work). However, this seems less advisable here as the hose lines could be damaged. Steps 3 to 5 of the leak test must then be repeated in each case.

Figures 1a and 1b illustrate the method of searching for a source of error. If a leak was found in the case of Figure 1a, you can first check the airspeed indicator for leaks by pulling off the hose line at point A and attaching the hose S directly to the (static pressure) connection of the airspeed indicator.

If the airspeed indicator proves to be tight, the next step is to loosen the hose connection at point 8 and close it airtight (see Figure 1b). If the leak is now found, the leak must be at the altimeter. Otherwise, the static pressure acceptance points and the connecting lines are possible sources of error. With a systematic approach, the leak can probably be clearly identified after a few more attempts.

II. Checks the lines for the total pressure with all connected instruments

The procedure is basically the same as when testing the static pressure system. So this case can be dealt with briefly here. In addition to the airspeed indicator, speed-to-fly Variometer, speed-to-flyer, electrically compensated Variometer and membrane compensator are connected to the total pressure. In order to get a positive deflection of the airspeed indicator, however, the air must not be sucked out, but an overpressure must be created by (carefully!) Blowing in. The individual steps are summarized again briefly:

Step 1: The total pressure decrease (pitot tube) is closed. In Figure 2 it was assumed that, in addition to the airspeed indicator, a speed-to-fly Variometer is also connected to the total pressure. The system cannot then be leak-proof, as the air would flow off via the capillary of the speed-to-fly Variometer. You therefore loosen the hose line at point C ("Variometer-side") and seal it airtight.

Step 2: A T-piece is installed in the overall pressure line and a hose line is attached to the free connection.

Step 3: It is carefully blown into the hose. Sudden changes in pressure must be avoided.

Step 4: If the airspeed indicator shows 150 km / h or another significant speed, the hose is closed. If the system is tight, the airspeed indicator display must remain constant for at least 2 to 3 minutes.

Step 5: The hose line is carefully opened again so that the overpressure is slowly released.

In the event of a leak, a systematic search for the source of the error is carried out as in the testing of the static pressure system.

III. Check the lines for the "nozzle pressure" with all connected instruments.

Today, variometers are usually connected to a compensation nozzle for total energy compensation. It supplies a negative pressure that is present in the Variometer housing as well as in the expansion tank and in the connecting lines.

As a result of the suction effect of the negative pressure, nozzle-compensated variometers react more sensitively to leaks than conventional uncompensated devices that are connected to the static pressure. If, for example, there is a leak between the Variometer and the expansion tank, the result is that the Variometer displays "Climb" immediately after take-off and remains in the climbing area during the entire flight. (Unfortunately, such an "optimistic" Variometer display can in no way have a positive effect on glider performance)

In the tests described so far, the airspeed indicator played a double role. On the one hand, it was a test object that was examined for leaks; on the other hand, it served as a pressure measuring device that made the tests described possible in the first place. If it has been found in tests I and II that it does not have any leaks, it can now be used specifically as a pressure measuring device. It is even better if another airspeed indicator is available so that the connections of the built-in airspeed indicator no longer have to be disconnected. Otherwise, the test is basically the same as the previous one.

Step 1: The compensation nozzle is sealed. The speed-to-fly capillary is removed at point D ("total pressure side") and sealed airtight.

Step 2: A branching piece with four connections (cross piece) is now installed at any point in the "nozzle line". One of the free connections of the cross piece is connected to the measuring pressure of an airspeed indicator; A hose line is attached to the other connection of the cross piece (see Fig. 3).

Step 3: It is carefully blown into the hose. The change in pressure must take place so slowly that the Variometer display does not go over full deflection.

Step 4: If the airspeed indicator shows 150 km / h or another significant speed, the hose is closed. After about 2 to 3 minutes you can decide whether the system is tight.

Step 5: The overpressure is slowly reduced again. If there is a leak, the search for the source of the error proceeds in the known manner.

If all systems have proven to be tight, the test is over. You now have the guarantee that incorrect displays and functional failures of the instruments caused by leaks will very probably not occur during the flight.

The tightness tests should be carried out whenever a change has been made to the instrument system, i.e. after every instrument installation or modification. In addition, the tests should be carried out at least once a year, ideally during the annual inspection of the glider.

Literature:

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- *I. Westerboer, The optimal instrument panel, Luftsport 6/1977*
- *Gebr. Winter GmbH & Co., KG Standard instructions for the leak test of the instrument system, January 1978 edition*