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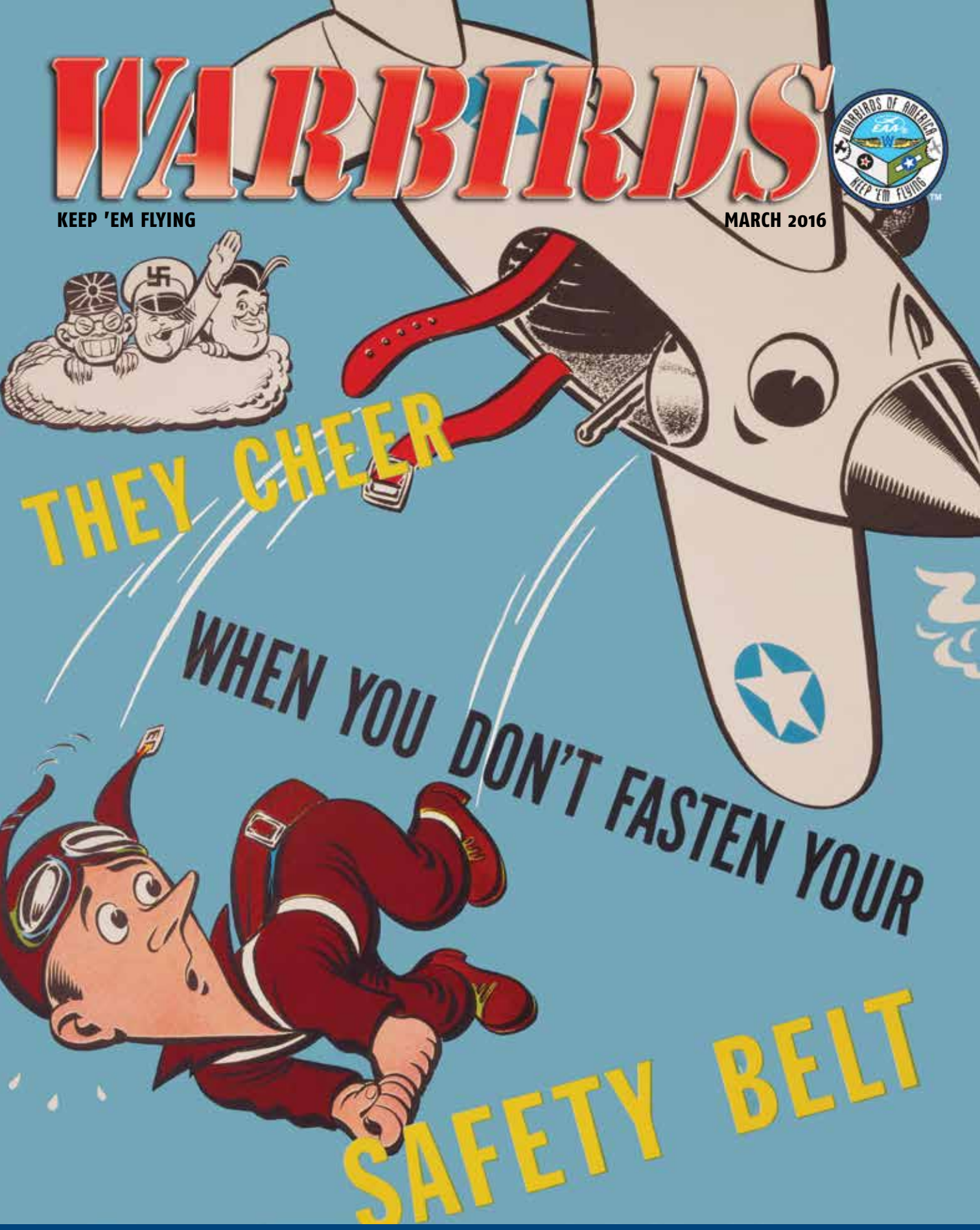

ANNUAL SAFETY ISSUE

Beware of Energy-Dissipating

Maneuvers on the Downline

BY DUDLEY HENRIQUES

Sadly, the history of air shows is awash with stories in which energy-dissipating maneuvers on the downline were attributed as a contributing factor in a fatal accident. But, as common as these types of accidents have been, they are also among the easiest to avoid. There are several schools of thought on how to deal with maneuvering on your downline. One deals with the mechanics involved in low-altitude dive recovery. The other is the common-sense approach, as opposed to the boring practice of stating Reynolds numbers, airfoil type, turbulent flow, laminar flow, and God only knows what else that can be stuck into some pedantic explanation that only the engineers among us can deal with. Pilots who know me know I respect the fact that they are already dealing with issues like this on a daily basis, and they don't need me lecturing them.

Instead, my practice when discussing safety is to try and convey information in a manner that can be taken along with a pilot when he/she applies that throttle for an air-show-oriented takeoff. Here's the aerodynamic explanation, short and sweet, for corner velocity. I'll state it just so it has been stated, then we'll discuss downlines from a common-sense point of view, so bear with me a moment. Most of you understand this, but there just might be a few newbies out there, and if it helps just one to a better understanding, I'll be a happy camper.

Basically speaking, your corner velocity can be found on the upper left-hand corner of your steady-state flight envelope. You can mate it for all practical purposes with your V_A, or maneuvering speed. It's simply the airspeed that, when mated with your maximum structural *g* limit will produce your maximum turn rate and minimum turn radius for a given gross weight. In the case of a downline recovery, we will be considering corner velocity as the speed you might need to achieve with max *g* to recover the airplane without stubbing your toe. Now this is the aero engineering. Most of you already know this, so let's go on into some good old common-sense thinking about downline safety.

The problem concerning the downline issue can occur when a pilot performs one too many energy-loss maneuvers on a downline, leaving the aircraft without the *optimum* energy needed to recover due to positioning at the recovery point, because the airplane is either on the front or back side of the aircraft's corner velocity as the last energy-loss maneuver is completed and recovery initiated. If this happens, the aircraft may become aerodynamically limited to accelerated stall before reaching that much-needed maximum-available *g* to produce a minimum turn radius or, if above corner speed, to slow down enough to allow that same available *g* to produce a minimum turn radius without overstressing the airplane.

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Now this is the aerodynamic situation. Keep this in mind while I tell you that there is a *huge* argument among pilots involving the teaching of the dependence on attaining corner velocity as a basic recovery mantra. I am one of these pilots! Let me give it to you straight. While you are slowing down or speeding up on your downline, seeking your corner velocity so you can apply that maximum *g* you need so badly, you could easily kill yourself because you simply don't have the room! Strong words, aren't they? Well the whole idea is *not* to kill yourself, and *that* is why I say learn and understand about corner velocity and how it can serve you as a display pilot. But the *real* answer to downline safety is not to get the airplane and yourself in a position where you need that corner velocity.

The mathematics and physics of the corner velocity issue differ from aircraft to aircraft and from air-show venue to air-show venue. Gross weight, density altitude, and weather conditions can also play a critical role. Also, any turning or bank during an attempted recovery can seriously hinder that recovery. So for the purpose of this article, level the wings *before* you apply any *g*, *please*!

So that's about it for the technical stuff. It is beneficial that air-show pilots performing energy-loss maneuvers on their downlines have a general working knowledge of corner velocity and how that can interface with a low-altitude recovery. Now you have that.

Consideration of any maneuvers that unnecessarily lose potentially lifesaving energy should be looked at very carefully. Can you be as entertaining to the audience with two snap rolls instead of three? Would you provide yourself with additional margins by changing your targeted recovery altitude from 250 feet to 500 feet? If your current sequence includes five energy-dissipating maneuvers on the downline, can you simply reduce that from five to four and address any potential problems in that way? If you are performing and unexpectedly find yourself behind on energy, can you build in places where you can make up that energy loss without interrupting your sequence?

The pilot in command must have responsibility for building a sequence that considers all of these issues, but ICAS wants to ensure that all of our performing pilots are aware that energy-dissipating maneuvers on the downline is a problem that is as old as air shows themselves. You may not need to make changes, but make the time to take a critical, analytical look at this specific element of your air-show sequence.

In closing, please feel free to discuss this issue amongst yourselves and bring it up at your pre-show safety briefings. All I ask of any of you is that you *think* about your downlines. You are some of the finest pilots in the world, and I'm proud to know many of you. Stay safe!