

DON'T HIT ME !! - Thoughts about warning markings on gliders

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Foto: Tobias Barth

The purpose of color warning markings on gliders is primarily to prevent possible collisions. In the case of gliders, this risk exists especially because gliders often fly close together upwind and en route. Statistically, many gliders involved in collisions have been within sight of each other for quite some time beforehand.

So how can such warning markings help us?

Recognition - Visibility - Conspicuousness

Most pilots immediately understand what is meant by the terms "visibility" and "conspicuity" in this context. It is about the property of an object to attract attention, even if it is not actively searched for.

Unfortunately, in many discussions this is often confused with "detectability" in the sense of "recognizable at long distances" - this has perhaps also led to the prejudice that color warning markings are useless or even reduce visibility.

Therefore, these terms will be examined a little more closely below:

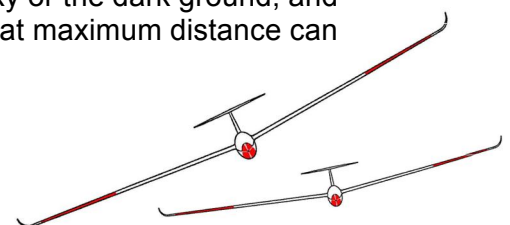
Recognizability at long distances

So let us first consider how we can detect an object (e.g. a glider) at the greatest possible distance.

At maximum distance, only a very small dot is perceived - as small as the proverbial mosquito on the windshield.

The pilot initially sees this dot only through the contrast it has with its surroundings and cannot yet assign a color to it.

In flight, this point is perceived either against the usually bright sky or the dark ground, and from this the optimal color scheme for best possible detectability at maximum distance can be derived:



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The aircraft would have to be as dark as possible (= black) if it is observed against the sky, or it should be as bright as possible (= white) if it is to be detected against the dark ground (and if there is not snow...).

This is exactly the reason why most military aircraft today are painted in medium shades of gray, because then the contrast is lowest on average and thus the detectability at long distances is minimal (which is the purpose of camouflage painting).

Studies that look at detectability at maximum distance therefore easily conclude that warning markings would have no advantage. A well-known example of this is the extensive study¹ conducted by Cranfield University in the United Kingdom, in cooperation with the Royal Air Force and the Royal Flying Cadets.

In this study, Royal Flying Cadets motor gliders with various warning markings were operated on converging courses under a random scheme and the distance at which initial detection was possible was determined. Consistent with the above, it was found that colored warning markings did not provide increased recognition distance, while a black painted underside proved beneficial.

This study was also cited as an essential part in the 2004 study "BEKLAS" (Detectability of Gliders and Small Motorized Aircraft)². Apparently, the effectiveness of warning markings was also defined there primarily in terms of the achievable detection distance.

Both studies also describe the possible danger that the design of individual parts of an aircraft in different colors could reduce the recognizability at long distances, since this would break up the outline.

However, it remains to be stated that recognizability at long distances is primarily a safety issue for the glider pilot if the danger from collisions with other fast-flying aircraft is to be reduced.

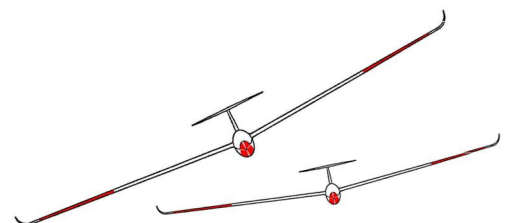
The crucial question, however, is:

What is the biggest collision hazard for us in gliding?

The sad and unpopular answer is quite clear: ...it is ourselves!!

If you look at the reports on collisions with gliders published by the BFU³ (Federal Bureau for Aircraft Accident Investigation), you will find a clear focus on such accidents when flying together in thermals or on slopes, or when entering or leaving the respective upwind zones. This is also in line with the own experience of every cross-country glider pilot, that every now and then a glider "suddenly was very close" or "all of a sudden the FLARM beeped" or "all of a sudden I didn't see the other one in the circle anymore, although he was still there". This experience of many pilots is (unfortunately or maybe fortunately?) not reflected much in the statistics of official bodies, because we almost never report such close encounters as dangerous incidents - the problem only becomes visible when evaluating the accident statistics of actual collisions.

A possible solution to the problem of this risk of collision between gliders has now become widely known and established in Europe with over 35,000 installations: the FLARM⁴ collision warning device.



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Today, it is hardly necessary to explain the principle or the use of FLARM to a glider pilot. Many of us no longer want to do without this additional information in the cockpit, and some of us may have reacted correctly at the decisive moment thanks to FLARM and thus prevented something worse. However, the problem remains that despite airspace observation or FLARM, a glider in the vicinity does not immediately "catch our eye" during decisive flight segments. This means that valuable seconds pass before we recognize the other aircraft and before we can initiate the necessary evasive action.

And this is exactly where warning markings come into play as an important element!

Visibility & conspicuity when flying together

Each of us knows the following scenarios:

- All the gliders are circling under the cloud, and in the cloud shadow and light haze the other gliders just look kind of gray.
- Against the contrasting background (varied landscape, such as in the mountains) the other glider hardly stands out.
- Or the opposite: with the monotonous, perhaps rather hazy or gray sky, it's hard to focus on infinity to see the others.
- And of course: one glider right ahead, but the other glider is just a narrow gray line without color.

In all these cases, daylight fluorescents can help considerably - there are two main reasons for this:

First, the definition: fluorescence is the emission of light previously absorbed in the form of light or other radiation at non-visible wavelengths. This means that a fluorescent color is brighter than a "normal" (= non-fluorescent) color because additional light is emitted, usually obtained by converting UV radiation into visible light.

Hence the name "dayglow paint" or also "DayGlo" in English.

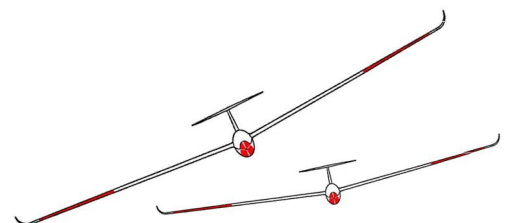
Secondly, fluorescent paint is a highly unnatural color. Every time the eye and brain perceive something that "doesn't belong there", attention is automatically drawn there, even if concentration is not so high at the moment, such as when circling other gliders forever.

For these two reasons, the visibility and conspicuity of a glider increases significantly as soon as appropriate warning markings are applied in daylight fluorescent colors and of sufficient minimum size.

Or in other words: no markings in "normal" red, orange, yellow, blue, etc., because these reduce / fragment the outline of the white glider and at best are of little use against a bright background.

Suitable and typical daylight fluorescent colors are RAL 2005 Fluorescent Orange, RAL 3024 Fluorescent Red or RAL 3026 Fluorescent Bright Red - these also form a strong contrast to blue skies. A few large, contiguous areas are much easier to see than many small areas - from the front, the largest area is the fuselage nose, but the profile noses also help with approach and conspicuity from the front.

Until now, such large-area warning markings were opposed by the certification requirement that the surfaces of fiber composite structures on gliders must be white, as described in the data sheets of our aircraft. This has now been remedied by an EASA-approved STC⁵.



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This now makes it possible to legally apply large-area warning markings as paint or as foil in conjunction with a simple temperature sensor to account for the increased heating of the now non-white surfaces. In addition, there are also initial developments by glider manufacturers to approve non-white gliders as new types⁶.

Thus, the only question left for every glider owner and pilot is whether to execute such warning markings as paint or as color, and the fun of operating the glider with large-area markings not only more conspicuous and better visible, but also a little different from the many "only" white colleagues.

Bibliography & Further Information:

- (1) Dr. Tony Head, Glider conspicuity trials held at RAF Bicester in June and October 2002, Human Factors Group, School of Engineering, College of Aeronautics, Cranfield University
- (2) Abschlussbericht BEKLAS - Erkennbarkeit von Segelflugzeugen und kleinen motorisierten Luftfahrzeugen, Forschungsbericht im Auftrag des BMVBW, Bonn, Mai 2004
- (3) Homepage www.bfu-web.de
- (4) Homepage www.flarm.com
- (5) Technische Mitteilung TM-L01 „Farbwarmmarkierungen“; EASA zugelassen 2015; Fiberglass-Technik Rudolf Lindner GmbH & Co. KG, Walpertshofen
- (6) z.B. ASG 32 der Fa. Alexander Schleicher Flugzeugbau



Foto: Werner Scholz

Note on durability and the question "foil or varnish?":

- Every daylight fluorescent paint fluoresces due to the UV light component present, but unfortunately it also breaks down in the long term as a result; this applies to film and to varnish and can only be strongly slowed down (more or less) by UV protection layers;
- -n the case of varnish, clear varnish is therefore sprayed over the luminous paint; in the case of foils, a good foil consists of several layers - with a layer of UV protection on top.
- Examples of two types of film: 3M film with very good color durability (relatively thin, more flexible, somewhat more expensive), and somewhat cheaper Oracal film (fades faster, thicker, stiffer), sources of supply are glider supplies or car letterers.
- Current 2-K paints (e.g. as used by aircraft manufacturers) are painted in two layers (dayglow paint and clear varnish for UV protection), and their durability also seems to be quite good according to customer experience.

