



**More on Center of Gravity**

In “One Size Fits All: The Danger of Average Weights,” by Keith Glasscock [ASW, 7/06, p. 55], a statistical analysis is made of possible errors in determining the center of gravity of, among other things, the passenger load in the cabin of an airplane resulting from the use of so-called average passenger weights rather than the actual passenger weights. It is concluded that such errors in the center of gravity position could, in extreme cases, lead to exceedance of the certified forward and aft center of gravity limits.

However, I do agree with most comments and observations made by Patrick Chiles “Filling the Envelope: How Risky Are Average Weights?” [ASW, 12/06, p. 24].

I’d like to add some explanatory notes on the position of the center of gravity of the passenger load in some examples of hypothetical cabins with uniformly distributed seats, varying in size between say four (two rows of two seats) and 400 (50 rows of eight seats). It is obvious that if all seats are taken, the center of gravity will be located in the middle of the cabin. This applies to the “four-seater” and to the “400-seater” as well as to all “in-between” cabins. If we look at a passenger load factor less than 100 percent, the same

applies, provided the passengers are distributed uniformly over the length of the cabin.

It will also be clear that the greatest possible center of gravity deviation will occur at a passenger load factor of 50 percent, if all passengers are either seated in the front half of the cabin or in the rear half. In these extreme cases, the center of gravity (of the passenger load) will be located at either the one-quarter position or the three-quarters position of the cabin length.

An important observation is that in case the passengers are free to select their seats, such extreme passenger distributions are very improbable on a 400-seater or even on a 40-seater, but very probable on a four-seater. This explains why small aircraft are much more sensitive to non-uniform passenger distributions than larger aircraft. For similar reasons, the use of average passenger weights on small aircraft may easily lead to large center of gravity errors and are, therefore, not acceptable on those aircraft. It is suspected that uncontrolled free seating (uniform passenger distribution not enforced in one way or another) probably occurs in the day-to-day routine many places in the world.

Both papers make reference to the recent FAA Advisory Circular

120-27E, which contains detailed directives on acceptable weight and balance procedures for U.S. operators. Many of the operators in the world, however, have to comply with different criteria that are not necessarily equivalent. It might be desirable for *AeroSafety World*, the journal of the international Flight Safety Foundation, to draw attention to this aspect.

**Joop Wagenmakers**

KLM Royal Dutch Airlines (retired)

Former consultant, Netherlands Civil Aviation Authority and Joint Aviation Authorities Performance Subcommittee



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*Write to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or e-mail <donoghue@flightsafety.org>.*

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