Inter thermal speed to fly, speed rings and speed command instruments.

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We occasionally receive requests for a speed ring to be fitted to the B400 vario in installations where there is no computer type vario with a speed command zero reader function or indicator.

A speed ring was not a design consideration for the B400 for the following reasons:

- **It encourages too much looking at the vario. Your time and attention are better spent on other things.**
- **The mechanical design of the B400 would be greatly complicated.**
- **There isn't a great demand for this feature.**
- **Anyway, it isn't that important to fly precisely at the optimum speed all the time.**
- **If it was you can be sure that some contest pilots would be doing it and winning every day.**
  Most contest results show that few pilots win every day, at least in higher level contests.

More on the last point:

Early in the 1980's a German group looked at how well pilots followed the speed command type vario and how close they were to the optimum speed at all times. The surprising answers were - not very well and hardly ever were the pilots flying at close to the optimum speed. Even more surprising was that it didn't matter whether the pilots were World contest standard or cross country beginners - they were all about equally hopeless.

The group then did some fancy mathematical analysis of what happens when gliders fly through lift and sink and came up with the optimum strategy for flying through a thermal that you aren't going to circle in. As you enter lift, increase speed, then as you fly through the best lift execute an approximately 6.5 G pullup then lower the nose, increase speed again until you fly out of the lift then resume inter thermal cruise according to the classic Macready theory.

This method isn't actually workable in the real world as the gains are very sensitive to where the 6.5 G pullup is executed and it is not possible to tell where the best lift is until after you have flown through it.

The gains in cross country speed over the classic Macready theory are of the order of 3 to 5% so the group tried to find a method that was almost as good and which was actually workable in the real world.

It turned out to be very simple - for the "fly through a thermal you aren't going to circle in" case just maintain a constant attitude through the thermal. Only vary the speed according to the classic Macready theory over time periods of 10 to 15 seconds. This time is actually half the stick free phugoid period.

The result is gains in cross country speed of 70 to 80% of the gain by the "optimum", not possible in the real world, method - i.e. 2.5 to 4% over the attempt to fly the classic second by second Macready theory.

There are some large advantages to this method - it requires very low pilot workload giving you much more time to look out at clouds, birds, other gliders etc. This may let you actually spot the next thermal instead of missing it and may even save your life by letting you see conflicting traffic!

The ride is much smoother than that achieved by always pushing and pulling on the stick.

If you are prone to airsickness this is a huge benefit and you can have the relatively smooth ride secure in the knowledge that you are doing close to the optimum thing.

Due to the low workload you have more time to think which might lead to better decisions.

Lastly, not deflecting the control surfaces excessively and not pulling high G loads is good for the performance of the glider.

For this reason we feel that not allowing for a speed ring on the B400 or the B40 was a reasonable decision.

For B400 only installations a small table of optimum speeds vs expected rate of climb is all you need. This method is advocated by 4 times World Champion Ingo Renner. As you don't need to be changing speed all the time you can select an appropriate cruising speed and just vary it smoothly when larger areas of lift and sink are encountered.

On the B500 vario, which has a speed command zero reader (a series of blue and amber LEDs in the pointer scale) and audio speed command, this function has a significantly longer time constant(slower response)than the variometer signal going into it so violent manoeuvers to keep the pointer approximately centered are not commanded or required. There are only two LEDs for faster and slower. No LEDs lit means you are within about 5 knots of the correct speed which is completely adequate for optimum performance.