Going digital...

Brian Hope weighs up the prospects of going digital when it comes to W&B calculations…

In the last issue I posed the view that all too many of us do not pay sufficient attention to carrying out a weight and balance calculation, and went through the recent weighing of our Jodel. I'm happy to say that my request for some information on 'going digital' with W&B calculation elicited a fair degree of comment, thank you everybody who got in touch. Later, I will run through two Excel spreadsheets (metric and imperial) very kindly sent by LAA Inspector and former taildragger Europa flyer, Oliver Smith, which I think is simple to populate with the data for a specific single- or two-seat light aircraft. They also fall in line with the LAA Engineering nominated W&B format as presented in last month's article. If the thought of using Excel strikes fear into your heart, please stay with me, I'm, shall we say, 'behind the curve' where Excel is concerned, so if I can get it, anybody can. Before that though, here are a few comments from some of the other correspondents.

Below Our Jodel spreadsheet, have a play to see how easy it is to check weight and CG.

		Weight and Balance Report				Metric		
Aircraft Type :	Jodel D112			Reg :	G-BHKT			
DATUM :	Wing LE			Weighed By:	B HOPE & J LUCK			
LEVEL REF:	Parcel Shelf			Date:	xxxxx			
Weighing System:		Electronic Scales						
Aircraft State:		Full Oil and Coolant,		Residual Fuel				
Empty Weight	Position	Weight Kgs	ARM mm	Moment				
	Pt Wheel	172.9	95.00	16425.50				
	Sbd Wheel	172.7	95.00	16406.50				
	Nos/Ta Wheel	22	4675.00	102850.00				
	Spare	0	0.00	0.00				
	Total	367.6	369.10	135682.00				
Most FWD	Empty Aircraft	367.6	369.10	135682.00				
	P1	55	580.00	31900.00				
	P2	0	580.00	0.00				
	Baggage 1	0	1150.00	0.00				
	Baggage 2	0	0.00	0.00				
	Total No Fuel	422.6	396.55	167582.00				
	Fuel to Max Gross Kgs							
	Tanks 1	41.04	-210.00	-8618.40				
	Tanks 2	0	1080.00	0.00				
	Totals	463.64		158963.60				
		Calc C /G	342.86			FWD Limit	290	
Most Aft	Empty Aircraft	367.6	369.10	135682.00				
	P1	86	580.00	49880.00				
	P2	86	580.00	49880.00				
	Baggage 1	25	1150.00	28750.00				
	Baggage 2	0	0.00	0.00				
	Total No Fuel	564.6	467.93	264192.00				
	Fuel to Max Gross Kgs							
	Tanks 1	0	-210.00	0.00				
	Tanks 2	28.8	1080.00	31104.00				
	Totals	593.4		295296.00				
		Calc C/G	497.63			AFT Limit r	580	
Max AUW	Empty Aircraft	367.6	369.10	135682.00				
or Flight	P1		580.00	0.00				
	P2		580.00	0.00				
	Baggage 1		1150.00	0.00				
	Baggage 2		0.00	0.00				
	Fuel tanks 1		-210.00	0.00				
	Fuel tanks 2		1080.00	0.00				
	Spare			0				
	Total	367.6		135682.00		MaxAUW K	617	
		Calc C/G	369.10					
Notes:								
						oswbm		

Even the experts get it wrong…

Colin Wilkinson, from the US, is a fellow Jodel owner with a DR1050 as well as a RV-7, and spent his working life doing handwritten load/trim sheets for airliners, BAC1-11 500s and various Boeings etc., and although he sees the benefit of digital solutions, is a firm believer in keeping things simple. He has *pro forma* for his aircraft which enables him to 'do the math' quickly and easily.

John Wilson is another former commercial W&B man and commented, "A loadsheet check should be carried out for every different configuration when required, providing the pilot knows what he is looking at. Education on Weight and Balance has a lot to be desired." He related the tale of a commercial pilot who asked him how far out of the envelope he could take his aircraft, and photographs of commercial aircraft sitting on the tarmac with their noses pointing skywards because they'd been loaded incorrectly, would seem to suggest that GA pilots are not the only ones who sometimes fall short. Following retirement, John set himself up to weigh light aircraft and operates as Demraview Ltd.

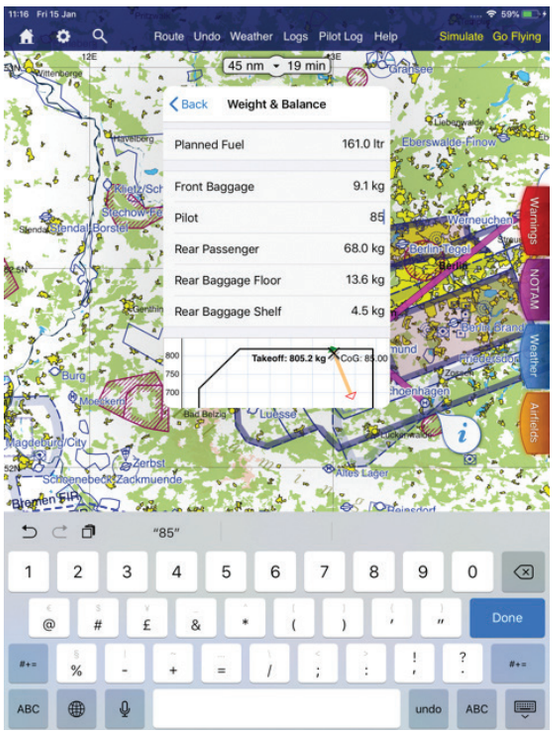
I guess we'd all like to think instructors know best, and Dick Flute certainly thought so when he hired a C172 while holidaying in Florida. He contacted the FBO the day before and asked that the aircraft only have half tanks as he, his wife and daughter would be making the sightseeing trip. When they turned up though, the tanks were full, and the instructor said all would be fine. On take-off, with the trim neutral, the aircraft left the ground and the nose rose dramatically, taking all Dick's strength to push it down while he trimmed fully forward.

SkyDemon W&B facility

Howard Apps was one of several who emailed to say that there is a very good feature in SkyDemon which allows you to set up a pictorial view together with the numbers of the CG envelope and loading data for your aircraft. Upon entering the specific loading for the flight it gives you the CG and includes a fuel usage vector.

I spoke with Rob at SD who provided the following info: One of the most common questions about the loading envelope is what the orange line with the crosses and arrows means – basically, the green full arrow is where the CoG would be with a full fuel tank, the red empty arrow being CoG at empty tank. The black cross is CoG at planned take-off weight, with the grey cross being estimated CoG at landing. In cases where there are multiple fuel tanks, or a destination hasn't been set, you won't see a grey cross.

For some people the initial aircraft and loading envelope set-up is the most challenging part of SkyDemon, since some Operators Handbooks are unclear. For example, in some cases the loading envelope graph will have an X axis



as the moment, whereas SkyDemon is expecting the X axis to be the distance from the datum. So, there may be extra calculations for the pilot at the set-up stage in order to get the SkyDemon envelope correct.

Excel excels

OK, back to the Excel spreadsheets that Oliver very kindly sent. As I say, they are based on the LAA preferred format, they're free, and they're adaptable for pretty much any single- or two-seat light aircraft. You can also use Excel on a tablet, so you can have it available in the aircraft.

Oliver transferred the Jodel's figures onto the spreadsheet that are shown in the last month's article, so you can directly relate the two. We have put this completed spreadsheet on the LAA website along with the two 'blanks' – metric and imperial – plus Oliver's instructions, so you can download them, try out the Jodel's completed W&B to see how easy it is to add fuel or change pilot and passenger weights etc., then populate your preferred blank to make your own schedule. To find them, go to the LAA website at *www.laa.uk.com*, click on Magazine and on the first page there will be a link to the files.

How to…

On the appropriate blank sheet – metric or imperial – enter the details exactly as for the LAA W&B form, i.e. Type, Model, Reg, weighing details etc.

The weights and arms from the weighing are entered in the appropriate boxes and lines and the programme will work out the **Empty CG**.

As you go down the sheet to the **most FWD situation**, the programme will have carried details down from the empty situation so you only need to enter the loads and arms for the crew, fuel and baggage and the CG will be calculated. If the CG is outside the limits, you will need to alter one or more of the loads to correct it – remove baggage or fuel.

Next is the **most aft situation** and the process is repeated with the new weights being entered. The arms will have been carried down from the **most forward** boxes.

The final section is where you can calculate the loading.

		Weight and Balance Report				Imperial
Aircraft Type :				Reg :		
DATUM :				Weighed By:		
LEVEL REF:				Date:		
Weighing System:		Electronic Scales				
Aircraft State:		Full Oil and Coolant,		Residual Fuel		
Empty Weight	Position	Weight lbs	ARM ins	Moment		
	Pt Wheel			0.00		
	Sbd Wheel			0.00		
	Nos/Ta Wheel			0.00		
	Spare			0.00		
	Total	0		0.00		
Most FWD	Empty Aircraft:	0		0.00		
	P1			0.00		
	P2			0.00		
	Baggage 1			0.00		
	Baggage 2			0.00		
	Total No Fuel	0		0.00		
	Fuel to Max Gross lbs					
	Tanks 1			0.00		
	Tanks 2			0.00		
	Totals	0		0.00		
		Calc C /G				FWD Limit ins
Most Aft	Empty Aircraft	0		0.00		
	P1		0.00	0.00		
	P2	0	0.00	0.00		
	Baggage 1		0.00	0.00		
	Baggage 2	0	0.00	0.00		
	Total No Fuel	0		0.00		
	Fuel to Max Gross lbs					
	Tanks 1		0.00	0.00		
	Tanks 2		0.00	0.00		
	Totals	0		0.00		
		Calc C/G				AFT Limit ins
Max AUW	Empty Aircraft	0		0.00		
or Flight	P1		0.00	0.00		
	P2		0.00	0.00		
	Baggage 1		0.00	0.00		
	Baggage 2		0.00	0.00		
	Fuel tanks 1		0.00	0.00		
	Fuel tanks 2		0.00	0.00		
	Spare			0.00		
	Total	0		0.00		MaxAUW lbs
		Calc C/G				
Notes:						
						oswbimp

Above The Imperial version of the blank ready and willing to be populated with your aircraft data.

Above left A screen grab of the SkyDemon W&B facility.

Again, the empty weight details and the various arms will have been carried forward so you only have to put in the appropriate weights for your flight and it will work out the AUW and CG.

Some points to note:

- When an arm is negative (as with the front fuel tank on the Jodel example) the value must have a minus sign preceding it
- Put in a zero where something is not used e.g. no P2, a second tank or baggage.
- The 'spare' line in the empty weight case can be used to find the effect of any ballast you may want to try to amend the cg. It cannot be used for rear seat passengers as it doesn't carry on into the FWD and AFT sections. However, you could use one of the 'baggage' or 'fuel tank' positions.
- If you have two wing tanks and both are at the same 'arm' you would treat them as one bigger tank and so only use one line of cells. Similarly, if you had a Zenair 601 or similar with two in-wing baggage holds, you would treat them as one.

Street legal

Carrying out a W&B calculation will help keep you on the right side of the law, but more important it will be a major step in keeping you, and your passengers safe. Whilst here in the UK we have thus far escaped the scourge of dedicated air police, in France, and particularly the Netherlands, you may well be accosted by an official who wants to check your papers, and that may well include the W&B for the flight you have just landed from. Better prepared than caught, I think. ■