Sailplane Instrument Installation and leak checking

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In order to obtain the best possible performance from your sailplane instruments it is essential that the installation be done correctly and be free of leaks.

A few simple installation rules are:

1. Use good quality tubing (Tygon brand is highly recommended) to connect the instruments.

2. DO NOT use very soft wall tubing for the Total energy line and make sure this line is well secured so that it cannot move under changing G loads due to manouevering and/or turbulence. This will prevent spurious transient signals on the vario caused by volume and hence pressure changes in this line. Long lengths of tubing should be of the less flexible plastic or rigid nylon pressure hose. This prevents problems with the sudden static pressure changes in the fuselage during zoom or pushover causing weird transients in the T.E. vario readings due to these pressure changes being transmitted through soft tubing in the T.E. line. Any soft wall gust filter bottles should be removed and disposed of for the same reasons.

3. All tubing must be in good condition and should be a very tight press fit over the fitting to avoid air leaks. Even a small air leak will compromise any variometer's performance. For extra insurance against air leaks we supply small, thick walled elastic 'donuts' which you may install over tubing several inches past the end. After the tubing is properly attached to the fitting on the instrument, slide the 'donut' back toward the end of the tube so that it supplies extra squeeze around the tubing/fitting area. You can use two on the TE line connections. Short lengths of thick wall silicone tubing may be used instead of the 'donuts'.

4. Do not use electronic type nylon cable ties or twisted wire on tubing fittings as this will almost certainly guarantee a leak.

5. Unless all the varios connected to the TE line are of the pressure transducer type, split the line as close to the TE probe as possible. This minimises interaction between the instruments caused by flow in the line from variometers which use capacity flasks and also prevents the pressure transducer vario response from being slowed by the presence of the flask causing a pneumatic low pass filter to be formed. In practice, placing the T piece under the seat near the rear of the seat area is good enough.
The most common mistake in variometer installations is to connect two vario systems to one Total Energy line with a T-piece at the instrument panel. The only time that this is permissible is when both instruments are of the pressure transducer type. That is, no flasks hence no flow. Flow sensor type instruments cause significant flows in the line to the T.E. probe and these flows can cause

instruments to interact with each other or with a pressure transducer type variometer causing unwanted transient indications and/or a general slowing of the response of both instruments connected to the T.E. probe.

6. DO NOT place restrictors or gust filters in the T.E. line and then split the line to two vario systems. Place a separate restrictor or gust filter in each line to the separate vario systems if you feel they are necessary. Try also to ensure that there is no excessive flow resistance in the T.E. probe mount or in the probe itself. Most modern electronic variometers convert the pneumatic signals to electronic signals and do any required filtering in the electronics so gust filter bottles and/or restrictors are generally unnecessary with these.
If a paper element filter (motorbike gasoline filter)is installed in the TE line the filter body MUST BE EXTREMELY RIGID otherwise the static pressure changes during a pullup will cause spurious variometer readings.

7. Providing a good T.E. source is very important.
The most common Total Energy probe in use is the modified Irving type. This type of probe is a simple 6mm or 1/4 inch diameter tube bent so the last 3 inches or 80mm or so is inclined to the airflow at 20 degrees forward of a right angle with two small holes 40 to 60 degrees apart at the back of the tube, a little more than 1.5 tube diameters from the end.
The Irving type probe, correctly manufactured, will provide satisfactory total energy and it is strongly recommended that any other type probe be replaced with one of this type. Irving type probes in aluminium alloy can be obtained from BORGELT INSTRUMENTS.

8. Electronic sailplane instruments will benefit from clean, noise and interruption free 12 volt power. A fuse should be mounted on the battery as close as possible to the positive terminal. Any wire between the battery terminal and the fuse is not protected by the fuse and care should be taken to double insulate this wire. Use a good quality polarised battery connector. It is important that it be polarised to prevent reverse polarity connection of the battery which is likely to cause expensive damage to radios and instruments. Borgelt varios are fitted with reverse polarity protection but it is not a good idea to test this. Power switches and fuses to individual services should be of high quality industrial type not cheap consumer grade. It is highly recommended to use mil spec aircraft wire for all power hook ups. Use heavy (16 gauge or larger) wire for power to the radio and transponder. It is also a good idea to run a separate high power buss (including ground) for these and another buss for the variometers and GPS. This will help prevent electrical noise and RF from feeding into sensitive instruments. A common cause of low voltage being delivered to instruments and causing poor performance is high resistance fuses and holders. Use a digital voltmeter to check the voltage at the battery and at the back of the instrument with the instrument switched on. If there is more than 0.2 volts difference find the cause and eliminate it.
Check that the coax from the radio and transponder is terminated correctly at the

BNC connector. The glider factories have been known to get this wrong. There is a correct method for stripping the outer cover, braid and inner insulator which can usually be obtained from the connector manufacturer. There is also a potential problem in older gliders where the dielectric in the coax may have deteriorated or connectors may be corroded. In some gliders with carbon fuselage and fin the antenna is in the fibreglass rudder and a connector is provided so that the rudder may be removed for maintenance. This connector is not usually waterproofed and is very vulnerable to corrosion and damage to the coax.

Leak check the system following installation.
In the glider there is a sensitive pressure gauge in the form of the Air Speed indicator. This can be used to detect any leaks in the instrument tubing, instruments and sailplane pitot, static and total energy systems.

You will need the following:

A large 60ml plastic syringe(vet supply houses)

A laboratory type hose clamp

A T piece to fit the glider instrument tubing

An instrument tubing joiner

Some spare instrument tubing

Smooth jaw long nose pliers

NOTE: All leak testing must be carried out at reasonably constant temperature in shade. If the temperature is changing it will be impossible to obtain steady pressures, likewise solar radiation will cause pressure changes in sealed systems. Also turn off any electronic instruments particularly thermistor or hot wire flow sensor variometers.
WARNING: All pressure changes should be made very slowly to avoid damage to instruments. Make sure tubing cannot slip off connections causing sudden pressure changes.

First check the ASI for leaks.
Connect the syringe to the ASI pitot connection with a length of tubing.
Gently increase the pressure so that the ASI reads 100 knots or so and then clamp off the tubing between the syringe and the instrument. The ASI reading should remain steady over at least one minute. You can GENTLY tap the case in the event that friction masks small leaks. Remove the clamp and slowly reduce the ASI reading to zero. Repeat this test with the syringe connected to ASI static but this time reduce the pressure until the ASI reads 100 knots or so and then clamp the line. If the ASI fails these tests, have the instrument overhauled and/or repaired.

Now you are ready to check the rest of the sailplane system.

The static system should be checked under pressure and also under suction.
Block the static ports of the glider with white wing sealing tape.
Use a T piece to plumb the syringe into the static side of the ASI and slowly reduce the pressure until the ASI reads 100 knots. Clamp off the line to the syringe and check that the ASI reading remains steady for one minute, gently tapping the case if necessary. Remove the clamp, reduce the ASI reading to zero, remove the tubing from the static connection of the ASI and attach it to the pitot connection and repeat the test but this time under positive pressure.
If the ASI reading does not remain steady use the long nose pliers to clamp off the tubing at various places until the leak is isolated. Leaks may be caused by case leaks in an instrument, internal leaks in an instrument, T pieces, joiners and at the skin of the glider where the static/pitot port pickups are glued to the skin. Leaks may also be caused by tubing which has gone hard and no longer provides clamping force on a fitting. Borgelt Instruments provides and recommends rubber rings to slip over tubing where it fits over fittings. These continue to provide clamping force even when the tubing does not.
The Pitot system should be checked under positive pressure. Block the pitot port and plumb the syringe into the ASI pitot line(or connect it to the pitot tube) and check that a constant reading is maintained with the syringe clamped off at about 100 KTS IAS.
The Total Energy system should be checked under suction(negative pressure) as this is how it functions in flight. Plumb the static side of the ASI into the TE line, block the holes in the TE probe with white wing tape and gently apply suction using the syringe. Clamp at 100 knots on the ASI and check for a steady reading for one minute. Leaks may be isolated using the long nose pliers to clamp tubing in various places until the leak stops.
CAUTION: Mechanical variometers in particular are very delicate devices and are easily damaged by very rapid pressure changes. Ensure that all pressure changes are achieved slowly without the instruments hitting their stops.

NOTE:
With some computer type variometers you will find large leaks in the pitot and static systems as some instruments of this type use a flow sensor in series with a capillary leak to measure airspeed. It is important however to ensure that the remainder of the pitot and static systems in the glider do not have leaks as these other leaks may introduce large errors into the airspeed as measured by these instruments resulting in very poor performance of netto variometers, speed to fly indicators and large errors in measured True Airspeed for wind calculation and navigation purposes.
If leaks persist despite using good tubing and T pieces without excessive mold flashing you can assemble the tube and fitting using a little Permatex Aviation Form-A-Gasket No.3 Non Hardening sealing compound. DO NOT USE Silicone RTV as the fumes given off during cure may seriously corrode internal parts of instruments.

Case leaks and internal leaks in instruments should be referred to the manufacturer or agent for rectification.

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